12th Annual meeting of the OceanPredict Science Team (OPST)

2026

Meeting notes

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ECCC/UQAM, Montreal, Canada

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OPST-12 Group photo in Montreal (People standing from left: Jae Il Kwon, Nam-Hoon Kim, Pierre-Yves Le Traon, Isabelle Gaboury, Fraser Davidson, Elisabeth Remy (in front), David Ford (behind), Stefano Ciavatta, Yosuke Fujii, Yann Drillet, Francois Roy, Simon van Gennip, Rachel Furner, Andrew Petersen, Kristian Mogensen, Greg Smith, Mikhail Entel. Sitting from left: Fabrice Hernandez, Anass El Aouni, Chunxue Yang, Joanna Staneva, Marie Drevillon, Andy Moore, Kirsten Wilmer-Becker, Eric Chassignet, Alexander Kurapov)

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Executive summary

The OceanPredict Science Team (OPST) meeting highlighted the rapid evolution of operational ocean forecasting worldwide and reaffirmed OceanPredict's role as the leading international forum coordinating advances in ocean prediction, observations, data assimilation, forecasting, verification, and user services. Participants reviewed progress since the current OceanPredict strategy was launched and identified priorities for the next five years, while also considering the programme's evolution beyond the UN Ocean Decade and towards 2030.

Across all centres and task teams, a common trend emerged: operational systems are increasingly moving towards coupled Earth-system prediction, integrating atmosphere, ocean, sea ice, waves, biogeochemistry, and ecosystems. Major forecasting centres—including ECMWF, the UK Met Office, Mercator Ocean, NOAA, Environment and Climate Change Canada, JMA, the Australian Bureau of Meteorology, Korea, and others—reported substantial investments in higher-resolution modelling, ensemble prediction, advanced data assimilation, Arctic forecasting, ocean reanalysis, and machine learning.

Artificial intelligence (AI) was a dominant theme throughout the meeting. Many centres are already operating or testing AI-based forecasting systems, while others are exploring hybrid approaches that combine machine learning with traditional physics-based models. Participants agreed that AI offers major opportunities across forecasting, data assimilation, observing systems, verification, and user applications. However, advances in physical modelling, parameterisation development, numerical methods, and scientific understanding remain essential. A key challenge will be maintaining expertise in ocean modelling and numerical methods while expanding AI capabilities.

Significant progress was reported in observations and data assimilation. New opportunities are emerging from SWOT, autonomous platforms, low-cost sensors, commercial satellite constellations, gliders, and citizen science initiatives. Participants stressed the importance of sustaining critical observing systems such as Argo, improving observation-impact assessment, strengthening feedback to observing communities, and exploring new techniques such as observation system simulation experiments (OSSEs), nature runs, and AI-enabled observing networks.

Task teams highlighted advances in forecast verification, coastal prediction, marine ecosystem forecasting, coupled prediction, observation impact assessment, and operational readiness. Common priorities included developing shared verification tools, common metrics, reproducible workflows, code repositories, and stronger links between AI and existing validation frameworks. There was strong support for expanding community resources through shared platforms, GitHub repositories, training materials, and a more visible OceanPredict web presence.

Updates from operational centres demonstrated a highly active global forecasting community. Key developments included two-way wave–ocean coupling, daily ocean analyses, ensemble forecasting, SWOT assimilation, Arctic coupled prediction systems, long-term reanalyses, coastal forecasting systems, and next-generation high-resolution models. While centres differ in missions and technical approaches, common priorities include uncertainty estimation, coupled prediction, machine learning, and improved support for operational users.

The meeting also reinforced the importance of downstream applications and societal value. Participants emphasised stronger engagement with users through co-design and co-development processes and proposed developing flagship use cases in areas such as marine hazards, search and rescue, environmental emergencies, ecosystem management, and marine protected areas. Demonstrating the societal benefits of ocean prediction will be increasingly important for securing long-term support from governments, funders, and observing networks.

Beyond science and technology, discussions focused on OceanPredict's future governance and international role. Participants agreed that OceanPredict should continue to serve as a global coordination mechanism linking organisations such as IOC, WMO, GOOS, the Ocean Prediction Decade Collaborative Centre (OP-DCC), Digital Twin Ocean initiatives, and national operational centres. A clearer vision for OceanPredict beyond 2030 should be developed in time for presentation at the 2027 UN Ocean Decade Conference in Brazil.

Finally, training, outreach, and workforce development emerged as critical priorities. OceanPredict intends to expand online learning resources, summer schools, workshops, and engagement with Early Career Ocean Professionals (ECOPs). Strengthening communication, increasing visibility, improving interoperability, and fostering collaboration across disciplines were repeatedly identified as essential to future success.

Overall, the meeting reaffirmed a shared vision of OceanPredict as a globally coordinated, interdisciplinary community advancing ocean prediction through observations, modelling, data assimilation, verification, AI, and user engagement to deliver more accurate, reliable, and societally relevant forecasting services worldwide.

1. Introduction

The meeting opened with logistical and technical announcements for attendees participating in person and online in Montreal. Participants were reminded about Wi-Fi access, presentation uploads, microphone use for hybrid discussions, emergency exits, lunch arrangements, and practical details such as leaving laptops securely in the meeting room during breaks.

Organizers outlined the social programme accompanying the meeting, including a group dinner in Montreal and a visit to a traditional Canadian Sugar Shack the following day. Attendees received guidance on transportation, timings, meeting points, and payment arrangements for the social events. A group photograph was also planned during the Sugar Shack visit.

Representatives from Environment and Climate Change Canada (ECCC) welcomed participants and highlighted Montreal's cultural diversity, arts, food, and dynamic weather. The speaker described ECCC's long-standing investment in ocean modelling and Earth system prediction, emphasizing partnerships with Canadian agencies and Mercator Ocean International. Canada's leadership in coupled forecasting systems, operational ocean prediction, and environmental modelling was also noted, underscoring the importance of international collaboration in advancing ocean forecasting capabilities.

The meeting then shifted to OceanPredict business, introducing several new task-team co-chairs as part of a broader renewal within the organization. New leadership was highlighted for the Artificial Intelligence Task Team (AITT), the Intercomparison and Validation Task Team (IVTT), and the Data and Information Task Team.

1.2 New Task Team co-chair introductions

Short introductions from new co-chairs followed.

- **Rachel Furner** (new co-chair of the AI-TT) described her career path from ocean modelling at the UK Met Office, through machine-learning-focused research during her PhD, to her current role at ECMWF applying machine learning to global ocean modelling.
- **Anass El Aouni** (new co-chair of the AI-TT) outlined his research at Mercator Ocean International, covering machine learning, ocean dynamics, data assimilation, search-and-rescue applications, and physically informed computer-vision techniques.
- **Chunxue Yang** (new co-chair of the IV-TT) from Italy's National Research Council presented her background in ocean reanalysis and evaluation, including her work coordinating an Ocean Decade project focused on assessing ocean analyses and reanalyses using process- and case-study-based approaches.
- **Stephanie Ciliberti**, Senior Scientist at Nologin Oceanic Systems in Madrid (new co-chair of the IV-TT), introduced her background in environmental and hydraulic engineering, high-performance computational fluid dynamics, and over a decade of experience in operational oceanography. She is actively involved in the Copernicus Marine Service, serves in the Iberian-Biscay-Irish Monitoring and Forecasting Centre, contributes to international operational forecasting standards through GOOS/IOC/WMO initiatives, and supports OceanPredict's Ocean Forecasting Co-Design Team. Within IVTT, her focus will be on strengthening monitoring and assessment of operational forecasting systems, advancing validation methodologies, promoting best practices, and developing new metrics and key performance indicators to improve forecast evaluation.
- Although **Babette Tchonang** (new early career co-chair of the IV-TT) was unable to speak, colleagues highlighted her background, which includes a PhD at Mercator Ocean International, subsequent work at NASA JPL and the U.S. Naval Research Laboratory, and expertise in validating state-of-the-art high-resolution global ocean prediction systems. She is also actively involved in initiatives supporting operational oceanography development in Africa. Her appointment reflects the task team's goal of bringing younger scientists into leadership roles.
- The session then moved to the new DA-TT co-chair **Marcin Chrust** (ECMWF), who was briefly introduced by Kristian Mogensen, noting his extensive work in atmospheric and ocean data assimilation and his leading role in the development of the NEMOVAR data assimilation system, particularly in background error modelling.
- **Anthony Weaver,** Senior Research Scientist at CERFACS in Toulouse (new co-chair of the DA-TT), introduced himself as a long-standing contributor to data assimilation research. With more than three decades of experience, he is one of the principal architects of the NEMOVAR ocean data assimilation system used operationally at organizations such as the Met Office and ECMWF. His research focuses on covariance modelling, estimation techniques, and ensemble methods. Reflecting on the evolving landscape, he emphasized that while artificial intelligence is becoming increasingly important, traditional data assimilation methods remain fundamental to operational ocean forecasting systems and will continue to play a critical role alongside emerging AI approaches.

1.3 Meeting objectives

Following the introduction of new OceanPredict task-team co-chairs, Marie presented the objectives and vision for the OceanPredict Science Team meeting, emphasizing that the gathering is intended not only to review progress but to shape the future direction of ocean prediction science for the remainder of the UN Decade of Ocean Science and beyond. The meeting is structured around revisiting the OceanPredict strategy developed in 2020–2021, assessing progress against its objectives, and developing a practical implementation plan for the next five years.

The first day was described as “setting the stage,” with presentations designed to review the current landscape and explore future opportunities. Subsequent sessions, including discussions at the Sugar Shack (gathering on day 2), will focus on identifying scientific priorities, collaboration opportunities, and implementation actions. The final day will be dedicated to drafting a concrete action plan, potentially including initiatives such as training activities, summer schools, workshops, and new mechanisms for international collaboration.

Marie reiterated OceanPredict’s core role as a scientific coordination programme that brings together expertise across the ocean prediction value chain—from observations and data assimilation through forecasting systems and user services. The emphasis is on advancing the science of ocean prediction through international collaboration, knowledge exchange, and the integration of different scientific communities. The goal of the current planning exercise is to identify priorities and pathways that will strengthen ocean prediction science and its societal value over the next five years.

Several drivers make this strategic review particularly timely. The UN Ocean Decade provides a major international framework in which ocean prediction must demonstrate its relevance and visibility. At the same time, rapid advances in artificial intelligence, machine learning, Earth-system coupling, and digital infrastructure are transforming prediction capabilities. User expectations are also increasing, with growing demand for more accurate forecasts, better uncertainty information, and products tailored to specific applications and decision-making needs. Looking ahead, the community also needs to prepare for major future initiatives such as the next International Polar Year.

The presentation highlighted the increasingly complex landscape of international ocean prediction activities. OceanPredict interacts with numerous programmes, including the Ocean Prediction Decade Collaborative Centre (DCC), the Ocean Prediction Decade Collaborative Center Coordination Centre (ECCO), observational initiatives, forecasting programmes, and other Ocean Decade actions. A key challenge for the coming years will be clarifying roles, improving coordination among these groups, and ensuring that resources are used efficiently while maximizing collaboration.

Several scientific and operational challenges were identified as priorities for discussion during the meeting. These include sustaining and optimizing global ocean observing systems, overcoming limitations in prediction systems, extending forecasting capability toward sub-seasonal and ecosystem-relevant timescales, improving forecast evaluation and uncertainty quantification, and strengthening collaborations across disciplines and institutions. Participants also noted the growing importance of digital twins, next-generation prediction platforms, and integrated AI-physics approaches, which offer opportunities to develop more interactive and user-focused forecasting systems.

A central theme throughout the discussion was the importance of international collaboration. Drawing on findings from the OceanPredict Symposium 2024, participants recognized that scientific advances alone are insufficient without strong coordination among organizations, programmes, and communities. OceanPredict’s role as a convening and coordinating body was therefore viewed as critical for achieving progress.

During the discussion period, participants raised questions about OceanPredict's governance, relationship with broader organizations such as WMO, and long-term plans beyond 2030. Several speakers stressed that the community must already begin thinking about post-2030 structures and strategies, ensuring continuity after the conclusion of the Ocean Decade. Others highlighted emerging areas, such as marine ecosystem prediction, where progress has been faster than anticipated and should be more prominently reflected in future planning. Overall, there was broad agreement that the meeting provides an important opportunity to consolidate achievements, identify gaps, and develop a shared vision for the future of ocean prediction science.

2. Setting the stage – current progress in ocean predictions

2.1 OP-DCC and UN Decade

Presenter: Enrique Alvarez, MOI

Enrique Alvarez provided an update on the Ocean Prediction Decade Collaborative Centre (OP-DCC), highlighting significant progress in building a global ocean forecasting community and developing practical tools to strengthen forecasting capacity worldwide. The programme is structured around three main pillars: a technical framework developed closely with OceanPredict, an increasingly active network of nine regional teams (eight currently operating effectively), and flagship implementation projects in Africa (OPERA) and Costa Rica.

The OPERA project is serving as a testing ground for many of the concepts being developed by the OP-DCC, using EU funding to support the creation of regional forecasting systems, applications, technology transfer, and capacity development. Lessons and tools developed through these projects will eventually be made available globally.

Key achievements include the growth of the Ocean Forecasting Atlas to over 300 documented systems, the expansion of the Knowledge Hub, publication of guidance documents and scientific special issues, and the development of new standards, training programmes, and operational assessment tools. Work is also underway to convert the Ocean Forecasting Architecture and Operational Readiness Level (ORL) frameworks into software tools that can help monitor and improve forecasting systems worldwide.

A recent survey of 350 stakeholders identified improved forecast accuracy and higher-resolution forecasting as the community's highest priorities, reinforcing the importance of continued scientific advancement. Enrique concluded by emphasising the strong and productive partnership between OP-DCC and OceanPredict and expressed optimism that the next few years will see substantial growth in the maturity, uptake, and global impact of these ocean forecasting resources.

2.2 ForeSea Progress

Presenter: Eric Chassignet, FSU

ForeSea is the Ocean Decade Programme established under OceanPredict to increase the visibility, accessibility, and societal impact of ocean prediction science. While OceanPredict focuses on advancing the science and operational foundations of ocean forecasting, ForeSea provides a framework for communicating, coordinating, and showcasing these activities within the UN Decade of Ocean Science.

A key message is that many of ForeSea's strategic objectives—such as strengthening global collaboration, improving prediction systems and assessments, enhancing capacity development, and supporting ocean modelling—have been advanced through the development of the **Ocean Prediction Decade Collaborative Centre (OP-DCC)**. TheOP-DCC has played an important role in implementing several priorities originally identified in the ForeSea strategic plan.

ForeSea also serves as an umbrella for a diverse set of Ocean Decade projects and programmes, promoting collaboration across initiatives and helping communicate achievements through newsletters, events, and international partnerships. Recent activities highlighted include the UN Ocean Conference (UNOC-3) call for action, endorsed by more than 900 participants, and ongoing efforts to strengthen cooperation among Decade projects. Looking ahead, key milestones include the 2027 UN Ocean Decade Conference in Brazil, a planned summer school in India, and preparations for OceanPredict 2029, which will help shape future ocean prediction priorities.

2.3 GOOS Status (provided by Joanna Post)

Presenter: Pierre-Yves Le Traon, MOI

A presentation was given on the status and future direction of the Global Ocean Observing System (GOOS), led by the IOC and supported by a global community of observing networks and partners. GOOS aims to deliver sustained ocean information for sustainable development, safety, well-being, and prosperity through a coordinated global observing system. It currently involves 64 countries, around 9,000 observing platforms, and multiple established and emerging observing networks that provide critical data for ocean forecasting and prediction.

A key message was the strong link between GOOS and OceanPredict, with ocean forecasting recognised as a strategic application area. GOOS is undergoing a reform process to strengthen coordination, increase engagement with users, and place greater emphasis on national-level coordination, where most observing investments and implementation occur.

Several challenges were highlighted, including funding and sustainability risks to the observing system, particularly concerns related to the United States' contribution, as well as broader vulnerabilities across the global network. GOOS stressed the need for a more resilient and sustainable observing infrastructure, continued workforce and technology development, and improved data delivery mechanisms.

The presentation concluded by emphasizing the importance of closer collaboration between the observing and modelling communities. GOOS seeks stronger engagement with OceanPredict to help demonstrate the value of observations, support observing-system design and prioritisation, develop use cases, and ensure observations effectively support forecasting and societal applications. Discussion afterwards focused on how OceanPredict can proactively contribute through observing-system experiments, validation activities, and evidence of observation impacts.

2.4 Satellite observations for ocean prediction

Presenter: Pierre-Yves Le Traon, MOI

This presentation focused on the role of satellite observations in ocean prediction, highlighting their critical contribution to ocean, wave, sea-ice, and biogeochemical forecasting systems through measurements such as sea level, ocean currents, sea surface temperature (SST), ocean colour, salinity, wind, and waves. Satellite altimetry remains particularly important, with multiple missions required to adequately constrain ocean forecasting systems.

Several key developments were highlighted. The upcoming launch of Sentinel-3C and future missions such as CRISTAL will strengthen ocean and sea-ice observations, while the SWOT mission is already transforming ocean monitoring by providing higher-resolution observations that are expected to enter operational forecasting systems in near real time. However, concern was raised over the cancellation of Sentinel-6C, which could create a gap in the long-term reference altimetry record before the next-generation Sentinel-6 missions become available.

The presentation outlined a strong future outlook for the European Copernicus satellite programme, with new expansion missions (including CIMR, CRISTAL, and ROSE-L) and next-generation Sentinel satellites expected to improve ocean observations significantly. At the same time, the cancellation of the proposed Odyssey (ODC) mission leaves a major gap in plans for direct measurements of surface ocean currents from space.

A key message for OceanPredict was the need to engage more actively with satellite agencies by assessing the impact of new satellite missions in forecasting systems, communicating their value, identifying observational gaps, and providing coordinated international recommendations on future observing requirements. Discussion also highlighted the growing capabilities of China's satellite programme and the importance of maintaining visibility of the satellite observations used by the ocean forecasting community to support future mission advocacy and planning.

2.5 AI transformation

Presenter: Rachel Furner, ECMWF and Anass El Aouni, MOI

This presentation explored the rapid transformation brought by artificial intelligence (AI) in ocean prediction. Traditional ocean forecasting has relied on physics-based numerical models developed over the past 50 years. While highly valuable for science and operational applications, these models are computationally expensive, require large high-performance computing resources, and can be difficult to improve due to their complexity.

The speaker highlighted how AI-driven forecasting has already advanced rapidly in the weather community since the early 2020s, with operational machine-learning models now complementing or challenging traditional approaches. Ocean prediction is following a similar path, but at a faster pace, adapting state-of-the-art AI architectures developed for weather forecasting to ocean applications.

However, the ocean community faces unique challenges, including complex coastlines, limited observational data, three-dimensional ocean structures, and multi-scale physical processes. As a result, the field is moving beyond simply adapting methods from weather forecasting towards developing ocean-specific AI architectures, training approaches, evaluation methods, and community tools.

The presentation emphasized that AI's impact extends beyond forecasting itself. It will influence data assimilation, digital twins, model evaluation, data storage, compression, cloud-native computing, and the transition from CPU- to GPU-based infrastructures. A key challenge will be ensuring that AI models are assessed not only through statistical metrics but also for their physical realism and consistency.

The overall message was that the ocean prediction community is reaching the end of the initial "adaptation phase" and is entering a period where it must help lead innovation. AI-driven forecasting, ecosystem prediction, data assimilation, and operational ocean services are expected to advance significantly over the next few years, requiring close collaboration across OceanPredict and the wider ocean science community.

2.6 HPC developments

Presenter: Kristian Mogensen, ECMWF

Kristian Mogensen highlighted that while AI is transforming ocean prediction, physics-based models remain essential for operational forecasting, scientific understanding, reanalyses, and training many AI systems. The future is likely to involve a combination of physics-based and AI approaches, including hybrid systems that blend the strengths of both.

A major challenge is the changing landscape of high-performance computing (HPC). The rapid growth of AI has dramatically increased demand for GPUs and memory, making them more expensive and less accessible for traditional ocean and weather modelling. As a result, the long-standing strategy of continually increasing model resolution through ever-larger computers may no longer be sustainable.

The presentation argued that many current Earth-system models are becoming increasingly difficult to maintain because they rely on ageing software architectures, Fortran code, and complex parallelisation methods. Future developments may require new approaches that separate scientific model development from low-level computing challenges. Emerging technologies such as domain-specific languages and modern software frameworks could allow scientists to focus on the underlying physics while computer systems handle parallelisation and optimisation automatically.

AI may also help modernise modelling systems by assisting with code translation, refactoring, and software development. Rather than manually rewriting decades of legacy code, AI-supported tools could accelerate the transition to more sustainable modelling frameworks.

Discussion highlighted that although some ocean models can already run on GPUs, achieving efficient operational performance remains challenging. Participants agreed that AI presents opportunities not only for forecasting but also for transforming how scientific models are developed and maintained. Overall, the key message was that future ocean prediction systems will likely combine physics, AI, and new computing paradigms to remain scientifically robust while adapting to rapidly evolving HPC architectures.

2.7 Digital Twins (DITTO)

Presenter: Joanna Staneva, Hereon

The Digital Twin Ocean (DITTO) programme, endorsed by the UN Ocean Decade, aims to create an accessible digital representation of the ocean that supports scientists, policymakers, industry, and society in exploring ocean conditions, testing scenarios, and supporting decision-making. Its key strength lies in enabling co-design and co-development between users and scientists, allowing stakeholders to ask “what now?”, “what if?” and “what next?” questions within a shared digital framework.

DITTO is organised around five core working areas: ocean observations and data networks, digital twin modelling (including AI integration), interoperability and architecture, community engagement, and capacity building. A second pillar focused on practical use cases has recently been added to demonstrate how digital twins can address real-world challenges across different regions and sectors.

Several challenges remain, including fragmented observing and modelling activities, limited integration of AI into operational systems, interoperability issues, insufficient validation approaches, and gaps between scientific developments and policy or decision-making needs. Addressing these challenges will require improved coordination, stronger links between programmes, and greater integration across disciplines.

For OceanPredict, DITTO offers significant opportunities through shared infrastructure, improved interoperability, stronger collaboration with observing and forecasting communities, and enhanced user engagement. Priority areas for collaboration include integrating observations, models, AI, and digital infrastructure; improving access to trustworthy data and uncertainty information; supporting end-to-end forecasting services; and strengthening links with international initiatives such as GOOS, WMO and OceanPredict.

The programme is increasingly focused on developing practical, globally distributed use cases and fostering international partnerships, with the next DITTO Summit planned for Japan in November 2026. Overall, DITTO is positioned as a key enabler for future ocean prediction systems, helping to connect science, technology, policy and society through accessible and interactive digital ocean services.

2.8 Joint WMO-IOC Collaboration Board (JCB)

Presenter: Fraser Davidson, ECCC

The Joint WMO–IOC Collaboration Board (JCB) serves as the formal mechanism linking the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC), with the goal of strengthening collaboration between the weather, climate, and ocean forecasting communities. Its role is to identify areas of mutual interest, improve coordination, and accelerate the transition of research advances into operational forecasting systems.

The presentation highlighted how ocean prediction is becoming increasingly integrated within broader Earth-system prediction frameworks. WMO now supports a network of World Meteorological Centres and accredited Ocean Forecast Centres, reflecting the growing importance of coupled atmosphere–ocean forecasting. At the same time, OceanPredict, the Ocean Prediction Decade Collaborative Centre (OP-DCC), and tools such as the Ocean Forecasting Atlas and Operational Readiness Levels (ORL) framework provide complementary mechanisms for assessing and advancing ocean forecasting capabilities.

A key discussion point was how to better connect OceanPredict activities with WMO operational structures, ensuring that developments in ocean forecasting, AI, observations, evaluation methods, and operational readiness are more effectively shared and adopted internationally. The JCB was identified as an important pathway for exchanging knowledge, harmonising standards, and strengthening links between research and operations.

Michelle Jean (WMO Infrastructure Commission) emphasised the need to simplify governance and coordination structures, making collaboration between WMO, IOC, and OceanPredict more efficient and responsive. Particular opportunities were identified around artificial intelligence, data sharing, operational forecasting systems, and emerging environmental prediction capabilities.

Overall, the discussion concluded that stronger engagement between OceanPredict and WMO could help accelerate research-to-operations pathways, improve international coordination, and ensure that advances in ocean prediction are more rapidly translated into operational forecasting services that support societal and environmental needs.

2.9 Joint Working Group on Forecast Verification Research and related WMO activities (JWGFVR)

Presenter: Barbara Casati, ECCC

Barbara Casati presented the work of the WMO–WCRP Joint Working Group on Forecast Verification Research, which develops verification methods and best practices for weather, environmental and climate prediction systems. A major recent focus has been understanding how to evaluate AI-based forecasting systems and compare them fairly with traditional physics-based models.

The group organised a major workshop in Montreal on verification of AI models in operational forecasting and contributes to the emerging Weather Prediction Model Intercomparison Project (WPMIP), which compares AI, hybrid and physical prediction systems using common datasets and evaluation methods. Key findings highlighted that traditional verification metrics are often insufficient for AI models, and new approaches are needed to assess physical consistency, explainability, uncertainty, and model behaviour across different spatial scales.

A new area of research is **"falsification"**, which tests whether AI forecasts remain physically realistic and obey known physical laws. Explainability is also becoming increasingly important, particularly as AI systems are adopted operationally and must meet emerging transparency and regulatory requirements.

The group emphasised that verification metrics now play a dual role: not only evaluating forecasts but also shaping AI forecasts during model training. Choosing appropriate metrics is therefore critical to avoid unintended biases such as overly smooth forecasts or unrealistic behaviour.

Looking ahead, verification practices are evolving to incorporate AI, hybrid and coupled models through new diagnostics, benchmarking approaches, and community projects. The broader goal is to ensure that future forecasting systems are not only accurate, but also physically consistent, explainable, and operationally useful. Many of the challenges identified are equally relevant to ocean prediction, offering opportunities for closer collaboration between weather and ocean verification communities.

3. System presentations

3.1 OPOS-WG overview

Presented by David Ford (Met Office)

The session focused on recent activities of the OceanPredict Operational Partners and Observing Systems (OPOS) Working Group, particularly around operational system reporting, validation, and collaboration with international initiatives.

A key priority is strengthening collaboration with the Intercomparison and Validation Task Team (IVTT) through a proposed seminar series where OceanPredict centres will present their operational forecasting and validation activities. These seminars aim to improve knowledge exchange across the community and support efforts to make Class 4 intercomparison activities more operational.

The OPOS Working Group is also working closely with the Ocean Prediction Decade Collaborative Centre (OP-DCC) and the Ocean Best Practices System (OBPS). Recent achievements include contributions to the development of the Operational Readiness Level (ORL) framework, which provides a standardised way of assessing the maturity of ocean forecasting systems in terms of production, validation, and service delivery.

Another major activity is the modernisation of OceanPredict system reporting. Historically, annual reports were collected from all operational systems, but this process has lapsed in recent years. The plan is to revive system reporting while leveraging information already collected through the Ocean Forecasting Atlas and ORL framework, reducing duplication and making information easier to update and share. Future reports may combine system descriptions, recent developments, validation information, and observation-use statistics.

A discussion followed on OceanPredict's relationship with the World Meteorological Organization (WMO). Participants emphasised that OceanPredict should work towards alignment with WMO operational frameworks while avoiding duplicate certification or endorsement processes. The ORL framework could provide a common basis for recognising forecasting system capabilities while remaining applicable to both global and regional systems.

The session concluded with recognition that OceanPredict's system reporting, operational readiness assessments, and validation activities can provide valuable information not only to forecasting centres but also to WMO, observing-system operators, funding agencies, and the wider ocean prediction community.

3.2 System summaries

The centre updates highlighted a common trend across the international ocean forecasting community: increasing use of coupled Earth-system modelling, ensemble prediction, improved data assimilation, high-resolution regional forecasting, and the growing integration of AI and machine learning.

3.2.1 UK – David Ford (Met Office)

The UK Met Office presented an overview of its operational ocean forecasting systems and future development plans. Current operational capabilities include a **fully coupled global atmosphere–ocean–sea ice forecasting system**, a **high-resolution global ocean and sea-ice system**, regional shelf-sea forecasting systems, wave models, storm surge models, and the OSTIA sea-surface temperature and sea-ice analysis products. Development activities include coupled biogeochemical forecasting, AI applications, and next-generation environmental prediction systems.

A major operational upgrade was implemented in **January 2026**, including migration to newer NEMO ocean model configurations, adoption of the SI^3 sea-ice model, improvements in ocean data assimilation through NEMOVAR, and enhanced observation processing. These changes have produced measurable improvements in sea-surface temperature, sea level, temperature and salinity forecasts across most ocean basins.

Looking ahead, key priorities include:

- Upgrading the ocean ensemble system to higher resolution and extending forecasts from 7 to 10 days.
- Assimilating **sea-ice thickness observations** in addition to sea-ice concentration.
- Transitioning toward **hybrid Ensemble-Variational (EnVar)** data assimilation approaches.
- Migrating operational systems to the **JEDI** framework for observation processing and future coupled data assimilation.
- Moving global coupled systems toward **1/12° ocean resolution**.
- Expanding assimilation capabilities to include salinity, currents, biogeochemical observations, glider data, and potentially BGC-Argo observations.

For regional systems, the Met Office is continuing development of high-resolution shelf-sea forecasting, including biogeochemistry, wetting-and-drying coastlines, improved boundary conditions, phytoplankton diversity assimilation, and eventual migration toward fully eddy-resolving coastal prediction systems.

Research activities include stronger coupling of physical and biogeochemical models, development of hybrid data assimilation techniques, sea-ice improvements, and exploration of AI-based forecasting products. The long-term vision is to deliver more integrated Earth-system forecasting through higher-resolution models, advanced data assimilation, coupled atmosphere-ocean interactions, and improved ecosystem prediction capabilities.

Discussion highlighted particular interest in sea-ice modelling developments, assimilation of new observation types, and the future role of JEDI as a common framework linking ocean and atmospheric data assimilation systems.

3.2.2 France – Yann Drillet (MOI)

Yann Drillet presented Mercator Ocean's operational forecasting activities within major European programmes, including Copernicus Marine, EDITO (European Digital Twin Ocean), OceanPrediction DCC, and the OPERA project supporting forecasting capacity development in Africa.

Mercator operates the Copernicus Marine global ocean forecasting system, delivering physics, wave, biogeochemical ("green ocean"), and sea-ice products through both real-time forecasting and multi-year reanalysis systems. Regional forecasting is also provided through the Iberian-Biscay-Irish (IBI) configuration at very high resolution (1/36° or approximately 2–3 km), including physical, wave, and biogeochemical forecasting.

A key recent achievement was the implementation of two-way coupling between waves and ocean physics, which has improved forecast skill, particularly in the tropical Pacific, for sea surface temperature, sea level, and biogeochemical variables. The IBI system has also been upgraded to higher resolution, resulting in significant improvements in variables such as oxygen and coastal biogeochemistry.

Several important developments are planned over the next few years. These include:

- Moving from weekly to daily ocean analyses, expected to improve forecast skill by up to 15% for some variables.
- Operational assimilation of SWOT satellite observations, which has demonstrated substantial improvements in sea-level and surface-current forecasts.
- Development of ensemble ocean analyses and forecasts to provide uncertainty information.
- Expansion toward a global 1/36° eddy-resolving ocean model, capable of representing much finer mesoscale ocean processes.
- Production of new generations of global and regional reanalyses with improved long-term consistency, ocean-colour simulations, and marine carbon system representation.

Mercator is also actively developing AI capabilities through the GlowNet machine-learning forecasting system, which is already available through the EDITO platform and serves as a foundation for future AI-based ocean prediction developments.

Overall, Mercator's strategy combines higher-resolution modelling, improved data assimilation, coupled physical-biogeochemical forecasting, ensemble prediction, digital twin technologies, and AI to advance both operational forecasting and ocean monitoring capabilities across Europe and internationally.

3.2.3 Korea – Jae-Il Kwon (KIOST)

Jae-Il Kwon (KIOST) presented an overview of the development of operational oceanography in Korea and the current status of the national forecasting system. Korea's operational ocean forecasting activities are led by the **Korea Hydrographic and Oceanographic Agency (KHOA)** through the **Korea Ocean Observing and Forecasting System (KOOS)**, while **KIOST** serves as the primary research institute developing forecasting technologies and transferring them into operations.

A key message was that operational oceanography in Korea has been strongly shaped by major marine disasters. The **Hebei Spirit oil spill (2007)** played an important role in securing government support for operational ocean forecasting, demonstrating the need for prediction systems capable of supporting emergency response. Similarly, the **Sewol ferry disaster (2014)** highlighted the importance of ocean drift forecasting, search-and-rescue support, and accurate current predictions, further strengthening investment in operational oceanography.

Since the first national ocean observing plans were established in the late 1980s, Korea has progressively expanded both observing systems and numerical forecasting capabilities. Today, KOOS operates more than ten forecasting systems covering coastal and regional applications, with many of these models developed by KIOST. Current operational services include ocean forecasting, oil-spill response, search and rescue support, maritime safety information, and services for the Korean Coast Guard and other government agencies.

KIOST currently employs more than 700 staff and leads the **K-Ocean Predict (KOP)** programme, a national research initiative aimed at developing next-generation forecasting systems from global to coastal scales. Priority applications include marine heatwaves, cold-water events, low-salinity intrusions, coastal flooding, wave-induced hazards, and other coastal disaster risks. The programme is also expanding its computational capacity, including new GPU infrastructure, and is actively exploring AI technologies as part of Korea's broader national strategy on sovereign AI.

Overall, the presentation illustrated how Korea has built a strong operational ocean forecasting capability over the past two decades, driven by societal needs, disaster response requirements, and close collaboration between research and operational agencies.

3.2.4 Australia – Mikhail Entel (BoM)

Mikhail Entel presented the current status and future plans for the Australian Bureau of Meteorology's operational ocean forecasting system. He noted recent organisational changes, including the departure of long-time ocean forecasting leader Gary Brassington, who has moved to a private AI-focused company, and a broader transition within the operational ocean modelling team.

Australia's current operational system, **OceanMAPS 4.1i**, became operational in June 2025. The system is based on the MOM5 ocean model with approximately 0.1° horizontal resolution and 51 vertical levels. A distinctive feature is its use of an **Ensemble Kalman Filter (EnKF)** for data assimilation, making it one of the few operational ocean forecasting systems worldwide that relies on an ensemble-based assimilation approach. The system runs a large ensemble of forecast members and assimilates a wide range of observations, including satellite altimetry.

The most significant recent upgrade was the move from analyses produced every three days to **daily ocean analyses**, substantially reducing observational latency and improving forecast accuracy. Verification results showed improvements in sea-surface temperature, sea-level anomaly, eddy representation, ocean currents, and overall forecast skill. The system is particularly effective at maintaining coherent mesoscale eddies over long periods, a key capability for ocean forecasting applications.

Looking ahead, BoM plans to migrate from MOM5 to **NEMO**, leveraging collaboration with the UK Met Office. The next-generation system, expected around 2028, will offer higher vertical resolution and improved forecast performance. Although the model development is largely complete, implementation is dependent on future high-performance computing upgrades. Future efforts will continue to focus on improving forecast skill, maintaining ensemble-based prediction capabilities, and strengthening collaboration with international operational ocean forecasting partners.

Overall, the presentation demonstrated steady progress in Australia's operational forecasting capabilities, with a strong emphasis on ensemble data assimilation, improved ocean analysis quality, and transition toward a more advanced NEMO-based forecasting framework.

3.2.5 Japan – Yosuke Fujii (MRI-JMA)

Yosuke Fujii presented updates to JMA's operational ocean prediction systems, focusing on both global coupled forecasting and long-term ocean reanalysis around Japan.

A major recent development was the implementation of the **Coupled Prediction System version 4 (CPS4)** in January 2026. While most upgrades were made to the atmospheric component, the new coupled system has significantly improved forecast performance through better atmosphere–ocean interactions. JMA has now introduced **50-member ensemble one-month forecasts** using the coupled system. Key improvements include reduced sea-surface temperature biases, better representation of tropical ocean conditions, and notably improved simulation and prediction of the **Madden–Julian Oscillation (MJO)**, resulting in higher forecasting skill for tropical precipitation and subseasonal weather variability.

JMA also presented a new high-resolution ocean reanalysis dataset, **FORA-JPN60**, covering the western North Pacific and Japanese waters from **1960–2020**. The system combines a 0.1° (~10 km) North Pacific reanalysis with higher-resolution downscaling around Japan. The 60-year dataset successfully reproduces important regional ocean variability, including the large meanders of the Kuroshio Current, even during the pre-satellite era. This provides a valuable resource for studying long-term ocean variability, climate impacts, and regional ocean dynamics.

Overall, JMA's recent efforts focus on strengthening coupled atmosphere–ocean prediction at monthly timescales while developing high-quality long-term regional ocean reanalyses. These advances improve both operational forecasting capabilities and scientific understanding of North Pacific and Japanese coastal ocean variability.

3.2.6 USA – Alex Kurapov (NOAA)

Alexis Chassignet presented an overview of NOAA's operational ocean forecasting activities, highlighting both ongoing organisational changes and major modelling developments across NOAA. Recent restructuring has strengthened links between operational forecasting groups and large infrastructure initiatives such as the **Unified Forecast System (UFS)** and **JEDI data assimilation framework**, while also reflecting wider changes in software engineering practices and AI adoption.

On the National Weather Service side, NOAA operates the **Real-Time Ocean Forecast System (RTOFS)** based on HYCOM with data assimilation. Future plans include migrating to the newer **HYCOM 1.6**, adopting the SI6 sea-ice model, expanding use of the UFS coupling framework, and implementing JEDI-based data assimilation. NOAA also runs global and regional wave forecasting systems, with ongoing efforts to improve wave–current interactions and modernise regional wave prediction capabilities.

Within the National Ocean Service, operational activities focus strongly on navigation, coastal forecasting, storm surge prediction, environmental hazards, oil-spill response, and search and rescue. NOAA has developed a hierarchy of coastal forecasting systems ranging from tide and storm surge models to three-dimensional regional ocean prediction systems. Recent efforts have moved from many small local models toward larger integrated systems, including continental-scale storm surge forecasting and high-resolution coastal prediction models.

A major area of development is Alaska and Arctic forecasting. New coupled ocean–ice systems based on SCHISM and SI6 are being tested, with encouraging results for simulating sea ice and coastal processes. These systems aim to fill a long-standing gap in operational forecasting for Alaskan waters.

The presentation also highlighted NOAA's increasing use of international collaborations and external forcing products, recognising that effective operational forecasting requires strong cooperation across national boundaries. Looking ahead, NOAA sees continued opportunities in coastal prediction, coupled atmosphere–ocean–ice forecasting, Arctic applications, machine learning, and integration of biogeochemical and ecosystem forecasting capabilities. While operational biogeochemical forecasting remains limited, there is growing research activity in harmful algal blooms, ecosystem applications, and model-agnostic biogeochemical frameworks that may support future operational products.

3.2.7 Canada – Greg Smith (ECCC)

Greg Smith presented an overview of Canada's **CONCEPTS** programme, a collaboration between Environment and Climate Change Canada (ECCC), Fisheries and Oceans Canada (DFO), the Canadian Coast Guard, the Canadian Ice Service, and the Department of National Defence. The programme supports a wide range of applications, including marine forecasting, sea-ice prediction, emergency response, navigation, fisheries, and environmental services.

CONCEPTS has evolved over two decades from a coupled Gulf of St. Lawrence forecasting system into a hierarchy of fully coupled global, regional, Arctic, coastal, and port-scale prediction systems. Major milestones include implementation of global ocean analyses, fully coupled atmosphere–ocean forecasting systems, Arctic prediction capabilities, seasonal and ensemble forecasting systems, and high-resolution coastal forecasting supporting electronic navigation and emergency response.

Current development efforts focus on the next operational upgrade cycle. Planned improvements include migration to **NEMO version 4**, ensemble-based ocean analyses, assimilation of sea-ice thickness, improved sea-ice form drag, enhanced coastal data assimilation, and increasing use of SWOT observations. A major area of research is the **Canadian Arctic Prediction System (CAPS)**, a fully coupled high-resolution atmosphere–ice–ocean forecasting system designed to improve prediction in the rapidly changing Arctic environment.

Canada is also investing heavily in **ocean reanalyses and historical reconstructions**, using operational systems to produce long-term datasets for climate studies, ecosystem applications, and machine-learning development. These activities include global and regional reanalyses as well as Arctic-focused coupled reanalysis experiments.

Several ongoing research projects target improved Arctic observing system design, SWOT assimilation, coastal modelling, high-resolution relocatable models, and artificial intelligence applications. Machine learning is seen as a major future challenge and opportunity, particularly for integrating emulators into the existing hierarchy of operational forecasting systems while maintaining forecast skill and physical realism.

Overall, CONCEPTS continues to move toward more integrated Earth-system forecasting through coupled modelling, ensemble prediction, improved data assimilation, Arctic prediction capabilities, and the gradual incorporation of AI and next-generation observing technologies.

3.2.8 Europe – Kristian Mogensen (ECMWF)

Kristian Mogensen provided an update on ECMWF's ocean forecasting and data assimilation systems, with a strong focus on upcoming operational upgrades and the growing role of machine learning. ECMWF's ocean activities are primarily designed to support atmospheric forecasting, seasonal prediction, and reanalysis rather than standalone ocean forecasting services.

A major operational upgrade is scheduled for **May 2026**, representing the first significant ocean system update in several years. Key changes include upgrading **NEMO from version 3.4 to 4.0**, introducing a multi-category sea-ice model, moving reanalyses to **ERA5 atmospheric forcing**, and incorporating a more advanced version of the NEMOVAR assimilation system. The upgraded reanalysis will also better represent the diurnal cycle in the upper ocean through improved vertical resolution and forcing frequency. ECMWF is additionally transitioning output formats away from NetCDF to improve operational efficiency and data dissemination.

In data assimilation, ECMWF is moving towards a more sophisticated ensemble-based approach. Future systems will increase the number of ocean ensemble members and use ensemble information directly to estimate background-error covariances, improving analysis quality and representation of uncertainty. Ocean reanalyses are also being extended back to the 1940s and will provide ocean-consistent fields for the next-generation atmospheric reanalysis (ERA6).

Machine learning is becoming an increasingly important component of forecasting activities. ECMWF already operates deterministic and ensemble machine-learning weather prediction systems and is beginning to include ocean and wave information in these models. Longer term, the goal is to develop fully coupled atmosphere–ocean machine-learning systems, although physical models and data assimilation remain essential for providing initial conditions and training data.

Looking ahead, ECMWF plans to upgrade its seasonal forecasting system, expand machine-learning capabilities for ocean and sea-ice prediction, and further strengthen coupled atmosphere–ocean data assimilation. While higher-resolution ocean models have been considered, rising computing costs mean that future advances may increasingly rely on machine learning and smarter use of existing physical modelling systems rather than continually increasing model resolution.

3.2.9 Summary of other systems

Presented by David Ford (Met Office)

Short updates were presented from several centres that could not attend the meeting in person, highlighting a wide range of developments across the international operational oceanography community.

South Africa presented progress on the **Somisana Project**, which currently operates high-resolution coastal forecasting systems forced by Copernicus Marine and atmospheric products. Plans include expanding coverage to the full South African shelf, coupling with wave models, improving visualisation tools, and introducing data assimilation capabilities.

China reported continued development of several high-resolution regional forecasting systems using ensemble-based data assimilation. In addition to traditional ocean products, the systems now provide information on marine heatwaves, ocean eddies, and other derived indicators. Future developments include the use of **SCVT (Spherical Centroidal Voronoi Tessellation) grids**, allowing globally consistent models with local refinement down to kilometre-scale resolution.

Norway described advances in the **TOPAZ Arctic forecasting system**, which combines ocean, sea-ice and biogeochemical forecasting with a 100-member Ensemble Kalman Filter assimilation system. Recent developments include sea-ice algae modelling, improved sea-ice concentration products, higher spatial resolution, wave-induced mixing, internal tides, and simulation of zooplankton vertical migration.

Italy highlighted updates to both its global forecasting and Mediterranean forecasting systems. Improvements include upgrades to the validation framework and data assimilation system, better use of coastal altimetry data, and a move from weekly to daily analysis cycles, resulting in improved short-range forecast skill.

Brazil reported progress in both deep-ocean and coastal forecasting. Current developments include assimilation of SWOT observations, expansion of coastal forecasting domains, enhancement of web-based forecasting services, and development of tools to support oil-spill response and search-and-rescue operations.

The discussion following the presentations reflected on common trends emerging across operational centres. Participants noted increasing interest in coastal prediction, ensemble forecasting, sub-seasonal prediction, machine learning, and improved operational interoperability. There was also discussion about whether OceanPredict should further expand its focus beyond traditional global forecasting systems to include coastal, Arctic, and subseasonal-to-seasonal ocean prediction applications, reflecting the growing diversity of operational ocean forecasting activities worldwide.

4. Task Team updates

The OceanPredict Task Teams reported strong progress across forecasting, observations, validation, ecosystems, data assimilation, coupled prediction and AI. A common theme was the need to move research advances into operational services while strengthening collaboration across teams.

IV-TT continues to develop internationally recognised forecast verification standards and is expanding evaluation methods to AI, ensembles and ecosystem applications. COSS-TT is focused on integrating coastal prediction into wider ocean forecasting systems, improving observations, data assimilation and user-oriented services. MEAP-TT is advancing operational marine ecosystem prediction, including fisheries, biodiversity and environmental management applications. DA-TT highlighted the growing convergence between data assimilation and AI, while promoting shared tools, open-source development and new collaborative projects. OSEval-TT, through the SynObs programme, continues to demonstrate the value of ocean observations and is working toward routine observation-impact monitoring while advocating for sustained observing networks. CP-TT is exploring the benefits of coupled Earth-system prediction, including atmosphere-ocean, sea ice and ecosystem interactions, with particular focus on tropical cyclones, polar regions and model resolution. The newly established AI-TT is building an international community around AI for ocean prediction, promoting benchmarking tools, shared datasets and practical pathways for operational AI adoption.

Across all teams, priorities for the next five years include greater interoperability, stronger links between observations and prediction systems, increased use of AI and digital twin technologies, workforce development, and closer collaboration to deliver more accurate, integrated and societally relevant ocean prediction services.

Cross-Cutting Themes between task teams

Several recurring themes emerged across all task teams:

- **AI and machine learning** are becoming increasingly important across forecasting, data assimilation, observations, validation and ecosystem applications.
- **Operationalisation** remains a key objective, moving research advances into routine forecasting services.
- **Interoperability and common frameworks** are needed for validation, benchmarking, data sharing and model evaluation.
- **Closer collaboration between task teams** is essential, particularly around AI, data assimilation, validation, observations, ecosystems and coastal prediction.
- **User-driven services** and stronger engagement with stakeholders are increasingly important to demonstrate societal value.
- **Workforce development and community renewal** require attention, including attracting early-career scientists and expanding international participation.
- **Observations remain fundamental**, with sustained investment in observing systems critical for future ocean prediction capabilities.

Together, the task teams are moving OceanPredict toward a more integrated Earth-system approach that combines physical, biogeochemical, ecosystem, coastal, observational and AI capabilities to deliver more accurate, actionable and societally relevant ocean forecasts.

4.1 Intercomparison and Validation (IV-TT)

Presented by Chunxue Yang (CNR)

The Intercomparison and Validation Task Team (IVTT) plays a central role in OceanPredict by developing and promoting internationally consistent approaches for evaluating ocean forecasting systems. Under new leadership from co-chairs Chunxue, Stefania, and Babette, the team is building on a strong foundation established over more than a decade of collaborative work. A key recent achievement is the submission of a comprehensive review paper to the *Bulletin of the American Meteorological Society (BAMS)*, documenting over 12 years of progress and highlighting the development of the widely adopted **Class 4 verification framework**, which has become the international standard for assessing operational ocean forecast skill.

The team's work has enabled forecasting centres worldwide to apply common verification methodologies, facilitating consistent comparisons and supporting ongoing improvements in ocean prediction systems. However, several challenges remain. These include limited availability of independent observations for validation—particularly in Arctic and coastal regions—the need to expand verification beyond traditional physical variables to include biogeochemistry and sea ice, and the requirement to develop robust methodologies for evaluating ensemble forecasting systems and emerging AI-based prediction approaches. Maintaining independent datasets for validation while maximising the use of observations in operational systems also remains an important consideration.

Looking ahead, IVTT plans to modernise and expand verification activities by further operationalising Class 4 metrics, extending evaluation methods to regional and coastal forecasting systems, supporting the assessment of AI-driven forecasts, and developing harmonised approaches for ensemble verification. Stronger collaboration with other OceanPredict groups, including AI, coastal prediction, observing-system evaluation, and marine ecosystem initiatives, will be a key priority. In particular, the team aims to strengthen links between forecast verification and observing-system design, using skill assessments and uncertainty information to identify where additional observations could most effectively improve forecasts.

To broaden community engagement, IVTT will launch an online seminar series showcasing validation activities and best practices from operational centres. An in-person meeting in Shanghai in November 2026 will further support collaboration, particularly with researchers developing AI-based forecasting systems. Through these activities, IVTT contributes directly to OceanPredict's strategic goals by providing standardised validation methodologies, benchmarking emerging technologies, supporting operational forecasting services, and ensuring that future ocean prediction systems can be assessed in a consistent, transparent, and internationally accepted manner.

4.2 Coastal Ocean and Shelf Seas (COSS-TT)

Presented by Alex Kurapov (NOAA)

The Coastal Task Team (Coast TT) works to advance coastal ocean forecasting by improving scientific understanding, operational prediction capabilities, and international collaboration. Coastal environments present unique challenges due to the influence of highly variable processes such as tides, river discharge, storm surges, estuarine dynamics, and compound flooding, all of which require higher-resolution observations, models, and forecasting systems than those used for regional and global oceans.

A key strength of Coast TT is its role in connecting a geographically distributed community of researchers and operational centres. Recent activities include a successful in-person meeting in Brest in 2025, the launch of a topical collection in *Ocean Dynamics*, and an ongoing Coastal Ocean Modelling Seminar series that highlights emerging scientific developments, including artificial intelligence (AI) applications. The next team meeting is planned for February 2027 near Rio de Janeiro.

The team's long-term vision is to create a more integrated coastal forecasting framework that links global, regional, and coastal prediction systems. Strategic priorities include strengthening research-to-operations pathways, developing interoperable and reproducible modelling workflows, integrating coastal systems into broader ocean prediction frameworks, and improving collaboration between scientists, operational centres, stakeholders, and end users. Particular emphasis is placed on supporting coastal resilience, ecosystem management, and blue economy applications.

Several scientific and technical challenges remain. Data assimilation continues to be a major limitation, despite the increasing availability of coastal observations and emerging technologies such as HF radar and SWOT satellite measurements. There is growing interest in AI-enhanced data assimilation, ensemble forecasting, and improved use of high-resolution observations. Coastal observing systems also require greater coverage, particularly in estuarine and nearshore regions, while forecasting models must better represent the full land–sea continuum through coupled atmosphere, ocean, hydrological, and river systems.

The team highlighted the need for more consistent verification and benchmarking approaches, as coastal systems often use different grids, domains, and variables. Initiatives such as FOCUS and EDITO are helping to develop common validation frameworks and tools. Looking ahead, Coast TT aims to strengthen partnerships across OceanPredict, including collaborations on AI, data assimilation, observations, validation, and ecosystem forecasting. Its overarching goal is to build a more integrated and interoperable international coastal prediction community capable of delivering improved forecasts and user-focused services for hazards, ecosystems, and coastal management.

4.3 Marine Ecosystem Analysis and Prediction (MEAP-TT)

Presented by Stefano Ciavatta (MOI)

The Marine Ecosystem Analysis and Prediction (MEAP) Task Team is leading OceanPredict's efforts to operationalise the "green ocean" by integrating marine biogeochemical and ecosystem processes into ocean prediction systems. With members from 22 organisations across 12 countries, MEAP provides a global forum for advancing ecosystem modelling, observations, and forecasting, while strengthening links between research, operational services, and end users.

A major focus of recent work has been the Horizon Europe **NECTON** project, a UN Ocean Decade-endorsed initiative that has significantly advanced operational marine ecosystem prediction. NECTON has delivered new forecasting products for marine pollution, fisheries, biodiversity, and benthic ecosystems, developed and standardised a wide range of ecosystem variables, and made ecosystem simulations, hindcasts, and climate projections publicly available through dedicated online platforms. These developments are helping expand ocean prediction beyond traditional physical and biogeochemical forecasting to support environmental management, fisheries, conservation, and policy applications.

MEAP has also strengthened the technical foundations for operational ecosystem forecasting by developing a flexible biogeochemical modelling framework that can be coupled with major ocean circulation models such as NEMO, HYCOM, MOM, and ROMS. This approach promotes international collaboration and enables forecasting centres to more easily incorporate ecosystem modelling capabilities. In parallel, the team is establishing an international consortium to support wider adoption and sharing of operational marine ecosystem models. MEAP members are also actively contributing to several **Digital Twin Ocean** initiatives, demonstrating the growing role of ecosystem information in next-generation ocean prediction systems.

Looking ahead, the team's priorities include transitioning ecosystem models from research tools into routine operational services, strengthening connections with observing networks such as Biogeochemical Argo, MBON, and GOOS, and improving the integration of observations and models to enhance forecast reliability. MEAP also plans to develop ecosystem indicators for ocean health, climate impacts, biodiversity, fisheries management, and Marine Protected Areas, supporting evidence-based decision-making. Strong stakeholder engagement remains central to the team's vision, with partnerships involving FAO, ICES, fisheries organisations, conservation bodies, and policymakers helping ensure ecosystem forecasts address real-world needs. Through these efforts, MEAP is helping transform ocean prediction into a more comprehensive Earth-system capability that combines physical, biogeochemical, and ecological information to support sustainable ocean management and climate adaptation.

4.4 Data Assimilation (DA-TT)

Presented by Sergey Frolov (NOAA)

The Data Assimilation Task Team (DATT) remains a cornerstone of OceanPredict, advancing ocean forecasting through the integration of observations and numerical models. Recent discussions have focused not only on technical developments but also on the long-term sustainability of the data assimilation community. A key concern is the difficulty of attracting and retaining early-career researchers, as the field increasingly relies on mid-career and senior experts. Many participants noted that artificial intelligence (AI) and machine learning (ML) are drawing new researchers away from traditional data assimilation, creating challenges for leadership succession and workforce renewal.

Despite these concerns, the community views AI less as a competitor and more as a significant opportunity. Discussions highlighted the growing convergence between AI and data assimilation through hybrid forecasting approaches, machine-learning-based observation processing, improved error estimation, and enhanced uncertainty quantification. Participants expressed optimism that advances in AI could ultimately strengthen the field by attracting new expertise and enabling innovative forecasting methodologies.

A major challenge remains the multidisciplinary nature of data assimilation, which requires expertise in oceanography, numerical modelling, statistics, optimisation, software engineering, and high-performance computing. This high barrier to entry has historically limited the number of specialists in the field. To address this, the team emphasised the need to improve visibility, strengthen training opportunities, and position data assimilation as a key component of the broader AI and Earth-system prediction landscape.

Significant scientific and technical developments are nonetheless underway. The new Horizon Europe **COMEDI** project, beginning in 2026, will support advances in operational ocean data assimilation through improved ensemble-based error estimation, enhanced observation error modelling, hybrid AI-data assimilation methods, open-source software development, and greater sharing of tools across institutions. Complementing these efforts are community frameworks such as **JEDI (Joint Effort for Data Assimilation Integration)**, which provide a more open and interoperable environment for developing ocean, atmospheric, and coupled Earth-system assimilation systems.

Looking ahead, DATT sees its future closely linked to advances in AI, ensemble forecasting, and coupled prediction. Priorities include strengthening collaboration with the AI Task Team, promoting open-source development and shared infrastructure, developing hybrid AI-data assimilation approaches, and building the next generation of expertise. While workforce challenges remain, the overall outlook is positive, with growing collaboration, new international projects, and shared community tools ensuring that data assimilation continues to be a fundamental component of future operational ocean prediction systems.

4.5 Observing System Evaluations (OSEval-TT)

Presented by Yosuke Fujii (MRI/JMA) and Elisabeth Remy (MOI)

The Ocean Observing Evaluation Task Team (OSEval-TT) is dedicated to assessing the value of ocean observations for forecasting systems and using this evidence to guide the design and optimisation of future observing networks. Its flagship initiative, **SynObs (Observing Network for Ocean Prediction)**, is a UN Ocean Decade project that brings together forecasting centres, observing-system experts, GOOS, WMO, satellite agencies, and other international partners to evaluate the impact of observations on ocean prediction.

Through coordinated **Observation System Experiments (OSEs)** and **Observation System Simulation Experiments (OSSEs)**, SynObs assesses how different observing networks contribute to forecast quality. A major strength of the programme is its use of multiple independent forecasting systems, enabling robust conclusions that are not dependent on a single model or data assimilation framework. Results have consistently demonstrated the critical role of observations in reducing forecast uncertainty, improving products such as ocean heat content estimates, tropical cyclone heat potential, and ENSO indicators. Argo profiling floats have been identified as particularly valuable, while a publicly accessible database hosted by JAMSTEC supports community-wide analysis and collaboration.

Since 2025, SynObs has expanded partnerships with major international initiatives including GOOS, WMO, CLIVAR, TPOS, Ocean Observing Co-Design, and satellite programmes. The extension of SynObs through **2030** aligns its activities with the UN Ocean Decade and provides a framework for long-term international collaboration. An upcoming joint workshop in Japan will further strengthen links between forecasting centres and observing-system planners, focusing on observation impact assessment, observing-system co-design, and future observing strategies.

Looking ahead, OSEval-TT aims to move from occasional impact studies towards **routine and near-real-time monitoring of observation impacts**, working closely with the Data Assimilation

Task Team to develop common methodologies and diagnostics. The team also seeks to broaden evaluations beyond traditional physical ocean variables to include biogeochemistry, marine ecosystems, coupled prediction systems, coastal observations, and emerging technologies. Increasing emphasis will be placed on assessing the societal value of observations for applications such as weather and climate prediction, hazard forecasting, ecosystem management, and coastal services.

A key challenge remains the sustainability of critical observing networks, many of which face funding pressures and declining coverage. OSEval-TT therefore aims not only to demonstrate the scientific benefits of observations but also to communicate their operational and societal value more effectively to decision-makers and funding agencies. Through SynObs, the team is helping to build a more integrated, evidence-based, and application-focused approach to ocean observing system design and evaluation in support of OceanPredict's long-term goals.

4.6 Coupled Prediction (CP-TT)

Presented by Kristian Mogensen (ECMWF)

The Coupled Prediction Task Team (CP-TT) is dedicated to advancing coupled ocean–atmosphere forecasting systems and improving understanding of how interactions between different components of the Earth system enhance prediction skill. Although coupled forecasting is now operational in many centres worldwide, the team recognised that CP-TT itself has experienced limited activity in recent years and is now undertaking a period of renewal to strengthen engagement, update membership, and redefine priorities.

A major focus is the upcoming **Coupled Prediction and Data Assimilation Workshop** at ECMWF, which will bring together forecasting and data assimilation communities to address the combined challenges of model development and initialisation. The workshop is expected to help revitalise CP-TT activities, define future collaborative projects, and support an update of influential coupled prediction white papers produced nearly a decade ago. The team is also launching a seminar series to encourage knowledge exchange among operational forecasting centres.

Scientifically, CP-TT is centred on the question of **how much coupling is needed to improve forecasts**. Priority areas include assessing the benefits of atmosphere–ocean coupling, understanding the value of coupling in regional versus global systems, and evaluating interactions involving sea ice, waves, biogeochemistry, ecosystems, and coastal processes. The goal is to provide practical guidance on where increasingly sophisticated coupled systems deliver measurable forecasting improvements.

Potential collaborative activities include a coordinated analysis of tropical cyclone forecasts from operational coupled systems, focusing on ocean responses such as sea-surface temperature changes, upper-ocean heat content, cold-wake development, and feedbacks on storm intensification. Polar prediction was also highlighted as a key opportunity, with the upcoming International Polar Year offering a platform for coordinated studies of atmosphere–ocean–ice interactions using new observational datasets.

Looking ahead, CP-TT aims to broaden its scope beyond traditional atmosphere–ocean coupling to include ecosystem forecasting, coastal prediction, and emerging technologies such as artificial intelligence. Increasing model resolution, representation of submesoscale processes, and integration of AI with coupled forecasting systems were identified as important future research areas. While many promising scientific themes have been identified, the main challenge remains translating these ideas into sustained collaborative activities. Through stronger partnerships across OceanPredict and a renewed programme of workshops and seminars, CP-TT aims to ensure coupled forecasting remains a central component of next-generation operational ocean prediction systems.

4.7 Artificial Intelligence (AI-TT)

Presented by Rachel Furner (ECMWF)

The AI Task Team (AITT), established in 2025, is OceanPredict's newest task team and serves as a focal point for advancing the application of artificial intelligence (AI) and machine learning (ML) in ocean prediction. With 25 members from 17 institutions across 10 countries, the team brings together expertise from operational forecasting centres, research organisations, ocean modelling, and machine learning. Beyond its formal membership, AITT is building a broader international community through open seminars, workshops, and a dedicated mailing list that connects ocean scientists with AI practitioners.

Despite its recent formation, the task team has already launched a successful seminar series, organised its first workshop, and begun defining priorities for the rapidly growing AI-ocean forecasting community. A key theme is the promotion of **hybrid approaches** that combine traditional physics-based ocean models with AI techniques. While fully data-driven forecasting systems are attracting significant attention, participants emphasised that hybrid methods may provide the most practical pathway for incorporating AI into operational ocean prediction systems.

AITT's strategic priorities focus on community building, knowledge sharing, and reducing barriers to AI adoption. The team aims to strengthen links between ocean forecasting centres and the wider AI ecosystem, including academia and industry. It is also supporting **OceanBench**, a community benchmarking framework that enables transparent and reproducible comparisons between AI-based and traditional forecasting approaches. Close collaboration with the Intercomparison and Validation Task Team will be essential in ensuring robust evaluation standards.

Another major objective is to make AI more accessible to operational oceanographers by providing tutorials, training materials, practical workflows, and support for emerging frameworks such as ECMWF's Anemoi. The team also plans to facilitate the sharing of trained models, datasets, software, and best practices, allowing organisations with limited computing resources to benefit from advances developed elsewhere.

As a highly cross-cutting initiative, AITT collaborates with all other OceanPredict task teams, including data assimilation, coupled prediction, coastal forecasting, ecosystem prediction, observing systems, and forecast verification. Looking ahead, its vision is not simply to develop new AI methods but to ensure that AI becomes a trusted, scientifically rigorous, and operationally useful tool across the ocean prediction community. By building partnerships, promoting shared resources, and encouraging responsible adoption of AI, the task team aims to help OceanPredict harness emerging technologies while maintaining transparency, reproducibility, and scientific credibility.

5. Implementation plan progress

Summary of the discussion on OceanPredict Strategic Priorities and Future Direction

The outcome of the discussion will lead to the publication of the 5-year OceanPredict implementation plan.

Discussions throughout the meeting focused on defining OceanPredict's priorities for the next five years and its longer-term role beyond the UN Ocean Decade. Participants agreed that OceanPredict already provides significant value by bringing together the international ocean prediction community through task teams, workshops, collaborative projects and knowledge exchange. However, stronger communication, greater interoperability, improved visibility and closer links across communities were identified as key priorities moving forward.

A major theme was the growing role of **artificial intelligence (AI)** across all aspects of ocean prediction. Participants highlighted opportunities to combine AI with traditional approaches in modelling, data assimilation, observations, verification and downstream services. At the same time, there was strong consensus that advances in physical modelling, parameterisation development and numerical methods remain essential. Hybrid physics-AI approaches were viewed as particularly promising, while preserving expertise in ocean modelling and numerical methods was recognised as an important challenge for the next generation.

In **data assimilation and verification**, priorities include attracting and training early-career scientists, strengthening links between AI and data assimilation, expanding access to training materials, and developing shared tools, frameworks and best practices. Verification activities should become more operational, with common metrics, reproducible workflows, shared code repositories and support for ensemble and AI-based systems. Several groups proposed developing OceanPredict-wide platforms, potentially through GitHub and improved website resources, to facilitate collaboration and transparency.

Observations and observation impact assessment remain central to OceanPredict. Participants emphasized the need for routine monitoring of observation impact, stronger feedback mechanisms to observing networks, greater engagement with observing system communities, and extension of impact studies to biogeochemistry, ecosystems, coastal systems and AI applications. Sustaining critical observing systems such as Argo was identified as a major concern. There was also interest in developing community observation system simulation experiments (OSSEs), nature runs, and new approaches to assessing societal benefits from observations.

The community also recognised emerging opportunities from **new observing technologies and industry partnerships**, including low-cost sensors, autonomous vehicles, commercial satellite constellations, fishing vessels, citizen science initiatives and private-sector observing networks. AI may enable greater use of these unconventional datasets, allowing valuable information to be extracted from observations previously considered too sparse or noisy for operational systems.

A strong focus was placed on **downstream services and user engagement**. Participants agreed that users should be involved much earlier through co-design and co-development processes. Developing a small number of flagship use cases—such as search and rescue, coastal hazards, marine protected area management and ecosystem applications—was proposed as a way of demonstrating societal value, strengthening stakeholder engagement and improving communication of ocean prediction benefits.

The meeting also addressed **OceanPredict's future governance and international role**. Participants discussed how OceanPredict should evolve after 2030 and how it should interact with organisations such as IOC, WMO, GOOS, OP-DCC and Digital Twin Ocean initiatives. There was broad agreement that OceanPredict should remain a key international coordination mechanism linking observations, research, operational forecasting and services. Developing a clearer vision for the post-Decade period, potentially for presentation at the 2027 UN Ocean Decade Conference in Brazil, was identified as an important objective.

Finally, **training, outreach and community development** were repeatedly highlighted as critical priorities. Proposed actions included expanding online training resources, strengthening summer schools and workshops, increasing engagement with Early Career Ocean Professionals (ECOPs), improving ocean literacy activities, and making learning materials more accessible through the OceanPredict website. Participants stressed that the future success of OceanPredict will depend not only on scientific advances, but also on its ability to communicate knowledge, support workforce development, foster collaboration across disciplines and demonstrate the societal value of ocean prediction.

Overall, the meeting reinforced a vision of OceanPredict as a globally coordinated, interdisciplinary community that integrates observations, modelling, data assimilation, verification, ecosystems, coastal prediction and AI to deliver more accurate, actionable and societally relevant ocean forecasting services.

Appendices

Appendix A – Agenda

Wed, 15 April - Day 1

Time	Item	Length in min
8:30 - 9:00	**Registration**	30
9:00 - 9:10	**Introduction (welcome, housekeeping, events) Greg or Kirsten**	10
9:10 - 9:20	Invited local host talk, land claim acknowledgement	10
9:20 - 9:50	**New TT chairs intro 3-5 min each** Rachel Furner - AI-TT (ECMWF) Anass El Aouni - AI-TT (MOI) Chunxue Yang - IV-TT (CNR) Stefania Ciliberti - IV-TT (NowSystems) *(remote)* Marcin Chrust - DA-TT (ECMWF) *(remote)* Anthony Weaver - DA-TT (CERFACS) *(remote)*	30
9:50 - 10:05	**OP overview and meeting objectives** - Greg Smith (ECCC) & Marie Drevillon (MOI)	15
	News and developments - setting the stage	
10:05 - 10:15	**OP-DCC and UN decade -** Enrique Alvarez (MOI)	10
10:15 10:25	**ForeSea progress -** Eric Chassignet (FSU)	10
10:25 - 10:35	**Discussion**	10
10:35 - 11:00	**Tea/coffee**	35
11:00 - 11:10	**In-situ observations (Argo, GOOS,..)** - Pierre-Yves Le Traon (MOI)	10
11:10 - 11:20	**Satellite obs (new missions, etc.) -** Pierre-Yves Le Traon (MOI)	10
11:20 - 11:30	**AI transformation -** Rachel Furner (ECMWF) & Anass El Aouni (MOI)	10
11:30 - 11:40	**HPC developments (GPUs, differential modelling)** - Kristian Mogensen (ECMWF)	10
11:40 - 11:50	**Digital Twins (DITTO) -** Joanna Staneva (Hereon)	10
11:50 - 12:10	**Discussion**	20
	WMO collaborations 30 min	
12:10 - 12:20	**JCB -** Fraser Davidson (ECCC)	10

12:20 - 12:40	**(JWGFVR) Joint Working Group on Forecast Verification Research and related WMO activities** - Barbara Casati (ECCC)	20
12:40 - 12:50	**Discussion**	10
12:50 - 14:00	**Lunch**	70
	Task team and WG sessions - visons and plans for the next 5 years	
14:00 - 14:20	**OPOS-WG -** David Ford, Met Office & Fraser Davdson, ECCC	20
14:20 - 15:35	**Covers 5 presentations [System presentations (short - 10+5 min)]** **UK -** David Ford (Met Office) - 14;20 - 14:35 **France -** Yann Drillet (MOI) - 14:35 -14:50 **Korea -** Jae-Li Kwon (KIOST) - 14:50 - 15:05 **Australia -** Mikhail Entel (BoM) - 15:05 - 15:20 **Japan -** Yosuke Fujii (MRI-JMA) - 15:20 - 15:35	75
15:35 - 16:00	**Tea/coffee**	30
16:00 - 16:45	**Covers 3 presentations (10+5 min) + 1 slot (30 min) to cover one slide presentations of absent systems** **USA -** Alex Kurapov (NOAA) - 16:00 - 16:15 **Canada -** Greg Smith (ECCC) - 16:15 - 16:30 **Europe** - Kristian Mogensen (ECMWF) - 16:30 - 16:45	45
16:45 - 17:30	**Discussion**	15
17:30	**Close of meeting**	
from 19:00	**Dinner in Montreal - Mauvais Garçons**	
		495

Thu, 16 April - Day 2

8:45 - 8:50	**Intro, housekeeping**	5
	Task team and WG sessions - visons and plans for the next 5 years - (15+10 min)	
8:50 - 9:15	**IV-TT -** Chunxue Yang (CNR)	25
9:15 - 9:40	**COSS-TT -** Alex Kurapov (NOAA) & Joanna Staneva (Hereon)	25
9:40 - 10:05	**MEAP-TT -** Stefano Ciavatta (MOI)	25
10:05 -10:10	**Discussion**	5
10:10 - 10:40	**Tea/coffee**	30
10:40 - 11:05	**DA-TT -** Sergey Frolov (Met.no) - remote	25
11:05 -11:30	**OSEval-TT/ SynObs -** Yosuke Fujii (MRI/JMA) & Elisabeth Remy (MOI)	25
11:30 - 11:35	**Discussion**	5

11:35 - 12:00	**CP-TT -** Kristian Mogensen (ECMWF)	25
12:00 -12:25	**AI-TT -** Rachel Furner (ECMWF) & Anass El Aouni (MOI)	25
12:25 - 12:30	**Dicussion**	5
12:30 - 13:45	**Lunch**	75
13:45 - 14:00	**Bus prep**	15
14:00 - 15:00	**Bus leaves for trip to Sugar Shack, leave at 14:00**	60
15:00- 15:10	**Group Photo**	10
15:10 - 17:30	**Breakout discussions at Sugar Shack**	120
17:30 - 18:30	**Free time , exploring the sugar shack**	
from 18:30	**Dinner at Sugar Shack**	
from 20:30	**Return to hotel**	**500**

Fri, 17 April - Day 3

8:55 - 9:00	**Intro, housekeeping**	5
	5-year plan discussions - 10 min per objectives: 3 min breakout summaries & 7 min discussion	
9:00 -9:50	**A. Building the ocean prediction capacity of the future (5 obj)** 1. Data assimilation: Improving ocean data assimilation capacity - **Greg Smih (ECCC)** 2. Verification: Research to improve monitoring for ocean prediction accuracy and utility by developing a common framework by which operational centres can participate in regular system inter-comparisons and verifications - **Fabrice Hernandez (IRD) and Chunxue Yang (CNR)** 3. Observing system evaluations: Contributing to projects and assessment to better design observing systems and assess the observation impact on prediction -**Yosuke Fujii (MRI-JMA)** 4. Models: Collaborating with various science R&D groups through OceanPredict task teams to improve ocean prediction - **Alex Kurapov (NOAA) & Stefano Ciavatta (MOI)** 5. Visualisation: Collaborating with ocean product developer and ocean services to improve - **Yann Drillet (MOI)**	50

9:50- 10:30	**B. Strengthening engagement with the international ocean science community (4 obj)** 6. Value-chain: Nurturing sustained productive dialogues with global and regional in-situ and satellite observing system agencies, coordinating R&D efforts with intermediate value-chain users and contributors such as coastal and biogeochemical prediction systems, and building close relationships with science partners and user groups to create a framework of operational oceanography. - **Fraser Davidson (ECCC)** 7. Operationality: Supporting the transition from research and development to operations of prediction system improvements by reporting relevant scientific developments to ETOOFS and the OceanPredict systems. - **David Ford (Met Office)** 8. International collaborations: Actively contributing to the UN Decade of Ocean Science goals for Sustainable Development. - **Jae-Il Kwon (KIOST)** 9. Downstream: Promoting access to data and information products and enhanced uptake of ocean analysis and forecasting products with governments, the public and private sector. - **Joanna Staneva (Hereon)**	40
10:30 - 11:00	**Tea/coffee**	30
11:00 - 11:40	**C. Co-design and co-develop ocean prediction and ocean observing systems (4 obj)** 10. Partnerships: Develop strong partnership with observation and NWP agencies with the objective to co-design/co-develop ocean observing and prediction systems - **Pierre-Yves Le Traon (MOI)** 11. Monitoring and assessments: Set up and improve monitoring systems for assessing the impact of observations and sharing results with associated partners. Increase use of these systems by operational centres. - **Andy Moore (UCSC)** 12. New observations: Engage key-observing and key-end-user-focussed partners to evaluate and communicate impact of new ocean observing systems **- Elisabeth Remy (MOI)** 13. Improving observation and prediction systems: Fostering and coordinating the development of emerging areas and new ocean monitoring, modelling and assimilation components to improve ocean forecasting and observing systems for both operational implementation and research (including physical, biogeochemical, and biological/ecological observations) - **Rachel Furner (ECMWF) & Anass El Aouni (MOI)**	40

11:40 - 12:20	**D. Increasing societal impact of ocean prediction (4 obj)** 14. Routine impact assessments for user benefit: Conducting routine impact analysis for various aspects of ocean observing systems on improving end user experience, as well as impact on other environmental prediction components - **Kristian Mogensen (ECMWF)** 15. New capabilities: Enhancing research value and utility for operational prediction centres through targeted collective multi-disciplinary projects on new capabilities for operational oceanography in cooperation with other relevant international research programmes, including adopting machine learning/AI where appropriate and beneficial. **- Marie Drevillon (MOI)** 16. Outreach - learning: Promote an increase in understanding and uptake of ocean prediction science and products by promoting knowledge and sharing of information equitably around the world. This will be achieved through organising and preparing symposia, summer schools, training workshops, online training and ocean literacy material, as well special publications. The goal is to nurture a growing community of scientists, students and public in general, on operational oceanography covering ocean observations, ocean prediction science, operational prediction systems, products, end use tools, downstream services and societal benefits. - **Kirsten Wilmer-Becker (Met Office)** 17. Outreach – supporting new operational system utility: Collaborate with upcoming prediction systems to support the transition from research to operations and facilitate end use - **Jae-Il Kwon (KIOST)**	40
12:20 -12:30	Wrap up discussion - 5 -year plan	10
12:30 - 14:00	**Lunch**	90
14:00 - 14:30	**OceanPredict general overview and Events -** Kirsten Wilmer-Becker (Met Office)	30
14:30 - 15:00	**Summary discussion and Wrap up -** Marie Drevillon (MOI) and Greg Smith (ECCC)	30
15:00	**Close**	
		360

Appendix B – Presentation links

No	Session / presentation title (pdf)	Presenter (affiliation)	Recording
	1. OPST-12 introduction, objectives and priorities		
1.0	Introduction	Greg Smith (ECCC)/ Kirsten Wilmer-Becker (Met Office)	
1.1	Meeting structure and objectives	Marie Drevillon (MOI) and Greg Smith (ECCC)	
	2. Science overview		
2.1	OP-DCC and UN decade	Enrique Alvarez (MOI)	
2.2	ForeSea progress	Eric Chassignet (FSU)	
2.3	GOOS Status (provided by Joanna Post)	Pierre-Yves Le Traon (MOI)	Recording
2.4	Satellite observations for ocean prediction	Pierre-Yves Le Traon (MOI)	Recording
2.5	AI transformation	Rachel Furner (ECMWF) & Anass El Aouni (MOI)	
2.6	HPC developments (GPUs, differential modelling)	Kristian Mogensen (ECMWF)	
2.7	Digital Twins (DITTO)	Joanna Staneva (Hereon)	
2.8	Joint Collaboration Board (JCB)	Fraser Davidson (ECCC)	
2.9	(JWGFVR) Joint Working Group on Forecast Verification Research and related WMO activities	Barbara Casati (ECCC)	
	3. Operational systems		
3.1	OPOS-WG introduction	David Ford (Met Office) & Fraser Davidson (ECCC)	
3.2	UK system	David Ford (Met Office)	
3.3	France system	Yann Drillet (MOI)	
3.4	Korea system	Jae-Il Kwon (KIOST)	
3.5	Australia system	Mikhail Entel (BoM)	
3.6	Japan system	Yosuke Fujii (MIR-JMA)	
3.7	USA system	Alex Kurapov (NOAA)	
3.8	Canada system	Greg Smith (ECCC)	
3.9	ECMWF system	Kristian Mogensen (ECMWF)	
3.10	Updates from other systems	David Ford (Met Office) & Fraser Davidson (ECCC)	
	4. Task Teams updates		
4.1	IV-TT	Chunxue Yang (CNR)	
4.2	COSS-TT	Joanna Staneva (Hereon)	

4.3	MEAP-TT	Stefano Ciavatta (MOI)	
4.4	DA-TT	Sergey Frolov (NOAA)	
4.5	OSEval-TT/ SynObs	Yosuke Fujii (MRI/JMA) & Elisabeth Remy (MOI)	
4.6	CP-TT	Kristian Mogensen (ECMWF)	
4.7	AI-TT	Rachel Furner (ECMWF) & Anass El Aouni (MOI)	
	5. Breakout session results		
5.1	Data assimilation	Greg Smith (ECCC)	
5.2	Verification	Chunxue Yang (CNR)	
5.3	Observing system evaluations	Yosuke Fujii (MRI-JMA)	
5.4	Models	Alex Kurapov (NOAA)	
5.5	Visualisation	Yann Drillet (MOI)	
5.6	Value-chain	Fraser Davidson (ECCC)	
5.7	Operationality	David Ford (Met Office)	
5.8	International collaborations	Pierre-Yves Le Traon (MOI)	
5.9	Downstream	Joanna Staneva (Hereon)	
5.10	Partnerships	Eric Chassignet (FSU)	
5.11	Monitoring and assessments	Andrew Moore (UCSC)	
5.12	New observations	Elisabeth Remy (MOI)	
5.13	Improving observation and prediction systems	Anass El Aouni (MOI)	
5.14	Routine impact assessments	Kristian Mogensen (ECMWF)	
5.15	New capabilities	Marie Drevillon (MOI)	
5.16	Outreach - learning	Kirsten Wilmer-Becker (Met Office)	
5.17	Outreach - supporting new operational system utility	Jae-Il Kwon (KIOST)	
	6. OP programme office report		
6.1	OceanPredict - general overview and events	Kirsten Wilmer-Becker (Met Office)	

Appendix C – List of participants

Not all attendees were able to participate in person; some joined the meeting online.

No	First name	Last name	Affiliation
1	Enrique	Alvarez Fanjul	Mercator Ocean International
2	Laurent	Bertino	NERSC
3	Barbara	Casati	Environment and Climate Change Canada
4	Eric	Chassignet	Florida State University
5	Marcin	Chrust	ECMWF
6	Stefano	Ciavatta	Mercator Ocean International
7	Stefania	Ciliberti	NowSystems
8	Stephanie	Cuven	Mercator Ocean International
9	Fraser	Davidson	ECCC
10	Pierre	De Mey	CNRS/LEGOS
11	Marie	Drevillon	Mercator Ocean International
12	Yann	Drillet	mercator ocean
13	Anass	El Aouni	Mercator Ocean International
14	Mikhail	Entel	Bureau of meteorology
15	David	Ford	Met Office
16	Sergey	Frolov	noaa
17	Yosuke	Fujii	JMA/MRI
18	Rachel	Furner	ECMWF
19	Isabelle	Gaboury	Fisheries and Oceans Canada
20	Fabrice	Hernandez	IRD/LEGOS
21	Nam-Hoon	Kim	Korea Institute of Ocean Science & Technology
22	Alexander	Kurapov	NOAA
23	Jae-Il	Kwon	Korea Institute of Ocean Science & Technology
24	Yvonnick	Le Clainche	Fisheries and Oceans Canada
25	Pierre-Yves	Le Traon	Mercator Ocean International
26	Guimei	Liu	NMEFC
27	Simona	Masina	CMCC
28	Kristian	Mogensen	ECMWF
29	Andrew	Moore	UC Santa Cruz
30	Elisabeth	Remy	Mercator Ocean International
31	Hal	Ritchie	Environment and Climate Change Canada
32	Andreas	Schiller	Unaffiliated
33	Ann Kristin	Sperrevik	MET Norway
34	Joanna	Staneva	Helmholtz Zentrum HEREON
35	Clemente	Tanajura	UFBA and REMO
36	Hendrik	Tolman	NOAA / National Weather Service
37	Simon	van Gennip	Mercator Ocean
38	Anthony	Weaver	CERFACS
39	Kirsten	Wilmer-Becker	Met Office

40	Chunxue	Yang	CNR-ISMAR
41	Andrew	Peterson	ECCC

Appendix D – Task Team summary details

A. Intercomparison and Validation (IV-TT)

Presented by Chunxue Yang (CNR)

Activities, Challenges and Future Plans

The Intercomparison and Validation Task Team (IVTT) has recently entered a new phase of leadership, with Chunxue, Stefania and Babette taking over as co-chairs from Greg Smith and Fabrice Hernandez. The team has a strong and diverse membership of more than 25 experts and aims to strengthen engagement and collaboration over the next five years.

Achievements and Current Activities

A major recent achievement is the submission of a review paper to the *Bulletin of the American Meteorological Society (BAMS)*, summarising more than 12 years of intercomparison and validation activities. The paper highlights key lessons learned and the development of internationally recognised Class 4 verification metrics, which provide a standardised framework for evaluating operational ocean forecasting systems.

The work has successfully established common approaches for forecast verification across international forecasting centres and has become an important legacy for the ocean prediction community. The Class 4 framework has enabled consistent assessment of forecast skill and supported improvements in ocean forecasting systems worldwide.

Current Challenges

Several challenges remain:

- Limited availability of independent observations for validation, particularly in the Arctic and coastal regions.
- Restricted coverage of variables used in verification, with biogeochemical and sea-ice variables still underrepresented.
- The need to transition verification methods from research activities to fully operational services.
- Difficulties in assessing emerging forecasting approaches, including AI-based forecasting systems.
- A need for updated approaches to ensemble forecast verification as ensemble systems become increasingly common.

Discussion also highlighted the importance of maintaining independent validation datasets. Participants noted the value of withholding subsets of observations for verification purposes, while recognising the operational need to assimilate as much observational data as possible.

Expanding Collaboration

The IV-TT is actively strengthening links with other OceanPredict task teams and initiatives, including:

- AI and machine learning activities (AITT)
- OceanBench and OceanForecasting benchmark initiatives
- Coastal forecasting task teams
- Observation system evaluation groups
- Marine Environment Prediction (MAR-EP)
- OceanPrediction Decade Collaborative Centre (DCC)

A key theme throughout the discussion was the importance of connecting forecast verification with observing system design. Improved validation metrics could help identify regions where forecast uncertainty is highest and where additional observations would provide the greatest benefit.

Future Plans

The team plans to expand and modernise verification activities by:

- Further developing and operationalising Class 4 metrics.
- Extending verification to regional and coastal forecasting systems.
- Supporting validation of AI-based forecast systems.
- Developing harmonised approaches for ensemble forecast verification.
- Including a wider range of observational datasets and variables.
- Strengthening links between verification and observing system evaluation.

To foster engagement and attract new contributors, the team will launch an online seminar series in which operational centres can present their validation activities and share best practices.

An in-person IVTT meeting is planned for **11–13 November 2026 in Shanghai**, where particular attention will be given to engaging researchers developing AI-based ocean forecasting systems and strengthening collaboration across OceanPredict task teams.

Key Discussion Points

Participants highlighted a need to review and renew task team membership, noting that some listed members are retired or no longer actively involved in the field. The proposed seminar series was seen as a valuable mechanism for attracting new participants and strengthening the verification community.

There was also strong support for closer collaboration with observation system experts to use verification results and model uncertainty information to guide future observational network design.

Contribution to the OceanPredict Strategy

The IVTT directly supports OceanPredict's strategic goals by:

- Providing standardised verification and validation methodologies.
- Developing new performance metrics for next-generation forecasting systems.
- Supporting operational ocean forecasting and reanalysis activities.
- Enhancing international collaboration across forecasting, observing and AI communities.
- Contributing to monitoring, assessment and benchmarking frameworks necessary for future ocean prediction services.

Overall, the task team aims to build a common, reproducible and internationally accepted framework for evaluating ocean forecasting systems, ensuring that emerging technologies, higher-resolution models and AI-based approaches can be assessed consistently and effectively.

B. Coastal Ocean and Shelf Seas (COSS-TT)

Presented by Alex Kurapov (NOAA)

The Coastal Task Team (Coast TT) focuses on advancing scientific understanding, operational forecasting, and international collaboration in coastal ocean prediction. Coastal forecasting presents unique challenges because coastal environments operate at smaller spatial scales where complex, highly variable processes dominate, including tides, shelf dynamics, river influences, storm surges, compound flooding, and estuarine interactions. These processes require higher-resolution observations, models, and forecasting approaches than those typically used for regional and global ocean prediction.

Current Activities

A major strength of Coast TT is its role as a coordinating body for a geographically dispersed community. The team held a successful in-person meeting in Brest, France, in 2025, which generated significant momentum, including a topical collection in *Ocean Dynamics* that remains open for submissions. The team also continues to organize the Coastal Ocean Modelling Seminar series, which serves as an important forum for sharing scientific advances, including emerging applications of artificial intelligence (AI).
The next Coast TT meeting is planned for February 2027 near Rio de Janeiro, immediately following the UN Ocean Conference (UNOC).

Strategic Priorities

The task team's overarching goal is to move coastal prediction toward a more integrated forecasting system that links global, regional, and coastal scales. While many coastal systems currently operate independently, the vision is to create stronger connections between observations, data assimilation, modelling, verification, and user services.

Key areas of focus include:

- Integration of coastal systems into broader ocean prediction frameworks.
- Strengthening research-to-operations pathways.
- Developing interoperable and reproducible modelling workflows.
- Building stronger links between scientists, operational centres, stakeholders, and end users.
- Supporting coastal resilience, ecosystem management, and blue economy applications.

Scientific and Technical Challenges

Several critical gaps were identified:

Data Assimilation

Data assimilation remains a major bottleneck for improving coastal forecast accuracy. Although many coastal observations exist, integrating emerging observing technologies—including HF radar, SWOT satellite measurements, and high-resolution current observations—remains challenging.

There is growing interest in:
- AI-enhanced and hybrid data assimilation approaches.
- Ensemble forecasting systems for coastal prediction.
- Better use of high-resolution observational datasets.

Observations

Coastal systems require substantially more high-resolution observations than are currently available, particularly in estuaries and nearshore regions. While new observing systems such as SWOT offer unprecedented opportunities, challenges remain regarding data accessibility, processing, and operational integration.
AI methods are increasingly being explored to fill observational gaps and generate higher-resolution coastal products.

Modelling

Future coastal prediction systems must better represent the full land-sea continuum by integrating river discharge, estuarine processes, coastal circulation, atmosphere, ocean, and hydrological components. Wider adoption of coupled forecasting systems, GPU-enabled models, and AI-based downscaling and emulation techniques is expected over the next five years.

Verification and Benchmarking

Unlike global forecasting systems, coastal models use a wide variety of grids, domains, and variables, making standardized verification difficult. The team highlighted the need for:

- Common validation metrics and benchmarking frameworks.
- Harmonised assessment methods across coastal systems.
- Greater use of shared validation tools.

The FOCUS and EDITO initiatives were highlighted as important efforts toward developing common validation toolboxes and reproducible assessment frameworks for coastal forecasting systems worldwide.
Participants also discussed opportunities to integrate new high-resolution satellite datasets, including 5 Hz sea-level anomaly products from Sentinel-3 and Sentinel-6, as well as SWOT observations, into coastal verification activities.

User-Oriented Services

A recurring theme was the need to better link forecast system development with societal needs. Coastal prediction products must increasingly support:

- Coastal hazard forecasting.
- Flood risk management.

- Ecosystem monitoring.
- Marine spatial planning.
- Blue economy and renewable energy applications.

The team emphasised co-design approaches with users and stakeholders, while recognising the importance of communicating forecast uncertainty clearly and transparently.

Partnerships and Future Collaboration

Coast TT maintains strong links with several international initiatives, including:

- CoastPredict
- OceanPrediction Decade Collaborative Centre (DCC)
- OceanPredict
- WMO coastal services activities
- Emerging Digital Twin Ocean initiatives

The importance of stronger collaboration with other OceanPredict task teams was repeatedly emphasised, particularly around AI, data assimilation, validation, observations, and marine ecosystem prediction.
A specific opportunity identified during discussion was closer collaboration with the Marine Ecosystem Prediction (MEAP) community to strengthen the integration of ecosystem variables into coastal forecasting systems.

Outlook

The Coastal Task Team aims to evolve from a collection of loosely connected coastal prediction efforts into a more integrated and interoperable international community. Over the next five years, the team will focus on improving coastal forecasting skill, harmonising validation approaches, incorporating emerging observing technologies and AI methods, strengthening user engagement, and ensuring coastal systems become a fully integrated component of the wider ocean prediction enterprise.

C. Marine Ecosystem Analysis and Prediction (MEAP-TT)

Presented by Stefano Ciavatta (MOI)

The Marine Ecosystem Analysis and Prediction (MEAP) Task Team aims to develop and operationalise the “green ocean” component of OceanPredict by advancing marine biogeochemical and ecosystem modelling, prediction, and observations. The team currently consists of 28 members from 22 organisations across 12 countries and five continents, reflecting its broad international reach.

Recent Progress and Team Activities

Over the past year, the task team has held regular meetings and seminars to strengthen collaboration and knowledge exchange. A recent member survey highlighted support for moving towards thematic working groups and expanding participation beyond a strict one-member-per-institution model. The team has also been active in outreach and scientific dissemination, including successful sessions at the Ocean Sciences Meeting and participation in the European Digital Twin Ocean Forum and other high-level policy and science events.

Advancing Operational Marine Ecosystem Prediction

A major focus has been the Horizon Europe **NECTON** project, a large international initiative endorsed by the UN Ocean Decade. NECTON brings together many MEAP members and has significantly advanced the operational modelling of marine ecosystems.

Key achievements include:

- Development of new operational products for marine pollution, fisheries, benthic ecosystems, and biodiversity.
- Creation of 27 new ecosystem-related variables.
- Standardisation of 20 new ecosystem variables through CF conventions.
- Production of publicly accessible ecosystem simulations, hindcasts, and climate projections through dedicated online visualisation platforms.
- Development of applications supporting organisations such as FAO, OSPAR, ICES and regional fisheries bodies.

The project aims to move beyond traditional physical and biogeochemical forecasting by providing operational products relevant to fisheries management, ecosystem monitoring, biodiversity conservation, and environmental policy.

Building Ecosystem Modelling Capacity

An important achievement has been the establishment of a flexible framework for operational biogeochemical modelling that can be coupled with major ocean circulation models, including NEMO, HYCOM, MOM and ROMS. This facilitates international collaboration and allows ecosystem modelling capabilities to be more easily adopted by forecasting centres worldwide.

The team is also establishing an international consortium to support wider implementation and sharing of operational marine biogeochemical models.

Digital Twins and Emerging Technologies

MEAP members are heavily involved in several Digital Twin Ocean initiatives.

Examples include:

- Contributions to the European Digital Twin Ocean.
- Integration of ecosystem models into EDITO and related Digital Twin programmes.
- Participation in the Earth-Hong Kong project, which is developing a regional Digital Twin Earth System for China.
- Collaboration with the Met Office and the Barcelona Supercomputing Centre to explore the integration of physical and biogeochemical information into seasonal forecasting systems.

These activities demonstrate how ecosystem models are becoming an increasingly important component of next-generation ocean prediction systems.

Key Challenges and Priorities

Looking ahead, the team identified several priorities for the next five years:

Operationalisation

Marine ecosystem models are reaching a level of maturity where they can become routine components of operational forecasting systems, similar to physical ocean forecasting today.

Observations and Data Integration

Stronger links are needed with marine ecosystem observing networks, including:

- Marine Biodiversity Observation Network (MBON)
- Biogeochemical Argo
- GOOS Biogeochemistry and Biology Panels
- ESA Climate Change Initiative programmes

Improved integration of observations and models will support more reliable ecosystem forecasts.

Indicators and Assessment Tools

The team plans to develop ecosystem indicators for:

- Ocean monitoring
- Ecosystem health assessment
- Climate impacts
- Marine Protected Areas (MPAs)
- Fisheries and biodiversity management

These indicators will support decision-makers and policy frameworks at regional and international levels.

Research-to-Operations

A major objective is to accelerate the transition of ecosystem modelling from research environments into operational services, ensuring products are routinely available and trusted by users.

Collaboration and User Engagement

The MEAP team emphasised the need to co-develop ecosystem forecasting products with stakeholders, including fisheries agencies, conservation bodies, marine protected area managers and policymakers.

Partnerships with organisations such as FAO, ICES, regional fisheries commissions, GOOS and OceanPredict's Decade Collaborative Centre are seen as essential for ensuring ecosystem forecasts address real-world management needs.

Contribution to the OceanPredict Five-Year Plan

MEAP's primary contribution is to make marine ecosystem prediction a fully operational component of the global ocean prediction enterprise. Through advances in biogeochemical modelling, ecosystem indicators, Digital Twin Ocean technologies, ecosystem observations and stakeholder engagement, the task team aims to provide the scientific foundation needed for sustainable ocean management, biodiversity conservation, climate adaptation and ecosystem-based decision-making.

Overall, the team is moving the community beyond physical ocean forecasting towards integrated prediction systems that combine physical, biogeochemical and ecological processes, helping deliver a more complete and actionable understanding of future ocean conditions.

D. Data Assimilation (DA-TT)

Presented by Sergey Frolov (NOAA)

The Data Assimilation Task Team (DATT) continues to play a central role in advancing ocean prediction through the integration of observations and models. While many team members are actively involved in projects and operational developments that support OceanPredict objectives, recent discussions focused less on specific technical activities and more on the future sustainability of the data assimilation community itself.

A Changing Community

A major challenge identified during the recent leadership transition is the difficulty of attracting and retaining the next generation of data assimilation scientists. The community increasingly consists of mid-career and senior experts, while comparatively few early-career researchers are entering the field.

One concern is the perceived "brain drain" towards artificial intelligence (AI) and machine learning (ML), which are often seen as more attractive and visible research areas. As a result, finding new leaders to take on key roles within the data assimilation community has become increasingly difficult.

However, participants emphasized that this trend should not necessarily be viewed negatively. Many argued that AI and data assimilation are closely related disciplines and that future developments are likely to create stronger synergies rather than competition between the two communities.

Data Assimilation and AI: Convergence Rather Than Competition

Several contributors highlighted that many AI methodologies share common foundations with data assimilation. Rather than competing fields, AI and data assimilation are increasingly converging through:

- Hybrid AI-data assimilation approaches.
- AI-enhanced forecast systems.
- Machine learning methods for observation processing and error estimation.
- Ensemble and uncertainty quantification techniques.

There was optimism that as AI matures, researchers from the AI community may increasingly engage with data assimilation problems, leading to what was described as a possible future "reverse brain infusion" into ocean data assimilation.

Experiences from the atmospheric forecasting community suggest that physical scientists can often adopt AI techniques more quickly than AI specialists can acquire the detailed oceanographic and physical understanding required for operational forecasting systems.

Workforce and Skills Challenges

Participants acknowledged that attracting people to data assimilation has always been difficult. The field requires expertise across multiple disciplines, including:

- Oceanography and geophysical fluid dynamics (GFD)
- Numerical modelling
- Statistics and optimisation
- Software engineering
- High-performance computing

This combination of skills creates a high barrier to entry. The growing popularity of AI has amplified the challenge by attracting students toward machine learning while fewer are pursuing traditional data assimilation training.

Several attendees suggested that improving the visibility of data assimilation and positioning it as part of the broader AI ecosystem could help attract new researchers.

Emerging Research and Development Initiatives

Despite workforce concerns, significant new developments are underway.

A major new Horizon Europe project, **COMEDI**, will begin in September and aims to improve operational ocean data assimilation systems supporting the Copernicus Marine Service.

The project includes:

- Development of advanced ensemble-based background error covariances.
- Improved observation error modelling.
- Hybrid AI-data assimilation approaches.
- Open-source software development.
- Greater sharing and consolidation of tools across operational centres and research institutions.

A key objective is to reduce fragmentation within the community by encouraging common frameworks and shared infrastructure.

Participants viewed this collaborative approach as essential given the limited number of specialists working in ocean data assimilation worldwide.

Community Infrastructure and Open Frameworks

The discussion also highlighted efforts to make ocean data assimilation more accessible through community frameworks such as **JEDI (Joint Effort for Data Assimilation Integration)**.

Ocean models including MOM6 and ROMS have already been coupled with JEDI, offering opportunities for:

- Easier development of ocean data assimilation systems.
- Greater interoperability with atmospheric systems.

- Support for coupled atmosphere-ocean-biogeochemical assimilation.
- Broader community participation.

Although implementation remains technically challenging, these shared frameworks represent an important step toward reducing barriers for new users and research groups.

Outlook and Contribution to OceanPredict

Looking ahead, DATT sees its future increasingly linked with developments in AI, ensemble forecasting, and coupled Earth-system prediction. Key priorities include:

- Strengthening links with the AI Task Team (AITT).
- Developing hybrid AI-data assimilation methods.
- Sharing tools, software, and best practices across institutions.
- Supporting open-source and collaborative development.
- Building the next generation of data assimilation expertise.

While concerns remain about workforce renewal, the overall outlook was positive. The emergence of large collaborative projects, increasing integration with AI, and community tools such as JEDI suggest that data assimilation will remain a foundational component of future operational ocean prediction systems and a critical contributor to OceanPredict's long-term strategy.

E. Observing System Evaluations (OSEval-TT)

Presented by Yosuke Fujii (MRI/JMA) and Elisabeth Remy (MOI)

The Ocean Observing Evaluation Task Team (OOETT) focuses on assessing the value of ocean observations for prediction systems and using this knowledge to guide the design of more effective future observing networks. Its flagship activity is **SYNOBS (Observing Network for Ocean Prediction)**, a UN Ocean Decade project that brings together forecasting centres, observing-system experts, GOOS, WMO, satellite agencies, and other international partners.

SYNOBS: Assessing Observation Impact

The central objective of SYNOBS is to evaluate how different observing systems contribute to ocean analyses and forecasts through coordinated Observation System Experiments (OSEs) and Observation System Simulation Experiments (OSSEs). A particular strength of SYNOBS is its use of multiple independent forecasting systems, allowing robust conclusions that do not depend on a single model or data assimilation system.

Results demonstrate the critical role of observations in reducing uncertainty. Multi-system experiments show that assimilating observations significantly narrows the spread among ocean forecasting systems, improving consistency and confidence in products such as ocean heat content, tropical cyclone heat potential, and ENSO-related indicators. Argo profiling floats were shown to have particularly large positive impacts, while impacts vary considerably across observing platforms and forecasting systems.

A publicly accessible SYNOBS database hosted by JAMSTEC now contains coordinated experiment outputs and diagnostics, enabling wider community participation and analysis.

Recent Activities and Achievements

Since 2025, SYNOBS has expanded its international engagement through presentations, workshops and collaborations with organizations including:

- GOOS
- Ocean Observing Co-Design
- WMO
- TPOS (Tropical Pacific Observing System)
- CLIVAR
- Various satellite agencies and observational programmes

A significant milestone was the extension of SYNOBS through **December 2030**, aligning its activities with the conclusion of the UN Ocean Decade.

The team also contributed to a major *Frontiers in Marine Science* special collection on observation impact assessment, which assembled a substantial body of work on ocean observing system evaluation.

International Workshop and Community Building

A major joint workshop between SYNOBS and Ocean Observing Co-Design will take place in Japan, bringing together the forecasting and observing communities. More than 60 abstracts were submitted, reflecting growing international interest in observation impact assessment and observing system design.

Workshop themes include:

- Better use of observational data.
- Evaluation of observation impacts.
- Ocean observing co-design.
- Future observational strategies.

This collaboration is helping bridge the long-standing gap between ocean prediction centres and observing-system planners.

Future Priorities

Operational Observation Impact Monitoring

A key ambition is to move from occasional observing system experiments to more routine and near-real-time monitoring of observation impacts. Achieving this will require closer collaboration with the Data Assimilation Task Team (DA-TT) to develop common methodologies and diagnostic tools.

The goal is to provide regular feedback to observing networks not only about which observations are used, but also about the value they provide to forecasting systems.

User-Oriented Evaluation

The team recognises that traditional metrics such as RMS error reduction are no longer sufficient. Future assessments should increasingly evaluate the impact of observations on real-world applications, including:

- Weather and climate prediction.
- Hazard forecasting.
- Marine ecosystem management.
- Coastal services.
- Sector-specific decision making.

This approach would better demonstrate societal benefits and help justify continued investment in observing networks.

Expanding Beyond Physical Oceanography

To date, most observing-system evaluations have focused on physical ocean variables. Future work will increasingly extend to:

- Biogeochemistry (BGC).
- Marine ecosystems.
- Coupled ocean-atmosphere prediction.
- Coastal observing systems.
- Emerging observing technologies.

Closer collaboration with MEAP (Marine Ecosystem Analysis and Prediction), COSS-TT and DA-TT was identified as a major priority.

Challenges

One of the most pressing concerns raised during discussions was the difficulty of maintaining critical observing networks. Participants highlighted that several long-term observing systems, including the PIRATA tropical Atlantic mooring array, are currently facing funding pressures and possible reductions in coverage.

A key message was that the community must move beyond simply demonstrating scientific value through OSEs and OSSEs and become more effective at communicating the operational and societal importance of observations to decision-makers and funding agencies.

Contribution to the OceanPredict Five-Year Plan

OSEVal-TT and SYNOBS directly support OceanPredict's objectives by providing evidence-based assessments of observing systems, improving observation design, strengthening links between observing and forecasting communities, and developing methodologies for future integrated Earth-system prediction.

Looking forward, the team aims to build a more operational, collaborative and application-focused framework for evaluating observations, while helping ensure that essential ocean observing networks are sustained and adapted to meet future forecasting and societal needs.

F. Coupled Prediction (CP-TT)

Presented by Kristian Mogensen (ECMWF)

The Coupled Prediction Task Team (CP-TT) focuses on advancing coupled ocean–atmosphere prediction systems and understanding how interactions between different components of the Earth system improve forecasting skill. While coupled prediction is now operational in several forecasting centres worldwide, the task team acknowledged that progress within CP-TT itself has been slower than hoped, with limited activity and challenges maintaining engagement across its current membership.

Current Status and Activities

The team is undergoing a period of renewal and reflection. Membership records require updating, as several listed members have changed roles or institutions. Despite these challenges, preparations are underway for a joint **Coupled Prediction & Data Assimilation Workshop**, scheduled for October at ECMWF. The workshop aims to bring together coupled prediction and data assimilation communities, recognising that accurate prediction depends not only on improved models but also on high-quality initial conditions.

The meeting is expected to serve as a catalyst for future CP-TT activities and contribute to updating earlier white papers on coupled prediction, which were developed nearly a decade ago. Given the rapid evolution of coupled forecasting systems since then, a revised assessment of the current state of the science is considered timely.

To stimulate broader engagement, the team is also launching a seminar series where forecasting centres can present their coupled prediction systems, share experiences, and discuss emerging challenges.

Scientific Priorities

A central scientific question for CP-TT is: **How much coupling is actually needed?**

While coupled atmosphere–ocean prediction is now widely adopted, the degree to which additional coupling improves ocean forecasts remains an open question. The team would like to explore:

- The benefits of ocean–atmosphere coupling for ocean prediction.
- The role of coupling in regional versus global forecasting systems.
- The impact of coupling with sea ice, waves, biogeochemistry and ecosystems.
- The importance of coupling frequency and model resolution.

The goal is to establish practical guidance on where coupling delivers measurable forecasting benefits and where simpler approaches may still be sufficient.

Tropical Cyclones and Extreme Events

One proposed collaborative activity is a coordinated analysis of tropical cyclone forecasts from operational coupled systems.

Rather than requiring centres to run new experiments, participants would share existing operational outputs to compare:

- Sea-surface temperature (SST) responses.
- Upper-ocean heat content changes.

- Cold-wake development beneath storms.
- Ocean feedbacks to atmospheric intensification.

The intention is to use common observational datasets to determine how well coupled systems represent ocean responses to extreme weather events and identify differences between forecasting systems.

Polar and Sea-Ice Prediction

Discussion highlighted the Arctic and polar regions as an important opportunity for future collaboration.

Participants noted that polar prediction remains particularly challenging due to:

- Sparse observations.
- Strong atmosphere–ocean–ice interactions.
- Emerging sea-ice processes.
- Rapid environmental change.

The upcoming International Polar Year (IPY) was identified as a potential focus for coordinated CP-TT activities, including model intercomparisons and evaluation using newly available observational datasets from polar and marginal ice zones.

Coupled Prediction Beyond Atmosphere and Ocean

Several participants encouraged CP-TT to broaden its scope beyond traditional atmosphere–ocean coupling to include:

- Sea ice.
- Waves.
- Marine biogeochemistry.
- Ecosystem forecasting.
- Coastal prediction systems.

There was also discussion about whether CP-TT could provide a home for broader numerical modelling questions within OceanPredict, particularly around model resolution, process representation, and operational forecasting system design.

Resolution and Emerging Technologies

The team recognised that model resolution is becoming an increasingly important issue, particularly as systems move toward eddy-resolving and submesoscale-resolving capabilities.

Future topics may include:

- The predictive value of higher ocean resolution.
- Representation of submesoscale processes.
- Interactions between global and coastal models.
- The role of machine learning and AI in coupled prediction systems.

Participants stressed that future forecasting systems will likely combine traditional coupled models with AI-based approaches rather than treating them as separate pathways.

Challenges and Outlook

The principal challenge remains converting good ideas into sustained collaborative activities. The task team has identified several scientifically important topics—including coupling impacts, tropical cyclone prediction, polar forecasting and model resolution—but has yet to establish coordinated projects around them.

The October workshop is therefore viewed as a critical opportunity to reinvigorate the community, identify shared priorities and generate concrete collaborative actions.

Contribution to the OceanPredict Five-Year Plan

CP-TT contributes to OceanPredict by improving understanding of how coupled Earth-system processes affect ocean forecasts, promoting collaboration between forecasting and data assimilation communities, and supporting the next generation of integrated forecasting systems. Future priorities include evaluating coupling impacts, expanding collaborations across other task teams, incorporating ecosystem and coastal prediction perspectives, and ensuring that coupled forecasting remains a core component of operational ocean prediction systems.

G. Artificial Intelligence (AI-TT)

Presented by Rachel Furner (ECMWF)

The AI Task Team (AITT) is OceanPredict's newest task team, formally established in 2025 to coordinate and accelerate the use of artificial intelligence (AI) and machine learning (ML) in ocean prediction. Co-chaired by representatives from ECMWF and Mercator Ocean, the team currently comprises 25 members from 17 institutions across 10 countries, representing both operational forecasting centres and research organisations. Beyond the formal membership, the team is building a wider international community through an open mailing list designed to engage scientists from both oceanography and machine learning backgrounds.

Scope and Community

The task team reflects the rapidly evolving landscape of ocean prediction. Members include traditional ocean modellers who are increasingly adopting AI approaches, as well as researchers with stronger machine learning expertise. Activities range from fully data-driven forecasting systems to hybrid approaches that combine physical ocean models with AI components, such as machine-learning-based parameterisations embedded within operational models.

A recurring observation was that hybrid methods remain underrepresented in the broader AI-ocean community, despite growing evidence that they offer a practical pathway toward operational adoption. The task team aims to strengthen the visibility of this work in future workshops and community activities.

Activities to Date

Despite being less than a year old, AITT has established several key initiatives:

- An online seminar series showcasing advances in AI and ocean prediction.
- The first AITT workshop, held alongside OceanPredict activities, which highlighted the breadth of AI applications across ocean prediction.

- Community-building efforts through an open mailing list and outreach to both ocean scientists and machine learning researchers.

The workshop included dedicated discussions on how the task team can best support the community and identified several priorities for the coming years.

Strategic Priorities

1. Community Building

The primary objective is to establish AITT as the focal point for AI in ocean prediction. This includes strengthening links between operational ocean forecasting centres and the wider machine learning community, including academic and industrial AI groups.

Participants highlighted the importance of engaging external AI expertise, noting that rapid advances in weather AI have been driven by collaboration with organisations such as Google, Huawei and NVIDIA.

2. Promoting OceanBench

AITT plans to support wider adoption of **OceanBench**, a community benchmarking framework designed to compare AI models and traditional numerical forecasting systems using common datasets and evaluation metrics.

OceanBench is viewed as an important mechanism for ensuring reproducibility, transparency and rigorous assessment of emerging AI approaches. Close collaboration with the Intercomparison and Validation Task Team (IVTT) will be essential in this area.

3. Lowering Barriers to AI Adoption

A key goal is to make AI tools more accessible to physical oceanographers and operational centres with limited machine-learning expertise.

This includes:

- Providing practical examples and tutorials.
- Supporting frameworks such as ECMWF's **Anemoi** and other relevant AI platforms.
- Developing ocean-specific workflows and training materials.
- Helping users apply AI techniques to real forecasting problems.

The emphasis is on enabling practitioners to experiment with AI quickly without requiring deep expertise in machine learning.

4. Sharing Models, Data and Resources

The team intends to develop community platforms for sharing:

- Trained AI model weights.
- Training datasets.
- Model configurations.
- Best-practice workflows.
- Reproducible experiments.

Such resources would allow centres without access to large GPU systems to benefit from AI developments already completed elsewhere and facilitate more collaborative model development.

Future Opportunities

Several additional opportunities emerged from discussions:

- Creating community challenges and competitions focused on ocean prediction problems, similar to successful initiatives in other AI domains.
- Establishing platforms (potentially GitHub-based) for sharing papers, software, datasets and community news.
- Developing newsletters or regular updates highlighting significant advances in AI relevant to ocean prediction.
- Strengthening links with related international AI activities in CLIVAR, GOOS, WMO and other programmes.

Cross-Cutting Role within OceanPredict

AI-TT is inherently cross-disciplinary and intersects with nearly every OceanPredict task team, including:

- Data Assimilation (DA-TT)
- Intercomparison and Validation (IV-TT)
- Coastal Prediction (COSS-TT)
- Marine Ecosystem Prediction (MEAP-TT)
- Coupled Prediction (CP-TT)
- Observing System Evaluation (OSEval-TT)

The team proposes establishing formal links with these groups through shared members, joint workshops, seminars and collaborative projects.

Vision for the Next Five Years

The long-term ambition is not simply to develop new AI models, but to ensure that AI becomes a well-understood and appropriately applied tool across the ocean prediction community. Success would mean that ocean scientists understand both the opportunities and limitations of AI, have access to shared tools and datasets, and can integrate AI methods into operational prediction systems where they provide genuine benefit.

In this way, AI-TT aims to act as a bridge between ocean science and the rapidly evolving AI ecosystem, helping OceanPredict harness new technologies while maintaining scientific rigor, transparency and operational relevance.