AUSWOT

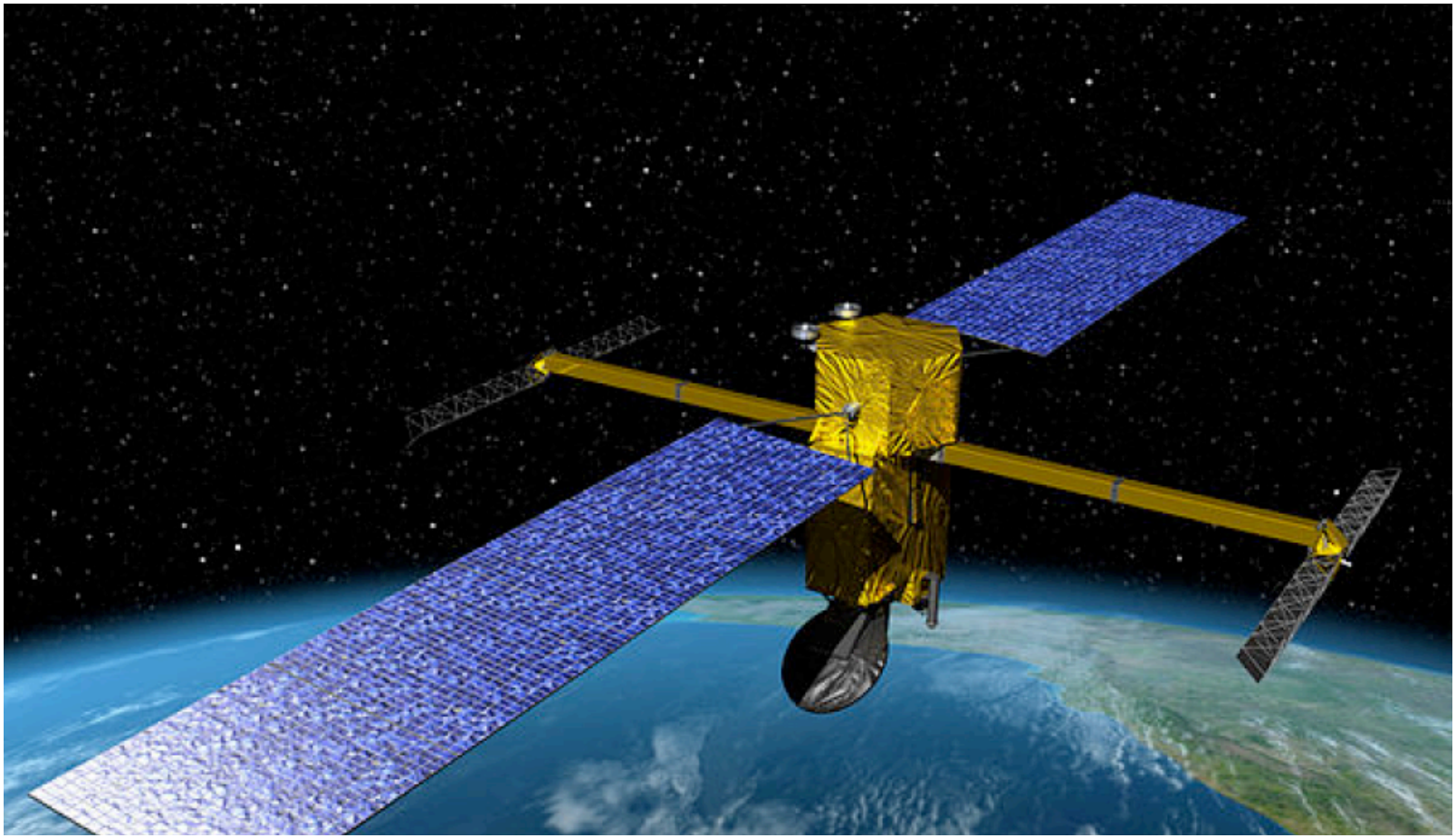
Australian Surface Water
Ocean Topography working group

THE SWOT MISSION:
OPPORTUNITIES AND CHALLENGES

SHANE KEATING, UNSW SYDNEY

BOM R&D WORKSHOP, 24 NOVEMBER 2020

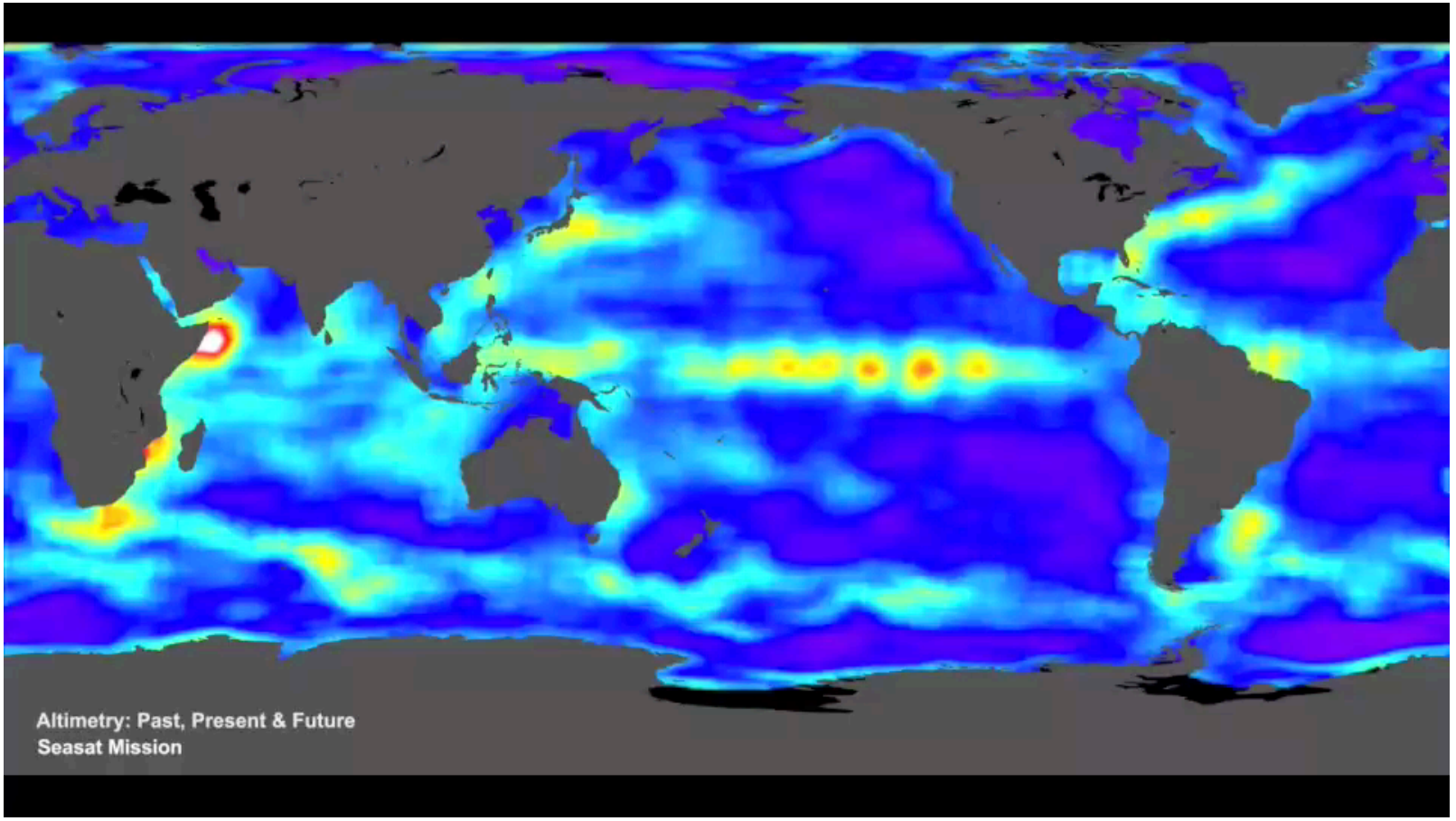
THE SURFACE WATER OCEAN TOPOGRAPHY (SWOT) MISSION



THE SURFACE WATER OCEAN TOPOGRAPHY (SWOT) MISSION

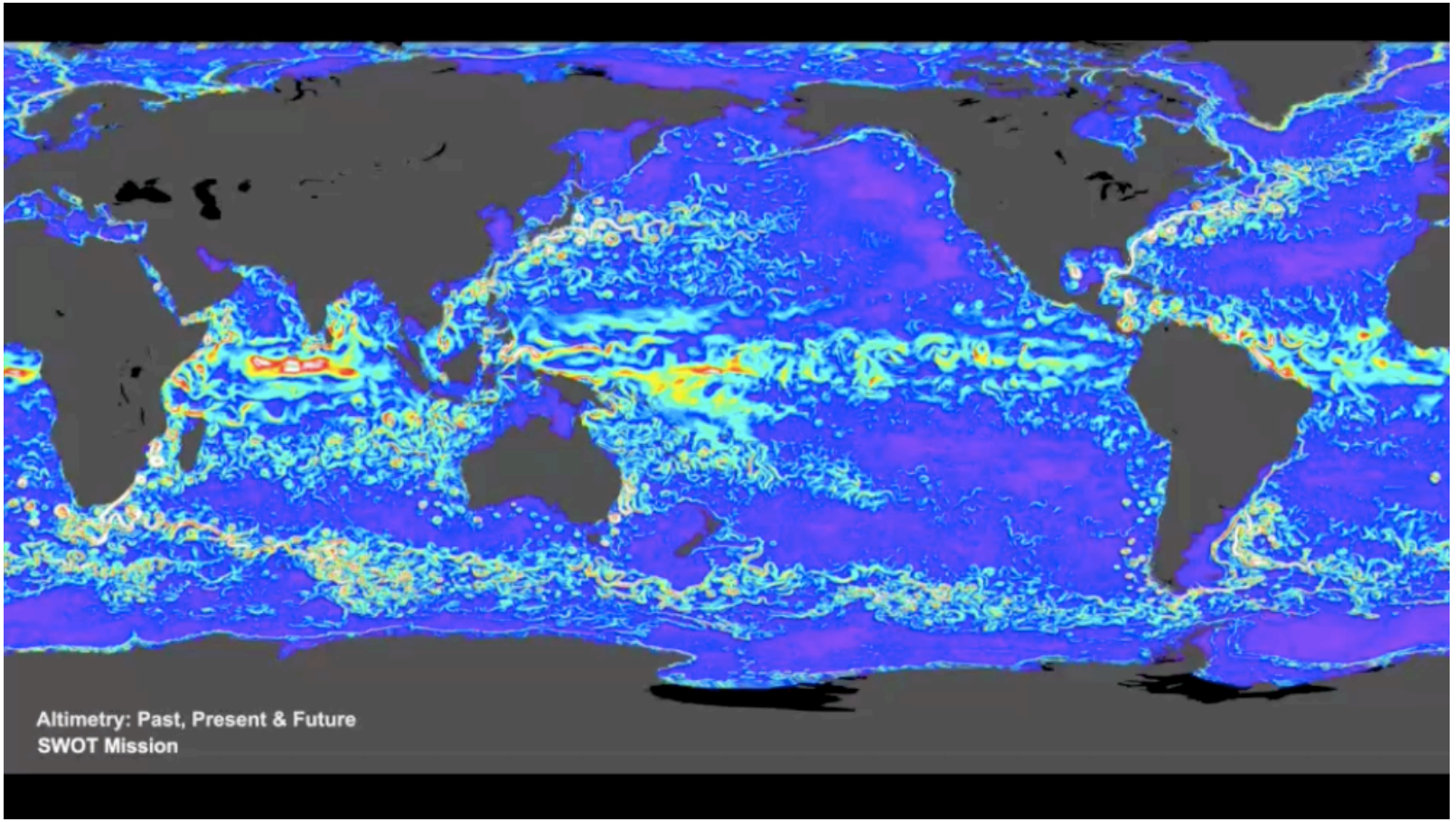
- Joint NASA/CNES project scheduled for launch **March 2022**
  - **Wide-swath radar interferometry** + nadir altimeter
  - **2D maps** of water elevation over 120 km swath
  - **10 times** the resolution of current generation altimeters
  - Australian government investment of $2.3M through IMOS/UTAS/CSIRO support for cal/val.
- Scientific objectives:
  - Monitor (terrestrial) **surface water** for the first time
  - Observe **ocean mesoscales and submesoscales** > 15 km
  - Coastal and high-latitude **tides and internal tides**
- Technological objective:
  - Set a new standard for **future altimetry missions**

THE SURFACE WATER OCEAN TOPOGRAPHY (SWOT) MISSION



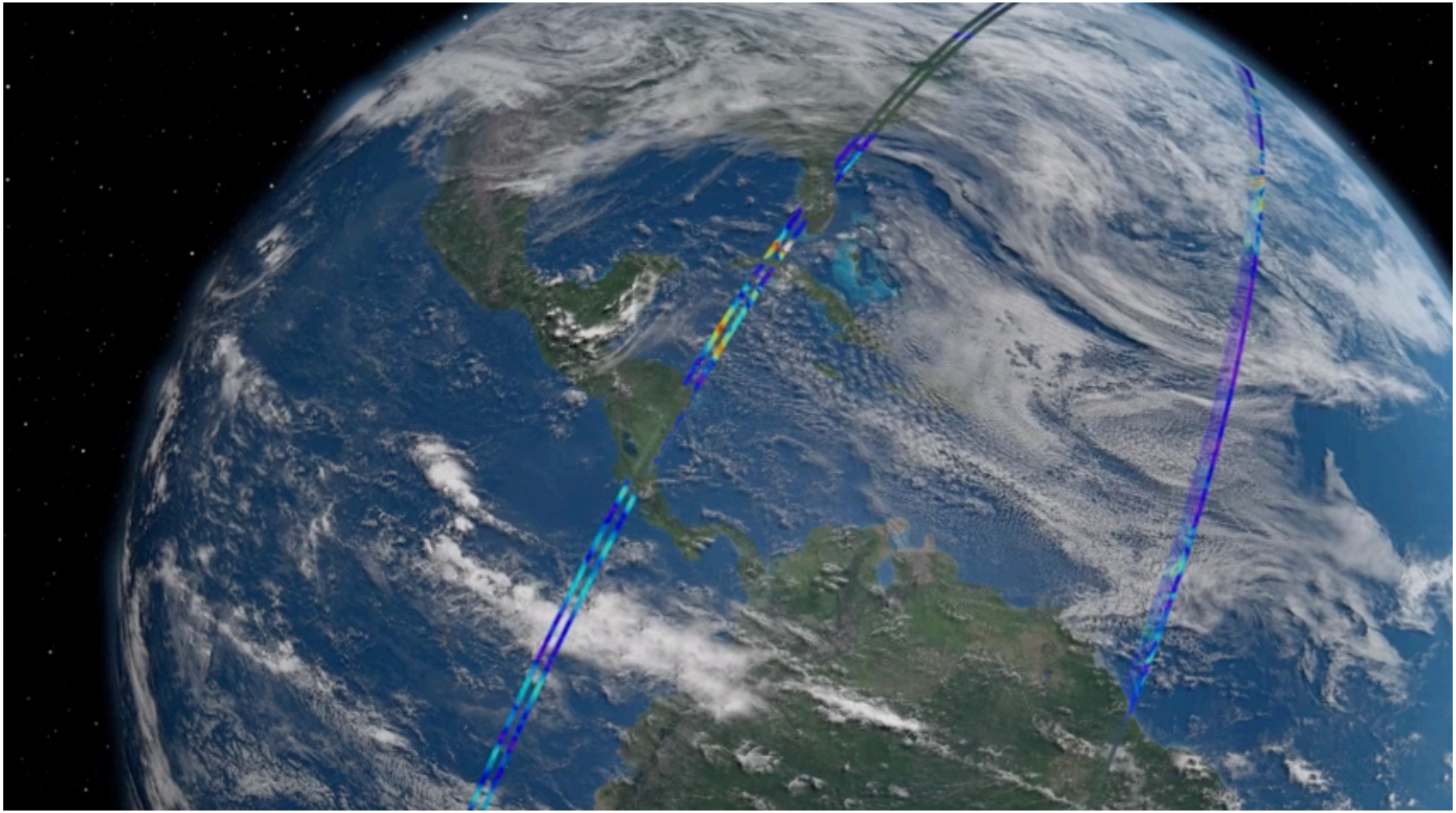
Credit: NASA JPL

THE SURFACE WATER OCEAN TOPOGRAPHY (SWOT) MISSION



Credit: NASA JPL

THE SURFACE WATER OCEAN TOPOGRAPHY (SWOT) MISSION

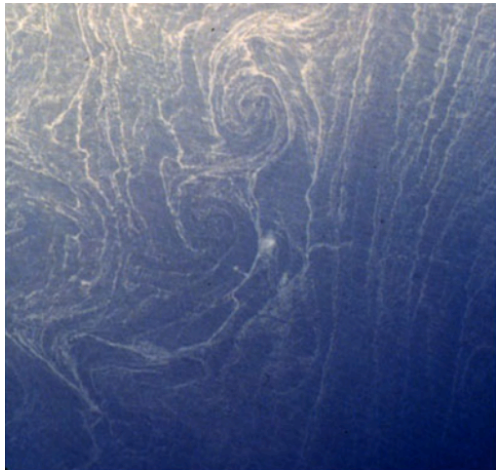


THE SURFACE WATER OCEAN TOPOGRAPHY (SWOT) MISSION

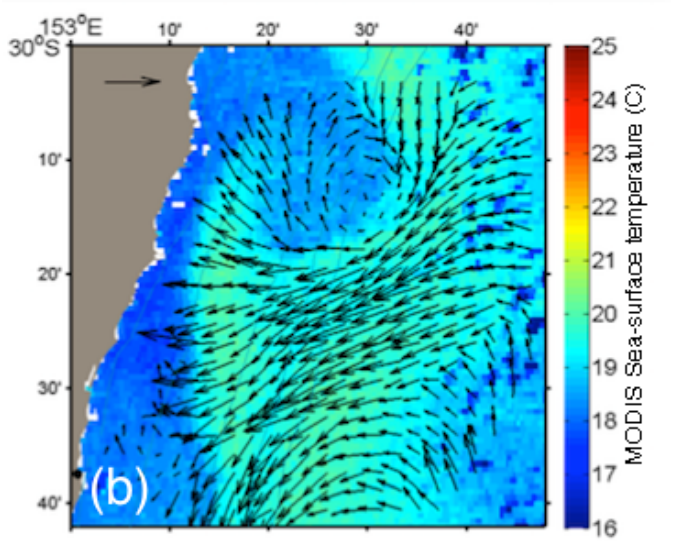
- **Nominal launch date:** March 2022 (SpaceX Falcon 9 rocket)
- **First 3 months** (~Apr-Jun 2022): instrument checkout
- **Second 3 months** (~Jul-Sep 2022): 1-day repeat fast-sampling phase over limited groundtrack
  - Ideal for studies of rapidly evolving small mesoscales, submesoscales, and internal tides/waves
- **3-year science orbit** (~Nov 2022-Nov 2025): 21-day repeat orbit with full global coverage
  - 2km resolution SSH + corrections + wind/waves (3-4 Gb/day)
- **Future SAR interferometry missions** (2025+): Guanlan, WiSA

OPPORTUNITIES FOR OPERATIONAL OCEANOGRAPHY

- **Fully resolve mesoscale eddies** in the open ocean
- **Coastal and shelf dynamics**, marginal seas, rivers/estuaries
- Ubiquitous **small mesoscale and submesoscale** ocean processes



Sea spirals (~5 km)

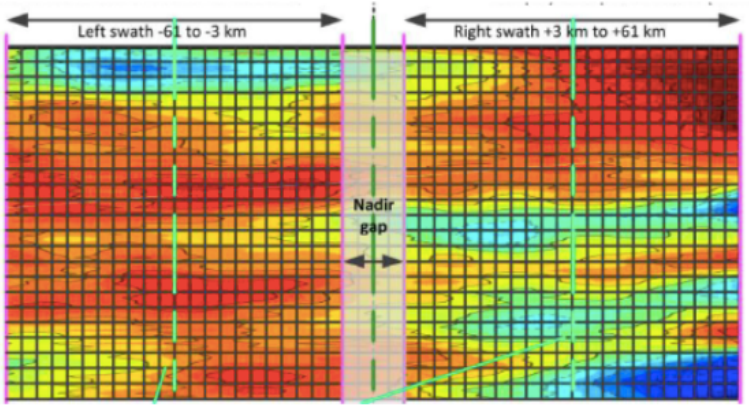


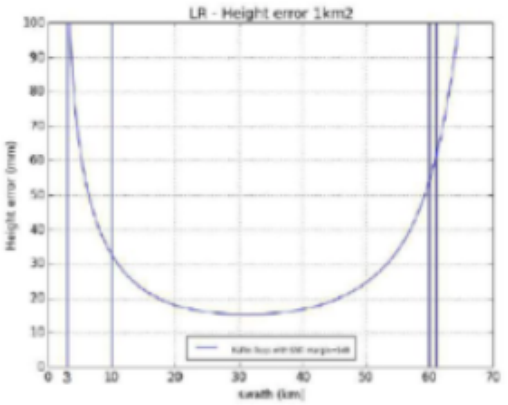
Frontal eddies (~40 km)

Pollutant dispersal

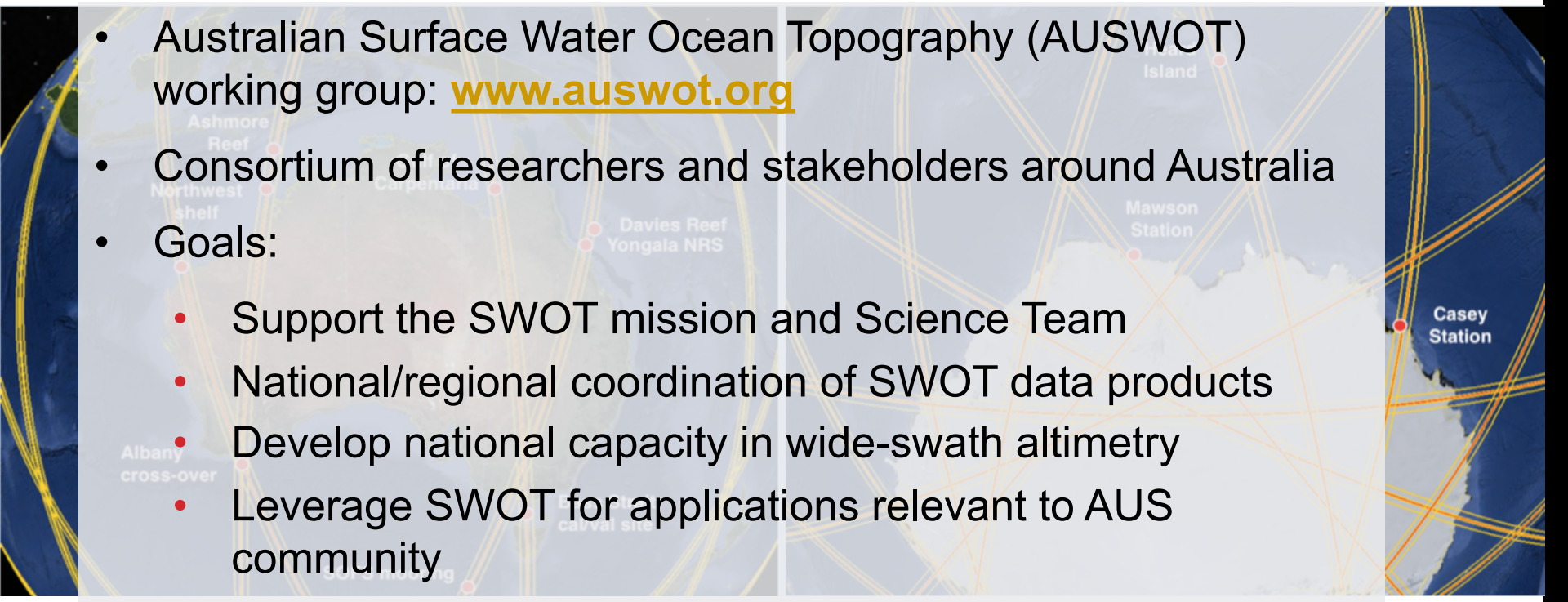
CHALLENGES FOR OPERATIONAL OCEANOGRAPHY

- **Observational error** varies across swath, depends on sea-state
- Estimating currents from SWOT SSH depends on **separation of tides and internal tides from geostrophic currents**
- **Mismatch** between spatial and temporal sampling scales
- Deriving **vertical velocities and surface vorticities**: a “Grand Challenge for ocean remote sensing”



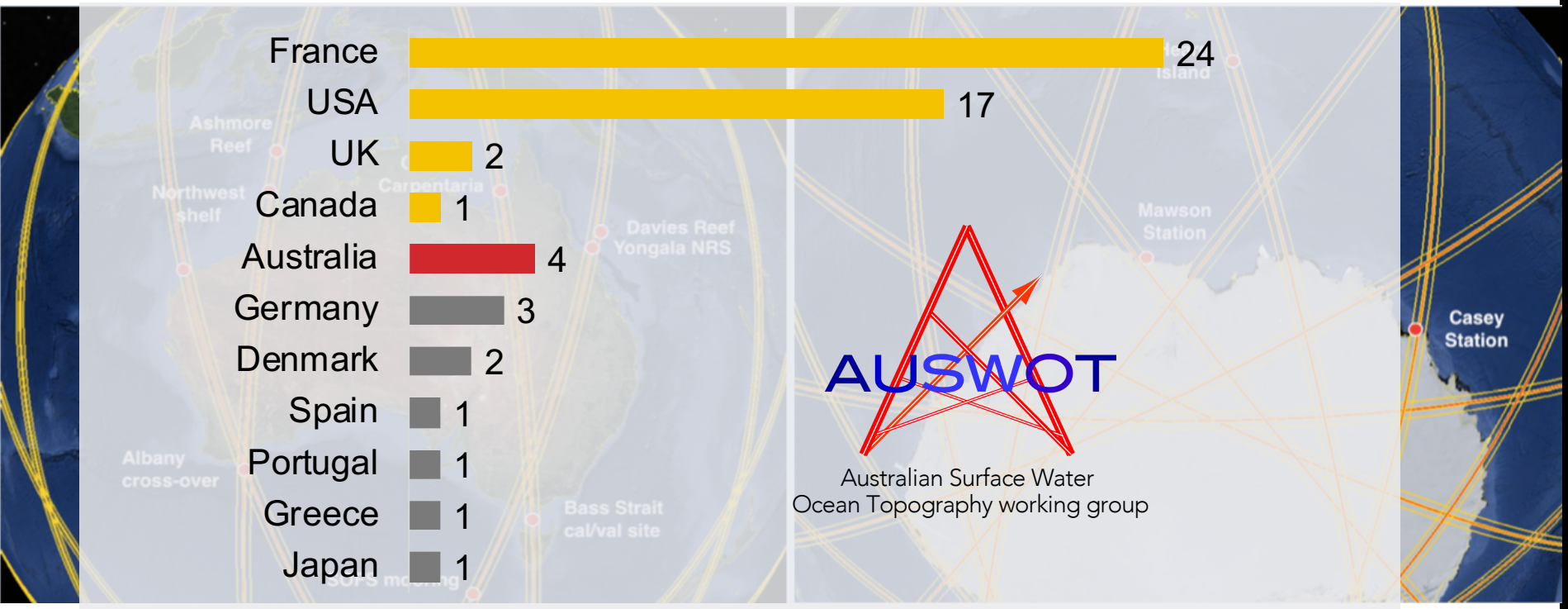


AUSWOT WORKING GROUP



- Australian Surface Water Ocean Topography (AUSWOT) working group: www.auswot.org
- Consortium of researchers and stakeholders around Australia
- Goals:
  - Support the SWOT mission and Science Team
  - National/regional coordination of SWOT data products
  - Develop national capacity in wide-swath altimetry
  - Leverage SWOT for applications relevant to AUS community

SWOT SCIENCE TEAM



SWOT SCIENCE TEAM

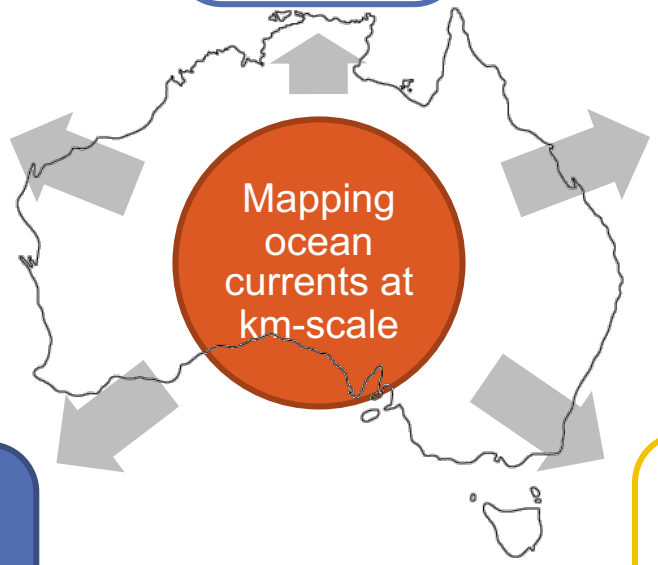
Australian Government
Bureau of Meteorology

Near-real time delivery and applications (Cahill)

UNSW SYDNEY

Internal waves on the NW shelf (Keating)

Synergistic field campaigns during fast sampling phase



THE UNIVERSITY OF WESTERN AUSTRALIA

Australian National University

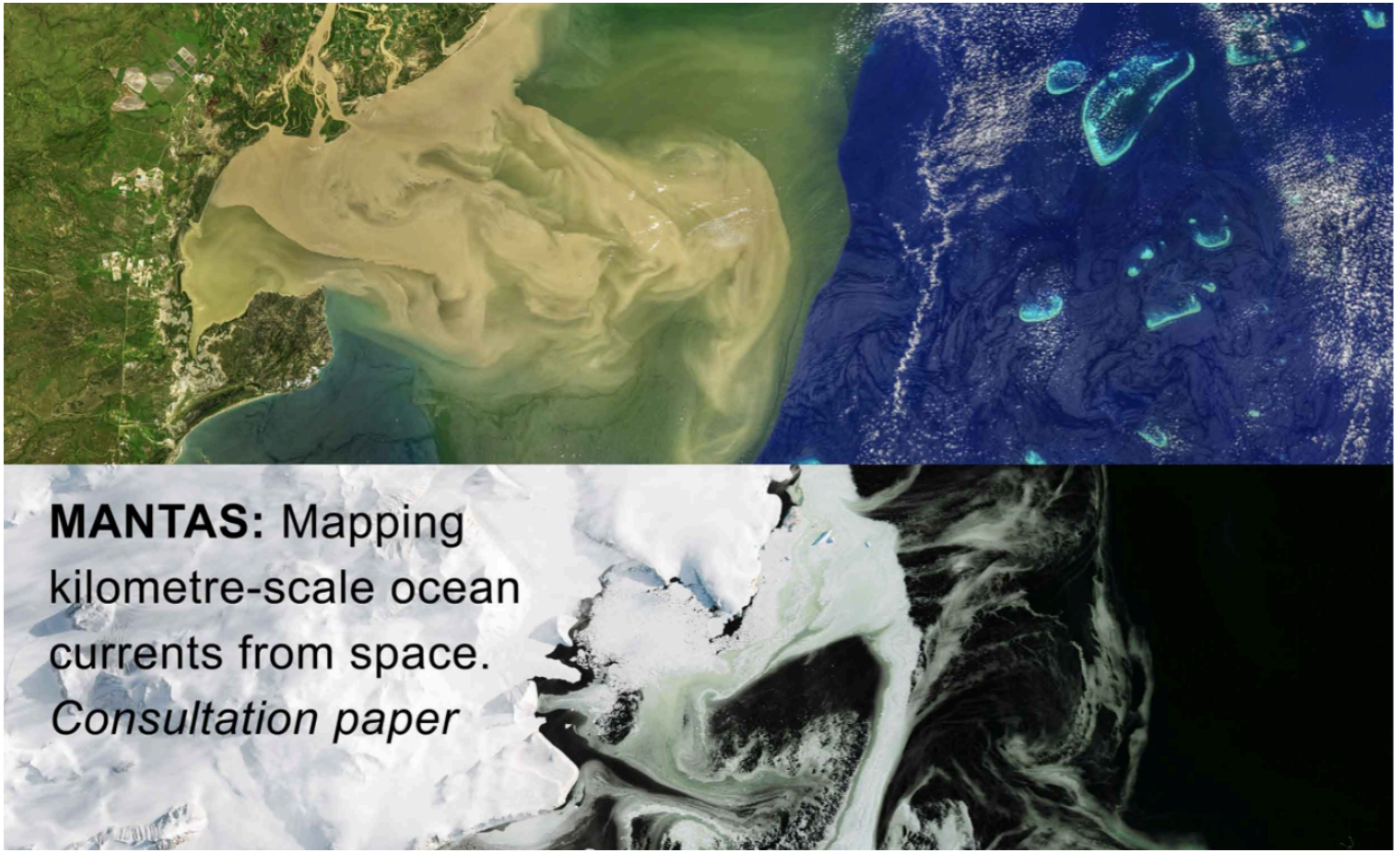
Smaller scales of Southern Ocean Dynamics (Legresy)

SWOT validation from Bass Strait (Watson)

CSIRO

UNIVERSITY of TASMANIA

AUSWOT WORKING GROUP



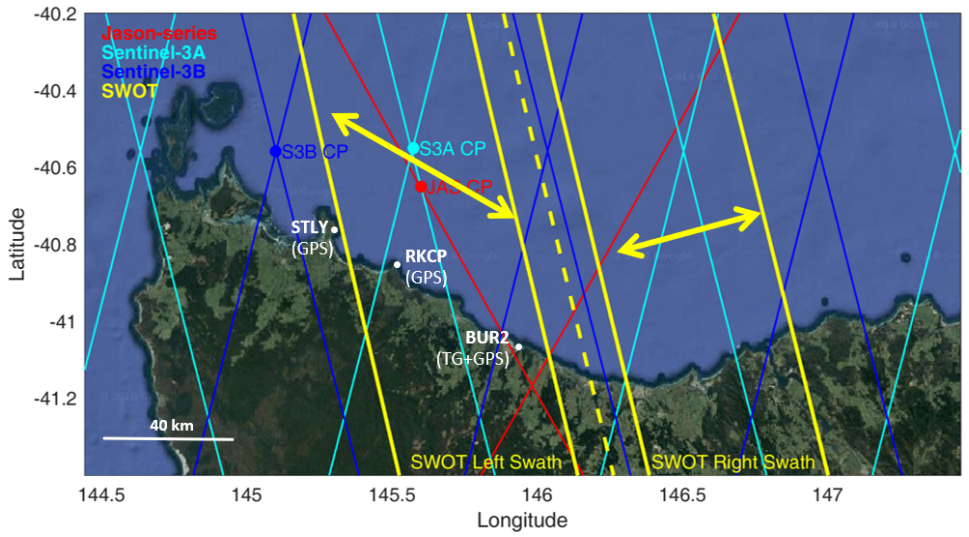
Consultation paper available at **https://auswot.org/activities/**

SUPPLEMENTARY MATERIAL

SCIENCE TEAM ACTIVITIES

- **Chris Watson** (UTas) and Benoit Legresy (CSIRO)
- SWOT calibration and validation
- $2.3M support through IMOS:
  - Bass Strait altimetry cal/val site
  - SOFS mooring (Southern Ocean)
  - Yongala NRS (Great Barrier Reef)

SWOT validation from Bass Strait



UNIVERSITY of TASMANIA

CSIRO

IMOS
Integrated Marine Observing System

SCIENCE TEAM ACTIVITIES

- **Benoit Legresy**, Steve Rintoul (CSIRO), Helen Phillips, Max Nikurashin, Nathan Bindoff (IMAS)
- Small-scale dynamics in ACC and standing meander south of Tasmania
- R/V Investigator cruises 2018 and 2022

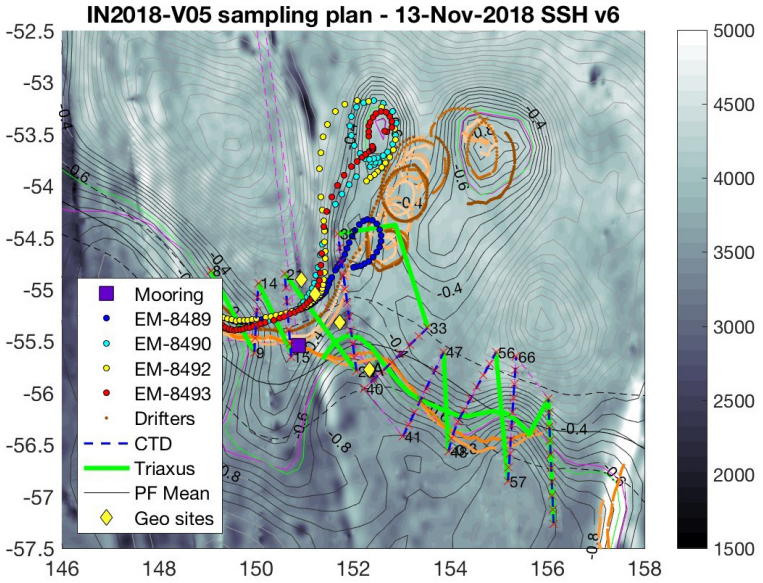
Smaller scales of Southern Ocean Dynamics

UNIVERSITY of TASMANIA

IMAS
INSTITUTE FOR MARINE & ANTARCTIC STUDIES

CSIRO

Marine National Facility



SCIENCE TEAM ACTIVITIES

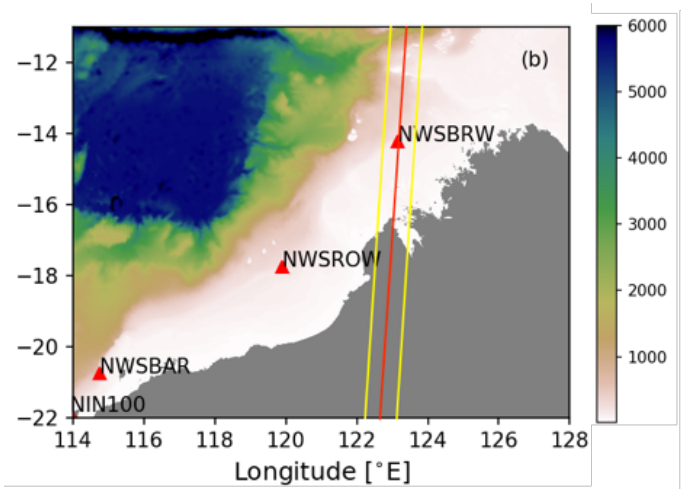
- **Shane Keating** (UNSW), Nicole Jones, Matt Rayson, Gregory Ivey (UWA),, Callum Shakespeare (ANU)
- Understanding and predicting internal gravity waves and interaction with background flow
- $750k supported from ARC Discovery scheme 2021
  - Existing mooring array in EAC off Brisbane
  - WA-IMOS to deploy mooring in Browse Basin

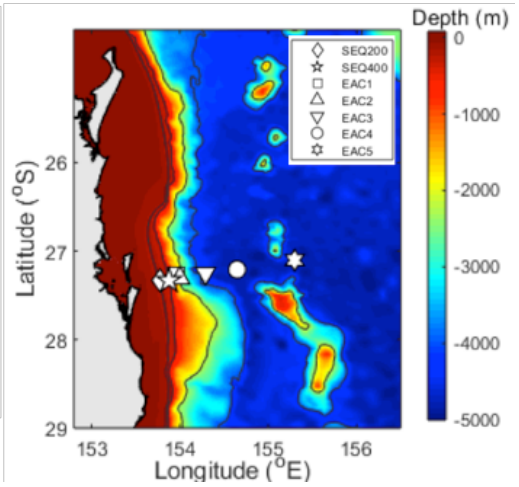
Internal waves on the NW shelf

UNSW SYDNEY

THE UNIVERSITY OF WESTERN AUSTRALIA

Australian National University

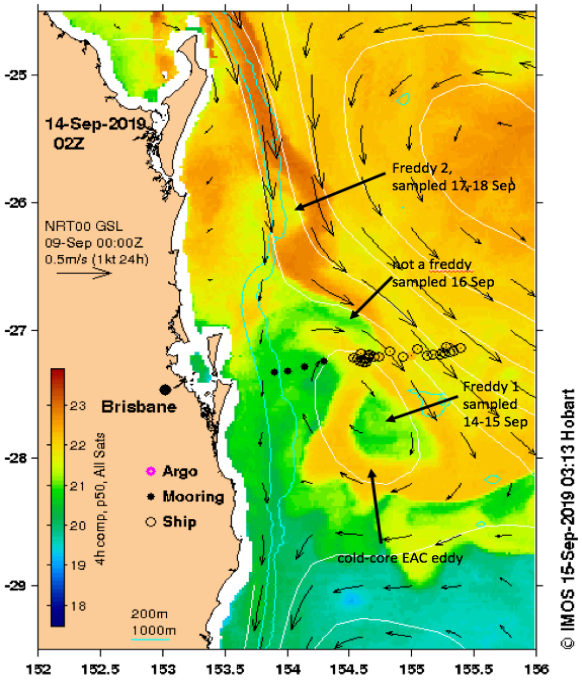


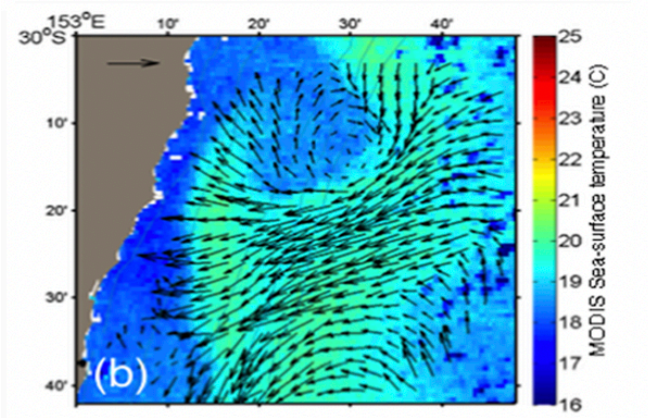


SCIENCE TEAM ACTIVITIES

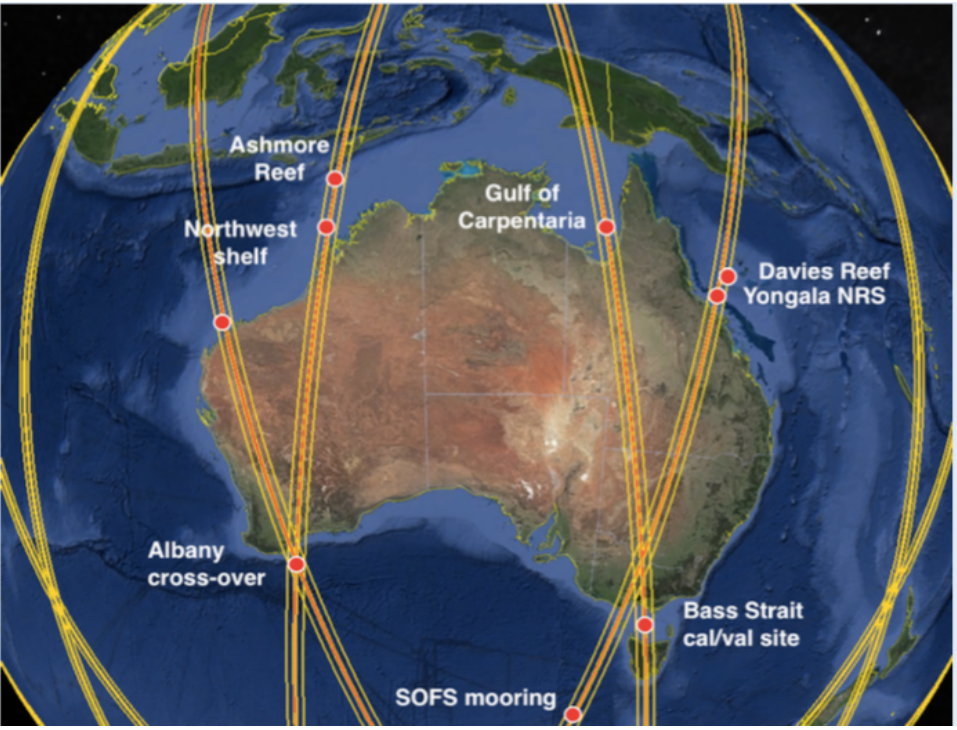
- **Madeleine Cahill**, David Griffin, Chris Chapman, Bernadette Sloyan (CSIRO)
- Near-real time delivery and applications
- Geostrophic velocities to be validation against high-frequency radar sites around Australia.

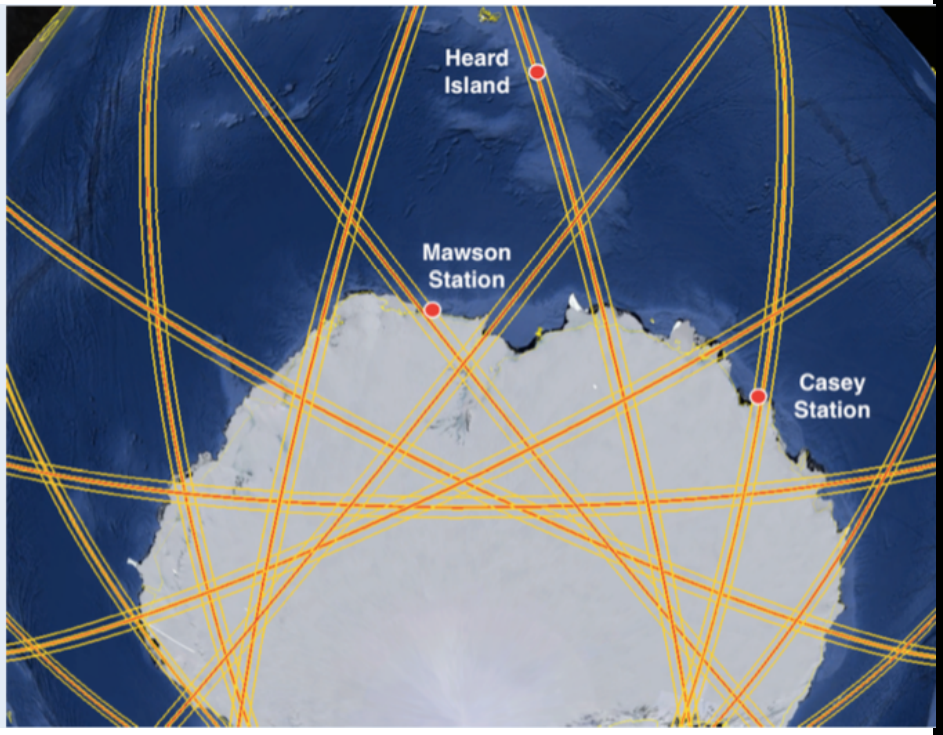
Near-real time delivery and applications





SYNERGISTIC ACTIVITIES



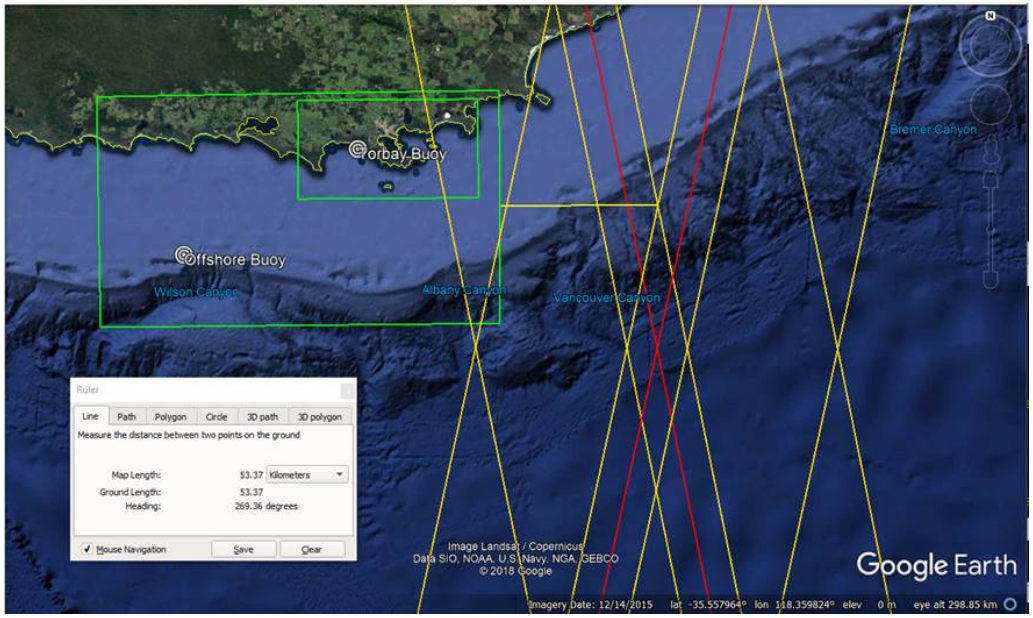


- **1-day repeat orbit** over limited region for first 3 months (~Jul-Sep 2022)
- Twice-daily observations at cross-over points
- “Adopt a cross-over” campaign: early access to SWOT data products

SYNERGISTIC ACTIVITIES

Surface wave-current interactions

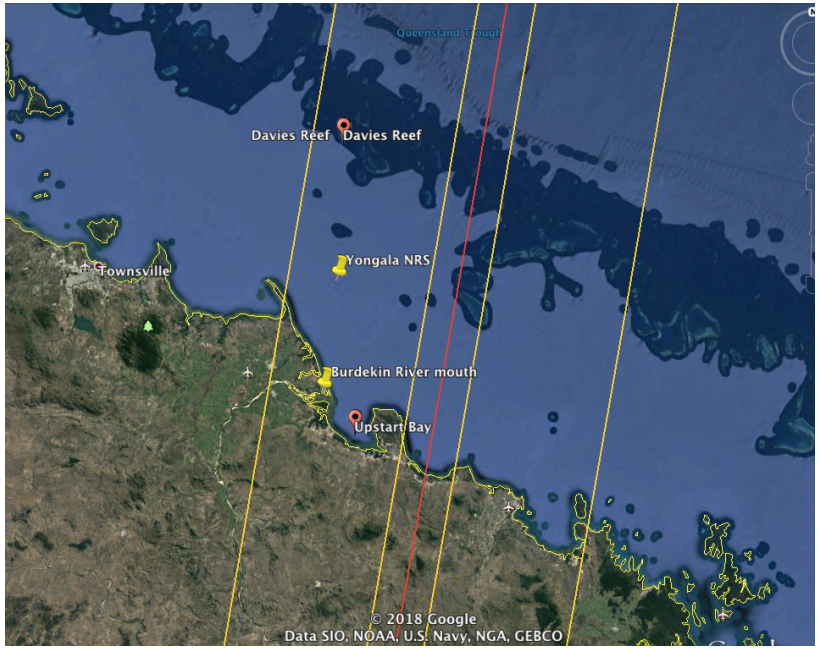
- Ryan Lowe, Jeff Hansen, Nicole Jones, Mark Buckley (UWA)
  - Observing and modeling coastal hydro-dynamics and surface waves in Albany region
- Mark Hemer and Salman Khan (CSIRO)
  - SAR directional surface wave observations in wave-current interaction case studies



SYNERGISTIC ACTIVITIES

- Daily flyover of Burdekin river outflow
- Submesoscale current/river plume dynamics
- Davies reef weather station (AIMS)
- Sediment transport onto reef

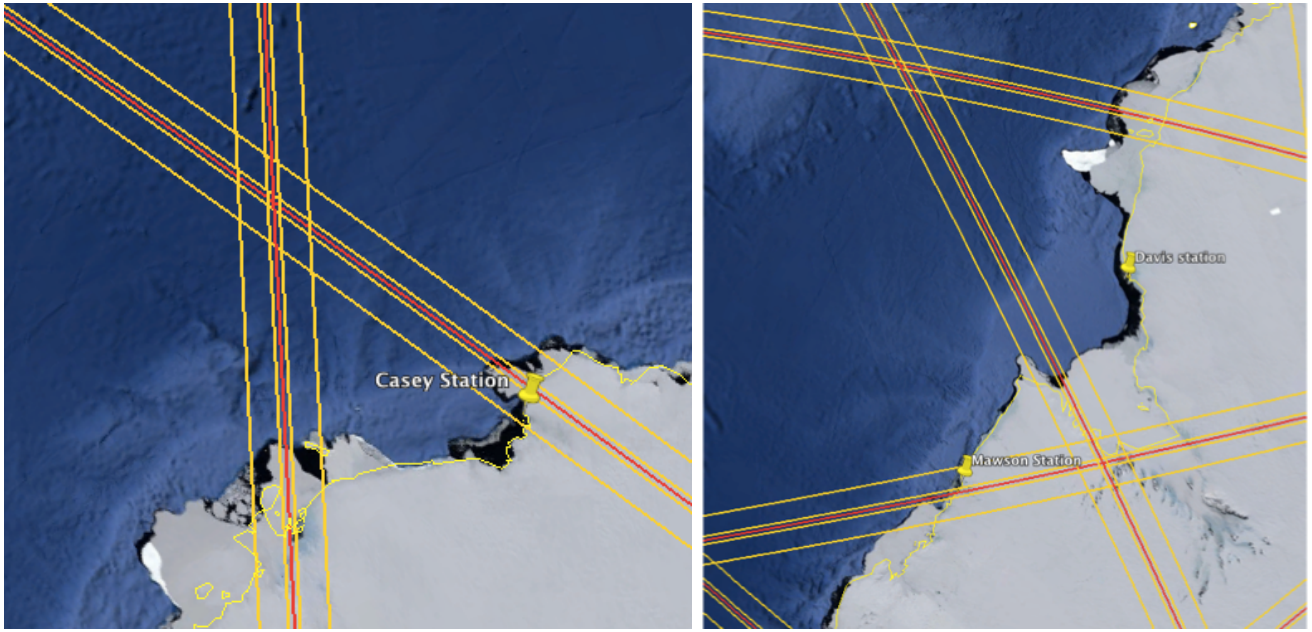
Reef dynamics and river outflow



SYNERGISTIC ACTIVITIES

- Daily flyover of Casey and Mawson Station
- Study waves and small-scale features in marginal ice zone (MIZ)
- Complement Arctic campaign (Ron Kwok, JPL) with summer sea ice observations

Sea-ice/ocean interactions in the MIZ



OPPORTUNITIES FOR AUSTRALIAN HYDROLOGY