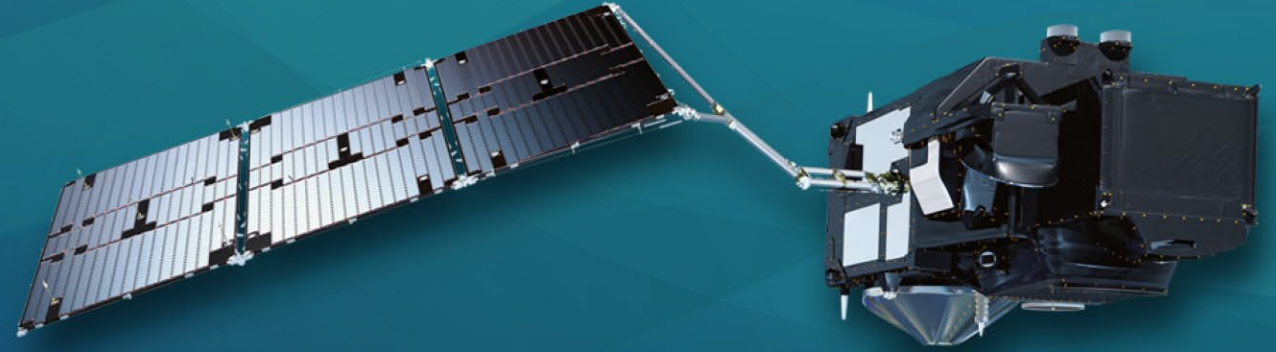




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9th Sentinel-3 Validation Team meeting 2026

30 March–01 April 2026 | ESA–ESRIN | Frascati (Rome), Italy

Updated Sentinel-3A/3B absolute bias results, and preparations for Sentinel-3C from Bass Strait, Australia

Christopher Watson^{1,3}, Benoit Legresy^{2,3}, Jack Beardsley^{3,1}

1. *University of Tasmania, Hobart, Australia.*
2. *CSIRO Environment, Hobart, Australia.*
3. *Integrated Marine Observing System*



1. Site Recap and Approach:

Multi-mission, absolute, in situ validation of satellite altimetry from the Bass Strait facility.

2. Updated Absolute Bias Estimates:

Missions: Sentinel-3A and Sentinel-3B.

Data: SRAL/MWR Level 2, G62, 1-Hz data to form SSH. Data from launch until 2025-06-30.

Variants: SAR and PLRM for comparative purposes.

3. Perspectives / Future Plans:

- Lessons learned from SWOT for S3NG-T.
- Plans for Sentinel-3C.



Bass Strait Validation Facility



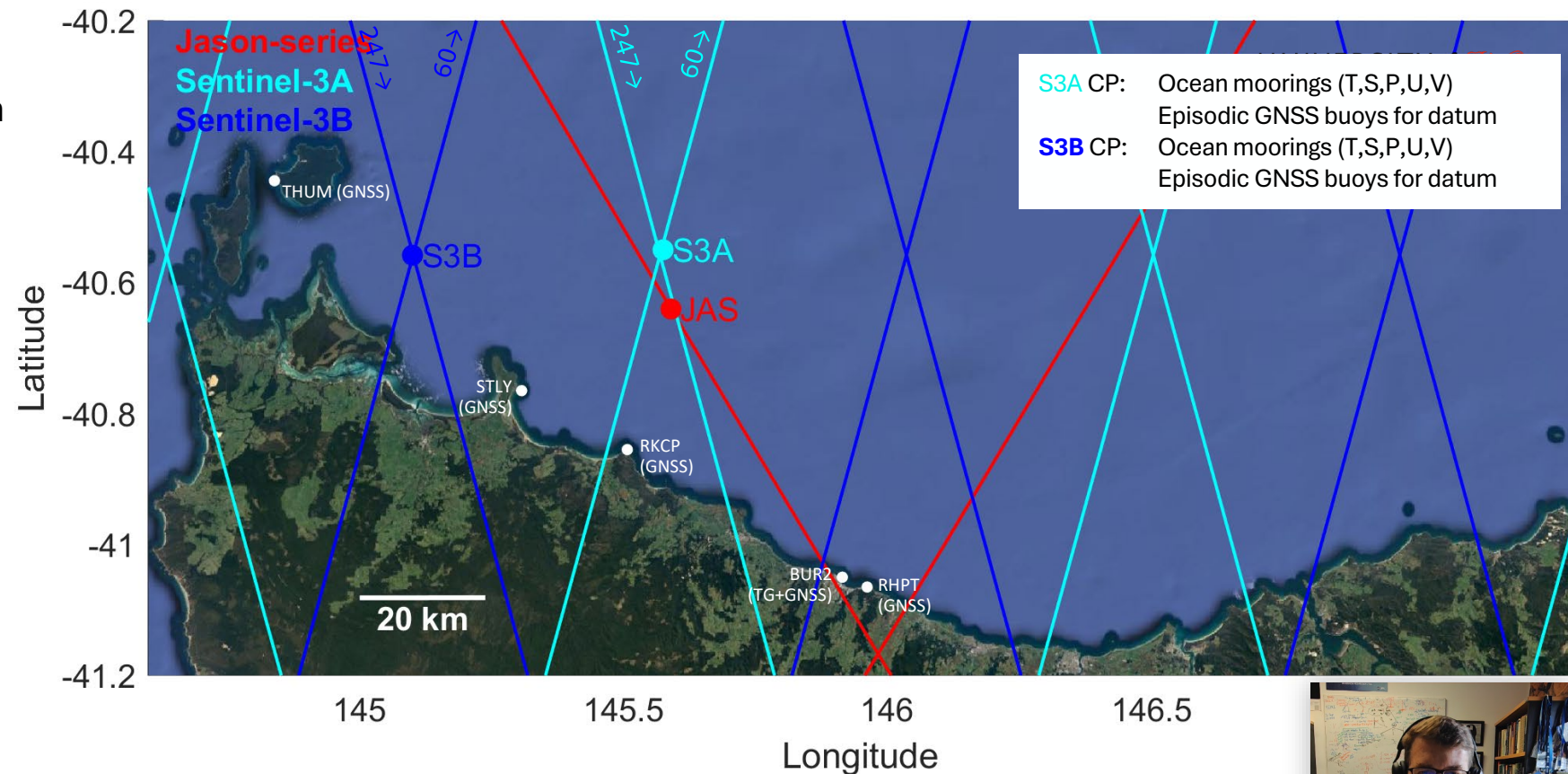
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- Sustained and independent monitoring of altimeter absolute bias since the launch of TOPEX / Poseidon in late 1992.
- Three comparison points with in situ observations of SSH in support of Jason-series (**JAS**), Sentinel-3A (**S3A**) and Sentinel-3B (**S3B**) missions.
- Both Sentinel-3 comparison points are located at cross overs of passes 060 and 247.
- Significant involvement with SWOT validation over its fast-sampling phase (1-day repeat orbit). Many experiences relevant for the future S3NG-T mission.



Approach



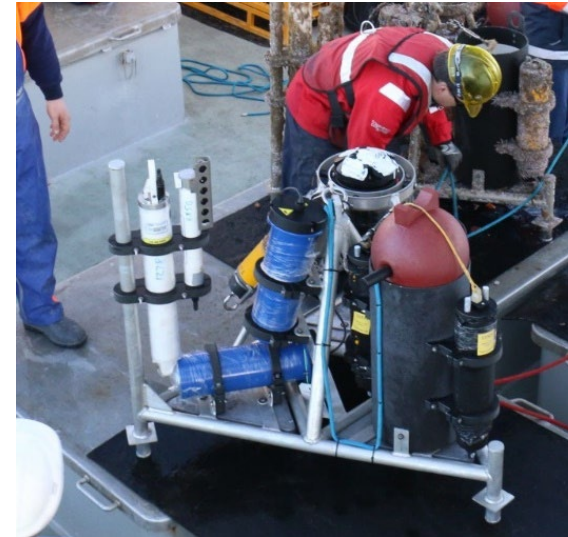
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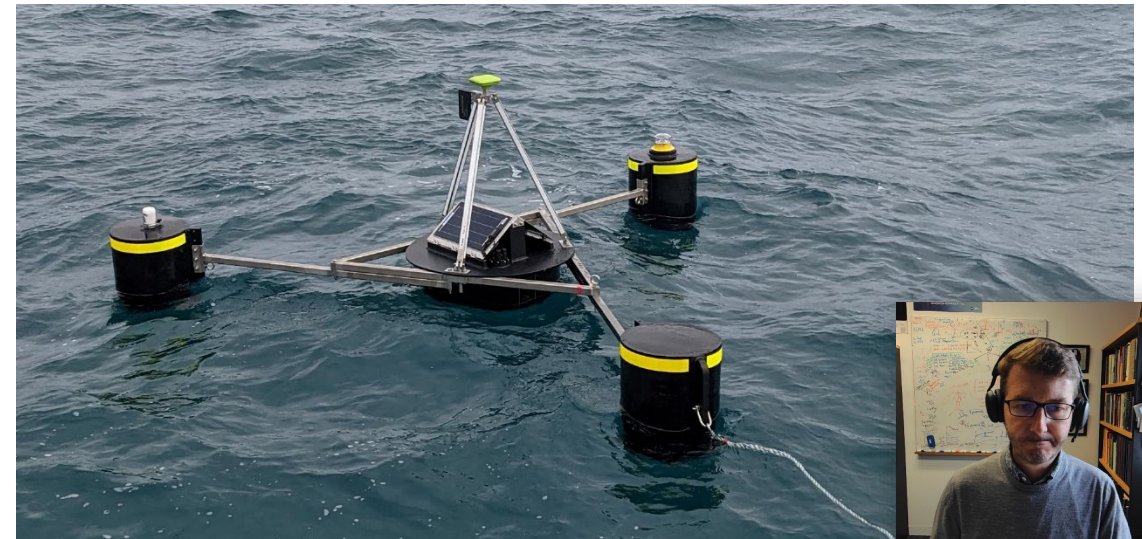


- Ongoing effort to enhance our in situ observations to keep pace with satellite developments.
- We are in the process of shifting across to 5-beam ADCPs which adds the acoustic approach to SSH, overcoming imperfections in the 'classic' approach (T/S/P), helping to gain extra mm in precision, plus delivering 3D currents and waves.
- GNSS/INS equipped buoys deployed over the oceanographic sensors provides the connection to the absolute datum (ITRF).
- Coastal climate-standard tide gauge provides redundancy in SSH.
- Land based GNSS delivers vertical land motion and insight into wet tropospheric delay.



- **Gimbal stabilized five beam Acoustic Doppler Current Profiler (ADCP) (SSH/U/V/W at 2 Hz).**
- **Bottom pressure, temperature and salinity sensors (P/T/S).**
- **Serviced 6-12 monthly.**

- **GNSS/INS equipped buoys (SSH/W/trop at 2 Hz).**
- **Deployed for ~2-4 weeks every 6 months.**



Results Preview



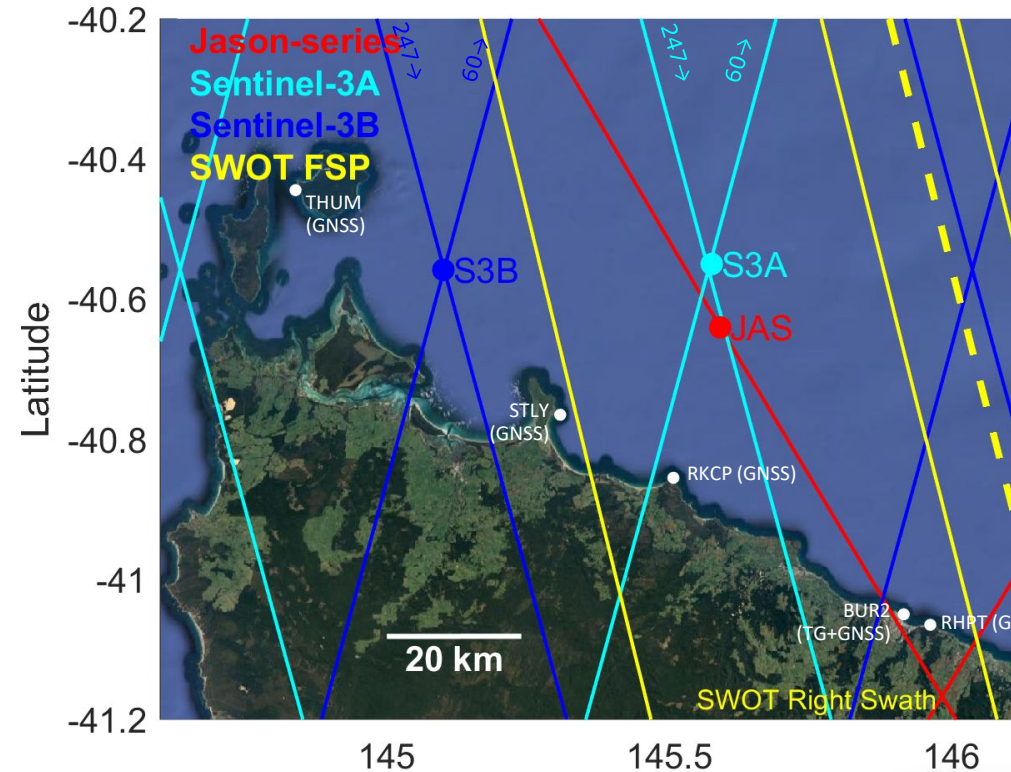
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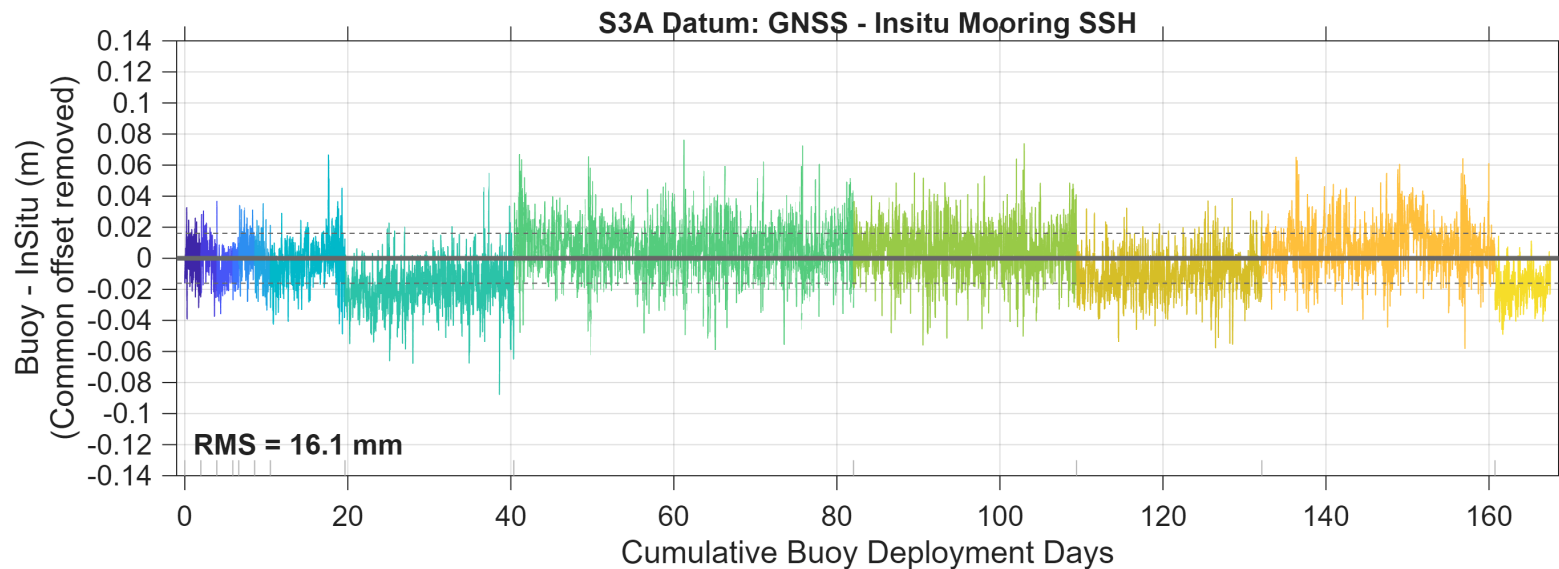
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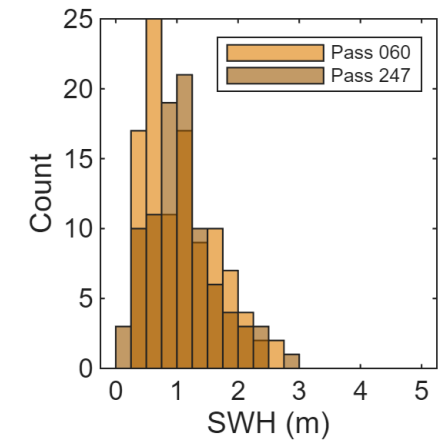
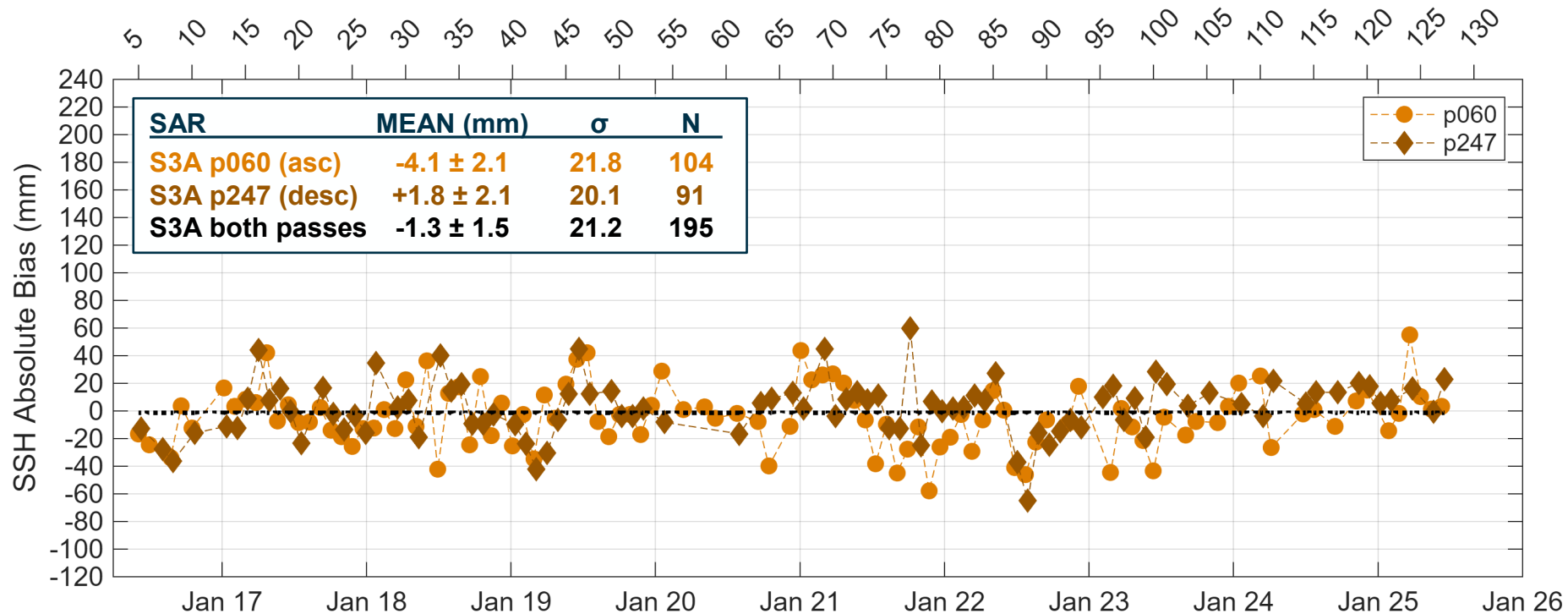
- **S3A** and **S3B** absolute SSH bias estimates from passes 247 and 060.
- We use SRAL/MWR Level 2, G62, SAR & PLRM data for SSH at 1 Hz.
- Data from launch until 2025-06-30 as provided to the S3VT.
- Other results for comparative purposes:
 - Jason-3 and Sentinel-6 MF at the **JAS** CP.
 - SWOT over the fast-sampling phase (1-day repeat orbit).



1. Each mooring SSH time series (6-12 months) is aligned to tide gauge yielding a consistent but arbitrary datum.
2. GNSS buoys are deployed for ~20-30 days every ~6 months corresponding to service visits for sub-surface moorings.
3. Absolute datum imposed by comparing series from 1) against GNSS buoy SSH from 2). Residuals from that process are shown below for S3A CP - each colour is a different buoy deployment.



Sentinel-3A, G62, Absolute SSH bias (1 Hz, SAR mode)

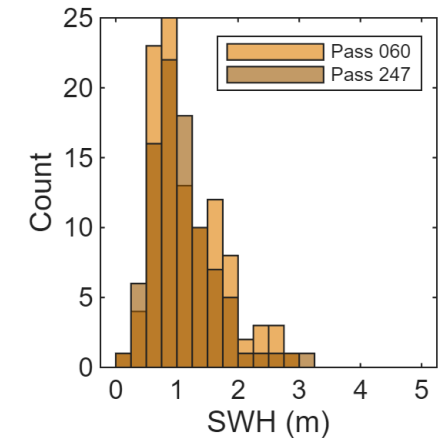
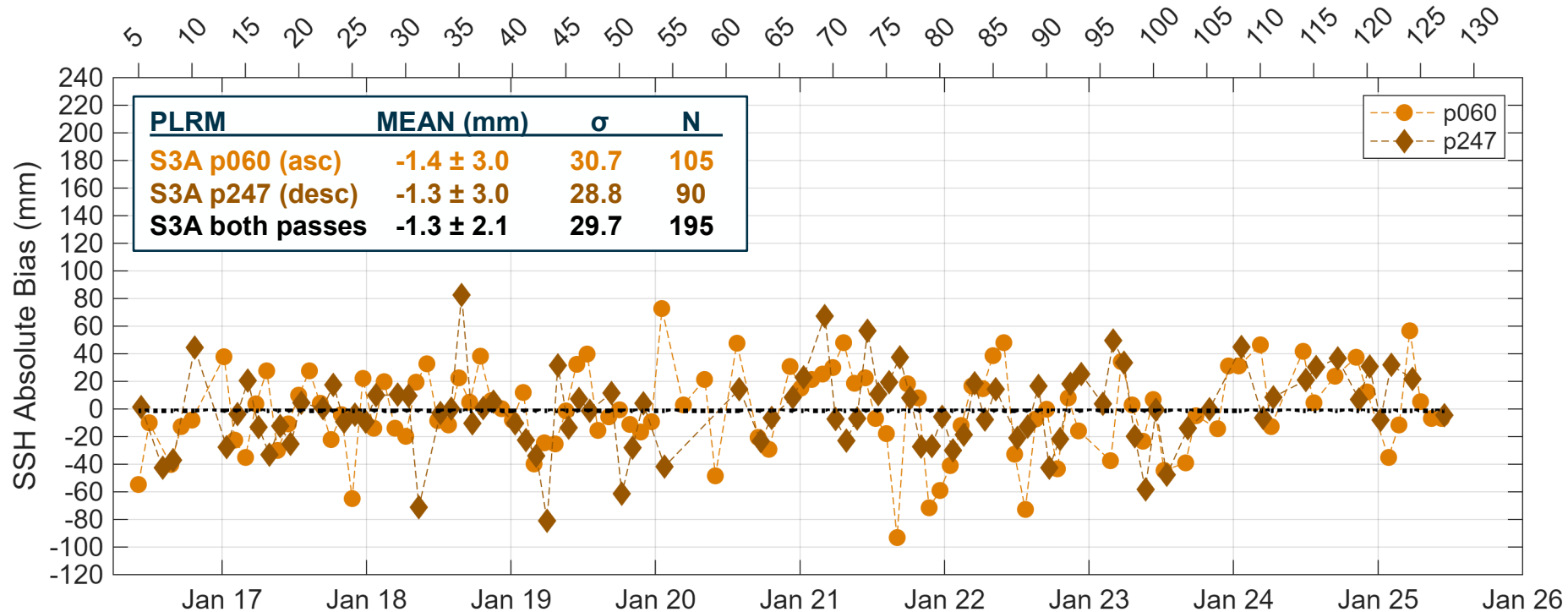


Sentinel-3A SSH absolute bias (at **S3A** CP):

- **SAR** mode: Mean absolute bias = -1 mm, std dev = ~2 cm
- Rate $+0.9 \pm 1.1$ mm/yr (insignificant)



Sentinel-3A, G62, Absolute SSH bias (1 Hz, PLRM mode)

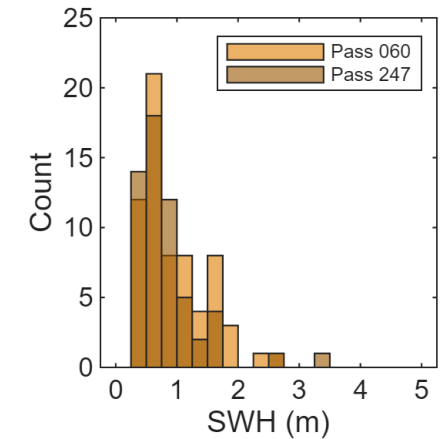
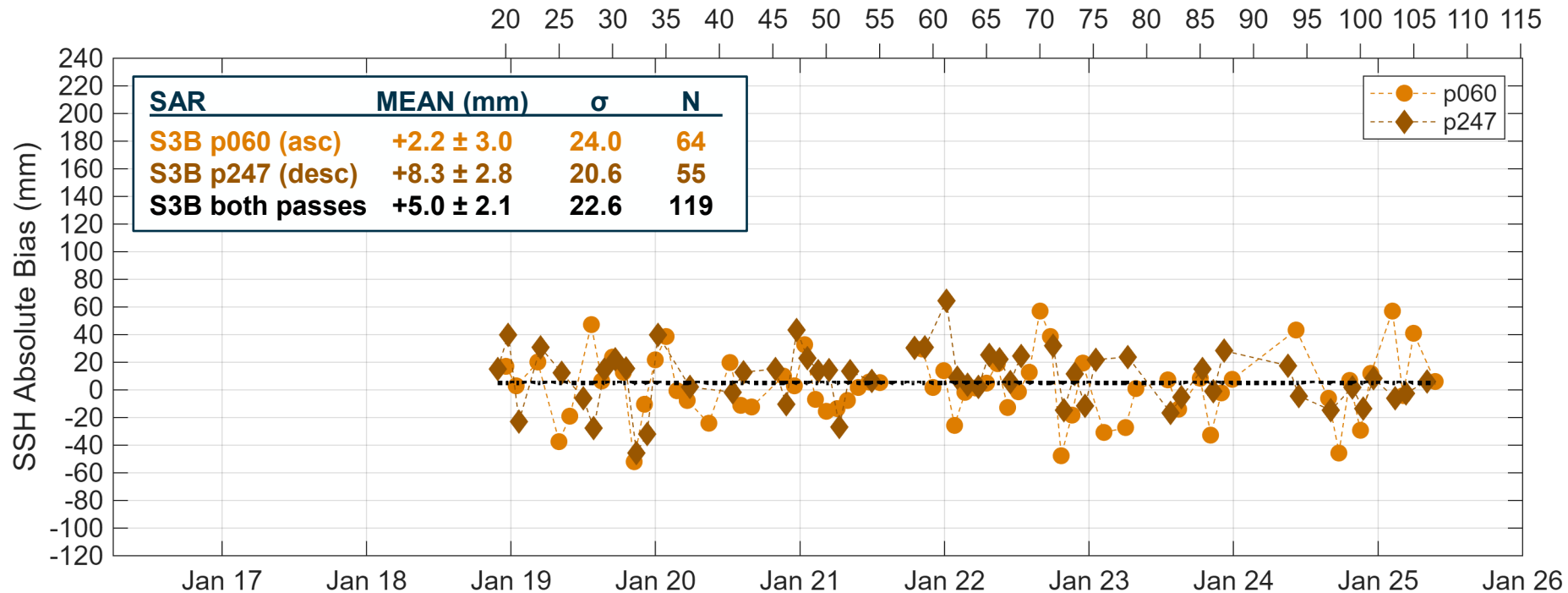


Sentinel-3A SSH absolute bias (at **S3A** CP):

- **PLRM** mode: Mean absolute bias = -1 mm, std dev = ~3 cm
- Rate $+1.6 \pm 1.6$ mm/yr (insignificant)



Sentinel-3B, G62, Absolute SSH bias (1 Hz, SAR mode)

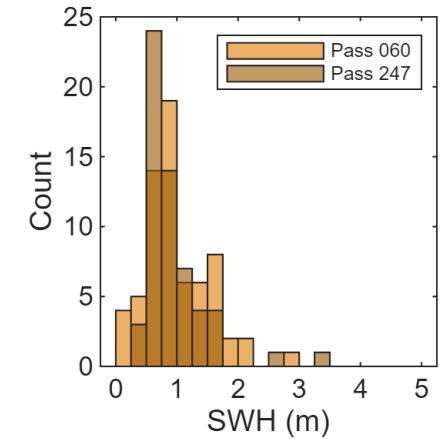
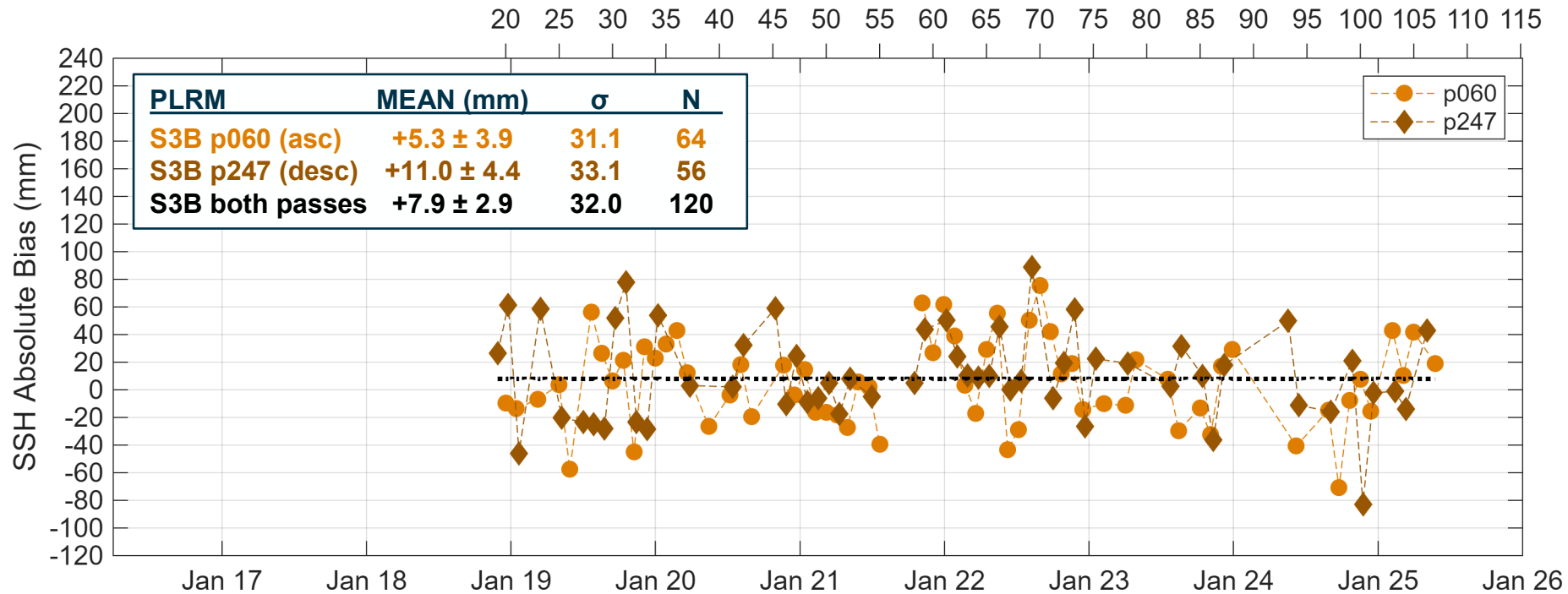


Sentinel-3B SSH absolute bias (at **S3B** CP):

- **SAR** mode: Mean absolute bias = +5 mm, std dev = ~2 cm
- Rate -0.8 ± 2.2 mm/yr (insignificant)



Sentinel-3B, G62, Absolute SSH bias (1 Hz, PLRM mode)



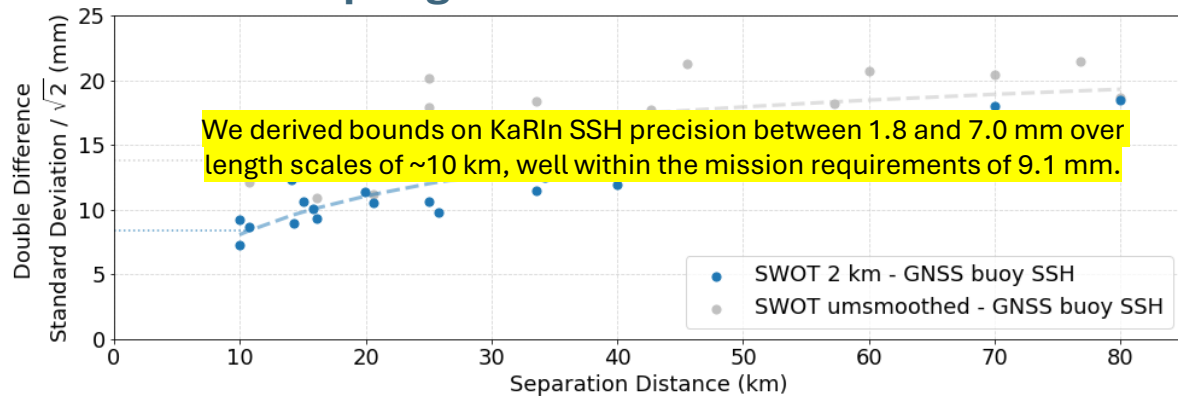
Sentinel-3B SSH absolute bias (at **S3B** CP):

- **PLRM** mode: Mean absolute bias = +8 mm, std dev = ~3 cm
- Rate -0.3 ± 3.3 mm/yr (insignificant)

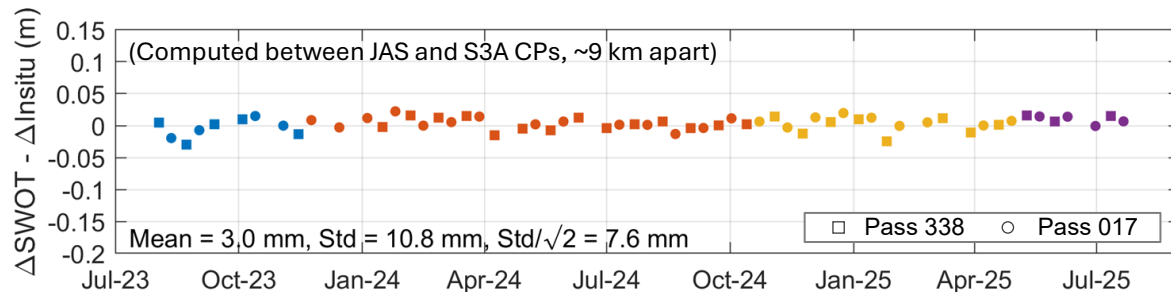
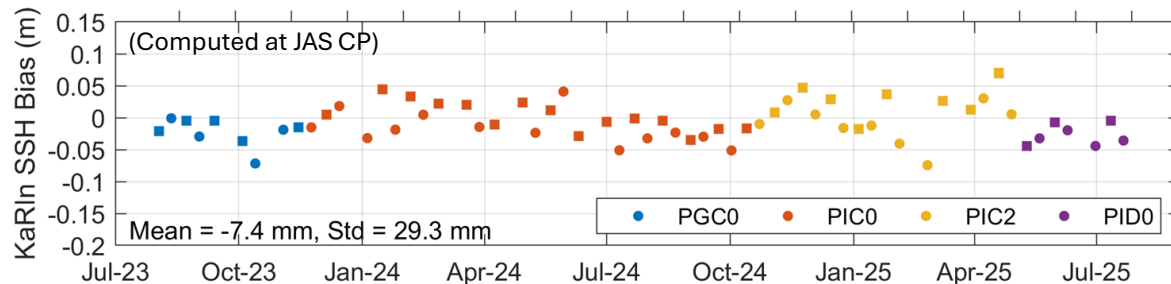


Insights from SWOT relevant to S3NG-T

Fast Sampling Phase:



Science Phase (absolute bias and Δ SSH bias):



Earth and Space Science

RESEARCH ARTICLE
10.1029/2025EA004326

In Situ Geometric Validation of SWOT Satellite Observations in Bass Strait, Australia

Andrea Hay^{1,2}, Christopher Watson^{1,3}, Benoit Legresy^{2,3,4}, Matt King¹, Boye Zhou⁵, Jack Beardsley^{1,2,3}, and Alejandro Bohé⁶

Special Collection:
Science from the Surface Water and Ocean Topography Satellite Mission

¹School of Geography, Planning, and Spatial Sciences, University of Tasmania, Hobart, TAS, Australia, ²CSIRO, Hobart, TAS, Australia, ³Integrated Marine Observing System, Hobart, TAS, Australia, ⁴Australian Antarctic Program Partnership,



Geophysical Research Letters

RESEARCH LETTER
10.1029/2024GL112778

Small Scale Variability in the Wet Troposphere Impacts the Interpretation of SWOT Satellite Observations

Andrea Hay^{1,2}, Christopher Watson^{1,3}, Benoit Legresy^{2,3,4}, Matt King¹, and Jack Beardsley^{1,2,3}

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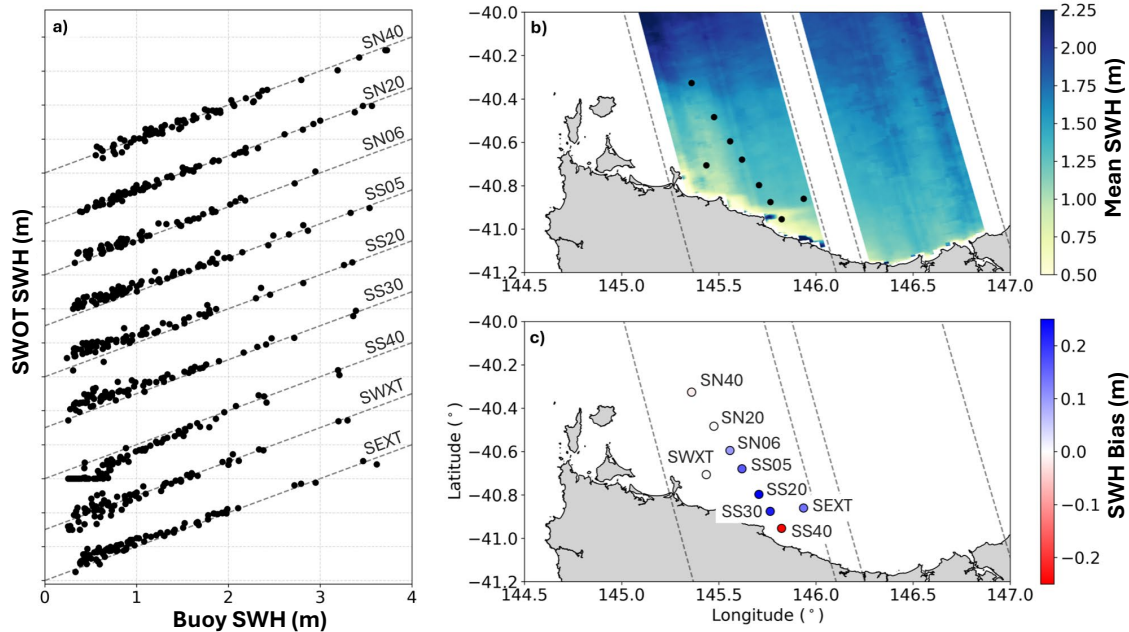
¹School of Geography, Planning, and Spatial Sciences, University of Tasmania, Hobart, TAS, Australia, ²CSIRO, Hobart, TAS, Australia, ³Integrated Marine Observing System, Hobart, TAS, Australia, ⁴Australian Antarctic Program Partnership, University of Tasmania, Hobart, TAS, Australia

Key Points:

- Array of 9 GNSS buoys along a ~80 km profile enables a geometric validation of sea surface slope across different short spatial scales.
- Also gives insights into small scale variability of the troposphere.



Insights from SWOT relevant to S3NG-T



Hay et al., 2025



IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 63, 2025

5209319

Measuring Significant Wave Height Fields in Two Dimensions at Kilometric Scales With SWOT

Alejandro Bohé¹, Albert Chen², Curtis Chen³, Pierre Dubois⁴, Alexander Fore⁵, Beatriz Molero⁶, Eva Peral⁷, Matthias Raynal, Bryan Stiles, Fabrice Ardhuin⁸, Andrea Hay⁹, Benoît Legresy¹⁰, Luc Lenain, and Ana B. Villas Bôas¹¹

- GNSS array also enables validation of SWOT wave products in 2D.
- Data from Bass Strait and our site in the Southern Ocean (SOFS) has enabled further evolution in SWOT wave algorithms by the agencies (Bohe et al. 2025).



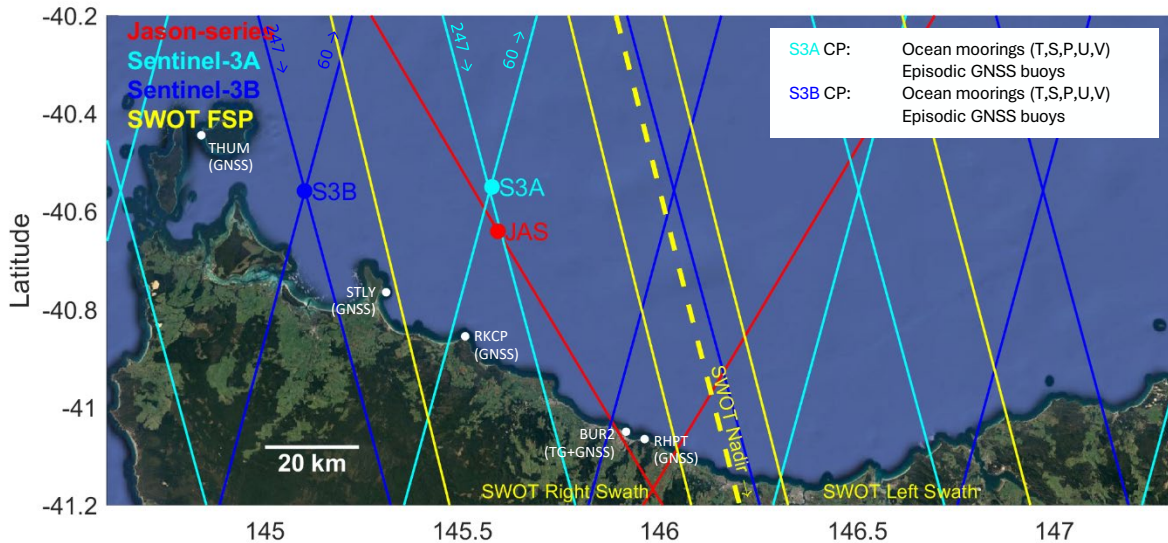
Summary



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| Mission | | Cycles | Absolute Bias | Std Dev (Sample Size) |
|---------------------|------|----------|---------------|-----------------------|
| S3A (G62): | SAR | 4 → 127 | -1 mm | 21 mm (n = 195) |
| | PLRM | 4 → 127 | -1 mm | 30 mm |
| S3B (G62): | SAR | 19 → 106 | +5 mm | 23 mm (n = 119) |
| | PLRM | 19 → 106 | +8 mm | 32 mm |
| Jason-3 (GDR-F): | | 1 → 212 | -2 mm | 23 mm |
| S6 SideA (PB-08/9): | HR | 4 → 30 | -7 mm | 16 mm (n = 25) |
| | LR | 4 → 30 | -6 mm | 19 mm |
| S6 SideB (PB-08/9): | HR | 32 → 176 | -7 mm | 16 mm (n = 132) |
| | LR | 32 → 176 | -2 mm | 20 mm |

Key points:

- **S3A** and **S3B** SAR and PLRM absolute SSH biases are **insignificantly different from zero** (version: G62). Compares to 15 and 21 mm, respectively for SAR/BC05.
- Variability of the SAR biases: ~2 cm underscoring the high performance of each mission and the Bass Strait in situ time series.
- Variability of the PLRM biases: ~3 cm.
- Non-averaging errors likely limit absolute bias uncertainty to ~10 mm.

Looking forward:

- Facility is currently supported to mid 2028, hence well positioned to contribute to validation of Sentinel 3-C.
- Our work with an array of GNSS buoys for the SWOT mission is relevant to considerations for S3NG-T.

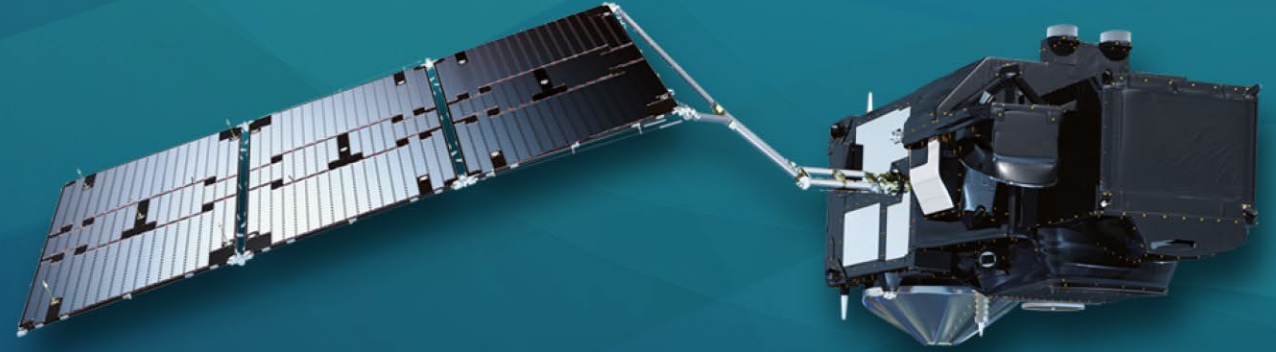




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Any questions or comments, please email:

Christopher Watson: cwatson@utas.edu.au

Benoit Legresy: Benoit.Legresy@csiro.au



Earth and Space Science

RESEARCH ARTICLE
10.1029/2025EA004326

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Mission

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Geophysical Research Letters

RESEARCH LETTER
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