

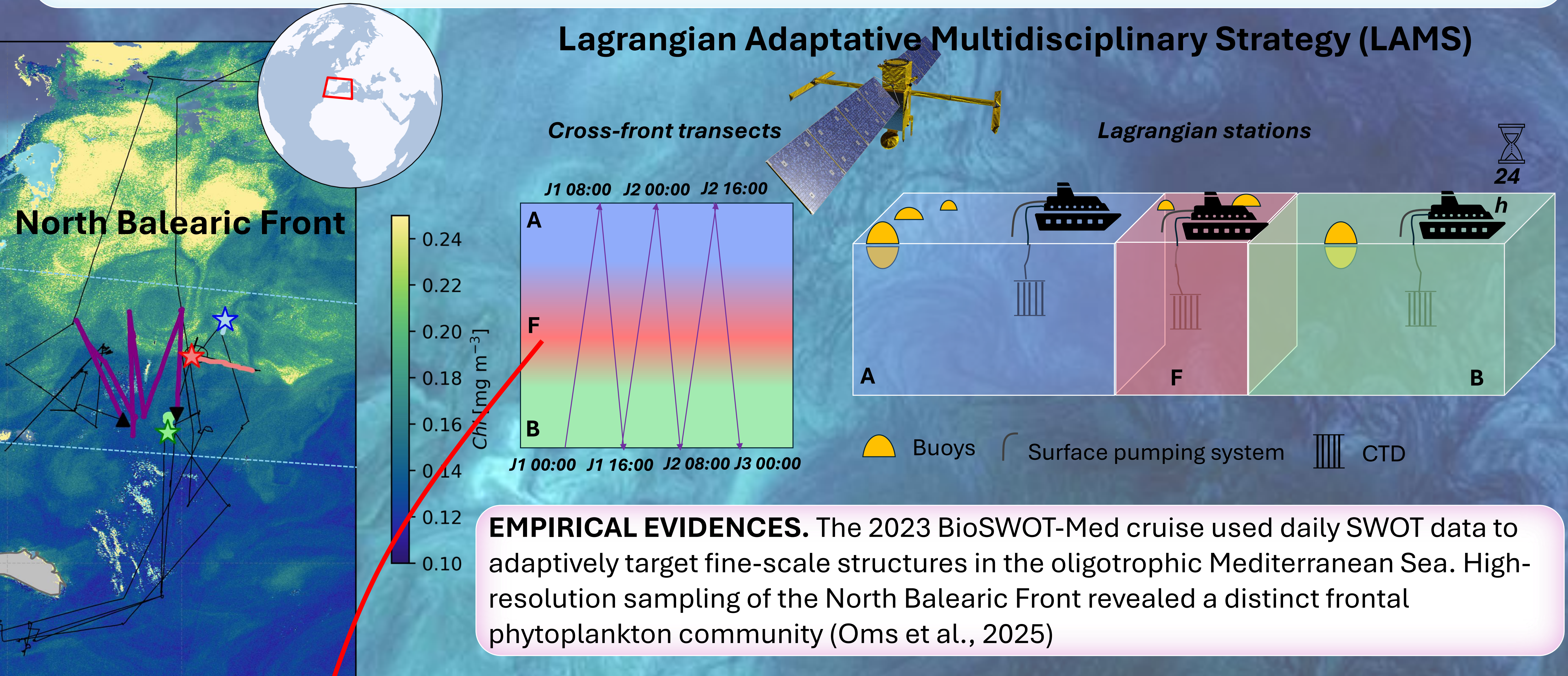
# Evidences and likely underlying mechanisms of fine-scale phytoplankton communities at the SWOT era

Laurina Oms, Monique Messié, Gérald Grégori, Andrea Doglioli & BioSWOT-Med team

Marine phytoplankton communities show high diversity shaped by fine-scale physical structures driven by ocean currents. The launch of the SWOT satellite in 2022 now enables observation of these fine-scale dynamics, offering new insights into physical-biological interactions, especially in previously unexplored frontal oligotrophic regions

## Are fronts capable of hosting distinct phytoplankton communities?

### Lagrangian Adaptive Multidisciplinary Strategy (LAMS)

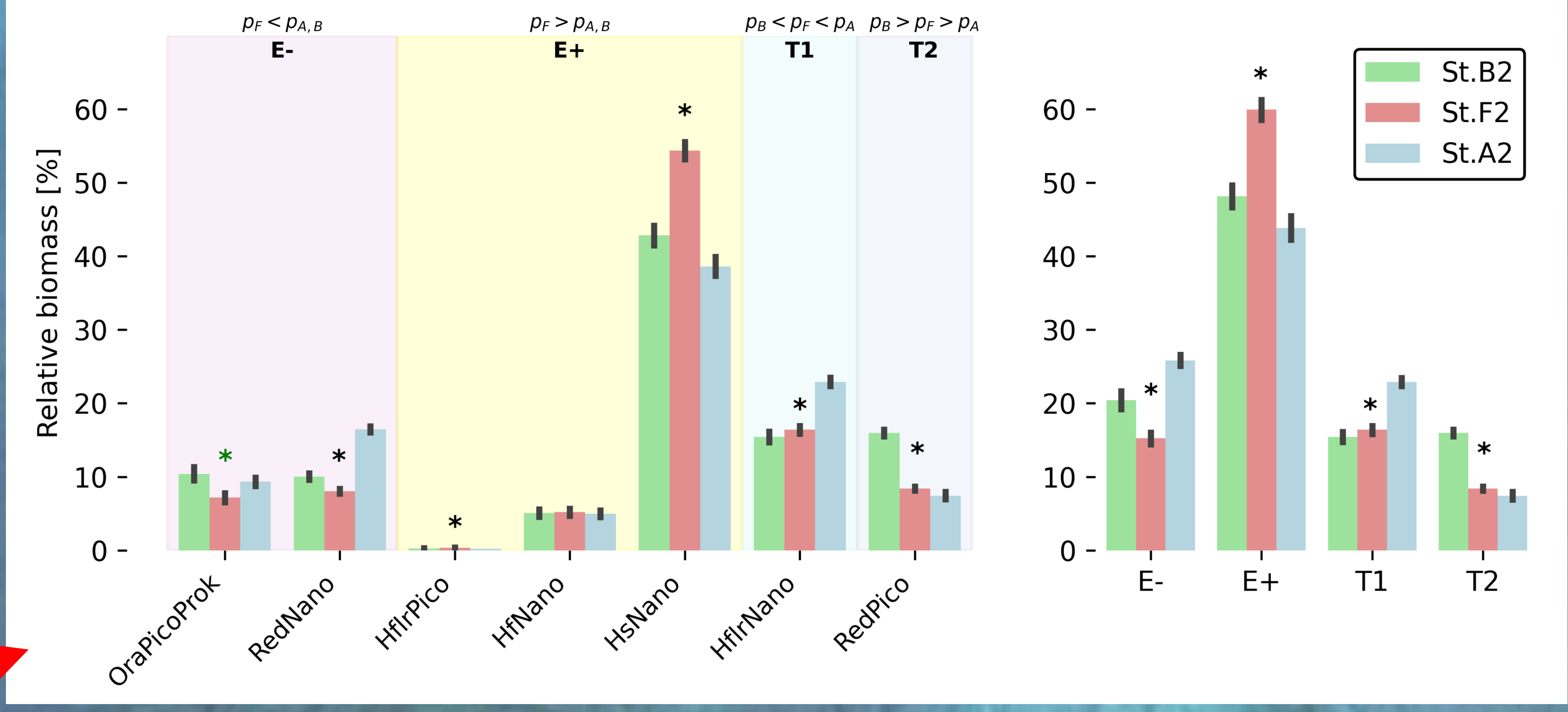


**EMPIRICAL EVIDENCES.** The 2023 BioSWOT-Med cruise used daily SWOT data to adaptively target fine-scale structures in the oligotrophic Mediterranean Sea. High-resolution sampling of the North Balearic Front revealed a distinct frontal phytoplankton community (Oms et al., 2025)

Frontal phytoplankton community?



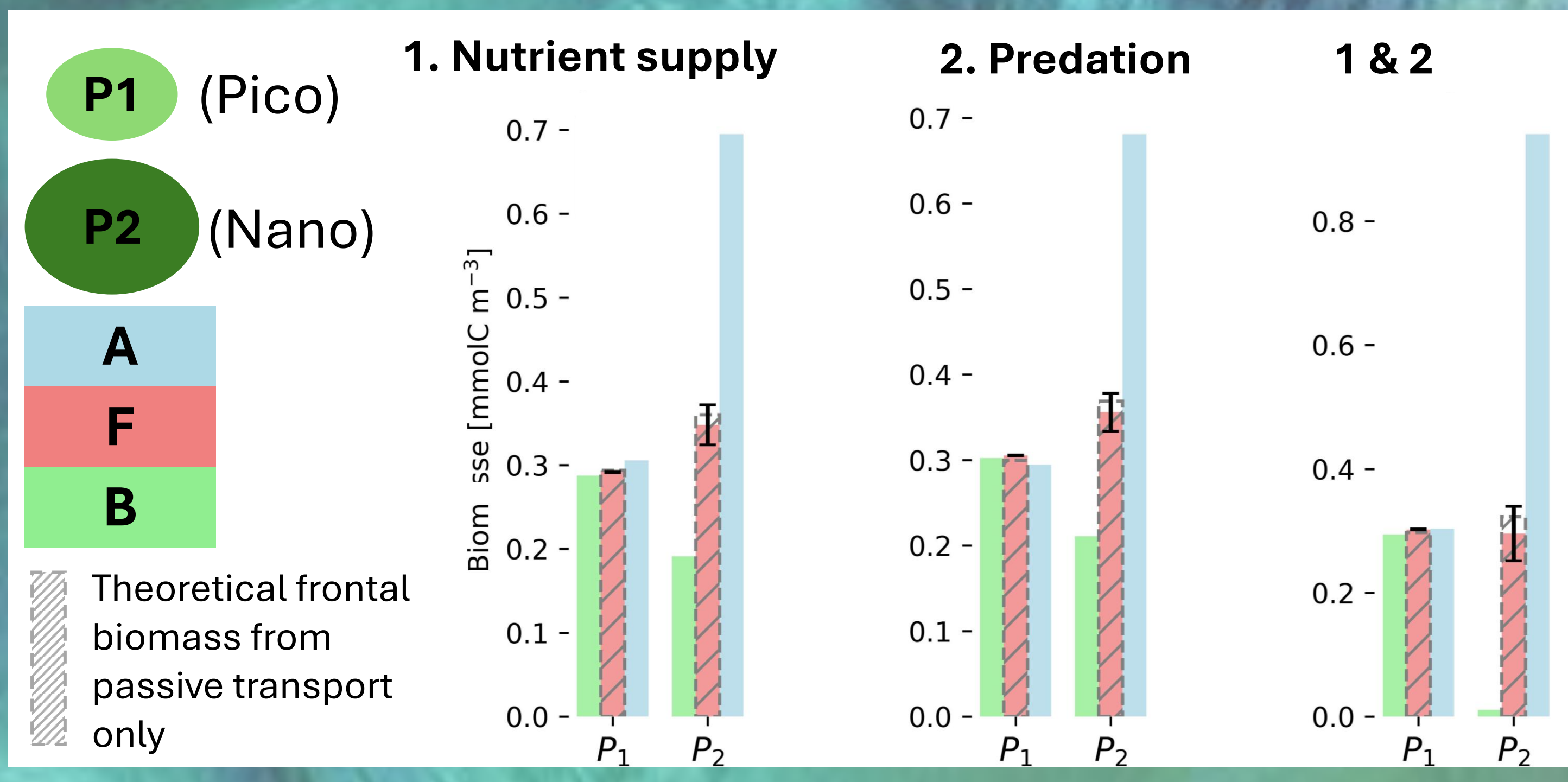
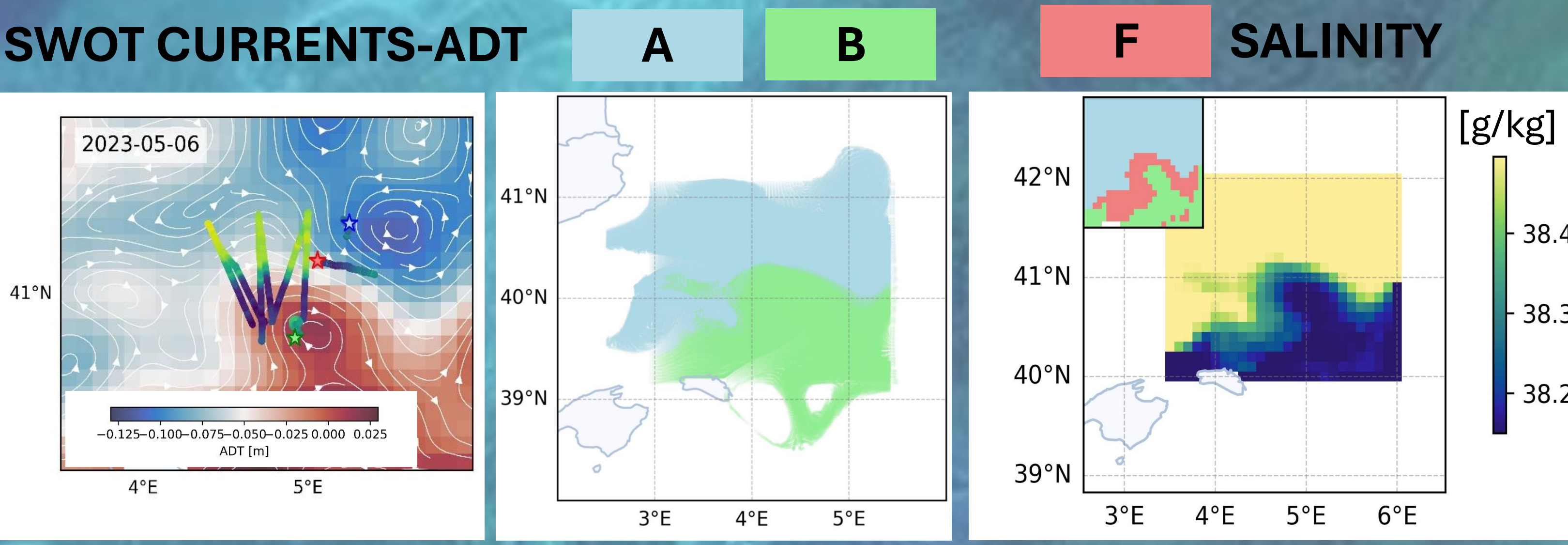
Automated flow cytometry (100 samples during 24h)



**UNDERLYING MECHANISMS.** We combined a Lagrangian physical model (Blanke & Raynaud, 1999) with a Nutrient-Phytoplankton-Zooplankton model (Oms et al., 2024) using SWOT-derived velocity fields to study fine-scale dynamics at the North Balearic Front. Our results show that while passive advection explains the community's presence, its persistence relies on the combined effects of transport, nutrient supply, and predation.

### Initialisation | Lagrangian trajectories | Frontal definition

### Modeled frontal phytoplankton community under different biogeochemical configurations



Oceanic fronts act as catalysts for phytoplankton community changes, creating ecological niches that sustain diversity even in oligotrophic and otherwise stable regions. The SWOT satellite enabled high-resolution targeting and Lagrangian tracking and modeling of fronts, allowing us to reveal that fine-scale physical gradients, combined with biological interactions, maintain distinct frontal phytoplankton communities and provide refuges for minority functional groups.