Regionalisation of Ocean Climate Indicators Training Session 23rd January 2026

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National University of Ireland, Maynooth
Mercator Ocean International

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Outline

This session will introduce the concept of ocean climate indicators, discuss their relevance and usefulness, and the role they play in the policy nexus.

In the context of ObsSea4Clim, we focus particularly on the physical ocean indicators for climate.

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Objectives

The training will cover the following areas:

- **Why the regionalisation of ocean indicators is needed and what approaches can be adopted?**
- **How to use multi-product datasets, accounting for uncertainties and method sensitivity to enable regionalization of ocean indicators?**
- **Some examples of regionalisation of ocean climate indicators and the variability observed.**

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Focus and Objectives

The overarching goal of ObsSea4Clim is to deliver an improved framework for nations' contributions to European ocean observations of EOV/ECVs (Essential Ocean Variables/Essential Climate Variables) in support of regional and global climate assessments, projections and actionable indicators for sustainable development.

The objectives of ObsSea4Clim are:

- To develop and deliver new ocean indicators for sustainable development, provide improved EOV/ECVs and evolve European ocean observing
- To advance the use of EOV and ECVs for improved Earth System Models (ESM) and reduce uncertainty in climate projections
- To create an interoperable data ecosystem serving multidisciplinary needs
- To develop best practices and standards for interoperable in-situ and satellite observing
- To place Europe in the forefront of the global coordination of the broader ocean-climate nexus

Learn about the building blocks of ObsSea4Clim

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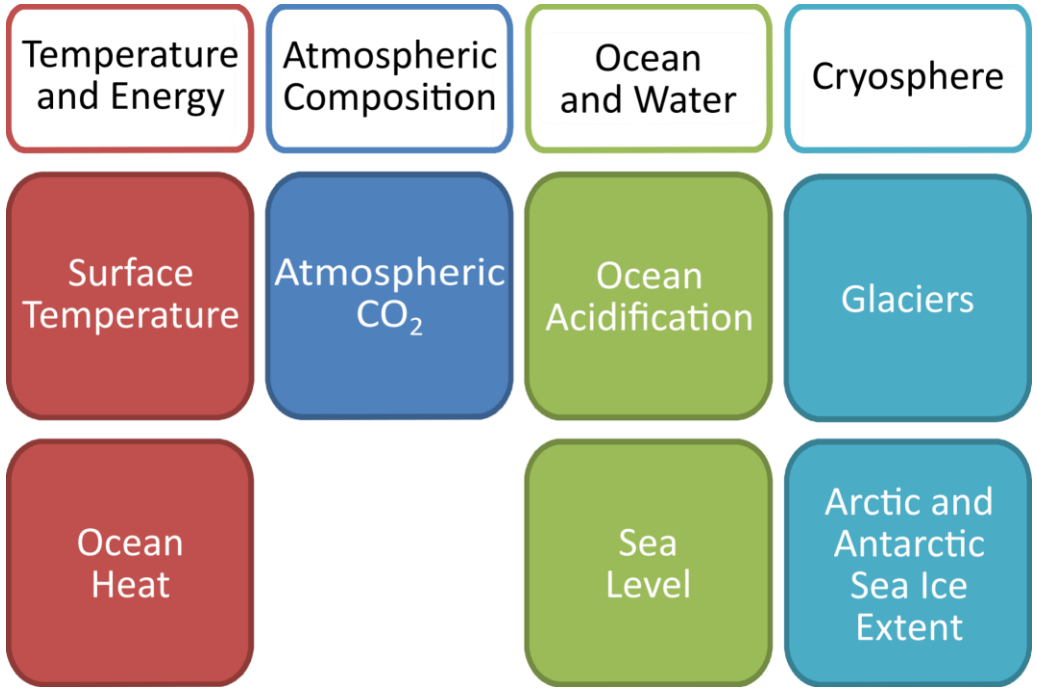
Need for Ocean Indicators



WMO 'State-of-the-climate' indicators, Ref:

https://climatedata-catalogue-wmo.org/climate_indicators

5 of the 7 WMO 'State of the Climate' indicators are ocean indicators – highlighting the importance of the ocean

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What are Ocean Indicators

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Measures based on **scientifically verified** approaches and data that **identify the state of the ocean** across a **range of temporal and spatial scales** and are **accessible to inform decision makers** and beyond

VERIFIED

The indicator must represent a state of an ocean phenomenon that relies on a peer-reviewed scientific rationale of the fully traceable indicator approach.

SIGNIFICANT

The indicator must provide robust information on the state of an ocean phenomenon within a scientific framework.

SCALABLE

An ocean indicator should be scalable spatially and temporally, and where possible interoperable.

JUSTIFIED

The indicator should be relevant to inform and support decision making and be understandable to a broad audience.

MEASURABLE

The indicator should be determined where relevant via one or more Essential Variable framework, such as EOVs, ECVs, and EBVs.

ACCESSIBLE

The ocean indicator should be provided whenever possible on a regular basis guided by FAIR and CARE principles, and enables past and near-term information, forecasts, and projections.

Link to article

From Global Ocean Indicators: Marking Pathways at the Science-Policy Nexus.
Von Schuckmann et al. 2025 Journal of Marine Policy

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Ocean Knowledge Transfer

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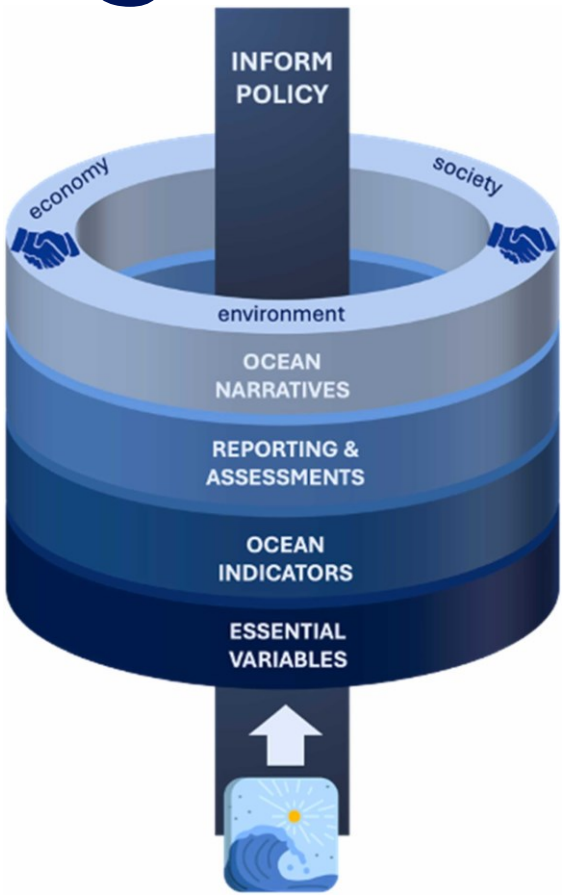

Link to article

The multi-layered chain to streamline evidence-based and tailored ocean knowledge transfer from science to policy. From Global Ocean Indicators: Marking Pathways at the Science-Policy Nexus. Von Schuckmann et al. 2025 Journal of Marine Policy

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Pilot Ocean Indicators

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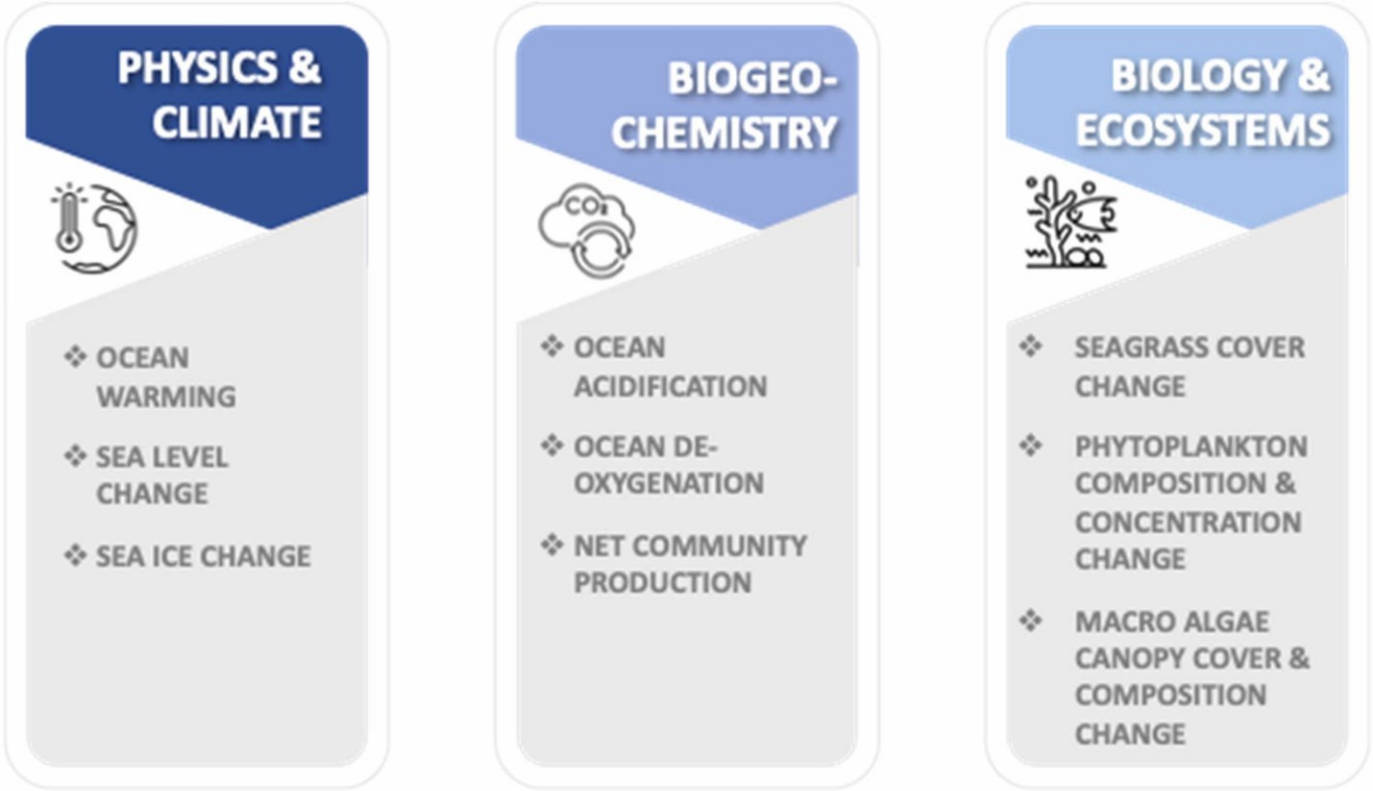

Link to article

The nine pilot indicators proposed by GOOS for three general disciplines: physics & climate, biogeochemistry, and biology and ecosystems.From Global Ocean Indicators: Marking Pathways at the Science-Policy Nexus. Von Schuckmann et al. 2025 Journal of Marine Policy

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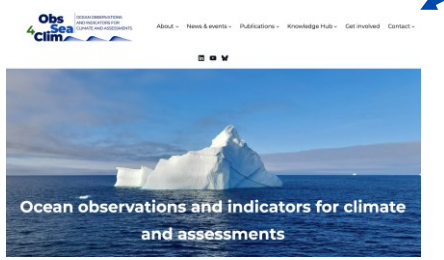
Pilot Ocean Indic



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PHYSICS & CLIMATE

- OCEAN WARMING
- SEA LEVEL CHANGE
- SEA ICE CHANGE

BIOGEO-CHEMISTRY

- OCEAN ACIDIFICATION
- OCEAN DE-OXYGENATION
- NET COMMUNITY PRODUCTION

BIOLOGY & ECOSYSTEMS

- SEAGRASS COVER CHANGE
- PHYTOPLANKTON COMPOSITION & CONCENTRATION CHANGE
- MACRO ALGAE CANOPY COVER & COMPOSITION CHANGE

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Pilot Ocean Indic

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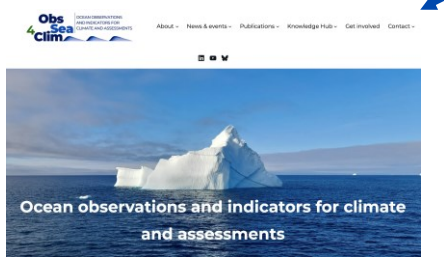

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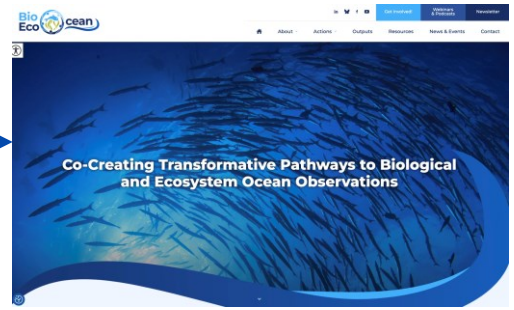

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Regionalisation of ocean indicators – Why?

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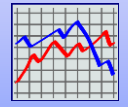
Unique Patterns in different regions

Regional trends compared to global



Why

Isolate the mechanisms and drivers

Provide stakeholders with data to develop policies to address local challenges

Ocean Indicators may have local and a remote influence

AMOC slowdown	Altered European Weather
Warmer North Atlantic Ocean	Changes in European weather
Melting Arctic sea ice	Changes to atmospheric circulation and more extreme weather

Also need to tailor the ocean indicator to the question you are trying to answer

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Local or remote ocean indicator – depends on the question

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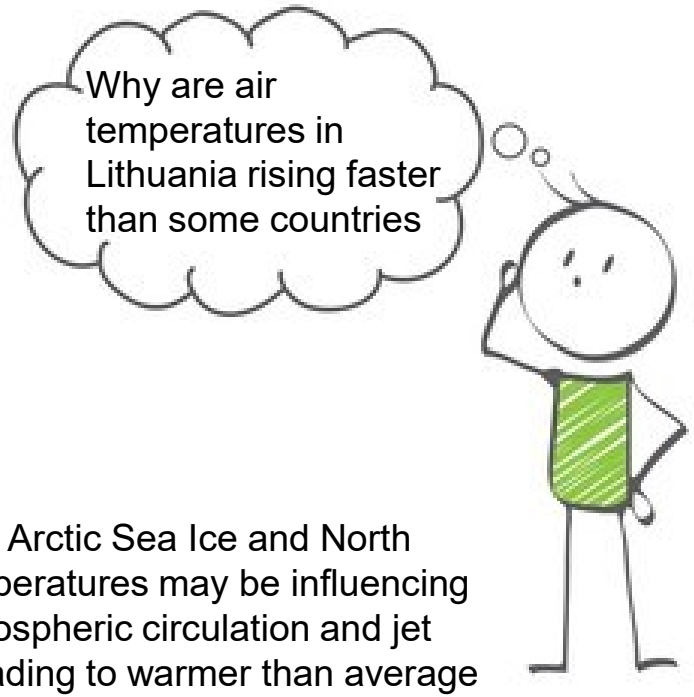
Link to paper here

Local Irish Sea changes in SST may be the best indicator



Remote changes in Arctic Sea Ice and North Atlantic Ocean temperatures may be influencing changes in the atmospheric circulation and jet stream patterns, leading to warmer than average temperatures over Lithuania

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Agreeing the Regions

EOV to be analysed
(SST, SSH, Sea Ice, Subsurface temperature)

Proposed Indicators
(Simple tool to describe, measure and monitor the ocean variable)

Proposed Regions
(Global, Regional, Seas, case studies and Thematic)

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Regionalisation of Ocean Indicators

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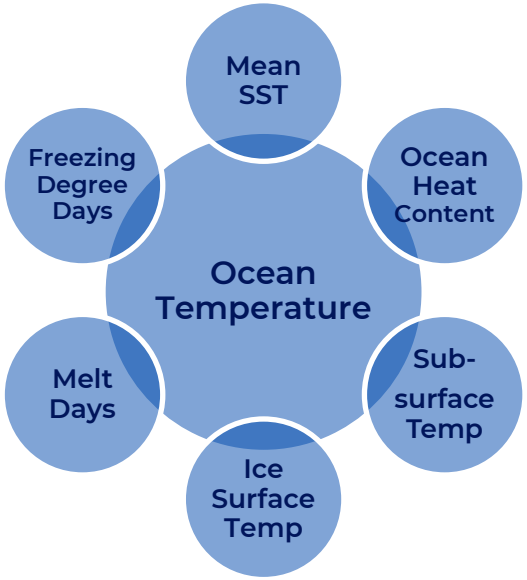
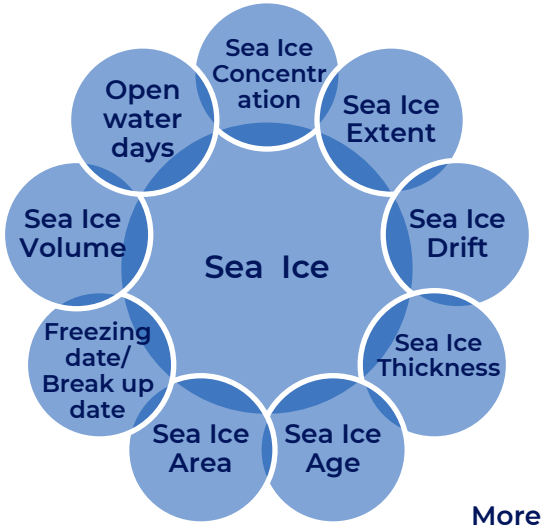
EOV to be analysed (SST, SSH, Sea Ice, Subsurface temperature)

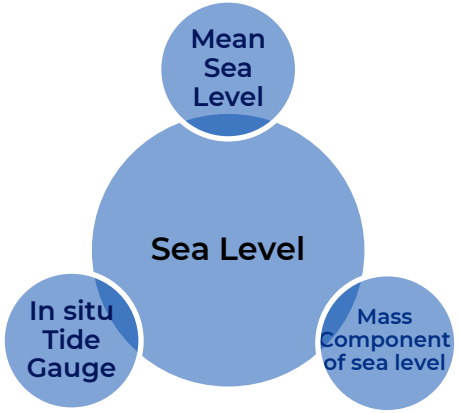
Proposed Indicators (Simple tool to measure and monitor the ocean variable)

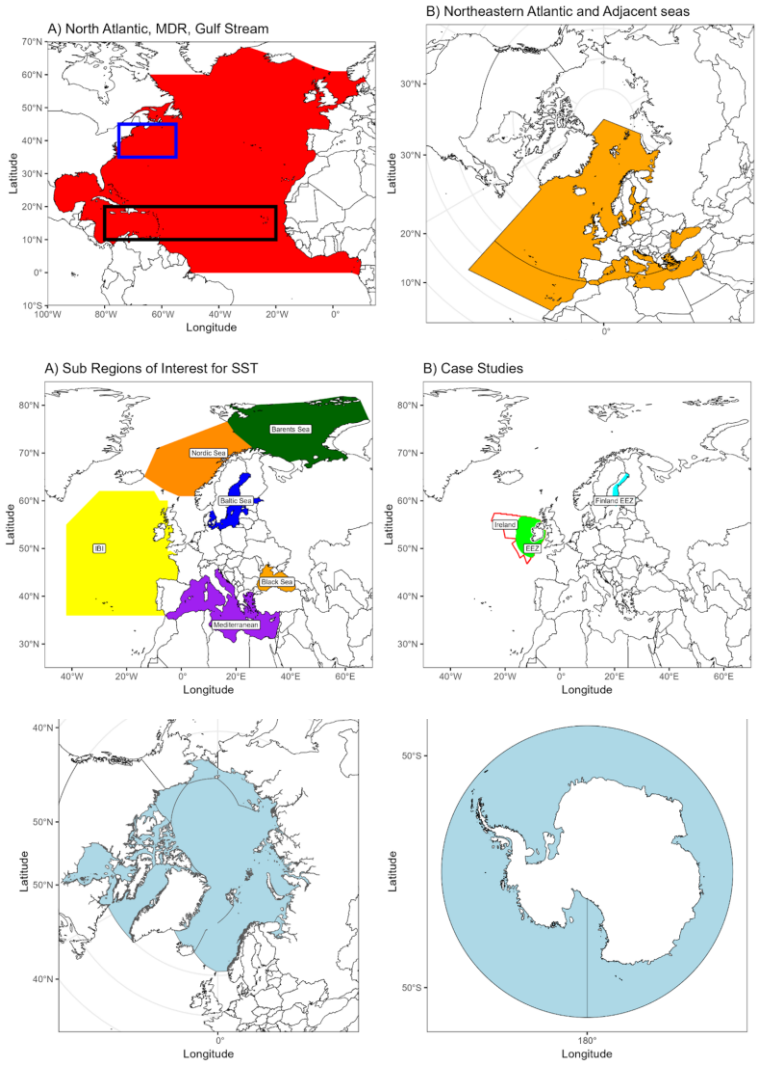
Proposed Regions (Global, Regional, Seas, LME's, case studies and Thematic)

More insights on temporal variations of regional indicators and underlying uncertainties









More information can be found here in the deliverable report 3.4

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Regionalisation of SST around Ireland

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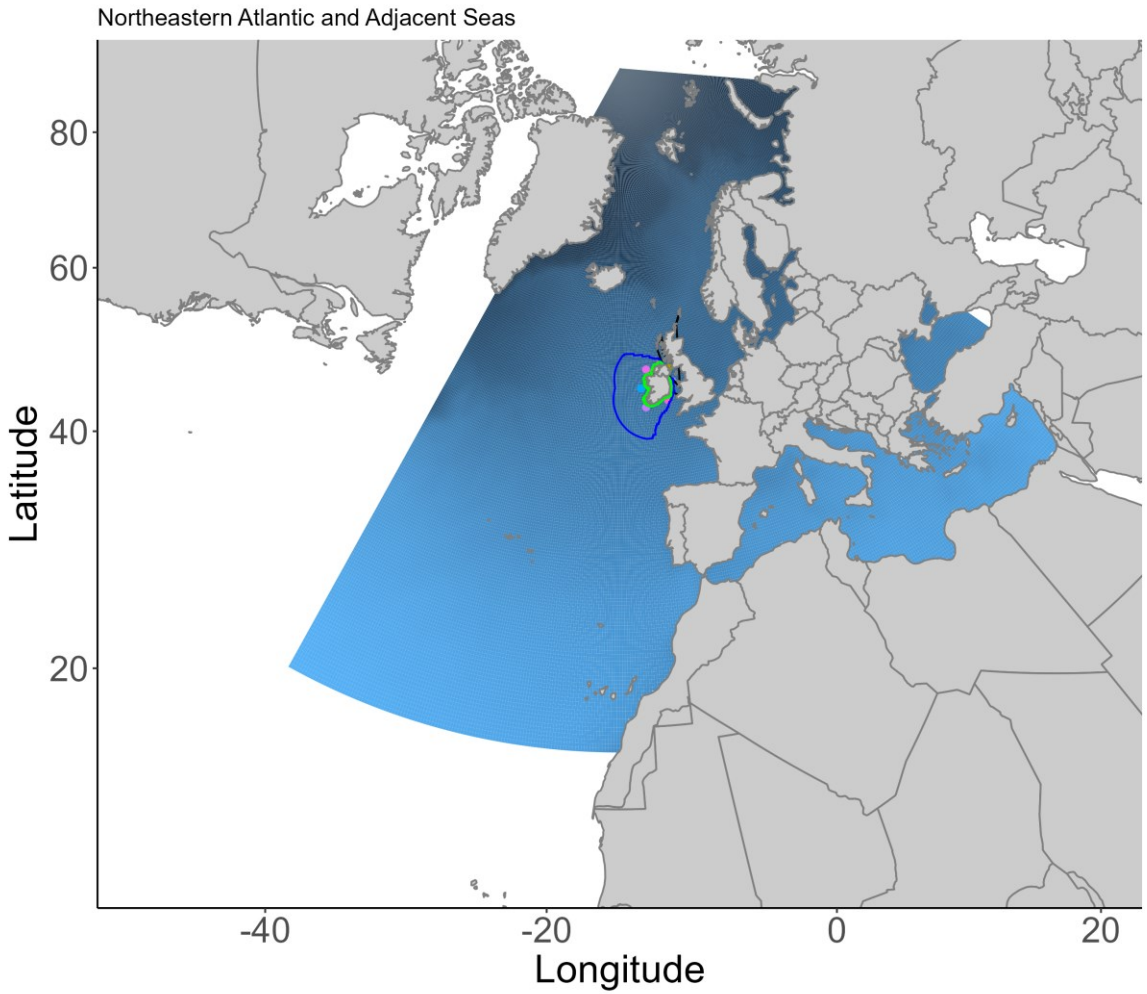

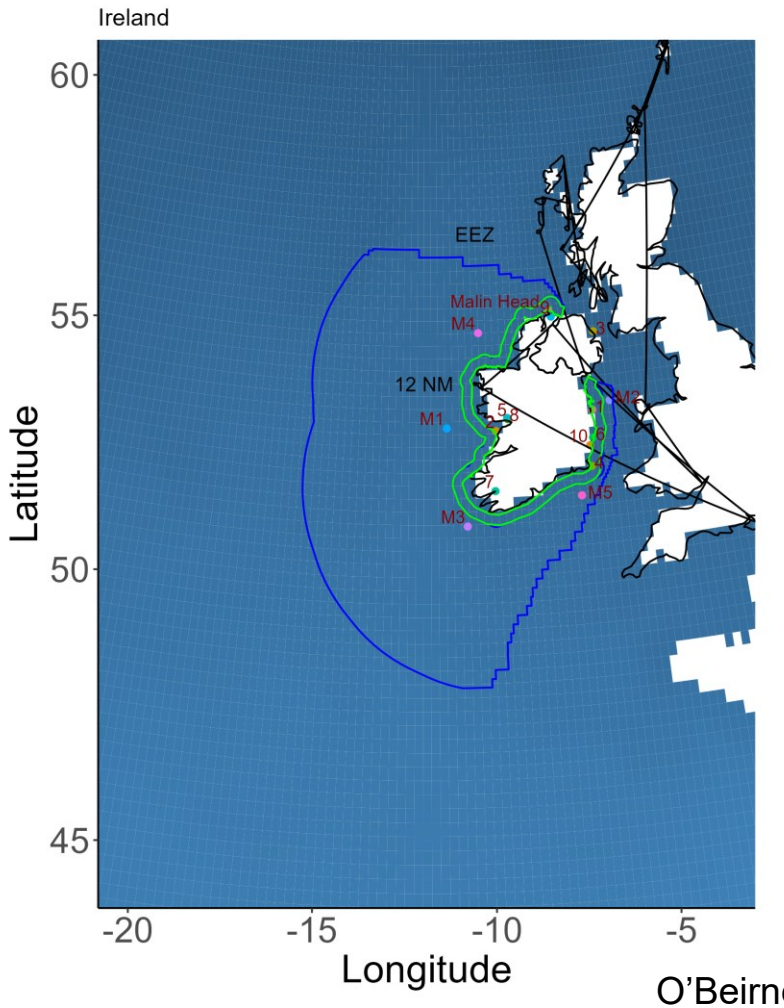

OISST satellite data
- NEAAS
- Irish EEZ
- Irish 12NM

Insitu
- Buoy Data
- Coastal Sites

O'Beirne et al. 2026 in prep

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In situ data from coastal sites

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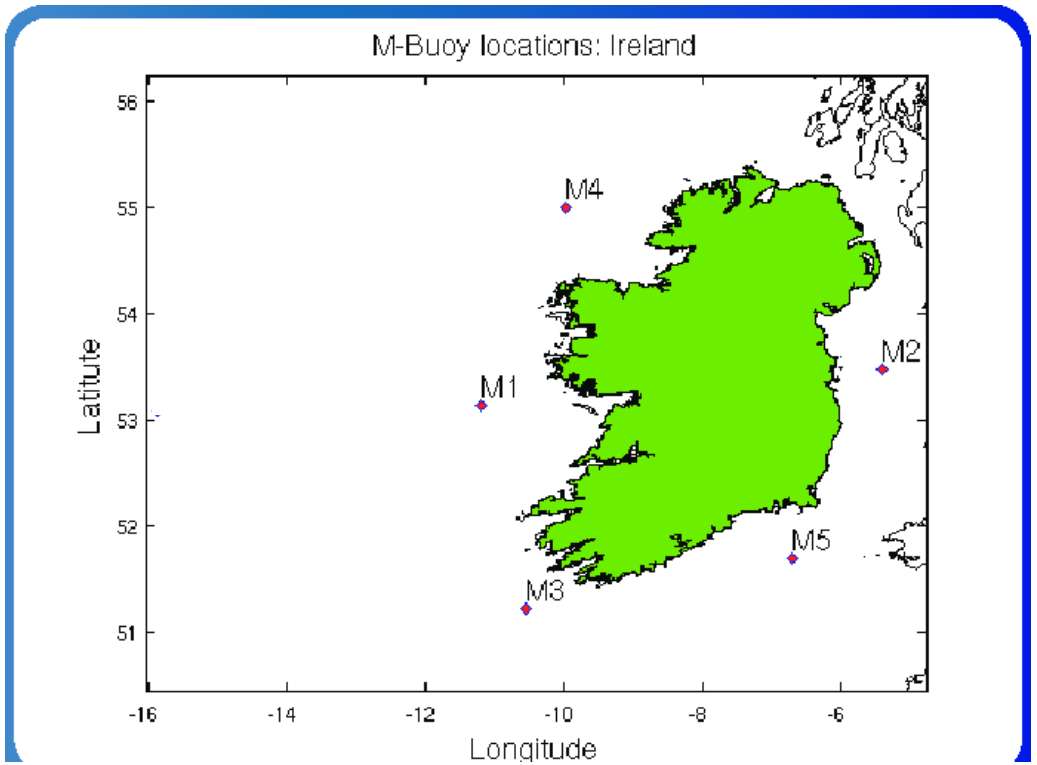
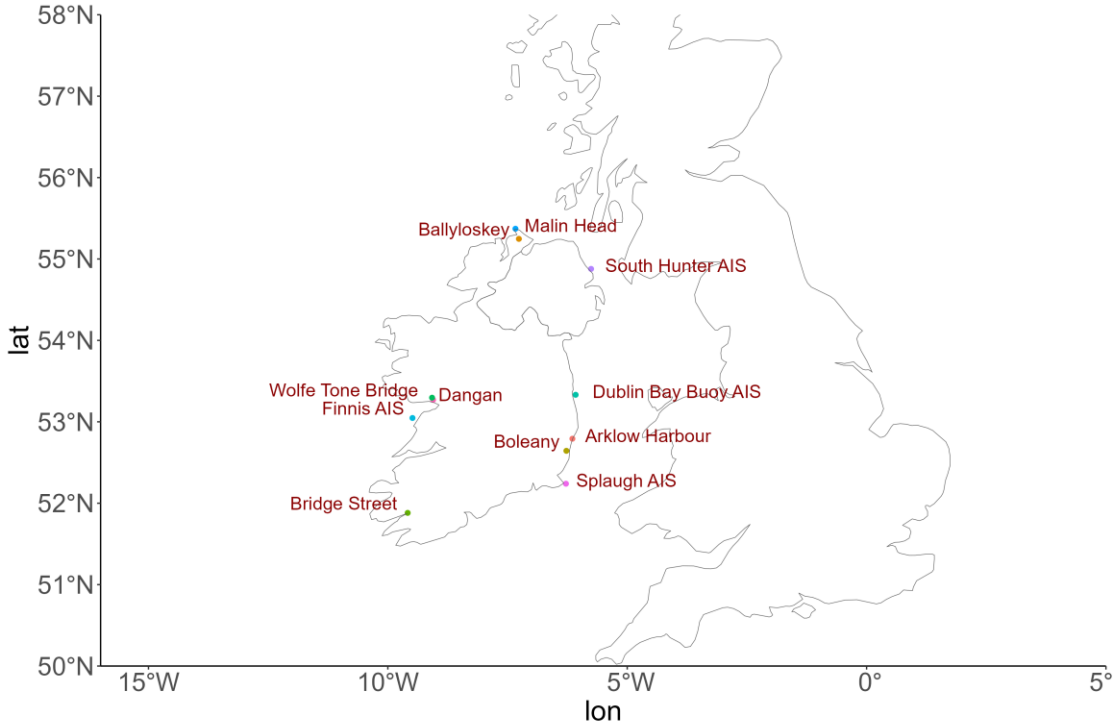


Éireann, Met & Gleeson, Emily & Mcgrath, Ray & Treanor, Mairéad. (2013). Ireland's climate: the road ahead.

All Coastal sites



O'Beirne et al. 2026 in prep

Malin Head

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Regional variability in SST

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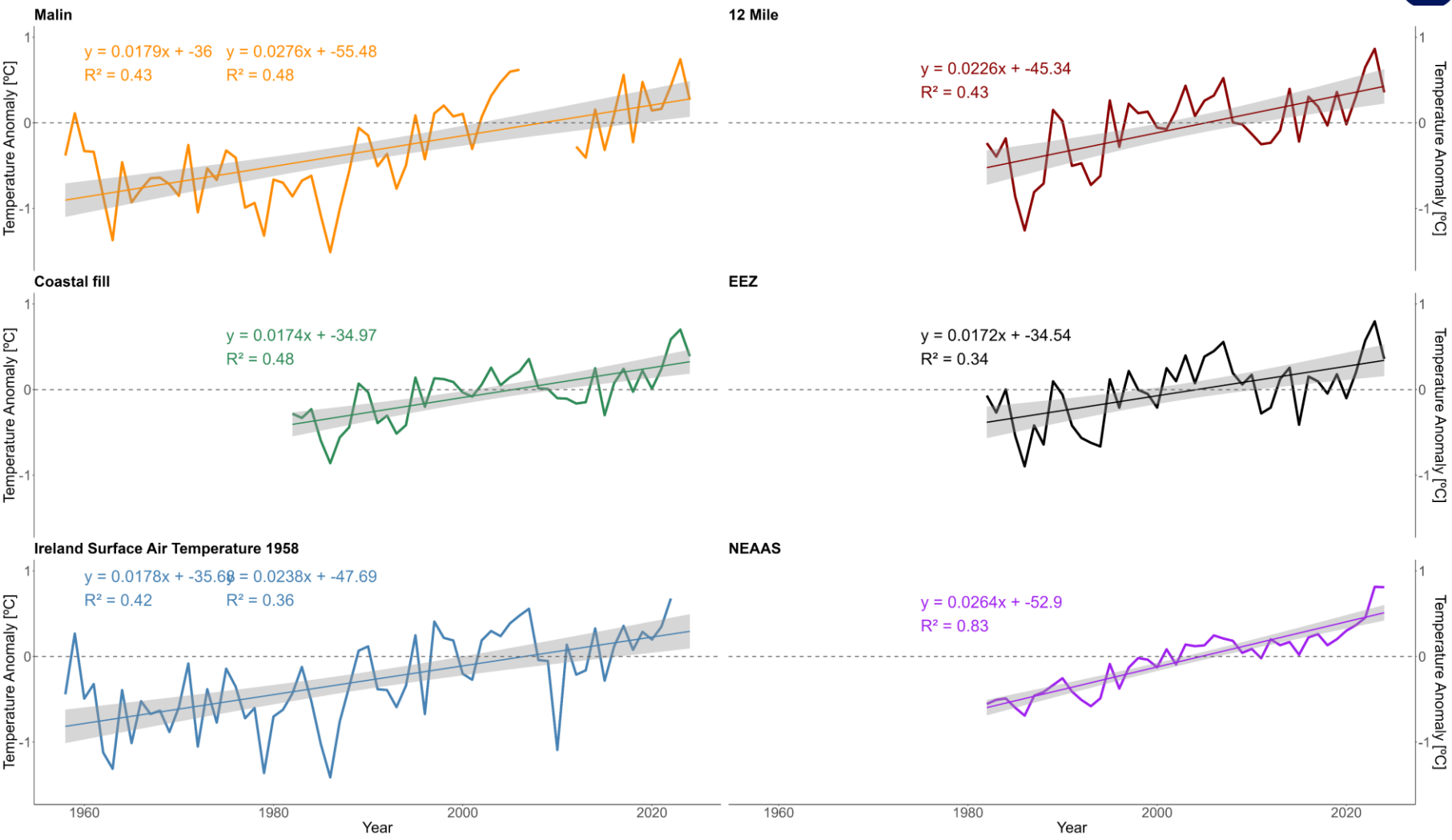

Decadal Trends since 1982

NEAAS – 0.26°C
EEZ – 0.17 °C
12NM – 0.23 °C

Coastal – 0.17 °C
Malin Head - 0.27°C

Irish Air Temp – 0.24 °C

O'Beirne et al. 2026 in prep

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Using sub surface ocean temperature as an indicator in prediction of hurricane intensity

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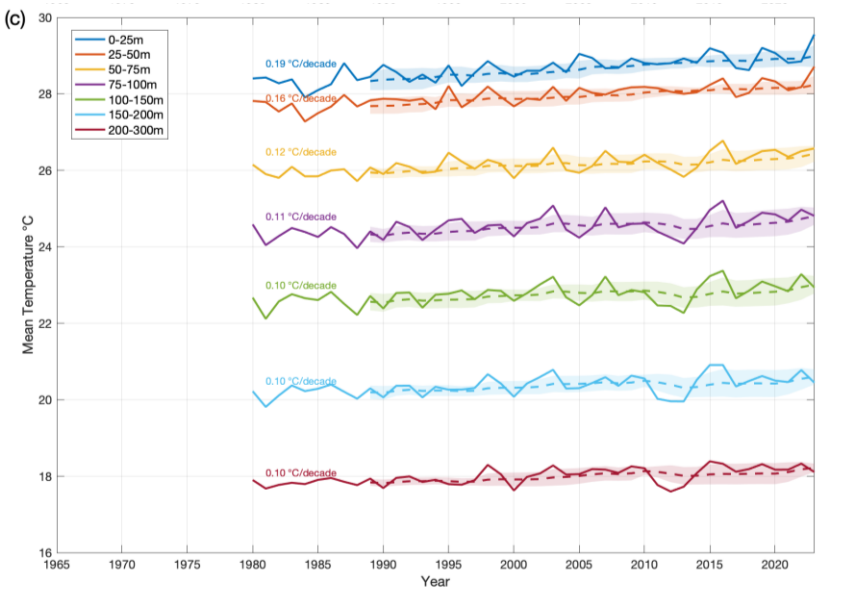
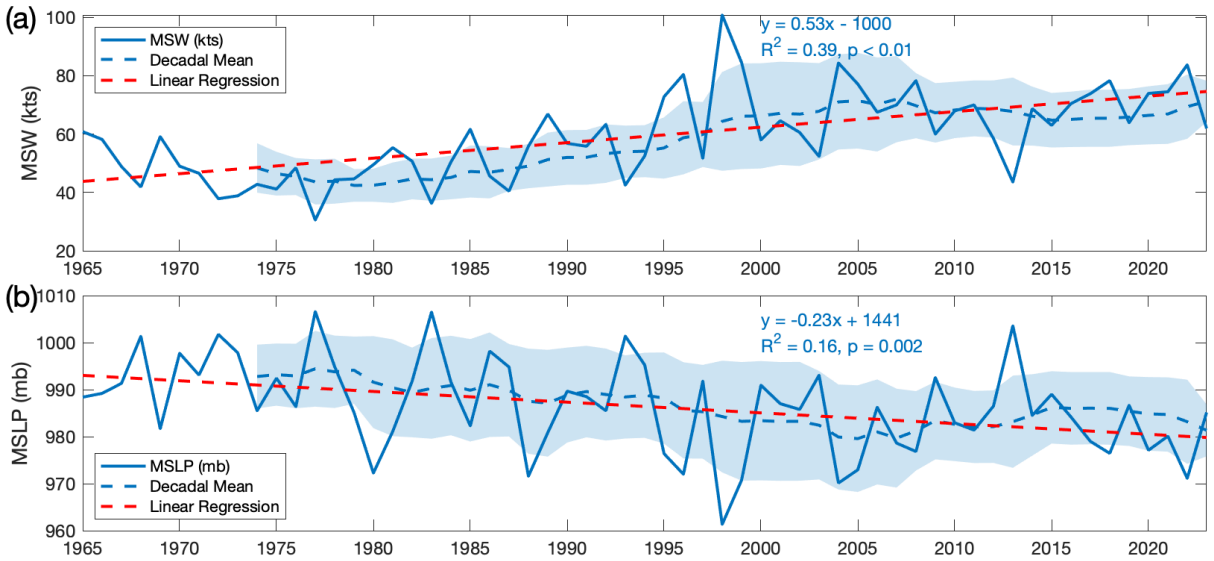


Caribbean upper ocean temperatures (10-30°N, 55-90°W) between 1980 and 2023 for August, September and October (ASO).



Caribbean tropical cyclones 1965-2023 and (a) Annual mean tropical cyclone maximum sustained wind (kts) (b) Annual mean tropical cyclone lowest minimum pressure (mb).

Correlation MSLP and $\overline{T_{100m}}$
r=0.44, p<0.05

Hallam et al, 2025 (submitted)

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Case Study: An example of using ocean indicators for hurricane intensity prediction using TOPIM.

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TOPIM PI output for Hurricane Beryl and Hurricane Melissa using $\overline{T_{100m}}$ and climatology (reference period 1981-2000)

	Hurricane Beryl 1st July 2024 at 12.00 UTC		Hurricane Melissa 28th October 2025 00.00 UTC	
	Actual conditions $\overline{T_{100m}}$ June 2024	Ocean climatology	Actual conditions $\overline{T_{100m}}$ October 2025	Ocean climatology
Ocean Temperature (°C)	28.5	27	29.7	28.3
PI MSW (kts)	135	100	162	126
PI MSLP (mb)	932	967	896	939
Hurricane Category	5	3	5	4

Tropical Cyclone Ocean-coupled potential Intensity Model (TOPIM). Uses subsurface ARGO float and Radiosonde data for potential intensity prediction. Using $\overline{T_{100m}}$ as opposed to SST improves hurricane prediction by between 20-30mb

TOPIM can also be used for ocean sensitivity analysis (keep atmosphere same). For example, hurricane Melissa ocean temperatures were 1.4°C warmer than climatology and Intensity 36kts stronger

Important for disaster preparedness

Scan here for TOPIM model web app

Hallam et al, 2025 (submitted)

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Thank you for listening

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