

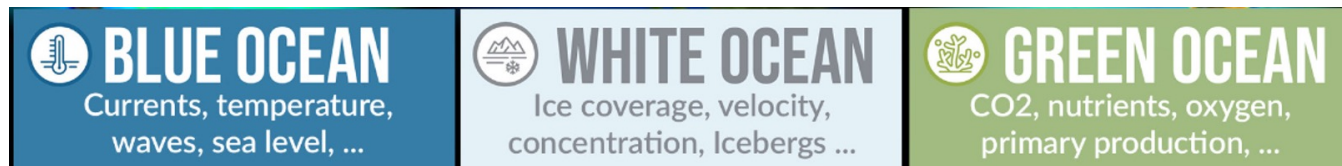
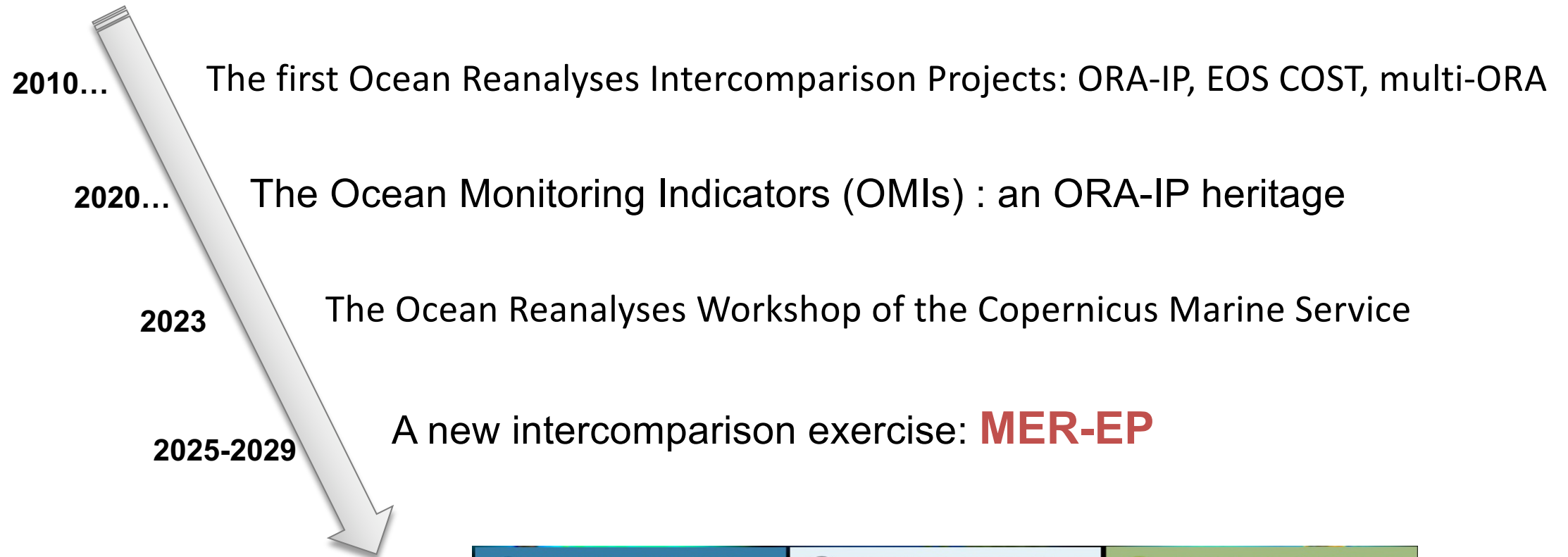
A new intercomparison exercise

MER-EP

(Marine Environment Reanalyses – Evaluation Project)



History of ocean reanalyses intercomparison





MER-EP: a user-oriented evaluation

MER-EP :

an international initiative to evaluate marine environment reanalyses to better use their potential for ocean monitoring and prediction

By sharing “best practices” derived from the studies and use cases:

- **Guidelines** on how to use reanalyses
 - for monitoring the state of the ocean
 - for training AI forecasting models
 - as environmental forcing for ecosystem models
 - ...
 - **Methods and tools** to handle the data
-



MER-EP as a UN decade project

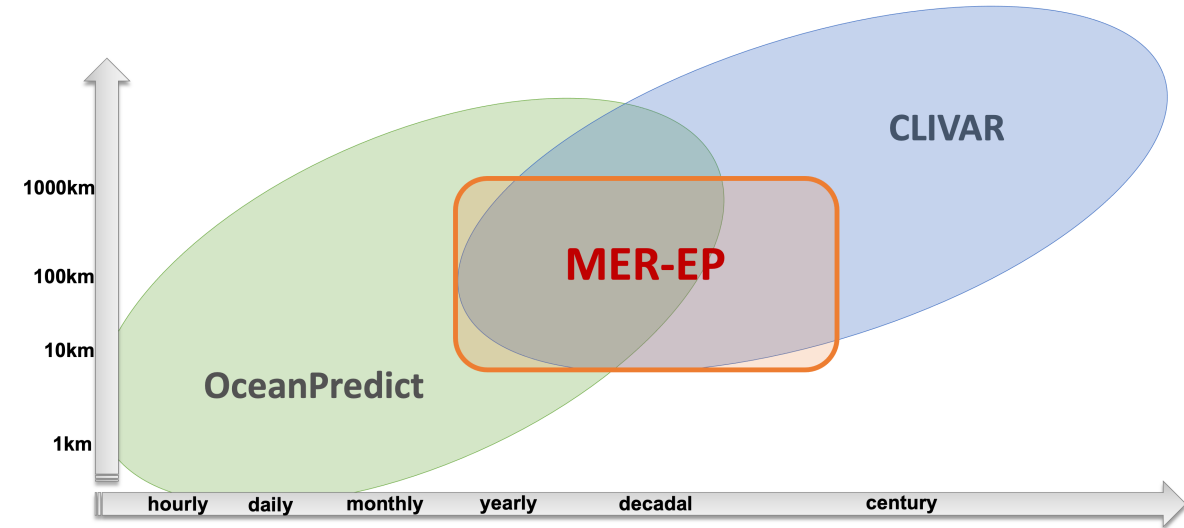
- A project endorsed under the ForeSea and DITTO programmes of the United Nations Decade
- An international collaboration framework with no direct funding, in kind contributions from international partners
- PIs: Drévilon Marie & Bourdallé-Badie Romain (MOi); Yang Chunxue (CNR)
- Partners who already joined MER-EP: Moi (France); CNR (Italy); HCMR (Greece); MIT (USA); NERSC (Norway); BOM (Australia); CMCC (Italy); Metoffice (UK); University of Reading (UK); University of Liège (Belgium); Magellium (France); ACRI-ST (France); JAMSTEC (Japan, TBC); UCSD (US); CSIRO (Australia); ECCC (Canada); OGS (Italy)
- Programs which support MER-EP initiative:





MER-EP: area of studies

- MER-EP at the frontier between OceanPredict and CLIVAR actions
- From global to regional approaches
 - Regional estimates could be compared to global ones on common area for OMI
 - Regional rea. could propose studies on local specificities
- From monthly to decadal time scales
- Physical ocean (temperature/salinity/dynamic/wave), sea ice (concentration/thickness, velocity, snow,..), marine ecosystem (Chlorophyl, O2,... low and high trophic levels)



MER-EP areas of studies



MER-EP: steps

- People/institutes interested to join this international effort are **still welcome**.
- Table of existing “use cases” available online and a document describing main structure under preparation by “Pis” (asked by participants)
- How MER-EP will proceed for each use cases:
 - Groups of institutes addressing a use case (an institute in charge of the lead)
 - List data needed (a maximum of worldwide products should be considerate **not only own product**)
 - Data sharing (EDITO, cloud facilities,...)
 - Specific validation studies performed and published
 - Working on downstream applications using reanalysis or recommendations for best practices
 - Exchange on how to better address user requirements

} Final
outcomes
of the
project



MER-EP: existing/status of “use cases”

Topic	lead	status
MHW	Ronan McAdam (CMCC)	started in GLORAN contract framework
OHC	Chunxue Yang (CNR)	Started in GLORAN contract framework
Polar Region	Jiping Xie (NERSC)	First meeting with use case leader performed
Ocean transport	Gael Forget (MIT)	started monthly MER-EP ocean transport meetings
Biomass/carbon	Valeria Biagio (OGS)	
Meso-scale/Eddies	Gregory Smith (Env. Canada)	Started in GLORAN contract framework
Earth System Model		
Surface Lagrangian		
Sea Level		
Wave height	Charikleia Oikonomou (HCMR)	First meeting with use case leader performed

- Possibility to join and/or take the lead of a “use case”
- Possibility to propose a new one more dedicated to specificities of a given region



Schedule

12/2024

01/2025

07/2025

12/2027

06/2029

12/2029

- Finalization of MER-EP structure
- Work on reference document and “use case” list
- General organization: ask people to position themselves in sections. Discussion to choose a point of contact for each section, a list of reanalyses/observations for each use case.
- Creation of dedicated mailing lists

- April 2025 : start of Copernicus supporting contract for Global Ocean Reanalyses
- **Presentation of MER-EP to COP2 regional producers**
- **June 2025: kick off project at UNOC**

- Climate information: A demonstration use cases for IPCC (ready for end of December 2027):
 - Mass/steric trends
 - Ocean transport

- Uses cases (scientific studies based on multi products, application to a use case):
 - MHW
 - Freshwater
 - Wave
 - Sea Ice
 - BGC
 - Zooplankton
 - ...

- Climate information:
 - Mass/steric trends
 - Ocean transport
 - Freshwater
 - Sea Ice
 - BGC
 - ...

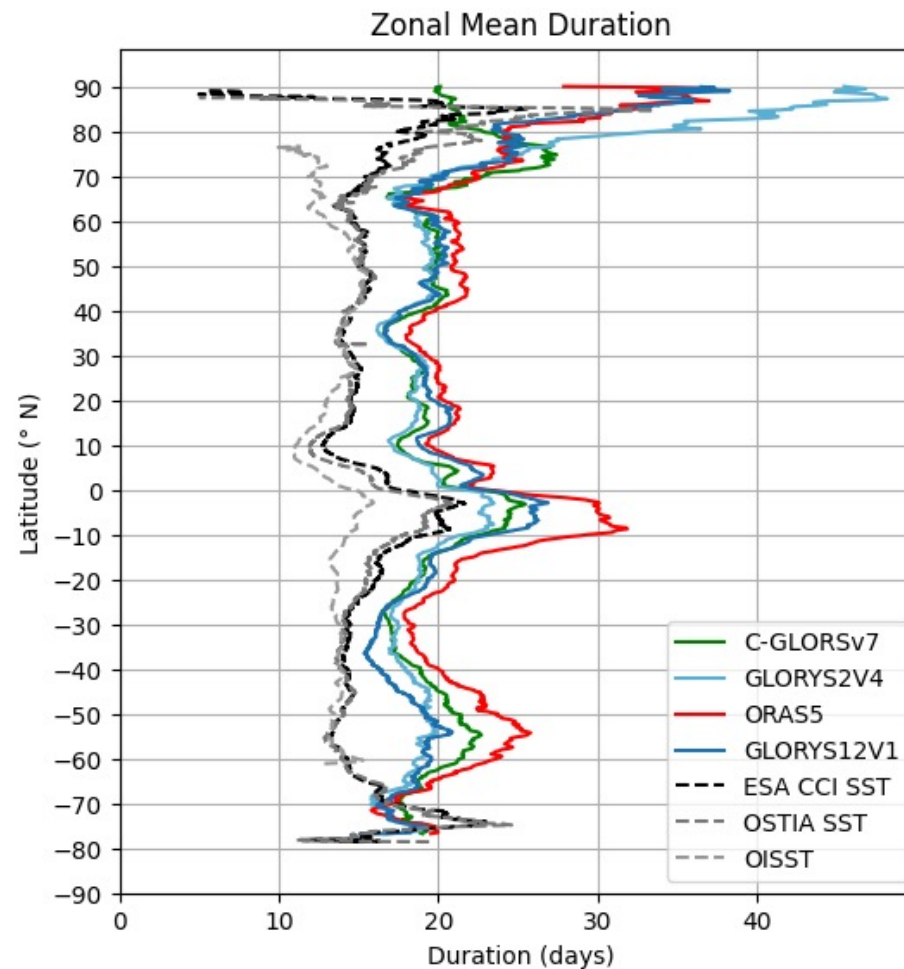
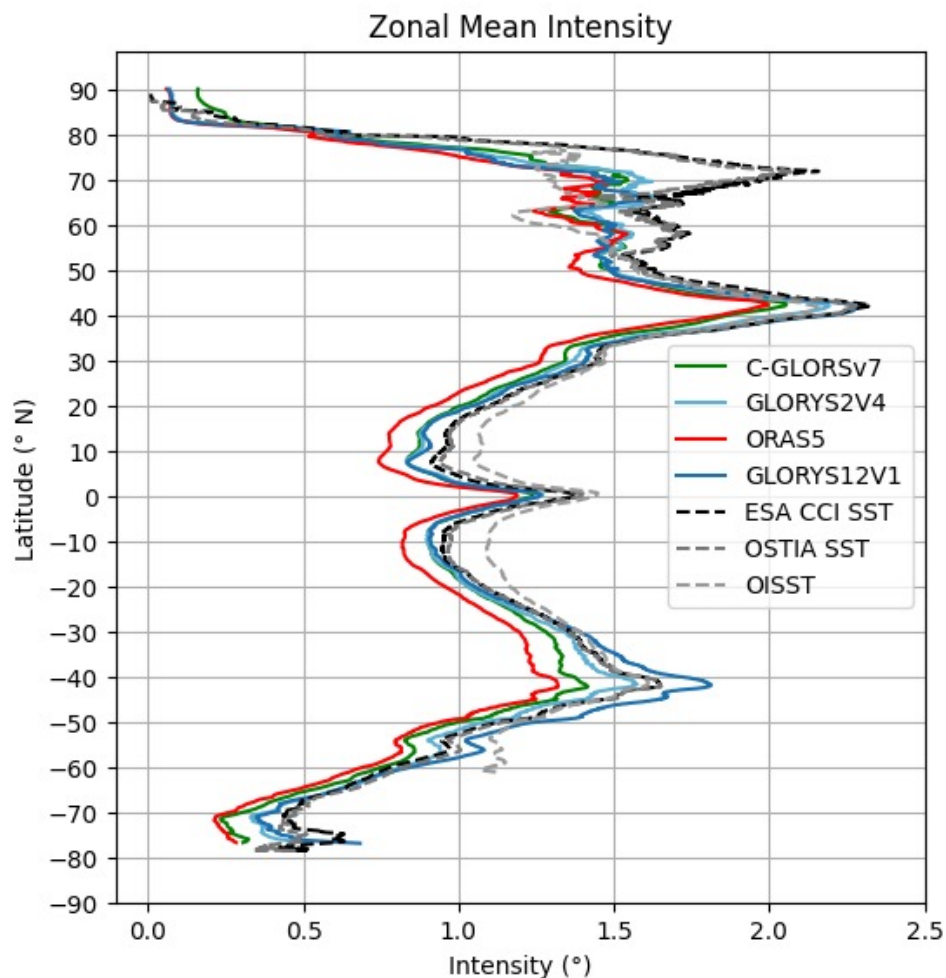
Finalisation of project outcomes



MER-EP: MHW, Towards a Global Intercomparison

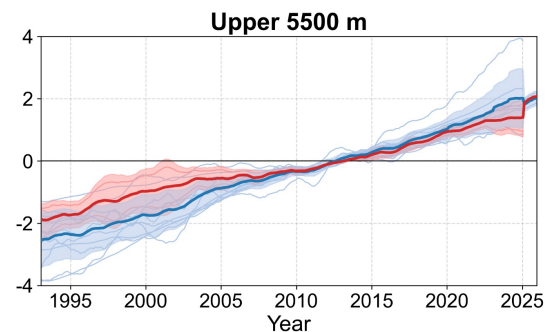
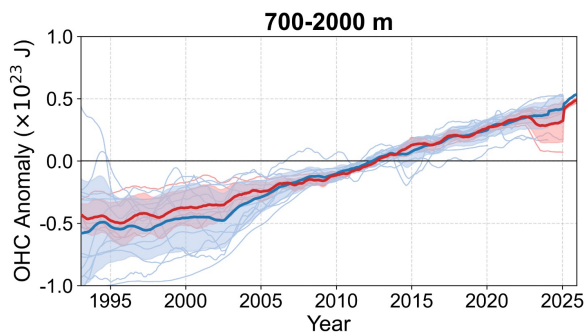
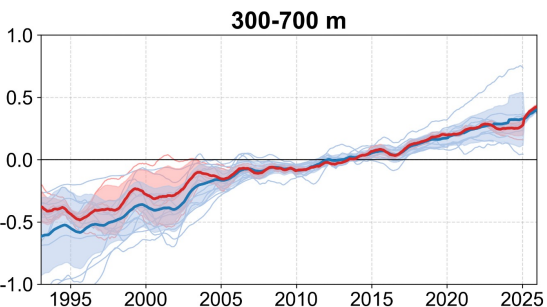
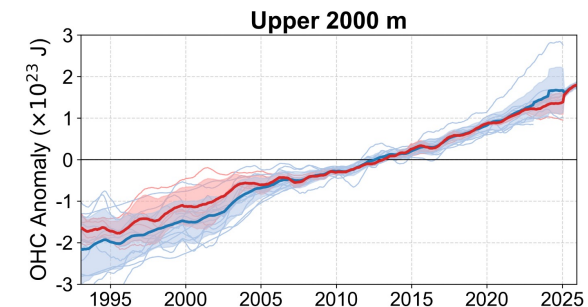
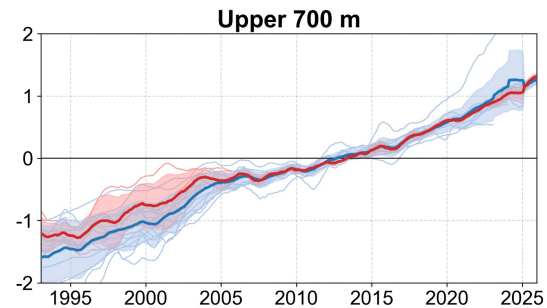
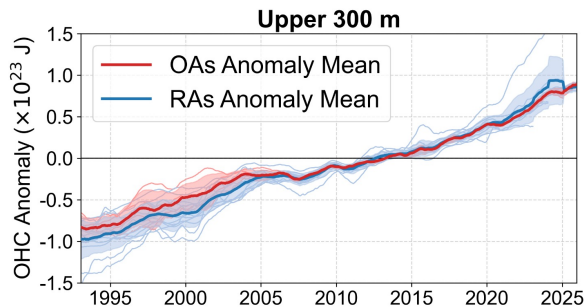
Biases in Surface MHW Characteristics

- Comparing spread of reanalysis and observations
- Highlight regions with greatest issues in representations (polar regions, WBCs)

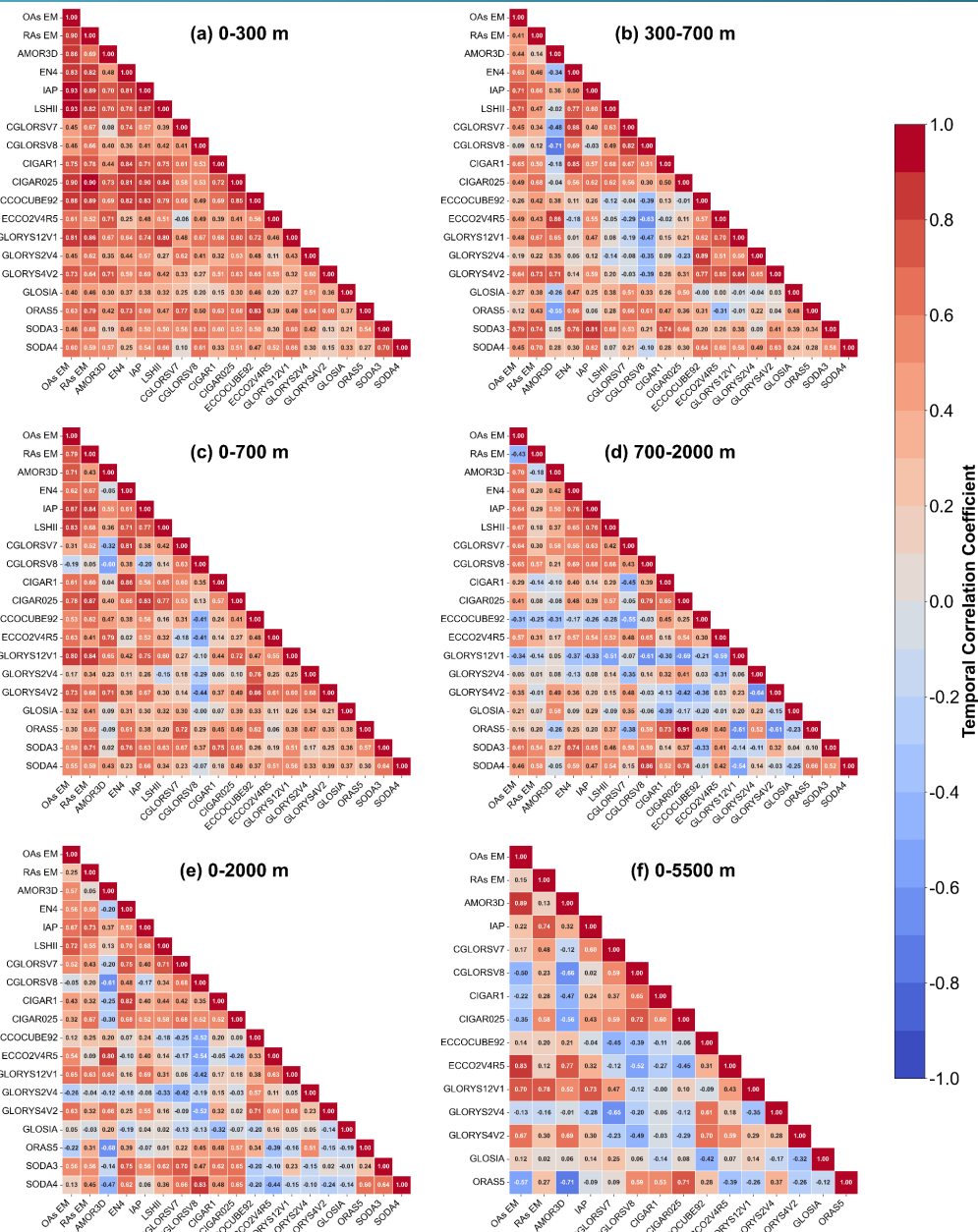




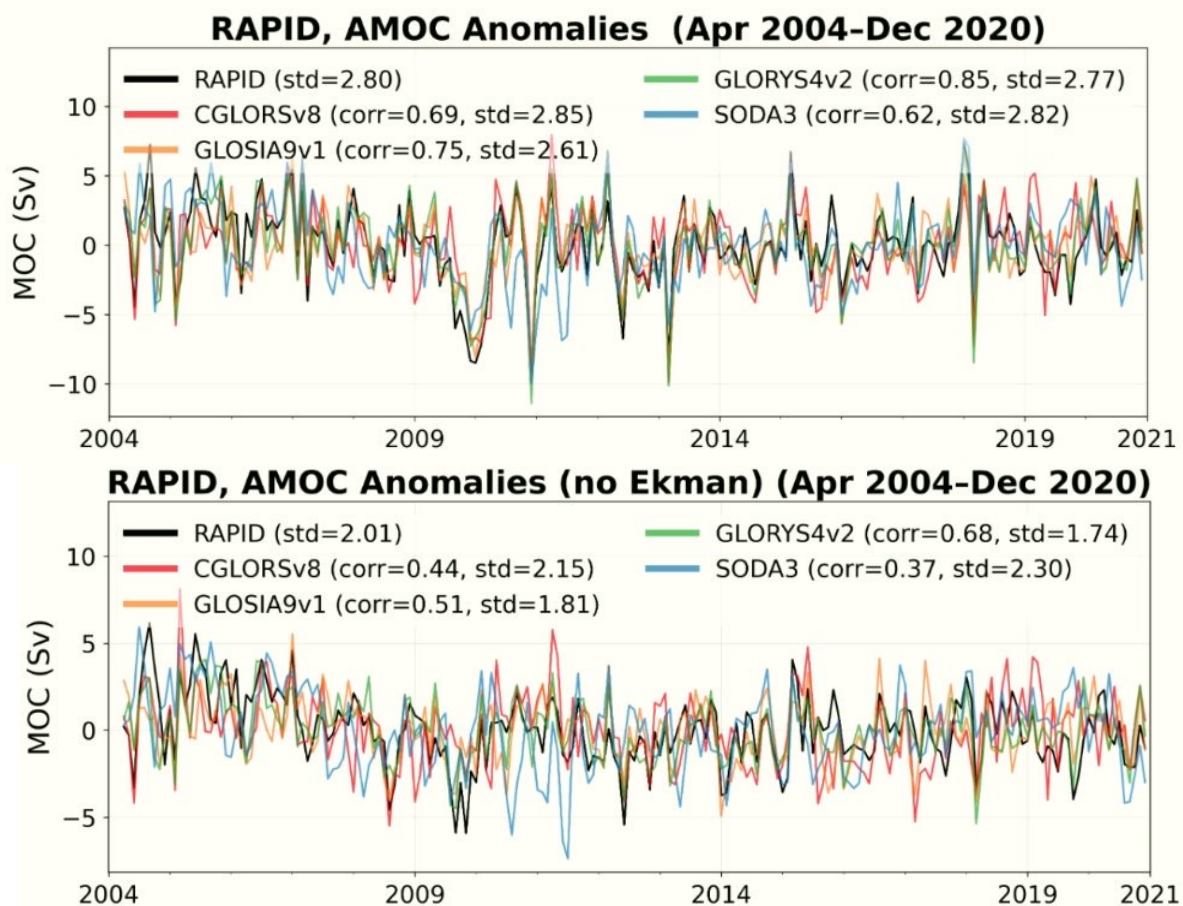
MER-EP: OHC Timeseries



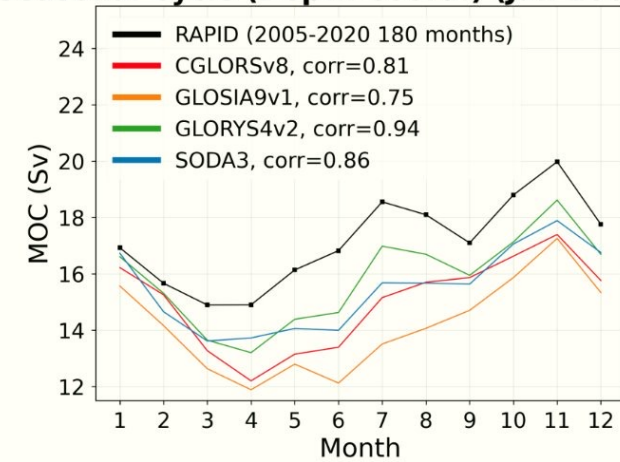
- RAs and OAs ensemble means are nearly identical.
- Post-2005 uncertainty is reduced.
- Data correlations drop with increasing depth.



- Generally good AMOC variability both seasonally and at lower and higher frequencies
- Ekman is removed to focus on indirect variability

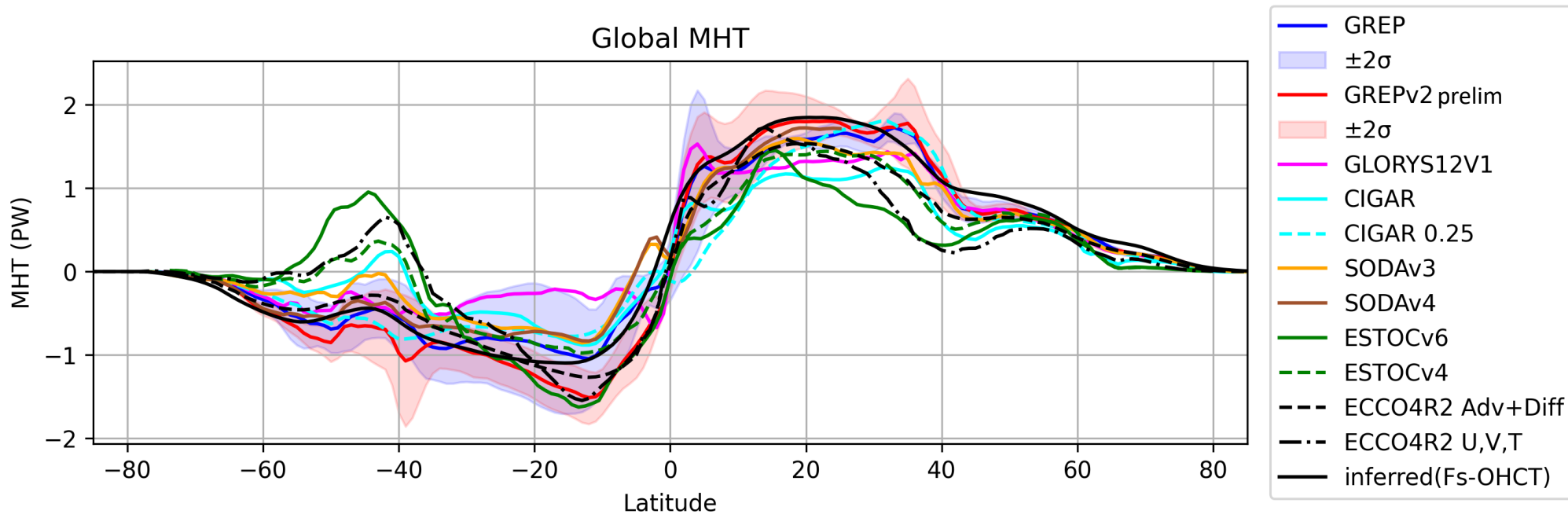


Mean Seasonal Cycle (Depth Coord.) (Jan 2005-Dec 2020)





MER-EP: Meridional Heat Transports



- Large-scale structure of MHT ok in most products but
- Substantial spread across products!
- Comparison with **inferred** MHT from the energy budget



- **OHCT**: ocean reanalysis, IAPv4, RFROM, MOHeaCAN
- **F_s** (inferred): ERA5, JRA3Q, MERRA2
- **MET**: GIOMAS, ocean reanalysis

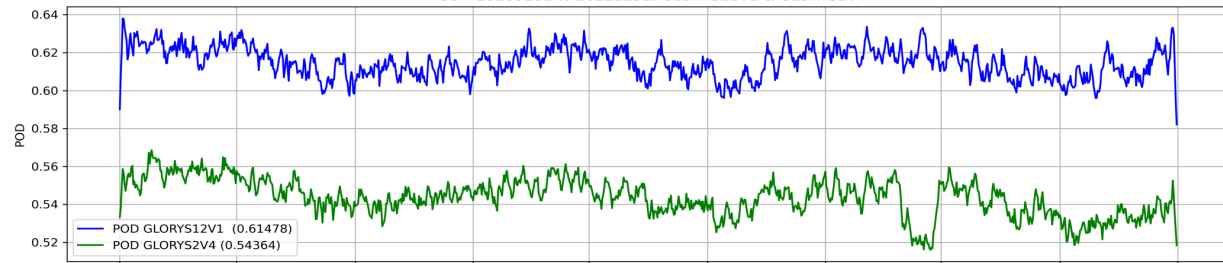


MER-EP: Eddy, Global evaluation: 2020 to 2022

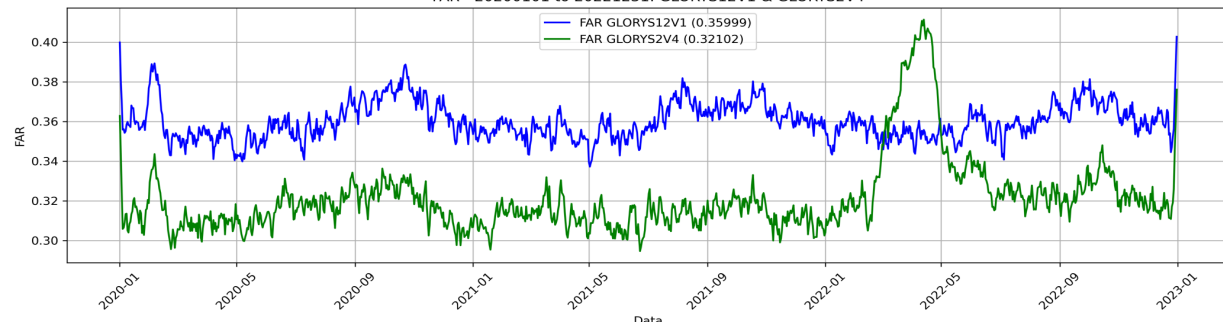
$$POD = \frac{Hits}{Hits + Misses}$$

$$FAR = \frac{False\ Alarms}{Hits + False\ Alarms}$$

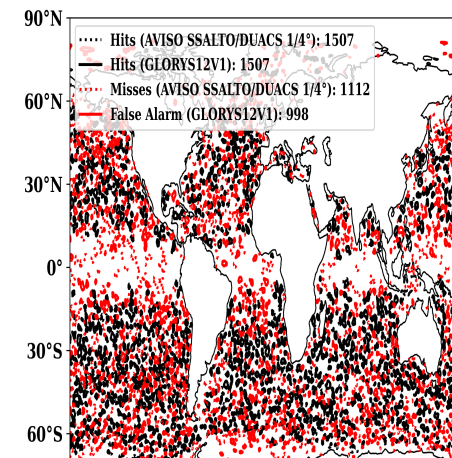
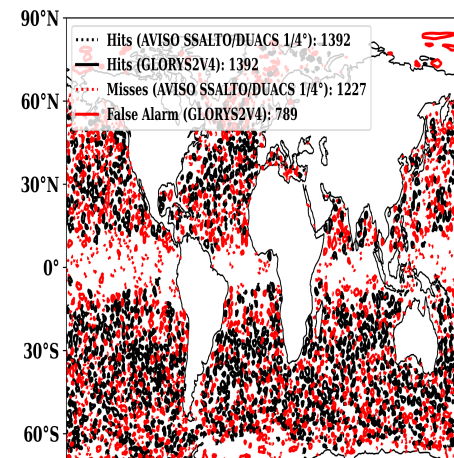
POD - 20200101 to 20221231: GLORYS12V1 & GLORYS2V4



FAR - 20200101 to 20221231: GLORYS12V1 & GLORYS2V4

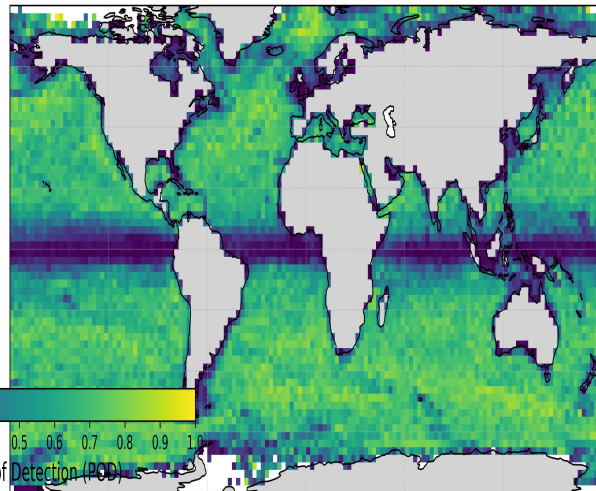
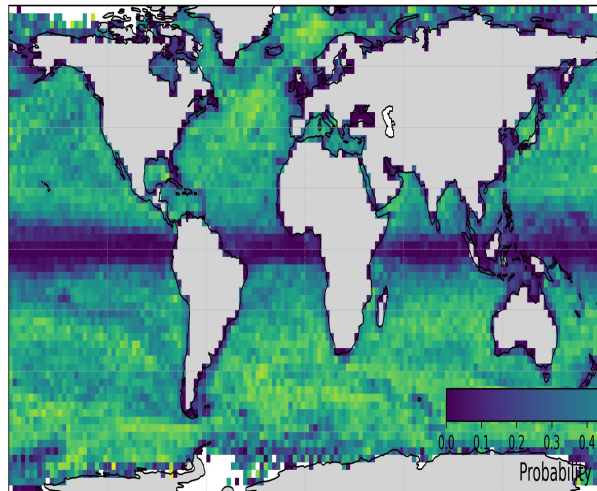


Anticyclonic Matches (2020-01-01)



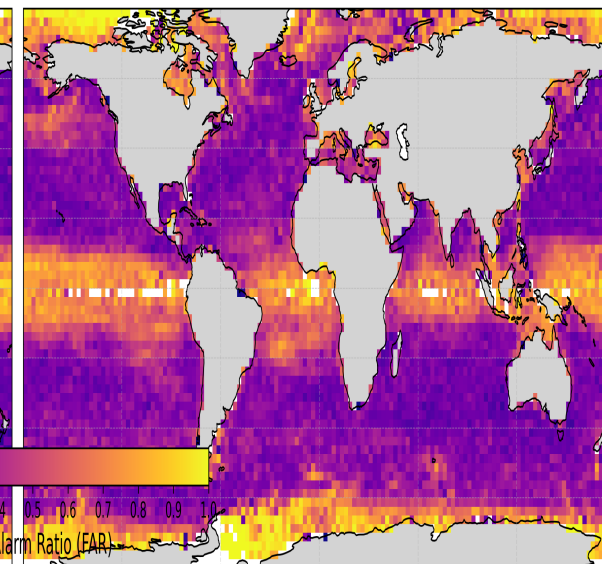
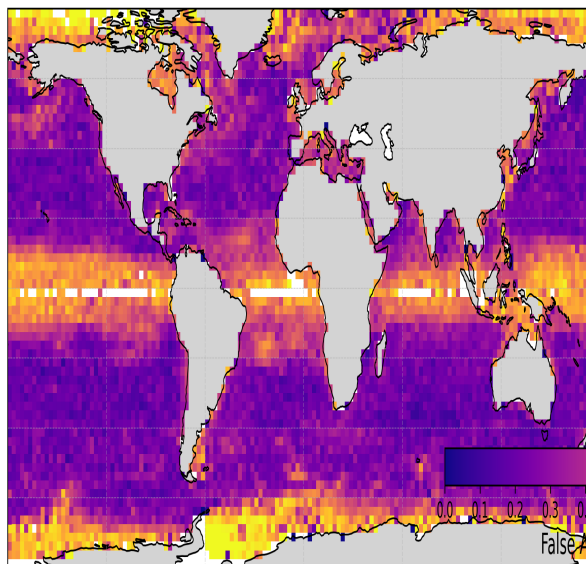
GLORYS2V4

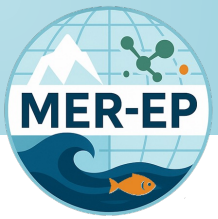
GLORYS12V1



GLORYS2V4

GLORYS12V1

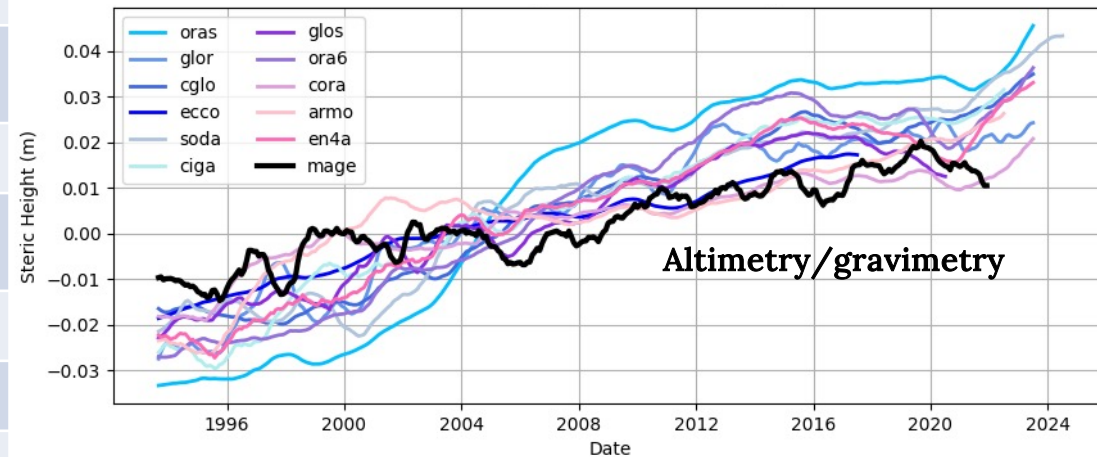




Sea Level: Inter-comparison of Steric Sea Level

Product	Period	Trend 1993-2017	Acceleration
ORAS-GREP	1993-2023	3.6 $mm\text{yr}^{-1}$	-0.02 $mm\text{yr}^{-2}$
GLORYS-GREP	1993-2023	2.17 $mm\text{yr}^{-1}$	-0.08 $mm\text{yr}^{-2}$
C-GLORS-GREP	1993-2023	2.17 $mm\text{yr}^{-1}$	0.09 $mm\text{yr}^{-2}$
ECCOV4r4	1993-2017	1.4 $mm\text{yr}^{-1}$	-0.05 $mm\text{yr}^{-2}$
SODA 3-15-2	1993-2024	2.12 $mm\text{yr}^{-1}$	0.02 $mm\text{yr}^{-2}$
CIGAR	1993-2022	2.35 $mm\text{yr}^{-1}$	-0.05 $mm\text{yr}^{-2}$
GloSia	1993-2020	1.93 $mm\text{yr}^{-1}$	0.03 $mm\text{yr}^{-2}$
ORAS6-Pilot	1993-2023	2.81 $mm\text{yr}^{-1}$	0.03 $mm\text{yr}^{-2}$
ORA Ens	1993-2017	2.32 ± 0.6 $mm\text{yr}^{-1}$	-0.0002 ± 0.61 $mm\text{yr}^{-2}$
EN4	1993-2023	2.23 $mm\text{yr}^{-1}$	-0.01 $mm\text{yr}^{-2}$
CORA	1993-2023	1.15 $mm\text{yr}^{-1}$	-0.07 $mm\text{yr}^{-2}$
ARMOR3D	1993-2023	1.3 $mm\text{yr}^{-1}$	-0.2 $mm\text{yr}^{-2}$
Obs-OA Ens	1993-2023	1.57 ± 0.5 $mm\text{yr}^{-1}$	-0.1 ± 0.5 $mm\text{yr}^{-2}$
AVISO Alt/Grav	1993-2022/05	0.95 $mm\text{yr}^{-1}$	0.01 $mm\text{yr}^{-2}$

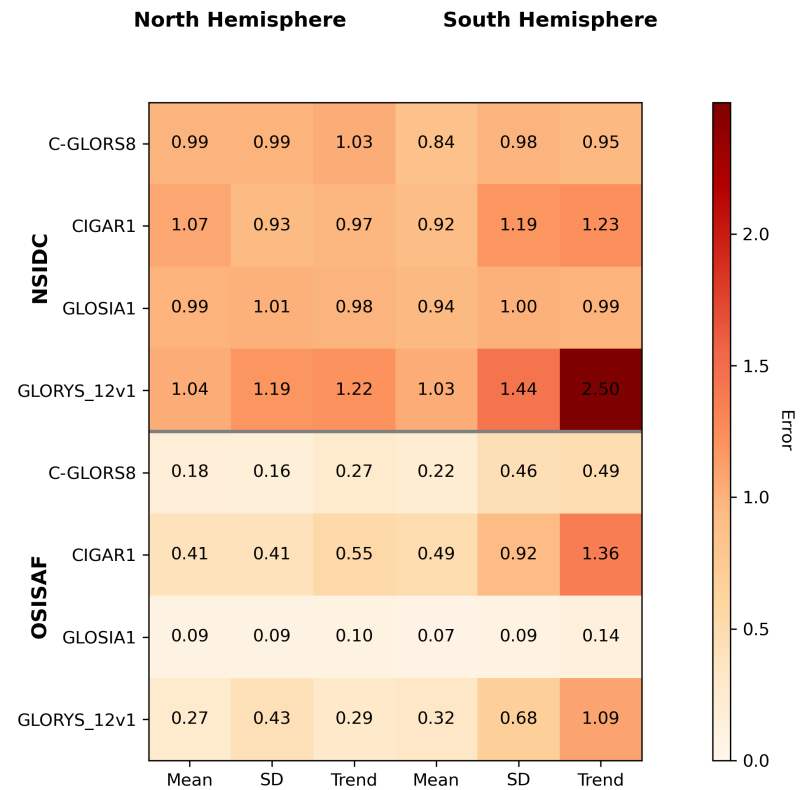
Steric height – 60S-60N



- Positive trend in steric height in all products
- Large spread
- Confirms low (negative?) trend acceleration from the steric component



MER-EP: Sea ice concentration



- Biases between both obs products (partly related to different ways to deal with melt ponds);
- SIC assimilated in most of the reanalyses;
- But not in CIGAR --> Good variability but systematic biases.

The ice concentration metrics of 4 reanalysis compared to (a) NSIDC-0051 and (b) OSI-450 data. The six columns correspond to model performance metrics on the mean state, standard deviation (SD Ano), and trend (Trend Ano) of monthly anomalies of the Arctic and Antarctic ice concentration during 1994–2020. Lower values indicate better skill.



Special issue

[Articles](#) / [Special issue](#)



Evaluation of ocean reanalyses to meet users' needs

Editor(s): Chunxue Yang (National Research Council, Italy), Romain Bourdallé-Badie (Mercator Ocean, France), Marie Drevillon (Mercator Ocean, France), and Bernadette Sloyan (Commonwealth Scientific and Industrial Research Organisation, Australia)

23 Apr 2026

LETKF-based Ocean Research Analysis version 2.0 for a quasi-global domain (LORA-QG): Validation and Intercomparison with eddy-permitting global ocean reanalysis datasets

Shun Ohishi, Takemasa Miyoshi, and Misako Kachi

EGUsphere, <https://doi.org/10.5194/egusphere-2026-2277>, 2026

Preprint under review for OS (discussion: open, 0 comments)

[Short summary](#)

23 Apr 2026

Quantitative Evaluation of Mesoscale Eddies in the North Atlantic Using Satellite Altimetry and Ocean Reanalyses

Paolo Mauriello, Gregory C. Smith, Andrea Storto, and Chunxue Yang

EGUsphere, <https://doi.org/10.5194/egusphere-2026-2257>, 2026

Preprint under review for OS (discussion: open, 0 comments)

[Short summary](#)

09 Apr 2026

Sea ice in the Barents and Kara Seas: models versus reanalyses

Cecilia Åijälä, Lucía Gutiérrez-Loza, Wolfgang Dorn, Siv K. Lauvset, Wieslaw Maslowski, and Petteri Uotila

EGUsphere, <https://doi.org/10.5194/egusphere-2026-1849>, 2026

Preprint under review for OS (discussion: open, 1 comment)

[Short summary](#)

31 Mar 2026

Evaluation of a Coupled Regional Reanalysis for the Mediterranean Region Covering the period 1993–2024

Andrea Storto, Vincenzo de Toma, and Chunxue Yang

EGUsphere, <https://doi.org/10.5194/egusphere-2026-1549>, 2026

Preprint under review for OS (discussion: open, 0 comments)

[Short summary](#)

Thank you for your attention

<https://oceanpredict.org/un-decade-of-ocean-science/mer-ep-un-decade-project/>

Contact: mer-ep@mercator-ocean.eu

