# Investigating Mediterranean phytoplankton diversity in fine-scale structures from space

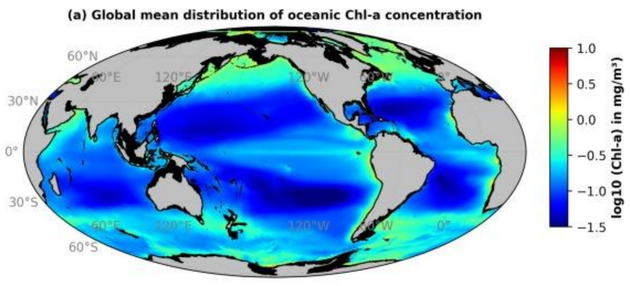
Théo Garcia[1], Louise Rousselet[2], Laurina Oms[3], Xavier Milhaud[1], Andrea Doglioli[3], Monique Messié[4], Claire Lacour[5], Pierre Vandekerkhove[5], Julien Le Sommer[6], Francesco d'Ovidio[7], Gérald Grégori[3], Denys Pommeret[1]

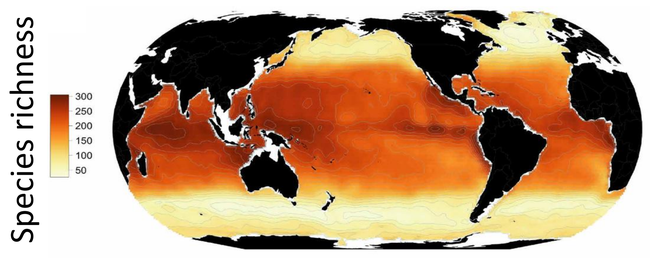
1 - Aix Marseille University CNRS, Centrale Marseille, I2M, Marseille, France ; 2 - Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS), Toulouse, France ; 3 - Aix Marseille Univ., Toulon University CNRS IRD MIO UM 110, Marseille, 13288, France ; 4 - Monterey Bay Aquarium Research Institute, Moss Landing, CA, USA ; 5 - Université Gustave Eiffel, LAMA (UMR 8050), 77420 Champs-sur-Marne, France ; 6 - CNRS, IRD, Grenoble INP, IGE, Univ. Grenoble Alpes, Grenoble, France; 7 - Sorbonne Université, CNRS, IRD, MNHN, Laboratoire d'Océanographie et du Climat: Expérimentations et Approches Numériques (LOCEAN-IPSL), Paris, France

*Contact: theo.garcia@univ-amu.fr*

## *1 - Introduction:*

Oligotrophy ← Why? → Diversity ← **Fine scales**? 1-100 km, day-month




Q1 : Can **fine-scale dynamics** explain the **distribution of phytoplankton** assemblages?

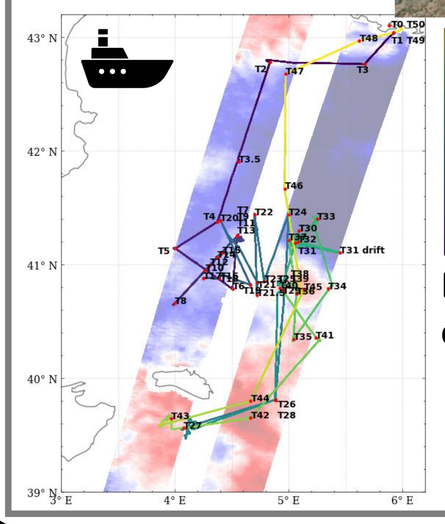
Q2 : Do **fine-scale structures** provide **new habitats** for **phytoplankton** assemblages?

## *2 –Satellite data and methods:*

### Case study : W-Mediterranean Sea

**Oligotrophic** & **hotspot for biodiversity**

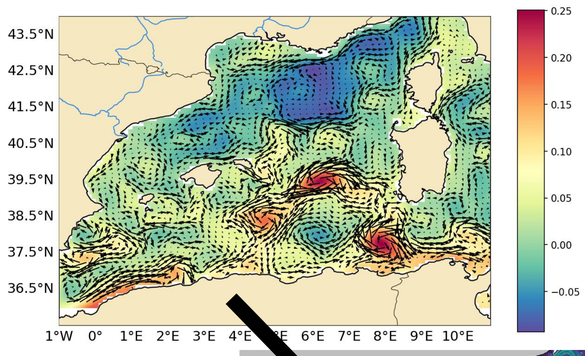
**Small scale laboratory** for global ocean



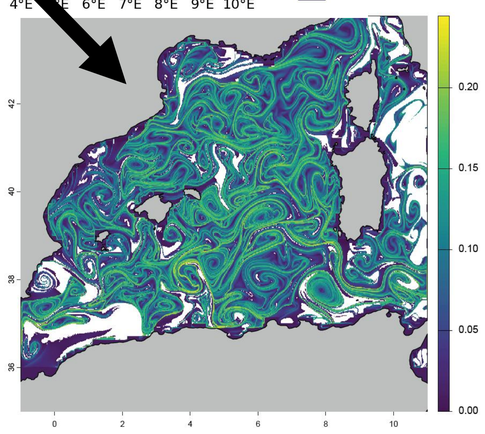

BIOSWOT Med cruise [1]

*BioSWOT-Med doi*

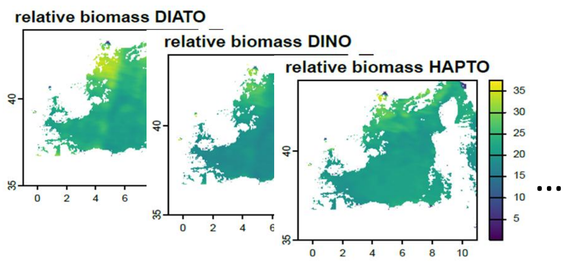
### Fine scales detection : Altimetry



Finite Time Lyapunov Exponents (FTLE) [2]



### Phytoplankton : Ocean Color




Relative biomass of 6 phytoplankton groups

*Gaussian Mixture Models*

$$Com = \sum_{i=1}^{K} \alpha_i . \mathcal{N}(\mu_i, \sum_i)$$

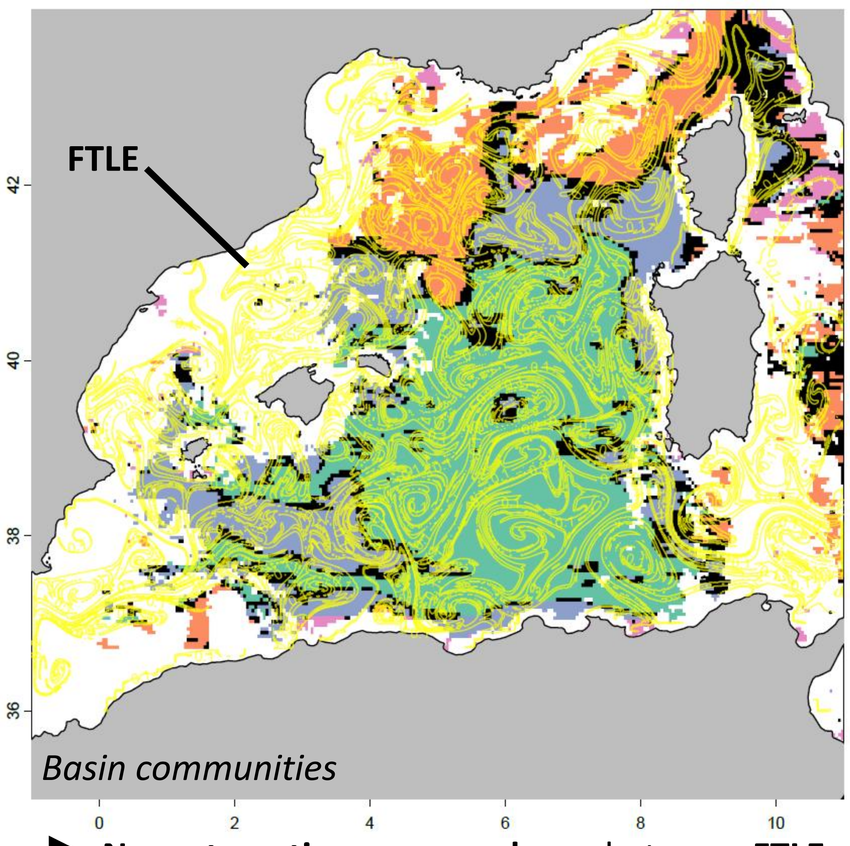
If $\alpha_i > 0.9$ = community i, else = front community

**Community i characteristics**

$\mu_i$ = *average relative biomass*

$\sum_i$ = *covariance matrix*

## *3 - Can fine-scale dynamics explain the distribution of phytoplankton assemblages?*




4 communities

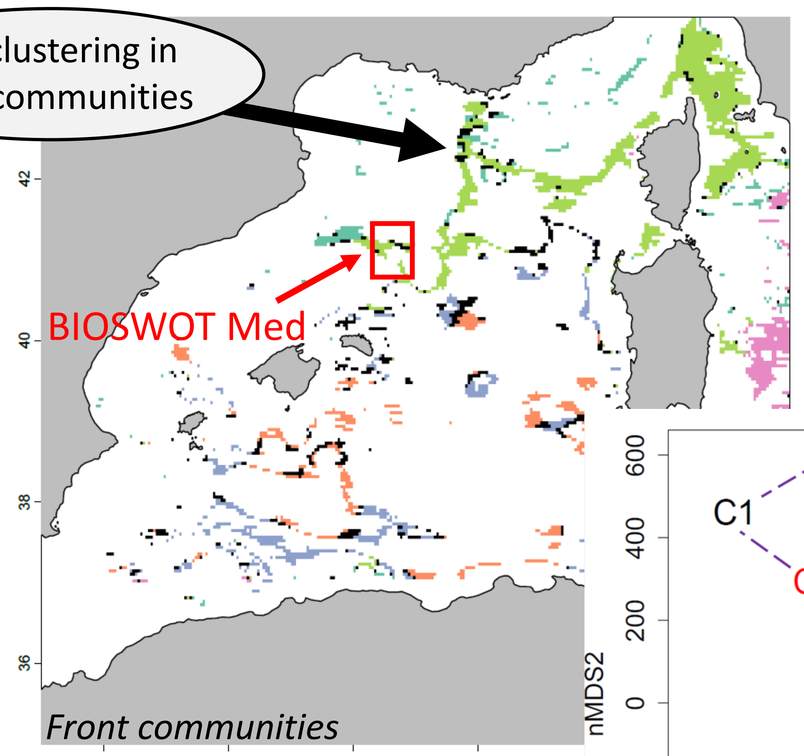
**Correspondance** of clustering with the **bioregions** of trophic conditions

→ **No systematic correspondance** between **FTLE** and change in **phytoplankton** assemblages (i.e. front communities)

→ **Other processes** may affect phytoplankton assemblages (vertical mixing, biological interactions)

## *4 – Do fine-scale structures provide new habitats for phytoplankton assemblages?*

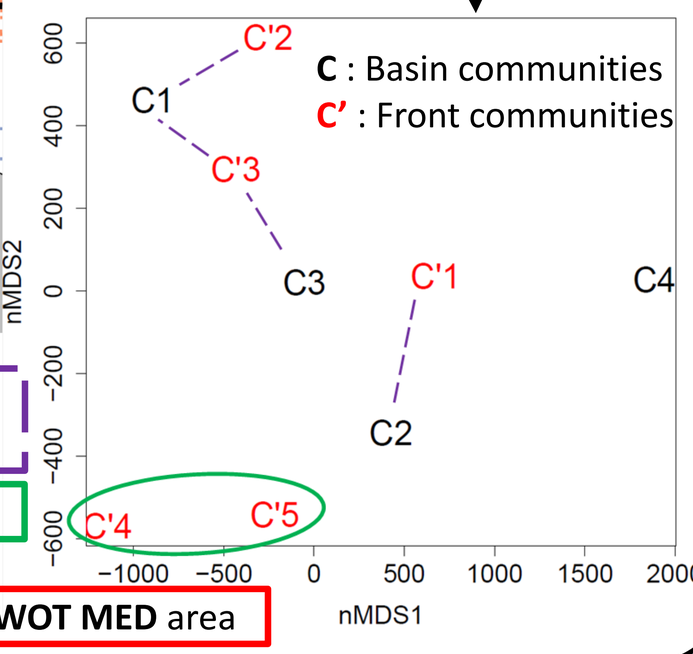
2nd clustering in front communities




α<0.9

5 communities

Similarity with basin communities?




**C** : Basin communities

**C'** : Front communities

C'1, C'2 and C'3 similar to existing communities

C'4 and C'5 are **new communities**

**New community** C'5 in the **BIOSWOT MED** area

## *5 – Conclusion:*

→ **Joint analysis of altimetry and ocean colour data highlights the link between fine-scale structures and phytoplankton communities distribution**

→ **These promising preliminary results will lead to further research using global datasets**

Laboratories associated with the SPAce-rODEo project: 1 Aix Marseille université · Institut de Mathématiques de Marseille · 2 LEGOS · 3 mio Mediterranean Institut of Oceanography · 4 MBARI Monterey Bay Aquarium Research Institute · 5 LAMA · 6 IGE Institut des géosciences de l'environnement · 7 LOCEAN

Funders : cnes

***References:***

[1] BioSWOT-Med cruise, RV L'Atalante, https://doi.org/10.17600/18002392, 2023

[2] ROUSSELET, Louise, D'OVIDIO, Francesco, IZARD, Lloyd, *et al.* A Software Package for an Adaptive Satellite-based Sampling for Oceanographic cruises (SPASSOv2. 0): tracking fine scale features for physical and biogeochemical studies. *Journal of Atmospheric and Oceanic Technology*, 2025.