EuroGOOS
European Global Ocean Observing System

EuroGOOS Annual General Assembly Meeting

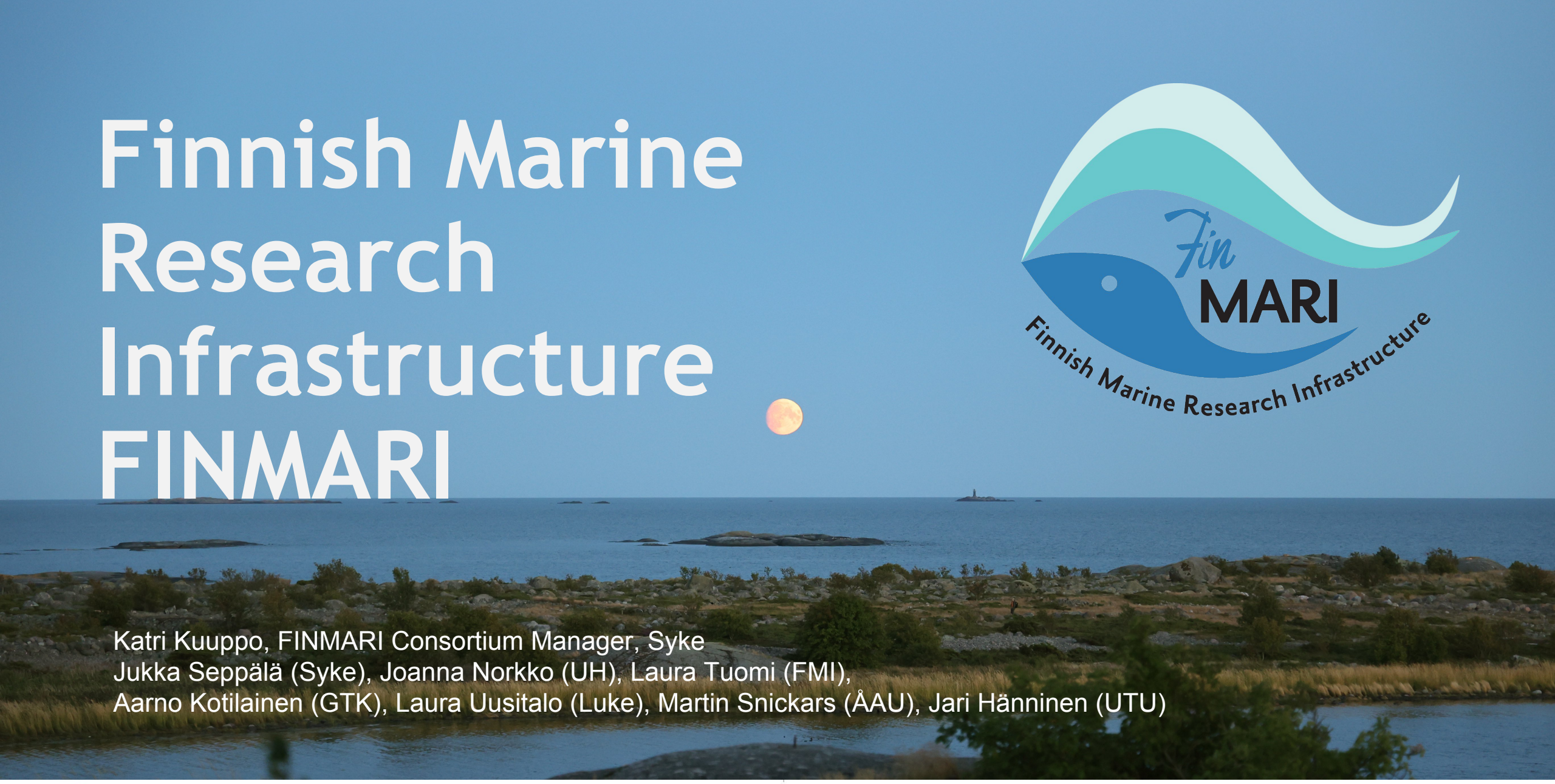
19-21 May 2025

AGENDA DAY 1

Monday 19 May

12:00 - 13:00	*Arrival and lunch (own expense)*
13:00 - 15:00	**Special Open Session on the Regional Developments and International Collaboration** - Part 1: Ocean observing value chain and governance in the Baltic Sea - Challenges, Opportunities, Offer
15:00 - 15:30	*Coffee/Tea*
15:30 - 17:30	**Special Open Session on the Regional Developments and International Collaboration** - Part 2: EuroGOOS and International Partnerships – Dialogue and Opportunities
19:00-22:00	*Board and Chairs dinner (Manala Restaurant, Dagmarinkatu 2, 00100 Helsinki, Finland) - Menu*

Finnish Marine Research Infrastructure FINMARI



Katri Kuuppo, FINMARI Consortium Manager, Syke
Jukka Seppälä (Syke), Joanna Norkko (UH), Laura Tuomi (FMI),
Aarno Kotilainen (GTK), Laura Uusitalo (Luke), Martin Snickars (ÅAU), Jari Hänninen (UTU)

FINMARI - Finnish Marine Research Infrastructure connects the marine research sector in Finland

It is a consortium of four research institutes

- Finnish Environment Institute Syke
- Finnish Meteorological Institute FMI
- Geological Survey of Finland GTK
- Natural Resources Institute Luke

and three universities

- University of Helsinki - Tvärminne Zoological Station
- University of Turku - Archipelago Research Institute
- Åbo Akademi - Husö Biological Station

under the administration of five ministries

Åbo Akademi University
UNIVERSITY OF TURKU
UNIVERSITY OF HELSINKI
Luke NATURAL RESOURCES INSTITUTE FINLAND
GTK
FMI
Syke
Fin MARI Finnish Marine Research Infrastructure

FINMARI is a distributed, multi-disciplinary marine research infrastructure

- FINMARI supports monitoring, research and innovation related to the global challenges of the Baltic Sea
- The partners are responsible for statutory monitoring of the EU directives in Finland (e.g., MSFD, WFD, Habitats Directive)
- It is a significant strategic national investment in the marine research

FINMARI brings added value by networking

FINMARI is a unique consortium on a European scale and its partners are widely networking in

- European Research Infrastructure Consortia (ERICs)
- European and national Research Infrastructure projects
- European and national research projects
- European data portals

FINMARI in numbers

11
years
on the national
RI roadmap*

10-12
M€ y^{-1}
budget

40-50
FTE^{-1}
supporting staff

>47
collaborative
projects

>600
on site
$users^{-1}$

100
scientific
$publications^{-1}$

15-30
“impact”
$papers^{-1}$

11
$PhD\ theses^{-1}$

*RI roadmap of the Research Council of Finland

“impact” papers = policy, modeling, review

FINMARI structure and governance

Four governmental research institutes, three universities, Syke coordinates

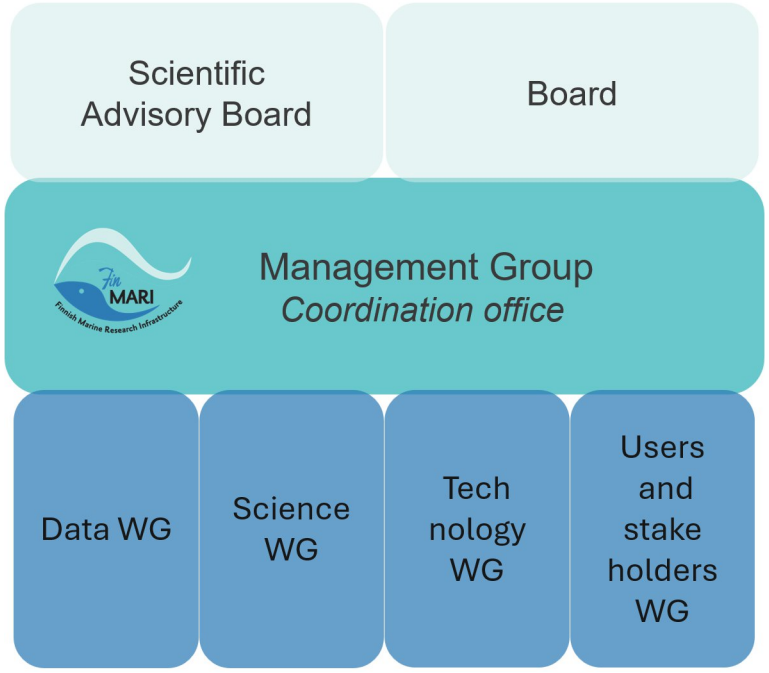
In the administration of five ministries

The Ministry of the Environment plays a central role

In the national Infrastructure Roadmap of the Research Council of Finland since 2014

Research Council of Finland

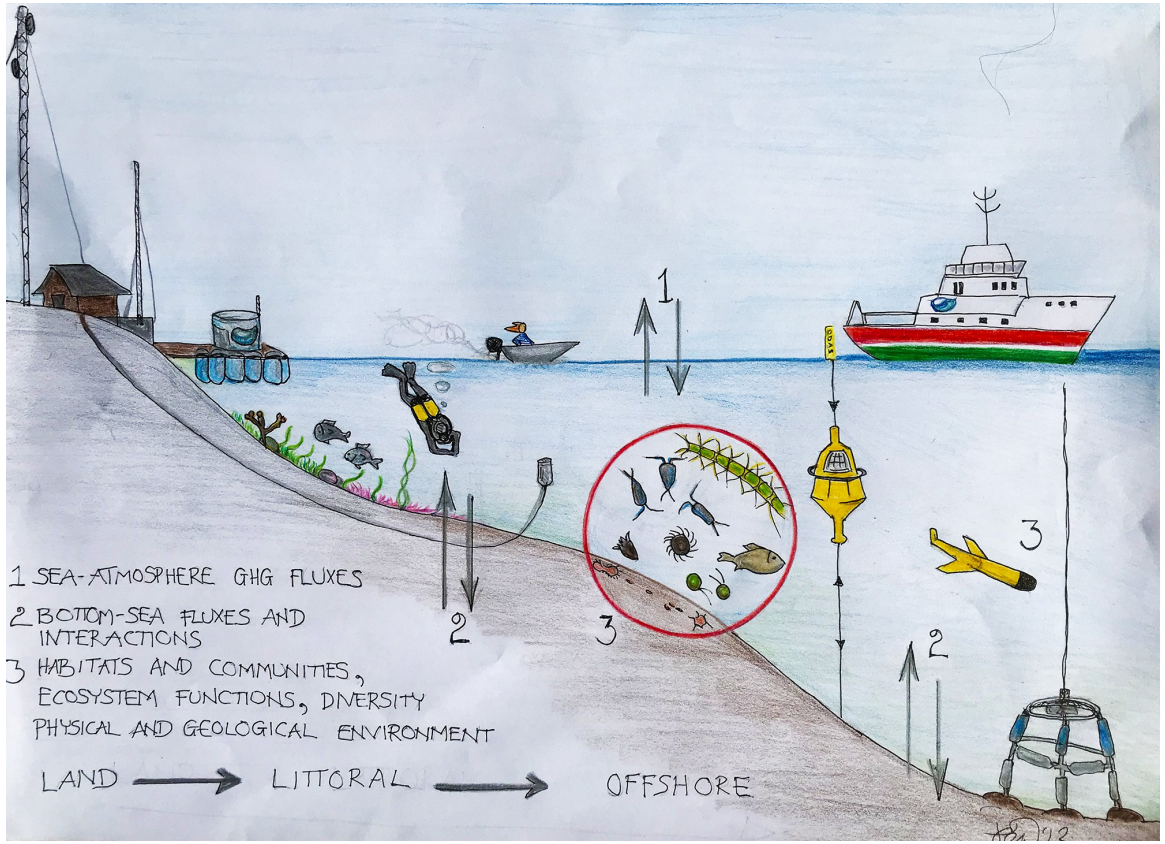
Structure and governance



The consortium integrates the fields of research and competences of the partners

Key fields of activity

Biological oceanography
Chemical oceanography
Physical oceanography
Fisheries research
Marine Geology
Green transition
Marine security and safety
Societal impacts
Teaching/education



Key competences

Field observations
Experimental research
Modeling
Databases
Marine Technology

What we offer to the research community and the society at large

Infrastructures

Research vessels

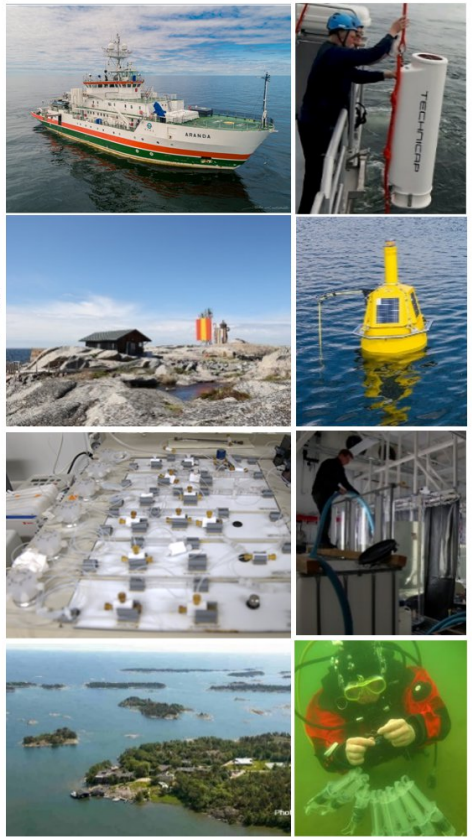
Field instruments

Autonomic observation platforms

Laboratories

Experimental facilities

Field stations



Activities

Research and monitoring cruises

Marine observation and mapping

Multidisciplinary research projects

Test platforms for technology development

Open access

University-level education

Products

Open databases FAIR data

Models and forecasts

Data products and reports

Expert and governmental services

Scientific publications

Research collaboration

Services for companies

International networks

Targets

CLIMATE CHANGE

BIODIVER-SITY LOSS

POLLUTION

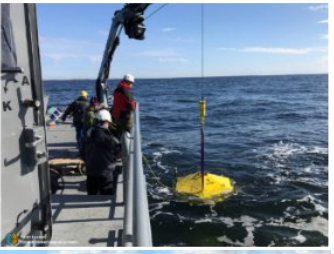
GREEN TRANSITION

MARINE SAFETY

Key infrastructures of FINMARI


Photo Jukka Seppälä


Photo Timo Tamminen



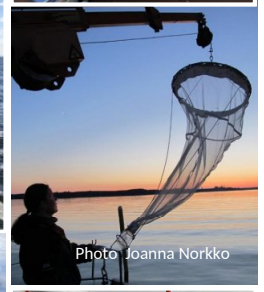


Photo Joanna Norkko


Photo Lauri Laakso

Photo Katri Kuuppo

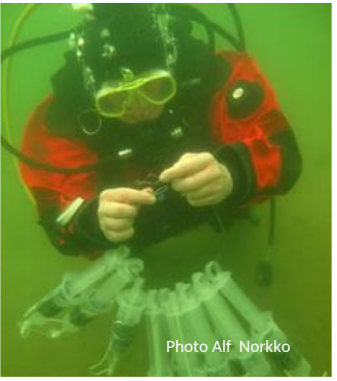
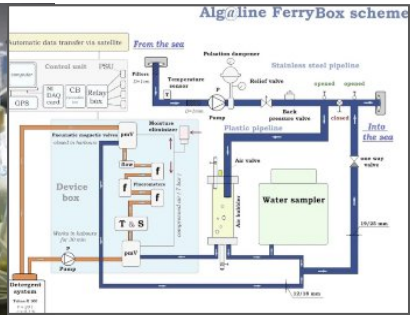


Photo Alf Norkko


Photo Katri Kuuppo


Photo Katri Kuuppo


Photo Kristian Spilling



- Field stations
- Research vessels
- FerryBoxes
- Autonomous buoys, gliders and benthic landers
- Automated real-time observations
- Experimental facilities
- Laboratories
- Culture collection of phytoplankton
- Traditional research equipment


Photo UTU/Seili


Photo Jesper Häggblom


Photo Juha Rahkonen


Photo Ilkka Lastumäki

Field Stations along the southern coast of Finland

Husö biological station

- Aquatic and other ecological research
- Monitoring of shallow waters
- Laboratory & experimental facilities

Archipelago Research Institute

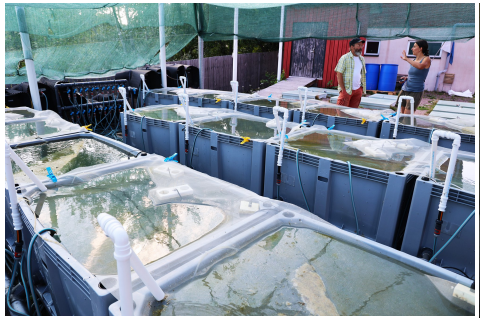
- Long-term monitoring
- Statistical time series modeling
- Experimental laboratory facilities
- RV Aurelia

Utö Atmospheric and Marine Research Station

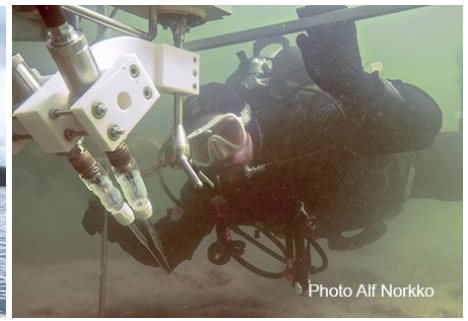
- Physical and biological real-time observations
- Part of many networks, e.g., HELCOM, EMEP, ICOS, JERICO
- Observations are supported by Alg@line

Tvärminne Zoological Station

- Biological and ecological research
- Long-term monitoring
- RV Augusta
- Large-scale field experiment facilities
- Laboratory and indoor experimental facilities
- Scientific diving







Photos: Katri Kuuppo, Jari Hänninen, Alf Norkko

Research vessels vary in their instrumentation and the range of operation

Aranda

- Length 59.20 m
- Cruising speed 11 knots Berths for 25 scientists
- Laboratory space, wet lab, acclimated rooms, computer lab and offices
- Sampling facility 132 m²
- Research and storage containers
- Owner Syke

Augusta

- Length 18.5 m
- Cruising speed 18 knots
- Range 20 h at cruising speed
- Crane capacities of 300 and 1000/500 kg
- Capstan and rope lock for buoy anchor
- Small field laboratory
- Owner Tvärminne Zoological Station

Aurelia

- Length 18.1 m
- Cruising speed 15 knots
- Passengers max 42
- Wet and dry laboratories
- CTD, sediment corers, grabs ADCP-profiler, on-line chlorophyll fluorometer, sonar systems
- Owner Archipelago Research Institute

Geomari

- Length 20.0 m
- Cruising speed 20 knots
- Berths for 3 scientists
- Equipment for seafloor mapping and research: seismic signal equipment, echosounder, sonars, seabed sediment sampling equipment
- Wet laboratory
- Owners GTK and Finnish Navy

Examples of autonomous platforms for marine observation

Argo Floats

- Free drifting, profiling Argo float measures T°C, salinity, currents and bio-optical properties in the sea
- Owner and operator FMI

Profiling Buoys

- Automated devices for measuring salinity, T°C, O_2, turbidity, chl-α, and blue-green algae in the whole water column.
- FINMARI has a profiling buoy network at the field stations

Gliders

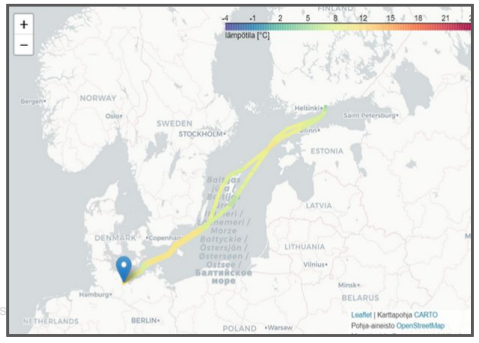
- Autonomous underwater vehicle used for measuring T°C, salinity, chl-α, turbidity and CDOM, noice, etc
- Owner and operator FMI

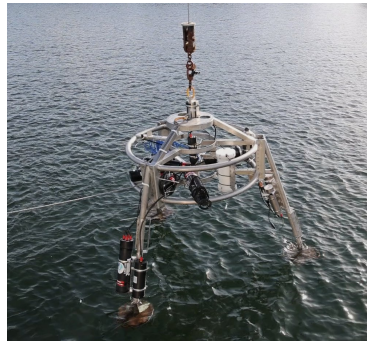
Ferryboxes

- Ferries equipped with flowthrough systems
- Measure T°C, salinity, turbidity, chl-a, phyco-cyanin and -erythrin, humic matter, pH, O_2 and pCO2 with 200 m resolution.
- Owner and operator Syke

Benthic lander

- Observation platform to be deployed on the seabed to record physical, chemical or biological activity
- Steel frame is equipped with sensors
- Owner and operator Syke and GTK

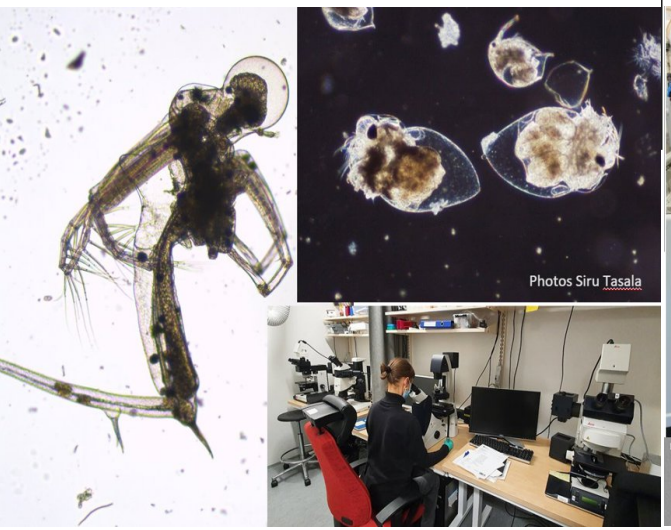




Plankton imaging instruments and microscopes

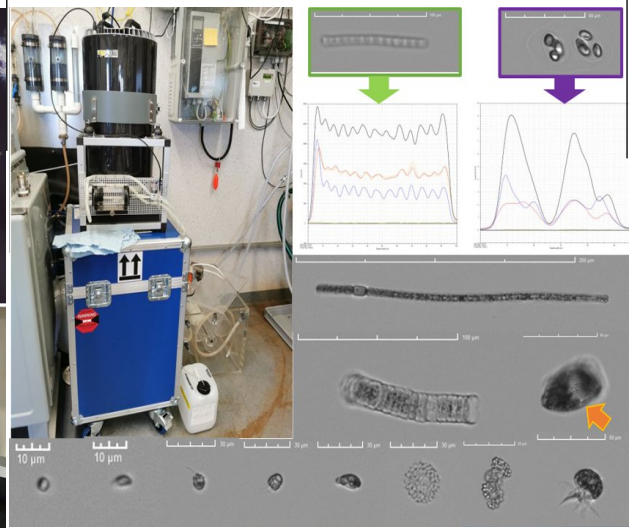
Research microscopes

Stereo, inverted and epifluorescence microscopes equipped with video/still camera



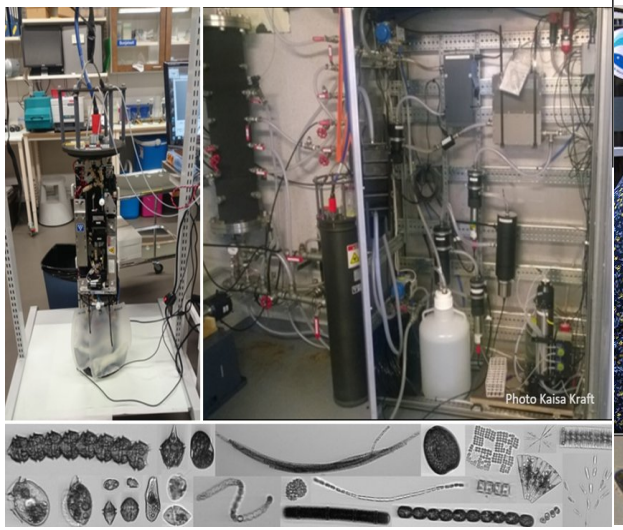
CytoSense

particle scanning and imaging for organisms 0.5-1000 µm



ImagingFlowCytoBot

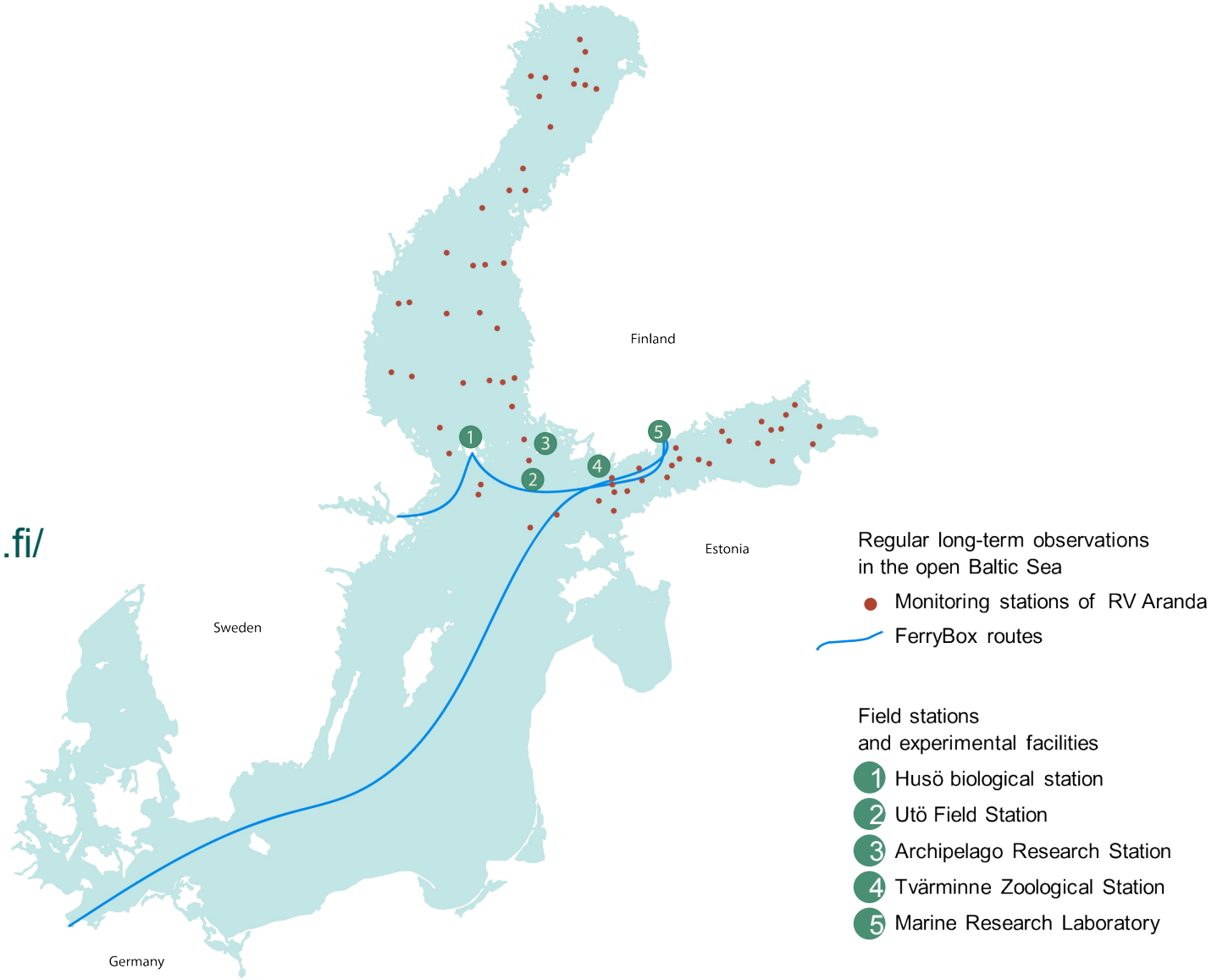
for organisms <10-150 µm



FlowCam

Image particle analyzer for 10-1000 µm organisms

https://www.finmari-infrastructure.fi/



Regular long-term observations in the open Baltic Sea

- Monitoring stations of RV Aranda
- FerryBox routes

Field stations and experimental facilities

1. Husö biological station
2. Utö Field Station
3. Archipelago Research Station
4. Tvärminne Zoological Station
5. Marine Research Laboratory

FinMARI Finnish Marine Research Infrastructure
Suomen ympäristökeskus Finlands miljöcentral Finnish Environment Institute
GTK
Ilmatieteen laitos Meteorologiska institutet Finnish Meteorological Institute
Luke Luonnonvarakeskus
Helsingin yliopisto Helsingfors universitet University of Helsinki
Åbo Akademi
University of Turku
Suomen Akatemia Finlands Akademi Academy of Finland


Photo Ilkka Lastumäki

BOOS – Marine Services for Marine Users and Policymakers

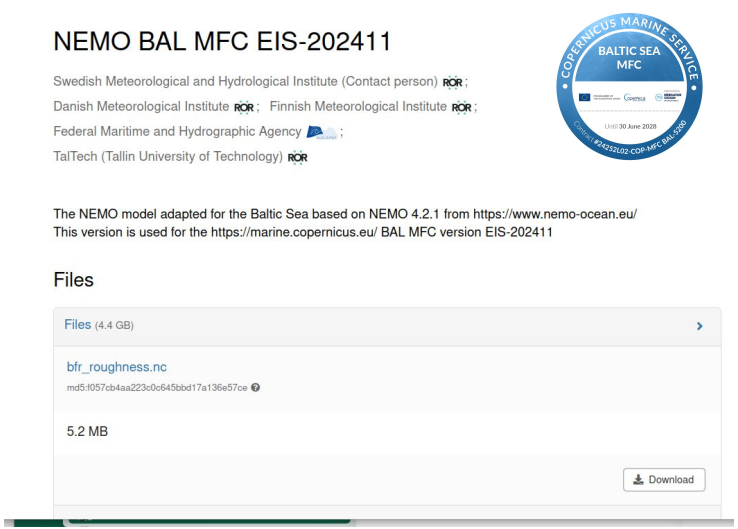
BOOS partners - presented by Laura Tuomi

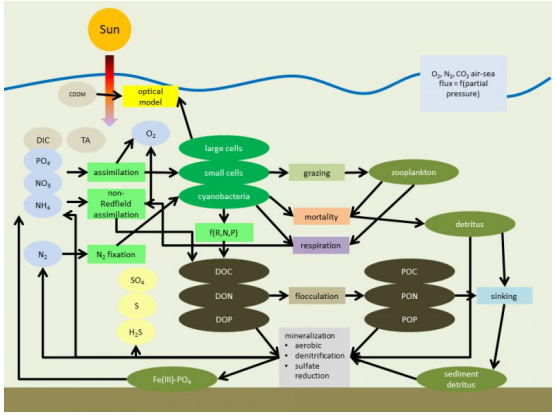
BOOS
Baltic Operational Oceanographic System

Improving modelling capabilities

- BAL MFC model development supporting basin scale modelling in the Baltic Sea
- In addition NEMO-Nordic cooperation further advancing uptake from research projects
- Cooperation enhancing in developing biogeochemical modelling in the Baltic Sea. Lead by IOW a group of scientists/institutes working together to share and co-develop ERGOM model
- NECCTON - fusing innovative ocean ecosystem models and new data.

NECCTON
NEW COPERNICUS CAPABILITY FOR TROPHIC OCEAN NETWORKS

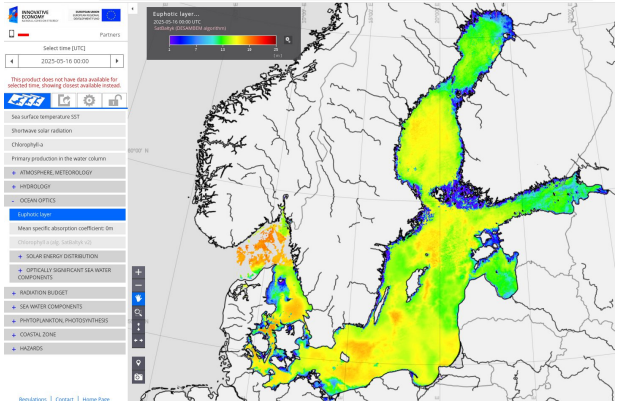




BOOS
Baltic Operational Oceanographic System

Services for satellite data

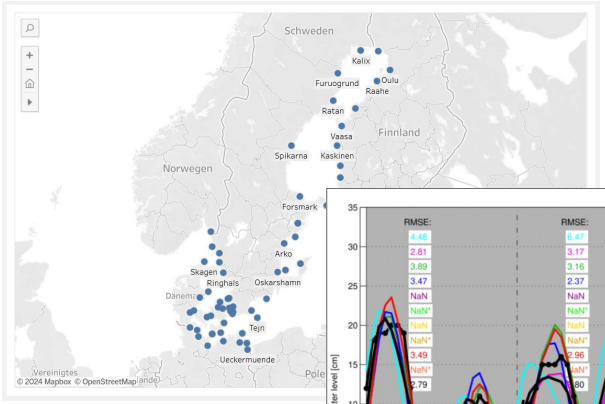
- Syke Tarkka and IO PAN satbaltyk services providing NRT open data for the Baltic Sea
- ESA – 4DBaltDyn project:
  - Utilising advancements in satellite products by the earlier ESA Baltic+ projects.
  - Aims to develop four-dimensional physical and bio-geochemical parameters by merging advanced satellite earth observation data with numerical models and AI methods.
  - Also, novel ML and AI methods are used for the 4D reconstruction

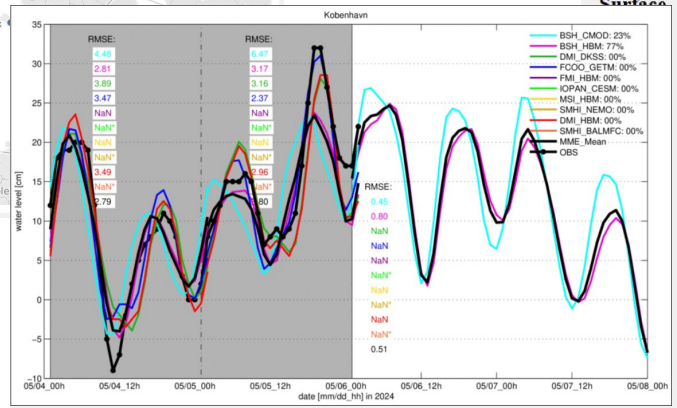


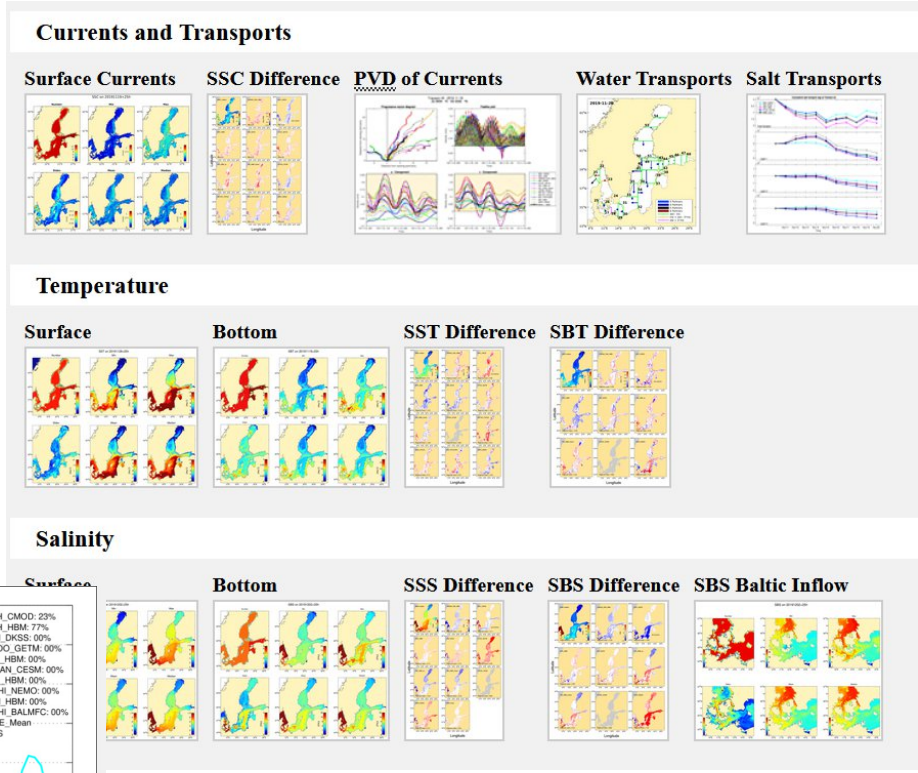
BOOS
Baltic Operational
Oceanographic System

BOOS community products

- Multi Model Ensemble



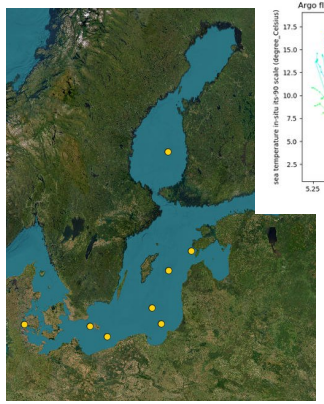


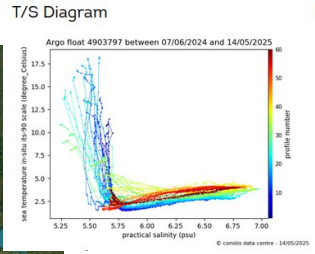


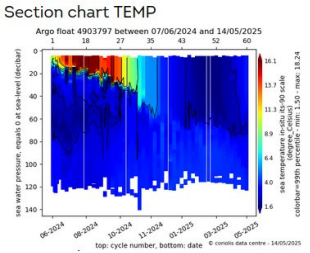
BOOS
Baltic Operational
Oceanographic System

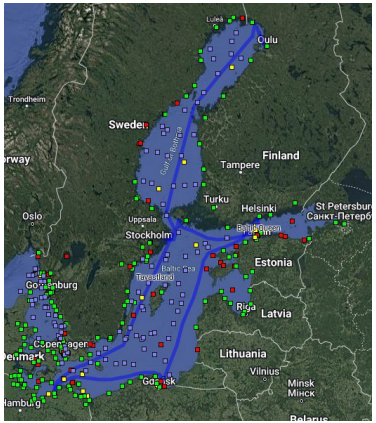
Baltic Sea observations

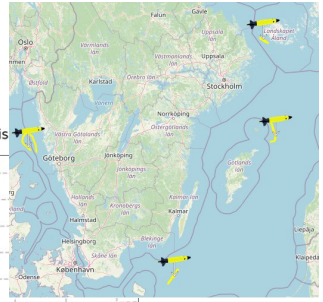
- Good cooperation between countries, BOOS partners and other operators
- Enhancing use of automated measurement devices to support Baltic Sea monitoring
- Working together for deployments and recoveries especially for autonomous devices
- Enhancing availability of the data and QC method development
- Challenges related to geopolitical situation

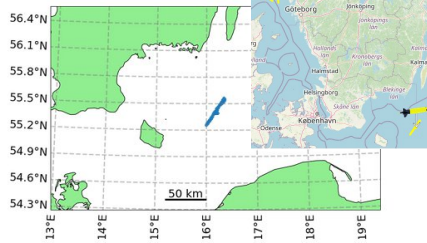


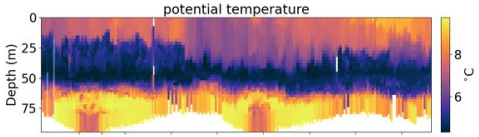


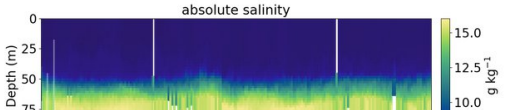








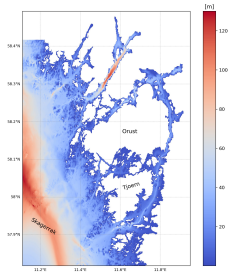




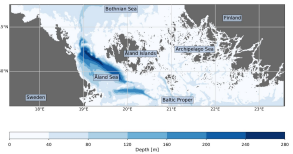
Baltic Sea coastal modelling activities

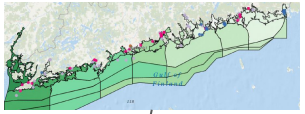
BOOS Baltic Operational Oceanographic System

Coastal WG

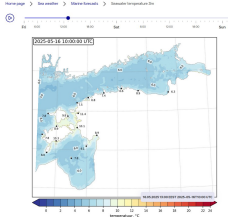


Finland: Water transport modelling for **environmental impact assessments** (**NEMO**).



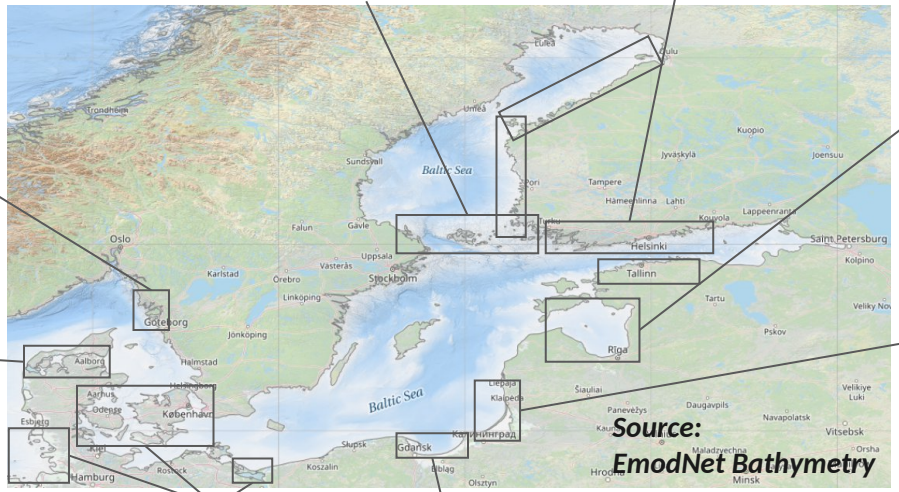


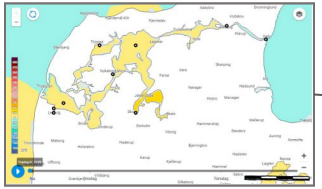
Finland: Nutrient load modelling, (**FICOS**) for water quality assessments, for the entire Finish coast.



Estonia: Coastal modelling service for sea water temperatures

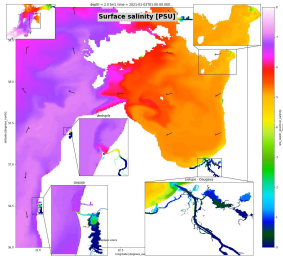
Sweden, high resolution fjord and lake modelling (**NEMO**): Brofjorden, Orust-Tjorn fjord, lake Vaenern, lake Mälaren, Stockholm Archipelargo.

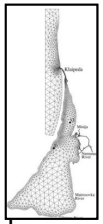




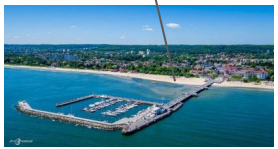
Denmark: CMEMS downstream service project FORCOAST: Marine Service for oysterground restauration. Microplastic transport studiers (**HBM**)

Latvia: Coastal model for servicing harbor operations and microplastic transport studies. (**HBM**)





Germany: **GCOAST** coupled atmosphere-land-wave-ocean model system including ecosystem and sediment transport model

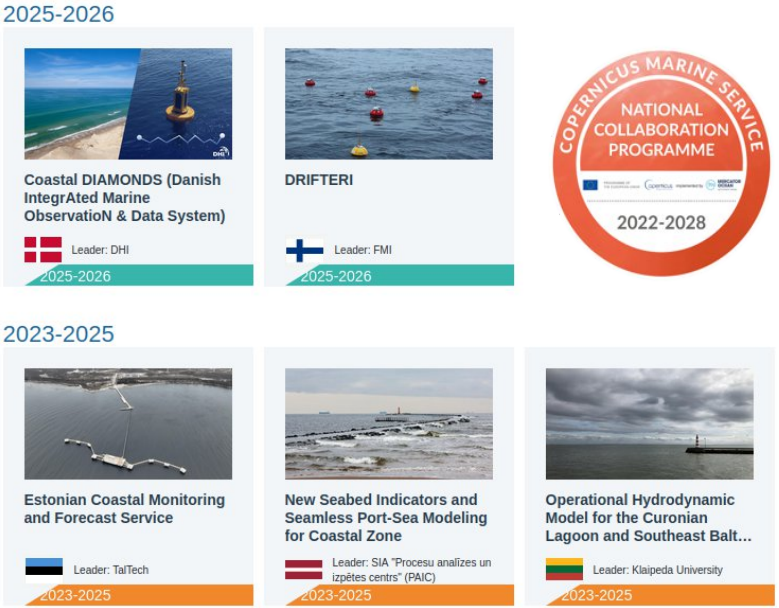


Poland (IOPAN): Baltic Sea (**ROMS-CICE**) Water quality assessments at Puuk Bay and Sediment transport studies at Sopot Pier (**DHI, Mike**)

Lithuania, Kuronian Lagoon **(SHYFEM-SWAT):** Climate/Hindcast service and assessment, Operational modelling planned, Particle tracking for bacterial tracers for bathing water quality.

BOOS - coastal services

- Copernicus Marine Service National collaboration programme enhances development of coastal services
- Horizon Europe project where BOOS partners are participating also advance coastal modelling, e.g. FOCCUS developing interfaces that connect the Copernicus marine service to the coastal services or LandSeaLot integrating data and models to better understand the land-sea continuum.
- BOOS AI/ML WG actively discussing and developing use of ML methods in development of coastal services



FOCCUS

LOT LAND SEA

BOOS - services for energy sector

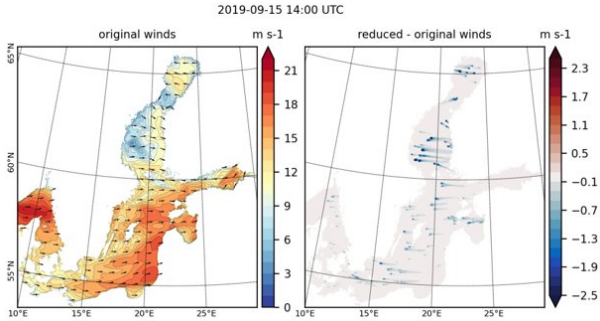
Several BOOS partners actively working with OWE sector

OLAMUR EU lighthouse project : high resolution ocean forecasts for OWE operations planning

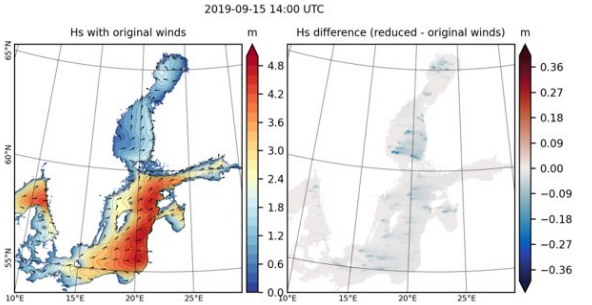
SBEP/DTO4OWE: Lead by Taltech, +partners from BOOS and NOOS + private sector

- Addresses challenges associated with the growing OWE sector in the Baltic Sea and the North Sea.
- numerical models, ML methods, in situ and remote sensing data

Wind



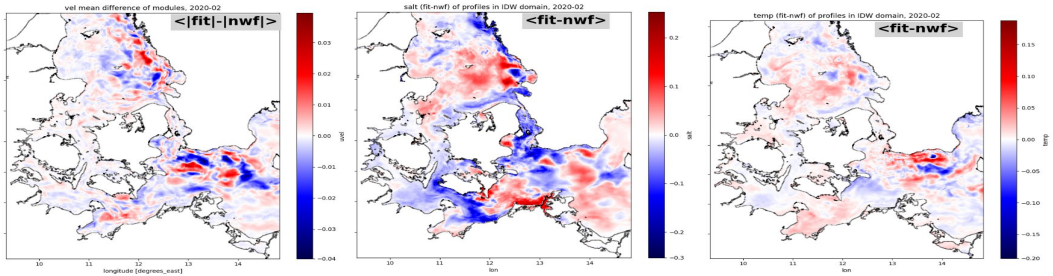
Waves



Currents

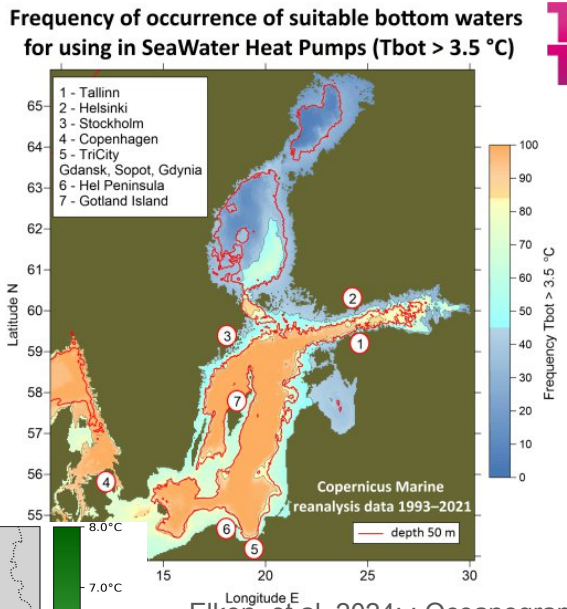
Salinity

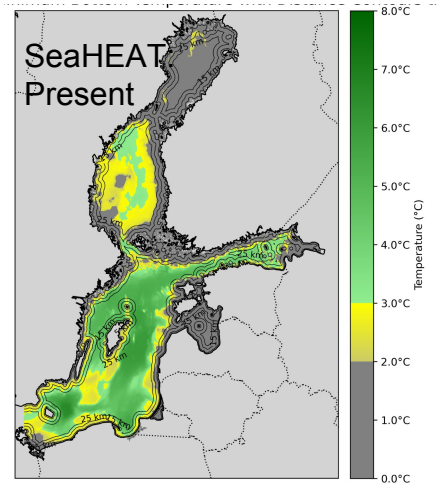
Temperature

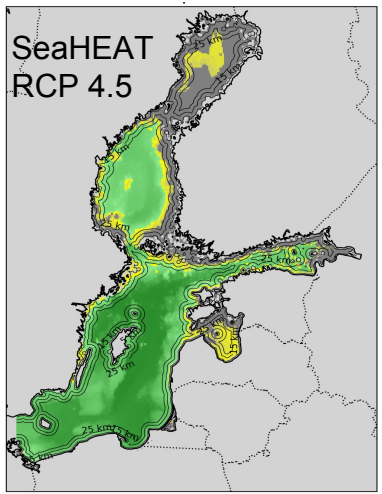


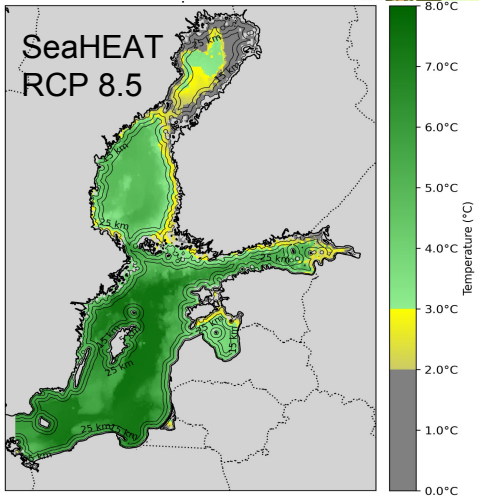
BOOS - services for energy sector

- Exploring the potential of Baltic Sea as a source of heat
- National projects by BOOS partners, e.g. SeaHEAT by FMI and Digital Twin of Marine Renewable Energy by Taltech
- Utilising Copernicus Marine Service data and SMHI ocean climate projections





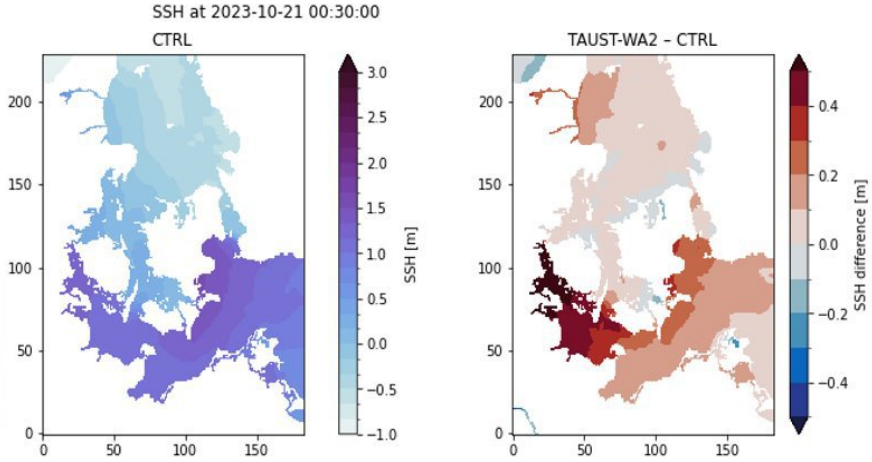




Elken, et al. 2024: : Oceanographic preconditions for planning seawater heat pumps in the Baltic Sea – an example from the Tallinn Bay, Gulf of Finland, in: 8th edition of the Copernicus Ocean State Report (OSR8), edited by: von Schuckmann, et al., Copernicus Publications, State Planet, 4-osr8, 9, https://doi.org/10.5194/sp-4-osr8-9-2024, 2024.

BOOS - Improving our understanding and forecasting of extreme events

- Storm Babet - Special issue Joint research to study
  - Overview of the storm
  - How forecast models performed
  - How can we improve forecast models in order to better predict extreme events - building future services
    - Coupling
    - Data-assimilation
  - Assessment of coastal erosion in storm Babet




Thank you for your attention!

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A Stakeholder-Driven Approach for Improving Marine Services

Presented by Hedi Kanarik

20.5.2025 EuroGOOS General Assembly 19-21 May 2025

Wave forecasts together with the **real time wave measurements** are identified as the key factors for save operations at the sea

Stakeholders need:

1. Betters nearshore forecasts

2. Tailored statistics for maritime traffic and different offshore activities

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Betters nearshore forecasts?

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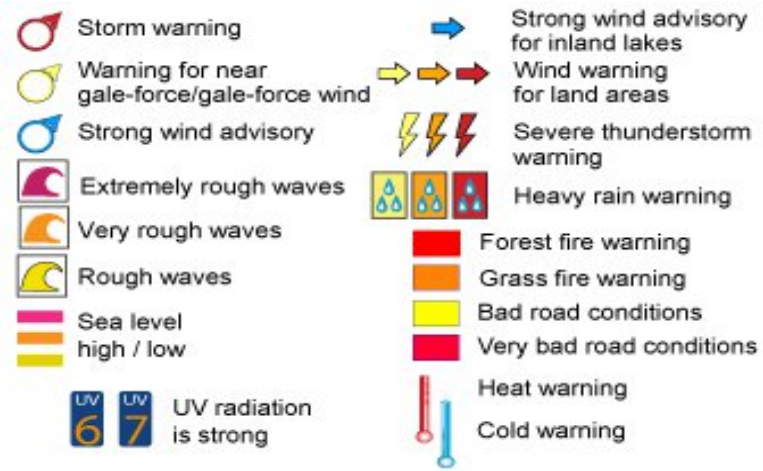
On demand high resolution coastal wave forecasts

Model resolution and accurate information on **bathymetry** have significant impact on the accuracy of the wave forecasts near shore.

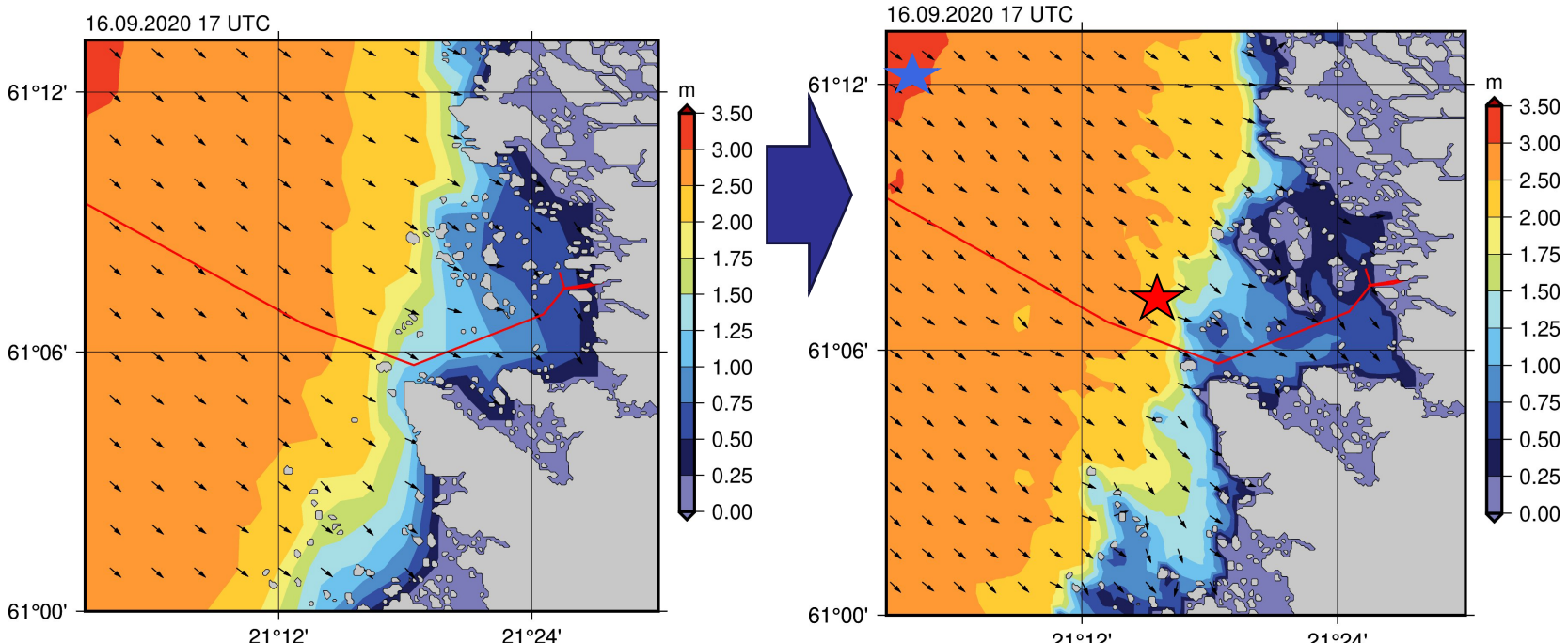
- Attenuation of waves due to bottom friction and depth induced wave breaking.
- Sheltering caused by archipelago.
- Concentration of wave energy due to shoals.



High resolution wave forecasts for

1) **on demand** wave forecast and to
2) support **machine learning applications**

1 nmi **0.1 nmi**



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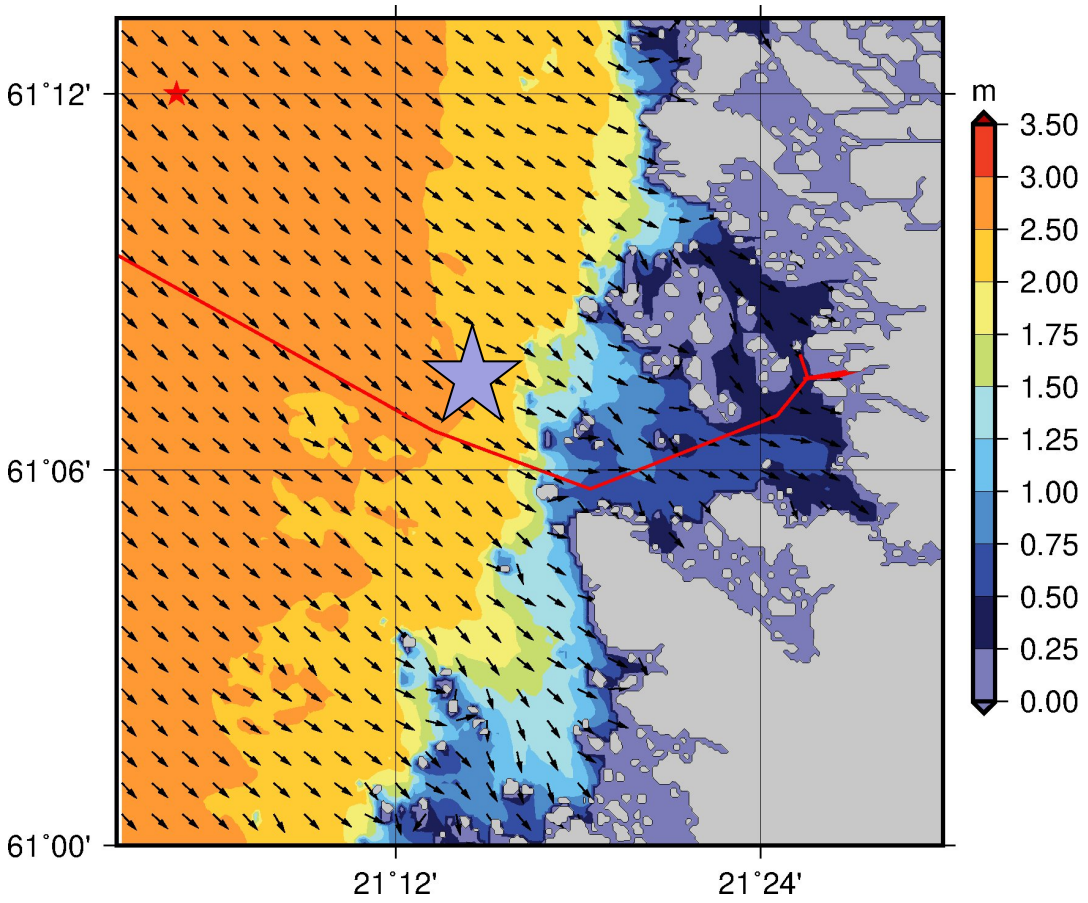
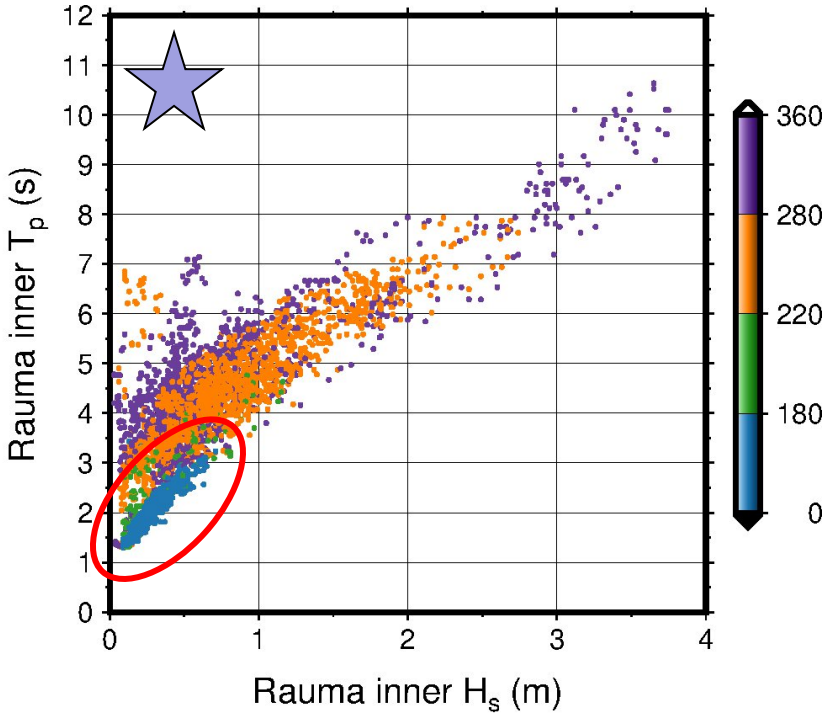
Knowledge from local seafarers



In the Rauma fairway **steep waves from south** cause challenges for navigation and piloting



Tailored statistic?

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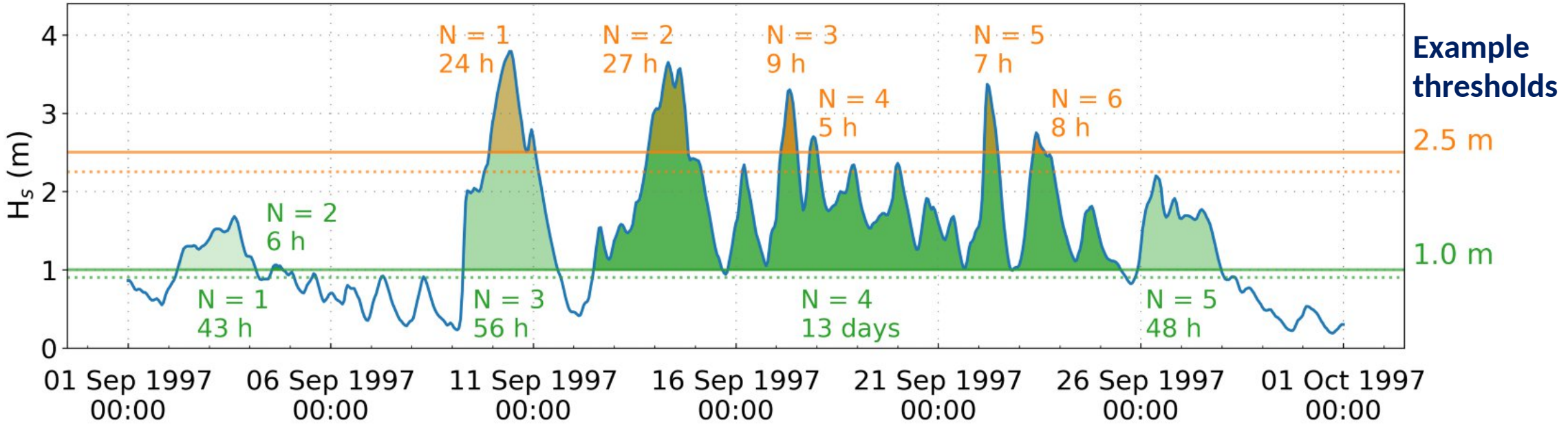
Event-based statistics

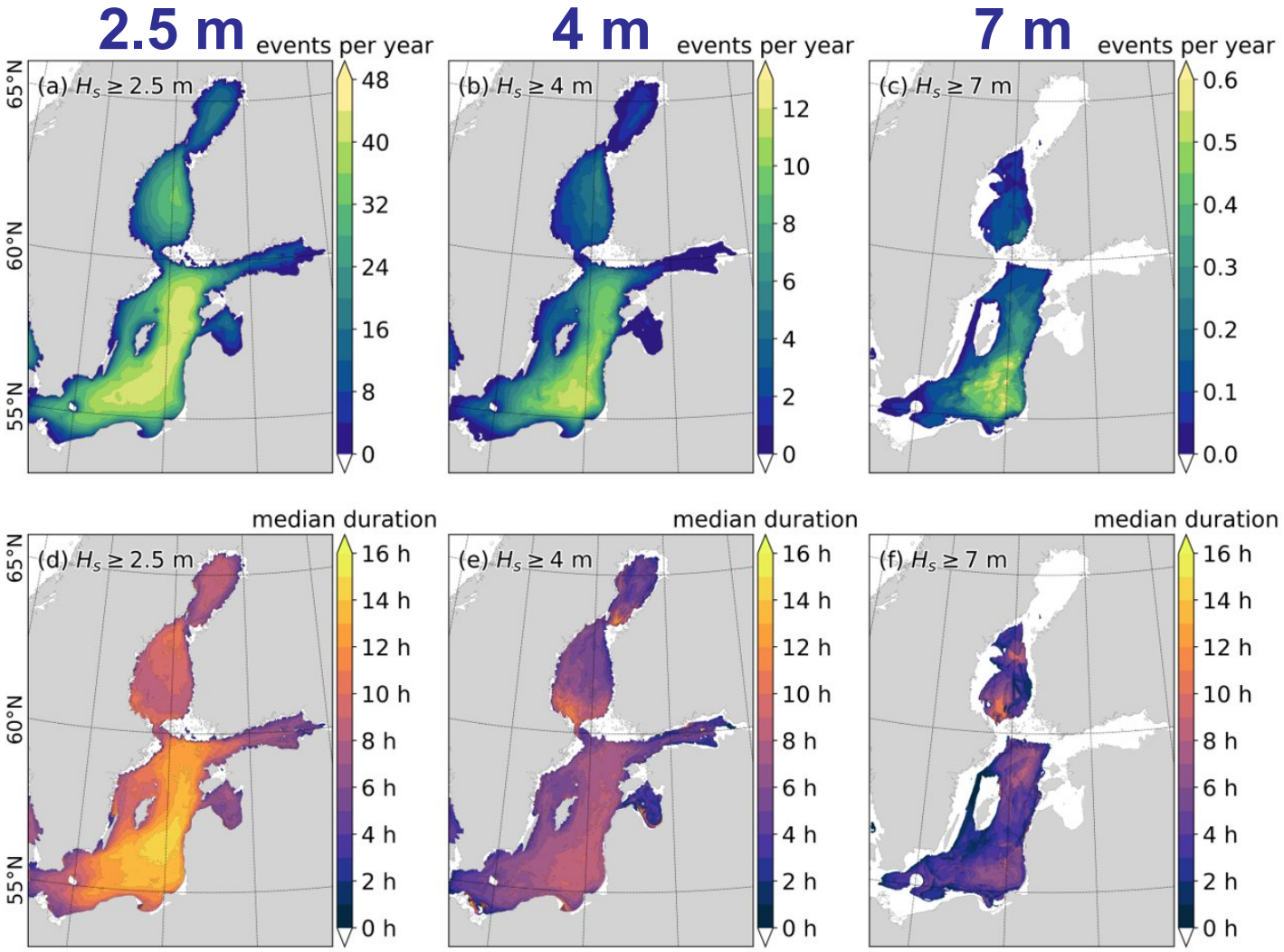


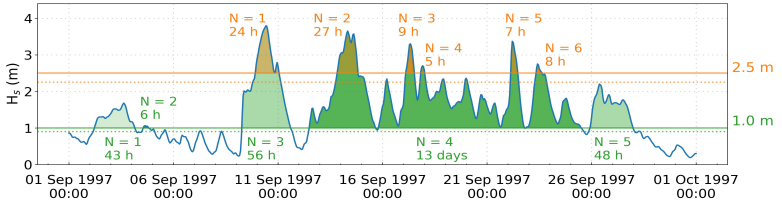
= **When**, **how many times**, and **for how long** significant wave height (Hs) exceeded the critical threshold for operations at sea

Figure shows short timeseries example of Hs from one model grid location. Solid line represents set threshold and dashed line the allowed short drop of the value to still be considered as the same event. N represent the number of events based on given threshold and below is given the duration of the event.

Björkqvist, J.-V., Kanarik, H., Tuomi, L., Niskanen, L., and Kankainen, M.: Event-based wave statistics for the Baltic Sea, in: 8th edition of the Copernicus Ocean State Report (OSR8), edited by: von Schuckmann, K., Moreira, L., Grégoire, M., Marcos, M., Staneva, J., Brasseur, P., Garric, G., Lionello, P., Karstensen, J., and Neukermans, G., Copernicus Publications, State Planet, 4-osr8, 10, https://doi.org/10.5194/sp-4-osr8-10-2024, 2024.

Long term statistics of exceedances:





Calculated for the whole study area:

- Hourly data from **1993 to 2021**

*Figure (a) shows number of events per year where **significant wave height (Hs)** exceeded 4 m and (b) represents the median duration of these events in hours.*

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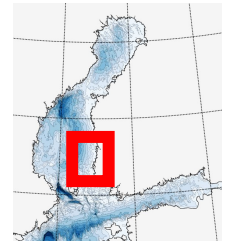
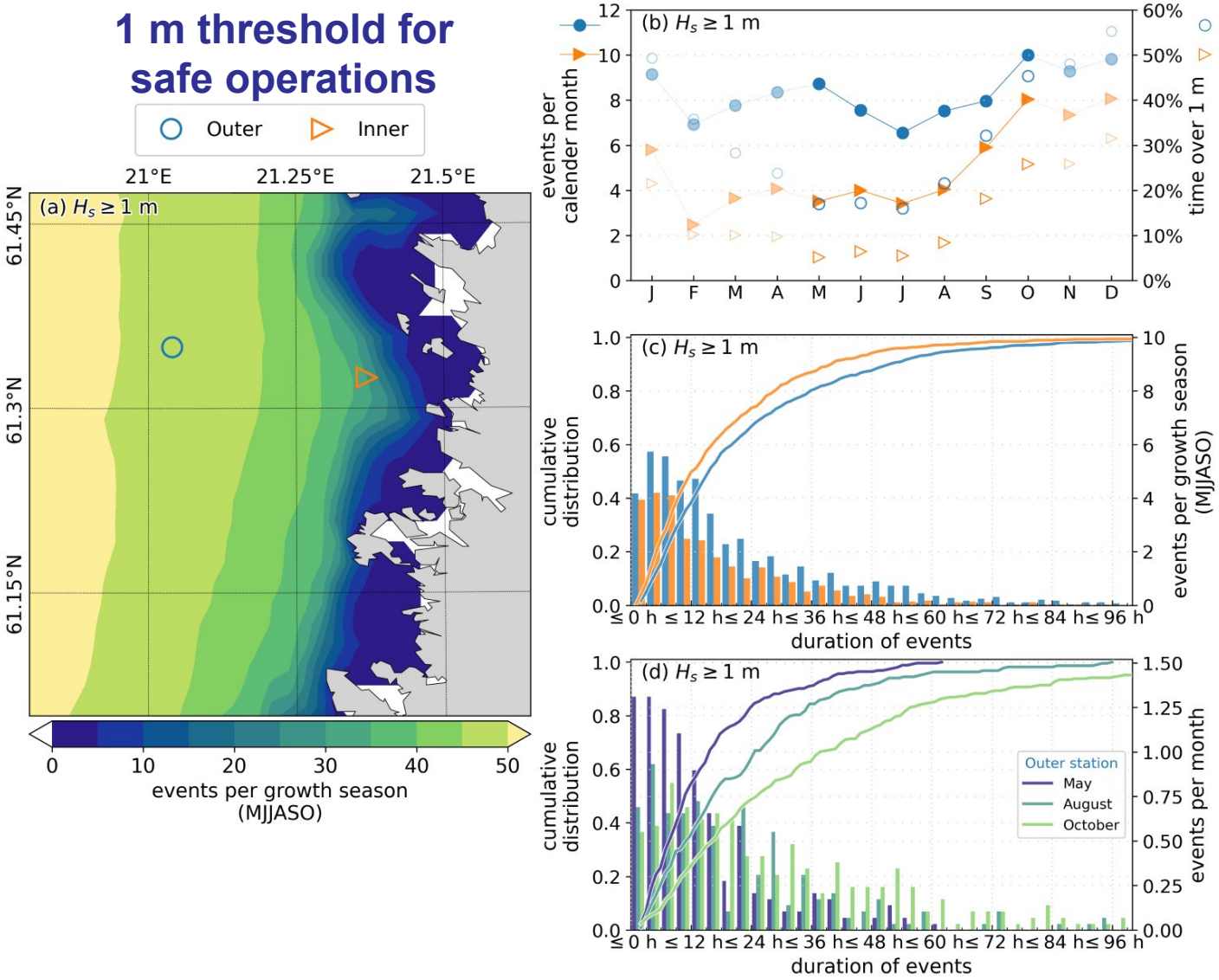
Björkqvist, J.-V., Kanarik, H., Tuomi, L., Niskanen, L., and Kankainen, M.: Event-based wave statistics for the Baltic Sea, in: 8th edition of the Copernicus Ocean State Report (OSR8), edited by: von Schuckmann, K., Moreira, L., Grégoire, M., Marcos, M., Staneva, J., Brasseur, P., Garric, G., Lionello, P., Karstensen, J., and Neukermans, G., Copernicus Publications, State Planet, 4-osr8, 10, https://doi.org/10.5194/sp-4-osr8-10-2024, 2024.

Case study: Locating fish farm further offshore





Example area in SE coast of Bothnian Sea

- Inner ca 10 km offshore
- Outer ca 30 km offshore
- 1 m limit for significant wave height (Hs)

*Figure (a) shows number of events per year where **significant wave height (Hs)** exceeded 1 m and locations of two study points*

(b) Left axis represents the number of events at different month. Right axis shows the durations of the events divided by the total number of hours in month

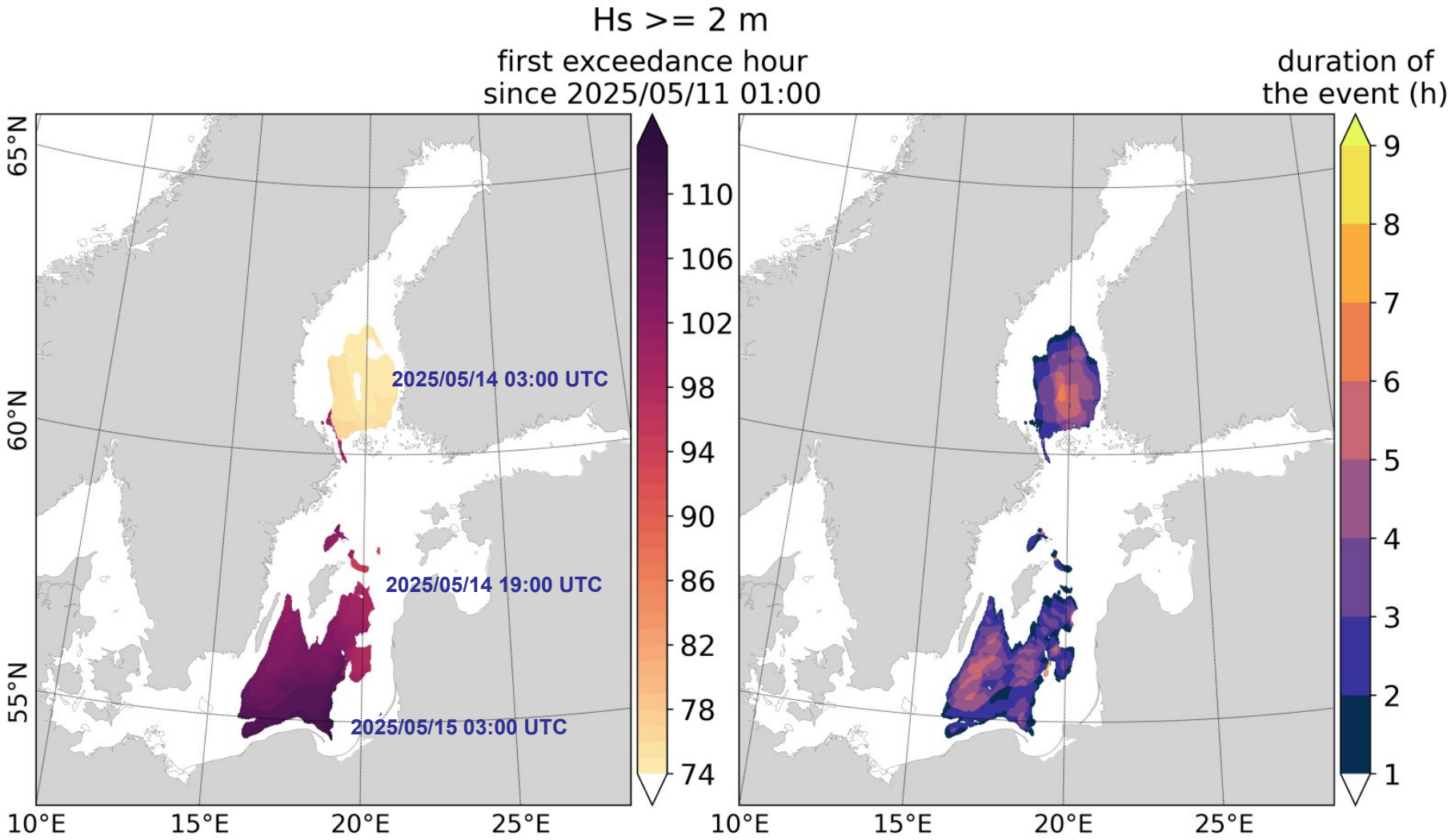
(c) Show distribution of event durations during growth season (May to October) with 3 h bin size.

(d) Shows the distribution during the three different months at the Outer station highlighting the fast difference in wave conditions between May and October.

Forecast warnings for on demand forecasts

Example from 202505/11 00 UTC CMEMS BAL forecast

When is the 2 m limit first exceeded in the forecast and how long it lasted?



Closing remarks

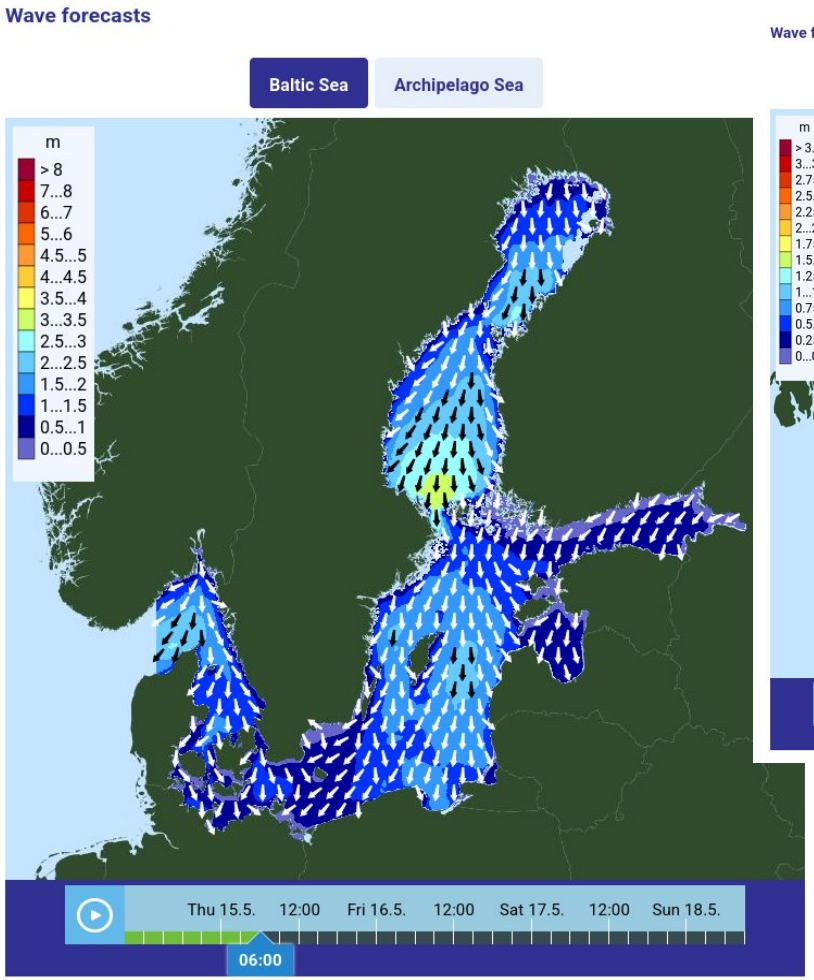
1. Improving the usability of nearshore forecasts
   - Nested on demand high resolution model setups
   - High resolution models as a training dataset for machine learning applications for more efficient forecasts in future
2. Tailored statistics for maritime traffic and different offshore activities
   - Event-based statistics

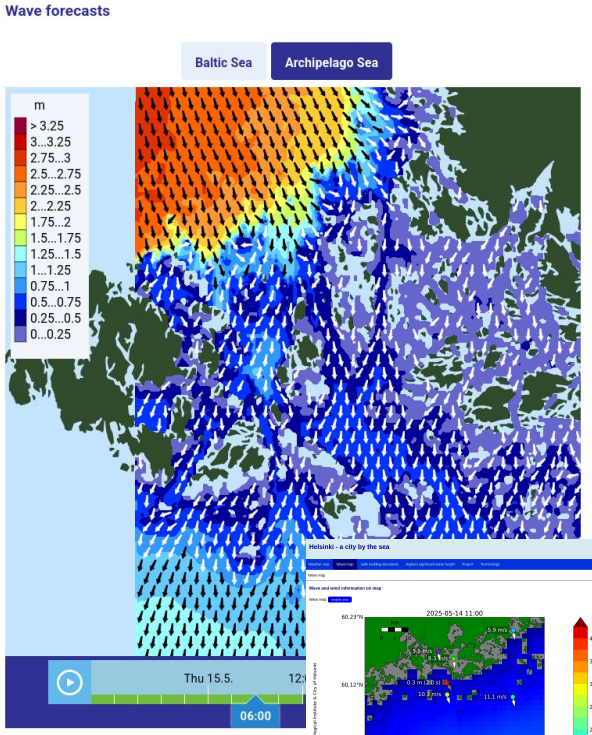
Thank you for your attention!

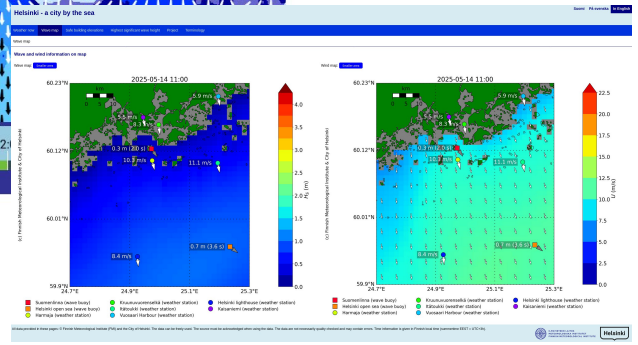
Questions or comments?

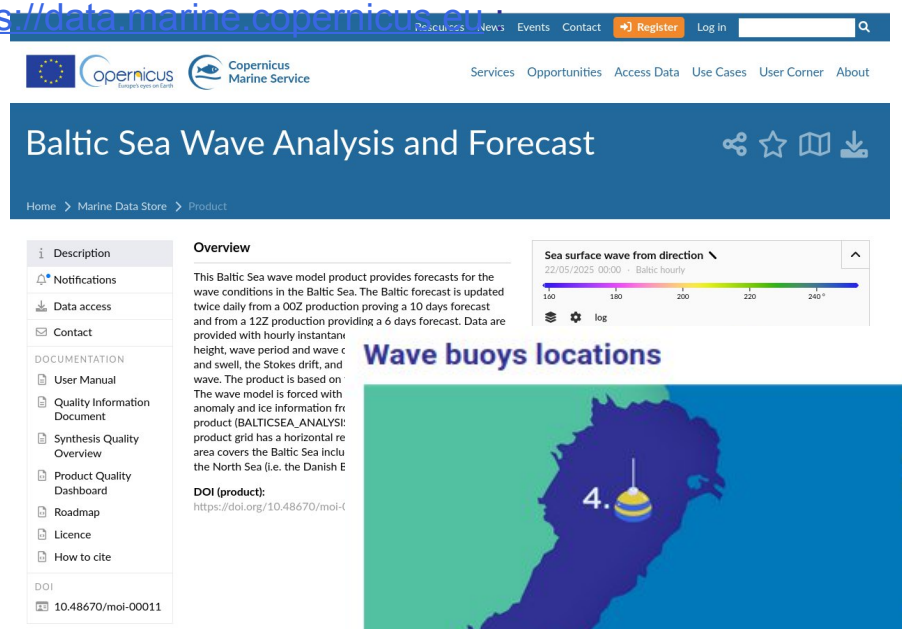
Operational wave forecasting in FMI:

Production unit of Copernicus Marine Service **Baltic Sea Wave Analysis and Forecast**
https://data.marine.copernicus.eu/

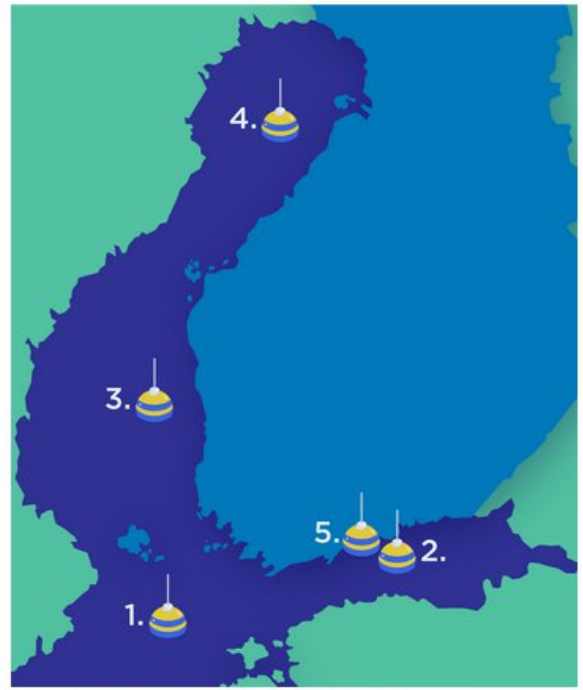








Wave buoys locations



1. Northern Baltic: 59°15´ N, 21°00´ E
2. Gulf of Finland: 59°58´ N, 25°14´ E
3. Bothnian Sea: 61°48´ N, 20°14´ E
4. Bay of Bothnia: 64°41´ N, 23°14´ E
5. Suomenlinna: 60° 7´ N, 24°58´ E

https://en.ilmatieteenlaitos.fi/wave-height
and https://swell.fmi.fi/Marinehelsinki

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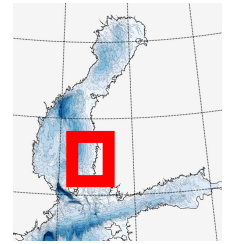
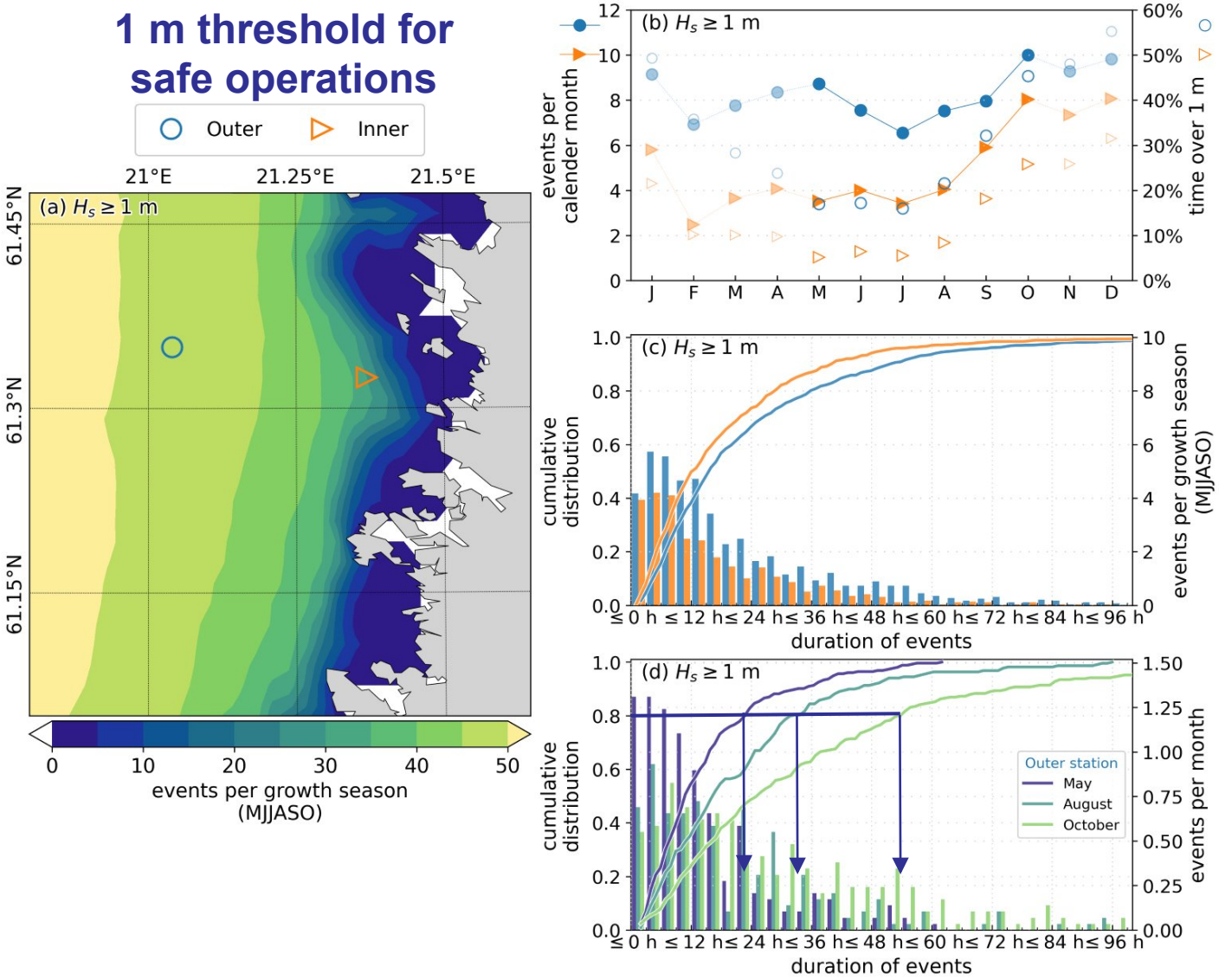
Case study: Locating fish farm further offshore





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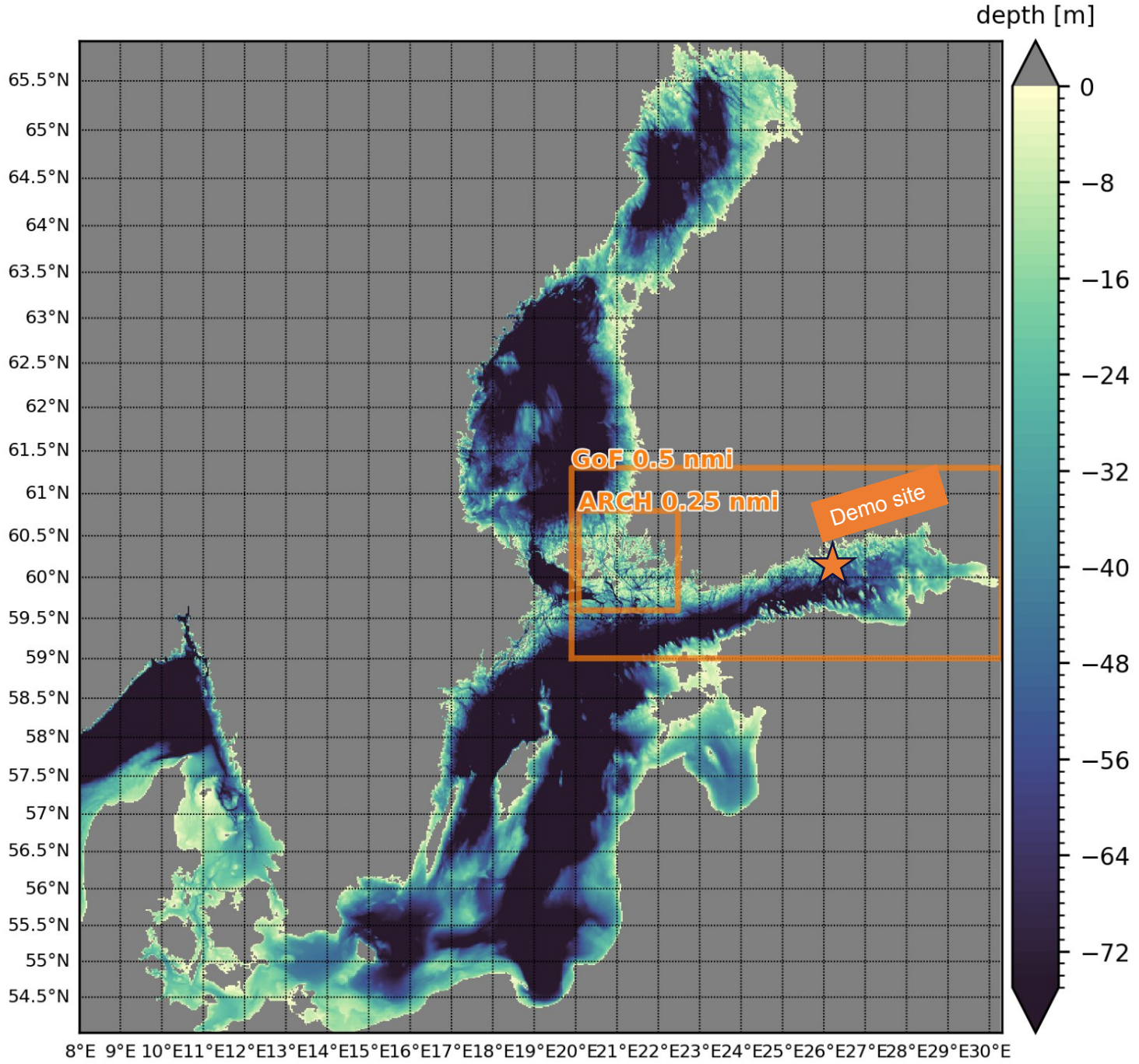
New nested model setup:



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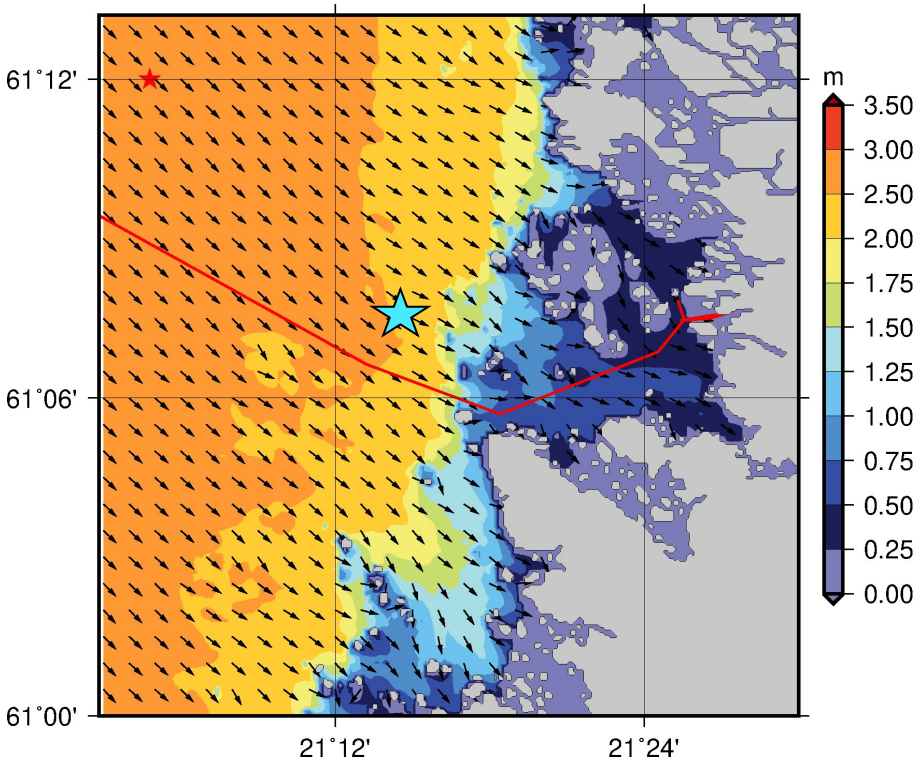
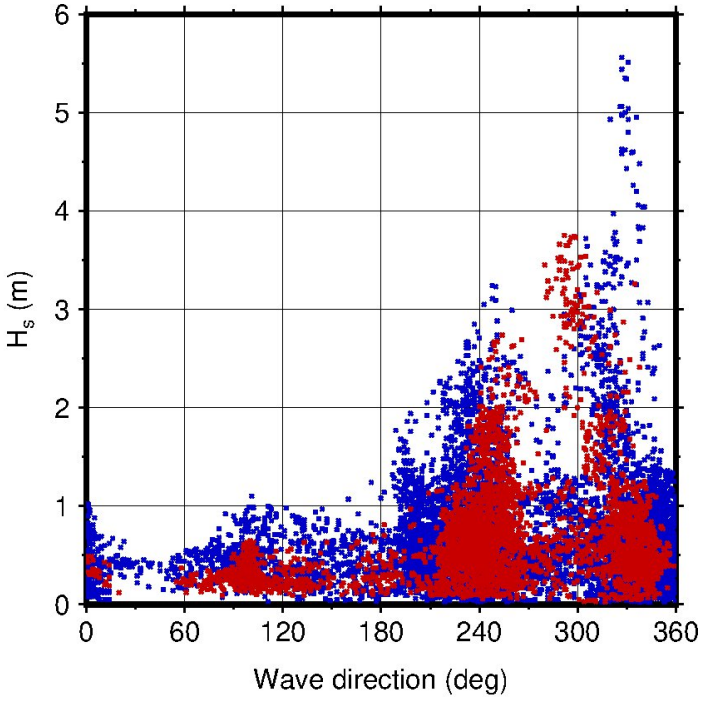
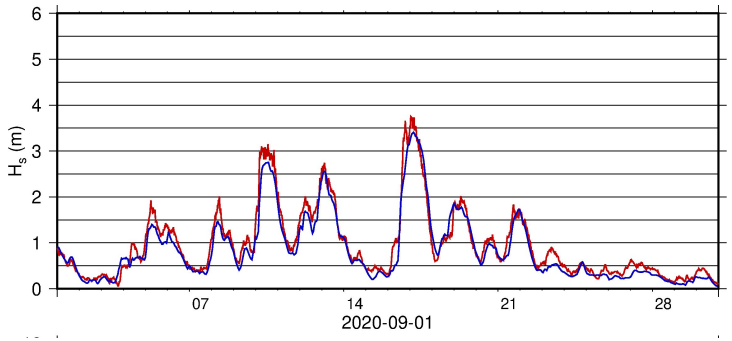
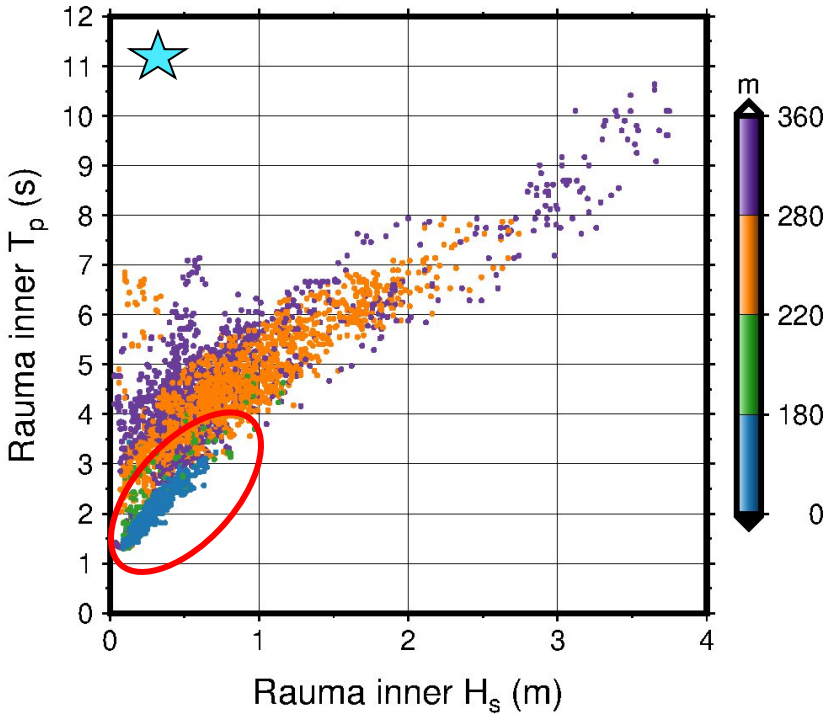
Services for coastal fairways







Attenuation of waves due to bottom friction and depth induced wave breaking. Sheltering caused by archipelago. Concentration of wave energy due to shoals.



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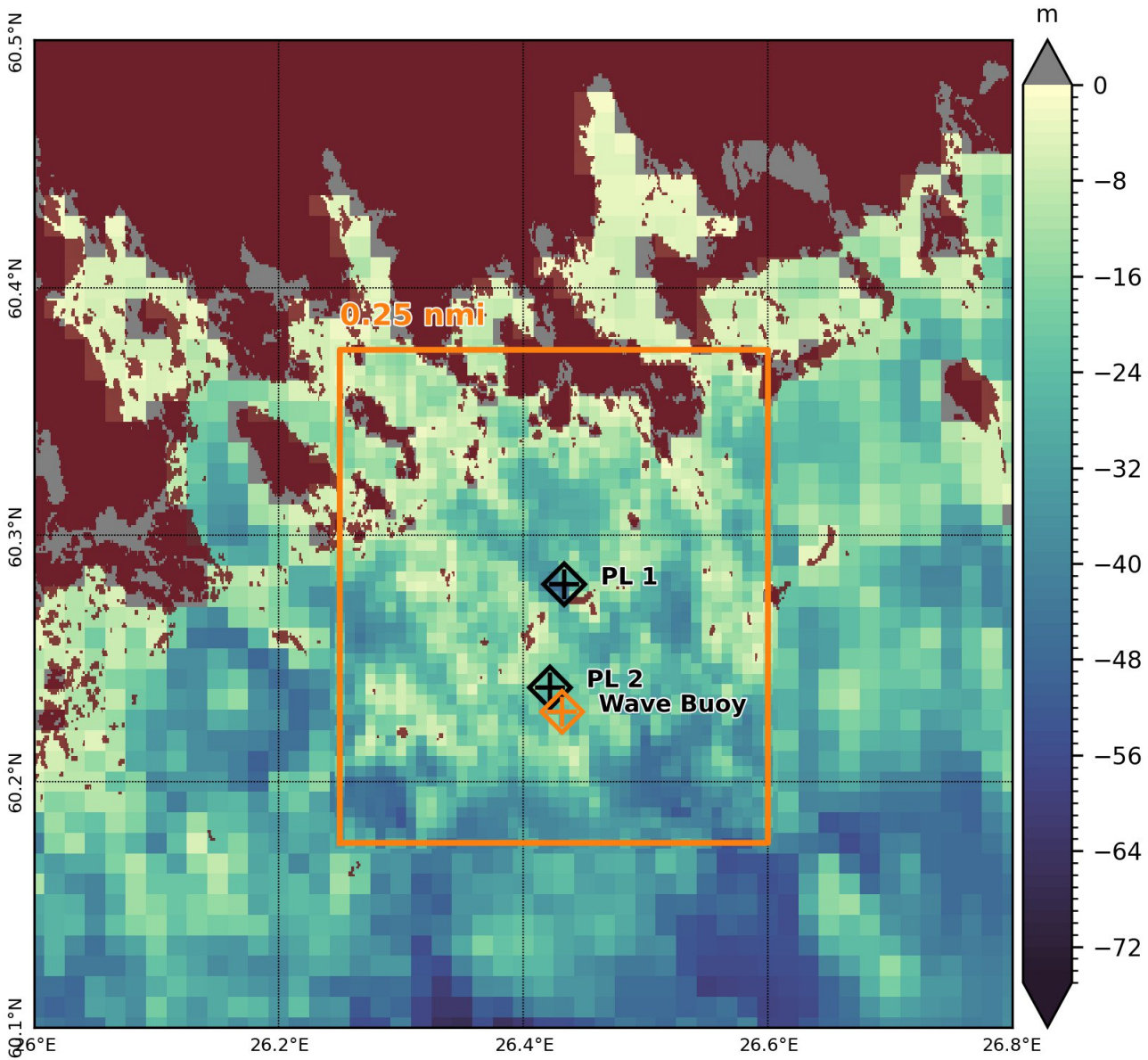
On demand high resolution forecasts:

Orrengrund demo site



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Operational Oceanography Challenges and Opportunities in the Current Geopolitical Situtation

EuroGOOS General Assembly

Aleksi Nummelin - FMI

20.5.2025

Picture: H. Kanarik

Geopolitics in the Balti

- Long tradition of co-operation in environmental protection, especially via HELCOM
  - Collaboration with the Russia has de facto stopped since the beginning of the Russian war on Ukraine.

Geopolitics in the Balti

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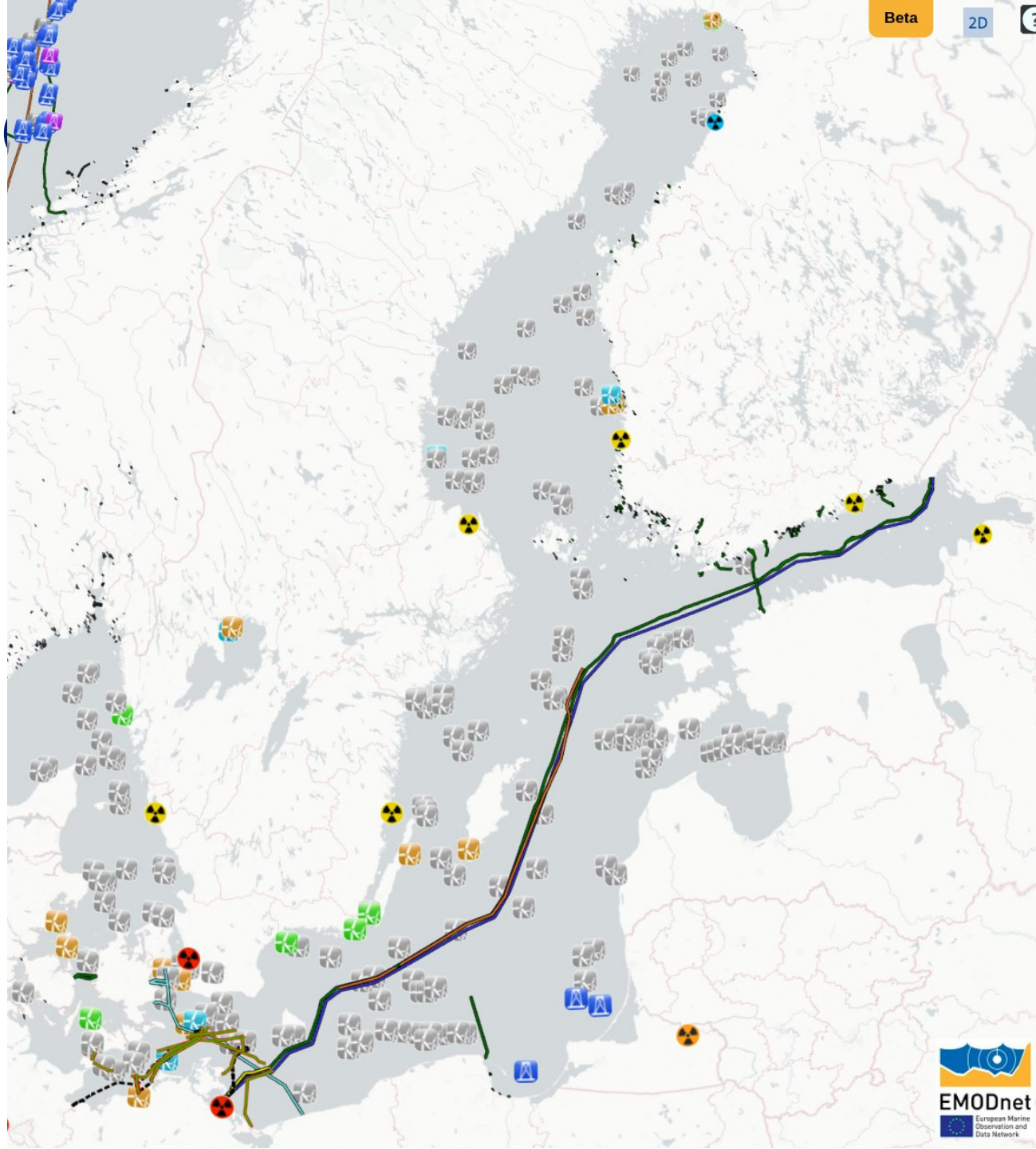
- Baltic Sea is an important throughway for Russian energy (oil and gas)
  - Since the Russian war on Ukraine most of the transport is carried by the 'shadow fleet' (old vessels, dubious condition, often no insurance)



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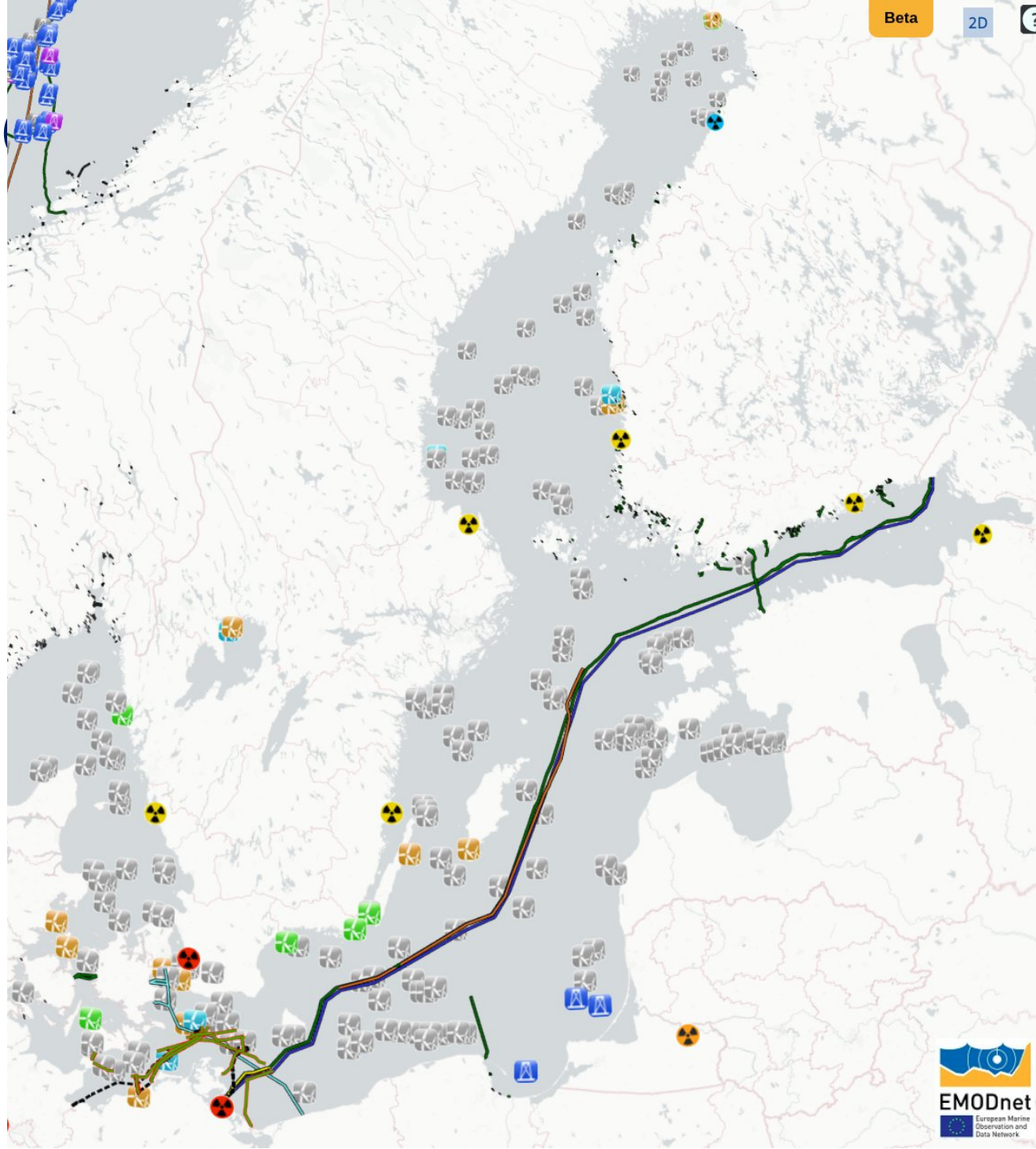
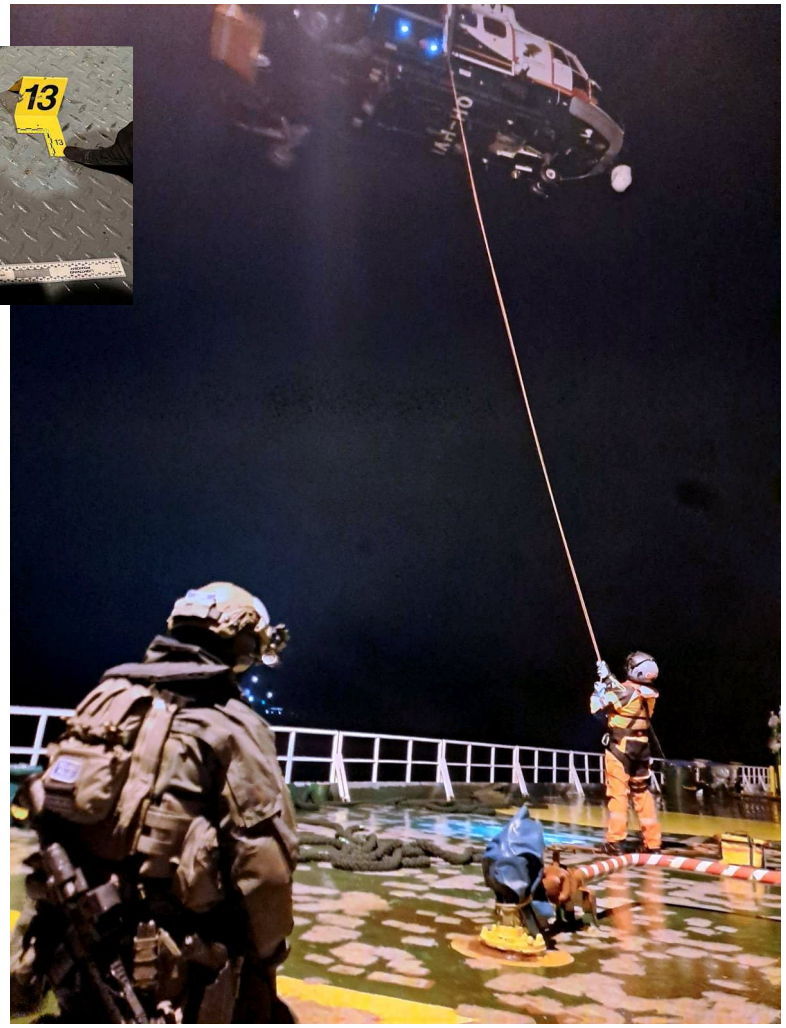
- Baltic Sea is an important throughway for Russian energy (oil and gas)
  - Since the Russian war on Ukraine most of the transport is carried by the 'shadow fleet' (old vessels, dubious condition, often no insurance)
- Baltic Sea is an important development area for EU, renewable energy, for the electricity grid, and for the telecommunication cables



Geopolitics getting real – recent incidents

Estlink cable disruption: Finnish Border Guard detains tanker linked to Russia's 'dark fleet' https://yle.fi/a/74-20133531



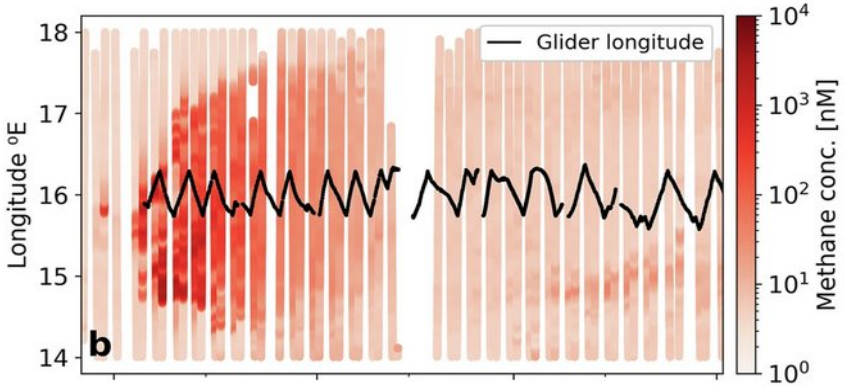
Baltic gas pipeline ruptured by Chinese ship back in service after €40m repair job

Article | Open access | Published: 15 January 2025

Nord Stream methane leaks spread across 14% of Baltic waters

Martin Mohrmann, Louise C. Biddle, Gregor Rehder, Henry C. Bittig & Bastien Y. Queste

Nature Communications **16**, Article number: 281 (2025) | Cite this article

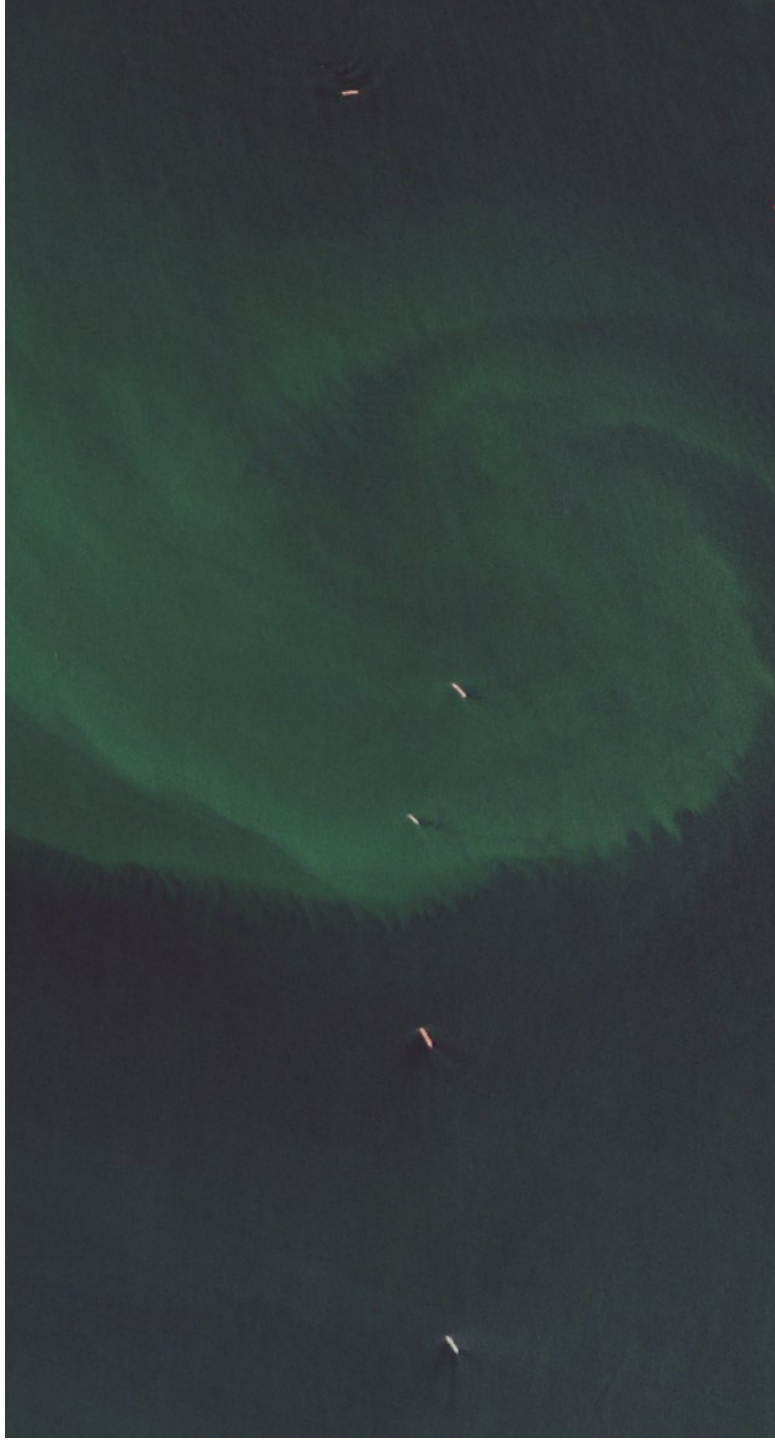


Reuters

Challenges for operational oceanography

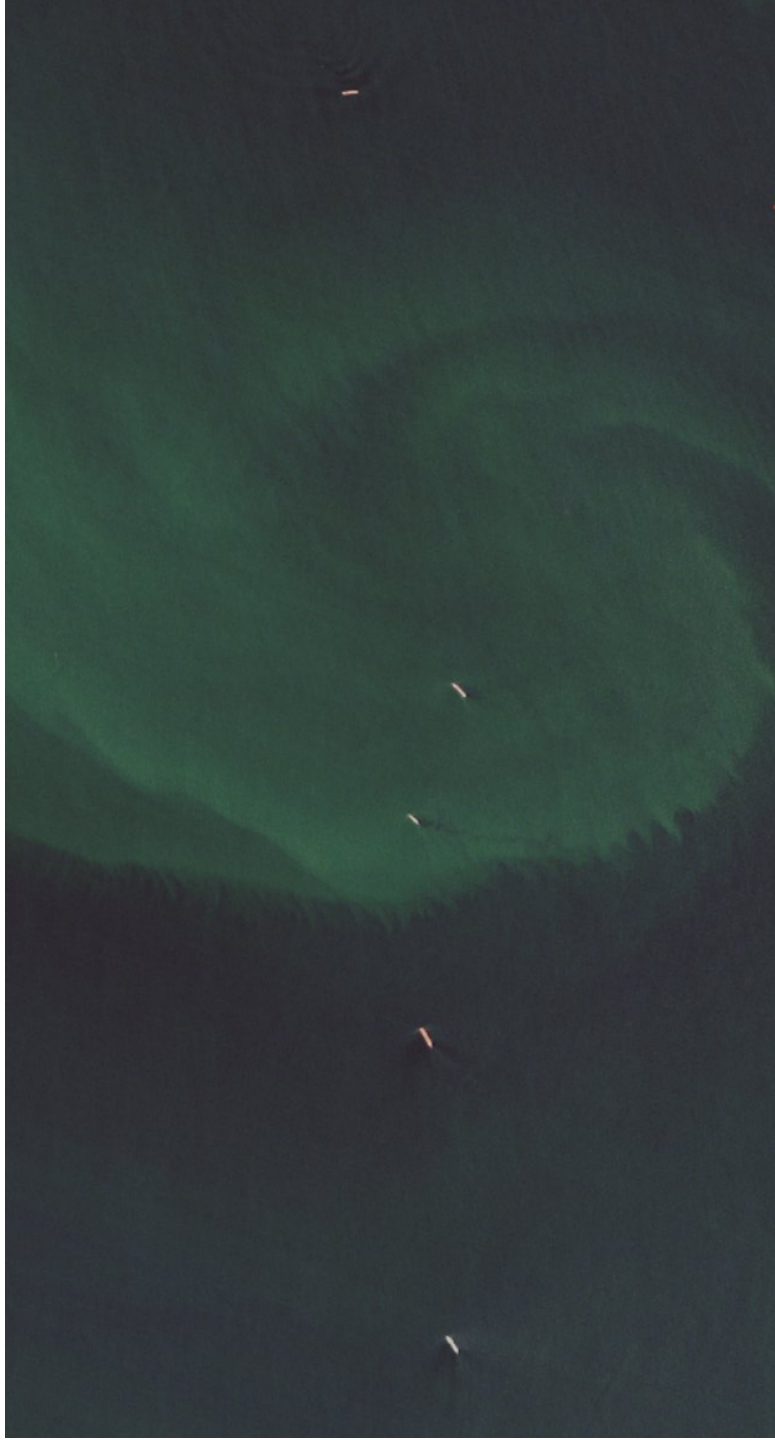
- Lack of data for validation, monitoring

- Open data
  - Using the best bathymetry has been a long-standing issue in the Baltic Sea
  - As a community we want and need to serve the European stakeholders, but we don't want to provide data to e.g. Russia
    - More stringent data access policies?
    - Design of model domains? Cutting of domains when sharing data?



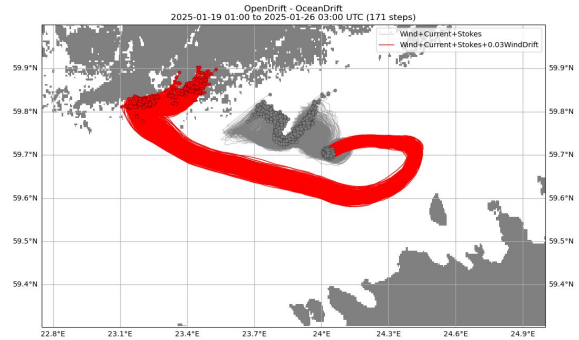
Opportunities for operational oceanography

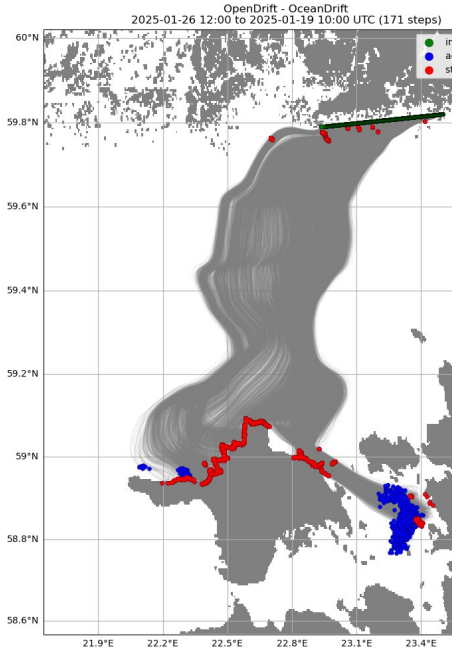
- New users, new needs (even for the old users)
  - Support for surface operations
    - Rapid deployment models/emulators
    - Lagrangian modelling (chemicals)
    - Atmospheric boundary layer (electromagnetic signal propagation), need for coupled modelling
  - Support for underwater operations
    - Acoustics, visibility
  - Environmental prediction/data integrated to surveillance/defense systems require seamless data
- Funding opportunities - new ways to sell our science/products
  - EU, national defense

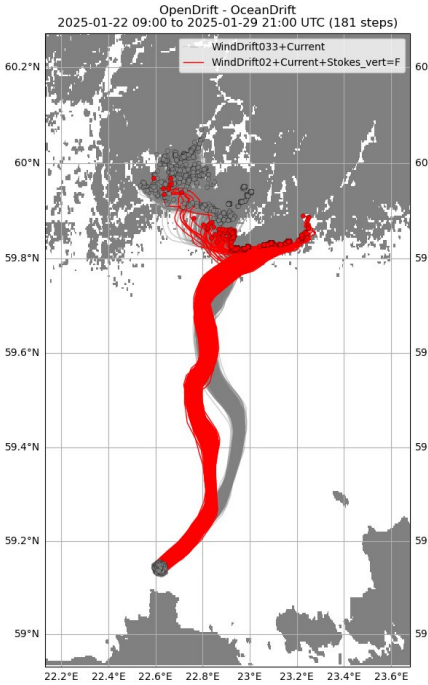


FMI activities

- **C**oastal **W**aters **U**nder **P**ressure
  - New project funded by the strategic research council (Finland) focusing on Gulf of Finland
  - Copernicus Marine Service NCP: DRIFTERI
  - Ongoing activities on signal propagation (atmospheric ducting) and underwater visibility
  - Emulators for MLD
- Efforts to fund new activities
  - Acoustic surveillance
  - Acoustic modelling



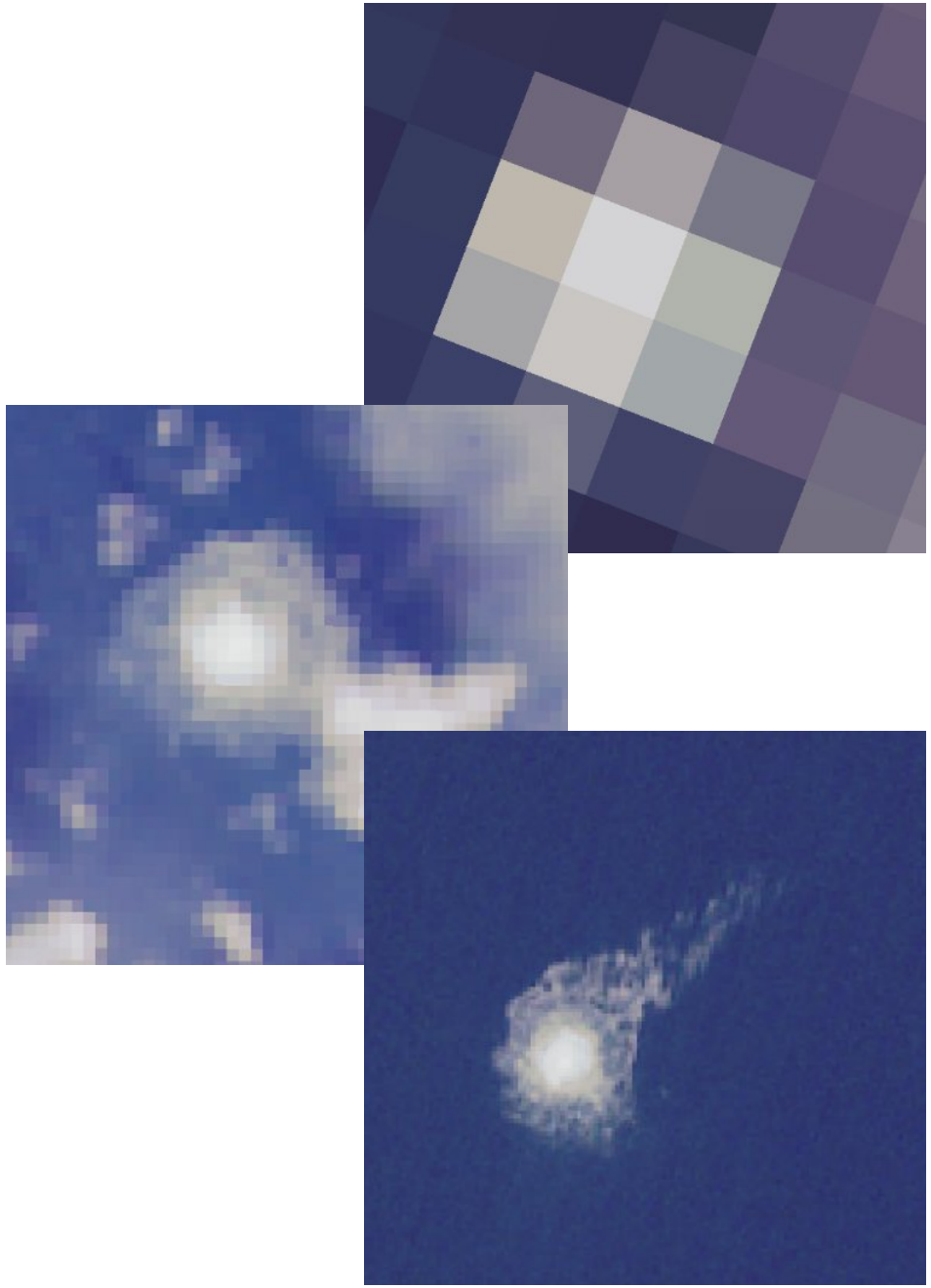




Credit: Veera Haapaniemi, DRIFTERI

Summary

- Geopolitics affect operational oceanography
- **Challenges**
  - Performing observations/monitoring as well as in providing open data
- **Opportunities**
  - Range from new type of operational services to new uses/users of existing services, and to new funding opportunities.



https://tarkka.syke.fi/eo-tarkka/map/

EuroGOOS in Global Coordination and Collaboration

Holger Brix

EuroGOOS General Assembly
19-21 May 2025

EuroGOOS Strategy

EuroGOOS
European Global Ocean Observing System

1

STIMULATE
communities of practice.

2

ADVOCATE
for coordinated and integrated European ocean observing and operational oceanography.

3

STRENGTHEN
and expand partnerships.

5

MOBILISE
the public on the importance of the ocean and oceanographic services.

4

PROMOTE
sustainability across the value chain of operational oceanography and ocean observing.

EuroGOOS Strategy

EuroGOOS
European Global Ocean Observing System

1

STIMULATE
communities of practice.

Strengthen internal partnership
Facilitate linkages
Enhance cooperation
Boost synergies
Provide guidance

2

ADVOCATE
for coordinated and integrated European ocean observing and operational oceanography.

Strengthen science-policy dialogue
Lead EOOS
Guide system design
Integrate observing and forecasting systems

3

STRENGTHEN
and expand partnerships.

Stimulate knowledge transfer
Facilitate cooperation among broader community

4

PROMOTE
sustainability across the value chain of operational oceanography and ocean observing.

Establish links with national funders
Support national coordination
Demonstrate value of observations
Advocate long-term commitment

5

MOBILISE
the public on the importance of the ocean and oceanographic services.

Co-design promotion materials
Organise events to engage with policymakers

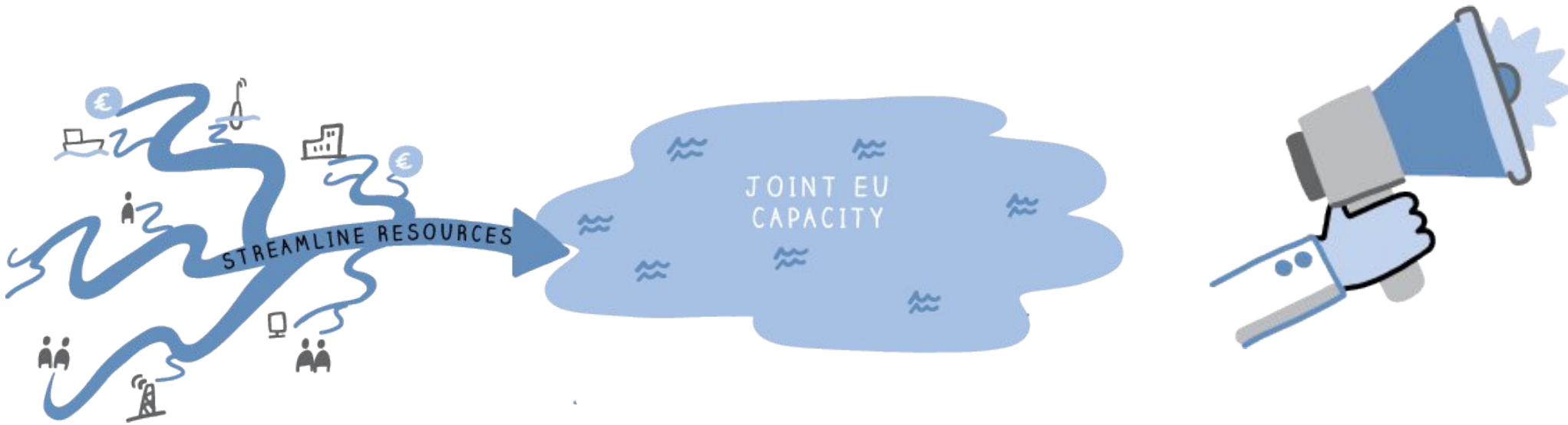
EuroGOOS in Global Coordination and Collaboration

- Strategic evolvement of EuroGOOS in selected international (read: extra-European) activities through:
  - EuroGOOS Office
  - ROOSes
  - EuroGOOS Office, Board and Members in global or large-scale initiatives (e.g., Ocean Decade, G7 FSOI, AAORIA, …)
- Connections to / Involvement in:
  - GOOS
  - Non-European partners in MonGOOS and the ArcticROOS
  - UN Ocean Decade (e.g., Coastal Resilience DCC, Ocean Prodiction, Data coordination
  - EuroGOOS is Decade Implementing Partner
  - AAORIA
  - …

EuroGOOS in Global Coordination and Collaboration

- Challenges / Changing environment
  - New (ocean related) policies in Europe (Ocean Pact)
  - Sustainable development of Ocean Observing
  - GOOS: Changes in the role of National Focal Points
  - Political / funding changes in the U.S.
  - Integration of “new” technologies (AI, low-cost sensors, etc.)
  - …

EuroGOOS
European Global Ocean Observing System



Global Ocean Observing in NOAA Research

David Legler

Director, Global Ocean Monitoring and Observing Program

EuroGOOS General Assembly, 2025

NOAA
GLOBAL OCEAN
MONITORING & OBSERVING

GLOBAL OCEAN MONITORING & OBSERVING PROGRAM

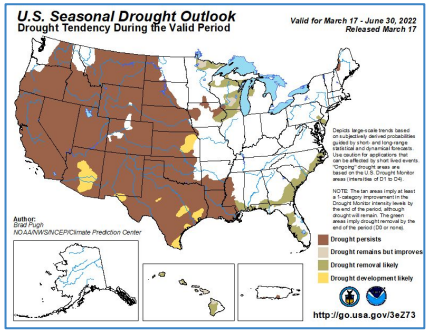
MISSION: To provide and support **high quality** global ocean observations and research to improve our scientific **understanding** and **inform** society about the ocean's role in environmental change.

VISION: A resilient, innovative, and fully **integrated** global ocean observing **system** that benefits scientific research, environmental stewardship, and serves society.

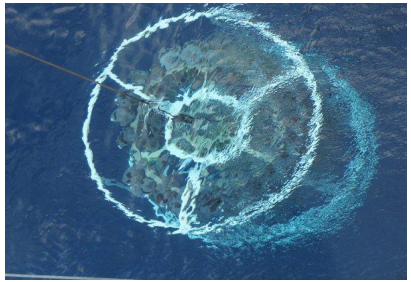
GLOBAL OCEAN MONITORING & OBSERVING PROGRAM

Global Ocean Data are the foundation for key knowledge, NOAA products, and services

- **E.g. ARGO data support 598 products** within NOAA



Weather, Climate, Ocean Forecasts

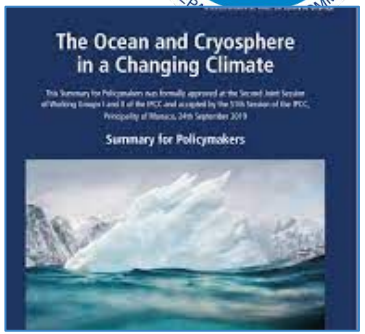


Scientific Research

ICOADS

SOCAT · SURFACE OCEAN CO_2 ATLAS ·

Data Syntheses/Products



Climate Assessments

Arctic System Forecasts, Assessments

PARAMETERS AND SCOPE

What GOMO Measures (EOVs):

- Ocean temperature
- Salinity
- Sea level
- Ocean currents
- Carbon/pH/biogeochemistry
- Sea ice
- Waves
- Marine ecosystems
- Ocean acoustics, etc.

Where GOMO Measures:

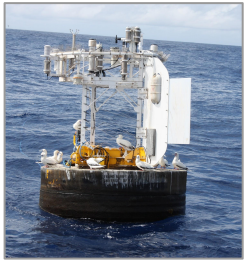
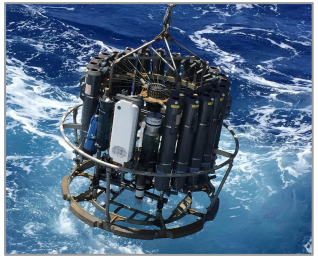
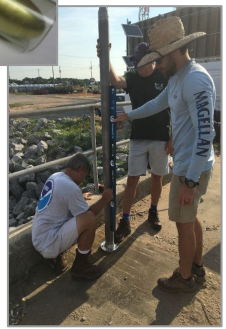
- Ocean-atmosphere interface
- Depths throughout the water column
- At the seafloor
- In every ocean basin and the Arctic

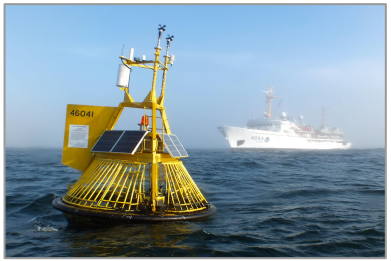
GOMO supports requirements development in IOC-GOOS, WMO, GCOS, etc. Many many stakeholders.

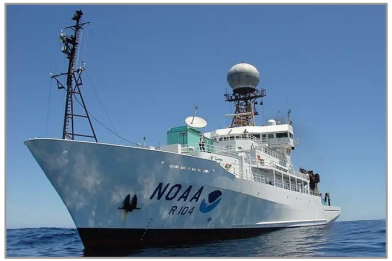
GOMO: OVER 3500 ACTIVE PLATFORMS







NOAA
GLOBAL OCEAN
MONITORING & OBSERVING

GLOBAL OCEAN MONITORING & OBSERVING

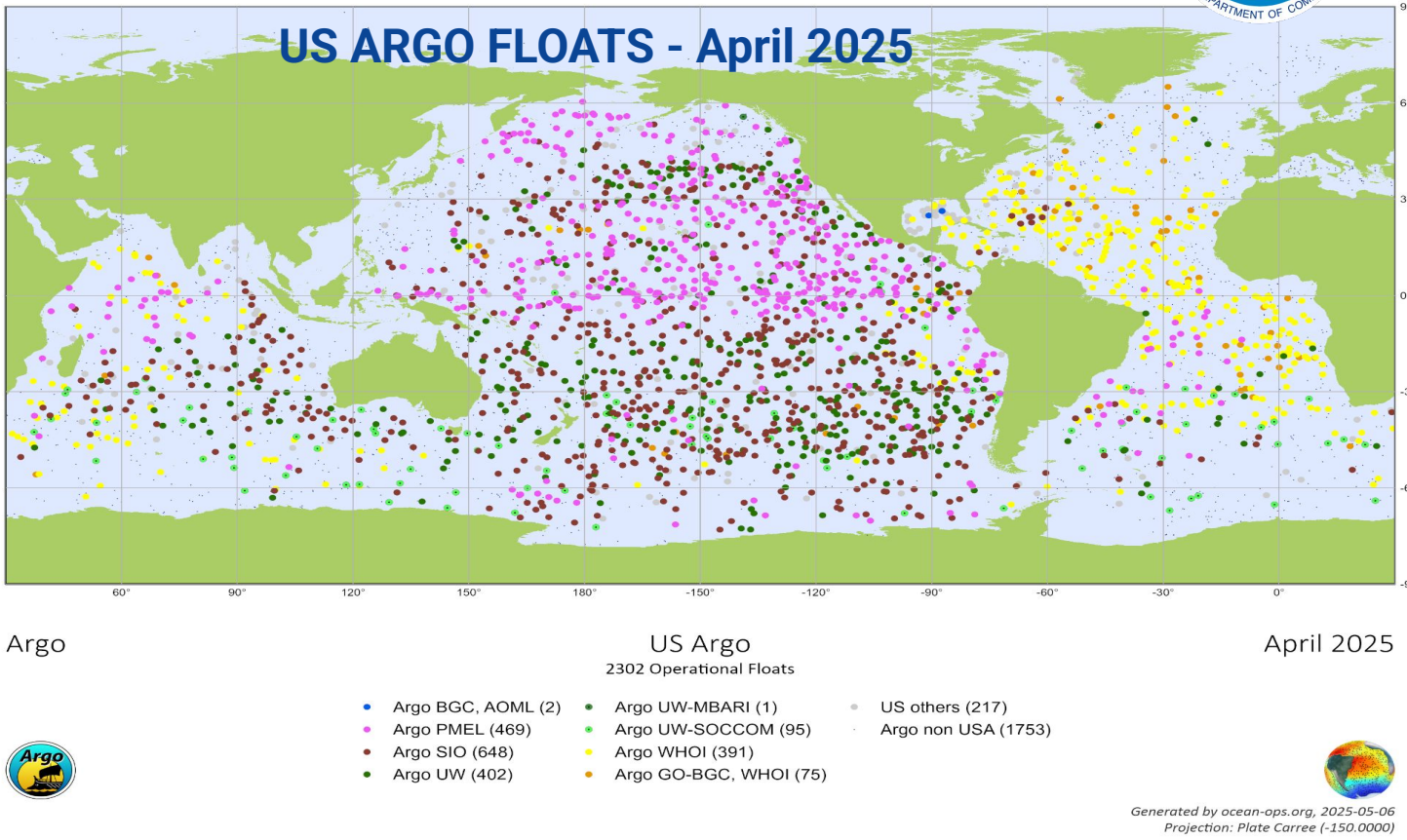
GOMO FACTS:

- GOMO provides **> 50%** of global ocean observing system
  - Addresses NOAA and US observing requirements
  - In alignment with robust US research interests
- Data are ALL openly accessible. Most in real-time
- **International partnerships** help GOMO sustain core research and observing e.g., ship time, observing platforms, national assembly of data and GDACs

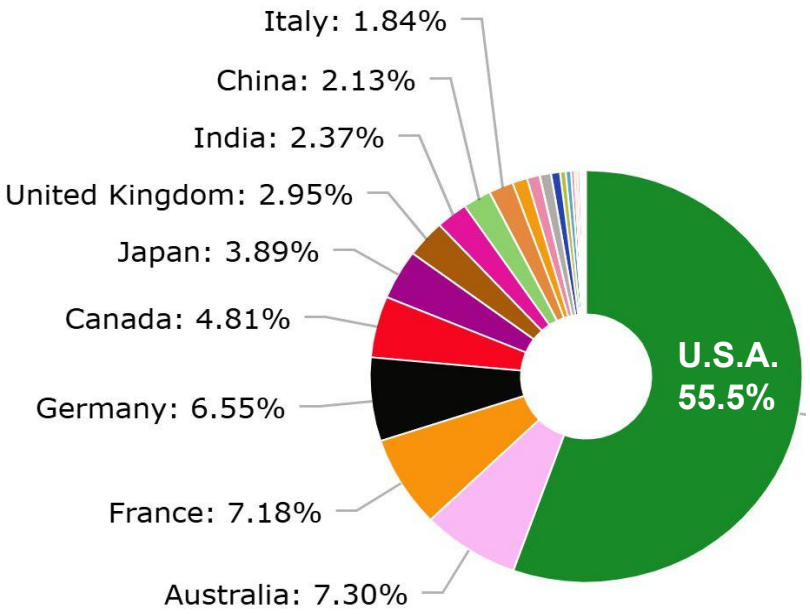
GOMO's ARGO PROGRAM

NOAA's Argo

- 6 member consortia
- Global coverage
- Hosts a GDAC & Permanent archive

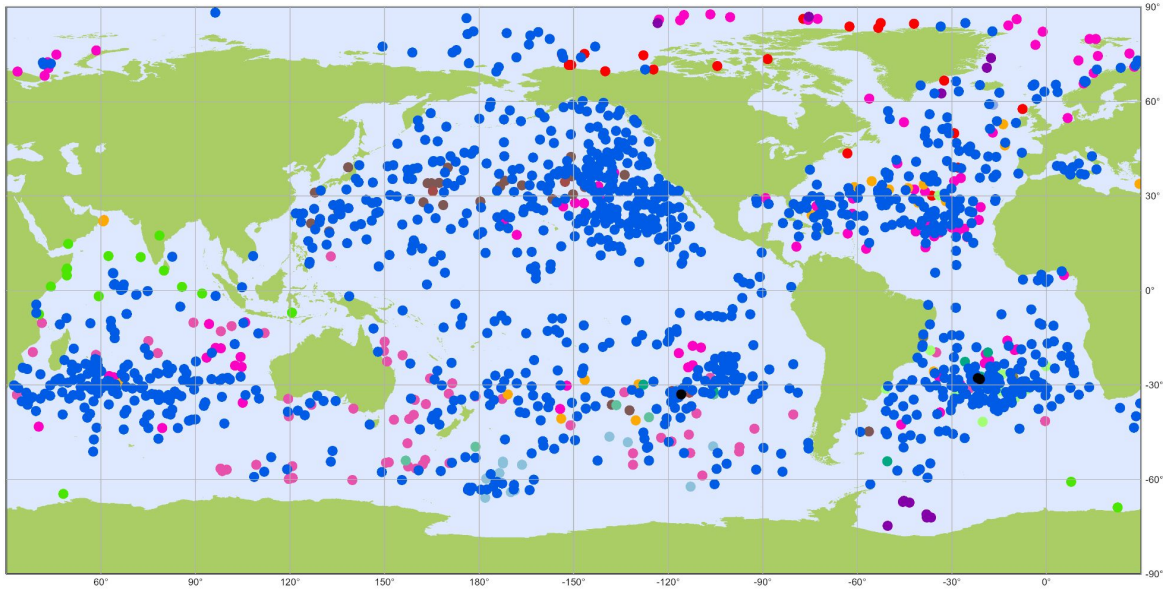


GOMO's ARGO PROGRAM



- Argo's success is traceable to many national contributions - the US celebrates and thanks these partners!
- US contributing most of Argo
- The growth and sustainment of Argo should not rest on a single institutional commitment

GOMO's Drifter PROGRAM



Data Buoy Cooperation Panel Drifting Buoys - Country of Deployment April 2025

Drifting Buoys operational during the month with their county of deployment. GTS data as received by Meteo France.

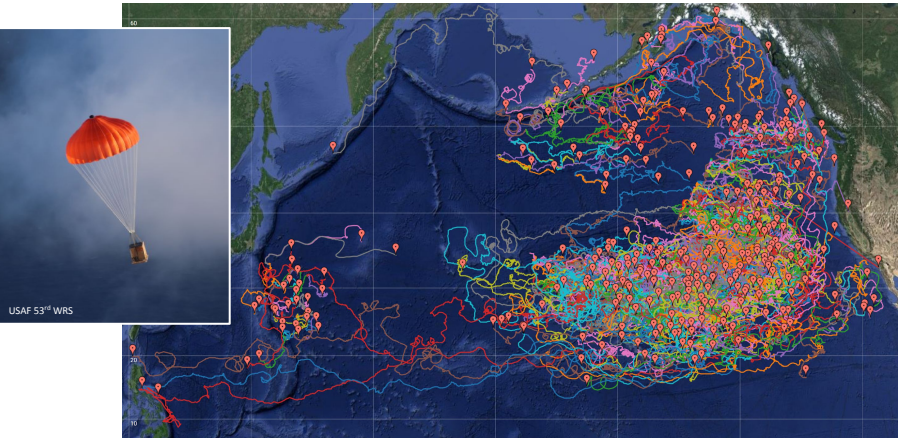
Australia	France	Japan	South Africa
Brazil	Germany	Korea (Republic Of)	United Kingdom
Canada	India	Netherlands	United States
European Union	Italy	New Zealand	Unknown

Generated by ocean-ops.org, 2025-05-04
Projection: Plate Carree (-150.0000)

GOMO Global Drifter Program - IMPACT OF DRIFTER's AIR PRESSURE DATA ON ATMOSPHERIC RIVER PRECIPITATION FORECAST AND ON CALIFORNIA's FORECAST-INFORMED RESERVOIR OPERATIONS (FIRO)

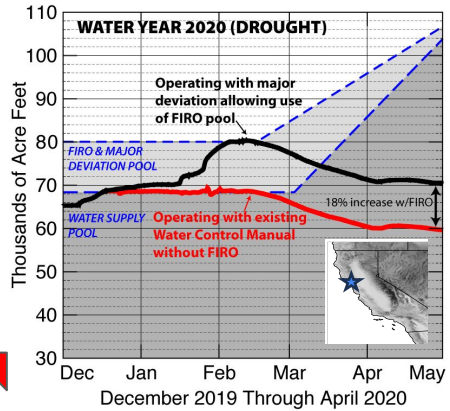
Scripps Institution of Oceanography's
LAGRANGIAN DRIFTER LABORATORY

DRIFTER DEPLOYMENT AND OBSERVATIONS



- Air pressure from drifters improve the 3–5 day forecasts NE Pacific (Reynolds et al, 2023)
- All CW3E data (including drifter data) improve the 3-day precipitation forecast up to 12%.
- Winter 2022/2023 was the first time the California State Operations Center used advanced forecasting, including CW3E's atmospheric river forecast information (benefitting from drifter data), in planning for allocation of emergency resources.

LAKE MENDOCINO WATER STORAGE HISTORIES



Water management tool that uses weather forecasts gives flexibility to water managers

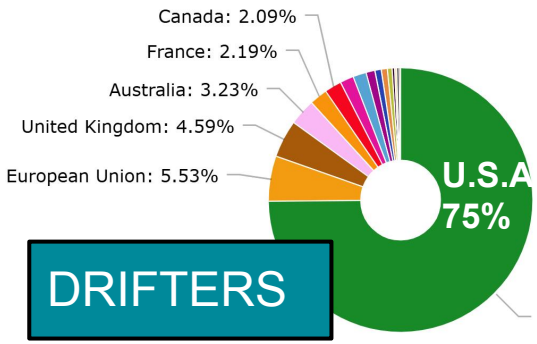
Actual (with FIRO; thick black line) and modeled (without; red line) storage histories at Lake Mendocino.

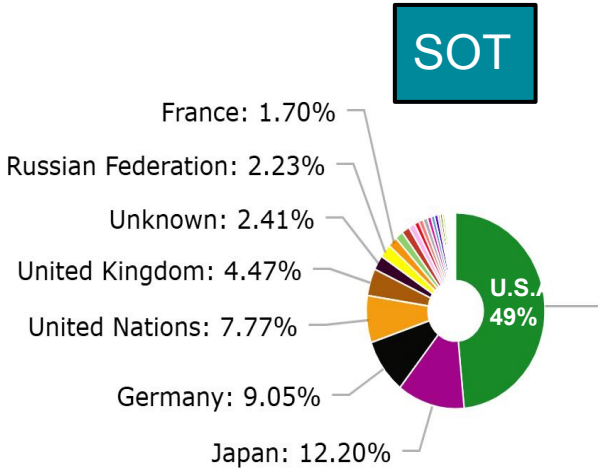
Courtesy of CW3E, SIO, UCSD

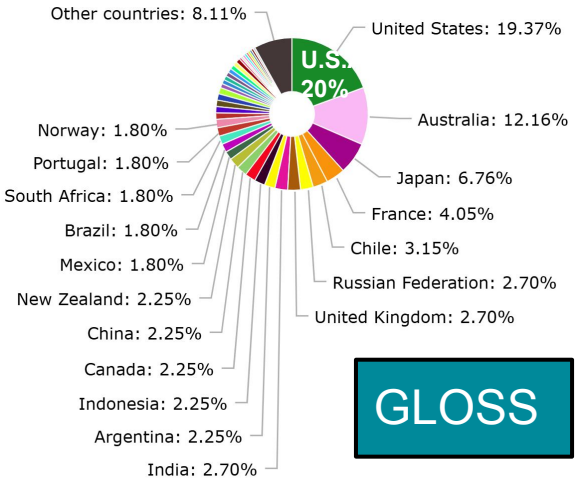
Key Finding for Public

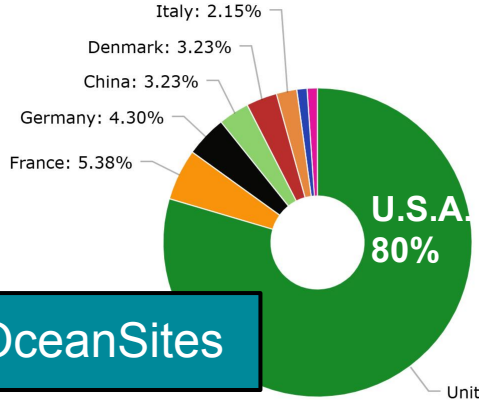
Better forecasts of extreme precipitation and streamflow enable greater flexibility in operating many reservoirs. Operators may now both store more water and reduce the risk of floods, creating a more reliable year-round water supply.

GOMO's Support for other Networks



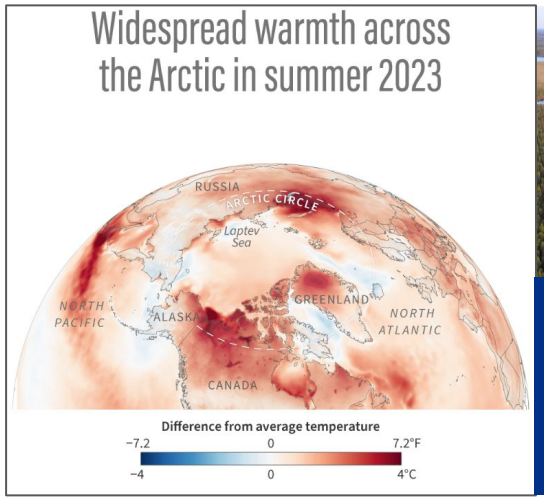






United States	28
Japan	23
United Kingdom	22
Canada	13
Germany	11
Spain	10
Norway	5
South Africa	5
Australia	3
France	2
Sweden	1
Ireland	1

GOMO's Arctic Research Program - Long term obs/modeling



ARP has led the development of the annual Arctic Report Card for 20 years!

The Arctic is warming 3-4x >> the globe

The **GOMO Arctic Research Program** aims to improve fundamental understanding of ocean-ice-atmospheric processes and marine ecosystem response.

How: sustained monitoring, annual research cruises, data-model integration, focusing on sea ice, ocean health, & marine ecosystems

New: Testing of Argo in the Actic

FINAL THOUGHTS

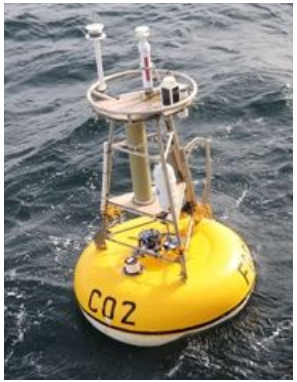
- Prior to 2025, it was evident the US could not sustain its global ocean observing systems contributions without significant new funds. Without action, projected reductions of 30-50% are likely by 2028.
- 2025:
  - Awaiting a number of decisions that will determine the scope of our activities
  - NOAA has lost significant expertise

NOAA
GLOBAL OCEAN
MONITORING & OBSERVING

NOAA
GLOBAL OCEAN
MONITORING & OBSERVING

THANK YOU

Contact: David Legler
David.legler@noaa.gov



GOMO and IOOS: how we work together

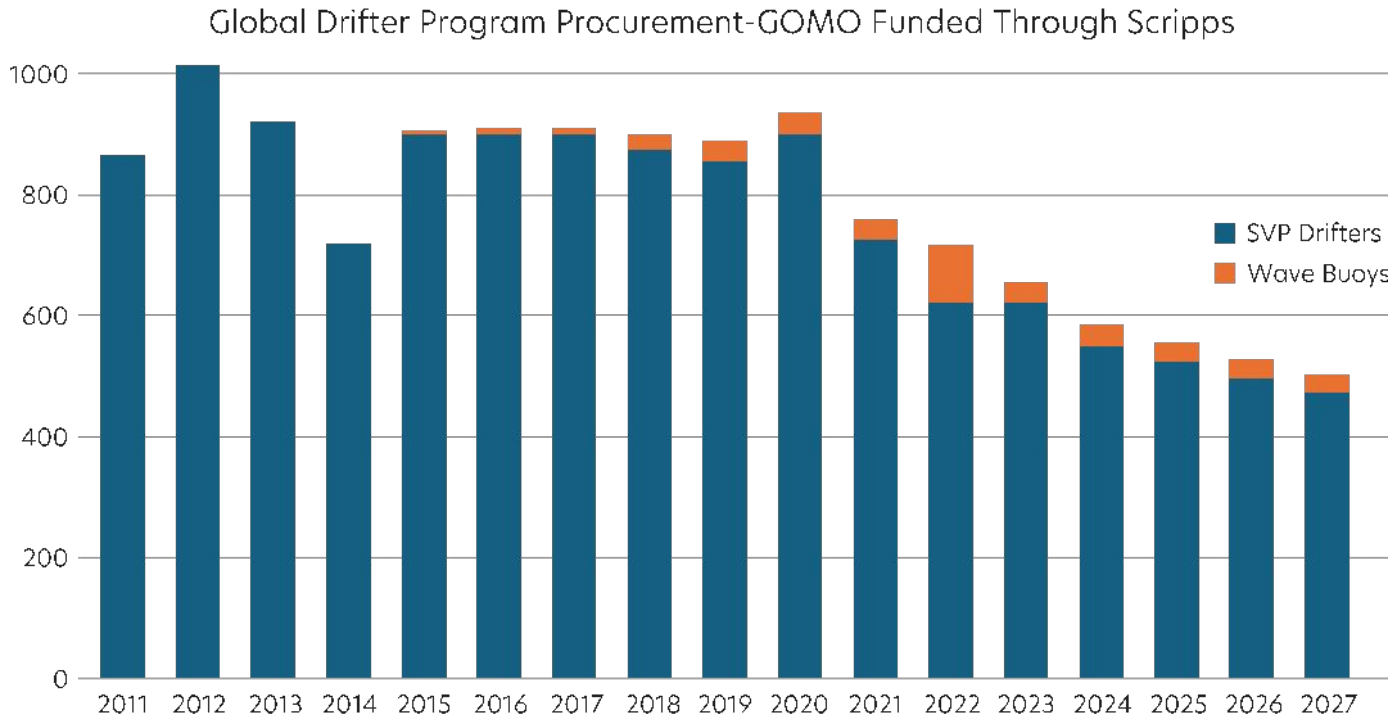
GOMO: Focuses on the **global ocean** including international partnerships.

IOOS: Focuses on US and Great Lakes **coastal waters** to the EEZ.

TOGETHER, we are . . .

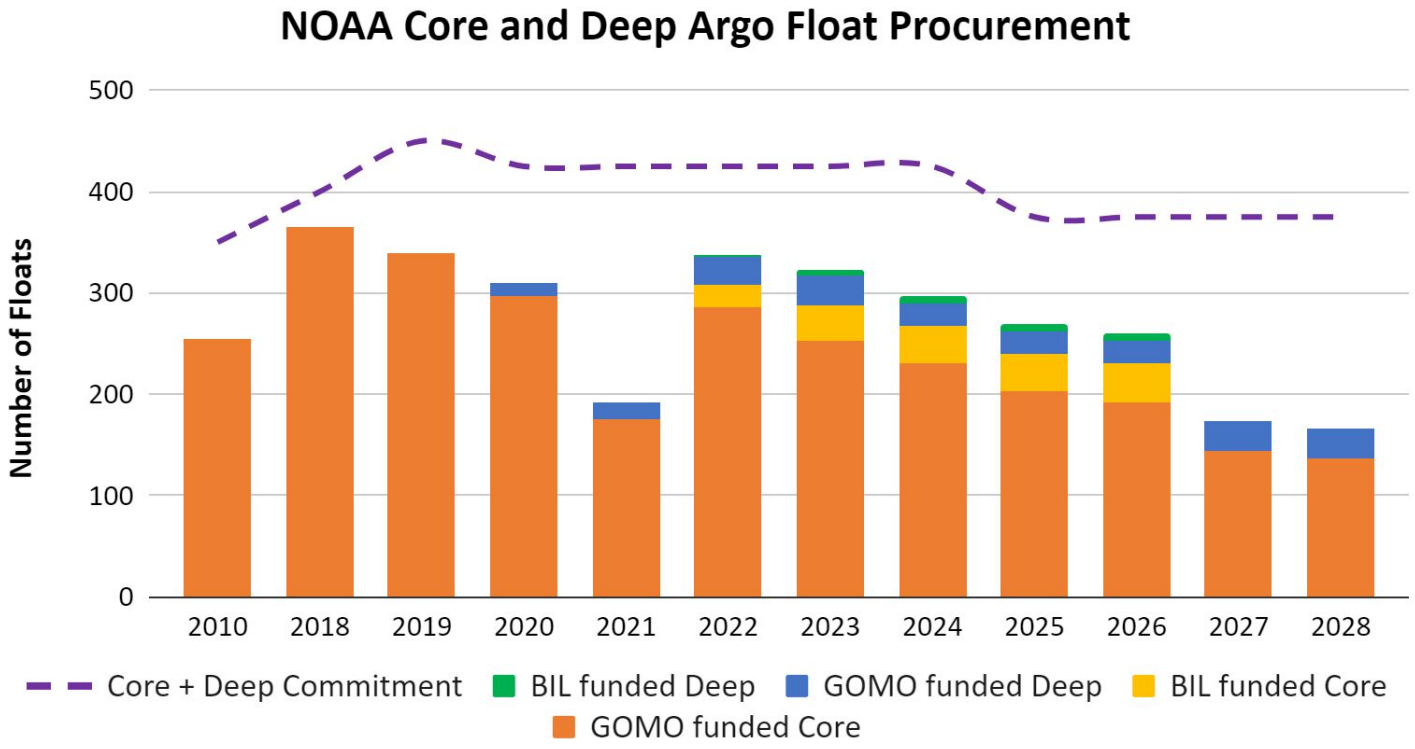
- Seeking to continue building stronger connections along with all NOAA in situ ocean obs programs!
- Collaborating on extreme events observing
- Engaged in NOAA/MTS/GOOS Industry project to better partner with the private sector
- Identifying shared gaps in obs info, such as boundary currents
- Building shared data management communities of practice

TRENDS OF DECLINE (as of December 2025)

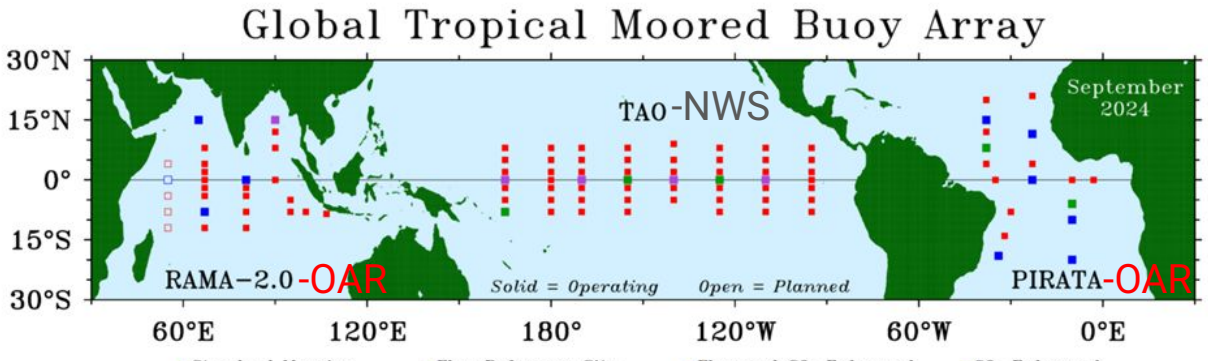


Potential 44% drop in NOAA drifters by FY28 (vs 10 yrs ago)

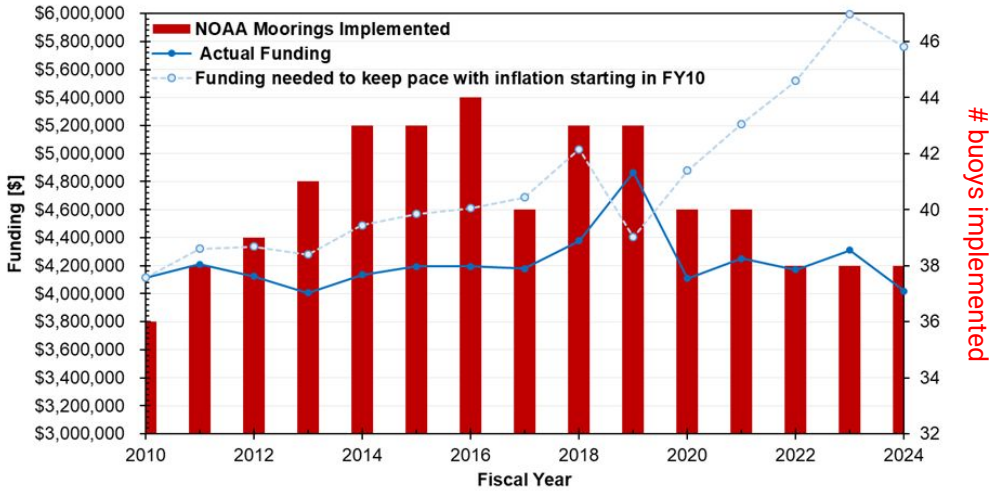
TRENDS OF DECLINE (as of December 2025)



Potential 50% drop in NOAA floats by FY28 (vs 10 yrs ago)

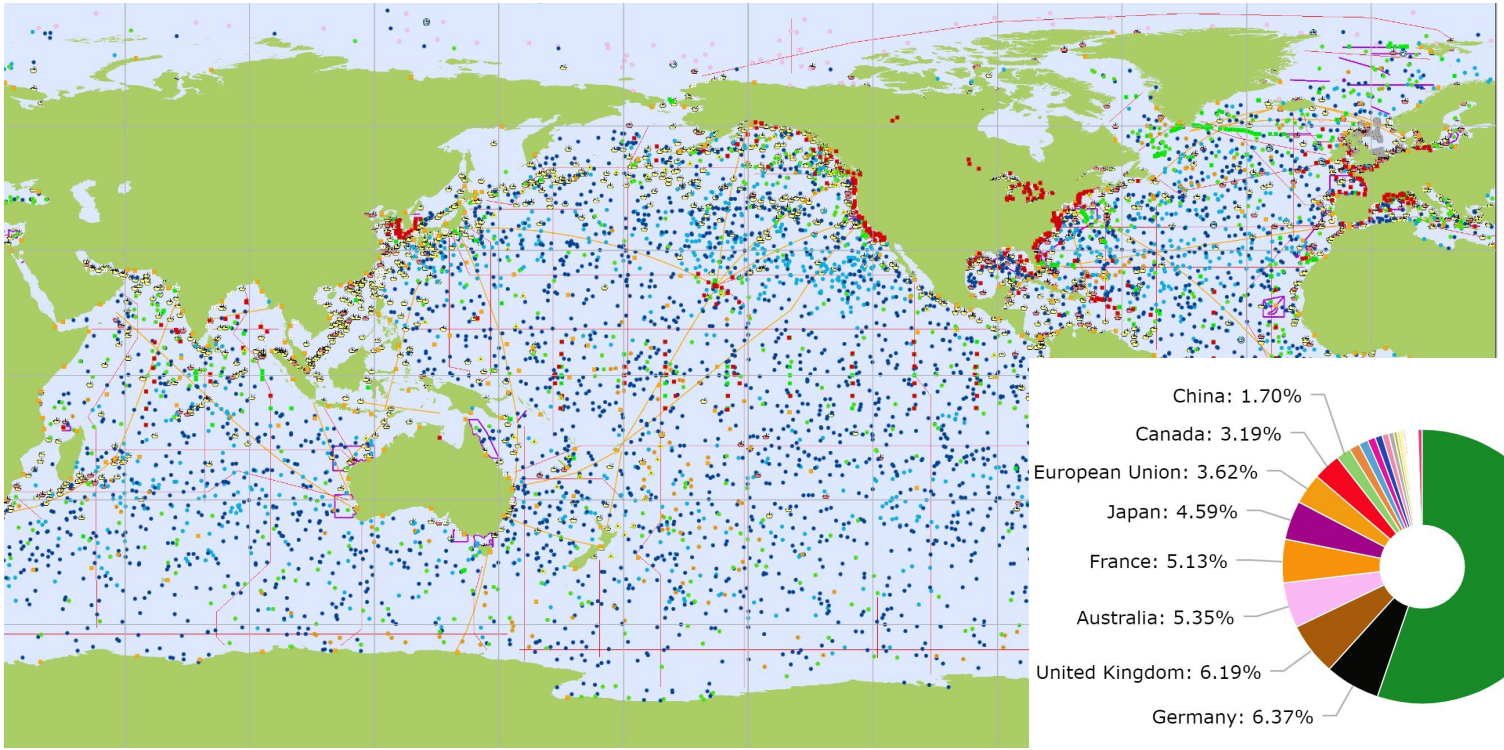


- Backbone of wide ranging weather, climate, extremes research, as well as weather, subseasonal, and ENSO forecasts, including droughts and monsoons
- OAR multi-decade partnerships with 6 countries (cost sharing)
- Supply-chain and inflationary cost increases are threatening continuation



OAR Tropical Buoy Deployments and Funding

GOMO's GLOBAL CONTRIBUTIONS



United States: 55.18%

Opportunities for action under AAORIA

Jessica Snowden

Deputy Director, Global Ocean Monitoring and Observing Program, NOAA

EuroGOOS General Assembly, 2025

AtlantOS

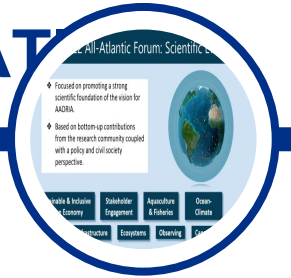
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Fisheries and Oceans Canada | Pêches et Océans Canada

OKEANO Supporting the All-Atlantic Ocean Research and Innovation Alliance

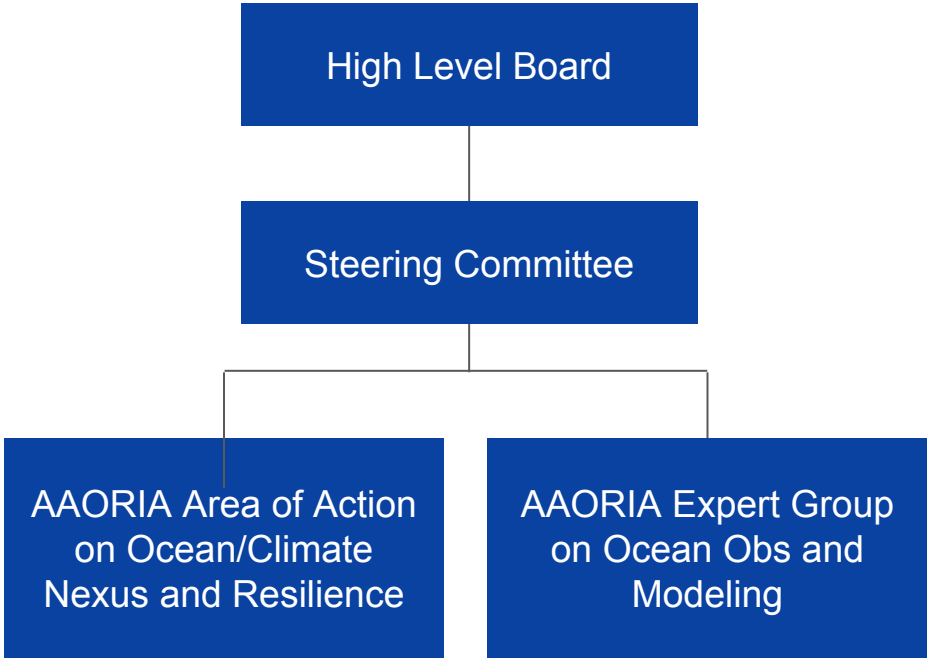
NOAA

ALL-ATLANTIC OCEAN RESEARCH & INNOVATION ALLIANCE



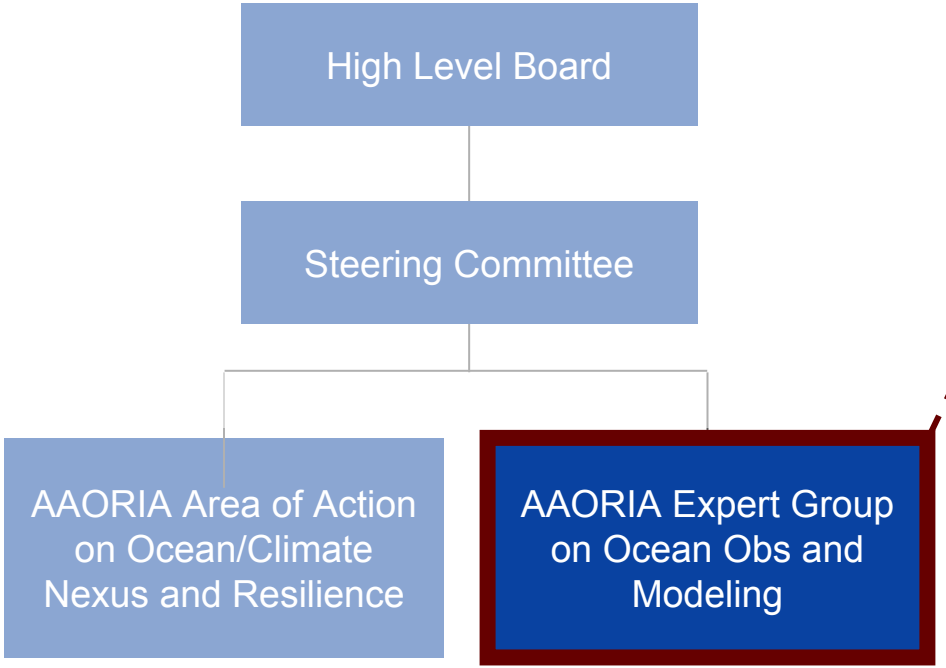
- The All-Atlantic Ocean Research and Innovation Alliance (AAORIA) results from science diplomacy efforts uniting countries across the Atlantic to enhance marine research and innovation cooperation.
- The “All-Atlantic Declaration” was signed to revitalize collaborations, improve coordination between working groups and projects, and attract new partners to the All-Atlantic community.

AAORIA STRUCTURE



- Partners 13 around the Atlantic
- 2 Expert Groups initiated in late 2024

AAORIA STRUCTURE



3 Priority Areas of Action:

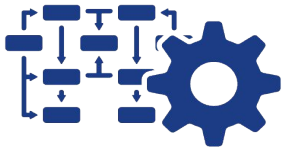
- Ocean productivity, incl. fisheries
- Atlantic Meridional Overturning Circulation
- Land, coast, and ocean interactions

ATLANT-OS

The vision of AtlantOS is to **evolve** the ocean **observing system** so that it is **co-designed** with **end-users** and **responds** to their needs.

- Build a community and community of practice;
- Provide a fit-for-purpose and reactive observing system;
- Connect and interconnect with Atlantic partners and key-stakeholders;
- Promote open sharing and exchange of information.

AIMED OUTCOMES



Link along **value chain and users**

Observing **design** for user need area

Economic value assessment

Blueprint for services if they don’t exist

Tracking of implementation against need

OPPORTUNITIES FOR ACTION

- **Three Working groups** developing Implementation Plans
  - Actionable Implementation Plan to be approved at 2025 Forum
- AAORIA Stakeholder Forum 2025
- Fund an activity
- **AtlantOS** Groups and **Activities**: Cost effective technology group, Sargassum prediction and forecasting system

THANK YOU

Contact:
jessica.snowden@noaa.gov

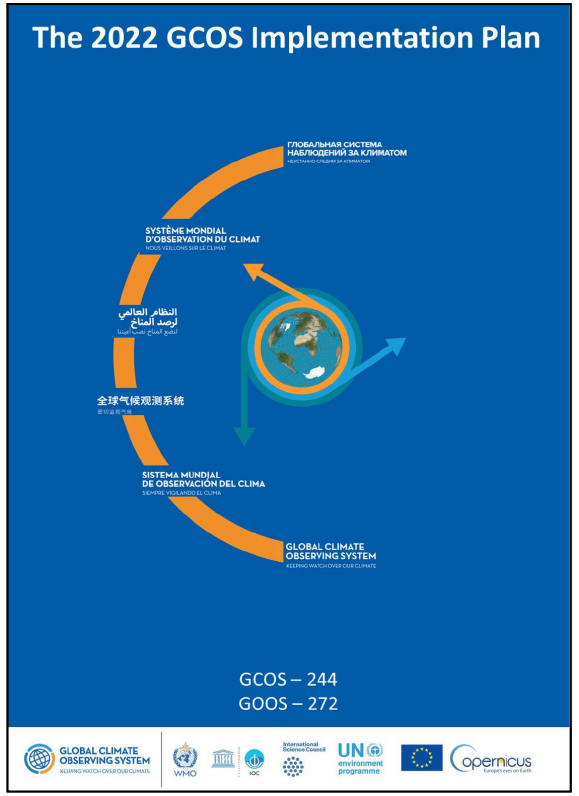
www.allatlanticocean.org

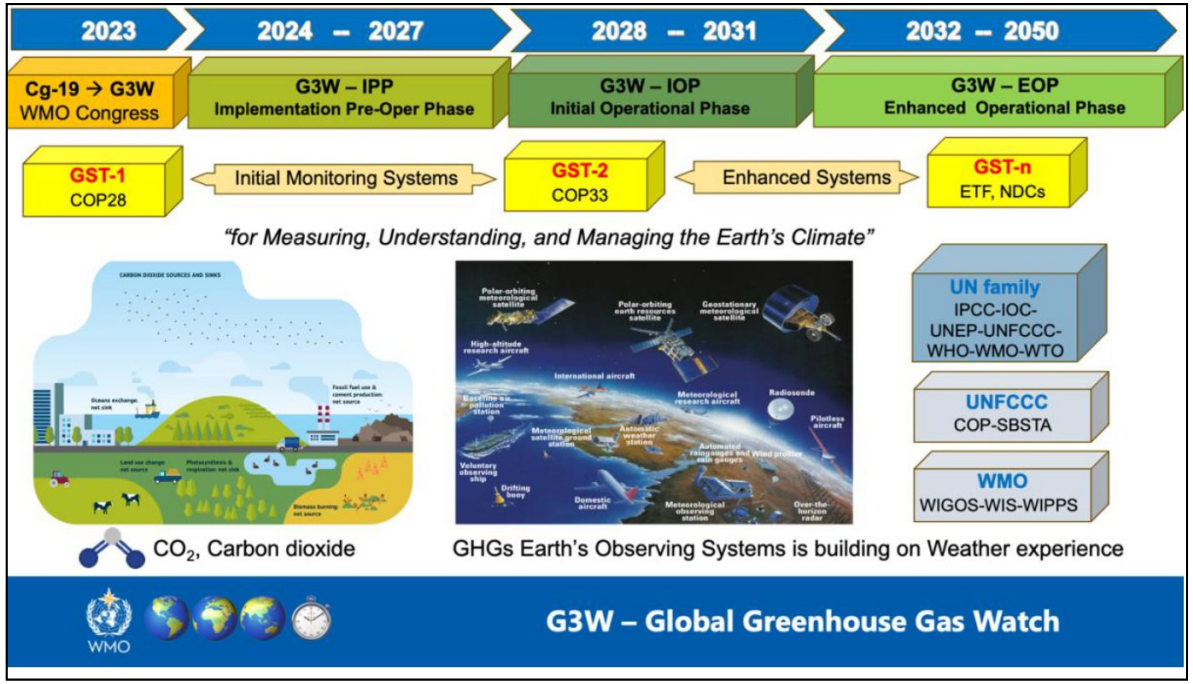
GOOS response to Ocean Carbon and Greenhouse Gas mandates

Adrienne Sutton (co-Chair, NOAA, USA),
Véronique Garçon (co-Chair, CNRS/IPGP, France),
Maciej Telszewski (Director, IO PAN, Poland)

Institute of Oceanology of Polish Academy of Sciences, ul. Powstańców Warszawy 55, 81-712 Sopot, Poland
Phone: +48 58 731 16 10 / Fax: +48 58 551 21 30, **www.ioccp.org**

GOOS is designated as the implementing body of ocean carbon actions in WMO and IOC plans

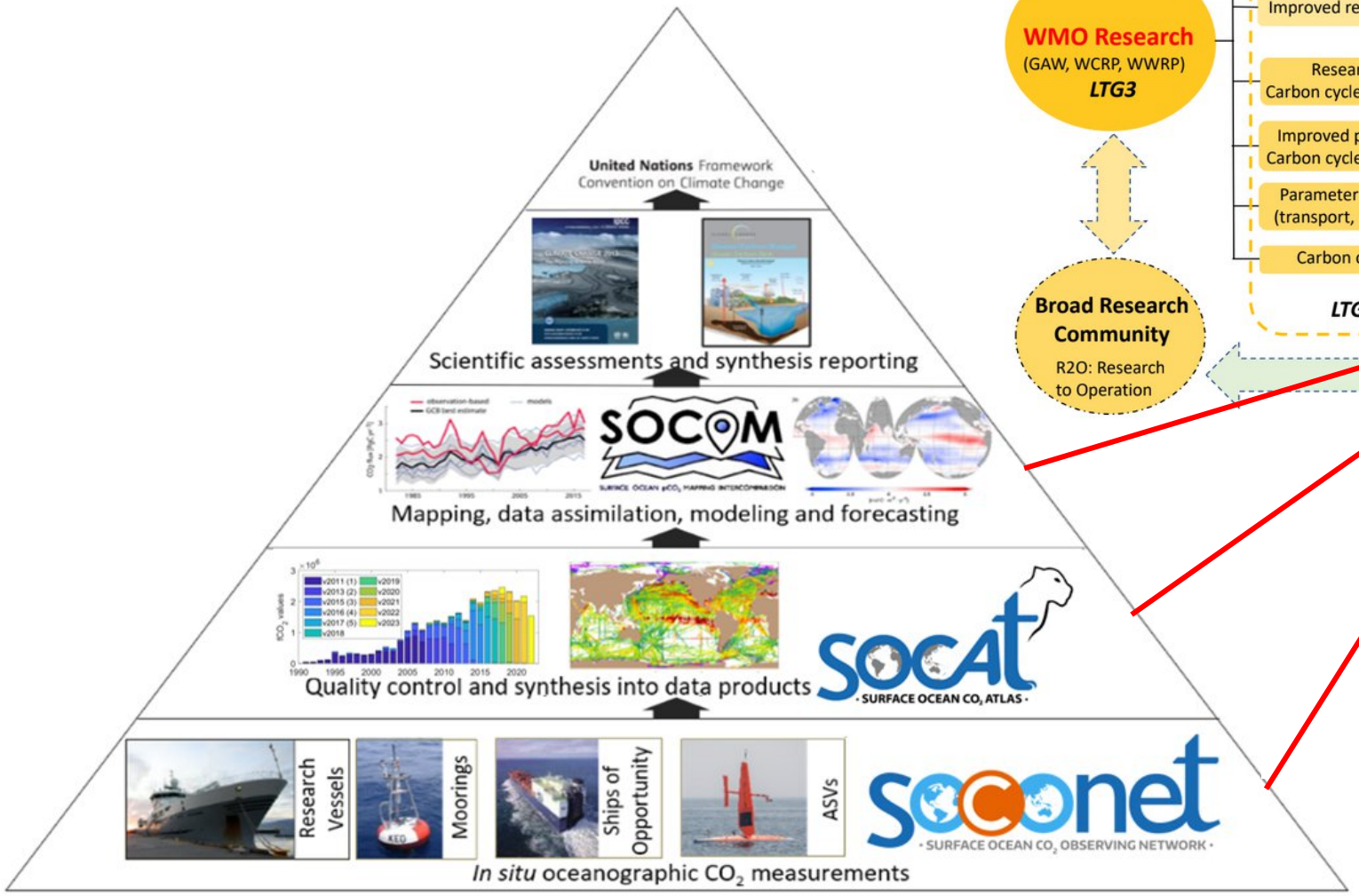


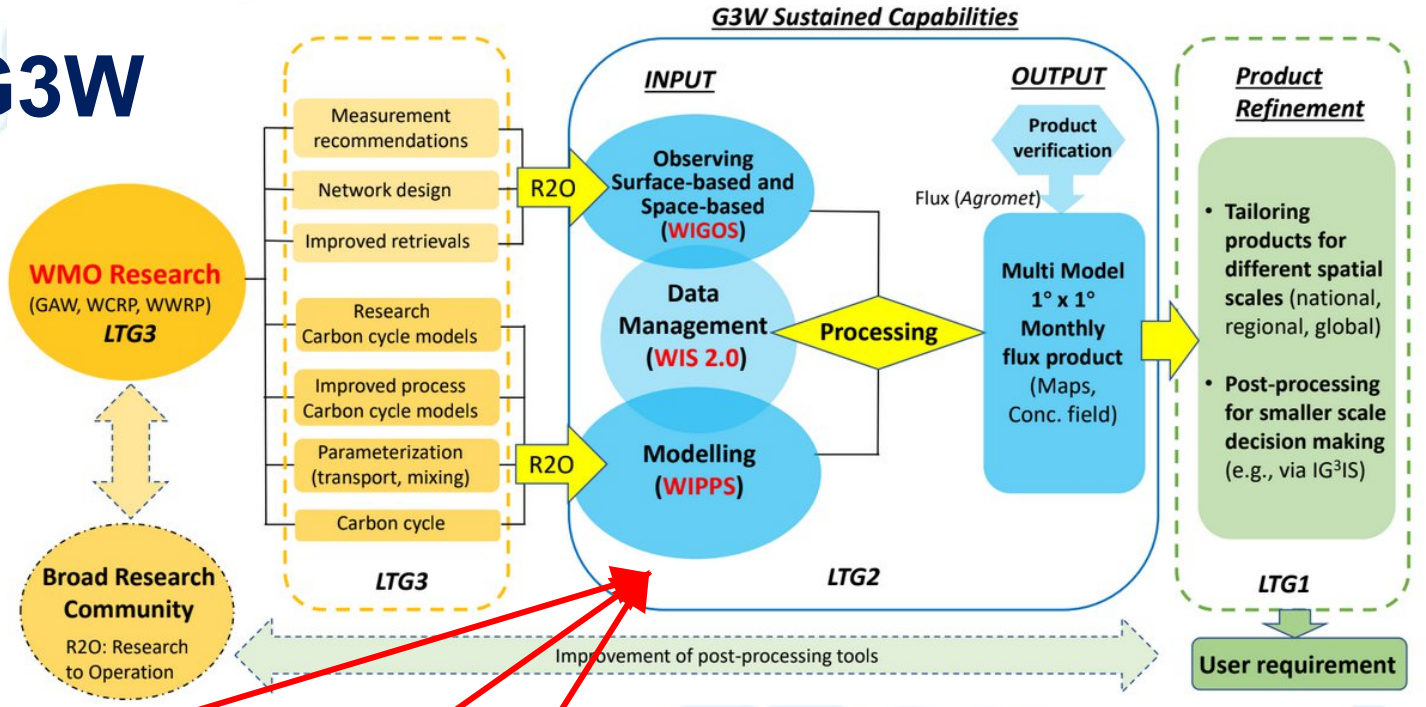


Actions fall within three focal areas:

1. COORDINATION OF **OCEAN GHG NETWORKS**
2. ONGOING **CORE GOOS** RESPONSIBILITIES
3. OCEAN CARBON **NETWORK DESIGN** DEVELOPMENT

The ocean component of G3W





INTERNATIONAL OCEAN CARBON COORDINATION PROJECT
IOCCP

The Global Ocean Observing System
GOOS
Biogeochemistry Panel

SOCONET – Sustained, global quality surface ocean and air CO2 measurements
SOCAT - Synthesis of surface ocean CO2 measurements with quality control

Surface Ocean pCO_2 workshop,
6-9 November 2023, Oostende, Belgium,

INTERNATIONAL OCEAN CARBON COORDINATION PROJECT
IOCCP

Declaration on Operationalising the Surface Ocean Carbon Value Chain

(www.ioccp.org, 04/01/2024)

We, the 100+ ocean experts and stakeholders specialising in surface ocean carbon measurements and quantification of ocean carbon uptake, representing Europe, Australia, Asia, North America, South America and Africa, assembled at the Flanders Marine Institute (VLIZ) in Oostende, Belgium and online (6-9 November 2023) to assess the status of the multi-component community effort capable of measuring, storing, synthesising and

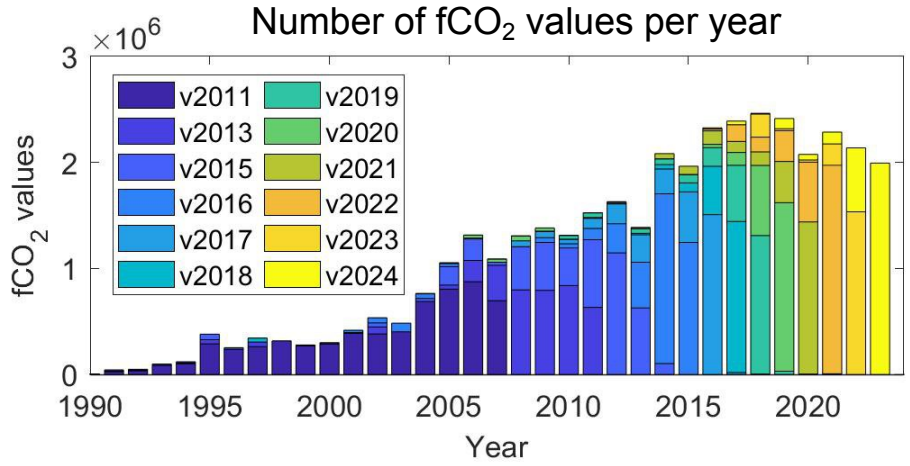
SOCAT version 2024

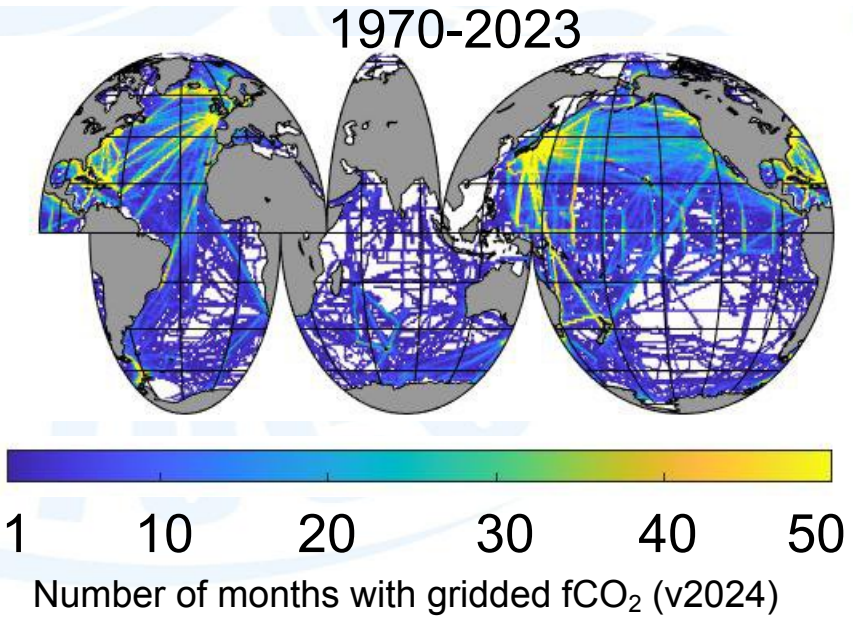
Surface Ocean CO_2 Atlas (www.socat.info)

- Synthesis of *in situ* surface ocean CO_2 measurements
- Public release since 2011, annual from 2015
- 39 million CO_2 values (1957-2023), accuracy < 5 µatm in monthly 1° x 1° gridded products
- 8 million CO_2 sensor data, accuracy 5-10 µatm

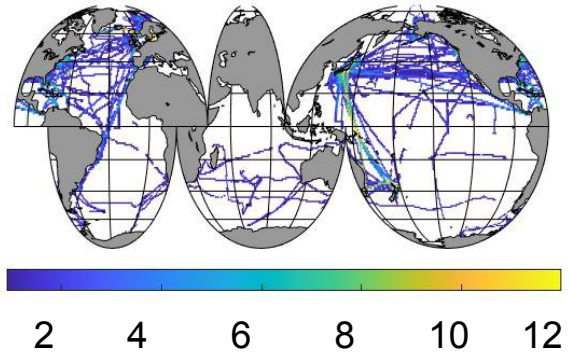
Value chain at risk

- Decline in open ocean CO_2 measurements
- SOCAT lost its European regional hub in 2022 and has chronic funding shortfalls. Only 1 US hub.





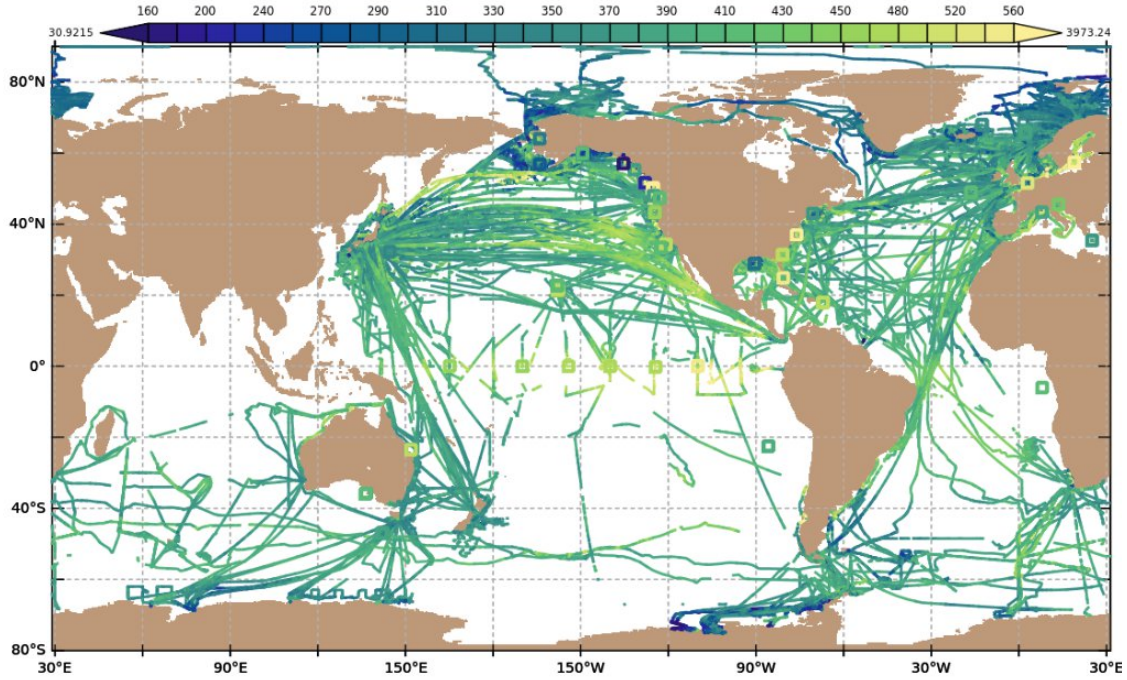
2022-2023



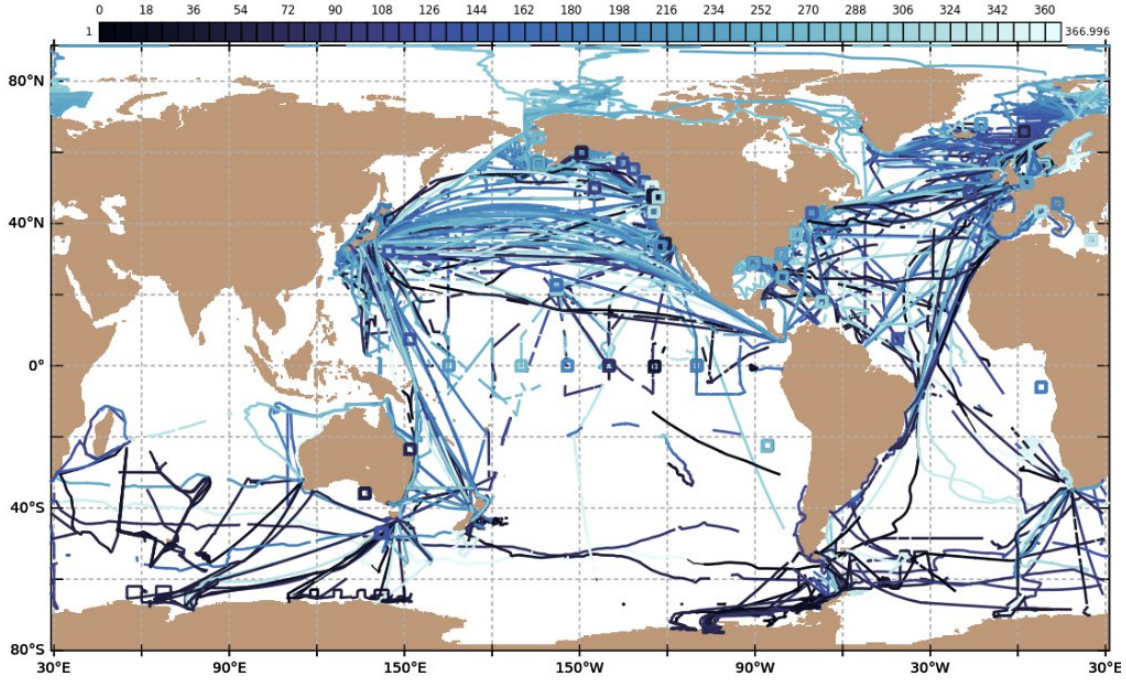
WMO G3W TT
Inventory of Ocean CO2 Observations

- 116 platforms with recurring surface ocean CO_2 measurements (from 2019 to 2023 in SOCATv2024 & new platforms)
- Ships (59), moorings (55), uncrewed surface vehicles (2)

Surface ocean fCO_2 (µatm)



Day of year



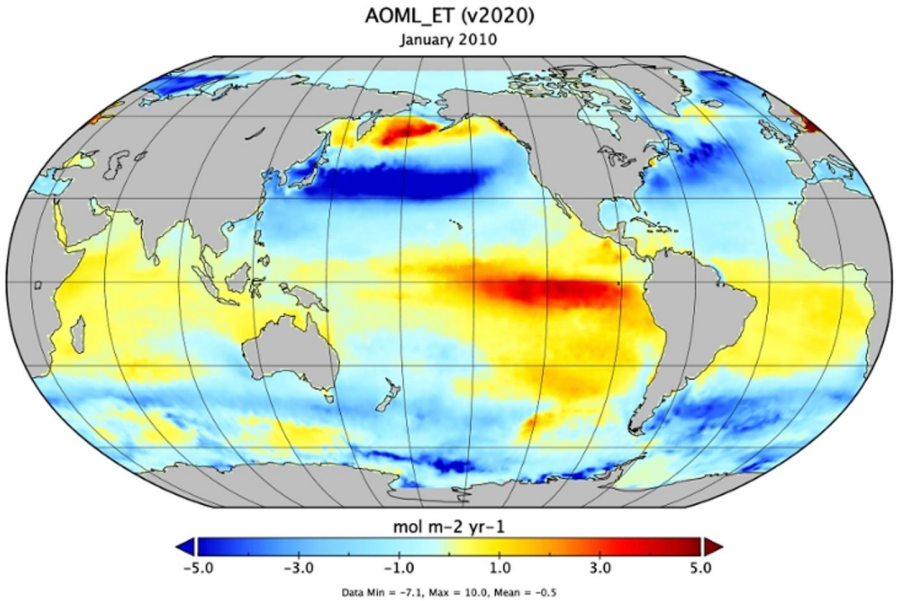
WMO G3W TT - Inventory of Ocean CO2 Observations

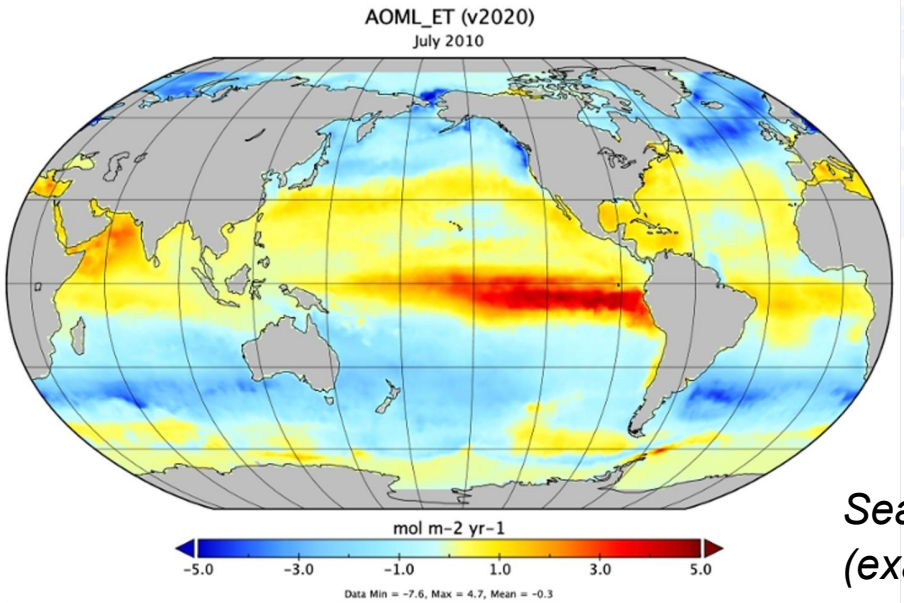
This is a questionnaire prepared by the G3W secretariat for supporting TT-Networks activity. All members are requested to fill in as much information as possible. We will appreciate gathering information from all our colleagues who are involved in measurements of greenhouse gases (CO2, CH4 and N2O)

TT-network members (in charge): Adrienne Sutton, Richard Sanders, Maciej Telszewski, Dorothee Bakker, Frank Muller-Karger, VVSS Sarma

	Network Name	Country operating the platform	platform_code	platform_name	Observing platform type	Site name / Region	Extra site info	Latitude (-ve:SH, +ve:NH)	Longitude (-ve:WH, +ve:EH)	Sampling type	Sampling frequency	Species name	Measurement precision - SOCAT qc_flag (if	Measurement scale	Data latency - SOCAT_version (latest)	Is QA/QC implemented at the level of the station/platform or centralized (please describe if	Investigator, sumame	Investigator, first name	Investigator email	Investigator affiliation	Notes
1		Argentina	08D8	Victor Angelescu	Ship	S. Atlantic				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Berghoff	Carla Florencia	cberghoff@inidep.edu.ar	INIDEP	
2	IMOS	Australia	09AR	Aurora Australis	Ship	Southern Ocean				continuous	variable	fCO2water	B (2 µatm)	WMO	2022	both (2nd stage SOCAT)	Tilbrook	Bronte	Bronte.Tilbrook@csiro.au	CSIRO	no longer operational?
3		Australia	09R9	Heron Island_152E_23S	Mooring	Southern Ocean	coastal			continuous	mooring	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Tilbrook	Bronte	Bronte.Tilbrook@csiro.au	CSIRO	
4		Australia	096U	Investigator	Ship	Southern Ocean				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Tilbrook	Bronte	Bronte.Tilbrook@csiro.au	CSIRO	
5	IMOS	Australia	09FS	Kangaroo_Island_136E_36	Mooring	Southern Ocean	coastal			continuous	mooring	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Tilbrook	Bronte	Bronte.Tilbrook@csiro.au	CSIRO	
6		Australia	09F9	Maria_Island_148E_43S	Mooring	Southern Ocean	coastal			continuous	mooring	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Tilbrook	Bronte	Bronte.Tilbrook@csiro.au	CSIRO	
7	ICOS	Belgium	11SS	Simon Stevin	Ship	North Sea				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Gkritzalis	Thanos	thanos.gkritzalis@vliz.be	VLIZ	
8	ICOS	Belgium	1199	Thornton Buoy	Mooring	North Sea				continuous	mooring	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Gkritzalis	Thanos	thanos.gkritzalis@vliz.be	VLIZ	
9		Canada	187F	KC_BUOY	Mooring	NE Pacific	coastal			continuous	mooring	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Evans	Wiley	wiley.evans@hakai.org	Hakai Institute	
10		Canada	1899	Quadra Island Field Statio	Mooring	NE Pacific	coastal			continuous	mooring	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Evans	Wiley	wiley.evans@hakai.org	Hakai Institute	
11		Canada	1899	Seaspan Royal	Ship	Pacific	coastal			continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Evans	Wiley	wiley.evans@hakai.org	Hakai Institute	
12	ICOS	Finland	?	Tvärminne	Mooring	Baltic Sea	coastal			continuous	daily	fCO2water					Geilfus	Nicolas-Xavier	nicolas-xavier.geilfus@helsinki.fi	University of Helsinki	
13		Finland	?	Silja Serenade	Ship	Baltic Sea				continuous	daily	fCO2water					Honkanen	Martti	martti.honkanen@fmi.fi	FMI	
14		France	357F	Boussole	Mooring	Mediterranean Sea				continuous	mooring	fCO2water	E (10 µatm)	WMO	2024	both (2nd stage SOCAT)	Coppola	Laurent	laurent.coppola@imev-mer.fr	LOV CNRS	
15	ICOS	France	65DK	Cap San Lorenzo	Ship	Atlantic				continuous	monthly	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Lefèvre	Nathalie	nathalie.lefevre@locean.ipsl.fr	IRD	
16		France	35MJ	Colibri	Ship	Atlantic, Mediterranean Sea				continuous	variable	fCO2water	D (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Lefèvre	Nathalie	nathalie.lefevre@locean.ipsl.fr	IRD	
18	PIRATA	France	?	Java_0N_10W	Mooring	Tropical Atlantic				continuous	mooring	fCO2water	E (10 µatm)	WMO			Lefèvre	Nathalie	nathalie.lefevre@locean.ipsl.fr	IRD	new mooring
19	PIRATA	France	?	Valse_6S_10W	Mooring	Tropical Atlantic				continuous	mooring	fCO2water	E (10 µatm)	WMO			Lefèvre	Nathalie	nathalie.lefevre@locean.ipsl.fr	IRD	new mooring
17		France	35MV	Marion Dufresne	Ship	Indian Ocean				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Lo Monaco	Claire	claire.lomonaco@locean.ipsl.fr	LOCEAN SU	
20	ICOS	Germany	06AQ	Polarstern	ship	Southern Ocean, Atlantic, Arctic				continuous	variable	fCO2water	B (2 µatm)	WMO	2018	both (2nd stage SOCAT)	Hoppema	Mario	Mario.Hoppema@awi.de	AWI	currently not operational
21	ICOS	Germany	34FM	Finnmaid	Ship	Baltic Sea				continuous	daily	fCO2water	E (10 µatm)	WMO	2024	both (2nd stage SOCAT)	Rehder	Gregor	gregor.rehder@io-warnemuende.de	IOW	
22	ICOS	Germany	74WX	Atlantic Sail	Ship	N. Atlantic				continuous	every 2 weeks	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Steinhoff	Tobias	tsteinhoff@geomar.de	GEOMAR	
23		Germany	58LY	Lysbris Seaways	Ship	North Sea				continuous	variable	fCO2water	E (10 µatm)	WMO	2024	both (2nd stage SOCAT)	Voynova	Yoana	yoana.voynova@hereon.de	Hereon	
24		Greece	?	POSEIDON FerryBox (PFB)	Ship	E. Mediterranean Sea						fCO2water			SOCONET		Frangoulis	Constantin	cfrangoulis@hcmr.gr	Hellenic Centre for Marine Research (HCMR)	
25	ICOS	Ireland	45CE	Celtic Explorer	Ship	N. Atlantic				continuous	variable	fCO2water	C (5 µatm)	WMO	2023	both (2nd stage SOCAT)	Cronin	Margot	margot.cronin@marine.ie	MI	
26	ICOS	Italy	4899	W1M3A	Mooring	Mediterranean Sea	coastal			continuous	mooring	fCO2water					Bozzano	Roberto	roberto.bozzano@cnr.it	CNR	new mooring
27	ICOS	Italy	48MB	Paloma	Mooring	Mediterranean Sea	coastal			continuous	mooring	fCO2water	E (10 µatm)	WMO	2022	both (2nd stage SOCAT)	Cantoni	Carolina	carolina.cantoni@cnr.it	CNR-ISMAR	
28	ICOS	Italy	#48E2	E2M3A	Mooring	Mediterranean Sea	coastal			continuous	mooring	fCO2water					Cardin	Vanessa	vcardin@ogs.it	OGS	new mooring
29	ICOS	Italy	?	Lampedusa	Mooring	Mediterranean Sea				continuous	daily	fCO2water					Sferlazzo	Damiano	damiano.sferlazzo@enea.it	ENEA	
30		Italy	4899	Miramare	Mooring	Mediterranean Sea	coastal			continuous	mooring	fCO2water					Solidoro	Cosimo	csolidoro@ogs.it	OGS	new mooring
31		Japan	49UF	Keifu Maru II	Ship	Pacific				continuous	variable	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Enyo	Kazutaka	seadata@met.kishou.go.jp	Japan Meteorological Agency	
31		Japan	49UP	Ryofu Maru III	Ship	W Pacific				continuous	variable	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Enyo	Kazutaka	seadata@met.kishou.go.jp	Japan Meteorological Agency	
32		Japan	49RY	Ryofu Maru	Ship	W Pacific				continuous	variable	fCO2water	D (5 µatm)	WMO	2017	both (2nd stage SOCAT)	Ishii	Masao	mishii@mri-jma.go.jp	JMA-MRI	no longer operational
33		Japan	49HH	Hakuho Maru	Ship	Pacific				continuous	variable	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Kosugi	Naohiro	nkosugi@mri-jma.go.jp	Meteorological Research Insitute	
34		Japan	49NZ	Mirai	Ship	Arctic Ocean				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Murata	Akihiko	murataa@jamstec.go.jp	JAMSTEC	
35		Japan	PANC	New Century 2	Ship	Pacific				continuous	monthly	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Nakaoka	Shin-Ichiro	nakaoka.shinichiro@nies.go.jp	NIES	
36		Japan	PAT5	Trans Future 5	Ship	Pacific				continuous	monthly	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Nakaoka	Shin-Ichiro	nakaoka.shinichiro@nies.go.jp	NIES	
37		Japan	49WB	Soyo Maru	Ship	Pacific				continuous	variable	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Ono	Tsuneo	tono@affrc.go.jp	National Research Institute for Far Seas Fisheries / Fisheries Resea	
38		Japan	49WA	Wakataka Maru	Ship	Pacific				continuous	mooring	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Tadokoro	Kazuaki	den@affrc.go.jp	Fisheries Research and Education Agency Shiogama Branch	
39		New Zealand	61P2	Polaris II	Ship	Pacific				continuous	variable	fCO2water	D (5 µatm)	WMO	2018	both (2nd stage SOCAT)	Law	Cliff	cliff.law@niwa.co.nz	NIWA	not operational
40		New Zealand	61TG	Tangaroa	Ship	Pacific				continuous	variable	fCO2water	C (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Law	Cliff	cliff.law@niwa.co.nz	NIWA	
41	ICOS	Norway	58US	Kronprins Haakon	Ship	N. Atlantic				continuous	variable	fCO2water	B (2 µatm)	WMO	2022	both (2nd stage SOCAT)	Fransson	Agneta	agneta.fransson@npolar.no	Norwegian Polar Institute	
42	ICOS	Norway	26RA	Tukuma Arctica	Ship	N. Atlantic				continuous	monthly	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Olsen	Are	Are.Olsen@uib.no	UiB	
43		Norway	MLSC	Sea-Cargo Express	Ship	North Sea	coastal			continuous	weekly	fCO2water					Omar	Abdirahman	abom@norceresearch.no	NORCE	new ship
44	ICOS	Norway	58G2	G.O. Sars	Ship	N. Atlantic				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Skjelvan	Ingunn	insk@norceresearch.no	NORCE	
45		Norway	5899	Station M	Mooring	N. Atlantic				continuous	mooring	fCO2water	C (5 µatm)	WMO	2022	both (2nd stage SOCAT)	Skjelvan	Ingunn	insk@norceresearch.no	NORCE	
46		South Africa	91AA	SA Agulhas II	Ship	Southern Ocean				continuous	variable	fCO2water	D (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Hamnca	Siyabulela	shamnca@csir.co.za	CSIR-SOCCO	
47		South Africa	91AL	Algoa	Ship	SE Atlantic	coastal			continuous	variable	fCO2water	D (5 µatm)	WMO	2024	both (2nd stage SOCAT)	Tsanwani	Mutshutshu	mtsanwani@dffe.gov.za	DFFE	
48	ICOS	Spain	?	ESTOC	Mooring	Atlantic				continuous	mooring	fCO2water	?				Delory	Eric	eric.delory@plocan.eu	PLOCAN	
49	ICOS	Spain	?	CanOA line	Ship	Atlantic				continuous	monthly	fCO2water					González-Dávila	Melchor	melchor.gonzalez@ulpgc.es	ULPGC	name of new ship to be confi
50		Spain	687B	Jona Sophie	Ship	N Atlantic	coastal			continuous	monthly	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	González-Dávila	Melchor	melchor.gonzalez@ulpgc.es	ULPGC	no longer operational
50		Spain	29SG	Sarmiento de Gamboa	Ship	Atlantic				continuous	variable	fCO2water	D (5 µatm)	WMO	2023	both (2nd stage SOCAT)	Padin	X. A.	padin@iim.csic.es	Instituto de Investigacións Mariñas (CSIC)	
51	ICOS	Sweden	77XT	Tavastland	Ship	Baltic Sea	coastal			continuous	weekly	fCO2water	C (5 µatm)	WMO	2022	both (2nd stage SOCAT)	Nilsson	Madeleine	madeleine.nilsson@smhi.se	SMHI	
52		Sweden	77FS	Östemgarnsholm	Mooring	Baltic Sea	coastal			continuous	mooring	fCO2water	E (10 µatm)	WMO	2024	both (2nd stage SOCAT)	Rutgersson	Anna	anna.rutgersson@met.uu.se	University of Uppsala	
53	ICOS	UK	74FS	Porcupine Abyssal Plain	Mooring	N. Atlantic				continuous	mooring	fCO2water	E (10 µatm)	WMO	2024	both (2nd stage SOCAT)	Hartman	Sue	s.hartman@noc.ac.uk	NOC	
54		USA	3250	Thomas G. Thompson	Ship	Pacific, Atlantic, Southern Ocean				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Alin	Simone	simone.r.alin@noaa.gov	NOAA PMEL	
55		USA	?	Tysla	Ship					continuous		fCO2water					Alin	Simone	simone.r.alin@noaa.gov	NOAA PMEL	
56		USA	331I	BlueFin	Ship	Pacific				continuous	every 2 weeks	fCO2water	B (2 µatm)	WMO	2022	both (2nd stage SOCAT)	Alin	Simone	simone.r.alin@noaa.gov	NOAA PMEL	
57		USA	3322	Bell M. Shimada	Ship	Pacific	coastal			continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Alin	Simone	simone.r.alin@noaa.gov	NOAA PMEL	
58		USA	33OA	Oscar Dyson	Ship	NE Pacific	coastal			continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Alin	Simone	simone.r.alin@noaa.gov	NOAA PMEL	
59		USA	33WA	F. G. Walton Smith	Ship	N. Atlantic, Caribbean				continuous	variable	fCO2water	B (2 µatm)	WMO	2024	both (2nd stage SOCAT)	Barbero	Leticia	lbarbero@earth.miami.edu	U.Miami/CIMAS	

Surface Ocean CO_2 Network Design





Seasonal variability in ocean CO_2 reconstruction (example from Wanninkhof et al. 2024)

SOCOM is a forum for the ocean CO_2 mapping community to intercompare different interpolation methods, and improve those methods

SOCOM will also help quantify the added value of observations to inform network design

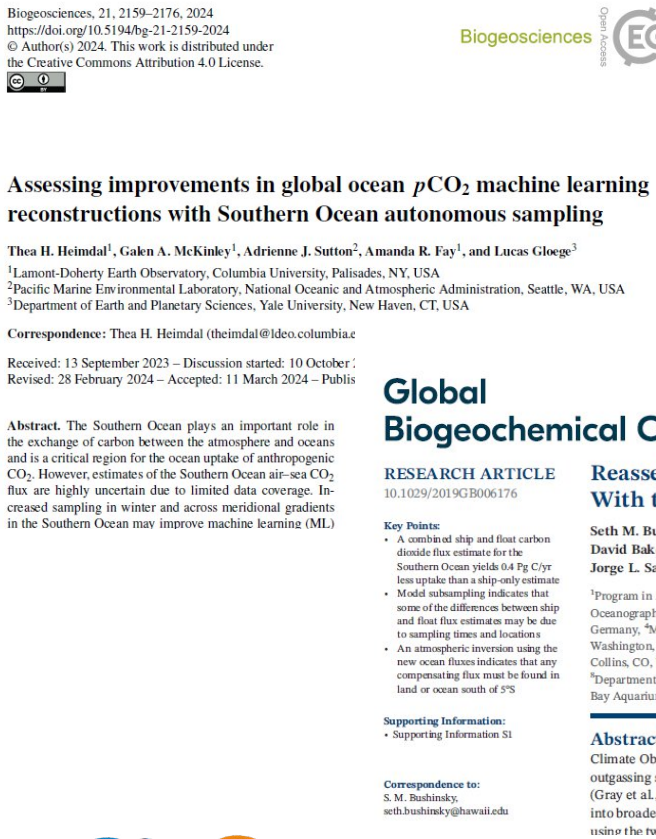
Planning a workshop in 2026 to have these network design conversations

Important to have representation from the G3W modeling community at that workshop, esp groups testing the use of annually-updated, observation-based ocean priors

Ocean Carbon Network Design

Global ocean observing design prerequisites:

1. Research-oriented, cross-network strategy for GOOS networks w/ role in global ocean carbon observing
2. Enhance collaboration within modelling community and improve understanding between observationalists and modelers



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Biogeosciences

Assessing improvements in global ocean pCO_2 machine learning reconstructions with Southern Ocean autonomous sampling

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[2]Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration, Seattle, WA, USA
[3]Department of Earth and Planetary Sciences, Yale University, New Haven, CT, USA
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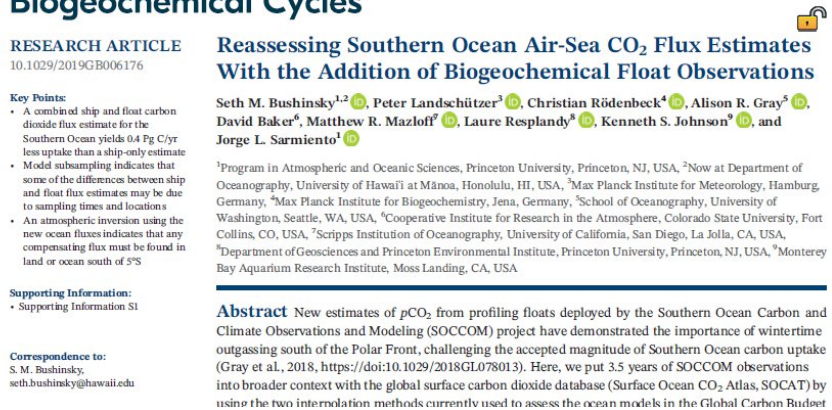
Revised: 28 February 2024 – Accepted: 11 March 2024 – Publis

Abstract. The Southern Ocean plays an important role in the exchange of carbon between the atmosphere and oceans and is a critical region for the ocean uptake of anthropogenic CO_2. However, estimates of the Southern Ocean air–sea CO_2 flux are highly uncertain due to limited data coverage. Increased sampling in winter and across meridional gradients in the Southern Ocean may improve machine learning (ML)



Global Biogeochemical Cycles

RESEARCH ARTICLE
10.1029/2019GB006176

Reassessing Southern Ocean Air-Sea CO_2 Flux Estimates With the Addition of Biogeochemical Float Observations

Key Points:
- A combined ship and float carbon dioxide flux estimate for the Southern Ocean yields 0.4 Pg C/yr less uptake than a ship-only estimate
- Model subsampling indicates that some of the differences between ship and float flux estimates may be due to sampling times and locations
- An atmospheric inversion using the new ocean fluxes indicates that any compensating flux must be found in land or ocean south of 5°S

Supporting Information:
- Supporting Information S1

Seth M. Bushinsky[1,2], Peter Landschützer[3], Christian Rödenbeck[4], Alison R. Gray[5], David Baker[6], Matthew R. Mazloff[7], Laure Resplandy[8], Kenneth S. Johnson[9], and Jorge L. Sarmiento[1]

[1]Program in Atmospheric and Oceanic Sciences, Princeton University, Princeton, NJ, USA, [2]Now at Department of Oceanography, University of Hawai'i at Mānoa, Honolulu, HI, USA, [3]Max Planck Institute for Meteorology, Hamburg, Germany, [4]Max Planck Institute for Biogeochemistry, Jena, Germany, [5]School of Oceanography, University of Washington, Seattle, WA, USA, [6]Cooperative Institute for Research in the Atmosphere, Colorado State University, Fort Collins, CO, USA, [7]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, [8]Department of Geosciences and Princeton Environmental Institute, Princeton University, Princeton, NJ, USA, [9]Monterey Bay Aquarium Research Institute, Moss Landing, CA, USA

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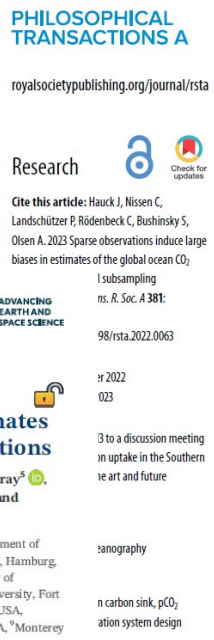
S. M. Bushinsky,
seth.bushinsky@hawaii.edu

Abstract New estimates of pCO_2 from profiling floats deployed by the Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM) project have demonstrated the importance of wintertime outgassing south of the Polar Front, challenging the accepted magnitude of Southern Ocean carbon uptake (Gray et al., 2018, https://doi:10.1029/2018GL078013). Here, we put 3.5 years of SOCCOM observations into broader context with the global surface carbon dioxide database (Surface Ocean CO_2 Atlas, SOCAT) by using the two interpolation methods currently used to assess the ocean models in the Global Carbon Budget

AGU100 ADVANCING EARTH AND SPACE SCIENCE



PHILOSOPHICAL TRANSACTIONS A

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Research

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ns. R. Soc. A **381**:
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3 to a discussion meeting
n uptake in the Southern
e art and future

eanography

n carbon sink, pCO_2
ation system design

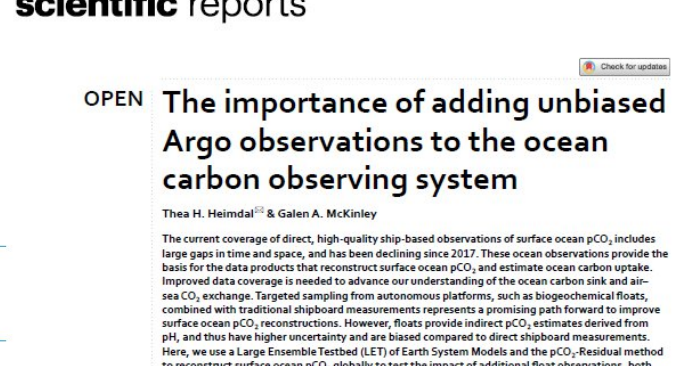
Sparse observations induce large biases in estimates of the global ocean CO_2 sink: an ocean model subsampling experiment

Judith Hauck[1], Cara Nissen[1,2], Peter Landschützer[3], Christian Rödenbeck[4], Seth Bushinsky[5] and Are Olsen[6,7]

[1]Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany
[2]Department of Atmospheric and Oceanic Sciences and Institute of Arctic and Alpine Research, University of Colorado Boulder, Boulder, CO, USA
[3]Flanders Marine Institute (VLIZ), Ostend, Belgium
[4]Max Planck Institut für Biogeochemie, Jena, Germany
[5]School of Ocean and Earth Science and Technology, University of Hawai'i at Mānoa, Department of Oceanography, Honolulu, HI, USA
[6]Geophysical Institute, University of Bergen, Bergen, Norway
[7]Bjerknes Centre for Climate Research, Bergen, Norway

JH, 0000-0003-4723-9652; CN, 0000-0001-5804-3191; PL, 0000-0002-7398-3293; CR, 0000-0001-6011-6249; SB, 0000-0001-5106-4678; AO, 0000-0003-1696-9142

Estimates of ocean CO_2 uptake from global ocean biogeochemistry models and pCO_2-based



scientific reports

Check for updates

OPEN

The importance of adding unbiased Argo observations to the ocean carbon observing system

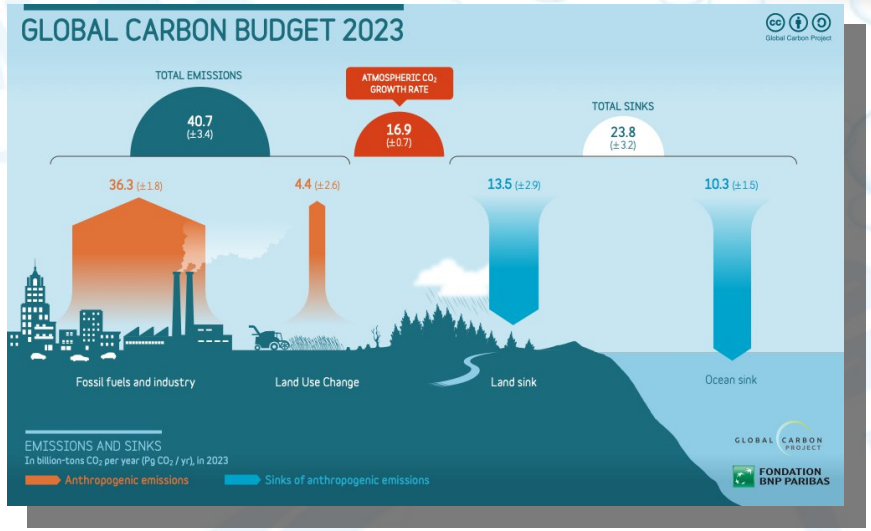
Thea H. Heimdal[✉] & Galen A. McKinley

The current coverage of direct, high-quality ship-based observations of surface ocean pCO_2 includes large gaps in time and space, and has been declining since 2017. These ocean observations provide the basis for the data products that reconstruct surface ocean pCO_2 and estimate ocean carbon uptake. Improved data coverage is needed to advance our understanding of the ocean carbon sink and air–sea CO_2 exchange. Targeted sampling from autonomous platforms, such as biogeochemical floats, combined with traditional shipboard measurements represents a promising path forward to improve surface ocean pCO_2 reconstructions. However, floats provide indirect pCO_2 estimates derived from pH, and thus have higher uncertainty and are biased compared to direct shipboard measurements. Here, we use a Large Ensemble Testbed (LET) of Earth System Models and the pCO_2-Residual method

Global Ocean Carbon Observing System Design

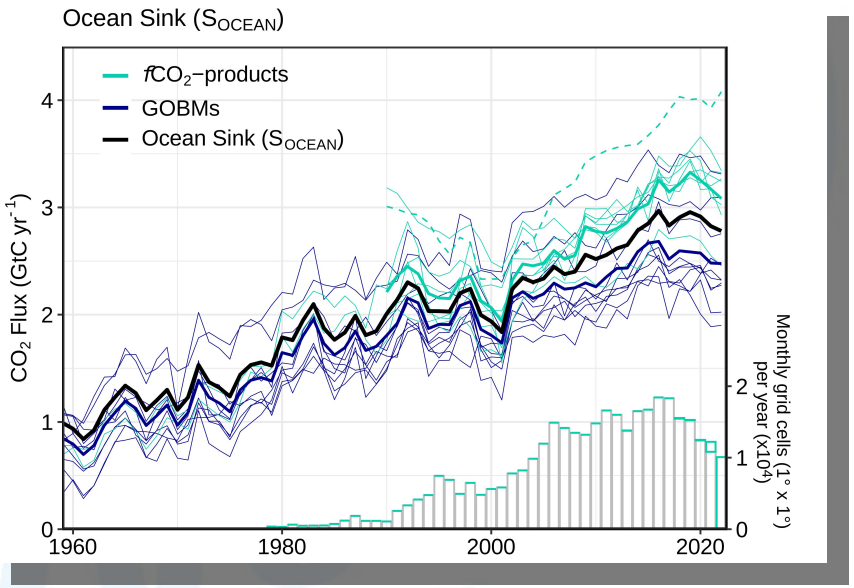
Integrated global ocean carbon observing system design across networks

- a summary of existing networks' (primarily GO-SHIP, SOCONET, BGC-Argo) missions, implementation plans, and network designs
- a clear cross-network strategy, describing the roles of each network and dependencies across networks, including satellite oceanography
- integrate designs across networks, and identify priority network enhancements and technology development to fill gaps



Global ocean carbon observing system design based on close collaboration with colleagues in the modelling community focused on optimizing observing systems:

- Discussions with several groups loosely affiliated under SOCOM umbrella are underway. Several ongoing project-based tasks focused on ocean carbon observing design will provide first results in 2025
- A workshop attended by observing networks and relevant colleagues in the modelling community is planned for 2026
- An outcome of this workshop will provide actionable recommendations



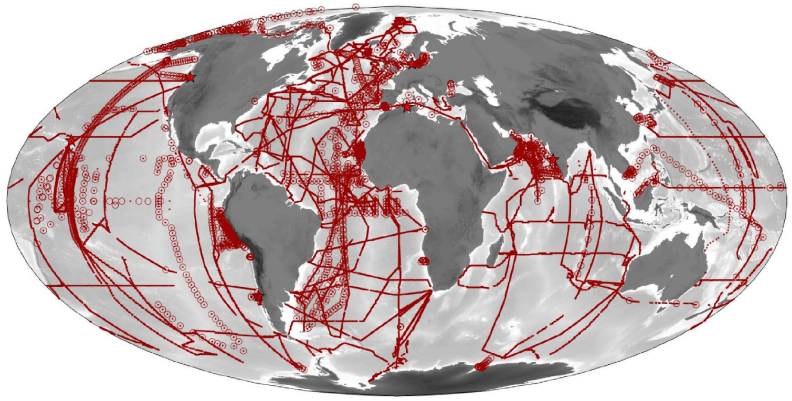
Marine N_2O and CH_4

MEMENTO
Marine CH_4 - N_2O database

Nitrous oxide (N_2O)

- Open and coastal oceans major sources (~ 30% of natural and anthropogenic of N_2O sources)

N_2O

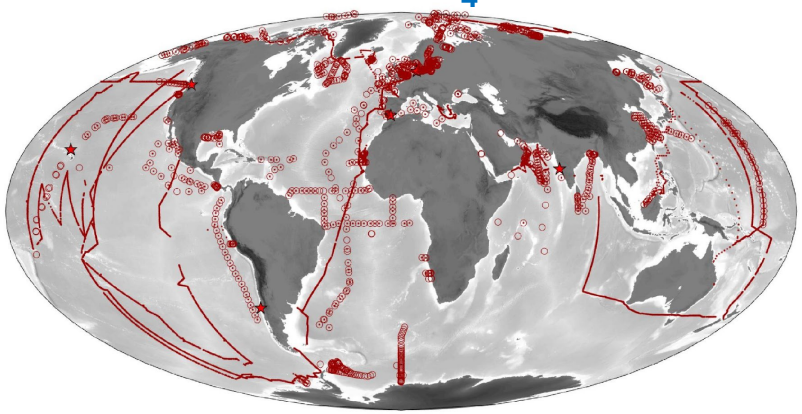


(MEMENTO version Nov. 2021)

Methane (CH_4)

- Open and coastal oceans minor sources (~ 1% of natural and anthropogenic CH_4 sources)

CH_4



(MEMENTO version Nov. 2021)

Marine CH_4 and N_2O database

- N_2O > 120,000 data entries
- CH_4 > 30,000 data entries

MEMENTO - memento.geomar.de

- Hermann Bange (hbange@geomar.de)
- Dormant

Ocean Observing Co-Design
by The Global Ocean Observing System

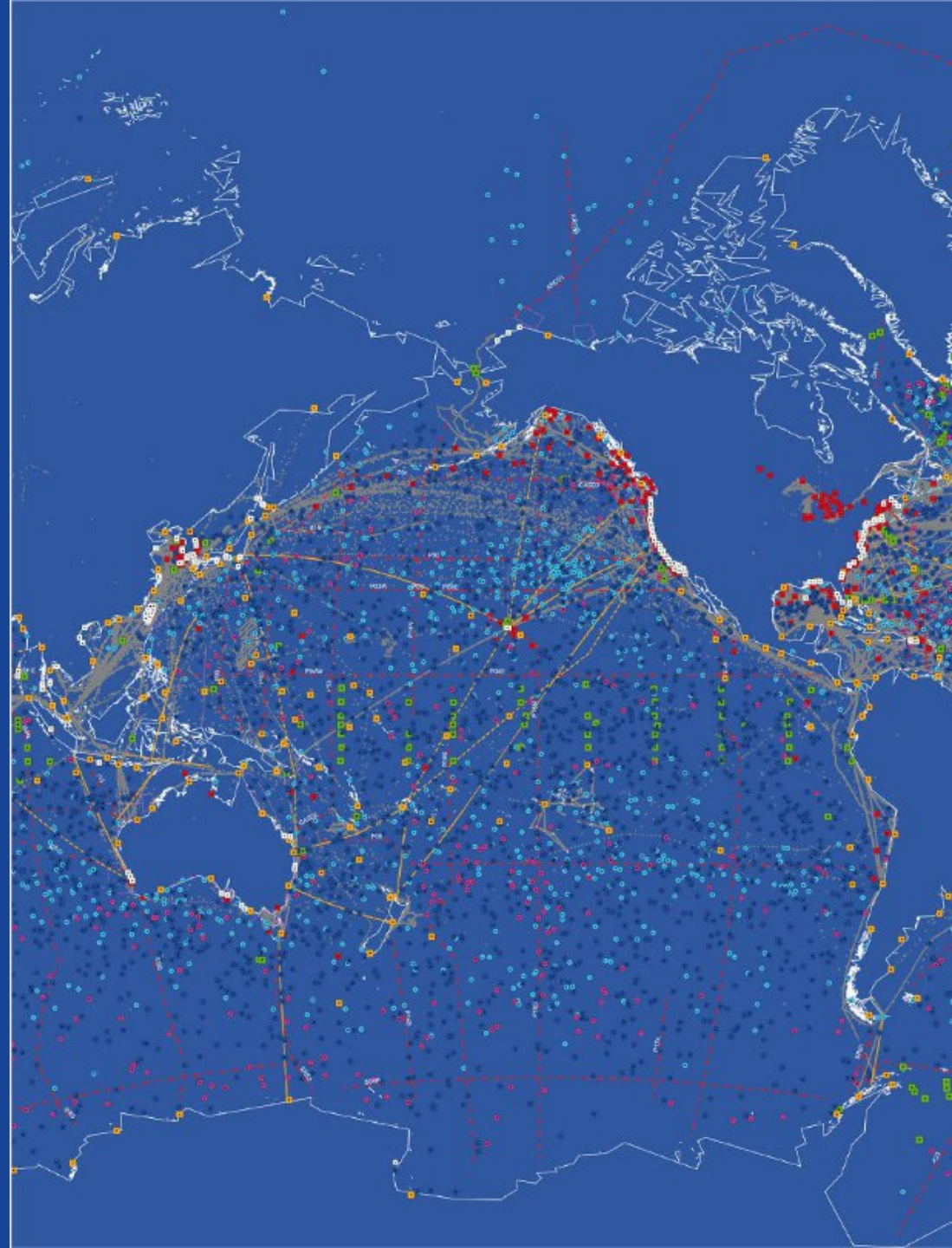
Ocean Carbon Cycle Exemplar

Ocean Observing Co-Design Contribution to Carbon Plan

Emma Heslop | Global Ocean Observing System, IOC-UNESCO
Richard Sanders | NORCE / ICOS
Anya Waite | Ocean Frontier Institute
Ronnie Noonan-Birch | Ocean Frontier Institute
Cristina Miño | UNESCO

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

This programme is endorsed by the UN Decade of Ocean Science



Co-Design Carbon Exemplar

Co-Design Ocean Carbon Exemplar

Carbon Plan Contribution

Focuses on

Co-Designing the system for additional observations and services that respond needs of new user groups

Exploring **funding and governance models** for private sector engagement

Building connections between observations, models, services, and end users

Carbon Exemplar 2025 Plans

- Develop a **Horizon Europe** Proposal on Ocean Carbon Governance
- Engagement for advancing research with the Global multi-scale Ocean Carbon Observatory initiative (GOCO) - Ocean Visions Working Group.
- Convene Horizon Europe discussions at One Ocean Science and UNOC to align priorities and build momentum.

TRICUSO
SOUTHERN OCEAN CARBON OBSERVATION

OceanICU

International Council for Science
SCOR
Scientific Committee on Oceanic Research

INTERNATIONAL OCEAN CARBON COORDINATION PROJECT
IOCCP

The Global Ocean Observing System
GOOS
Biogeochemistry Panel

UNESCO
United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

A communication and coordination service for marine biogeochemistry

Thank You!

Institute of Oceanology of Polish Academy of Sciences, ul. Powstańców Warszawy 55, 81-712 Sopot, Poland
Phone: +48 58 731 16 10 / Fax: +48 58 551 21 30, **www.ioccp.org**

The Global Ocean Observing System
GOOS
Biogeochemistry Panel

ArcticROOS
EuroGOOS Arctic Regional Ocean Observing System

Towards a Regional Alliance for the Arctic Ocean

By the Arctic Ocean Regional Alliance (ArORA) Task Team,

Craig Lee (University of Washington, USA),
Anna Nikolopoulos (UiT The Arctic University of Norway)

Steering Group: David Allen (NOAA, USA), Maia Hoeberechts (ONC, Canada), Michael Karcher (AWI, Germany), Molly McCammon (AOOS, USA), Maribeth Murray (AINA, Canada), Jeremy Wilkinson (BAS, United Kingdom), Eun Jin Yang (KOPRI, Republic of Korea).

GOOS Regional Alliances (GRA)

- Integrate national needs into regional systems – Regional Alliances.
- Coalitions of nations and/or institutions working within the GOOS framework. Focused on regional and local priorities and organized around ocean basins or coastal environments.
- 14 GRAs, plus Southern Ocean Observing System (SOOS) and Sustaining Arctic Observing Networks (SAON)
- Each is unique – tailored to regional priorities/needs, resources and culture.

The Global Ocean Observing System

- Develop global ocean observing system to deliver information for Climate, Forecast and Warning, Ocean Health (global to local).
- Led by Intergovernmental Oceanographic Commission (IOC) of UNESCO, co-sponsored by World Meteorological Organization (WMO), United Nations Environmental Programme (UNEP) and International Science Council (ISC).
- **Coordination, advocacy and support for community of international, regional and national ocean observing programs, governments, UN agencies, research organizations and individual scientists.**
- Elements of GOOS – Expert Panels, Networks, Regional Alliances.

Examples of global Networks under or affiliated with GOOS

GO-SHIP

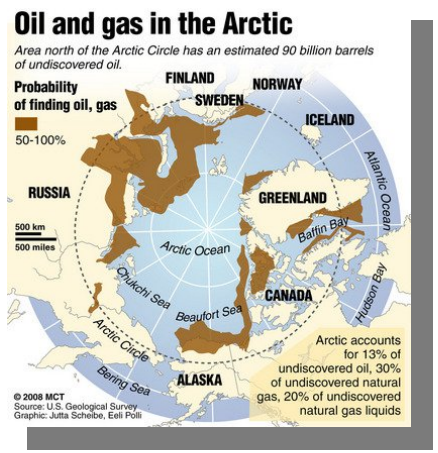
ANIBOS

OceanSITES

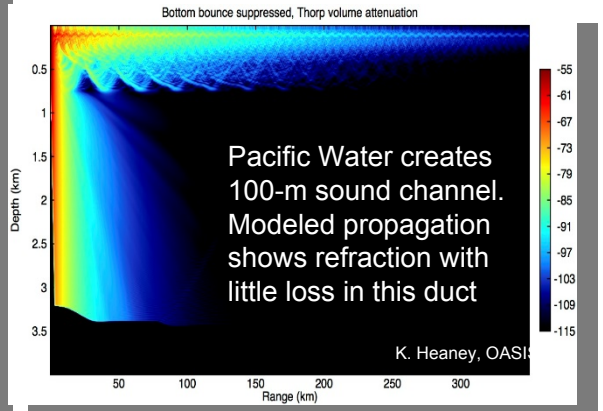
Argo

GOA-ON
Global Ocean Acidification Observing Network

Why now?



Sound Channel Allows Long-Range Propagation in Beaufort Sea



Economics
Industry

Northern Communities

National Security

Climate and Ecosystem Change

- Increased awareness of the Arctic Ocean's role in the climate system.
- Severe climate impacts on Arctic communities.
- Accelerating human activity.
- Many existing initiatives and programs for observing the Arctic marine environment.
- Coordination at national level, but broader cooperation challenging due to complex, heterogenous environment.
  Need an overarching voice for the marine sector.
- UN Decade of Ocean Science and endorsement from
  G7 Future of Seas and Oceans Initiative may provide opportunities to advance broad coordination efforts.

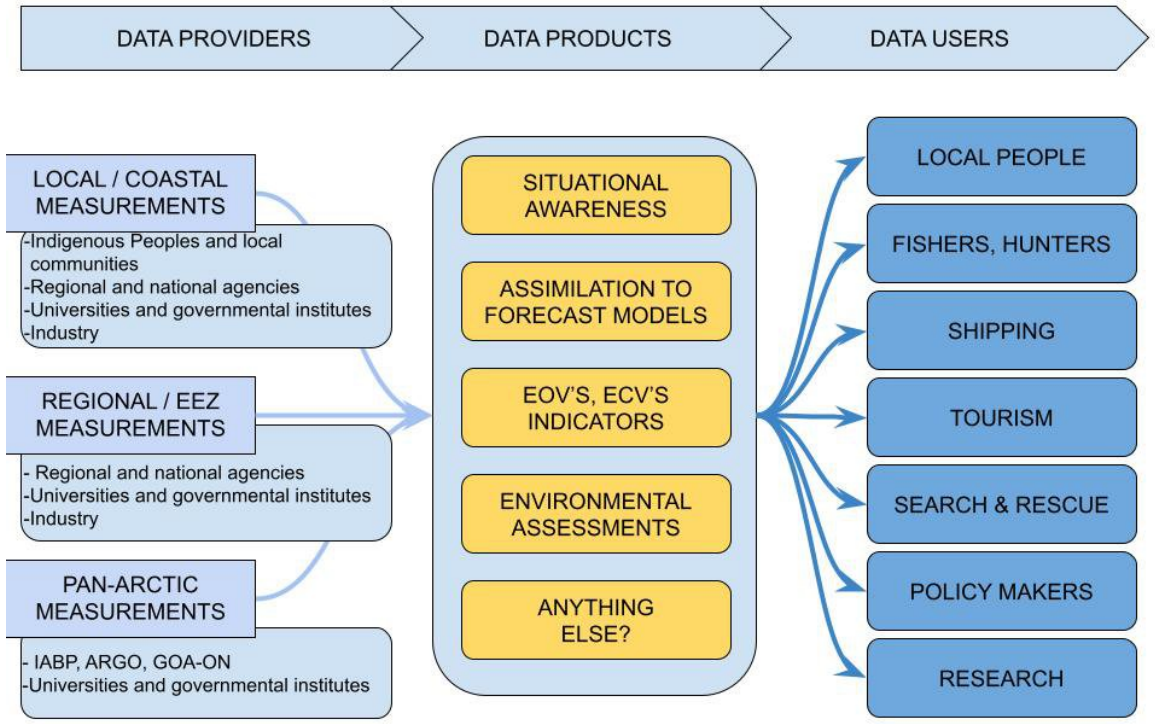
An Arctic Ocean Regional Alliance (ArORA)

AMAP
Arctic Region

- Arctic broadly defined (AMAP)
- Existing GRAs encompass elements of this region (US iOOS, EuroGOOS, CIOOS).
- ArORA to **complement** existing regional alliances, **facilitate** pan-Arctic communication and coordination within the ocean sector.

Rationale and Function for the ArORA

- **Formal representation** of the Arctic Ocean within GOOS.
- Encourage Global Ocean Observing Systems to **extend coverage into the Arctic**.
- Sustained Arctic Ocean observing efforts would benefit from a stable, **overarching framework** to enable coordination and collaboration.
- **Fundamental engagement with rightsholders and stakeholders** – align activities with needs.
- **Strengthen Arctic representation** in international bodies, planning and advocacy in international and national forums.



(draft diagram)

Build on, and evolve, earlier roadmaps, as e.g. Lee C.M., Starkweather S., Eicken H., et al. 2019
doi: 10.3389/fmars.2019.00451

Task Team Objectives

1. Lead the process to **co-develop an implementation strategy** for a future pan-Arctic ocean observing alliance.
2. **Ensure wide engagement** of relevant rights holders and stakeholders in this process, including representatives of Arctic Indigenous and Local communities and organizations.
3. **Produce a proposal (to GOOS, SAON)** for a pan-Arctic ocean observing alliance, including goals, functionality, governance and relationship to existing organizations.
4. **Prepare for the implementation** of the proposed pan-Arctic ocean observing alliance that includes equitable partnerships with Arctic Indigenous Peoples.

Progress and Plans

- **Arctic Science Summit Week 2023 Roundtable**: Need enhanced pan-Arctic coordination.
  - *SWOT analysis of GRA effort – identified many compelling opportunities.*
- **2023 G7 Future of Seas and Oceans (FSOI),** prioritized Arctic Ocean observing and supported formation of an Arctic (G)RA as a vehicle for coordination and focusing national support.
  - Task Team Terms of Reference and establishment of Steering Group.
  - Official designation of Task Team by SAON and GOOS.

Progress and Plans

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Expanding TT membership, ***seeking Indigenous and Local voices,*** *and other under-represented groups*

- Task Team Terms of Reference and establishment of Steering Group.
- Official designation of Task Team by SAON and GOOS.
- **Arctic Science Summit Week 2024** panel discussions on Arctic ocean observing –
  - *Global context and large-scale regional initiatives (GOOS, SOOS, C-IOOS, ArcticROOS, AOOS, PAG, DBOs, and SAS)*
  - *The rights, needs, and contributions of Arctic communities*
- **Arctic Science Summit Week 2025** panel and break-out discussions
  - *Functions and benefits,*
  - *Different needs of each community/party; Missing voices,*
  - *Envisioned first steps,*
  - *Role of ArORA in IPY-5*

How to Contribute to the Design Process

- Join the Task Team – open to all! Self-nominate by contacting Craig or Anna.
- Workshops and Townhalls held at Arctic-related meetings (e.g. Arctic Science Summit Week, Arctic Observing Summit, Arctic Circle, European Geosciences Union, …).
- **Proposal will undergo a public comment period.**
- Watch for website (coming soon) where updates and opportunities will be posted to review and comment on draft documents.
- We continue looking for paths to engage more broadly. Suggestions welcome on how!

Arctic Ocean Regional Alliance (ArORA) Task Team

Co-Chairs: Craig Lee (University of Washington, United States) and Anna Nikolopoulos (UiT, Norway)

Steering Group: David Allen (NOAA, USA), Maia Hoeberechts (ONC, Canada), Michael Karcher (AWI, Germany), Molly McCammon (AOOS, United States), Maribeth Murray (AINA, Canada), Jeremy Wilkinson (BAS, United Kingdom), Eun Jin Yang (KOPRI, Republic of Korea)

Members: Nicoletta Ademollo (CNR-ISP, Italy), Maurizio Azzaro (CNR-ISP, Italy), Manuel Bensi (OGS, Italy), Dominique Berod (WMO, Int), Agnieszka Besczynska-Moeller (IOPAN, Poland), Maria Teresa Bezem (UiB, Norway), Melissa Chierci (IMR, Norway), Cathy Coon (Department of Interior, United States), Brad deYoung (CIOOS, Canada), Parnuna Egede Dahl (Oceans North, Greenland), Agneta Fransson (NPI, Norway), Hannah-Marie Garcia (Tribal Government of St Paul Island), Maria Grigoratou (EPB, Int), Jari Haapala (FMI, Finland), Emma Heslop (GOOS, Int), Maria Hood (MOi, France), Monika Kedra (IOPAN, Poland), Jing Li (GOOS, Int), Takashi Kikuchi (JAMSTEC, Japan), Vidar Lien (IMR, Norway), Inga Lips (FL, Belgium), Joseph Nolan (SeaScape Belgium, Belgium), Steffen Olsen (DMI, Denmark), Ben Rabe (AWI, Germany), Nicholas Roden (NIVA, Norway), Hanne Sagen (NERSC, Norway), Stein Sandven (NERSC, Norway), Haliehana M. Stepetin (Ted Stevens Center for Arctic Security Studies, USA), Toste Tanhua (GEOMAR, Germany), Melinda Webster (CliC, Int)

Open to new members!

Task Team Structure and Responsibilities

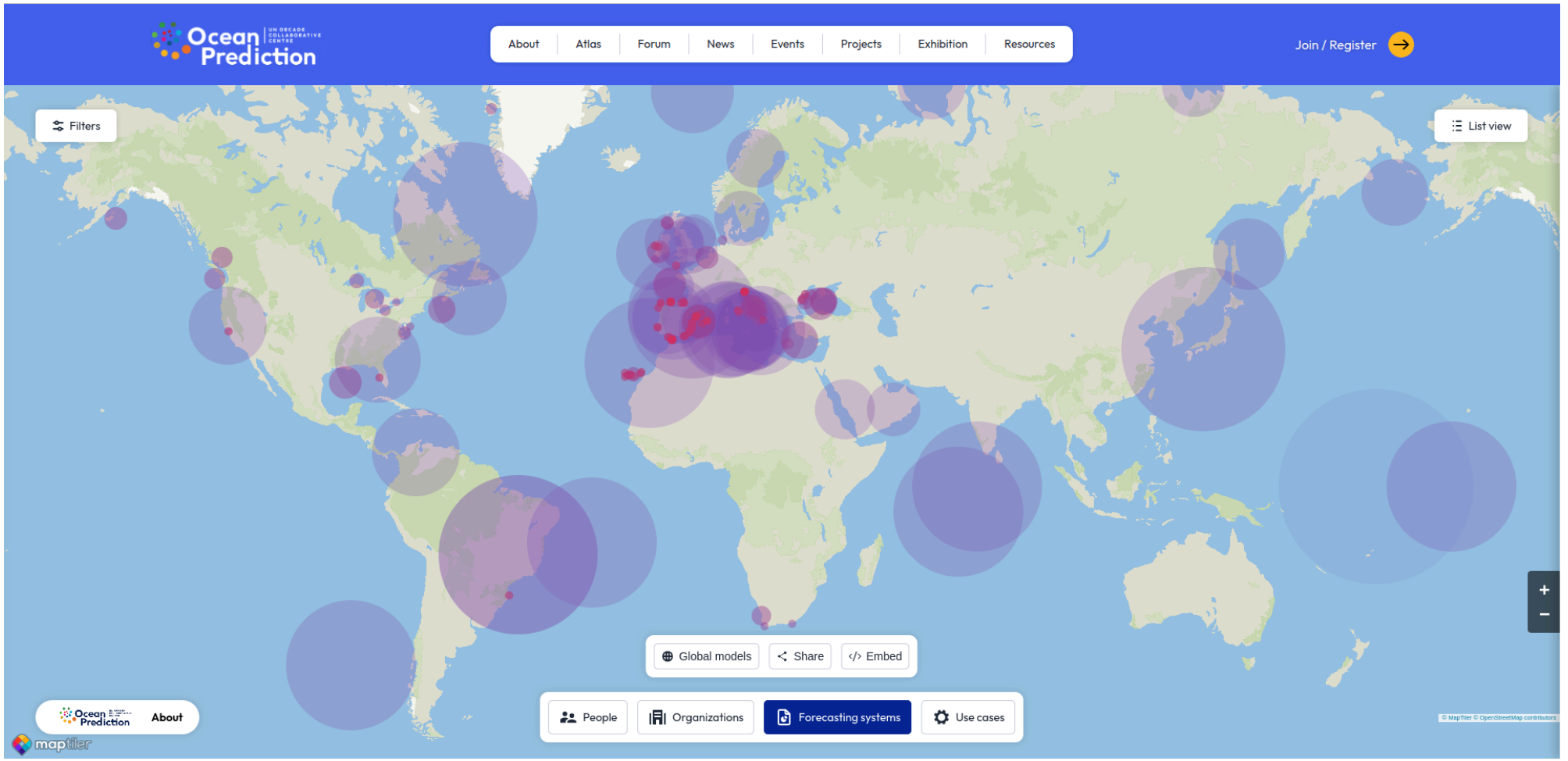
- Open to all, with members serving on a volunteer basis.
- Members represent the needs of broad cross sections of the Arctic community.
- Term extends to end of the Task Team's current mandate (October 2025).
- Lend expertise and experience to shape the proposed Arctic Regional Alliance.
- Virtual meetings (roughly 1 hour per month).
- In-person/hybrid meeting linked to other events (e.g. ASSW/AOS, Arctic Circle)
- Assist with writing and reviewing the associated proposal for GOOS and SAON.
- Task Team makes decisions for moving the proposal and the and the alliance forward.
- Limited financial support for Indigenous Task Team members. Travel and time for European members, working on similar for North American members.

OceanPrediction Atlas

A. Capet, E. Alvarez, … and many others !

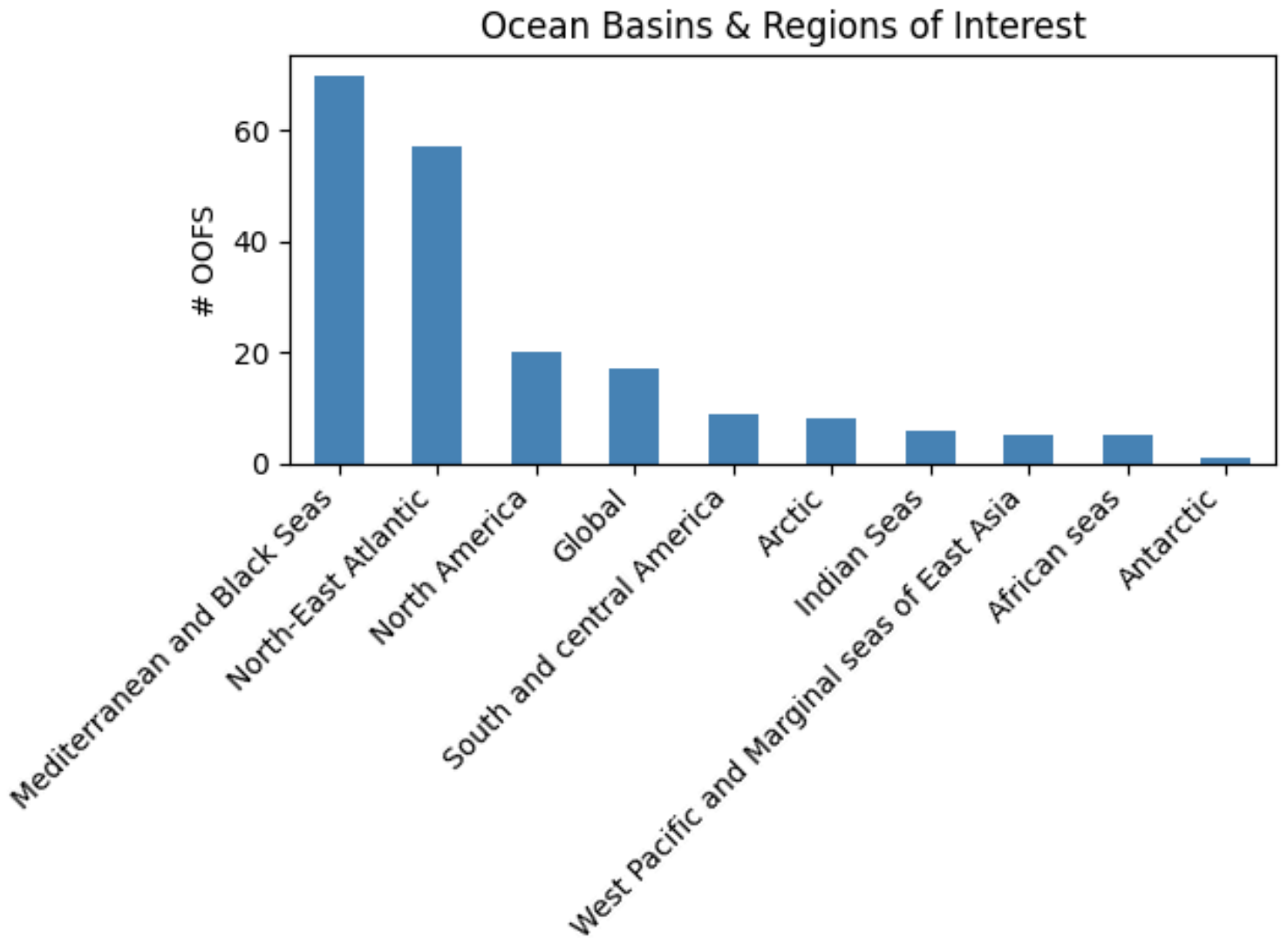
EuroGOOS Annual General Assembly Meeting
19-21 May 2025

The DCC Atlas

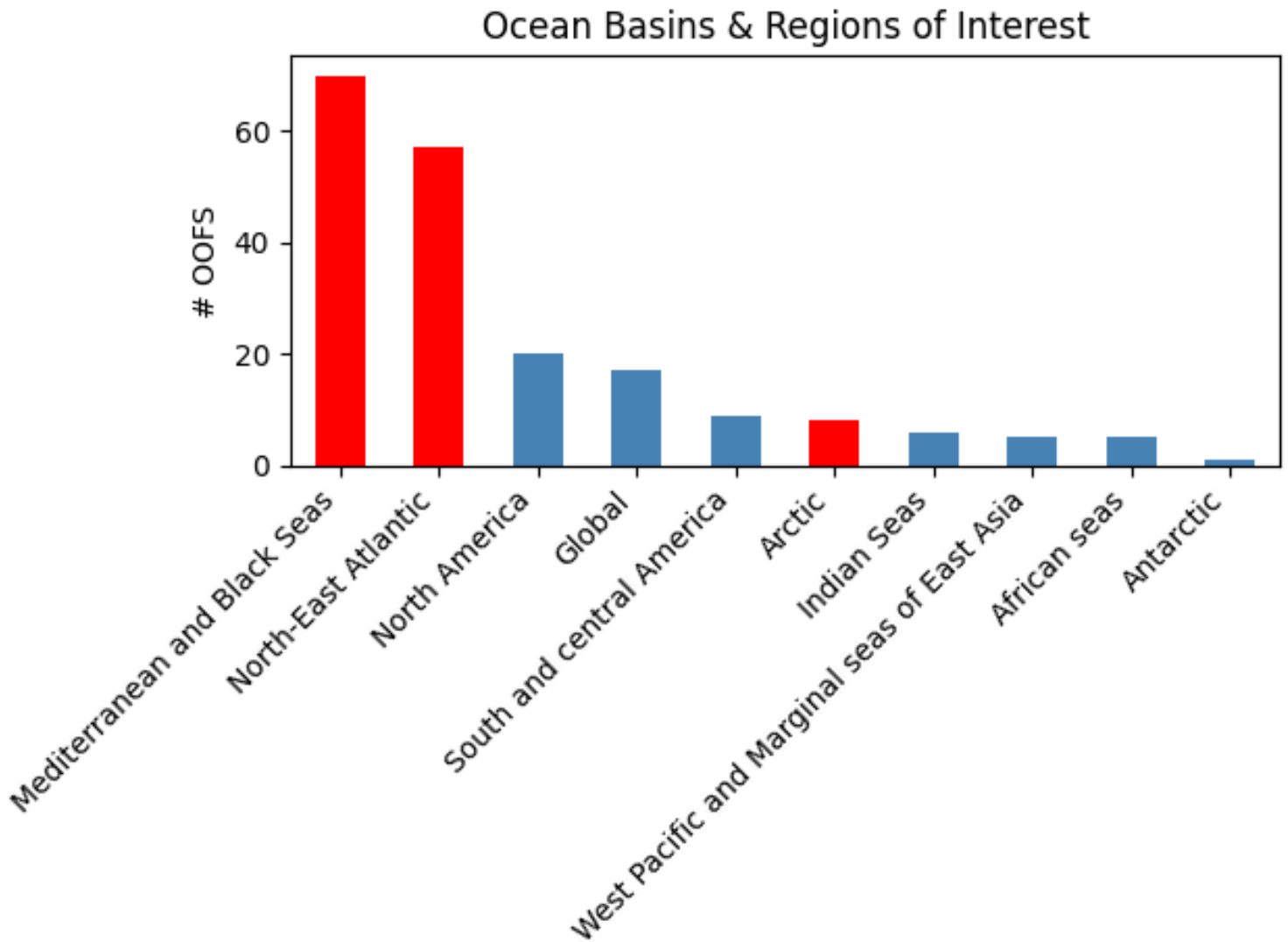


https://cartography.unoceanprediction.org/models

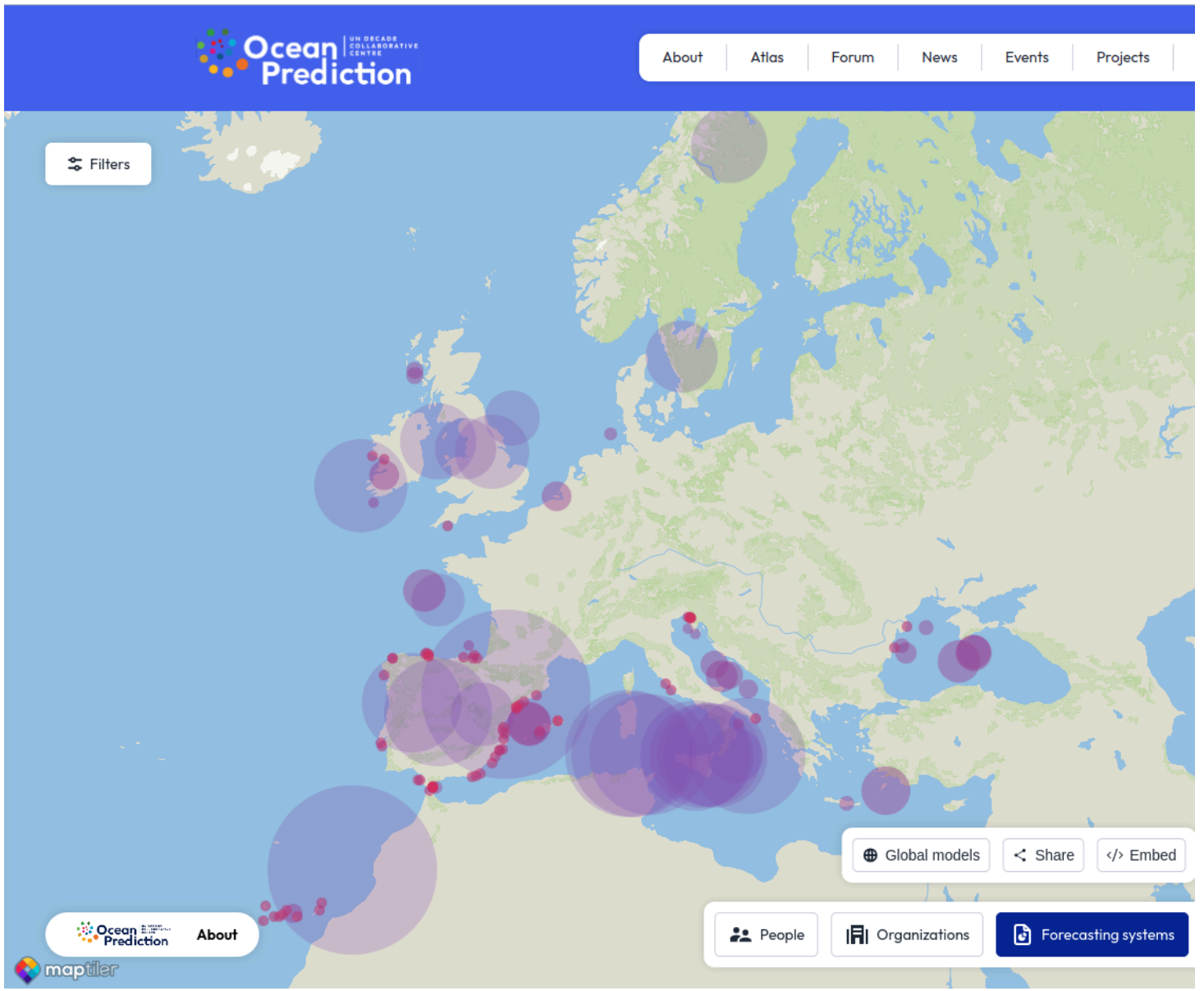
209 Ocean Operational Forecast Systems reported worlwide !



127 European systems



Foccus on Europe

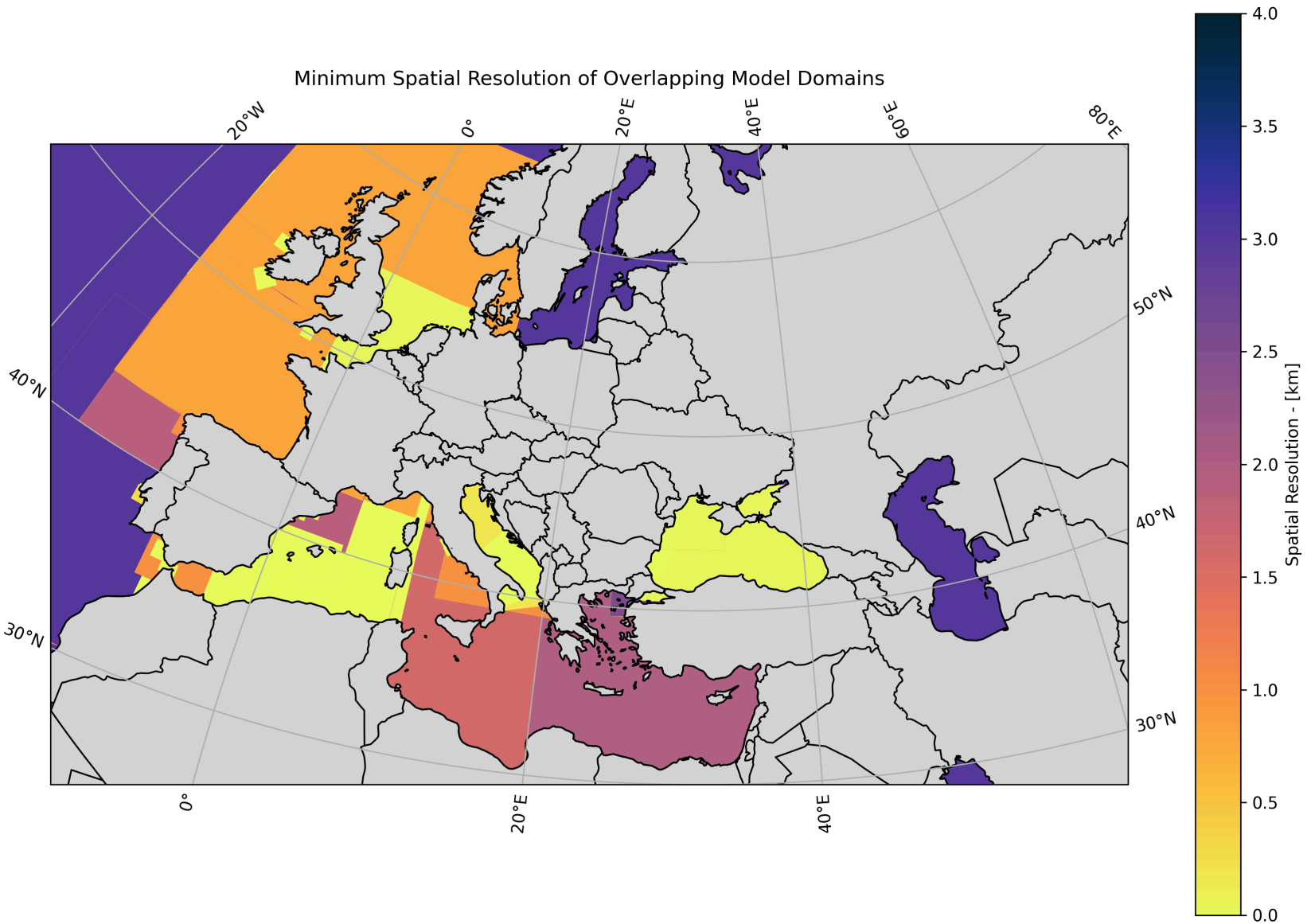


Supported by **42** Institutions :

Organizations in Atlantic, Mediterranean, Black Sea or Antarctic Systems

[1] +ATLANTIC CoLAB
[3] AZTI
[1] BSH
[3] Balearic Islands Coastal Observing and Forecasting System
[8] CMCC
[2] CSIC-UIB)
[2] Cyprus
[2] Danmarks Meteorologiske Institut
[1] Deltares
[1] Environment and Climate Change Canada
[2] Environment and Energy of Emilia-Romagna
[1] Federal Maritime and Hydrographic Agency
[1] Foundation for Research and Technology-Hellas
[2] French Hydrographic and Oceanograhic Service
[5] HCMR
[5] Helmholtz-Zentrum hereon
[2] Institute of Marine Sciences of the National Research Council of Italy
[1] Istituto Nazionale di Geofisica e Vulcanologia
[2] Laboratório Nacional de Engenharia Civil
[6] Marine Institute
[2] Marine Research Center Lomonosov Moscow State University
[2] Mediterranean Institute for Advanced Studies (IMEDEA
[3] Mercator Ocean International
[1] Met Office
[1] Météo-France
[2] Nansen Environmental and Remote Sensing Center
[3] National Institute for Marine Research and Development “Grigore Antipa”
[2] National Institute of Biology
[3] National Institute of Oceanography and Applied Geophysics
[2] Nicosia
[6] Nologin Oceanic Weather Systems
[3] Norwegian Meteorological Institute
[2] ORION Research
[1] Plymouth Marine Laboratory
[47] Puertos del Estado
[2] Regional Agency for Prevention
[1] Royal Belgian Institute of Natural Sciences
[2] Scottish Association for Marine Science
[2] Service hydrographique et Océanographique de la Marine
[1] Servicio Meteorológico de la Armada de Chile
[6] Slovenian Environment Agency
[3] seamod.ro

Capacity


Minimum Spatial Resolution of Overlapping Model Domains
20°W
0°
20°E
40°E
60°E
80°E
40°N
30°N
50°N
40°N
30°N
0°
20°E
40°E
Spatial Resolution - [km]
4.0
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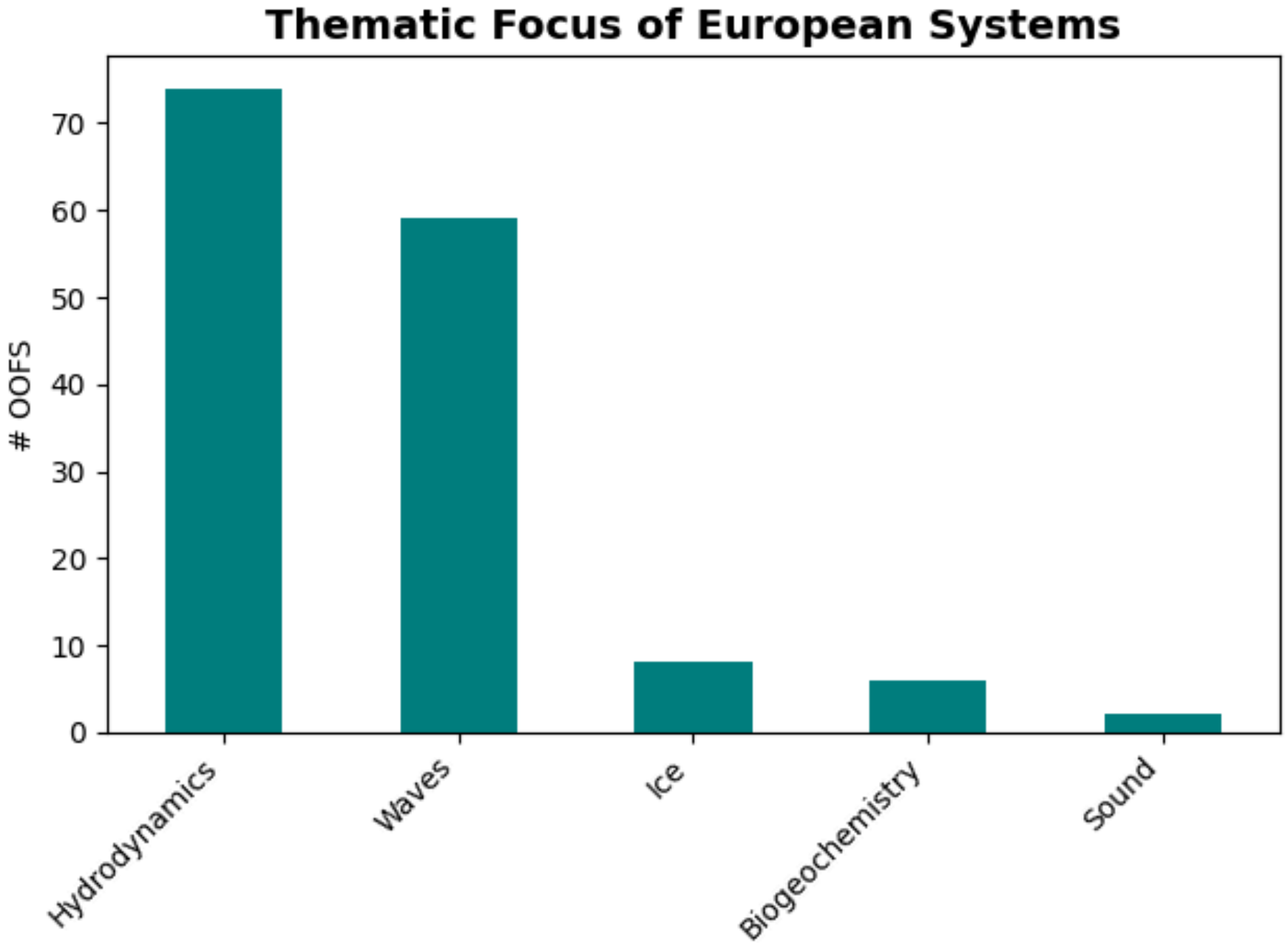
3.0
2.5
2.0
1.5
1.0
0.5
0.0


Thematic Focus of European Systems
OOFS
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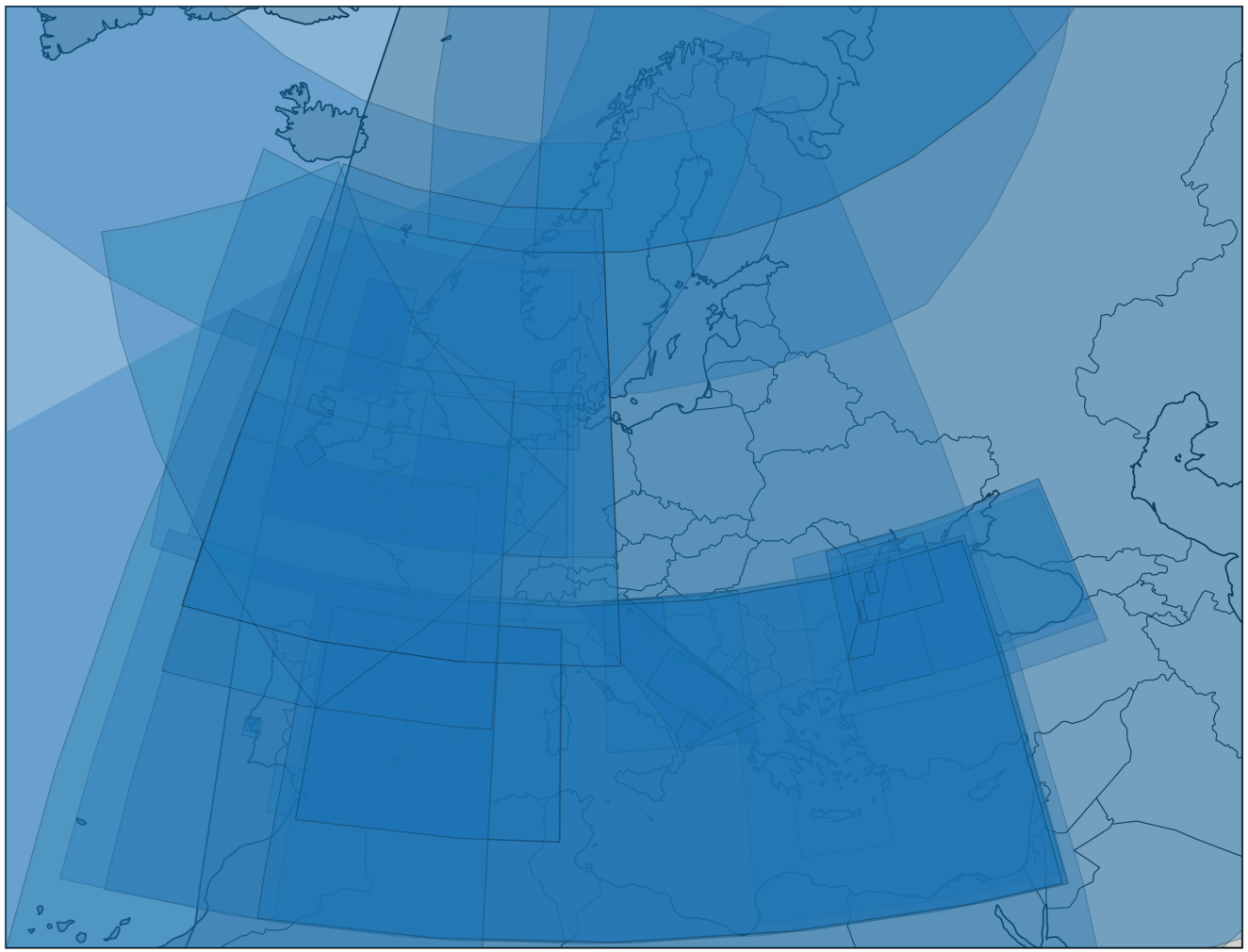
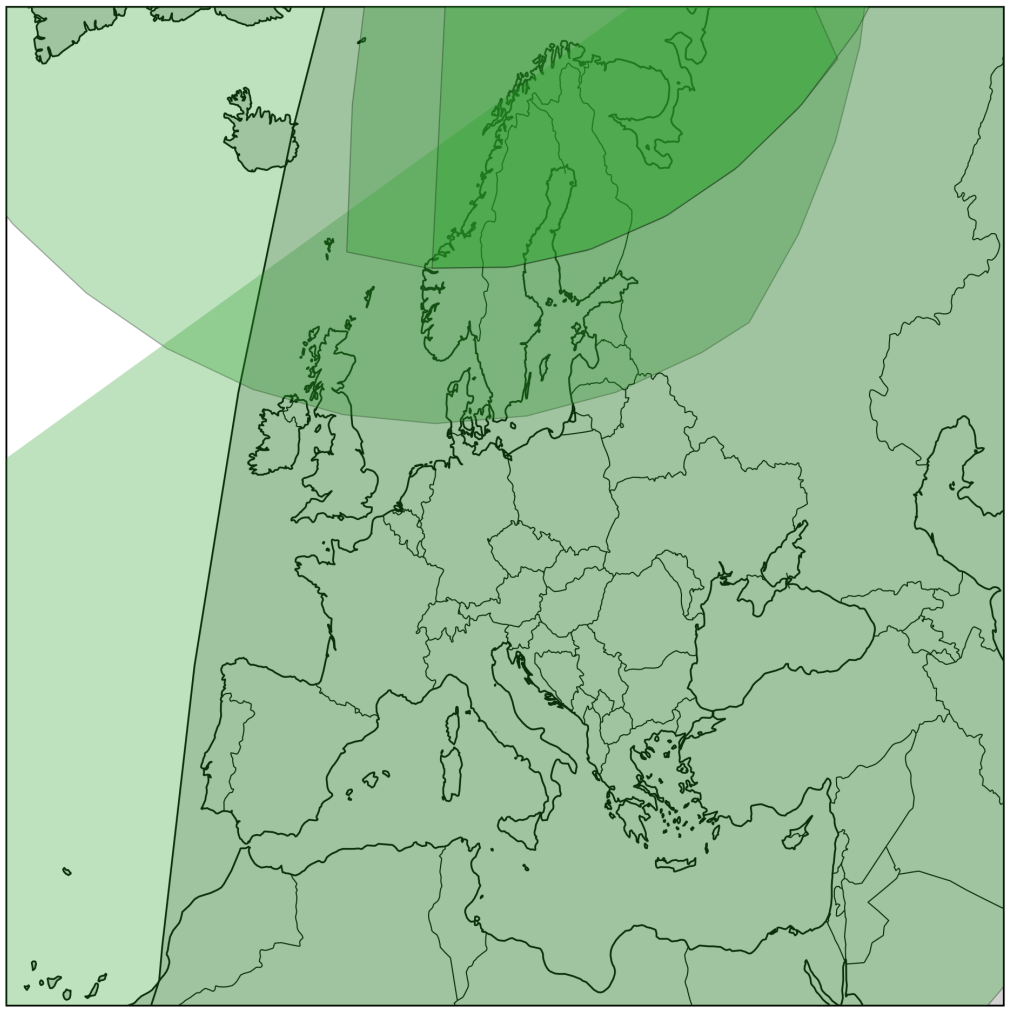
70
Hydrodynamics
Waves
Ice
Biogeochemistry
Sound

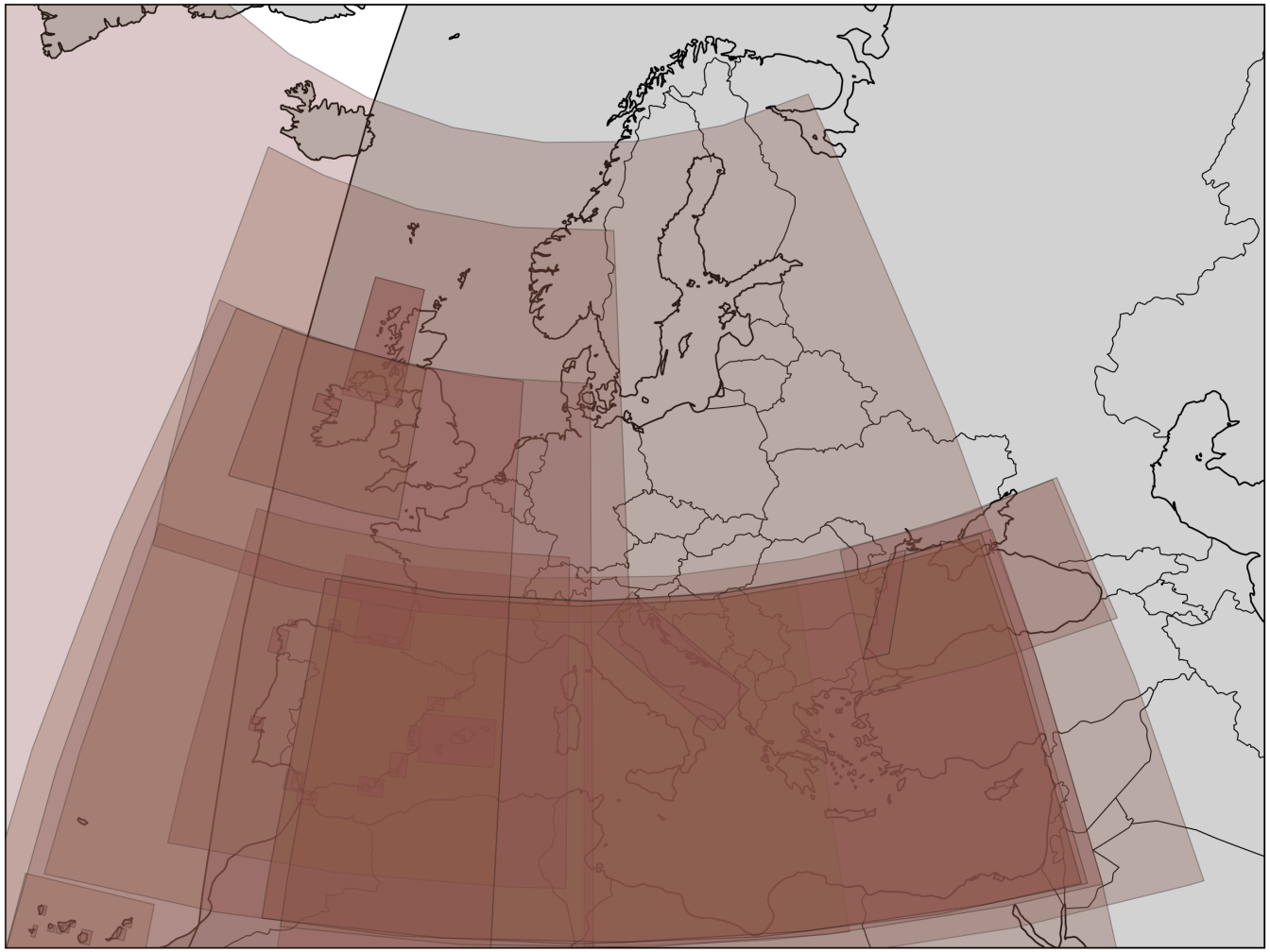
Hydrodynamics Systems - Model Domains



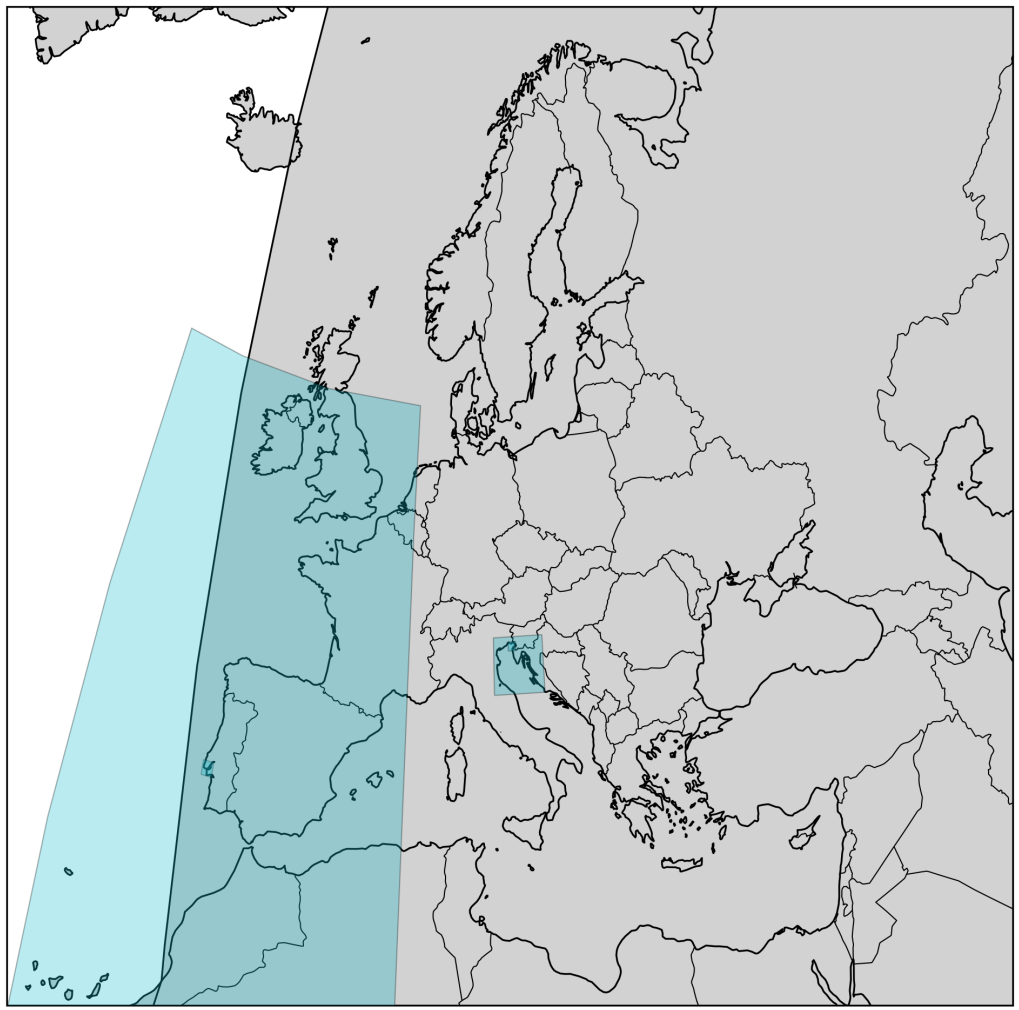
Ice Systems - Model Domains



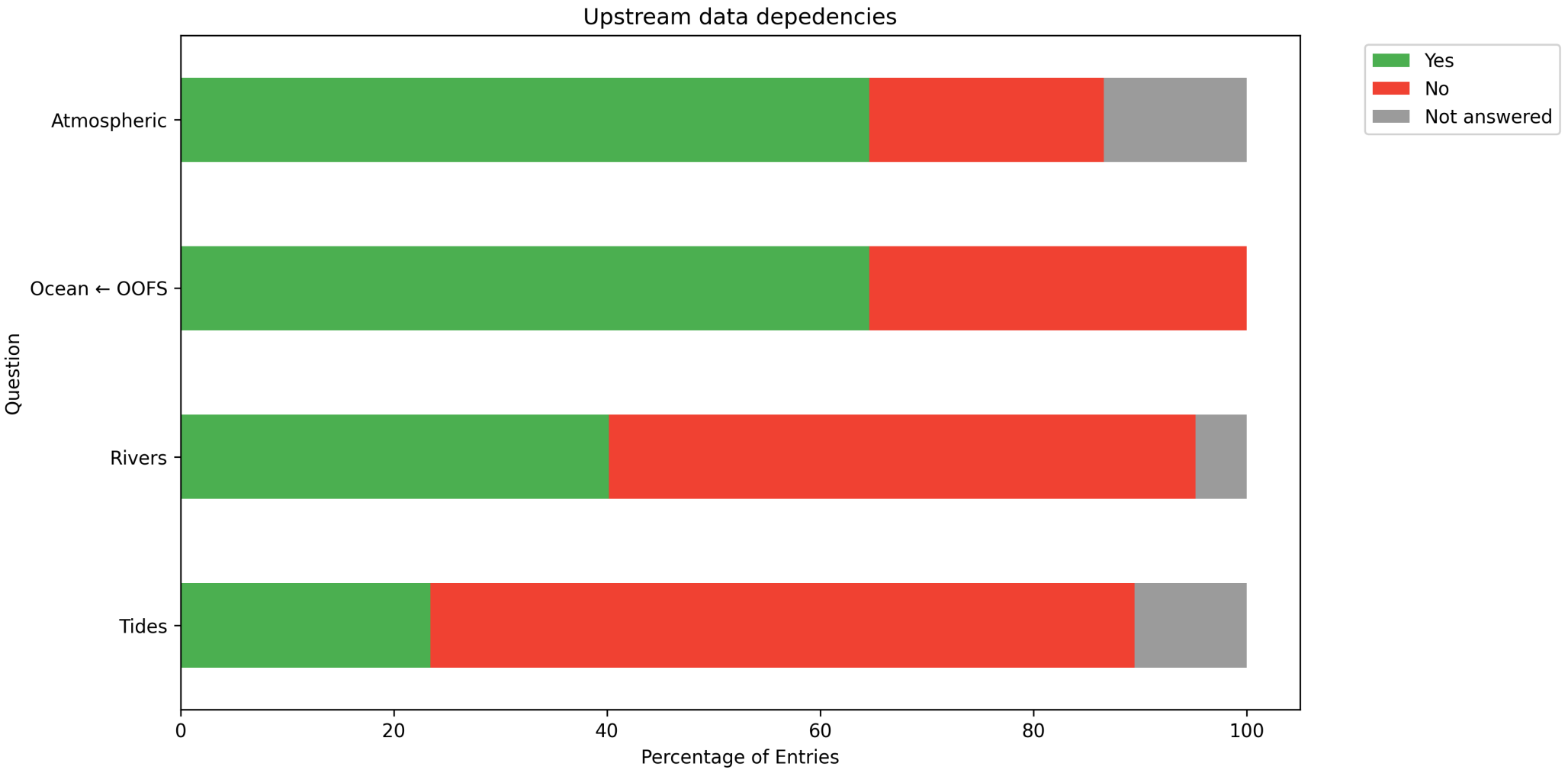
Waves Systems - Model Domains



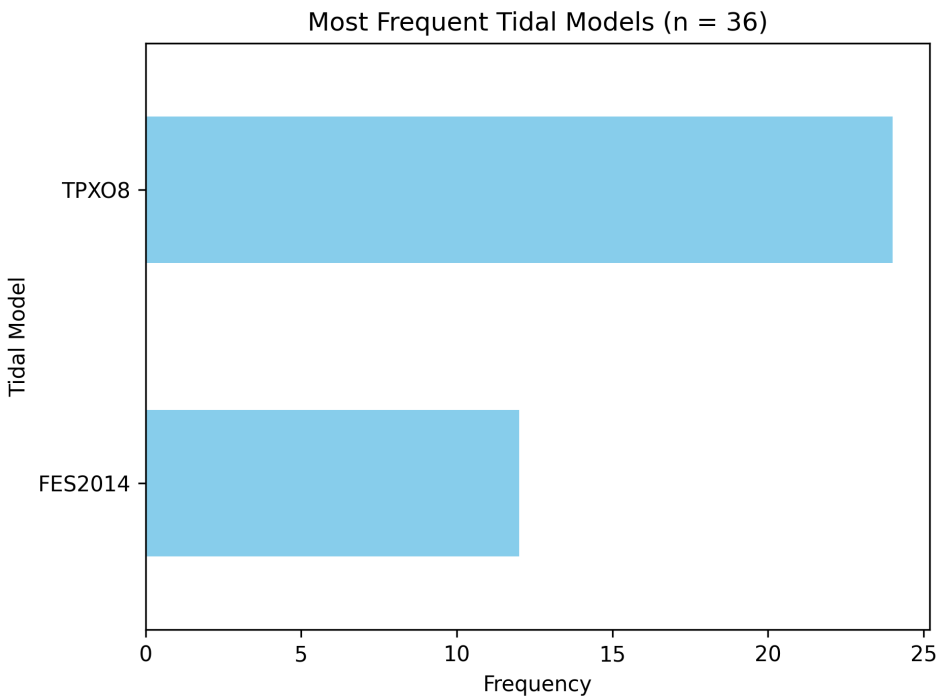
Biogeochemistry Systems - Model Domains

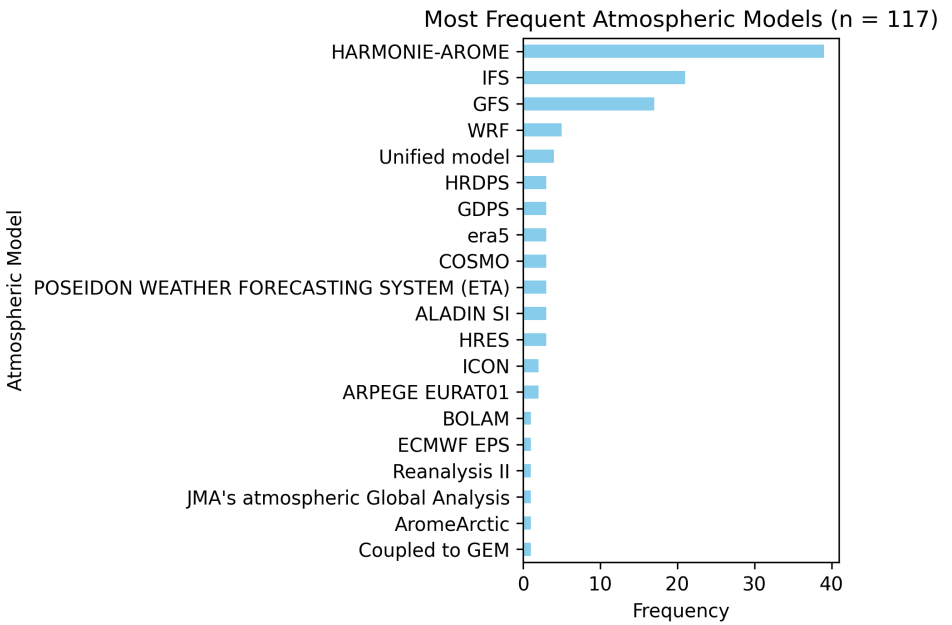


External dependencies

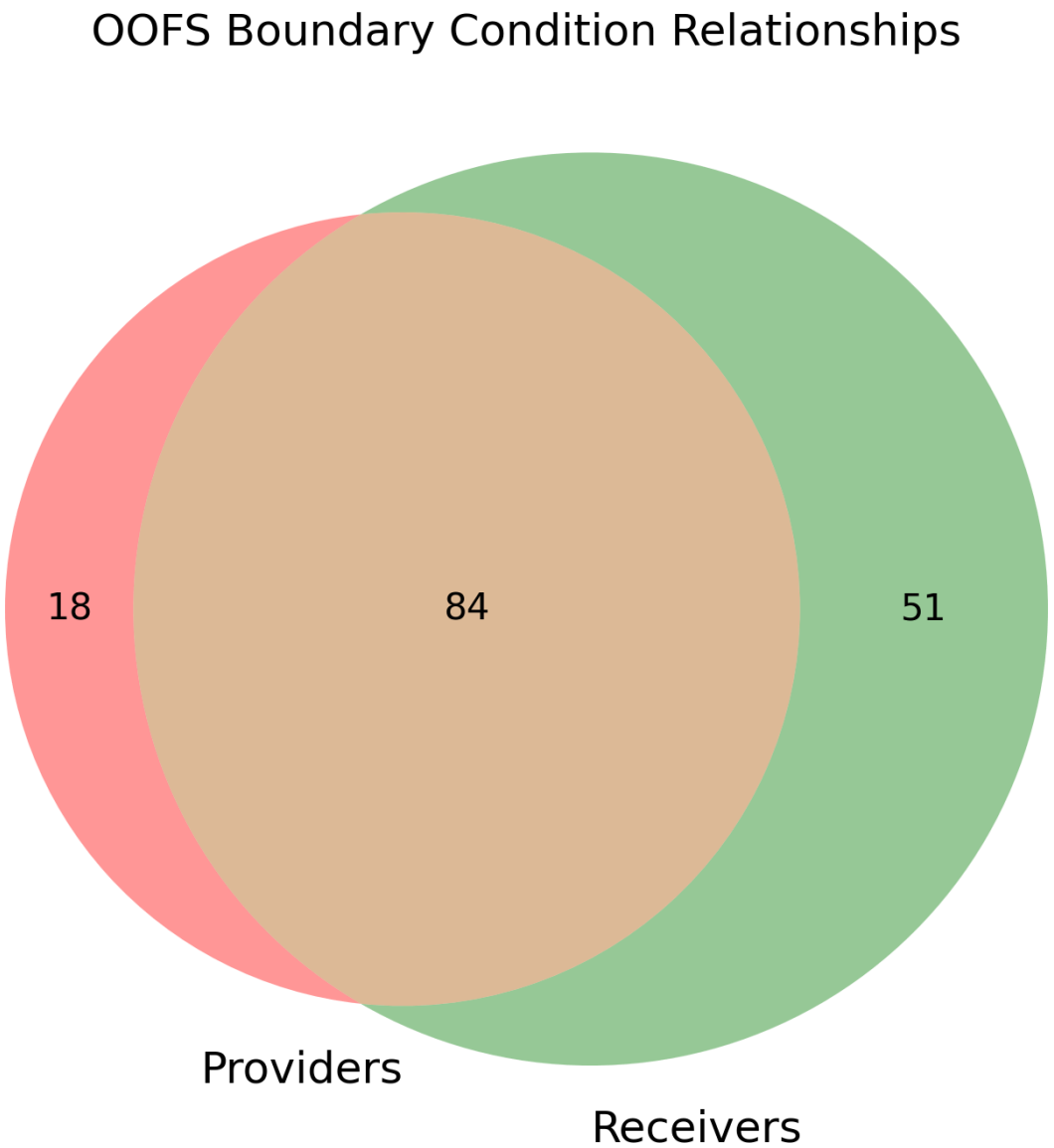


Linking to upstream dependencies



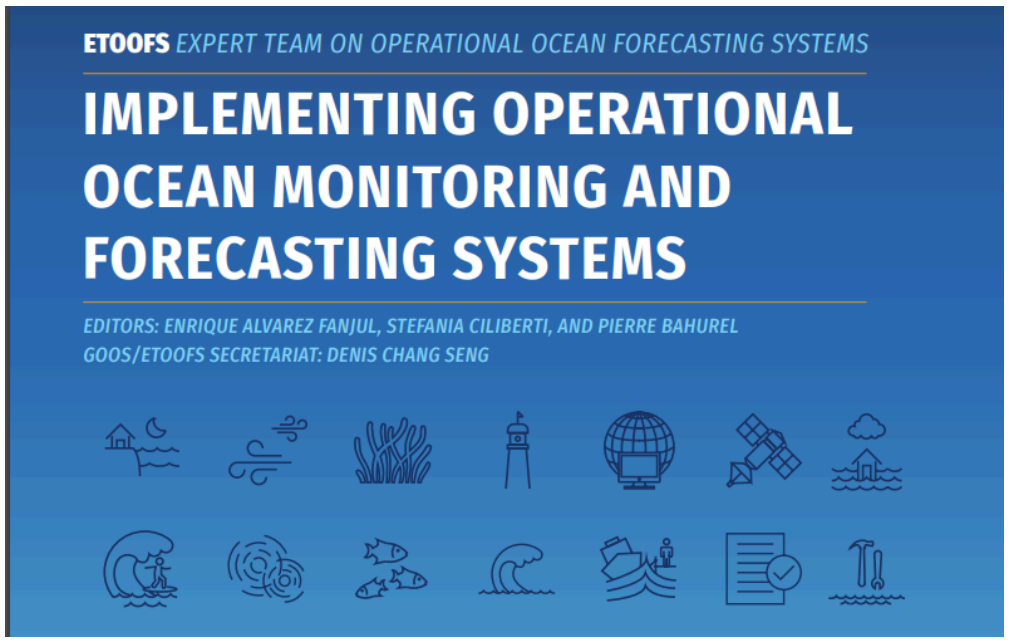


It’s a network !



Main messages

- Architecture and guide
  - $\rightarrow$ Analyze the Atlas to check compliance
  - $\rightarrow$ Roadmaps



- Enforce homogeneity in regional representation, and level of details

One question

What refrains biogeochemical OOFS implementation ?

- Technical restrictions ?
- Interest in downstream applications ?