

Title : Fine scale community structure of marine phytoplankton

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Abbreviated abstract: Automated flow cytometry analyses of phytoplankton highlight the role played by finescale on structuring the phytoplankton community. Coupling physical and biological in situ measurements is mandatory but tricky due to the high spatio-temporal frequency required to address the fine scale, particularly for biology. The adaptive Lagrangian sampling strategy coupled with a high-resolution sampling and analysis of phytoplankton at the single cell level help in characterizing and following the stock and dynamics of the phytoplankton in the finescale structures of interest. The results from the last cruises pave the way to the future BIOSWOT-Med cruise in 2023 in the southwestern Mediterranean Sea under the future SWOT satellite tracks, expanding the investigation to the more levels of the trophic network.

Related publications:

Tzortzis et al (2021). 10.5194/bg-18-6455-2021

Rousselet et al (2019). 10.1029/2018JC014392

Marrec et al (2018). 10.5194/bg-2017-343

How fine-scale dynamics influence the distribution (diversity) and abundance of phytoplankton?

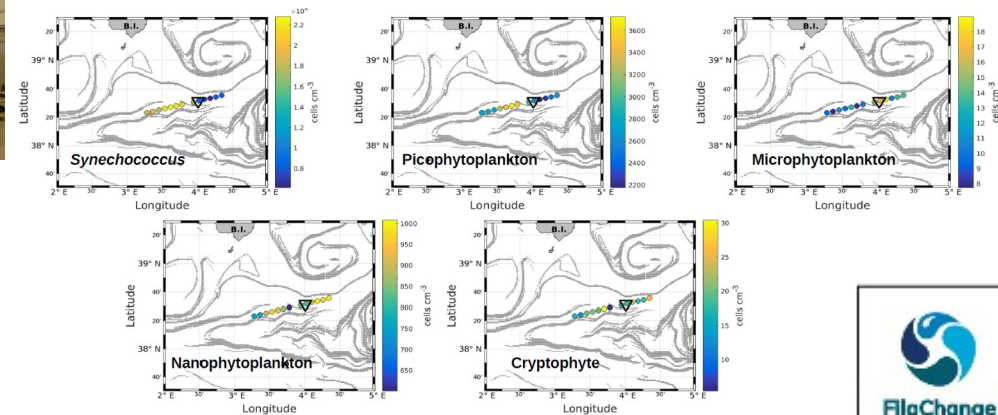
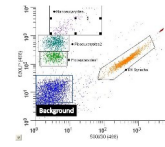
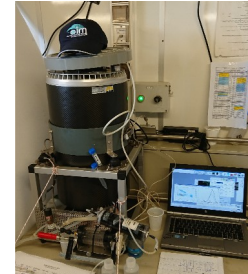
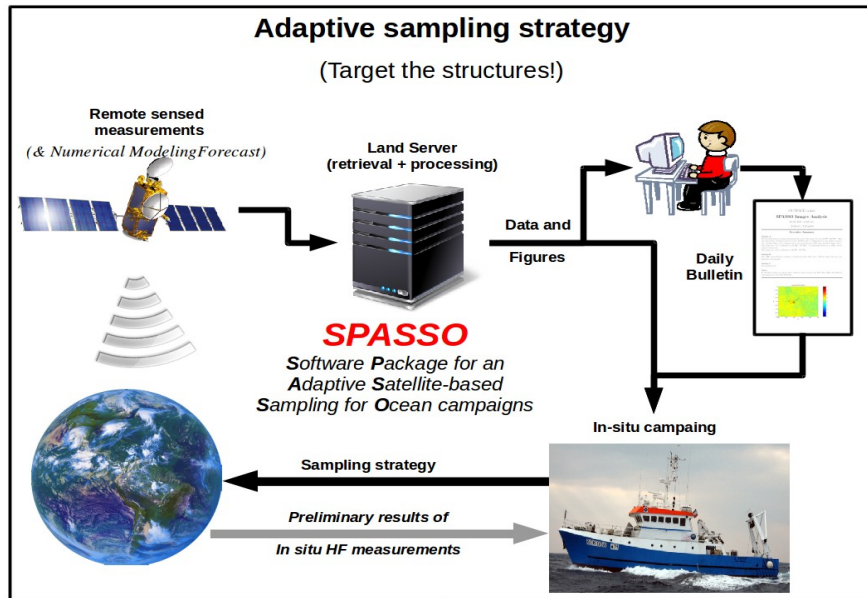
A possible explanation : *Phytoplankton temporal scale is of the same order of magnitude as the one of finescale processes, suggesting a close coupling between phytoplankton growth and finescale forcing.*

In situ measurements at submesoscale : a big challenge due to the ephemeral character of these structures

Our approach :

Exploit the satellite NRT data to guide the in-situ sampling for physics and biology

Automated flow cytometry used with an innovative multidisciplinary instrumentation (towed vehicles, gliders, AUV, drifters...)



Results from previous campaigns OSCAHR'15, OUTPACE '15, PROTEVSMED_SWOT'18, FUMSECK'19

Automated flow cytometry proved to be successful to target phytoplankton (abundance and dynamics) when applied in satellite-based adaptive and Lagrangian strategies in order to characterize fine-scale structures in situ.

Highlight the important role of the fine scales in structuring the phytoplankton community (fluid dynamical barriers and biodiversity hot-spots).

Innovative analytical methods are in development to directly analyse the data collected in situ by flow cytometry (automated clustering by CNN) and apply the Sosik's adapted model to estimate the growth rates and production of phytoplankton. These data would be implemented in SPASSO.

Outlook for the next campaign BIOSWOT-Med 2023

To perform a cruise in the oligotrophic and moderately energetic SW Med :

- i) sampling fine-scale dynamics,
- ii) measuring nutrient concentrations at nanomolar-precision,
- lii) performing high-resolution cytometry for phytoplankton, heterotrophs and viruses,
- iv) estimating accurately the zooplankton grazing.

Main recent key advancements :

Automated flow cytometry compatible with the lagrangian multidisciplinary strategies, for high-frequency biological sampling and analysis of phytoplankton in near real time.

Incoming opportunities :

SWOT mission providing a better resolution of the fine scale structures (altimetry-derived high-resolution surface currents)

Include other levels of the trophic network (heterotrophic bacteria & flagellates, ciliates, viruses), nutrients at high resolution, and grazing to better explain how the fine scale features influence the microbial structure and dynamics

Future possible outstanding knowledge locks :

Better understand the physical-biological coupled dynamics at the fine scale in an area of low energy like the NW Med.