DATA BUOY COOPERATION PANEL

Thirty-Eighth Session

01 – 04 November 2022

Geneva, Switzerland

(Hybrid Meeting)

Meeting Report No. 65

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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

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FINAL REPORT

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EXECUTIVE SUMMARY

The Thirty-eighth Session of the Data Buoy Cooperation Panel (DBCP 38) was held as a hybrid event at Salle C1 of the World Meteorological Organization (WMO), Geneva, Switzerland, from 01 – 04 November 2022. One hundred sixty-five members from 60 countries representing buoy operators, network managers, researchers, buoy manufacturers, telecommunication providers, and others involved in data buoy activities participated in the meeting.

This year's meeting continued the enhanced focus on the following:

- Stronger engagement with the DBCP user community
- Science and Technology workshop – ocean data for research and user impact
- Environmental Stewardship
- Engagement with the Private Sector
- How the new WMO Policies strengthen the DBCP

Dr. Anthony Rea, Director of the Infrastructure Department of the World Meteorological Organization (WMO), Dr. Emma Heslop representing the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), Dr. David Legler of NOAA, Chair of Observation Coordination Group (OCG), and the Chair of the DBCP, Dr. Boris Kelly-Gerreyn from BOM provided welcome remarks. During welcome remarks, speakers highlighted the priorities of WMO, IOC, and the United Nations Decade of Ocean Science (UN Decade) activities and how DBCP contributes to those priorities. Further, speakers also highlighted the connection and collaboration between the priority activities such as the WMO Rolling Review of Requirement (RRR) and the Co-design project under the UN Decade.

The Science and Technology (S&T) workshop focused on delivering global surface data for research, operation, and user impact. Dr. Nelly Florida Riyama from Indonesia and Dr. Sidney Thurston from the United States of America (USA) co-chaired the S&T workshop. Twenty-two abstracts were selected to present out of thirty abstracts received at the session. Two posters were also included in the workshop. Annex 2 provides a compiled list of abstracts.

Three invited speeches were delivered on strengthening the DBCP connection with the user community, demonstrating the value and impact of DBCP data, and facilitating potential cooperation among different stakeholders. These speeches included experience contributing to the ocean observations during a record-breaking sailing trip circumnavigating the Antarctic solo and unassisted, how Industry, science, and Government can work together to advance Ocean Observing for 2030, and . experience in preparing the expression of interest to receive a wave buoy funded by DBCP to deploy in the coat of Solomon Islands.

The DBCP chair provided the history of DBCP and an overview of the current status, working practices, and vision for the future. Technical Coordinator's (TC) report included TC activities during the last inter-sessional period. It also included the status of the network performance and metadata status based on the OceanOPS metadata system. It highlighted the gaps in the observing network, which is prominent in the Indian Ocean region.

There were thirty-three national reports presented from Argentina, Australia, Barbados, Benin, Brazil, Canada, Chile, China, Colombia, Comoros, Ecuador, El Salvador, France, Guatemala, Hong Kong of China, India, Italy, Japan, Kuwait, Morocco, New Zealand, Peru, Portugal, Republic of Korea, Russia, Saudi Arabia, Solomon Islands, South Africa, Spain, Suriname, Sweden, United Kingdom, the United States of America and Vietnam. This is a significant increase in the number of reports compared to the previous years. National reports identified current and planned networks as well as gaps and opportunities.

Action Group reports identified key areas of activities for the Panel. Some of the Key activities are; DBCP's continued assistance in advancing the barometer upgrade programme and growing array of directional wave spectrum drifters alongside an array of drogued drifters measuring ocean currents, increased engagement with national and international counterparts to collaborate in filling the observations gaps primarily in Indian and Southern oceans.

The three parallel breakout sessions were organized on Environmental stewardship, demonstrating the social-economic value of buoy observing network and enhancing inclusivity and diversity in the DBCP. The outcomes of these discussions were reported at the plenary.

Task Teams (TTs) reported on how the work of the TTs aligns with the DBCP Strategy, highlighted the work accomplished during the previous inter-sessional period, and the key focus areas for the next inter-sessional period. Some of the key messages from the TTs were the importance of metadata, data accuracy, availability, and timeliness, the requirement to clarify and advance metadata objectives to meet user needs, increase engagement between TTs and between DBCP networks to leverage from each other's work, and increasing awareness on Environmental Stewardship.

The chair provided an overview of the DBCP five-year strategy and the progress that has been made to-date. WMO and IOC Secretariats highlighted the activities relevant to the Panel. Major initiatives of the Secretariats are WMO Unified data policy, Global Basic observing Network(GBON), GOOS 2030 strategy, and the UN decade of Ocean Science which were presented in detail.

Discussion with Observations Coordination Group networks identified challenges, opportunities, and areas where networks could collaborate. It was identified that engagement with the user community, network sustainability, data accessibility, and pilot projects to integrate new sensors and technologies are primary challenges across the networks.

DBCP Financial report demonstrated a healthy balance of funds, and the Panel approved the spending plan for the next inter-sessional period. While thanking all DBCP members making continuous contributions to the DBCP Trust Fund over the years, other members are requested to contribute.

No nominations were received for the two vacant executive board memberships (impact, value, and operational excellence) and the DBCP Chair. DBCP members are requested to submit nominations, and the deadline for these three vacant positions was extended until 30 November 2023. The panel agreed to complete the appointment of three vacant positions through email communications following the DBCP operating principles. The current chair agreed to continue until a new chair gets elected.

The DBCP members are also requested to formally express their interest in hosting the next DBCP-39 meeting towards the end of 2023 (October-November). The DBCP chair and the Secretariats thanked all for contributing to a very successful DBCP session, and the meeting convened at 14:00 on Friday, November 04, 2022.

GENERAL SUMMARY OF THE WORK OF THE DBCP-37 SESSION

1. Opening and Welcome to the DBCP-38 Session

Dr. Dominique Bérod, Head of the Earth System Monitoring Division, Infrastructure Department of the World Meteorological Organization (WMO), opened the Thirty-Eighth Data Buoy Cooperation Panel Session (DBCP-38), and Scientific and Technical Workshop at 9:00 CET at Salle C1 in WMO, Geneva, Switzerland as a hybrid session using ZOOM platform.

Dr. Anthony Rea, Director of the Infrastructure Department of WMO, gave his opening remarks on behalf of the WMO Secretariat. He highlighted three major components of the WMO Infrastructure, WMO Information System (WIS), WMO Integrated Global Observing System (WIGOS), and Global Data Processing and Forecasting System (GDPFS,) which will be renamed to WMO Integrated Prediction and Processing System (WIPPS) soon. Dr. Rea explained that the Earth System approach at WMO is a system of systems that integrates the atmosphere with the ocean and space. He mentioned the importance of the WMO Unified Data Policy (Data Policy) and members' commitment to providing the free and unrestricted exchange of observational and modelling data. Further explaining, he said that the Data Policy is a framework that sets out rules about the spatial and temporal density of data required for National Meteorological Services (NMS) to operate and is set up in a way that it can be updated with technology changes and evolving requirements without changing the policy. Dr. Rea further explained that the WIGOS manual sits under the Data Policy, responding to the observation requirements, and includes information on the Global Basic Observing Network (GBON), which is a result of a rigorous process of Rolling Review of Requirement (RRR) that defines the Earth System Monitoring (ESM). He said that the evolution of the RRR process has strong links to the ocean community, particularly with the ocean co-design process, a project of the United Nations Decade for Ocean Science (UN Decade). Dr. Rea mentioned that initially, GBON would cover the meteorological, upper air, and surface observations but will be expanded into the hydrology cryosphere and ocean in the future. He also identified the challenge in regulating observations from the open ocean, which is not a territory or a jurisdiction of any Member yet requires finding innovative solutions to cover the open ocean. He explained how GBON will be achieved with support from the Systematic Observation Financing System (SOFF), where countries identified in need of financial support will receive funding to establish, enhance and sustain their observing system to comply with WMO Member commitments. SOFF will be expanded to achieve ocean observation requirements in the future. He stated that WMO recognizes the importance of ocean observations in the context of the Earth System approach and provided considerable material support to the OceanOPS as well. He said the ocean is recognized for its importance when everyone is moving towards coupled models. He reminded the members that COP 27 is starting the following week with a dedicated Earth Information Day where WMO is planning to put forward a strong case with a unified position on the need for sustained observations and the need of filling critical observation gaps to have an implementation plan of the Global Climate Observing System (GCOS). At COP 27, Dr. Rea expects to have a similar consistent message to the parties from other agencies such as Global Ocean Observing System (GOOS) which will result in a global goal on observations needed for climate, adaptation, and mitigation. Finally, Dr. Rea wished all participants a successful meeting.

Dr. Emma Heslop made opening remarks on behalf of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). She mentioned that the profile of the ocean and the importance of ocean observations has increased in the last few years not only within governments but also in the public perception.Dr. Heslop said there are challenges to growing the ocean observing system and DBCP has an important part to play. She mentioned that DBCP manages three of the twelve global ocean observing networks and emphasized the importance of in-situ observations from the global drifting buoy network to the global weather forecasting systems, and models. She reiterated the importance of DBCP networks for services such as climate prediction, severe weather warnings, coastal hazard warnings, etc. She identified raising and advocating for the globalization of a sustainable observing system as a challenge for the ocean observing community. Dr. Heslop mentioned that UN Agencies will team up at the COP 27 to raise visibility and the need to invest in observing systems that will deliver information for people to face and deal with the changes and challenges in extreme weather, climate, biodiversity, ocean health, etc. She also mentioned the IOC lead Ocean Decade activities highlighting the need for ocean observations, data, and science to answer society's questions. Providing an example, Dr. Heslop said that the ocean observing co-design project under the UN Decade led by the Observations Coordination Group (OCG) will consider tropical cyclones and forecasting which will link to the WMO RRR process. She also highlighted the importance of working with the private sector to enhance the innovation and investments which can assist in delivering sustained observing systems. She further mentioned that DBCP has taken a step forward in these areas under its new five-year strategy. Also, Dr. Heslop highlighted that having a separate section on Ocean data in the Annex to the WMO Data Policy greatly benefits the ocean community. She appreciated DBCP's efforts to move forward in many important areas through their Action Groups (AG) and Task Teams (TT). She finally thanked DBCP Chair for his leadership in the last year.

Dr. David Legler, Chair of the OCG, congratulated the 38th session of the DBCP and appreciated the dedication of participants across the globe, which shows the importance of the DBCP. He provided an overview of the OCG activities mentioning that OCG overseas twelve global ocean-observing networks and sub-networks assisting to encourage the coordination and efficient operations of those under primary focus areas such as ocean observing networks requirements, processes, data, management, environmental stewardship, and capacity development. Dr. Legler highlighted that OCG interacts with WMO in many focus areas that Dr. Rea has already mentioned, including WMO unified data policy, GBON, requirements, and best practices. He further mentioned that OCG activities are at the center of IOC/GOOS, particularly in observing the ocean to understand climate change. He appreciated the work of DBCP in the areas of new technologies, the private sector, environment stewardship, and user engagement, which are also areas that OCG is turning its attention towards. Dr. Legler said that users are increasingly more central to the success of ocean observing. Further, he said, co-designing the ocean observing system and co-production of data and information guide the user efforts towards resilience, adaptation, and management practices. Dr. Legler emphasized the importance of working with modellers whose feedback is important for the observing community to improve prediction and monitoring capabilities. Finally, Dr. Legler thanked the DBCP Chair for his leadership and DBCP for the progress that has been made over the past several years particularly under exceptional circumstances during the global pandemic.

Chair of the DBCP, Dr. Boris Kelly-Gerreyn thanked all, about one hundred and fifty participants coming from fifty-six countries across the globe representing all six regions of WMO. He mentioned that diversity and inclusivity is an important strategic objective of DBCP and is working towards increasing the diversity across the network. He listed the number of participants and countries at annual DBCP sessions for the last ten years which particularly shows a dramatic increase during the last three years primarily due to the hybrid format of the meetings. Dr. Kelly-Gerreyn reminded participants that with the launch of the new DBCP strategy in 2022, a new executive board was established and started to deliver on the strategic objectives which will be presented in the next few days. He identified many achievements of the panel during the previous intersessional period; development of the anti-vandalism videos in eleven languages, hosting the first Mediterranean DBCP capacity development workshop, first-ever DBCP-funded wave drifter buoy in the Solomon Islands, funding in-person participation of 3 Members to

DBCP-38, Drifting buoy metadata fully synchronized with OSCAR/WIGOS, Scrips Institute of Oceanography (SIO), and Atlantic Oceanographic and Meteorological Laboratories (AOML) are endorsed as Data Acquisition Centres (DAC) under Marine Climate Data System (MCDS), dialogues with Industry, and engagement with Study Group on Ocean Observations and Information Systems (SG-OOIS) were among them. He also identified DBCP user communities; meteorological services, satellite community, National Weather Prediction (NWP), ocean modelling, tsunami service providers, science and climate community, and commercial weather providers. Dr. Kelly-Gerreyn highlighted the areas with data gaps due to a lack of drifter buoys and a severe drop in the global tropical moored buoy array in the Indian ocean which needs to be fixed in coming years. He reiterated the importance of the work of DBCP especially to deliver toward large-scale initiatives such as the WMO unified data policy, COP 27, UN Ocean Decade, and GOOS 2030 strategy.

2. Adoption of the Agenda and working arrangements

The chair briefly presented the agenda highlighting the focus of each day. The panel approved the agenda without any changes and the approved agenda is provided in Annex 1. Ms. Champika Gallage from WMO Secretariat and the DBCP Technical Coordinator (TC) Dr. Long Jiang provided the working arrangements.

3. Science and technology workshop

The Science and Technology (S&T) workshop was chaired by Dr. Nelly Florida Riyama from Indonesia and Dr. Sidney Thurston from the United States of America (USA). The theme of the S&T session is delivering global surface data for research, operation, and user impact. Dr. Riyama mentioned that they received thirty abstracts, which is a record number, and twenty-two were selected to present at the session. The compilation of S&T workshop abstracts is provided in Annex 2. Additionally, two posters were also presented.

List of scientific and technical presentations.

I. The Next Evolution of the TAO Array: The Implementation of a Tropical Pacific Observing System (TPOS) Co-Designed Observing System (K. Grissom)
II. The GOOS Observations Coordination Group Data Implementation Strategy (K. O'Brien)
III. The Development of a "Florida Coastal Ocean Observing System" (FLCOOSTM) (R. Cole)
IV. Operational Oceanography Value Chain: Observations to Ocean Information and Advisory Services (P. Rao)
V. Accurate Surface Wind Observations from SVPWTM (Minimet) Drifters (L. Centurioni)
VI. Diurnal Vertical Migration Observed in the ADCP Measurements in Arabian Sea (T. Sudhakar)
VII. Iceberg Tagging Experiment (ITEx) 2021 (I. Rigor)
VIII. Directional wave spectra from Lagrangian drifters (M. Schonau)
IX. Uncertainty traceability diagrams for improving the metrology of Fiducial Reference
Measurements of drifting buoys for satellite validation (M. Lucas)
X. OceanOPS Metadata Management for TRUSTED (FRM) Drifting Buoys (M. Belbeoch)
XI. Why We Need to Monitor Eddy Currents in the Indonesian Seas: Towards National Collaboration Between Met-Ocean Research and Operational Institutions (W. Pranowo)

XII. The role of Ocean Reference Stations that Withhold Data to Create Independent Benchmarks for Assessing Models and Remote Sensing (R. Weller)
XIII. Observing Air-Sea Interaction for a predicted, safe, clean, healthy, resilient, and productive ocean (R. Venkatesan)
XIV. A closer look at Inner Indonesian Seas through drifter buoys and float profilers deployment (S. Adiprabowo)
XV. Towards Fiducial Reference Measurements (FRM) from drifting buoys for satellite sea surface Temperature Calibration and Validation (Cal/Val) (A. O'Carroll)
XVI. The new Iridium Certus service & NAL's Research Quicksilver (J. Huynh)
XVII. Lagrangian Drifter Lab Real-time Data Management (L. Braasch)
XVIII. Hourly temperatures from NOAA's Global Drifter Program (S. Dolk)
XIX. The SMART Cables Initiative for Observing the Ocean and Earth: An Update (B. HoweRemote)
XX. Backyard Buoys: A Project at the Intersection of New Technologies and Indigenous Knowledge (S. Boulay)
XXI. Introduction of the self-sustaining deep profiling float: Fuxing-4000 (J. XuRemote)
XXII. Distributed, Agile Buoy Network to Advance Private-Public Partnerships (P. Smit)

List of posters;

- Iceberg tagging experiment (ITEX) update and next steps (Ignatius Rigor, John Woods, Cy Keener, Keld Qvistgaard, Justine Holyman, Ben Cohen)
- FX-400 self-sustaining deep profiling float (Tianjin University, Pilot National Laboratory for Marine Science and Technology, Qingdao)

4. Getting to know the DBCP

Dr. Boris Kelly-Gerreyn, the chair of the Panel, gave a presentation on behalf of the DBCP Executive Board and evolution of the DBCP. The presentation is available on the website[1]. The chair started with the history of the DBCP, then showed the audience the components, Task Teams, Action Groups, and the strategy of DBCP. He also briefly introduced other important ocean-observing networks and initiatives under GOOS. The current Executive Board (EXB) members are Ms. Karen Grissom (Environmental Stewardship), Mr. Lance Braasch (Technology Innovation), Ms. Jiang Qiu (Rachel) (Diversity and Inclusivity), Ms. Rita Esteves (Scientific Excellence), Dr. Sid Thurston (International Cooperation and Partnerships) took the floor in turn and introduced their responsibilities and visions for the future work. The chair also introduced the chair's role and responsibility as well as the two vacant positions in EXB, Operation Excellence, and Impact and Value. He ended his presentation by calling for deeper conversation during the session and active engagement and commitment to the DBCP activities in the future.

The Panel appreciated the outstanding work of the EXB under the leadership of Dr. Boris Kelly-Gerreyn and their contributions during the upcoming transition period.

5. Invited Speeches

This agenda item was dedicated to strengthening the DBCP connection with the user community, demonstrating the value and impact of DBCP data, and facilitating potential

[1] https://oceanexpert.org/downloadFile/51610

cooperation among different stakeholders. Three invited speeches were delivered as follows.

5.1 Impact and Value of DBCP Observations to a Record-Breaking user

Ms. Lisa Blair gave a presentation on her record-breaking sailing story(circumnavigating the Antarctic solo and unassisted), and her passion for the ocean, environment, and climate change, for example, by launching the campaign climate action. She shared several videos taken during her sailing to show the audience an indication of what life was like in the Southern Ocean. It was noted with appreciation that Ms. Blair's contribution to the ocean observing community by deploying drifters, Argo floats, and collecting other measurements.

The Panel highly appreciated Ms. Blair's sharing of her inspiring stories and her contributions to the ocean observations. Questions were raised on: How to decide against the tiredness at sea? How did she find out who to talk to in the ocean community to deploy the drifters and floats? Any gap in the information that the observing community could assist with? In responding to the questions, Ms. Blair indicated that it was not easy to find the right person to talk to; it was the Decade of Ocean Science for the Australian activities that offered her the opportunity to connect to the OceanOPS. She also emphasized the importance of measuring ocean currents, ice measurements, and ice lines, which are incredibly important for navigation. She also announced her plan for a solo non-stop curriculum navigation of the Arctic Circle.

5.2 Industry Dialogues on Global Ocean Observations

Ms. Zdenka Willis, the President of the Marine Technology Society (MTS) introduced the Forum for Dialogue with Industry: How can Industry, Science, and Government together advance Ocean Observing for 2030. She said that the dialogue with Industry is a joint effort between MTS, GOOS, and the National Oceanic and Atmospheric Administration. She presented the background of Dialogues with the Industry and the four scheduled sessions which are targeted at different stakeholder groups. The four sessions are Dialogue 1: Instrument Provision: Supply & Development of Sensors/ Platforms, Dialogue 2: Multi-Sectoral Ocean Architecture: Integrating New Observing Networks and Business Models, Dialogue 3: User-driven Ocean Information Services, and Dialogue 4: Looking Ahead: New Technology for the Ocean Decade. Going through the key takeaways of Dialogue 1 and Dialogue 2, she mentioned that easy-to-use equipment is hard to build, and oceanographic equipment is a niche market. Thus, manufacturers need support from the governments for innovations. She also said there is a lack of authoritative market reports to provide credible information about the overall international ocean observing market. This information will help companies and businesses plan their activities.

The Panel appreciated this important initiative led by MTS, GOOS, and National Oceanic and Atmospheric Administration (NOAA) to strengthen the relationships between the traditional players and the new commercial sector. Questions and discussions focused on the huge proliferation of the commercial sector into the ocean observations in the last number of years, and the motivation for private sectors for providing and sharing data, she said. Ms. Willis mentioned that the uncrewed market is starting to respond to the growing needs of the oil and gas companies as well as the growing recognition of the importance of the ocean. She said, for data sharing, there is no short answer, and it depends on the company and the type of data. Providing examples, she said that there has been significant progress with some companies sharing their data, however, companies collecting oceanographic information as part of their core business may not make their data freely available outside of the company and it may take a while for those companies to make progress in this regard. She also emphasized issues with data licensing and the end-user licensing agreements that are related to data sharing. Dialogues 1 and 2 with industry reports[2] are available and DBCP members are requested to visit them for more information.

5.3 Outcomes of the expression of interest (EOI) on deploying wave drifter

Mr. Max Zitai, the Principal Meteorological Officer with the climate section of the Solomon Islands Meteorological Service gave a presentation on the outcomes of the expression of interest (EOI) on Deploying Wave drifter. He thanked DBCP for providing financial assistance for him to attend the DBCP session and allowing talking about the new wave drifter to be deployed in Solomon Island waters which is funded by the DBCP. Mr. Zitai explained the process followed in preparing the application and selection of the proposed drifter buoy deployment location/site based on scientific, technical, and operational analysis. He emphasized the importance and impact of the deployment to the Solomon Island Meteorological Service to improve ocean services, marine weather warnings and advisories in real time and near-real time, to better understand the coastal current behaviors resulting in coastal dwellers, and provide critical ocean information to protect the coastal community from swells, waves, and coastal inundations. He ended the presentation by introducing Solomon Island Meteorological Service's plan for future operation. This included increasing the budget for Ocean Services to support equipment repairs, replacement, training, and recruitment of more technical officers to maintain and ensure the smooth running of the drifter buoy; support the expansion of drifter buoy network; and provide ocean data storage in the CliDE database[3] or a local server. The Panel noted with appreciation the willingness of Solomon Island to share the data. The Q&A focused on how to make strong political support to the GOOS, the data sharing with the SIO, carry out ocean observation in the exclusive economic zones (EEZs), retrieve and redeploy plan of the drifters, and the WMO systematic observation financing facility (SOFF) which may be available in the future for ocean communities and countries like Solomon Island.

***1. Action**: DBCP community is requested to be actively involved in the future dialogue with the industry. (DBCP members; for Dialogue 3 & 4[4])*

***2. Action**: The task Team on Waves Measurements (TT-WM), Task Team on Data Buoy Best Practices and Technology Development (TT-DBPD), and Task Team on Data Management (TT-DM) are requested to provide further technical training and assistance to Solomon Islands Meteorological Service on the regular maintenance and deployment of the drifter (TT-WM, TT-DB, TT-DM; next 2-4 years)*

6. DBCP and OceanOPS report

Dr. Long Jiang, the Technical Coordinator (TC) of the DBCP reported the status of DBCP networks, Technical Coordinator activities, and the overall OceanOPS activities related to DBCP. He recalled the GOOS/OCG tasked OceanOPS to monitor and integrate metadata of all ocean networks and OceanOPS has therefore developed a system to harmonize and integrate metadata. Dr. Jiang identified the number of mandatory metadata fields for buoys in the current template: 1) program, 2) buoy model, 3) deployment location (latitude, longitude), 4) deployment date, 5) deployment ship, 6) telecommunication system/number, 7) sensors, and 8) WMO ID if already allocated. He explained that if

[2] https://goosocean.org/index.php?option=com_content&view=article&id=400&Itemid=448
[3] http://www.bom.gov.au/climate/pacific/about-clide.shtml
[4] https://goosocean.org/index.php?option=com_content&view=article&id=400&Itemid=448

moored buoys are re-deployed, operators have the option to copy the metadata from previous deployments which will avoid re-entering the same information and update only the fields with changes. He also noted that on behalf of WMO, OceanOPS has the delegated authority to issue WMO identifications, and an automated system is in place through OceanOPS web to obtain WMO identifications, thus all operators are requested to use this system.

He requested everyone to review the OceanOPS Metadata document for details[5] including information on comma-separated values (CSV) templates for moored and drifting buoys metadata submission[6]. Dr. Jiang reminded the members that the OceanOPS report card which is an annual publication providing the status of the global ocean observing networks under GOOS included a dedicated session on buoy data application for coastal inundation modelling and forecast in its 2022 issue[7].

Providing the status of networks in the last intersessional period he mentioned, moored buoy Binary Universal Form for Representation of meteorological data (BUFR) migration has been at 61% without progress, and the average number of operational units of drifters and moored buys dropped 5.7% and 2% respectively. Dr. Jiang provided statistics on long-term trends of the number of operational platforms and there is a clear decline in the numbers primarily for drifters and tropical moored buoys and tsunameters during the last two years. He said that these reductions are partially due to pandemic-related issues. He noted an increase in monthly sea level pressure (SLP) observations from 56% at the last reporting period to 62% in the past intersessional period.

Dr. Jiang highlighted the virtual wave workshop by the Task Team on Wave Measurements on 11-12 October 2022[8], and the virtual part of the First Training workshop for the Mediterranean by the Task Team on Capacity Building 9-11 November 2022[9]. Dr. Jiang informed the completion of the WMO processes to deploy two wave drifters in the Solomon Islands that will be implemented by SIO. Dr. Jiang also thanked SPC for providing shipping arrangements for the two drifters.

In addition to regular DBCP newsletters, Dr. Jiang contributed to the paper “'The Effects of the Pandemic on Observing the Global Ocean” led by Tim Boyer to be published by Bulletin of the American Meteorological Society (BAMS).

DBCP members are requested to review the DBCP TC report[10] and those of the Task Teams for more details.

***3. Action**: DBCP drifter buoy operators are requested to increase the number of barometer drifter deployments and/or to take advantage of the barometer upgrade programme. (DBCP members, ongoing)*

***4. Action**: WMO WIGOS manual (WMO No. 1160)[11] provides “Attributes specific to surface marine stations” (Appendix 5.2). DBCP members are requested to provide as many meteorological variables as possible among those listed in Attachment 5.1. (DBCP members, ongoing)*

***5. Action**: Drifter buoy operators are requested to plan their deployments to close the primary data gaps in the Indian Ocean (AG International Buoy Program for the Indian Ocean (AG-IBPIO), by DBCP-39)*

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[5] https://www.ocean-ops.org/metadata/
[6] https://www.ocean-ops.org/metadata/#platform-metadata-submission-supported-formats
[7] https://www.ocean-ops.org/reportcard2022/
[8] https://goosocean.org/wm-2022
[9] https://goosocean.org/medi-1
[10] https://oceanexpert.org/document/31095
[11] doc_num.php (wmo.int)

***6. Action**: TT and AGs are requested to strengthen their communication with OceanOPS to optimally use the services offered by the OceanOPS (TT and AG chairs; ongoing)*

***7. Action**: DBCP members who are willing to have drifters upgraded with a wave sensor are requested to contact GDP. (DBCP members; DBCP-39)*

***8. Action**: To even out the drifter density across the global ocean (currently a denser network in North Atlantic and less in the Indian ocean), primarily the Panel members from the European region are requested to consider deploying their drifters in data sparse Indian Ocean region. (DBCP members; DBCP-39)*

7. National Reports

Ms. Qiu Jiang (China) chaired the National Reports session. The Panel received 33 National/territorial Reports on current and planned buoy programmes from Argentina, Australia, Barbados, Benin, Brazil, Canada, Chile, China, Colombia, Comoros, Ecuador, El Salvador, France, Guatemala, Hong Kong of China, India, Italy, Japan, Kuwait, Morocco, New Zealand, Peru, Portugal, Republic of Korea, Russia, Saudi Arabia, Solomon Islands, South Africa, Spain, Suriname, Sweden, United Kingdom, the United States of America and Vietnam. It was a significant increase in National Report submissions compared to the DBCP-37 session which received 29 reports.

20 countries/territories made 03 min presentations on National activities. Here are some highlights from the presenters. Please refer to the detailed National Reports on the event webpage[12] for more detail.

Dr. Boris Kelly-Gerreyn introduced the current status of the Australian data buoy network which consists of deep-sea mooring, wave buoys, tsunami buoys, and drifting buoys. He highlighted that the drifter was modified and put on the deck of a ship to provide real-time air pressure data. He further said that Australia has a new national infrastructure for wave observations that are well underway to provide consistency and standardization around the wave measurements. He pointed out some issues and risks of Buffer migration. He emphasized that all the data shared with the Global Telecommunication System (GTS) also goes into the Integrated Marine Observing System (IMOS), the Australian Ocean data network database which is used by many researchers.

Mr. Jonathan Alleyne, National Focal Point for Barbados buoy program delivered their report. He introduced the plan of deploying 4 autonomous (AutoNaut) platforms in the east of Barbados in the Atlantic Ocean in early 2023 to collect meteorological and oceanographic observations for climatological research and forecasting purposes. He noted that the AutoNauts' are powered by renewable energy and are remotely controlled. He also noted that vandalism theft and bio-fouling are key issues. Finally, he requested external funding and guidance on the best strategies to sustain and implement the project and provide an impactful product.

Mr. Zacharie Sohou, the DBCP National Focal Point of Benin reported the deployment of the First oceanographic Data buoy in Benin under the Early Warning System project, funded by the United Nations Development Project (UNDP) SAP-Benin Project. He provided details on the buoy components and sensors, as well as the data interface. He identified vandalism by fishermen as the biggest challenge. He also identified several areas requiring DBCP assistance such as youth capacity-building support, and low-cost equipment, and suggested expanding the DBCP membership to include individuals.

Lt Tobias Ferreira from the Brazilian Navy Hydrography Center presented the overall GOOS-related activities in Brazil that include 43 moored buoys, 17 tidal gauges, 503 drifters, and 9 Argo floats. He also mentioned the planned expansion of their ocean

[12] https://goosocean.org/index.php?option=com_oe&task=viewEventDocs&eventID=3570

observing system with more moored buoys, wave drifters in Drake passage, two unmanned surface vehicles (USV) on the Brazilian coast, and a glider. He said that one of the biggest challenges is buoy vandalism by fishing boats attaching to the moorings. He also shared the URLs of the different data portals[13]. He requested DBCP experts to provide mooring design support, best practices, sensor calibration, low-cost technologies, and database development.

The National Report of Canada was presented by Mr. Alexander Zucconi, the manager of the marine networks at Environment and Climate Change Canada. He said that the Canadian moored buoy network currently has 43 moored boys, across Canada, 18 in the Pacific, 19 that are seasonal on inland lakes, and 6 in the Atlantic. He further said that Canada also operates a Drifting Buoy Network with ~37 active drifters per year. He highlighted their aims to re-seed the Arctic Ocean and the Beaufort Sea with 10-15 drifting buoys annually to maintain the array and planned integration of new payload and spectral wave capabilities. Mr. Zucconi stated that reliable public sector ship-time capacity to service moored buoys and sustainable funding to assist long-term operations are primary challenges. He reported one vandalism incident in the West Bay of Fundy due to intentional interferences to release fishing gear.

The National Report of Chile was presented by Mr. Juan Pablo Jorquera Garcia. He introduced the oceanographic and meteorological wave program that operates three watchkeepers and two TRIAXYS wave buoys and National Tsunami Warning System with five DART buoys. He mentioned that the Covid pandemic-related issues impacted servicing the platforms and data delivery. Mr. Garcia provided information on their new mooring lines which is an alternative for the rope to reduce cost and shipping time. He emphasized the importance of making real-time data open and available for public for the social benefits.

Ms. Xinyang Yue presented the National Report of China. She mentioned that 25 new buoys were deployed by the Ministry of Natural Resources (MNR/SOA), China Meteorological Administration, and Chinese Academy of Sciences during the last inter-sessional period and another 6 moored buoys are planned to be deployed for the operational and scientific purpose in China Seas and adjacent waters, Indian Ocean, and in the Arctic Ocean. She shared the technical developments in low-temperature environment sensors, improvements to wave sensors, and solar power energy supply. She reported that the difficulty of buoy maintenance and the shortage of professional personnel are their primary challenges. Further identifying challenges, she mentioned due to COVID pandemic-related issues international cooperation and maintenance of overseas buoys have become challenging.

Mr. Gabriel Herrera reported the status of the Colombian Metocean Buoy Network-SURGE REDEMPOMM- DIMAR, including Metocean Mobiles, MetOcean Koist, MetOcean WatchKepper, Oleaje Axys, and Senalizacion. He highlighted several challenges: Lack of dedicated technical staff and resources, lack of ship time for maintenance natural and anthropic Vandalism, and the impact of the COVID pandemic. He shared the link to the operational access and monitoring website[14] for more details.

Mr. Yahaya Mohamed presented the national report from Comoros in French[15]. He provided information on their TRIAXZS wave buoy deployed in the port of Moroni in shallow water (20m depth) which provides marine observations (waves, swell, sea surface temperature, humidity, etc.) to prepare bulletins and forecasts on waves, swell, and tides, and variation of sea surface temperatures that are disseminated on the maritime economic sectors such as fishing, tourism, and transport. Unfortunately, this buoy is currently not in operation due to a lack of funding to maintain it and also a lack of

[13] Global Ocean Observing System (goosocean.org)
[14] Global Ocean Observing System (goosocean.org)
[15] Global Ocean Observing System (goosocean.org)

expertise in the installation and maintenance of the buoy. He requested DBCP to provide training on the installation and maintenance of the buoy to integrate their oceanographic observations into the international marine observation networks.

The national report of Ecuador was delivered by Ms. Sonia Recalde from the oceanographic and Antarctic Institute of the Navy. She provided information on the three wave buoys (two TRIAXYS and one SPOTTER buoy) deployed on the coasts of Santa Cruz Island-Puerto Ayora, Manabí-Bahía de Jaramijó respectively, and Darwin Island-Wellington reef, to observe waves, currents, and Sea Surface Temperature (SST), and two tsunami buoys. She mentioned that 1 Tsunami buoy and 5 oceanographic buoys are planned to be deployed in the next 12 months.

Mr. Francisco Gavidia Medina from the Environment Ministry presented the national report of El Salvador. He introduced the oceanographic observations network of El Salvador, which consist of 2 cameras, 3 tide gauges, and 2 buoys located in four harbors. He said that the key risk for El Salvador is the maintenance cost of the platforms. He requested assistance from DBCP to integrate and share their buoy data into the National Data Buoy Center (of USA) and to the GTS.

French national report was delivered by Mr. Christophe Guillerm from Météo France. Mr. Guillerm mentioned that France maintains a network of waveriders (24) where one was deployed in the Indian Ocean, moored buoys (14), and a large number of drifting buoys. Further, he said that 138 drifter buoys (100 with Barometers), and 7 waverider buoys are planned to be deployed in 2023 by Meteofrance, Cerema, and SHOM. He reported one vandalism event on a waverider buoy located on the Guadeloupe coast and this buoy will be relocated to another location in Guadeloupe.

Mr. Chi-kin Chow from the Hong Kong Observatory (HKO) reported on the buoy network in Hong Kong, China. He said that two drifting buoys (MetOcean SVP-I-BDGS) were deployed primarily to monitor tropical cyclone activities to study genesis and changes in intensity and structure. He highlighted the importance of drifter data to weather monitoring, tropical cyclone forecasting, and navigation safety in the region. Mr. Chow expressed interest in HKO acquiring a new version of drifting buoys with wave and wind measurements.

The National Report of India was delivered by Dr. Tata Sudhakar from the National Institute of Ocean Technology (NIOT). He mentioned the buoy network of 16 wave rider buoys, 15 Surface Velocity Programme (SVP) drifters, and 4 wave drifters were maintained in 2021-2022. He further mentioned that India is planning to procure 20 drifters and 30 wave drifters during the 2022-23 period to fill the gap of in-situ wave observations in the Southern Ocean for wave parameter validation. He also reported that 17 coastal Acoustic Doppler Current Profilers (ADCPs), 3 equatorial current meters, and 7 tsunami buoys are also operational in the Indian Ocean. DBCP appreciated their contribution and collaboration with NOAA-PMEL to maintain the tropical moored buoy array (RAMA). Dr. Sudhakar mentioned that vandalism is an ongoing issue where buoys in the North Arabian Sea are frequently vandalized making it difficult to maintain the network in that region.

Ms. Myriam Tamayo Infantes presented the national buoy network of Peru. She said that there are 2 oceanographic buoys and 9 Argo floats deployed in the Peruvian sea especially to monitor El Niño/La Niña events, high seas waves (irregular waves), and climate monitoring. She further said that Peru experienced significant impacts operational, logistical, and economic, during and after the COVID pandemic. She requested DBCP consider a training program in the maintenance of buoys, sensors, and anti-vandalism systems in the region.

Ms. Rita Esteves reported that Portugal maintains a moored buoy network of 16 moorings and deployed 25 drifters in the Atlantic on behalf of E-SURFMAR contributing to the GDP.

She described the implementation of acoustic monitoring equipment in Portuguese offshore buoys, and cooperation with the Portuguese-speaking countries, Cabo Verde, Angola, São Tomé, and Principe in deploying Spotter buoys.

The National Report of the Russian Federation was presented by Dr. Vasily Smolyanitsky. He highlighted the successful deployment of 23 drifting buoys in the northmost part of the Eurasian seas, the Arctic Basin. He gave a brief introduction on the design and specification of ice SVP-B, iceSTB, iceBTC, and icemeteo buoys. Mentioning their plans for next year, he said that in support of GBON, Russia is planning to deploy 20-30 drifting buoys and as a contribution to GOOS, an experimental buoy with salinity will be deployed in the spring of 2023.

The National Report of Saudi Arabia was presented by Mr. Saud Jaber Al-Harthi. He provided information on the planned moored buoy deployments (5 in total) by the National Center for Meteorology (NCM) in the Red Sea (3 platforms) and Arabian Gulf (2 platforms). He further explained the proposed location of the buoys, the design schema, and the existing NCM central data system.

The National Report of South Africa was delivered by Ms. Isabelle Ansorge. She gave an overview of the current status of buoy deployments and highlighted the opportunities that South Africa would like to extend to other countries for drifter deployments. She mentioned that South Africa has 57 drifters in operation and a large array of moorings, stretching across the South Atlantic as part of the Samok South Africa initiative. She raised the concern of a shrinking number of Ice buoys to re-seed the array.

Mr. Fraser Cunningham presented the United Kingdom (UK) national report. He said that the UK Met Offices operates 6 moored boys and 2 waveriders and deployed 20 SVP-B in South Atlantic. He further said that Met Office also co-operates one moored buoy with the National Oceanography Centre, two moored buoys with the Plymouth Marine Lab, and has light vessels operated by trinity House with Met Office system installed. In addition to these, Mr. Cunningham presented other observing networks in the UK, such as Cefas WaveNet which provides real-time wave data from a network of wave buoys located in areas at risk from flooding, Cefas SmartBuoys that provide multi-parameter platforms to collect marine environmental data for eutrophication, environmental variability and change, ecosystem function monitoring, and about 50 offshore oil and gas platforms exchanging data on the GTS. He highlighted the new generation of buoys rolled out across the whole Met Office network. He identified data processing and providing the data in BUFR format as their challenges.

The national report of the United States of America (USA) was delivered by Dr. Rick Lumpkin. He highlighted that 862 drifters were deployed last year and thanked all the international partners for their joint efforts. Then he reported other operational activities including the 122 drifters deployed by the USA Interagency Arctic Buoy Program (IABP), National Data Buoy Centre (NDBC) operated 20 Coastal Weather Buoys, 27 Tsunameters, 24 Tropical Atmospheric Ocean (TAO) buoys, 17 Prediction and Research moored Array (PIRATA) in the Tropical Atlantic, 5 Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA), and the 8 ALAMO floats deployed by Naval Oceanographic Office, and 40 wave buoys deployed by the Coastal Data Information Program (CDIP). Listing some of the achievements, Dr. Lumpkin mentioned, the deployment of a new generation mooring data system, a Pacific Marine and Environmental Lab (PMEL) designed CO_2 and ocean acidification observations system at one RAMA site, and a next-generation TAO buoy in the test phase. He also mentioned the achievement of over 100 peer-reviewed research papers published in the intersessional period that rely on data from the buoy programmes.

Mr. Do Huy Duong reported the planned buoy programme(s) in Vietnam. He informed the Panel that Vietnam does not have a buoy observing system yet, but the Vietnam

Meteorological and Hydrological Administration will install 35 moored buoy stations by 2050. He requested DBCP's support with investments, technical assistance, information sharing, and training.

9. Action*: Assist El Salvador to distribute their buoy data to the GTS and other data centers (i.e. NDBC, USA). (Technical Coordinator with TT-DM, August 2023)*

10. Action*: Allocate more time in the agenda for the new countries to introduce themselves and build a connection with the community (DBP EXB, DBCP-39)*

11. Action*: Allocate more discussion time after major topics of the agenda (DBP EXB, DBCP-39)*

12. Action*: Try to diversify the TTs, AGs, and WGs membership with a focus on getting young members for succession planning and report the progress at DBCP-39 (TT, AG, WG Chairs; DBCP-39)*

13. Action: *Panel members are requested to submit the National Report at least 1 month before the session and inform the Secretariats of their intention to deliver an oral presentation by the deadline listed in the WMO/IOC invitation letter (DBCP members; DBCP-39)*

8. The DBCP Action Groups

A parallel session of the Action Groups (AGs) and Task Teams (TTs) took place 14:30-16:00 UTC on the 2nd of November 2022 at meeting rooms C1, Lake 4, and Lake 6. They run their sessions for 30 minutes each, one after the other, then returned to the plenary and reported the challenges, opportunities, risks, success measures, and recommendations aligned with the DBCP strategy implementation.

8.1 Global Drifter Programme (GDP)

Dr. Rick Lumpkin reported that during the last intersessional period, many meetings were conducted, including biweekly GDP telecons GOMO Extreme Events and Ocean Observations (EEOO) telecons. He introduced the evolution of the array through October 2022 as well as the progresses in several areas including certification and deployment of A-sized drifters from NOAA P-3 research aircraft, maintenance of the global array with 862 deployments during the intersessional period, and the number of GDP publications exceeding 1180. He explained that in the next intersectional, the GDP will focus on increasing the array with barometer buoys through the barometer upgrade programme, growing the array of directional wave spectrum drifters alongside an array of drogued drifters measuring ocean currents, and strengthening connections with operational agencies such as NOAA/National Weather Service/Ocean Prediction Center. Dr. Lumpkin mentioned that while Global Drifter Array coverage was impacted by increased Iridium transmission costs and the pandemic, deployments are increasing in data-sparse regions.

14. Action*: All panel members are invited to make use of the barometer upgrade opportunity (DBCP members; ongoing)*

8.2 International Arctic Buoy Programme (IABP)

Dr. Ignatius Rigor, the IABP coordinator, reported on the progress made by the IABP in the last intersessional period. He introduced the overall status of the IABP buoys reporting in October 2022, and the progress made in the Seasonal Ice Zone Reconnaissance Surveys (SIZRS). He mentioned that the major concern for the IABP is the large data gap on the Russian side of the Arctic Ocean. He highlighted that recent deployments by the Arctic and Antarctic Research Institute (AARI) helped to fill some data gaps. Dr. Rigor mentioned that the war between Russia and Ukraine will impact some of the future work due to not having access to Russian icebreakers to deploy drifters and moorings primarily on the Eurasian side. He further said that IABP is exploring other deployment opportunities such as air deployments through International Cooperative Engagement Program for Polar Research (ICE-PPR) and ship deployment from the German research ship Polarstern. He emphasized the importance to fill the data gaps on the Eurasian side because many of the changes in climate are centered on the Eurasian side. He ended the presentation by sharing the development plans for 2023 which are available in his presentation[16].

8.3 International Programme for Antarctic Buoys (IPAB)

On behalf of the IPAB chair Dr. Perta Heil, Dr. Ignatius Rigor reported on the activities of IPAB[17]. He reported that IPAB is not as active as IABP. Showing the status maps of IPAB, he emphasized that there are some drifting boys in the open water, but very few along the ice edge. He acknowledged the contributions from partners; the USA Antarctic program, Japan's National Institute for Polar Research (NIPR), New Zealand's Navy, Alfred Wagner Institute (Germany), Bureau of Meteorology (BoM), Korean Polar Research Institute (KOPRI). He ended the presentation by raising the hope of leveraging New Zealand’s involvement in ICE PPR to deploy buoys on sea ice using C-130s in the Antarctic region.

15. Action*: Investigate the opportunities to collaborate with the Southern Ocean Observing System*[18] *(SOOS) in the Antarctic observing activities (IPAB; DBCP-39)*

16. Action*: Connect with* Animal Borne Ocean Sensors *(AniBOS)*[19] *to find potential collaboration to deploy more sensors (i.e. air pressure) using the AniBOS network (IPAB; DBCP-39)*

17. Action*: Suggested to coordinate with South African Polar Research Infrastructure*[20] *(SAPRI)in marginal sea ice research (IPAB; DBCP-39)*

8.4 International Tsunameter Partnership (ITP)

Mr. Christopher Moore reported on the activities of ITP during the past inter-sessional period. He noted that it had been a challenging year for ITP due to many turnovers for the program in the USA and the research side. He said New Zealand had significantly invested in tsunami warnings, including 12 new DART buoys in the Southwest Pacific. He also highlighted the recapitalization effort of NOAA to upgrade the existing USA-owned ITP buoys with DART 4G sensors in the Pacific. He said that there is progress in technologies including the SMART CABLE network initiative presented at the S&T workshop on Monday by Dr. Bruce Howe, cable network installation by Japan, and the technical developments by Google to detect tsunamis using the state of polarization changes in response to mechanical disturbances along the submarine cable network. He further mentioned that a survey was conducted to gather requirements for tsunami detection with the plans to hold a workshop on new tsunami detection technologies to identify needs for accurate tsunami detection and forecasting to fulfill end-user

[16] https://oceanexpert.org/downloadFile/51623
[17] https://oceanexpert.org/downloadFile/51622
[18] https://soos.aq/
[19] https://anibos.com/
[20] https://soos.aq/news/south-african-polar-research-infrastructure-sapri-platform

requirements. Mr. Moore highlighted a gap in sharing the ITP platform information among the ITP community due to the holes in data and metadata flow path information, where discussions are going on with platform operators and IOC to establish a metadata hosting service.

18. Action*: Review the data and metadata flow diagrams circulated by the TT-DM and provide comments on ITP data flow (ITP; May 2023)*

8.5 Surface Marine Programme of the Network of European Meteorological Services, EUMETNET (E-SURFMAR)

Mr. Olivier Desprez de Gesincourt reported on the activities of E-SURFMAR. Highlighted a few achievements during the previous intersessional period he mentioned; the reception of 13 drifter buoys under Trusted phase 3, recovery/refurbishment/re-deployment of drifting buoys, and improvements to the Quality Control (QC) and data management are key. Identifying the focus areas in the next intersessional period, he mentioned, completing the deployment of Drifter under the Trusted phase 3 project, participation in EUMETSAT HRSST ice buoy programme, continuous improvement of E-SURFMAR QC tools, deployment of 15 ice buoys in the north pole, continue to involve in E-SURFMAR environmental stewardship activities, produce required information for WIGOS Quality Monitoring System (WDQMS), and building synergies with satellite agencies are the primary activities. Mr. Gesincourt ended his presentation by thanking all collaborators in drifter deployments under E-SURFMAR, including European Union (EU) countries, the USA, and Canada.

19. Action*: Panel members are invited to join the AGs, contribute to their activities, and share their thoughts on how to enhance the work of AGs (DBCP members; DBCP-39)*

20. Action*: Allocate more time for AG parallel sessions allowing to address the most important subjects and especially giving time for new members to express their ideas (DBCP EXB; DBCP-39)*

21. Action*: The leads of the AGs and TTs are requested to submit the report at least 2 weeks before the DBCP annual session (AG and TT chairs; DBCP-39)*

9. The DBCP Task Teams and Working Groups

Ms. Rita Esteves chaired this session on reports from Task Teams (TTs) and Working Groups (WGs) on the 3rd day of the session, where TTs and WGs presented challenges, opportunities, risks, success measures, and recommendations aligned to the DBCP strategy implementation.

9.1Task Team on Data Management (TT-DM)

Mr. Lance Braasch reported on the activities of the Task Team on Data Management and suggested the meeting participants refer to the TT-DM written report for additional detail. Mr. Braasch summarized the statistics for the reporting period indicating three meetings held, one action completed, one action ongoing, and two actions not yet progressing. He laid out the pillars of the task team as impact and value, and scientific and operational excellence. Mr. Braasch elaborated on the three top key strategic actions: 1) Follow and promote international data-sharing practices 2) Standardize our processes in coordination with other global ocean observing networks 3) Adopt, define, and promote best practices in the lifecycle of data.

He explained that the Task Team measures these actions' success with metadata and data accuracy, availability, and timeliness. He shared the key highlights: an update to the Task Team Terms of Reference, the Intersessional meeting to review OCG Data

Implementation Strategy ahead of OCG meetings, and the OceanOPS web and API interface for platform registration and WMO ID allocation. Next year's focus will be on 1. OCG Data Flow Chart (DBCP35 A8.5/2) 2. The data source for the given observing network and their citations (DBCP35 R8.5.1/1 [delayed mode] and R8.5.1/2 [real-time]) 3. WIGOS Metadata M2M transfer (API or XML/JSON) (DBCP35 A6.1/1, A6.5/3, A8.5/2). In conclusion, Mr. Braasch placed particular emphasis on the work that had gone into the data mapping flow charts and the future focus to be placed on better data submission practices.

Mr. Kevin O'Brien confirmed that data maps are living documents, which will likely continue to undergo small tweaks and improvements. He informed the plenary that both WMO and International Oceanographic Data and Information Exchange (IODE) had expressed interest in this mapping, so it will likely incorporate more information on where OCG data is going in the future and continue to grow into an even more useful reference.

22. Action*: All platform operators are requested to submit their metadata in WIGOS metadata format to OceanOPS (DBCP platform operators; ongoing)*

23. Action*: Allocate more time for TT parallel sessions (DBCP EXB; DBCP-39)*

24. Action*: OceanOPS is given delegated authority to issue WMO Identifications for all ocean platforms. Platform operators should obtain WMO IDs from the OceanOPS platform (DBCP Platform operators; ongoing)*

1. Recommendation*: Organize a webinar or other information resources (i.e. short videos) explaining the process to request WMO Identifications for ocean platforms (OceanOPS)*

9.2 Task Team on Moored Buoys (TT-MB)

Dr. Kenneth Connell reported on the activities of the Task Team on Moored Buoys (TT-MB). Dr. Connell stated that three inter-sessional meetings had been held and the one assigned action completed. Dr. Connell acknowledged the difficulty in selecting only three strategic pillars before settling on impact and value, technology innovation, and international cooperation and partnerships. He shared the top three critical strategic actions for the TT-MB: 1. Promote international data-sharing practices, 2. Encourage R&D prioritized to meet defined user needs, and 3. Foster collaboration and leverage partnerships. He indicated that the success of these strategic actions is measured by the growing number of publications and growth of Findable, Accessible, Interoperable, and Reusable (FAIR) data availability, user data needs to be met, and increasing membership and partner engagement. He shared the highlights from the reporting period, which included an update to the metadata format and template, the formation of a new TPOS governance, and low Indian Ocean MB data returns, which will improve as 2023 RAMA cruises are completed. Dr. Connell covered the future of the task team, which focuses on engagement with TT-DM and TT-WM to improve machine-to-machine cross-network metadata and data standard harmonizing to ensure user needs are being met, review of the OCG Data-flow mapping charts, recapitalization of moorings in tropical arrays and leverage of Indian Ocean partnerships to resume RAMA cruises to address Indian Ocean data gaps to re-establish data throughput >70% by end of 2023.

Answering a question on the machine-to-machine metadata exchange capabilities that can avoid the need for networks to fill in multiple templates, Mr. Belbeoch confirmed that a simple exchange scheme had been set up to allow for the full machine-to-machine. He emphasized that the most important thing is the willingness of the operator to share information so they can adapt approaches that work based on their capabilities.

***25. Action**: Interested DBCP members are invited to join quarterly roundtables to discuss data flow issues within the networks and contribute to the discussions. TC to circulate quarterly roundtable information to DBCP members (DBCP members, TC; DBCP-39)*

9.3Task Team on Wave Measurements (TT-WM)

Mr. Val Swail summarized the inter-sessional activities of the Task Team on Wave Measurements as two meetings, with most of the work carried out by correspondence, which seemed to be a very effective working method and allowed the TT to complete their one assigned action. Mr. Swail listed the task team's top three strategic pillars: Impact and Value, Scientific and Operational Excellence, and Technology Innovation. He explained that the task team was unable to narrow their focus to only three strategic actions, so instead looked to the following five:

• Promote the use of data from ocean buoys among DBCP members, partners, and other users for scientific research into air-sea interaction, ocean circulation, extreme events, and climate, ocean, weather, and earth system prediction.

• Contribute to and provide leadership in both scientific understanding and technology development that deliver new knowledge and applications to address the greatest user needs.

• Standardize our processes in coordination with other global ocean observing networks to enhance clarity, transparency, and efficiency in the use of data, metadata, operational methods, and science-based approaches.

• Adopt, define, and promote best practices in the lifecycle of our data from measurement - through its use and reuse - to archiving.

• Encourage prioritized research and development activities to meet defined user needs.

He shared the indicators of the success of these strategic actions as the number of scientific publications and presentations promoting the need for ensuring that DBCP wave data is of high and consistent quality, i.e., the need for wave measurement evaluations; benchmarking against peer-reviewed international/best practice standards; and adoption and/or assessments of emerging technologies.

He highlighted the accomplishments over the reporting period, including the virtual "Workshop on Operational Wave Measurements", two published papers on wave measurement evaluations, and one paper on the wave management database (drawing particular attention to the latter and the related USACE Coastal and Hydraulics Laboratory Quality Controlled, Consistent Measurement Archive), an independent wave drifter evaluation, and documented wave measurement activities.

He shared the task team's future focus areas, including a second Wave Measurement Workshop, an upgrade to WaveEvalTool, and additional moored buoy wave data evaluations. He continued data recommendations from previous DBCP sessions and wave measurement workshops. Mr. Swail also shared a message from the WMO community that DBCP and OceanOps have completely failed the waves community and, worse, have abandoned them. He further explains that the minimal metadata contained in the proposed integrated metadata repository does not serve the users' needs, which brings the question: Who does it help? However, he also informed the plenary that work had been carried out on this exact question in the previous day's working group, so progress is already being made.

Mr. Thierry Carval noted that while there is no GDAC for waves or moored buoys within Copernicus, there is a wave product that gathers as much wave data as possible from fixed and drifting buoys. A group of experts regularly assesses this wave data every six months, meaning a new version of Copernicus wave data is routinely published and freely available. He also noted that Coriolis essentially performs all of the functions of a GDAC for moored buoys without officially being recognized as such.

Dr. Connell noted previous discussions centered on finding a GDAC brought to light the main issue: the financial resources required to run this type of center. As a result, the task team has been reframing how to find resources for a GDAC. Coriolis' expression of interest in being recognized as a moored buoy GDAC could address this issue.

26. Action*: Work towards establishing Coriolis as a Data Acquisition Centre (DAC) or a Global Data Assembly Centre (GDAC) for Moored buoys and wave data (TT-WM, TT-MB; DBCP-39)*

9.4 Task Team on Capacity Building (TT-CB)

Ms. Qiu-Rachel Jiang reported on the activities of the Task Team on Capacity Building, which carried out seven intersessional meetings and completed their two assigned actions. Ms. Jiang listed out the task team's three key pillars (Impact and value, international cooperation and partnerships, and diversity and inclusivity) and their related top three key strategic actions, all focused on diversifying representation and leadership and cultivating relationships with indigenous communities. She shared the following highlights of activities through the year including the first DBCP Mediterranean Training Workshop on Ocean Observations and Data Applications[21], DBCP Trust Fund sponsorship of 3 to 5 DBCP-38 participants, and wave drifter deployment for the Solomon Islands. She reported that the task team's future actions will continue to focus on the Part-2[22] of the Mediterranean workshop and continued fostering of diversity.

The DBCP Chair highlighted the events of the last virtual meeting, in which Tunisia expressed interest in training opportunities which resulted in the First Mediterranean Capacity Building workshop, hosted by Tunisia. He noted with enthusiasm that this is a positive move from the group's historical focus on Asia for capacity-building workshops.

Dr. Nelly Riama indicated that Indonesia would be interested in hosting a DBCP capacity-building workshop next year, but that the following year (2025) would not be possible for Indonesia.

27. Action*: DBCP members willing to host a capacity-building workshop in their country/ region are requested to contact TT-CB chair (DBCP members; March 2023)*

9.5Task Team on Environment Stewardship (TT-ES)

Ms. Karen Grissom reported on the activities of the Task Team on Environment Stewardship (TT-ES) which carried out four intersessional meetings and is progressing on all three of their actions. Ms. Grissom listed out the task team's 3 top pillars Pillar: Environmental Stewardship (ES), Technology Innovations, and Scientific and Operational Excellence. She outlined the actions as follows: working with ocean observing partners to baseline and continuously review their environmental impact; encouragement of research and development activities prioritized to meet defined user needs; adoption, definition, and promotion of best practices in the life cycle. The success of these actions is measured in the completion of the baseline (which is very close), new green technologies (which are progressing), and availability of best practices (which is slow and evolving).

[21] https://www.goosocean.org/medi-1-1
[22] https://www.goosocean.org/medi-1-2

She shared highlights from the year including a meeting with materials researchers, which was interesting in that they had received a grant to develop biodegradable materials for use in sensors, and it will be determined how that evolves in this continued search for new creative technologies to minimize environmental impact. She mentioned that a publicity poster was created for Sea Tech week that underlines the need to continue operations sustainably. Finally, she informed the plenary that the baseline survey is near complete and ready to be released.

She reported the key foci for the coming year include: completion of the baseline with the interpretation of the survey results (planned for May); membership building and increased awareness of the work; and finalizing best practices.

She shared these important takeaways:

- It is critical to be involved in the growing movement and awareness around ES and spread this message beyond just the Ocean observing community but to other audiences such as funders or press.

- It is critical to continue to focus on minimizing the impact on the environment and sustainably using our resources.

- DBCP should include ES in discussions and meetings, and consider it a Standing Operating Procedure (SOP), so it’s built into observations planning.

Ms. Grissom indicated that she is seeing lines for environmental assessments show up more in the funding request, which is a strong indication that it is of growing importance to members of the ocean observations community.

***28. Action**: TT-CB is requested to collaborate with TT-ES to include Environmental Stewardship and awareness in capacity building agenda (TT-CB; DBCP-39)*

9.6 Vandalism and outreach

Ms. Karen Grissom also presented the status of work around vandalism and outreach. She noted the link to the Vandalism cartoon, with 11 versions recently released. Vandalism data reports were received from Australia, Canada, China, Columbia, France, India, Korea, and the USA. Ms. Grissom shared her belief that other countries are also having issues with vandalism, but better efforts should be made to track and report it, which would potentially allow for more power to influence this within GOOS and WMO. She said that in the US they have a dedicated person tracking vandalism. She showed the distribution of vandalism reports, which is skewed to the USA due to the nature of reporting. She noted to the plenary that the current increased incident of vandalism is more of a reflection of improved reporting than increased incidents.
She shared the methods for monitoring vandalism such as tracking Automatic Identification System (AIS) signatures, looking at data signatures for significant spikes (potentially due to tugs, for example), and reviewing recovering logs that indicate if fishing lines are tied to buoys and installation of cameras. She further noted challenges posed by measuring this information in international waters, in which case the state department works with the nations directly to resolve issues.

Ms. Grissom explained that initially they were using less expensive commercial game cameras - which is recommended as a starting point – and they subsequently developed proprietary camera equipment as they progressed with their work. Ms. Grissom invited members to reach out to her with questions and she would pass on any information she has that may be helpful in terms of camera equipment.

***29. Action**: DBCP members are requested to report vandalism events which are crucial to know the extent to find solutions (DBCP members; DBCP-39)*

***30. Action**: Provide more information to Mr. Faiza AL-YAMANI of Kuwait on the cameras installed on buoys to tackle vandalism issues (TC with Ms. K Grissom; March 2023)*

9.7 Report from Global Data Assembly Centers (GDAC)

The two Global Data Assembly Centers (GDAC) for drifter buoy data provided details of their activities

9.7.1 Report from GDAC Coriolis

Mr. Thierry Carval presented the report on the Coriolis GDAC data collation activities. He indicated that Coriolis continually collated, quality control, and archived level 1 buoy data from WMO-GTS, World Ocean Database (WOD), USA National Data Buoy Centre (NDBC), and Lagrangian Drifter Laboratory (LDL) ERRDAP, Ocean Canada, Australian IMOS, and Copernicus marine service. He mentioned in November 2022 there were 1,500 active drifting buoys out of 25,000 and 1,400 fixed data buoys active out of 23,000. He indicated a strong demand from Copernicus to get spectral data for the waves, so they have started on this activity and will continue to expand on it. He noted that quality-controlled, hourly averaged current data are calculated from GDAC drifting buoys and distributed weekly on Copernicus marine services[23]. He also noted that real-time and delayed mode wave data from several sources (i.e. EU Coriolis DAC, US NDBC, IOOS and LDL ERDDAP, Australia IMOS, Oceans Canada, etc.) are collated and made available through Copernicus[24]. Further, he said that both current and wave data are scientifically quality controlled and published on Copernicus marine service, twice a year.

Dr. Mark Lucas asked about access to the Cassandra elastic search interface, and Mr. Carval confirmed that one couldn't access it directly but can create an API to make a query.

The DBCP chair asked about an estimate of how much global data is coming through the Coriolis GDAC. Mr. Carval confirmed that most data available in Europe, the USA, and Australia is getting into Coriolis, but there is still work to be done with other countries.

Mr. Carval also confirmed that they are monitoring data usage with different products and that each access request is logged, and statistics are published every three months by Copernicus.

Dr. Luca Centurioni made a recommendation that consideration be given to the different needs of operational agencies that may need real-time data and may not have the same rigorous quality control as delayed data. Mr. Carvel explained that Copernicus real-time data stream was established to make it easier for the non-NWP community to access the real-time data on the GTS. The DBCP chair reminded the group that with the WMO unified data policy (WMO Resolution-1), the underlying foundation of data exchange is that it's free and unrestricted. So if you put it on the GTS it is free and unrestricted.

9.7.2 Report from GDAC MEDS

Mr. Trajce Alcinov from Fisheries and Oceans Canada presented the GDAC operated by Marine Environmental Data Section (MEDS). He gave an overview of the data collected explaining that MEDS collects real-time BUFR data from GTS, monitors compliance of coded messages and volumes of data flows, and makes available all decoded BUFR messages on a File Transfer Protocol (FTP) server. He shared current plans of MEDS that includes continued monitoring and reporting of identified GTS routing and format issues,

[23] https://resources.marine.copernicus.eu/product-detail/INSITU_GLO_UV_NRT_OBSERVATIONS_013_048/INFORMATION
[24] https://doi.org/10.48670/moi-00036

facilitation of publishing of additional drifting buoy datasets from Canadian data distributors, and coordination. He also shared the current challenges that include the need for additional partner coordination and feedback on data products, metadata management, standardized QC methodologies, and the lack of data user feedback. Mr. Alcinov noted that MEDS has a strategic plan and is working on an implementation plan that is very much inspired by interoperability and not 'reinviting the wheel'. He agreed that more conversation is required to understand who does what in GDACs and DACs.

A lively discussion continued around the underlying need for maximizing data sent to GTS, and the implications of making data publicly available in real-time outside of the GTS. Dr. Centurioni called for a discussion around these points in the future, especially considering if the data is open it will give organizations pause to share the data. The DBCP chair countered that people could put data on the GTS with restrictions and suggested more clarity around this issue may arise out of the following days' discussions.

31. Action*: Organize a meeting or a workshop with all DACs and GDACs to better understand and document what information (data and products) is made available by each GDAC and DAC (TT-DM with TC; DBCP-39)*

32. Action*: Provide information on the data and products made available by each DAC and GDAC on the DBCP website (TC; DBCP-39)*

33. Action*: Arrange a meeting with the applicable WMO department and LDL to clarify rules around data shared on the GTS (WMO Secretariat; March 2023)*

34. Action*: Assist MEDS to correct issues with GTS routing and header (TC; May 2023)*

10. DBCP Task Teams and Action Groups

In response to a query on any gaps in focus areas or the need to phase out any Task Teams from the DBCP Chair, Ms. Gallage suggested that there could be some combining of groups where activities overlap such as vandalism activities to include under operational excellence. Ms. Jiang suggested an ongoing need to involve the voices of women scientists. Dr. Thurston voiced the need for a more dedicated and focused effort to work with the proliferating private commercial sector.

11.Breakout session reporting back

All participants joined three parallel breakout groups to discuss how to proceed with DBCP activities related to Environmental Stewardship, the Social economic value of buoy observing networks, and enhancing diversity and inclusivity in the DBCP. Breakout session chairs presented a summary of the discussions at the plenary session.

11.1 Environmental Stewardship

On behalf of Karen Grissom, DBCP Chair relayed the key outcome of breakout discussions on Environmental Stewardship (ES). He mentioned best practice is identified as an important area to work on. He highlighted the upcoming anonymous survey planned in January 2023 that will be used to establish a baseline to understand the current status of ES activities and practices across the globe and encourage meeting participants to complete that survey when received.

11.2 Demonstrating Social economic value of buoy networks

Dr. Sid Thurston provided a summary of the discussion on demonstrating the social-economic value of buoy networks. He said the group discussed the social economic benefits which include defining and categorizing user communities (coastal/open ocean, different time scales, NWP/climate, operational/research, insurance), exemplars (hurricane/tropical cyclones, storm surge, Tsunami, calibration/validation of satellite with in-situ data) and a way forward (small/low-cost instruments, identification of gaps, integration, increased sensors, education, and advocacy). He mentioned that further discussion centered around NWP and the economic benefits of improving forecast and disaster risk management. Dr. Thurston also noted that WMO-IOC collaboration on the GOOS co-design will add a lot of value in the future. He listed some specific social economic benefits that came out of the breakout group: better tracking, better prediction and warning for extreme events, management of ocean resources and impact assessment, empowerment of society to adapt to change, and seeing things holistically. He listed some other specific benefits with examples such as Solomon Islands moored drifter waves to provide safer ferry navigation, active and interactive co-design process, giving voice to community needs, and a first set of GOOS co-design exemplars.

11.3 Enhancing inclusivity and diversity in the DBCP

Ms. Rachel Jiang talked about what came from the brainstorming session around diversity and inclusivity that included ways to foster an environment of respect and encouragement for diverse points of view, creativity, and inclusion for membership from all parts of the world. She said that this initiative has been successful with capacity development workshops in developing countries and Small Island Developing States (SIDS). She highlighted the need for a balance of different cultures and equal opportunities for participation of all ages, gender, and regions. She provided an example of how the project “backyard buoys” empowers Indigenous and other coastal communities to collect, steward, and use wave data that complements their existing knowledge to support their blue economy: maritime activities, food security, and coastal hazard protection. She shared the suggestion that workshops in more African countries may provide more of these types of opportunities.

Ms. Champika Gallage added that geographical diversity has increased in DBCP over the past few years and that the online sessions may have facilitated that by allowing participation from more regions; However, there is more room to improve. She continued that it’s important to also capture the future leaders by focusing on young oceanographers through capacity development workshops, webinars, or some other mechanisms.

35. Action*: Encourage and facilitate female youth scientists to join DBCP activities (All AG, TT, WG chairs; DBCP-39)*

12. Strategic Discussion

12.1 The DBCP Strategy- its first year of implementation

Mr. Boris Kelly-Gerreyn provided an overview of the DBCP 5-year Strategy and the status of its implementation. He reminded the Panel that DBCP Strategy[25] was developed with internal and external consultation and launched at the DBCP-37 session. His presentation primarily highlighted what was achieved and advanced in the implementation of the strategy using the table presented on the fourth page of his presentation[26] under the six strategic pillars, where the actions are in either planning, delivery, or completing stages with green tick marks identifying where progress has been made. He further explained with examples the status of specific actions under each strategic pillar which are listed in his presentation[2]. Dr. Rick Lumpkin reiterated that scientific publications are an important international contribution to advancing our knowledge and the information on publications including from tropical moored buoy arrays (RAMA, PIRATA, and TAO)

[25] https://www.ocean-ops.org/dbcp/doc/DBCP%20Strategy/DBCP%20Strategy%202022-2027.pdf
[26] https://oceanexpert.org/document/31128

divided into different programmes are included in the National Report provided by the United States[27].

36. Action: *Aggregate information of the DBCP programs-related scientific publication information provided through a variety of sources including National reports and report them under the Scientific Excellence at DBCP annual sessions (Chair of the Scientific Excellence with DBCP TC, DBCP-39)*

2. Recommendation: *Often, ocean science-related publications refer to multiple ocean observing networks. Therefore, to coordinate the efforts of tracking science publications on ocean observing networks, OceanOPS is requested to maintain a central repository of scientific publications with the ability to filter the information on a network basis (OceanOPS)*

12.2 Relevance of DBCP

12.2.1 Decisions and forward-looking activities of WMO and IOC including GOOS and UN Decade

Ms. Champika Gallage from the WMO secretariat presented the most relevant activities, decisions, and recommendations of WMO governing bodies to DBCP. She highlighted the most relevant outcomes from the second Joint Collaborative Board (JCB), the second session of the WMO Commission for Weather, Water, Climate and Environmental Services (SERCOM-2), WMO Technical Conference on: “the global early warning initiative for climate adaptation: early warnings for all”, second session of the infrastructure commission (INFCOM-2) and ongoing activities of WMO unified data policy, Global Basic Observing System (GBON) and Rolling Review of Requirements (RRR). Ms. Gallage mentioned that the work plan agreed at JCB-2 includes many items important for DBCP where collaboration and finding synergies between WMO and IOC in the areas of WMO data policy, GBO, RRR, ocean best practices, ocean carbon observations, regional activities, and capacity development are the key. She also mentioned that SERCOM-2 launched the WMO Guidelines on Implementation of a Coastal Inundation Forecasting Early Warning System (CIF-EWS, WMO-No.1293) which assists vulnerable countries to implement their CIF-EWS with guidelines and planning tools for coastal zone management. Ms. Gallage provided outcomes of the workshop organized on early warning for all by 2027 which was announced by the UN Secretary-General on the 2022 World Meteorological day, where WMO is spearheading this activity. Outcomes and more information on this workshop can be found on the WMO website[28]. She then summarized the decisions and recommendations of the Study Group on Ocean Observations and Infrastructure Systems (SG-OOIS), which were approved at the INFCOM-2 session. She further explained that the SG-OOIS report includes 29 recommendations under 8 major areas with 6 high-priority requirements which are mostly related to the WMO RRR. The full report of SG-OOIS is available through INFCOM-2 session information[29]. WMO priority activities that are ongoing; WMO Unified data policy, RRR, GBON, and Systematic Observing Financing Facility (SOFF) will be covered in the next Agenda item 12.2.2. A detailed report on the information provided here is available on the DBCP-38 website[30].

Dr. Emma Heslop from IOC/UNESCO delivered the information on GOOS today ‘building fit-for-purpose global ocean observing system. She highlighted that the ocean is key to

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[27] https://oceanexpert.org/document/30901
[28] Early Warnings for All | World Meteorological Organization (wmo.int)
[29] https://meetings.wmo.int/INFCOM-2/_layouts/15/WopiFrame.aspx?sourcedoc=/INFCOM-2/English/2.%20PROVISIONAL%20REPORT%20(Approved%20documents)/INFCOM-2-d06-5(1)-RECOMMENDATIONS-STUDY-GROUP-OOIS-approved_en.docx&action=default
[30] https://oceanexpert.org/document/31049

pressing societal issues primarily in the areas of climate and weather, ocean health, and coastal communities where ocean data is vital to provide a solution to those societal issues. She then provided an overview of the GOOS 2030 strategy[31], the status of GOOS today, GOOS core coordination, and Essential Ocean Variables (EOVs). She emphasized that with all the work that has been done, to face key challenges, there is a need for a step change. GOOS coordinates global observing networks including biological and ecological observations networks. She said that the Observations Coordination Group (OCG) which operates under GOOS, coordinates global ocean observing networks including DBCP. Further, she mentioned, OCG networks have an overlap with biological and ecological observation networks and this overlap will increase in the future. Further mentioning observing coordination under GOOS, she said that the OceanOPS which is governed by OCG is the central coordination mechanism for global observing networks and maintains the repository for metadata. Ms. Emma highlighted other observing coordination mechanisms such as GOOS Regional Alliances (GRA) GOOS national focal points and projects i.e. TPOS, Ocean Best Practices System (OBPS), etc. She mentioned that the forecasting community also integrates into GOOS through the Expert Team on Operational Ocean Forecast System (ETOOFS). She highlighted the importance of monitoring the observing system health and integration which is published annually by OceanOPS in the ocean observing report card. She also emphasized the importance of looking not only in-situ but satellite observations and the entire value chain to deliver to a wide range of downstream applications. She presented the three co-programmes GOOS undertakes under the UN Decade umbrella; ocean observing co-design, observing together and coast predict which are looking at three areas of the values chain while addressing the integration along the value chain. Further explaining the co-design project, she said that there are several exemplar projects under the themes of Tropical cyclones, Carbon Cycle, Marine heatwaves, storm surge, boundary currents, and marine life 2030 which are underway where DBCP and other observing networks will play a role in some of these. She further emphasized that there are many commonalities between these UN Decade projects and RRR where a connection will be made in the future. She also touched on the key recommendations made by the SG-OOIS where GOOS will be taking a more active role in connecting with WMO priority areas; ocean domain components of GBON and RRR are the key. Ms. Emma explained the IOC Executive council decision on EEZ (Decision IOC/EC-55/3.4[32]) where GOOS is invited to provide detailed information on the issues regarding sustained ocean observations in areas under national jurisdiction identified in the report of the workshop (GOOS Report 246[33]) and to propose awareness-raising and capacity building activities to help States realize the value of observations, including a positive impact on States' adaptation to climate change and sustainable economic development. Lastly, Dr. Heslop mentioned that an important area for action is to advocate for the need for ocean observations which underpins most of the work across the UN and GOOS takes this very seriously.

12.2.2 WMO Unified data Policy (Resolution 1), GBON, SOFF & RRR

Mr. Lars Peter Rijshojgaard, Director of the WIGOS Branch in the Infrastructure Department of WMO presented the WMO Unified Data Policy and how it is implemented through GBON and SOFF. He started his talk with a profound statement "weather and climate know no boundaries". He said that the atmosphere connects all domains, thus the impact of observations on forecast scale can mysteriously spread around the globe and conversely the lack of observations limits the ability to monitor, understand and predict weather and climate, both locally and globally. Further, he mentioned that weather prediction beyond 3-4 days for any location on the globe requires an exchange

[31] https://goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=24590
[32] OceanExpert | Document
[33] Global Ocean Observing System (goosocean.org)

of observations worldwide, thus lack of observations will initially lead to poor quality of model data locally; over time this will spread globally. He explained that the successful application of weather and climate services depends on a functioning meteorological value chain starting from observations, and data exchange to the National Weather Prediction (NWP), to local data processing, forecasting, warning and advisory, products, to delivery of weather and climate services and to effective decision making where societal impact value is achieved. He emphasizes the importance of the exchange of global observations to produce an accurate longer-term local forecast. He highlighted that one of the primary and most important activities of WMO is to organize the international exchange of data. To successfully implement the data exchange he mentioned five key steps; understanding the requirements and gaps (RRR), outreach and advocacy through analysing and explaining the benefits of data exchange to stakeholders, Data policy to have a general commitment of Members, Regulatory material (e.g. GBON) to provide specifics and financial and technical support to develop capacity (SOFF) in areas of need. Mr. Rijshojgaard mentioned that ocean observations are required in this process but need further development to address the high seas where WMO needs to continue the discussion with DBCP and other ocean communities. Then he explained the history of data policy at WMO starting with Resolution 40 which was in effect for about the last 25 years and the reasons to develop a new data policy as decided by Congress 18 (Cg-18) to address three major issues; concerns about persistent insufficient observational data coverage, need to move toward integrated Earth system modelling and opportunities and challenges related to the growing role of the private sector. He provided three examples of why WMO moved towards earth system prediction and modelling; greenhouse gas (GHG) monitoring, coral bleaching, and droughts where we need to know about integrated systems between the atmosphere, ocean, and hydrology to understand these events. He reminded that the WMO's new Unified Data Policy addresses the weaknesses of the existing data policy resolutions; takes the best from them and builds on it to strengthen the free and unrestricted data exchange from all domains, between WMO Members. Further explaining the data policy, he mentioned the data exchange is expected in two tiers; Members shall provide on a free and unrestricted basis the core data and should also provide the recommended data. Further explaining he said, free and unrestricted means are available for use, re-use, and sharing without charge and with no conditions on use[34]. Mr. Rijshojgaard said GBON is an example of the regulatory implementation of core data in the data policy. With observation density and timeliness maps, he explained how GBON implementation will address the data gaps contributing to poor model performance and verification leading to less accurate weather and climate predictions. He mentioned that WMO Convention and Paris Agreement implicitly assume that observations are solely a national responsibility while there is a good correlation between the ability to observe and the ability to pay for the observations (i.e. GDP/km2 surface space). Mr. Rijshojgaard mentioned that GBON regulations establish the commitment of all WMO Members to acquire and transmit in real-time certain observations at fixed minimum horizontal density and at fixed minimum time-frequency; and provide critical input to weather prediction and climate analysis needed for disaster preparedness, climate adaptation, etc. Introducing SOFF, he mentioned, the sole purpose of SOFF is to provide technical and financial support to the implementation and operation of GBON where it is most needed. Further explaining, he mentioned SOFF is a dedicated and innovative financing mechanism that will provide financial and technical assistance to Members to address foundational observations and problems systematically. However, he noted that SOFF and GBON are not yet extending to the high seas (open ocean) which will be a possibility in the future. Addressing the ocean domain, Mr. Rijshojgaard mentioned that operators of ocean observing systems are largely in compliance with WMO data policy by providing freely and openly available data. He identified a few issues for the ocean community such as how to use the WMO Unified Data Policy to strengthen the ocean observing system, including marine

[34] Requests for attribution not considered a condition; attribution recommended

observations, especially from high seas in GBON, and dealing with observations from EEZ including 3rd part data.

12.3 Observations Coordination Group (OCG) special session

This session focused on providing information on OCG and its networks and identifying common opportunities and issues across the networks where networks can work collectively. Ms. Emma Heslop moderated this session. Chair of the OCG Dr. David Legler provided an overview of the OCG stating that OCG works to efficiently operate, maintain, coordinate, and integrate a comprehensive in-situ global ocean observing system consisting of 12 networks including DBCP. He mentioned that OCG targets 8 foci for action across these networks and those are; requirements, observing advances across the system, standards and best practices, data management, OceanOPS to support all networks monitoring the health of the system, metrics to track the progress, environmental stewardship, and capacity development. He then mentioned several OCG achievements such as the annual ocean observing report card describing the state, challenges, progress, and knowledge of the ocean observing system. While describing the activities across networks and where OCG is heading in the future, he highlighted, the engagement with the private sector, integrating new technologies, engagement with WMO on user requirements and high-level guidance, coordinating UN Decade projects i.e. observing system co-design projects, harmonizing network data and metadata as some of the key areas where DBCP has an opportunity to engage. He further suggested initiating pilot projects to progress in some of the above-mentioned areas such as private sector engagement, new technology development, and integrations.

Eleven OCG network leads joined this session to provide key highlights of their networks. Dr. Clive McMahon co-chair of the AniBOS (animal-borne ocean sensor) network, an emerging network of OCG, mentioned that their primary aim is to collect and complement GOOS by providing observations, particularly from the high polar regions and also from coastal and tropical regions. He motioned that the greatest advancement of AniOBS in recent years was the simulation of animal observations into gridded products and in climate models. Elaborating on the future of AniBOS, Dr. McMahon said their plan is the integration the animal-derived observations into the global observations system, by providing quality-controlled salinity profile and other data in real-time to the GTS and delayed mode to other data-relevant channels. He identified the lack of dedicated personnel and financial resources as challenges and having well-operational instruments to expand the network to data-sparse ocean regions and extreme weather events as an opportunity.

Co-chair of the OcenSITES network Dr. Raquel Somavilla said their mission is to coordinate, collect and deliver high quality, high frequency, long-term, multidisciplinary observations from fixed locations of the ocean and from the surface to the bottom of the ocean. She mentioned that OceanSITES observe over twenty variables, from physical, chemical, and biological domains. She further mentioned that their longest time series is seventy-two years long and the observing platform includes a weather station. She said the strength of OceanSITES is its data management system, however, the challenge is the discoverability of data due to the decentralised system. She further identified the integration of Biogeochemical (BGC) data and finding synergies with modelling community as other challenges.

Representing the Global High-Frequency Radar (GHFR) Network, Dr. Hugh Roarty said that GHFR is a remote sensing technology primarily to measure ocean surface currents and also can provide wave height, period, and space weather as secondary measurements. He said the GHFRs biggest achievement was receiving licenses to operate in a dedicated radio frequency band from the International Telecommunication Union (ITU). Dr. Roarty mentioned that GHFR has long-surviving stations providing time series data spanning two to three decades allowing to identify climate signals while the stations are running for many decades refurbishing these stations to maintain the quality of observation is a challenge.

Mr. Darin Figurskey, the chair of the Ship Observations Team (SOT) mentioned that there are three panels under SOT; the Voluntary Observing Ships (VOS) scheme, the Ship of Opportunity Programme (SOOP), and the Automated Shipboard Aerological Program (ASAP). Highlighting SOT achievements, he mentioned that the VOS programme provided three million observations in 2021 which is a 4% increase compared to previous years, SOOP deployed over then thousand EXpendable BathyThermograph (XBT) profiles in 2021 which is a 65% increase compared to the previous year, ASAP launched over four thousand six hundred areological soundings. Further, he mentioned SOT continues to work with the industry and working on a metadata scheme to provide better-organized metadata for users. Mr. Figurskey said that although SOT was able to increase the number of observations, they face the challenge to increase the spatial density of observation across the globe but taking the opportunity of private sector engagement to close the observation gaps. Further, he mentioned data QC before it is delivered to the GTS also identified as a challenge for the network.

Director of the Argo programme, Dr. Breck Owens mentioned that the Argo network has around twenty years of history making temperate and many other ocean measurements over the upper two kilometers of the ocean. He said the network is expanding towards making observations up to six thousand meters in depth and integrating BGC sensors which will allow to study and evaluate carbon pump to the ocean deoxidation. Identifying challenges, he mentioned the cost of BGC Argo is four times of a regular Argo float and the existing funding model is not sustainable for BGC expansion. Further, he said Argo has an 83% global coverage compared to the Argo network design however this coverage is declining significantly due to the impact of the COVID pandemic with the increase in instrument cost. He highlighted that Argo data is globally made available within 3-12 hours after measurement. Identifying Argo network challenges, Dr. Owens said that interacting with end users to understand data quality and their requirements and integration of BGC into Argo including data QC are challenges.

Dr. Brad deYoung, co-chair of the ocean Glider network said that the Glider community is working on data format and metadata standards to deliver data to the GTS as well as globally, expanding the operations in coastal regions through a programme called “Boundary Ocean Observing Network” (BOON) to capture spatial variability at the regional level, and operating gliders in front of a hurricane system to improve the intensity forecast at landfall, and operational forecast. He further said the Glider community is developing standards and best practices to assist prospective glider operators and to assist glider data users to better understand the data. Identifying challenges and opportunities of his community, Dr. Young said that identifying how to properly observe the earth system with existing capabilities by understanding the sensors and data in real-time and climate sense is a challenge as well an opportunity for his community. He also mentioned that sustainable funding is a challenge for many ocean-observing networks.

DBCP chair Dr. Gerrine, mentioned data gaps in the Indian Ocean, uneven data coverage of drifting buoy network, and lack of global data centers for moored and wave buoys are the challenges for the DBCP community. He also mentioned that DBCP is working on environmental stewardship and planning to share the experience with other networks of OCG.

On behalf of OceanOPS, Dr. Jiang mentioned that harmonization and integration of metadata across OCG networks is a challenge and would like to see more synergies between networks in instrument deployments and platform maintenance as an opportunity for better coordination.

Giving final comments on this session Dr. Legler mentioned, that engagement with the user community, network sustainability, data accessibility, and pilot projects to integrate new sensors, and technologies came as primary challenges across the networks.

***Recommendation**: Under the OCG umbrella networks are encouraged to continue collaboration and discussions between networks to find collective solutions to the challenges of integrating BGC observation and data management into their networks.*

13. Financial Report

Ms. Champika Gallage from WMO Secretariat presented the financial report of DBCP and provided details of the currently operational trusts funds managed through WMO and IOC as well as donor information and how the contributions to the DBCP trust fund are distributed among DBCP, SOT, and OceanOPS. She emphasized that donors have the authority to request how they wish to distribute their contribution among DBCP, SOT, and OceanOPS, while recommended distribution based on previous years' spending habits is 13%, 8%, and 61% respectively for DBCP, SOT, and OceanOPS. Ms. Gallage mentioned that due to COVID pandemic-related issues, funds were underutilized, and the expected available budget for DBCP activities by December 2022 is about 176,000 US$, thus estimated budget for 2023 is provided in Table 1 below.

ITEM	DBCP TF (US$)	IOC TF (US$)
Balance Brought Forward from the previous year	$114,827	$61,158
National Contributions*	$28,000	$10,000
Funds Available on 1st Jan 2023	**$142,827**	**$71,158**

Table 1: Estimated 2023 Panel budget available (*Estimated amount of contributions)

Ms. Gallage mentioned that after reviewing the financial situation, DBCP Executive Board made recommendations (Table 2) on expenditure for DBCP in the year 2023. She requested the DBCP to review, comment and approve the DBCP 2023 expenditure provided in Table 2. She further informed the maximum expenditure identified in Table 2 does not include the 3% support cost.

DBCP – Draft Spend Plan - 2023	***WMO/DBCP TF***	***IOC/DBCP TF***
Travel of DBCP Chairperson and other Exec Board or Panel members	$15,000	
DBCP Capacity Building	$10,000	$30,000
TT and other DBCP activities	$20,000	
Communications	$5,000	
Total	***$50,000***	***$30,000***

Table 2: DBCP maximal expenditure for 2023

Participants of the DBCP-38 approved and adopted the DBCP expenditure plan without any changes as provided in Table 2.

Ms. Gallage requested DBCP members to refer to the financial report[35] for details. Finally, she thanked all contributors for their continued support for the DBCP activities and requested other DBCP members to consider contributing to the DBCP-TF towards DBCP activities.

[35] https://www.goosocean.org/index.php?option=com_oe&task=viewDocumentRecord&docID=31076

***37. Action**: Request Panel members to consider contributing to the DBCP-TF towards DBCP and OceanOPS activities (DBCP members, DBCP-39)*

14. Election of chairperson and new executive board members (Operational Excellence and Value & Impact positions)

Ms. Champika Gallage provided information about the vacant positions in the DBCP EXB. She mentioned that according to DBCP operating principles a DBCP Chairperson can serve four years in the position. Further, she said as the current chair is completing four years, the chair position is open to accept nominations and in addition, there are two other EXB positions to lead on, impact and value, and operational excellence. Ms. Gallage said that a notification requesting nominations for above mentioned three posts went out but no nominations were received. Therefore, she requested members to continue to submit nominations until November 30th, 2022, and if there will be more than one nomination for one position, a virtual election will be conducted following the DBCP Operating principles. She explained that the target is to have new EXB members selected by mid-December 2022 and to announce the new EXB members before the end of the year 2022.

***38. Action**: Send out the Executive Board nomination request with all the details to the DBCP members with an extended deadline of November 30, 2022 (WMO Secretariat; 10 November 2023)*

15. Review of Actions

DBCP chair suggested reviewing the actions with the meeting report review. Accordingly, Ms. Gallage from Secretariat explained that the actions and recommendations will be separately identified in the meeting report and requested all meeting participants to review the draft report and send their edits once the report is made available. Mr. Braasch mentioned that Actions and recommendations from the meeting formulate the work plan for the following intersessional period and it is important to capture them accurately in the meeting report. He further stressed that there must be adequate time to review actions and recommendations during the meeting or on the last day of the meeting.

***39. Action**: Allocate appropriate time to review the actions and recommendations either on the last day of the meeting or at the end of each day of the meeting (DBCP EXB, DBCP-39)*

16. Date and Place of the next session

Ms. Gallage mentioned that there were several countries expressed their interest to host the next DBCP-39 meeting towards the end of the year 2023 (October-November). She requested members who are willing to host the next session to send a formal letter to the secretariat expressing their interest with suggested dates and location. She reminded those planning to host future meetings that with the success experienced in hybrid meetings, future meetings will be organized in a hybrid format and take that into account when members are committing to hosting the meeting. She further mentioned that if there are multiple offers to host the DBCP-39, a decision will be made by the EXB based on a location where DBCP has never been held before, ease of travel, and also a place where we can engage with local and regional entities to improve ocean observations and make a difference

17. Closing of session

DBCP-38 session was convened at 14:00 on Friday, November 04, 2022.

Annex 1
Agenda

1. Opening and Welcome to DBCP-38
2. Adoption of the agenda and working arrangements
3. Scientific and Technical Workshop (Delivering Data for Research, Operations, and User Impact)
4. Getting to know the DBCP
5. Invited Speeches
   5.1 Impact and value of DBCP observations to users (Lisa Blair)
   5.2 Industry dialogues on global ocean observations (Zdenka Willis)
   5.3 Outcomes of the EOI on deploying wave drifter (Solomon Island Rep)
6. DBCP and OceanOPS report
7. National Reports
8. The DBCP Action Groups - challenges, opportunities, risks, success measures, and recommendations
   8.1 Global Drifter Programme (GDP)
   8.2 International Arctic Buoy Programme (IABP)
   8.3 International Programme for Antarctic Buoys (IPAB)
   8.4 International Tsunameter Partnership (ITP)
   8.5 Surface Marine Programme of the Network of European Meteorological Services, EUMETNET (E-SURFMAR)
9. The DBCP Task Teams and Working Group - challenges, opportunities, risks, success measures, and recommendations
   9.1 Task Team on Data Management (TT-DM)
   9.2 Task Team on Moored Buoys (TT-MB)
   9.3 Task Team on Wave Measurements (TT-WM)
   9.4 Task Team on Capacity-Building (TT-CB)
   9.5 Task Team on Environment Stewardship (TT-ES)
   9.6 Vandalism and outreach
   9.7 Report from Global Data Assembly Centers (GDAC)
      9.7.1 Report from GDAC Coriolis
      9.7.2 Report from GDACMEDS
10. DBCP Task Teams and Action Groups - What do we need going forward: when, where, how and why
11. Breakout Discussions
   11.1 Environmental Stewardship
   11.2 Demonstrating social economic value of buoy observing network
   11.3 Enhancing inclusivity and diversity in the DBCP
12. Strategic Discussions
   12.1 The DBCP strategy - its first year of implementation
   12.2 The relevance to the DBCP of
      12.2.1 Decisions and forward-looking activities of WMO and IOC including GOOS and UN Decade
      12.2.2 WMO Unified data Policy (Resolution 1), GBON, SOFF & RRR
   12.3 Observations Coordination Group (OCG) special session
13. Financial Report
14. Election of chairperson and new executive board members (Operational Excellence and Value & Impact positions)

15. Review of Actions/Recommendations
16. Dates and Place for the Next Session
17. Closure of the Session

Annex 2
Science and Technology Workshop - Abstracts

The Next Evolution of the TAO Array: The Implementation of a Tropical Pacific Observing System (TPOS) Co-Designed Observing System

(*Karen Grissom, Steven DiNapoli, Kevin Kern, James Elliott, and William Burnett*)

At close to 40 years, the Tropical Atmosphere Ocean (TAO) array is one of the longest sustained in-situ ocean observing networks in the world. Since its conception in 1984, TAO has been a major observational component of El Niño Southern Oscillation (ENSO) research and seasonal to sub-seasonal (S2S) forecasting. While the array has allowed for vast improvements in our knowledge of ENSO and S2S predictions, it is important to note that this is not a solved problem. To meet current and future needs of the operational and research communities, NDBC received funds to implement a TAO Recapitalization project informed by the Tropical Pacific Observing System (TPOS) 2020 final report. This project will modernize aging and obsolete technology within the array and provide additional enhancements to measure key weather and ocean parameters based on the TPOS science recommendations. The newly recapitalized TAO array, or TAO Recap, will include fewer, but more capable moorings focused on mixed layer dynamics and surface fluxes. TAO Recap moorings will be moved to some meridional lines north and south into the ITCZ and SPCZ, to advance the TPOS vision of integrated complementary technologies. We will describe progress made to date, discuss how the TAO Recap achieves TPOS 2020 objectives and describe overall benefits to WMO services.

The GOOS Observations Coordination Group Data Implementation Strategy

(*Kevin O'Brien*)

The GOOS Observations Coordination Group (OCG) oversees and coordinates the activities of the global ocean networks which, of course, includes the DBCP. One of those activities is data and metadata flow within and across the global networks. Lately, there has been a strong global push to improve data interoperability and thereby maximize the value of ocean data. This can be seen in the rise of the FAIR data principles as well as in many of the programs that have been endorsed by the UN Ocean Decade.

GOOS OCG has been developing a data implementation strategy to help ensure that the data collected by the OCG networks finds its place in this global digital ecosystem. The process began by mapping the data flows from the OCG networks in an effort to identify opportunities for improved efficiencies and reducing data friction. In this presentation we will explore the recommendations that will underpin the OCG data implementation strategy, discuss the efforts to provide improved data and metadata flows across OCG, and demonstrate how this work will ensure that OCG data is part of programs such as the UN Ocean Decade and the evolution of the WIS.

The Development of a "Florida Coastal Ocean Observing System" (FLCOOSTM) A "Zoom-In" Approach Connecting the Sea-Surface and Water-Column, Advancing the GOOS Mission

(*Rick Cole, Founder and President, RDSEA International, Inc., St Pete Beach, FL Scott Duncan, Founder and President, Navocean, Seattle, WA*)

Florida's coastal regions are low, flat, heavily populated, barely above sea level and are extremely vulnerable to impact weather, pollution, acidification, algal blooms, and fisheries decline. All of which are aggravated by climate change and sea level rise. Sea level rise alone threatens to submerge thousands of square miles of coastal land, displacing millions of people, and hurricanes, once rare, are now an annual severe threat. Decisions made during the next decade will have life altering implications for Florida's 22+ million residents. Understanding the coastal ocean processes of Florida is crucial to understanding the oceanic processes of the entire region. Funding shortfalls and a divided plan leave existing observing programs with gaps spanning hundreds of miles in critical areas. RDSEA and Navocean have set forth plans for a comprehensive “Florida Coastal Ocean Observing System” (FLCOOSTM) for the coastal/littoral zone, spanning east to west. The backbone of this proposed system is an array of “Coastal Warning and Rapid Response Data Density” (Sea-WARRDD) observing stations, comprised of RDSEA Coastal Hybrid Buoys and Navocean Nav2 Automated Surface Vehicles (ASV) working in tandem. The Sea-WARRDD array will provide capacity for high-quality (surface, water-column, bottom-boundary) sensor data with near-real-time telemetry to stakeholders filling gaps and addressing Florida's pressing needs. "SeaWARRDD” can take comprehensive measurements relating single-point surface data anomalies to mesoscale and full ocean depth processes in critical high-value areas, creating a "Zoom-In" approach augmenting broad area surface measurement systems. FLCOOSTM enhances the GOOS mission, creates multiple partnerships, new models, supports existing models, and continues best practices. New “Blue-Technologies” are planned for the array as well as application for U.N. Ocean Decade Program Endorsement.

Operational Oceanography Value Chain: Observations to Ocean Information and Advisory Services

(*E. Pattabhi Rama Rao*, *Aneesh Lotilker and T. Srinivasa Kumar*)

Sustained ocean observations are crucial to understand complex oceanic processes, their variability and interaction with the atmosphere, and the development of operational ocean services for the benefit of society. To support the operational ocean information and advisory services, INCOIS established a wide spectrum of ocean observing networks (OON) along the coast and in the Indian Ocean. The scientific rationale of the observation programme is to obtain long-term high quality in-situ near-surface met-ocean and sub-surface oceanographic data to meet the operational oceanography requirements and to support the greater goal of sustainable development, innovation and using advanced technologies for low-cost multidisciplinary observation and improving global ocean observation networks.

INCOIS OON programme includes the data buoys comprising the Lagrangian and Eulerian type of platforms viz., Wave Rider Buoys, Coastal Water Quality Monitoring Buoys and Coastal ADCPs along the Indian coast; Drifting Buoys, Directional Wave Spectrum Buoys, Tsunami Buoys and Equatorial Current Mooring Arrays in the Indian Ocean. Data from some of these platforms are being collected and transmitted in real-time, efficiently and effectively utilised for generating ocean information and advisory services and for various research applications.

The ocean information and advisory services provided by INCOIS include the eco-system based services (marine fishery advisories, coastal water quality monitoring, harmful algal bloom information, coral reef bleaching alerts), ocean state forecast, multi-hazard early warning services (tsunami and storm surge early warnings, high wave alerts, oil spill trajectory, marine heat wave advisories, search and rescue), ocean climate change advisory services, data services and customized products for various stakeholders (fishing community, ports and harbors, offshore industry, oil and gas industry, navy, coast guard and disaster management agencies).

The data generated from the observational network are invaluable and greatly help in improving the weather and ocean forecasts, disaster risk reduction, development of products and support the blue economy initiatives. INCOIS, as the National Oceanographic Data Center, manages oceanographic data in the country and provide data services to the users through Digital Ocean, Live Access Server etc.

MoES-NOAA OMNI-RAMA Joint Indian Ocean Data Portal is jointly developed by INCOIS, NIOT and PMEL/NOAA showcase the large inventory of meteorological and oceanographic data sets with direct access for data display and delivery. This joint data portal is meant to improve access to high-quality moored time series data and to stimulate broader utilization for scientific research and applications.

Accurate Surface Wind Observations from SVPWTM (Minimet) Drifters

(Luca R. Centurioni[36], Theresa Paluszkiewicz[37] and Martha Schönau[36])

The SVPW™, or Minimet drifter, (Centurioni, 2018) is a member of the satellite tracked SVP drifter family that was designed at the Lagrangian Drifter Laboratory (LDL) of the Scripps Institution of Oceanography to be air-deployed in concurrence with tropical cyclone and severe storms. It carries the same air pressure sensors of the SVPB drifter and a high-quality anemometer measures the horizontal wind velocity. The surface buoy of the SVPW™ is larger than the one used for other drifter types and has a wind vane that stabilizes the buoy in the presence of strong winds. An LDL developed algorithm performs altitude and geographical corrections and discards the invalid anemometer data, thus returning in near-real time a clean data record of wind velocity at the ocean surface.

Due to its unique ability to concurrently measure the Lagrangian ocean currents and local wind, the SVPW™ drifter has been used for air-sea interaction studies during tropical cyclones as well as to study the near-surface ocean response to wind forcing. In this talk we present a summary of the technology and of scientific results obtained during the passage of hurricanes and typhoons (Hormann et al. 2014, Schönau et al. in preparation). We also discuss recent SVPW™ observations in the North Atlantic where important differences are observed when the energy input of the wind on wind-generated near-inertial currents is computed from direct observations and compared with corresponding quantities calculated from operational reanalysis wind products (Klenz et al. 2022).

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Diurnal Vertical Migration Observed in the ADCP Measurements in Arabian Sea
(*Tata Sudhakar*)

National Institute of Ocean Technology under the Ministry of earth Sciences, Government of India maintains the moored buoy network in Indian Seas since 1997. The OMNI (Ocean Moored Network for the Northern Indian Ocean) buoys in the Bay of Bengal and Arabian Sea provide real time observations to support improved weather prediction and understanding of cyclones and their interaction with the upper ocean. The OMNI buoys fitted with a suit of sensors measure the meteorological, surface and subsurface oceanographic parameters. The Acoustic Doppler Current Profiler (ADCP) fitted in the mooring at depth of 5 meters measures the current speed and current direction up to depth of 240 meters from the surface. The ADCP measurements indicate the diurnal vertical migration (DVM) of mesopelagic biomass between the deep layers between 100 and 240 meter depth in the central Arabian Sea. The diel vertical migration pattern is observed the movement of some organisms to shallow during night time and deeper depths during the day time. The vertical migration depends on the presence of light, predators, feeding strategy, phytoplankton abundance etc. This shows the complex interaction of oceanographic and optical conditions in driving the complex dynamics of pelagic and mesopelagic activity in this region

Iceberg Tagging Experiment (ITEx) 2021
(*Ignatius Rigor, and many of the participants of the IABP*)

The Arctic Ice Sheet have been warming, which increases the flow of icebergs from land to the ocean. These icebergs drift with the ocean currents and winds, and frequently ground on the ocean floor. To study their drift the IABP tagged icebergs north of Alaska, Canada and around Greenland during the spring and summer of 2021. We will show our methods to tag the ice bergs, satellite imagery of these icebergs over time, and some preliminary results.

Directional wave spectra from Lagrangian drifters
(*Martha Schönau, Luca Centurioni, Terri Paluszkiewicz and Lancelot Braasch*)

Directional Wave Spectra Drifters (DWSDs)TM provide real-time, open-ocean wave observations through several data relay systems, including the Global Telecommunication System (GTS), and thus available to the operational community. These drifters, developed by the Lagrangian Drifter Laboratory of Scripps Institution of Oceanography, can operate concurrently several oceanographic and atmospheric sensors, including water temperature and barometers (DWSBDs) TM, and advanced to be rapidly deployable by aircraft through A-size chute (A-DWSDs) TM ahead of tropical cyclones. An example of DWSD and surface MiniMet (wind and SLP) observations are shown for Hurricane Michael (2018), which was a Category 5 hurricane when it made landfall on the Florida Panhandle. These observations provide high-resolution wave energy and wave age across the storm, which can impact momentum exchange at the air-sea interface. Observations better captured the strength and location of the Michael's center compared to model results. Deep-water wave observations from surface drifters can be readily incorporated into, and sustained by, the Global Drifter Program (GDP) to improve storm surge and tropical cyclone forecasts, and to monitor real-time marine conditions.

Uncertainty traceability diagrams for improving the metrology of Fiducial Reference Measurements drifting buoys for satellite validation
(*Marc Lucas, Marc le Menn, & Anne O'Carroll*)

The DBCP drifting buoy network is a unique and valuable source of in-situ measurements that delivers high-quality data to many users for operational uses such as ingestion in weather forecast models or the investigation of longer time series for climate research. In the last couple of decades, the DBCP has driven substantial improvements in the data retrieval quality enabling the satellite community to improve its products, show-casing the close cooperation of all the actors involved, from the buoy manufacturers to the data archiving scientists.

In the latest phase of the Copernicus TRUSTED project, the team is now actively engaging with the metrology community through collaboration with European National Metrology Institutes (NMIs). The aim is to define the best practices required for a TRUSTED drifting buoy SST temperature measurement to be certified as FRM. To this end, an uncertainty diagram has been developed for TRUSTED drifting buoys to satisfy traceability to SI.

This presentation will present the current status of the TRUSTED uncertainty model and traceability diagram and get feedback from DBCP members. The aim is to contribute to the interactions of the drifting buoy community with the metrology community and to participate in improvements to calibration procedures to address the specific challenges of a drifting buoy system.

OceanOPS Metadata Management for TRUSTED (FRM) Drifting Buoys

(*Mathieu Belbeoch*, *Long Jiang*, *Magali Krieger*, *Anthonin Alize*, *Marc Lucas*, *Anne O'Carroll*)

Metadata affiliated with data, measurements, and instruments are of particular importance to date managers and users for various applications, for example, the Sea Surface Temperature (SST) comparison with in-situ data by drifters and those retrieved from satellites.

OceanOPS has the mandate to maintain and manage metadata of networks by the Observations Coordination Group of the Global Ocean Observing System (OCG/GOOS). One of its five strategic goals (2021-2025) is to lead metadata standardization and integration across the global ocean observing networks of GOOS.

The European Union's Copernicus-funded TRUSTED project (Towards Fiducial Reference Measurements of Sea-Surface Temperature by European Drifters) has deployed around 150 state-of-the-art drifting buoys for improved validation of SST from the Sentinel-3 Sea and Land Surface Temperature Radiometers (SLSTR). Proper representation of metadata is highly needed, especially for Fiducial Reference Measurement (FRM) sensors against paired conventional ones.

OceanOPS has been incorporating TRUSTED drifters metadata with its integrated system from the start of the project. The system has the capacity to well document essential elements of metadata for sensor performance analysis and necessary interventions with buoy operation. In the meantime, OceanOPS is working on adjustments to fully accommodate these metadata after discrepancies have been identified.

Why we need to monitor eddy currents variability in the Indonesian Seas: Towards National collaboration between Met-Ocean Research and Operational Institutions

(Widodo Setiyo Pranowo, Albertus Sulaeman, Nugroho Dwi Hananto, Nelly Florida Riama, Andri Ramdhani, Furqon Alfahmi, Nurhidayat, Johar Setiyadi, Erma Yulihastin, Noir Primadona Purba, Angga Ferdyan, Ivonne Milichristi Radjawane)

Eddy currents have a unique character because it depends on geographic location. The diameter and intensity can also vary to a certain depth. Cyclonic eddies are counter-clockwise in the northern hemisphere, while anti-cyclonic eddies are clockwise. In contrary, in the southern hemisphere, cyclonic eddies are clockwise, while anti-cyclonic eddies are counter-clockwise. Eddy currents in the Indonesian seas becomes varied because Indonesian seas is passed by the equator, and a monsoon wind system existed, with featured by complex bathymetry. These eddy currents are important because it can be associated with upwelling which correlated with primary productivity to support the fisheries sector, and it can be also related to navigation/shipping safety. Up to now, there is not any operational meteorology-oceanography existed in Indonesia that specifically monitors and provides information about the eddy currents. The progress that has been achieved so far is still in the level research studies of eddy current and its modeling, partial in several seas in Indonesia. The national level requires collaboration among institutions and universities. The collaboration can be conducted by releasing drifters/floats, improvement of the eddy currents modeling, and sharing its information from drifters/floats directly to public who have an interest in activities in the Indonesian seas.

The role of Ocean Reference Stations that withhold data to create independent benchmarks for assessing models and remote sensing

(*Robert A. Weller, Albert J. Plueddemann, Sebastien Bigorre, Jim Potemra, Roger Lukas, Chris Fairall*)

Three well-instrumented surface moorings have been maintained for ~20 years. The surface meteorological data collected by instrumentation on the surface buoys are not placed on the Global Telecommunication System (GTS) in order to create surface meteorological and derived air-sea flux time series that can serve as independent benchmarks for assessing the realism of models and remote sensing products. As a result, these three surface moorings are named Ocean Reference Stations (ORS). We first present our assessment of the accuracies of the ORS surface meteorology and air-sea fluxes. Then we present comparisons of the ORS time series with time series from atmospheric reanalyses (ERA5, NCEP2, MERRA2) and coupled climate models (CMIP6). Model-ORS differences are significant given the known uncertainties in the ORS time series. We also find that model-reanalysis differences vary over time. These results suggest to us the need for a small number of such well-documented, quality surface moorings where data are withheld in order to enable assessment of model performance. We look forward to discussion of how to facilitate stronger interactions between deployments of ORS and modelling activities.

Key findings: Modern atmospheric reanalyses have significant biases in net air-sea heat flux, delivering ~30 W m-2 too little heat into the ocean. Reanalysis model - surface mooring differences show surprising variability over twenty years. Coupled climate models' historical runs show significant regional biases in sea surface temperature and also deliver too little ehat into the ocean.

Observing Air-Sea Interaction for a predicted, safe, clean, healthy, resilient, and productive ocean

(*R Venkatesan, Meghan Cronin, Christa Marandino, Sebastiaan Swart*)

The atmosphere and the ocean influence each other and the ocean surface is an important contributor to the dynamics that drive the atmosphere. In spite of numerous research studies, the challenges still remain with limitations in our understanding of air-sea coupling. Currently, there is an increase in societal demands for improved prediction accuracy and raising expectations for scientific outcomes. To meet these expectations, need for globally distributed network of mobile air-sea interaction observing platforms built around an expanded network of fixed stations that provide long-term time series in key regions. In addition, with advancement in technology that include innovative in situ and remote observing platforms and instruments, expansion of computing infrastructure and data analysis and processing capabilities, such as machine learning and data assimilation.

The Observing the Air-sea strategy (OASIS) is developed by the SCOR Working Group #162, whose diverse membership spans data creators to information users, across multiple disciplines and methodologies. The OASIS is working to develop a practical, integrated approach for observing air-sea interactions globally. This sea-change in observing will lead to improved Earth System (including ecosystem) forecasts and surface ocean information, such as annual Global Stock take assessments of the ocean uptake of CO2 called for under the Paris Agreement. Principles of co-design are fundamental to OASIS, which has its roots in the OceanObs'19 (https://www.oceanobs19.net). With air-sea interactions improved in models, predictions of weather, climate, water will be extended and better. Bringing ecosystems into Earth system modeling will allow us to identify hotspot areas (ocean acidification, hypoxia) that need urgent intervention. OASIS calls for improved understanding and process representation of coupling in a hierarchy of Earth System models. One of the most challenging aspects of measuring air-sea fluxes, the need to measure multiple co-located Essential Ocean Variables (EOV), into a transformative opportunity to co-design an ideal and fit-for-purpose observing system. OASIS is developing best practices and performing interoperability tests, and by building a culture of mentorship and partnership, the capacity of the observing system could be significantly expanded, while providing opportunities for Early Career Ocean Professionals (ECOP) and scientists from under-resourced nations and institutions. A series of virtual workshops with stakeholders have been held to anchor the strategy to societal issues. In particular, OASIS has held virtual workshops for Air-Sea Observations for: a Predicted Ocean (Cronin et al. 2021), a Clean Ocean (Marandino et al. 2022), a Safe Ocean, an Accessible Ocean, and for Offshore Wind Energy. To find out more about OASIS and to download the workshop reports, go to: https://airseaobs.org/

A closer Look of Inner Indonesian Seas Through Drifter Buoys and Float Profilers Deployment

(*S. Adiprabowo, A. Ramdhani, N. F. Riama, E Prasetyo*)

The marine weather information demand increases alongside the marine activities around Indonesian waters. Additionally, ocean observation supports the marine weather forecast operation by assimilating, validating, and improving data accuracy. Indonesia's weather authority (BMKG) initiated the float profilers and drifters deployments to support the marine weather forecast operation through MMS - I (Maritime Meteorological Strengthening) Program. During the 2022 to 2024 period, this program deploys 48 floats and 72 drifters around Indonesia's prime and strategic waters, i.e., Natuna Sea, Karimata Strait, Java Sea, Makassar Strait, Banda Sea, Savu Sea, the Pacific Ocean, and the other future deployment spots. The ongoing deployments provide numerous ocean data. The visualized data depict Southeast Asia, especially Indonesia's ocean dynamics vary seasonally by monsoon and other forcings. We gain ocean stratification, deep ocean profile (temperature, salinity, and density), and ocean current with the SST (sea surface temperature) from the float profiler and drifter buoys. The interesting and well-known Indonesian Through Flow (ITF) is detected and well-visualized by the drifter's movement in Makassar Strait, and it varies during the monsoon and strong tidal currents. Additionally, the ongoing deployments portray the ocean's variability due to the monsoon along the Natuna Sea, Karimata Strait, to Java Sea dynamics. Further investigation and an extended data period are necessary to gain long-term variability of ocean dynamics in order to understand our changing ocean.

Towards Fiducial Reference Measurements (FRM) from drifting buoys for satellite Sea-Surface Temperature Calibration and Validation (Cal/Val)

(*Anne O'Carroll, Marc Lucas , Gary Corlett and Igor Tomazic*)

Recent Satellite SST validation activities have shown that there have been significant improvements in global drifting buoy SST, following requests initiated 10 years ago from the Group for High-Resolution Sea-Surface Temperature (GHRSST). All satellite SST data providers successfully routinely use global drifting buoy measurements for validation activities.

As a further subset of these drifting buoy in-situ measurements, extremely high-quality reference in-situ measurements of Sea-Surface Temperature (SST) are also essential for satellite validation activities providing a way to ensure climate quality satellite SST time-series and deriving their uncertainties, such as from the Copernicus Sentinel-3 missions. These in-situ measurements are referred to as Fiducial Reference Measurements (FRM). FRM of drifting buoy SST are a sub-set of calibrated measurements, provided together with metadata, Quality Control (QC) information, stability analyses, SI traceability and validated uncertainty models per instrument.

The Copernicus funded TRUSTED project made progress towards the definition of FRM specifications in the context of the need for satellite SST Cal/Val. A set of recommendations were formulated during the science review workshop in 2021 in coordination with the DBCP and GHRSST communities.

This presentation will give a summary of the latest status of FRM definitions and how these relate to HRSST. Ongoing coordination and activities with the DBCP and global drifting buoy and Metrology communities towards these aims will be summarised. Progress of work towards the design of a sea-ice drifter will also be described.

The new Iridium Certus service & NAL's Research Quicksilver

(*J. Huynh*)

Currently, NOAA buoys used in the Tropical Array, Indian Ocean, and Pacific Array utilize Narrowband's 2.4 kbps service which requires much preprocessing of the buoy data due to its ultra-low bandwidth. A major issue that arises from this sort of data preprocessing is that the information is received as averages rather than giving a full set of data for analysis. The new Iridium Certus service, in conjunction with the use of the NAL Research Quicksilver, provides 88kbps for downlink and 22kbps for uplink, alleviating the need for hourly or daily data averaging. The Quicksilver has AT Command capability and RS-232 which allows for easy communication with NOAA buoys. As a result, users would now be able to get real-time data providing more useful and accurate forecasting models.

Lagrangian Drifter Lab Real-time Data Management

(*Lance Braasch and Luca Centurioni*)

The Lagrangian Drifter Lab (LDL) at Scripps Institution of Oceanography, oversees the fabrication and purchase of approximately 1,000 Surface Velocity Program (SVP) drifters per year. In addition to drifter hardware engineering, procurement and fabrication, the LDL also manages their data stream, from satellite airtime, data collection, decoding and archival, to distribution to stake holders and onto the Global Telecommunications System (GTS). Here, we present the progress, findings and lessons learned from the management and evolution of a real-time drifter array over the past decade and it's impacts to society.

Hourly temperatures from NOAA's Global Drifter Program

(*Shane Elipot, Adam Sykulski, Rick Lumpkin, Luca Centurioni, Mayra Pazos*)

A new dataset of hourly sea surface temperatures around the world has been derived from drifting buoy observations of NOAA's Global Drifter Program (GDP) and published in the peer-reviewed literature. Total, diurnal, and non-diurnal SST components and their formal error bars were derived to accompany the on-the-hour locations and velocities of the GDP Hourly Data. This talk will present an overview of the methodology, show examples of hourly time series, and suggest some potential applications.

The SMART Cables Initiative for Observing the Ocean and Earth: An Update
(*Bruce Howe*)

The Joint Task Force for Science Monitoring And Reliable Telecommunications (SMART) Subsea Cables is working to integrate environmental sensors (temperature, pressure, seismic acceleration) into submarine telecommunications cables. This will support climate and ocean observation, sea level monitoring, observations of Earth structure, tsunami and earthquake early warning and disaster risk reduction. We present an overview of the initiative and a description of ongoing projects, including: the InSea wet demonstration project off Sicily; progress towards installation of a cable connecting Vanuatu and New Caledonia; cable plans between islands of Indonesia; the CAM ring system connecting the Portuguese mainland, Azores and Madeira; a planned cable from New Zealand to the Chatham Islands; and a plan for a cable connecting Antarctica to New Zealand. These regional SMART pilot systems are the initial steps to trans-ocean and global implementation and will be influential in the final standards and policies that evolve. In addition to the diverse scientific and societal benefits, the telecommunications industry mission of societal connectivity will also benefit because environmental awareness improves both individual cable system integrity and the resilience of the overall global communications network, upon which data distribution and early warning depends.

Backyard Buoys: a project at the intersection of new technologies and indigenous knowledge
(*Sebastien O.C. Boulay, Jan Newton, Sheyna Wisdom, Melissa Iwamoto*)

Under the National Science Foundation (NSF) Convergence Accelerator program, Team Backyard Buoys brings together regional ocean observing networks (PACIOOS, NANOOS, AOOS) of the U.S. Integrated Ocean Observing System (IOOS), underserved Indigenous coastal communities, and a sensor company as partners working collectively to democratise local wave measurements and provide a solution to the existing hurdle of observing technologies that are too expensive to purchase and to sustain. Our work starts to address inequities and helps to increase autonomy, as community members will choose where and how the buoys are deployed—in places where it matters most to them—and will steward the buoys in their community. This facilitates their blue economy with safer and more efficient fishing, cultural practices, and local entrepreneurs.

During Phase I, our team produced an actionable research and implementation planning model for community engagement and ocean observing stewardship, working with partners across the three geographically distinct regions (Pacific Northwest, Alaska, Pacific Islands) including diverse Indigenous partners within each region. The outcome of this Phase I effort is the detailed outline for what we are calling a Community Research Implementation and Stewardship Plan (CRISP).

In Phase II we will utilise a modular, sustainable, and exportable process for community-led stewardship of affordable ocean buoys in each region. Through training modules, communities will be involved along with ocean observing system staff. The hyper-local wave data will be available to improve localised weather and ocean forecasts; new baseline data enhances nearshore climate dynamics research and plans for effective adaptation strategies. We will develop region-specific curricula with new partners to inform a wider community and entrain the next generation.

Introduction of the self-sustaining deep profiling float: Fuxing-4000

(*Dr. Jiayi Xu, Tianjin University, Pilot National Laboratory for Marine Science and Technology (Qingdao)*)

As an observation platform capable of long-term, continuous and accurate observation for the 4000-meter deep ocean, the "Fuxing-4000", jointly developed by Tianjin University and Pilot National Laboratory for Marine Science and Technology (Qingdao) for 6 years, has advantages of ultra-low power operation, accurate hovering observation, stable satellite transmission with IRIDIUM/BDS, and can be equipped with various types of sensors, such as conductivity, temperature, and depth sensor or sound velocity profiler. At the same time, the developed hardware-in-the-loop simulation system can significantly improve the reliability of "Fuxing-4000" by simulating the distribution of ocean density. "Fuxing-4000" was first deployed in the Western Pacific in August, 2019 and 48 cycles with temperature and salinity data over 4000 meters have been operated. The temperature is basically consistent with WOA2018, and the salinity is within 0.01PSU compared with WOA2018. Later in December 2021, "Fuxing-4000" has been deployed in the Indian Ocean. A single set of equipment has obtained 136 sets of 4,000-meter-level profile temperature data, which comprehensively reflect the temperature distribution in the depth range of 0-4,000 meters. The successful deployment of "Fuxing-4000" can effectively improve the observation ability of deep data, and provide reliable data support for the research on the deep sea.

Distributed, Agile Buoy Network to Advance Private-Public Partnerships
(*Pieter Smit*)

Small, easily deployed drifter buoys are ideal for public-private partnership projects that seek to quickly observe data-sparse areas. Sofar Ocean is currently participating in multiple projects - including work with regional U.S. Integrated Ocean Observing System (IOOS) organizations, the U.S. National Oceanographic Partnership Program (NOPP), and the U.S. National Ice Center - that empower local communities, researchers, and government entities with ocean data on a rapid timeline.

Over the past 3 years, Sofar Ocean has continuously deployed free-drifting Spotter wave buoys globally, building up to a network of more than 700 sensors. The buoys are solar-powered and satellite-connected, and collect data about waves (including wave spectra), wind, sea surface temperature, and barometric pressure. The assimilation of the full spectral data combined with publicly available satellite data into Sofar's operational WaveWatch3 forecast model improved model skill (up to 50%) compared to the other global wave model based on satellite data assimilation alone.

Data from these sensors is available to the research community to improve the maritime domain awareness and skills of numerical models. In this talk we wish to discuss several successful public-private partnerships that Sofar has engaged with in parallel to these deployment efforts.

List of posters;

- Iceberg tagging experiment (ITEX) update and next steps (*Ignatius Rigor, John Woods, Cy Keener, Keld Qvistgaard, Justine Holyman, Ben Cohen*)

- FX-400 self-sustaining deep profiling float (*Tianjin University, Pilot National Laboratory for Marine Science and Technology, Qingdao*)

Annex 3

List of Participants	NAME	AFFILIATION	COUNTRY
1	A. M Al Janahi	Marine Emergency Mutual Aid Centre	Kingdom of Bahrain
2	Abdalbast H. I. Fadel	Libyan Intergovernmental Oceanographic Commission of UNESCO	Libya
3	Alex Velasco	AXYS Technologies	Canada
4	Alexander Zucconi	Meteorological Service of Canada	Canada
5	Alvaro Scardilli	Servicio de Hidrografía Naval	Argentina
6	Ambesi Hans Ndonwi	Department of National Meteorology	Cameroon
7	Amr Zakaria Hamouda	National Institute of Oceanography and Fisheries	Egypt
8	Ann-Christine Zinkann	NOAA	United States
9	Anthony Rea	WMO	Switzerland
10	Audia Azizah Azani	Indonesian Agency for Meteorology Climatology and Geophysics	Indonesia
11	Basanta Kumar Jena	National Institute of Ocean Technology	India
12	Boris Kelly-Gerryn	BOM	Australia
13	Bruce Howe	JTF SMART Cables, Univ of Hawaii at Manoa	United States
14	Candice Hall	USACE ERDC	United States
15	Caridad Ibis Gonzalez	GDP/AOML/NOAA	United States
16	Champika Gallage	WMO	Switzerland
17	Charina Lyn A. Repollo	Marine Science Institute, University of the Philippines	Philippines
18	Ching-chi Lam	Hong Kong Observatory	Hong Kong, China
19	Chi-kin Chow	Hong Kong Observatory	Hong Kong, China
20	Christopher Moore	NOAA Pacific Marine Environmental Lab	United States
21	Chunying Liu	NOAA/NCEI	United States
22	David Legler	NOAA	United States
23	David W. Velasco	Nortek Group	United States
24	Denizhan Erol	Turkish State Meteorological Service	TURKEY
25	Dewdath Bhaggoe	Ministry of Public Works, Meteorological Department Suriname	Suriname
26	Dickson Dick-Shum LAU	Hong Kong Observatory	Hong Kong, China
27	Dijana Klarić Rebac	Meteorological and hydrological service of Croatia	CROATIA
28	Dilwei M. Ngemaes	NOAA National Weather Service, WSO Palau	Palau
29	Divine Worlanyo Hotor	Council for Scientific and Industrial Research (CSIR) - Water Research Institute (WRI)	Ghana
30	Dominic Berod	WMO	Switzerland
31	Dongbin Zhang	China Meteorological Administration	China
32	E. Pattabhi Rama Rao	Indian National Centre for Ocean Information Services (INCOIS)	India
33	Emma Heslop	IOC/UNESCO	France

34	Emre GÜLHER	Turkish Navy-Office of Navigation, Hydrography & Oceanography	Türkiye
35	Emre Tukenmez	Office of Navigation, Hydrography and Oceanography	Türkiye
36	Eric Asuman	Ghana Meteorological Agency	Ghana
37	Faiza Al-Yamani	Kuwait Institute for Scientific Research	Kuwait
38	Fan Jiang	North Branch of MNR	China
39	Fores Collins	IOC/UNESCO	France
40	Francisco José Gavidia Medina	Natural Hazards and Resources Observatory. Environment Ministry	El Salvador
41	Fraser Cunningham	Met Office	United Kingdom
42	Gabriel Antonio Herrera Diaz	DIRECCION GENERAL MARITIMA	Colombia
43	Gabriel Hoinsoude Segniagbeto	Laboratory of Ecology & Ecotoxicology, Faculty of Sciences, University of Lome	Togo
44	Gabriele Nardone	ISPRA	Italy
45	Gibson Dicovichs Márquez Hernandez	Directorate Hydrography and Navigation	Peru
46	Guillerm Christophe	Meteo France	France
47	Ignatius Rigor	U. Washington	United States
48	Igor Ashik	Arctic and Antarctic Research Institute (AARI)	Russian Federation
49	Inês Marina Serra Martins	Instituto Hidrográfico	Portugal
50	Jimmi Nugraha	Research and Development Center, Indonesia Agency for Meteorological, Climatological, and Geophysics (BMKG)	Indonesia
51	John Nangle	NOAA	United States
52	John Ngatia Ndarathi	UNESCO - IOCAFRICA	Kenya
53	John/Huai-Min Zhang	US NOAA National Centers for Environmental Information (NCEI)	United States
54	Jonathan Alleyne	Barbados Meteorological Services	Barbados
55	Jonathan Huynh	NAL Research	United States
56	Jonathan Turton	Met Office	United Kingdom
57	José Luis Alcívar González	Instituto Oceanográfico y Antártico de la Armada.	Ecuador
58	Joseph Naughton	NOAA	United States
59	Joseph Nyingi Kamau	Kenya Marine Fisheries Research Intitute	Kenya
60	Juan Pablo Jorquera	Hydrographic and Oceanographic Service of the Chilean Navy	Chile
61	Jungwook Shin	KHOA	Republic of Korea
62	Kafayat Bakarr	Widop Charity Org	Sierra Leone
63	Kai Herklotz	Federal Maritime and Hydrographic Agency	Germany
64	Kalpana Chaudhari	Institute For Sustainable Development and Research, ISDR, India	India
65	Karen Grissom	NOAA/NDBC	United States
66	Ken Connell	NOAA / PMEL	United States
67	Kevin O'Brien	UW/CICOES, NOAA/PMEL, GOOS OCG	United States
68	Khafid Rizki Pratama	BMKG	Indonesia

69	Kim Woosuk	KMA - Korea Meteorological Administration	Republic of Korea
70	Kwame Adu Agyekum	Department of Marine & Fisheries Sciences, University of Ghana	Ghana
71	Kyle MacInnis	MetOcean Telematics	Canada
72	Lancelot Braasch	Scripps Institution of Oceanography Lagrangian Drifter Laboratory	United States
73	Lee Taeyun	Korea Meteorology Administration	Republic of Korea
74	Liu Na	National Meteorological Information Center	China
75	Liu Yuan	Atmospheric Observation Technology Centre	China
76	Liutao	National Meteorological Information Center	China
77	Long Jiang	OceanOPS	France
78	Lotfi Khammari	National Institute of Meteorology	Tunisia
79	Luc Bujold	Fisheries and Oceans Canada, Government of Canada	Canada
80	Luca Centurioni	Lagrangian Drifter Laboratory, Scripps Institution of oceanography	United States
81	Luis Pedro García Arroyave	National Institute for Seismology, Volcanology, Meteorology, and Hydrology -INSIVUMEH-	Guatemala
82	MAIDAAWE BAHANE Hadjati Pulchérie	Department of National Meteorology of Cameroon	Cameroon
83	Makaoui Ahmed	Institut National de Recherche Halieutique (INRH)	Morocco
84	Marc Lucas	CLS	France
85	Marco Picone	ISPRA	Italy
86	María Victoria Yang	Servicio de Oceanografía Hidrografía y meteorología de la Armada SOHMA	Uruguay
87	Martha Schonau	SIO/LDL	United States
88	Martin Kramp	OceanOPS	France
89	Mathieu Belbeoch	OceanOPS	France
90	Max Norman Sitai	Solomon Islands Meteorological Service	Solomon Islands
91	Mika Odido	Intergovernmental Oceanographic Commission of UNESCO	Kenya
92	Mike Angove	US NOAA/NWS Tsunami Program Manager	United States
93	Miriam Lucero M.	Instituto Oceanográfico y Antártico de la Armada	Ecuador
94	Mohamed Adel Abdelaziz Ramadan	Ocean Sciences and Techniques Academy	Egypt
95	Mohamed Arcene	National Agency for Civil Aviation and Meteorology	Comoros
96	Ms.Somita Chaudhari	Institute For Sustaianble Development and Research, ISDR, India	India
97	Myrian Tamayo Infantes	Dirección de Hidrografía y Navegación	Perú
98	Nadim Mahmud	Bangabandhu Sheikh Mujibur Rahman	Bangladesh

		Maritime University	
99	Nan ZHANG	China Meteorological Administration	China
100	Nelly Florida	BMKG	Indonesia
101	Ngoc Hoang	NAL Research	United States
102	Noah N Ngisiange	Kenya Marine and Fisheries Research Institute	Kenya
103	Nuran Altay	Türkish State Meteorological Service	Turkey
104	Olivier Desprez de Gésincourt	METEO-FRANCE	France
105	OMAR FUAD SAEED BA GUNAID	Hadramout sat	Yemen
106	Paul Ng'ala Oloo	Assistant Director/Kenya Meteorological Department	Kenya
107	Paulo André de Sousa Coelho	Instituto Nacional de Investigação Pesqueira e Marinha	Angola
108	Peace Dziedzom Gbeckor - Kove	Environmental Protection Agency-Ghana	Ghana
109	Petra Heil	Australian Antarctic Division and Australian Antarctica Program Partnership	Australia
110	Pinar Eskioglu	Turkish State Meteorological Service	TURKEY
111	Pritha Lila Tutasi Lopez	Instituto Oceanografico Y Antartico de la Armada	ECUADOR
112	Prof Isabelle Ansorge	University of Cape Town	South Africa
113	Qiu(Rachel) Jiang	NCOSM	China
114	Radulescu Vlad	National Institute for Research and Development on Marine Geology and Geo-ecology – GeoEcoMar	Romania
115	Raja Acharya	India Meteorological Department	India
116			
117	Rick Cole	RDSEA International, Inc.	United States
118	Rick Lumpkin	NOAA/AOML	United States
119			
120	Rita Esteves	Instituto Hidrográfico	Portugal
121	Robert E. Jensen	USACE Engineer Research and Development Center / Coastal and Hydraulics Laboratory	United States
122	Robert Weller	Woods Hole Oceanographic Institution	United States
123	Sabir Ali	Pakistan Meteorological Department	Pakistan
124	Samuel Radityo Adiprabowo	BMKG	Indonesia
125	Saud Jaber Musallam Al-Harthi	National Center for Meteorology	Kingdom of Saudi Arabia
126	Sebastien Boulay	Consultant	New Zealand
127	Serge Hagan-Deschamps	Retired Marine Manager	Canada
128	Seungho Lee	Korea Hydrographic and Oceanographic Agency	Republic of Korea
129	Shaun Dolk	NOAA/AOML	United States
130	Shou Shimamura	Japan Meteorological Agency	Japan

131	Shin Jungwook	KHOA	Republic of Korea
132	Silipa Art Mulitalo	Samoa Meteorological Service	Samoa
133	Sohou Zacharie	Institut de Recherches Halieutiques et Océanologiques du Bénin (IRHOB)	Republic of Benin
134	Sonia Recalde	Instituto Oceanográfico y Antártico de la Armada	Ecuador
135	Steve Knowles	MetService	New Zealand
136	Susan West	NOAA/National Weather Service	United States
137	Suzan Mohamed Elgarabawy	National Institute of Oceanography and fisheries	Egypt
138	Taeyun Lee	KMA	Republic of Korea
139	Tamaryn Morris	South African Weather Service	South Africa
140	Tania Daniels	South African Weather Service	South Africa
141	Tareq Omer Alsayali	Marine Science & Biological Research Authority - Hadramout Branch -Yemen	Yemen
142	Tata Sudhakar	National Institute of Ocean Technology	India
143	Tetsuya Takemi	Kyoto University	Japan
144	Than Naing	Department of Meteorology and Hydrology	Myanmar
145	Theresa Paluszkiewicz	SIO/LDL	United States
146	Thierry Carval	Ifremer	France
147	Thomas Zackious	Chief forecaster/Kiribati met service	Kiribati
148	Tin (Julia) Yu	IOC/UNESCO	France
149	Tobias Ramalho dos Santos Ferreira	Brazilian Navy Hydrography Center (Centro de Hidrografia da Marinha)	Brazil
150	Trajce Alcinov	Marine Environmental Data Section (MEDS), Fisheries and Oceans Canada	Canada
151	Val Swail	Environment and Climate Change Canada	Canada
152	Vasily Smolyanitsky	Arctic and Antarctic Research Institute (AARI)	Russian Federation
153	Verena Hormann	Scripps Institution of Oceanography, UC San Diego	United States
154	Veselka Marinova	Institute of Oceanology, Bulgarian Academy of Sciences (IO-BAS)	Bulgaria
155	Weilin “Will” Hou	Office of Naval Research Global	United States
156	William H. Burnett	NOAA/National Weather Service/OBS/National Data Buoy Center	United States
157	Xiaixia Li	CMA	China
158	Yeltay Aizat	RSE Kazhydromet	Kazakhstan
159	Yombom Balthaza Awenti	Department of National Meteorology	Cameroon
160	Xinyang Yue	National Marine Data and Information Service	China
161	Zhaobin Sun	CMA Meteorological Observation Center	China
162	Zhihong Liao	National Meteorology Information Centre	China
163	Ziad Safi	NAL Research	United States

Annex 4
Links to documents

DBCP OceanOPS report

Task Team on Data Management

Task Team on Moored Buoys

Task Team on Wave Measurements

Task Team on Environmental Stewardship

Decisions of WMO

DBCP Financial Report

Annex 5
Actions and Recommendations

Actions

	Action	By who	By when
1.	The DBCP community is requested to be actively involved in future dialogue with the industry.	DBCP members	Feb 2023
2.	Task Team on Waves Measurements (TT-WM), Task Team on Data Buoy Best Practices and Technology Development (TT-DBPD), and Task Team on Data Management (TT-DM) are requested to provide further technical training and assistance to the Solomon Islands Meteorological Service on the regular maintenance and deployment of the drifter	TT-WM, TT-DBPD, TT-DM	next 2-4 years
3.	DBCP drifter buoy operators are requested to increase the number of barometer drifter deployments and/or to take advantage of the barometer upgrade programme	DBCP members	Ongoing
4.	WMO WIGOS manual (WMO No. 1160) provides "Attributes specific to surface marine stations" (Appendix 5.2). DBCP members are requested to provide as many meteorological variables as possible among those listed in Attachment 5.1	DBCP members	Ongoing
5.	Drifter buoy operators are requested to plan their deployments to close the primary data gaps in the Indian Ocean	AG-International Buoy Program for the Indian Ocean (IBPIO)	DBCP-39
6.	TT and AGs are requested to strengthen their communication with OceanOPS to optimally use the services offered by the OceanOPS	TT and AG chairs	ongoing
7	DBCP members who are willing to have drifters upgraded with a wave sensor are requested to contact GDP.	DBCP members	DBCP-39
8	To even out the drifter density across the global ocean (currently a denser network in North Atlantic and less in the Indian ocean), primarily the Panel members from the European region are requested to consider deploying their drifters in data sparse Indian Ocean region.	DBCP members	DBCP-39
9	Assist El Salvador to distribute their buoy data to the GTS and other data centres (i.e. NDBC, USA)	Technical Coordinator with TT-DM	August 2023
10	Allocate more time in the agenda for the new countries to introduce themselves and build a connection with the community	DBCP EXB	DBCP-39
11	Allocate more discussion time after major topics on the agenda	DBCP EXB	DBCP-39
12	Try to diversify the TTs, AGs, and WGs membership with a focus on getting young members for succession planning and report the progress at DBCP-39	TT, AG, WG Chairs	DBCP-39
13	Panel members are requested to submit the National Report at least 1 month before the session and inform the Secretariats of their intention to deliver an oral presentation by the deadline listed in the WMO/IOC invitation letter	DBCP members	DBCP-39
14	All panel members are invited to make use of the barometer upgrade opportunity	DBCP members	ongoing
15	Investigate the opportunities to collaborate with the	IPAB	DBCP-39

	Southern Ocean Observing System (SOOS) in the Antarctic observing activities		
16	Connect with Animal Borne Ocean Sensors (AniBOS) to find potential collaboration to deploy more sensors (i.e. air pressure) using the AniBOS network	IPAB	DBCP-39
17	Suggested to coordinate with South African Polar Research Infrastructure (SAPRI)in marginal sea ice research	IPAB	DBCP-39
18	Review the data and metadata flow diagrams circulated by the TT-DM and provide comments on the ITP data flow	ITP	May 2023
19	Panel members are invited to join the AGs, contribute to their activities, and share their thoughts on how to enhance the work of AGs	DBCP members	DBCP-39
20	Allocate more time for AG parallel sessions allowing to address the most important subjects and especially giving time for new members to express their ideas	DBCP EXB	DBCP-39
21	The leads of the AGs and TTs are requested to submit the report at least 2 weeks before the DBCP annual session	AG and TT chairs	DBCP-39
22	All platform operators are requested to submit their metadata in WIGOS metadata format to OceanOPS	DBCP platform operators	ongoing
23	Allocate more time for TT parallel sessions	DBCP EXB	DBCP-39
24	OceanOPS is given delegated authority to issue WMO Identifications for all ocean platforms. Platform operators should obtain WMO IDs from the OceanOPS platform	DBCP platform operators	ongoing
25	Interested DBCP members are invited to join quarterly roundtables to discuss data flow issues within the networks and contribute to the discussions	DBCP members, TC	DBCP-39
26	Work towards establishing a Data Acquisition Centre (DAC) or a Global Data Assembly Centre (GDAC) for Moored buoy and wave data	TT-WM, TT-MB	DBCP-39
27	DBCP members willing to host a capacity-building workshop in their country/region are requested to contact TT-CB chair	DBCP members	March 2023
28	TT-CB is requested to collaborate with TT-ES to include Environmental Stewardship and awareness in capacity building agenda	TT-CB	DBCP-39
29	DBCP members are requested to report vandalism events which are crucial to know the extent to finding solutions	DBCP members	DBCP-39
30	Provide more information to Mr. Faiza AL-YAMANI of Kuwait on the cameras installed on buoys to tackle vandalism issues	TC with K. Grissom	March 2023
31	Organize a meeting or a workshop with all DACs and GDACs to better understand and document what information (data and products) is made available by each GDAC and DAC	TT-DM with TC	DBCP-39
32	Provide information on the data and products made available by each DAC and GDAC on the DBCP website	TC	DBCP-39
33	Arrange a meeting with the applicable WMO department and LDL to clarify rules around data shared on the GTS	WMO Secretariat	March 2023
34	: Assist MEDS to correct issues with GTS routing and header	TC	May 2023
35	Encourage and facilitate female youth scientists to join DBCP activities	All AG, TT, and WG chairs	DBCP-39
36	Aggregate information of the DBCP programs-related	Chair of the	DBCP-39

	scientific publication information provided through a variety of sources including National reports and report them under the Scientific Excellence at DBCP annual sessions	Scientific Excellence with DBCP TC	
37	Request Panel members to consider contributing to the DBCP-TF towards DBCP and OceanOPS activities	DBCP members	DBCP-39
38	Send out the Executive Board nomination request with all the details to the DBCP members with an extended deadline of November 30, 2022	WMO Secretariat	10 November 2022
39	Allocate appropriate time to review the actions and recommendations either on the last day of the meeting or at the end of each day of the meeting	DBCP EXB	DBCP-39

Recommendations

	Recommendation	To
1	Organize a webinar or other information resources (i.e. short videos) explaining the process to request WMO Identifications for ocean platforms	OceanOPS
2	Often, ocean science-related publications refer to multiple ocean observing networks. Therefore, to coordinate the efforts of tracking science publications on ocean observing networks, OceanOPS is requested to maintain a central repository of scientific publications with the ability to filter the information on a network basis	OceanOPS
3	Under the OCG umbrella networks are encouraged to continue collaboration and discussions between networks to find collective solutions to the challenges of integrating BGC observation and data management into their networks.	OCG Networks

Annex 6
Table of Abbreviations

AARI	Arctic and Antarctic Research Institute
ADCP	Acoustic Doppler Current Profilers
AG	Action Groups
AIS	Automatic Identification System
AniOBS	Animal Borne Ocean Sensors
AOML	Atlantic Oceanographic and Meteorological Laboratories
ASAP	Automated Shipboard Areological Program
BGC	Biogeochemical
BoM	Bureau of Meteorology
BOON	Boundary Ocean Observing Network
BUFR	Binary Universal Form for Representation of meteorological data
CDIP	Coastal Data Information Program
CSV	Comma-Separated Values
DAC	Data Acquisition Centres
DBCP	Data Buoy Cooperation Panel
EEOO	Extreme Events, and Ocean Observations
EEZ	Exclusive Economic Zones
EOI	Expression Of Interest
EOV	Essential Ocean Variables
ES	Environmental Stewardship
ESM	Earth System Monitoring
ETOOFS	Expert Team on Operational Ocean Forecast System
EU	European Union
EXB	Executive Board
FAIR	Findable, Accessible, Interoperable, and Reusable
FRM	Fiducial Reference Measurements
FTP	File Transfer Protocol
GBON	Global Basic Observing Network
GCOS	Global Climate Observing System
GDAC	Global Data Assembly Center
GDP	Global Drifter Programme
GDPFS	Global Data Processing and Forecasting System
GHFR	Global High-Frequency Radar
GHG	Greenhouse Gas
GOOS	Global Ocean Observing System
GTS	Global Telecommunication System
HKO	Hong Kong Observatory
IABP	Interagency Arctic Buoy Program
IMOS	Integrated Marine Observing System
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange
IPAB	International Programme for Antarctic Buoys
ITEX	Iceberg Tagging EXperiment
ITP	International Tsunameter Partnership
ITU	International Telecommunication Union
JCB	Joint Collaborative Board
KOPRI	Korean Polar Research Institute
LDL	Lagrangian Drifter Laboratory
MB	Moored Buoy
MCDS	Marine Climate Data System

MEDS	Marine Environmental Data Section
MTS	Marine Technology Society
NCM	National Center for Meteorology
NDBC	National Data Buoy Centre
NIOT	National Institute of Ocean Technology
NIPR	National Institute for Polar Research
NMS	National Meteorological Services
NOAA	National Oceanic and Atmospheric Administration
NWP	National Weather Prediction
OBPS	Ocean Best Practices System
OCG	Observations Coordination Group
PMEL	Pacific Marine and Environmental Lab
Q&A	Questions and Answers
QC	Quality Control
RRR	Rolling Review of Requirement
S&T	Science and Technology
SIDS	Small Island Developing States
SIO	Scrips Institute of Oceanography
SIZRS	Seasonal Ice Zone Reconnaissance Surveys
SLP	Sea Level Pressure
SOFF	Systematic Observation Financing Facility
SOOP	Ship of Opportunity Programme
SOOS	Southern Ocean Observing System
SOP	Standing Operating Procedure
SOT	Ship Observations Team
SST	Sea Surface Temperature
SVP	Surface Velocity Programme
TAO	Tropical Atmospheric Ocean
TC	Technical Coordinator
TPOS	Tropical Pacific Observing System
TT	Task Teams
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USACE	US Army Corps of Engineers
USV	Unmanned Surface Vehicles
VOS	Voluntary Observing Ships
WDQMS	WIGOS Data Quality Monitoring System
WG	Working Groups
WIGOS	WMO Integrated Global Observing System
WIPPS	WMO Integrated Prediction and Processing System
WM	Wave Measurements
WMO	World Meteorological Organization
XBT	EXpendable BathyThermograph