Updates on the Surface Water and Ocean Topography (SWOT) satellite

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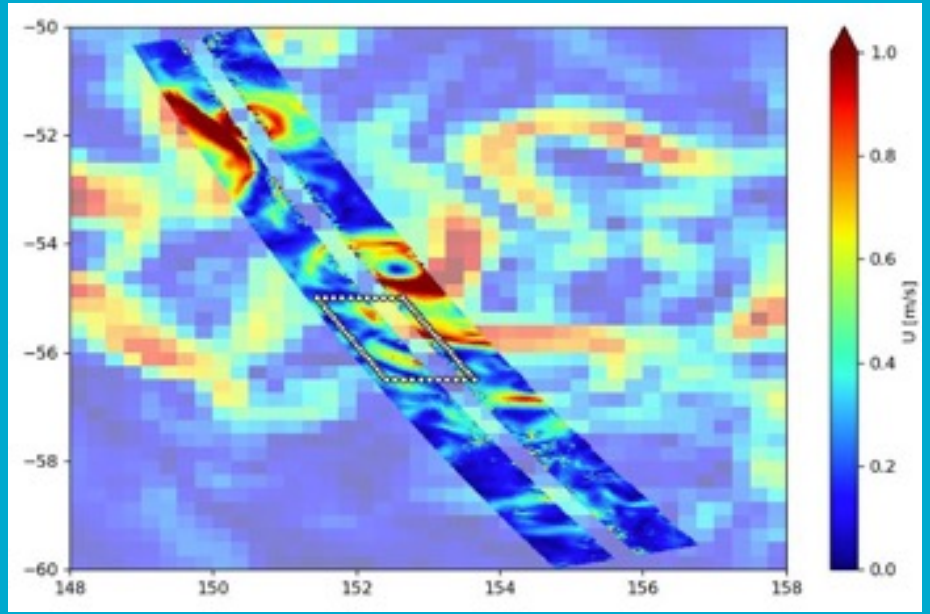


A nice image of SWOT in the ACC from early June. Background is CMEMS geostrophic current intensity, overlaid is SWOT for the one day.

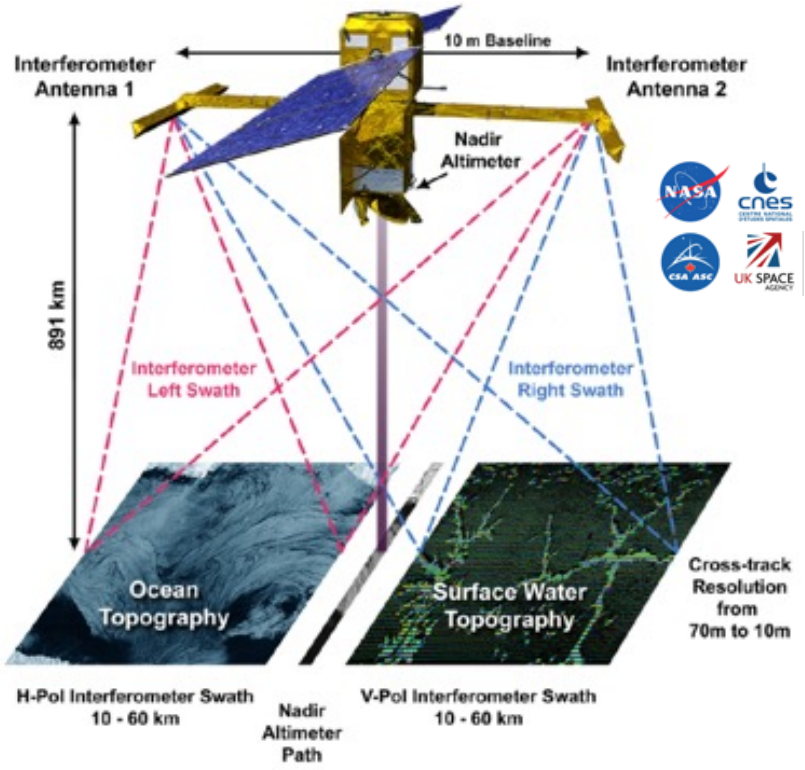
SWOT overview

https://swot.jpl.nasa.gov/

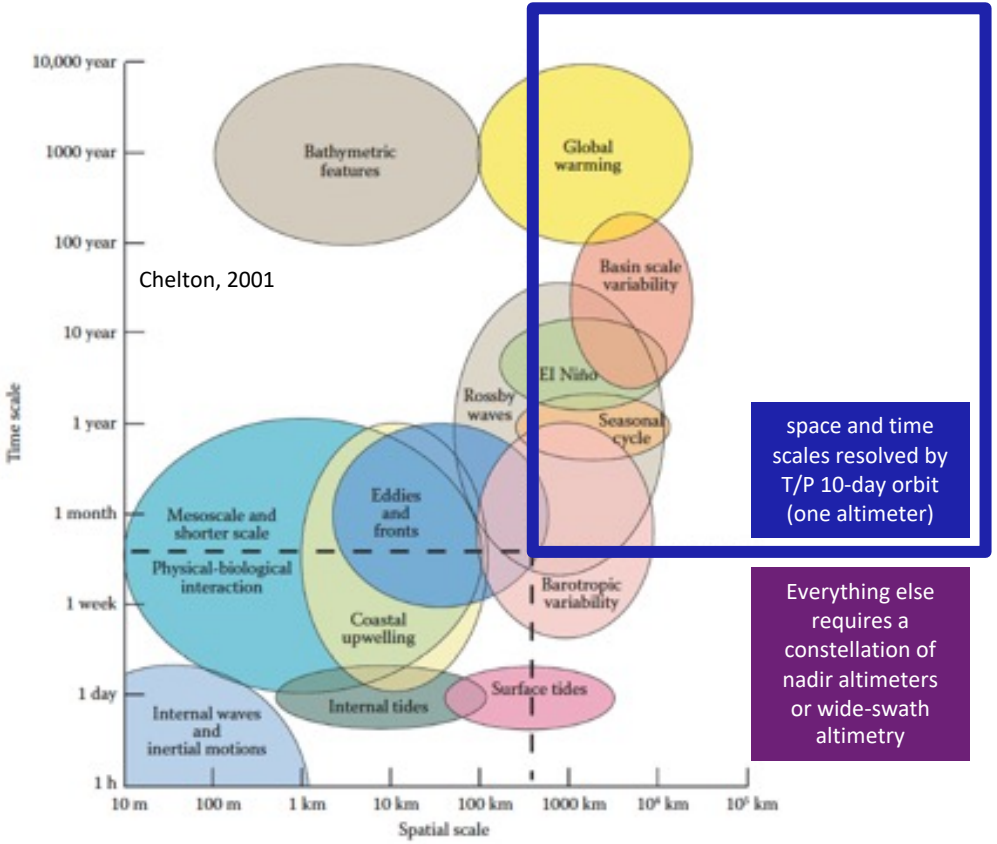
- Wide-swath altimeter (120 km wide) using SAR interferometry

Current altimetry	SWOT
> 150 km (mapped)	15-150 km

- **Dec/2022 – Jun/2023**: 6 months of fast-sampling orbit (1 day, 857 km altitude)
- **3 years** of science orbit (21 days, 891 km altitude)
- The KaRin mission's data is planned to be released to the public before end of 2023 (but likely not NRT/operational yet)
- For now: nadir data is available (CNES/Aviso ftp and RADS4).
- **Delivery time** for fully calibrated products → 30 days



Why SWOT?


10,000 year
1000 year
100 year
10 year
1 year
1 month
1 week
1 day
1 h
Time scale
10 m
100 m
1 km
10 km
100 km
1000 km
10⁴ km
10⁵ km
Spatial scale
Bathymetric features
Global warming
Basin scale variability
El Niño
Rossby waves
Seasonal cycle
Eddies and fronts
Mesoscale and shorter scale
Physical-biological interaction
Barotropic variability
Coastal upwelling
Internal tides
Surface tides
Internal waves and inertial motions
Chelton, 2001
space and time scales resolved by T/P 10-day orbit (one altimeter)
Everything else requires a constellation of nadir altimeters or wide-swath altimetry

Updates

- September/2023: SWOT Science Team in France, discussions on data quality and mission status

- November/2023: Ocean Surface Topography Meeting (OSTST) in Puerto Rico:
  - Noise is less than expected
  - CNES is producing L3 data for SWOT Science Team
  - CNES is working on different methods to include SWOT data into gridded SLA product

- 7-8 December/2023: 10th SWOT Applications Meeting, Caltech + Hybrid (https://swot.jpl.nasa.gov/events/62/10th-swot-applications-meeting/)

SWOT data – possible uses

Map smaller mesoscale dynamics (eddy diameters of 7-15 km)

Better quantify KE of ocean circulation

Further understand fine scale exchanges at boundaries (ocean-atm and ocean-sea ice)

Better understand ocean uptake of heat and carbon

Better quantify conversion of PE to KE, and eventually to dissipation

Advance studies on wave-current interaction

Better quantify property exchanges between ocean surface and ocean interior

Study the interaction between internal tides & internal waves with balanced ocean circulation

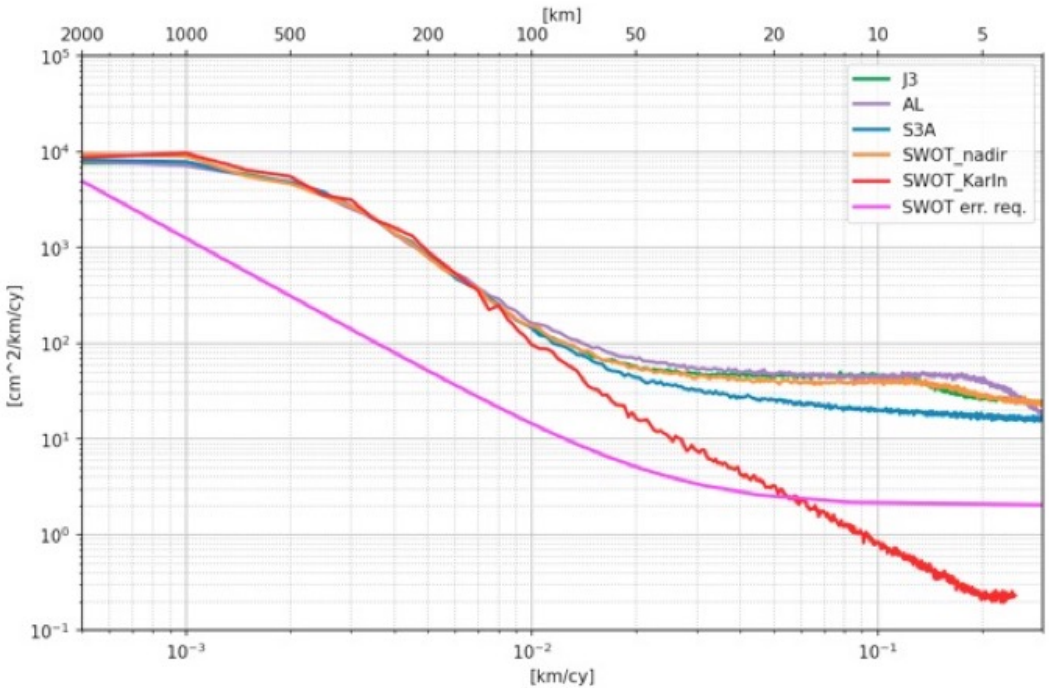
Validate high-resolution models

Better understand baroclinic tides, internal tides, shelf/coast tides, and high latitude tides.

Look at the full range of tidal constituents (SWOT's non-sun-synchronous orbit!)

First Results

Wavenumber spectra of SSH from conventional altimeter in comparison with SWOT KaRIN

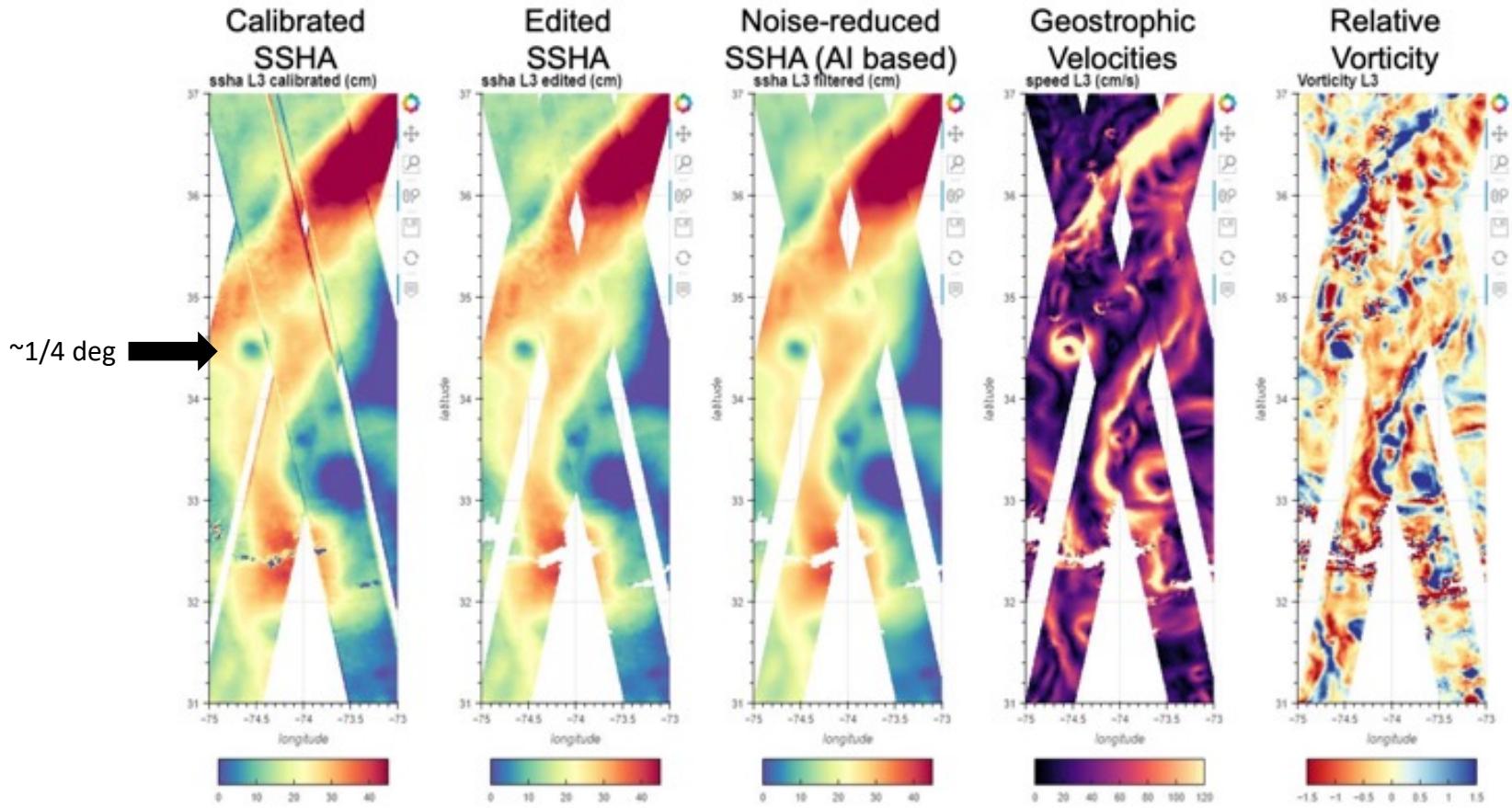


The random noise of SWOT Ka-band Radar Interferometer (KaRin) measurements over the ocean is significantly less than the requirement, making the spatial resolution of detecting ocean features less than 10 km.

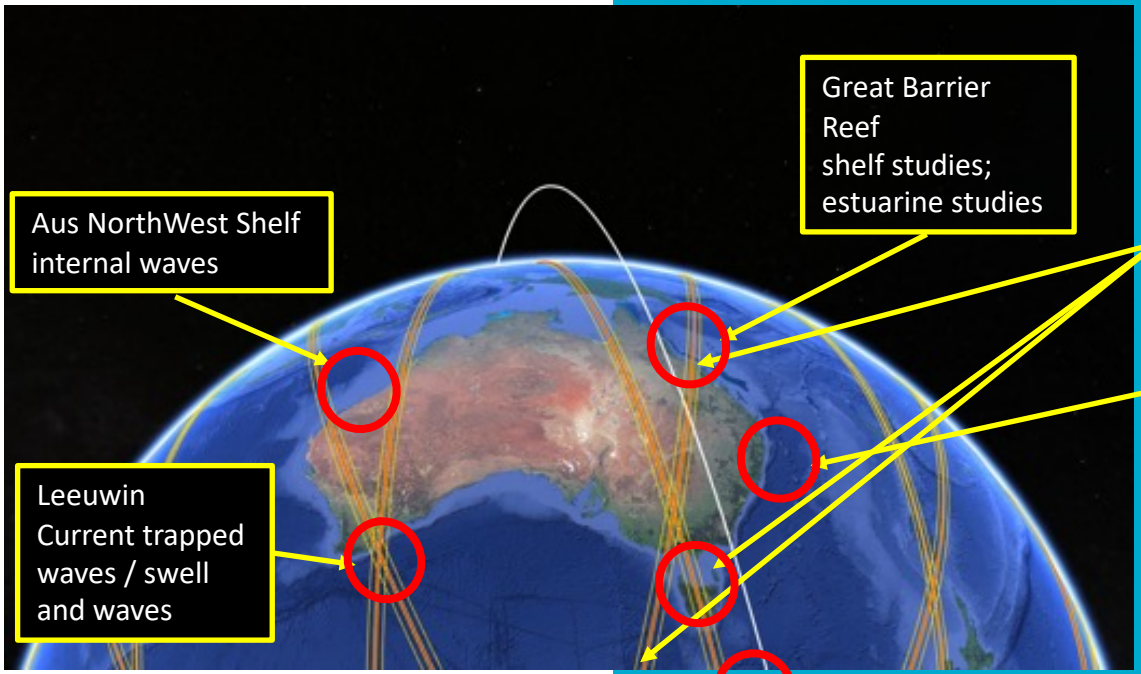
KaRIn SSH wavenumber spectra shows a smooth energy cascade down to several tens of km wavelength, whereas nadir altimetry noise blocks wavelengths < 70-100 km.

Slide from Clement Ubelmann, 2023 OSTST

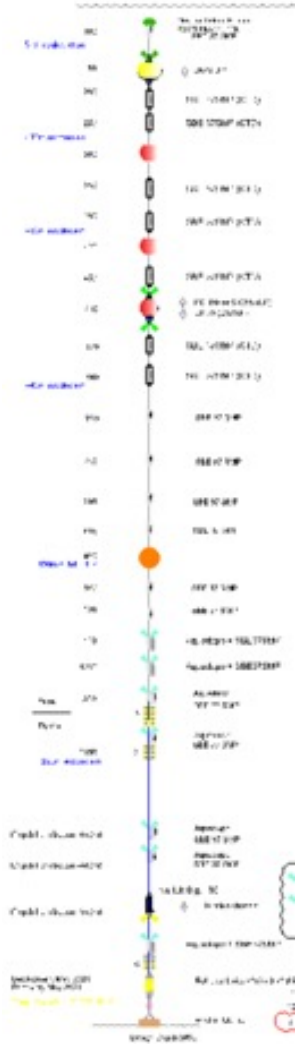
Editing, denoising, and derived variables (L3 at the science-team level)



Calibration & Validation, and field campaigns



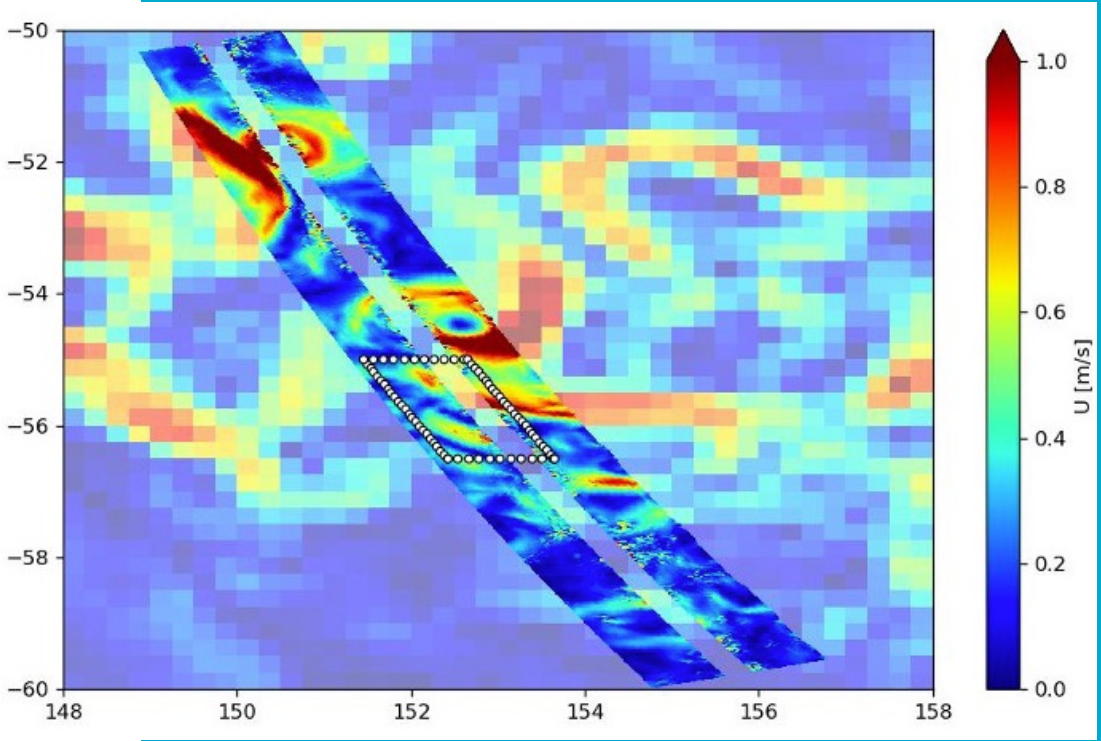
See the campaigns here: https://www.swot-adac.org



SWOT-ACC
R/V Investigator
2023 v07

- ACC standing meander, south of Tasmania: hot spot, with high eddy heat flux
- This region is mapped every 5 days by SWOT in the science phase.
- Air-sea fluxes
- Heat and carbon transfers into and across the ocean
- Internal tides and internal waves
- Fine scale BGC processes
- 3 DOXY Argo floats

Legresy, Phillips, Thompson, Polzin, Watts, Fonohue, Rintoul, Bindoff, Drushka, Shwadwick, Foppert, Pena-Molino, Nikurashin, Morrow



A nice image of SWOT in the ACC from early June. Background is CMEMS geostrophic current intensity, overlaid is SWOT for the one day, and waypoints are where we're profiling right now.

Challenges

A few challenges ahead:

- Awkward spatial and temporal resolution
- Challenges in data assimilation
- Large sources of errors: sea-state bias (waves), internal tides (not as bad as thought!)
- Geophysical and atmospheric corrections need improvement

*"SWOT data **alone will not fully address the many pressing scientific questions** concerning ocean variability at horizontal wavelengths below 150 km, but there are exciting opportunities to make advances on these questions by **combining SWOT data with other measurements**."*

Morrow et al., 2019

Thank you

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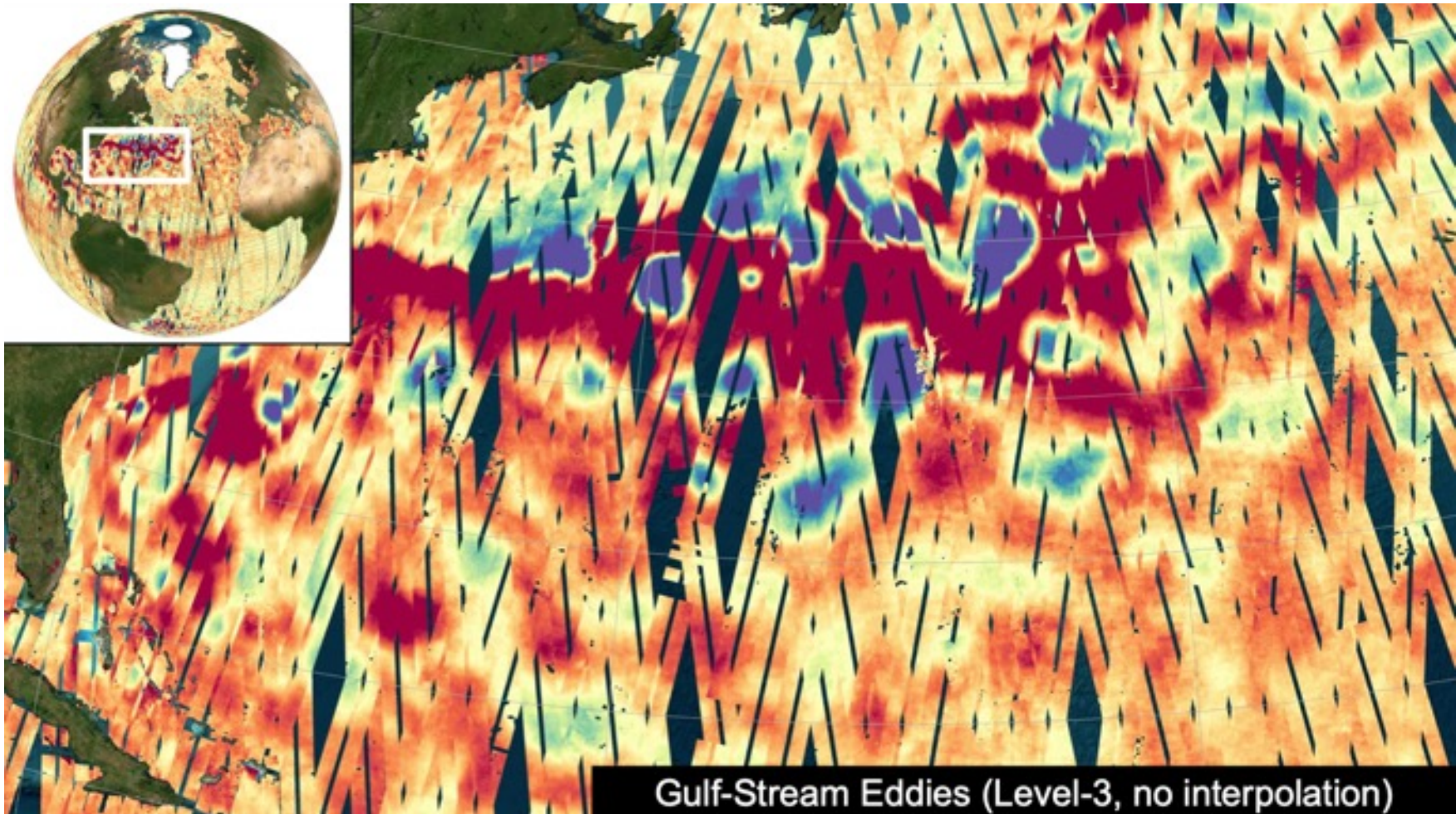
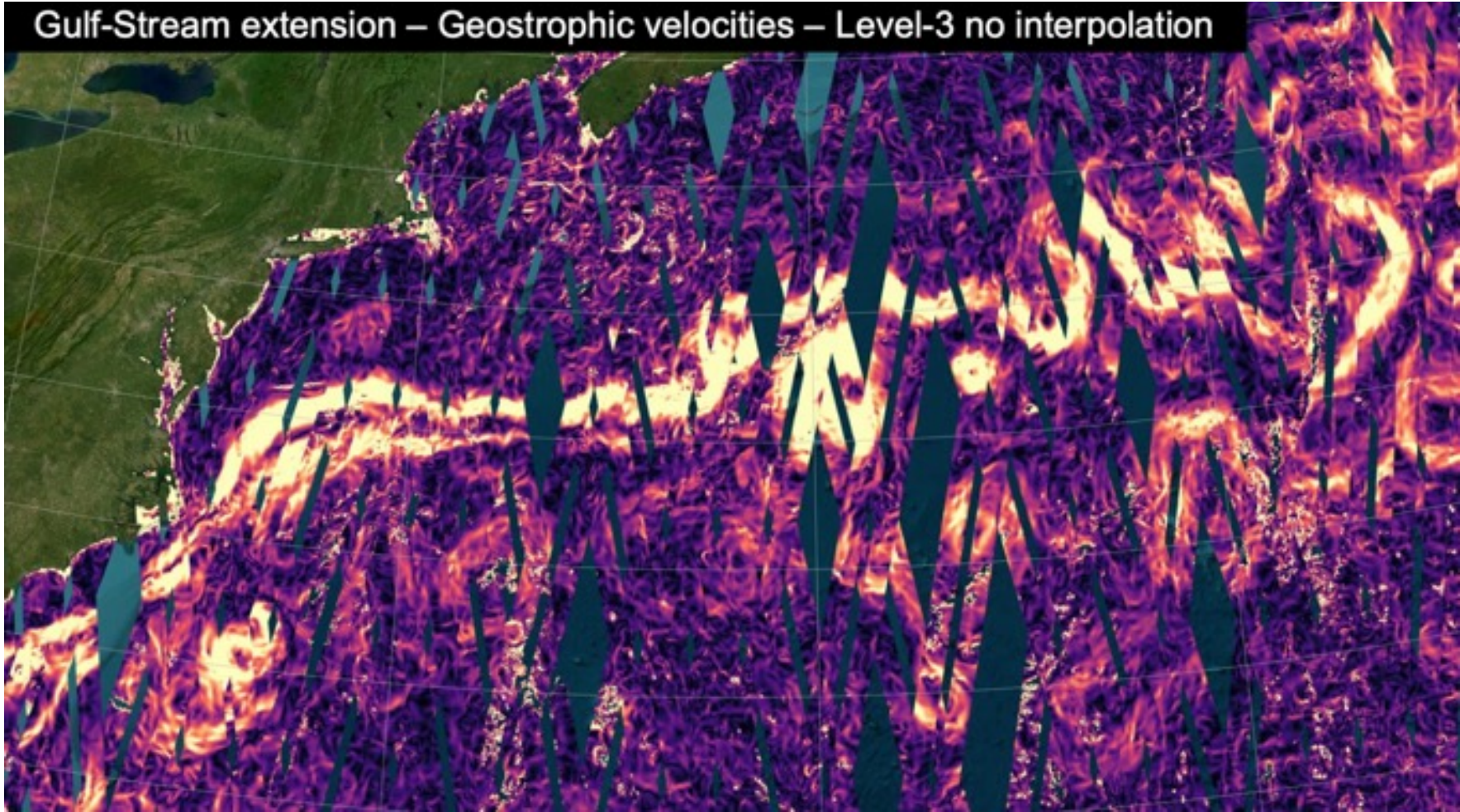
Questions?

Slide from Clement Ubelmann, 2023 OSTST

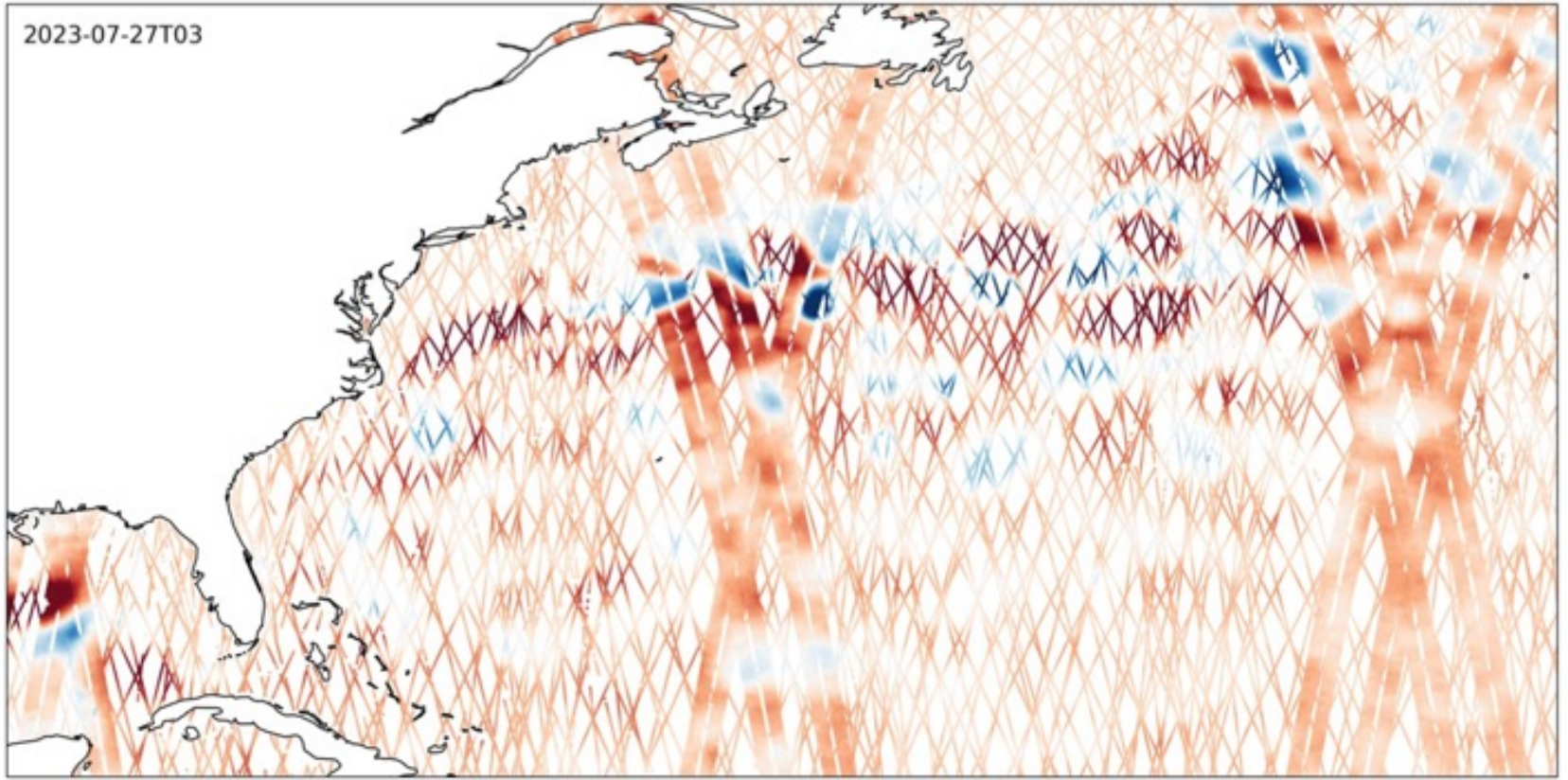


Slide from Clement Ubelmann, 2023 OSTST



Slide from Clement Ubelmann, 2023 OSTST

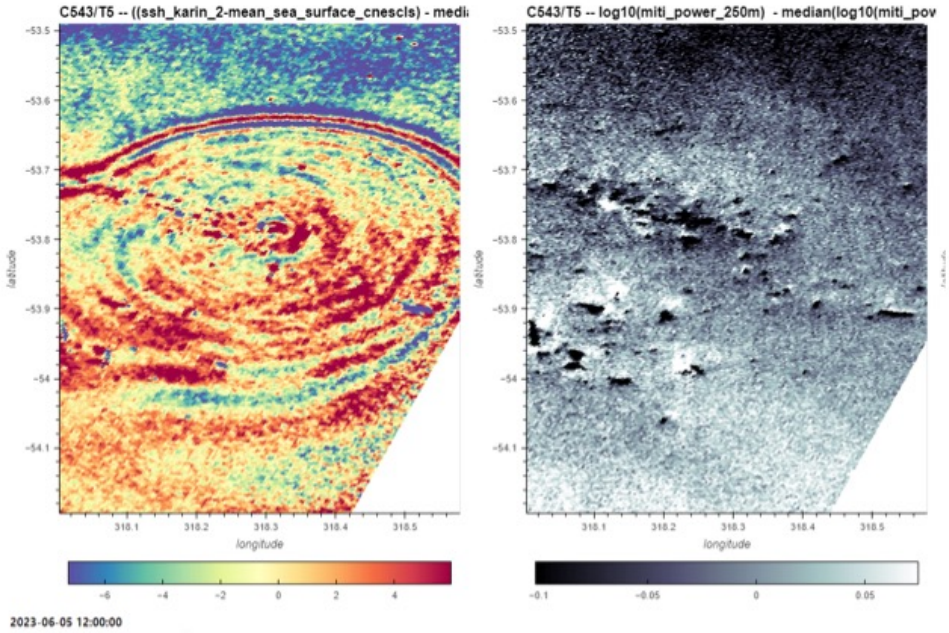
Karin calibrated : SWOT consistency with the nadir constellation (here with experimental L3):



First Results

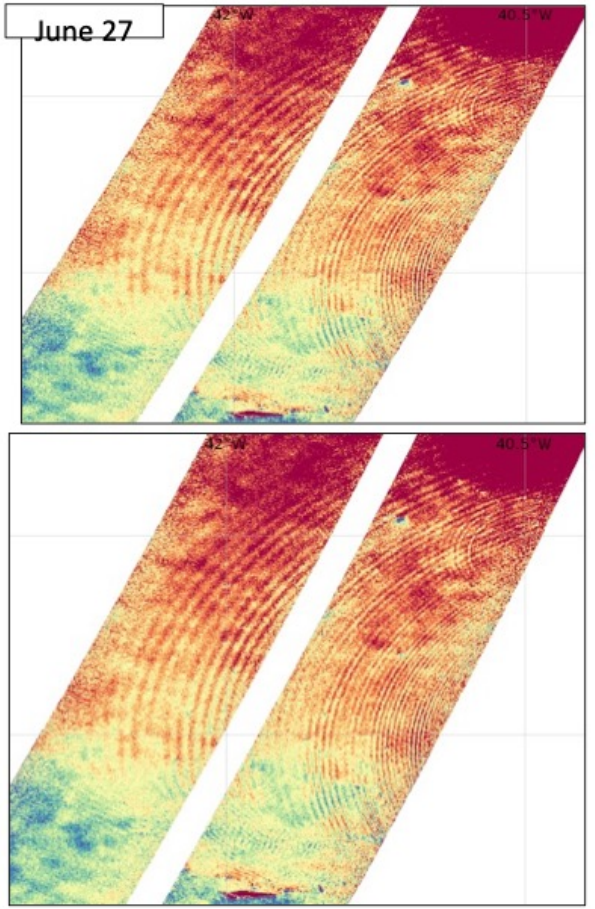
Slide from L-L. Fu, 2023 OSTST

Mini-tsunamis as the iceberg capsizes



Sea surface height (cm)

Relative sigma0



Courtesy G. Dibarboure