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OceanPractices

Ocean Best Practices Workshop VII & Focus Sessions 09-20 October 2023 [ONLINE]

Proceedings

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Executive Summary

The 2023 OceanPractices: OBPS Workshop VII aimed at providing some “common” solutions to the 10 selected challenges set by the UN Ocean Decade for collective impact.

The online workshop 09-13 October 2023 was divided into two sessions per day (each day about 3-4 hours in total with breaks), covering an introductory session including a Panel of distinguished speakers, with the rest of the week scheduled with Workshop Sessions addressing the UN Ocean Decade Challenges. The sessions offered plenty of time for discussion and Q & A. Each session addressed such questions as: "*What kind of Ocean best practice should be developed for major topics (e.g. climate change, energy, environment)?*", "*Where are the gaps in best practices in your discipline?"; "Are best practices transversal, i.e., not silo-like?*" or "*Beyond best practices, what do we do?*".

https://oceandecade.org/challenges/

Challenge 1: Understand and beat marine pollution
Challenge 2: Protect and restore ecosystems and biodiversity
Challenge 3: Sustainably feed the global population
Challenge 4: Develop a sustainable and equitable ocean economy
Challenge 5: Unlock ocean-based solutions to climate change
Challenge 6: Increase community resilience to ocean hazards
Challenge 7: Expand the Global Ocean Observing System
Challenge 8: Create a digital representation of the ocean
Challenge 9: Skills, knowledge and technology for all
Challenge 10: Change humanity’s relationship with the ocean

The following week, 16-20 October 2023 was devoted to Focus Sessions organised by different communities of practice to share activities in establishing and using best practices in ocean observing, and for gaining endorsement for these practices from the community.

Focus Sessions

Workshop and Focus Session Recordings

INTRODUCTION

The UN Decade of Ocean Science for Sustainable Development has influenced how the ocean community collaborates and addresses societal issues. Concomitantly, the pace for identifying more global solutions in science and technology has increased. However, several challenges remain to transform innovations, methods and practices into sustainable solutions for the goals of the UN Ocean Decade and beyond.

The 10 Ocean Decade Challenges unite experts from different disciplines and regions around a specific topic, fostering the exchange of ideas, innovation and building a roadmap and a common measure for addressing these challenges successfully. Unequal knowledge sharing and limited local capacity building still exist and hinder development towards the goals of the Ocean Decade. Thus, the Ocean Decade provides a unique opportunity to reverse this by empowering regional experts, fostering collaborations, and promoting inclusive research.

The goal of the 7th Ocean Best Practices System workshop (OBPS-WS VII) was to explore the role of standards and best practices in the UN Ocean Decade Challenges. Best practices have been highlighted as an integral part of the UN Ocean Decade (Ryabinin et al., 2019; https://doi.org/10.3389/fmars.2019.00470). They can help to transform the visions we have to address the 10 Ocean Decade Challenges into action successfully.

The workshop consisted of several sessions addressing Challenges 1, 2, 6, 7, 8 and 9 as well as a number of focussed sessions around the topic.
The workshop served as
(1) a platform for discussion and knowledge exchange from experts around the field,
(2) recommendations on including best practices into the strategic ambitions from each of the Ocean Decade Challenge working groups and
(3) recommendations from the community on how OBPS can support the successful implementation of the strategic ambitions.

Welcome to the Workshop

Recording
OBPS Workshop VII - Introduction to the Challenges

The OBPS co-chairs Rene Garello and George Petihakis opened the OBPS Workshop VII and provided a brief background on the mission and vision of OBPS and the endorsed Ocean Decade Programme *Ocean Practices for the Decade*.

Introduction to the Challenges

The plenary consisted of short perspectives from IOC (Vladimir Ryabinin) IODE (Peter Pissierssens), GOOS (Joanna Post) and representatives from the oceanographic community (Audrey Hasson) and the Ocean Vision 2030 Challenge 9 Working Group co-lead Edem Mahu (and OBPS SG Member). The presentations were followed by a panel discussion moderated by Craig McLean. Full recordings of the session are linked below and main highlights are provided for each of the panellists.

Vladimir Ryabinin (Executive Secretary, IOC - recording);
IOC Ocean Decade 4 Best Practices

Vladimir Ryabinin underlined the universal need for best practices (BP) since we do not have conventions. BP can act as accelerators; they support capacity development for emerging professionals and allow us to move forward on sustainable development. In his presentation, he noted that currently we are "treating the disease" but to "cure the ocean" the doctors need to talk to each other. Interoperable BP will work to further knowledge exchange and this is where co-design makes the UN Ocean Decade so successful.

Peter Pissierssens
(Head, UNESCO/IOC Project Office for IODE)
IODE Perspective on OBPS

Peter Pissierssens outlined how the International Ocean Data and Information Exchange (IODE) in its founding principles references best practices (BP) and supports the work of OBPS by :

-facilitating and promoting the exchange of BPs
-encouraging a long term archival
-developing and use of BP

He highlighted the IOC Manuals and Guides publication series, which are also made available through the OBPS Repository, but recognised that all are possibly not 'best' practices

[Editors note: *The Ocean Best Practices System (OBPS) Repository accepts ocean/marine research and applications methodological documents at various levels of development, adoption and maturity; not all are 'best' practices'. This permits new practices to be published, tested, and used. It also enables practices tailored for a regional application to be accessible to interested users. The repository is a global open access resource, serving the needs of a broad range of ocean stakeholders*].

Global use of endorsed, agreed and adopted best practices provides trust in the data and information produced. Best Practices must include fully transparent and accessible quality control methods, and the practice documents should utilise seamlessly interoperable vocabularies and ontologies, be compatible for interoperability arrangements/technology, and be accompanied by high-quality provenance metadata.

Joanna Post
(Head, Observations and Services Section (GOOS),
Intergovernmental Oceanographic Commission of UNESCO
Best Practices and GOOS

Joanna Post emphasised the intergovernmental need for systematic integration of data and information and discussed how best to respond to these needs. She confirmed that GOOS facilitates the flow of data to various communities of practice,

ensuring that this data ultimately addresses societal needs and helps develop methods that can evolve into best practices.

She highlighted that GOOS together with OBPS has piloted an Endorsement Process (with 10 GOOS Expert Panel endorsed practices then), and introduced some of the requirements needed to qualify as a "GOOS endorsed practice" [Hermes, 2020].

a. have completed a rigorous community review process whereby comments are publicly invited, adjudicated and actioned by the author
b. originate from a network that is at least "pilot'' in all the BioEco or OCG network attributes (when applicable, i.e. originating from a BioEco or OCG network);
c. be approved by the leadership of the relevant network, expert team or other community leaders.
d. is fit for the purpose as defined and fully satisfies the definition of a best practice on the OBPS
e. has been recognised as such through the relevant GOOS body, e.g. GOOS BioEco panel, BGC panel, OOPC or OCG or ETOOFS, after the approval of the relevant network leadership
f. Is available and identifiable within the OBPS repository or will be submitted as soon as endorsement is received.
g. is updated at relevant timeframes

Audrey Hasson (Director, GEOBluePlanet)
Monitoring and Forecasting Marine Plastic- Integrated Marine Debris Observing System (IMDOS)

Audrey Hasson introduced the Integrated Marine Debris Observing System (IMDOS) which is an endorsed GOOS Project and which serves as an example of a group working toward ocean best practices and addressing the UN Ocean Decade Challenges. She highlighted IMDOS activities as:

- addressing knowledge gaps and stakeholder needs with adequate data and information.
- focussing (like many other projects) on 1-2 challenges but addresses all of the challenges multidimensionally.
- aiming to provide coordination guidance which includes harmonized data and training fed by societal needs and observational requirements

- technical readiness which then feeds into interoperable data management and decision making.

Relating to ocean best practices, IMDOS :

- provides recommendations on the design and evolution of marine debris observing system
- gives guidance on assessment and harmonization of monitoring methodologies
- promotes guidelines for harmonization, standardization and quality control toward a federated and interoperable data management system
- ensures open access following the FAIR principles.

Edem Mahu (University of Ghana) :
Ocean Best Practices System - Insights from Africa

Edem Mahu opened her contribution by explaining the importance of the OBPS, as directly feeding into and addressing the UN Ocean Decade challenges. She added OBPS can significantly contribute to bridging knowledge and capacity gaps that exist in the ocean science community if adopted by all, addressing inequalities in resource, knowledge, skills and technology distribution. The global OBPS repository offers a search engine for standardized protocols and methodologies.

She then focused on how the Ocean Science Community in Africa can adopt the OBPS by promotion, contribution and utilisation. She listed some benefits to the African Community.

- Enhanced capacity in terms of research methodologies and personal skills and interoperable and accessible data sharing
- Address challenges/ barriers to technology adoption
- Advocacy considerations:
    - awareness about OBPS capacity among ECOPs through webinars, workshops, social media during conferences.
    - Encourage graduate students to utilize the resources of OBPS.
- Best practices in research funding how sustainable are some of the research funding we get? Collaborate with donor communities. Use OBPS to develop funding plans that are truly sustainable
- Promote the collaboration with industry
- Best practices in co-designing projects
- Best practices in capacity development and sharing

- Best practices in ocean literacy and outreach

Panel Session

Moderator: **Craig McLean**

Moderated by Craig McLean the Panel Session of the Keynote Speakers responded to his questions:

Q.1. Treaty vs. voluntary organisations (GOOS, IOC, IODE) do we need something stronger or are best practices we can do now?
Peter Pissierssens: IOC activities are done on a voluntary basis. There is no obligation to share. We do have a data policy in terms of use but in the end it is the Member States who decide. Data systems could disappear or be completely destroyed which is a major issue. IOC agrees on an interoperable mechanism on a minimum data structure that is an agreed upon best practice. To build trust, it is crucial that users can rely on data, which is central to OBPS. IOC must ensure that its manuals and guides remain relevant. Using authorized ontologies and vocabularies is a best practice supported by ODIS. Providing high-quality information is essential, but the connection between data products, services, and decision-making support is still lacking.
Joanna Post: We are working in a value chain with ultimately decision making. Science needs to serve the Agreements eg., Global Biodiversity framework etc. GOOS is a bottom up delivery, there is a lot of need for co-design where you need to bring the stakeholders together to make an informed decision on where to put our priorities. If you start a multilateral process it takes a while, so we need to have these conversations more coordinated and to do this BPs are needed. GOOS provides a good framework and is trying to strengthen this conversation.

Q.2. Is the methodology of defining best practices sufficient to build the next generation of observing systems. Challenges interrelate: do we need a component of the observing system
Audrey Hasson: Partnerships working together with existing efforts. BP are at the heart and it is important to have everyone around the table. Working with Expert Panes to connect directly to the decision making process.

Q.3. Development of much of the world depends on capacity development. Do you find that definition of Best practices helps to generate support and get the resources necessary for your research/ observing platforms

Edem Mahu: BP are good because they guide us to implement programmes in ways that maximize a resource that we need. There are many initiatives but we need to understand which ones are really problem driven. Capacity development is different for different communities. To bring all of these together we can leverage on best practices to know that we are doing the right thing. We need best practices that guide us so we can avoid some of the challenges.

Q.4. As regional communities are developing. Then you need resources and OBPS help you to express what you need. Are there some existing areas?

Edem Mahu: Linking research and industries where we really need BP to facilitate this collaboration. Another example would be collaboration between global north and global south.

Peter Pissierssens: The issues are willingness to share data. If you can identify a clear societal problem then the resources become available. An example is the Tsunami Warning System in the Indian Ocean. After the tsunami there was a clear demand from Society which knocked down the barriers of data sharing.

Essentially, it is important to understand the importance of best practices applicable in regional scenarios and acknowledge that OBPS supports the creation of practices specifically recommending the use of low cost sensors.

Q.5. Following up on Q.2 Different observing systems - the challenge is to merge them and make them as components of one global observing system

Joanna Post: Agree, the need is to come into the system not come out of it. Observations need to be a group effort. GOOS is the HUB where we can have these conversations. Come to us first and then we can see together how you fit in the solution space and the federal aspects.

Q.6. How have you approached the definition of best practices.

Audrey Hasson: Component to GOOS, working with experts that already have expertise in building networks and connecting with decision makers. (“mix and match”)

Q.7. Needs of Africa, suggestions made - Edem, has that worked for you? Have BP been made available.

Edem Mahu: BP are in use, for example, when working with the acquisition of physical observations with many different schools. Our goal was to develop activities for high school students and increase their awareness and support in generating

data in areas where data is missing. To generate data that is globally comparable we needed to utilize best practices and it is important to promote among early-career professionals and graduate students to use BP as a resource to find quality methods.

Q.8. Where do we go with BPs in the future: evaluate existing ones, create new ones? Who is doing it? Should it be channelled up. How does an individual get in touch?

Peter Pissierssens: For maximum access to BP, the federated approach should be followed [Editor Note: *see Focus Session on **Ocean Practices Federated Network***]. OBPS provides document templates which outline what aspects should be considered when creating a best practice.

Rene Garello: Integration!

Joanna Post: Use GOOS as the HUB for the global ocean observing system.

Audrey Hasson: Ocean Best Practices is not only a tool to provide Ocean Best Practices but is also an encouragement to having people around the table to work toward a common goal

Edem Mahu: OBPS should be adopted by all of us. It's only when we use it that we identify the gaps that need change.

The Panellists were thanked for their very insightful contributions.

WORKSHOP SESSIONS

UN Ocean Decade Challenges

CHALLENGE 1 : Understand and beat marine pollution.

Recording: OBPS Workshop VII - Challenge 1: Understand and beat marine pollution

Moderator: **Audrey Hasson** (GEOBluePlanet): *Introduction*

Purpose of the session: How BP could help tackle marine pollution. Are there any gaps that we want to look at?

Tostas Topouzelis, (Univ. Aegean) *Lessons Learned for Detecting and Monitoring Marine Litter using Remote Sensing*

The presentation introduced the Plastic Litter Project (PLP) and listed some achievements and proposed aims:

- Develop algorithms to detect plastics and to understand the limitations of the algorithm
- Create a decision tree for detecting plastic using satellite images.
- Utilising the Coastal Marine Litter Observatory (CMLO) using drone data and then using an AI algorithm to differentiate the plastic.
- SPOTS project: Spectral properties using different approaches (cameras-7 heights) to do a hyperspectral analysis.

Fantina Madricardo, (BlueMissionMed and Coordinator of MAELSTROM) *Ocean Best Practices in the Med.*

The presentation summarised the aims of the BlueMissionMed Project as working toward the Sustainable Development Goal 14.1 and to connect, empower and involve all the actors.

- Sources of pollution are linked to different stakeholders and also align with all the European National Policies including business models.
- The focus is on emerging pollution and OBPS can contribute toward streamlining the observations between projects.
- MAELSTROM Project - Covers the whole pipeline from collecting litter to its recycling. An app to track the recycled products has been created.

Alexander Turra, (USP, Brazil) *Understand and beat marine pollution : problem and solution*

The presentation explained that Marine Litter is a complex issue with different pathways demanding very specific solutions for each pathway which also relates to different stakeholders (Industry, government, citizens including school children etc). Solutions are based on 3 different strategies:

1) Indicators
   Link to Policy concerns so we can improve the dialogue between government and society.
2) Hotspotting
   Demography, climate, information of the solid waste treatment and recycling. Need to inform the Government, to fill this data gap.
3) Governance
   A complicated problem: we need an interdisciplinary, transdisciplinary, integrated and adaptive approach.

Vesna Kuralt, (Remedies, HE Innovation Action) *Remedies: let's restore our ocean*
REMEDIES is an Horizon Europe innovation Program, and part of the EU Mission "Restore our Ocean and Waters", creating innovative solutions and technologies to monitor, collect, prevent and valorise (micro)plastic from our oceans. Their approach is rooted in science, circularity, and community engagement aiming to protect water ecosystems, reduce pollution and develop a climate-neutral blue economy.

Zacharie Sohou, (IRHOB, Benin) *Benin Fisheries and Ocean Research Institute (IRHOB)*
The presentation explained that IRHOB has a multiplatform approach to monitoring coastal regions and acquiring data: Onset data, Buoy data, EUMET Cast data, Camera data, Fisheries data and Environmental metadata.

Marisa Almeida, (NetTAG+) *Preventing , Avoiding and Mitigating Environmental Impacts of Fishing Gears and Associated Marine Litter*
The presentation explained that discarded or lost fishing gear is a major litter problem that threatens marine habitats and wildlife. The timely tracking and recovery of lost fishing gear can minimize this risk and help preserve our oceans and boost the fishing sector. The integrative prevention approach of the NetTAG Project now needs to be upgraded and upscaled and translated to the Mediterranean area. This is an essential step to prevent, mitigate and avoid, co-development with the fishers and will empower the fisher industry. Their voluntary work to improve the gear and reduce the loss of fishing gear should be recognized and rewarded.
Recommendations: NetTAG should work with the fishers on a 'best practice' guide which is freely available to all fishers so that they can easily see what to do with the litter on board (e.g., where to put it; how to separate it etc.). The guide should address local and regional conditions e.g. size of the boat and port activities/requirements. Improvements to the practices can be through discussions, workshops and questionnaires.

Questions and Answers:

Q. The OBPS is a service for method sharing, data integration and interoperability.
Comments:

- **Vesna Kuralt**: Best practices are scattered around the world. There are not a sufficient number of BP 'remedies' hence everyone is reaching out to different stakeholders to find better solutions.
- **Rene Garello:** ban plastic bags legally. But there are no incentives when you buy them. So it is definitely on the consumers as well.
- **Audrey Hasson:** Behaviour change is easier for younger generations but then the solutions are also disproportionately on the shoulders of the younger generations.

Q. **Do we need a change of technology? Should Best practices be specifically developed for the global south?**

- **Zacharie Sohou**: Global fight against bad practice. However, for regional uses there should be best practices.

Q. **Is data produced actually used by the scientific community?**

- **Zacharie Sohou**: Data produced is used by the scientific community and should be shared at national, regional and local level. Sharing could also be done by organising a conference.

CHALLENGE 2 : Protect and restore ecosystems and biodiversity.

Recording:

OBPS Workshop VII - Challenge 2: Protect and restore ecosystems and biodiversity

Moderators: **Frank Muller-Karger** (USF) **, Joana Soares,**(AIR Centre)

SESSION HELD JOINTLY WITH MARINE BIODIVERSITY NETWORKING FRIDAY

Frank Muller-Karger (USF) and **Aileen Tan Hwai (**Universiti Sains Malaysia) : *The Ocean Decade Vision 2030 initiative*

Frank Muller-Karger and Aileen Tan Hwai Shau, Co-leads of the UN Decade of Ocean Science for Sustainable Development, Challenge 2, introduced the session acknowledging that it brought an opportunity to open the process up and have a larger audience helping to set the vision and goals going into 2030 to set the Ocean Decade up for success.

Challenge 2 aims to understand the effects of multiple stressors on ocean ecosystems, and develop solutions to monitor, protect, manage, and restore

ecosystems and their biodiversity under changing environmental, social, and climate conditions. This challenge is closely connected to the Convention on Biological Diversity.
The overall goal of this workshop session was to share activities in establishing and using best practices in ocean observing and to gain endorsement for these practices from the community.

To ensure the UN Ocean Decade remains relevant over its duration, the Ocean Decade needs to develop an evolutionary approach. Through a participatory and iterative process, Ocean Decade Vision Expert Working Group 2 is setting a tailored and specific strategic ambition, and associated milestones, allowing the Decade Coordination Unit of the Intergovernmental Oceanographic Commission of UNESCO and partners to measure progress towards fulfilment of the Challenge. This collaborative effort fosters the exchange of ideas, best practices, and the development of impactful initiatives to address the Ocean Decade Challenge 2. The resulting White Paper on the strategic ambition Challenge 2 will be presented and discussed at the April 2024 UN Ocean Decade Conference in Barcelona.

The co-leads provided some recommendations concerning practices and methods in this Challenge 2 area:

- There is a need to develop a coordinated approach, with common language, open data, and interconnectivity.
- A mismatch between the expectations and funding groups and what takes place on the ground. We need to shift the narrative of what restoration looks like. When looking for funding, tell stories effectively, and find examples of where it's been done right.

Specifically for the IOC's Ocean Best Practice System (OBPS)

- To work together to define what actions are needed to engage people more broadly, and what minimum set of metrics can be agreed internationally so that data can be shared.
- Need to focus on co-design.

The Co-Leads welcomed the two speakers

Mark Beeston, (Blueecosystems): *Best Practice Guidelines for Mangrove Restoration - What have we learned from a global restoration community?*

As nations, institutions, and communities start to feel the impact of losing their mangroves, a major desire and opportunity for restoration is emerging (Ellison et al., 2020). Of the 1,100,000 hectares (ha) of mangroves that have been lost since 1996, around 818,300 ha of mangroves are considered “restorable” while other areas are considered irretrievably lost to urbanisation, erosion, or other causes. While there have been many successful mangrove restoration efforts, some regions still see failure rates of up to 80% due to science-based methods not being followed – most notably poor project planning and lack of local engagement, reliance on planting in unsuitable areas, or planting without also addressing hydrology, nutrient, and sedimentation requirements (Primavera and Esteban, 2008, Kodikara et al., 2017). The position of mangroves in the landscape, at the margin of land and sea, also adds complexity as environmental conditions for mangrove establishment can vary on small spatial scales and land ownership and management of the area may be unclear. Sometimes restoration may even cause environmental damage when other valuable habitats such as mudflats and seagrass beds are planted over with mangrove saplings.

The excitement and potential for mangrove restoration has never been higher and it is imperative that we get this right. With this idea in mind, the Global Mangrove Alliance (GMA) and the Blue Carbon Initiative (BCI), are initiating and hosting these Global Mangrove Restoration Guidelines, and are bringing together NGOs, governments, scientists, industry, local communities, and funders towards a common goal of conserving and restoring mangrove ecosystems in a science based, fair, and equitable manner.

Getting to this point of producing a single set of guidelines incorporating more than 20 authors and with global support from NGOs, plus leading academics in the field of mangrove restoration, is the result of years of community building and co-operation. Here we share not just the resulting document (scheduled for public launch only a few days earlier in Singapore), but also the story behind this and related products targeted to drive sustainable and ethical ocean restoration.

The organisation of the guidelines is laid out according to the stages of the project cycle:

i) Goal setting and feasibility – before you begin. What are the legal permissions, who needs to be on board, etc.;

ii) Project design – what are we going to do?;

iii) Monitoring and evaluation – is what we are doing effective? Best practice guidelines will be released soon. A key point would be to see how the guidelines could be more broadly applied.
He outlined where he saw future collaboration:

- Global mangrove watch – basic data on mangrove extent over time and national-level data on blue carbon. Smithsonian has the coastal carbon atlas, which is a good data repository, to help get an estimate of the impact of Global Mangrove Alliance work.
- Ideas for suggested actions:
    - Focus on the Kunming-Montreal global biodiversity framework,
    - Develop a strategy to better identify what to conserve, develop, and protect,
    - Implement a strategy for data mobilisation.

Artash Nath, (MonitorMyOcean.com) : *The Silence of Global Oceans: Acoustics Impact of the Covid-19 Lockdown*

Low-frequency noise from marine shipping is an underwater acoustic pollutant in oceans. The noise spectrum overlaps with frequencies marine mammals use to communicate and navigate, leading to stress and increasing collision with ships. This research established a model to measure the contribution of anthropogenic activities to underwater noise levels.

The COVID-19 lockdown led to a global decline in commercial and cruise shipping. The model quantified the reduction in noise levels before and during the lockdown in the Arctic, Atlantic, Pacific Oceans, and the Mediterranean Sea. Underwater ocean sound peaks between 10 – 100 Hz and is dominated by noise from shipping traffic. Hydrophones (underwater microphones) data from seven ocean observatories were analyzed at 1 Hz spectral and 1-minute temporal resolution. Power spectral densities were calculated, aggregated into monthly long-term spectral averages, and noise levels in the 63 Hz third-octave band compared to previous years.

The analysis revealed that global oceans quietened by an average of 4.5 dB, or the peak sound intensity decreased 2.8 times during the lockdown period. The maximum decrease was at locations close to major shipping channels and cruise tourism destinations. The findings were validated by comparing shipping traffic using the satellite-based Automated Identification System (AIS). The study proved that strategic “anthropauses” can reduce underwater noise levels and give marine

mammals a chance to reverse the decline in their population. An open-source interactive web application MonitorMyOcean.com was created to provide updated anthropogenic noise levels in global oceans. Policymakers can determine if measures such as shifting shipping channels or moratorium on new shipping routes are leading to "Quieter Oceans." The App has been endorsed by the Intergovernmental Oceanographic Commission (IOC) of the UNESCO as a UN Ocean Decade Activity.

Frank Muller-Karger suggested MonitormyOcean.com make a connection to the GOOS Ocean Sound Essential Ocean Variable (EOV) work. He mentioned bringing marine connectivity to the Challenge 2 discussion and identified https://www.sea-unicorn.com/ and Audrey Darnaude offered to look at contributing.

CHALLENGE 6 : Increase community resilience to ocean hazards

○

Recording:

OBPS Workshop VII - Challenge 6: Increase community resilience to ocean hazards

Moderator: **Nadia Pinardi** (UNIBO) : *Introduction*

Nadia Pinardi, Co-Lead of UN Ocean Decade Challenge 6, described coastal resilience as a dynamic process and the capacity to return to some healthy and essential function after a perturbation (e.g. an ocean hazard). These ocean hazards include geophysical/ geological, biological, ocean weather, hydrology and climate, ecological and local anthropogenic hazards. The intersectional effect is also very important to consider. She explained that coastal resilience runs in a loop:
PLANNING - including stakeholders, co-design - prevention and protection
ACTION - Preparedness - capability to respond by the communities
RECOVERY
ASSESSMENT - science based monitoring.

The Vision 2023 Challenge 6 White Paper includes elements for a strategic ambition with outcome aspirations for a safe ocean where life and livelihood are protected from ocean hazards -

1) Design of early-warning systems

2) Design of adaptation planning strategies

Presentations were given by Pedro Almeida, Fabio Hochleiter and Luiz Paula Assad, and Ediang Okuku Archibong, followed by a discussion moderated by Nadia Pinardi.

Pedro Almeida (CoLAB + Atlantic,) : *EOatSEE Project*
The EOatSEE (Earth Observation advanced science tools for Sea level Extreme Events) Project is funded by ESA - and covers earth observations but datasets together with other tools and looking at coastal hazards. The objectives are: a community effort to exploit latest advances in EO technology; provide data driven dynamic reconstruction of ESL events in different test regions; enhance science understanding and predictive capacity of ESL event and related coastal hazards; assess the potential of the project outputs to better prepare for the impacts of ESL events
PROJECT APPROACH: Scientific challenges are the main drivers of the project work: predictability process understanding; risk and vulnerability assessment, looking at short terms and long term scenarios.
USE CASES AND DEMONSTRATORS: Seven global coastal sites had been selected, All are low lying and vulnerable to sea level demonstrating dynamic morphological response of the coast to extreme sea level events. He showed that comparison between model and satellite tracks show good agreement and the use of coupled circulation and wave models provided better prediction of extreme sea level events than using individual models.
PRELIMINARY RESULTS : Included nearshore topography and tipping points for coastal flooding and coastal total water level pipeline analysis with flooding estimation of the process.

Fabio Hochleitner and Luiz Paula Assad, (LAMCE COPPE/UFRJ): Increase community resilience to ocean hazards: environmental modellling R & D Initiatives in Brazil
The presentation set out to show the context of the reality of challenges in Brazil related to coastal resilience because 40% of the population live near the coastline which measures some 7400km and which has many different coastal ecosystems and stakeholders (fishermen, oil and gas, renewable energy etc). Brazil has six different climate zones and biome units. This complex system is further complicated by socio- economic aspects so trying to understand the natural hazards is a huge challenge.

A number of projects were identified:
AZUL Project - developed an ocean observing system and data acquisition for Santo Basin region, primarily to support the demands of the oil and gas industry but also addressed the challenge of natural hazards.
Coste Norte Project - defined the vulnerability of the equatorial margin due to oil spill accidents but as with the Azul Project although commenced for oil spill hazards it was also broadened to address natural hazard challenges. Drifters had been launched to obtain regional and local observation and this was complemented by simulation to integrate all the aspects. He also described further projects supporting ocean and atmospheric circulation and water quality.
Baia Digital (Planet Environmental People Lab) - where water management was utilised to improve resilience to hydro-climatic extremes. Maps were created of social and health data integrated with ocean and meteorological data.
The presentation ended with the initiative from the National Institute for Oceanic Research to Increase communication between science and society and bring global challenges such as climate change into the conversation with the evidence gained from their projects.

Ediang Okuku Archibong (Nigerian Meteorological Agency.) : *A review of Seasonal Climate Prediction (SCP) under Nigerian Meteorological Agency (Nimet) for increase Community Resilience to Ocean Hazards in Nigeria*

The presentation introduced a study analyzing the Strategic Climate Prediction (SCP) of the Nigerian Meteorological Agency (NiMet) from 2010-2022, focusing on community resilience to ocean hazards in Nigeria. The findings show a rise in natural and human-induced disasters, particularly coastal flooding, rainstorms, windstorms, pollution, migration, and weather-related coastal accidents. NiMet's advice to community-based organizations, along with localized weather predictions for coastal states, has led to positive outcomes in managing these increasing weather challenges. Advice from the SCP of NiMet for both coastal and internal water is provided to community-based organizations and the downscaling of it's prediction to coastal states in Nigeria confronted with these increased weather phenomenon has been yielding positive responses and results.

Questions and Answers:

The discussion began with Nadia Pinardi questioning the need to justify research for "blue growth" rather than focusing on protecting coastal populations, which remain vulnerable to hazards.

Pedro Almeida emphasized that societal awareness, education, and media attention drive political action, advocating for a bottom-up approach to influence research and change.

Luiz Paula Assad agreed with the need to protect communities but highlighted the importance of balancing the blue economy with community needs for sustainable development. He pointed out Brazil's gradual shift from oil and gas towards renewable energy, such as offshore wind, and stressed the need to bridge gaps between society, scientists, businesses, and governments for effective policies. Jay Pearlman added that discussions should also focus on the social dynamics of coastal resilience, such as how communities adapt to environmental challenges. He concurred, underscoring the importance of socio-economic factors and how they evolve over time in understanding regional vulnerability and social interactions.

CHALLENGE 7 : Expand the Global Ocean Observing System

Recording: OBPS Workshop VII - Challenge 7: Expand the Global Ocean Observing System

Moderator: **Paula Salge** (+ATLANTIC; Univ Algarve)

Paula Salge introduced that the goal of the session was to share activities that are implementing best practices. The session included 4 presentations of 15min followed by a final discussion.

Joaquin Tintore (SOCIB and IMEDEA (CSIC-UIB) **:** *Contribution from regional seas observing systems to global ocean observing: applications and impacts, advancing towards regional digital twins*
This presentation opened with an implementation of best practices success stories. Significant work on identifying HF radar practices has been produced during the JERICO S3 Project in which BP had been collaboratively defined. The deliverable is

also available in the OBPS Repository. Mention was made of the SOCIB repository and he noted that this is linked to European Marine Portals (Copernicus, Blue Cloud, etc.). The presentation finished by identifying a challenge: we need a real transformation towards ocean integration. “From egosystems to ecosystems”

Ioanna Karagali (Danish Meteorological Institute) : *Operational Sea-Surface Temperature data retrieved from satellites*

Sea surface temperature (SST) is a fundamental physical variable for understanding, quantifying and predicting complex interactions between the ocean and the atmosphere. Such processes dictate how heat from the sun is redistributed across the global oceans, directly impacting large-and small-scale weather and climate patterns. The provision of daily maps of global SST for operational systems, climate modelling and the broader scientific community is now a mature and sustained service coordinated by the Group for High Resolution Sea Surface Temperature (GHRSST) and the CEOS SST Virtual Constellation (CEOS SST-VC). GHRSST (http://www.ghrsst.org) is comprised of SST experts representing many communities including space agencies, meteorological agencies and universities around the world. The partnership between GHRSST and the CEOS SST-VC is organised with GHRSST implementing the framework for SST-VC activities. GHRSST coordinates a suite of global high-resolution SST products. Data processing and distribution are organised through Data Assembly Centres and products are provided according to the community agreed GHRSST Data Processing Specification (GDS) V2.0 common specification. SST products rely on a combination of low earth orbit infrared and microwave satellite imagery, geostationary orbit infrared satellite imagery, and in situ data from moored and drifting buoys, Argo floats, and Fiducial Reference Measurements (FRM) for product validation. The presentation gave an overview of the operational exploitation of SST derived from satellites. Current GHRSST priorities include high-resolution SST around coasts, improvements in high-latitude SST and feature resolution.

Kwame Adu Agyekum (University of Ghana): *Supporting ocean and coastal monitoring using satellite data*

Importance of co-design was stressed in this presentation, particularly, at the very beginning when discussing and designing from the ideas. He outlined some successful approaches his work had followed: together, they reached solutions by talking to various stakeholders; they interacted in a participatory way and this approach made it easier to be accepted among the community.

Challenges still include government interaction, constant engagement, varying geopolitical interest, developing Targeted solutions.

Bouhali Mohamed Amine (University of Science and Technology Houari Boumediene (USTHB): *Oceanography Operational: Satellite Data-Computing Technologies Vision, a Tool for Observing and Monitoring Oceanic System* (RECORDING)

Remote sensing, electronic map, high-speed computing and broadband communication technologies, have created a new ability to examine planet Earth like never before. These advances made it possible to begin the study of the Earth as a total entity, operational oceanographic activities use advanced tools and platforms using the latest technological developments, by autonomous tools. The presentation illustrated the latest advances used in scientific research in the field of operational oceanography; space remote sensing, technological platform for data exchange, satellite data processing software. All these advances were combined to set up an numerical simulation video-map application of ocean variables of Western Mediterranean Sea (Algerian Coast).

Questions and Answers:

Q1. Do you have standards for sea surface temperatures?

Ioanna Karagali: The role of the GHRSST team is to establish standards and best practices. The website has different types of products and validations for example what type of systematic biases you can expect etc. Also different products and quality levels.

Q2. You mention to focus about new techniques? What type of new techniques can you have in these regions.

Ioanna Karagali : Coastal upwelling there is a big challenge for retrieval of the data. Cloud masking algorithms have challenges in coastal areas. Now machine learning AI could be an important technique to fill this gap.

Q3. Capacity development activities

Kwame Adu Agyekum: Sometimes we do targeted training with individual trainers but it varies and we are flexible and respond to specific needs.

CHALLENGE 8 : Create a digital representation of the ocean.

Recording:

OBPS Workshop VII - Challenge 8: Create a digital representation of the ocean

Moderators: **Jan-Bart Calewaert** (Ocean Data Sharing, Decade Coordination Office)**, Ann-Christine Zinkann (**NOAA Global Ocean Monitoring and Observing Programme)

Jan-Bart Calewaert : *Challenge 8 - introduction*

Jan Bart Calewaert introduced the Strategic Objectives, which include:

1) Develop an ocean digital ecosystem
2) Improve data and information discovery and usability
3) Build trust in data and information
4) Prioritize digital solutions
5) Expand, empower and mobilise global communities

Further, he highlighted that a reality within challenge 8 is that we need federated networks. Federated data systems are needed to support the diverse needs of different communities. Since these communities have varying levels of technology and resources, we need different tools that can still work together in a shared framework. This means everyone should have access to the same data layers, with a coordinated approach from data collection to practical use, supported by offices for Ocean Observing (GOOS), Ocean Data Sharing (IODE), and Ocean Predicition (MERCATOR). The main goals are to create a digital ocean ecosystem, make data easier to find and use, build trust in data, focus on digital solutions, and empower global communities. It's also important to ensure that the right data gets to the right people at the right time, while solving any issues that slow this process down.

Piotr Zaborowski (OGC): *Bring Your Own Digital Twin of The Ocean - how to build interoperability layers based on the modular approach.*

According to the UN, oceans are the "lungs of our Planet and a major source of food and medicine and a critical part of the biosphere". At the same time, they are one of the most unexplored and unmonitored areas of the Globe. Tremendous efforts in satellite remote sensing are helping to cover the white stains with increasingly accurate and timely data. Still, it is not foreseen they will ever entirely supersede in-situ observations, the ground truth and the only information of the invisible from space. The ocean is also one element of the ecosystem whose state is influenced and sometimes influences watercourses, the atmosphere, tectonics and coast ecosystems, which naturally requires multi-source data and services integration. Efforts in standards, data, model cataloguing and interoperability, bring us forward in the vision of futuristic inferencing. We have known good practices of the FAIR, TRUST data on the web for a few years. However, overarching homogenous approaches have yet to be proven. Huge, stable repositories and research environments twinning oceans are now co-existing with emerging novel models, services and their results. Currently observed trends revolve around cloud and distributed processing, open science principles, inter-standards, multi-level crosswalks and modularity. Based on the Iliad - Digital Twin of the Ocean experience, we have recognised that modularity can be the key to scalable interoperability. The approach is based on the building blocks that are common pieces used in various combinations, and the community uses good examples of combining these. Standard world example of this kind is OGC APIs and IHO standards that enable modular composition of data and visualisation, and the other are technical-semantic

interoperability practices allowing for unambiguous information crosswalks. Full exploitation of that potential is not the most straightforward solution technically, but it will enable us to avoid duplicating problems with questionable results of recent generative models. Regardless of the architectural approaches, it allows addressing various stakeholders' needs while minimising maintenance and limiting the burden required to proceed with cross-domain innovations.
Examples and lessons learned were presented from the OGC FMSDI and Iliad, where multi-pilot projects implementation integrated scientists, data, platforms and software providers work following the bottom-up approach with the common goal to harmonise digital twin efforts. Both widely used techniques and novel approaches are tested within these activities to recognise new good practices.

Peter Baumann (Constructor University, Bremen) : *Federated, Democratic, Open: EarthServer and How Its AI-Cubes Contribute to Digital Twins*
Datacubes are an accepted cornerstone towards analysis-ready geo data leading to easier, faster, and better insight into the massive spatio-temporal data arriving continuously in increasing amounts today. The open, transparent EarthServer federation unites independent data providers establishing a single common pool of currently 160+ PB of datacubes of satellite, weather/climate, maritime, and further thematic data. Currently the underlying datacube platform, rasdaman, gets enhanced with AI integration to allow searchable libraries of pretrained models for any purpose.

Having such a rich, continuously extending spectrum of spatio-temporal data can lead to better understanding of existing and hypothetical scenarios and, therefore, constitutes a solid fundament for Digital Twin of land, sea, and atmosphere.
In our talk we present concepts, status, and plans of EarthServer, illustrated by live demos many of which participants can replay. Particular emphasis is on ocean data and their exploitation.

Conor Delaney and Vicente Fernandez (EMODnet) : *EMODnet Central Portal: a case study of Open Source software and OGC standards to provide an interoperable web service and viewer*
The European Marine Observation and Data Network, EMODnet, is a long-term European Commission initiative set up to provide open access to in situ marine data and derived data products, tools, and services. Until 2022, EMODnet existed as a collection of nine (Bathymetry, Biology, Chemistry, Human Activities, Seabed Habitats, Physics, Geology, Central Portal and Data Ingestion) thematic web portals

which provided access to their outputs in a similar way. Seven of those portals have now been merged into the EMODnet Central Portal, which unifies the EMODnet data services of the different thematics through a single access point: emodnet.ec.europa.eu. The content is still managed by the different lots and remains their responsibility.

The new EMODnet Central Portal provides unified data, metadata discovery, visualisation and download services. These are presented to the user through a new map viewer and metadata catalogue powered by a collection of back-end web services. While more and more of the services are hosted centrally, the majority are distributed over the existing data servers of the EMODnet thematic lots. The functionality of the new EMODnet Portal is dependent on the interoperability provided by these web services. With seven separate thematic groups publishing web services it is essential that the services comply with a set of geospatial (OGC) and RESTful (ERDDAP) data service standards.

He presented the EMODnet portal technology stack as a best practice for publishing ocean data products. In addition, he discuss distributed architectures, the web service standards selected and how they were used to provide the functionality of the map viewer and the metadata catalogue. Finally, he discussed the merits of the selected standards and the positive and negative aspects of managing a distributed spatial data infrastructure with plans for further refinement by means of the EDITO-INFRA Project.

Megan Ann French (OGS) : *EMODnet Chemistry: open and trusted data, products and services for understanding the evolution of marine water quality*

Since 2009, the network of organisations that make up the European Marine Observation and Data Network (EMODnet) has been supported by the EU Integrated Maritime Policy to observe the sea, process the data according to international standards and make this information freely available as interoperable data products. For almost 15 years, this data-driven knowledge has helped identify the most effective ways to restore marine and coastal habitats, support a sustainable blue economy and mitigate and adapt to climate change.

As one of the seven themes, EMODnet Chemistry (https://emodnet.ec.europa.eu/en/chemistry) has the overarching goal of facilitating the discoverability, accessibility and usability of marine chemical datasets and derived data products on eutrophication, ocean acidification, contaminants and marine litter in three matrices: water, biota, and sediment. All major European

marine regions are covered. To this end, EMODnet Chemistry first collects and validates data and makes them freely available and interoperable. Secondly, EMODnet Chemistry generates and publishes standardised, harmonised and quality-controlled data collections and reliable derived products to visualise, for example, the distribution and density of sampling stations and the abundance of a variety of pollutants over space and time. In addition, users can perform in-depth scientific analyses, subset and extract data and prepare all kinds of visualisations with the help of practical online functions. In this way, EMODnet Chemistry plays a key role in the implementation of European Union marine policies such as the Marine Strategy Framework Directive (MSFD), the Water Framework Directive and the Maritime Spatial Planning Directive. In particular, EMODnet Chemistry contributes to descriptors 5 (eutrophication), 8 (chemical pollution) and 10 (marine litter) of the MSFD.

She explained some of the latest best practices, such as the "Updated Guidelines for SeaDataNet ODV Production: Eutrophication & Contaminants" (DOI: 10.13120/c1933032-9fa9-4678-8539-effa1560921c), which includes a section on ocean acidity data in addition to information on how to properly submit pollutant and eutrophication data. The guidelines highlight that 1. the inclusion of parameters related to ocean acidification (e.g. temperature, salinity and pressure) whenever available would improve the description of the carbonate system and 2. the addition of relevant metadata would increase the scientific value of the datasets.

She explained the thoroughly revised questionnaire that was used to obtain information on sampling, data analysis methods and validation procedures for contaminants in seawater, sediment and biota. The questionnaire was sent to the network of laboratories that provide data to EMODnet Chemistry in order to improve and update the available information. Despite advances in legislation, there is still relatively little implementation of the requirements of the current directives and protocols. To fill this gap, the questionnaire asks for accurate and comprehensive information on sampling/analysis methods and QA/QC procedures implemented by member countries. The survey and the information obtained are described in a scientific paper, which is currently being revised.

The EMODnet Chemistry tools and guidelines are available on the EMODnet portal, as are the ever-growing use cases.

Conor Delaney (EMODnet), Kevin O'Brien (NOAA) : *A review of ERDDAP the established best practice in sharing gridded and tabular data from the Earth Sciences community*

ERDDAP is a data server that provides users with a simple and consistent way to download subsets of gridded and tabular scientific datasets into different file formats. It receives data queries and file format conversion commands via standard HTML URL calls, which users can share with others or integrate into their data flows. ERDDAP is Free and Open-Source Software (FOSS) originally developed at National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Southwest Fisheries Science Center (SWFSC) Environmental Research Division (ERD).

Over the last decade usage of ERDDAP has increased and what was once a primarily NOAA driven and used software tool is now relied upon by over 100 organizations in at least 16 countries. ERDDAP is an open-source JAVA based web application, with online resources to support efficient interactions between ERDDAP developers, administrations, and user communities. These include: a GitHub Organization (https://github.com/erddap) that includes all ERDDAP source code, a GitHub-based issue/discussion (https://github.com/ERDDAP/erddap/discussions) process for technical input by developers and contributors, and an active and community-supported user forum (https://groups.google.com/g/erddap) for support. It is imperative to maintain this culture of openness and continue growing, supporting, and promoting ERDDAP.

To help guide ERDDAP advancement and interaction with the global ERDDAP community, a Strategic Insight Group (ERDDAP-SIG) has been established by NOAA to provide support, oversight, and direction for the continued growth of ERDDAP. The ERDDAP developer and user communities are more vigorous than ever, and ERDDAP-SIG provides a clear opportunity to cultivate the momentum that ERDDAP has created in the data management community over the last decade. The global ERDDAP user community can be confident that ERDDAP continues to be strongly supported by NOAA (NMFS/ERD) as well as by an active and engaged international community.

In this presentation, along with the new advisory structure, he reviewed the ERDDAP data server and discussed the multitude of benefits that the data platform provides. These benefits include: support for dozens of popular formats; standards-based metadata and data services and formats; support for both human and machine interactions; improved discovery of datasets; and many more. We will demonstrate how the use of ERDDAP, both from the data provider and data user perspectives,

has resulted in the grass roots growth of a worldwide network of interoperable servers publishing scientific quality marine data. In addition, the use of ERDDAP was discussed as a capacity development tool aimed at lowering the technical barriers to providing and accessing data.

Colm Walsh (MEDIN, NOC) : *Improving access to ocean data via Ocean InfoHub using the MEDIN Discovery Metadata Standard*

The Marine Environmental Data and Information Network (MEDIN) is the hub for United Kingdom (UK) marine data and has been promoting good data management practices since 2008. Providing a marine discovery metadata standard, marine data guidelines, tools and an online portal, MEDIN aims to make UK marine data Findable, Accessible, Interoperable and Re-usable (FAIR). The MEDIN Portal contains over 17,000 marine environmental datasets from around the world, owned or managed by UK organisations.

The MEDIN Discovery Metadata Standard contains the list of information required to accompany a dataset to allow other people to find out what the dataset contains, where it was collected and how they can access it. The MEDIN Discovery Metadata Standard is a marine profile of the UK Government Standard GEMINI2 and complies with other international conventions such as INSPIRE and ISO19115. Version 3.1.2 was published in 2022 and sets out a specific format to record details of a dataset, so that, in the future, other people can easily discover marine data that may be of use to them. Datasets complying with the MEDIN Discovery Metadata Standard feed into the MEDIN Portal.

The Ocean InfoHub project facilitates discovery and interoperability of existing information systems through the Ocean Data and Information System (ODIS) infrastructure, with the ultimate goal of coordinating action and capacity to improve access to ocean data and knowledge. MEDIN has been contributing to the development of Ocean InfoHub by sharing its catalogue of dataset discovery metadata records with the ODIS Catalogue where they are now searchable in the Ocean InfoHub web portal. Ocean InfoHub and the ODIS Catalogue use the schema.org vocabulary and JavaScript Object Notation for Linked Data (JSON-LD) mark-up language to publish metadata resources. MEDIN has already exposed schema.org semantics using JSON-LD to make discovery metadata available in the Google Datasets search engine. This made it possible for MEDIN to add 17,460 dataset records to the Ocean InfoHub web portal with only the need for some minor modification to its pre-existing JSON-LD code. Ocean InfoHub contributes to the

Ocean Data 2030 Programme of the United Nations Decade of Ocean Science for Sustainable Development.

MEDIN's longstanding commitment and experience making UK marine environmental data FAIR has enhanced access to the evidence base for decision-making and research across commercial, policy, academic and conservation sectors. Making the MEDIN Discovery Metadata Standard available via Ocean Best Practices enables a broader, international audience to benefit from MEDIN's 15 years' experience improving access to valuable marine data resources. Exposing the MEDIN catalogue of datasets via Ocean InfoHub increases the findability of those datasets and supports MEDIN's ethos of 'measure once, use many times.'

CHALLENGE 9 : Skills, knowledge and technology for all.

Recording:OBPS Workshop VII - Challenge 9: Skills, knowledge and technology for all

Moderators: Edem Mahu; (Univ. Ghana), Talen Rimmer (Univ. Victoria, BC)

Edem Mahu highlighted that Challenge 9 specifically addresses the user needs and technology development for different communities. There is a big gap in science where science and technology is inequitably distributed particularly between the Global North and Global South. Capacity remains a cross-cutting need throughout all other challenges within the Ocean Decade.

Cassandra Hartery (OTN) :
The role of the Ocean Tracking Network's equipment loaner program in addressing challenges for collective impact under the UN Ocean Decade

The Ocean Tracking Network (OTN) is an aquatic research, data management and partnership platform headquartered at Dalhousie University in Halifax, Nova Scotia, Canada. OTN's mission is to inform the management and conservation of aquatic animals by providing knowledge on their movements, habitats and survival in the context of changing global environments. Since 2008, OTN has been deploying state-of-the-art ocean monitoring equipment and marine autonomous vehicles (gliders)

in key ocean locations and inland waters. These new technologies are enabling groundbreaking research that is helping to inform the management of sustainable fisheries and the assessment of environmental impacts. OTN's Data Centre is enhancing the way this information is stored, managed, shared and visualized, thereby connecting and sustaining research networks across the globe.

Acoustic telemetry is a valuable research tool to understand the movements of ecologically, culturally and commercially important aquatic species, but data acquisition is currently limited by the geographic range of deployed acoustic receivers. To support the expansion of aquatic animal tracking worldwide, OTN maintains a loaner pool of acoustic receiver units available to borrow by researchers within academia, government, non-profits and industry. This equipment increases the geographic range of aquatic telemetry research studies, leverages valuable research funding and supports the expansion of OTN's global community of users.

The presentation outlined how OTN's equipment loaner program has supported more than 100 acoustic telemetry projects in 30 countries. Examples will illustrate how OTN's equipment loaner program helps meet challenges under the UN Ocean Decade, such as helping to enable the growth of the Global Ocean Observing System (GOOS) and providing technology for all.

Patrick Gorringe (SMHI) : Democratising ocean observations by using low cost sensors.

Patrick Gorringe covered in his presentation the emerging and significantly growing activities of data collection with low cost sensors. He started by quoting a figure of 1.4Bn euros for collecting marine data in Europe (figures from an EMODnet study) which indicated that there was room for complementary low cost sensor data collection and a benefit in bringing all the communities of low cost sensor developers and users of marine data to show examples of what exists. He then described a number of low cost sensors for collecting various ocean parameters available from many regions including data collected from fishing vessels (FVON- Fishing Vessel Ocean Observing Network). His aim is to connect the community and pull all the data together and make them freely available (FAIR) and to guide the process to make this data more visible, usable and open up the world of data sharing for FAIR and machine to machine readability. He wants to move away from 'cheap' because that conjures up 'low quality'. New projects are being funded combining low cost sensor development and citizen science, but the movement is also connected to

existing global projects such as Co-Lab, Coast Predict, Sailing4Science and the OBPS Task Team on Coastal Observations in Under-Resourced Countries.

Mary Frances Davidson

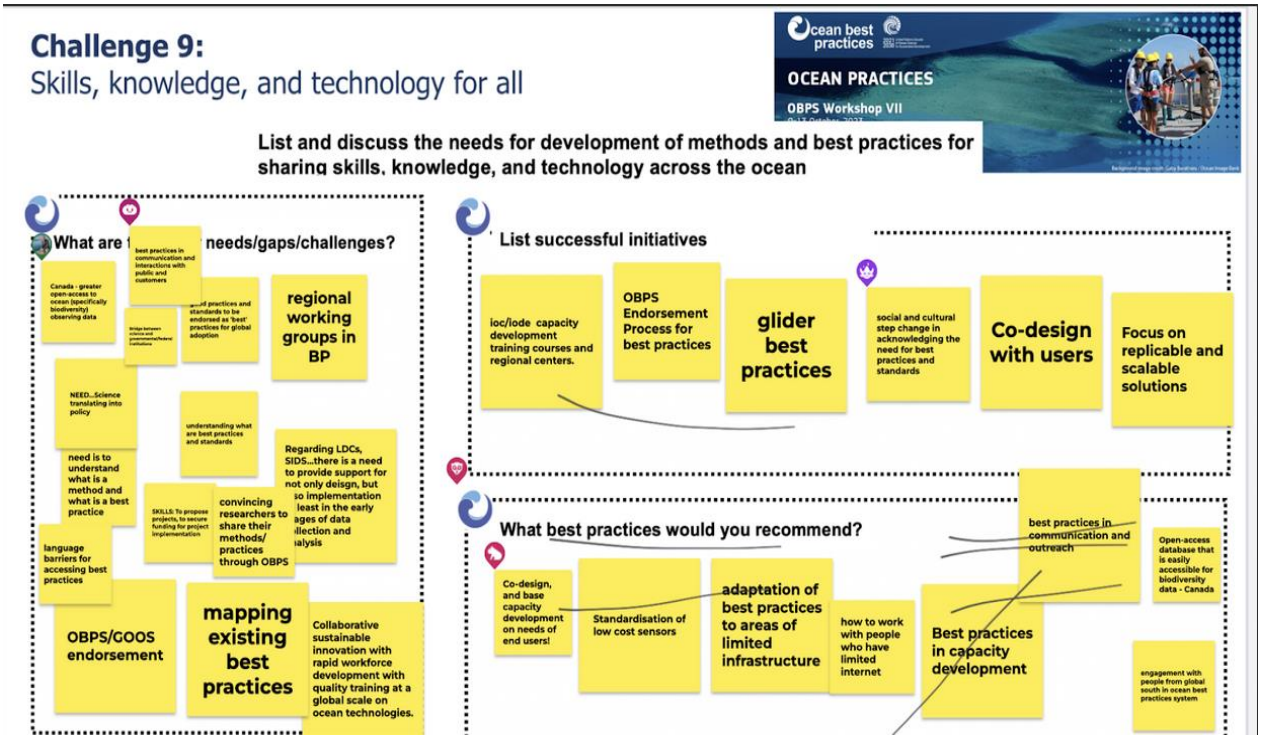
Ocean Decade Capacity Development Facility

Mary Francis Davidson started by acknowledging that we cannot deliver the science we want without the capacity development to support it. Capacity Development of the Ocean Decade Facility is brand new, and is starting with aa needs-based evaluative mechanism that works to support capacity development needs of actors within the Decade and to involve the communities that so far have been underrepresented in the Decade e.g. Under resourced countries, SIDS, ECOPS etc, She outlined four components of the facility:

1. Needs assessment - not the technology but the human capacity needs and sharing training knowledge, It is an enormous field and this component will include a stock taking exercise of existing training programmes. The assessment will pull from surveys to identify capacity priorities
2. Delivery and Matchmaking - a lot or organisations are providing capacity development and the facility will work with such as OTGA, but also invent new initiatives
3. Support - the facility will be responsible for supporting the Community of Practices in the Ocean Decade. There will be a need to identify capacity development BP but she confirmed one size does not fit all. Sharing of BP will be supported by the facility.
4. Resource Mobilization - is particularly aimed at communities not previously involved with the Decade without the knowledge to respond to the Ocean Decade Calls. The Decade call now includes 'expression of interest' and the facility are now introducing a Co-design course on how to write programme /project proposals. The difference with this initiative is that there will be possible funding after the capacity development course.

   Ending, she hoped that in a year's time she would identify BP in capacity development some of which will have been created by the facility. The Facility has been created to be a responsive mechanism rather than a top down process.

Jamboard outcomes presented by Talen Timmer



FOCUS SESSIONS

Nine Focus Sessions organized by the community brought together experts and stakeholders to address the next frontiers in best practices and standards.

The requested output of each theme session, to be delivered to the workshop organizers, was a report (template provided) summarising the Focus Session

requirements and recommendations for best practices, and recommendations to the OBPS Steering Group for future planning. These materials are reproduced below.

Focus sessions:

Best Practices for Observing the Air-Sea Transition Zone (open session)
Best Practices in regional downscaling for operational ocean forecasting
Best Practices on Storytelling and the Restoration of Ecosystem: How to effectively engage stakeholders
Challenges of Using Citizen-Generated Data for Ocean Sustainability and Policy Advancement
Digital Twins of the Ocean - Experiences and Best Practices
EarthServer: Federated Fusion on Analysis-Ready Datacubes
Exploring Ocean-Climate Dynamics: Observations, Collaboration, and Policy Implications
OBPS Focus Session on Better Biomolecular Ocean Practices (BeBOP)
Ocean Practices Federated Network - Governance

Best Practices for Observing the Air-Sea Transition Zone (Open Session)

Focus Session Meeting recording OBPS Workshop VI: Air Sea Interactions (Session 2)

Best Practices for Observing the Air-Sea Transition Zone, Focus Session Report
Submitted by Lucía Gutiérrez-Loza

Scope of the Session

The focus session on Best Practices for Observing the Air-Sea Transition Zone, organized by the Observing Air-Sea Interactions Strategy (OASIS) programme, was looking to promote the development of best practices for air-sea interaction observations towards endorsement and widespread adoption. The session was designed to accommodate two different audiences with two separate objectives, thus divided in two blocks. The first block of this session was used as a platform for a closed-door discussion between experts of the surface radiation community to

address the final steps prior to submission of a Surface Radiation Best Practices paper. In the second block, the community was invited to an open discussion aimed to identify the major knowledge gaps on air-sea interaction observations and setting the next steps for the development of best practices to address the community needs.

Recommendations

The community must work together compiling information about the relevant technologies and methodologies, as well as addressing knowledge gaps, to ultimately provide with the most up-to-date guidelines for a variety of air-sea interaction observations. The endorsement of best practices is essential for promoting the widespread adoption of these best practices and building interoperable and sustained global ocean observing efforts.

OASIS seeks to continue to be a platform for the development and promotion of bestpractices by collaborating with the community through:

- ➢ Intercomparison studies, such as the one is being planned for air temperature.
- ➢ Promoting collaboration between communities.
- ➢ Organizing workshops and other capacity building exercises.

Best Practices in regional downscaling for operational ocean forecasting

Focus Session Meeting recording

OBPS Focus Session on Best Practices in regional downscaling for operational ocean forecasting

Best Practices in regional downscaling for operational ocean forecasting Focus Session Report

Submitted by David Ford

Scope of the Session

Regional ocean forecasts, including of the coastal zone, are vital for many applications, as this is where the majority of human use of the ocean is. A number of approaches can be taken, from running bespoke high-resolution models, to statistically downscaling open access global forecasts, and may depend on how

resource-limited the country is. This session addressed some of these applications and approaches, to develop best practices.

Recommendations:
Maintain and further develop representation between OBPS and ocean forecasting initiatives, in particular the OceanPrediction DCC. Within the ocean forecasting community, established (OceanPredict, ETOOFS) and Decade (OceanPrediction DCC, CoastPredict, ForeSea) initiatives should make sure to coordinate, all have the potential to endorse and inspire confidence and trust. There have been capacity development activities which have touched on ocean forecasting (e.g. GMES & Africa), but to our knowledge none on best practices - there is scope for these to be developed.
OceanPrediction DCC and relevant Decade programmes should include best practices as part of their focus, and coordinate with OBPS on these.

Best Practices on Storytelling and the Restoration of Ecosystem: How to effectively engage stakeholders

Focus Session Meeting recording

OBPS Focus Session on Best Practices on Storytelling and the Restoration of Ecosystem

Best Practices in Storytelling … Focus Session Report

Submitted by: Jessica Giannoumis

Scope of the Session

BlueMissionAA and Prep4Blue collaboratively dove deep into storytelling and best practices for stakeholder engagement. The aim was to bring together representatives from public, private, academic sectors as well as civil society, NGOs and other organisations connected to restoration and protection of natural marine resources, and focus on opportunities of using storytelling as a way to communicate with, develop a narrative, and engage with stakeholders and citizens. This focus session used the learnings and approaches piloted by the IMPRECO

project to expand on the storytelling aspects which we believe to be a vital part of co-learning and co-creation, particularly among communities and stakeholders.

Recommendations:

Two hours was a good time-frame for this type of workshop. However, to enable communities to create and tell their own stories, we would recommend in-person workshops or a week-long workshop which would allow participants to fully craft their own stories and understand how they can use that knowledge to enable community-led and narrative-led change.

The focus session showed great potential to use storytelling as a technique to co-design how and why marine stakeholders and communities should engage in decision-making processes. The successful adaptation of the storytelling technique requires continuous community engagement to develop and continuously reinforce the community-led narrative.

View the YouTube Link which teaches attendees how to develop their own story and how to use this methodology. A short video demonstrating the output from the focus session has been created, OBPS can use this as an example as a good practice on how to tell a story.

OBPS should provide practices on how to create safe and inclusive spaces, this could assist interested parties in identifying opportunities and challenges that they may observe in their own communities.

OBPS could highlight the increased importance of storytelling methodology particularly in terms of engaging marginalised and vulnerable communities and capturing the barriers and enablers of behavioural change.success stories

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Better Biomolecular Ocean Practices (BeBOP)

Focus Session Meeting recording

OBPS Focus Session on Better Biomolecular Ocean Practices (BeBOP)

Better Biomolecular Ocean Practices (BeBOP), Focus Session Report

Scope of the Session

During the Better Biomolecular Ocean Practices (BeBOP) focus session we discussed our ongoing work developing metadata specifications for protocols (Minimum

Information for an Omics Protocol - MIOP) and machine-readable protocol templates. In the rapidly evolving field of biodiversity detection using biomolecular approaches, uncovering the detailed protocols currently in use can be a difficult task. Furthermore, in order to align efforts and interpret results datasets need to be linked to protocols used to generate them. The tools developed within the BeBOP working group will enable better sharing of biomolecular protocols and allow more transparency. In this session we reviewed our progress, invited others to use the BeBOP infrastructure, and gathered feedback.

Recommendations

Increase awareness of the repository, and to simplify the upload process for new protocols. Maintain OBPS channels such as this workshop to advertise and recruit participants.

As we build a critical mass of standards we will appreciate support in disseminating information about the collected work, and continuing to invite more submissions.

OBPS can encourage projects and scientists working in marine genomics to either contribute to, or to use, the BeBOP system.

Endorsement from large, well established research groups can lend confidence that a method has been tested and is reliable. Use of the same protocols in multiple projects demonstrates broad applicability and supports comparable data sets.

Challenges of Using Citizen-Generated Data for Ocean Sustainability and Policy Advancement

Focus Session Meeting recording

Challenges of Using Citizen-Generated Data for Ocean Sustainability and Policy Advancement

No final report submitted

Scope of the Session

The emerging volume of citizen-generated data related to oceans and coastal habitats presents unprecedented opportunities for advancing ocean sustainability, coupled with new formidable challenges. This moderated discussion aimed to

highlight the key challenges of using citizen science (CS) to contribute to ensuring ocean sustainability and policy advancement.

In particular, the discussion was geared towards identifying key challenges and opportunities in:

1. The standardization and adoption of novel approaches, including the use of low-cost sensors by citizens.
2. Community engagement in biodiversity conservation and ecosystem restoration projects while adhering to
best practices.
3. Building trust in citizen-generated data and their use for policy compliance and advancement.

Innovative technologies, such as low-cost sensors, have revolutionized CS by making data collection more accessible and affordable. The discussion will explore the potential of these technologies to expand the scope and accuracy of citizen-generated data, particularly in data-scarce regions. Additionally, it addressed the need for rigorous validation and calibration procedures to enhance the reliability of sensor-derived data. Diverse sources of data, often collected using varying methodologies and technologies, pose significant challenges for data integration and analysis. Addressing these challenges requires the development of standardized protocols and data formats, ensuring the interoperability of CS data with other adopted sources and their exploitation for policy advancement. The discussion explored the collaborative efforts necessary to create a harmonized framework for CS, promoting data accuracy and reliability, and, thereafter, their seamless integration into data repositories and digital twins of the ocean.

Policy advancement is a critical component of leveraging CS for ocean sustainability. The discussion evaluated the existing policy landscape and identified opportunities for policy innovation. It also discussed the importance of fostering partnerships among governments, academia, NGOs, and industry stakeholders to develop policies that incentivize CS, streamline data sharing, build trust in citizen-generated data and promote their responsible use for decision-making.

The 1.5-hour moderated discussion highlighted the critical challenges and obstacles standing in the way of the transformative potential of CS in enhancing our understanding of ocean ecosystems, facilitating informed decision-making, and advancing the global agenda for sustainable ocean management. The insights gained from this discussion serve as a catalyst for collaborative action to better harness the power of CS in safeguarding our
oceans.

Digital Twins of the Ocean - Experiences and Best Practices

Focus Session Meeting recording

OBPS Focus Session Digital Twins of the Ocean - Experiences and Best Practices

Digital Twins of the Ocean - Experiences and Best Practices Focus Session Report

Submitted by Daniele Groppi/Issam Achour

Scope of the Session

The Mediterranean Platform for Biodiversity (MBP developed by UNEP/MAP : SPA/RAC) is developing an interoperable and data-intensive Digital Twin of the Ocean. The session discussed capabilities, challenges and achievements of the Iliad Project and other initiatives such as DITTO, EDITO, EMODnet, and showcased concrete solutions and working examples demonstrating the practical applications and benefits of DTO in various ocean-related domains.
The Session provided the possibility to explore opportunities for standardization, integration, and scalability of digital twins initiatives to maximize their impact on sustainable ocean management and address challenges and discuss best practices for achieving standardization and interoperability in the digital twin domain.

Recommendations

The discussion about recommendations for the development of Digital Twins focused mostly on identifying the future market that will develop and thus the investors and the users that will impact the pathways of development towards smaller and tailored digital twins or towards a general bigger digital twin. The recommendation is that research and development will have to adjust to the investors' needs and requests that will most likely lead towards several tailored digital twins so particular attention will have to be paid to interoperability. Common development is seen to be favourable and viable for data-handling and data-management processes and regulation since this is a shared process to all digital twins.

Given the large breadth that digital twins may have, it is important for the research and development community to remain open to the users' requests and needs.

Indeed, in this step of digital twins evolution it is important to team up with industries of different sectors to secure investments and to increase visibility of the digital twin technology. ILIAD, as the system of the systems approach, has been able to show incredible adaptability and vision by working on so many different topics, from aquaculture to renewable energies, and different end-users, from private companies such as insurances and ports to public administrations such as municipalities.

Moving forward will be key to continue adapting to different end-users in order to demonstrate the immense adaptability of digital twins and the potential that it may reach both for planning, management and operation. Additionally, it is essential to emphasize the sustainability aspect of delivering these solutions. Ensuring the longevity and eco-friendly impact of Digital Twin Oceans (DTO) solutions is a must for their continued effectiveness and positive contribution to environmental and societal challenges.

The OBPS role could be important to work as a multiplier for dissemination and communication purposes and to provide a global breadth to local and/or specific projects and best practices. This role could be key to attract investors and to clarify the potential of digital twins by showcasing all the successful stories already available. Furthermore, OBPS can work as a platform for discussion and knowledge creation given its wide audience. Collaboration between OBPS and the major projects dealing with digital twins such as ILIAD, DITTO, EDITO, NOAA should continue since it is clear that a strong collaboration on best practices and standards supports the important interoperability between models.

EarthServer: Federated Fusion on Analysis-Ready Datacubes

Focus Session Meeting recording

OBPS Focus Session on EarthServer: Federated Fusion on Analysis-Ready Datacubes

No final report submitted

Scope of the Session

Datacubes homogenize the myriads of files on a sensor or theme into single spatio-

temporal units, ready for navigation and analytics. As such, datacubes today form an accepted cornerstone for Analytics-Ready Data (ARD). Furthermore, Petabyte-proven standards exist for accessing datacubes in a vendor-neutral manner.
This Focus Session gave a practical introduction to working with datacubes. We first introduce the concept of "coverages" as the standardized model for datacubes, allowing both regular and irregular grids. Based on this, we proceed to services by accessing operational examples, ranging from metadata inspection over extraction to analysis and visualization. Many of the examples can be recapitulated with any Internet-connected browser, and even be modified, by the participants. In particular, it will be shown live how data centres from US, Europe, and Asia are connected into the unique EarthServer datacube federation, establishing a single common information pool allowing, among others, location-transparent distributed data fusion. Further, examples of current datacube research are illustrated, including AI-Cubes as established in the EU FAIRiCUBE and NATO Cube4EnvSec projects. Room for discussion, was provided with the goal of stimulating uptake and collaboration among the participants.Ample in the material distributed was provided for further own studying and experimentation. A coverage tutorial as well as the interactive coverage datacube sandbox were provided to prepare for the session.

Exploring Ocean-Climate Dynamics: Observations, Collaboration, and Policy Implications

Focus Session Meeting recording

Focus Session Exploring Ocean-Climate Dynamics: Observations, Collaboration, and Policy Implications

Exploring Ocean-Climate Dynamics Focus Session Report

Submitted by: Erika Hayashi and Chiara Bearzotti

Scope of the Session

The main objective of this focus session was to highlight the important role that the ocean plays in the global and regional climate, and stresses the need for measuring and observing the status of oceanic properties. Satellite and in-situ observations provide key data that can be used in climate models, climate services, evaluating and

forecasting tipping points and for decision-making at national and international levels. The session reflected on international science collaboration in informing the above efforts, and explored opportunities for cooperation with a view to developing joint solutions to common challenges.

Recommendations

Emerging from the Focus Session, a list of resources and best practices was compiled from the discussion:

- Ocean Diplomacy
  - https://www.nature.com/articles/s41599-021-00729-6
  - https://www.frontiersin.org/articles/10.3389/fmars.2021.664066/full
- Data principles and specifications FAIR DATA: https://www.go-fair.org/fair-principles/
- INSPIRE data: https://inspire.ec.europa.eu/data-specifications/2892
- Sea Surface Temperature Data Services from the Group for High Resolution Sea Surface Temperature (GHRSST) GHRSST catalogue: https://www.ghrsst.org/ghrsst-data-services/for-sst-data-producers/ghrsst-catalogue/#/search?from=1&to=30
- GHRSST resources for data users: https://www.ghrsst.org/ghrsst-data-services/for-sst-data-users/
- Relevant Horizon 2020 and Horizon Europe Projects
  - OCEAN:ICE: https://ocean-ice.eu/
  - ENGAGE 2020 project: http://engage2020.eu/news/science-society-and-engagement-an-e-anthology-is-now-published/
  - Blue Action Fish forecasts: https://blue-action.eu/policy-feed/fish-forecasting
- Engaging with policy-makers and other non-technical audiences Euan Paterson (SAMS) training on talking to the media: https://zenodo.org/records/3906360
- Stefan Fritz (KDM) training on engaging with policy makers: https://zenodo.org/records/5084703
- Music composed by Michael Begg: https://omnempathy.bandcamp.com/track/the-arctic-day
- Marine Heat waves music: https://youtu.be/MRY6f_Zk1JQ?feature=shared
- Policy briefing at the European Parliament with the two projects Blue-Action and Atlantos, funded by Horizon 2020 (a story about cod - connecting across geographies and sectors): https://zenodo.org/records/1408097

Ocean Practices Federated Network - Governance

Focus Session Meeting recording

OBPS Focus Session on Ocean Practices Federated Network - Governance

No final report submitted

Scope of Session

The Ocean Practices Federated Network (OPFN) is a global distributed system of independent interoperating Methodology Management Systems that supports a transformative cultural shift in how diverse ocean communities can share their practices for global adoption.

OPFN will facilitate the creation of a federated network of interoperating ocean practices systems across all rights-holders and stakeholders that provides discovery and access to ocean observing community methods and best practices.

The sharing is done through an agreed data governance. Federated nodes may implement data governance policies to manage data sharing, access control, data ownership, and compliance with legal and regulatory requirements, consistent with the policies of independent participating organizations. The creation and use of data governance frameworks ensures that data is used and shared appropriately within the federation and with users.

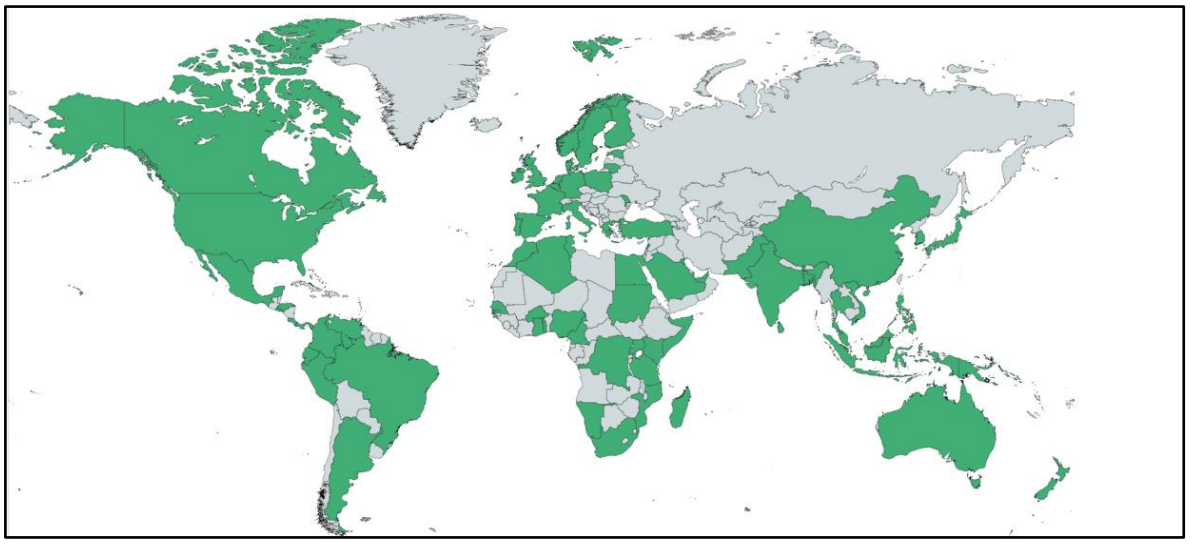
This focus session aimed to identify the core principles and values for the governance model that will be established through the OPFN.

Workshop Co-Chairs: Prof. Rene Garello Dr Cora Horstmann

Annex 1: PARTICIPANTS

The workshop registrations reached 1042 and we were delighted that a large proportion of those were able to attend the sessions.

The global spread of registrations evidences the increasing interest in standards and best practices and their essential role in ensuring interoperability and FAIRness.



Annex 2: AGENDA

Agenda /

09 OCT UTC	Presentation	Speakers
Introduction to the Challenges		
11.30	Welcome	**Rene Garello / George Petihakis**
11.45.	**Vladimir Ryabinin** (IOC - recording); **Joanna Post** (GOOS) ; **Peter Pissierssens** (IODE); **Audrey Hasson** (GEOBluePlanet); **Edem Mahu** (University of Ghana)	Moderator: **Rene Garello / Craig McLean**
13.00	Panel and Open Discussion	Moderator: **Craig McLean**
13.30	**CLOSE OF DAY**	

10 OCT UTC	Presentation	Speakers
Challenge 7 - Expand the Global Ocean Observing System.		**Moderator: Paula Salge**
11.30	Challenge 7 - introduction	Moderator **Paula Salge** (+ATLANTIC; Univ Algarve)
	Contribution from regional seas observing systems to global ocean observing: applications and impacts, advancing towards towards regional digital twins	**Joaquin Tintore,** (SOCIB and IMEDEA (CSIC-UIB)
	Operational Sea-Surface Temperature data retrieved from satellites	**Ioanna Karagali** (Danish Meteorological Institute)
	Oceanography Operational: Satellite Data-Computing Technologies Vision, a Tool for Observing and Monitoring Oceanic System (RECORDING)	**Bouhali Mohamed Amine** (University of Science and Technology Houari Boumediene (USTHB)
	Open Discussion	Moderator: **Paula Salge** +(+ATLANTIC; Univ Algarve)
13.00	BREAK (30 Mins)	
Challenge 1 - Understand and beat marine pollution. Moderator: Audrey Hasson		
13:30	Challenge 1 - introduction	**Audrey Hasson** (GEOBluePlanet)
	TBA	**Tostas Topouzelis,** (UAegean)
	TBA	**Fantina Madricardo,** (BlueMissionMed and Coordinator of MAELSTROM)
	TBA	**Alex Turra,** USP, Brazil
	TBA	**Vesna Kuralt,** (Remedies HE Innovation Action)
	TBA	**Zacharie Sohou,** (IRHOB, Benin)
	TBA	**Artur Palacz,** (IOCCP)
	Open Discussion	Moderator: **Audrey Hasson** (GEOBluePlanet)
15.00	**CLOSE OF DAY**	

12 OCT UTC	Presentation	Speakers
Challenge 8 – Create a digital representation of the ocean. Co-Chairs: Jan-Bart Calewaert, Ann-Christine Zinkann		
11.30	Challenge 8 - introduction	**Jan-Bart Calewaert** (DCO for Ocean Data Sharing)
	Bring Your Own Digital Twin of The Ocean - how to build interoperability layers based on the modular approach.	**Piotr Zaborowski** (OGC)
	Federated, Democratic, Open: EarthServer and How Its AI-Cubes Contribute to Digital Twins	**Peter Baumann** (Constructor University, Bremen)
	EMODnet Central Portal: a case study of Open Source software and OGC standards to provide an interoperable web service and viewer	**Conor Delaney, Vicente Fernandez** (EMODnet)
	EMODnet Chemistry: open and trusted data, products and services for understanding the evolution of marine water quality	**Megan Ann French** (OGS)
	A review of ERDDAP the established best practice in sharing gridded and tabular data from the Earth Sciences community	**Conor Delaney** (EMODnet) ;
	Improving access to ocean data via Ocean InfoHub using the MEDIN Discovery Metadata Standard	**Colm Walsh** (MEDIN, NOC)
	Open Discussion	Moderator: **Jan-Bart Calewaert** (DCO for Ocean Data Sharing)
13.30	**CLOSE OF DAY**	

13 OCT UTC	Presentation	Speakers
Challenge 2 – Protect and restore ecosystems and biodiversity. Co-Chair: Frank Muller-Karger, Joana Soares, and Aileen Hwai,		
11.30	**SESSION JOINTLY WITH MARINE BIODIVERSITY NETWORKING FRIDAY**	
	The Ocean Decade Vision 2030 initiative	**Frank Muller-Karger** (USF) and **Aileen Hwai** (Universiti Sains Malaysia)
	The Silence of Global Oceans: Acoustics Impact of the Covid-19 Lockdown	**Artash Nath,** (MonitorMyOcean.com)
	Best Practice Guidelines for Mangrove Restoration - What have we learned from a global restoration community?	**Mark Beeston,** (Blueecosystems)
	Open Discussion	
	Next steps (including WG work methodology	
	Summary	**Frank Muller-Karger** (USF) and **Aileen Hwai** (Universiti Sains Malaysia)
13.00	BREAK (30 Mins)	

Challenge 9: Skills, knowledge and technology for all. Co-Chair: Edem Mahu;Talen Rimmer		
13.30	Challenge 9 - introduction	**Edem Mahu, Talen Rimmer**
	The role of the Ocean Tracking Network's equipment loaner program in addressing challenges for collective impact under the UN Ocean Decade	**Cassandra Hartery** (OTN)
	Democratizing ocean observations through low-cost technologies	**Patrick Gorringe** (SMHI)
	Panel/ Open Discussion	Edem Mahu, Talen Rimmer, Cassandra Hartery, Patrick Gorringe, Mary Frances Davidson
15.00	**CLOSE OF WORKSHOP**	

end