



Near-inertial wave trapping inside a fine-scale anticyclonic eddy during the BioSWOT-Med 2023 cruise: Turbulence and energy flux

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SWOT
Science Team Meeting
www.swot2025.org



cnes NASA ESA SPACE
ARCACHON - France
14-17 OCT. 2025

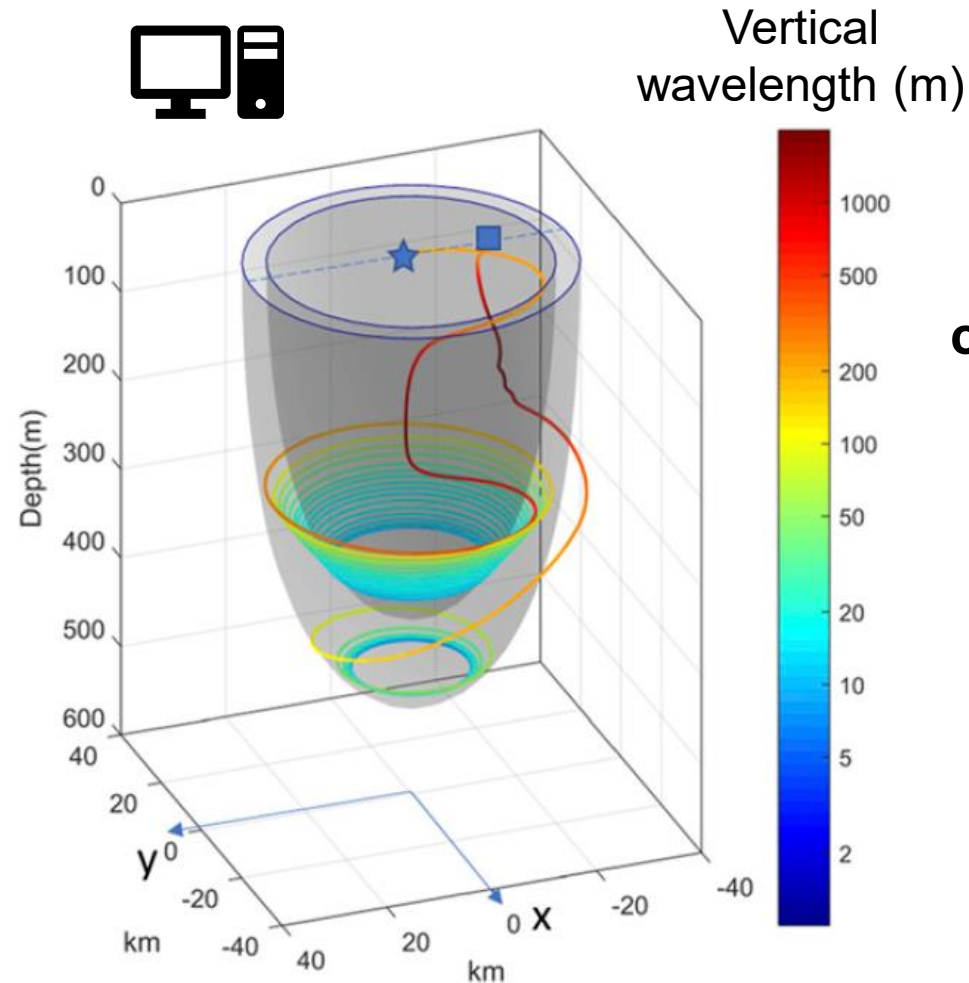
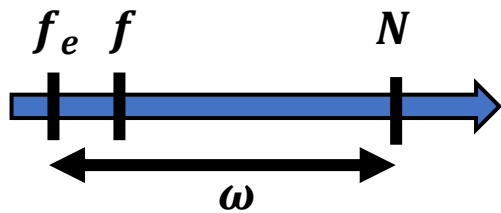
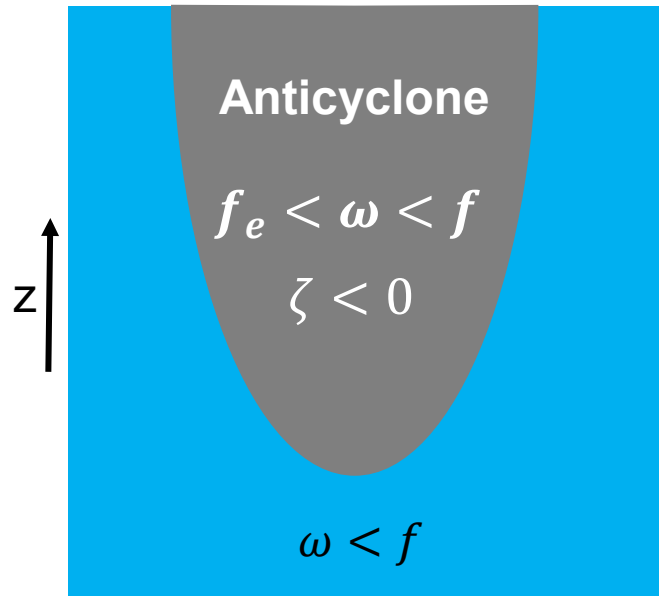
Tides and Inertia-Gravity Waves
16/10/2025

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Anticyclonic eddies trap near-inertial waves

→ Favor propagation and enhance kinetic energy dissipation

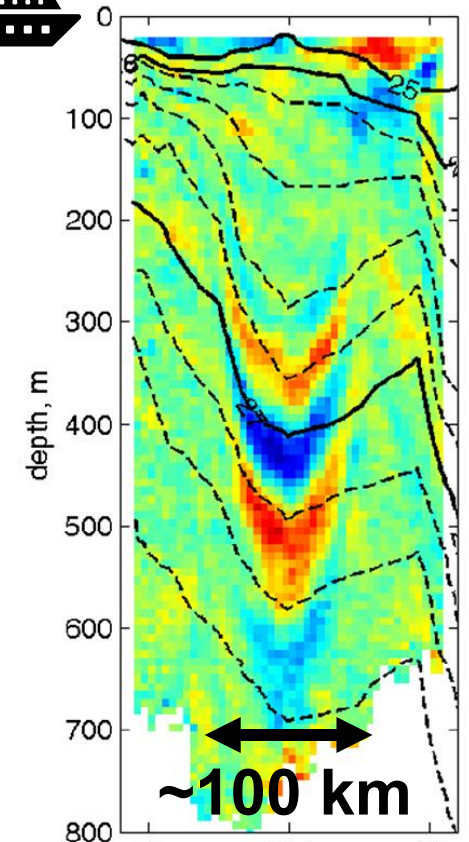
$$f_e \approx f + \zeta/2$$



Lelong et al., 2020



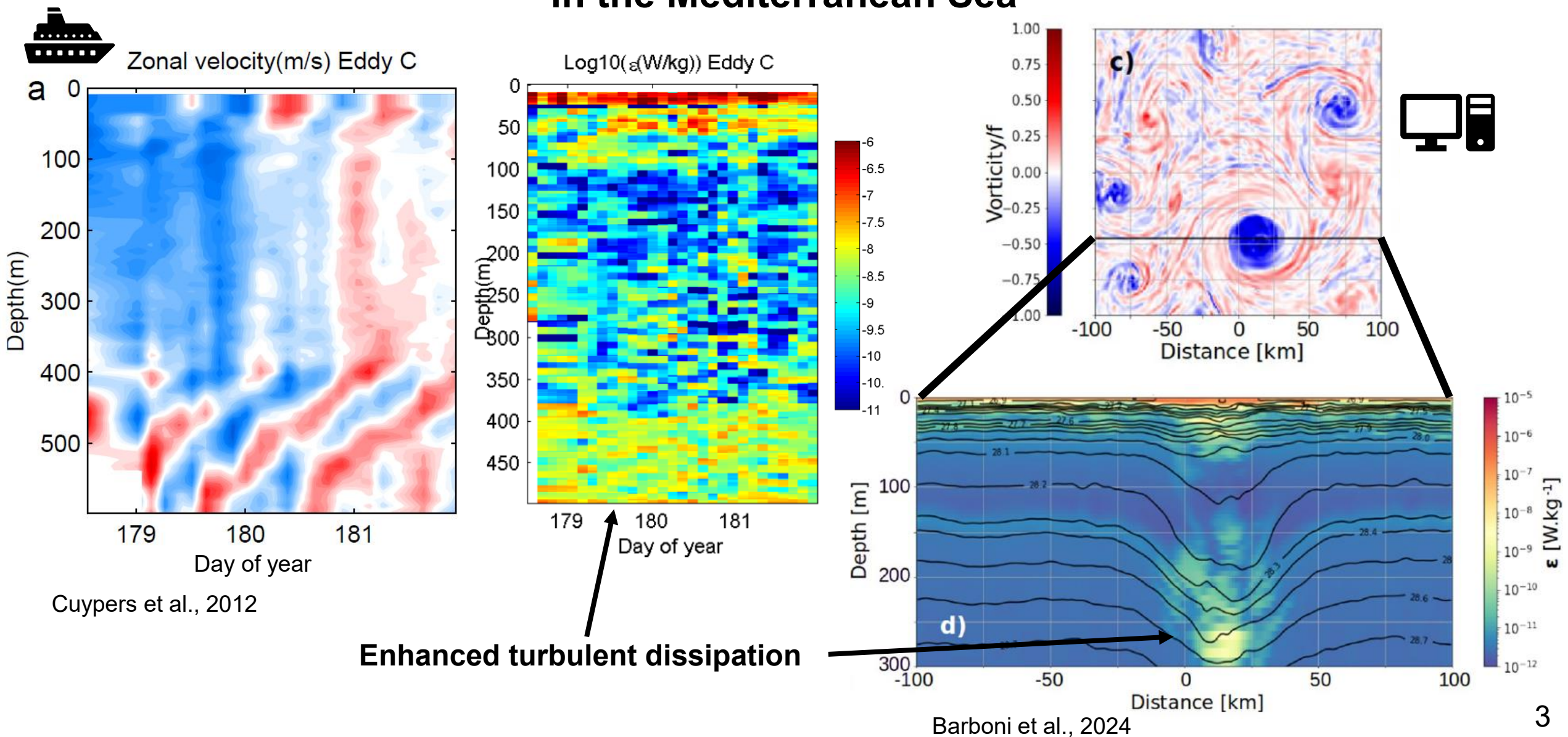
Zonal velocity



u (m/s)

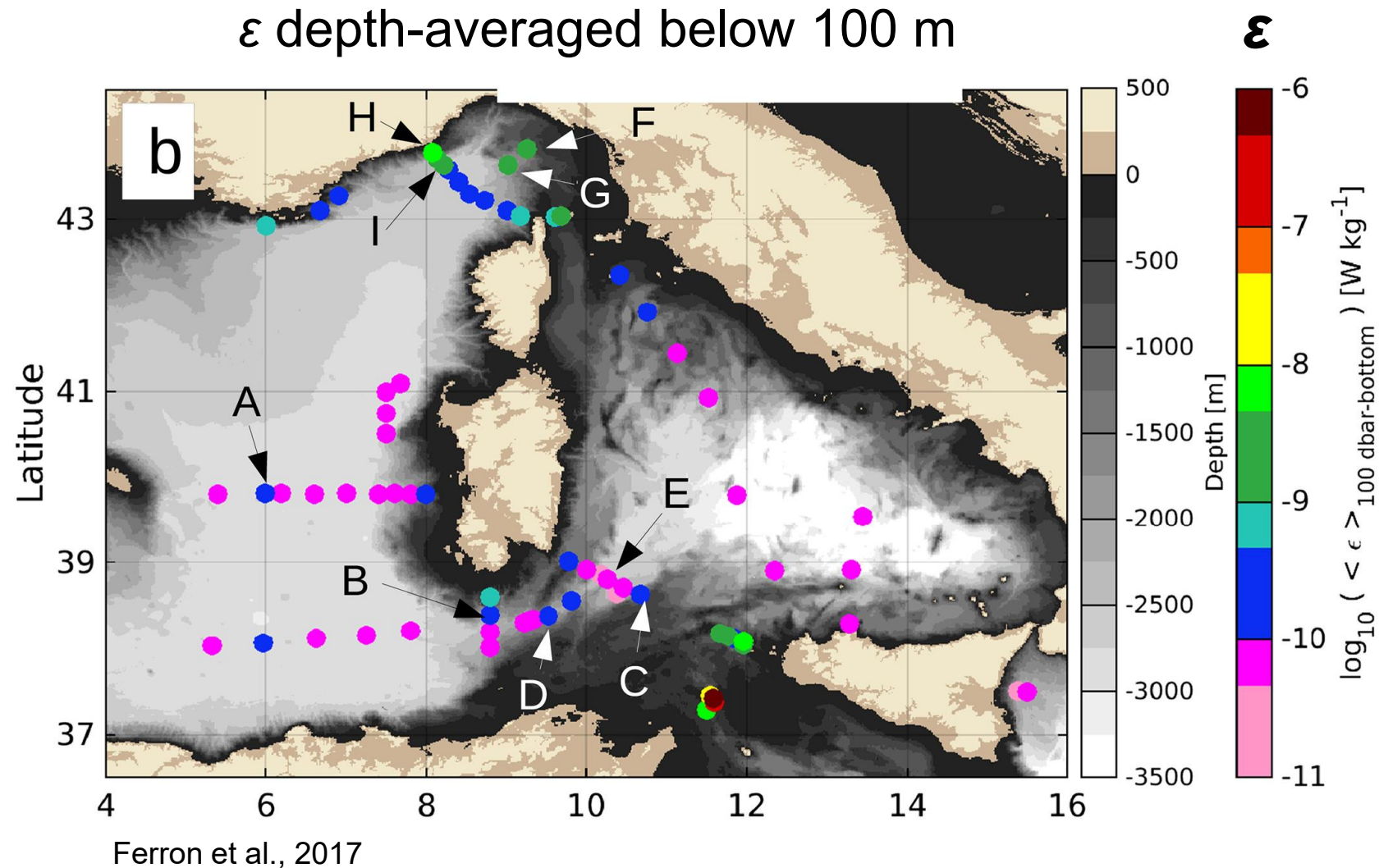
Joyce et al., 2013

Few examples of near-inertial wave trapping in large anticyclonic eddies in the Mediterranean Sea



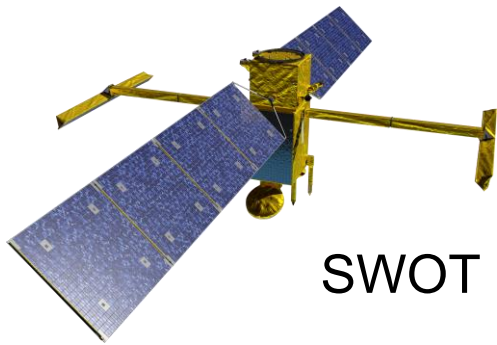
Weak turbulence in the Mediterranean Sea far from straits and boundaries

- Hotspots: Sicily Channel and Corsican Channel, Straits
 - **Weak** elsewhere
- Weak internal tides
- **Role of NIW trapping?**



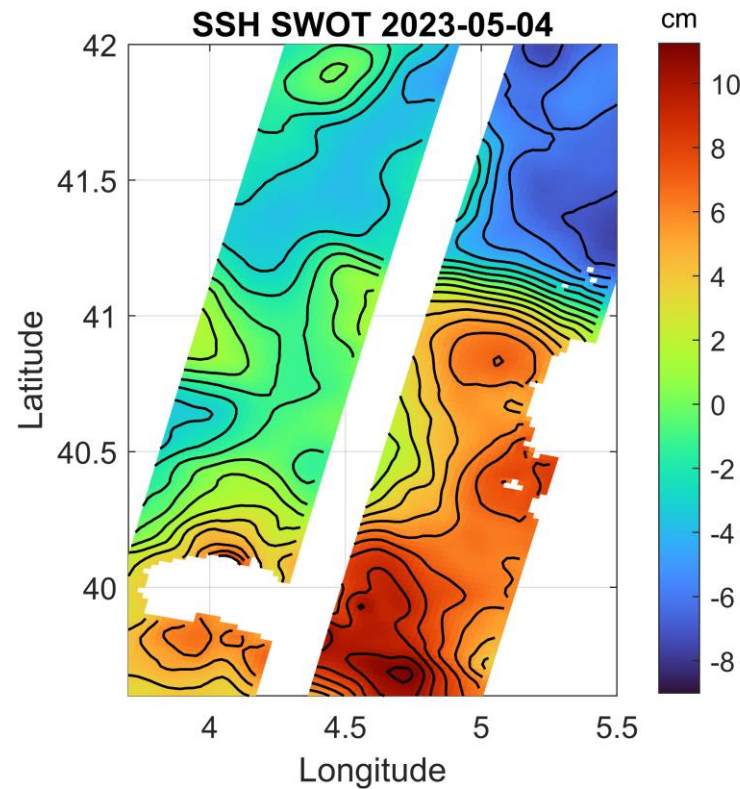
SWOT reveals small eddies in the Mediterranean Sea

Surface Water &
Ocean Topography

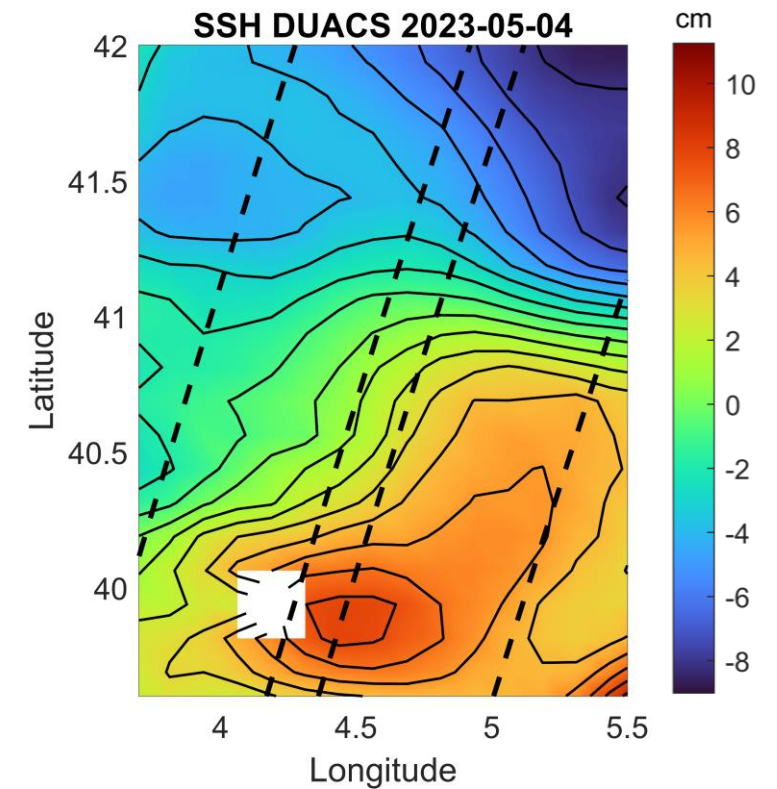


Rd = 5–15 km
in the Med Sea

SWOT:
>10–15 km of diameter



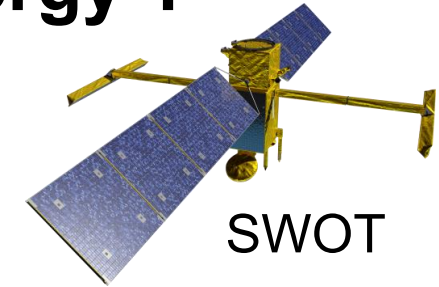
Conventional altimetry:
>70–100 km of diameter



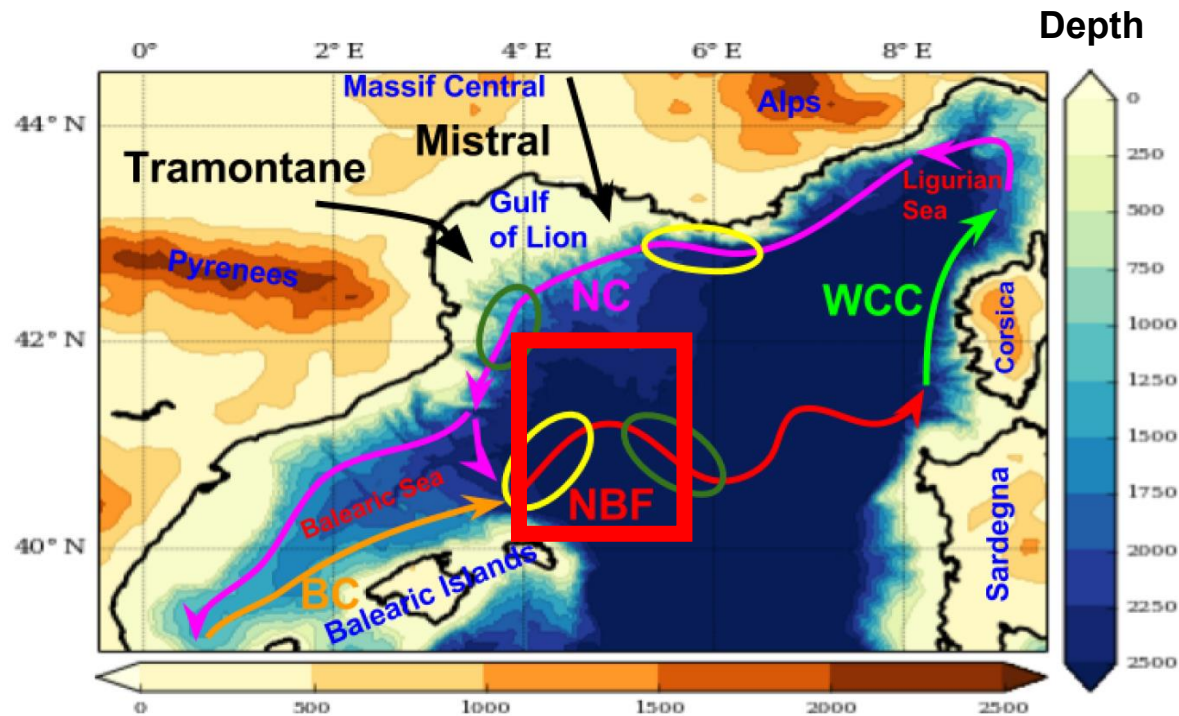


Are the small eddies revealed by SWOT playing a role in the dissipation of kinetic energy ?

BioSWOT-Med cruise: study the bio-physical coupling in a moderately energetic region taking advantage of SWOT data



21/04 – 15/05 2023



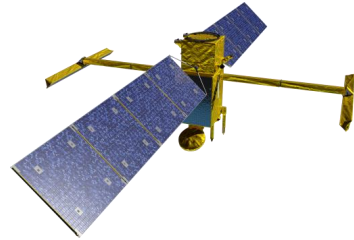
NC = Northern Current NBF = North Balearic Front
 BC = Balearic Current WCC = West Corsica Current

Seyfried et al., 2019

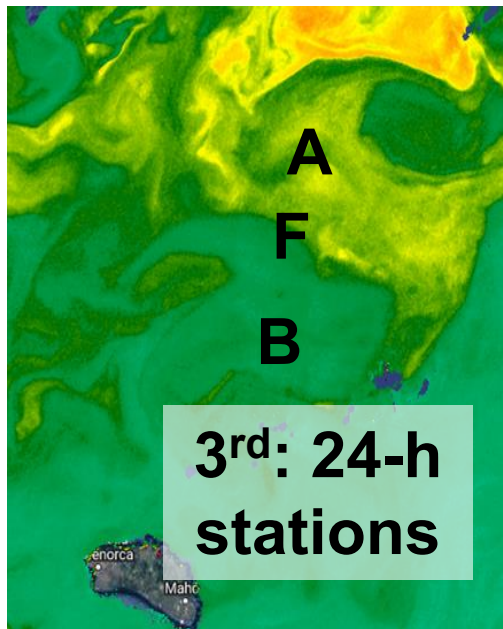


An adaptative sampling strategy

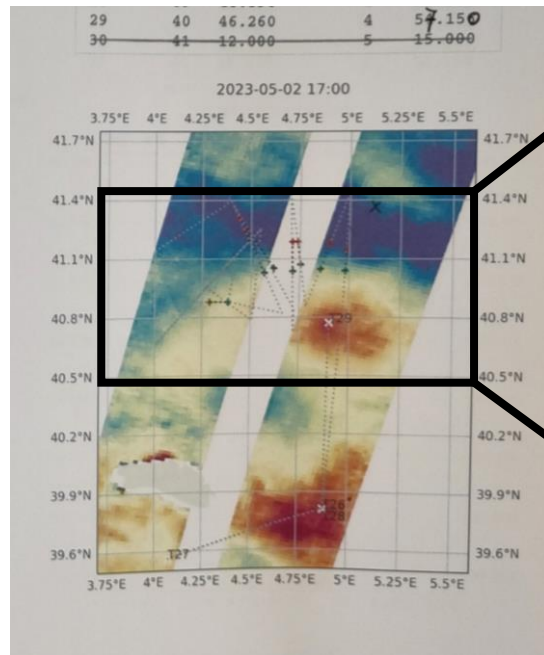
1st: find a structure



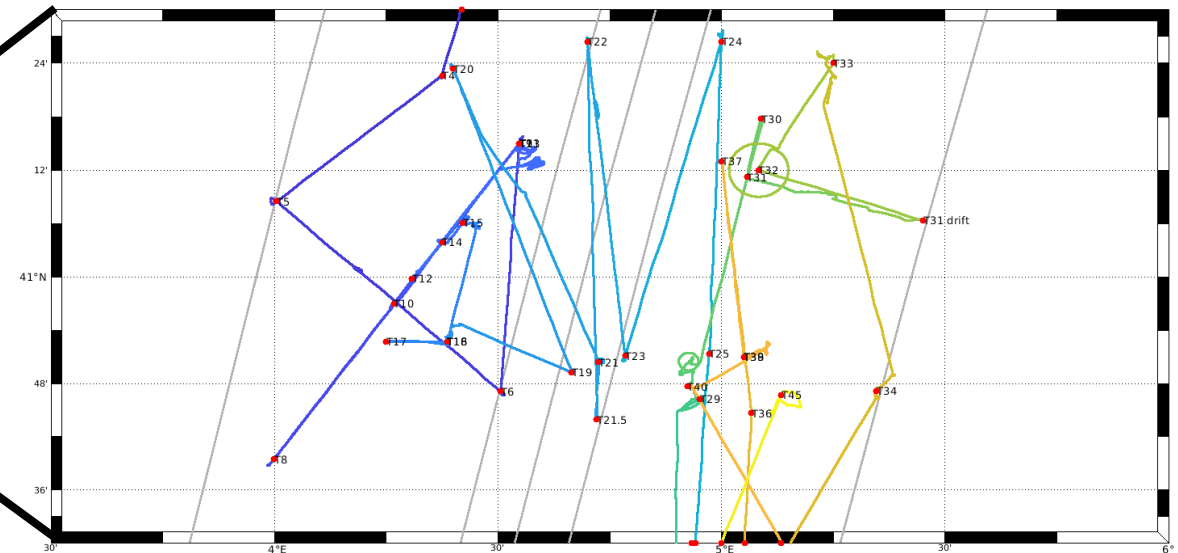
2nd: map it



Chlorophyll-a (satellite)



1st SWOT images for in-situ cruises

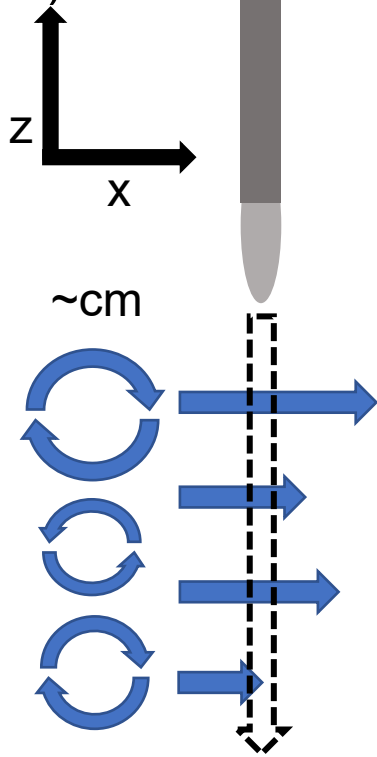
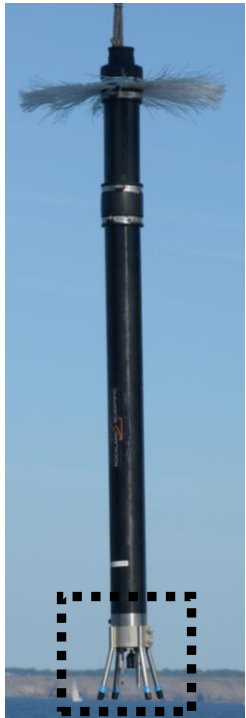


Ship trajectory



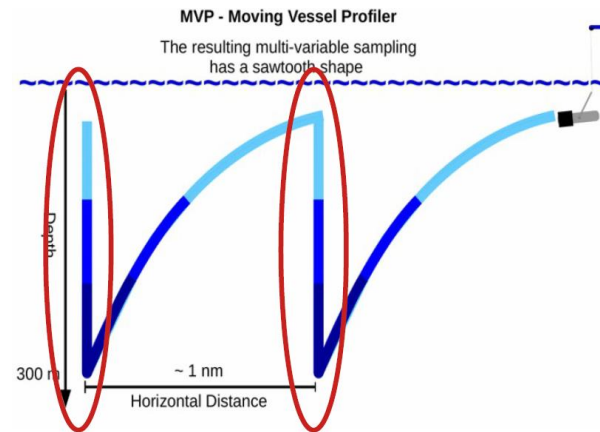
A wide variety of data

Vertical Microstructure Profiler (dissipation ϵ)



Shear probe
(512 Hz)

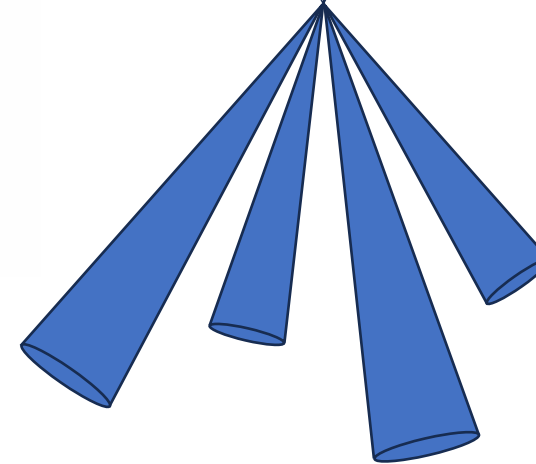
Moving Vessel Profiler (T, S)



Gliders



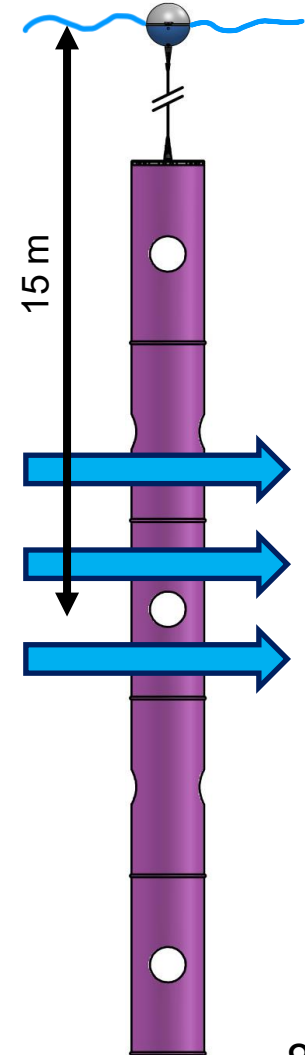
Ship-ADCP (currents)



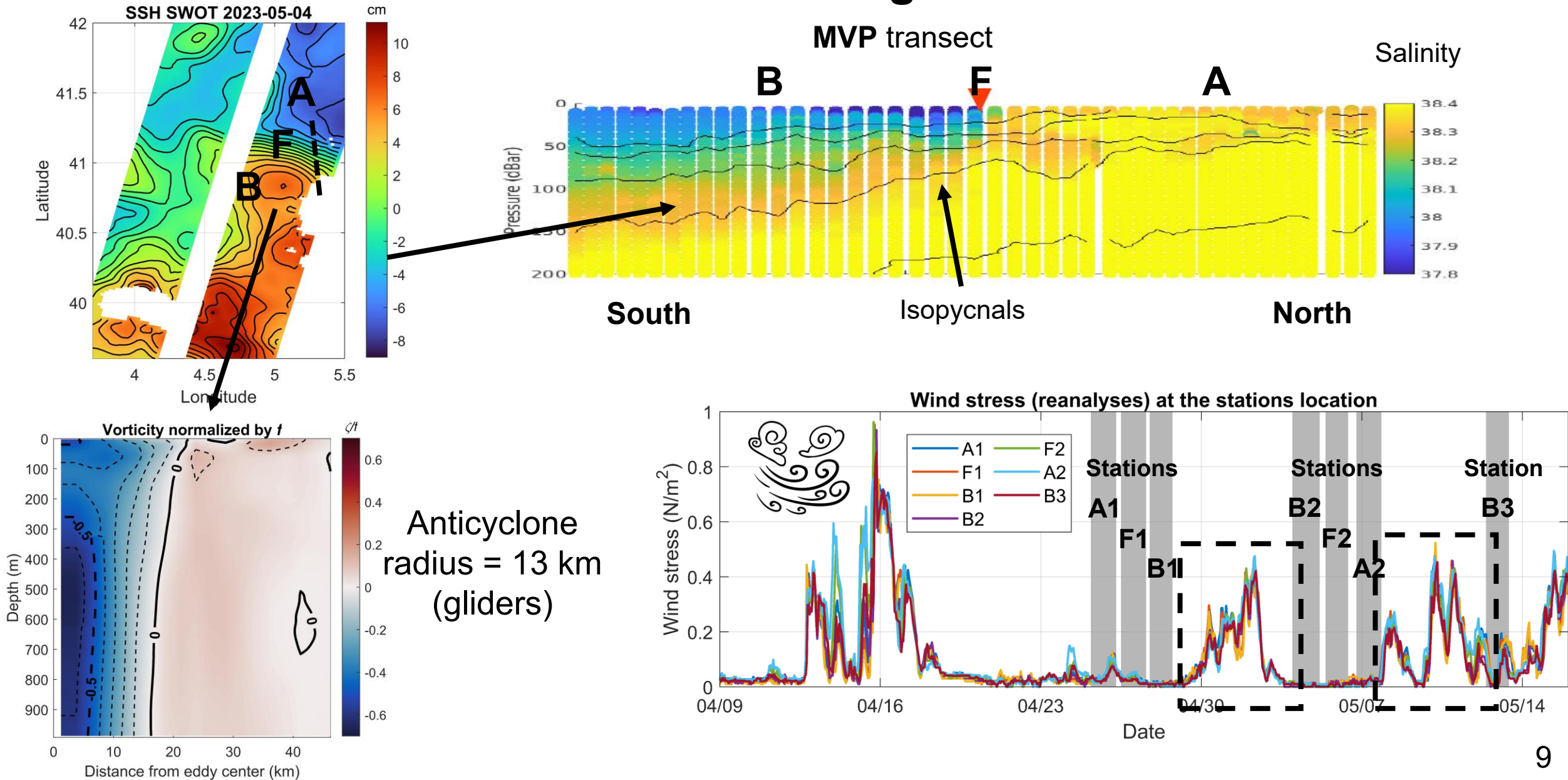
38 kHz
dz = 20 m
Max 800–1000 m

150 kHz
dz = 6 m
Max 200–250 m

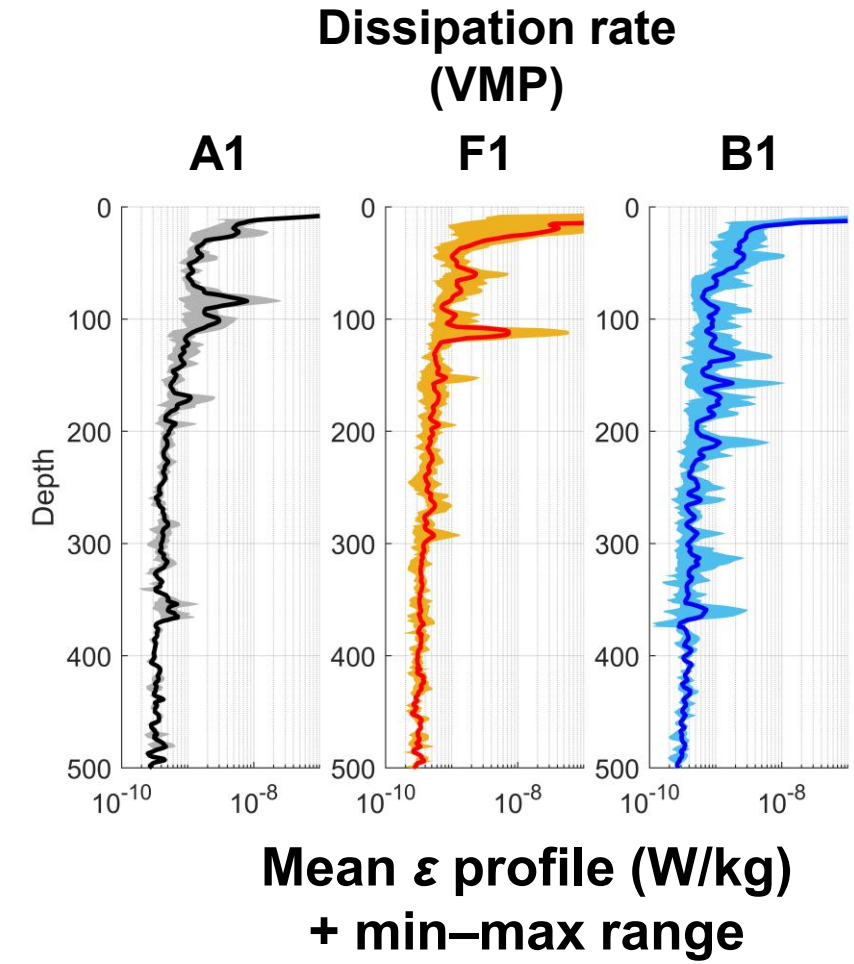
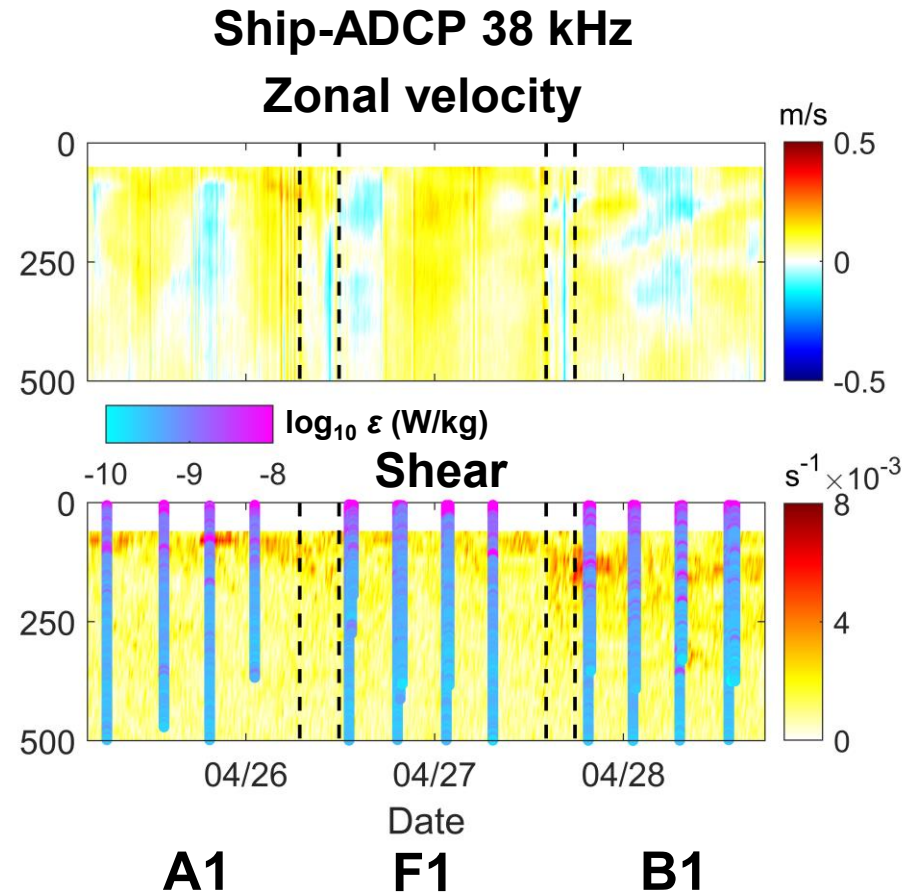
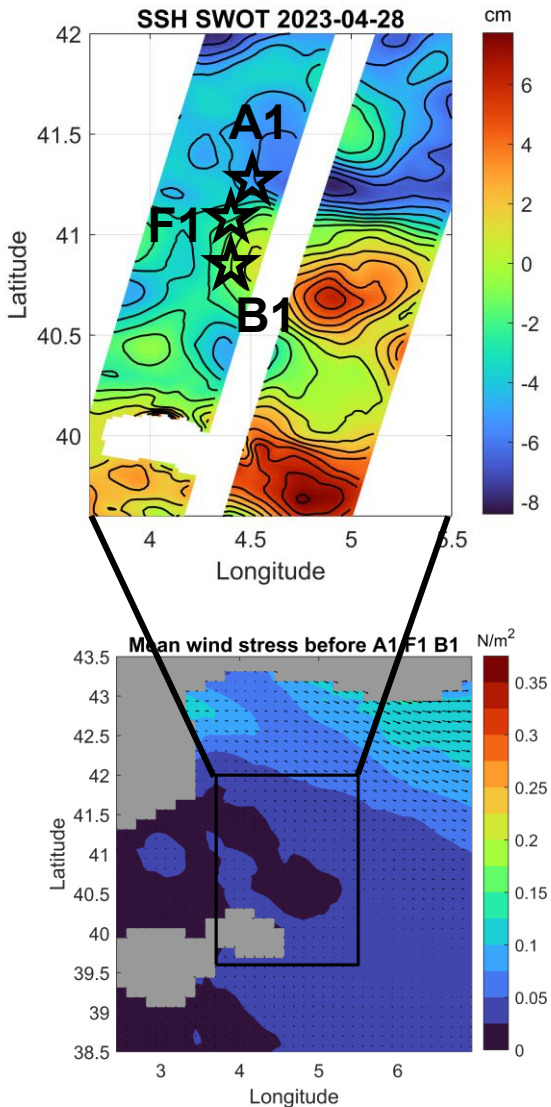
Drifting buoys (surface current)



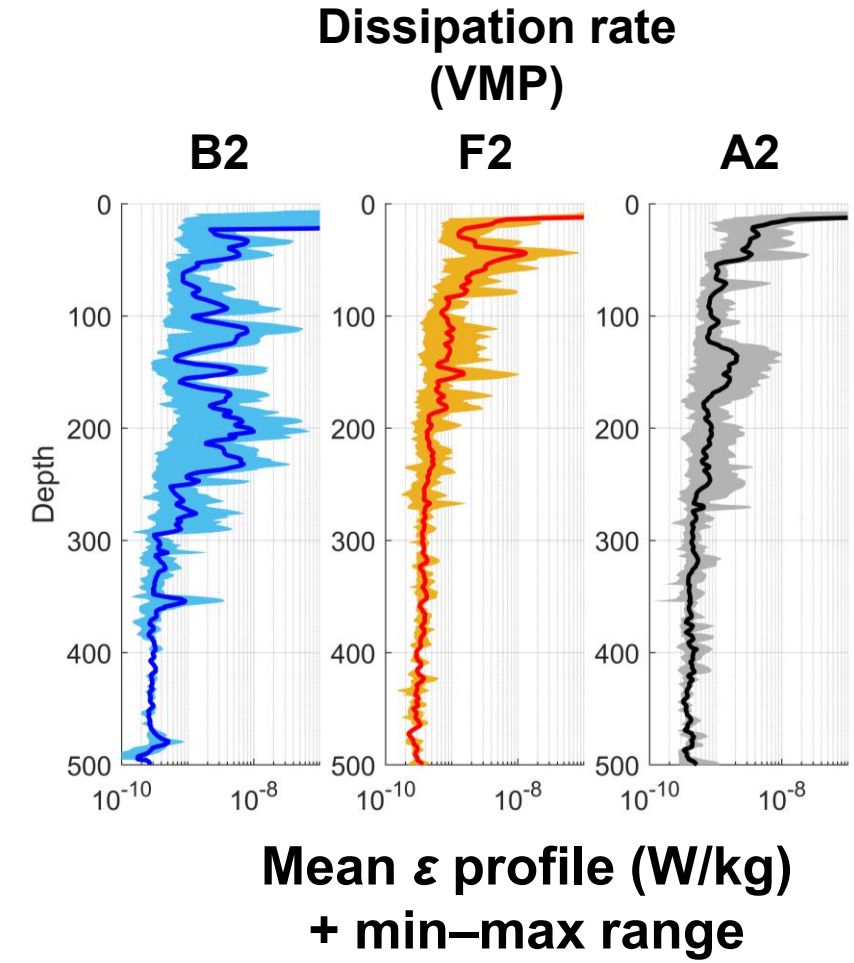
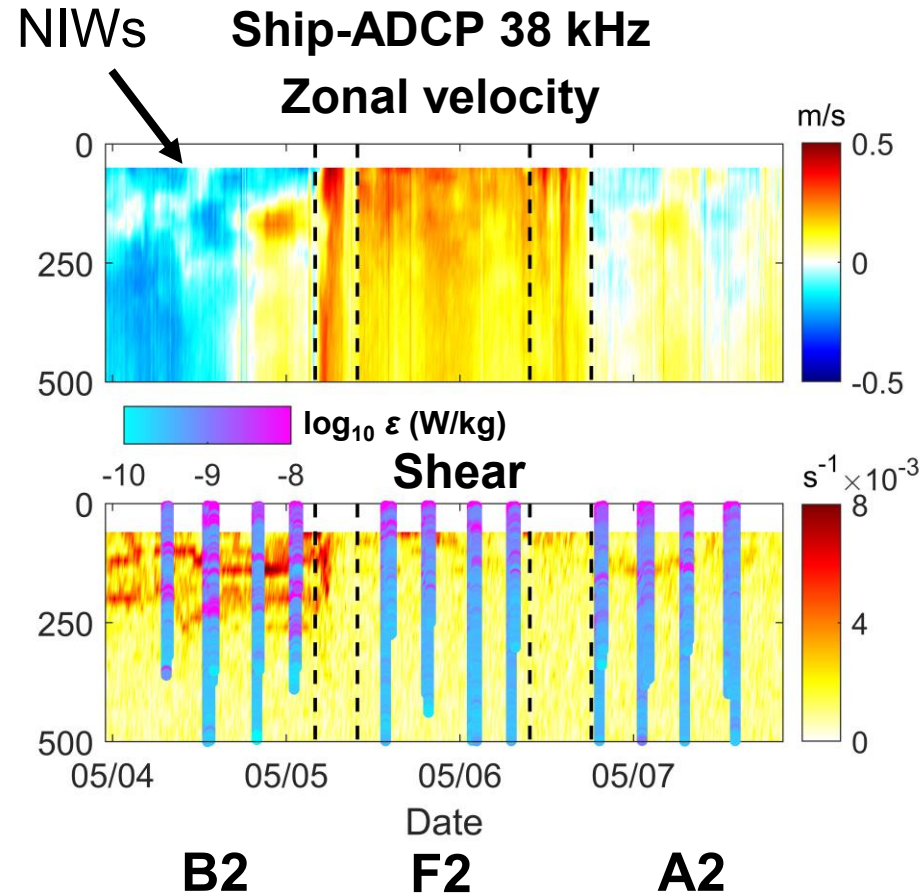
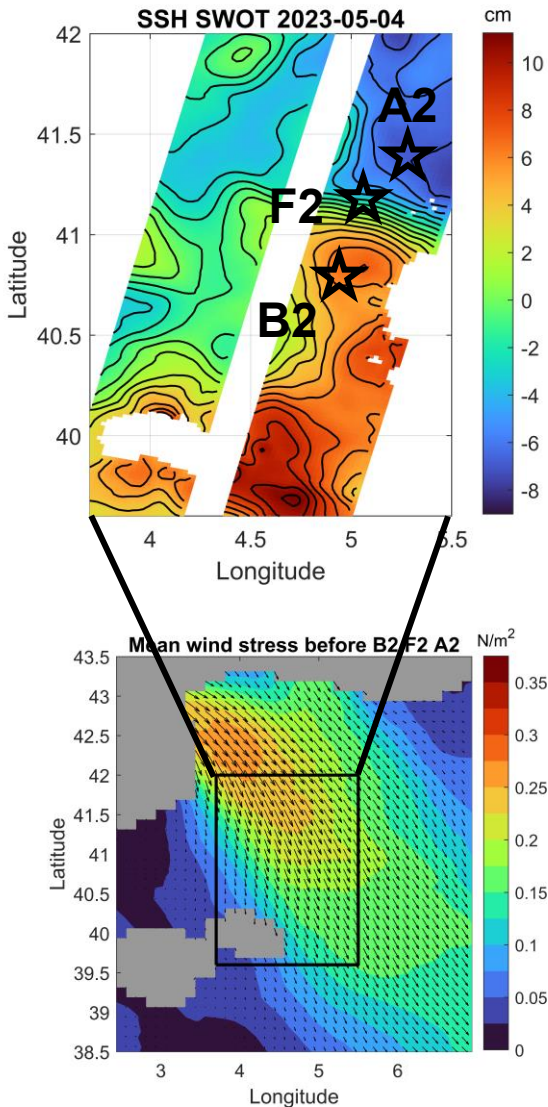
A frontal area and strong wind events



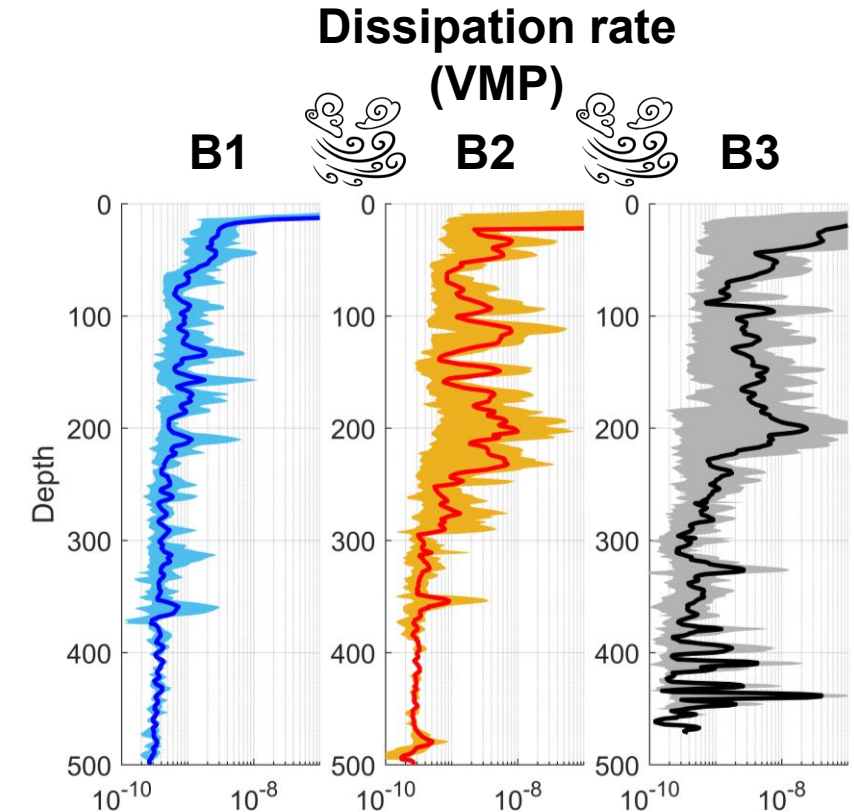
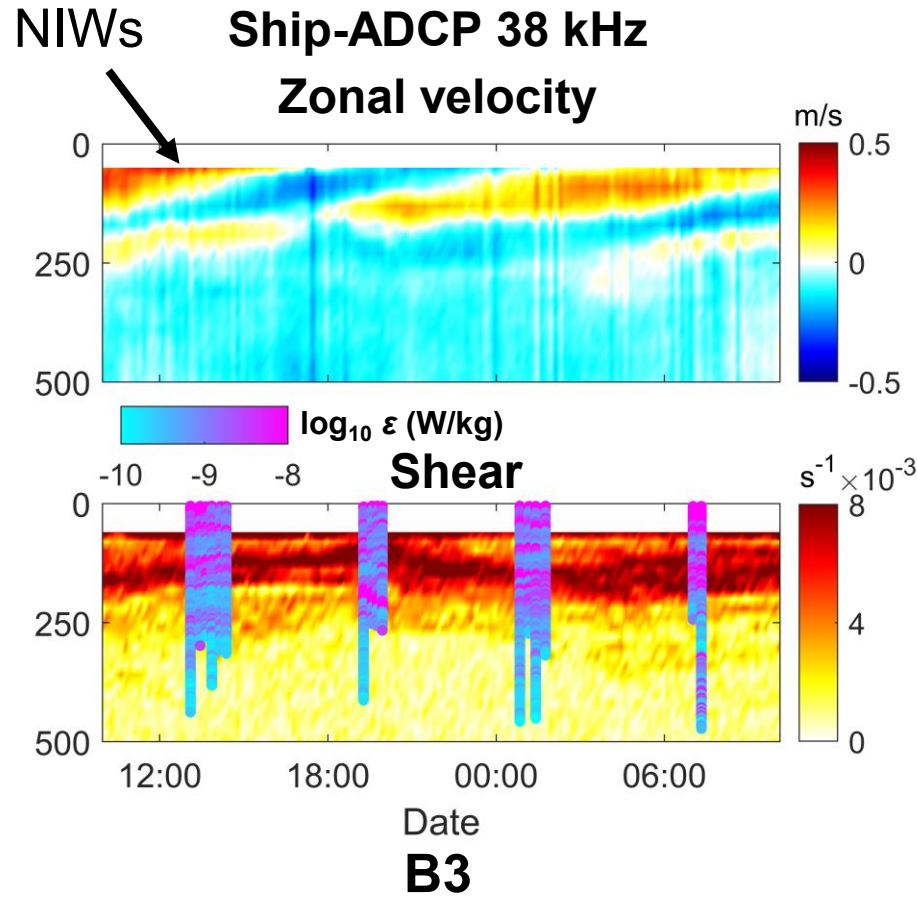
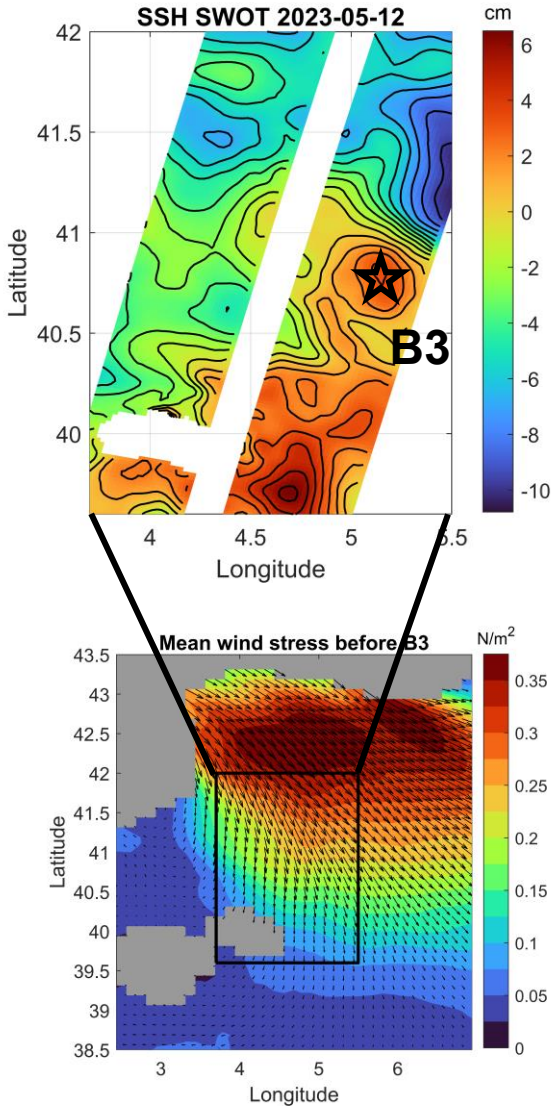
1st stations: no near-inertial wave No contrast, weak dissipation



2nd stations: 1st strong wind event NIWs in B2, contrast in dissipation



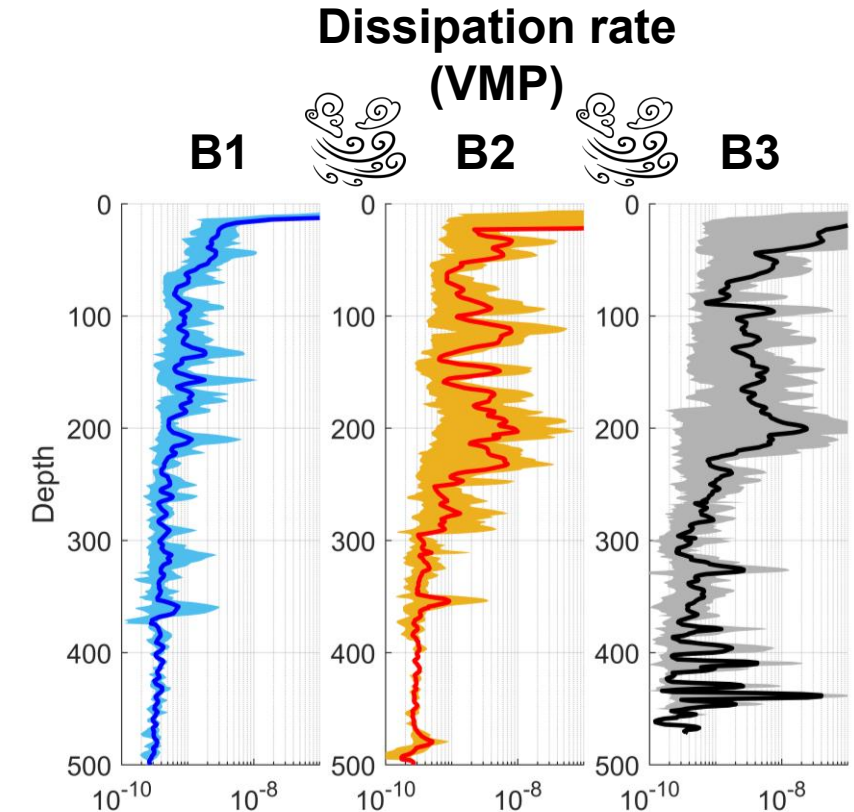
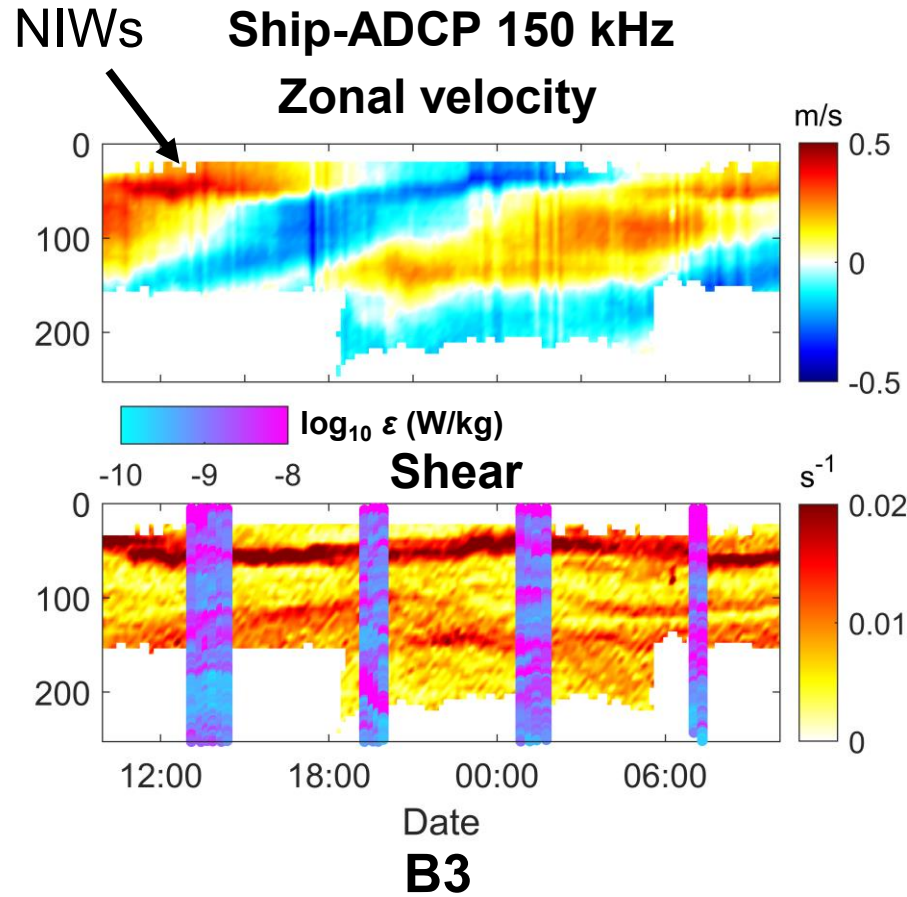
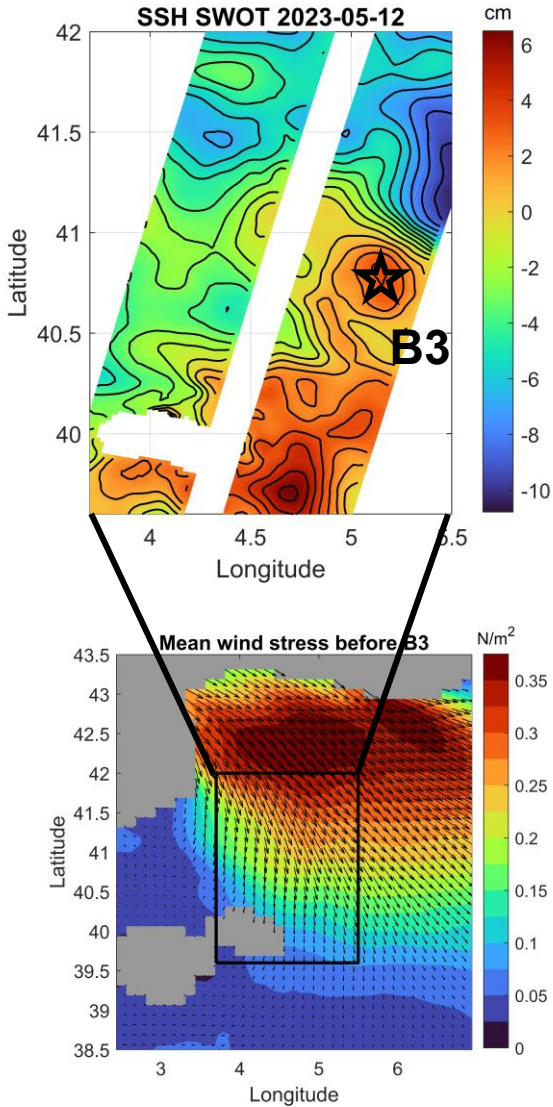
3rd station (B3 only): 2nd strong wind event NIWs and turbulence reinforced



Mean ε profile (W/kg)
+ min–max range

Dissipation
~10–100x stronger

3rd station (B3 only): 2nd strong wind event NIWs and turbulence reinforced

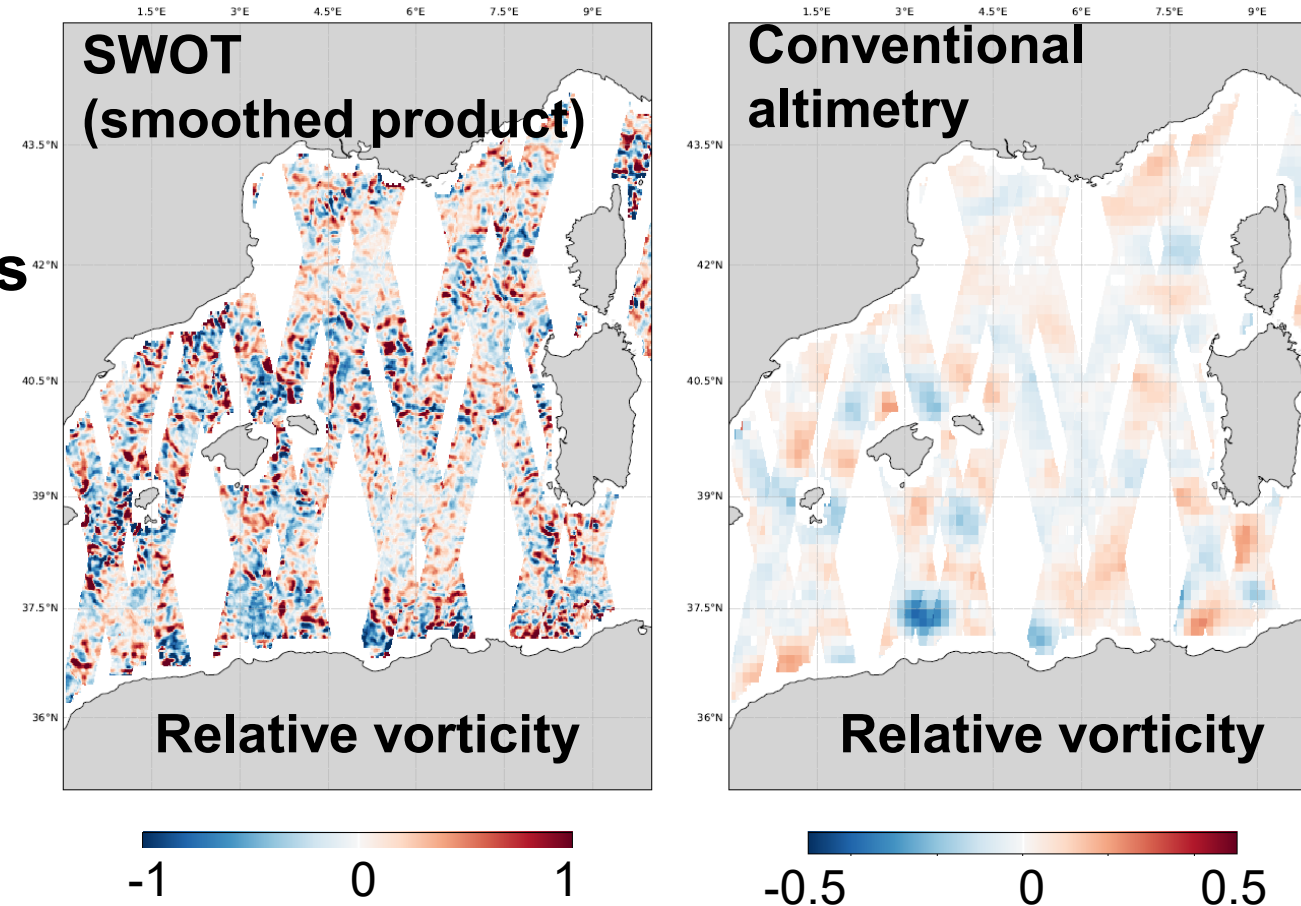


Mean ε profile (W/kg)
+ min–max range

Dissipation
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Conclusion & perspectives

- Induced KE flux $\sim 4\text{--}6 \text{ mW/m}^2 \rightarrow$ see the future preprint for details
- These structures induce **strong turbulence** and **NIW vertical KE fluxes**
- **Crucial role of SWOT** to target the eddy and interpret in-situ data
- What is the **global contribution** of this process in term of turbulence/mixing in the Mediterranean Sea?



In revision \rightarrow re-submission soon!

Courtesy: Lloyd Izard