



# AUSTRALIAN BUREAU OF METEOROLOGY COUNTRY REPORT

Reporting on activities supporting Pacific Key Outcomes (PKOs) of the  
Pacific Islands Meteorological Strategy (PIMS) 2017-2026

This Report is presented to the Fifth Pacific Meteorological Council (PMC-5) Meeting held in Apia from 7-9 August 2019

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## 1.0 Summary

This report outlines activities in which the Australian Bureau of Meteorology (the Bureau) is engaged in the Pacific Island Countries and Territories (PICTs) including:

- Aid-funded activities supported by the Australian Department of Foreign Affairs and Trade;
- Activities the Bureau has supported directly through its core funding allocation and activities conducted under part cost-recovery arrangements;
- Information on the Australian contribution, through the Bureau, of guidance products from the Bureau's National Operations Centre (NOC) and the Darwin Regional Specialised Meteorological Centre (RSMC);
- The Bureau's role in hosting the WMO Regional Instrument Centre (RIC); and
- Training activities carried out by the Bureau of Meteorology Training Centre.

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## 2.0 Aid-funded activities supported by the Australian Department of Foreign Affairs and Trade

### 2.1 Climate and Oceans Support Program in the Pacific: 2012 - 2022

The Climate and Oceans Support Program in the Pacific (COSPPac) is a component of Australia's contribution to minimising the impacts of climate variability and change in the Pacific and to meeting the Australian Government's climate change aid objectives. COSPPac Phase 1 was a six year program (\$39m, 2012-18) which supported 14 Pacific Island Countries (PICs) to collect and analyse sea level data, provide climate and ocean monitoring and prediction services (seasonal forecasts), and communicate this information to Pacific governments, communities and the private sector.

As part of the Australia-Pacific Climate Program (APCP) climate information services, COSPPac was extended for a second phase of four years (\$26.157m, 2018-22). COSPPac2 builds on Australia's long-term support for core climate information services across the Pacific, ensuring the continued development of valued products and services for optimum impact for Pacific Island governments and communities.

The aim of the program is: *Pacific Island stakeholders are using climate, ocean and sea level information to strengthen climate and disaster resilience.*

COSPPac2 will focus on delivering support to achieve the following outcomes:

- National meteorological services (NMSs) and land and survey departments (LSDs) are delivering climate, ocean and sea level data, products and services that are responsive to stakeholder needs.
- SPC and SPREP are enabling Pacific NMSs/LSDs to interpret climate, ocean and sea level information, understand stakeholder needs and provide effective communication products.
- SPC and SPREP are maintaining key tools and equipment and increasingly supporting onsite calibration.

COSPPac2 is being delivered through three project components:

1. **Pacific Sea Level and Geodetic Monitoring Project (PSLGM)** generates, processes and analyses sea level and geodetic data to produce information products for analysis and the generation of sea level information-based products, such as tide calendars and survey/location data, to inform coastal infrastructure planning.
2. **Climate Data for the Environment (CliDE)** is a locally hosted climate data management system that provides each country with a central database for meteorological records. The data can be used to develop tailored services and information products to inform

decision-making by governments, communities and sector groups to achieve their social, economic and environmental goals, including through the New Zealand-developed application **Climate Data for the Environment Services Client** (CliDEsc).

3. **Seasonal Prediction Project** (SPP) supports the delivery of seasonal and intra-seasonal climate and ocean monitoring and prediction services that allow a range of Pacific Island end users to plan actions that mitigate the impacts of climate change and climate variability on their lives and activities.

The delivery of these components is supported by the **Coordination and Communications Unit** (CCU) which manages the technical resources needed to support the communications, training and capacity development activities that are common across COSPPac2. This includes Traditional Knowledge associated with climate and geo-hazards, which is used to support the communication of climate information to communities and promote its uptake.

The Program is focused on the needs of NMHSs in 14 Pacific Island Countries (Cook Islands, Fiji, Federated States of Micronesia, Kiribati, Nauru, Niue, PNG, Palau, Republic of the Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu), with Land and Survey Departments (L&SD) also important user stakeholders. COSPPac2 is implemented by the Australian Bureau of Meteorology (the Bureau), in partnership with Geoscience Australia (GA), the New Zealand National Institute of Water and Atmospheric Research Limited (NIWA), the Pacific Community (SPC), and the Secretariat of the Pacific Regional Environment Programme (SPREP).

COSPPac contributes to regional priorities and aligns with the Pacific Islands Meteorological Strategy (PIMS) and the Pacific Roadmap for Strengthened Climate Services (PRSCS).

As part of the Australian Government's performance assessment process, an Independent Progress Review (IPR) was commissioned in early 2014, the mid-point of COSPPac Phase 1. The IPR had two purposes: to assess the progress of COSPPac against its design, including any modifications agreed to by its partners through Annual Work plans; and to consider how Australia can best support Pacific NMHSs after 2016.

The IPR stated that "The Program is highly effective in many different ways across 14 partner countries" and "The key Program stakeholders, Pacific Island NMHSs, consistently identified positive and substantial benefits in all areas of programming." It recommended that COSPPac products and services be transferred to regional partners where appropriate. In response, COSPPac has been in active transition since 2015; staffing within the Bureau has been significantly reduced and recruitment and training of similar positions has taken place in Pacific Regional Organisation Partners as part of the transition process. The Bureau has continued to support the Pacific organisations in running services operationally in COSPPac2.

The transition of a significant science and technology Program to its Pacific partners has not been undertaken on this scale before, the transition of products and services to the region is demonstration of the capacity building success of the program. Some aspects of the transition have been more successful than others. Communications and Capacity Development has developed a Pacific flavour which has been of great benefit to the program. Other aspects of the transition such as the software development and development of climatological products and services will need longer term support.

In early 2018, the New Zealand Ministry of Foreign Affairs and Trade (MFAT) approached Department of Foreign Affairs and Trade (DFAT) about the possibility of co-funding COSPPac2. The program aligned with the 'data for decision making' component of New Zealand's 'Pacific re-set' and regional climate change support. MFAT identified an interest increasing the investment in CliDE to cover un-funded activities for CliDE, and support further strengthening of the system. MFAT funding will also expand the roll out of the related Climate Data for the Environment Services Client (CliDEsc) through COSPPac2. The CliDEsc application uses the data in CliDE to provide customised reports for sectors. CliDEsc was developed by the New Zealand National Institute of Water and Atmospheric Research Limited (NIWA) and has been implemented in eight PICs to date. In May 2019 MFAT and DFAT entered a Delegated Cooperation Agreement to provide additional funding (NZD 3 Million) to COSPPac2.

COSPPac2 supports the development of products and services that meet user needs and inform better decision making. In developing climate and oceans products and services, our aim is to enhance the capacity of Pacific Island agencies and communities to manage and mitigate the impacts of climate variability and coastal hazards. We work with our Pacific stakeholders to build tools that forecast and report on climate, tides, and the ocean. We also work together to determine how best to communicate this information to communities, businesses and governments.

COSPPac2 supported products and services include:

- Tidal information and sea level data
- Tide Calendars
- Sea Level Station - Real Time Data Display (RTDD)
- Pacific Ocean Portal
- Seasonal Climate Outlooks in Pacific Island Countries (SCOPIC)
- ACCESS Global Forecast System for the Pacific
- Online Climate Outlook Forum (OCOF)
- COSPPac Climate Bulletin
- Climate Data for the Environment (CliDE)
- Regional and National Early Action Rainfall (EAR) Watch bulletins
- Malaria Early Warning System (Solomon Islands)

- Pacific Climate Change Data Portal
- Southern Hemisphere Tropical Cyclone Portal
- Traditional Knowledge (TK) Database & Communication Products

There will also be opportunities to see how these products and services and fit with both DFAT’s emerging Pacific climate change strategy and potential extension opportunities through alternative funding mechanisms, such as the Green Climate Fund. COSPPac2 is continuing to work closely with the Australia Pacific Climate Partnership to support climate informed planning and decision making across the Pacific.

## **2.2 Papua New Guinea Capacity Development Program (PNGCDP): 2017 - 2022**

The Papua New Guinea Capacity Development Program (PNGCDP) is a dedicated effort between the Government of Papua New Guinea, the Bureau of Meteorology, Australian Department of Foreign Affairs and Trade and the Department of Infrastructure, Regional Development and Cities (Infrastructure). It is supported under the Transport Sector Support Program - a 15-20-year humanitarian aid commitment valued up to \$400M, to support the Government of Papua New Guinea to achieve a well-maintained transport infrastructure network. PNGCDP is co led by the PNG National Weather Service (PNG NWS) and is funded by the DFAT. PNGCDP is focused on the restoration of meteorological observations country wide for Papua New Guinea, meteorological forecaster technical capacity development and support for governance and strategic planning efforts under the PNG Ministry of Transport and Infrastructure. It has a total budget of approximately \$4.85M for five years. The timeline of the program is 1 July 2017 to 30 June 2022. Initially the project had a budget of ~\$500K over two years. DFAT have since extended the project by three years to expand capacity development activities aimed at addressing the meteorological needs of the transport industry in PNG.

The PNG NWS is positioned within the Technical Services Division of the PNG Department of Transport (DoT) and operates within a highly challenging physical and social environment, providing critical warning, weather and climate services to a diverse community of maritime, aviation and road transport users, emergency services organizations, agricultural users and the general public. The PNG NWS struggles with aging facilities, outdated technology, broken or poorly calibrated instruments and poor service delivery mechanisms and as a result there is a great need to enhance the capacity of PNG weather and climate services.

Years 1 and 2 have focused on four key areas:

1. the establishment of a strategic planning process for the PNG NWS;

2. the provision of forecaster technical training to support the delivery of improved weather services and forecasting support for APEC 2018;
3. addressing the immediate need for improved observations through the adoption of 3rd party Automated Weather Station networks; and
4. provision for a Bureau Subject Matter Expert (SME) advisor to the NWS focused on supporting the management of restoration efforts.

Years 3, 4 and 5 (2019-2022) expand and extend the project to include the following key capacity development areas:

- Addressing the immediate need for support to implement the NWS Strategic Plan (2019-2023);
- Extended deployment of a Bureau advisor to the NWS;
- Provision of observational data from PNG by supplementing with existing 3rd party Automated Weather Station (AWS) networks;
- Restoration of the existing NWS observational network including repairs, maintenance and upskilling of observational staff;
- Implementation of sustainable approaches to maintenance, footer calibration, verification and communication of observational data by the NWS observational network under restoration;
- Establishment of a twinning relationship between NWS and the Bureau forecasters for mentoring and collaboration purposes, particularly during severe weather events;
- Improved forecaster access to Numerical Weather Prediction data in PNG through the provision of data from ACCESS-R (or relevant regional equivalent).
- Technical capacity building of NWS forecasters to meet basic entry requirements for the WMO BIP-M course and training in forecast and analysis tools and techniques;
- Assimilation of observations from PNG (initially 3rd party provided and later from the restored NWS network) for improved NWP guidance for the tropical western Pacific informed by PNG observations.

### **2.3 Increasing community benefits from Early Warning and Response systems in the Solomon Islands**

The Bureau of Meteorology is part of a consortium led by World Vision Australia. This consortium is supported by the Department of Foreign Affairs and Trade's Disaster READY element of the Australian Humanitarian Partnership (AHP) that will run from 2017 to 2022. The AHP is a \$50-million partnership between DFAT and Australian NGOs that aims to save lives, alleviate suffering and enhance human dignity during and in the aftermath of conflict, disasters and other humanitarian crises. Disaster READY is an important new strategic initiative within the AHP aimed at strengthening disaster preparedness and management across the Pacific and Timor Leste.



The project involving the Bureau of Meteorology is primarily aimed at increasing community benefits from Early Warning and Response Systems in a small number of communities in the Solomon Islands. The project will also strengthen the capacity of the Solomon Islands Meteorological Service to effectively liaise with communities, NGOs and agencies in the Solomon Islands that contribute to the Early Warning and Response Systems communities rely upon. Other key partners in this project include World Vision Solomon Islands and the Solomon Islands Meteorological Service.

Disaster READY will strengthen local humanitarian capability in the Pacific and Timor-Leste so that communities are better prepared for and able to manage and respond to rapid and slow onset disasters. This includes ensuring that women, people with disabilities, youth and children's rights and needs are being met in disaster preparedness and response at all levels. Disaster READY will assist government, NGOs, the private sector and communities coordinate more effectively for inclusive disaster preparedness and response, and to increase the influence and capacity that national NGOs and churches have in country-level humanitarian systems.

Through the AHP, DFAT has partnered with six peak Australian NGOs and their consortium partners. The six Consortium leads are World Vision Australia, CARE Australia, Save the Children Australia, Caritas Australia, Plan International Australia, and OXFAM Australia. The World Vision Australia-led consortium includes the Bureau of Meteorology, Habitat for Humanitarian Australia, CBM Australia and Field Ready.

### **3.0 Activities under the Pacific Public Sector Linkages Program (PPSLP) and the Government Partnership for Development (GPDF)**

#### **3.1. Quality Management System for Aviation Weather Services Project (Addresses PIMS PKO 1, 11)**

The Objective of this project was to assist Pacific Island NMHSs to achieve certification to the International Organization for Standardization (ISO) 9001 Quality Management Standard) through a sustainable national internal audit regime for aviation weather services.

Following on from this project, the Quality Assurance Unit continues to assist Members on the development and implementation of their quality management systems via the Bureau hosted and managed quality management website and forum. Underpinning this assistance is the Quality Assurance Unit's updated **WMO No.1100** – *Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services* and other relevant services providers within an ISO 9001:2015 Quality Management Framework (Ed 2017). For more detailed information, refer to Annex I, Attachment A.

### **3.2 Training and implementing systems for participation by Pacific Island countries in open international exchange of meteorological information (Addresses all PIMS PKOs)**

The key objective of this activity was to assist counterpart organisations to develop the capacity for full participation in WMO systems for transmitting and handling the weather, climate and environmental information that are vital for the sustainable economic development and mitigation of severe weather and natural disasters.

## **4.0. Contributions from the Bureau's core budgeted funds and through cost-recovery activities**

### **4.1 Externally funded activities under part cost recovery arrangements**

#### **A. Implementation of WMO Information System/ Table Driven Code Form (WIS/TDCF) (Addresses PIMS PKO 7)**

The project was aimed at assisting NMHSs to be informed of what needs to be done to implement WIS/TDCF. A WIS Implementation Plan has been developed for WMO RA V countries, including the counterpart countries for this project. This plan is aimed at guiding RA V Members to implement WIS functionality in their identified data exchange centres and to become effective WIS users in a timely and harmonized manner, in order to participate in open international exchange of meteorological information (see Annex 1, Attachment B for further details).

#### **B. Update on Fiji Integrated Meteorological Forecast System (FIMS) Upgrade (Addresses PIMS PKO 10)**

FMS operates FIMS (an adaption of the Australian Integrated Forecast System, AIFS) at its Head Office in Nadi, Fiji. This system consists of two FMS AIFS servers and a storage system, which were upgraded in 2015. The upgrade consisted of a hardware upgrade and a move to the Linux operation system and updated applications to remain consistent with Bureau applications and support. The hardware had been previously replaced in 2008(see Annex 1, Attachment C for further details).

#### **C. Van-KIRAP project: Green Climate Fund project on Climate Information Services for Resilient Development in Vanuatu (Addresses PIMS PKOs 6 and 9)**

The Van-KIRAP project seeks to improve climate information services, from data availability (data rescue, high quality datasets) to seasonal outlooks and climate change across five key sectors: water, agriculture, fisheries, tourism and infrastructure in Vanuatu. The Bureau is one of three delivery partners (alongside CSIRO and APCC) delivering on activities such as data rescue (including training of Vanuatu Meteorology and

Geo-Hazards Department's staff), seasonal forecasts and incorporating traditional knowledge in climate services to improve understanding and uptake in communities.

#### **D. Aviation audits in support of the Pacific Aviation Safety Office (PASO) (Addresses PIMS PKO 1)**

PASO is an intergovernmental civil aviation authority providing safety oversight for 10 Pacific Island Countries under the Pacific Island Civil Aviation Safety Security Treaty (PICASST). Australia is a supporting member of PICASST with representation from Department of Infrastructure Regional Cities and Development. PASO engages the Australian Bureau of Meteorology, through the Meteorological Authority Office (MAO), to conduct compliance audits of meteorological services in the Pacific. The MAO conducts these activities on a cost recovery basis. The MAO has audited the Solomon Islands and is in negotiations to audit Nauru, Tonga and Tuvalu in 2019. This activity support PKO1 in the PIMS which the MAO drafted in support of PMC and their representation to the Pacific Island Aviation Weather Services Panel (PIAWS).

## **5.0 Support under the WMO World Weather Watch Framework**

### **5.1 Guidance products (Addresses PIMS PKOs 1-6)**

Broadly the Bureau supports forecasting services in the south Pacific through the WMO Regional Association V, the Melbourne WMC and the Darwin RSMC under the Global Data-Processing and Forecasting System. The Bureau's guidance products for the Pacific consist of a mixture of manual and NWP products, provided through public and Registered User web pages, by direct availability of model data where this has been organised, and also provided directly to the Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project web site. These are provided by the Bureau National Operations Centre in Melbourne and Darwin RSMC. The Bureau National Operations Centre is also the RA V coordination point for on demand requests for high resolution Himawari-8 rapid scan data.

Following the commissioning of a new supercomputer, the Bureau has commenced a series of upgrades to the core numerical prediction products. In mid-2019 the Bureau commissioned into operations a global ensemble model as part of a major upgrade to its existing global deterministic atmospheric NWP model. These advancements provide benefit opportunities for the Pacific area. (See Annex 1, Attachment D for more detail).

In 2019, the Bureau of Meteorology became an RSMC for Global Ocean Wave prediction. This means that the Bureau's wave model guidance is available to Members located in the Pacific to utilise in support of their marine forecast services. The gridded products will be available via the WMO Information System (WIS), and wave model image products are available on the Bureau's website.

## 5.2 Melbourne WMO Regional Instrument Centre and Regional Radiation Centre (Addresses PIMS PKO 7)

The Melbourne Standards and Metrology Laboratories are measurement and instrumentation laboratories that fulfil the WMO roles of a Regional Instrument Centre (RIC) and Regional Radiation Centre (RRC). They maintain international traceable reference standards in Temperature, Humidity, Pressure, Solar Radiation, Rainfall (through Mass) and Electrical. The Melbourne Standards and Metrology Laboratories regularly calibrate reference instruments for the Bureau and RA V members. The RIC has provided technical advice, inter-comparisons and calibrations to RA V. This service has been utilised by New Zealand, Fiji and Indonesia in the last 2 years. The RIC also hosts an annual visit by staff of BMKG Indonesia staff to the laboratory which provides them with upskilling of their experts, reference calibrations and the opportunity to strengthen ties in the region.

In 2017 the Melbourne Standards & Metrology Laboratories undertook a solar instrument (pyrheliometer) inter-comparison at Tsuba Japan. This was a critical inter-comparison of RA-II and RA-V pyrheliometers timed to take place between international pyrheliometers comparisons at PMOD in Switzerland scheduled every 5 years.

In 2018, they participated in a multi-region (II, V and VI) inter-laboratory comparison with Japan, China, the Philippines, Slovenia and Italy as well as the University of Ljubljana.

The Melbourne Standards and Metrology Laboratories have embarked on a major calibration systems upgrade, aiming to increase capacity and automation and introduce environmental testing as part of calibration.

### **Sea Level Monitoring**

In late 2016 the Bureau completed construction of a new length calibration laboratory for sea-level monitoring. This state of the art facility replaced the calibration laboratory that has operated for the last 20 years at the National Tidal Unit in South Australia. Routine calibration of the primary sea level sensors, associated thermistors and levelling instrumentation continues to be undertaken on an 18 month cycle. A calibration system has been designed and commissioned for the secondary sea level sensors. The aim is to establish reliable inter-comparisons between the primary and secondary sea level sensors with the view to using the current secondary sensors in place of the primary. The secondary sensors are more reliable and robust and expected to provide as good or better sea level observation at lower cost.

The Bureau and Geoscience Australia are currently working to connect the sea level measurements to GNSS benchmarks on each island. This will enable reliable sea level observations relative to the geoid and ellipsoid for the Southwest Pacific.

## 6.0 Education and Training Activities

### 6.1 Onsite and online training at the Bureau of Meteorology Training Centre (Addresses PIMS PKO 11)

Activity	Details
Pacific Island graduates on Graduate Diploma in Meteorology course (40 weeks, Jan-Nov)	2017 – 2 students (Tonga) 2018 – 5 students (1 x Fiji, 3 x Tonga, 1 x Kiribati) 2019 – 2 students (2 x Fiji)
BMTC delivered the 12 <sup>th</sup> Southern Hemisphere Tropical Cyclone workshop, which was hosted by Fiji.	Held 14-22 September 2017 Fiji (5), American Samoa (1), Cook Is (1), Indonesia (2), Kiribati (1), Micronesia (1), New Zealand (2), Niue (1), Papua New Guinea (1), Solomon Islands (1), Tonga (1), Tuvalu (1), Vanuatu (1), Western Samoa (1)
BMTC conducts monthly online "Regional Focus Group" meetings for RA-V as part of our activities as a Centre of Excellence in WMO-CGMS Virtual Laboratory in Satellite Meteorology, Education and Training program.	2017 - 20 attendees over 7 meetings; Cook Islands (1), Fiji (3), Guam (2), New Zealand (3), Niue (1), Solomon Islands (3), Tonga (3), Tuvalu (2), Vanuatu (2) 2018 – 43 attendees over 11 meetings: New Zealand (15), Fiji (6), Hawaii (3), Guam (1), Papua New Guinea (8), Samoa (9), Tonga (1) 2019 – 20 attendees over 6 meetings: New Zealand (3), Fiji (3), Samoa (11), Tonga (2), Vanuatu (1)
Delivered radar maintenance training at three sites in Fiji, and conducted radar maintenance of two radars.	2018 - 4 attendees from Fiji attended training course delivered 1-10 October.
South Pacific Region 'Training Needs Review' meeting hosted by FMS on 19 February 2015	WMO, US NWS, COMET, FMS and Bureau stakeholders

### 6.2 In country training supported by the Bureau of Meteorology (Addresses PIMS PKO 11)

The Bureau provided the training for the WMO Tropical Cyclone and Public Weather Workshops held in Fiji in September 2017. A total of 21 forecasters attended representing 13 countries from the Pacific and Indonesia. (5 Fiji, 2 from New Zealand and Indonesia, 1 each from American Samoa, Cook Is, Kiribati, Fed. States of Micronesia, Samoa, Vanuatu, Niue, Solomon Is, Tuvalu, Solomon Is, PNG). The Bureau will also provide the support at the next such Tropical Cyclone workshop in Fiji in Sept 2019.

## **ANNEX I - Attachments to Australian Country Paper to PMC-5**

### **Quality Management System for Aviation Weather Services Project**

### **ANNEX I Attachment A**

#### **Objective**

Achieving certification to the ISO 9001 Quality Management Standard through a sustainable national internal audit regime for aviation weather services.

#### **Brief description of project**

The aim of the project was to assist counterpart organisations (PICs) to develop a quality management system (QMS) to meet the International Civil Aviation Organization (ICAO) *Annex 3 to the Convention on International Civil Aviation, Meteorological Services for International Air Navigation*, requirements to deliver their aviation weather services in conformity with the International Organization for Standardization (ISO) 9000 series of quality assurance standards and in particular, the international ISO 9001 Quality Management Standard .

The project was conducted in three stages. It commenced in November 2012 with an “in-region” five-day internal auditor training course with two participants from each PIC (a total of 22), in Port Vila, Vanuatu. Participants were provided with an internationally recognised qualification as an internal Quality Management auditor.

The second stage involved inviting 20 PIC participants who had successfully completed the auditor training course (stage 1) to participate in real-time audits with the Bureau’s experienced QM Section auditors. The participants were placed in 6 teams of 3 participants all from different Met Services and one team of two from Fiji. The mixed team approach enhanced the QM network throughout the SW Pacific and was a strategy to assist in ensuring the sustainability of QMSs throughout the Region. It also provided an ideal opportunity to consolidate their stage 1 workshop training in a practical environment and benchmark their audit techniques and performance as well as provide face-to-face guidance on issues they may have faced in developing and implementing their own QMS.

The third stage involved the selection of 12 participants who had successfully completed stages 1 and 2 to be provided with the opportunity to undertake Lead Auditor training. The training was conducted in Nadi, Fiji, in conjunction with Gary Management Systems Pty Ltd, an Australian Registered Training Organisation and the Bureau’s Quality Assurance Unit. The Lead Auditor course is approved by the International Register of Certified Auditors (IRCA). All 12 participants successfully passed and have been awarded an internationally recognised Lead Auditor qualification.

#### **Status of implementation to date and achievements**

Stage 1 workshop has been completed and was very successful – this was supported by the very positive and extensive feedback from participants.

Stage 2 involved real-time practical QM auditor training conducted within the Bureau. Participant feedback was very positive and strongly endorsed the approach adopted.

Stage 3 was successfully completed with 12 fully qualified and internationally recognised quality management lead auditors in the South West Pacific.

### **Issues and proposed way forward**

The Bureau continues to host the WMO Quality Management website on behalf of WMO. The website provides valuable information, resources and publications and tools for WMO Members on how to successfully implement a QMS.

The Bureau also manages a WMO Quality Management Forum on behalf of WMO. The purpose of the forum is to provide WMO Members with an opportunity to ask questions relating to the implementation of their QMS, source valuable QM resource material and advice on how to address any roadblocks that they may be experiencing. There are currently 240 registered members.

**WMO No.1100** – *Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services and other relevant services providers within an ISO 9001:2015 Quality Management Framework* (Ed 2017).

This document written by Bryan Boase and Helen Tseros provides step by step guidance on how to implement a quality management system for NMHSs and other relevant service providers. The Guide has been updated to reflect the new requirements of ISO 9001:2015 and has a wealth of resource material as well as tools that have proven very successful in providing tangible audit evidence that demonstrates that the requirements of ISO 9001:2015 have been met. The Guide is available at: [https://library.wmo.int/index.php?lvl=notice\\_display&id=15574#.XTaKZTqpW70](https://library.wmo.int/index.php?lvl=notice_display&id=15574#.XTaKZTqpW70).

There is now a need to be aware of, and to identify the new and enhanced requirements within ISO 9001:2015. It should also be noted that QM auditors are also required to upgrade their knowledge and skills to enable them to conduct effective audits against the new ISO 9001:2015 Standard.

The Quality Assurance Unit continues to receive numerous requests for assistance to develop and implement quality management including practical training, resources and tools.

## **International exchange of meteorological information**

## **ANNEX I Attachment B**

### **Training and implementing systems for participation by Pacific countries in open international exchange of meteorological information**

19 countries participated in the training workshop, 29 April – 3 May 2013, including 12 Pacific partner countries and 7 other Member countries of WMO in the South-West Pacific region. Experts from Global Information System Centres (GISC) in Australia, China, Japan, Korea, WMO Secretariat and the Association of Hydro-Meteorological Equipment Industry (HMEI) contributed to the workshop by delivering speeches and lectures.

The aim of the activity is to assist counterpart organisations to fully participate in WMO systems for transmitting and handling the weather, climate and environmental information. This activity prepares partner countries to 1) adopt the new arrangements for the future free and open international exchange of weather and climate information and products through a more comprehensive information service known as the WMO Information System (WIS); and 2) to adopt the new data formats required to participate in the World Meteorological Organisation (WMO) coordinated international exchange of weather and climate related information, i.e. to migrate to Table Driven Code Form (TDCF) for the exchange of observed and predicted weather data and products.

To achieve this aim, a two-stage approach was adopted. In the first stage, a training workshop on WIS/TDCF was conducted in Melbourne to convey the concept and preparedness for WIS and TDCF in the counterpart organisations. In the second stage, an implementation plan was developed for each partner country in consultation with the counterpart organisation. On-site assistance was provided by the Applicant to implement the plan, so that the partner countries can take advantage of the services provided by the WIS, will be able to submit necessary metadata, to exchange their weather data in TDCF under the framework of the WMO WIS Core Network, and to receive and fully utilise the data made available in WIS. The free exchange of essential weather data supports the mitigation of severe weather events and natural disasters such as tropical cyclones, drought, storm surge and tsunamis.



## **Support and upgrade of Fiji Integrated Meteorological Forecast System FIMS**

## **ANNEX I Attachment C**

FMS operates the Australian Integrated Forecasting System (AIFS) at its Head Office in Nadi, Fiji, for the preparation of public and aviation forecasts and warnings. This system was first installed in 1998.

Since 1998, the FMS AIFS system and its underlying infrastructure—the Fijian Integrated Meteorological System (FIMS)—has been upgraded three times with the assistance of Bureau IT staff, once in 2004 and again in late 2008 and late 2015, on a cost-recovery basis.

The most recent upgrade migrated FMS mission-critical forecasting operations to a virtualised Linux cluster like that now used in Bureau State Offices. As part of the upgrade the Bureau provided updated software applications, databases, documentation and additional training.

The benefits to FMS of the upgrade included:

- reduced running costs, including power consumption and cooling;
- reduced hardware costs (by about 50 per cent) for equivalent or improved performance;
- a scalable architecture, whereby more servers and storage trays can be added over time;
- simplified system management and high availability through server virtualisation; and
- the ability to support both Linux and Windows servers in one cluster, through server virtualization.

During October 2015, two FMS staff (one IT staff member and one forecaster) visited the Bureau for the initial setup of the FMS systems in Melbourne. The FMS staff members reviewed and provide feedback on how well the setup matched FMS requirements. Following the review and further work, the applications and system configuration was transported to Nadi when a Bureau systems engineer visited. These visits were fully funded by the FMS AIFS Upgrade project.

In November 2015 two BoM IT staff visited Fiji Met Service to conduct system audit for the Fiji AIFS Upgrade Project, assist with User Acceptance Testing and contribute to the upgrade of the Fiji Met Service's operational forecasting system.

The upgraded system was commissioned in December 2015 and has been operational ever since.

Two FMS IT Staff were invited to attend training on supporting the AIFS system at the Bureau in late August 2017.

## **Bureau's contribution of guidance products to PIC NMHSs**

## **ANNEX I Attachment D**

### **Manual Analysis**

A key product produced by RSMC Darwin is a suite of broad scale tropical analyses produced by forecasters in Darwin. Streamline analyses at gradient level and 200hPa are performed each day at 00UTC and 12UTC, supplemented by a MSLP analysis at 00UTC, available on the RSMC Darwin web site.

### **Climate Diagnostics**

RSMC Darwin provides a range of climate diagnostic information to stakeholders in the region, focused on key climate drivers in the tropics such as the El Nino-Southern Oscillation, Madden-Julian Oscillation, Indian Ocean Dipole and significant tropical waves. As well as a wealth of information on the Bureau website, RSMC Darwin climatologists produce a 'Weekly Tropical Climate Note' which discusses the current state of the climate as well as expectations for the next two to four weeks.

### **Numerical Weather Prediction**

A wide range of Numerical Weather Prediction (NWP) products are provided to countries in the region from the ACCESS suite of models. Model fields are made available as GRIB2-format gridded products that can be ingested into local software systems or as pre-generated charts over the domain of interest. Coincident with a series of major upgrades in the Bureau's supercomputing capabilities, the Bureau's models are being upgraded, with each upgrade benefiting countries in the Pacific region through data and service provision arrangements.

A major upgrade in the Bureau's ACCESS model suite (APS3) was implemented in mid-2019, which delivered improved horizontal resolution (grid size decreased from 25km to 12km), improved assimilation of observational data and improved model physics in the Bureau's global NWP model, ACCESS-G. Very significantly, this upgrade brings with it the Bureau's first operational ensemble NWP model, ACCESS-GE, with 18 members each at 33km grid resolution, arranged as a time-lagged 36-member system. The upgrade to the ACCESS-Global model will flow through to downstream numerical prediction systems, including AUSWAVE models, as configuration updates are completed in the second half of 2019. Within the Australian domain, the ACCESS-City model (covering parts of Australia at 1.5 km resolution) has shown considerable improvement in the handling of convective regimes.

### **Ocean Wave Prediction**

The Bureau's ocean wave model (Auswave) is available to countries in the region, as part of the Bureau's responsibilities as an RSMC for Global Ocean Wave prediction. The Auswave model is available at 25 km for the 7-day forecast period.

### **The Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project (SWFDDP)**

RSMC Darwin continues to be actively involved in the SWFDDP, which aims to improve the ability of NMHSs to forecast severe weather events as well as to improve guidance to NMHSs through feedback to modelling agencies and RSMCs. The current phase of the project is focused on the southwest Pacific, including Fiji, New Zealand, Samoa, Vanuatu, Tonga and the Solomon Islands.

RSMC Darwin is providing a wide range of charts and NWP output from the ACCESS model suite to NMHSs participating in the project via the MetConnect Pacific web page. This page acts as a hub for guidance material being used in the region and is hosted by the Meteorological Service of New Zealand. Tropical cyclone forecast tracks and bulletins are available from the Bureau's high-resolution ACCESS-TC model on the Met Connect Pacific web site. Track bulletins from ACCESS-TC are sent directly to several south Pacific meteorological services to ingest into Bureau-developed forecasting software (TC Module) for use in tropical cyclone warning centre operations.

Apart from the above, the Bureau supported the SWFDDP through the provision of a Darwin RSMC representative on the Regional Subproject Management Team, representation on the RA V Tropical Cyclone Committee (David Grant) and also on the overall SWFDDP Steering Group.

### **The Coastal Inundation Forecast Demonstration Project, Fiji Sub-project (CIFDP-F)**

The WMO CIFDP-F sub-project is focused on the development of an efficient forecasting and warning system for coastal inundation in Fiji. The Bureau has been involved with this project since 2012, by providing technical advice and expertise for planning, system design and periodic stage reviews. The Bureau has also been providing customized wave forecasts for the southern coastal areas of the main Fiji island Viti Levu (the so-called Coral Coast) to help researchers from the Pacific Community (SPC) with the development of a reliable wave inundation forecast system for this area.

### **Support to Volcanic Ash Advisory Services**

The Volcanic Ash Advisory Centres (VAACs) provide eruption detection and ash dispersion guidance for use by aviation forecasters in each State. VAAC Darwin covers the western Solomon Islands, PNG, and westwards to Indonesia, and VAAC Wellington covers the area to the east of that across the remainder of the south Pacific. Australia and New Zealand have worked hard to improve mutual back up arrangements across this region, which covers a large part of the Pacific 'Ring of Fire'. An ongoing issue in the region is the status of volcanic monitoring. ICAO requires States to monitor active or potentially active volcanoes, preferably instrumentally. Australia continues to actively discuss ways to improve operational monitoring arrangements in PNG. Use of social media platforms have provided successful additional pathways for collaborative international sharing of real-time information during events.

### **High Resolution Satellite Imagery**

Requests from registered RA V members for event based on demand high resolution rapid scan Himawari-8 satellite imagery are coordinated through the Bureau National Operations Centre, in collaboration with the Japan Meteorological Agency.