# FEASIBILITY STUDY

## FOR A PACIFIC BASED

## WMO Regional Training Centre

*Dr Geoff Love, Dr Maria Mamaeva and Mr Jeff Wilson*

Supported by UNDP through the Disaster Resilience in the Pacific Project (RESPAC)

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Feasibility Study for a Pacific Based WMO Regional Training Centre

# PART 1:
# REGIONAL EDUCATION AND TRAINING NEEDS

Dr Geoff Love, Dr Maria Mamaeva and Mr Jeff Wilson

*Photo credit: Josh Sorenson*

# *Acknowledgements*

The study team acknowledge and thank all of the people who took time to meet with the study team, sometimes out of hours or over weekends. The study team also thank UNDP, in particular Mr Navin Bhan for making the travel arrangements and contacting the many people involved in the study. The Study Team further wish to thank Mr Navin Bhan and Mr Noud Leenders from UNDP, Mr Alan Porteous (NIWA) and Mr James Lunny (Met Service New Zealand) for their constructive comments and feedback on the first draft of this report.

# *Content*

# 1. Introduction

This first report from the study team uses results from visits to 13[1] of the 15 NMHSs and the survey completed by 14 of the countries during June 2018 to examine the feasibility of a Pacific based WMO Regional Training Centre. The 15 countries (Figure 1) were selected as they comprise the Pacific Meteorological Council and have developed the Pacific Island Meteorological Strategy. Figure 1 also shows the Exclusive Economic Zones (EEZs) of the countries which provide a proxy for the area of responsibility for each of the NMHSs.

The Study Team also visited Guam and Honolulu as they work closely with the Republic of Palau, the Federated States of Micronesia and the Republic of the Marshall Islands in the provision of their meteorological services and in the training of their staff. NOAA's Pacific Island Training Desk (PITD) in Honolulu also provides training to most of the Pacific Countries considered in the Study.


**15 Countries comprise of the Pacific Meteorological Council** and have developed the Pacific Island Meteorological Strategy.


[1] It was not possible to visit Nauru or Tokelau in the time allocated for the study however a meeting was held with the Office for Tokelau Administration in Samoa. Some data sourced from reports that Nauru provided to the 2017 Pacific Meteorological Council session in the Solomon Islands are incorporated into the study.

Figure 1: The 15 Countries and their Exclusive Economic Zones (EEZs)

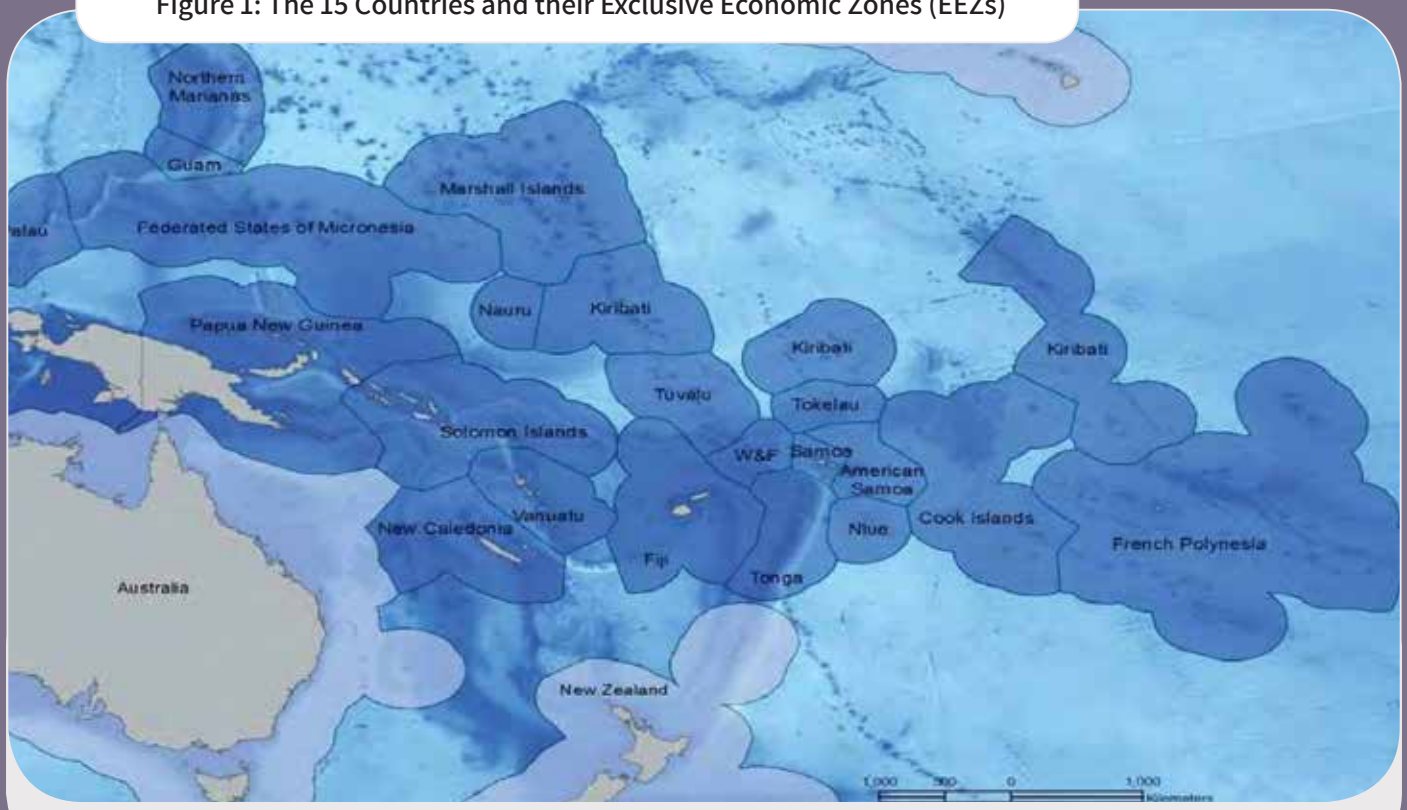



***Figure 1:*** The fifteen countries and their Exclusive Economic Zones (EEZs). The EEZs provide an indication of the areas covered by each of the NMHSs.

***Disclaimer:*** This map is indicative only of agreed and potential maritime jurisdictional limits within the Pacific region. Not all countries represented on this map were considered as a part of this Study. The map does not imply the expression of an opinion by UNDP, the Feasibility Study Team or SPREP on the legality of any boundary shown. (Adapted from: Pacific Islands Meteorological Strategy 2017–2026, with permission of SPREP)

The survey data collected by the study team has been used to determine the training needs that must be addressed to enable the Pacific NMHSs accomplish their goals and objectives in line with the Pacific Islands Meteorological Strategy (PIMS) 2017-2026. The assessment examines the NMHS organizational knowledge, skills, and abilities to identify existing gaps or areas of need against the overarching PIMS Pacific Key Objectives (PKOs). With the training needs determined, training objectives and appropriate educational providers (to the extent possible) will be examined in the second report.

*The survey results have provided the major elements for the development of a business case to support the establishment of an RTC in the Pacific Region based upon the:*

- Competencies and qualifications of the staff of the Pacific Island Country NMHSs and their capacity to achieve the PIMS PKOs that they have incorporated into their corporate plans;
- Recruitment requirements and practices of the NMHSs;
- Impact of staff turnover; and,
- Ability of the NMHSs to financially support an RTC either through direct financial contributions or by funding the education and training of their staff at such an institution.

*The following sections of this report, using the Study Team's analysis of the survey data and their own experience in the provision of training in NMHSs, addresses:*

- Size and nature of the NMHSs in the fifteen countries;
- NMHSs and PIMS priorities;
- Anticipated initial education and training numbers;
- Recruitment practices and staff turnover;
- Ability of the NMHSs to financially support an RTC; and,
- Implications of current training activities from FMS and the NOAA Pacific Training Desk.
- The findings presented under this report are mostly focussing on common trends and patterns relevant to all 15 countries. More detailed and nuanced country level reports are subsequently annexed. The survey team has produced a report which tries to factor in the variances and different dynamics of the Pacific region and the countries that fall under it. The team has used common statistical methods such as averaging and linear regression to present a common solution that works for a country like PNG with its 7 million in population while at the same time addressing the needs of Niue with a population of approximately 1500.

## 2. Size and Nature of the NMHSs in the Fifteen (15) Countries

Many of the NMHSs operate with infrastructure and staffing constraints that limit their capability. Furthermore it appears that national budgets are at times limited to funding salaries, basic operations and office requisites, with very few resources left for training or upgrading of infra-structure. A large number of the staff are weather observers, with limited if any tertiary qualifications although it should be noted that many of these same group of observers have undertaken class room training at the Fiji Meteorological Service (FMS) in Nadi, Fiji (mostly funded by the Japanese Government through JICA), at NOAA's Pacific Island Training Desk (PITD) in Honolulu, Hawaii (funded by the US Government through NOAA) and through project-based on-the-job competency training provided by NIWA. In the absence of a regular flow or fixed funding to supplement more technically oriented training, many of the NMHSs considered in this Study rely heavily on donor support for modernisation of their observation network and associated training of their staff. It was also observed that donor support that can be infrequent and not necessarily aligned to country or regional priorities as defined in the PIMS Strategy, hence NMHSs Directors face difficulties in managing these resources when they are available.

The 15 NMHSs in the Pacific are not homogeneous in terms of staff numbers (Figure 1). Only two of the NMHSs (Fiji and Vanuatu) include hydrology and water resource management in their mandate. Hydrology for the most part is managed through a separate department often in another department or ministry separate from those which supervise meteorological work. Climate services are well developed in a few NMHSs whilst others rely on external support to create climate products or can only provide very basic climate services. Several of the NMHS Directors reported that their services were being nationally under-utilized as sources of information and expertise on weather and climate service / climate change issues. At best, ocean services are limited to marine observations, coastal water forecasts, and warnings. Under PIMS 2017 - 2026 it is anticipated that ocean services in the region will be significantly developed from those provided at the current time. The staff numbers shown in Figures 2 and 3 and Table 1 do not include staff working in the hydrology or water resource management area where this is separate from the meteorological service.

It is possible to group the 15 countries based on staff numbers and services as per table 1. This table clearly separates out the NMHSs and these differing service levels identify the range of education and training challenges that will face an RTC in the region. The NMHSs range from Nauru and Tokelau which have only two

staff and are just developing services to Fiji and Solomon Islands, which are offering a full range of services and have more than 100 staff each.

## Figure 2: NMHS Staff Numbers as a Function of Time

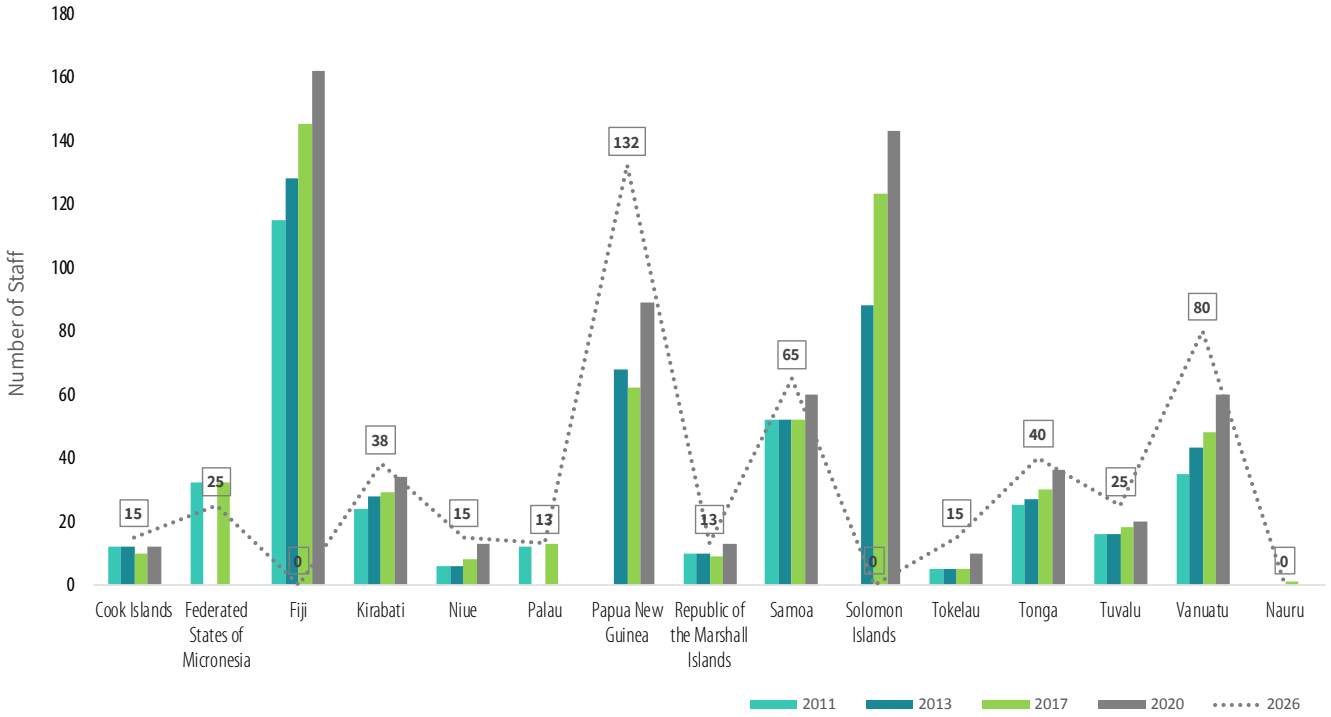



***Figure 2:*** Total staffing levels provided by the NMHSs as a function of time. Not all countries provided complete responses to this question. The Nauru data was extracted from the 2017 Country report to the PMC meeting in the Solomon Islands.

## Table 1: Grouping of Pacific NMHSs

**MAPPING OF NMHSS AGAINST SERVICES AND TOTAL STAFF NUMBERS**

| TOTAL STAFFING | PROVIDED SERVICES | | | |
|---|---|---|---|---|
| | Observing and basic climate data | Observing and basic climate services with interpretation / elaboration of forecasts and warnings from Fiji Meteorological Service or Hawaii | Observing and climate services with at least some in-house forecasting capability. Aviation forecasts from other country | Observing, Climate Services and full forecasting capability |
| More than 60 staff in 2017 | | | | Fiji<br>Papua New Guinea<br>Solomon Islands |
| Between 20 and 59 staff in 2017 | | FSM | Kiribati<br>Samoa<br>Tonga | Vanuatu |
| Less than 20 staff in 2017 | Nauru<br>Tokelau | Cook Islands<br>Niue, Palau<br>RMI, Tuvalu | | |

***Table 1:*** Grouping of Pacific NMHSs based upon total staff numbers and broad service areas.

**Figure 3: Estimated Total Staffing Numbers**

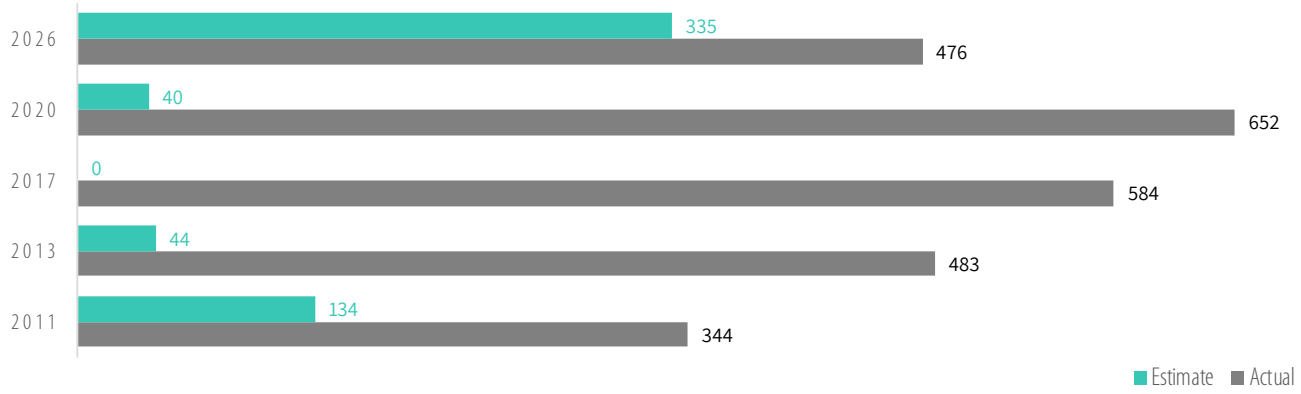
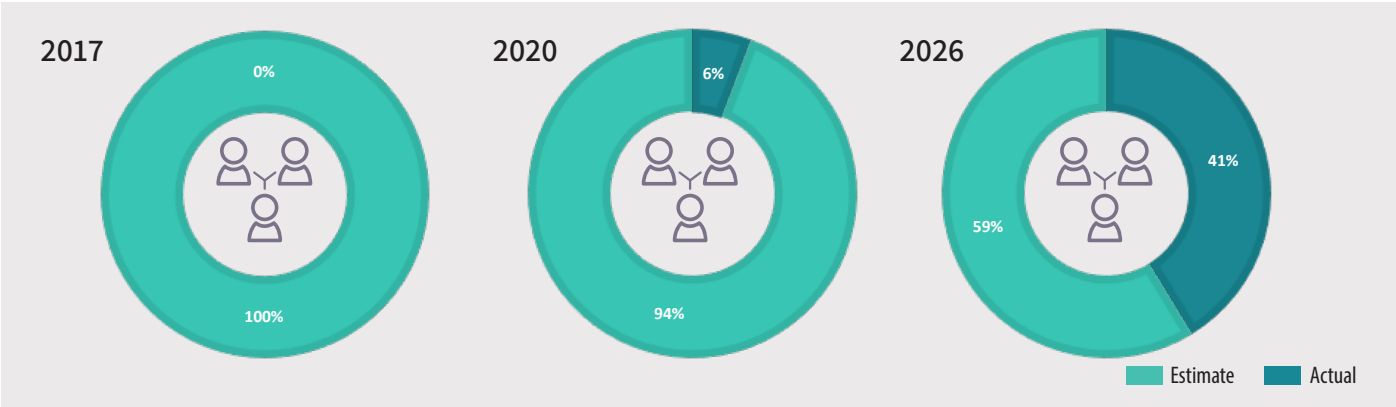



***Figure 3:*** Total staff numbers (provided by the NMHSs and estimated by the study team) for the 15 meteorological services as a function of time. Blue data provided by the NMHSs, brown data interpolated from the NMHS data by study team where data were missing.




With the exception of Tokelau all 14 countries have international airports and provide meteorological services to support international civil aviation. Thus they need to have a Quality Management System (QMS) in place as well as a competency framework for aeronautical meteorological observers and aeronautical meteorological forecasters (where appropriate).

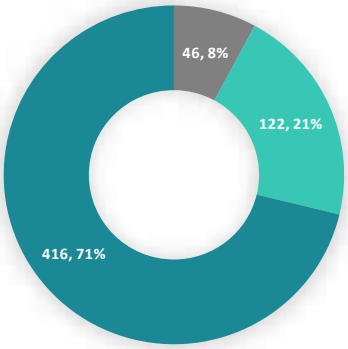
Ongoing and initial training of aeronautical meteorological observers and aeronautical meteorological forecasters thus need to incorporate QMS and competency requirements and meet international standards to meet international civil aviation requirements. In 2011 it appears that the meteorological workforce across the fifteen meteorological services was of the order of 470. In 2017 the number was of the order of 580 and by 2026 this is expected to increase to around 800 personnel[2], Figure 3.

Based on the survey results, 215 personnel (Figure 4 and Table 2) or approximately 38% of the workforce is made up of officers involved with taking weather and climate observations. Figure 4 is dominated by the overwhelming number of observers. This is similar to the global average for NMHSs in similar countries[3] however it underlines the challenges for the Pacific Island NMHSs and the RTC of retraining these staff to take on new and emerging roles as the role of the weather observer is automated. The next grouping of staff is in the general forecasting area (Figure 4 and Table 2) with approximately 90 weather forecasters or (16% of the total staff). Approximately two thirds (or 60 out of 90) of these weather forecasters are staff without any formal post secondary or tertiary qualification and are providing forecasting services. While the percentage of overall staff dedicated to forecasting is similar to the global average of 17% for equivalent countries, the key point to note is the high number of forecasters in the Pacific NMHSs who do not have qualifications linked to the BIP-M.

2 These numbers come from the survey data PLUS some interpolation where individual years were not reported but a reasonable inference could be made.
3 The comparison was done with staffing data from WMO Members (106 countries) who contribute 0.02% of the WMO budget which is the same as the WMO Members involved in this study.

Table 2. Breakdown of 2017 Staff Numbers in the NMHSs

| Roles | Other | Professional | Technical | Grand Total |
|---|---|---|---|---|
| Administration and Management | 15 | 25 | 39 | 79 |
| Aviation Forecasting | 10 | 6 | 1 | 17 |
| Climate Services | 1 | 19 | 20 | 40 |
| Communications and Computing | - | 8 | 14 | 22 |
| Environmental Monitoring | - | - | 2 | 2 |
| Equipment maintenance and Repair | 2 | 9 | 34 | 45 |
| General Forecasting | - | 27 | 60 | 87 |
| Hydrological Services | - | 3 | 14 | 17 |
| Marine and Ocean Services | - | - | 1 | 1 |
| Marine and Oceanographic Services | - | 1 | - | 1 |
| Observations | 3 | 7 | 215 | 225 |
| Other Support Functions | 14 | 6 | 13 | 33 |
| Research | - | 2 | - | 2 |
| Training | 1 | - | 1 | 2 |
| Tropical Cyclone Forecasting | - | 9 | 2 | 11 |
| Grand Total | 46 | 122 | 416 | 584 |




46 Other Functions

122 Professional Functions

416 Technical Functions

Grand Total 584

***Table 2:*** Breakdown of 2017 staff numbers in the NMHSs as function of role. Also see Figure 4.

The Directors of the 13 NMHSs interviewed in the course of the Study emphasised that the RTC would need to train graduates with little or no meteorological knowledge to be competent across such areas as marine, public weather and aviation meteorology. Consistent with current WMO practices the final assessment for competency must be done in each country as it is dependent upon the facilities and services provided by the NMHS. Under the arrangements for a jointly supported RTC there is the possibility of the PMC / PIMMM making a decision that there are common competencies across all 15 NMHSs (taking into account that not all NMHSs will deliver all services to the same extent) and in this case the assessment of competency could be carried out by a central group, most likely an NMHS rather than a university due to the operational nature of the competencies.

The RTC BIP-M could also include aspects of a range of optional competencies such as climate services, hydrological services, data management, etc., that could be substituted for one or more of the core competencies listed above if the student, or his/her sponsor so desired, and the course materials had been developed by the RTC.

The 15 NMHSs can be roughly grouped by number of staff and the types of services they produce. The current regional workforce is estimated at 584 of which 416 are classified as technical (non degreed), 122 as professional (degreed) and 46 as other. The grouping by different service levels is consistent with the groupings being used by WMO in describing different types of NMHSs. The groupings also link to the types of competencies the staff are expected to obtain to deliver the services and the education and training that need to be provided through the RTC.

A common concern raised by the NMHS Directors was the difficulty of getting the Public Service agencies in their countries to recognise the non accredited education and training provided to their technical staff through in-house development plus institutions such as FMS and PITD. Whilst the Directors report the new skills and expertise developed by the staff at these institutions improved service it did not improve the pay and conditions of their staff.

Figure 4: Staff Numbers as a Function of Role

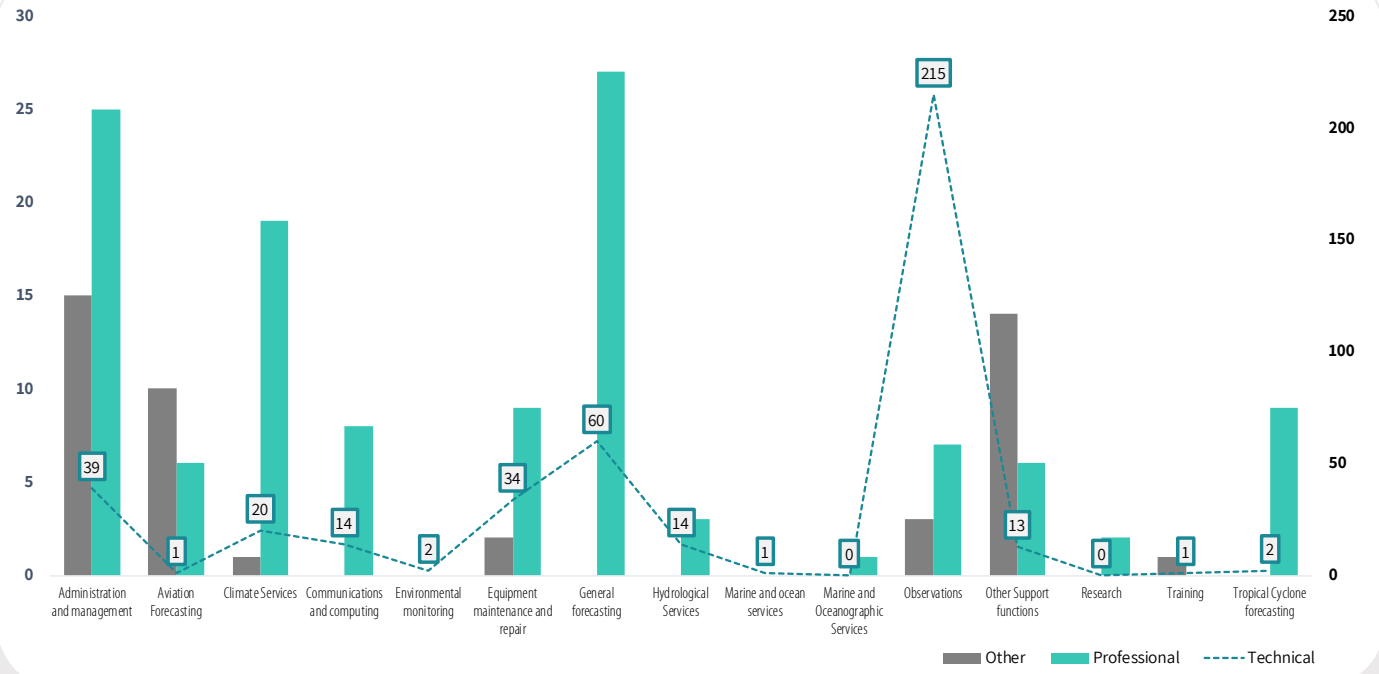


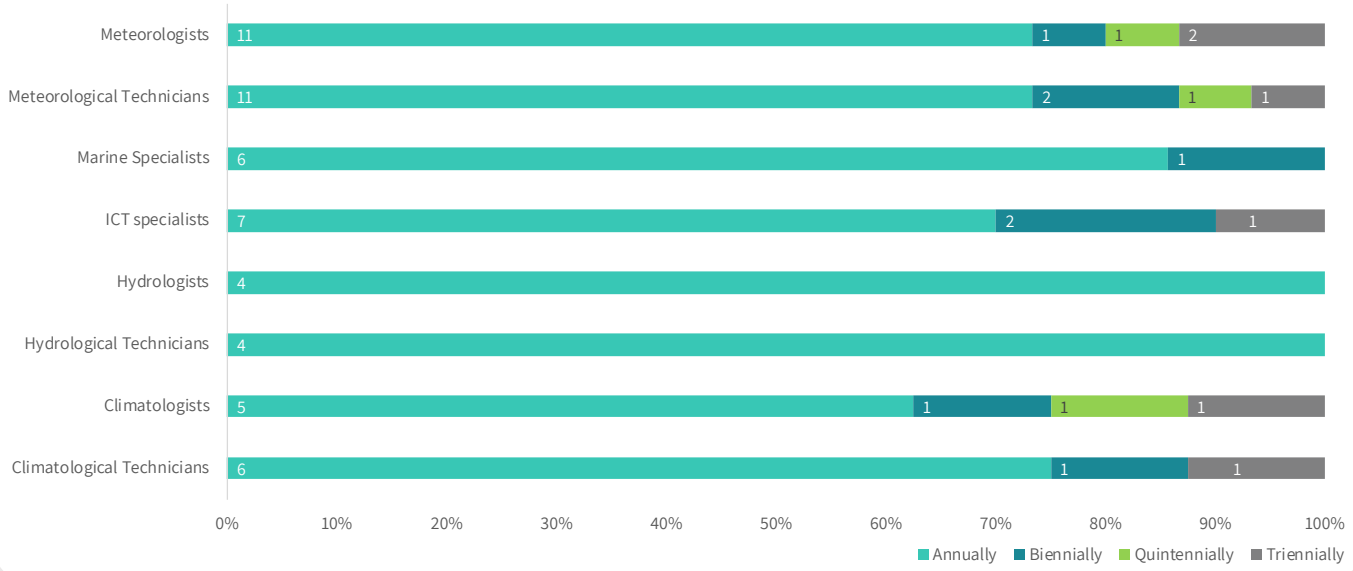

***Figure 4:*** Staffing profile for all fifteen NMHSs in 2018. Brown data indicates staff numbers holding degrees, green data indicated staff numbers with some post secondary vocational training (in many cases the training is not from certified courses), blue data indicates staff numbers with little or no post secondary training. Weather observers dominate the workforce and will present a retraining challenge to the NMHSs and the RTC as the role of the weather observer changes with automation.

# 3. NMHSs and PIMS Priorities

The NMHSs were asked to indicate which of the PIMS PKOs they were either addressing or were planning to address over the next five to ten years (Figure 5). In general, the range of services is not expected to change dramatically over the next five to ten years. Perhaps the most important change is in the aeronautical (or aviation) meteorological area where three NMHS (Kiribati, Samoa and Tonga) are anticipating providing aeronautical meteorological forecasting services in the near to medium term future. One possible explanation for their desire to increase their services is to support an expanding domestic aviation industry in these three island states.

Whilst the NMHSs are not expecting to dramatically increase the broad types of services they provide, they are all aiming to improve the quality of the services they are offering and the number of products in the current service areas. This aim is evident in Figure 6 which shows the number of NMHSs listing the given service area in their top three priority areas for additional education and training. Perhaps the most marked trend in Figure 6 is the demand for professionalization of the climate, forecasting and marine areas whilst the observations area remains a domain for technical staff with 2-year or lesser qualifications. New products in the climate services area could address topics such as support for agriculture, renewable energy, water resource planning and management. As new products are being developed the RTC will be expected to provide courses and support to the staff who are producing the products.

## Figure 5: Numbers of NMHSs Addressing or Planning to Address PIMS Service Areas




## Figure 6: PIMS PKO Areas Rated in the Top Three (3) Priority Areas by Staff Type

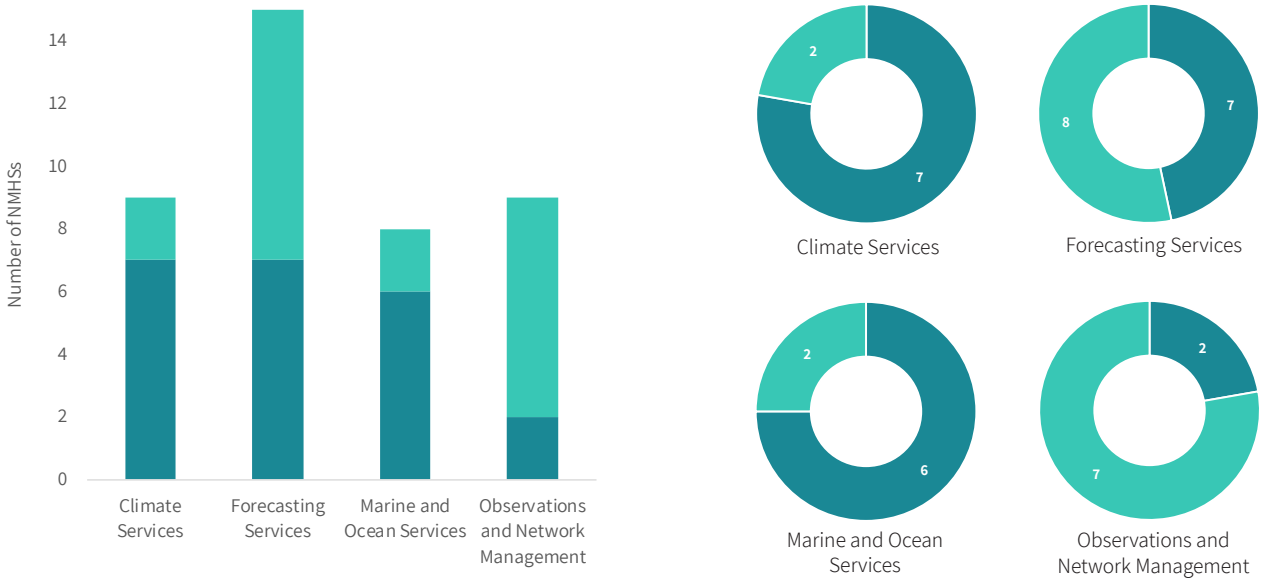



***Figure 6:*** Top three priority areas for education and training as a function of staff type

Due to the QMS and competency requirements, education and training offerings at all levels should include aspects of QMS and competency management / assessment. It may be possible to deal with these topics as prerequisites with participants undertaking standalone face-to-face or online sessions prior to attending the training courses in other topics. Similarly an RTC should be working with the NMHSs to address other capability areas such as management and leadership, Occupational Health and Safety, project management and writing / reporting skills.

# 4. Anticipated Initial Education and Training Numbers

Figure 7 summarises the anticipated annual recruitment of new staff across all NMHSs except Nauru (no data available). The data assumes that budgets and project funds grow as the NMHS Directors anticipate however the final outcomes will depend upon the views of their Ministry of Finance, their Minister, their Prime Minister/President and whether any donors recognise and are sympathetic to the needs of their Service. As a consequence the numbers in the forward projections must be treated with some care when considering the demand for the RTC.

Figure 7 shows the projected recruitment of trainees in the next eight years. With the exception of the categories of weather observers (Meteorological Technicians) and Meteorologists the numbers are quite small and do not reflect the likely revolution as improved ICT technologies sweep the region, as the focus moves to improved services and as observing systems become increasingly automated (or abandoned). Where automated observing systems are being implemented, and our understanding is that most, if not all the NMHSs in the Pacific are seeking additional AWSs and those with hydrology responsibilities are likely considering automated stream gauging equipment, there is an as yet unquantified demand for electronic technician training to support this instrumentation. These numbers also do not include data from Nauru, Tonga, Tuvalu, Vanuatu as they did not respond to this particular question in the survey. As Tonga and Vanuatu are amongst the larger NMHSs it would be expected that these numbers would be higher if their data were available.

The number of staff expected to undergo education and training is critical to the feasibility of the proposed RTC. In early June 2018 the Fiji National University advised the study team that a BSc course would need approximately 25 enrolled students in each year level for the course to be sustainable. At the same meeting the University of the South Pacific noted that a 12 month post graduate diploma would need at least five students every year to be sustainable. These figures are consistent with the experience of the study team for Australia.

**Figure 7: Number of New Staff to be Trained Annually by Course Area**

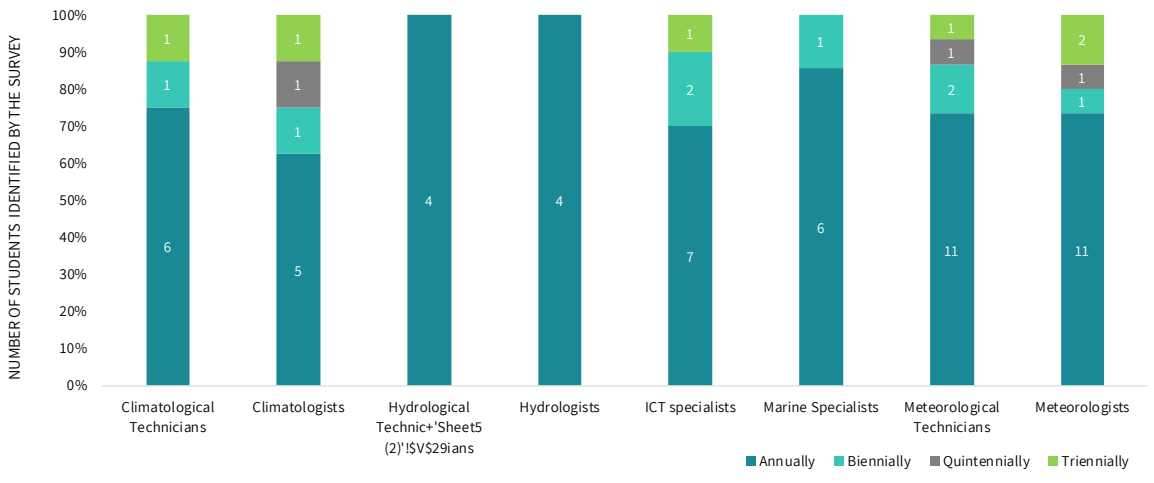



***Figure 7:*** Number of new trainees per year as foreseen by the NMHS Directors for the period 2020 to 2026. No data available for Nauru, Tonga, Tuvalu, Vanuatu for this question. Their data should increase the numbers.

Using the data obtained from the survey it would appear that there are probably not enough students to justify a BSc in meteorology but there are probably sufficient students to run a post graduate diploma that meets the BIP-M requirements. For the graduates of such a course to work as operational forecasters, additional education and training in operational meteorology topics would be required. In countries such as Australia, Canada, New Zealand, South Africa the academic component is combined with the operational component with successful graduates obtaining either a post graduate diploma or an MSc qualification.

It would appear that there are sufficient students to justify an annual meteorological technician course, particularly if it was accredited by the national qualification authority of the host country. Such a course could have two or three articulated levels from junior Meteorological Technician to mid level Meteorological Technician to senior level Meteorological Technician with differing entry points matching the initial qualifications and experience of the students.

## 5. Recruitment Practices and Staff Turnover

With the exception of Tokelau all the NMHSs report that they can recruit new staff with base level qualifications for the position and send them away for specialised education and training.

Generally the NMHS workforce in the Pacific is quite young with many NMHSs having staff in the 30 to 40 year age range (Figure 8) and thus in the short to medium term there should be few problems caused by mass retirements. As would be expected Administration and Management are generally older however even in this grouping the 30 to 40 year age grouping is marked. Individual services may experience problems if a senior member retires and it has not been possible to recruit a replacement prior to their retirement, this is particularly important in the smaller services where there may only be one or two staff in critical areas.

For meteorological observers an apprenticeship style training regime is widely used where a new recruit is mentored by one or more senior and experienced staff to undertake the basic observer duties and roles. After a period of time the recruit is formally assessed by the senior staff and provided they pass the assessment they will then undertake duties as a junior observer. Further training is sought from Fiji Meteorological Services, the RTC at the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) or other organisations as it becomes available.

For staff undertaking weather forecasting there is a mix of approaches. One approach is to recruit staff with two-year college degrees in technical areas and through an apprenticeship style system, with experienced forecasters carrying out on-the-job training, produce forecasters that can work with minimal supervision. These staff do not usually meet the BIP-M standard. The more expensive, generally preferred but less used approach is to recruit staff with three- or four-year university degrees in math and physics which is then supplemented with an additional year of formal meteorological education and training as it becomes available. This final additional training is generally donor supported, and such staff are qualified at the BIP-M level.

The staff losses noted below in Table 3 are generally low however they could be misleading if the losses all

occurred in areas where the staff numbers are small and thus the loss of one or two staff may mean that an NMHS can struggle to deliver services in that area. The questionnaire did not break down the staff losses by domain. Another potential contributor to the relatively low staff turnover is the lack of portability of the knowledge and skills of the staff, particularly the non degreed staff. The study team anticipate that as more staff gain transportable qualifications the staff turnover rates could increase unless pay and conditions for the NMHS staff are sufficient to retain them.

Figure 8: Staff Age for Different Job Roles

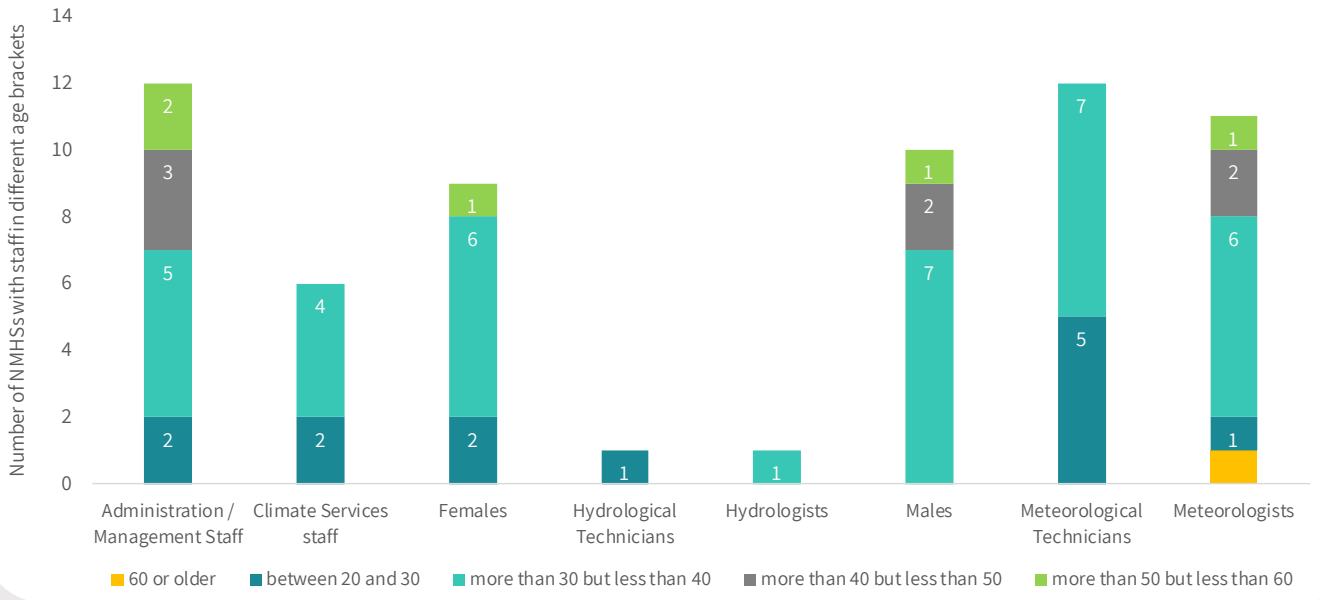



***Figure 8:*** Average age of NMHS staff.

Table 3. Staff Losses by NMHS in the Last Five Years

| *Country* | *Total Number Lost* | *Total Staff in 2017* | *% Loss of Total Staff* |
|---|---|---|---|
| **Fiji** | 10 | 143 | 7% |
| **Niue** | 2 | 8 | 25% |
| **Papua New Guinea** | 1 | 62 | 2% |
| **Samoa** | 5 | 52 | 10% |
| **Tokelau** | 2 | 5 | 40% |
| **Tuvalu** | 3 | 18 | 17% |
| **Vanuatu** | 3 | 48 | 6% |

In general the NMHSs have position descriptions for each position which also include minimum qualifications and / or experience. Noting that the knowledge, skills and competencies for the weather observing roles are not available via accredited courses the minimum qualifications are often successful completion of secondary school. The basic secondary school qualifications leads to the public service classifications of the weather observers inevitably being quite low and despite the additional on-the-job training they undertake there is often little change in their classifications during their careers. The creation of the RTC is expected to change this, particularly if the weather observer course is

incorporated into the wider Basic Instruction Package for Meteorological Technicians (BIP-MT) and this is accredited by the national qualification authority of the host country and then recognised regionally through the appropriate Regional Ministerial processes. It is recommended that if the RTC is established a key task of the Director would be to manage the accreditation process for those courses which require it, with assistance from the Directors of the 15 NMHSs and financial support from one or more donors. It would likely take a minimum of three years to achieve accreditation of a course.

It should be noted that the BIP-MT is typically broken into junior, middle and senior levels. The full BIP-MT comprising the three levels is commonly undertaken as a two year diploma course. It could be taken as separate courses such that new recruits undertaking weather observations from all of the NMHSs take the junior level BIP-MT whilst staff working in climate or ICT could enter the middle or senior level courses if they did not require the basic course. If the courses were accredited by the national qualification authority it would then be possible for successful graduates from the BIP-MT course to gain credit towards further university studies. This model was requested by the Directors of most of the NMHSs during interviews with the study team.

## 6. Ability of the NMHSs to Financially Support an RTC

The study team asked each of the NMHSs through the survey to identify what component of their annual budget was set aside for training. Only six of the NMHSs answered this question with the results ranging from 0% to 10% (approximately $US10,000) of their annual budget.

Outside of the NMHS the national governments of many of the islands are able to provide scholarships for students to study at institutions such as USP. In more than half of the countries there is a bonding scheme that requires the students to return to their home country for several years or repay the scholarship.

Another option for funding an RTC could be charging countries an annual fee based upon their GDP or GDP/population, Table 4 below. Neither option seems to provide a reasonable ranking, the GDP/population potentially disadvantages the Cook Islands due to the high level of grant support and relatively low population whilst the more typical UN approach of charging as a function of the total GDP may not be popular with Papua New Guinea.

If an existing institution(s) is/are going to make up the RTC it may be best to use their charging policies on a per student capacity with some form of annual contribution towards the costs of running the additional requirements of the RTC itself. Whichever method is chosen donor support would seem to be a requirement.

Table 4. GDP and Population Data for the Study Countries

(http://dfat.gov.au/trade/resources/Pages/trade-and-economic-fact-sheets-for-countries-and-regions.aspx)

| GDP AND POPULATION DATA FROM THE AUSTRALIAN DEPARTMENT OF FOREIGN AFFAIRS | | | | | | |
|---|---|---|---|---|---|---|
| Country | Year | Population | GDP (USD) | GDP/Pop (USD) | Land Area (Km$^2$) | % Total GDP |
| Cook Islands | 2016 | 11,700 | 287,983,800 | 24,614 | 240 | 0.9% |
| Fiji | 2016 | 885,000 | 5,079,900,000 | 5,740 | 18,270 | 15.2% |
| FSM | 2016 | 102,000 | 322,116,000 | 3,158 | 700 | 1.0% |
| Kiribati | 2016 | 112,000 | 173,264,000 | 1,547 | 810 | 0.5% |
| Nauru | 2016 | 13,000 | 101,712,000 | 7,824 | 21 | 0.3% |
| Niue | 2012 | 1,500 | 19,417,500 | 12,945 | 260 | 0.1% |
| Palau | 2016 | 18,000 | 309,168,000 | 17,176 | 460 | 0.9% |
| Papua New Guinea | 2017 | 8,300,000 | 23,746,300,000 | 2,861 | 452,860 | 71.2% |
| RMI | 2016 | 5,400 | 19,396,800 | 3,592 | 180 | 0.1% |
| Samoa | 2016 | 195,000 | 784,875,000 | 4,025 | 2,830 | 2.4% |
| Solomon Islands | 2016 | 601,000 | 1,233,853,000 | 2,053 | 27,990 | 3.7% |
| Tokelau | 2016 | 1,319 | 8,276,725 | 6,275 | 12 | 0.0% |
| Tonga | 2016 | 104,000 | 411,528,000 | 3,957 | 720 | 1.2% |
| Tuvalu | 2016 | 11,000 | 37,136,000 | 3,376 | 30 | 0.1% |
| Vanuatu | 2016 | 275,000 | 807,950,000 | 2,938 | 12,190 | 2.4% |

# 7. Implications of Current Training Activities from FMS and the NOAA Pacific Training Desk

During the visits to the 13 countries the study team became aware of the breadth and depth of training provided by the Fiji Meteorological Service with JICA support and NOAA's Pacific Island Training Desk to the fifteen study countries. Tables 5 and 6 below indicate the number of staff trained at each of the institutions since 2014 and the areas of training. For comparison, tables 5 and 6 also include the number of weather observers for each service in 2018.

In addition to the activities of these two institutions the ongoing COSPPac project (http://cosppac.bom.gov.au/) has been focussing on climate data and climate services. Thus these three initiatives are addressing the main priority education and training areas identified by the NMHS Directors, however:

- None of them offer accredited courses or parts thereof; and,
- There is little or no coordination between them on timing or content.

Even if the RTC does not proceed there could be benefits to the NMHSs and potentially FMS, PITD and COSPPac to improve the coordination of their activities.

Table 5. Fiji Met Service /JICA Supported International Training since 2014

| Country | # Obs on Staff in 2018 | BIP-MT | Climate | Equipment | Forecasting | Observations | QMS | Total |
|---|---|---|---|---|---|---|---|---|
| Cook Islands | 6 | 1 | 2 | 5 | 2 | 6 | 15 | 31 |
| Fiji | 24 | 17 | 6 | 22 | 10 | 1 | 3 | 59 |
| FSM | 18 | 1 | 2 | 3 | 2 | 0 | 1 | 9 |
| Kiribati | 13 | 1 | 2 | 5 | 2 | 15 | 1 | 26 |
| Nauru | | 1 | 1 | 2 | 2 | 0 | 1 | 7 |
| Niue | 5 | 2 | 2 | 5 | 2 | 1 | 1 | 13 |
| PNG | 24 | | 2 | 4 | 2 | 1 | 1 | 10 |
| Samoa | 10 | 1 | 2 | 5 | 2 | 1 | 1 | 12 |
| Solomon Islands | 70 | 3 | 2 | 5 | 2 | 1 | 1 | 14 |
| Tonga | 14 | 3 | 2 | 5 | 2 | 1 | 1 | 14 |
| Tuvalu | 7 | 1 | 2 | 5 | 2 | 1 | 1 | 12 |
| Vanuatu | 13 | 1 | 3 | 8 | 2 | 2 | 1 | 17 |

**Table 6. Pacific Island Training Desk (Honolulu).** The training is aligned with parts of the BIP-MT providing foundation skills and knowledge in basic meteorology, the use of Numerical Weather and Prediction (NWP) output, satellite imagery data and products and forecasts and warnings from centres such as Guam, Hawaii and RSMC Fiji.

| Country | No: of OBS on staff in 2018 | No: of # Trained by PITD since 2014 | % of obs trained |
|---|---|---|---|
| Cook Islands | 6 | 3 | 50% |
| Federated States of Micronesia | 18 | 22 | 122% |
| Fiji | 24 | 11 | 46% |
| Kirabati | 13 | 9 | 69% |
| Niue | 5 | 3 | 60% |
| Palau | 6 | 6 | 100% |
| Papua New Guinea | 24 | 8 | 33% |
| Republic of the Marshall Islands | 4 | 6 | 150% |
| Samoa | 10 | 10 | 100% |
| Solomon Islands | 70 | 8 | 11% |
| Tokelau | 2 | 2 | 100% |
| Tonga | 14 | 8 | 57% |
| Tuvalu | 7 | 7 | 100% |
| Vanuatu | 13 | 8 | 62% |

The total annual investment in education and training for the 15 study countries using figures for the last five years from PITD, FMS/JICA and COSPPac is estimated at more than $USD1,100,000 per annum. The PITD and COSPPac programs are expected to continue for past 2020 whilst the current JICA program will end in 2018. The study team were advised that JICA are considering options to continue their support for training in the Pacific with FMS as a partner.

| Provider | Estimated annual funding in US$ |
|---|---|
| FMS / JICA | The JICA 2014 - 2018 Project to Reinforce the Regional Training Capacity of FMS is costed at $ US 1.6M for the four year period thus annual costing is of the order of $400,000 |
| PITD | $ 644,000 (for Guam and Honolulu) based upon an estimated cost of $23,000 per student and 28 students a year) |
| COSPPac | Estimated at more than $USD50,000 annually |

# 8. Summary

*The Terms of Reference for this study stipulate that this first report is to address the following topics:*

(a) Assess whether the NMHSs are using the right benchmarking tools in developing job descriptions and setting minimum qualification requirements to attract qualified candidates and employ them as staff to carry out technically oriented services in the NMHSs.

(b) The extent to which NMHSs staff currently have regular and uninterrupted access to tertiary level training i.e., in Universities and Technical Colleges as well as specialized Meteorological Training Centers from other designated WMO RTCs, to upgrade skills and knowledge to better perform their day to day functions.

(c) The extent to which NMHSs can retain staff once they have acquired advanced qualifications and if turnover of staff is in any way hindering the operations of the NMHSs.

(d) Assess the financial viability and long-term sustainability of the 15 NMHSs in the PSIDs by quantifying their current resource allocations against operational demands. This is primarily to determine whether individual NMHSs are provided adequate resources from their Government's fiscal budget over medium and long-term scenarios to support additional recruitment and training needs for new staff and provide on the job learning for existing staff and meet current operational demands.

## Job Descriptions and Qualification Requirements

Based upon the discussions the study team held with the various NMHSs and the results to the online survey the majority of the NMHSs either have or are in the process of developing job descriptions for their services. For the technical positions, as there are no suitable accredited courses available in the Pacific or neighbouring countries the minimum qualification for technical positions is typically completion of secondary school studies. For the traditional weather observer role, secondary school qualifications may be sufficient however, as automation takes over the role of the traditional observer, the NMHSs develop new services and new technology is introduced, secondary school qualifications are probably not sufficient for the longer term.

The ideal situation for most of the NMHSs would be to have the option of recruiting new base level staff with secondary school qualifications and over time have them complete on the job training and study that leads to certificate, diploma or eventually degree level qualifications.

The linking of qualifications to positions must be made on a country by country basis due to the linkage of qualifications to salary. Within WMO the emphasis has been on ensuring that staff have the competencies for the required roles and leaving the linking of qualifications and roles to individual countries. The WMO documentation and experience is that in many areas Senior Meteorological Technicians and junior and middle level Meteorologists can carry out similar roles. This provides countries with the flexibility to take their financial situation and other factors into consideration when setting the qualifications for each position. Experience in the Caribbean and parts of Africa indicates that senior level Meteorological Technicians are typically diploma level whilst junior and middle level technicians are at lower certificate levels. As noted earlier in this report the

NMHS Directors are keen for the RTC to offer accredited courses for their staff that allow them to move from one level to the next.

Most services have either created or are in the process of creating some positions that require staff to have a university degree to carry out new and higher order services. With the exception of Tokelau the Public Service guidelines allow the NMHSs to recruit staff with general degrees and send them away for specialist education and training.

In summary, the Public Service agencies in each of the 15 countries are responsible for setting the job descriptions and minimum qualifications for government positions. Within the NMHSs the job descriptions and minimum qualifications have been built around traditional roles that are in the process of changing. The Directors all see the need for the proposed RTC to provide articulated accredited courses that would allow them to better fit their workforce into the existing Public Service structures.

## Access to Post Secondary Training for NMHS Staff

The NMHSs face a number of difficulties in regularly accessing tertiary education in the Pacific and neighbouring countries. These include:

- Funding to cover airfare, living expenses and tuition costs;
- For some positions attracting new staff with suitable qualifications and experience to gain admittance to Universities and specialist training centres outside of the region. The Australian Bureau of Meteorology Training Centre has found that candidates from the Pacific are typically much weaker in mathematics and physics than the Australian recruits on the same course and struggle with the more theoretical subjects, the study team have been advised of similar experiences in other institutions outside of the region;
- Within the region, the need for students with the New Zealand NCEA secondary school qualification to essentially repeat their last year of their secondary schooling by having to undertake foundation studies at USP has been detrimental in attracting students to study at USP; and,
- Passing English language skills entry level requirements at some international universities.

For in-service training courses funding is typically the main impediment stopping staff from participating in face-to-face education and training opportunities around the globe. Some moderated online training courses are available but internet capability, lack of familiarity or interest with this type of training, finding out about the courses and timing are typically cited as the primary things stopping staff from participating in these activities.

For the training of new staff, funding remains a key issue but the other points indicated above also play a role.

In summary the NMHSs face difficulty in accessing regular and uninterrupted access to education and training opportunities in Universities, Technical Colleges and Specialized Centres primarily due to limitations in national funding. Where funding is provided as part of the training opportunity the NMHSs are usually able to access it. The training reports from FMS with JICA funding and from NOAA's Pacific Island Training Desk underscore this point.

## Staff Turnover

With the exception of Fiji, staff turnover across the region is generally low in the 15 NMHSs, possibly because the staff

typically have few if any tertiary qualifications. Whilst the Fiji and "Compact" countries situations potentially have some national elements, it is anticipated that other NMHSs may face similar problems of increased staff turnover as they employ more staff with transportable qualifications. The bonding situation used by most countries provides one measure of addressing the problem in the short term but it may not be enough to retain staff in the longer term. Ultimately, such factors as salaries, conditions of employment, opportunities for advancement, etc., that are comparable with those of their professional peers in their country will hold degreed meteorologists within the NMHS.

## NMHS Funding from National Sources for Education and Training

This part of the survey had the fewest responses. From the limited data available to the study team from the questionnaire plus discussions with the staff and experience in other parts of the world it would appear to the study team that the NMHSs, with few exceptions, do not have the financial resources required to fully fund the education and training their staff ideally require to deliver the services the NMHSs outlined under the PKO's.

Where the courses are academic courses at USP or similar the governments of the countries have scholarship or reimbursement schemes to offset the costs for individuals provided they have NMHS approval.

Where the courses are not accredited, i.e. either long or short term in service courses, the NMHSs typically have to rely on donor support to get staff to the courses.

# 9. Conclusion

The study team were impressed by the enthusiasm of the NMHS Directors and their staff in improving weather and climate services to their countries. The Directors foresaw the need to improve, and over time change, the mix of the staff qualifications and numbers in order to address the PKO's they hope to address before 2026.

In general the average ages of the NMHS personnel across the region are quite low (between 30 and 40) so loss of staff due to retirement is not an immediate issue. Generally staff turnover is low possibly due to lack of transportable qualifications and experience that has been gained using manual, rather that state-of-the-art, automated systems. In Fiji and the "Compact" countries where there are more professional staff, turnover is higher which give the NMHS Directors in those countries some cause for concern.

Noting that Nauru, Tonga, Tuvalu, Vanuatu did not provide estimates of their forward staffing requirements by job role it would appear that there are probably not enough students to justify the running of a BSc in Meteorology within the region but there could be sufficient students to run a post-graduate diploma in meteorology with a strong operational focus, certainly on at least a triennial basis and possibly more frequently. There would certainly appear to be sufficient numbers to develop a series of articulated accredited courses leading to a diploma level course for senior meteorological technicians undertaking aviation forecasting and other higher level duties.

The survey results indicate that the demand for education and training was highest for operational forecasting,

climate services, marine and ocean services, ICT and equipment maintenance and repair. The demand for education and training in hydrology and water resource management is under represented in this report as the study team were not able to meet with most of the responsible senior officers. Initial indications suggest that the number of staff in hydrology and water resources are low however the management of water resources is vital to the viability of each of the countries and needs to be further explored.

Discussions with the NMHS Directors and other bodies indicate that the Fiji Meteorological Service with JICA support, NOAA's Pacific Island Training Desk and SPREP through COSPPac are already providing opportunities in these areas. USP is seen as having the potential to strengthen their course offerings but may not have sufficient staff numbers and experience in the short term to deliver an accredited course that fully addresses the BIP-M and the allied operational orientated training. The potential makeup of an RTC will be addressed in the second report from the study team.

# REPORT PART 1: Annexes

- ANNEX ONE | Country and Organisation Profiles
- ANNEX TWO | Country Responses to the Survey
- ANNEX THREE | Glossary of Abbreviations and Terms

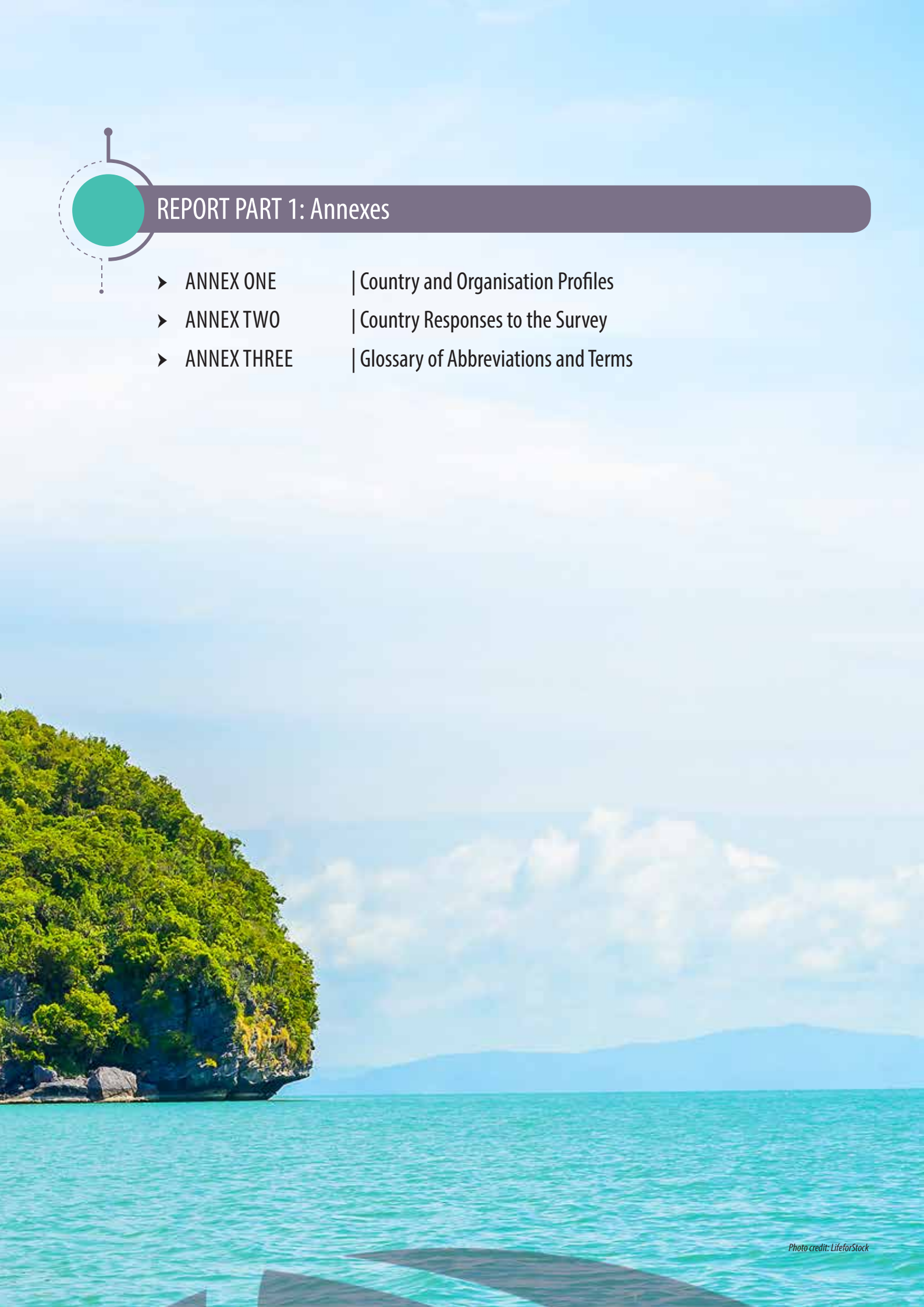


*Photo credit: LifeforStock*

# ANNEX 1

## Country and Organisation Profiles

# Content

# *Country and Organisation Profiles*

The information in the following country profiles was developed by the Study Team as a result of the discussions with the Directors and Senior Managers of the Meteorological and Hydrological Services, results from the study teams survey, reports by the NMHSs to the 2017 Pacific Meteorological Council plus basic information from the Australian Department of Foreign Affairs, the World Bank and World Population website (population, GDP, land area).

The study team thank and acknowledge the following people for their time in reviewing and making suggestions on the country / organisation profiles for their institution:

Mr Arona Ngari, Ms Rossylynn Pulehetoa-Mitiepo, Mr Seiuli Aleta, Ms Paula Faiva, Mr Penehuro Lefale, Mr Roger Cornforth, Mr Salesa Nihmei, Mr Philip Malsale, Mr Robert Duncan McIntosh, Mr Henry Taiki, Mr Ausetalia Titimaea, Ravind Kumar, Esline Garaebiti, Tauala Katea, Ms Jennifer Lewis, Dan Beardsley and H. Gingerlei Porter.

The Cook Islands comprise 15 small islands, spread over 2.2 million square kilometres of the Pacific Ocean between approximately 20S and 10S latitude. The Cook Islands are northeast of New Zealand, lying between American Samoa and French Polynesia. The Cook Islands are in the Western Hemisphere and thus one day behind islands such as Fiji, Samoa, Tonga, Vanuatu and the Solomon Islands. The resident population is about 13,200. Rarotonga, housing the capital Avarua, is the most populous island.

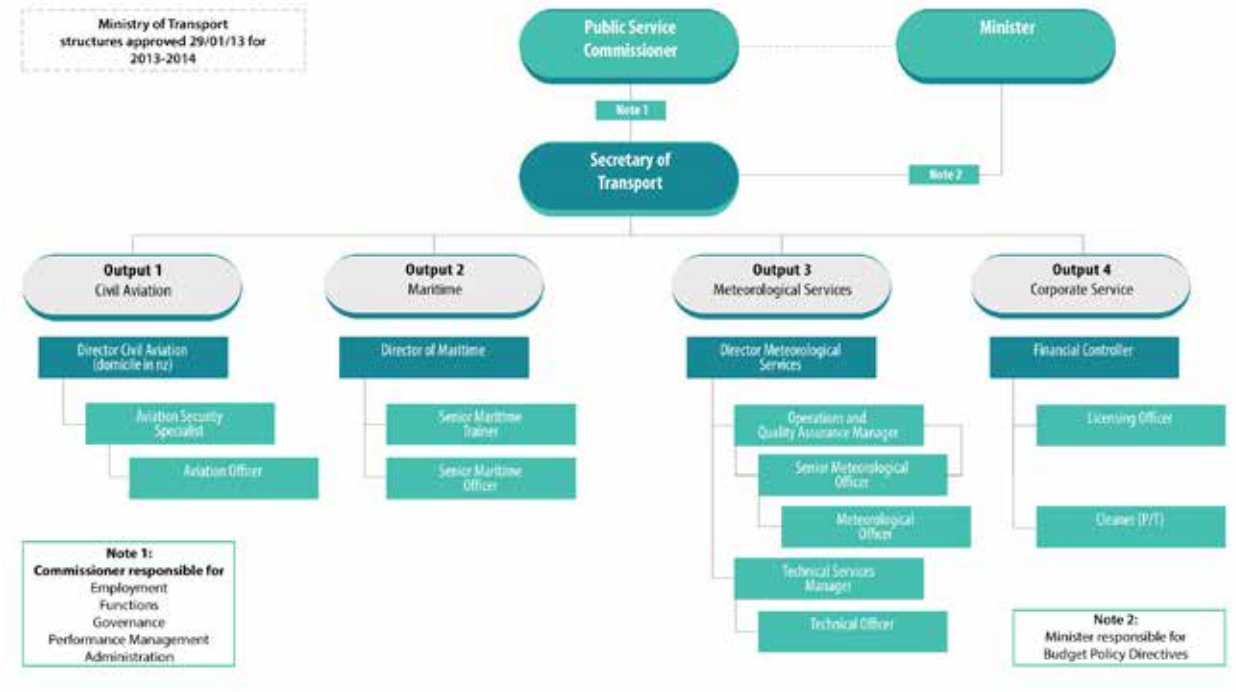
## *Meetings*

- Mr Arona Ngari, Director, Cook Islands Meteorological Service
- Mr Ned Howard, Secretary, The Department of Transport, Cook Islands

## *NMHS General Information (structure, functions, staffing, expectations, challenges)*

The Cook Islands Meteorological Service (CIMS) is part of the Department of Transport. The CIMS has eleven established positions with eight of them currently filled. As per the organigram (Figure 1) there are six different roles for the personnel including three with management responsibilities.

**Figure 1: Organogram for the Cook Islands Meteorological Service**




The Meteorological Office is located in the vicinity of the airport. It is primarily for surface and upper air observations with no formal forecasting role. No upper wind flights have been carried out for at least two years due to an inability

to purchase consumables. WMO has been approached to help procure radiosondes. Hydrogen for the balloons comes from a Proton Generator Hydrogen electrolytic unit. Two lightning detector systems are installed, one at the main Meteorological Station on the island of Rarotonga and the second unit on one of the northern islands.

Forecast products (aviation up to 10 TAF locations, marine and high seas) come from the Fiji Meteorological Service as part of their WMO Regional Specialised Meteorological Service (RSMC) responsibilities with CIMS staff providing additional interpretative details (elaborative briefing) based upon local observations, climatology and local experience. The elaborative briefings are provided to tourist operators, disaster management and other arms of government, and marine operators. The freely provided forecast services from the Fiji Meteorological Service are highly appreciated and well used by the Cook Islands, however Mr Ngari, the Director of CIMS, would prefer to have them formalized under a Letter of Agreement or similar.

At the present time Fiji Meteorological Service only receive surface observations from Raratonga but up to 10 AWS across the Cook Islands are envisaged under funding obtained from the Climate Early Warning System (CLEWS) and some support from the Disaster Resilience for Pacific Small Island Developing States (RESPAC) project. Eight of the AWS will be installed outside of the main island. It is expected that the AWS will be co-located with the telecom towers of the local provider (Blueskye) with CIMS only having to pay the communication costs.

In the aviation area there is one staff member whose primary role is quality assurance of the (observational) services to civil aviation. Competency assessment of the observers has been carried out but their Quality Management system has not been formally completed. This is expected to occur later in the year with support from the Cook Island Civil Aviation Authority.

The Director is working to strengthen the professional (university degreed) staffing in CIMS. The priority is to strengthen research capability so the Cook Islands can benefit from collaborative activities with regional partners such as Australian and New Zealand and the wider scientific community. The Director is anticipating an increase of two people along these lines, they would contribute to climate services, climate policy development and review, development of skills sets within the office for dealing with data and strengthen the coordination with clients on operational products from Fiji.

Graduates from courses such as the University of Reading MSc in Meteorology with Climate and Management (ie a 12 month MSc with coursework in standard meteorology and climate science, climate policy and some MBA units with a minor thesis) or the USP MSc in climate change could have suitable background for the envisioned roles outlined above. Whilst preferring to recruit degreed staff the Director noted that some of the envisioned roles could also be carried out by qualified Senior Meteorological Technicians which would have less impact upon salary caps.

Public Service staff are bonded for longer term training at a 1 to 1 rate. At this stage there is no requirement for training provided to Public Service staff to be certified or to be able to articulate into other certificates or diplomas.

New technical recruits are essentially trained by the apprenticeship method (ie on the job training) and advantage is taken of courses from FMS or others as they arise.

### *Education and Training Needs*

The education and training needs for CIMS differ between professional and technical training. At the technical

level the needs focus on improving sustainability and quality of the existing services; maintenance and repair of equipment, observations and network management and communications and computing whilst at the professional level the needs focus on improving the ability of CIMS staff to contribute to wider research projects, improve climate services and strengthen the knowledge and skills in communication and computing in the office. CIMS only expects a small increase in staffing in the next five to ten years and this is reflected in the low numbers for new staffing.

## *Educational and Training Offerings at the National Level*

The Cook Islands follow the New Zealand education framework of thirteen (13) years of schooling. Five years in primary school and eight years of secondary schooling. The final year of secondary schooling provides successful graduates with the New Zealand National Certificate of Educational Achievement which is required to gain entry to universities in New Zealand. Students wishing to undertake studies at the University of the South Pacific need to undertake a foundation studies year either instead of year thirteen in the New Zealand framework or following successful completion of the NCEA qualification.

The Cook Islands Tertiary Training Institute (CITTI) offers post-secondary vocation education and training focusing on health and nursing, trades and technology, and hospitality and management. Whilst CITTI does not provide any meteorological specific training opportunities it does offer some modules that cover management, IT and O&HS topics.

The University of the South Pacific hosts a campus on the Cook Islands with an in-country coordinator for the USP EU Climate Change programme.

## *Any RTC Supporting Mechanisms in Place*

Nil.

## *Conclusions / Recommendations*

The Director of CIMS, Mr Ngari is also the Chair of the PMC Pacific Island Education, Training and Research Panel (PIETR Panel).The report from Feasibility Study will be considered by the PIETR panel before it goes further in the PMC process. At this stage the PIETR Panel have not looked at any governance structure or coordination mechanisms for the RTC to ensure that it delivers the types of courses and graduates that the PMC are requesting. In the discussions around this topic it was foreseen that there would be a need for some overarching group, most likely chaired by the (rotating) chair of the PMC and involving representatives of the institution(s) making up the RTC and representatives of the PMC and perhaps key donors would be required. Given that the PMC sessions are getting longer each time due to the side events it was suggested that this group would not meet around the PMC but perhaps a different schedule and that they may need to meet at least annually until the RTC has become operational.

## *Material derived from:*

- Interview with Mr Arona Ngari and Mr Ned Howard on 12 June 2018
- Responses provided by Cook Islands to the Study Team's questionnaire
- Draft PMC-4 country report from Cook Islands
- DFAT Country Profile http://dfat.gov.au/geo/tokelau/Pages/cook-islands-country-brief.aspx

## *National Training Needs and NMHS Interactions with Training Institutions*

The capital of the Federated States of Micronesia (FSM) is Palikir, located on Pohnpei Is (in the State of Pohnpei). In addition to Pohnpei State, the FSM has three other States; Yap, Chuuk and Kosrae (Table 1). While land area of the FSM is small (about 702 km$^2$ or 271 sq mi) its oceanic area is about 2,600,000 km$^2$ (1,000,000 sq mi) of the Pacific Ocean, giving the country the 14th largest Exclusive Economic Zone in the world. In 2017 the FSM had a GDP of $329M and a population of 105,000 (or a GDP per capita of $US3,133)1.

**TABLE 1: The Demographics of FSM**

| State | Capital | Land Area km$^2$ | Land Area (mi$^2$) | Population |
|---|---|---|---|---|
| Yap | Colonia | 118.1 | (45.6) | 11,500 |
| Chuuk | Weno | 127.4 | (49.2) | 49,500 |
| Pohnpei | Kolonia | 345.5 | (133.4) | 38,000 |
| Kosrae | Tofol | 109.6 | (42.3) | 7,000 |

## *Meetings*

### IN KOLONIA, POHNPEI

**At the Pohnpei WSO**

- Mr Kenly Andon, Acting Meteorologist-in-Charge (MIC), Pohnpei WSO
- Mr Johannes Berdon, Meteorologist-in-Charge, Chuuk WSO

**At USAid Office**

- Mr Steve Boland, Officer-in-Charge, USAid, Pohnpei

### IN PALIKIR, POHNPEI

**At the College of the Federated States of Micronesia**

- Mr Kenly Andon, Acting Meteorologist-in-Charge, Pohnpei WSO
- Prof. Joseph Habuchmai, Vice President for Enrollment Management & Student Services

## *The FSM Weather Service Office (WSO)*

The FSM has three Weather Service Offices (WSOs) that are fully supported financially by the US Government through the US National Oceanic and Atmospheric Administration (NOAA), located in Pohnpei, Chuuk and Yap. There currently is a total of 32 staff employed in these three offices (Table 2).

Staff of the WSO expressed a desire to upgrade from two-year to four-year qualifications and were enthusiastic that new opportunities be created. They appreciated the biennial training programs from Guam and the month long

1 https://data.worldbank.org/country/micronesia-fed-sts?view=chart

postings to the Pacific Desk, but considered that it was unfortunate that these training events do not lead to formal qualifications or offer university course credits.

**TABLE 2: Staff Disposition of the FSM WSOs**

| Staff Position \ WSO | Yap | Chuuk | Pohnpei |
|---|---|---|---|
| 4-year degree + Meteorology | 1 | 1 | - |
| 2-year College. Tech Officer (Engineering) | 2 | 2 | 2 |
| 2-year College. Tech Officer (Meteorology) | 6 | 6 | 8 |
| Facilities Maintenance. 2-year College. Tech Officer. | 1 | 1 | 1 |
| Administrative Assistant. 2-year College. | 1 | 1 | 1 |
| TOTAL | **9** | **11** | **12** |

The acting MIC of the office noted that there was no plan to expend the service capability of the office beyond providing advice to the National Emergency Management Organization in the lead up to, and during severe weather events.

It was clear that the two-year qualified staff of the FSM WSOs would be motivated (incentivized) through access to a BIP-M course that is associated with an accredited university. Furthermore, if successful completion of courses created possible credits for other university-based undergraduate and/or graduate courses the staff would be able to expand their career options.

## *Tertiary Education in the FSM*

The College of Micronesia (CoM) has around 2200 full time students spread across 6 campuses in Pohnpei, Yap and Chuuk. The Palikir campus on Pohnpei is modern, spacious and appears well appointed. It has good Internet connectivity. The CoM delivers two-year qualifications that enable its students to enter the 3rd year of four-year degree courses at larger universities. As an accredited two-Year College, the CoM is allowed to deliver one four-year degree course, and is now in the process of establishing a four-year BA degree in Nursing Studies.

Relevant to a proposed Pacific RTC, the CoM does provide mathematics and statistics courses as well as technical certificates in electricity and electronics that could help prepare students for a BIP-M or BIP-MT. The CoM does not include physics in its curriculum.

Student fees are around $US2,000 for a full time student, rising to $US2,800 for a resident, full-time student. The CoM previously offered distance learning options but no longer does so. This said, the CoM lecturers make good use of the Internet to supply students with course materials and to interact with them in other ways. The CoM has no formal links to the USP but prepares many students for USP courses (especially medicine). The CoM has links to the University of Guam and the University of San Diego.

The annual funding base of the CoM is around $US21M secured from a variety of sources: student fees (largely from Pell Grants), the US through the Compact Agreement, the Government of FSM and academic grants.

The CoM would not be in a position to offer an undergraduate degree in meteorology as there is simply not the demand for such a course. Relevant to the need to upgrade the qualifications of a number of staff to BIP-M in

particular, but also BIP-MT, the CoM position that it may be possible for it to host an intensive one-year course for a cohort of 15 plus students if the meteorological community could secure donors and experienced meteorologists to deliver the core, meteorological content.

The nation of Fiji is comprised of over 332 islands (with area of 18,272 km2), although only 110 of those are actually inhabited. Fiji's Population is 912,061 as of 2018 according to http://worldpopulationreview.com/countries. The last census was in 2017 and the total populations stands at 884,887 with an increase of 5.7% compared to a decade ago (Bureau of Statistics, 2017).

Fiji is ranked as the 14th most exposed country in the world to natural disasters (World Risk Index, featured in the World Risk Report, 2016).

## *Meetings*

- Mr Ravind Kumar, Director of Fiji Meteorological Services
- Mr Sosiceni Dumukuru, Senior Training Officer, Training Unit of the Fiji Meteorological Services
- Mr Awnesh Singh, Physical Oceanographer, Lecturer, University of the South Pacific
- Mr Ajal Kumar, Lecturer, University of the South Pacific
- Mr Fereti Atalifo, Deputy Director Information Technology Sciences, University of the South Pacific
- Dr Jimaima Lako, Associate Professor and Head of Applied Sciences, College of Engineering, Science and Technology, Fiji National University
- University of Fiji

## *NMHS General Information (Structure, Functions, Staffing, Expectations, Challenges)*

FMS is aligned to a Ministry of Disaster Management and Meteorological Services. FMS has been provisionally certified to be the Aviation Meteorological Service provider for air navigation and Climate Services. ISO 9001:2008 certified until 2017 and now certified to ISO 9001:2015. Work in ongoing for meeting the requirements under Safety of Life at Sea (SOLAS) convention and Marine Weather Services certified in 2019, Public Weather and Hydrological Services by 2020. Under the Director of Meteorology, there is RSMC and the following units forms the Governance structure of the Department: National Weather Forecasting Centre, Climate Service Division, Hydrology Division, Computing and Information System Division, Technical System Division, Reporting and Facilities Division, Corporate Services Division, Business Development Unit (to be established), Accounts Section, Training Sections, Quality Management System, Media Officer.

The number of staff is 145.

**Staffing numbers for the various service areas as follows:**

- Administration, management and training – 26 (1 with degree) incl. 3 established staff for training with no degree (1 more is expected with degree for scientific training)
- General forecasting - 40 in total (15 with degree)
- Observations – 25 (1 with degree)
- Climate Services - 14 (5 with degree: 2 in place 3 are vacant)

- Hydrological Services – 14 total (3 with degree)
- Communications and computing – 8 IT and 1 Media officers (3 with degree)
- Equipment maintenance and repair – 6
- Other Support functions - 12 officers

The Government of Fiji has strengthened the workforce of FMS by establishing 16 new positions and allocating funding in the 2017/18 financial year. The new position covers for an Assistant Director, 4 Senior Scientific Officer, Instrument Technician, QMS Officer. Recently introduced Media Center as new capability to enhance visibility of FMS, Weather Office for Vanua Levu to cater for growing demands from islands and rural population for and climate services.

To meet the WMO and ISO requirements, weather forecasters and technical support staff have undergone competency assessments.

Funded through the FMS project for improvement of equipment for disaster risk management 2015 were: a Wind Profiler in Nadi, a Tide Gauge in Vatia, Tavua, Lighting Detection System in Rakiraki, Labasa, Nadi and Suva, VSAT Communication System in Viwa, Lakeba, Matuku, Udu Point and Nadi, Calibration Equipment in Nadi, and an Automatic Weather Station in Suva).

The FMS budget has been about $9 million dollars for the last three years and is expected to increase in the coming years. With the FMS Business Development Unit in place, revenue generated will further boost FMS investment in meteorological and hydrological infrastructure and services modernization in the coming years.

FMS is exploring the opportunity to host a Regional Instrument Calibration centre (RIC) as endorsed by Pacific Meteorological Council and will be further collaborating with the President and the Management Group of RA V, in coordination with CIMO and relevant departments of WMO, to achieve this by 2020.

### *Education and Training Needs*

There is a need for the upgrading of specialized and basic observational equipment both in spatial space and modernized technology, developing a high resolution NWP models for atmospheric, marine and land environments and up-skilling staff to meet these challengers. FMS staff consider that while universities teach Maths and Physics as core subjects, these are rarely used in operational work, and instead more emphasis on computer programming is needed.

Capacity development at all levels is a must for sustaining services and this in return requires enhanced training-of the-trainers for the FMS Training Unit.

**Extract from PMC-4 Country report (types of training needed to enhance the generation and production of climate services):**

- Basic Instruction Package for Meteorologists (BIP-M)
- Research exposure through Master's Degree
- Climate applications training, such as, agro-meteorology, hydro-meteorology, etc
- Sub-seasonal forecasting
- Dynamical downscaling

- Climate change science and projections
- Drought monitoring
- Data homogenization
- Geographic Information System
- Programming
- Quality control of meteorological data
- Data archival and rescue
- CliDE

## *Educational and Training Offering at the National Level*

**The University of Fiji**, the smallest, fully registered university has two campuses; Saweni, Lautoka and Samabula, Suva. It comprises five schools namely: School of Humanities and Arts, School of Science and Technology, School and Business and Economics, Umanand Prasad School of Medicine and Health Sciences, Justice Davendra Pathik School of Law. Conventional degrees and diplomas: Bachelor of Science in Physics, Mathematics, Chemistry. Degrees course offered: Masters in Renewable Energy Management, MBA.

**Fiji National University** has proposed a three-year BSc Met programme (in-progress for 2016-2018) based on previous experience of Certificate IV Meteorology Programme offered in 2012 – 2013.

**University of South Pacific** is a regional university jointly owned by 12 Pacific Island Countries (Fiji, Cook Islands, Kiribati, Marshall Islands, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Samoa). Advanced communication technologies through USPNet are used to reach distance and flexible learning students across the vast expanses of the Pacific Ocean in the 14 USP campuses. USP has the facilities to support training, that is, IT services and teaching labs. **USP offers:**

- Certificate or diploma for equipment or IT technicians
- Certificate in Information Systems
- Diploma in Computing
- Diploma in Information Systems
- Bachelor's degree in Computing
- Bachelor's degree in Information Systems
- Diploma in Geospatial Science Systems

**Courses that serves the needs of the Pacific Islands Met Services (in addition to BSc in Maths/Physics/CS/IS):**

- PHYSICAL OCEANOGRAPHY
  **Undergraduate** (MS213 Physical Oceanography)
  **Postgraduate** (*PC430 Advanced Physical Oceanography)
- METEOROLOGY
  **Undergraduate** (PH202 Environmental Physics)
  **Postgraduate** (PC428 Tropical Meteorology)
- CLIMATE SCIENCE
  **Postgraduate** (PC415 Climate Science)

**For Graduate Diploma a Minimum of five students per course is needed for it to be sustainable. For three-year BSc/ Diploma/Certificate course:**

- **100 LEVEL** – minimum 30 students per course
- **200 LEVEL** – minimum 20 students per course
- **300 LEVEL** – minimum 15 students per course

USP does not have a specialized undergraduate degree in meteorology, however, USP graduates with a three-year BSc degree majoring in Mathematics and Physics, which is offered by USP, are absorbed into the NMHSs. They are then sent for BIP-M training overseas. The BSc degree in Mathematics and Physics includes courses in physical oceanography, environmental physics, calculus, algebra, classical physics, information systems, which provide prospective NMHSs staff with a good background and foundation. In addition, USP offers a course in Tropical Meteorology at the postgraduate level. A postgraduate course in Physical Oceanography is currently in process for approval, which builds on the undergraduate course in physical oceanography. Many NMHSs staff have taken the tropical meteorology course already. This course also introduces programming in Python, which is useful in analysis of climatological data that the NMHSs have access to.

For most effective delivery its courses, USP invites guest lecturers to deliver lectures in specialized areas if needed. This is done on mutual agreements and there is no need for a MOU to be in place for this to be done.

Cost for each student enrolled at USP depends on the programme they are enrolled in. Tuition fees for certificate course - FJ$3,750 for 6 courses.

- **BACHELORS DEGREE** (3 years) - ~FJ$40,000
- **MASTERS DEGREE** (4 years) - ~FJ$70,000
- **PHD DEGREE** (5 years) - ~FJ$177,000

USP works with its development partners and partner institution to create opportunities for students and staff to undertake scholarships at any of its campuses around the region (https://www.usp.ac.fj/index.php?id=stud_ scholarships). Students may receive funding for their research irrespective of scholarship status, including publication costs. Also, the Tertiary Scholarship and Loans Board (https://www.tslb.com.fj/Home) helps students (Fijian citizens only) through their scheme as well. Respective governments offer pre-service or in-service scholarships to their citizens to undertake studies at USP also.

USP does communicate to the NMHSs representatives whenever possible. The offering of the postgraduate course in tropical meteorology eventuated initially from the demands of the NMHSs. The proposed postgraduate course in physical oceanography is based on the demands from the NMHSs.

A Student Assessment Policy is in place (https://www.usp.ac.fj/index.php?id=21321).

USP now houses Climate Data for the Environment (CliDE) (software deveoped by the Australian Bureau of Meteorology for the management of climate data) on its server. There is an opportunity to learn how to program in various computer languages to analyze data, for e.g., Python, Matlab, R, Ferret, etc.

USP offers all its courses in English. Being aware that English is the second language for all Pacific Island countries, USP has courses in place at the 100- and 200-levels to accommodate the issue of English as a second language. Experience

has shown that USP students are easily able to adapt, understand and follow slight variation in accent from USP academics in the various courses.

USP offers its courses both on a face-to-face basis as well as online through the Moodle platform. This makes it efficient for students to study from anywhere in the world at any time. Refreshment courses for NMHS staff can also be developed.

Many NMHSs staff are graduated from USP and they are welcomed back to USP through the Pacific RTC to allow them to easily fit into the USP culture. They know the policies, procedures and administrative services in place to be able to continue their future studies or upgrade skills.

FMS Training Unit hosts many training courses and intends to develop new training offerings based on the identified needs of the region, and interested in possibility of establishing the Regional Training Centre with collaboration with USP, WMO, SPREP and other interested parties. In the last 3 years, the following training courses were organized/hosted (as examples) with co-funding provided by JICA, UNDP, FMS:

- BIP-MT Training (05.09-11.11.2016, 24.04-29.06.2017) conducted by FMS training officers
- Himawari-8 Satellite and Satellite Training (SATAID)
- Wave, Tide and Storm-surge
- QMS training
- TV weather presenters
- Tropical cyclone and public weather service
- Maintenance and calibration of met. instruments
- Media training
- Ocean and Tide
- Advanced Groundwater Monitoring in Pacific SIDS workshop
- Induction training for recently employed staff, refreshing training for observers,
- Climate training
- Hydrology
- Airport Fiji Limited Aeronautical Technicians and Air Traffic Controller (Met Module)
- Fiji Airways Cabin Crew Met Training
- Hydrology Training and some others

Upon successful completion, certificate of completion issued. National trainee pay nothing, internationally funds are provided by donors (travel, accommodation, DSA) while local arrangements can be done by FMS via funds from UNDP, JICA, SPREP, COSPAC, FINPAC). Registering FMS Training Section under Fiji Higher Educational Commission is under planning.

FMS Training Unit currently consisting of 2 Training Officers (both technical staff but with great experience according to their CVs) responsible for training (curricula development, evaluation). Training needs assessment is done via travelling within 9 countries (Tonga, Samoa, Niue, Cook Islands, Nauru, Solomon Islands, Vanuatu, Kiribati, Tuvalu). An additional member of the training staff is expected to be employed later this year for scientific and research training including organization of workshops and seminars. Financial and other support for organizing training is mainly coming from JICA, however the Australian Bureau of Meteorology (BoM) and New Zealand's Institute for Water and Atmosphere (NIWS) also provide support on ad-hoc basis.

FMS already has experience in conducting BIP-MT which they intend to expand to BIP-M (however there is currently a

lack of appropriately qualified staff). That will ideally be up to 10 months training for those people who already have background university level in science. Face-to-face training mode is considered to be the most effective way but exploring Moodle possibilities is worthwhile.

There is a class room available for about 30 seats and 15 PC available. Another facility (for about 40 seats) is available in Suva.

Providing training in Fiji seems has reasonable advantages: the regional countries are more able to attend the quality trainings saving funds for not covering cost-demanded air-flights, visa and living expenses out of the region. A list of training conducted in cooperation with JICA in the period of Feb 2017- Mar 2018 was provided. It includes the group training, in-country training and on-the-job training. The feedback from the trainees is very positive. The FMS has trained 219 staff from 12 countries since 2014 (Table 1).

**Table 1: Fiji Met Service International Training in Terms of Numbers of the Regional Staff Trained since 2014**

| Country | BIP-MT | Climate | Equipment | Forecasting | Observations | QMS | Total Staff Trained since 2014 |
|---|---|---|---|---|---|---|---|
| Cook Islands | 1 | 2 | 5 | 2 | 6 | 15 | 31 |
| Fiji | 17 | 6 | 22 | 10 | 1 | 3 | 54 |
| FSM | 1 | 2 | 3 | 2 | 0 | 1 | 9 |
| Kiribati | 1 | 2 | 5 | 2 | 15 | 1 | 26 |
| Nauru | 1 | 1 | 2 | 2 | 0 | 1 | 7 |
| Niue | 2 | 2 | 5 | 2 | 1 | 1 | 13 |
| PNG | - | 2 | 4 | 2 | 1 | 1 | 10 |
| Samoa | 1 | 2 | 5 | 2 | 1 | 1 | 12 |
| Solomon Islands | 3 | 2 | 5 | 2 | 1 | 1 | 14 |
| Tonga | 3 | 2 | 5 | 2 | 1 | 1 | 14 |
| Tuvalu | 1 | 2 | 5 | 2 | 1 | 1 | 12 |
| Vanuatu | 1 | 3 | 8 | 2 | 2 | 1 | 17 |

Targeted countries are Cook Islands, Kiribati, Nauru, Niue, Papua New Guinea, Solomon Islands, Samoa, Tonga, Tuvalu, PNG, Federate State of Micronesia and Vanuatu, which benefited because of enhancing regional exchange of meteorological knowledge and skills via one regional network.

### *Any RTC Supporting Mechanisms in Place*

The Permanent Representative of Fiji with WMO is planning to promote Pacific RTC within RA-V via PMC meetings and requesting funds during international climate weather meetings to run regional trainings.

FMS declared having the quality and training policy, as well as procedures those meet ISO9001: 2015, and updating it to be in line with the RTC requirements and self-evaluation criteria published by WMO.

Tertiary Scholarship and Loans Board (https://www.tslb.com.fj/Home) helps students (Fijian citizens only) through their scheme.

Respective governments offer pre-service or in-service scholarships to their citizens to undertake studies at USP also. This integrates well for the establishment of a Pacific RTC as NMHS staff can use resources at the respective campus if and when needed.

## *Conclusions / Recommendations*

While there are many educational and training offerings available overseas, it is considered that some stages of academic and professional training process should focus on the solid and sustainable local/regional base so as to develop an in-region centre of excellence to meet regional educational and training needs not yet covered elsewhere (bearing in mind that partnership is the key to success in PIMS 2026).

It was suggested that the **formula for success** is:

**(FMS+USP/FNU) * collaboration with stakeholders * coordination = Pacific WMO RTC***
(*provided that the criteria for recognition and reconfirmation of the WMO RTC are met)

Universities are needed to work more collaboratively not duplicating educational and training offerings. Needs more tailor made programmes in the University curriculum as opposed to standard courses currently offered.

The BSc Met is currently being developed by Fiji National University (FNU).

USP offers recognized in the region qualifications at all levels via settled distributed structure and supporting national scholarship mechanisms. USP can accommodate the BIP-M and BIP-MT into their offerings through a new one-year Postgraduate Certificate or Diploma programme in collaboration with FMS Training Unit. A priority training for NMHSs is on instrumentation handling and operation, maintenance, etc., can be tailor made to be offered at Certificate level. This can be targeted at NMHS staff who already hold a BSc degree and also secondary students, who will first need to complete the BSc degree majoring in Mathematics and Physics.

Registering FMS Training Section under Fiji Higher Educational Commission can work to contribute to achievement of this goal of BIP-M/MT training.

Universities' curricula are to be linked to BIP-M as expected exercise.

Kiribati comprises 32 low-lying atolls and the raised phosphate island of Banaba. These atolls straddle the equator in the mid-Pacific ocean. Apart from Banaba in the West, Kiribati has three groups of islands – the Gilbert Islands (16 populated atolls), the Phoenix Islands (8 atolls unpopulated other than for a government outpost on Kanton) and the Line Islands in the East (9 of the 11 atolls are part of Kiribati and two – Palmyra and Jarvis Islands – are US territories). Only three of the Line islands have populations: Kiritimati (Christmas Island) the largest atoll in the world, Teraina (Washington Island) and Tabeuran (Fanning Island).

Kiribati's atolls are wide-spread, mostly less than two metres above sea level and vulnerable to the impacts of climate change. They total 811 square kilometres of land distributed over 3.5 million square kilometres.

Kiribati's population is estimated at 114,000. The atoll of Tarawa in the Gilberts group is the capital and its crowded southern arm contains half the country's population. Most of the remaining population also lives in the Gilbert Islands.

## *Meetings*

- Mr Ruui Tabutoa, Deputy Secretary from the Office of Te Beretitenti (President)
- Mr Ueneta Toorua (Director, Kiribati Meteorological Service)
- Mr Kairoronga Labeti (Station Technical Officer)
- Ms Kamaitia Rubetaake (Climate Officer)
- Ms Mwata Keariki (Assistant Climate Officer)

## *NMHS General Information (structure, functions, staffing, expectations, challenges)*

The Kiribati Meteorological Service (KMS) is part of the Office of the President and has a current staffing establishment of 31 positions of which 28 are currently occupied and three are in the process of being advertised. KMS has six offices, the Headquarters on Betio Island in South Tarawa which is also the site for a full surface and upper air station (1 radiosonde flight / day) and a small (non-aviation) forecasting office with a Himawari LRIT receiving station, an observing office at the main international airport also on South Tarawa, an office on Christmas Island and three SYNOP stations on the outer islands. Work has begun through the Pacific Met Desk at SPREP to create a draft Meteorology Act for Kiribati.

The Director of the KMS is Mr Ueneta Toorua who has been able to convince the Government of the value of investing in meteorological and climate services. KMS issue a daily public weather and near coastal weather forecast as well as a monthly climate outlook, In the coming years Mr Toorua plans to have the KMS take over the production of TAFs for Kiribati from the Fiji Meteorological Service. KMS currently have two staff training to become meteorologists, one undertaking an MSc in Meteorology from Victoria University in Wellington and another undertaking the Graduate Diploma of Meteorology at the Australian Bureau of Meteorology Training Centre.

The KMS Climate Section has three staff two of whom have degrees from USP. A position as Quality Assurance Officer has been created but not yet filled, this person will also function as the Deputy Director of the KMS. Recently an IT graduate from USP was hired to oversee the IT and basic equipment maintenance. Forecasts are distributed via radio and press as well as social media. Kiribati does not currently have a TV station but is in the process of creating one. Hydrology is handled by another department with the main water supply for the island being artesian bores.

Like the Public Service on Niue the Kiribati Public Service do not know how to deal with the specialist but non accredited training undertaken by the meteorological observers and at this time their skills are not reflected in their classification of pay grades. Mr Toorua would welcome the RTC offering TVET courses for his meteorological observers as this would help address one of the problems his staff are facing in getting their training recognised by the Public Service Office.

Mr Toorua and his Deputy Secretary both anticipate further growth of the KMS.

### *Education and Training Needs*

The education and training needs of the KMS are similar to other NMHSs in the Pacific. In the professional area the top four priorities are forecasting, management of equipment maintenance and repairs, climate services and marine / oceanographic services. In the technical area the top four priorities are forecasting services, equipment maintenance and repair, observations and network management, and climate services.

### *Educational and Training Offerings at the National Level*

The Kiribati Education system is based upon the New Zealand model. There are junior and senior secondary schools with secondary schooling lasting seven years. At the end of the sixth year of secondary school students can enrol in the USP foundation courses which if they are successful provides entry in USP 100 level Bachelor courses. Alternatively they can continue in the Kiribati education system and gain an NCEA (National Certificate of Educational Achievement which is the New Zealand secondary school qualification). Students who go the NCEA route and subsequently wish to study at USP will, in most cases, then need to take the seven Foundation Studies units which are similar to the last year of the NCEA studies. There is no university on Kiribati but there is a Kiribati Institute of Technology (KIT). APTC also has a campus on Kiribati. KIT and APTC both provide formal post-secondary school courses at certificate level in the trades areas. The Kiribati Government provide scholarship funding for students studying overseas and students are expected to return for at least two years to work off their bonds.

### *Any RTC Suppporting Mechanisms in Place*

Nil.

### *Conclusions / Recommendations*

The Kiribati Meteorological Service is a led by a young enthusiastic Director who has convinced the Government of the value of meteorological and climate services. The number of staff is growing and the services provided by the

service are also growing. As KMS wish to take over aviation forecasting for Kiribati from the Fiji Meteorological Service they are in the process of increasing the number of staff who met the BIP-M requirements. Climate and ocean services are also seen as a growing area. A key requirement for KMS is to ensure that the courses their staff undertake are accredited so that the KMS staff paid according to their skills and qualifications.

### *Material derived from*

- Interview with Mr Ueneta Toorua and Mr. Ruui Tabutoa, Deputy Secretary from the Office of Te Beretitenti (President) on 22 June 2018
- Responses provided by Kiribati to the Study Team's questionnaire
- PMC-4 country report from Kiribati
- DFAT Country Profile http://dfat.gov.au/geo/kiribati/Pages/kiribati-country-brief.aspx

Nauru, officially the Republic of Nauru, is 42 kilometers south of the Equator and 4,000 kilometers northeast of Sydney. A raised, fossilised coral atoll, Nauru is one of three great phosphate rock islands in the Pacific Ocean – the other two being Banaba (Ocean Island) in Kiribati and Makatea in French Polynesia. Nauru has a total land area of 21 square kilometers.

Nauru has a population of approximately 13,000 people, most of whom are indigenous Nauruans predominantly of Micronesian origin. Non-Nauruans are principally other Pacific islanders, Chinese, Australian and Filipino expatriates, as well as other temporary residents (primarily asylum seekers and refugees).

## *Meetings*

The study team were unable to visit Nauru due to time constraints and to date it has not been possible to organise a teleconference with the responsible authorities. The material in this report has been extracted from the Nauru report to the fourth (2017) Pacific Meteorological Council session in the Solomon Islands plus material available via the internet, see reference material at the end of the report

## *NMHS General Information (Structure, Functions, Staffing, Expectations, Challenges)*

The National Meteorology Service was established in May 2015, under the Ministry of National Emergency Services (NES). In July 2017 there was one substantive officer responsible for the NMHS with another officer from the NES assisting. The one man office is due to the fact that the NMHS centre is still not built. Until the physical office is completed further recruitment action will not take place. It is envisaged that the National Meteorology Service will operate 24/7 once it is established and provide some climate services in addition to observing functions and interpretation and elaboration of forecasts and warnings from centres such as the Regional Specialised Meteorological Centre in Nadi.

In July 2017 the Nauru NMHS had neither Legislation nor Act. However, the NMHS was mentioned briefly under the NDRM Act 2016 as an established structure under the National Emergency Services. The main role envisaged for the NMHS is to be a fully fledged and dedicated NMHS that will provide weather forecasting for Nauru and equally important, the NMHS will also play a role as an Early Warning Centre, in regards to monitoring and observing Severe and Cyclonic Weather, monitoring of Tsunami Warning Messages and many more that are required under NMHS.

The established officer has under gone some training with the Fiji Meteorological Service in Nadi. Under the department's capacity building program another officer within the NES department has also been trained to assist the substantive NMHS officer. The training was funded by JICA.

The Government are in the process of building the National Emergency Operation Centre (NEOC) and NMHS centre as part of a joint project with the European Union (EU) and the Africa Caribbean Pacific (ACP) called Building Safety

and Resilience in the Pacific ED-EF10 (BSRP project), however the construction will take time as it moves through the following phases 1), bidding of the construction to bidders (expected to be completed prior to November 2017) and secondly, the completion of the site where the construction will take place to build the NMHS and the NEOC centre.

Mr Roy Harris, who is Secretary for the National Emergency Service oversees the development of the National Meteorology Service.

The Australian Bureau of Meteorology has been assisting Nauru with items such as tide gauges, the CLiDE software for climate data and an AWS.

The two observers have undertaken a number of training sessions with the Fiji Meteorological Service under JICA funding.

## *Education and Training Needs*

Given the low base that the National Meteorology Service is building from it would be expected that the education and training needs will be similar to those for the other small NMHSs in the Pacific, ie basic observer and meteorology training, ICT and equipment maintenance and repair. In order for the National Meteorology Service to fully participate in the climate outlook forums some degree of climate services training would also be required.

## *Educational and Training offerings at the national level*

USP has a campus on Nauru focusing on courses in Education and Management. APTC also has a campus on Nauru covering a range of trade areas.

## *Any RTC Supporting Mechanisms in Place*

Nil

## *Conclusions / Recommendations*

The study team are attempting to contact the National Meteorology Service to check the brief details in this report. Given the small number of staff and that the service is just beginning it would be expected that the initial and ongoing demands for education and training will be similar to the other small services. At this stage it is not known what the demand for staff with qualifications meeting the BIP-M requirements will be.
Material derived from

- PMC-4 country report https://www.pacificmet.net/sites/.../NAURU_PMC-4%20Country%20Reports_0.pdf
- DFAT Country Profile http://dfat.gov.au/geo/samoa/Pages/samoa-country-brief.aspx
- News article from the Building Safety and Resilience in the Pacific (BSRP) Project, a jointly funded EU / ACP project.http://bsrp.gsd.spc.int/index.php/2018/02/20/meteorological-services-a-first-for-the-country-of-nauru/

The island of Niue is east of Tonga and northeast of New Zealand. Niue is a self-governing state in free association with New Zealand, an arrangement dating from October 1974. Niueans are New Zealand citizens with the right to enter and live in New Zealand and Australia. Approximately 90 per cent of Niue's population lives in New Zealand. Niue's resident population is about 1500.

## *Meetings*

- Mr Sean Tukutama, Scientific Officer
- Dr Josie Tamate, Director General of the Ministry for Natural Resources
- Ms Rossylynn Pulehetoa-Mitiepo, Director Niue Meteorological Service
- Mr Andre Siohane, Director General of the Ministry for Infrastructure

## *NMHS General Information (Structure, Functions, Staffing, Expectations, Challenges)*

The Niue Meteorological Service sits within the Ministry of Natural Resources. There are three departments in the Ministry: Meteorology; Environment; and, Agriculture, Forestry and Fisheries.

The Niue Meteorological Service consists of eight officers and has a flat two-level structure of the Director and all other staff. The Director of the Service, Ms Rossylynn Pulehetoa-Mitiepo holds a science degree in Geography from the University of Auckland and a post graduate certificate in climate change from USP. The Public Service structure recognises qualifications or more than five years experience in the same or an equivalent field when considering eligibility criteria for positions. The dual test allows Niueans without formal qualifications to apply for posts in which they can start at a basic level as a trainee. The Director General would like RTC courses to lead to recognised qualifications (certificate, diploma and or degree) to enable staff to access higher paid positions.

The average age of the staff is less than 30 years with five of the eight officers being female. The Service has lost the occasional staff member in recent years but this is primarily due to movement to other Departments in the Niue Public Service rather than retirement (one) or movement outside of the country.

## *Observing Functions*

The Niue Meteorological Service currently operate one observing site adjacent to the aerodrome. The site is surface observations only and operates seven days a week, 0800 to 1600 (Mondays, Wednesday and Thursdays) 0000 to approximately 1600 on Tuesdays and Fridays because of the two incoming / return aircraft flights a week. Weekend coverage is limited to two hours in the mornings. The site has an AWS but currently it does not have a ceilometer or visibility sensor fitted. These observations are added manually when the observer is present. The Director is looking for donor opportunities to upgrade the existing AWS to cover the full range of observations. A rainfall station (Liku) is located on the eastern side of the island and operated by the former Director of the Niue Meteorological Service. A second observing site was located at the agricultural research farm but observations were discontinued some years

ago as the staff at the station were not able to routinely record the observations.

A lightning detection system has been installed. Synoptic observations are passed by email to MetService New Zealand who inject them into the GTS.

### *Services*

Niue rely on the general forecasts (24 hour duration issued three times / day) from Fiji RSMC but officers on duty elaborate on the FMS forecasts by providing local knowledge as well as web based analysis and diagnosis from FMS and other sources to produce an openly accessible forecast covering public weather and boating forecasts for vessels immediately offshore. These twenty four hour products are disseminated via email, Facebook, TV and radio to the public in English and the local language. A 3 day elaborated forecast goes out to a paying subscriber list. If the officers identify potential conflicts with the FMS forecasts there is consultation with the Director of the Niue Meteorological Service on how to proceed. For officers to take on this elaboration / forecasting role they must have completed internal training and supervision. TV weather graphics are provided to the Broadcasting Corporation of Niue (BCN) 4 days / week. They do not provide forecasts for aviation.

For severe weather situations the Meteorological Service are involved in coordination with the emergency services of the island. Niue Met Service Office has been identified as the temporary Emergency Operating Centre for events but the Director has had difficulty in getting upgrades to the facility to better support the EOC operations.

In the coming years the Director General of the Ministry of Natural Resources sees a slow growth in the Service's staff numbers primarily around climate, climate change policy and climate service activities. At the present time the Meteorological Office issue a Niue Climate Outlook on a monthly basis. The Climate Outlook primarily focuses on rainfall (likelihood of above, average or below average rainfall) with outlook for the next 3 months, ENSO status, plus items of general interest regarding weather / climate matters in the last month. Staff from the Meteorological Office participate in the Pacific Climate Outlook forums prior to the issue of the Niue Climate Outlook.

Niue Meteorological Service has commenced work on implementing their QMS (WMO/ICAO requirement) but it has not been completed due to staff movement and workload. Under the FINPAC program some assessment of staff competency for aeronautical meteorological observations was made in conjunction with the Fiji Met Service but Niue Meteorological Service runs its own competency assessment.

### *Staff Training*

At the present time staff are recruited with secondary school qualifications. They are recruited as trainees under a Niue Public Service classification (typically 12 months duration). Initially they undertake on-the-job training with more senior observers and undergo a formal assessment to demonstrate that they have reached a competent level for observations. Following this national training they are then encouraged to undertake any regional observation training as it becomes available.

All officers except the Director are rostered on for observational duties. In addition to the observing roles one officer is responsible for much of the IT and equipment maintenance and repair and forecasting, another is responsible for media / communications with the public and a third looks after climate data entry / monitoring and forecasting in

addition to the observation duties. However, senior staff also multi-task on these areas.

The Director General would welcome courses offered to the Meteorological Service staff being part of a qualification framework leading to certificates, diplomas or degrees.

## *Hydrology*

Hydrological services and water resource management comes under the Department of Infrastructure and there are two posts covering these roles plus water quality and reticulation.

## *Education and Training Needs*

The priority for professional education and training is in the climate change / climate services area.

**Priorities for technical training for Niue Meteorological Service are:**

- ICT training
- Equipment maintenance and repair
- Refresher courses in meteorology covering forecasting, climate and general meteorology
- Initial training for observers
- Training courses to equip staff to deal with donor (writing proposals and reports, project management ...). The Niue Public Service occasionally offer some HRD training but not on a regular basis.

## *Educational and Training Offerings at the National Level*

Niue follows the New Zealand education framework of 13 years of schooling. Five years in primary school and eight years of secondary schooling. The final year of secondary schooling provides successful graduates with the New Zealand National Certificate of Educational Achievement (NCEA) which is required to gain entry to universities in New Zealand. Students wishing to undertake studies at the University of the South Pacific need to undertake a foundation studies year either instead of year thirteen in the New Zealand framework or following successful completion of the NCEA qualification. The Director of the Niue Meteorological Service noted that the need to essentially repeat year 13 studies by taking the USP foundation course prior to undertaking first year university units put many students from Niue off studying at USP.

The University of the South Pacific hosts a campus on the Niue. The most popular courses are those associated with management or IT.

## *Any RTC Supporting Mechanisms in Place*

Nil.

## *Conclusions / Recommendations*

The Niue Meteorological Service is a small well organised group with young enthusiastic staff. The number of staff is growing slowly and the number of services provided by the staff is also increasing. As with other NMHSs of similar size there is an ongoing need for education and training in equipment maintenance and repair, ICT, climate data and climate services. It is foreseen that some of the new recruits will either be university graduates who will require further education and training in meteorology / climate or who will hold diplomas and be expected to undertake further study leading to a university degree with further specialist education and training in meteorology / climate.

## *Material derived from*

- Interview with Ms Rossylynn Pulehetoa-Mitiepo and Dr Josie Tamate on 18 June 2018
- Responses provided by Niue to the Study Team's questionnaire
- PMC-4 country report from Niue
- DFAT Country Profile http://dfat.gov.au/geo/tokelau/Pages/niue-country-brief.aspx

## *National Training Needs and NMHS Interactions with Training Institutions*

The Republic of Palau is an island country made up of approximately 340 islands, has a land area of 466 km$^2$ (180 sq mi) and a population of 21,503. The most populous island is Koror, while the capital, Ngerulmud, is located on the nearby island of Babeldaob, in Melekeok State. In 2016 the World Bank estimated that Palau had a per capita GDP of $US14,428[2].

## *Meetings*

**Palau WSO:**

- Ms Dilwei M. Ngemes, Meteorologist-in-Charge, Palau WSO
- Other staff of the Palau WSO

The Republic of Palau (Palau) has a single Weather Service Office (WSO) in Koror that is fully supported financially by the US Government through the US National Oceanic and Atmospheric Administration (NOAA). There currently is a total of 13 staff employed in this office (Table 1).

**Table 1: Staffing in 2018 by Category of the Palau WSO**

| Staff by Category | Number of Staff |
|---|---|
| Meteorologists 4-year degree qualified | 2 |
| IT Professionals | 0 |
| Technical Officers (Met Observers) 2-year qualified | 6 |
| Technical Officers (Eng) 2-year qualified | 3 |
| Facilities manager 2-year qualified | 1 |
| Administrative Officer 2-year qualified | 1 |
| TOTAL | **13** |

In addition to the six meteorological observers listed in Table 1, there are an additional six contracted observers located at Ngara, Melekeok and Kayangel (surf observations), and Ameliik, Koror Airport and Peleliu (synoptic observations).

The Meteorologist-in-Charge (MIC) of the WSO considered that over the next five to ten years the staffing of the office is likely to remain fairly constant, and that the current staffing number is well suited to meet the existing duties of the office. In addition to conducting surface and upper air observations, in the lead up to, and during severe weather events the WSO provides briefing services to the National Emergency Management Organization (NEMO).

The MIC of the WSO expressed the opinion that it would be desirable for the WSO to provide a greater range of meteorological services to the community, however further training would be required for some of the two-year qualified observing staff (through BIP-M courses) so that there would be enough qualified meteorologists to sustain

2 https://data.worldbank.org/country/Palau

the services. She noted that on average one BIP-M trainee per year would be required, and, in common with the views of the Director-General of the PNG NWS, considered that intermittent cohorts of two or three students from Palau would be the most appropriate way for the BIP-M training to be carried out. She was attracted to the concept that BIP-M courses could be accredited with a university, thereby giving students who passed them college credits for either four-year university degrees or post graduate degrees.

In terms of in-service (updating) training, the Palau WSO uses the skills of the two qualified meteorologists rather than resources from Guam. The MIC noted that the WSO has no contact with the RAV training centres in Indonesia and the Philippines; furthermore she considered that training programs delivered by SPREP at times appeared to neglect the needs of the countries in the North Pacific.

The only tertiary educational institution in the Republic of Palau is the Palau Community College (the PCC). The PCC offers two-year courses only, focusing on occupational skills. PCC has been accredited by the Western Association of Schools and Colleges (WASC) for the last thirty-six (36) years. The MIC of the Palau WSO did not consider the PCC to offer any opportunities for advancement of her staff, all of whom already hold two-year college qualifications.

Assuming that the Palau WSO is supported in its desire to provide a greater range of weather and climate services to the Palau community, access to BIP-M training at an average rate of one per year would be required intermittently over the next decade, for batches (cohorts) of around three students should be made available. It is unlikely that these opportunities could be provided in Palau.

## *National Training Needs and NMHS Interactions with Training Institutions*

The estimated[3] population of Papua New Guinea in 2018 is 8.42 million. The largest city and capital is Port Moresby, with a population of about 310,000. Only 18% of the population in Papua New Guinea lives in an urban area. In 2016 the GDP per capita was estimated as $US2,500[4].

Linguistically Papua New Guinea is one of the most diverse countries in the world with 848 different languages spoken (12% of the world's languages). Most languages have fewer than 1,000 speakers. There are hundreds of ethnic groups indigenous to Papua New Guinea, although the largest is the Papuans, whose ancestors arrived in the area tens of thousands of years ago. While Papua New Guinea is one of the World's fastest growing economies, 30% of the population still lives below the international poverty line of $US1.25 per day. Most people in Papua New Guinea still live on subsistence-based agriculture.

## *Meetings*

**At the PNG NWS:**

- Mr Sam Maiha, Director-General of the PNG National Weather Service (NWS)
- Other staff of PNG NWS

**At the University of Papua New Guinea:**

- Dr Kisolel Posanau, Lecturer, Physics Department, UoPNG
- Dr Moyap Kilepak, Lecturer, Physics Department, UoPNG
- Dr Jeremiah Malaibe, Lecturer, Physics Department, UoPNG

The Papua New Guinea (PNG) National Weather Service (NWS) has 62 staff is located in Port Moresby and in observing offices throughout the country.

The PNG NWS has recently signed an MOU with the Australian Government which should see the funding increase over the next decade, enabling an increase in staff from the current 62 to around 132. At the same time the NWS plans to automate its surface observing programs. Should these projected macro-changes to the NWS to occur it is likely that there will be a need for two additional meteorologists per year over the next decade, along with (approximately) an annual requirement of one additional IT professional and the re-training of one technical officer (meteorology) through a BIP-M course to become a meteorologist to repair, maintain and use the automated technology required for the PNG NWS.

3 http://worldpopulationreview.com/countries/papua-new-guinea-population/
4 https://data.worldbank.org/country/papua-new-guinea

TABLE 1: Staffing in 2018 by Category in the PNG NWS

| Staff by Category | Number of Staff |
|---|---|
| 4-year Degree Meteorologist | 6 |
| IT Professionals | 2 |
| Technical Officers (Meteorology) two-year qualified | 16 |
| Technical Officers two-year college course (electronics) | 4 |
| Observers | 32 |
| Administrative Officers | 2 |
| TOTAL | **62** |

TABLE 2: Project Staffing in 2028 by Category in the PNG NWS

| Staff by Category | Number of staff |
|---|---|
| 4-year Degree Meteorologist | 28[5] |
| IT Professionals | 9 |
| Technical Officers (Meteorology) 2 Year qualified | 5 |
| 2-year College course (electronics) | 10 |
| Observers | 30 |
| Administrative Officers | 2 |
| TOTAL | **87** |

For a relatively large country (as compared to the other 14 countries in the Study), and one which faces quite hazardous weather and a very variable climate, PNG operates a modest sized weather service. The funding currently available for training (in the 2018 budget – Table 3) is very small, representing 0.6% of the total budget. Without the additional funding support expected from the MOU it is difficult to see how the training needs of the Service could be met.

TABLE 3: The 2018 PNG NWS Budget in Summary Form

| 2018 PNG NWS Budget | KINA | US$ |
|---|---|---|
| Staff Costs | 3,324,928 | 1,662,464 |
| Travel | 60,000 | 30,000 |
| Office Costs | 85,000 | 42,500 |
| Operational Costs | 273,569 | 136,785 |
| Training | 20,000 | 10,000 |
| TOTAL | **3,763,497** | **1,881,749** |

**The Director-General of the PNG NWS is of the view that:**

**(a)** Training of meteorologists should occur in PNG to the greatest extent possible; and,

**(b)** The meteorologists should be trained in cohorts of at least three so as to be supportive of one another.

## *The University of Papua New Guinea*

The University of Papua New Guinea (UoPNG) has a number of ex-PNG NWS staff within its Physics Department

5 Currently there are 8 professionals in the NWS, 6 Meteorologists and 2 IT professionals. Upgrading the qualifications of 10 existing staff and recruiting 10 more, and training them in a BIP-M process could (theoretically) meet the NWSs' need for meteorologists in 2028.

who are keen to add meteorology to its course curriculum. The University needs a minimum of five students in any course that has a course work component[6] and ideally would have at least ten students. The UoPNG staff noted that it appeared unlikely that there were students available to make a BSc degree in meteorology viable.

The UoPNG charges K2,436 ($US 755)[7] per annum for a student undertaking course work, and if residence on the campus is sought this would cost an additional K9,000 ($US 2,790) to K11,000 ($US 3,410) depending upon the accommodation option chosen.

If students were to undertake a Graduate Diploma meteorologist course for four-year science graduates (math, physics) thereby qualifying for a BIP-M, these students would likely need external funding.

### *Key Observations*

1. An undergraduate course in meteorology is unlikely to be sustainable in PNG unless students are attracted from other countries;
2. Assuming that the PNG NWS's projections eventuate, access to BIP-M training that focuses on the delivery of services to aviation and to a public exposed to the hazards of tropical weather will be required intermittently over the next decade, for batches (cohorts) of around three students; and,
3. UoPNG should be considered, along with other options, for hosting a cohort of BIP-M students at some future time.

6 Research-based courses (eg a masters degree by research), without a course work component can have a single student registered.
7 2017 tuition rates. K1=0.31$US as at June 2018

## *National Training Needs and NMHS Interactions with Training Institutions*

The country's population of around 53,000 people is spread out over 29 coral atolls, comprising 1,156 individual islands and islets. The largest town in the Republic of the Marshall Islands (RMI) is Majuro with around 37,000 people. The majority of the citizens of the RMI are of Marshallese descent, though there are small numbers of immigrants from the United States, China, Philippines, and other Pacific islands. The two official languages are Marshallese and English. In 2016 the World Bank estimated that the RMI had a per capita GDP of $US3,665[8].

## *Meetings*

- Mr Reginald White, Meteorologist-in-Charge, Majuro WSO
- Prof. Theresa Koroivulano, President of the College of the Marshall Islands (CMI)
- Mr Clarence Samuel, Director of the Office of Environment Policy, Planning Coordination (OEPPC)
- Ms Allison Nashion, Director of the National Training Council (NTC)
- Prof. Irene Taa'faki, Director, University of the South Pacific, Marshall Islands Campus (USP-RMI)

The Weather Service Office (WSO) in Majuro is the only national meteorological element in the RMI. It is fully supported financially by the US Government through the US National Oceanic and Atmospheric Administration (NOAA). The WSO currently has nine staff, with a staff ceiling of 13. The Meteorologist-in-Charge (MIC) of the WSO expects to be able to "staff-up" to its ceiling in the next year or so.

The MIC of the station holds a four-year degree in meteorology from the University of Hawaii. Seven of the remaining staff hold two-year (junior) college degrees (two in electronics and the other five from math/science streams). The ninth staff member, a recent hiree, is a school leaver.

The WSO carries out an observation program for NOAA that comprises twice daily radiosonde flights and 3-hourly synoptic observations. The WSO is located next to the airport on which are located US standard automated systems for observing a variety of meteorological parameters including an Automated Weather Observing System (AWOS), runway visibility measurement and a ceilometer. The WSO does not generate weather forecasts nor does it provide routine weather services. The MIC advised that he does brief RMI Emergency Management personnel in the lead up to expected severe weather events.

There is concern that while the two-year qualified staff receive good skills and competency training in technical (electronics and equipment management) and meteorological areas these are typically, at most one-month courses that are focused on work related skills and do not contribute to improving the students qualifications of contribute to college credits. The MIC indicated that he would strongly support staff wishing to upgrade their qualifications, but saw no avenue at present for this to occur. He would, for example allow for time during work hours for study and also seek funding from NOAA for recompense for tuition fees and any course associated travel.

One challenge for improving the qualifications of the Majuro WSO staff may be their level of English. Because there is a single language spoken throughout the Marshall Islands (Marshallese) there has not been the widespread usage

8 https://data.worldbank.org/country/marshall-islands?view=chart

of English in the school systems as has happened in countries with multiple native languages. It would therefore be expected that if a BIP-M course became available any course participants from the RMI would need to complete a 12 to 18 month "foundation" course in English, math and physics to prepare them for the challenge of advanced concepts and mathematics included in a BIP-M course.

## *Tertiary Education in the RMI*

There are two university campuses on Majuro: The College of the Marshall Islands (CMI), a junior college, and the University of the South Pacific campus of the RMI (USP-RMI).

CoMI is accredited by the Western Association of Schools and Colleges (WASC) and, because of this accreditation its RMI students are eligible for Pell Grants. Such students with Pell Grants comprise 98% of its 1,000 students. As a junior college it is limited to two-year courses except that it can deliver one four-year degree course. Next year the CoMI will begin its four-year BA in nursing.

While the CoMI could not assist in delivering four-year BSc or higher level courses but it would be able to assist in delivering what it calls "foundation" courses in English, math and physics which are tailored to raising a student's competence in these subjects to high school leaver/first year college level. It was not clear whether this alone would meet BIP-M entry level requirements, possibly some additional background training might be necessary. Successfully completing "foundation" training courses should be a pre-requisite to being considered as a candidate for the BIP-M.

The USP-RMI campus has around 120 students in two-year degree programs. It also offers foundation courses in English, math and other science topics. The USP-RMI campus has applied for accreditation with the WASC as a college able to deliver four-year and higher degree courses. It will be advised of the success or otherwise of its application on 30 June 2018. With this accreditation in place USP-RMI would be able to receive Pell Grants and also deliver BIP-M and related higher-degree courses.

The USP-RMI could provide a campus for a cohort of up to 15 BIP-M students. The USP-RMI is located on the site of a former hotel and has hotel style accommodation for around this number at $US50 per night. Lower standard accommodation is available for $300 per month for student rental. Fees are $US600 per course, which may be negotiable if the course organisers supply professional staff to deliver specialized subjects (eg dynamic meteorology, radar meteorology, numerical weather prediction, and the like).

## *Key Observations*

Staff in the WSO in the RMI would benefit from receiving BIP-M training that focuses on the delivery of services to aviation and to a public exposed to the hazards of tropical weather.

USP-RMI, subject to accreditation, could well be considered, along with other options, for hosting a cohort of BIP-M students at some future time.

Samoa, officially the Independent State of Samoa, is a Polynesian Pacific country northeast of Fiji. Samoa consists of four inhabited and five uninhabited islands. The capital Apia is located on Upolu, the most populous and developed of the islands. Upolu and Savai'i, the other main island, account for 99 per cent of Samoa's 192,000 population. In 1962, Samoa became the first Pacific island country to achieve independence.

## *Meetings*

SAMOA METEOROLOGY DIVISION

- Mr Ausetalia Titimaea, Assistant Chief Executive Officer (Director) of the Samoa Meteorology Division
- Mr Luteru Tauvale, Principal Scientific Officer, Weather Forecasting
- Mr Tile Tofaeono, Principal Scientific Officer, Climate Services
- Mr Silipa Mulitalo, Scientific Officer

PACIFIC METEOROLOGY DESK, SPREP, SEE SEPARATE SPREP REPORT

- Mr Salesa Nihmei

WORLD METEOROLOGICAL ORGANISATION, SEE SEPARATE SPREP REPORT

- Mr Henry Taiki

OFFICE OF TOKELAU IN SAMOA, SEE SEPARATE TOKELAU REPORT

- Mr Eleta, Acting General Manager
- Ms Paula Faiva
- Mr Penehuro Lefale, Adviser to Tokelau on Climate Change matters

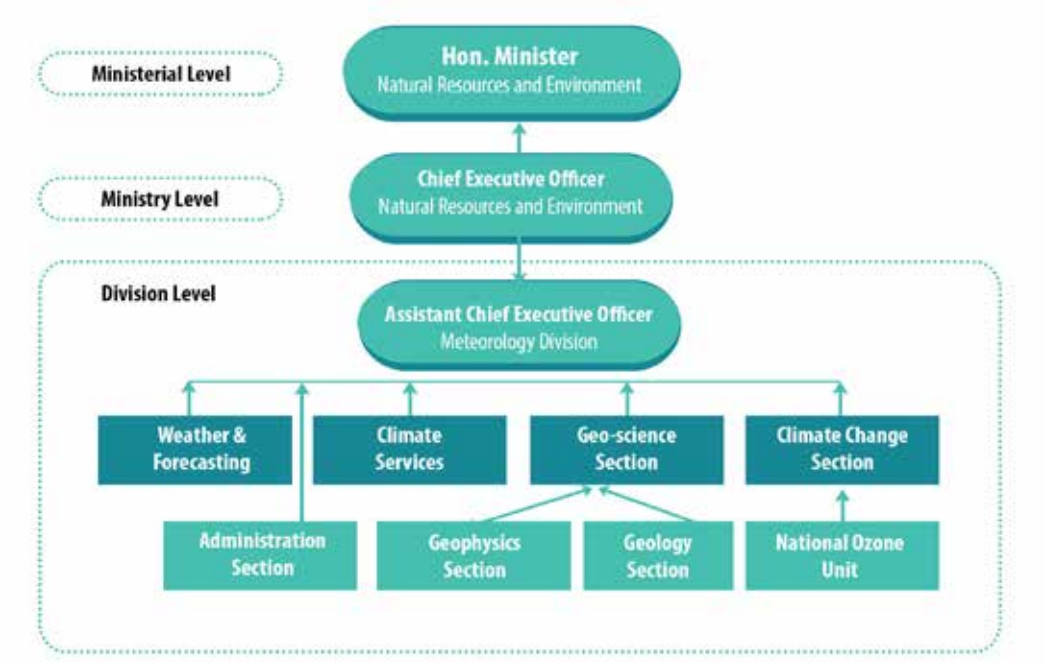
## *NMHS General Information (Structure, Functions, Staffing, Expectations, Challenges)*

The Samoa Meteorology Division (SMD) mandate is to provide meteorological, geo-science, climate change advice in support of sustainable development of natural resources. SMD has two offices, both on the Upolu Island. The headquarters of SMD is in the capital of Samoa, Apia and there is a separate office at Faleolo International airport. SMD has 47 staff plus another four positions that are currently vacant. The SMD organigram is below and a short description of each major area follows. The SMD website is http://www.samet.gov.ws.

## *National Tropical Cyclone Center*

The SMD is responsible for the National Tropical Cyclone Warning Center (NTCWC) that provides cyclone forecasts warnings and other non-cyclonic severe weather events. The NTCWC operates and governs by approved Standard Operating Procedures (SOPs). The National Tropical Cyclone Warning System sends alerts via SMS, website and the Samoa weather application for smart phones to selected community representatives and response agencies. Whilst the study team was in Samoa, officers from SMD were participating in meetings with the World Bank regarding improvements and upgrade of the Multi-hazard Early Warning System (MHEWS) for Samoa.

Figure 1: Organogram of SMD




## *Local Weather*

The SMD provides Public Weather and Coastal Forecasts for the public (twice a day), and in the process of being certified to provide Aviation Weather Forecasts for all airlines operating within Samoa's air space. At the present time Aviation Weather Forecasts are provided by the Fiji Meteorological Service as part of its Regional Specialised Meteorological Centre (RSMC) role.

## *Seismic Monitoring*

The SMD is responsible for seismic monitoring in Samoa. It operates a network of seismographs that provide real time and continuous monitoring of earthquakes and support the study of ground motion. The seismic information is used within Samoa's National Tsunami Warning System.

## *National Tsunami Warning Center*

SMD provides tsunami warnings and alerts for Samoa. The NTWC operates and is governed by approved Standard Operating Procedures (SOPs). Samoa's Tsunami Early Warning System has the capability for sending SMS to selected community representatives and agencies.

## *National Climate Early Warning System (CLEWS)*

The SMD is responsible for CLEWS, that provides tailored alerts, climate forecasts, El Nino Southern Oscillation

updates, climate summaries, climate trends and climate data for sectoral planning and management of climate risks.

### *National Weather, Climate and Sea Level Observation Network*

The SMD administers a National Weather and Climate Observation Network. The network consists of 42 manual rainfall stations, 8 manual climate stations (two of which are synoptic stations), 12 automated rain gauges with telemetry capability, two AgMet stations and 19 full automatic weather stations (AWS).

### *Historical Climate Data*

The SMD keeps detailed historical data sets on wide range of climate information and traditional knowledge.

### *Education and Training Needs*

The professional education and training needs for SMD are: Communications and Computing; Forecasting; Climate Services; and, Marine and Oceanographic Services. In the technical education and training area the needs are: Communications and computing; Observations and Network Management; Equipment maintenance and repair; and, Climate Services.

These needs are consistent with the NMHS plans for increasing the range of services that they plan to provide in the next five to seven years as well as the service areas that are expected to receive additional staffing.

Noting the relatively low staff turnover (about 1 a year) the initial specialist training of new recruits is seen as one every two to three years in each of the staff categories. Update training for existing staff is requested every two to five years.

### *Educational and Training Offerings at the National Level*

**Samoa has its own Qualifications Authority (SQA). In terms of post School Education & Training the SQA oversees:**

1. Tertiary Level at University
2. Pre and In Service Professional Training
3. Technical and Vocational Education
4. Theological Colleges and Religious Instructions
5. Apprenticeship
6. Non Formal Learning
7. On the Job Training

The National University of Samoa (NUS) was created in 1984 and now has the following faculties: Applied Science, Arts, Business and Entrepreneurship, Education, Health Science, and Science. The Science Faculty includes mathematics

and physics but SMD have found that NUS has not always been able to offer the level of mathematics courses required for graduates to subsequently undertake meteorology courses such as the MSc at Victoria University in Wellington or the Graduate Diploma in Meteorology at the Bureau of Meteorology in Australia.

In addition to NUS, Samoa has a campus of the Australia Pacific Technical College (APTC, http://www.aptc.edu.au) which offers vocational education and training from certificate to diploma level in a wide range of areas. The courses are accredited under the Australian Qualifications Framework. None of the courses are directly applicable to meteorology or hydrology but they do cover many areas of interest to NMHSs such as ICT, management, Occupational Health and Safety and elements of equipment maintenance and repair.

## *Any RTC Supporting Mechanisms*

Nil from SMD. Further information available in the SPREP report.

## *Conclusions / Recommendations*

The Director of the SMD is very supportive of the proposal for a Pacific based Regional Training Centre. He believes that the RTC is justified on economic grounds as it will be cheaper for students to travel and study in the Pacific rather than travel outside of the Pacific Islands. He also believes that a Pacific based RTC is much better for the welfare of the students and their families as it makes it possible for students to travel home if required or for families to join the students at their study location. The Director recalled that this matter had come up several times in the past but had not come to fruition. Mr Mulipola Ausetalia Titimaea believes that the creation of the Pacific Meteorological Council (PMC) and the Pacific Meteorology Desk hosted by SPREP mean that the proposal has a better chance of success this time. Ideally the PMC recommendations would be considered at the Pacific Leaders Forum to give them more substance.

Mr Mulipola Ausetalia Titimaea would like to recruit professional staff with a science degree and whilst undertaking junior assistant forecasting duties undertake additional studies in mathematics, physics and meteorological subjects to qualify for them for general forecasting duties. From the general forecasting duties he then needs them to undertake further studies to meet the BIP-M requirements so they can be used for aviation forecasting and other high profile services. He wants the staff to be able to work and study part time and be able to claim credits from training courses towards achieving qualifications that meet the BIIP-M requirements.

The development of the Pacific Climate Change Centre (PCCC) should provide increased education and training opportunities in the area of climate services and climate data.

## *Material derived from*

- Interview with Mr Ausetali Titimaea and staff on 7 June 2018
- Responses provided by Samoa to the Study Team's questionnaire
- DFAT Country Profile http://dfat.gov.au/geo/samoa/Pages/samoa-country-brief.aspx

Solomon Islands Population is 622,961 as of 2018. The capital and largest city is Honiara, with a population estimated at 67,000. There are no other cities with a population of more than 10,000. Area is 28,896 km2. (http://worldpopulationreview.com/countries)

Solomon Islands ranked at the sixth most at risk country in the world to natural disaster. (World Risk Index, featured in the World Bank Risk Report, 2016)

## *Meetings*

- Mr Chanel Iroi, Under Secretary, Solomon Islands Government, Ministry of Environment, Climate Change, Disaster Management and Meteorology
- Mr David Hiba Hiriasia, Director of the Solomon Islands Meteorological Service
- Mr Charlie Bepapa, Director of the Water Resource Management Division, Ministry of Mining, Energy and Rural Electrification
- Mr Malefoasi, Under Secretary, Ministry of Education and Human Resource Development
- Prof. Prem Rai, Dean for School of Natural Resources at Solomon Islands National University (SINU), accompanied by Mr George Horoasia, Head of Environment Department, and Mr Peter Mahoa, Head of Forestry Department
- Mr Alan Porteous, Dip Field Technology Group Manager, Climate Data and Applications, NIWA

## *NMHS General Information (Structure, Functions, Staffing, Expectations, Challenges)*

Solomon Islands Meteorological Service (SIMS) is a division of the Solomon Islands Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM).

Review of the current organizational structure and the preparation of a new organizational structure of the MECDM was completed in 2017 and included SIMS. The review established that the structure of SIMS is a normal hierarchical one with clear lines of command, reporting and working relationships linking the different levels of hierarchy. As a result the plan is to retain the current structure going forward but to change the job titles of the Heads of Sections to Managers, retitle some of the sections to enhance the reflection of their respective functions and to show a number of vacancies to enable the recruitment of additional support in order to strengthen the service.

The SIMS is responsible for assisting the development of the Solomon Islands through the provision of climate and weather information, including essential meteorological services. A new unit has been established within SIMS for ocean services.

**The Solomon Islands Meteorological Service (SIMS) provides:**

- Daily and extended Weather and Marine forecast.
- Tropical Cyclone, flood and Tsunami Warnings.
- Climate Data Analysis (local climate briefs; seasonal climate outlooks; and monthly weather summaries)

- Seasonal (Three Monthly) Forecast on Rainfall and Temperatures.
- Aeronautical Forecast and Weather Information for Aviation.
- 24/7 Weather Observations across the country.
- Other functions such as those related to those supporting disaster risk management and information technology.

The current staffing level of SIMS is 115 and is expected light increase over the next 5 years. SIMS is providing training of newly arriving observers and refresher training for observers on an annual basis.

A customer survey of aviation meteorology services is done annually. Last year the feedback was positive. This survey is conducted by the SIMS Quality Management Unit (2 staff involved) and is expected to expand to other areas.

SIMS graduate recruits mostly come from USP (Fiji). SIMS is able to send employed staff to study in degree level programmes while allowing them to keep their positions and salary.

Almost half of total budget coming from donors (subject to each year application). Annual average budget is about $US1,000,000.

**Solomon Islands Water Resource Management Division has very limited human resources, but new responsibilities are arising, such as:**

- Services related to disaster risk management (flood monitoring, raising awareness and warning the community of flooding risks).
- Underground water assessment (water supply services).
- Water quality monitoring; and,
- Water resources assessment.

The SIMS Director is positive about distance learning and on-line possibilities. Two of the four staff that have degrees graduated from USP, the remainder from Australia and New Zealand. The total staff number is eight. SIMS provides on-job training to newly arriving staff using internal staff resources however there is no certification or accreditation in place. SIMS does not expect to recruit additional staff to undertake newly introduced functions as it has not received funds from government to support them this year. The SIMS annual average budget, sourced from national funding, is $US125,000.

Provision of Disaster Risk Reduction/Disaster Risk Management (DRR/DRM) services by the SIMS hydrologist is vital to support the Water Resources Management Division in implementing community based disaster risk management and reduction. Training is necessary to develop the SIMS hydrologist's capacity to provide relevant support in DRR/DRM to vulnerable communities. This is an new (additional) function of the division, and positive feedbacks have been received from vulnerable communities on the importance of the program.

Additionally, groundwater assessment and management is important for the Hydrogeology Section of the Division which will be implementing a groundwater assessment and drilling program for the country. A ground water drilling training program would be of great benefit to the drilling technicians of the Hydrogeology Section.

## Education and Training Needs

- Degree level Oceanographer
- Information Technology and programming skills (computer languages)
- Meteorological forecasting and met/technician training
- Specialized climate products utilization
- Hydrological observation and services, network management, DRR/DRM

## Educational and Training Offerings at the National Level

School of Natural Resources and Applied Sciences (SNR) at Solomon Islands National University (SINU) represented by three departments: Environment, Forestry and Agriculture. There is also School of Technology and Maritime Studies and School of Business and Management (not visited). SNR offers 1 or 2 years Certificate or Diploma courses in Environmental Studies. The courses and units offered by the Schools through the distance mode are the same as those offered through the conventional (on-campus) mode. 23 staff employed. In total SINU accommodating 2200 students in campus and the same amount distantly. At that SNR's share is about 400 students. A specialized centre coordinates distance courses. Curricula and training materials are developing by SINU staff and are subject to detailed procedures to ensure quality assurance. The study period (time to complete a given course) of distance students usually lasts longer than that of a comparable campus-based student. The majority of students are from the Solomon Islands. The training language is English. The main source of funding is tuition fee covered by students, sponsors, fellowships.

There are some modules on basics of hydrology, climate change and weather related subjects, natural disaster management, ground water resources within the BSc programme (3 years face-to-face).

In addition to Solomon Islands-based institutions, NIWA is active player in the country and the region. Technical training has been provided at NIWA for about 20 Pacific Island technical staff, focused mainly on meteorological and hydrological operational roles and services, and managing climatic risk to communities and structures.

NIWA has been developing a systematic, task-based, technical competencies course, 'Pacific Climate Networks and Operational Services: Workbook for Operational Competencies'. The course content is referenced to WMO-100 Guide to Climatological Practices, and emphasises on-the-job training where competencies are learned and sustained by operational practice. NIWA has also run a three-month on-line course for hydrology technicians, supported by WMO, attended by over 30 Pacific-based participants with 10 successfully completing the final certificate.

## Any RTC Supporting Mechanisms in Place

There is fellowship programme overseen by the Ministry of Education and Human Resource Development in cooperation with Ministry of Development, Planning and Aid Coordination. In practice the coordination between fellowship programme and labor market could be improved. There is Solomon Islands National University and USP where students who receive fellowships could undertake with their study. Requests for study in Australia, NZ are also made. About 400 awards are provided annually in the Solomon Islands, but no further statistics available concerning the outcomes of the programme. Bi-lateral agreements appear to be lacking.

NIWA operates primarily on a project-based, cost recovery basis, and hence their participation in an RTC would require identification of external or project funding to cover NIWA staff time and disbursements. Financial support for technical training can be provided under some circumstances, for example, the NZ Government's Short-Term Training Scholarships to New Zealand, for which NIWA is a provider. As an example: https://www.mfat.govt.nz/assets/Uploads/STTS-Tonga-Information-Sheet-2017.pdf. NIWA also has provides a limited number of Post-Doctoral Fellowships.

### *Conclusions / Recommendations*

Solomon Islands Meteorological Service is very supportive to establishing Pacific WMO RTC as there is a clear need for human resource and capacity building improvements but no solid mechanisms in place to support the initiative. They are positive about distant learning opportunities and believe e-learning could help to partially meteorological training needs.

Tokelau is a non- self-governing territory of New Zealand, located 500km north of Samoa. It consists of three small coral atolls that lie between latitudes 8 and 10 degrees South, and 171 and 173 degrees West. Atafu, the most northern atoll has a surface area of 3.5km$^2$; Nukunonu, the central atoll is 4.7km$^2$ and Fakaofo, the southern atoll is 4km$^2$. From Atafu in the north to Fakaofo in the south, Tokelau is made up of 123 coral atolls and islets (motus). Its total EEZ is about 300,000km$^2$. Tokelau has a combined population of approximately 1,499 people (2017)[9] An additional 7,194 Tokelauans live in New Zealand (2013 census) and around 1,655 live in Australia (2011). New Zealand is responsible for Tokelau's foreign affairs and defence.

Tokelau currently has no air transportation. The only means of transport is by sea from Samoa (the trip usually takes between 24 and 30hours). All travel and supplies into and out of Tokelau originate and terminate in Samoa, Tokelau's closest neighbour. Feasibility studies have been carried out for the development of an airport however no decision has been taken on the final location for such an undertaking.

Tokelau's GDP is NZ$14 million (2015/16), which equates to USD6,275 per capita[10]. The principal sources of revenue are from agriculture and fishing, accounting for NZ$569,800 of total earnings in 2015/16. Among the members states of the Pacific Community, the Tokelau value of USD6,275 for 2015/16 is roughly 1.5 times the per capita GDP of Samoa, Fiji, Marshall Islands, Tonga, and Tuvalu; but less than half that of American Samoa, Nauru, Niue, Northern Marianas, Palau, and Wallis & Futuna.[11] It is way less than that of Cook Islands, Guam, New Caledonia, and French Polynesia.

Per capita GDP in Kiribati, Papua New Guinea, Solomon Islands, and Vanuatu lies well below the Tokelau value[12]. By contrast, the New Zealand annual GDP is NZD256,190 million. Per capita GDP is USD38,000 (current prices, year ended September 2016) in New Zealand, on a par with that of the United Kingdom's USD41,000 (2015).

Tokelau receives 90 per cent of its electric power from solar photovoltaic power stations funded by New Zealand. A Tokelau International Trust Fund, an intergenerational Trust Fund established by the Governments of New Zealand and Tokelau in 2000 and formally executed on 10 November 2004, stands at around NZ$82,614 million at the end of 2016[13]. The purpose of the Fund, as outlined in Clause 2 of the Trust Deed, is "...to contribute to the long term financial viability of Tokelau..."

Funds are available for distribution each year to the extent that they are funds remaining from that year's Fund returns, after the administration and other costs of the Fund have been met, and after reinvestment of such funds that are required to maintain the Real Value of the Fund.

## *Meetings*

- Mr Seiuli Aleta, Acting General Manager Office of the Council for the Ongoing Government of Tokelau and Director of Education, Government of Tokelau.
- Ms Paula Faiva, Head of the Tokelau Climate Change Office, Mr Penehuro Lefale, Climate Advisor, Government of Tokelau.

9 https://www.tokelau.org.nz/Bulletin/April+2017/GDP+first.html.
10 Ibid.
11 Ibid.
12 Data from the SPC 2015 Pocket Statistical Summary
13 https://www.tokelau.org.nz/site/tokelau/files/2017Docs/Tokelau%20International%20Trust%20Fund%20Annual%20Report%202016.pdf

## NMHS General Information (Structure, Functions, Staffing, Expectations, Challenges)

Present operational meteorological services in Tokelau comes under the Department of Economic Development Natural Resources and Environment (EDNRE). Meteorological services are considered part of the roles of the Environment Division of the Department. Three positions are allocated for meteorological activities. Only two of the positions are currently filled. The occupant of one of the filled posts is co-located with the Samoan Meteorological Service in Apia. Public weather forecasts for Tokelau are derived from regional weather bulletins issued by Fiji Meteorological Service[14] and downscaled by the Samoan Meteorological Service and translated into local language in Tokelau and provided to the inhabitants via Facebook, SMS and TV from Samoa. Meteorological activities are covered in the national Strategic Plan entitled "Sustainable and Responsible Development for Tokelau".

No official government meteorological (weather or climate) observations have been recorded in Tokelau since 2010 although this is expected to be addressed in the near future via the NZ Ministry of Civil Defense and Emergency Management (MCDEM)/Tokelau Disaster Risk Reduction, 2016-2020[15] and UNDP RESPAC program. The two met staff from Tokelau participated in regional climate outlook forums hosted by SPREP, and the NOAA funded Pacific Island Training Desk in weather forecasting in Hawaii. Both have not undertaken specialized formal meteorologist and/or climatologist university training.

## Education and Training Needs

**The top three education and training needs for Tokelau at the professional and technical level are:**

- Weather forecasting services
- Restoration, sustainable management, operation and maintenance of national observational network
- Public awareness, outreach, communication and computing

Over the next five to ten years, the number of staff involved in providing meteorological services to Tokelau is expected to slightly increase, subject to more Tokelauans interested in Science, Technology, Engineering and Mathematics (STEM) courses. At this stage, not many have expressed interest in STEM. It is expected as the staff numbers increase and the facilities improve in the immediate future, the range and level of education and training will commensurately increase. One difficulty facing Tokelau is the national requirement that new recruits must already be qualified and trained for the role they are applying for, such as a certified meteorologist. This contrasts with other Pacific Island countries in the region who require a basic qualification (e.g. BSc Physics & Maths (Hons) but allow new staff to travel overseas to undertake specialist technical and/or professional education and training.

## Educational and Training Offerings at the National Level

The Tokelau education system follows that of New Zealand with a thirteen (13) year programme. Each atoll has its own school covering preschool to year eleven. The last two years of schooling occur in Samoa under a government scholarship system before going on to do undergraduate studies at Universities in NZ, Australia, Samoa and Fiji.

14 http://www.met.gov.fj/tokelau.php

15 https://www.civildefence.govt.nz/assets/Uploads/publications/MCDEM-Business-Plan-2016-2020-v2.pdf

## *Any RTC Supporting Mechanisms in Place*

Nil. Tokelau was also the only country surveyed who believed that the RTC should not offer distance learning courses.

## *Conclusions / Recommendations*

Meteorological services in Tokelau do not exist other than two staff involved in distributing weather bulletins prepared by Samoa and Fiji. It is envisioned Tokelau would establish a dedicated meteorological service with observation sites and equipment (including at least one AWS providing data to the GTS) on each of the atolls within 2-3 years. In the medium to longer term, Tokelau aspires to develop some capacity to derive basic weather and climate services as well as work with more developed services, such as New Zealand, Samoa, Fiji, Australia, USA (NOAA Pacific Headquarters, Honolulu).

## *Material derived from*

- Interview with Mr Aleta, Ms Faiva and Mr Lefale on 11 June 2018
- Responses provided by Tokelau to the Study Team's questionnaire
- https://www.tokelau.org.nz/Bulletin/April+2017/GDP+first.html.
- https://www.tokelau.org.nz/site/tokelau/files/2017Docs/Tokelau%20International%20Trust%20Fund%20Annual%20Report%202016.pdf
- http://www.met.gov.fj/tokelau.php
- https://www.civildefence.govt.nz/assets/Uploads/publications/MCDEM-Business-Plan-2016-2020-v2.pdf
- PMC-4 country report from Tokelau
- DFAT Country Profile http://dfat.gov.au/geo/tokelau/Pages/tokelau-country-brief.aspx

The Kingdom of Tonga is an archipelago made up of 176 islands with a total area of 748 km$^2$ that are spread over 270,000 square miles in the southern Pacific Ocean. In 2018, the population of Tonga is estimated at 109,008 (http://worldpopulationreview.com/countries)

## *Meetings*

- Mr Vatulele Tuputupu, Acting CEO for Ministry of Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC responsible for MET services office)
- Mr Ofa Faanunu, Director of the Tonga Meteorological Service, by phone
- Mrs Seluvaia 'Ilolahia Finaulahi, Acting Director for MET services office
- Mr Nonga Soakai, Deputy CEO of the Tonga Institute of Science and Technology (TIST)

## *NMHS General Information (structure, functions, staffing, expectations, challenges)*

**Tonga Meteorological Services located at the Domestic terminal at Fua'amotu airport. The Tonga Meteorological Service provides regional and national:**

- National and regional forecasts
- Climate summaries
- Satellite imagery
- Aviation weather services provides pilot briefings, METAR, TAFs, ARFOR, SIGMET
- Coast Watch services; and access to numerical models for meteorological and climatological purposes

The 6 stations TMS operating are located at all the airports. Fua'amotu HQs operates on a 24 hour basis.

Average age of NMHS staff is between 30 and 40 excepting management and administration which are older.

Total staff is 30 with 4 Females (slow growth is expected). Degreed staff is 7 (Administration and Management 1, Tropical Cyclone Forecasting 2, General forecasting 3, Communication and computing 1). Post-secondary qualifications staffing 22 (Administration 1, General Forecasting 2, Observers, Climate Services 2. Equipment maintenance 2, Other support staff 2). Staff overload result is poor performance.

Staff obtained the highest degree in the Pacific Islands.

Average annual budget is approximately 1,000,000 USD (with about 50% nationally sourced).

**According to the PMC-4 meeting the following updates, challenges and priorities are noted:**

- Established new met station through DFAT funding

- One met staff trained at PAGASA and two at BoM
- Involved with APCC agrimeteorology services project
- Himwaricast installed by JICA
- Producing television weather service forecasts
- Involved in new community early warning system project
- Developed tsunami early warning system project with JICA
- Carrying out national tsunami drill in November 2017
- Need to upgrade technical maintenance staff and enact regulations for the Met Act
- Established maritime observations equipment, cost recovery services
- Received certification in aviation weather services
- Setting up NCOF for the agricultural sector in Tonga in November 2017

## *Education and Training Needs*

Technical skill areas the service most in need of are as follows:

- Observations and network management
- Forecasting Services
- Equipment maintenance and repair
- Climate Services
- Communications and Computing
- Training
- Marine / Oceanographic Services
- Agricultural Services

## *Educational and Training Offerings at the National Level*

Tonga Institute of Science and Technology (TIST) seems does not have any solid links to NHMS. Before recently TIST comprised four Schools (Engineering and Constructions, Agriculture, Maritime, Tourism and Hospitality). Now only School of Engineering left (with no scientific or related to earth-science component). Others (such agriculture) moved to Tonga Institute of Higher Education.

Tonga Institute of Higher Education did not reply on the request to complete the on-line Questionnaire (was sent on 8th June 2018)

## *Any RTC Supporting Mechanisms in Place*

Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications recognized important role of the met/hydro/climate services. Support in establishing of the sustainable Pacific based RTC under the model which could accommodate complimentary services from different educational and training providers could be considered.

Tuvalu has a 2018 population of 11,287 according to the latest estimates from the UN›s World Population Prospects. Area is 26 km$^2$ (http://worldpopulationreview.com/countries)

Sea level rise, along with elevated risks in terms of increased variability of weather, climate, storm surges and coastal inundation bring immense challenges to this small country.

## *Meetings*

- Mr Tauala Katea, Director of the Tuvalu Meteorological Service (TMS)
- Mr Pisi Seleganiu, Head of Water and Plumping Division, Public Works Department
- Mr Uinga Paelate, Director Civil Aviation
- Mr Setima Piita, Human Resource Development Officer, Human Resource Management, Office of the Prime Minister, Government of Tuvalu
- Mr Peteli Paulo, Education Department, Ministry of Education
- Dr Rosiana Lagi, Director of the USP Tuvalu Campus

## *NMHS General Information (Structure, Functions, Staffing, Expectations, Challenges)*

The Tuvalu Meteorological Service (TMS) is the principal meteorological observatory of Tuvalu and is responsible for providing weather services to the islands of Tuvalu. The meteorological office is an agency of the Ministry of Communications and Transport. The main observational office is on the Island of Funafuti. TMS operates outstations on Nanumea, Nui and Niulakita. TMS operates four synoptic stations; five rainfall stations; one upper air research program; one tide gauge along with a tsunami warning system; one Continuous Global Positioning System (CGPS) station; and one Seismic station (USGS). TMS operates 2 meteorological programms (surface observation and upper air programme). Synoptic stations are manual (operated by 10 observers).

**The following infrastructure enhancements of TMS's capability were noted:**

- Installation Himawari Cast equipment by JICA
- Completed installation of HF radio for early warning system communication
- Transmitting daily weather observations every six hours
- Installation of new tide gauge for monitoring sea level rise
- Set up container storage for hard copies of Met data

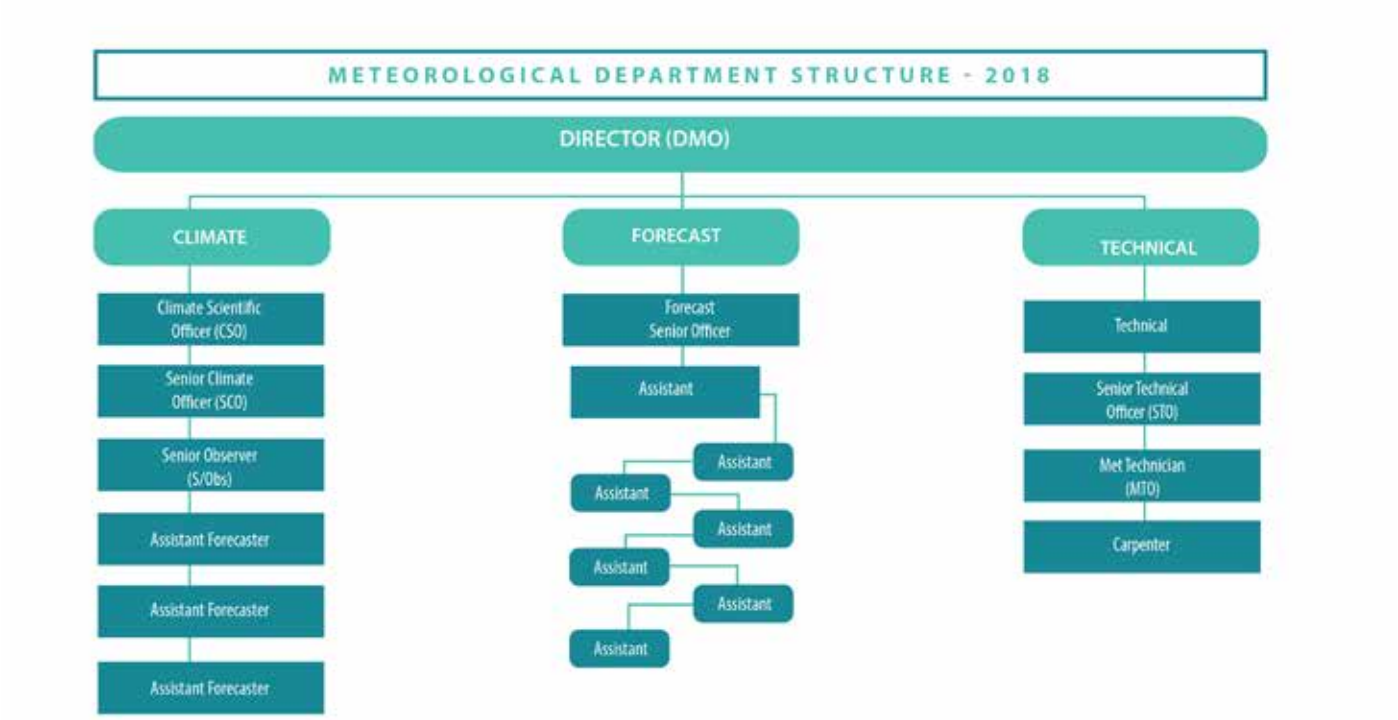
The TMS publishes weather forecasts, warnings as of tropical cyclones, weather charts and weather satellite images on its website, with weather forecasts and storm warnings also broadcast by the Tuvalu Media Corporation, which operates Radio Tuvalu.

The Meteorological observations of the TMS are shared with other regional agencies that attempt to predict how many tropical cyclones and severe tropical cyclones will develop within the Southern Pacific.

TMS closely cooperates with New Zealand MetService, Fiji Meteorological Service, Australian Bureau of Meteorology, Geoscience Australia, United States Geological Survey and National Weather Service, SPREP and WMO.

Among proposed activities to be carried out over the next 2 years are:

- National Drought Management and Response Plan
- Upgrading internet connection bandwidth
- Development of an Impact-based Forecasting Tool for monitor and improve coastal inundation modelling of storm surge/waves and sea level inundation associated with tropical cyclones.
- Tsunami community awareness programmes
- Enhanced international communications systems to enable effective and efficient broadcast and two-way information exchange
- Effective, efficient and sustainable mechanisms for dissemination of tsunami and multi-hazard warnings to local centres
- Improved in-country coordination of communications systems to enable effective use, interoperability and reliability for tsunami warnings, multi-hazard warnings, emergency response and other functions
- Prepare hazard mapping for all islands from available near shore bathymetry & topography dataset and simulations




There are three sub-division namely Forecast, Climate & Technical with 18 staff in total with the 10 Observers now been approved to re-designated their position as 10 Assistant Forecasters due to extra daily weather forecasting and severe weather monitoring responsibilities embed within their position descriptions.

Highest degree six staff who have graduated from USP (Fiji) and NZ.

The Tuvalu Public Works Department (Water and Plumbing Division) with total staff of 15 is managing available water resources and related government facilities (water reservoir, desalination plant). Additionally, it manages plumbing works including connecting the water network to homes. The Water and Plumbing Division is also responsible for the collection of data from rainwater harvesting systems and the water storage of each individual household so as to develop a model that can provide more effective and efficient outcome which guide the department in terms of water management and decision making at all levels.

There is currently no hydrologists in the department and it is vital to provide training that could give a better understanding of how to examine and determine the extent of Tuvalu's underground water resource. Also important is the need to develop a methodology to measure community awareness of water-related issues and to engage the community in advocating how to manage water.

## *Educational and Training Needs*

**Priorities identified to meet Pacific Key Outcomes of PIMS:**

- Competent staff to gather, process, archive and facilitate the rapid exchange of data and products
- Capability to prepare and deliver high quality early warnings and forecasts of weather, climate and water related hazards to respond effectively to the stakeholders needs
- More in-country scientific research to support CC adaptation & mitigation projects and decision making.
- Capacity to maintain high standards of observation instruments, equipment and data backup system, calibration of instruments, AWS maintenance is under planning for future
- Effective approaches in management/administrative
- Certifying of eight technical staff as Aeronautical Meteorological Observer (AMO) under ICAO/WMO requirements (to achieve this BIP-MT training is needed)
- Water resources management, hydrological and hydrological technician training

It is expected to create two new posts within the Technical and Climate Division (a meteorologist/IT officer to accommodate monitoring the climate network and database servers and a Climatologist to conduct full-time data entries and quality control for imminent mitigation and adaptation project requirements due to climate change). Technical assistance is needed in terms of training staff on how to manage the desalination system. Apart from the water management they are also managing the sludge from septic system. Training on different types of sewage mini treatment plant that are more economical and environmental friendly is needed. Currently the overflow of septic sludge is either dumped next to the septic tank or discharged into the ocean. Neither solution is environmentally friendly or socially acceptable.

## *Educational and Training Offerings at the National Level*

USP Campus in Tuvalu is hosting 312 part-time local students. It provides fundamental courses to prepare students for taking university-level courses (such as a BA in Maths).

## *Any RTC Supporting Mechanisms in Place*

TMS is positive about establishing Pacific RTC, and it needs funds to support travel and living expenses its small staff. Government of Tuvalu has an approved Human Resources Development Plan which provides two opportunities to get national scholarships: Career Development (for post-secondary level students to get initial university degree) and Work Force (for already employed staff to improve qualifications) Pathways. Last year about 12 scholarships were awarded for the first Path (mainly for study at USP), and 10 – for the second Path. Currently training needs assessment analysis is ongoing with expected outcomes in August 2018.

## *Conclusions / Recommendations*

Training needs partially met by FMS, but more support needed for training overseas. National scholarship mechanism is in place to partially address educational and training needs. The Director of NMHS is supportive to the WMO RTC in the Pacific region as this could reduce costs for travel overseas. Distance learning is also considered as effective but there is an Internet access constraint.

The estimated 2018 population of the Republic of Vanuatu was estimated at 282,117[16]. Vanuatu's total area is roughly 12,274 square kilometres (4,739 sq mi), of which its land surface is very limited (roughly 4,700 square kilometres (1,800 sq mi)). Most of the islands are steep, with unstable soils and little permanent fresh water.

## *Meetings*

- Ms Esline Garaebiti, Acting Director of the Vanuatu Meteorology and Geo-Hazards Department (VMGD)
- Mr Roy Obed Fanongo Taripoarroto, Director Educational Services, Ministry of Education and Training
- Mr John Kaltau, PEO Scholarship Unit of the Ministry of Education and Training
- Mr Ruben Bakeo Markward, Director of the Emalus Campus, University of the South Pacific
- Phone briefing with Mr Johnson Toa, TVET Unit, Division of Tertiary and High Education of the Ministry of Education and Training

## *NHMS General Information (Structure, Functions, Staffing, Challenges)*

The Vanuatu Meteorology and Geo-Hazards Division (VMGD) is a Department within the Ministry of Climate Change Adaptation, Meteorology, Geo-hazards, Energy, Environment and Disaster Management. It has six technical Divisions responsible to provide the required services and products (Observation, Forecasting, Climate, IT and Engineering, Administration and Geo-Hazards Division). As of 2018, there are 46 staff (with 34 male) employed (see Table 1).

**Table 1. Staff by Categories**

| Divisions | Permanent | Temporary | Total |
|---|---|---|---|
| Administration | 4 | - | 4 |
| Weather Forecasting | 7 | - | 7 |
| Climate Services | 4 | - | 4 |
| Geo-Hazards | 6 | - | 6 |
| Observations | 13 | 2 | 15 |
| IT and Engineering | 10 | - | 10 |
| Total | **44** | **2** | **46** |

VMGD provides regional and national: atmospheric forecasts; marine forecasts; tidal information; tropical cyclone outlooks; tsunami information and warnings; climatological information.

Quite many young professionals recently employed (around 20 years old), who are mainly graduates from USP and other universities in Australia, New Zealand and New Caledonia. Project management and administration skills are in great demand. Newly employed staff are trained by managers and supervisors who, acting as Instructors, improve their technical skills and make them ready for operational work. There is also one Principal Scientific Officer for Training who helps to organize such field and on-job-training.

One upper air station operates and 11 of the VMGD weather stations are now automated.

16 http://worldpopulationreview.com/countries

Data is automatically transmitted to VMGD's CLiDE database for storage, analysis and research purposes as well as for sector impact forecasting. Skills on data collection, processing and management need to be significantly improved. Additionally, computer languages, software, telecommunication training are also needed.

The weather forecasting division installed an integrated weather forecasting system called Meteo factory in collaboration with Meteo France (the VCAP project). Tsunami warning systems (sirens) have been installed in Port Villa and Luganville as part of the final phase of a project funded by Japan Government (initiated in 2013). The system includes the tsunami sirens, tsunami evacuation routes and tsunami evacuation maps.

VMGD is the provider of Meteorological Services to the aviation. Through its observation program, VMGD provides meteorological data for the main Vanuatu airports.

VMGD has rarely conducted objective evaluation of their services and they have had little feedback from consumers of their services and products.

Projects supporting VMGD: Green Climate Fund: Climate services for resilient development in Vanuatu – $US22.9 million is being implemented within the department and includes five sectors; Water, Tourism, Agriculture, Infrastructure, Fisheries. It is expected that each sectors will have sector coordinators supported by the Green Climate Fund to work in partnership with VMGD to strengthen climate information services through hydrology, infrastructure, fisheries, tourism and agriculture.

VMGD is a part of the regional project "Early Warning System" developed in partnership with WMO. Aim is to strengthen flood forecasting capabilities but also early warning services to rural communities.

## *Educational and Training Needs*

**Priorities identified:**

- Project management, administration skills
- Skills on data collecting, processing and management (CLIDE)
- Computer language, telecommunication
- Hydrology, agriculture – to be shortly recruited
- Face-to-face mode is considered as only effective

## *Educational and Training Offerings at the National Level*

There are several education and training providers like Vanuatu Institute of Technology, National College, National University of Vanuatu. More relevant for the study is USP Vanuatu Campus, TVET (Technical and Vocational Education and Training), APTC (Australia-Pacific Technical College).

Face-to-face Science courses (Chemistry and Biology) began in 2015 and in 2016 at the USP Emalus Campus as Lecturer in Chemistry and Training Assistant for Physics were hired by the university. Campus started 200 level courses in Chemistry but there still need for resources to start 300 Level courses.

Other subjects are delivered in distant mode for 30-40 students on semester basis. Entry requirements are set but the first level students often quite low (their knowledge level needs to be significantly improved in the science subjects).

Students cover tuition fee by themselves/sponsors or via fellowships awarded by the National Governments.

It is expected that Vanuatu "In-Country Science Programme" will promote science courses that will be offered at the Emalus Campus in 2018 -2019. As part of this programme, Science Teachers Accelerated Program (STAP) offers an opportunity for Teachers to upgrade their science qualification to science degree. This is a response to the Vanuatu Government through the Ministry of Education and Training that made a request to have more scientific program here, available face-to-face sessions for science students.

The Vanuatu Government provide scholarship to students (annually about 300 new awards) for university-level programmes. "In-Country Science Programme" is considered for bringing science to the region and cutting of expenses of private and government sponsored students.

Courses related to Sciences are in less demanded as majority of students go to economics, finance, art studies. But there are mechanisms being developed to ensure a reasonable balance between the subject areas.

### *Any RTC Supporting Mechanisms in Place*

If the WMO RTC is established, fellowship could be allocated for scientific-related study as Climate and Disaster Resilience pillar is among one of the objectives set by the Government in the priority list (Vanuatu National Sustainable Development Plan 2016 – 2030).

### *Conclusions / Recommendations*

VMGD is supportive of the establishment of an RTC in the Pacific region but has no resources available to allocate to it. Distance education and training is not considered as appropriate.

Scholarship support of the Ministry of Education and Training could be considered for sending students to distributed facilities (different campuses/institutions) to get qualifications in line with the set priorities.

## *Background: The Compact of Free Association*

The Compact of Free Association (COFA) is an international agreement that governs the relationships of free association between the United States and the three Pacific Island nations of the Federated States of Micronesia, the Marshall Islands, and Palau. The compact came into being as an extension of the U.S.–U.N. territorial trusteeship agreement, which obliged the federal government of the United States "to promote the development of the people of the Trust Territory toward self-government or independence as appropriate to the particular circumstances of the Trust Territory and its peoples and the freely expressed wishes of the peoples concerned".

Under the compact, the U.S. federal government provides guaranteed financial assistance over a 15-year period administered through its Department of the Interior, Office of Insular Affairs, in exchange for full international defense authority and other responsibilities.

The U.S. treats these countries uniquely by giving them access to many U.S. domestic programs, including disaster response and recovery and hazard mitigation programs under the Federal Emergency Management Agency, and services provided by the National Weather Service, the United States Postal Service, the Federal Aviation Administration, the Federal Communications Commission, and U.S. representation to the International Frequency Registration Board of the International Telecommunication Union.

Today, in the Federated States of Micronesia, the Marshall Islands, and Palau, government is large in proportion to its workforce with around half of government spending being supported by CoFA aid. Direct economic aid provisions in the COFA expire in 2023, when proceeds from a trust fund established in a 2003 revision are expected to partially replace U.S. grants. Because GDP growth has been slow or negative since the trust fund's inception in 2003 the three countries face an approaching a "fiscal cliff" in which the government may not be able to meet its projected obligations.

While the CoFA meteorological offices are generally small in community significance, when droughts are developing, when tropical cyclones are approaching, when international aviation demands a high standard of meteorological services, a cadre of well trained, professional meteorological service providers in each of the three countries provides an invaluable resource. To meet this need for additional meteorologist of BIP-M standard and meteorological technicians of BIP-MT standard there will need to be further training over the next five years.

Over the past several decades the US National Ocean and Atmospheric Administration's National Weather Service (NWS), through its Pacific Island Training Desks (PITDs) in Guam and Honolulu Weather Forecast Offices has invested heavily in training staff throughout the Pacific, with a particular emphasis on these three compact countries.

Through the US NWS Regional Office in Hawaii the following (approximate) funding allocations were made in 2017 for the WSOs in the compact countries: $US 700,000 pa for the operation of the Weather Service Offices (WSO) in Majuro, Republic of Marshall Islands (RMI), $US800,000 for the WSO in the Republic of Palau and $US 1,700,000 for the three WSOs in the Federated States of Micronesia (FSM). In addition to these amounts there was around $800,000 other items including training and for dealing with any emergencies that arise during normal operations.

## Meetings in Honolulu

- Ray Tanabe, US NWS Regional Director for Hawaii
- Ms Jennifer Lewis and Dan Beardsley, US NOAA NWS, International Section (by teleconference)
- Staff of the Hawaii Weather Forecast Office (WFO), led by John Bravender (Warning Coordination Meteorologist)
- Staff of the Pacific International Training Desk (PITD), led by Ray Tanabe and including: H. Gingerlei Porter, Christina Higa and Jennifer Strahl

## Meetings in Guam

- Mr Chip Guard, Acting Meteorologist-in-Charge, Guam WFO
- Ms Genevieve Miller, Meteorologist-in-Charge, Guam WFO

## The Hawaii and Guam Weather Forecast Offices

The Weather Forecast Offices (WFOs) in Hawaii and Guam are very well equipped, modern, efficient WFOs delivering high quality public weather services, aviation weather services, coastal and ocean marine services as well as functioning as forecast and warning centers for Tropical Cyclones. It was clear that morale and operating efficiency were high and that their staff enjoyed their work. These WFOs supply the forecast products that are delivered to users in the compact states and to other service users in the region as well as supporting the PITD function.

## Pacific Islands Training Needs

**In regard to training needs in general in the Pacific a number of factors are emerging:**

- The National Meteorological and Hydrological Services (NMHSs) in the Pacific Island have a strong interest in more technical training in IT generally, and in IT Systems Management/Integration, noting that many have a variety of donated, independent systems which they find complicated to maintain.
- A part of the current investments by US in the Pacific are working towards integrating some of the regional communications solutions, especially where this can improve access to data and emergency communications systems. The PITD does training on some of these systems - but it likely does not address in detail the systems management capabilities the smaller NMHSs need.
- There has been a proposal for Regional ICT Center located at SPREP, and the US is considering a request for funding support.
- The US has tried to help coordination and align its improvements in its communications systems with current HiMWARI – cast.
- The Climate Center being established in Samoa (with JICA support) will have an emphasis (in part) on training. The question arises as to how it will work towards complimenting other training efforts in the region?

## *The Pacific Island Training Desk*

The PITD offer a 3-year training program. The Desk's students are generally meteorological observers or forecasters that do not have an extensive formal, educational background in meteorology. They travel to Guam or to Hawaii to undertake a one month course. In their first year the students receive a very basic introductory course in meteorology. In their second year the complexity of the course work increases and the breadth narrows somewhat. In the third year (not yet reached by any students) the complexity of the course work will increase further and the breadth narrow yet again. Each year 20 students from the South Pacific (non-Compact countries – see attached note on the "Compact" countries) visit UH in five cohorts of four students who spend one month. There is a similar program operated out of Guam for students from the Compact countries.

The PITD is now in its 17th year of operations. It has trained 174 students from 21 countries, principally from RA V but increasingly, when spaces are available, from RA 2 (including Cambodia, Philippines, Vietnam and Malaysia). Multiple requests from RA 2 member countries of the Tropical Cyclone Committee (TCC) including Laos and Vietnam for their staff to attend training were submitted to the PITD for consideration since 2015 (Table 1).

The training program was established after a review that identified the need for training to educate staff recruited as observers in the Pacific countries in meteorology. Initially the course was two months long with 5-6 students annually between 2001-2013, however experience indicated that a shorter course would be more effective, and so the course length was reduced from two months to one month. The one month long course was launched in 2014 after a redesign of the curriculum to include both a meteorology and a communication systems component. Currently, the PITD trains up to 35 students annually in its Honolulu and Guam locations. The Honolulu site trains observers from the South Pacific Islands while the Guam site trains those from the North Pacific (Federated States of Micronesia, Marshall Islands and Palau). It is estimated that the course cost is around $US 23,000 per person.

The PITD offers two courses, an Introductory and Intermediate level courses. The Introductory Level course or Level 1 training covers Introductory Tropical Meteorology topics, including: Thermodynamics; Satellite Interpretation; Surface and Upper-Air Analysis; General Circulation; Local Circulations; Tropical Weather Features; Numerical Weather Prediction; Forecast Philosophy; Forecast Verification; Marine Forecasts; Tsunamis; Severe Weather and Tropical Cyclones; Tropical Climate Variability; and Messaging and Weather Communications. The Level 2 course covered intermediate tropical meteorology topics, including: Atmospheric Forces and Balances Tropical Weather Features, Satellite Interpretation, RGB Products, Numerical Weather Prediction, Diagnosis and Analysis of Current and Past Weather, Short- and Medium-Range Weather Forecasting, Tropical Cyclones, Offshore and Coastal Wave Observation and Prediction, Equatorial Waves, Intra-seasonal Variability, Communication of Weather Information, Website Maintenance, and Interactions with Key Partners such as Emergency Management.

This year there will be in-country course conducted in American Samoa for a cohort of four students for one month. The most requested course topics are for training related to tsunamis, tropical cyclones and aviation weather services.

**Table 1: The Breakdown (per country, of participants who completed PITD training)**

| Country | 2001-2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|
| Cambodia | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Cook Islands | 3 | 1 | 1 | 0 | 1 | 0 | 6 |
| FSM* | 0 | 0 | 0 | 9 | 9 | 4 | 22 |
| Fiji | 2 | 3 | 2 | 2 | 4 | 0 | 13 |

| Country | 2001-2013 | 2014 | 2015 | 2016 | 2017 | 2018 | Total |
|---|---|---|---|---|---|---|---|
| Indonesia | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Kiribati | 6 | 1 | 2 | 2 | 2 | 2 | 15 |
| Malaysia | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| Marshall Islands | 0 | 0 | 0 | 3 | 3 | 0 | 6 |
| New Caledonia | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Nauru | | | | | | 2 | 2 |
| Niue | 2 | 1 | 1 | 0 | 1 | 0 | 5 |
| Palau | 0 | 0 | 0 | 3 | 3 | 0 | 6 |
| Papua New Guinea | 6 | 2 | 0 | 4 | 0 | 2 | 14 |
| Philippines | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| Samoa | 5 | 2 | 4 | 2 | 2 | 0 | 15 |
| Solomon Islands | 7 | 1 | 1 | 2 | 4 | 0 | 15 |
| Tokelau | 1 | 0 | 0 | 2 | 0 | 0 | 3 |
| Tonga | 7 | 0 | 6 | 2 | 0 | 0 | 15 |
| Tuvalu | 4 | 2 | 0 | 2 | 3 | 0 | 11 |
| Vanuatu | 7 | 0 | 2 | 1 | 3 | 2 | 15 |
| Vietnam | 3 | 0 | 0 | 0 | 0 | 0 | 3 |
| TOTAL | **61** | **13** | **19** | **34** | **35** | **12** | **174** |

*Chuuk (7), Pohnpei (8), and Yap (7)

**Table 2: Age Distribution of PITD students**

| Age | Number |
|---|---|
| 18-34 | 59 |
| 35-50 | 44 |
| 50+ | 15 |
| Total | 118 |

The PITD has done a very thorough job of documenting existing capabilities and equipment used by of each of the National Meteorological and Hydrological Services (NMHSs) involved in the training desks. In addition to this, they have built cohorts of very engaged participants whom it appears they have frequent dialogs after they return to their respective WFOs. It is likely that they have been able to achieve this close cooperation because they are a National Weather Service-based training facility not a university faculty working independently, nor an RTC not closely aligned with an active National Weather Service.

There is a review board that oversights the PITD course curriculum and a small board that reviews applications for the course and recommends which students should be accepted. Students applying are advised to undertake COMET modules as preparation, and successful completion of the modules is taken as evidence of commitment to working diligently when on the course. For students from the Compact countries attending the course at Guam, the compact countries pay for travel and accommodation.  Students at Hawaii have this covered by NOAA, NWS.

## *Organisation Profile Focussing on Weather and Climate Matters*

SPREP (the Secretariat for the Pacific Regional Environment Program is an intergovernmental environment organization assisting countries and territories of the Pacific to better manage their environments and to give greater prominence to environmental issues in the Pacific. SPREP is one of several inter-governmental agencies comprising the Council of Regional Organisations in the Pacific (CROP). It was established in Samoa in 1993 following a move from the Secretariat of the Pacific Community in Noumea, New Caledonia.

The agreement establishing SPREP describes its purposes are to promote cooperation in the South Pacific Region and to provide assistance in order to protect and improve the environment and to ensure sustainable development for present and future generations (Art.2).

With 26 member countries and territories, SPREP comprises five Programmes: Islands and Ocean Ecosystems, Waste Management and Pollution Control, Climate Change Resilience, Environmental Monitoring and Governance; and Strategic Planning, Project Coordination and Information Services, plus two Departments (Finance and Human Resources). Communications and Outreach and Legal Services teams report directly to the Director General of SPREP. SPREP has actively led key regional processes, including the Pacific Climate Change Roundtable and the Disaster Roundtable and the Pacific Meteorological Council. These fed into the Integrated Framework for Resilient Development in the Pacific (FRDP), which was endorsed by Pacific Island Forum Leaders in September 2016.

In May 2018 a ground breaking ceremony for the Pacific Climate Change Centre (PCCC) was held at SPREP. The PCCC will be the regional centre of excellence for climate change information, research and innovation. A Steering Committee drawn from a wide range of key stakeholders including SPREP member countries and territories, partners, donors, CROP (Council of the Region Organisations of the Pacific) agencies and the Government of Japan is currently consulting with a view to finalise the details of the role and functions of the PCCC, as well as its governance structure and budget. The draft plans identify training as a key component of the centre.

## *Meetings*

**SPREP (Secretariat for the Pacific Regional Environment Program)**

- Mr Roger Cornforth, Deputy Director
- Mr Salesa Nihmei
- Mr Philip Malsale
- Mr Robert Duncan McIntosh

**WORLD METEOROLOGICAL ORGANISATION**

- Mr Henry Taiki

## SPREP General Information (Structure, Functions)

Meteorology and climate at SPREP is part of the Climate Change Resilience Progamme. The Programme has 12 staff with funding support from sources such as the Climate and Ocean Support Program in the Pacific (COSPPac) and the Vanuatu Climate Information Services for Resilient Development Project (Van-CIRSDP).

The Pacific Meteorology Desk Partnership (PMDP) is located at SPREP providing a platform for regional coordination of meteorological services development in the Pacific Region. PMDP has two components: the Apia based Secretary component provided by SPREP and the WMO Office for the South-West Pacific; and, a partners component which is the collective of technical institutions who provide expertise to build the capacity of Pacific National Meteorological and Hydrological Services (NMHSs).

The role of the PMDP is to help the NMHSs in the Pacific region in various areas including securing funding support and also to do the organisation and support the bi-annual meeting of the Pacific Meteorological Council and the Pacific Islands Ministerial Meeting on Meteorology (PIMMM).

## Education and Training Opportunities

The discussions at SPREP foresaw a regionally distributed RTC drawing upon the strengths of a number of organisations already providing education and training support to the NMHSs in the region. In WMO parlance this would be identified as an RTC with multiple components.

The discussions suggested that the three key institutions could be the University of the South Pacific (USP) for the academically orientated courses, the Fiji Meteorological Service (FMS) for the more operationally orientated vocational courses and SPREP covering climate data and climate services courses through the Pacific Climate Change Centre (see following section) as well as a range of operationally orientated ICT and management courses. SPREP would like to see the courses jointly developed and delivered by the three institutions and accredited by USP as a regional University.

It was recommended that the roles of the three institutions should be endorsed by the PMC and the PIMMM. This endorsement by the PMC and PIMMM would assist each institution taking up the matter through their various councils and boards for endorsement.

For the RTC to function effectively it was suggested that a key action will be getting as many donors as possible to support and work through the RTC components for training related matters. An example of this is the work that the Japan International Cooperation Agency (JICA) is already doing with FMS and the work JICA is proposing to do with the PCCC once it has been fully established. SPREP would welcome our report recommending that the UNDP Office in Suva, Fiji work with SPREP and WMO to organise a donor round table during the next PMC in 2019 where this topic could be discussed by the various institutions and potential donors. By encouraging stronger linkages between the donors and one or more of the RTC components it is expected that there will be increased strengthening of the training institutions to carry on the underlying training related to the project once the project has completed

During the discussions SPREP it was noted that the Samoa Qualifications Authority (SQA) had been discussing with SPREP about the need to accredit SPREP as a registered training organisation as well as certify at least some of the courses being offered by SPREP. If this was achieved it would help address one of the issues raised by many of the

NMHS Directors regarding the need for their staff to undertake accredited courses for recognition in their respective countries.

### *Educational and Training Offerings at the National Level*

See the separate report for Samoa.

### *Any RTC Suppporting Mechanisms in Place*

The PCCC regional Centre of excellence for climate change information, research and innovation will be based at SPREP headquarters in Apia, Samoa. The PCCC will host climate change experts, researchers and officials for applied research, training and policy initiatives. More specifically, the PCCC will, inter alia: deliver capacity development programmes in adaptation, mitigation, climate services and project development; improve the flow of climate change information between users and providers, including meteorological services, climate practitioners, policy makers and implementers, researchers and scientists; and provide a space for visiting researchers and experts to work and provide support to the region. It will also: improve access to scientifically robust, practical information; host and support applied research aligned with the needs of Pacific communities; and support implementation of the proposed Pacific climate science research strategy.

The Centre will improve coordination of climate change training efforts by building partnerships and promoting events; foster innovation and promote the development of new climate services and products; host "challenge events" to bring together stakeholders to find solutions to climate-related problems; and support implementation of the Pacific Roadmap for Strengthened Climate Services 2017-2026 and the Pacific Island Meteorological Strategy 2017-2026. As noted earlier the business plan for the PCCC is being updated to ensure that the centre will be sustainable and will meet the regional needs.

### *Conclusions / Recommendations*

Given the current goals and strategies proposed for the PCCC it is hard to envisage the PCCC not being a component of a Pacific based RTC where demands for training in climate data and climate services has come up in nearly all countries visited by the study team. Similarly SPREP are already playing a key role in the training of NMHS personnel so including an RTC component built around SPREP and the PCCC would seem a reasonable step forward.
Material derived from

- Discussions with Mr Roger Comforth on 24 June 2018
- Discussions with Mr Salesa Nihmei on 8 June 2018
- Discussions with Mr Henry Taiki, Mr Philip Malsale and Mr Robert McIntosh on 11 June 2018

**The SPREP website: https://www.sprep.org**

# ANNEX 2

Results from
Study Team NMHS Questionnaire

## *Results from Study Team NMHS Questionnaire*

The information in this annex was collated from the responses fourteen of the NMHSs provided to the study team by the NMHSs. The data is also being provided in a separate xls file for ease of use. Despite a number of efforts to establish contact with Nauru no data was received from them for the questionnaire.

# Content

# *Introduction*

The country data that follows was collected by the study team through an online survey using Survey Monkey. Fourteen of the fifteen countries completed the survey (no response was received from Nauru and the study team were unable to visit Nauru due to time limitations).

Table 1 provides an overall view of the responses from the NMHSs to the Study Team's questionnaire. Not every question was answered by each NMHS (see yellow shaded cells). Except for question 29 "Number of new staff you would expect to require training at the RTC annually" the odd missing or incomplete response should not have a major impact upon the overall conclusions. As a number of the larger NMHSs did not complete question 29 the results from this question may underestimate the actual demand for education and training of new staff. This potential under estimate may offset what could be seen as a potentially overly optimistic annual demand from the countries who did respond, particularly the smaller NMHSs.

The study team will provide RESPAC with an MS Excel version of the data.

**TABLE 1.** Green coloured cells show indicate the NMHS provided a response to this question. For the Solomon Islands where a response was received from the Meteorological Service and the Hydrological Service these have not been separated in this table but the analysis does consider them separately.

| Q # | Question Text | Cook Islands | Federated States of Micronesia | Fiji | Kiribati | Niue | Palau | Papua New Guinea | Republic of the Marshall Islands | Samoa | Solomon Islands | Tokelau | Tonga | Tuvalu | Vanuatu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Country | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | Name of Institution | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | International Training language | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | Job role | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | Name | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 6 | Email address | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 7 | PIMS Service areas to be addressed | 1 | 1 |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8 | Current Professional Staff Nos | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 9 | Current Technical Staff Nos | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | Current Other Staff Nos | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 11 | Do staffing classifications / pay rates depend upon their academic qualifications | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 12 | Total reported staff numbers with time | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 13 | Gender breakdown in your service | 1 | 1 | 1 | 1 | 1 | 1 |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 14 | What is the retirement age for your NMHS | 1 | 1 | 1 | 1 | 1 | 1 |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 15 | Average age of NMHS staff | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 16 | Which professional skill areas is your service most in need of? | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  | 1 | 1 |
| 17 | Which technical skill areas is your service most in need of? | 1 | 1 |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |  |
| 18 | Service areas staffing has increased in | 1 |  | 1 | 1 | 1 |  |  | 1 | 1 | 1 | 1 | 1 | 1 |  |
| 19 | Are your staffing numbers less than the approved staffing plan for your organisation? | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Yellow cells indicate no response received from the NMHS for this question. Except for Q29 the Study Team do not see this as a major problem in the analysis of the data.

| Q # | Question Text | Cook Islands | Federated States of Micronesia | Fiji | Kiribati | Niue | Palau | Papua New Guinea | Republic of the Marshall Islands | Samoa | Solomon Islands | Tokelau | Tonga | Tuvalu | Vanuatu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | What is the recruitment process for new staff at the junior professional level? | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 21 | Number of staff with MSc or above | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 22 | Number of staff with BSc only | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 23 | In which country(ies) did your staff obtain their highest degree | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 24 | Number of staff lost in last five years | 1 | | 1 | 1 | 1 | | 1 | | 1 | | 1 | | 1 | 1 |
| 25 | Do you believe that a Pacific Island RTC should offer distance education courses | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 26 | If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 27 | If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 28 | If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | 1 | 1 | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 29 | Number of new staff you would expect to require training at the RTC | 1 | 1 | | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | |
| 30 | What frequency do you anticipate requiring for update traing of perhaps one to two weeks for the following service areas | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 31 | What has been your average annual budget in USD$ over the last five years | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 32 | What percentage of the budget is provided by the national government? | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 33 | What is the nationally sourced component of your budget expected to do over the next five years | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 34 | If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 35 | Total Estimated staff numbers with time | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Cook Islands | Cook Islands Meteorological Service | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Arona Ngari | arona.ngari@cookislands.gov.ck |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Provide as advice or in general terms |
| Marine Forecasting | Provide as advice or in general terms |
| General forecasting | Provide as advice or in general terms |
| Observations | Regularly provide products or services |
| Climate Services | Provide as advice or in general terms |
| Hydrological Services | Do not currently provide |
| Communications and computing | Provide as advice or in general terms |
| Agricultural Meteorology | Provide as advice or in general terms |
| Marine and ocean services | Provide as advice or in general terms |
| Research | Regularly provide products or services |
| Community awareness / Public education and outreach / traditional knowledge | Regularly provide products or services |
| Environmental monitoring | Regularly provide products or services |
| Equipment maintenance and repair | Regularly provide products or services |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 1 |
| General forecasting | 0 |
| Observations | 6 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 1 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Yes the PS classification is dependent upon qualification |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 12 |
| 2013 | 12 |
| 2017 | 10 |
| 2020 | 12 |
| 2026 | 15 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 10 |
| Females | 0 |

| Q14. What is the retirement age of your NMHS | - 60 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | more than 50 but less than 60 |
| Meteorological Technicians | between 20 and 30 |
| Males | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 5 |
| Management of Observation network | 4 |
| Climate Services | 2 |
| Hydrological Services | N/A |
| Communications and computing | 3 |
| Agricultural Meteorology | 7 |
| Marine and ocean services | 6 |
| Research | 1 |
| Environmental monitoring | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Management of equipment maintenance and repair | 8 |
| Training | N/A |
| Other Support functions | N/A |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 4 |
| Observations | 2 |
| Climate Services | 5 |
| Hydrological Services | N/A |
| Communications and computing | 3 |
| Agricultural Meteorology | 7 |
| Marine and ocean services | 6 |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 1 |
| Training | N/A |
| Other Support functions | N/A |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Observations | 2020, 2025 |
| Research | 2020 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Short a technical services manager |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit staff with general degrees and send them away for specialist training |
| Q21. How many of your staff have higher degrees (MSc or above)? | 1 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 0 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Pacific Islands |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 0 |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | - Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | – Donor |

| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
|---|---|
| Meteorologists | 1 in 5 years |
| Meteorological Technicians | 1 in 5 years |
| Hydrologists | 0 |
| Hydrological Technicians | 0 |
| Climatologists | 1 in 5 years |
| ICT specialists | 1 in 5 years |

| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
|---|---|
| Management and Administration | Two to five years |
| Climate Services | Every two years |
| Observations and networks | Two to five years |
| Marine and oceanographic services | Two to five years |

| | |
|---|---|
| **Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas** | |
| Research | Two to five years |
| Equipment maintenance and repair | Two to five years |
| **Q31. What has been your average annual budget in USD$ over the last five years -** | 250,000 |
| **Q32. What percentage of the budget is provided by the national government?** | - All sourced nationally |
| **Q33. What is the nationally sourced component of your budget expected to do over the next five years** | - Keep up with inflation |
| **Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories** | -Training 5% or around12,500 |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Fiji | Fiji Meteorological Service | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Ravind Kumar | ravind.kumar@met.gov.fj |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Regularly provide products or services |
| Marine Forecasting | Regularly provide products or services |
| General forecasting | Regularly provide products or services |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Regularly provide products or services |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Regularly provide products or services |
| Marine and ocean services | Regularly provide products or services |
| Research | Regularly provide products or services |
| Community awareness / Public education and outreach / traditional knowledge | Regularly provide products or services |
| Environmental monitoring | Regularly provide products or services |
| Equipment maintenance and repair | Regularly provide products or services |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 3 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 3 |
| General forecasting | 15 |
| Observations | 1 |
| Climate Services | 5 |
| Hydrological Services | 3 |
| Communications and computing | 3 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 24 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 39 |
| Observations | 24 |
| Climate Services | 9 |
| Hydrological Services | 11 |
| Communications and computing | 3 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 3 |
| Training | 0 |
| Other Support functions | 12 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Depends on position and qualifications (person with normal secondary school lower than diploma level) |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 115 |
| 2013 | 128 |
| 2017 | 145 |
| 2020 | 162 |
| 2026 | |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 130 |
| Females | 13 |

| Q14. What is the retirement age of your NMHS | 55 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | more than 30 but less than 40 |
| Meteorological Technicians | more than 30 but less than 40 |
| Hydrological Technicians | more than 30 but less than 40 |
| Climate Services Staff | more than 30 but less than 40 |
| Administration / Management Staff | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |
| Management of Observation network | |
| Climate Services | 5 |
| Hydrological Services | |
| Communications and computing | 3 |
| Agricultural Meteorology | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Marine and ocean services | |
| Research | 4 |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | 2 |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | 0 |
| Forecasting Services | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Hydrological Services | 2020 |
| Research | 2020 |
| Training | 2020 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Yes |
| Q20. What is the recruitment process for new staff at the junior professional level? | Depending upon qualification requirement |
| Q21. How many of your staff have higher degrees (MSc or above)? | 2 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 0 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Australia, Philippines, India<br>Other |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 10 |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes and face to face courses |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | |

| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
|---|---|
| Meteorologists | 2 |
| Meteorological Technicians | 1 |
| Hydrologists | 1 |
| Hydrological Technicians | 2 |
| Climatological Technicians | 2 |
| Marine Specialists | 1 |
| Climatologists | 1 |
| ICT specialists | 1 |

| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
|---|---|
| Management and Administration | |
| Climate Services | |
| Observations and networks | |
| Marine and oceanographic services | |
| Research | |
| Equipment maintenance and repair | |

| | |
|---|---|
| Q31. What has been your average annual budget in USD$ over the last five years - | 450,000 |
| Q32. What percentage of the budget is provided by the national government? | - All sourced nationally |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |

*Survey Responses*

# Federated States of Micronesia

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Federated States of Micronesia (FSM) | Pohnpei WSO | English | Senior Manager, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Kenly Anton | kenly.anton@noaa.gov |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Provide as advice or in general terms |
| Tropical Cyclone forecasting | Do not currently provide |
| Marine Forecasting | Do not currently provide |
| Aviation Forecasting | Do not currently provide |
| General forecasting | Do not currently provide |
| Observations | Regularly provide products or services |
| Climate Services | Do not currently provide |
| Hydrological Services | Do not currently provide |
| Communications and computing | Provide as advice or in general terms |
| Agricultural Meteorology | Do not currently provide |
| Marine and ocean services | Do not currently provide |
| Research | Regularly provide products or services |
| Community awareness / Public education and outreach / traditional knowledge | Plan to provide before December 2025 |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Do not currently provide |
| Training | Do not currently provide |
| Other Support Functions | Do not currently provide |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 3 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 18 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 9 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 3 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Qualifications plus experience determine salary |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 32 |
| 2013 | |
| 2017 | 32 |
| 2020 | |
| 2026 | 25 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 28 |
| Females | 4 |

| Q14. What is the retirement age of your NMHS | No retirement age but people generally aim for 60 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | 60 or older |
| Meteorological Technicians | more than 30 but less than 40 |
| Administration / Management staff | Between 20 and 30 |
| Males | more than 30 but less than 40 |
| Females | Between 20 and 30 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |
| Management of Observation network | 5 |
| Climate Services | 3 |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | 2 |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | 4 |
| Training | 6 |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 3 |
| Observations | |
| Climate Services | 2 |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 1 |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| | |
| | |
| | |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Yes |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can't recruit meteorologists and we cannot send degreed recruits away for meteorologist qualifications |
| Q21. How many of your staff have higher degrees (MSc or above)? | 0 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 0 |
| Q23. In which country(ies) did your staff obtain their highest degree? | |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Not clear – likely donor after 2023, NOAA before then |

| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
|---|---|
| Meteorologists | 2 to 3 every year across all categories |
| Meteorological Technicians | |
| Hydrologists | |
| Hydrological Technicians | |
| Climatologists | |
| ICT specialists | |

| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
|---|---|
| Forecasting Services | Every two years |

| | |
|---|---|
| Q31. What has been your average annual budget in USD$ over the last five years - | 1,600,000 |
| Q32. What percentage of the budget is provided by the national government? | - All sourced nationally |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Decrease below the current level |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Kiribati | Kiribati Meteorological Service | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Ueneta Toorua | cmo@met.gov.ki |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Provide as advice or in general terms |
| Marine Forecasting | Regularly provide products or services |
| Aviation Forecasting | Plan to provide before December 2025 |
| General forecasting | Regularly provide products or services |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Regularly provide products or services |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Plan to provide before December 2025 |
| Marine and ocean services | Regularly provide products or services |
| Research | Plan to provide before December 2025 |
| Community awareness / Public education and outreach / traditional knowledge | Regularly provide products or services |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Regularly provide products or services |
| Training | Plan to provide before December 2025 |
| Other Support Functions | Do not currently provide |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 2 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 1 |
| Observations | 1 |
| Climate Services | 2 |
| Hydrological Services | 0 |
| Communications and computing | 1 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 1 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 2 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 1 |
| General forecasting | 4 |
| Observations | 13 |
| Climate Services | 1 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Hydrological Services | 0 |
| Communications and computing | 1 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 2 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | According to the Public Service Office's post qualification requirement. |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 24 |
| 2013 | 28 |
| 2017 | 29 |
| 2020 | 34 |
| 2026 | 38 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 20 |
| Females | 8 |

| Q14. What is the retirement age of your NMHS | 55 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | more than 50 but less than 60 |
| Meteorological Technicians | between 20 and 30 |
| Climate Services staff | between 20 and 30 |
| Administration / Management Staff | more than 30 but less than 40 |
| Males | more than 30 but less than 40 |
| Females | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | 0 |
| Forecasting Services | 1 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Management of Observation network | 8 |
| Climate Services | 3 |
| Hydrological Services | N/A |
| Communications and computing | 6 |
| Agricultural Meteorology | 9 |
| Marine and ocean services | 4 |
| Research | 5 |
| Environmental monitoring | N/A |
| Management of equipment maintenance and repair | 2 |
| Training | 7 |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |
| Observations | 3 |
| Climate Services | 4 |
| Hydrological Services | |
| Communications and computing | 6 |
| Agricultural Meteorology | |
| Marine and ocean services | 5 |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 2 |
| Training | 7 |
| Other Support functions | N/A |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | 2017 |
| Aviation Forecasting | 2025 |
| General Forecasting | 2017 |
| Observations | 2013 |
| Climate Services | 2013 |
| Communications and Computing | 2020 |
| Agricultural Meteorology | 2025 |
| Marine and ocean services | 2020 |
| Research | 2025 |
| Equipment maintenance and repair | 2020 |
| Training | 2025 |
| Other Support function | 2020 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Yes, we are in the process of filling the vacant positions |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit staff with general degrees and send them away for specialist training |
| Q21. How many of your staff have higher degrees (MSc or above)? | 1 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 5 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Australia<br>New Zealand<br>Pacific Islands<br>Philippines |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 0 |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |

| | |
|---|---|
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Government and Donor |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | 1 in 2 years |
| Meteorological Technicians | 1 in 2 years |
| Marine Specialists | 1 in 2 years |
| Climatogical Technicians | 1 in 2 years |
| Climatologists | 1 in 2 years |
| ICT specialists | 1 in 5 years |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | Two to five years |
| Climate Services | Annually |
| Forecasting Services | Annually |
| Observations and networks | Annually |
| Hydrological Services | Annually |
| Agricultural Meteorological Services | Two to five years |
| Marine and oceanographic services | Annually |
| Research | Two to five years |
| Equipment maintenance and repair | Annually |
| Training | Two to five years |
| Q31. What has been your average annual budget in USD$ over the last five years - | 400,000 |
| Q32. What percentage of the budget is provided by the national government? | More than 75% sourced nationally |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Increase above inflation |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | 50% |
| Operating expenses | 30% |
| Purchase of equipment / infrastructure | 10% |
| Administration | 10% |
| Training | No specific funding set aside |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Niue | Niue Meteorological Service | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Rossyln Pulahetoa-Miliepo | rossy.mitiepo@mail.gov.nu |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Provide as advice or in general terms |
| Marine Forecasting | Provide as advice or in general terms |
| General forecasting | Provide as advice or in general terms |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Do not currently provide |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Do not currently provide |
| Marine and ocean services | Provide as advice or in general terms |
| Research | Provide as advice or in general terms |
| Community awareness / Public education and outreach / traditional knowledge | Regularly provide products or services |
| Environmental monitoring | Regularly provide products or services |
| Equipment maintenance and repair | Regularly provide products or services |
| Training | Regularly provide products or services |
| Other Support functions | Do not currently provide |
| Other Support Functions | Do not currently provide |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 5 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 2 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Yes dependent upon qualification and long term experience |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 6 |
| 2013 | 6 |
| 2017 | 8 |
| 2020 | 13 |
| 2026 | 15 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 3 |
| Females | 5 |

| Q14. What is the retirement age of your NMHS | 60 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Administration / Management Staff | more than 30 but less than 40 |
| Meteorological Technicians | between 20 and 30 |
| Males | more than 40 but less than 50 |
| Females | between 20 and 30 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |
| Management of Observation network | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Climate Services | 1 |
| Hydrological Services | |
| Communications and computing | 2 |
| Agricultural Meteorology | |
| Marine and ocean services | 3 |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 3 |
| Observations | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | 2 |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 1 |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | 2020 |
| General forecasting | 2025 |
| Observations | 2017, 2020 |
| Climate services | 2020 |
| Communications and computing | 2020 |
| Equipment maintenance and repair | 2020 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Lack of staff in climate change, climate services, and staff have to multi task and drop lower priority activities |
| Q20. What is the recruitment process for new staff at the junior professional level? | Will depend upon the ToR for the position and the OTJ training provided |
| Q21. How many of your staff have higher degrees (MSc or above)? | 0 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 1 |
| Q23. In which country(ies) did your staff obtain their highest degree? | New Zealand |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | Lost 2 staff in the last five years |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes but staff would require funding for airfare and per diem |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Donor |

| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
|---|---|
| Meteorologists | 1 in 3 years |

| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
|---|---|
| Meteorological Technicians | 6 in the next 7 years |
| ICT specialists | 1 in 3 years |

| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
|---|---|
| Management and Administration | Annually |
| Climate Services | Annually |
| Forecasting services | Every two years |
| Observations and networks | Two to five years |
| Marine and oceanographic services | Every two years |
| Equipment maintenance and repair | Annually |

| Q31. What has been your average annual budget in USD$ over the last five years - | 150,000 |
|---|---|

| Q32. What percentage of the budget is provided by the national government? | More than 75% nationally |
|---|---|

| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Keep up with inflation |
|---|---|

| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
|---|---|
| Salaries | 70% |
| Operating expenses | 30% |
| Purchase of equipment | Comes from donor support |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Palau | Palau WSO | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Maria Ngemaes | maria.ngemaes@noaa.gov |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Provide as advice or in general terms |
| Tropical Cyclone forecasting | Do not currently provide |
| Aviation Forecasting | Do not currently provide |
| Marine Forecasting | Do not currently provide |
| General forecasting | Do not currently provide |
| Observations | |
| Climate Services | Do not currently provide |
| Hydrological Services | Do not currently provide |
| Communications and computing | Do not currently provide |
| Agricultural Meteorology | |
| Marine and ocean services | Do not currently provide |
| Research | Do not currently provide |
| Community awareness / Public education and outreach / traditional knowledge | Do not currently provide |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Do not currently provide |
| Training | Do not currently provide |
| Other Support functions | Do not currently provide |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 1 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 1 |
| Observations | 6 |
| Climate Services | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 4 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | |
| Tropical Cyclone forecasting | |
| Marine Forecasting | |
| Aviation Forecasting | |
| General forecasting | |
| Observations | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Yes but experience counts as well as merit promotion |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 12 |
| 2013 | |
| 2017 | 13 |
| 2020 | |
| 2026 | 13 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 9 |
| Females | 4 |

| Q14. What is the retirement age of your NMHS | 62 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Administration / Management Staff | more than 30 but less than 40 |
| Meteorologists | more than 30 but less than 40 |
| Meteorological Technicians | more than 30 but less than 40 |
| Males | more than 30 but less than 40 |
| Females | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 4 |
| Management of Observation network | 7 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Climate Services | 3 |
| Hydrological Services | |
| Communications and computing | 6 |
| Agricultural Meteorology | 5 |
| Marine and ocean services | 2 |
| Research | 9 |
| Environmental monitoring | |
| Management of equipment maintenance and repair | 8 |
| Training | 1 |
| Other Support functions | |
| | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 3 |
| Observations | |
| Climate Services | 2 |
| Hydrological Services | |
| Communications and computing | 1 |
| Agricultural Meteorology | |
| Marine and ocean services | 4 |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 5 |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | |
| General forecasting | |
| Observations | |
| Climate services | |
| Communications and computing | |
| Equipment maintenance and repair | |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | No |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit staff with general degrees and send them away for specialized training |
| Q21. How many of your staff have higher degrees (MSc or above)? | 0 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 2 |
| Q23. In which country(ies) did your staff obtain their highest degree? | USA |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 0 |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | NMHS |

| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
|---|---|
| Meteorologists | 2 |
| Meteorological Technicians | |
| ICT specialists | |

| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
|---|---|
| Management and Administration | |
| Climate Services | |
| Forecasting services | Annually |
| Observations and networks | |
| Marine and oceanographic services | |
| Equipment maintenance and repair | |
| Other | Conduct meteorology and related training every year inhouse |

| Q31. What has been your average annual budget in USD$ over the last five years - | 1,600,000 |
|---|---|
| Q32. What percentage of the budget is provided by the national government? | All from the USA |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Stay at current level |

| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
|---|---|
| Salaries | 70% |
| Operating expenses | 30% |
| Purchase of equipment | |
| Other | 25% of 2 staff time spent on training |

# Papua New Guinea

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Papua New Guinea | National Weather Service | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Mr Samuel Maiha | pngnws@daltron.com.pg |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | |
| Tropical Cyclone forecasting | |
| Marine Forecasting | Regularly provide products or services |
| Aviation Forecasting | Regularly provide products or services |
| General forecasting | Regularly provide products or services |
| Observations | |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Regularly provide products or services |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | Regularly provide products or services |
| Research | |
| Community awareness / Public education and outreach / traditional knowledge | |
| Environmental monitoring | |
| Equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 5 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 4 |
| Hydrological Services | 0 |
| Communications and computing | 1 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 24 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 1 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 2 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 10 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 10 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 1 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 1 |
| Training | 1 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | |
| 2013 | 68 |
| 2017 | 62 |
| 2020 | 89 |
| 2026 | 132 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | |
| Females | |

| Q14. What is the retirement age of your NMHS | |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | more than 30 but less than 40 |
| Administration / Management Staff | more than 40 but less than 50 |
| Meteorological Technicians | more than 30 but less than 40 |
| Males | more than 30 but less than 40 |
| Females | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 2 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Management of Observation network | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | 1 |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | |
| Other Support functions | |
| | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |
| Observations | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | 1 |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 1 |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | |
| General forecasting | |
| Observations | |
| Climate services | |
| Communications and computing | |
| Equipment maintenance and repair | |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Shortage in aviation, weather forecasts for disaster preparedness and response, climate services for climate variability and change |
| Q20. What is the recruitment process for new staff at the junior professional level? | |
| Q21. How many of your staff have higher degrees (MSc or above)? | 4 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 10 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Australia<br>New Zealand<br>United Kingdom<br>India<br>Egypt |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 1 in the last five years |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |

| | |
|---|---|
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | |
| Meteorological Technicians | |
| ICT specialists | |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | Every second year |
| Aviation forecasting | Every second year |
| Climate Services | Every second year |
| Forecasting services | Every second year |
| Observations and networks | Every second year |
| Marine and oceanographic services | Every second year |
| Equipment maintenance and repair | Every second year |
| Q31. What has been your average annual budget in USD$ over the last five years - | 200,000 |
| Q32. What percentage of the budget is provided by the national government? | More than 75% nationally |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Increase above inflation |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | 88% |
| Operating expenses | 11.9% |
| Purchase of equipment | 7% or whatever donor support is available |
| Training | 0% from regular budget but occasionally some from donor funds |
| Other | Donor support goes preferentially to the Pacific, not PNG. Would prefer to do the BIP-M / BIP-MT in Port Moresby |

*Survey Responses*

# Republic of the Marshall Islands

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Republic of the Marshall Islands | Majuro WSO | English | Senior Manager, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Reginald White | reginald.white@noaa.gov |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Provide as advice or in general terms |
| Tropical Cyclone forecasting | Do not currently provide |
| Marine Forecasting | Do not currently provide |
| Aviation Forecasting | Do not currently provide |
| General forecasting | Provide as advice or in general terms |
| Observations | Regularly provide products or services |
| Climate Services | Provide as advice or in general terms |
| Hydrological Services | Do not currently provide |
| Communications and computing | Provide as advice or in general terms |
| Agricultural Meteorology | Do not currently provide |
| Marine and ocean services | Provide as advice or in general terms |
| Research | Do not currently provide |
| Community awareness / Public education and outreach / traditional knowledge | Provide as advice or in general terms |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Provide as advice or in general terms |
| Training | Provide as advice or in general terms |
| Other Support functions | Provide as advice or in general terms |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 4 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 1 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 2 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 1 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Yes but seniority and experience also count |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 10 |
| 2013 | 10 |
| 2017 | 9 |
| 2020 | 13 |
| 2026 | 13 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 9 |
| Females | 0 |

| Q14. What is the retirement age of your NMHS | 65 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | more than 40 but less than 50 |
| Meteorological Technicians | more than 40 but less than 50 |
| Males | more than 40 but less than 50 |
| Females | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |
| Management of Observation network | 3 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | 2 |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | |
| Other Support functions | |
| | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |
| Observations and network management | 3 |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | 4 |
| Agricultural Meteorology | |
| Marine and ocean services | 2 |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | 2020 |
| General forecasting | |
| Observations | 2020 |
| Climate services | |
| Communications and computing | |
| Equipment maintenance and repair | 2020 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Yes, more overtime, tiredness and frustration. Missed deadline |
| Q20. What is the recruitment process for new staff at the junior professional level? | Must recruit staff who are already qualified and trained for the job |
| Q21. How many of your staff have higher degrees (MSc or above)? | 0 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 1 |
| Q23. In which country(ies) did your staff obtain their highest degree? | USA |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 0 |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | NMHS |

| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
|---|---|
| Meteorologists | 6 staff need to be upgraded via BIP-M to meteorologists |
| Meteorological Technicians | |
| ICT specialists | |

| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
|---|---|
| Management and Administration | |
| Climate Services | |
| Forecasting services | Annually |
| Observations and networks | |
| Marine and oceanographic services | |
| Equipment maintenance and repair | |
| Other | Annually to get every one up to speed, 2 to 5 years after that |

| Q31. What has been your average annual budget in USD$ over the last five years - | 700,000 |
|---|---|
| Q32. What percentage of the budget is provided by the national government? | All sourced nationally |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Keep up with inflation |

| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
|---|---|
| Salaries | 60% |
| Operating expenses | 40% |
| Purchase of equipment | |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Samoa | Samoa Meteorology Division | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Mulipola Ausetalia Titimaea | ausetalia.titimaea@mnre.gov.ws |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Regularly provide products or services |
| Marine Forecasting | Regularly provide products or services |
| Aviation Forecasting | Plan to provide before December 2025 |
| General forecasting | Regularly provide products or services |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Do not currently provide |
| Communications and computing | Plan to provide before December 2020 |
| Agricultural Meteorology | Plan to provide before December 2020 |
| Marine and ocean services | Plan to provide before December 2020 |
| Research | Regularly provide products or services |
| Community awareness / Public education and outreach / traditional knowledge | Plan to provide before December 2020 |
| Environmental monitoring | Plan to provide before December 2020 |
| Equipment maintenance and repair | Regularly provide products or services |
| Training | Plan to provide before December 2025 |
| Other Support functions | Regularly provide products or services |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 2 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 2 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 3 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 2 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 10 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 4 |
| Hydrological Services | 0 |
| Communications and computing | 2 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 2 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 2 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 6 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Yes we have degreed and non degreed staff providing forecasting but paid different amounts |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 52 |
| 2013 | 52 |
| 2017 | 52 |
| 2020 | 60 |
| 2026 | 65 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 47 |
| Females | 5 |

| Q14. What is the retirement age of your NMHS | 55 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | between 20 and 30 |
| Administration / Management Staff | between 20 and 30 |
| Meteorological Technicians | More than 30 but less than 40 |
| Climate services | between 20 and 30 |
| Males | More than 30 but less than 40 |
| Females | More than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 2 |
| Management of Observation network | 7 |
| Climate Services | 3 |
| Hydrological Services | |
| Communications and computing | 1 |
| Agricultural Meteorology | 6 |
| Marine and ocean services | 4 |
| Research | 8 |
| Environmental monitoring | |
| Management of equipment maintenance and repair | 5 |
| Training | 9 |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |
| Observations and network management | 2 |
| Climate Services | 4 |
| Hydrological Services | |
| Communications and computing | 1 |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 3 |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | |
| Aviation forecasting | 2017 |
| Tropical Forecasting | 2017 |
| General forecasting | |
| Observations | |
| Climate services | 2017 |
| Communications and computing | |
| Equipment maintenance and repair | 2017 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Need extra staff to increase effective service delivery. Have requested additional numbers from the government |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit staff with general degrees and send them away for specialist training |
| Q21. How many of your staff have higher degrees (MSc or above)? | 4 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 9 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Australia<br>China<br>New Zealand<br>Pacific Islands<br>United Kingdom |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 10% |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |

| | |
|---|---|
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | In special circumstances official approval possible, otherwise it is up to the supervisor |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Donor |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | 1 in 3 years |
| Meteorological Technicians | 1 in 3 years |
| Climatologists | 1 in 3 years |
| Climatological Technicians | 1 in 3 years |
| ICT specialists | 1 in 2 years |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | Two to five years |
| Climate Services | Every two years |
| Forecasting services | Every two years |
| Agricultural Meteorological Services | Two to five years |
| Observations and networks | Two to five years |
| Marine and oceanographic services | Two to five years |
| Equipment maintenance and repair | Two to five years |
| Research | Two to five years |
| Training | Two to five years |
| Community awareness, working with the public | Two to five years |
| Q31. What has been your average annual budget in USD$ over the last five years - | 1,300,000 |
| Q32. What percentage of the budget is provided by the national government? | Approximately 50% from national funds |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Increase above inflation |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | 600,000 |
| Operating expenses | 200,000 |
| Purchase of equipment | 100,000 |
| Other (activities) | 400,000 |

# Solomon Islands (Hydrology)

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Solomon Islands | Water Resource Management Division, Ministry of Mines, Energy and Rural Electrification | English | Director, of the Water Resources Division |

| Q5. Name | Q6. Email Address |
|---|---|
| Charlie Bepapa | cbepapa@mmere.gov.sb |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | |
| Tropical Cyclone forecasting | |
| Marine Forecasting | |
| General forecasting | |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Regularly provide products or services |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Provide as advice or in general terms |
| Marine and ocean services | |
| Research | Provide as advice or in general terms |
| Community awareness / Public education and outreach / traditional knowledge | Provide as advice or in general terms |
| Environmental monitoring | Regularly provide products or services |
| Equipment maintenance and repair | |
| Training | Provide as advice or in general terms |
| Other Support functions | Regularly provide products or services |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 2 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 2 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 1 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 0 |
| Hydrological Services | 3 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Yes dependent upon position and qualification |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | |
| 2013 | 8 |
| 2017 | 8 |
| 2020 | 18 |
| 2026 | |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 8 |
| Females | 0 |

| Q14. What is the retirement age of your NMHS | 55 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Administration / Management Staff | more than 50 but less than 60 |
| Hydrologists | more than 30 but less than 40 |
| Hydrological Technicians | between 20 and 30 |
| Males | |
| Females | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Management of Observation network | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |
| Observations | 2 |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Hydrological Services | 2020 |
| Other Support Functions | 2020 |
| Observations | |
| Climate services | |
| Communications and computing | |
| Equipment maintenance and repair | |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | No funds to support additional staff |
| Q20. What is the recruitment process for new staff at the junior professional level? | Depends upon the position. We can require a degree or without and train them later |
| Q21. How many of your staff have higher degrees (MSc or above)? | 2 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 2 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Australia<br>New Zealand<br>Pacific Islands |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |

| | |
|---|---|
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | National Government |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Hydrologists | 1 |
| Hydrological Technicians | 2 to be trained in 2019 |
| ICT specialists | |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Hydrological Services | Annually |
| Climate Services | |
| Forecasting services | |
| Observations and networks | |
| Marine and oceanographic services | |
| Equipment maintenance and repair | |
| Q31. What has been your average annual budget in USD$ over the last five years - | 125,000 |
| Q32. What percentage of the budget is provided by the national government? | All sourced nationally |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Stay at the current level |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | 50,000 |
| Operating expenses | 60,000 |
| Purchase of equipment | 10,000 |
| Other | 5,000 |

# Solomon Islands (Meteorology)

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Solomon Islands | Solomon Islands Meteorological Institution | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| David Hiriasia | david.hiba@met.gov.sb |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Regularly provide products or services |
| Marine Forecasting | Regularly provide products or services |
| Aviation Forecasting | Regularly provide products or services |
| General forecasting | Regularly provide products or services |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Do not currently provide |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Provide as advice or in general terms |
| Marine and ocean services | Plan to provide before December 2025 |
| Research | Regularly provide products or services |
| Community awareness / Public education and outreach / traditional knowledge | Provide as advice or in general terms |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Regularly provide products or services |
| Training | Provide as advice or in general terms |
| Other Support functions | Regularly provide products or services |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic  Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 3 |
| Observations | 0 |
| Climate Services | 3 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 2 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Administration and management | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 10 |
| Observations | 70 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 5 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Depends upon circumstances |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | |
| 2013 | 80 |
| 2017 | 115 |
| 2020 | 125 |
| 2026 | |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 110 |
| Females | 5 |

| Q14. What is the retirement age of your NMHS | 55 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Administration / Management Staff | more than 30 but less than 40 |
| Climate Services Staff | more than 30 but less than 40 |
| Meteorologists | more than 30 but less than 40 |
| Meteorological Technicians | more than 30 but less than 40 |

| Q15. Average age of NMHS staff | |
|---|---|
| Males | |
| Females | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |
| Management of Observation network | 8 |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | 1 |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |
| Observations | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | 1 |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | |
| General forecasting | |
| Observations | |
| Climate services | |
| Communications and computing | |
| Marine and ocean services | 2020 |
| Equipment maintenance and repair | |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | We cannot expand our services (for example, weather forecasting for surfing, tourism, specific products like rainfall forecasting for mining) |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit staff with general degrees and send them away for training |
| Q21. How many of your staff have higher degrees (MSc or above)? | 2 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 1 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Australia<br>Pacific Islands |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | None |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |

| | |
|---|---|
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Donor |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | 0 |
| Meteorological Technicians | 4 |
| ICT specialists | 1 |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | |
| Climate Services | |
| Forecasting services | Annually |
| Observations and networks | Annually |
| Marine and oceanographic services | |
| Equipment maintenance and repair | |
| Q31. What has been your average annual budget in USD$ over the last five years - | 1,000,000 |
| Q32. What percentage of the budget is provided by the national government? | Approximately 50% from national funds |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Stay at the current level |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | 80% of national funds |
| Operating expenses | |
| Purchase of equipment | |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Tokelau | Ministry of Climate Change | English | Officer in department overseeing NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Dr Paula Faiva | paula.faiva@tokelau.org.nz |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Provide as advice or in general terms |
| Tropical Cyclone forecasting | Provide as advice or in general terms |
| Aviation Forecasting | Do not currently provide |
| Marine Forecasting | Provide as advice or in general terms |
| General forecasting | Regularly provide products or services |
| Observations | Do not currently provide |
| Climate Services | Do not currently provide |
| Hydrological Services | Do not currently provide |
| Communications and computing | Provide as advice or in general terms |
| Agricultural Meteorology | Do not currently provide |
| Marine and ocean services | Do not currently provide |
| Research | Do not currently provide |
| Community awareness / Public education and outreach / traditional knowledge | Provide as advice or in general terms |
| Environmental monitoring | Provide as advice or in general terms |
| Equipment maintenance and repair | Do not currently provide |
| Training | Do not currently provide |
| Other Support functions | Do not currently provide |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 2 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 2 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 1 |
| Research | 0 |
| Environmental monitoring | 2 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | Yes dependent upon qualification and experience |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 5 |
| 2013 | 5 |
| 2017 | 5 |
| 2020 | 10 |
| 2026 | 15 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 2 |
| Females | 3 |

| Q14. What is the retirement age of your NMHS | 60 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Administration / Management Staff | more than 50 but less than 60 |
| Meteorological Technicians | |
| Males | more than 50 but less than 60 |
| Females | more than 50 but less than 60 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Management of Observation network | 2 |
| Climate Services | 7 |
| Hydrological Services | |
| Communications and computing | 3 |
| Agricultural Meteorology | |
| Marine and ocean services | 6 |
| Research | 8 |
| Environmental monitoring | |
| Management of equipment maintenance and repair | 5 |
| Training | 4 |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 1 |
| Observations | 2 |
| Climate Services | 7 |
| Hydrological Services | |
| Communications and computing | 3 |
| Agricultural Meteorology | 8 |
| Marine and ocean services | 6 |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 4 |
| Training | 5 |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | 2017 |
| Tropical Cyclone Forecasting | 2020 |
| Aviation Forecasting | 2020 |
| General forecasting | 2017 |
| Observations | 2017 |
| Climate services | 2025 |
| Hydrological Services | 2025 |
| Communications and computing | 2017 |
| Agricultural meteorological services | 2025 |
| Marine and Ocean Services | 2020 |
| Research | 2025 |
| Environmental monitoring | 2017 |
| Equipment maintenance and repair | 2017 |
| Training | 2017 |
| Other support | 2017 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Yes |
| Q20. What is the recruitment process for new staff at the junior professional level? | Must recruit staff who are already qualified and trained for the role |
| Q21. How many of your staff have higher degrees (MSc or above)? | 0 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 5 |
| Q23. In which country(ies) did your staff obtain their highest degree? | New Zealand<br>Pacific Islands |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | Lost 2 staff in the last five years |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | No |

| | |
|---|---|
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | No |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | No |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Donor |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | 2 |
| Meteorological Technicians | 2 |
| Hydrologists | 0 |
| Hydrological Technicians | 0 |
| Climatologists | 1 |
| Climatological Technicians | 2 |
| Marine Specialists | 2 |
| ICT specialists | 2 |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | Annually |
| Climate Services | More than ten years |
| Forecasting services | Two to five years |
| Observations and networks | Annually |
| Hydrological Services | More than ten years |
| Agricultural Meteorological Services | More than ten years |
| Marine and oceanographic services | Annually |
| Research | Two to five years |
| Equipment maintenance and repair | Annually |
| Training | Annually |
| Q31. What has been your average annual budget in USD$ over the last five years - | Classified |
| Q32. What percentage of the budget is provided by the national government? | Classified |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Classified |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | Classified |
| Operating expenses | Classified |
| Purchase of equipment | Classified |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Tonga | Tonga Meteorological Service | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Ofa Faanunu | ofaf@met.gov.to |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Regularly provide products or services |
| Aviation Forecasting | Plan to provide before December 2025 |
| Marine Forecasting | Regularly provide products or services |
| General forecasting | Regularly provide products or services |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Do not currently provide |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Regularly provide products or services |
| Marine and ocean services | Regularly provide products or services |
| Research | Plan to provide before December 2025 |
| Community awareness / Public education and outreach / traditional knowledge | Provide as advice or in general terms |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Regularly provide products or services |
| Training | Regularly provide products or services |
| Other Support functions | Do not currently provide |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 2 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 3 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 1 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 2 |
| Observations | 14 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 2 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 2 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 1 |
| Training | 0 |
| Other Support functions | 1 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | There is a minimum qualification for each position |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 25 |
| 2013 | 27 |
| 2017 | 30 |
| 2020 | 36 |
| 2026 | 40 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 26 |
| Females | 4 |

| Q14. What is the retirement age of your NMHS | 60 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Administration / Management Staff | more than 40 but less than 50 |
| Meteorologists | more than 30 but less than 40 |
| Meteorological Technicians | more than 30 but less than 40 |
| Climate Services Staff | more than 40 but less than 50 |
| Males | more than 30 but less than 40 |
| Females | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Forecasting Services | |
| Management of Observation network | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | 2 |
| Observations | 1 |
| Climate Services | 4 |
| Hydrological Services | |
| Communications and computing | 5 |
| Agricultural Meteorology | 8 |
| Marine and ocean services | 7 |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 3 |
| Training | 6 |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Administration and management | 2011 |
| Tropical Cyclone forecasting | 2020 |
| Aviation forecasting | 2020 |
| General forecasting | 2020 |
| Observations | 2013 |
| Climate services | 2020 |
| Communications and computing | 2020 |
| Agricultural meteorological services | 2020 |
| Marine and ocean services | 2020 |
| Research | 2020 |
| Equipment maintenance and repair | 2020 |
| Training | 2020 |
| Other Support Functions | 2020 |
| Training | 2017 |
| Other support | 2017 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Yes, staff overload result is poor job performance |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit staff with general degrees and send them away for specialist training |
| Q21. How many of your staff have higher degrees (MSc or above)? | 2 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 4 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Pacific Islands |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | None |

| | |
|---|---|
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Donor and some NMHS support |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | 2 |
| Meteorological Technicians | 2 |
| Climatologists | 1 |
| Climatological Technicians | 1 |
| Marine Specialists | 1 |
| ICT specialists | 1 |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | Every two years |
| Climate Services | Annually |
| Forecasting services | Annually |
| Observations and networks | Annually |
| Agricultural Meteorological Services | Every two years |
| Marine and oceanographic services | Annually |
| Research | Every two years |
| Equipment maintenance and repair | Annually |
| Training | Annually |
| Q31. What has been your average annual budget in USD$ over the last five years - | 1,000,000 |
| Q32. What percentage of the budget is provided by the national government? | Approximately 50% from national funds |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Keep up with inflation |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | 80% |
| Operating expenses | 10% |
| Purchase of equipment | 5% |
| Administration | 2% |
| Training | 3% |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Tuvalu | Tuvalu Meteorological Service | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Tauala Kalea | tauala.k@gmail.com |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Provide as advice or in general terms |
| Marine Forecasting | Regularly provide products or services |
| Aviation Forecasting | Do not currently provide |
| General forecasting | Regularly provide products or services |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Do not currently provide |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Provide as advice or in general terms |
| Marine and ocean services | Provide as advice or in general terms |
| Research | Provide as advice or in general terms |
| Community awareness / Public education and outreach / traditional knowledge | Regularly provide products or services |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Regularly provide products or services |
| Training | Regularly provide products or services |
| Other Support functions | |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 1 |
| Tropical Cyclone forecasting | 0 |
| Marine and Oceanographic Services | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 1 |
| Observations | 2 |
| Climate Services | 1 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 1 |
| Training | 0 |
| Other Support functions | 0 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 2 |
| Observations | 7 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Climate Services | 2 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 2 |
| Training | 0 |
| Other Support functions | 0 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | No |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 16 |
| 2013 | 16 |
| 2017 | 18 |
| 2020 | 20 |
| 2026 | 25 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 14 |
| Females | 4 |

| Q14. What is the retirement age of your NMHS | 55 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Administration / Management Staff | more than 40 but less than 50 |
| Meteorological Technicians | between 20 and 30 |
| Meteorologists | more than 40 but less than 50 |
| Climate Services Staff | more than 30 but less than 40 |
| Males | |
| Females | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Forecasting Services | 6 |
| Management of Observation network | |
| Climate Services | 2 |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | 3 |
| Research | |
| Environmental monitoring | |
| Management of equipment maintenance and repair | |
| Training | 4 |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |
| Observations | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | 2 |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Tropical Cyclone Forecasting | 2020 |
| Marine and ocean services | 2020 |
| Research | 2020 |
| Training | 2020 |
| Communications and computing | 2020 |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | Yes |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit but depends on the budget (some current project can support climate staff and government can later support them to continue) |
| Q21. How many of your staff have higher degrees (MSc or above)? | 0 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 5 |
| Q23. In which country(ies) did your staff obtain their highest degree? | New Zealand<br>Pacific Islands |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | 15% |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | Yes |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | Yes |

| | |
|---|---|
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Donor and possible NMHS support |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | |
| Meteorological Technicians | |
| ICT specialists | |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | Every two years |
| Climate Services | Annually |
| Forecasting services | Annually |
| Observations and networks | Annually |
| Marine and oceanographic services | Annually |
| Research | Annually |
| Equipment maintenance and repair | Annually |
| Training | Annually |
| Q31. What has been your average annual budget in USD$ over the last five years - | 200,000 |
| Q32. What percentage of the budget is provided by the national government? | All funded by government but can bid for grant funds from donors |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Stay at the current level |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | 60% |
| Operating expenses | 20% |
| Purchase of equipment | 10% |
| Administration | 9% |
| Training | 1% |

| Q1. Country | Q2. Name of Institution | Q3. Main Training Language | Q4. What is your job role? |
|---|---|---|---|
| Vanuatu | Vanuatu Meteorology and Geo-Hazard Department | English | Director, NMHS |

| Q5. Name | Q6. Email Address |
|---|---|
| Esline Garaebiti | gesline.@vanuatu.gov.au |

| Q7. Please nominate the service areas your NMHS addresses or intends to address under the PIMS action plan | |
|---|---|
| Administration and management | Regularly provide products or services |
| Tropical Cyclone forecasting | Regularly provide products or services |
| Aviation Forecasting | Regularly provide products or services |
| Marine Forecasting | Regularly provide products or services |
| General forecasting | Regularly provide products or services |
| Observations | Regularly provide products or services |
| Climate Services | Regularly provide products or services |
| Hydrological Services | Plan to provide before December 2020 |
| Communications and computing | Regularly provide products or services |
| Agricultural Meteorology | Provide as advice or in general terms |
| Marine and ocean services | Regularly provide products or services |
| Research | Regularly provide products or services |
| Community awareness / Public education and outreach / traditional knowledge | Regularly provide products or services |
| Environmental monitoring | Do not currently provide |
| Equipment maintenance and repair | Regularly provide products or services |
| Training | Regularly provide products or services |
| Other Support functions | Regularly provide products or services |
| | |

| Q8. Please provide professional (degreed) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 6 |
| Tropical Cyclone forecasting | 2 |
| Marine and Oceanographic Services | 1 |
| Aviation Forecasting | 1 |
| General forecasting | 1 |
| Observations | 1 |
| Climate Services | 1 |
| Hydrological Services | 0 |
| Communications and computing | 2 |
| Agricultural Meteorology | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 7 |
| Training | 0 |
| Other Support functions | 6 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 5 |
| Tropical Cyclone forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 2 |

| Q9. Please provide technical (post secondary qualification) staffing numbers for the various service areas. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Observations | 13 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 7 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 7 |
| Training | 1 |
| Other Support functions | 1 |

| Q10. Please provide staffing numbers for the various service areas for staff not covered by the previous two questions. If a staff member works in more than one area only count them in their main area. | |
|---|---|
| Administration and management | 0 |
| Tropical Cyclone forecasting | 0 |
| Marine Forecasting | 0 |
| Aviation Forecasting | 0 |
| General forecasting | 0 |
| Observations | 0 |
| Climate Services | 0 |
| Hydrological Services | 0 |
| Communications and computing | 0 |
| Agricultural Meteorology | 0 |
| Marine and ocean services | 0 |
| Research | 0 |
| Environmental monitoring | 0 |
| Equipment maintenance and repair | 0 |
| Training | 0 |
| Other Support functions | 0 |

| Q11. Do staffing classifications / pay rates depend upon their academic qualifications. If Yes (please provide brief explanation): | N/A |
|---|---|

| Q12. Total staff numbers with time, best estimate for coming years | |
|---|---|
| 2011 | 35 |
| 2013 | 43 |
| 2017 | 48 |
| 2020 | 60 |
| 2026 | 80 |

| Q13. Gender breakdown in your service | |
|---|---|
| Males | 34 |
| Females | 14 |

| Q14. What is the retirement age of your NMHS | 55 |
|---|---|

| Q15. Average age of NMHS staff | |
|---|---|
| Meteorologists | more than 30 but less than 40 |
| Meteorological Technicians | between 20 and 30 |
| Climate Services staff | more than 30 but less than 40 |
| Administration / Management Staff | more than 30 but less than 40 |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |

| Q16. Which professional skill areas is your service most in need of? | |
|---|---|
| Management of Observation network | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | 1 |
| Marine and ocean services | |
| Research | 4 |
| Environmental monitoring | |
| Management of equipment maintenance and repair | 8 |
| Training | |
| Other Support functions | |

| Q17. Which technical skill areas is your service most in need of? | |
|---|---|
| Administration and management | |
| Forecasting Services | |
| Observations | |
| Climate Services | |
| Hydrological Services | |
| Communications and computing | |
| Agricultural Meteorology | |
| Marine and ocean services | |
| Research | |
| Environmental monitoring | |
| Equipment maintenance and repair | |
| Training | |
| Other Support functions | |

| Q18. Nominate in which service areas staffing has increased in, or is expected to increase in, | |
|---|---|
| Tropical Cyclone Forecasting | |
| Marine and ocean services | |
| Research | |
| Training | |
| Communications and computing | |

| | |
|---|---|
| Q19. Are your staffing numbers less than the approved staffing plan for your organisation? If yes, why and what impact is it having on your service delivery: | No evaluation of the impact has been carried out |
| Q20. What is the recruitment process for new staff at the junior professional level? | We can recruit staff with general degrees and send them away for specialist training |
| Q21. How many of your staff have higher degrees (MSc or above)? | 4 |
| Q22. How many of your staff have bachelor degrees as their highest academic qualification? | 8 |
| Q23. In which country(ies) did your staff obtain their highest degree? | Australia<br>China<br>New Zealand<br>Pacific Islands<br>Philippines<br>United Kingdom<br>USA |
| Q24. Over the last five years approximately what percentage of your degreed and higher degree staff have you lost annually? | Lost 3 staff annually |
| Q25. Do you believe that a Pacific Island RTC should offer distance education courses? | No |
| Q26. If the RTC offered distance learning courses would your staff be eligible for study time during working hours to undertake courses? | Yes |

| | |
|---|---|
| Q27. If the RTC offered distance learning courses that required some residential component (for example one week a semester) would your staff be eligible for study leave to undertake the courses? | No |
| Q28. If the distance learning course required a residential component, who would fund your staff members flights and living expenses? | Donor |
| Q29. On average, how many new staff would you expect to require training at the RTC on an annual basis? (if less than one / year state, for example 1 every five years or similar) | |
| Meteorologists | |
| Meteorological Technicians | |
| ICT specialists | |
| Q30. What frequency do you anticipate requiring for update training of perhaps one to two weeks for the following service areas | |
| Management and Administration | Annually |
| Climate Services | Annually |
| Forecasting services | Annually |
| Observations and networks | Annually |
| Hydrological Services | Annually |
| Agricultural Meteorological Services | Annually |
| Marine and oceanographic services | Annually |
| Research | Annually |
| Equipment maintenance and repair | Annually |
| Training | Annually |
| Q31. What has been your average annual budget in USD$ over the last five years - | 1,100,000 |
| Q32. What percentage of the budget is provided by the national government? | Approximately 50% from national funds |
| Q33. What is the nationally sourced component of your budget expected to do over the next five years | Keep up with inflation |
| Q34. If possible please provide a rough breakdown in USD$ of your budget into the following broad categories | |
| Salaries | |
| Operating expenses | |
| Purchase of equipment | |
| Training | Budget for training is very limited |

# ANNEX 3

## Glossary of Abbreviations and Terms

# *Glossary of Abbreviations and Terms*

| | |
|---|---|
| **AMDAR** | Aeronautical Meteorological Data Relay |
| **AMF** | Aeronautical Meteorological Forecaster |
| **AMO** | Aeronautical Meteorological Officer |
| **BIP-M** | Basic Instruction Package for Meteorologists (also BIP/M) |
| **BIP-MT** | Basic Instruction Package for Meteorological Technicians (also BIP/MT) |
| **BOM** | Australian Bureau of Meteorology |
| **CDMS** | Climate Data Management System |
| **CIMH** | Caribbean Institute for Meteorology and Hydrology |
| **CLEWS** | Climate Early Warning System |
| **CliCom** | System of hardware and software built in the 1980s to meet World Meteorological Organisation requirements for climate data storage, which has now been replaced by more modern systems. |
| **CliDE** | Climate Data for the Environment – a climate data management system developed by the Australian Bureau of Meteorology which is used in 18 Pacific Island countries to archive climate data |
| **CliDEsc** | CliDE services client – the product generator software developed by NIWA to analyse and visualise climate data as time series, tables and maps. It links to CliDE and other database platforms and web services |
| **COSPPac** | Climate and Ocean Support Program in the Pacific |
| **ENSO** | El Nino Southern Oscillation |
| **EWS** | Early Warning System |
| **FIR** | Flight Information Region |
| **FNU** | Fiji National University |
| **GAW** | Global Atmospheric Watch Programme |
| **GEF** | Global Environment Facility |
| **GEO** | Group on Earth Observations |
| **GEOSS** | Global Earth Observation System of Systems |
| **GFCS** | Global Framework for Climate Services |
| **GHG** | Green House Gas |
| **GIFS** | Global Interactive Forecast System |
| **GIS** | Geographic Information System |
| **ICAO** | International Civil Aviation Organization |
| **IOC** | Intergovernmental Oceanographic Commission |
| **ITCZ** | Intertropical Convergence Zone |
| **ITIC** | International Tsunami Information Center |
| **JCOMM** | Joint Commission for Oceanography and Marine Meteorology |
| **JICA** | Japan International Cooperation Agency |
| **KMS** | Kiribati Meteorological Service |
| **KPI** | Key Performance Indicator |
| **NDMO** | National Disaster Management Office |
| **METAR** | A weather observation coded for use by aviation |

| | |
|---|---|
| **M&E** | Monitoring and Evaluation |
| **MHEWS** | Multi-Hazard Early Warning System |
| **MIC** | Meteorologist-In-Charge |
| **MJO** | Madden-Julian Oscillation |
| **MSNZ** | Meteorological Service of New Zealand Ltd (Metservice) |
| **MTSAT** | Multifunctional Transport Satellites |
| **NCEA** | New Zealand Certificate of Educational Achievement |
| **NIWA** | National Institute of Water and Atmospheric Research (New Zealand) |
| **NMHS** | National Meteorological and Hydrological Service |
| **NMS** | National Meteorological Service |
| **NOAA** | National Oceanographic and Atmospheric Administration (USA) |
| **OIC** | Officer-In-Charge |
| **Pacific HYCOS** | Pacific Hydrological Cycle Observing system |
| **PAGASA** | Philippine Atmospheric Geophysical and Astronomical Services Administration |
| **PASO** | Pacific Aviation Safety Office |
| **PICTS** | Pacific Island Countries and Territories |
| **PIMS** | Pacific Islands Meteorological Strategy 2012 – 2021 |
| **PKO** | Pacific Key Outcomes |
| **PNG NWS** | Papua New Guinea National Weather Service |
| **PMC** | Pacific Meteorological Council |
| **PMDP** | Pacific Meteorological Desk Partnership |
| **PR** | Permanent Representative to the WMO |
| **PSIDS** | Pacific Small Island Developing States |
| **PTWC** | Pacific Tsunami Warning Center |
| **PTWS** | Pacific Tsunami Warning and Mitigation System |
| **QMS** | Quality Management System |
| **RA V** | WMO Regional Association five (South-West Pacific and South East Asia) |
| **RESPAC** | The Disaster Resilience in the Pacific project |
| **RCC** | Regional Climate Center |
| **RIC** | Regional Instrument Center |
| **RMI** | Republic of the Marshall Islands |
| **RSMC** | Regional Specialized Meteorological Centre |
| **SIGMET** | Significant Meteorological Information message for aviation use |
| **SIMS** | Solomon Islands Meteorological Service |
| **SIS** | Smaller Island States |
| **SMD** | Samoa Meteorology Division |
| **SOPAC** | Applied Geoscience and Technology division of SPC |
| **SPC** | Secretariat of the Pacific Community |
| **SPREP** | Secretariat of the Pacific Regional Environment Programme |
| **SPECI** | 'Special' weather report for use by aviation |
| **TAF** | Terminal Aerodrome Forecast for aviation |
| **UG** | University of Guam |

| | |
|---|---|
| **UH** | University of Hawaii |
| **UN** | United Nations |
| **UNDP** | United Nations Development Programme |
| **UNESCO** | United Nations Educational, Scientific, and Cultural Organization |
| **UNFCC** | United Nations Framework for the Convention on Climate Change |
| **UPNG** | University of Papua New Guinea |
| **USA** | United States of America (also US) |
| **USP** | University of the South Pacific |
| **UV** | Ultra Violet |
| **VMGD** | Vanuatu Meteorology and Geo-Hazards Division |
| **WIGOS** | WMO Integrated Global Observing System |
| **WIS** | WMO Information System |
| **WLS** | Water Level Sensor |
| **WMO** | World Meteorological Organization |
| **WWIS** | World Weather Information System |

Feasibility Study for a Pacific Based WMO Regional Training Centre

# PART 2:
# RECOMMENDATIONS AND IMPLEMENTATION PLAN

Dr Geoff Love, Dr Maria Mamaeva and Mr Jeff Wilson

*Photo credit: UNDP/Dr Geoff Love*

# *Acknowledgements*

The Study Team thanks the United Nations Development Programme (UNDP) through its RESPAC programme for its generous support in funding and providing the logistic arrangements for the Study. The Team especially wishes to thank Mr Navin Bhan and Mr Noud Leender for their advice and feedback on the two reports prepared by the Team. The Team also acknowledges and thanks all the NMHS staff, academic institutions, donors working in the Pacific and meteorological and hydrological service users who provided us their time, a great deal of valuable information and much well considered advice. A detailed list in Annex Nine summarizes the Team's interactions during this Study.

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# Table of Contents

# *Table of Contents*

# *Executive Summary*

This document is the second report of a study commissioned by UNDP under the RESPAC project to examine the feasibility of establishing a WMO recognised Regional Training Centre (RTC) in the Pacific. The purpose of the RTC would be to service the education and training needs of the National Meteorological and Hydrological Services (NMHSs) in the fifteen countries1 that make up the Pacific Meteorological Council (PMC) and the Pacific Islands Ministers Meeting on Meteorology (PIMMM). The study was requested by the PIMMM in 2015 as part of the Nuku'alofa Declaration.

The first report of this Study identified the education and training needs of the 15 NMHSs and their prospective student numbers for the next five to seven years. The Directors of the 15 NMHSs prioritized operational forecasting, climate services, marine and ocean services, ICT and equipment maintenance and repair for courses to be provided by the RTC. Additionally, accreditation of the courses offered by the RTC, particularly for longer courses for staff in the technician category was seen as a high priority.

**This second report of this Study investigates the following topics related to the feasibility of a Pacific based RTC:**

- What is an RTC (Chapter 3);
- What institutions are currently providing education and training in the field of weather, water and climate (Chapter 4);
- Alternative models for a Pacific RTC (Chapter 5);
- The institutions in the region that could partner in an RTC (Chapter 6);
- The benefits and risks to stakeholders of having a Pacific based RTC (Chapter 7);
- The financial case for an RTC (Chapter 8);
- The potential governance arrangements for an RTC (Chapter 9);
- The overall risks associated with developing and running an RTC (Chapter 10), and
- The steps needed to implement an RTC.

The investigations suggest that the Fiji Meteorological Service and the University of the South Pacific along with the Pacific Climate Change Centre could form the core of the RTC. However, from a risk management perspective, it would be desirable for FMS and USP to partner with NOAA's Pacific Island Training Desk and the University of Hawaii until they build the in-house expertise to cover the full range of the BIP-M and the operational training required for forecasting duties, particularly aviation meteorology.

**The Study Team make eleven recommendations for the formation and operation of a Pacific based RTC as well as a set of implementation steps. The recommendations are:**

1. That the PIETR Panel / PMC pursue the creation of a specialist education and training institution in the Pacific to address the education and training demands of the 15 NMHSs.
2. The PMC consider options for creating a small task group responsible for operationalizing the findings of this report.
3. That the stakeholders in the RTC include following institutions in addition to the 15 NMHSs and the students: the Fiji Meteorological Service (FMS), the University of the South Pacific (USP), the Pacific Climate Change Centre (PCCC) and its parent organisation SPREP. Ideally these institutions would either partner or closely liaise with

1 Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of the Marshall Islands, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu

NOAA's Pacific Island Training Desk and the Meteorology Department of the University of Hawaii (UH).

4. FMS and USP partner to develop and deliver a three level accredited BIP-MT course (certificate level 2 for junior (entry level) meteorological technicians, certificate level 4 for middle level meteorological technicians and a diploma level course for the senior level meteorological technician course.
5. USP and FMS continue to build their capacities in terms of teaching staff and training courses while also seeking other university partners such as UH or the University of the West Indies to assist in developing and delivering a BIP-M course for the Pacific that has an operational focus (i.e. providing the knowledge and skills to support the relevant WMO competency framework) and is at a graduate diploma level.
6. FMS to provide in-service operationally focussed courses in weather and hydrology.
7. The PCCC, potentially with support from COSPPac, provide in-service courses in climate data and climate services.
8. That SPREP in coordination with the other prospective partners take the lead in identifying providers for in-service courses covering areas such as leadership, management, project management, occupational health and safety, and grant applications.
9. That the RTC has an oversight board comprising at least one representative from each of the learning institutions, several Directors of the NMHSs, several students (current and recent), the PR of the host country, a representative from the Pacific Met Desk and chaired by the most recent chair of the PMC.
10. A small secretariat or RTC Office is created to ensure that the actions identified by the oversight board are carried out and to provide the day-to-day coordination and liaison with the learning providers and out to the NMHSs and other users.
11. That the PIETR Panel, through the RTC Secretariat, request support from the PacTVET project for the development of the accreditation framework and standards, and for assistance in achieving regional adoption of the accreditation framework and standards

The development and ongoing operation of a WMO Regional Training Centre providing education and training opportunities to the NMHSs of the region as well as the users of weather, water and climate services should be seen as part of the region's disaster preparedness and security mechanisms.

The Study Team are aware of the difficulties and challenges that will face the PMC in pursuing the creation of a Pacific based RTC but the major elements are already in place. It now requires leadership and trust to ensure that the institutions and individuals focus on the benefits of working together rather than difficulties.

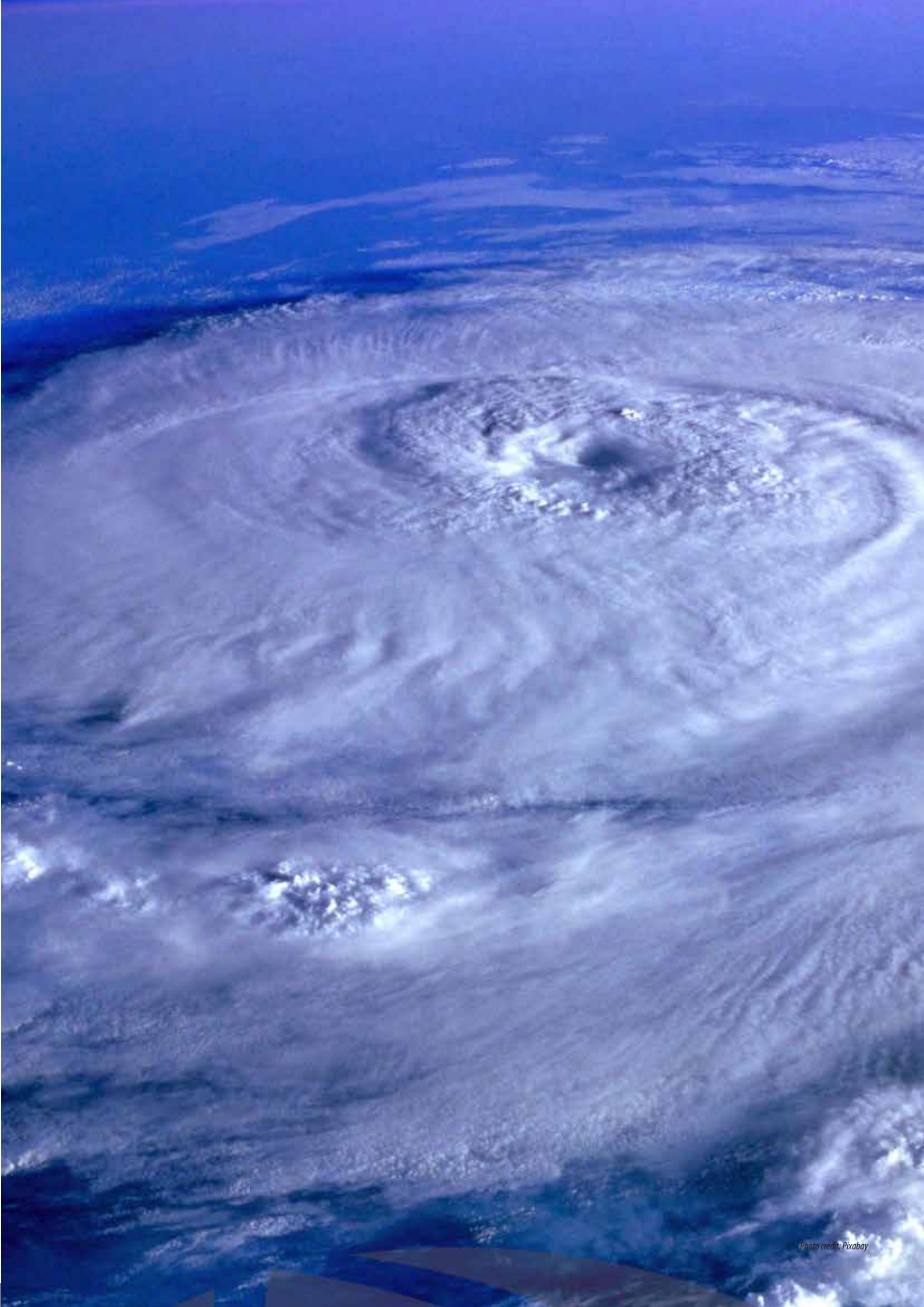


Photo credit: Pixabay

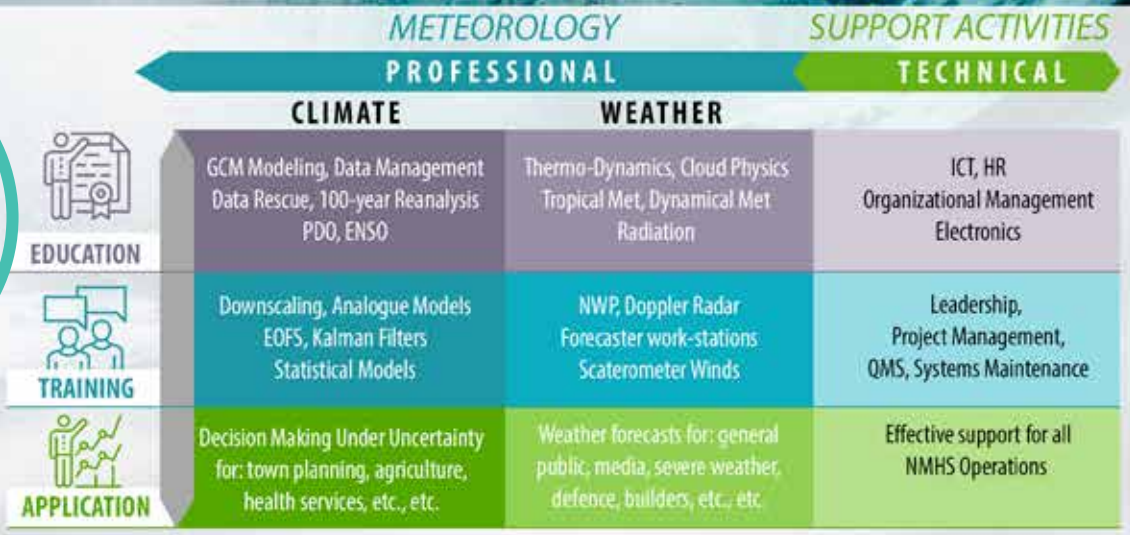
# 1. Introduction

This Report was sought, as a matter of priority, by 15 Directors of Pacific Island National Meteorological and Hydrological Services (NMHSs)[2], twelve of which have responsibilities in the Southern Hemisphere. For many years the shortage of well trained and appropriately qualified meteorologists, hydrologists and support technicians in these NMHSs has been of considerable concern, not only to the Directors of the NMHSs but also to their governments and to those who rely on meteorological, hydrological and climatological services in their day-to-day decision making, including; aviators, ship operators, builders, tourists, tourism operators, defence forces and many others. The shortage has come about for a variety of reasons including; the lack of a training facility in the South Pacific, the high cost of training meteorologists, hydrologists and support technicians in the (relatively) nearby countries of Australia and New Zealand, the high costs of accessing training facilities in Indonesia, the Philippines and Hawaii, the cultural and meteorological differences between these locations and the Pacific, and the loss of many (expensively) trained staff to other countries and careers shortly after they return to the Pacific.

The question has been asked a number of times; "why a Feasibility Study"? We know that a meteorological and hydrological Regional Training Facility (RTC) in the Pacific has not been established in the past because no single nation has seen the level of demand for meteorological and hydrological training sufficient to justify such an institution, or none of the 15 NMHSs has had the resources necessary to establish an RTC. While noting this background the Pacific Island NMHS Directors have sought an independent Feasibility Study to determine whether circumstances have changed sufficiently with more cost effective ways of teaching, increased demand in the region for new climate services and improved weather services, so as to allow for the creation of a sustainable RTC in Pacific if they all work together in supporting it.

The first report of this study established the education and training needs and prospective student numbers of the fifteen NMHSs in terms of the services they are currently providing, and their plans for increased services under the Pacific Island Meteorological Strategy (PIMS) 2017 – 2026. The first report indicated that the demand for education and training was highest for operational forecasting, climate services, marine and ocean services, ICT and equipment maintenance and repair. Figure 1 depicts the education and training needs for professional and technical staff in specialist areas as well as the wider capability areas such as management and leadership, finance, project management and Occupational Health and Safety.

**FIGURE 1:** Matrix of Education and Training Needs versus Different Roles of Personnel




2 Cook Is., Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Papua New Guinea, Republic of Marshall Is., Republic of Palau, Solomon Is., Samoa, Tokelau, Tonga, Tuvalu, and Vanuatu.

Whilst there is an ongoing need for specialist technician training many of the NMHSs foresee the need to increase the number of degreed staff in their organisations to support a broader and more diverse range of climate and marine services and for Kiribati, Samoa and Tonga to provide aeronautical meteorological forecasts. Noting that Nauru, Tonga, Tuvalu and Vanuatu did not provide estimates of their forward staffing requirements by job role for the first report it would appear that there are probably not enough students to justify the running of a BSc in Meteorology within the region but there could be sufficient students to run a post-graduate diploma in meteorology with a strong operational focus. There would certainly appear to be sufficient numbers to develop a series of articulated accredited courses leading to a diploma level course for senior meteorological technicians undertaking aviation forecasting and other higher level duties.

During the past decade, as noted in the Pacific Island Meteorological Strategy (PIMS) 2017-2026, there has been significant development and improvement in the capacity and capabilities of many of the 15 NMHSs through development aid and close cooperation with countries such as Australia, China, Denmark, Finland, France, Italy, Japan, New Zealand, Republic of Korea, UK and USA and economic groupings such as the European Union. The NMHSs have also benefited from the global network of meteorological observations, information and services provided through WMO although Nauru, Republic of the Marshall Islands, Palau and Tokelau are not members of WMO.

In the coming years it is anticipated that ocean services, multi-hazard early warning systems and integrated observing and communication systems will be significantly developed. The NMHSs recognise that it is essential for them to engage with their stakeholders to ensure their products and services are accessible and tailored to the needs of the users.

Despite significant progress has been made it should be noted that some of the NMHSs are still experiencing problems with poor infrastructure, lack of staff numbers and lack of competencies. These deficiencies affect their ability to undertake observations and manage weather and climate data, provide forecasts and warnings and install and maintain equipment. These deficiencies also impact on archive, quality control and management of climate data, analysis of climate data, and developing seasonal predictions and climate change scenarios.

# 2. Background

In this Background Chapter we feel it necessary to set the overall context in which a Pacific RTC would be expected to operate and to prove sustainable. This context has a number of elements that are unique to the tropical western Pacific between (approximately) latitudes 10°N and 25°S and longitudes 160°E to 160°W (Figure 1) which includes the Exclusive Economic Zones of the 15 Pacific Island countries that initiated this Study and encompasses an area of approximately 50 million sq km.

**This background Chapter of the Report focusses on four aspects of the Study Area, they are the:**

- Meteorology and hydrology;
- Economic circumstances;
- Cultures and cultural diversity; and,
- Communications and transport infrastructure.

FIGURE 2: Exclusive Economic Zones of the 15 Pacific Island countries

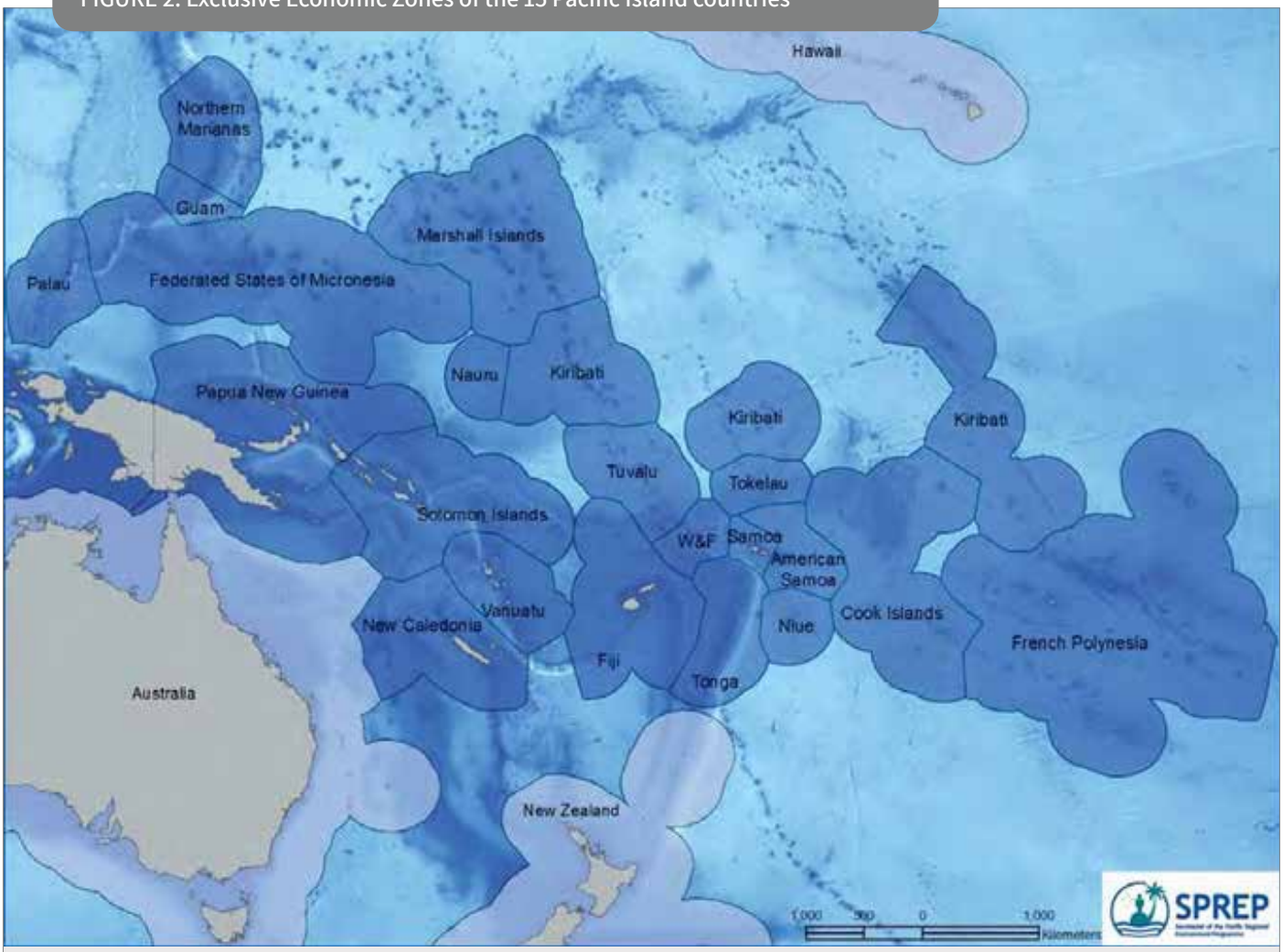



***Figure 2:*** This map is indicative only of agreed and potential maritime jurisdictional limits within the Pacific region. Not all countries represented on this map were considered as a part of this Study. The map does not imply the expression of an opinion by SPREP, the UNDP or the Feasibility Study Team on the legality of any boundary shown. (Source: Pacific Islands Meteorological Strategy 2017–2026)

# *The Meteorology and Hydrology of the Region*

## METEOROLOGY

The entire region experiences a tropical climate with easterly trade winds predominating in the winter/dry season and more variable winds in the summer/wet season that comprise the southwest monsoon in the Northern Hemisphere and the northwest monsoon in the Southern Hemisphere (Figure 3).

Figure 3: A Schematic of the Major Weather Influences in the Feasibility Study Area

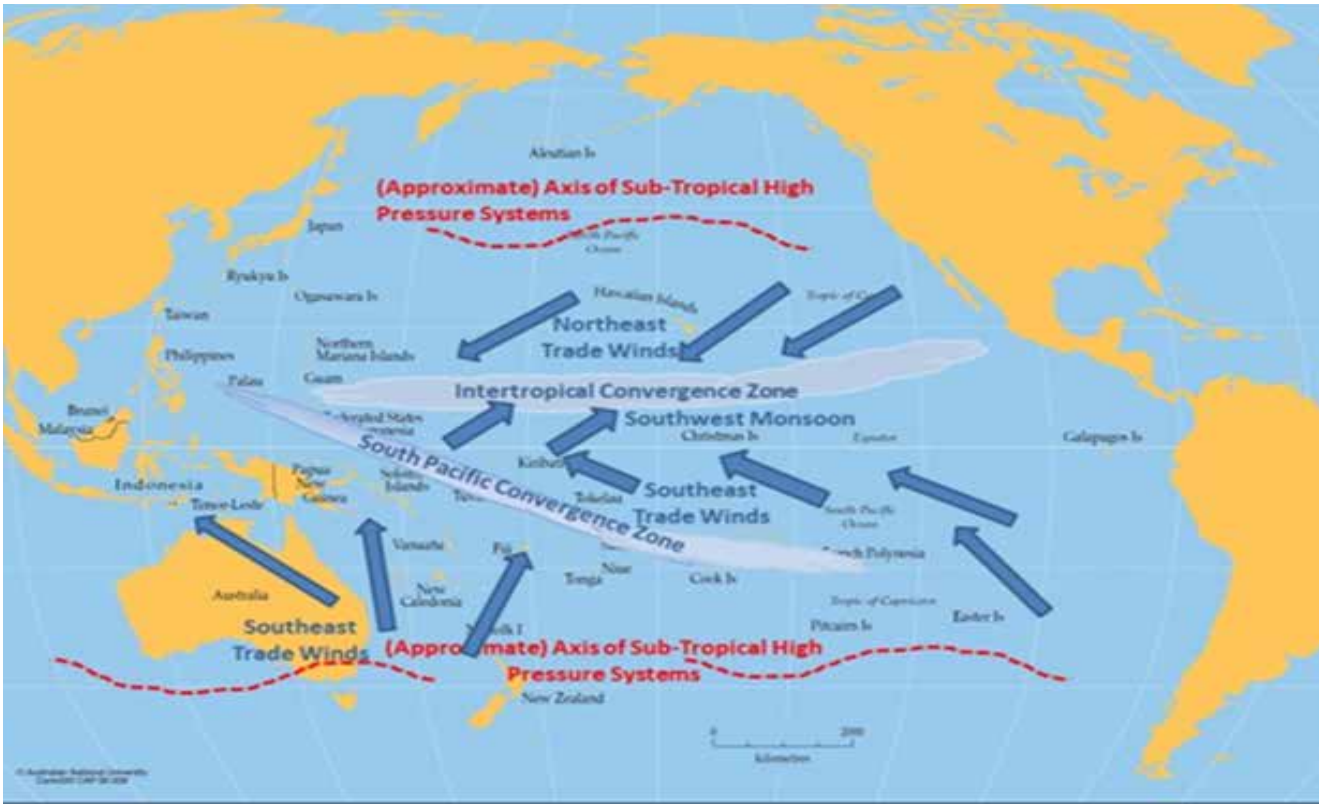



***Figure 3:*** A schematic of the major weather influences in the Feasibility Study area. This representation is of the Northern Hemisphere (Boreal) summer/wet season situation. In the Southern Hemisphere (Austral) summer/wet season the intertropical convergence zone slips south across the equator and northwesterly monsoonal winds develop between it and the equator.

In both the northern and southern hemispheres tropical cyclones (typhoons in the Northern Hemisphere) occur in the wet season months. These tropical cyclones can have devastating impact upon the small economies of all 15 countries of the region. For example, tropical cyclone Kina (December 1992/January 1993) caused an estimated US $120 million in damages (2% of Fiji's GDP at that time) and resulted in 26 fatalities. Tropical cyclone Evan (December 2012) resulted in an estimated US$ 315 million of damage and 14 fatalities across Samoa, Fiji, Wallis and Futuna, Tonga and New Zealand. More recently, tropical cyclone Pam (March 2015), a severe category 5 tropical cyclone, resulted in damages exceeding US$360 million, with 11 fatalities. These are only a few of the many TCs that occur in the South Pacific each year.

In the Northern Hemisphere all three countries in the Study; Palau, the Marshall Islands and the Federated States of Micronesia experience the impacts of tropical cyclones. For example, Micronesia has been affected by devastating cyclones several times in the last few decades. Typhoon Mitag[3] in 2002 caused 1 fatality, devastated food crops, destroyed buildings and caused US$ 150 million in losses. Less than half a year later, typhoon Chata'an struck Chuuk State with intense rain, causing floods as well as major landslides that killed 47 and injured over 100.

3 Word Bank "PACIFIC CATASTROPHE RISK ASSESSMENT AND FINANCE INITIATIVE: The Federated States of Micronesia", September 2011.

Even though the RSMCs in Honolulu, Hawaii and Nadi, Fiji provide accurate and timely warnings for tropical cyclones in the northern and southern hemisphere respectively, each of the 15 countries in the Feasibility Study area needs properly trained meteorologists and meteorological technicians to gather data to enable the RSMCs to make their forecasts and to take the forecasts of a tropical cyclone's track and intensity from the responsible RSMC to specify local effects and recommend to national disaster management authorities the most appropriate disaster mitigation measures ahead of the onset of destructive winds and storm surges in their coastal waters.

While Figure 3 schematically illustrates the large-scale influences of day-to-day weather over the tropical Pacific, the dominant influence on seasonal and annual variability of the Pacific tropical climate is the so-called El Nino – Southern Oscillation (ENSO) cycle, a large-scale atmosphere –ocean interaction with three phases; the El Nino phase, the neutral phase and the La Nina phase. ENSO is an inter-annual phenomenon that occurs in the Pacific and has regional and global impacts. During the neutral and La Nina phases of ENSO the Pacific Ocean waters along the equator and the South American coastline are generally relatively cool due to the upwelling of cold sub-surface waters, which is a result of easterly winds flowing over the ocean surface. During these times most of the December to February heavy rains in the equatorial belt occur over Indonesia and Northern Australia - the La Nina and Neutral years (Figure 4). The difference between the La Nina and neutral phases is the intensity and extent of the cold waters. From time-to-time this easterly wind regime is replaced with westerly winds, the cold ocean surface is replaced by anomalously warm waters as a consequence the heavy rains in the equatorial belt are displaced eastwards to around the dateline, and northern Australia, Indonesia and even islands as far east as Fiji experience drought conditions – these are the El Nino years.

Figure 4: A Schematic of the December to January areas of Maximum Rainfall

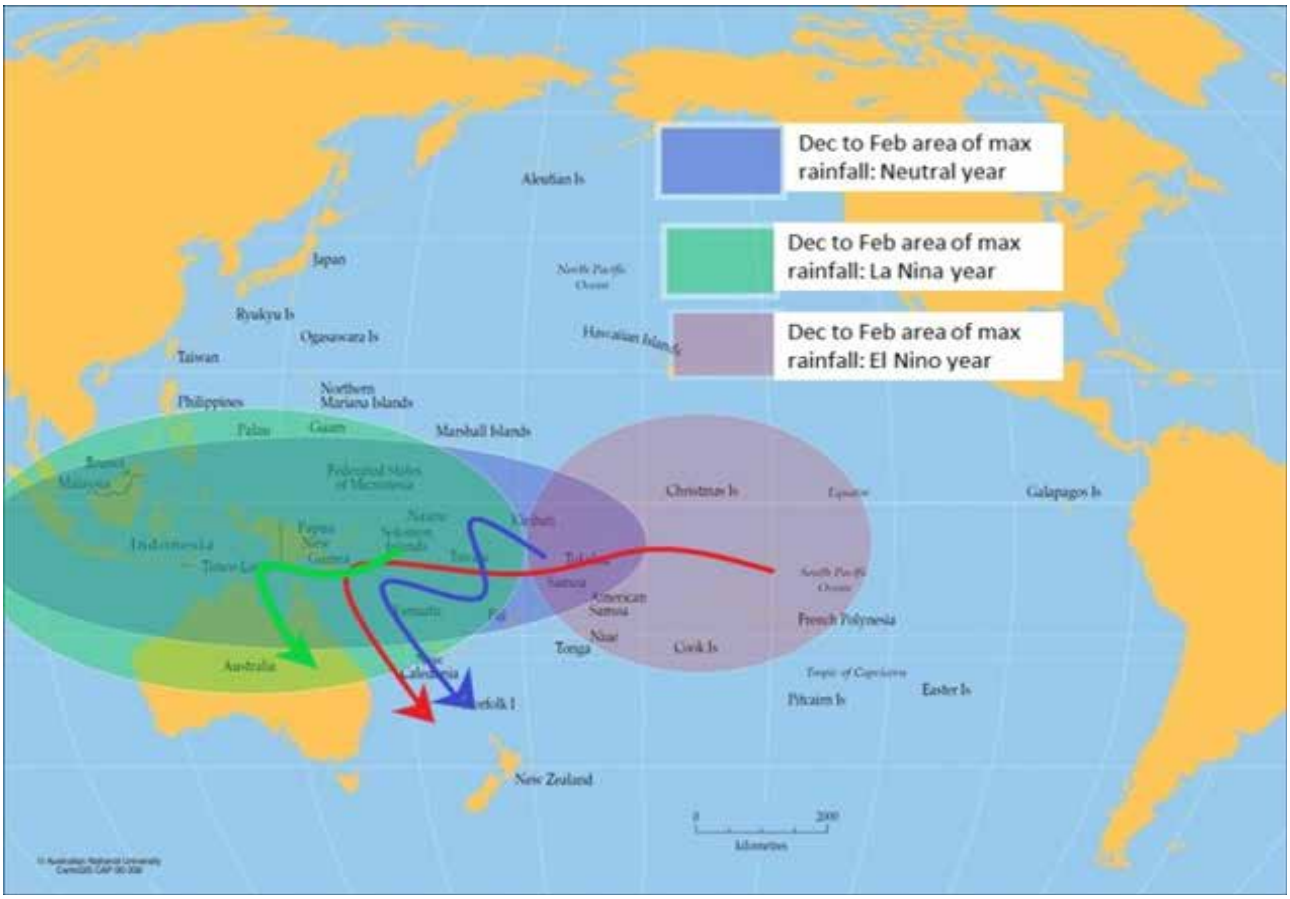



***Figure 4:*** A schematic of the December to January areas of maximum rainfall for La Nina, Neutral and El Nino years in the Pacific region. The red, blue and green arrows depict idealised tropical cyclone tracks originating from the preferred genesis areas in El Nino, Neutral and La Nina years respectively.

The areas of maximum rainfall are also the areas of preferred development of tropical cyclones, and so with the eastward shift of rainfall in El Nino years there is also an eastward shift in the areas where tropical cyclones form in both the Southern Hemisphere during the Austral summer and in the Northern hemisphere during the Boreal summer. With this shift in the areas of maximum rainfall there is a shift in the preferred areas for tropical cyclone genesis, with a shift eastwards in the El Nino years relative to preferred genesis areas in other years. This impact on the tropical cyclone climatology is not retricted to the southern hemisphere, for example, in the northern hemisphere the island of Guam has only experienced category five (the most intense category) typhoons in El Nino years, possibly because it is during the El Nino years when the tropical cyclones undergo genesis furthest east in the central Pacific and then travel a long way gaining intensity as they move westward towards Guam.

## HYDROLOGY

The hydrology of the 15 Pacific countries is linked to two factors, the topography of the country and the rainfall regime it experiences. In essence there are two types of island in the Pacific, volcanic islands with significant mountain or highland areas that rise hundreds or even thousands of metres above high tide level and coral atolls that rise only one to two metres above high tide level.

The heaviest precipitation in the Study area, averaging 7 to 9 mm/day, is associated with the intertropical convergence in the North Pacific and the broader South Pacific convergence (Fig. 3 and Fig. 5).

Figure 5: Long term, 1979 to 2010 average Precipitation across the Globe

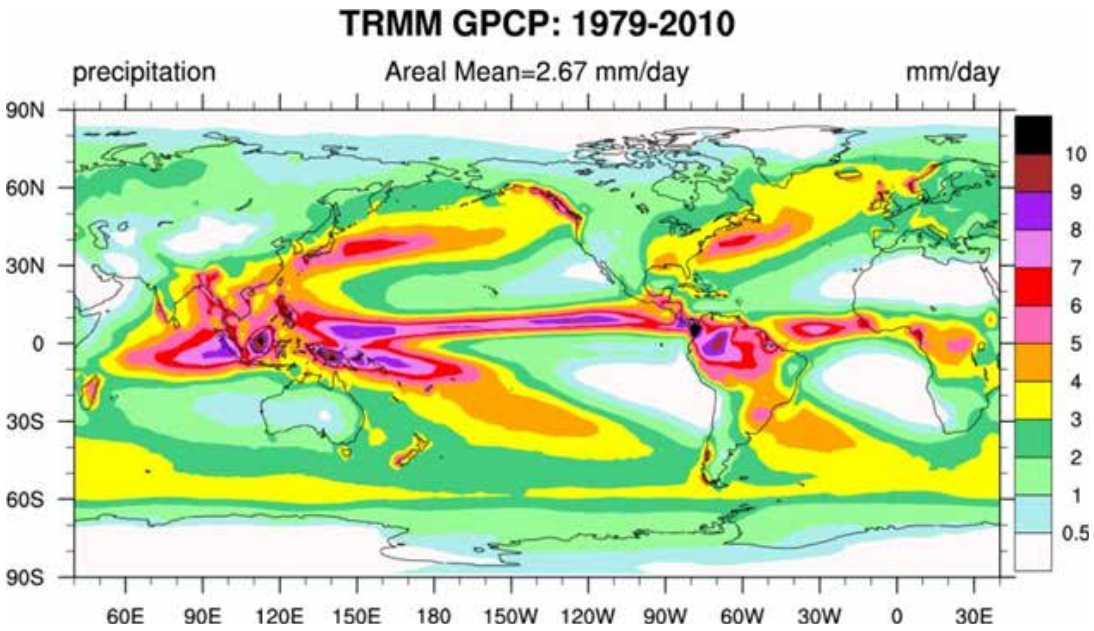



***Figure 5:*** Long term, 1979 to 2010, average precipitation (mm/day) across the globe. The narrow maximum associated with the intertropical convergence in the North Pacific and the broader South Pacific convergence can be seen. Source: https://climatedataguide.ucar.edu/climate-data/gpcp-monthly-global-precipitation-climatology-project

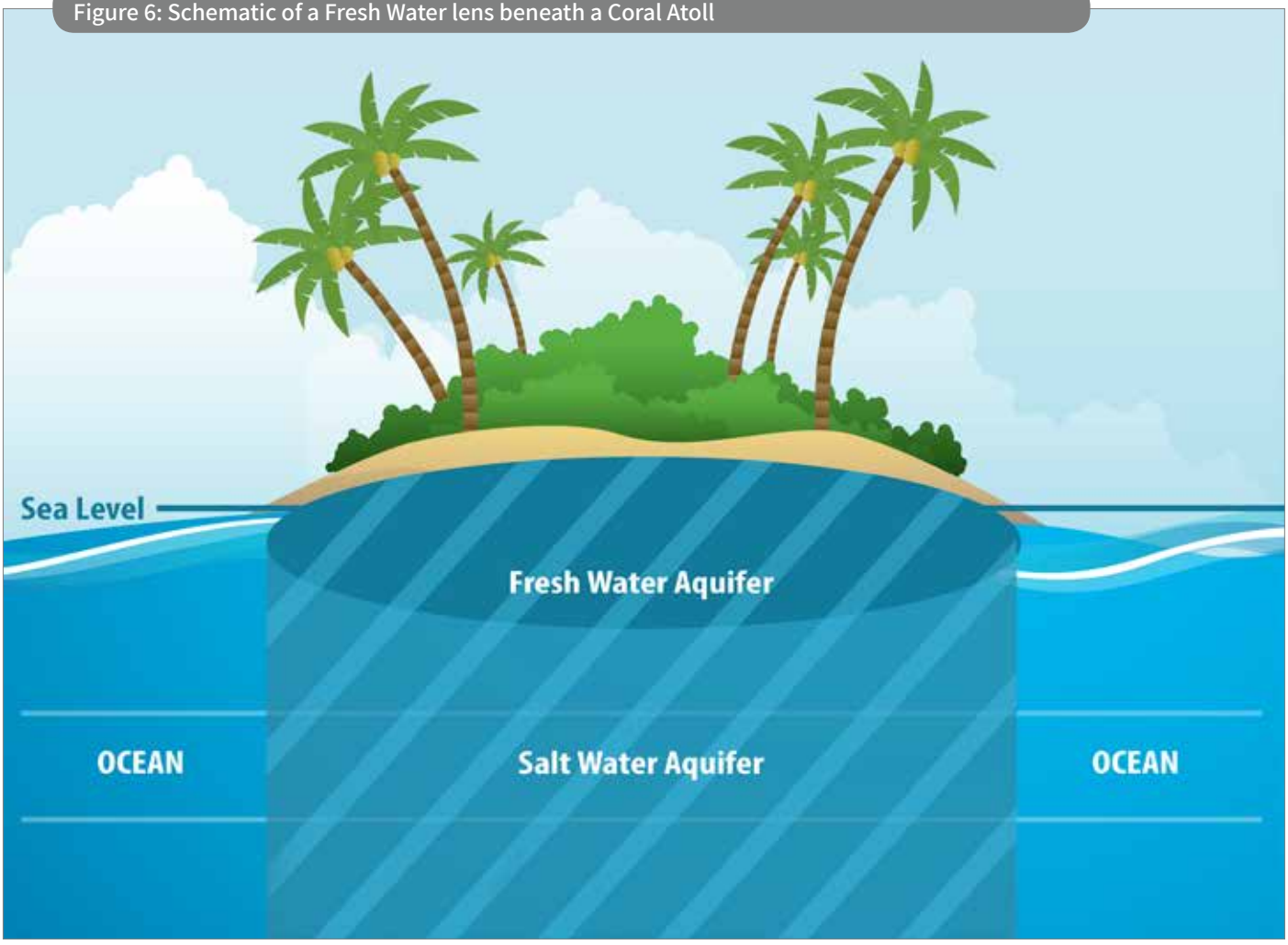
For the volcanic islands rainfall is generally plentiful on the windward side where orographic lifting of the moist tropical air produces rain showers and thunderstorms, with generally drier conditions prevailing on the leeward side of these volcanic islands. The challenge for communities on volcanic islands comes from flash flooding brought about by heavy rainfall associated with tropical thunderstorm systems. Such flooding can be accompanied by landslides and substantial loss of life. Volcanic islands with well-defined river systems are able to build reservoirs to store water but always face the challenge of multi-use water storages that can serve as sources of drinking water, water for agriculture

and storage for flood management.

The very flat coral atolls do not give rise to orographic lifting of on-shore winds and so experience less rainfall. Most atolls in the Pacific experience their extremes in rainfall in association with the prevailing phase of ENSO. For atolls east of the dateline El Nino brings more rain and more tropical cyclones (for example, Cook Islands and parts of Kiribati), for atolls west of the dateline (for example, the Marshall Islands, atolls amongst the Fiji group of islands) El Nino can bring drought and devastate agriculture.

Many coral atolls have a shallow fresh water lens beneath them, which is a pool of fresh water within the sand and rock that composes the atoll, floating on a layer of denser salt water within the sand and rock beneath the atoll (Fig 6). Where this lens has not been damaged by salt water intrusion or by pollution from human activities, these can be vital sources of water, particularly during El Nino-related droughts. A fresh water lens is a delicate environment and its depth and salinity are strongly influenced by local rainfall amounts as well as by changes in the sea level that can be brought about by storm events. Where there is no fresh water lens available care must be taken to capture rain as it falls, purify it as necessary, and store and distribute via the island's reticulation system. Water management is a crucial social issue for all 15 countries in the study area and properly trained hydrologists and hydrological technicians are required to advise government of water management issues and to assist in the design of locally appropriate water management infrastructure; including dams, drainage and irrigation systems.

Figure 6: Schematic of a Fresh Water lens beneath a Coral Atoll



## *The Economic Circumstances of the Region*

With the exception of Papua New Guinea, the other 14 countries considered in this Study are Small Island Developing States, and New Guinea suffers many, if not all of the economic disadvantages of the Small Island Developing States in the Study, which arise from the following intrinsic characteristics:

- Small population size is a limiting factor. In a small country higher income levels can increase overall economic size to only a limited extent, as there are few opportunities to create economies of scale. As a consequence (among many others) small size typically leads to disproportionately expensive public administration and infrastructure. A small population typically has a narrow skills base, often exacerbated by high rates of out-migration as young, talented people seek opportunities in bigger economies;
- Small Island Developing States face threats related to global environmental issues which appear to be very costly to mitigate, including; waste pollution and scarcity of water as populations increase, climate change which is, and will continue to be, accompanied by sea-level rise, destruction of coral reefs critical to food security and ecosystem adaptation, loss of biodiversity, and acidification of the oceans.
- The Small Island Developing States of the Study area are geographically remote from major markets – the large distances exports must be transported combined with low transport and communications volumes typically mean high freight and communications costs;
- Vulnerability to sudden changes in the external economic environment from either the availability of needed imports or for demand of their exports (so-called demand and supply-side shocks). Due to the small size of their economies, Small Island Developing States are highly dependent on trade but lack the factors that determine competitiveness. Similarly, international macroeconomic shocks tend to have higher relative impacts on their small economies. The combination of small size and remoteness leads to high production and trade costs, high levels of economic specialization and exposure to commodity price volatility; and,
- Small Island Developing States, because of their limited landmass have few natural resources to fuel their sustainable development. Energy, water, mineral and agricultural resources are relatively limited, and resource extraction tends quickly to exhaust local supplies on small islands.

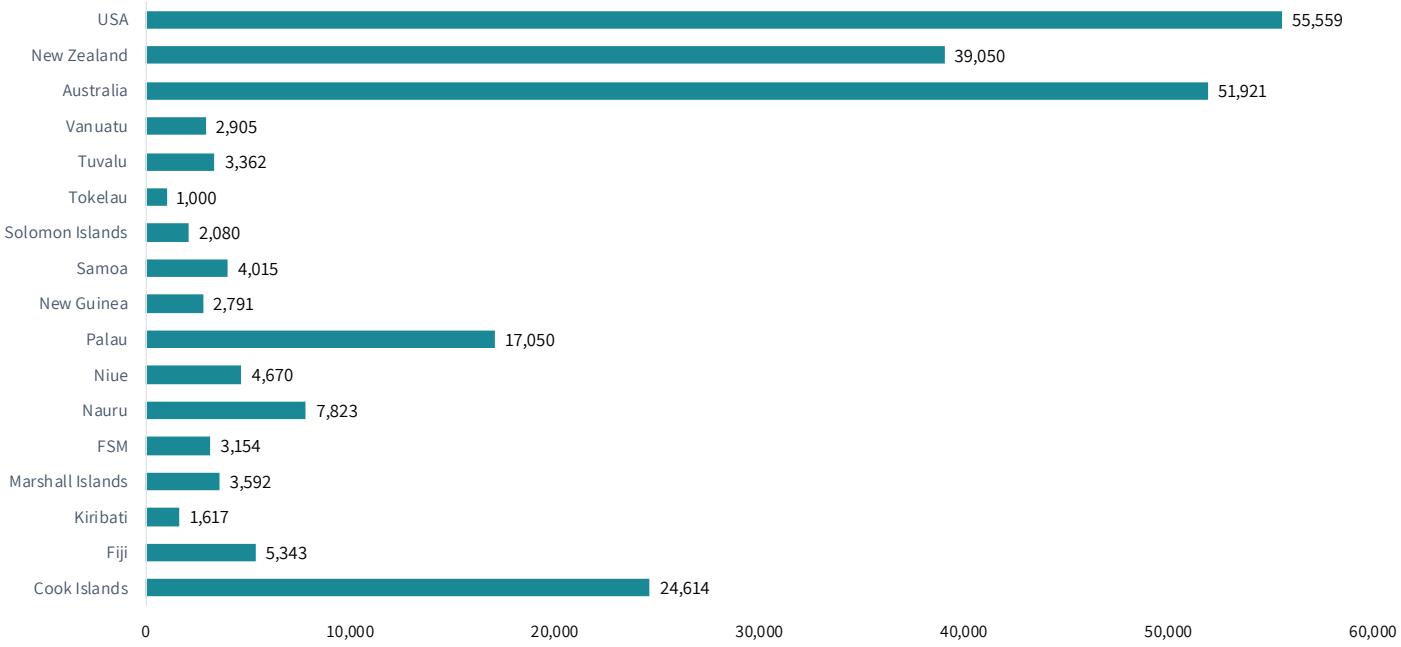
In the World Bank publication "Pacific Possible" (2017) a similar set of environmental constraints faced by the Pacific communities' economies is identified and the following conclusion is reached (Pg 13); ***"Indeed, the constraints imposed by geography are so severe that even with an optimal environment for private sector activities–infrastructure, regulation, supportive macroeconomic policies–the range of viable economic opportunities will still be narrow".***

With exception of New Guinea the 15 countries have small populations (Table 1) and, consistent with the economic disadvantages of Small Island Developing States listed above, all have small GDP per capita ratios when compared to the nearby developed countries of Australia (Table 1 and Fig 7), New Zealand and the USA. The economies of the 15 countries are reliant upon agriculture, fishing, tourism, and remittances from expatriates for foreign currency earnings and, to a greater or lesser degree, subsistence farming to assist communities that are not well connected with the cash economy.

**TABLE 1:** GDP, GDP per capita and population data for the 15 countries in the Study area and for the three developed countries that have historically played a major role in the development of the 15. All data sourced from the Australian Government, Department of Foreign Affairs; "Country Fact Sheets".

| Country | GDP 2016 Billion (USD) | GDP/PC (USD) | Population |
|---|---|---|---|
| Cook Islands | $0.288 | 24,614 | 10,500 |
| Fiji | $4.700 | 5,343 | 885,000 |
| Kiribati | $0.200 | 1,617 | 115,000 |
| Marshall Islands | $0.200 | 3,592 | 55,000 |
| FSM | $0.300 | 3,154 | 102,000 |
| Nauru | $0.100 | 7,823 | 13,000 |
| Niue | $0.020 | 4,670 | 1,600 |
| Palau | $0.300 | 17,050 | 18,000 |
| New Guinea | $22.600 | 2,791 | 8,300,000 |
| Samoa | $0.800 | 4,015 | 198,000 |
| Solomon Islands | $1.200 | 2,080 | 614,000 |
| Tokelau | $0.002 | 1,000 | 1,353 |
| Tuvalu | $0.037 | 3,362 | 11,000 |
| Vanuatu | $0.800 | 2,905 | 281,000 |
| Australia | 1,266,000 | 51,921 | 24,800,000 |
| New Zealand | 185,400 | 39,050 | 4,800,000 |
| USA | 18,624,000 | 55,559 | 325,900,000 |

**FIGURE 7: GDP per capita (US$) for the 15 Study Countries plus Australia, New Zealand and USA**




In all of these 15 countries foreign aid plays an important role in infrastructure projects and in capacity development through training and education initiatives. The level of foreign aid (expressed in US$ per capita) in some of the smaller countries, most particularly Tokelau and Niue, exceeds the national GDP per capita (Fig 8), in others (Palau, Marshall

Is., The Federated States of Micronesia, Tuvalu, and Nauru) the foreign aid per capita is around 50% of the GDP per capita. Overseas development aid, as a percentage of Gross National Income, is between 30% and 50% in Tuvalu, the Federated States of Micronesia, and the Marshall Is., (Fig 9).

The five largest foreign aid donors for the Pacific over the period 2006 to 2014 are listed in Figure 10. While it is difficult to say precisely what their aggregate levels of contribution were, Figure 10 provides at least an order of magnitude estimate of US$ 13.5B over the 9 years, 2006 to 2014 inclusive, or US$1.5B per year. Later in this Report it will be clear that some of this foreign aid "trickles down" to meteorology and hydrology, and that when it does so, it is spent in two ways; partially for infrastructure (automatic weather stations, weather radars, weather and hydrology data collection instruments, etc.,) and partially for education and training. Because of the importance of foreign aid in these 15 countries, the discussion of forming a new RTC in the Pacific identifies that RTC could optimally interact with the donor funds that currently are allocated, on a national basis, to meteorological and hydrological training in the Pacific.

**FIGURE 8: Overseas Development Aid (ODA) per capita provided to the Pacific Islands (and Timor-Leste – which is not in the Study area) in two time periods, 2000-20002 and 2012-14.** The very small populations indicate that on a per capita basis Tokelau and Niue are major beneficiaries. OECD and World Bank data. All figures are in 2014 USD.
*Source: Matthew Dornan and Jonathan Pryke, Asia & the Pacific Policy Studies, vol. 4, no. 3, pp. 386–404.*

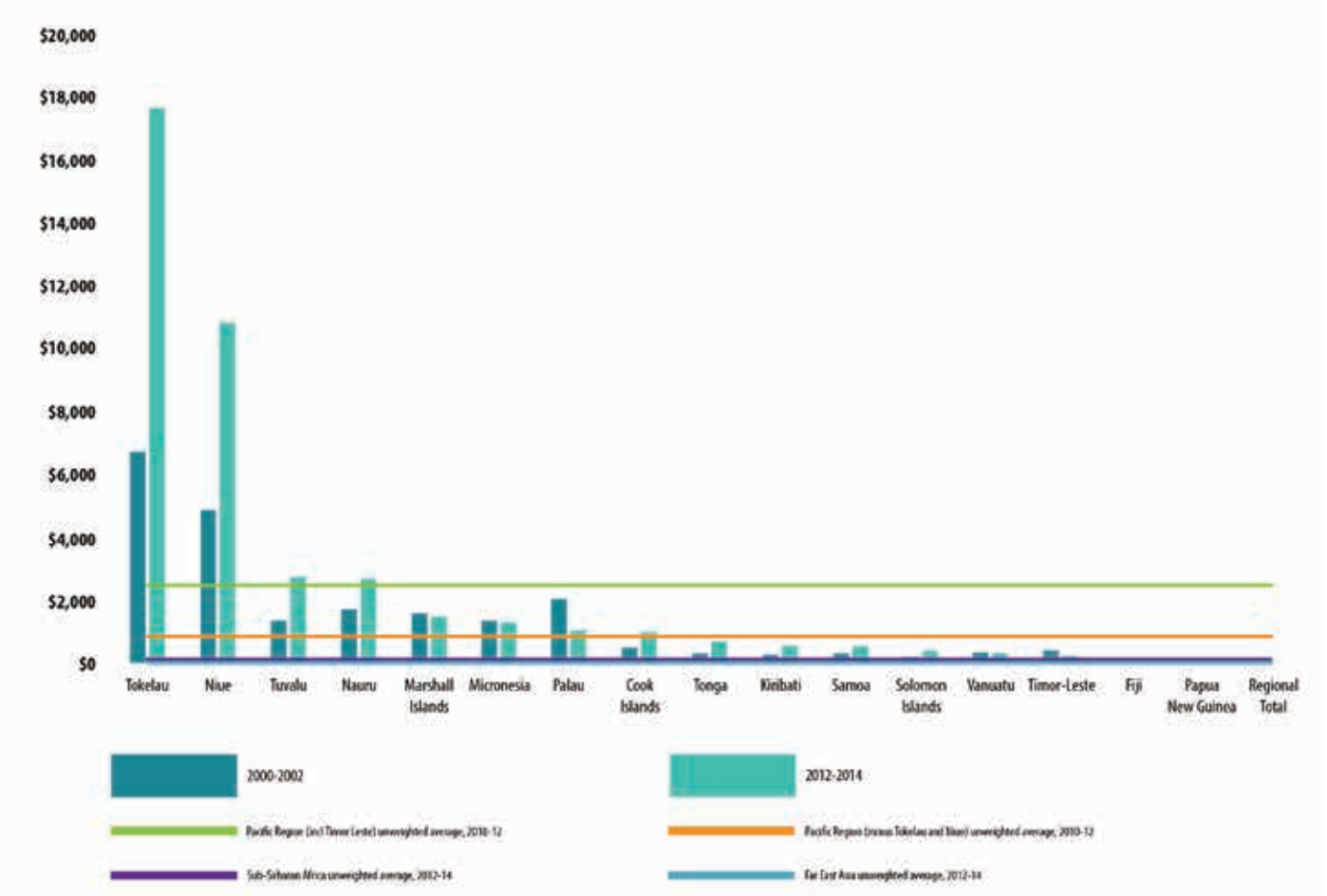


**Figure 9: Overseas Development Aid as a percentage of Gross National Income (GNI).**
*Source: Matthew Dornan and Jonathan Pryke, Asia & the Pacific Policy Studies, vol. 4, no. 3, pp. 386–404.*

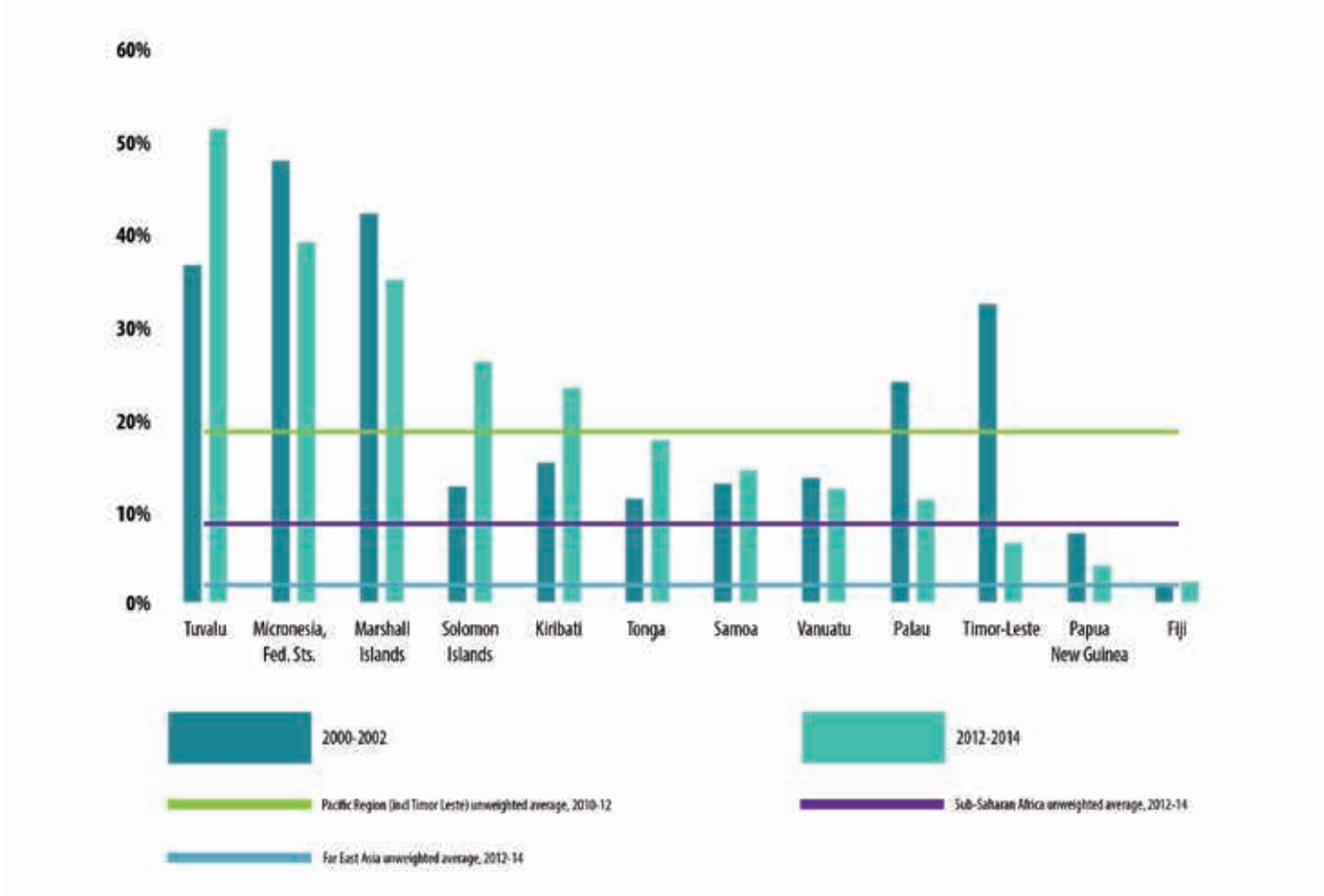
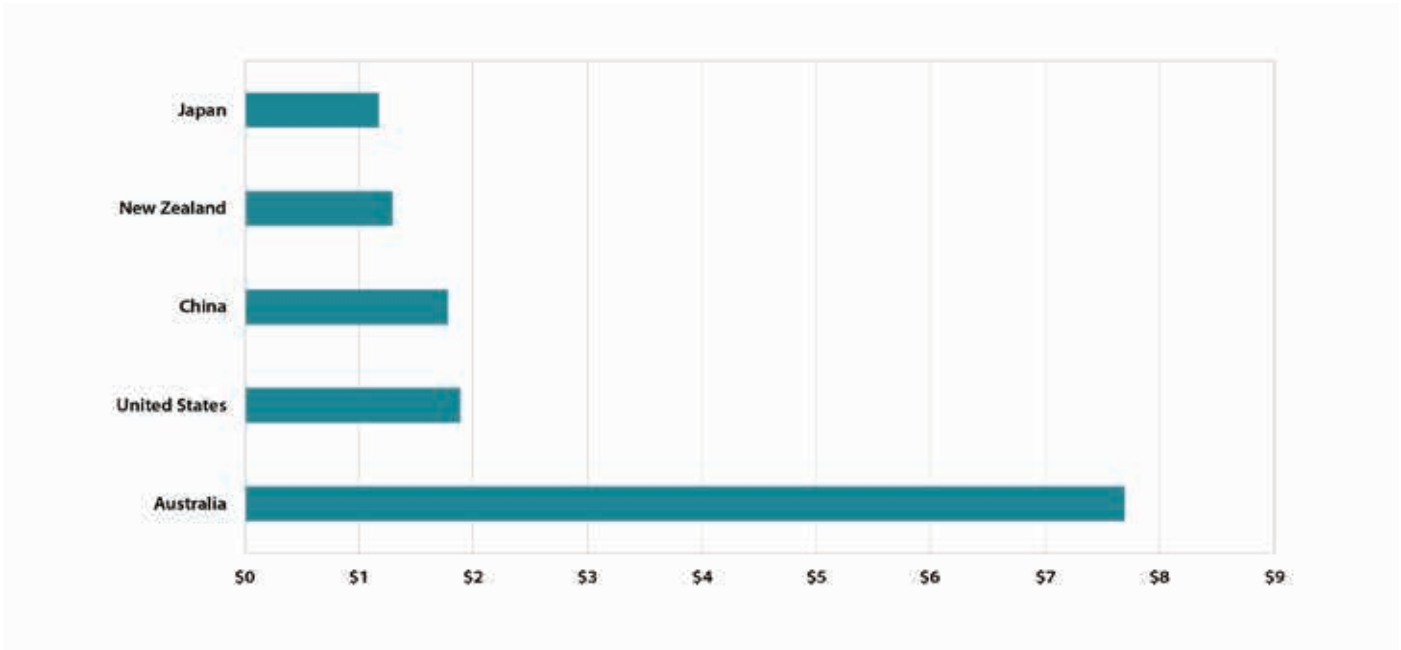



**Figure 10: Top Five Donors to the Pacific Countries in 2006-14 (US$ x billions).** Data provided to authors courtesy of the Lowy Institute. (Note 1: Chinese aid is likely overstated as it includes both concessional loans that would in turn be discounted in future years as they are repaid, and also includes projects approved in 2015 and early 2016.
*Source: Matthew Dornan and Jonathan Pryke, Asia & the Pacific Policy Studies, vol. 4, no. 3, pp. 386–404.*



## *The Cultures and Cultural Diversity of the Region*

Prior to the arrival of European explorers there were three distinguishable ethnic groups in the 15 country Study region; Melanesian, Polynesian and Micronesian. These three groups clearly interacted over the centuries; trading, warring and inter-marrying, particularly in the areas in the vicinity of the borders between the groups (Fig 11), but nevertheless, for the purpose of this background they are discussed as being separate communities.

Figure 11: Schematic of the Distribution of the three dominant Ethnic Groupings in the Pacific

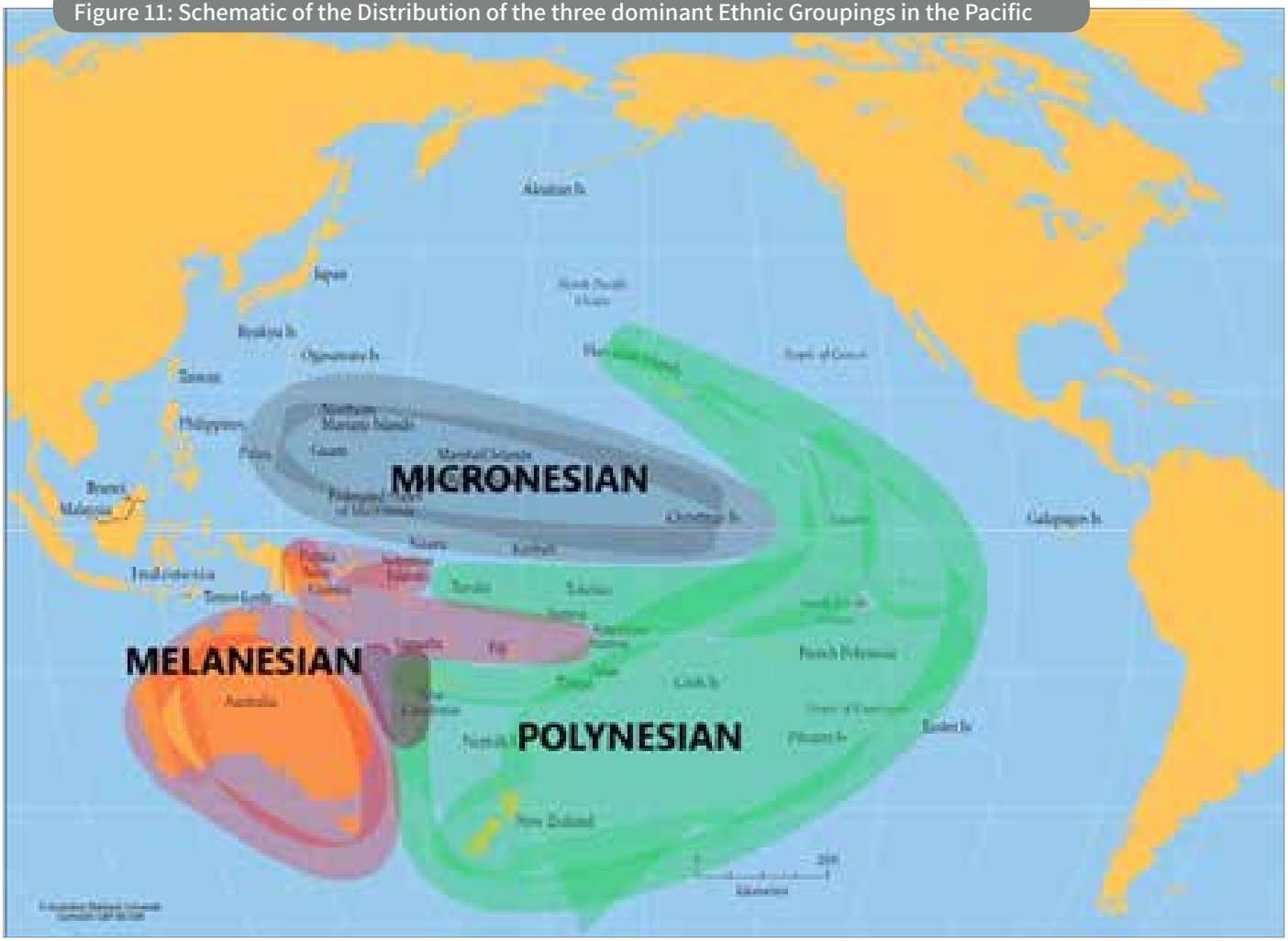



***Figure 11:*** Schematic of the distribution of the three dominant ethnic groupings in the Pacific immediately prior to entry by Europeans into the region. Sources: https://www.guampedia.com/people-of-melanesia, https://www.guampedia.com/people-of-micronesia, https://www.guampedia.com/people-of-polynesia

### MELANESIA – PRE-COLONIAL ERA

Of the three culture areas of the Pacific, Melanesia is believed to be the earliest settled by humans. The Torres Strait Islands near Australia, for example, are believed to have been one of the earliest inhabited places with people migrating there some 70,000 years ago when New Guinea was still part of the Australian continent. New Guinea probably was first populated around 40,000 years ago with people moving there from Southeast Asia. These early Melanesian peoples were followed years later by a wave of Austronesian-speaking people who brought a sophisticated knowledge of ocean voyaging.

The ancestral Papuans were a hunter-gatherer culture, adapted to life in the tropical rainforests of what would become New Guinea. The Austronesian peoples arriving later in ocean-voyaging canoes, occupied parts of the islands now

known as the Bismarck Archipelago. These people were of the Lapita culture, marked by distinctive pottery, shell jewellery and seafaring technology. They settled in the Solomon's, Vanuatu and New Caledonia. While the collective term "Melanesian" is used today to distinguish the descendants of these people from other Pacific Islanders, it understates the breadth of cultural diversity that exists in this region, or the complexity of the similarities between cultures in Melanesia with those of Polynesia and Micronesia.

Melanesian societies in general were largely egalitarian, and did not have pronounced hierarchies of social status and chiefly titles. Instead, certain men became rich and powerful by their hard work, intelligence, political marriages, and their recognized skills and ability to produce food and share with others, especially through large feasts. These "Big Men" acquired their social status and did not inherit it. They competed with each other and had to continuously defend their position until they retired, died or were replaced by another more successful or ambitious individual.

Inheritance could either be through the male line (patrilineal descent), the female line (matrilineal descent) or a combination of both. Patrilineal descent was more common in northern Vanuatu, New Caledonia and lowland New Guinea, while matrilineal descent was seen in communities in the Massim, Bismarck Archipelago, and the Solomon Islands, with some variations. Intermarriage was important in maintaining connections between kin-groups, or creating alliances with enemies.

Without centralized political units and with an inherent feeling of suspicion of other groups, many of the populations within Melanesia were isolated, and anthropologists find it reasonable that so many cultures and languages, each with their own characteristics and idiosyncrasies, would have evolved over time. Indeed more than 1,200 different Melanesian languages exist today, and most of them are part of the Austronesian family of languages.

## POLYNESIA – PRE-COLONIAL PERIOD

Polynesia is made up of more than 1,000 islands in the central and southern Pacific Ocean. The indigenous people of Polynesia are descendants of Austronesian-speaking navigators who first settled western Polynesia as many as 3,000 years ago. Geographically, the Polynesian Triangle is within the points of Hawai`i, New Zealand (Aotearoa) and Easter Island (Rapa Nui). The other island groups within the Polynesian Triangle are Samoa, Tonga, the Cook Islands, Tuvalu, Tokelau, Niue, Wallis and Futuna, and French Polynesia.

The Polynesian people are considered to be, by linguistic, archaeological and human genetic ancestry, a subset of the sea-migrating Austronesian people. The Polynesian languages place their prehistoric origins in the Malay Archipelago and ultimately Taiwan.

Polynesia divides into two distinct cultural groups, East Polynesia and West Polynesia. The culture of West Polynesia is conditioned to high populations. It has strong institutions of marriage and well-developed judicial, monetary and trading traditions. The groups of Tonga, Niue, Samoa and the atolls of Tuvalu to the north are all considered part of West Polynesia. It is likely the pattern of settlement involved the spread of Polynesians out from the Samoan Islands into the Tuvaluan atolls, with Tuvalu providing a stepping stone to migration into the Polynesian Outlier communities in Melanesia and Micronesia.

Eastern Polynesian cultures are highly adapted to smaller islands and atolls, as seen principally in the Cook Islands, Tahiti, the Tuamotus, the Marquesas, Hawai`i, Rapa Nui and smaller central-Pacific groups. The large islands of New Zealand were first settled by Eastern Polynesians who adapted their culture to a non-tropical environment.

All Polynesian societies had chiefs and community members who traced themselves to a common ancestor. Chiefs

controlled a fairly stable territory. Unlike in Melanesia, leaders were chosen in Polynesia based on their hereditary bloodline. (Samoa, however, had another system of government that combined elements of heredity and real-world skills to choose leaders. This system is called Fa'amatai.) In Polynesian societies, rank and status depended on inheritance–the standing of both parents was important (in general, political power was inherited from the father's line, but rank and status were inherited from maternal lines). Chiefs generally had absolute authority, decided all the laws and matters of justice, but their rule was tempered by more pragmatic concerns, such as being good and fair leaders, listening to the advice of peers and considering the interests of their subjects.

Women in general did not wield political power, even though they may be of higher rank than their brothers, husbands or sons. Still, women could be very influential in the political realm by sheer force of their character or personality.

The religious attributes of Polynesians were common over the whole Pacific region. While there are some differences in their spoken languages they largely have the same explanation for the creation of the earth and sky, for the gods that rule aspects of life and for the religious practices of everyday life. People travelled thousands of miles to celebrations that they all owned communally.

Of the many cultural traditions in the Pacific, Polynesian tattooing is considered one of the most intricate and skillful tattooing of the ancient world. The Polynesians believed that a person's mana is displayed through their tattoo. Each Polynesian group had their own designs and motifs. Elaborate geometrical designs which were often added to, renewed, and embellished throughout the life of the individual until they covered the entire body.

## MICRONESIA-PRE-COLONIAL PERIOD

Micronesia, the "little islands," is a geographic and cultural region that is comprised of over 2,500 islands spread across the vast north, west and central Pacific Ocean in an area equivalent in size to the continental United States. Although the term Micronesia refers to their relatively small land mass, the individual islands actually vary in size and shape—from high islands with tall mountains and rain forests, to low lying atolls.

Micronesia is divided into four distinct archipelagos and their outlying islands: the Caroline Islands, the Marshall Islands, the Mariana Islands, and Kiribati. Also included are Nauru and Wake Island. The Caroline Islands are further divided into the Western Carolines, which include Palau and Yap, and the Eastern Carolines, which include Chuuk, Pohnpei and Kosrae. Although often considered as a single geographic region, each of these Micronesian island groups has its own unique culture, language and traditions.

The populating of Micronesia likely occurred from the movement of several distinct, loosely connected groups of people, each bringing their own cultural practices into the region. The original inhabitants of western Micronesia likely came from island Southeast Asia and the ancestors of eastern Micronesia from somewhere between eastern Melanesia and West Polynesia. Archeological evidence points to the settling of the Mariana Islands as far back as 4,000 years ago, and Palau around 3,500 years ago. About 2,000 years later another wave of migration probably took place into the eastern Caroline Islands. Culturally and linguistically different from either the ancestors of the Palauans or the Chamorros of the Marianas, these individuals likely moved from East Asia, through Melanesia and through western Polynesia. Clearly, to settle the scattered, farther islands of Micronesia, people would have required a deep understanding of canoe technology and skilled navigation. These early travelers also would have brought with them familiar food plants that they transplanted onto their new settlements. Linguistically, the peoples of Micronesia speak languages belonging to the Austronesian family of languages, the largest and most widely distributed family of languages that extends from Madagascar to Easter Island. Unlike Polynesia, the languages of Micronesia are quite diverse, but not as diverse as the languages of Melanesia.

Lineages were, as they are today, the backbone of Micronesian communities. Members of a lineage held land in common, worked the land together, acted together and interacted with other lineages. Within each community there were several different clans, and clans could be dispersed among different communities on different islands. With few exceptions, inheritance of land or resources was usually matrilineal (or through the maternal or mother's line of descent), but in other communities, patrilineal or even mixed group lines of descent prevailed. In matrilineal societies, males and females would become members of their mother's matrilineage or clan. Siblings were ranked by birth order, and children within a lineage were also ranked by the birth order of their mothers. Groups of lineages that shared a common name or ancestor would be organized as clans. Even clans were hierarchical. Members of a clan were obligated to care for and protect each other and their shared resources. Leaders or chiefs of high-ranking clans would most likely also be the ones to occupy key leadership roles for the entire community.

For practical reasons, Micronesian communities generally recognized relatives from both parents' sides. While there was an emphasis on matrilineage, there was also a recognition and honor of patrilineal (or paternal) ties. People felt free to call on or interact with close relatives regardless of the formal relationship. However, matrilineal ties were seen as more important because they were inherently enduring or lasting, whereas patrilineal ties to a father, his descent group and children, were not considered permanent.

In matters of religion, people in Micronesian island societies did not worship a pantheon of deities as seen in Polynesia. Rather, they venerated their ancestral spirits, or believed in the presence of spirits in objects and natural phenomenon that could control success or failure of daily activities or warfare and an individual's health.

## THE REGION - COLONIAL ERA

The colonial era in the Pacific north of the equator has seen Spain, Germany, Japan and the USA all having a major role in the governing of various Pacific islands. South of the equator the British and French have had a long continuous presence, with the USA, Australia and New Zealand taking over the British role post-World War two.

During the early years of European contact, the islanders were introduced to different facets of European civilization, including Christianity, metals, disease and medicine, languages, food, and ideas like democracy and social justice. In the new port towns, firearms were sold, and drunkenness, gambling and prostitution were established. Of all the changes contact with western civilization brought, perhaps religion has been continuously the most important in terms of overall impact. With the introduction of Christianity came the establishment of Christian missions, schools and western education. With western education came changes in the way societies were governed, justice administered and infrastructure developed.

The overlays of traditional culture, western culture, the mix of languages, beliefs and value systems has produced a region of great diversity but underlying this is the belief that there is a Pacific culture, it is unique and it is definitely worth preserving. While it is very difficult to define the common elements in the modern Melanesian, Polynesian and Micronesian cultures some writers and politicians have tried to identify a "Pacific Way" of behaving and working together in Pacific communities. It was the late Prime Minister Ratu Sir Kamisese Mara, a Fijian paramount chief whose ancestry is also tied to Tonga and Samoa, who conceptualised and enhanced the true meaning of the phrase the Pacific Way. Mara didn't devote much effort to actually defining the Pacific Way, it has been suggested that this was because the Ratu often didn't see the need to explain things because defining custom too exactly can limit a chief's ability to appeal to 'tradition' to deal with a specific problem. In essence though, it seems that the Pacific Way has been used in the Pacific by the indigenous governing elites to focus on conversation and consensus, respect for sovereignty and non-interference in the internal affairs of neighbours.

In conducting this Feasibility Study the Team was conscious that we are not of the Pacific, but nevertheless, in keeping with the Pacific Way we have listened carefully to those of the Pacific, sought to identify consensus where possible and to respect the way each country goes about tackling the many challenges, and seizing the many opportunities their situation in the Pacific offers. We hope that we have done this well.

## *Communications and Transport*

### TELECOMMUNICATIONS

Having access to communication services is crucial to the 15 countries being considered in this Study. They are all vulnerable to natural disasters such as cyclones and drought, as well as rising sea levels. In emergency situations these 15 countries need access to the outside world. In addition, telecommunications can assist in alleviating the isolation experienced by many of the more remote islands as well as provide important access to health care, education and government services.

Telecommunications also play an important part in economic stability. The Pacific Islands are highly dependent upon the tourism industry and because complaints are often made by tourists regarding the poor network coverage and high service prices across the region, improving connectivity in the Pacific is vital for growth in this sector.

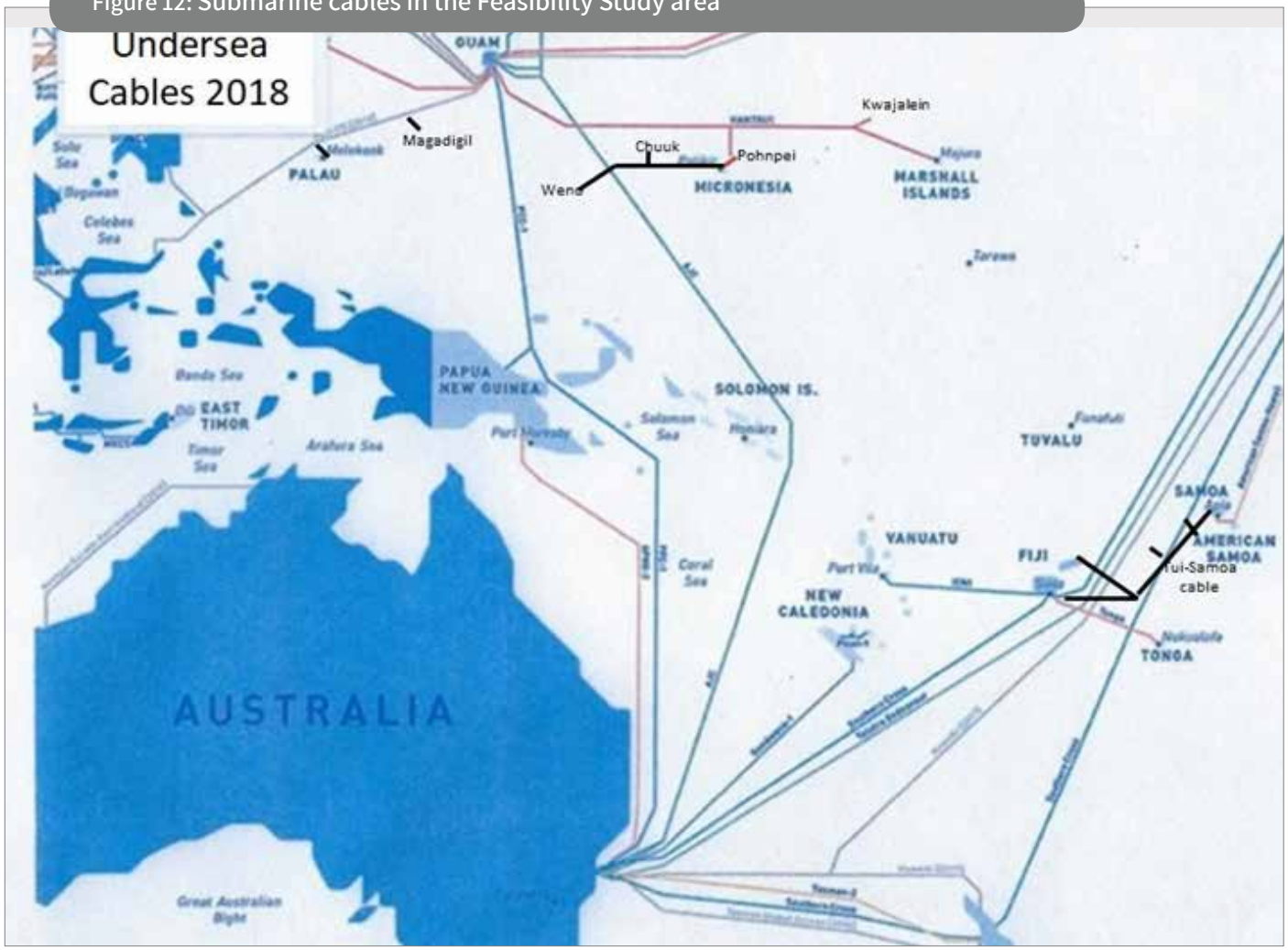
The geography of the South Pacific region has made internet connectivity a serious problem for many of the remote islands. Submarine fibre-optic networks are expensive to build and maintain, with capital costs prohibitive for the smaller island communities. Some countries have to rely solely on geostationary satellites. As a result, bandwidth is limited and broadband prices are high.

In recent years, there has been significant progress in improving telecommunications services in the Pacific. Concern regarding climate change has led to increased international interest in the South Pacific as it is in the frontline for rising sea levels and natural disasters. Telecoms and digital technologies are used by the global community to monitor the progress of climate change from a meteorological perspective and its impacts from a sociological perspective. As a result international funding, grants and private investment have been directed towards improving conditions, including telecoms infrastructure. International submarine cables are being deployed in some instances and satellite services are also being upgraded. Since 2016 a new submarine cable between Suva and Apia (Tui-Samoa) has been established and new undersea links to Chuuk (Federated States of Micronesia) and Palau (Fig 12).

For the average islander a major change has been the increased accessibility of mobile telephony. There has been an increase of mobile subscribers across the board in the South Pacific, while the usage of fixed lines has been declining. It is becoming apparent that mobile technologies are far more suited to providing services to the many islands spread across a vast geography. While mobile penetration is still low when compared to more developed markets, in most of the Pacific Island nations there is good mobile coverage in the capital cities and in some cases there is also reasonable coverage across some of the more remote atolls.

**Figure 12: Submarine cables in the Feasibility Study area. Heavy black cables are newly installed since 2016.** Sources: https://submarine-cable-map-2016.telegeography.com and https://submarine-cable-map-2018.telegeography.com)

Figure 12: Submarine cables in the Feasibility Study area




One significant development underway is the agreement that Kacific Broadband Satellite (http://kacific.com/) has made with a number of Pacific Islands which will see vast improvements in satellite broadband access and speed. Kacific is a Singapore-based telecoms company. Kacific-1, which is planned to launch in 2019, will be a Ka-band, high throughput satellite, in a geostationary orbit, and will potentially provide high speed internet to the 40 million people of the Pacific region. Kacific has signed service agreements with Tuvalu Telecommunications Corporation (TTC), Solomon Telekom Company Limited (Our Telekom), Telecom Services Kiribati Limited (TSKL) to provide high-speed broadband to the 33 islands and atolls of Kiribati, and with Teletok the local telecommunications company of Tokelau.

With the rapidly changing face (and declining cost) of telecommunications in the Pacific the meteorological and hydrological communities will need to recruit and train technicians and scientists to take advantage of these technologies with a range of new and improved hydrological and meteorological services.

## AVIATION

Air transport to and from the Cook Islands, Fiji, Guam, Kiribati, the Marshall Islands, Micronesia, Papua New Guinea, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu (hereafter referred to collectively as the Pacific Islands) creates four distinct types of economic benefit:

- Perhaps most importantly it provides an efficient way for the inter-related family groups on different remote islands to meet from time-to-time;
- There is the "economic footprint" of the industry, measured by its contribution to GDP, jobs and tax revenue generated by the sector and its supply chain.
- There are benefits created for the customer, the passenger or shipper using the air transport service to conduct their business; and,
- The connections created between cities and markets represent an important infrastructure asset which generates benefits, in the case of the 15 Pacific Islands through enabling the development of their tourism sectors.

The aviation sector contributes US $261million (1.5%) to GDP[4] in the Pacific Islands region. This total comprises: US $151 million directly contributed through the output of the aviation sector (airlines, airports and ground services); US $36million indirectly contributed through the aviation sector's supply chain; and US $74million contributed through the spending by the employees of the aviation sector and its supply chain.

At the present time the aviation services in the Pacific link 14 of the 15 countries (only Tokelau does not have an airport) and also link the region to important sources of tourism and other commercial opportunities in Los Angeles, Auckland, Sydney, Brisbane, Cairns, Singapore, Hong Kong, Seoul, Tokyo, Guam and Honolulu (Fig 13). These linkages are crucial for the region and should be strengthened by ensuring that there is a well-qualified group of aviation forecasters providing TAFs, ROFORs, SIGMETs and AIRMETs for the Pacific and a properly trained work force of meteorological technicians to operate and maintain the weather observing infrastructure.

Figure 13: Air Transport Connectivity within the Pacific

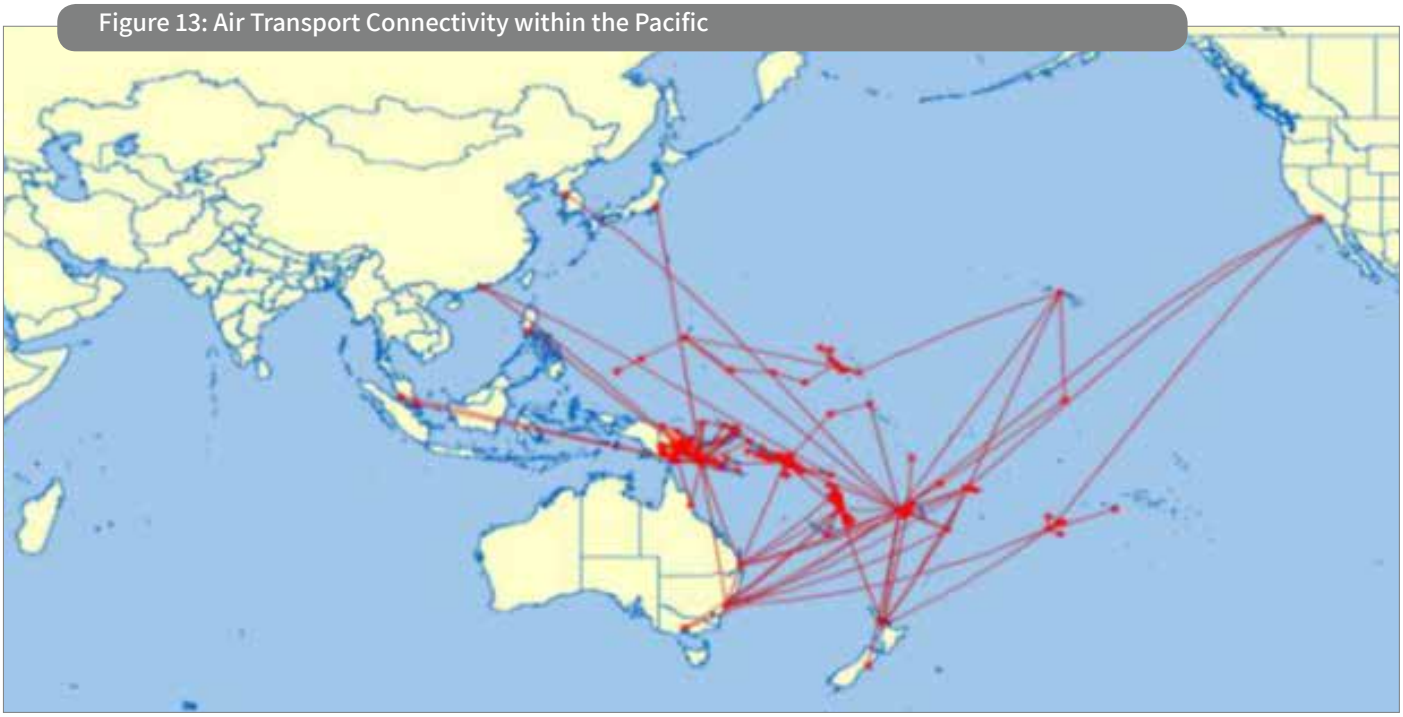


***Figure 13:*** Air transport connectivity within the Pacific, and between the Pacific and key partners beyond the Pacific. Source: IATA

4 (Source: https://www.iata.org/policy/Documents/Benefits-of-Aviation-Pacific%20Ocean%20Islands-2011.pdf)

Supporting the continued safe operation of aviation throughout the Pacific has long been a goal of all the NMHSs in the region. One of the strong calls from NMHSs as the Study Team has spent time with directors and staff of the 13 NMHSs they met with is support in improving the qualifications of the aviation forecasters. This can only be done through having more staff attain BIP-M and BIP-MT level qualifications and by retaining these staff in the NMHs. The most cost effective way to achieve this goal is to have an RTC in the Pacific that sponsors a properly accredited graduate diploma in meteorology that covers the BIP-M curriculum and a certificate level course for the BIP-MT.

## SHIPPING

As previously discussed, Small Island Developing States have high levels of vulnerability that arise from a number of intrinsic characteristics including; small size, remoteness, narrow resource base and exposure to global environmental challenges. It is noteworthy that many domestic inter-island voyages would represent a major international voyage in other parts of the world and some inter-island voyages in the Pacific region are longer and potentially more hazardous than many intercontinental voyages. These geographic and economic characteristics have a direct impact on the provision of efficient, frequent, reliable, affordable, safe and environmentally sound shipping services in the Pacific.

For the Pacific countries seeking to export their produce a considerable number of the segments of inter-island shipping can be characterized by low and often irregular traffic volumes, long voyage distances, imbalanced cargo flows and low unit values of exports. For countries seeking to export goods to the Pacific there are considerations of ship economics (ship size in relation to volume of cargo, required service frequency, route length, ship speed, physical constraints to ship size at ports and time in ports). Furthermore there may be limitations on how and where exports can be directed due to lack of adequate seaport infrastructure and equipment. Finally, in countries where imports and exports are grossly imbalanced (often there are far more imports than exports through Pacific ports) the result is under-utilized capacity (lack of outward bound cargo), low service frequencies, and high costs.

These constraints and challenges of operating shipping in the Pacific can lead to a "vicious downward spiral" of events. The inability of ship operators to make adequate profits leads, in turn, to a further deterioration in shipping services, entailing difficulties in securing finance, low levels of investment, inadequate maintenance, ageing fleets, inability to attract seafarers and qualified shipping company management staff, low productivity, poor service quality (frequency and reliability) or unavailability of services, and compromised safety standards[5].

These difficulties can be further compounded by constraints in the ship repair industry, including: lack of adequate repair facilities, particularly in remote locations; difficulties in obtaining spare parts, especially for aged equipment and machinery; high costs of repairs and low standards of workmanship in ship repairs. In addition, there are various institutional, organizational and cultural constraints that impact on the sector, including: maritime legislation failing to meet international standards; the legislative environment not being conducive to enforcement of ship mortgages or maritime liens; ships being uninsured or uninsurable; limited enforcement of safety standards; inadequately trained seafarers; lack of transparency in the operation of government-owned fleets and in awarding and monitoring of route licenses and contracts for subsidized shipping services.

These many challenges have sometimes led governments to intervene, with mixed results. Their interventions have generally taken two forms. Some have gone into direct service provision through investments in shipping companies, and some have attempted to manage market access to protect operators. The evidence is that neither approach has been very successful, but the experience gained has revealed other ways to facilitate services that do work.

Costly public-sector investments have been made in national flag carriers in a number of countries. A few have survived

5 "Strengthening Inter-island Shipping in Pacific Island Countries and Territories". By John R Moon. 10 July 2013. https://www.unescap.org/sites/default/files/Background-Paper.pdf

and evolved into successful commercial enterprises, but more often than not these investments have required large ongoing subsidies and even led to failures at considerable cost to fragile economies that can least afford them. Governments have also restricted access to routes in an effort to improve the sustainability of a limited number of operators, most often those owned by the government or its nationals. The result has been fewer services provided in a region that demands more of them, and weaker operators that are less able to compete effectively as services and markets are integrated.

There have also been some notable successes that offer key lessons for future development. The Pacific Forum Line was founded as a cooperative regional shipping service in the 1970s as governments saw opportunities to pool resources and develop larger-scale operations. It struggled initially, as narrow national interests clashed with market realities, before reforming along commercial lines and becoming a market leader. Pacific Forum Line vessels currently operate on five routes that connect the Pacific Islands to New Zealand and Australia and provide an important South Pacific Inter-island link. The Pacific Forum Line carries containerised and break-bulk cargo on the New Zealand and Australian trade routes. In addition, to and from Australia bulk liquids are also carried in purpose built tanks.

Shipping remains the most cost effective way to move large heavy cargoes around the Pacific. It is here to stay and needs to be operated cost effectively, safely and in a way that minimizes harm to the environment. The success of the Pacific Forum Line could prove to be an excellent metaphor for a model of a Pacific RTC in which 15 countries co-own an educational institution operated along modern management and business principles appropriate for the organisation. The NMHS of the region have agreed through the PIMS process to increase their focus on marine services and supply improved services to the industry. To meet these goals they will need additional properly trained forecasters and technicians that an RTC in the Pacific would be well placed to provide.

# 3. What is an RTC?

The focus of this study is on the feasibility of a Pacific based World Meteorological Organisation (WMO) recognised Regional Training Centre (RTC). But what is an RTC?

**From a WMO perspective an RTC is defined as:**

*"a national education and training institution, or group of institutions, recognized by Congress or the Executive Council (following recommendation of the relevant WMO regional association(s) as:*

*a) Providing education and training opportunities for WMO Members in the Region, particularly staff of National Meteorological and Hydrological Services (NMHSs);*
*b) Providing advice and assistance on education and training to WMO Members;*
*c) Promoting education and training opportunities in weather, water and climate for WMO Members.*

*These activities are undertaken in accordance with WMO regulations and guidelines. An institute supported by several Members to provide such services could also be recommended by the relevant regional association as an RTC."* See Annex Two – WMO RTC Criteria for further details.

This study examines the feasibility of a Pacific based WMO RTC as a response to one of the line items in the 2015 Nuku'alofa declaration (Annex Seven – NUKU'ALOFA Declaration) following the PIMMM in Tonga. In Figure 14 the elements of the RTC are depicted along with key characteristics that need to be agreed as the RTC proposal is formulated by the Pacific Meteorology Council (PMC) and the Pacific Islands Ministers Meeting on Meteorology (PIMMM). The four elements (NMHSs, Students, Courses and Institutions) are connected by double ended arrows indicating the two way interactions between them. Recalling that the purpose of the RTC is to support the Pacific Key Outcomes (PKOs) of the Pacific Island Meteorological Strategy (PIMS) 2017 – 2026 as shown in Figure 15 it is appropriate to commence the discussion of the four elements of the RTC with the NMHSs who are responsible for the weather, water and climate services to ensure that the focus of the RTC is on the PKOs.

## NMHSs AND OTHER ORGANISATIONS GENERATING AND UTILISING WEATHER, WATER AND CLIMATE SERVICES

Table 2 (from the Study Team's first report) separated the NMHSs based upon staff numbers and different service levels. The columns indicate the highest level of services for each different NMHS type. For each column it is possible to identify generic job roles that accumulate as you move from left to right (i.e. the NMHSs in the column labelled "Observing, climate services and full forecasting capability" would have staff competent in the generic job roles in each of the other columns).

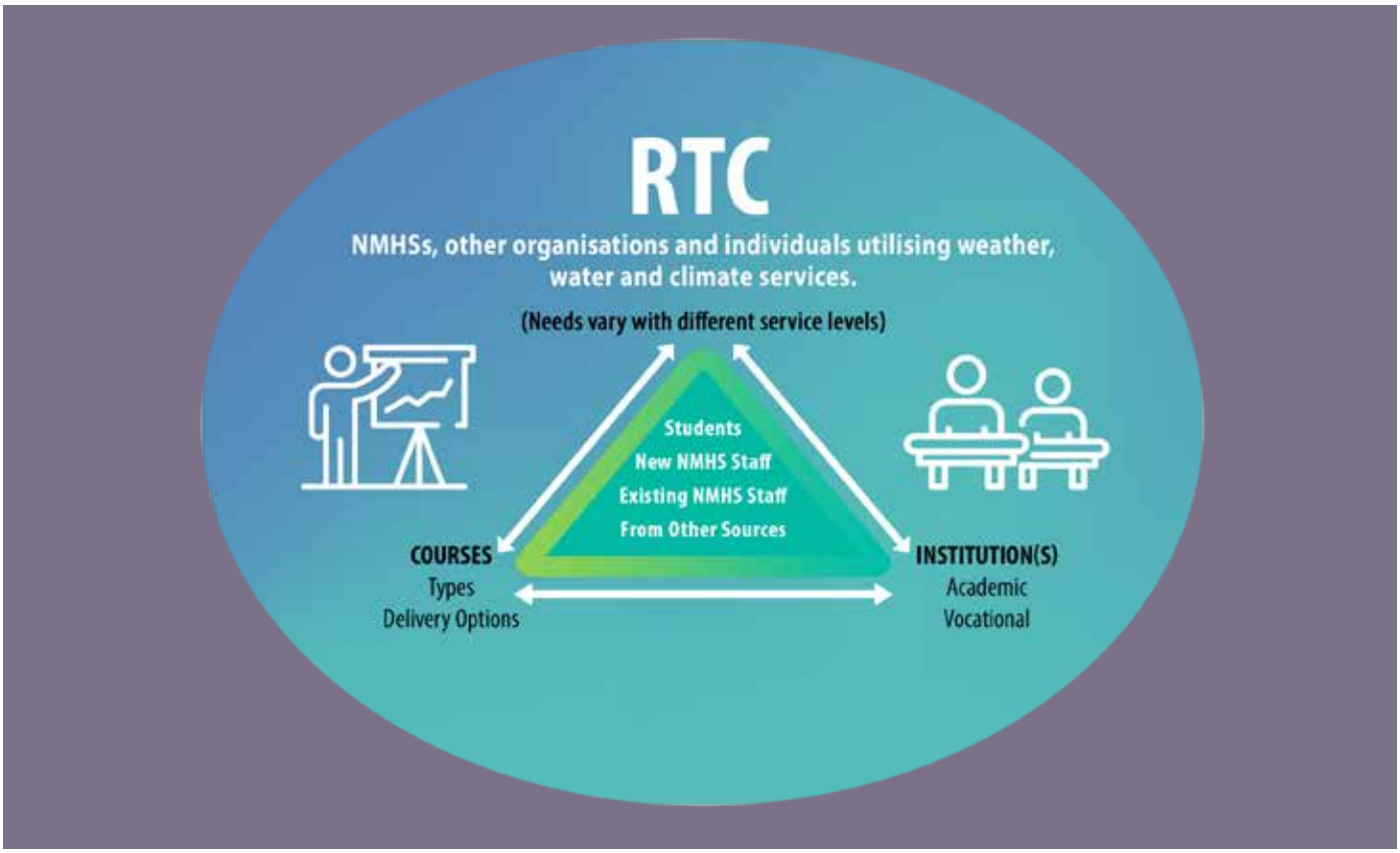



***Figure 14.*** *Schematic of RTC and sub points for each of the elements.*

Table 2: Grouping of Pacific NMHSs

MAPPING OF NMHSS AGAINST SERVICES AND TOTAL STAFF NUMBERS

| TOTAL STAFFING | PROVIDED SERVICES | | | |
|---|---|---|---|---|
| | Observing and basic climate data | Observing and basic climate services with interpretation / elaboration of forecasts and warnings from Fiji Meteorological Service or Hawaii | Observing and climate services with at least some in-house forecasting capability. Aviation forecasts from other country | Observing, Climate Services and full forecasting capability |
| More than 60 staff in 2017 | | | | Fiji<br>Papua New Guinea<br>Solomon Islands |
| Between 20 and 59 staff in 2017 | | FSM | Kiribati<br>Samoa<br>Tonga | Vanuatu |
| Less than 20 staff in 2017 | Nauru<br>Tokelau | Cook Islands<br>Niue, Palau<br>RMI, Tuvalu | | |

***Table 2:*** Grouping of Pacific NMHSs based upon total staff numbers and broad service areas.

Whilst the job roles will be similar across the 15 NMHSs it is up to each country to determine the qualifications that will be required in their service to carry out that job role. The importance of the generic job roles is that they provide the RTC information about the underlying knowledge, skills and behaviours that the staff are required to develop to be able to competently deliver the various services. WMO has many examples of generic job roles and competencies for different service areas that could be used by the NMHSs and the institution(s) making up the RTC to help decide upon course contents and levels. In the end, only if the NMHSs are able to meet the PKOs will the RTC be seen as successful and thus it is critical that the development of the course contents and levels are jointly developed and regularly monitored by the NMHSs and the learning institutions and adjusted as required.

In addition to the NMHSs it is highly likely that other organisations utilising weather, water and climate services will be interested in having their staff attend some of the courses and learning opportunities to be provided by the RTC. The development of staffing profiles and job needs for these potential students will need to be undertaken as the demand grows.

**Figure 15. The purpose of the RTC is to support the NMHSs**

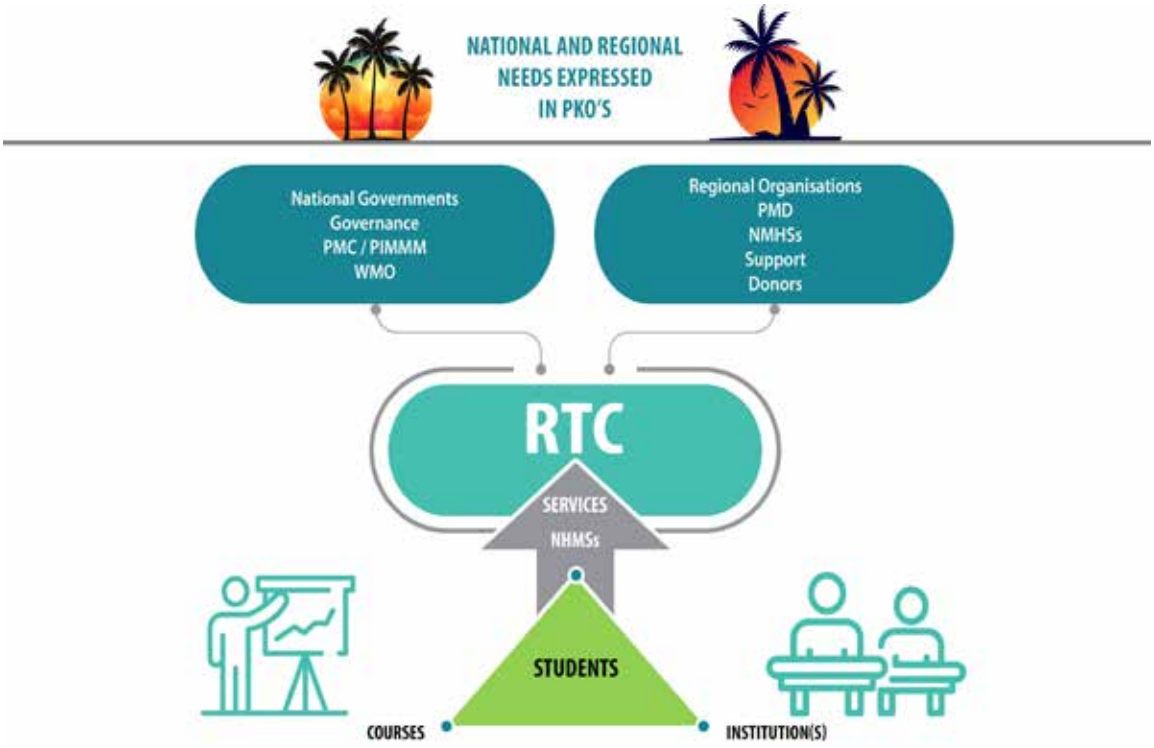



***Figure 15:*** The purpose of the RTC is to support the NMHSs deliver improved weather, water and climate services that will meet the PKO's each country has opted to address. The RTC will be supported by a range of organisations and will be subject to governance at a national, regional and global level.

## STUDENTS

The NMHSs need a workforce to deliver the required services. Other streams of potential students will come from organisations that utilize weather, water and climate products, the general public and research communities. These additional streams of students will have different requirements to the students from the NMHSs.

The NMHS stream has been separated into courses and learning opportunities for new staff and existing staff. Within

these sub-streams there will be further sub divisions relating to job roles and potentially differences between those in professional (degreed) categories and those in technical (non-degreed) categories. The NMHS directors have clearly indicated to the Study Team that they want the technical students to undertake accredited courses at the certificate or diploma level with the possibility of them articulating their studies into degreed courses at a later date.

The generic job roles referred to in the Chapter on NMHSs can be linked to the different types of NMHS staff. For the non NMHS staff it may be possible to identify similar job roles to help determine course contents and levels.

## COURSES

The course types (levels and content) essentially come from the different types of students and their requirements. With the exception of Tokelau all of the NMHS Directors indicated that they want the RTC to be able to deliver face-to-face, online and blended courses (Tokelau did not want online courses). On-the-job training is often used by the NMHSs for training new staff and by donors as they implement projects. On-the-job training allows international trainers to adapt their training to suit local conditions and complement the formal classroom or online training.

The online courses can vary from synchronous (i.e. students undertake studies at the same time but in different locations) to asynchronous where they undertake the studies at their own pace. Blended courses combined online components with face-to-face components.

The different delivery methods have their own advantages and disadvantages which will vary with the course content, experience and expectations of the learners, technology and communication characteristics and the skill of the course designers.

The Directors would like new staff to be able to undertake online courses (possibly asynchronous covering basic technical topics and personnel capability areas) as soon as they join the NMHS and then join moderated courses as they become available.

Similarly having a range of asynchronous in-service and foundation courses available to existing staff assists the Directors in their staff development planning.

## INSTITUTIONS

The academic and vocational institution(s) that will provide the learning opportunities for the students need to be able to cover the priority areas and levels that the 15 NMHSs have identified. As there are a number of existing institutions in the Pacific that have expertise in some of the areas the NMHS Directors have identified it would seem appropriate for them to be involved in the discussions related to forming the RTC. Other institutions have also indicated an interest in participating in the formation of a possible RTC and they could be invited based upon the merits of what they can bring to the RTC and their ability to develop the required expertise.

## DISCUSSION

As discussed in the Chapter 5. Options for a Pacific RTC there are many models for an RTC and many different governance models. Given the role of the PMC and PIMMM in initiating this study, the Study Team suggest that for the Pacific the RTC partners are broader than the academic and vocational institutions that will provide the learning opportunities. The Study Team recommend that the RTC is seen as the learning institutions plus their courses, the students and the

National Meteorological and Hydrological Services (NMHSs) and other organisations for whom the students work or will work. Deciding which parties make up the RTC will be critical when it comes to agreeing the governance for the RTC. Including the NMHSs, the learning institutions and the students as partners in the RTC ensures that they all have a role to play in making it successful and sustainable.

# 4. Market Analysis

This Chapter of the report examines the institutions in and around the study area that have provided education and training opportunities to the 15 NMHSs in the Study area. The Study Team have included expanded details on the institutions, student costs and numbers of students attending the courses from the study area in Annex Four – Education and Training capacity in the field of meteorology and hydrology in the study area.

**The education and training demands from the NMHSs can be broken into:**

- Education and training for new staff at the professional and technician level
- In-service specialist education and training for existing staff at the professional and technician level
- In-service education and training for existing staff at professional and technician level in areas such as finance, management and leadership, project management and Occupational Health & Safety.
- Education and training for new users particularly in the application of climate and water services.

This Chapter examines the institutions in the study area focusing on the first two dot points as they are at the heart of the RTC. The areas in the third dot point are also important but as many other organizations also require their staff to undertake education and training in these capability areas there are a range of private, national and regional providers such as public service departments, some technical colleges, universities and regional institutions. During the visits to the NMHSs the Study Team had the opportunity to meet with the water managers of some of the countries. They expressed interest in the RTC and the possibility of training their staff but no firm numbers were available.

Within the Study area the following institutions are active: the Fiji Meteorological Service (in partnership with JICA), the University of South Pacific, the Secretariat of the Pacific Regional Environment Programme (in-conjunction with the Pacific Climate Change Centre, COSPPac and other donors), NOAA's Pacific Island Training Desk and the University of Papua New Guinea. None of these providers currently have the capacity to provide a BSc in Meteorology that meets the BIP-M requirements and the associated operational training needed to undertake operational forecasting duties for aviation. The University of Hawaii does provide a BSc in Meteorology that meets the BIP-M requirements however this is not offered through the Pacific Island Training Desk. FMS offers a training courses that addresses those parts of the BIP-MT required for typical tasks undertaken by junior and middle level meteorological technicians (surface and upper air observations, routine maintenance, data entry, basic climate data and basic meteorology). The Pacific Island Training Desk provides education and training that address aspects of the senior Meteorological Technician role. Table 3 lists the relevant institutions and which of the high level NMHS needs they address.

Table 3. Pacific institutions and the high level NMHS needs they address

| Institution | BIP-M | BIP-MT | Specialist in-service training |
|---|---|---|---|
| **Fiji Meteorological Service in partnership with JICA** | | Non accredited training for the roles of junior and middle level meteorological technician | Non accredited courses for meteorological technicians and meteorologists covering a wide range of specialist topics |
| **University of the South Pacific** | Accredited subjects. Partially covers the BIP-M at undergraduate and post graduate levels | | |
| **University of Papua New Guinea** | Accredited subjects. Addresses some aspects of the BIP-M at undergraduate and post graduate levels | | |
| **SPREP** | | | Non accredited in-service courses addressing ICT, climate data, management and with the development of the PCCC advanced climate data and services. Also cooperates with COSPPac on climate services |
| **NOAA's Pacific Island Training Desk in** | | Partially addresses aspects of the BIP-MT at the senior Met Tech level. Non acc | |
| **University of Hawaii** | Accredited BSc in Meteorology course addressing the BIP-M requirements. Established links with NWS to cover operational aspects. | | |

Outside of the Study area the Bureau of Meteorology Training Centre (BMTC) in Australia, the Indian Meteorology Department (IMD), the Philippines Atmospheric and Geophysical Astronomical Service Administration (PAGASA), the University of the Philippines (UoP) and Victoria University in Wellington (in partnership with Met Service New Zealand) have regularly provided education and training for some or all of the 15 NMHSs. All of these institutions provide courses that meet the BIP-M requirements although the IMD and PAGASA courses are not accredited.

In addition to the NMHS students there are potential students from organisations outside of the NMHSs (i.e. other government departments, regional institutions etc.,) who may wish to access some of the training courses. Improving the ability of organisations to apply the services and products the NMHSs develop is particularly important in the climate and water sector where many countries rely on rain water for their drinking water or for rain water to replenish the ground water supplies.

There are only three institutes offering initial training courses for meteorological technicians. They are the NMHS training centres in FMS, PAGASA and IMD. None of the courses is accredited with the tertiary sector in their country.

## Discussion

Table 4 indicates the annual tuition costs in USD for students undertaking a meteorology course that meets BIP-M requirements in a range of institutions in and around the Pacific. The green shaded cells indicate institutions running accredited courses at either the BSc or MSc level. The table gives the costs for resident / regional students and non-resident / international students. As can be seen from the table the courses vary from non-accredited courses of 12 months to MSc courses of up to two years. Tuition costs also vary dramatically from nil to very low at India Meteorological Department, PAGASA and the University of the Philippines to US $40,000 at Victoria University of Wellington in New Zealand. To calculate the total costs for the courses it would be necessary to include return airfares, living expenses, visas and health insurance costs.

**Table 4: Comparison of tuition costs between the universities offering courses that address some or all of the BIP-M.** Green cells indicate accredited courses that meet the BIP-M requirements.

| | Comparison of Annual Tuition Fee Rates (all costs $US) | | | |
|---|---|---|---|---|
| | Resident[6] fees | | Non resident | |
| | Undergraduate | Graduate | Undergraduate | Graduate |
| **University of Guam** | £ 5,040 | $ 5,130 | | |
| **University of Hawaii** | $5,544 | $7,800 | $16,560 | $18,840 |
| **University of Papua New Guinea** | $2,975 | | $5,923 | |
| **University of the South Pacific** | ~$6,000 | ~$2,100 | ~$11,450 | ~$12,700 for Post Graduate<br>~$13,500 for MSc |
| **Bureau of Meteorology Training Centre (Post graduate diploma)** | | | | $25,000 |
| **University of Victoria Wellington (MSc)** | | | | $ 25,000 for 6 month post graduate course and $40,000 for 12 month MSc |
| **University of the Philippines (MSc and post graduate diploma but they only address the BIP-M requirements, not the operational training)** | | | | $ 1,200 for the 12 month post graduate diploma<br>$1,200 per year for the two year MSc |
| **India Meteorology Department (12 month non accredited course)** | | | IMD are waiving costs for FMS | |
| **PAGASA (11 month non accredited course)** | | | Students from the SW Pacific are not charged tuition fees | |

6 For USP there are three tuition fee rates. An international rate that applies to students who do not come from the 12 countries who make up USP. Students from the 12 countries that make up USP are charged a third country rate (about three times the regional rate) if they have scholarships or a regional rate if they are self-funding. For the purpose of this study the regional rate for USP is considered as the resident rate. The regional rate varies for different courses.

Table 4 indicates that there are many opportunities for staff from the Pacific Islands to access courses that meet the BIP-M requirements, quite a few of them with accredited courses, provided funding is no obstacle. There are far fewer opportunities for the NMHSs to access technician training and none of the technician courses are accredited.

The analysis in Annex 4 indicates that there are many opportunities for the NMHSs to access in-service education and training opportunities in and around the Pacific. CMATC and NUIST typically run more than 8 short term courses every year. Whilst there are no tuition fees for these courses, countries are expected to fund their return airfares and visa fees which is not possible for nearly all of the NMHSs in the study area.

# 5. Options for a Pacific RTC

The Study Team were tasked to provide and evaluate options for an RTC in the Pacific. To do this the current WMO RTCs were examined to identify different options for forming RTCs and to see if there were any existing RTCs addressing similar geographic or education and training needs. This chapter also uses some of the WMO RTC selection criteria (Annex Two – WMO RTC Criteria ) and requirements that came up during the discussions to develop a set of criteria. These selection criteria are then used to evaluate the institutions identified in Annex 6 and what sort of RTC model could be pursued.

## SELECTION CRITERIA

Annex Two – WMO RTC Criteria outlines the considerations that must be addressed by WMO when considering a request for a new RTC. There are two parts to the process:

The procedural part where the proposal is discussed and hopefully agreed at the regional association session. Provided it is agreed then the proposal is considered by the WMO Executive Council based upon advice from the Secretary-General, the Executive Council Panel of Experts on Education and Training, the regional association and other parties as required; and,

**The detailed criteria where the Member offering to host the RTC ensures that it has the human and financial resources and facilities to undertake the following activities (see Annex Two for the full details):**

- Identify (regional) learning needs;
- Design the learning service;
- Deliver the learning service;
- Assess learning and evaluate the learning service; and,
- Administer and manage the learning service.

See also Annex Three - Roles and Responsibilities of Parties involved in an RTC for further details of the various roles that individuals and institutions involved in an RTC take on when an RTC is approved. Typically the Permanent Representative of the country hosting the RTC will ensure that there are Memoranda of Understanding in place between the various institutions outlining how it will work in practice.

The Study Team have considered the WMO RTC criteria plus the background to the study in developing the following criteria to be used when considering the model and institutions who could be involved in a Pacific RTC. All criteria have an equal rating. The criteria were designed to ensure that first and foremost the needs of the 15 NMHSs are met in an ongoing fashion.

- Meets most if not all of the NMHS needs
- Regionally supported / representative
- Sustainable (minimise cost and have sources of funding)
- Increases expertise in region (NMHS and regional institution(s))
- Have sufficient intellectual capital or can be reasonably expected to gain it

- Facilities and supporting mechanisms in place
- Experience in working regionally
- Willingness / potential commitment to the RTC
- Courses should be accredited within the post-secondary education framework
- Courses address the WMO education and training requirements
- Alignment of course offerings with the PIMS strategies and priorities
- Long term commitment from the education and training providers and supporting mechanisms to ensure that a solid operational basis is established and continued into the future
- Flexibility to customize the programmes, ability to tailor programs to accommodate persons for whom English is a second language

A further consideration is that whatever model is selected it should reduce duplication of effort.

## EXISTING RTC MODELS

According to the WMO website (https://www.wmo.int/pages/prog/dra/etrp/rtcs.php) there are 27 WMO RTCs (see Annex One – Examples of RTCs in other countries, for further details). The Study Team have grouped them into three categories based upon their structure to help in the assessment of options for the Pacific. The RTCs can be grouped along the following lines:

- **Single component RTC**
- **Multiple component RTC**
- **Regionally funded RTC**

Using their knowledge of the WMO RTCs the Study Team has selected an example from each group that addresses similar requirements to those that the NMHS Directors in the study area have identified. As the study is to be forward looking a further option along the lines of the WMO Global Campus (https://public.wmo.int/en/resources/training/wmolearn) is considered.

## SINGLE COMPONENT RTC

None of the RTCs in Annex One – Examples of RTCs in other countries offers the full range of courses to international students that the NHMS Directors have requested. Nationally the RTCs in Iran, Korea, South Africa and Turkey do address the range of courses that have been identified but only Korea and South Africa are registered training organisations delivering accredited courses. All of these RTCs are embedded in the NMHS. One of the reasons for the RTCs not offering all of their courses internationally is language, with the exception of South Africa, the national language of all of the other RTCs is not English.

Within the study area the NMHSs that include a training unit are Fiji and Tonga. Neither of these training units offers the full range of courses that the Directors have requested although FMS indicated that they plan to increase the range of courses they are currently providing.

## MULTIPLE COMPONENT RTC

Noting that four regional institutions (FMS/JICA, NOAA/PITD with the University of Hawaii, USP and SPREP/COSPPac) are currently providing education and training opportunities covering the identified priority areas perhaps the best

examples from the multiple component RTCs are the Russian Federation and Brazil. The RTC in the Russian Federation has three components (university, NMHS and a vocational college), all from different ministries in the Russian Government. In the case of Brazil the RTC has more than 15 different components with a small coordinating office to oversee and promote the RTC. The majority of the other cases are RTCs with a university and NMHS component, in the case of India there are four components to the RTC, two from the NMHS, one from the Central Water Authority and the last a University Department with a hydrology focus.

Within the study area the NMHSs of Fiji and Papua New Guinea have developed partnerships with a university within their country to provide some specialized education and training. Through its role as a WMO Regional Specialised Meteorology Centre (RSMC) and its membership of the Pacific Meteorological Council the Fiji Meteorological Service already has relationships with US National Weather Service Office in Hawaii which hosts the PITD and SPREP which could help it take a leading role in developing an RTC in the Pacific.

## REGIONALLY FUNDED RTC

The Caribbean Institute for Meteorology and Hydrology (CIMH) in Barbados offers a model for how 16 small island tropical countries in the Caribbean agreed to work together to fund an institute that specifically addresses their education and training issues. Each of the 16 countries pays an annual subscription towards the running of the institute. CIMH has 35 staff in total, with 13 academic staff, 7 technical staff, a Principal, an ICT specialist, a librarian and a range of administrative staff. The primary roles for CIMH are to:

- Provide facilities for the training of various categories of meteorological and hydrological personnel
- Operate as a centre of research in meteorology and hydrology and associated sciences
- Operate as contractors and consultants on various meteorological and hydrological projects
- Maintain a service for the upkeep, repair, and calibration of meteorological instruments
- Provide advice to participating governments on meteorological and hydrological matters
- Collect, analyse, and publish meteorological and hydrological data

In the Pacific USP is a regionally funded organisation that is already providing some education and training opportunities to the NMHSs in the study area.

## A DISTRIBUTED RTC BASED ON THE WMO GLOBAL CAMPUS PRINCIPLES

The WMO Global Campus is a concept that encourages more coordination and cooperation between training institutes, particularly WMO RTCs. The WMO Global Campus concept was discussed by the World Meteorological Congress in 2015 with Congress requesting that a fully prepared proposal was provided to the Congress in 2019 for consideration for formal approval.

For the Pacific an RTC created using the principles of the WMO Global Campus could provide a framework to allow multiple partners in the region to contribute to the overall training effort. It also provides a mechanism for the Pacific to engage with other RTCs and training institutions to cover specialist areas that institutions in the Pacific either cannot cover or cannot fully cover. The RTC in Brazil follows this model but on a national basis. If the Pacific took this route it would be the first regional example of this type of training centre.

## EVALUATION OF THE OPTIONS

For the purposes of evaluation FMS and JICA are considered as a unit. However, the Study Team note that JICA stresses self-sustainability as a basic philosophy common to all its assistance programmes. If JICA does not extend its support to FMS past the end of 2018 FMS may not have the funding support necessary to increase and improve the courses they are offering or even continue them at the current level unless another long term donor is identified. Similarly SPREP, the Pacific Climate Change Centre (PCCC) and COSPPac are considered as one unit due to their close cooperation and coordination.

The Study Team used the selection criteria discussed above to evaluate the five potential institutions identified during the study (Annex Six – Evaluation of regional institutions against the Study Team's selection criteria). Four of the five institutions have indicated a strong interest in being involved in the development of a Pacific RTC. NOAA's Pacific Island Training Desk did not comment on whether they wished to be part of the RTC or not. The Study Team included the PITD /University of Hawaii based on the course content and their reach in the past and expected reach in the future.

The evaluation showed that none of the institutions meet the criteria, however a combination of the institutions could address the needs of the 15 NMHSs. The Fiji Meteorological Service with continued support from JICA or another long term donor appears to be a key institution. A partnership of USP and the University of Hawaii potentially with some involvement from the UPNG could provide a course that meets the BIP-M and operational requirements, however USP or USP and UPNG by themselves may have difficulty initially being able to deliver a course that meets the BIP-M and operational requirements. FMS becoming a Registered Training Organisation and accrediting the longer technician courses at either certificate or diploma level would address one of the big requirements expressed by the NMHS Directors. SPREP and the PCCC with their focus on climate data / climate services and support to the 15 NMHSs would appear to be key player in addressing the regional climate data / climate services' needs. Ideally the PITD in conjunction with the University of Hawaii and / or University of Guam would either be part of the RTC or coordinate closely with the RTC for the benefit of the 15 NMHSs.

If the institutions agreed to work together as a WMO RTC to meet the education and training needs of the 15 NMHSs the RTC model would either follow the multiple component model or potentially follow the WMO Global Campus principles with a multi-institution partnership.

The Study Team are well aware of the complexity and difficulties in developing multi-institution partnerships however the overall benefits for the region and the potential to increase expertise in the partner institutions would appear to make this approach worthwhile considering. This is particularly appropriate for a course such as a Graduate Diploma of Meteorology that addresses the BIP-M requirements as well as the operational requirements.

# 6. Potential Partners in a Pacific RTC

Under the Terms of Reference the Study Team are required to undertake a thorough and impartial review of interested or prospective regional or national Institutions in terms of their capacity to host the RTC. In many cases the functions of RTC's are carried out by a partnership of NMHS with one or more academic institutions though there are a wide number of variations, see Annex One – Examples of RTCs in other countries for further details.

Figure 15 shows the RTC as a critical element for the NMHSs being able to deliver the PKOs as expressed in the 2017-2026 PIMS. The RTC is made up of the NMHSs, the students, the courses and the institution or institutions delivering the courses. The RTC is supported in its role by the Pacific Meteorological Desk, other regional organisations and donors whilst governance would be provided by an agreed arrangement involving the PMC / PIMMM plus national governments and WMO.

To identify potential partners in a Pacific RTC the Study Team compiled a listing by country of the institutions that either had proven experience of providing education and training opportunities to one or more of the 15 NMHSs in the study area or those that had expressed interest in doing so. The complete listing is shown in Annex Four – Education and Training capacity in the field of meteorology and hydrology in the study area. It should be noted that Universities and TVET institutions who do not specifically service the needs of the NMHSs still have a role to play in providing the basic science and technology related courses required as prerequisites for the follow on specialist studies.

Based upon their long term commitment to providing education and training opportunities to the 15 NMHSs the Study Team decided that the following institutions should be further considered for participation in the RTC: the Fiji Meteorological Service; the University of the South Pacific; the University of Papua New Guinea; and the Secretariat for the Pacific Environment Programme (SPREP) particularly the Pacific Climate Change Centre as it develops.

In the future other institutions in the Pacific could develop expertise that would warrant including them within an RTC and the WMO processes allow for this possibility. For example the TVET institutions typically provide trade related courses at either certificate or diploma level. The modular nature of many of the TVET courses would make it possible to use units from a range of areas of interest to the NMHSs (such as Occupational Health and Safety, Management and Leadership, ICT and quality management) to create specific diploma or certificate level courses if the core meteorological units could be developed and accredited. This could come about through a partnership between one of the NMHS training units such as Fiji, Papua New Guinea or Tonga and one or more of the TVET institutions. Alternatively the FMS training unit may gain Registered Training Organisation status and go on to accredit the specialist meteorological or hydrological courses themselves. Similar considerations can be made for university courses or partnerships between an NMHS and a University.

In addition to the four institutions noted in the earlier paragraph for further investigation the Study Team recommend that the Pacific Island Training Desk in Honolulu / University of Hawaii is also further considered for a role in the proposed RTC.

The Study Team recognise that JICA have a long term commitment to providing education and training to the NMHSs in the Pacific. In the past JICA has provided education and training in Japan in-conjunction with the Japan Meteorological Agency and more recently with FMS. In the near term future JICA will also be partnering with the Pacific Climate Change Centre (PCCC)[7]. The study team consider the JICA/FMS partnership a key component in the proposed RTC as JICA funding plays an important part in supporting travel and per diem for the students as well as supporting developments at FMS. If JICA do not continue the partnership with FMS it may be difficult to maintain the same student numbers at FMS.

The Study Team also examined other education and training providers who had provided education and training opportunities to the 15 NMHSs. These institutions are described in the second table in Annex Four – Education and Training capacity in the field of meteorology and hydrology in the study area. These institutions cover a wide range of courses and levels and could, subject to administrative arrangements, potentially support the proposed RTC as it sets up and commences delivery of courses. In the first instance they have been excluded from the shortlisting based upon feedback from the 15 NMHS Directors that they are not in the Pacific and thus the Directors have no input into their course content or delivery, the organisational cultures are quite different and they focus on the weather and climate aspects of their own regions meaning the Pacific students are not as prepared for work in the Pacific as they would be if they trained locally.

Table 5 outlines the rationale for shortlisting USP, UPNG, FMS, SPREP and PITD / University of Hawaii for further consideration in the feasibility study.

**Table 5. Rationale for Shortlisting Institutions for Consideration in the Feasibility Study**

| Institution | Rationale for Inclusion in the Study |
|---|---|
| **Fiji Meteorological Service (FMS)** | FMS has a training unit that has a long history of providing education and training opportunities in many different subjects to meet education and training needs of the NMHSs across the Pacific. With the assistance of JICA the FMS training capability is being significantly increased |
| **University of the South Pacific (USP)** | USP is a regional university with campuses in most of the countries in the study area. It has modern facilities and telecommunications infrastructure to support synchronous and asynchronous distance learning. Through the PaCE-SD initiative it is already addressing some aspects of climate, climate change, climate change policy as well as some aspects of weather and in the near future oceanography. Recently USP has been accredited to provide TVET courses. The Suva campus is close to the Suva office of the Fiji Meteorological Service and the two institutions have identified the mutual benefits for closer cooperation. |
| **University of Papua New Guinea (UPNG)** | The Physics Department of the University of Papua New Guinea has a number of ex staff from the Papua New Guinea National Weather Service who are keen to run either a meteorology course or potentially a graduate diploma in meteorology. Ideally ten students a year are needed to make the course viable. The Physics department are currently offering 2 units related to meteorology and climate as part of the BSc and another 2 units as part of their fourth year graduate program. The Dept of Geography also provides a hydrometeorology course and a tropical climatology course. |

7 Regarding the PCCC, JICA granted total funding for the PCCC construction and has also approved an education and training project through the Center for three years. The detailed plan of the training project is still under consideration. It is expected to focus on adaptation, mitigation and climate finance access.

| Institution | Rationale for Inclusion in the Study |
|---|---|
| SPREP | SPREP's mandate includes acting as a focus for support to the 15 NMHSs in the study. This support includes identifying funding opportunities and education and training opportunities. SPREP, usually in conjunction with a donor has already offered a range of training courses in climate data, ICT and management for the NMHSs and with the establishment of the PCCC will be offering a much wider range of courses related to climate data and climate services. In addition SPREP is working closely with COSPPac in the organisation and delivery of climate related education and training opportunities. |
| NOAA's Pacific Island Training Desk (PITD) in conjunction with the University of Hawaii. | NOAA's PITD has a long record of supporting the 15 NMHSs with education and training opportunities. A review of the desk's role some years ago saw it focus on basic meteorology, working with clients and interpreting numerical weather prediction output and satellite data. |

**In the Chapter on 4. Market Analysis it was stated that the education and training demands from the NMHSs can be broken into:**

- Education and training for new staff at the professional and technician level
- In-service specialist education and training for existing staff at the professional and technician level
- In-service education and training for existing staff at professional and technician level in areas such as finance, management and leadership, project management and Occupational Health & Safety.
- Education and training for new users particularly in the application of climate and water services.

This classification is now used to examine the how the institutions could partner in a Pacific RTC. Whilst the focus in the following text is on meteorology similar arguments can be made for courses and study addressing climate and hydrology requirements of the NMHSs and other organizations in the study area.

## *BIP-M and BIP-MT Initial Education and Training Courses*

### BASIC INSTRUCTION PACKAGE – METEOROLOGIST (BIP-M)

Successful completion of a Basic Instruction Package – Meteorologist (BIP-M) course at university-degree level is mandatory for personnel providing meteorological services to the aviation industry, for all other areas of forecasting it is strongly recommended. The BIP-M learning outcomes are specified in WMO Publication 49, WMO Technical Regulations Volume I – General meteorological standards and recommended practices and further elaborated in WMO Publication 1083, Guide on the Implementation of Education and Training Standards in Meteorology and Hydrology. Volume 1, Meteorology.

It is instructive to recall that the overall aim of the BIP-M is to provide an individual with a robust and broad range of knowledge of atmospheric phenomena and processes, together with skills related to the application of this knowledge.

The BIP-M learning outcomes are typically achieved by completing either a BSc in Meteorology or by completing a science or engineering degree to gain the required background mathematics, physics, computing and laboratory skills and then taking an intensive post graduate course in Meteorology.

WMO 1083 goes on to specify that individuals wishing to work in areas such as weather analysis and forecasting, climate modelling and prediction, and research and development will need to undertake further education and training to

achieve the specialized job competencies in these areas. As the Pacific RTC is only being formed to meet the needs of the NMHSs any BIP-M course will need to also cover these additional specialist areas.

Within the study area the Meteorology Department at the University of Hawaii offers a course that addresses the BIP-M requirements and through its links with the US National Weather Service Office in Honolulu it provides the required operational education and training. The Fiji National University commenced a BSc in Meteorology but suspended it due to lack of student numbers. They have stated that they are prepared to launch it again if there were enough student numbers. The University did not state whether or not their course was BIP-M compliant. At this stage the Study Team does not consider that USP alone can offer the full BIP-M or the requisite operational education and training knowledge and skills.

In terms of developing capacity in the Pacific the Study Team encourage USP to liaise with the University of Hawaii and the University of Papua New Guinea and potentially with the Caribbean Institute of Meteorology and Hydrology to examine options for developing and delivering a shared teaching programme that addresses the formal and operational BIP-M requirements. The Study Team are aware of other universities in the Pacific developing and delivering shared programs with partners in and around the Pacific to address niche domains that they would not have the student numbers to address by themselves. As FMS increase their training capacity it may be able to take on more of the operational knowledge and skill development delivery. Ideally each of the partners would be able to contribute towards the teaching load in either core or elective areas.

A slight variation on how the BIP-M might be delivered through a Pacific RTC would be every two or three years a cohort of students (perhaps as many as 15 or 20) be identified to undergo a six months theoretical course-work component followed by three months of operational knowledge and skill development at an appropriate Pacific NMHS. USP, UPNG and UH could possibly all contribute staff with donor aid being used to underwrite the triennial course on a project basis. In the intervening years between courses potential students could be encouraged to complete COMET courses and other “foundational” training.

The Study Team does not underestimate the challenges involved in creating a cooperative undertaking through a Pacific RTC but believe that the benefits for the students and the institutions are worth the effort. Such a partnership would likely evolve over time with each of the partners finding the role most suited to it, and the level of demand for such training would become clearer.

## BASIC INSTRUCTION PACKAGE – METEOROLOGICAL TECHNICIAN (BIP-MT)

Successful completion of a Basic Instruction Package – Meteorological Technician (BIP-MT) course is recommended for personnel working in NMHSs in a technical capacity. The BIP-MT learning outcomes are specified in WMO Publication 49, WMO Technical Regulations Volume I – General meteorological standards and recommended practices and further elaborated in WMO Publication 1083, Guide on the Implementation of Education and Training Standards in Meteorology and Hydrology. Volume 1, Meteorology.

Where Meteorological Technicians are providing meteorological forecasts to the aviation industry, the personnel must successfully complete a course that meets the BIP-M requirements consistent with the weather phenomena in the area, the required services and local practices and procedures. In the Caribbean the Senior Meteorological Technician Course from the Caribbean Institute of Meteorology and Hydrology addresses the BIP-M requirements at university degree level but graduates are awarded a diploma not a degree as the course does not have the breadth and depth of a full university degree.

It is instructive to recall that the overall aim of the BIP-MT is to provide an individual with a basic knowledge of

atmospheric phenomena and processes, together with skills related to the application of this knowledge.

Individuals wishing to work in areas such as weather observing, climate monitoring, network management, and provision of meteorological information and products to users will need to undertake further education and training to meet the specialized job competencies in these areas.

Whilst the BIP-MT does not specify an academic level the Directors of the 15 NMHSs clearly indicated to the Study Team that they desire the RTC to provide an accredited course for the Meteorological Technicians at either certificate or diploma level. Ideally their staff would be able to undertake progressive courses that built upon one another and that could provide exemptions towards possible degree studies at a later date.

Within the study area FMS and the PITD provide complementary courses that address many of the aspects of the BIP-MT although neither course is accredited in the tertiary system of Fiji or Hawaii. The Study Team encourages FMS to seek options for getting their BIP-MT course accredited either by FMS becoming a registered training organization and then accrediting the course within the Fiji TVET system or by partnering with another institution such as USP to get the course accredited. Additionally the NMHSs in the study area would be well served by FMS liaising with the PITD to seek options for better coordinating the content and level of their courses to minimize overlap and together more fully cover the many roles undertaken by the meteorological technical officers in the study area.

## SPECIALIST IN-SERVICE EDUCATION AND TRAINING FOR METEOROLOGICAL PROFESSIONALS AND TECHNICIANS

Within the study area FMS is the main provider of specialist in-service education and training opportunities for meteorological professionals and technicians. These courses are typically run in partnership with JICA using the FMS facilities and their training staff and professionals with additional international experts as required. Some of the courses are essentially one-time events addressing particular issues whilst others are repeated as funding and needs dictate. The Study Team recommend that FMS examine options for including these regular in-service courses as electives or units within the BIP-MT or BIP-M courses to ensure that the participants get added value from the training although it may mean additional learning for them to meet the accreditation requirements.

In addition to these courses COSPPac is providing climate service related courses. In the near future SPREP through the Pacific Climate Change Centre will also be providing courses addressing climate data and climate service needs.

There are many other organizations and projects providing training opportunities to the staff of the NMHSs. The Study Team believe that the 15 NMHSs would be well served if the RTC, in partnership with the Pacific Met Desk and WMO Sub Office in RA V, could liaise with the various providers to better coordinate the timing and content of the training opportunities available to the NMHSs. The RTC would be able to take advantage of the WMO Learn Events calendar (part of the WMO Global Campus https://public.wmo.int/en/resources/ training/wmolearn) to list and identify training opportunities for the region and to promote their own courses and activities.

## DISCUSSION

In summary, by examining the capabilities of the institutions with the 15 study countries the Study Team have identified four regional institutions that could play a role in the development of an RTC in the Pacific. Additionally the Study Team have included a fifth institution, the PITD / University of Hawaii due to its ongoing support to the 15 countries and strength of the meteorology programme. Furthermore by looking at the types of courses required by the NMHSs the Study Team have suggested how the institutions could partner to address the NMHS needs.

# 7. Benefits and Risks of a Pacific RTC

To identify the benefits and risks of a Pacific RTC it is first necessary to define the different groups of stakeholders. The Study Team have identified the following groups of stakeholders:

- Staff of NMHSs who want to build a career in meteorology
- The 15 NMHSs that are the primary users of the RTC;
- Other organisations or groups with an interest in weather, water and climate
- The institution or institutions that would form the RTC;
- The regional organisations involved in supporting weather, water and climate activities in the Pacific;
- Development agencies and donors supporting weather, water and climate activities in the Pacific; and,
- The RTCs and training institutes that have been supporting the 15 NMHSs.

The benefits, challenges and risks for each of these groups is examined in Table 6.

**TABLE 6: Benefits, Risks and Challenges for different stakeholders in a Pacific RTC**

| | Benefits | Risks | Challenges |
|---|---|---|---|
| **NMHS Staff** | • Motivated by being able to see an accessible educational structure that will let them build a career in meteorology through gaining properly accredited qualifications | • Staff will potentially have greater mobility with internationally recognised qualifications | • To ensure that the education and training is of a high standard and fit for meteorologists working in the Pacific. |
| **15 NMHSs** | • Education and Training needs are met regionally using cost-effective approach.<br>• More control over the types of courses and topics that are offered.<br>• Courses directed to Pacific needs and interests<br>• Encourages networking and coordination across the 15 NMHSs | • NMHSs may need to identify funding to pay annual subscriptions to the RTC<br>• Courses may not run annually due to small class sizes | • Getting agreement between the NMHSs on detailed priorities<br>• Getting agreement on governance model and whether and how much annual subscriptions |
| **Other Users** | • Access to weather, water and climate training opportunities<br>• Increased awareness of NMHS activities and improved coordination | • Non NMHS users may not be able to influence the content of the courses or have priority access to the courses<br>• RTC may not be willing to adapt courses for non specialist users | • Having RTC and NMHS seeing the needs of the other users as a priority |

| | Benefits | Risks | Challenges |
|---|---|---|---|
| **RTC Components** | • Increased student numbers which may allow increase in staffing and improvement in facilities<br>• Increased profile in regional and global education and training<br>• Higher profile to attract new funding and research collaboration<br>• Regional education and training offerings coordinated and developed with no duplication in efforts. | • NMHSs may not be able to provide the funding or student numbers required to make some courses viable<br>• Having staff with the required knowledge, skills and behaviours to provide the high quality / effective learning opportunities | • Establishing a governance model<br>• Getting agreement with partners on who will cover what<br>• Coordinating activities between partners<br>• Getting agreement with the users on their needs and priorities<br>• See the other components as partners rather than competition |
| **Regional Organisations** | • A one stop shop for education and training requests | • Not overcoming competition, distrust and suspicion between organisations that may have overlapping interests | • Obligation to consider new regional / international player making any strategic/political decisions<br>• Developing strong working relationship with organisations that may be competing for similar funds in other contexts |
| **Development Agencies** | • A one stop shop for education and training requests<br>• Provides a focus for development of a regional facility.<br>• Provided the RTC is used for training associated with development projects there will be regional experience left once the project has completed | • RTC may not be able to deal with their requirements in the required time frame | • Working with a multi -organisation bureaucracy.<br>• Encouraging the RTC to recognise and adapt to the development agencies' needs. |
| **Other RTCs and Training Institutions** | • A one stop shop for education and training requests<br>• A new partner and new skills that may be of use or interest to their domestic users | • Decreased student numbers in their courses | • It could change existing partnerships |

**WMO lists the benefits of hosting an RTC (Chapter 2, page 11 of WMO 1169) as:**

- **RAISING VISIBILITY**. Having RTC status can raise the visibility of an institution on a national, regional and global basis and thereby attract more students and increased financial support;
- **SUPPORTING CAPACITY DEVELOPMENT**. RTCs support capacity development by providing services at the RTC or by sending instructors to provide training at NMHSs;

- **IDENTIFYING EDUCATION AND TRAINING NEEDS**. RTCs can take the lead or be a key contributor to identifying national or regional education and training needs;
- **ELICITING FUNDS TO SUPPORT INTERNATIONAL STUDENTS**. Being designated as an RTC provides institutions with an increased ability to elicit funds from governments to support international students;
- **PROVIDING ADVICE TO THE SECRETARIAT**. RTCs can be points of contact for the Secretariat in the development of activities and policies concerned with education and training;
- **ACTING AS AGENTS**. RTCs can act as WMO agents in their own countries and as an interface between WMO initiatives and national education and training systems;
- **IMPROVING INFRASTRUCTURE**. Having RTC status provides increased opportunities to obtain national and international support to improve infrastructure (for example, computing facilities) which then benefits the wider meteorological community;
- **PROVIDING CONSULTANCY SERVICES**. RTC status provides an opportunity to offer consultancy services which provide an additional source of income and help develop expertise.

## DISCUSSION

This Chapter has identified a number of stakeholders in the RTC and the benefits, risks and challenges for them. The benefits for the different stakeholders are reinforced by the benefits identified by WMO in WMO Publication No. 49. The Study Team have interpreted Risks as what happens if the Challenges are not dealt with successfully. The challenges primarily relate to funding, low student numbers and developing and maintaining the required partnerships between the various organisations involved in the RTC.

# 8. Financial Case for an RTC in the Pacific

## BACKGROUND

The Caribbean Institute for Meteorology and Hydrology (CIMH) is a WMO RTC located in Barbados. CIMH is funded by the 16 Member States that comprise the Caribbean Meteorological Organization (CMO). The CIMH provides an example of a cooperative RTC that illustrates some of the financial issues a Pacific RTC may face.

The CIMH budget currently stands at about USD 3.6 million per annum with about 70-80 percent obtained through fees and charges, and NMHS/member government "subventions". The annual subvention of each Member State is controlled by a contribution formula which takes into consideration social and economic factors as well as host country benefits from having the RTC in-country. The contribution formula is re-visited periodically as social and economic circumstances change. In the case of the CIMH, Barbados pays about 25% of the annual cost of CIMH because of the host country benefits it derives from having the Institute on the island (e.g., staff contribute to the local economy through their spending; the majority of the staff are Barbadian so they contribute to the local income tax base; technology and know-how readily flows from the Institute to the local community; students contribute to the local economy through their spending; there are many business that benefit from providing services to CIMH, etc).

The CIMH also generates revenue through the provisions of products and services to a range of clients through consultancies and the delivery of specialized services. In addition, the CIMH increases its level of revenue through including the overhead expenses it incurs from the implementation of projects and programmes. The training services they provided to University of the West Indies fall into this category. The amount of funding generated though these mechanisms is on the order of several hundreds of thousands of USD.

**Some of the challenges of operating an institute along the CIMH funding model include:**

- Arrears owed by Member States to CIMH total approximately USD 13.5 million. This has arisen as there are no penalties for non-payment of subventions.
- Subvention transfers from Member States are not structured for time of payment so cash flow problems may arise if expenditures, including those for implementation of annual work plans and the hiring of staff, are not carefully managed;
- Countries with the largest subventions often attempt to assume ownership of the CIMH work programme at the expense of benefits that should flow to the smaller contributors;
- Maintenance and upgrading of infrastructure can be a problem;
- The build-up arrears can be a disincentive for donors to invest in the institution - some donors have raise concerns about the sustainability of CIMH given the size of its debt to the Government of Barbados;
- Some States have argued that if they don't use the services of the Institute, then they should not pay. As a result, CIMH has created products and service that provided benefits to all Member States on daily, monthly and annual timeframes. The delivery of daily numerical weather prediction products along climate outlooks has played a major role in this initiative.

Clearly these challenges are faced by any international organization relying on a range of funding sources,

risks of this nature must be managed carefully if a Pacific RTC is to be sustainable.

## AN INDICATIVE FINANCIAL CASE

For the purpose of examining the financial case of a Pacific RTC it is necessary to develop at least a general concept, or model, of the key features of the RTC. For the sake of this analysis it is assumed that the Pacific RTC will have four components:

- A small Secretariat that coordinates BIP-M and BIP-MT style courses. This coordination task includes liaising with NMHSs and potential donors, as at the current time overseas development aid provides for a large amount of meteorological education and training in the Pacific that is undertaken by the NMHSs. NMHS funding would be a key part of the Secretariat's funding. The Secretariat would also work with the Directors of the NMHSs to achieve accreditation of relevant courses;
- One or more academics in the partner university (or universities) who coordinate the academic input for their institution (most likely part-time payment or pro-bono contribution). This would likely be a small part of the work load of an academic until a course took place, at which time they would be appropriately remunerated for their contribution to that course;
- An experienced meteorologist in each NMHS who would liaise with the RTC secretariat to inform it of training needs and donor commitments to training in their NMHS. Again, not an RTC-funded position, rather a staff member of the participating NMHSs who would likely devote around 10% or less of their time on the function; and,
- Academic and experienced operational meteorologists who come together from time-to-time to deliver a particular course. The funding for their participation would likely be donor funded.

To establish the Secretariat would cost of the order of $US30,000 and the ongoing annual cost would be of the order of $US120,000 (Box 1). Some of the annual ongoing cost may be reduced by sharing accommodation with one of the partners but the majority of the cost is in staffing and securing high quality, well motivated staff will be a key to the success of the endeavor.

In delivering a BIP-M course, for costing purposes, it is assumed that a course with a cohort of 18 students is conducted every three years. The teaching staff for the course is assumed to be a mixture of staff already resident at the partner university, at the partner NMHS and that experienced meteorologists from overseas institutions that can be recruited to deliver specialised courses at (approximately) master's degree level in the theoretical topics included in the BIP-M. Donor support would be needed to fly in these specialised staff and to cover fees associated with using university partner's staff. It may be possible to use ICT for remote lectures to reduce the time the specialist staff need to be physically at the RTC, alternatively it may be possible for the Pacific students to take subjects from partner Universities outside of the Pacific. The estimated course cost including flying the specialists in for the month (Box 2) would be of the order of $80,000 or $US4,354 per student.

BOX 01

Secretariat structure and indicative cost
All costs in $US, and are based upon local salary levels for the Pacific (indicative costs only).

One-off establishment of the Secretariat offices:
- Office equipment $US 30,000

STAFF COSTS:
- Director of RTC $US 37,500 p.a.
- Senior coordinator – training $US 20,000 p.a.
- Senior PR office $US 20,000 p.a.
- Office Support/book keeping $US 10,000 p.a.

ON-GOING COSTS:
- Office rental $US 15,000 p.a.
- Supplies (power, water, cleaning, telephones) $US 3,000p.a.

BOX 02

Indicative cost ($US) for an eight-month BIP-M course
A two semester (eight month) BIP-M Course to Grad Dip standard with fully accredited units.

BIP-M (8 MONTH)

$US 300 return airfare per student
8x$US 120 per month semester university college accommodation
8x$US 120 per month semester university college living expenses
Total: $US 2,220
Other University fees: $US800
Additional staff costs - 4xOverseas staff, one month engagements
$US 1,500 airfares. Accommodation $US2,000. Expenses $US2,500
4x$US 6,000 = $US24,000
Total cost of BIP-M Course:
18x$US 3020 + 4x$US 6,000 = $US 78,360

There is much greater demand for BIP-MT courses for meteorological observers and IT technicians. It is proposed that the RTC could target one course per year of ten students lasting three months. It is recognised that the PITD believes that three one-month courses is required to bring a two-year college graduate with no meteorological training to the level of a fully trained, technical staff member. While the US experience has shown that shorter one-month courses (as opposed to two month courses) are more effective, here for simplicity a single three month course is used for costing purposes. The cost per student is around $US 2,602.

These costs are well below those of the developed countries such as Australia where the BIP-M course alone costs an estimated $US 28,000 with living costs likely to be of the same order. In Hawaii, the BIP-MT equivalent course costs around $US 23,000 and again living costs for one month in Hawaii would cost of the order of $3,00 to $4,000 per student.

BOX 03

Indicative cost ($US) for a three-month BIP-MT course
Indicative costs for a three-month BIP-MT course with fully accredited units
$US 300 return airfare per student
3x$US 120 per month university college accommodation
3x$US 120 per month university college living expenses
Total $US 1,020
University fees $US 400
2xOverseas staff, one month engagements
$US 1,500 airfares. Accommodation $US2,000. Expenses $US2,500
2x$US 6,000 = $US12,000
Total cost of BIP-MT course with ten students
10X$US 1,420 + $US 12,000 = $US 26,020

If the Secretariat costs are added to the student costs as an additional overhead, the $120,000 pa of Secretariat cost is shared 16 ways (an average of 6 BIP-M students and 10 BIP-MT students per year) results in an additional cost of $US 7,500 per student. So at a cost per BIP-M student of around $US 12,000 and BIP-MT student of around $US 10,000, this is well below the cost of sending students to nearby developed countries of Australia, New Zealand or the United States.

## DISCUSSION

The final funding model selected for the RTC will be dependent upon the Memorandum of Understanding between the various partners and the amount of longer term donor support that the RTC can mobilize. The CIMH provides one model but this relates to a particular physical institution whereas the Study Team, noting the existing institutions, recommend a partnership model.

The figures developed above indicate that the cost of education and training students in the Pacific is approximately half of that in the developed countries around the Pacific. These figures could be even lower if online learning is used in the longer term courses. This financial advantage combined with a more familiar social and cultural environment and a focus on regional weather and climate service needs provides a good foundation for developing a Pacific based RTC.

# 9. Governance Options

This Chapter examines governance options and some of the high level functions that will need to be carried out for the RTC to successfully undertake its roles.

The PIMMM through article 13 of the 2015 Nuku'alofa Declaration (see Annex Seven – NUKU'ALOFA Declaration) "Requested the Education, Training and Research Panel of the PMC to work with PICTs' NMHSs, USP, SPREP, SPC and other regional organizations, and WMO to address the education and training needs of NMHSs in PICTs with a possibility to establish a WMO Regional Training Center (RTC) and the development of regional research capacity". As the PIMMM made this request it appears to the Study Team that the governance of a Pacific based RTC will be on multiple levels.

## GLOBAL

At a global level the WMO through regional association V (South West Pacific) and the WMO Executive Council and its sub bodies will initially determine whether the request for an RTC is approved and then every four years after that whether the recognition of the RTC is continued. As noted earlier " Annex Two – WMO RTC Criteria" and "Annex Three - Roles and Responsibilities of Parties involved in an RTC" are extracted from the WMO Technical Regulations and Guides and provide full details of the various requirements for gaining and maintaining recognition of an RTC as well as the roles and responsibilities of the various parties involved in an RTC. In short, the process begins when one or more of the WMO Members in the study area make a proposal to RA V for their country(ies) to host the RTC.

**WMO identifies the role of the regional associations as:**

- Prioritize education and training needs of the regional association and communicate them to the RTCs at least every four years;
- Keep abreast of the activities and plans of each RTC and its components through the annual report they provide;
- Provide RTCs, Members and the Secretary General with feedback on whether the RTCs are meeting the needs of the regional association;
- Contribute to quadrennial reviews of the RTCs arranged by the Executive Council in order to address the extent to which the RTCs are meeting the identified education and training needs of the regional association;
- At each session of the regional association, recommend RTCs to the WMO Executive Council for possible confirmation, based on performance against the established criteria;
- Promote the activities and use of the RTCs by members of the regional association;
- Seek funding and resource opportunities to support and expand the work of the RTCs in addressing the education and training needs of the regional association.

**WMO identifies the roles of the PR of the host country(ies) as:**

- Inform the Secretary General and the regional association of the contact details of the Coordinator of an RTC and the Director of an RTC component and of any changes thereto;
- Where the RTC is made up of multiple components, ensure ongoing communication and coordination between the components to maximize education and training opportunities for Members;
- Facilitate coordination between the RTC and the regional association concerned regarding regional education and training needs, funding and resource opportunities;
- Promote the resourcing of the RTC through support from government and other national and international funding bodies;
- Provide the regional association and the Secretary General with annual reports about the RTC's activities in the previous 12 months and its plans for the next 12 months with an outlook for future years;
- Collaborate with other Permanent Representatives hosting RTCs to promote collaboration between the RTCs;
- Oversee and act as an advocate for the RTC to (a) comply with national and WMO standards and guidelines and (b) keep pace with evolving technological and educational developments.

The governance mechanisms and responsibilities at the global level have been preset by WMO and are expressed in a formal MoU that the PR of the host country will sign with WMO after the RTC is formally recognised.

## REGIONALLY

Noting that the PMC and the PIMMM through article 13 of the 2015 Nuku'alofa Declaration requested the PIETR Panel and a group of other organisations to investigate the possibility of establishing a WMO Regional Training Centre it appears to the Study Team that the PIMMM as an intergovernmental meeting will provide the top level regional governance and reporting mechanism for the RTC. At the very least the Study Team anticipate that the PMC and the PIMMM would approve the makeup of the initial institution(s) proposed to form the RTC and their approval would be an important part of the supporting documentation provided to WMO in the request for recognition of the RTC.

Functionally the PMC / PIMMM would be expected to set the broad directions and priorities for the RTC and ultimately decide whether the RTC is addressing the needs of the NMHSs for which it was formed. The PMC / PIMMM may potentially make decisions or recommendations to other regional forums such as Ministers of Education or the Pacific Leaders Forum about the need for courses to be accredited, whether successful graduates of a senior BIP-MT course from the RTC be considered as meeting the aviation forecasting requirements for the region, funding structures for courses or the RTC itself etc. The PIMMM may decide to delegate some of the more routine tasks to the PMC to carry out on its behalf.
WMO does not set any roles for organisations at this level however it would seem appropriate that the PMC would duplicate some of the roles laid out for the regional associations.

## RTC LEVEL

In Chapter 3 of this report the Study Team recommended that the make up of the RTC include the learning institution(s), the Directors of the NMHSs and other organisations using weather, water and climate services and the students.

In terms of governance at the RTC level it would be expected that there would be a board or oversight committee of some kind composed of representatives from the learning institutions, potentially several representatives of the NMHSs selected either geographically or as representing the different types of services or some combination, and one or more representatives of the students. Other representatives from long term donors, other regional organisations, Ministry of Education, other user groups etc., could also be included as the PMC / PIMMM decide. Following normal

practices the chair of the oversight body would most likely be from the PMC, the PR of the host country or at the very least the PMC's PIETR Panel. The RTC Director would most likely act as the Secretary for this oversight body.

The role and function of this body would be to oversee the development and ongoing operations of the RTC. As the RTC develops the oversight body would be expected to consider questions such as the following and either make recommendations for the PMC / PIMMM or decisions where they have the delegation:

- Identification of generic courses and course levels based upon the generic job roles and staff categories in each of the 15 NMHSs
- Linking the generic Pacific job roles, courses, course levels and competencies with the WMO standards and recommended practises and those of relevant global and regional organisations
- Developing and maintaining an inventory of the skill sets and qualifications of the staff of every NMHS to assist with the planning for and scheduling of in-service training (implementing and maintaining a Learning Management System for education and training across the 15 NMHSs may be the best way to organise this)
- Monitoring learning opportunities in the region and external to the Pacific for areas that the RTC cannot cover. Additionally from time to time having students attend courses outside of the RTC will help the RTC benchmark its courses against others providing similar opportunities. Similarly inviting students from other areas to the RTC courses will help benchmark courses.
- Promoting RTC opportunities in and out of the 15 NMHSs
- Planning, reporting and monitoring activities and impact of the RTC courses for the NMHS Directors, the PMC and WMO

These roles are consistent with or one level higher than those foreseen by WMO for the RTC Director or Coordinator of RTC components.

## INSTITUTION LEVEL

At institution level the governance mechanisms would be expected to be part of the ongoing operations of that institution consistent with the WMO approaches and in the line with the principles described in WMO-1169 "Guide to the Management and Operation of WMO Regional Training Centres and Other Training Institutions".

## DISCUSSION

The final governance model for a Pacific based RTC will depend upon a wide range of factors including:

- What role(s) the PIMMM / PMC decide to take in setting the strategic direction and supporting the RTC;
- Which country or countries offer to host the RTC;
- Which institutions decide to participate in the development of the RTC and under what conditions;
- National / regional regulations and procedures;
- What resources / funding will be available from subscriptions, donors, the institutions or the host country to support the running of the RTC;
- Whether some of the RTC management roles can be subsumed into ongoing roles of existing national or regional organisations;
- The readiness of national and regional organisations to work together to develop a specialist shared education and training institution.

The roles and functions above should be seen as indicative and provide a starting point for the discussions as the RTC begins to take shape.

# 10. Overall Risks Associated with a Pacific Based RTC

**In this chapter the Study Team identify the major risks, uncertainties, mitigation strategies and their likely impact in forming a Pacific RTC. To do this the Study Team assume the following RTC structure:**

- A partnership between FMS and USP to develop and deliver a three level accredited BIP-MT course (certificate level 2 for junior (entry level) meteorological technicians, certificate level 4 for middle level meteorological technicians and a diploma level course for the senior level meteorological technician course. Detailed examination may adjust the levels).

- A partnership between USP, FMS and another university such as the University of Hawaii or the University of the West Indies to develop and deliver a BIP-M course with an operational focus at a graduate diploma level.

- In-service courses in weather and hydrology primarily offered by FMS in partnership with JICA and other donors

- In-service courses in climate data and climate services offered by the Pacific Climate Change Centre in partnership with COSPPac.

- In-service courses covering areas such as leadership, management, project management, occupational health and safety, grant applications through SPREP and other parties.

The Study Team further assume that the RTC will have an oversight board comprising at least one representative from each of the learning institutions, several Directors of the NMHSs, several students (current and recent), the PR of the host country, a representative from the Pacific Met Desk and chaired by the most recent chair of the PMC. The oversight board reports to the PMC and the PMC report RTC activities and plans to the PIMMM. To ensure that the actions identified by the oversight board are carried out and to provide the day to day coordination and liaison with the learning providers and out to the NMHSs and other users there will be a small RTC office or these duties will be carried out as part of the ongoing duties of an existing organisation such as the Pacific Met Desk.

The Study Team assume that the courses will be delivered using face-to-face, online options, blended opportunities and on-the-job training as appropriate.

As the major courses are accredited tuition fees are charged with either the NMHSs or the national governments covering the costs though the students may need to make upfront payment and then recover their funds. For the in-service courses it is assumed that many of the costs will be covered through donor programs.

## *Major Risks and Uncertainties*

The major risks and uncertainties can be grouped into:

### POLITICAL AND LEGAL:

i) Unexpected problems developing and maintaining the partnerships (between the RTC component, Oversight Board, donors, other stakeholders like NMHSs, RA, other WMO RTCs in the region, etc.),
ii) Inability to keep national scholarship mechanisms working and supporting students at the RTC,
iii) Early termination of MoU/Agreement by one of the Parties,
iv) Governmental decisions negatively affecting the stakeholders.

### FINANCIAL AND ECONOMIC:

v) Under funding the RTC Office (salaries, office and travel expenses, expenses for the Oversight Board' activities),
vi) Under funding teaching staff development in the learning institutions in teaching and specialist content including participation in WMO ETR activities,
vii) Under funding maintenance of the teaching facilities,
viii) Funding does not keep up with inflation,
ix) One or more of the Partners lose a major donor.

### MARKETING:

x) Difficulty in building and maintaining reputation and visibility of the RTC and its components with donors and regional organizations,
xi) RTC unable to attract students from outside the NMHSs,
xii) Not getting sufficient student numbers to keep the courses viable,
xiii) Increase in the costs makes RTC less attractive for regional users.

### ADMINISTRATIVE AND MANAGERIAL:

xiv) Non-fulfillment of obligations by one or more of the Parties involved in the RTC,
xv) Operation of the Oversight Board and local management of the RTC is not effective,
xvi) Problems ensuring the quality of the learning offerings (via appropriate accreditation procedures, self-assessment and corrective measures, WMO recognition and reconfirmation procedures).

### OPERATIONAL:

xvii) Ensuring sufficient teaching numbers and skills,
xviii) Ensuring upgraded and enough teaching resources (materials and equipment),
xix) Ensuring effective training mode (on-line, face-to-face, blended, duration, pedagogical approaches with consideration of language and cultural features),
xx) Force majeure.

The following table groups the risks into three categories: high, medium and low after treating the risks with the mitigation actions listed in the final column.

Table 7. Overall Risk Management Table for the RTC

| Risks | High | Medium | Low | Possible actions for mitigation the risks |
|---|---|---|---|---|
| **Political and Legal** | | x | | • MoU/Agreement signed at the beginning setting all the mechanisms and relations between the Parties involved, responsibilities and roles clearly defined.<br>• MoU/Agreement kept under review and adjusted as circumstances change<br>• PMC / PIMMM actively support the RTC |
| **Financial and Economic** | x | | | • Long-term Business plan developed and agreed by all Parties involved, funding opportunities identified and financial risks considered well in advance<br>• Major donors regularly engaged<br>• Budget includes provision for unforeseen expenses and development of a working reserve |
| **Marketing** | | x | | • Study Team report considered and adjusted in-line with Partners ambitions and NMHS needs to develop Strategic and Operational plans consistent with the Business plan<br>• RTC regularly reviews and updates Strategic and Operational plans. |
| **Administrative** | | x | | • Oversight Board ToRs approved by PMC and Partners,<br>• RTC Secretariat roles and functions approved by Oversight Board and PMC<br>• Institution staff ToR defined and explained<br>• RTC Secretariat and Institution staff selected from motivated and qualified members<br>• Personnel and professional development policies put into operation |
| **Operational** | | | x | • Financial conditions included in the Long-term Business and Financial plans<br>• Partnering with other University Met Departments to ensure a broad range of skills and experience. |

## DISCUSSION

This Chapter identifies the major risks and associated mitigation actions the Study Team anticipate facing the RTC in first one to two years of operation. These risks and mitigation actions are based upon a "model" RTC defined at the start of the Chapter and will need to be adjusted as the actual RTC develops. The RTC Secretariat will be key to the success of the RTC. As they will be responsible for the day-to-day activities associated with the RTC they will need to develop the trust and respect of the NMHSs, the regional organisations, the students, the PMC / PIMMM and regular donors.

# 11. Key Steps Required to Implement an RTC

This Chapter uses the model RTC proposed at the start of Chapter 10 to outline the main steps the Study Team believe are required to get the RTC up and running. These steps will need to be reviewed and adjusted as the concept matures to take into account the resources and requirements that the prospective partners can bring to the RTC.

The steps by themselves will not create the RTC. A key ingredient will be the formation of a small group or team who will champion the formation of the RTC. This has not been explicitly included into the steps but it could come out of the PIETR Panel discussions or later PMC discussions. This small group or team are the people who will build the trust and respect of the NMHS Directors and staff, the broader community and the donors. This small group or team will be the people who actively champion the proposal through the various steps rather than it mechanically follow the steps. In the end they are likely to form the nucleus of the RTC Oversight Board.

These steps recognise that there are two parts to the formation of the RTC. The first part outlines the actions that need to be taken by institutions and organisations within the study area to form a partnership to address the education and training needs of the 15 NMHSs. By the end of the first part a specialist meteorological education and training organisation should be operating, it just would not be formally recognised as a WMO Regional Training Centre.

The second part outlines the steps that need to be taken to gain recognition as a WMO Regional Training Centre. The second part begins with the WMO regional association in the South West Pacific passing a resolution recommending an institution or group of institutions to be considered for RTC recognition. These parts would normally be carried out sequentially. The next session of the regional association is in Tonga in mid-October 2018 and the following session will be in 2022.

It is unlikely that a fully formed proposal will be available for the October 2018 WMO Regional Association V (RA V) session to consider, however an interim report could be presented to the session and agreement sought that a full proposal is forwarded to WMO prior to 2022 provided it is approved by the regional association management group.

## PART 1 – STEPS TO FORM A SPECIALIST METEOROLOGICAL EDUCATION AND TRAINING FACILITY IN THE PACIFIC

- Study Team revise, finalise and provide the report to UNDP by late August / early September 2018;
- UNDP provide PIETR panel with final report in late August / early September 2018;
- PIETR Panel to review RTC Feasibility report by late September and provide recommendation to PMC Directors;
- PMC Directors to review PIETR Panel recommendation and decide whether to raise the matter as a resolution at RA V session in Tonga in mid-October 2018;
- Stakeholders to further consider PMC decision (decide upon selection criteria and models to be used, and who will apply the selection criteria). By early-2019;

- Agreed selection criteria are used to decide upon final Pacific Training Centre model and institution(s) comprising the initial RTC. By mid-2019;
- Final models and partners agreed by PMC / PIMMM at 2019 PMC in Samoa;
- Training Centre Governance structure agreed by stakeholders, partners, national governments and PMC with appropriate MoUs signed. By end of 2019;
- Training Centre operations commence. Early-2020;
- RTC Oversight Board prepare documentation for formal RTC recognition by mid-2020. Ideally the proposal is endorsed by the PMC prior to it being forwarded to the WMO RA V Management Group by the PR of the host country.

## PART 2 – GAINING FORMAL RECOGNITION AS A WMO REGIONAL TRAINING CENTRE

- Resolution raised at 2018 RA V session seeking [endorsement of RTC / recognising work underway and recommending continuance with view of final proposal going to WMO Executive Council prior to next session of RA V in 2022 provided RA V Management Group approve];
- The Permanent Representative of the country hosting the RTC sends full RTC proposal to RA V Management Group by late-2020;
- RA V Management Group consider proposal and make recommendation to the President and Secretary General of WMO by early-2021;
- WMO processes followed aiming for recommendation on recognition to be considered by the WMO Executive Council in mid-2021;
- Formal MoU signed between WMO and PR of host country by end of 2021.

# 12. Recommendations

This is the second report by the Study Team into the feasibility of a Pacific WMO Regional Training Centre.

The first report identified the education and training needs of the 15 NMHSs and their prospective student numbers for the next five to seven years. The Directors of the 15 NMHSs prioritized operational forecasting, climate services, marine and ocean services, ICT and equipment maintenance and repair for courses to be provided by the RTC. Additionally, accreditation of the courses offered by the RTC, particularly for longer courses for staff in the technician category was seen as a high priority. The report also identified that there were not enough students to justify a BSc in Meteorology course however there should be sufficient students to operate a graduate diploma in meteorology, particularly if it was only run every second or third year.

Having established the education and training needs of the 15 NMHSs in the study area this second report investigated the following topics related to the feasibility of a Pacific based RTC:

- What is an RTC (Chapter 3);
- What institutions are currently providing education and training in the field of weather, water and climate (Chapter 4);
- Different models for a Pacific RTC (Chapter 5);
- The institutions in the region who could partner in an RTC (Chapter 6);
- The benefits and risks to stakeholders of having a Pacific based RTC (Chapter 7);
- The financial case for an RTC (Chapter 8);
- The potential governance arrangements for an RTC (Chapter 9);
- The overall risks associated with developing and running an RTC (Chapter 10), and
- The steps needed to implement an RTC.

As an outcome of the investigations the Study Team make the following recommendations for the formation and operations of a Pacific based RTC.

## RECOMMENDATION ONE

That the PIETR Panel / PMC pursue the creation of a specialist education and training institution in the Pacific to address the education and training demands of the 15 NMHSs. Furthermore it is worthwhile for the 15 NMHSs to seek WMO recognition of this training institution as a WMO Regional Training Centre (RTC).

## RECOMMENDATION TWO

The PMC consider options for creating a small task group responsible for operationalizing the findings of this report. Ideally a partner would be identified who could provide full time staffing and financial support for up to 12 months to move the proposal forward.

## RECOMMENDATION THREE

That the stakeholders in the RTC include following institutions in addition to the 15 NMHSs and the students: the Fiji Meteorological Service (FMS), the University of the South Pacific (USP), the Pacific Climate Change Centre (PCCC) and its parent organisation SPREP. Ideally these institutions would either partner or closely liaise with NOAA's Pacific Island Training Desk and the Meteorology Department of the University of Hawaii (UH).

## RECOMMENDATION FOUR

FMS and USP partner to develop and deliver a three level accredited BIP-MT course (i.e. providing the knowledge and skills to support the relevant WMO Competency Frameworks) (certificate level 2 for junior (entry level) meteorological technicians, certificate level 4 for middle level meteorological technicians and a diploma level course for the senior level meteorological technician course. Detailed examination by an implementation team may result in adjustment to these levels.

## RECOMMENDATION FIVE

USP and FMS continue to build their capacities in terms of teaching staff and training courses while also seeking other university partners such as UH or the University of the West Indies to assist in developing and delivering a BIP-M course for the Pacific that has an operational focus (i.e. providing the knowledge and skills to support the relevant WMO Competency Frameworks) and is at a graduate diploma level.

## RECOMMENDATION SIX

FMS to provide in-service operationally focussed courses in weather and hydrology. Ideally, FMS would be able to partner with a donor such as JICA to provide financial support to participants.

## RECOMMENDATION SEVEN

The PCCC, potentially with support from COSPPac, provide in-service courses in climate data and climate services. The Study Team encourage the PCCC to coordinate with FMS and USP to ensure seamless transition for the students who will take climate data / services / change courses across the three institutions.

## RECOMMENDATION EIGHT

That SPREP in coordination with the other prospective partners take the lead in identifying providers for in-service courses covering areas such as leadership, management, project management, occupational health and safety, and grant applications.

## RECOMMENDATION NINE

That the RTC has an oversight board comprising at least one representative from each of the learning institutions, several Directors of the NMHSs, several students (current and recent), the PR of the host country, a representative from the Pacific Met Desk and chaired by the most recent chair of the PMC. The oversight board should report to the PMC and the PMC report RTC activities and plans to the PIMMM. The role of the oversight board could include:

- Identification of generic courses and course levels based upon the generic job roles and staff categories in each

of the 15 NMHSs

- Linking the generic  Pacific job roles, courses, course levels and competencies with the WMO standards and recommended practises and those of relevant global and regional organisations
- Developing and maintaining an inventory of the skill sets and qualifications of the staff of every NMHS to assist with the planning for and scheduling of in-service training (implementing and maintaining a Learning Management System for education and training across the 15 NMHSs may be the best way to organise this)
- Monitoring learning opportunities in the region and external to the Pacific for areas that the RTC cannot cover. Additionally from time to time having students attend courses outside of the RTC will help the RTC benchmark its courses against others providing similar opportunities. Similarly inviting students from other areas to the RTC courses will help benchmark courses.
- Promoting RTC opportunities in and out of the 15 NMHSs
- Planning, reporting and monitoring activities and impact of the RTC courses for the NMHS Directors, the PMC and WMO

## RECOMMENDATION TEN

A small secretariat or RTC Office is created to ensure that the actions identified by the oversight board are carried out and to provide the day-to-day coordination and liaison with the learning providers and out to the NMHSs and other users.

Alternatively these duties could be carried out as part of the ongoing duties of an existing organisation such as the SPREP Pacific Met Desk.

## RECOMMENDATION ELEVEN

That the PIETR Panel, through the RTC Secretariat, request support from the PacTVET project for the development of the accreditation framework and standards, and for assistance in achieving regional adoption of the accreditation framework and standards.

## SUMMARY

The Study Area comprises a significant proportion of the earth's surface and is one of the most natural disaster prone regions on the planet. The development and ongoing operation of a WMO Regional Training Centre providing education and training opportunities to the NMHSs of the region as well as the users of weather, water and climate services should be seen as part of the region's disaster preparedness and security mechanisms.

The Study Team are aware of the difficulties and challenges that will face the PMC in pursuing the creation of a Pacific based RTC but the major elements are already in place. It now requires leadership and trust to ensure that the institutions and individuals focus on the benefits of working together rather than difficulties.

The opportunity to interact with the Directors and Staff of the 15 NMHSs in the study area was key to gathering enough information to conclude this Study, and again thanks go to all who assisted in the information gathering phase.

# REPORT PART 2: Annexes

- ANNEX ONE | Examples of RTCs in other countries
- ANNEX TWO | WMO RTC Criteria
- ANNEX THREE | Roles and Responsibilities of Parties involved in an RTC
- ANNEX FOUR | Education and Training Capacity in the Field of Meteorology and Hydrology in the Study Area
- ANNEX FIVE | Profiles for six Pacific Universities
- ANNEX SIX | Evaluation of regional institutions against the Study Team's selection criteria
- ANNEX SEVEN | NUKU'ALOFA Declaration
- ANNEX EIGHT | Glossary of Abbreviations and Terms
- ANNEX NINE | Individuals consulted by the Study Team

*Photo credit: Emiliano Arano*

# ANNEX 1

Examples of RTCs in other countries

## *Examples of RTCs in Other Countries*

**The WMO website (https://www.wmo.int/pages/prog/dra/etrp/rtcs.php) shows there 27 WMO RTCs.** It is possible to group the RTCs in many ways but for the purpose of this report the Study Team are grouping by structure and type as it is most relevant to this report. The RTCs can thus be grouped in the following manner:

TABLE 8: Single Component RTCs Hosted by One Member

| WMO Member | Name of institution | Academic Status | |
|---|---|---|---|
| **Algeria** | IHFR | University | Long term courses |
| **Angola** | Instituto Nacional de Meteorologia e Geofísica (INAMET) | Part of NMHS, non accredited | Currently not active |
| **Costa Rica** | Universidad de Costa Rica (UCR) | University | Long term courses |
| **Egypt** | The Egyptian Meteorological Authority (EMA) | Part of NMHS, non accredited | Long and short term courses |
| **Iran** | Islamic Republic of Iran Meteorological Organization (IRIMO) | Part of NMHS, non accredited | Short term courses |
| **Iraq** | Iraqi Meteorological Organization (IMO) | Part of NMHS, non accredited | Short term courses |
| **Israel** | Postgraduate Training Centre for Applied Meteorology (PTCAM) | | Short term courses |
| **Italy** | National Research Council Institute of Biometeorology (CNR-IBIMET) | University | Short term courses |
| **Korea** | Korea Meteorological Administration (KMA) | Part of NMHS, accredited as Registered Training Organisation | Short term courses |
| **Madagascar** | Ecole Supérieure Polytechnique à Antananarivo (ESPA) | University | Long term courses |
| **Qatar** | Qatar Aeronautical College (QAC) | University | Mainly long term courses but occasionally short term courses when external funding available |
| **Turkey** | Turkish State Meteorological Service (TSMS) | Part of NMHS, non accredited | Short term courses |
| **South Africa** | South Africa Weather Service (SAWS) | Part of NMHS and working in conjunction with the University of Pretoria | Provides long and short term courses |
| **Uzbekistan** | Tashkent Hydrometeorological Profecional College (THMPC) | Part of NMHS, non accredited | Long term courses |
| **Venezuela** | Universidad Central de Venezuela (UCV) | University | Long term courses |

TABLE 9: Multiple Component RTC Hosted by One Member

| WMO Member | Name of Institutions | | |
|---|---|---|---|
| **Argentina** | Universidad de Buenos Aires (UBA) | University | Long term courses |
| | Servicio Meteorológico Nacional (SMN) | Part of NMHS, non accredited | Short and long term courses |

| WMO Member | Name of Institutions | | |
|---|---|---|---|
| **Brazil** | Centro Virtual de Ensino e Treinamento em Meteorologia (CVEM) | This RTC is made up of multiple universities and colleges coordinated by a small group located within the NMHS | Long and short term courses |
| **China** | Nanjing University of Information, Science and Technology (NUIST) | University | Long and short term courses |
| | China Meteorological Administration Training Centre (CMATC) | Part of NMHS | Primarily short term courses but some longer occasionally |
| **India** | India Meteorological Department Training Centre (IMD-New Delhi) | Part of NMHS, non accredited | Long and short term courses |
| | Central Training Institute (IMD-Pune) | Part of NMHS, non accredited | Long and short term courses |
| | National Water Academy (NWA-Pune) | Part of National Water Authority | Short term courses |
| | Indian Institute of Technology Roorkee (IIRT-Roorkee) | University | Long and short term courses |
| **Indonesia** | Agency for Meteorology, Climatology and Geophysics (BMKG) | Part of NMHS, non accredited | Short term courses |
| | Research Centre for Water Resources (RCWR) | Part of national water authority, non accredited | Short term courses |
| **Kenya** | Universty of Nairobi (UON) | University | Long term courses |
| | Institute for Meteorological Training and Research (IMTR) | Part of NMHS, non accredited | Long and short term courses |
| **Nigeria** | Federal University of Technology, Akure (FUTA) | University | Long term courses |
| | Meteorological Research and Training Institute (MRTI) | Part of NMHS, non accredited | Long and short term courses |
| **Peru** | Universidad Nacional Agraria La Molina (UNALM) | University | Long and short term courses |
| | NMHS training centre | Part of NNMHS, non accredited | Short term courses |

| WMO Member | Name of Institutions | | |
|---|---|---|---|
| **Philippines** | | University | Long term courses |
| | | Part of NMHS, non accredited | Long and short term courses |
| **Russian Federation** | Russian State Hydrometeorological University (RSHU) | University | Long term courses |
| | Advanced Training Institute of Roshydromet (ATI) | Technical college, part of NMHS | Long and short term courses |
| | Moscow Hydrometeorological Technical School (MGMTEH) | Technical college | Long and short term courses |

TABLE 10. Regionally Funded Institution Recognised as RTCs

| WMO Member | Name of Institution | | |
|---|---|---|---|
| **Caribbean (located in Barbados)** | Caribbean Institute for Meteorology and Hydrology (CIMH) | Accredited training institution funded by 16 Caribbean countries. Staff are also on the faculty of the University of the West Indies | Long and short term courses |
| **East Africa (located in Madagascar)** | Ecole Nationale d'Enseignement de l'Aéronautique et de la Météorologie (ENEAM) | Accredited training institution which is part of the ASECNA aviation grouping | Long and short term courses |
| **West Africa (located in Niger)** | Centre Régional Agrhymet (AGRHYMET) | University funded by countries in West Africa. | Long and short term courses |
| **West Africa (located in Niger)** | Ecole Africaine de la Météorologie et de l'Aviation Civile (EAMAC) | Accredited training institution which is part of the ASECNA aviation grouping | Long and short term courses |

# ANNEX 2

## WMO RTC Criteria

# *WMO RTC Criteria*

**These criteria are extracted from Appendix B of WMO Publication 49, Volume 1, General Meteorological Standards and Recommended Practices,** *https://library.wmo.int/doc_num.php?explnum_id=4065 (2015 edition, updated in 2017)*

## CRITERIA FOR THE DESIGNATION OF WMO REGIONAL TRAINING CENTRES

(See Part VI, 1.5.2)

**A Regional Training Centre (RTC) is a national education and training institution, or group of institutions, recognized by Congress or the Executive Council (following recommendation of the relevant WMO regional association(s) as:**

(a) Providing education and training opportunities for WMO Members in the Region, particularly staff of National Meteorological and Hydrological Services (NMHSs);
(b) Providing advice and assistance on education and training to WMO Members;
(c) Promoting education and training opportunities in weather, water and climate for WMO Members.

These activities are undertaken in accordance with WMO regulations and guidelines. An institute supported by several Members to provide such services could also be recommended by the relevant regional association as an RTC.

Each institution forming part of an RTC is considered to be an RTC component.

**When a Member proposes an institution or a group of institutions to the relevant regional association for recommendation as an RTC, the proposal shall meet the following criteria:**

(a) An RTC or its component is established only to meet the expressed requirements of more than half of the Members of the regional association that cannot be met by existing resources;
(b) An RTC or its component is designed to meet the requirements of the Region, as expressed in a decision of the regional association and recorded in a resolution or statement in the general summary of the abridged final report of the regional association session. However, it is recognized that some RTCs or their components might also take on a broader international remit;
(c) The RTC is located within the Region concerned, its location decided by the Executive Council in the light of the recommendation of the regional association, the advice of the relevant technical commission and the Executive Council Panel of Experts on Education and Training, and the comments of the Secretary-General.

**A Member hosting the institution to be designated as an RTC component shall ensure it has the human and financial resources and facilities to satisfy the following:**

## IDENTIFYING LEARNING NEEDS:

The RTC component has processes in place to gain information about the education and training needs of the Region.

## DESIGNING THE LEARNING SERVICE:

- The RTC component selects methods of learning that respond to the aims and requirements of the curriculum

and learning outcomes, and are appropriate for the learners;

- The RTC component ensures that its courses of instruction and other activities, such as delivering or developing elearning, running offsite activities and providing advice or support, are carried out in a way that is consistent with the standards and guidance material issued by WMO;
- The RTC component provides courses and other resources and activities that address the expressed education and training needs of the Region.

## DELIVERING THE LEARNING SERVICE:

- The RTC component demonstrates that, during the previous four years, it has contributed to meeting the education and training needs identified by the regional association;
- The RTC component delivers training: (a) with competent instructors in terms of their scientific/technical ability and training expertise; and (b) in an environment that is conducive to learning, with adequate learning resources, buildings, information and communication technology systems and training facilities.

## ASSESSING LEARNING AND EVALUATING THE LEARNING SERVICE:

- The RTC component assesses the knowledge and competency of students, documents this information in a fashion suitable for a recognized quality management system, and provides students with a record of the education and training that has been successfully completed;
- The RTC component has processes for measuring the effectiveness and quality of the learning service, including obtaining feedback from stakeholders.

## ADMINISTERING AND MANAGING THE LEARNING SERVICE:

- The RTC component has adequate arrangements for administration, governance, planning, staffing, continuous professional development, reporting and self assessment;
- If the RTC component has no national accreditation as a provider of vocational training, it can demonstrate that it carries out its training activities in accordance with the requirements of ISO 29990:2010;
- The RTC component produces an annual report on activities carried out in the previous twelve months, and on its plan for the next 12 months with an outlook for future years;
- The RTC component is: (a) open to students from all countries in the Region and, subject to availability of resources, to interested countries in other Regions; and (b) has appropriate services in place to support international/ regional students.

# ANNEX 3

## Roles and Responsibilities of Parties involved in an RTC

# *Roles and Responsibilities of Parties involved in an RTC*

**Extracted from WMO Publication 49, Volume 1, General Meteorological Standards and Recommended Practices, Part VI, section 1.5.2.** *https://library.wmo.int/doc_num.php?explnum_id=4065 (2015 edition, updated in 2017)*

## 1.5 Meteorological Education and Training Facilities

1.5.1 Members should endeavour to provide national facilities, or participate in regional facilities, for the education and training of their personnel.

1.5.2 As not all national training facilities are recognized as regional training facilities, the criteria given in Appendix B to this volume apply to each institution designated as being part of a WMO Regional Training Centre (RTC). Each of those institutions is referred to as an RTC component.

Note: In recognizing, reconfirming and managing an RTC component, the regional association, the Permanent Representative of the host country, the Director of the RTC component and the Coordinator of the RTC with multiple components take shared responsibility for the performance and ongoing status of the institution(s) as an RTC. Guidance on the roles and responsibilities of each of the parties is provided in Guide to the Management and Operation of WMO Regional Training Centres and Other Training Institutions (in preparation).

### Regional Association

- Prioritize education and training needs of the regional association and communicate them to the RTCs at least every four years;
- Keep abreast of the activities and plans of each RTC and its components through the annual report they provide;
- Provide RTCs, Members and the Secretary General with feedback on whether the RTCs are meeting the needs of the regional association;
- Contribute to quadrennial reviews of the RTCs arranged by the Executive Council in order to address the extent to which the RTCs are meeting the identified education and training needs of the regional association;
- At each session of the regional association, recommend RTCs to the WMO Executive Council for possible confirmation, based on performance against the established criteria;
- Promote the activities and use of the RTCs by members of the regional association;
- Seek funding and resource opportunities to support and expand the work of the RTCs in addressing the education and training needs of the regional association.

### Permanent Representative of the Host Country

- Inform the Secretary General and the regional association of the contact details of the Coordinator of an RTC and the Director of an RTC component and of any changes thereto;
- Where the RTC is made up of multiple components, ensure ongoing communication and coordination between the components to maximize education and training opportunities for Members;
- Facilitate coordination between the RTC and the regional association concerned regarding regional education and training needs, funding and resource opportunities;
- Promote the resourcing of the RTC through support from government and other national and international funding bodies;
- Provide the regional association and the SecretaryGeneral with annual reports about the RTC's activities in the previous 12 months and its plans for the next 12 months with an outlook for future years;
- Collaborate with other Permanent Representatives hosting RTCs to promote collaboration between the RTCs;

- Oversee and act as an advocate for the RTC to (a) comply with national and WMO standards and guidelines and (b) keep pace with evolving technological and educational developments.

### Director of an RTC Component

- Monitor and plan the activities of the RTC component in accordance with the expressed education and training needs of the regional association;
- For vocational training activities, use processes within the RTC component that are consistent with ISO 29990:2010, Learning services for nonformal education and training – Basic requirements for service providers;
- Monitor the skills and capabilities of the RTC staff informing the appropriate authorities of the requirements to develop and maintain the professional and training expertise of staff and to ensure the availability and maintenance of an adequate infrastructure for training and for information and communications technology;
- Submit to the Permanent Representative annual reports about the activities of the RTC component in the previous 12 months and plans for the next 12 months with an outlook for future years;
- Inform Members, through regular communication, of the benefits of the services offered by the RTC component and provide them with easy access to the RTC's education and training programme and contact information;
- Work with other RTC components to (a) coordinate activities and (b) share resources and experience in addressing regional education and training needs;
- Seek additional funding and resource opportunities to expand the ability of the RTC component to address the regional education and training needs.

### Coordinator of an RTC with Multiple Components

- Coordinate the overall activities of the RTC components in accordance with the expressed education and training needs of the regional association;
- Coordinate preparation of annual reports about the RTC's activities in the previous 12 months and plans for the next 12 months with an outlook for future years, for submission to the Permanent Representative;
- Coordinate arrangements for (a) promoting and providing information about the RTC's services to Members through regular communication, and (b) the sharing of resources and experience among the RTC components in addressing regional education and training needs;
- Ensure that the RTC components collaborate and that each is apprised of the other's education and training activities;
- Support the RTC components in seeking additional funding and resource opportunities to expand the ability of the RTC to address the regional education and training needs.

# ANNEX 4

## Education and Training Capacity in the field of meteorology and hydrology in the study area

# *Education and Training Capacity in the Field of Meteorology and Hydrology in the Study Area*

Table 11 indicates which of the study countries host post secondary education and training institutions and their relevance to the study. Where an institution has a record of providing education and training to national meteorological services it is named, if a university or TVET institution exists but does not have a record of providing education and training specific to the needs of the NMHS it is depicted by a "Yes". A separate column labelled Other has been included to encompass the training components of meteorological services such as Fiji, Tonga and SPREP.

Universities and TVET institutions who do not specifically service the needs of the NMHSs still have a role to play in providing the basic science and technology related courses required as prerequisites for the follow on specialist studies.

**TABLE 11. Countries in the Study Area Hosting Universities, TVET or Other Education and Training Institutions**
(*The University of the South Pacific has campuses in the following countries:* Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Samoa. For brevity only the main campus in Suva, Fiji is shown.)

| Country | University | Technical and Vocational Education and Training (TVET) | Other | Study Team Comments |
|---|---|---|---|---|
| **Cook Islands** | | Yes | | |
| **Federated State of Micronesia** | Yes (2 year colleges) | Yes | | |
| **Fiji** | USP[8], | | Fiji Meteorological Service | USP hosts the Pacific Centre for Environment and Sustainable Development (PaCE-SD). PaCE-SD offers courses at the graduate diploma, MSc and PhD level addressing climate and climate change. A semester course in tropical meteorology is offered and a unit on oceanography is under preparation. Whilst PaCE-SD has some 80 staff there are only a small number of specialists covering the area of meteorology. None of them have operational experience.<br><br>Fiji National University trialled a meteorology course several years ago but cancelled it after one semester due to lack of student numbers.<br><br>The FMS training centre provides courses ranging from one or two week in-service courses for observers and forecasters to courses of several months duration for initial observers. There are currently two permanent staff in the FMS Training Unit with a third position to be filled in the near future. FMS specialist staff for the Climate and Forecasting areas support the Training Unit with lectures and practical sessions as required. |
| | Fiji National University, | | | |
| | University of Fiji | | | |

8 USP, the University of the South Pacific, has 14 campuses located in: Fiji (Labasa, Lautoka, Suva), Tonga, Tuvalu, Vanuatu, Tokelau, Solomon Islands, Niue, Marshall Islands, Kiribati, Nauru, Cook Islands and Samoa.

| Country | University | Technical and Vocational Education and Training (TVET) | Other | Study Team Comments |
|---|---|---|---|---|
| Kiribati | | Yes | | |
| Nauru | | | | |
| Niue | | | | |
| Palau | Yes (2 year colleges) | Yes | | Not regarded by the OIC of the Palau WSO as offering courses relevant to their mission. |
| Papua New Guinea | University of Papua New Guinea | Yes | | The Physics Department of the University of Papua New Guinea has a number of ex staff from the Papua New Guinea National Weather Service who are keen to run either a meteorology course or potentially a graduate diploma in meteorology. Ideally ten students a year are needed to make the course viable. The Physics Department of the University of Papua New Guinea has a number of ex staff from the Papua New Guinea National Weather Service who are keen to run either a meteorology course or potentially a graduate diploma in meteorology. Ideally ten students a year are needed to make the course viable.<br><br>The Physics Department are currently offering 2 units related to meteorology and climate as part of the BSc and another 2 units as part of their fourth year graduate program. The Department of Geography also provides a hydrometeorology course and a tropical climatology course. |
| Republic of Marshall Islands | Yes (2 year colleges) | Yes | | |
| Samoa | Yes | Yes | SPREP / PCCC | |
| Solomon Islands | Yes | | | |
| Tokelau | | | | |
| Tonga | Yes | | | |
| Tuvalu | | | | |
| Vanautu | Yes | Yes | | |

TABLE 12: Indicates Countries Outside of the Study Area that Provide Education and Training Opportunities for Countries in the Study Area

| Country | University | Other | Study Team Comments |
|---|---|---|---|
| **Australia** | | Bureau of Meteorology Training Centre (BMTC) | BMTC offers a 33 week Graduate Diploma BIP-M course focussing on operational meteorology, cost for NMHS students is AUD $34,100 (~ USD$ 25,000). Students can exit the course at 25 weeks with a certificate from BMTC stating that their studies have met the BIP-M requirements. The cost for the non accredited shorter course is AUD$ 28,300 (~ USD $21,000). for NMHS students<br><br>BMTC also offers a range of courses for Meteorological Technicians but these are not accredited and do not run regularly at the present time. |
| **Caribbean** | University of the West Indies | Caribbean Institute of Meteorology and Hydrology (CIMH) | CIMH is an RTC supporting 16 countries in the Caribbean. The staff at CIMH also run the meteorological course at the University of the West Indies. Some students from the Pacific have attended the 18 month Senior Meteorological Technician course at CIMH under UNDP funding. CIMH has also enrolled students from the Pacific into a number of online hydrology and GIS courses. |
| **China** | Nanjing University of Science and Technology (NUIST) | China Meteorological Training Centre (CMATC) | NUIST and CMATC make up the two components of the RTC in China. CMATC focuses on operational meteorology for national and foreign students whilst NUIST offers a full range of university level courses for meteorology. |
| **India** | | Pune Central Training School | The Indian Meteorological Department (IMD) provides non accredited BIP-M forecaster and BIP-MT observer training in Pune and New Delhi. |
| **Japan** | | Japan International Cooperation Agency (JICA) | In the framework of the technical cooperation project "Reinforcing Meteorological Training Function of FMS[9]" JICA has two contractors working with the FMS Training Unit. The project is funded for the period 2015 – 2018. The project has provided: Training of trainers, Regional group-training for common needs, In-country training for individual needs, On-the-job training for specific skills. |
| **Republic of Korea** | | KMA in-service<br><br>APEC Climate Centre (APCC) | The Korea Meteorological Administration (KMA) have hosted an RTC since 2015. It provides a range of one to two week in-service training course for students from Asia, the Pacific and Africa. KMA fully funds the courses including airfares and living expenses.<br><br>The APEC Climate Centre (https://www.apcc21.org) offers training programs for developing countries and a young scientist support program. |

9 The JICA project covers Cook Is, Fiji, Kiribati, Nauru, Samoa, Solomon Is, Tonga, Tuvalu, Vanuatu

| Country | University | Other | Study Team Comments |
|---|---|---|---|
| **New Zealand** | University of Victoria (Wellington) | Met Service New Zealand<br><br>NIWA provides training for CLiDE Desk | The University of Victoria offers a nine month MSc in partnership with Met Service New Zealand |
| **Philippines** | University of the Philippines | Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA). | An MSc in meteorology is offered by the University. PAGASA offers non accredited BIP-M and BIP-MT courses |
| **United States of America** | | Pacific Island Training Desk (PITD) | The PITD is funded by NOAA but is run by the University of Hawaii. The course is aimed at meteorological observers and has three distinct components: an initial, pre-involvement online component covering basic meteorology using COMET modules (meted.ucar.edu). This is followed by three four-week residential courses over three years developing meteorological knowledge and skills in increasing depth and complexity as a student moves from course 1 to course 2 to course 3. |

Table 13 lists the main providers of specialist meteorological education and training for new technicians and professionals in the Asia Pacific region. The table lists the primary institutions open to the 15 NMHSs to currently educate and train their staff. Tuition costs for accredited courses range from US 1,000 or so to approximately US 40,000 for the MSc in New Zealand. There are no tuition costs for non accredited courses in India and the Philippines.

**TABLE 13: Courses for New Staff at the Technician and Professional Level in the Asia Pacific Region**

| Institute | Course type | Comments |
|---|---|---|
| **Fiji Meteorological Service** | Technician training | One-week intensive technical training courses of different subjects. 2 month BIP-MT course, runs irregularly, course fees and accommodation costs typically covered by JICA |
| **Victoria University, Wellington New Zealand** | Meteorologist training | Offers a six month Post Graduate in Meteorology (tuition cost approximately $US 25,000) or a nine month Masters in Meteorology (tuition cost approximately $USD 40,000). Students may need to produce English proficiency evidence. High levels of mathematics and physics prerequisites. |
| **Australian Bureau of Meteorology Training Centre, Melbourne, Australia** | Meteorologist training | 33 week Post Graduate Diploma. Requires BSc or equivalent with mathematics and physics units to 3rd year level. Tuition fees of approximately $US 25,000. Per diem costs of around $USD 20,000. A shorter, non accredited BIP-M course of 25 weeks is also available for approximately USD $ 21,000. |
| **Philippines Atmospheric and Geophysical Astronomical Services Administration, Manila, Philippines** | Meteorologist training<br><br>Technician Training | Meteorologist course of approximately 11 months. It is BIP-M compliant but not accredited. Costs are typically jointly covered by PAGASA / Philippines Government and WMO. Course runs irregularly.<br><br>Technician Course of approximately five months. It is BIP-MT compliant but not accredited. Costs are typically jointly covered by PAGASA / Philippines Government and WMO. Course runs irregularly. |

| Institute | Course type | Comments |
|---|---|---|
| **University of the Philippines. Manila, Philippines** | Meteorologist training | The University of the Philippines offers a graduate diploma of six months and a 2 year MSc course and it accepts new students annually. The course is BIP-M compliant but does not have the operational education and training required for graduates to directly join the forecasting bench. The Diploma level course tuition costs are of the order of $US 1,000 whilst the MSc tuition costs are of the order of $US2,000. |
| **India Meteorological Department. Pune, India** | Meteorologist training | International students are able to join IMD students on their annual meteorologist course. The course is of the order of 9 months duration and is not accredited. FMS have recently sent staff to IMD for training and the students indicated that they did not get the same level of training as the FMS students attending courses at PAGASA. Course costs have been covered by WMO and IMD. |
| **University of Hawaii, USA** | Meteorologist training | The UH is a four-year college offering undergraduate degrees in meteorology that include practical forecasting as well as a range of theoretical courses. UH also offers masters and doctorate degrees in meteorology. All courses have a distinct tropical focus. Practical work is done in cooperation with the US NWS that shares the building occupied by the UH meteorology department. |
| **University of Guam, Guam** | Meteorologist training | The UG is a four year college. UG does not offer meteorology as a subject. Its environmental sciences courses are more focused on the biological rather than physical sciences. It does offer undergraduate courses in physics, maths, chemistry and statisitics, along with Masters abd doctoral degrees in environmental sciences. |
| **Nanjing University of Information Science and Technology, Nanjing, China. NUIST** | Meteorologist training | NUIST is one of the major atmospheric science universities in China. Students can attend for a five year undergraduate course (four years of university plus one year of Chinese language tuition) or for an MSc which can be taken in English. The courses are BIP-M compliant and have some operational aspects but not enough to allow people to directly join the forecasting bench on return. The Chinese Government offers scholarships in-conjunction with WMO. Approximately 25 WMO supported students from Africa and Asia commence study every year. |
| **Caribbean Institute of Meteorology and Hydrology (CIMH)** | Meteorologist training<br><br>Technician Training | CIMH offers a range of training courses for technicians and professionals in meteorology and hydrology. The technician courses are accredited with the senior technician course taking 18 months. Graduates of the Senior Meteorological Technician (SMT) course are able to operate as aeronautical meteorological forecasters in the Caribbean as the course meets the BIP-M requirements in a Caribbean context. Course costs. A number of staff from the Pacific have undertaken the SMT with UNDP Suva funding in the past. |

Table 14 summarises the regular providers of in-service training for the 15 NMHSs in the study area. In addition to these providers the 15 NMHSs also have access to education and training opportunities through the various donor programmes, particularly for equipment. In some of the countries the World Bank is investigating the implementation of a Multi Hazard Early Warning System which will come with its own suite of training activities.

TABLE 14: In-service Courses for Existing Staff at the 15 NMHSs

| Institute | Types of Courses |
|---|---|
| FMS / JICA | Short term face-to-face training courses of about 1-week duration covering observations, equipment, QMS, forecasting.<br><br>Duration of the BIP-MT training course is 2 months |
| Australian Bureau of Meteorology Training Centre | Online courses<br><br>WMO Virtual Laboratory monthly online satellite discussions<br><br>Every year part of the Bureau's Advanced Forecaster Course is broadcast online |
| Caribbean Institute of Hydrology and Meteorology | Online courses in GIS, Hydrology |
| NUIST | One to two week face to face courses funded by China in a wide variety of subject domains, primarily professional |
| China Meteorological Administration Training Centre (CMATC) | One to two week face to face courses funded by China in a wide variety of subject domains, primarily professional |
| Pacific Island Training Desk (PITD) | A coordinated three part course run over 3 years. The NWS and UH offer five groups of four students (i.e. 20 students) per year the one month residential course. A student can then progress to the level two course at some later time and finally the level three course. The depth of subject matter increases with increasing level. To date no students have done the level three course |
| COSPPac | COSPPac funds a "Capacity Development and Training" function which is planning to undertake the following activities in 2018-19 in cooperation with SPREP and SPC:<br><br>• Support training needs analysis and assist COSPPac projects to deliver workshops, work attachments and student internships;<br><br>• Support in-country and sub-regional training in CliDE, seasonal predictions and related climate and oceans services and science;<br><br>• Deliver in-country workshops for NMHS stakeholders (and other national agencies such as aid coordination and planning ministries, finance ministries and treasury, sectoral ministries, local community leaders, and national and local media) to increase their understanding of climate change and variability, seasonal predictions and the potential applications of seasonal climate forecasting and ocean services;<br><br>• Deliver training for lands and survey staff in geospatial information management, sea level vertical height determination and other relevant issues pertaining to the PSLGM project; and<br><br>• Deliver training for climate staff in science communication, presentation skills and media (social media). |
| NIWA | Technical training, focused on meteorological and hydrological operational roles and services, and managing climatic risk to communities and structures.<br><br>NIWA has run a three-month on-line course for hydrology technicians, supported by WMO. |
| SRPEP / PCCC | Short term courses in climate data, climate services, application of climate data to different sectors of the economy. |

With the assistance of WMO and the BMTC the Study Team have been able to tabulate the numbers of students attending BIP-M and BIP-MT courses since January 2014, Table 15 below. The MSc course at the University of Reading attended by several students from the study area is an "MSc in Applied Meteorology and Climate with Management". It is aimed at students who have already completed a BSc in Meteorology and as such is not BIP-M compliant. It focuses on linking meteorology, climate change and climate policy with elements from the University's MBA program. Funding for the students attending the BMTC course has come from WMO, UNDP and the Pacific Resilience Program and MEIDIC (Tonga).

**TABLE 15. Numbers of Study Area Students attending BIP-M and BIP-MT Courses in the time period of 1 January 2014 to id 2018**

| Country | | BMTC | IMD Pune | PAGASA | UK | Grand Total |
|---|---|---|---|---|---|---|
| **Fiji** | | | | | | |
| | BIP-M | 1 | 2 | 2 | | 4 |
| **Kiribati** | | | | | | |
| | BIP-M | 1 | | | | 1 |
| | BIP-MT | | | 1 | | 1 |
| **Micronesia, Federated States of** | | | | | | |
| | BIP-MT | | | 1 | | 1 |
| **Samoa** | | | | | | |
| | BIP-MT | | | 2 | | 2 |
| **Solomon Islands** | | | | | | |
| | BIP-M | 2 | | | | 3 |
| | MSc at Reading | | | | 1 | 1 |
| **Tonga** | | | | | | |
| | BIP-M | 5 | | 2 | | 2 |
| | BIP-MT | | | 1 | | 1 |
| | MSc at Reading | | | | 1 | 1 |
| **Vanuatu** | | | | | | |
| | BIP-M | 2 | | 1 | | 3 |
| | BIP-MT | | | 1 | | 1 |
| **Grand Total** | | **10** | **2** | **11** | **2** | **25** |

With the assistance of FMS, PITD and WMO the Study Team have been able to compile a listing of students attending short term courses (course duration up to one month) in Fiji, India, China, Philippines and the Pacific Island Training Desk. Note that the numbers indicate people attending the courses and they include the same students doing different courses, e.g. Nauru only has one staff member and a support person and between them they have attended 7 courses. Whilst training centres outside of the region do provide opportunities FMS and PITD provide the overwhelming number of opportunities.

TABLE 16. Students Numbers attending Short-Term (duration of less than one month) Courses at various Training Centres

| Country | FMS | IMD | NUIST | PAGASA | PITD | Grand Total |
|---|---|---|---|---|---|---|
| Cook Islands | 31 | | | | 3 | 34 |
| Fiji | 55 | 1 | | | 11 | 67 |
| FSM | 9 | | | 1 | 22 | 32 |
| Kirabati | 26 | 1 | | 1 | 9 | 37 |
| Nauru | 7 | | | | | 7 |
| Niue | 13 | | | | 3 | 16 |
| Palau | | | | | 6 | 6 |
| PNG | 10 | 1 | 1 | | 8 | 20 |
| RMI | | | | | 6 | 6 |
| Samoa | 12 | 1 | 1 | 2 | 10 | 26 |
| Solomon Islands | 14 | | | | 8 | 22 |
| Tokelau | | | | | 2 | 2 |
| Tonga | 14 | | | 1 | 8 | 23 |
| Tuvalu | 12 | 1 | | | 7 | 20 |
| Vanuatu | 17 | | | 1 | 8 | 26 |
| Grand Total | **220** | **5** | **2** | **6** | **111** | **344** |

# ANNEX 5

Profiles for Six (6) Pacific Universities

# *Profiles for Six (6) Pacific Universities*

This brief overview document looks at six Universities in the Pacific that offer bachelors, masters and doctoral degrees; the University of Guam (UG), the University of Hawaii (UH), the University of Papua New Guinea (UPNG), the University of the South Pacific (USP), the University of Fiji and the Fiji National University. Two of these have expressed an interest in participating in an expanded training effort for meteorological personnel in the Pacific; UPNG and USP, the other two; UG and UH have been considered because they are in the Pacific and have a high potential to play a role.

## UNIVERSITY OF GUAM (UG)

### OVERVIEW

*Enrollment:*

Undergraduate 3,627
Graduate 328
Certificate 44

*Enrollment status:*

Full-time 2,704 full time
Part-time 935

*Gender balance of full-time students:*

1,068 men full time
1,636 women full time

The University of Guam (UG) is a four-year land-grant institution, located in the village of Mangilao on the United States territory of Guam. It is accredited by the Western Association of Schools and Colleges and offers thirty-four degree programs at the undergraduate level and eleven master's level programs. Of the University's 3,387 students, 94% are of Asian-Pacific Islander ethnicity, and nearly 72% are full-time (fall 2012 figures).

**The College of Natural and Applied Sciences of the UG offers the following four-year degree courses:**

- Bachelor of Science in Agriculture and Life Sciences
- Bachelor of Science in Biology
- Bachelor of Science in Chemistry
- Bachelor of Science in Computer Information Systems
- Bachelor of Science in Computer Science
- Bachelor of Science in Mathematics

The UG does not offer meteorology or physics among its natural and applied science courses. The College of Natural and Applied Sciences awards Master of Science Degrees in Biology and Environmental Science.

***Costs***

The cost of attendance at UG varies according to whether a student is resident or non-resident and whether the student is enrolled in an undergraduate (UG) or graduate course (GR) (Table 1)

**Table 17:** Annual student costs at UG 2018-19. The costs above (other than tuition, fees and dorm rates) are based on information gathered from the U.S. and Guam Departments of Labor, the U.S. General Services Administration and the U.S. Department of Agriculture and adjusted for Guam using data from the Guam Bureau of Statistics and Plans. (UG undergraduate, GR graduate level courses)

(Source: https://www.uog.edu/_resources/files/financial-aid/tuition-and-fees/2018-2019_coa.pdf)

| RESIDENCE | DORM | | OFF-CAMPUS | | WITH PARENTS | |
|---|---|---|---|---|---|---|
| | UG | GR | UG | GR | UG | GR |
| TUITION | 5,040 | 5,130 | 5,040 | 5,130 | 5,040 | 5,130 |
| FEES | 764 | 764 | 764 | 764 | 764 | 764 |
| BOOK & SUPPLIES | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 | 2,050 |
| ROOM & BOARD | 3,850 | 3,850 | 11,169 | 11,169 | 2,700 | 2,700 |
| TRANSPORTATION | 450 | 450 | 1,472 | 1,472 | 1,472 | 1,472 |
| PERSONAL EXPENSES | 1,800 | 1,800 | 1,800 | 1,800 | 1,800 | 1,800 |
| **TOTAL** | **13,954** | **14,044** | **22,295** | **22,385** | **13,826** | **13,916** |

At this stage the Study Team do not recommend including the University of Guam for further consideration in the RTC.

## UNIVERSITY OF HAWAII (UH)

### OVERVIEW

*Enrollment:*

Undergraduate: 12,881
Graduate: 4,731
Total: 17,612

*Enrollment status:*

Full-time: 75.5%
Part-time: 24.5%

*Gender balance full-time students;*

6,588 men full time
8,023 women full time

*Student diversity:*

Hawaiian/ Part Hawaiian 15%
Filipino 10%
Chinese 7%
Japanese 8%
Pacific Islander 2%
All Other 20%
Mixed 15%
Caucasian 23%

*Residency status:*

Hawai'i 70.5%
U.S. Mainland 21.1%
U.S. Affiliated 1.3%
Foreign 6.4%
Unknown 0.7%

The UH offers courses that meet the BIP-M requirements through its Atmospheric Sciences Department. The UH also offers degrees in information sciences, physics, mathematics and oceanography, all of which, if readily available to the 15 countries of the Pacific, could greatly assist in upgrading personnel qualifications and on-the-job capabilities. (source: http://www.catalog.hawaii.edu/degrees/degrees-cert.htm)

#### Atmospheric Sciences at UH

The Atmospheric Sciences Department at UH has at least 15 doctorate-level qualified staff covering all aspects of meteorology. The atmospheric sciences BS students receive comprehensive training in tropical weather analysis and forecasting. Graduate students often pursue their research in tropical meteorology; some of their study topics take advantage of Hawai'i's unique natural laboratory. Some students pursue graduate research with funding from the National Weather Service, whose Honolulu Weather Forecast Office is housed in the same building as the atmospheric

sciences department. Atmospheric sciences faculty cooperate actively with physical oceanography faculty through the Joint Institute for Marine and Atmospheric Research and the International Pacific Research Center in the study of air-sea interaction and climate variability. Students also have access to both research databases and cooperative employment opportunities at the Joint Typhoon Warning Center, Pearl Harbor.

**Table 18.University of Hawaii Fees**

| RESIDENCE | UNIVERSITY OF HAWAII 2018-2019 | | | |
|---|---|---|---|---|
| | UG | G | UG | GR |
| TUITION FEES | 5,544 | 7,800 | 16,560 | 18,540 |

Source: https://www.hawaii.edu/finaid/tuition.html (UG undergraduate, G graduate level courses)

***Estimated additional costs:***

$860 fees
$13,030 room & board
$952 books and supplies

(Source : https://www.cappex.com/colleges/University-of-Hawaii-at-Manoa)

## UNIVERSITY OF PAPUA NEW GUINEA (UPNG)

### OVERVIEW

Schools: Schools of Business and Public Policy, Law, Humanities and Social Sciences, Medicine and Health Sciences, and Natural and Physical Sciences.

*Average student enrollment per year:* 11-12 thousand students

*Average graduates per year:* 1,500

*Origins of students:* Papua New Guineans, South Pacific Islanders, Asians, Africans, and Europeans.

The UPNG School of Natural and Physical Sciences has the disciplines of Biological Sciences, Chemistry, Environmental Sciences and Geography, Earth Sciences, Mathematics, Statistics and Computer Science and Physics.

**Atmospheric Sciences at UPNG**

The eight academic staff of the physics department hold four-year degrees in physics, and one of these staff, a former meteorologist with the PNG NWS, has a Graduate Diploma in Meteorology. The physics department is in the process of developing a number of meteorology-related electives within the physics program and plan to offer these to both PNG NWS staff and other students. At the present time the courses offered are “Introduction to Meteorology” and “Introduction to Climate Studies” at 3rd year level, and “Physics of Climate” and “Environmental Physics” at fourth year level. These can comprise are part of the Physics program in BSc program. The Geography Department of UPNG offers courses in “Hydrometeorology” and “Tropical Climatology”.

***Costs***

Tuition fees and other costs cost of students in the Natural and Physical Sciences Division of UPNG: (source: http://www.upng.ac.pg/site/university-fees.html)

Table 19. University of Papua New Guinea Fees

| RESIDENCE | UNIVERSITY OF PNG | | | |
|---|---|---|---|---|
| | National Students | | International Students | |
| | Kina | US$ | Kina | US$ |
| TUITION (Full-time) | 9,596 | 2,974.76 | 19,105 | 5,922.55 |
| **HOUSING** | | | | |
| Basic Twin Share<br>Single Room | 8,562<br>9,885 | 2,654.22<br>3,064.35 | 8,563<br>9,885 | 2,654.53<br>3,064.35 |
| International House | 9,885 | 3,064.35 | 9,885 | 3,064.35 |
| Double / En-Suite | 11,072 | 3,432.32 | 11,073 | 3,432.63 |
| Village Twin Share | 12,000 | 3,720 | 12,001 | 3720.31 |
| One kina = $0.31 US$ | | | | |

## UNIVERSITY OF THE SOUTH PACIFIC (USP)

USP is an intergovernmental organisation and public research university with locations spread throughout a dozen countries in Oceania. It is an international centre for teaching and research on Pacific culture and environment. USP's academic programmes are recognised worldwide, attracting students and staff from throughout the Pacific region and internationally. USP is owned by the governments of 12 Pacific island countries: the Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu. The USP has 16 campuses throughout the Pacific and operates a high speed Internet between these campuses which serves teaching, research and administration.

Table 20: "Head Count", by Nationality of Undergraduate Students at USP in 2016

| UNDERGRADUATE HEAD COUNT | 2016 | | |
|---|---|---|---|
| **Nationality** | **Male** | **Female** | **TOTAL** |
| Cook Islands | 12 | 55 | 67 |
| Fiji | 3,507 | 4,825 | 8,332 |
| Kiribati | 212 | 412 | 624 |
| Marshall Islands | 35 | 43 | 78 |
| Nauru | 16 | 22 | 38 |
| Niue | 0 | 1 | 1 |
| Samoa | 169 | 221 | 390 |
| Solomon Islands | 1,012 | 670 | 1,682 |
| Tokelau | 11 | 26 | 37 |
| Tonga | 245 | 435 | 680 |
| Tuvalu | 95 | 152 | 247 |
| Vanuatu | 604 | 605 | 1,209 |
| International | 38 | 52 | 90 |
| **TOTAL** | **5,956** | **7,519** | **13,475** |

Table 21: "Head Count", by Nationality of Graduate Students at USP in 2016

| GRADUATE HEAD COUNT | 2016 | | |
|---|---|---|---|
| Nationality | Male | Female | TOTAL |
| Cook Islands | 1 | 3 | 4 |
| Fiji | 435 | 403 | 838 |
| Kiribati | 8 | 14 | 22 |
| Marshall Islands | 4 | 7 | 11 |
| Nauru | 0 | 1 | 1 |
| Niue | 0 | 0 | 0 |
| Samoa | 5 | 13 | 18 |
| Solomon Islands | 33 | 18 | 51 |
| Tokelau | 0 | 0 | 0 |
| Tonga | 15 | 35 | 50 |
| Tuvalu | 7 | 14 | 21 |
| Vanuatu | 4 | 4 | 8 |
| International | 20 | 23 | 43 |
| **TOTAL** | **532** | **535** | **1,067** |

The great majority (slightly more than 99%) of USP's students originate from the 12 countries that share ownership of the University. Females comprise 56% of the undergraduate student population whereas the graduate student gender split is around 50:50, male : female (Tables 20 and 21).

Table 22: Mode of Study (by FTE) of Students at USP in 2016

| MODALITY OF FULL TIME EFFECTIVE (FTE) STUDENTS | 2016 |
|---|---|
| Onsite undergraduate students (FTE) [4-yr degree] | 7,369 |
| Onsite graduate (FTE) [MSc & PhD] | 545 |
| Distance education undergraduate students (FTE) | 2,582 |
| Distance education graduate students FTE | 55 |

On a FTE basis, 9% of graduate students are learning by distance education (blended + Internet + online + print), whereas 25% of undergraduates were learning by distance (Table 22).

### USP Bachelor of Science major disciplines

The USP Bachelor of Science is a three-year programme comprising twenty-four courses; of which eight courses are at 100-level, eight courses at 200-level, and eight courses at 300-level. The disciplines permitted as a major or minor for the Bachelor of Science degree in 2018 are: Biology, Chemistry, Computing Science, Electrical/Electronic Engineering, Geography, Geospatial Science, Mathematics, and Physics. Meteorology (the science of atmosphere including climate and weather) is currently not addressed at the undergraduate level.
(Source, USP Handbook and Calendar_2018: https://www.usp.ac.fj/index.php?id=proffice_publication)

## USP PACIFIC CENTRE FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT (PACE-SD)

The Pacific Centre for Environment and Sustainable Development (PaCE-SD) works with all faculties across the University to offer postgraduate programmes in climate change. These include:

- A postgraduate diploma in climate change (PGDip CC) that consists of four 400-level courses;
- An MSc in climate change based on a research thesis; and,
- A PhD in climate change based on a research thesis

Because of the cross-cutting aspect of climate change and of the specificity of the region, the courses under the PGDip CC, MSc and PhD research thesis cover a broad range of topics, from climate sciences to the social, financial and economic aspects of climate change, traditional knowledge and the integration of climate change and disaster risk management. Because of this, research students under the climate change programme are encouraged to collaborate with external co-supervisors from other USP faculties and/or other universities.

**USP Tuition Fees (2018)**

Regional Students (holding passports from one of the 12 "owning countries")
Graduate Diploma (FJ$ 1,250 per 400 level course X 4) FJ$ 5,000.
Masters Degree and PhD: Full time FJ$ 4,455 per year, Part time FJ$ 2,230 per year

**International Students**

Graduate Diploma (Fj$ 4,980 per 400m level course X 4) FJ$ 15,920
Masters Degree and PhD: Full time FJ$ 19,225 per year, Part time FJ$ 9,640 per year.

**Table 23: USP Postgraduate Tuition Fees Expressed in $US**

| TUITION FEES - USP | | |
|---|---|---|
| | **Graduate Diploma** (4 x 400 Level Units) | **MSc and PhD** (fees per year) |
| **Regional Students** | $2,380 | $2,121 |
| **International Students** | $7,578 | $9,151 |
| 1FJ$-0.476US$ Source: https://www/usp.ac.fj/index.php?id=proffice_publication | | |

## THE UNIVERSITY OF FIJI

The University of Fiji is a recognized provider of higher education in Fiji. The Ministry of Education and the University have signed an MOU to provide a framework for the relationship between the Government and The University of Fiji until an Act is passed to provide a complete legislative framework for the University.

The University of Fiji has entered into arrangements with a number of universities to ensure international recognition of its qualifications and to encourage joint research and publications, including the University of Canberra, University of Waikato and the University of New England.

The University offers programmes through its five Schools at the Certificate, Diploma, Undergraduate Degree and Postgraduate levels in disciplines such as Accounting, Economics, Management, Computing Science, Information Technology, Mathematics, Language and Literature.

According to the 2012 Annual report, the University has created five Centres of Excellence to promote public lectures, discussion and debate, research, writing and publication: Centre for Climate Change, Environment, Energy and Sustainable Development; Centre for Diasporic Studies, Centre for Gender Research; Centre for International and Regional Affairs and Centre for iTaukei Studies. Students enrolment numbers are in 2011 – 1262, in 2012 – 1423; in 2013 – 1701.

**Table 24. Ethnicity and Gender Breakdown for the University of Fiji**

| Ethnicity and Gender | Indian | Fijian | Others | Total |
|---|---|---|---|---|
| 2011 | | | | |
| Female | 390 | 284 | 15 | 689 (55%) |
| Male | 358 | 199 | 16 | 573 (45%) |
| Total | 748 (59%) | 483 (38%) | 31 (3%) | 1262 |
| 2012 | | | | |
| Female | 426 | 309 | 25 | 760 (53%) |
| Male | 423 | 223 | 17 | 663 (47%) |
| Total | 849 (60%) | 532 (37%) | 42 (3%) | 1423 |
| 2013 | | | | |
| Female | 550 | 371 | 31 | 952 (56%) |
| Male | 468 | 261 | 20 | 749 (44%) |
| Total | 1018 (60%) | 632 (37%) | 51 (3%) | 1701 |

Degree, Master and Post Graduate programmes are the most demanded. Number of PhD – up to 10.

The Foundation Studies programme is also in high demand. It is equivalent to the Fiji Form Seven examination or Year 13 in New Zealand and Australian secondary schools. It provides an alternative pathway to degree studies for students who leave secondary school after successfully completing the Fiji School Leaving Certificate (FSLC) in Form Six or Year 12 in New Zealand and Australia or the Pacific Senior Secondary Certificate (PSSC). The PSSC is taken by students in Form 6 in Tonga, Samoa, Solomon Islands, Kiribati, Vanuatu, Tuvalu and Nauru. PSSC is also equivalent to the NCEA level 2 certificate. To gain entry to New Zealand and Australian universities an NCEA level 3 pass is required.

**School of Science and Technology comprises of three departments:**

- Department of Computer Science and Information Technology (1 Lecturer and 4 Assistant Lecturers)
- Department of Mathematics (lowest number of students - less than 10 at the second and third levels, while maintaining healthy numbers at year 1), (1 Lecturer and 1 Assistant Lecturer with MSc)
- Department of Science (Biology: 83 students at all courses as of 2013, (2 Lecturers with MSc and 2 Assistants), Chemistry: 72 full-time students as of 2013, (1 Lecturer with MSc, 2 Assistant Lecturers, 1 Professor in Renewable Energy) and Physics: 34 full-time students as of 2013. Field trips for year 1 and year 2 students are organizing for visiting Fiji Meteorological Service for students enrolled for Physics.

**Department of Science in 2013 reported new programme offerings:** BSc in Environmental Science.
Courses developed and taught includes Qualitative and Quantitative Techniques, Applied and Environmental Chemistry, Atmospheric Physics, Physics of the Environment, Scientific Methods, Electricity and Electronics, Physical Geography.

**Tuition Fees** are different for different subjects (only those appropriate for this Study data are included below). Tuition

fee for Fiji Citizens and Citizens of Pacific Islands Forum Countries (PIFC) (except Australia & New Zealand) is half the cost of that for citizens from other countries (see table below).

**Table 25. University of Fiji Fees**

| | | Fiji Citizens & Citizens of Pacific Islands Forum Countries (PIFC) (except Australia & New Zealand) | Citizens of Other Countries (including Australia & New Zealand) |
|---|---|---|---|
| | **Subject Area** | **Fees (USD) – per course** | **Fees (USD) – per course** |
| **Pre Degree Studies** | Foundation | 154 | 307 |
| **100 Level Courses** | Management | 158 | 316 |
| | Mathematics | 134 | 269 |
| | Science | 180 | 360 |
| **200 Level Courses** | Management | 242 | 484 |
| | Mathematics | 192 | 384 |
| | Science | 799 | 1598 |
| **300 Level Courses** | Management | 264 | 528 |
| | Mathematics | 288 | 576 |
| | Science | 288 | 576 |
| **Postgraduate Courses** | | 336 | 672 |
| **MBA** | | 514 | 1027 |
| **Master's Thesis & PhD** | | | |
| **– Full Time** | | 1680 p.a. | 3360 p.a. |
| **– Part Time** | | 828 p.a. | 1656 p.a. |

At this stage the Study Team do not recommend including the University of Fiji for further consideration in the RTC.

## FIJI NATIONAL UNIVERSITY

The Fiji National University, formally established in 2010, has campuses and centres at 33 locations throughout the country, running a total of approximately 300 different courses and programmes with a staff of more than 2000 and a record student enrolment of more than 25,000.

FNU is offering more and more options for studying in a flexible mode from home, work or virtually any location in a students own time and pace. This is called Flexible Learning (FL). FL aims to deliver a quality university education to Fijian students and those from the region.

For those students who do not meet the minimum entry requirement, the university offers bridging programmes to help to achieve needed level.

To promote the advancement of tertiary level education in Fiji, the FNU Council established a Student Financial Aid Scheme to enable the recruitment of quality performing students, to promote and reward academic excellence, and to allow students who are financially needy but academically deserving to gain access to higher education (no statistics available).

Appropriate to the aim of this study, the former Fiji Institute of Technology is now part of the FNU's College of Engineering, Science and Technology (CEST) and is the University's Samabula Campus. It was originally established in 1963 to train students in technical and vocational disciplines, to meet the engineering human resource needs of Fiji. The College provides education to cater for the human resource needs of Fiji and the South Pacific in the areas of engineering, technology, including information technology and electronics, marine training and the sciences.

University and CEST statistics are presented in the tables below:

**Table 26: Fiji National University Student Numbers**

| Student Headcount | 2015 | 2016 |
|---|---|---|
| CEST | 5180 | 5589 |
| Total | 29035 | 25958 |
| Equivalent Full-Time Students | | |
| CEST | 2265 | 1970 |
| Total | 8836 | 8393 |
| Headcount by Courses | | |
| Pre-degree courses | 9628 | 8494 |
| Bachelor | 6543 | 6789 |
| Post-graduate | 482 | 606 |
| Others | 358 | 706 |
| Total | **17011** | **16595** |

7 % of total student numbers are non-Fijian students. Gender-balance: 48 % are male and 52% female.

**Staff Breakdown**

**Table 27: Fiii National University Staff Breakdown**

| Staff Breakdown | 2015 | 2016 |
|---|---|---|
| Academic Staff | 865 (231 for CEST) | 862 (258 for CEST) |
| Support Services Staff | 1839 | 1427 |
| **Total** | **2704** | **2289** |

CEST is the largest College at FNU, comprising eight schools: School of Building and Civil Engineering; School of Electrical and Electronics Engineering, School of Mechanical Engineering, School of Mathematical and Computing Sciences, School of Pure Science, School of Applied Science, School of Transport, and the Fiji Maritime Academy.

The College provides Technical, Vocational Education and Training (TVET) and Higher Education (HE) programmes in Engineering, Science and Technology.

There are about 90 programmes, including Foundation, Certificates 3 & 4, Trade Diplomas, Higher Education Diplomas and Degrees. The TVET programmes offered in the College such as the Certificate III in Electronics Engineering have elements of interest to the NMHSs in equipment maintenance and repair.

**SCHOOL OF MATHEMATICAL & COMPUTING SCIENCE** comprises of two departments, namely: the Department of Mathematics and Statistics, and the Department of Computer Science and Information Systems all of which offer programmes that cut across the entire faculty and spread to Schools in other faculties. The School offers different programmes as Certificate IV in Information Technology, Trade Diploma in Information Technology, Degree level (Bachelor of Science (Mathematics & Computer Science), Bachelor of Science (Computer Science & Information Systems), Bachelor of Information Systems), Post Graduate Diploma in Mathematics, Masters of Science in Mathematics, Ph.D in Mathematics.

**SCHOOL OF PURE SCIENCES** offers the following programmes: Preliminary Science, Foundation Science, Higher Education Diploma in Industrial Laboratory Technology, Degree (Bachelor of Science (Physics, Chemistry, Biology (single or double Maior), Mathematics/Physics), Post Graduate Diploma, Master of Science, PhD in Biology, Chemistry, Physics.

The Environmental Conservation and Climate Change program is developed to provide an opportunity for Pacific Islands to develop and implement integrated approaches for the sustainable development of island economies and communities.

FNU has also proposed to develop a 3 year BSc Meteorology programme based on its previous experience of Certificate IV Meteorology Programme offered in 2012 – 2013. However, there is a lack of experienced staff to teach the program.

**Tuition fee** is usually two-to-three times less for local students than regional students. For example,

- Certificate III in Electronics Engineering (90 credit points) is about USD 1,200 dollars for local students and USD 2,760 for other citizens.
- Bachelor of Sciences (Mathematics and Computer Sciences) (360 credit points, 3 years) is about USD 4,965 USD dollars for local students and USD 14,893 for others.
- Bachelor of Sciences (Mathematics and Physics, double major) (360 credit points, 3 years) is USD 5,590 and USD 16,282 accordingly.
- Foundation Science program (two semesters, 120 credit points) is about USD 1,232 and USD 3,695 accordingly.
- Post graduate Diploma in Physics (120 credit points) USD 3,118 and USD 9,330 accordingly.
- Master of Sciences in Physics (240 credit points) is USD 8,129 and USD 24,387 accordingly.

At this stage the Study Team do not recommend including the Fiji National University for further consideration in the RTC but the situation regarding their BSc in Meteorology program needs to be kept under review. If the program develops, meets the BIP-M requirements and the costs for regional students are acceptable this could change the situation.

# ANNEX 6

## Evaluation of Regional Institutions Against the Study Team's Selection Criteria

# *Evaluation of Regional Institutions against the Study Team's Selection Criteria*

| | USP | UPNG | FMS/JICA |
|---|---|---|---|
| **Meets most if not all of the NMHS needs** | Would need to significantly strengthen existing courses to meet BIP-M and operational requirements for Meteorologists.<br><br>New courses would be required to meet the technician training requirements | Would need to significantly strengthen courses to meet BIP-M and operational requirements for Meteorologists.<br><br>New courses would be required to meet the technician training requirements | Does not offer accredited courses but does offer a full range of technician courses in meteorology including aviation forecasting and observing and climate data / climate services.<br><br>Does offer an initial BIP-MT and in-service courses for technicians and meteorologists. |
| **Regionally supported / representative** | Yes | UPNG has experience in hosting many medical students from the Pacific that would stand them in good stead for hosting students studying meteorology. | Yes |
| **Sustainable (minimise cost and have sources of funding)** | Yes, students attending USP are eligible for national scholarships | UPNG course and accommodation costs relatively low | JICA has provided additional financial support to FMS to strengthen its training ability and support regional training |
| **Increases expertise in region (NMHS and regional institution(s)))** | Yes if long term staffing numbers increased. Does not increase USP expertise if contractors from outside of the area are used to cover missing areas | Yes if long term staffing numbers increased. No if external contractors are used to cover missing areas | Yes if long term staffing numbers increased. Does not increase FMS expertise if contractors from outside of the area are used to cover missing areas |
| **Have sufficient intellectual capital or can be reasonably expected to gain it.** | Study Team were advised that additional expertise could be contracted in | Additional staff and expertise would be required for a BIP-M course. The current staffing should capable of developing and delivering a BIP-MT courses | FMS are in the process of increasing the staff numbers in their training unit by one. Further staffing increases, particularly meteorologists would be required to take on more of the BIP-M |
| **Facilities and supporting mechanisms in place** | Yes | Upgrade of facilities and telecommunications would be required. | Nadi could need further expansion to take on a larger role. The Suva office provides options if working with USP |
| **Experience in working regionally** | Yes | Partial | Yes |
| **Willingness / potential commitment to the RTC** | Yes | Yes | Yes |
| **Courses should be accredited within the post secondary education framework** | Yes | Yes | FMS are exploring the option to become a Registered Training Organisation and then accredit some of their courses. This is a major undertaking and requires ongoing support to maintain the Registered Training Organisation status and keep the courses accredited. |
| **Courses address the WMO education and training requirements** | USP have committed to doing this | Not at this stage. | The initial BIP-MT course is an example of FMS addressing this point |
| **Alignment of course offerings with the PIMS strategies and priorities** | Partially through training of meteorologists and oceanographers | Not at this stage | The JICA project provides support to address many of the PKOs. |
| **Long term commitment from the education and training providers and supporting mechanisms to ensure that a solid operational basis is established and continued into the future** | Yes, through regionally agreed structure and supporting mechanisms | | Minimal level can be maintained (own training unit and facilities, professional expertise, participants from NMHS of the Pacific supported by external funds to attend the technical training). |
| **Flexibility to customize the programmes** | Yes, a few courses developed based on FMS' request. | | Definitely yes, examples of such practice presented. |
| **Ability to tailor programs to accommodate persons for whom English is a second language** | Yes | | Yes |

| | SPREP/PCCC with COSPPac | PITD with University of Hawaii |
|---|---|---|
| **Meets most if not all of the NMHS needs** | Would need to significantly strengthen existing courses to meet BIP-M and operational requirements for Meteorologists.<br><br>New courses would be required to meet the technician training requirements | Focuses primarily on developing knowledge, skills and behaviours in interpreting and using data from numerical models, meteorological satellites and forecasts and warnings from major forecasting centres. |
| **Regionally supported / representative** | Yes | Yes |
| **Sustainable (minimise cost and have sources of funding)** | Yes, students attending USP are eligible for national scholarships | Yes through the NOAA international training desk program. |
| **Increases expertise in region (NMHS and regional institution(s)))** | Yes if long term staffing numbers increased. Does not increase USP expertise if contractors from outside of the area are used to cover missing areas | Uses expertise from the US NWS and University of Hawaii. |
| **Have sufficient intellectual capital or can be reasonably expected to gain it.** | Study Team were advised that additional expertise could be contracted in | Yes |
| **Facilities and supporting mechanisms in place** | Yes | Yes |
| **Experience in working regionally** | Yes | Yes |
| **Willingness / potential commitment to the RTC** | Yes | |
| **Courses should be accredited within the post secondary education framework** | Yes | Not at this time |
| **Courses address the WMO education and training requirements** | USP have committed to doing this | The BIP-MT was the reference document when designing the course. |
| **Alignment of course offerings with the PIMS strategies and priorities** | Partially through training of meteorologists and oceanographers | Addresses some of the PKOs |
| **Long term commitment from the education and training providers and supporting mechanisms to ensure that a solid operational basis is established and continued into the future** | Yes, through regionally agreed structure and supporting mechanisms | |
| **Flexibility to customize the programmes** | Yes, a few courses developed based on FMS' request. | |
| **Ability to tailor programs to accommodate persons for whom English is a second language** | Yes | |

# ANNEX 7

## NUKU'ALOFA Declaration

# *NUKU'ALOFA Declaration*

**NUKU'ALOFA MINISTERIAL DECLARATION For SUSTAINABLE WEATHER AND CLIMATE SERVICES FOR A RESILIENT PACIFIC 24th July 2015, Nuku'alofa, Tonga**

**Tuesday, 28 July 2015 11:09**

**28 July 2015:** The First Pacific Ministerial Meeting on Meteorology was held on 24th July 2015 in Nuku'alofa, Kingdom of Tonga with representation from American Samoa, Australia, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Kiribati, Marshall Islands, Nauru, New Caledonia, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, United States of America and Vanuatu.

WE, the attending Secretariat of the Pacific Regional Environment Programme (SPREP) Member Countries' Cabinet Ministers responsible for Meteorology, and their representatives, are calling for support from our governments, development partners and donors to ensure that National Meteorological and Hydrological Services (NMHSs) have the necessary capacity to support sustainable development;

1. **PRESENT** this Declaration as a statement of our political will to support the development of weather, climate, water, and related environmental services in the Pacific Island Countries and Territories (PICTs) fully taking into account national development priorities, regional and global meteorological strategies and other relevant frameworks;

2. **RECOGNISE** the vital importance of the mission of NMHSs, as stated in the Convention of the World Meteorological oganization (WMO), in providing meteorological, hydrological and related services in support of relevant national needs, including protection of life and property, sustainable development and safeguarding the environment. NOTE that weather and climate services are not an option but are a responsibility and a basic human right;

3. **RECOGNISE** the importance of timely and accurate weather and climate information to aviation to ensure the highest standards for flight safety, reduction of the environmental impacts of aviation and increasing efficiency of air traffic operations;

4. **COMMIT** to maintain the PICTs' NMHSs role in the development of effective methods for the provision of services to aviation to meet International Civil Aviation Organization (ICAO) and WMO requirements including Quality Management System (QMS) implementation in line with the International Organization for Standardization (ISO) 9000 series of quality assurance standards, and competency standards. WE URGE PICTs' NMHSs that are not yet compliant to take necessary steps to achieve and sustain compliance with QMS and staff competency requirements;

5. **RECOGNISE** the need to improve the capacities and services of PICTs' NMHSs to address weather, climate, water, drought and related environmental impacts and hazards and to improve the safety and security of our region;

6. **ENCOURAGE** our governments, regional organizations and development partners to establish and support the implementation of impact-based multi-hazard early warning systems (MHEWS) and Multi-Hazard Information Systems (MHIS);

7. **RECOGNISE** that this region is also highly prone to tsunami with several countries having recently experienced

locally generated tsunamis, requiring rapid detection and prompt dissemination of tsunami warnings to coastal communities and therefore the need to strengthen Early Warning Systems for this hazard;

8. **ACKNOWLEDGE** the vital contributions of environmental satellites from United States of America, Japan, China, Korea and Europe necessary for the provision of remotely sensed data and derived products to the PICTs' NMHSs to improve weather, climate, water and related environmental services;

9. **EXPRESS CONCERN** about inadequate infrastructure and limited human resources of PICTs' NMHSs as factors that limit the effective uptake of scientific and technological advances to improve services of NMHSs;

10. **AGREE** that telecommunication networks and Information Technology (IT) infrastructure used by NMHSs are critical for exchange and delivery of weather, climate, water and related environmental observations and data, and products vital for the timely delivery of alerts, impact-based forecasting, and successful operation of the Multi-Hazard Early Warning System and the Multi-Hazard Information System. WE FURTHER AGREE to prioritize improvements in the capabilities of PICTs' NMHSs with our national telecommunication authorities and mobile phone carriers to provide greater reach for warning services to remote

11. **CALL ON** our governments, regional organizations, development partners, PMC and its Panels on Education, Training and Research; Marine and Ocean Services, Climate Services and Aviation Services, and donors to support the implementation of the Pacific Islands Meteorological Strategy (PIMS) 2012-2021 and other related regional frameworks, and PMC outcomes;

12. **REQUEST SPREP**, University of the South Pacific (USP), Secretariat of the Pacific Community (SPC) and other regional organizations, WMO and development partners to expedite the implementation of the Pacific Roadmap on Strengthening Climate Services in the Pacific region, and to explore possibilities for the establishment and operation of a Regional Climate Centre (RCC), and future annual Pacific Island Climate Outlook Forum (PICOF);

13. **REQUEST** the Education, Training and Research Panel of the PMC to work with PICTs' NMHSs, USP, SPREP, SPC and other regional organizations, and WMO to address the education and training needs of NMHSs in PICTs with a possibility to establish a WMO Regional Training Center (RTC) and the development of regional research capacity;

14. **REQUEST** support from SPREP, SPC, USP and other regional organisations and WMO to improve the capacity of National Hydrological Services in the region to ensure adequate level of service delivery in PICTs for flood and flash flood forecasting and early warnings; and CALL for further collaboration between WMO, SPREP and SPC to increase operational hydrology as part of the Pacific Meteorological Desk Partnership;

15. **ENCOURAGE PICTs NMHSs** to participate in climate change forums at national, regional and international levels including the United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC);

16. **COMMEND** the establishment and support from development partners to the PMC as a subsidiary body of the SPREP Meeting and the Pacific Meteorological Desk Partnership hosted and managed by SPREP. WE URGE development partners and SPREP member countries and territories to continue their support to PMC and PMDP;

17. **COMMEND** the continuous support from WMO to PICTs' NMHSs through initiatives such as the Voluntary Cooperation Programme (VCP), Canada/WMO Programme for Implementing Global Framework for Climate Services (GFCS) at Regional and National Levels, training fellowships, the Severe Weather Forecast and Disaster Risk Re-

duction Demonstration Project (SWFDDP), the Coastal Inundation Forecast Demonstration Project (CIFDP) and other initiatives;

18. **COMMEND** the establishment by the 17th World Meteorological Congress of the Programme for WMO Small Island Developing States (SIDS) and Member Island Territories, and request strong support and partnerships of the international community for implementing concrete, focused, forward looking initiatives that contribute to the SIDS Accelerated Modality of Activities (S.A.M.O.A.) Pathway priority areas, the Post-2015 Sustainable Development Goals, Sendai Framework on Disaster Risk Reduction 2015-2030, and the outcomes of the 21st Conference of the Parties of UNFCCC and sustainable development;

19. **COMMEND** the draft Strategy for Climate and Disaster Resilient Development in the Pacific (SRDP) to guide resilient development through the mainstreaming of integrated climate change and disaster risks into political, social, ecological and economic development of PICTs. Further, WE WELCOME the intended support from the European Union (EU), World Bank, Australia and other donors for the implementation of the SRDP and the proposed Pacific Resilience Partnership and encourage all efforts to ensure the early adoption and implementation of the SRDP in the Pacific;

20. **ACKNOWLEDGE** the support of the Government of Fiji to its Meteorological Service to perform its functions as the WMO designated Regional Specialized Meteorological Centre for Tropical Cyclones (RSMC Nadi-TCC); as the ICAO designated Tropical Cyclone Advisory Center (TCAC) for aviation, and Meteorological Watch Office (MWO) for Nadi Flight Information Region (FIR).

    **NOTED** that the aviation and other weather services provided by Fiji Meteorological Services to Cook Islands, Kiribati, Nauru, Niue, Tokelau, Tonga and Tuvalu with no formal arrangements with these countries;

21. **ACKNOWLEDGE** the continuous support from development partners and donors for critical programmes, projects and other initiatives which have supported WMO, SPREP, SPC and other regional organisations, PMC, PMDP, the Pacific Island Climate Services (PICS) Panel and RSMC Nadi/ICAO TCAC/MWO for Fiji FIR in the various roles they play in the PICTs' region;

22. **ACKNOWLEDGE** the Statement of the WMO and Partner's Conference on the Gender Dimensions of Weather and Climate Services, calling upon all partners at all levels to take the necessary steps to improve the understanding of gender-specific impacts of weather and climate through the systematic collection and use of gender-disaggregated data and to pursue strategies and structures to increase the involvement of women in the development and communication of gender-sensitive weather, hydrological and climate services, among others.

    **WE ARE COMMITTED** to promote gender in developing and implementing weather and climate programmes, projects and activities;

23. **EXPRESS APPRECIATION** to the Government and the people of the Kingdom of Tonga for the excellent facilities and hosting of the First Pacific Ministerial Meeting on Meteorology;

24. **EXPRESS APPRECIATION** to the Government of Finland through its Ministry of Foreign Affairs and WMO for co-sponsoring the First Pacific Ministerial Meeting on Meteorology, and WE ENCOURAGE them and other development partners to continue providing financial support for future Meetings;

25. **DECIDE** to establish the Pacific Ministerial Meeting on Meteorology and to hold its sessions at least once every two years and REQUEST SPREP, with the support of WMO and development partners to convene the Meetings;

26. **COMMIT** to implementing this Declaration and INVITE SPREP Director-General and WMO Secretary-General to bring this declaration to the attention of the 2015 Pacific Leaders Meeting, the SPREP Meeting and the Council of Regional Organization in the Pacific (CROP) agencies and to the WMO Executive Council, respectively;

**Adopted in Nuku'alofa, Kingdom of Tonga, on 24th July 2015**

# ANNEX 8

## Glossary of Abbreviations and Terms

# *Glossary of Abbreviations and Terms*

| | |
|---|---|
| **AMDAR** | Aeronautical Meteorological Data Relay |
| **AMF** | Aeronautical Meteorological Forecaster |
| **AMO** | Aeronautical Meteorological Officer |
| **BIP-M** | Basic Instruction Package for Meteorologists (also BIP/M) |
| **BIP-MT** | Basic Instruction Package for Meteorological Technicians (also BIP/MT) |
| **BOM** | Australian Bureau of Meteorology |
| **CDMS** | Climate Data Management System |
| **CIMH** | Caribbean Institute for Meteorology and Hydrology |
| **CLEWS** | Climate Early Warning System |
| **CliCom** | System of hardware and software built in the 1980s to meet World Meteorological Organisation requirements for climate data storage, which has now been replaced by more modern systems. |
| **CliDE** | Climate Data for the Environment – a climate data management system developed by the Australian Bureau of Meteorology which is used in 18 Pacific Island countries to archive climate data |
| **CliDEsc** | CliDE services client – the product generator software developed by NIWA to analyse and visualise climate data as time series, tables and maps. It links to CliDE and other database platforms and web services |
| **COSPPac** | Climate and Ocean Support Program in the Pacific |
| **ENSO** | El Nino Southern Oscillation |
| **EWS** | Early Warning System |
| **FIR** | Flight Information Region |
| **FNU** | Fiji National University |
| **GAW** | Global Atmospheric Watch Programme |
| **GEF** | Global Environment Facility |
| **GEO** | Group on Earth Observations |
| **GEOSS** | Global Earth Observation System of Systems |
| **GFCS** | Global Framework for Climate Services |
| **GHG** | Green House Gas |
| **GIFS** | Global Interactive Forecast System |
| **GIS** | Geographic Information System |
| **ICAO** | International Civil Aviation Organization |
| **IOC** | Intergovernmental Oceanographic Commission |
| **ITCZ** | Intertropical Convergence Zone |
| **ITIC** | International Tsunami Information Center |
| **JCOMM** | Joint Commission for Oceanography and Marine Meteorology |
| **JICA** | Japan International Cooperation Agency |
| **KMS** | Kiribati Meteorological Service |
| **KPI** | Key Performance Indicator |
| **NDMO** | National Disaster Management Office |
| **METAR** | A weather observation coded for use by aviation |
| **M&E** | Monitoring and Evaluation |

| | |
|---|---|
| **MHEWS** | Multi-Hazard Early Warning System |
| **MIC** | Meteorologist-In-Charge |
| **MJO** | Madden-Julian Oscillation |
| **MSNZ** | Meteorological Service of New Zealand Ltd (Metservice) |
| **MTSAT** | Multifunctional Transport Satellites |
| **NCEA** | New Zealand Certificate of Educational Achievement |
| **NIWA** | National Institute of Water and Atmospheric Research (New Zealand) |
| **NMHS** | National Meteorological and Hydrological Service |
| **NMS** | National Meteorological Service |
| **NOAA** | National Oceanographic and Atmospheric Administration (USA) |
| **OIC** | Officer-In-Charge |
| **Pacific HYCOS** | Pacific Hydrological Cycle Observing system |
| **PAGASA** | Philippine Atmospheric Geophysical and Astronomical Services Administration |
| **PASO** | Pacific Aviation Safety Office |
| **PICTS** | Pacific Island Countries and Territories |
| **PIMMM** | Pacific Island Ministers Meeting on Meteorology |
| **PIMS** | Pacific Islands Meteorological Strategy 2012 – 2021 |
| **PKO** | Pacific Key Outcomes |
| **PNG NWS** | Papua New Guinea National Weather Service |
| **PMC** | Pacific Meteorological Council |
| **PMDP** | Pacific Meteorological Desk Partnership |
| **PR** | Permanent Representative to the WMO |
| **PSIDS** | Pacific Small Island Developing States |
| **PTWC** | Pacific Tsunami Warning Center |
| **PTWS** | Pacific Tsunami Warning and Mitigation System |
| **QMS** | Quality Management System |
| **RA V** | WMO Regional Association five (South-West Pacific and South East Asia) |
| **RESPAC** | The Disaster Resilience in the Pacific project |
| **RCC** | Regional Climate Center |
| **RIC** | Regional Instrument Center |
| **RMI** | Republic of the Marshall Islands |
| **RSMC** | Regional Specialized Meteorological Centre |
| **SIGMET** | Significant Meteorological Information message for aviation use |
| **SIMS** | Solomon Islands Meteorological Service |
| **SIS** | Smaller Island States |
| **SMD** | Samoa Meteorology Division |
| **SOPAC** | Applied Geoscience and Technology division of SPC |
| **SPC** | Secretariat of the Pacific Community |
| **SPREP** | Secretariat of the Pacific Regional Environment Programme |
| **SPECI** | 'Special' weather report for use by aviation |
| **TAF** | Terminal Aerodrome Forecast for aviation |
| **TVET** | Technical and Vocation Education and Training |

| | |
|---|---|
| **UG** | University of Guam |
| **UH** | University of Hawaii |
| **UN** | United Nations |
| **UNDP** | United Nations Development Programme |
| **UNESCO** | United Nations Educational, Scientific, and Cultural Organization |
| **UNFCC** | United Nations Framework for the Convention on Climate Change |
| **UPNG** | University of Papua New Guinea |
| **USA** | United States of America (also US) |
| **USP** | University of the South Pacific |
| **UV** | Ultra Violet |
| **VMGD** | Vanuatu Meteorology and Geo-Hazards Division |
| **WIGOS** | WMO Integrated Global Observing System |
| **WIS** | WMO Information System |
| **WLS** | Water Level Sensor |
| **WMO** | World Meteorological Organization |
| **WWIS** | World Weather Information System |

# ANNEX 9

## Individuals Consulted by the Study Team

# *Individuals Consulted by the Study Team*

| COUNTRY OR ORGANISATION | INDIVIDUALS |
|---|---|
| **Australia** | Dr David Walland, Manager, Climate Data Services, National Climate Centre<br>Mr Paul Froude, Supervisor, Technical and General Studies, Bureau of Meteorology Training Centre |
| **CIMH** | Dr David Farrell, Principal, Carribean Institute of Meteorology and Hydrology |
| **Cook Islands** | Mr Arona Ngari, Director, Cook Islands Meteorological Service<br>Mr Ned Howard, Secretary, the Department of Transport, Cook Islands |
| **Federated States of Micronesia** | Mr Kenly Andon, Acting Meteorologist-in-Charge (MIC), Pohnpei WSO<br>Mr Johannes Berdon, Meteorologist-in-Charge, Chuuk WSO<br>Mr Steve Boland, Officer-in-Charge, USAid, Pohnpei<br>Mr Kenly Andon, Acting Meteorologist-in-Charge, Pohnpei WSO<br>Prof. Joseph Habuchmai, Vice President for Enrollment Management & Student Services |
| **Republic of Fiji** | Mr Ravind Kumar, Director of Fiji Meteorological Services,<br>Mr Sosiceni Dumukuru, Senior Training Officer, Training Unit of the Fiji Meteorological Services<br>Mr Awnesh Singh, Physical Oceanographer, Lecturer, University of the South Pacific<br>Mr Ajal Kumar, Lecturer, University of the South Pacific<br>Mr Fereti Atalifo, Deputy Director Information Technology Sciences, University of the South Pacific<br>Dr Jimaima Lako, Associate Professor and Head of Applied Sciences, College of Engineering, Science and Technology Fiji National University |
| **Kiribati** | Mr Ruui Tabutoa, Deputy Secretary from the Office of Te Beretitenti (President)<br>Mr Ueneta Toorua (Director, Kiribati Meteorological Service)<br>Mr Kairoronga Labeti (Station Technical Officer)<br>Ms Kamaitia Rubetaake (Climate Officer)<br>Ms Mwata Keariki (Assistant Climate Officer) |
| **New Zealand** | Mr Chris Webster, Training Manager, Met Service New Zealand<br>Mr. Alan Porteous, Dip Field Technology Group Manager, Climate Data and Applications, NIWA |
| **Niue** | Mr Sean Tukutama, Scientific Officer<br>Dr Josie Tamate, Director General of the Ministry for Natural Resources<br>Ms Rossylynn Pulehetoa-Mitiepo, Director Niue Meteorological Service<br>Mr Andre Siohane, Director General of the Ministry for Infrastructure |
| **Pacific Island Training Desk** | Ray Tanabe, US NWS Regional Director for Hawaii<br>Ms Jennifer Lewis and Dan Beardsley of US NOAA NWS, International Section<br>Staff of the Hawaii Weather Forecast Office (WFO), led by John Bravender (Warning Coordination Meteorologist)<br>Staff of the Pacific International Training Desk (PITD), led by Ray Tanabe and including: H. Gingerlei Porter, Christina Higa and Jennifer Strahl<br>Mr Chip Guard, Acting Meteorologist-in-Charge, Guam WFO<br>Ms Genevieve Miller, Meteorologist-in-Charge, Guam WFO |
| **Palau** | Ms Dilwei M. Ngemes, Meteorologist-in-Charge, Palau WSO<br>Other staff of the Palau WSO |
| **Papua New Guinea** | Mr Sam Maiha, Director-General of the PNG National Weather Service (NWS)<br>Dr Kisolel Posanau, Lecturer, Physics Department, UoPNG<br>Dr Moyap Kilepak, Lecturer, Physics Department, UoPNG<br>Dr Jeremiah Malaibe, Lecturer, Physics Department, UoPNG |

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| **Philippines** | Dr Cynthia Celebre, Chief Research & Development and Training Division (PAGASA) |
| **Republic of the Marshall Islands** | Mr Reginald White, Meteorologist-in-Charge, Majuro WSO<br>Prof. Theresa Koroivulano, President of the College of the Marshall Islands (CMI)<br>Mr Clarence Samuel, Director of the Office of Environment Policy, Planning Coordination (OEPPC)<br>Ms Allison Nashion, Director of the National Training Council (NTC)<br>Prof. Irene Taa'faki, Director, University of the South Pacific, Marshall Islands Campus (USP-RMI) |
| **Samoa** | Mr Ausetalia Titimaea, Assistant Chief Executive Officer (Director) of the Samoa Meteorology Division.<br>Mr Luteru Tauvale, Principal Scientific Officer, Weather Forecasting<br>Mr Tile Tofaeono, Principal Scientific Officer, Climate Services.<br>Mr Silipa Mulitalo, Scientific Officer |
| **Solomon Islands** | Mr Chanel Iroi, Under Secretary, Solomon Islands Government, Ministry of Environment, Climate Change, Disaster Management and Meteorology<br>Mr David Hiba Hiriasia, Director of the Solomon Islands Meteorological Service<br>Mr Charlie Bepapa, Director of the Water Resource Management Division, Ministry of Mining, Energy and Rural Electrification<br>Mr Malefoasi, Under Secretary, Ministry of Education and Human Resource Development<br>Prof. Prem Rai, Dean for School of Natural Resources at Solomon Islands National University (SINU),<br>Mr George Horoasia, Head of Environment Department, and Mr. Peter Mahoa, Head of Forestry Department |
| **SPREP** | Mr Roger Cornforth, Deputy Director<br>Mr Salesa Nihmei<br>Mr Philip Malsale<br>Mr Robert Duncan McIntosh |
| **Tokelau** | Mr Eleta, Acting General Manager<br>Ms Paula Faiva<br>Mr Penehuro Lefale, adviser to Tokelau on climate change matters |
| **Kingdom of Tonga** | Mr Vatulele Tuputupu, Acting CEO for Ministry of Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC responsible for MET services office)<br>Mr Ofa Faanunu, Director of the Tonga Meteorological Service<br>Mrs Seluvaia 'Ilolahia Finaulahi, Acting Director for MET services office<br>Mr Nonga Soakai, Deputy CEO of the Tonga Institute of Science and Technology (TIST) |
| **Tuvalu** | Mr Tauala Katea, Director of the Tuvalu Meteorological Service (TMS),<br>Mr Pisi Seleganiu, Head of Water and Plumping Division, Public Works Department<br>Mr Uinga Paelate, Director Civil Aviation<br>Mr Setima Piita, Human Resource Development Officer, Human Resource Management, Office of the Prime Minister, Government of TUVALU<br>Mr Peteli Paulo, Education Department, Ministry of Education<br>Dr Rosiana Lagi, Director of the USP Tuvalu Campus |
| **Republic of Vanuatu** | Ms Esline Garaebiti, Acting Director of the Vanuatu Meteorology and Geo-Hazards Department (VMGD)<br>Mr Roy Obed Fanongo Taripoarroto, Director Educational Services, Ministry of Education and Training<br>Mr John Kaltau, PEO Scholarship Unit of the Ministry of Education and Training<br>Mr Ruben Bakeo Markward, Director of the Emalus Campus, University of the South Pacific<br>Mr Johnson Toa, TVET Unit, Division of Tertiary and High Education of The Ministry of Education and Training |

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| **University Center for Atmospheric Research** | Dr Richard Jeffries |
| **WMO** | Mr Henry Taiki, WMO Office for the SW Pacific<br>Dr Yinka Adebayo, Director, Education and Training Office<br>Ms FAN Hong, Fellowship Officer<br>Ms Leah Yeddes, Fellowship Clerk |

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