

THE SURFACE WATER AND OCEAN TOPOGRAPHY (SWOT) MISSION AND ECCO

Jinbo Wang

(with many SWOT and ECCO colleagues)

Jet Propulsion Laboratory

California Institute of Technology

ECCO Workshop

1/25/2023

Launched on December 16, 2022

The main instrument Ka-band Interferometer was turned on
Preliminary measurements are encouraging

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Surface Water and Ocean Topography

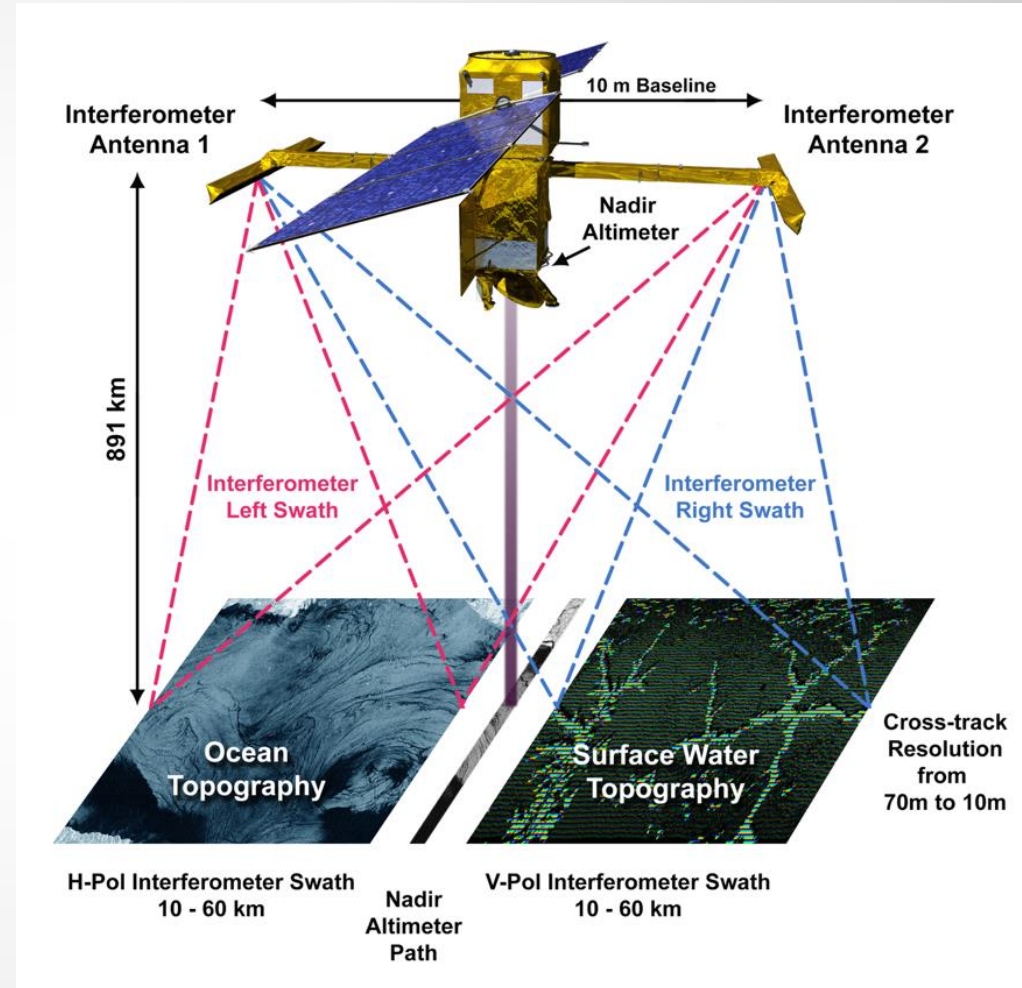
Ka-band Interferometer (KaRIn)

SWOT has two thrusts

1. Low-instrument noise
2. Two-dimensional swath measurements

The Jason-class Nadir Altimeter will ensure the continuity of satellite altimetry

Launched on December 16, 2022

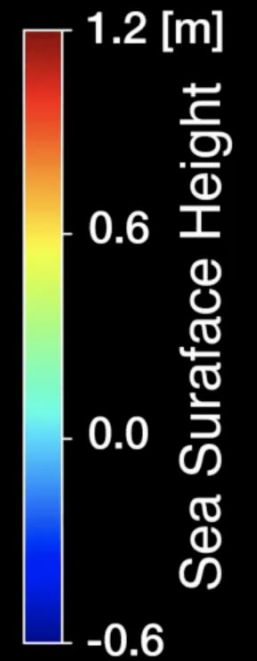
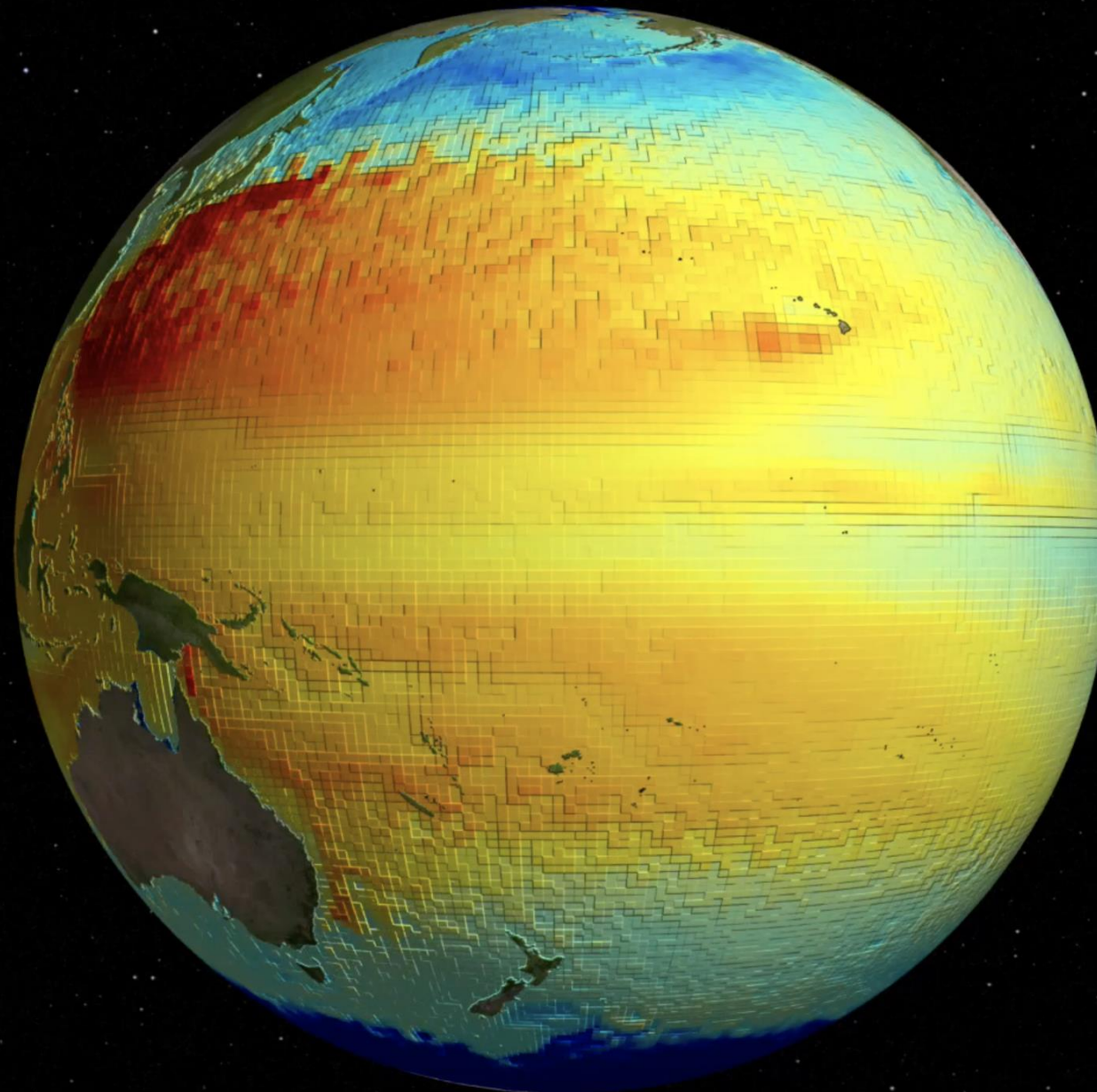


120km-wide swath, 2km pixels in Level 2



WHY SWOT?

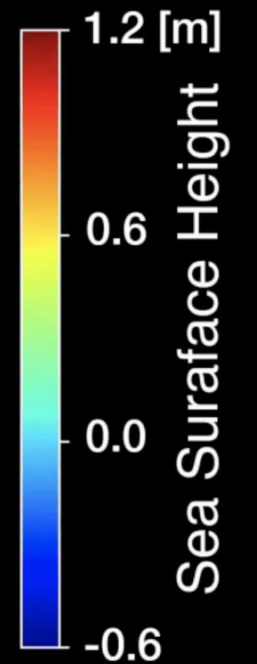
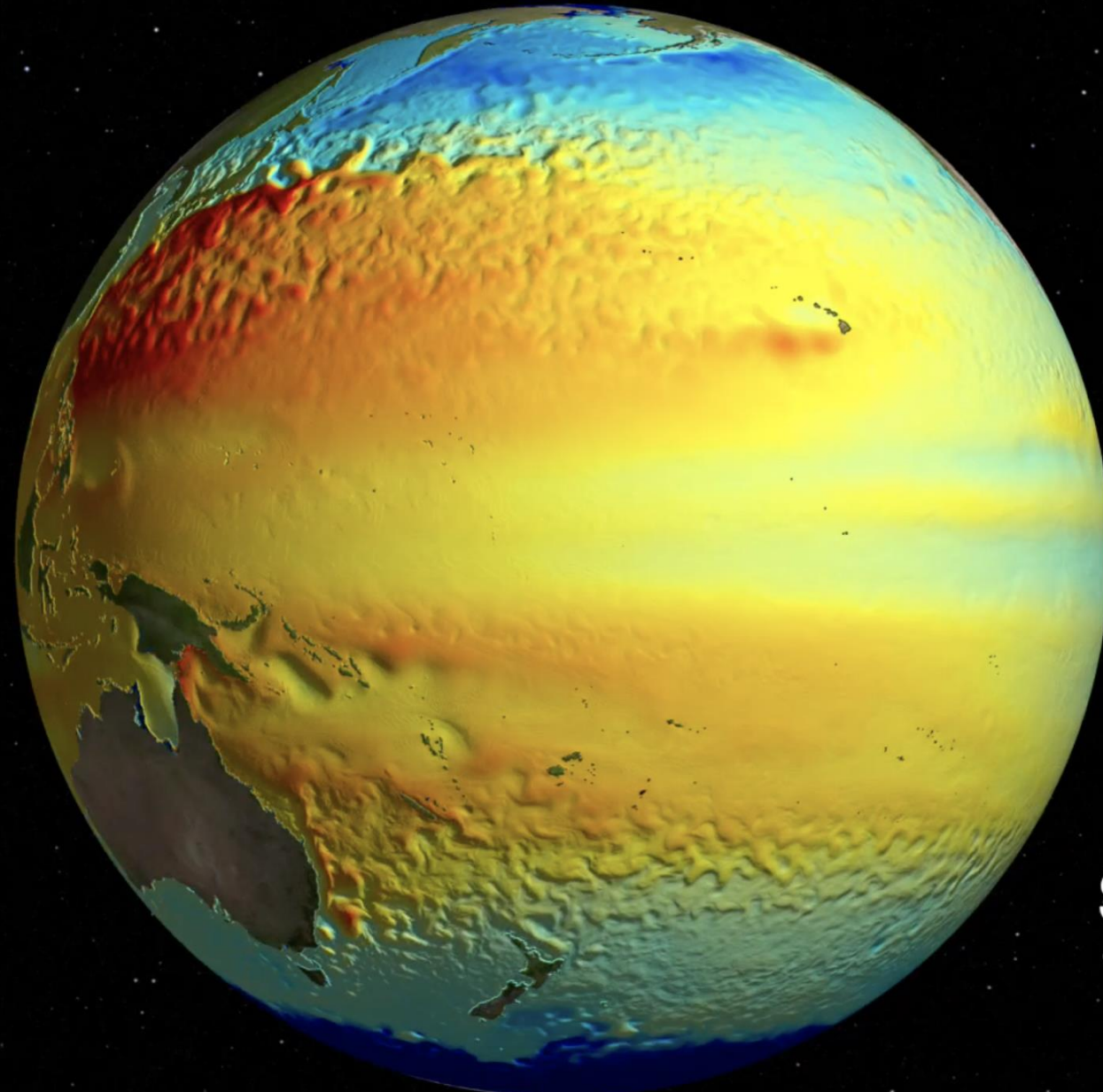
1. HIGHER RESOLUTION



Spatial resolution:
1 degree



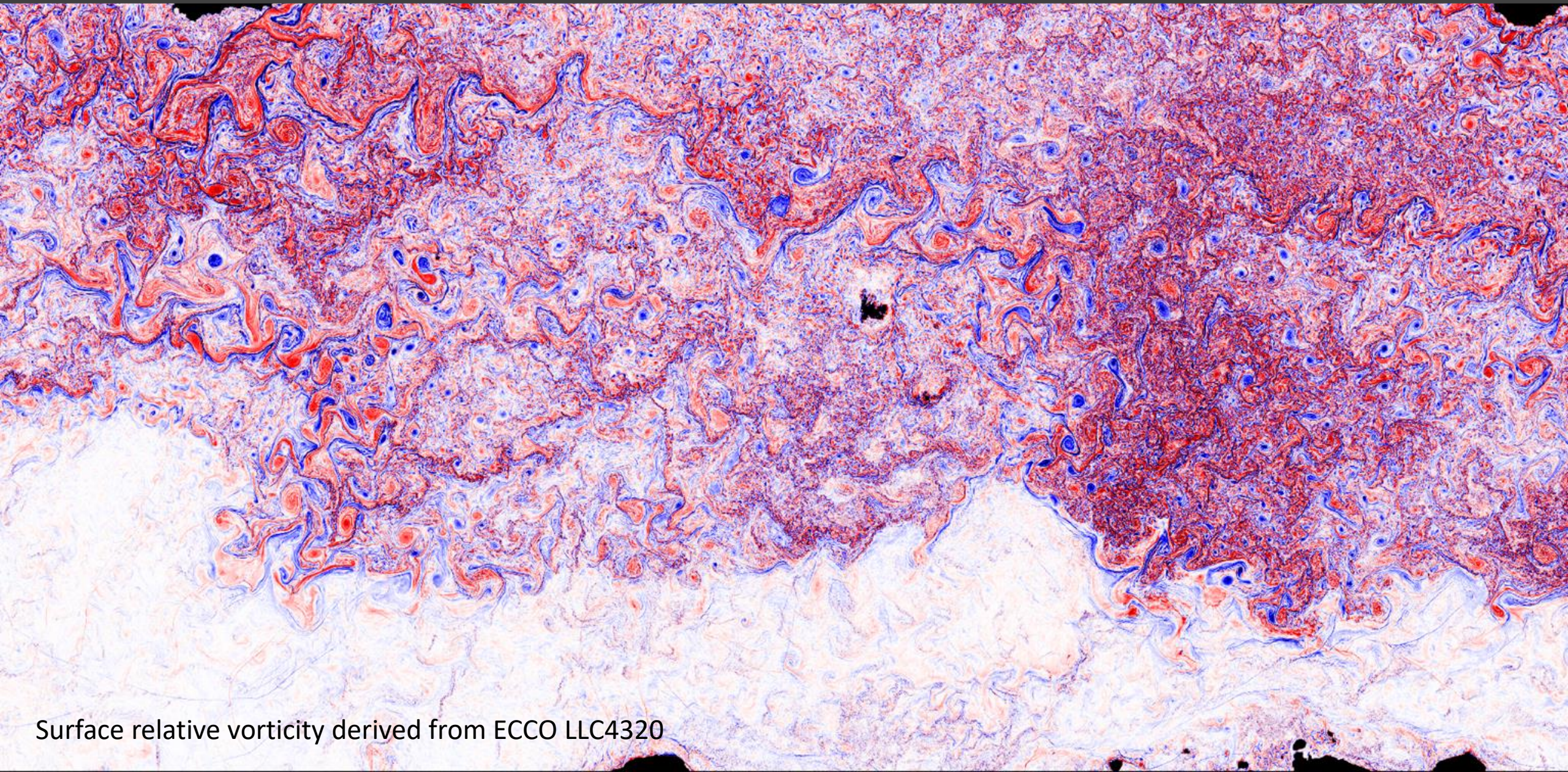
1. HIGHER RESOLUTION



Spatial resolution:
15 kilometers

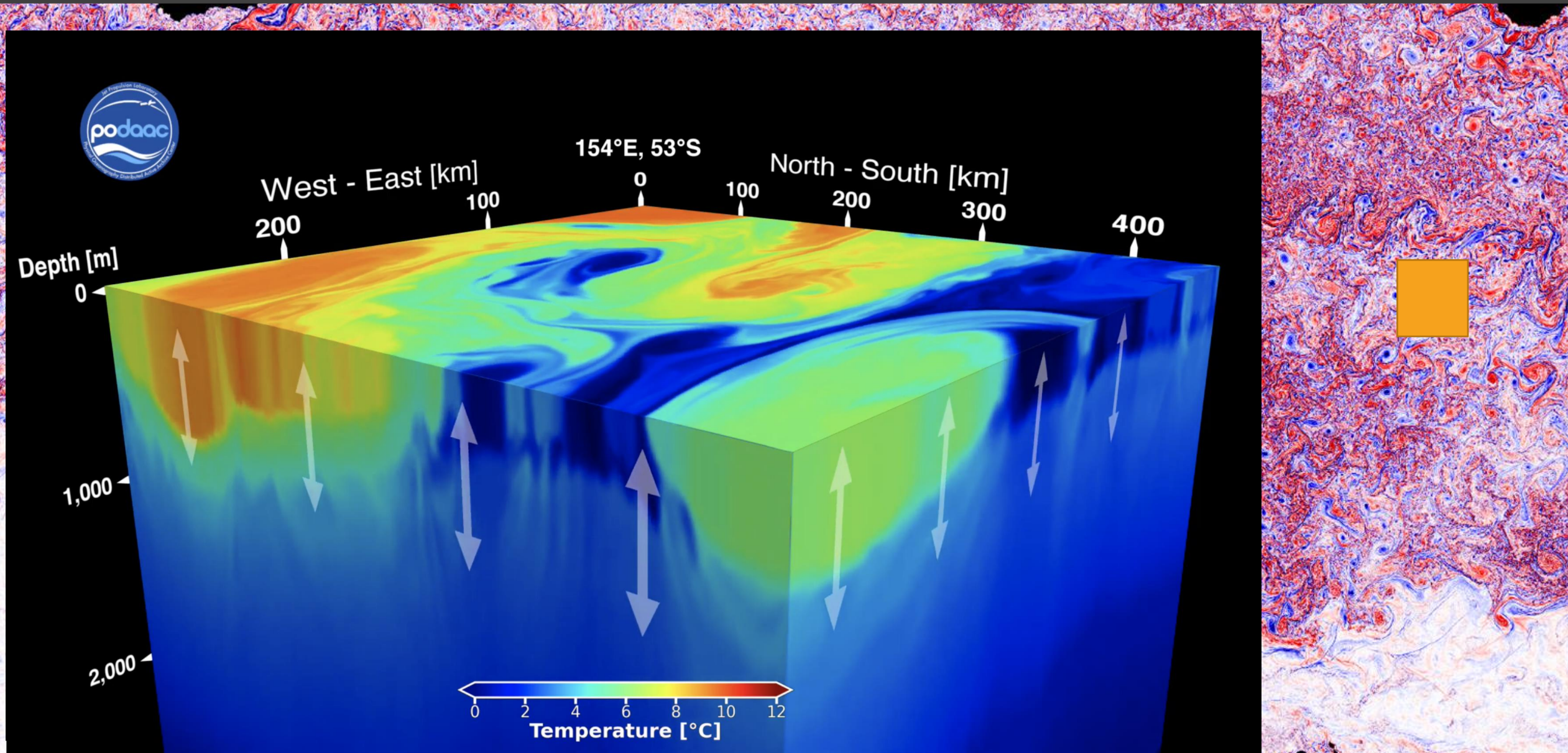


1. HIGHER RESOLUTION SMALL MESOSCALE OCEAN CIRCULATION

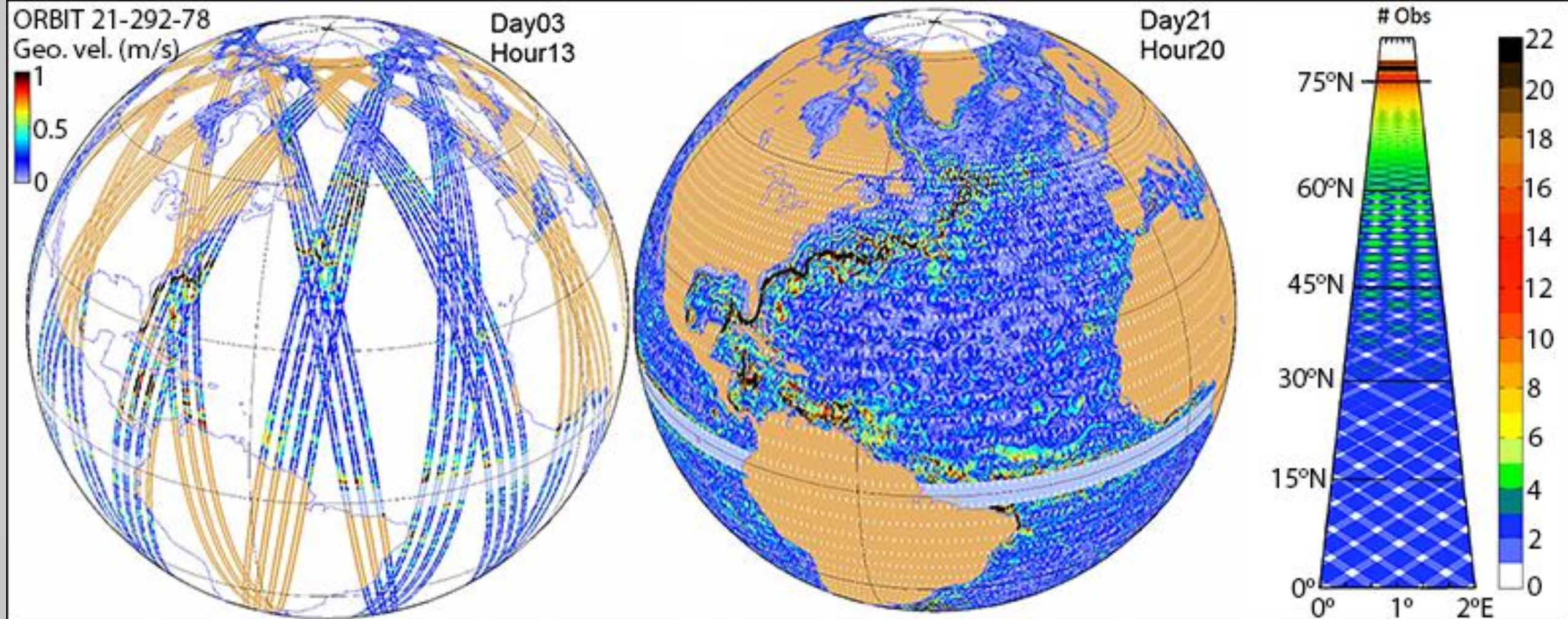


Surface relative vorticity derived from ECCO LLC4320

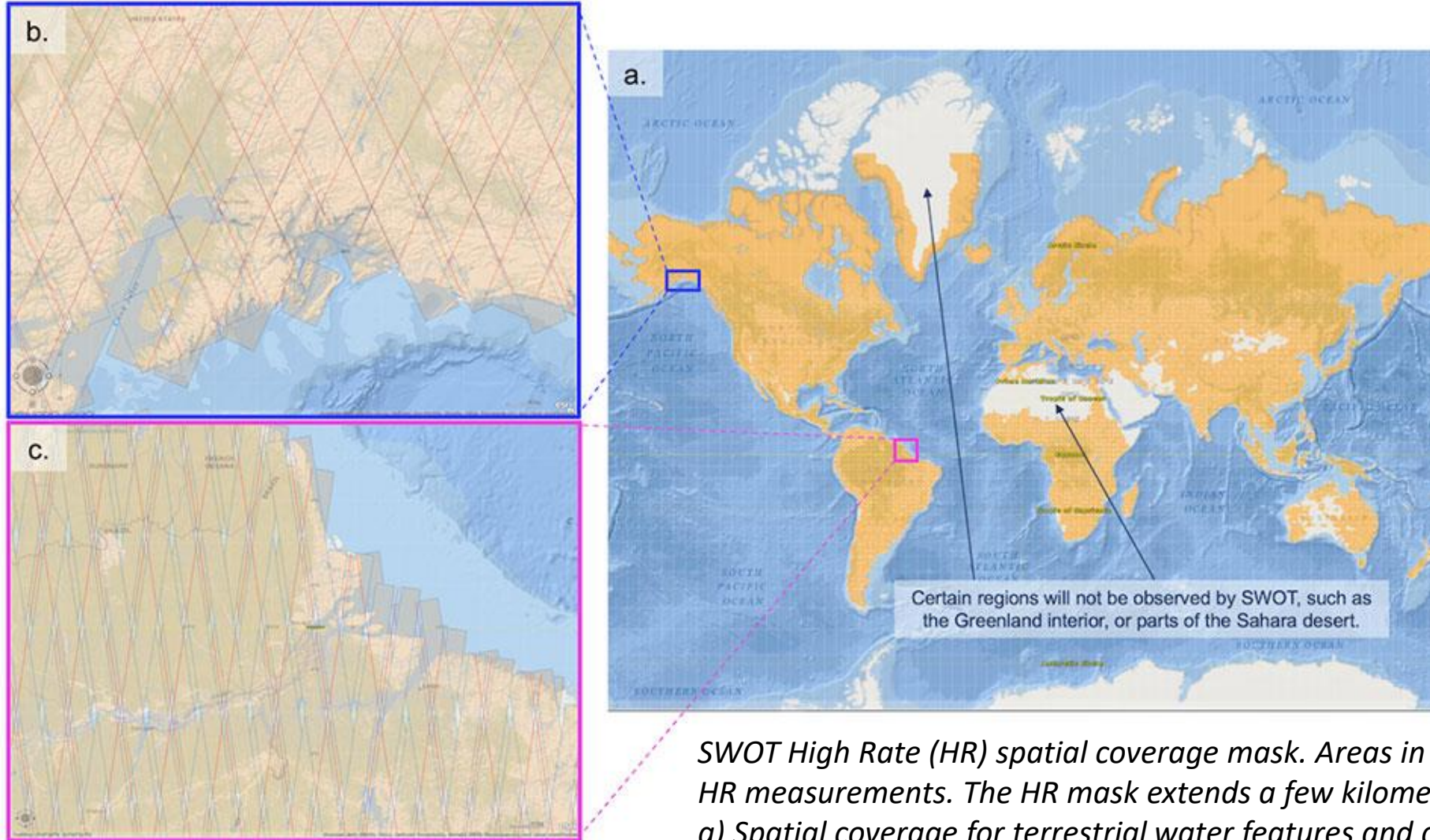
1. HIGHER RESOLUTION SMALL MESOSCALE OCEAN CIRCULATION, VERTICAL TRANSPORT



2. WIDE SWATH -> GLOBAL COVERAGE



3. COASTAL ALTIMETRY



SWOT High Rate (HR) spatial coverage mask. Areas in yellow will have HR measurements. The HR mask extends a few kilometers off the coast. a) Spatial coverage for terrestrial water features and coastal areas. b) Cook Inlet, AK. c) Amazon River Delta.

A satellite image of the Arctic region, showing the dark landmasses of the Arctic islands and the surrounding white ice and snow. A white text box with a black border is centered in the upper portion of the image.

4. INCLINATION 78° -> BETTER POLAR COVERAGE
~ ONE IMAGE EVERY TWO DAYS (CLOUD FREE)

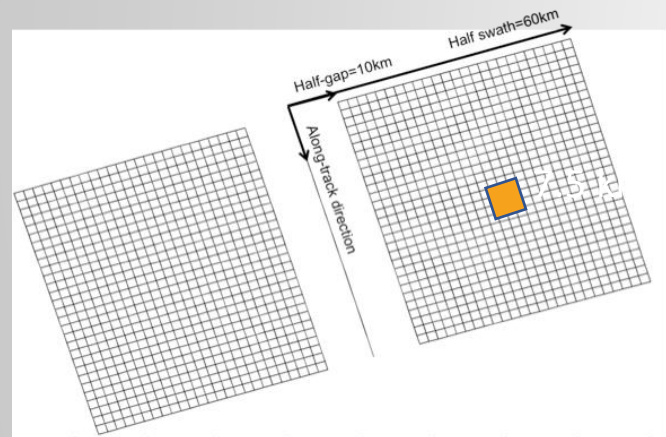
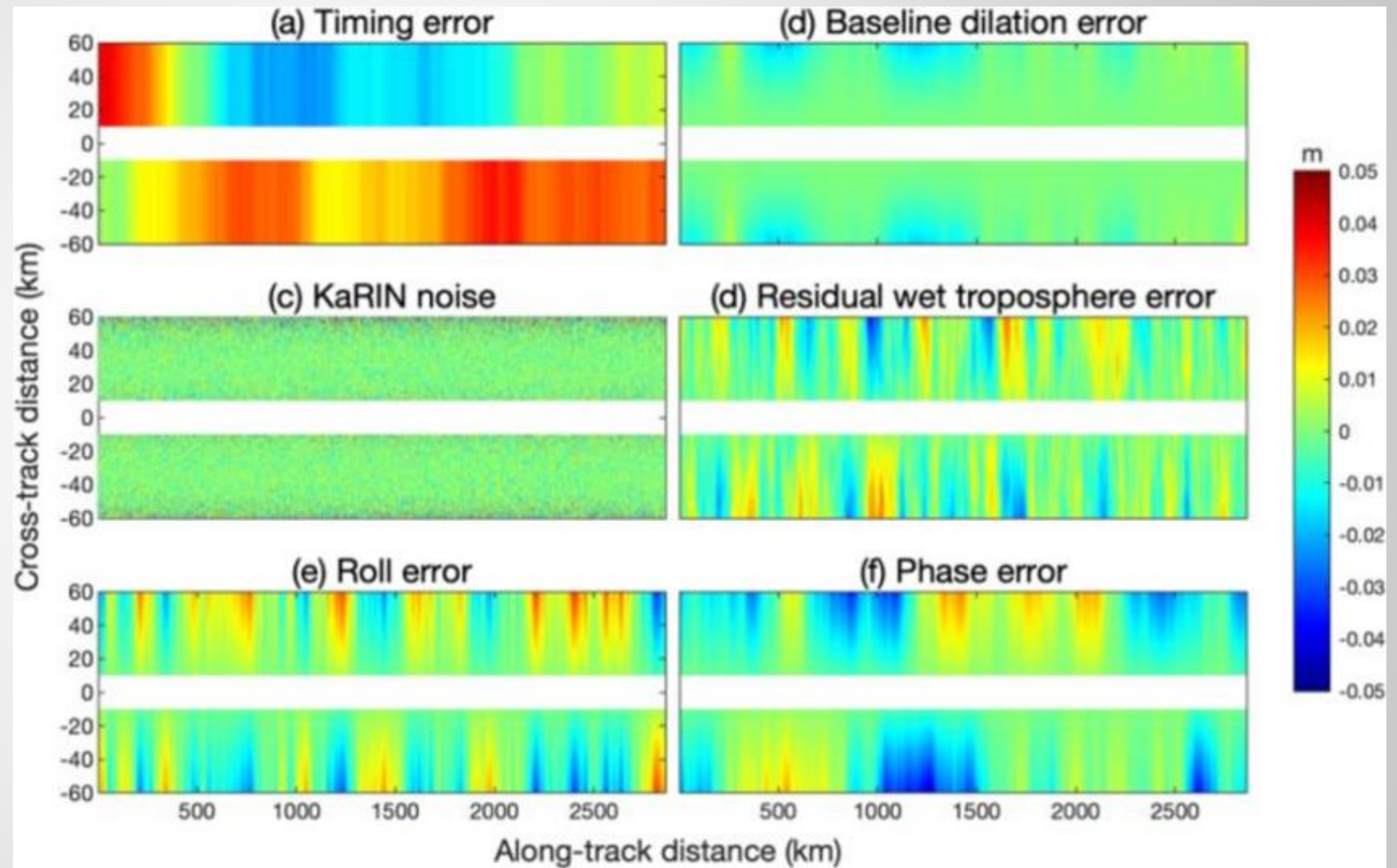
Terra/MODIS Corrected Reflectance (Credit: NASA WorldView)



PAST

ECCO LLC4320 WAS USED TO
SUPPORT THE MISSION
DEVELOPMENT

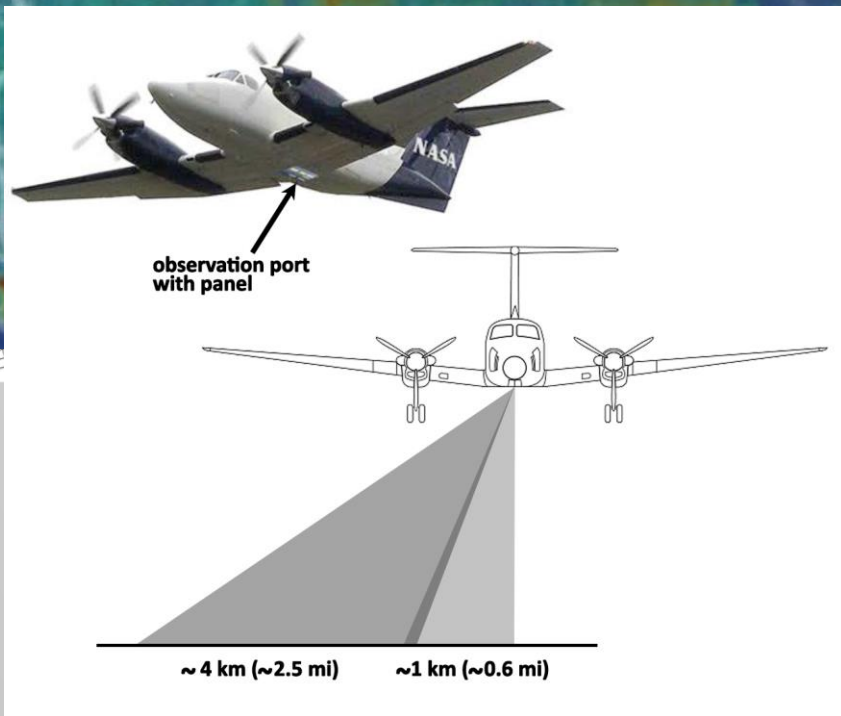
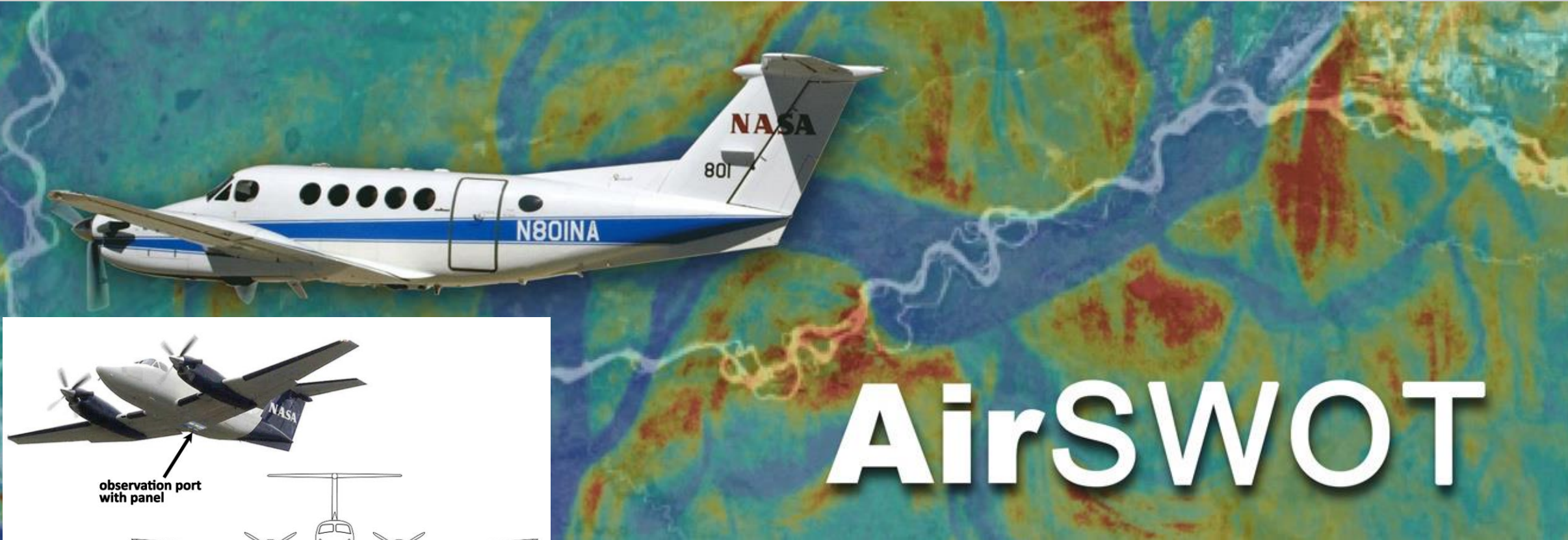
SWOT CALIBRATION AND VALIDATION



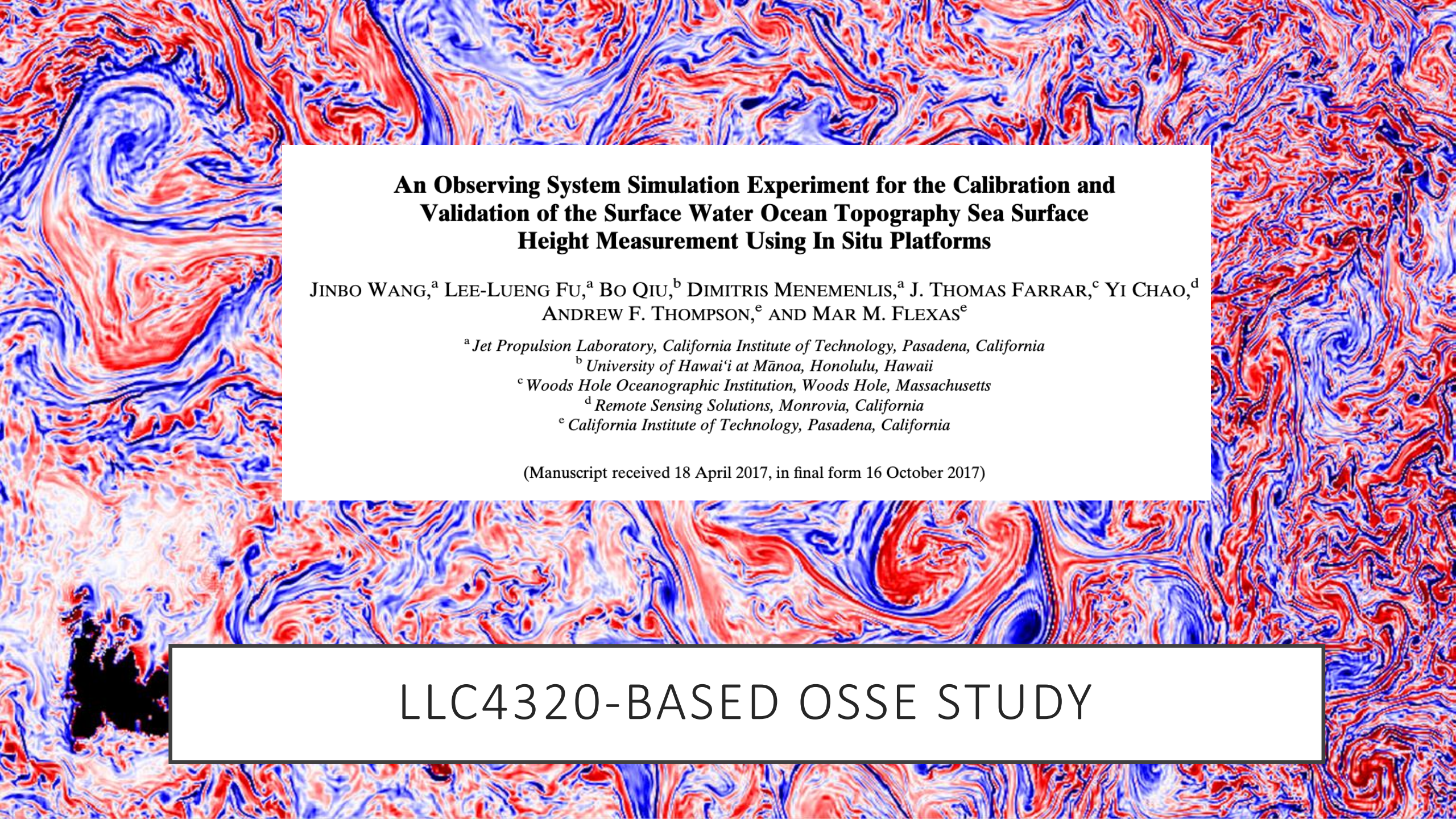
New requirement

Need new ground truth

SWOT CALIBRATION AND VALIDATION



Airplane is too slow. Surface waves introduce significant noise/error. -- 2016



An Observing System Simulation Experiment for the Calibration and Validation of the Surface Water Ocean Topography Sea Surface Height Measurement Using In Situ Platforms

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ANDREW F. THOMPSON,^e AND MAR M. FLEXAS^e

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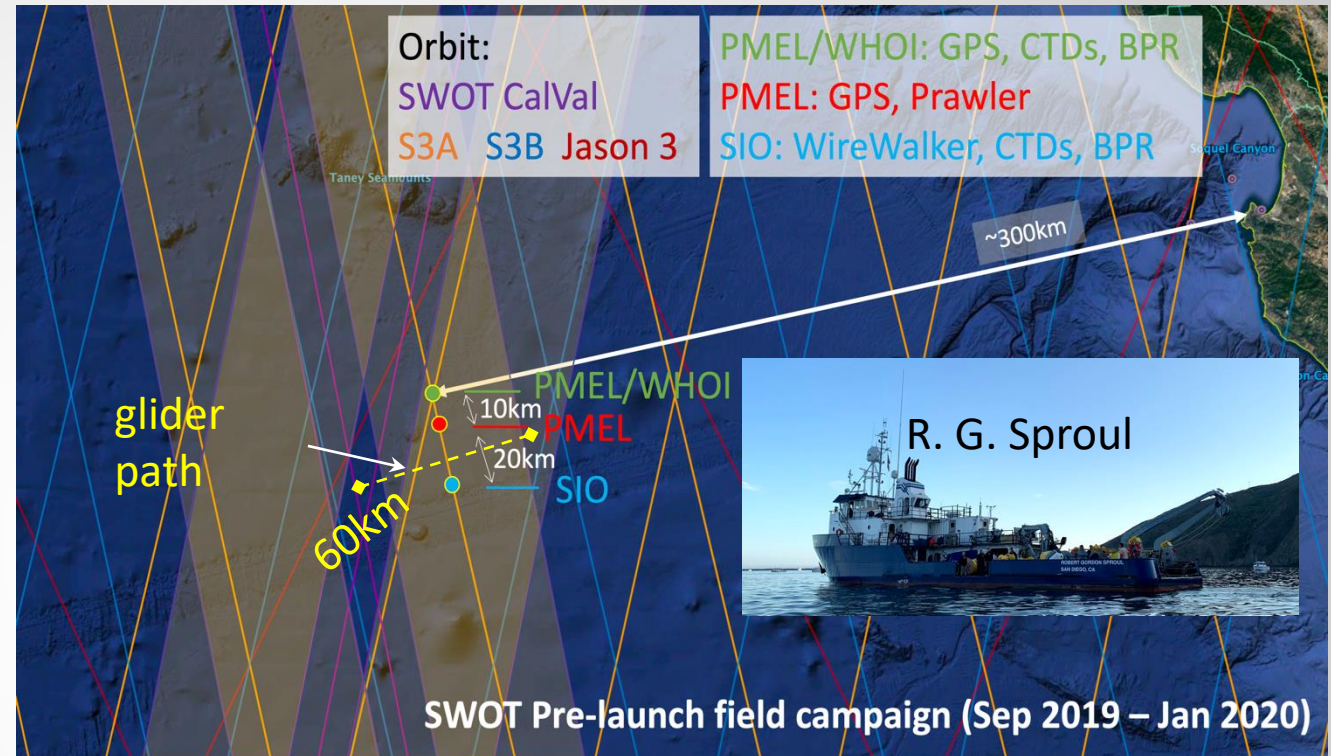
(Manuscript received 18 April 2017, in final form 16 October 2017)

LLC4320-BASED OSSE STUDY

2019-20 SWOT pre-launch Campaign

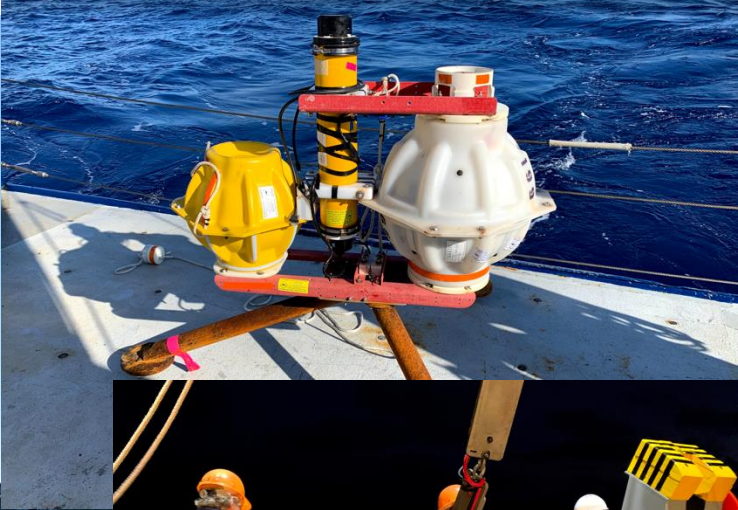
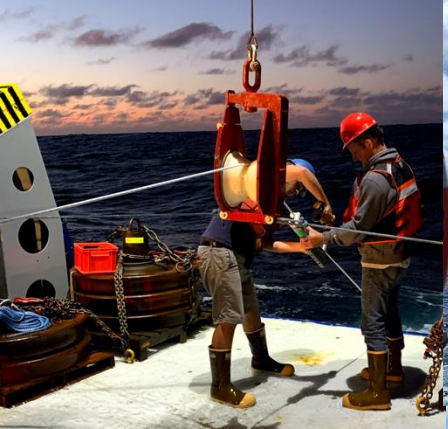
objectives

1. Test the SSH closure with GPS buoy, CTD mooring, and bottom pressure recorder (BPR)
2. Evaluate the vertical scale of the steric SSH at the SWOT scales for different frequency bands
3. Evaluate the roles of bottom pressure in SWOT SSH signals
4. Assess the information content of the in-situ observations
5. Continuation of the SSH wavenumber spectrum from Sentinel 3A to SWOT regime
6. Evaluate the reconstruction of the upper ocean circulation
7. Provide information for the design of the post-launch in-situ observing system.

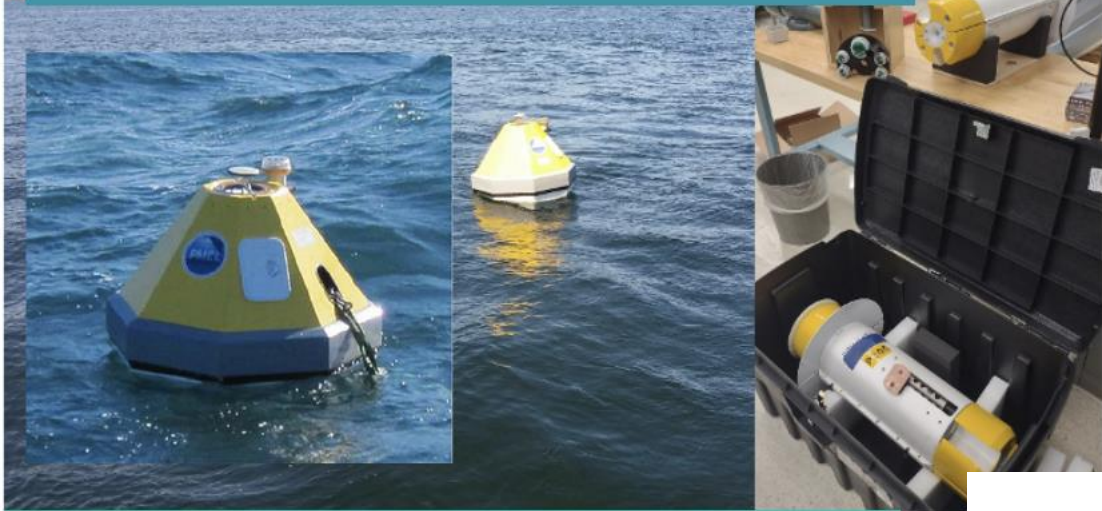


Campaign participants: Christian Meinig, Scott Stalin, Mike Craig, Danny Devereaux, Yi Chao, Oscar Schofield, John Kerfoot, David Aragon, Uwe Send, Andrew J. Lucas, Rob Pinkel, Matthias Lankhorst, Jeff Sevadijan, Ethan Morris, Riley Baird, Romain Heux, Tyler Hughen, Paul Chua, Drew Cole, Bofu Zheng, J. Thomas Farrar, Sebastien Bigorre, Ray Graham, Emerson Hasbrouck, Ben Pietro, and Al Plueddemann, Bruce Haines, Lee-Lueng Fu, Jinbo Wang

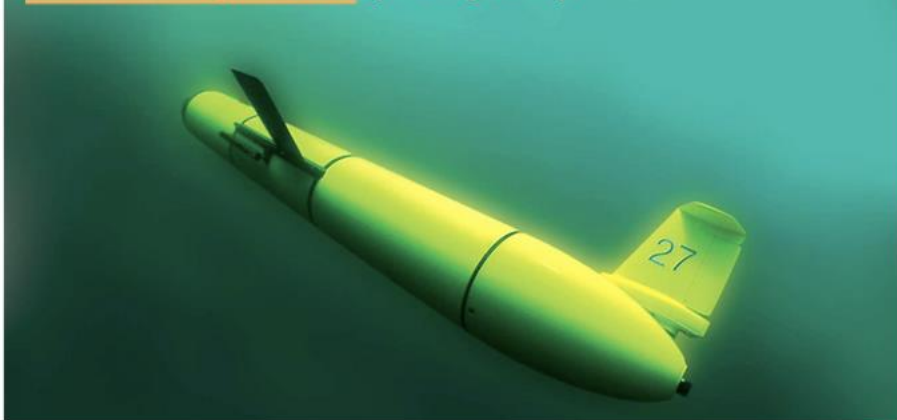
Acknowledgment: Matthew Archer, Richard Ray, David Sandwell, Hong Zhang, Anna Savage, Marie Eble, George Mungov



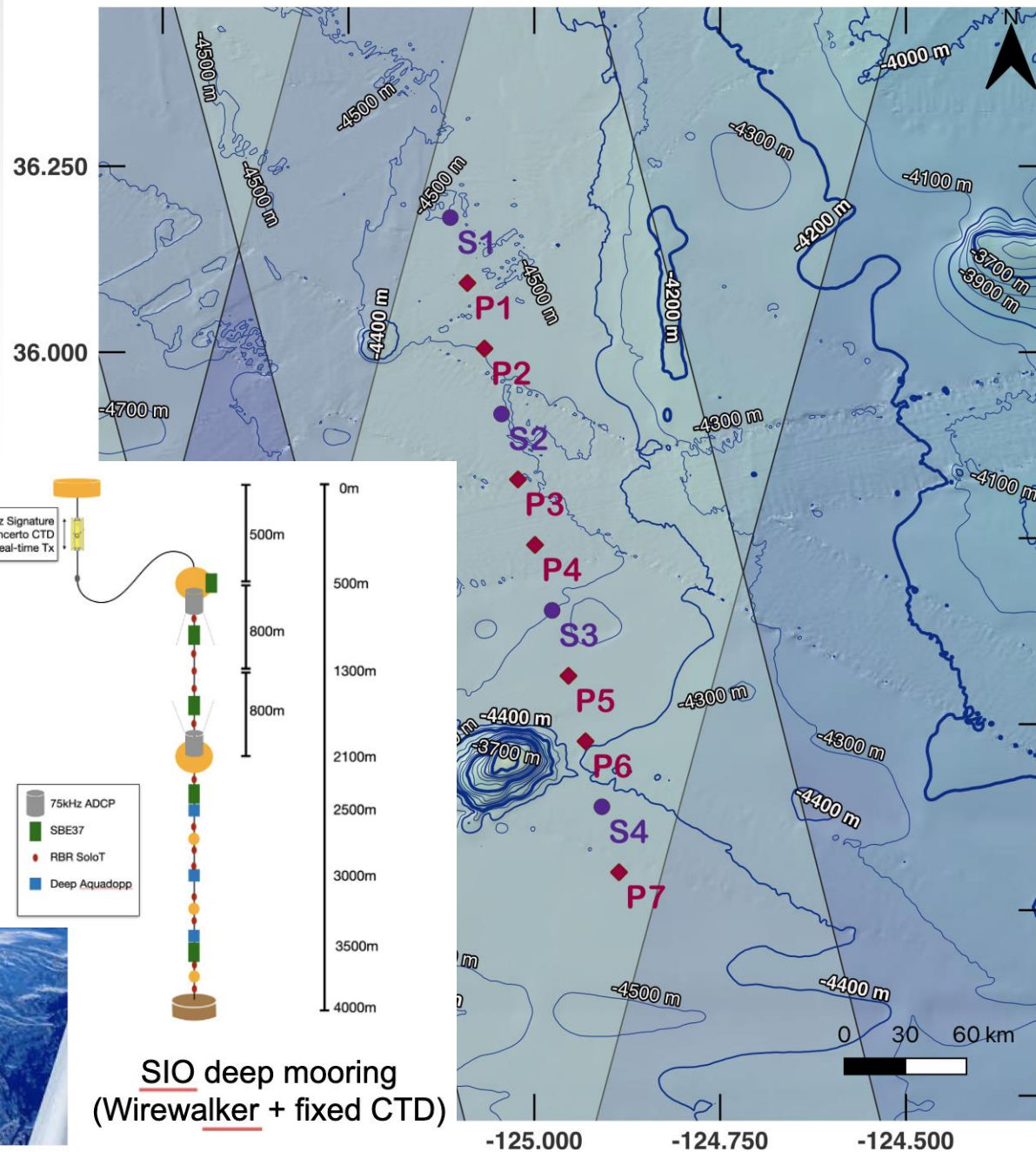
PMEL/NOAA Prawler (GPS+Prawler)



Slocum gliders (Rutgers)



Mooring Positions SWOT Post-Launch Cal/Val



SIO deep mooring (Wirewalker + fixed CTD)

PRESENT

ECCO-SWOT REGIONAL

laboratory
Technology

Jan 2023

Matt Archer's Talk

ECCO-SWOT

A regional implementation of MITgcm-ECCO 4DVAR
for direct support of the SWOT CalVal
in the California Current system

Matthew Archer, Babette Tchonang, Jinbo Wang, and Lee-Lueng Fu
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

Ganesh Gopalakrishnan, Bruce Cornuelle, Matt Mazloff, and Ariane Verdy
Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA

Nested Regional Modeling

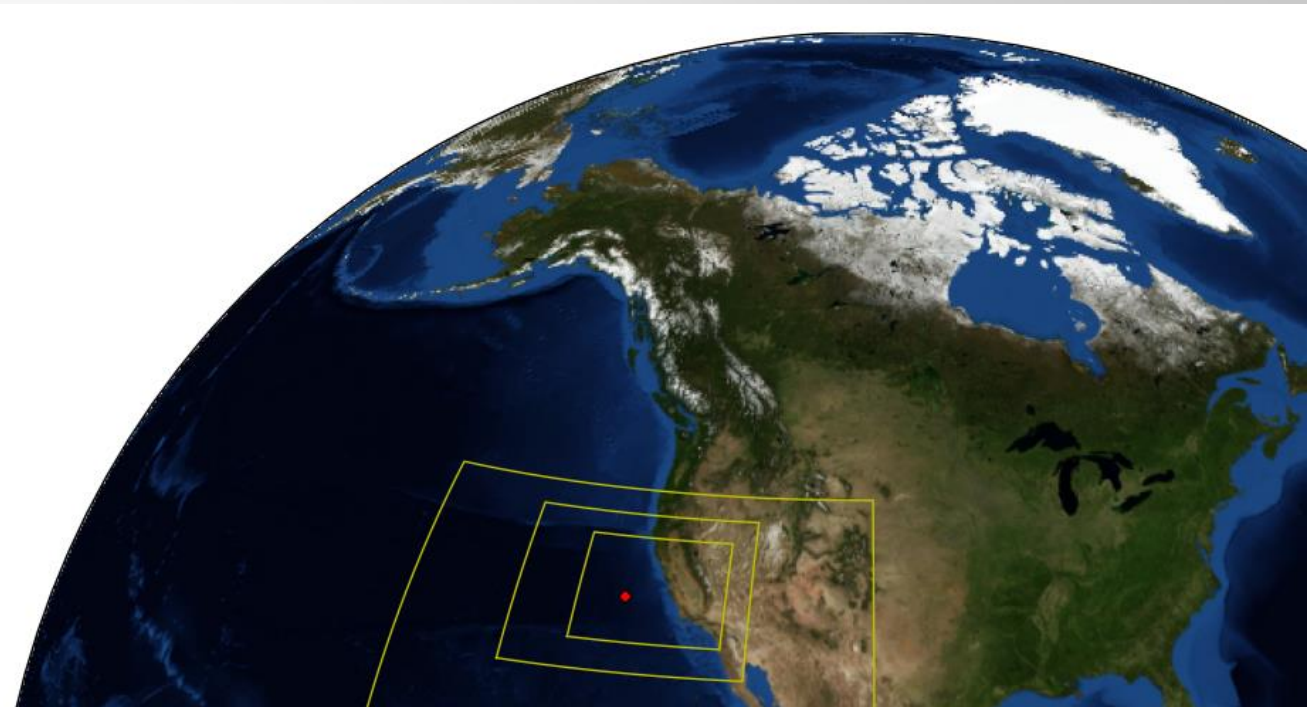
with a focus on the California Current near
the SWOT Cal/Val site

Mike Wood^{1,2}, Jinbo Wang¹, Ian Fenty¹, Hong Zhang¹,
Carine van der Boog¹, April Shin¹

¹Jet Propulsion Laboratory

²Moss Landing Marine Laboratories

Mike Wood's talk



FUTURE
ECCO-SWOT REGIONAL NESTED TO ECCO
LOW-RES

CONCLUSIONS

1. ECCO was instrumental in supporting the SWOT mission and science development by providing a high-resolution ocean simulation.
2. ECCO will play an important role in assimilating high-resolution SWOT by providing a regional DA framework.
3. LLC4320 facilitated many high-impact SWOT-related studies but not presented today.

DISCUSSIONS/QUESTIONS

1. How to take the full advantage of SWOT?
2. Need regional DA systems over the key regions, such as coastal regions and ocean-cryosphere boundaries
3. Short DA windows to focus on small temporal scale processes
4. Is a $1/24^\circ$ global ECCO achievable in the near future?