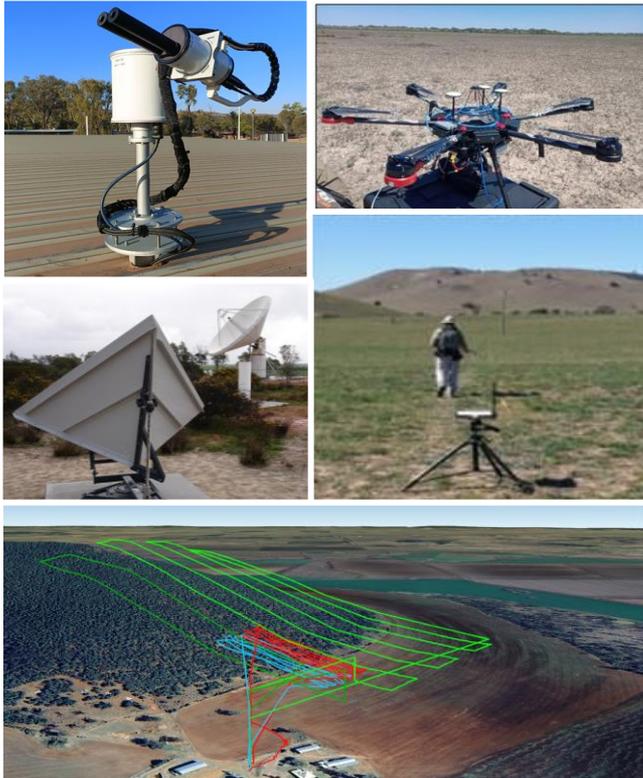


Geoscience Australia Report



Medhavy Thankappan
Agenda Item 1.6
WGCV-55
8-11 July 2025
Hyderabad, India



- ❖ About Geoscience Australia
- ❖ Landsat Next Cal Sites
- ❖ Infrastructure for Cal Val
- ❖ Field Validation Campaign
- ❖ SAR ARD Quality Assessment

- ❖ Australia's national geoscience organisation, ~700 staff, mostly based in Canberra, Australian Government (part of Industry Science and Resources portfolio), 3 Science Divisions: Space; Minerals, Energy & Groundwater; Place and Communities www.ga.gov.au
- ❖ Satellite Ground Station in Alice Springs, geographically dispersed national cal val infrastructure



- ❖ We provide over 5 petabytes of satellite data dating back to 1988 and 7 petabytes of Copernicus satellite data to the user community in the Indo-Pacific region.
- ❖ Our annual coastal and terrestrial EO products released in May 2025, measured and analysed changes over 30+ years in over 300,000 waterbodies and 37,000 km of coastline covering the Australian continent.
- ❖ The Alice Springs Ground Station routinely captures over 99% of scheduled satellite passes exceeding performance targets as part of a sustained Australia - U.S. partnership dating back to 1979. New ground station facilities, advanced data processing and analytics capabilities are being developed to support the Landsat Next mission.
- ❖ CSIRO, Geoscience Australia, and the Bureau of Meteorology secured Australia's role as the 2026 CEOS Chair.

- ❖ CSIRO will provide calibration and validation services in support of Landsat Next, under a contract.
- ❖ Includes the establishment and maintenance of instrumented cal val sites in Australia with specified performance goals for operation.
- ❖ Cal Val sites will adopt established CEOS protocols (e.g. RADCALNET, Fiducial Reference Measurements).

Pinnacles Calibration Site (PIAU)



Proposed RADCALNET site at Pinnacles, Western Australia



- ❖ Being developed by CSIRO to be part of RADCALNET
- ❖ CE 318-TU12 BRDF Sun Photometer
- ❖ Gill GMX600 Weather Station
- ❖ Kipp and Zonen CMP3 Pyranometer
- ❖ Raspberry Pi
- ❖ Sky camera with fisheye lens



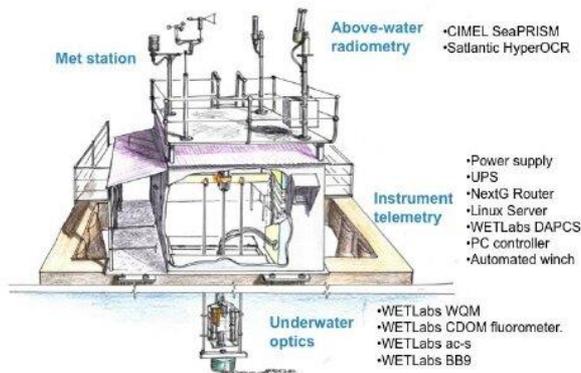
DION pontoon in the Googong Reservoir, NSW



- ❖ 3 x TRIOS Ramses Hyperspectral Radiometers (Ed, Lw, Lsky)
- ❖ Weather Station (temp, humidity, pressure, dew point, wind speed)
- ❖ Thermistor Chain (temp at surface and 1-8 m)
- ❖ 2 x Heitronics Thermal Radiometers
- ❖ Webcams (water, sky)
- ❖ Kurloo GPS Instrument (water surface height)



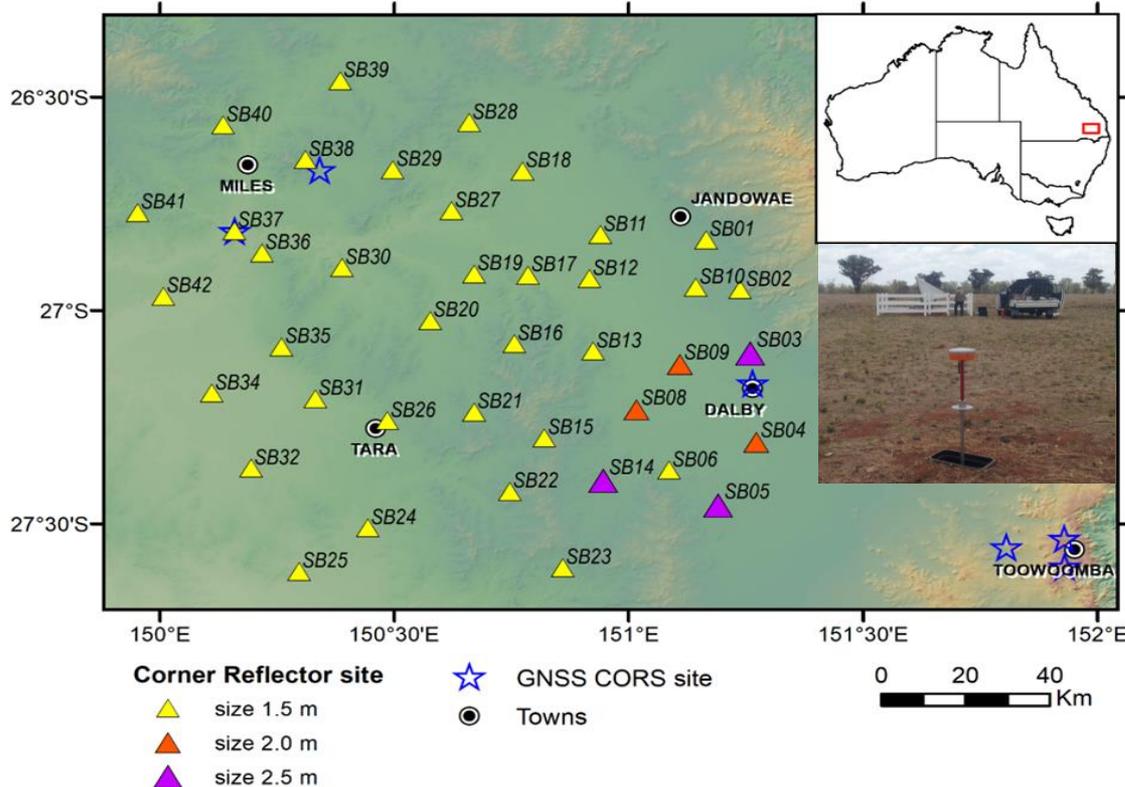
LJCO Facility



<< LJCO seen on a satellite image

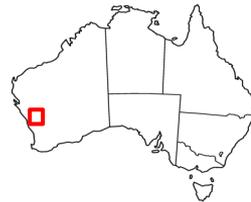
- ❖ Satlantic HyperOCR Radiometer
- ❖ CIMEL CE318-T SeaPrism Radiometer
- ❖ Vaisala Weather Station
- ❖ Sea Bird x 4 – ACS, WQM, B89, EcoTriplet
- ❖ Hemispherical Webcams

Queensland Corner Reflector Array (QCRA)



- ❖ Geoscience Australia operates the QCRA, 40 CRs spread over 100km x 100km in South-east Queensland, Australia
- ❖ Enables consistency in the quality of SAR data from multiple sensors, and will be a key contribution to the SARCalNet initiative
- ❖ The QCRA has supported calibration of several SAR missions including Sentinel-1 since 2014
- ❖ Maintenance / re-survey planned for 2025

Yarragadee Corner Reflectors (YGCR)



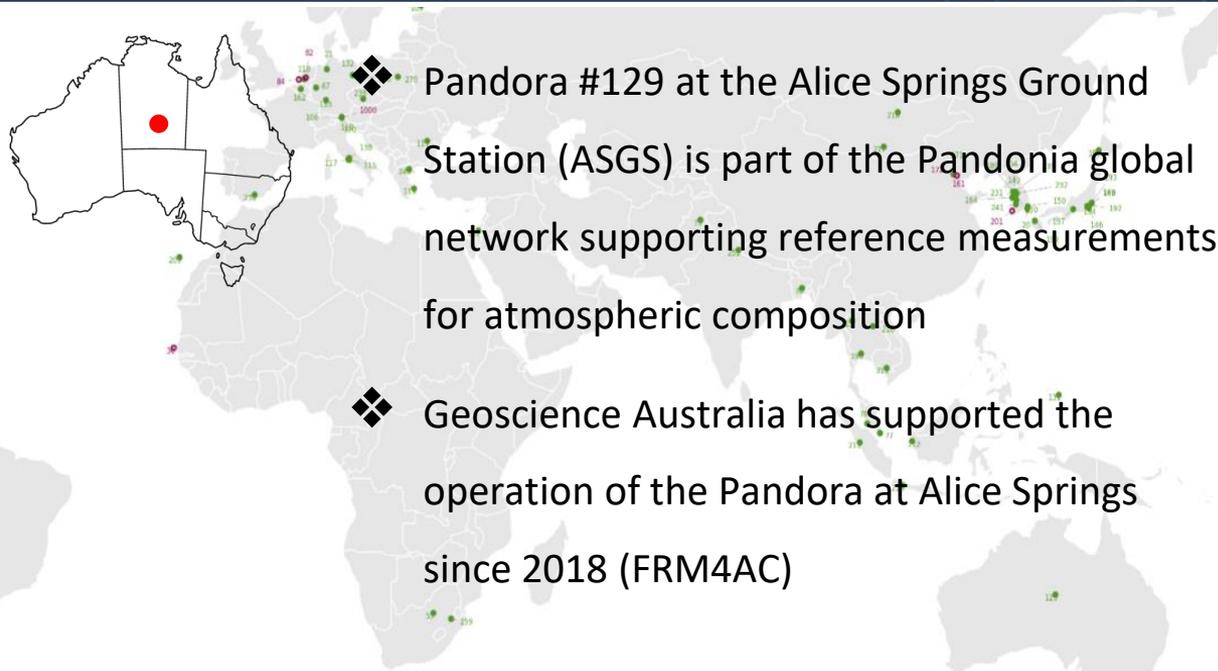
- ❖ Yarragadee is one of the few fundamental geodetic co-location stations in the world.
- ❖ One ascending and one descending trihedral CRs (1.5m), permanently installed in August 2018
- ❖ Permanent Yarragadee CR coordinates independently verified by TSX 3D SAR solution, results within 2 cm
- ❖ 2025 survey showed agreement with previous results (within expected survey limits)

Corner reflectors deployed for ascending and descending modes

	X	Y	Z		X	Y	Z
2018 CR_A	-2388932	5043314	-3078611	CR_D	-2388946	5043330	-3078572
2025 CR_A	-2388932	5043314	-3078611	CR_D	-2388946	5043330	-3078572
	-0.019	0.012	-0.017		-0.012	0.025	-0.015



Pandora Instrument at ASGS



- ❖ Pandora #129 at the Alice Springs Ground Station (ASGS) is part of the Pandonia global network supporting reference measurements for atmospheric composition
- ❖ Geoscience Australia has supported the operation of the Pandora at Alice Springs since 2018 (FRM4AC)

PGN status

official non official

real time

delayed



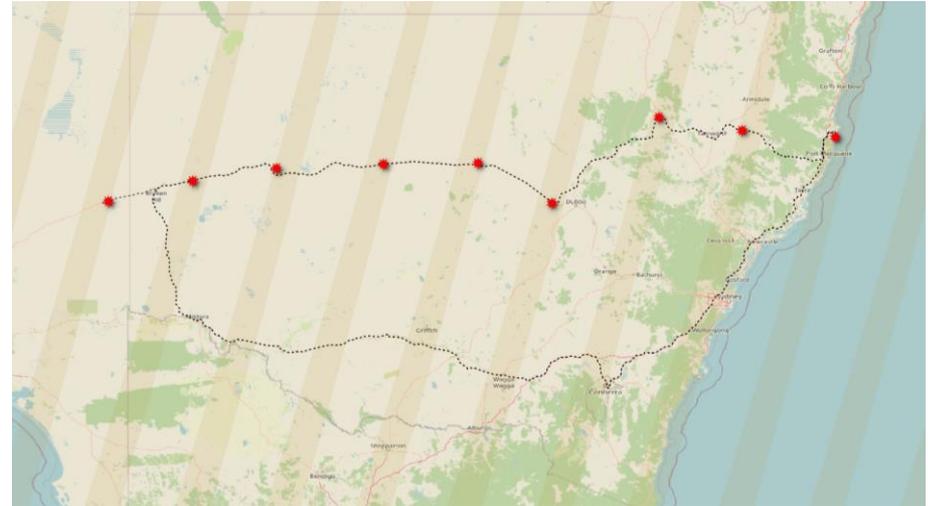
PANDONIA GLOBAL NETWORK

Reference Measurements of Atmospheric Composition

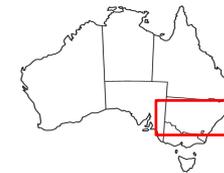
2025 Field Validation Campaign



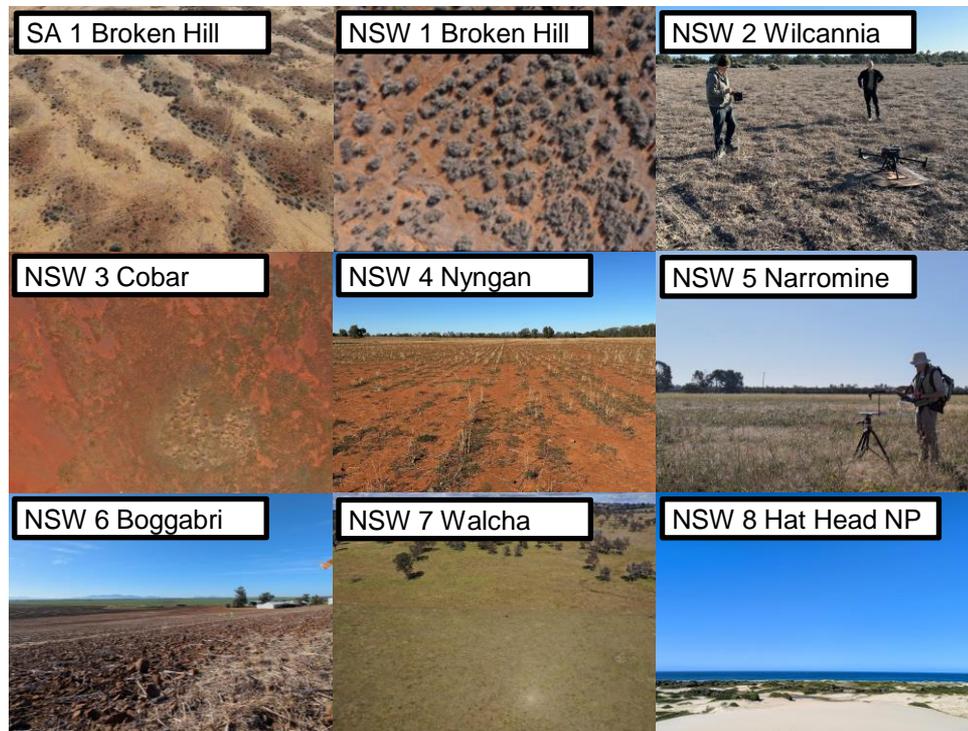
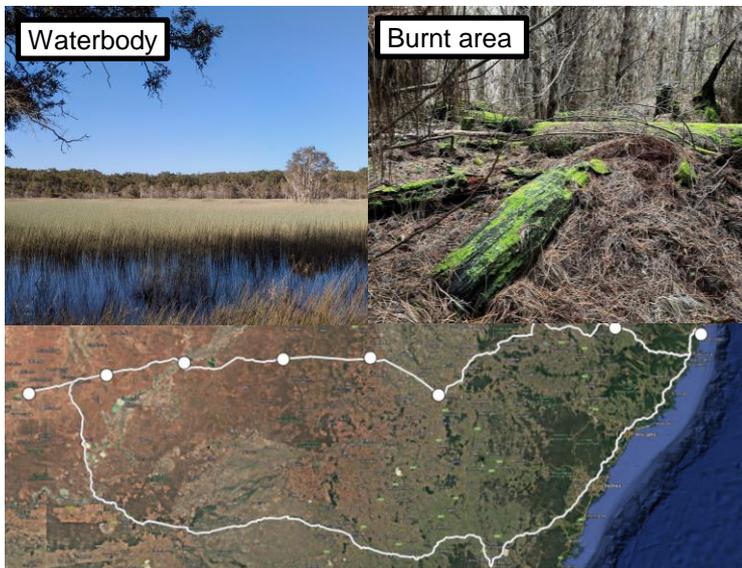
- ❖ Thirteen (13) spectroscopy measurements for Surface Reflectance (SR) validation carried out by the Digital Earth Australia (DEA) team.
- ❖ One hundred (100) vegetation samples to validate DEA's Fuel Moisture Content (FMC) product.
- ❖ Six (6) drone-based LiDAR and multi-spectral flights to validate
 - Water body extents for DEA's Waterbodies product
 - DEA's Fractional Cover product
 - DEA's Burnt Area Mapping product
- ❖ Integration and testing of ArcGIS Field Maps into CalVal's data collection workflow



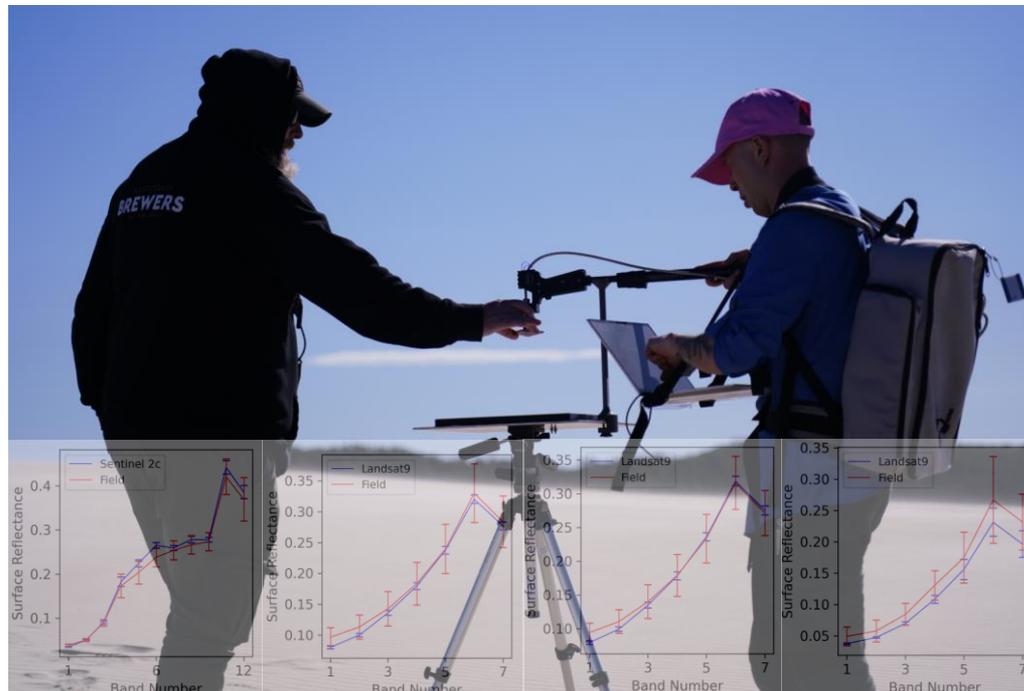
Field site locations aligning Landsat 8, 9 and Sentinel 2A, 2B and 2C swaths across SA & NSW



- ❖ Nine (9) primary field sites to collect SR spectra
- ❖ Ten (10) secondary sites for downstream product validation.



- ❖ Two handheld spectroscopy teams: SR-3500 and ASD.
- ❖ Aligned with CEOS protocols for field-based SR data collection.
- ❖ Excellent matchup quality to time-of-day overpass (L8, L9, S2A/B/C).
- ❖ Data available through Australian National Spectral Database.



- ❖ Six (6) drone-based LiDAR and multi-spectroscopy flights to validate
 - Water body extents for DEA's Waterbodies product
 - DEA's Wooded Cover Fraction product
 - DEA's Burnt Area Mapping product
- ❖ DJI Matrice 300 RTK and DJI FlyCart.
- ❖ Zenmuse L1 LiDAR, Micasense Spectrometer.
- ❖ Drone mounted SR-3500 hyperspectral for complex terrain SR and BRDF validation.



Fuel Moisture Content (FMC) Validation



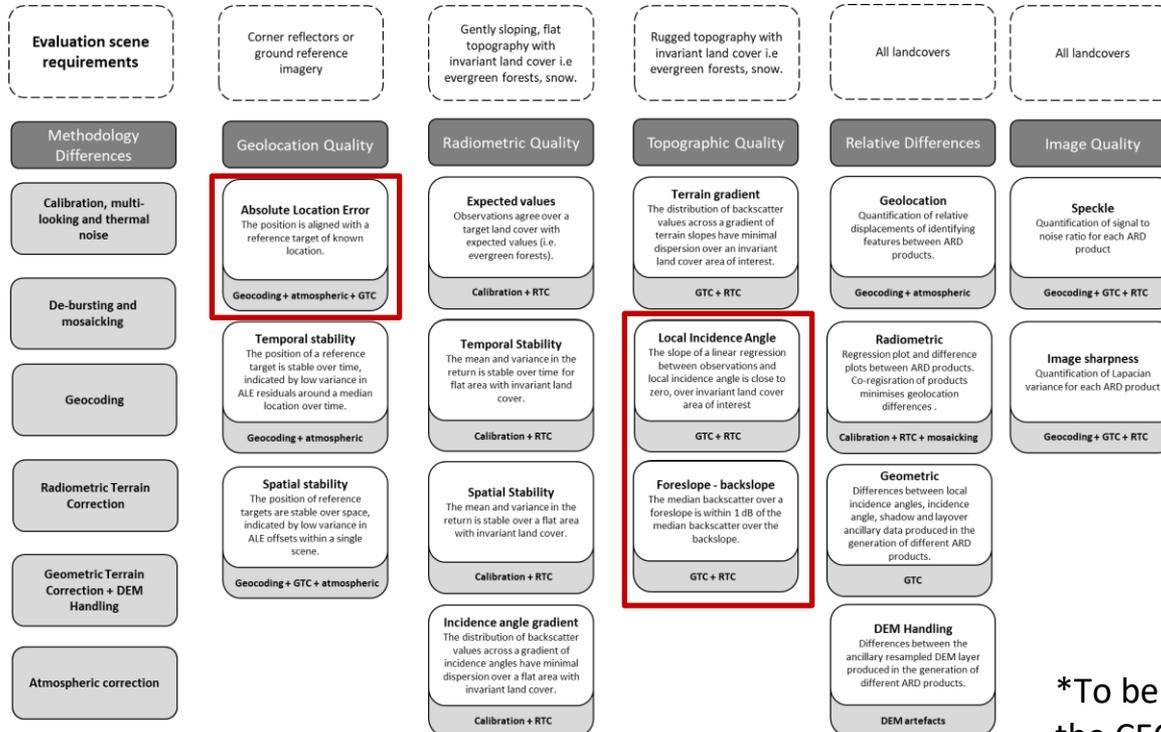
- ❖ Over 100 vegetation samples collected across SA and NSW in line with ANU protocol from over ten sites.
- ❖ All samples recorded using ArcGIS Field Maps.
- ❖ Moisture analysis conducted at GA labs.
- ❖ Results compared to time-of-day overpass (L8, L9, S2A/B/C).
- ❖ Calibrated by height to LiDAR of sampling zone.
- ❖ Evaluation of FMC comparison to multispectral (Micasense) flights underway.



Quality Assessment of SAR ARD



◆ To communicate the impacts of different workflows for NRB and inform GA product decisions

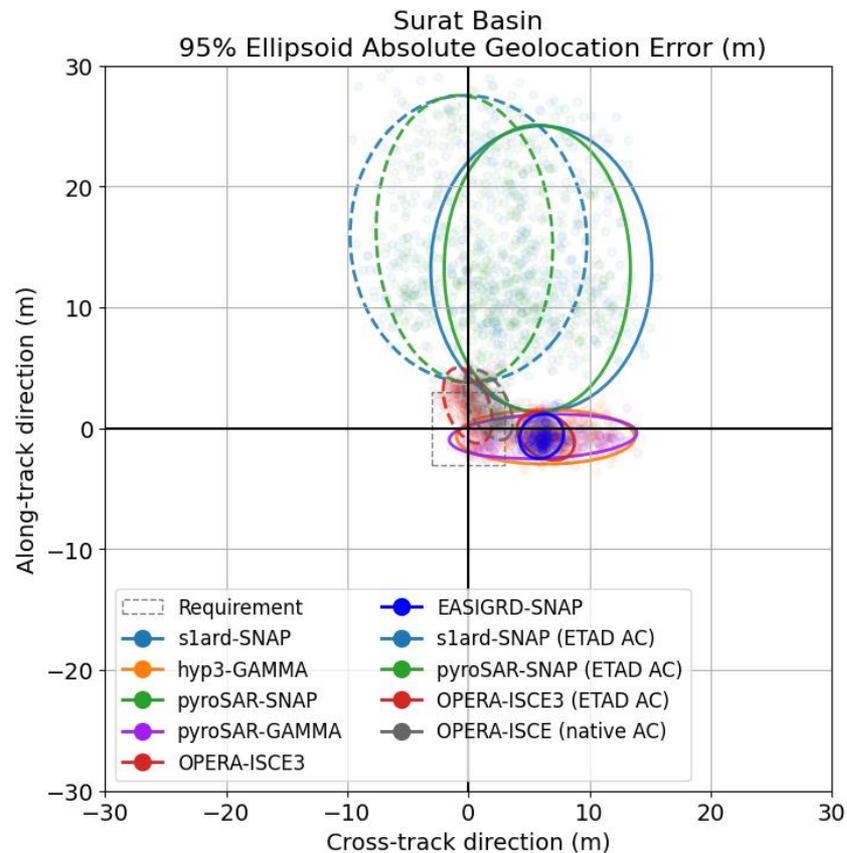


Workflows :

- S1ard-SNAP (ESA)
 - Hyp3-GAMMA (ASF)
 - pyroSAR-SNAP (J Truck)
 - pyroSAR-GAMMA (J Truck)
 - OPERA-ISCE3 (NASA/JPL)
 - EASIGRD-SNAP (CSIRO)
- + ETAD atmospheric correction
+ ISCE3 atmospheric correction

*To be presented at IGARSS and discussed within the CEOS SAR working group

Geolocation Quality

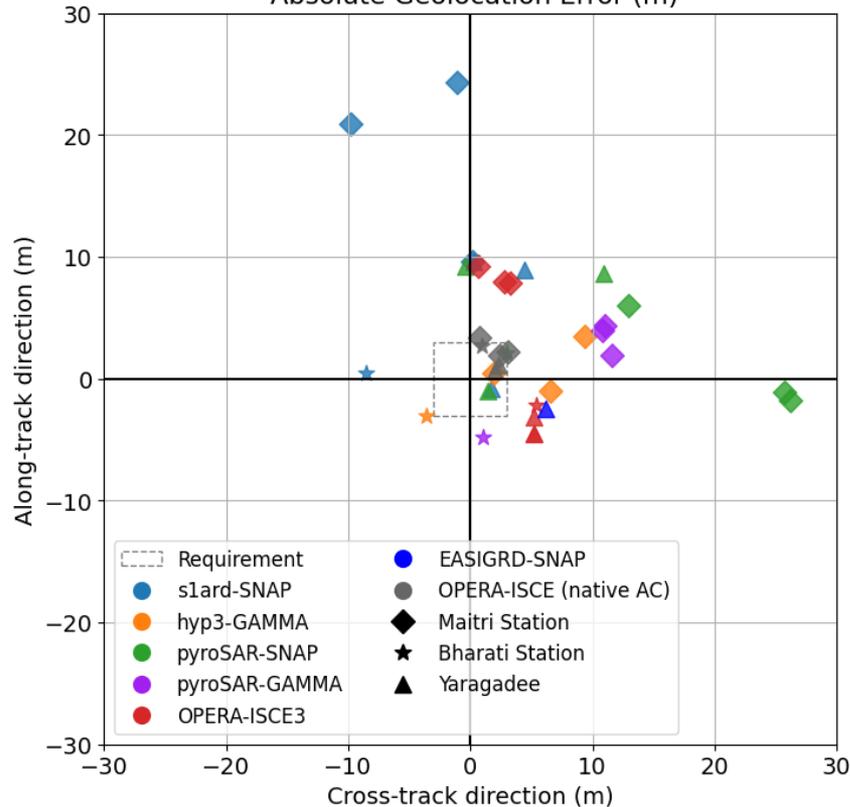


- ❖ QCRA (Surat Basin) provides a robust estimate of geolocation ellipsoid error
- ❖ CRs are identified in georeferenced ARD images, not SLC radar coordinates
- ❖ ISCE3 has comparable performance to GRDs
- ❖ Atmospheric correction improves cross-track ALE
- ❖ Sub-pixel accuracy achieved for 10m + only with AC
- ❖ Identified a georeferencing bug within the SNAP codebase, introducing ALE up to 30 m in the along-track direction.
- ❖ SNAP team have implemented a fix to address the issue (V12)

Geolocation Quality

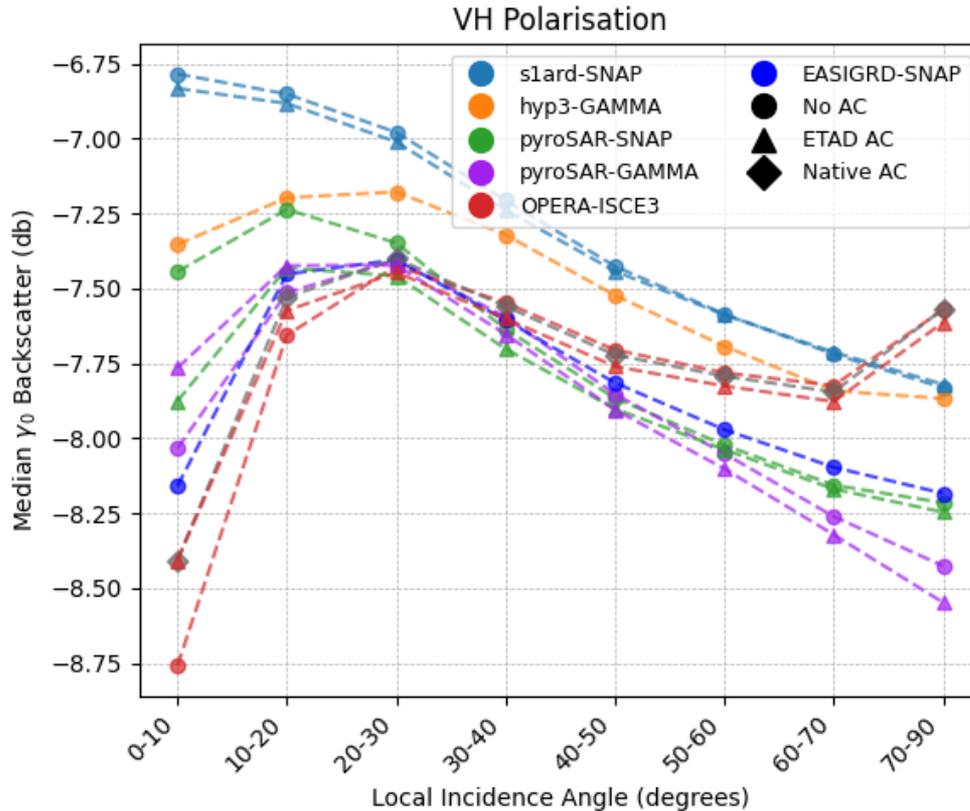


Other Locations
Absolute Geolocation Error (m)



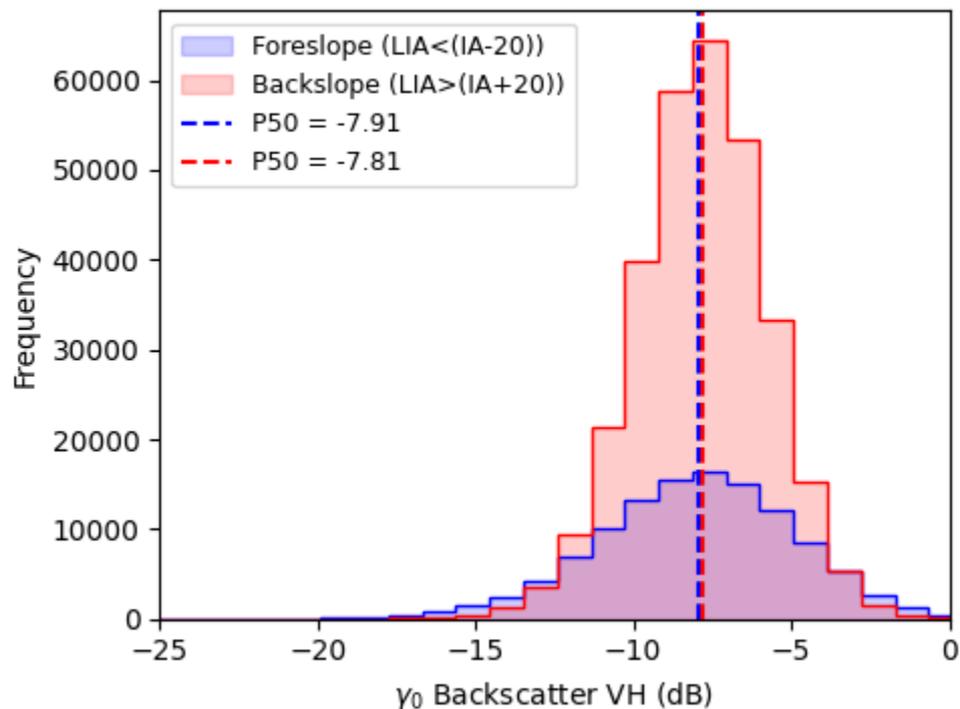
- ❖ Antarctic CRs are useful for assessing performance of atmospheric corrections
- ❖ Vastly different ALE across CR sites without AC applied
- ❖ Sub-pixel geolocation accuracy only achieved for 10m with AC

Topographic Quality



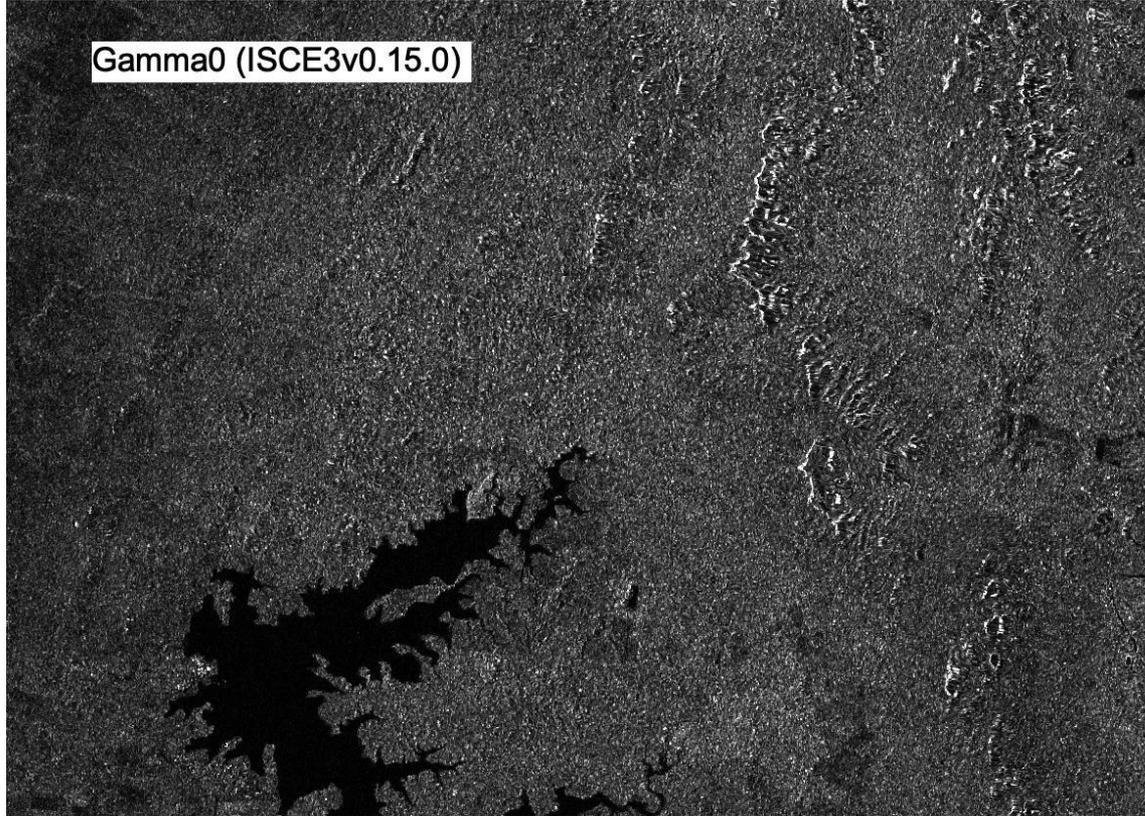
- ❖ Layover and shadow areas masked
- ❖ ISCE3 'flattest' excluding low LIA (dark, shadow) and high LIA (bright, layover)
- ❖ Few data in low LIA and high LIA bins
- ❖ Trends derived from medians are not influenced by the log scale conversion to dB

OPERA-ISCE (native AC)



- ❖ For OPERA-ISCE3 with AC median foreslope-backslope within 0.1 db

Gamma0 (ISCE3v0.15.0)



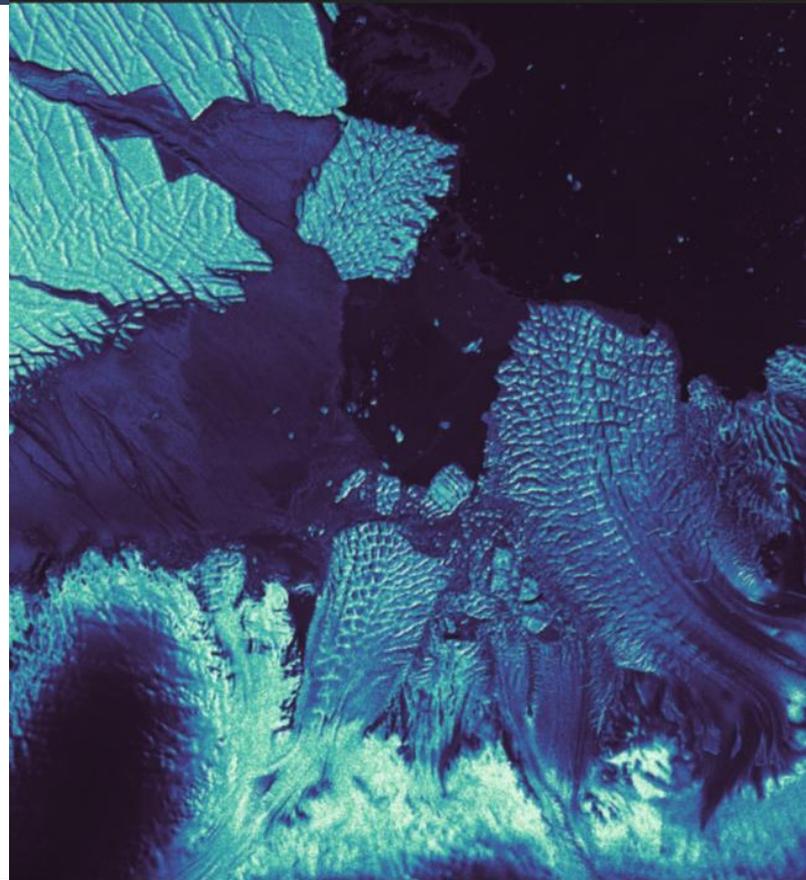
- ❖ This work identified a bug in the OPERA-RTC workflow
- ❖ Introduced by atmospheric correction
- ❖ We worked with NASA JPL to resolve this fix and it is now implemented in ISCE3 v.0.24.0

Sentinel-1 NRB Product



- ❖ Implementation of NASA's OPERA-RTC ISCE3 workflow
- ❖ To be back-processed over Australia and Antarctica
- ❖ 20 m resolution, implementation of static layers to support γ_0 , β_0 and σ_0
- ❖ Collaboration with CSIRO to ensure user uptake
- ❖ User-controlled speckle filtering
- ❖ Submission of self-assessment for CEOS-ARD compliance imminent

S-1 image over Antarctica processed using ISCE3 w/flow >>



Thank you