SWOT-ST meeting - 2025 - Arcachon

Mediterranean Sea fine scale dynamics as revealed by SWOT

Louise Rousselet, Jean-Baptiste Roustan, Alexandre Barboni, Anne Petrenko, Anthony Bosse, Francesco d'Ovidio, Pierre Garreau, Franck DUMAS, Stéphanie Barrillon, Andrea Doglioli.

LEGOS

omp RECHERCHE EN SCIENCES DE LA TERRE ET DE L'UNIVERS

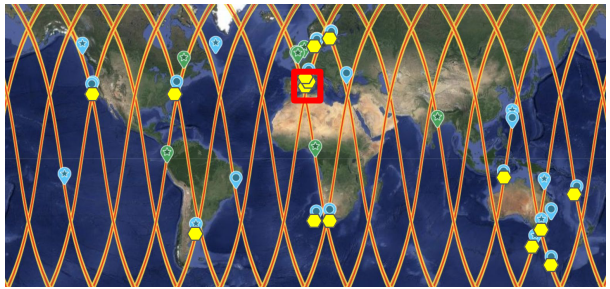
SHOM L'océan en référence

mio Institut Méditerranéen d'Océanologie

IPSL LOCEAN

Ifremer

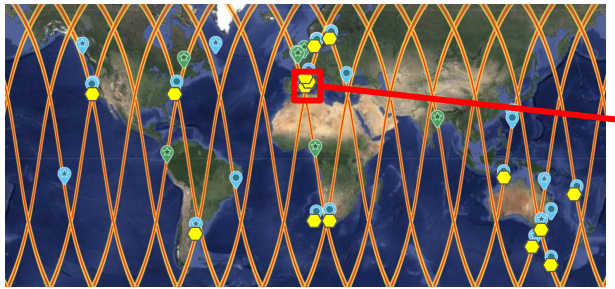
AdAC campaigns in the Mediterranean Sea



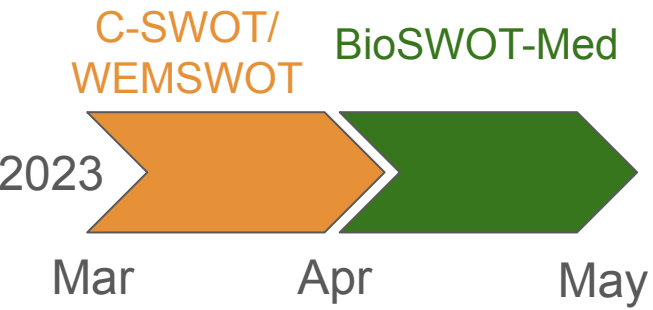
SWOT fast sampling phase
(March-July 2023)

SWOT “Adopt-A-Crossover” consortium: ~30 in situ campaigns for Cal/Val and fine-scale activities

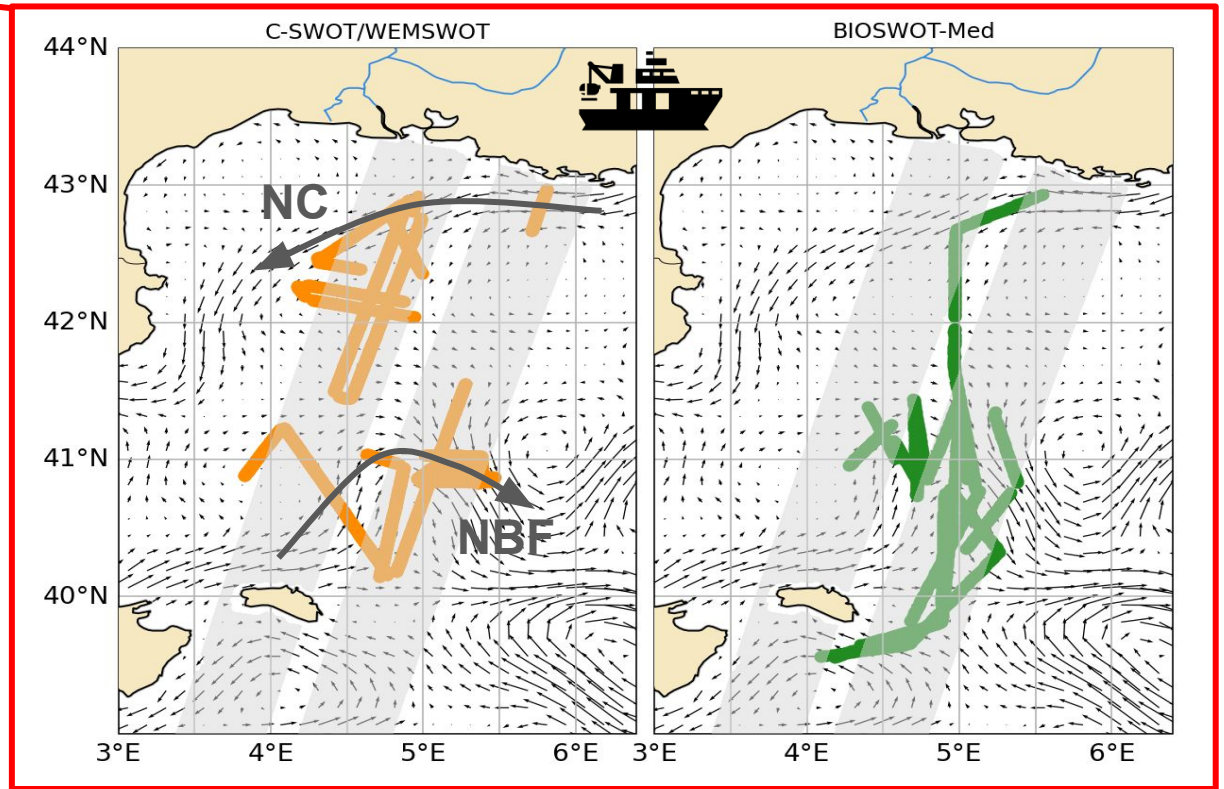
AdAC campaigns in the Mediterranean Sea



SWOT fast sampling phase
(March-July 2023)



SWOT "Adopt-A-Crossover" consortium: ~30 in situ campaigns for Cal/Val and fine-scale activities



Geostrophic velocities and SSH reconstruction

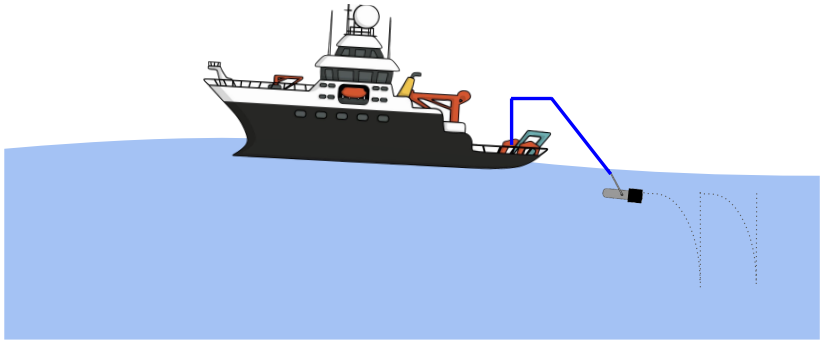
Objective: *In situ* estimation of Vgeo and SSH

Geostrophic velocities and SSH reconstruction

Objective: *In situ* estimation of Vgeo and SSH

- Towed instruments (Seasoar, MVP) → density (σ)

$$V_{geo}^{in\_situ} = \frac{g}{f\rho_0}\int_{Z_{ref}}^{surf}\frac{\partial\sigma}{\partial x}dz$$



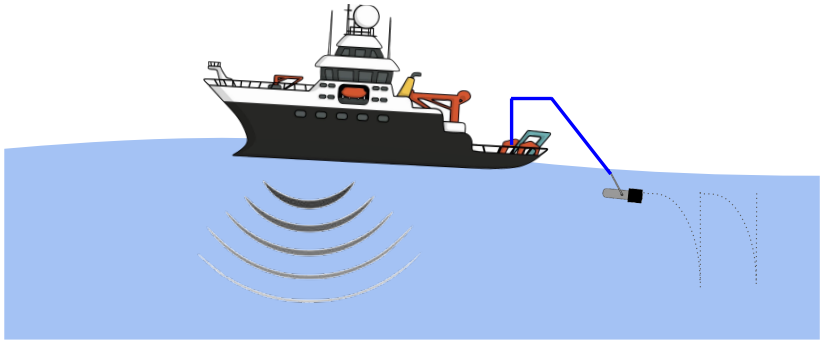
Geostrophic velocities and SSH reconstruction

Objective: *In situ* estimation of Vgeo and SSH

- Towed instruments (Seasoar, MVP) → density (σ)
- ADCP → horizontal velocities (u,v)

$$V_{geo}^{in\_situ} = \frac{g}{f\rho_0}\int_{Z_{ref}}^{surf}\frac{\partial\sigma}{\partial x}dz$$

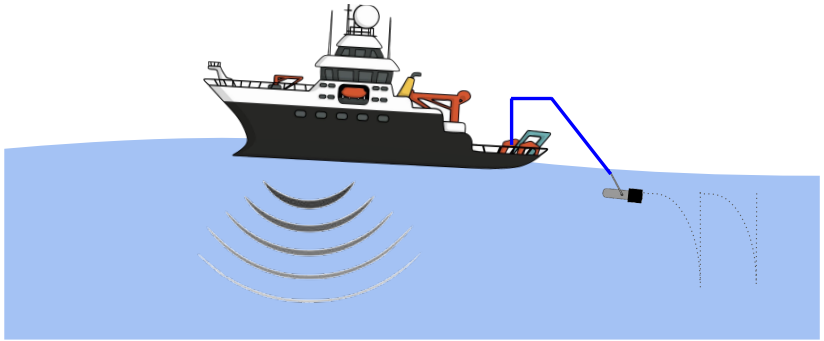
$$V_{geo}^{all} = V_{geo}^{in\_situ} + V^{ADCP}(Z_{ref})$$



Geostrophic velocities and SSH reconstruction

Objective: *In situ* estimation of Vgeo and SSH

- Towed instruments (Seasoar, MVP) → density (σ)
- ADCP → horizontal velocities (u,v)



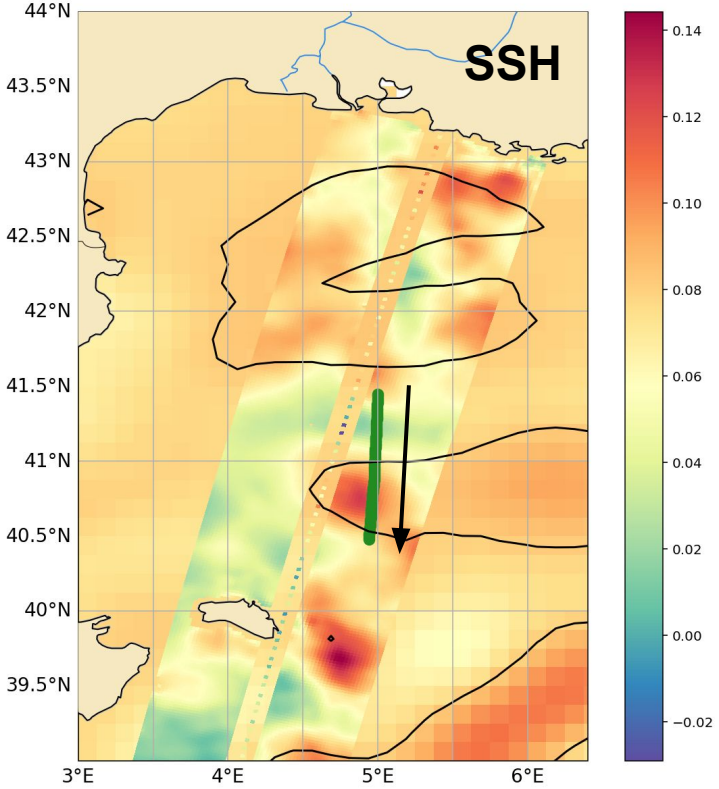
$$V_{geo}^{in\_situ} = \frac{g}{f\rho_0}\int_{Z_{ref}}^{surf}\frac{\partial\sigma}{\partial x}dz$$

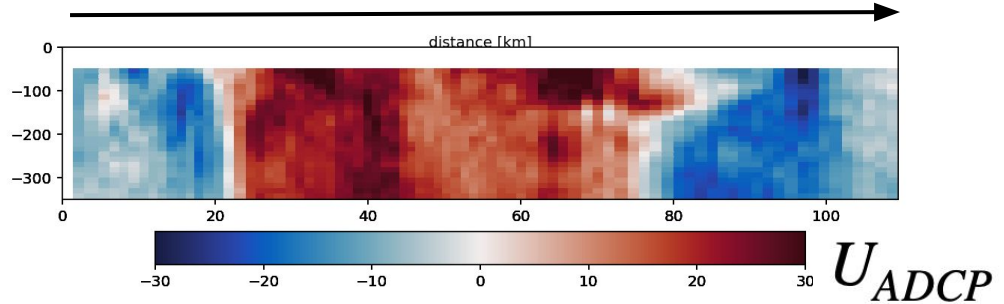
$$V_{geo}^{all} = V_{geo}^{in\_situ} + V^{ADCP}(Z_{ref})$$

$$\eta^{in\_situ}(x) = \frac{f}{g}\int_{x_0}^{x} V_{geo}^{full}dx$$

Geostrophic velocities and SSH reconstruction

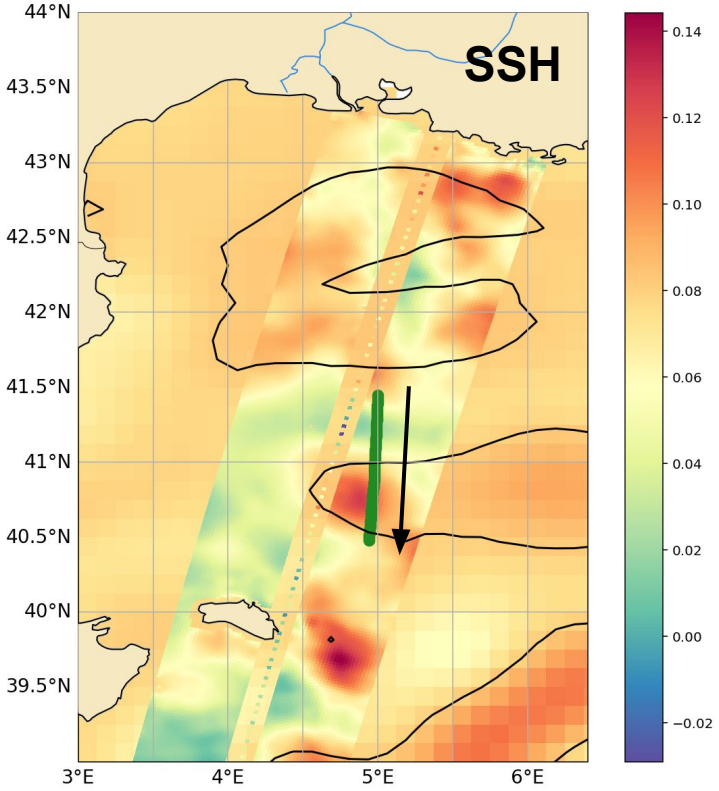
Fine-scale feature example

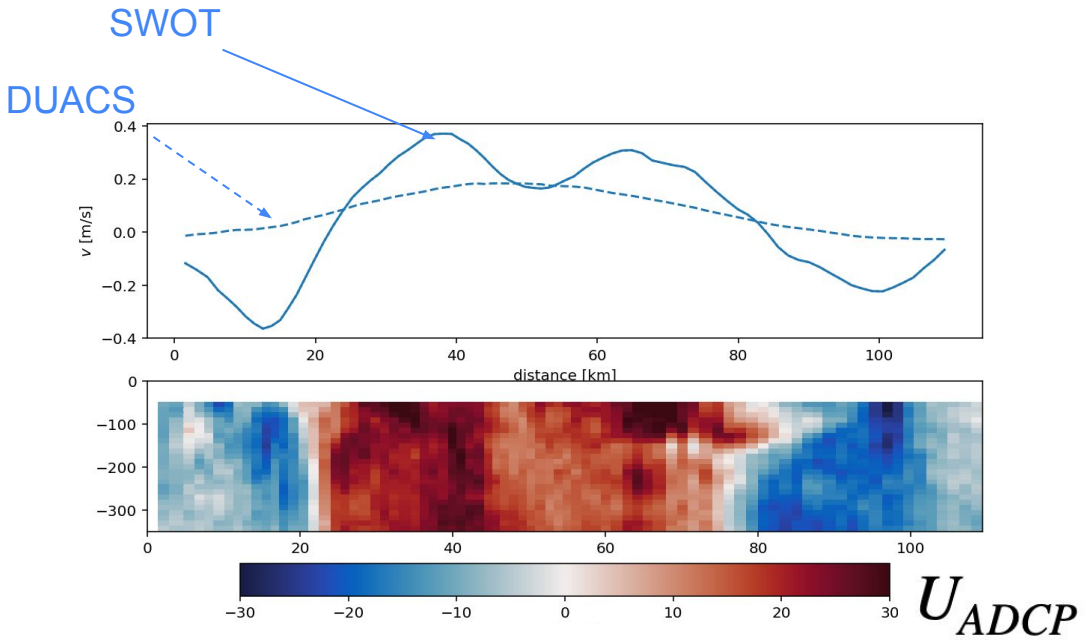




Geostrophic velocities and SSH reconstruction

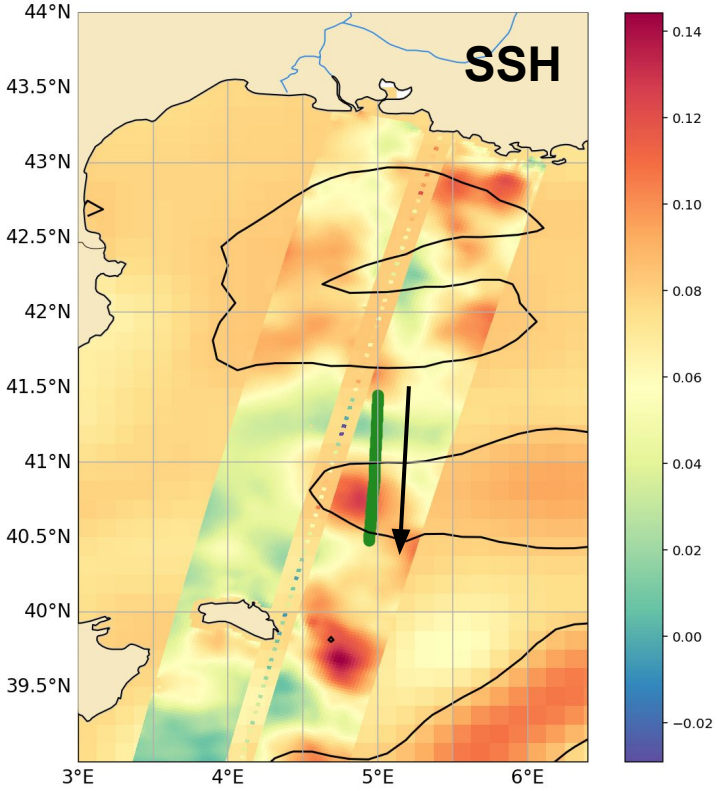
Fine-scale feature example

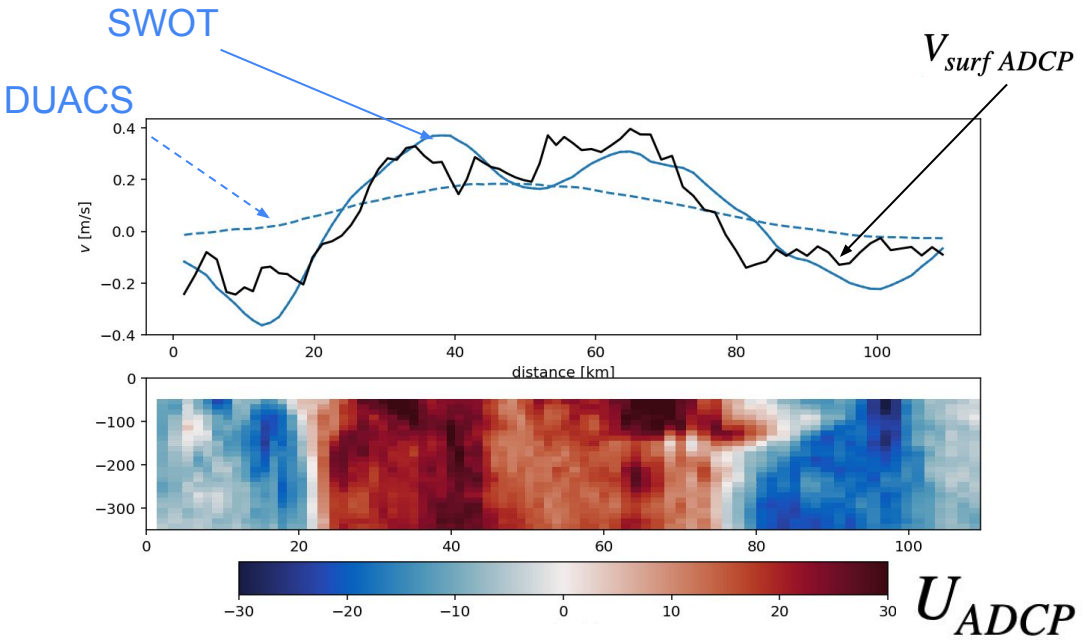




Geostrophic velocities and SSH reconstruction

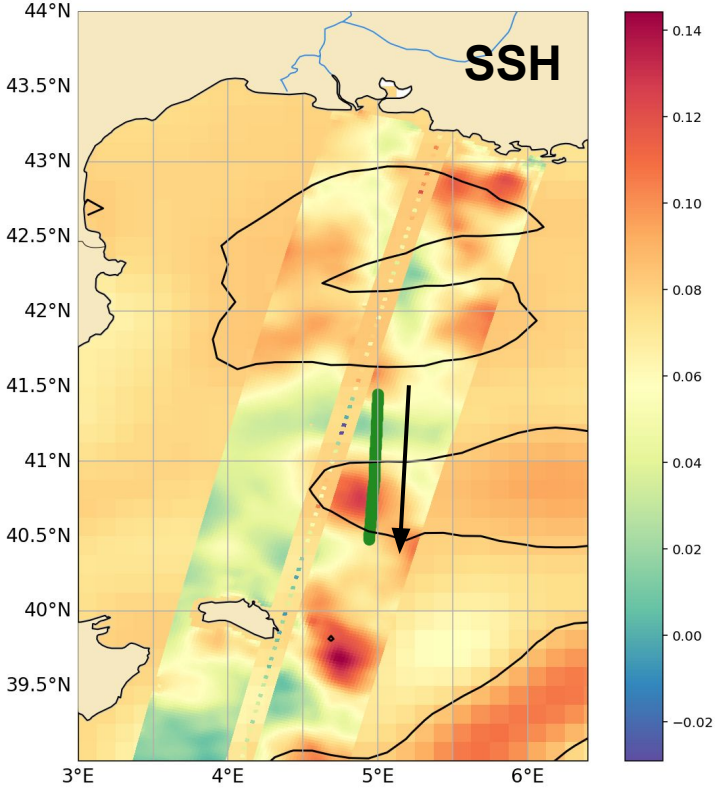
Fine-scale feature example

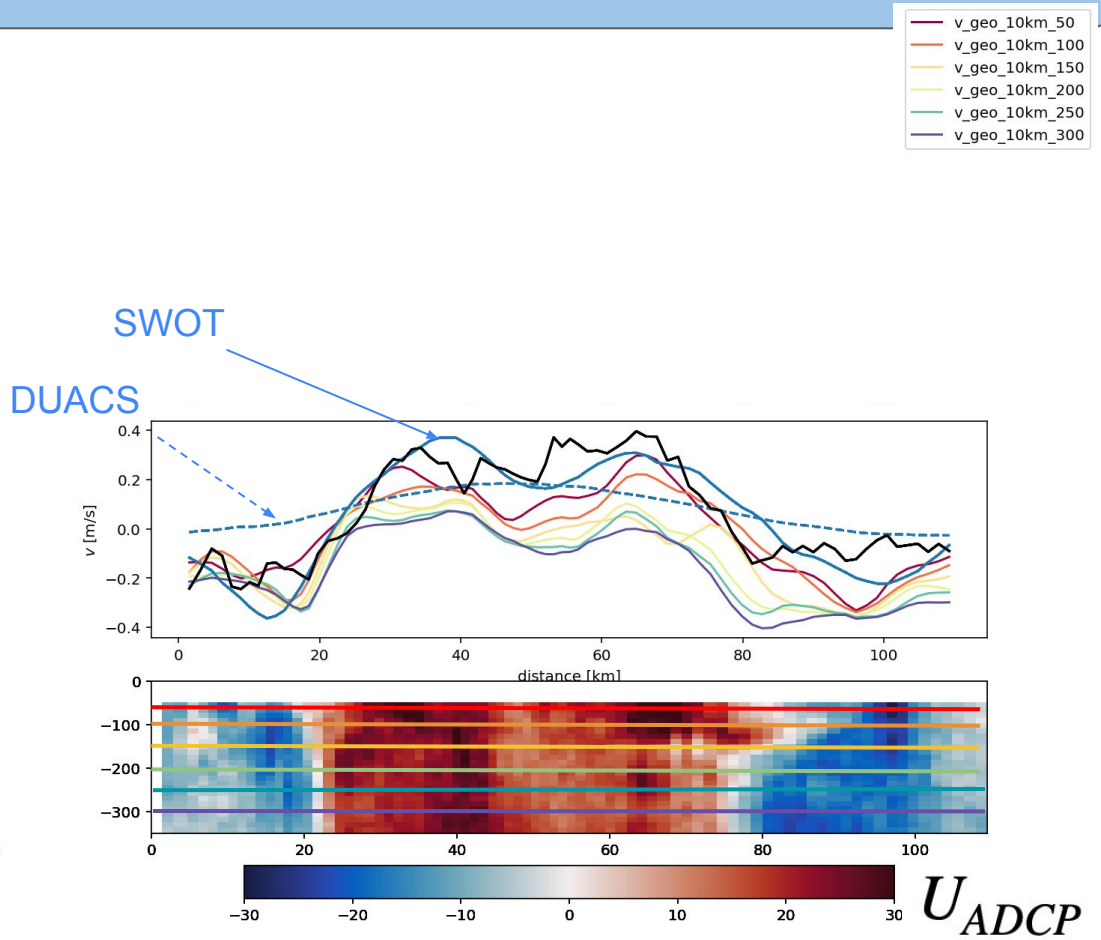




Geostrophic velocities and SSH reconstruction

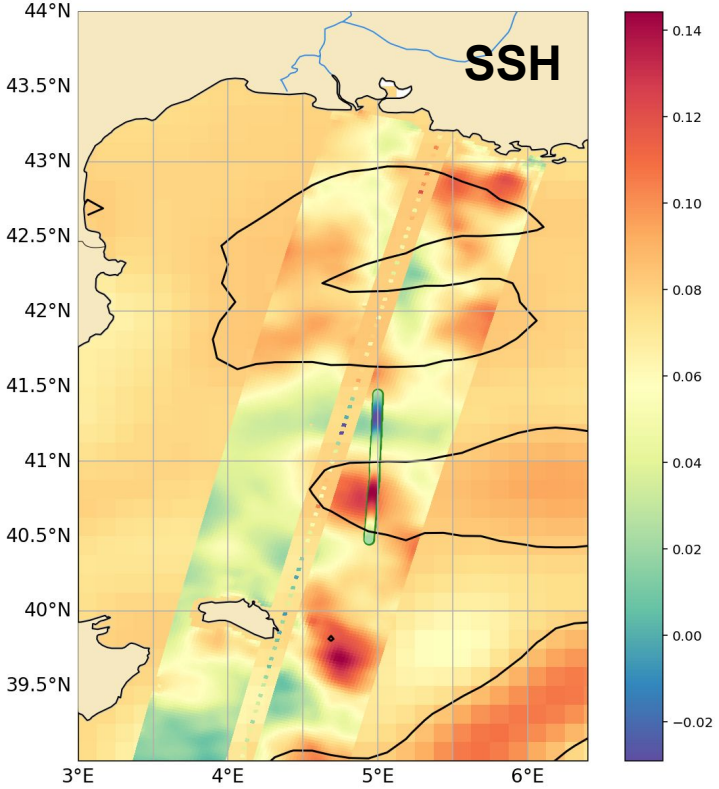
Fine-scale feature example

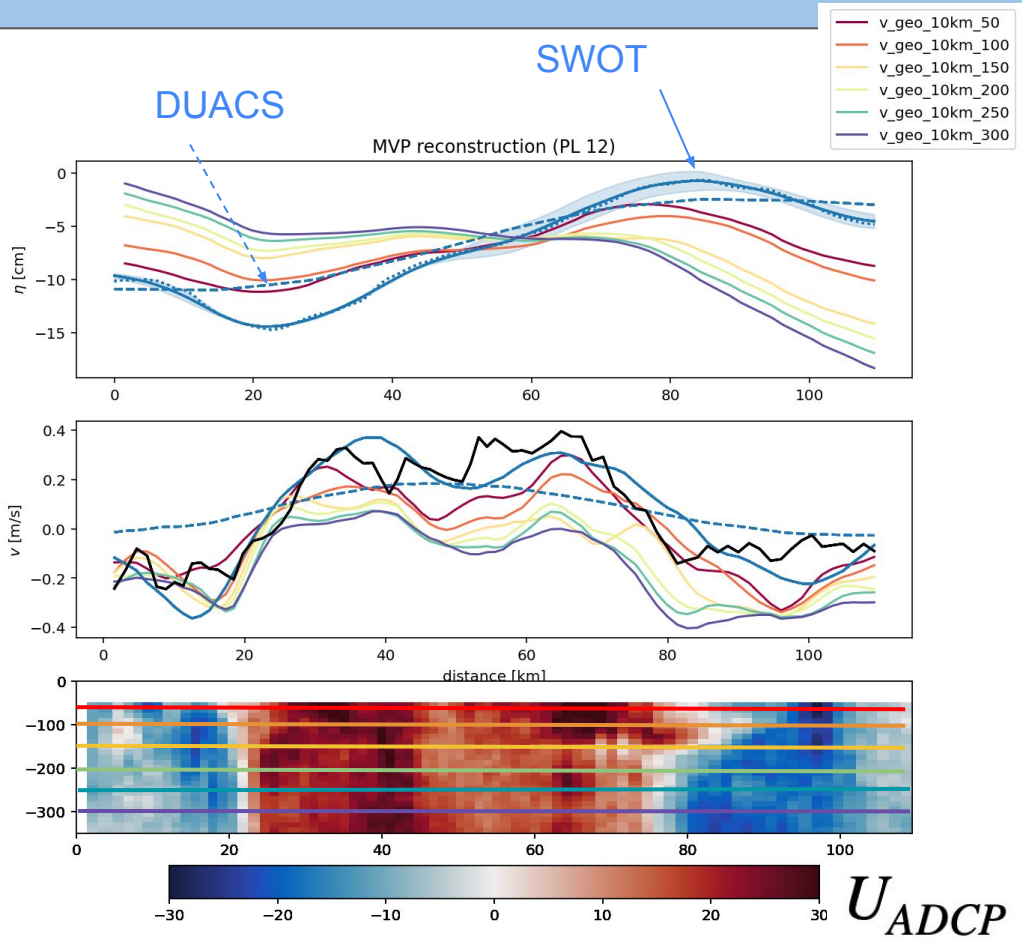




Geostrophic velocities and SSH reconstruction

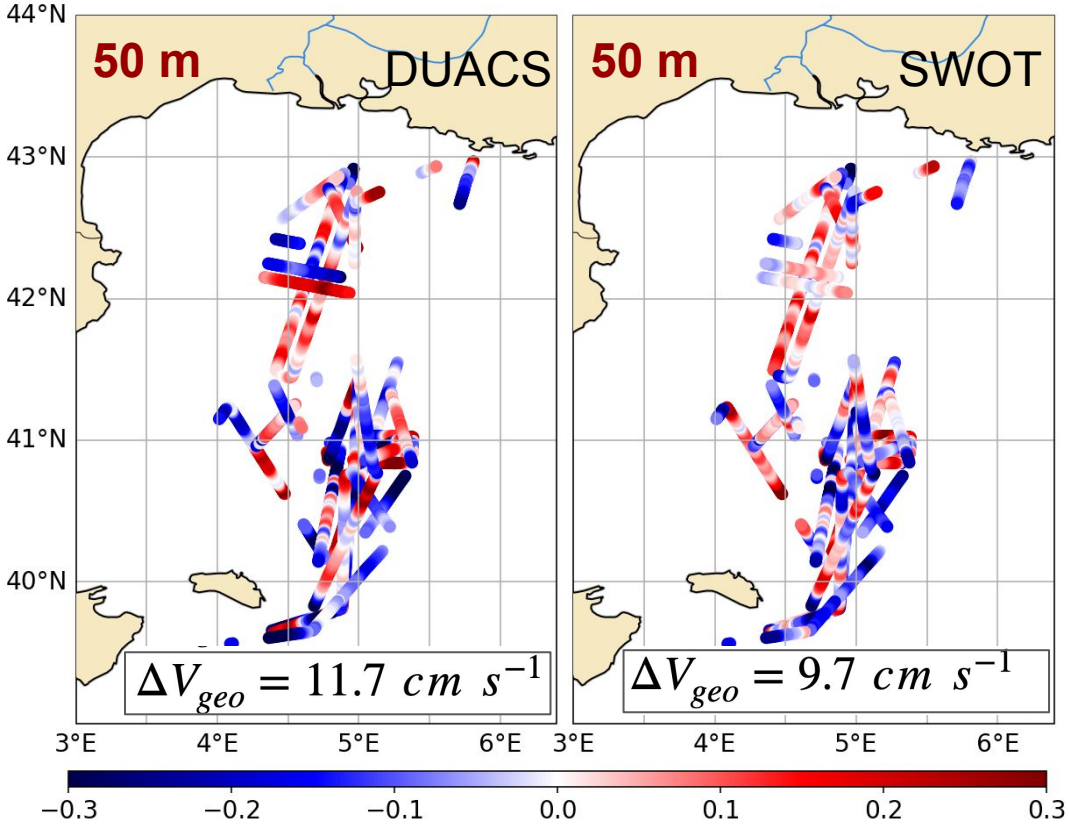
Fine-scale feature example





Geostrophic velocities and SSH reconstruction

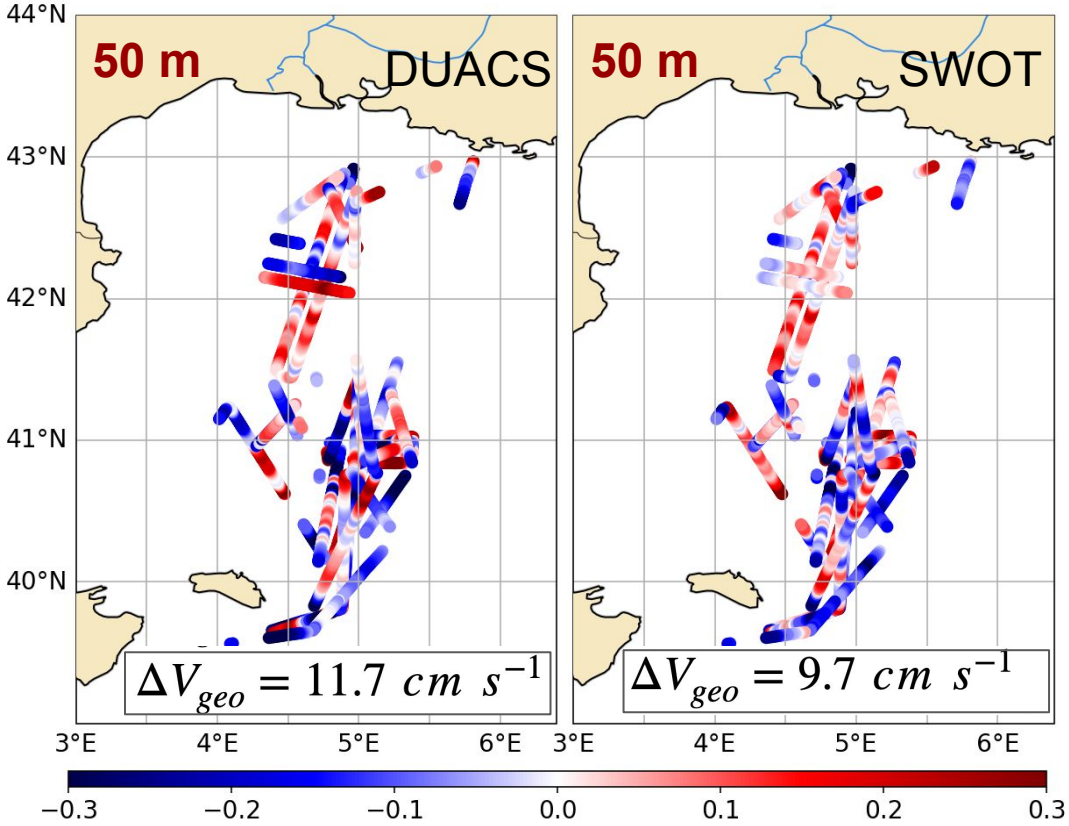
Western MedSea comparison



Z = 50m	DUACS	SWOTv2.0.1 filtered
RMSE SSH [cm]	10.2	9.9
RMSE Vgeo [cm s-1]	14.8	12.3

Geostrophic velocities and SSH reconstruction

Western MedSea comparison



Z = 50m	DUACS	SWOTv2.0.1 filtered
RMSE SSH [cm]	10.2	9.9
RMSE Vgeo [cm s-1]	14.8	12.3

Z = 250m	DUACS	SWOTv2.0.1 filtered
RMSE SSH [cm]	10.7	10.2
RMSE Vgeo [cm s-1]	17.9	18.4

Geostrophic velocities and SSH reconstruction

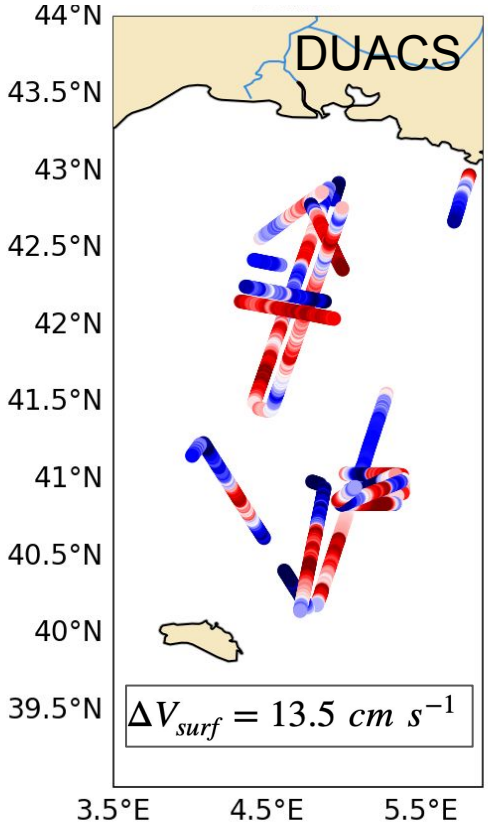
Western MedSea comparison

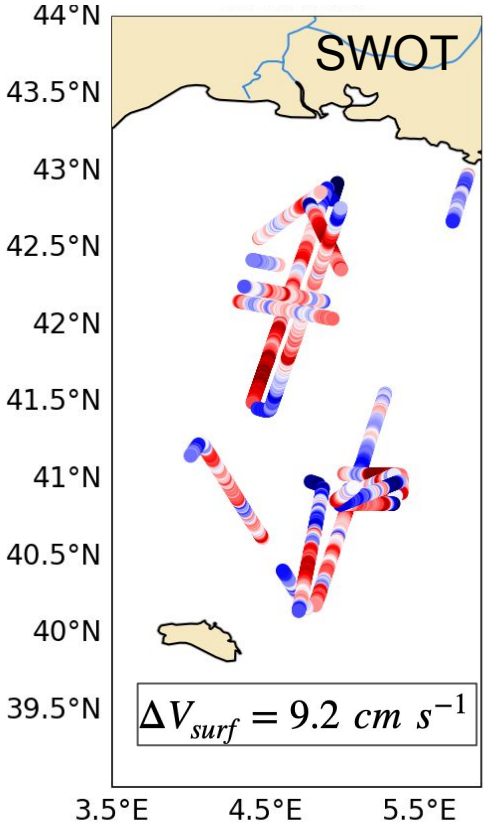
$$\Delta V_{surf} = |V_{geo_{sat}} - V_{ADCP_{14m}}|$$

geostrophy

Total current

Even better agreement between SWOT geo and surface total currents …





Conclusions

★ SWOT detects fine scale features unseen by conventional altimetry (~20 km, Doglioli's presentation and Cardot et al., ST2025OS1_008)

★ SWOT vs in situ Vgeo RMSE ~ 12.3 cms-1 (Ballarotta et al., RMSD 10-15cm.s with in situ drifters)

★ SWOT derived geostrophic velocities compare better with surface total currents than with in situ geostrophic velocities estimation

➔ Investigation on geostrophic vs ageostrophic processes captured by SWOT (using 3D simulation over the MedSea cf. Tolu et al., Thursday at 11:30)