LSI-VC-19

ISRO's Updates on SAR CEOS-ARD products

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Indian Space Research Organization(ISRO)

Agenda Item # L2.2, LSI-VC-19, Sioux Falls, USA

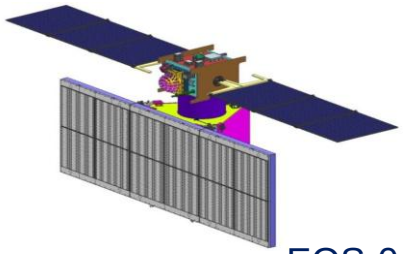
20-24 April, 2026

CEOS

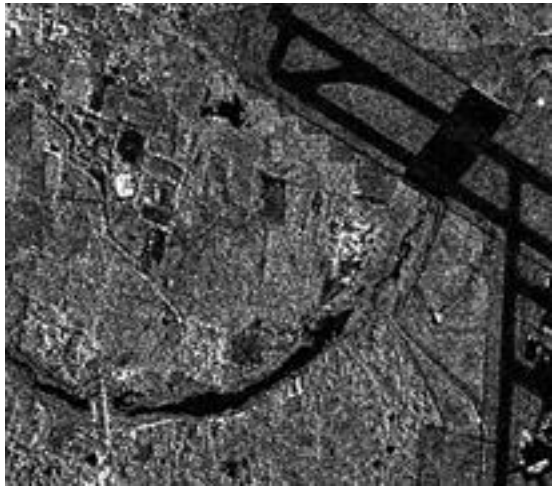
Committee on Earth Observation Satellites

Indian Space Research Organisation (ISRO)

Objective : To develop space technology and its application for national needs. Key focus areas include satellite communication, Earth observation(Optical, SAR, Hyper Spectral, Thermal), disaster management, navigation, and space science exploration, utilizing indigenous technology to drive economic development and national security.

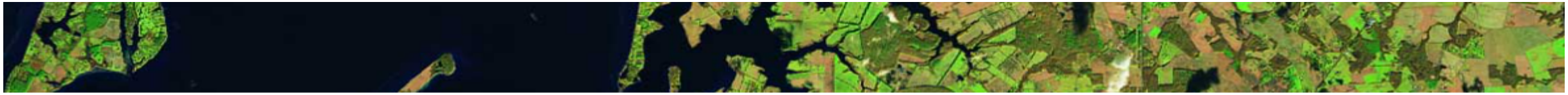


EOS-04 SAR



C-band SAR image

ISRO's CEOS SAR-ARD Status:



CEOS Analysis-Ready Datasets

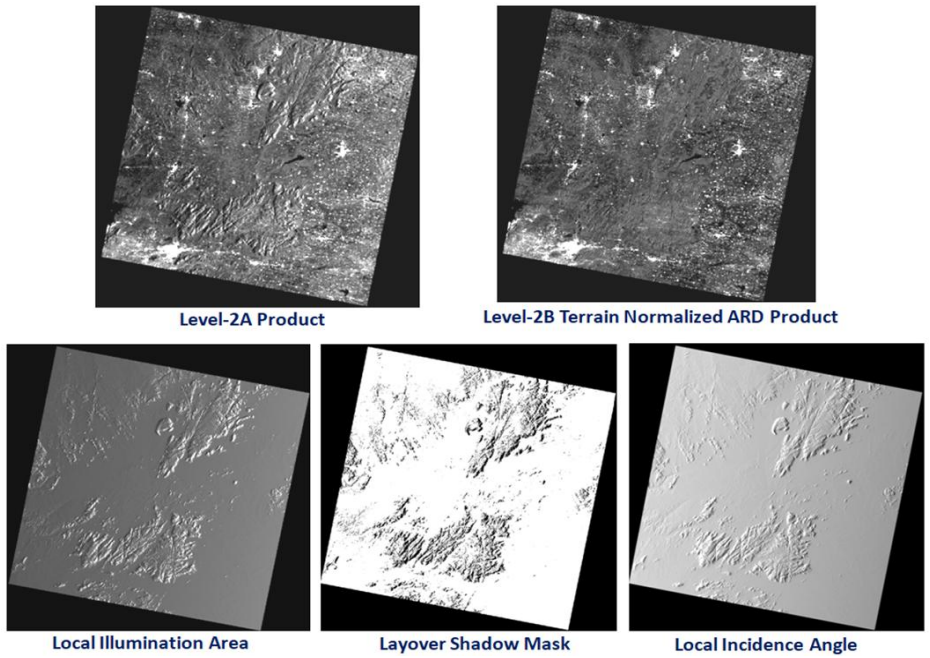
The following table summarises all of the satellite EO datasets that have been assessed as CEOS Analysis Ready Data (CEOS-ARD) or which are working towards it (either under development or at the peer review stage). DOI links are provided for access, along with links to further information, sample products, and the completed CEOS-ARD self-assessment and peer review outcome documents.

	AGENCY/ORGANISATION ISRO	Count 7					
19	RISAT-1A/ POL	Under Development	SAR-POL		ISRO	RISAT-1A,
20	RISAT-1A (EOS-04) NRB	CEOS-ARD	SAR-NRB	v1.0	ISRO	RISAT-1A (EOS-04)
21	RISAT-1A (EOS-04) NRB India Mosaic	CEOS-ARD	SAR-NRB	v1.1	ISRO	RISAT-1A (EOS-04)
24	NovaSAR-1 NRB	Under Development	SAR-NRB		ISRO	NovaSAR-1
25	NISAR NRB / GCOV / GSLC / GUNW	Under Development	SAR-NRB SAR-GSLC SA		ISRO	NISAR

ISRO- Indian Space Research Organization, Department of Space, India

Sample data of EOS-04 ARD Products

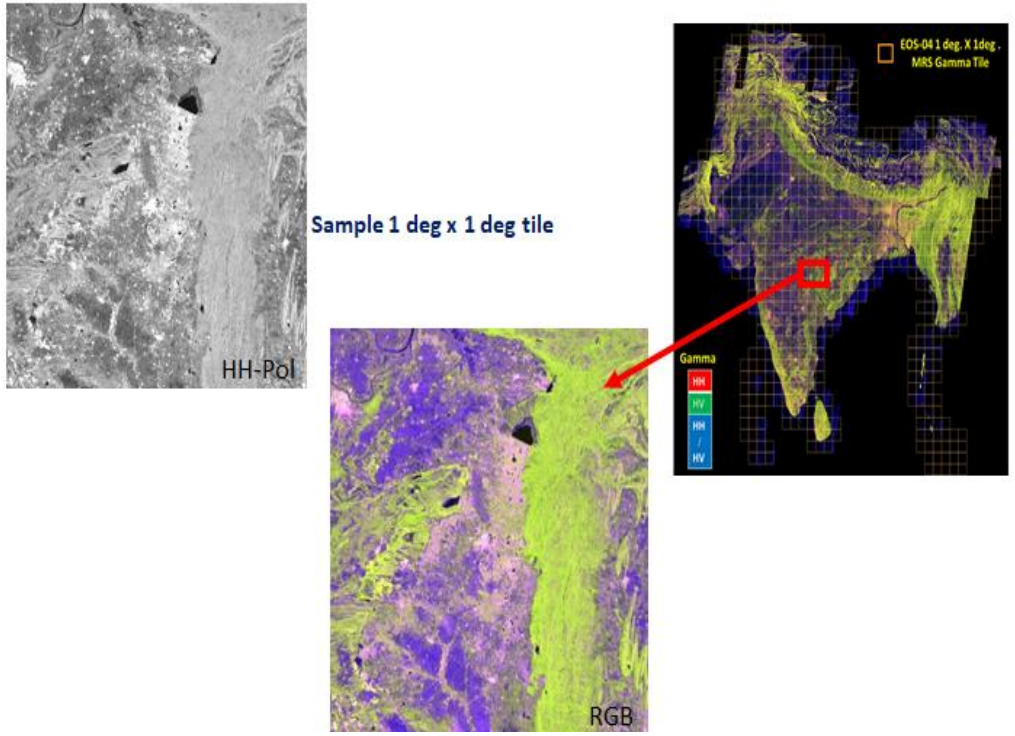
Level-2B NRB data products (CEOS-ARD Endorsed)



Medium Resolution ScanSAR(MRS) – 18m

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

EOS04 – Tiled based India Mosaic Product (CEOS-ARD Compliant)



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

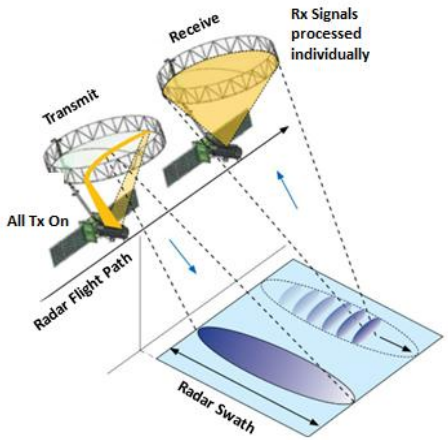
https://bhoonidhi.nrsc.gov.in/

ISRO CEOS-Compliant SAR - ARD Product Generation – A Road Map

SNO	ARD Product	Sensor	Product Type	Timeline	CEOS Endorsement Status
1	Normalized Radar Backscatter	EOS-04 (RISAT-1A)	Level2B[NRB]	2024	Completed
		EOS04	India Mosaic[NRB] (Tiled Product)	2025	Completed.
2	Polarimetric Radar	EOS-04	Geocoded Polarimetric Decomposition Products (Level-3B) [PRD]	2025	Planned to submit for CEOS Endorsement before LSI-VC-20, Sep 2026. (Final Designer level product package validation is in progress at ISRO.)
		EOS-04	GCOV (Geocoded Covariance Product) [CovMAT]	2026	
		NISAR	GCOV (Level-2) [CovMAT]	2026	Launched successfully on 30th July, 2025 at SHAR/ISRO – India. S-SAR Data Acquisition and Data products validation is in progress as per NISAR Reference Observation Plan and Pan India Corner Reflector Network.
3	Geocoded Single Look Complex	NISAR	GSLC (Level-2)	2026	
4	Interferometric Products	NISAR	GUNW (Geocoded – Unwrapped Interferogram)	2027	

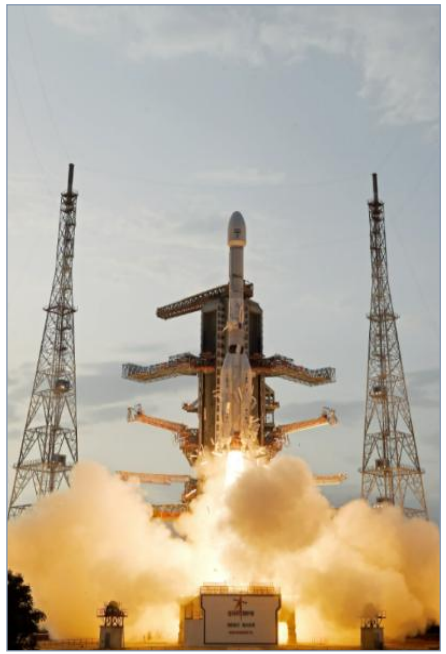
NISAR Mission

- The NASA-ISRO Synthetic Aperture Radar (NISAR) mission, jointly developed by ISRO and NASA, was successfully launched aboard GSLV-F16 on 30 July 2025 from SHAR-ISRO, India
- World's first mission with dual frequency SAR—NASA's L-band and ISRO's S-band—using the advanced SweepSAR technique,
- Capable to capture high-resolution polarimetric and interferometric data over a wide swath.
- Designed for Global Earth system monitoring - Land, Cryosphere and Ocean surfaces.
- Reptivity: Every 12 days during mission life providing exceptional insights into our planet's dynamics.



SwweepSAR Technique

NISAR Spacecraft



Launched successfully on 30th July, 2025

NISAR Characteristic	Enables...
L-band (24 cm wavelength)	Low temporal decorrelation and foliage penetration
S-band (9 cm wavelength)	Sensitivity to light vegetation
SweepSAR technique with Imaging Swath > 240 Km	Global data collection
Polarimetry (Single/Dual/Quad)	Surface characterization and biomass estimation
12-day exact repeat	Rapid Sampling
3-10 m mode-dépendent SAR resolution	Small-scale observations
3 years science operations (5 years consumables)	Time-series analysis
Pointing control <273 arcseconds	Deformation interferometry (D-InSAR)
Orbit control < 500 meters	Short baseline D-InSAR
> 10% (S) / 50% (L) observation duty cycle	Complete land/ice coverage
Left-only pointing (Left/Right capability	Uninterrupted time-series Rely on Sentinel-1 for Arctic

NISAR – Science Applications

NISAR Science & Application Themes

NISAR is set to unveil groundbreaking insights into the Earth system and provide a revolutionary suite of Level-4 science products.

Ecosystems : Forest & Agriculture

Monitoring forest biomass, afforestation, vegetation disturbance, national maps of active crops, food security planning, mangrove classification and change detection.

Coastal & Ocean

Coastal Flood mapping & Early warning, Ocean surface winds, weather forecasting, cyclone tracking, Bathymetry, shoreline change maps etc.

Cryosphere: Himalayan & Polar

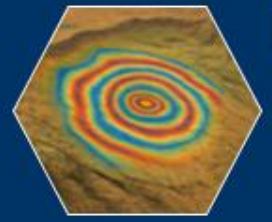
To systematically monitor glacier velocity and deformation, snow wetness and fresh snow mapping additional to polar monitoring from Indian-Antarctic stations.

Hydrology & Soil Moisture

Heading towards to Drought-risk management, precision farming, irrigation management, smart farming start-ups, wetland & inundation mapping.

Natural Hazards & Disaster

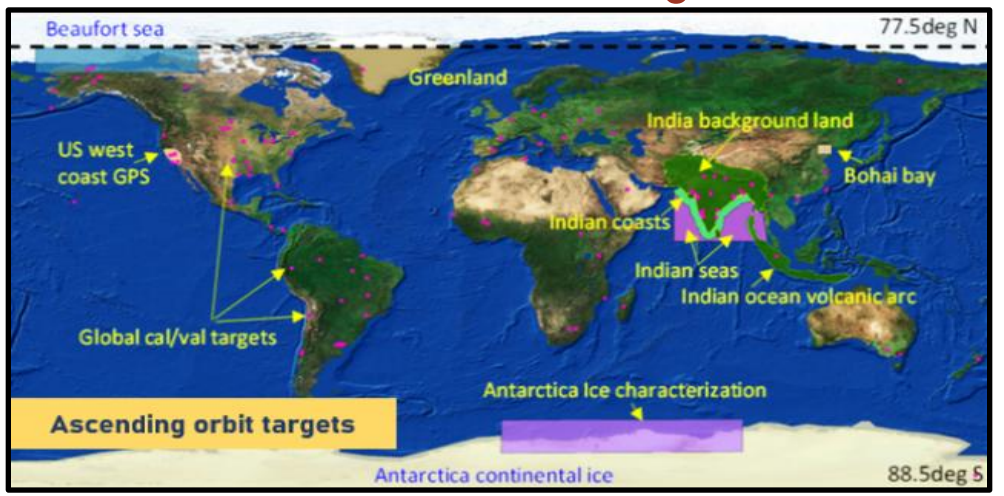
Flood inundation monitoring and assessment, volcanic monitoring, opening new avenues for geo-hazard science and research on early warning systems.

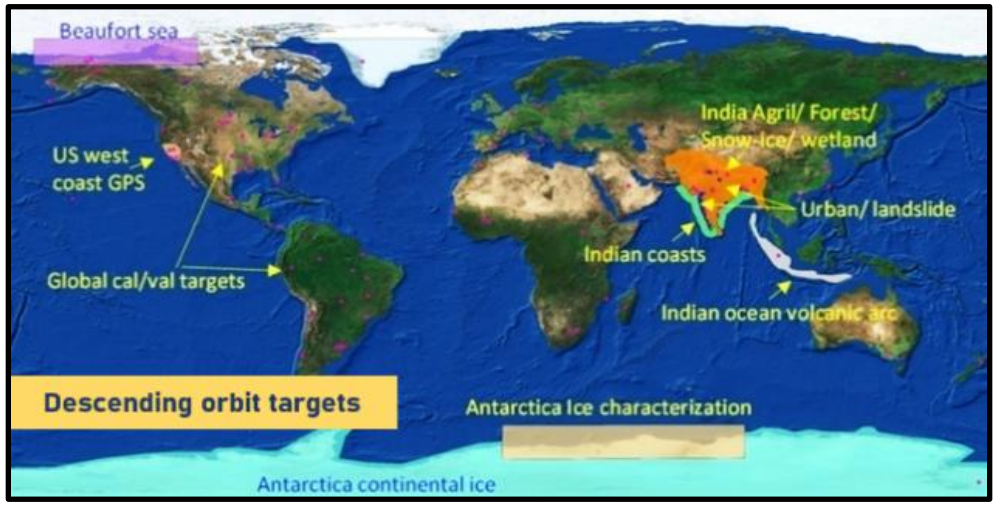


Solid Earth: Deformation

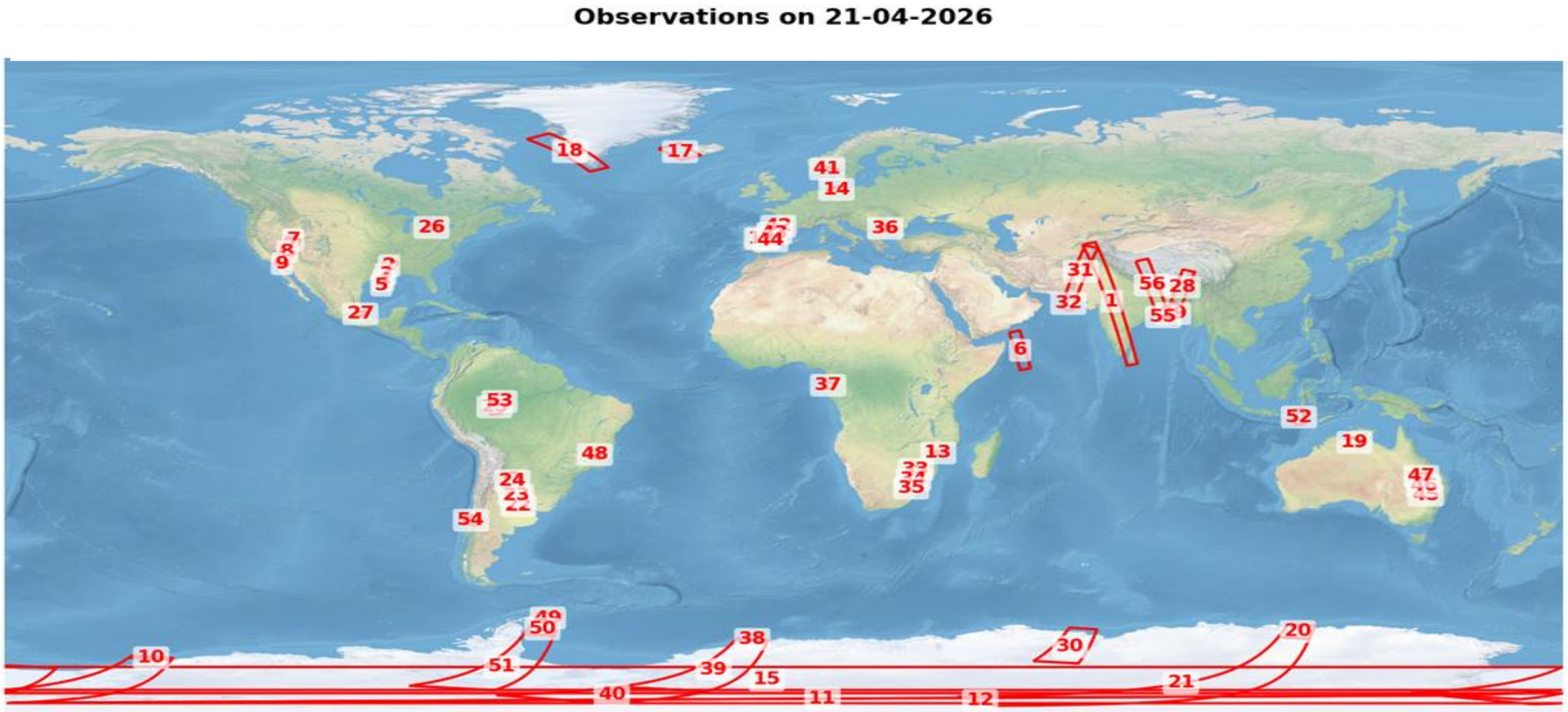
Measuring crustal deformation, earthquake hazard assessment, across space and time, monitoring landslide risk zones and urban subsidence.

ISRO identified Targets





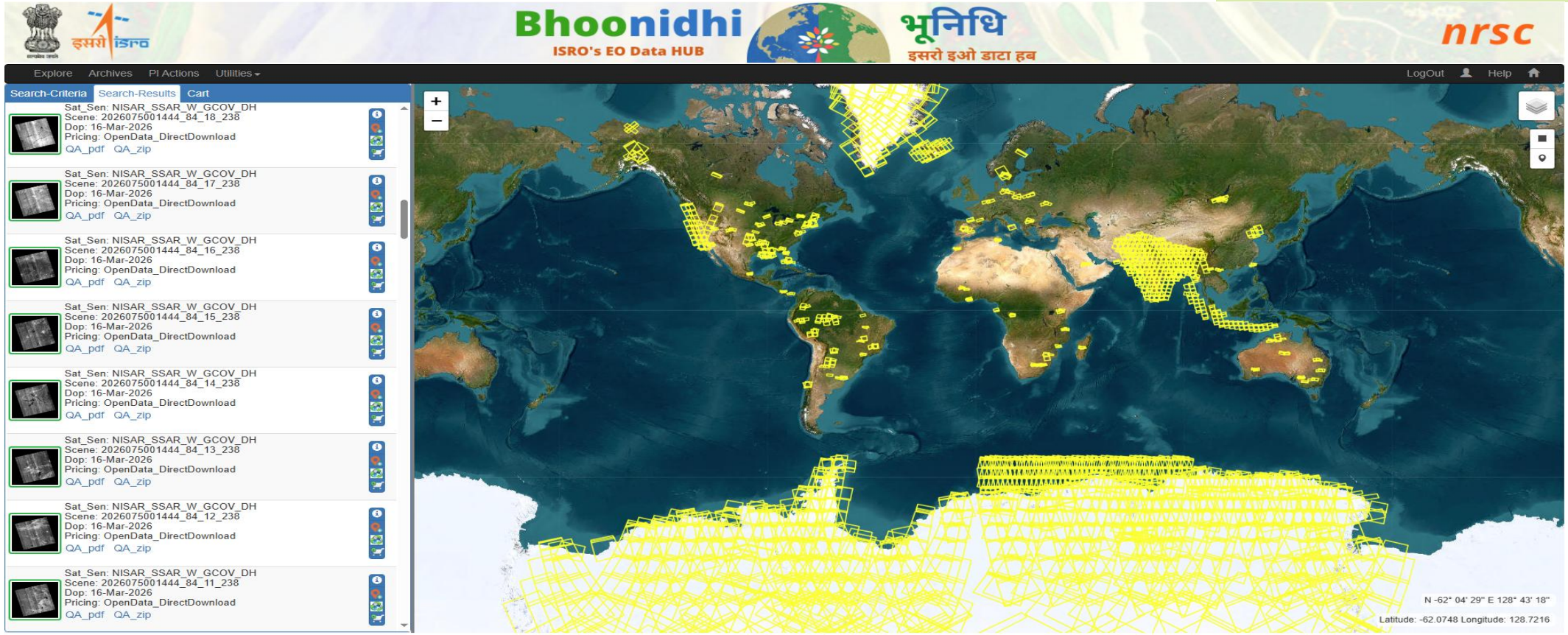
Sample of S-SAR Observations planned as per Science Reference Observation Plan



S-SAR Global Data acquisitions of NISAR

- through ISRO's Bhoonidhi Dissemination portal

Cycle No: 15 (12 day repetivity)



NISAR data dissemination via ISRO's Data Dissemination Portal, Bhoonidhi.
Presently, the data products are under validation phase.

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

NISAR Data Dissemination @Bhoonidhi

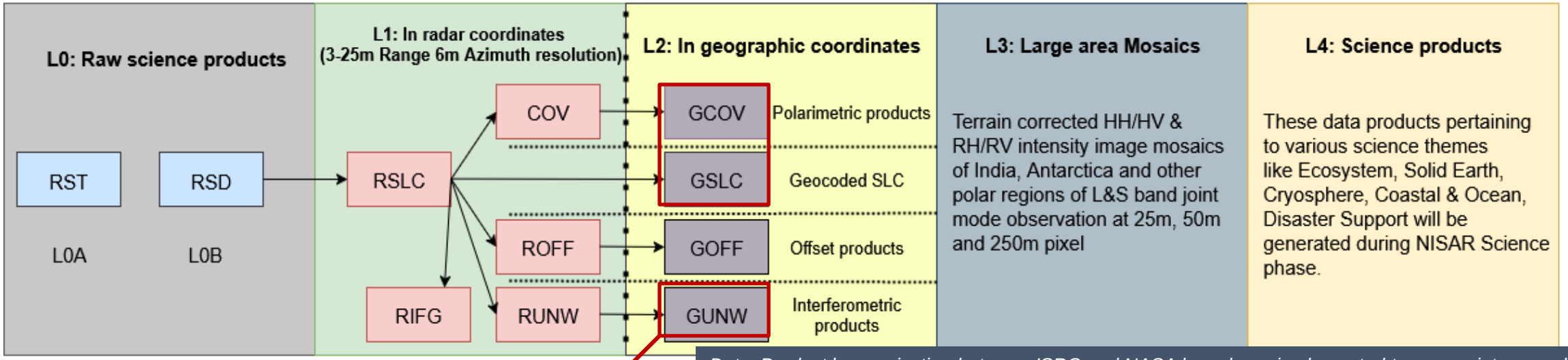
- NISAR data available under the Open Data category on Bhoonidhi.
- The platform provides easy access to data collected over ISRO-targeted areas in S-band, L-band, and Joint (L+S) modes.

Spatio Temporal Asset Catalogue (STAC)	STAC data catalogue for increased data interoperability
API based data access	API for machine-to-machine data access
Bhoonidhi Browse&Order	Search, select and download NISAR data products
Bhoonidhi VISTA	Online NISAR data visualization at native resolution
Bhoonidhi CodeLab	Cloud-based custom compute environment as a service
Bhoonidhi ODP (On Demand Processing)	On demand Information Product Generation and Exploitation

NISAR: https://bhoonidhi.nrsc.gov.in/NISAR

Advanced search filters - including track/frame, polarization, etc., are enabled for efficient browsing and downloading of NISAR data.

NISAR Data Products



Data Product harmonization between ISRO and NASA have been implemented to ensure interoperability and consistency in data exploitation across diverse scientific disciplines and thematic applications.

RST –Raw Science Telemetry (Level 0A)
RSD-Radar Signal data (Level 0B)
RSLC- Range Doppler Single Look Complex
COV–Polarimetric Covariance Matrix
RIFG - Nearest-Time Interferogram
RUNW- Nearest-Time Unwrapped Interferogram
ROFF – Range Doppler Pixel Offsets
GSLC – Geocoded Single Look Complex
GNUW – Geocoded nearest –time unwrapped interferogram
GCOV – Geocoded Polarimetric Covariance Matrix
GOFF – Geocoded pixel offset

Level 0B, Level 1 & Level 2 Product in HDF-5 Format

Proposed for CEOS Endorsement

L2-GSLC
GEOCODED SLC
Geocoded L1 SLC product using the MOE (Medium Orbit Ephemeris) state vectors and a DEM

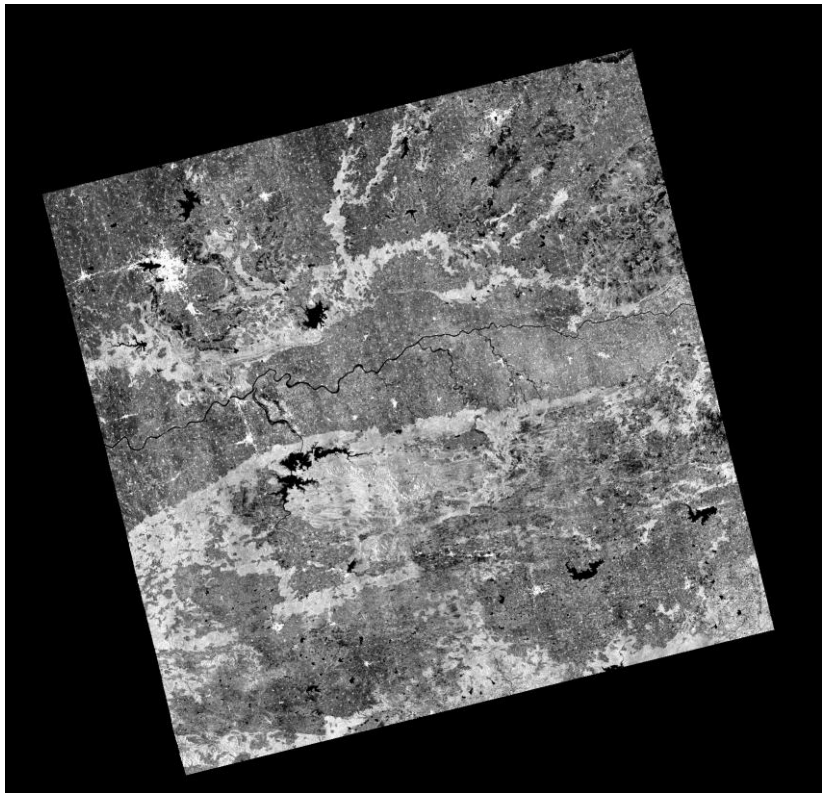
L2-GUNW
GEOCODED NEAREST-TIME UNWRAPPED INTERFEROGRAM
Geocoded multi-looked unwrapped differential Interferogram. Same as UNW but resampled onto a UTM / UPS grid

L2-GCOV
GEOCODED POLARIMETRIC COVARIANCE MATRIX
Geocoded polarimetric covariance matrix (1, 3, or 6 layers) using the MOE state vectors and a DEM

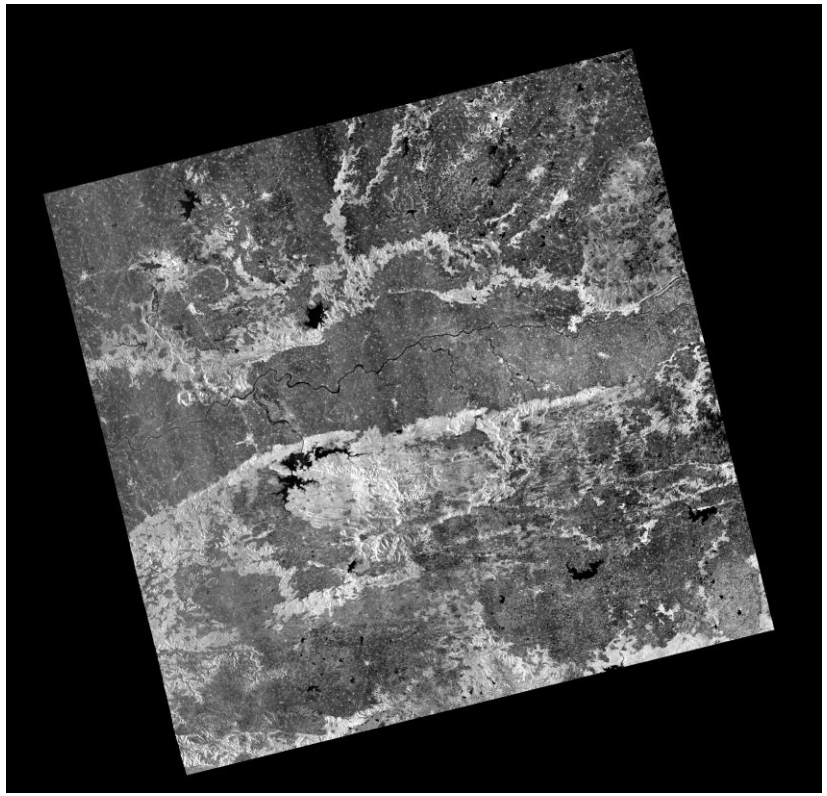
NISAR S-SAR Data Products are being calibrated using PAN India Corner Reflector Network and Distributed Homogenous targets.

NISAR S-SAR Dual Pol (HH-HV) Sample Data Products

RSLC Product
HH -Polarization



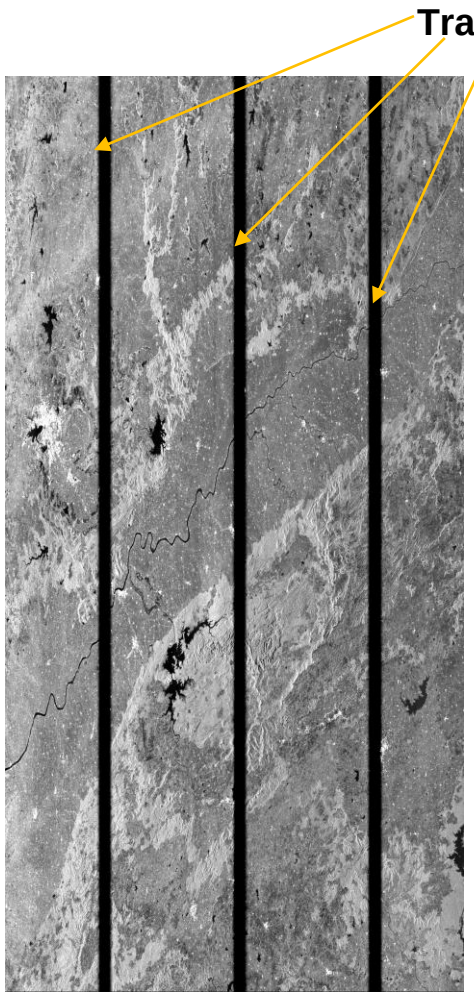
ARD GSLC/GCOV Product
HH -Polarization



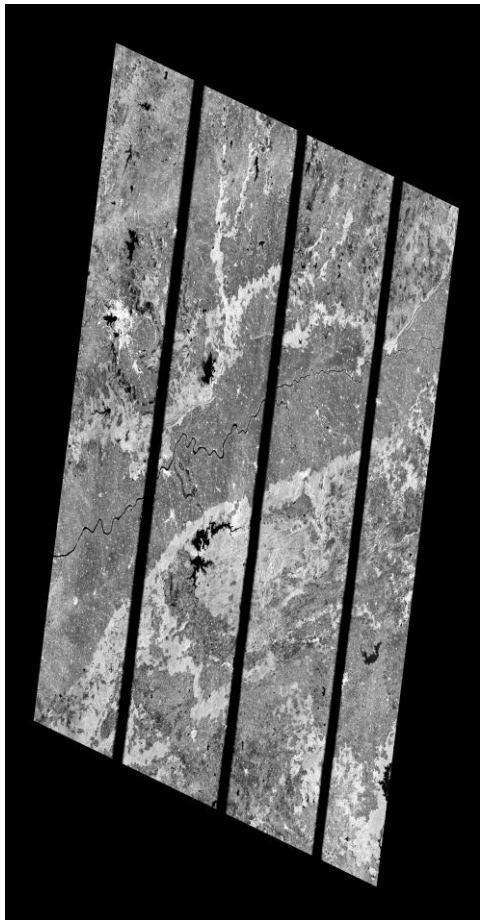
ARD GSLC/GCOV Product
HV -Polarization

HH-HV Data Narmadapuram (Hoshangabad) MP, India DOP: 21 Nov. 2025 Track: 156 Frame: 13 Bandwidth: 37.5 MHz : Ascending Node

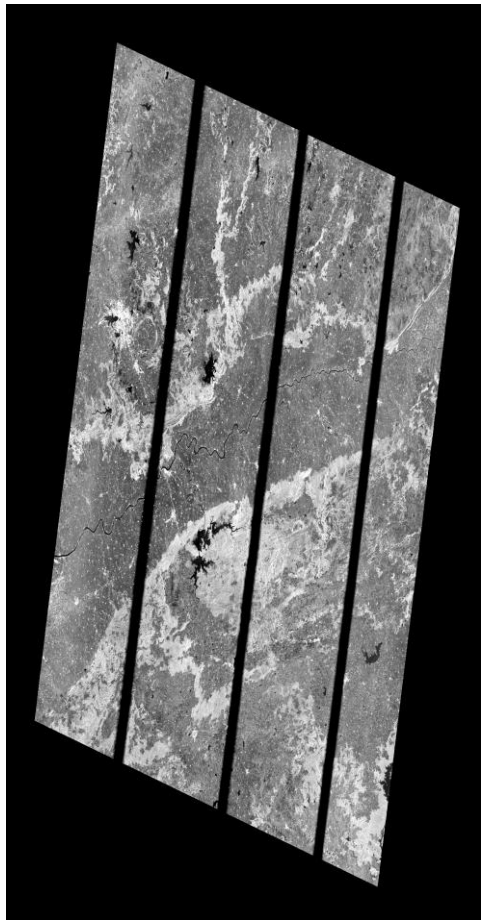
NISAR S-SAR Circular Pol (RH-RV) Sample Data Products



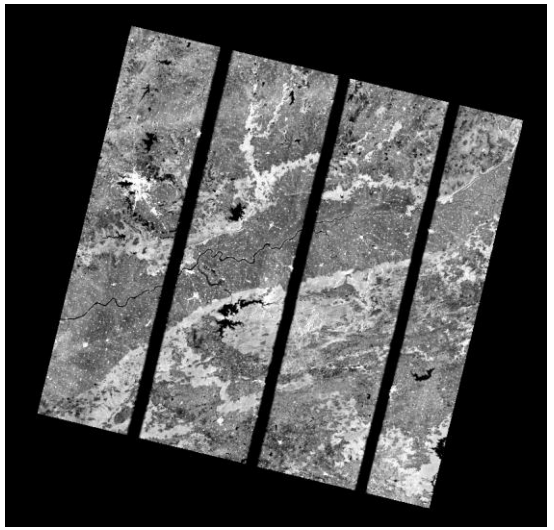
RSLC Product
RH -Polarization



ARD GSLC Product
RH -Polarization

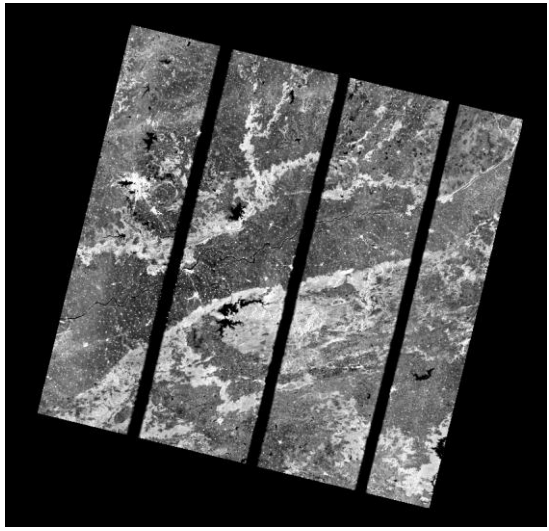


ARD GSLC Product
RV -Polarization



ARD GCOV Product
RH -Polarization

Place (Hoshangabad), India
DOP: 02 Feb. 2026
Track: 5 Frame: 77
Bandwidth: 25 MHz
Descending Node

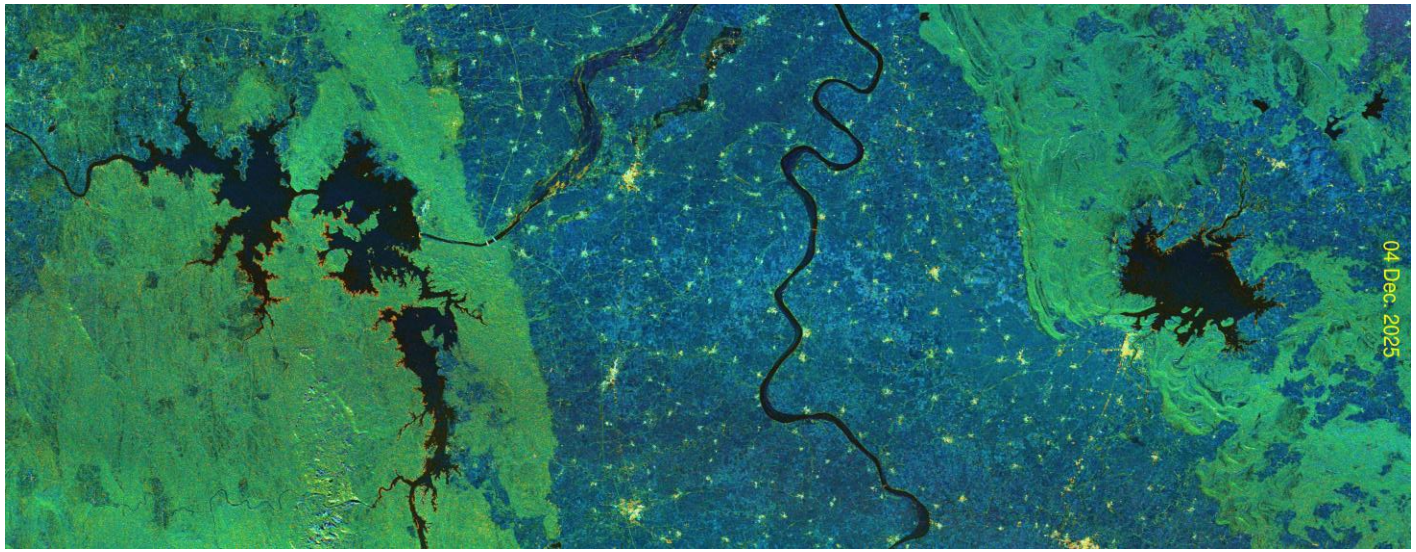


ARD GCOV Product
RV -Polarization

NISAR S-SAR Systematic Coverage over Indian Land-Mass

Ascending Pass (6 am) in Dual Polarization HH-HV Polarizations

HH | HV | HH/HV



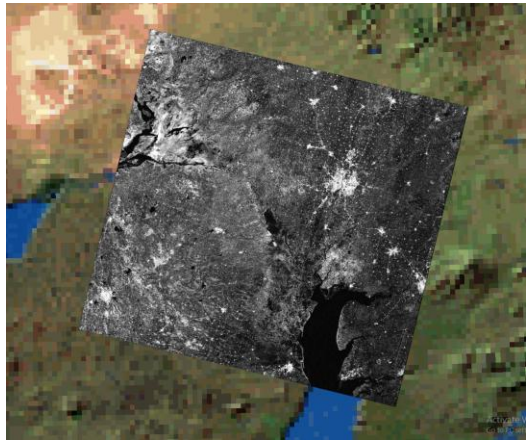
Descending Pass (6 pm) in Circular Polarization RH-RV Polarizations

Even Bounce | Volumetric Scattering | Odd Bounce

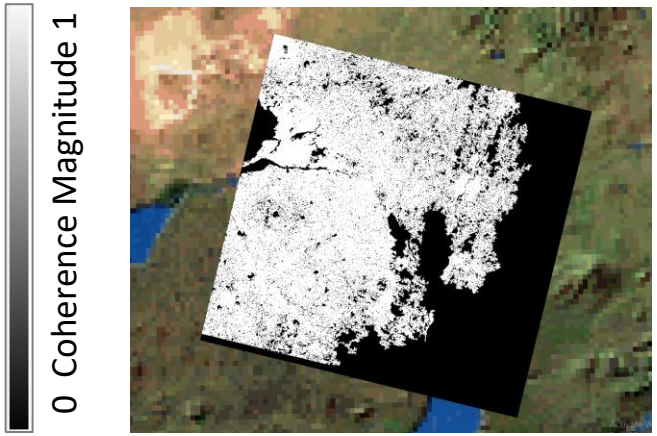
NISAR S-SAR ARD GUNW Sample Data Products

Gujarat, India (Ahmedabad and nearby regions)

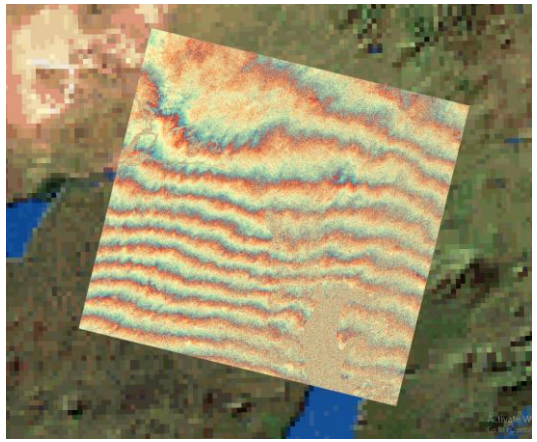
Sensor	NISAR S-SAR
DOP	26th Oct, 7th Nov
Ground Orbit	1278, 1451
RCID	216 (CR)
Track No.	135
Frame No.	77
Parll. Baseline	~ 46.151 m
Perp. Baseline	~ 39.736 m
Polarization	RH



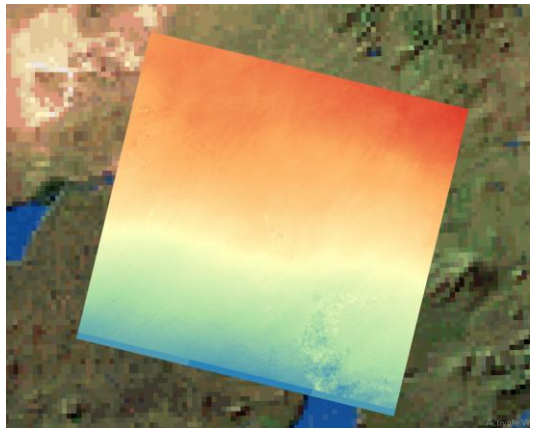
Coherence Magnitude



Connected Components

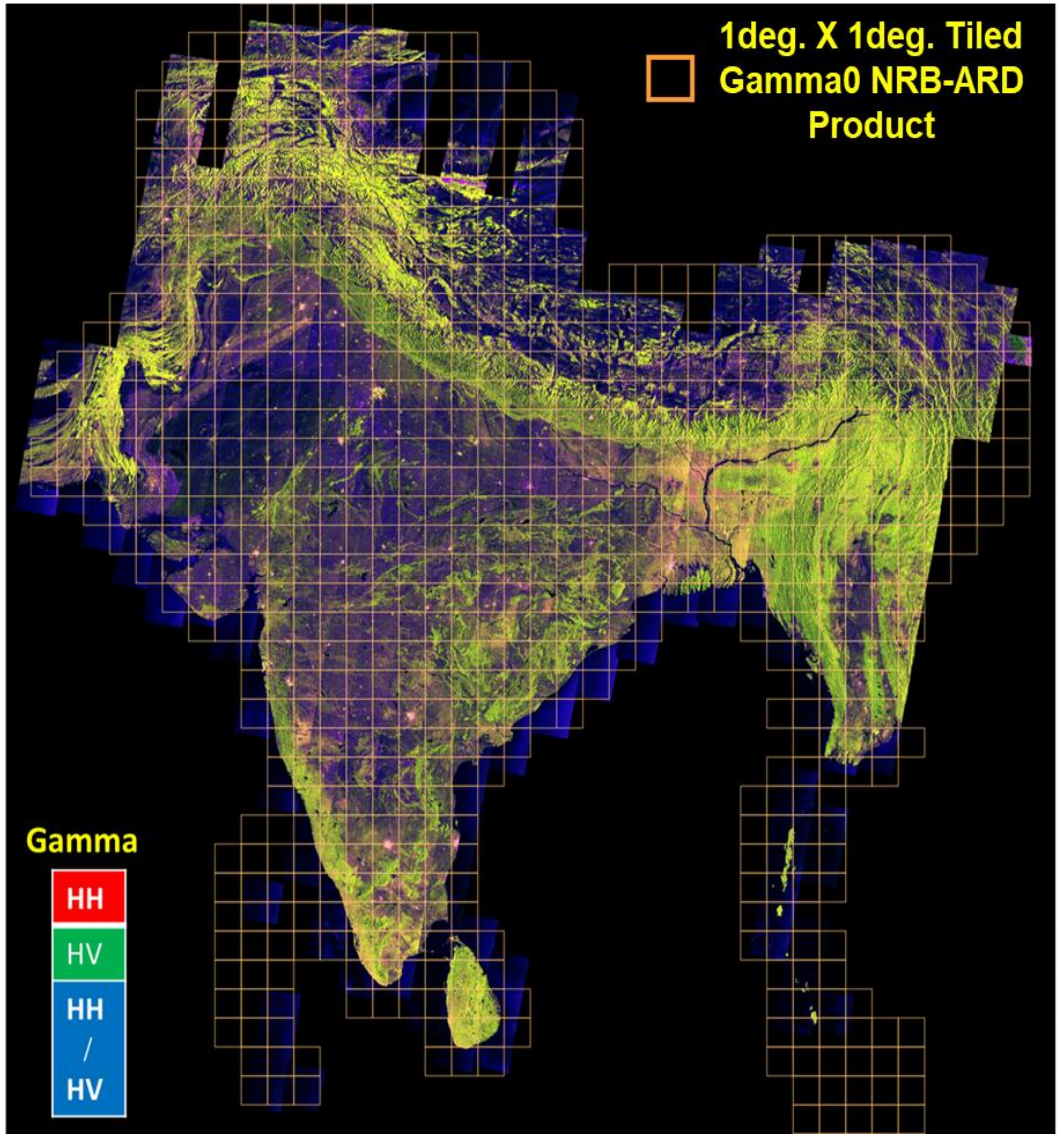


-3.141 Wrapped Phase (radian) 3.141



-19.327 Unwrapped Phase (radian) 75.398

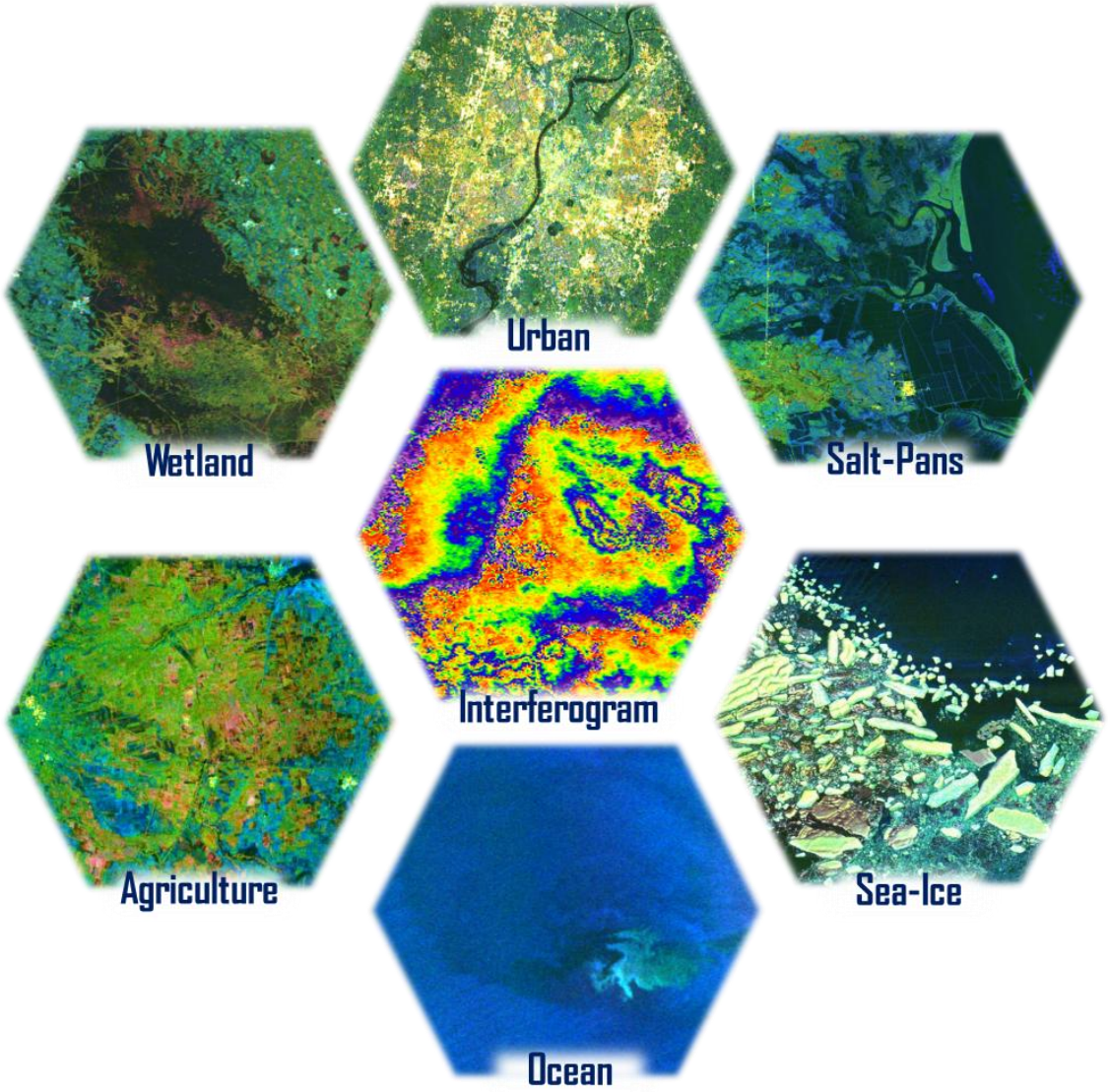
NISAR L and S Band India Mosaic ARD Product (Level-3)



Specifications 1^0 X 1^0 Tiles for NISAR India Mosaic ARD Product	
Total No. of Tiles (India Mosaic Product) per cycle (12 days)	809
Layers per Tile Product	**6** : HH-HV RTC Gamma0, LIA, Area, Mask, Date
Node/Look	Ascending/Left
Tile Spacing (Geographic Lat-Lon)	$=0.00018178512^0$ (for 20 m pixel size)
Volume per Tile Product	508 MB
Format of tile Product	Cloud Optimized GeoTIFF (COG)
Mask, Date	Unsigned Short Int 16
Gamma0, Area , LIA	Float32
Products Repository	
https://bhoonidhi.nrsc.gov.in	

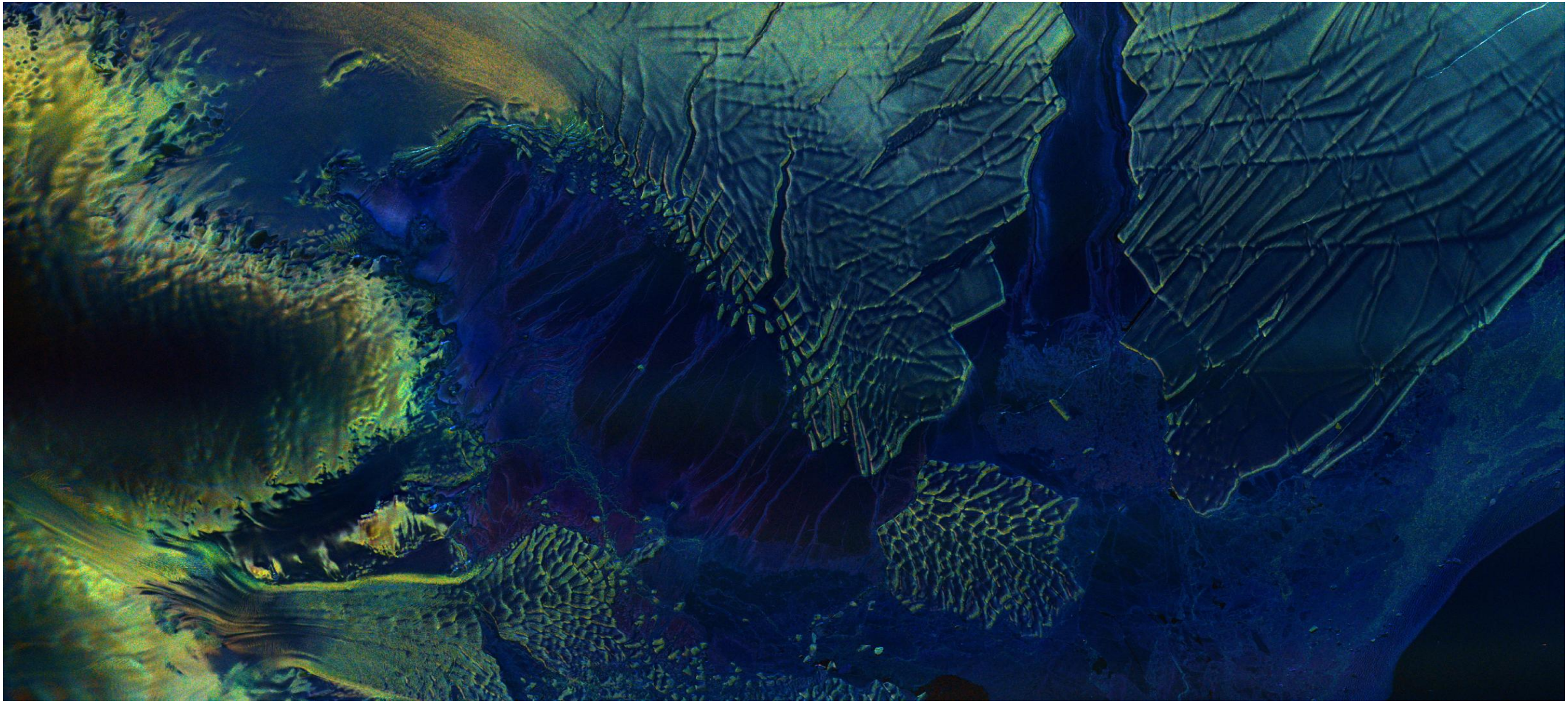
Product Contents
ASCII Meta Parametrs file
Per Pixel HH Polarization RTC Gamma0
Per Pixel HV Polarization RTC Gamma0
Per Pixel Normalization Area for RTC
Per Pixel Local Incidence Angle
Per Pixel Layover-Shadow Mask
Per Pixel Acquisition Date (relative date offset from first cycle day 23rd September, 2025 : 00:00:00 UTC)
Meta XML as per CEOS ARD NRB PFS specifications
Decimated Tile Browse Geo png in gray scale
Decimated Tile Browse Geo png in rgb
Tile Google Earth kmz file

NISAR Level-4 Application Data Products



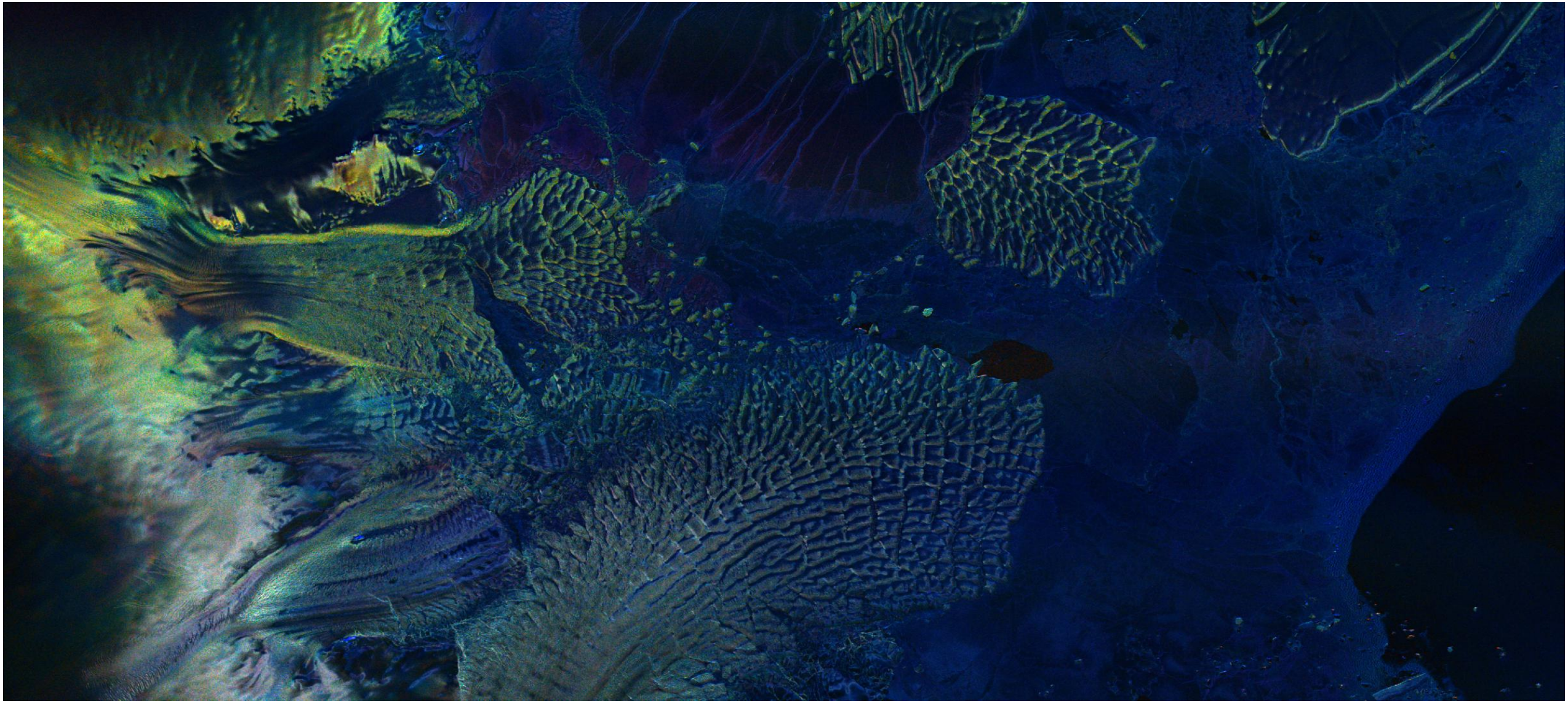
1.	High Resolution Soil Moisture
2.	Surface water extent product
3.	Ocean surface wind
4.	Wet Snow Cover Products over Himalayan region
5.	Glacier facies over Himalayan –Karakoram (H-K) regions
6.	Active Crop Map
7.	Forest Above Ground Bio-mass
8.	Forest disturbance maps
9.	Mangrove extent for Indian coastal region
10.	Ice velocity fields over H-K regions
11.	Ice velocity fields over Antarctica
12.	Oil Spill

NISAR S-SAR Antarctica Acquisition DOP: 11th Feb 2026
RH-RV Polarization



Even Bounce | Volumetric Scattering | Odd Bounce

NISAR S-SAR Antarctica Acquisition DOP: 11th Feb 2026
RH-RV Polarization



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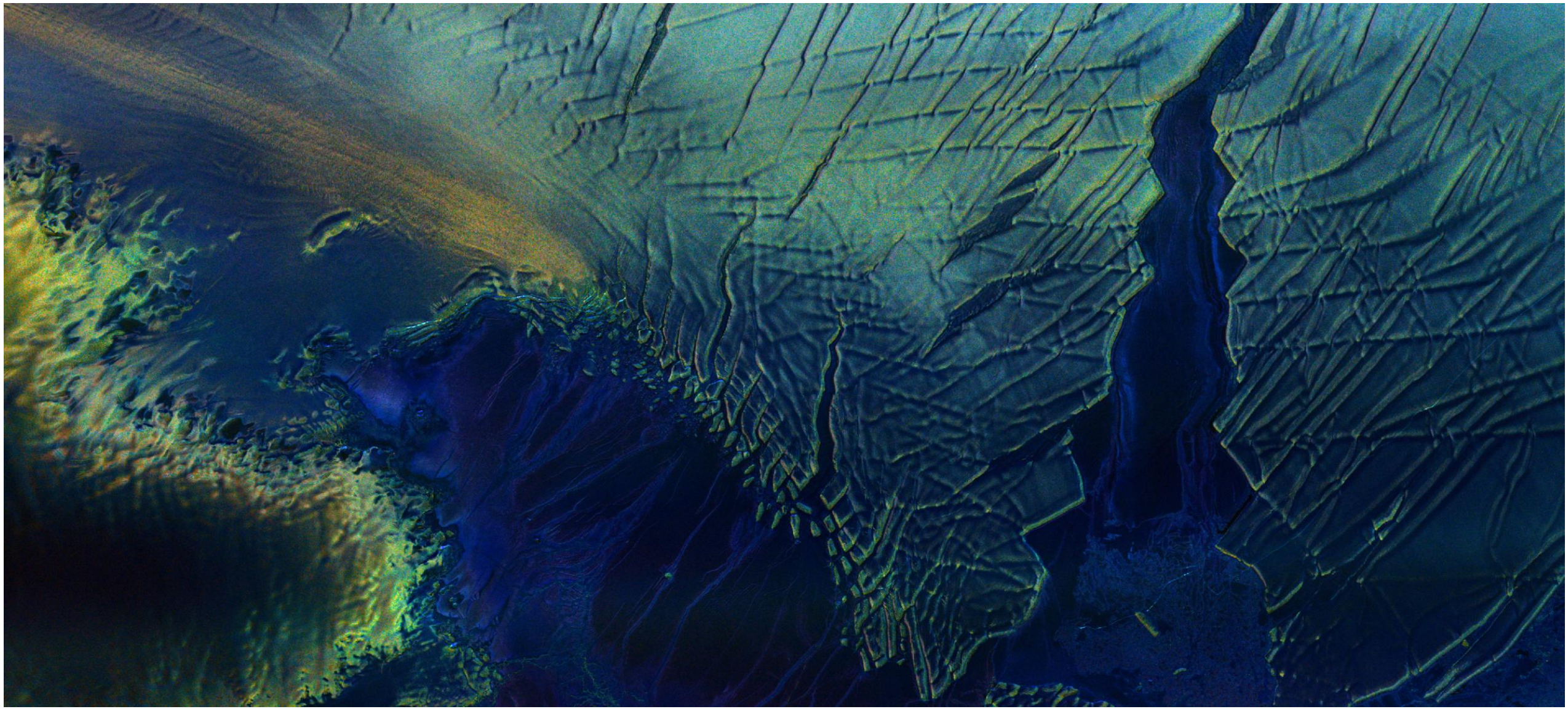
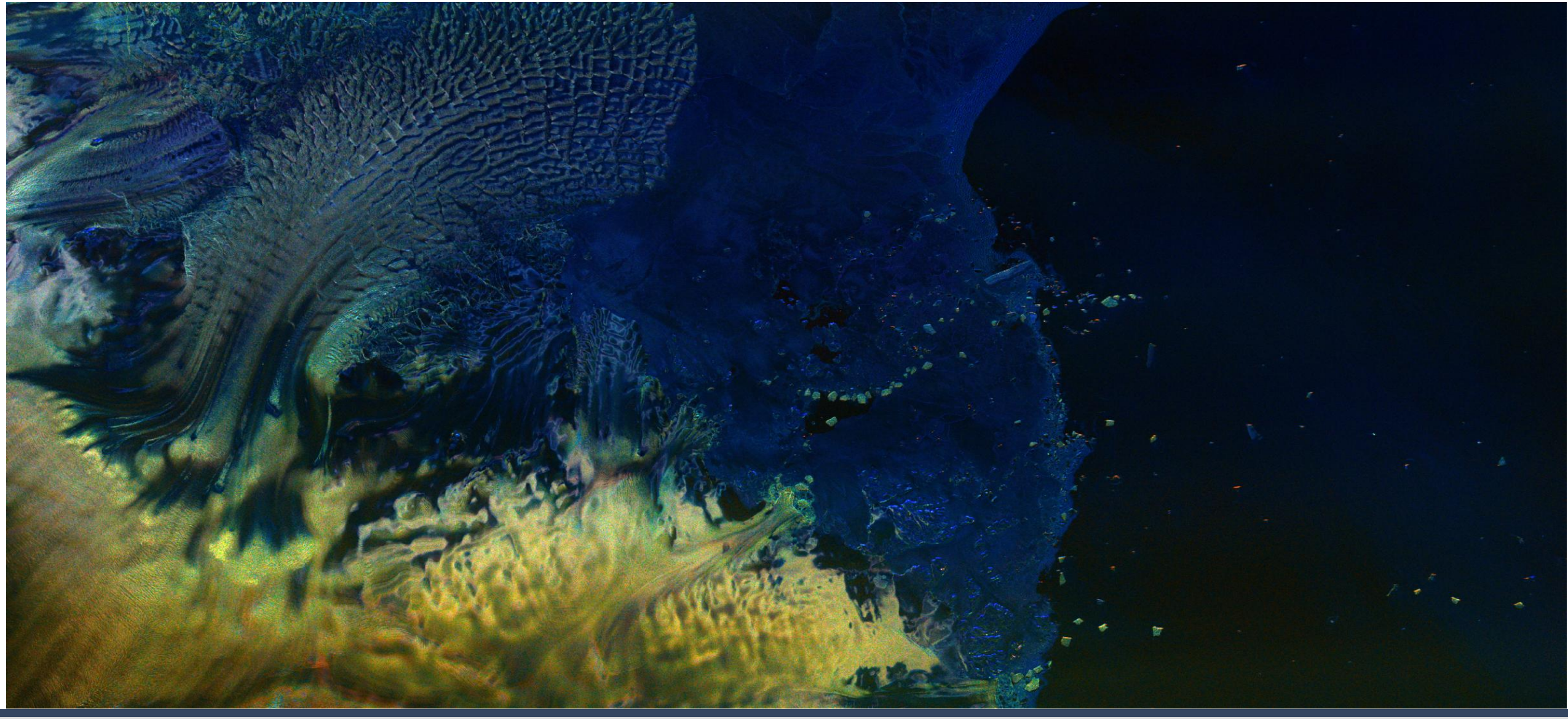
NISAR S-SAR Antarctica Acquisition DOP: 11th Feb 2026
RH-RV Polarization



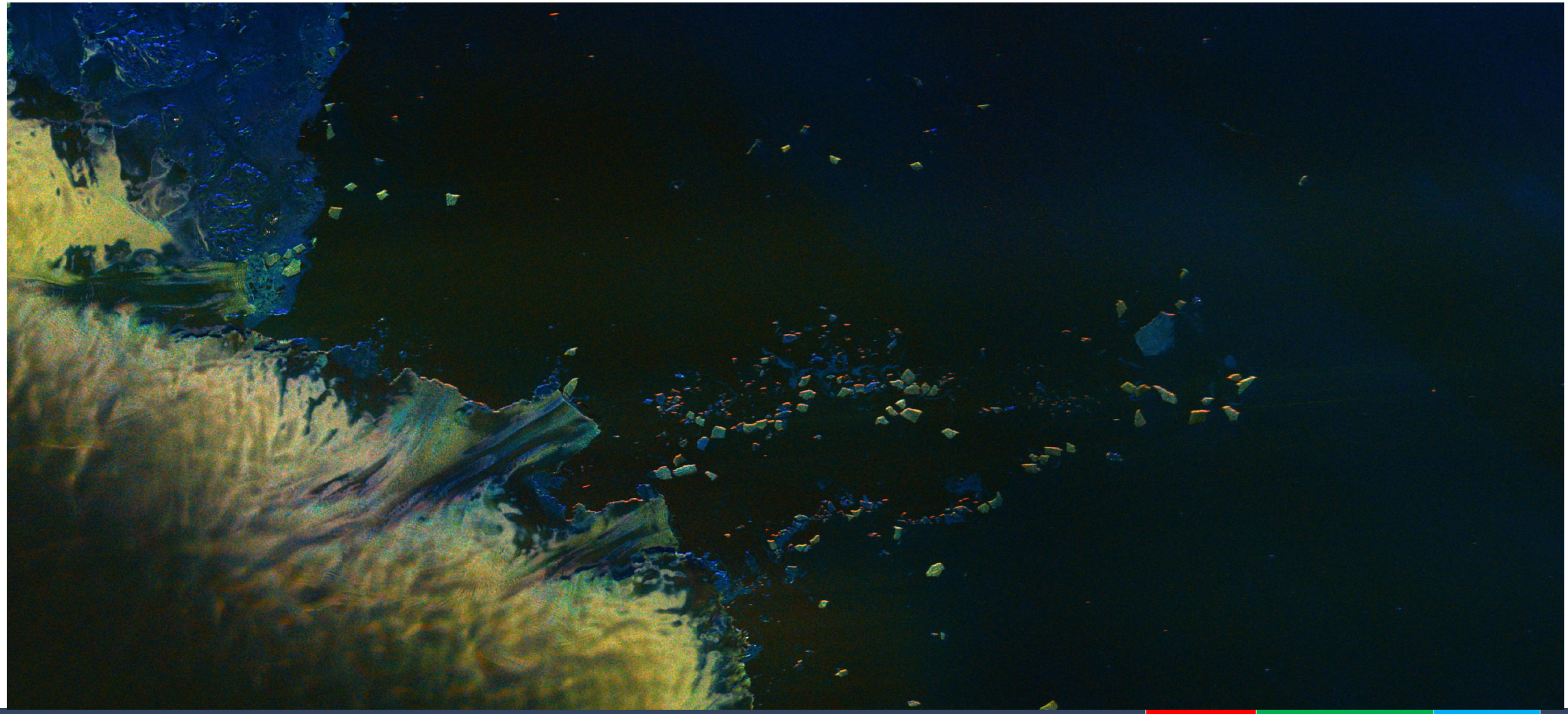
Even Bounce | Volumetric Scattering | Odd Bounce

NISAR S-SAR Antarctica Acquisition DOP: 11th Feb 2026
RH-RV Polarization



Even Bounce | Volumetric Scattering | Odd Bounce

NISAR S-SAR Antarctica Acquisition DOP: 11th Feb 2026
RH-RV Polarization



Even Bounce | Volumetric Scattering | Odd Bounce

Thank You