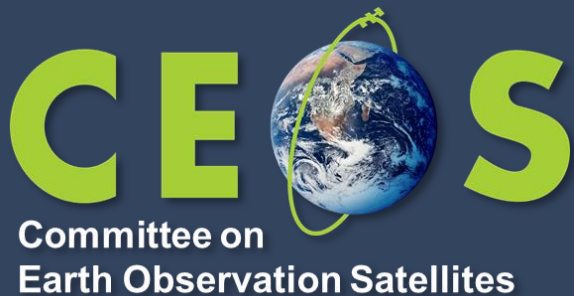


Report on ISRO Cal/Val activities



Raghavender N, NRSC-ISRO

Agenda Item #W6.7

WGCV-56 / LSI-VC-19

USGS EROS, Sioux Falls, SD, USA

20-24 Apr 2026

Outline of the presentation



1. Radiometric performance of operational satellite missions

(Optical / Microwave)

- Resourcesat-2A (Three-tier imaging natural resource monitoring)
- EOS-04 (Microwave Imaging sensor)
- EOS-06 (Ocean Color Monitor sensor)
- EOS-06 (Scatterometer)

2. Science phase missions

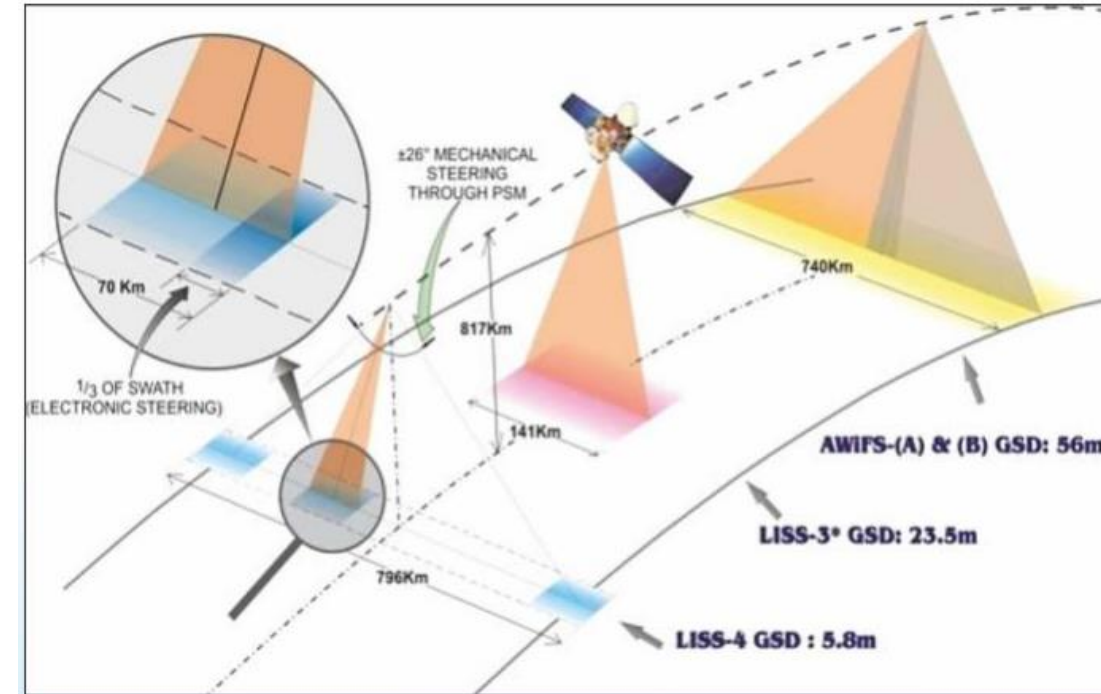
- NISAR (L & S Band imaging sensor)

Resourcesat-2A status



- ❖ Continuation mission to Resourcesat-2.
- ❖ Launched in December 2016
- ❖ Operational Period: 9+ years (planned 5 years)

Payload	LISS-4	LISS-3	AWiFS
Spatial Resolution (m)	5.8	23.5	56
Swath (km)	70.0 in MX mode and Mono mode	141	740
Spectral Band (microns)	0.52-0.59 0.62-0.68 0.77-0.86	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70
Quantisation (bits)	10	10	12 (VNIR) 14 (SWIR)
Data Rate (MBPS)	105	105	105

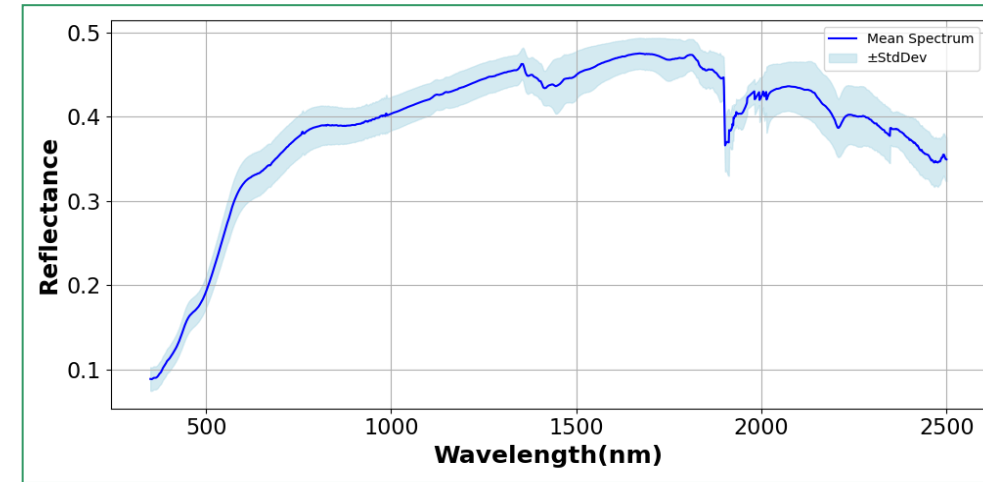


Absolute radiometric validation of RS2A:AWiFS @ Lanela, Rajasthan (2018-25)



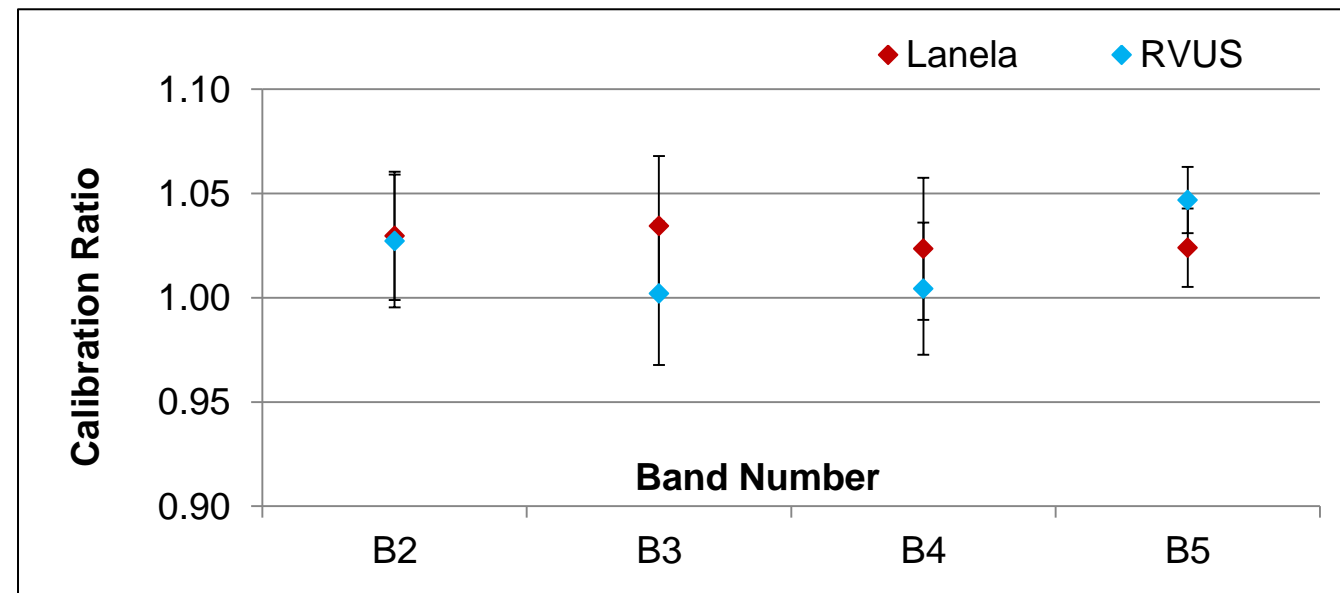
- **Surface Stability (spatial & temporal):** better 3%
- **Atmospheric and surface stability:** AOD ≤ 0.4 ; WV $< 1.5 \text{ g/cm}^2$
- Validated the results with **RVUS** with over 20 datasets spanning year 2019 to 2024.

RS2A-AWiFS demonstrates stable radiometric performance



RS2A-AWiFS imaging over Lanela

Date	AOD	WV (g/cm ²)	Ozone (DU)
21-Mar-2018	0.45	0.83	325.36
20-Feb-2020	0.33	0.62	314.80
24-Mar-2021	0.51	1.01	320.24
25-Apr-2025	0.32	1.48	325.36



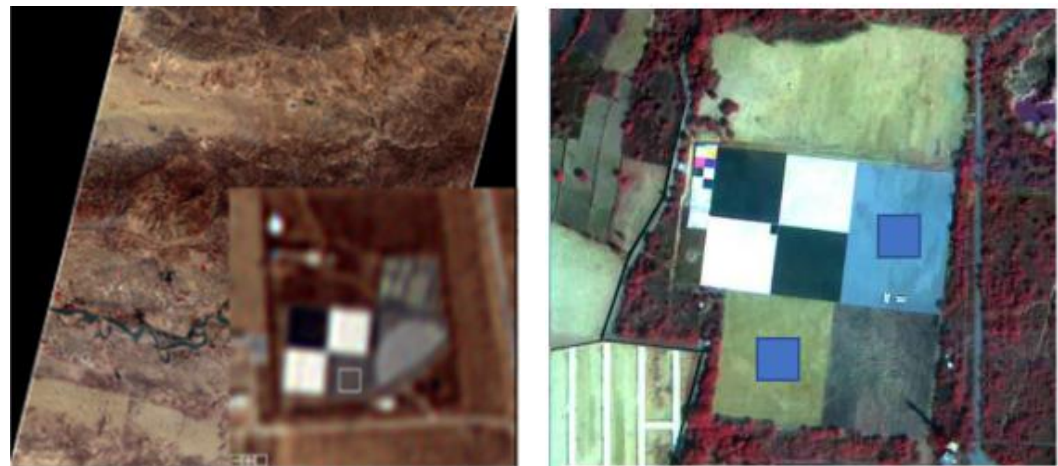
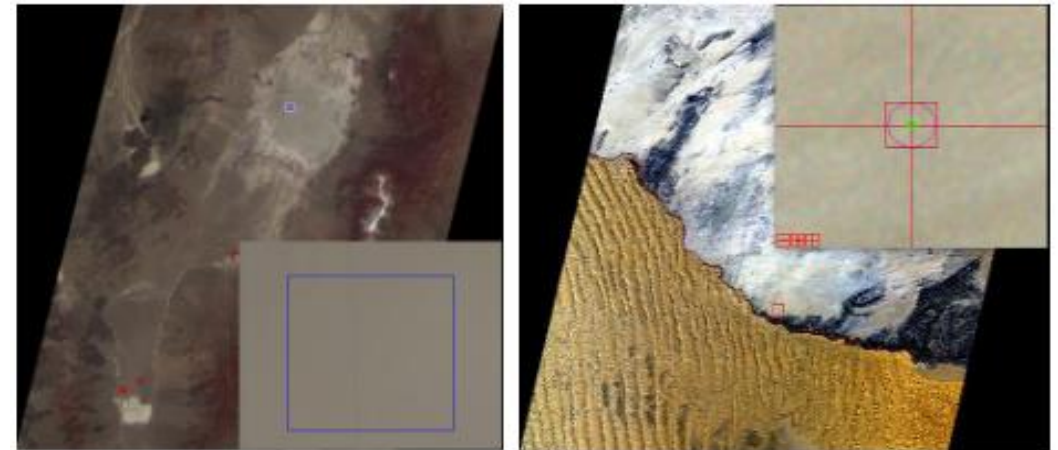
Absolute radiometric validation of RS2A:LISS4 (2017-24)



- **Methodology:** Vicarious reflectance-based
- Sites selected: RVUS, GONA, BTCN, ISRO/NRSC (Shadnagar site)

Site (Years Considered)	RVUS (2017-2024)	GONA (2018-2023)	BTCN (2021-2023)	NRSC-Site (2017-2023)
No. of Validation Experiments	17	15	6	12

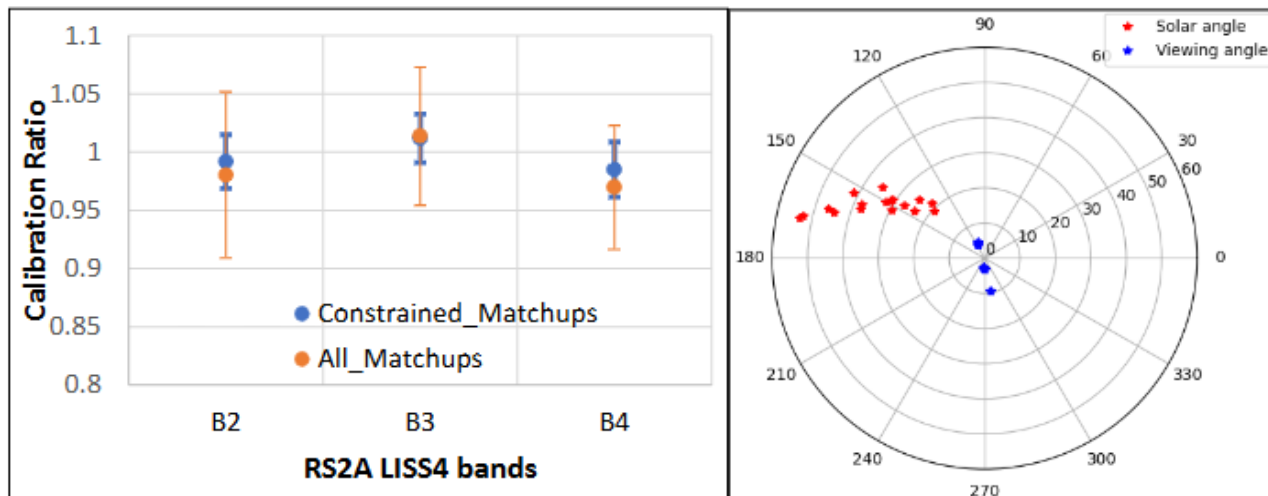
Site	Altitude (m)	AOD		WV (gm/cm ²)		O3 (DU)	
		Mean	Stdev	Mean	Stdev	Mean	Stdev
RVUS	1435	0.057	0.030	0.793	0.308	300.6	31.7
GONA	510	0.069	0.052	1.002	0.587	271.4	11.5
BTCN	1307	0.156	0.064	0.810	0.714	321.8	30.8
NRSC	640	0.388	0.138	1.306	0.781	324.6	27.9



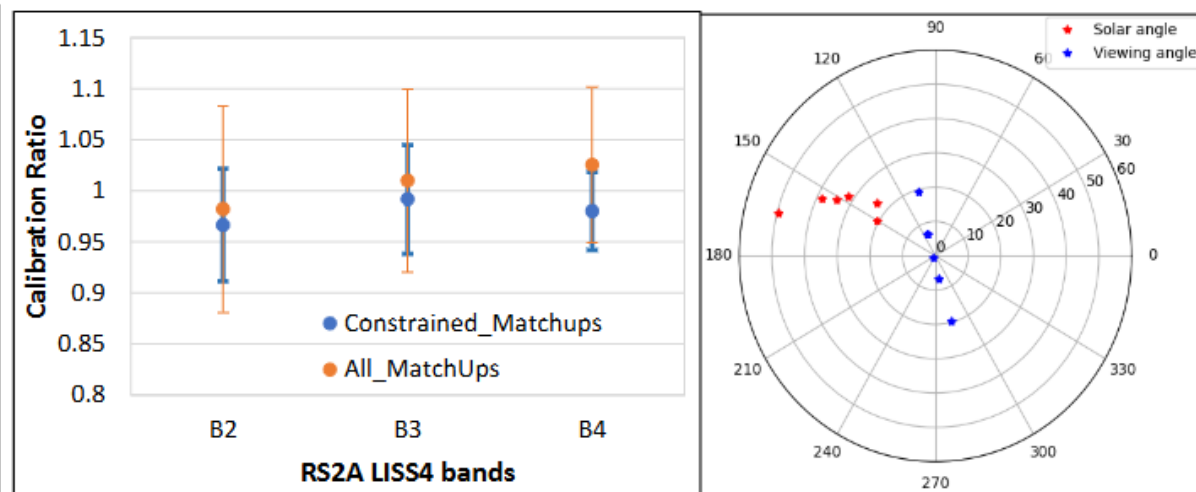
Absolute radiometric validation of RS2A:LISS4 (2018-25) Cont...



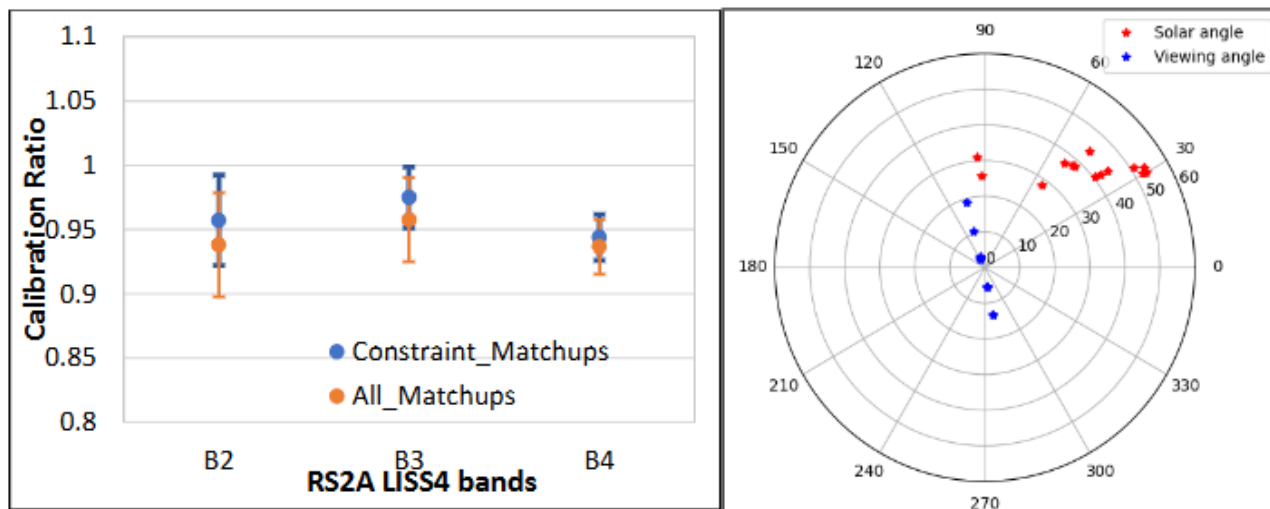
RVUS site



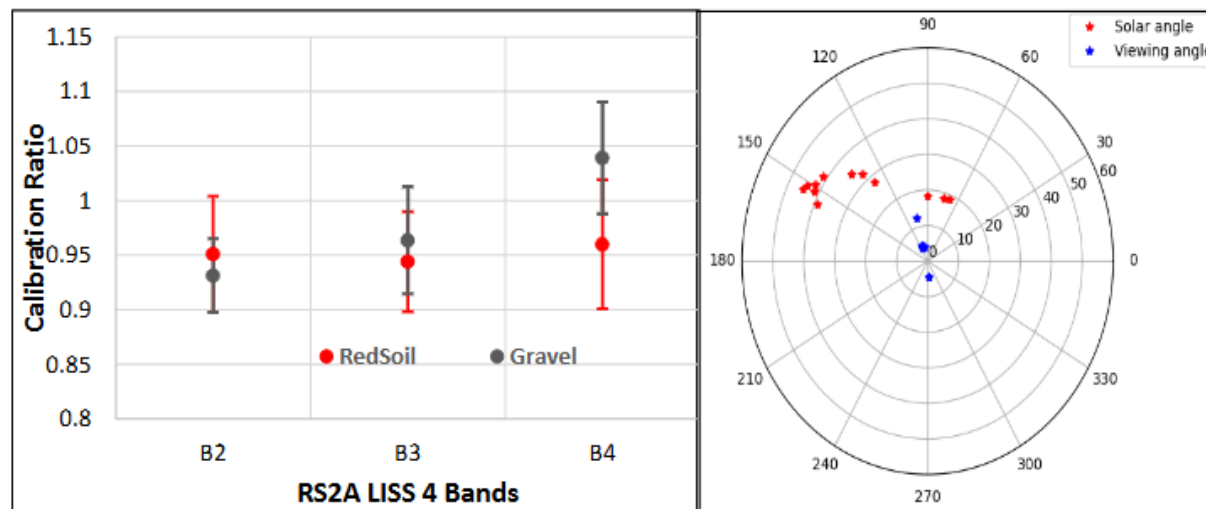
Baotou site



GONA site



ISRO / NRSC site

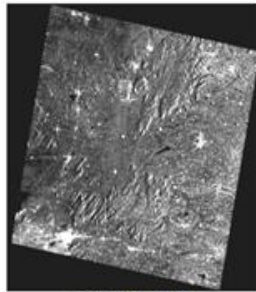


EOS-04 ARD products

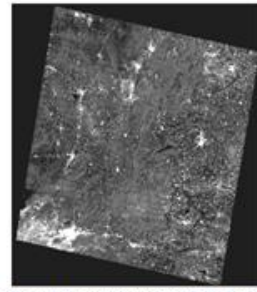


EOS-04 data products from the Medium Resolution ScanSAR (MRS) and Coarse Resolution ScanSAR (CRS) modes, with pixel spacings of 18 m and 36 m respectively, are CEOS ARD-compliant NRB products in accordance with SAR Product Family Specifications (PFS).

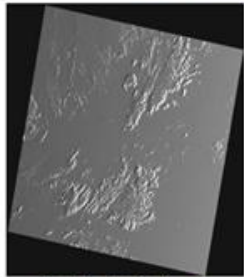
EOS-04 MRS Level-2B NRB data products



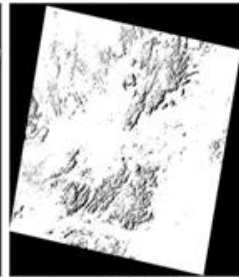
Level-2A Product



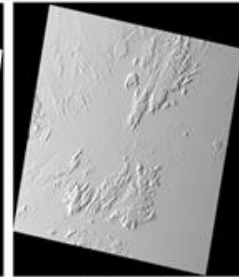
Level-2B Terrain Normalized ARD Product



Local Illumination Area

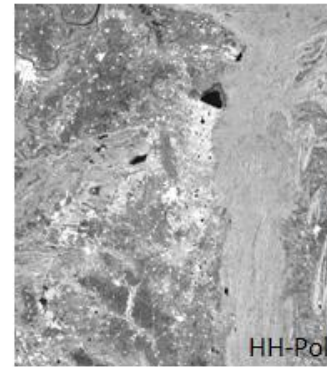


Layover Shadow Mask

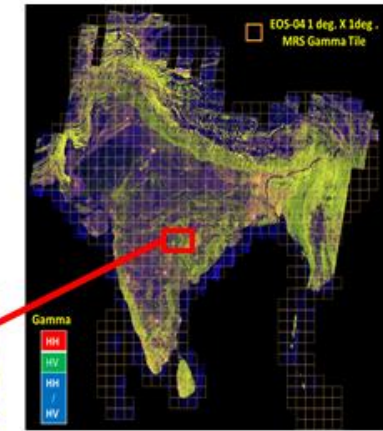
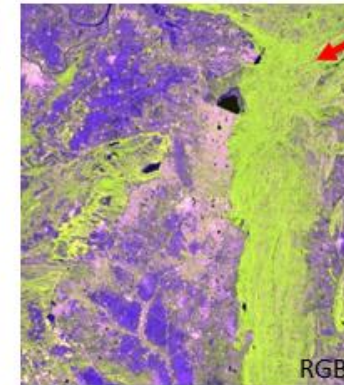


Local Incidence Angle

EOS04 – Tiled based India Mosaic Product from MRS systematic coverage



Sample 1 deg x 1 deg tile



https://doi.org/10.46693/NRSC/10/E04_SAR_MRS_STUC00ZTD

https://doi.org/10.46693/NRSC/10/E04_SAR_MRS_FIGC00ZTD

EOS-04 NRB Data Products are available at ISRO's Data Dissemination Portal "Bhoonidhi" for FREE Download to User community

<https://bhoonidhi.nrsc.gov.in/>

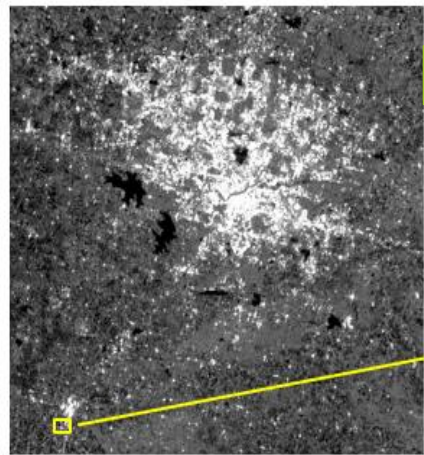
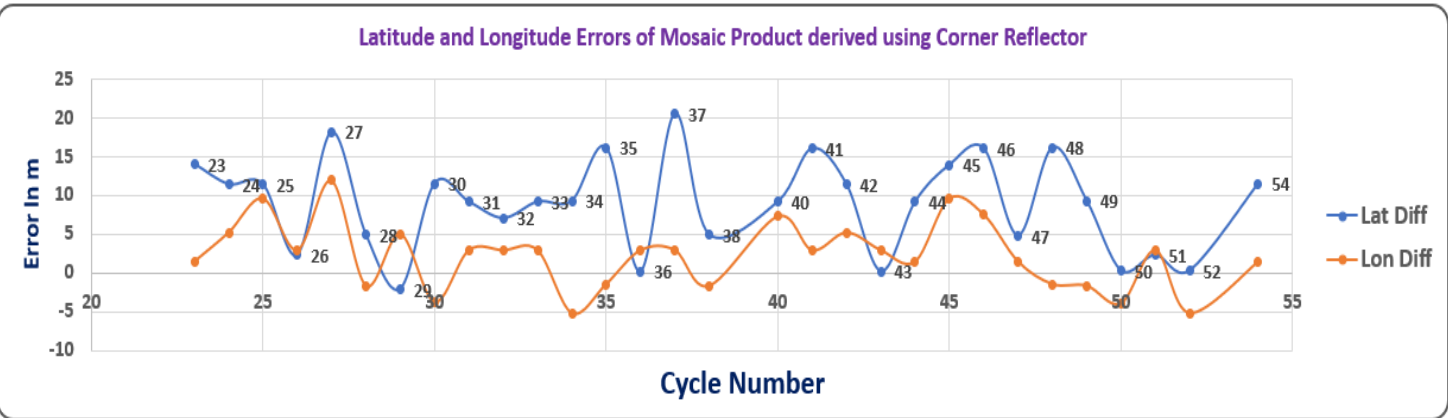
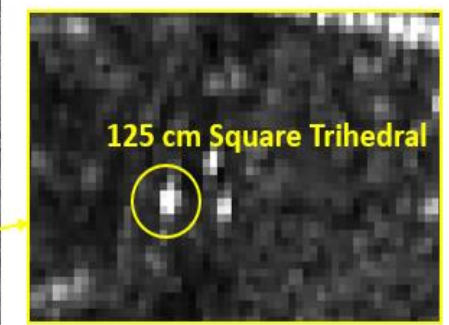
Courtesy: Microwave Data processing Group (MDPG), NRSC

EOS-04 ARD assessment

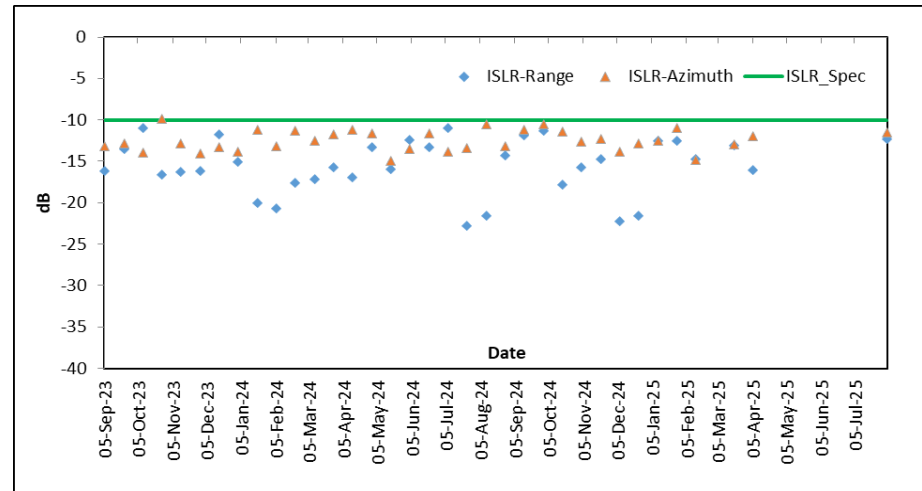
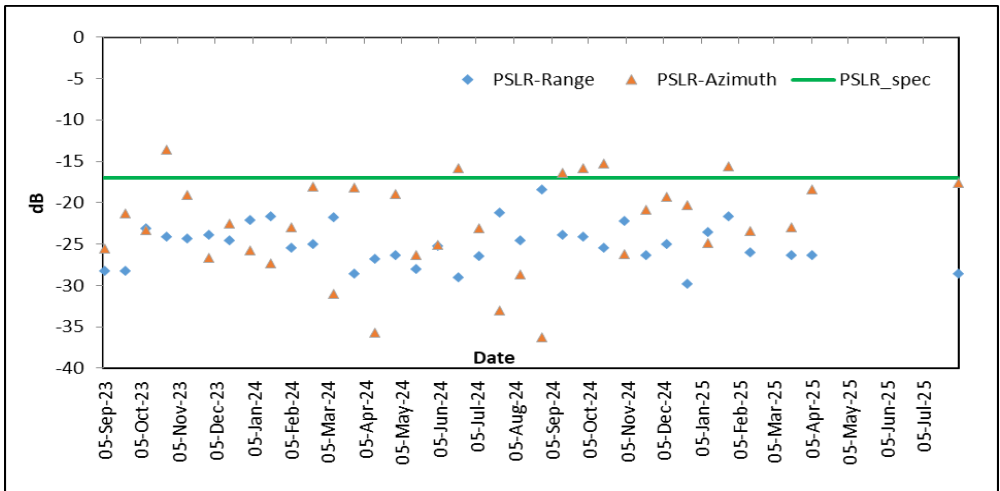


Radiometric and Geometric Accuracy Assessment of Level-2B of MRS data

NRSC / ISRO Shadnagar Site



150cm reflector deployed at Challakere for NISAR



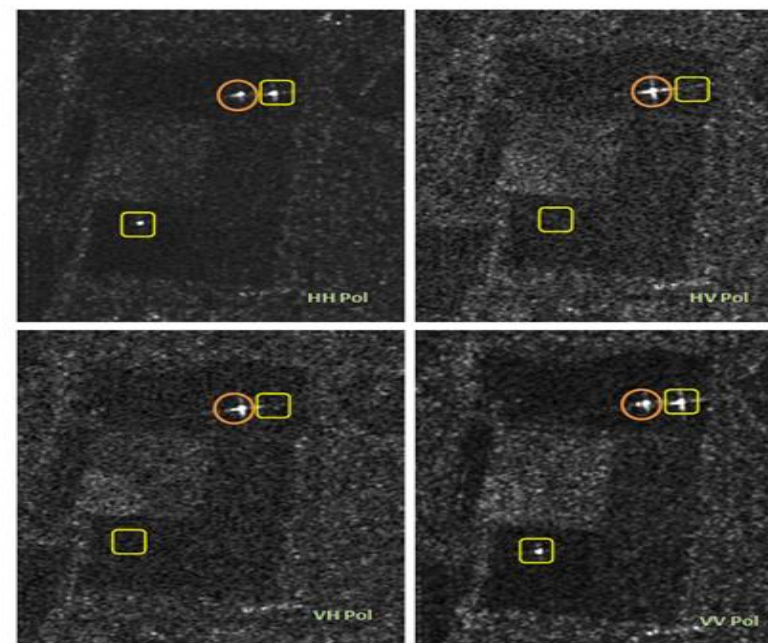
Courtesy: MDPG & SDEG, NRSC

EOS-04 calibration



Point Target Analysis using ARC and Corner Reflectors: (Full Pol, FRS)

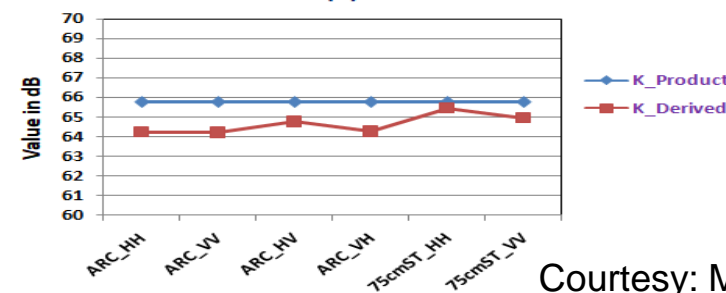
Target	Polarization	Azimuth			Range		
		PSLR (dB)	ISLR (dB)	Resolution (m)	PSLR (dB)	ISLR (dB)	Resolution (m)
ARC	HH	-16.26	-16.5	3.44	-14.45	-13.28	2.25
ARC	VV	-18.06	-17.46	3.44	-13.11	-12.15	2.25
ARC	HV	-17.57	-17.12	3.44	-19.37	-15.35	2.47
ARC	VH	-17.63	-17.55	3.44	-19.52	-16.06	2.25
75cm Square Trihedral	HH	-20.42	-18.74	3.44	-20.88	-18.83	2.25
75cm Square Trihedral	VV	-20.77	-18.51	3.44	-22.36	-19.3	2.47



○ - Active Radar Calibrator
□ - Square Trihedral Corner Reflector

Target	Co Pol Channel Imbalance	Co Pol Phase Imbalance	Cross Pol Channel Imbalance	Cross Pol Phase Imbalance
ARC	0.97	-1.98	1.021	4.49

Calibration constant(K) derived Vs Product



Courtesy: MDPG, NRSC

Derived radiometric & polarimetric parameters are within specifications

Radiometric performance of EOS-6 (OCM-3)

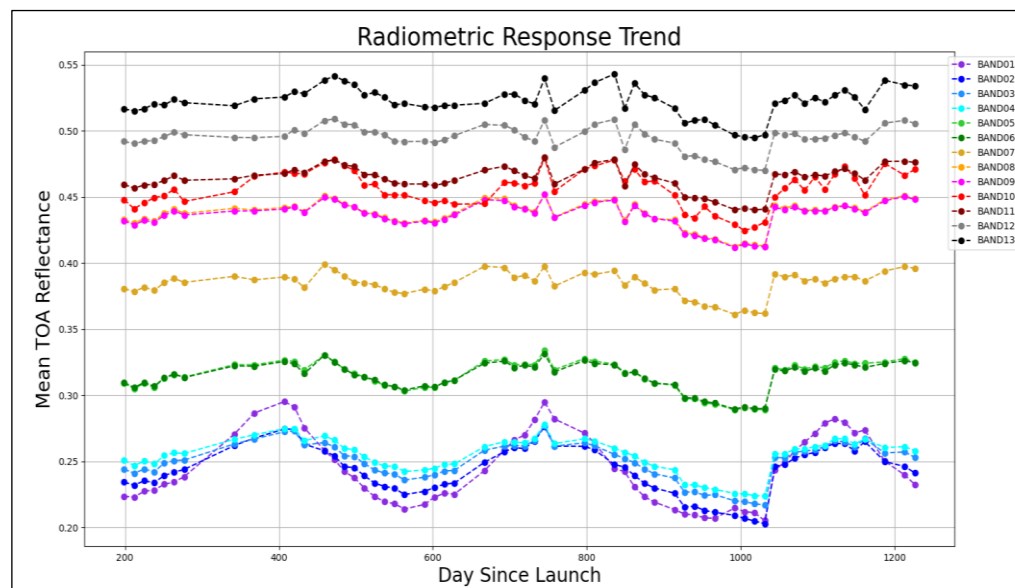
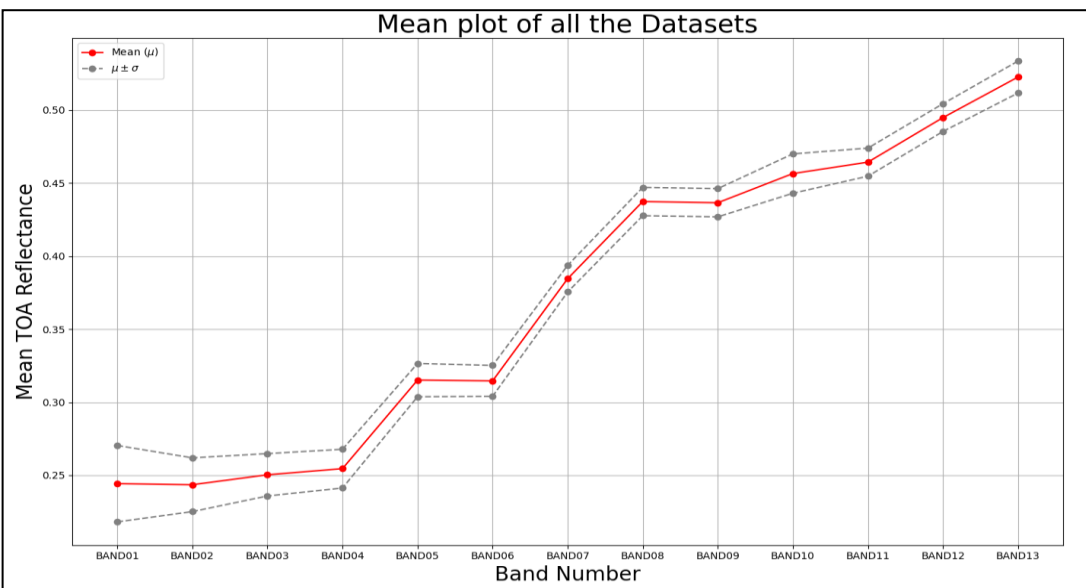


EOS-06 Launch	:	26-11-2022
Site Details		
• Site Name	:	Libya4
• Center Lat/Lon	:	28.55N / 23.39E
• Window Size	:	11km X 11km
Passes Details		
• Coverage Type	:	GAC
• Path/Row	:	27 / 13
• No. of datasets	:	61 (cloud free)
• Sat. Ele. Angle Range	:	64.81° to 68.08°
• Sat. Azi. Angle Range	:	35.937° to 173.21°
• Sun Ele. Angle Range	:	37.82° to 84.47°
• Sun Azi. Angle Range	:	180.10° to 214.24°

Response studied from Jun'23-Apr'26

- Standard Deviation
- Band1: ± 0.025
 - Band2-Band4: ± 0.018
 - Band5-Band13: ± 0.01

Radiometric response is consistent over CEOS/PICS

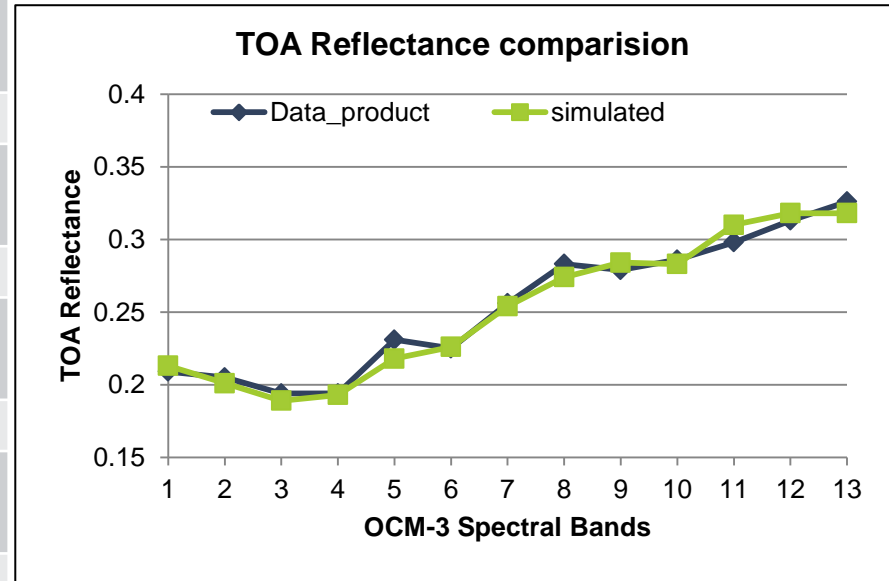


Radiometric performance of EOS-6 (OCM-3)

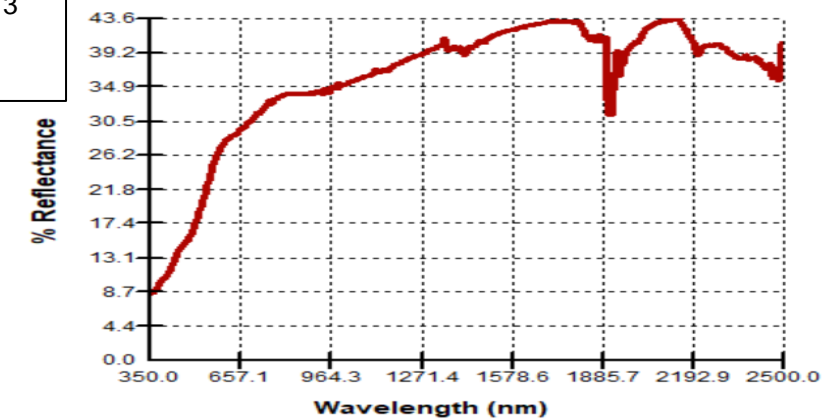


Methodology: Vicarious reflectance-based

Sl.no	Parameter	EOS-06 OCM-3
1	Satellite Over pass time (UTC)	07:24:25
2	Path/Row	53/13
3	Water Vapour (WV)	1.7 g/cm ²
4	Ozone	285 DU
5	Aerosol Optical Depth (AOD)	0.428
6	Sun Zenith Angle	26.1°
7	Sun Azimuth Angle	50.15°
8	View Zenith Angle	33.05°
9	View Azimuth Angle	133.79°
10	Pixels Averaged	6



Lanela site as imaged by Multispectral sensor of Cartosat-2E satellite on 27th March 2026.



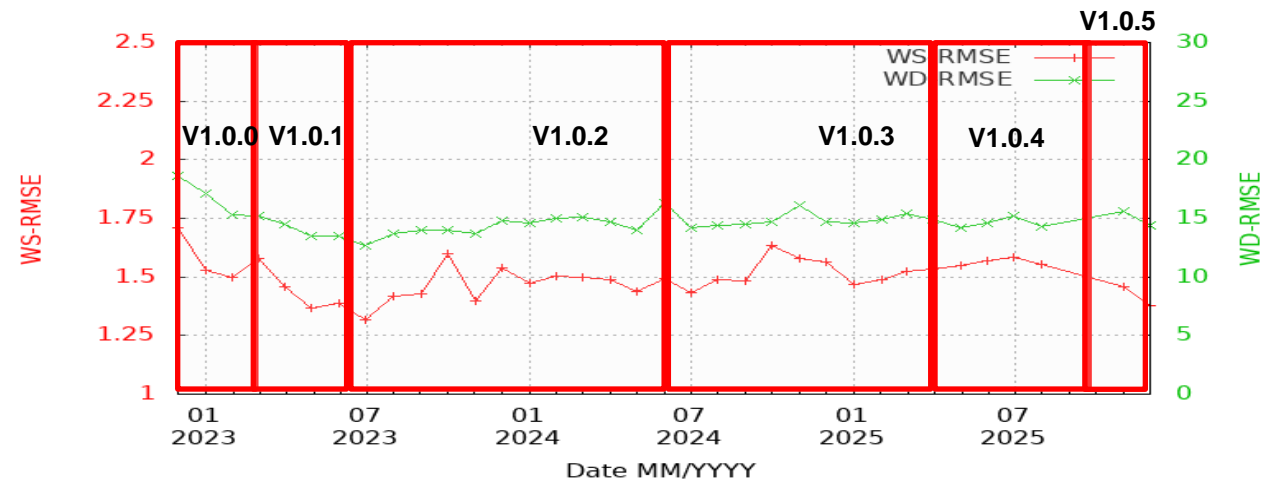
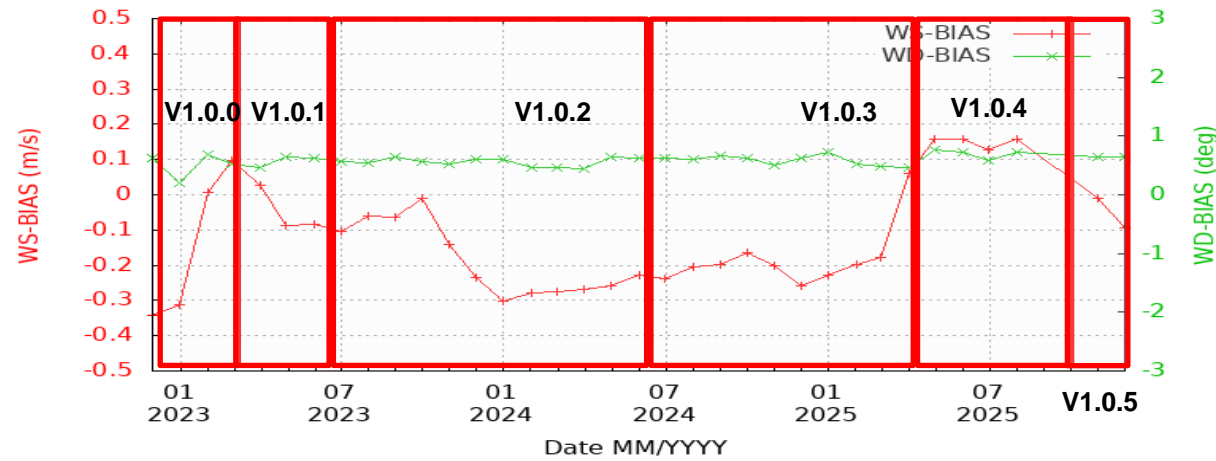
TOA reflectance in all bands agree well with in 5%

Performance update of EOS-6 (SCAT-3)



EOS-06 Scat Status: Operational Since April 2023 and products (L1B, L2A, L2B, L3W) are now routinely disseminated through Bhoonidhi.

Data processing version: 1.0.5 dated 01-Oct-2025

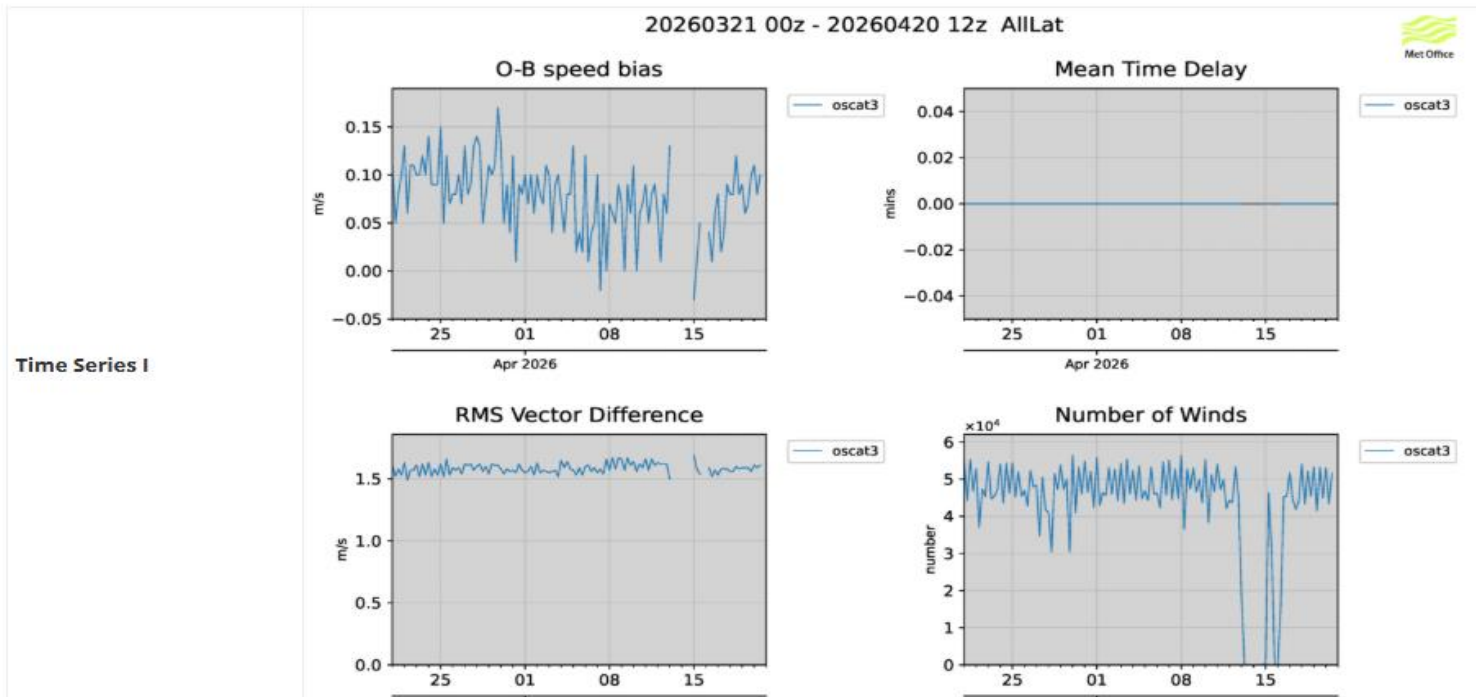


Courtesy: Dr Rajesh & team, ECSA, NRSC

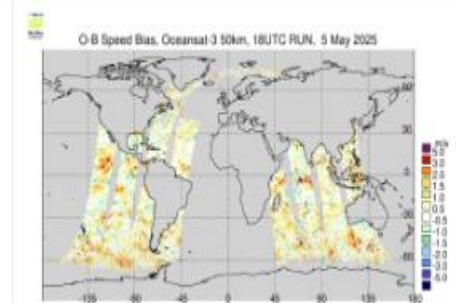
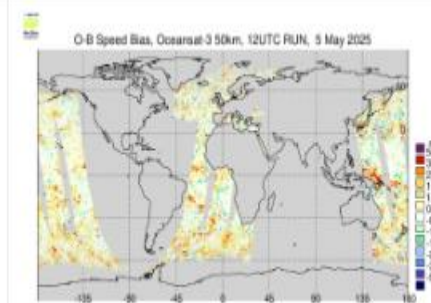
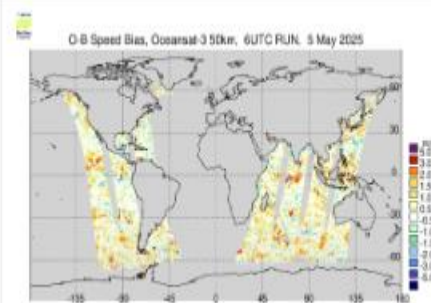
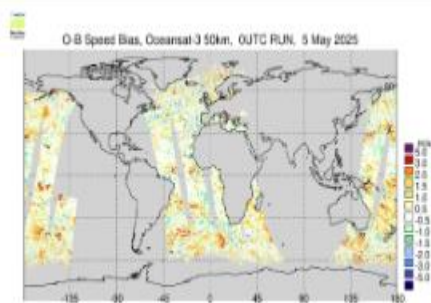
Performance update of EOS-6 (SCAT-3) Cont..



Last 30 days (updated once per day)



Map O-B Speed Bias



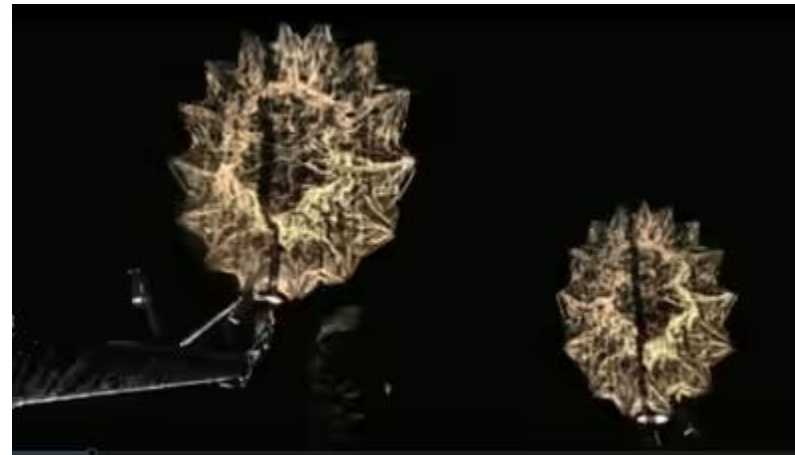
Update on NISAR



NISAR: Successfully launched on July 30, 2025, completed the deployment phase, commissioning phase and now in science phase.

Data products dissemination: Through Bhoonidhi (<https://bhoonidhi.nrsc.gov.in/>)

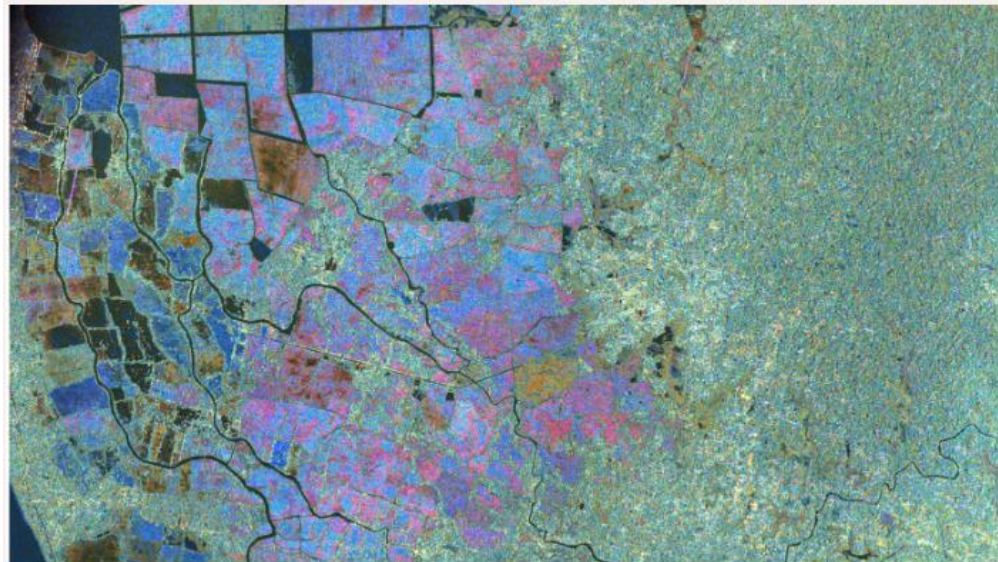
Data acquisition: As per reference science observation plan



Unfurling of large 12m antenna



GSLV-F16 rocket carrying NISAR satellite



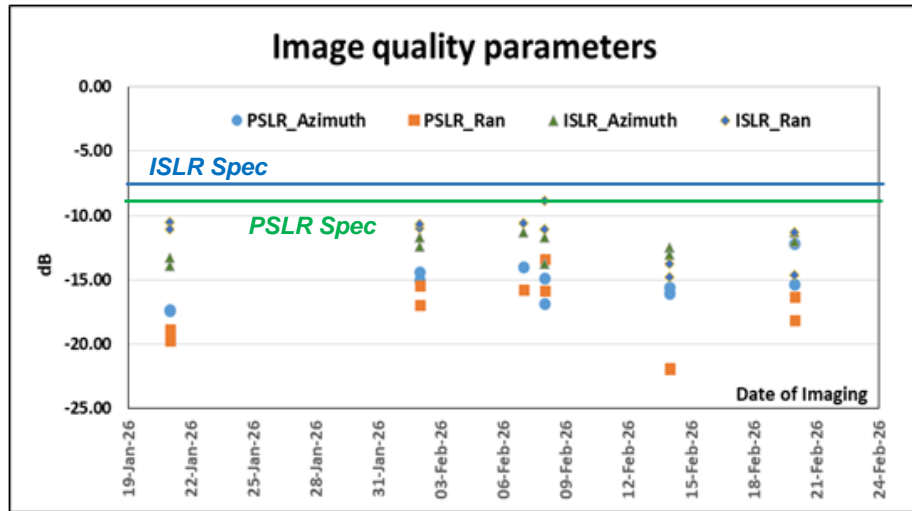
Vembanad-Kol Wetland, India - a Ramsar site



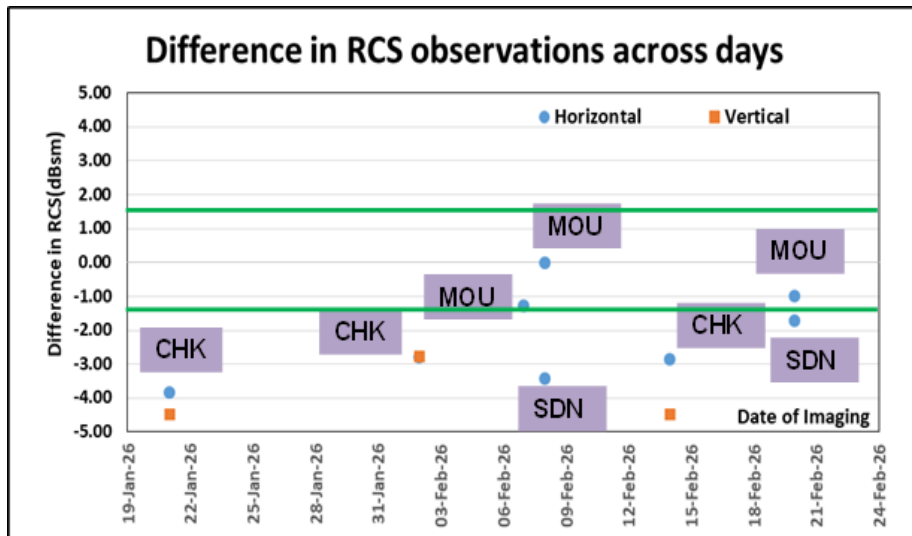
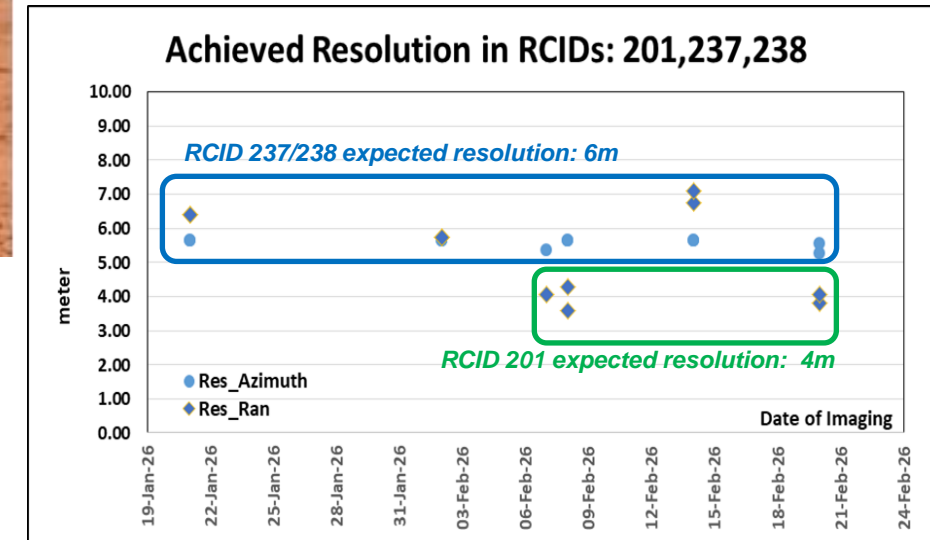
Ahmedabad, India

Courtesy: Bhoonidhi, NRSC

Update on NISAR (Cont...)



Deployed PAN India CR's for NISAR calibration at more than TEN sites



- ❖ Difference in RCS over **SDN** and **MOU** sites is **< 2 dBsm**.
- ❖ Large RCS deviations are observed over **CHK** site.
- ❖ PSLR, ISLR and achieved resolution are as expected.

CHK: Challakere
MOU: Moula-Ali
SDN: Shadnagar

Team members:

Harsha Vardhan Reddy Y

Saritha P K

Satya Soma Shekhar K

Santhi Sree B (WGCV member)

Special thanks:

**Dr. S. MuraliKrishnan,
Deputy Director (DPA)**

**Dr. Prakash Chauhan,
Director, NRSC**

Thank you for the kind attention !!!