
Jet Propulsion Laboratory
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SAR Satellites including the NASA-ISRO SAR Mission
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with NISAR slides from
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2025 EarthScope InSAR Processing and Analysis (ISCE+)
online
August 21 , 2025
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Classic SAR satellites

	repeat cycle (days)	wave-length (cm)
European ERS-1/ERS-2 '92-'01(-2011)	35 (1,3,183)	6
Canadian Radarsat-1 1995-2013	24	6
European Envisat '03-Sep.'10('10-Apr.'12)	35 (30)	6
Japanese ALOS Jan. 2006–Apr. 2011	46	24
German TerraSAR-X '07, TanDEM-X '10	11	3
Italian COSMO-SkyMed 4x launched '07-'10	16 (1,4,7,8)	3
Canadian Radarsat-2 launched Dec. 2007	24	6

SAR satellites processing

	Modes	ISCE2 processing support?
ERS-1/ERS-2	1 strip map	yes raw, SLC
RADARSAT-1	7 standard strip 5 fine strip ScanSAR	strip: maybe CEOS raw ScanSAR: no
Envisat	7 standard strip (IM) ScanSAR (WS)	strip: yes raw, SLC ScanSAR: no
ALOS	strip FBS, FBD, POL ScanSAR	strip: yes raw, SLC ScanSAR: no
TerraSAR-X, PAZ	strip ScanSAR Spotlight	strip: SLC ScanSAR: no Spotlight: SLC
COSMO/SkyMed	strip, ScanSAR, Spotlight	strip: raw, SLC Spotlight: SLC
RADARSAT-2	strip (4 types), ScanSAR, Spotlight	strip: SLC Spotlight: ?

other SAR spacecraft

	repeat cycle (days)	wave-length (cm)
US SeaSat 1978 (110 days)	17/3	24
Japanese JERS-1 1992-1998	44	24
US Shuttle Imaging Radar–C (SIR-C) 1994 (2x 10-day flights)	1 day, 6 months	3, 6, 24

new SAR spacecraft

satellite (launch or planned)	repeat cycle (days)	wave-length (cm)
Copernicus Sentinel-1 (A: Apr. 2014, B: Apr. 2016–Dec. 2021, C: Dec. 2024)	12(6)	6
Japanese ALOS-2 (May 2014)	14	24
Indian RISAT-1 (Apr. 2012)	25	6
NASA-ISRO SAR (NISAR) mission (July 2025)	12	12,24

New SAR satellites processing

	Modes	ISCE2 proc.
Sentinel-1A, B, C	stripmap TOPS	strip: SLC (raw extra work) TOPS: SLC (topsApp.py)
ALOS-2 (alos2App.py, alosStack)	strip (3 types) ScanSAR Spotlight	strip: SLC ScanSAR: full-aperture SLC Spotlight: SLC
RISAT-1	stripmap ScanSAR	strip: SLC, raw extra work ScanSAR: no

new SAR spacecraft

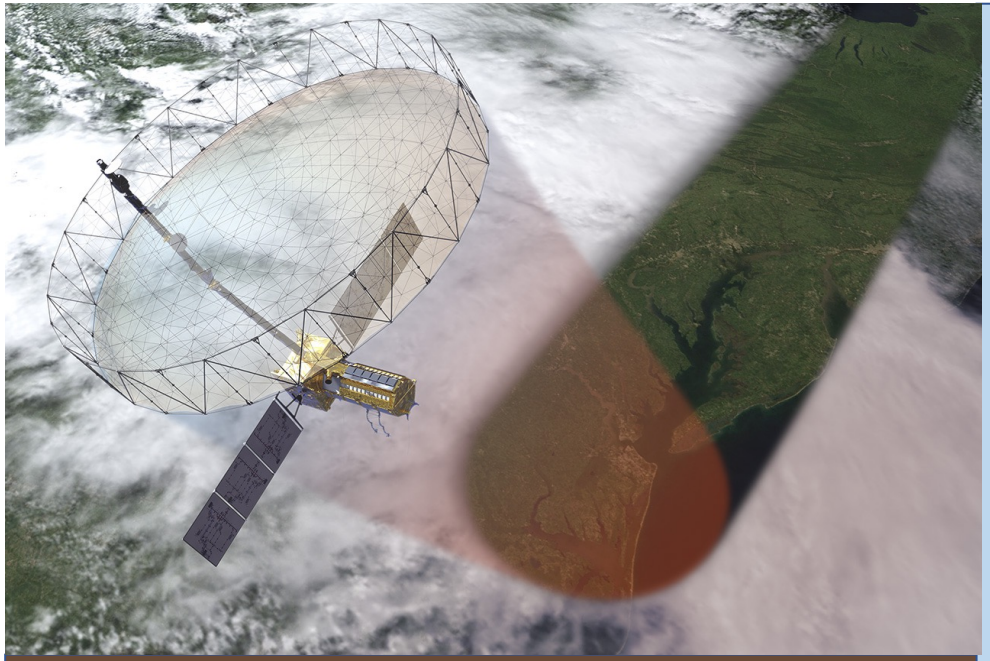
satellite (launch or planned)	repeat cycle (days)	wave-length (cm)
Argentina SAOCOM-1 (A: Oct. 2018, B: Aug. 2020)	16(8)	24
Japanese ALOS-4 (June 2024)	14	24
Italian COSMO-SkyMed 2nd Gen. (1: Dec. 2019, 2: Jan. 2022, 3:, 4:)	N/A	3
Canadian RADARSAT Constellation Mission 3x (Jun. 2019)	4	6

More new SAR spacecraft

Satellite (launch or planned)	Repeat cycle (days)	Wavelength (cm)
South Korea KompSat-5 (2013-2022)	16(8)	3
Spanish PAZ (clone TerraSAR-X) (Feb. 2018)	11 (4,7)	3
Capella-1 through -n (2018–present) adding InSAR-capable	?	3
ICEYE ~44 satellites now (in Jan. 2025) some satellites have 1-day separation	1	3
Umbra 24 satellites planned (first launched 2021), no InSAR yet	N/A	3
Several other countries and companies have launched SAR and InSAR-capable satellites		

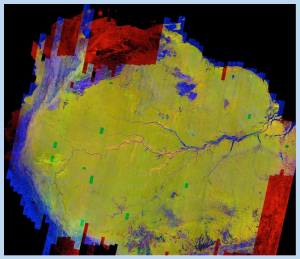
NISAR Science and Applications

Understanding Climate, Carbon, and Catastrophic Change
Resource Management



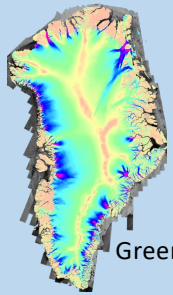
Global systematic, all-weather, day-night, time-series measurements of surface deformation and change

Global Biomass Dynamics



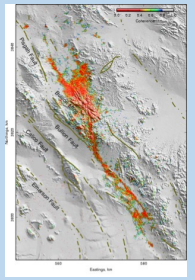
Amazonia

Global Ice Dynamics



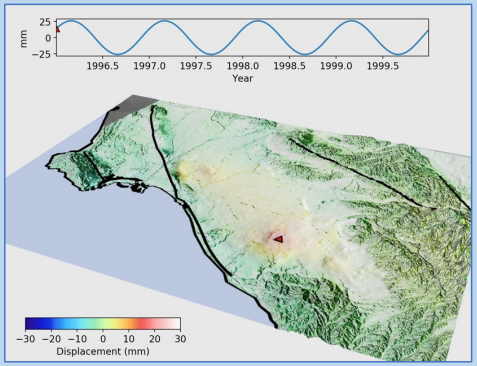
Greenland

Global Hazards

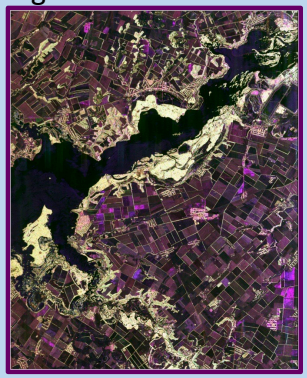


Earthquake damage

Aquifer Health



Agriculture



It is time to get ready

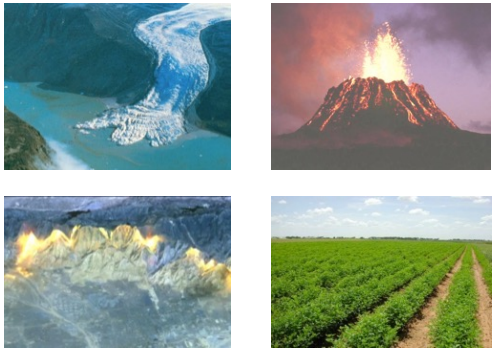
- NISAR launched July 30, 2025!!
- First light images ~2 months after launch
- Science operations 3 months after launch
- Global products to Level 2 will be fully and openly available to the global community
- Broad scientific and applied uses
- Cloud-based data, tools and services will facilitate access and use
- Data processed and stored in Amazon cloud (AWS)

For more information: ***https://science.nasa.gov/mission/nisar/***
News updates: ***https://science.nasa.gov/blogs/nisar/***

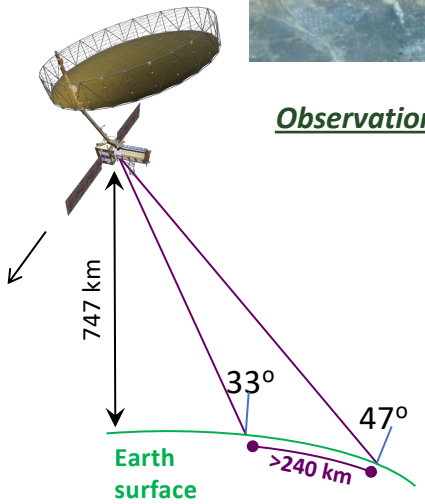
NISAR Science Observation Summary

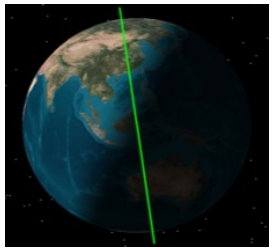
NISAR Characteristic:	Would Enable:
L-band (24 cm wavelength)	Low temporal decorrelation and foliage penetration
S-band (9.4 cm wavelength)	Sensitivity to light vegetation
SweepSAR technique with Imaging Swath > 240 km	Global data collection
Polarimetry (Single/Dual/Quad)	Surface characterization and biomass estimation
12-day exact repeat	Rapid Sampling
3 – 10 meters mode-dependent SAR resolution	Small-scale observations
3 yrs (NASA) / 5 yrs (ISRO) science operations	Time-series analysis
Pointing control < 273 arcseconds	Deformation interferometry
Orbit control < 500 meters	Deformation interferometry
> 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 Will Uniquely Capture the Earth in Motion



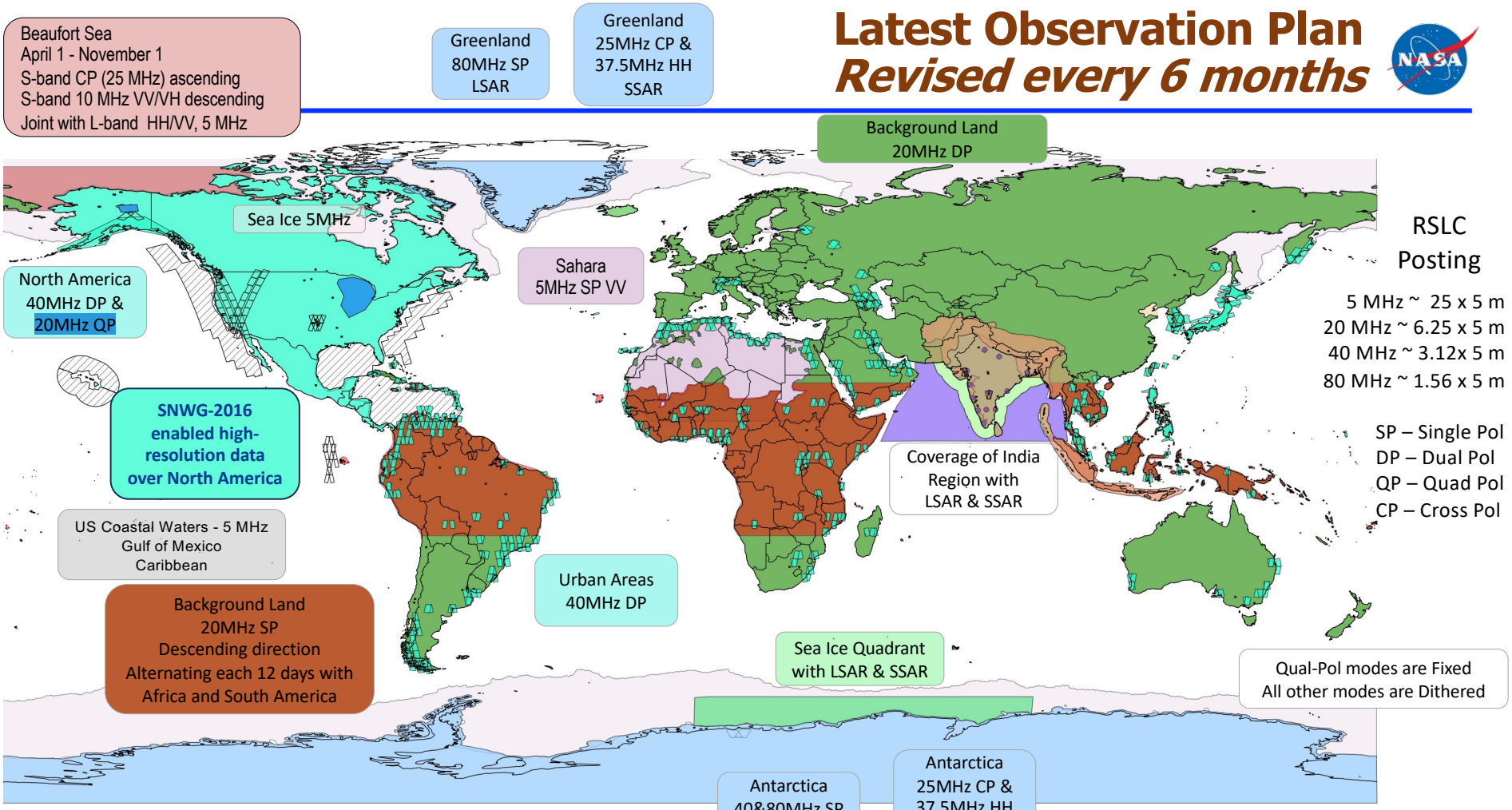
Observation Geometry





6 AM / 6 PM

Latest Observation Plan
Revised every 6 months

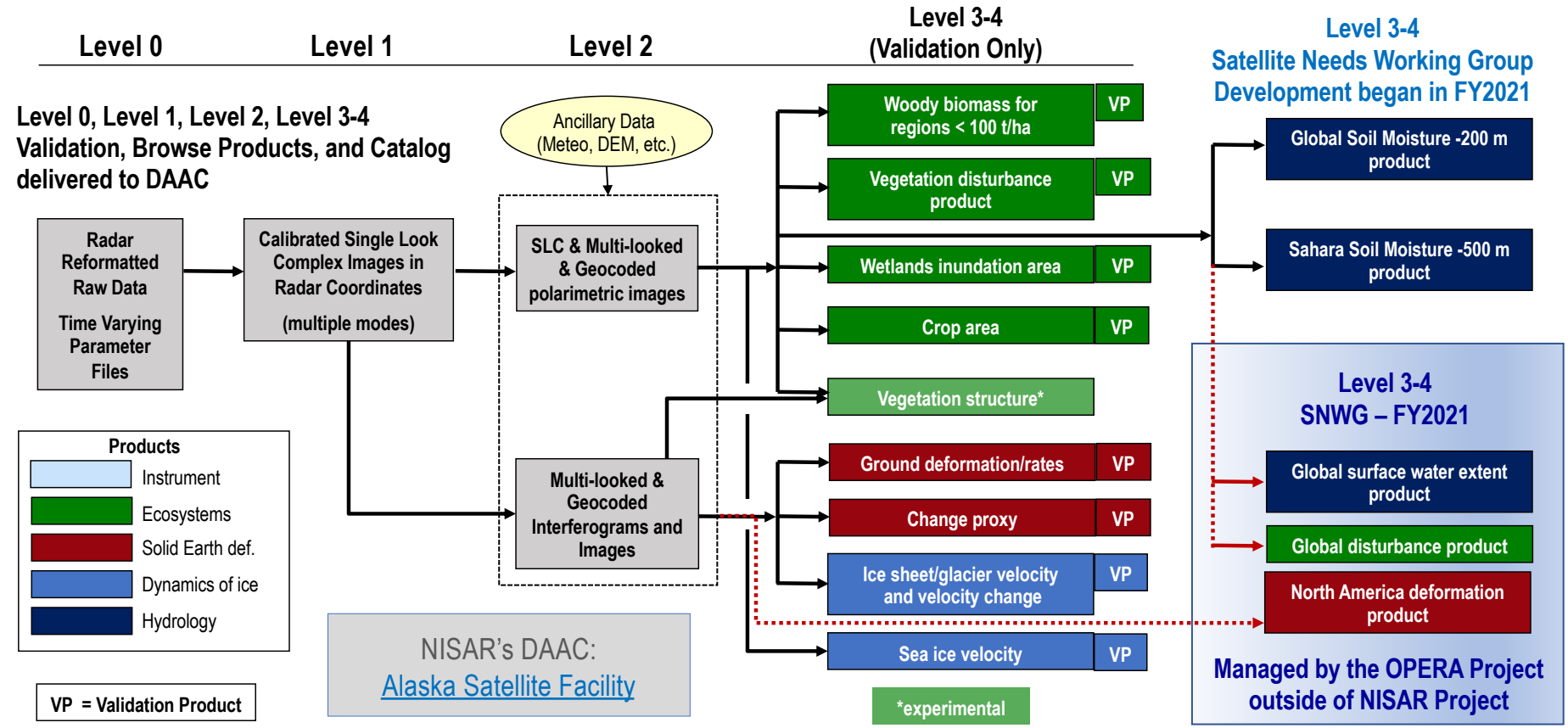


RSLC Posting

5 MHz ~ 25 x 5 m
20 MHz ~ 6.25 x 5 m
40 MHz ~ 3.12x 5 m
80 MHz ~ 1.56 x 5 m

SP – Single Pol
DP – Dual Pol
QP – Quad Pol
CP – Cross Pol

NISAR Science Data Analysis and Archive Approach



Open-Source Science for NISAR

- Post-launch Science products
  - ASF Vertex searchable after 2-3 months after launch
  - NISAR HDF5 specification: https://science.nasa.gov/mission/nisar/data/
  - NISAR-format sample data from other SAR https://science.nasa.gov/mission/nisar/sample-data/
- Open Source Software – SDS and data processing code available for download
  - InSAR Scientific Computing Environment, Enhanced Edition (ISCE3): https://github.com/isce-framework/isce3
- Open Source Science algorithms for science products
  - Jupyter notebooks available for download: https://gitlab.com/nisar-science-algorithms
- Open Source Training Opportunities
  - Jupyter notebooks in cloud training environments at Alaska Satellite Facility OpenScienceLab
  - ARSET and other courses: https://science.nasa.gov/mission/nisar/sar-education-resources/
  - Cloud computing resources for NASA subscribers