EXPERT MEETING REPORT

The Global Ocean Observing System

Tenth Session of the GOOS Regional Alliance Forum

ONLINE
PART 1: 9 - 10 SEPTEMBER 2022
PART 2: 27 OCTOBER 2022
PART 3: 16 DECEMBER 2022

unesco Intergovernmental Oceanographic Commission

WORLD METEOROLOGICAL ORGANIZATION

UN environment United Nations Environment Programme

International Science Council

JANUARY 2023
REPORT NO.: GOOS-279

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Executive Summary

The Tenth Session of the GOOS Regional Alliance Forum (GRF-X) was held online consisting of a series of four meetings on 9 and 10 September, 27 October, and 16 December 2021. Mr Albert Fischer, Director of GOOS, welcomed the participants on behalf of the IOC-UNESCO. The Forum, led by GOOS Regional Council Chair Mr R. Venkatesan, convened the representatives from thirteen GRAs, as well as emerging national GRAs. The GRF-X discussed GRA core activities carried out in the last two years, the Benefits of Ocean Observations Catalog (BOOC) and how GRAs can contribute to it, GOOS activities and engagement with GRAs, as well as the United Nations Ocean Decade actions and GOOS Decade Programmes. GRA representatives and GOOS projects (AtlantOS, TPOS) participated for the first time in the GOOS Steering Committee workshop and discussed the development of a new GOOS/GRA regional approach for a thriving regional coordination ecosystem.

GRF-X also elected Mr Carl Gouldman, Director of the U.S Integrated Ocean Observing System (US-IOOS), as new chair and Ms Michelle Heupel, Director of the Integrated Marine Observing System (IMOS) vice chair of GRA Council for the next two years.

The new GRA Council Chair Mr Carl Gouldman was previously the Vice-Chair of the GRA Council. He succeeds Mr R. Venkatesan, from the Indian Ocean GOOS (IOGOOS). The GOOS Secretariat thanked Mr R. Venkatesan for his significant contribution to GOOS and GRA Council leadership.

GRAs appreciated the efforts of the U.S. Integrated Ocean Observing System (US-IOOS) to create the Benefits of the Ocean Observing Catalog (BOOC), an online, geographically referenced, searchable database of use cases focused on the end user's specific choices that they make from information, products and services from the ocean observing systems. The BOOC online database seeks to build a better understanding of how ocean observations, measurements and forecasts can deliver societal and economic benefits for the support of scientific research, economy and governance. GRAs were invited to contribute in different ways to the development of BOOC.

The key achievements of the GRAs in the last two years included the development of new low-cost technology wave buoys to be transferred to other countries, development of a coral bleaching alert system, enhancement of animal tracking technology to integrate biodiversity and animal movement data, improved support to technologies such as under water gliders and surface vessels, new ocean literacy products, new databases to monitor the support of operational ocean forecasting systems and disaster risk reduction, and a continuation of ocean cruises and research initiatives. Several GRAs have also developed new strategic plans aligned with the GOOS 2030 Strategy.

GRA representatives also had a chance for the first time to participate in the Tenth GOOS Steering Committee – Part 2 (GOOS SC –X– Part 2) workshop from 29 November to 2 December, 2021 focusing on what GRAs need from GOOS and vice versa, as well as the development of a new GOOS/GRA regional approach for a thriving regional coordination ecosystem. The workshop proposed the development of a new GOOS regional policy.

The final meeting of the GRF-X Forum discussed a key decision of the GOOS SC –X– Part 2 concerning the proposed new GOOS regional policy. This will include the constitution of a sub-task or working group composed of members from the GOOS Governance Task Team, GOOS Steering Committee, GRAs Leadership and Regional Projects which will develop the proposal for an updated GOOS Regional Policy 2022 and conduct other key activities. The GRAs also addressed the possibility of a GRA international badge of quality that is respected internationally, aimed to better characterize and build on GRAs capabilities. There were mixed views concerning the matter. The meeting agreed to discuss this subject at the first GRA Council meeting in 2022.

GRAs discussed and agreed on new GRA priorities and actions which are highlighted below:

TOOLS AND PRODUCTS

- **ACTION 1** GOOS Regional Alliances (GRAs) to help in the development of the Benefits of Ocean Observations Catalog (BOOC) by testing the prototype and contributing with use cases.

PARTNERSHIPS

- **ACTION 2:** EuroGOOS, MONGOOS, and IOGOOS to strengthen their alliance with GOOS AFRICA.

COMMUNICATION AND VISIBILITY

- **ACTION 3:** GRAs to provide a list of products for the update of the GRA website.

- **ACTION 4:** Secretariat and GRAs to produce two-minute videos on success stories of GRAs.

- **ACTION 5:** The GOOS Secretariat with the support of GRAs to prepare news articles to highlight the development of Benefits of Ocean Observations Catalog (BOOC) and its Advisory Group.

- **ACTION 6 a:** The GOOS Secretariat to prepare a short, distilled document on how to engage with GOOS. The document should explain how GOOS operates, and the links between the panels and GRAs etc.

- **ACTION 6 b:** GRAs to contribute to the forward looking vision and capabilities of GOOS in accordance to the GOOS 2030 Strategy.

- **ACTION 7 a:** GOOS Secretariat/GRAs to develop a prospectus on the benefits of participating within a GRA to get others to join.

- **Action 7 b:** The Secretariat and GRAs to develop communication about what GRAs/ regional structures do.

- **ACTION 8:** GRAs / GOOS to communicate to end users about the different use and value of data (e.g. from Gliders, etc.) and input in different stages of the operational forecasting system.

CONNECTIVITY & ENGAGEMENTS

- **ACTION 9:** To further establish better connection between GRA Forums and other meetings, e.g., panel, or OCG meetings.

ASSESSMENTS, QUALITY STANDARDS AND PERFORMANCE

- **ACTION 10:** Develop an international badge of quality that is respected internationally (Tiers of GRA Level and requirements at each level of maturation).

- **ACTION 11:** Map existing GRA capabilities and what is associated with them.

- **ACTION 12:** Compile regional needs to scale up and inform global priorities.

GOVERNANCE AND COORDINATION

- **ACTION 13:** GOOS Regional Alliances to support the development of the GOOS Regional Policy 2022.

The GRF-X did not decide on the timing and location of GRF-XI, pending on the evolution of the COVID-19 Pandemic.

Part 1, Meeting 1: 9 September 2021
Tenth Session of the GOOS Regional Alliance

Participants of the GRF-X Part 1, Meeting 1

1. OPENING

The Tenth Session of the GOOS Regional Alliance Forum (GRF-X), Part 1 was held online with two successive meetings from 9 – 10 September 2021. Mr Carl Gouldman, Vice-Chair of GOOS GRAs and Director of the U.S. Integrated Ocean Observation Systems (US-IOOS) delivered a brief welcome to the meeting.

Mr Albert Fischer, Director of GOOS also welcomed participants and informed the meeting about the endorsement and approval of three Ocean Decade GOOS Programmes:

1. CoastPredict
2. Observing Together
3. Ocean Observing Co-Design

Mr Albert Fischer highlighted that the 31st Session of the IOC Assembly approved the Decade GOOS Programmes in June 2021. The GOOS Steering Committee (SC) was held from 26-29 April 2021. The SC is presently focussed and committed on governance reform to ocean observing and forecast systems. The GOOS SC is developing a Global GOOS National Focal Point (NFP) Network. The GOOS NFPs are expected to engage with GRAs and other GOOS related regional structures.

Mr Denis Chang Seng, Programme Specialist at GOOS Office highlighted that there is increasing expectations regarding the role of GRAs in reference to the UN Ocean Decade, GOOS Programmes and activities.

Participants then introduced themselves. The Forum adopted the meeting agenda with no change.

2. OVERVIEW OF GRF-IX ACTIONS

- Mr R. Venkatesan, Chair of GRA Council informed that GOOS Focal Points will bring more visibility on the work and contributions rendered by GRAs to Member States. To empower end user applications, there is an action spearheaded by US-IOOS to develop case studies such as the Benefits of Ocean Observations Catalog (BOOC).
- To engage with other parts of GOOS and observing system partners, the Chair encouraged further GRAs cross engagement and transfer of technology and scientific knowledge. One key area of interest is to enhance collaboration with the African Member States e.g. collaboration between GOOS Africa, MONGOOS, IOGOOS and EuroGOOS WGs.
- Mr R. Venkatesan underlined that the three transformative GOOS Decade Programmes have integration as a central theme: integrated system design, connecting to local stakeholder communities and integrating observations into the coast. He also highlighted that there is a need for stronger regional interaction between the World Meteorological Organization (WMO) Regional Alliances and IOC GOOS GRAs.
- Mr R. Venkatesan informed that GRAs need to elect a new Chair and Vice-Chair. His tenure as Chair will end on 31 December 2021. As per GRA Council practice, the Vice

-Chair is usually elected as Chair of GRA Council. Mr Carl Gouldman, Director of US-IOOS, and Ms Michelle Heupel, Director of IMOS have been proposed as the new Chair and Vice-Chair.

- Mr Denis Chang Seng reported that 75 % of GRF-IX actions have been implemented, 5 – 10 % are in the process of implementation, while a few actions have not been addressed yet. The unaddressed actions will be carried forward and discussed during the GRF-X part 2 meetings in October 2021.
- He also encouraged GRAs to discuss the proposed GRA Council leadership. Election of GRA Council Officers will be decided on the last day of the GRF-X session.

3. BENEFITS OF OCEAN OBSERVATIONS CATALOG (BOOC)

Mr Ralph Rayner, US-IOOS Industry Liaison, delivered a presentation on the current status and future objectives of the Benefits of Ocean Observation Catalog (BOOC) initiative. He briefed the meeting regarding the latest developments in the implementation of BOOC; and areas where GRAs can help in building BOOC to the point of making it into a community tool.

3.1. Overall Goal

The overall goal of the BOOC is to build a better understanding of how ocean observations, measurements and forecasts deliver societal and economic benefits. It is about transferring information from the different value chains together into one place to look at the way in which ocean observations benefit a particular user community or a particular geography.

BOOC incorporates simple or very detailed use cases and creates a simple and straightforward mechanism to bring them into the catalog. Then, they are classified and put into a searchable database (different keys and geographies) where the output are focused reports of particular uses and benefits for a given area (Figure 1). BOOC is key to support scientific research, economy and governance.

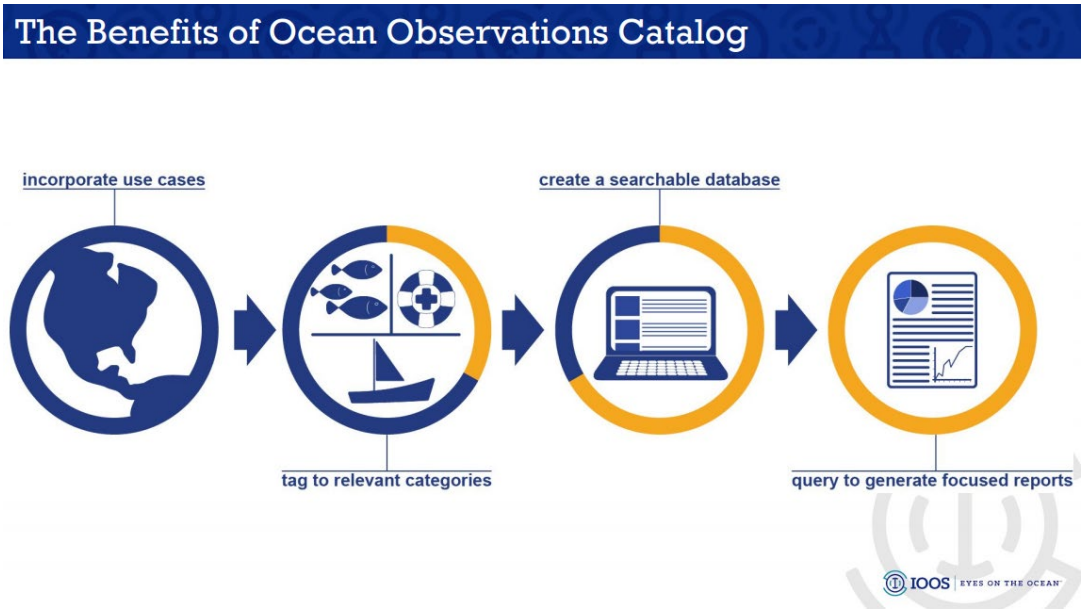


Figure 1. Benefits of Ocean Observations Catalog (BOOC).

3.2. BOOC Work Packages

The BOOC contract is composed of five key tasks: Task 1 on defining function and structure; Task 2 on developing the prototype; Task 3 on testing of prototype; Task 4 on developing deployment plan; and Task 5 on implementing deployment plan.

Presently, the initiative is at an early stage of its development (task 2 on prototype development) and efforts are being taken to have a global collaboration of GRAs to support the implementation of BOOC.

3.3. Potential GRAs Contribution to BOOC

The first step is to assist in defining the taxonomy, input process and final structure of the catalog. For this, volunteers are invited to join the prototype testing process to provide criticism and comments for improvement. GRAs will be invited to help in identifying and developing simple or complex use cases. GRAs can support the development of a template to give guidance to organizations and people on how to write use cases and submit them to BOOC once it becomes fully operational. Once the prototype has been developed, there are plans to convene workshops on helping people take conceptual ideas and convert them to use cases that can be added into the catalog.

Discussion

- The meeting noted that the BOOC initiative was planned at the OceanObs'19 conference in 2019. In 2021, the US-IOOS finalised the contract to begin its development process.
- BOOC vision and aims:
    - Operated and owned by the community, captures everything we know about the value chain matching ocean observations to the end benefit. It would allow the users community to find any data of the use of e.g. ocean observations in fisheries, offshore renewable energy, etc. for any particular geographical region.
    - Support least developed nations and put in observing assets to make smart business decisions. BOOC will ultimately upgrade and enhance services since observing systems would be well understood.
    - BOOC will be able to show benefits from a local, regional, and global scale depending on the query specifications.
- US-IOOS has been working closely with the GeoValue Programme because they are developing similar initiatives, but not quite the same approach for earth observations. The fundamental difference between GeoValue and BOOC is that the former is a bibliographic catalog – a compilation of peer reviewed published materials about earth observations. It is unclear if there is an immediate counterpart to BOOC in the atmosphere observations community.
- There is a detailed time frame for each of the five tasks. The target is to complete every one of the steps up to when US-IOOS rolls out the implementation plan by

March 2022. In broad terms, the goal is to have the prototype in place, fully tested and to roll out the operational system by the end of the first quarter of 2022.

- US-IOOS is looking for volunteers to help in the development process of BOOC by either reviewing the details specification, testing the prototype and most importantly contributing their use cases, the ones already developed or those that they are looking to develop.
- Suggestion to have a BOOC Advisory Group that can meet frequently and engage directly in discussions regarding the development of the prototype and use cases for BOOC**.**
- Ms Catherine Tobin, US-IOOS Ocean Science and Technology Partnership Fellowship, will assist in capturing those institutions interested in assisting the development of BOOC.
- Agreed that GRAs contribution will be key for BOOC to reach many sectors of society.
- Potential future publication of an article in the GOOS website, to showcase the development of BOOC and its advisory group.

4. GRA REPORTING

4.1. Integrated Marine Observing System (IMOS)

Ms Michelle Heupel, Director of IMOS, provided a background report about IMOS achievements, challenges, and opportunities. IMOS observing capabilities ranges from deep water mooring, Argo floats, animal tracking, (satellite transmitters on seals, sharks, fish and other animals), gliders, AUVs, ship observations, satellite remote sensing, and coastal radar installations. Additionally, IMOS has started working in the field of marine microbiology to better understand ocean health.

IMOS has been very effective in event-based sampling as it provided critical water temperature data to help researchers and managers monitor the marine heatwave on the Great Barrier Reef. She reported on the positive and promising project results concerning wave measurements using trial low-cost wave buoys in comparison to conventional buoys. IMOS acoustic tracking programme has built a national network of acoustic receivers to observe animal's movements in the Australian marine ecosystems (see ANNEX II, for more information on success stories).

IMOS aims to further advance its work on technology, exploring the application of new technologies and methodologies (e.g., eDNA) to increase resilience, efficiency, effectiveness of ocean observations. IMOS has been successful in the delivery of services to the research community, however the system has to be improved to deliver information to the non-specialist groups such as industry managers, etc. The ultimate goal is to create societal benefits.

Potential opportunities across GOOS Proposed Decade Programmes range from working with partners (e.g., CSIRO and BOM) to investigate how it can provide knowledge and capacity to its regional neighbours. IMOS stands ready to discuss potential co-design principles and is ready to share experience and knowledge with the GOOS community as required. IMOS is

interested in discussing the CoastPredict concept at global and regional levels and notes the increased coastal focus in IMOS' forward strategy, especially towards its next funding phase.

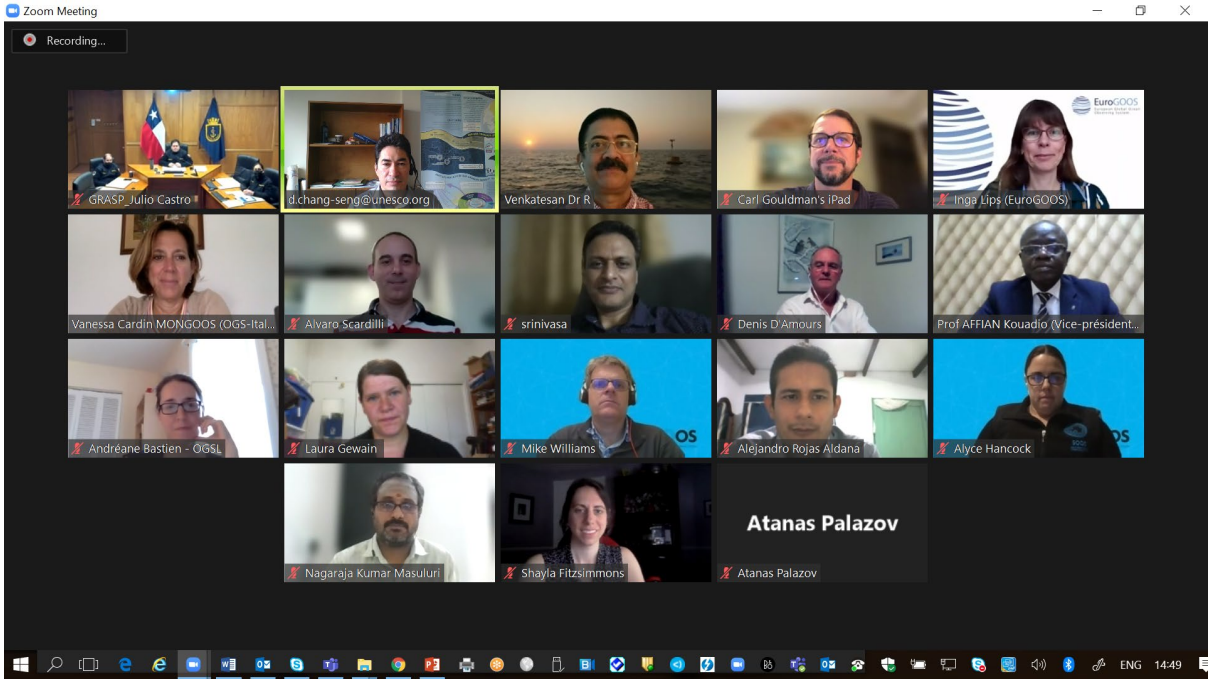
Discussion

- IMOS new low-cost technology approach is an important aspect for all GRAs. It is also a topic of interest at the Marine Technology Society.
- If low-cost technology is proved effective in comparison to conventional technologies, it would be an opportunity for international cooperation with other countries, including least developed countries.
- The cost of the wave buoys (low cost technology) is about $12.000 USD in comparison to a conventional device which would normally cost around $250.000 USD.

5. CLOSURE

Mr Denis Chang Seng thanked everyone who participated in the first GRF-X meeting. The GRF-X will continue with meeting 2 of Part 1 scheduled on 10 September 2021.

Part 1, Meeting 2: 10 September 2021
Tenth Session of the GOOS Regional Alliance



Participants of the GRF-X Part 1, Meeting 2

1. OPENING

Mr Denis Chang Seng, Programme Specialist at GOOS Office opened the meeting. He reminded participants that meeting 2 will be fully focused on the continuation of GRAs reporting.

2. GRA REPORTING

2.1. The Regional Alliance for the Upper Southwest and Tropical Atlantic (OCEATLAN)

Mr Alvaro Scardilly, Secretary of OCEATLAN, presented a background report of OCEATLAN developments since GRF-IX. As of December 2019, OCEATLAN had its present Implementation Plan approved. This year the Implementation Plan will undergo an update to incorporate present strategies and objectives regarding the UN Decade of Ocean Science for Sustainable Development (2021-2030). The lead of the group will change from Argentina to Uruguay in 2022.

OCEATLAN programmes such as South Atlantic Meridional Overturning Circulation Programme (SAMOC) and Advanced CIRCulation Model and Tide Empiric Prediction Model (ADCIRC) have provided successful in the understanding of heat content and meridional transport as well as prediction of tidal waves in the Rio de la Plata area of Buenos Aires. In addition, through the Ocean Teacher Global Academy (OTGA), OCEATLAN has provided a training course on "Determination of the Outer Limit of the Continental Shelf" to researchers around the globe and aims to provide a second course on Sea Ice (Polar Waters) in the upcoming months. Programmes such as GLOSS, PIRATA and PNBOIA are still under operation, while XBTs has been discontinued.

OCEATLAN does not have any specific initiatives designed yet to contribute to the UN Ocean Decade but will evaluate its position and interest in the upcoming months.

2.2. The Indian Ocean Global Ocean Observing System (IOGOOS)

Mr Srinivasa Kumar, Interim Chair of IOGOOS, provided a GRA background report of IOGOOS since GRF-IX. IOGOOS was set up in the Indian Ocean Conference in 2002. There are 5 offices representing different regions. There are 29 member institutions from 17 countries within the Indian Ocean region, and other associate members situated outside of the Indian Ocean region. The funding comes from IOC-UNESCO PPO sponsorship and also from IOC-AFRICA.

IOGOOS is fully involved in the second phase of the International Indian Ocean Expeditions-2 (IIOE-2) extended to 2025. In addition, the Indian Ocean Observing System (IndOOS) through the Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER) and the Indian Research Forum (IRF), have reported positive results. These results include the implementation of the IndOOS Observing Plan (2021-2030). The provision of real time and high-resolution data products via the ChloroGIN initiative is an important oceanographic product for different countries in the region.

Mr Srinivasa Kumar stressed that the UN Ocean Decade can infuse a lot of interests to close gaps and challenges on governance and observation systems within IOGOOS. A way to do this is through its patronage and strategic/operational links with IIOE-2. IOGOOS is equally very interested in engaging with all GOOS UN Ocean Decade endorsed programmes through the UN Indian Ocean Region (IOR) Decade Coordination Centre in observations, capacity building and planning workshops.

Discussion

- Noted the ongoing efforts to establish an IOC sub-commission in the Indian Ocean.
- Further collaboration and strengthened links with ETOOFS to enhance OOFS.
- Noted that IOGOOS has several operational forecasting systems and products. The products are not being optimally used.
- Recommended to have a strong intergovernmental mechanism to build a link within users and forecasting systems to make the products available to e.g. fisheries, oil spills, other key stakeholders, etc.
- Interest to develop very high-resolution forecast products. These discussions can take place in trainings such as those provided by ETOOFS.

2.3. The Southern Ocean Observing System (SOOS)

Ms Alyce Hancock, SOOS Executive Officer, provided a background report about SOOS developments since GRF-IX. The SOOS has been in operation since 2011 and recently, it has drafted a new 5-year Implementation Plan (2021-2025), which is under review by the Scientific Committee for Antarctic Research (SCAR) and the Scientific Committee for Oceanic Research (SCOR).

SOOS has identified five community agreed science themes to focus on: cryosphere and ocean interactions; Southern Ocean circulation; carbon and biogeochemistry; Southern Ocean ecosystems; and fluxes. There are five different Regional Working Groups (RWGs) within SOOS designed based on the different areas of interest from the nations within the Southern Ocean. There are three Capability Working Groups (CWGs) and three Task Teams to enhance gaps in the observing system. There is a set Data Management Sub Committee (DMSC) and two key data products in SOOS. The two data products are SOOSmap and DueSouth.

SOOS is engaged with the UN Decade of Ocean Science for Sustainable Development (2021-2030). It co-convened a Southern Ocean regional workshop in February 2020. Additionally, SOOS coordinated the Southern Ocean community response to the zero draft of the UN Ocean Decade Implementation Plan and it is a key partner in the Southern Ocean Task Force to lead and drive the Southern Ocean regional programme contributing to the UN Ocean Decade. A link was provided to those interested in learning about the Southern Ocean contributions to the UN Ocean Decade.

2.4. The Mediterranean Operational Network for the Global Ocean Observing System (MONGOOS)

Ms Vanessa Cardin, Chair of MONGOOS, presented a background report of MONGOOS since GRF-IX. MONGOOS is non- funded and formed by 48 institutions from 14 countries. Most of the facilities are located in the northern part of the Mediterranean Sea. Very few North African countries are members of MONGOOS.

MONGOOS and GOOS Office Secretariat organised a meeting with the GOOS AFRICA Chair. The meeting set the basis for a proposal(s) at the International level to include the northern African countries as associate partners of MONGOOS. There have also been workshops and dedicated sessions to boost MONGOOS scientific components. A key project is the "Seamless European Marine Climate Service" (SMECS). The Project which has served as the first collaboration among all EuroGOOS ROOS (es). MONGOOS reported progress in the integration of glider and sea level tide gauge station data into the MONGOOS web page.

In terms of the UN Ocean Decade, MONGOOS through the GOOS Observing Together Decade Programme seeks to transfer technological and scientific knowledge from Europe to Africa. This can be done through joint projects, summer schools and workshops. For Ocean Observing Co-Deisgn, MONGOOS is ready to discuss and share experience and knowledge with the community. In the case of Coast-Predict Programme, MONGOOS has endorsed the programme and looks forward to discussing it at the Mediterranean level.

Discussion

- Noted that SMECS project was aimed for marine climate service and GOOS AFRICA was not a part of this project. MONGOOS is working through iCoast to collaborate with GOOS AFRICA.
- Encouraged further collaboration between GOOS AFRICA, MONGOOS, IOGOOS, Black Sea GOOS and EuroGOOS. Collaboration can be achieved through capacity building and become a pilot for other regions to partner.
- The National Institute of Oceanography and Experimental Geophysics (OGS) of Italy in collaboration with MONGOOS are issuing transnational actions to include workshops where experienced users will support southern Mediterranean countries to develop their capacity for example in instrumentation and collecting data.
- MONGOOS is developing an inventory within GLOSS of all tide gauge stations from the Mediterranean Sea. There are many African tide gauge stations not included within the European data bases. This should be addressed for the benefit of both regions.

2.5. EuroGOOS AISBL

Ms Inga Lips, Secretary General of EuroGOOS, presented a background report about EuroGOOS since GFR-IX. EuroGOOS is composed of 44 members in 18 European countries. Key projects include Horizon 2020 projects such as EuroSea, Jerico S3 and DS, DOORS, and INTAROS.

EuroGOOS highlighted organizational and networking success during these past two years. Key to their operations have been the launch in 2021 of the EuroGOOS 2030 Strategy; the 1st EuroSea Tide Gauge Network Workshop; Establishment of the European Ocean Observing System (EOOS) Operations Committee which had successfully engaged 26 European GOOS National Focal Points besides all the relevant European research infrastructures; EOOS European GOOS National Focal Points Survey; EuroGOOS Ocean Literacy Network/WG; the UN Decade of Ocean Science for Sustainable Development (2021-2030); EuroGOOS policy brief on Recommendations for the Ocean Decade ; and the establishment/strengthening of new task teams aimed to promote scientific synergy and technological collaboration among European ocean observing infrastructures.

EuroGOOS has recorded some challenges such as gaps and duplication on the tide gauge data portals. In addition, the ocean glider missions have been hampered because the operations in the Exclusive Economic Zones are not regulated by law.

In relation to the Observing Together Decade Programme, EuroGOOS hopes to contribute to the communication of Ocean Observing benefits to the community through EOOS and EuroGOOS activities and structures. In the case of the Ocean Observing Co-Design Decade Programme, EuroGOOS wants to contribute to the development of the European OceanOPS to monitor the plans and measure capability to advance integration and co-design. EuroGOOS wishes to strengthen partnership and coordination of observing and modelling capabilities as a contribution to the CoastPredict Programme.

Discussion

- Appreciated that EuroGOOS Models map is a good platform to compile products. EuroGOOS is planning to update the European part (with a slight modification of the platform). When completed, EuroGOOS can request updated information from other GRAs.
- Noted that EuroGOOS has two types of funding mechanisms. Approximately half of the funding is received form Member contributions and the other half from the European projects and tenders (not into innovation or scientific nature). Tenders are there to fulfill an obligation or to get assessments done.
- Noted that GOOS AFRICA is ready to work with IOGOOS, EuroGOOS, MONGOOS, Black Sea GOOS and any other GRA to continue its work on capacity building and sharing of technology.

2.6. GOOS Regional Alliance for the South-East Pacific (GRASP)

Mr Julio Castro, GRASP Secretary, presented a background report about GRASP since GRF-IX. The GRASP committee chair is held by a Member State committee every two years. Currently, the position is held by Chile and for the period of 2022-2023, it will be Colombia.

GRASP has been successful in sharing operational products within its Member States. It has also developed a portal for the visualization of global numerical models of oceanography and meteorological data in the region. A digital repository of operational meteorological and

oceanographic documentation has been created. Additionally, ten webinars have been conducted in the region since 2019. GRASP has also developed a strategic plan for the period of 2021-2025.

The UN Ocean Decade has endorsed a GRASP project activity/initiative on 2 July 2021 about the development of a web portal that aims to present tide gauge sea level data for the entire region. GRASP believes that the tandem collaboration of this initiative alongside the three GOOS Decade Endorsed Programmes will improve the current observation programmes of GRASP. It will take advantage of new technologies to improve ocean observation, and strengthen partnerships to improve tidal and wave forecasts.

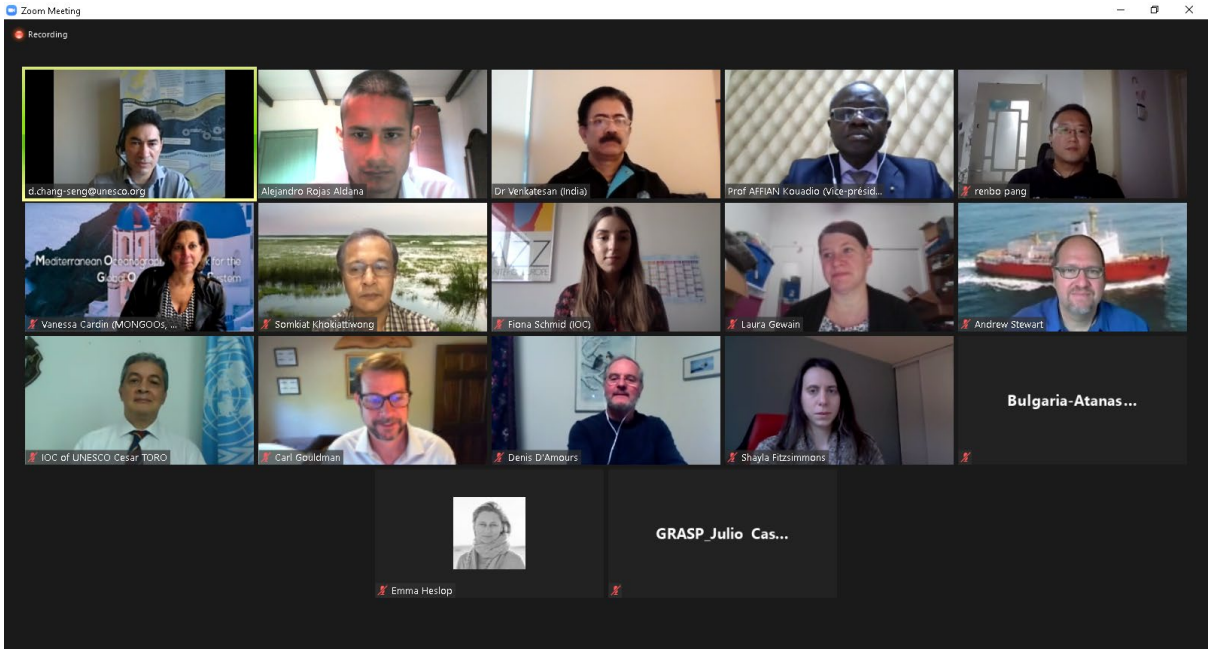
Discussion

- Noted that GRAs are interested to contribute to the UN Ocean Decade. The GRF-X part 2 meeting scheduled in October 2021 will provide a presentation and insight about the UN Ocean Decade and the GOOS Ocean Decade Endorsed Programmes.
- GRAs encouraged to take the opportunity to promote ocean observations and the GOOS Ocean Decade Endorsed Programmes at the UN Ocean Decade Laboratory, 15 – 17 September 2021
- Chair invited all participants to join an event organized by the Marine Technology Society on 14 September 2021, where the role of students in marine technology, engineering and science will be discussed.
- Chair informed the meeting with GOOS Officers to discuss the role of GRAs within GOOS National Focal Points in advance to the GRF-X part 2 meetings.

3. CLOSURE

Mr Denis Chang Seng thanked the participants and reminded them that he will be sending an email with a poll to decide the best dates to have the GRF-X part 2 meetings in October. He also encouraged GRAs to express their interests in collaborating with the BOOC initiative ahead of the next meetings.

Part 2, Meeting 3: 27 October 2021
Tenth Session of the GOOS Regional Alliance



Participants of the GRF-X Part 2, Meeting 3

1. OPENING

Mr Albert Fischer, Director of GOOS opened the meeting. He invited GRA representatives to join the GOOS Steering Committee workshop on Monday 29 November 2021. The goal of the workshop is to show what the GRAs have done in the past decades, and to show the GRA success stories. The meeting will serve to provide additional feedback on what the regional structures want from engaging with GOOS, and a vision for how to move forward with greater success. The workshop will brainstorm to gather the best information.

- The background and vision paper would be provided prior to the GOOS SC workshop.
- The meeting noted the last GRF-X meeting (part 2, meeting 4), will also take place in the upcoming weeks. The last GRF-X meeting will focus on GRA actions, as well as next GRA council leadership.

The Chair thanked all participants for their work and involvement in the GRF-X and introduced the next section which continued on GRA reporting.

2. GRA REPORTING

2.1. US-IOOS

Mr Carl Goudman, Director of US-IOOS, presented a background report about US-IOOS since GRF-IX. The US-IOOS is composed of 17 Federal agencies, and 11 US-IOOS Regional Associations (RAs). US-IOOS also listed the Coordinated Ocean Observations Research Act of 2020 as a key bill to clarify the authority of the Administrator of the National Oceanic and Atmospheric Administration with respect to post-storm assessments, and to require the establishment of a National Water Center, and for other purposes. US-IOOS build communities and partnerships around different technologies and capabilities, and work on using the technologies and applying them at different scales.

US-IOOS has seen very strong support for ocean observing in the current Administration/Government of the US, including a budget increase (up to 7 M USD) to better support initiatives such as the High Frequency Radar network (HRF). US-IOOS supports technologies such as underwater gliders and surface vessels, for which a team of over 30 institutions helped to operate and support Glider Data for the 2020 hurricane season. The Marine Life 2030 UN Decade Programme, co-lead by US-IOOS and MBON has been endorsed. Data volume in ATN has expanded to 149 projects, 61 species and 3676 tags. In relation to Quality Assurance for Real Time Operational Data, (QARTOD), standard and protocols of best practices documented as part of the Ocean Best Practices repository, a new paper and manuals will be released and worked on for the next calendar year.

The US-IOOS is fully committed to participate in the UN Decade of Ocean Science and will seek to find a strategy or ways to better provide a supporting role. US-IOOS is looking forward to working together with other GRAs to build a BOOC task team to help identify projects together along the ocean observations value chain.

Discussion

- Noted that there are a lot of federal players within NOAA (corals, marine debris programmes, etc.) that may be contributing to the UN Ocean Decade and for this reason, the US-IOOS remains unsure on how to specifically play a role to support the Decade. There are US-IOOS regional associations, and eleven directors with teams of experts. Needed to better understand the way in which all the different components of NOAA will support the UN Ocean Decade remains a challenge.
- Noted there is a cross NOAA internal team for the UN Ocean Decade.

2.2. IOCARIBE-GOOS

Mr Cesar Toro, Head of IOCARIBE presented a background report about IOCARIBE-GOOS since GRF-IX. Presently, the GRA is re-organising the Working Group of Experts and leadership following the 2018 GOOS Steering Committee.

IOCARIBE-GOOS has established seven working groups to support the achievement of each of the Decade six societal outcomes, including one focusing on capacity development.

They have carried out a series of webinars, regional consultations, and joint partnerships with WMO, UNDRR, FAO, UNEP, the International Seabed Authority, and the International Hydrographic Organization to provide support to these working groups.

The IOCARIBE–GOOS has engaged in a series of recommendations including:

- Building ocean observation systems;
- Use the GOOS 2030 Strategy to connect observations through data management for use in analyses and models;
- Demonstration projects to promote data sharing and trans-boundary observations;
- Strengthen inter-country cooperation for developing joint research in the Exclusive Economic Zones (EEZ).

Discussion

- Plenary recalled a discussion during an IOCARIBE-GOOS meeting about a new Global Storm and Tide Operational Forecast System that has been made available. US-IOOS recalled being interested in the low-cost wave buoys (5 -6 k USD each). The question is how to build a demonstration project using a given model capability (and for this specific product, some lower cost sensors similar to the GOA ON network). Seemingly, there is a need for technical experts to work with stakeholders locally, to get the right match for a demonstration project.
- Noted the need to develop the UN Ocean Decade actions in order to move forward. The goal is to find out how to develop those actions and translate them to programmes or projects. One example is to develop a series or number of projects targeting questions that we would like to address in a region, e.g. How to improve the already existing alliance for gliders in the region, to improve forecasting capacities for hurricanes. IOCARIBE-GOOS is working on the co-designing of those UN Ocean Decade

actions.

2.3. Black Sea GOOS

Mr Atanas Palazov, Executive Secretary of Black Sea GOOS presented a background report about Black Sea GOOS since GRF-IX. The Argo Float Programme is the most important observing Programme in the Back Sea with approximately 16 active floats deployed since 2020. A network of nine moored wave buoys was placed along the Black Sea coast to obtain real time wave measurements every hour. This data is available through the Black Sea GOOS dedicated website. The Black Sea GOOS contributed to the Copernicus Black Sea Monitoring and Forecasting Center Thematic Assembly Center by providing real time and historical data. The Black Sea GOOS is also a member of the Copernicus Black Sea Monitoring and Forecasting Center which provides physical, biogeochemical, wave forecast and re-analysis for the Black Sea with a resolution of 3 km.

The Black Sea GOOS plans to establish a Black Sea ARGO Community and extend ARGO contributors. In 2021, two European Commission Projects started, named "Advancing Black Sea Research and Innovation to Co-Develop Blue Growth within Resilient Ecosystems" (BRIDGE-BS) and "Developing Optimal and Open Research Support for the Black Sea" (DOORS). The main goal of the two projects is to contribute to the development of the blue economy in the Black Sea.

The Black Sea GOOS aims to improve the synchronization of observing systems between different countries and will aim to convince the Black Sea GOOS Member States to apply the IOC Open Data Programme to encourage data sharing in the region.

2.4. GOOS AFRICA

Mr Kouadio Affian, Chair of GOOS AFRICA presented a background report about GOOS AFRICA since GRF-IX. The GOOS AFRICA has seen an important partnership established between GOOS AFRICA and the Global Monitoring for Environment and Security and Africa (GMES & Africa). GOOS AFRICA is fully involved in the African Decade of Oceans and Seas, and the African Blue Economy Strategy in the broader context of the African Vision' 2063.

There has been good cooperation with IOC AFRICA for mutual reinforcements towards achieving the goals of the IOC-UNESCO. GOOS AFRICA had meetings with MONGOOS to seek mutual collaboration between the GRAs.

AFRICA GOOS has established an action plan in line with the GOOS Implementation Plan. The most important aspects are to provide visibility of what GOOS is doing towards implementing the 2030 Strategy, enable cross GOOS priority setting, address gaps through partnerships, and create cohesive cross-GOOS actions, and use GOOS resources more effectively.

Discussion

- IOC Tsunami and GOOS Sections have been working in tandem with IOC AFRICA to improve sea level data/mechanism issues.
- How to move forward from the success of the webinar on operational oceanography in Africa.
- Recognised that the main challenge in GOOS AFRICA is capacity building and appreciates the need to enhance inter-cooperation with GRAs to accomplish this.
- MONGOOS will offer opportunities to attend courses with priority to the African Mediterranean Member States. Deadline is the third week of November 2021.
- GOOS AFRICA and MONGOOS agreed to follow up on this matter.

2.5. Canadian Integrated Ocean Observing System (CIOOS)

Mr Andrew Stewart, Fisheries and Oceans Canada, presented a background report about CIOOS since GRF-IX. CIOOS is built on three Regional Associations (Pacific Canada, Atlantic Canada, and the Gulf of St. Lawrence). The key partners of CIOOS are the Marine Environment Observation, Prediction and Response Network (MEOPAR), Hakai Institute, Dalhousie University, University of Victoria and St. Lawrence Global Observatory.

In 2021, CIOOS completed the "CIOOS Strategic Plan (2021-2026) in both English and French. The Vitality partnership was a success in leveraging CIOOS to accelerate the ocean sector by developing tools and linkages between CIOOS and three emerging environmental technology and data-heavy sectors (aquaculture, tidal power, and offshore wind). The collaboration occurs through 10 partners across Canada by sharing private sector data, defining commercial outcomes for businesses by advancing data analysis, management and visualization capabilities and products, and supporting the resolution of near term labour, skill and capacity.

GRA cross collaboration with the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS), Great Lakes Observing System and Northwest Association of Networked Ocean Observing Systems (NANOOS) have been key to CIOOS success.

Long-term operational sustainability remains a big challenge for CIOOS. Current emphasis is on finding additional funding solutions in both the short and long term.

A webinar series was organized by CIOOS Atlantic and NERACOOS which was officially endorsed as a UN Ocean Decade event. Canadian participation in the UN Ocean Decade is being facilitated by the establishment of the National Decade Coordination Center.

Discussion

- There is a connection between the Canadian and US observing systems from national to regional scale.
- CIOOS focuses on the data side of monitoring systems. Fisheries and Oceans Canada are partners with CIOOS as well as research institutions, Non-Governmental

Organizations involved in ocean observing and collection and analysis of data such as for example Ocean Networks Canada.
- CIOOS works on various ocean related Canadian government departments e.g., National Defense projects.
- Investments and work mechanisms vary from province to province. CIOOS works closely with regional associations within provinces.

2.6. Southeast Asian Global Ocean Observing System (SEAGOOS)

Mr Somkiat Khokiattiwong, Chair of SEAGOOS, presented a background report about SEAGOOS since GRF-IX. The SEAGOOS is operated under the IOC Sub-Commission for the Western Pacific (WESTPAC). Key projects of SEAGOOS include the Ocean Forecasting System (OFS), Monsoon Onset Monitoring and its Impacts on Social and Ecosystem (MOMSIE), and Ocean Acidification (OA). Funding is provided by WESTPAC and Member States.

There are two ocean forecast systems operated by the First Institute of Oceanography (China) and the Phuket Marine Biological Center (Thailand). The ocean acidification and its impact on coral reefs project was first developed in 2013 with an initial 22 pilot sites; presently, the pilot sites number has increased to 120. The experience of OFS, MOMSIE, and WESTPAC in coral conservation and resilience lead to a concept proposal and implementation since 2019 of a coral bleaching alert system. The system needs to be further developed and improved including validation, to this end, only Thailand has been conducting validation.

SEAGOOS faces the challenge of funding since it has not been able to secure funds yet for long term operation/observation in some member states.

Discussion

- The GRA Council Chair suggested that SeaGOOS collaborate with IOGOOS on capacity building because they have common concerns such as for example tropical cyclones.
- SeaGOOS has a center in ocean data that provides training. SeaGOOS Chair said that 75% of the trainees come from within the region and the remaining 25% from other parts of the world including Africa, United States, and India.
- Consensus that joint trainings serve to move capacity building forward. The Ocean Teacher Global Academy (OTGA) is a good platform to conduct trainings and capacity building activities.
- Ocean acidification data has been submitted to the IOC-UNESCO and it is on the ocean acidification project site of IOC-UNESCO.

2.7. The North-East Asian Regional GOOS (NEAR-GOOS)

Mr Renbo Pnag, National Marine Environment Forecasting Center (NMEFC), presented a background report about NEAR-GOOS since GRF-IX. The Coordinating Committee for NEAR-GOOS is composed of members from IOC/WESTPAC. There are three Working Groups in NEAR-GOOS: Ocean Forecasting Systems, NEAR-GOOS Products, and Data Management.

Two pilot projects of NEAR-GOOS, “Climate Monitoring Section '' and “Ferry Based Monitoring”, aim to improve the understanding of the response of the regional seas climate change and to monitor the status and changes in the marine environment, respectively. Regional Real-Time Data Base (RRTDB) and Regional Delayed Mode Data Base (RDMDB) are stably operated and forecasting service products including currents, wave, wind, sea surface temperature, sea surface height have been provided daily by Agencies from China, Japan, Korea and Russia.

NEAR-GOOS is developing a NEAR-GOOS gateway website funded by the National Marine Environment Prediction Center (NMEFC, China), the first NEAR-GOOS gateway website will provide a unified introduction, news and events of NEAR-GOOS to increase its visibility. It will be in pilot operation by the end of 2021.

NEAR-GOOS is looking to engage and benefit from the GOOS 2030 Strategy by strengthening partnership to improve delivery of forecast, services and scientific assessments; build advocacy and visibility with stakeholders through communication with key users and national funders; and ensure GOOS ocean observing data and information are findable, accessible, interoperable, and reusable.

Discussion

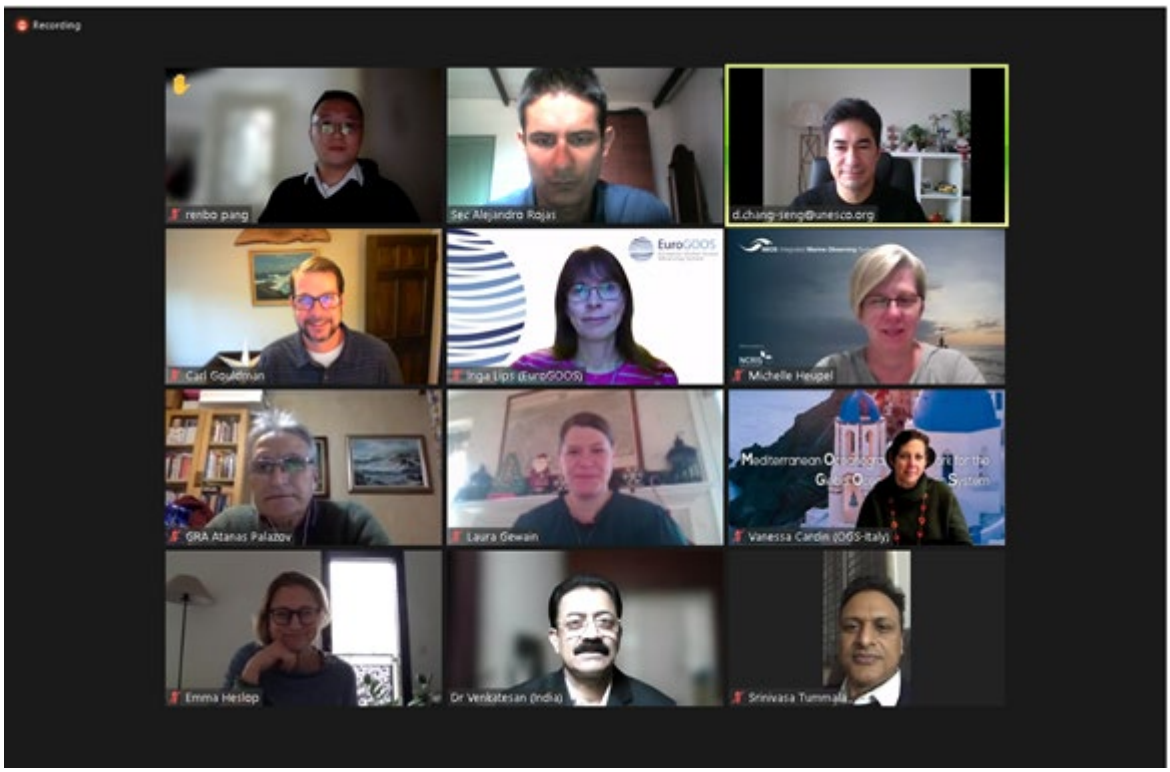
- Concern regarding the creation of products by collaboration including standard issues. There is a need for a unified standard for forecasting products.
- There is a working group for NEAR-GOOS products to coordinate with member states the formation of a unified standard for forecasting products.
- In reference to the theme on standards for forecasting products, there is an IOC Ocean Info Hub, with the idea to connect different portals and databases. However, there is a concern about standards for forecasting and how it can deliver a particular set of rules that apply to the forecast for all users. It is the final phase, the delivery of the forecast that needs to be standardized, to deliver the same rules for a final forecast. In tsunami and hurricane warning the standards have been well tested and can help us to understand where GRAs need to focus on.
- There is a focus on creating standards for the frequency of the forecasts and NEARGOOS will publish the forecast products on the NEAR-GOOS gateway website.
- Advice to refer to the standard operating procedures, to develop any standards for forecasting and how to define a product when we deliver a forecast.
- Noted the pilot project: Climate Monitoring Section, has been implemented for several years.

3. CLOSURE

Mr Denis Chang Seng closed the third meeting, and informed two key final points to the GRAs. First, the need to characterise GRAs according to their different focus. Second, the need to increase GRAs visibility. For this matter, he advised that a good opportunity would be to

create two-minute videos to cluster stories (GRAs success stories) according to the strategic objectives of GOOS.

Part 3, Meeting 4: 16 December 2021
Tenth Session of the GOOS Regional Alliance



Participants of the GRF-X Part 3, Meeting 4

1. OPENING

Mr Denis Chang Seng, Programme Specialist of OOS, opened part 3, meeting 4 of the GRF-X. He recalled the GOOS Regional Alliances (GRAs) representatives' participation for the first time in the GOOS Steering Committee (GOOS SC –X– Part 2) - GOOS Regional Structures Workshop meeting from 29 November to 2 December 2021. The workshop discussed regional approaches, vision, and policy for a thriving regional coordination ecosystem.

Mr R. Venkatesan, Chair of GRAs, expressed his gratitude for the two years he spent in the GRA Council Leadership and reminded that it is key to continue building the visibility of GRAs, to continue its participation in the GOOS Steering Committee, and engagement with GOOS National Focal Points.

2. NEW GRA COUNCIL LEADERSHIP

The new GRA Council Chair nominee is Mr Carl Gouldman, Director of the U.S Integrated Ocean Observing System (US-IOOS). Previously, he was the Vice-Chair of the GRA Council. He succeeds Mr R. Venkatesan, Indian Ocean GOOS (IO GOOS). The new Vice-Chair of the GRA Council nominee is Ms Michelle Heupel, Director of the Integrated Marine Observing System (IMOS). The new GRA Council Leadership was endorsed by all GRA participants. The GOOS Secretariat and the GRF-X participants thanked Mr R. Venkatesan for his significant contribution to GOOS and GRA Council leadership for the past two years.

3. GOOS STEERING COMMITTEE –X– PART 2

Ms Emma Heslop, Programme Specialist of OSS, presented a report of the GOOS Steering Committee (GOOS SC –X– Part 2) on GOOS Regional Structures Workshop from 29 November to 2 December, 2021. She reported on the draft decisions, as follows:

Decision 1. To constitute a sub-task or Working Group under the GOOS Governance Task Team to:

a) Review the GOOS Regional Policy 2013, highlighting gaps, weaknesses and where it is inconsistent.
b) Evolve a vision for the GRAs role in the GOOS.
c) Identify the commitment required from GOOS to support a thriving GRA ecosystem.
d) Define possible attributes for different level of ambition / capacity of GRAs.
e) Explore mechanisms to engage WMO and UNEP in the process of GRAs and link up to those regional structures.
f) Understand links to GOOS National Focal Points.
g) Review role in connection to the users of ocean information.
h) Develop proposal for an updated GOOS Regional Policy 2022, in-line with the Global Ocean Observing System 2020 Strategy and current societal needs for ocean information.

The sub-task or Working Group should include members of the Governance Task Team, GOOS Steering Committee, GRA leadership and regional projects.

The outcomes, recommendations and a draft GOOS Regional Policy 2022 should be ready for approval in 2022, following preview by the GOOS Sponsors, World Meteorological Organization (WMO), Intergovernmental Oceanographic Commission (IOC), United Nations Environment Programme (UNEP), and the International Science Council (ISC).

If the proposal is mature enough it will be of input to the IOC Executive Council in June 2022. This implies a draft GOOS Regional Policy 2022 proposal should be ready in April 2022.

There is a background document prepared by Maria Hook, which will help review the current policy and identify its present issues. This document was included in the background document prepared for the GOOS SC –X– Part 2, GOOS Regional Workshop. The first meeting of the GOOS Governance Task Team will take place in late January / early February 2022.

Discussion

- Encouraged GRAs to review the GOOS regional approach background document and the GOOS Regional Workshop report to have discussions within the sub-task or Working Group, to complete the Draft GOOS Regional Policy 2022.
- Chair of GRA Council reminded the meeting about the 30th year anniversary in 2024 since the formation of the GRAs as an association. There is a need to look at the evolution (e.g. emergence of different GRAs) and success stories as key factors to include in the Draft GOOS Regional Policy 2022.
- Noted the process to enter and exit of GRAs is a part of what specifically needs to be discussed in the Draft of the GOOS Regional Policy 2022.
- The process to set up the Governance Task Team has been moving forward. The idea is that during the first meeting of the Governance Task Team, the constitution of the sub-task or Working Group can be discussed. Membership to the sub-task or Working Group needs to be inclusive and be composed of approximately 15 members. The GRA Council will be approached and asked who they would like to nominate to the sub-task or Working Group (approximately 7-8 members).

Mr Denis Chang Seng provided a presentation about, a "Thriving Regional Coordination Ecosystem. What Do Regional Structures Want from GOOS, and What GOOS Want from the Regional Structures?" He presented the preliminary results from the Mural Board Interaction that took place during the GOOS Steering Committee (GOOS SC –X– Part 2), GOOS Regional Structures Workshop.

The GOOS regional visions for a thriving regional coordination ecosystem addressed questions such as how can GRAs, and projects better contribute to the global strategy and what are some key attributes of an evolving regional coordination of GOOS. The question about what regional structures want from GOOS examined deeper into its core team or panels, network, national focal points, and what has worked that needs to be sustained.

Responses from GRA and regional project representatives reflected that a healthy and successful regional coordination system requires harmonization, integration, alignment,

capacity building and training, common efforts, vision and strategy, inclusivity and connectivity with societal and industrial needs, to have structures based on focus area and explore opportunities supporting development.

There is a need for GOOS to adopt an Earth System Observation approach, have a single voice and strategy, enhance joint collaboration with for example WMO and IOC Sub-commissions, while increasing the engagement and recognition of regional activities. There is also a need to enforce the collaboration and connectivity between GOOS, GOOS components and GRAs on a regional to global and regional to national scale. GOOS National Focal Points need to be strengthened and stronger links established between countries, agencies, and data providers. A common regional interest has to be identified to better coordinate and support funding bids/proposals.

The Chair recommended that an interaction between the GRAs and the IOC Secretariat needs to be further strengthened. He recommended GRAs to share their success stories with the IOC Secretariat for public awareness and visibility purposes via IOC-UNESCO and GRAs social media websites. In addition, seeking support from different organizations for the funding and execution of GRAs related activities is key. To conclude, he encouraged capacity building, trainings and data sharing cooperation between GRAs.

4. GRF-X KEY ACTIONS & RECOMMENDATIONS

Mr Denis Chang Seng, presented the GRF-X key actions based on the GOOS Steering Committee –X– Part 2 meetings, as well as actions that need to be carried forward from GRF-IX. The GRF-X key actions and recommendations were reviewed during plenary and the adopted version is included in Annex I.

5. ANY OTHER BUSINESS

No other business was raised to be considered by the session.

6. CLOSURE

The meeting was closed on Thursday, 16 December 2021 at 15:30.

ANNEX I: GRF-X Proposed Key Actions & Recommendations

ACTIONS #	ACTIONS
TOOLS AND PRODUCTS	
ACTION 1	GOOS Regional Alliances (GRAs) to help in the development of the Benefits of Ocean Observations Catalog (BOOC) by testing the prototype and contributing with use cases.
PARTNERSHIPS	
ACTION 2	EuroGOOS, MONGOOS, and IOGOOS to strengthen their alliance with GOOS AFRICA.
COMMUNICATION AND VISIBILITY	
ACTION 3	GRAs to provide a list of products for the update of the GRA website.
ACTION 4	Secretariat and GRAs to produce two-minute videos on success stories of GRAs.
ACTION 5	The GOOS Secretariat with the support of GRAs to prepare news articles to highlight the development of Benefits of Ocean Observations Catalog (BOOC) and its Advisory Group.
ACTION 6 a	The GOOS Secretariat to prepare a short, distilled document on how to engage with GOOS. The document should explain how GOOS operates, and the links between the panels and GRAs etc.
ACTION 6 b	GRAs to contribute to the forward looking vision and capabilities of GOOS in accordance to the GOOS 2030 Strategy.
ACTION 7 a	GOOS Secretariat/GRAs to develop a prospectus on the benefits of participating within a GRA to get others to join.
Action 7 b	The Secretariat and GRAs to develop communication about what GRAs/ regional structures do.
ACTION 8	GRAs / GOOS to communicate to end users about the different use and value of data (e.g. from Gliders, etc.) and input in different stages of the operational forecasting system.
CONNECTIVITY & ENGAGEMENTS	
ACTION 9	To further establish better connection between GRA Forums and other meetings, e.g. panel, or OCG meetings.
ASSESSMENTS, QUALITY STANDARDS AND PERFORMANCE	
Action 10	Develop an international badge of quality that is respected internationally (Tiers of GRA Level and requirements at each level of maturation). [Request to alternatively carry out a sub ranking of the

	priorities of GRAs and or rubric of quality for entry of GRAs. [The meeting agreed to discuss further in future GRA Council meetings]
Action 11	Map existing GRA capabilities and what is associated with them.
ACTION 12	Compile regional needs to scale up and inform global priorities
GOVERNANCE AND COORDINATION	
ACTION 13	GOOS Regional Alliances to support the development of the GOOS Regional Policy 2022.

KEY RECOMMENDATIONS		
1	**GOVERNANCE, STRATEGY AND FRAMEWORKS** **RECOGNITION, VISIBILITY AND COMMUNICATION**	**1.** Further explore how to support the implementation of the GOOS UN Decade Programmes at the regional level through case studies **[REC 1]** **2.** To better define practical ambition for GOOS & GRAs **[REC 2]** **3.** To better articulate GOOS priorities (EOVs, and others) and evidence for those priorities in support of regional and national scale advocacy to generate funding **[REC 3]**
2	**Engagement and Impact of SO 1** **Integration and delivery of SO 2** **COLLABORATION, CONNECTIVITY, COORDINATION AND INTERGRATION**	**1.** Enhance connections and multilateral cooperation of GRAs with global stakeholders (WMO, IMO, OECD, IHO, African Union etc. through broader meetings **[REC 4]** **2.** Improve connection among GRAs and alignment of GRA Projects / Initiatives with those of GOOS **[REC 5]** **3.** GOOS national focal points need to be strengthened and stronger links established between countries, agencies , data providers etc. **[REC 6]** **4.** GOOS office can be a clearinghouse or matchmaker to connect people with specific needs **[REC 7]** **5.** Support experts on the ground **[REC 8]** **6.** Provide a collaboration framework for common research, not necessarily in operational oceanography **[REC 9]**
3	**Building for the future** **FUNDING AND CAPACITY DEVELOPMENT**	**1.** Coordinate and support funding bids/proposals and the identification of common regional interest **[REC 10]** **2.** Co-Design of funding proposals and sharing of data **[REC 11]** **3.** GOOS supporting training sessions, tools, experts **[REC 12]** **4.** Regional assistance and support e.g. equipment calibration, purchase expensive equipment **[REC 13]** **5.** GOOS role in communicating funding needs and identifying opportunities **[REC 14]**

ANNEX II: GRA Reporting Success Stories

Integrated Marine Observing Systems (IMOS)

1.1. Event-based sampling

Presently, Australia experiences marine heat waves for which coral reef habitats are heavily impacted. In 2020, IMOS provided critical water temperature data to help researchers and managers monitor the marine heatwave on the Great Barrier Reef. IMOS quickly mobilized gliders into regions at greatest risk of coral bleaching to better manage and predict these situations into the future.

1.2. Wave Measurements

IMOS has published a new global ocean wind speed and direction database on the ODN portal. The dataset can be used to study the impacts of extreme wind speed and assist maritime industries such as the navy, offshore oil and gas platforms, and anyone looking at safety and navigation in the region.

IMOS has funded a project to trial low-cost wave buoys to compare their performance with conventional buoys in a range of oceanic conditions (especially close to shore) to determine their sustainability for long term deployments. They have been working really well since they were placed in the water in the first quarter of 2020. In fact, the new technology buoys recorded very accurate and real time data about a superstorm off the coast in Perth, Western Australia. The buoys recorded a 9 meter height wave, and survived to the next morning.

1.3. Acoustic Tracking Programme

IMOS has built a national network of acoustic receivers to provide a powerful tool for observing animal movements especially of sharks and fish that are recreational and important to Australian ecosystems (879 active receivers, 101.4 million detectors and 153 species tracked). The data informs fisheries management and status reports, and threatened species management at State and Commonwealth levels. A 2021 paper highlights the power of IMOS continental-scale network to detect movements amongst fishery jurisdictions. The network analysis revealed previously unknown population connections in some species.

The Regional Alliance for the Upper Southwest and Tropical Atlantic (OCEATLAN)

1.4. South Atlantic Meridional Overturning Circulation Programme (SAMOC)

It studies the role of the South Atlantic in the meridional overturning circulation. It aims to better understand the internal variability of the heat content and meridional transport in this part of the world. Since 2009, OCEATLAN has developed 18 cruises between Brazil and Argentina with funding from iAtlantic. Presently, there is an array of instruments that will be installed in 2022, in the 700 meter isobaths of the area. The moorings will measure temperature, salinity and dissolved oxygen at different levels of the water column.

1.5. Advanced CIRCulation Model and Tide Empiric Prediction Model

It is a model that measures tides. It is presently being deployed in an area (Rio de la Plata, Buenos Aires) where wind from the south east could become problematic. To be able to calculate the prediction of tidal waves, the model uses a methodology in which it applies a fixed amount of component tidal waves considering the amplitude of the most important tidal waves in each area. The application of the model allows for a prediction of up to 7 days.

1.6. Ocean Teacher Global Academy (OTGA)

Argentina was selected to host a special center for ocean sciences through OTGA conducted by the Naval Hydrographic Service (SHN), School of Marine Sciences of the Argentine Navy and the University of Buenos Aires. One training course has been completed: Determination of the Outer Limit of the Continental Shelf. In this course, the experience of more than 20 years from the Argentine policy regarding limitation of the continental shelf in the South Western Atlantic Ocean is showcased and taught to researchers around the globe. A second training that will be delivered in OTGA is related to Sea Ice (Polar Waters).

1.7. Other Programs

Programmes such as GLOSS, PIRATA, PNBOIA are still under operation, while XBTs have been discontinued due to the Covid-19 Pandemia.

Indian Ocean Global Ocean Observing System (IOGOOS)

1.8. International Indian Ocean Expeditions-2 (IIOE-2)

The second phase which has been undergoing since 2015. It has now been extended to 2025. The main sponsors are IOC, SCOR and IOGOOS. There are 41 endorsed scientific projects from 19 countries that conduct ocean cruises and research initiatives in the Indian Ocean region. The IIOE-2 has been identified as potentially one of the UN Decade of Ocean Science for Sustainable Development (2021-2030) initiatives. The International Indian Ocean Science Conference (IIOSC) was originally scheduled during 16 – 20 March 2020 at Goa, India to discuss new scientific results emerging from the highly successful IIOE-2 campaign that was launched in 2015, however, it was suspended due to the Covid-19 pandemic. The meeting is to be rescheduled to take place during 2021.

1.9. Indian Ocean Observing System (IndOOS)

Two key initiatives in the IndOOS have been the Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER) which is primarily a biogeochemical observation systems; and Indian Research Forum (IRF), a high-level members meeting to facilitate the allocation and alignment of resources in the Indian Ocean to achieve a sustained, basin-wide ocean observing system. It is highly involved in implementing the IndOOS Observing Plan (2021-2030).

There have been good developments in ocean data management; there is an IIOE-2 metadata portal that enables search and discovery of metadata from the cruises under IIOE-2. There is an IndOOS Data Portal that provides links to all information data portals, for example, the MoES-NOAA OMNI-RAMA Data Portal.

1.10. ChloroGIN

IOGOOS has been providing GloroGIN real time and high resolution data products on sea surface temperature, quasi-tru color composites, chlorophyll (K490), provided to 8 different countries in the region.

1.11. Capacity Building

Several Training Programmes conducted in two category-2 training Centres operated by IOGOOS Member institutions in India and Iran.

The Southern Ocean Observing System (SOOS)

1.12. SOOSmap

SOOSmap is hosted and maintained by EMODnet Physics. It is an interactive map of the southern ocean that shows aggregated data layers from the southern ocean. By clicking on and off data layers and data points of interest, the map will provide metadata and initial reference of the point.

1.13. Due South

A database of upcoming expeditions to the southern ocean. It is hosted and maintained by the European Polar Board. In the Due South database, you can see present and past expeditions to the southern ocean including the involved research projects.

The Mediterranean Operational Network for the Global Ocean Observing System (MONGOOS)

1.14. First Meeting with GOOS AFRICA

Working session with GOOS-Africa – GOOS on July 1st, 2021 that aimed to set the basis for a future collaboration. Among topics discussed included to identify proposal(s) at the International level to include the northern African countries as associate partners. As such, AFRICA-GOOS will be an intermediary to negotiate with North African countries from the Mediterranean region. Additionally, another objective is to provide scientific and technical assistance to Mediterranean North African States.

1.15. BOOST to Scientific Component

Enhance research and technological resources to cope with environmental and societal problems. This would build on a research and scientific based information system. To do this there has been MONGOOS dedicated sessions in the European Geophysical Union conference in 2020, 2021 (and 2022); MONGOOS special issue in Ocean Sciences Journal (Copernicus) “Advances in interdisciplinary studies at multiple scales in the Mediterranean Sea'';

Coordinated Independence of Task Teams and Working Groups through coordination with Co-chairs and EuroGOOS ambassadors; and a Workshop “New ocean observation approaches for a blue Mediterranean Sea: physical and biogeochemical systems, data and model assimilation (December 2020)”.

1.16. Seamless European Marine Climate Service (SMECS) Project

The project is the first joint collaboration among all EuroGOOS ROOS (es). It brought together 24 partners and was an excellent “exercise” of synergies between regional observing systems. It has gained large momentum for a next call.

1.17. Enhancement of MONGOOS Data Center: Update & Integration of Glider Data into the MONGOOS Webpage

A data center of activities in the Mediterranean Sea. A close collaboration with GROOM and OceanObs, MONGOOS is now able to extrapolate data integration of gliders and give visibility to the Member States activities. MONGOOS is also presently updating the sea level tide gauge station information and hopes to include information from Mediterranean North African member states.

EuroGOOS AISBL

1.18. Adoption of the EuroGOOS 2030 Strategy

In 2021, a major achievement has been the adoption of the EuroGOOS 2030 Strategy which is underpinning the implementation of the full GOOS scope. One of the early outcomes of the strategy has been the formation of the biological observations working group. The first priority of this newly formed working group would be to set initial standard operations and data procedures for eDNA, multi-omics, and imaging protocols.

1.19. 1st EuroSea Tide Gauge Network Workshop

The workshop was organised from 12-14 January 2021, by the EuroGOOS Tide Gauge Task Team. The event brought together the global tide gauge community to share experiences, exchange information on recent activities, and discuss ways to overcome the challenges across different geographical regions.

1.20. Establishment of the European Ocean Observing System(EOOS) Operations Committee

The Committee has successfully engaged 26 European GOOS National Focal Points besides all the different European research infrastructure, space agencies, EuroGOOS tasks teams and regional observing systems.

1.21. EOOS European GOOS National Focal Points Survey

Funding and coordination across ocean observing and marine monitoring in Europe. This work was acknowledged by the European Commission and used on their product ocean observing initiative work.

1.22. The EuroGOOS Ocean Literacy Network/Working Group

The EuroGOOS has been very active since June 2019 in ocean literacy, including work from the Ocean Literacy WG in the UN Decade of Ocean Science for Sustainable Development (2021-2030). Such work included an ocean literacy course and EuroGOOS policy brief both organized and done within the UN Ocean Decade.

1.23. Establishment of EuroEGOOS Glider Task Team; Re-establishment of EuroGOOS Fixed Platform Task Team; EuroGOOS HR Radar Task Team.

These task teams aim to promote scientific synergy and technological collaboration among European ocean observing infrastructures. It has also helped in sharing open source tools and making data available to EuroGOOS data portals.

GOOS Regional Alliance for the South-East Pacific (GRASP)

1.24. Operational Products

GRASP member states have shared operational meteorology and oceanographic information such as national sea level networks, altimetry maps, sea surface temperature, salinity, wave models, surface winds and ice cover**.**

1.25. Web portal for visualization of numerical models

This portal developed in 2017 and implemented since 2019, shows the visualization of global models of oceanographic and meteorological data in the Southeast Pacific region, which is hosted in the Oceanographic and Antarctic Institute of the Ecuadorian Navy (INOCAR) website.

1.26. Digital Documentation Repository

GRASP created a digital repository of operational marine meteorological and oceanographic documentation for the Southeast Pacific region, which is hosted in the Colombian Data Center (CECOLDO).

1.27. Webinars

In 2020-2021, GRASP conducted ten webinars with different themes such as: transmission, reception and data quality control; Numerical models for operational oceanography; Scientific dissemination of oceanographic phenomena; Free software for the development of operational oceanography; and, Observation Systems.

1.28. Strengthen Capacities and Integration Program

In 2021, GRASP invited the CPPS WG and the regional tsunami programme to participate in virtual conferences and present their work within the framework of the Alliance, in order for GRASP to learn about the different topics and allow for a contribution on operational products.

1.29. Contribution to the UN Ocean Decade

GRASP developed a web portal named “Regional Observational Network”. Within the portal, there is a “Regional Sea Level Network” to present tide gauge sea level data for the region. This Ocean Decade activity was endorsed on 2 July, 2021. In the future, this portal could incorporate additional environmental variables, such as Sea Surface Temperature and meteorological variables.

U.S IOOS

1.30. High Frequency Radar (HRF)

The budget that is needed to support the entire network still is lower but has seen an increase of about 7 Million USD per year. There have been 30 new HRFs installed in the last 4-5 years. Wind turbine interference will be an issue as more of these become deployed specially along the east coast, for this, US-IOOS has been doing some research and development work on how to mitigate the impact and commit wind turbine companies to put more sensors to help tackle the techniques that will have to be deployed.

1.31. Glider Data Assembly (DAC) and Interagency Team

US-IOOS supports unscrewed technologies such as under water gliders and surface vessels to understand boundary kinds, severe storms, and try to measure ocean features in a more systematic way and how to design the observing capabilities to best deliver the data information to operational models and forecast. There is a data assembly center to assimilate data into regional ocean forecast models, which are pulled into some of the models of the hurricane system. In this manner, assimilation of ocean data is taken into atmospheric models. A team of over 30 institutions helped to operate and support Glider Data for the 2020 hurricane season.

1.32. Marine Biodiversity Observation Network (MBON)

The Marine Life 2030 UN Decade Programme, co-lead by US-IOOS and MBON has been endorsed. US-IOOS is soliciting new joint US MBON-TN projects and funding.

1.33. Animal Telemetry Network (ATN) & AniBOS

Data volume in ATN has expanded to 149 projects, 61 species and 3676 tags. US-IOOS is keeping U.S. beaches safe with R/T shark detection buoys and text alerts. There has been an integrated U.S./Canadian Atlantic Coast acoustic telemetry tracking single point access for PIs to thousands of rcvrs. MBON/ATN “BioTrack” established to integrate biodiversity and animal movement data. AniBOs is formally approved by OCG as an emerging GOOS Network and US-IOOS has added an animal tagging expert to the advisory committee, ATN Network coordinator on Steering Committee and ATN DAC Manager on Data Sub-committee.

1.34. Environmental Sensor Map

US-IOOS works to have national data integration capabilities, the environmental sensor map is focused on in situ data that is near real time of different parameters such as wave height, water temperature, etc.

1.35. Quality Assurance for Real Time Operational Data (QARTOD)

Quality Assurance for Real Time Operational Data, a new paper and manuals will be released and worked on for the next calendar year. These are standard and protocols of best practices documented as part of the Ocean Best Practices repository. US-IOOS continues to support the Ocean Best Practices System in any given domain area.

IOCARIBE-GOOS

The IOCARIBE-GOOS has moved forward with projects and activities related to *Sargassum* Algal Blooms, oil spills, gliders and high frequency radars. The UN Ocean Decade has seen the establishment of seven working groups by IOCARIBE-GOOS to assist in the achievement of each of the six initial societal outcomes and one specific for capacity development. There is a series of webinars, regional consultations, and joint partnerships with WMO, UNDRR, FAO, UNEP, the International Seabed Authority, and the International Hydrographic Organization to provide support to these working groups.

Black Sea GOOS

The Black Sea GOOS has seen continuation of success in the Argo Programme. The Argo Programme is the most important observing Programme in the Back Sea with approximately 16 active floats deployed since 2020. There have been several contributors to it including Turkey, Bulgaria, Romania, Germany, France, and Italy. In 2021, two events were organized in the frame of the Euro-Argo RISE project, the first was a workshop focused on the Mediterranean Black Sea with the goal to demonstrate the application of Argo and show how to use the floats in shallow waters. The second was the Euro-Argo political event with the goal to attract more countries to contribute to the Black Sea Argo Programme.

A network of nine moored wave buoys was placed along the Black Sea coast to obtain real time wave measurements every hour. This data is available through the Black Sea GOOS dedicated website.

The Black Sea GOOS contributed to the Copernicus Black Sea Thematic Assembly Center by providing real time and historical data. The Black Sea GOOS is also a member of the Copernicus Black Sea Monitoring and Forecasting Center which provides physical, biogeochemical, wave forecast and re-analysis for the Black Sea with a resolution of 3 km's.

GOOS AFRICA

The GOOS AFRICA has had a good revitalization since the first quarter of 2020. An important partnership has been established between GOOS AFRICA and the Global Monitoring for Environment and Security and Africa (GMES & Africa). This means that GOOS AFRICA has been fully endorsed by the African Union Integrated Maritime Strategy. GOOS AFRICA also has had

a full implication in the African Decade of Oceans and Seas, and the African Blue Economy Strategy in the broader context of the African Vision' 2063.

There has been good cooperation with IOC AFRICA for mutual reinforcements towards achieving the goals of the IOC-UNESCO including an initiative undertaken towards the establishment of a national community for the UN Decade of Ocean Science for Sustainable Development. A webinar dedicated to operational oceanography in Africa was organized and GOOS AFRICA had meetings with MONGOOS to seek mutual collaboration between the GRAs.

Canadian Integrated Ocean Observing System (CIOOS)

In 2021, CIOOS completed the "CIOOS Strategic Plan (2021-2026) in both English and French. As Canada's nucleus for ocean observing, CIOOS makes connections for a sustainable ocean future. The mission is to foster partnerships and grow a powerful online platform that generates information, knowledge, and place-based solutions to advance our understanding of the ocean.

The Vitality partnership was a success, in leveraging CIOOS to accelerate the ocean sector by developing tools and linkages between CIOOS and three emerging environmental technology and data-heavy sectors (aquaculture, tidal power, and offshore wind). The collaboration occurs through 10 partners across Canada by sharing private sector data, defining commercial outcomes for businesses by advancing data analysis, management and visualization capabilities and products; and supporting the resolution of near term labour, skill and capacity.

GRA cross collaboration with the Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS), Great Lakes Observing System and Northwest Association of Networked Ocean Observing Systems (NANOOS) have been key to CIOOS success.

Southeast Asian Global Ocean Observing System (SEAGOOS)

1.36. Development of Ocean Forecasting System and its Service

The ocean forecasting system operated by the First Institute of Oceanography (China) was launched in 2012, and the one operated by the Phuket Marine Biological Center (Thailand) was launched in 2015.

1.37. Ocean Acidification and Its Impact on Coral Reef

The project was developed in 2015 with the proposal of 22 pilot sites by SEAGOOS member states to monitor Ocean Acidification. Since then, there are now 120 monitoring sites and member states contribute their data to achieve the Sustainable Development Goal 14.3.1 on *"Average marine acidity (pH) measured at agreed suite of representative sampling stations"*.

1.38. Joint Effort Among the WESTPAC Project Between Regional Training and Research Center on Ocean Dynamic and Ocean Forecasting System on Capacity Building

Knowledge about climate dynamics, air-sea interactions, and regional application of coupled climate models is integrated in the Regional Training and Resource Center on Ocean Dynamics and Ocean Forecasting Systems (RTRC-ODC) to construct capacity building and pass on the knowledge to young scientists from the region and other regions of the world.

1.39. Initiated Joint Effort of OFS, MOMSIE, and WESTPAC Coral Conservation & Resilience to Develop a Coral Bleaching Alert System

The concept of the system was proposed and introduced at the first WESTPAC training workshop from 11 to 13 September 2019. The system has been proposed and developed from the experience of OFS, MOMSIE, and WESTPAC in coral conservation and resilience. The system needs to be further developed and improved including validation, so far, only Thailand has been conducting validation.

North-East Asian Regional GOOS (NEAR-GOOS)

1.40. Climate Monitoring Section Pilot Project

Aims to improve the understanding of the response of the regional seas to climate change. There are annual connecting CTD- sections across the basin by the Japan Meteorological Agency (JMA, Japan) and Pacific Oceanological Institute (PIO, Russia) since 2011. The plan is to continue every year observations, add other sections in the east, biological samplings and marine microplastic sampling.

1.41. Ferry Based Monitoring Pilot Project

Monitoring the status and changes in the marine environment. It was proposed and promoted by the National Institute of Fisheries Science (NIFS, Korea). Ferry boats observe the surface water temperature and salinity during cruising between Donghae, Korea and Vladivostok, Russia. A new sensor was installed following the recommendation by the North Pacific Marine Science Organization (PICES). The data will be shared among the members of the project by the end of 2021. Another observation line between Donghae city, Korea and Sakhalin Island using a cargo ship became operational. For the future, there is a plan to establish monitoring lines with Japan.

1.42. Provide Stable Oceanographic and Meteorological Data

Regional Real-Time Data Base (RRTDB) and Regional Delayed Mode Data Base (RDMDB) are stably operated by Agencies from China, Japan, Korea and Russia. The total volume of oceanographic/marine and meteorological data equals over 230GB by June 2021. Over 89.000 files and 50.4 GB data were downloaded from RDMDB of JODC of Japan in 2020, and there was an Increase in the total times for accessing NEAR-GOOS RRTDBs and RDMDBs from 2019 to 2020.

1.43. Provide operational Forecasting Products

Forecasting service products including currents, wave, wind, sea surface temperature, sea surface height have been provided daily from the websites of China, Japan, Korea and Russia.

1.44. Develop NEAR-GOOS gateway website

Funded by the National Marine Environment Prediction Center (NMEFC, China) for development, the first NEAR-GOOS gateway website will provide a unified introduction, news and events of NEAR-GOOS to increase its visibility. In addition, it will provide an interactive overview of metadata of observing tools under NEAR-GOOS and links to download observing data of these tools (from 47 ocean stations, 7 buoys, 2 ships). It will be in pilot operation by the end of 2021.

ANNEX III: ACRONYM LIST

ADCIRC	Advanced Circulation Model
AUV	Autonomous Underwater Vehicle
BOOC	Benefits of Ocean Observations Catalog
BOM	Bureau of Meteorology - Australia
CWGs	Capability Working Groups
ChloroGIN	Chlorophyll Global Integrated Network
CSIRO	Commonwealth Scientific and Industrial Research Organization
DOORS	Developing Optimal and Open Research Support for the Black Sea
eDNA	Environmental DNA
EOVs	Essential Ocean Variables
ETOOFS	Expert Team on Operational Ocean Forecasting System
EuroGOOS	European GOOS Regional Alliance
GLOSS	Global Sea Level Observing System
GOOS	Global Ocean Observing System
GOOS AFRICA	Africa GOOS Regional Alliance
GOOS SC	GOOS Steering Committee
GRA	GOOS Regional Alliance
GRASP	GOOS Regional Alliance of Southeast Pacific
GRF	GOOS Regional Forum
IIOE-2	International Indian Ocean Expeditions-2
IMOS	Integrated Marine Observing System
IndOOS	Indian Ocean Observing System
INTAROS	The INTegrated ARctic Observation System

IOC	Intergovernmental Oceanographic Commission
IOCAFRICA	IOC Africa Sub-Commission
IOGOOS	Indian Ocean GOOS Regional Alliance
JERICO-S3	Joint European Research Infrastructure of Coastal Observatories: Science, Service, Sustainability
JMA	Japan Meteorological Agency - Japan
MOMSIE	Monsoon Onset Monitoring and its Impacts on Social and Ecosystem
MONGOOS	The Mediterranean Operational Network for the Global Ocean Observing System
NIFS	National Institute of Fisheries Science - Korea
NMEFC	National Marine Environment Prediction Center - China
NOAA	National Oceanographic and Atmospheric Administration
OCEATLAN	GOOS Regional Alliance for the Upper Southwest and Tropical Atlantic
OOFS	Operational Ocean forecasting System
OGS	Oceanography and Experimental Geophysics - Italy
OTGA	Ocean Teacher Global Academy
PIO	Pacific Oceanological Institute - Russia
PICES	North Pacific Marine Science Organization
PIRATA	Prediction Research Moored Array in the Tropical Atlantic
PNBOIA	Programa Nacional de Boias
PPO	Perth Programme Office
RDMDB	Regional Delayed Mode Data Base
RRTDB	Regional Real-Time Data Base
RTRC-ODC	Regional Training and Resource Center on Ocean Dynamics and Ocean Forecasting Systems
ROOS	Regional Operational Oceanographic Systems

SAMOC	South Atlantic Meridional Overturning Circulation Programme
SCAR	Scientific Committee for Antarctic Research
SCOR	Scientific Committee for Oceanic Research
SMECS	Seamless European Marine Climate Service
SIBER	Sustained Indian Ocean Biogeochemical and Ecological Research
SOOS	Southern Ocean Observing System
UN Ocean Decade	UN Decade of Ocean Science for Sustainable Development (2021-2030)
UNESCO	United Nations Educational Scientific and Cultural Organization
US-IOOS	United States Integrated Ocean Observing System
WESTPAC	IOC Sub-Commission for the Western Pacific
WMO	World Meteorological Organization
XBTs	eXpendable BathyThermographs

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ACKNOWLEDGMENTS

The Global Ocean Observing System

unesco Intergovernmental Oceanographic Commission

WORLD METEOROLOGICAL ORGANIZATION

UN environment United Nations Environment Programme

International Science Council

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Published in 2022 by the Global Ocean Observing System Programme under the Intergovernmental Oceanographic Commission of UNESCO, 7, Place de Fontenoy, 75352 Paris 07 SP, France
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For bibliographic purposes, this publication should be cited as follows: Tenth Session of the GOOS Regional Alliance Forum Report, GOOS Report No.279