



A CELL IN AN EDDIE

What are the close links between ocean physics and biology?

Ocean circulation is an important factor to consider in the distribution of marine organisms. The dynamics of water masses not only affect the availability of resources such as light and nutrients, but also the transport of organisms. Recent questions arise on the spatio-temporal scales to be considered to study this close coupling between the physics and biology of the ocean, which because of the ephemeral nature of these two components requires an adapted research reflection.

Take home message :
Ephemeral physical structures can segregate phytoplankton communities. A new strategy and new tools will allow in the near future to better understand this segregation, especially in a 3D view.

Which biology?

Thanks to their role as a primary producer phytoplankton species support marine life. Consequently, they are a key link between ecological patterns and biogeochemical cycles in the ocean. There is still a lot of mystery about the behavior of phytoplankton communities, like the "Plankton paradox": Why is there such a phytoplankton diversity in ocean compared to the few resources available? How so many species can coexist together in contradiction with the principle of competitive exclusion?

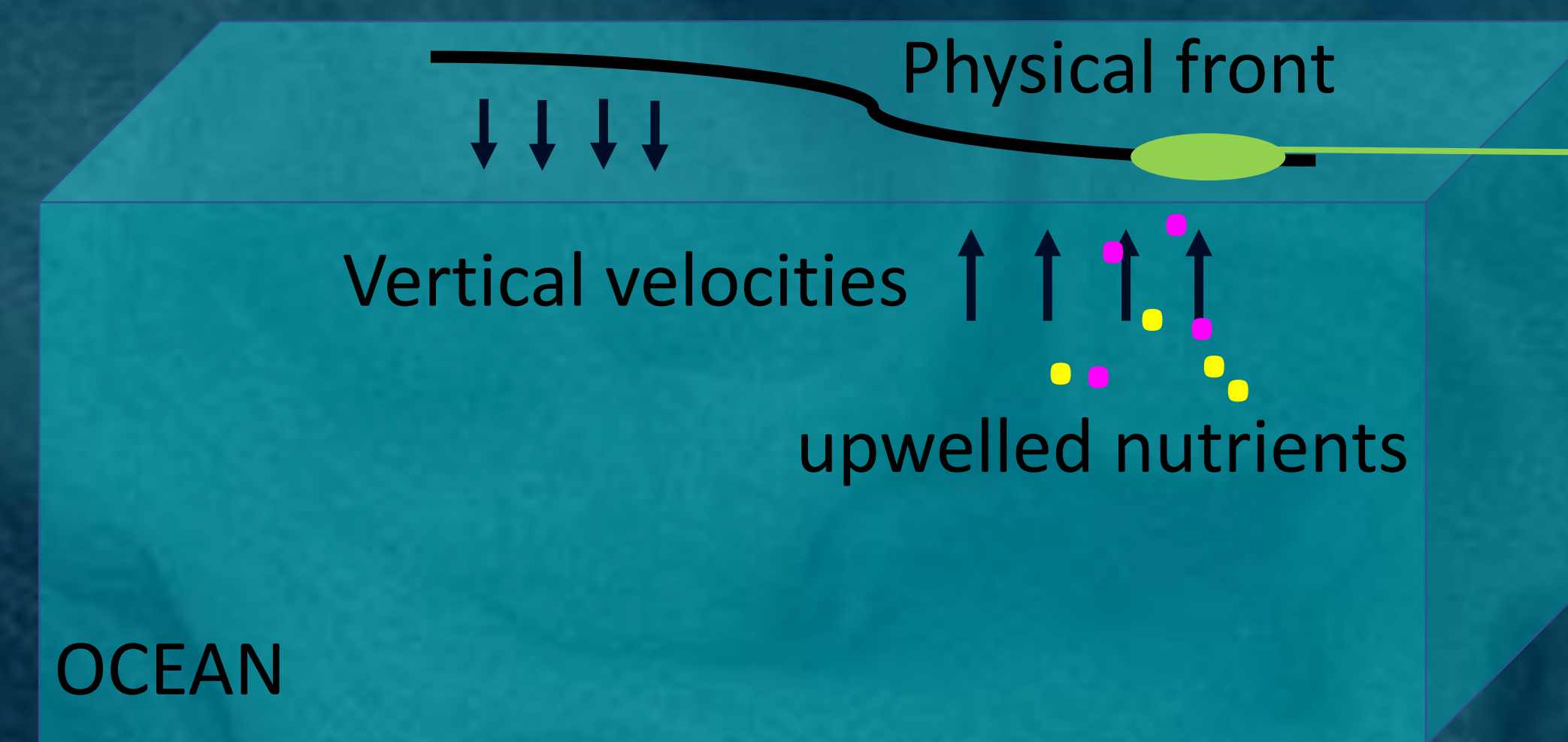
Which coupling?

Satellite observations have revealed that phytoplankton abundances at the surface of the ocean are characterized by a **patchy distribution induced in part by fine scales features forming hydrodynamical niches**.

Objective : better understand how phytoplankton communities are organized within these patches

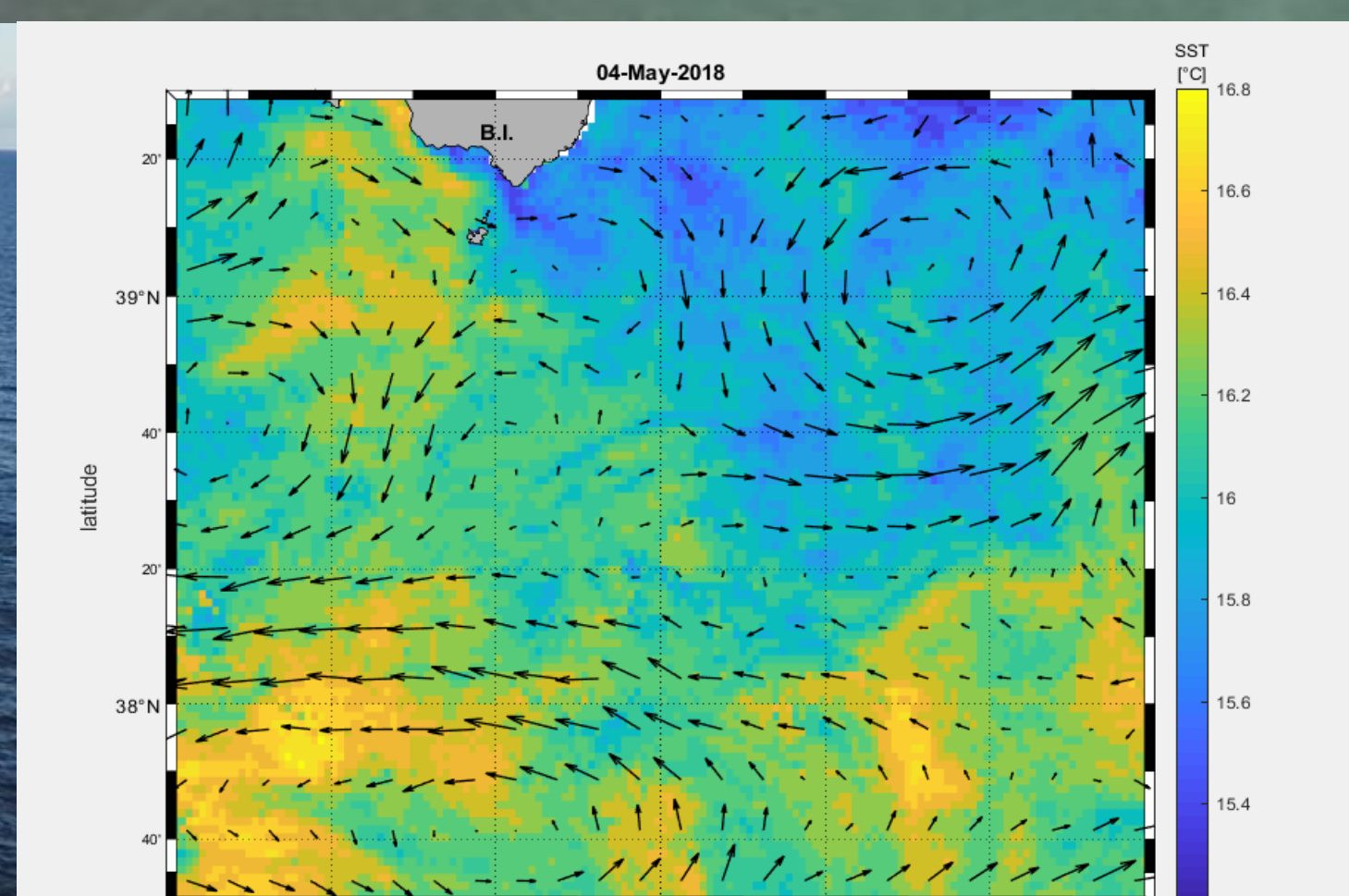
Which physics?

Fines scales physical features (1-100km horizontally) are ephemeral structures with a lifetime similar to the time scale of phytoplankton growth. These structures (eddies, fronts and filaments) created by instabilities in large currents, are often associated with high vertical velocities and can form a hydrodynamic barrier against transport.



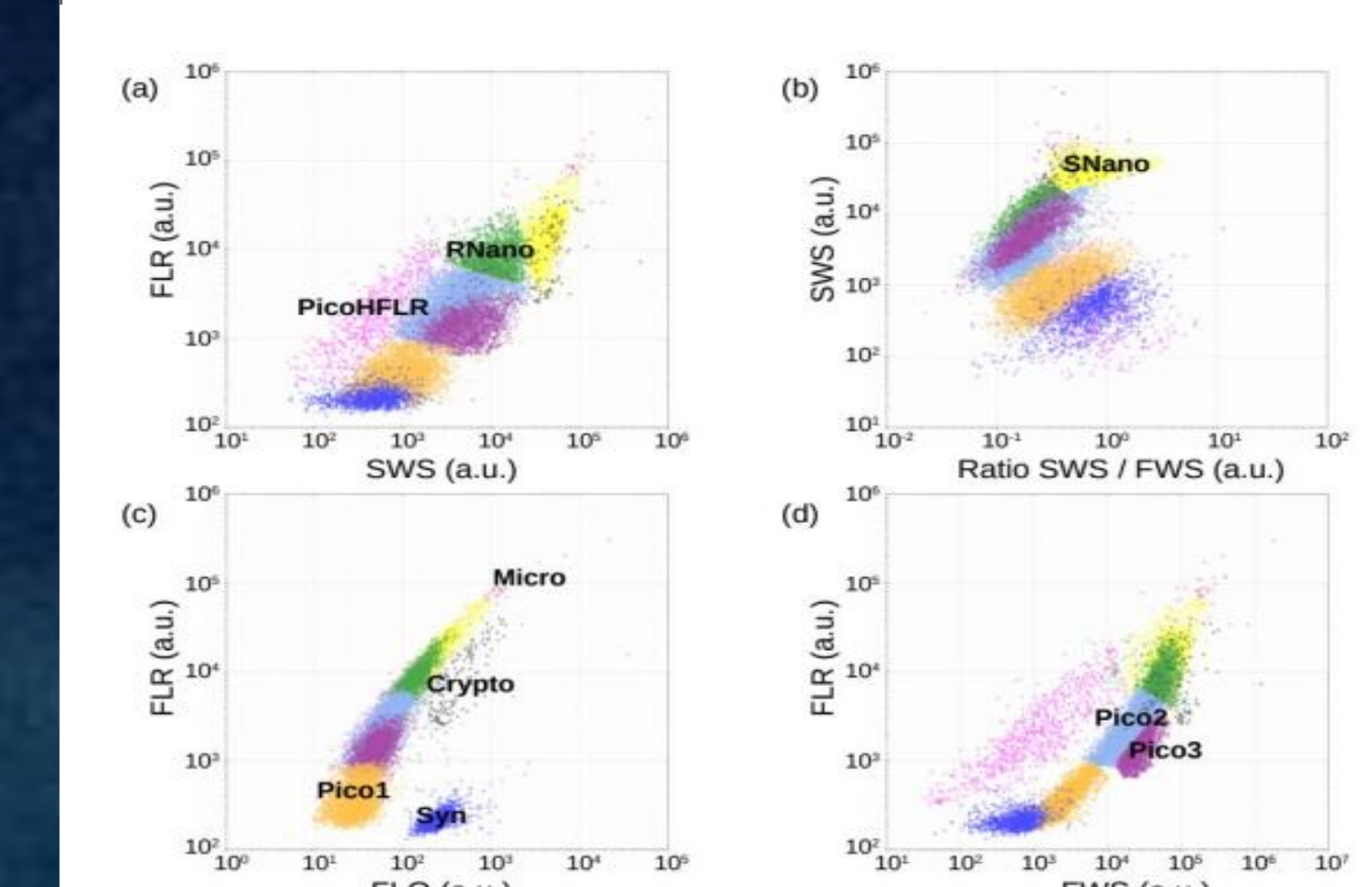
TRAPPED ADAPTED
PHYTOPLANKTON
COMMUNITIES

Which tools?

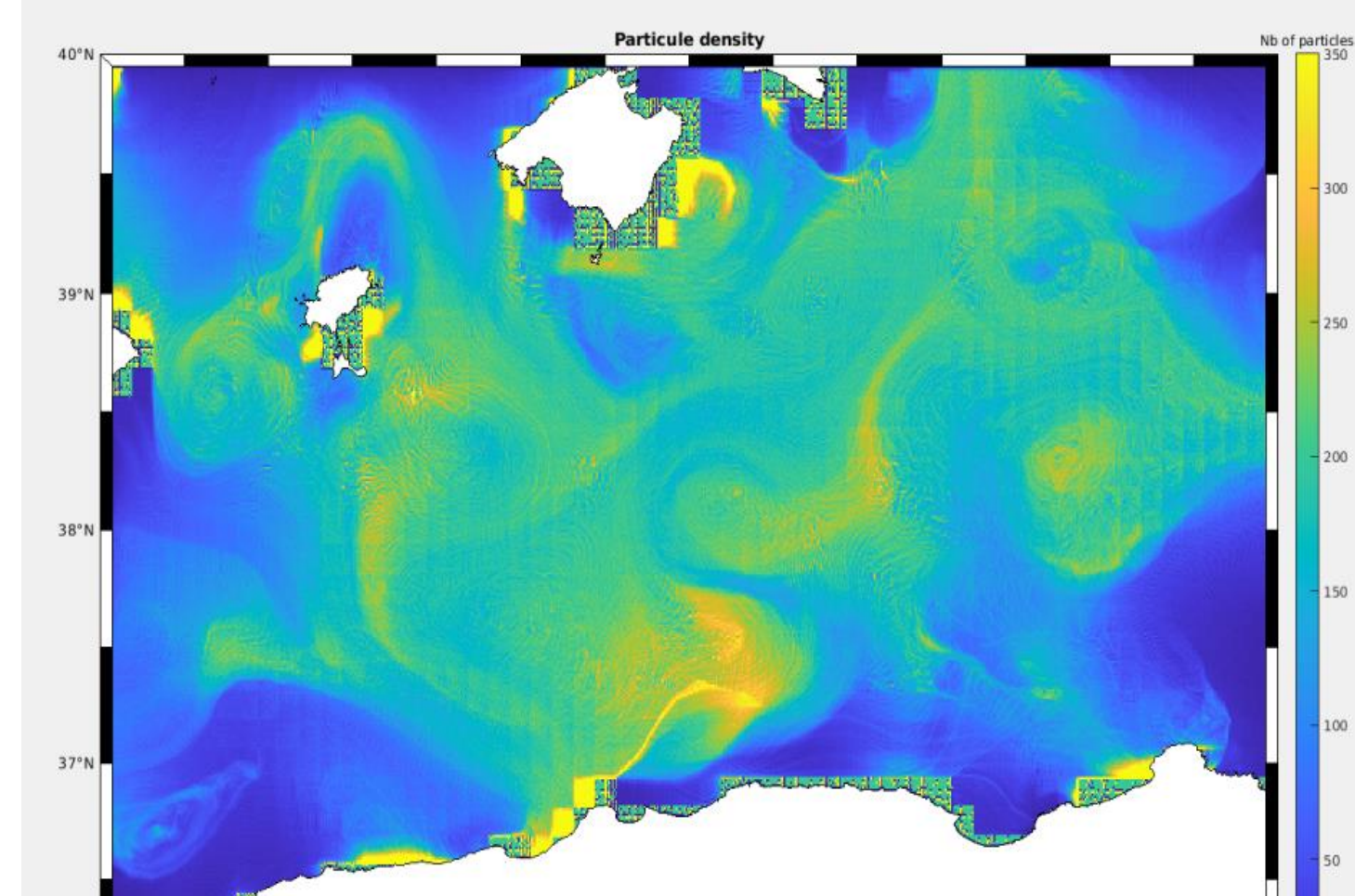


In situ measurements

Satellite observations



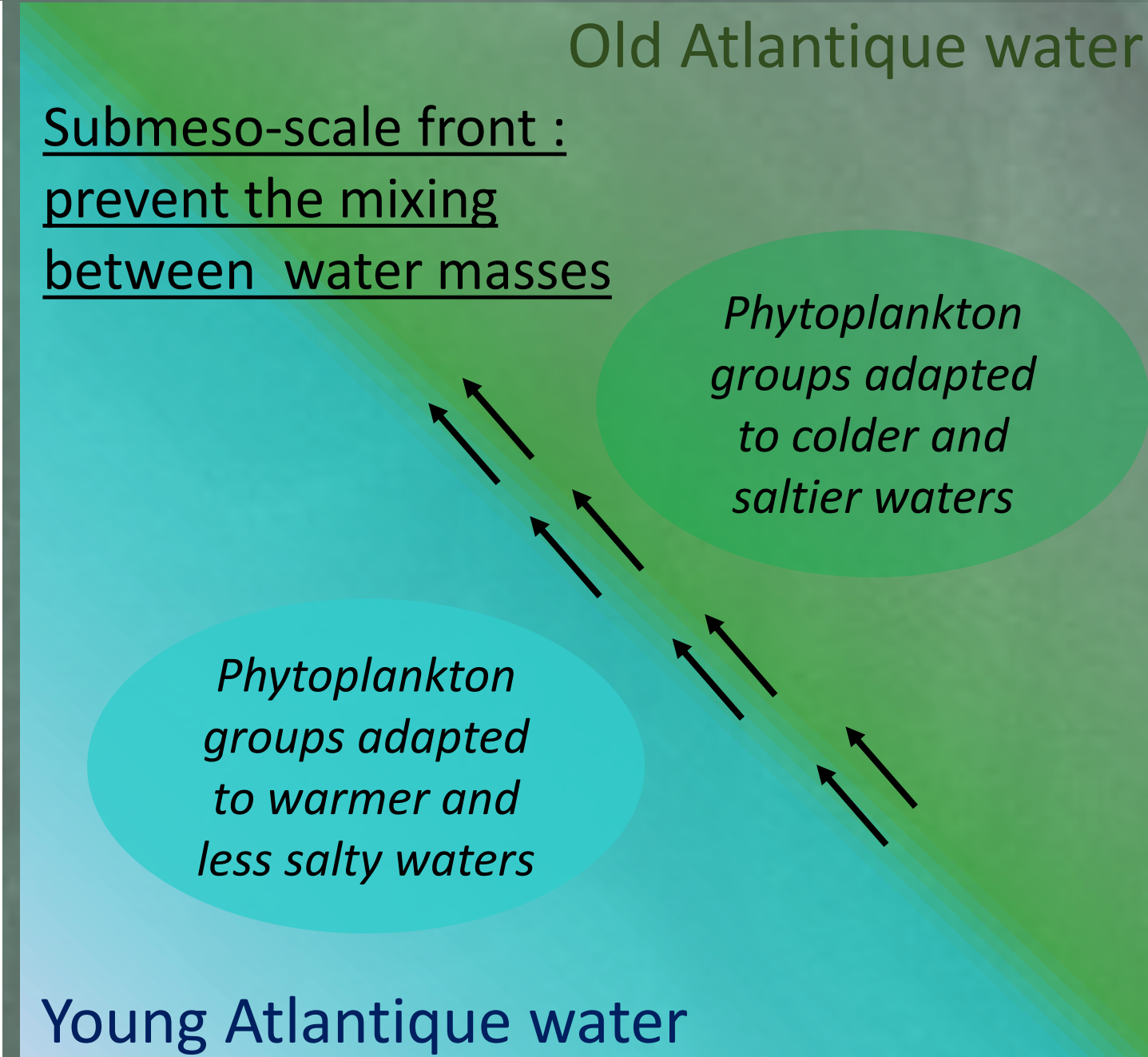
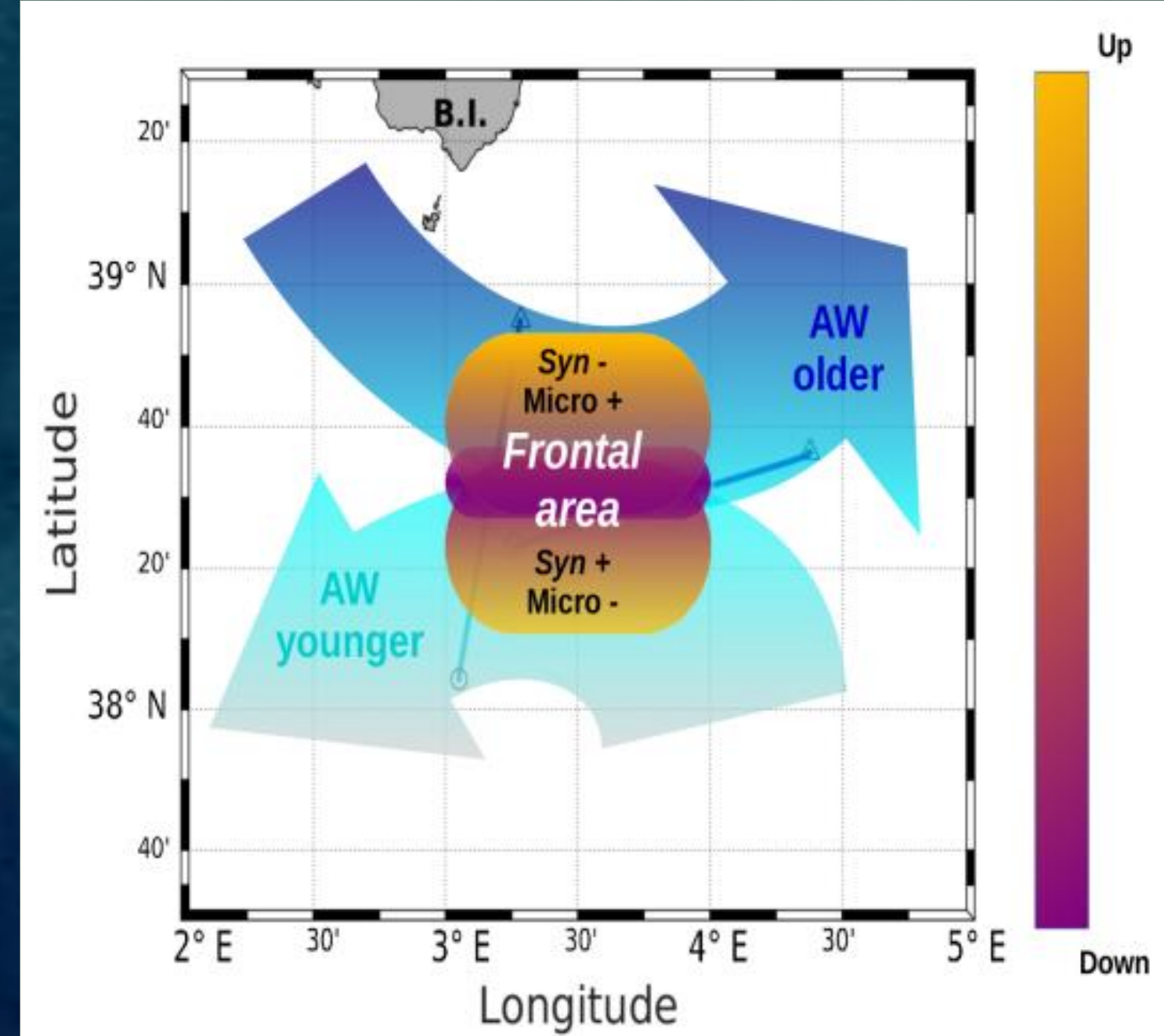
Cytometry analysis



Numerical modelisation

Lagrangian adaptative strategy and high frequency analysis to track ephemeral features and study their influence on phytoplankton

Our current knowledges?

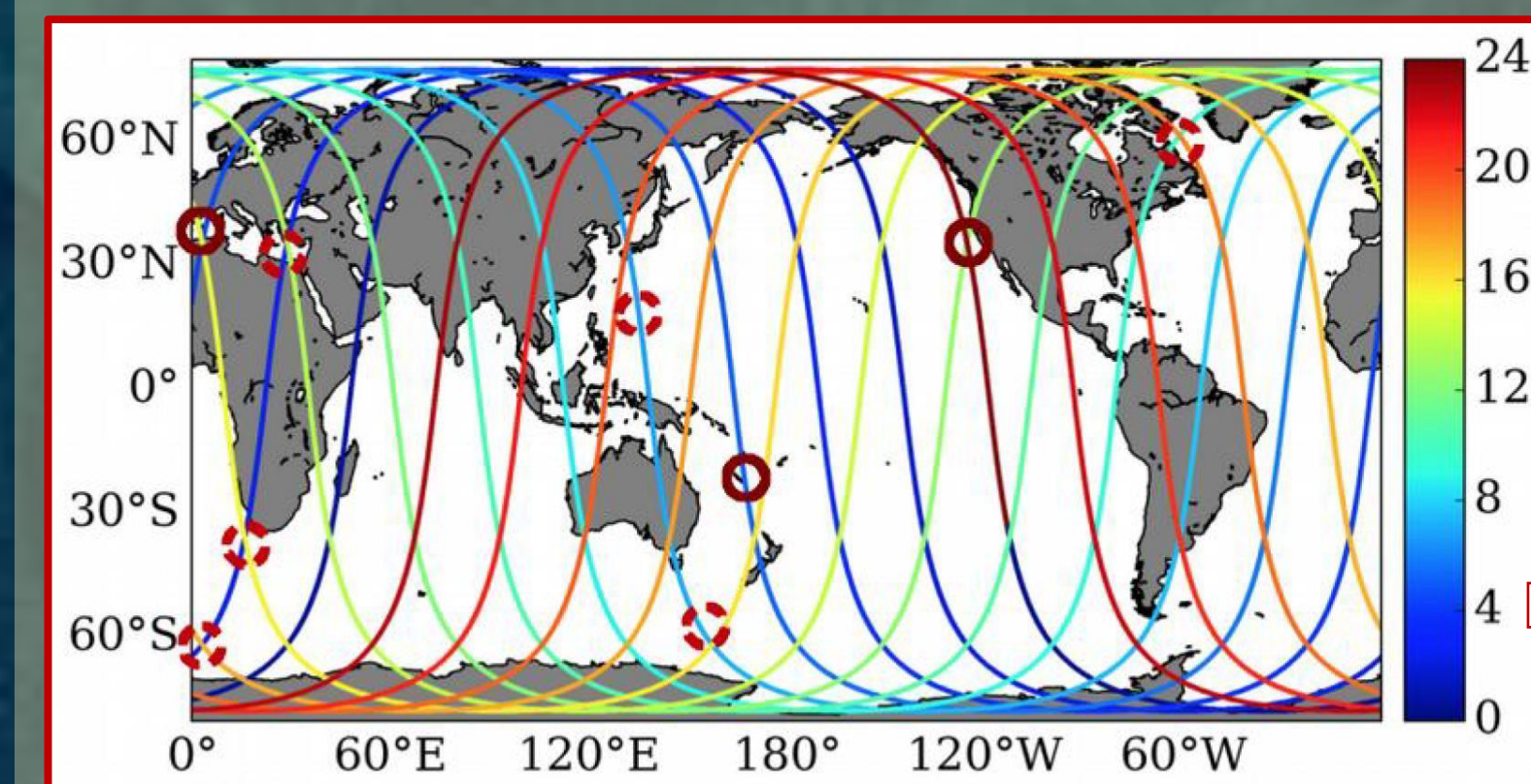


In the western Mediterranean Sea, distribution of phytoplankton groups showed contrasted abundances across the front

Strong structuring effect of physical fronts on phytoplankton communities: by forming a hydrodynamic barrier that separates the different groups in surface.

To understand what is happening in the front we need a better spatio-temporal resolution...

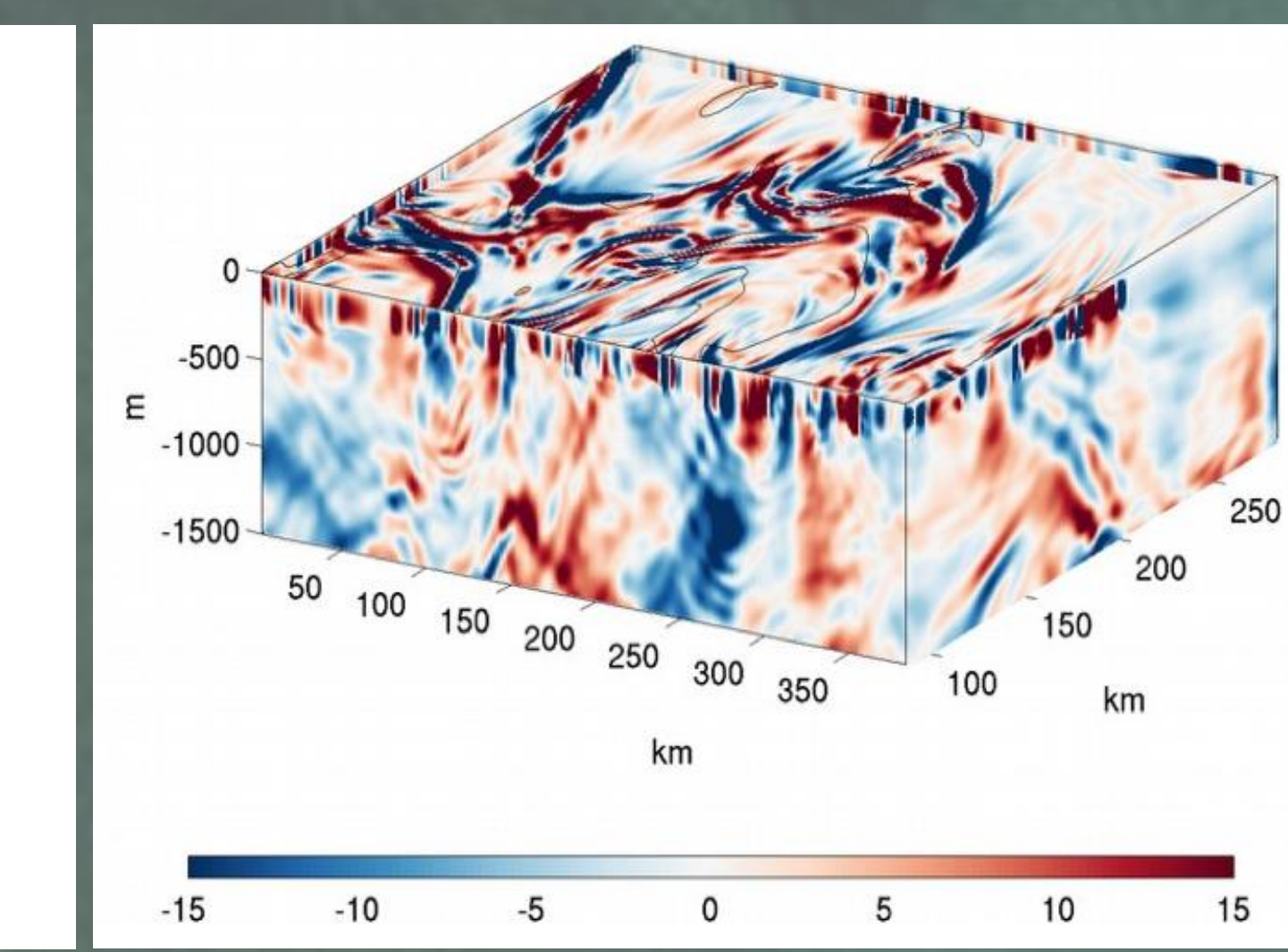
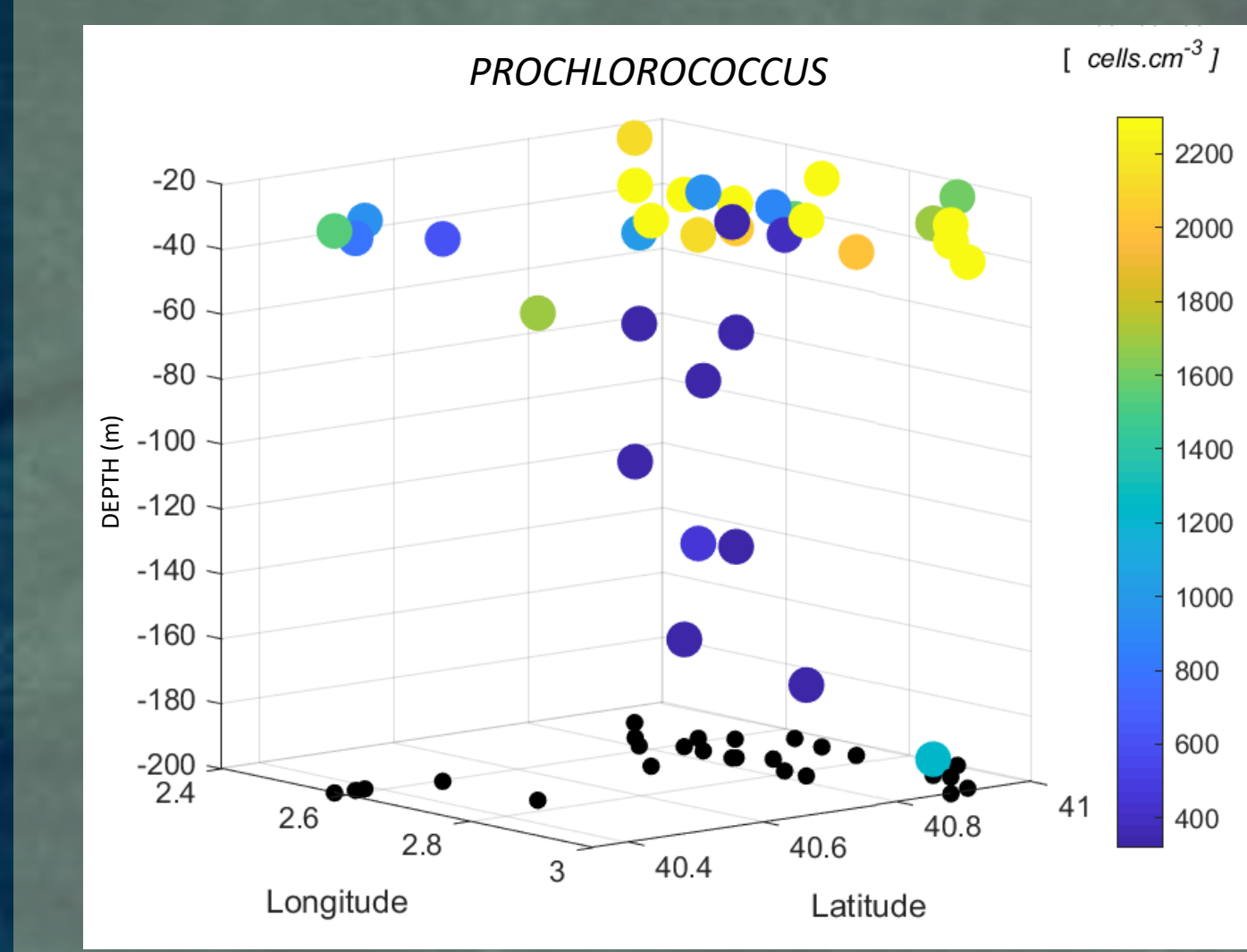
What next?



The BIOSWOT project aims to use SWOT observations for the understanding of fine-scale biophysical processes.

Orbit of the SWOT satellite to be launched in 2023, which will resolve the spatial and temporal variability of small-scale ocean features over a band about 120 km wide

Extend the study to the 3D with depth



Example of study : Estimates of vertical velocities to construct vertical biogeochemical fluxes, determine if sub-mesoscale fronts and horizontal transport are barriers for phytoplankton distribution.