Assimilating Satellite and BGC-Argo data into operational modelling of the Mediterranean Sea biogeochemistry

OGS
Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

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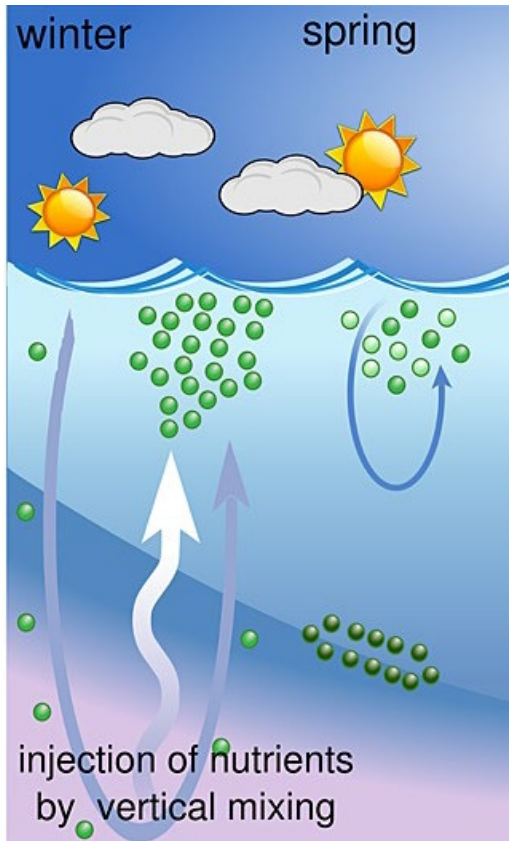
25 May 2022

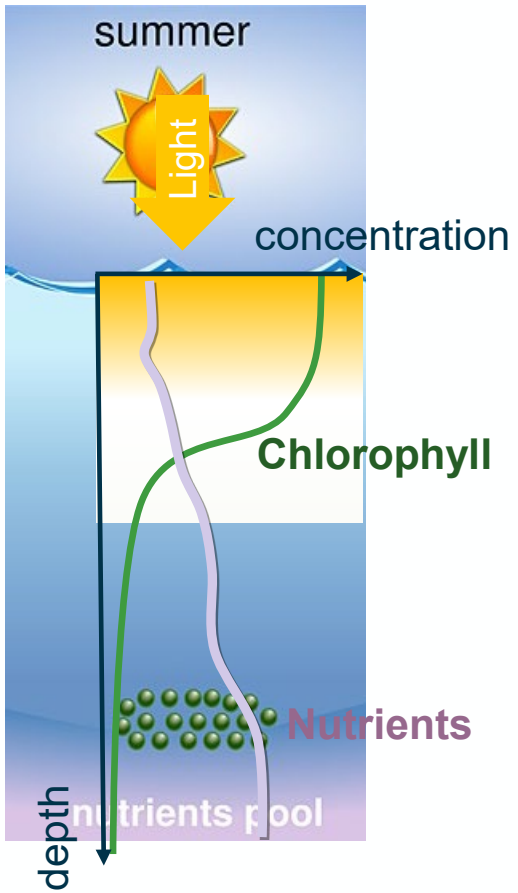
Seasonality of the Mediterranean Sea biogeochemistry

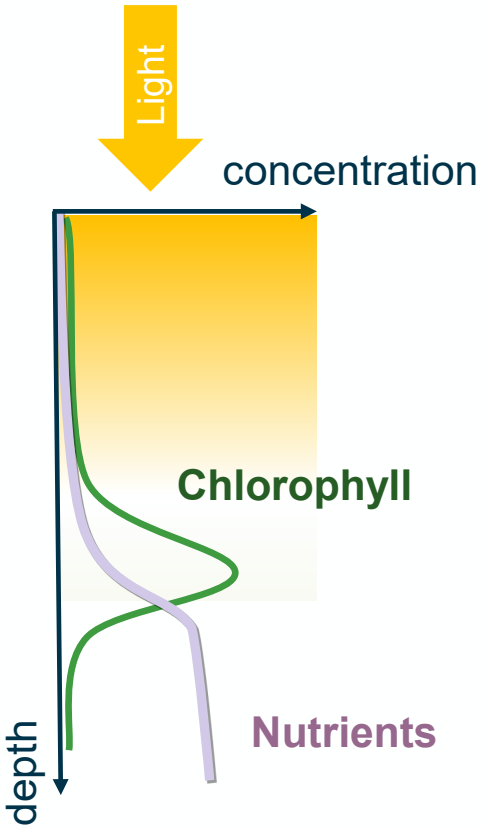
Adapted from
Mignot et al., 2014

Winter bloom



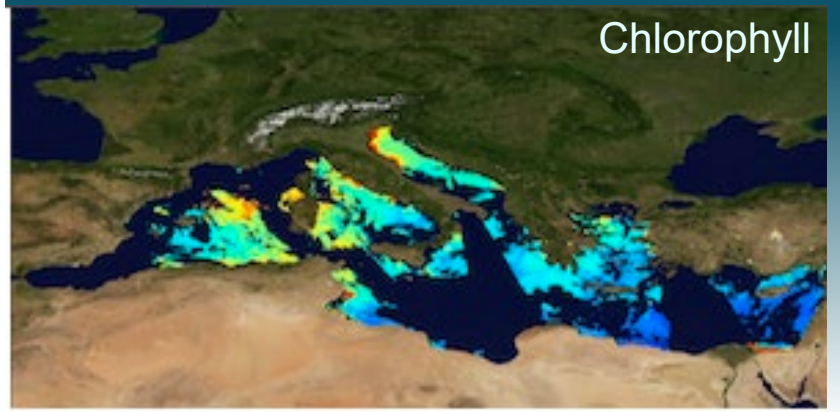
Deep chlorophyll maximum (DCM)



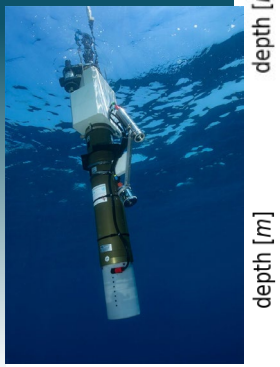


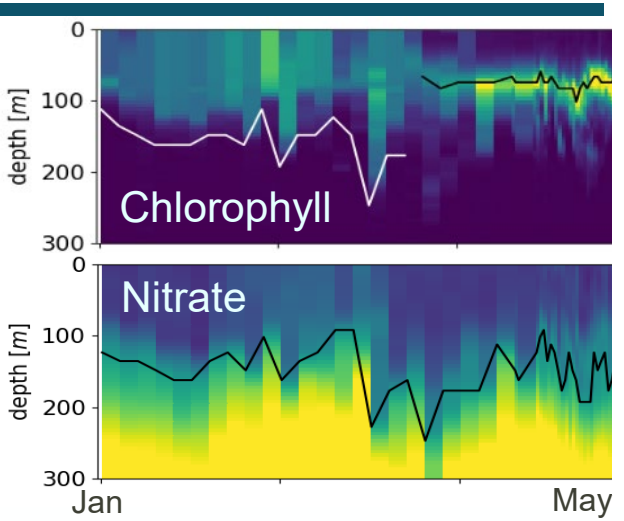
Data assimilation

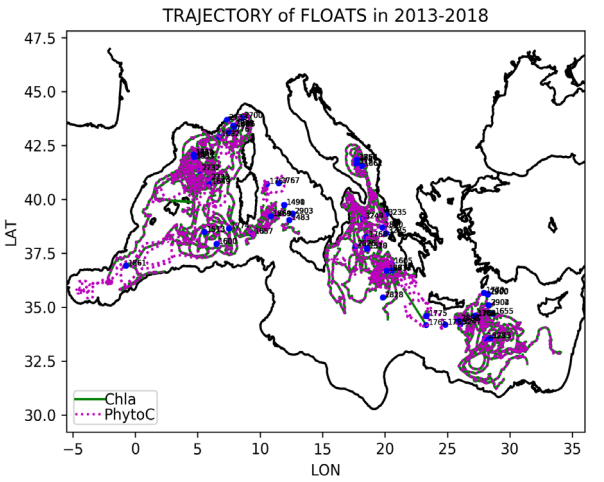
Satellite



BGC-Argo floats

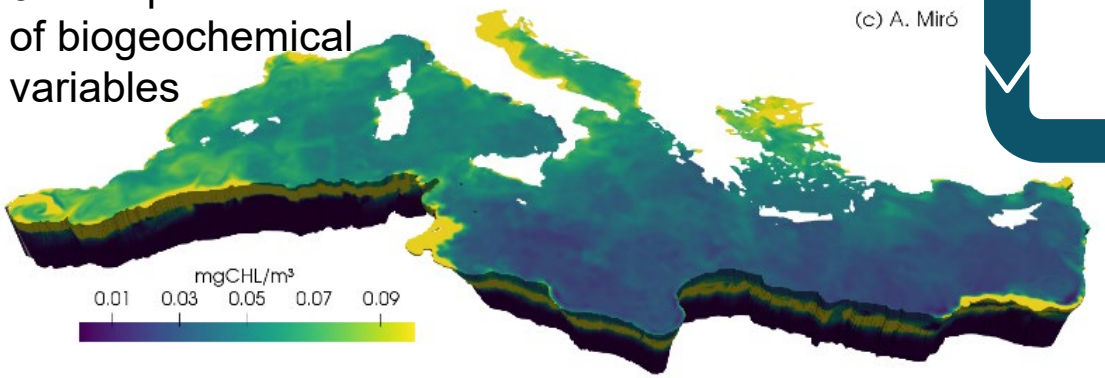






Models

3D temporal evolution of biogeochemical variables

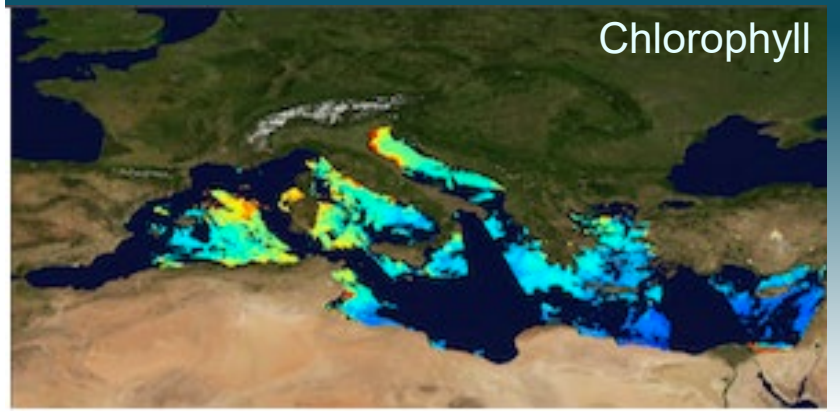


Data assimilation

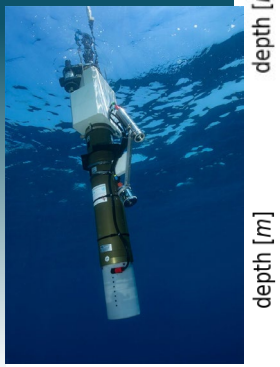
Combines observations and model with their uncertainties to provide a better representation of reality

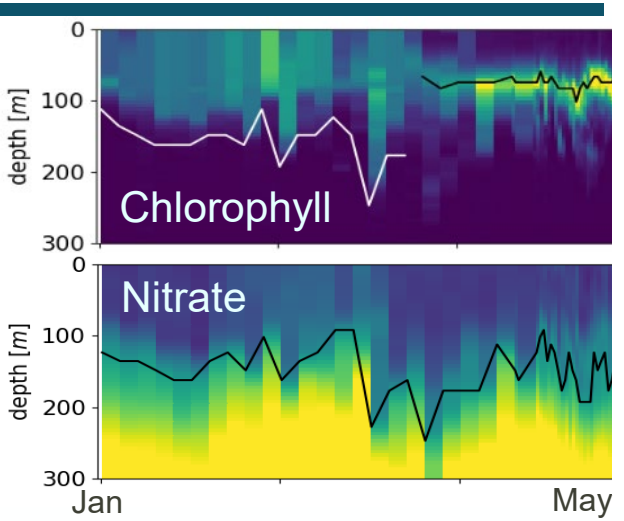
Data assimilation

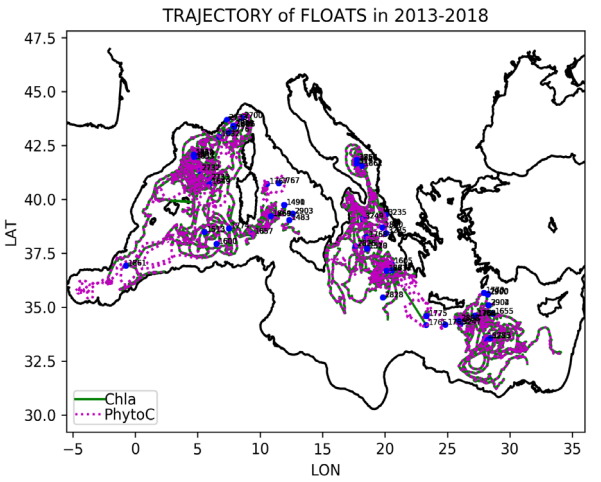
Satellite



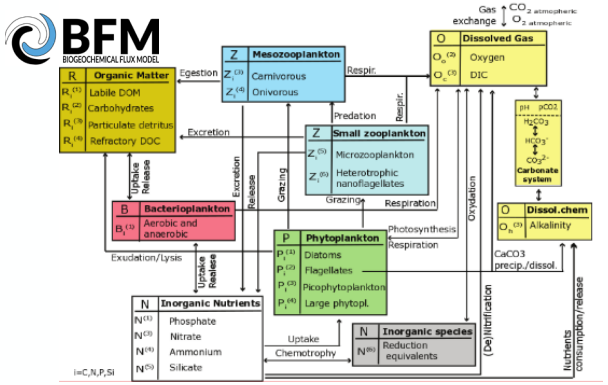
BGC-Argo floats







Models



1/16° horizontal resolution

70 levels

One year simulation 2015

Data assimilation

Daily assimilation of BGC-Argo chlorophyll and nitrate

Weekly assimilation of BGC-Argo chlorophyll and nitrate

Updates of phytoplankton and nutrient variables

Results – Assimilation impact on nitrate

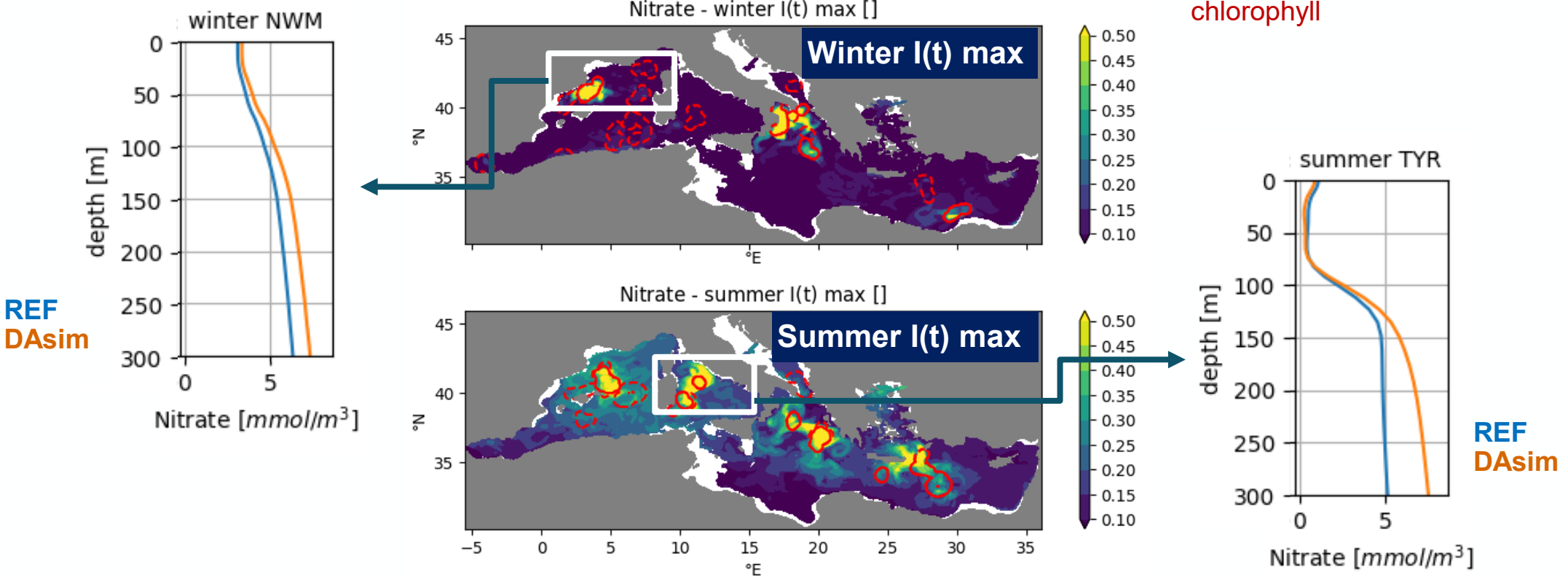
Simulation WITH data assimilation (DAsim)

REF simulation WITHOUT data assimilation

$$Impact\ indicator\ 0-200\ m\ I_{xy}(t) = \frac{|ScFcn(t) - REF(t)|_{200}}{\overline{REF(t)_{200}}}$$

BGC-Argo chlorophyll

BGC-Argo chlorophyll and nitrate



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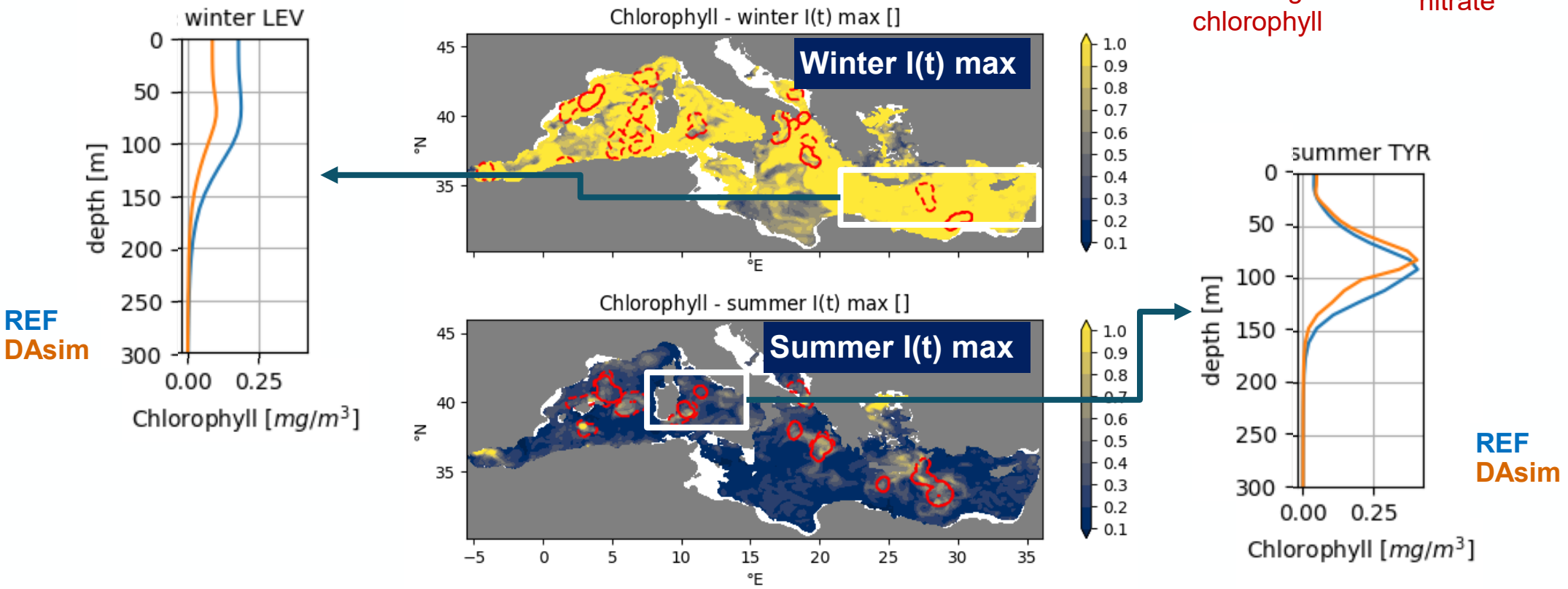
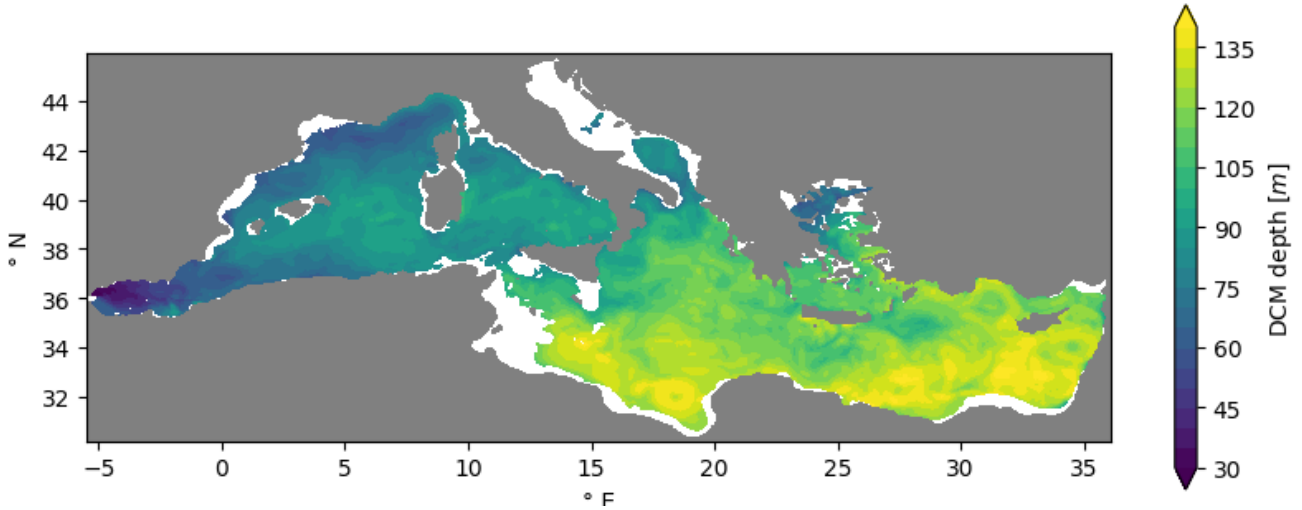
BGC-Argo chlorophyll

BGC-Argo chlorophyll and nitrate



DCM in the assimilated simulation



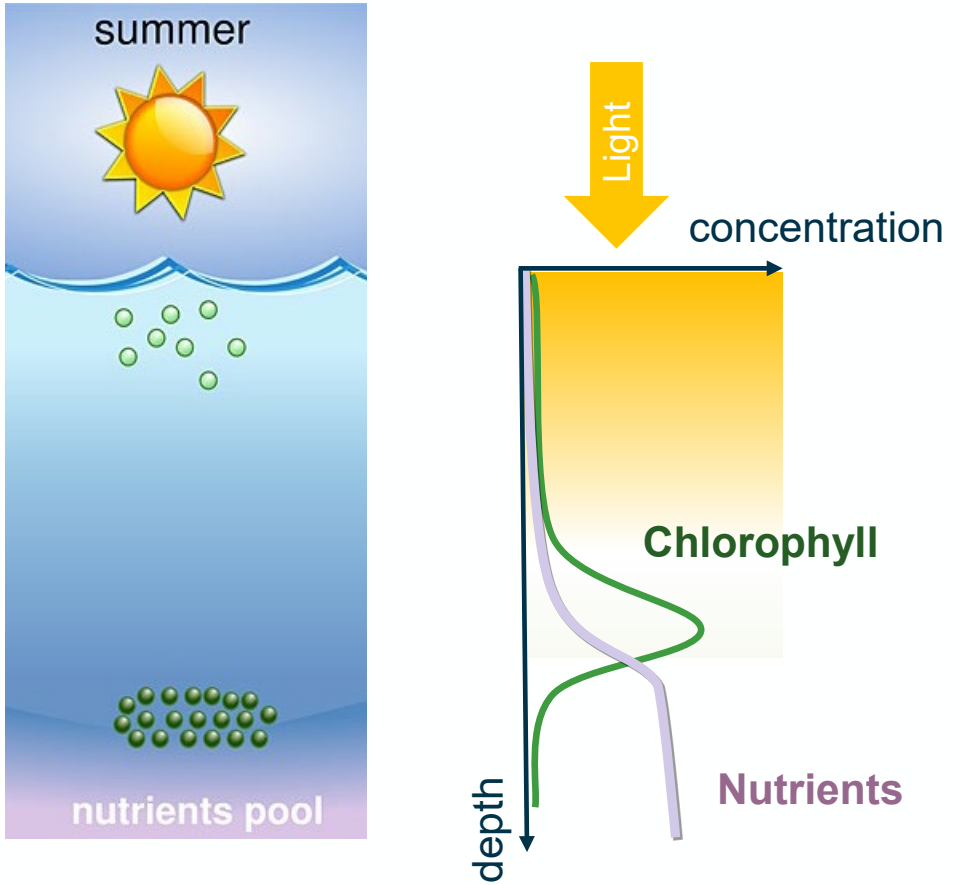
DCM depth west-east gradient

(Barbieux et al., 2019; Mignot et al., 2014)

DCM features in the western and eastern Mediterranean

Adapted from Mignot et al., 2014

Deep chlorophyll maximum (DCM)

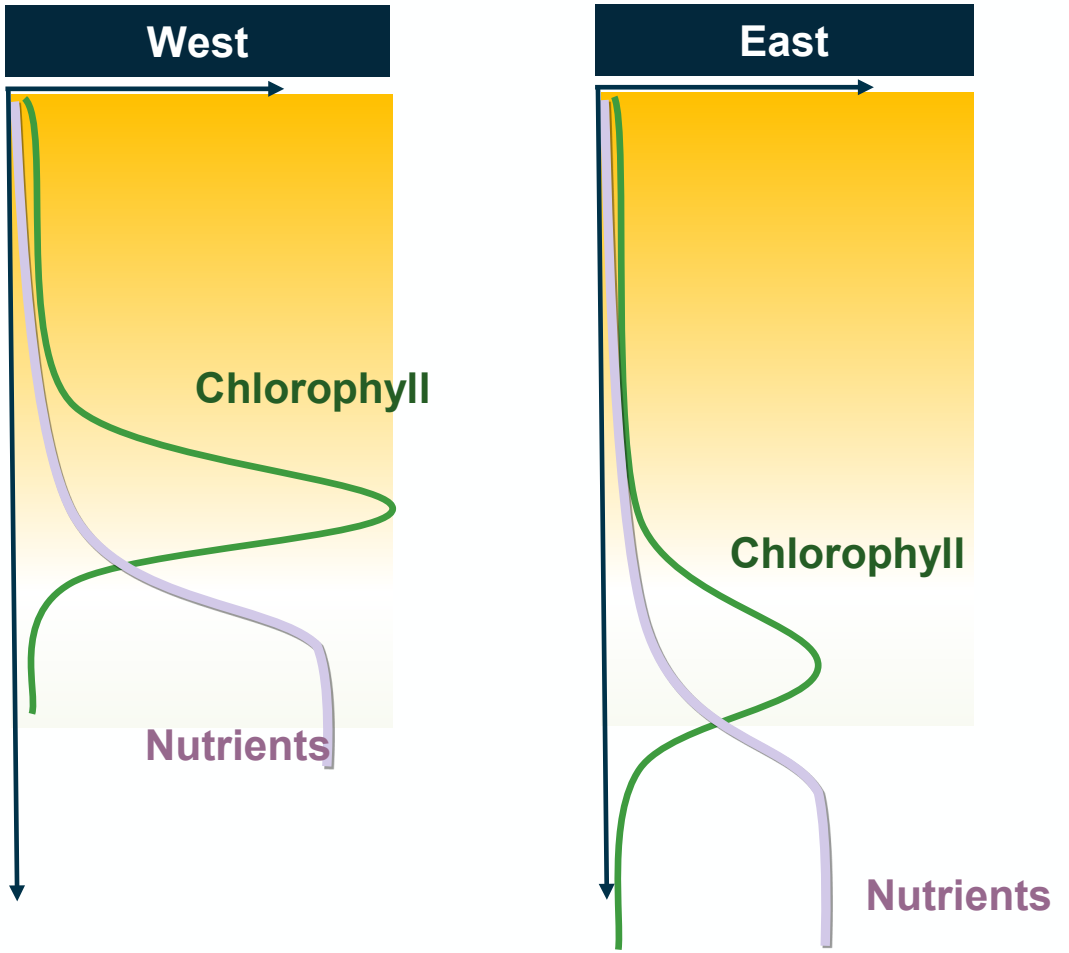


DCM west-east differences

DCM	West	East
DCM depth [m]	75-90	100-125
Chlorophyll at DCM [mg/m^3]	0.4-0.48	0.3-0.4
DCM thickness [m] (chlorophyll > 0.5 chlorophyll at DCM)	40-50	50-70

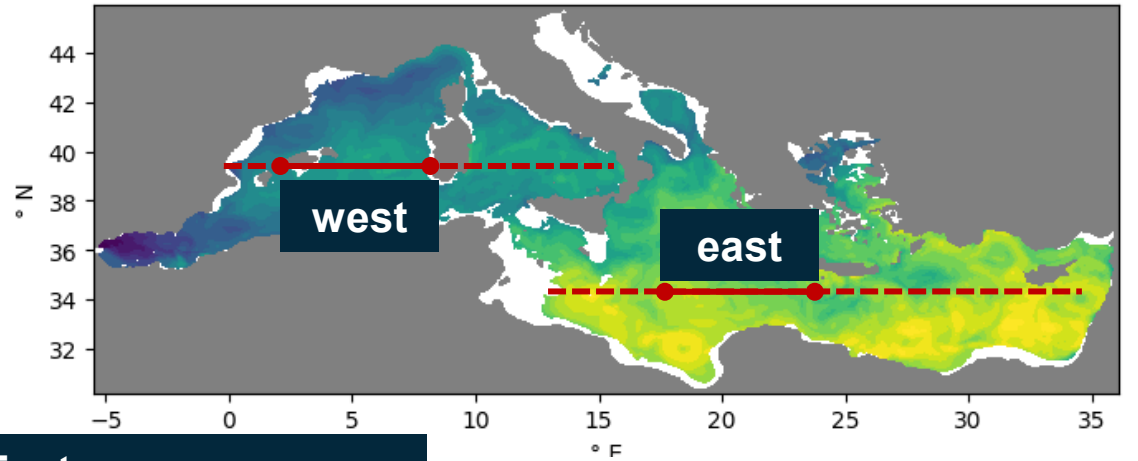
Nitracline (depth of maximum nitrate variation)	West	East
Nitracline depth [m]	80-100	125-150
Nitracline slope [mmol/m^4]	0.08-0.10	0.03-0.05
Nitrate concentration below DCM layer [mmol/m^3]	6-7.5	4.5-5

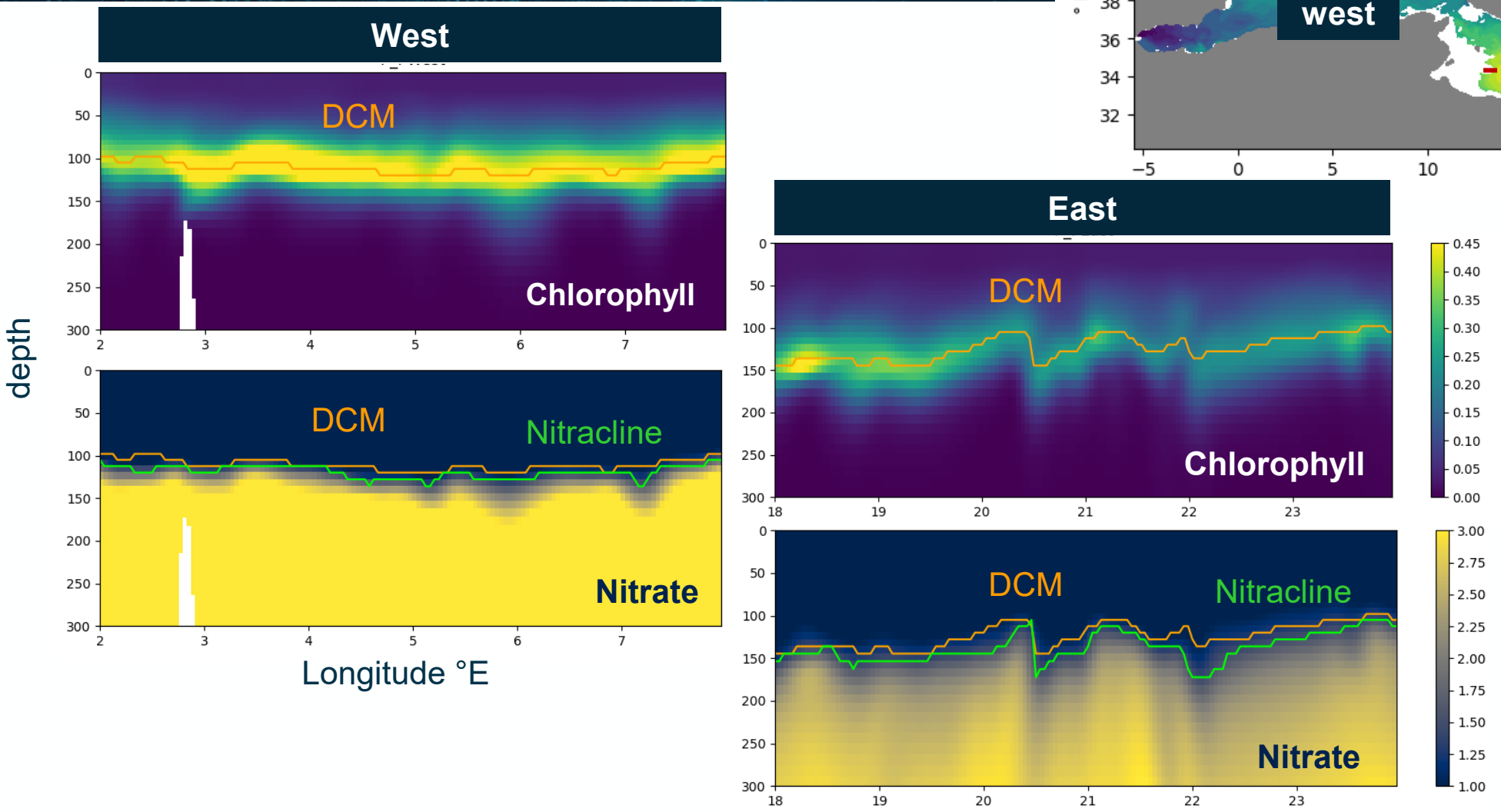
PAR	West	East
PAR at DCM [mol quanta/m^2/d^1]	1.5-2	0.6-1



DCM more productive in the western Mediterranean

DCM west-east differences





Summary and conclusion

- **Implementation of satellite chlorophyll and BGC-Argo data assimilation**

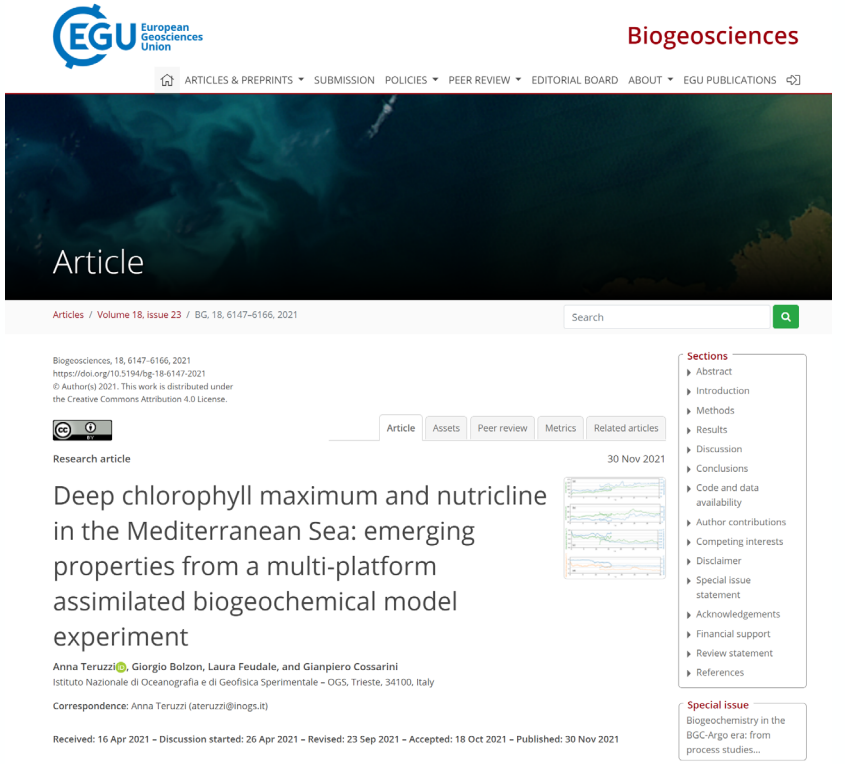
  Operational in Copernicus Marine Service using OC TAC and BGC-Argo

  + Oxygen data assimilation in November 2022

  Further development of multi-platform data assimilation in SEAMLESS H2020 project

- **West-east differences in Mediterranean Sea DCM**

  More productive western DCM



Teruzzi, A., Bolzon, G., Feudale, L., and Cossarini, G, Biogeosciences 2021 https://doi.org/10.5194/bg-18-6147-2021

Discussion

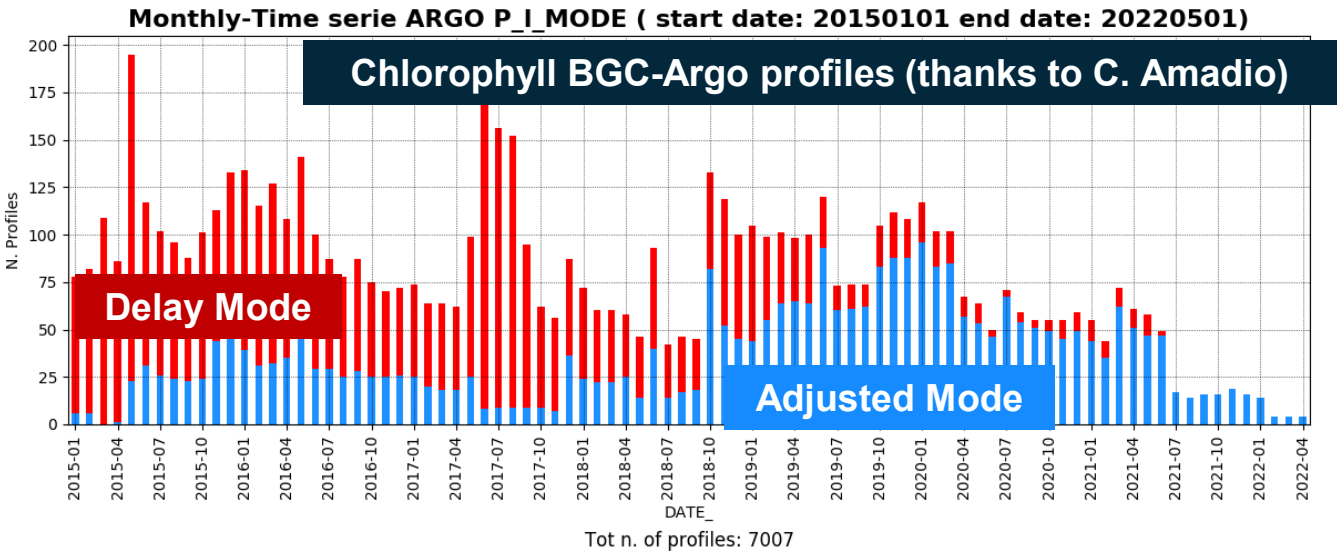
BGC-Argo valuable sources of information

View of the ocean interior

Several observed variables

Used in a near time framework → assimilation and validation

Use of more variable in the future (optics)



Consistency with other data sets → satellite

Quality control in near real time

Good coverage should include at least 2 fully equipped BGC-Argo in the eastern and western Mediterranean

Quality or coverage degradation → impact on Copernicus Marine Service Analysis and Forecast products

DLR

esa

living planet symposium | BONN 23–27 May 2022

TAKING THE PULSE OF OUR PLANET FROM SPACE

SEAMLESS

Copernicus Marine Service

EUMETSAT ECMWF EUSPA

THANK YOU

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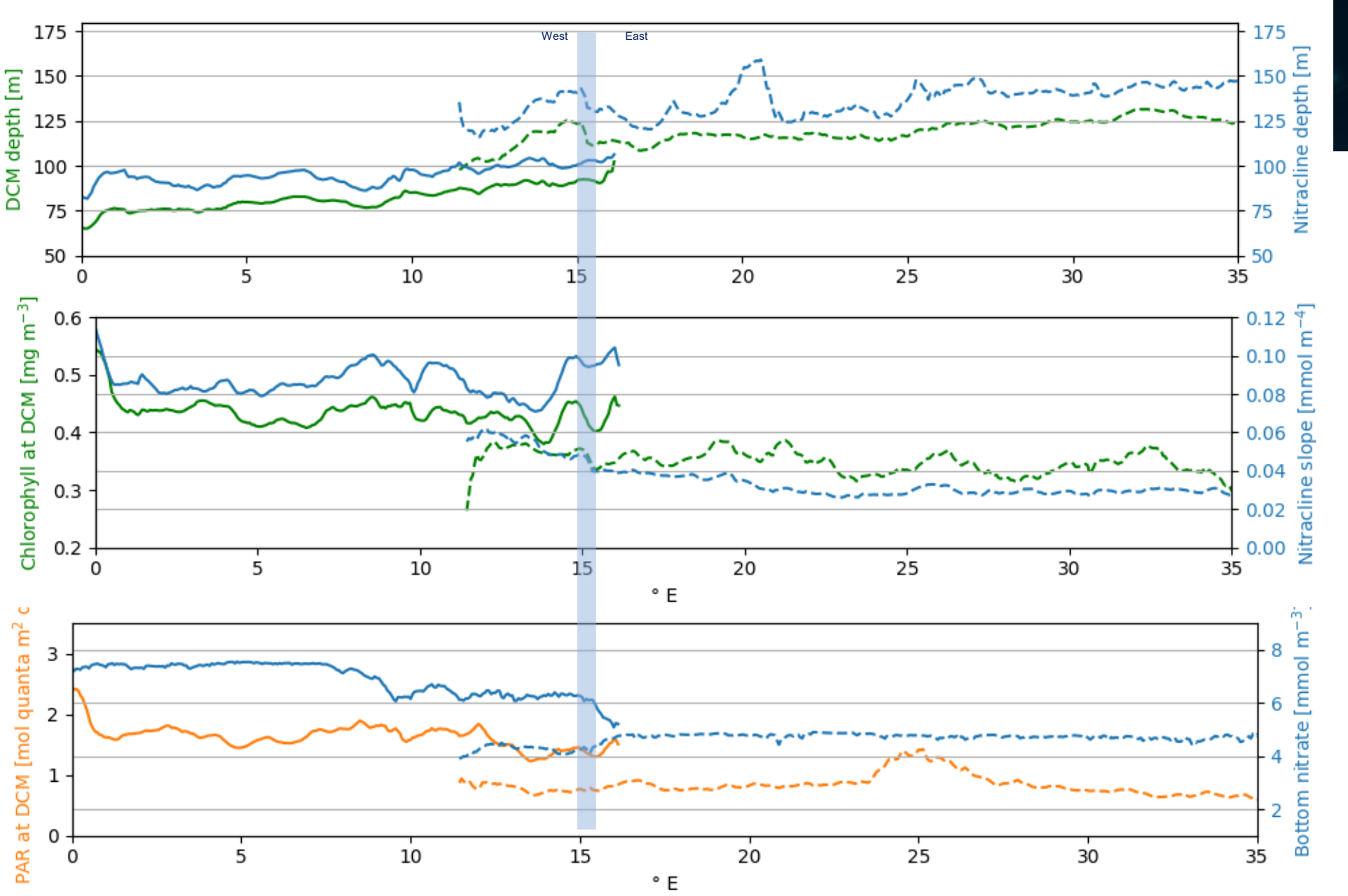
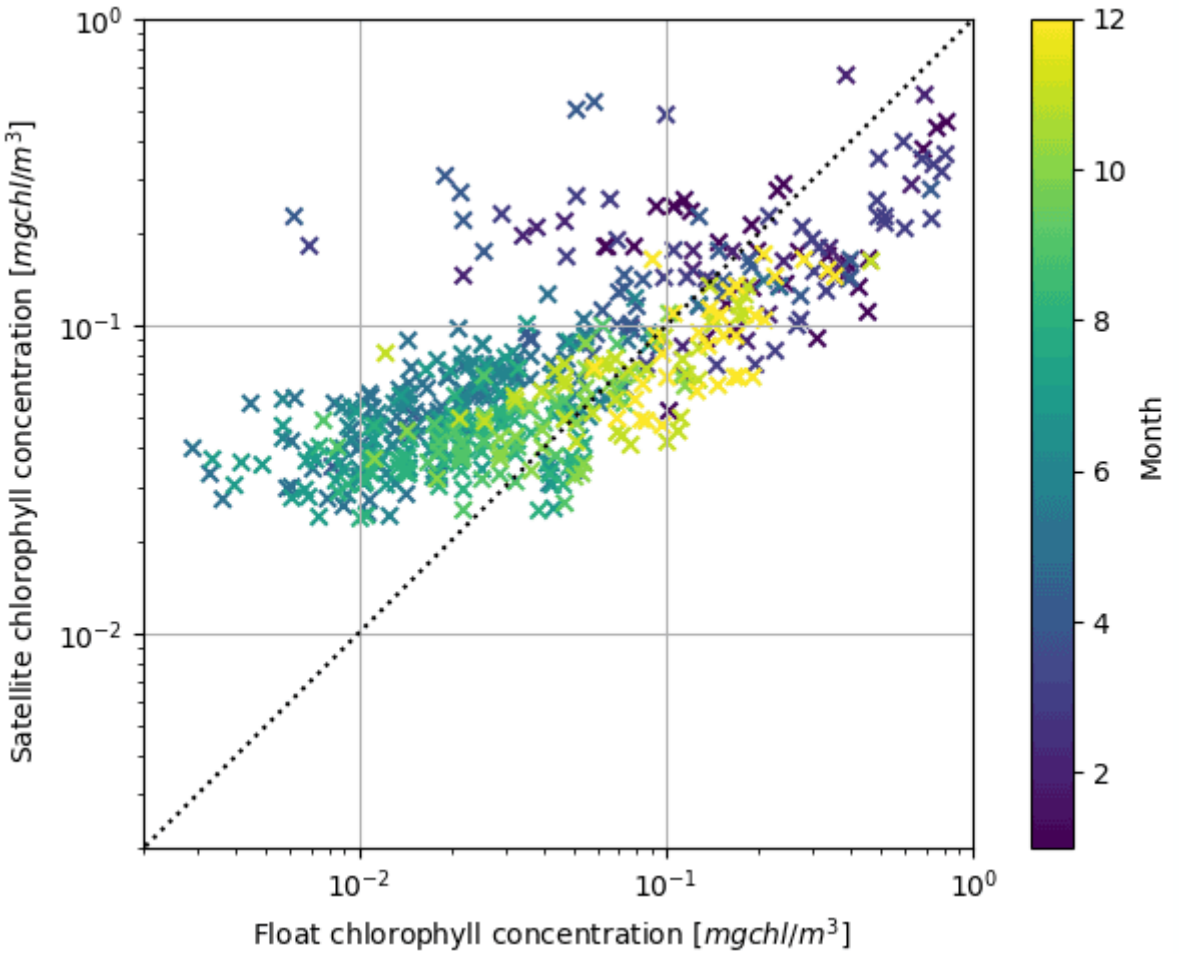
- **DCM and nutricline depth**
- **Chlorophyll at DCM and nutricline slope**
- **Light at DCM and bottom nutrient concentration**




10^0
10^{-1}
10^{-2}
Satellite chlorophyll concentration [$mgchl/m^3$]
10^{-2}
10^{-1}
10^0
Float chlorophyll concentration [$mgchl/m^3$]
12
10
8
6
4
2
Month