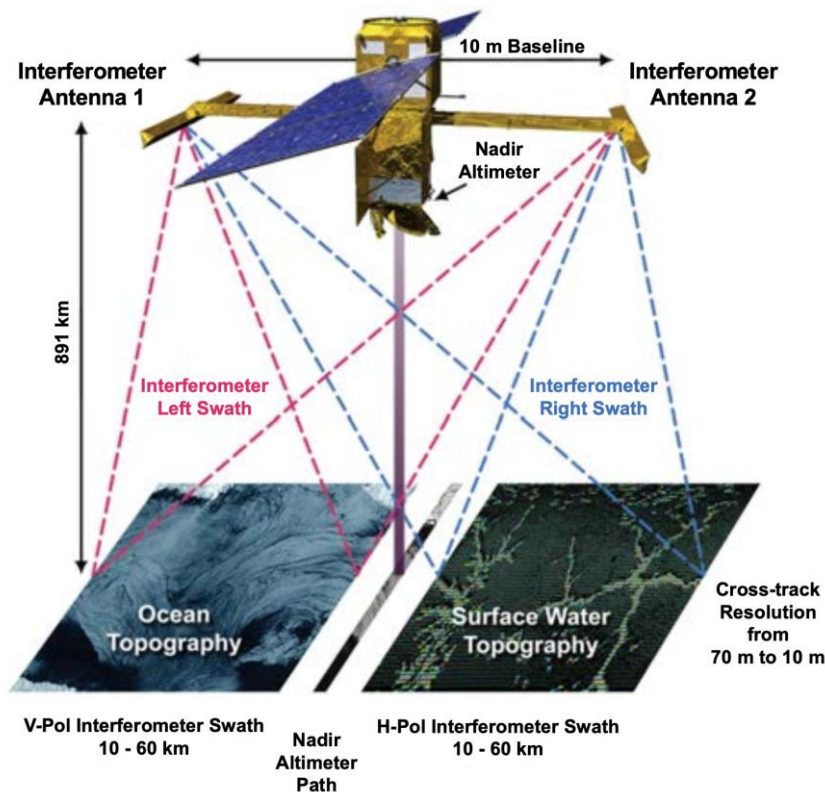# Exploiting SWOT Wind-Wave data in Australia

Salman Khan / 23 September 2025

Research Team Lead

Environment Research Unit

CSIRO, Australia

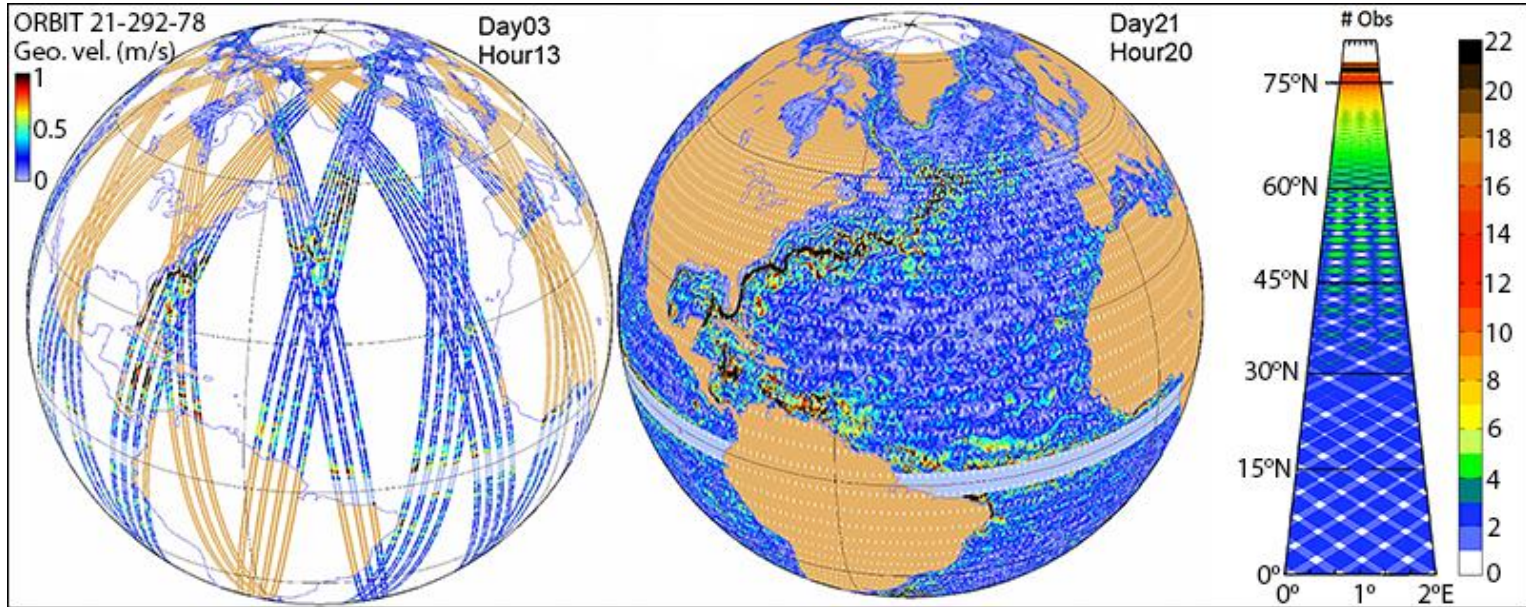# SWOT Mission

Credit: NASA SWOT

- ✓ NASA & CNES partnership with contributions from CSA and UKSA
- ✓ Launch: 16 Dec 2022
- ✓ Commissioning phase
- ✓ Fast sampling/calibration phase: 1-day repeat orbit (29 Mar – 09 Jul 2023)
- ✓ Science orbit: 21-day repeat orbit (Jul 2023-present)
- ✓ Ka-band (35.75 GHz), near-nadir (+/2.7°) radar interferometer (KaRin) with two SAR antennae at opposite ends of a 10-m boom.
- ✓ **Terrestrial** surface water such as lakes, rivers, and wetlands (WSE; water surface slope; river width; water surface area etc.)
- ✓ **Ocean** sea surface height, sea surface height anomaly, wind speed, significant wave height
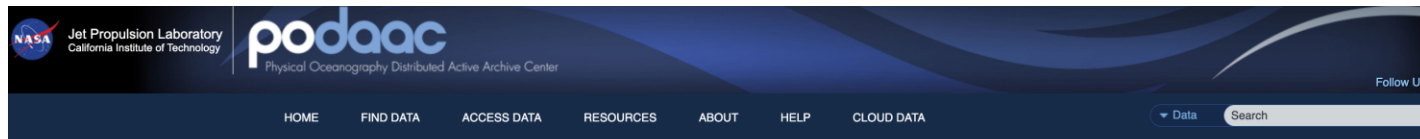- ✓ Data available at PODAAC (NASA) via the NASA Earthdata Cloud (hosted in AWS)

SWOT Ocean Coverage

Source: C. Ubelmann, CLS (left, center) and JPL/NASA (right)

SWOT Ocean Product

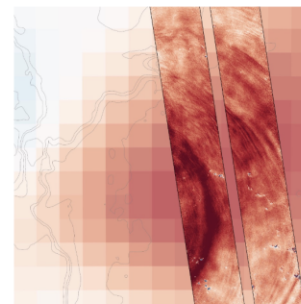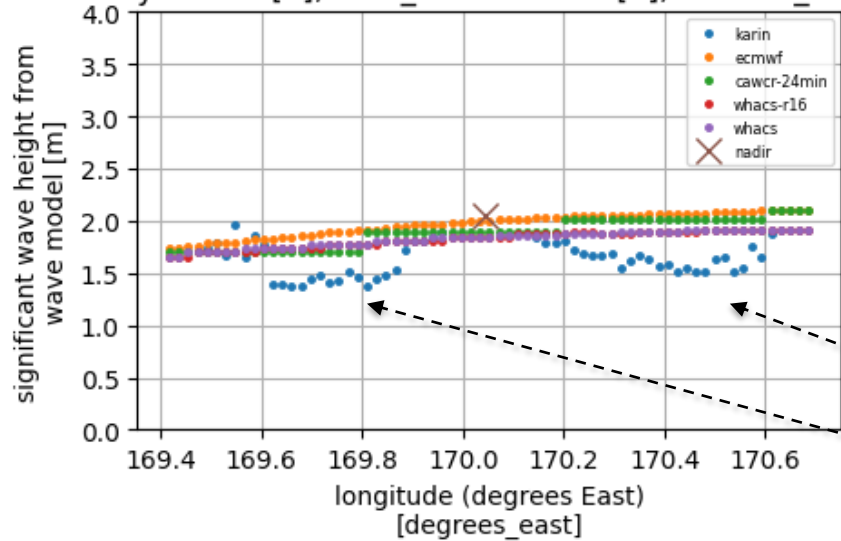Measures previously unseen small-scale variability of wave field that models don't capture
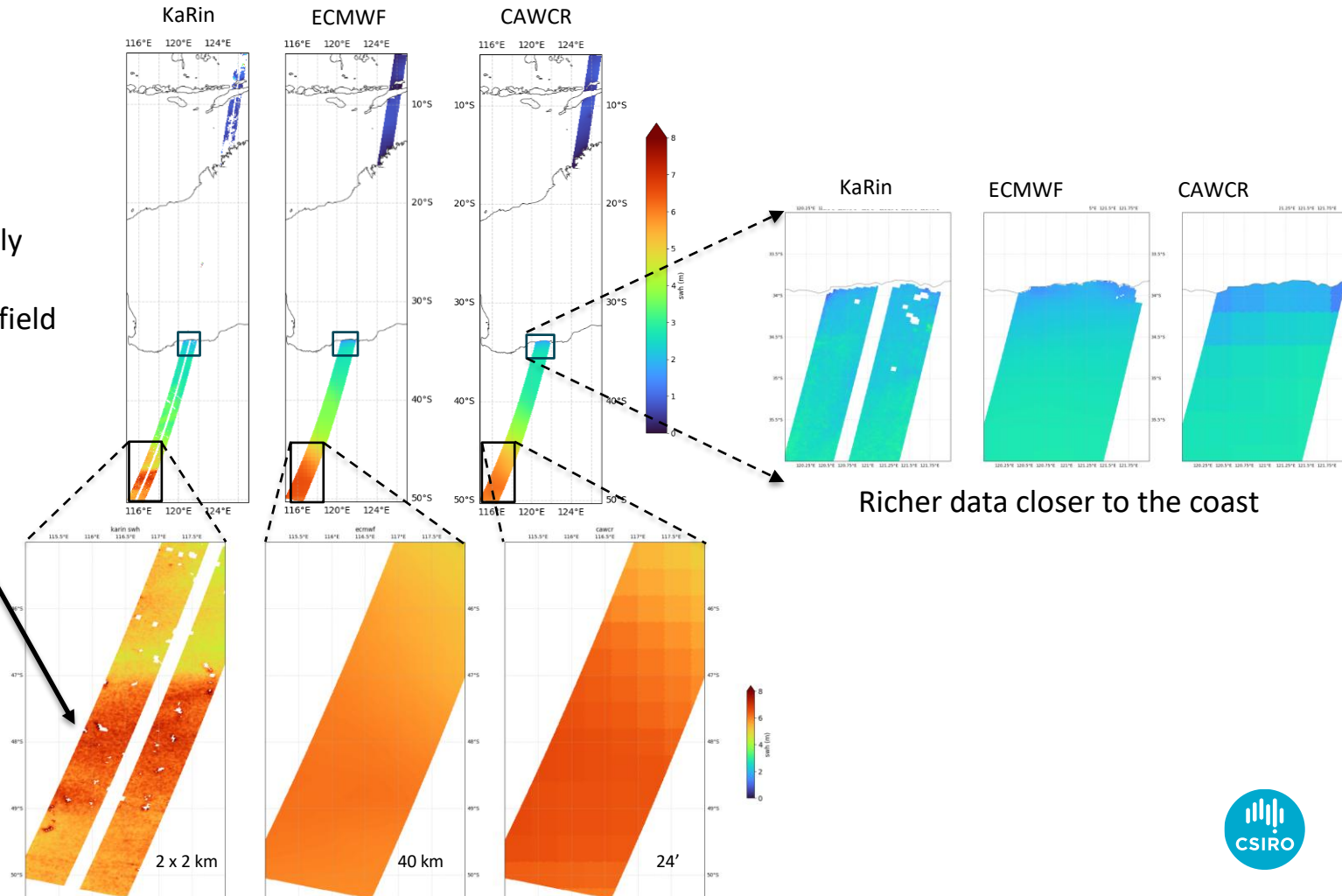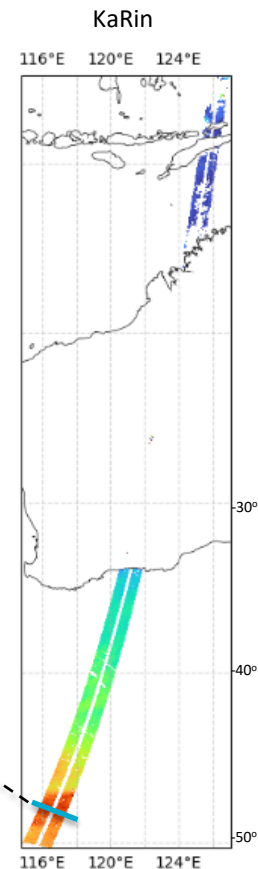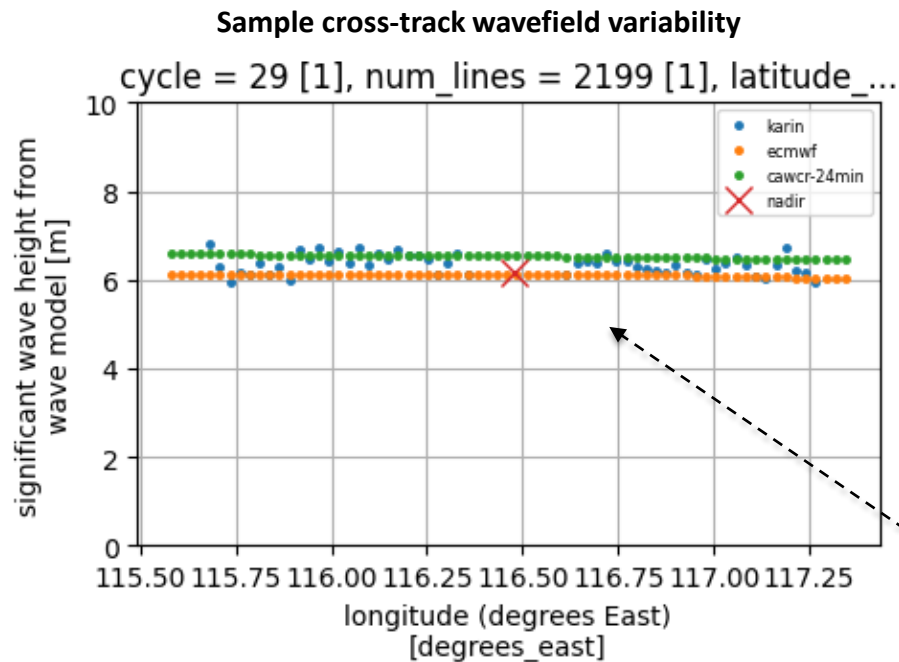
Richer data closer to the coast

Sample cross-track wavefield variability

Sample cross-track wavefield variability

Needs assessment of potential instrumentation affects - possibly more pronounced at low wave regimes
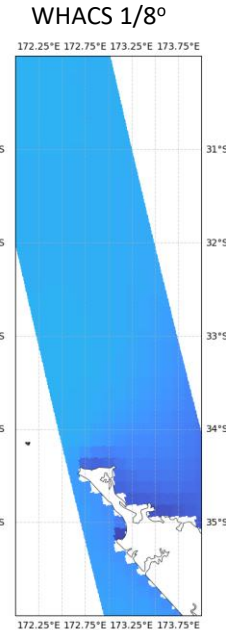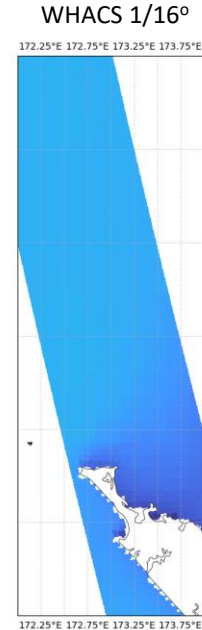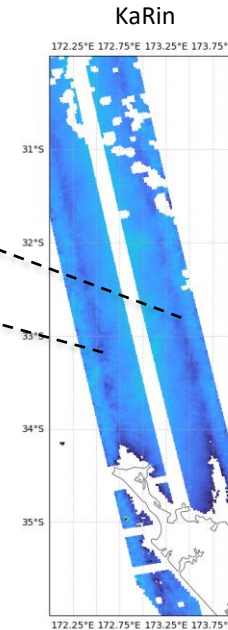
KaRin
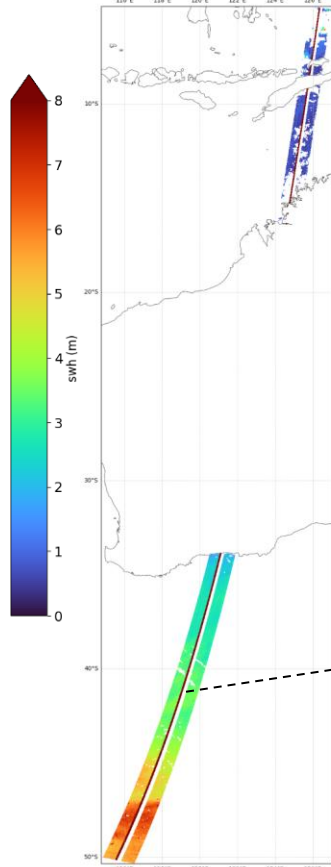
CAWCR

ECMWF
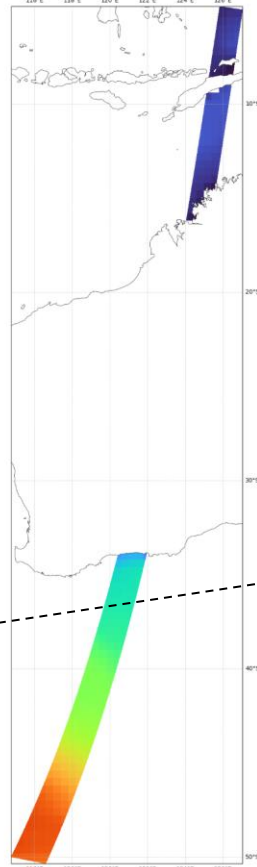
Sample along-track wavefield variability
for **one SWOT (KaRin) pixel (pixel =30)**
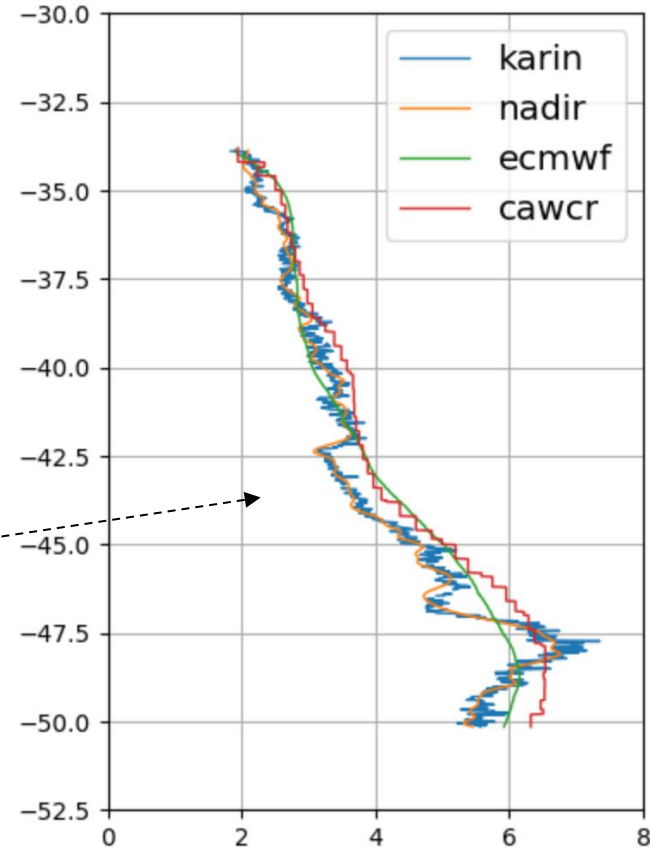
Tropical Cyclone Alfred wave field

Cyclone Alfred: Severe intensity; long-lived; erratic track; coastal erosion; heavy rain
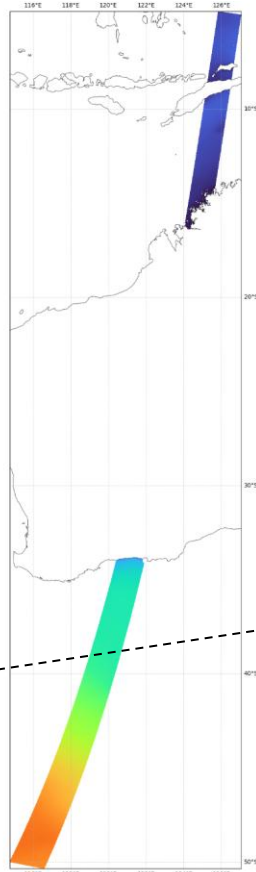

by 2003 LN6

© IMOS 28-Feb-2025 18:40 Hobart
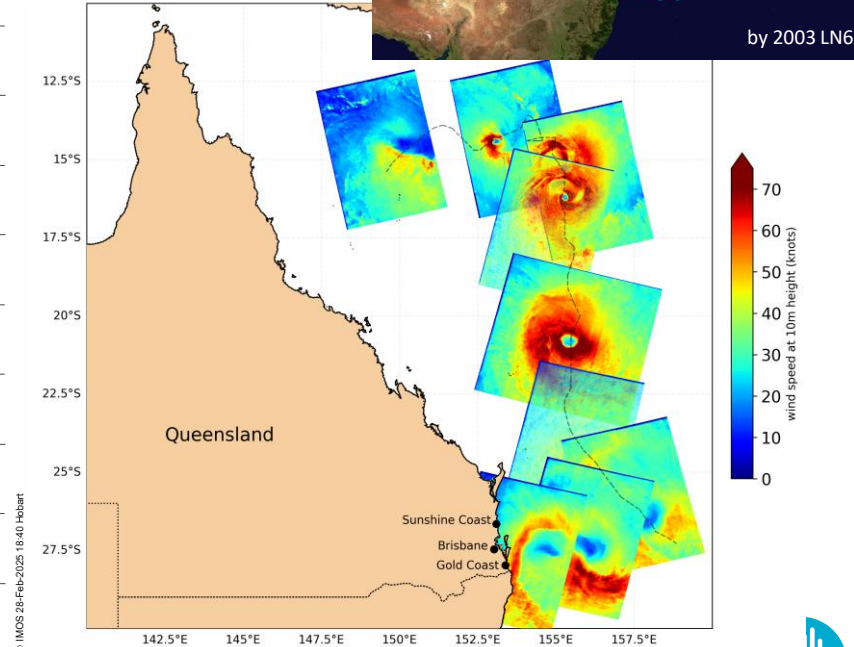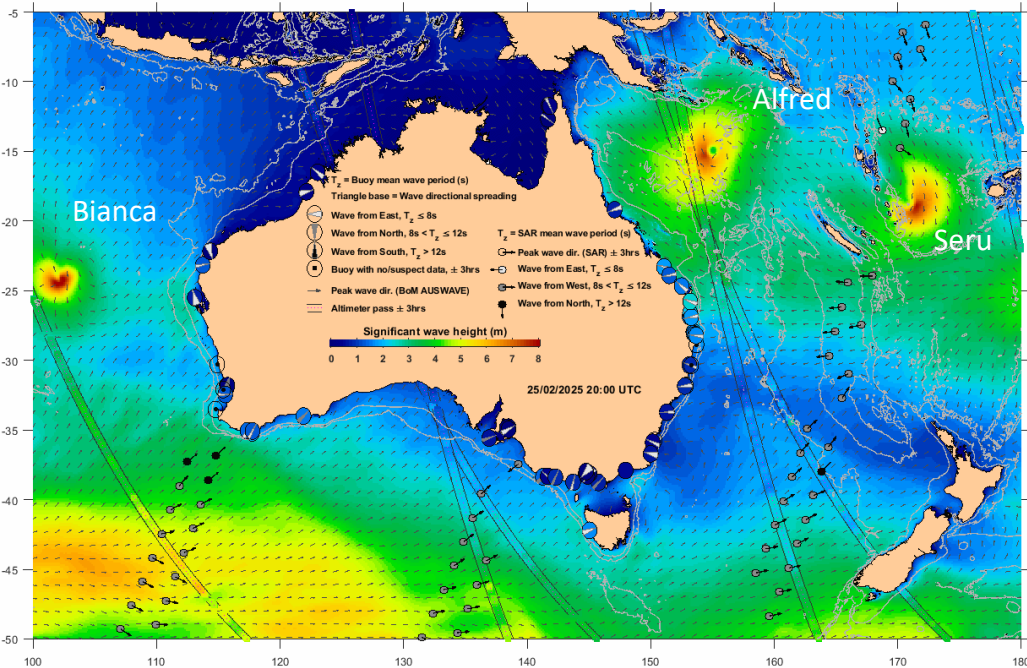
TC Alfred near surface wind speed as imaged by several SAR satellites (Sentinel-1, Radarsat-2, and Radarsat Constellation Mission 1+2+3). Data sourced from NOAA.

Tropical Cyclone Alfred wave field
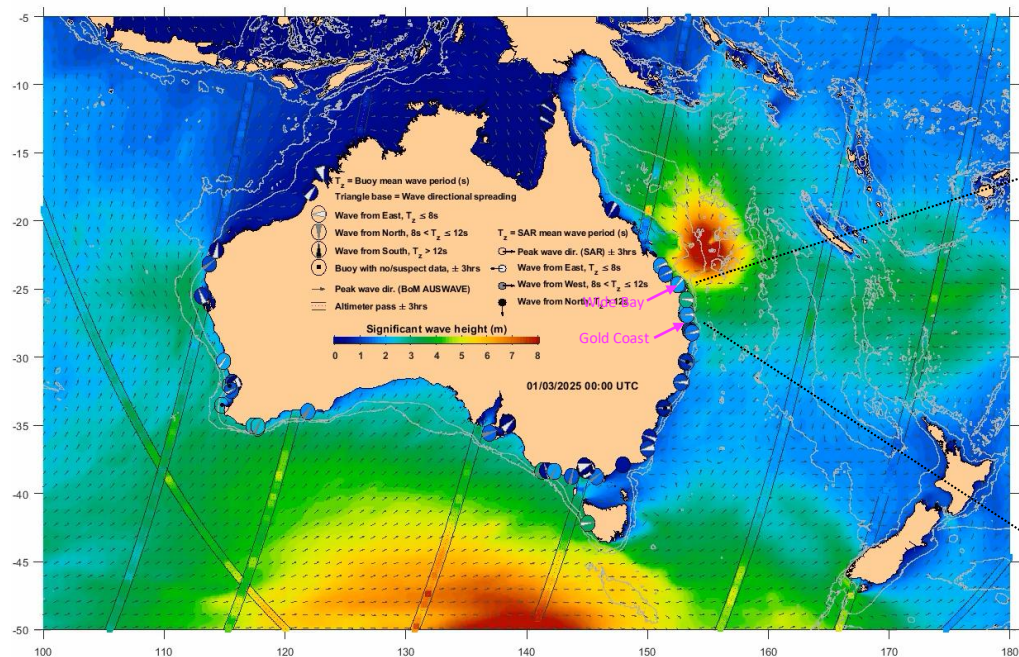
https://oceancurrent.aodn.org.au/waves/waves3.php
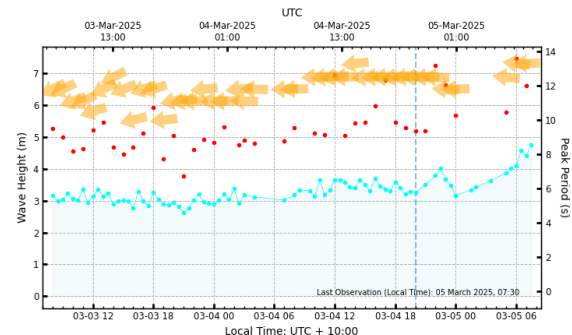
Tropical Cyclone Alfred wave field
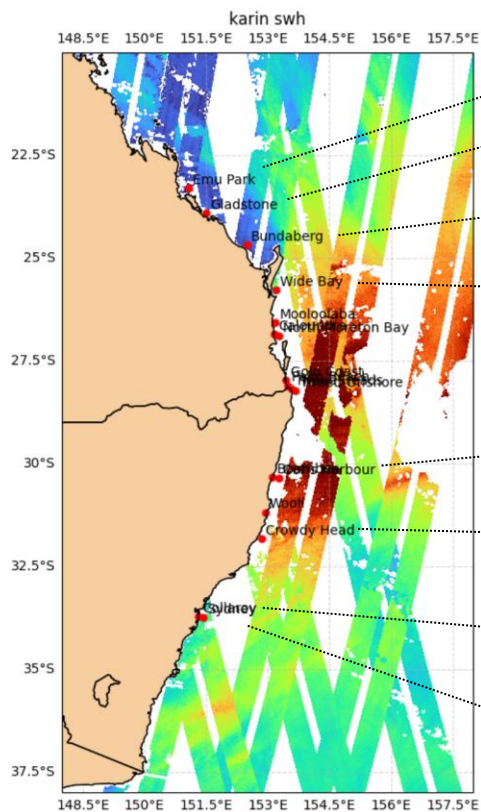
SWOT measurements

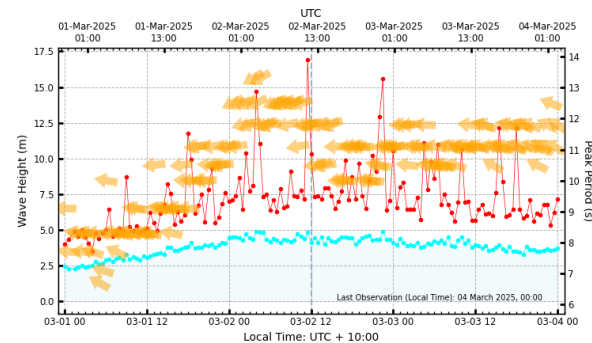KaRin SWH 25th Feb – 06 Mar 2025
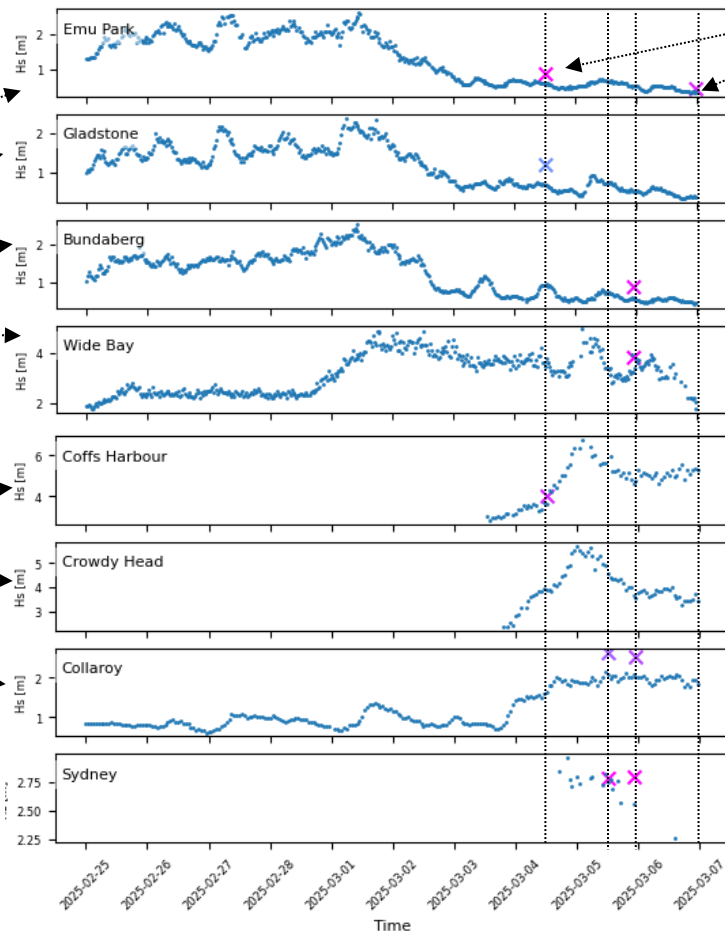
Criteria and filtering
- ✓ Within 15km and 30 mins
- ✓ > 1km from coast
- ✓ No rain
- ✓ Only good quality data
- ✓ 0<SWH<30
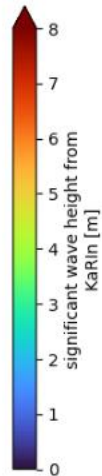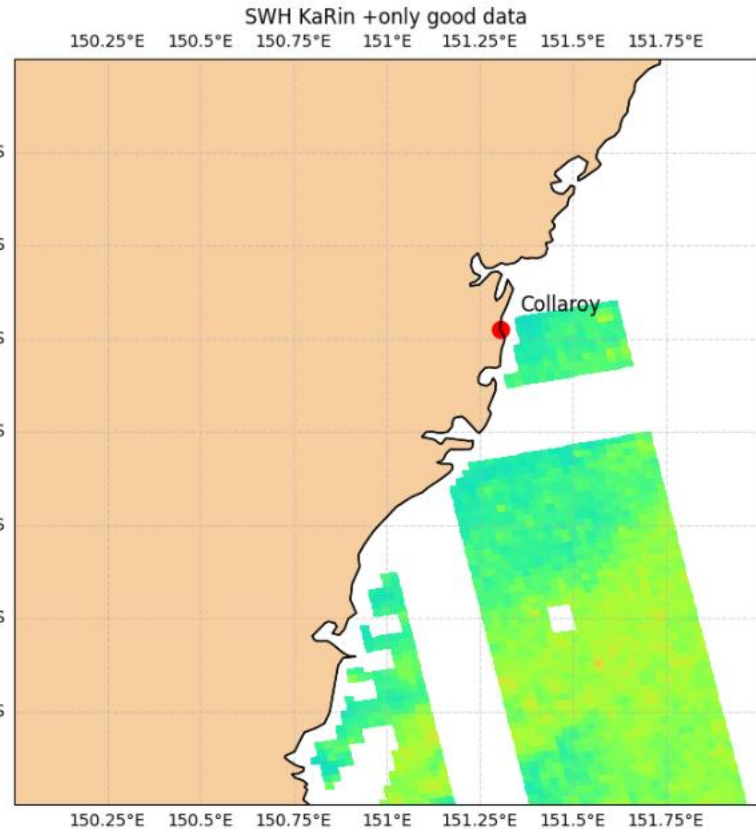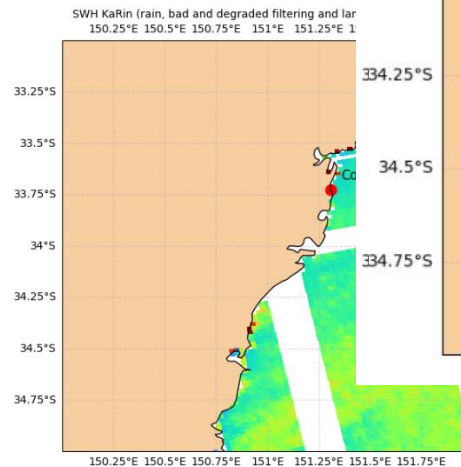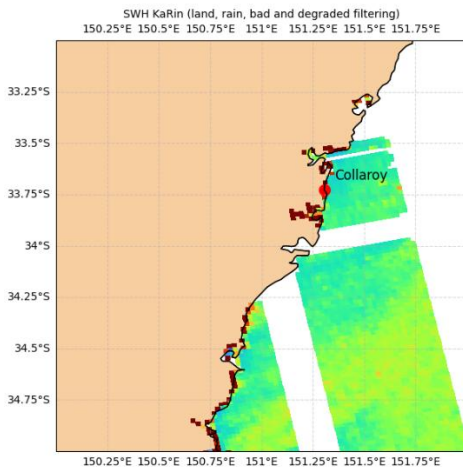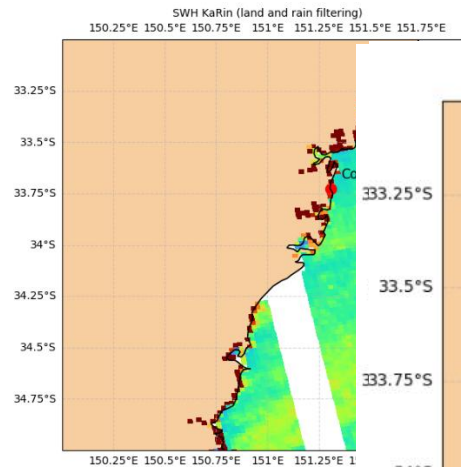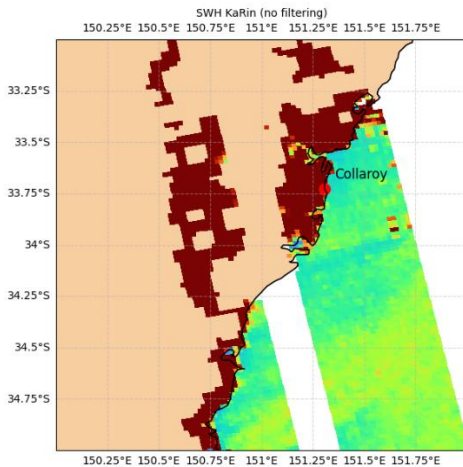
SWH KaRin (no filtering)

SWH KaRin (land and rain filtering)

SWH KaRin +only good data

Collaroy

significant wave height from KaRin [m]

SWH KaRin (land, rain, bad and degraded filtering)

SWH KaRin (rain, bad and degraded filtering and land)

Collaroy

Filtering and QC

Tropical Cyclone Alfred wave field

*MFWAM refers to the MFWAM based CMS
wave analysis

Tropical Cyclone Alfred wave field

*MFWAM refers to the MFWAM based CMS
wave analysis

Swath cross-track SWH accuracy

Summary

Key Messages

- Dense, richer coastal data
- Captures spatial variability at scales not observed before
- User needs good understanding of data filtering and quality flag
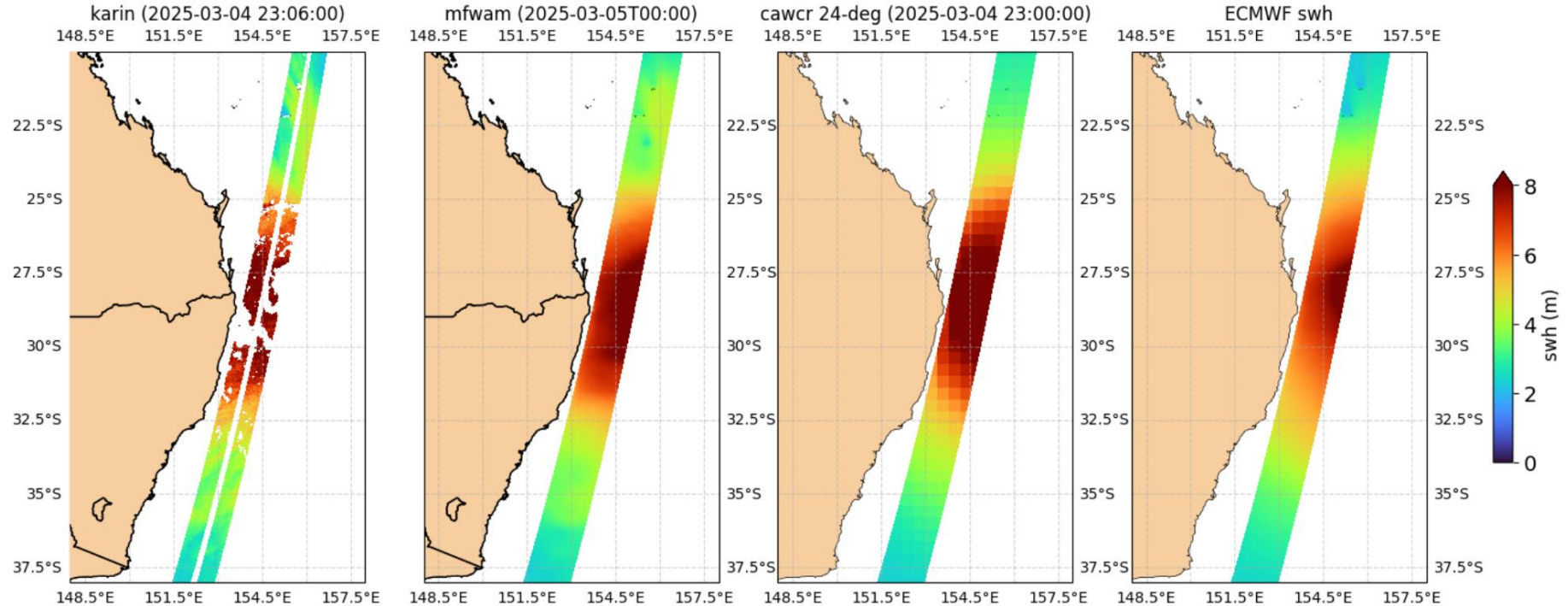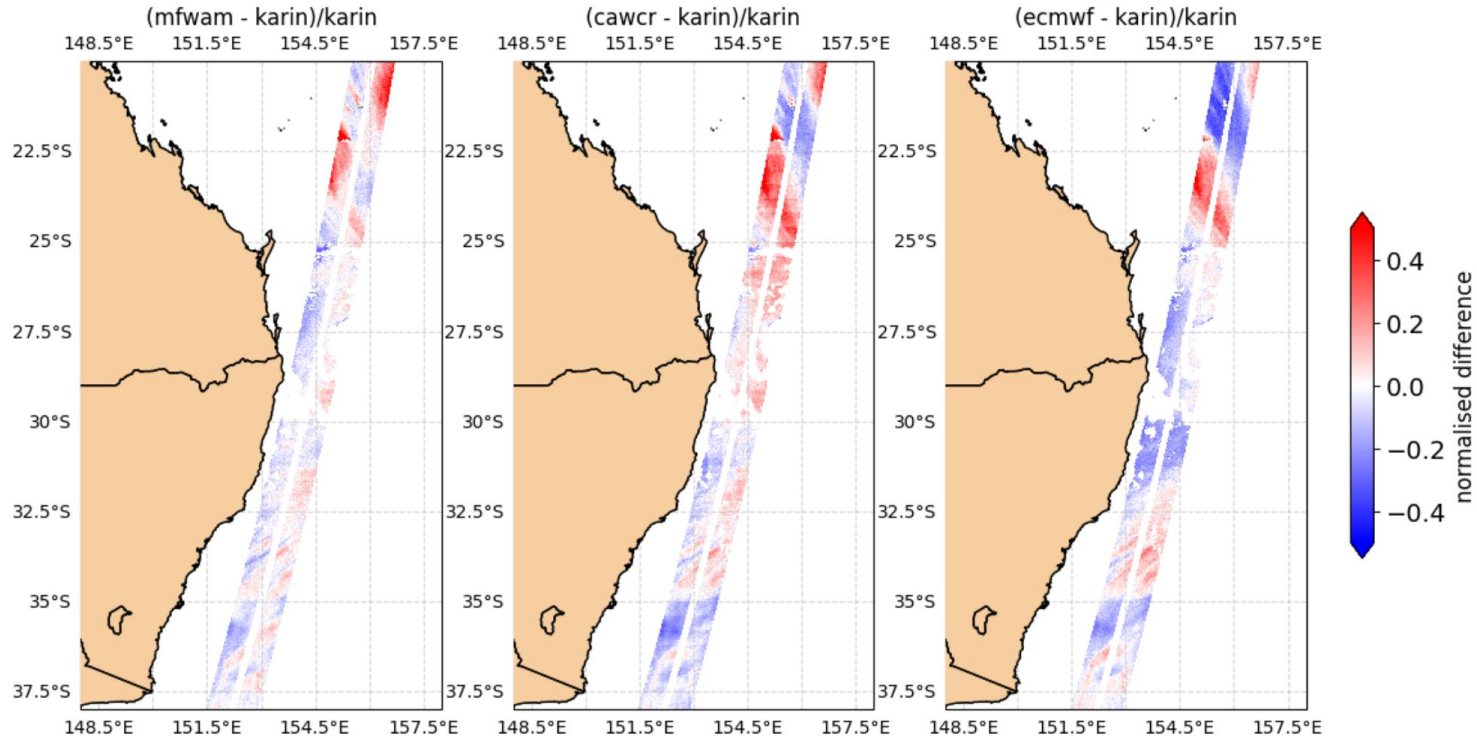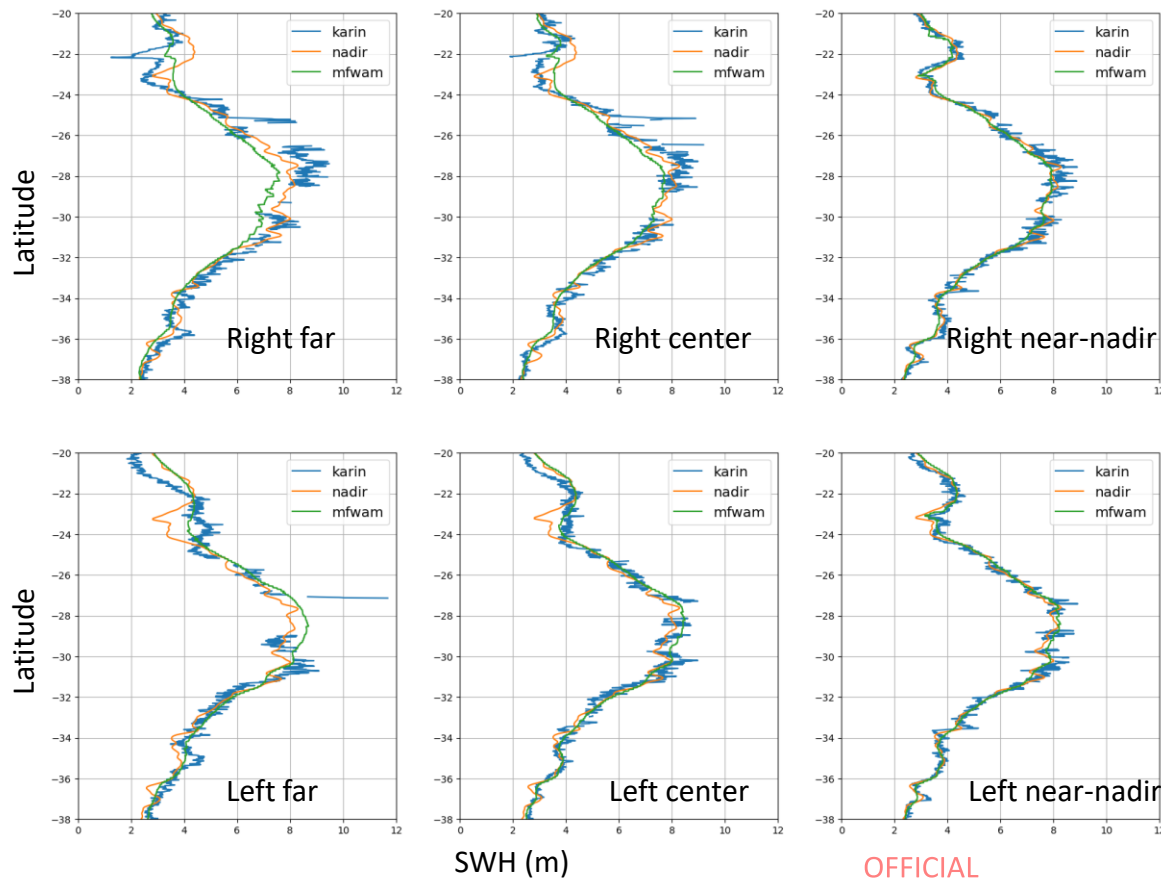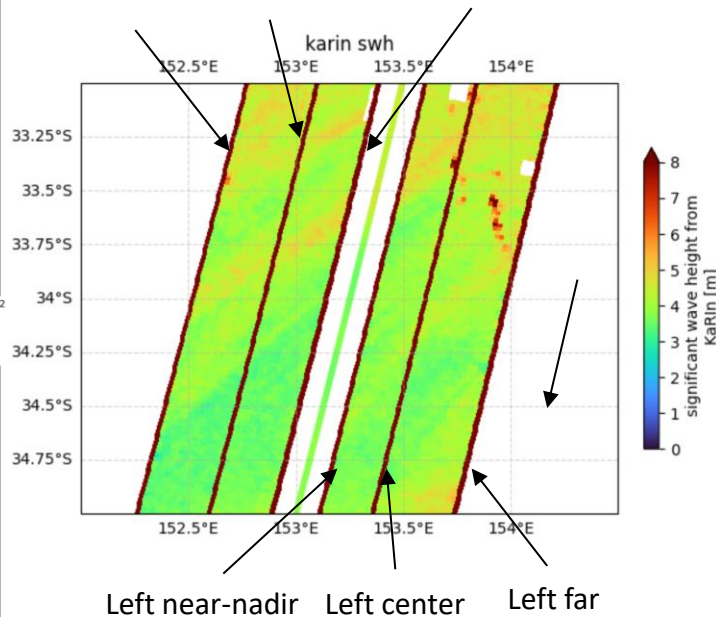- Data accuracy varies across the swath and needs further look

Outlook

- Increasing # of coastal wave buoys around Australia opportunity to utilize for SWOT coastal application
- Interesting additional dataset for potential validation of Australian wave models: wave hindcasts, ABOM operational wave model, and regional bespoke models
- SWOT observations across the land-sea interface (covering nearshore, intertidal, estuarine, in-land waters) - including water levels, SWH, and wind speed (along with ancillary data) - are complimentary with the potential to help address challenges in this dynamic zone.