FIFTH PACIFIC ISLANDS CLIMATE OUTLOOK FORUM (PICOF-5)

Official Report

Venue: Institut de Recherche pour le Development (IRD)
Noumea, New Caledonia
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1. Background

The PICS Panel has been coordinating the Pacific Islands Climate Outlook Forum (PICOF) since 2015 in collaboration with SPREP, WMO with the support of other international and regional partners (including Meteo France, BoM, NIWA, NOAA, IFRC, APCC, POSTECH and Environment and Climate Change Canada). PICOF is a platform to discuss the seasonal outlook (cyclone, precipitation, temperature and oceanic conditions) and state of ENSO, capacity build and enable knowledge exchange between National Meteorological and Hydrological Services (NMHSs), and strengthen relationships between NMHSs and stakeholders.

PICOF occurs once a year and has a sector focus (e.g. Health, Agriculture and Food Security, Water Resources, Energy, DRR, Tourism and Fisheries). This year the PICOF-5 focussed on Agriculture sector. PICOF-5 was kindly hosted by Meteo France New Caledonia in collaboration with SPREP, WMO, Environment and Climate Change Canada, RESPAC, APCC and POSTECH.

Day 1 – Official Opening Ceremony – PICS Panel Meeting

Opening remarks and welcome from Government of New Caledonia.

The Chair provided an overview of the Climate Services evolution and development in the Pacific. The agenda is to strengthen climate services in the Pacific. One of the ways to strengthen CS in the region was convening a Forum, following WMO guidance, where model guidance can be discussed and seasonal climate forecasts can be discussed with sectoral users.

PICOF discusses recent science, how we do our outlooks, how we communicate our outlook and feedback on how our users utilise our outlooks.

These PICOFs have been fantastic to be part of and all National Meteorological and Hydrological Services (NMHSs) have been interacting in this platform for the past 5 PICOFs. Through some amazing work from SPREP, the PICS Panel is able to access funding from various sources annually to hold PICOFs, such as this years' collaboration with APCC/POSTECH.

The PICS Panel Chair is standing down due to other commitments and recognised the benefit of new leadership in the PICS Panel going forward.

2. Session 1 – Definition of El Nino Southern Oscillation Events

Session 1a: Ben Noll, Meteorologist, NIWA

Summary:

Ben outlined the different ENSO definitions and trigger points for event declaration and advisory that are used by WMO/IRI, NOAA, BoM, NIWA, APCC.

Advisories and declarations tend to be more aligned during strong ENSO events. The WMO advisory system inevitably lags behind the others due to the consensus process.

NMHSs shared their individual in-country systems for ENSO event advisory and declaration. Many NMHSs align to one of the advisories provided by regional providers (NOAA, BoM, NIWA) but also take into account observed impacts on climate variables in their public advisories.

A summary compilation of the different global and regional ENSO event definitions and trigger points was proposed by NIWA to be presented as a guide on the WMO RA-V Regional Climate Centre website.

A graph showing advisories and declarations tend to be more aligned during strong ENSO events. Source: NIWA

Feedback and discussion:

Most NMHSs supported this proposal, but suggested that it be only available to NMHSs, not the general public. Some feedback and suggestions were gathered from NMHSs and providers by a MentiMeter survey, summarized below and provided in Annex 2:

- Given ENSO complexity and differential impacts public information should be issued by individual NMHSs, based on a consensus process. In some cases NMHSs could be assisted by regional agencies to develop their own definitions, based on impacts in individual countries, or research existing definitions to adopt the one that best suits their climate.
- Very helpful as a guide as to where to seek further info. Additional 'good practice' guidance on how to deal with situations when different institutional definitions are giving different advisory would be helpful as would guidance on communicating with the media
- Information in impacts e.g. likely rainfall anomalies in different countries would be helpful
- Information on ENSO event lifecycle and each stage's impact in different countries would be helpful

- Need to include success rate of different institutional watch definitions
- Desire for a Pacific and or international consensus ENSO definition

Additional considerations include: 'El Niño-like' situations that can lead to impacts comparable to full blown El Niño; considering increased incidence of Modoki type events; guidance on tracking different El Niño types.

Session 1b: Dr. Yuriy Kuleshov – Space-based Weather and Climate Extremes Monitoring (SWCEM) Demonstration project (SEMDP)

Dr. Kuleshov presented on the Space-based Weather and Climate Extremes Monitoring (SWCEM) Demonstration Project (SEMDP). Recognizing high impact of weather and climate extremes on society, the World Meteorological Organization (WMO) initiated the Space-based Weather and Climate Extremes Monitoring (SWCEM) Demonstration Project (SEMDP). The aim of the project is the provision of timely and accurate information on monitoring and prediction of extreme events helps to build greater resilience of society against drought, floods, storms and other hydro-meteorological hazards.

The Workshop on Operational Space-based Weather and Climate Extremes Monitoring (SWCEM) was held in Geneva, Switzerland on 15-17 February, 2017. The workshop provided a dialogue amongst satellite operators, WMO Regional Climate Centres (RCCs), National Meteorological and Hydrological Services (NMHSs), and the science community to stimulate the utilization of space-based observation data and products for monitoring selected weather and climate extremes (heavy rainfall and drought in particular) on a routine basis ("in operations"), in response to current and future user requirements.

- Following the workshop's recommendations, WMO Executive Council (EC-69 and EC-70) decided on conducting a demonstration project on space-based weather and climate extremes monitoring (SEMDP) in WMO RA II and RA V.
- The demonstration project is established to run for two years (2018-2019) and be focused on weather and climate extremes such as drought and heavy precipitations over the South-East Asia and the Pacific region.
- Cg-18 approved SEMDP moving into operational stage (2020-2021).

SEMDP is concentrated on products at national and regional levels:

- monitoring drought and accumulated heavy precipitation;
- making best use of existing and newly developed satellite derived products and time series of measurements;
- making best use of products that combine satellite information with *in-situ* and/or model reanalysis data;
- recommendations as to which products should be transitioned from research to operations, including an assessment of those products.

SEMDP products available from CPC/NOAA and EORC/JAXA include

- precipitation estimates on various time scales e.g. hourly, daily, pentad (five days), weekly, 10 days and monthly, and
- derived products e.g. the standardized precipitation index (**SPI**), the normalized difference vegetation index (**NDVI**), the vegetation health index (**VHI**) etc.

Resolution of the satellite must be improved for local measurements. Monitoring at that scale must hep NMS draw some conclusions on precipitation and drought. CMORPH products will cover land and the oceans.

3. Session 2 – Guidance for consensus forecasting

Session 2a: Simon McGree, BoM

Summary:

Simon McGree presented on the WMO Guidance on Operational Practices for Objective Seasonal Forecasting – WMO Commission for Climatology and Commission for Basic Systems.

The problem in the Pacific is that there are several providers that are in play. Many NMHSs in the Pacific struggle to know which one to use. There is also confusion on which mode of operation – single model approach or multi-model approach.

The WMO guidance is that a combination of predictions from different and complementary models helps improve predictive ability making combining different climate model predictions advantageous and an advisable approach.

It is usually not recommended to develop forecasts based on a single prediction system. Reasons:

- Not a simple matter to establish with certainty which is a skilful prediction system;
- May not be prudent to be over-dependent on one system. There may be occasions were the single system is an outlier and other perspectives useful to draw consensus;
- Several literature studies demonstrate forecast skill may be enhanced by combining forecasts from different systems.

Considerations with model selection for consensus approach:

- Forecast lead time. Use of 1-month lead will eliminate a number of models (forecast release timing to be determine by end-users)
- Models biases e.g does it get the SPCZ position right? Is there a double ITCZ?
- Model selection based on components of the model. Models used in the Pacific must for coupled atmosphere-ocean models, contain MJO, have a reasonable subsurface profile etc
- Model biases in a particular season.

The other factor to consider is the Model skill verification which is difficult in the Pacific. The Pacific is not using a common hindcast period (97-99), verification method (correlation coefficient), or verification datasets.

Over the region different models have different skills – this suggest model should be weighted differently for a consensus forecast. However the literature recommends otherwise, with short hindcast periods equal weighting performs better.

Some exceptions for GPCs-LRF. Typically weighted in proportion to the square root of ensembles size.

Feedback and Discussion:

- A funded project is required as a PICS Panel activity, to assess suitability of available models in the Pacific and develop good practice guidance for consensus forecasting in the Pacific

- The WMO guidance is a useful guidance but may not be suitable for all Pacific Island locations. Vanuatu was supportive of the multi model ensemble approach and will offer good guidance for southern islands of Vanuatu.
- There is work between APCC and SPREP to develop a guide to help NMHS making a MME and all different solutions.
- APCC and SPREP requested BOM, NIWA and others to collaborate to share data and research regarding how a consensus forecast can be instituted in the Pacific. NOAA and UoH to confirm their involvement. Fiji Met Service encourage the PICS Panel to do this.

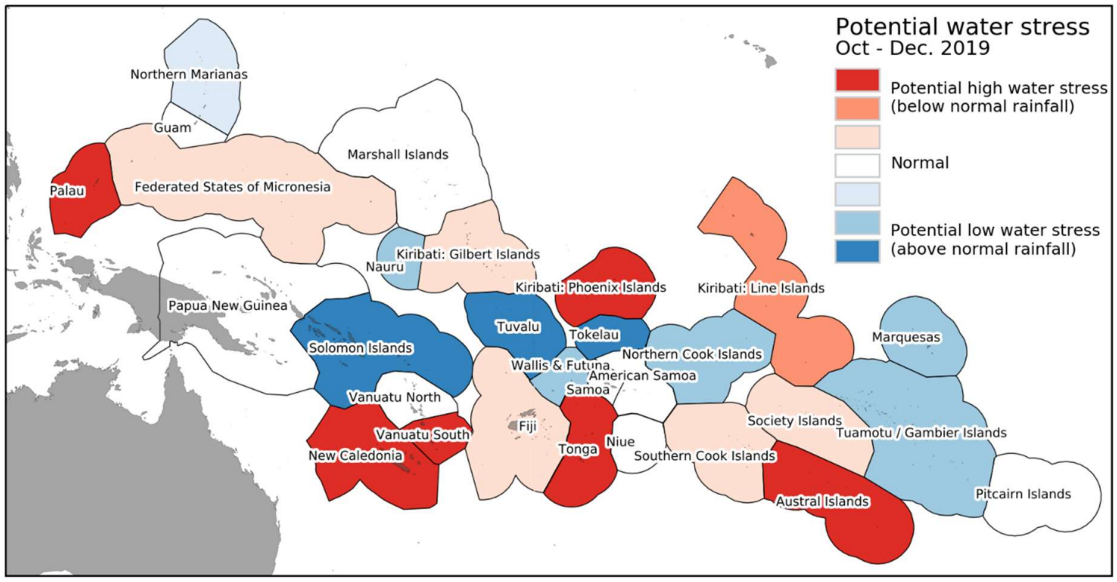
Further feedback gathered via MentiMeter is available in Annex 3.

Session 2b: Ben Noll, NIWA – Island Climate Update: a new method for deriving forecasts

Summary:

Ben Noll, NIWA discussed the shift to an objective approach in 2019 in relation to Island Climate Update (ICU), averaging from ECMWF, UKMO, Meteo-France, DWC and CMCC available on the Copernicus Climate Data Store [https://cds.climate.copernicus.eu/cdsapp - !/home].

The blend of the 5 members here is accurate for one single member. New data arrives at 00z on the 13th of each month. Available on web portal and through API (Application programming interface). Combining all 5 models from Copernicus and TRMM results in making something useful such as Potential Water Stress Map and Seasonal Climate Prediction. There is also a video on the Pacific Climate Update.



Discussion and Feedback:

- IFRC asked about the timescale used for the water stress product. NIWA confirmed it's a 6-monthly accumulated.
- Fiji Met praised NIWA for excellent communication eg videos/animations. Request the methodology in seasonal rainfall outlook and how to include other available models. NIWA is considering writing up the methodology and to share with the climate community.

- Fiji sought clarification on which NMHSs are using the ICU products and how they are aligning it to national outlooks. NMHSs appreciate the products. NIWA acknowledged that the timing of the release of the ICU is not aligned with release of national products using SCOPIC and they are looking into alignment.
- IFRC suggested that NIWA peer review and publish the methodology for deriving the water stress product
- SPREP requested that due to the high interest in the ICU from non-NMHS users, the ICU needs to more prominently encourage users to consult national sources.

4. Session 3 – Election of the new PICS Panel Chair

The meeting noted the withdraw of Dr. Andrew Tait from the Chair due to appointments within NIWA. The meeting commended his leadership and the many achievements of the PICS Panel during his leadership.

The meeting acknowledged the appointment of Mr. Allan Rarai, Vanuatu, as Vice Chair.

There were two nominees for the Chair, Mr. Simon McGree, BOM; and Dr. Olivia Warrick, IFRC. Votes were tied and as a result, both candidates will represent the PICS Panel as Co-Chairs.

Dr. Andrew Tait thanked SPREP (Salesa Nihmei, Sunny Seuseu and Philip Malsale) for providing support to the Chairman and the panel. John Marra, NOAA presented Dr. Tait with a gift and thanked Dr. Tait for his wonderful leadership of the PICS Panel.

5. Official Opening Ceremony – PICOF-5 Meeting

5.1 Welcome

Olivia Warrick officially welcome the participants to the PICOF proper and thanked Meteo France and IRD for hosting the event and the hospitality extended to everyone from abroad.

5.2 Opening statements

World Meteorological Organisation

Anahit Hovsepyan, WMO gave opening remarks on behalf of the Secretary General of WMO, Mr Petteri Taalas. She congratulated the New Caledonia Met Service for hosting this special event and Meteo France and IRD for the excellent facilities. She also thanked SPREP and all regional partners for supporting the PICOF this year. Ms Hovespyan noted the importance of RCOFs for regional partnership, improvement of members of interpretation of forecasts for decision making and capacity development of NMSs and sectors.

Secretariat of the Pacific Regional Environment Programme

Philip Malsale welcomed the participants to the fifth Pacific Islands Climate Outlook Forum. Mr. Malsale highlighted SPREP's mandate to address climate change and support meteorological services in the region. He noted that the Pacific Climate Change Centre will be the focal point for NMS for the coordination and implementation of the Pacific Islands Meteorological Strategy and the Pacific Islands Roadmap for Strengthened Climate Services. SPREP thanksed the WMO, FAO, COSPPac project, Global Framework for Climate Services and Government of Korea for making PICOF-5 possible.

5.3 Invitation for rapporteur team

The volunteers to the drafting committee include: Olivia (Co-Chair/IFRC), Sunny (SPREP), Allan (Vice Chair/Vanuatu) and Bo Ra (APCC)

5.4 Invitation for PICOF Regional statement team

Co-chair Simon McGree provide an overview of the PICOF-5 Regional statement and the process for its release. The statement will not be released at the end of PICOF. The statement is provided to NMS Director for a week, for feedback and endorsement.

Meteo France was nominated to Chair the Regional Statement team as host with support from regional organisations (SPC, Fiji Met, NIWA, NOAA, New Caledonia Met Service, APCC and SPREP).

Fiji sought clarification on process for NMHS to provide feedback on the draft statement and expressed concern that the regional statement may cause confusion with national statements. PICOF statements are drafted to refer to sub-regions and no reference to any particular country.

6. WMO Activities on the implementation of Climate Services Information System

Dr. Anahit Hovsepyan discussed the WMO Activities on the implementation of Climate Services Information System. The WMO spearheaded international initiative coordinates efforts by the United National, governments and organisation to develop science-based climate information for various climate sensitive sectors. Aspects include:

i) Global Products

WMO provides quarterly El Nino and La Nina updates. Need to include other large-scale indices and consider regional impacts in future Updates. Global Seasonal Climate Update concept incudes major general circulation features.

ii) WMO Regional Climate Centres

WMO RCCs are Centres of Excellence that produce regional climate products in support of regional and national climate activities.

iii) Regional Climate Outlook Forums

Coordinate regional climate outlook forums, and help NMS improve the utility of seasonal climate prediction. Key limitations of RCOF outlooks are:

- Format can be unsuitable for application in specific decision making
- Forecast skills not routinely evaluated/communicated

RCOF review was undertaken in 2017. The next generation of RCOFS will involve objective seasonal forecasting schemes in selected regions.

Key milestones:

- Operational climate prediction workshop series to be key drivers of good practices in partnership with research community.
- CBS/CGI Guidance on Operational Practises for Objective Seasonal Forecasting – to be published by 2020.
- Global review of Regional Climate Centre functions – Nov 2018.

iv) National Climate Outlook Forums

A guidance document is under development.

7. Session 4 – Review of 2018/19 climate and ocean

7.1 Review of 2018/19 climate

ENSO: There have been differences between agencies in El Niño advisories since PICOF-4 in late 2018. Atmospheric conditions did not exceed BoM's El Niño threshold criteria. As NOAA's criteria are more ocean based, El Niño was declared by NOAA in May 2019, in part because atmospheric thresholds were not exceeded. Eastern and central equatorial Pacific warming continued at or near weak El Niño thresholds until mid-2019 when conditions returned to ENSO neutral. Warmer SSTs continued in the western Pacific however.

Rainfall: Across the South Pacific, rainfall patterns were quite variable. Late in 2018 and early in 2019, rainfall was above normal in the vicinity of the International Dateline. In mid 2019, rainfall patterns were mixed, consistent with ENSO neutral conditions. In early 2019, drought conditions prevailed across much of the tropical North Pacific. Rainfall from June through August was quite variable.

Model skill: the models are forecasting the strong ENSO events well, but for the 2018-19 situation, models did not perform particularly well, reflecting the lack of atmospheric response. Models predictions are generally in agreement for ENSO neutral going forward.

Indian Ocean Dipole: the strong positive IOD will most significantly likely lead to less Madden Julian Oscillation activity although with some rainfall suppression in western PNG.

7.2 Review of 2018/19 Ocean

Sea surface temperatures: 12 month average SSTs showed most positive anomalies in the western and central Pacific. Of note, these were associated with very hot air temperatures surrounding Hawaii.

Sea level anomalies: Sea level in late 2018 and early 2019 was higher than normal along the equator and most of the South Pacific (10-20 cm). This pattern continued up until March 2019 for most South Pacific countries except for those close to the Coral Sea, which began to experience normal or below normal conditions. During mid 2019, the central and eastern Pacific continued to have higher than normal sea levels, however the west and some of the southern regions experienced a trend toward normal, typical of ENSO neutral. Of note, the highest tide for 2019 in Palau was experienced in early August related to sea level anomalies.

Coral bleaching alerts: Consistent with the warmer than normal sea surface temperatures in the western and central tropical Pacific, much of the South Pacific had coral bleaching alerts during late 2018 and 2019, indicating low-level thermal stress and the possibility of coral

bleaching. Of note, Northwestern Fiji experienced very high SSTs leading to coral bleaching events.

8. Session 5 – Seasonal forecast guidance for 2019/20

8.1 Presentation from APCC

Professor Jong-Seong Kug presented 2019 October November December Outlook for the south west Pacific islands.

In summary:

- NOAA, BOM and APCC models agree that ENSO is in neutral status with neutral remaining the most likely outcome into early 2020. An area of warm SSTs in the western Pacific is rapidly decaying with some easterly anomalies emerging.
- Most climate models tend to predict neutral state of El Niño in the following winter.
- However, observational evidence suggests a sizeable Central Pacific El Niño, and even possibility on reemergence of the eastern Pacific warming.
- Climate outlooks for the Pacific Island show very diverse rainfall forecasts, possibly due to the prediction for weak ENSO or neutral states.
- Above normal air temperature is expected in the western Pacific

8.2 Presentation from NOAA

John Marra presented on the outlook for the north Pacific.

Through December 2019, seasonal rainfall is forecast to be near normal for Kosrae in the FSM and Majuro in the Republic of the Marshall Islands (RMI); normal to above normal for Pohnpei in the Federated States of Micronesia (FSM), Kwajalein in the RMI, Guam, and Saipan in the Commonwealth of the Northern Mariana Islands (CNMI); normal to below normal for Yap and Chuuk in the FSM; and below normal for Koror in Palau.

Elevated levels of heat stress will exist across a wide band extending northeast to southwest across the Pacific, with the highest bleaching threat extending from Nauru to the Phoenix Group in Kiribati. The RMI and FSM are expected to remain at a Bleaching Watch throughout this period. Coral mortality is possible in some areas.

In parts of the tropical northwestern Pacific (especially near the RMI) and southwestern Pacific (north of Fiji), sea levels will remain above normal during the next three to six months (5-15 cm). Dynamical forecast models suggest steady or slightly rising sea levels in the northwestern Pacific (continued above normal around Majuro and Pohnpei) and in the southwestern Pacific (above normal around Funafuti and Pago Pago; near normal around Suva and Rarotonga). For some countries east of the Coral Sea, normal or below normal sea levels are forecast (-3 to -6 cm).

8.3 WMO Lead Centre Multi-model-ensemble (MME)

WonMoo Kin and WMO LC-LRFMME Team Seasonal for upcoming ONDJFM 2020 season.

Dr WonMoo Kim provided information on the 13 WMO-designated Global Producing Centres for long range forecasts. WMO LC-LRF provides support to Global Seasonal Climate Update

Forums and Regional Climate Outlook Forums. Meteo France has recently joined the PMME in 2019.

For October to December warm SST anomalies are predicted across the western Pacific Ocean. Temperature prediction skill is high in the Pacific, however in a strong signal the skills is high. In ENSO Neutral state the models perform poor hence skill is low.

Precipitation skills is generally higher in the Pacific. When there is strong signal there is higher confidence in the skill and lower confidence when ENSO signal is weak during ENSO neutral. For rainfall only 5 GPCs for PMME.

9. Session 6 - Tropical Cyclone verification for 2018/19 and outlook for 2019/20

9.1 Presentation from NIWA (SW Pacific region)

Mr. Ben Noll, NIWA provided a recap of NIWA's 2018/19 tropical cyclone outlook & season. 7-11 named tropical cyclones were forecast by NIWA between 1350 E and 120 o W. 3-4 severe tropical cyclones. Overall it was a very good outlook.

Mr Noll then presented the NIWA tropical cyclone outlook for the upcoming 2019/20 season. He discussed the methodology they use in the generation of the outlook. The climatology for the TC density full season climatology. NIWA use the IBTRACKS dataset for selection of the analogue years.

TC Forecast: NIWA is expecting 9-12 named tropical cyclones (10-normal) from November 2019 to April 2020. A near normal early season, elevated activity east of the Dateline late season. Four analogue years selected: 1969/70, 1992/93; 2002/03, and 2004/05. A key feature to look at for Tropical Cyclone genesis in the Pacific is the warmth in the Nino 3.4 region, the positive IOD has helped keep that warm area in place.

The meeting noted the NIWA video on the SW Pacific Tropical Cyclone for 2019/20 season.

IFRC asked whether a verification analysis has been undertaken on the seasonal TC outlooks. It was noted by the meeting that such an analysis would be very useful. NIWA will investigate this.

9.2 Presentation from NOAA (North Pacific region)

Mr. John Marra, NOAA presented the Tropical Cyclone Outlook Guidance for the North Pacific Region. The forecast for the eastern North Pacific (issued on May 23 2019) called for a 70% chance of an above-normal season (15-22 named storms), a 20% chance of a near-normal season, and only a 10% chance of a below-normal season. A total of 14 named storms have formed through September.

With respect to NOAA's Accumulated Cyclone Energy (ACE) index, which accounts for the combined intensity and duration of named storms and hurricanes during the season, the 2019 outlook indicated a 70% chance that the ACE range will be 100%-180% of the median, reflecting an above-normal season.

9.3 Guidance on national statements

Five National Meteorological Services indicated interest in developing national statements that can be released jointly with the PICOF-5 Regional Statement. These NMSs are Cook Islands, Samoa, Solomon Islands, Tuvalu, Samoa, Kiribati and Tonga.

Day 2 – Improving consensus forecasts to the agriculture sector

Day 2 began with a summary of the 2018/19 climate, the seasonal outlook and the tropical cyclone outlook, delivered by Elise Chandler, BoM.

The ensuing discussion highlighted the importance of face to face engagement with sectors and users (e.g. NCOFs, targeted NDMO meetings, sector forums, engaging intermediaries) in communicating seasonal forecasts and uncertainty.

10. Session 7 – Building collaboration between agriculture sector and National Meteorological Services (NMSs)

10.1 Climate impacts on agriculture sector and agriculture impacts across the region over the last few years (SPC/FAO)

Ms Elenoa Salele, presented on the challenges in food security and agriculture in the context of climate change and natural disasters. There is declining food production and declining production contributing to declining contribution to the GDP. The Pacific Community's response to impacts in the Agriculture in the Pacific includes a number of initiatives. Salele presented findings of assessments completed for six Pacific Island countries and the adaptive capacity of communities to climate variability and climate change.

Community Vulnerability Assessments is one of many tools that can be utilised to evaluate risk, exposure and vulnerability of local communities and level of food security for each beneficiary country in the project. The study also found that access to land is one constraint to food security and improving livelihood. SPC also has a programme that develops local tissue cultures that are more resilient to changing climate in contrast to other introduced species and strains.

Climate change impact on Agriculture in the region is a big concern and addressing climate change should be holistic, thus collaboration between agriculture sector and NMHSs is fundamental.

10.2 Current regional and global Agriculture warnings and forecasts (SPC/FAO)

Ms. Mariko Fujisawa, FAO, Rome presented on the current regional and global agriculture warnings and forecasts. Fujisawa also presented on FAO's global monitoring tools: GIEWS is the Global Information and Early Warning System for monitoring of drought. There is also a World Food Outlook issued quarterly and focusses on regions across the globe and discussed market situations and assistance for food. There is also an "Oceania" Food Outlook in this publication which will be useful for Pacific Islands countries, Australia and New Zealand.

GIEWS presents country specific reports as well as drought monitoring for drought on NDVI, Vegetation health index and ASI (Agriculture Stress Index). The drought index information is updated every 3 days.

Fujisawa also provided examples of agrometeorological services that can be helpful for country participants to formulate national Agromet information to local users. The 3-step process for the development of agrometeorology services was presented;

1. Data
2. Information
3. Advisories and users.

In summary, Agromet services must be designed and guided by who are the users, what are the users needs/requirements and is providing data enough for users? It is essential to enhance the collaboration of Agriculture and Met is essential to translate climate data into agriculture context.

10.3 Country presentation – Papua New Guinea (PNG)

Anna Kimam and Kisolel Posanau presented the partnership between NMS and Agriculture in PNG and ways to improve the current situation. The agromet information generated is ongoing. At the policy level there is a DAL has an existing climate smart plan and seek to align with Climate Smart Policy. There is also a PNG Drought Response Agriculture Recovery Plan 2018-2022. NWS has an agreement with all government agencies in data sharing and has good relationship with Agriculture department. PNG NWS has an in-house Agrometeorologist that generates information and share bulletins on a monthly basis.

Best practises for PNG include the following:

1. Seasonal Forum/NCOF
2. Central Province Drought Adaptation Training – farm advise on Drip irrigation
3. Water storage (well)
4. Green House Farming
5. Smart farming practices eg mix cropping, crop rotation, cover cropping, crop diversification.
6. Juncao Technology – the introduction of grass which is grown to change dry arid area into agriculture use land.
7. PNG Water Board -urban water supply system the use of untreated water for farming purposes that is supplied to farms

Challenges include (a) products are too technical (b) Most rural farmers having no access to weather and climate forecast information (c) Few weather stations to collect data.

10.4 Country presentation – Solomon Islands

Mr Peter Trena, Director Planning and Land Use, Solomon Islands presented on the strengthening partnerships between Met services and Department of Agriculture. In terms of policy, there is a Ministry of Agriculture and livestock (MAL) Sector Policy 2015-2019. Currently there is no formal MOU or LOA between the two agencies. There are shared products such as Seasonal Climate Outlook, Soil Balance (CliDesc) and Monthly drought bulletin.

Other climate information that is available include Malaria risk outlook bulletin Ocean outlook, climate data, tropical cyclone outlooks and CliDesc – soil water balance. In terms of communication SIMS climate outlooks were provided monthly to Ministry of Agriculture for their information. Trena encourage the strengthening of the working relation of MAF and Met Services.

10.5 Country presentation – Vanuatu

Mr Pakoa Leo, the Vanuatu Klaemet Blong Redy, Adapt mo Protekt (Van-KIRAP) Agriculture Sector Coordinator presented on existing mechanisms for strengthening working relations between Vanuatu Meterology and Geo-Hazards Department (VMGD) and Department of Agriculture and Rural Development (DARD). Communications include climate field schools, facebook and phone calls, radio talkback and Q & A. Leo presented that best practices that are working well in Vanuatu include:

1. Coordinator
2. Action Plan
3. Communication Plan
4. Awareness (extension network)

AWS are installed in Agriculture site for field trials, development of a Crop Climate Diary and ICT Extension Tool for collecting and analysing agriculture data.

10.6 Country presentation – Fiji

There is a long-standing working relationship between the Fiji Meteorological Services (FMS) and Ministry of Agriculture. There is a 5-year plan Fiji Implementation Plan for Enhanced Climate Services 2019-20. This policy will guide the further development of agromet services as shown by Vanuatu.

Fiji has a Drought Early Warning System that is in place to provide advanced information on preceding drought events that may affect Fiji. Fiji Sugarcane Rainfall Outlook is also a useful product that supports the large sugarcane industry that is the backbone of Fiji's economy.

FMS provides information to Ministry of Agriculture and SRIF for communication to farmers via extension officers. In preparation for extreme weather conditions weather data are communicated to Provincial Disaster Management team for decision making.

Regular face to face communication is key, multi-timescale information and products are becoming user friend and informative drought plan.

Key recommendation for future work includes to develop a MET 101/Climate 101 program for farmers, SESAME App and Videos to be used for communication of technical information.

10.7 Country presentation – Samoa

Tommy Tuuamalii, Ministry of Agriculture presented on Samoa's experience. There is a Samoa Agriculture Sector Plan 2016-2020 to strengthen capacities in rural communities' landowners, farmers, fishers to use national resources in a sustainable way.

The ICCRAHS project Ministry of Natural Resources and Environment (MNRE) coordinates this project with Ministry of Agriculture and Fisheries (MAF) through Crops Division. The project developed crops suitability maps. Another project called Samoa Agriculture and Fisheries Cyclone Response Project funded by the World Bank.

MAF uses the climate summary bulletin, Seasonal rainfall outlook, EAR and weather bulletin. In terms of communication, training and meetings and workshops are very useful way of communicating and distribute information to farmers and the winder community.

10.8 Country presentation – Tonga

Mr Tevita Tukia, Mainstreaming of Rural Development Innovation Tonga Trust presented. The Tonga Strategic Development Framework (TSDF) and Tonga Agriculture Sector Plan (TASP) provides the leading policies for strengthening agriculture and food security in the Kingdom of Tonga.

There is a project with the University of Tokyo to reduce the impacts of breadfruit from tropical cyclones. Farmers access climate information on radio, TV and email. There is also a Tonga Climate Service for Agriculture (TOCSA). ToCSA provides Agromet Index-based warning, Crop yield statistics and more. TOCSA has help exporter of yam and other crops.

Session 7 Feedback and Discussions

- Fiji Met suggested for NMS to assess the value of seasonal prediction for farmers and food security and measure the impact of outlooks. Fiji uses dialogue with the farming community to assess how impactful the products they provide for agriculture.
- In Vanuatu, socio-economic data from farmers will be used to assess the value of climate information services to crop productivity under the Vanuatu Klaemet Blong Redy, Adapt mo Protekt (Van-KIRAP) project
- All countries expressed the need for a 'Met/Climate 101' training package, perhaps developed as a regional package that could be adapted to individual countries. Van-KIRAP will develop a Climate 101 Course for Vanuatu farmers will can be used in other countries that have shown interest.
- There's a need for NMSs to work internally to provide multi-scale information to users
- There's a need for decision support tools to be developed to ensure that outlooks are applied in decision making and matched with anticipatory actions
- Sector targeted NCOFs are a priority for many countries

11. Session 8 - Evaluation of current relationships between NMHSs and Agriculture Sector

Groups discussed ways that information is currently shared between the NMS and the agriculture sector, what is working well about methods of information sharing, and what improvements are needed.

Key points from group discussions:

- Relationships between agriculture sector and NMS vary depending on country and history of interaction. Where little relationship or information sharing exists, NMSs require support to understand what information needs are from the agriculture sector e.g. rainfall and temperature information.
- Programmes that target collaboration between agriculture and NMS, involving training, ToT workshops, assessments of tools and information, development of possible projects etc. are important to building relationships. Development of MOUs/LOAs are a way to institutionalize relationships and ensure collaboration is incorporated into ministerial corporate plans.
- Regular and institutionalized face-to-face meetings with sectors in the form of regular monthly updates, NCOFs, utilization of agricultural extension forums and agriculture shows are very important to ensure information in bulletins is communicated effectively. Funding for NCOFs is required in many countries.
- Email updates, facebook updates, monthly radio shows with seasonal outlooks, dedicated sector facebook pages are all effective communication means. Smartphone apps that package all early warnings together are needed.
- There are challenges with pushing information to farmers via high level sector decision makers in capital cities. Agriculture representatives within the NMS aid this communication and knowledge brokering as do 'climate champion' farmers. E.g. in Vanuatu, 'model farmers' are trained by local farming centres who can then train others in the community in a peer to peer mode. Tonga also use local groups and the media to disseminate information.
- Priority improvements in information sharing required include: simplification of information into farmer-targeted products; translation of information into local languages; development of short videos for social media rather than brochures, handbooks etc.;
- More regular direct face to face communication and interaction with farmers is required such as upscaling the model farmer method in Vanuatu and increasing relationships between NMSs and intermediaries such as NGOs, education sector, church leaders.
- Impact based forecasting is required for farmers to understand the implications of forecasts. Where impact information is already integrated into bulletins, this is very useful for users.
- Funding and technical support is required for many NMSs to identify what information needs are from the agriculture sector and to develop tailored agro met tools and products. Generic monthly bulletins may not be addressing needs. CLiDEsc has great potential for product development, but needs need to be unpacked first and more training is required.
- Monthly outlooks are needed for the agriculture sector
- Many NMSs require user surveys or other means of gathering feedback on understanding and use of outlooks

  There are some requests that NMSs don't have the ability to forecast for example, SST in the lagoon in French Polynesia.

12. Session 9 – Country-level planning

Groups identified initiatives to address the priority improvements identified during the previous session and developed high level action plans for implementation.

Some examples of key initiatives include:

- Identify broad sector information needs and then developing prototype products to show the sector what's possible

- Develop a Meteorology 101 training curricula
- Finalize a National Framework for Climate Services to lay out a roadmap for collaboration. Requires the technical assistance of a consultant, SPREP and WMO and peer support from other countries who have already developed NFCSs.
- Undertake analysis of historical droughts including economic consequences to illustrate how seasonal forecasts can be used to offset costs and losses.
- Develop MOU and initiate monthly climate briefings for agriculture sector and formalize the process e.g. through development of a committee or working group, and creation of a technical multi-agency group to lead development of an agromet bulletin
- Organise a workshop with agriculture sector to initiate partnership, possibly through an NCOF, funds permitting
- Develop agromet bulletins/ products, but funding and technical support is required via projects from assessment of information needs through to product development.
- Incorporate traditional knowledge into climate services products. Requires research into an appropriate means of doing this.

13. Session 10 – Draft Regional Statement and discussion

The meeting discussed the draft regional statement and encourage the participants from the National Meteorological Services and Departments of Agriculture to utilise the statement in formulating national statements for local consumption.

The meeting agreed that the official release of the statement will be on Tuesday 29th October 2019 and NMS Directors to provide input prior to the official release date.

Feedback and discussion:

- SPREP emphasised the importance of the statement to demonstrate an output from the PICOF process supported by donors.
- SPREP suggested that with the establishment of the Regional Climate Centre, the Regional Statement should become a product of the RCC.
- Fiji issues their own national statement although Fiji is happy to contribute to and support the Regional Statement as it is useful for lower capacity NMSs who rely on the statement for creation of their own outlook statements
- Some NMSs expressed concern with the timing of release of the regional seasonal TC Outlook, as individual NMSs are releasing their own and information may be conflicting. It was agreed that the PICS Panel will address this matter during a meeting and present recommendations to the PMC.
- The meeting supported a PICS Panel proposal to hold an online PICOF at the beginning of the dry season e.g. in early May, in addition to the October PICOF and a dry season Regional Statement to be released via the RCC. Many NMSs will have already produced their national statements by this point, but these can feed into the Regional Statement.

14. Session 11 – PICOF Panel Report presentation

The structure of the draft report for PICOF-5 was presented for feedback.

Evaluation

The chairs led a round the room reflection on PICOF-5 and improvements for PICOF-6. Key feedback included:

- A need for more discussion between regional providers and NMSs
- The use of Menti-meter was effective for gathering feedback and comments
- Themes proposed for future PICOFs included climate change and oceans/fisheries. In the case of Oceans, the need to consult with the PIMOS Panel was noted.
- Vanuatu offered to host a PICOF 6 and NOAA propose to host future PICof .
- The meeting agreed to integrate a stronger Gender and Social Inclusion element into future PICOFs, possibly as a dedicated session. The WMO offered to investigate whether there could be funding from a WMO source to support this.

Closing ceremony

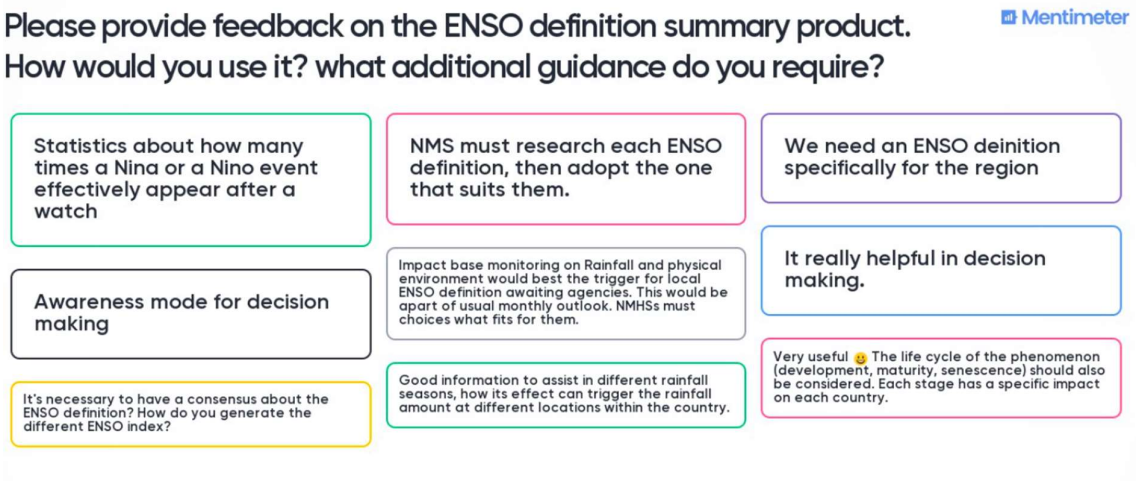
The PICS panel chair thank everyone who have participated and contribute to PICOF 5 and officially close the meeting.

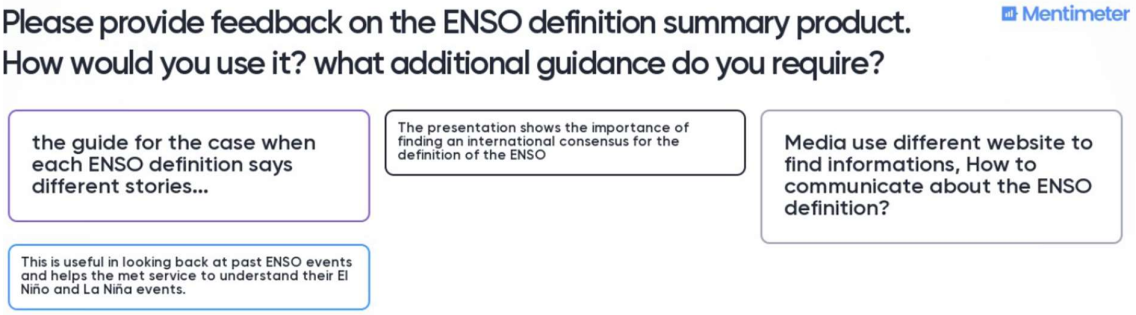
Annex 1 – List of PICOF-5 Participants

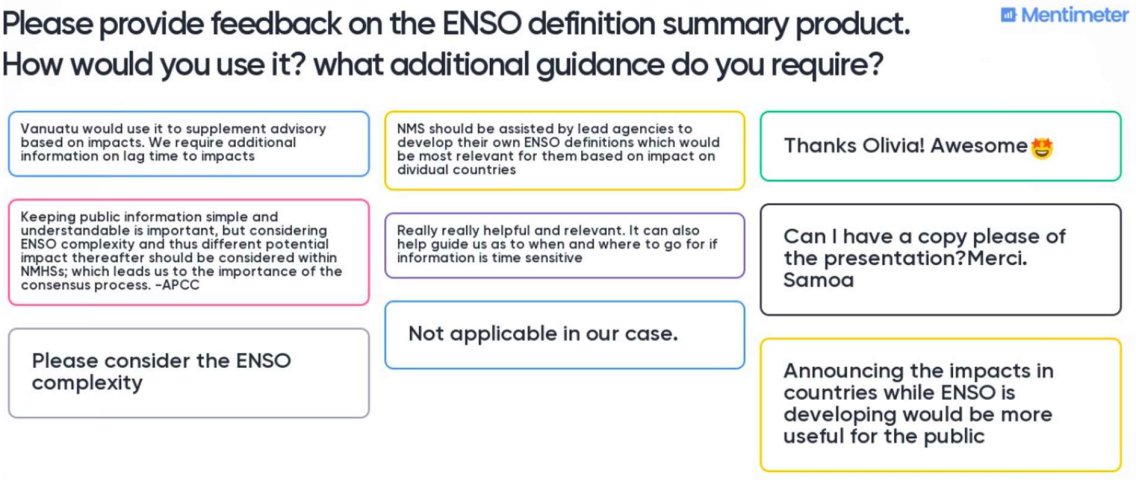
	Name	*Designation*	*Organisation*
1	Alexandre Peltier	Head of Climate Dept	Meteo France
2	Allan Rarai	Manager, Climate Division	Vanuatu Met
3	Amena Daunidraki	Principal Research Officer	Fiji Ministry of Agriculture
4	Anahit Hovsepyan	Scientific Officer	WMO
5	Andrew TAIT	Chief Scientist - Climate, Atmosphere and Hazards	NIWA
6	Anna Kimam	Principle Horticulture Officer - Food Security	PNG Dept of Agriculture
7	Bates Manea	Operations Manager	Cook islands Met
8	Bell Noll	Meteorologist	NIWA
9	Bipendra Prakash	Senior Climatologist	Fiji Met
10	Bo Ra Kim	Senior International Project Manager	APEC Climate Center
11	Cecilia Fatima Amosa	Associate Project officer	WMO
12	Christophe Point-Dumont	Mteorologist	Meteo-France
13	Connie Sewere	Technical and Finance officer	SPREP-Vanuatu CSIRD Project
14	Eden Skilling	Officer in Charge	FSM Met
15	Elenor T Salele	Lands Division	SPC
16	Elifaleti Ene	Senior Climate Officer	Tuvalu Met
17	Elise Chandler	Climatologist	BOM
18	John J Marra	Regional Climate Services Director, Pacific Region	NOAA
19	Jonghwa Lee	Researcher	POSTECT
20	Professor. Jong-Seong Kug	Professor	POSTECH
21	Kisolel Posanau	Climatologist	PNG Met
22	Kotoni Faasau	Climatologist	Samao Met
23	Kwang-Hyung	Research scientist	APEC Climate Center
24	Dr. Laurent L'HUILLIER	CEO	IAC
25	Lenita Tongiamana	Meteorological Officer	Niue Met
26	Mariko Fujisawas	Climate Change specialist	FAO
27	Max Sitai	Principal Meteorological Officer	Solomon Island Met
28	Miriam Kataunati	Acting assistant Climate Officer	Kiribati Met
29	NA YEON SHIN	graduate student	POSTECH
30	Nover Juria	Climate Science Officer	Marshall Islands Met
31	Olivia Yu	Climatologist	Meteo France –New Caledonia
32	Olivia Warwick	Senior Pacific Climate Adviser	Red Cross Climate Centre
33	Pakoa Leo	VANKIRAP Agriculture sector coordinator	Vanuatu Department of Agriculture

34	Peter Rarahabura	Director Planning and Land Use management	Solomon Ministry of Agrculture
35	Mr Philip Malsale	COSPPac Climatologist	SPREP
36	Ricky Joram	Met officer	Nauru
37	Seluvaia Finaulahi	Senior Forecaster	Tonga Met
38	Simon Mcgree	COSPPac Team leader CliDE and Seasonal Prediction	BOM
39	Dr.Soo-Jin Sohn	Research Fellow	APEC Climate Centre
40	Sunny Seuseu	Acting Manager – Van-KIRAP	SPREP
41	Terry Atalifo	Principal Scientific Officer - Climate	Fiji Met
42	Tevita Tukia	Farming System & Farm Field School Officer	Tonga Agriculture
43	Thomas Abinun	Meteorologist	Meteo-France -FP
44	Tile Tofaeono	CliPSCo	SPREP
45	Tommy Tuuamalii	Principal Crop advisor	Samoa ministry of Agriculture and Fisheries
46	Victoire Laurent	Meteorologist	Meteo France – French Polynesia
47	WonMoo Kim	Research Fellow / WMO LC Rep	APEC Climate Center
48	Yun-Young Lee	Research Fellow	APEC Climate Center
49	Yuri Kuleshov	Science lead	BOM
50	Zulfikar Begg	COSPPac Ocean Science Officer	SPC

Annex 2: Feedback on ENSO definition summary product (Session 1)







Annex 3: Feedback on support required to enable consensus forecasting (Session 2)