



Australia's National Science Agency

# Exploiting SWOT Wind-Wave data in Australia

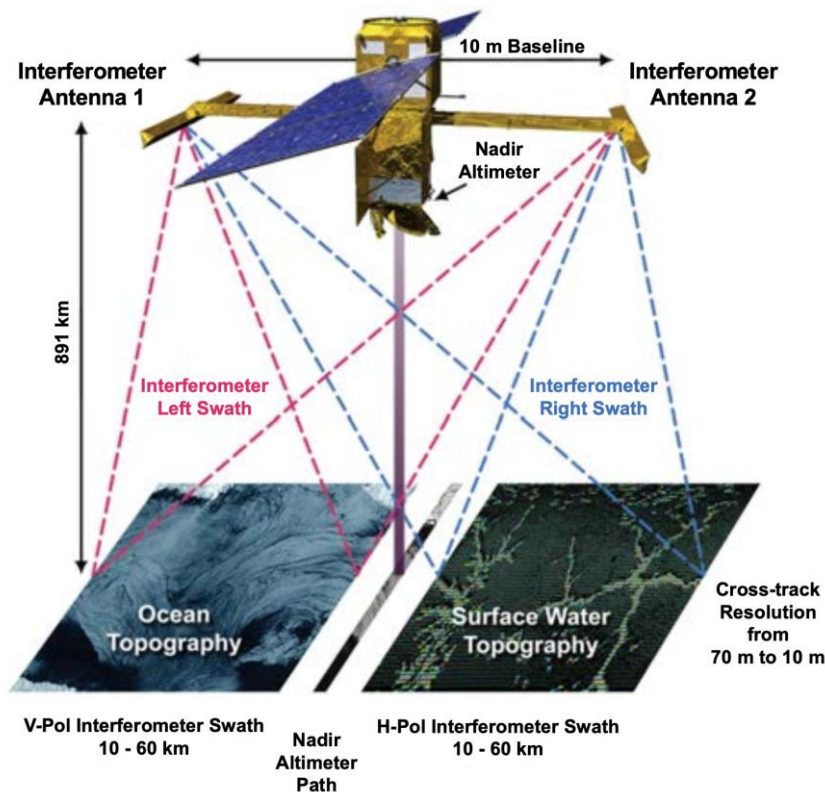
Salman Khan / 23 September 2025

Research Team Lead

Environment Research Unit

CSIRO, Australia

# SWOT Mission



Credit: NASA SWOT

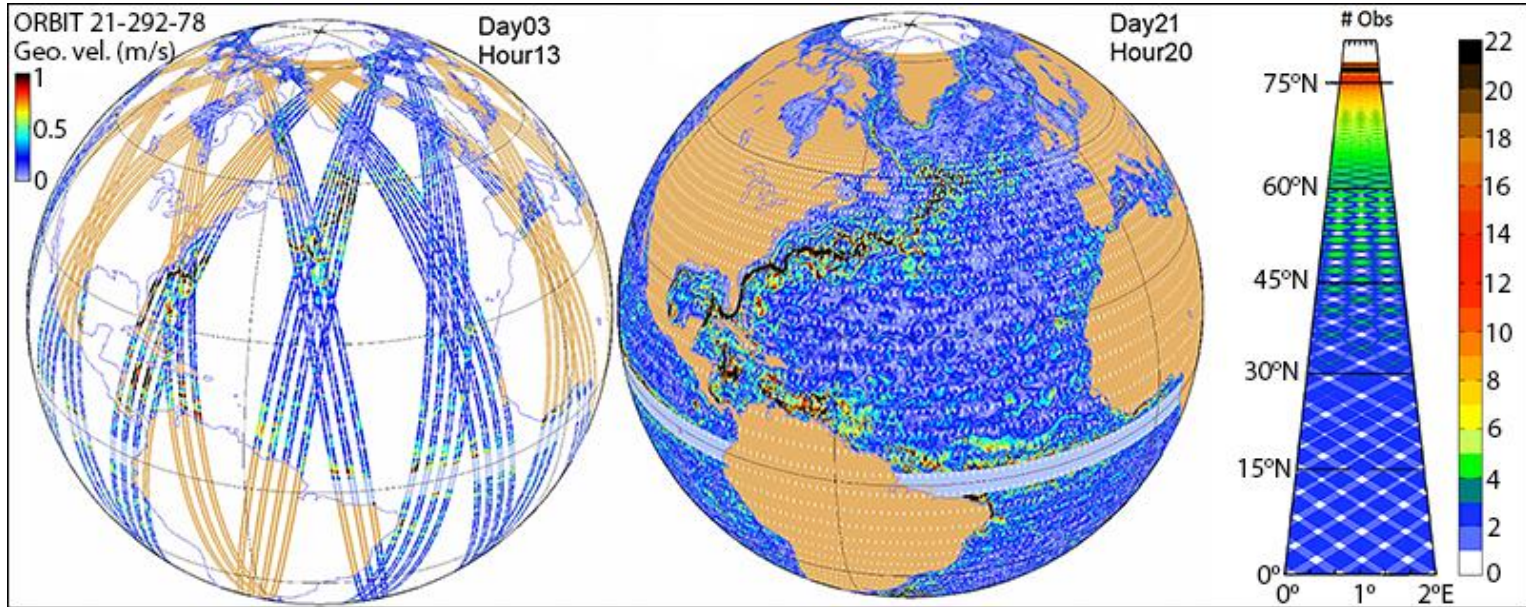
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- ✓ NASA & CNES partnership with contributions from CSA and UKSA
- ✓ Launch: 16 Dec 2022
- ✓ Commissioning phase
- ✓ Fast sampling/calibration phase: 1-day repeat orbit (29 Mar – 09 Jul 2023)
- ✓ Science orbit: 21-day repeat orbit (Jul 2023-present)
- ✓ Ka-band (35.75 GHz), near-nadir ( $\pm 2.7^\circ$ ) 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)

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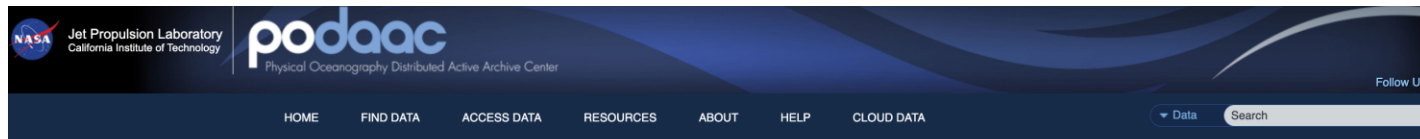


# SWOT Ocean Coverage



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

# SWOT Ocean Product



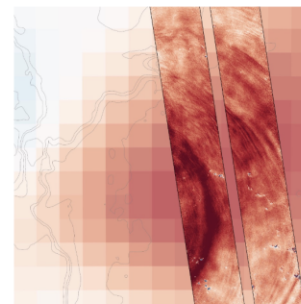
[Home](#) » [Dataset Discovery](#)

## SWOT Level 2 KaRIn Low Rate Sea Surface Height Data Product, Version C (SWOT\_L2\_LR\_SSH\_2.0)

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Information
Coverage
Data Access
Variables
Documentation
Citation

<b>Version</b>	2.0
<b>Processing Level</b>	2
<b>Start/Stop Date</b>	2022-Dec-16 to Present
<b>Short Name</b>	SWOT_L2_LR_SSH_2.0
<b>Description</b>	<p>The SWOT Level 2 KaRIn Low Rate Sea Surface Height Data Product from the Surface Water Ocean Topography (SWOT) mission provides global sea surface height and significant wave height observations derived from low rate (LR) measurements from the Ka-band Radar Interferometer (KaRIn). SWOT launched on December 16, 2022 from Vandenberg Air Force Base in California into a 1-day repeat orbit for the "calibration" or "fast-sampling" phase of the mission, which completed in early July 2023. After the calibration phase, SWOT entered a 21-day repeat orbit in August 2023 to start the "science" phase of the mission, which is expected to continue through 2025.</p> <p>The L2 sea surface height data product is distributed in one netCDF-4 file per pass (half-orbit) covering the full KaRIn swath width, which spans 10-60km on each side of the nadir track. Sea surface height, sea surface height anomaly, wind speed, significant waveheight, and related parameters are provided on a geographically fixed, swath-aligned 2x2 km2 grid (Basic, Expert, Windwave). The sea surface height data are also provided on a finer 250x250 m2 "native" grid with minimal smoothing applied (Unsmoothed).</p> <p>Please note that this collection contains SWOT Version C science data products. This dataset is the parent collection to the following sub-collections:  <a href="https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_Basic_2.0">https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_Basic_2.0</a>  <a href="https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_WindWave_2.0">https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_WindWave_2.0</a>  <a href="https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_Expert_2.0">https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_Expert_2.0</a>  <a href="https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_Unsmoothed_2.0">https://podaac.jpl.nasa.gov/dataset/SWOT_L2_LR_SSH_Unsmoothed_2.0</a></p>



CLOUD ENABLED

Status: ACTIVE

Short Name:  
SWOT\_L2\_LR\_SSH\_2.0

Collection Concept ID:  
C2799438306-POCLOUD

Spatial Coverage:  
N: 90° S: -90°  
E: 180° W: -180°

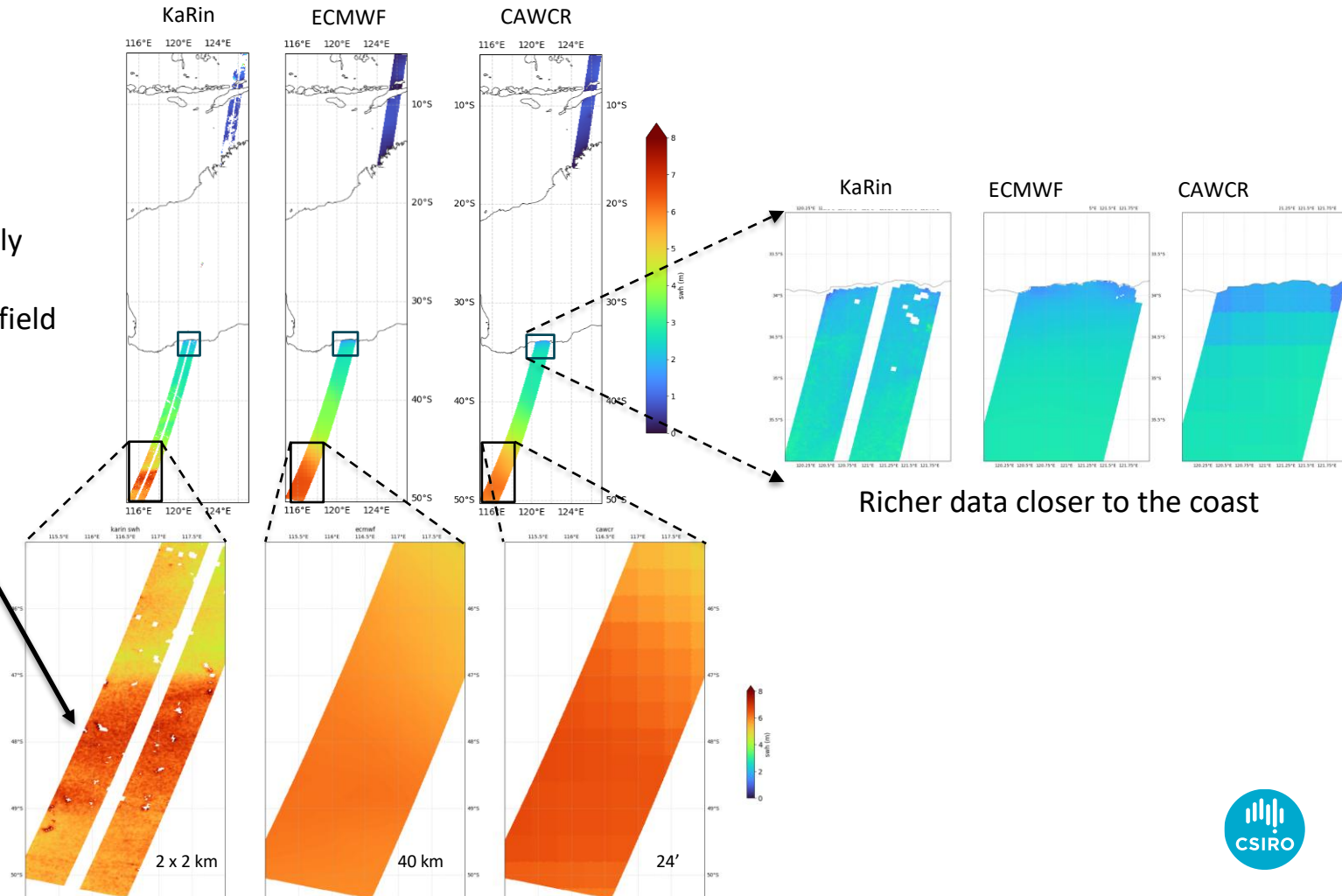
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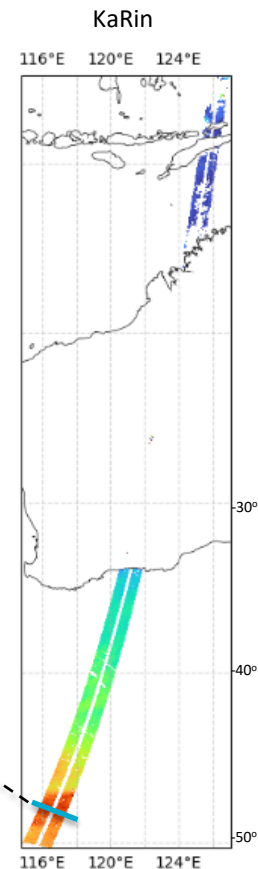
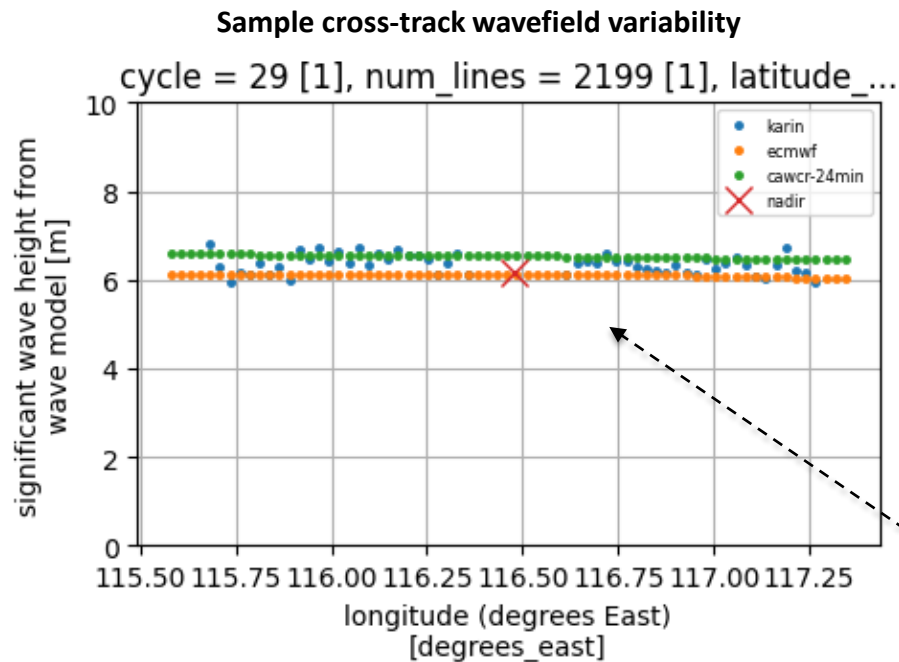
- Browse Granule Listing
- Search Granules

Capabilities:



Measures previously  
unseen small-scale  
variability of wave field  
that models don't  
capture

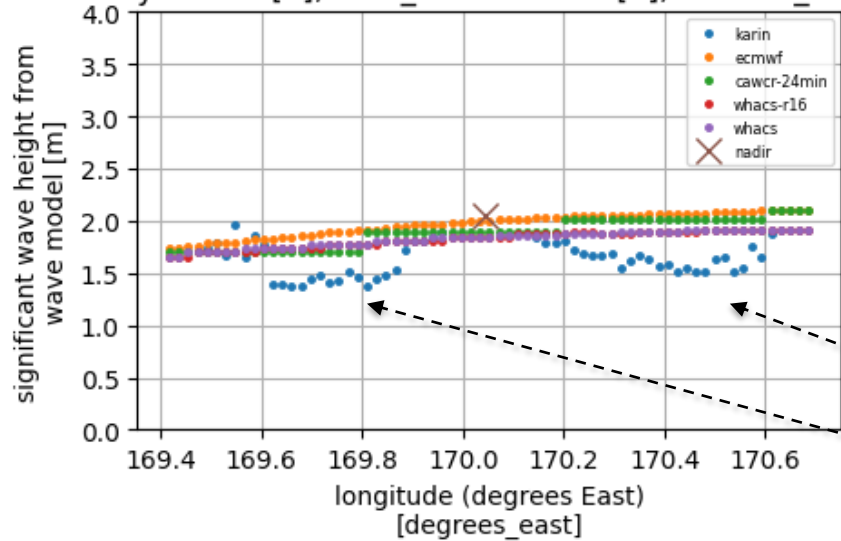




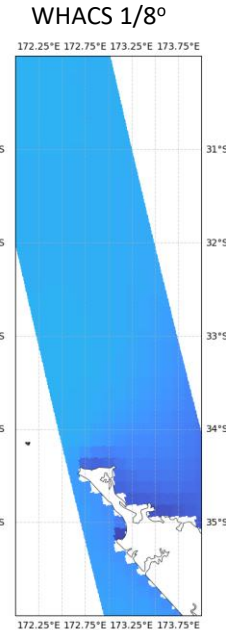
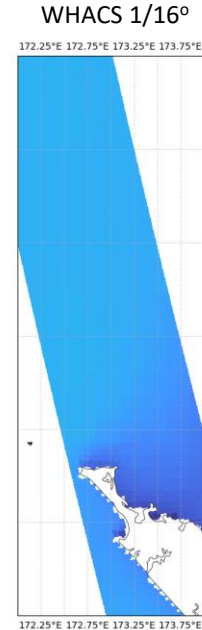
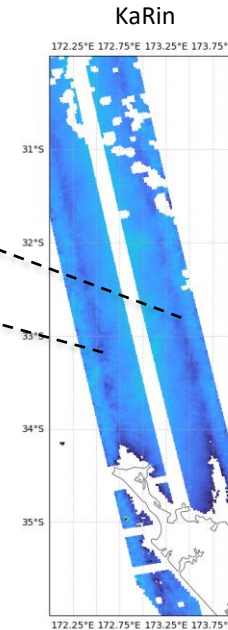


### Sample cross-track wavefield variability

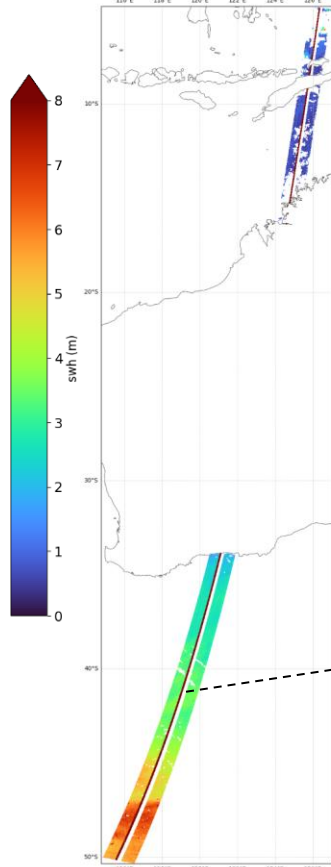
cycle = 8 [1], num\_lines = 5957 [1], latitude\_n...



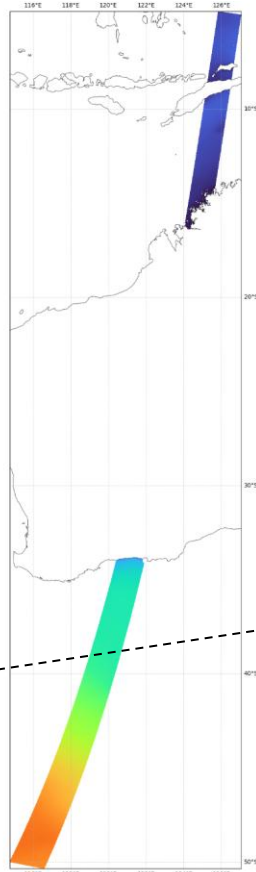
Needs assessment of potential instrumentation affects - possibly more pronounced at low wave regimes



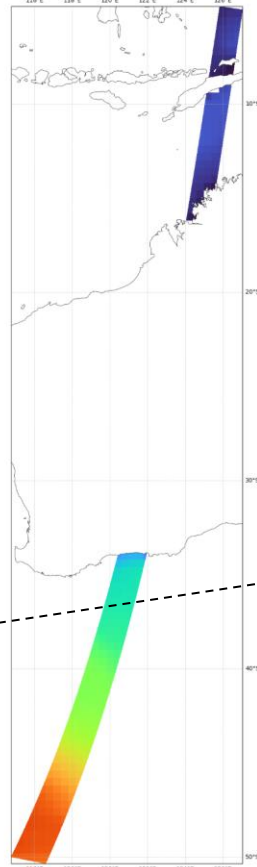
KaRin



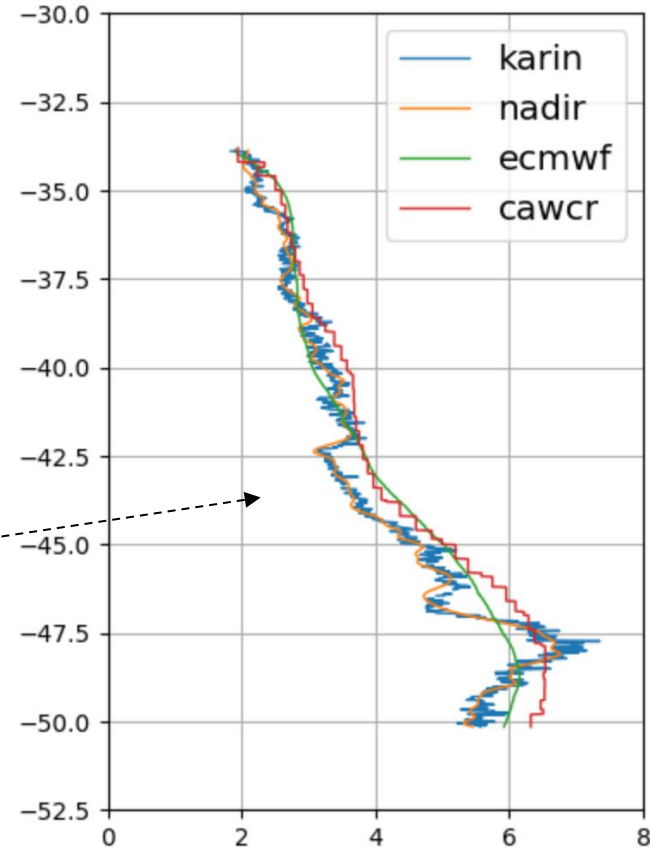
CAWCR



ECMWF



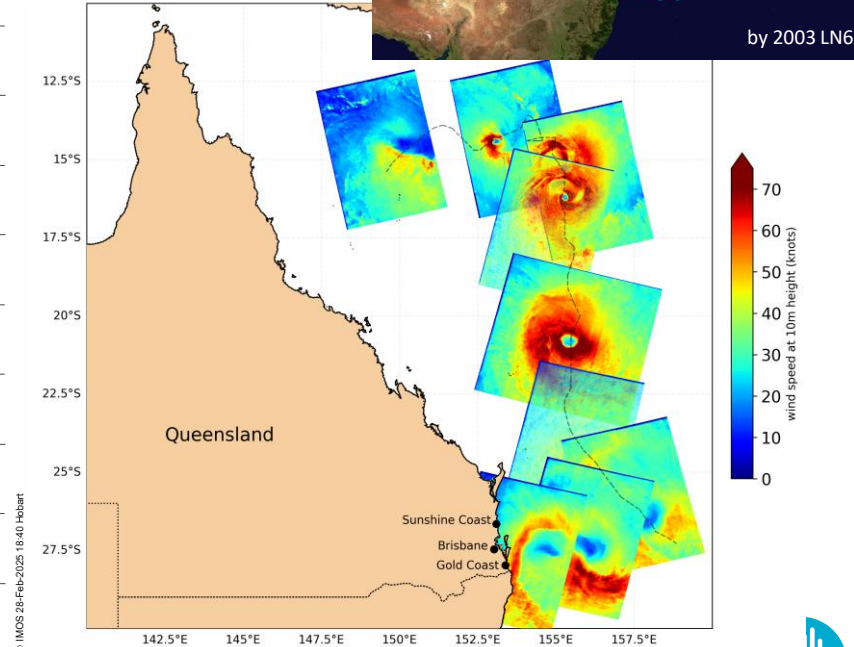
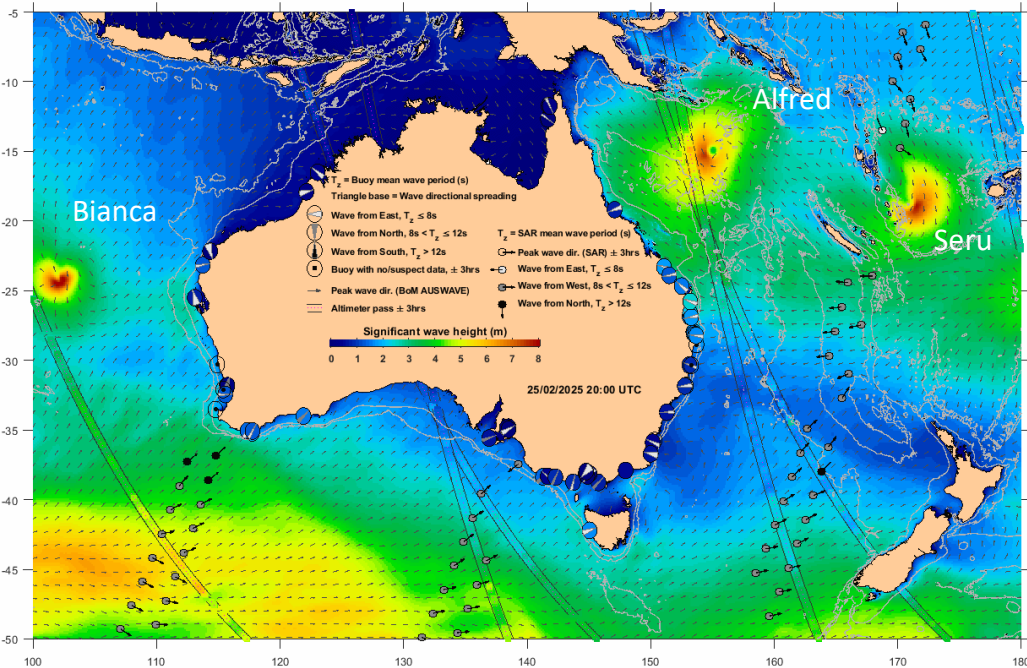
Sample along-track wavefield variability  
for one SWOT (KaRin) pixel (pixel =30)





# Tropical Cyclone Alfred wave field

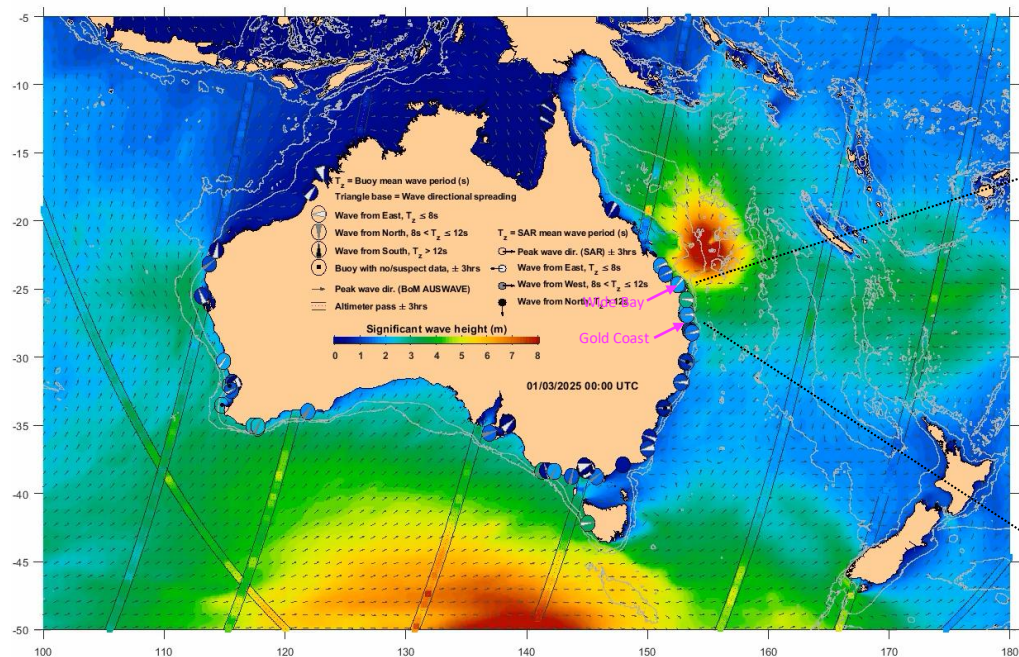
Cyclone Alfred: Severe intensity; long-lived; erratic track; coastal erosion; heavy rain



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

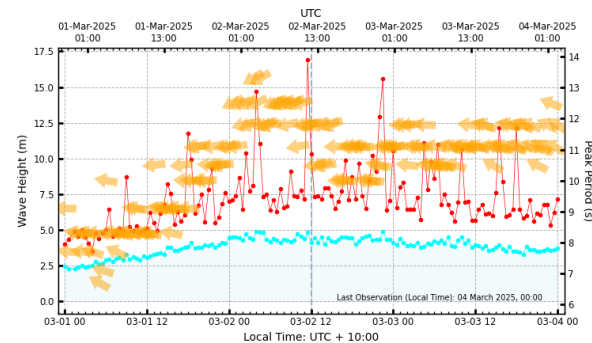
<https://oceancurrent.aodn.org.au/waves/waves3.php>



## Wide Bay

Buoy Location: 153.2°E, -25.77°S Custodian: Queensland Department of Environment and Science

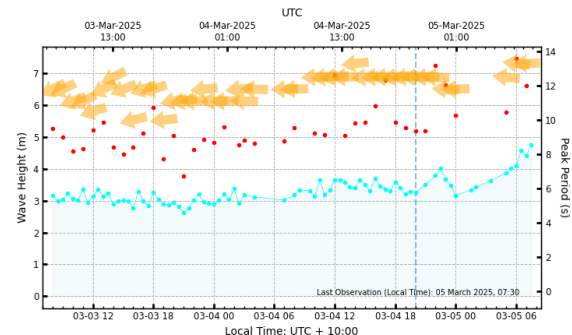
Significant Wave Height (m) Maximum Wave Height (m) Peak Wave Period and Direction (s & deg)



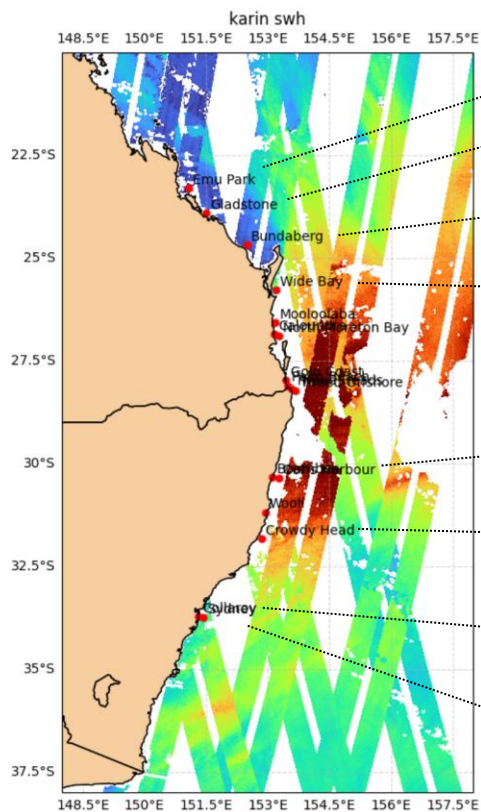
## Gold Coast

Buoy Location: 153.45°E, -27.97°S Custodian: Queensland Department of Environment and Science/Gold Coast City Council

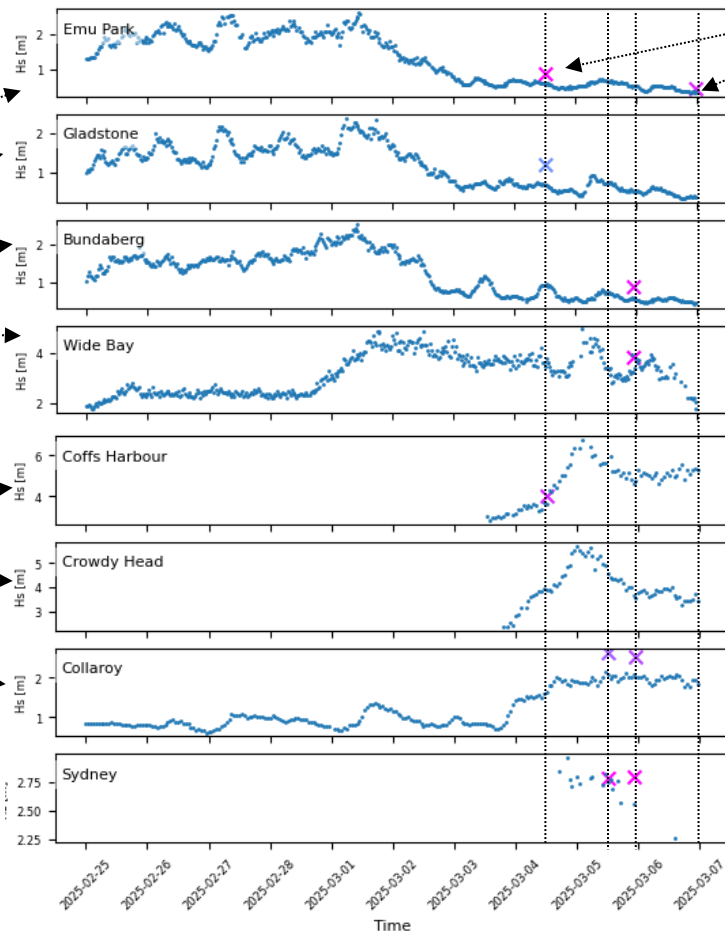
Significant Wave Height (m) Maximum Wave Height (m) Peak Wave Period and Direction (s & deg)



# Tropical Cyclone Alfred wave field



KaRin SWH 25<sup>th</sup> Feb – 06 Mar 2025



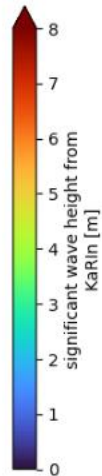
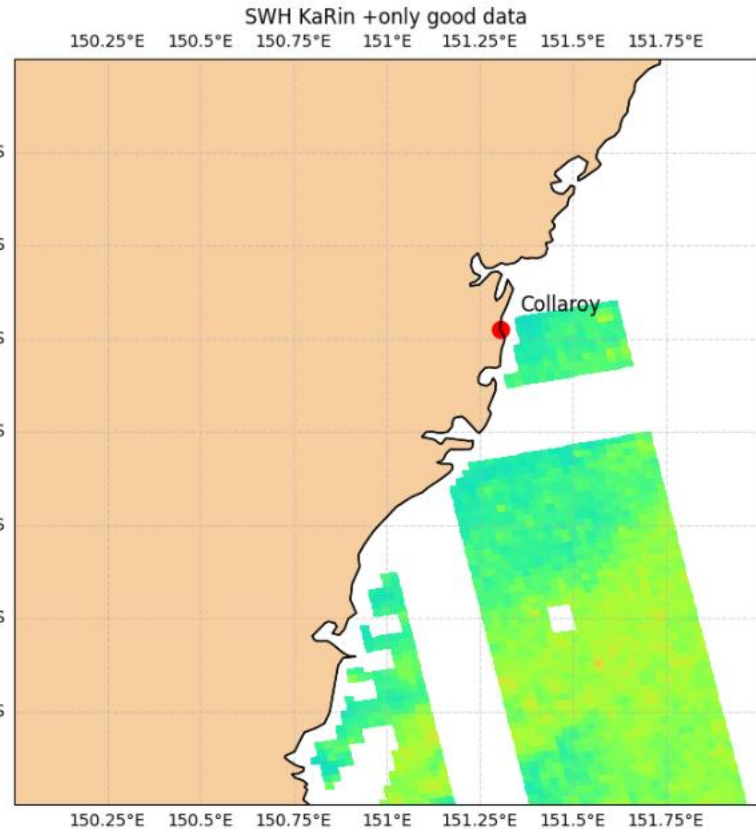
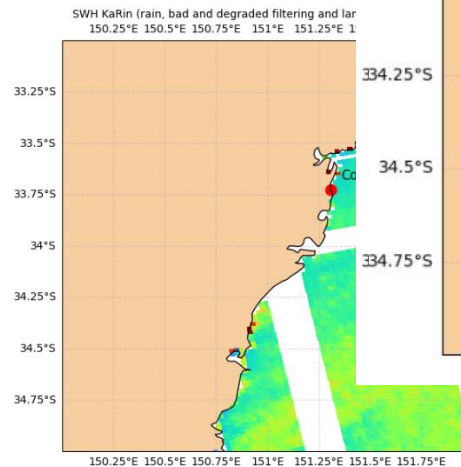
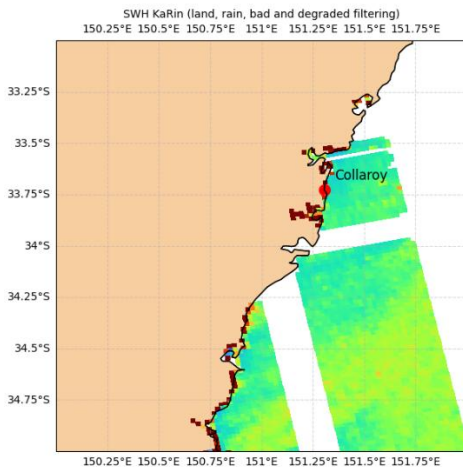
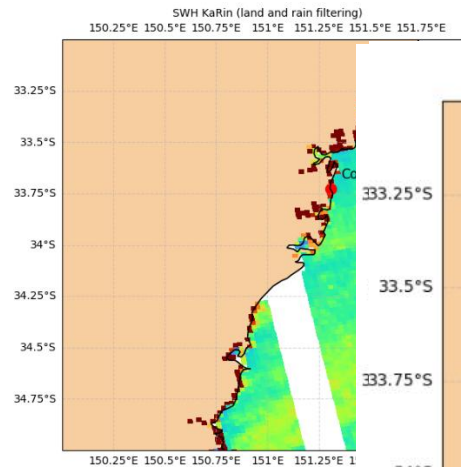
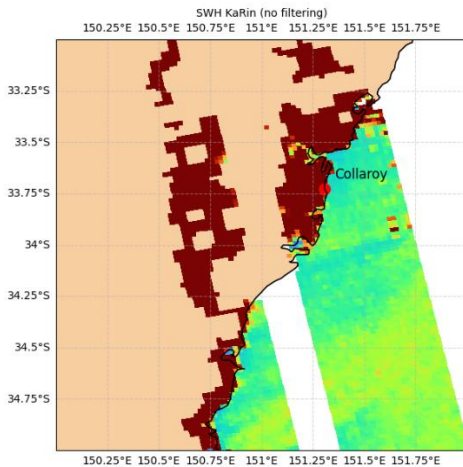
SWOT  
measurements

## Criteria and filtering

- ✓ Within 15km and 30 mins
- ✓ > 1km from coast
- ✓ No rain
- ✓ Only good quality data
- ✓  $0 < SWH < 30$



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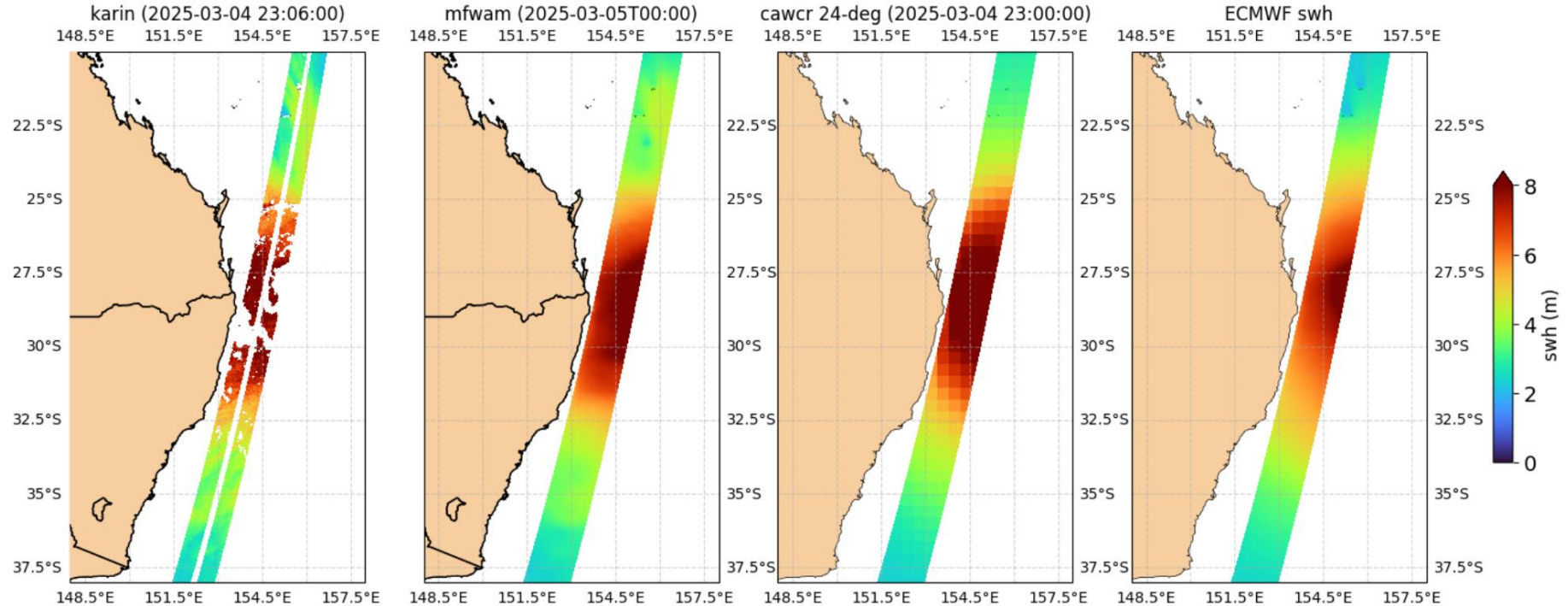


Filtering and QC

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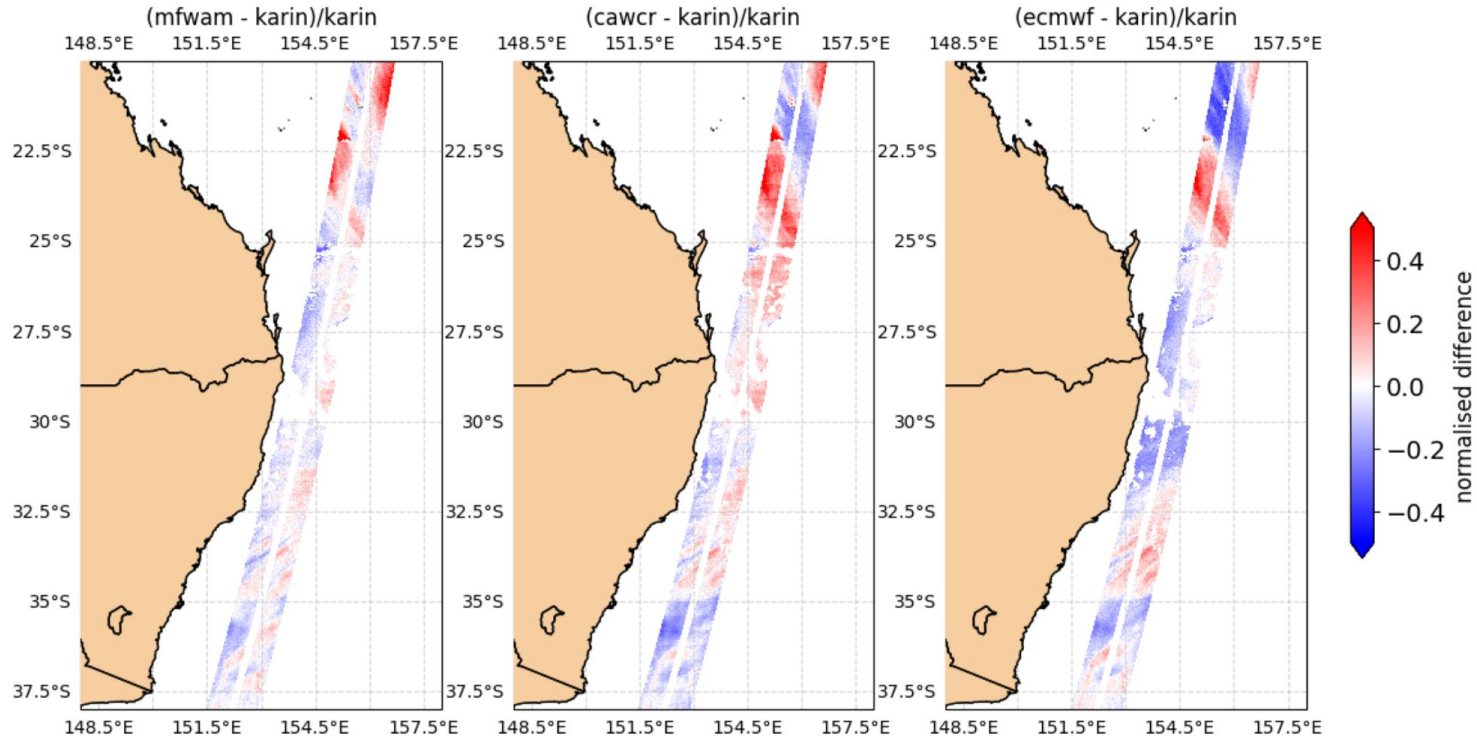


# Tropical Cyclone Alfred wave field



\*MFWAM refers to the MFWAM based CMS  
wave analysis

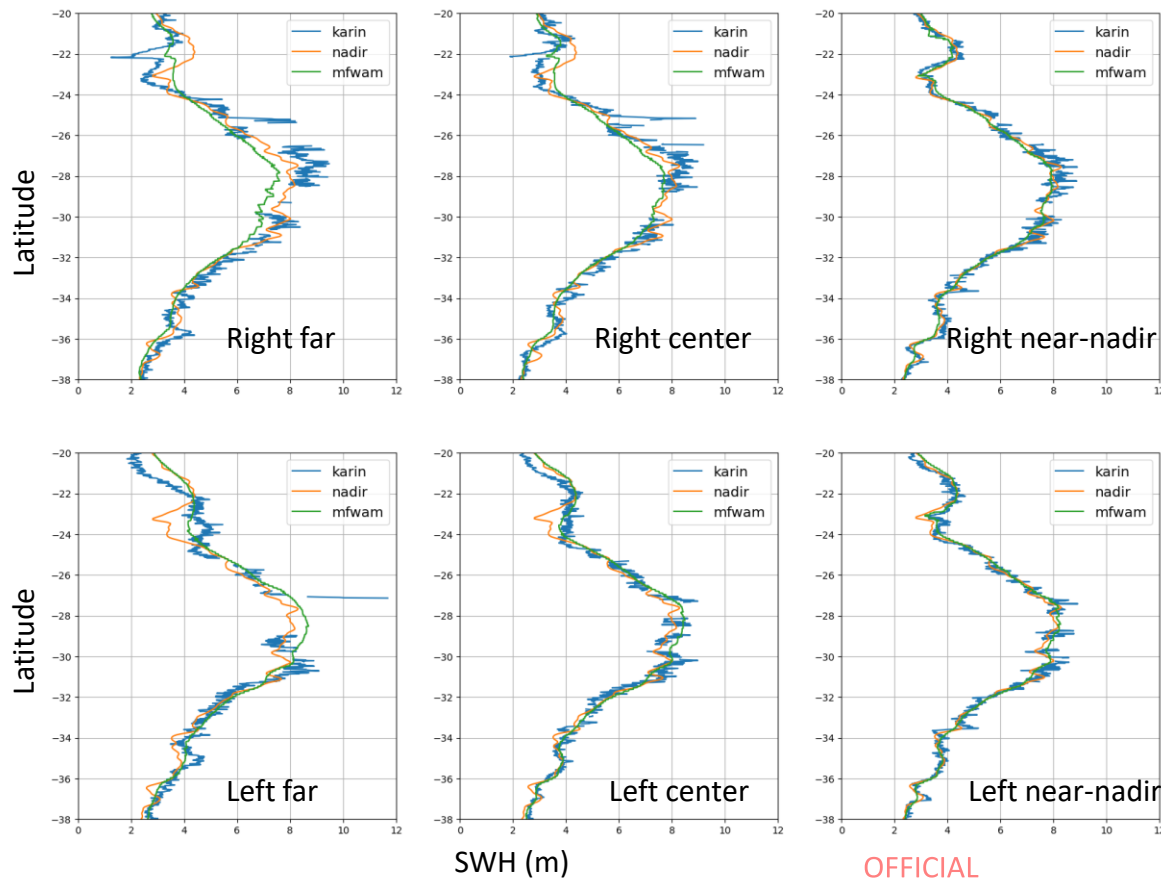
# Tropical Cyclone Alfred wave field



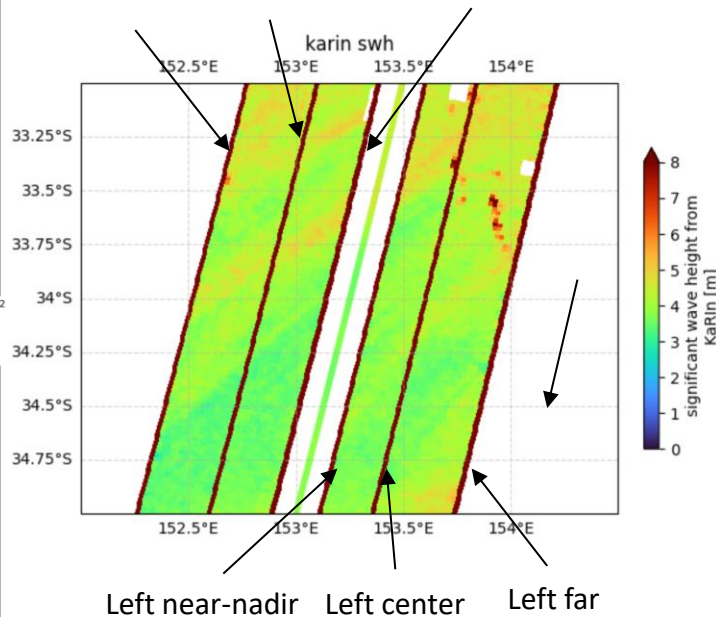
\*MFWAM refers to the MFWAM based CMS wave analysis



# Swath cross-track SWH accuracy



Right far Right center Right near-nadir



# 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.