NORTH ATLANTIC ARC WORKSHOP REPORT

Fishing Vessel Ocean Observing Network (FVON), www.fvon.org

4 December 2025 | 15:00-17:00 UTC

AGENDA

15:10	**Welcome and Introduction**	Cooper Van Vranken
15:20	**North Atlantic Arc Project Framing**	Chris Cusack
15:30	**OceanOPS Dashboard**	Victor Turpin
15:40	**Breakout Rooms: Regional Gaps and Demands**	Angel Ruiz-Angulo Blair Greenan Caroline Cusack César González-Pola Charlotte Williams Hjálmar Hátún Miguel Santos Patrick Gorringe
16:30	**Summaries and Discussion**	
16:55	**Next Steps**	Cooper Van Vranken

ATTENDEES

Ainhoa Caballero *AZTI*
Angel Ruiz-Angulo *University of Iceland*
Anne-Sophie Ste-Marie *CIOOS*
Aubrey Taylor *EDF*
Barb Bryden *DP Energy*
Blair Greenan *DFO*
Carles Castro Muniain *ODN*
Caroline Cusack *Marine Institute*
César González-Pola *IEO*
Charlotte Williams *NOC*
Christopher Cusack *EDF*
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Cooper Van Vranken *ODN*
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Emilie Breviere *SMHI*
Eoghan Daly *Marine Institute*
Eydna í Homrum *FAMRI*
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Frederic Cyr *MI-MUN*
Greg Johnson *RBR Global*
Hassan Moustahfid *IOOS*
Henning Wehde *IMR*
Hjálmar Hátún *FAMRI*
James Mosher *Clearwater Seafoods*
João Martins *MFRI*
João Souza *CIRES, CU-Boulder*
Johan Söderqvist *GEOMETOC*
John Radford *ZebraTech*
Li Zhai *BIO*
Linus Stoltz *CFRF*
Lucia Bruni *Ocean Engineering Graduate*
Mason Kenny *HAFRO*
Miguel Santos *IPMA*
Naomi Greenwood *Cefas*
Patrick Gorringe *SMHI*
Rafael González-Quirós *IEO*
Rita Esteves *IPMA*
Scott Bruce *MI-MUN, CIOOS*
Steve Woll *Little Creek Applied Science*
Tom Brown *MI-MUN*
Tom Louden-Cooke *Met Office*
Victor Turpin *OceanOPS*
Vitali Sharmar *CMCC*
Youyu Lu *DFO, BIO*

INSTITUTIONS

Canada	
BIO	Bedford Institute of Oceanography
CIOOS	Canadian Integrated Ocean Observing System
-	Clearwater Seafoods
DFO	Fisheries and Oceans Canada
MI-MUN	Marine Institute, Memorial University of Newfoundland
Faroe Islands	
FAMRI	Faroe Marine Research Institute
Iceland	
HAFRO	Hafrannsóknastofnun
MFRI	Marine and Freshwater Research Institute
UI	University of Iceland
Ireland	
-	Marine Institute
-	DP Energy
Norway	
IMR	Institute of Marine Research
Portugal	
IPMA	Portuguese Institute for Sea and Atmosphere
Spain	
-	AZTI
IEO	Spanish Institute of Oceanography
Sweden	
SMHI	Swedish Meteorological and Hydrological Institute
United Kingdom	
Cefas	Centre for Environment, Fisheries and Aquaculture Science
-	Met Office
NOC	National Oceanography Centre
International / Other	
CFRF	Commercial Fisheries Research Center
CIRES	Cooperative Institute for Research in Environmental Sciences
CMCC	Euro-Mediterranean Center on Climate Change
CU-Boulder	University of Colorado Boulder
EDF	Environmental Defense Fund
GEOMETOC	Joint Geo-Meteorological and Oceanographic Support Centre
IOOS	US Integrated Ocean Observing System
-	Little Creek Applied Science
-	OceanOPS
ODN	Ocean Data Network
-	RBR Global
-	ZebraTech

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EXECUTIVE SUMMARY

On 4 December 2025, the Fishing Vessel Ocean Observing Network (FVON) convened the North Atlantic Arc Workshop to co-design the first year of a regional pilot deploying fishing-vessel-based ocean observing across the North Atlantic Ocean. The workshop brought together representatives from fisheries agencies, ocean observing programs, meteorological services, research institutions, and industry across Canada, Iceland, the Faroe Islands, the United Kingdom, Scandinavia, Ireland, Spain, and Portugal, alongside global coordination bodies such as OceanOPS.

The workshop had **three primary objectives**:

1. Identify priority gaps in subsurface ocean data across the North Atlantic “Arc”
2. Understand how additional fishing-vessel-based data could support shared applications across countries and sectors
3. Inform the placement of FVON deployments in Year 1 of the pilot in a way that maximizes collective regional benefits

Across all regions, participants consistently highlighted that while offshore and open-ocean observations are relatively well-established, coastal, shelf, and shelf-edge regions remain critically under-observed, despite being the areas of highest ecological productivity, economic activity, and societal risk. These gaps limit the skill of ocean and weather forecasts, constrain ecosystem-based fisheries management, and reduce the ability of industries and governments to respond to extreme events and climate change.

A central finding of the workshop was the **high degree of overlap in data needs** across countries and sectors. Subsurface temperature observations collected by fishing vessels were identified as foundational inputs for a wide range of applications, including:

- Operational ocean and weather forecasting and real-time data assimilation
- Fisheries stock assessment, habitat monitoring, and ecosystem-based management
- Early detection and characterization of marine heatwaves and bottom warming
- Offshore energy, shipping, and insurance risk assessments
- Climate reanalysis, model validation, and long-term trend analysis

Breakout sessions revealed **multiple transboundary corridors and shared-benefit regions** where FVON deployments could deliver value to more than one country simultaneously. Key examples include:

- The Labrador Current and Tail of Grand Banks, where additional observations would improve forecasts and ecosystem understanding from Atlantic Canada downstream to the Northeast United States
- The Iceland-Faroe Ridge, a critical gateway for Atlantic inflows and deep-water formation with implications for fisheries, climate regulation, and ecosystem health across the basin
- Shelf-edge regions near the Faroe Bank and the Dooley Current, which influence cross-shelf exchange and forecast skill for the UK, Scandinavia, and adjacent seas
- The Celtic Sea and Iberian shelf, where warming trends, marine heatwaves, and fisheries impacts affect Ireland, Spain, and Portugal
- Regions accessed by Portuguese and Spanish fleets beyond Europe, including waters off Northwest Africa and island states with limited national observing capacity

Participants emphasized that FVON's model of leveraging fishing vessels as cost-effective, persistent observing platforms offers a practical mechanism to complement existing national observing systems, reduce reliance on expensive fixed infrastructure in harsh environments, and support equitable access to data for countries with limited resources.

The workshop concluded with agreement that Year 1 of the North Atlantic Arc pilot should prioritize deployments that serve multiple countries and applications, align with existing modeling and forecasting systems, and demonstrate clear benefits to fishers and other end users. The outcomes of this workshop will directly inform pilot vessel selection, deployment locations, and stakeholder engagement strategies as FVON moves toward initial installations beginning in 2026.

Workshop recording, presentations, and other materials can be found in the Appendix of this report.

INTRODUCTION

Introduction to FVON

Cooper Van Vranken (FVON Steering Committee Co-Chair)

While satellites offer valuable sea surface information and the Argo program operates in much of the open ocean, there is a critical lack of subsurface data in the world's coastal and shelf regions. Counterintuitively, this gap is where much of the world's anthropogenic and economic activities are concentrated: fisheries, aquaculture, tourism, insurance, shipping, climate science, weather forecasts, and emerging blue economy industries all suffer from incomplete data coverage.

Unlike conventional data platforms, fishing vessels regularly operate close to shore and deploy fishing gear through the water column. By attaching sensors to fishing gear, FVON presents an elegant method for collecting data in the critically under-sampled coastal and shelf seas. The use of existing data platforms (fishing vessels) and deployment mechanisms (fishing gear) means that this approach is orders of magnitude more cost-effective than other observing technologies, and it's fully automatic and unobtrusive for fishers. FVON is committed to providing open data via the Global Telecommunication System, and vessel identities are anonymized to mitigate any privacy concerns of the fishers.

Endorsed by the Global Ocean Observing System as an emerging network, FVON is backed by science and proven internationally. It is fully operational on approximately 500 vessels and counting—from small-scale artisanal vessels in Tanzania to commercial fleets in the United States—and data quality is demonstrated to be comparable to established platforms with similar data serving standards and conventions. Meanwhile, data assimilation has resulted in significant model improvements. Most importantly, fishers are seeing benefits like reduced fuel consumption and better catch quality because they have access to the important ocean information they collect.

Beginning in 2026, FVON has funding to equip sensors on 36 vessels in the "North Atlantic Arc" region—primarily near Iceland, the Faroe Islands, and Scotland, with the potential to extend completely around the North Atlantic to the equator in partnership with nearby countries. This workshop invites stakeholders to co-design the first year of the pilot and the placement of an initial 18 vessels. By discussing the gaps and demands of ocean data for both public and private sectors, FVON encourages transboundary and cross-sector collaboration for collective regional benefits and long-term, sustained impact.

North Atlantic Arc Project Framing

Chris Cusack (FVON Financial Innovation Subcommittee Co-Chair)

While significant societal and economic value depends on accurate, timely ocean information, current funding for ocean observing remains fragmented, creating patchy and non-sustained data coverage. This gap stifles economic growth in the blue economy and hinders support for the resilience and well-being of coastal communities. The overarching objective of the North Atlantic Arc project is therefore not only to generate new data over the next several years but also to align diverse North Atlantic data users around long-term, scalable support for ocean observing through the following strategies:

1) Establish pilot observing networks with North Atlantic partners and ensure that the resulting data reaches key users including fisheries managers, meteorological agencies, hurricane forecasters, scientists, the private sector, and others

2) Rigorously document and communicate the impacts of these data through various communications materials to elevate awareness and strengthen the case for investment.
3) Increase the value proposition for fishers by developing tools that enhance fishing efficiency, provide better weather and ocean insights, and help communities understand ecological changes.
4) Convene and support regional consortia of countries to jointly fund ocean data collection, recognizing that forecasting and modeling benefits depend on observations that transcend boundaries. This includes engagement with meteorological services, ocean agencies, and other government stakeholders to articulate shared benefits and facilitate cross-border agreements.
5) Enable private-sector participation. Public research grants and government programs alone cannot sustain observing systems indefinitely. Work with offshore wind, aquaculture, shipping, insurance, and intermediate data users (such as modeling service providers) to identify, quantify, and communicate the value of ocean data.

Approximately 500 vessels are already helping to fill critical coastal data gaps under FVON. The goal is to expand to tens of thousands by 2030 under a new financially sustainable and scalable ocean observing paradigm across the North Atlantic and beyond.

OceanOPS Dashboard

Victor Turpin (OceanOPS Technical Coordinator)

The Global Ocean Observing System (GOOS) is the United Nations coordinating body for all ocean monitoring worldwide. OceanOPS serves as the central operations hub for GOOS, aggregating key tracking information (metadata) from a wide range of platforms and working closely with partners like the World Meteorological Organization to ensure that these observations are accessible, interoperable, and usable across applications.

A central theme of OceanOPS is the importance of metadata in evaluating the health, coverage, and fitness-for-purpose of observing networks. As a result, OceanOPS is advancing efforts to better integrate metadata so that regions can more easily assess whether existing observations are adequate for specific applications such as weather forecasting. The OceanOPS dashboard is a tool for displaying current data coverage worldwide, including in the North Atlantic Ocean.

OceanOPS also leads the 10,000 Ships Initiative in collaboration with FVON, UN agencies, and industry partners. This project aims to dramatically expand the number of commercial, fishing, research, and volunteer vessels contributing to real-time ocean observations. The effort focuses on standardizing instrumentation, simplifying data flows, and enabling public–private partnerships to leverage existing maritime traffic for large-scale, cost-effective ocean data collection.

BREAKOUT ROOMS: REGIONAL GAPS AND DEMANDS

❖ Canada

***Blair Greenan (DFO)**, Dustin Colson Leaning (EDF), Anne-Sophie Ste-Marie (CIOOS), Comfort Eboigbe (MI-MUN, CIOOS), Fred Page (DFO), Greg Johnson (RBR), Hassan Moustahfid (IOOS), Li Zhai (BIO), Linus Stoltz (CFRF), Scott Bruce (MI-MUN, CIOOS), Steve Woll (Little Creek Applied Science), Youyu Lu (DFO, BIO)*

There are two core components of Canada's observing and forecasting capacity relevant to the North Atlantic: the Atlantic Zone Monitoring Program (AZMP) operated by Fisheries and Oceans Canada (DFO) and the Regional Ice Ocean Prediction System (RIOPS) operated by Environment and Climate Change Canada (ECCC).

AZMP has been operational since 1998 and integrates multiple platform types. Research vessels conduct two to three surveys annually along fixed lines, supplemented by data collected during DFO stock assessment cruises. Monthly glider transects along the Halifax Line and occasionally the Bonavista Line provide high-resolution water column profiles, and buoys contribute additional real-time observations. All data are available through the Canadian Integrated Ocean Observing System (CIOOS).

RIOPS is the 6-km resolution ice-ocean forecasting system for Canada's Atlantic coast. RIOPS assimilates satellite sea-surface height and temperature, as well as salinity profiles from Argo floats, gliders, moorings, and other in situ sources, and is initialized using analyses from the global GIOPS system. It provides boundary conditions for the higher-resolution (approximately 2-km) Coastal Ice Ocean Prediction System for the East Coast (CIOPS-E). ECCC has ongoing plans to develop a comprehensive data-assimilation ocean reanalysis (1993-present) using RIOPS or GIOPS to support climate services.

Data Applications

Modeling improvements and national infrastructure

- Regional Ice Ocean Prediction System (RIOPS)
- Model evaluation and ground truthing
- Ocean reanalysis and hindcasts
- Improvements in public weather forecasting
- National defense
- Marine spatial planning
- Climate change (ocean acidification) monitoring
- Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ Agreement)

Fisheries safety, sustainability, profitability, and resilience

- Weather forecasting for safety and situational awareness
- Monitoring habitat changes and migration patterns
- Deep sea fisheries environmental impacts and long-term sustainability

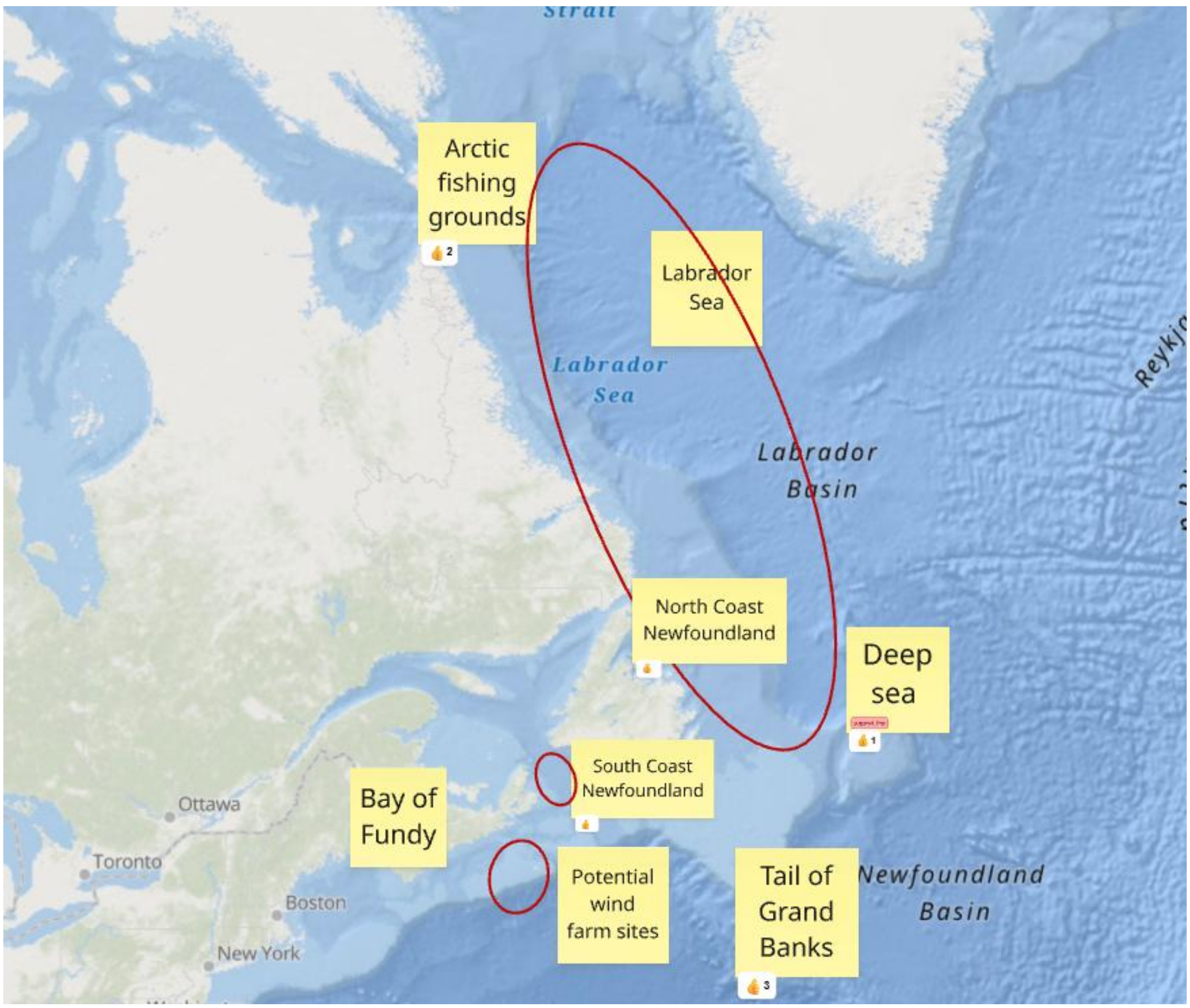
Economic resilience and commercial users

- Data products built for blue economy industries
- Offshore wind
- Aquaculture environmental monitoring and warning systems
- Shipping and maritime activity
- Recreation: surfing, sailing

Conservation

- Evaluation of vulnerable marine ecosystems (VMEs)
- Toxic algae blooms (SLGOs)

Sites of Interest



- *Labrador Sea*: Very harsh environment for moored buoys and other platforms. Fishing vessels would likely be able to provide data much more reliably.
- *Bay of Fundy*: Useful to lobster fishers and potentially herring fishers and scallop productivity. Also likely supports toxic plankton bloom prediction.

- *Tail of Grand Banks*: It's hard to get interannual variation and distribution of temperature on the tail of Grand Banks, making in situ data particularly valuable. This would also be of value for understanding the downstream impacts of interannual variability of ocean conditions for the blue economy on the Scotian Shelf and Gulf of Maine.
- *Deep sea bottom data*: Given the existing deep sea fishing fleet, it's a good opportunity to collect deep sea bottom data to fill gaps and improve ocean models, ultimately addressing Deep Sea Fisheries Management within the NAFO regulatory areas.

Additional Notes: Ensure collaboration with various stakeholders to reduce conflicts between the fishing industry and other ocean data interests. Consult fishers to find out where they would value data collection the most. Ocean Tracking Network (OTN) provides existing ocean datasets.

❖ Iceland & Faroe Islands

***Angel Ruiz-Angulo (University of Iceland)**, **Hjálmar Hátún (FAMRI)**, Aubrey Taylor (EDF), Cooper Van Vranken (ODN), Eydna í Homrum (FAMRI), João Martins (MFRI), João Souza (CIRES, CU Boulder), Mason Kenny (HAFRO)*

Iceland's long-term hydrographic monitoring network, coordinated by the Marine and Freshwater Research Institute (HAFRO), has collected standard CTD sections across the region since 1990. This provides a rich archive for analyzing mixed-layer depth variability, stratification, and trends. Concurrent glider observations resolve the Iceland-Faroe Front and associated exchange processes in high detail, and they are a valuable source of near-real-time, fine-scale data.

The Faroese pilot project Vónadagur was implemented in 2011 through the pelagic fishing vessel *Finnur Fríði* and marked the beginning of Vikmar's systematic environmental data sampling program, which has since expanded considerably. Between 2016 and 2024, trawlers have generated a substantial record of environmental measurements, supported by Vørn and the Faroe Marine Research Institute (FAMRI). These efforts demonstrate the viability of integrating fishing vessels into routine ocean observing and illustrate how operational fleets can serve as persistent platforms for environmental monitoring.

However, the Iceland-Faroe Ridge is a critical region that remains under-observed. The Bottom Boundary Current south of the Ridge contributes substantially to North Atlantic Deep Water formation (the main component of Atlantic Meridional Overturning Circulation, AMOC). New modelling and satellite-derived analyses indicate that the Bottom Boundary Current is warming, and there are additional patterns of marine heatwaves occurring around Iceland, all increasingly threatening regional fisheries. The Iceland-Faroe Ridge front also provides ventilation for important ecosystems, including key fishing grounds and deep-water coral habitats. Similarly, it influences fish distribution and impacts the operational efficiency of fishers. Pelagic species often aggregate along fronts where distinct water masses meet, so improved detection and monitoring of these features through temperature and salinity measurements can significantly reduce fuel use, lower emissions, and enhance fishing efficiency.

Data Applications

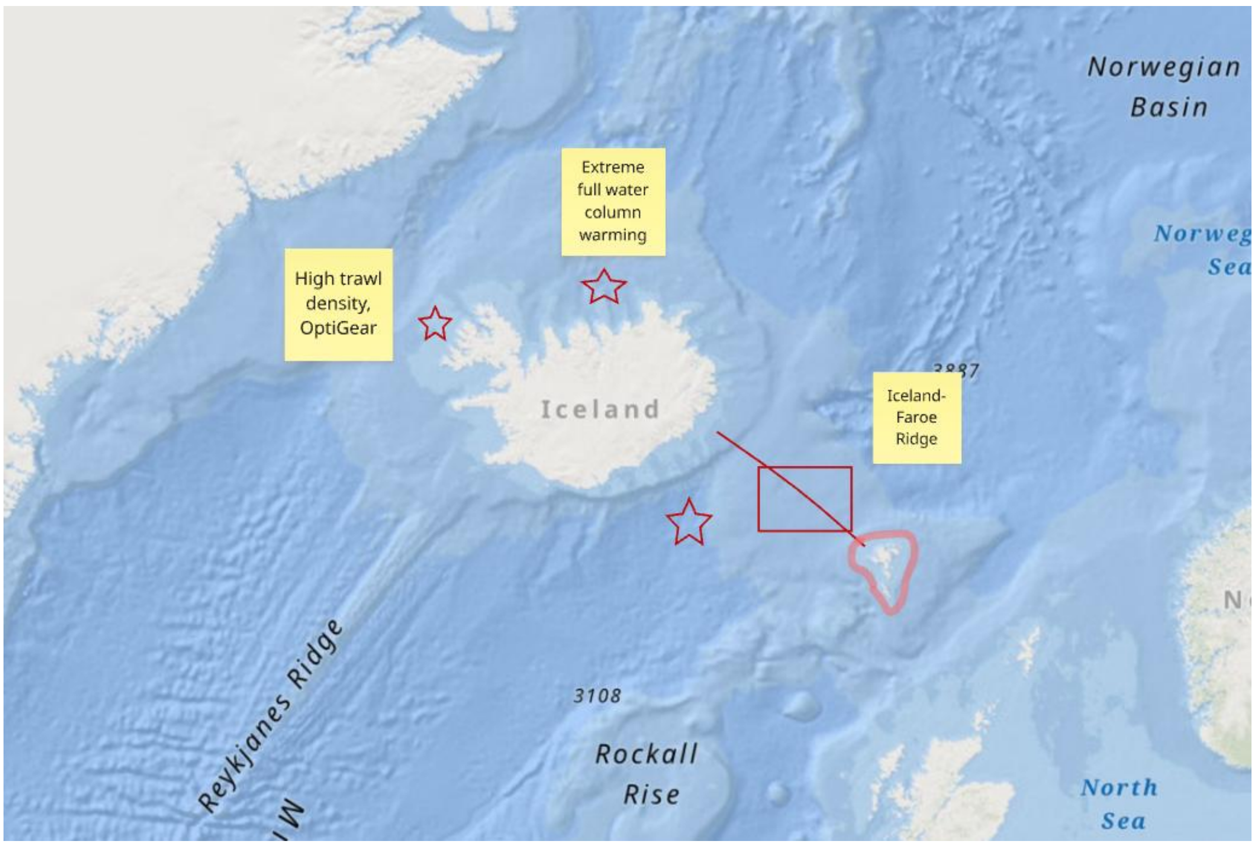
There are limited operational models in place in this region. It may be useful to reach out to Mercator or nearby regional modeling centers or consult the public domain Regional Ocean Modeling System (ROMS) implementation to develop more modeling capacity.

Overall, the fishing industry is central to the Iceland-Faroes population and economy. By using in situ temperature data (ideally co-located with seasonal catch information) to determine front boundaries and structures, improve stock assessments, determine bottom trawl impacts, and develop statistical applications like GreenFish, the fishing industry would see various benefits:

- Reduced search time and emissions
- Optimized fishing efficiency on the vessel level
- Improved sustainability and reduced environmental impacts

However, when talking to fishing captains it is essential to mitigate any potential concerns over competition and private sector conflicts and instead emphasize the benefits of the data and collaboratively design a project they support.

Sites of Interest



- *North Coast of Iceland:* Important to collect full water column profiles to monitor bottom warming and support ongoing academia.
- *Northwest Iceland:* There is a high density of trawlers in this region. Optigear needs environmental data to combine with fishing effort and catch to assess fishing performance.
- *Iceland-Faroe Ridge:* A critical gateway between warm Atlantic and cold Nordic waters and central to understanding North Atlantic Deep Water and global climate regulation. Also key for understanding fish stock dynamics.
- *Faroe Bank:* Open ocean connectivity to the shelf. Helps understand how changes to large-scale circulation (like AMOC) might impact the shelf.

- *Faroese shelf boundary:* Useful for determining productive pelagic fishing grounds.

❖ United Kingdom & Scandinavia

***Charlotte Williams (NOC)**, **Patrick Gorringe (SMHI)**, Chris Cusack (EDF), Emilie Breviere (SMHI), Henning Wehde (IMR), Johan Söderqvist (GEOMETOC), Naomi Greenwood (Cefas), Tom Louden-Cooke (Met Office)*

The UK has an established Marine Monitoring and Assessment Strategy (UKMMAS) driven by regulatory obligations under the UK Marine Strategy and the EU Marine Strategy Framework Directive (MSFD). These programs support assessments of Good Environmental Status (GES), and sea temperature is a core indicator. The MSFD reporting notes that long-term temperature time series remain incomplete or discontinuous in several areas, underscoring the need for additional sustained observations.

UKMMAS includes Marine Directorate offshore Long-Term Monitoring programs, the Scottish Coastal Observatory, Cefas Smartbuoys, the ICES-coordinated International Bottom Trawl Survey, UK Met Office Moored Buoys, and contributions from the UK Integrated Marine Observing Network (UK-IMON). Research-led observing also plays a crucial role. The Met Office Glider (MOGli) program, beginning in 2022, is an important new contribution for continuous observation in the Fair Isle Current (FIC) and feeding real-time data into operational forecast models.

However, substantial gaps persist in the Faroe Bank, the Wyville Thomson Ridge, and the shelf region west of Orkney. The Dooley Current and associated northward flows bordering the Norwegian Trench have strong currents and heavy fishing traffic that make deployment of fixed observing infrastructure difficult but are optimal for FVON. These data could materially improve modeling of cross-shelf processes (including the AMM7 and AMM15 models), strengthen biogeochemical flux estimates, and enhance understanding of connectivity between open-ocean variability and shelf-sea temperatures, including interactions with the subpolar gyre.

There are growing industrial and policy needs related to warming waters, marine heatwaves, and bottom temperature trends. Increases in bottom temperature are linked to operational risks and costs for oil and gas and offshore wind sectors, including impacts on pipelines and cable performance.

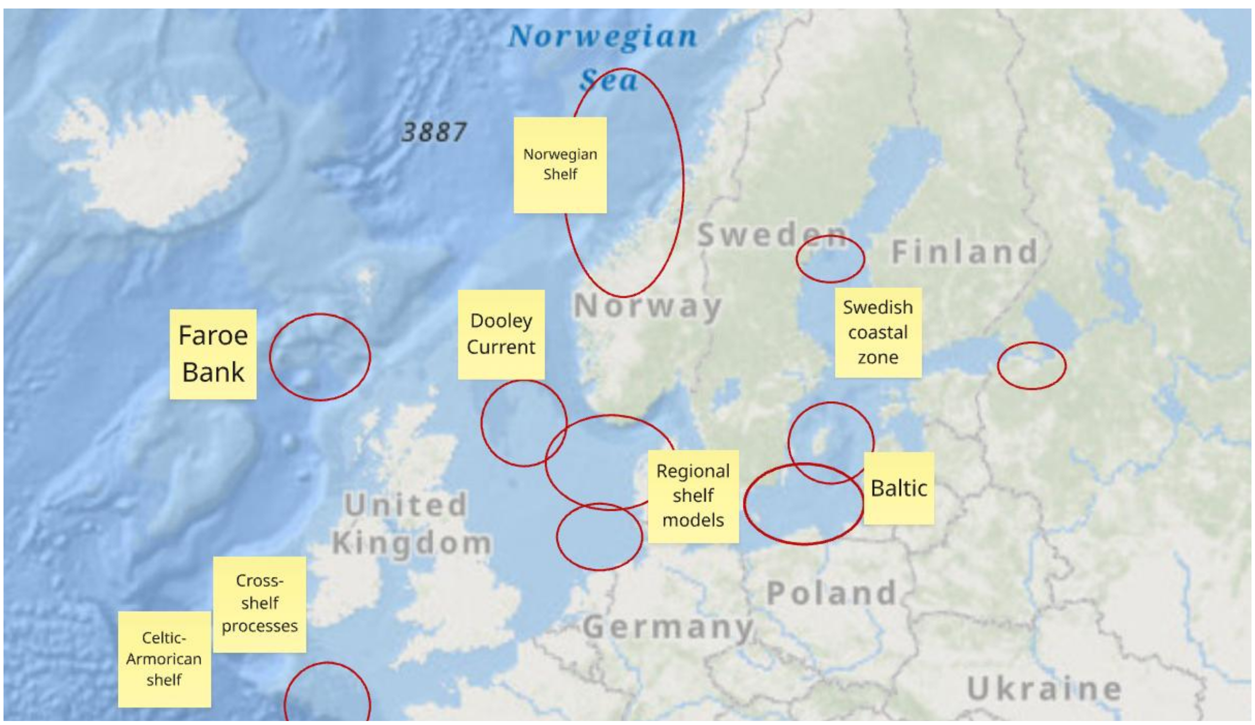
There is also strong potential for regional cooperation across the UK, Scandinavia, and broader Europe. Enhanced data collection could feed into multiple international assessments and programs, including the ICES Report on Ocean Climate, Copernicus Marine Service Ocean State Reports, the European Global Ocean Observing System, GO-SHIP hydrographic surveys, and future EU Interreg and Horizon Europe initiatives.

Data Applications

- *Oil and gas*: Bottom temperatures have an impact on the amount of gas that can be pumped. Bottom temperature fluxes also indicate potential stresses.
- *Offshore wind*: Better understanding of seasonality and strength of stratification, and the potential impact of turbines on the primary productivity of the ecosystem (which impacts trophic levels). However, fishing vessels can't operate directly in those areas.

- *Shipping*: Safe navigation and better vessel traffic services through improved operational forecasts (including sea level). This is relevant to DMI in Denmark and private companies like Green Steam.
- *Recreation*: Swimmers, boaters, surfers, etc. are impacted by accurate ocean information.
- *UK policy*:
    - Agencies use the data for assessments under regional seas conventions such as OSPAR (Protection of the Marine Environment of the North-East Atlantic) and frameworks such as the EU's WFD (Water Framework Directive). These measurements describe biodiversity and food webs using descriptors such as eutrophication.
    - Policy reports and assessments also call for long-term monitoring of temperature. Near-bed region temperatures have impacts on biology and oxygen levels.
    - In situ data is used for defense applications.
- *Modeling and operational forecasts*:
    - Climate modelers use environmental data for validation and calibration. This is essential for operational forecasts in every country (ocean and atmosphere), which also depend on RT assimilation.
    - Regional ocean models also need in situ data to make cross-shelf fluxes more accurate. These are then coupled with biogeochemical models to make estimates of carbon and nutrient budgets between the open ocean and the coast.
    - There are complementary efforts (Sweden) between intermediary ocean models.

Sites of Interest



- *Celtic-Armorican shelf:* Sparse observations and cross-shelf exchange processes are not currently captured in models correctly (there are differences between AMM7 and AMM15).

- *Faroe Bank:* Includes key currents with North Atlantic inflows. Would provide information in between two long-term monitoring stations.
- *North Sea:* Oil and gas are widespread in this region, and offshore wind development is increasing. Anywhere in the northern North Sea, subsurface temperatures are useful because marine heatwaves are predicted to increase in that region.
- *Dooley Current:* Under-observed because of difficulties operating data platforms in the strong current and dense fishing environment.
- *Cross-shelf processes:* These are not being resolved, creating big differences between models.
- *Regional shelf models:* These are important for characterizing ocean processes and localizing salinity and temperature. OSPAR determined that regional shelf models are failing the bottom dissolved oxygen threshold, and more bottom oxygen measurements are needed.
- *Norwegian Shelf:* Needs more data everywhere. Valuable for improving information and assimilation into models.
- *Swedish coastal zone:* Needs more data. Collecting data close to the coast is quite problematic. In general, Sweden needs subsurface data in the Baltic Sea and the Kattegat/Skagerak to improve the coastal zone model.
- *Baltic:* Important for climate projections. More observations are needed to understand the pathway of deep water inflow. There are only two Argo floats in that area currently.

Additional Note: All offshore transport routes are also important for maritime weather forecasting.

❖ Ireland, Spain, & Portugal

***Caroline Cusack (Marine Institute)**, **César González-Pola (IEO)**, **Miguel Santos (IPMA)**, Rita Esteves (IPMA), Ainhoa Caballero (AZTI), Carles Castro Muniain (ODN), Eoghan Daly (Marine Institute), John Radford (ZebraTech)*

The existing Atlantic observing system captured on OceanOPS illustrates that while offshore observations are relatively well represented, substantial gaps persist in shelf regions where fishing activity is concentrated. These gaps are particularly evident in subsurface temperature measurements.

Ireland's national monitoring efforts and historical sampling intensity (1999-2020) show uneven spatial and temporal coverage around Irish waters. However, there is a strong overlap between regions with sparse data and regions with high fishing activity, particularly along the shelf break. Meanwhile, Portugal's coastline is lined with opportune fishing ports, and Spanish fishing fleets traverse up the coastline and sweep the region surrounding Ireland, the UK, and the North Sea.

There are opportunities to extend observing efforts beyond mainland Europe. Portuguese fishing harbors extend west into the Azores and south to Madeira, as well as Cabo Verde (off the coast of Northwest Africa) and São Tomé and Príncipe (in the Gulf of Guinea).

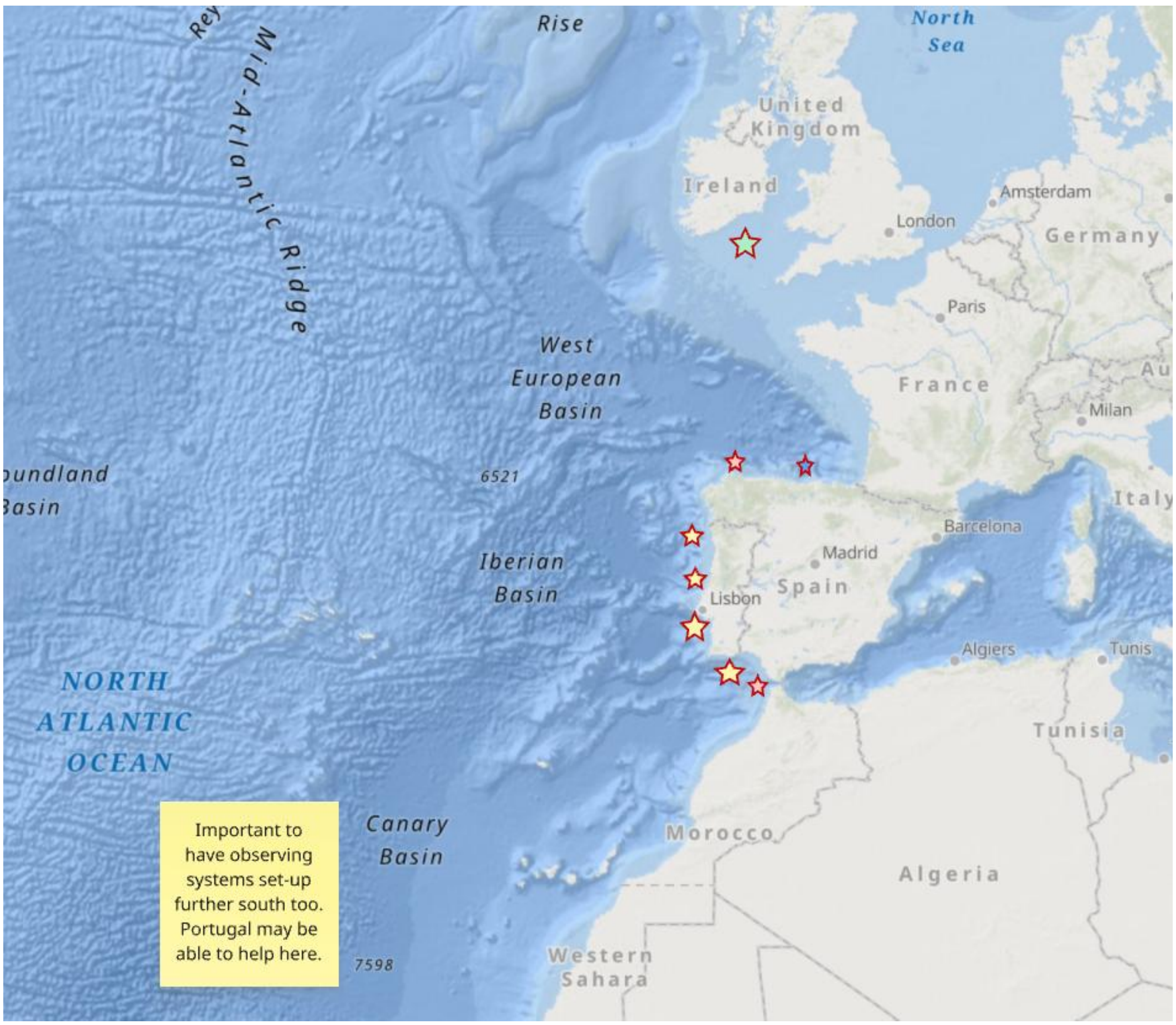
Data Applications

Bottom and water column temperature and salinity (along with dissolved oxygen, another important indicator) are important for a variety of applications:

- Aquaculture (fish health)
- Fisheries science (spawning areas)

- Fisheries applications (marine heatwaves and cold waves recruitment)
- Policy
    - EU Marine Strategy Framework Directive, MSFD
    - EU Water Framework Directive, WFD (water quality)
    - OSPAR North-East Atlantic Strategy (in particular, the COCOA group dealing with ocean climate monitoring)
- Weather forecasting
- Operational ocean modeling (validation and assimilation)
- Shipping sector (benefits from ocean models and weather forecasts)

Sites of Interest



- *Ireland:* Celtic Sea region (South Ireland)
- *Spain:* Southern Bay of Biscay, Northeast Iberia, Gulf of Cadiz, Canary Islands
- *Portugal:* Various sites along the coast. More analysis needed.

As an initial assessment, it would make sense to divide each Exclusive Economic Zone into a 5°×5° grid and analyze the temperature data currently available from existing sensors (buoys, Argo, CTD, etc.) and then prioritize investment in the grid cells with limited data coverage.

DISCUSSION

The breakout room discussions provided detailed, regional-specific understanding of where FVON deployments could have the greatest impact, while also reinforcing the importance of thinking beyond national boundaries. Taken together, the sessions outlined a coherent picture of how Year 1 deployments could strengthen the North Atlantic observing system as a whole.

Canada: Boundary Currents, Shelf Edges, and Downstream Impacts

Discussions in the Canada breakout underscored the strong foundation provided by existing programs such as AZMP and RIOPS, while highlighting persistent gaps in harsh and operationally challenging environments. Participants emphasized that boundary currents and shelf-edge regions—notably the Labrador Sea, Tail of Grand Banks, and Bay of Fundy—are among the highest-value targets for FVON.

These regions influence not only Canadian waters but also downstream conditions along the northeastern United States. Improved subsurface data would directly support real-time forecasting, ocean reanalysis, fisheries stock assessments (particularly for lobster), and the protection of vulnerable marine ecosystems. Fishing vessels are especially well-suited to these environments, where moorings and other fixed platforms are difficult to maintain. However, a key theme was the need for bottom-up engagement with the fishing industry, ensuring that deployments align with fisher priorities and deliver tangible operational benefits such as improved safety, fuel efficiency, and situational awareness.

Iceland & Faroe Islands: Fronts, Deep Circulation, and Fisheries Performance

The Iceland-Faroes breakout highlighted the region's role as a dynamic oceanographic gateway connecting the Atlantic and Nordic Seas. Participants emphasized the importance of the Iceland-Faroe Ridge and adjacent shelf regions for understanding deep-water formation.

FVON deployments would directly support fisheries by improving detection and monitoring of ocean fronts that strongly influence fish aggregation, search time, and fuel use. Given the relative lack of operational regional models, FVON data could also play a catalytic role in expanding modeling capacity to improve understanding of bottom warming and marine heatwaves.

United Kingdom & Scandinavia: Cross-Shelf Exchange and Operational Forecasting

The UK-Scandinavia breakout focused on regions where cross-shelf processes are poorly resolved due to strong currents and dense fishing activity, making them inaccessible for fixed platforms but ideal candidates for FVON deployments. Priority areas included the Faroe Bank, Wyville Thomson Ridge, Dooley Current, northern North Sea, and Norwegian Shelf.

Additional subsurface observations would improve real-time assimilation into operational forecast systems used by meteorological agencies across northern Europe. They would also improve ecosystem assessments used in regulatory reporting under OSPAR, MSFD, and WFD, and benefit industrial operations of offshore oil, gas, and wind sectors.

Ireland, Spain, & Portugal: Opportunities for Extended Reach

The Ireland-Spain-Portugal breakout highlighted substantial gaps in subsurface observations along the Celtic Sea, Iberian shelf, and Bay of Biscay. Participants stressed the importance of improved data for understanding marine heatwaves, spawning habitats, and fisheries recruitment; however, the EU Marine Strategy Framework Directive and OSPAR North-East Atlantic Strategy (along with the EU Water Framework Directive for coastal data) are the only legal instruments that enforce action and explicitly identify the need for ocean climate monitoring.

A distinctive opportunity identified in this session was the geographic reach of Spanish and Portuguese fleets, which operate far beyond national waters, including in Atlantic Canada and along the African coast. This creates the potential for FVON deployments that simultaneously benefit European forecasting systems and data-poor regions in Africa, where national observing capacity is limited.

Implications for Year 1 of the North Atlantic Arc Pilot

Across all breakout rooms, the highest-value FVON deployments are those that serve multiple countries, multiple applications, and multiple user communities at once. For Year 1 of the North Atlantic Arc pilot, this suggests prioritizing:

- Boundary currents and shelf-edge corridors with downstream impacts
- Regions where fixed observing infrastructure is impractical or insufficient
- Areas already linked to operational forecasting and modeling systems
- Fleets that operate across EEZs and into data-poor regions
- Early deployments that visibly benefit fishers, strengthening long-term buy-in

By focusing on these shared priorities, the North Atlantic Arc pilot can demonstrate the collective value of fishing-vessel-based ocean observing and lay the foundation for a sustained, transboundary observing system that delivers tangible benefits across science, policy, industry, and coastal communities.

NEXT STEPS

Task	Activities	Lead(s)
Pilot Deployment	• Synthesize feedback from the workshop to refine priority regions for Year 1 deployments. • Conduct targeted outreach to fishing fleet operators. • Install sensors before the Ocean Sciences Meeting in February.	FVON
Data Access	• Develop an FVON data portal on the website to ensure that collected data are easy to discover, access, and use by a broad range of stakeholders. • Explore integration with national data systems and open-source tools such as CIOOS Catalogue Maps. • Coordinate with OceanOPS, GOOS, and other agencies to ensure FVON data are interoperable and contribute to existing operational systems.	FVON, in collaboration with CIOOS and partners
Stakeholder Engagement	• Continue connecting potential end users of data with FVON to ensure that data collection aligns with high-impact applications.	All participants

Communications	• Use early pilot data and case studies to demonstrate value to fishers and other stakeholders, supporting bottom-up engagement and long-term participation.	FVON
Funding Pathways	• Develop a funding proposal template that outlines technical requirements, costs, and use cases for implementing FVON. (See initial information included in the Appendix.) • Support countries and institutions seeking to secure funding and scale deployments.	FVON, Regional Leads
Knowledge Sharing	• Share information on public-domain ROMS model implementations to support regional modeling efforts and uptake of ocean intelligence by private sector actors.	All participants
Year 2	• Attend the follow-up North Atlantic Arc Workshop at the end of Year 1 to review pilot results, assess data impacts, and co-design Year 2 activities, including deployment of an additional 18 vessels.	All participants

APPENDIX

FVON Information

FVON Specification Sheet

North Atlantic Arc One-Pager

Presentations

Introduction to FVON and the North Atlantic Arc Project: Cooper Van Vranken and Chris Cusack

Canada Breakout Room: Blair Greenan

Iceland-Faroes Breakout Room: Angel Ruiz-Angulo and Hjálmar Hátún

UK-Scandinavia Breakout Room: Charlotte Williams and Patrick Gorringe

Ireland-Spain-Portugal Breakout Room: Caroline Cusack, César González-Pola, and Miguel Santos

More Resources

Full workshop recording

Full Miro Board