

**Intergovernmental Oceanographic
Commission of UNESCO**

**World
Meteorological Organization**



DATA BUOY COOPERATION PANEL

**RECOMMENDATIONS/ACTIONS OF THE FOURTH PACIFIC ISLANDS TRAINING WORKSHOP ON
OCEAN OBSERVATIONS AND DATA APPLICATIONS (DBCP-PI-4)**

13 - 16 September 2019, Honolulu, Hawaii, USA

DBCP Technical Report No. 61

- 2019 -



PI-4 Participants

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OCEAN OBSERVATIONS AND DATA APPLICATIONS (DBCP-PI-4)

Hosted by
U.S. Pacific Islands Ocean Observing System (PacIOOS)

Venue: University of Hawaii (UH)
Honolulu, Hawaii, USA

DBCP Technical Report No. 61

2019

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CONTENTS

Workshop Report 7

Annex 1 Workshop Agenda..... 9

Annex 2 List of participants..... 14

Annex 3 Status of PI-3 workshop recommendations 18

Annex 4 Workshop Hands on Exercise Flip Chart Notes..... 19

Annex 5 Recommendations of the workshop..... 23

Annex 6 Organizing committee..... 27

Annex 7 Acronyms..... 28

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WORKSHOP REPORT



PI-4 is a Workshop in a Series of IOC/WMO JCOMM [PANGEA](#) Workshops:

- [1st Western Indian Ocean Capacity Building Workshop](#)
- [2nd Western Indian Ocean Capacity Building Workshop](#)
- [3rd Western Indian Ocean Capacity Building Workshop](#)
- [4th Western Indian Ocean Capacity Building Workshop](#)
- [1st In-Region Capacity Building Workshop for Asian Countries](#)
- [2nd Typhoon Workshop for the North Pacific Ocean and Marginal Seas \(NPOMS-2\)](#)
- [5th Western Indian Ocean Capacity Building Workshop](#)
- [3rd Typhoon Capacity Building Workshop for the North Pacific Ocean and Marginal Seas](#)
- [1st Pacific Islands Training Workshop on Ocean Observations and Data Applications](#)
- [4th Typhoon Capacity Building Workshop for the North Pacific Ocean and Marginal Seas](#)
- [2nd Pacific Islands Training Workshop on Ocean Observations and Data Applications](#)
- [5th Typhoon Capacity Building Workshop for the North Pacific Ocean and Marginal Seas](#)
- [3rd Pacific Islands Training Workshop on Ocean Observations and Data Applications and 5th JCOMM marine instrument workshop for Asia-Pacific region](#)

Fourth Pacific Island workshop (PI-4) was Co-Sponsored by the IOC/WMO Data Buoy Cooperation Panel ([DBCP](#)), NOAA's Office of Climate Observation ([OCO](#)), and generously sponsored and hosted by the Pacific Islands Ocean Observing System ([PacIOOS](#)), USA. The composition of the Organizing Committee is provided in [Annex 6](#).

Forty-one (41) participants from seventeen (17) countries participated at the workshop (see list of participants in [Annex 2](#)). Trainees came from 13 Pacific Island (PI) nations.

Opening ceremony was led by Dr. Melissa Iwamoto, the Director of PacIOOS. After the opening remarks, keynotes were provided by Mr. Boris Kelly-Gerreyn, the Chair of the DBCP, Ms Qiu Jiang (Rachell), the chair of the DBCP Task Team on Capacity Building (TT-CB), Ms. Champika Gallage, WMO and IOC/UNESCO Secretariats representative, and Dr. Eric Lindstrom, the chief organizer of the OceanOBS'19 conference. Dr. Lindstrom emphasized that El Niño Southern Oscillation (ENSO) is the strongest inter-annual climate cycle on Earth. Thus Pacific observing system is the most important part of the entire Global Ocean observing system. He also provided a brief history of OceanObs conference which started in 1999 and some information on [OceanOBS'19](#) ; 1400 participants have registered for the OO'19, 140 white papers , 600 posters and 50 exhibition stalls.

The following PI-4 sessions took place (see complete agenda in [Annex 1](#)):

1. Session 1: Global Ocean Observing System,
2. Session 2: Hands on experience on needs assessment, pre-deployment, field work/operations, data telemetry, access and utility,
3. Session 3: Best Practices of Marine Observation,
4. Session 4: Round table discussions,

Ms Qiu Jiang presented the workshop objectives which are listed below;

- Continue to build capacity within the PI region to apply ocean observing data for enhanced weather and climate forecasting capabilities y;
- Demonstrate the role of ocean observations for understanding and predicting regional weather, ocean state and climatology;
- Demonstrate the societal and economic benefits of delivering enhanced ocean observing system data for better informed decision making;
- Enhance the capacity of quality control of marine observation, data processing and ecology recovering and island protection;
- Increase awareness of the importance of the ocean, scientific understanding and traditional knowledge, and how marine processes affect the lives of Pacific Islanders;
- Learn practical implementation aspects of ocean observing systems.
- Evaluate data gaps within the region and how they can be addressed;
- Encourage cooperation with and support for existing monitoring programmes such as the Argo programme and the Global Drifter Program;
- Hands on training of instruments, including pre-deployment, deployment, and post-deployment activities;
- Advance the design and coordination of ocean observing in the Pacific Islands.

She further reported on the progress of recommendations from PI-3 where good progress has been made. The status of PI-3 recommendations is available in [Annex 3](#).

This year's workshop was organized with more time for plenary discussions to increase the engagement opportunities for the participants. Hands on exercises were organized around needs assessment, pre-deployment, field work/operations, data telemetry, access and utility. Results of these discussion workshops are provided in [Annex 4](#). In addition, participants visited a HF radar station site and a water quality sensor site. Participants also had the opportunity to attend the first day of OceanOBS'19 Conference. This opportunity was kindly sponsored by the U.S. NOAA.

The PI-4 workshop participants made 12 recommendations in addition to the national requests and recommendations made by the 13 trainees. The list of recommendations are in [Annex 5](#).

The workshop documents and presentations are available at www.jcomm.info/PI-4.

The participants wished to recognize with sincere gratitude the kind and warm hospitality and support of local host the PacIOOS. Specifically all participants offer their sincere appreciation for the tireless efforts of Dr. Melissa Iwamoto and her team to make this event a success. The participants also thanked Ministry of Natural Resources of China and NOAA for the continuous support to the DBCP and capacity building task team.

ANNEX 1

AGENDA

Fourth Data Buoy Cooperation Panel (DBCP) Pacific Islands Training Workshop on Ocean Observations and Data Applications (DBCP-PI-4)

**Host: U.S. Pacific Islands Ocean Observing System (PacIOOS)
University of Hawaii (UH), Manoa Campus**

**Honolulu, Hawaii, USA,
13-16 September 2019**

**Day 1: Friday 13 September 2019
Information Technology Center (ITS), University of Hawaii at Manoa**

TIME	SUBJECT	LEAD
08:30-08:55	Opening Remarks Local Host, Director PacIOOS Chair of DBCP Chair of DBCP Capacity Building World Meteorological Organization (WMO) Chief Organizer of the OceanOBS'19	Melissa Iwamoto Boris Kelly-Gerreyn Qiu Jiang (Rachel) Champika Gallage Eric Lindstrom
08:55-09:00	Logistical Information	Fiona Langenberger (PacIOOS)
09:00-09:15	Workshop Objectives & Adoption of the Agenda	JIANG Qiu (Rachel) (DBCP) Sidney Thurston (NOAA)
Session 1: Global Ocean Observing System (GOOS) <i>Rapporteur: Fan Jiang</i>		
09:15-09:35	WMO Integrated Global Observing System (WIGOS) and WMO Information System(WIS)	Champika Gallage (WMO)
09:35-09:55	Tropical Pacific Observing System for 2020 (TPOS-2020)- Redesigning the tropical Pacific Observing system to be more advanced, resilient and multi-disciplinary.	Sidney Thurston (NOAA)
09:55-10:15	Group Photo and Coffee Break	Fiona Langenberger (PacIOOS)
10:15-10:30	Empowering Users with Ocean Information	Melissa Iwamoto (PacIOOS)
10:30-10:50	Development, Priorities and Gaps of PI-GOOS (TBC)	Duncan McIntosh (PI-GOOS)
10:50-11:10	Integrated Marine Observing System (IMOS) of Australia	Boris Kelly-Gerreyn (BoM)

11:10-11:30	GOOS and UN Decade of Ocean Science for Sustainable Development Strategies	PANG Renbo (IOC) (<i>remotely</i>)
11:30-12:30	Lunch Break	
Session 2: Hands on Exercises Chair: Sidney Thurston <i>Rapporteur: Simon Ellis</i>		
12:30-14:00	Sphere of Capacity 1: Needs Assessment a. Identifying user needs/issues c. Networking and partnerships	Melissa Iwamoto Fiona Langenberger (PacIOOS)
14:00-14:15	Coffee Break	
14:15-15:45	Sphere of Capacity 2: Pre-Deployment a. Best instruments/tools b. Logistics	Gordon Walker Chip Young (PacIOOS)
15:45-16:00	Today's Wrap Up and Overview for Tomorrow	JIANG Qiu (Rachel) (DBCP)
16:00	Adjourn Day-1	

Day 2: Saturday 14 September 2019
University of Hawaii at Manoa (Room(s) TBD)

TIME	SUBJECT	LEAD
Session 2: Hands on Exercises		
08:30-10:30	Sphere of Capacity 3: Field Work/Operations a. Deployment b. Operations c. Maintenance	Gordon Walker Chip Young (PacIOOS)
10:30-10:45	Coffee Break	
10:45-12:15	Sphere of Capacity 4: Data telemetry, Access and Utility a. Data discovery b. Data access, storage and transfer c. Data products & data visualization d. Interpretation	Jim Potemra John Maurer Chip Young (PacIOOS)
12:15-12:30	Wrap up and introduction/logistics for afternoon	Melissa Iwamoto (PacIOOS)
12:30-14:00	Lunch Break	
14:00-14:15	PacIOOS High Frequency Radar Introductory presentation	Pierre Flament (PacIOOS)
14:15 -15:15	PacIOOS High Frequency Radar Station Site Visit (Kakaako Water Front Park, Kakaako)	Pierre Flament (PacIOOS)
15:15-16:30	PacIOOS water quality near shore sensor site visit (Atlantis Dock, Waikiki)	Gordon Walker (PacIOOS)

16:30-17:30	Today's Wrap Up and Overview for Tomorrow	JIANG Qiu (Rachel) (DBCP)
17:30-18:30	Explore Waikiki on own	All Participants
18:30-22:30	PI-4 Group Dinner (Self-funded) (Buho Cocina y Cantina Restaurant)	

Day 3: Sunday 15 September 2019
University of Hawaii at Manoa (Room TBD)

Session 3: Best Practices of Marine Observation		
<i>Rapporteur: Long Jiang</i>		
09:00-09:20	Ocean Best Practices (OBP)	Jay Pearlman (Institute of Electrical and Electronic Engineers -IEEE)
09:20-09:40	The WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology in situ Observations Programme Support Centre (JCOMMOPS)	JIANG Long (JCOMMOPS)
09:40-10:00	The Recent Investigation Over Tropical Indian Ocean by China's First Institute of Oceanography (FIO)	LIU Lin China Ministry of Natural Resources (FIO, MNR)
10:00-10:15	Establish the Salinity Measurement Capacity in Region	JIANG Fan National Center for Ocean Standards and Metrology (NCOSM,MNR)
10:15-10:35	Morning Tea Break	
10:35-10:55	Building Capacity for Ocean Acidification Research in the Pacific Islands	Alicia Cheripka NOAA Ocean Acidification Program (OAP)
10:55-11:15	National Weather Service(NWS) Use of Buoys	Ashley D. Evans Honolulu Weather Forecasting Office (WFO, NOAA)
11:15-11:35	Global Drifter Programme's(GDP) new developments	Luca Centurioni (Scripps Institute of Oceanography(SIO))
11:35-11:45	The Pacific Community Center for Ocean Science (Current and Planned Ocean Observations, Modelling, and Regional Capacity Building Activities)	Molly Powers/Moritz Wandres Pacific Community(SPC)
11:45-12:00	WMO-IOC Centre for Marine-Meteorological and Oceanographic Climate Data (CMOC) /China and Data Quality Control (QC)	YU Ting (Julia, remote) National Marine Data

		and Information Service (NMDIS), China Ministry of Natural Resources (MNR)
12:00-12:50	Lunch	
Session 4: Round Table Discussion <i>Rapporteur: Jennifer Lewis</i>		
12:50-13:50	Priorities, needs and gaps for the Capacity Building Workshops 1. Needs and gaps for the Capacity Building the Region 2. Future DBCP Indo-Pacific Capacity Building 3. Concept for Future	Lead: Sidney Thurston (NOAA), All Participants
13:50-14:20	PI-4 Workshop Report: 1. Action Items 2. Recommendations	Champika Gallage, All Participants
14:20-14:35	Workshop concluding Remarks	Boris Kelly-Gerreyn Qui Jiang
14:35-14:50	Review Transportation and Logistics for Monday's Field Trip to OceanObs'19 at Honolulu Convention Center	Melissa Iwamoto (PacIOOS)
14:50-15:00	Break and reconfigure room for Indigenous Forum at OO'19	All Participants
15:00-16:30	Preparatory session for Indigenous Forum at OO'19	Kim Juniper Melissa Iwamoto
16:30	Adjourn Day-3	

Day 4: Monday 16 September 2019
OceanObs'19-An Ocean Of Opportunity
Day-1: Perspective, Setting the Stage
Hawaii Convention Center

TIME	SUBJECT	LEAD
Session 4: OceanOBS'19		
09:00-10:30	Opening Plenary: Conference Statement	Sidney Thurston (NOAA), All PI-4 Participants
10:30-11:00	Break	
11:00-12:00	Ocean Observations in support of Global Policies and Actions	
12:00-13:30	Lunch	

13:30-15:30	Perspective Plenary: <i>Successes and opportunities for Ocean Observations</i>	
15:30-16:00	Break	
16:00-18:00	Special Indigenous Event	All attend, Indigenous trainees participate
18:00-19:30	OceanObs'19 Reception & Networking Opportunity	All PI-4 Participants

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ANNEX 3

Status of PI-3 workshop recommendations

1. China offered to contribute oceanographic and marine meteorological observations from 13 sites and sea level data from 6 stations to PacIOOS voyager portal through CMOC/China. **Done**
2. Make tools available on JCOMMOPS web application to access parameter based information selection and parameter based monthly maps. **Done**
3. JCOMMOPS require more resources to add new networks information to the JCOMMOPS database. Members are requested to provide additionally required funding to move things forward to facilitate with needed human resources. **Unfolding**
4. Atmospheric model data assimilation is complicated. This workshop may benefit from an atmospheric scientist well versed in this area. **Unfolding**
5. DBCP's barometer upgrade [program](#) provides opportunity to contribute additional sea level pressure (SLP) measurements in regions of interest to participating partners. **Unfolding**
6. Provide information on available training tools such as OceanTeacher Global Academy (OTGA) and such in the JCOMM website under capacity building. **Unfolding**
7. RMIC/AP has shown that the calibration labs who are participating in intercomparisons perform well compared to non-participants; thus recommend others who manage similar facilities to join the regular intercomparisons available. **Unfolding**
8. Recommended to have more intercomparison activities similar to project through DBCP. Requested from DBCP to lead further intercomparison projects , i.e. CO2 fluxes. **Unfolding**
9. Recommended to have the data from South China Sea typhoon array openly available via CMOC/China or any other mechanism which will benefit many other countries especially in the region which are often get effected by the typhoons in the region. **Unfolding**

ANNEX 4

4th DBCP Pacific Islands Workshop Hands-on Exercise Flip Chart Notes

Sphere 1. Combined break-out group notes

1. Key Steps to Building Trust with Partners

- Give correct, needed information
- Community outreach and meetings
- Regional organizations need to improve outreach and awareness to support national efforts
- Knowing and understanding roles
- Small workshops to educate communities
- Make friends and use relationships
- Funding and food to encourage participation
- Tangible outcomes that are relayed from the beginning
- Use Facebook and social media
- Sharing data and shared interests
- Surveys (dependent on audience)
- Continuous support
- “last mile” focus, work in local language
- Use of traditional knowledge to augment forecasts
- Understand the culture
- Gauge the target audience level of understanding
- Partner and community workshops
- Work with people you know first
- Use a social and relaxed setting
- Establish what both parties can bring to the table
- Stakeholder assessments – who and why

Specific Examples

- Samoa – use of traditional knowledge for warnings/forecasts. Engaging elders/communities in collecting traditional knowledge
- Solomons – training communities on climate information and understanding
- Fiji – recent maritime/ocean sector workshop resulting in improved cross collaboration
- PacIOOS – use of regional liaisons on the ground in communities
- Vanuatu – embedded people in sectors and sectors in the Met office.
- Involve multiple stakeholders – community, NGO and Government
- Identify clear roles with local points of contact
- Fostering relationships for the long term, follow up
- Personal relationships are very important especially at the beginning
- Piggy back meeting opportunities to increase face to face interactions
- Formalize relationships e.g. bilateral agreements

How do you identify the problem/issue that needs to be addressed?

- Tsunami drills and engaging communities around critical hazards. Using opportunity of a recent event to educate. SOP's
- Talk back show on radio
- Prioritize/target your key sectors
- Don't take on too much and manage expectations
- Use an event as an opportunity to have a discussion and educate (not just cyclones but heating events, algal blooms etc.)
- Focal points across countries to share information and relay back to HQ.
- Work with NGO's and share the work with others.
- Umbrella organizations
- Community level meetings
- Workshops

- High level mandates
- Surveys – face to face

How do you identify all the partners involved in your network of interest?

- Disaster preparedness and response organizations such as IOM and Red Cross.
- Health and public safety
- Community leaders
- Our role is to provide information and facilitate outreach.
- Money and food are required.

How do you know what actions to take to address the identified problem/issue?

- Find out who knows what the impacts are
- What are the data gaps?
- What are the resources
- Prioritizing actions
- Low hanging fruits
- What can each partner bring to the table? Example – NOAA provided buoys in Indian Ocean. Indian government provided boat support.
- What is in place and where are the gaps
- Prioritize – how do you do this?

What strategies will ensure the project is a useful and applicable one

- Putting the last mile first – how will beneficiaries benefit? What changes will happen?
- Feedback – surveys and stories; community feedback (face to face); metrics?
- Social media hits
- Outcome checklist
- Roadshows/outreach
- Response after an event
- Awareness/prevention
- Forecast verification
- Getting a second opinion by collaborating with others
- Make sure the data you are collecting is informing the problem
- Feedback and communication
- Data sharing
- Planning and budgeting from the start
- Priorities principles and SOP's developed in a framework right at the start
- Expectations spelled out during planning
- Develop in country capacity and resources to sustain projects
- Monitoring and evaluation plans in place

Sphere 2

Example provided by participants on “what do you want to measure”

Samoa. Earthquakes. The shallower the quake and the closer the location is to the epicenter relates to the level of damage incurred. Instruments were procured through a Samoa – China collaboration. Five stations established.

Key Points from Sphere 2.

1. Sites and sources of information to find out which instruments are available
2. Network of professionals to discuss options for instrumentation
3. Availability of best practices of SOP's

Participant Comments

- Need for collaboration between small island states and larger partners or countries to get instrumentation
- In New Zealand there is a focus on health and safety which leads to a lot of planning, check lists, and scenario development

- Need for lab testing or dry runs before deploying instruments.

Sphere 3

Participant Comments

- Some things are beyond the team control. An example is interisland flights which are sporadic and unreliable. In this case the team prepares to spend extra days
- Need a plan for what might go wrong
- Changes in data from a deviation in the protocol. A log is kept and comments are made on anything unusual or deviating from the norm.
- Safety First. This should always be backed up by the supervisor
- Standards for data collection are being made uniform so results can be comparable.
- Safety standards. Working in the Pacific there are few or no standards so it up to the implementing team to ensure safe operation
- Safety can often be neglected along with SOP's
- Instrument vandalism? To be addressed later

Sphere 4

Part 1. Joe Gilmore

- Security on connections? Use VPN
- Websites for information on scripting? Raspberry Pi website is good resource. Also Python or Bash
- Iridium connection kit cost about \$300

Part 2. John Mauer

- How does standardization apply? Consistency of output.
- Open GIS is new technology
- WMO-WIS
- PacIOOS and others have ERRDAP which makes you data globally available
- Not all data centers use ERRDAP

Discussion on Vandalism

- There is an international team under the DBCP that has been working on raising the visibility of vandalism and its negative impacts on data buoy programs
- Outreach has been partially successful and the WMO, IOC, and a number of Regional Fisheries Organizations have taken efforts to combat vandalism
- Cameras on buoys have been used to document vandalism events. They don't provide images publically
- SPC has a factsheet that describes benefits of data buoys to local communities
- Definition of vandalism is different for different users, but it almost always has a significant expense to buoy operators and leaves the community without precious data.
- Need to articulate benefits of the data buoy information to the community
- Users of data buoy information can become partners in helping to stop vandalism

HF Radar

High frequency (HF) radar systems measure the speed and direction of ocean surface currents in near real time. Currents in the ocean are equivalent to winds in the atmosphere because they move things from one location to another. These currents carry nutrients as well as pollutants, so it is important to know the currents for ecological and economic reasons. These radars can measure currents over a large region of the coastal ocean, from a few kilometers offshore up to about 200 km, and can operate under any weather conditions.

- Cost of a package is \$36K plus the antennae
- Once properly installed almost no maintenance

- 150 person/days for installation on average
- Running costs is for data collection only at approximately 2 FTE people for 6-8 radars.

Evaluation

What did people like?

- Sphere approach
- Tour of wave buoy/water quality lab
- Instrument selection and deployment scenario activity
- Great interactions and networking
- It's great to know in advance of all the details of ocean observations from instruments, data extraction, analysis and applications
- The atmosphere is awesome

What people did not like?

- Possibly a 4 day event is not enough time for important discussions
 - Death by PowerPoint - ensure Pacific relevance of presentations
 - Would be great to get the attendee list on Day 1
 - Need more examples of Pacific Island countries especially atoll nations
-

ANNEX 5

PI-4 WORKSHOP RECOMMENDATIONS

1. PacIOOS and PI-GOOS should have opportunities to better collaborate and mutually benefit. Therefore suggested to increase opportunities for better coordination and collaboration between the two groups.
2. Data providers from the Pacific Islands should make an effort to have their data in more standard formats so they can be shared widely. The ERDDAP offers an opportunity to share the data and more training in its use should be given to Pacific Islands. Data providers from PI region are encouraged to make contribution to PacIOOS ERDDAP.
3. Pacific Community workshop on UN Decade of Ocean Science for Sustainable Development took place in Noumea, New Caledonia in July 2019. This Workshop offered a crucial opportunity to co-design mission-oriented research strategies in line with the 2030 Agenda and the Samoa Pathway, focusing on Small Island Developing States specific needs and priorities in terms of transforming knowledge systems; accelerating transfer of technology; enabling training and education; and fostering science-policy dialogues. All participants of PI-4 are encouraged to engage in the national follow up activities on UN Decade of Ocean Science for Sustainable Development, and especially to be part of the PI planning working group for UN Decade.
4. JCOMM Observation Coordination Group (OCG) networks i.e. DBCP, SOT, Argo, GLOSS, etc., are requested to make a list of available instruments and related information (type of instruments, vendors, accuracy, etc.) to measure primary variables and make it available and accessible.
5. PI countries (in need) requested WMO to assist them with data policy development, data sharing, and data quality control.
6. Requested the PI members to share their documentation on vandalism prevention with DBCP-TC to make it widely available through the DBCP website.
7. Requested the PI members to work with their NMHS and the DBCP-TC to get their data, that is not widely shared at the moment, to the GTS.
8. PI countries are requested to cooperate with GDP in deploying the drifters in the region by offering ship-time and person power. The GDP offered the countries buoy for those who would like to deploy them and pay for a barometer upgrade. (<http://www.jcommops.org/dbcp/doc/BaroUpgradeBrochure.pdf>)
9. Honolulu Weather Forecasting Office (WFO) requested people to assist in coordinating deployments in the Pacific Ocean between Hawaii and California.
10. Requested CMOC-China to consider organizing a CMOC stakeholder engagement training workshop (take SPC stakeholder engagement survey results into consideration) for PI member countries.
11. Requests and needs from the PI countries;

Cook Islands –before getting too far in deployments, there is a need to know the real training needs in the islands. Cook Islands needs a lot more training than Fiji. It is not one size fits all in PI region. As most of the PI nations are at such a basic level, they need better products to describe ocean conditions and its impacts in their areas. Access to a data portal and easier to use products are also identified as needs.

SPC mentioned that a Green Climate Fund Project is in the pipeline which includes funding for environmental buoys, gliders, and HF radar for Tuvalu, Cook Islands, and

Niue. SPC suggested a National capacity mapping exercise. WMO CIFDP has a national capacity assessment process.

Fiji: Has a vast area of responsibility as the Regional Meteorological Service Center(RSMC) but it is lacking adequate numbers of observations in the RSMC. Fiji would like to get more instruments to increase the observations density, improved expertise, and more collaboration with other agencies for funding, and access to all available data(i.e. wave data) Fiji has few wave buoys, however the swell forecast is not validated through their observations. Therefore 3D wave drifters would help. There is a training need for oceanographers, technicians, data analysts to reduce dependency on SPC. (Fiji Meteorological Service does not have qualified oceanographers). Highlighted the need of a common portal for sharing wave data in the region (GTS).

Kiribati: Tide predictions now available in Kiritimati and Canton from COSPPac Project (COSPPac real time Sea Level Station in Betio and U Hawaii in Kiritimati). Planning to install one wave buoy next year. Requested assistance to deploy more wave buoys in data sparse regions of the country. Further requested that KMS be consulted on the implementation of projects and understand how to use the data from the buoys for marine services. Limited in funds for maintenance of the wave buoy. Need other opportunities to install wave buoys and to measure sea levels and monitor tides in other outer islands. and wave buoys to monitor tides. Further requested WMO assistance to improve competencies (i.e. SOLAS requirements) and other qualifications, training in Ocean studies.

Marshall Islands: With the assistance from PacIOOS, 2 more datawell wave buoy deployments are planned . PacIOOS will assist to train ,deploy and maintain the buoys. Requested more training on deployment, maintenance, data management and how to use the data for the stakeholder use in country. Requested PacIOOS to provide in-house training.

Federated States of Micronesia (FSM): Workshops are good for working level people to enhance their knowledge, however need to increase the country profile, get more assistance from the initiatives available (instruments, training, etc.). Need workshops in the country to help motivate national stakeholders. There are vandalism issues with Fish Aggregating Devices (FADs) in the region. They also mentioned that there are a lot of road blocks for asking for additional resources. Still in need of a water level station.

New Zealand: Has a lot of high seas marine forecasting obligations through WMO, therefore in need of more data in the Pacific Islands to fulfill these requirements. New Zealand is doing the GDP upgrades. PI nations need help with getting data on the GTS. New Zealand serves number of MetAreas in the region and Search and Rescue. Therefore all available data needs to be on the GTS especially for disaster relief. To help the PI nations, New Zealand government needs to know the requirements of the PI Nations. New Zealand requested PI nations to assist with GDP drifter retrieval and redeploy these instruments. New Zealand can help with deployment and also could help them with retrieved drifters to get them back for post calibration.

Papua New Guinea (PNG): Participated for the first time in this workshop series. There is a big gap and need to catchup with other PI nations in the region on ocean

observations. Requested WMO, SPC, and other PI nations to help PNG in Ocean Observations. There are no ocean observations only Automatic Weather Stations (AWS). There is work underway to develop a national ocean policy by the end of the year. PNG needs to establish national policy to streamline all national agencies to be on the same line. If feasible PNG would consider ocean observing network on cost recovery basis. This should be a national level decision. Currently using satellite data with the assistance from Bureau of Meteorology (BOM), Australia for marine ocean forecast. Suggest that PNG aim for better data flow across agencies. Requested support to combat vandalism using social media i.e. Facebook, twitter, etc.

Samoa: DART buoys are important for Samoa especially at a location between Samoa and Tonga. Being close to the Tonga Trench it would be very helpful to have a DART buoy for Tsunami warning. Also requested another sea level gauge. Requested WMO to assist in developing a data policy for Samoa.

Solomon Islands: All islands have different needs which are also expensive. Being a country with lot of islands, majority of the transportation is on canoe, boats and ships. There are high number of fatalities from marine transport. Need a better and reliable forecast for marine transport in particular. Great need of instruments to measure waves, etc. to improve the ocean forecast between islands. Information delivery mechanisms are available to deliver the information to the public (internet, social media, etc.) but not enough observations. Would like to have drifters (to understand surface currents), moored buoys and training on data usage (how to get the data, and analyse them using matlab, R etc.). Solomon Island signed the MOU with IOC on Argos BGC floats. Requested to get high resolution regional models for wave forecasting on island level. Focusing more on impacts based forecasts.

Tonga: All 3 DART buoys were vandalized within one month of deployment. Would like to have assistance of oceanographers. Tonga requested drifter buoys and informed that they can deploy buoys on their own.

Tuvalu: Sea level rise is a major issue. Need more buoys in addition to the SPC provided buoys. Assistance is needed in instruments, deployment and analysing the data. Accessibility to a data portal or hub (SPC) to improve access to data is helpful. Country is only 4 meters above sea level and need the capacity to inform the public on related hazards. Inundation tool is running on internet which is very slow. Help in this area (i.e. improved internet speed) is very much needed.

Vanuatu: Data sharing is important particularly to prevent damages from Tsunami and other weather related disasters. Need some buoys to fill the gaps in satellite ground truthing. Appreciate the continuous improvement of numerical weather predictions. Like most other Pacific nations, Vanuatu is a signatory to has the international mandate on SOLAS which requires them to provide information for safety at sea. This requires more observations. Also need WMO guidance which is also highlighted at the Pacific Met Council (PMC) earlier this year. Data sharing, display of parameters, fisheries, sustainability, and training for technicians, data analysts, oceanographers. Need to get the governments to develop necessary. The country has capacity to deploy drifter buoys but the challenge is internal coordination between agencies. This is a common challenge for data sharing as well. It was also mentioned that sharing data is important for sustainable data flow and also increase the data value. Vanuatu has many training needs. Also need to develop national regulations internally. Requested to fund SPC to expand the high resolution wave models to other areas of the PI beyond Fiji and to serve as a forecast development center for the region.

12. Pacific Data hub is a single catalogue to find all ocean related data (www.Pacificdata.org). Training resources are requested to search and research data i.e. data published on research papers and elsewhere.
 13. PacIOOS will coordinate a strategic PI countries requirement assessment exercise to identify the priorities and needs related to ocean, weather and climate forecasting of the region. Based on the key recommendations of this PacIOOS strategic assessment, NOAA's Global Drifter Program ([GDP](#)) has kindly offered to augment existing in-situ Sea Surface Temperature (SST), 3-D Wave Spectra, surface currents, Sea Level Pressure (SLP) and other ocean observations by deploying additional drifting buoys, moored buoys and new Directional Wave Spectra Drifters (DWSD) into the PI Region.
 14. Recommendations that came out of the Pacific Community regional workshop on the planning the UN Decade of Ocean Science for Sustainable Development included, among other priorities, the following related to Ocean Observing systems:
 - Inventory/ stock take of regional expertise, infrastructure, available data, predictive modelling
 - Design and implement appropriate bio-physical-ocean/climate Pacific OOS guided by GOOS frameworks and protocols, with relevant national scales to support ecological processes that threaten ecosystems/ socio-economic values
 - Enhance regional modelling capacity for local, national and regional needs
 - Convert ocean global forecast to local impact- EWS that provide local information
 - Better integrate Traditional Knowledge into EWS and OOS
 - Quantify risk to strengthen community preparedness
 - Research on resilience/rebounding of ecosystems after extreme events
 - Standardize data collection, management and dissemination, support and strengthen agreements/MOUs
 - Identify and priorities Pacific Community values and needs for ocean data
 - Improve data accessibility and understand user requirements- not just development of portals and visualization tools but outreach to user communities, industry etc.
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ANNEX 6

PI-4 ORGANIZING COMMITTEE

1. Qiu Jiang - National Center of Ocean Standard and Metrology (NCOSM) of MNR, China
 2. Fan Jiang - National Center of Ocean Standard and Metrology (NCOSM) of MNR, China
 3. Melissa Iwamoto - Pacific Islands Ocean Observing System (PacIOOS), USA
 4. Sidney Thurston – NOAA Climate Program Office, USA
 5. Champika Gallage - WMO Secretariat, Geneva, Switzerland
 6. Renbo Pang - IOC Secretariat, Paris, France
 7. Long Jiang – JCOMMOPS, Geneva, Switzerland
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ANNEX 7

ACRONYMS

AWS:	Automatic Weather Stations
BoM:	Bureau of Meteorology, Australia
CO-OPS:	Center for Operational Oceanographic Products and Services
DWSD:	Directional Wave Spectra Drifters
FADs:	Fish Aggregating Devices
FIO:	First Institute of Oceanography of MNR, China
FSM:	Federated States of Micronesia
GDP:	Global Drifter Program
GDP:	Global Drifter Programme
GHRST:	Global High Resolution Sea Surface Temperature
IEEE:	Institute of Electrical and Electronic Engineers
IOC:	Intergovernmental Oceanographic Commission
MNR :	Ministry of Natural Resources of China
NCOSM:	National Center of Ocean Standards and Metrology of MNR
NMDIS:	National Marine Data and Information Service of MNR
NOAA:	National Oceanic and Atmospheric Administration, United States
NWS:	National Weather Service
OAP:	NOAA Ocean Acidification Program
PacIOOS:	Pacific Islands Ocean Observing System
PCCOS:	The Pacific Community Center for Ocean Science
PMC:	Pacific Met Council
PNG:	Papua New Guinea
SLP:	Sea Level Pressure
SPC:	Pacific Community
SST:	Sea Surface Temperature
WFO:	Weather Forecast Office
WMO:	World Meteorological Organization