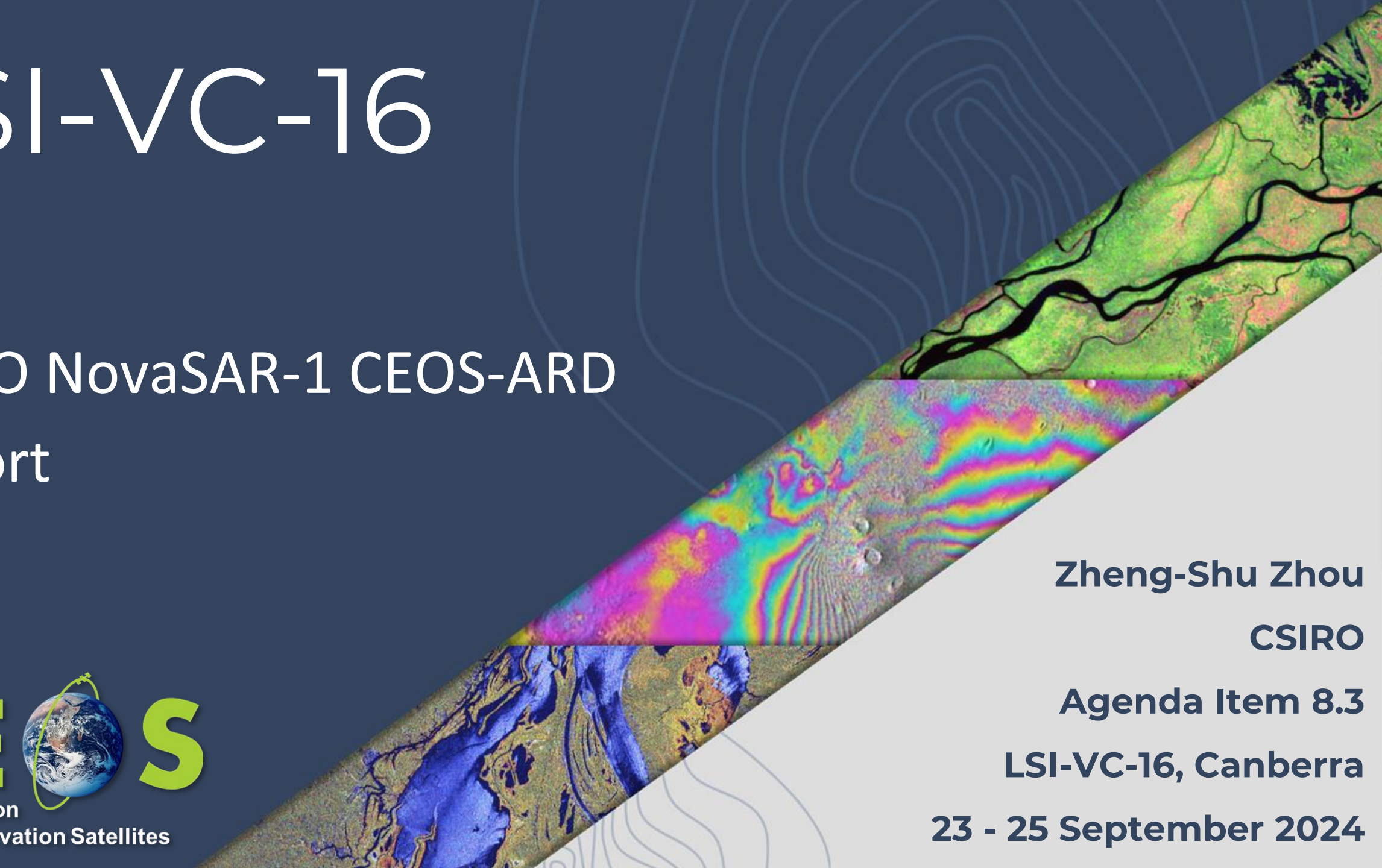
LSI-VC-16

CSIRO NovaSAR-1 CEOS-ARD Report



Zheng-Shu Zhou

CSIRO

Agenda Item 8.3

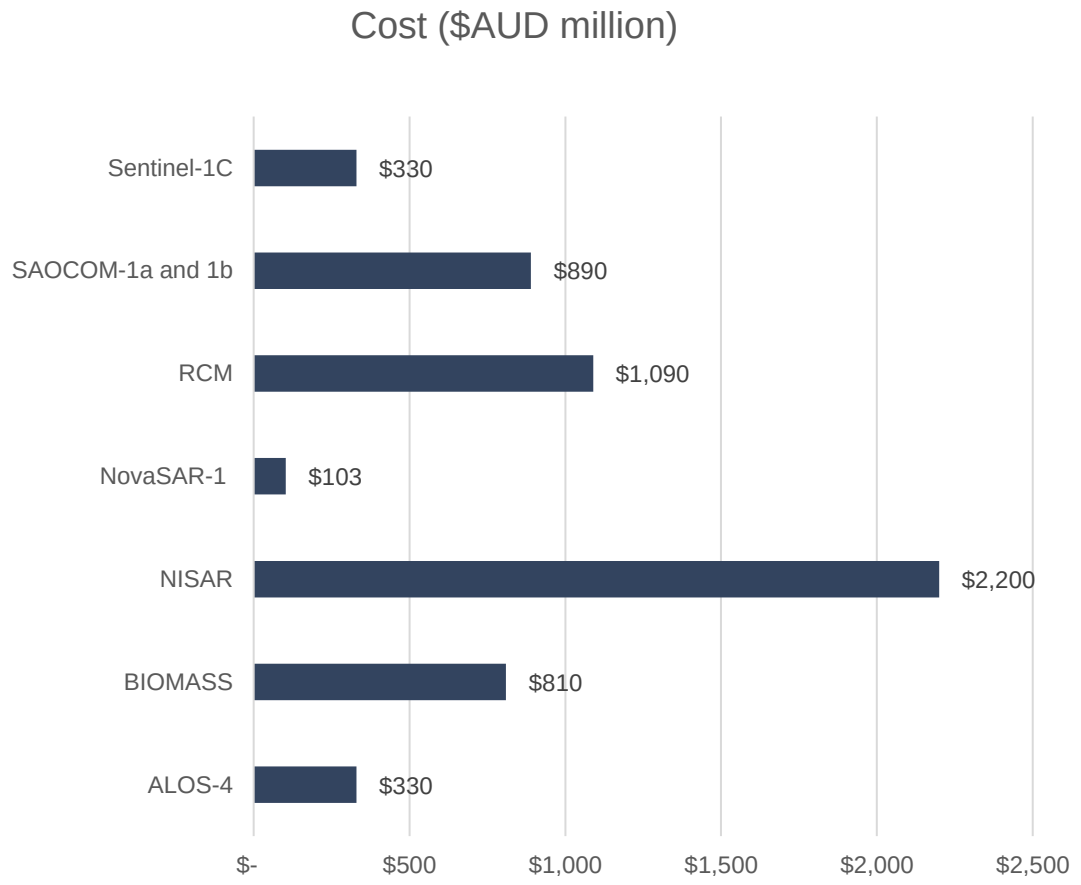
LSI-VC-16, Canberra

23 - 25 September 2024

CEOS
Committee on
Earth Observation Satellites

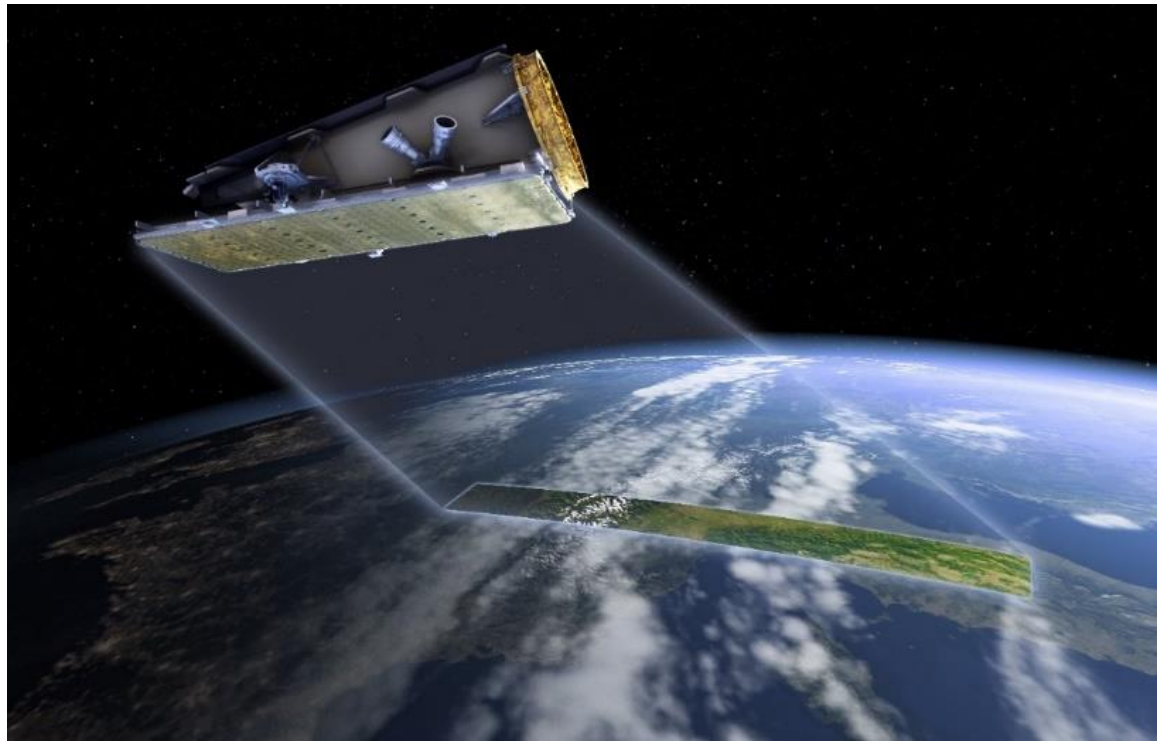
NovaSAR-1 – a Low-Cost Mission

Developed as a low-cost SAR technology demonstrator by Surrey Satellite Technology Ltd, UK (SSTL), and Airbus DS, funded by the UK Space Agency



(Brindle et al. 2024)

NovaSAR-1 –Specs and Parameters



(Image credit: SSTL)

CSIRO acquired a 10% share in the acquisition and tasking capacity of this new satellite, providing the nation with a first-ever sovereign civilian EO satellite capability

Parameter	Value
Imaging frequency band	3.1-3.3GHz (S-band)
Antenna	Microstrip patch phased array (3m x 1m)
No. of phase centers	18
Peak RF power	1.8kW
Polarisations	HH, HV, VV
Imaging polarization	Single, dual, tri- or quad polar
Design life	**7 years**
Mass	**<400kg**
Optimum orbit	583km
Propulsion system	Xenon
Payload duty cycle	**2-4min per orbit**
Payload data memory	**Up to 544GBytes**
Downlink rate	400Mbps
TTC frequency band	S-band (2025-2110MHz, 2200-2290MHz)
Downlink frequency band	X-band (8.025-8.4GHz)

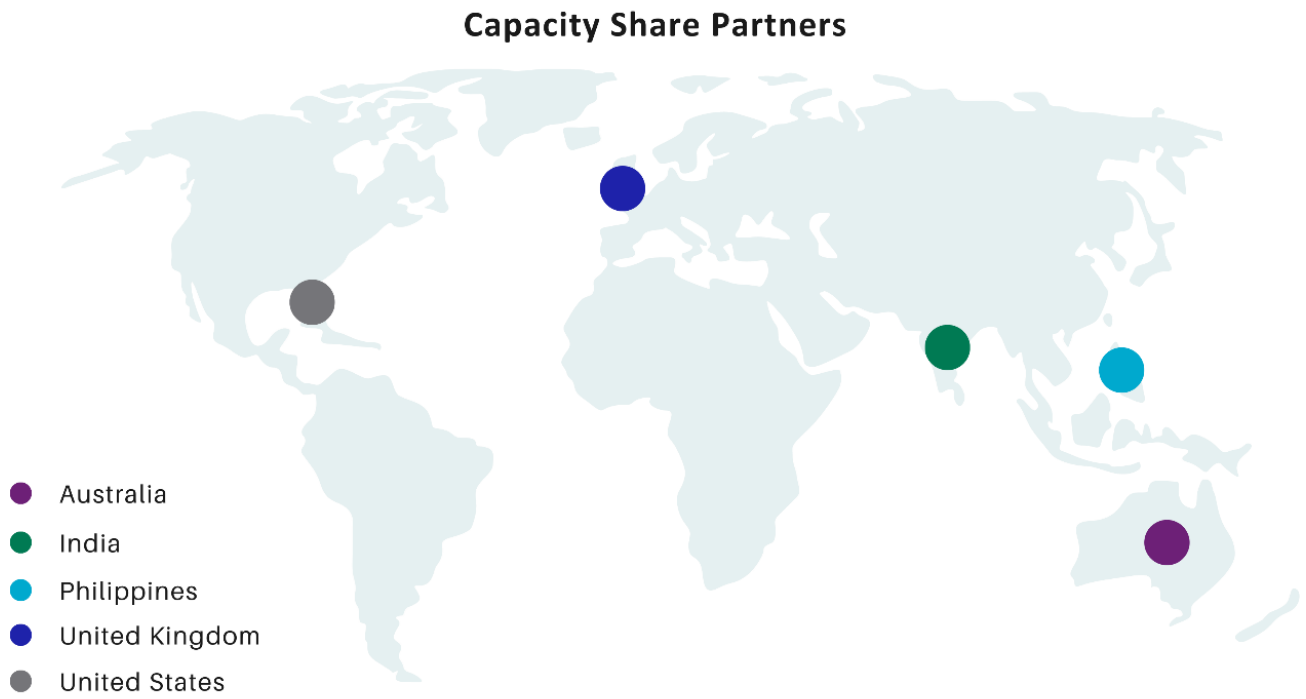
Satellite Status

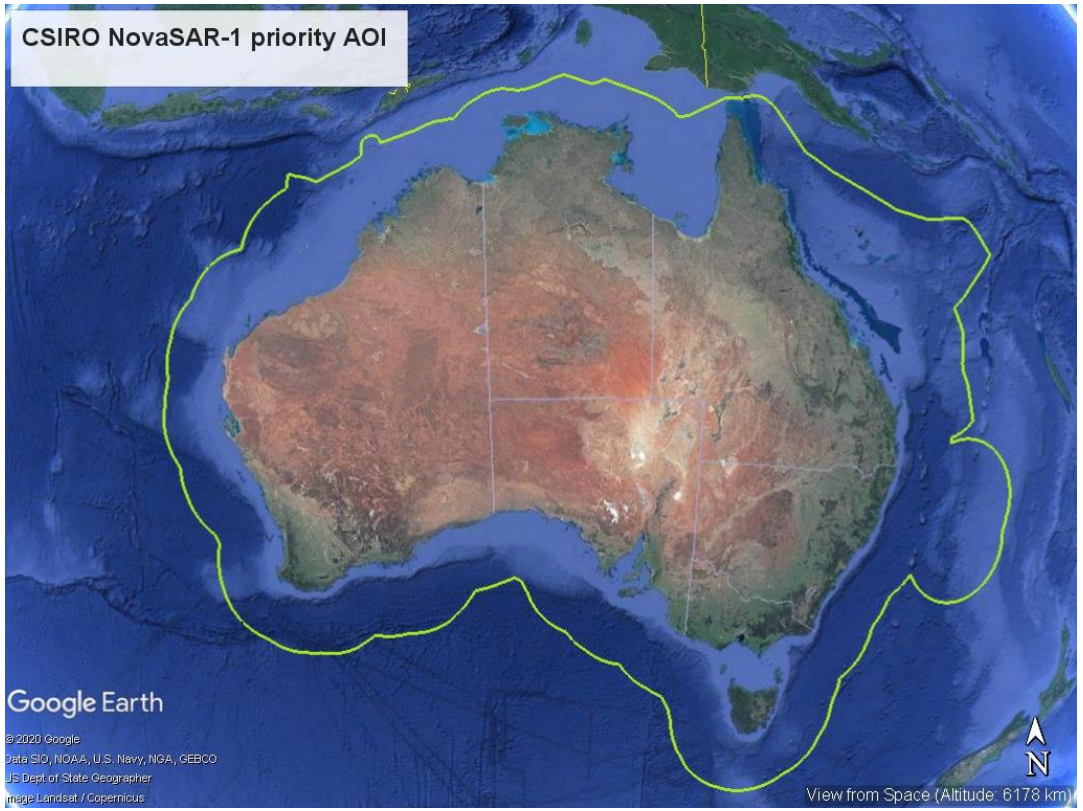
Original predicted end of lifetime in Dec 2026

SSTL are happy with the current health and have mentioned a 3-year extension

Calibration is ongoing with annual campaigns

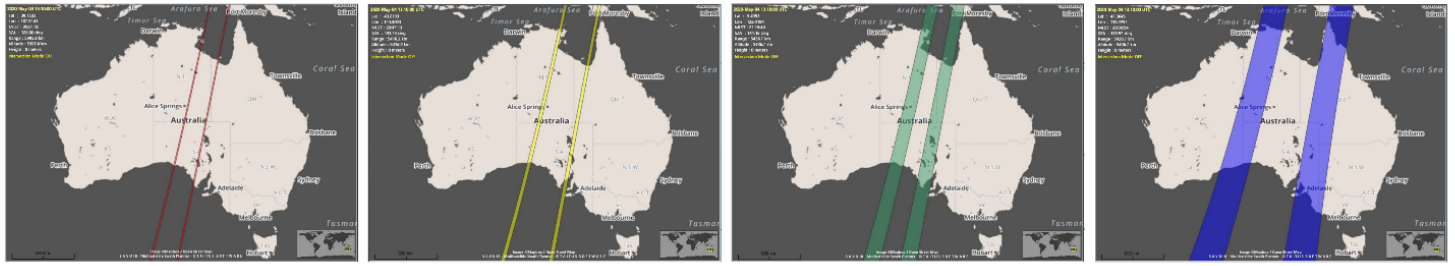
Capacity Share Partners





(Image credit: Laura Brindle)

NovaSAR-1 Acquisition Modes



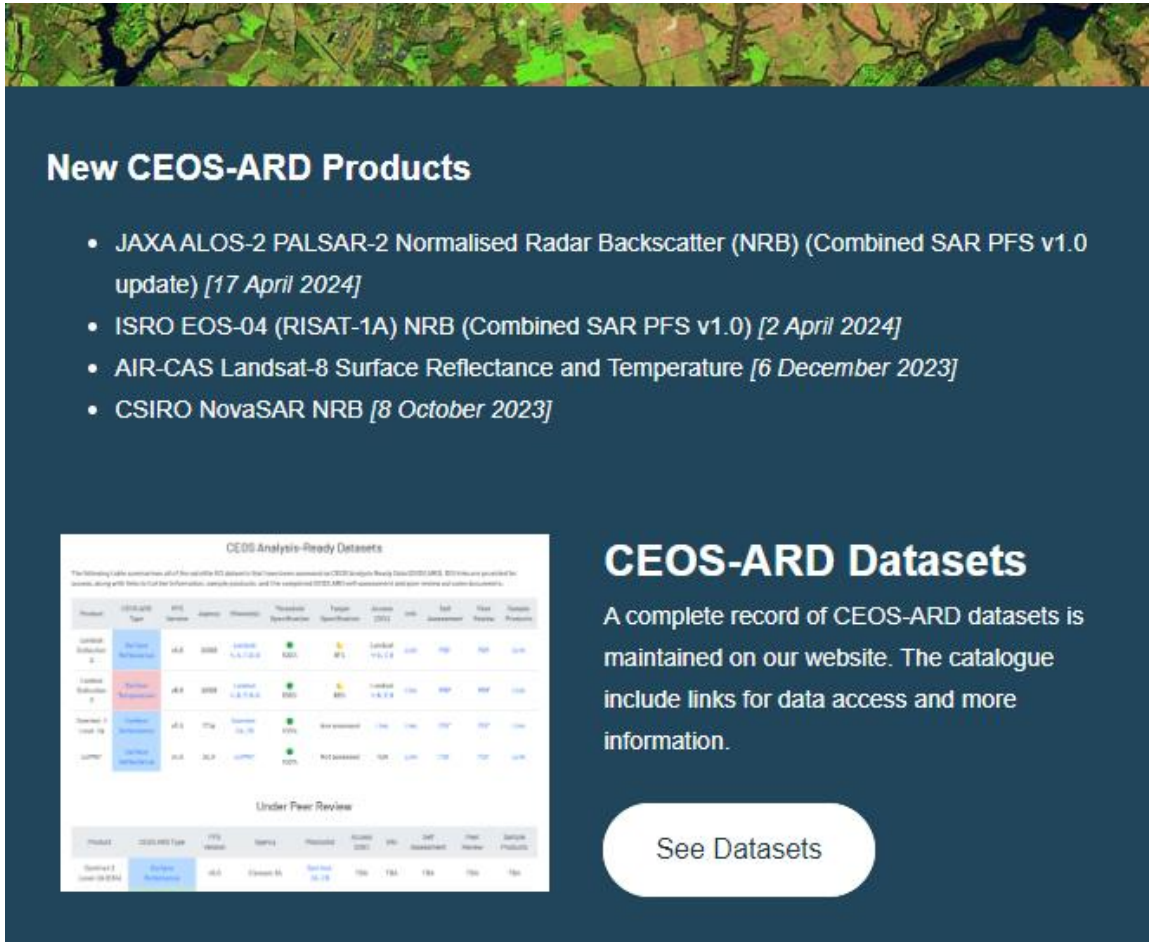
Mode	Stripmap	ScanSAR	ScanSAR Wide	Maritime
Resolution	6 m	20 m	30 - 50 m	Deliberately Ambiguous in Azimuth
Swath	13 - 20 km	50 & 100 km	50 - 195 km	400 km
Use Case	Detailed observations	Nominal mode	Large area monitoring	Ship detection in combination with AIS

CEOS- ARD SAR

CEOS Analysis Ready Data (CEOS-ARD):

- processed to a minimum set of requirements
- organised into a form that allows immediate analysis with a minimum of additional user effort
- Allow interoperability both through time and with other datasets

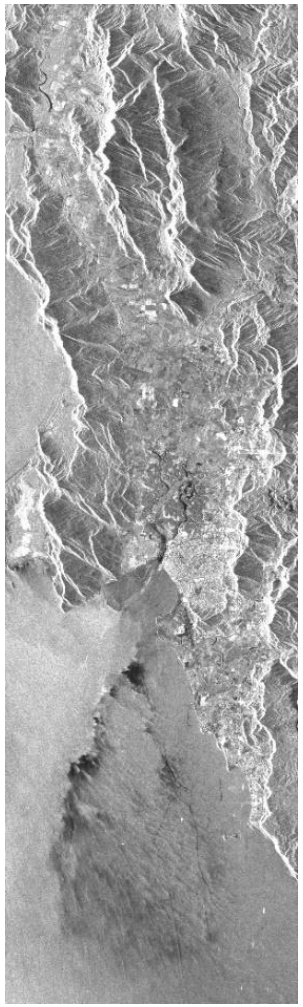
CSIRO NovaSAR-1 ARD products follow the requirements of CEOS-ARD NRB PFS version 5.5.

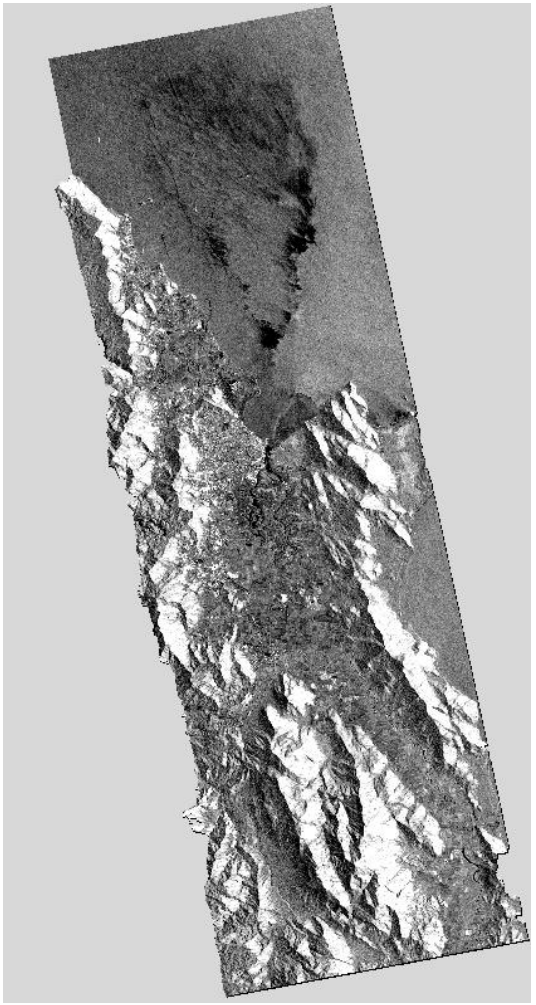


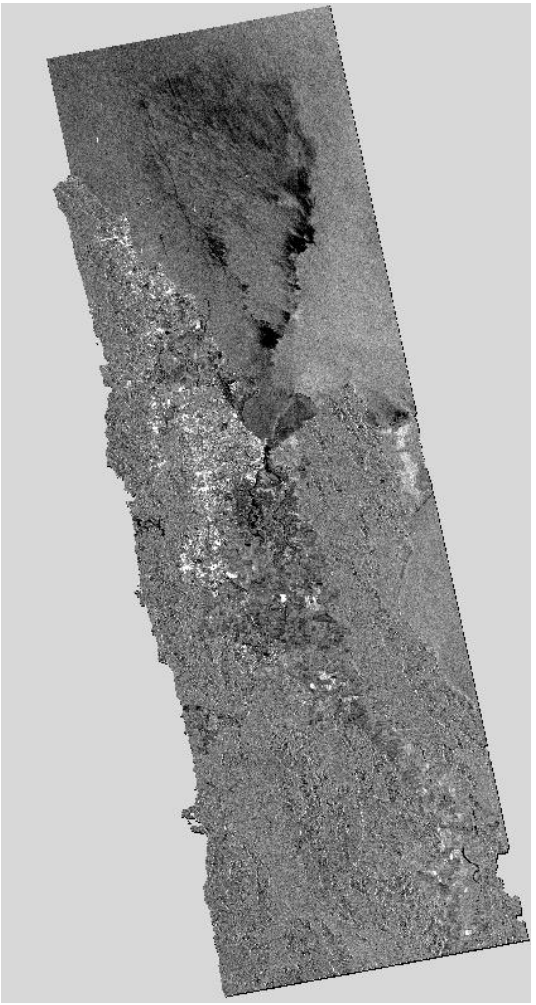
Source: CESO-ARD Newsletter #3 May 2024

CEOS-ARD Compliant ARD Production

Sample of NovaSAR-1 ARD Processing for Acquisition 39919: Footprint (left), HH Source in radar geometry (left-mid), Beta0 (right-mid) and Gamma0-RTC (right) in map projection







NovaSAR-1 CEOS- ARD

All archive NovaSAR-1 SCD (excluding Maritime mode) and GRD data acquired in Australian region have been processed into ARD

Submitted CSIRO self-assessment for CEOS-ARD NRB PFS v5.5 compliance review to CEOS in August 2023

CEOS Review results were released on 5 October 2023: 14 CSIRO NovaSAR-1 NRB products have been evaluated as CEOS-ARD compliant at the threshold level

On 21 March 2024, the processed archive completed ingestion to the datahub and the AWS processing was integrated into the NovaSAR-1 image processing chain

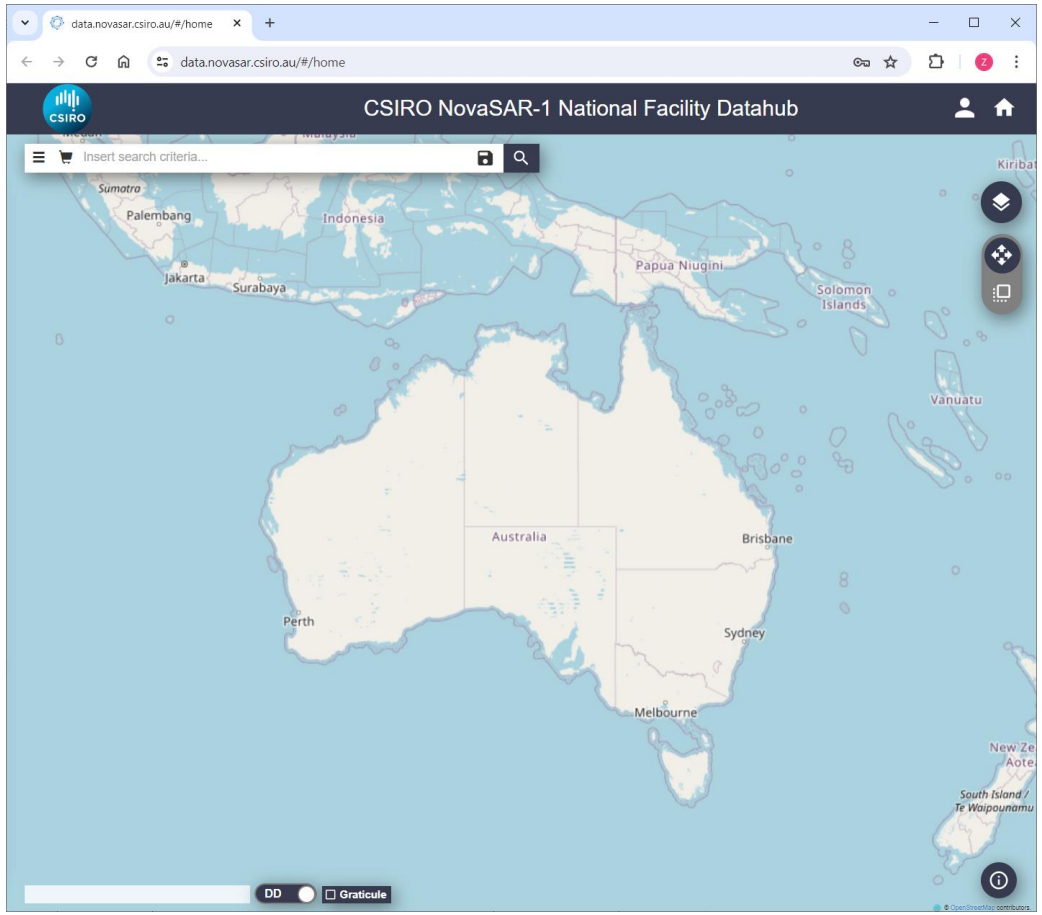
NovaSAR-1 National Facility Datahub

The CSIRO NovaSAR-1 catalogue is available for free download online

5300+ L1 products

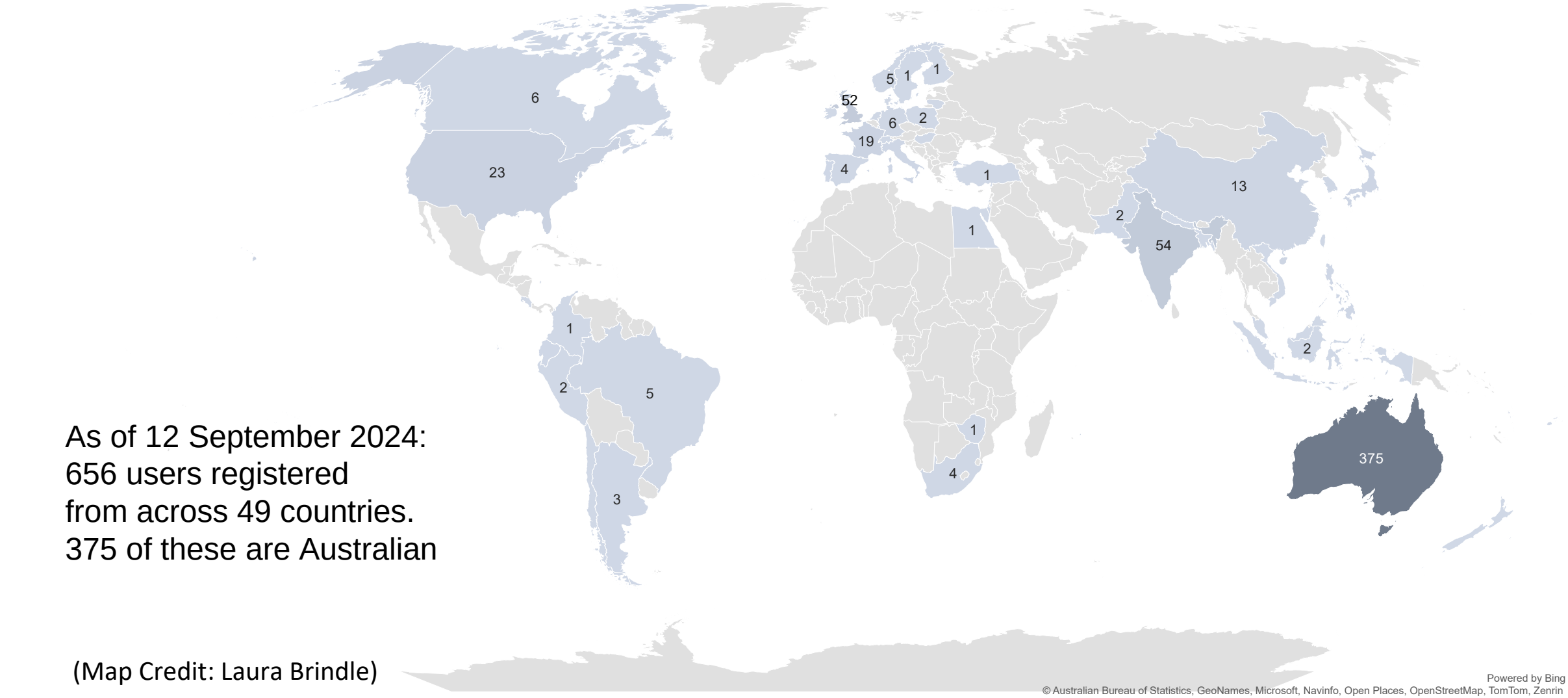
2800+ CEOS-ARD NRB products (currently for acquisitions in Australia only)

ARD on-demand for acquisitions outside of Australia



https://data.novasar.csiro.au/#/home

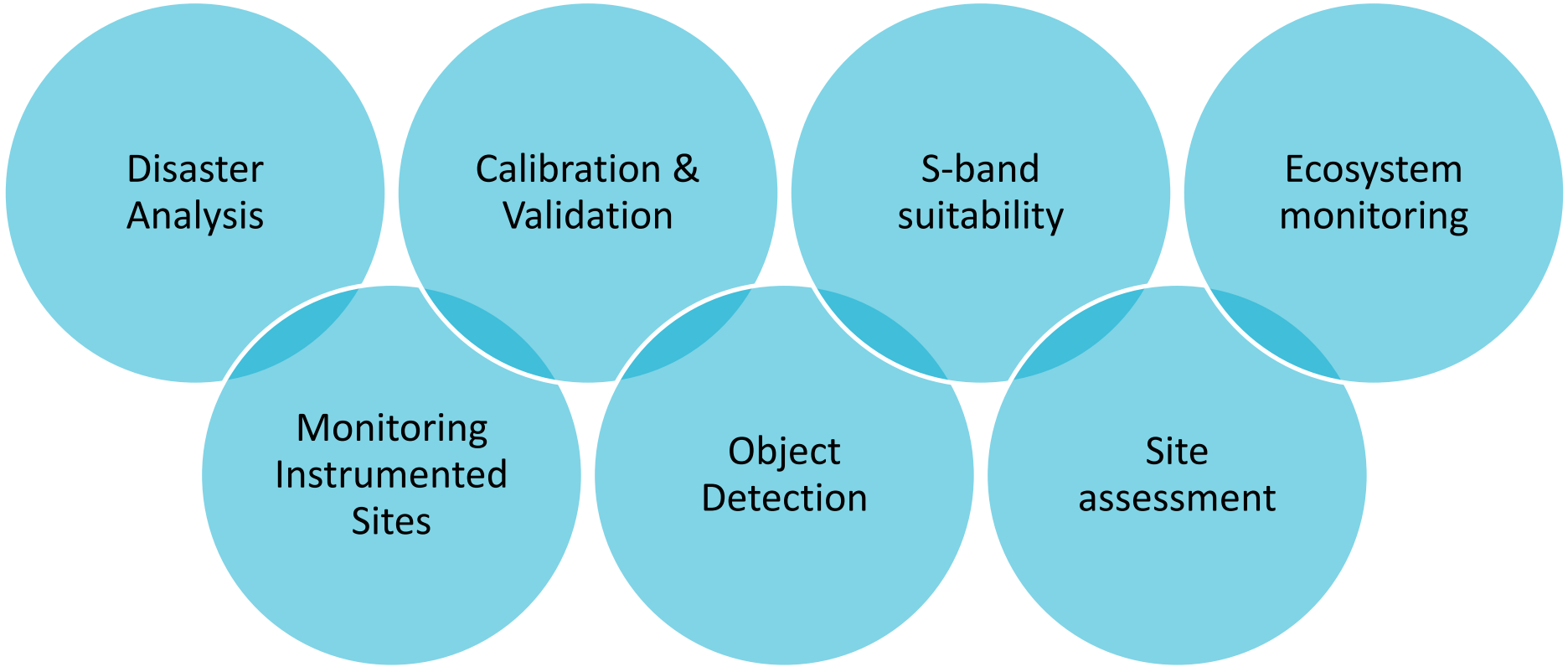
Locations of NNF Datahub Users



As of 12 September 2024:
656 users registered
from across 49 countries.
375 of these are Australian

(Map Credit: Laura Brindle)

More Application Cases



Acquisitions at TERN SuperSites

Worked with TERN during the NovaSAR-1 launch to show data acquisitions across their network

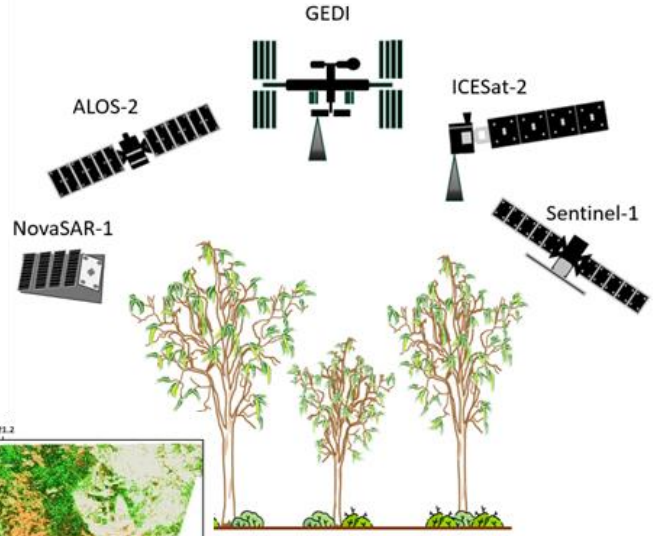
Ongoing collections with 299 images collected since March 2020 across 16 TERN SuperSites

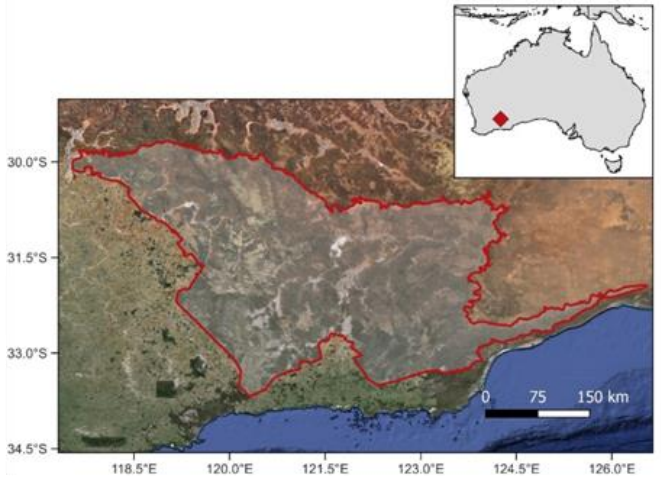
TERN - Australia's Terrestrial Ecosystem Research Network

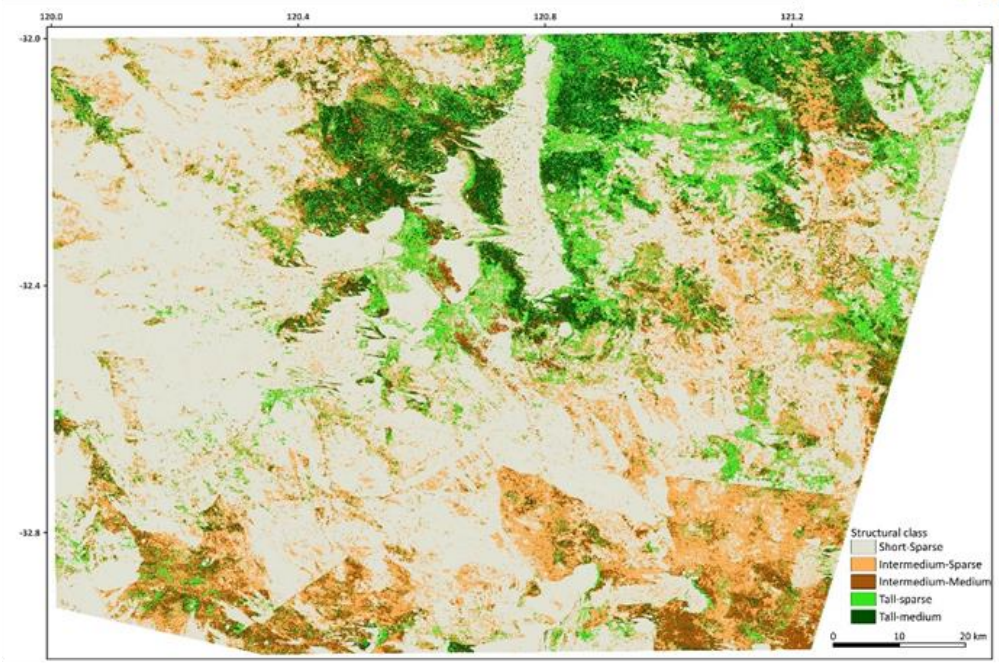
Ecosystem Extent Mapping

(Parra-Ruiz et al, 2024)

Designing a multisource approach for estimating ecosystem extent in the Great Western Woodlands of WA

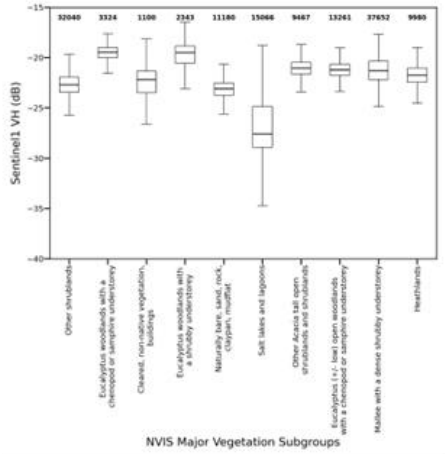






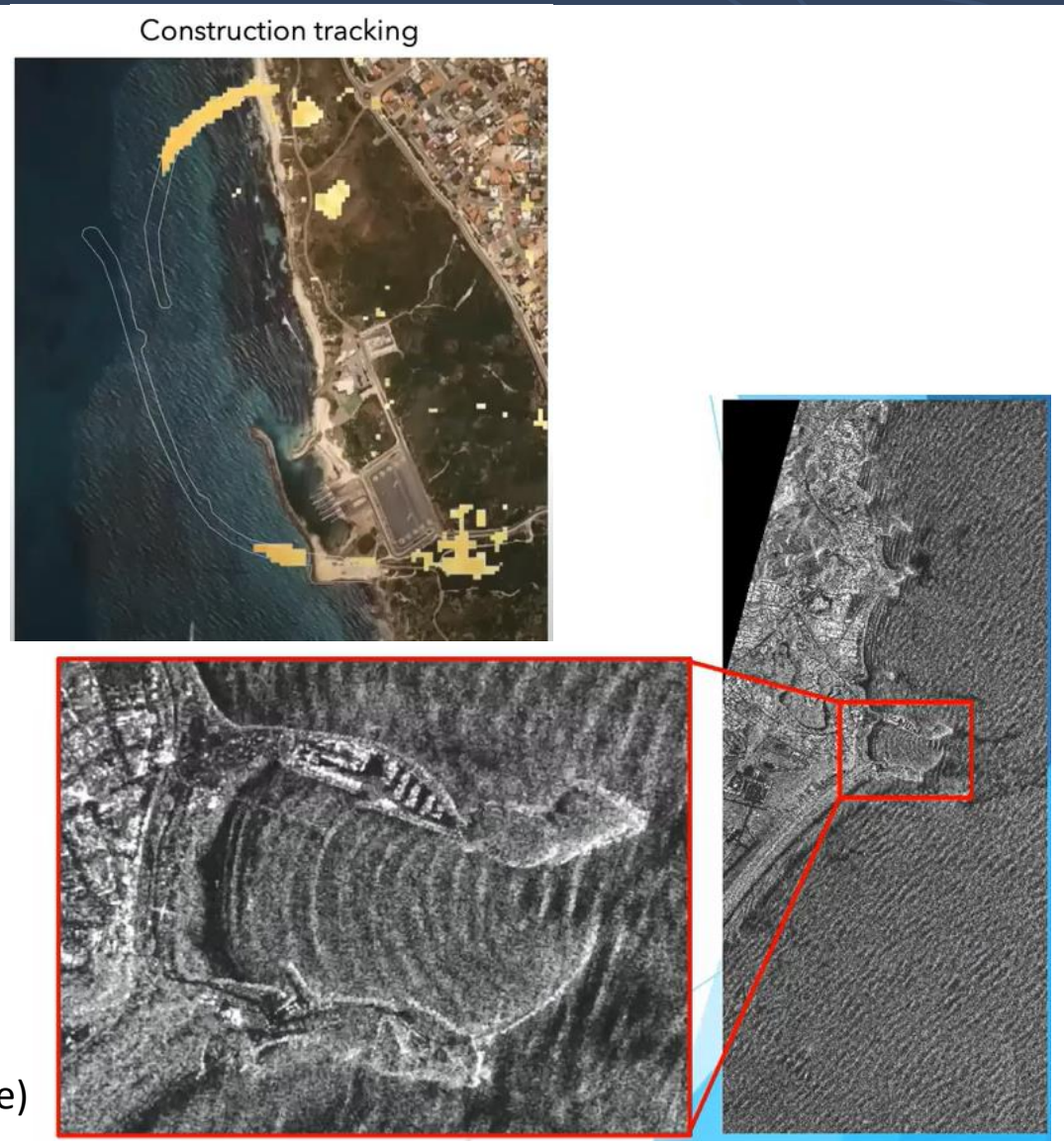
Random forest classification map using Sentinel-1 backscatter, coherence and polarimetric decomposition parameters

Check out Adriana's talk in the Multi-sensor session on Wednesday!



EO for Climate Smart Innovation project

- CSIRO and Geoscience Australia initiative to support the growth and implementation of Earth observation based products and services in South-East Asia.
- Powered by CSIRO's Earth Analytics Science and Innovation hub (EASI).
- NovaSAR-1 data was acquired over 2 sites:
    1. Coffs Harbour, NSW - Example for a persistent site that has previously had change but should be stable (unless any significant storms in the near future).
    2. Ocean Reef, WA - Example for a changing site where construction is actively occurring. We should be able to see the progress of construction and align with ground truth data.



(Image credit: Laura Brindle)

Various Studies in Antarctica

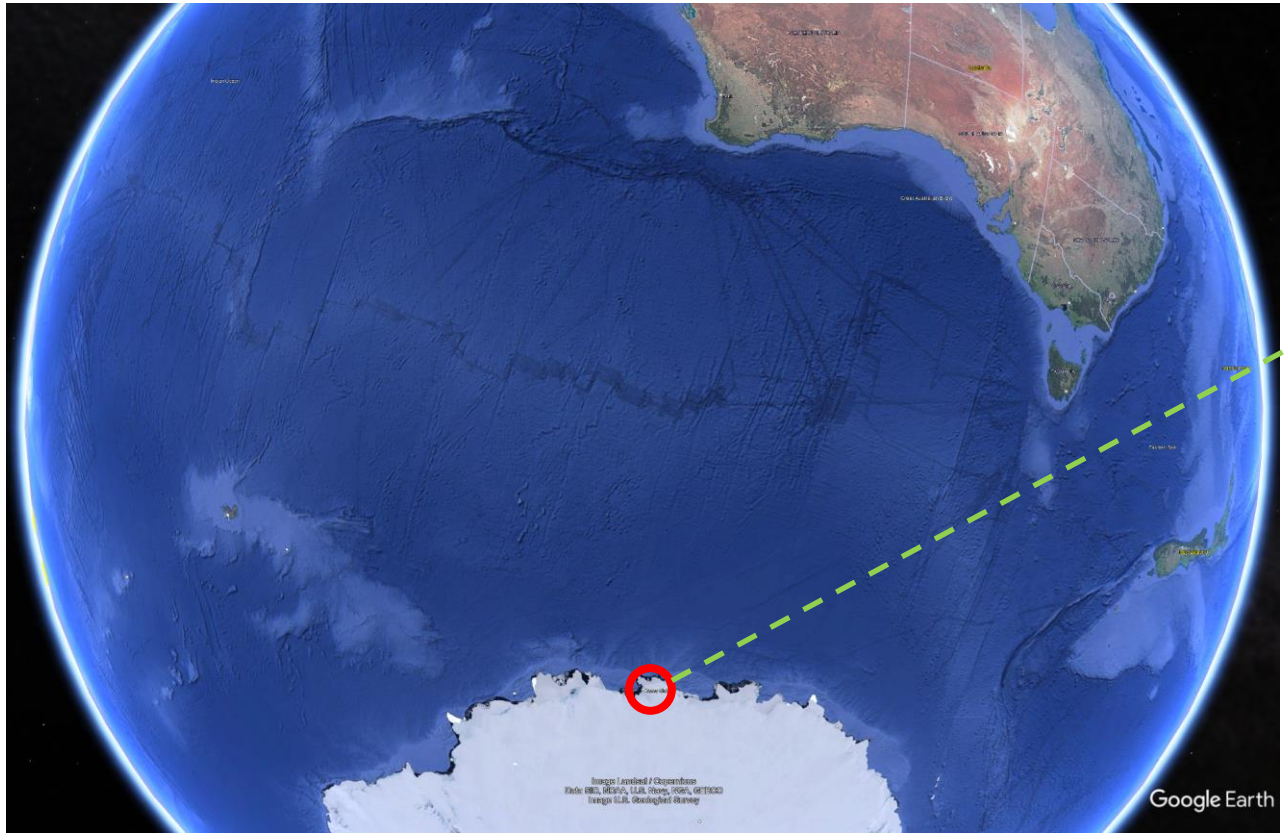
Site Assessment of Australian Sites in Antarctica for Calibration Target Site Suitability with AusCalVal to support AAD and JPL

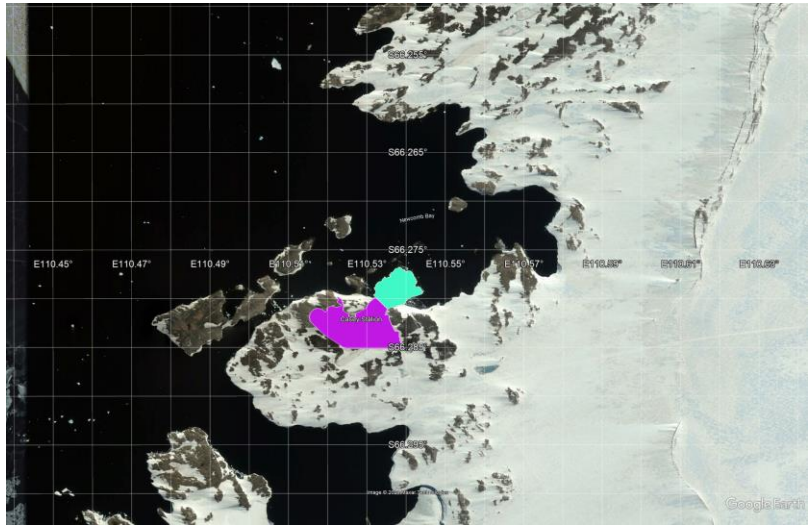
(Casey Research Station – Image Credit: Justin Chambers)

N1 images tasked for looking for lost vehicle for AAD to assist potential retrieval

(Image Credit: Dave Connel 2007)

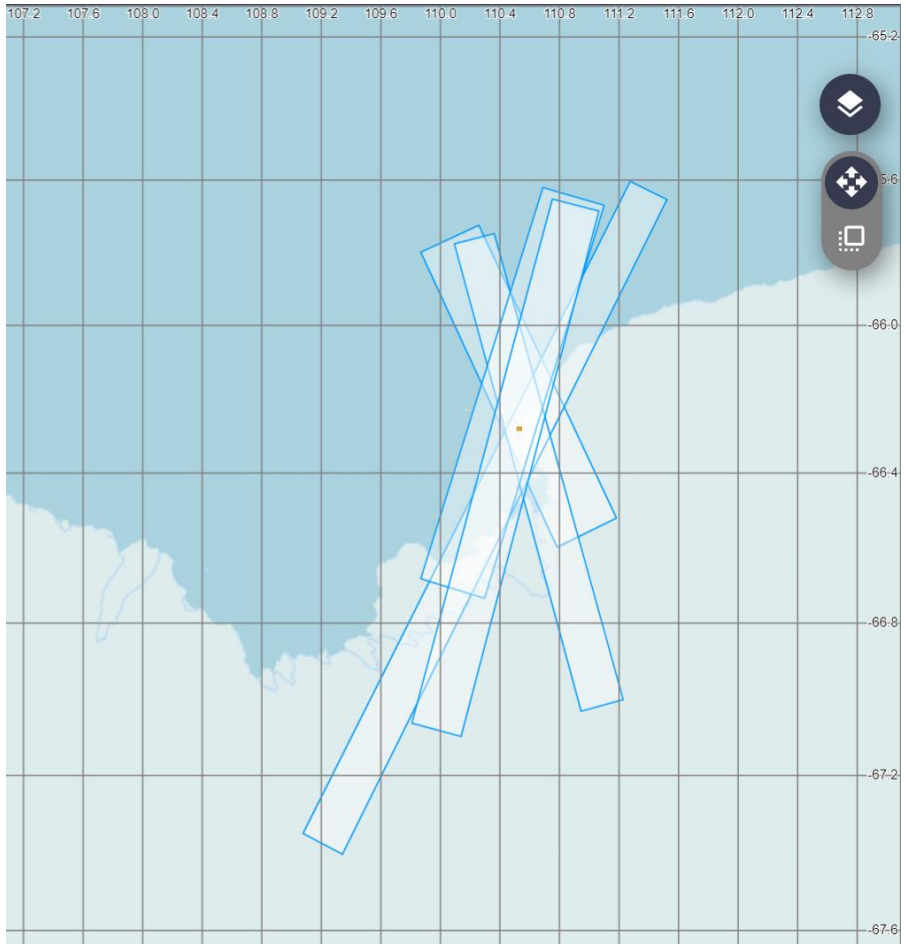
Casey Station of AAD

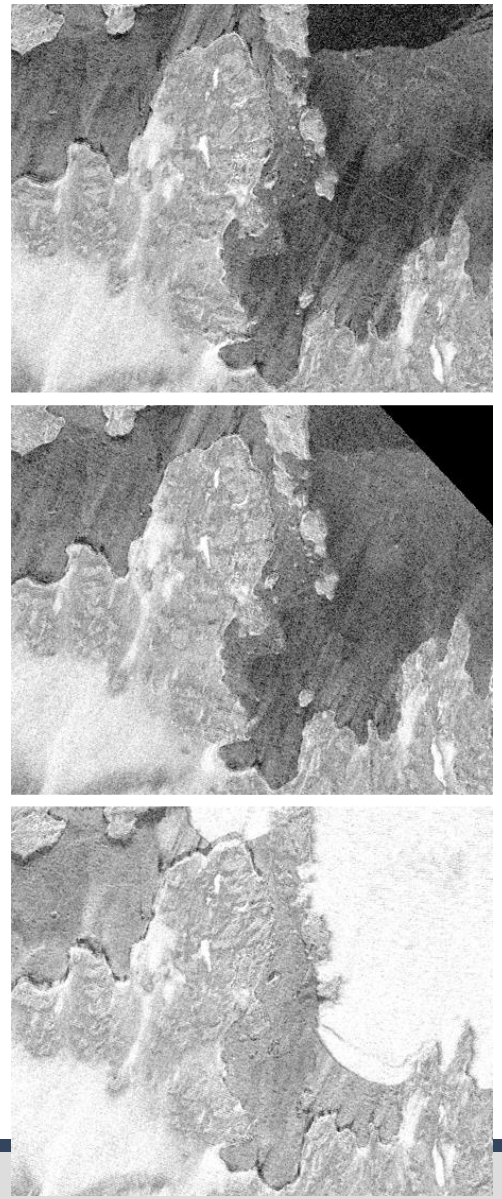




(Map credit: Melissa Fedrigo)

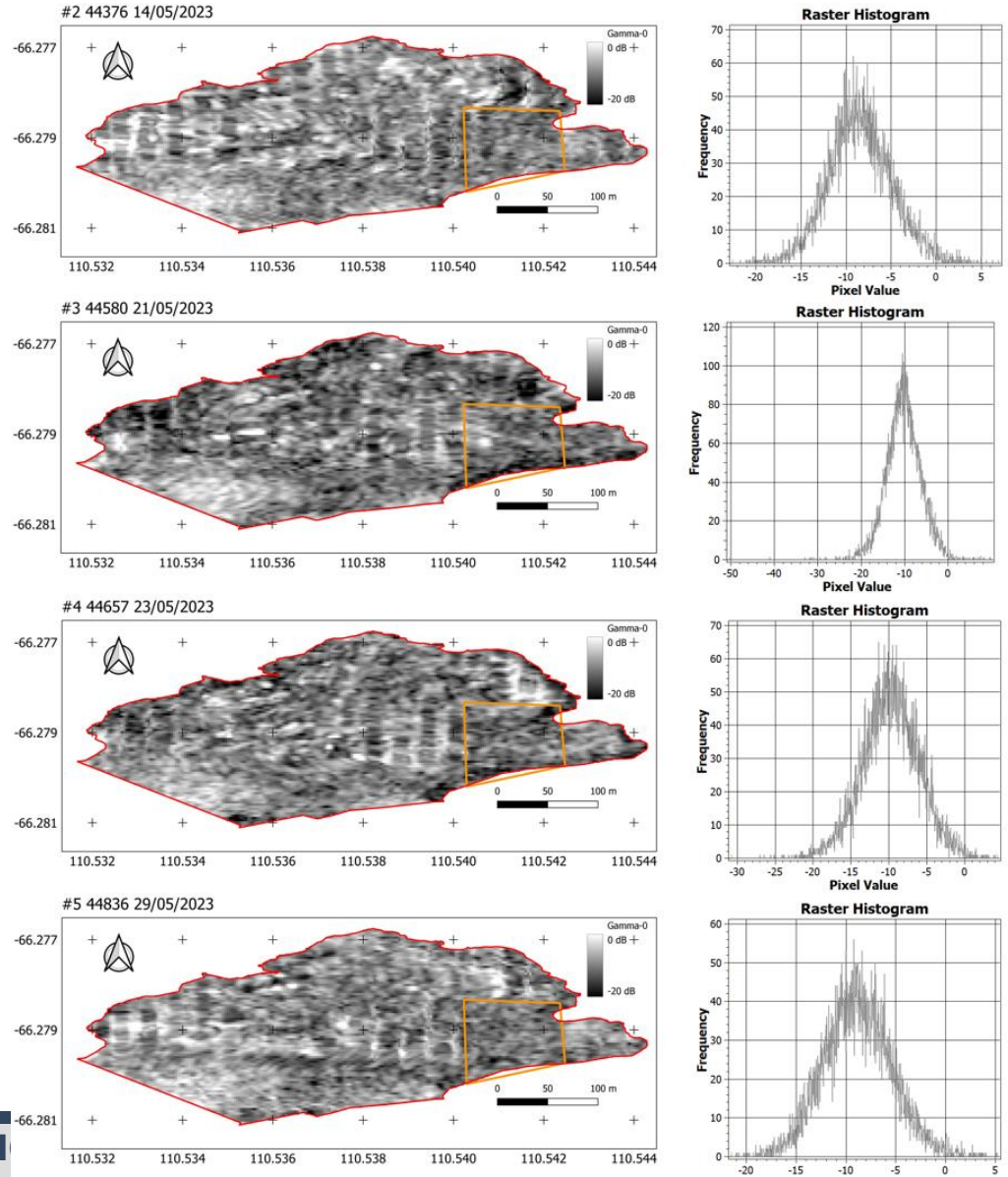
NovaSAR-1 Acquisitions over Casey St





Subsets of acquisitions on 21/05/2023 (top), 23/05/2023 (centre) and 29/05/2023 (bottom)

Image Assessment for Casey St



#	Acquisition date	Extended station limits					Subset area				
		Max (dB)	Mean (dB)	Min (dB)	Std Dev (dB)	Num samples	Max (dB)	Mean (dB)	Min (dB)	Std Dev (dB)	Num samples
2	14/05/2023	6.94	-8.39	-22.58	3.54	12867	-2.19	-10.15	-17.72	2.57	1284
3	21/05/2023	9.95	-10.19	-50.33	4.00	12869	0.82	-11.36	-23.67	3.66	1286
4	23/05/2023	4.38	-9.70	-30.79	3.72	12873	0.97	-11.39	-22.49	3.42	1286
5	29/05/2023	5.26	-8.81	-21.53	3.43	12867	-5.22	-10.79	-20.74	2.41	1284

NovaSAR-1 RTC Gamma-0 images cropped to the Casey extended station limits area (red polygon)

(Garthwaite et al, 2024)

Thank you

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CEOS
Committee on
Earth Observation Satellites