HOW DO OCEAN REANALYSES IMPROVE OCEAN PREDICTION?

MER-EP Project: Marine Environment Reanalyses - Evaluation Project

Overview: The MER-EP project is a UN Decade initiative aimed at evaluating marine environment reanalyses to enhance their potential for ocean monitoring and prediction. This project is a collaborative effort involving international partners and is supported by ocean science observation and prediction programs.

MER-EP 2025-2028

Raising awareness of ocean reanalyses

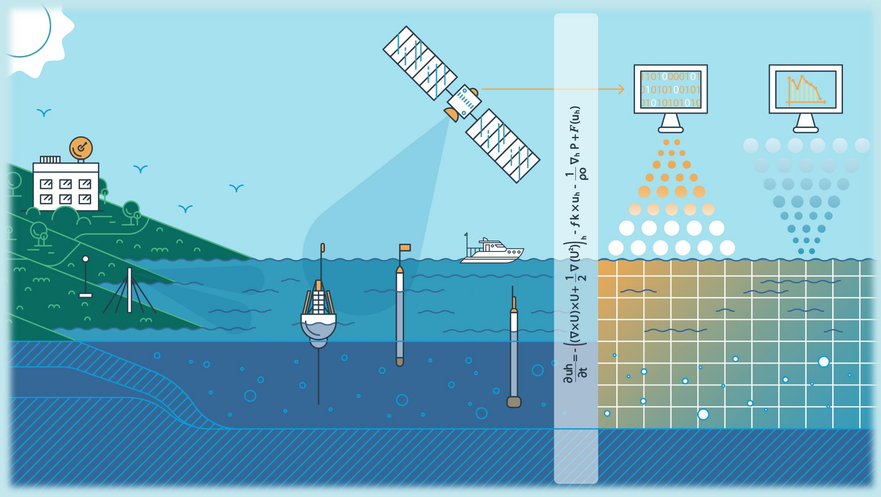
Facilitating the use of ocean reanalyses to monitor the state of the ocean for an increased number of parameters and users (climate, biodiversity, decision-making)

Improving our knowledge of the past marine environment and improving forecasting capabilities

MER-EP UN decade page

Ocean reanalyses are produced with models assimilating high quality observations (reprocessed, Quality Checked)

atmosphere reanalysis at the surface (ex ERA5)



They are used to monitor year to year changes in the ocean, initialise seasonal forecasts, to build anomalies etc…

many types of reanalyses are available: global, regional
blue (physics), green (biogeochemistry, biology), white (sea ice)
3D, homogeneous in time, up to 2-3 km resolution

References

Key Objectives

Evaluation of Marine Environment Reanalyses: Assess the quality and reliability of marine reanalyses to improve their use in ocean monitoring and prediction.

Best Practices: Share guidelines and methods on how to effectively use reanalyses for various applications, including AI forecasting models and ecosystem models.

Collaboration: Encourage international collaboration and data sharing among researchers and institutions.

Expected outcomes by 2030

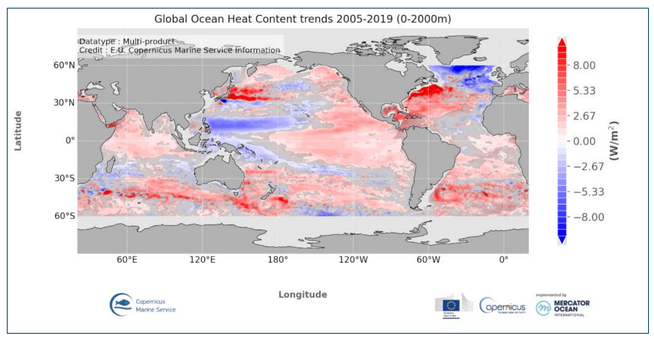
Increased use of Marine Reanalyses including for surface waves, sea ice and biogeochemistry parameters.

New guidelines and conditions of use for marine applications including training AI applications.

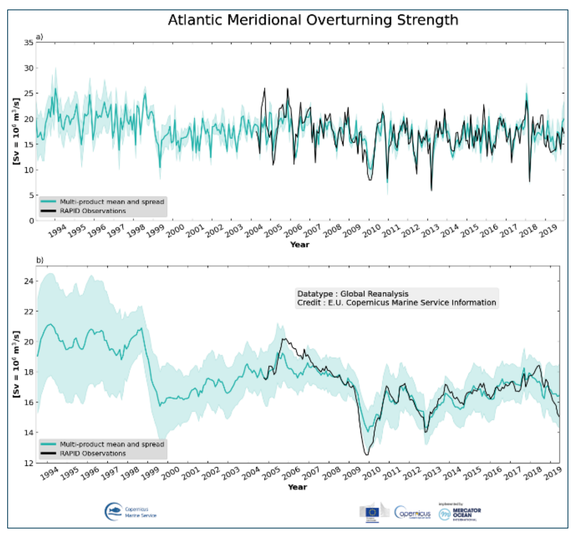
New reference publications, resuming previous community efforts such as the international ORA-IP, EOS COST action, and the European Copernicus Marine Indicators and State of the Ocean Report, and including a larger community of users in the evaluation process.

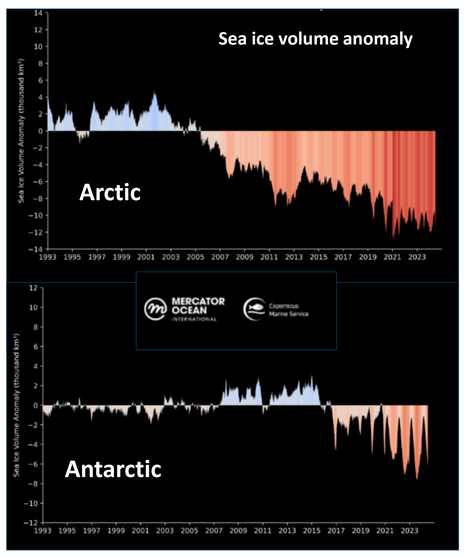
Examples of use cases : using ocean reanalysis …

… to monitor the ocean state



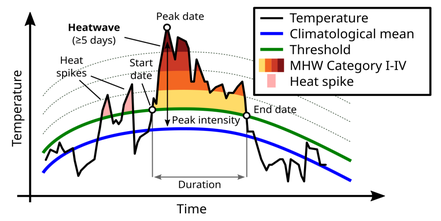
Extending the observing network to unobserved areas and parameters





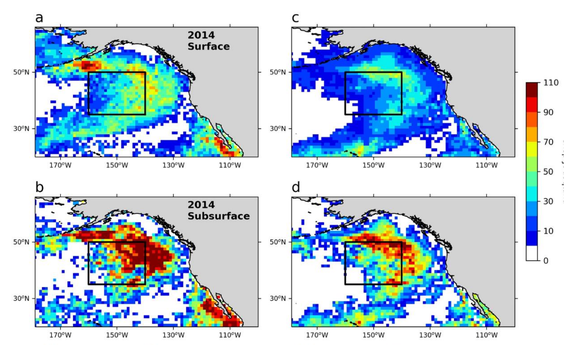
The Copernicus Ocean State Report

… as reference periods for detecting extreme…



From https://www.marineheatwaves.org/mhw-overview.html

… temperature…



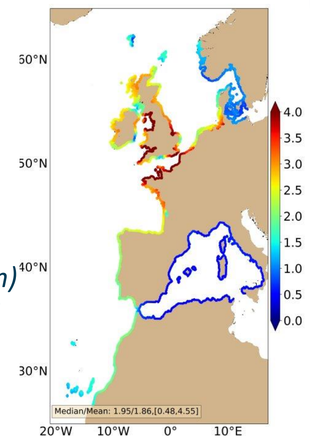
Number of MHW days between mid-May and September for (**a**) surface events (ESA CCI satellite-derived SST), (**b**) subsurface events (GREP reanalysis), (**c**) forecast surface events and (**d**) forecast subsurface events (both from CMCC-SPS3.5). The area within the black box is used to calculate the time series in Fig. 1 and Extended Data Fig. S1.

From McAdam et al (2023) https://www.nature.com/articles/s43247-023-00892-5

See also examples of marine heawaves short term forecast bulletins

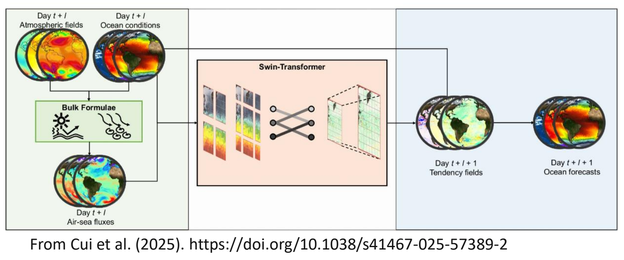
… or sea level …

Assessing dynamic sea level one in ten-year events amplitude (m)
Ex : 1993-2015 hindcast



See also extreme sea level forecast skill study : Irazoqui Apecechea et al (2023) https://doi.org/10.3389/fmars.2022.1091844

… to train AI applications or to benchmark them



From Cui et al. (2025). https://doi.org/10.1038/s41467-025-57389-2

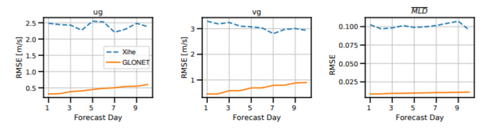
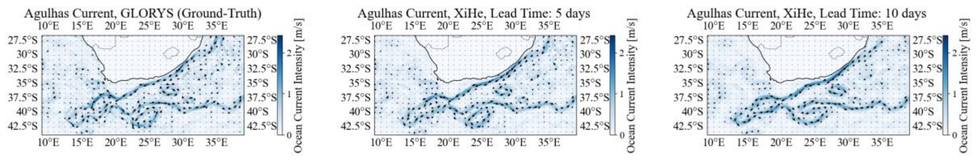


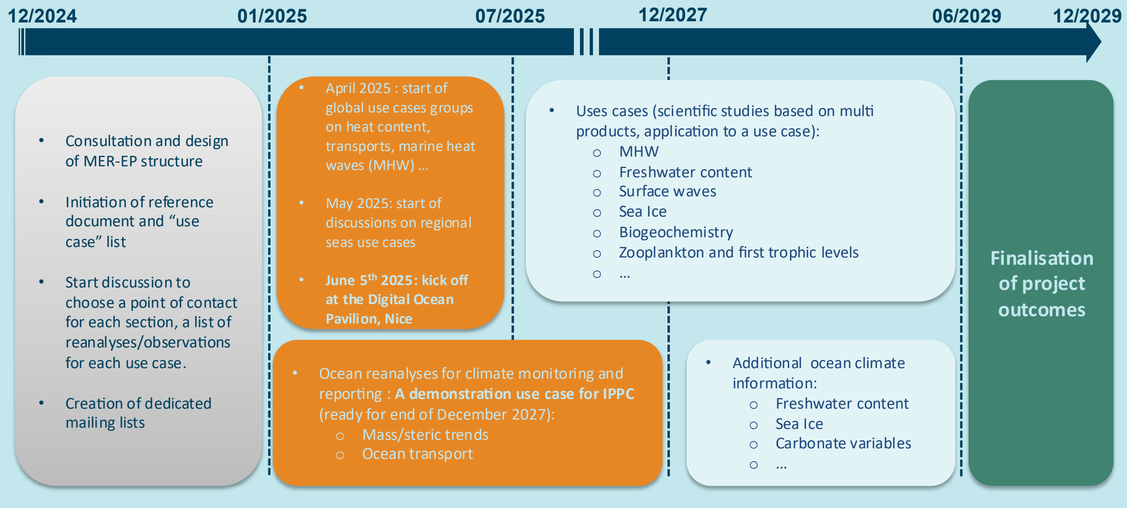
Figure 11: Root Mean Square Error (RMSE) for the reconstructed geostrophic current and MLD for both GLONET, Xihe models. Calculations span from January to July 2024, using GLORYS12 as the reference. Geostrophic current and MLD are computed based on forecasts that are initialized weekly on Wednesdays, following the operational protocol.

From El Aouni et al. (2024) https://doi.org/10.48550/arXiv.2412.05454



From Wang et al. (2024) https://doi.org/10.48550/arXiv.2402.02995

Timeline of the project



Next steps in 2025

Start intercomparison of global blue reanalyses

Go on mobilising participants in the international community and including use cases

Start the use case « climate monitoring and reporting » (IPCC) and the use cases « regional reanalyses in the European seas » (Copernicus Marine)

Co Pis: Marie Drevillon, Romain Bourdallé-Badie (Mercator Ocean International), Chunxue Yang (CNR) and partners:

meet us on Thursday at the Digital Ocean Pavilion
MER-EP
kick off event