DATA BUOY COOPERATION PANEL

Thirty-Seventh Session

08 – 11 November 2021

Virtual Meeting

Meeting Report No. XXX

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WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

DATA BUOY CO-OPERATION PANEL

THIRTY-SEVENTH SESSION

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Contents

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EXECUTIVE SUMMARY

The Thirty-seventh Session of the Data Buoy Cooperation Panel (DBCP-37) was held virtually via video conference from 08 – 11 November 2021. 145 members from 46 Members/Member States 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:

- Stronger engagement with the DBCP user community
- Science and Technology workshop – how DBCP data saves lives
- Environmental Stewardship
- Developing ties with the Private Sector
- How the new WMO Policies strengthens the DBCP

Dr Dominique Bérod, Head of the Earth System Monitoring Division, Infrastructure Department of World Meteorological Organization (WMO), opened the Thirty-Seventh Data Buoy Cooperation Panel Session (DBCP-37), and Scientific and Technical Workshop which was the second virtual session through the MS Teams Meeting platform.

Dr Anthony Rea, Director of the Infrastructure Department of World Meteorological Organization (WMO) gave his opening remarks on behalf of the WMO Secretariat. He reinforced the importance of the DBCP community to the WMO and the observations provided to the international community.

Dr Emma Heslop (IOC/UNESCO) stated that it is a very important time for the DBCP with the formulation of the new Strategy moving forward. Her presentation showed how DBCP connects into GOOS and the vital role it plays within the Global Ocean Observing System.

Dr David Legler of NOAA, Chair of Observation Coordination Group (OCG) summarized the new OCG Terms of Reference (ToR). OCG works with several

observing systems to ascertain that the ocean observing system is working effectively, coordinates all activities, evaluates the progress to date, and helps to identify gaps. They are working to integrate across all these networks to ensure a comprehensive in-situ global observing system.

Dr. Boris Kelly-Gerreyn from BOM, Chair of DBCP, made his opening remarks, giving thanks to the opening speakers. On behalf of the DBCP Executive Board, we are delighted to welcome all to DBCP 37 live across the world. The DBCP brings together a global community that is dedicated and committed to in-situ observations which significantly contributes to the scientific understanding of the earth system and underpins critical services that helps to save lives.

The Science and Technology workshop focused on the impact and value that buoy data has on the user community, including for Numerical Weather Prediction (NWP), climate, extreme events, and the potential contribution to UN Ocean Decade. The workshop was co-chaired by Dr Rick Lumpkin and Ms. Rita Esteves and seven presentations were delivered.

Dr Jiang Long delivered the DBCP and OceanOPS report. Dr Jiang identified his extensive support to the Task Teams, notably their Terms of Reference realignment to the new DBCP Strategy and the establishment of the new task team on Environmental Stewardship. Dr Jiang underlined issues for the Panel that will need to be addressed such as the gap in the Indian and South Atlantic Oceans for the global drifter array, only 1% of the wave data from drifting buoys are visible on the GTS and others based on OceanOPS record. Finally, Dr Jiang presented the Technical Coordinator's work priorities for the coming intersessional period for review and approval by the Panel.

Ms Laura Medeiros (Canada) chaired the National Reports session. The Panel received 29 National/Territorial Reports on current and planned buoy programs, while 14 of them made presentations on their activities.

The User Impact and Engagement session demonstrated the importance of the DBCP data, to make sure that it has the right observations in the right place being delivered

where and when they are most needed. The two invited guest speakers demonstrated how DBCP data saves lives.

- Dr Srinivasa Kumar Tummala, Director of the Indian National Center for Ocean Information Services (INCOIS) of India described the role of Observing Networks in Tsunami Early Warning.

- Mr Kenneth Graham, Director of the National Hurricane Center for NOAA's National Weather Service (NWS) presented on how better observations leads to better services.

Dr Boris Kelly-Gerreyn presented the DBCP 5-year Strategy along with the Operating Principles and the Operating Principles. The Implementation of the Strategy will be the focus of the new Executive Board. The DBCP Strategy 2022-27 guides everything that the DBCP does from now on.

The Task Teams and Action and Working Groups presented on the activities that were completed this year and their planned tasks for next year. Their major task was the review of their terms of reference to make sure that they are aligned with the new DBCP Strategy. A new Task Team on Environmental Stewardship was developed. It demonstrated the amount of work done by DBCP Members for the ocean community.

Ms Karen Grissom, Oceanographer at the NDBC, is the Chair of the new Task Team on Environmental Stewardship (TT-ES). She presented on the importance of environmental stewardship as in pertains to the DBCP. TT-ES needs the members of DBCP to recognize that environmental stewardship is to be considered as part of their normal operations.

Dr Emma Heslop from IOC and Dr Sidney Thurston of NOAA were the speakers for the session on the growing engagement with the commercial sector. GOOS envisions an Ocean Observing System to be co-designed with industry partners that will result in a set of recommendations that both the Marine Technology Society (MTS) and

GOOS have the ability and interest to support. The goal of the SC-ON – HMEI discussions is to produce practical and actionable recommendations.

Topics for discussions

What key issues you would like raised through Industry Dialogue?

What key areas most need innovation and/or new technologies?

What experiences have you had engaging with Private Sector and opportunities that you see to constructively engage?

Dr Dominique Bérod presented the results and decisions from the WMO Extraordinary Congress. There are 3 decisions related to the Oceans. The WMO Unified Data Policy, the Global Basic Observing Network, and the Systematic Observations Financing Facility. These 3 Policies are completely inter-connected. The goal of these policies is to have better observing systems and data for better services.

Dr Boris Kelly-Gerreyn, Chair of the DBCP, presented the Executive Board report. He described the work that was accomplished over the past year, as well as participating in OCG-12 as Chair of DBCP. The Panel approved the 2022 DBCP Panel Expenditure Plan.

Dr Bérod announced the DBCP Executive Board Election Results and thanked all that had put their names forward and to the board members that rotated off.

GENERAL SUMMARY OF THE WORK OF THE DBCP-37 SESSION

1. Opening and Welcome to the DBCP Session

Dr Dominique Bérod, Head of the Earth System Monitoring Division, Infrastructure Department of World Meteorological Organization (WMO), opened the Thirty-Seventh Data Buoy Cooperation Panel Session (DBCP-37), and Scientific and Technical Workshop at 12:00 UTC on Monday, 08 November 2021, as a virtual session through MS Teams Meeting platform.

Dr Anthony Rea, Director of the Infrastructure Department of World Meteorological Organization (WMO) gave his opening remarks on behalf of the WMO Secretariat. He reinforced the importance of the DBCP community to the WMO and the observations provided to the international community. They are critical to the Earth System approach that the WMO has adopted. The sea surface temperatures are drivers of tropical cyclone intensity, hurricane intensity, and to the understanding the oceanic circulation. They are critical in understanding of the interactions between ocean system and sea-ice and ice-shelves for climate research. Ocean temperature observations will be critical to our understanding in the coming years. The WMO has a critical role in terms of informing what is happening now – the weather forecasts. The Numerical Weather Models are now coupled with the Sea Surface Temperatures and the Atmosphere. This is critical to improve the quality of the forecast. From impact studies, the surface pressure observations from drifting buoys are the number 1 observations for the numerical weather prediction on a per observation basis. Other ocean measurements are critical as well to global NWP, seasonal prediction, climate analysis and longer-term prediction. At the Extraordinary Congress, WMO approved a Unified Data Policy (UDP) across the entire Earth System domain including the aspect of the oceans. Resolution 1 of the Extraordinary Congress, the Unified Data Policy defines the Core data that **Shall** be freely, openly, and unrestricted exchanged along with the Recommended data which should be exchanged. This is aligned with IOC/GOOS. The Extraordinary Congress also approved the Global Basic Observing Networks which explains what WMO Members must do in terms of Surface Based Observing Networks (weather and upper air stations). Moving forward, the dialogue will be on how GBON might evolve to the future to include ocean observing systems. The importance of ocean observations and a sustained observing system was

reinforced time and time again at COP 26. There are many intersections between the WMO and the broader ocean community. Sustained observation networks were recognized as a critical need in the output of subsidiary body on research and systematic observations. Dr Rea stressed WMO has been working in a very collaborative way with the ocean community. He then wished everyone a great meeting.

Dr Emma Heslop (IOC/UNESCO) stated that it is a very important time for the DBCP with the formulation of the new Strategy moving forward. Her presentation showed how DBCP connects into GOOS and the vital role it plays within the Global Ocean Observing System. She emphasized the importance of observations coming from the DBCP network, key ocean and atmospheric data that are vital not only to climate, as demonstrated at COP 26, but also to weather, tsunami warnings and many more marine services. The innovation that is happening within the network is supplying the research organization with information and data that is available for future products. This is for the whole of the global ocean observing system. Over 1500 platforms are from the DBCP network from its many members, contributing many EOVs and ECVs. Quotation from Lars Peter Riishojgaard, Director of the Earth System Branch of the WMO, "The weather forecasting systems will run off the rails if they don't have the surface pressure information over the ocean to constrain them," - meaning the drifting buoys in this case. DBCP plays a vital role among the 10 other ocean observing networks that the Observation Coordination Group (OCG) manages. The DBCP is tackling areas within its new Strategy that are vital to the future of the global ocean observing system under its 6 pillars for success. Unfortunately, COVID-19 impacts are continuing, there is a decline of near 10% of the data over all the various platforms. Within the Tropical Moored Array (TMA) there are issues with outages, RAMA running at 24%. Question to DBCP 37, should we begin to highlight this and give urgency through GOOS. In addition, there is a decrease in drifter deployments which is not evenly distributed within the various ocean basins. The Atlantic is likely over seeded while the Pacific and Indian oceans are under seeded. At this point, Dr Heslop gave to Dr David Legler.

Dr David Legler of NOAA, Chair of Observation Coordination Group (OCG) summarized the new OCG Terms of Reference (ToR). OCG works with several

observing systems to ascertain that the ocean observing system is working effectively, coordinates all activities, evaluates the progress to date, and helps to identify gaps. They are working to integrate across all these networks to ensure a comprehensive in-situ global observing system. Recent activities include input on the development of the WMO Data Policy, contributed to OceanOPS report card, reviewing data and metadata flows across the Ocean Coordination Group network, working with the modeling community to understand the impacts, starting a series of dialogues with the private sector – looking at private-public sector partnerships, and focusing on environmental stewardship – acknowledged the role and leadership of the DBCP in leading this initiative. An important focus is the United Nations Decade of Ocean Science and Sustainable Development. The Ocean Decade - The Science we need for the Ocean we want. Focusing on 3 new approved programs - Ocean Observing Co-Design, CoastPredict and Observing Together. Ocean Observing Co-Design, reviewing our current ocean observing system on how we co-design it with the perspective of ocean observers and ocean users. CoastPredict, is looking at an integrated observing and modeling development in the coastal regions. Observing Together, is making sure that stakeholder needs are considered, and that those stakeholders are engaged so that they can help design the ocean observing system together. For DBCP, how will you engage in the new observing platforms and technologies. We are monitoring the progress of the observing system and how we characterize those both in communicating within our own community and externally.

Dr. Boris Kelly-Gerreyn from the Australian Bureau of Meteorology, Chair of DBCP, made his opening remarks, giving thanks to the opening speakers. On behalf of the DBCP Executive Board, we are delighted to welcome all to DBCP 37 live across the world.

The DBCP brings together a global community that is dedicated and committed to in-situ observations which significantly contributes to the scientific understanding of the earth system and underpins critical services that helps to save lives. We are meeting virtually for the second time due to the global pandemic, and hope you are all keeping well and safe. DBCP 36 and 37 were originally destined to be held in the beautiful St Petersburg (Russian Federation), thanks to our colleagues from the Russian Arctic and Antarctic Research Institute who generously offered to host DBCP in their city,

not only once but twice. In particular, Igor Ashik and Dr Vasily Smolyanitsky for their effort to bringing about this wonderful offer. However, we meet virtually for a second time. Participation at DBCP 37 is amazing. We have 46 countries joining us and 137 registered participants across all WMO regional associations. This includes 6 new participating countries – Armenia, Kazakhstan, Myanmar, Nigeria, Tanzania, and Tunisia - welcome. As part of our focus on inclusion and diversity we are looking for greater participation from women.

The current 26% participation is a great start, but we would like that number to grow. Key developments over the past year were the launch of the new DBCP Strategy, the Pacific Islands virtual capacity building training workshop (PI-5) headed by Qiu Jiang, funding of a wave buoy purchase and deployment (successful recipient to be announced soon), setting up a new Task Team for Environmental Stewardship Chaired by Karen Grissom of NOAA, and running an OCG workshop on environmental stewardship to raise the importance of environmental stewardship to reduce our network footprint. We have a healthy and resilient f global drifter array; however, the North Atlantic is over sampled while the Indian Ocean is under sampled. 65% of Moored Buoys report in the WMO BUFR format but need to improve to 100%. To note, 100% of the drifter metadata are now synchronized with OSCAR/WIGOS databases making the data easier to access and find.

We developed a data flow mapping across several OCG networks for both data and metadata. We have a much clearer understanding how the data flows from start to finish. We are also working to build relationships with commercial data suppliers. We face challenges in reporting of data – especially from the tropical mooring array, the uptake of barometer upgrades needs to increase along with adding wave measuring capabilities to the drifters. We need the coastal buoys and tsunameters to report in BUFR.

We see a new era for the DBCP, we will have a refreshed Executive Board membership in line with the strategic Pillars of the new Strategy. Implementing the Strategy and establishing a new Task Team focused on our users will be a primary goal. We will be looking at prioritizing deployments in under sampled areas, actively promoting the barometer upgrade program, embedding ourselves more deeply in the UN Ocean Decade, strengthening our relationships with commercial entities, and leading international workshops – tsunami detection innovation / Operational wave

measurements / PI-6 capacity building. The need for the DBCP has never been greater given the new WMO Extraordinary Session decisions, UN Decade, COP 26 and others. Please make the most of our virtual time together. A reminder to the eligible voters to vote to elect the new DBCP Executive Board.

Dr. Long Jiang, Technical Coordinator DBCP/OceanOPS, welcomed all participants and provided information on meeting arrangements and virtual session etiquette. He also gave more details on the DBCP Executive Board election process which will be open after the close of this opening session.

2. Scientific and Technical Workshop

The Scientific and Technical (S&T) workshop opened at 12:30UTC on 08 November and ended at 14:30 UTC. The workshop was co-chaired by Dr Rick Lumpkin and Ms. Rita Esteves. The S&T workshop is always an important forum for stimulating discussions among data buoy operators, designers, and data users. The aim of the workshop was to provide an opportunity for scientists, operators, and manufacturers to share their experiences, to exchange knowledge, and to build on and learn from innovations, developments, and good practices of peers.

This year the virtual S&T workshop focused on the impact and value that buoy data has on the user community, including for Numerical Weather Prediction (NWP), climate, extreme events, and the potential contribution to UN Ocean Decade.

Seven presentations were delivered on the satellite verification, calibration, and validation of drifting buoys on high resolution sea surface temperature, moored buoy science, and low cost and compact technology for salinity measurements that can be used as smart moored buoys as well as drifters to serve remote indigenous communities for wave measurements and coastal hazards early warning and forecasts. The S&T session demonstrated how the DBCP, and all the ocean community is contributing to the UN Decade of Ocean Science, in particular the links with OASIS program on air sea interactions monitoring and predictions**.**

S&T oral presentations:

I. Sustained ocean observations and access to underserved communities (Mr Sebastien O.C. Boulay).
II. Evaluation of HRSST drifters using Copernicus SLSTR (Dr Gary Corlett)
III. 40 years of moored buoys in Portugal (Ms. Rita Esteves)
IV. Persistence of Cold Wedges in the Somali Current System (Dr Verena Hormann)
V. A new challenge towards Fiducial Reference Measurements (FRM) from drifting buoys for satellite Sea-Surface Temperature Calibration and Validation (Dr Marc Lucas)
VI. An Innovative SVT Technology for the Near-Surface Salinity Observations and its Applications to Thermodynamics in Polar Oceans (Dr E Lunev & Dr Y. Kawaguchi)
VII. Observing Air-Sea Interactions Strategy (OASIS) – amplifying DBCP activities (Dr M. Cronin)

Abstracts are available through the meeting website[1]. The Panel agreed that the quality of abstracts, diversity and focus was excellent. These presentations generated a lot of discussions.

Mr. Sebastien O.C. Boulay presentation (I Sustained ocean observations and access to underserved communities) was pre-recorded and as a result he was not available for questions. However, he wanted to emphasize that the SOFAR wave data is available to the research community at the following link – https//www.sofarocean.com/products/sofar-free-marine-data-for-research.

Evaluation of HRSST drifters' presentation produced MS Teams chat discussion surrounding the importance of robust online metadata.

Dr Verena Hormann (IV Persistence of Cold Wedges in the Somali Current System) answered Dr Kelly-Gerreyn question on vandalism in the Indian Ocean. She confirmed that acts of vandalism in the Somali Current system is low, however

[1] https://goosocean.org/index.php?option=com_oe&task=viewEventDocs&eventID=3021

vandalism in other regions of the Indian Ocean is still problematic especially near the coastlines.

Dr Marc Lucas (V A new challenge towards Fiducial Reference Measurements (FRM) from drifting buoys for satellite Sea-Surface Temperature Calibration and Validation) answered Dr Kelly-Gerreyn that they did have two opportunities to do post deployment calibration and concluded that the quality of the instrument was unchanged after one year at sea. They would like to do more; however, they currently do not have a budget for the shipping cost of beached drifters.

In closing the S&T session, co-chairs of the session, Dr Rick Lumpkin thanked all who presented at the S&T session and thanked Ms. Rita Esteves who helped in organizing the session. Dr Boris Kelly-Gerreyn presented the last speaker Dr M. Cronin of NOAA PMEL. Dr Cronin is the Co-Chair of OASIS (Observing Air-Sea Interactions Strategy) which is an UN Ocean Decade program along with the related Score Working Group. Her presentation demonstrated this program's relevance to the DBCP. Dr Kelly-Gerreyn thanked Dr Cronin on how well she demonstrated on how DBCP is important in answering some of the questions raised in the presentation and how we can work together going forward.

Dr Long Jiang delivered the DBCP and OceanOPS reports. He first showed the overall health status of the platforms of drifting buoys, moored buoys, tsunameters and fixed platforms (monthly operational units averaged 1585, 413, 36 and 96). This also included 65 high resolution sea surface temperature drifters, and 12 wave drifters (USA and Japan). 96.9% of global drifters distributed data within one hour, and averaged delay is 30.6 minutes. Dr Jiang also highlighted BUFR migration of moored buoys sustained at around 65%, and drifter metadata OSCAR synchronization reached almost 100%.

Dr Jiang reported his extensive support to task teams and groups. This included consultation of revised terms of reference of six current and new task teams to align with Strategic pillars of new Strategy. Major updates are as follows:

1) Rephrased related groups and activities after WMO reform, JCOMM disbandment, and GOOS,
2) Expanded scope of work for task team on drifter best practices and technology development to include both drifting and moored buoys,
3) Strengthened interactions and linkages of task teams on cross cutting activities, esp. data management, standards and best practices, and wave measurements,
4) Established task team on environmental stewardship, and a webpage for the TT.

In addition, some highlights of support to task teams and groups were:

5) TT-DM: Data and metadata mapping upon request of the GOOS OCG. Draft mapping for real time and delayed mode data and metadata was completed and requires could further review and validation by the TT-DM. He also noted drifter wave spectra data for attention when decoding need headers notified beforehand.
6) TT-MB: Updated metadata template. However, OceanOPS will not maintain excel files anymore and will replace with web-based system. Dr Jiang started regular dialogue with TT-MB and OceanOPS in the migration.
7) TT-CB: A successful two sessions training workshop was organized with SPC. TT-CB is working with SIO to pilot wave drifter deployment(s) based on recommendations of PI workshops.
8) ITP: Dr Jiang supported a survey for tsunami detection workshop with DBCP Chair and ITP colleagues.
9) WG-Vandalisms: Dr Jiang advocated buoy protection on various occasions and promoted communication materials, such as PI-5 and PMO-6.

However, Dr Jiang pointed out there are issues for the Panel to be aware of and address in the coming intersessional period:

1) For global drifter array, there is an obvious deployment and data gap in the Indian Ocean and South Atlantic Ocean, while the North Atlantic Ocean was overly seeded with drifters.

2) For global tropical moored buoys array, he reaffirmed the observation from Emma Heslop and Boris Kelly Gerreyn that the array experienced heavy drop with overall 70% operational and RAMA buoys only 24%!
3) There is an ever-stronger requirement for sea level pressure from buoys, both drifting and moored as noted by ECMWF
4) While there were encouraging technologies for wave measurements by drifting buoys, less than 1% of drifters have this capability- although they are visible on the GTS.
5) Less than 1/3 of members (that submitted a national report) shared 50% or more of their buoy data on the GTS

In addition, Dr Jiang continued regular communications with the Panel by bi-monthly newsletters, OceanOPS quarterly bulletin, and OceanOPS annual report card. He also contributed to the Ocean Paper regarding buoy data and its impact in the WMO Bulletin.

Dr Jiang then stated that the WMO Unified Data Policy, Global Basic Observing Networks, and System Observations Financing Facility may have profound impact to the observing networks incl. DBCP. He also shared that the WMO regional associations RA-II and RA-V sessions highlighted ocean, particularly buoy networks.

Dr Jiang then reported he relocated to Brest and is with OceanOPS team since 1st September 2021. He briefed on the progress of OceanOPS in the implementation of their five-year strategy, annual report card 2021 that highlighted technology innovation of wave drifters, and the quarterly bulletin. Dr Jiang also invited DBCP for deployment opportunities with the Ship Observing Team in the coming years to make the best of shipping time. He also noted progress of metadata integration of SOT into OceanOPS.

Lastly, Dr Jiang proposed work priorities in the coming intersessional period for the Panel to review and approval:

1) Further optimization of global drifter array design and platform deployments as noted above
2) Improve global tropical moored buoys array, particularly Indian Ocean.
3) Improve metadata completion and integration of drifting and moored buoys

4) Promote data sharing in agreed format to GTS, progress to BUFR migration, complete NetCDF to enable ERDDAP services for metadata harvest by OceanOPS
5) Promote sensor upgrades to meet sustained and emerging data requirements (barometer, wave)

Dr Kelly-Gerreyn thanked Dr Jiang for demonstrating all the work that is behind the scenes. At this point, he thanked all the speakers for their presentations and drew the session and Day 1 to a close.

Actions:

1. *TC works with members to contribute to the global ocean observation network and to share their data to the GTS*

3. National Reports

The National Repots session took place 12:00-13:30 UTC on the 09 November 2021. Ms Laura Medeiros (Canada) chaired the session. The Panel received 29 National/Territorial Reports on current and planned buoy programs from Argentina, Australia, Brazil, Canada, Chile, China, Colombia, France, Hong Kong of China, Islamic Republic of Iran, India, Italy, Japan, Morocco, New Zealand, Peru, Portugal, Republic of Korea, Russian Federation, Saudi Arabia, South Africa, Spain, Sweden, Tanzania, Trinidad and Tobago, Tunisia, United Kingdom (UK), the United States of America (USA) and Viet Nam.

14 countries and territories made 5-minute presentations on their activities. Below are some highlights from the presenters. Please refer to the - National Reports [2]for more detail.

India's National report was presented by Dr R. Venkatesan. He opened by stating that despite the Covid-19 pandemic, India has been able to keep regular cruises to maintain their buoys including support to the RAMA program. They are implementing a new agreement with NOAA/PMEL to share the RAMA-OMNI data. They are starting

[2] https://goosocean.org/index.php?option=com_oe&task=viewEventDocs&eventID=2637

to collect atmospheric chemistry data at a few of the moored buoys. They are developing a Fishing Vessel Basic Observing System where they install meteorological instruments on small fishing vessels. India works directly with OceanOPS/DBCP to share their data.

Australia National report was presented by Mr Joel Cabrie. He gave the status of the current network. They have 60 active drifting buoys in the Indian and Southern Oceans, 6 Tsunami buoys, 41 Wave buoys and 1 SOFS (Southern Ocean Flux Station) mooring. One of the Tsunami buoys in the Indian Ocean will be relocated due to repeated vandalism incidents. Planned for next year, deploy 40 SVP-B drifters, 8 of which will be accomplished by Lisa Blair during her circumnavigation of Antarctica (https://lisablairsailstheworld.com/the-record), annual maintenance of the 4 BOM wave buoys, 3 maintenance trips to Tsunami buoys and deployment of a moored Minimet buoy. However, these are pending as Australia still has strict restrictions due to Covid-19. They have a new project underway to standard national wave buoy practices to standardize QC and metadata collection and different data formats.

Lieutenant Tobias Ferreira presented the Brazil National buoy programme. Their mission is to maintain 10 weather buoys along the coast, 4 wave buoys near oceanic islands and 2 wave buoys in Antarctica. Brazil had 9 active buoys in 2016 but are now down to 4 mainly due to vandalism. They currently have 4 active buoys and plan to deploy 6-8 weather and wave buoys in the coming year including 9 drifting buoys, 1 Spotter buoy, 1 glider and 5 Argo floats. They have developed 2 in-house Brazilian buoys, a weather buoy, and a small low-cost wave buoy. Due to vandalism, they have now equipped buoys with video cameras.

National report from China was presented by Ms Yue Xin Yang. She started with the status of the Chinese buoy program. China has 64 moored buoys, 80 Argo floats 3 drifting buoys and 27 of other types of buoys. She identified vandalism as a major issue for their program. They plan to deploy 6 moored buoys next year. China is developing the second generation of Bailong buoys to meet future marine data needs.

Dr Juan Leonardo Moreno Rincon presented the National report for Colombia. Colombia's first deployment of the year was on October 29th due to Covid 19 restrictions. He stated that they have issues with vandalism. In the next year, they plan to deploy 3 wave buoys and 7 moored buoys. Access to Colombia's marine data is not yet accessible as they have not yet been able to homogenize the data to place

them on an accessible platform. Colombia would like to collaborate more with DBCP to be able to have the data on the GTS. The historical information from the data buoys is Colombia's contribution to the UN Decade program and can be accessed at www.cedoldo.dimar.mil.ca

The French national report was presented by Mr Christophe Guillerm. They deployed drifting buoys under the E-Surfmar program -. Despite the COVID-19 pandemic France was able to deploy drifters in North Atlantic, maintain over 60 moored buoys, and just recently successfully deployed a wave rider near Mayotte Island in the Indian Ocean. Unfortunately, they had 3 incidents of vandalism. For next year, they plan to deploy 100 drifters in the North Atlantic and 7 wave riders near the French coast.

Dr. Chow Chi Kin presented the report from Hong Kong, China. They deployed 5 drifters to monitor cyclone activities in South China Sea and western North Pacific. All buoys were successfully deployed despite Covid-19 pandemic. Unfortunately, they experienced 2 incidents of vandalism this fall. They plan to deploy another 5 drifters in the same area next year. 3 of the 5 buoys are still active and transmitting data. One of the drifters passed through the centre of Typhoon Kompasu and another drifter was close to the centre of Tropical Storm Lupit giving excellent data on these storm events. A new requirement would be to have a buoy that can measure not only waves but wind near the sea-surface.

> From the Chat - the South China Sea is a busy but relatively small basin, the drifters usually went aground or captured by vessels soon after deployment. It is lucky this year, there are still three buoys alive, five months since deployment.

Dr. A. Makaoui presented the national report for Morocco. Morocco operates 1 weather buoy located south of Morocco to monitor coastal upwelling. Unfortunately, due to incidents of vandalism, the buoy is currently on land being repaired. In part due to the vandalism, the repaired buoy will be deployed in a new location in Dakhla bay to monitor the impact of coastal upwelling on the Dokhla bay ecosystem. Morocco still needs to build linkages with DBCP/OceanOPS.

Ms Rita Esteves presented the Portugal national report. Portugal maintains 16 moored buoys where 8 of them are along Portugal's coast, 6 are located in the Azores and 2 near the Madeira Islands. The main purpose of these buoys are for marine safety,

support to military operations, extreme events evaluations, the study of wave climatology and to validate forecast models. Portugal operates 2 types of moored buoys, the datawell waverider and the wavescan sensors. They quality control the data, not only with the automated program but with a manual follow up to verify any outliers. Portugal deployed 16 drifting buoys in support of the E-Surfmar and NOAA GDP programs. They are deploying an additional 16 drifting buoys in the next few months between Portugal and the Cape Verde Islands.

Mr Seungho Lee of Korea Hydrographic and Oceanographic Agency presented the national report on behalf of Mr Yongjin Kim from the Korea Meteorological Administration (KMA) from Republic of Korea. Two major institutes; Korea Meteorological Administration-KMA and Korea Hydrographic and Oceanographic Agency-KHOA, operate buoys in Korea. Currently KMA operates 24 moored and plan to deploy 2 additional buoys in the next 12 months. Additionally, they operate 71 wave buoys in coastal regions. KHOA operates 35 moored buoys and are planning to deploy 3 more moored buoy in coming year. KMA has introduced sensor duplication on their moored buoys for stability, continuity, and efficiency of data collection. This also gave them the ability to react rapidly to equipment/sensor failures.

Ms Mouna Ketata presented the national report for Tunisia. The Coastal Observatory/Coastal Protection and Planning Agency have deployed a network of buoys which includes 5 moored buoys, 4 drifting buoys and 7 tide gauges. The main purpose of the network is to help in decision making for climate adaptation, coastal and marine planification, early warning system and catastrophic risk reduction. The deployment area along the Tunisian Coast from Tabarka to Zarzis. They had 2 incidents of vandalism in 2021 where the buoys were stolen. The data is transmitted in real time to their system.

From Chat - Lotfi KHAMMARI (INM, Tunisia)

Please note that we need your assistance and support for the capacity building of control and maintenance of current buoys to ensure their sustainability and we also need to expand the network of marine observations given the significant lack of this type of information in Africa, in the Mediterranean and particularly the Tunisian coasts...

Please reach out to ljiang@wmo.int and Rachel JIANG

Rachel JIANG

Mouna KETATA Welcome to join us. Look forward to collaborating with you and wish the progress in TUNISIA.

Mr Fraser Cunningham presented the national report from the United Kingdom (UK). The UK maintains a network of moored platforms that includes meteorological and oceanographic buoys, wave rider buoys, light vessels and a new light buoy. The main focus of the buoy program is forecasting and early warning of severe weather and the validation of the wave model. They are rolling out an inhouse built next generation buoy based on the CR1000X logger and Iridium communication. These are not only installed on the moored buoys hull but on ships as well. They deployed 33 SVP-B drifters, 5 for the E-Surfmar program in the North Atlantic and 28 for GDP program in the South Atlantic. 34 deployments are scheduled for next year. Unfortunately, two moored buoys are missing. Mr Cunningham also displayed other marine networks operated by different agencies such as Cefas WaveNet and SmartBouys and RigNet MetReach that they collect information from.

Dr Rick Lumpkin presented the national report from United States of America (USA). He highlighted the deployment of 896 drifting buoys under the Global Drifter Program (GDP) in partnerships with many countries across the globe. The US Interagency Arctic Buoy Program (USIABP) deployed over 50 mixed buoys. The National Data Buoy Center deployed 43 buoys along with 33 Tsunameters. 28 buoys were deployed for the Tropical Atmospheric Ocean (TOA) array. The Prediction and Research moored Array in the Tropical Atlantic (PIRATA) deployed 13 surface toroids. Due to Covid impacts, no deployments were carried out for the Research Moored Array for African-Asian-Australian Monsoon Analysis and prediction (RAMA). The Naval Oceanographic Office (NAVOCEANO) deployed 10 drifters, while the Coastal Data Information Program (CDIP) deployed 40. A new generation of mooring data acquisition system is being tested.

Dr Do Huy Duong presented the national report for Viet Nam. The Viet Nam Meteorological and Meteorological Administration does not have any buoys currently deployed. They are looking to have a modern network of 35 buoys to monitor the elements of the sea and ocean as well as the Tropical Cyclone activity. They are

looking forward to the cooperation of the international community on technical support and training, especially from the OceanOPS/DBCP team.

From Chat - dhduong@monre.gov.vn (Guest) Please reach out to ljiang@wmo.int and Rachel JIANG

The session was ended with Dr Kelly-Gerreyn thanking Laura Medeiros for chairing the session and to all the presenters. "We are always impressed by the passion, energy, and capabilities that you have in making sure that the observation networks continue to deliver impact and value to those who use the data".

There were great comments and web links entered in the Chat section

- community education program about vandalism - The DBCP has a document about this that can help.
    - https://public.wmo.int/en/resources/bulletin/protecting-buoys-our-safety
    - https://oceanexpert.org/document/20341
    - https://www.ocean-ops.org/dbcp/deployments/anti-vandalism.html
- For Members needing help – please contact Dr Long Jiang DBCP TC

Actions:

2. *Environmental Impact of Drifting buoys has been raised by ships assisting with drifter deployments. This needs to be discussed at higher level (i.e. OCG) and provide guidance to DBCP community. It should be noted, however, that many drifters (such as the GDP ones) already use recycled plastic and have some components made of bioplastic and use alkaline batteries. It should also be noted that DBCP members have already conducted investigations with UN experts on the subject matter, which have concluded that deploying expendable instruments does not contravene existing conventions and regulations (DBCP EXB; DBCP-38)*

3. *Investigate how to expand sensor upgrade programme to add additional sensors i.e. waves, winds, similar to the barometer upgrade programme (TT-DBPD; DBCP-38)*

4. User Impact and Engagement

The User Impact and Engagement session demonstrated the importance of the DBCP data, to make sure that it has the right observations in the right place being delivered where and when it is most needed. This means that critical services can be provided to save lives, protect property, enable sustainable development, and deliver economic prosperity. This year, two invited speakers drawn from the critical user community demonstrate how important the DBCP observations are. The first presentation provides the impact of buoy data on tsunami early warning system, and the second on how ocean observations improve the forecast which leads to better decisions.

Role of Observing Networks in Tsunami Early Warning

Dr Srinivasa Kumar Tummala, Director of the Indian National Center for Ocean Information Services (INCOIS) of India. After the 2004 tsunami, Dr Tummala coordinated the successful establishment of the Indian Tsunami Early Warning System. He presented the role of observing networks in Tsunami Early Warning. He stated that the Global Tsunami Early Warning System is coordinated through OIC UNESC. Dr Tummala pointed out that nearly 2.4 billion people living within 100 km of the coast and these coastlines are vulnerable to oceanic disasters. More than 80% of Tsunamis are caused by earthquakes. The early warning system are focused on the earthquake generated Tsunamis. The need to understand the mechanics of Tsunami generation is of great importance to design the observation needs and system to detect Tsunami events. Warning Centers need to be able to know the time needed to detect an earthquake and the response time to be able to have effective advance warning. To have an effective early Tsunami warning system, there is a need for a dense seismic detection network, sea level network, and bottom pressure networks. The Tsunami Warning System works under 3 pillars, Risk Assessment, Detection / Warning / Dissemination, and Tsunami Awareness and Preparations. The performance of the warning system is determined by a set of 3 performance indicators, the amount of time for detection, accuracy of earthquake detection, and the amount of time a center can issue a bulletin. There is always a need to improve

on timeliness and accuracy. Dr Tummala demonstrated some of the challenges, highlighting the fact that only 3 buoys out of 7 deployed are operational. There are also other causes of Tsunamis, submarine land slide and volcano eruption. To detect all Tsunamis, development in these areas will be needed. There are emerging technologies which look promising in enhancing Tsunami warnings in the near and medium term. Dr Tummala is working on the Ocean Decade Tsunami Program, which includes new observation technologies, improved awareness and preparedness, and Tsunami resilience which will include greater accurate real-time forecast.

Dr Kelly-Gerreyn mentioned that the ITP (International Tsunami Partnership) is a Working Group within the DBCP, is leading an international effort in collaboration with the IOC to run a workshop with the aim of identifying and developing new, innovative, and cost-effective ways of detecting and monitoring Tsunamis.

- From the Chat
    - Dear DBCP Colleagues, FYI, Here is the Indian Ocean Observing System (IndOOS) 2020-2030: https://www.clivar.org/clivar-panels/indian/IndOOS
    - World Tsunami Awareness Day | United Nations - The objective of World Tsunami Awareness Day is to increase international cooperation for deeper political and public understanding of risk reduction measures. https://www.un.org/en/observances/tsunami-awareness-day

Ocean Observations – Better Forecast, Better Decisions

Mr Kenneth Graham, Director of the National Hurricane Center for NOAA's National Weather Service (NWS) presented on how observations affect services. He worked directly with Emergency Management Officers advising them during numerous high impact weather events. The best way to link observations to service is to look at the history. Every major leap in observations lead to improvements in services. He presented the start of data gathering with the systematic weather observations in North America began in 1644 and by 1814 the collection of weather data at army posts was established. The advancement in technology throughout the years has helped save lives, from the use of kites to balloons to aircrafts, to RADARs and satellites. In 1961, Tropical Cyclone Carla was the first system to have its entire history recorded by research flights. There were also advancements in how to advise

the population. The main goal was to give advance noticed of oncoming weather events. It is all about the impacts. The increased number of observations lead to improvements in forecasting which leads to better decision making. Mr Graham demonstrated the reduction of the Hurricane track forecast error from 1990 to 2019, which translated to better information to Emergency Managers for decision making. In 1999, 2.6 million people were evacuated due to uncertainties of Hurricane Floyd's track. In 2019, over 3 million people were NOT evacuated given the improvements in track forecasting for Hurricane Dorian. His final statement truly defined the importance of observations to services – "Operational forecasters use your data and turn them into services and together we save countless lives around the world".

- From the chat
    - [10:38 AM] Thuy (Guest) - Thank you for your presentation. Would you mind if I ask your help for operational typhoon and storm surge forecasting in Vietnam?
    - Dear DBCP Colleagues, FYI This is some of the work NOAA is doing on the deployment of in-situ ocean observations to improve Hurricane Intensity Forecasts: https://globalocean.noaa.gov/News/Workshop-Improving-Hurricane-Intensity-Forecasts
    - DBCP Capacity Building has looked at Typhoons https://goosocean.org/index.php?option=com_oe&task=viewEventRecord&eventID=1278

Dr Kelly-Gerreyn thanked the presenters for demonstrating the positive impacts that the DBCP has to their programs and with that he brought this session to a close.

5. Five-year Strategy, Operating Principles, and Implementation Plan

Dr Boris Kelly-Gerreyn presented the DBCP 5-year Strategy along with the Operating Principles and the Implementation Plan. These are key DBCP documents. The DBCP Strategy 2022-27, which was approved September 1, 2021, provides our purpose.

The Implementation Plan describes how the Strategy will be implemented. And the Operating Principles provides the details of how the DBCP is administrated which was approved September 15, 2021. He gave a detailed overview of the Strategy (DBCP Strategy 2022-2027.pdf (ocean-ops.org). There are several drivers guiding the DBCP direction, such as the UN Ocean Decade, Societal challenges such as pollution, and Technology advancements and innovations. The DBCP needs to distinguish itself from its partners through its Strategy. The DBCP 's Vision is fully aligned with the broad initiative that it is coupled to. The Mission is to make certain it serves the current and emerging needs of society. The Users are at the core of the DBCP, and it supports them through the six Pillars of Success. Finally, the impact and value the DBCP brings to the users. Each Pillar has measurable outcomes to measure progress and ultimately its success. The Implementation of the Strategy will be the focus of the new Executive Board. The DBCP Strategy 2022-27 guides everything that the DBCP does.

6. Update from Task Teams, Action Groups, Working Groups

6.1 Global Drifter Program (GDP):

Dr Lumpkin reported on the activities of the GDP. The working group met regularly especially during high impact weather events. Their Terms of Reference (ToR) are aligned to the new DBCP Strategy pillars of success. They successfully developed and tested A-sized drifters and are now ready for deployment during the next hurricane season. They will continue to promote the Barometer Upgrade Program as a cost-effective way to improve weather forecasting.

6.2 Task Team on Data Buoy Best Practices and Technology Development (TT DBBPD)

Dr Lumpkin reported on the development of transforming the Drifter Best Practices to include all data buoys. This is an opportunity to broaden the Task Team (TT) to include all data buoys. The TT team needs a new Chair with expertise on moored

buoys and/or tsunameters. New Terms of References (ToR) will need to be written to realign with the DBCP Strategy.

- From Chat
    - How is TT on best practice different than TT-MB?
    - Action for both TT to discuss

6.3 Action Group on EUMETNET Surface Marine Program (E-SURFMAR):

Mr Desprez Gésincourt, new E-SURFMAR program Manager, reported on the activities of E-SURFMAR. The purpose of E-SURFMAR is to coordinate, optimize and integrate European activities for surface observations over the sea. The program includes moored and drifting buoys and ship observations (VOS). The operational area covers the North Equatorial Atlantic and in the Arctic Oceans. They deployed 92 drifting buoys since July 2020. They continue to support the TRUSTED project by deploying 46 buoys last year and an additional 25 next year. Despite Covid 19, they can maintain deployments above the target of 150 drifters. They are working on reducing the environmental impact of drifting buoys.

6.4 Action Group on International South Atlantic Buoy Program (ISABP):

Ms Tania Daniels provided an update on the International South Atlantic Buoy Program (ISABP) activities. She reported that they have 176 drifting buoys reporting in the ISABP region and they were able to re-partner with Argentina for the first time in more than 10 years. They will continue to address the observational gap. A total of 101 drifters were deployed this year. Drifter deployments for next year are 100 in the Tropical Atlantic, 40 in the Extra Tropical Atlantic and 40 in the Southern Atlantic. ISABP encourages other interested members to join and current members to take advantage of barometry upgrade program.

6.5 Action Group on International Tsunameter Partnership (ITP)

Dr R Venkatesan reported on the activities of ITP. The International Tsunami Program earlier developed Best Practices and guidelines on the Tsunameter which were approved by the IOC Congress. They are developing an international workshop which will focus on innovative, cost-effective detection and monitoring solutions. To guide the workshop, the ITP is sending a survey to the Tsunami Centers on 3

requirements: Customer, Operational and Technology. Participation is open to not only ocean experts but also to other related expertise such as mathematicians, geologists, and non-traditional fields. He stated that India has sustained the Tsunami buoy network since 2007 and that there has been advancement in the Indian Tsunami buoys and Bottom Pressure Recorder systems. Finally, Submerged Tsunami buoy technology has been transferred to industry to develop a cost-effective sensor.

- Action - Dr Rachel Jiang to send Chinese South China Sea Warning Center contact to Dr Venkatesan

6.6 Working Group on Vandalism

Ms Grissom reported on the statistics of vandalism from the DBCP members that have reported occurrences of vandalism. In 2016, better reporting and tracking of vandalism is skewing the graph to demonstrate an increase in vandalism. The Working Group will work towards normalizing pre 2016 data. She emphasized the importance of all members to report occurrences of vandalism. To note, there was an occurrence of vandalism in the Arctic reported by China, unfortunately this demonstrates that all regions are susceptible to this activity. Ms Grissom thanked Dr Jiang for all his communication and advocacy efforts on behalf of the working group. The WMO Buoy Videos are now available in English, French, Hindi, and Fijian. She stated that there is a need for a Spanish version of buoy protection video.

Action – Please send acknowledgement of the usefulness of the videos to Ms Grissom.

6.7 International Arctic Buoy Program & International Program on Antarctic Buoys (IABP & IPAB)

Unfortunately, Dr I Rigor was not able to join. The presentation and report are available online.

6.8 Tropical Moored Buoy Implementation Panel (TIP)

Mr Kenneth Connell presented a summary of the Tropical Moored Buoy Implementation Panel. There is a significant decrease in data, in particularly in the Indian Ocean. No RAMA maintenance cruises have occurred since 2019. As a result, buoys are operating well beyond their expected timeline and incurred some loss of

assets. The final 2 TRITON moorings have been retired. He highlighted, the launch of the new RAMA-OMNI partnership which includes the buoys data portal. They plan a return to regular cruises to maintain the buoys. TPOS-2020 Project transitioned into WIGOS Pre-operational Pilot.

6.9 Task Team on Moored Buoys (TT-MB)

Mr Kenneth Connell reported on the status of TT-MB activities. The Task Team hosted 2 virtual general meetings and 4 task specific meetings. 5 new action items have been added. He demonstrated how the Task Team aligns with the new DBCP Strategy pillars of success. They updated the template for Moored Buoy Metadata and recommended essential variables-based indicators to demonstrate the value of the data. The TT will continue improving the metadata accessibility and the implementation of the proposed indicators. They are developing a workshop on metadata exchange.

Action – to provide link to metadata template (Dr L Jiang)

https://www.ocean-ops.org/share/DBCP/metadata/Moored%20Buoy%20Metadata/Moored%20Buoy%20Metadata%20V1.3.pdf

https://www.ocean-ops.org/share/DBCP/metadata/Moored%20Buoy%20Metadata/DBCP_MB%20METADATA_TEMPLATE_V1.3.xlsx

6.10 Task Team on Wave Measurements (TT-WM)

Mr Val Swail presented the highlights of Task Team on Wave Measurements (TT-WM) activities. 1 virtual meeting was held, while most tasks are done by correspondence. He demonstrated how the TT aligns with the new DBCP Strategy pillars of success. They had 2 papers published, several evaluations were completed, and new evaluations are underway. They facilitated the use of wave data (CORDC) by ECMWF. A virtual Wave Measurement Workshop will be developed. The workshop will be broken into sub-topics over several virtual meetings. The TT will follow up on recommendations from DBCP 36. He emphasized how evaluations continue to be a

critical element of wave observing programs especially for emerging systems and machine-readable metadata.

From discussions – Dr L Jiang DBCP TC confirmed that 1% of wave drifters and 66% of moored buoy wave data is captured on the GTS.

6.11-1 Task Team on Data Management (TT-DM)

Mr Lancelot Braasch reported on the Task Team activities. The Task Team has met regularly with 1 group virtual meeting and 4 task specific sub-group meetings. He demonstrated how the TT aligns with the new DBCP Strategy pillars of success. Both MEDs and Météo-France confirmed that they are receiving wave spectral data via the GTS and the data is being archived. They reported minimal disruptions with respect to data management through the Covid 19 pandemic. They will focus on the machine-to-machine metadata transfer to improve cross-network metadata harmonization. They will enable the machine-to-machine access of OceanOPS metadata for verification of receipt and accuracy.

Action – request for DBCP organizational chart (Dr L Jiang)

6.11-2 Canadian Drifting Buoys Global Assembly Center (GDAC) Report

Dr Zhimin (Robert) Ma from the Department of Fisheries and Oceans Canada (DFO) presented the GDAC Report. In 2017, the Marine Environmental Dara Section (MEDS) of DFO was chosen as the GDAC for the drifting buoys. The GDAC has 5 functions, acquire and decode real-time data, monitor data stream interruptions, examine compliance of received BUFR messages, distribute data on multiple channels, and conduct data comparisons. He presented the real-time data processing flow chart that demonstrate the 5 functions. Their actions can detect issues and trends. They plan to add the wave spectral data to the archive.

6.12 Task Team on Capacity Building (TT-CB)

Ms Qui Jiang (Rachel) provided an update on the Capacity Building Task Team. The team met regularly to prepare for the 5th Pacific Islands workshop (PI-5). She demonstrated how the TT-CB aligns with the new DBCP Strategy pillars of success. The key highlight of the Task Team was the successful PI-5 workshop. They plan to implement recommendations from PI-4&5 in 2023, that is to jointly deploy buoys with members to share best practices and for the member to take responsibility of

the maintenance once deployed. TT-CB will work on enhancing the training included in the workshop. The Task Team is seeking expressions of interest for the proposed Joint Deployment Pilot, and members to host Capacity Building Workshops in 2022.

Action – members interested in the pilot deployment to send expression of interests to Ms Jiang directly to jlzxjq@163.com

Actions:

4. *Dr Rachel Jiang to send Chinese South China Sea Warning Center contact to Dr Venkatesan*
5. *Please send acknowledgement of the usefulness of the videos to Ms Grissom*
6. *Dr L Jiang to provide link to metadata template*
7. *Dr L Jiang to share DBCP organizational chart*
8. *members interested in the pilot deployment to send expression of interests to Ms Jiang directly to jlzxjq@163.com*

7. Review of DBCP expert groups: Environmental Stewardship – A new DBCP task team (TT-ES)

Ms Grissom, Oceanographer at the NDBC, is the Chair of the new Task Team on Environmental Stewardship (TT-ES). She presented an update on the newly formed Task Team. She defined 'Environmental Stewardship' as it relates to the DBCP. The 3 strategies that accompanies environmental stewardship are to Reduce, Promote and Evade. Along with the strategies there are 3 stewardship actions that are relevant to Ocean Science Stewardship. Community Awareness and Restore and Protect. Environmental Stewardship will need to be considered in every part of the work, from planning processes to operations. DBCP has included Environmental Stewardship as 1 of the Pillars to promote technologies and practices that reduces its environmental impacts. The actions required of the new TT-ES include the establishment of the TT focusing on environmental impacts, work with the community to baseline and continuously review and minimize the DBCP environmental footprint and collect feedback from members, and report on plans, actions, and progress to reduce environmental impacts. Over the past year, the TT was formed, the ToR were completed, created a webpage, and led a workshop on environmental stewardship.

She displayed common concerns and challenges and some solutions and approach to these that came out of the workshop. The main task is to undertake an environmental assessment of the programs to determine if the outcome will have an impact on the environment. TT-ES needs the members of DBCP to recognize that environmental stewardship is to be considered as part of their normal operations.

https://www.ocean-ops.org/dbcp/community/environmental.html

8. Report of Engaging with Commercial Sector

Dr Kelly-Gerreyn presented Dr Emma Heslop from IOC and Dr Sidney Thurston of NOAA as the speakers for the session on the growing engagement with the commercial sector. Dr Heslop began the talk from the Global Ocean Observing System (IOC/GOOS) perspective. There has been collaborative work between GOOS, OCG and the Marine Technology Society (MTS). The GOOS vision encompasses more than the observing system but also includes partnerships down the value chain to ensure data reaches the users. The Strategy states that support and expertise from the private sector will be needed. She demonstrated how GOOS is missing some of the existing networks such as SOFAR drifting buoys, sail drones, future coastal aerial drones. There is need to be able to have the private sector data integrated with the public sector data. The discussions with the private sector grew not only from emerging commercial networks but also from issues from public networks needing resolutions. There were discussions surrounding supply issues, size of the market to develop the maturity of the market. The private sector can attract funding that the public sector cannot access. Supporting the ocean observing industry maturity will help the community in reducing costs, speedup technology advancement, integration of an observing system that will have all sectors - public, private academic and others. The GOOS – MTS dialogue goals are to create a forum for meaningful dialogue to dismantle barriers and highlight opportunities to achieve a mature Ocean Observing Enterprise. To be able to meet the user demands there will need to be an active dialogue between industry, academia, and government agencies to achieve a more efficient, cost-effective fit-for-purpose ocean observing system. We envision an Ocean Observing System to be co-designed with industry partners that will result

in a set of recommendations that both MTS and GOOS have the ability and interest to support.

Topics for discussions

What key issues you would like raised through Industry Dialogue?

What key areas most need innovation and/or new technologies?

What experiences have you had engaging with Private Sector and opportunities that you see to constructively engage?

Dr Thurston presented the status of the discussions from the WMO Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON) perspective and private industry. They have reached out to Hydrological-Meteorological Equipment Industry Association (HMEI). HMEI represents over 140 private companies. Its objectives are to advance technologies, standards, operational uses and sustainability of equipment, software, systems, and services supporting the global weather enterprise. The WMO has developed a new approach for greater engagement with the private industry – Public-Private Engagement (PPE). It refined its guidance and policies to encourage Members to pursue mutually beneficial partnerships. He noted that there has been a rapid expansion of the commercial sector into the ocean observing community. The goal of the SC-ON – HMEI discussions is to produce practical and actionable recommendations. Reviewing mutual priorities that would benefit from enhanced and sustained observations. Discussions began on how the public and private sector can harmonize in a concerted way. The industry has grown from supplying hardware to delivering products and services. The discussions produced a list of areas of common interest. The 3 topics of interest for possible collaboration are Earth Observing System Design and Evolution, WIGOS Tools, and Oceans. In closing, he highlighted that the new A-form drifter had a successful test deployment from the NOAA Hurricane Hunter aircraft on November 10, 2021.

Q&A and from Chat

- Harmonizing of platforms (visualization, data formats, etc.) - Standards
- Improving early warnings of floods, droughts, and cyclones will require large expansion in ocean observations for utilizing the data from the uncovered regions. To build a fully integrated global ocean observing system, mostly drifting and moored buoys reliance on intergovernmental and government

funding will be insufficient and here is the need for backing and expertise from the corporate sector in terms of technology and finance. The sensor technologies and other related buoy components are both developed by the public and private sector as well.

https://olc.worldbank.org/system/files/goos-2030-strategy-brochure-rev%20%281%29.pdf

I think it would be great to somehow convince companies like Sofar (and others collecting real time data) to contribute at least some synoptic observations in near real-time from their "private" observing network to the GTS to help improve forecasts, etc.

What about for smaller, Least Developed countries, afraid they could be left behind?
Dr Thurston reminded that the new WMO policy SOFF is exactly for helping LDCs and SIDS nations to access funding.
Dr Heslop pointed out that private industry can be nimbler and more cost effective. There are also several different business models that might help nations that cannot sustain a full ocean program but could purchase the data needed.

Actions: -

9-Members to take the 3 questions from the presentations and send all feedback to Dr Heslop and Dr Thurston.

9. WMO Governing Body outcomes

Dr Dominique Bérod presented the results and decisions from the WMO Extraordinary Congress. There are 3 decisions related to the Oceans. The WMO Unified Data Policy, the Global Basic Observing Network, and the Systematic Observations Financing Facility. These 3 Policies are completely inter-connected. The goal of these policies is to have better observing systems and data for better services. The WMO Unified

Data Policy is for all data (in-situ, satellite, atmospheric, ocean, etc.) from all Members (Government, Academia, Private, etc.). The Data policy is based on Public Safety and Protection of Life. He noted that they defined Core data as what Members SHALL exchange, while Recommended data is what Members SHOULD exchange. The evolution of GBON, INFCOM to continue exploring paths for future evolution and specifically an exploration to strengthen the exchange of ocean observations.

Dr Thurston stated that the WMO is now fully embracing ocean observations and in doing so has enhanced the WMO as a key stakeholder.
The WMO Bulletin includes this Oceans Paper
https://public.wmo.int/en/resources/bulletin/global-ocean-observing-system-oceans-of-data-earth-system-predictions?utm_source=WMO+Bulletin&utm_campaign=bdc5fa08a7-EMAIL_CAMPAIGN_2018_11_20_01_43_COPY_01&utm_medium=email&utm_term=0_46acf39490-bdc5fa08a7-

From Chat
https://community.wmo.int/gbon
GBON - Global Basic Observing Network | World Meteorological Organization
https://public.wmo.int/en/our-mandate/what-we-do/observations/Unified-WMO-Data-Policy-Resolution
WMO Unified Data Policy Resolution (Res.1)
The free and unrestricted exchange of observational data from all parts of the world and of other data products among all WMO Members must be updated and strengthened to accommodate the explosive g...

https://public.wmo.int/en/media/news/new-financing-mechanism-will-boost-international-response-climate-change-0
New financing mechanism will boost international response to climate change
On Wednesday 3 November, the World Meteorological Organization (WMO), the UN Development Programme (UNDP) and the UN Environment Programme (UNEP) will announce a new United Nations Coalition Fund.

Actions:

10. Executive Board Summary

Dr Boris Kelly-Gerreyn, Chair of the DBCP, presented the Executive Board report. Prompted by a question from Day 3 of the conference, he displayed the DBCP Governance chart and explained their tasks and connections to GOOS Observation Coordination Group (OCG). He presented and thanked the members of the outgoing Executive Board. He described the work that was accomplished over the past year, monthly virtual calls, preparation of the DBCP 37 virtual conference, soliciting and reviewing nominations for the new Executive Board, Solicited expression of interest for a wave buoy to be deployed, finalized the DBCP Strategy and Operating Principles, established a new Task Team on Environmental Stewardship, provided assistance for the Ocean Observing Report Card, and successfully conducted the 5th Pacific Islands Capacity Building Workshop PI-5. As Chair of DBCP, Dr Kelly-Gerreyn participated in OCG-12.

The Executive Board is seeking the Panel's approval of the Financial Statement and Financial Budget for 2022. Dr Kelly-Gerreyn displayed the DBCP Trust Fund table

Table 1 – 2020 DBCP Trust Fund; a 30-year-old, multi-donor, multi-user trust fund

2020 Contributions	**In Currency of Payment**	**In US$**	**WMO/DBCP TF OceanOPS**	**WMO/ DBCP TF DBCP**	**WMO/DBCP TF SOT**	**IOC/ DBCP TF**
E-SURFMAR	€55,000	65,032	$42,552	$9,755	$9,755	
Meteorological Services of New Zealand	€1,800	2,128	$1,298	$660	$170	

Environment and Climate Change Canada	CAD$ 34,000	27,390	$16,708	$8,491	$2,191	
Bureau of Meteorology, Australia	€11,700	13,834	$8,439	$4,289	$1,107	
National Institute of Ocean Technology, India	US$5,000	5,000	$3,050	$1,550	$400	
South African Weather Service (SAWS)	€4,000	4,730	$2,885	$1,466	$378	
BSH, Germany	€3,600	4,257	$2,597	$1,320	$341	
MNR - China	$20,000	20,000				20,000
Total		**$142,371**	**$80,499**	**$27,530**	**$14,342**	**$20,000**

Table 2 – 2021 DBCP Panel Budget

$ US Currency	**DBCP TF**	**OIC TF**
Balance brought forward from previous year 2020	$102,541	$22,912
National Contributions	$27,530	$20,000 TBC
Funds Available	**$130,071**	**$42,912**
Expenses	$0	$0

Expenses (Direct & Indirect costs)	$0	$0
Balance at Dec 2021	**$130,071**	**$42,912**

Table 3 – 2022 DBCP Panel Budget

$ US Currency	**DBCP TF**	**OIC TF**
Balance brought forward from previous year	$130,071	$42,912
National Contributions	$27,530	$20,000
Funds Available at 1st Jan 2022	**$157,601**	**$62,912**

Table 4 – 2022 DBCP Panel Expenditure Plan

DBCP – Draft Spend Plan - 2022	**WMO/DBCP TF**	**OIC/DBCP TF**
Travel of DBCP Chairperson and other Exec Board or Panel members	$15,000	
DBCP Capacity Building	$10,000	$20,000
TT activities (e.g. tsunami workshop, baseline environmental footprint assessment)	$40,000	
Wave Buoy Pilot	$20,000	
Communications (e.g. DBCP Strategy brochure, promotional material related to engagement with WMO GBON/SOFF	$10,000	
Total	**$95,000**	**$20,000**

Detailed financial report is available on the meeting website[3].

Dr Kelly-Gerreyn pointed out that due to the Covid 19 pandemic, the funds have been building up. However, as we see borders re-opening and travel resuming, the

[3] Global Ocean Observing System (goosocean.org)

expenditures will return to normal, and the balance will be drawn down. He requested the Panel to approve the estimated budget for the next intersessional period.

Decision:

2022 DBCP Panel Expenditure Plan was approved

Dr Kelly-Gerreyn extended a formal request to panel members to consider contributing to the DBCP-TF towards DBCP activities.
Dr Bérod thanked all contributors and emphasized that no contributions are too small.

11. DBCP Executive Board Election Results

Dr Bérod announced the DBCP Executive Board Election Results and thanked all that had put their names forward and to the board members that rotated off.

DBCP Executive Board
Scientific Excellence – Ms Rita Esteves, Portugal
Operational Excellence – Ms Laura Medeiros, Canada
International Cooperation & Partnerships – Dr Sidney Thurston, USA
Diversity and Inclusivity – Ms Qiu (Rachel) Jiang, China
Technology Innovation – Mr Lance Braasch, USA
Environmental Stewardship – Ms Karen Grissom, USA

Dr Boris Kelly-Gerreyn continues to be chair for another year.

12.Closure of the session

Dr Bérod expressed in his closing remarks, he is completely amazed by the amount of work done by the DBCP Panel. It is hidden work, the complexity behind data gathering and this is accomplished through great coordination which is the work of the DBCP Panel. He stated that he is proud to be part of it. Dr Bérod is expecting a great contribution from DBCP to the GBON and WMO Unified Data Policy and contributing to the overall chain. Thankful to Long Jiang and the OceanOPS Team, and to all.

Dr Kelly-Gerreyn closed with his final thoughts and presented his highlights of the week. The opening remarks from the speakers pointed out the importance of the DBCP. The Science & Technology workshop showcased the DBCP contributions to science and research. The remarkable amount of activity being done demonstrated in the National Reports. The User Impacts session showed how important DBCP data is to saving lives. The new DBCP Strategy guiding the DBCP in a rapidly evolving landscape. The Task Teams and Working Groups session demonstrated how busy and productive the DBCP truly is. The development of the new Task Team on Environmental Stewardship. The growing engagement with the commercial sector, the Executive relevant to the DBCP Board activities, the WMO resolution and the new Executive Board election result. 46 Members joined the virtual conference with nearly 140 participants registered. He encouraged increased involvement from members in the DBCP https://www.ocean-ops.org/DBCP/ . Next year, for DBCP 38, we are hoping to be able to accept the generous offer from our Russian colleagues from the Arctic and Antarctic Research Institute in St Petersburg, RU. We all must be mindful that the situation could still be active and could affect countries in different ways. There is a need for a backup offer to host DBCP 38 to have greater flexibility if needed.

The DBCP-37 session was closed at 14:00 UTC on Thursday 11 November 2021

ANNEX I

AGENDA DBCP-37 2021

1.Opening and Welcome to the DBCP Session

2 Scientific and Technical Workshop

3 National Reports

4 User Impact and Engagement

4.1 Role of Observing Networks in Tsunami Early Warning

4.2 Ocean Observations – Better Forecast, Better Decisions

5 The DBCP Strategy

6 Updates from the Task Teams, Action Groups, Working Groups

7 Review of DBCP expert groups: Environmental Stewardship – A new DBCP task team (TT-ES)

8 Report of Engaging with Commercial Sector

9 WMO Governing Body outcomes

10 Executive Board Summary

11 DBCP Executive Board Election Results

12 Closure of the session

ANNEX II

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ANNEX III

DECISION LIST

Decision #	Agenda Item #	Decision
1	10	2022 DBCP Panel Expenditure Plan was approved

ACTION LIST

Action #	Agenda Item #	Action	Leading Responsibility	Timeline
1	2	TC works with members to contribute to the global ocean observation network and to share their data to the GTS	TC	On going
2	3	Environmental Impact of Drifting buoys has been raised by ships assisting with drifter deployments. This needs to be discussed at higher level (i.e. OCG) and provide guidance to DBCP community. It should be noted, however, that many drifters (such as the GDP ones) already use recycled plastic and have some components made of bioplastic and use alkaline batteries. It should also be noted that DBCP members have already conducted investigations with UN experts on the subject matter, which have concluded that deploying expendable instruments does not	DBCP EXB	DBCP 38

		contravene existing conventions and regulations		
3	3	Investigate how to expand sensor upgrade programme to add additional sensors i.e. waves, winds, similar to the barometer upgrade programme	TT-DBPD	DBCP 38
4	6	Dr Rachel Jiang to send Chinese South China Sea Warning Center contact to Dr Venkatesan	Dr Rachel Jiang	completed
5	6	send acknowledgement of the usefulness of the videos to Ms Grissom	All members	On going
6	6	provide link to metadata template	TC	completed
7	6	share link DBCP organizational chart	TC	Date??
8	6	members interested in the pilot deployment to send expression of interests to Ms Jiang directly to jlzxjq@163.com	All members	Date??
9	8	Members to take the 3 questions from the presentations and send all feedback to Dr Heslop and Dr Thurston	All members	On going
10	9	Members to review the Water Declaration process	All members	On going

ANNEX IV

LINKS TO THE DOCUMENTS

Data Buoy Cooperation Panel (DBCP)
https://www.ocean-ops.org/DBCP/

DBCP 37 Reports and Presentations
Global Ocean Observing System (goosocean.org)

DBCP-37 Financial report
Global Ocean Observing System (goosocean.org)

DBCP Executive Board Meeting report
Global Ocean Observing System (goosocean.org)

DBCP Strategy 2022-27
Global Ocean Observing System (goosocean.org)

DBCP and OceanOPS report
Global Ocean Observing System (goosocean.org)

The Ocean Decade
The Ocean Decade - The Science we need for the Ocean we want

DBCP documentation regarding vandalism
https://public.wmo.int/en/resources/bulletin/protecting-buoys-our-safety
https://oceanexpert.org/document/20341
https://www.ocean-ops.org/dbcp/deployments/anti-vandalism.html

DBCP documentation regarding metadata
https://www.oceanops.org/share/DBCP/metadata/Moored%20Buoy%20Metadata/Moored%20Buoy%20Metadata%20V1.3.pdf
https://www.oceanops.org/share/DBCP/metadata/Moored%20Buoy%20Metadata/DBCP_MB%20METADATA_TEMPLATE_V1.3.xlsx

DBCP documentation on Environmental Stewardship
https://www.ocean-ops.org/dbcp/community/environmental.html

WMO Extraordinary Congress
https://community.wmo.int/gbon

https://public.wmo.int/en/our-mandate/what-we-do/observations/Unified-WMO-Data-Policy-Resolution

https://public.wmo.int/en/media/news/new-financing-mechanism-will-boost-international-response-climate-change-0

ANNEX V

LIST OF ACRONYMS

AARI	Arctic and Antarctic Research Institute, Russian Federation
AIS	Automatic Identification System
AOML	Atlantic Oceanographic and Meteorological Laboratory
AP	Atmospheric Pressure
ASV	Automatic Surface Vehicles
AT	Air Temperature
BUFR	Binary Universal Form for the Representation of. meteorological data
CD	Capacity Development
CDIP	Coastal Data Information Programme
Cefas	Centre for Environment, Fisheries and Aquaculture Science, UK
Cg-18	WMO 18th Congress
CSIS	Climate Services Information System
CTD	Conductivity, Temperature, and Depth
DAC	Data Acquisition Center
DBCP	Data Buoy Co-operation Panel (WMO-IOC)
DBCP-EXB	DBCP Executive Board
DRR	Disaster Risk Reduction
DWSD	Directional Wave Spectrum Drifter
DWSD	Directional Wave Sensor drifters
ECMWF	The European Centre for Medium-Range Weather Forecasts
ECV	Essential Climate Variables
EEZ	Exclusive Economic Zone
EOS	Earth Observing Systems
ESM	Earth System Monitoring
ESP	Earth System Prediction

E-SURFMAR	EUMETNET Surface Marine Programme
EU	European Union
FAIR data	Findable, Accessible, Interoperable, and Reusable data
GBON	Global Basic Observing Network
GDN	Global Drifter Network
GDP	Global Drifter Programme
GFCS	Global Framework of Climate Services
GOOS	Global Ocean Observing System
GOS	Global Observing Network
GPC	Global Processing Centre
GTS	Global Telecommunications System
HF	High Frequency
HMEI	Hydrological Meteorological Equipment Industry
HRSST	High Resolution Sea Surface Temperature
HYCOM	Hybrid Coordinate Ocean Model
IABP	International Arctic Buoy Programme
ICOADS	International Comprehensive Ocean-Atmosphere Data Set
IMO	International Maritime Organization
INFCOM	Commission for Observation, Infrastructures and Information Systems
IOC	International Oceanographic Commission
ISABP	International South Atlantic Buoy Program
ISC	International Science Council
ITP	International Tsunameter Partnership
JCB	WMO- IOC Joint Collaboration Board
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology

JET-EOSDE	Joint Expert Team on Earth Observing System Design and Evolution
KHIA	Korea Hydrographic and Oceanographic Agency
KMA	Korea Meteorological Administration
LDL	Lagrangian Drifter Laboratory
MCDS	Marine Climate Data System
MEWS	Multi- hazard Early Warning System
MIT	Massachusetts Institute of Technology
MTS	Marine Technology Society
MSR	Marine Scientific Research
NAVOCEANO	Naval Oceanographic Office, USA
NDBC	National Data Buoy Center
NIMS	National Institute of Meteorological Sciences
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
OceanOPS	Joint WMO-IOC center for Oceanography and Marine Meteorology in situ Observations Programme Support
OTGA	Ocean Teacher Global Academy
pdf	probability density function
QA	Quality Assurance
QC	Quality Control
RMICs	Regional Marine Instrument Centres
RRR	Rolling Review of Requirements
S&BP	Standards and Best Practices
S&T	Scientific and Technical
SC	Surface Currents
SC-ON	WMO Standing committee on Earth Observing Systems and Monitoring Networks

SG-OOIS	Study Group on Ocean Observations and Infrastructure Systems
SG-OOIS	Study Group on Ocean Observations and Infrastructure Systems
SIDS	Small Island Developing States
SIO	Scrips Institute of Oceanography
SOFF	Systematic Observation Financing Facility
SOFS	Southern Ocean Flux Station
SOLAS	Safety of Life at sea
SOP	Special Operational Period
SOT	Ship Observations Team
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
SVP	Surface Velocity Programme
SVP-B	SVP with barometer
TAC	Traditional Alphanumeric Code
TAO	Tropical Atmospheric Ocean
TT	Task Team
TT-CB	Task Team on Capacity Building
TT-DBPD	Task Team on Drifter Best Practices and Technology Development
TT-ES	Task Team on Environmental Stewardship
TT-MB	Task Team on Moored Buoys
TT-RPT	Task Team on Recruitment, Promotion and Training of SOT
TT-WM	Task Team on Wave Measurements
UK	United Kingdom
UKMO	UK MetOffice
UN	United Nations
UN Decade	United Nations Decade of Ocean Science for Sustainable Development
UNEP	United Nations Environmental Programme

UNSDG	United Nations Sustainable Development Goals
USA	United States of America
USACE	United States Army Corps of Engineers
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WMO	World Meteorological Organization
YOPP	Year of Polar Prediction