Glider observations across the scales of the ocean dynamics during BioSWOT- Med

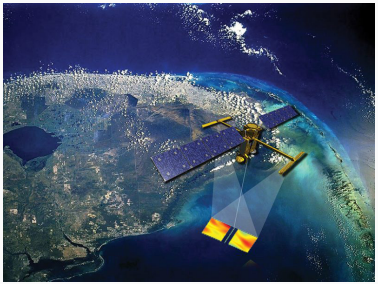
Internation Underwater Glider Conference, 9th EGO meeting

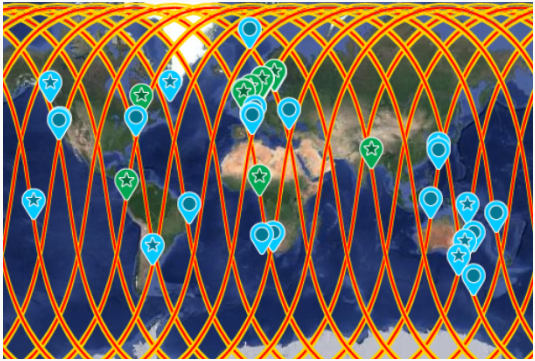
A. Bosse*, T. Maytie, I. Fer, R. Rolland, Y. Cuypers, P. Bouruet-Aubertot, L. Rousselet, S. Gastauer, M. Ohman, P. Testor, A. Doglioli, F. Dovidio

*Physicien-adjoint CNAP, Aix-Marseille Université, OSU Pythéas, MIO, Marseille

Marseille, 7–8 December 2023

General Context : SWOT AdAC Consortium

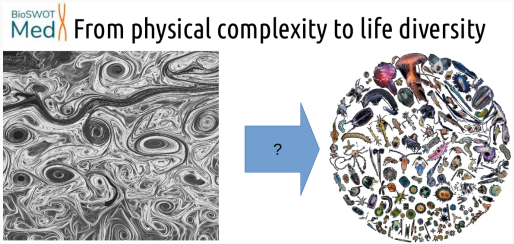




→ SWOT satellite launched in December 2022
↪ **CalVal from April-July 2023 (”fast sampling” : 24h orbit cycle)**

→ **”Adopt A Crossover”** : a CLIVAR-endorsed action to support CalVal ocean experiments (+30 worldwide, incl. **BioSWOT-Med**)
↪ Satellite data, NRT KaRIn images, Lagrangian analysis, communication

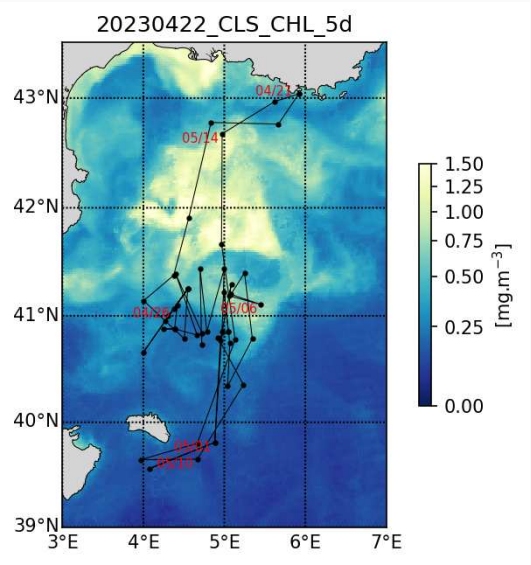
BioSWOT-Med cruise (21 April – 15 May 2023, PI: A. Doglioli, G. Gregori, F. D'Ovidio)



→ Multi-disciplinary approach (Physics to Biology) to study (sub)mesoscale fronts

↪ CTD/ADCPs/VMP (turbulence), towed CTD (MVP), drifters, flow cytometry, chemistry, biology (omics, zoopk nets), ...

... and **gliders**



BioSWOT-Med : stations map

BioSWOT-Med : synergy with MOOSE glider observatory

1 Seaglider : MOOSE T02 line

+ 4 Gliders deployed/recovered

→ 2 Seaexplorer (CTD, O2, FLBBCD)
MIO-Marseille (JL Fuda, N. Bhairy, C. Luneau)

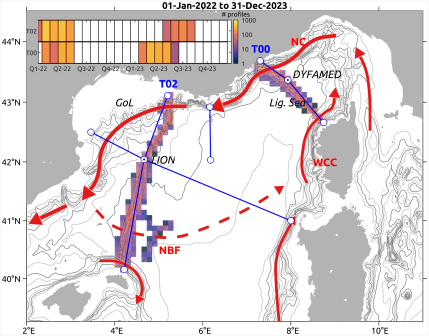
→ 1 Slocum with microstructure
University of Bergen (I. Fer, F. Elliott, A. Brakstad)

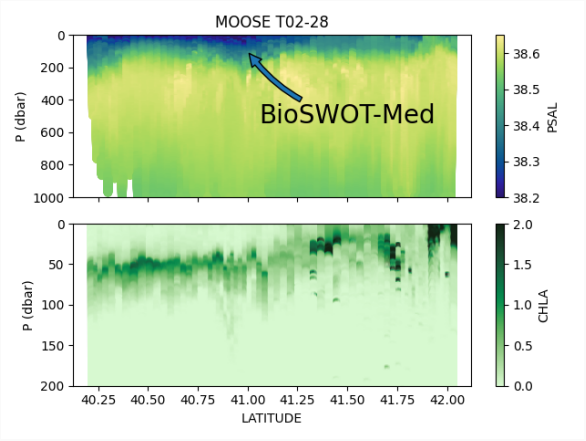
→ 1 Zooglider with echosounder + zoocam
SCRIPPS (M. Ohman, S. Gastauer)

MOOSE T02 endurance line : Marseille/Minorque

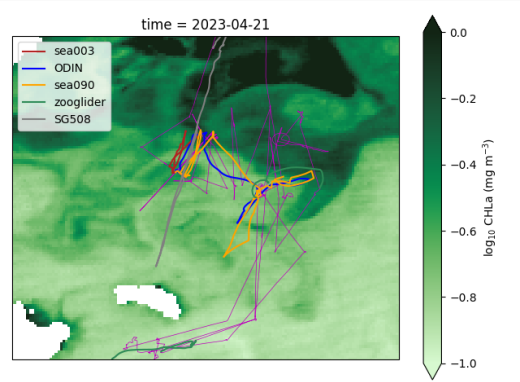
MOOSE: ”Mediterranean Ocean Observing System for the Environment”

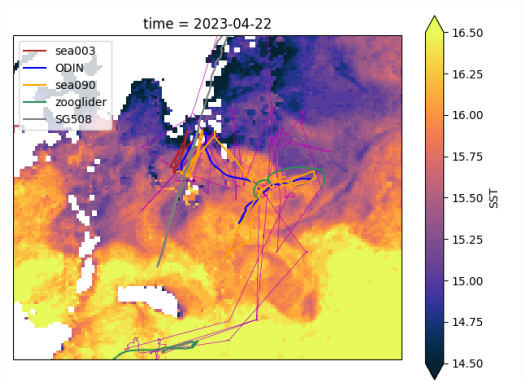
Multi-platform integrated Ocean Observing System dedicated to the long-term monitoring of the NW Mediterranean since 2010.





The BioWOT-Med gliders





→ Initial plan : target a front and go back and forth
↪ The gliders discovered an eddy and could cross in and out
(SEA003 leaked; SEA090+Odin and then Zooglider)

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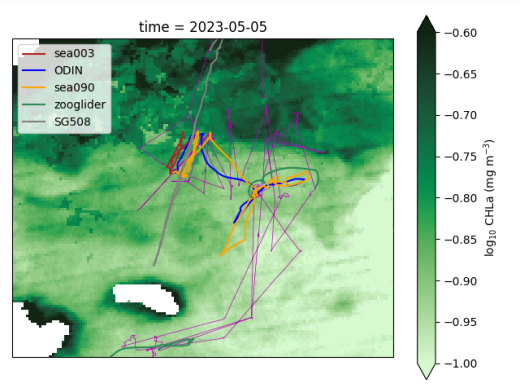

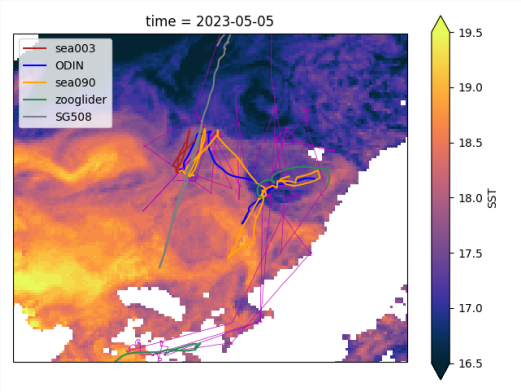

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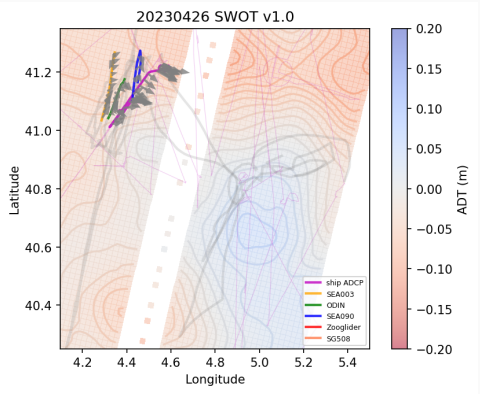
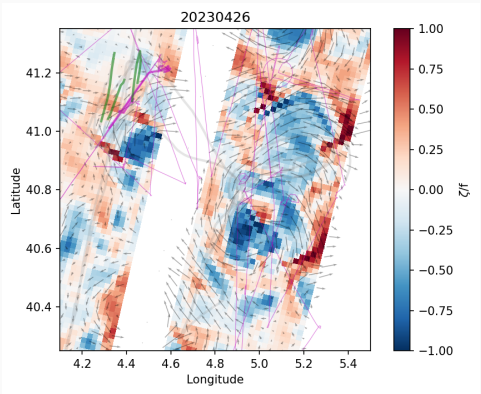
→ **Coherent eddy structure** during the whole cruise!

First results from SWOT and gliders





→ SWOT = Unprecedented maps of ADT @ **2km resolution**

→ **Rich dynamics O(5–10km)** in currents and vorticity
Cyclo-geostrophic balance balance inverted by variational approach Bertrand V. et al., IGE-Grenoble) : https://jaxparrow.readthedocs.io/)

→ Gliders will allow comparison with their geostrophic currents

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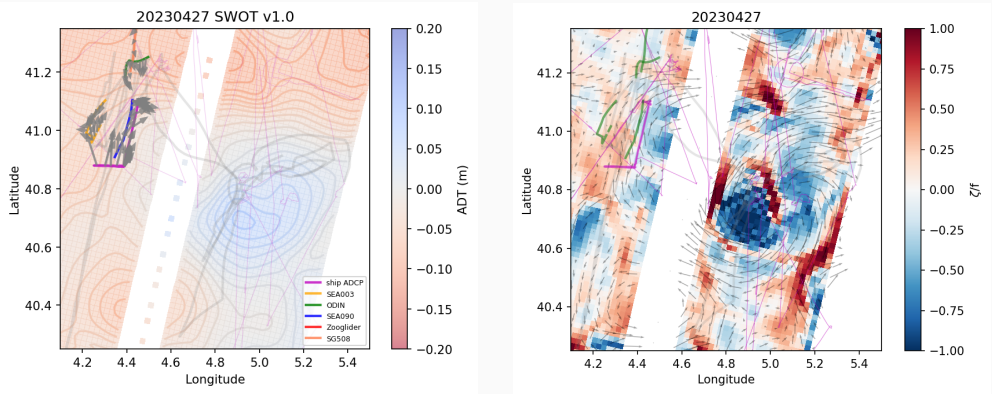

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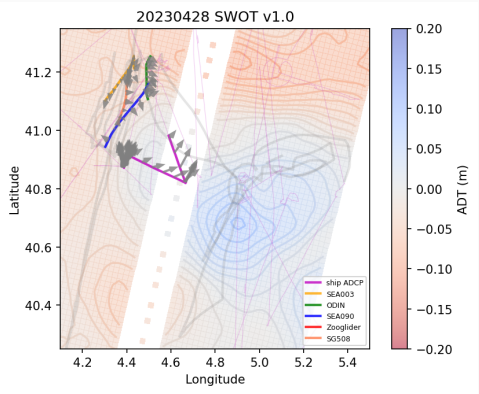

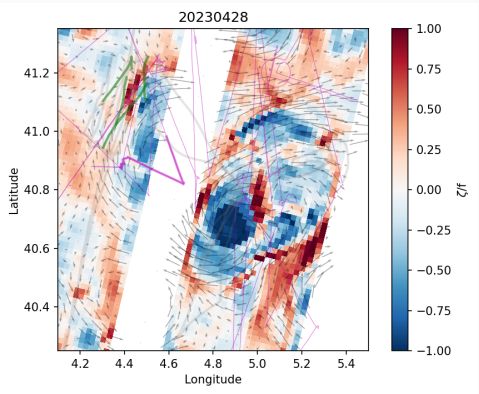

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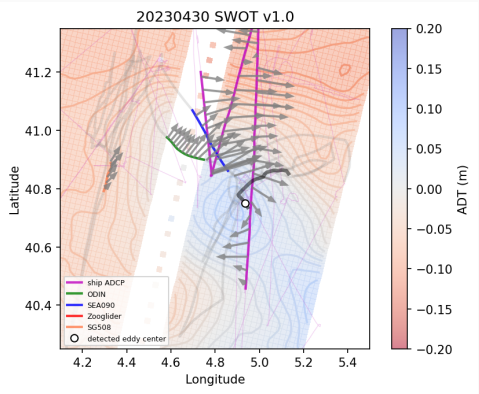

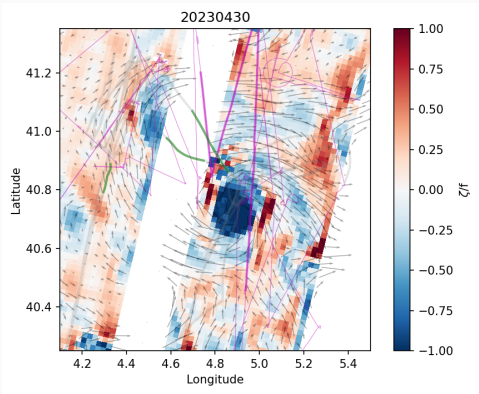

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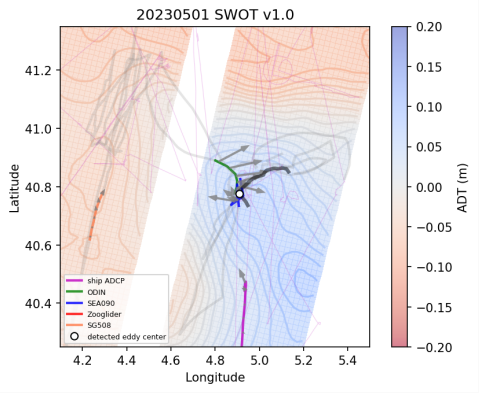

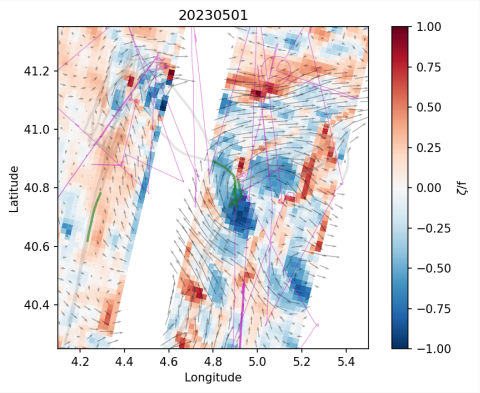

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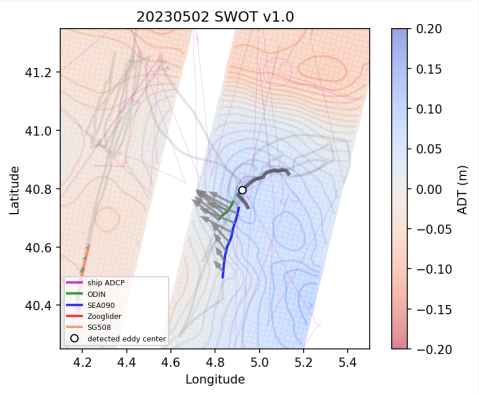

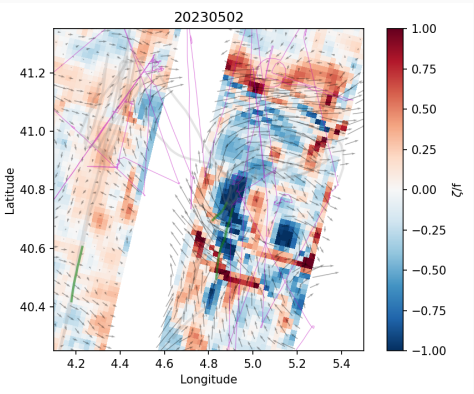

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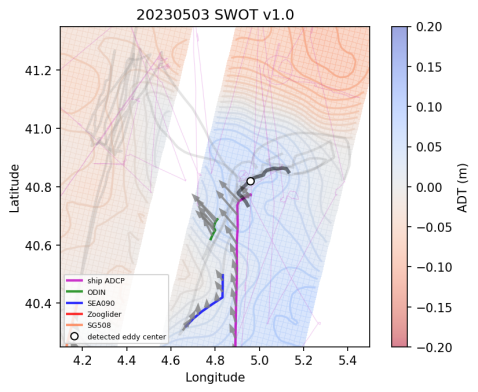

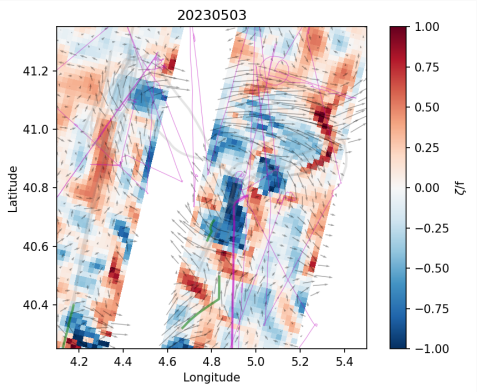

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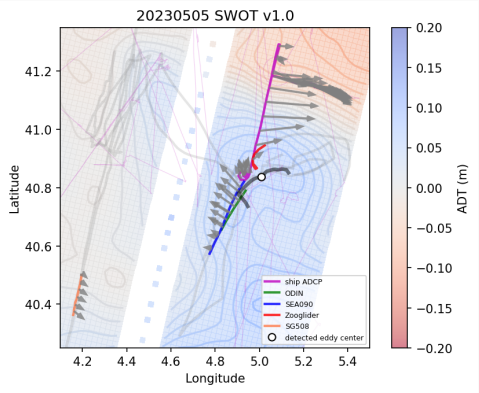

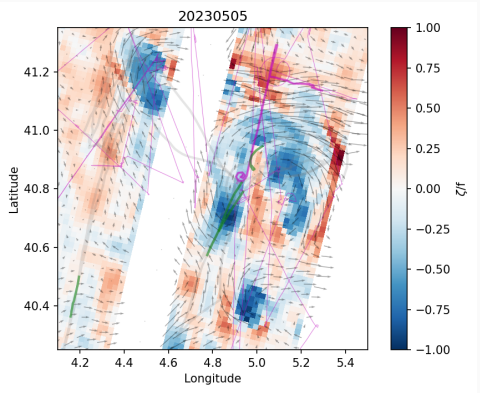

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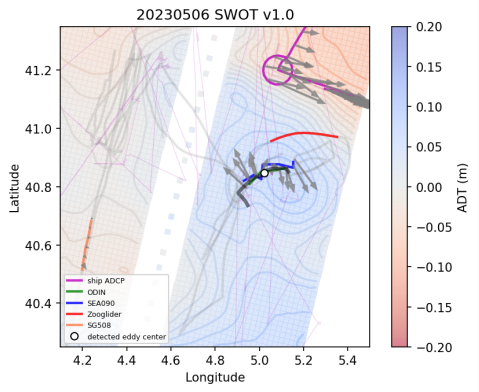

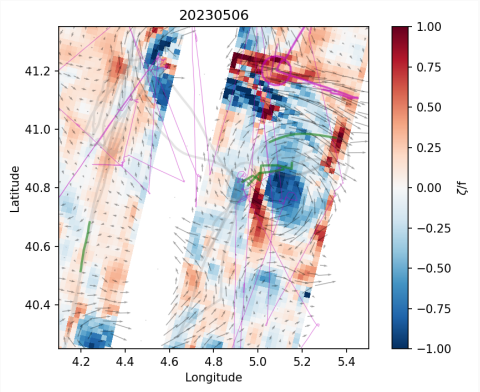

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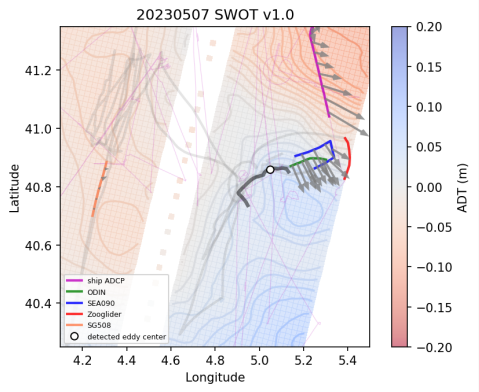

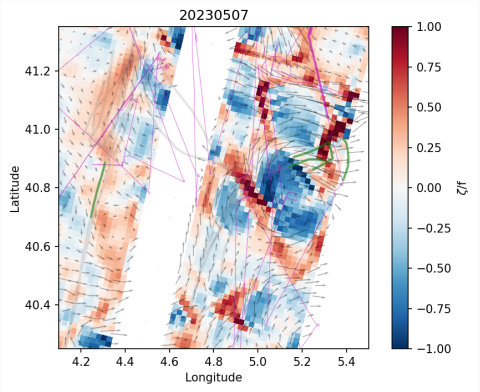

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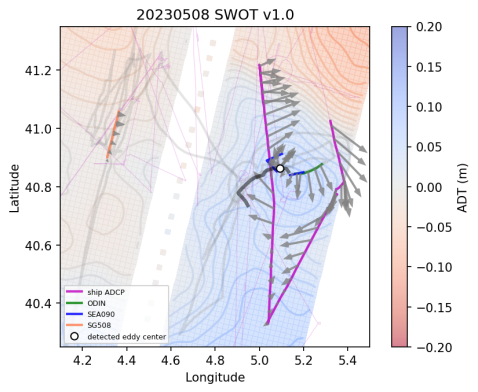

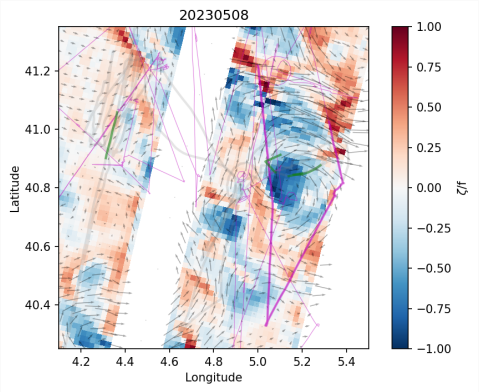

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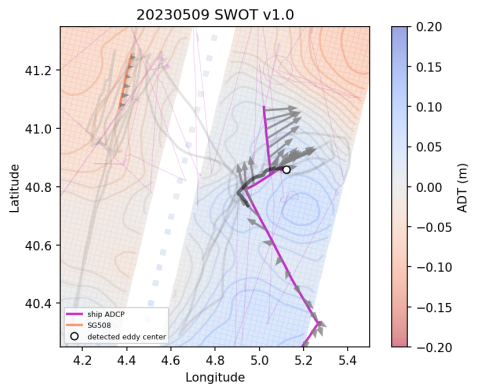

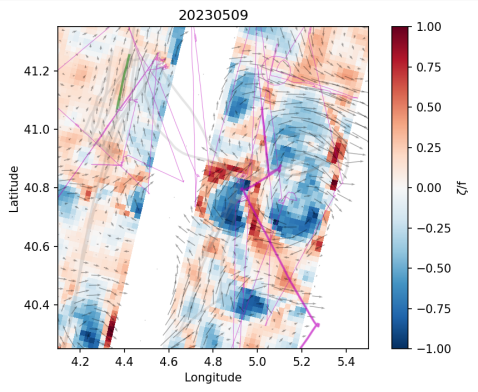

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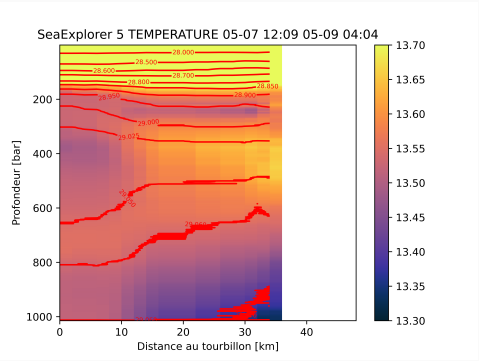
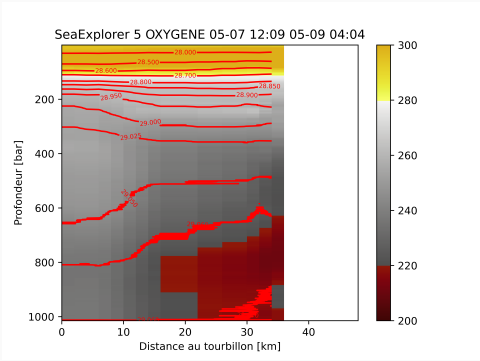
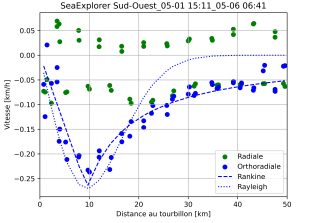
SEA090 : eddy characterisation







→ Eddy sampled with SEA090 (T,S,Chla,O2,ϵ)

→ Core of a deep anticlonic eddy (high O2, low T)

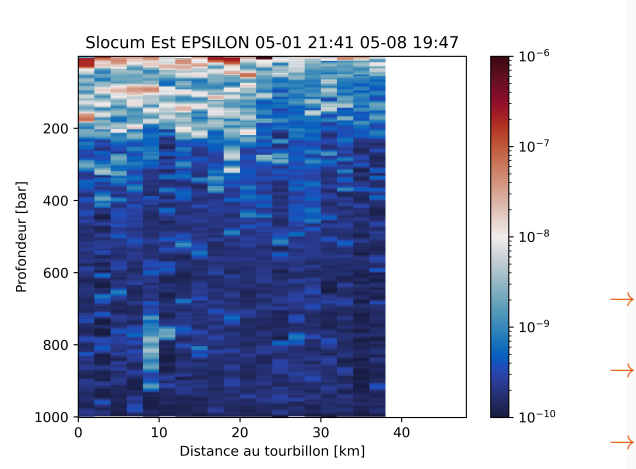
↪ extension down to 1500m

→ R $\sim$ 10km, Vm $\sim$ 0.25m/s $\Rightarrow$ Ro ~ -0.5

→ + **Odin (T,S,turbulence)**

First results from microstructure glider

+ T. Maytie (MIO), I. Fer (UIB)



→ Anticyclonic eddy = **hotspot of turbulent mixing**

→ Impact on vertical fluxes (nutrients, carbon, ...)

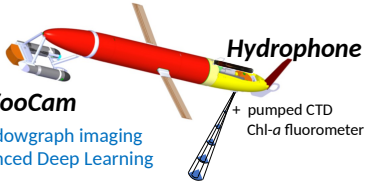
→ Impact on biology (grazer/plankton interaction)?

→ turbulence enhanced in the eddy core in 0–300m

↪ NIW trapping ($\omega < f$) + dissipation at eddy bottom

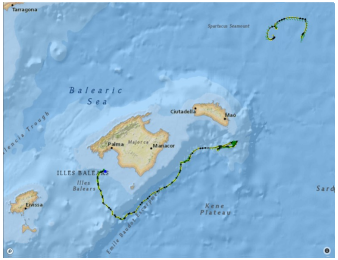
Zooglider

BioSWOT Med



Shadowgraph imaging
Advanced Deep Learning

200 & 1000 kHz



Deployment thanks to colleagues at SOCIB & IMEDEA

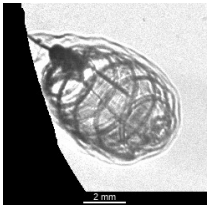
Mark Ohman
Sven Gastauer
Jeff Ellen

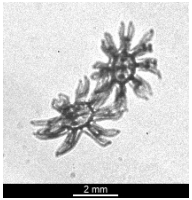
SIO
Thünen Institute
NWIC

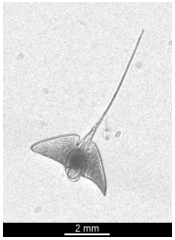
Designed and built by the
Instrument Development Group

SCRIPPS INSTITUTION OF OCEANOGRAPHY
UC San Diego

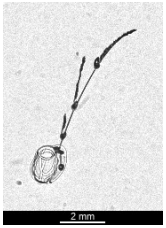
- Ellen, J. S. & M.D. Ohman. (in review) L & O Methods
- Gastauer, S., C.F. Nickels, & M.D. Ohman. 2022. L & O **67: 300-313 doi 10.1002/lno.11993**
- Whitmore, B. M., & M. D. Ohman. 2021. *L & O* ***66: 3811-3827 doi 10.1002/lno.11920***
- Ellen, J. S., C. A. Graaf, & M. D. Ohman. 2019. L & O Methods **17: 439-461 doi 10.1002/lom3.10324**
- Gaskell, D. E., M. D. Ohman, & P. M. Hull. 2019. J Foram Res **49: 390-404**
- Ohman, M. D., R. E. Davis, J. T. Sherman, K. R. Grindley, B. M. 2018. L&O Methods ***doi 10.1002/lom3.10301***

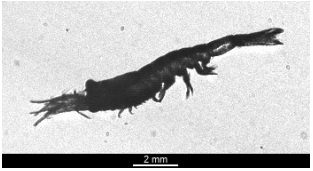


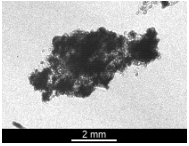




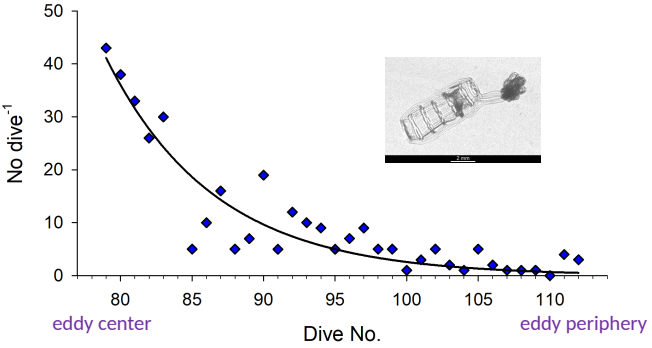
BioSWOT Med

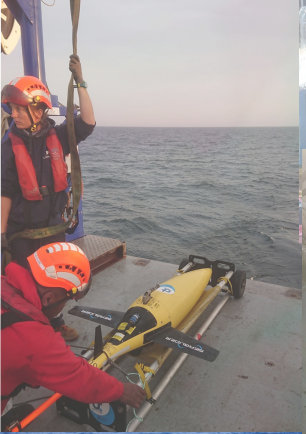






Doliolid changes across the eddy





Thanks for your attention!
Questions?