

The SWOT (Surface Water and Ocean Topography) Mission and Its Status

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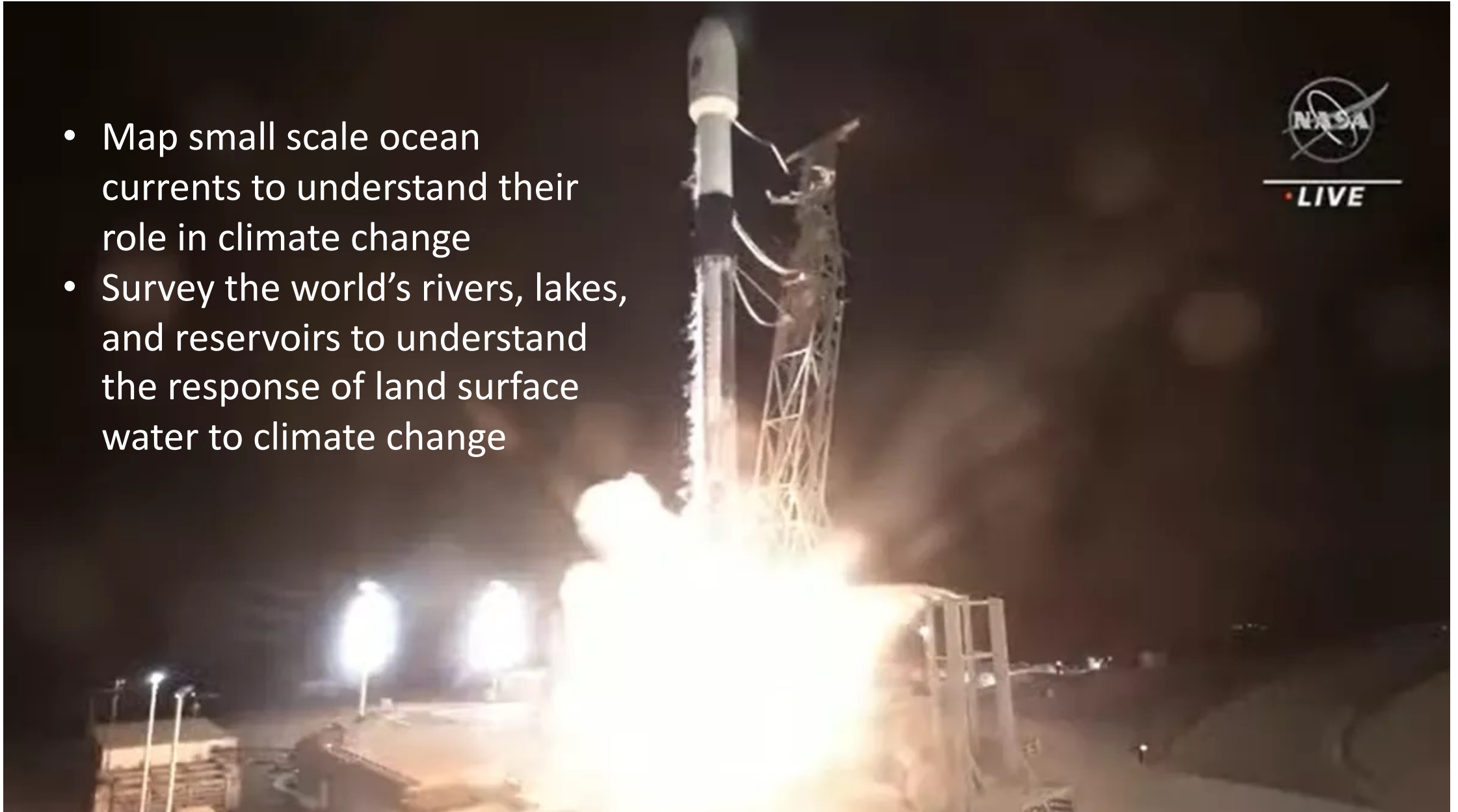
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LEGOS, Toulouse, France

Tom Farrar
Woods Hole Oceanographic Institution

2023 OSTST

SWOT was launched on December 16, 2022

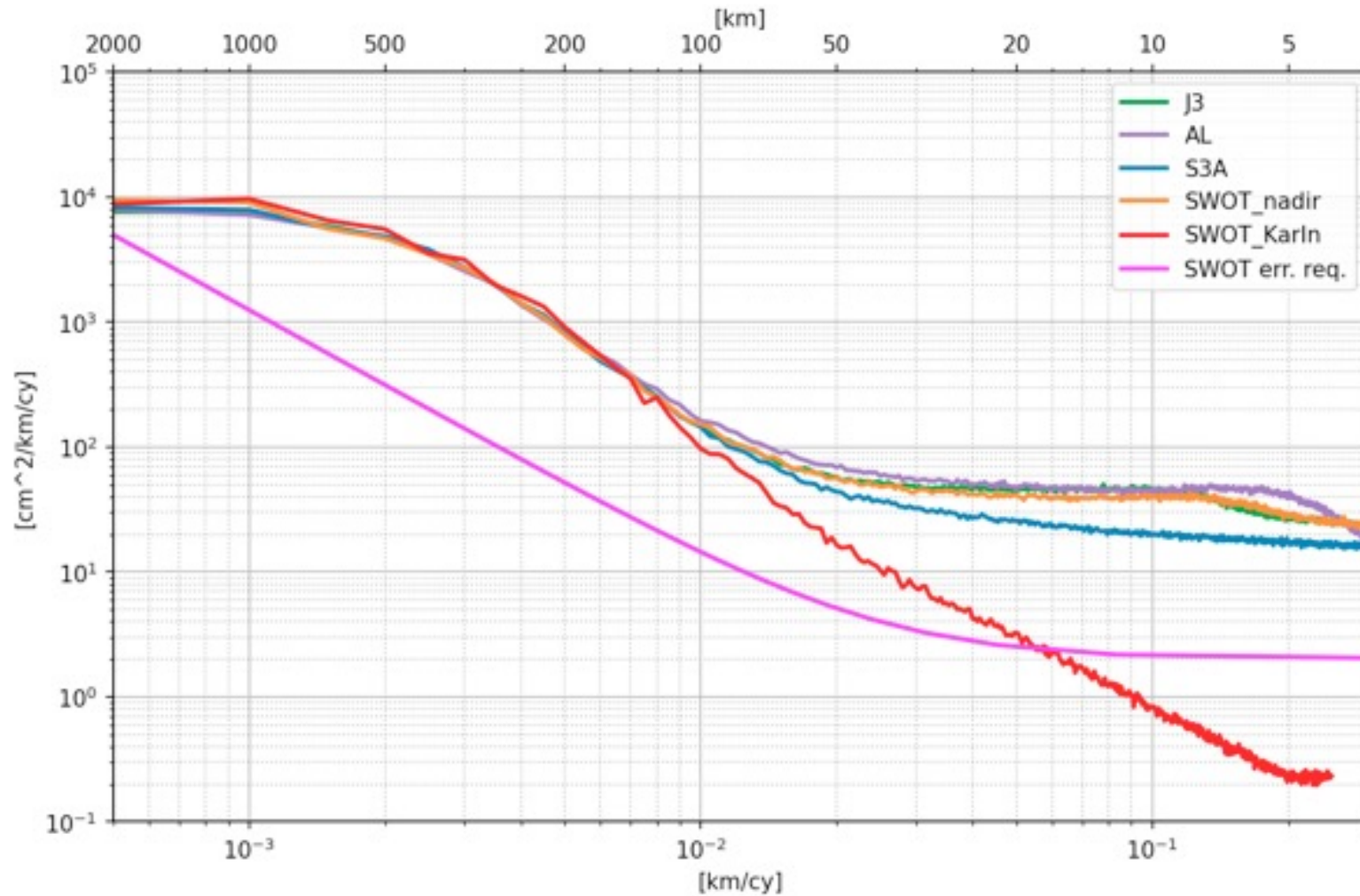
- Map small scale ocean currents to understand their role in climate change
- Survey the world's rivers, lakes, and reservoirs to understand the response of land surface water to climate change

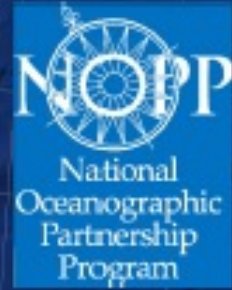


One-day repeat phase for initial Cal/Val

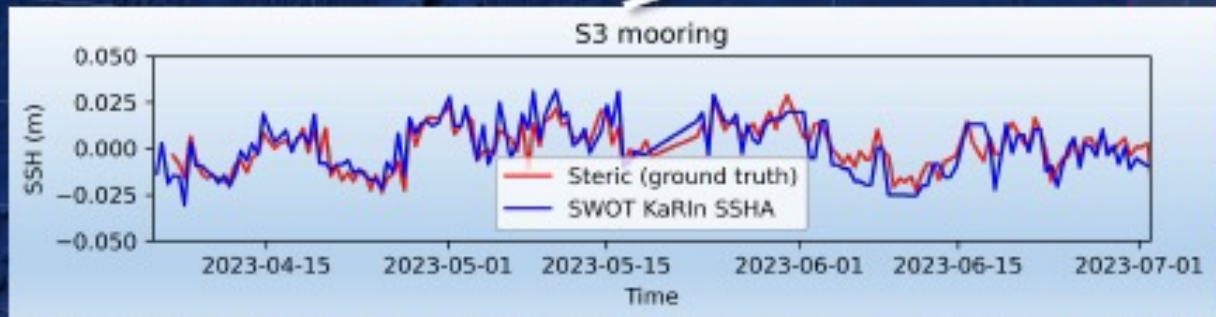
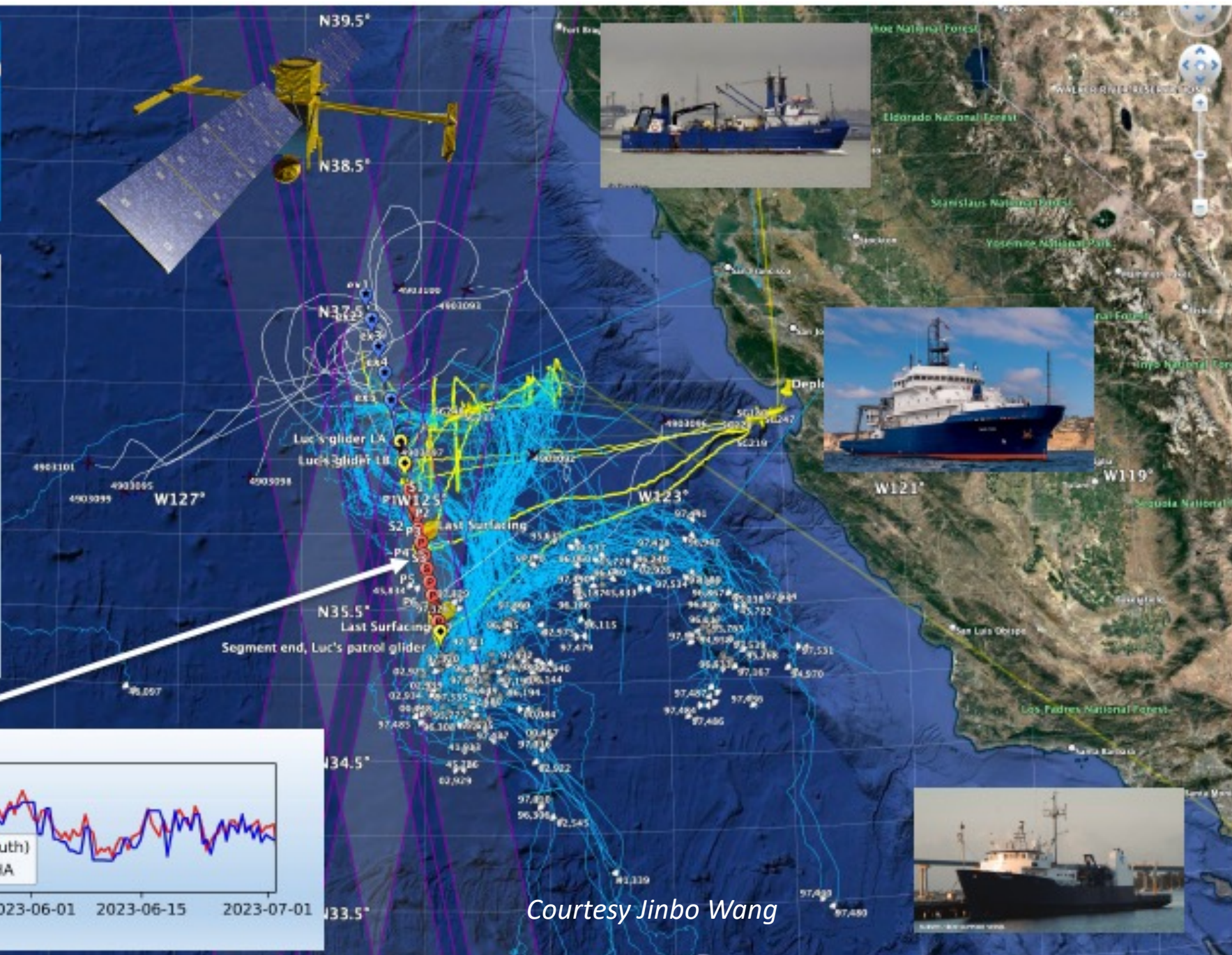


Wavenumber spectra of SSH from conventional altimeter in comparison with SWOT KaRIN





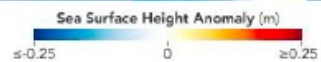
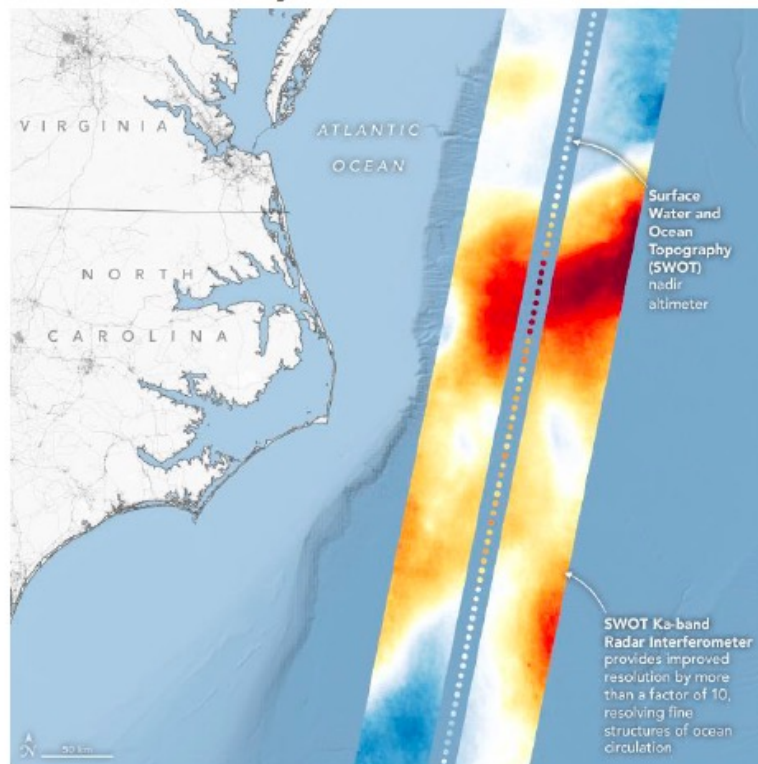
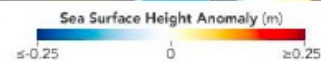
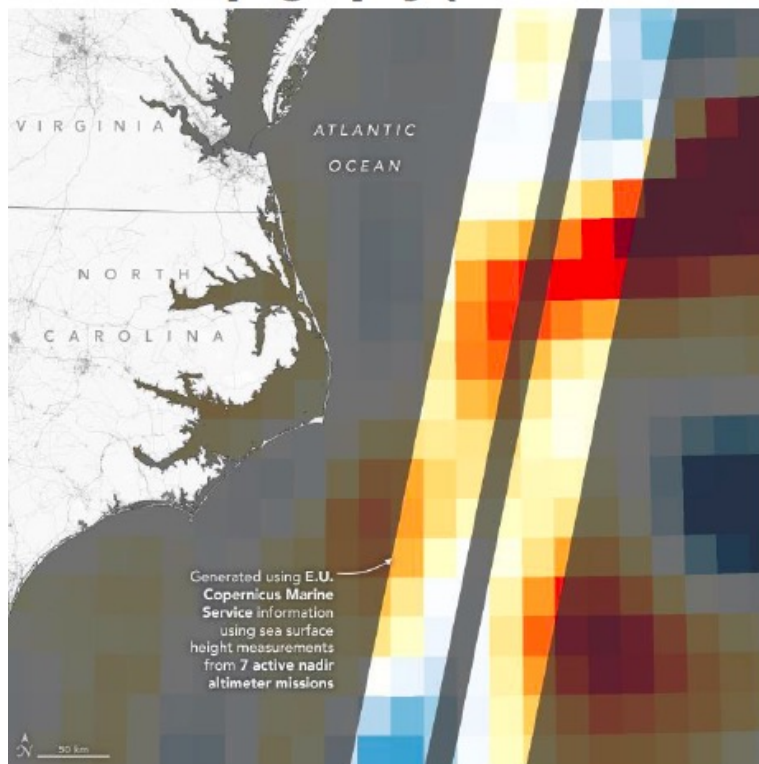
- ### SWOT Campaign
- 2 ships
 - 2 Gliders
 - 4 deep moorings
 - 7 upper ocean & GPS moorings
 - 2 ADCP + current meters (NOPP)
 - 3 PIES (NOPP)
 - 5 NAVO gliders (SMODE)
 - 4 UW gliders (SMODE)
 - 139 drifters (SMODE)



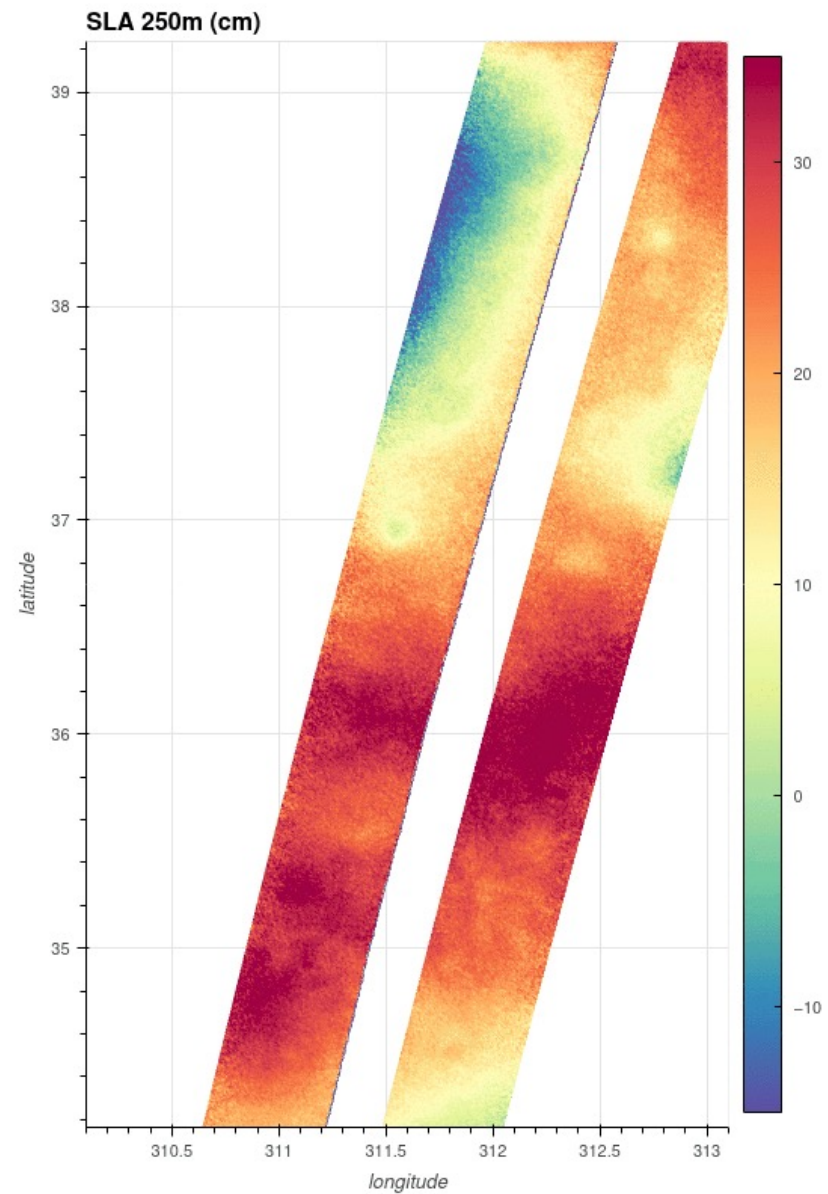
Courtesy Jinbo Wang

Comparison of SSH from AVISO altimetry data product (left) with SSH from SWOT KaRIN and nadir altimeter (right)

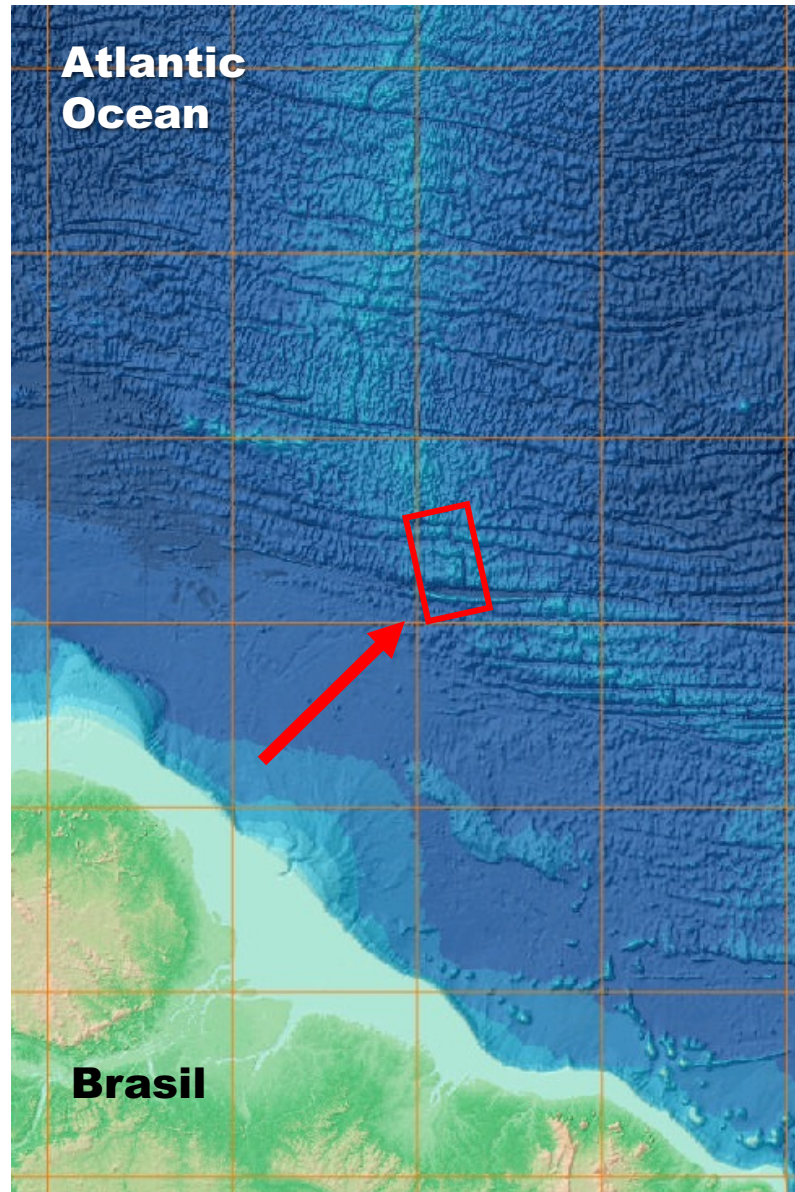
Ocean topography (1D constellation VS KaRIN 2D)



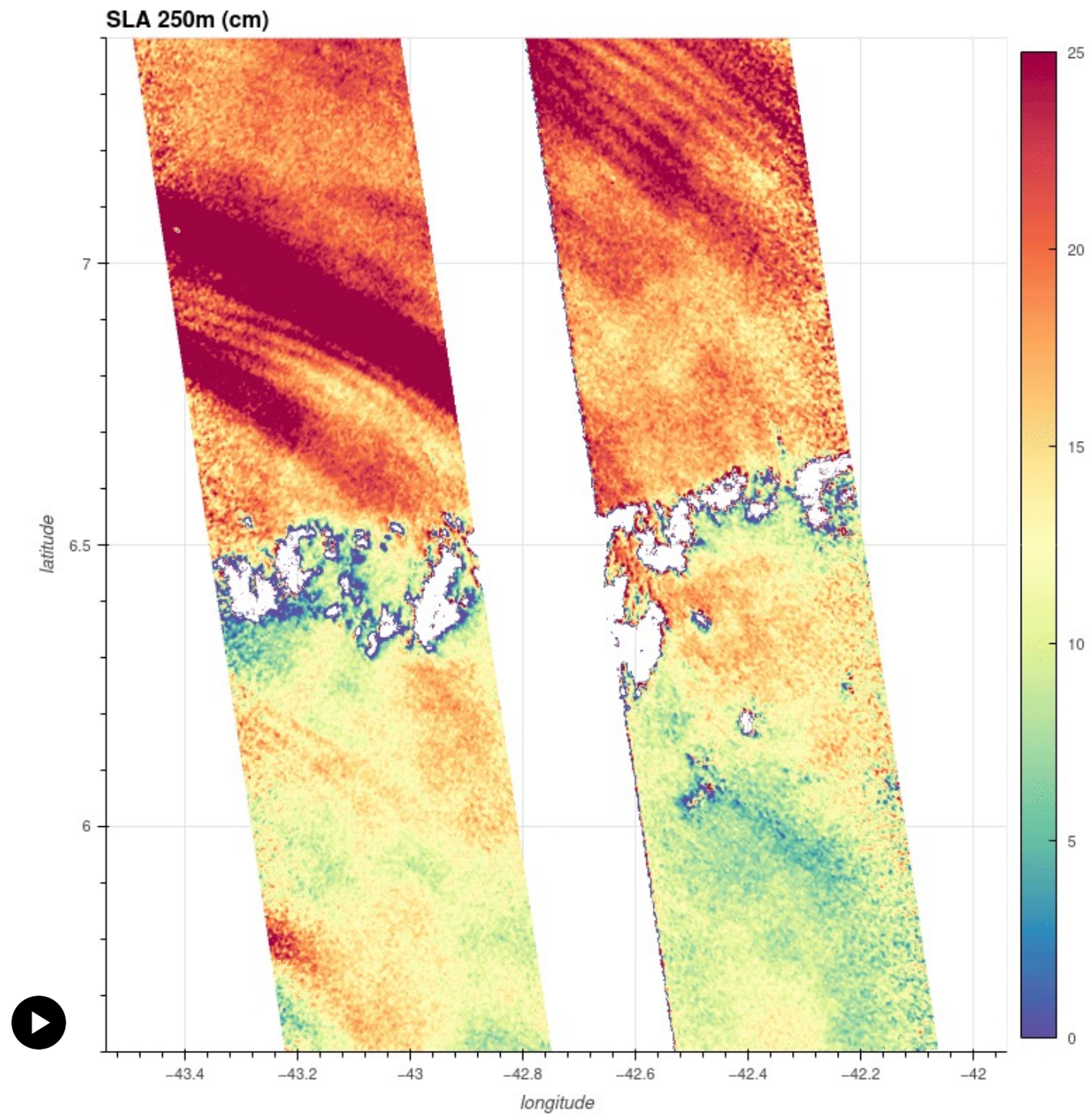
Tracking a cold eddy



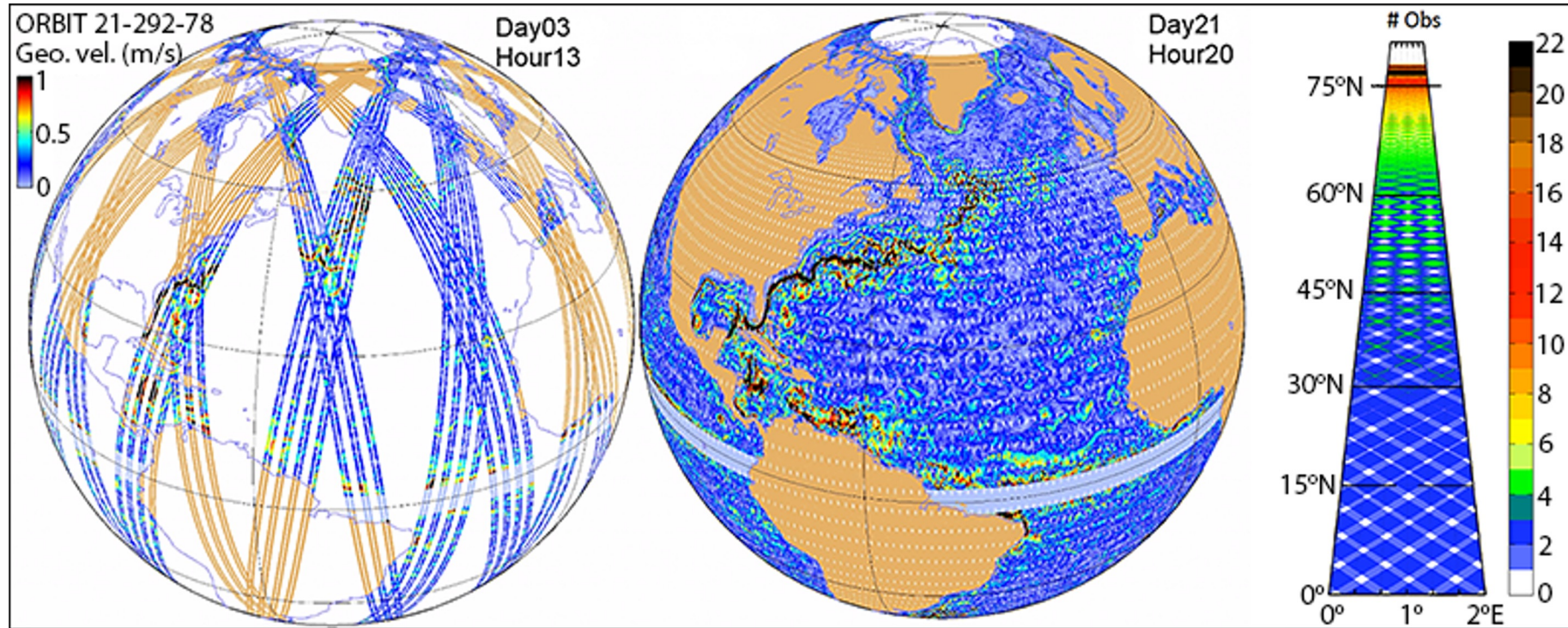
Internal solitary waves



Courtesy G. Dibarboure



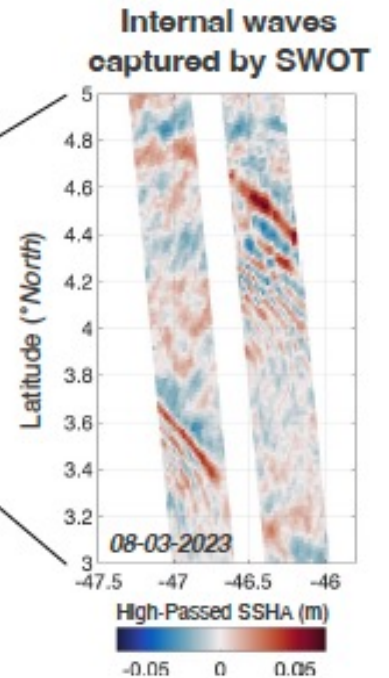
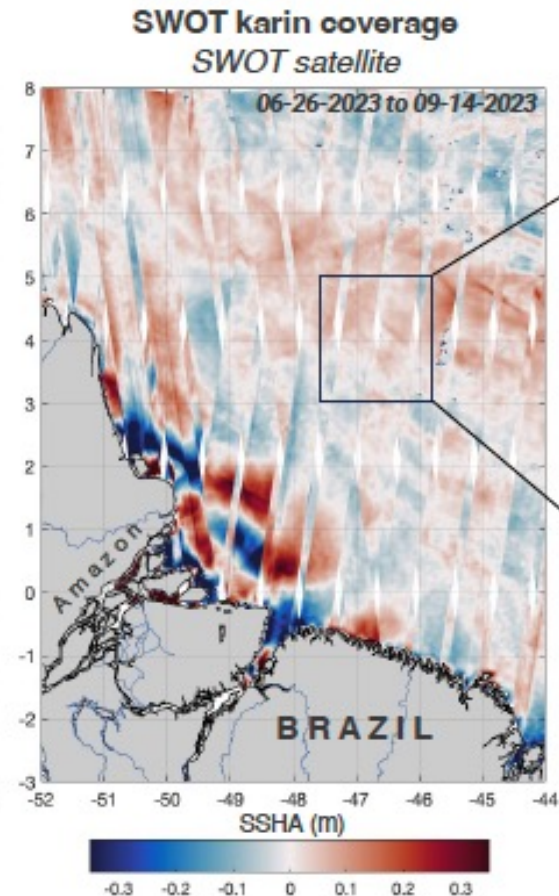
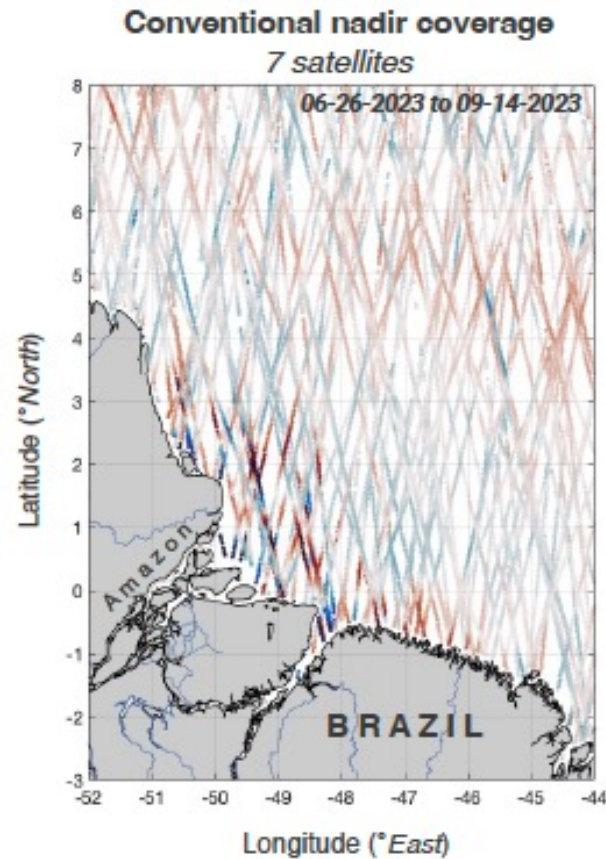
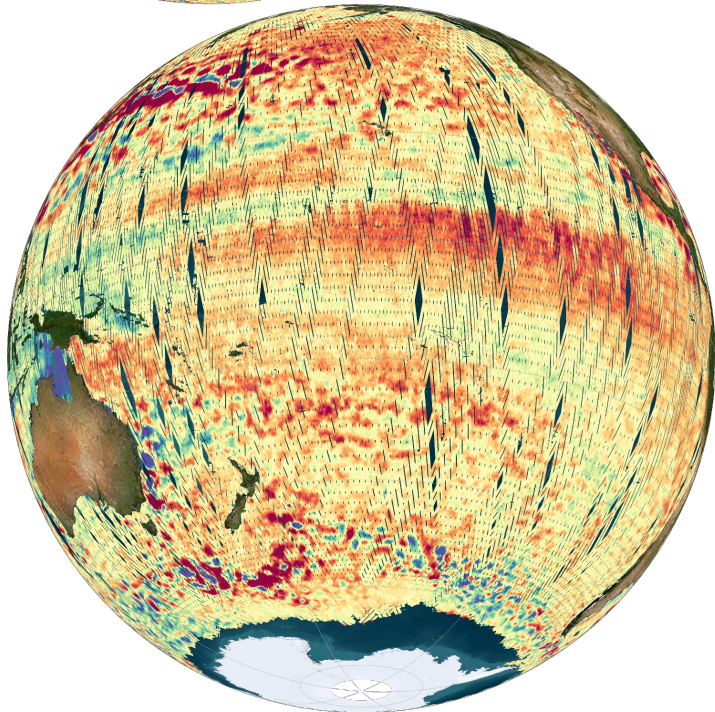
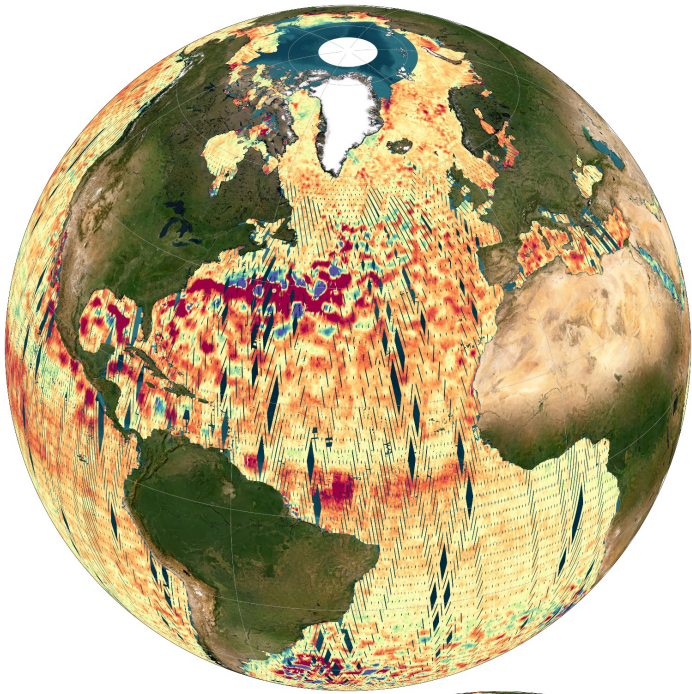
Sampling pattern of the 21-day Science orbit



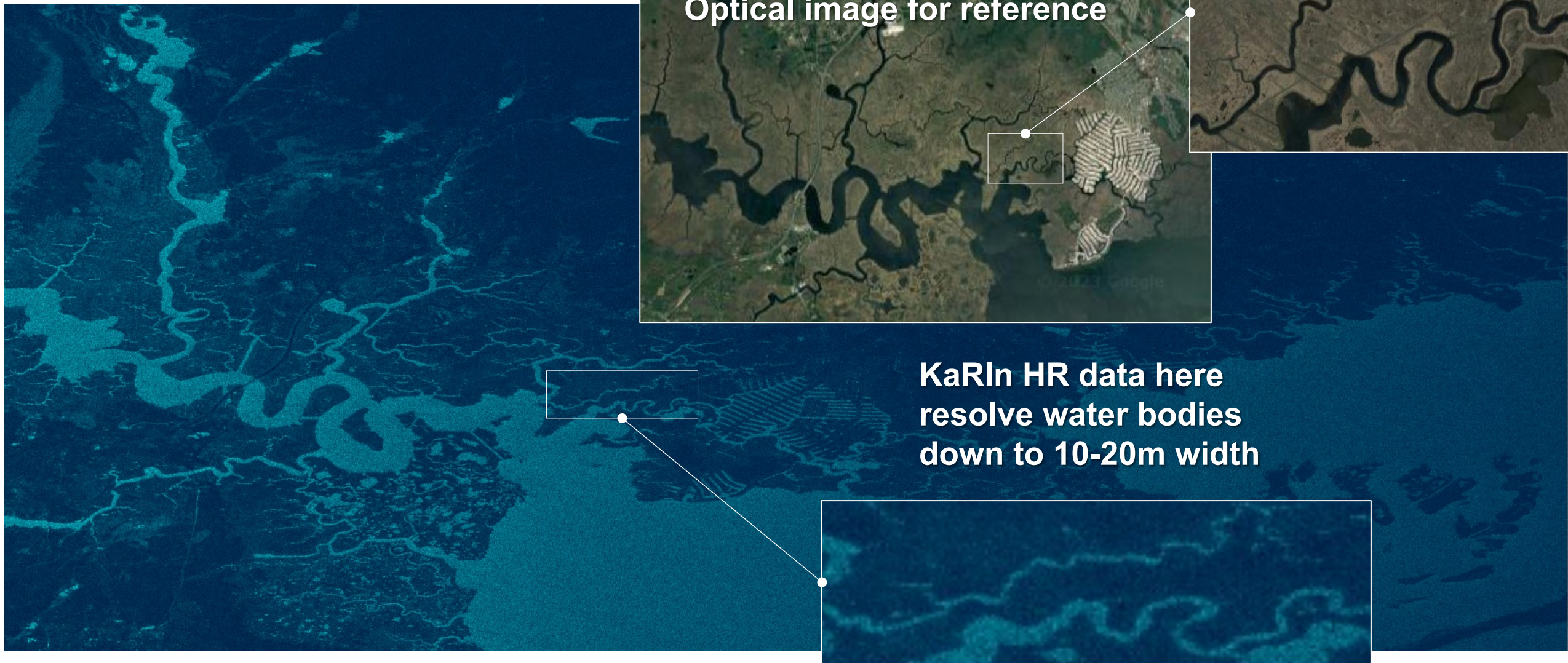
- A true global coverage with minimal gaps after every full 21-day cycle
- Mapping the ocean and land waters for 3 annual cycles
- With 3 month engineering checkout and 3 month Cal/Val, the total mission length is 42 months

Breakthrough of radar remote sensing

SWOT coverage is better than the combination of 7 radar altimeters with the resolution of ocean topography approaching imaging radar



KaRIn HR data (Mullica River, New Jersey)



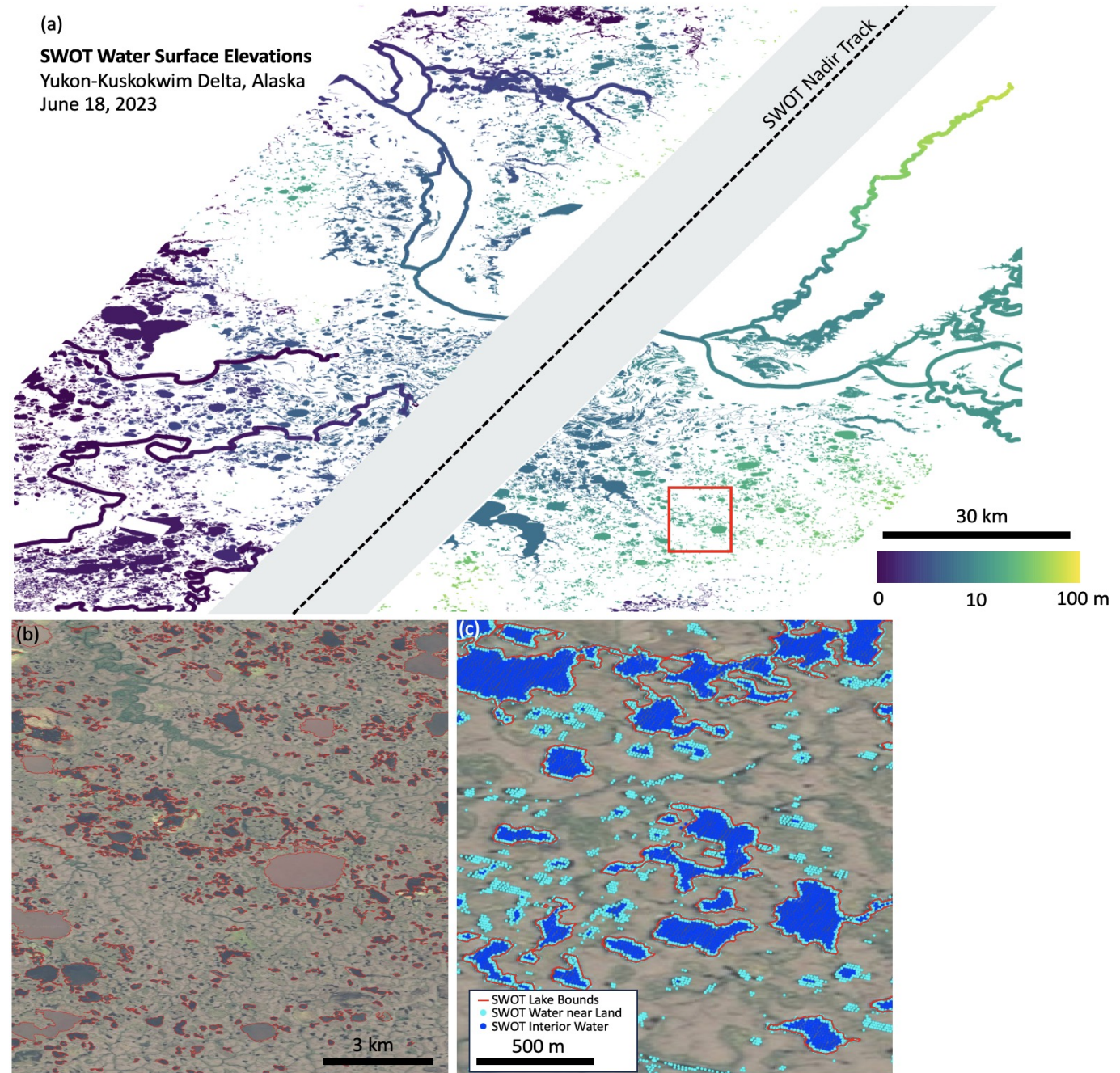
SWOT science requirement is to monitor rivers larger than 100m (goal 50m) and lakes larger than 250x250m² (goal

River and Lake data products

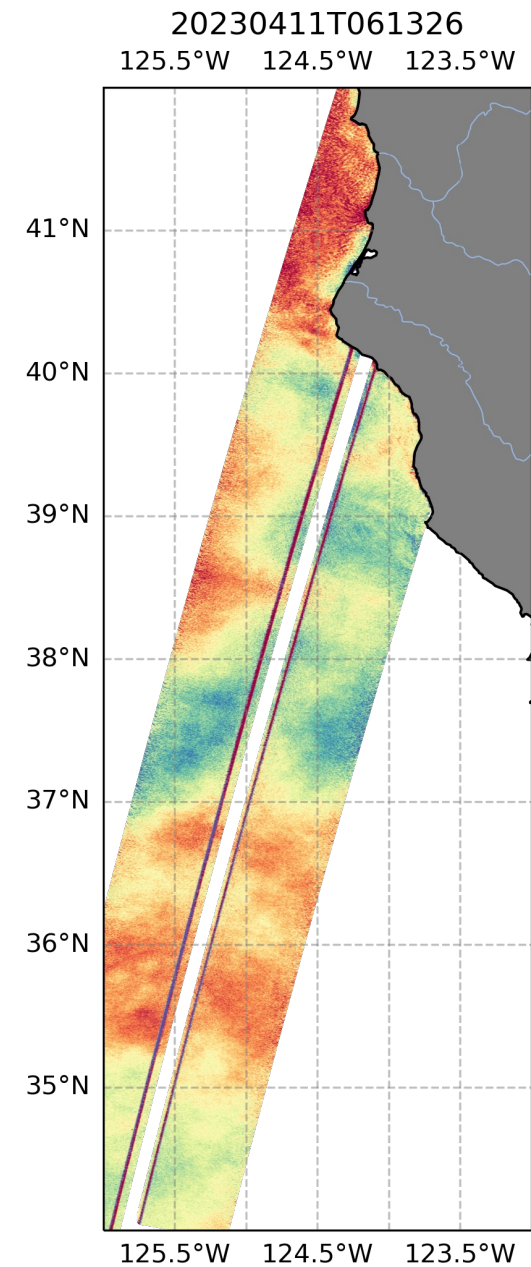
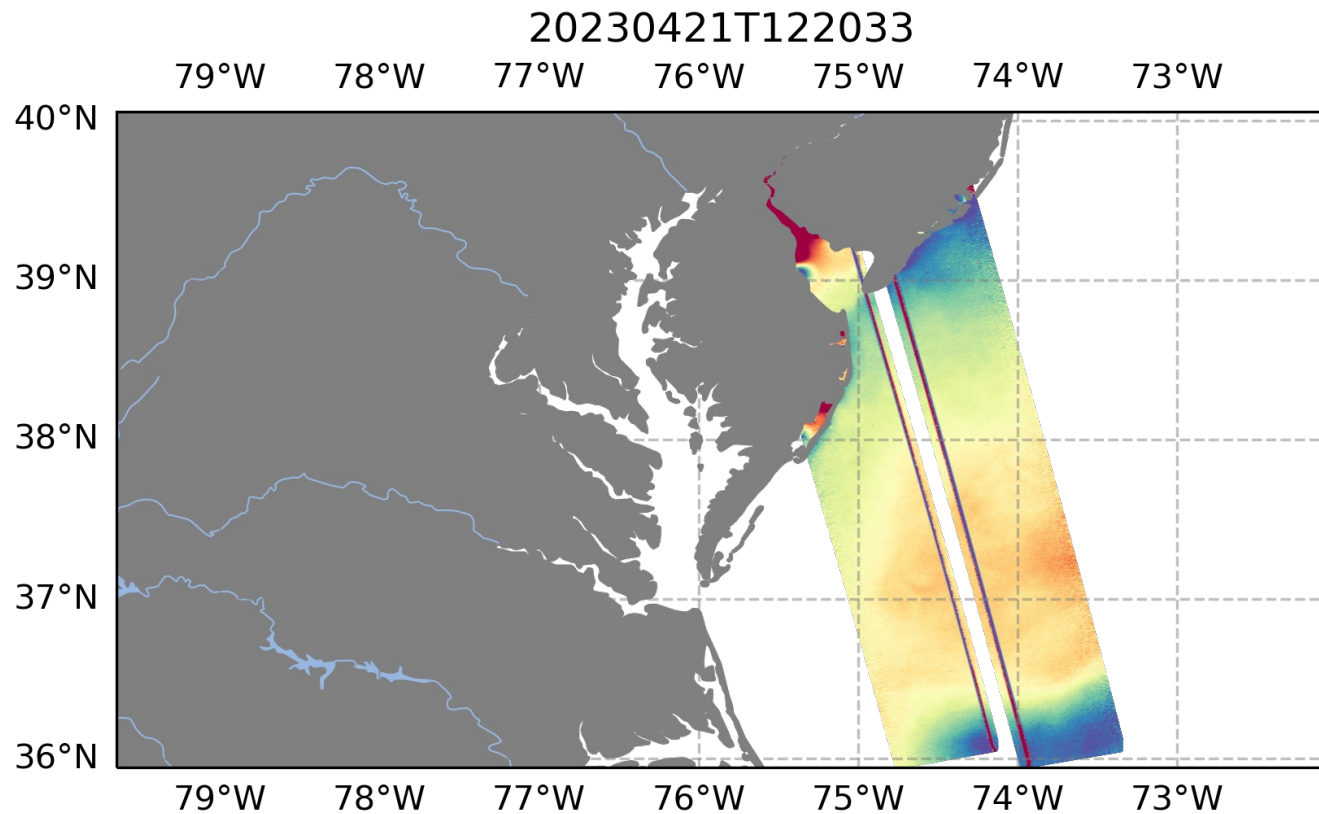
(a) SWOT water surface elevation data over a portion of the Yukon River Delta in Alaska.

(b) zoom-in o SWOT lake boundaries overlaid on high resolution optical imagery showing the close correspondence between SWOT-derived boundaries and this imagery.

(c) further zoom in showing SWOT lake boundaries in red and SWOT water pixels from which they are derived. Note that many lakes **smaller than 1 hectare** are visible in SWOT pixel cloud data, illustrating SWOT's capabilities to observe water bodies even smaller than original mission goals.

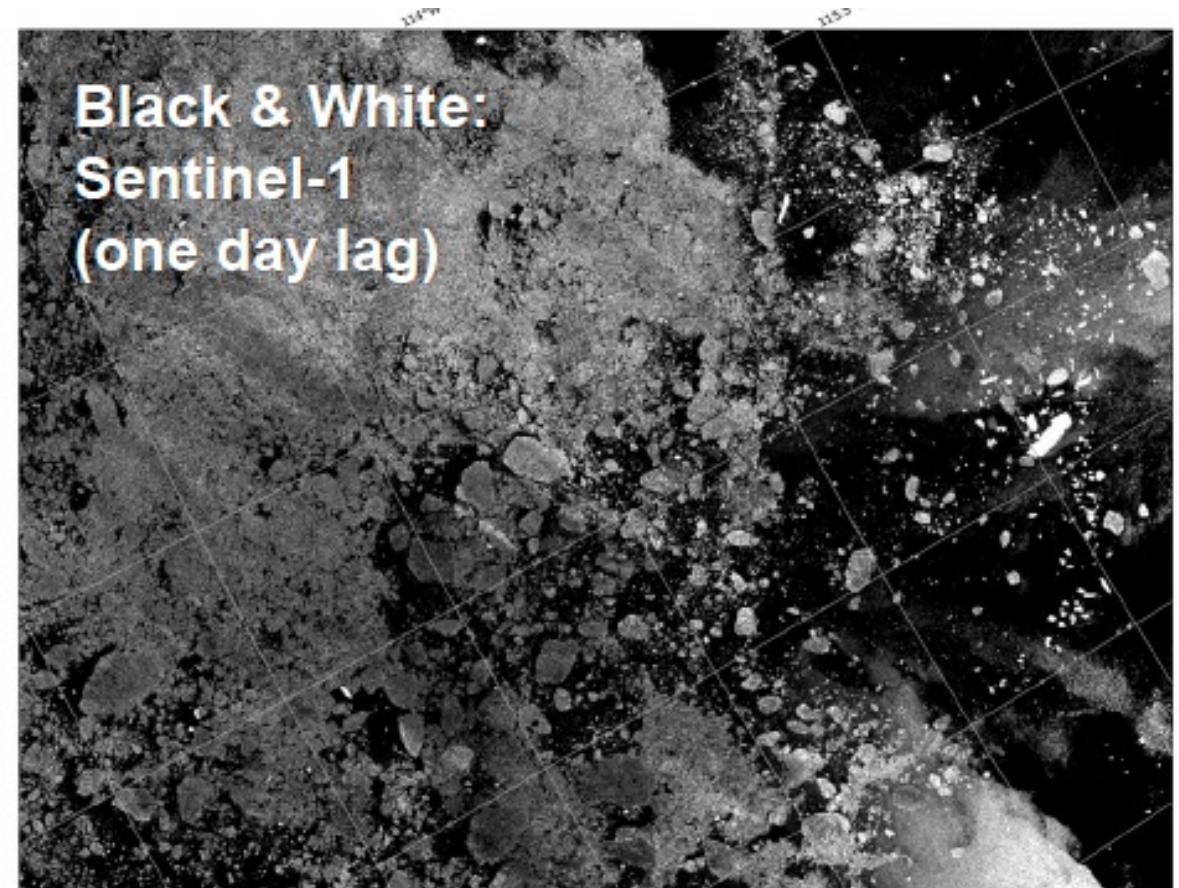
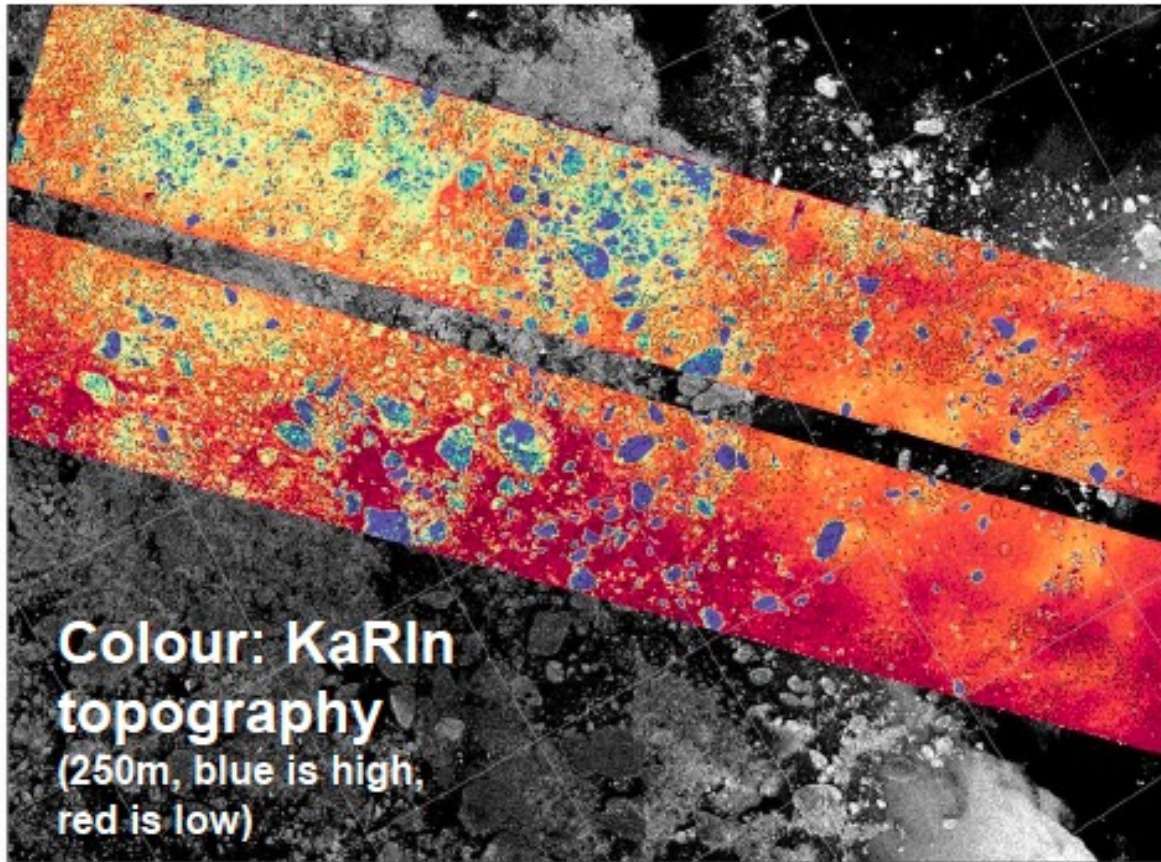


250 m data offshore from the US coast

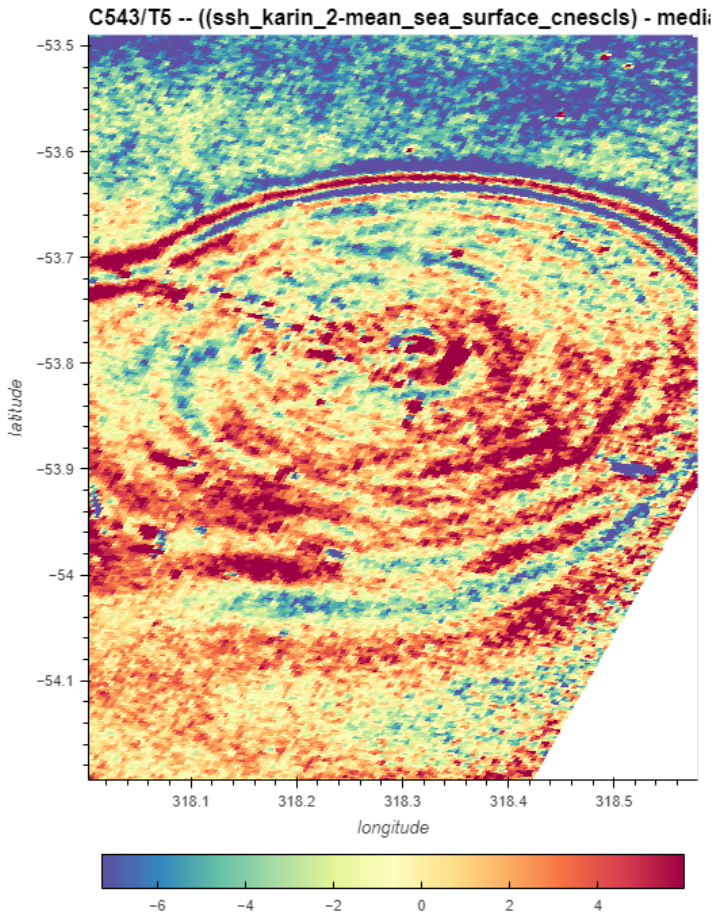


Courtesy Jinbo Wang

SWOT observations of sea ice

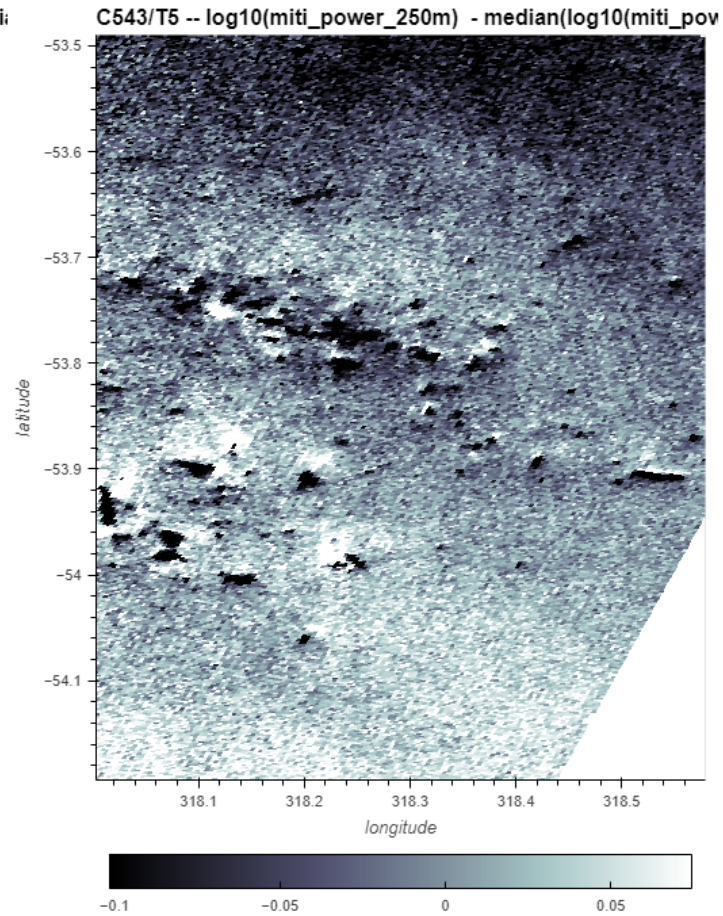


Mini-tsunamis as the iceberg capsizes

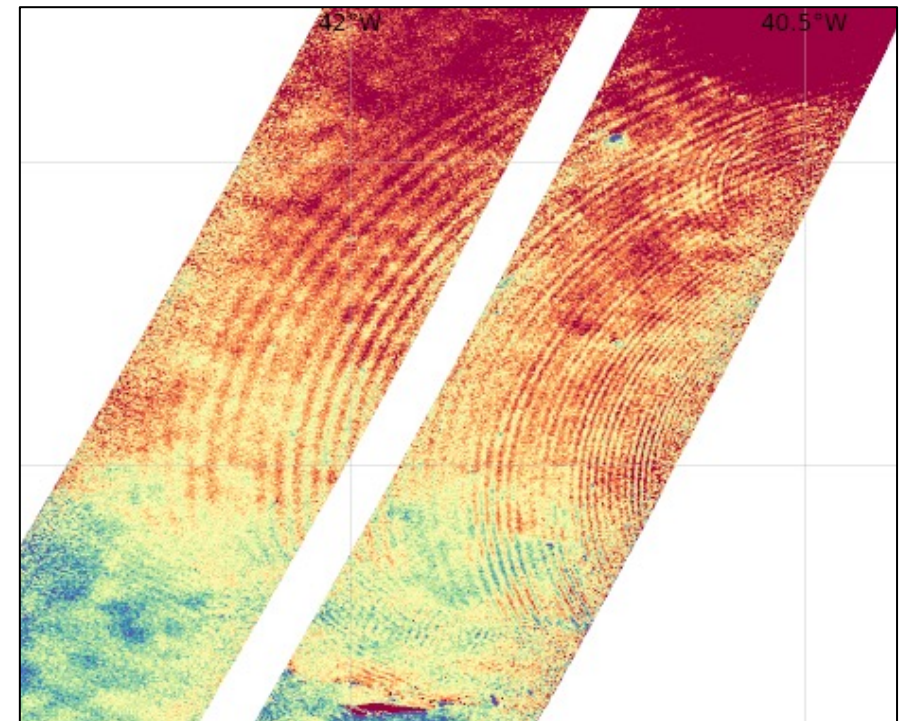
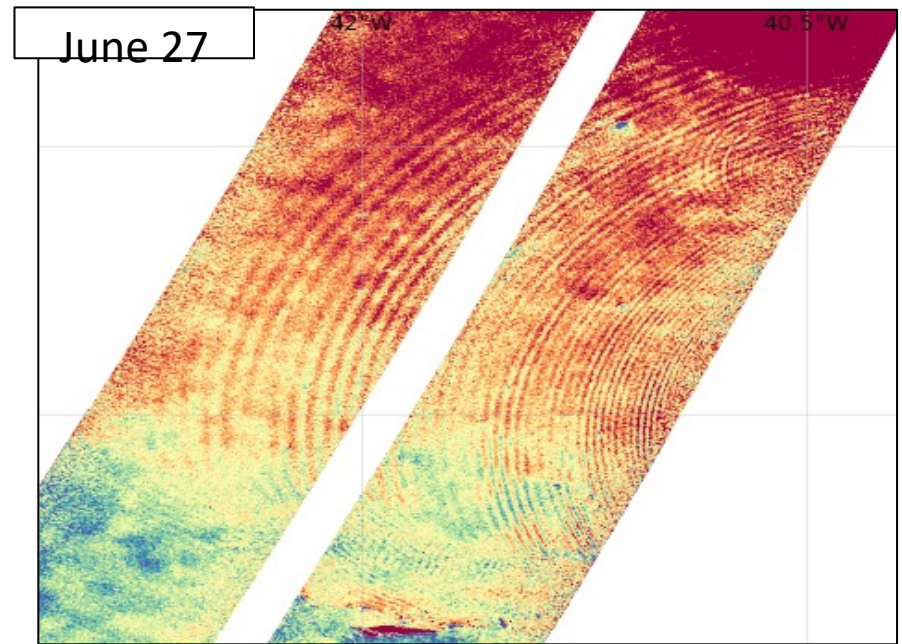


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Sea surface height (cm)



Relative sigma0



Summary

- The random noise of SWOT Ka-band Radar Interferometer (KaRIN) measurements over the ocean is significantly less than requirement, making the spatial resolution of detecting ocean features less than 10 km.
- SWOT is able to resolve rivers larger than 100 m wide, lakes larger than 250mx250m, with actual performance probably exceeding requirements.
- The mission completed CalVal and changed from 1-day repeat orbit to 21-day repeat orbit in late July to start the global mapping phase.
- The strength of the 21-day orbit is its global coverage. Its weakness is the missing information from the temporal gaps. How to make use of a gappy time series presents a grand challenge to maximize the utility of SWOT in its global mapping phase.
- The mission's data are planned to be released to the public before end of 2023.