IMPACT OF ENHANCEMENT OF THE NUMBER AND TYPES OF ASSIMILATED OBSERVATIONS IN THE BIOGEOCHEMICAL MODELLING OF THE MEDITERRANEAN SEA

ANNA TERUZZI, SIMONE SPADA, CAROLINA AMADIO AND GIANPIERO COSSARINI

OGS National Institute of Oceanography and Applied Geophysics

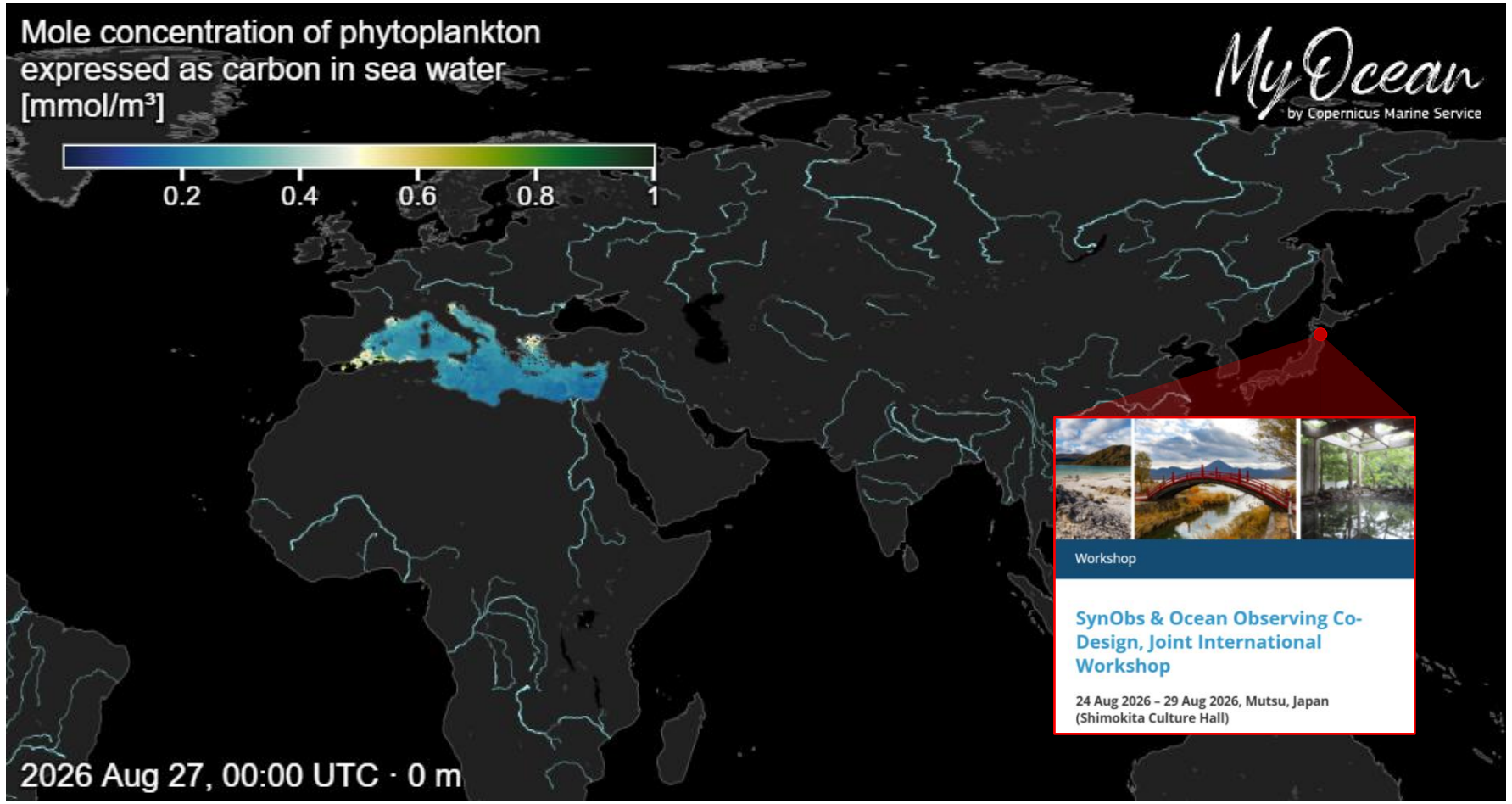


SynObs & Ocean Observing Co-Design Joint International Workshop

24 Aug 2026 – 29 Aug 2026, Mutsu, Japan

OPERATIONAL BIOGEOCHEMICAL MODELLING

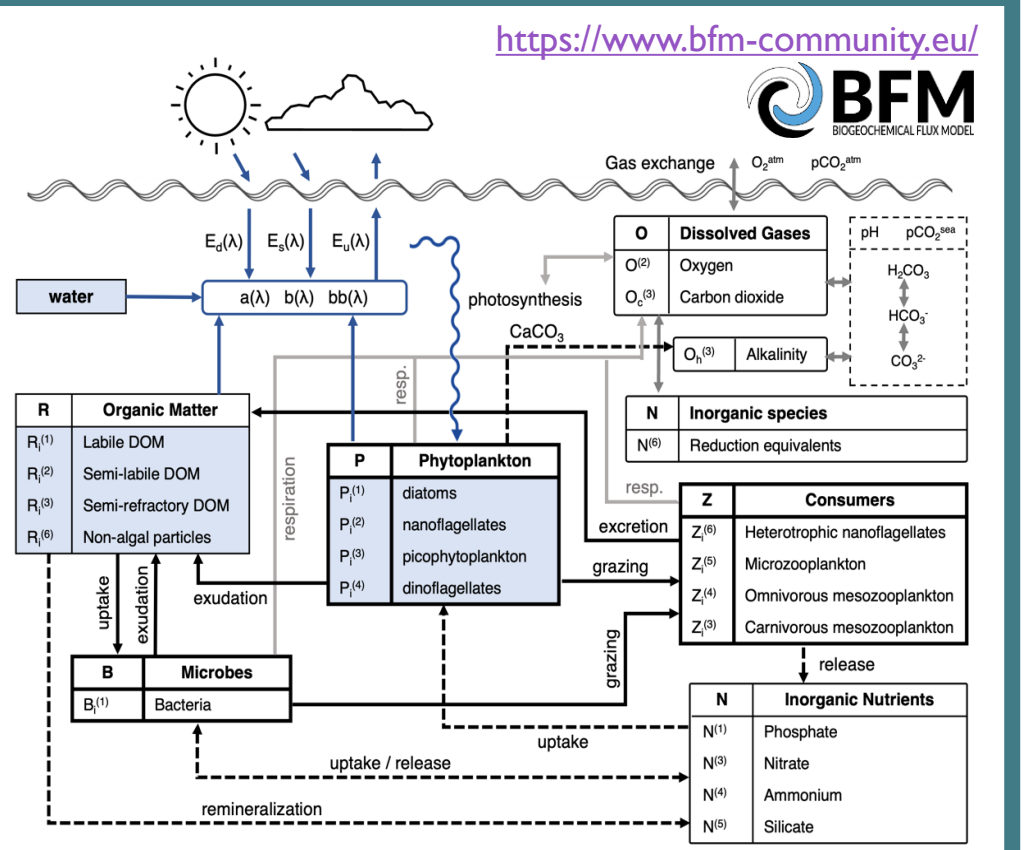
Forecast and reanalysys of Mediterranean Sea biogeochemistry
https://marine.copernicus.eu/



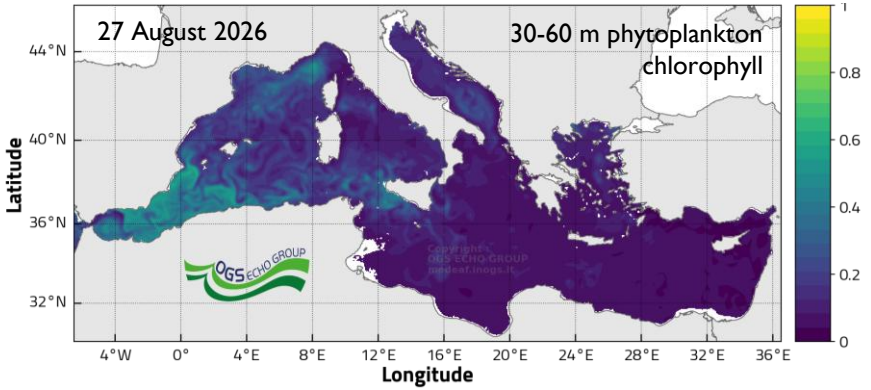
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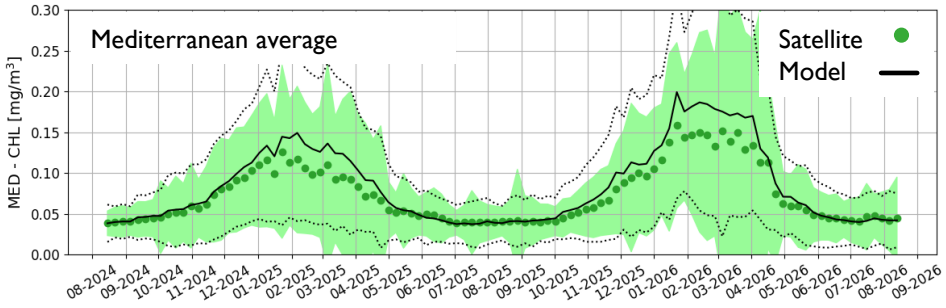
MedBFM system

https://www.bfm-community.eu/



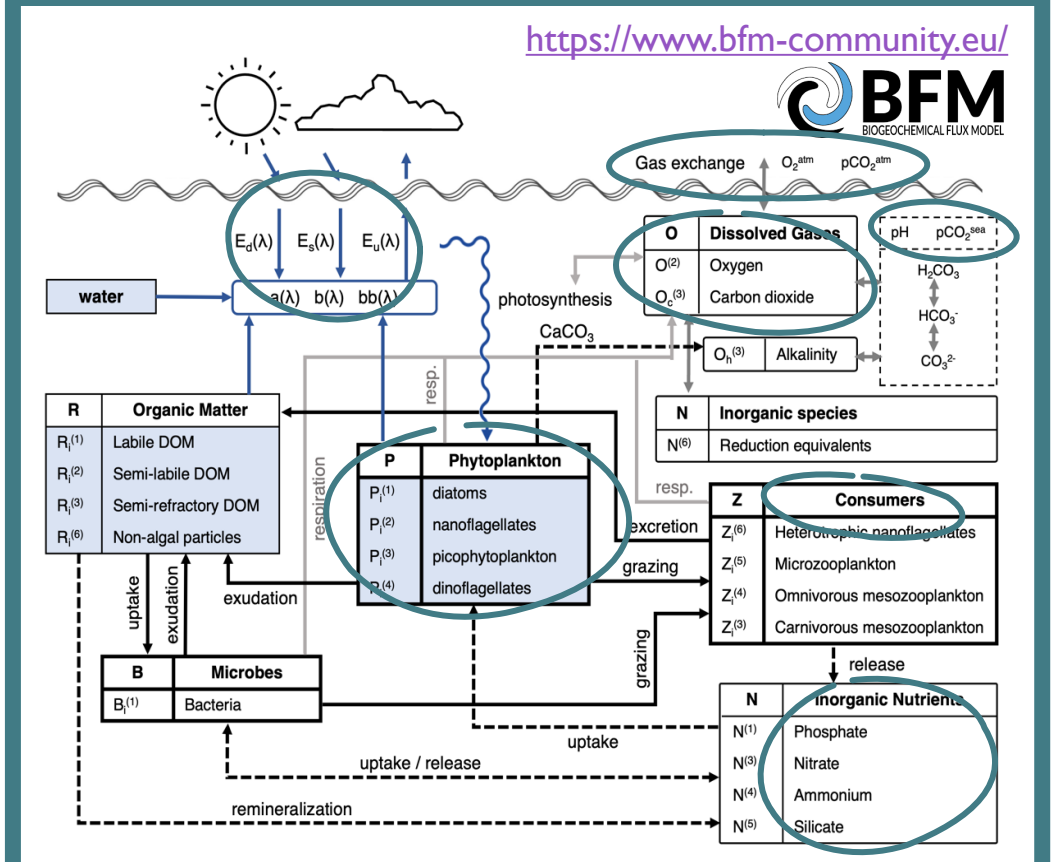
Spatiotemporal evolution of >50 variables





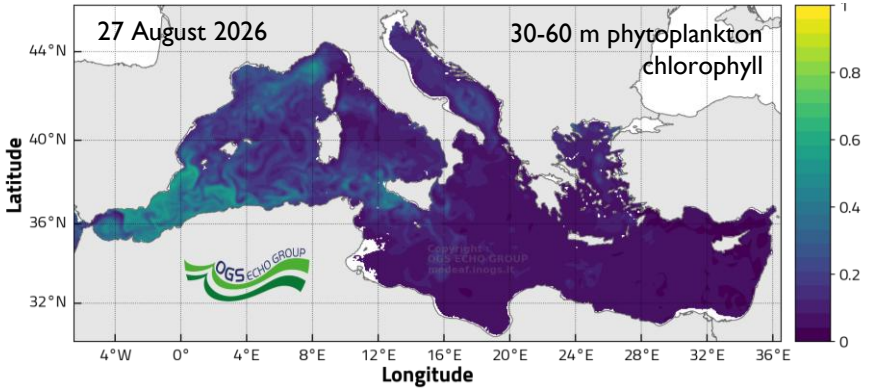
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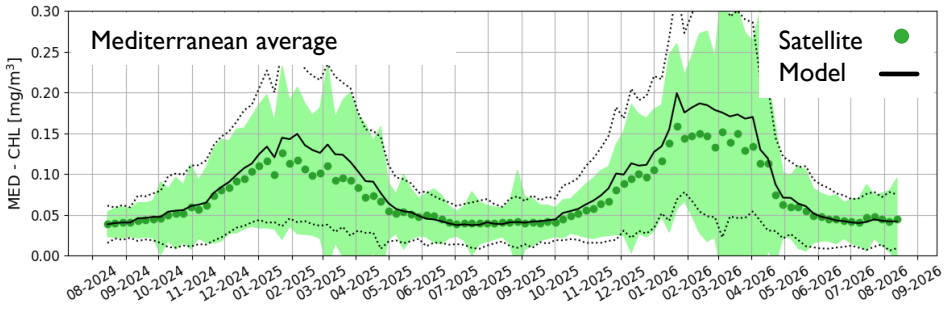
MedBFM system



Spatiotemporal evolution of >50 variables

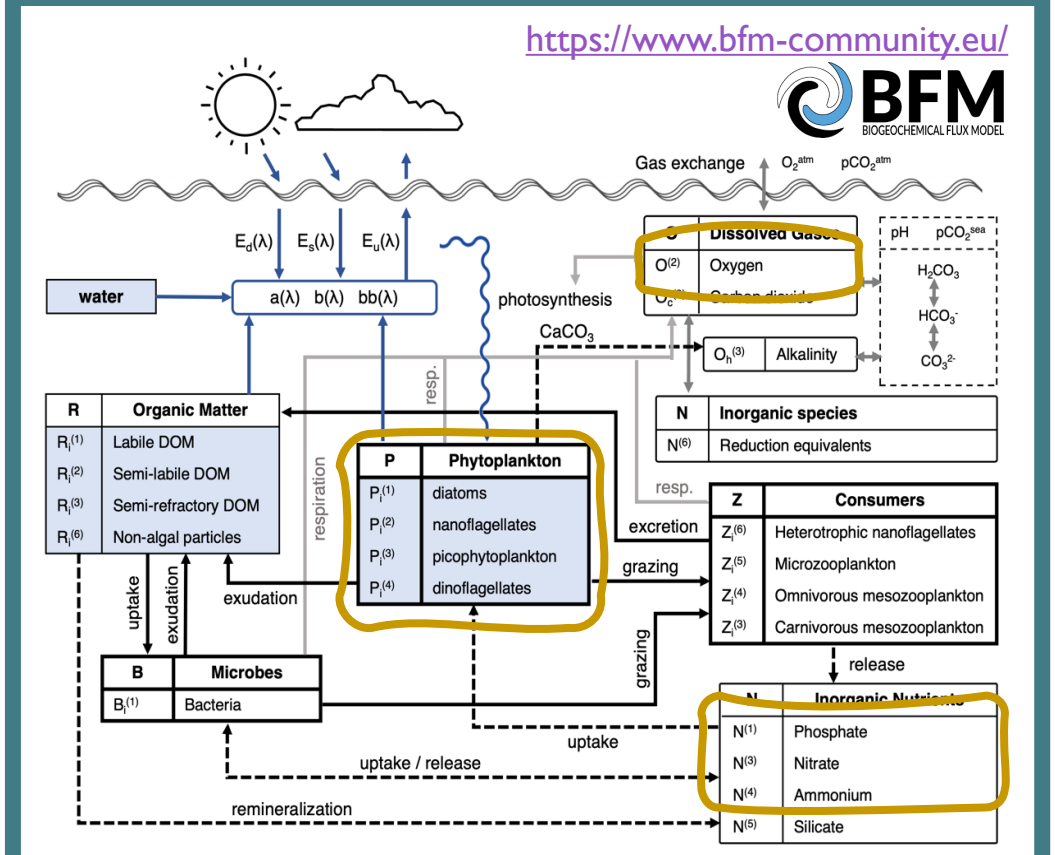
→ 23 operational products



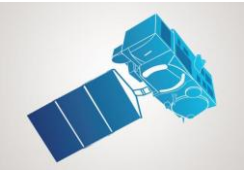


OPERATIONAL BIOGEOCHEMICAL MODELLING

MedBFM system



Data assimilation



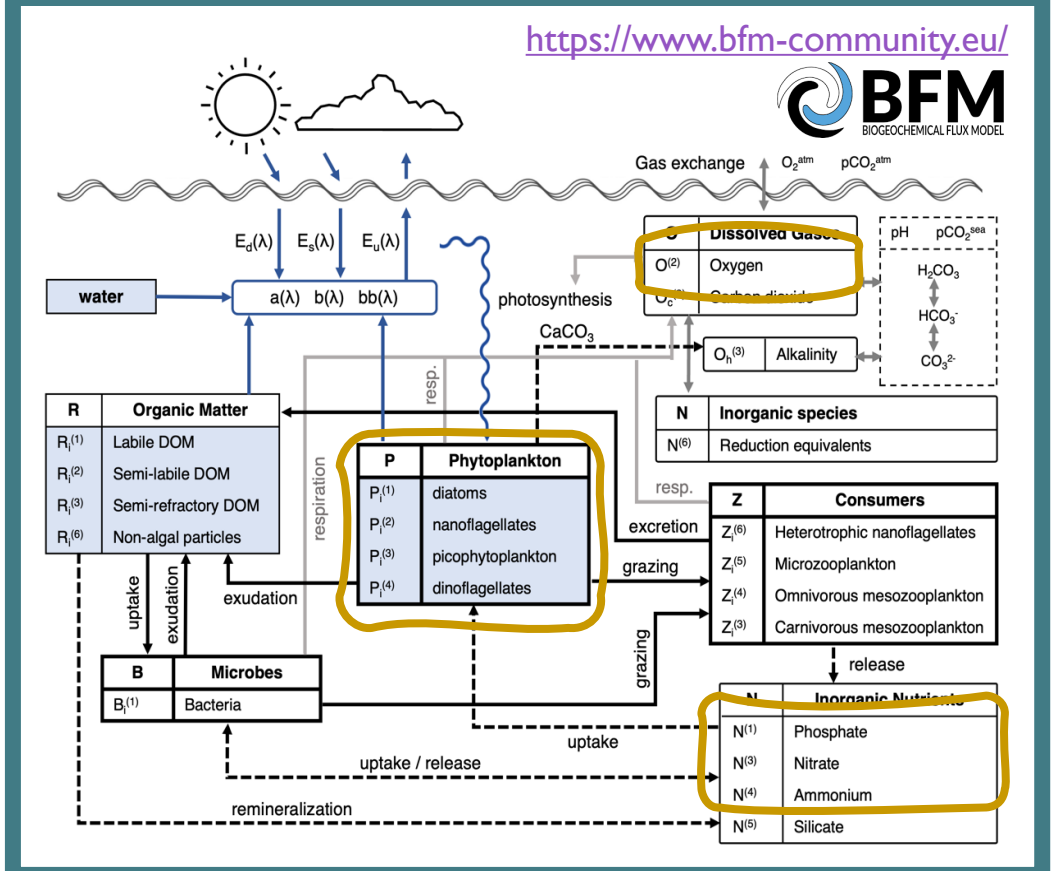
- Satellite chlorophyll
- BGC-Argo float chlorophyll, nitrate and oxygen



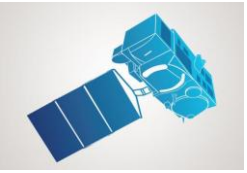
→ **Phytoplankton variables**
→ **Nitrate and phosphate**
→ **Oxygen**

OPERATIONAL BIOGEOCHEMICAL MODELLING

MedBFM system



Data assimilation

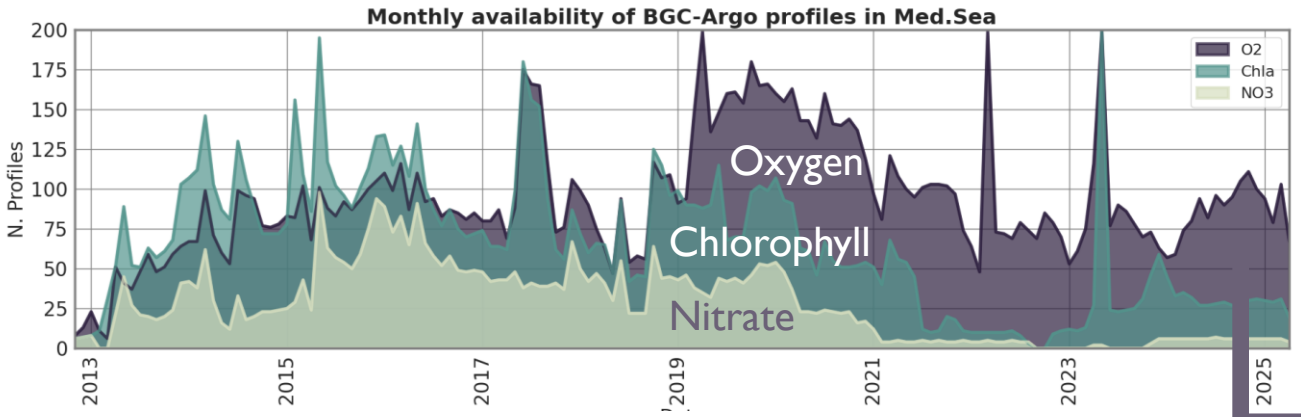


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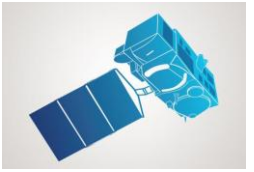


How to improve the predictability of the vertical dynamics?

INCREASE INFORMATION IN DATA ASSIMILATION



Data assimilation



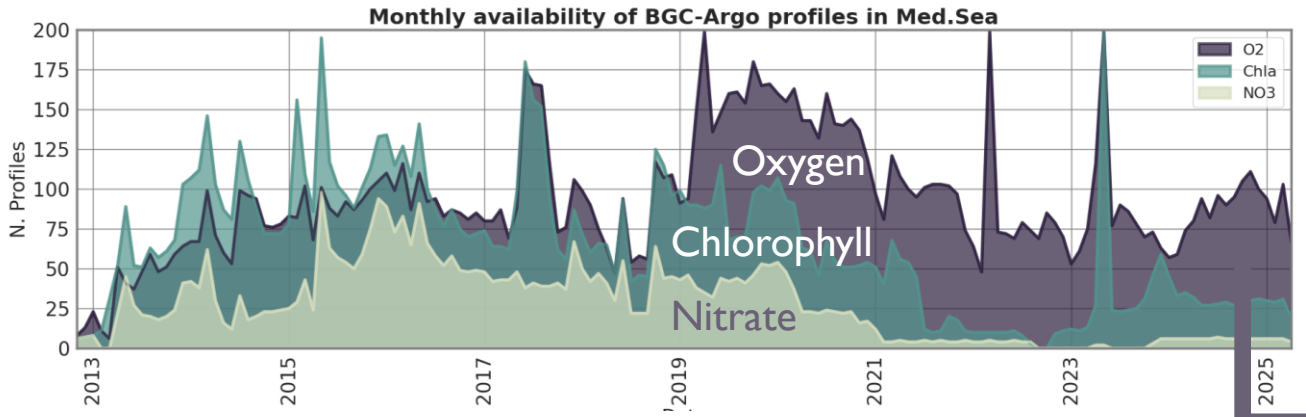
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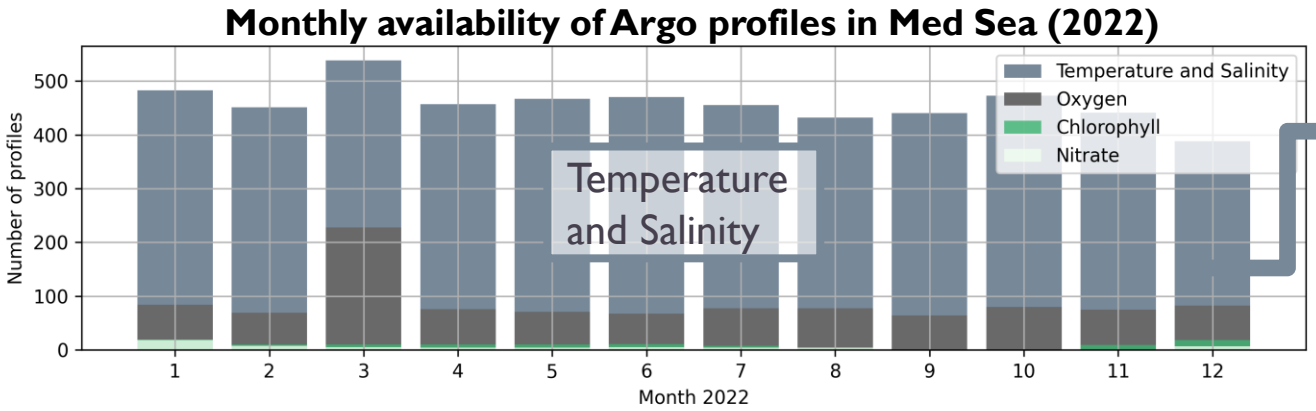


- Neural Network-augmented nitrate profiles from Oxygen, Temperature and Salinity profiles

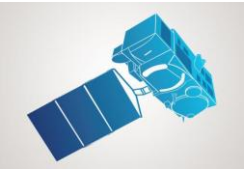
Amadio et al. (Ocean Science, 2024)

INCREASE INFORMATION IN DATA ASSIMILATION





Data assimilation



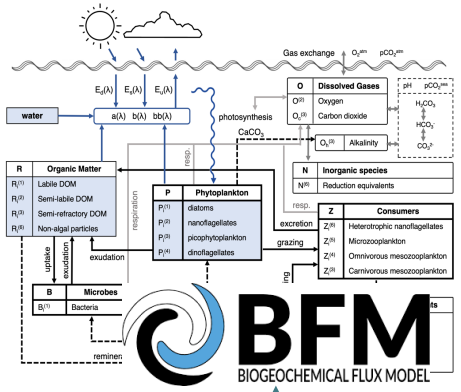
- Satellite chlorophyll
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- Neural Network-augmented profiles
- Information from temperature and salinity profiles based on density-nitrate correlation

ASSIMILATION OF DENSITY INCREMENTS

Mediterranean biogeochemistry

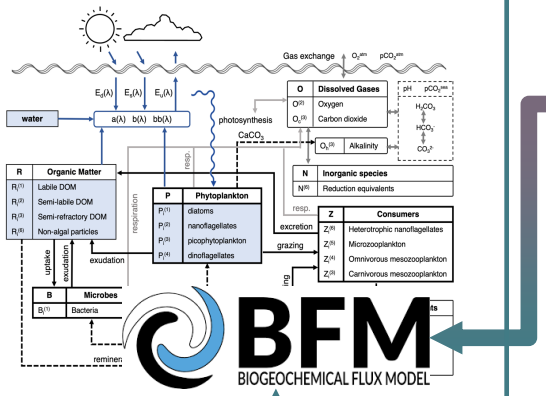


Chl, Nut, Oxy increments

Data assimilation of chlorophyll oxygen and nitrate

ASSIMILATION OF DENSITY INCREMENTS

Mediterranean biogeochemistry



Chl, Nut, Oxy increments

Data assimilation of chlorophyll oxygen and nitrate

Mediterranean marine physics

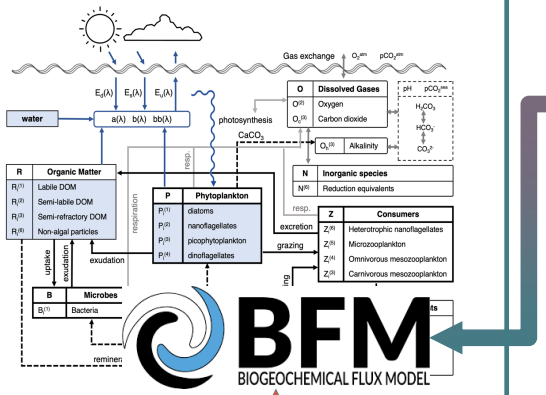
Offline coupled physical forcings

T, S increments

Data assimilation of temperature and salinity

ASSIMILATION OF DENSITY INCREMENTS

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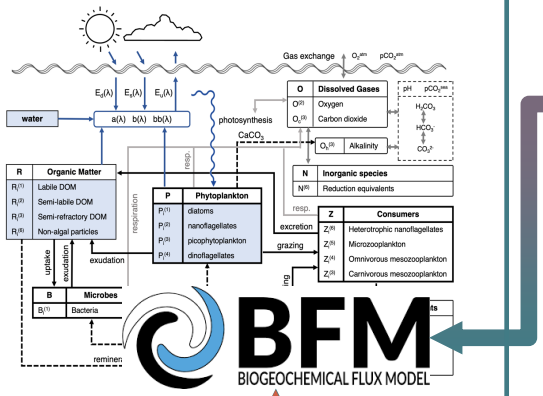
Data assimilation of temperature and salinity

Nut increments

Density increments

ASSIMILATION OF DENSITY INCREMENTS

Mediterranean biogeochemistry



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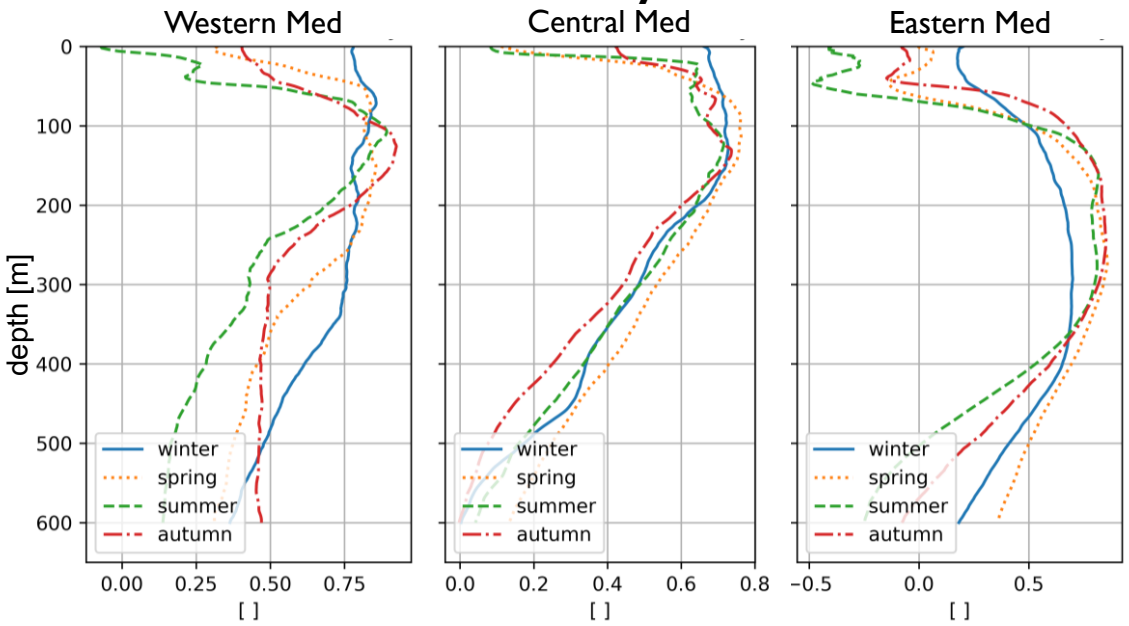
Nut increments

Density increments

Novel coupled BGC-PHY assimilation

- Update of the BGC-DA code – 3DVarBio
- Correlation by multivariate vertical EOFs computed on Argo profiles

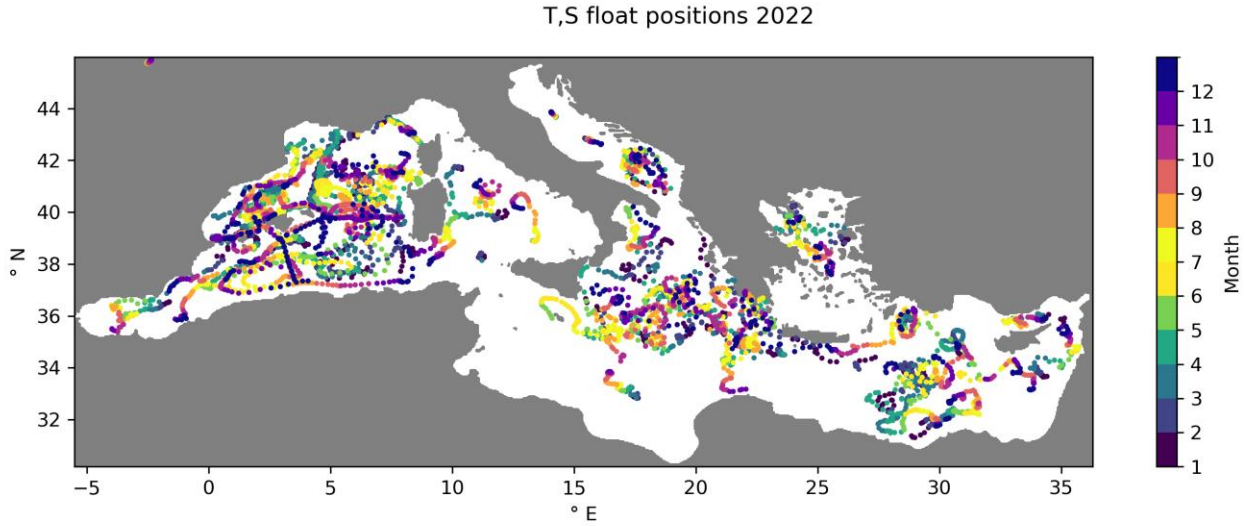
Nitrate-density correlation



RESULTS

Coupled BGC-PHY assimilation

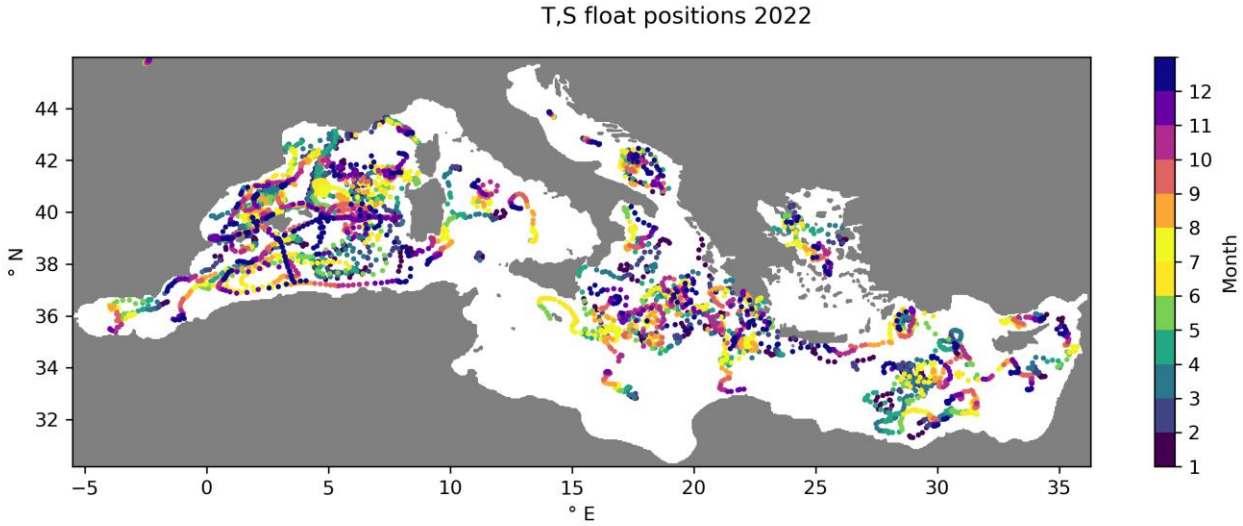
- One year simulation - 2022
- Nearly 10-15 density increment profiles assimilated per day
- Increments on nitrate and phosphate



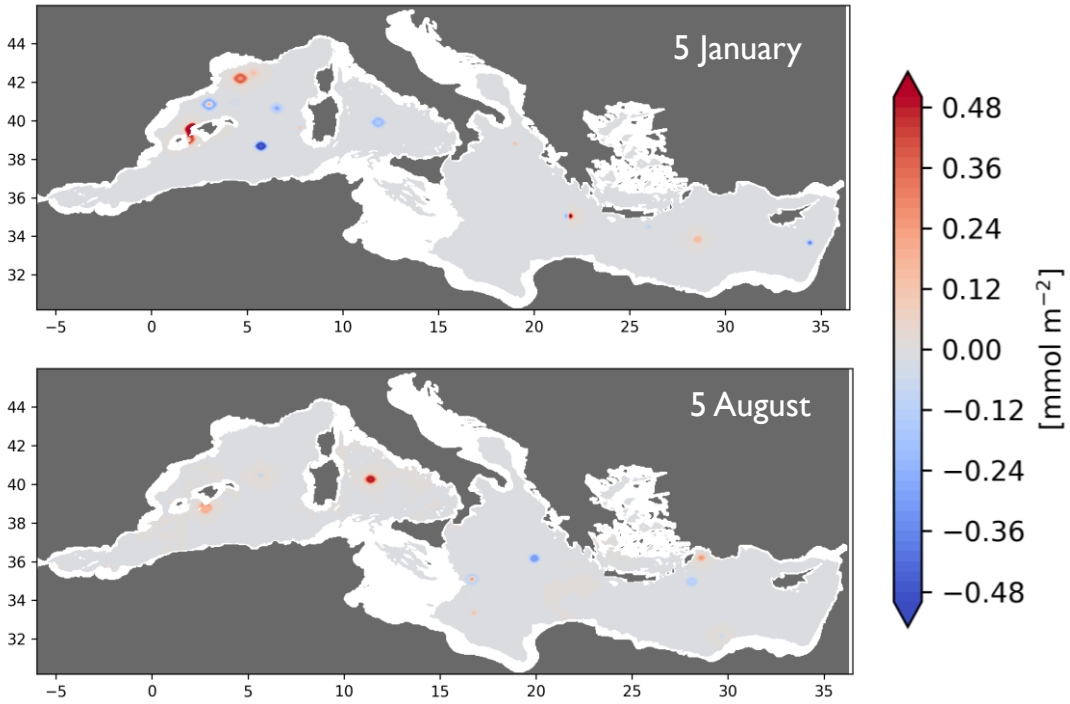
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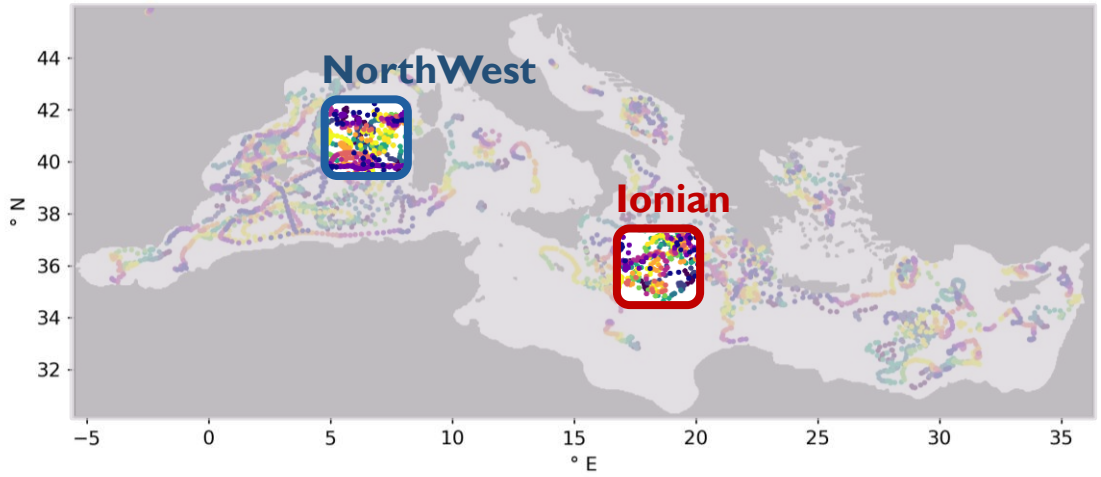
Average nitrate increments 0-600 m



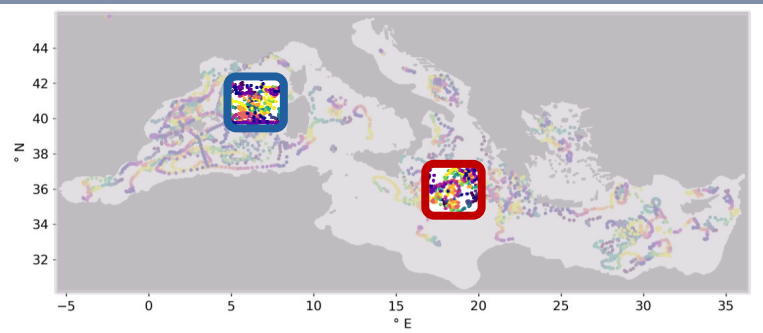
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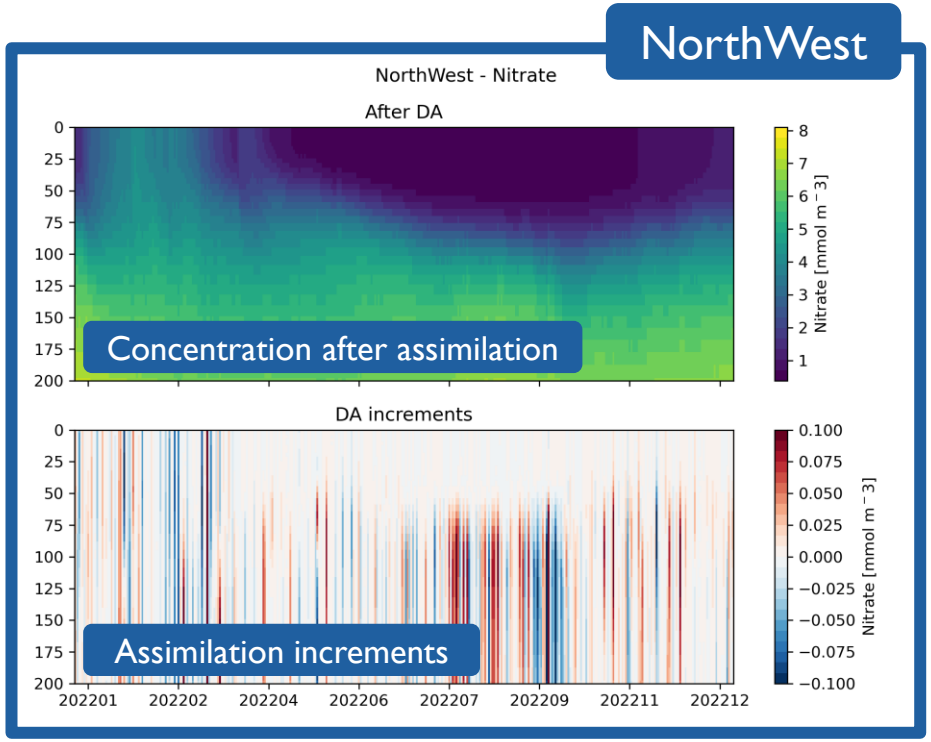


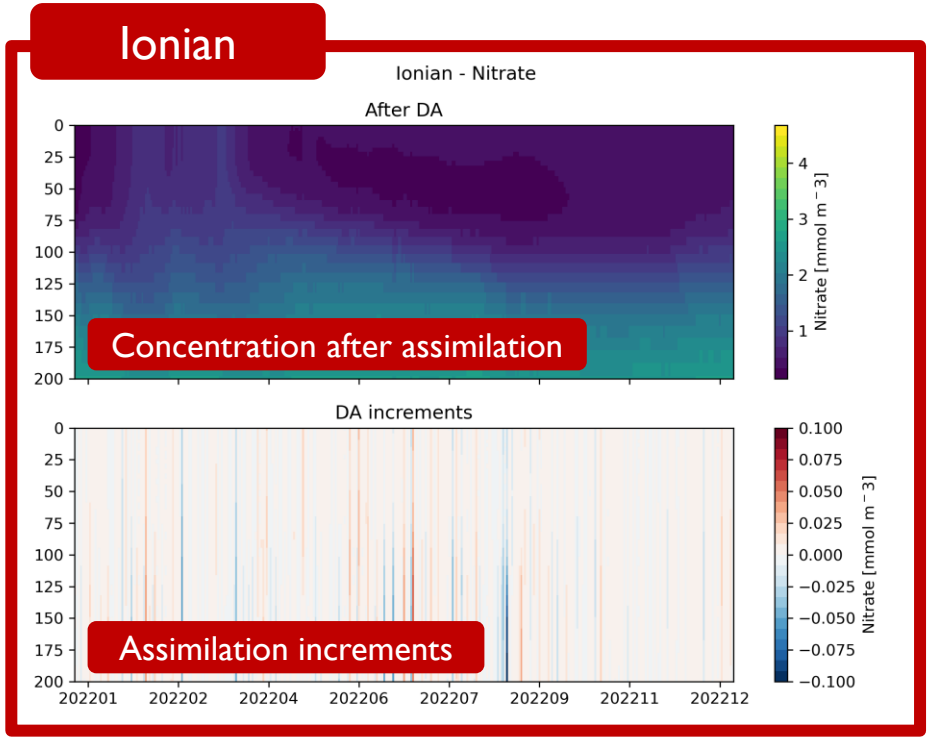
RESULTS



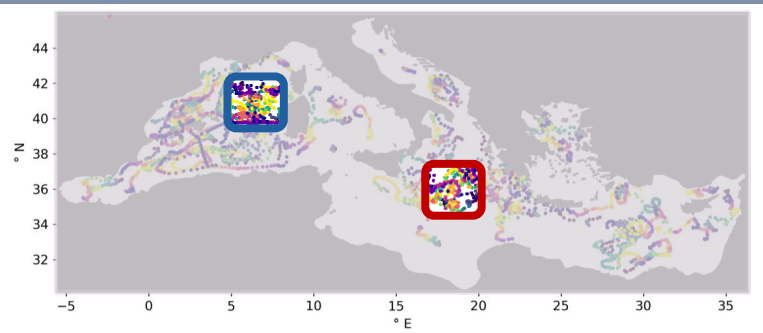
Impact on nitrate

- Temporal and spatial variability
- Larger impact in NorthWest





RESULTS



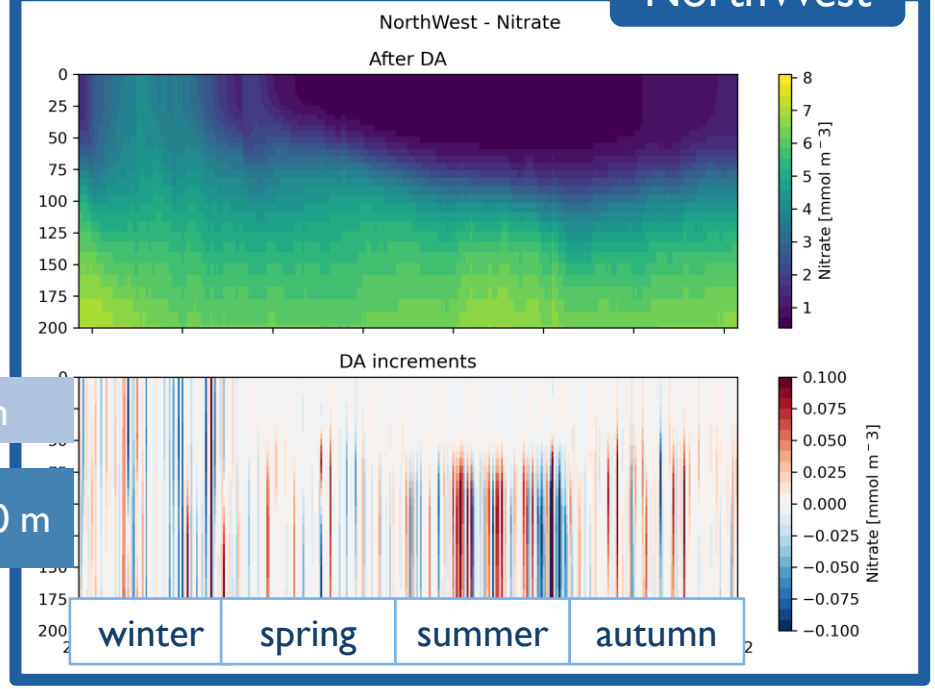
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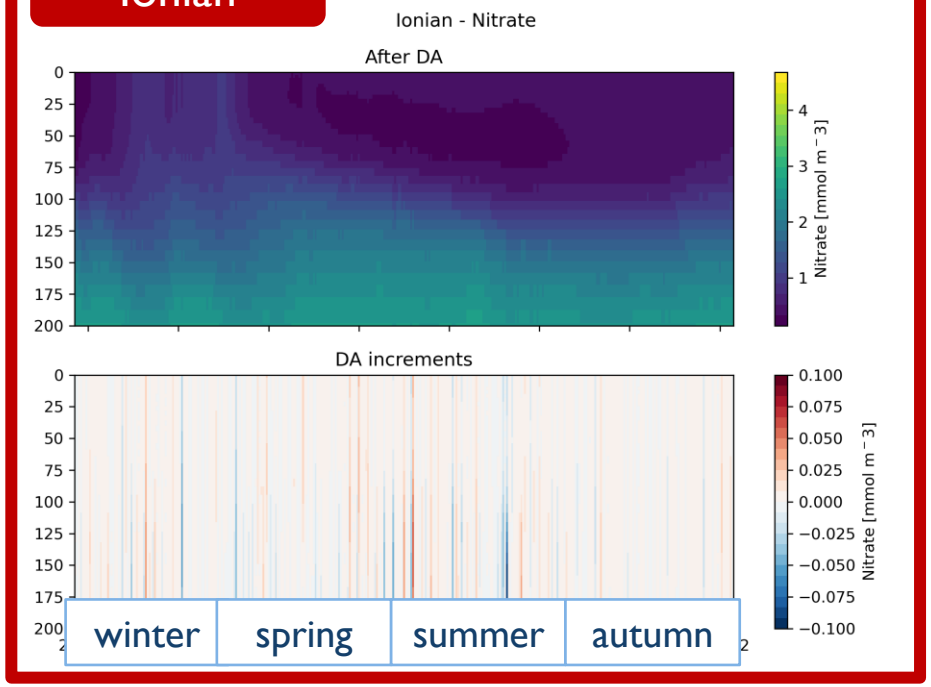
Surface 0-50 m

Nutricline 75-150 m

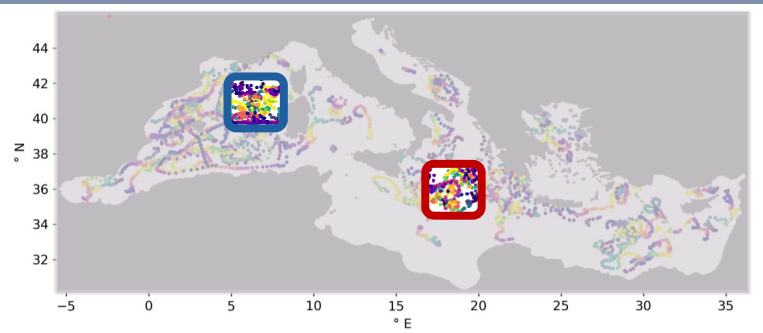
NorthWest



Ionian

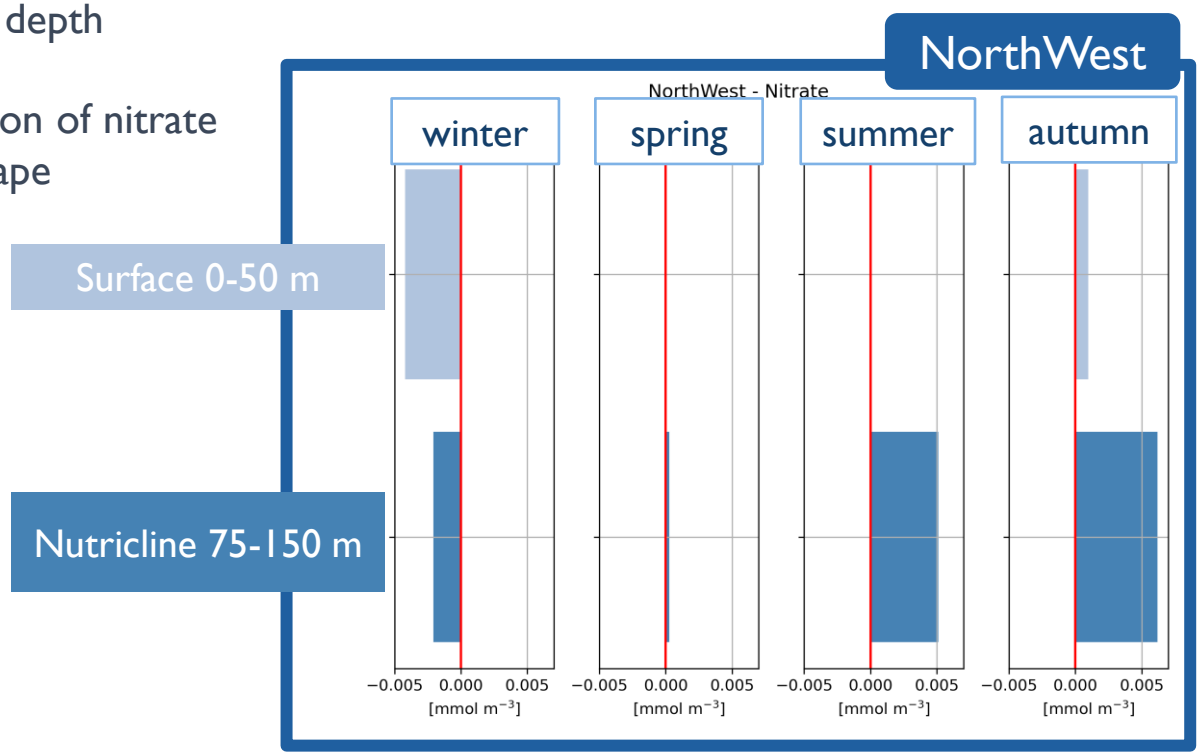


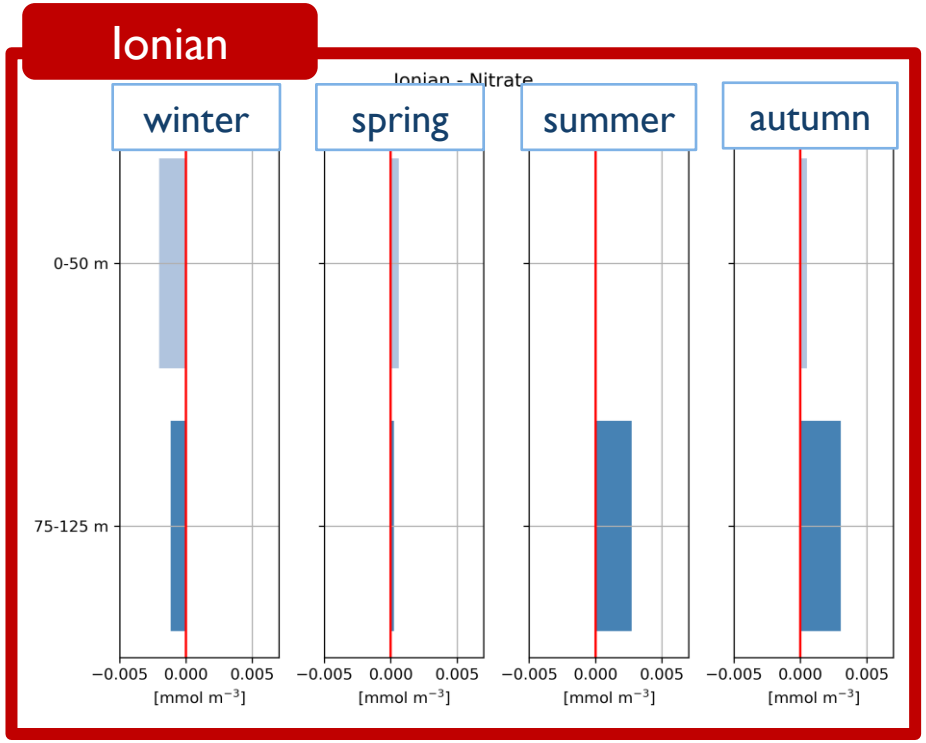
RESULTS



Impact on nitrate

- In summer and autumn larger corrections at nutricline depth
- Modification of nitrate profile shape





CONCLUSIONS AND PERSPECTIVE

- Coupled BGC-PHY assimilation based on density-nitrate covariances
- Impacts on nutrients vary seasonally and across macro sub-basins
- Effects on the shape of nutrient profiles
  - → Sharper summer nutricline
  - → Lower winter surface values

- Evaluate impacts on key ecosystem indicators
- Compare with other assimilation strategies using Argo data
  - → Assimilation of nitrate NN-segmented data

THANK YOU - ありがとう

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