



Technology Forum 2024

**CATCHING THE MOMENTUM IN OCEAN OBSERVING TECHNOLOGY:
OPTIMISING VALUE AND DATA PROVISION**

Operations Committee

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Executive Summary

The **EOOS Technology Forum 2024**, held at **Oceanology International** in London on 13 March 2024, brought together ocean observing technology users, manufacturers, developers and others with an interest in the growth of accessible technologies to observe and understand the ocean. The Technology Forum was titled '**Catching the momentum in ocean observing technology: optimising value and data provision**'.



Understanding the needs of the ocean observing community in regards to accessible technology is key. This is particularly true in collaborative activities with international stakeholders. In Europe there is a growing community working on accessible ocean observing technology issues, often in the framework of funded projects. Strengthened engagement and collaboration with partners around the world, for example via the **UN Ocean Decade**, will optimally advance the access to ocean observing technology, increasing the value of investment in ocean observing and data collection.

Various opportunities and challenges exist for accessible ocean observing technologies. Not least of these is understanding accessibility of technology. Cost, often the greatest factor determining accessibility for users, should be considered with regard to the entire ocean knowledge value chain and not only procurement of platforms, instruments and sensors. To be truly accessible, technologies must be openly developed, produced and distributed with support of the public and private sectors collaboratively. Human resources are key, with training, maintenance, data processing and other operational costs necessary to realise any value from investment in ocean observing technology. Additionally, there is a need to better share, disseminate, showcase and advance innovation in ocean observing technology, while ensuring commercial interests are respected.

Data quality is a key issue for ocean observing technologies of all kinds. Perceptions that high-cost and high-tech ocean observing solutions necessarily deliver higher-quality data than more accessible

EXECUTIVE SUMMARY

alternatives can be difficult to overcome. Metrology, including sensor development, testing and calibration, is essential to the reliability of all ocean observing technologies - relatively small investments in this part of the ocean knowledge value chain provide major benefits to data quality and overall value. It is also imperative to understand the data quality needs of different users and stakeholders. Ensuring proper quantification of data quality is possible with full open metadata, documentation and certification throughout the ocean knowledge value chain and allows users to make the best decisions on ocean observing technology investments according to their specific data needs.

Sustainability of ocean observing technology, in all regards, is a central consideration for all stakeholders. To be truly accessible, ocean observing technologies must be both environmentally sustainable and economically sustainable for manufacturers and users alike. Demand by customers, shareholders and regulation, especially in the growing and maturing Ocean Enterprise, further drives manufacturers towards environmental sustainability of ocean observing technologies. With this in mind, there is a need for a unified, prevailed and applied methodology to assess the environmental impact of ocean observing technologies. Improving the recoverability, repairability and reusability of platforms and sensors when no longer operational, should be a priority. Economic sustainability of technologies is of equal relevance - without a clear business model for manufacturers, technologies can never be accessible to users.



Introduction

The **European Ocean Observing System** (EOOS) is the infrastructure, platforms, sensors and people that gather the required data and information about Europe's ocean, seas and coastal waters. With a **vision** of an EOOS that is sustained and meets the specific needs of users, the **EOOS Framework** has the mission to coordinate and integrate European communities and organisations operating, supporting and maintaining ocean observing infrastructures and activities, fostering collaboration and innovation.

To increase the cost-benefit and sustainability of ocean observing platforms and systems, observers have turned their attention toward technologies that can deliver data from greater coverage at effective cost. The **2024 EOOS Technology Forum brought together technology developers, manufacturers and users to exchange knowledge on platforms and sensors of all types, costs and levels of technical sophistication with the goal to enhance accessibility of ocean observations**. Key technological issues such as ease of maintenance, evolution and adaptation, ease of deployment and sustainability, were discussed. The event identified and promoted emerging synergies in the technology community to advance the optimisation of ocean observing worldwide. **Oceanology International**, which is scheduled every two years in London, is the major event in Europe where a very large number of oceanographic instrumentation manufacturers meet. It was therefore the ideal opportunity to bring together a panel of companies contributing to technological development for oceanographic observation during a workshop, and thus promote the link between the industry and EOOS.

The focus of this event explored the technologies and systems transforming the ongoing operations of critical marine observing infrastructure and initiatives. The innovation and practical steps needed to expand capabilities in terms of value, return-on-investment and data provision while continuing to preserve functional cost-effectiveness and asset integrity were also discussed.

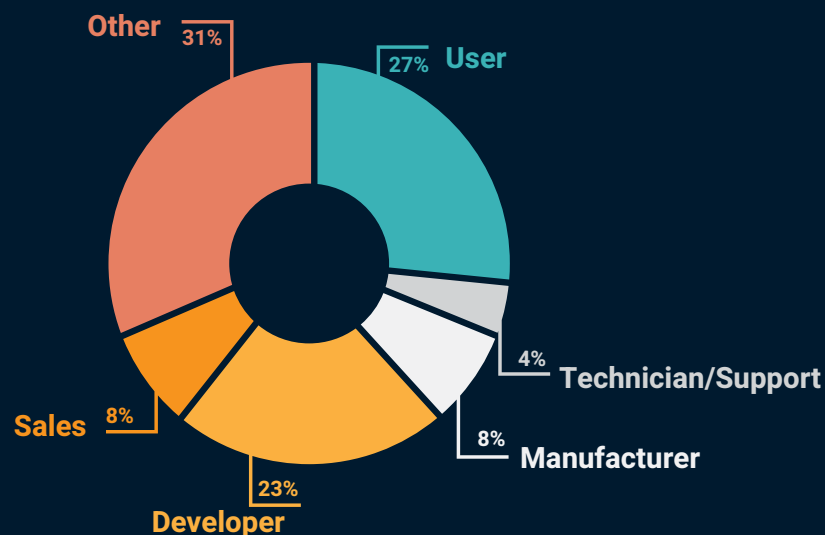
Various polls were launched during the event to give an impression of the profile of attendees and to gather their input and opinions on key questions discussed throughout the Technology Forum.

SLIDO POLLS

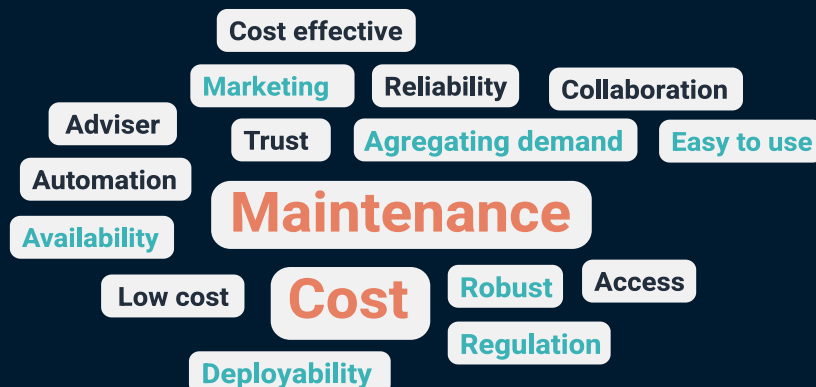
1. In which country are you based?



2. Which best describes your role with ocean observing technology?



3. In one word, what do you consider as the most important aspect in making ocean observing technologies accesible? (e.g. cost, maintenance, adaptability, procurement, etc.)



SESSION 1

Accessible Technology: Needs of the Ocean Observing Community

Laurent Delauney

JERICO COORDINATOR AND RESEARCH AND DEVELOPMENT ENGINEER IN OCEANOGRAPHIC INSTRUMENTATION

Laurent Delauney is the coordinator of the EU projects dedicated to establishing the Joint European Research Infrastructure for Coastal Observation (JERICO). He has worked at Ifremer for 30 years on in-situ monitoring systems development. Laurent Delauney's fields of interest are sensor development for coastal autonomous monitoring stations and seabed observatories, biofouling protection for marine in situ sensors and transfer from research to PME of marine sensors developments and In situ Observation harmonisation process (Best Practices). He is co-chair of the EuroGOOS Technological plan Working Group and Chair of the EOOS Operations Committee.



Moderator

Virginie Van Dongen-Vogels

SCIENCE OFFICER AT THE EUROPEAN GLOBAL OCEAN OBSERVING SYSTEM (EUROGOOS) SECRETARIAT IN BRUSSELS

Virginie facilitates and coordinates operational oceanographic related activities and projects within the European ocean community and is an active member of the Ocean Best Practice System committee. She has extensive sailing and multidisciplinary background (Ecology, Environmental Science, Oceanography (PhD)) and more than 15 years of experiences in the ocean observing realm. Virginie provided her expertise to various national and international research projects (US, EUR, AUS) and has been supporting and actively engaged in the Australian National Mooring Network of the Integrated Marine Observing System (IMOS) since its implementation.



Moderator

This opening session aimed to understand the technology needs of the ocean observing community, and how accessible technologies can be key in efforts to realise the fully operational EOOS. Accessible ocean observing technologies are those that are readily available to the community, and present high value with regards to investment and data provision.

Accessible technologies present a means to observe the ocean, meeting the needs of all users, in an affordable, reliable manner, with solutions that are easy to deploy and maintain, adaptable to changing needs, able to evolve

with new developments, avoiding redundancy. To truly meet the needs of the ocean observing community, it is essential that the data quality of observations is known. Technologies must also be sustainable, both in terms of their environmental impact, and their long-term prospects in the business models of manufacturers and service providers.

This session set the scene for the EOOS Technology Forum 2024, detailing the technology needs of developing observing networks or systems at regional and global scales.

SESSION 1

Session Summary

The EOOS Technology Forum 2024 was opened by Laurent Delauney Co-Chair, EuroGOOS Technology Plan Working Group / Ifremer and Virginie van Dongen-Vogels (EuroGOOS Office). The full event programme was introduced, including sessions on 'Accessible technology: needs of the ocean observing community', 'Opportunities and challenges for accessible ocean observing', 'Data quality aspects of accessible ocean observing technologies', and 'Sustainability aspects of accessible ocean observing technologies'.

Joseph Nolan (EuroGOOS Office) presented a summary of the [European Ocean Observing System \(EOOS\) Strategy 2023-2027](#) and accompanying [Roadmap for Implementation](#). EOOS is a community-driven bottom-up initiative, engaging the broadest spectrum of actors in the European ocean observing community. The EOOS Framework includes operators, managers of networks and infrastructure, scientists, data experts, policymakers, funders and others. It was emphasised that EOOS is currently in a co-design phase during its current strategy period, with the next period to focus on implementation before entering a fully operational phase. The EOOS Technology Forum is organised as part of the EOOS Roadmap for Implementation activity 'Fostering innovation in ocean observing'.

Patrick Gorringe (SMHI) gave an introduction to the concept of accessible ocean observing technology, stressing the avoidance of relative terms such as 'low-cost' and 'low-tech'. European investment in ocean data collection was also noted - approximately € 1.4 billion annually - underlining the major potential benefits that could be achieved with accessible technologies. Additionally, the EU has set a target of 20% of ocean data being collected through citizen science activities by 2025

as part of its [Mission Starfish](#). A growing community is developing around accessible ocean observing technologies in Europe and globally, with new projects such as [LandSeaLot](#) working to develop new technical solutions for cost-efficient ocean observing.

Viviana Piermattei (CMCC) presented the CoastPredict programme of the UN Decade of Ocean Science for Sustainable Development. CoastPredict is a global programme aiming to co-design and implement an integrated coastal ocean observing and predicting system adhering to best practices and standards, designed as a global framework and implemented locally. CoastPredict has six focus areas: Integrated observing and modelling for short term coastal forecasting and early warnings; Future Coastal Ocean climates: Earth System observing and modelling; Solutions for integrated coastal management; Coastal Ocean and Human Health; Coastal Ocean Resource Infrastructure System; and Equitable coastal ocean capacity. Progress in all six focus areas will be enhanced and supported by improved accessibility of ocean observing technologies. Accessible ocean observing technologies are essential to the success of CoastPredict, and enable data collection that will underpin key services, particularly in regions with limited capacity.

Dominique Durand (Covartec AS) gave an introduction to [JERICO](#), the European coastal ocean observing system. Accessible ocean observing technology is essential to the development of JERICO, to densify observations and promote global cooperation. In order to empower citizens in science monitoring, technologies must be robust, easy to use, maintainable, deployable and recoverable, with zero or minimal footprint on the marine environment. Existing technologies can be complemented by data from more accessible solutions.

SESSION 1

Zdenka Willis (Marine Technology Society, MTS) presented the Dialogues with Industry programme and the Ocean Enterprise Initiative launched and run by the Global Ocean Observing System (GOOS), MTS and the National Oceanic and Atmospheric Administration (NOAA) together with partners from the private sector. The growing demand for ocean observing globally will not be met by the science community alone. Engagement with industry is essential to ensure that ocean data are available to all users that need them. Dialogues with Industry set out to connect the public and private sector stakeholders in the GOOS – across the value chain. It aims to expand ocean observations, the market for the private sector, and the Ocean

Enterprise. The [Dialogues with Industry Roadmap](#) details needs and requirements related to the ocean, and defines four market segments across the ocean observing value chain of observing technology, observations, data and information delivery. The initiative aims to improve the marketplace of the ocean enterprise, strengthening ocean observing and developing mutual benefits for the public and private sectors. Accessible ocean observing technologies are of growing importance - strengthening dialogues between users and manufacturers will advance ocean observing and grow the market for such technologies.

Take-Home Messages

- There is a strong need to take **accessible ocean observing technologies** into account at the level of international stakeholders.
- **At European level**, we have a **vision, projects, players** and **a forum to support this**.
- At this stage, it appears that **collaborations on ocean observation** between United States and European Union which started in bilateral research cooperation is now well supported by more global frameworks (i.e. Ocean Decade, GOOS)
- In this respect, **international marine networks have a major role to play**. Amongst all the well-established events, **Oceanology International** is one of the largest.

SESSION 1

Speakers

Joseph Nolan

SCIENCE OFFICER AT THE EUROPEAN GLOBAL OCEAN OBSERVING SYSTEM (EUROGOOS)
SECRETARIAT IN BRUSSELS

Working to facilitate collaboration across the European ocean observing and operational oceanography community, Joseph supports the European Ocean Observing System (EOOS) Steering Group including in strategic development and interaction liaison with policymakers. With a background in polar science, Joseph has several years of experience working at the interface of science, observations, policy and technology at European and international levels and across environmental domains.



Patrick Gorringe

MANAGER OF INTERNATIONAL OCEAN RELATIONS AT THE SWEDISH METEOROLOGICAL AND
HYDROLOGICAL INSTITUTE (SMHI)

Patrick has devoted a lot of his work in bringing together diverse ocean observing communities and building partnerships in order to enhance the cooperation and by this increase the accessibility of oceanographic data. This includes emerging low-cost observing technologies and initiatives together with citizen science communities to democratize access to the ocean and ocean data.



Viviana Piermattei

SCIENTIST IN OCEAN OBSERVATIONS AND RESPONSIBLE OF THE ADVANCED OBSERVING SYSTEMS
RESEARCH UNIT OF THE GLOBAL COASTAL OCEAN (GOCO) DIVISION AT CMCC FOUNDATION

The current research activity is focused on the development of very low-cost sea level sensors and innovative animal tags, on the use of cost-effective autonomous oceanographic platforms for the study of coastal processes and marine habitats and on the development of a low-consumption and easy-to-install systems toward the spreading of coastal fixed stations.



SESSION 1

Speakers

Dominique Durand

FOUNDER / EXECUTIVE DIRECTOR OF COVARTEC AS

Dominique Durand is a recognized marine science expert. In 2015, he founded COVARTEC AS (Norway), a SME providing consulting on ocean governance and sustainable blue economy. He has a PhD in information technology for ocean science. After having trained professionals in Earth Observation, worldwide (1991-1996), he developed satellite-based warning system for coastal environments, at NERSC/Norway. Then, he headed the oceanography department at NIVA/Norway, developing the European Ferrybox capacity. In 2012, he became EVP at IRIS/Norway, leading the Environment & Biotechnology branch. The last 25 years, Durand has been working on bridging industry, academia and public bodies through large RD&I projects.



Zdenka Willis

PAST PRESIDENT, MARINE TECHNOLOGY SOCIETY

Zdenka Willis, L.L.D is the Immediate Past President of the Marine Technology Society and CEO of Veraison Consulting, LLC. Ms. Willis retired from NOAA's Senior Executive Service and was the founding Director of the United States Integrated Ocean Observing System Office. She had a 25 year career as a Meteorology and Oceanography officer, retiring with the rank of Captain.



SESSION 2

Opportunities and Challenges for Accessible Ocean Observing Technologies

Jean-François Rolin

MARINE TECHNOLOGY DESIGN ENGINEER

His last position was at Ifremer: responsibility of subsea observatories and deputy management of the Technological R&D unit. As head of the instrumentation design teams of Ifremer, he participated in the development of tens of profiling floats, landers, benthic stations, buoys and instruments for coastal and deep seas. Involved in a number of EU research projects: final ESONET coordinator, EMSO PP deputy coordinator, leader of marine subdomain of ENVRI+ (EU environment large research infrastructures), etc. While retired, he serves as vice-president of a nonprofit organization training people starting small businesses in Brittany, France.



Moderator

Jessica Sandoval

FOUNDER AND CEO OF AQUAVELA

Dr. Jessica Sandoval is the Founder and CEO of AquaVela, an ocean technology consulting company. She serves as the Lead Network Coordinator for the Deep Ocean Observing Strategy (DOOS), with a lens towards synergizing global efforts for low-cost ocean technology. She serves as the Director of Engineering to the Ocean Discovery League, where she leads the planning and development of accessible ocean sensors. She has 8 years of experience as a pilot and technician of deep-sea Remotely Operated Vehicles (ROVs). She has her Bachelor's from MIT, Master's and PhD from the University of California, San Diego.



Moderator

Within this session, the invited panellists represented both new and well-established ocean observation technologies and networks, with a lens toward 'low-cost', accessible instrumentation.

This session gave an overview of the current challenges faced by the field of accessible ocean observing technology (i.e., sensors and platforms), and highlighted current innovations and successes that are expanding the field and progressing towards an accessible ocean.

The session culminated an assessment of future collaboration and technological opportunities within a global context, identifying priorities for accessible design, effective low-cost alternatives, and broadening participation within ocean research.

The session was opened by Jean-François Rolin and Jessica Sandoval (DOOS). The speakers each gave a short introduction to their activities and thoughts in relation to opportunities and challenges for accessible ocean observing.

SESSION 2

Key Points from the Panel Discussion

- When considering cost-effective, or accessible technologies, it is necessary to consider the entire value chain (e.g. procurement, manufacturing, assembly, calibration, deployment, post-processing, recovery, recycling, etc.). Cost-efficient technologies may not in themselves result in cost-efficient data and observations if costs are high in other areas of the value chain.
- The cost of human resources, training and education is a major factor in the overall cost-effectiveness of ocean observing. Ensuring technologies are accessible with existing expertise, or with readily available training, is important.
- Not all users have the same requirements for data quality, accuracy or precision - for many applications, lower-quality data can be used and integrated. However, it is essential that the quality of data is known and quantified, and shared transparently as part of metadata.
- Successful citizen science or community monitoring programmes must be designed in close collaboration with all stakeholders to ensure that any changes in activities associated with the measures are understood and accepted by all, with clear benefits for all those involved.
- A key factor in the success of accessible ocean observing technologies is scalability of some key components. It must be associated with the need to be fit-for-purpose for a full range of regions, of observers backgrounds and education.
- The economical accessibility is quite different among communities. Significant endeavours to raise the observing capacity can be seen everywhere.
- Accessible ocean observing technologies will be successful, if they are used widely and enable the generation of many data points in many regions. While this requires for the technologies to be fit-for-purpose on the one hand, large scale uptake and use enable an economy of scale and might be needed to bring down production cost for enhanced applicability on the other hand. In a further matured ocean observing market more lively competition could further help to lower product prices.

Take-Home Messages

- The **cost of the data** could be a good metric to monitor to define 'accessible' techs.
- To be **accessible, most technologies need to be open**, both national governments and the private sector have to contribute.
- There is a **need to enhance, share and disseminate the innovations** regarding **accessible technologies**. Training aspects and Best Practices sharing should mobilise the community.
- There is a **need to offer opportunities** to all communities to **showcase new ideas** and new achievements. Traditional events such as OI should evolve to support the dissemination of such promising practices.
- **JERICO** and **EOOS** could be great catalysts of this evolution.

SESSION 2

Speakers

Carlos Dominguez-Carrió

INSTITUTE OF MARINE SCIENCES – OKEANOS, UNIVERSITY OF THE AZORES

Carlos Dominguez-Carrió is a deep-sea scientist focused on better understanding the ecology of deep-sea benthic species and communities using underwater imaging technology as the main sampling device. He aims to decipher what are the ecological processes that shape the diversity and spatial distribution of deep-sea fauna at different spatial scales, from small patches to larger geomorphological units, such as submarine canyons and seamounts. In recent years he has also worked on the development of affordable camera systems for the exploration of deep-sea habitats, such as the Azor drift-cam, in order to facilitate the access to the deep sea.



Thibaut Pollina

CEO OF FAIRSCOPE

He leads the development of the PlanktoScope, a tool he designed to meet the scientific community's need for reliable and consistently benchmarked microscopy equipment. Launched in 2023, FairScope aims to provide scientists, educators, students, and citizen scientists worldwide with the PlanktoScope, enabling them to broaden their research and educational efforts. The device is already in use by over 50 leading research institutions globally, including NOAA and the Scripps Institute of Oceanography. FairScope's mission extends to building the largest plankton monitoring network and ensuring equitable access to advanced scientific tools, emphasizing open-data, transparency, and collaboration.



Breanna Motsenbocker

PHD CANDIDATE AT THE UNIVERSITY OF RHODE ISLAND

Her research is focused on the development of cost-effective technology for the deep sea. She is particularly interested in using additive manufacturing to produce sensing/imaging systems that are simple to replicate even with limited resources. The primary goal of her work is to increase the accessibility of deep-sea research and technology development. This also involves engaging in outreach and education initiatives to engage young students from diverse backgrounds to participate in and eventually lead research in this field.



SESSION 2

Speakers

Inger M. Graves

DIRECTOR OF ENVIRONMENTAL SALES IN EUROPE FOR XYLEM

Inger M. Graves has worked in the ocean industries for over 20 years in technology development, product management and sales. Along with the team in Xylem – Aanderaa, she has taken on numerous projects to collect ocean data in observatories, from buoys and for industries like Aquaculture, Offshore Energy and Ports and Harbours. The special focus for her work has been on ocean currents, waves, salinity and oxygen, and data delivery to reliably provide this data to the end user. During the EuroSea project, two buoys were installed that served the end users with operational data for aquaculture, while also providing the data to CMEMS.



Yves Dégrés

MANAGING DIRECTOR OF NKE INSTRUMENTATION

Graduating with an engineering degree in 1985, he is specialised in electronics and mechanics. He was the Head of the oceanographic instrumentation department at Nke in 2001, in charge of sales, marketing and R&D.

Yves is the Managing Director of Nke instrumentation since 2012, whose aim is designing, manufacturing and selling instruments for the measurement and the monitoring of oceans and fresh waters. The fields of applications are rivers, lakes, estuaries, oceans and deep sea.



Carles Castro

CHIEF TECHNICAL OFFICER AND CO-FOUNDER OF OCEAN DATA NETWORK

He is also part of the Fishing Vessel Ocean Observing Network (FVON) which is a project under the GOOS CoastPredict UN Decade programme. He holds a dual masters degree in industrial and electrical engineering specializing in automation and robotics. Carles handles the systems automation and data management processes that keep ODN's data flowing seamlessly to ocean modelers and other end users. Based in Valencia, Spain, he also directs operations and fleet outreach in Europe.



SESSION 2

Speakers

Collin Closek

STAFF SCIENTIST AT STANDFORD UNIVERSITY'S HOPKINGS MARINE STATION

Ph.D. (he/him) is a Staff Scientist at the Stanford Center for Ocean Solutions (COS) at Stanford University's Hopkins Marine Station. Collin's research background includes development of technologies that reduce barriers to access as well as applying molecular and ecological methods to determine the health and physiological state of marine organisms in aquaculture, coastal, and open ocean systems. He serves as principal investigator on two environmental DNA (eDNA)-focused projects in Monterey Bay and the Republic of Palau. Collin also serves as the Co-design and Low-Cost Technology Manager at Synchro, a consortium of institutes that accelerates ocean technology solutions.



SESSION 3

Data Quality Aspects of Accessible Ocean Observing Technologies

Lucie Cocquempot

FRENCH RESEARCH INSTITUTE FOR EXPLOITATION OF THE SEA (IFREMER)

Lucie Cocquempot is in charge of the coordination of observation networks within French Research Institute for Exploitation of the Sea (Ifremer), and an executive board member for national research infrastructures dedicated to the understanding of the oceans. She has recognized skills in leading cross-disciplinary groups, in co-construction of observation strategies and in marine data management. As an engineer in physical oceanography by training, she developed interests in the coordination of multidisciplinary systems, participatory sciences including the valorization of indigenous knowledge, low-tech labs and other open science projects. Within the European projet JERICO-S3, she is leading the work package on Sustainability.



Moderator

Patrick Gorringe

MANAGER OF INTERNATIONAL OCEAN RELATIONS AT THE SWEDISH METEOROLOGICAL AND HYDROLOGICAL INSTITUTE (SMHI)

Patrick has devoted a lot of his work in bringing together diverse ocean observing communities and building partnerships in order to enhance the cooperation and by this increase the accessibility of oceanographic data. This includes emerging low-cost observing technologies and initiatives together with citizen science communities to democratize access to the ocean and ocean data.



Moderator

We need the best data to do the best science. But to what extent should data quality be balanced with other considerations for ocean observing technologies (cost, environmental impact, etc.)? In recent years, the question has evolved from "What to do with our data?" to "How to deal with our data?". This is due in part to the transformative call of the UN Ocean Decade for "The science we need for the ocean we want", catalysing a paradigm shift from "observing what we can" to "observing what we need". Accessible ocean observing technologies play a key role in this shift, but understanding data quality remains imperative.

In this session the panel explored the whole ocean data value chain, covering preparation and calibration, collection and acquisition, data management, transformation to information (product and service development), and advice to society and information decisions.

Can accessible ocean observing technologies, whether relatively lower-cost, lower-tech or otherwise, produce data of equal quality to conventional options? Is it possible to quantify and disclose data quality in a standardised manner? Depending on the application, where is the right balance between data quality and data quantity? Even where data quality is lower, may it still be useful? These

SESSION 3

Key Points from the Panel Discussion

questions and others were addressed during this session.

The session was opened by moderators Lucie Cocquempot (Ifremer) and Patrick Gorringe (SMHI). The need for the best data to facilitate the best science was emphasised. However, it was noted that data quality must be balanced against other considerations and priorities, such as financial cost, environmental impact and social impact. Furthermore, different users have different requirements in regard to quality - so as long as the quality of data is quantified and known, they may be useful for many applications. Panellists were introduced, highlighting their role as actors along the ocean data value chain including preparation and calibration, observing operators, data aggregators, application and service providers, and end users.

- Calibration of instruments, and fully transparent and traceable certification of calibration, are essential to understanding data quality. Documentation and metadata relating to calibration of instruments is often incomplete or misunderstood. While perceived as an expensive process, calibration is a relatively small expense in the ocean knowledge value chain, but increases data value significantly.
- Not all users have the same data quality requirements. The accessibility of ocean observing technologies can be improved with more appropriate levels of accuracy balanced with cost.
- The full value chain of ocean knowledge must be con-

sidered with regards to cost and accessibility. Data aggregation and curation costs have to be taken into account.

- Metadata is key. Documentation must be understandable to both humans and machines. Common standards and languages across the ocean observing community enable greater accessibility and increase the value of ocean data.
- Citizen science initiatives are an effective way to gather data in a cost-effective manner and to increase spatial resolution. However, it is important that such initiatives are managed by experts at each stage of the value chain to ensure data quality is known and meets user requirements.
- Calibration of sensors alone is insufficient. The integration of sensors with the platform is critical. Calibration and testing must be done with the platform as a whole.
- Details of how data is processed is not always shared by sensor manufacturers. This poses problems for platform developers who are unable to state uncertainties accurately, e.g. sensors outputting averaged data without details of how the average is calculated.
- Users of ocean observations can be key in imposing standards on manufacturers of technologies. To be effective, users must be coordinated with aligned agreement on standards, collectively demonstrating a market to manufacturers.

Take-Home Messages

- Regarding the data value chain, there is a **methodology needed to assess the costs of the calibration step**. Initiatives such as MINKE should be taken over by Research Infrastructure such as JERICO.
- Actions should be taken to **strengthen the trust** and understanding between **users** and **manufacturers** regarding **sensor calibration**.
- **Processes or capacity sharing services are needed** to adapt data accuracy to different uses.

SESSION 3

Speakers

Dick M.A. Schaap

DIRECTOR MARIS

Coastal engineer with major expertise in marine data management. Founder of MARIS, spin-off from a Netherlands governmental initiative. Very experienced in managing EU projects for development and operation of networks and infrastructures for marine data. MARIS is engaged in many EU projects and initiatives, aimed at improving FAIRness and coverage of leading marine data infrastructures, like EMODnet, ENVRI, JERICO, EuroFleets, and EOOSC. Technical coordinator of SeaDataNet, pan-European network of data centres; technical coordinator of EMODnet Bathymetry and Chemistry; coordinator of EMODnet Ingestion. Core initiator of the Blue-Cloud initiative, acting as technical coordinator of Blue-Cloud 2026.



Sue Hartman

MARINE BIOGEOCHEMIST AT THE NATIONAL OCEANOGRAPHY CENTRE

Dr. Sue Hartman is a marine biogeochemist at the NOC (National Oceanography Centre, UK), with over 30 years' experience in carbonate and nutrient chemistry. She is a work package leader within the EU project MINKE (Metrology for Integrated Marine Management and Knowledge-Transfer Network) minke.eu. MINKE aims to improve data quality through linkages with Metrology laboratories. Sue has specialist knowledge in the use of biogeochemical sensors on various platforms, including the Porcupine Abyssal Plain Sustained Observatory (PAP-SO), noc.ac.uk/pap.



Anahita Laverack

FOUNDER OF OSHEN

Holding a degree in Aeronautical Engineering from Imperial College London, Anahita completed her Master's in the design and navigation of transatlantic autonomous micro-vessels. In early 2022, she founded Oshen, a startup focused on the mass deployment of autonomous, micro-vessels for ocean data collection. Along with co-founder and partner Ciaran, she initially developed the micro-vessel technology in North Wales, living on a 25ft sailboat and using it as a base to test their technology at sea. Anahita currently oversees Oshen's strategic development and hardware design, applying her specialised knowledge to advance autonomous marine sensing technologies.



SESSION 3

Speakers

Justin Buck

ROBOTICS ENGINEER IN THE NATIONAL OCEANOGRAPHY CENTRE

Dr Justin Buck has recently taken on a new role as a principal robotics engineer in the National Oceanography Centre (NOC) for the Marine Autonomous Robotic Systems (MARS) group and their groundbreaking vehicles. Dr Buck focuses on the development of digital systems and services for users of marine autonomous systems in the fast-growing field of marine autonomy. Prior to this Dr Buck has a wealth of experience processing and understanding ocean derived data, having spent 16 years as a data scientist in the British Oceanographic Data Centre specialising in the end-to-end data workflows needed for autonomous ocean observing.



Rob Craft

CALIBRATION MANAGER FOR THE NATIONAL OCEANOGRAPHY CENTRE

Rob Craft is the Calibration Manager for the National Oceanography Centre, home of the UK's National Maritime facilities. He has been a Calibration Engineer and Technician for the last 30 years and is key to the accuracy and quality of NOCs Data generation.

With over 10 years' experience in mainstream Laboratories, he has taken that experience and applied it to the Oceanographic and Metrological field. Having been involved with the development and deployment of various items of survey equipment and platforms at different TRL levels, Rob is an expert in his field.



Antoine Cousot

FOUNDER OF OCEANO VOX

He is a French former yacht captain and expedition leader. He holds a Msc Earth Sciences from The Open University.

He founded Oceano Vox in 2022, the future largest ocean citizen science driven community. With partnership from Ifremer, Oceano Vox combines world class research on ocean sciences and New Space technology to reduce sensors cost and access to quality in situ ocean data using sailing boats. During summer 2024 more than 100 sailing boats will be collecting in situ real time data to chasing extreme weather events.



SESSION 3

Speakers

Theo Moura

FOUNDER OF COASTAL-E SOLUTIONS

Theo Moura is a physical oceanographer and holds a PhD in wave mechanics and coastal processes, with experience in physical and numerical modeling, in-situ data collection, analysis, and interpretation. In recent years, he has founded Coastal-e Solutions, a company dedicated to developing complete IoT solutions (hardware and software) for Coastal and Ocean Observing Systems.



SESSION 4

Sustainability Aspects of Accessible Ocean Observing Technologies

Peer Fietzek

SENIOR BUSINESS DEVELOPMENT MANAGER OCEAN SCIENCE AT KONGSBERG DISCOVERY

Peer Fietzek works as a Senior Business Development Manager Ocean Science at Kongsberg Discovery with a focus on innovative applications for quantitative acoustic sensors and for comprehensive digital ocean data solutions. He is a convinced advocate for science-industry collaboration to mature the Ocean Enterprise and grow the New Blue Economy. Peer supports research projects and community activities through work in advisory boards/groups and technical committees. After having graduated in physics, he has been spending his entire career in the marine sector working for a research institute, a start-up, an SME, and a global corporation.



Moderator

Dominique Durand

FOUNDER / EXECUTIVE DIRECTOR OF COVARTEC AS

Dominique Durand is a recognized marine science expert. In 2015, he founded COVARTEC AS (Norway), a SME providing consulting on ocean governance and sustainable blue economy. He has a PhD in information technology for ocean science. After having trained professionals in Earth Observation, worldwide (1991-1996), he developed satellite-based warning system for coastal environments, at NERSC/Norway. Then, he headed the oceanography department at NIVA/Norway, developing the European Ferrybox capacity. In 2012, he became EVP at IRIS/Norway, leading the Environment & Biotechnology branch. The last 25 years, Durand has been working on bridging industry, academia and public bodies through large RD&I projects.



Moderator

This session addressed three dimensions of sustainability related to ocean observing technology with a specific focus on how these might be affected through a change towards more accessible solutions. The first dimension represents (i) economical sustainability and viability of ocean observing products. The second comprises (ii) the environmental sustainability and footprint or the greening of ocean observations. While the third dimension covers (iii) political and regulatory sustainability related to observations of the ocean.

Short interventions set the scene and were followed by a panel discussion that also engaged the audience.

Interested Ocean Enterprise stakeholders with private, public or academic job affiliations were invited to join and contribute to the discussion. Ocean observing technology developers, data users, blue economy company representatives, innovation enablers, members of the science and ocean literacy community, to select some examples, were all invited to listen and add to the discussion on sustainability aspects of ocean observing technology.

The session was opened by the moderators, Peer Fietzek (Kongsberg Discovery) and Dominique Durand (Covartec AS). Introducing the session topic, a framework for sustainability in ocean observing was presented, including economic, societal and environmental sustainability.

SESSION 4

Key Points from the Panel Discussion

- When considering environmental sustainability of ocean observing technologies, it is important that the whole value chain ('cradle-to-grave') is considered, including the operations of manufacturing companies as a whole, not only the products produced.
- There is a generational dimension in how sustainability is understood. For younger generations it has become a core value.
- With a growing demand for environmental sustainability by customers and shareholders (and of course regulation), manufacturers consider it more within their activities and products.
- Events such as Oceanology International demonstrate the large market and demand for ocean technologies in general; the ocean observing market, i.e. the Ocean Enterprise, should be further developed. The demand from the ocean observing community is very valuable in this context and their power of demand can also make a difference towards sustainable solutions.
- Overall Ocean Enterprise market improvements (e.g. stimulated through science-industry collaborations) also help with the economic sustainability of ocean observing technology.
- There is a need to better quantify the environmental impact of ocean observing technologies. For example, there is not a globally adopted method for carbon accounting. There is a need to standardise how impacts are quantified.
- Manufacturers should ensure recyclability at the end of a platform or sensor's life.
- Regulations on environmental impacts of technologies are heterogeneous globally. Efforts to move away from harmful practices or technologies must be brought forward and coordinated globally.
- The political framework could be even more supportive for ocean observing in general, since ocean knowledge and service products are indispensable for policymaking, governance and management, and essential to life and livelihoods for society in Europe and globally. Changes in regulation or legislation can, furthermore, prompt development of new, more sustainable technologies, and open up new markets for these. Such changes are slow, but can have lasting positive impacts for the sustainability of ocean observing technologies.
- There is a responsibility of the ocean observing community to set a good example to future generations. If it is considered acceptable to allow platforms to be left unrecovered at the bottom of the ocean at the end of their life, without efforts to find technical, political or other solutions for this, then sustainability will not be a genuine priority.

Take-Home Messages

- Demand by customers, shareholders and regulation, especially in the growing and maturing Ocean Enterprise, further drives manufacturers towards environmental sustainability of ocean observing technologies.
- There is a need for a unified, prevailed and applied methodology to assess the environmental impact of ocean observing technologies.
- Improving the recoverability, repairability and reusability of platforms and sensors when no longer operational, should be a priority. Given their positions of well-established prescriptors, Research infrastructures should support/initiate/harmonise manufacturers and regulators actions
- Economic and regulatory sustainability of ocean observing, alongside environmental sustainability, is key to achieving the EOOS vision.

SESSION 4

Speakers

Peer Fietzek

SENIOR BUSINESS DEVELOPMENT MANAGER OCEAN SCIENCE AT KONGSBERG DISCOVERY

Peer Fietzek works as a Senior Business Development Manager Ocean Science at Kongsberg Discovery with a focus on innovative applications for quantitative acoustic sensors and for comprehensive digital ocean data solutions. He is a convinced advocate for science-industry collaboration to mature the Ocean Enterprise and grow the New Blue Economy. Peer supports research projects and community activities through work in advisory boards/groups and technical committees. After having graduated in physics, he has been spending his entire career in the marine sector working for a research institute, a start-up, an SME, and a global corporation.



Océane Barre

OCÉANE BARRE - SALES & MARKETING MANAGER AT SEABER

Océane is Sales and Marketing Manager at SEABER and has been immersed in the field of oceanography since completing her Business Development studies in 2018. She is passionate about new technologies to explore the depths of the ocean and has a keen interest in bridging the gap between business and science. Objective achieved, as SEABER is committed to making AUV technology accessible to all by setting the standard of underwater exploration.



Speaker

Brian Connon

VICE PRESIDENT OF OCEAN MAPPING AT SAILDRONE

Captain Brian Connon, US Navy (Ret) is Vice President, Ocean Mapping at Saildrone, Inc. and President of The Hydrographic Society of America. A certified hydrographer, he holds a BS in Geography from the University of South Carolina, an MS in Oceanography and Meteorology from the Naval Postgraduate School in Monterey, CA, and an MS in Hydrography from the University of Southern Mississippi. He is a Chartered Marine Scientist (Hydrography) and Fellow of the Institute for Marine Engineering, Science and Technology. Brian served for over 28 years as an oceanographer and hydrographer in the US Navy and is passionate about mapping, exploring, and protecting our oceans.



SESSION 4

Speakers

Lucie Cocquempot

FRENCH RESEARCH INSTITUTE FOR EXPLOITATION OF THE SEA (IFREMER)

Lucie Cocquempot is in charge of the coordination of observation networks within French Research Institute for Exploitation of the Sea (Ifremer), and an executive board member for national research infrastructures dedicated to the understanding of the oceans. She has recognized skills in leading cross-disciplinary groups, in co-construction of observation strategies and in marine data management. As an engineer in physical oceanography by training, she developed interests in the coordination of multidisciplinary systems, participatory sciences including the valorization of indigenous knowledge, low-tech labs and other open science projects. Within the European projet JERICO-S3, she is leading the work package on Sustainability.



Amy West

SYNCHRO PROGRAM MANAGER

Amy's journey into the deep-sea and technology realm began in 2001 as an engineering intern at the Monterey Bay Aquarium Research Institute (MBARI), where she studied remote underwater video techniques in Monterey Bay and New Zealand's fiords. With a background spanning two decades as a marine scientist, she embarked on field expeditions from Antarctica to the Arctic, driven by a passion for deep-sea ecology and fisheries. After many outreach roles to excite non-scientists about the ocean, she pursued a second career as a science communicator and science journalist, creating multimedia stories for universities, newspapers, print, and government.



James Kirkbride

SENIOR SCIENTIST CHELSEA TECHNOLOGIES

James is senior scientist at Chelsea Technologies working on testing and development of new and existing products as well as running R&D programs. He has a DPhil in laser spectroscopy from the University of Oxford following a Masters in Chemical Physics from Edinburgh University and has worked in technology development since leaving academia. He has now been with Chelsea for 7 years, has deep knowledge of the technical aspects of sensor development and is passionate about increasing the capabilities and accessibility of the technologies we offer.



SESSION 4

Speakers

Greg Johnson

PRESIDENT OF RBR

A familiar face in the oceanographic community, Greg has served as President of RBR for the last 13 years. His deep technical background and never-ending curiosity has allowed RBR to grow rapidly under his leadership. Greg is a natural teacher with a unique ability to make complex technical topics accessible to everyone. His PhD in Material Science from the University of Manchester complemented his Bachelors in Electrical Engineering from McGill University in Montreal.



Closing session

Henning Wehde

PROGRAMME DIRECTOR FOR THE ECOSYSTEM NORTH SEA

Henning Wehde is a Programme Director for the Ecosystem North Sea at the Institute of Marine Research in Bergen Norway. He holds doctoral degree on physical oceanography from Hamburg University from 2001. Focal point for his activity was to integrate biological and physical observations with numerical modelling and was involved in and led many projects contributing to the development of observation methodology. In addition he has been involved in the European branch of the GOOS activities by chairing the activities for the North West European Shelf (NOOS) for 8 years followed by the involvement and later chairing of the EuroGOOS Board of Directors earning a deep understanding of the challenges and opportunities within that environment.



Moderator

Laurent Delauney

JERICO COORDINATOR AND RESEARCH AND DEVELOPMENT ENGINEER IN OCEANOGRAPHIC INSTRUMENTATION

Laurent Delauney is the coordinator of the EU projects dedicated to establishing the Joint European Research Infrastructure for Coastal Observation (JERICO). He has worked at Ifremer for 30 years on in-situ monitoring systems development. Laurent Delauney's fields of interest are sensor development for coastal autonomous monitoring stations and seabed observatories, biofouling protection for marine in situ sensors and transfer from research to PME's of marine sensors developments and In situ Observation harmonisation process (Best Practices). He is co-chair of the EuroGOOS Technological plan Working Group and Chair of the EOOS Operation Committee



Moderator

