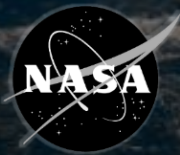


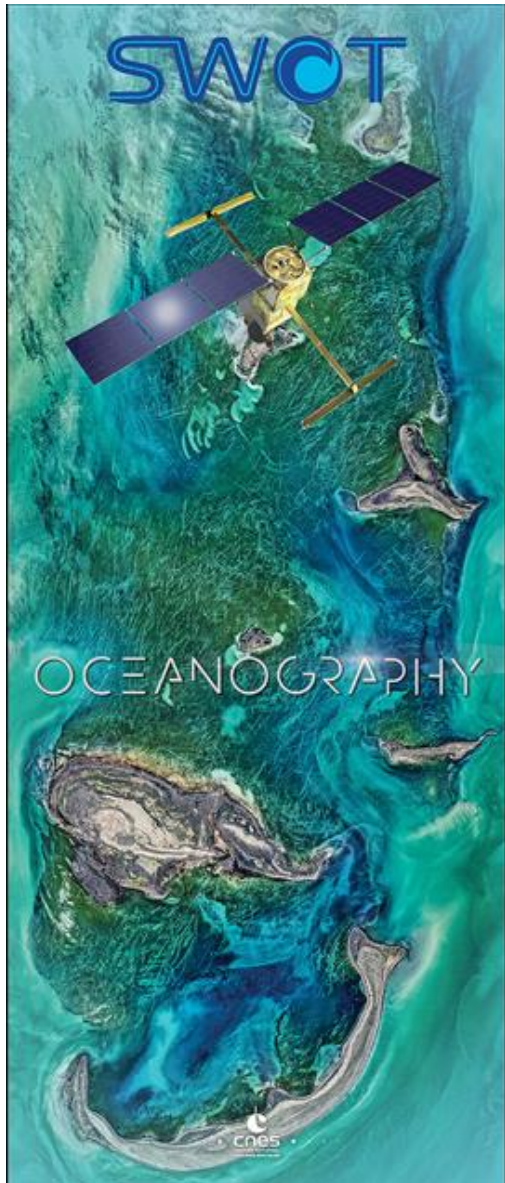
# SWOT Overview

*G.Dibarboure (CNES)*




*Ocean Predict Science Team meeting,  
Busan, 6-10 Nov 2023*

# Surface Water and Ocean Topography (SWOT) mission



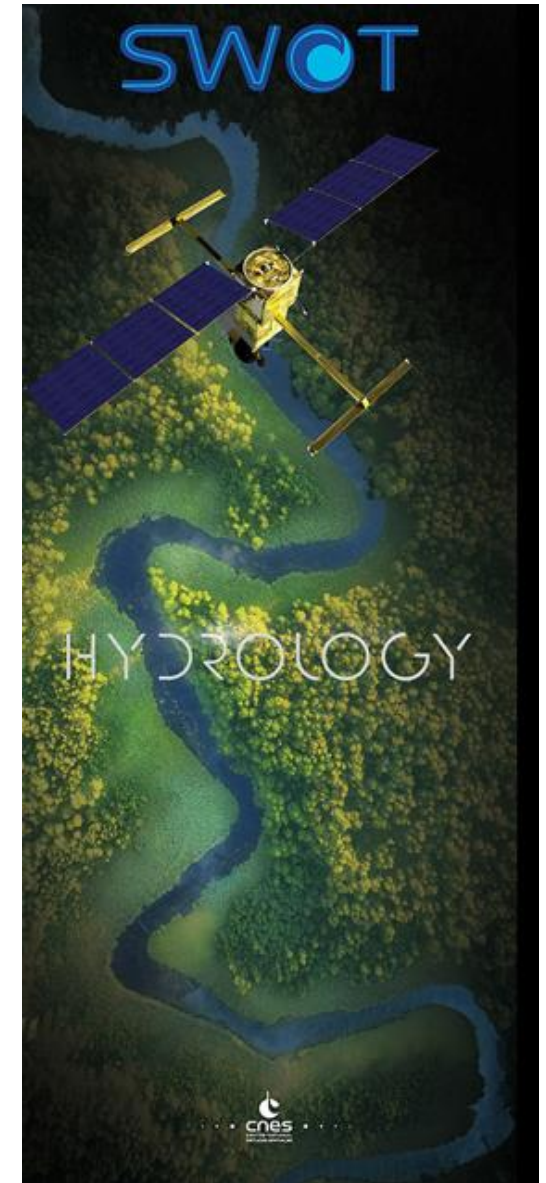
SWOT will make the first global survey of Earth's surface water.



Global inventory of inland fresh surface water heights (and river discharge)

Ocean Surface Topography (massive coverage, 2D images, precision improved by a factor of 10)

Additional synergistic science and application objectives: coastal margins, sea and land ice, geodesy...



## Cooperation between NASA and CNES

- 30 years of cooperation in altimetry missions and surface water height
- Additional contributions from UK and Canadian Space Agencies

## Ambitious and innovative

- Driven by ambitious science objectives
- First interferometer instrument of its kind
- Really impressive engineering challenges to overcome
- Demonstration for future operational altimeters (e.g. Sentinel-3 NG)

## Timeline

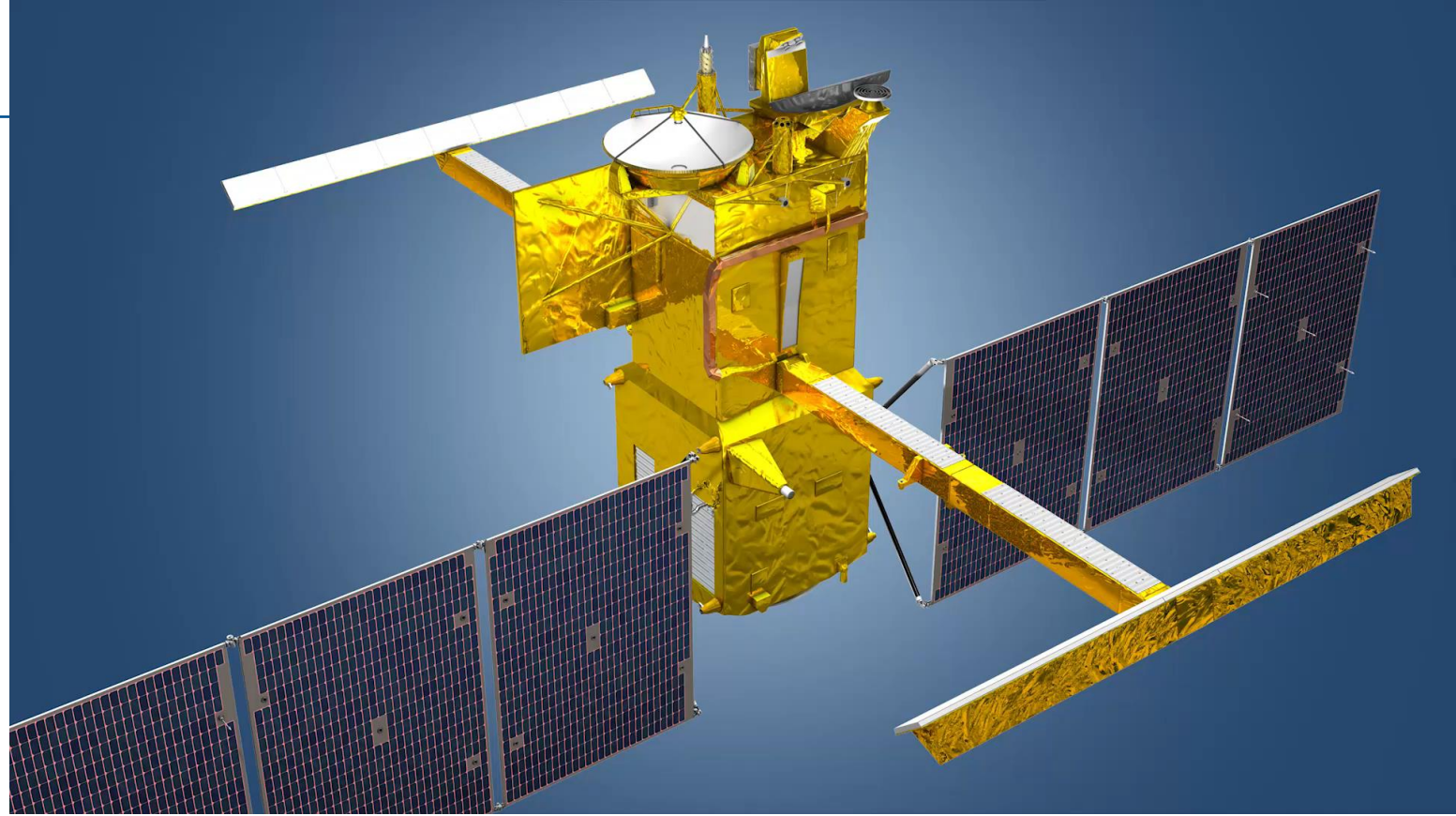
- Dec 2022: Successful launch
- Jan-Jul 2023: LEOP, Commissioning, and Cal/Val (1-day revisit orbit)
- July 2023: SWOT reaches science orbit (21-day revisit orbit)
- Aug 2023: release of beta product samples (for CalVal purposes only)
- Nov/Dec 2023: public release of pre-validated product (open & worldwide)
- April 2024: end of validation phase, release of validated product



# SWOT Engineering Firsts

## Technical Challenges that were overcome to make SWOT a reality

- First 2,000 W Ka-band Interferometric SAR (KaRIn)
- Deployable Antenna with a  $0.004^\circ$  co-alignment stability (10 m baseline)
- Antenna pointing to  $0.0001^\circ$  (incl. platform control and AOCS)
- First on board real-time interferometric processing
- Thermal stability of less than  $0.05^\circ\text{C}/\text{minute}$  while rejecting more than 1,000W of waste heat
- Largest deployable dual reflectarray antenna in space each 5 m x 0.25 m
- First X-band antenna transmitting high data rate (620 Mbps) without a gimbal mechanism
- Mass data processing: thousands of CPU core on Cloud & HPC



# SWOT's FIRST YEAR

LEOP – Commissioning – Calibration – Science

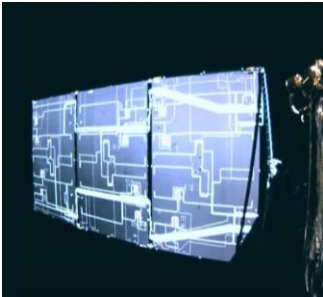
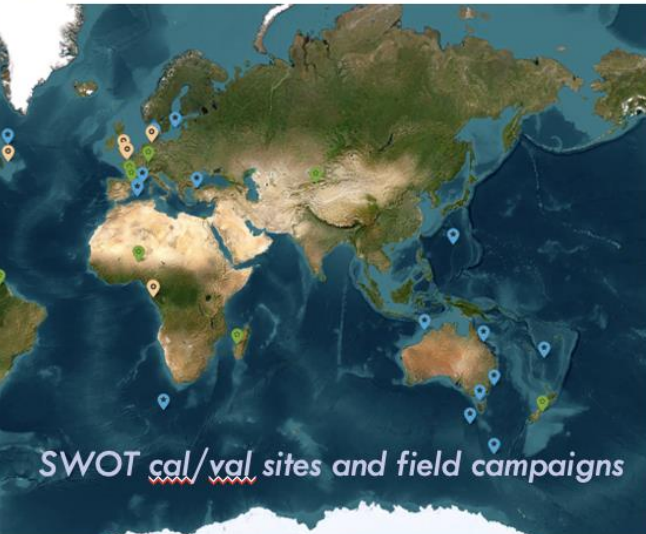
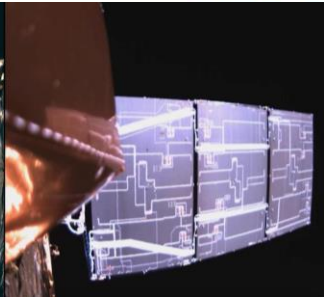
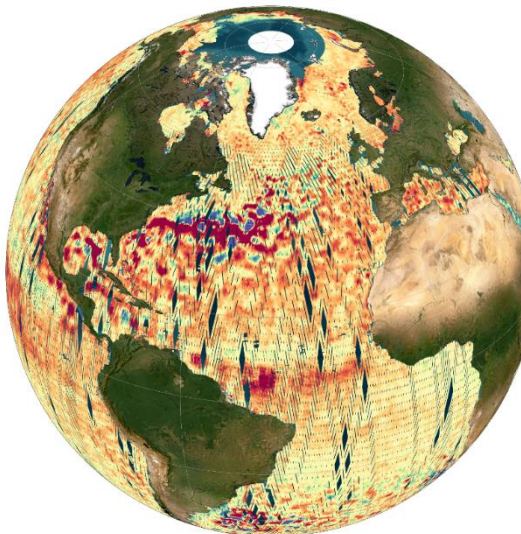
50+ field campaigns worldwide

Beta pre-validated data release

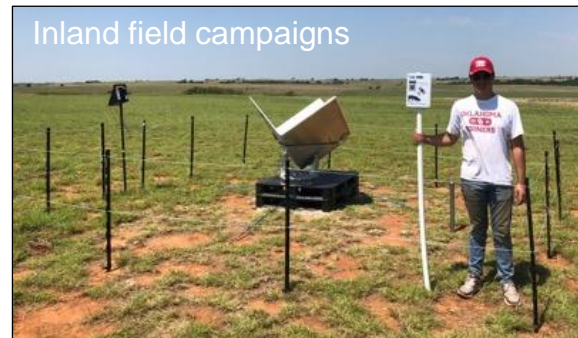
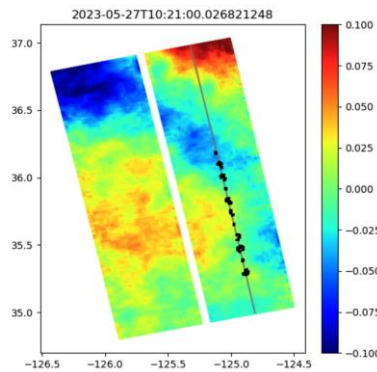
Early Adopters integration

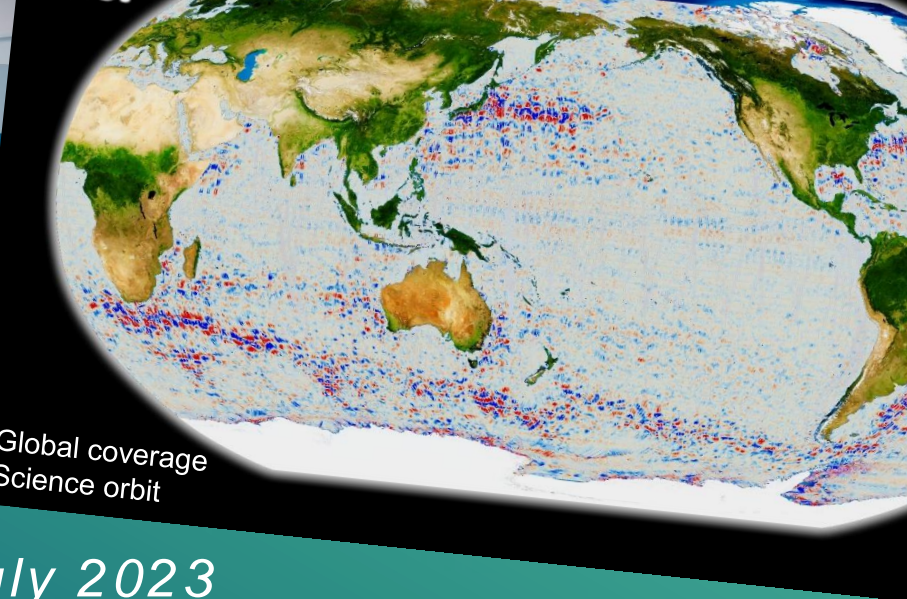
Media, events, public engagement

Awards



# One-Day Repeat Phase for initial Cal/Val & Unique Science Opportunity

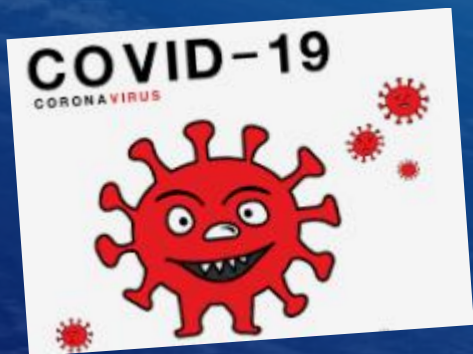




## *Start of Global Science Phase: July 2023*

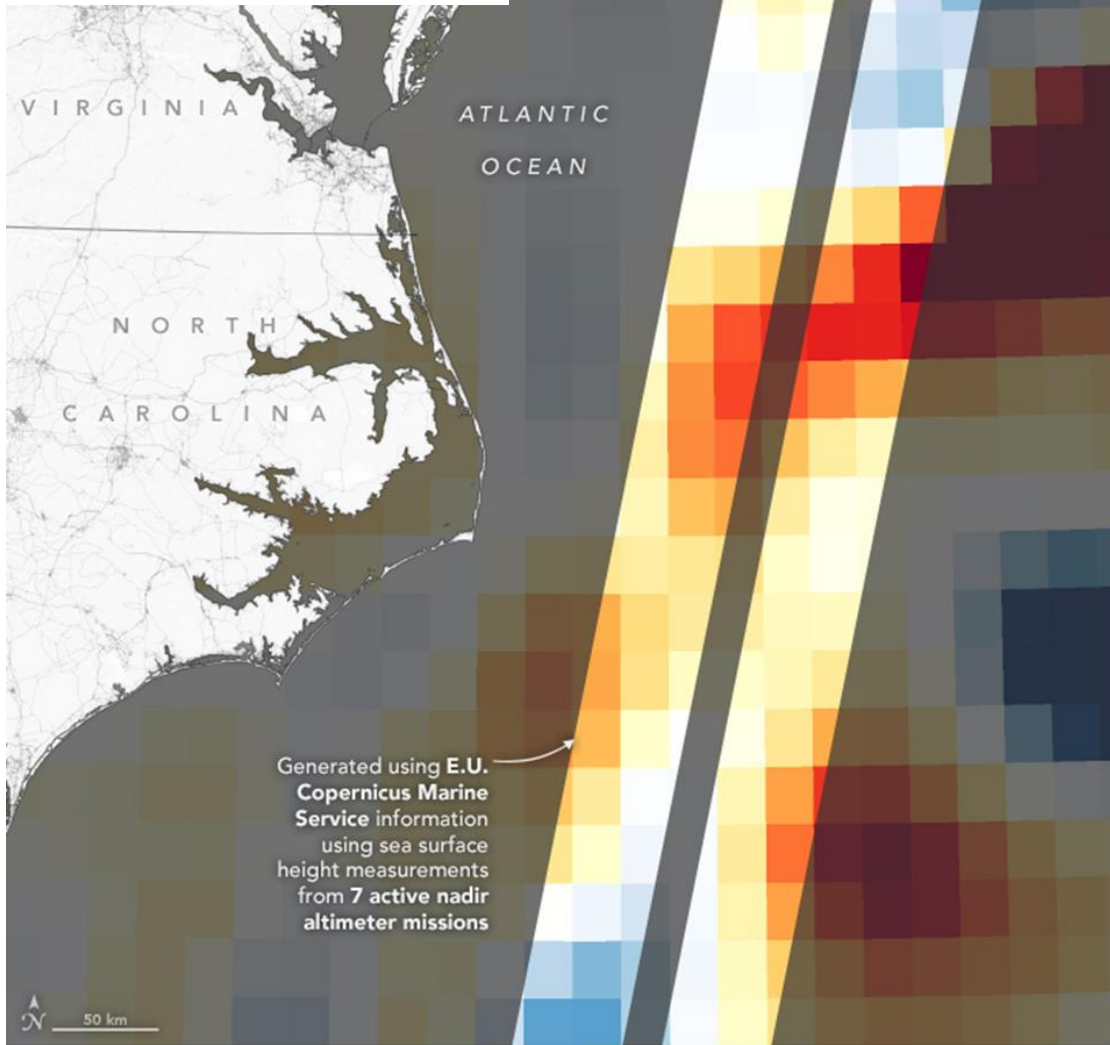
*Integration and Testing, Launch, Commissioning & Calibration phases were all successfully completed on schedule...*

*...despite some substantial challenges*



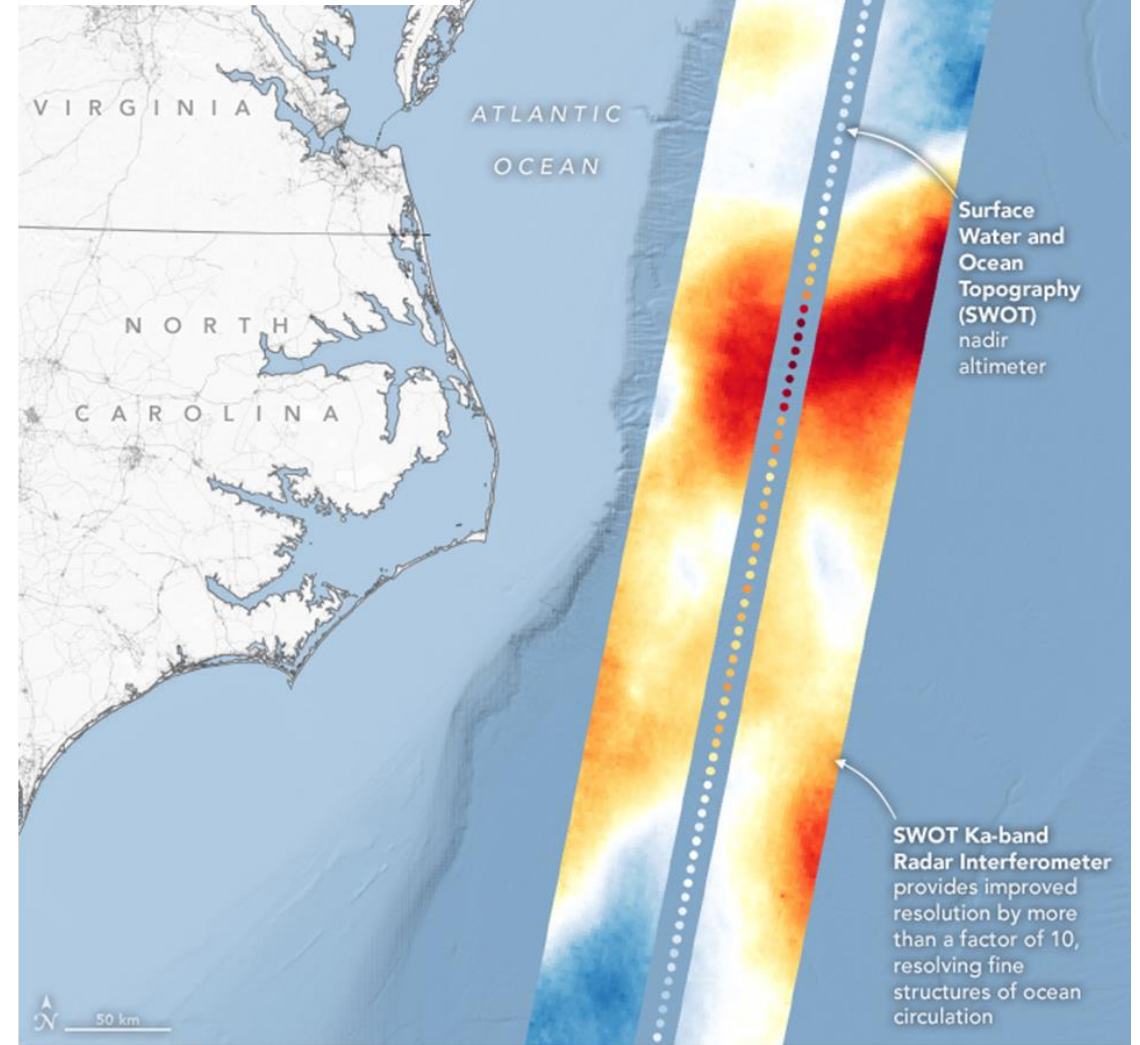
# SWOT mission – first ocean image (Jan 2023)

## 1D altimetry (7satellites)



Sea Surface Height Anomaly (m)  
≤-0.25      0      ≥0.25

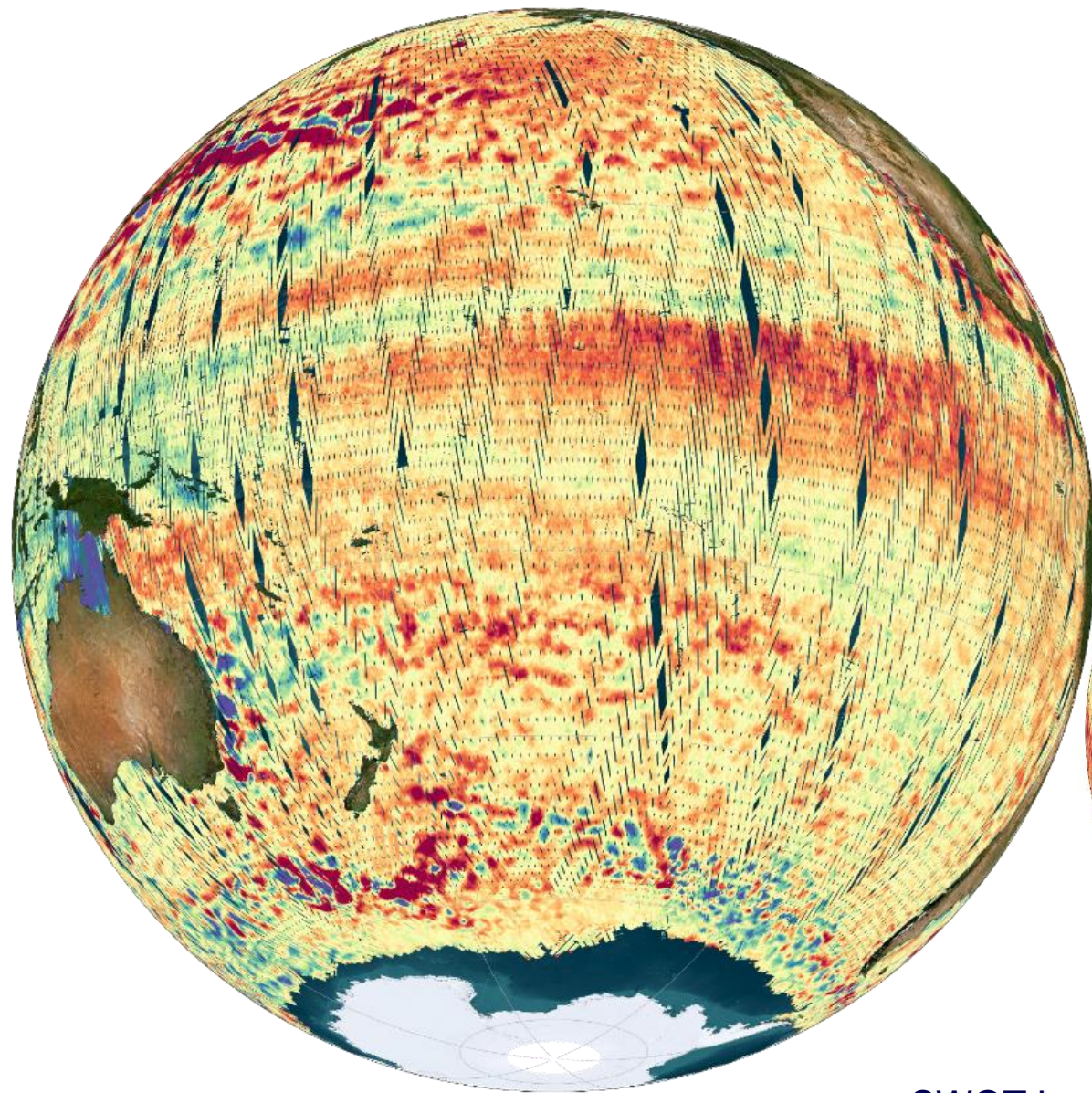
## 2D altimetry (SWOT)



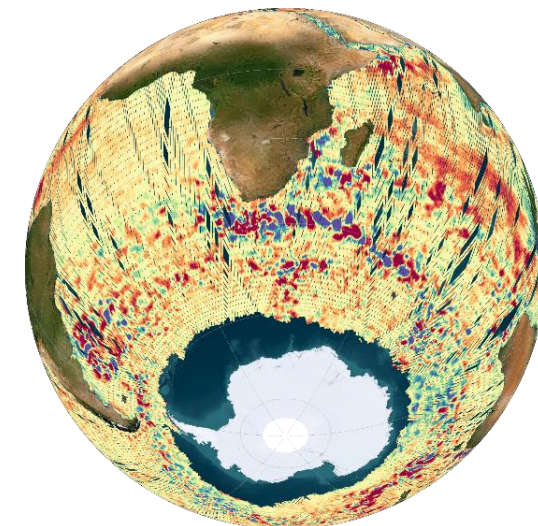
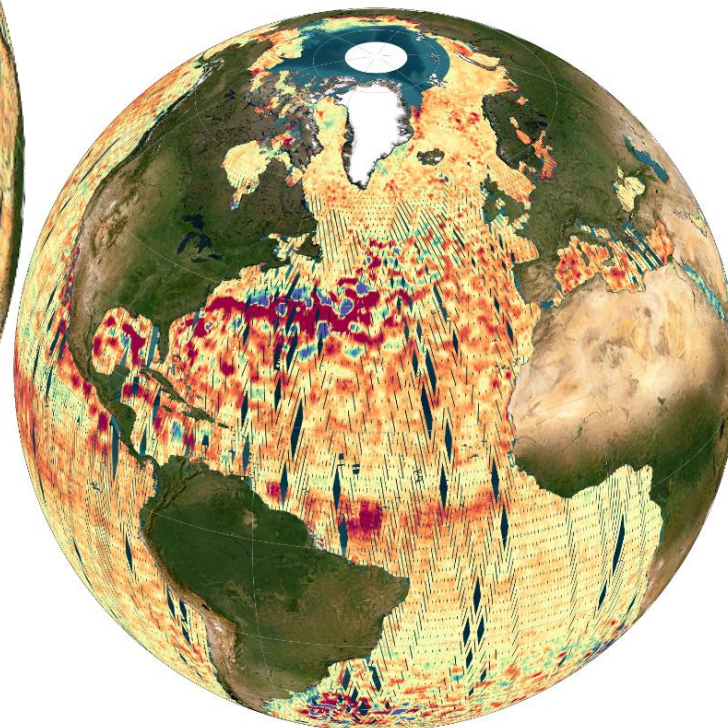
Sea Surface Height Anomaly (m)  
≤-0.25      0      ≥0.25



# Massive improvement of Ocean Surface Topography coverage

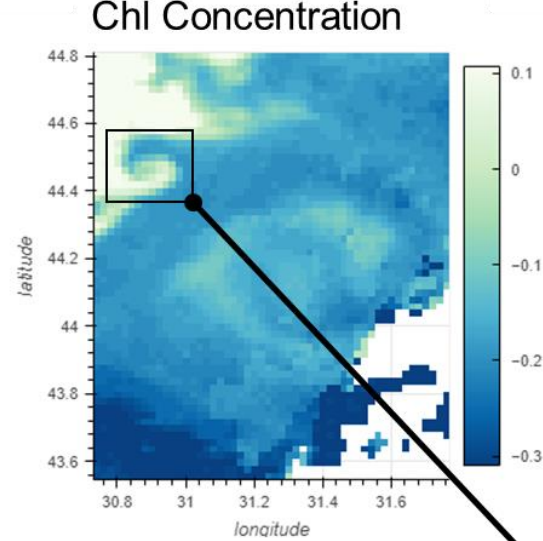
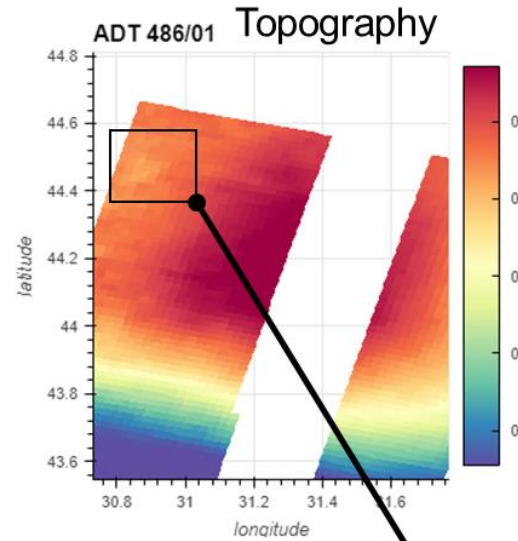
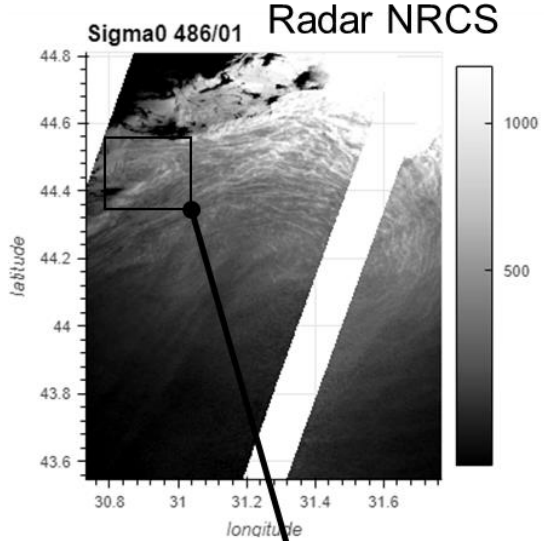


SWOT coverage is better than the combination of 7 radar altimeters, precision improved by a factor 10, 2D resolution up to 250-m



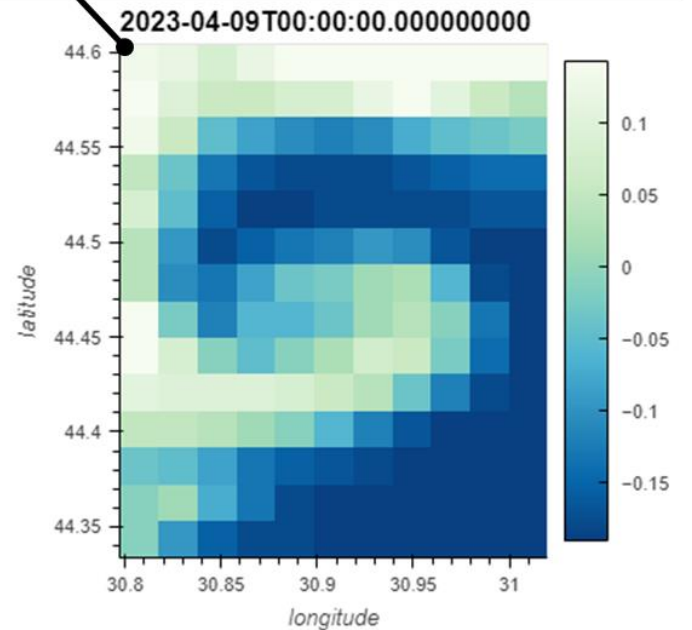
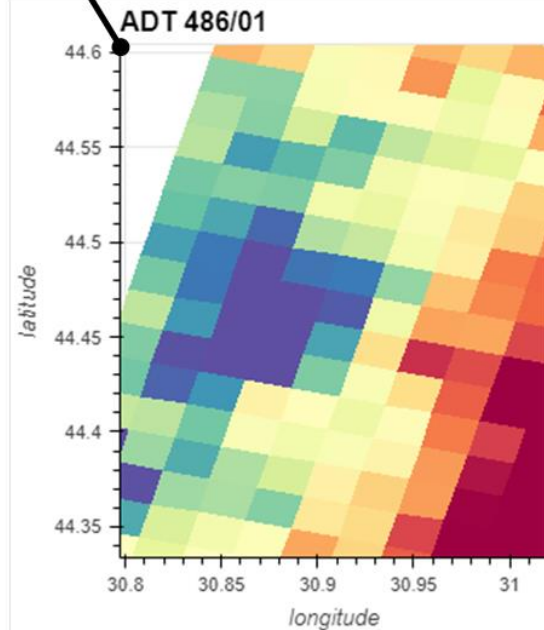
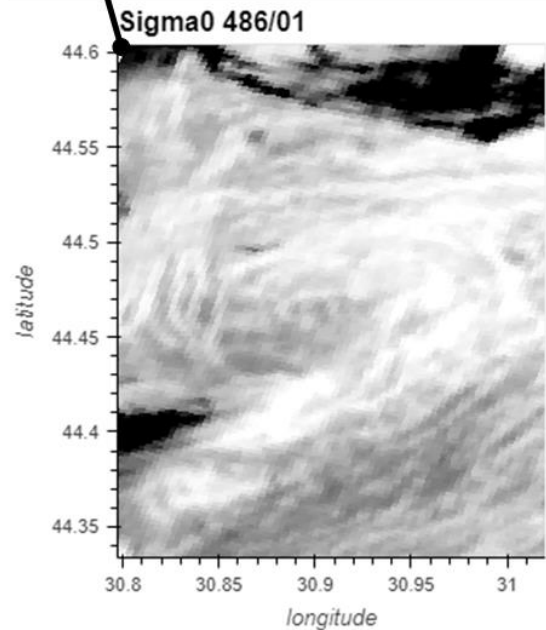
SWOT Level-3 product (no interpolation whatsoever)

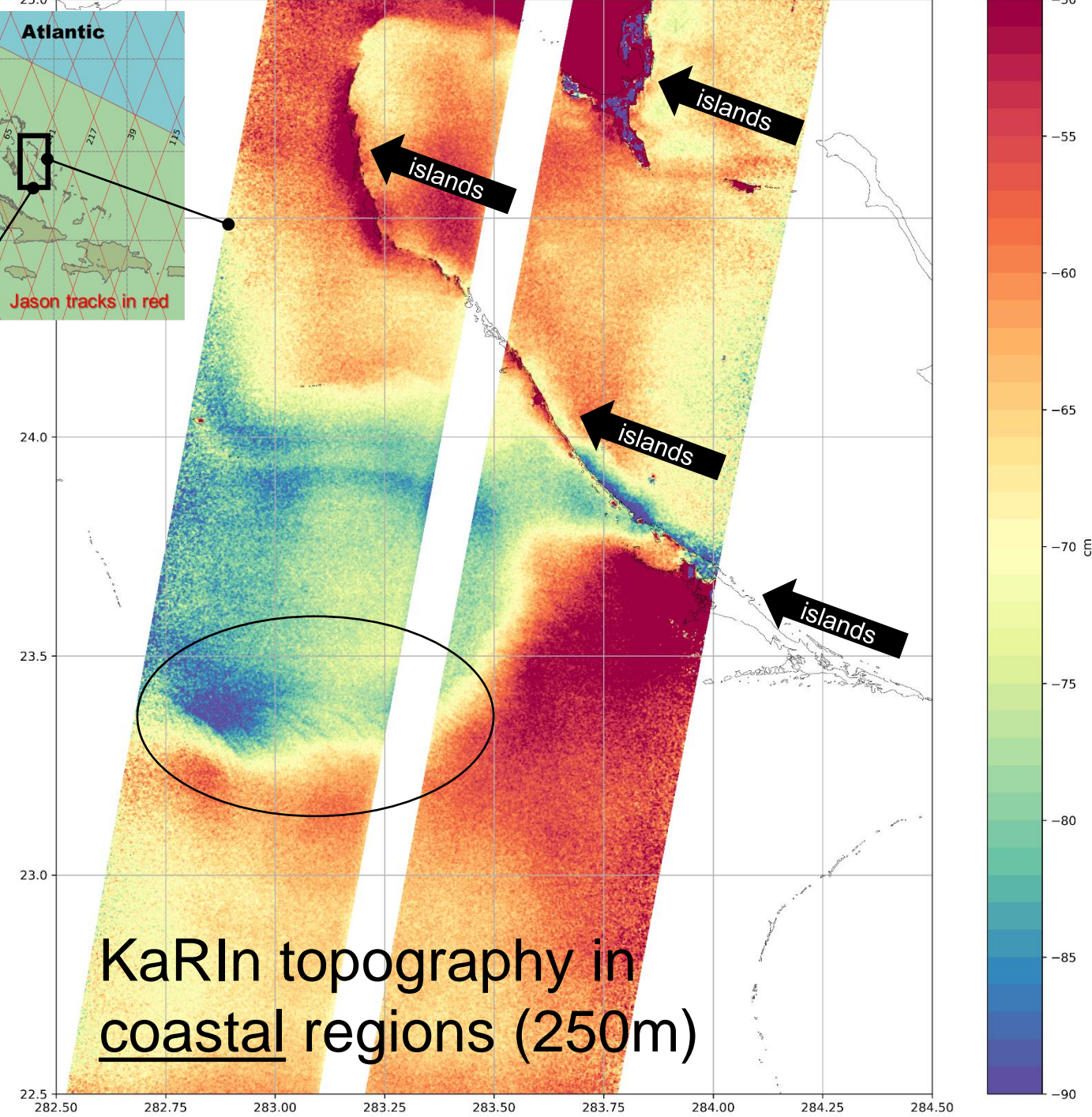
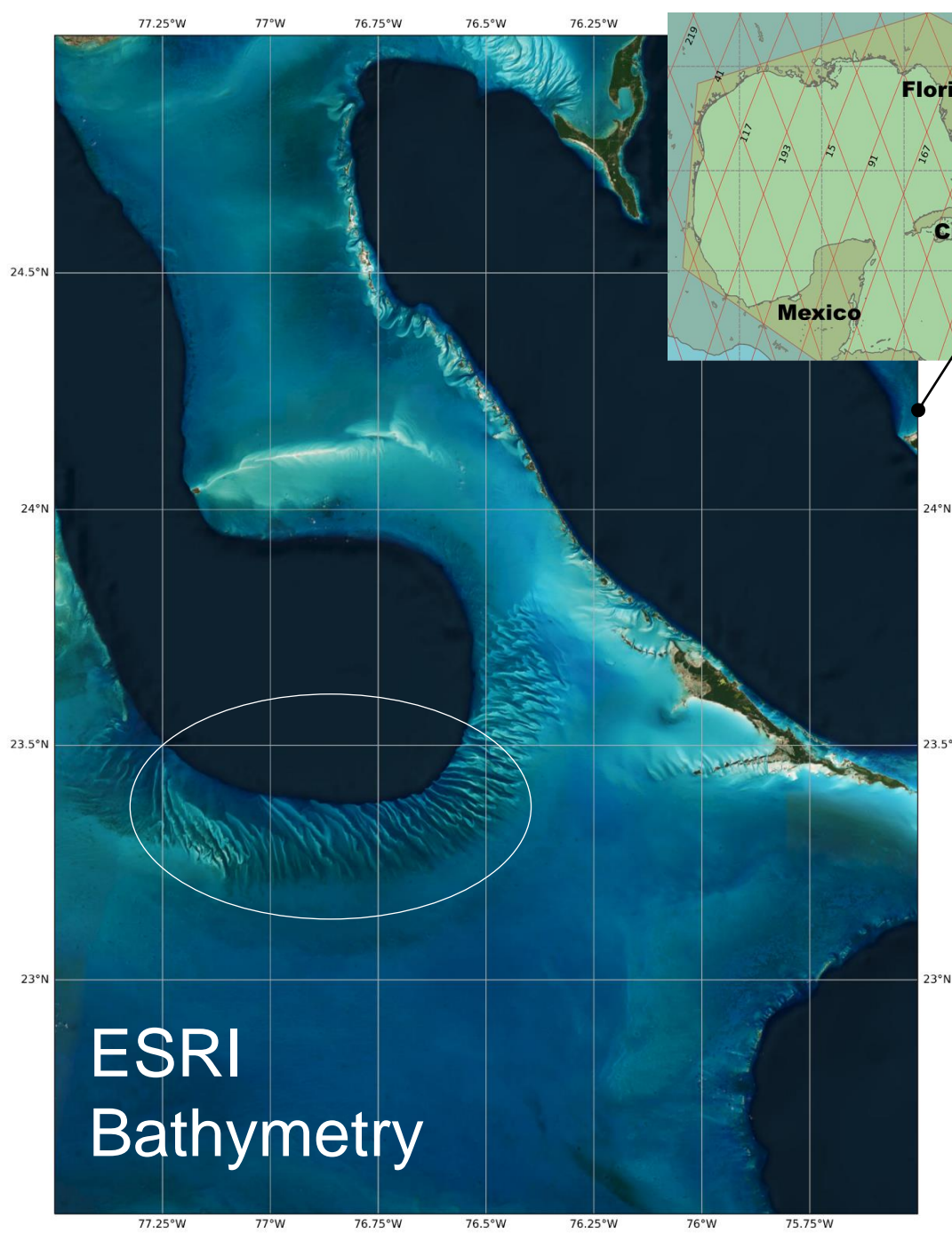
# From large mesoscale to submesoscale



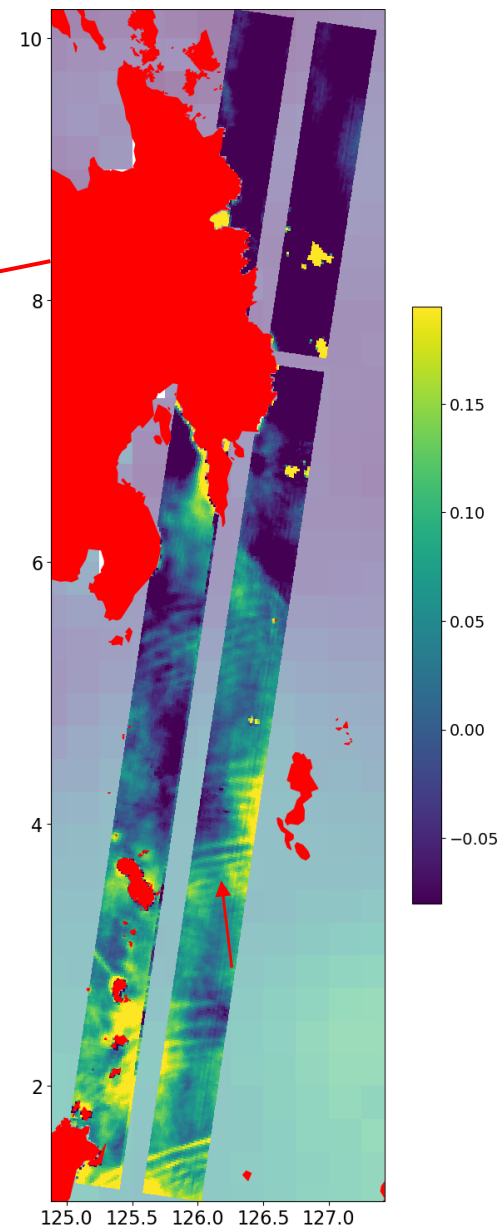
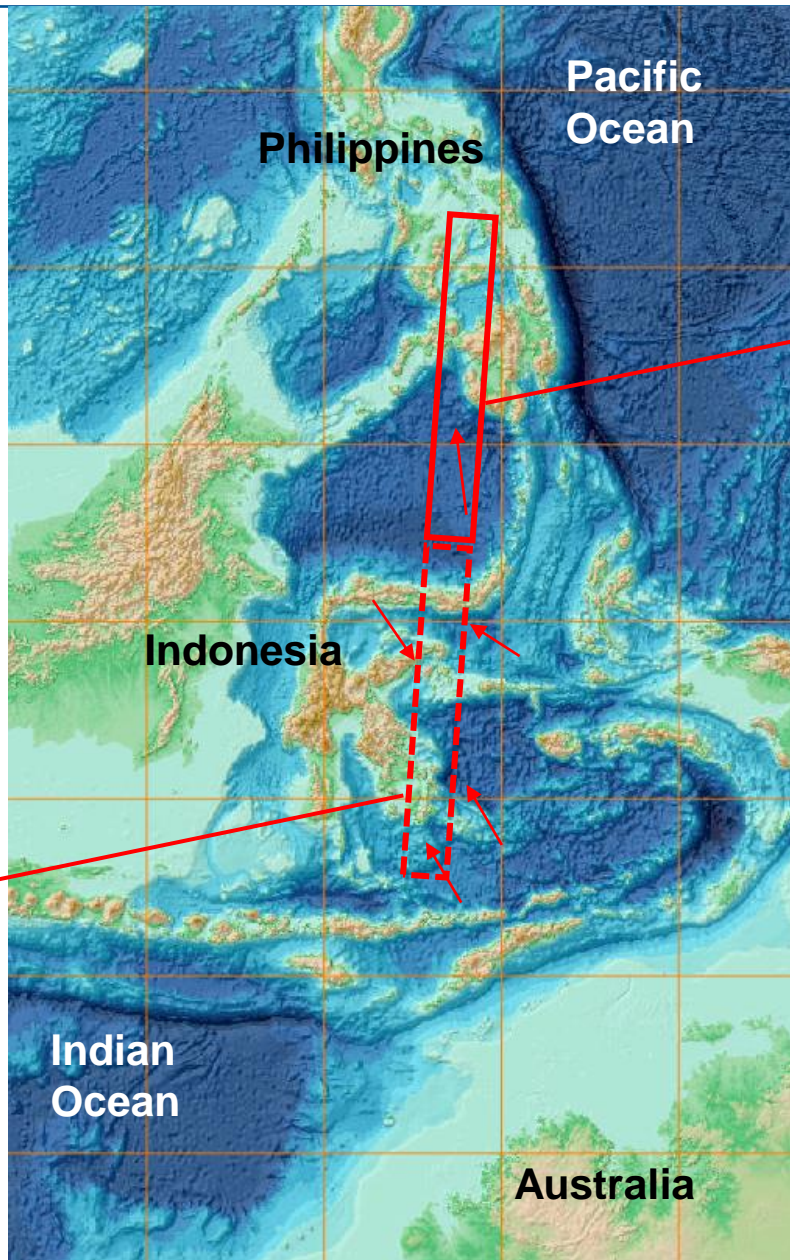
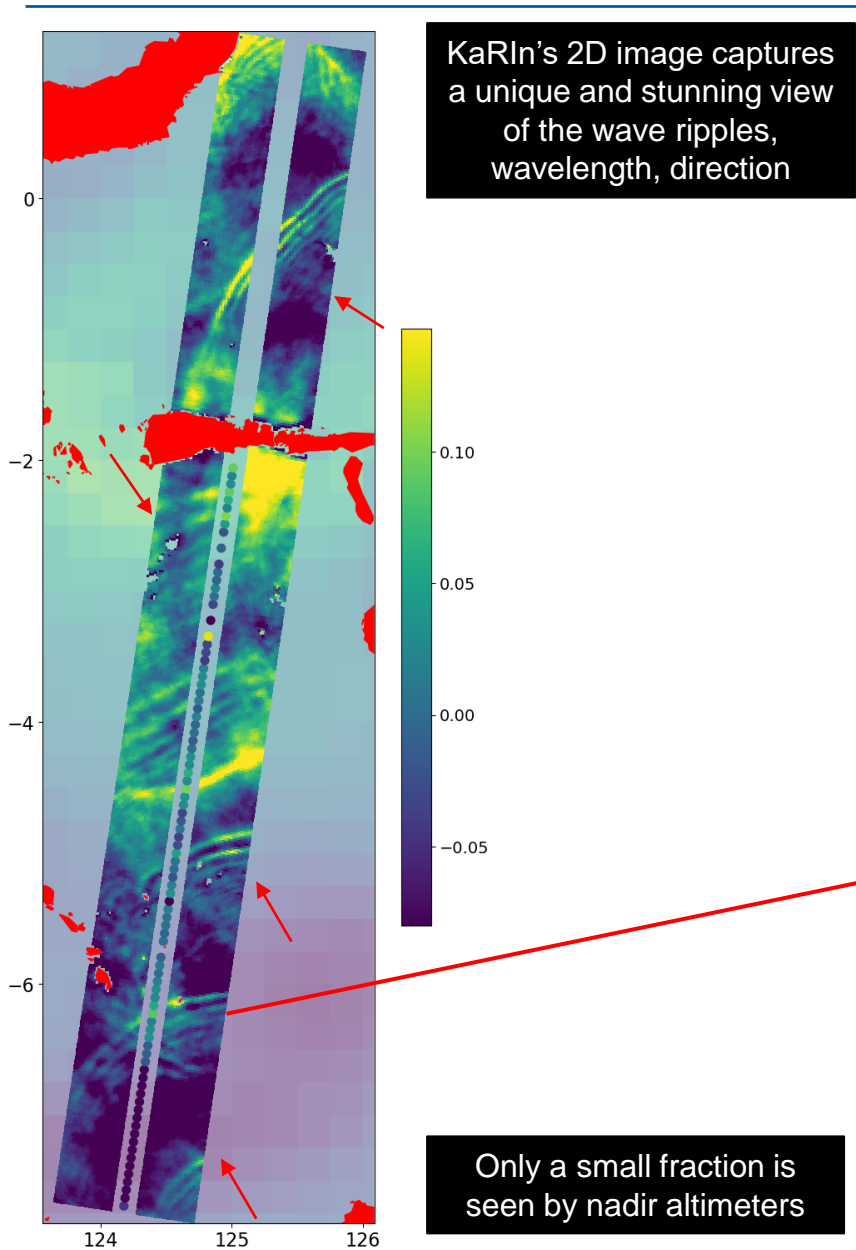
100 km mesoscale eddy

10 km submesoscale



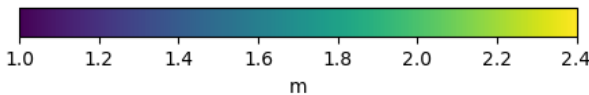
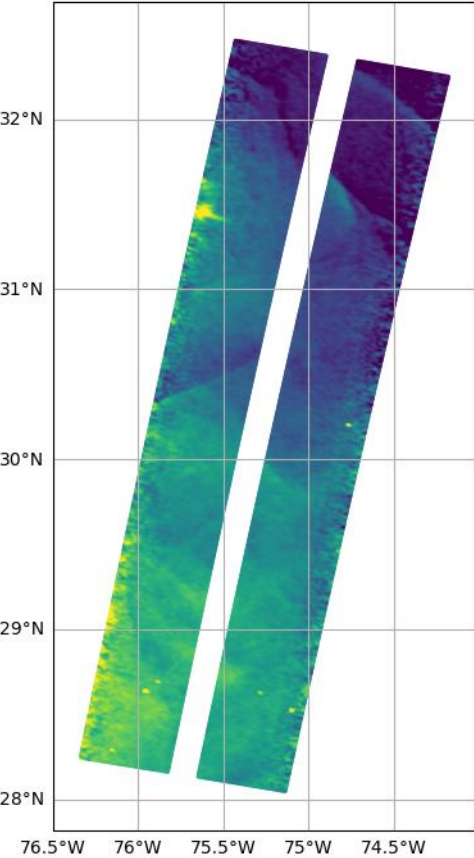


# Internal waves (here from tides) observed by SWOT

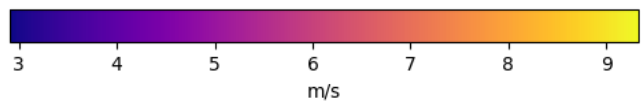
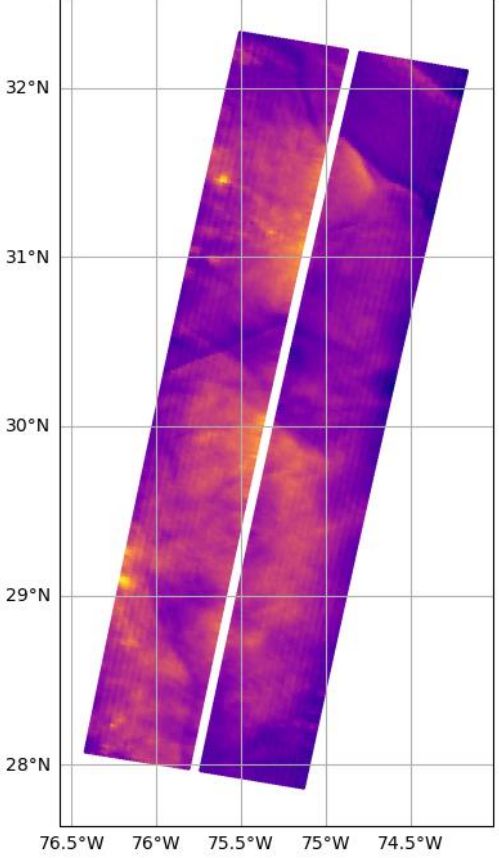


# 2D wind & wave measurements

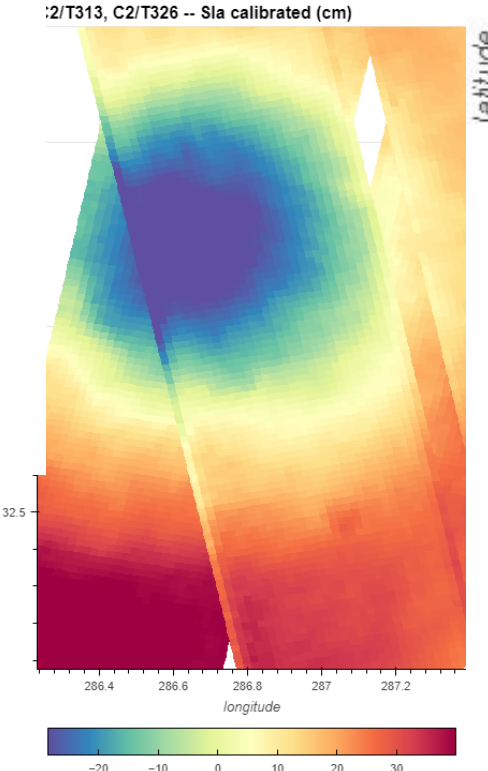
Significant Wave Height



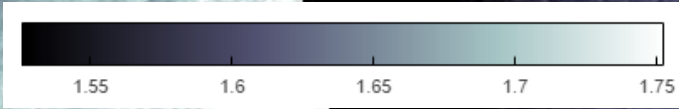
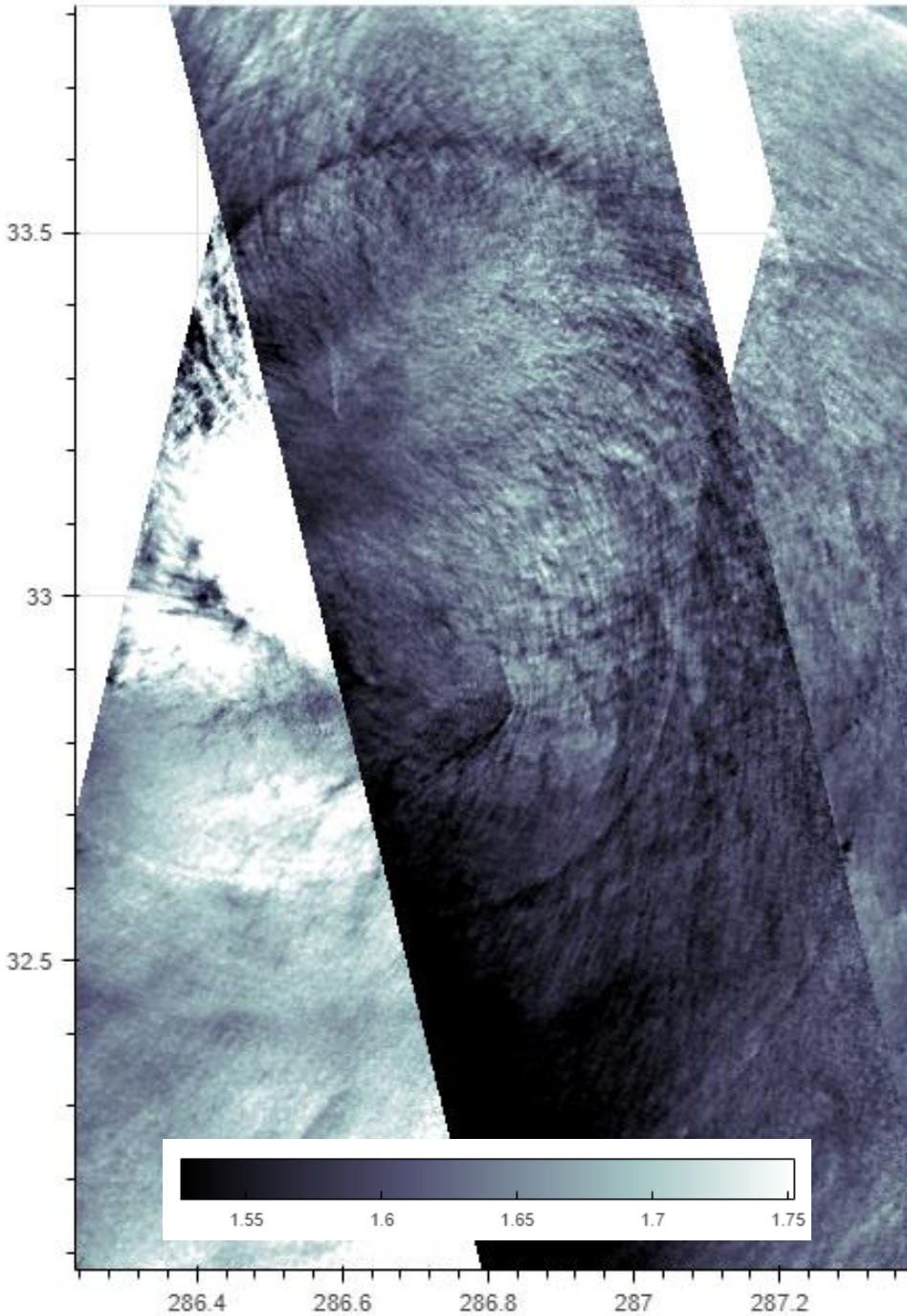
Wind Speed



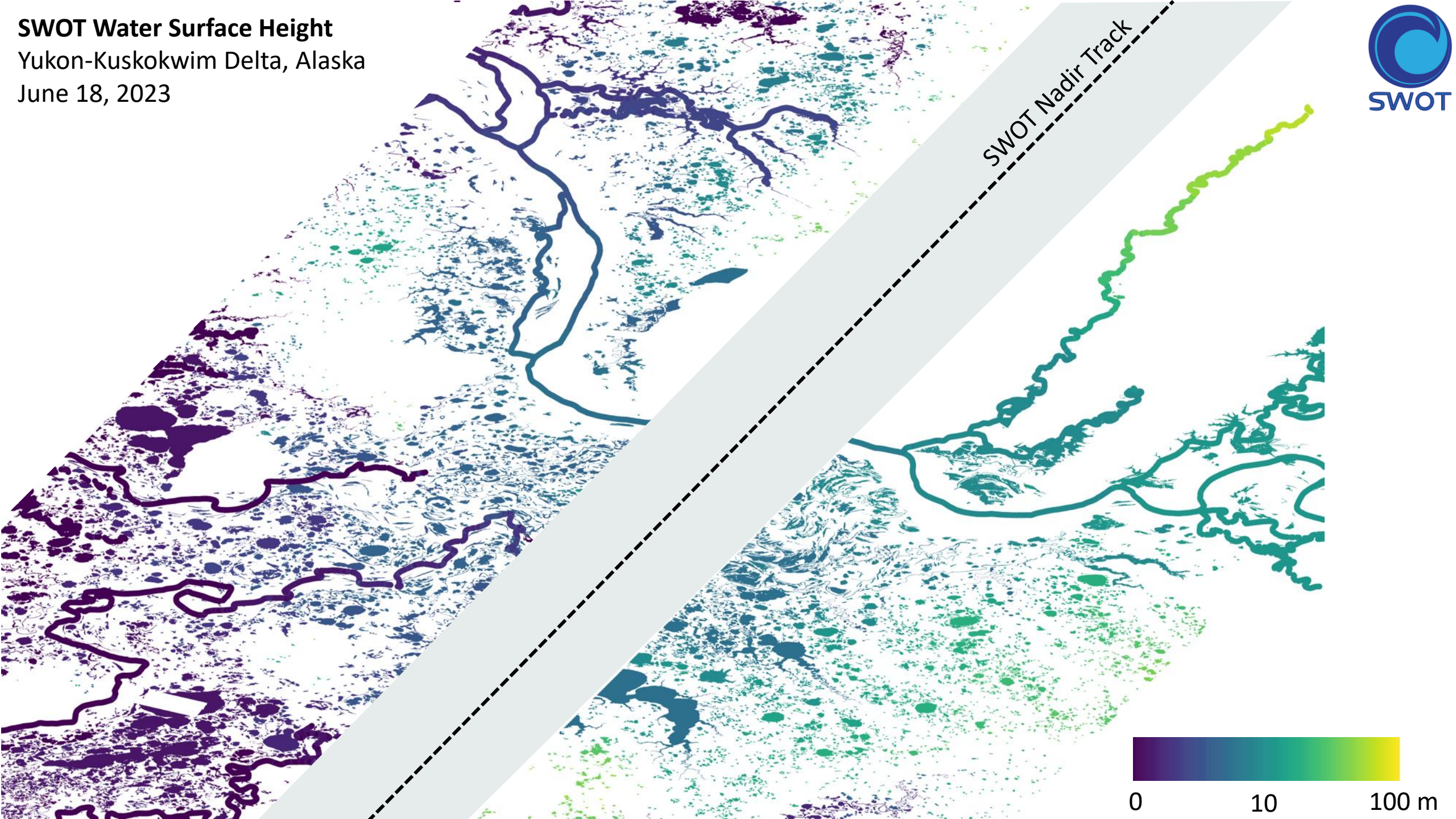
Sea-state and mesoscale interactions (SWOT radar NRCS and topography)



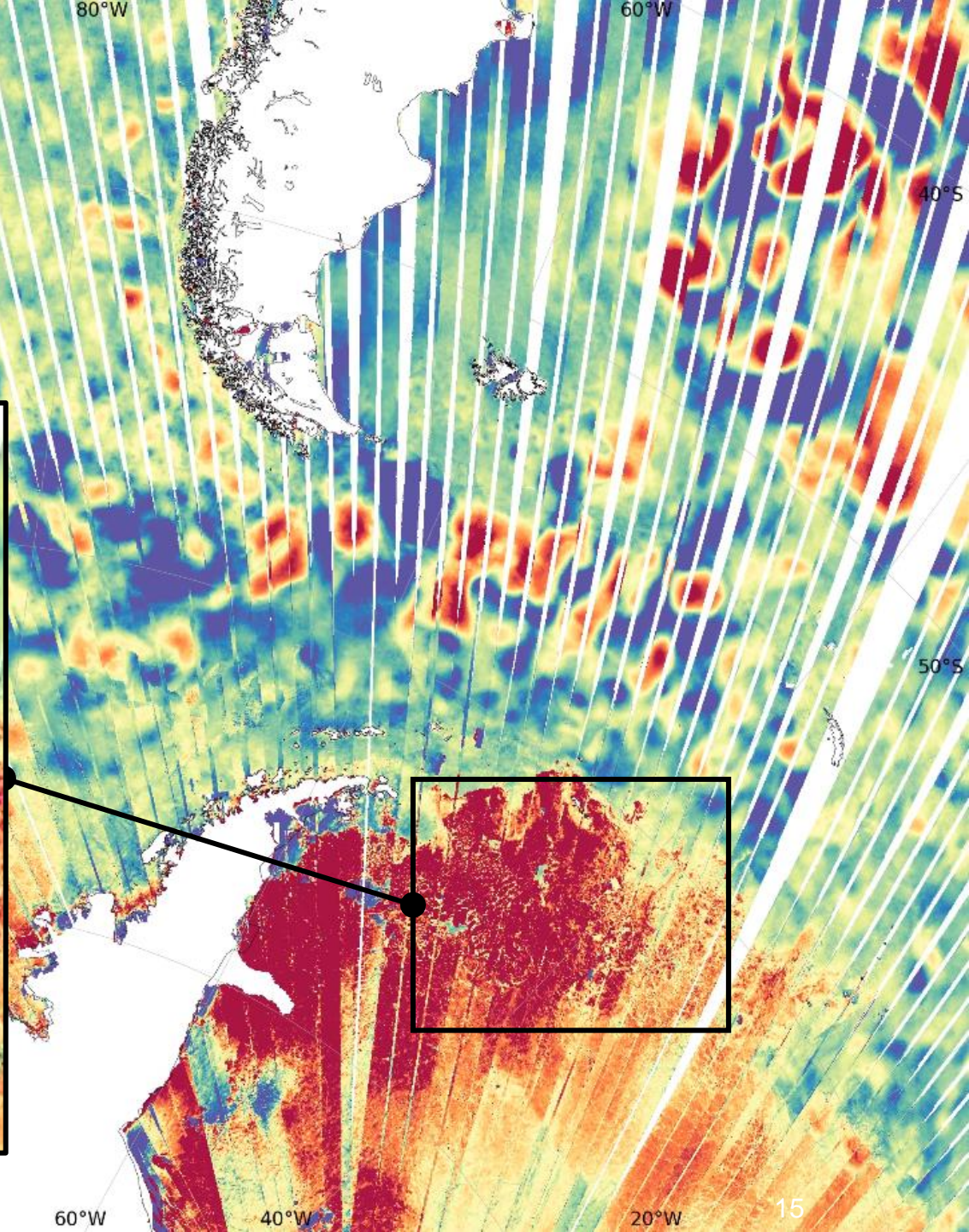
C2/T313, C2/T326 -- Sigma 0 250m (db)



**SWOT Water Surface Height**  
Yukon-Kuskokwim Delta, Alaska  
June 18, 2023



**10 days of KaRIn topography over  
the Southern Ocean and sea-ice  
(no interpolation, no smoothing)**



160°W

140°W

120°W

100°W

80°W

60°W

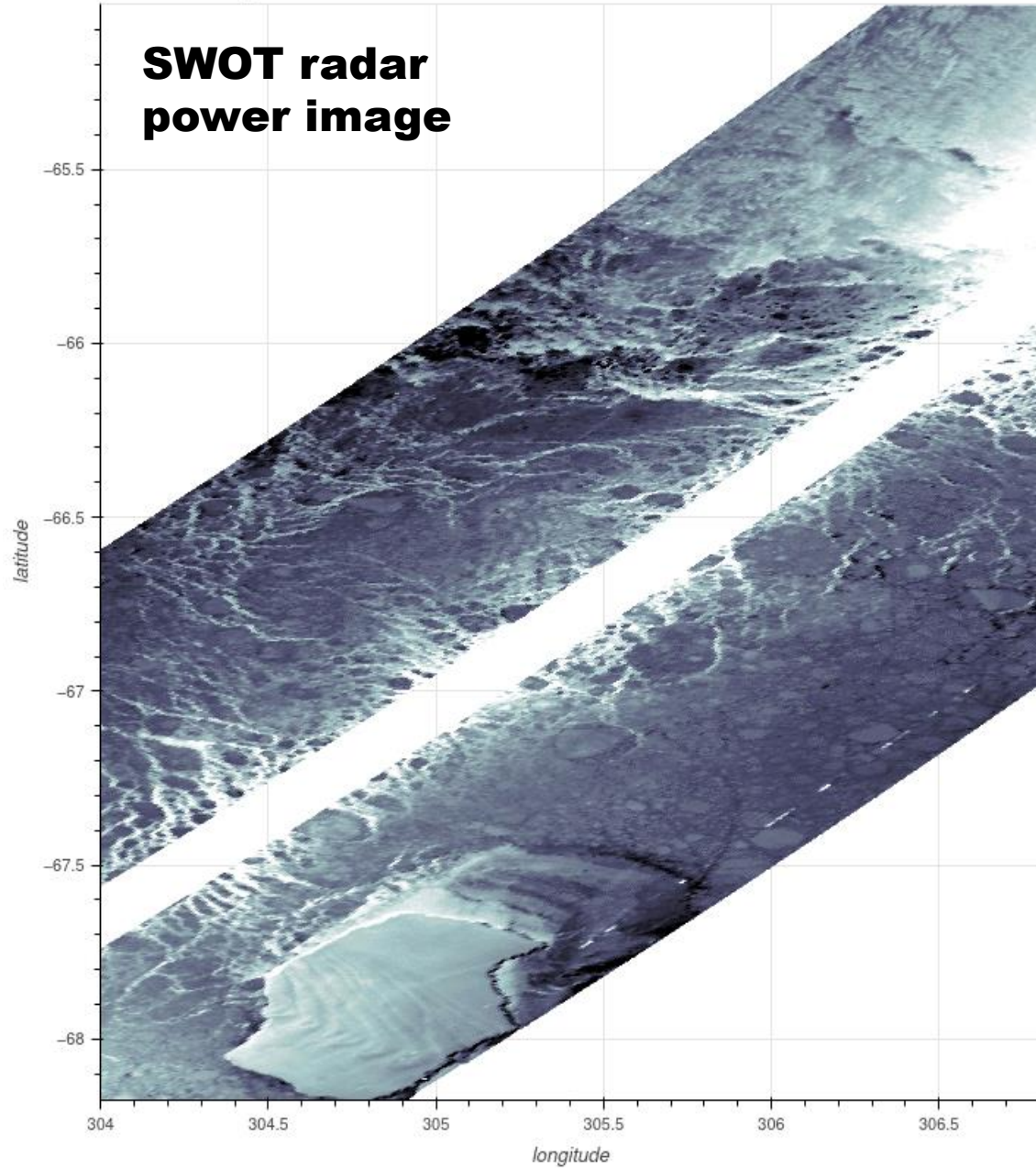
40°W

20°W

15

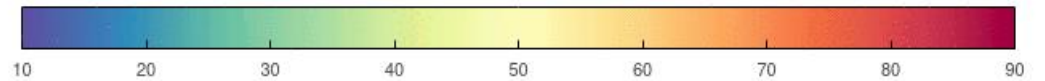
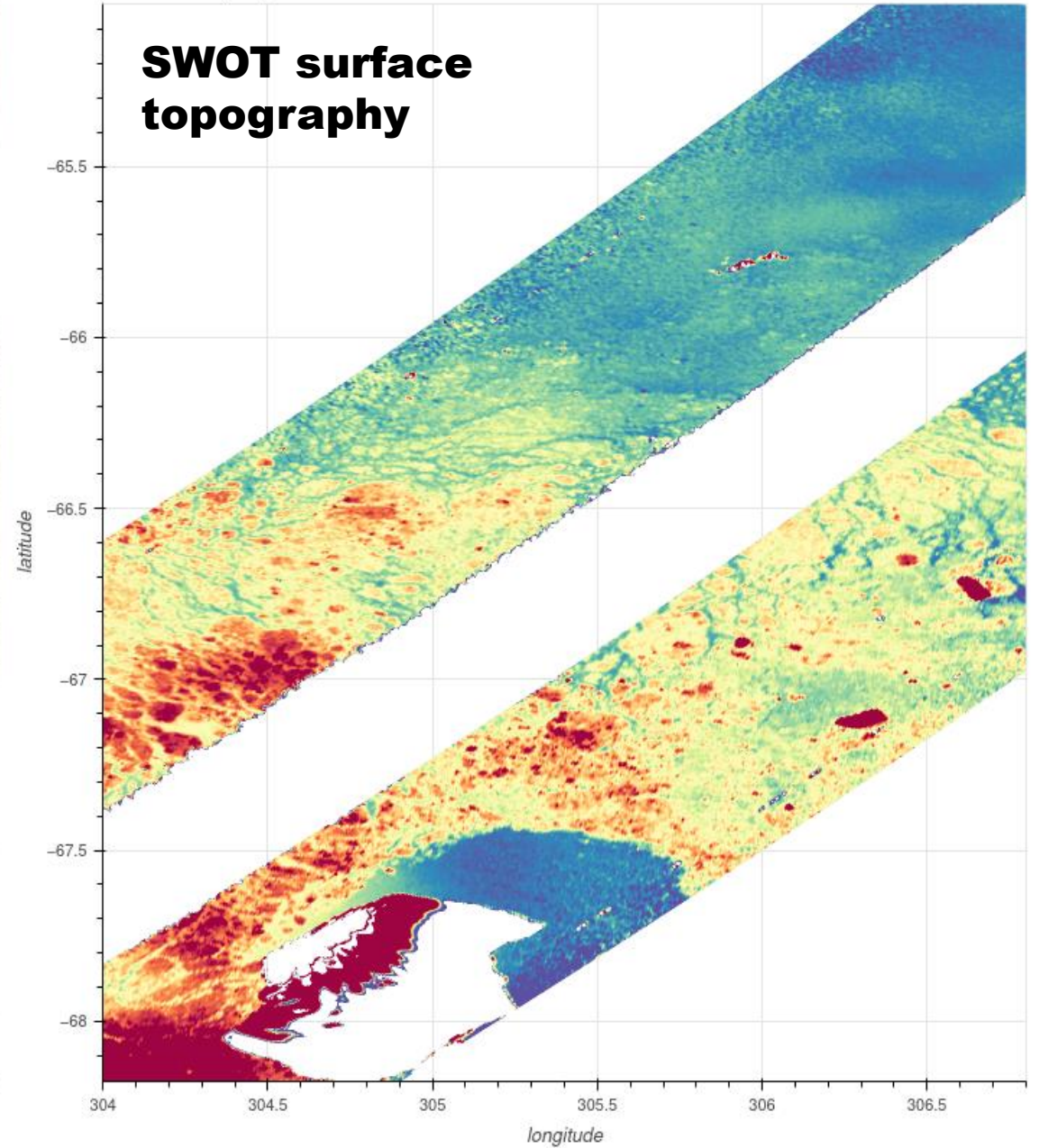
C486/T5 -- Sig0 250m

# SWOT radar power image



SLA 250m (cm)

# SWOT surface topography





# Question asked by Ocean Predict to SWOT



## How can ocean predict strengthen SWOT?

- Help needed for validation: get SWOT products (pre-validated) and inspect them with your experts' eye
- Advanced user feedback: use them in model validation and/or assimilation and report the outcome
- Contribute to Science Team discussions (e.g. separation of balanced/wave motions, atmospheric corrections...)

## What feedback is needed from the forecasting systems on SWOT

- Report obvious bugs and glitches
- Report suspicious features that are not realistic nor in your models
- Share your good stories as well: assimilation results, new findings, new OO capabilities with SWOT
- Make recommendations on the product format & content and way forward (e.g. geophysical corrections)

## Any other points you would like to convey to Ocean Predict

- The altimetry of 2030-40 is being defined now (e.g. SWOT-2, Sentinel-3 NG, China's GUANLAN & HY2)
- Various Space Agencies may have to choose between different technologies and trade-offs (1D or 2D)
- If you think there is added value (for OO) in SWOT measurements, say it now and say it loud!

➔ Coordinated feedback from OP would help the Space Agencies