4th Annual meeting of the

OceanPredict Science Team (OPST)

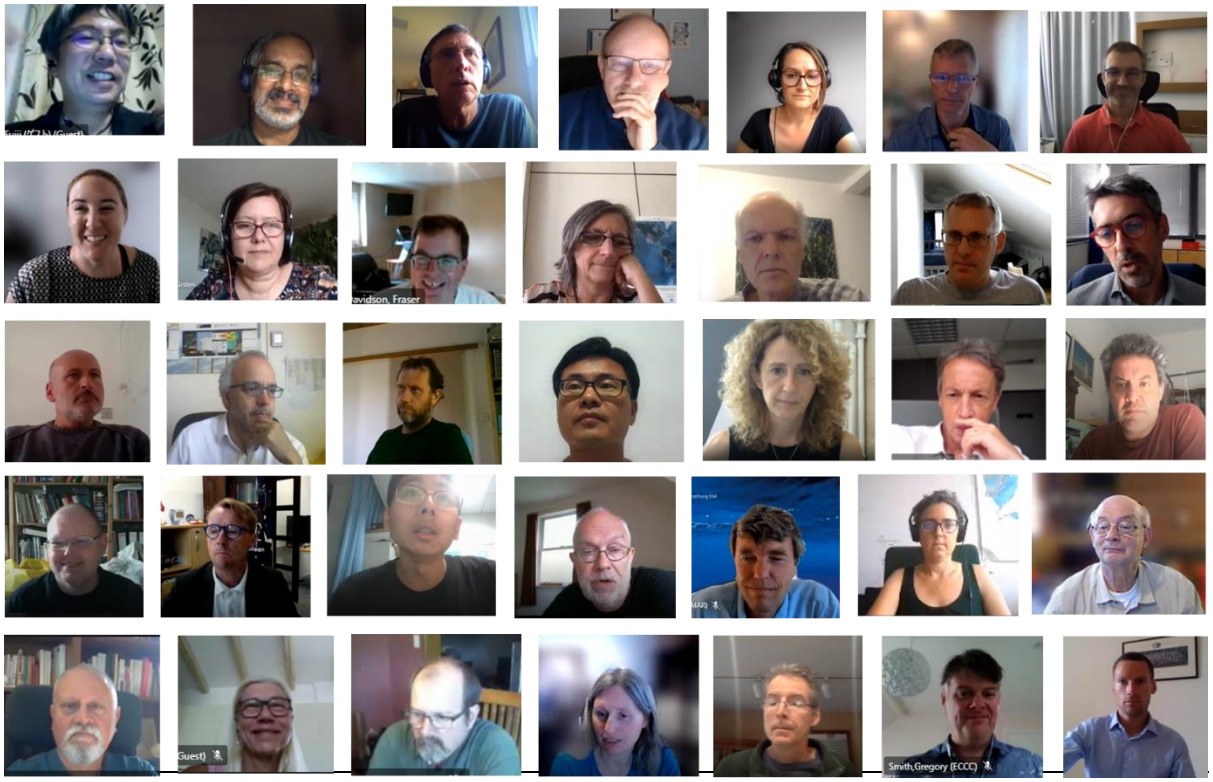
2021

Semi-annual

OPST-4 Report

16, 17, 21st June and 4th July

MS Teams meeting



Snapshot of some attendees of the 4th OPST online meeting, June 2021

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Content

1. Overview and meeting objectives

Presented by Fraser Davidson

The meeting took place over 4 days with 90 min/120 min slots per day. The main meeting objective was to prepare OceanPredict for its involvement with the UN Decade OceanPredict, especially discussing the ForeSea programme. Representatives from partner programmes were invited to participate in initial discussions to set the scene for subsequent collaboration within the UN Decade. The meeting also included items covering the OP strategy, ET-OOFS interactions, OP communication as well as task team progress reports.

Guests at the meeting included Martin Visbeck (GEOMAR), Emily Smail and Audrey Hasson (both Geo Blue Planet) and Maria Hood (G7/FSOI).

2. OceanPredict Strategy finalisation and endorsement

Presented by Fraser Davidson

Many consultations with the OPAS (OP advisory board) and OPST members contributed to a comprehensive version of the OP strategy by the meeting date. Late comments/ input provided within the meeting 4-day period were used for updates. After the meeting the strategy was finalised, uploaded to the website where a web-form invited OP members to endorse the strategy.

The strategy documents will be sent for comments/feedback to external partners in the next months.

OPST4-1:	**KWB** to set up an online form by end of July 2021 to provide a mechanism for OPST members to endorse the new OP strategy.
OPST4-2:	**OP co-chairs** to arrange for OP strategy document to be sent to OP partners for comments and feedback in the next few months.

3. OceanPredict and UN Decade programmes

Presented by Fraser Davidson

The OceanPredict programme ForeSea, submitted to the UN Decade of Ocean Science for Sustainable Development programme earlier in the year was endorsed by the UN Decade in late May 2021 and an overview was presented by Eric Chassignet. To complete the endorsement process, the UN Decade is requesting feedback and input to several questions (including project planning, communication material, resource requirements, etc.) The OP co-chairs will provide the requested input after OPST-4.

OPST4-3:	**OPST co-chairs** to prepare material and provide the response to UN Decade on the ForeSea endorsement.

A summary of the ForeSea presentation is provided in 3.1. In addition, two of the other UN Decade partner programmes, CoastPredict and DITTO, were invited to provide an overview of the programmes and to open up the communication for developing future collaborations.

3.1 ForeSea

Presented by Eric Chassignet

Eric summarised the UN Decade vision and mission to "generate and use knowledge for the transformational action needed to achieve a healthy, safe, and resilient ocean for sustainable development by 20230 and beyond". He summarised the processes the UN Decade used to identify Decade programmes and contributions, and introduced ForeSea as the endorsed UN Decade programme proposed by OceanPredict.

ForeSea's vision is for a strong international coordination and community building initiative to create the ocean prediction capacity of the future, including

- Improving the science, capacity, efficacy, use and impact of ocean prediction systems
- Building a seamless ocean information value chain, from observations to end users, for economic and societal benefit

The transformative aspect of the ForeSea programme is going to be realised through the co-creation of a framework for operational oceanography enabling scientists to collaborate on all components of the ocean information value chain in support of a sustainable operational oceanography system that is responsive to user needs. ForeSea, in collaboration with partner programmes, is planning to democratise ocean data and predictions, enabling less developed countries to access and benefit from free and accessible ocean information. It also plans to engage diverse stakeholders in the co-design processes through emerging partnerships. ForeSea plans to coordinate its plans through dedicatee projects, building on the OP task teams. In co-creating a new information platform, ForeSea not only supports its easy access but will contribute to setting standards and best practices for ocean prediction.

The next step is to set up the ForeSea Steering Committee and to develop the ForeSea implementation plan, which will include setting up projects/project processes, developing and enhancing partnership with fellow programmes and UN Decade groups, and soliciting of national endorsement for ForeSea/OceanPredict coordination.

ForeSea (and other programmes) have already identified and endorsed one project to support the(ir) programme(s). *SynObs*, initiated by Yosuke Fujii and Elisabeth Remy (OS-Eval TT co-chairs) will explore the optimal combinations of in-situ and satellite ocean observations for ocean prediction purposes in optimizing assimilation methods, and so draw synergistic benefits from the observation combinations for user benefit. The project aims at redesigning the ocean observation network in a more integrated format so that observation data can be used more efficiently.

The presentation on the "ForeSea programme" by Eric Chassignet can be viewed on the OceanPredict website.

3.2 CoastPredict

By Villy Kourafalou

CoastPredict is a partner programme of ForeSea under the UN Decade and is concerned with "Observing and Predicting the Global Coast Ocean". The programme aims to

- Revolutionise Global Coastal Ocean observing and forecasting
- Co-design the needed infrastructure
- Offer open and free access to coastal information

The transformative aspect of CoastPredict is the

- Redefinition of the concept of the Coastal Global Ocean
- Innovative multidisciplinary observational technologies and fit for purpose observing system in the Global Coastal Ocean
- Innovative numerical modelling, data assimilation and data science tools (including Coastal Earth System Modelling)
- Coastal solutions/services
- A virtual information/digital infrastructure
- A new Global Coastal Ocean Network

OceanPredict, through the COSS-TT, is an important collaborator of CoastPredict, while CoastPredict will add value to ForeSea solutions and products by extending to inland waters and urban coastal environments. ForeSea will benefit from the CoastPredict network that includes island nations and under-resourced coastal nations. CoastPredict and ForeSea will co-develop frameworks needed to solidify the Operational Oceanography value chain in both coastal and basin/global settings.

The presentation on the "CoastPredict programme" by Villy Kourafalou can be viewed on the OceanPredict website.

3.3 DITTO

by Martin Visbeck (GEOMAR)

The DITTO programme is, as ForeSea and CoastPredict, interested in furthering the integration of observations, data systems and knowledge to empower decision making for the benefit of society, and to allow actors within this field of science and marine services to work together.

Digital twins are fine-grained virtualizations of physical objects and systems which have been widely applied in the engineering realm for tasks such as engine optimization and port management. As a concept, digital twinning is gaining momentum in Earth and Ocean science, particularly as a way to intuitively bundle and provide easy access to marine data, models, and simulations. A well-constructed digital twin of the ocean will enable a wider range of users to interact with digital assets to explore current and future scenarios, especially related to human interactions with the ocean.

While the ocean observation and information value-chain (operational oceanography) is looking towards describing the current and predicted ocean state, the Ocean Digital Twin concept is looking at what-if scenarios and is assessing intervention options.

The DITTO programme is planning to establish and advance a digital framework to explore ocean related development scenarios in collaboration with 40 international partners. Opportunities for DITTO – ForeSea & OceanPredict collaboration includes:

- Fully embrace the opportunities of the 'digital revolution' in shaping the future of the digital knowledge ecosystem to be collaborative, shared and equitable
- Establish a Digital Ocean community that is build on the momentum of the Ocean Decade, the Ocean Mission, The Digital Twin Earth actions, the G7 agreement and global, regional and national initiatives.
- Work together in a Community of Practice around ocean prediction (Decade Outcome).

The presentation on the "Digital Twins of the ocean (DITTO)" by Martin Visbeck (GEOMAR) can be viewed on the OceanPredict website.

3.4 UN programme discussion

A digital platform (ideally cloud-based), a so-called data lake, is a core element of the Digital Twin approach and would bring together observation data, model data, existing scenarios, etc. For both ForeSea and DITTO using the "data lake" is useful from a technical perspective. MV proposed to synchronise building the ForeSea and DITTO implementation plans together, to benefit from each other's expertise and vision, and bring about commonalities.

In the first year DITTO is planning to explore existing digital twin ocean constructs (ESRI or Fugro) to help optimise them in bringing them together with the environmental twins. In the longer-term DITTO will enable a community ocean model with plug & play modules to build a modular system to allow easy access to ocean products for users. MV highlighted the aspect of learning from the engineering twins while developing DITTO and the digital twin environment, including organising training, and growing partnerships with industry.

Programmes will be organised through projects, and it was still unclear at the time of the meeting how projects supporting the Decade action are being identified or initiated. There is going to be a process the UN Decade will oversee where project can be proposed, but there is also the option to self-organise projects. It was argued that Decade calls for projects can provide their endorsement which could allow an easier path to acquire project funding.

UN Decade programmes are unlikely to have physical infrastructures (buildings), however, CoastPredict (for example) will support coordination and communication for its programmes through an office located at Bologna (with funding from CMCC). It was understood that funding of UN Decade programmes will be a challenge and approaches should be made for specific applications, rather than as a blanket request for support.

OPST4-4:	**ForeSea SC** to arrange setting up a ECOP group within ForeSea (Audrey Hasson (GBP) could provide information on an ECOP meeting should was taking part in).
OPST4-5:	**ForeSea SC** to develop ForeSea implementation in collaboration with associated UN Decade programmers, e.g. DITTO, CoastPredict, and ObsCoDe.

OPST4-6:	**ForeSea SC** to develop the UN Decade **project** identification, acceptance, funding and endorsement process with the help of UN Decade and programme partners

4. OP communication

Presented by PN Vinayachandran and Kirsten Wilmer-Becker

OceanPredict, through its new strategy and the involvement with the UN Decade (ForeSea programme), has identified increased interactions and demand for collaborations with a growing number of partners. This demands an elaborate response in the form of improved communication and higher visibility. OP has therefore set up a communication committee (7 members) to address demands for increased interactions with partners and to develop communication processes to deliver high-quality, consistent and relevant communication internally and externally.

A communication plan is being developed and will be implemented in the next months. It is hoped that it will

- improve knowledge of OP / ForeSea activities in the community
- improve opportunities for engaging in ongoing/new activities with partners
- increase OP recognition as a global player in shaping the operational oceanography of the future
- strengthen engagement and integration with partners, e.g. UN Decade

OP will need to find ways of resourcing the new communication plan, on one hand through practical help from OPST members *(through supporting newsletter article, submitting publication information or contributing to webinars)* and on the other hand through financial or managerial support from partners and sponsors.

It was decided that the communication committee will initially also support the ForeSea communication, while OP prepares the UN Decade programme for implementation with partners. It is hoped that national system communication teams will be able to contribute to this effort.

One step of improving OP's external communication with partners are regularly meetings of the OP programme coordinator with the G7/FSOI and GEO Blue Planet offices which have been set up recently to align efforts and activities.

Use of the UN Decade communities of practice on communication should also be adopted, to improve collaboration and to making targeted plans for communication.

The presentations "OP communication 1"and "OP communication 2" by PN Vinayachandran and Kirsten Wilmer-Becker can be viewed on the OceanPredict website.

4.1 Communication discussion / agreements

It was highlighted by ES (GEO Blue Planet) and other contributors that a lot of information is currently being circulated about the UN Decade and associated activities and partners, and that this is increasingly leading to information fatigue. It was proposed to coordinate information flows from/with UN programme partners more effectively, so that information can be targeted better, and the time and effort it takes to produce it is reduced.

For better coordination within OceanPredict, it was agreed that the OP communication committee will also (for the time being) cover the communication effort of ForeSea. However, as ForeSea is evolving the arrangements might be updated. In future, ForeSea

- should involve external partners as the communication committee evolves
- Steering Committee should link with the OPST on questions of communication
- should set up ToR on governance
- should collaborate with partners on a common communication strategy (to not duplicate comms, provide consistent output,..)
- should include SynObs and other projects in its communication scope

Proposals for ForeSea to

- Link with YOPP to support the YOPP summit 2022, and provide a link into the national systems/ associated projects
- Map out the UN Decade programme linkages, aims, overlaps, etc. to explain how the programmes fit together

OPST4-7:	The **OP communication committee** to extend its scope to also develop the **ForeSea communication** plan including covering projects.

For the OP communication committee to achieve this action, it should

- seek guidance from OP co-chairs and ForeSea steering committee
- seek help from OP national centres on various OP communication requirements
- extend the committee membership to programme partner groups (when required)
- should develop regular OP / ForeSea webinars, newsletters and publication collection for the website
- should consider contributing to the final YOPP summit in 2022
- should update ToR for the OP/ForeSea communication, also with regard to interactions with partners

4.2 Geo Blue Planet

By Audrey Hasson (GEO Blue Planet – EU Action Coordinator at Mercator Ocean International)

The Blue Planet Initiative is concerned with the sustained development and use of ocean and coastal observations for the benefit of society, specifically by

- processing of observation data into information
- linking this information with societal needs in line with the GEO engagement priorities

GEO Blue Planet is the ocean and coastal branch of GEO and includes social scientists and ocean scientists as well as end user stakeholders. It aims at supporting the GEO engagement priorities, which are represented through the UN sustainable development goals, Paris Climate agreement and Disaster Risk reduction. The main drive is to strengthen links with stakeholders through knowledge hubs (example is the Sargassum Working Group hub) and provision of decision-making tools. This effort is supported practically by 7 working groups doing core actions, including developing

indicators, supporting best practices, indicator development to advise and bridge the gap with stakeholders.

One example of GEO BP activity is the Marine Litter Working Group of which Eric Chassignet is a member. The group has produced a Marine Litter Monitoring and Best Practices white paper to feed the building up of the GPML Digital Platform and is co-organising best Practices Workshops and other events.

The new ToR and implementation plan for GEO Blue Planet will be published in autumn 2021.

The presentation on the "GEO Blue Planet" by Audrey Hasson (GEO Blue Planet, Mercator Ocean international) can be viewed on the OceanPredict website.

4.3 G7/FSOI

By Maria Hood (G7 Future of the Seas & Oceans Initiative – EU Action Coordinator at Mercator Ocean International)

The G7 Future of the Seas & Oceans Initiative in Europe is part of the EU4OceanObs, which is an international ocean governance project to strengthen international ocean governance the collection, sharing and use of ocean data to address environmental and societal challenges. This is achieved through two pillar programmes, the G7/FSOI and the GEO Blue Planet, whose offices are based at Mercator Ocean international. Last year OceanPredict programme office joined the collaboration effort to support the critical link from in-situ observations and use of data to satellite data, DA and modelling and forecasting.

In 2016, the G7 approved five action areas mostly focused on improving the in-situ observing system, by working closely with GOOS on developing, enhancing and working towards a sustained ocean observing system, but also by improving the information for assessments and reporting, promoting the improvement of global data sharing infrastructure, improving regional observing capacity and promoting G7 political cooperation on ocean issues.

The G7 FSOI working group will meet end of June 2021, to consider joint priorities and activities in each of these action areas. In May 2021, the G7 Ocean Navigation Plan for the Decade was adopted which marks the beginning of the G7's commitment to, and support for, the UN Decade. MH highlighted two pending spotlight activities (for which scoping documents have been developed) that have the closest link with OceanPredict:

- Digital Twin Ocean capability to bring together G7 digital twin ocean initiatives including their relationship with the wider digital earth initiatives, and sharing best practices
- Augmented Observing and Forecasting Capacity for Marine Life *(project pending)*
- Observing System Evaluation framework *(project pending)*

The presentation on the "G7/FSOI" by Maria Hood (G7/GOOS, Mercator Ocean international) can be viewed on the OceanPredict website.

5. OP Task Teams – latest progress and UN Decade involvement

All OP tasks teams presented on their latest progress with regard to communication, community interaction, future plans, and specifically in view of supporting the UN Decade.

The tables in ***Appendix C*** reflect the results of a survey all TT co-chairs contributed to and were presented at the meeting. The survey information was collected from the TTs on the following topics:

Task Team communication

- Information about TT products/knowledge/advances (data, reports, events, etc.)
- Use of communication of TT products to science community, to operational systems, public, ..
- Suggestions to how increase the information and communication flow on TT and OP advances

Community interaction

- Users of TT outputs
- TT collaborating groups

Task Team future plans

- Existing knowledge/expertise gaps in knowledge/expertise from your TT perspective
- 3-5 year challenges for the TT
- Long-term outlook for TT field of expertise (10 years)
- Possible benefits form the UN Decade
- Engagement with SynObs and/or CoastPredict

Appendix C provides details.

5.1 Task Team discussions

The subsequent task team discussion highlighted the most pressing issues and future plans of the TTs:

COSS-TT

- is working closely with the ET-OOFS on the provision of coastal system information for the ET-OOFS guide
- consideration to work interdisciplinary with Hydrology, e.g. by collaborating with hydrologists on real-time estimates of river runoff for the global coastal ocean;
- computer science regards machine learning and AI *(see also chat day 2; COSS-TT part)*
- plan to write a strategy note for the COSS-TT later in the year (revision of ToR and scientific objectives)

- plan for the next COSS-TT meeting in April 2022 as a F2F event, revisiting membership and considering inviting new members from new areas (e.g. hydrology)

IV-TT

- requirement to transfer some of the IV-TT activities to operational systems including covering ensembles
- issues finding resources, personnel, and computer space for the intercomparison and validation effort of IV-TT. This is a technical rather than scientific issue. Monitoring and intercomparison efforts can only be sustained with the help of operational centres. Suggestion that the operational centres fund a person with tech background to run class-4 intercomparisons and that new joiners should put such a configuration in place before joining IV-TT. Could be tied into the operational contract at the centres.
- CMCC requested information about IV-TT/class-4 info online
- Greg proposed to look at the best effort example of displaying class 4 files, by clicking on the dots on the map to open the profile plots of the various systems with Class4: https://navigator.oceansdata.ca/public/?query=%7B%22center%22%3A%5B%22-33.7109%22%2C%2251.0536%22%5D%2C%22dataset%22%3A%22giops_day%22%2C%22depth%22%3A0%2C%22projection%22%3A%22EPSG%3A3857%22%2C%22time%22%3A2255860800%2C%22variable%22%3A%22votemper%22%2C%22vectorid%22%3A%22class4_20210601_GIOPS_CONCEPTS_3.0_profile%22%2C%22vectortype%22%3A%22class4%22%2C%22zoom%22%3A4%7D (see also *chat day 2; IV-TT part*)

MEAP-TT

- keen to collaborate with CP-TT and COSS-TT, but no concrete plans in place yet
- consideration to support DITTO collaboration wrt to verification; verification of BGC variables very relevant
- SynObs would welcome contributions from MEAP-TT since there are few BGC specialists in OSEval TT, and to seek synergy between satellite ocean colour and in-situ observations *(proposed paper: Skákala, J., Ford, D., Bruggeman, J., Hull, T., Kaiser, J., King, R.R., Loveday, B., Palmer, M.R., Smyth, T., Williams, C.A. and Ciavatta, S., 2021. Towards a multi-platform assimilative system for North Sea biogeochemistry. Journal of Geophysical Research: Oceans, 126(4), p.e2020JC016649*
- MEAP-TT would be pleased to strengthen interaction with IV-TT (specifically for chlorophyll and carbon)

DA-TT

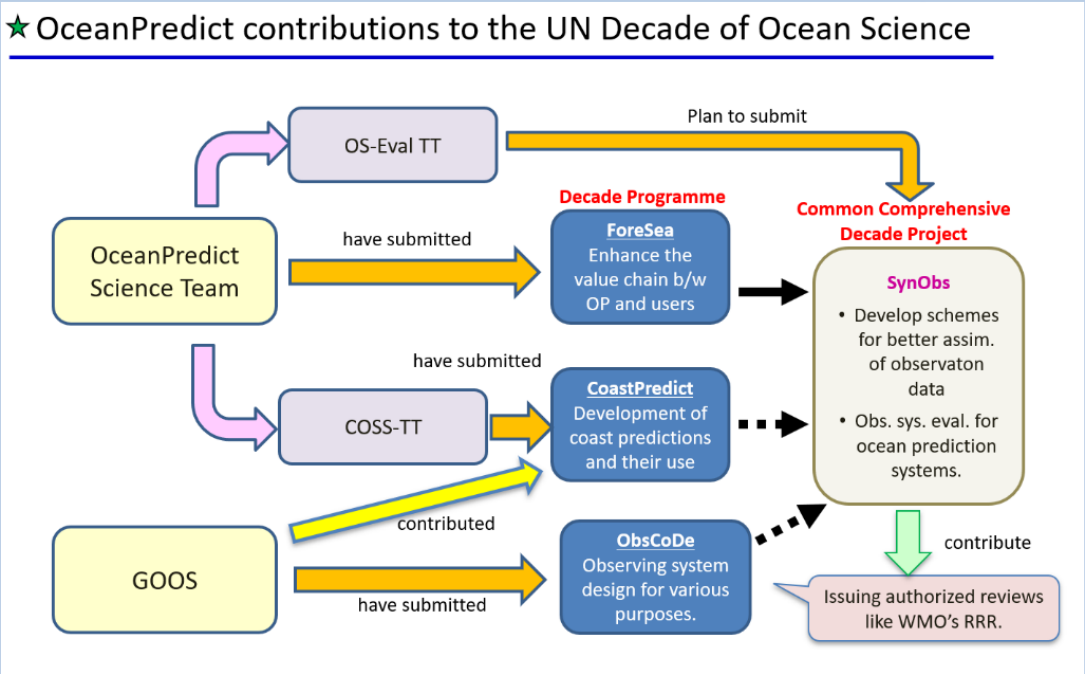
- regular DA-TT online seminars/webinars planned
- Hendrik confirms that building the DA for all components in the same infrastructure is a massive step forward (JEDI) for a strongly coupled system
- Matt would like to use existing infrastructures (NOAA) to help show the benefit and what investment is justified.
- Andy highlighted that it is still early days for JEDI and ocean DA, so unsure whether DA-TT should take that stance yet. It is a LOT of technical effort to get a model into JEDI, so it is a significant investment of resources for any group.

CP-TT

- currently in the process of reorganisation
- in a recent meeting it was agreed to seek two 'interim' co-chairs to revisit and re-define the task team scope and community building.
- Santha Akella and Kristian Mogensen have agreed to be part of this activity.
- given "coupled" interests of both DA-TT (coupled DA) and COSS-TT (regional coupled systems) future TT may well have more of a global/large-scale coupled modelling focus and will ideally involve others outside the existing OceanPredict community. A consultation and engagement with OPST members over next few months is planned.
- Yosuke suggests increasing collaboration with the CP-TT, also in support of the OS-Eval TT involvement in the WMO Earth system observation impact studies.
- CP-TT should interact with groups already involved in coupled prediction like WGNE and identify its niche in respect of those groups.
- UN Decade involvement: CP-TT should consider providing coherent information to users using coupled prediction outcomes (currents and winds); consider role of CP-TT in producing forecast products (value added of CP). Coupled prediction is highly relevant to the focus on Arctic prediction, particularly given the increasingly ice-free variability. Also, ocean-wave coupling very relevant.

OS-Eval TT

- At the time of the meeting the SynObs project is anticipating working with ForeSea, CoastPredict and ObsCoDe. A graphic showing connections and planned interactions is provided below.



- MEAP-TT can contribute to the SynObs goals directly via the H2020 SEAMLESS project: https://seamlessproject.org
- The planned symposium of the OS-Eval TT has been postponed to Nov 2022

6. OceanPredict working with ETOOFS

Presented by Pierre Bahurel and Enrique Alvarez Fanjul

6.1 ETOOFS: current activities

ETOOFS, the Expert Team for Operational Ocean Forecasting Systems, has moved from JCOMM, which was disbanded during the IOC & WMO restructuring process, to become a IOC/WMO component situated under GOOS. It is understood that ETOOFS now represents its ocean modelling and forecasting capacity. The role of ETOOFS is to create guidance, to improve capacity, quality and interoperability of ocean forecast systems and products. ETOOFS acitvities aim to:

- Manage and maintain documents and standards to foster OOFS efficiency and international intregration
- Promote and support initiatives to foster OOFS influence and capacity development

ETOOFS recent activities include:

- E-learning Workshop on Operational Ocean Monitoring and Forecasting Systems (Awareness: 14-16 June + Practical: 22-24 June)
- Development of the Guide to Operational Oceanography
- ETOOFS booklet (summary of the Guide)

The presentation on the "ETOOFS recent activities: connection with OceanPredict" by Pierre Bahurel and Enrique Alvarez Fanjul can be viewed on the OceanPredict website.

6.2 ETOOFS and OceanPredict

OceanPredict is understood as a comprehensive network to develop cutting-edge science & technology for ocean forecasting, to run experiments, to identify best practices *with the goal to improve the overall quality of OOF systems.* ETOOFS is a body to document operational standards and best practices and support their adoption through capacity building, *with the goal to improve the OOFS capacity worldwide.* ETOOFS needs OceanPredict to ensure proper scientific and technical content and innovation, and can help OceanPredict to reach out through the formal decision frameworks of IOC, WMO & other bodies to connect with intermediate users.

In 2021, the focus will be on (a) Finishing the Guide to Operational Oceanography, (b) Building a community of emerging players in numerical modelling and (c) Defining a long-term strategy, including connection with OceanPredict, GEO Blue Planet and the UN Ocean Decade.

There is consideration to develop a quality label for OOFS to promote best practices when implementing and operating OOFS. This would need to be prepared in coordination with leading scientists from OceanPredict and should also involve the support from the IV-TT.

Joint activities of OceanPredict and ETOFFS could include:

- Co-building and informing (with other partners) an overarching ocean prediction framework (setting standards, best practices)
- Support from ETOOFS for OceanPredict when collaborating with UN Decade programmes to strengthen the OO value-chain

- Phased OP/ETOOFS approach for increasing ocean prediction capacity

The presentation on the "Ideas on ETOOFS future evolution" by Pierre Bahurel and Enrique Alvarez Fanjul can be viewed on the OceanPredict website.

6.3 ETOOFS – discussion

OPST4-8: **OceanPredict** to invite ETOOFS leads as members of the OPST

Fraser supports the point of co-building (with other partners) an overarching ocean prediction framework, setting standards, best practices, also with support from IV-TT through evaluation and validation of the performance of the systems. The framework should include the full operational aspects, from observations to service to users. Coordination of the implementation of the framework should be done through the OP operational centres. Many of the operational partners are representing coastal systems which is where the OP interface with CoastPredict will become important.

The guide will be an important tool for ETOOFS and OP to promote operational oceanography and allow emerging partners to build an operational system.

OPST4-9: **ForeSea/ OP** in collaboration with partners to map out the UN Decade programme linkages under the "A predicted Ocean" challenge

Mapping out the ETOOFS, OceanPredict and other partner's linkages will provide strengthening connection with the intermediate users (ocean production centre, etc.) and eventually end-users.

Questions/comments about the Guide to Operational Oceanography:

- initial conditions for the system will be provided in an individual, specific chapter
- ETOOFS link to intermediate users: GEO Blue Planet would be able to support the downstream connection working with ETOOFS and OP. Connections to users are fluid, outreach through training and through capacity development, learning of the motivation for operational oceanography and building systems/services
- Sea-ice currently not highlighted enough – should be more emphasized, NERSC would be happy to support this
- guide needs to be updated regularly to avoid out-dated information
- guide index to be improved to include ice forecasting

OPST4-10: **Fraser** to set up regular interaction between OP (ForeSea) and ETOOFS addressing:

- Support co-design of OO framework
- Develop plans for close collaboration btw ETOOFS and ForeSea
- Develop a prospectus/presentation highlighting OP/ETOOFS role in UNDOS to be given at IOC-WMO-JCB level
- Consideration of engage WMO-IOC to set up OO framework
- Plan to involve IV-TT and ETOOFS in discussion of guide/best proactive for the OO framework

7. OP system reports

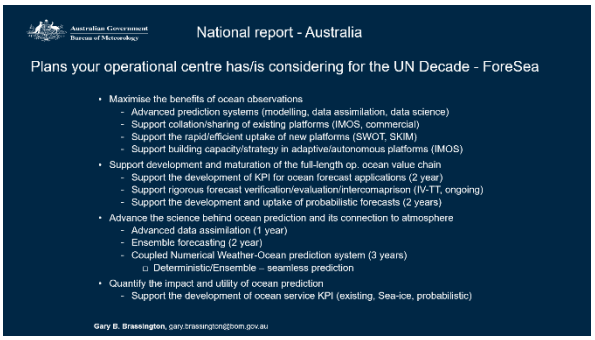
Presented by various operational system representatives

In preparation of the meeting all national representatives from OP operational systems were invited to submit a summary slide to present their plans for the UN Decade as well as critical system updates. *Clicking on the images opens the slide(s) as pdf.*

- **Australia (BlueLink)** - *presented by Gary Brassington (BoM)*

Plans operational centre has/is considering for the UN Decade – ForeSea

- Maximize the benefits of ocean observations
- Support development and maturation of the full-length op. ocean value chain
- Advance the science behind ocean prediction and its connection to atmosphere
- Quantify the impact and utility of ocean prediction



Critical updates related to the operational system/activities of relevance to the Decade

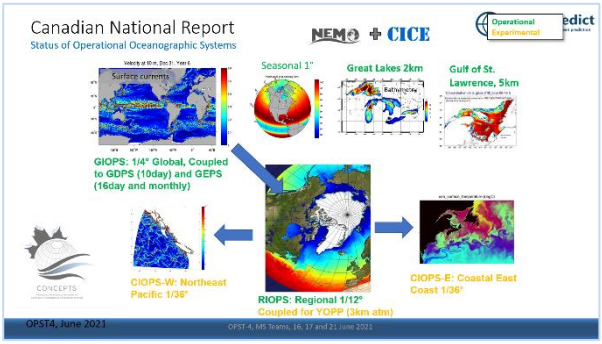
- Multi-scale data assimilation (BRAN2020 and OceanMAPSv3.4)
- Ocean current verification
- Blue Maps
- Plan to work with of the UN Decade programmes

- **Brazil (REMO) – Clemente Tanajura (UFBA)** - *presented by Clemente Tanajura (UFBA)*

The initiative related to the UN Decade in Brazil in guided by the Ministry of Science, Technology and Innovations (MCTI). The ministry has organised several regional workshops, not only involving the science communities but also other groups (e.g. surfer associations, fishery communities, etc.) to explore the demands and gaps that need to be fulfilled to achieve better infrastructure and research. This has resulted in drafting a strategy plan which focusses on disseminating the importance of the ocean to Brazil development in a national and global context.

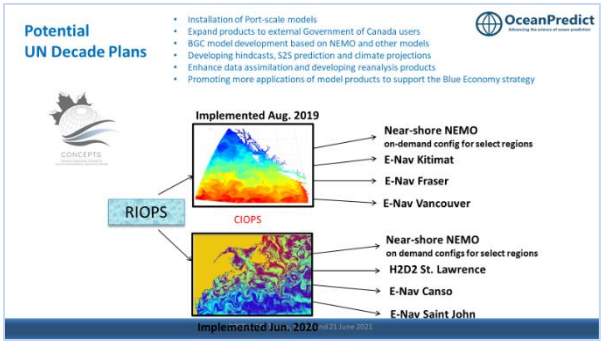
- **Canada (CONCEPTS)** – *presented by Greg Smith (ECCC)*

CONCEPTS systems and applications



- two full analysis systems
- global system feeds the operational atmosphere/ice/ocean medium range and monthly coupled forecast (also up-scaled for seasonal operational forecasting
- feeds a regional system (coasts and in-land) with various configurations
- significant expansions for waves and storm surge covering global, regional, ensembles
- applications focusing on sea-ice, but also DFO, S&R, defence, storm surge, etc.

Potential UN Decade plans



- Installation of Port-scale models
- Expand products to external Government of Canada users
- BGC model development based on NEMO and other models
- Developing hindcasts, S2S prediction and climate projections
- Enhance data assimilation and developing reanalysis products
- Promoting more applications of model products to support the Blue Economy strategy

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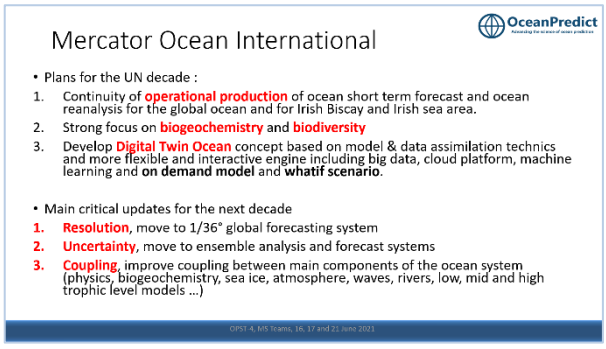
- **France (Mercator Ocean international)** – *presented by Elisabeth Remy/ Yann Drillet (MOi)*

UN Decade plans



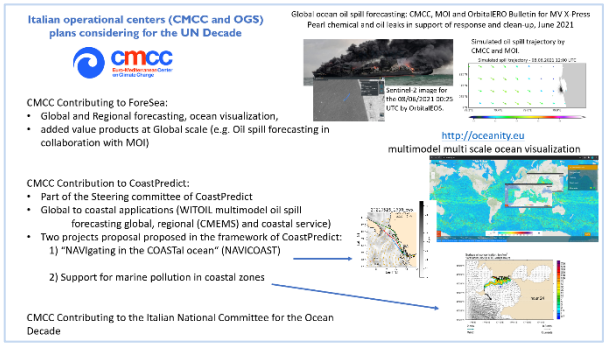
- Continuity of operational production ocean short term forecast and ocean reanalysis for the global ocean and for Irish Biscay and Irish sea area.
- Strong focus on biogeochemistry and biodiversity
- Develop Digital Twin Ocean concept based on model & data assimilation technics and more flexible and interactive engine including big data, cloud platform, machine learning and on demand model and what-if scenario.

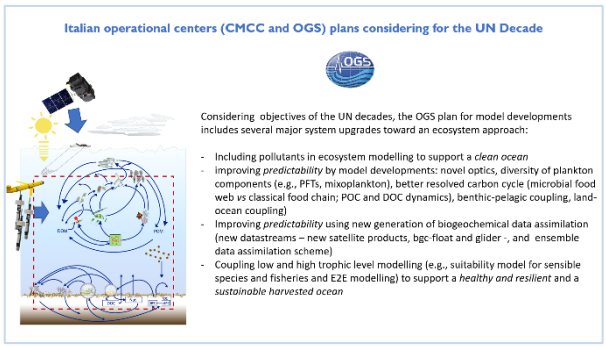
Critical system updates

- Resolution, move to 1/36° global forecasting system
- Uncertainty, move to ensemble analysis and forecast systems
- Coupling, improve coupling between main components of the ocean system (physics, biogeochemistry, sea ice, atmosphere, waves, rivers, low, mid and high trophic level models …)

- **Italy (CMCC and OGS)** – *presented by Giovanni Coppini (CMCC)*

Critical updates at CMCC operational systems of relevance for the UN Decade





Italy will continue to improve the Mediterranean operational systems for the physical and biogeochemical components in the framework of the Copernicus Marine Service (CMEMS) within the Med-MFC consortium to support users, services and applications for societal activities in a sustainable way. The perspectives for the UN decade developments include several major system upgrades:

- a fully coupled physics-wave system
- improved representation of the vertical dynamics
- better representation of river inputs in the coastal areas
- ensemble forecasting achieved by perturbing the atmospheric forcing and the initial conditions
- development of an atmo-ocean-wave coupled system

Italy will also continue to improve the Global Ocean Forecast System at 1/16◦ GOFS16 http://gofs.cmcc.it/ including:

- a new atmospheric forcing
- tidal components
- assimilation of sea ice concentration and sea ice thickness
- improved validation tool

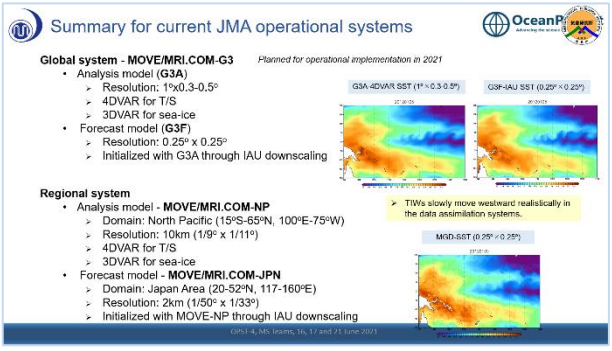
Italian operational centers (CMCC and OGS) plans considering for the UN Decade (for more info please click on slides)

- **Japan (JMA Ocean Prediction System Japan)** – *presented by Goro Yamanaka (MRI-JMA)*

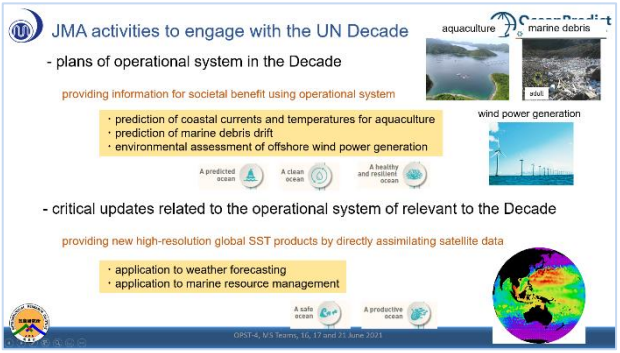
- global system / seasonal prediction
- regional system/ coastal prediction

JMA planned UN Decade activities

- operational system are planned to provide informtion for societal benefit in various areas, including:



- prediction of coastal currents and temperature for aquaculture
- prediction of marine debris drift
- environmental assess of offshore wind power generation



Critical updates

- to provide new high-res global SST prodcuts through assimilation of satellite data, supporting applications in weather forcasting and marine resource management

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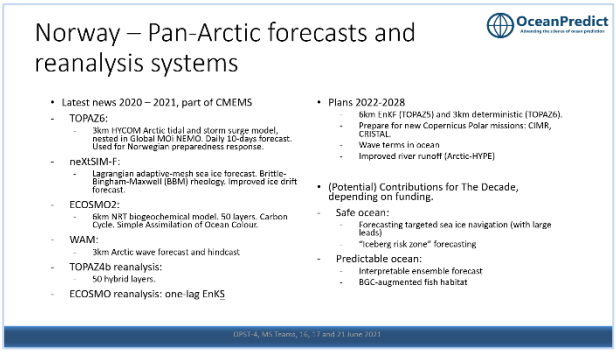
- **Norway (TOPAZ)** – *presented by Johnny Johannessen / Laurent Bertino (NERSC)*

System updates

- Topaz 3 km, coupled with sea-ice model (neXtSIM-F) provides promising results
- Ecosystem model 6km, coupled to HYCOM ocean model,
- TOPAZ6 coupled to wave model for the arctic
- Plans for 2022-28:
  3kn deterministic TOPAZ6, prepare for CIMR and CRISTAL (polar Copernicus mission), wave terms and improve river runoff

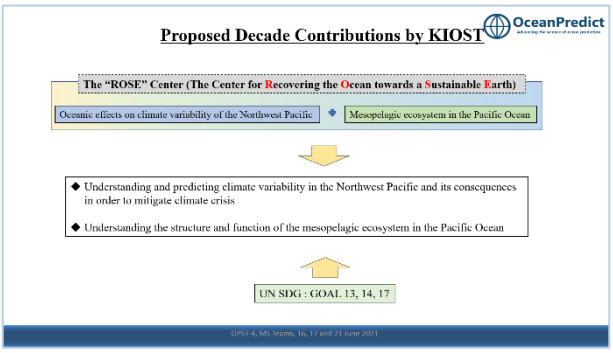


Potential contributions to the Decade

- Working in support of the "Safe Ocean" and "A Predicted Ocean"

- **South Korea (KHOA+ KIOST system)** – *presented by Do-Seong Byun (KHOA)*

- In support of the UN Decade KIOST is planning to set up the "Center for **R**ecovering the **O**cean towards a **S**ustainable **E**arth (ROSE Center)
- It is looking at Oceanic effects on climate variability of the Northwest Pacific combined with Mesopelagic ecosystem in the Pacific Ocean to
  - Understanding and predicting climate variability in the Northwest Pacific and its consequences in order to mitigate climate crisis
  - Understanding the structure and function of the mesopelagic ecosystem in the Pacific Ocean

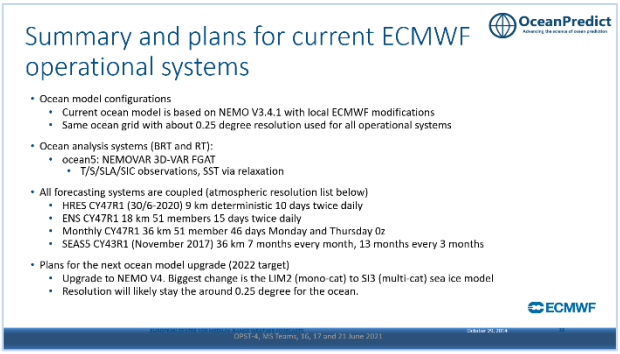


- This will support the UN Sustainable Development Goals 13, 14 and 17

- **UK/Europe (ECMWF operational systems)** – *presented by Kristian Mogensen (ECMWF)*

Ocean model configurations

- Current ocean model is based on NEMO V3.4.1 with local ECMWF modifications
- Same ocean grid with about 0.25 degree resolution used for all operational systems



Ocean analysis systems (BRT and RT)

- ocean5: NEMOVAR 3D-VAR FGAT
- T/S/SLA/SIC observations, SST via relaxation

All forecasting systems are coupled (atmospheric resolution list below)

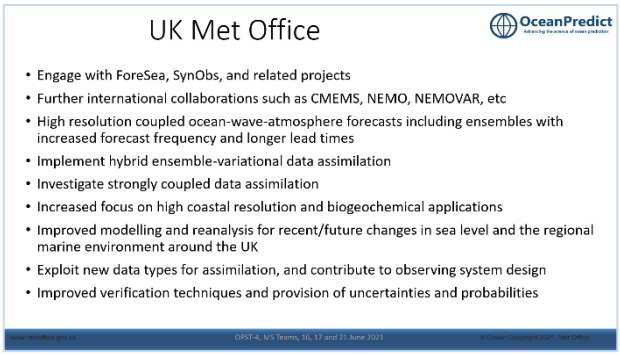
- HRES CY47R1 (30/6-2020) 9 km deterministic 10 days twice daily
- ENS CY47R1 18 km 51 members 15 days twice daily
- Monthly CY47R1 36 km 51 member 46 days Monday and Thursday 0z
- SEAS5 CY43R1 (November 2017) 36 km 7 months every month, 13 months every 3 months

Plans for the next ocean model upgrade (2022 target)

- Upgrade to NEMO V4. Biggest change is the LIM2 (mono-cat) to SI3 (multi-cat) sea ice model
- Resolution will likely stay the around 0.25 degree for the ocean.

- **UK (FOAM)** – *presented by David Ford (Met Office)*

- Engage with ForeSea, SynObs, and related projects
- Further international collaborations such as CMEMS, NEMO, NEMOVAR, etc
- High resolution coupled ocean-wave-atmosphere forecasts including ensembles with increased forecast frequency and longer lead times
- Implement hybrid ensemble-variational data assimilation



- Investigate strongly coupled data assimilation
- Increased focus on high coastal resolution and biogeochemical applications
- Improved modelling and reanalysis for recent/future changes in sea level and the regional marine environment around the UK
- Exploit new data types for assimilation, and contribute to observing system design
- Improved verification techniques and provision of uncertainties and probabilities

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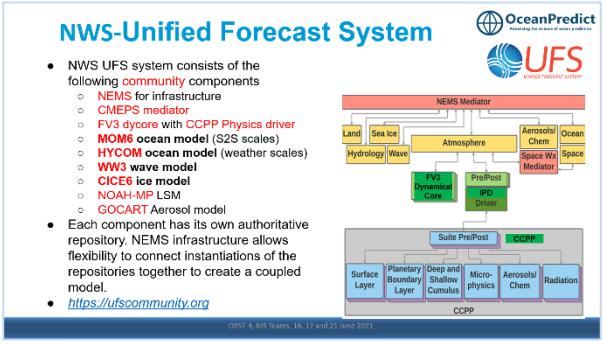
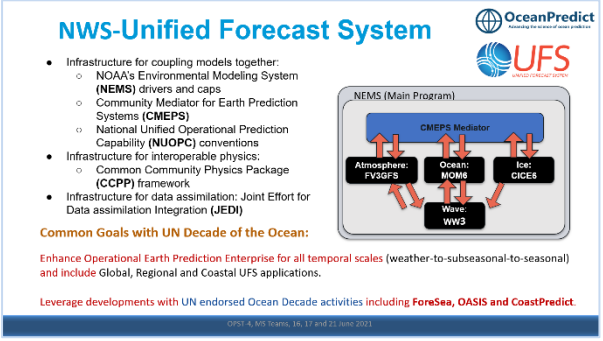
- **USA (NOAA/NCEP) –** *presented by Avichal Mehra (NOAA)*

NCEP is building a new system called UFS: Unified Forecast System, using two models MOM6 and HYCOM with various components with their own authoritative repositories.

The common goals within the UN Decade

- Enhance operational earth prediction enterprise for all temporal scales and include global, regional and coastal UFS applications
- Leverage development with the UN endorsed Decade activities including ForeSea, OASIS and CoastPredict





- **USA – UN Decade ocean-shot for OceanPredict.US** – *presented by Eric Bayler (NOAA)* submitted to the U.S. National Committee for the UN Ocean Decade

All national groups presentations slides can be viewed on the OceanPredict website.

8. UN Decade and ForeSea

8.1 ForeSea organisation and implementation

Discussion

OP plans to set up a ForeSea steering committee (and a ForeSea Advisory committee). Members of the steering committee will initially be recruited from OceanPredict, but in the longer term, members from partner programmes and external organisations will be invited. ForeSea could consider setting up a new task team within OceanPredict to start designing the framework approach, by identifying partners and start communicating with the IOC-WMO-JCB on elements of the framework. This would include solidify operations of ocean verification and support for SynObs.

OPST4-11: **Eric C** to organise the setting-up of a "**ForeSea Steering Committee"** by mid Aug.

Collaboration with UN Decade programme partners might be helped by putting together a prospectus for ForeSea in the form of a brief document or presentation of all relevant UN Decade programmes, and to get feedback on this from other programme and contributing groups.

The UN Decade is looking for a long-term legacy, which means that the full value chain for OO needs to be long-term sustainable. Therefore, ForeSea will run for the whole decade and beyond. Within this time, ForeSea will evolve to work closely or even merge with other programmes.

8.2 UN Decade Laboratories

- *The Ocean Decade Laboratories are a creative, interactive platform to support action for the Ocean Decade around the globe.*
- *They are a virtual catalyst of action for the Ocean Decade.*
    - *Catalyse action for the ocean decade*
    - *Showcase Ocean Decade Actions*
    - *Strengthen dialogue*
    - *Communication and outreach*
- *Microsoft Word - 20210415_CallforOnlineSessions2021_Guidelines.docx (oceandecade-conference.com)*
- *An Inspiring and Engaging Ocean - UN Decade Kampagne (oceandecade-conference.com)*

In the upcoming UN Laboratory "A Predicted Ocean" three key newly endorsed Decade Programmes will be showcased, as well as the clear connections and collaboration between these programmes and entities which will be key to fulfilling the Decade's vision. This will be organised in the form of a satellite activity (among others) and provide an introduction and opportunity to receive feedback on the GOOS UN Decade Programme's ***Ocean Observing Co-Design and CoastPredict, and OceanPredict's ForeSea Programme****. These programmes are already aligned with the Decade and through partnership and co-projects represent a cornerstone of collaborative action for the Decade.*

The UN laboratories provide the opportunity for an extended launch of the UN Decade, which had to be curtailed in early June due to Covid. This means we will see a number of smaller events, called laboratories to happen over the next year, which feature various satellite activities including representation from ForeSea and its partner programmes. The laboratory relevant for CoastPredict, ObsCoDe, ForeSea and partners is "A Predicted Ocean" which takes place on the 15-17 Sep 2021. The main objective is to raise awareness, receive feedback and to show the close relationship between observations and predictions. It will help to inform the programme planning, provide an opportunity to learn about other initiate, and should inform and attract investors.

OPST4-12:	**Vinay, Villy and Fraser** to prepare the contribution to the UN Laboratory on "A Predicted Ocean" in Sep 2021 representing ForeSea and partner programmes.

8.3 UN Decade projects

Projects will be important components of the UN decade programmes and will define the framework needed to solidify the overall operational oceanography value chain. It is understood that projects can be identified/initiated by the programmes and but that programmes can also use UN Decade calls to action to find fitting projects. It is not yet clear how the process for endorsing and funding projects will work. More interaction with the UN Decade is needed to understand the process. For the newly formed ForeSea Steering Committee (when created) the next steps include answering a number of questions:

- What projects would fit under ForeSea to support its strategy, objectives and expected outcomes (long-term view) – soliciting project that fit?
- What type of project coordination can be expected from ForeSea?
- Over the Decade, what is the timeline for making calls for projects?
- Ideally, project should come with a plan for resources, but if not how will projects be funded?

ForeSea will have to define a "project" under UN Decade, and should provide a vision for project planning, areas of interest and approval processes. Before accepting projects, funding opportunities should be explored. Taking SynObs as an example, interested agencies (e.g. obs/space) could be contacted for funding options.

Projects can be proposed by national centres and other group but would ideally include cross-national collaboration. Projects should meet ForeSea goals i.e., co-designing and strengthening the value-chain or advancing ocean predictions science, as well as consider the operationalisation of project outcomes.

ForeSea projects could be set up spontaneously or could be proposed by the UN Decade (through their calls for action). SynObs has already been confirmed as a ForeSea project, but coordination for SynObs is still to be determined.

8.3.1 SynObs

It is understood that SynObs has been officially endorsed (by the Decade) with the endorsement of ForeSea. ForeSea will build the *ecosystem* in which SynObs will contribute and there could be other

projects that could be linked to SynObs, and also enable partnerships across the different programmes. We have to make sure that SynObs can fully leverage opportunities available in the Decade. ForeSea should uplift outcomes from SynObs and make them available to other programmes.

ForeSea will act like a catalyst for joining projects together and making sure project outcomes are moved forward and implemented so to adjust the framework of OO in a sustained way. Benefit of SynObs being part of ForeSea is that SynObs will bring the technological expertise on top of the science knowledge, and ForeSea will make sure that this will become part of an overall framework. Additional comments:

- ForeSea will need help to support communication with partners, and UN Decade, ETOOFS, etc,
- Setting up joint experiments may require funding above what is done at operational centres
- SynObs is now planning to include BCG, coastal and other areas, becoming very broad, and will therefore need help from all task teams to run experiments
- SynObs representation online is needed; OS-Eval TT co-chairs are planning to discuss how to link SynObs into the OP website
- OS-Eval TT would like to discuss the SynObs activities with the other OP TTs

OPST4-13: **OS-Eval TT co-chairs** to organise web meeting with all other TT co-chairs in order to discuss ways to support and manage activities of SynObs.

Appendices

Appendix A: Attendance list (collated from all 4 meeting days)

Co-chairs (3):	Eric Chassignet, FSU, USA	(EC)
	Fraser Davidson, DFO, Canada	(FD)
	PN Vinayachandran	(PNV)
OPST members (30):	Laurent Bertino, NERSC, Norway	(LB)
	Gary Brassington, BoM, Australia	(GB)
	Do-Seong Byun, KHOA, South Korea	(DSB)
	Abhisek Chatterjee, INCOIS, India	(AC)
	Stefano Ciavatta, PML, UK	(SC)
	Giovanni Coppini, CMCC, Italy	(CC)
	Pierre De Mey-Frémaux, CNRS/LEGOS, France	(PDM)
	Yann Drillet, Mercator Ocean international, France	(YD)
	David Ford, Met Office, UK	(DF)
	Yosuke Fujii, MRI/JMA, Japan	(YF)
	Chris Harris, Met Office, UK	(CH)
	Patrick Heimbach, MIT, USA	(PHE)
	Fabrice Hernandez, Mercator Ocean, France	(FH)
	Pat Hogan, NRL, USA	(PHO)
	Villy Kourafalou, University of Miami, USA	(VK)
	Guimei Liu, NMEFC, China	(GL)
	Simona Masina, CMCC, Italy	(SM)
	Matt Martin, Met Office, UK	(MM)
	Avichal Mehra, NOAA, USA	(AM)
	Kristian Mogensen, ECMWF, UK	(KM)
	Andrew Moore, UCSC, USA	(AM)
	Arya Paul, INCOIS, India	(AP)
	Elisabeth Remy, Mercator Ocean, France	(ER)
	Hal Ritchie, ECCC, Canada	(HR)
	Andreas Schiller, CSIRO, Australia	(AS)
	Gregory Smith, ECCC, Canada	(GS)
	Clemente Tanajura, UFBA, Brazil	(CT)
	Kirsten Wilmer-Becker, Met Office, UK	(KWB)
	Goro Yamanaka, MRI-JMA, Japan	(GY)
	Xueming Zhu, NMEFC, China	(XZ)
OPAS members (10):	Pierre Bahurel, MIO	(PB)
	Eric Bayler, NOAA/NESDIS, USA	(EB)
	Yang-Ki Cho, Seoul National University	(YKC)
	Paul DiGiacomo, NOAA/NESDIS, USA	(PDG)
	Mikhail Entel, BoM, Australia	(ME)
	Isabelle Gaboury, DFO, Canada	(IG)
	Johnny Johannessen, NERSC, Norway	(JJ)

	Pierre-Yves Le Traon, MOi, France	(PYLT)
	Estelle Obligis, EUMETSAT, Germany	(EO)
	Hendrik Tolman, NOAA/NCEP, USA	(HT)
Guests (5):	Enrique Alvarez, Puertos del Estado	(EA)
	Audrey Hasson, MOi/GEO Blue Planet, France	(AH)
	Maria Hood, MOi/G7-FSOI	(MH)
	Emily Smail, Geo Blue Planet/NOAA, USA	(ES)
	Martin Visbeck, GEOMAR, Germany	(MV)

Total participation – 48 attendees over 4 days

Appendix B: Meeting agenda (days 1-4)

Meeting overview & topics

Topics	Specifics	Length	Day
Meeting objectives	Objectives and actions	5 min	Day 1
Strategy	Strategy endorsement	20 min	Day 1
ForeSea UN Decade / Clustering	Current status and plans	30 min	Day 1
OP communications	Current status and plans	30 min	Day 1
TT reporting	Current status and plans	90 min	Day 2
National group reporting	Current status and plans	35 min	Day 3
ET-OOFS discussion	Current status and plans	10 min	Day 3
OP future discussion	Current status and plans	45 min	Day 3
OP strategy endorsement	Updates and endorsement process	5 min	Day 4
Communication plans	Get feedback from OPST on Nat rep support, webinar idea, newsletter needs and publication contributions	25 min	Day 4
Working with ETOOFS	Latest plans	20 min	Day 4
Core discussion: UN Decade programmes and ForeSea integration	How OP/ForeSea is beginning to contribute to the Decade Should be led by questions identified by OPST and partners → to be confirmed	45 min	Day 4
Core discussion continued: ForeSea	Decisions on plans and actions	20 min	Day 4

Meeting dates & times

The meeting will take place on **three days: 16, 17, 21 June and 7 July** using 90 min/2 hour slots using MS Teams, starting at the same time every day.

Times are as:

West Coast US (PDT):	*6:00 am*
Washington DC (EST):	*9:00 am*
Montreal/Ottawa (EDT, Canada):	*9:00 am*
Brazil (BRT):	*10:00 am*
St John's (NDT, Canada):	*10:30 am*
UK (BST, Europe):	*14:00 pm*
Europe (CEST, continent):	*15:00 pm*
India (IST):	*18:30 pm*
China (Beijing):	*21:00 pm*
South Korea	*22:00 pm*
Japan (Tokyo):	*22:00 pm*
Australia (Sydney, Hobart, ..)	*23:00 pm*

Day 1 – Wednesday 16th June (MS Teams) – 90 min

Participants can join up to 15 min before the meeting. Chat is open to everyone and the meeting will be recorded.

Time	Description	Meeting chair and presenters	Shared material, comments
5 min	**Welcome and meeting objectives**	**Co-chairs**	**Meeting objectives** could be circulated before the meeting - tbc
10 min	**Intro to OceanPredict Strategy finalisation and endorsement** (to be completed on day 3 of meeting)	**Fraser Davidson**	**Latest strategy document** to be circulated before meeting.
40 min	**ForeSea / UN Decade Clustering approach** – brief UN Decade/ForeSea overview and talks by chairs of clustering UN Decade programmes	**Eric Chassignet** **Villy Kourafalou** **Martin Visbeck**	**Villy - ForeSea <> CoastPredict interconnect** **Martin Visbeck - DITTO[1] and ForeSea connections; engagement with OP**
30 min	**OP communications (15+5)** **(5 min→ G7/FSOI)** **(5 min → GEO Blue Planet)**	**Vinay / Kirsten** **Maria Hood** (G7/FSOI) **Audrey Hasson** (GBP)	**OP communication ToR**
5 min	**Adjourn / feedback next day's meeting**	**Co-Chairs**	

[1] DITTO: Digital Twins of the Ocean

Day 2 – Thursday 17th June (MS Teams) – 90 min

Participants can join up to 15 min before the meeting. Chat is open to everyone and the meeting will be recorded.

Time	Description	Meeting chair and presenters	Shared material, comments
90 min	OP TT reporting and plans including * ▪ COSS-TT ▪ IV-TT ▪ MEAP-TT ▪ DA-TT ▪ CP-TT ▪ OS-Eval TT	TT co-chairs	▪ What are the products/knowledge/advances generated by the TT? ▪ How are these advances communicated to the science community, to operational systems, to the public ..? ▪ What steps could be taken to increase the information and communication flow on TT and OP advances? ▪ Who uses TT output? ▪ What groups does the TT collaborate with? ▪ What gaps in knowledge/expertise that need to be filled from your TT perspective? ▪ What do you see as challenges for the TT for next 3-5 years? ▪ If available, what is the longer-term outlook in the TT field of expertise (next 10 years)? ▪ Where do you anticipate benefit in the Decade? ▪ How do you plan to engage with SynObs and CoastPredict?

* A power point template with the questions listed under comments is provided

Day 3 – Monday 21st June (MS Teams) – 90 min

Participants can join up to 15 min before the meeting. Chat is open to everyone and the meeting will be recorded.

Time	Description	Meeting chair and presenters	Shared material, comments
5 min	**Brief intro to day 3**	**Co-chairs**	Brief overview of outcomes and plans for the day
20 min	**ETOOFS -** **Guide and Capacity Building**	**Pierre Bahurel or Enrique Alvarez**	**ETOOFS Guide PDF link**
30 min	**National group updates – focus on plans to support the UN Decade and possible interaction with OP/TTs**	**National group representatives**	**Summary of national plans in the Decade + Critical updates from National centers** (if available) **(collated presentation, 1-2 slides per group)**
40 min	**Future plans and activities** ▪ Impact of discussion last 2 days ▪ Where are we going with OP? Questions / issues / concerns ▪ Actions for the next months	**Discussion:** **Co-chairs and all OPST**	
5 min	**Strategy endorsement**	**Fraser Davidson and all OPST**	Formal agreement /endorsement of the strategy to be signed off ready for publication
5 min	**AOB and meeting close**		Consideration to have next OPST meeting in Dec 2021 (~ 90 min slots on 3 days) AND OPST face-to-face (tentative) in 2022 (May-June)

Day 4 – Wednesday 7th June (MS Teams) – 2 hours

Time	Type	Description	Chairs/ presenters	Material
5 min	Presentation	**Meeting objectives**	Co-chairs	
5 min	Presentation	**OP strategy updates/revisions and endorsement** (process)	Fraser Davidson	▪ OP strategy doc (final version)[2]
25 min	Presentation (5 min) and discussion	**OP communications** (new comms ideas for OP and approaches to ForeSea communication issues)[3] **General OP communication** - Suggestion for additional comms (if it is wanted): → Webinars on topics relevant to OP and ForeSea (and partners) → Regular collection and online display of newest OP related publication → OP newsletter (internal and/or external) → Other? **ForeSea communication solutions?** - Will national system organisations be able to support OP/ and ForeSea through their comms teams (as asked in email) - How will ForeSea be initiated – event, announcements, website, etc?	PN Vinayachandran / Kirsten Wilmer-Becker	▪ Communication plan (latest)

[2] including having a weblink ready to collect strategy support/endorsement online
[3] including discussion of National Centre support for comms, webinar demands, willingness to provide publications on a monthly basis, and invite other ideas for comms

20 min	Presentation	**Working with ETOOFS** - What are the respective roles of ETOOFS and OceanPredict on the communication aspects with "intermediate users", stakeholders and capacity building which includes standards, requirements?	Enrique Alvarez/ Fraser Davidson	▪ Relevant ETOOFS doc(s)
45 min	Presentation/ intro (10 min) with questions and discussion	**UN Decade collaborations – How to make ForeSea work**[4] **UN Laboratories** - What are the UN Laboratories (in this case for the Predicted Ocean)[5] – and how can they improve the relationship btw GOOS and OceanPredict through CoastPredict and ForeSea? **UN Projects** - What UN projects could be initiated or identified by OP in support of ForeSea and/or to closing gaps with other programmes? - What is the schedule and methods of setting up UN Decade projects? - Who can propose / submit UN Decade projects (national centres, TTs,..)? - Can external groups propose a UN Decade project for ForeSea? - How many UN Decade projects will ForeSea need? - How will UN Decade projects be funded? **OP member/partner support for ForeSea**	Eric Chassignet	▪ ForeSea programme doc ▪ Programme docs of associated UN Decade programmes ▪ Laboratories docs/ links *(Predicted Ocean)*

[4] should be detailed by a set of questions (still to be confirmed), and should include a discussion about further ForeSea projects to be invited/initiated

[5] should introduce the beginning of ForeSea involvement in the Decade and how laboratories support collaboration

		- What kind of ForeSea contribution(s) is expected from National systems or TTs? - How will ForeSea collaborate with its partner programmes (e.g. CoastPredict, DITTO, etc.) – activities, recommendations, coordination, communication, or slightly rephrased, is there a plan being put in place for how the various efforts, some of which have a lot of overlap, are meant to interact? **ForeSea implementation** - Will there be a ForeSea Steering Committee (same as ForeSea working group)? - What the UN Decade requirements for ForeSea (and other programmes) on deliverables, reports, etc.? - Is ForeSea planned to run for the whole decade?		
15 min	Summary of discussion and agreement of actions	**OP / ForeSea plans, activities and actions**	Fraser Davidson	
5 min		**Adjourn / feedback next day's meeting**	Co-Chairs	

Appendix C: Task Team reports

	Communication		
COSS--TT	**Type of TT outcomes**	**Type of TT communication**	**Communication improvements**
	• Peer-reviewed papers & book chapters • Coastal system information table • Special session at AGU and OSM • COSS-TT general meetings • Common sessions with ARCOM/CAW • Support for ET-OOFS guide • Co-initiation of CoastPredict • *Recent* COSS-TT meeting (June 2021) to discuss TTs involvement with the decade and partner programmes/projects	• Journal publications • OP / COSS-TT web pages • Events • COSS community interaction (surveys) • Activities with partner groups • ET-OOFS guide • CoastPredict strategy meeting	No suggestions

	Type of TT outcomes	**Type of TT communication**	**Communication improvements**
IV-TT	• Standardisation on metrics and intercomparison tools and data • Effective best effort and alive intercomparison dataset based on Class4/1 metrics since 2013 among more than 5 global operational centres + other initiatives (e.g. HYCOM hindcasts) • Contributions to other intercomparison initiatives (e.g. Monthly Ocean Bulletin by NOAA/NCEP; CMEMS product quality assessment) • Exchanges about validation/verification with other OP TT (e.g. COSS-TT) • Recent linkage with the atmospheric verification experts: participation to JWGFVR meetings	Publications (2015) (methods, results from intercomparisons), conferences, workshops, summer schools → new TT publication on Op. System Performance based on Class 4, late 2021?	• Transfer NRT intercomparisons activities to operational bodies (e.g. ETOOFS) • Get more short scales observations • Focus on methodologies toward validation/verification for users: process and user-oriented metrics

	Type of TT outcomes	**Type of TT communication**	**Communication improvements**
MEAP-TT	• Leading/contributing the ET-OOFS Guidebook, BGC chapter • Editors of the Special issue of Biogeosciences /Ocean on "Biogeochemistry in the BGC-Argo era: from process studies to ecosystem forecasts", 2021 • IOCCG (2020). Synergy between Ocean Colour and Biogeochemical /Ecosystem Models • Fennel & MEAP-TT, 2019, OceanObs paper + co-authorship in several others	We host stakeholder groups @ each quarterly video-meeting	No suggestion

	• Contributions to the Global Biogeochemical-Argo Fleet: Knowledge to Action Workshop, linked to the G7 FSOI, May 2021 • Contribution to the CMOS webinar series, Feb 2021 • Contribution to the OceanSITES 13th Science Committee, Sept 2020		

	Type of TT outcomes	Type of TT communication	Communication improvements
DA-TT	*(Most recent)* DA-TT co-organised important joint ECMWF /OceanPredict workshop on "Advances in Ocean Data Assimilation" (17-20 May, 2021) with 170+ registered attendees. • A combination of 36 plenary talks, 29 poster presentations, 4 working group discussions and informal virtual breaks facilitated the exchange of information and seeding of new ideas.	The workshop website includes oral and poster presentations and recordings, plus the working group reports and the final workshop report. • An ECMWF news item was published about the workshop. • An article has been written for an upcoming ECMWF newsletter which summarises the workshop and its recommendations.	An online DA-TT technical seminar series is being planned.

	Type of TT outcomes	Type of communication used by TTs	TT communication improvements
OS-Eval TT	• Regular web meetings *(two-monthly)* with presentations and discussions on ongoing OS-Eval studies at different OP centers • Table of observation usage by OP centers *(on the OP website)* • Discussions with the Argo Steering team	• Presentations of OS-Eval studies given at different science conferences (25y of Altimetry, PIRATA, US CLIVAR, CLIVAR-GSOP) and organisation meetings (WMO/IOC/OBP, GOOS) • TT webpages with the presentations on the OP website • Contribution from the TT to "external" documents (ex. Ocean Obs. Req for IOC/WMO)	• Find the right level of communication depending on the "subject" between OP ST and the TT and the different international organisations managing "ocean observations". • Need to identify and know the role of those different international organisations we would like to interact with more closely • set up of the OP communication plan will clarify those aspects. • *SynObs project is having an important communication aspect*

Community interaction

COSS-TT

Users of TT output	TT partners & collaborators
• Coastal Ocean Forecasting Systems operators • Coastal and large-scale modellers, observations and data assimilation specialists • General scientific community	• OPST and most TTs (DA, OSEval, MEAP, IV) • Coastal Altimetry Workshops • OceanObs • CoastPredict & GOOS • ET-OOFS • JCOMM: Expert Team on "Integrated Marine Meteorological and Oceanographic Services within WMO and IOC Information Systems" (IPET-MOIS) • Local organizers of COSS-TT meetings (2022: Environment and Climate Change Canada)

IV-TT

Users of TT output	TT partners & collaborators
• The IV-TT participants • Other TT projects (e.g. COSS-TT) • Scientific community via use of standardized metrics	• Other OP TT • Regional operational bodies through the participants of the IV-TT intercomparison tasks (e.g. CMEMS) • Atmospheric verification experts: JWGFVR • Ideally, ETOOFS.. But in practice not….

MEAP-TT

Users of TT output	TT partners & collaborators
• Users of Copernicus Marine Service BGC models	• BGC Argo • GO-BGC (Global Ocean Biogeochemestry Array) • OceanSItes • G7/FSOI • GEO Blue Planet

DA-TT

Users of TT output	TT partners & collaborators
• Operational ocean forecasting system developers • Academic research groups	• Other OceanPredict TTs: we've previously had joint workshops with MEAP-TT and OSEval-TT, and welcome involvement from other TT co-chairs/members. • WMO/WWRP Working Group on Data Assimilation and Observing Systems (DAOS) (Andy Moore is a member) • ECMWF (for the recent workshop) • Other WMO groups: S2S, WGNE, OMDP (new collaborations via DAOS)

OS-Eval TT	Users of TT output	TT partners & collaborators
	• Space agencies • TPOS, Argo community • H2020 European project • OP centers • WMO/IOC/OBP and GOOS …	• Other TTs in OP – mostly DA (for SynObs preparation, and the joint Symposium) • externally Argo, TPOS, CLIVAR-GSOP.

TT future

	Knowledge gaps and emerging priorities (preliminar	3–5-year challenges	Long-term outlook (10 year)	Decade benefit?	Decade collaborations
COSS-TT	• Need for closer interaction with OP "national systems" • Fit-for-purpose OP large-scale estimates for coastal systems (COSS-TT) and CoastPredict uses • Farther reach via "global coastal ocean" concept and CO typology • Advance and promote good COF practices within an integrated downscaling/modelling/observation framework (OceanObs paper; promotion via ET-OOFS) • Definition of suitable coastal in situ observing systems (with OSEval-TT, SynObs, co-design w/GOOS) • Good practices for assessment in coastal regions, added value of downscaling (with IV-TT) • Good practices for using future altimetry data in coastal regions (with SWOTST?) • Role of Machine/Deep Learning in the CO, esp. given our sparse obs. Network • Extend COFS to include estuaries/deltas as an integrated system (up to catchment area) • Assess the quality of surface current estimates in regional/coastal systems, and develop better approaches • Assess multidisciplinary extended range predictive capabilities for the coastal zone (from events to climate) – test atmospheric forcing capabilities in CO – "Coastal CMIP"	See communication and community interaction above	See communication and community interaction above	UN Decade is an opportunity to advance coastal ocean science and services	• Actively participate in the CoastPredict Steering Committee and Working Groups • Need to anchor CoastPredict to COSS-TT coastal ocean modelling, observation and forecasting science and expertise… • and beyond the COSS-TT, to global ocean forecasting science, expertise and services (OceanPredict /ForeSea).

	• Coastal vulnerability: advances on coastal relocatable models for emergency situations				

	Knowledge gaps and emerging priorities	3–5-year challenges	Long-term outlook (10 year)	Decade benefit?	Decade collaborations
IV-TT	• User oriented metrics dedicated to monitor the upper ocean / short scales dynamics • Metrics dedicated to measure improvements along time of Operational Forecast, and Observing system efficiency	• Adapted transfer and implementation of ongoing intercomparison activities to more operational bodies – need for strategic plan among the TT (late 2021) • Focus on state-of-art approaches (user-oriented metrics, and big data base methods) • Unresolved and not observed scales: the unconstrained range • Development of uncertainty estimates	Seamless verification approaches fit for Coastal Global Prediction projects	Data integration, big data methods, allowing broader assessment on operational oceanography products in relation with user's needs	• Propose intercomparison focusing on upper ocean / shorter scales • Intercomparison for uncertainty estimations on key variables (e.g., Sea Level, Currents)

ME	Knowledge gaps and emerging priorities	3–5-year challenges	Long-term outlook (10 year)	Decade benefit?	Decade collaborations

	• Improve accuracy of model prediction through better understanding, formulation & parameterization of ecosystem processes and humbly revise current paradigms (e.g. mixotrophy, role of bacteria in C cycle, viruses, spectral optics…) • Data assimilation methods for BGC (non-linearity, non-gaussianity, uncertainties) • MEAP can facilitate efficient exchange of experiences and solutions among international experts working on operational assimilation of expanding float/glider fleet data. • Convince users of the reliability of BGC model outputs (DA helps!) • AI/ML in the ocean BGC framework • BGC in high resolution models • Difficulty to ensure a good representation of the biogeochemical modelling communities in the South American and African continents	See left	Fully integrated biogeochemical-physical monitoring-modelling systems with smart guidance of the observing platforms	• More visibility for MEAP challenges and needs • More direct interaction with stakeholders and policy makers	• SynObs aims to optimize various combinations of different platforms in the ocean observation: 4.Satellite ocean colour observations and in-situ (Argo) observations, e.g. Skakala et al., 2021; Teruzzi et al., submitted

DA-I	**Knowledge gaps and emerging priorities**	**3–5-year challenges**	**Long-term outlook (10 year)**	**Decade benefit?**	**Decade collaborations**

	• Development of operational ***ensemble systems,*** how to balance increases in model resolution and number of ensemble members, and how best to make use of ensemble information in the DA. • Research to consolidate the motivation ***for strongly coupled ocean-atmosphere DA***. • How best to introduce ***machine learning*** in the operational DA/forecasting process. • How best to deal with ***model error*** during the DA process and to inform model development. • Dealing effectively and efficiently with ***observation error correlations*** in DA systems to make best use of upcoming satellite missions (e.g. SWOT). • How to ***improve collaboration*** between operational centres, and between operational and academic groups, e.g. through improved software infrastructure and cloud solutions. • ***Training and recruitment*** of the young generation of DA scientists. • ***Utilization of JEDI infrastructure***	See left	• Increased use of machine learning. • Increased implementation of 4D DA methods. • Higher resolution models with larger ensembles. • More collaboration through the use of shared DA software infrastructure. • Improvements in methods for coupled ocean/atmosphere DA. • Ability to run DA software on new HPC architectures (e.g. GPUs). • Good use being made of new satellite missions measuring ocean mesoscale dynamics (e.g. SWOT, SKIM, ….)	• Improved collaborations between operational forecasting groups and observing system groups (in situ and space agencies). • Better access to funding to address important DA developments. • Expanded use of community infrastructure, such as JEDI.	• DA-TT members will be heavily engaged in both these projects/programmes. • We strongly support these projects/programmes as the DA-TT. Appropriate avenues of engagement should become obvious as both projects evolve (e.g. joint workshops, targeted WGs, etc)

	Knowledge gaps and emerging priorities	3–5-year challenges	Long-term outlook (10 year)	Decade benefit?	Decade collaborations
OS-Eval TT	• OS-Eval Methodology for efficient and prompt evaluation • Extending the OS-Eval to BGC and coastal areas (coll. with other TTs) • Real time assessment of observing systems • Regular and formatted report to Observation Agencies (OIS)	• Develop methods to improve the complementarity of various observation systems and to evaluate the synergy (SynObs project) • Link with other communities to draw requirements on Ocean Observing system evolution based on OS-Eval (OOS are multi-purpose).	• Establish a mechanism so the OceanPredict community can commit to the maintenance and evolution of the ocean observing networks.	• The Decade gives us a good opportunity to enhance the collaboration with observational communities, such as GOOS, and the earth system prediction community.	• The TT plans to lead the SynObs UN decade project to reinforce enhances the link between the OceanPredict and observational communities, which also contributes to the enhancement of the whole ocean prediction value chain.

All presentation corresponding to the TT contribution to OP and the results from the survey (tables above) can be viewed/downloaded from the OP website:

- COSS-TT presentation by Pierre De Mey-Frémaux and Villy Kourafalou
- IV-TT presentation by Fabrice Hernandez and Greg Smith
- MEAP-TT presentation by Stefano Ciavatta and Katja Fennel
- DA-TT presentation by Matt Martin and Andy Moore
- CP-TT presentation by Chris Harris

Appendix D: List of presentations

Day 1 – 16 June 2021

General overview presentations covering "**OP strategy, UN Decade programme clustering, OP communication and introduction of new partners**".

Title	Presenter	Affiliation	Role
ForeSea programme – The Science We Need for the Ocean We Want	Eric Chassignet	COAPS/ Florida State University	OPST co-chair
CoastPredict – Observing and Predicting the Global Coastal Ocean	Villy Kourafalou	University of Miami/ RSMAS	OPST member and COSS-TT chair
"Digital Twins of the Ocean" opportunities to connect science to society	Martin Visbeck	GEOMAR	Invited speaker
OceanPredict Communication	PN Vinayachandrand, Kirsten Wilmer-Becker	Indian Institute of Science, Met Office	OPST co-chair and programme office coordinator
The G7 Future of the Seas and Oceans Initiative	Maria Hood	G7/FSOI – Mercator Ocean international	Invited speaker
The Blue Planet Initiative	Audrey Hasson	GEO Blue Planet – Mercator international	Invited speaker

Day 2 – 17 June 2021

OceanPredict Task Teams reports on "**Communication of task team outcomes, task team community interaction and future plan in the UN Decade context**".

Title	Presenter	Affiliation	Role
COSS-TT report	Pierre De Mey-Frémaux	CNRS/LEGOS	COSS-TT co-chairs (shared with VIlly Kourafalou)
IV-TT report	Fabrice Hernandez	IRD / MOi	IV-TT co-chair (shared with Greg Smith)
MEAP-TT report	Stefano Ciavatta	PML	MEAP-TT co-chair (shared with Katja Fennel)
DA-TT report	Matt Martin	Met Office	DA-TT co-chair (shared with Andy Moore)
CP-TT report	Chris Harris	Met Office	CP-TT chair
OS-Eval TT report	Elisabeth Remy	MOi	OS-Eval TT co-chair (shared with Yosuke Fujii)

Day 3 – 21 June 2021

Reports on "**ETOOFS, national group critical update/UN decade involvement, strategic plan and future discussion**".

Title	Presenter	Affiliation	Role
ETOOFS recent activities: connection with OceanPredict	Pierre Bahurel and Enrique Alverez	Mercator Ocean international / SOCIB	OPAS member / invited speaker

National group presentations (UN Decade support and critical system updates)	Representatives of the OP national groups	Various	OPST members
Brief strategy comments and figure options	Fraser Davidson	DFO	OPST co-chair

Day 4 – 7 July 2021

Discussions on "**OP communications, ETOOFS/OP interactions, and ForeSea plans**".

Title	Presenter	Affiliation	Role
OP communication plan update	PN Vinayachandran and Kirsten Wilmer-Becker	Indian Institute of Science and Met Office	OPST co-chair and OP coordinator
Ideas on ETOOFS future evolution	Pierre Bahurel and Enrique Alvarez-Fanjul	MOi and Puertos del Estado	OPAS member and invited guest
UN Laboratories call announcement and guidelines	Villy Kourafalou	University of Miami/RSMAS	OPST member and COSS-TT co-chair

Appendix E: Decisions and Actions

OPST4-1: **KWB** to set up an online form by end of July 2021 to provide a mechanism for OPST members to endorse the new OP strategy.

OPST4-2: **OP co-chairs** to arrange for OP strategy document to be sent to OP partners for comments and feedback in the next few months.

OPST4-3: **OPST co-chairs** to prepare and provide response to UN Decade on ForeSea endorsement

OPST4-4: **ForeSea SC** to arrange setting up a ECOP group within ForeSea (Audrey Hasson (GBP) could provide information on an ECOP meeting should was taking part in).

OPST4-5: **ForeSea SC** to develop ForeSea implementation in collaboration with associated UN Decade programmers, e.g. DITTO, CoastPredict, and ObsCoDe.

OPST4-6: **ForeSea SC** to develop the UN Decade **project** identification, acceptance, funding and endorsement process with the help of UNDOS and programme partners

OPST4-7: The **OP communication committee** to extend its scope to also develop **ForeSea communication** plan including covering projects.

OPST4-8: **OceanPredict** to invite ETOOFS leads as members of the OPST

OPST4-9: **ForeSea/ OP** in collaboration with partners to map out the UN Decade programme linkages

OPST4-10: **Fraser** to set up regular interaction between OP (ForeSea) and ETOOFS addressing:

- Support co-design of OO framework
- Develop plans for close collaboration btw ETOOFS and ForeSea
- Develop a prospectus/presentation highlighting OP/ETOOFS role in UNDOS to be given at IOC-WMO-JCB level
- Consideration of engage WMO-IOC to set up OO framework
- Plan to involve IV-TT and ETOOFS in discussion of guide/best proactive for the OO framework

OPST4-11: **Eric C** to organise the setting-up of a "**ForeSea Steering Committee"** by mid Aug.

OPST4-12: **Eric, Vinay and Fraser** to take part in UN Laboratory on Predicted Ocean in Sep 2021 representing ForeSea

OPST4-13: **OS-Eval TT co-chairs** to organise web meeting with all other TT co-chairs in order to discuss ways to support and manage activities of SynObs.