Ecoregions and carbon fluxes in the Mediterranean Sea through the assimilation of ocean-colour phytoplankton functional types

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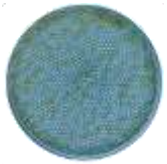
Background – Phytoplankton Functional Types (PFTs)

PFTs share common biogeochemical functions and they occupy different niches in ocean ecosystems

PFTs

Diatoms

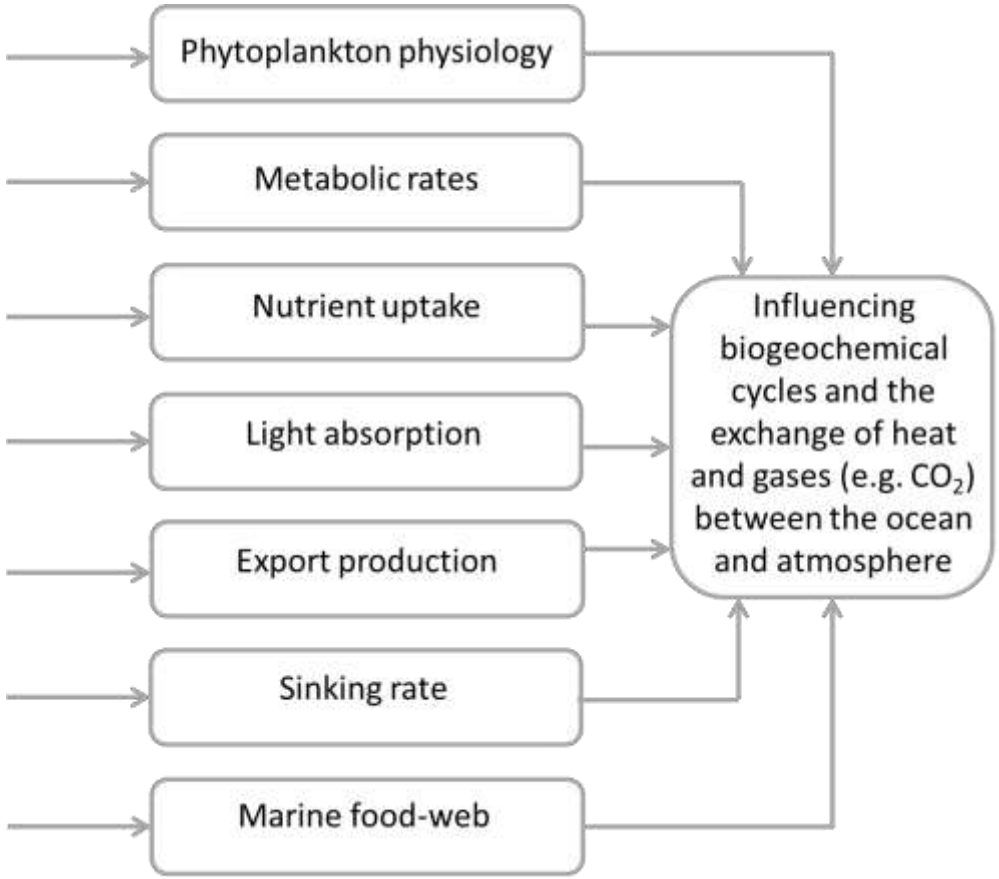


Dinoflagellates

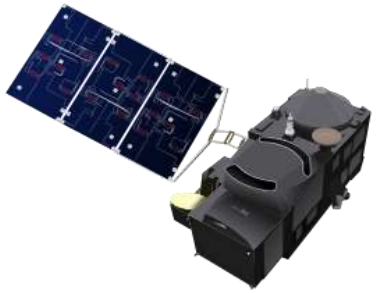
Nanophytoplankton

Picophytoplankton

Impacts

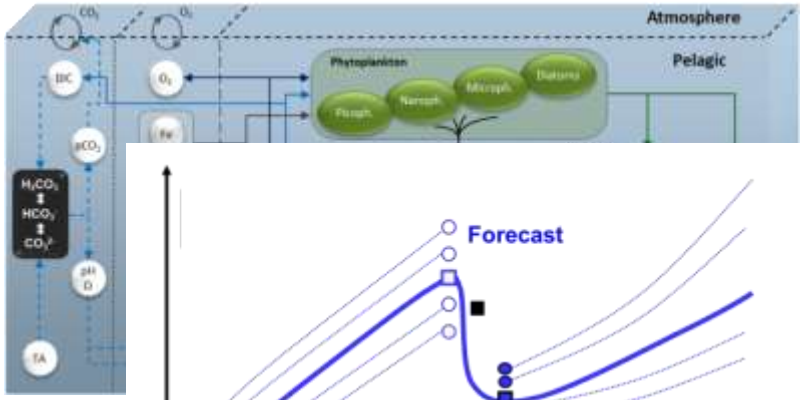


Can be observed from space



Sathyendranath, IOCCG, 2014

Can be predicted by models



Can be assimilated into models

Ciavatta et al., 2018

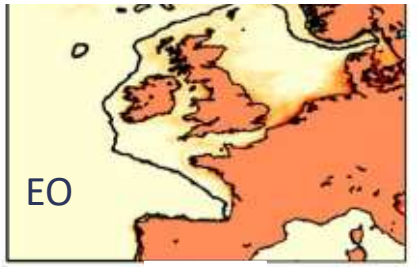
PFT/TOT CHL important for, e.g., C export

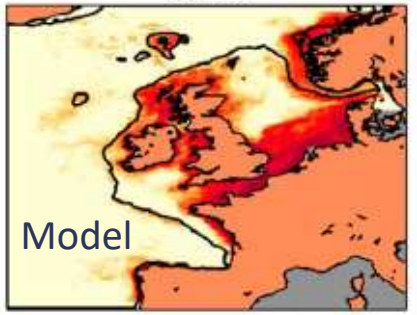
Background

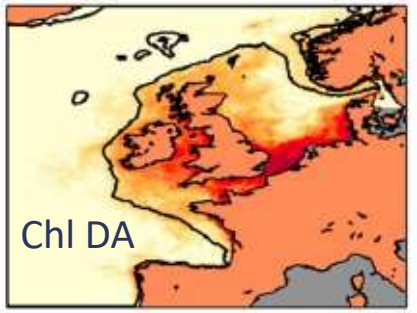
Ocean colour PFTs (Brewin et al., 2017) DA outperformed the traditional assimilation of TOT Chlorophyll in the North West European shelf-seas:

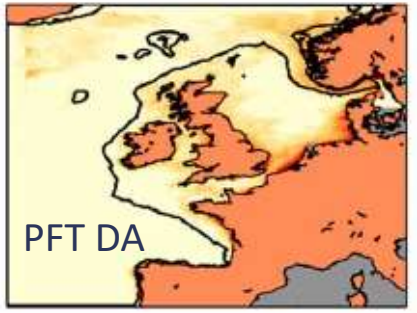
- In reanalysis of C fluxes (Ciavatta et al, JGR, 2018)
- In (pre)operational forecasts of PFTs distributions (Skakala et al.,2018)

Dinoflagellates









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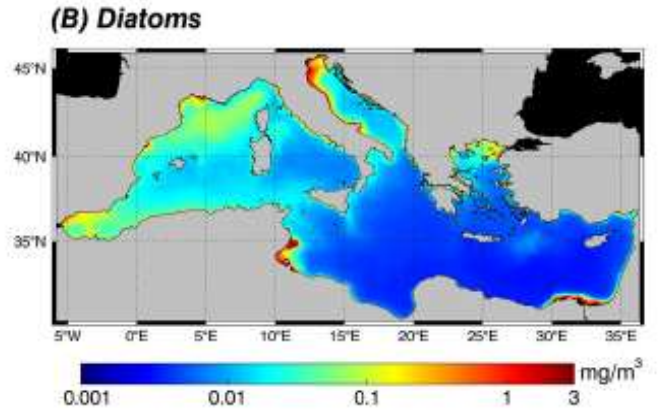
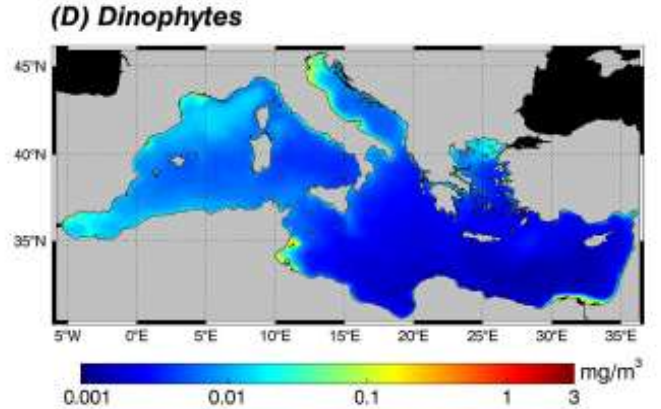
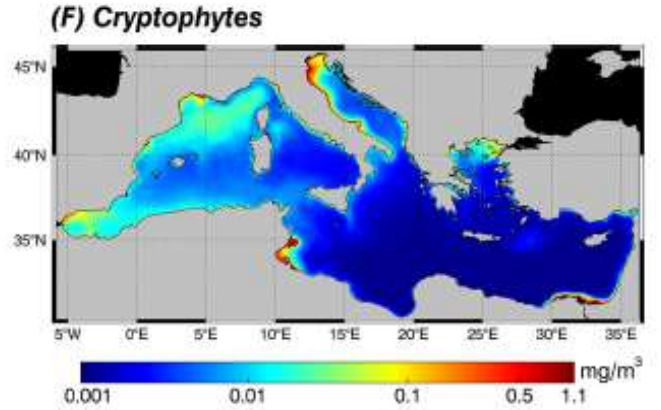
ocean colour cci

Motivation/Objectives

1. **Reanalyze the Mediterranean phytoplankton community structure**
2. **Define Mediterranean "ecoregions" based on PFT reanalysis!**







Ciavatta et al., JGR, in press

Di Cicco et al., 2017

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European Commission

TAPAS

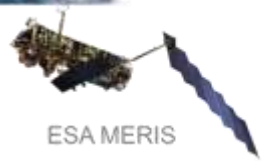
The regional ocean colour PFT data

NASA MODIS

NASA SeaWiFS

esa

ocean colour cci



ESA MERIS

↓

Rrs

↓

Regional algorithms
for case 1 & 2 waters

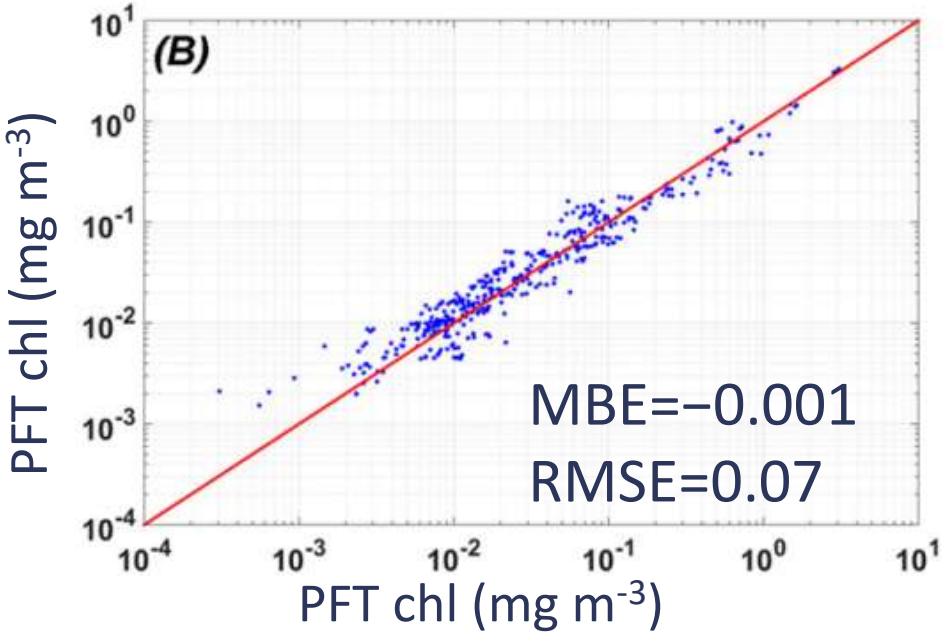
TOT CHL

↓

Regionally tuned (pigments)
abundance-based algorithm

PFT CHL

Validation (e.g. diatoms)



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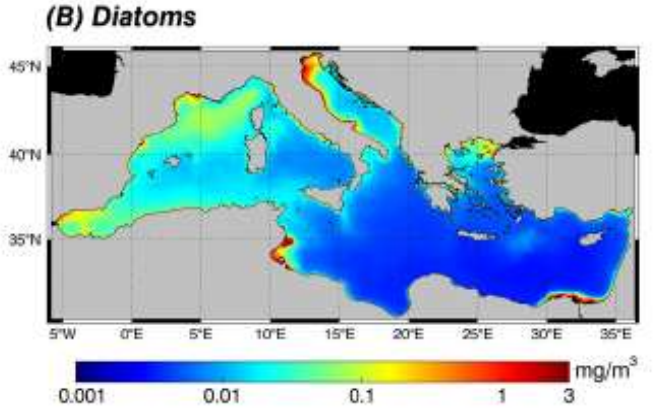
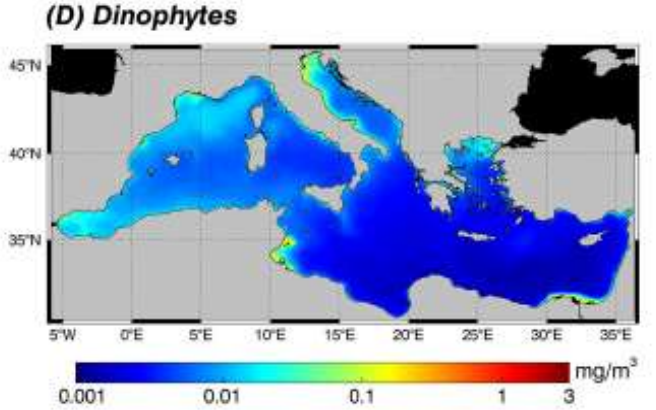
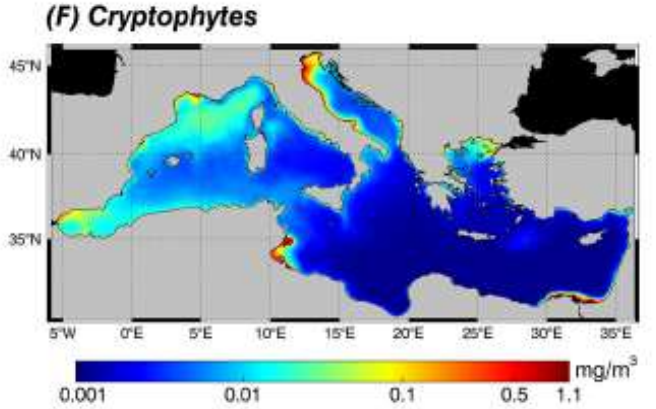
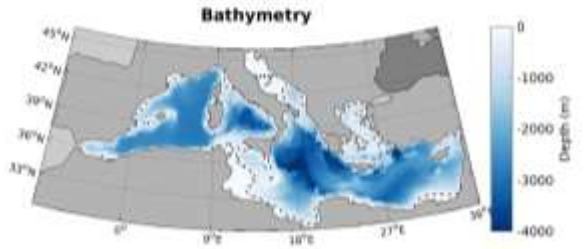


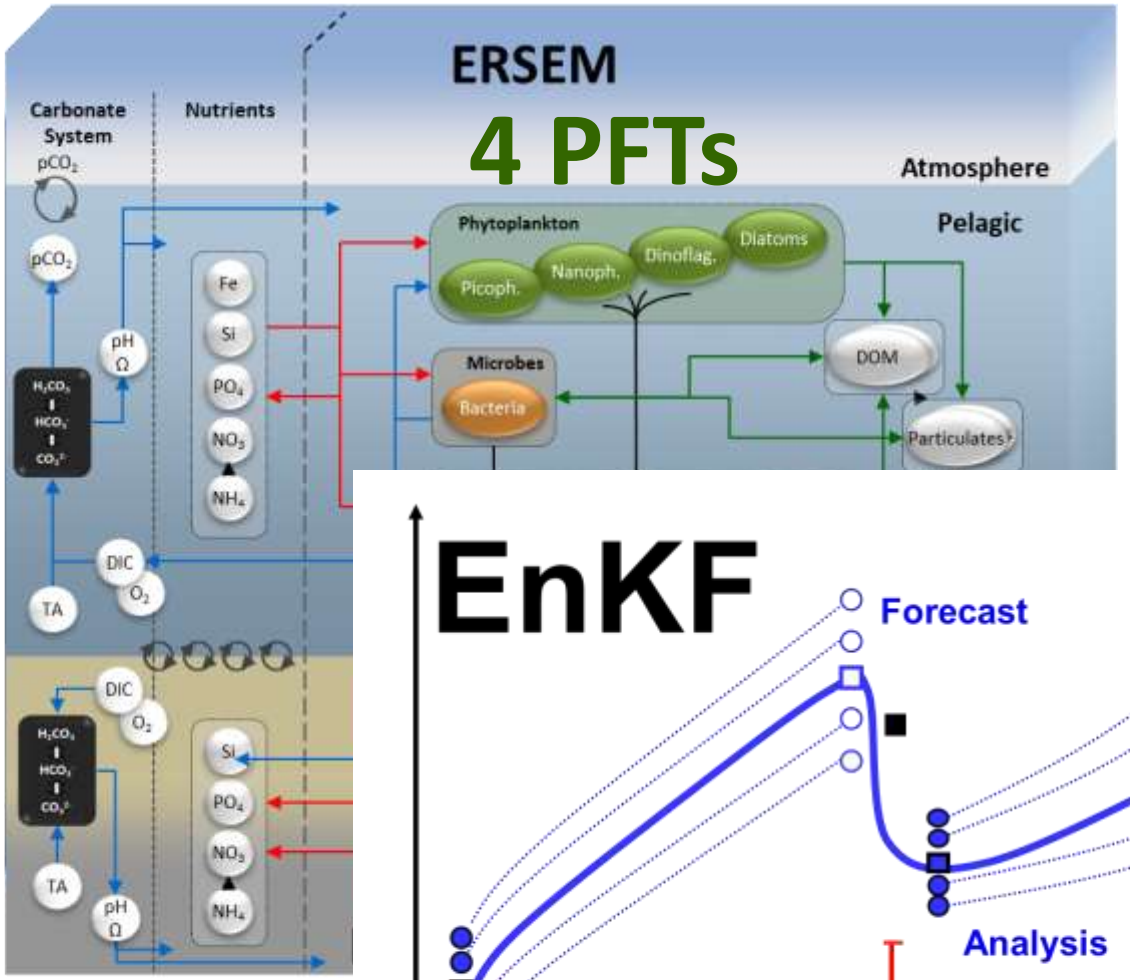




Di Cicco et al., 2017

The Mediterranean Sea model: **ERSEM**





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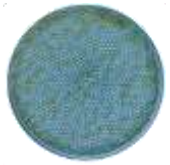
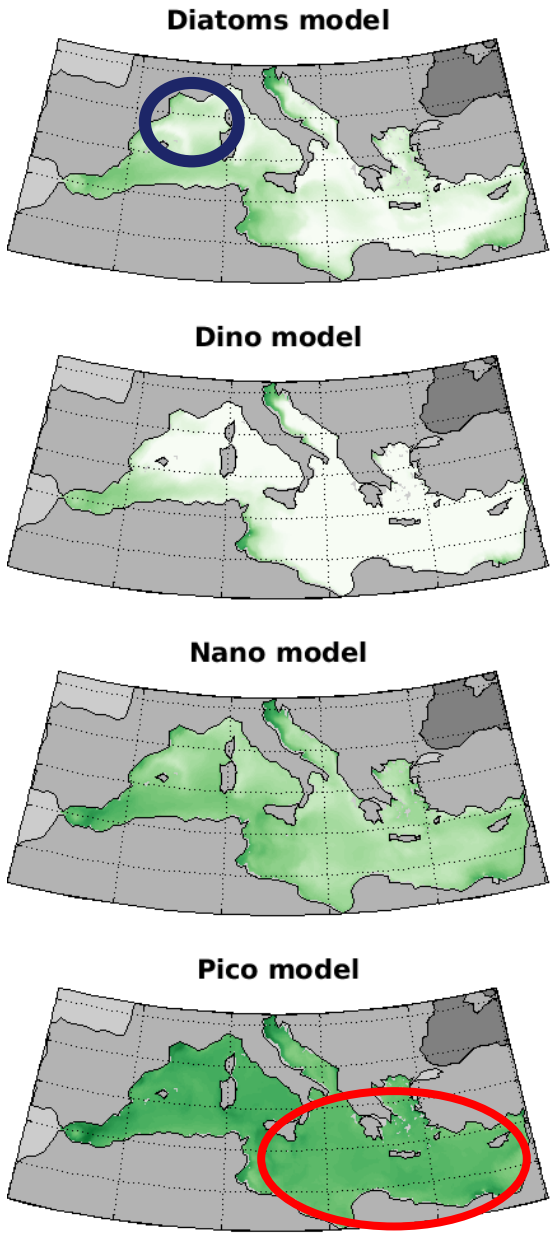
Reanalysis results: chlorophyll



Reanalysis

Ocean-colour



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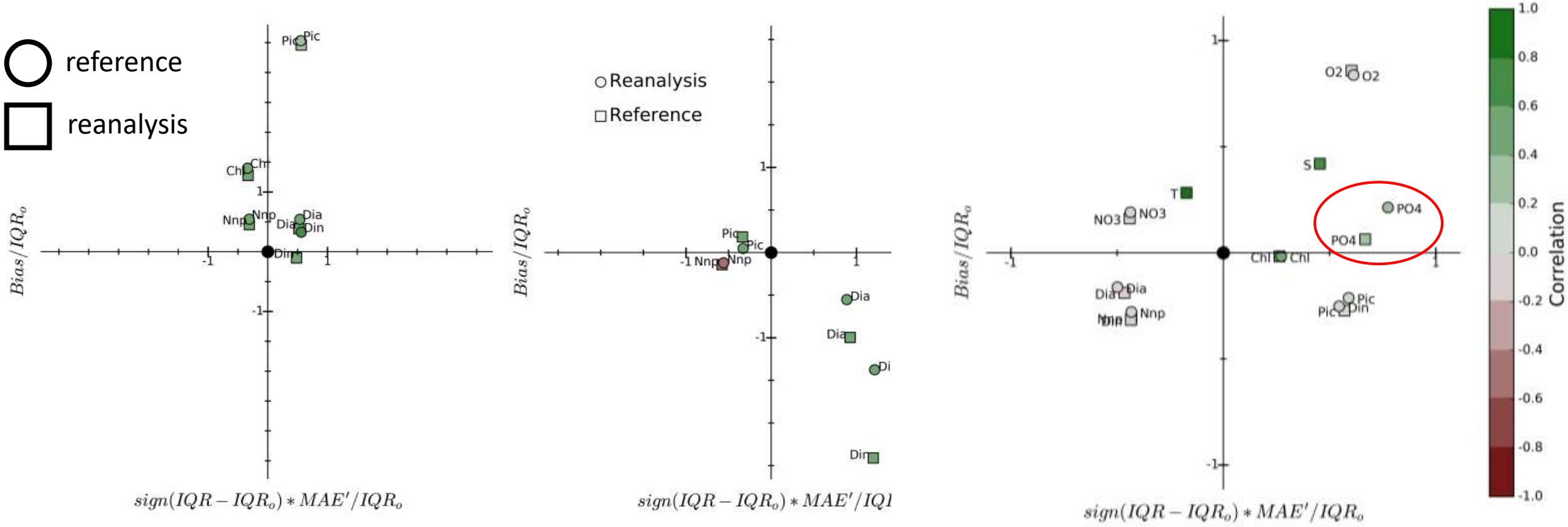
PFT conc : small effect

PFT ratios: improved

BGC conc : small effect



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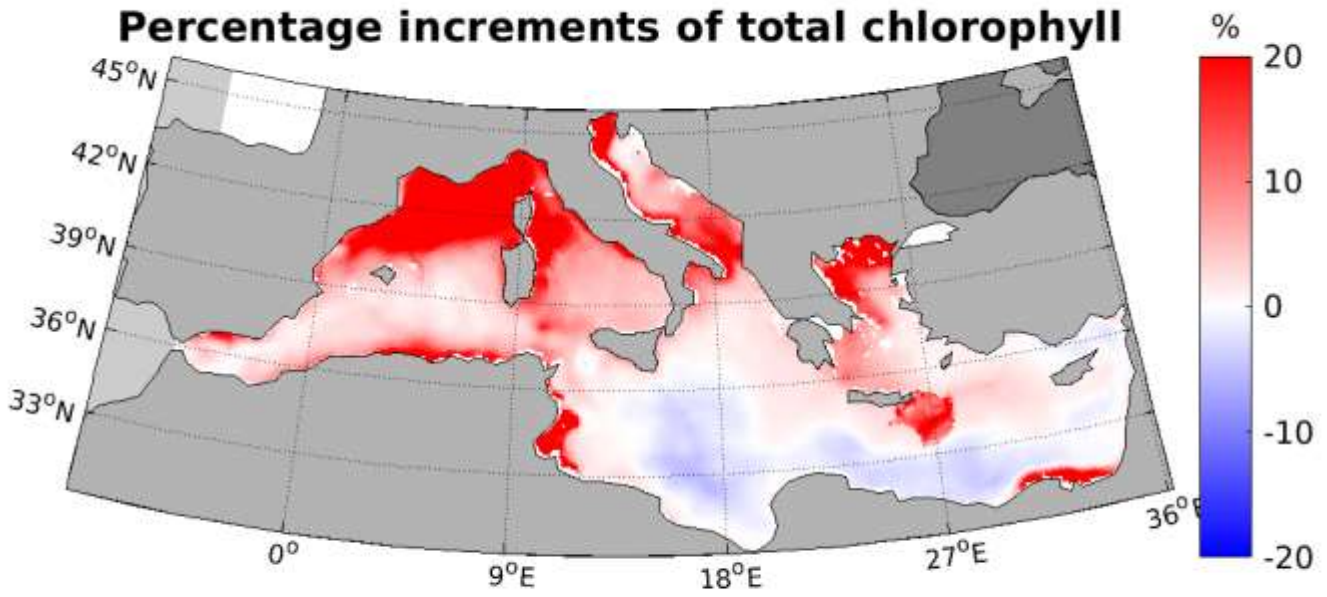
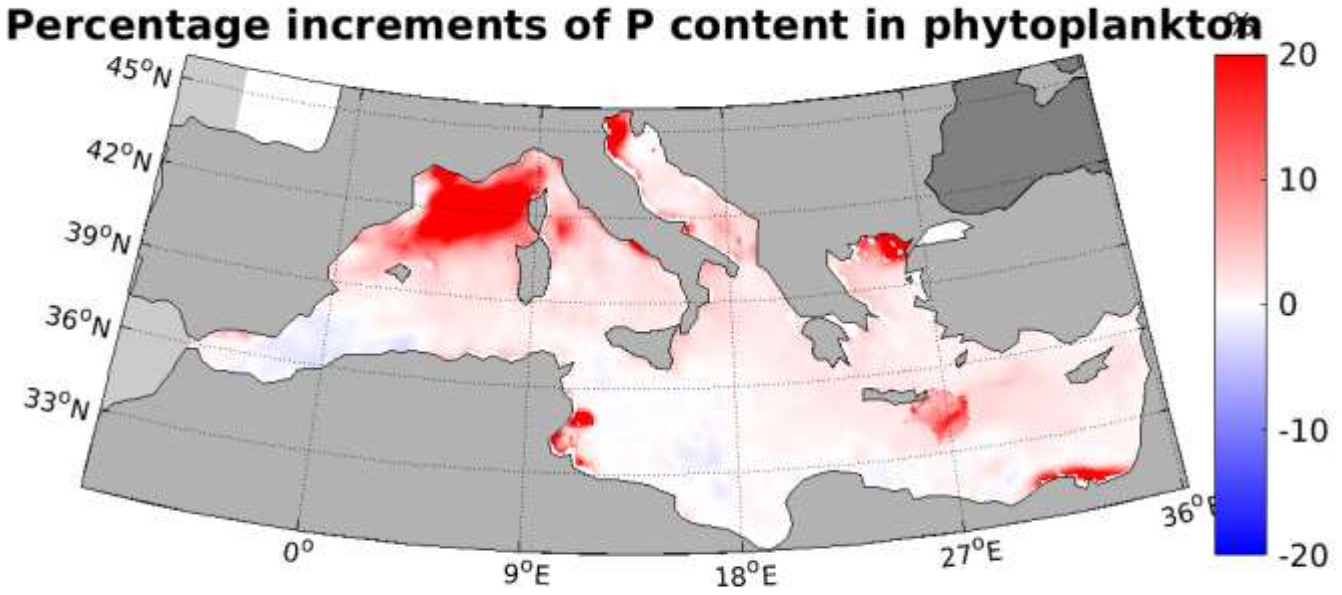
Causes of mild [PFT] changes and P deterioration





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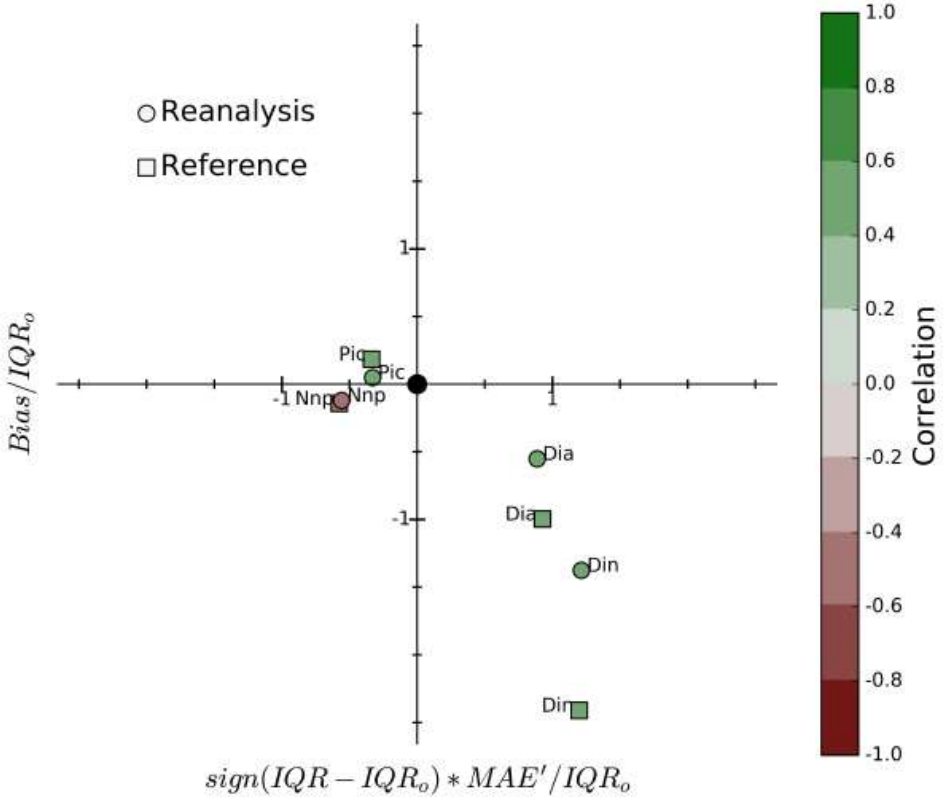
PFT ratios: improved



PFT/TOT CHL important for, e.g., C export

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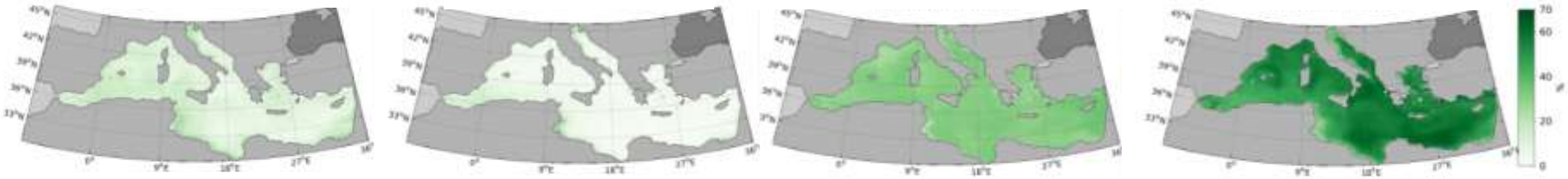
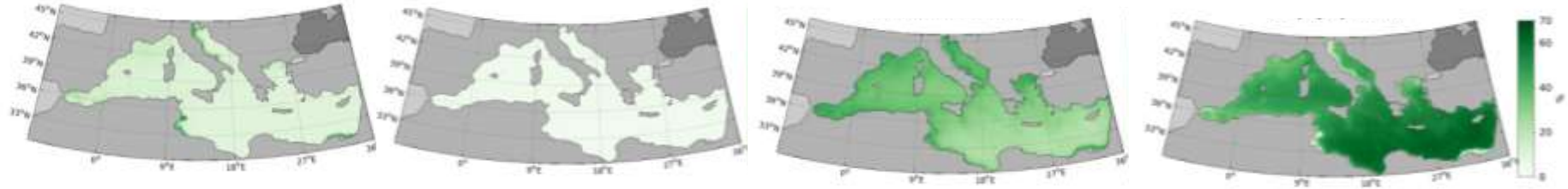
Results: PFT chlorophyll fractions [%]

Diatoms | Dinoflag | Nano | Pico

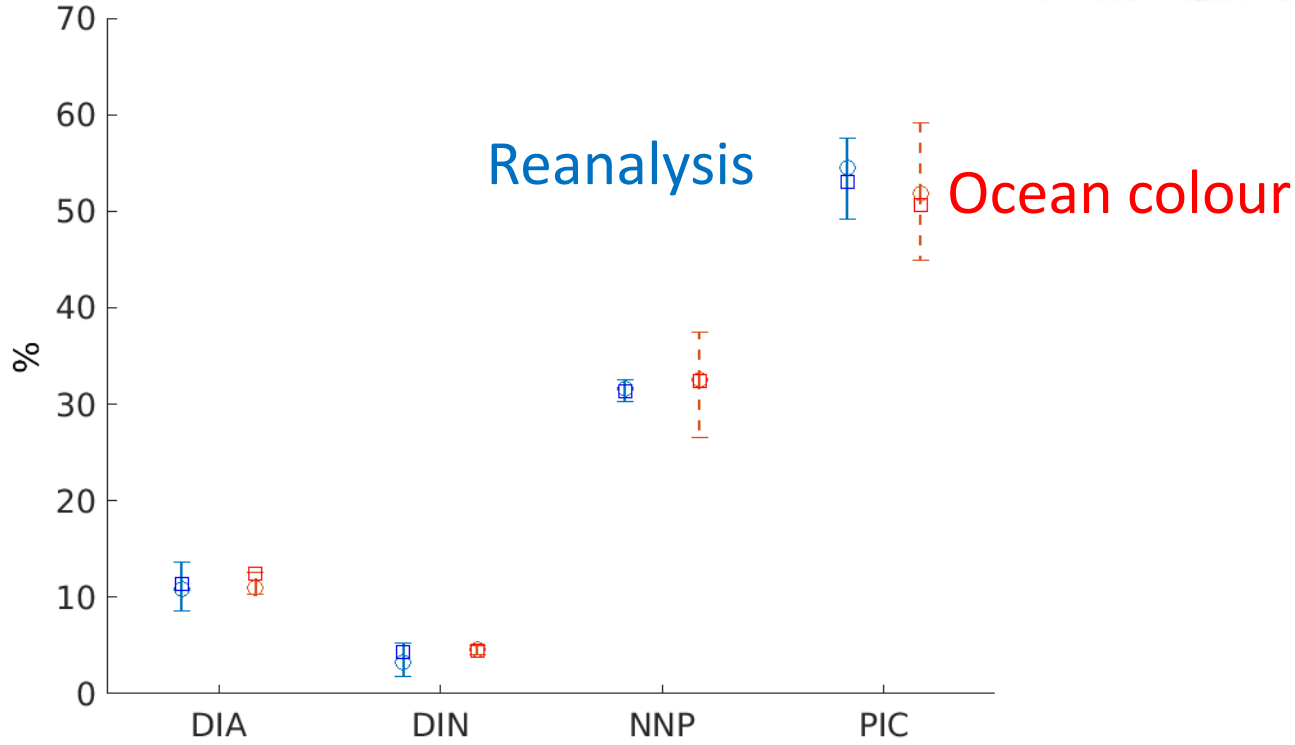
Reanalysis



Ocean colour



PFT fractions are fine!



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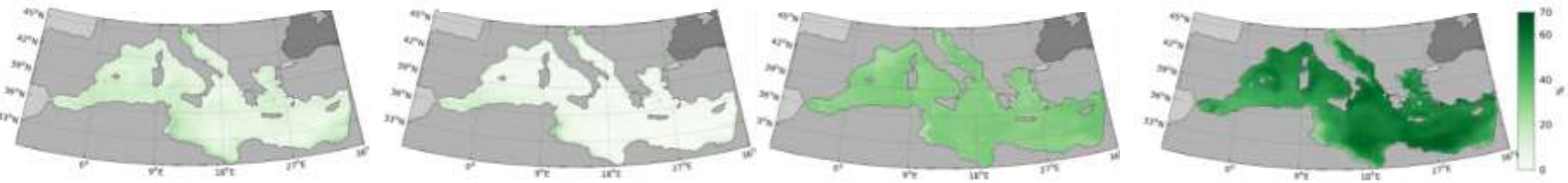
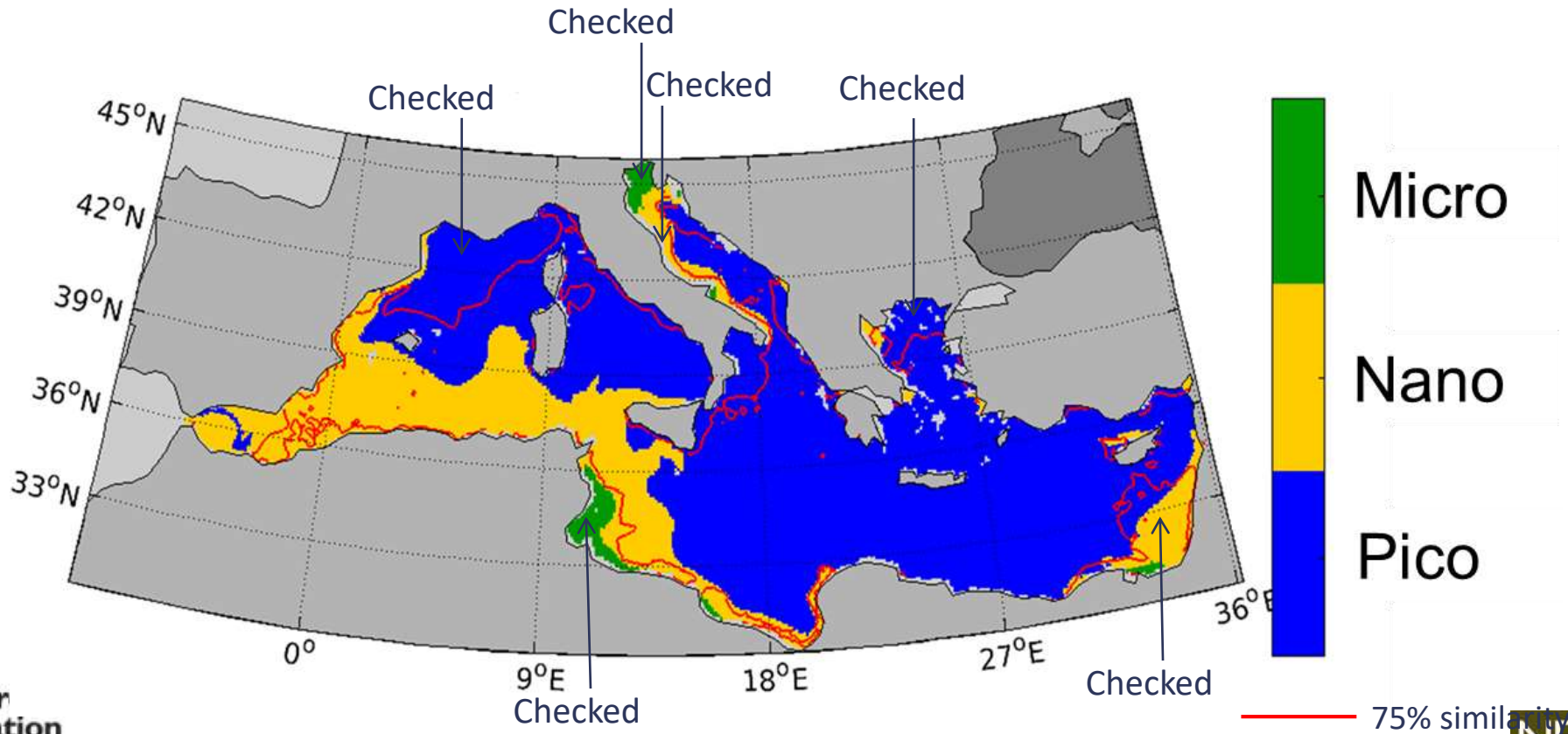
Results: PFT ecoregions

Reanalysis

Diatoms | Dinoflag | Nano | Pico





Checked, but still high resolution, local models & PFT in situ data are needed

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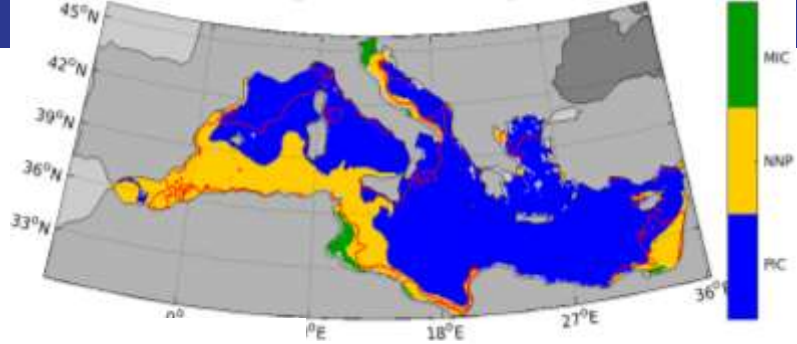
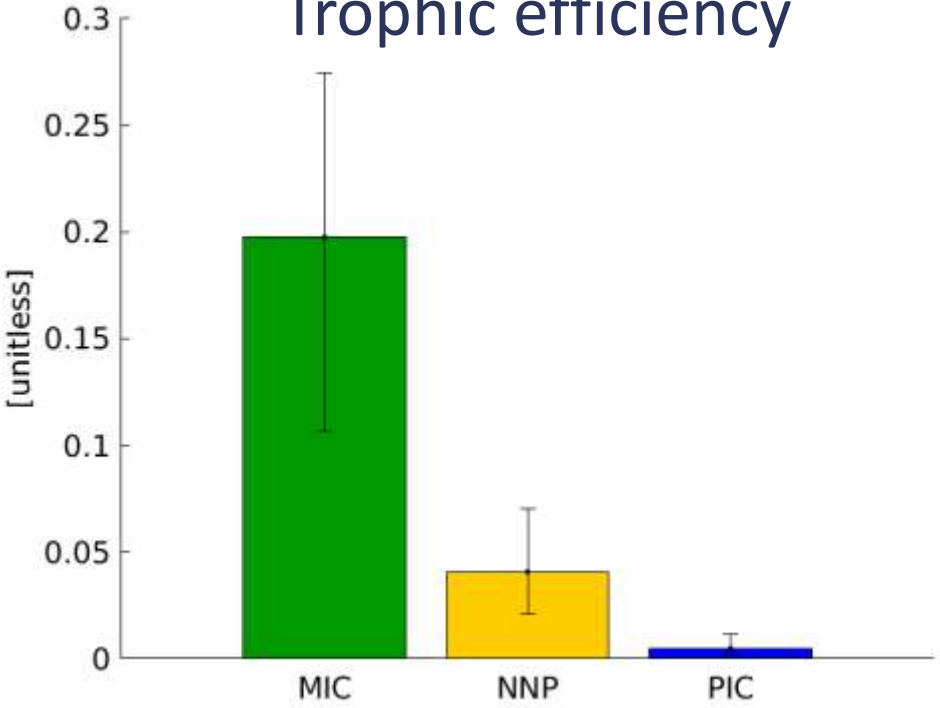
Results: ecoregions' carbon fluxes

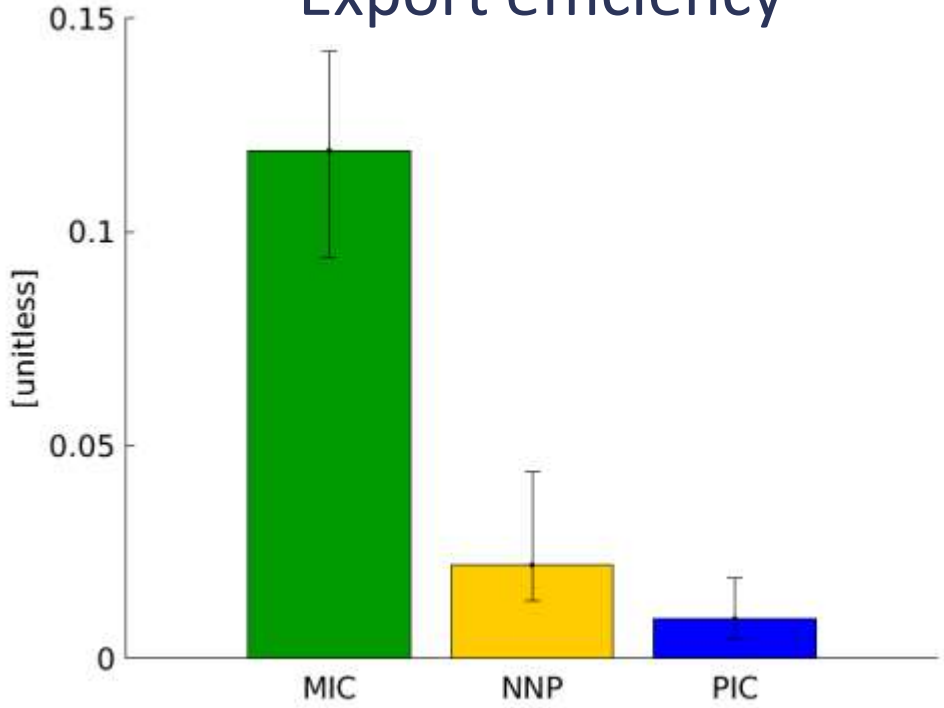


Trophic efficiency



$$\frac{Mesozooplankton}{Phytoplankton}$$

Export efficiency



$$\frac{POC_{sink}}{GPP}$$

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The microphytoplankton region is the "most efficient"

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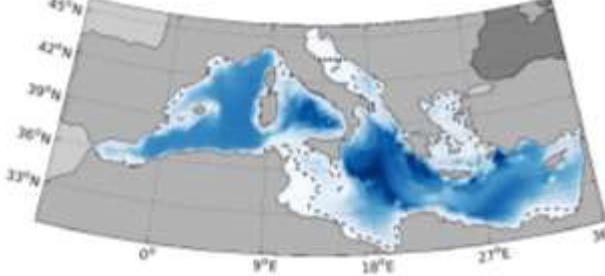
Results: Mediterranean carbon fluxes



Flux (g C m^{-2} yr^{-1})	Mean	min-max	Uitz et al., 2006 (sat data)
Net production total phyto	69	65.6÷72.1	68 (65÷71)

A very good match!

Likely we overestimated pico production. But did the satellite underestimate it ?

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Conclusions/future

- **The MIC region** has the highest trophic and carbon export efficiencies, e.g. can sustain fisheries and **aquaculture** (H2020 TAPAS)
- **OC PFT assimilation** in the Mediterranean is useful but we need to better characterize ocean-colour PFT errors (ongoing NCEO UoR & PML)
- PFT DA (chl, carbon) into a global model to improve ocean C flux estimates (NCEO)

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Thank you

TAPAS
Ritmare
OPTIMA