

WOC 2022

World Ocean Circulation User Consultation Meeting

Ship Routing Optimisation based on Metocean conditions

Artemis **Ioannou**¹, Alexandre **Stegner**^{1,2}, Evangelos **Moschos**^{1,2}, Briac **Le Vu**¹

10/10/2022

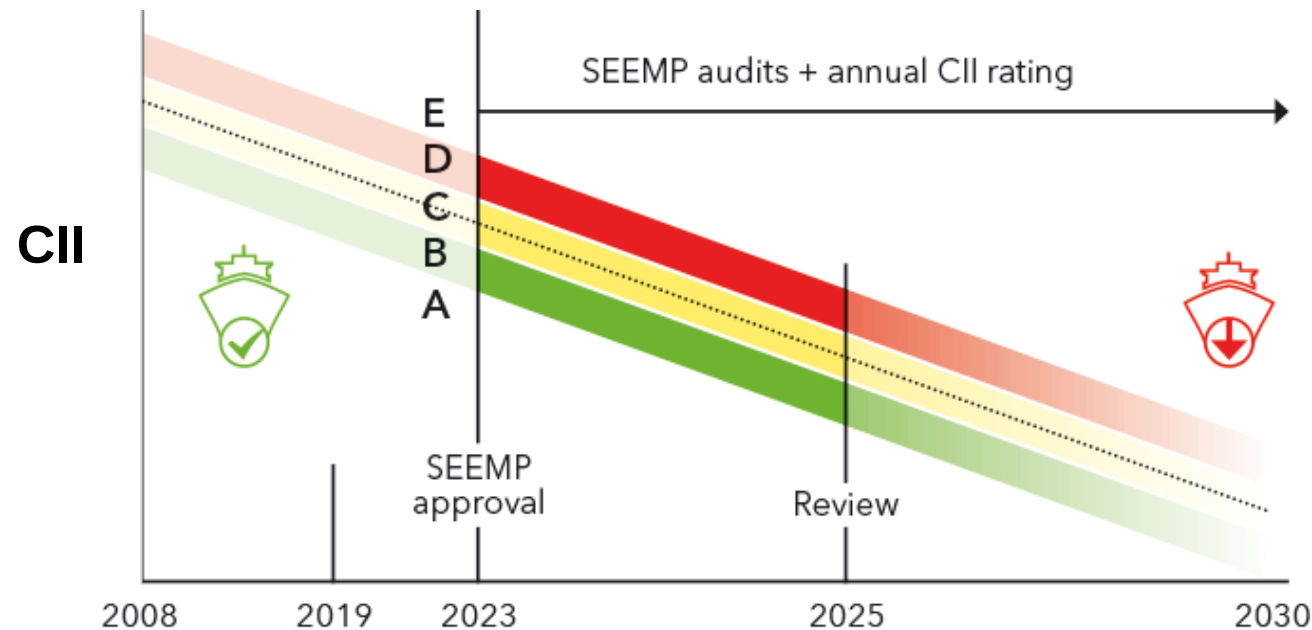
12/10/2022

¹ Amphitrite, X-Novation Center, Ecole Polytechnique, France

² LMD/CNRS, Ecole Polytechnique, Palaiseau, France

Towards Maritime Decarbonisation

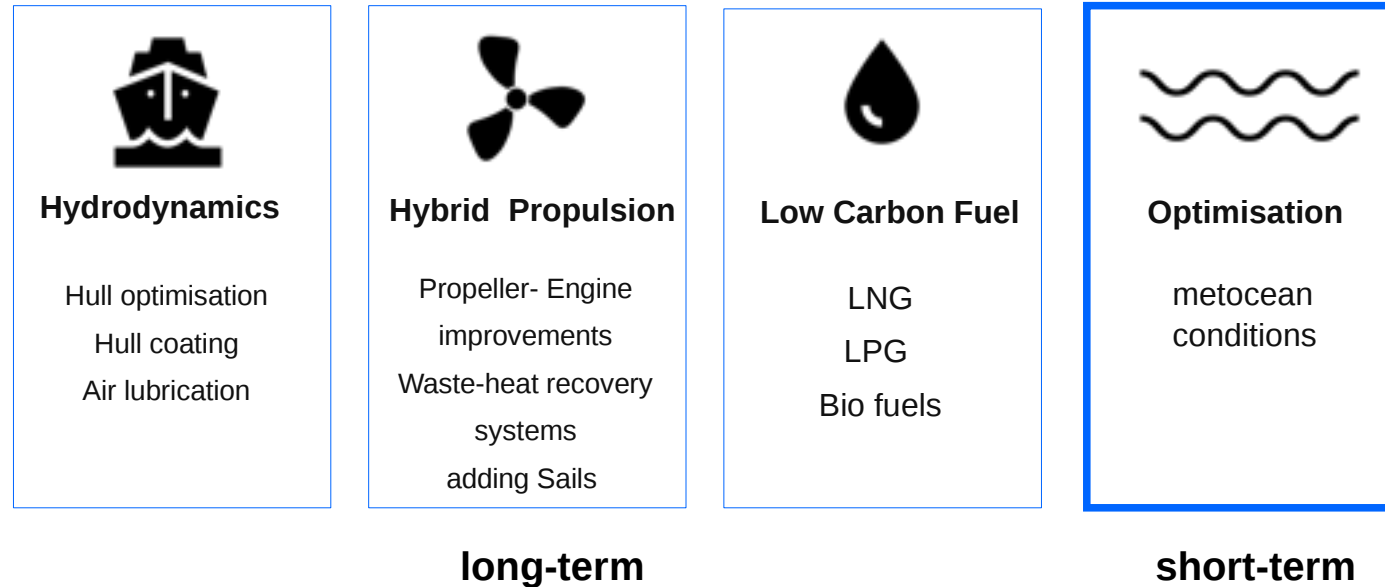
- **EU targets to 55% reduction in greenhouse gases by 2030**
stricter **IMO** legislations emission reduction -2% per year
operational **Carbon Intensity Index (CII)** from 2023 on!



$$\text{CII} = \frac{\text{Annual Fuel consumption CO}_2 \text{ factor}}{\text{Annual Distance travelled Capacity}}$$

Towards Maritime Decarbonisation

Strategies

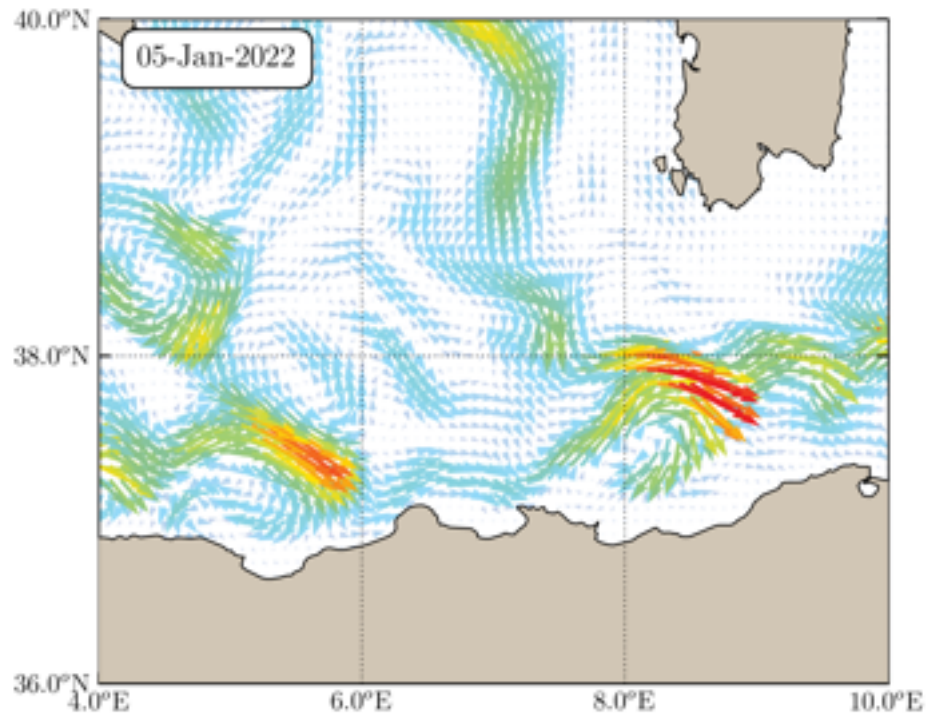


optimisation based on **oceanic currents** requires high quality data!

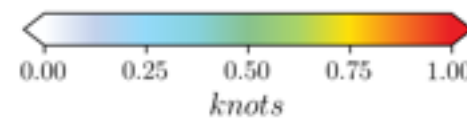
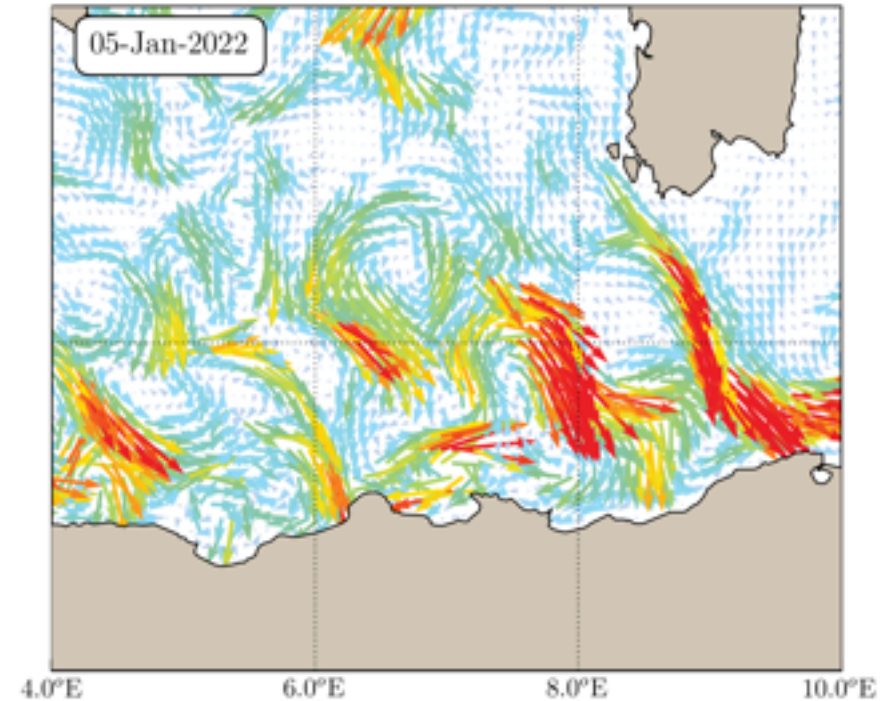
Disagreement between operational models



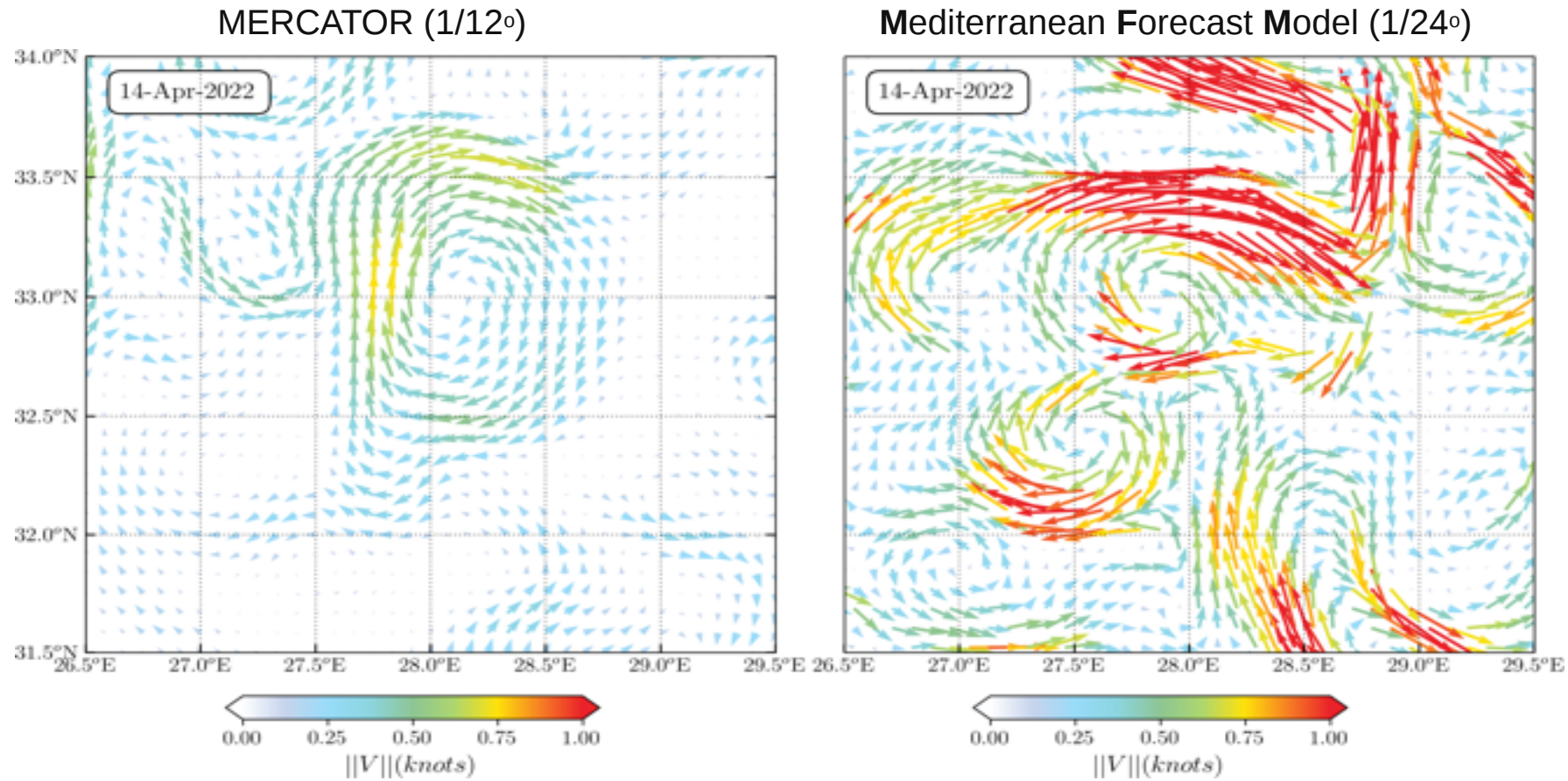
MERCATOR (1/12°)



Mediterranean Forecast Model (1/24°)



Disagreement between operational models

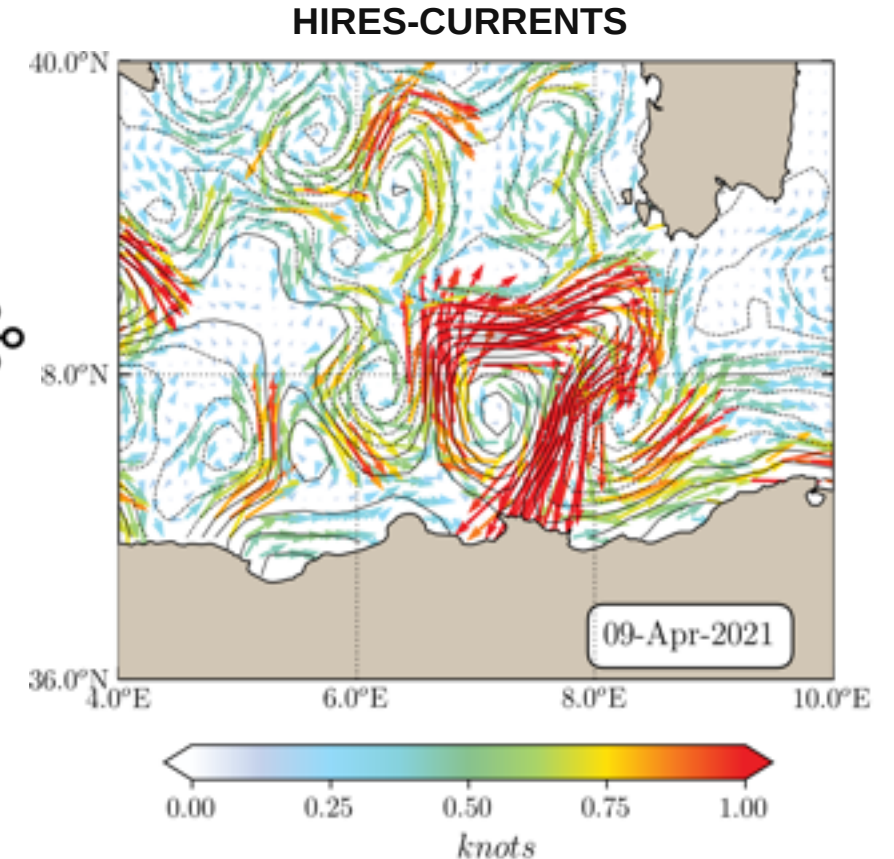
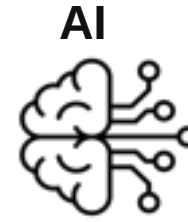
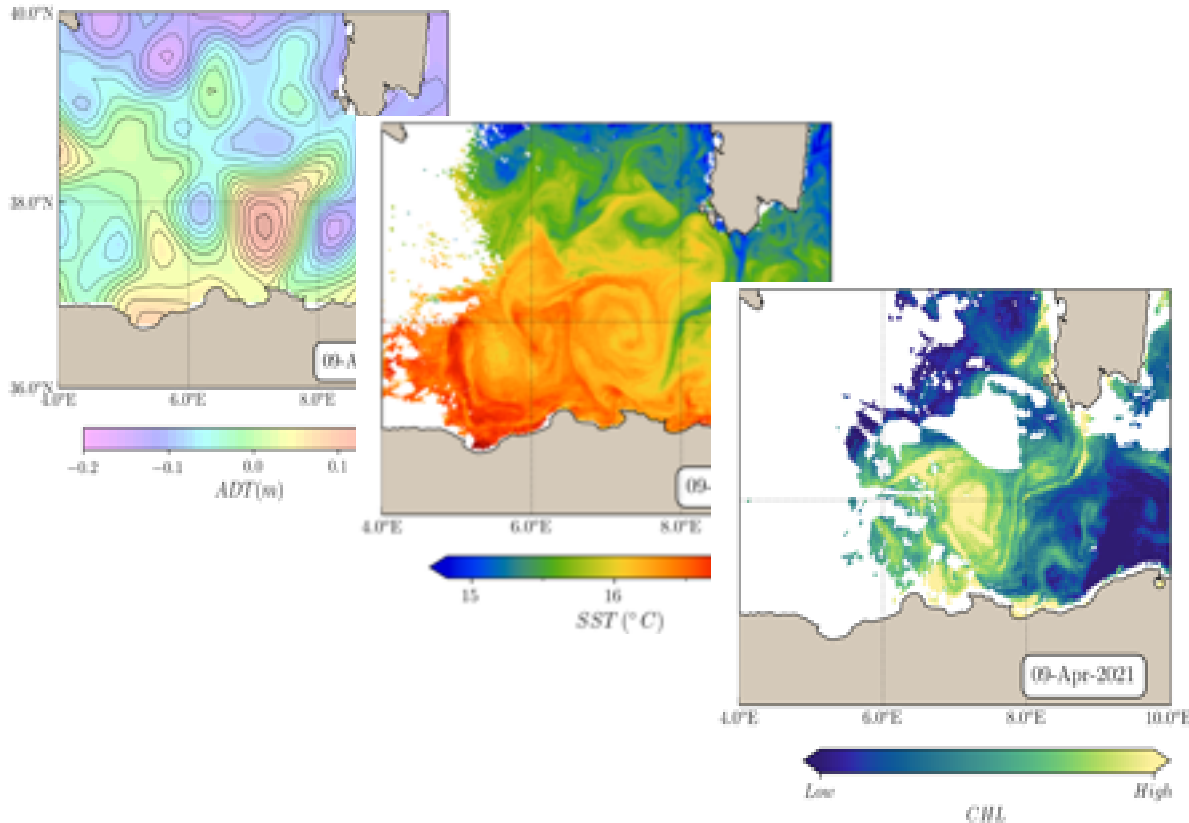


which **operational model** to use?

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Real-time satellite observations!

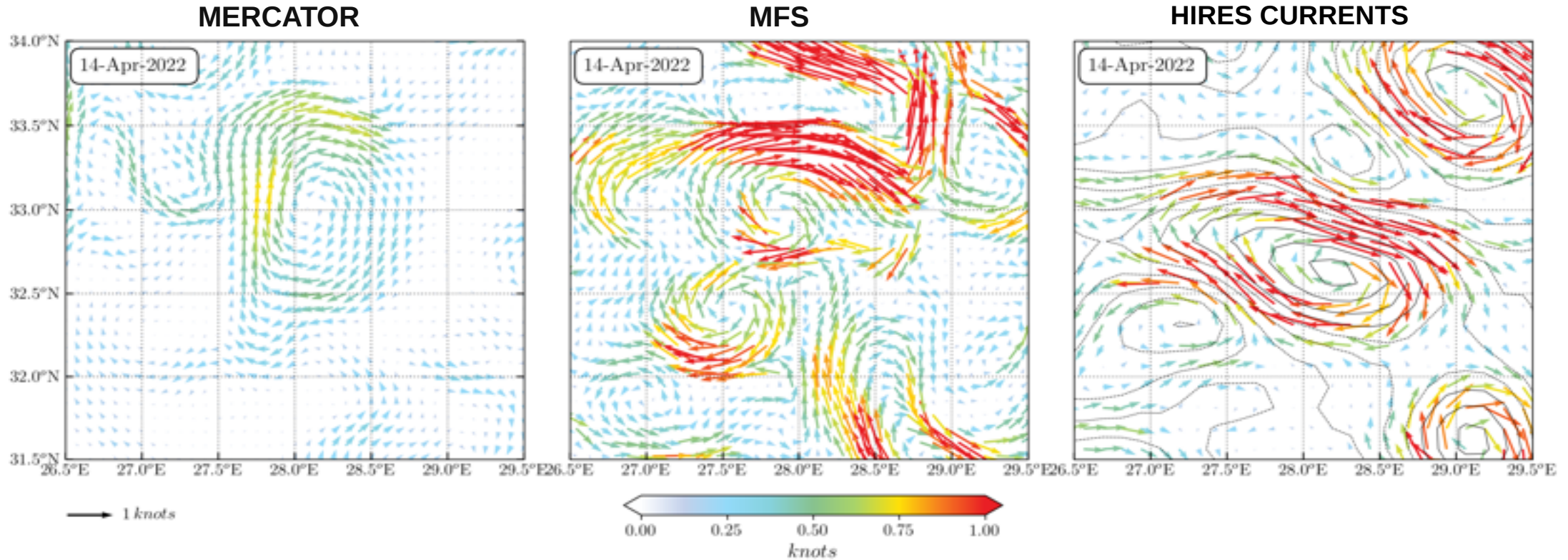
Fusion of different satellite observations



ID 113 "Semantic Segmentation and Super Resolution for Reliable Ocean Circulation Maps"

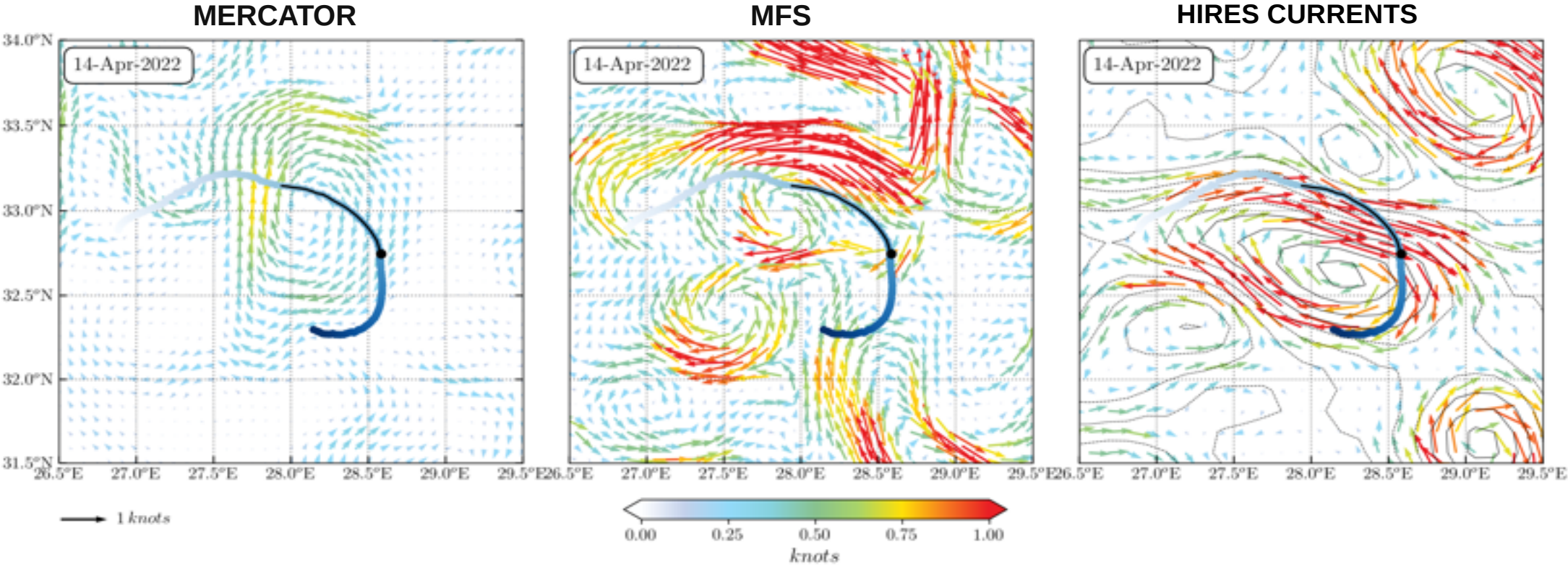
ID 130 "Deep-Eddy-Scan : a new tool for real time eddy detection based on the fusion of SST and altimetry satellite data"

Ocean data of high reliability



why **nowcast** is better?

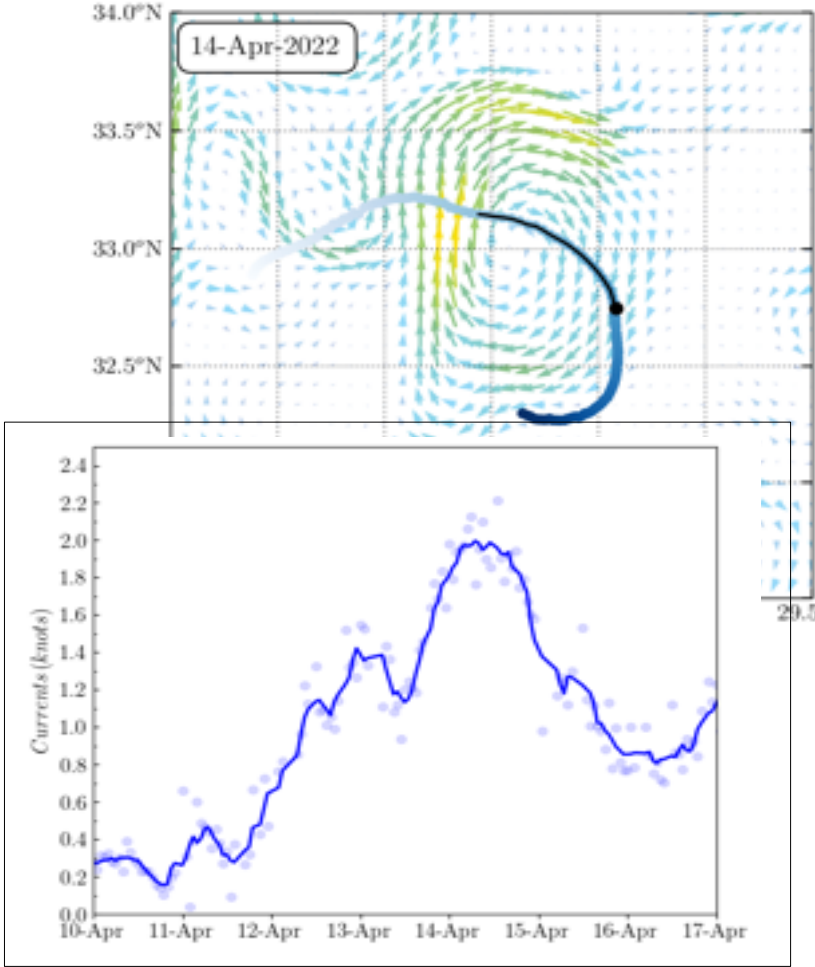
Drifter validation



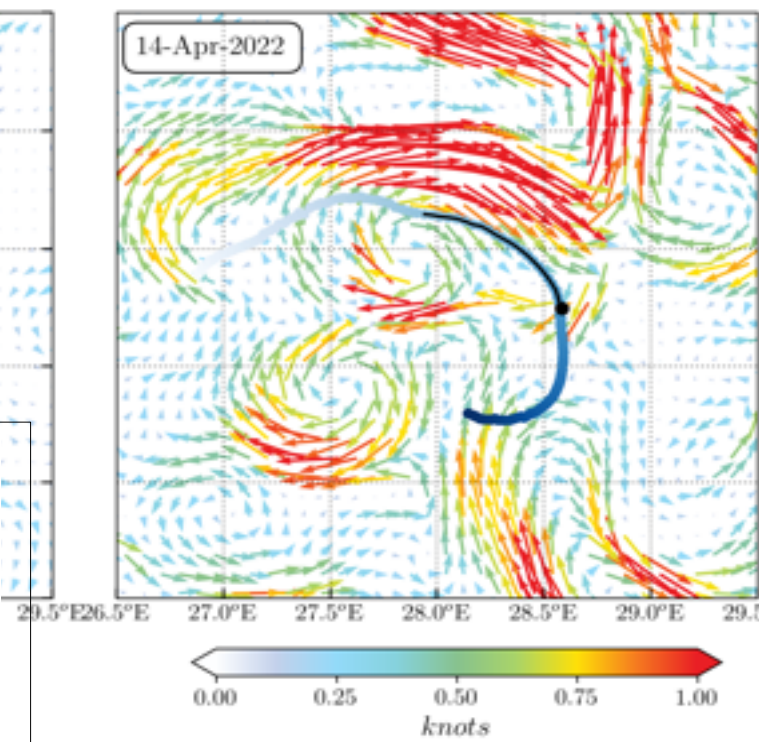
Drifter validation



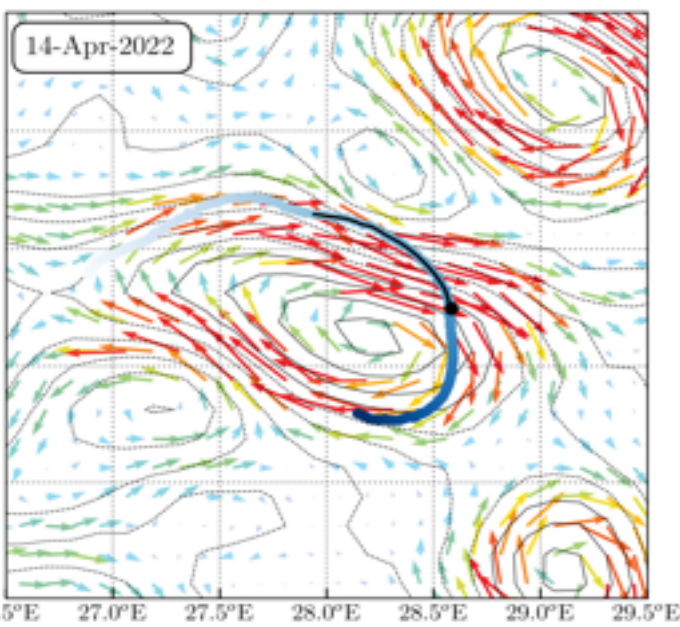
MERCATOR



MFS



HIRES CURRENTS



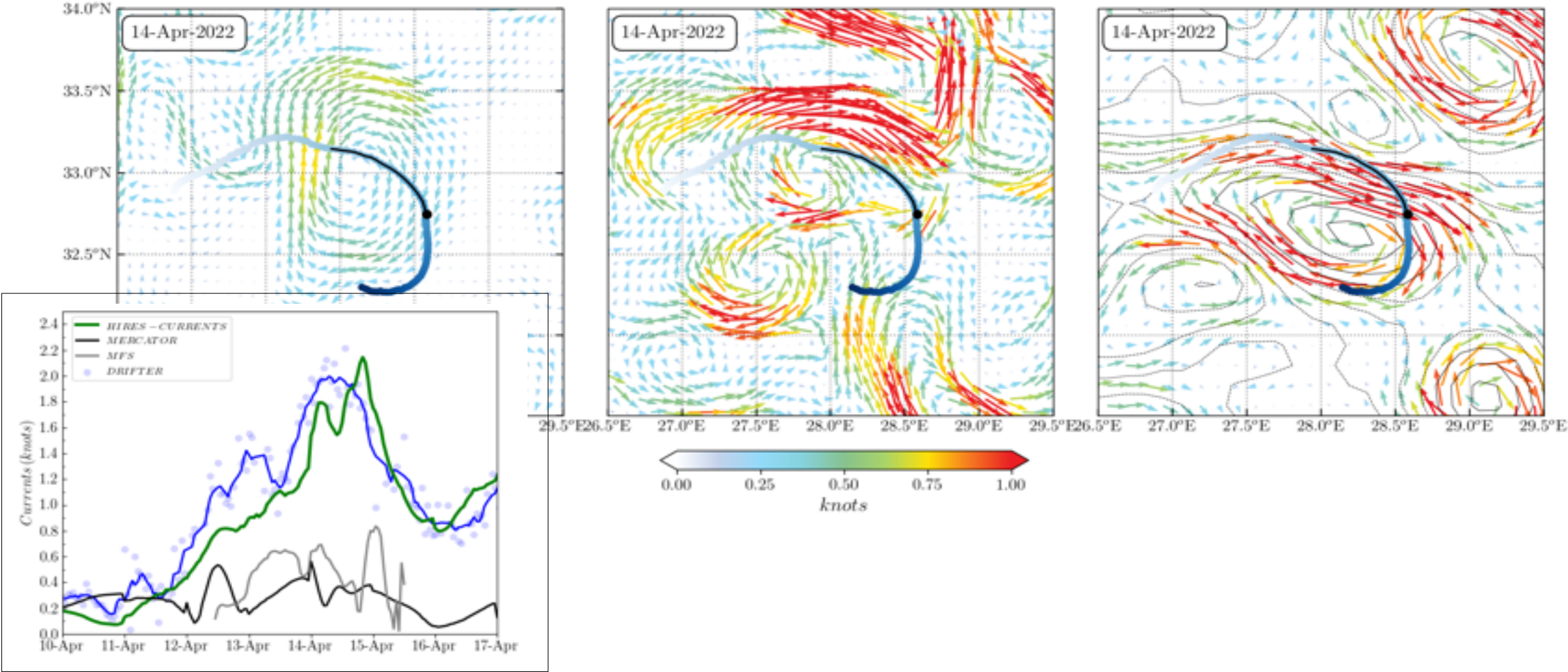
Drifter validation



MERCATOR

MFS

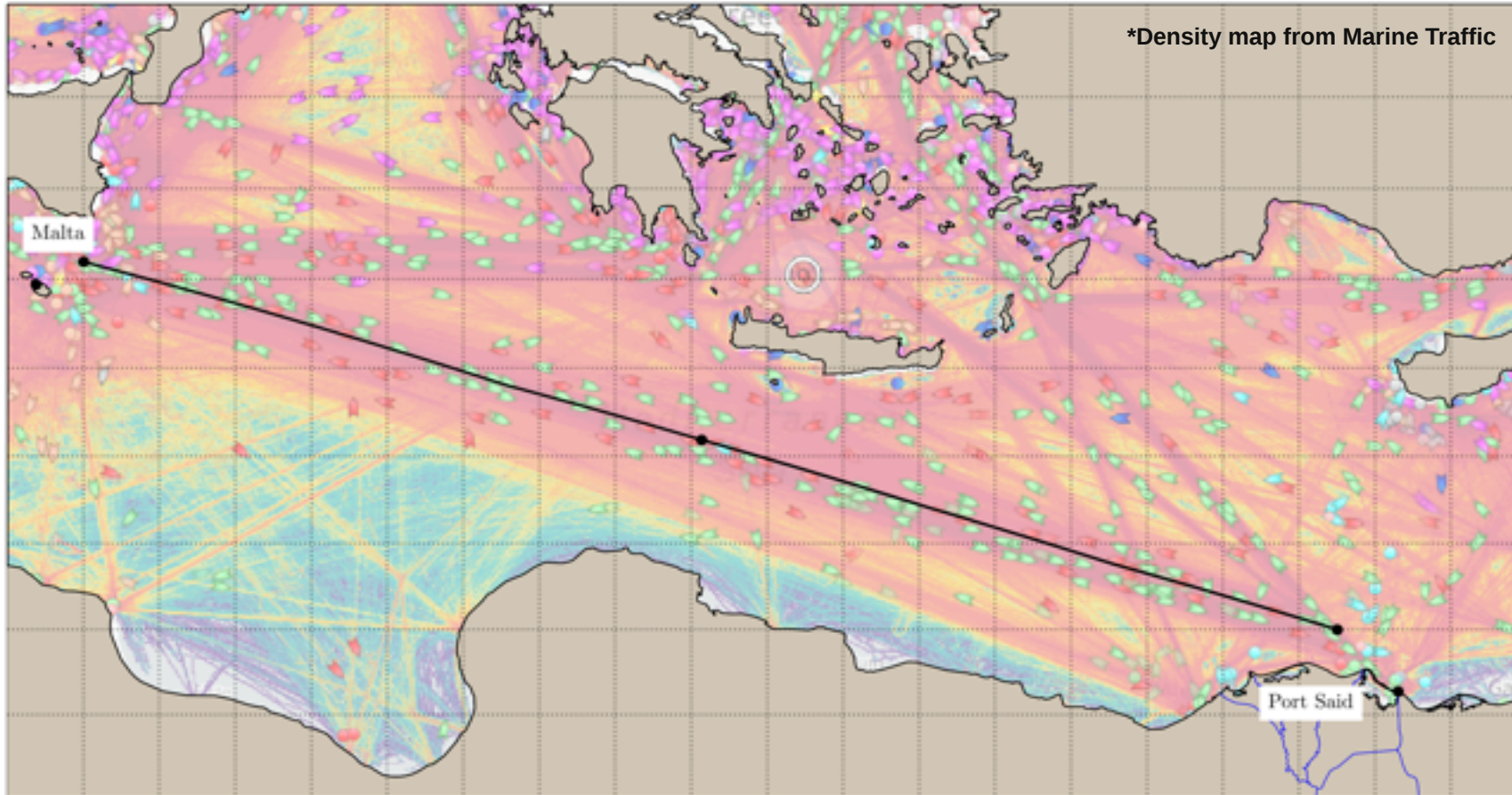
HIRES CURRENTS



why **reliable surface high resolution currents** aid maritime decarbonisation?

An important shipping road

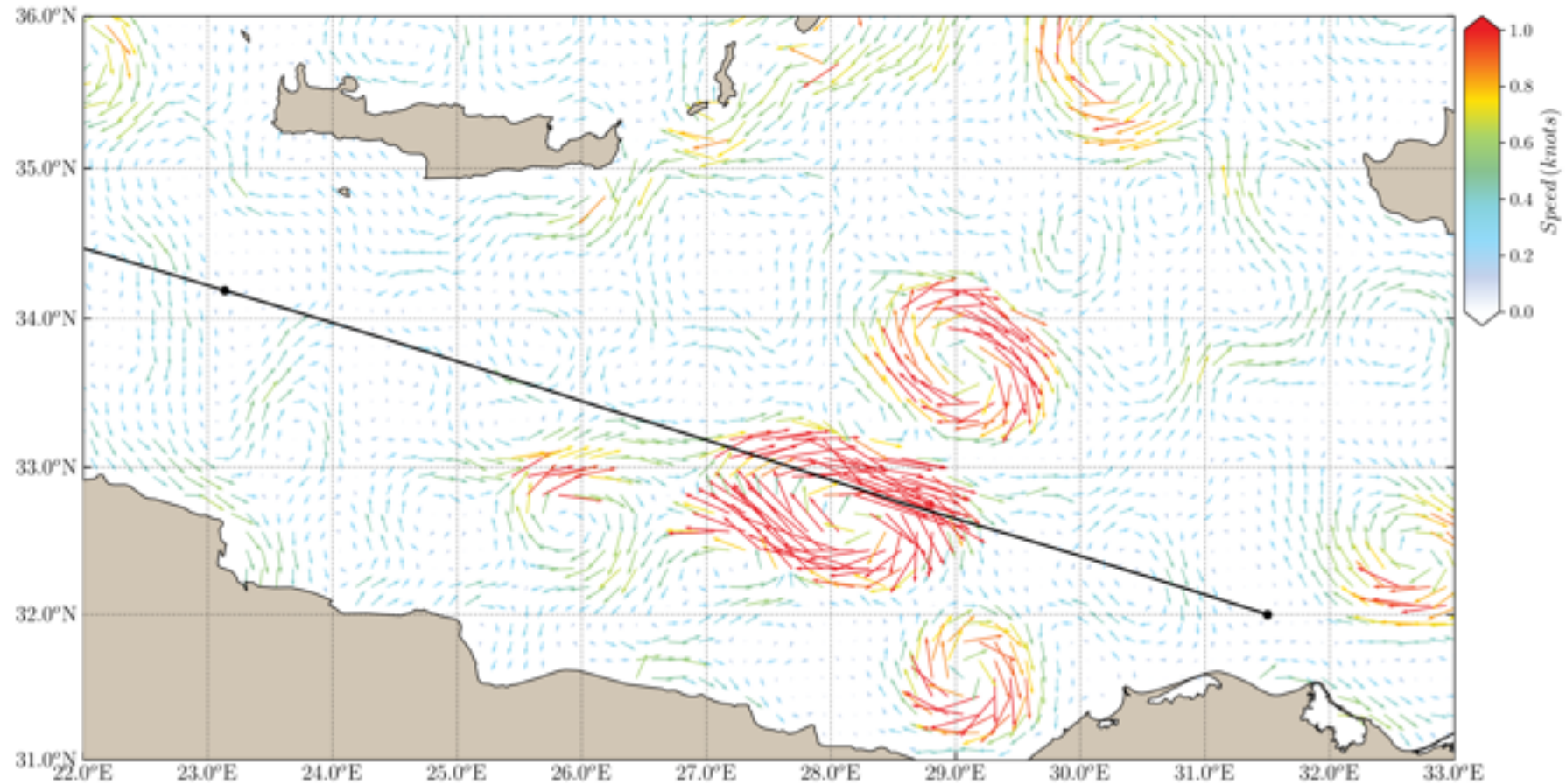
Port Said → MALTA



More than 50 ships exit SUEZ canal everyday! ↑

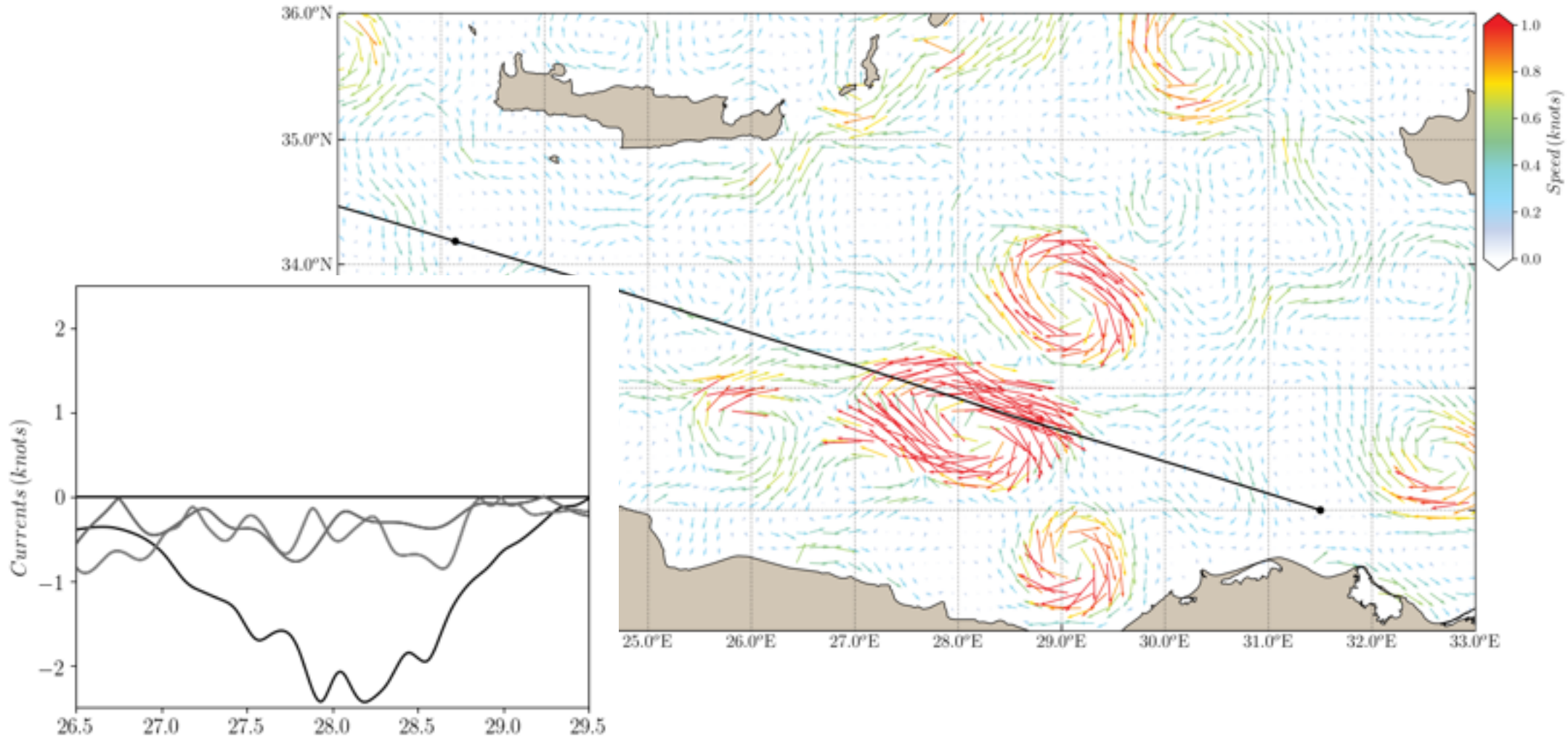
Crossing an intense eddy

affects **E**stimated **T**ime of **A**rrival (ETA)



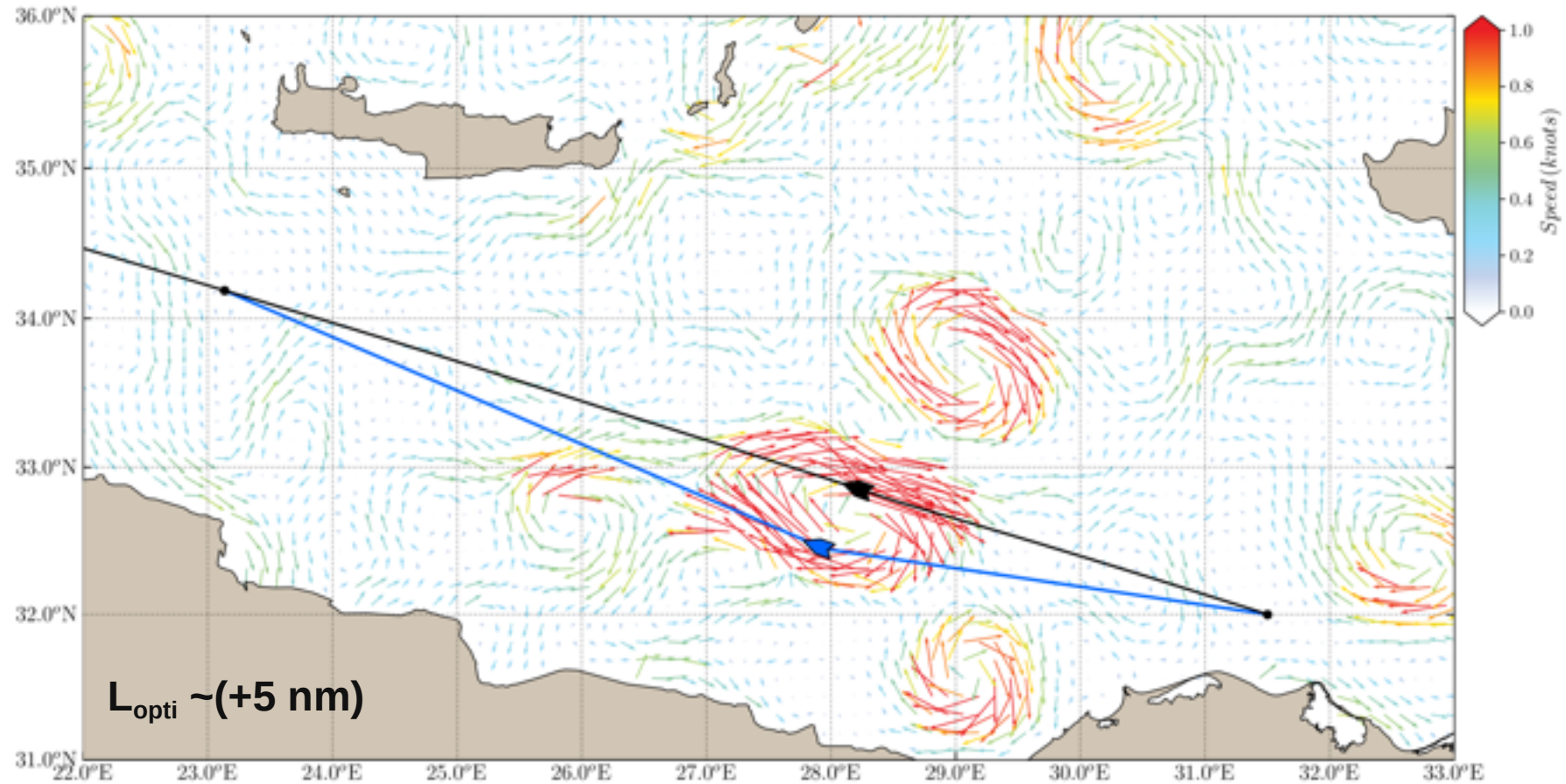
Crossing an intense eddy

can slow you down!



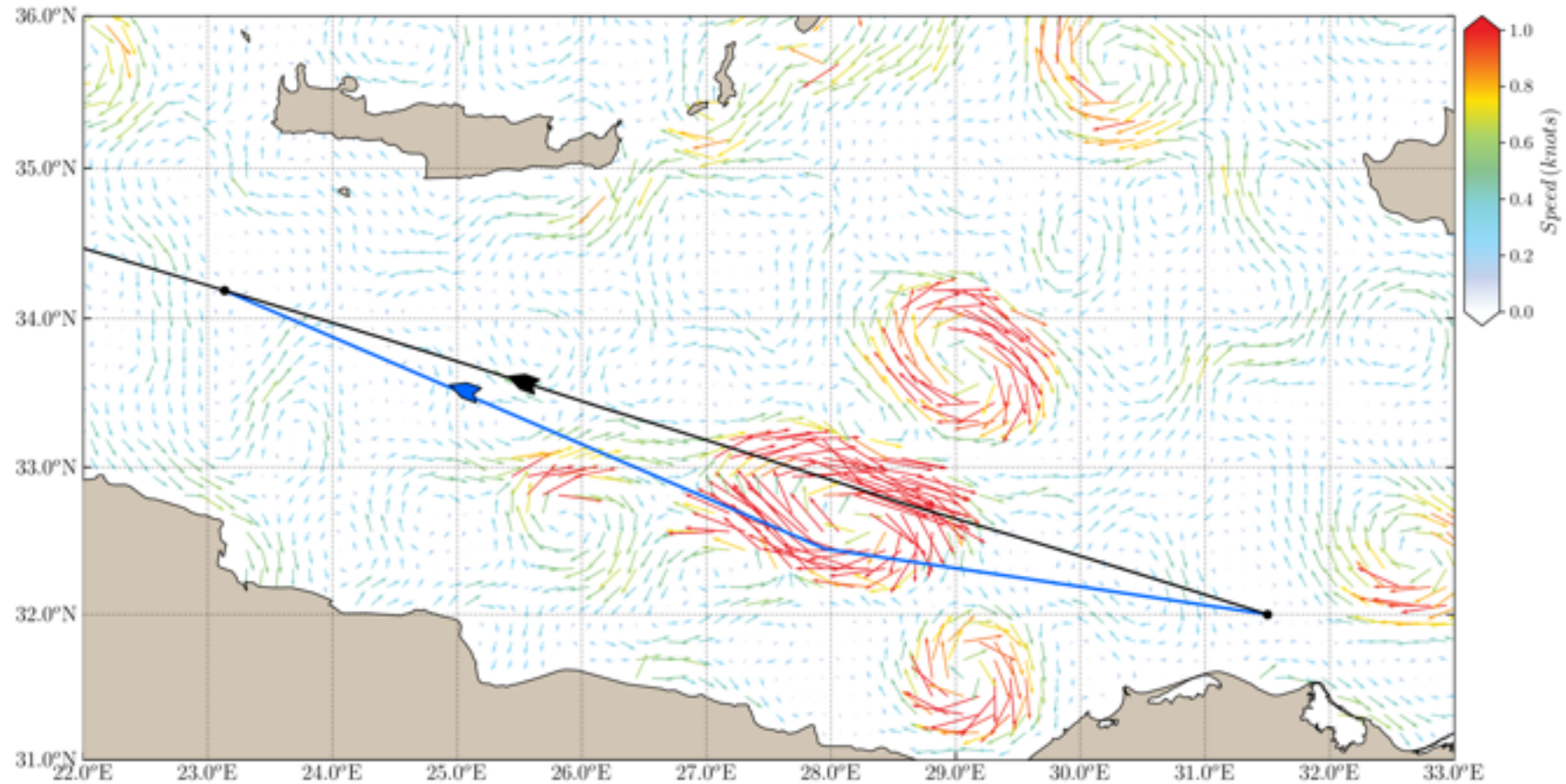
Short Term Optimisation Routing (STOR)

adjusting a **SINGLE waypoint** we can save **time** and **fuel**!



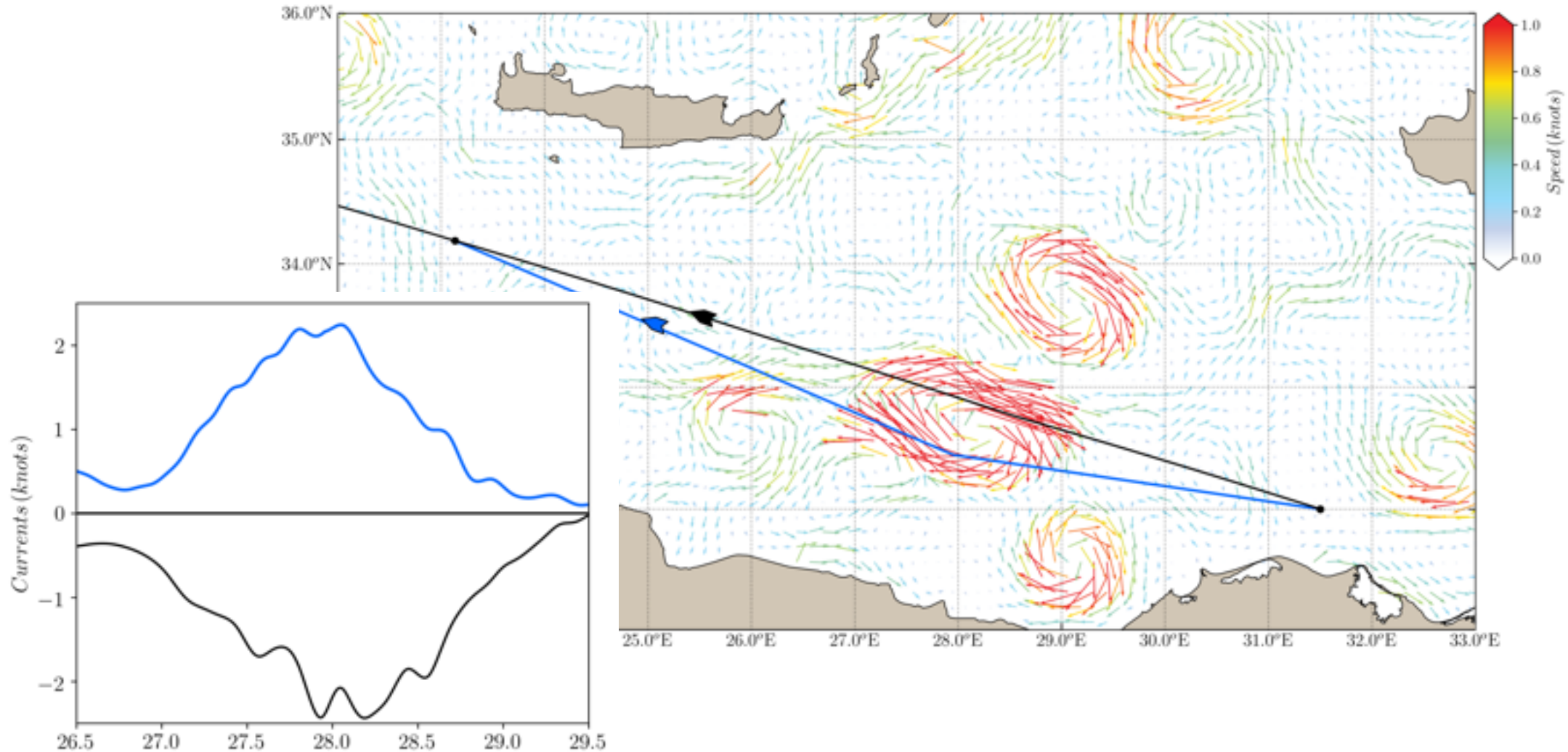
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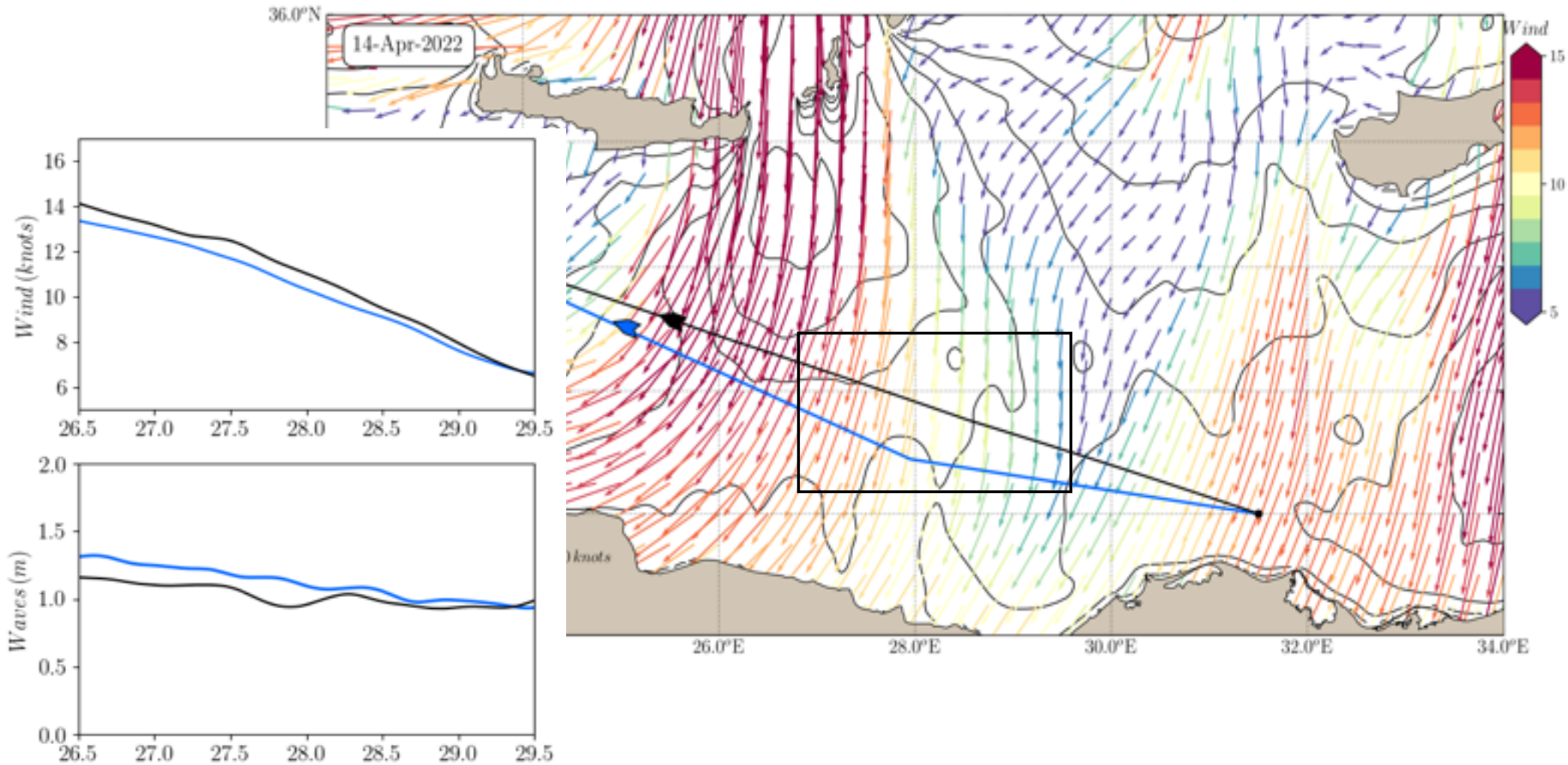


Short Term Optimisation Routing (STOR)

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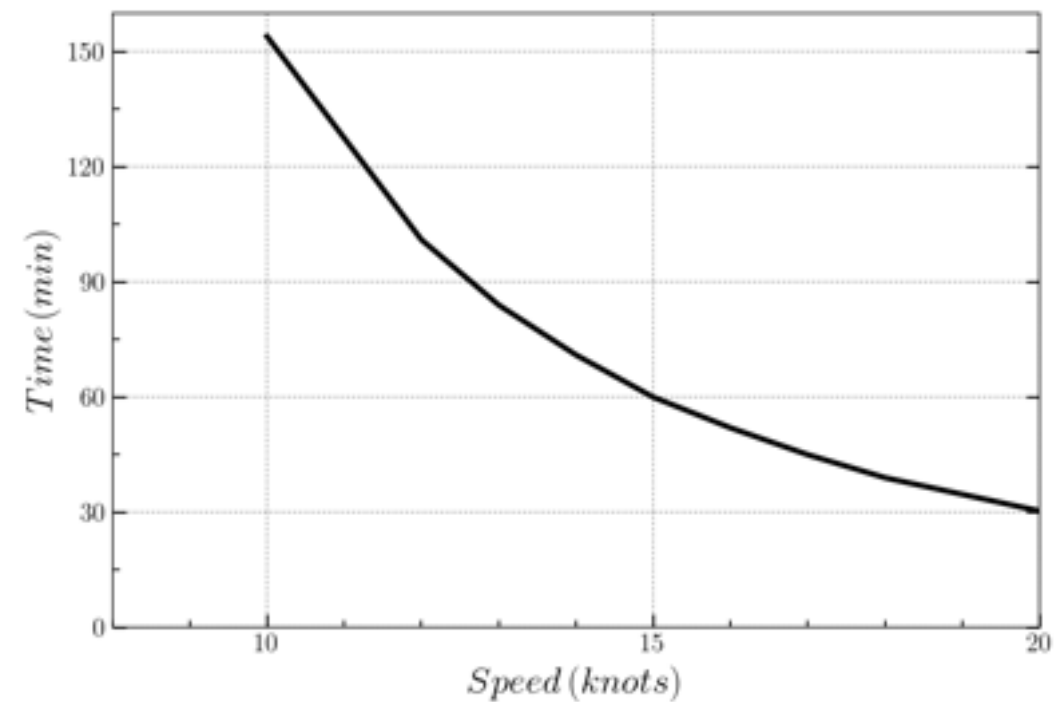


STOR not impacted by wind and waves

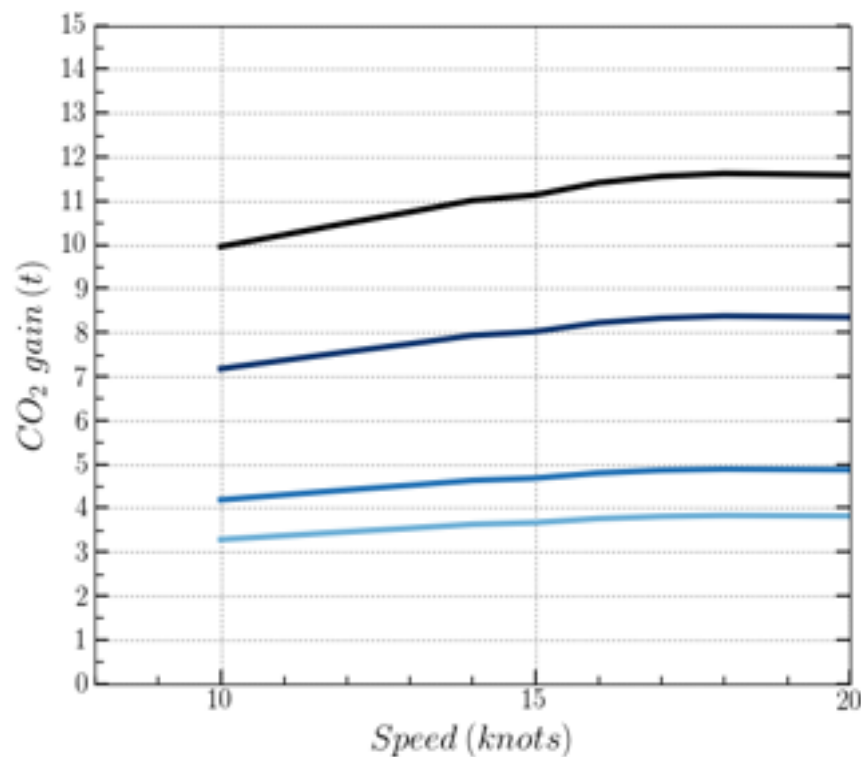
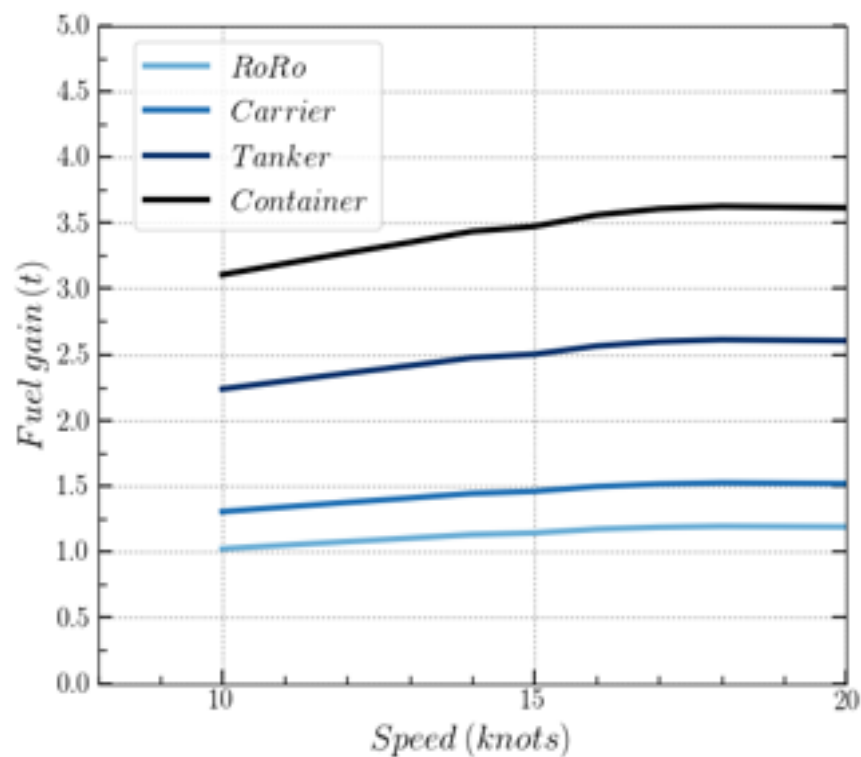


Saving operational time

depends on navigational speed



Fuel & CO₂ reduction in a single day

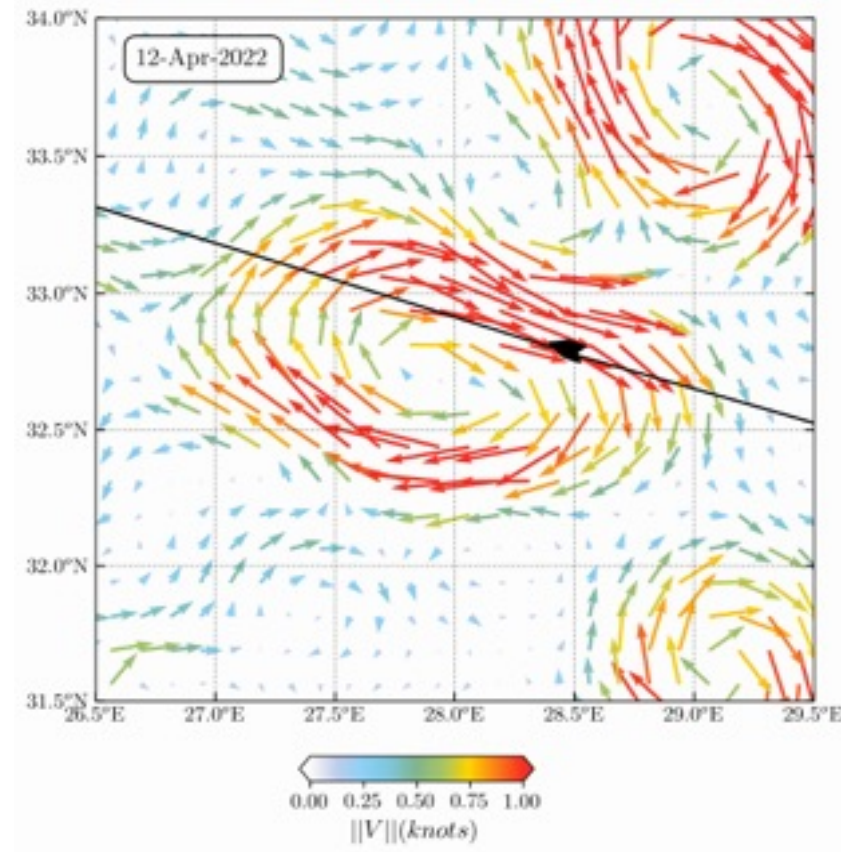


*Adland et al. (2020)
*Bialystocki et al. (2016)

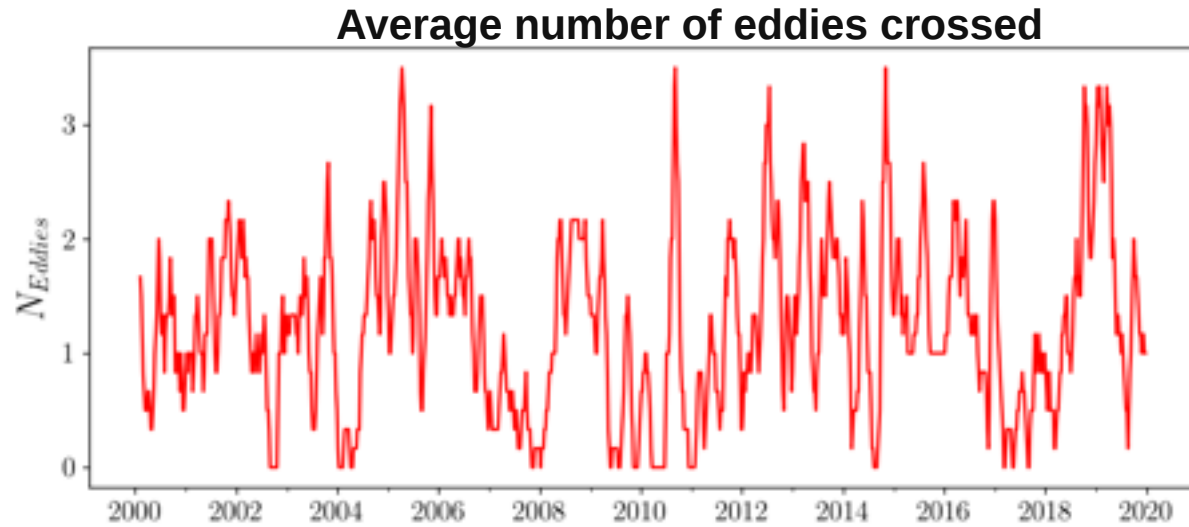
CII reduces up to 6.5%

Slow eddy evolution

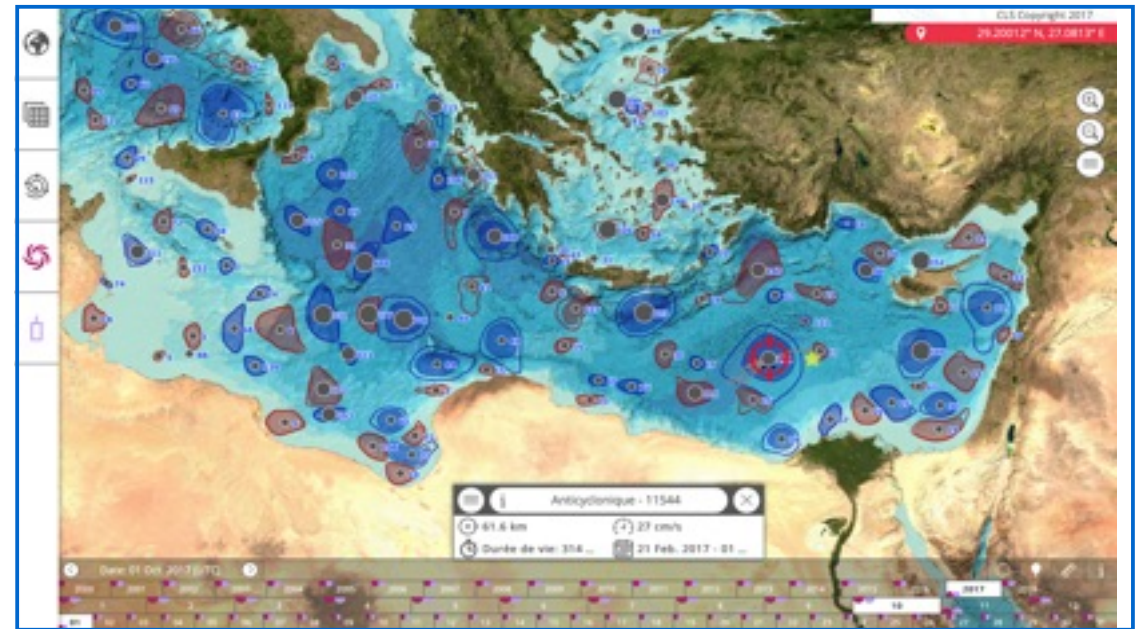
eddies can remain for long time periods (weeks till months)



Several intense eddies along SUEZ-GIBRALTAR

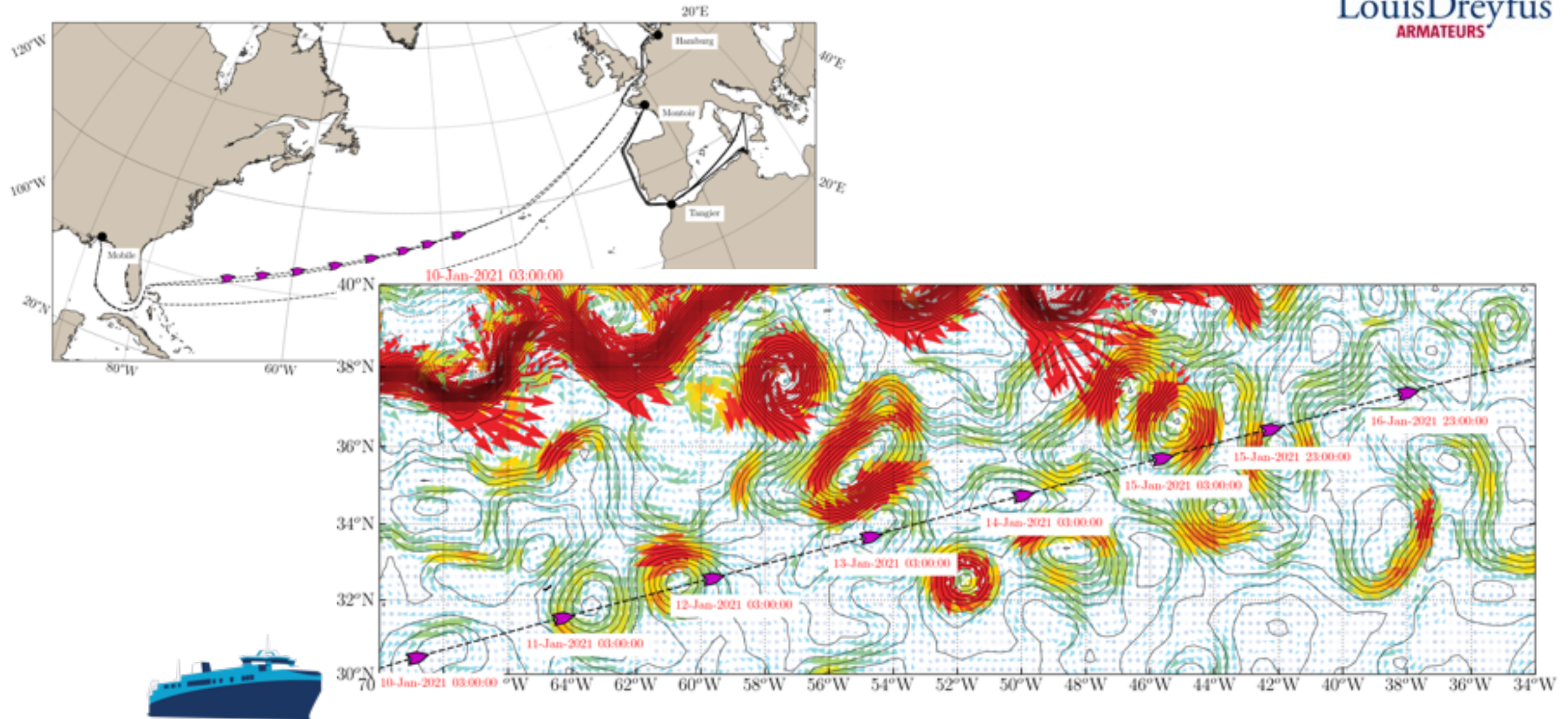


20 year eddy database (DYNEDAtlas)

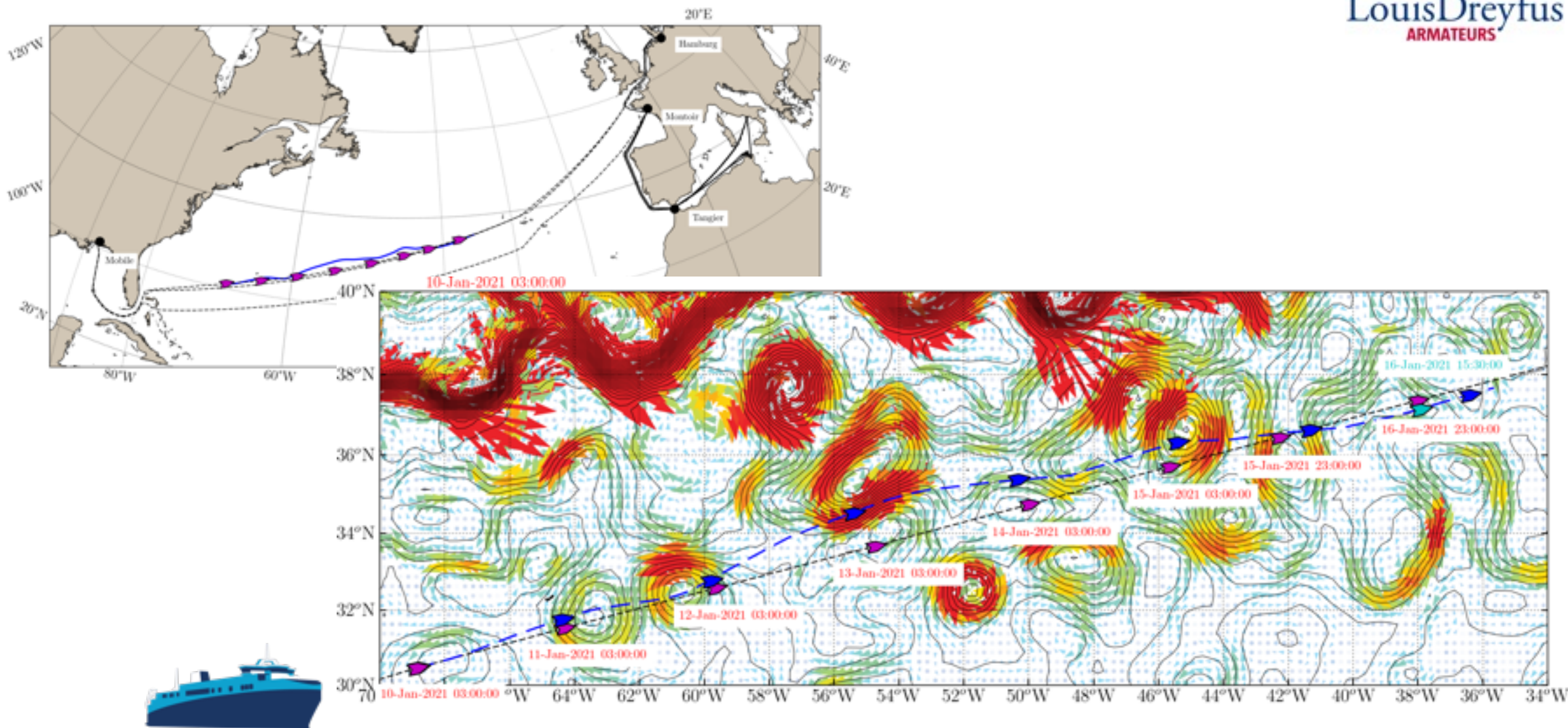


ships cross on average **1.3 eddies per trajectory**

STOR in a transatlantic route



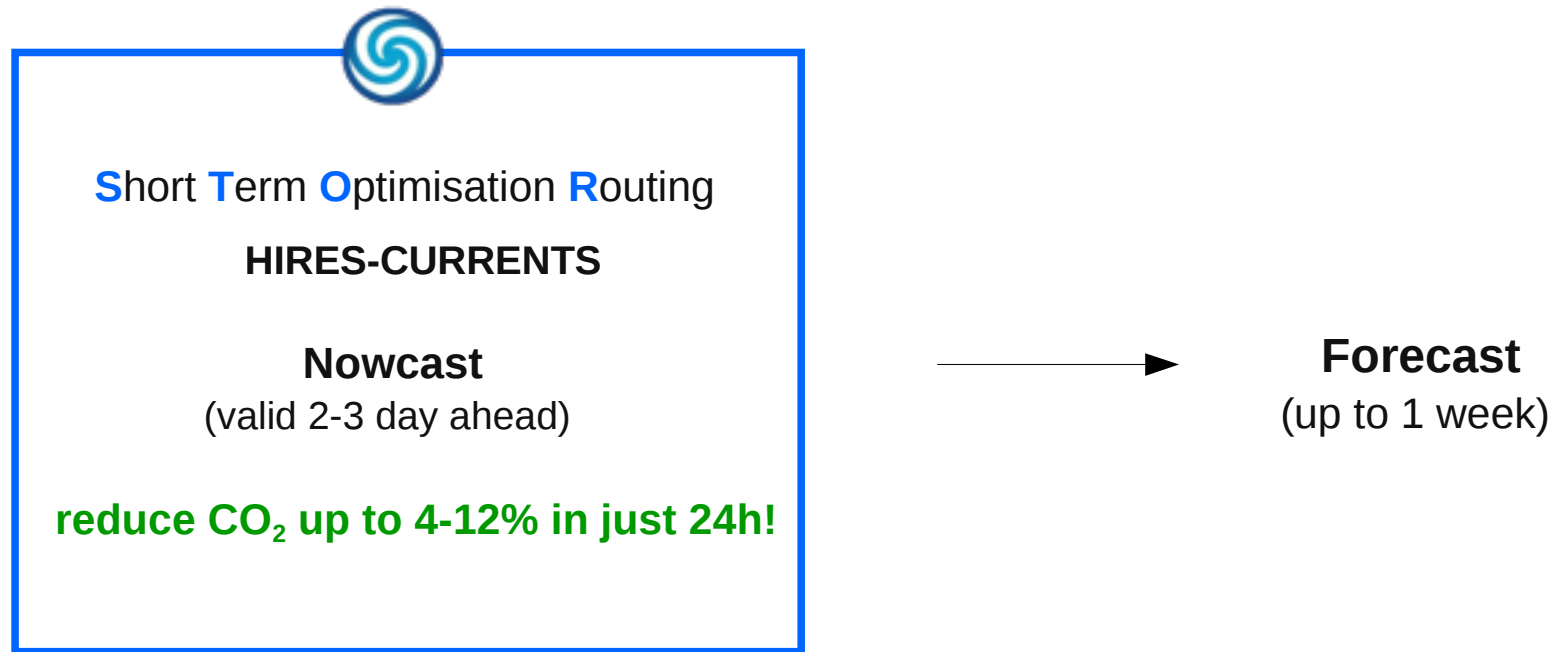
STOR in a transatlantic route



~8 hours gain in time, -5t fuel savings -5% CO₂

Conclusions & perspectives

- reliable and high resolution surface currents
- short term routing optimisation is now possible



Thank you for your attention!

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