Copernicus Marine Service

COPERNICUS MARINE

8th GENERAL ASSEMBLY

Production Centers: Achievements and Plans: The Green Ocean: models

Marilaure Grégoire, Gianpiero Cossarini, Elodie Gutknecht, Susan Kay, Julien Lamouroux, Annette Samuelsen, Lena Spruch, Luc Vandenbulcke and all PU-BIO members.

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PROGRAMME OF THE EUROPEAN UNION

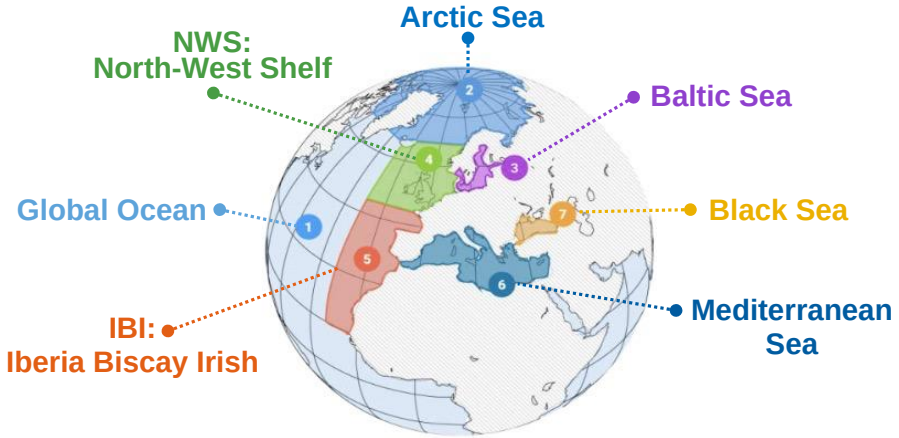
Copernicus Europe's eyes on Earth

implemented by MERCATOR OCEAN INTERNATIONAL

Outlines

- System Evolutions in 2023
- Improvement of the quality of the green ocean products over 2023-2024
- System Evolutions for 2024

7 Monitoring & Forecasting Centers



PRODUCTS (minimum)

- Plankton: Chla, PHY, PP
- Nutrients: NO3, PO4
- O2
- Carbonate: pH, pCO2

Multi Year

Reanalysis: last decades (at least 1998-2021)

Interim: up to m-1

- Monthly mean
- Daily Mean
  - Hourly Mean
  - (air-sea fluxes))

Near Real Time

Analysis: - 2 years

Forecast: 10 days

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System Evolution in 2023

NRT Systems' evolutions in 2023

Model resolution/domain

- BALTIC: 2km resolution, 56 vertical levels
- ARCTIC: coccolithophores; improved air-sea CO2 fluxes and light dependent growth

BIO Models/Products

- BLACK: updated chlorophyll.
- MED: BFM 5.3.with multispectral light formulation and multiple PFTs
- GLOBAL: updated Low and Mid-Trophic Levels, Kd
- North West Shelf: Ibi system

Data Assimilation

- BALTIC: Updated DA in the physics including sea-ice, EMEP monthly dataset for NO3, NH4; air-sea spco2 fluxes updated from Hawaii dataset (constant , modified by factor) to use CAMS dataset (regular updated),
- BLACK: NEMO 4.2,

Forcings & Coupling

- GLOBAL: New dynamical forcing fields: 1/12° (coarsened to 1/4°), with physical data assimilation. Offline coupling.
- IBI: nesting into the new GLO PHY & BGC NRT systems

Simulations/Availability

MY Systems' evolutions in 2023

Model resolution/domain

- BALTIC: 2km resolution, 56 vertical levels

BIO Models

- BALTIC: updated Ergom

Data Assimilation

- BALTIC: NEMO4.0, SI3, E-hype updated version.
- GLOBAL: correction of the transport scheme, switch of the diffusion coefficient to a more biologically consistent value, better initial conditions

Forcings & Coupling

Availability

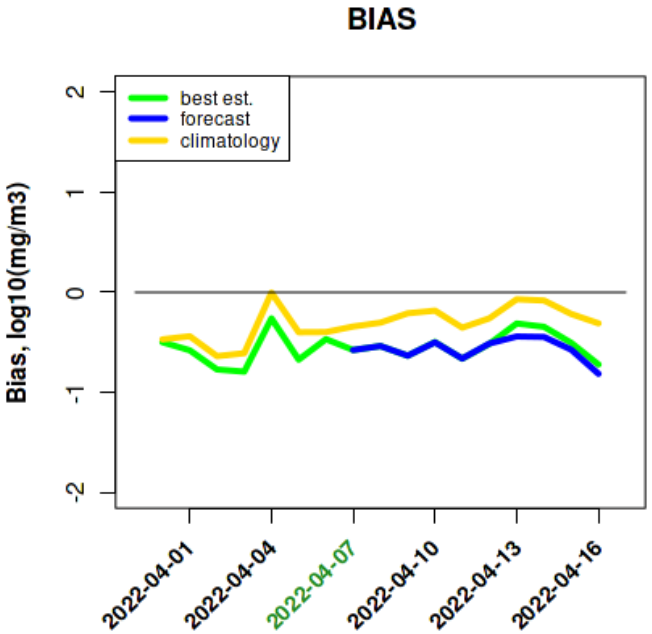
- IBI: Extension of the reanalysis upt to 2022

Improvement of the quality of green ocean products

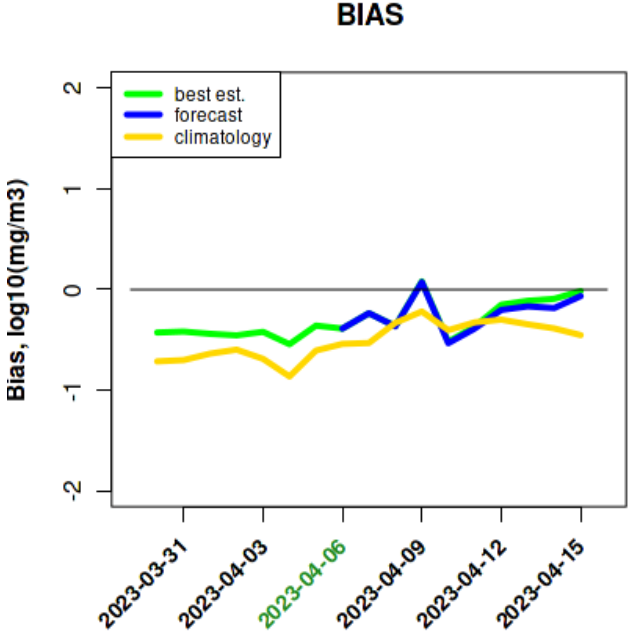
Arctic (NRT)

PRODUCTS: Chla, PHY, PP, NO3, PO4, O2, pH, pCO2, **ZOO, POC, SiO2, Kd**.
Resolution: 6.24*6.25 km, 40 vertical levels

2022 – old light dependent growth



2023 – new light dependent growth



Model update (light effect)

- Reduction of bias during the early spring bloom.
- Reduction Biais 0.448 to 0.074

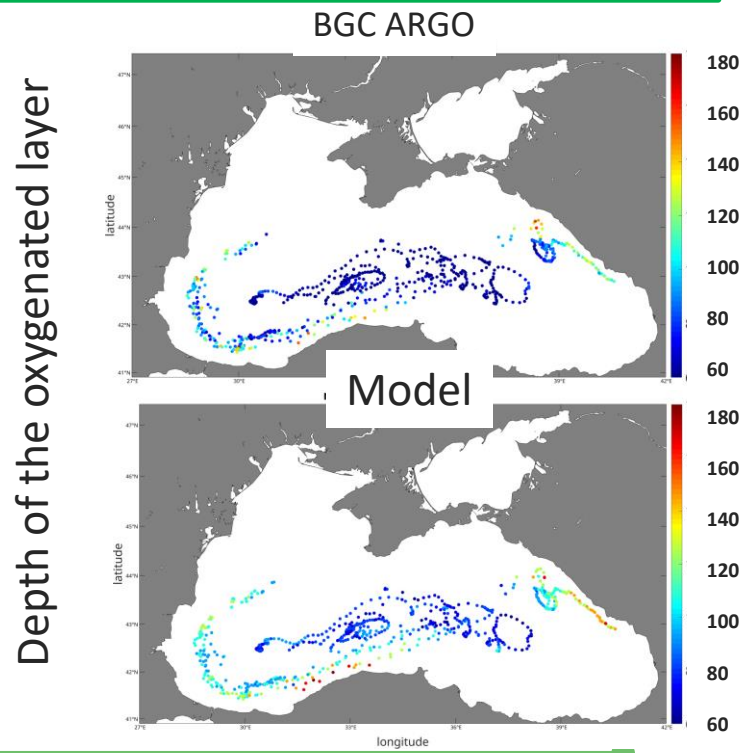
Black Sea (NRT)

PRODUCTS: Chla, PHY, PP, NO3, PO4, O2, pH, pCO2, **DIC, Alk, air-sea flux of CO2, Kd**
Resolution: 2.5*2.5 km, 59 vertical levels

Physics: Switch to Nemo 4.2
Model bio: Update chla

Model-BGC ARGO error statistics for oxygen in the NRT product

Oxygen	Value at V202205	**Value at V202311**
Bias (mmol m^{-3})	28.5	**9.28**
RMSD (mmol m^{-3})	59.5	**31.75**
Standard deviation ratio (no unit)	0.76	**0.82**
Nash-Sutcliffe (no unit)	0.49	**0.85**
Pearson coefficient (no unit)	0.89	**0.96**



Iberian Shelf (NRT)

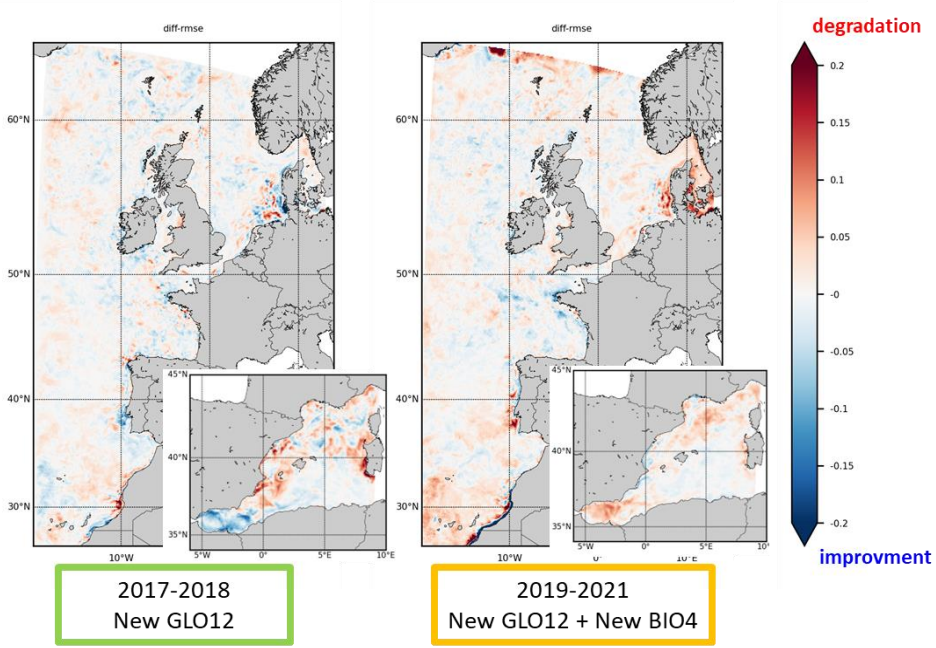
PRODUCTS: Chla, PHY, PP, NO3, PO4, O2, pH, pCO2, **Fe, SiO2, DIC Zeuph.**
Resolution: 0.028*0.028 degree, 50 vertical level

New boundary conditions from the global ocean system

Comparison with Ocean colour

--> Slight improvement on the very coastal area of the Morocco upwelling, Biscay, around Brittany
--> Slight degradation in the south-east part (oligotrophic gyre), around Danmark and Med Sea (Alboran, Gulf of Lion)
--> alternation of negative / positive differences in the open ocean
--> scale of differences very small !
--> No clear pattern

Difference of RMSD (RMSD V7 – RMSD V6)



2017-2018
New GLO12

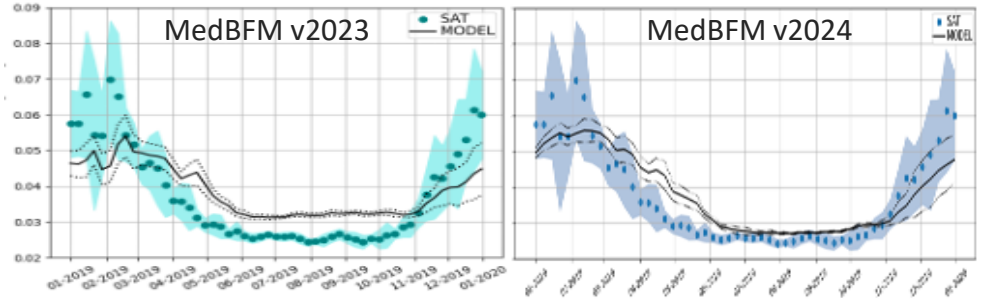
2019-2021
New GLO12 + New BIO4

Mediterranean Sea (NRT)

PRODUCTS: Chla, PHY, PP, NO3, PO4, O2, pH, pCO2, **PFT(4), SiO2, NH4, air-sea flux of CO2, Alk, DIC, Zd.**
Resolution: 0.042*0.042 degree, 125 vertical levels.

1. Improved quality for surface Kd490 [m-1] in summer

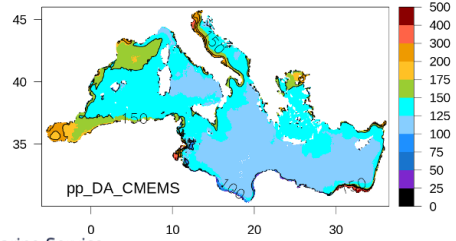
Update bio: revision of the bio-optical model.



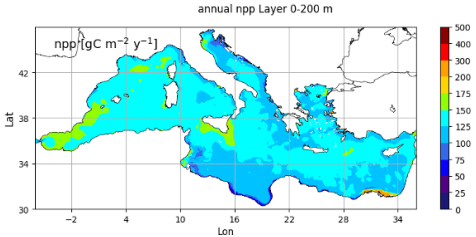
Model vs OCTAC for one of the Mediterranean subbasins

2. improved quality for net primary production (better representation of east-west gradient). Use of an improved OCTAC dataset (after positive interaction between OCTAC and Med-MFC teams)

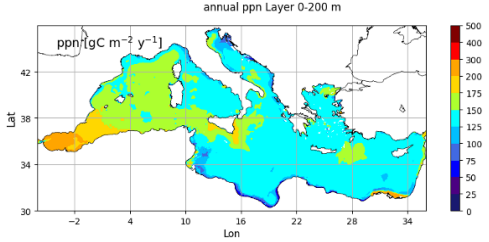
OCTAC



MedBFM v2023



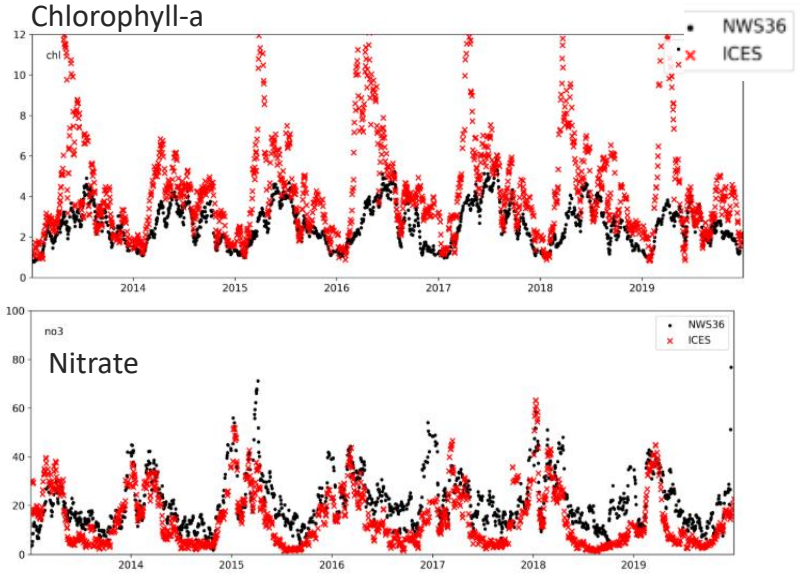
MedBFM v2024

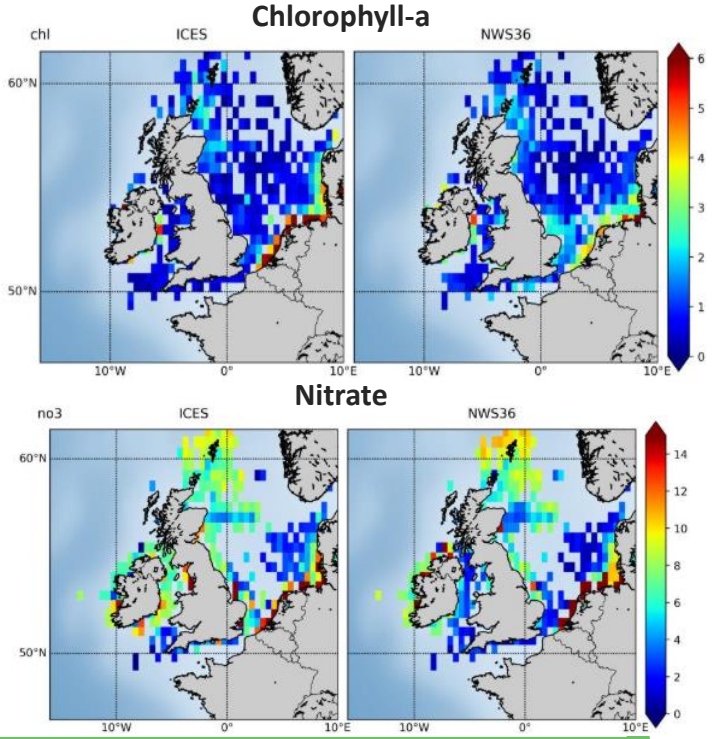


NWS (NRT)

PRODUCTS: Chla, PHY, PP, NO3, PO4, O2, pH, pCO2, **Kd.**
Resolution: 0.028*0.028 degree, 50 vertical levels.

Change of the modelling system configuration and resolution.





Baltic Sea (MY)

PRODUCTS: Chla, PHY, PP, NO3, PO4, O2, pH, pCO2, **NH4, Sechi Disk.**
Resolution: 2*2 km, 56 vertical levels

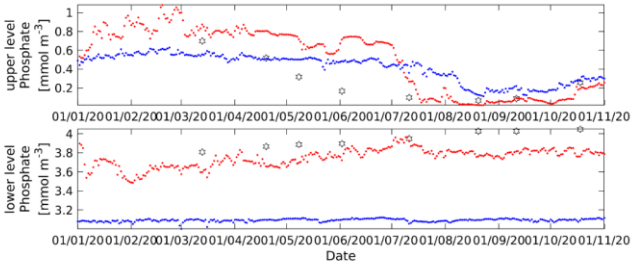
Switch to **Nemo 4.2.1**

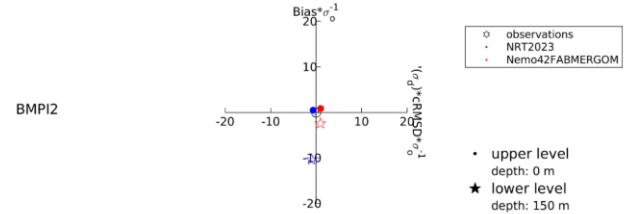
Update bio model ERGOM to new version (bio-optical module with CDOM)

Increased resolution

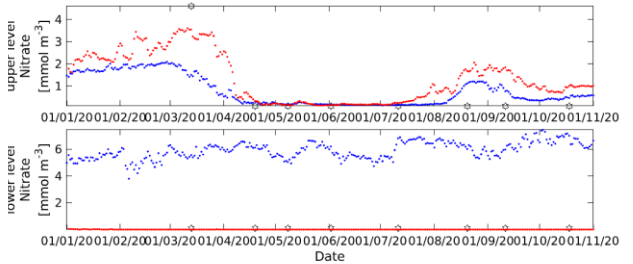
Improved boundary conditions: updated- e-hype.

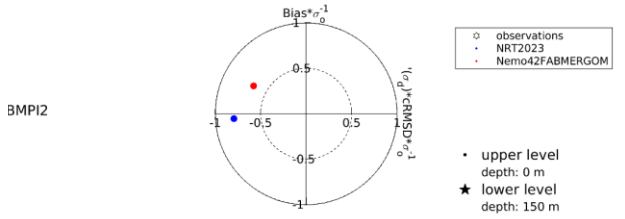
Phosphate





Nitrate

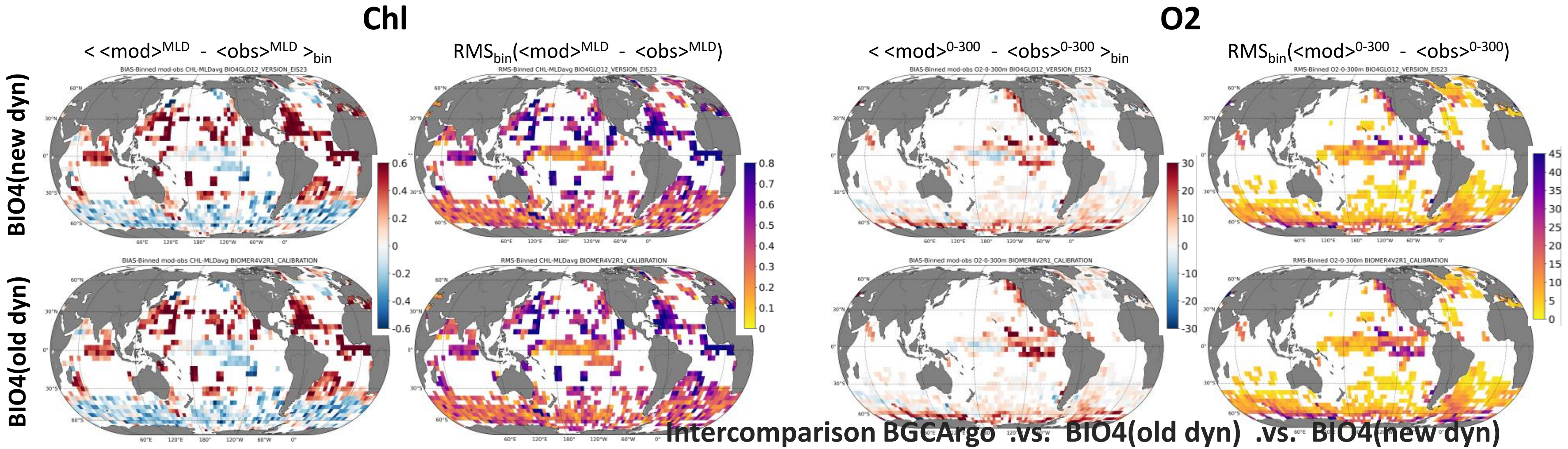




Global Ocean (MY)

PHYSICS: improved transport, parametrization.

PRODUCTS: Chla, PHY, PP, NO3, PO4, O2, pH, pCO2, **Fe, SiO2.**
Resolution: 0.25*0.25 degree, 50 vertical level



Intercomparison BGCArgo .vs. BIO4(old dyn) .vs. BIO4(new dyn)

dataset – 2019-2022

=> Overall similar performances…
model slightly overproductive, but O2 slightly more realistic

System Evolution in 2024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NRT Systems' planned evolutions in 2024

Model resolution/domain

- ARCTIC: Inclusion of sea ice algae
- BALTIC: Bio-optic model
- BLACK: Radiative transfer, ZOO, ODU
- MED: revised bio-optics
- GLOBAL: 3D ZOO, Low and Mid-Trophic Levels

BIO Models/Products

- IBI: Kd
- North West Shelf: Ibi system

Data Assimilation

- Black: multi-obs (Argo)
- MED: ML-derived nitrate + balancing scheme

Forcings & Coupling

- ARCTIC: Physics with DA
- BLACK: two-way coupling with NEMO 4.2, CAMS

Simulations/Availability

- IBI: daily updates of the 10-day forecasts

MY Systems' planned evolutions in 2024

Model resolution/domain

- ARCTIC: 30 km -> 12km, 28->50 hybrid layers
- GLOBAL: switch to a Yin/Yang computational grids framework

BIO Models

- IBI: ZOO
- ARCTIC: phys-bio: satellite (SST, Sea-ice), in-situ (Argo, others)
- BALTIC: multiobs (O2, nutrients)

Data Assimilation

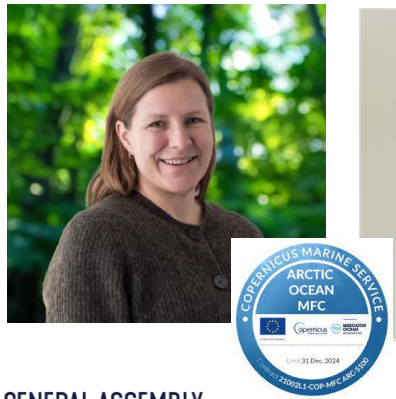
- ARCTIC: GLO-MFC, climatological freshwater discharge from Arctic hype + E-Hype and Greenland Ice sheet CCI climatology

Forcings & Coupling

- ARCTIC: Long-term hindcast 1950-2022
- BLACK: Long-term hindcast 1950-2022
- BALTIC: Long-term hindcast 1980-1995
- GLOBAL: interim production up to month-1

Availability

- IBI: Extension of the reanalysis upt to 2023



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