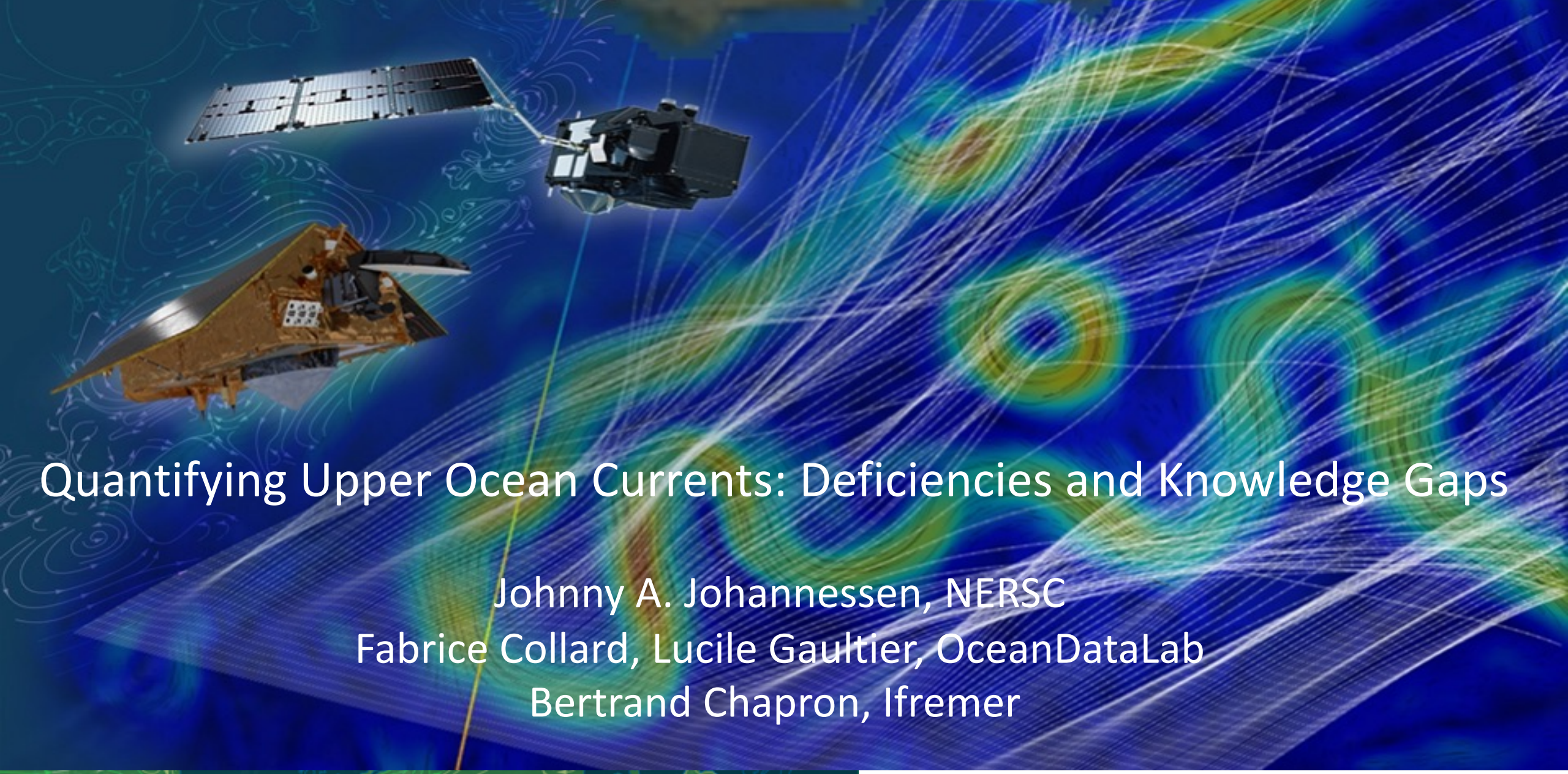
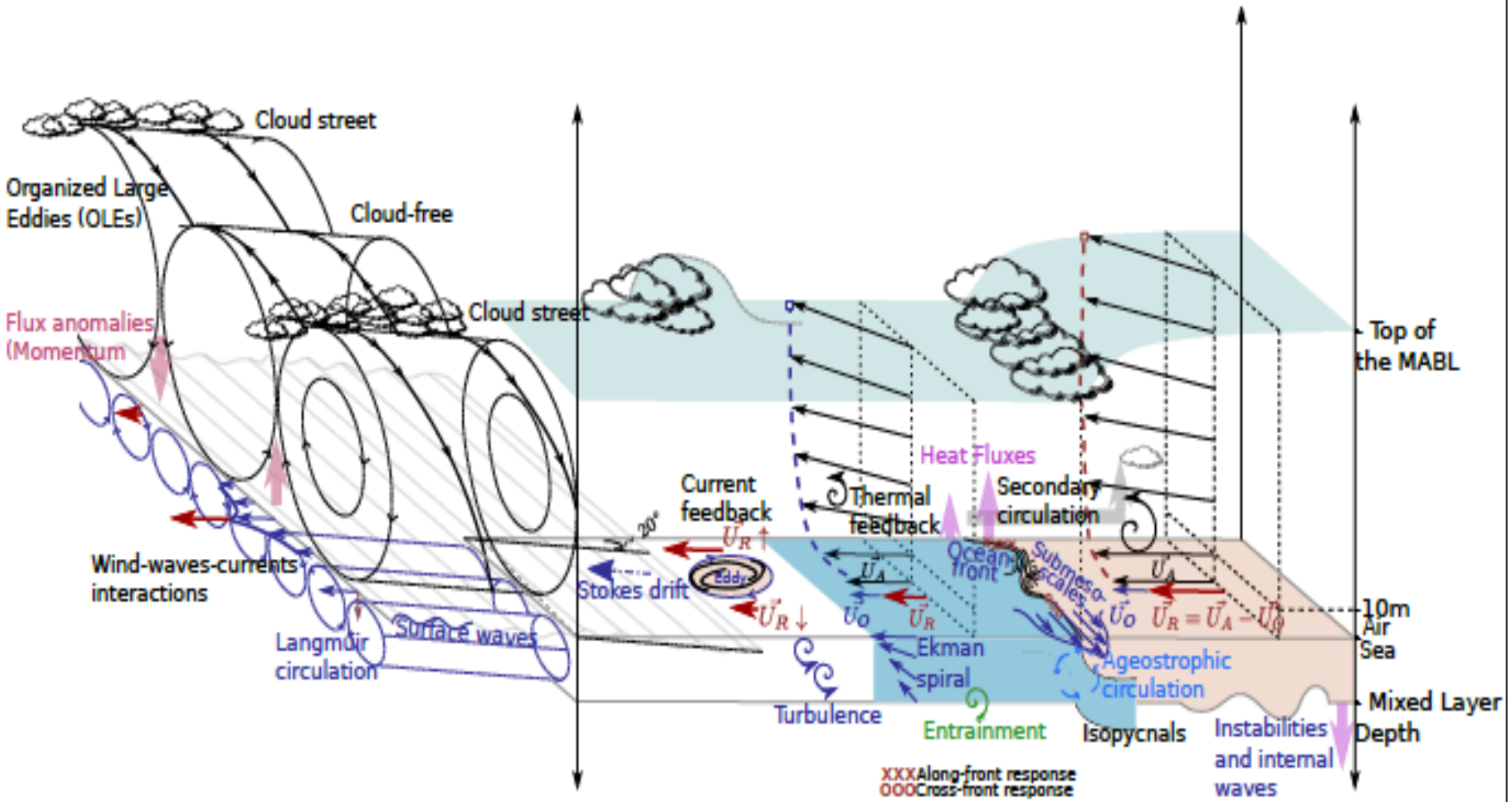


Quantifying Upper Ocean Currents: Deficiencies and Knowledge Gaps

Johnny A. Johannessen, NERSC
Fabrice Collard, Lucile Gaultier, OceanDataLab
Bertrand Chapron, Ifremer

WOC User Consultation Meeting 2022
10–12 October | ESA–ESRIN | Frascati (Rome), Italy

Knowledge Gaps and Deficiencies



After EE10 Harmony

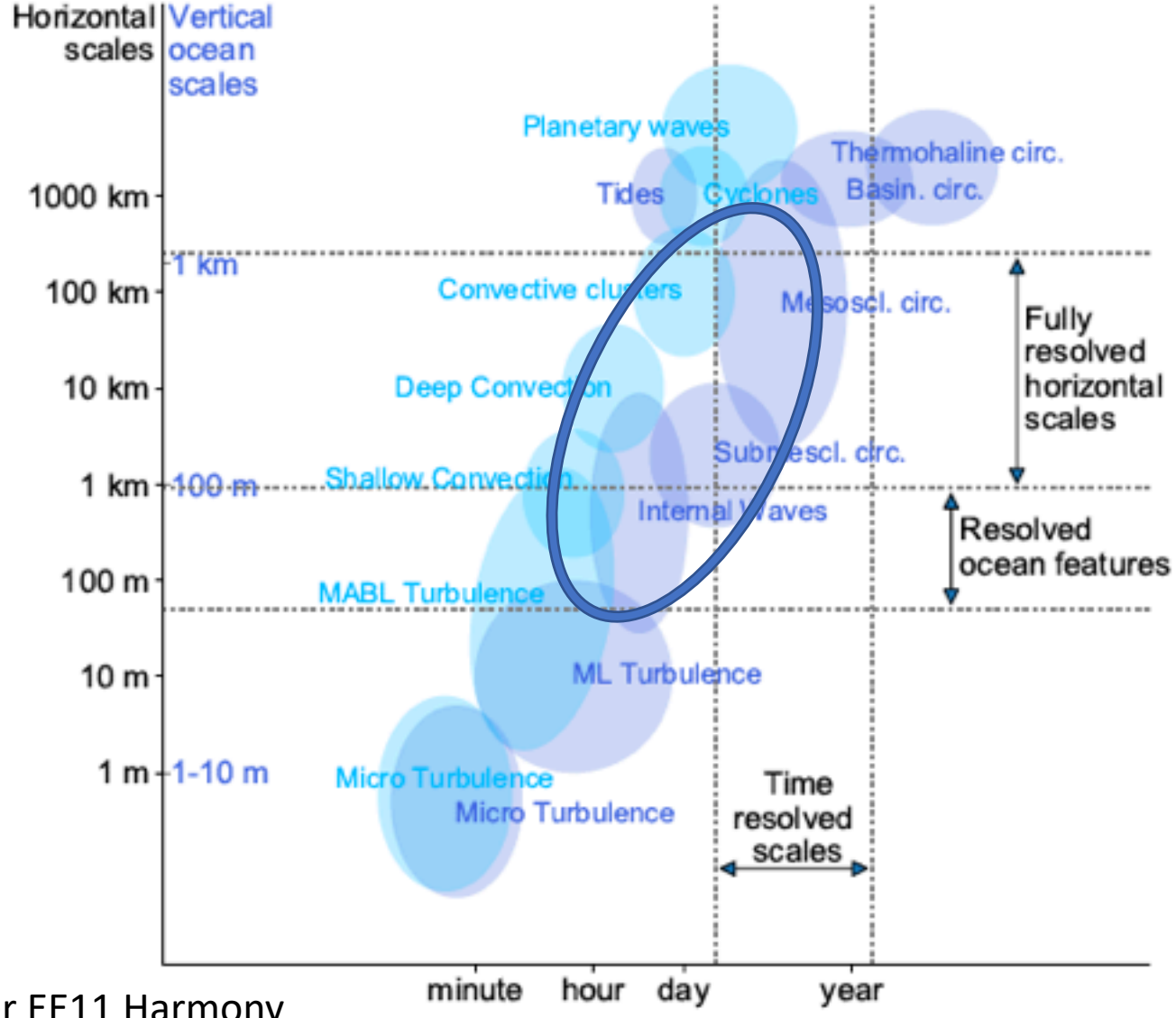
What: *We lack proper quantitative understanding of the coupled marine atmospheric boundary layer (MABL) – ocean surface – and upper ocean system.*

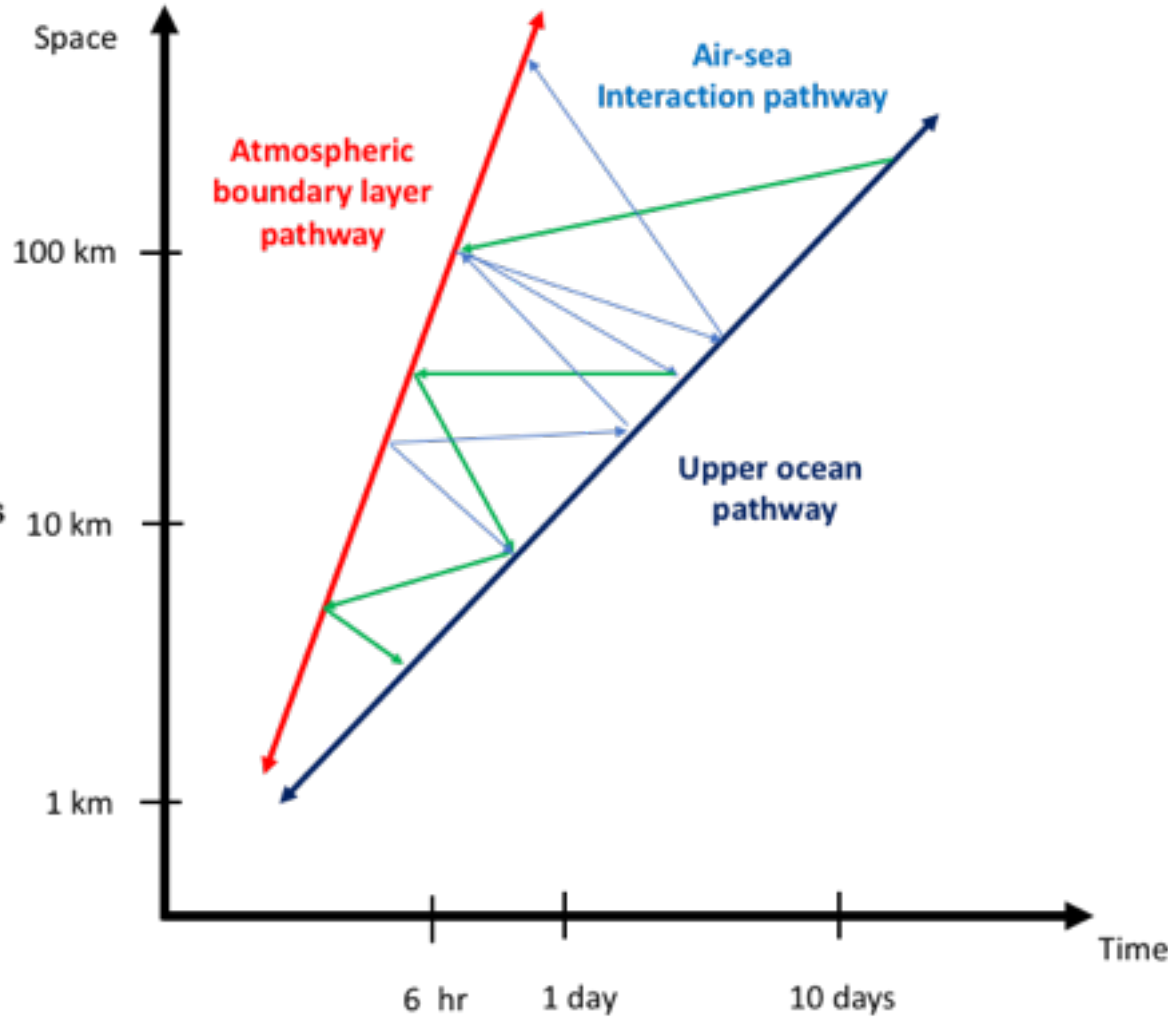
Why: *Limited knowledge across scales of:*

- *MABL thermodynamics*
- *Air-sea interaction*
- *Upper ocean dynamics and thermodynamics.*

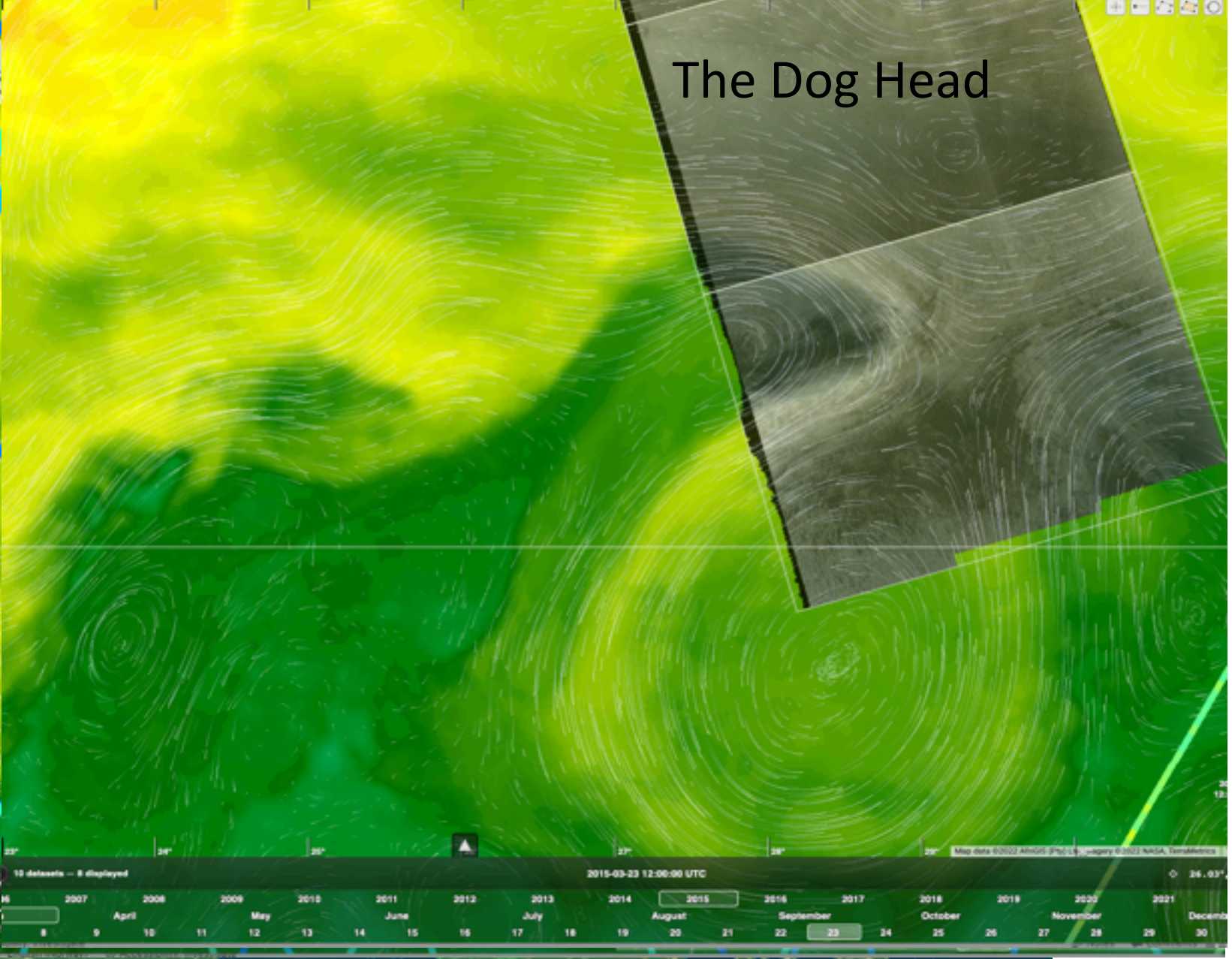
So: *Challenges to derive accurate estimate of the near surface wind, transfer of momentum to the ocean and estimate of the surface to near-surface currents.*

The Space -Time Characteristics



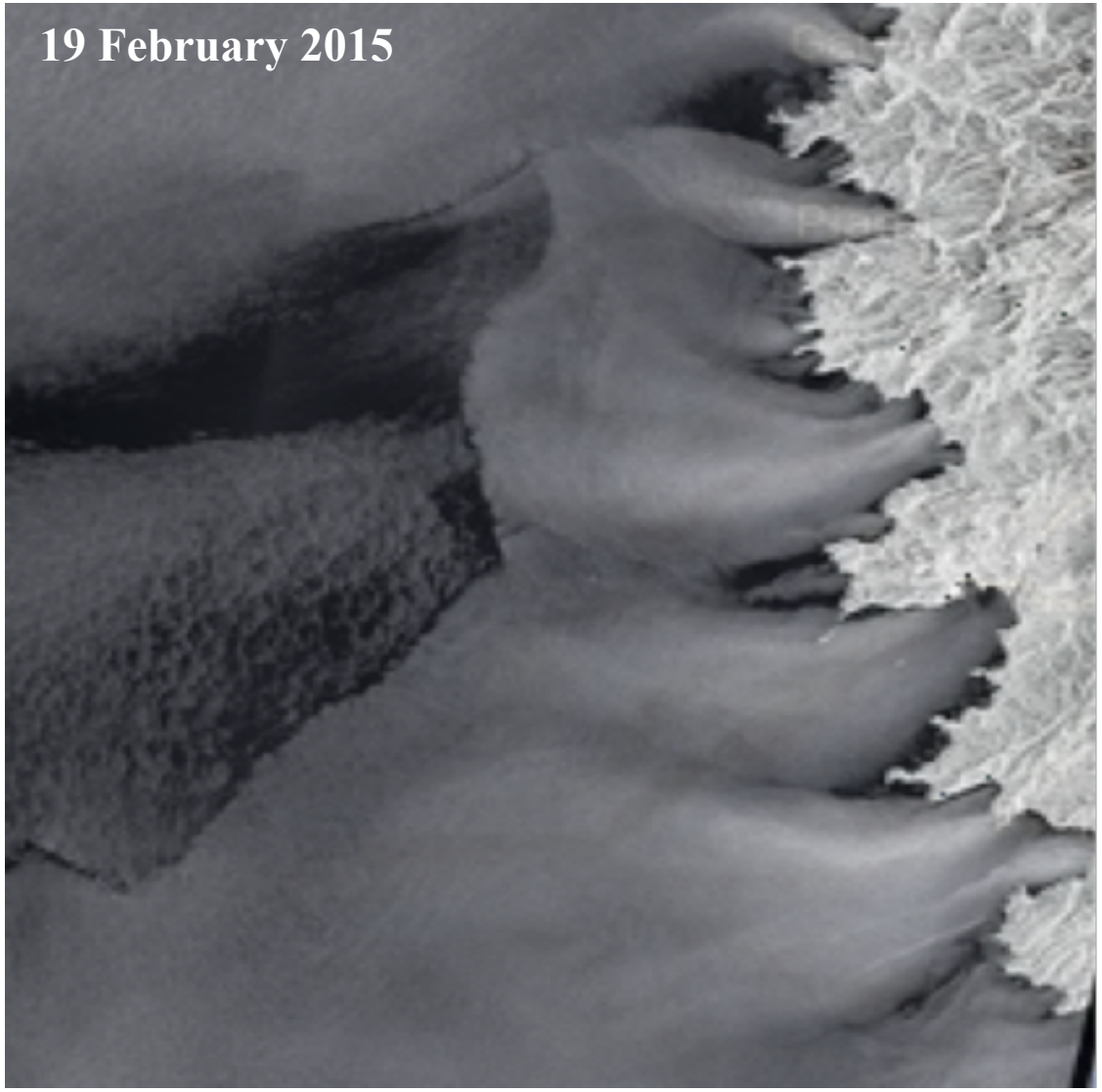


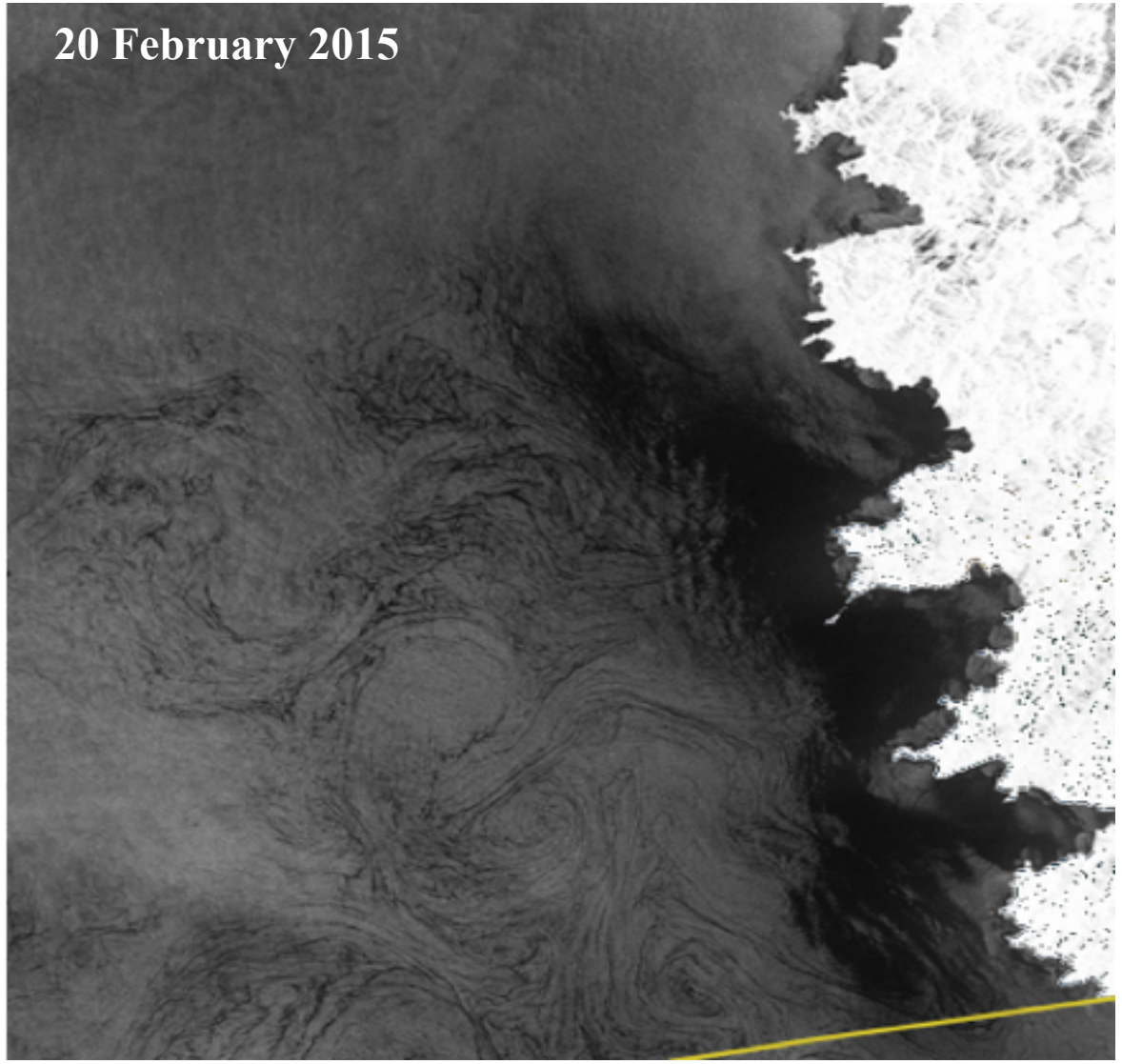
After EE11 Harmony



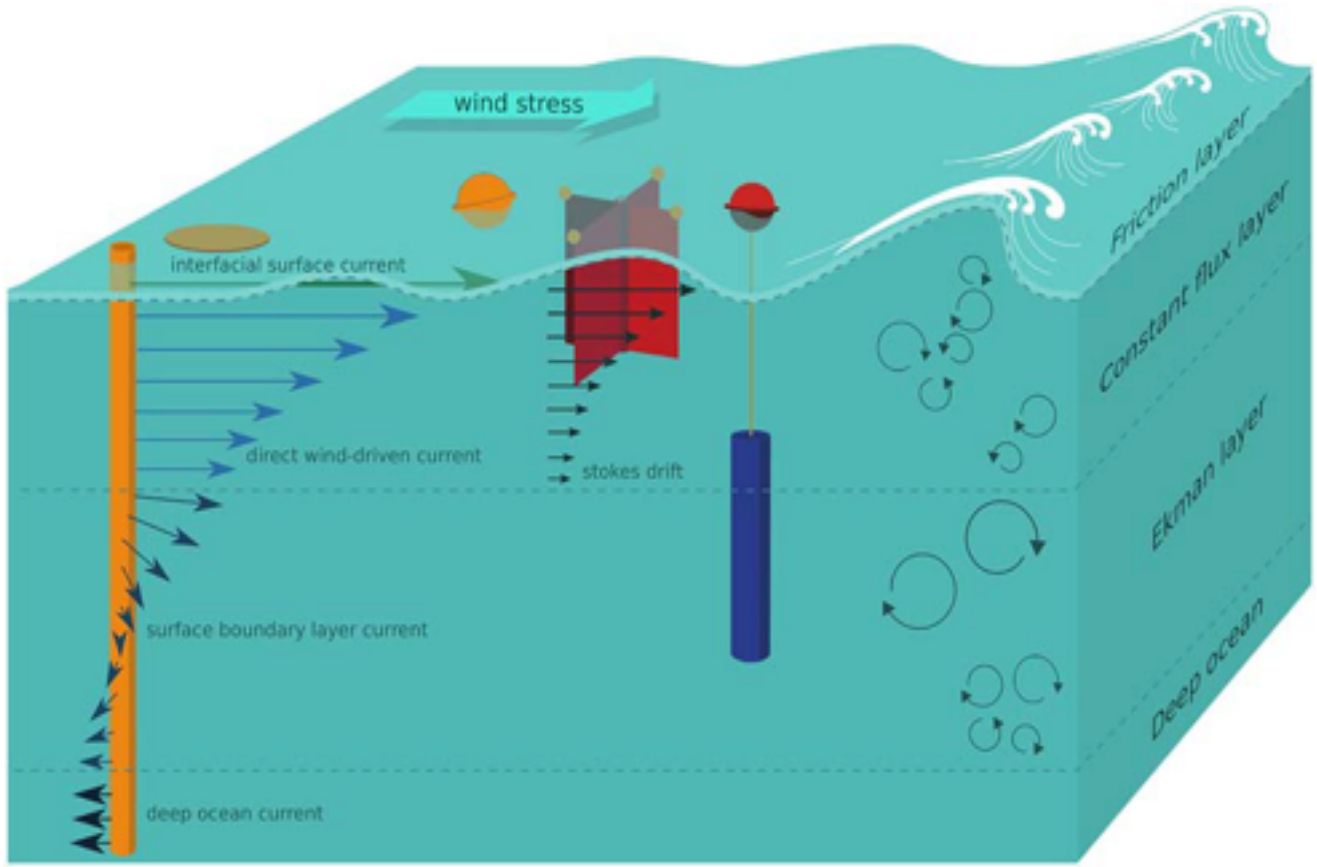
Synoptic snapshot of the so-called “dog head” feature showing the combined 2-D SST map (colour) and surface geostrophic current (stippled streamlines) on 23 March 2015. Now with the Sentinel-1 SAR image for the same day.

Sentinel-1 SAR image off west coast of Corsica



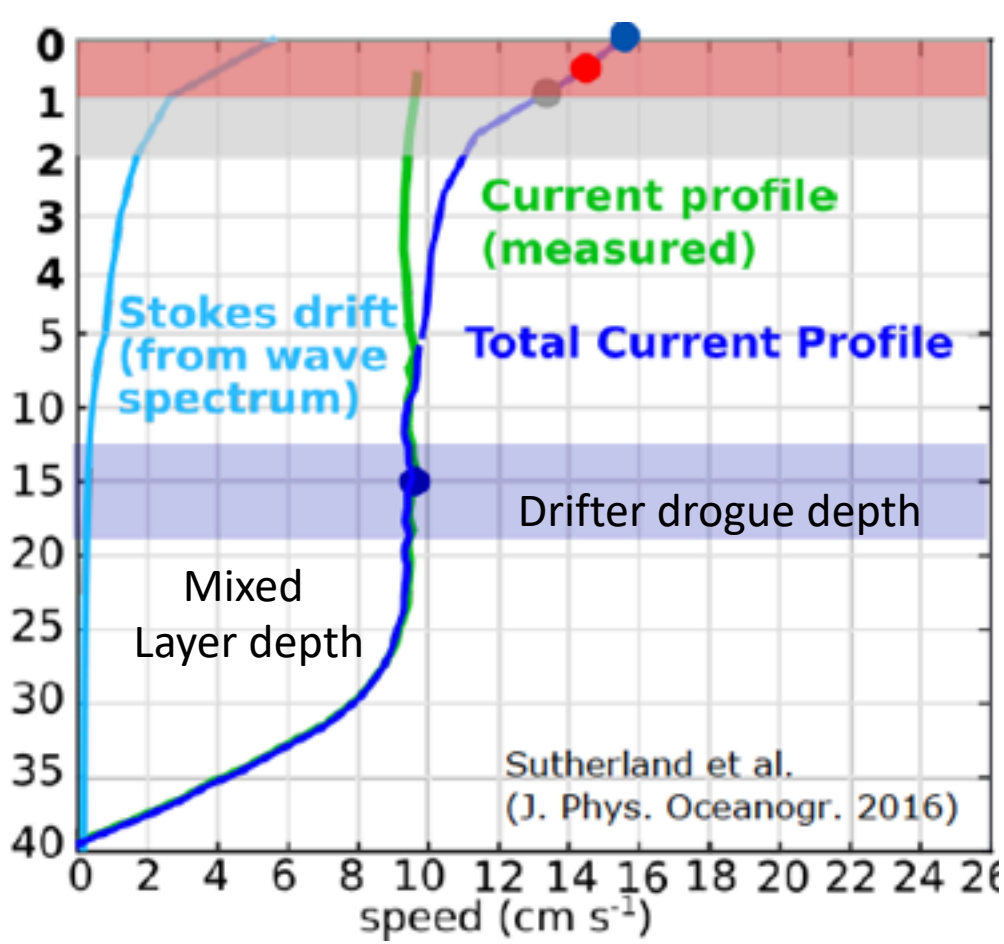


Upper ocean dynamics and currents



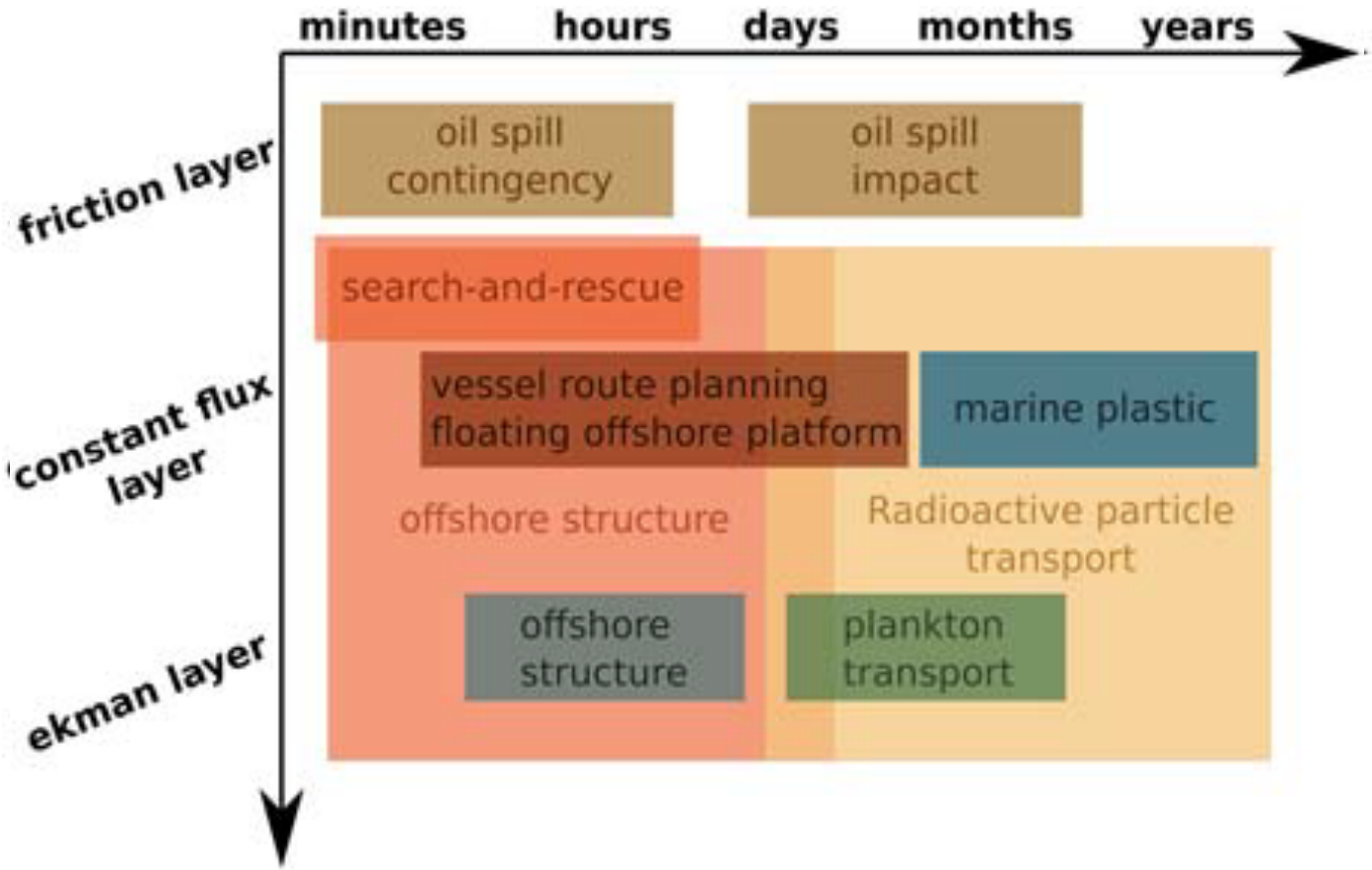
Røhrs et al 2021

Current Profile in the Upper Ocean

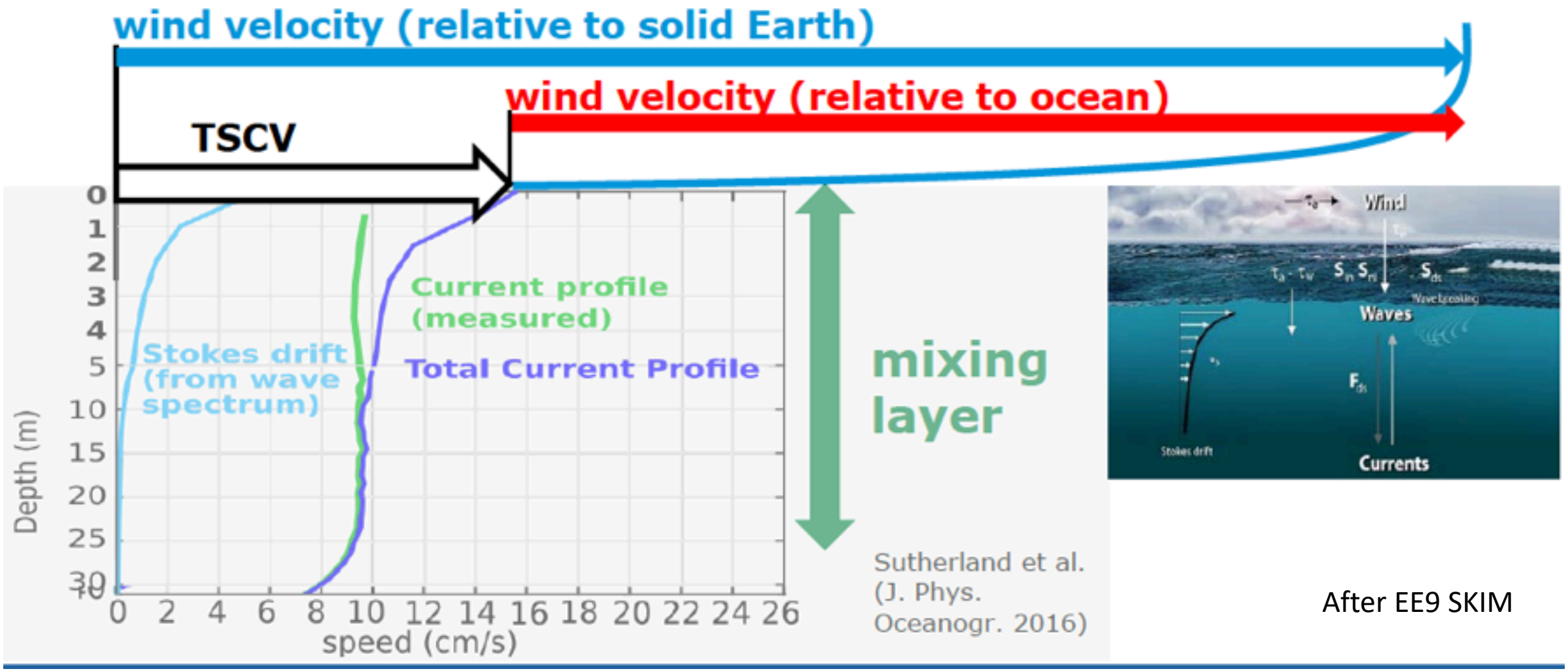


Incompatible surface current notation:

- *The depth representations often differ because observations measure at different depths.*
- *Time scales differ because observed and model data are provided as average over a time period.*
- *Physical mechanisms and representations differ because direct-indirect observations and models are based on assumptions that leave out parts of the surface currents.*

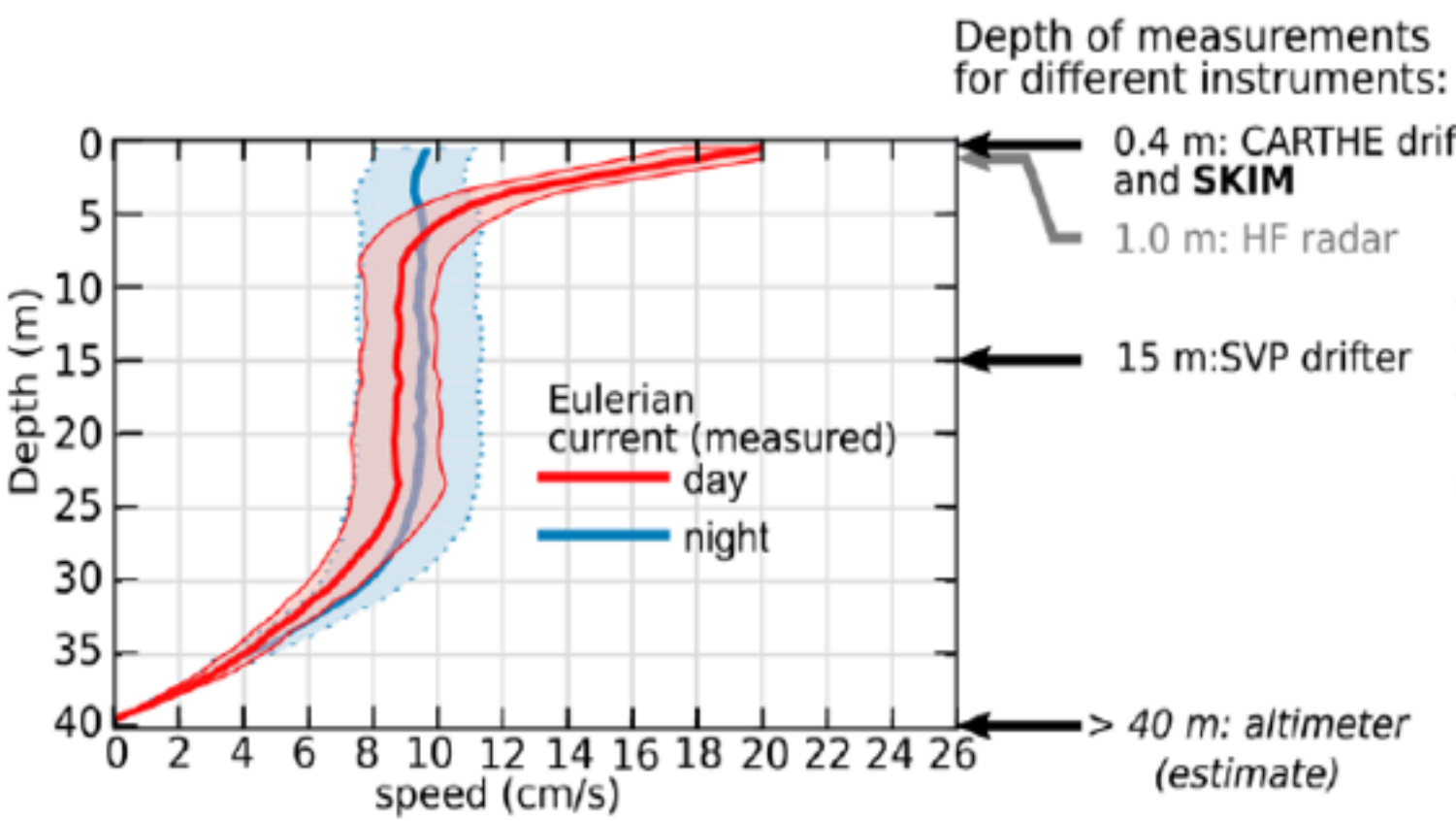


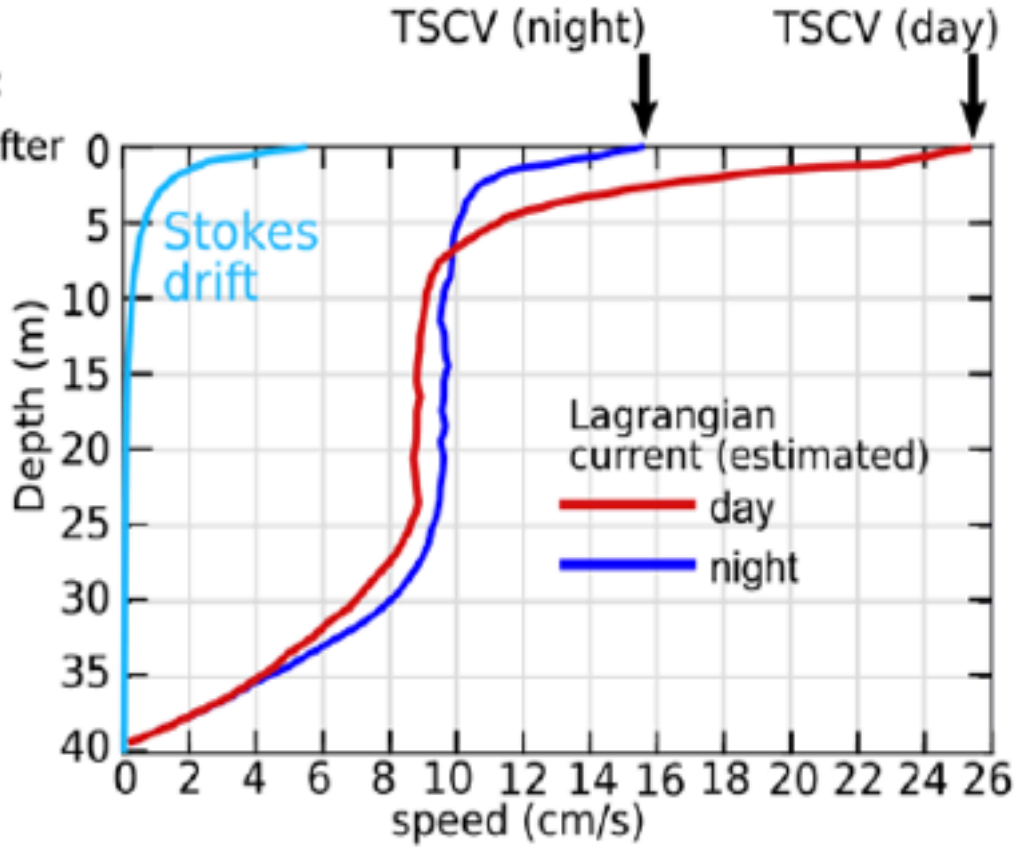
Applications that utilise surface current data, organised by the involved depth and time scales that are relevant for each application. From Røhrs et al 2021.



After EE9 SKIM

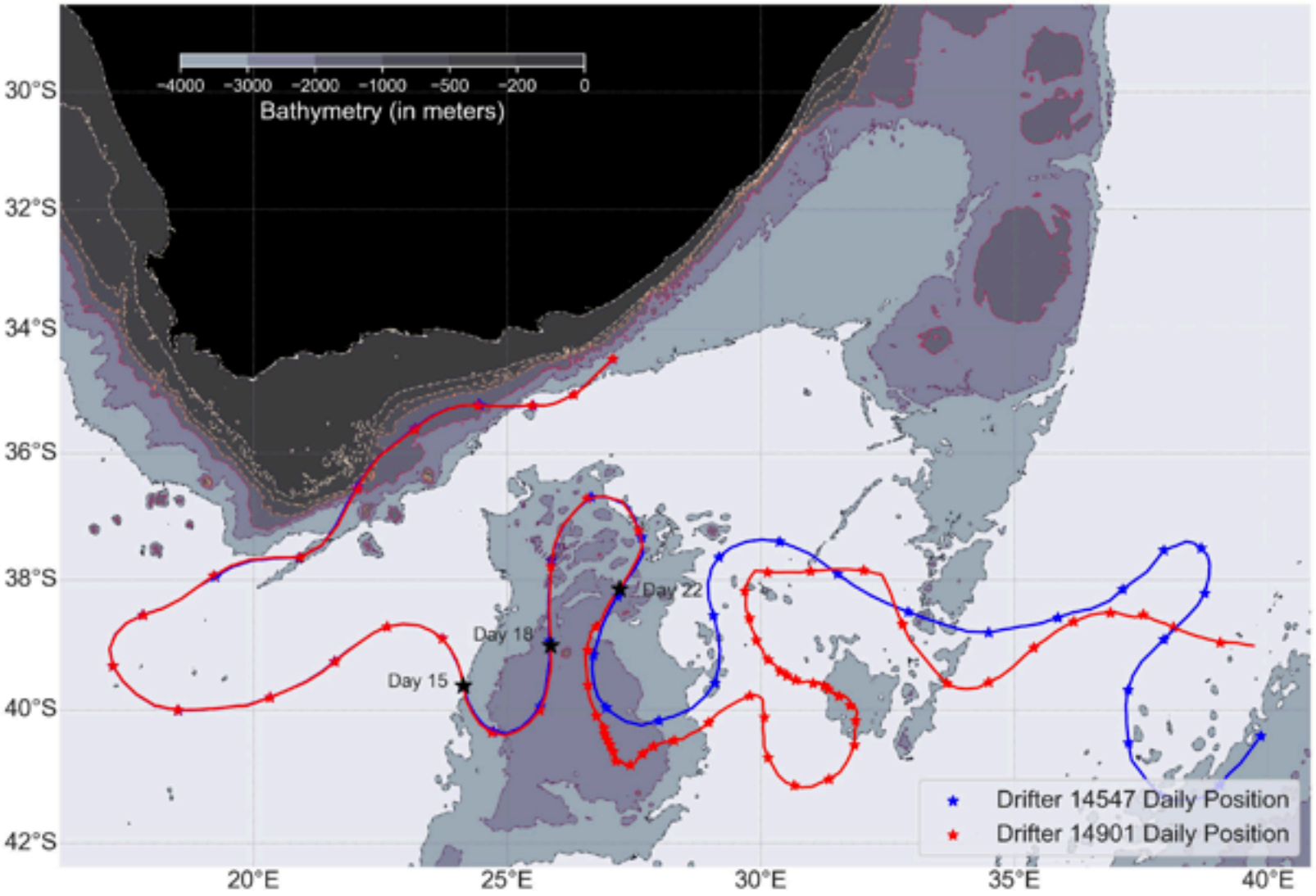
Eulerian versus Lagrangian





After EE9 SKIM

Langrangian Drifter Pathway in the Agulhas Current



The drifter pair were deployed next to each other.

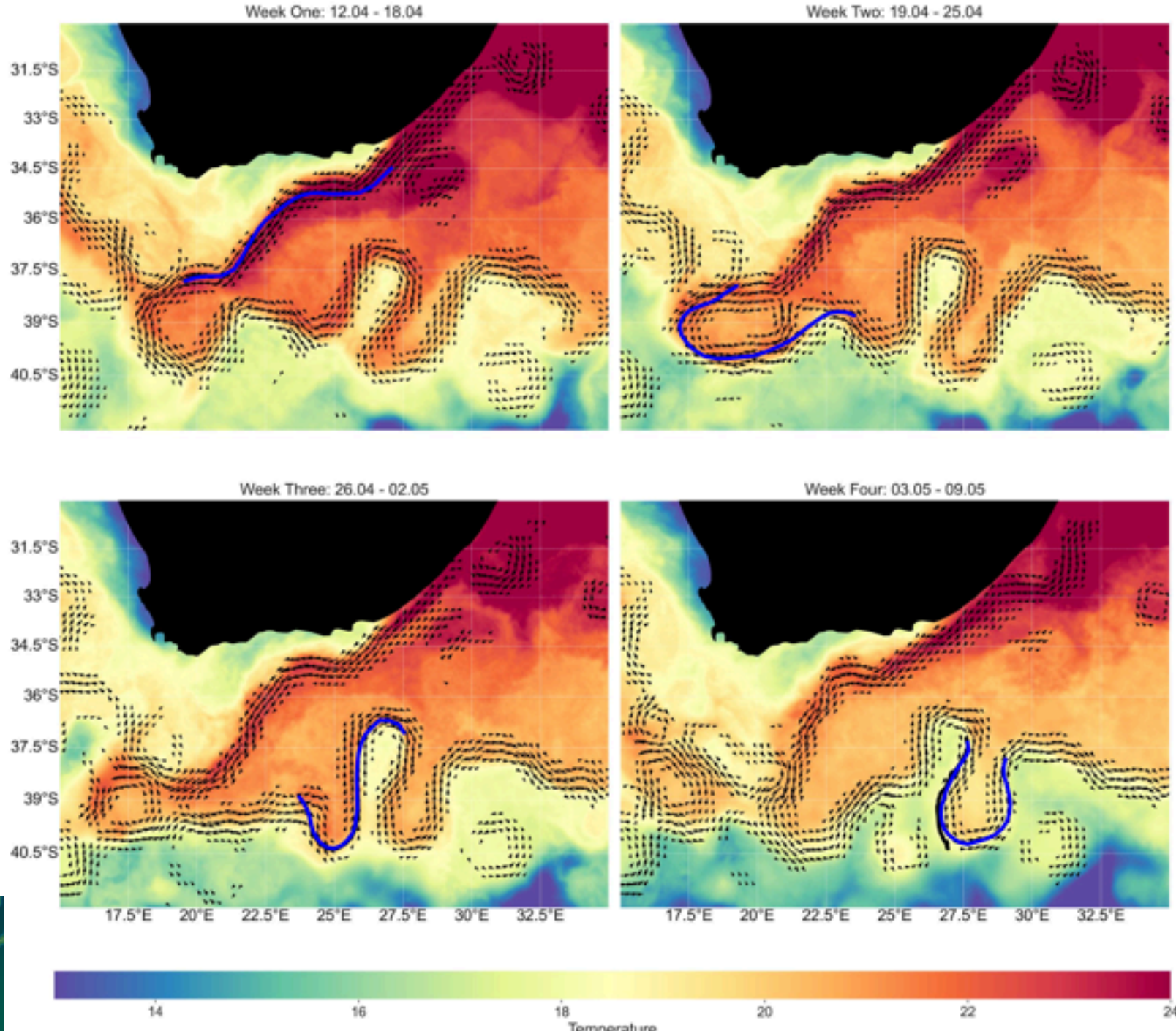
The stayed together for 22 days drift period?

This is highly remarkable

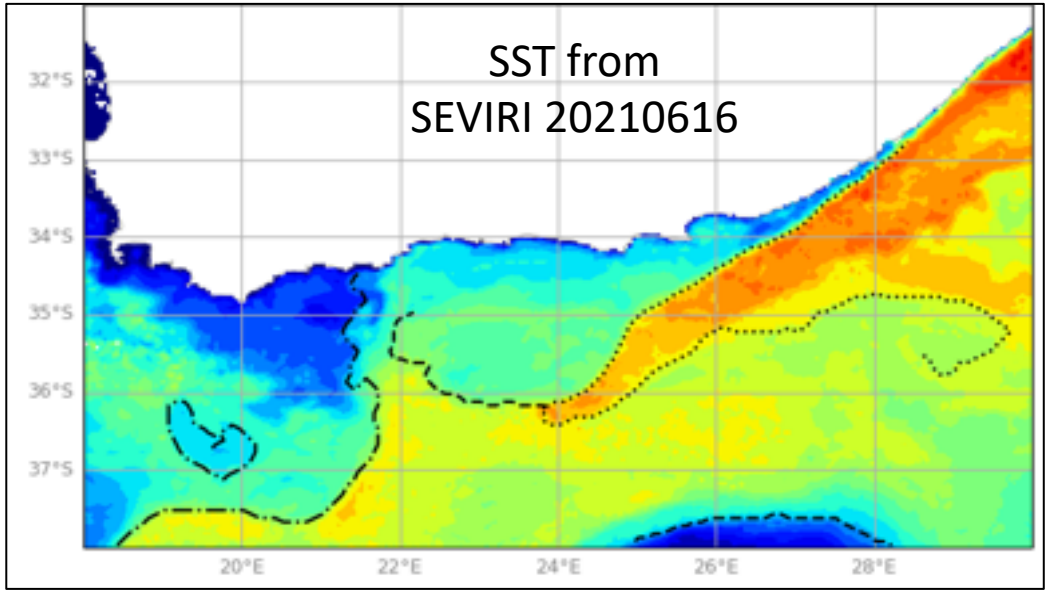
GlobCurrent surface velocity field (lack lines) and passive microeave SST in color.

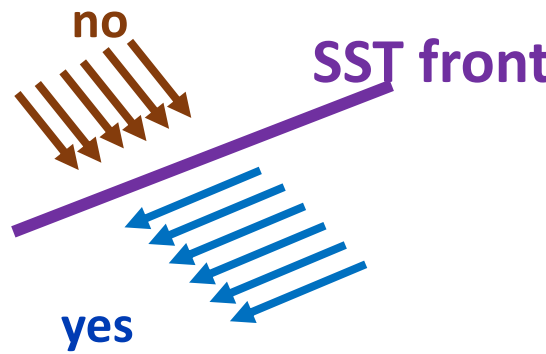
Blue lines represent Drifter trajectories.

Striking agreement with Trajectories and frontal boundaries

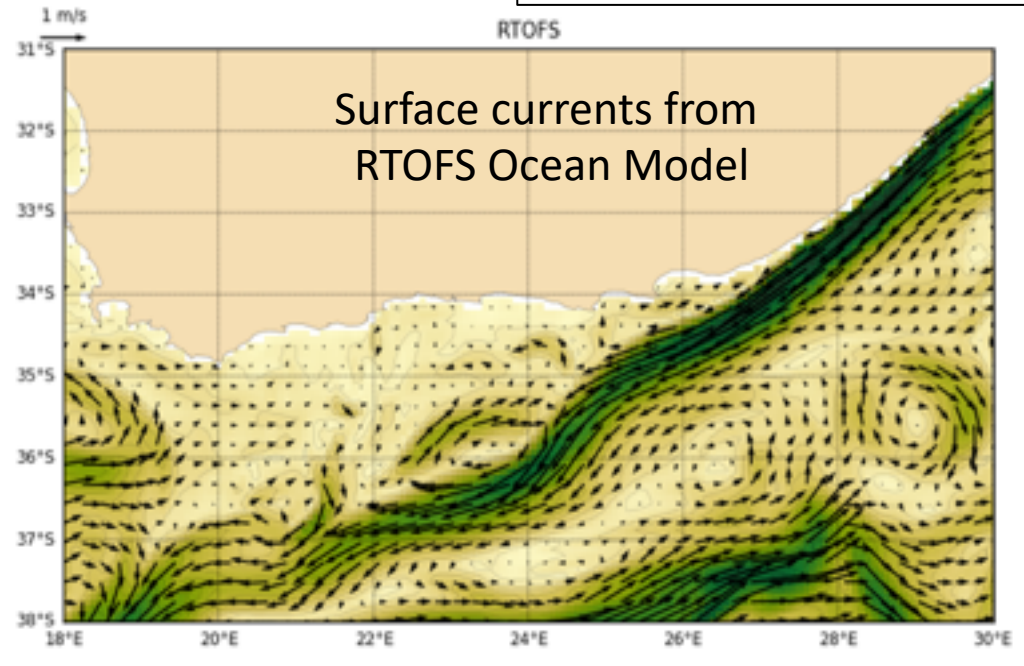


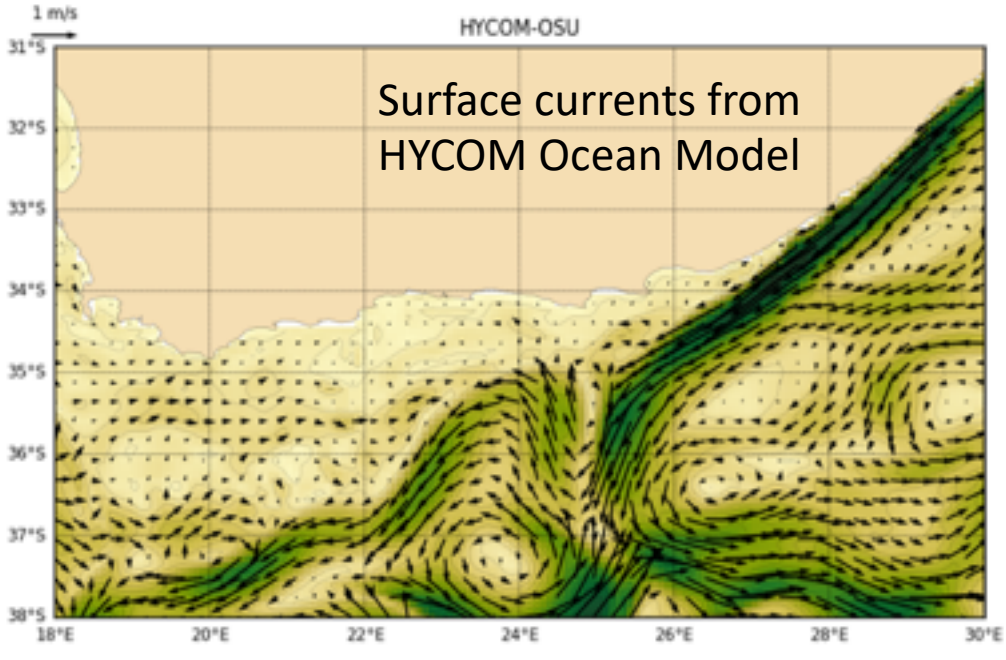
SATELLITE SST AND MODEL CURRENTS





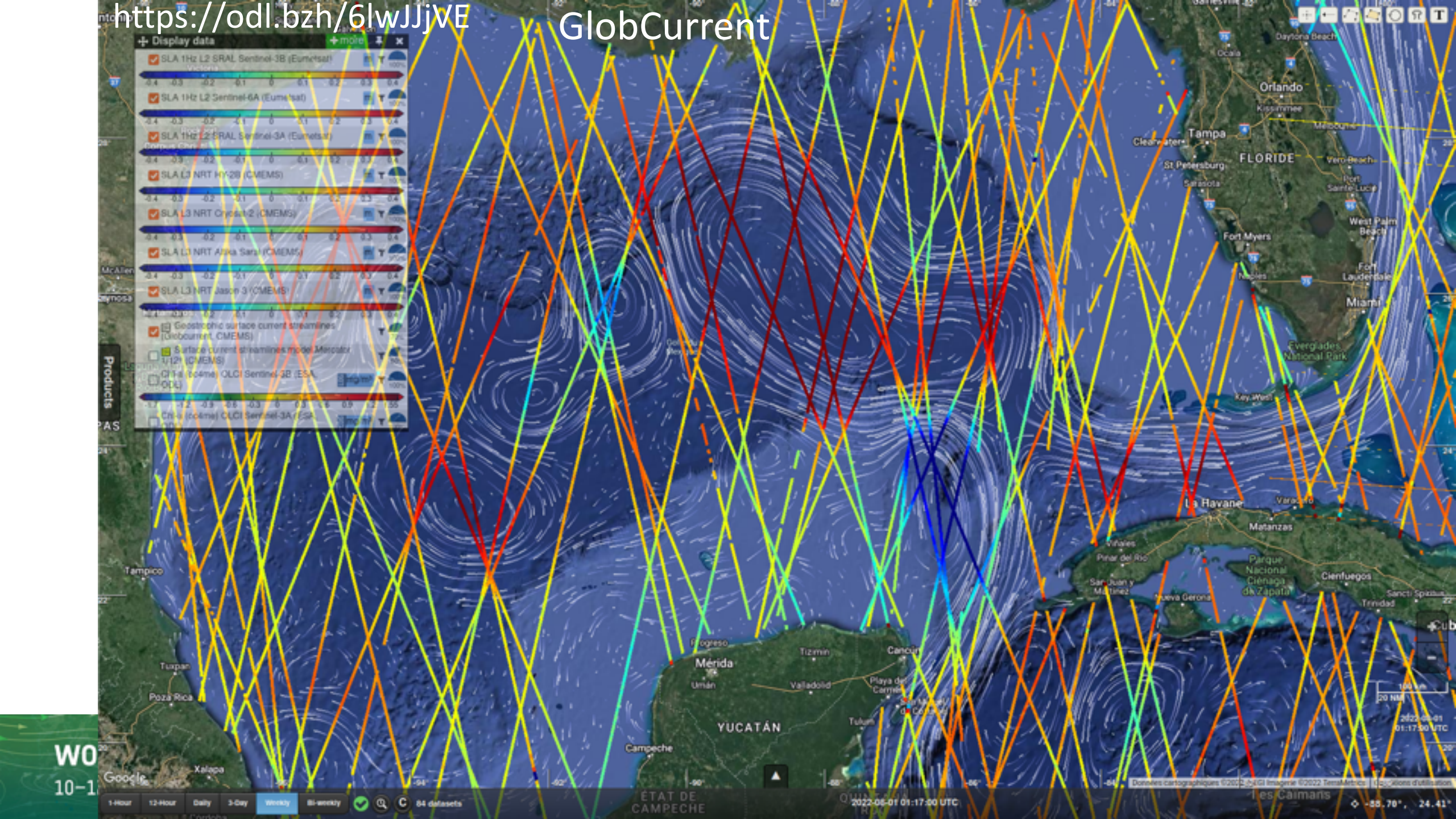
Current flow direction

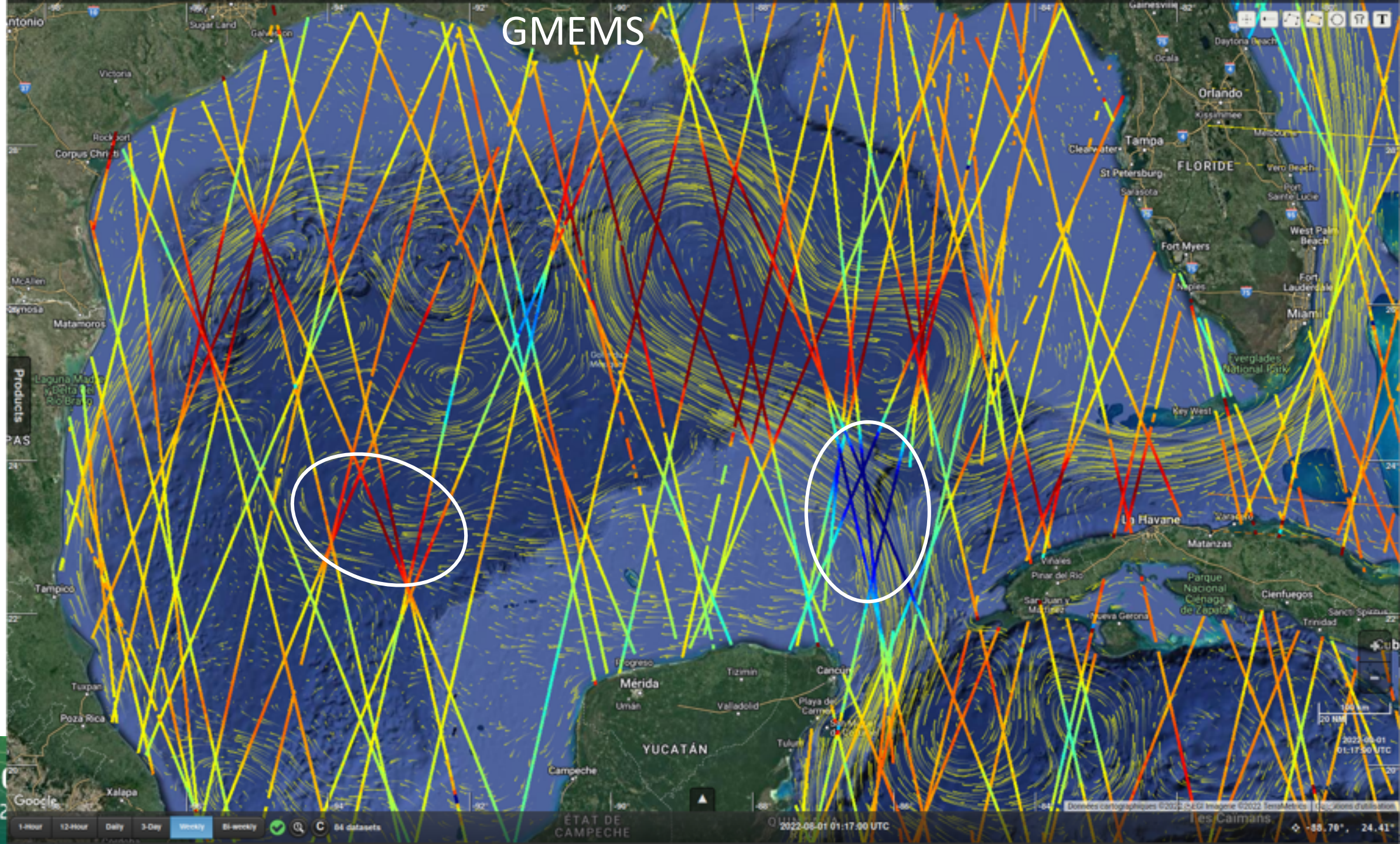




Ifremer

https://odl.bzh/6lwJJjVE GlobCurrent

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Matamoros
Tampico
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Campeche
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Tizimín
Valladolid
Cancún
Playa del Carmen
Progreso
Umán
Tulum
Corpus Christi
Victoria
Sugar Land
Galveston
Rockport
McAllen
Orlando
Tampa
St Petersburg
Clearwater
Sarasota
FLORIDE
Fort Myers
Naples
Miami
Fort Lauderdale
West Palm Beach
Vero Beach
Port Saint Lucie
Daytona Beach
Ocala
Everglades National Park
Key West
La Havane
Matanzas
Viñales
Pinar del Río
Cienfuegos
Trinidad
Sancti Spíritus
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Nueva Gerona
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Daily
3-Day
Weekly
Bi-weekly
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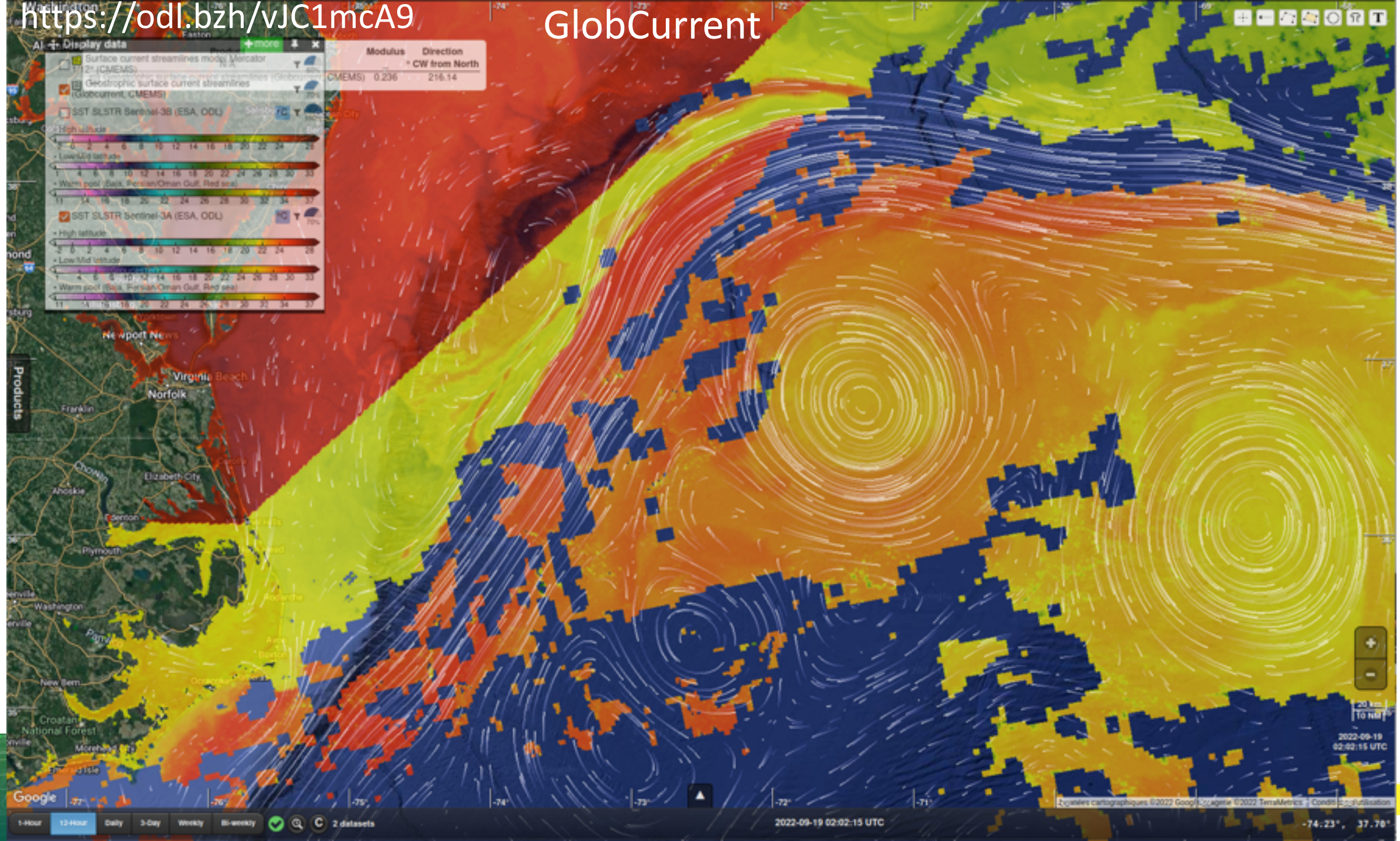
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Elizabeth City
Google
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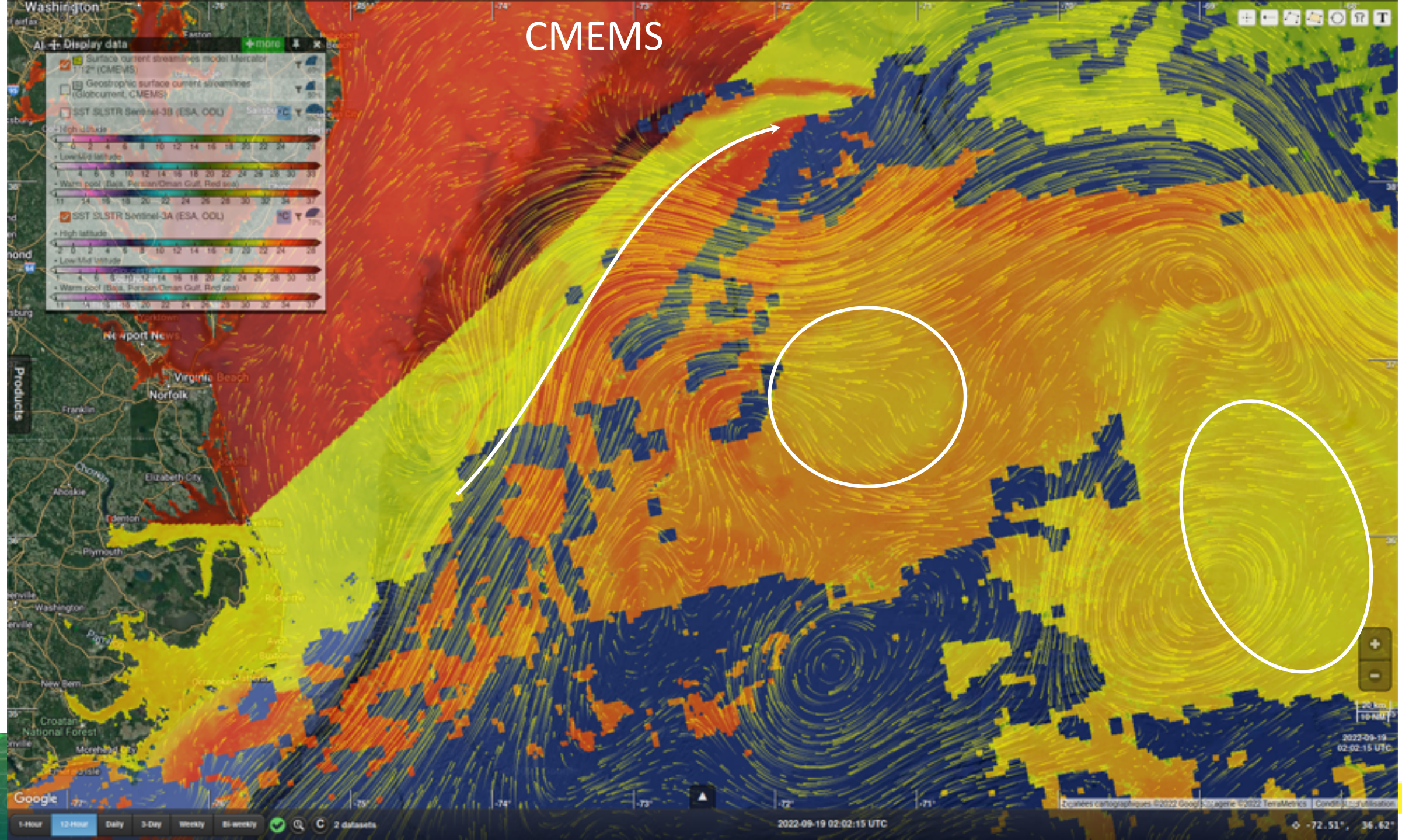
CMEMS
Display data
more
Surface current streamlines model Mercator 1/12° (CMEMS)
Geostrophic surface current streamlines (Globcurrent, CMEMS)
SST SLSTR Sentinel-3B (ESA, OOL)
SST SLSTR Sentinel-3A (ESA, OOL)
High latitude
Low/Mid latitude
Warm pool (Bala, Persian/Oman Gulf, Red sea)
Products
Newport News
Virginia Beach
Norfolk
Franklin
Elizabeth City
Edenton
Plymouth
Washington
New Bern
Croatan National Forest
Morehead City
Google
1-Hour
12-Hour
Daily
3-Day
Weekly
Bi-weekly
2 datasets
2022-09-19 02:02:15 UTC
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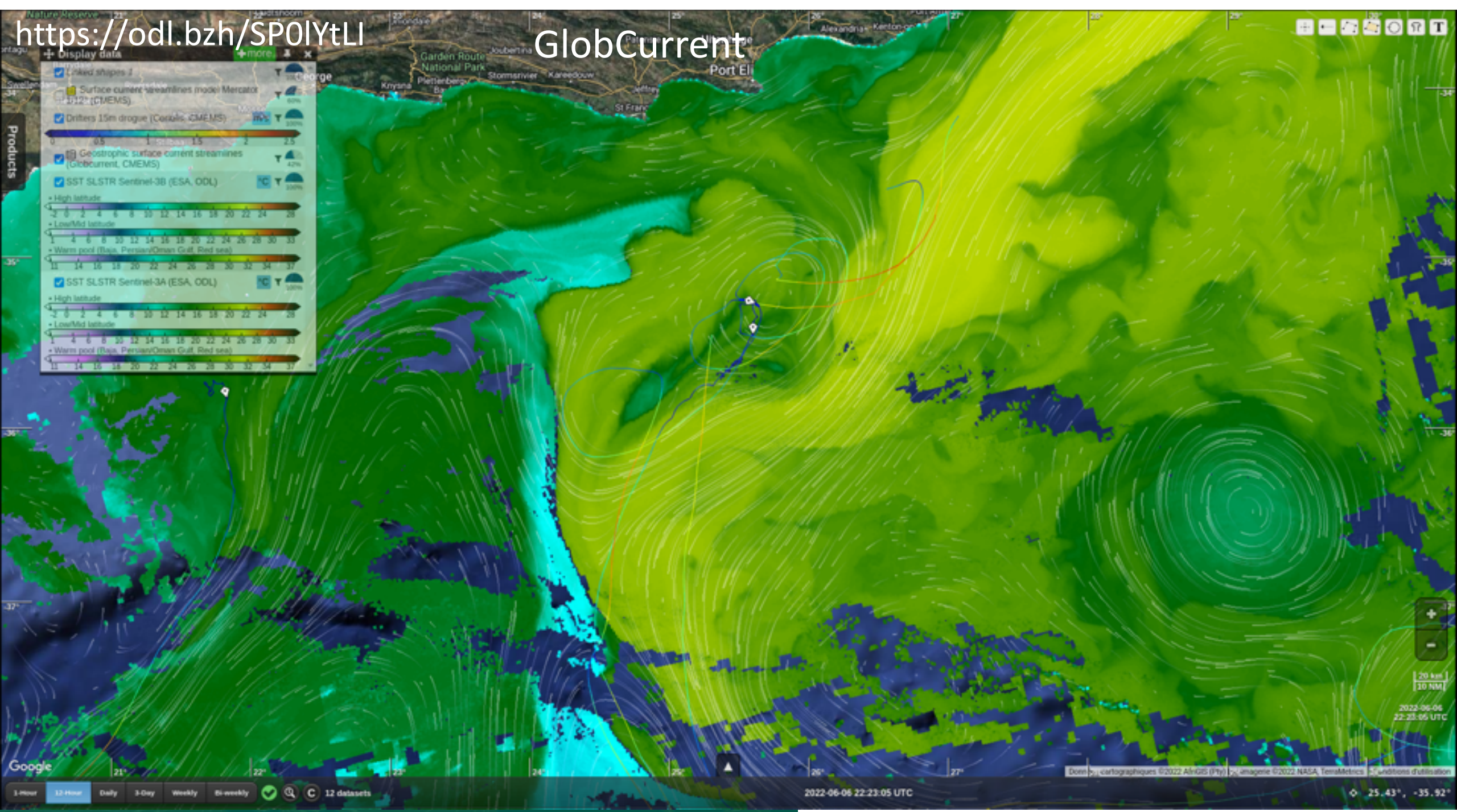
https://odl.bzh/SP0lYtLI
GlobCurrent
Display data
more
Linked shapes 1
Surface current streamlines (model Mercator 1/12° (CMEMS))
Drifters 15m drogue (Cerabis, CMEMS)
Geostrophic surface current streamlines (Globcurrent, CMEMS)
SST SLSTR Sentinel-3B (ESA, ODL)
SST SLSTR Sentinel-3A (ESA, ODL)
High latitude
Low/Mid latitude
Warm pool (Baja, Persian/Oman Gulf, Red sea)
Products
Garden Route National Park
George
Port El
Google
1-Hour
12-Hour
Daily
3-Day
Weekly
Bi-weekly
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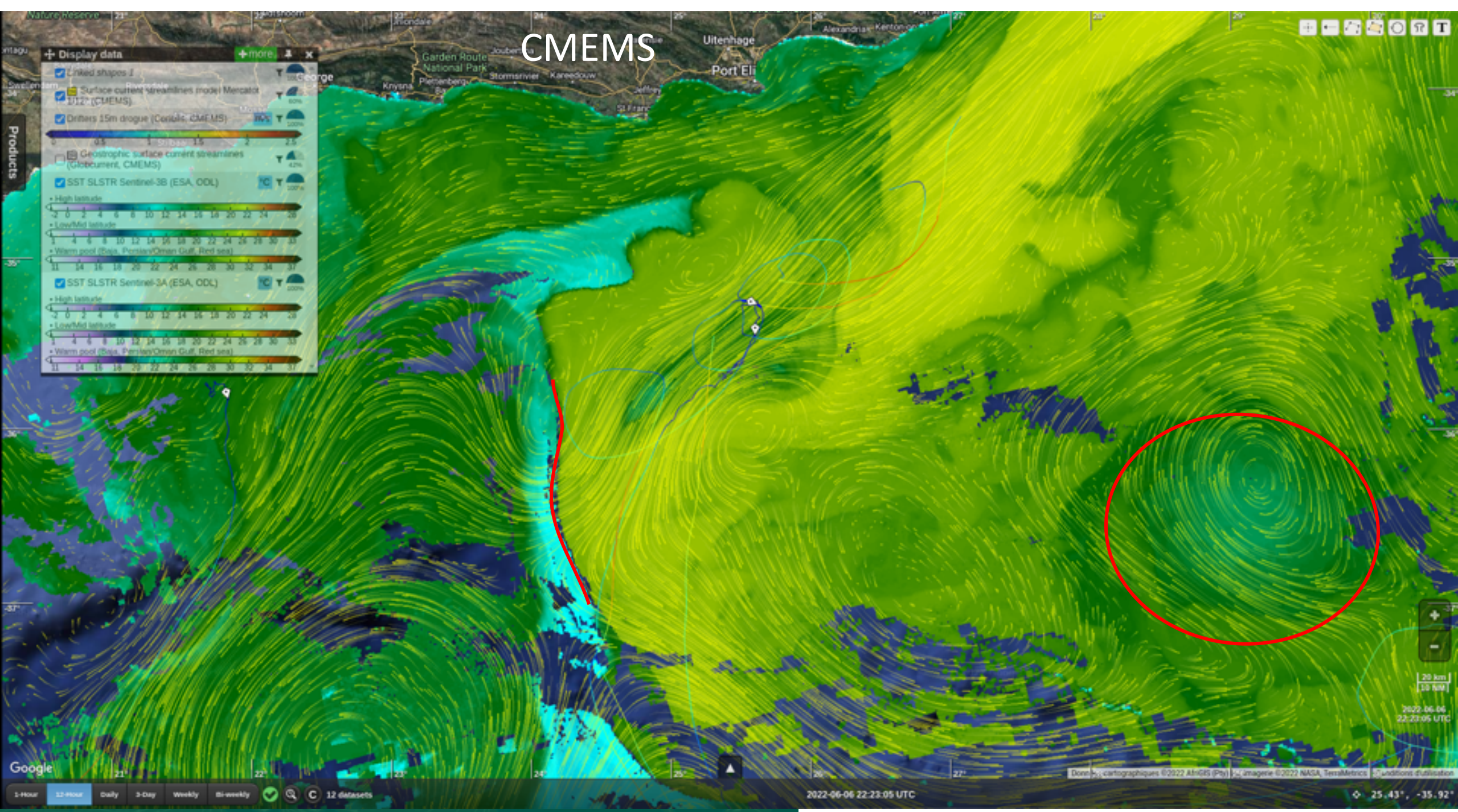
CMEMS
Display data
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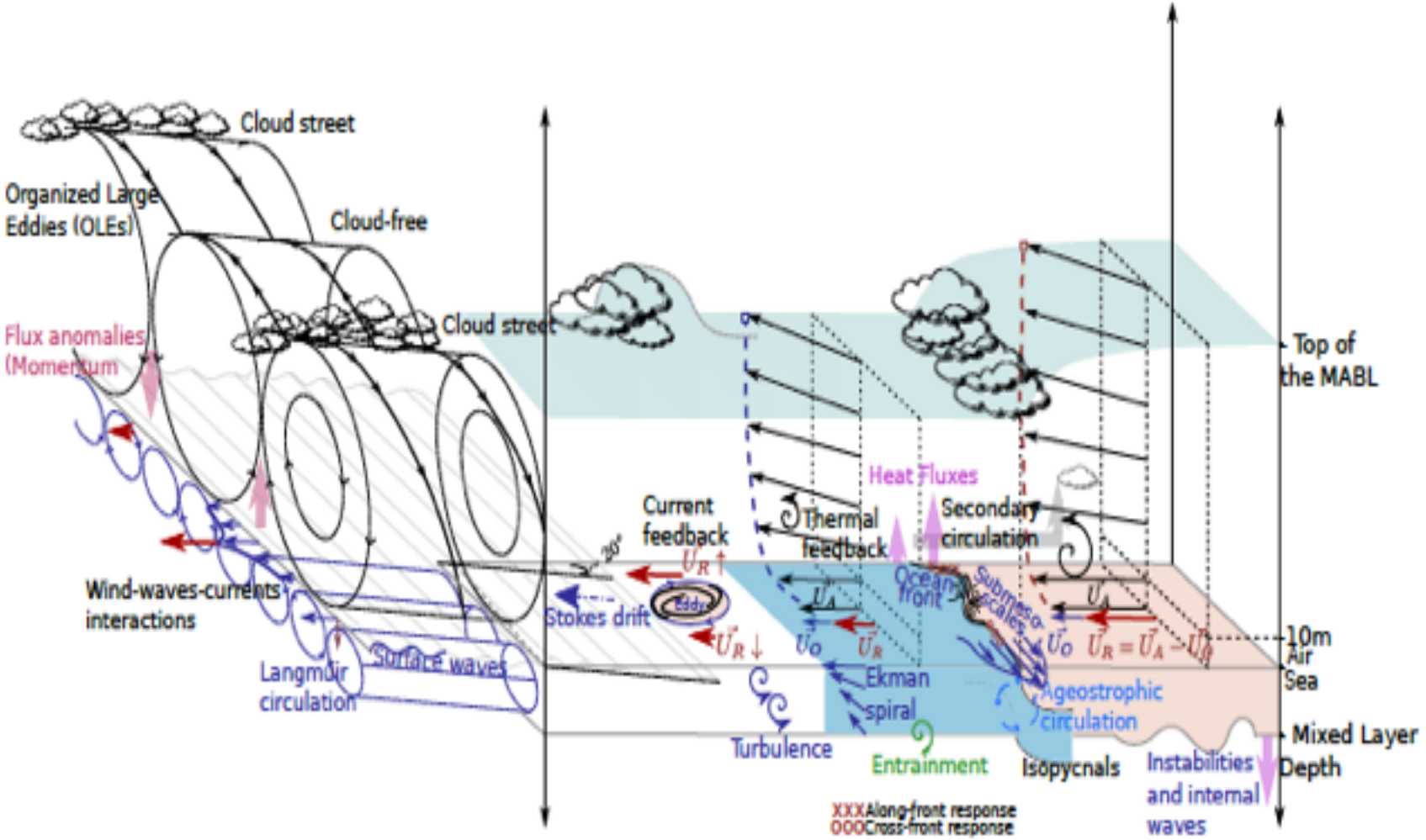
Linked shapes 1
Surface current streamlines model Mercator 1/12° (CMEMS)
Drifters 15m drogue (Coriolis, CMEMS)
m/s
Geostrophic surface current streamlines (Globcurrent, CMEMS)
SST SLSTR Sentinel-3B (ESA, ODL)
°C
High latitude
Low/Mid latitude
Warm pool (Baja, Persian/Oman Gulf, Red sea)
SST SLSTR Sentinel-3A (ESA, ODL)
Products
Garden Route National Park
Uitenhage
Port Eli
George
Google
1-Hour
12-Hour
Daily
3-Day
Weekly
Bi-weekly
12 datasets
2022-06-06 22:23:05 UTC
25.43°, -35.92°

Removing Knowledge Gaps related to air-sea interaction, lead processes and feedback

- *Strengthen high-quality in-situ (MABL, surface and upper ocean) observations.*
- *Advance physical-based data driven co-variability analyses accounting for the multi-scale complexity, combined with machine learning tools.*
- *Improve process understanding and parameterization.*
- *Increase efforts in data and model intercomparison, validation and co-analyses.*
- *Improve forecast skills of the exact locations and evolution of sub-mesoscale to mesoscale processes and corresponding feature developments will become better.*



After EE10 Harmony

Tusen Takk

Thank You

Merci Beaucoup

WOC User Consultation Meeting 2022

10–12 October | ESA–ESRIN | Frascati (Rome), Italy

esa

NERSC

oceandatalab

Ifremer