Welcome to the EarthScope Geodetic Imaging (WInSAR) Lunch

December 11, 2024

NSF USGS NASA GAGE SAGE Operated by EarthScope Consortium

Reminder: WInSAR Dissolution

As part of formation of EarthScope & streamlining of governance, WInSAR dissolved as a consortium within the consortium.

Recommendations:

- Make WInSAR an integral part of EarthScope, rather than a separate consortium.
- Expand vision to include “geodetic imaging” more generally.
- Improve community activities with an eye toward inclusion and equity.
- Unify data access with other EarthScope systems.
- Enable archiving & DOIs for time series and other derived products
- Enhance SSARA for federated search.
- Advocate for open data, talk to commercial SAR operators about access to archival data.

2022 Townhall Report: https://docs.google.com/document/d/14K60OsPgZXrGaxnSaAiQEgpI2YXy8dHqYPn7-5dpGpY/edit?usp=sharing

Post-WInSAR

Practical Implications:

DPSAC provides governance for SAR / geodetic imaging activities at ES.

Rebranding and web-content updates to merge WInSAR-related pages into the EarthScope website.

Revisit license terms with space agencies for existing data.

Data Products and Services Advisory Committee

The Data Products and Services Advisory Committee advises on data and metadata distribution, standards, and quality for all geophysical data and data products in EarthScope Consortium's Data Services.

Member/Organization	Term Start/Term End
Angelyn Moore (Chair) Jet Propulsion Laboratory/Caltech	January 2023/December 2024
Jonathan Ajo-Franklin Rice University	January 2023/December 2023
Noel Bartlow University of Kansas	January 2023/December 2024
Frossie Economou LSST (Vera C Rubin Observatory)	January 2023/December 2024
Mike Floyd Massachusetts Institute of Technology	March 2023/December 2025
Ved Lekić University of Maryland	January 2023/December 2023
Eric Lindsey University of New Mexico	January 2023/December 2023
Natalia Ruppert Alaska Earthquake Center, UAF	March 2023/December 2025
Zack Spica University of Michigan	March 2023/December 2025
Tonie van Dam (BoD Liaison) University of Utah	January 2023/December 2023

The Future of WInSAR

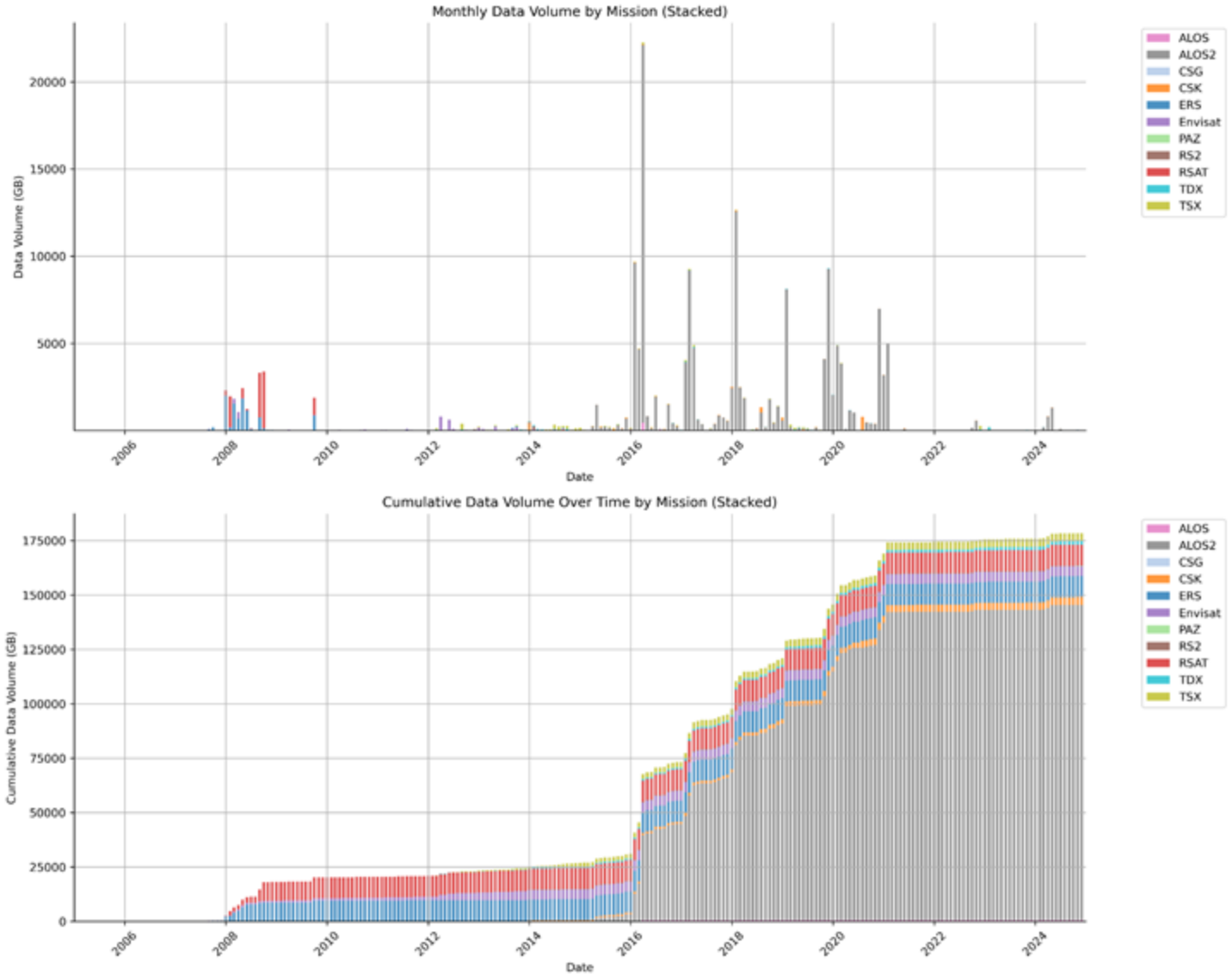
GAGE and other awards to EarthScope will provide support for the following previously WInSAR-branded activities:

1. InSAR short courses (e.g., the InSAR Processing and Theory with GMTSAR, and the InSAR Processing and Analysis (ISCE+) short courses)
2. Annual luncheon at the AGU meeting
3. Data download, storage, and sharing of PI restricted datasets from ALOS-2, TSX, and CSK
4. Seamless SAR Archive tools (SSARA) for federated search and access to SAR data
5. InSAR Product Archive for publication of InSAR pairwise and time series products

Agenda

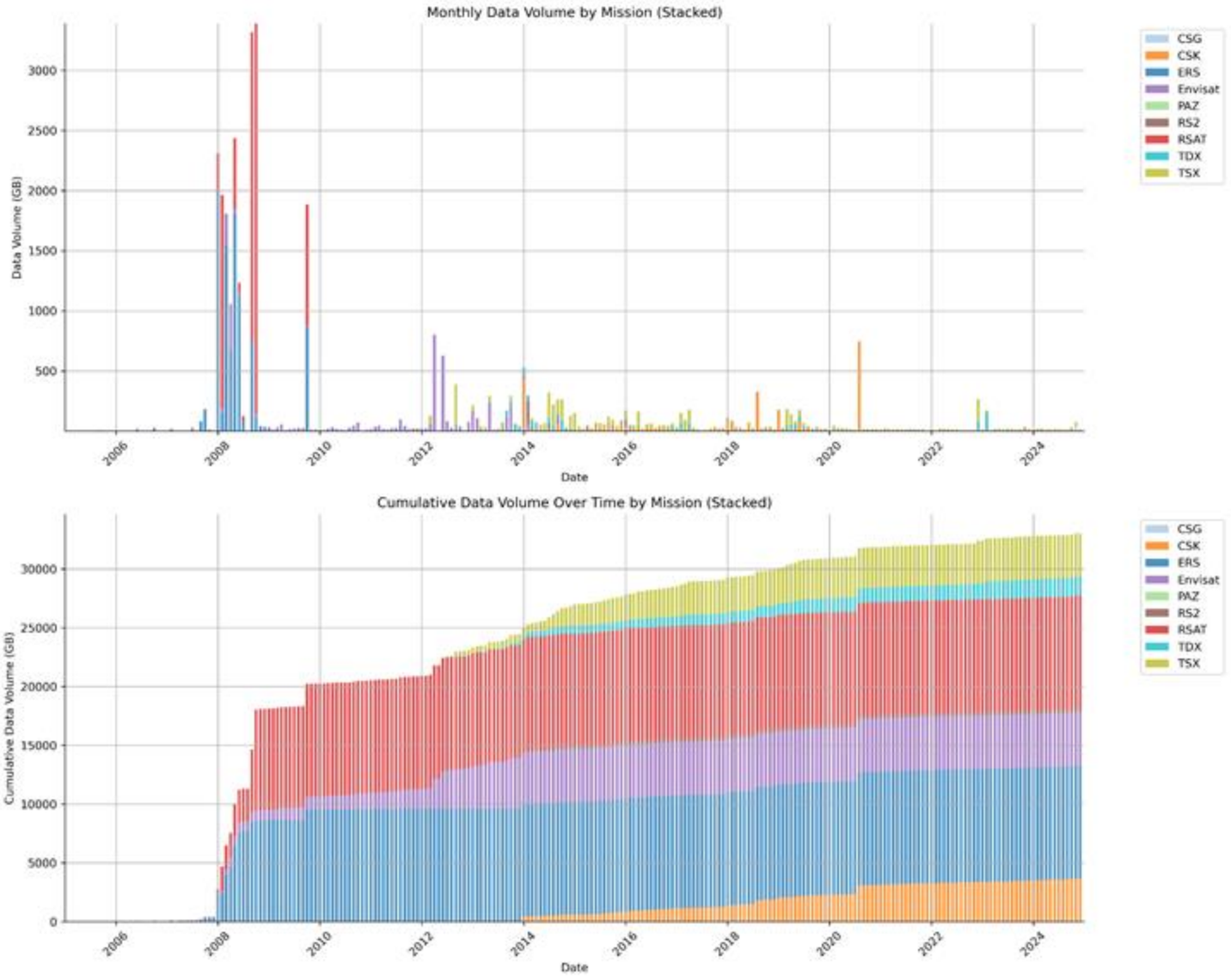
1. Welcome and update from the EarthScope CEO: Rebecca Bendick (EarthScope)
2. Report on EarthScope Geodetic Imaging activities: Chris Crosby (EarthScope)
3. NASA: Gerald Bawden (NASA)
4. ISCE3: Heresh Fattahi (JPL)
5. UAVSAR: Yunling Lou (JPL)
6. ASF: Franz Meyer/Wade Albright (ASF)
7. OPERA: David Bekaert (JPL)
8. JAXA: Yukihiro Kankaku (JAXA)
9. ~~ESA: Nuno Miranda / Claus Zehner (ESA)~~
10. GMTSAR: Xiaohua (Eric) Xu (USTC)
11. GEO Supersites: Patricia Mothes (IGEPN)
12. Discussion / Q&A

Current status of ES SAR archive



- ES Geodetic Imaging program facilitates data downloading, archive and sharing for various SAR missions
- Most SAR data are acquired through PI proposals
  https://winsar.unavco.org/proposals/mine
- > 175 TB

Current status of ES SAR archive



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Major recent updates

- New software tool to download and ingest JAXA ALOS/ALOS-2 data from GPortal
- Updated software tool to download and ingest ASI CSK/CSG and DLR TSX/TDX data
- New software tool to ingest INTA PAZ data
- Migrated the whole software stack for the SAR Portal and SSARA to a new VM on NSF ACCESS Jetstream2 at Indiana University to address **intermittent data corruption issues** related to disk mounting due to older operating system

SSARA

https://web-services.unavco.org/brokered/ssara/

EarthScope Consortium

Welcome to the Seamless SAR Archive (SSARA) Federated Web Service

Service	URL Endpoint	Description
Data Search and Access GUI	/brokered/ssara/gui	GUI map interface to construct federated data queries
SSARA SAR Service	/brokered/ssara/api/sar/search	Delivers SAR granule metadata meeting user specified criteria
SSARA InSAR Service	/brokered/ssara/api/insar/search	Delivers InSAR product granule metadata based on user specified criteria and QC parameters
Select Pairs Service	/brokered/ssara/api/insar/selectpairs	Provides every combination of interferometric pairs for a single InSAR stack base on query input

Please note that some SAR data in the EarthScope Geodetic Imaging archive were acquired through PI's proposals with various space agencies. To access these datasets, you will need to contact the relevant PI for authorization. Login with your EarthScope SAR account to view the complete list of SAR data collections.

Please visit the SSARA repository on Gitlab for an overview of the project, API details, and command line utilities and clients. For questions or assistance, please contact geodeticimaging@earthscope.org.

Short courses

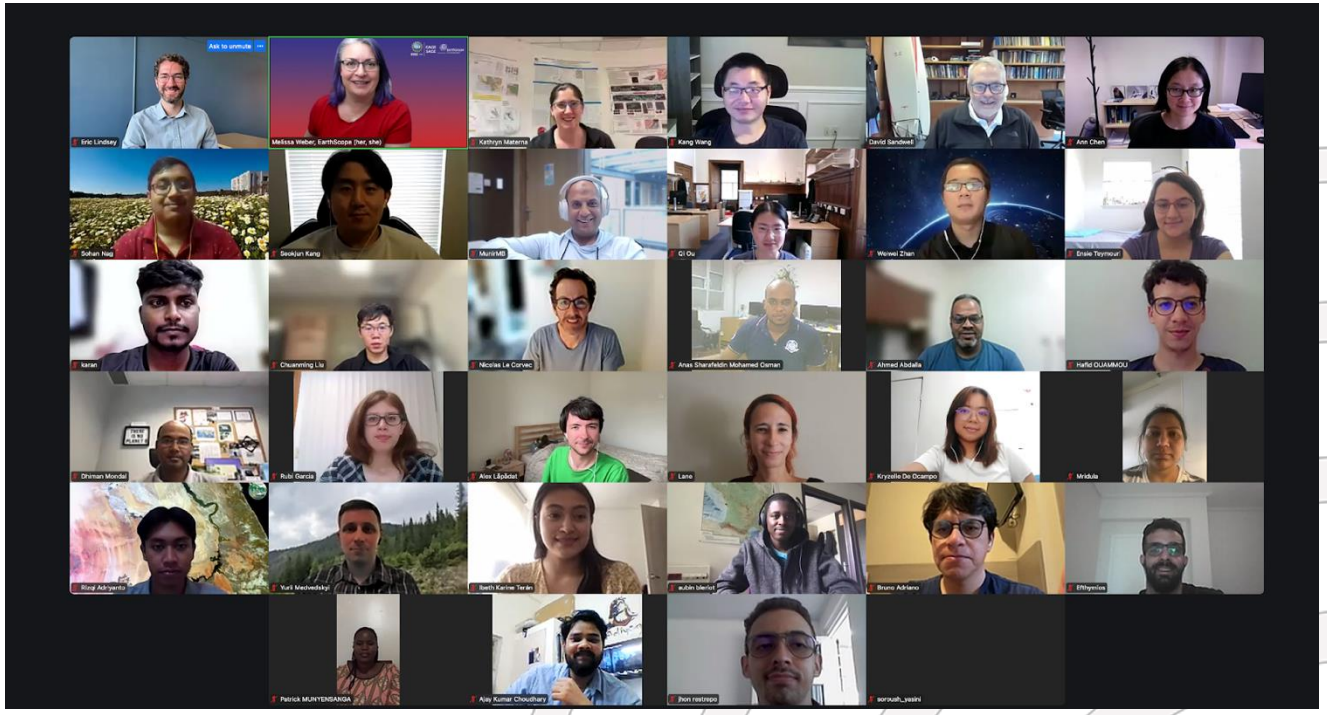
Each year EarthScope facilitates short courses on SAR / InSAR theory and applications.

Virtual. Taught by members of the community.

GMTSAR (~100 students)

ISCE (~66 students)

Hundreds of applications. International cohort.



Future work

- New web design transitioning WInSAR to ES Geodetic Imaging
- New architecture for user registration/authentication and data sharing
- New site endpoints (URLs) to align with other ES web services
- New module for archive and publication of data products (e.g., Interferogram and InSAR time series) from the community

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National Aeronautics and
Space Administration

NASA
earth

NASA's Geodetic Imaging Program

NISAR, SDC, UAVSAR➔AirSAR-NexGen, OPERA, International SAR

Gerald Bawden, Ph.D.

Program Scientist

Earth Science Division

AGU24
Washington, D.C. | 9–13 December 2024
WHAT'S NEXT FOR SCIENCE

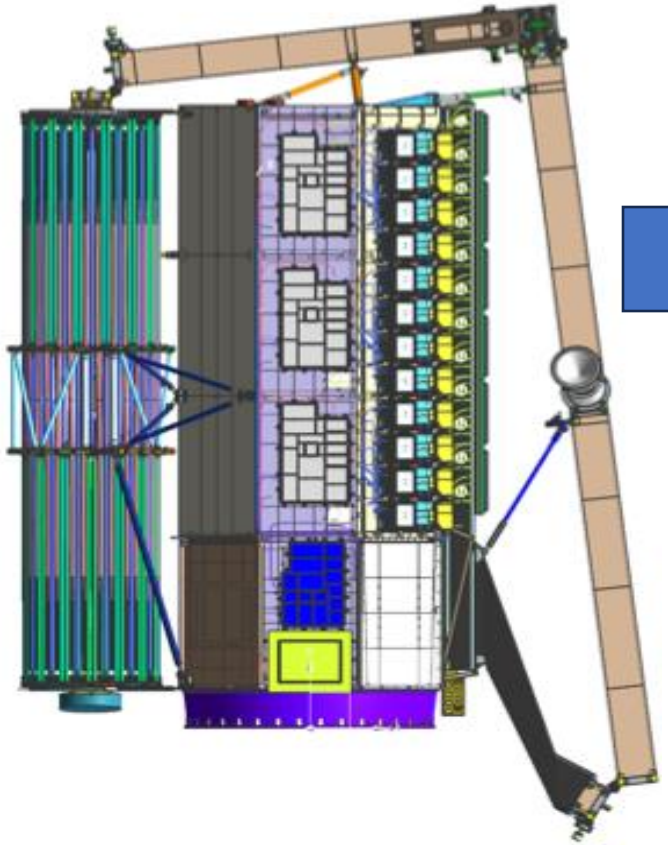
EarthScope (Formerly WInSAR)

The NISAR Mission Is Ready to Launch

Launch Window Opens Late March 2025

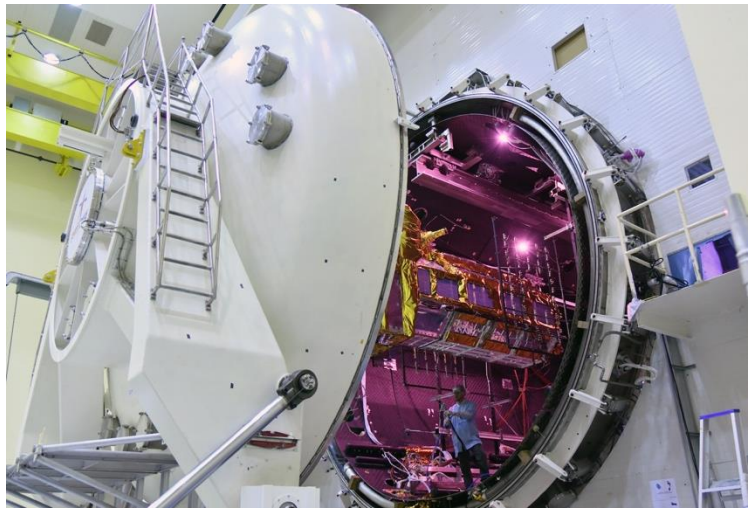
- **NISAR is 100% fully integrated and tested**
- NISAR is in storage at ISRO's ISITE facility in Bengaluru, India
- NISAR will launch from ISRO's Satish Dhawan Space Center – SHAR
- ISRO's NVS-02 launch is scheduled in mid-January, ahead of NISAR
- ISRO will need to prepare the launch pad
- Based on current estimates, NISAR's launch window opens in late March 2025
- Day 48: Science orbit obtained
- Day 65: First light images
- Day 91: Science operations start
- NISAR ROSES solicitation released

NASA – ISRO Partnership – Concept to Reality



Courtesy: ISRO ISITE
Chaitra Rao, NISAR PM

Changes to the Radar Reflector Array in 2024



https://www.isro.gov.in/NISARNASA.html

Courtesy: ISRO ISITE
Chaitra Rao, NISAR PM

SDC – Repeat-pass InSAR after NISAR
Phase A start uncertain

EARTH SYSTEM OBSERVATORY

LD
Low Duty-Cycle

MS
Multi-squint

RL
ROSE-L Augmentation

SD
Sub-Daily

SS
Split-Swath

September 2023 NASA HQ Guidance:
- **Complete architecture trade study in mid-2024**
- **Continue NISAR lessons learned planned activities**
- **Continue collaboration study with ESA on ROSE-L**

Study Recommendation
End of FY25

NASA dispositions SDC with respect to Decadal Survey
FY26

Decadal Survey
FY27

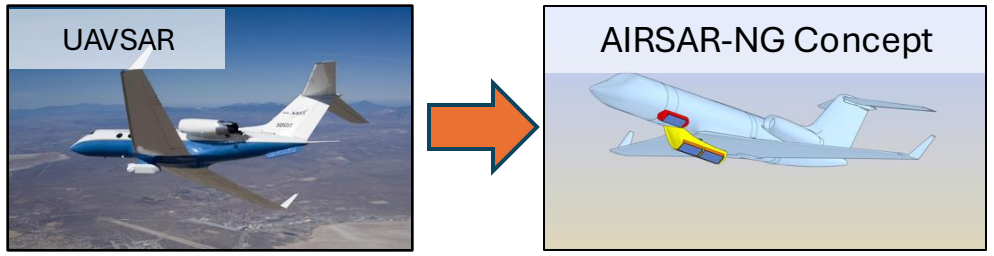
SDC
Mission Concept Review
FY27-FY28

SDC Architecture Recommendation Goals:
- **Lay the groundwork to facilitate NASA decisions**
- **Position support for SDC confirmation in the 2027 Decadal Survey**
- **Determine if geodetic or phase + backscatter is best fit**

UAVSAR Modernization ➔ AIRSAR-NexGen

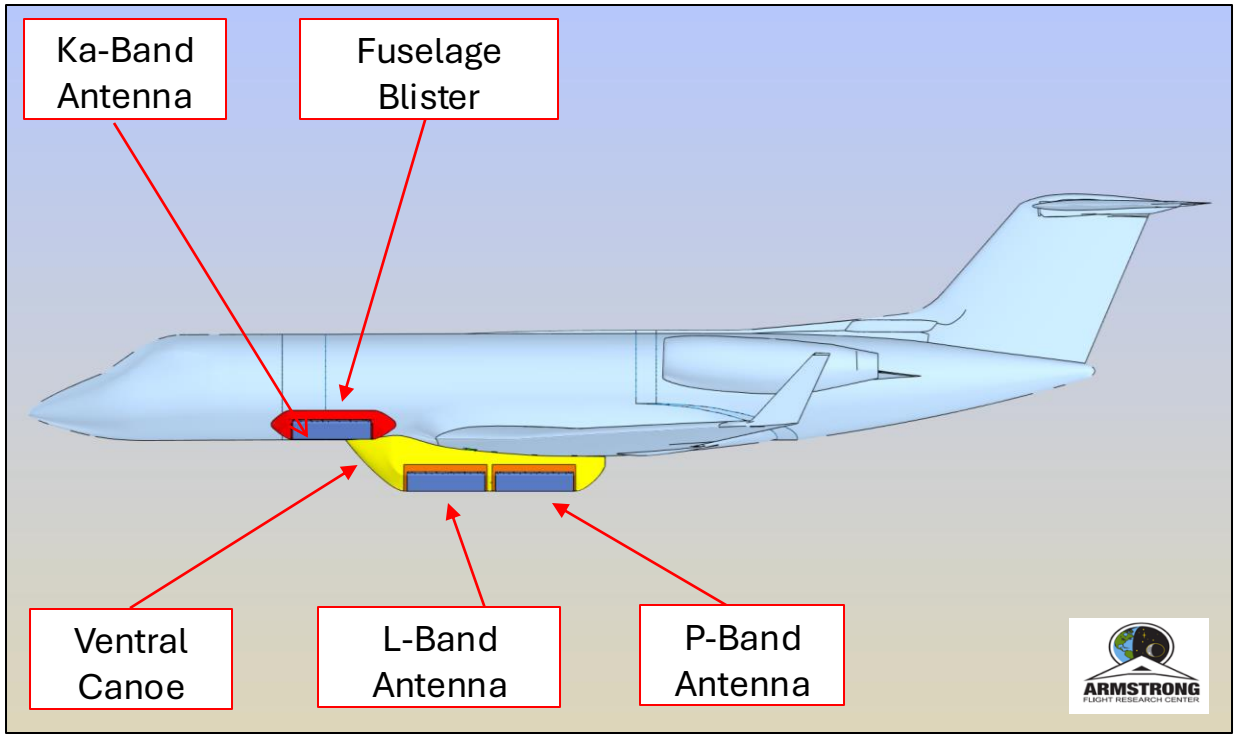
- Maintain current capabilities of UAVSAR (P, L, Ka-band)
- Simultaneous P- and L-band repeat-pass PolInSAR for vegetation structure and soil moisture studies
- Option for simultaneous L- and S-band repeat-pass PolInSAR to simulate/cross-calibrate with NISAR
- Option to add stereo optical imager
- Ability to support bistatic/multi-static observations

Orange indicates new capabilities



G-III G-IV

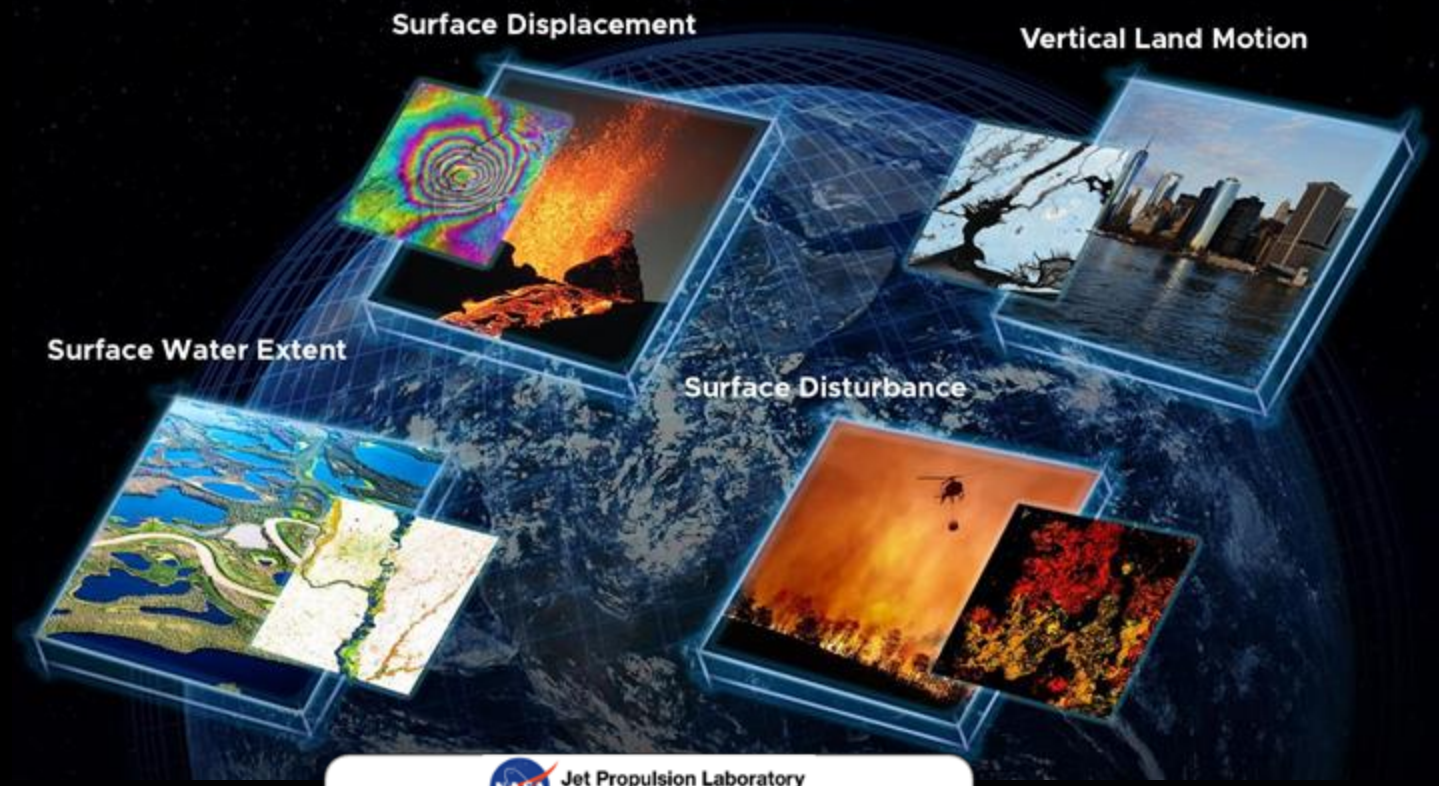
Yunling Lou will cover the details shortly



OPERA Enabling End-Users to Take Action

OPERA

Observation Products for End-users from Remote sensing Analysis



Jet Propulsion Laboratory
California Institute of Technology

USGS · NASA Goddard · UAF University of Alaska Fairbanks · SMU · EarthScope Consortium · GLAD

- **<u>Free and open</u> Analysis Ready Data** products designed for science and application stakeholders.
- 6 product lines in production
  - Water: DSWx-HLS and S1
  - Disturbance: DIST-HLS
  - RTC-S1
  - CSLC-S1
- Displacement: DISP-S1, Feb. 2025
  - ***OPERA funded for creation of a Vertical Land Motion Product***

OPERA is spearheading an innovative model within NASA that goes beyond a single mission (Landsat 8/9, Sentinel-1/2, NISAR) to develop multiple product lines

SAR Coordination

JAXA

- ALOS-2 ScanSAR archive to be mirrored at ASF
- ALOS-2 data agreement for NASA funded research, USGS, and NOAA scientists will be extended to include ALOS-4
- See AGU Session on Friday: GC51M – posters and GC52J 2 pm Room 103 A-B

CSA

- RCM data access for academics is now available
- RCM data access for NASA researchers – In development: NASA will become a vetted user to access archive.
- CSA has agreed to collect RMC data to support NISAR north of 77.5° to help fill in Arctic pole-hole in Northernmost Greenland and Arctic sea ice

ESA

- ASF will mirror Sentinel-1C data
- AfriSAR-2 campaign (Summer 2024) collected airborne P- and L-band UAVSAR data and DLR's FSAR system to better understand where NISAR's L-band saturates for biomass measurements and the lower thresholds for ESA's BIOMASS mission
- Joint NASA-ESA ROSE-L and SDC co-flyer study underway

NASA CSDA

- Commercial SAR and related data: https://csdap.earthdata.nasa.gov/
- Airbus (TSX, TDX, PAZ), Capella Space, EarthDEM,

ICGS-SAR
INTERNATIONAL COORDINATION GROUP FOR SPACEBORNE SAR MISSIONS

AGU24 WHAT'S NEXT FOR SCIENCE

More on NISAR and SDC

U34A-01 The NASA-ISRO Synthetic Aperture Radar Mission – Science and Development Status

Wednesday 4 pm Ballroom A, Convention Center

Research from joint JAXA – NASA Collaboration

Climate Change Study and Disaster Response Using L Band SAR Missions by Japan and the United States

GC51M – Posters Friday 8:30 – 12:20 Poster Hall

GC53J – Oral Friday 2:10 – 3:40 pm 103 A-B

Thank You

Dr. Gerald Bawden

Program Scientist/Manager

NISAR/SDC/UAVSAR/OASIS/

OPERA/ASF

NASA Headquarters

ISCE updates

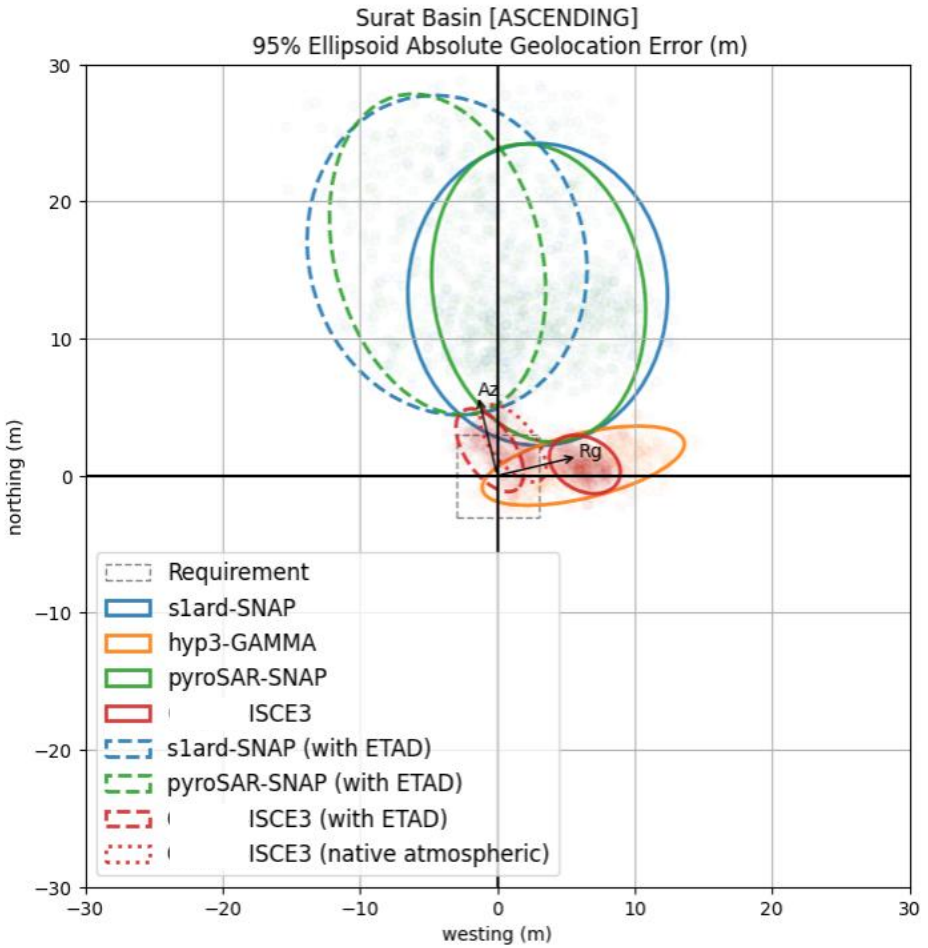
ISCE3 (InSAR Scientific Computing Environment Enhanced Edition)

- ISCE3 developer team has continued developing core modules and maturing workflows for processing NISAR data
- NISAR remains the main driver of the ISCE3 developments
- 10 formal releases in 2024:
  - v0.19 in Dec 2023 to v0.24.1 in Dec 2024
- More than **292 K** downloads of ISCE3 on conda-forge
- Primarily supports NISAR
- With a reader for Sentinel-1, two workflows (geocoded SLC and RTC) are adopted for Sentinel-1

The user community has started verifying ISCE3

- Independent investigators have compared geolocation accuracy from different software and concluded best geolocation accuracy from ISCE3!

- Josef Kellndorfer, Earth Big Data President, and NISAR Ecosystems Science Team Member has incorporated ISCE3 into his SEPPO cloud processing system.
  - “Easy to incorporate with conda environment installation”
  - Allows custom processing of standard NISAR products using the public version of ISCE3
  - Allows optional GeoTiff and COG output (instead of HDF5)

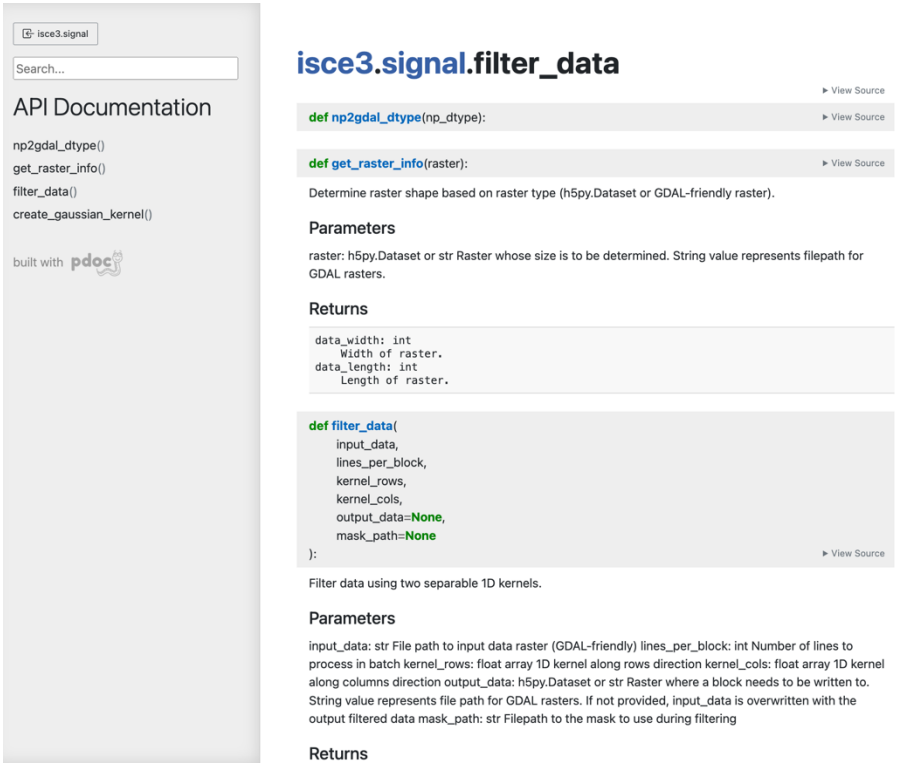


https://github.com/s1tools/s1-etad/discussions/4

- ISCE3 team is working on pushing the developments to public github to increase community engagement and to comply with Open Science best practices:
  - The team is working on improving documentations
    - Live code documentation (a test version is live now)
    - Quick starts
    - Installation guides
    - Tutorials
  - The team is working on setting CI/CD with

  GPU support for ISCE3 on public github to facilitate migration of development to public github

https://isce3-testing.github.io/isce3-ci-sandbox/api/python/isce3.html



ISCE3 team understands the interest of the community for ISCE3 to support a wider range of sensors. The team is working on securing supports for such developments

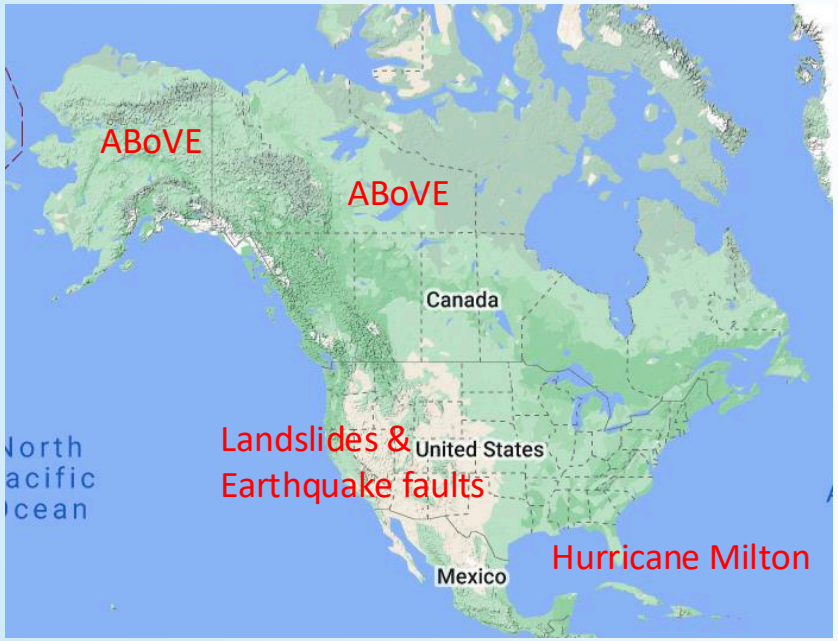
UAVSAR & AirSAR-NG Updates

UAVSAR Project Manager: Yunling Lou

EarthScope Meeting, December 11, 2024

UAVSAR Campaigns flown in 2024

- Busy year supporting AfriSAR-2, ABoVE, R&A studies, rapid responses, and technology demonstrations
- Flew over 400 hours between April-November 2024
- Supported multiple disciplines: terrestrial ecology, solid earth, cryosphere, and rapid response

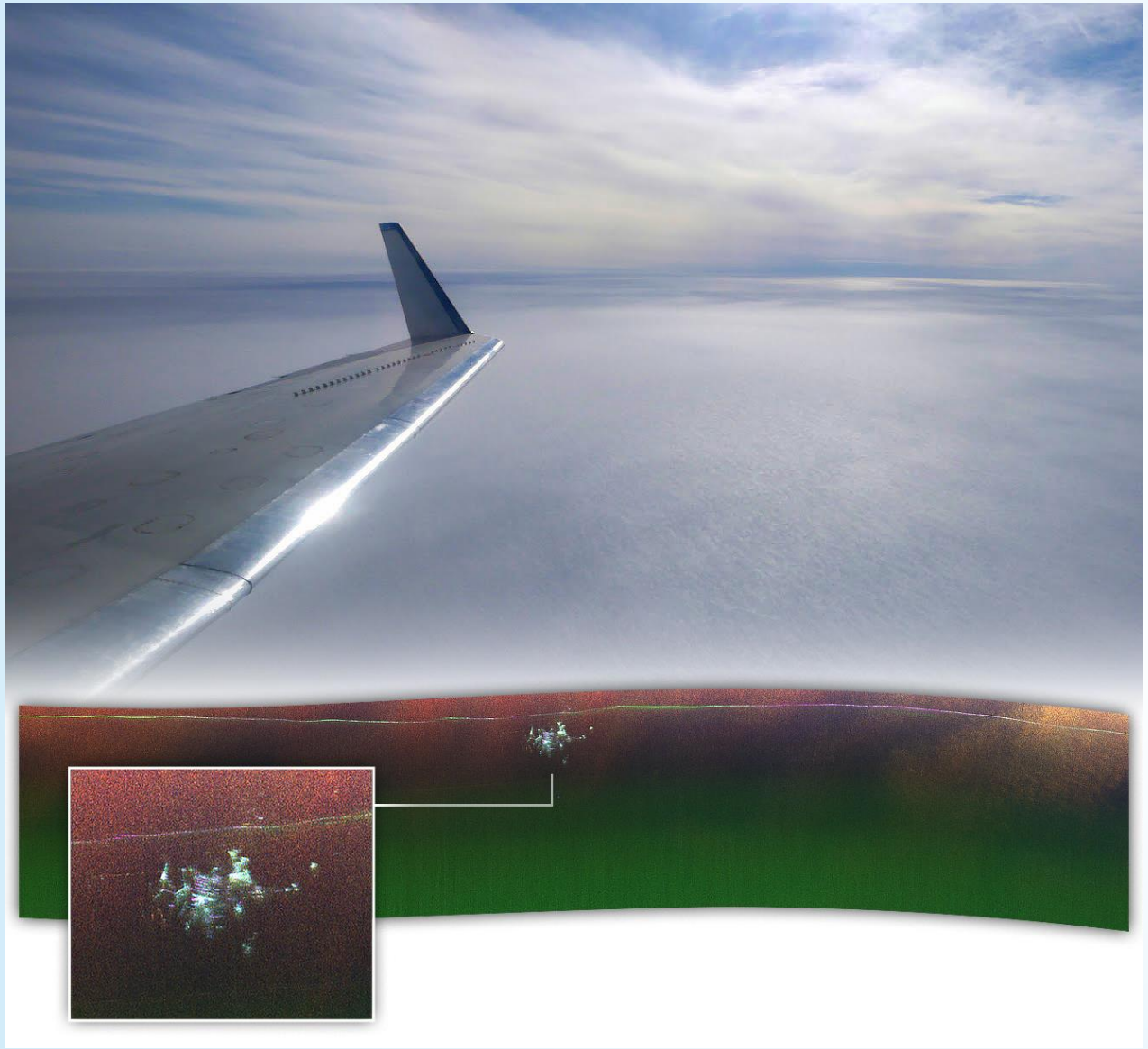


August (ABoVE), solid earth studies throughout the year

Greenland P-band subglacier bedrock geometry mapping experiment

May (P-band), July (L-band)

NASA Earth Observatory Image of the Day (Nov. 25, 2024)



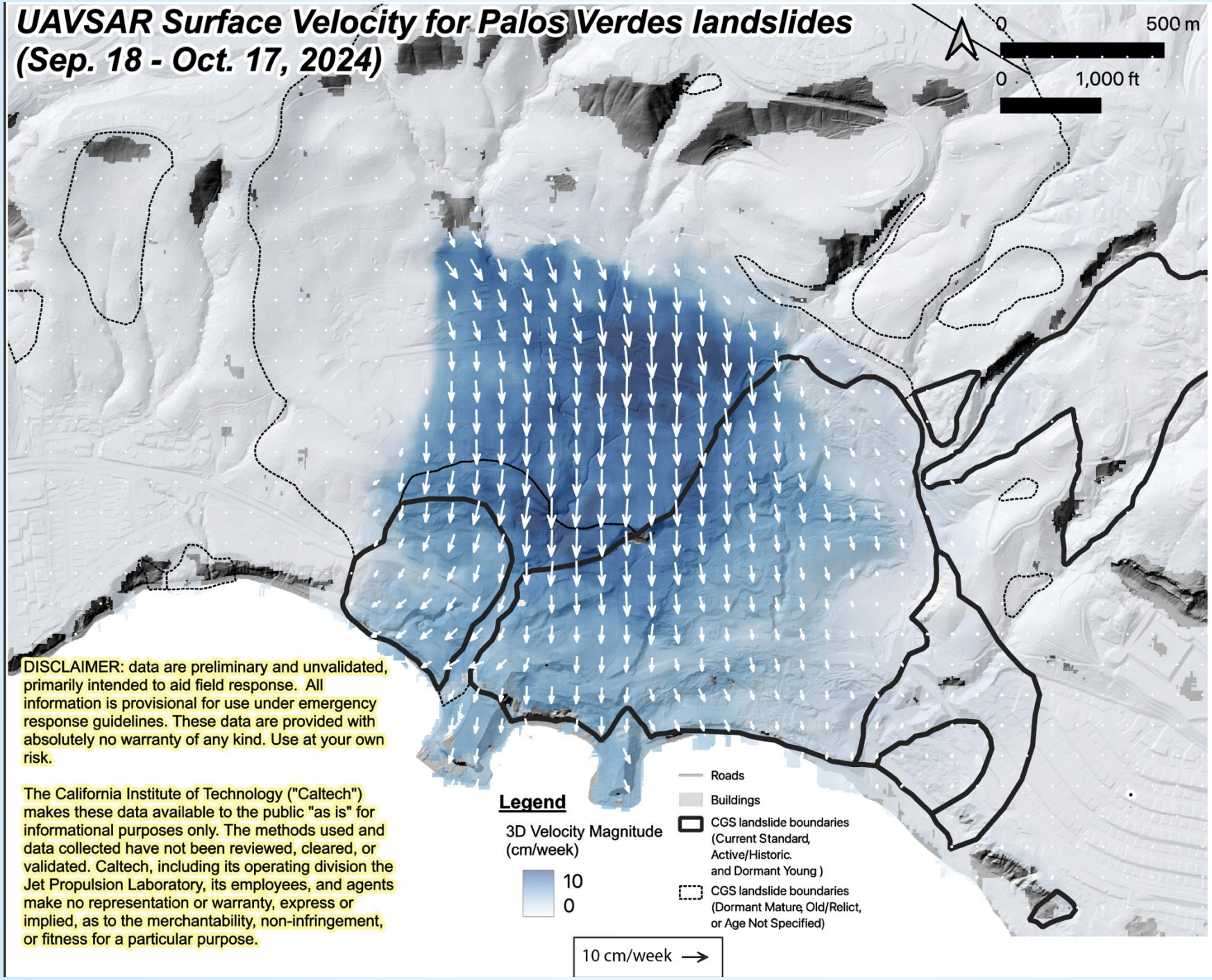
A novel radar image reveals structural elements of Camp Century, an abandoned U.S. military base buried within the Greenland Ice Sheet.

In April 2024, flying about 150 miles east from Pituffik Space Base in northern Greenland, Chad Greene snapped this photo from the aircraft's window showing the vast, barren expanse of the ice sheet's surface. That's when the radar unexpectedly detected something buried within the ice.

"We were looking for the bed of the ice and out pops Camp Century," said Alex Gardner, a cryospheric scientist at JPL, who helped lead the project. "We didn't know what it was at first."

Camp Century, also known as the "city under the ice," is a relic of the Cold War. The U.S. Army Corps of Engineers built the military base in 1959 by cutting a network of tunnels within the near-surface layer of the ice sheet. After it was abandoned in 1967, snow and ice continued to accumulate, and the solid structures associated with the facility now lie **at least 30 meters (100 feet) below the surface**.

UAVSAR Surface Velocity for Palos Verdes landslides (Sep. 18 - Oct. 17, 2024)



Map Information

This map shows 3D surface velocity magnitude for the active landslides on the Palos Verdes Peninsula, CA. Buildings and roads are also shown. All data are draped on hillshade.

Data Sources

Product: UAVSAR Surface Velocity.

Satellite/Sensor: UAVSAR (NASA/JPL)

Resolution: 5 meters

Data availability:
https://uavsar.jpl.nasa.gov/

https://aria-share.jpl.nasa.gov/20241028-Palos_Verdes_Landslides/

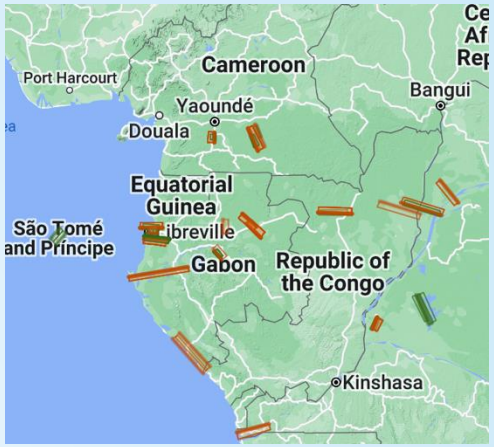
UAVSAR interferograms available at ASF DAAC.

Auxiliary Data: Buildings and roads from OpenStreetMap. Lidar from USGS3DEP accessed via OpenTopography. Landslide boundaries provided by California Geological Survey (CGS).

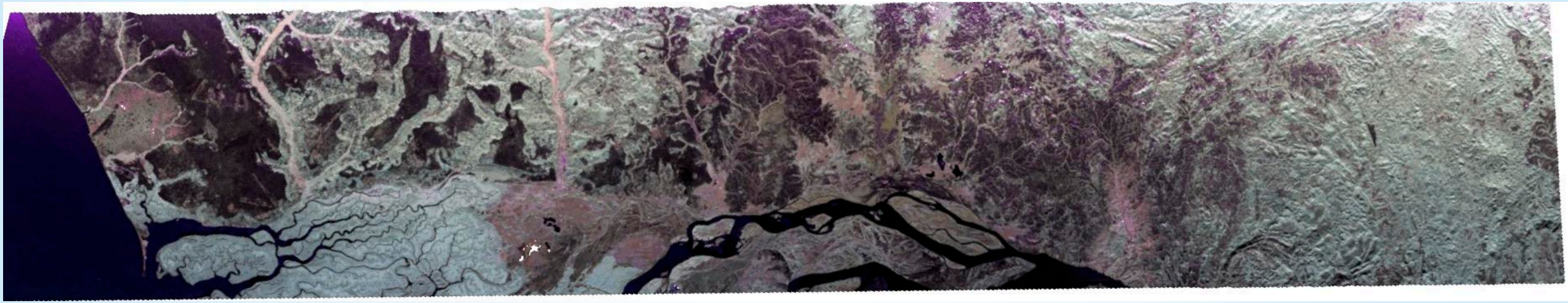
Credits

NASA JPL-Caltech ARIA/UAVSAR Team

NASA JPL UAVSAR P- band and L-band Campaign to Central and West Africa 2024



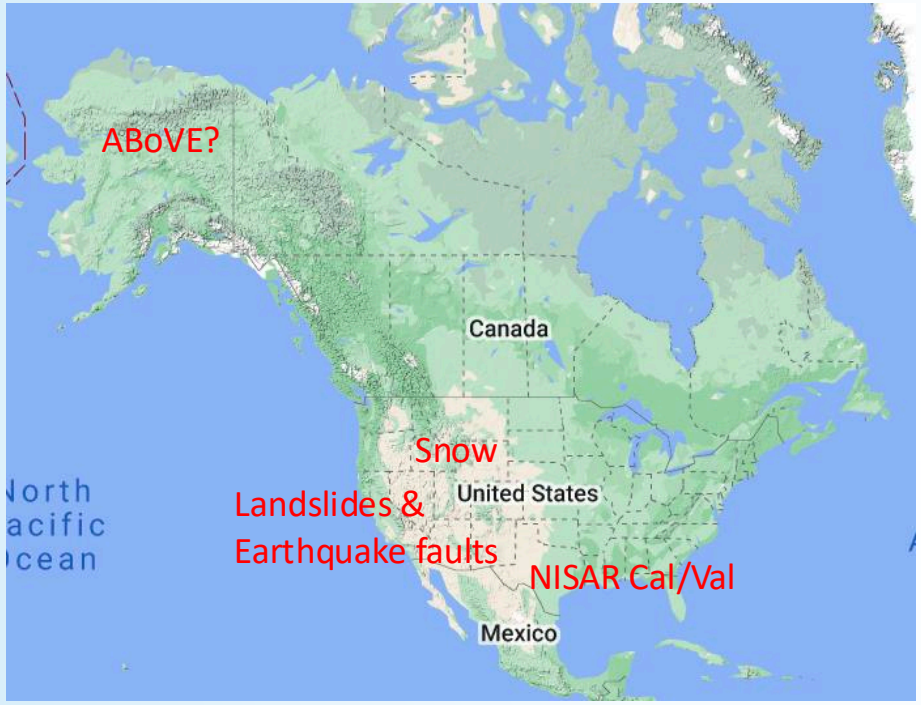
UAVSAR coverage over Gabon, Sao Tome, Cameroon, DRC, Rep. of Congo and Ghana



UAVSAR L-band image of Kitombe National Park in the Democratic Republic of Congo. This image shows the northern part of the Congo River Delta, an area with a mosaic of landform and ecosystem types, including mangrove forests (bottom left), freshwater wetlands, Savanna and tropical forests. **This area is of particular interest for calibrating and validating spaceborne SAR measurements of canopy height and aboveground biomass, water levels and flood extent, determining wetland extent and type, and other land cover**. Using the UAVSAR data we can build maps of inundation extent, including under dense canopy forests such as those found in the Congo Basin as well as estimate structure biomass and carbon stocks.

Planned UAVSAR Campaigns in 2025

- Busy year supporting ABoVE, R&A studies, NISAR (and BIOMASS?) post-launch Cal/Val activities, and technology demonstrations



January 2026

Snow variability (Feb-Mar), NISAR Cal/Val along the Gulf Coast and ABoVE? (August), solid earth studies throughout the year, Western US wildfires, STV ASCENT campaign (TBD location)

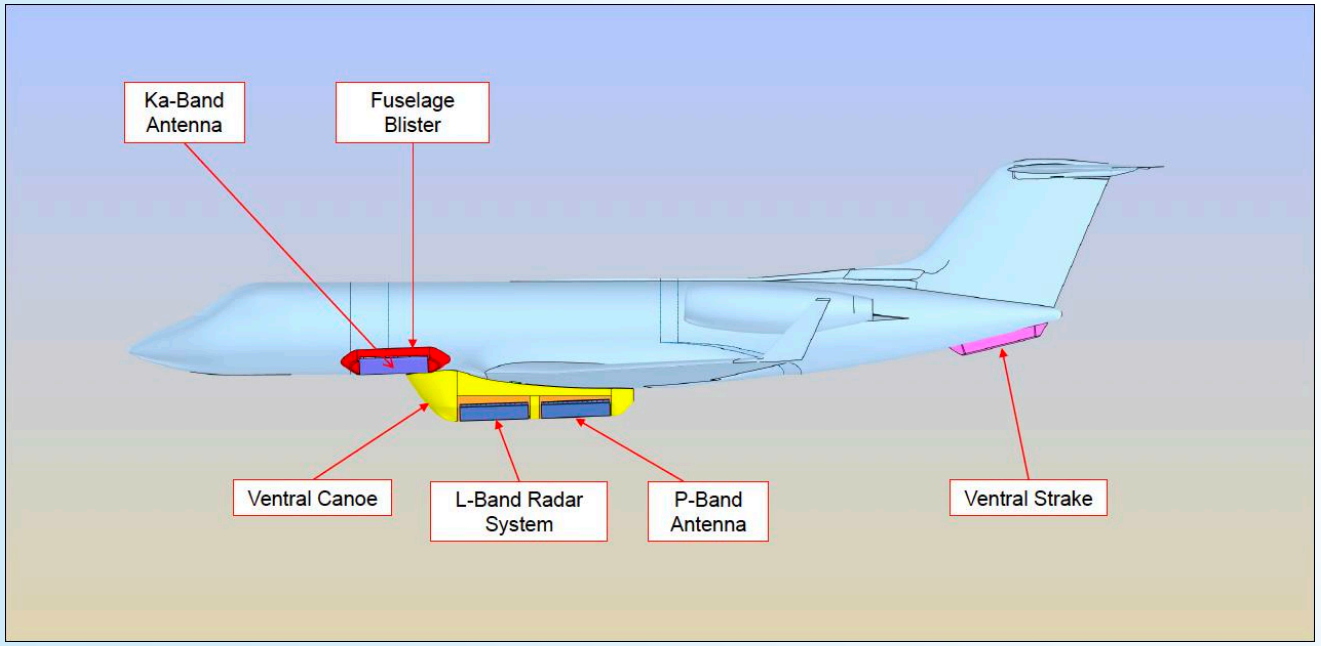
Accepting flights requests for any of the areas mentioned here, including Central and South America

UAVSAR-NextGen Status

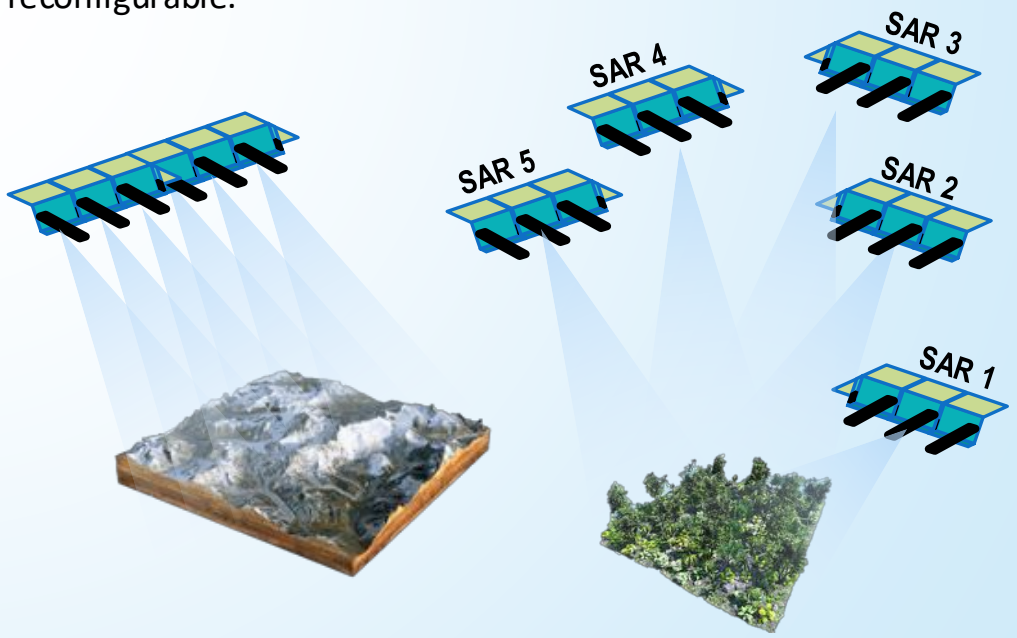
NextGen Objectives

- Ensure robustness of current capabilities; acquired a G-IV towards NextGen development
- Modernize UAVSAR capabilities so that it could be a testbed to push the envelope of future technologies that will enable future decadal surveys to make new measurements
- **Demonstrate flexible onboard digital beamforming synthetic aperture with UAVSAR**

G-IV AIRSAR-NG Concept, aircraft mod. in 2025, **L/P-band ready for flight in summer 2026**



IIP concept with docked CubeSats to form a distributed aperture: Master-Sat performs digital beamforming and data downlinking for the Node-Sats. Flexible SAR aperture is expandable and reconfigurable.



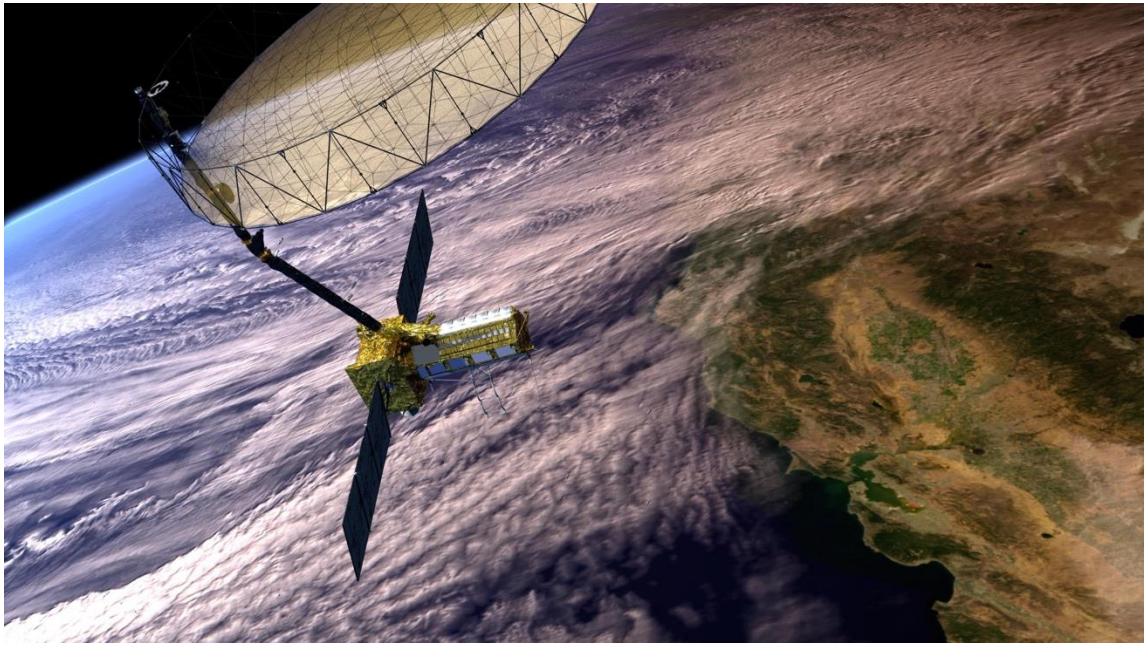
ASF Update 2024

Wade Albright ASF Director

December 11, 2024

ASF Is Ready for NISAR

- Ingest pipeline complete
- Initial Services
  - Subsetting
  - Mosaicing
  - Conversions to multiple file formats

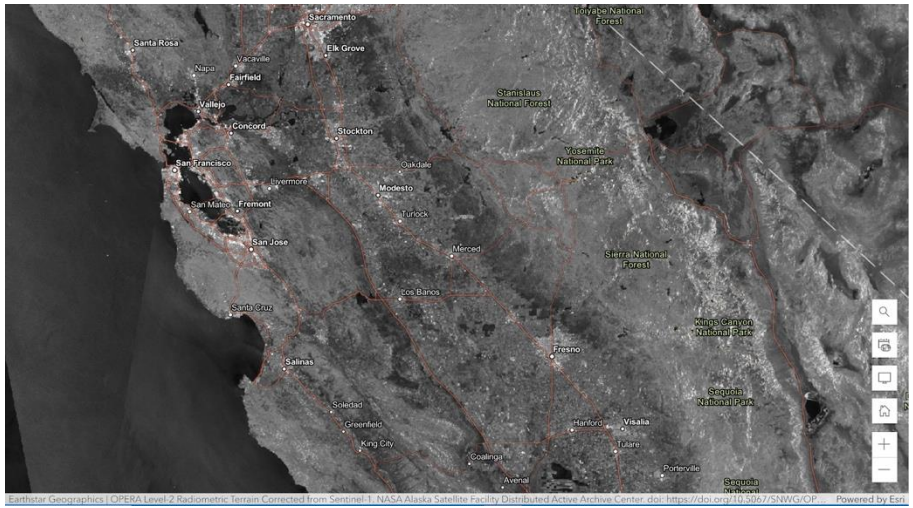


Source: https://nisar.jpl.nasa.gov/resources/206/nisar-satellite-in-earth-orbit-artists-concept/

OPERA Products

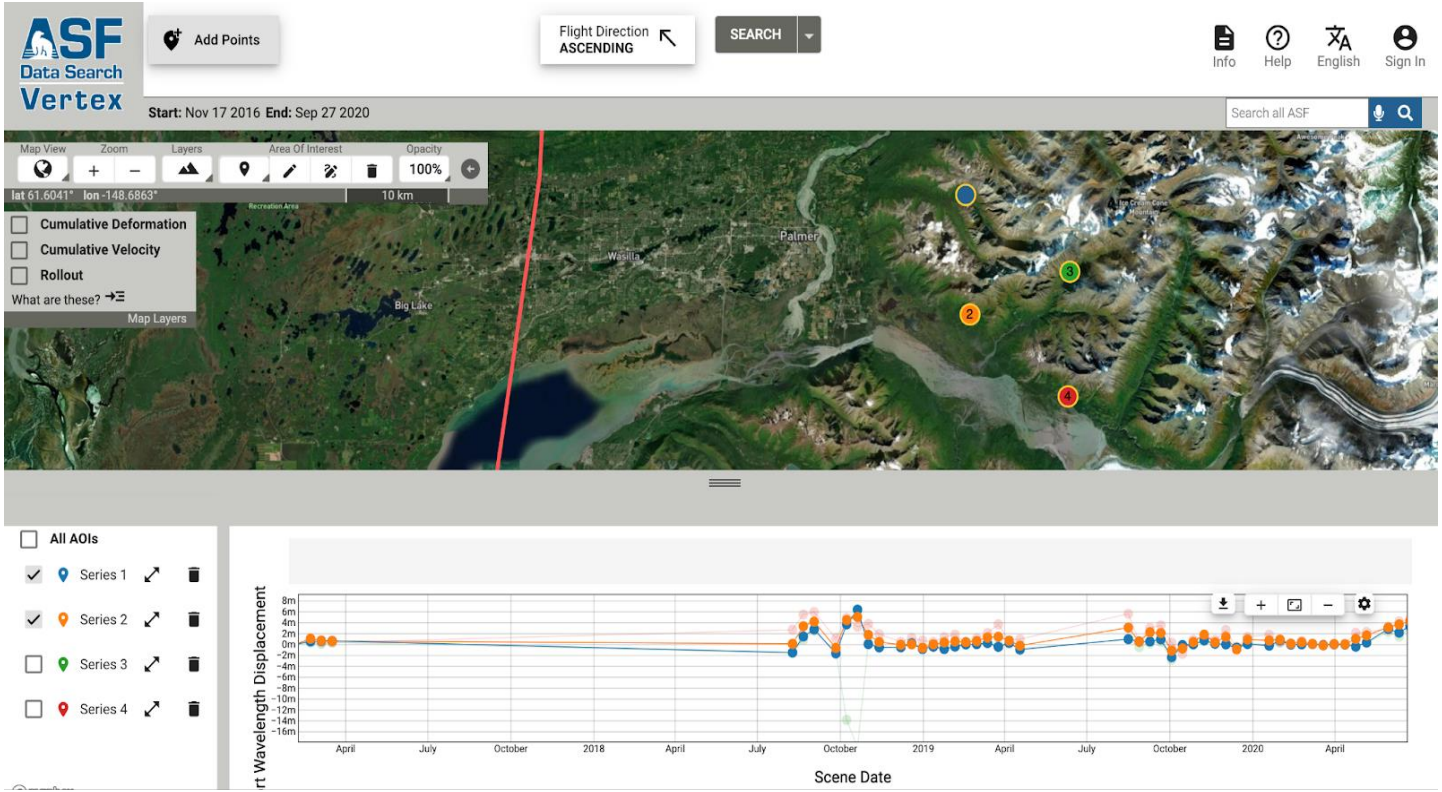
- Sentinel-1 CSLC (near global) and RTC (North America) available for distribution now
- RTC available via Image Services on NASA EGIS

EGIS Image Services



RTC Product Information

OPERA S1 Displacement

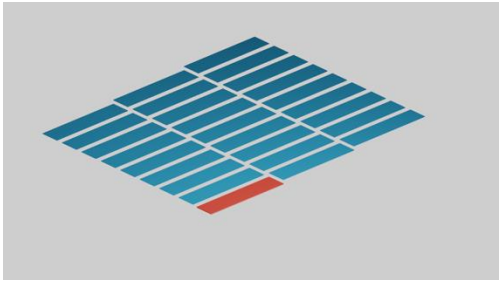


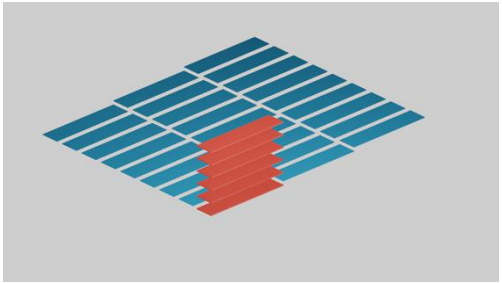
Visualization of time series values within Vertex

The user selects points on the map and the associated time series is displayed below

Sentinel-1 Bursts: Bite-sized, Consistently Framed SLC data

Bursts enable easier data access

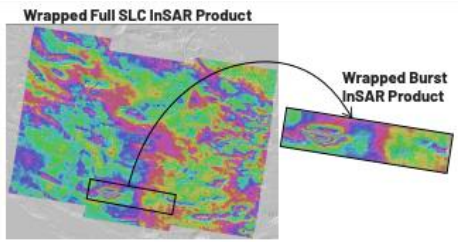




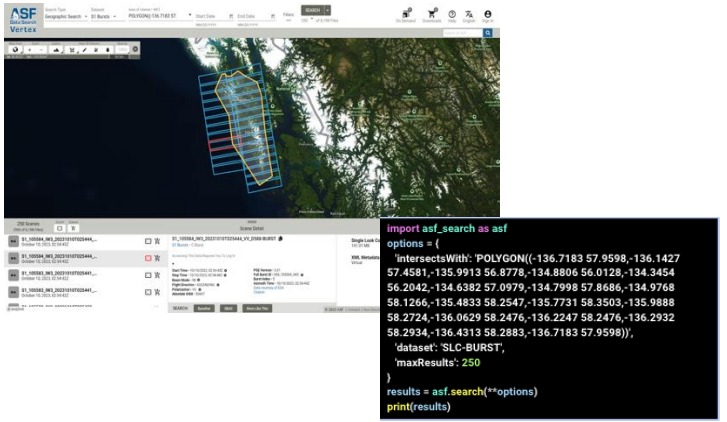
Entire Sentinel-1 archive is now available via bursts

Burst SLC data Documentation

Burst-based InSAR available in HyP3



S1 Bursts in Vertex, and programmatically



S1 Frames are big : ~ 250 km

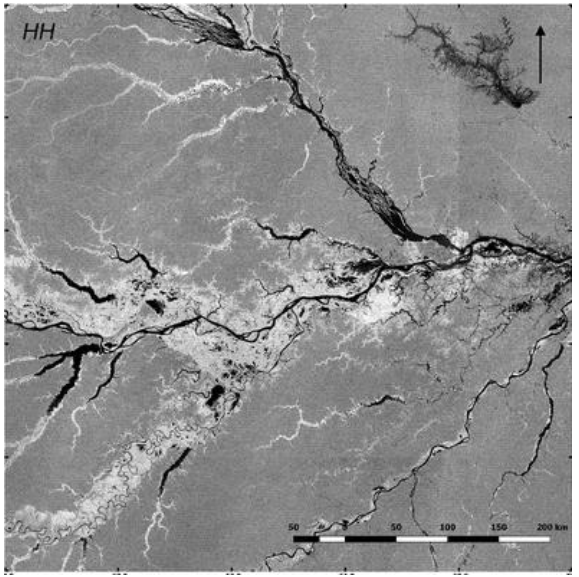
Sentinel-1C

- Launched successfully!
- NASA approved Sentinel-1C at ASF
- Access to S1C will be same as S1A and S1B

Source: https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-1/Double_win_for_Europe_Sentinel-1C_and_Vega-C_take_to_the_skies

ALOS-2 Global ScanSAR Mirror

- ASF to be a global mirror of JAXA PALSAR-2 data
- Ingest pipeline nearly complete
- Data will be available in Q1 2025
  - ~4PB of data transferred
  - Transfer of remaining data is ongoing
- If community wants services similar to S1 please let us know
  - Baseline visualizations
  - RTC and InSAR on-demand processing



Source: https://www.researchgate.net/figure/ALOS-2-PALSAR-2-ScanSAR-5-5-tile-composite-PALSAR-2-cycle-27-July-2017-over-the_fig1_340880521

OpenSARLab

- ASF apologizes for the abrupt disruption of service for customers of NASA's OSL in May
  - Victims of our own success; costs outgrew budget
  - Miscommunication created break in service
  - Provided opportunity to reset on a controlled budget
- Custom deployments continue to be available
- NASA OSL has been relaunched

Thank you for your advocacy!

QUESTIONS ?

Visit our UAF/GI
Booth #931
@ AGU
Next to NASA

Contact ASF at:
uso@asf.alaska.edu
www.asf.alaska.edu

Wade Albright
rwalbright@alaska.edu

OPERA Enabling End-Users to Take Action

Observation Products for End-users from Remote sensing Analysis

- **<u>Free and open</u> Analysis Ready Data** products designed for science and application stakeholders.

- **<u>New since last AGU</u>**
  - S1 Surface Water in production.
  - OPERA funded for a Vertical Land Motion Product from S1 and NISAR.
  - S1 and NISAR Displacement products funded till end of FY29
  - Global SAR satellite agnostic tropospheric zenith correction from ECMWF

OPERA is spearheading an innovative model within NASA that goes beyond a single mission (Landsat 8/9, Sentinel-1/2, NISAR) to develop multiple product lines

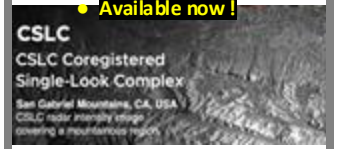
OPERA Products

National Aeronautics and Space Administration

Level-2 products

- **Description:** S1 radar backscatter corrected for the topography.
- **Coverage:** Near-global

Available now !



- **Description:** Geocoded and coreg. SLC (S1, NISAR).
- **Coverage:** North America

Available now !

Level-3 products

- Maps surface water using optical (HLS) and SAR imagery (S1, NISAR)
- **Coverage:** Near-global

Available now !

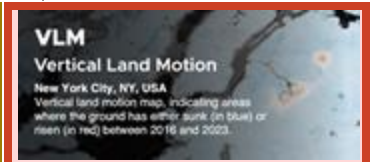
- Maps disturbance using optical (HLS) and SAR imagery (S1)
- **Coverage:** Near-global

Available now !

- Maps surface displacements in LOS (S1 and NISAR)
- **Coverage:** North America

Available Feb. 2025

Level-4 products



- Maps surface disp. in vertical + horiz. (S1 and NISAR)
- **Coverage:** North America

Available in 2028

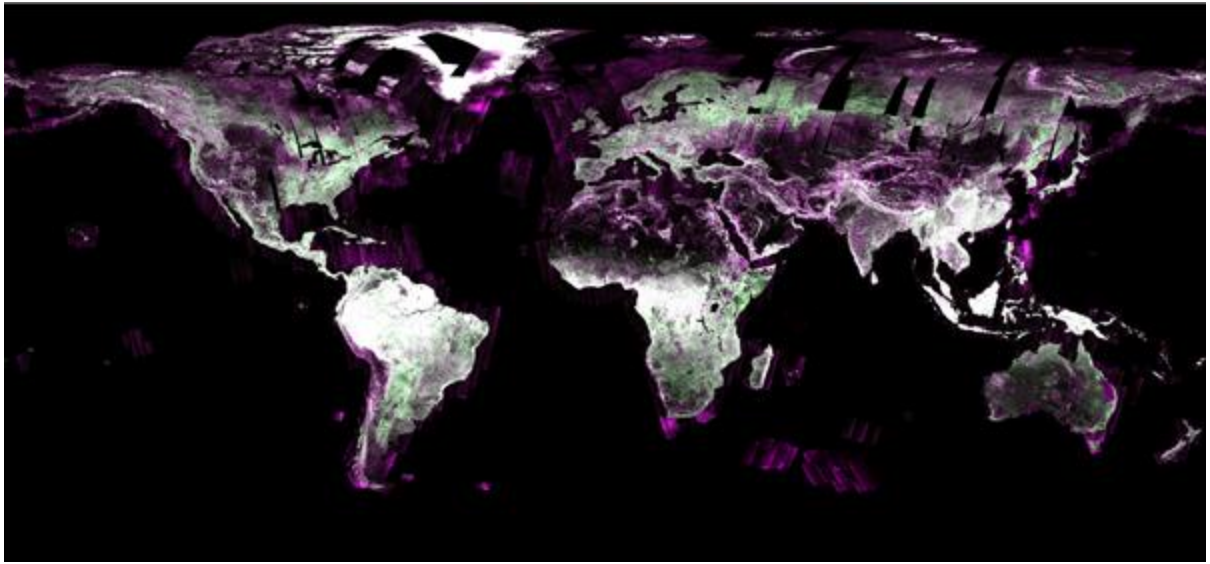
Latency: As soon as the input data is available
Posting: 30m or better
Temporal Sampling: sub-weekly to weekly

OPERA data is available through SNWG data portal:
https://search.earthdata.nasa.gov/search?portal=snwg&q=%22OPERA%22

S1 = Sentinel-1
NISAR = NASA-ISRO SAR mission
HLS = Harmonized Landsat Sentinel-2

Radiometric Terrain Corrected SAR from S1 (RTC-S1)

National Aeronautics and Space Administration



Download OPERA RTC via ASF DAAC

ASF vertex

https://search.asf.alaska.edu/#/

First NASA radar product to attain CEOS-ARD status

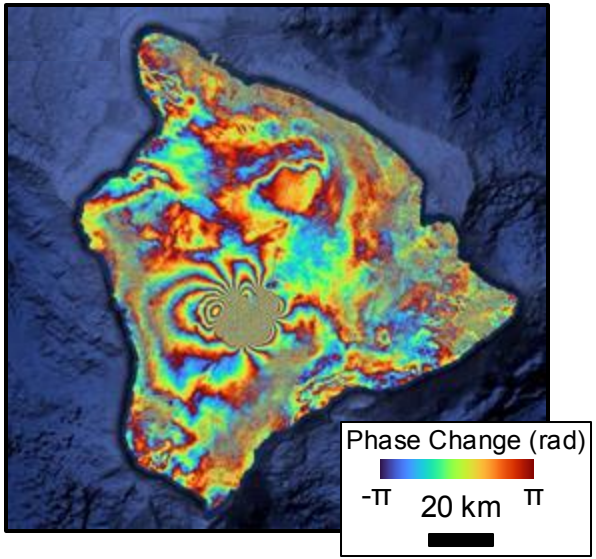
Current RTC-S1 record from Oct. 2023 onwards.

- Starting Feb. 2025, two more years of historical data will be added (Oct. 2021 onwards).
- Intermediate for Surface Water and Surface Disturbance S1 products
- S1C integration planned for Sep. 2025 (will process full S1C record)
- ASF On-demand capability for custom OPERA RTC products being developed.

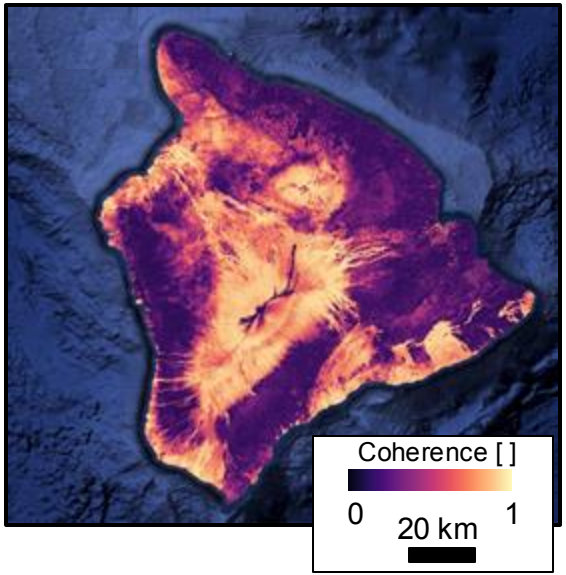
Coregistered Single-Look Complex from S1 (CSLC-S1)

National Aeronautics and Space Administration

Interferogram from CSLC-S1



Coherence from CSLC-S1



Download OPERA CSLC via ASF DAAC

ASF vertex

https://search.asf.alaska.edu/#/

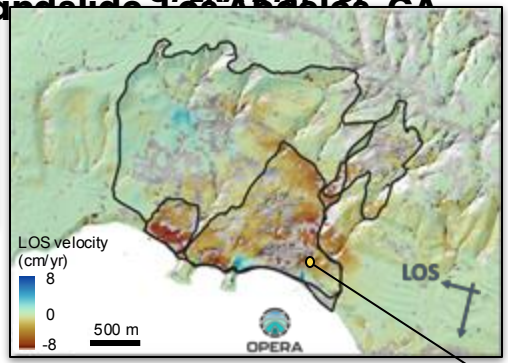
CSLC-S1 record from June 2016 onwards:

- S1C integration planned for Sep. 2025 (will process full S1C record)
- CSLC-S1 supported till end of FY29 (intermediate product for DISP-S1)
- Covers Cascadia Subduction Zone to support partnership with NSF CRESCENT

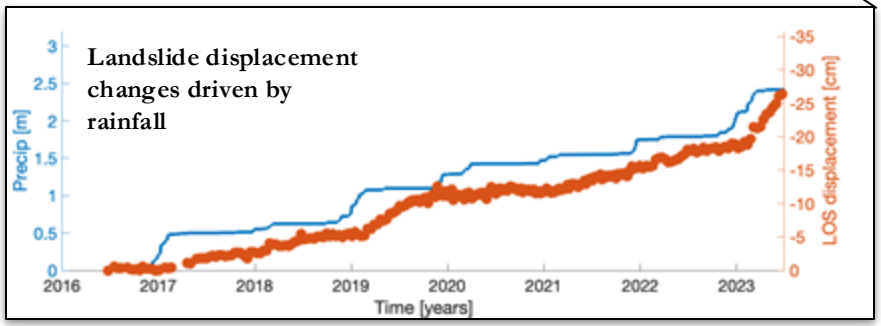
Surface Displacement (DISP) from SAR

(Jason Armond / Los Angeles Times)

Increased activity at Portuguese Bend landslide since 2023 has led to a State of Emergency



OPERA DISP-S1 Time series



Prelim. OPERA DISP-S1 data provided by S. Staniewicz (OPERA - JPL). Rainfall data from PRISM

DISP-S1 record to span June 2016 onwards:

- S1C integration planned for Sep. 2025 (will process full S1C record)
- DISP-S1 supported till end of FY29 (intermediate product for VLM)
- Multi-phase roll out starting Feb. 2025

DISP-NI to follow upon NISAR validated record release till end of FY29

SAR agnostic global tropospheric correction

- Production start end of June 2025
- Record to span 2016 onwards
- Derived from ECMWF HRES (9km) model

OPERA DISP will be supported via a new ASF DAAC portal. See ASF poster at AGU

Vertical Land Motion (VLM) from SAR

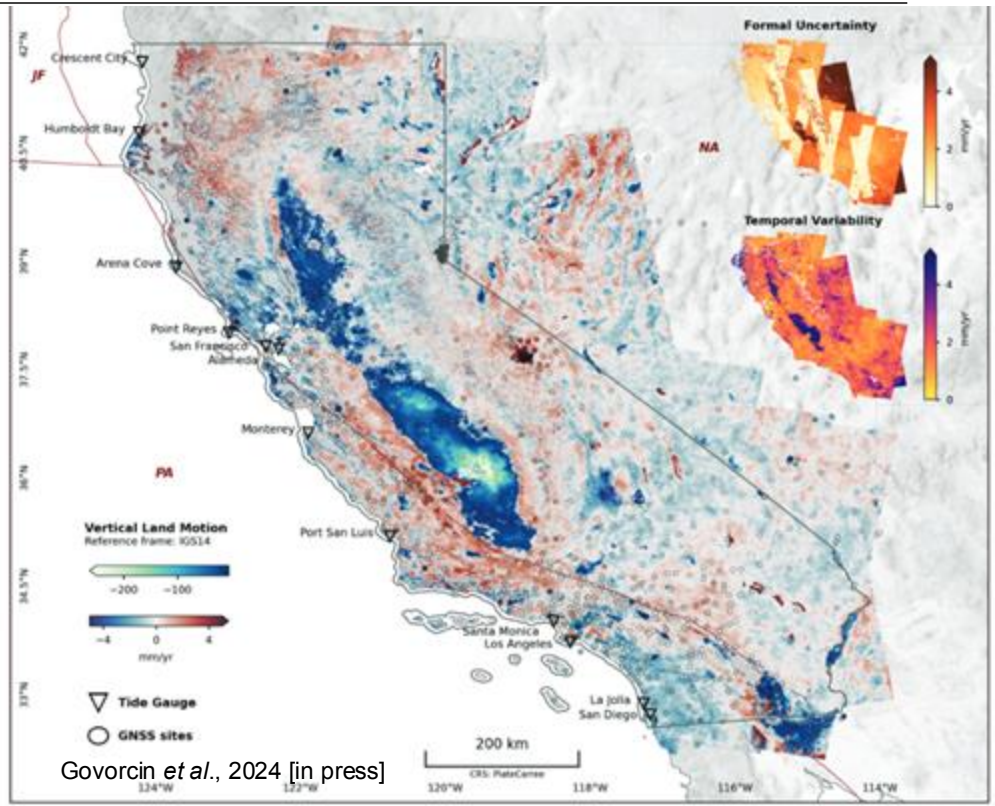
National Aeronautics and Space Administration

VLM-S1 record to start June 2019 onwards:

- Includes S1A-C
- VLM-S1 supported till end of FY29

VLM-NI record to span NISAR validated record till end of FY29

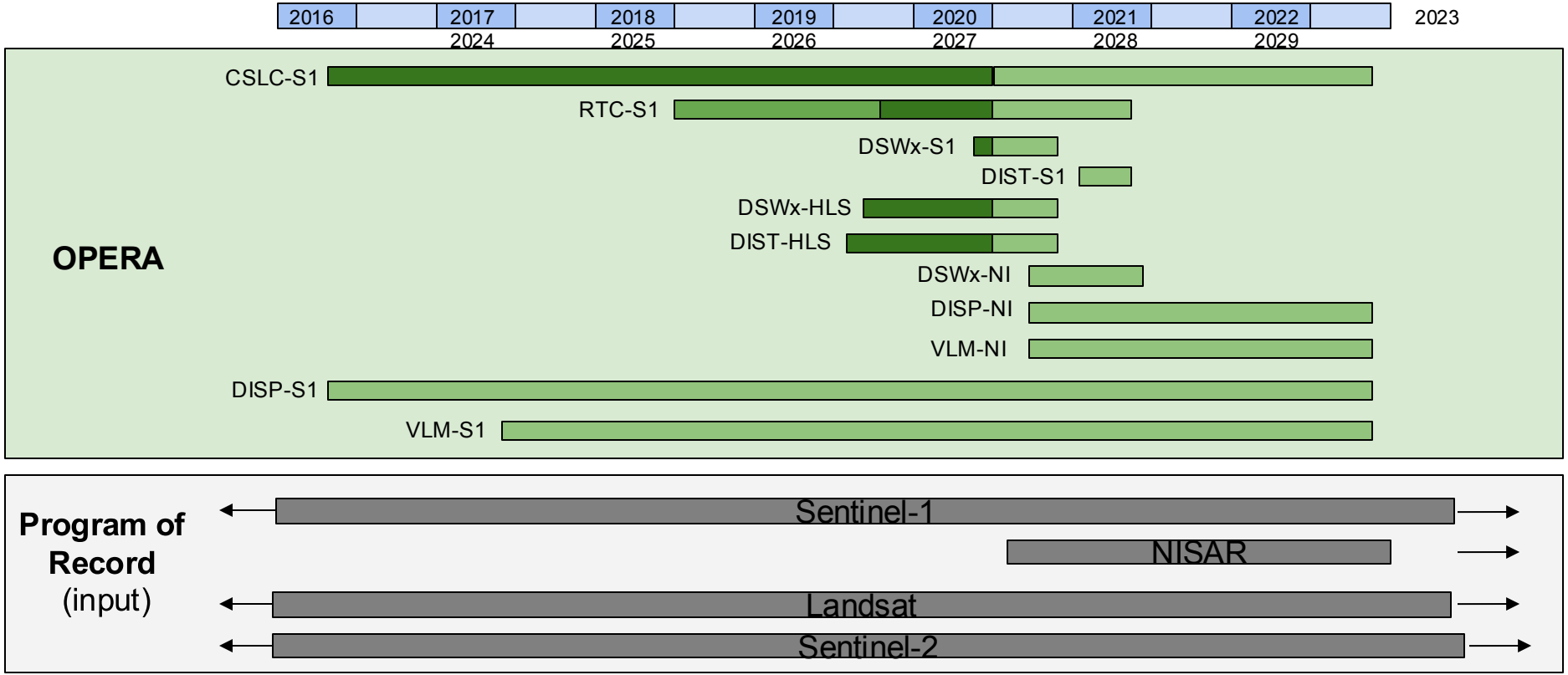
OPERA VLM will be supported via a new ASF DAAC portal.



Govorcin *et al*., 2024 [in press]

backup

Product Records

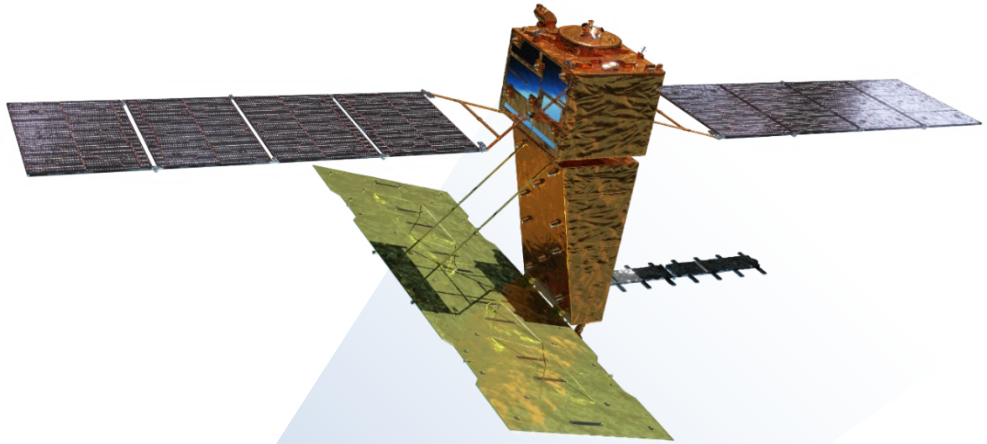


JAXA's SAR Activities and Plans

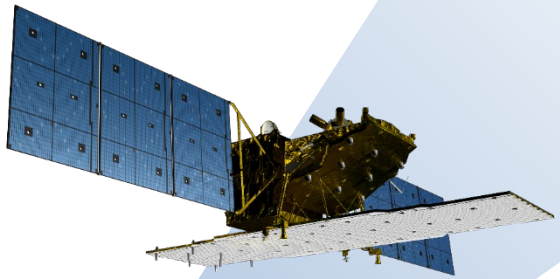
Shinichi Sobue and Yukihiro Kankaku
Japan Aerospace Exploration Agency (JAXA)

December, 2024

JAXA's ALOS-series L-band SAR



ALOS-4
(2024~ in operation)
PALSAR-3, SPAISE3



ALOS-2
(2014~ in operation)
PALSAR-2, SPAISE2

ALOS
(2006-2011)
PALSAR, AVNIR-2, PRISM

- The ALOS series satellites are continuously developed and operated by JAXA mainly for the purpose of land/ocean monitoring and technological development.
- L-band SAR has been developed and caried in the ALOS series.

Mission objectives of ALOS series:

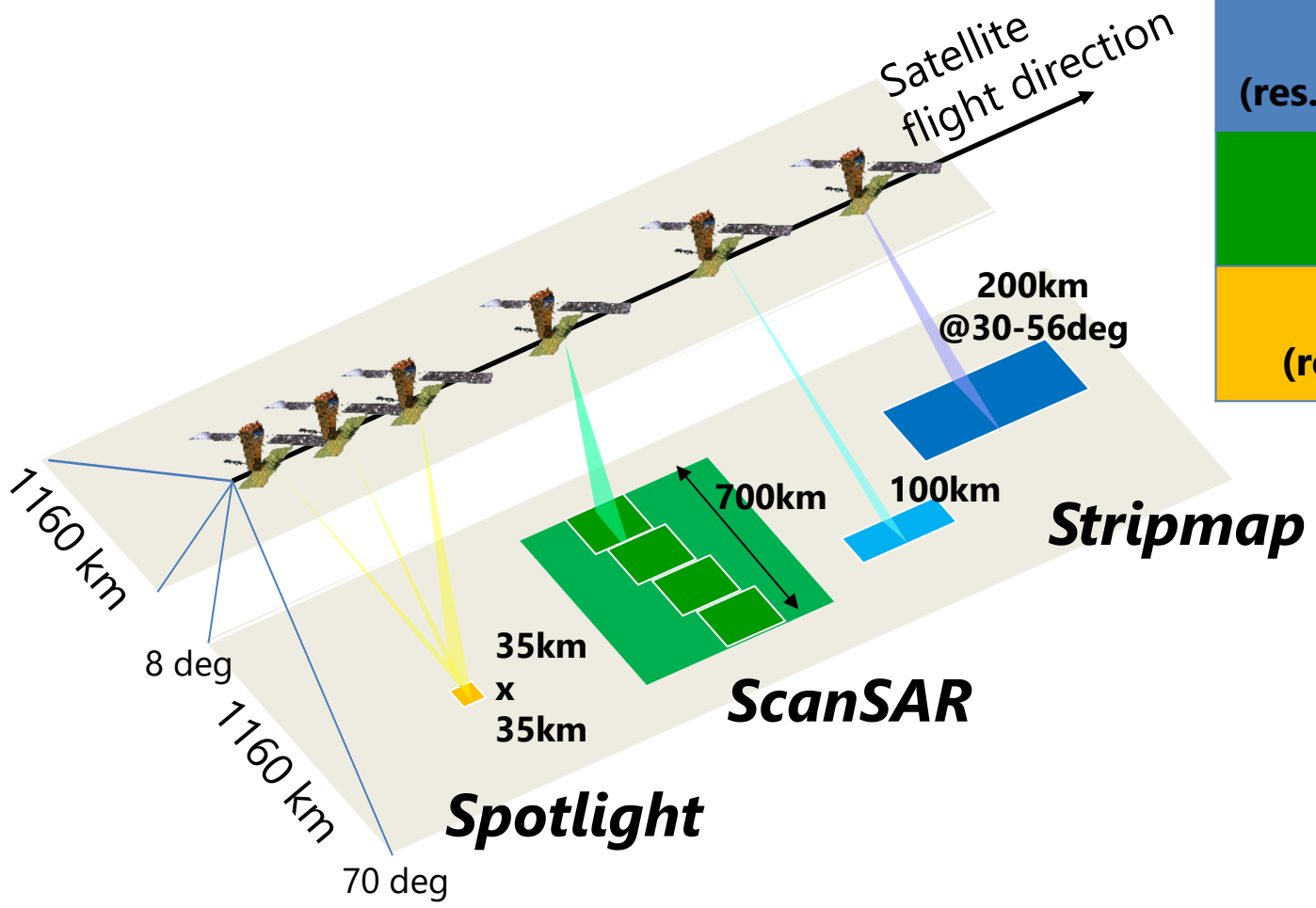
Disaster damage assessment
Flood, Landslides, Building damage, Typhoon, etc.

Land deformation
Volcano, Earthquakes, Landslides, Land subsidence, etc.

Maritime
Vessels, Ocean wind, Sea ice, etc.

Global environment
Deforestation, Glacier, Agriculture, etc.

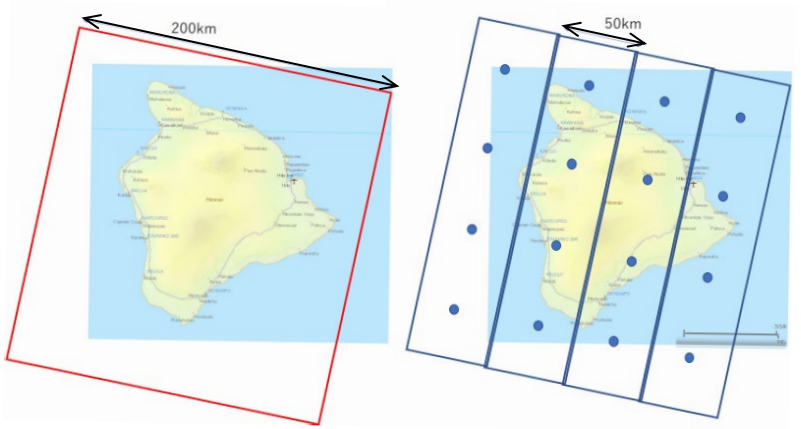
ALOS-2/-4 Observation Mode



Obs. mode	ALOS-4 (PALSAR-3)	ALOS-2 (PALSAR-2)
Stripmap **(res. 3 m/6 m/10 m)**	**100 or 200 km**	30-70 km
ScanSAR **(res. 25 m)**	**700 km**	350 or 490 km
Spotlight **(res. 3 m x 1 m)**	**35 km x 35 km**	25 km x 25 km

ALOS-4/PALSAR-3
Stripmap mode
200 km swath

ALOS-2/PALSAR-2
Stripmap mode
50 km swath



Island of Hawaii

JAXA Japan Aerospace Exploration Agency

ALOS-2

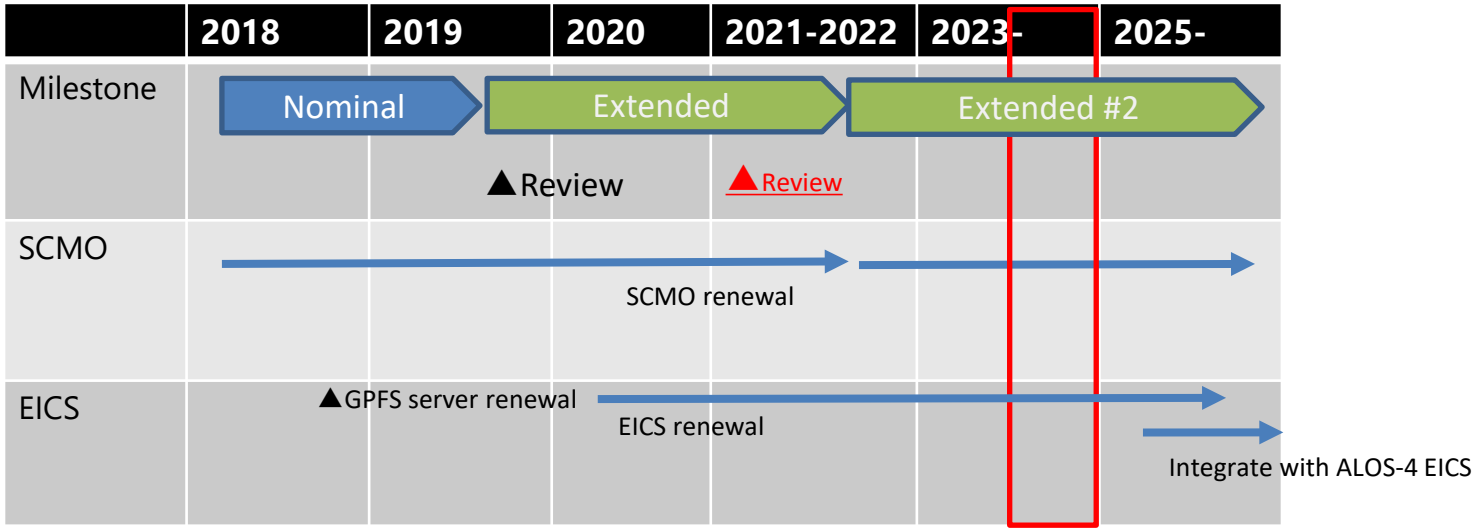
Application	Disaster, Land, Agriculture, Natural Resources, Sea Ice & Maritime Safety
L-band SAR (PALSAR-2)	Stripmap: 3 to 10m res., 50 to 70 km swath ScanSAR: 100m res., 350km/490km swath Spotlight: 1×3m res., 25km swath
Orbit	Sun-synchronous orbit Altitude: 628km Local sun time : 12:00 +/- 15min Revisit: 14days Orbit control: ≦+/-500m
Life time	5 years (target: 7 years)
Launch	May 24, 2014; H-IIA launch vehicle
Downlink	X-band: 800Mbps(16QAM) 400/200Mbps(QPSK) Ka-band: 278Mbps (Data Relay)
Experimental Instrument	Compact InfraRed Camera (CIRC) Space-based Automatic Identification System Experiment 2 (SPAISE2)

ALOS-2 system operation status summary

Subsystem	Status	Note
SAP	**Green**	-
EPS	**Green**	-
AOCS	**Green**	ESA operations are suspended
Propulsion	**Green**	-
CDMS	**Green**	-
DT	**Green**	-
DRS	**N/A**	August 5, 2017 DRTS operation was completed
MDPS	**Green**	System reset because of SEU
THERMAL	**Green**	-
PALSAR2	**Green**	System reset because of SEU

Cal/Val status: Green: https://www.eorc.jaxa.jp/ALOS-2/calval/calval_jindex.htm

Extended observation phase #2



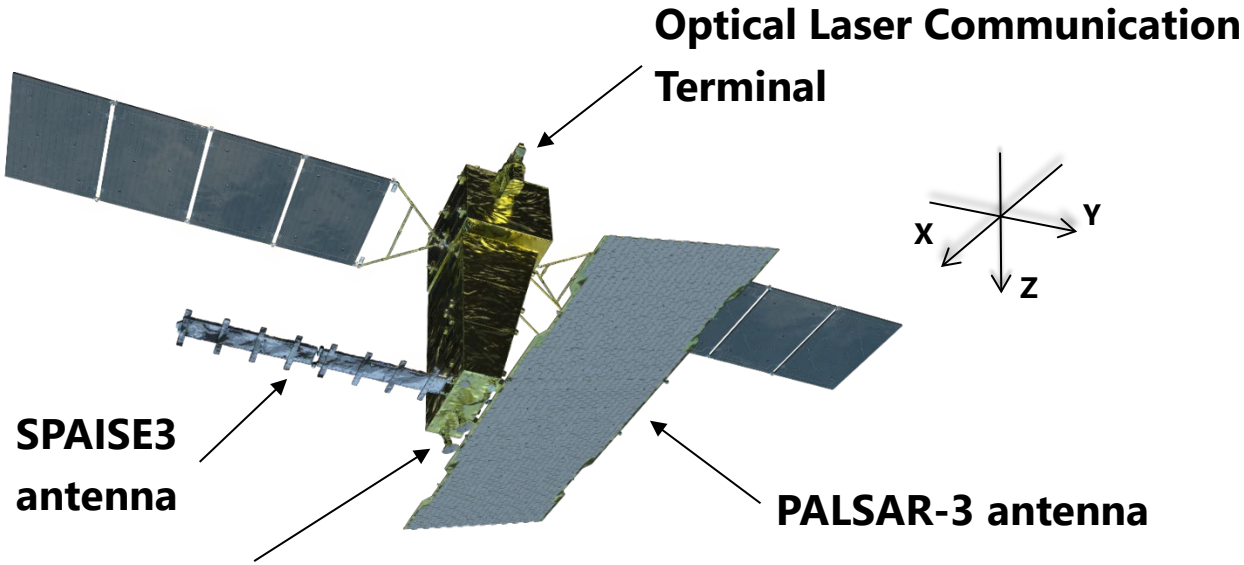
Target of ALOS-2 mission for 2024 operations

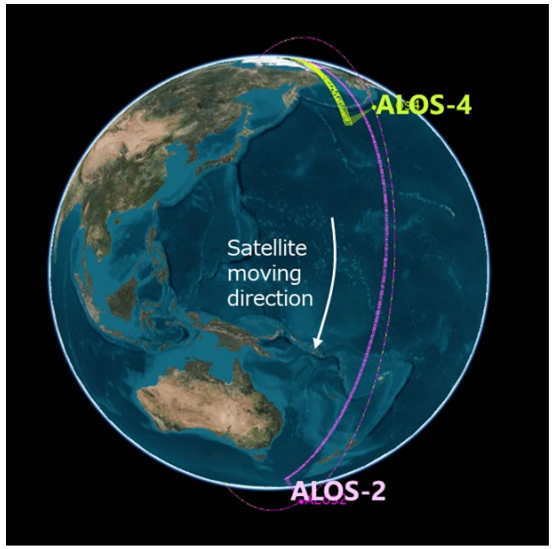
・10 years continuous observation operations

・Archive global and continuous SM3 and WD1 observations with intensive time series observations in selected areas, including research and development to prepare ALOS-4 bi-weekly SM3 observations and promoting multi frequency observations in cooperation with ASI, CSA, ESA, NASA and other international partners.

・2025 ALOS-2/4 constellation flight with high temporal or R/L observation in specific area

Overview of ALOS-4





ALOS-4 flies on the same reference orbit as ALOS-2, enabling combined observations and data analysis by both.

Lifetime		7 years
Mission Instruments		PALSAR-3 (L-band SAR) SPAISE3 (AIS receiver)
Size (X, Y, Z)		10.0 m × 20.0 m × 6.4 m
Satellite Mass		Approx. 3,000 kg
Electrical Power	**Solar cells**	Approx. 7,000 W
	Battery	380 Ah
Data recorder		Approx. 1 Tbyte
Downlink		3.6 Gbps (Ka-band) 1.8 Gbps (Optical data relay)
Orbit (Same as ALOS-2)	**Type of orbits**	Sun-synchronous sub-recurrent orbit
	Altitude	628 km
	Local sun time at descending	12:00 ± 15 min
	Revisit time	14 day
	Inclination angle	97.9 deg.

Launch of ALOS-4

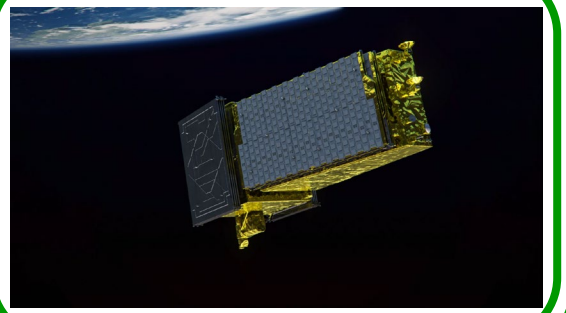
ALOS-4 was launched aboard the third H3 Launch Vehicle at 12:06:42 (JST) on July 1, 2024, from the Tanegashima Space Center.

The events following the launch

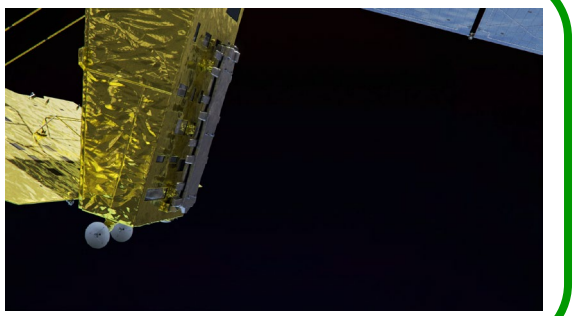
Launch
(1/7/2024 12:6:42 JST)

Separation

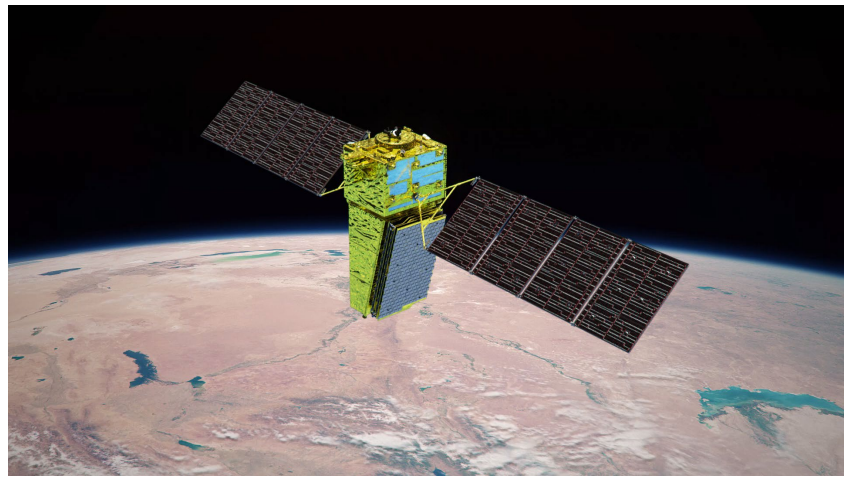
Solar array Deployment



SPAISE3 Deployment



3 days

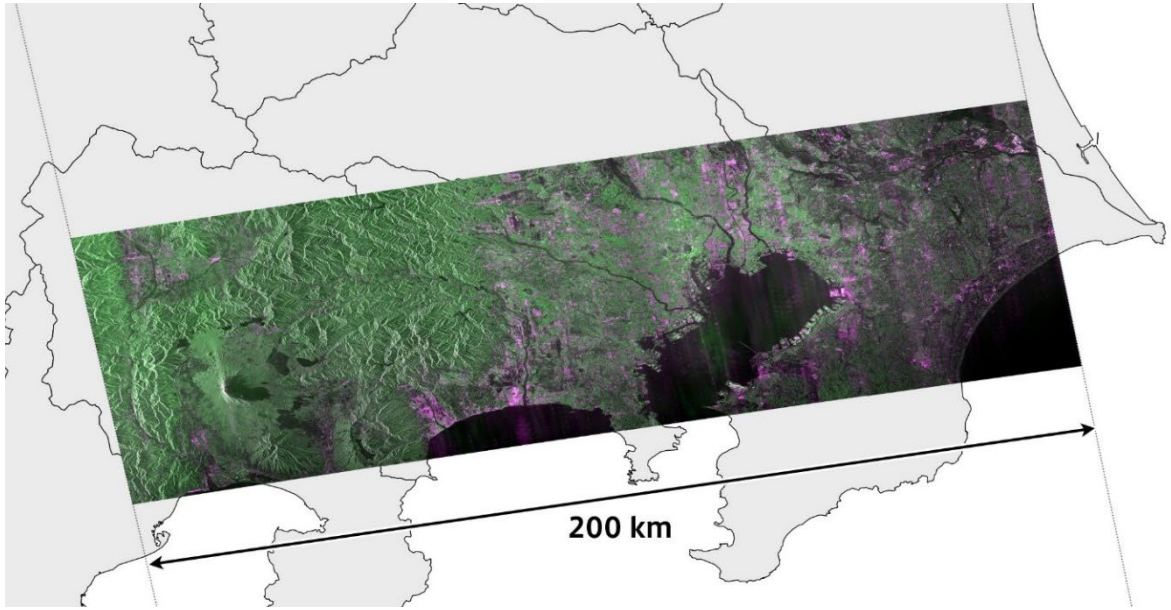


PALSAR-3 Deployment

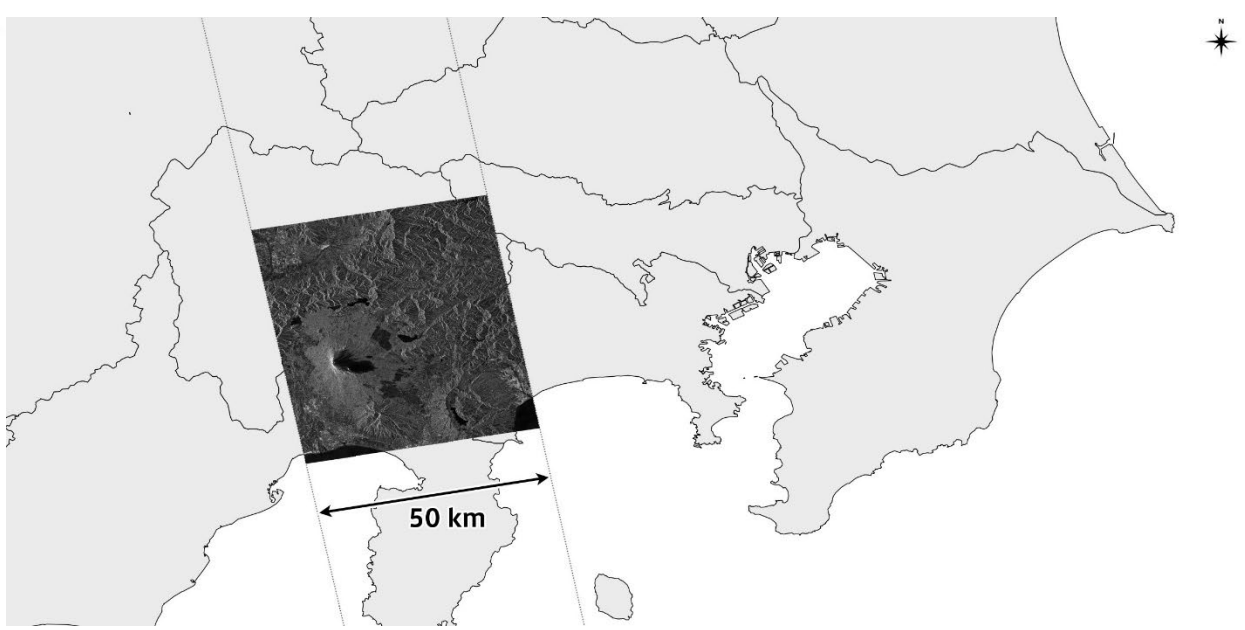
Completion of Critical Operation (3/7/2024)

First light images of PALSAR-3

- The first PALSAR-3 observation was conducted during July 15 to 17, 2024.
  - ✓ Successfully observed over a 200 km swath width with 3 m resolution. PALSAR-3 can observe 4 times wider than the 50 km swath of PALSAR-2.
  - ✓ Use of the new Ka-band data transmission enabling observations of large volumes of dual-polarization data. In PALSAR-2, the high-resolution 3 m mode is operated with one polarization.



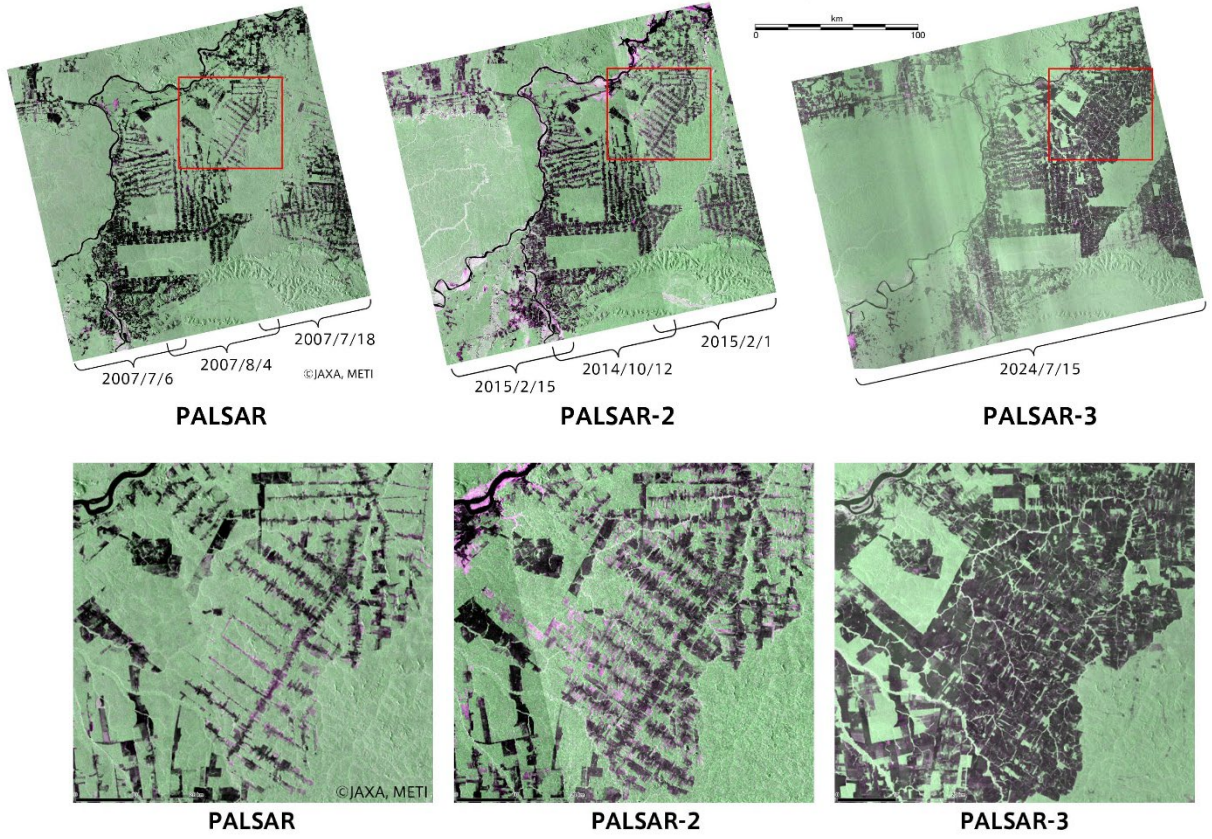
PALSAR-3 image over Tokyo~Mt. Fuji, Japan
(200 km swath, HH and HV polarization)



PALSAR-2 image
(50 km swath, HH-polarization)

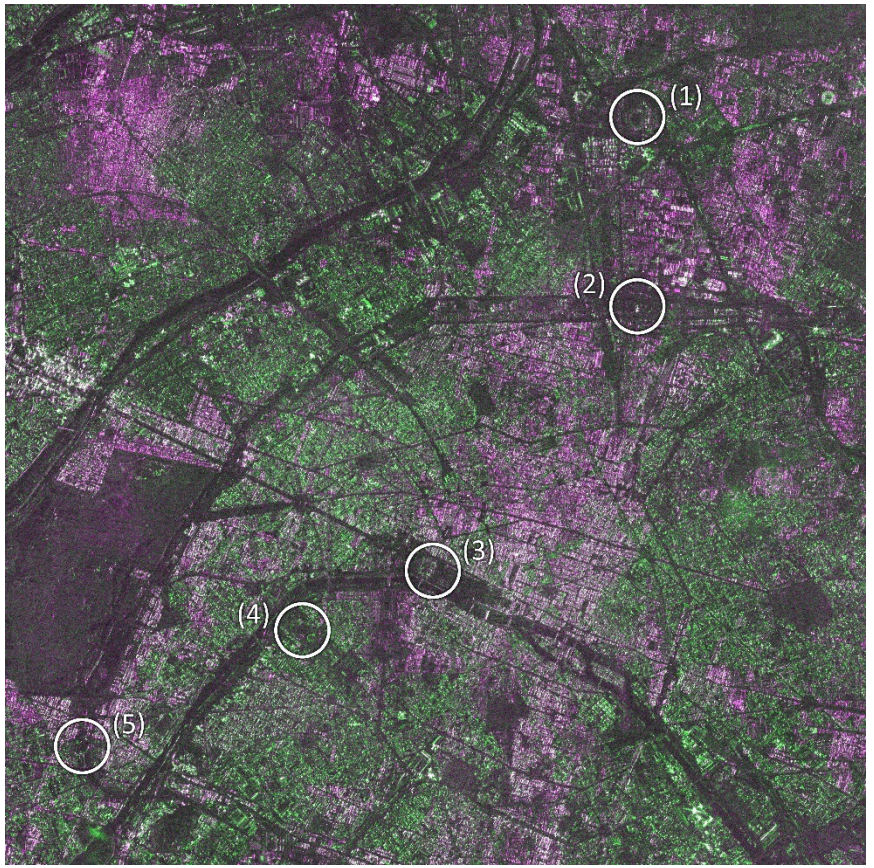
First light images of PALSAR-3

✓ Continuous global observation with 10 m resolution and 200 km swath width



Amazon forest in the State of Rondonia, Brazil

✓ Spotlight mode with 1m × 3 m resolution



Paris, France; Major venues for the Paris 2024 Olympics Games are marked with white circles

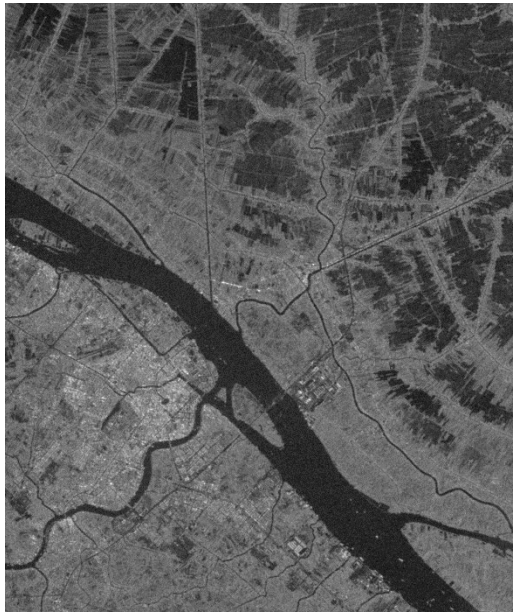
(1) Stade de France, the main venue, (2) Porte de la Chapelle Arena, (3) Place de la Concorde, (4) Eiffel Tower Stadium, and (5) Parc des Princes

First light images of PALSAR-3

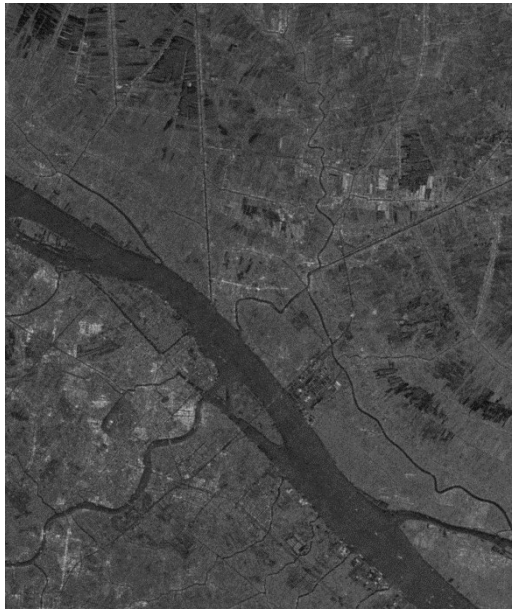
- ✓ Full polarimetric SAR image with 6 m resolution for global observation once per year

Urban and agricultural areas near Can Tho City, Vietnam

HH polarization



HV polarization

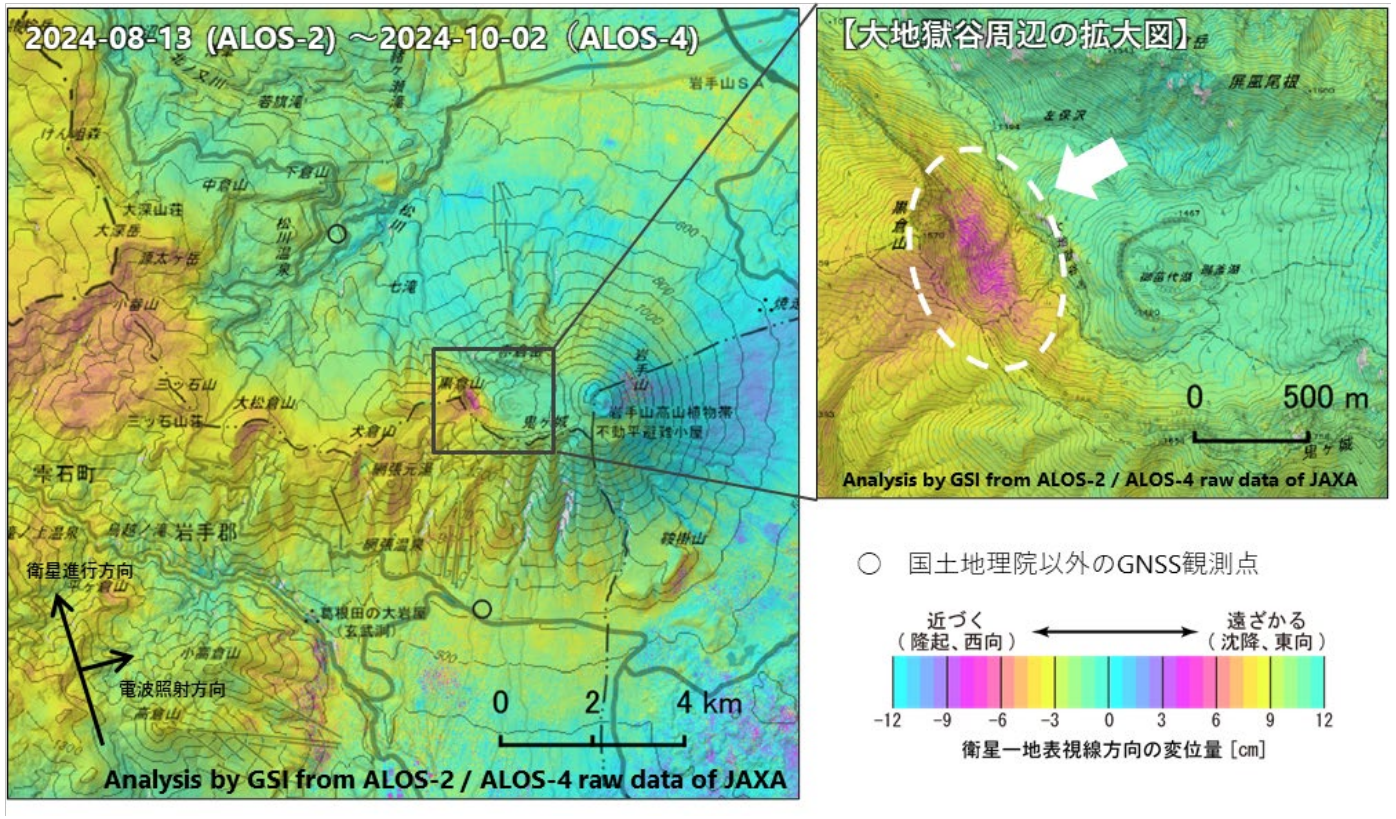


VV polarization

Color composite image
（R：HH、G：HV、B：VV）

Continuous observation with ALOS-2/-4

- During the initial check-out of ALOS-4, interferometric SAR between PALSAR-3 and PALAR-2 was also successfully conducted.
- More frequent and long-term monitoring will be possible by combining with ALOS-2's future observations and its archived data for the past 10 years.



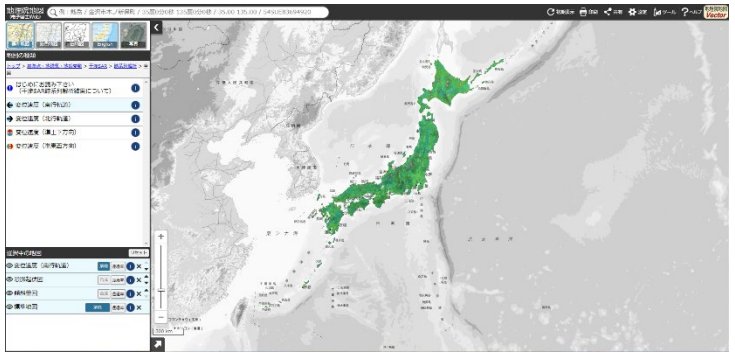
InSAR analysis results of PALSAR-2 and PALSAR-3 at Mt. Iwate, Japan by Geospatial Information Authority of Japan

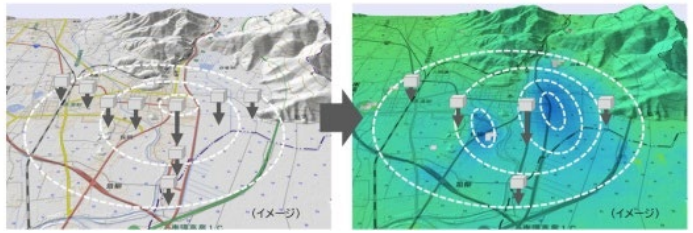
This information is used by the government to evaluate eruption warnings

Promoting social implementation of SAR data use

- Toward the continuous social implementation of SAR data use, we are working on R&D and implementation in cooperation with various data analysis and service provision partners.

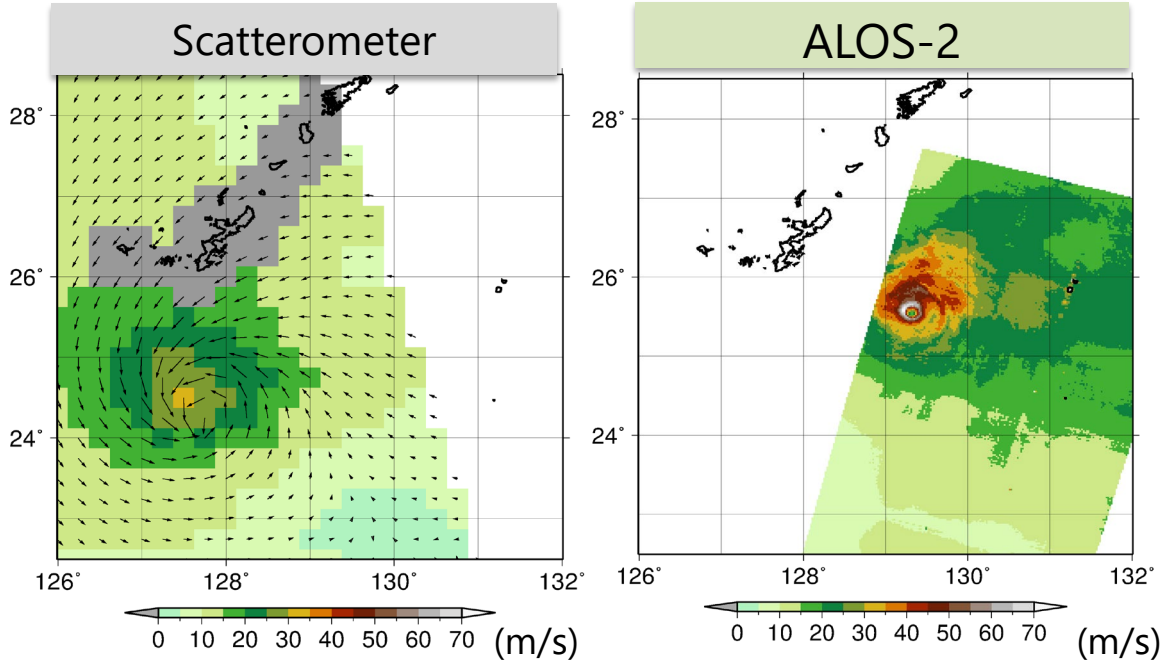
e.g.1) Time-series InSAR data and manuals for national public surveying by Geospatial Information Authority of Japan





Leveling and InSAR combination (concept image)

e.g.2) Typhoon wind speed monitoring for improving forecast by Meteorological Research Institute



PALSAR-3 operation plan

Launch

▲

Jul. 1

Critical operation (LEOP)	Initial check-out operation	Initial cal/val operation	Regular observation
After satellite separation, attitude establishment, solar array paddle deployment, followed by PALSAR-3 and SPAISE3 antenna deployment	Confirmation that the satellite system and mission equipment have the required functions and performance	Calibration and validation on PALSAR-3 products	Start providing PALSAR-3 standard products (*)
Completed Jul. 3	**Completed Oct. 18**	to around Jan. 2025 (about 3 months)	

* JAXA plans to provide PALSAR-3 standard products to general users (all users other than those who have an agreement/arrangement with JAXA) from multiple private companies selected by JAXA.

JAXA is now calling for applications for this data and service providers.

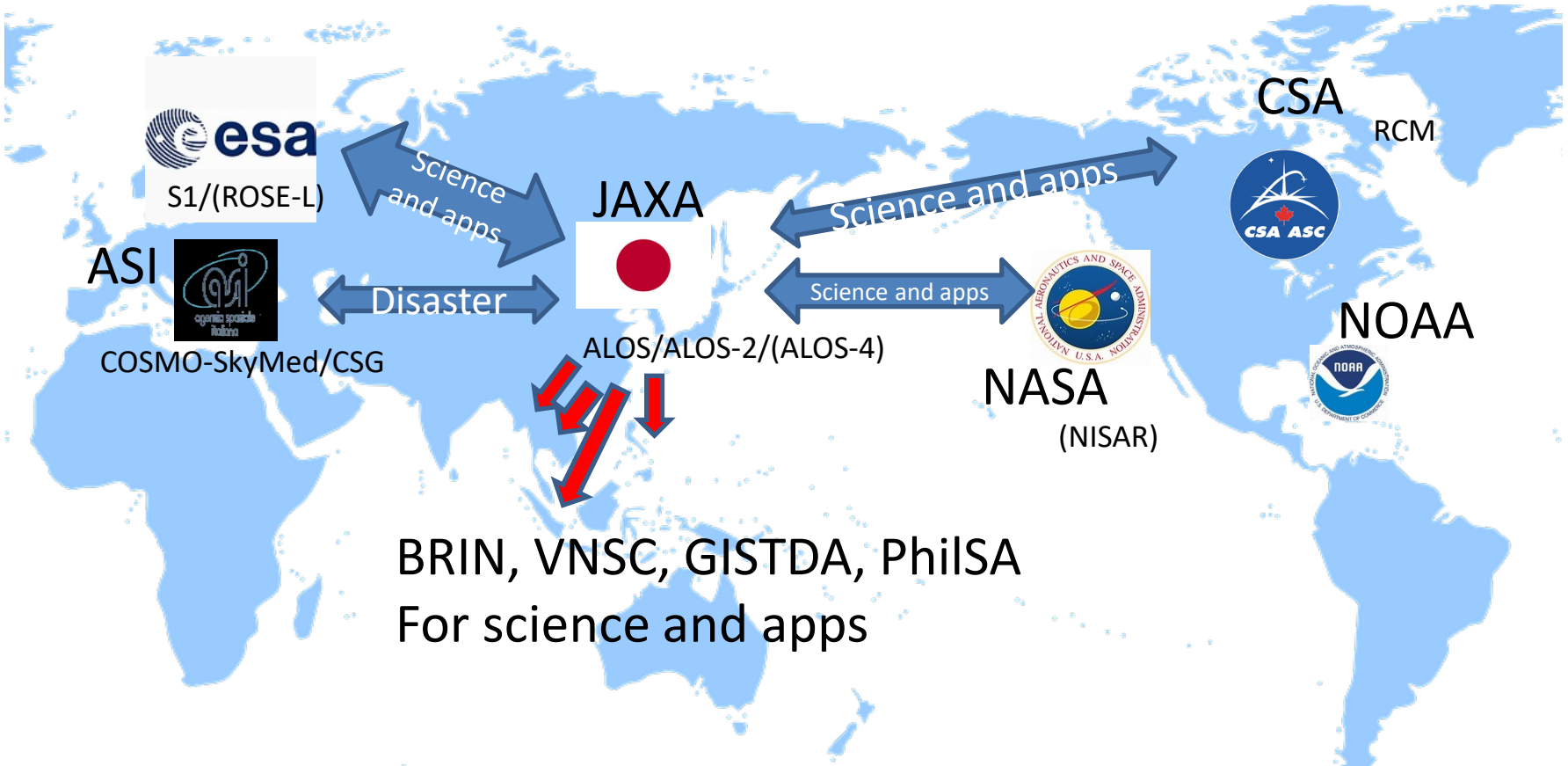
PALSAR-3 Basic Observation Scenario

- For regular observations, PALSAR-3 observations will be performed according to the Basic Observation Scenario (BOS). The BOS will be continuously updated based on user feedback during operation.
- Global observations incorporate full polarimetry observations and observations of selected regions for several topics (forest, agriculture, polar/ice, land deformation, etc.).

Area	Theme	Observation			
		Mode	Pol.	Direction	Frequency
Japan	**Disaster basemap**	Stripmap 3 m/200 km swath, ScanSAR	Dual	Right and Left	1 year (left 30-44 deg. only),3 years (the others)
	Timeseries observations	Stripmap 3 m/200 km swath	Dual	Right	Around 20 times/year Reduced frequency is allowed during basemap acquisition.
Global	**Global basemap**	(Asc.) Stripmap 10 m/200 km swath (Des.) Stripmap 6 m/100 km swath	(Asc.) Dual (Des.) Full	Right	1 year
	Disaster basemap	ScanSAR 700 km swath, Stripmap 10 m/200 km swath	Dual	Right	Once every 3 years
	Thematic observations	Depends on theme	Depends on theme	Right	Depends on theme

SAR international cooperation

- SAR-related cooperation is ongoing with space agencies around the world



- Science and apps: Ocean (Sea Ice, ship detection, oil spills), Land use (agriculture, soil moisture, SWE, crustal deformation - volcanos, subsidence, LULCC, forests) with disaster response

Promoting of public-private partnerships

- An industry-government-academia consortium for satellite Earth observation in Japan (“CONSEO”) was established in 2022, with JAXA working as the secretariat.
- In this year, drills on disaster observation and data utilization are planned to identify the issues and future goals of cooperation between public and private SAR/optical satellites.

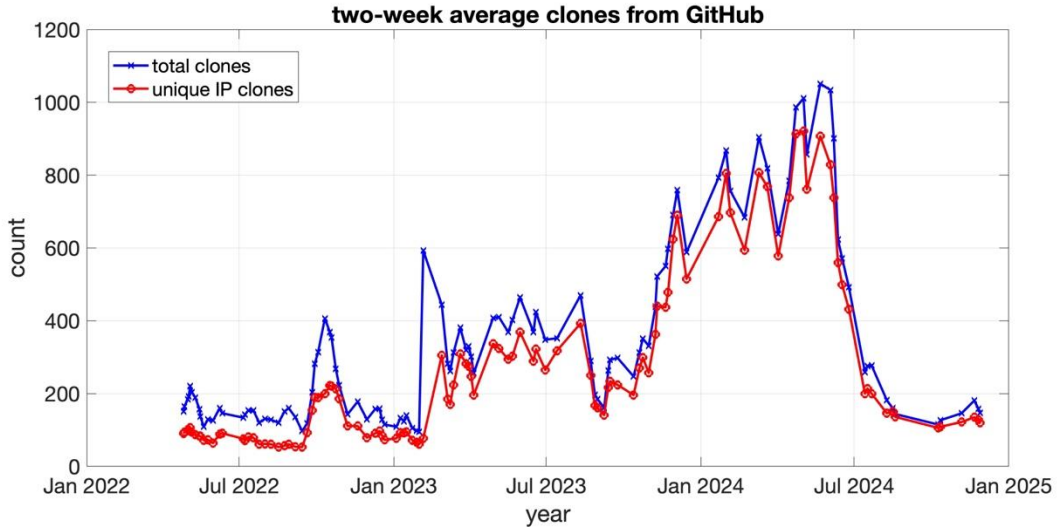
GMTSAR Progress 2024

Developer/Instructor Team: Xiaohua Xu, David Sandwell, Rob Mellors, Xiaopeng Tong, Matt Wei, Eric Lindsey, Katherine Guns, Kang Wang, Kathryn Materna, Ekaterina Tymofyeyeva, Wojciech Milczarek, Dunyu Liu, Wanpeng Feng, Wei Tang, Ann Chen, Qi Ou, …

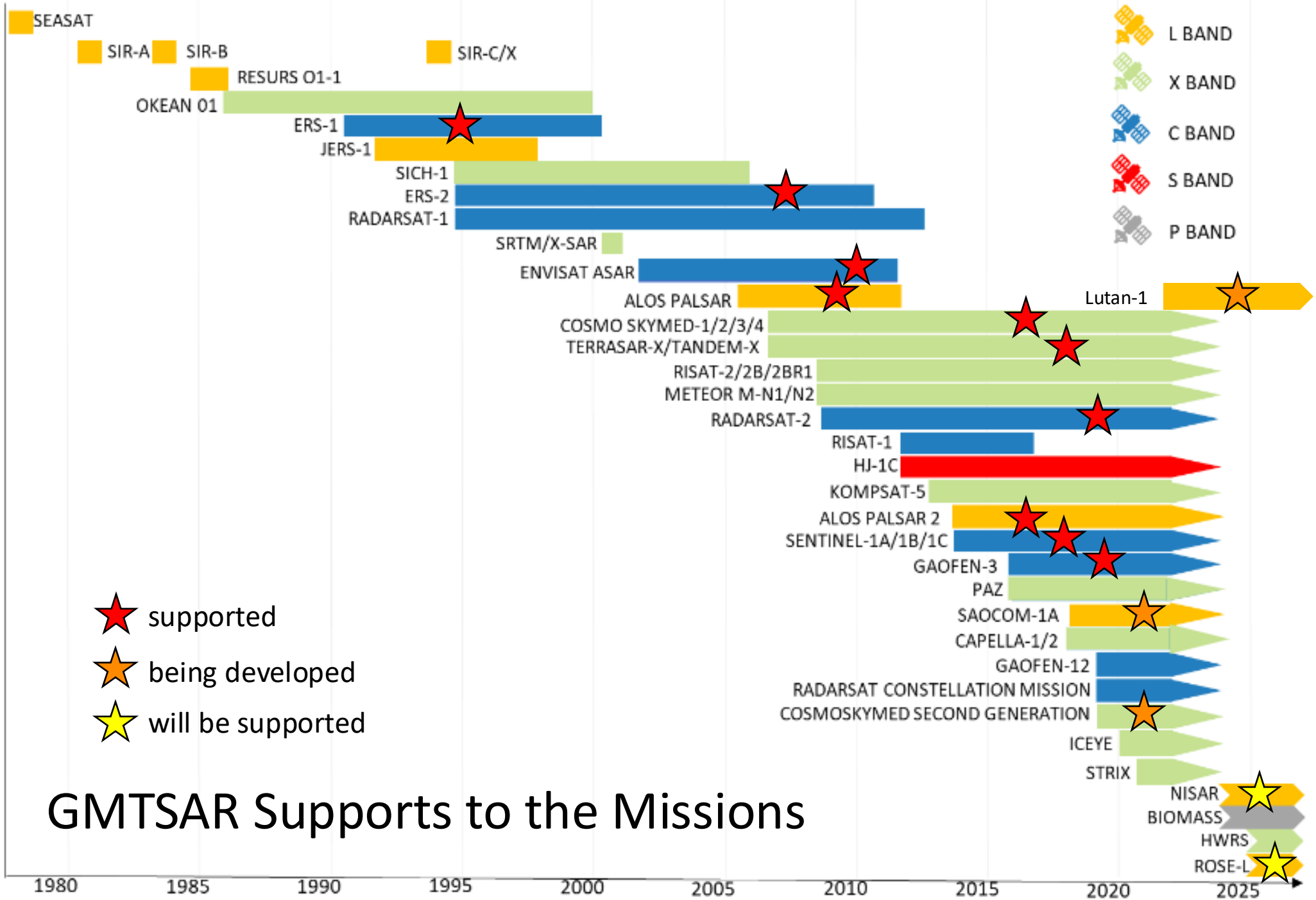
Past and Current Funding Support: NSF Geoinfomatics, NSF Cyberinfrastructure, NSF CSSI, SC/EC, …

Some Metrics:

Year	Yearly GitHub clones / clones with unique IPs	GitHub clones/clones with unique IPs per 2 weeks	GitHub issues addressed	Summer school students	Committed changes on GitHub	Issues addressed on GitHub*
2023	5400/3400	208/130	326	~130	70	326
2024	12580/10790 ↑	484/415	139 ↓	~200 ↑	55	139

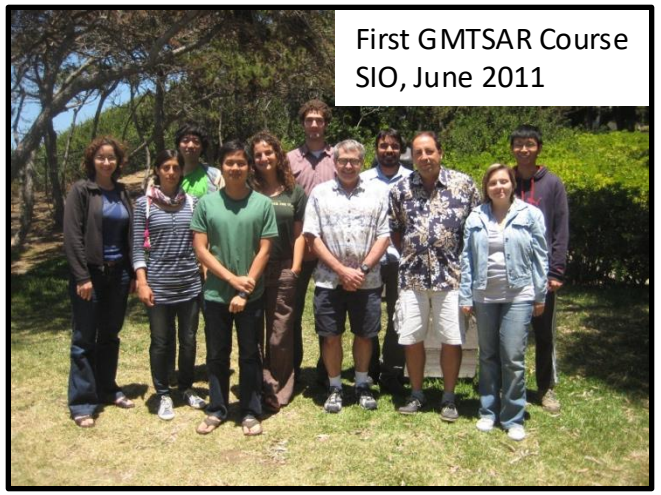


Developments: NISAR support, Python modules, InSAR Theory Book with GMTSAR published, Tutorial Book on its way, Documentation Webpage ready …

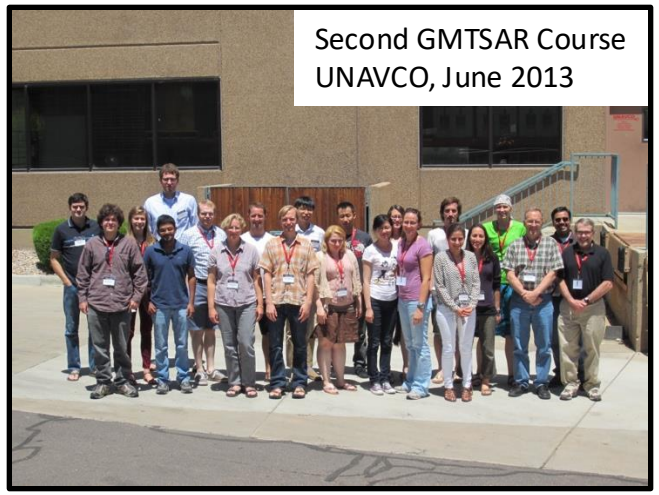


GMTSAR Supports to the Missions

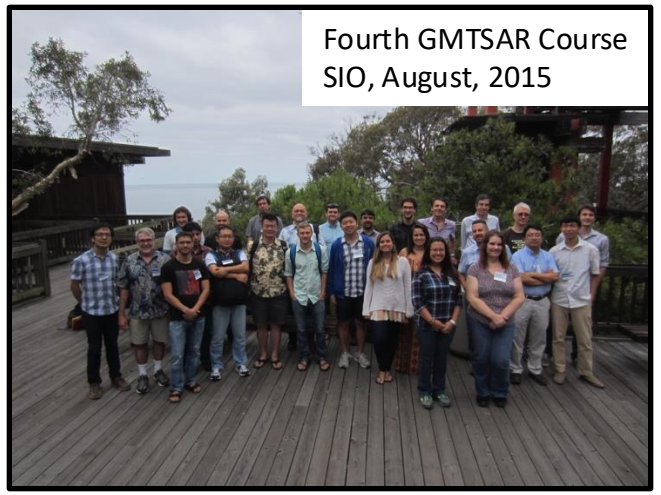
GMTSAR Short Course Supported By EarthScope



First GMTSAR Course
SIO, June 2011



Second GMTSAR Course
UNAVCO, June 2013



Fourth GMTSAR Course
SIO, August, 2015

Sixth GMTSAR Course
Chinese Academy of Sciences,
June, 2017

Tenth GMTSAR Course
On-Line, July 22-23, 2020

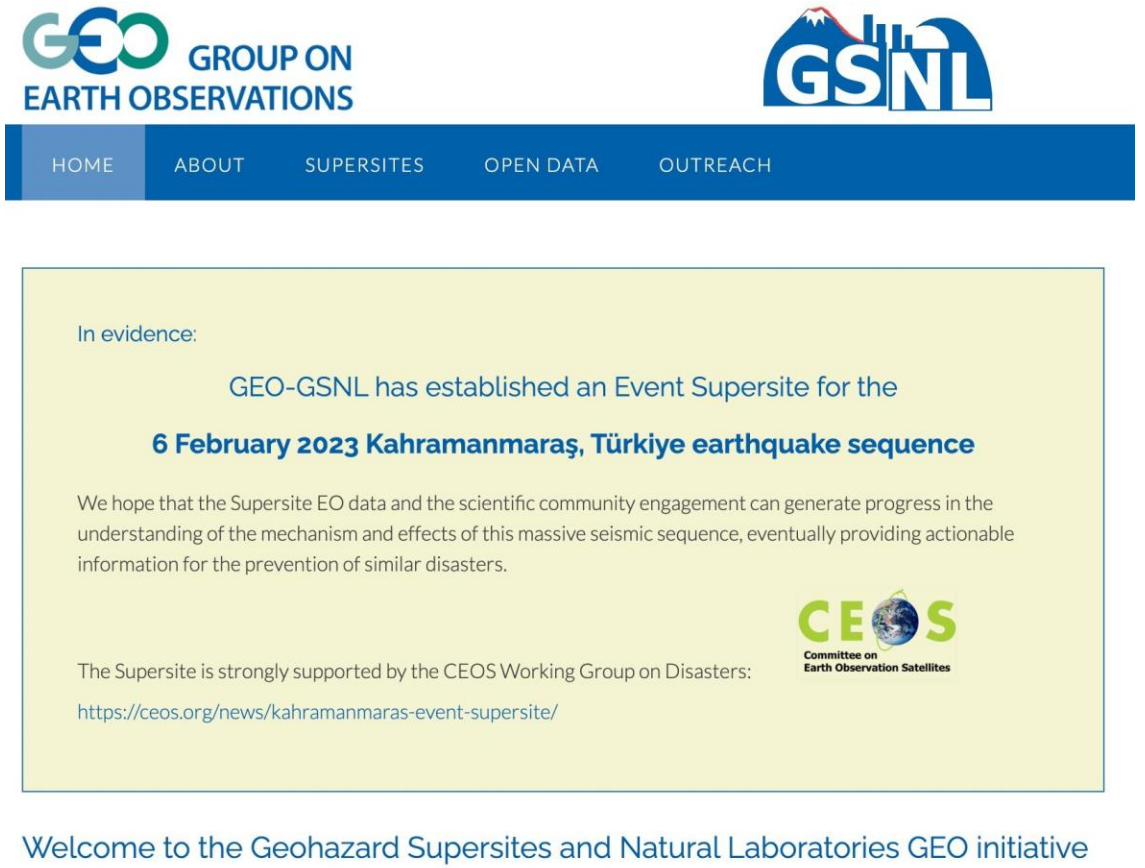
GMTSAR
GMT
MintPy
…

More to come:
GACOS
PS+DS / SHPs
Topo Mapping
…

Thanks for the continuous and solid support from EarthScope !!!

Stefano Salvi
INGV
Chair of the Geohazard Supersites and Natural Laboratories

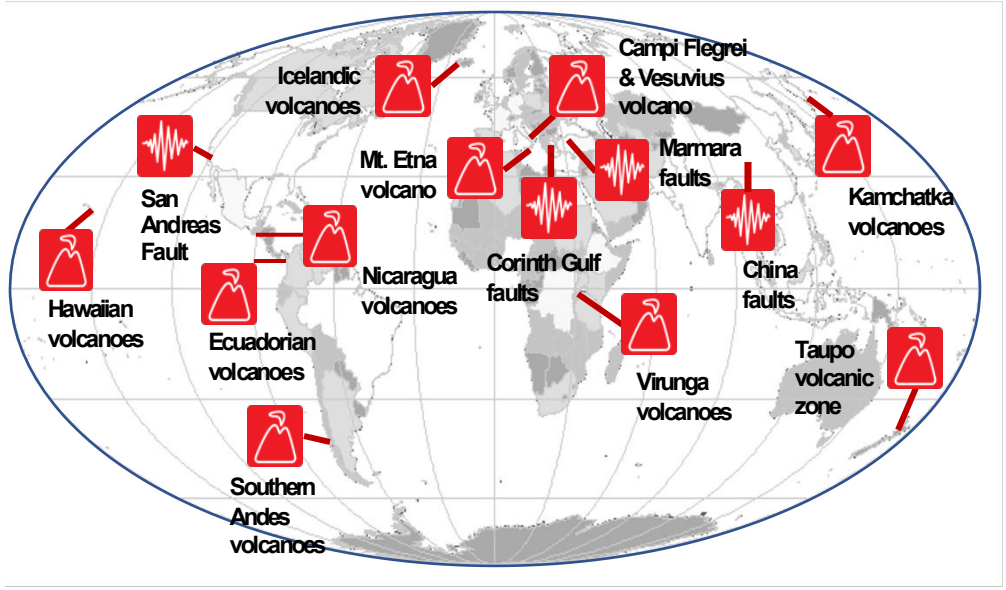
GEO initiative geo-gsnl.org



……Since UNAVCO now is fused in EarthScope, we would need to establish new contacts. Before it was mainly Chuck Meertens who supported GSNL.

What we would need is a way to provide easy access to the Supersite data, for instance through the SSARA archive of UNAVCO, if they maintain it, and some support for training in InSAR processing for students from developing countries Supersites.

Geohazard Supersites and Natural Laboratories

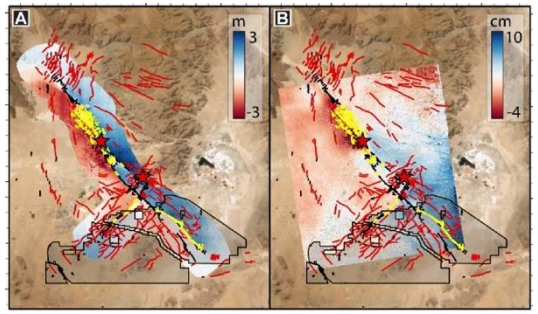


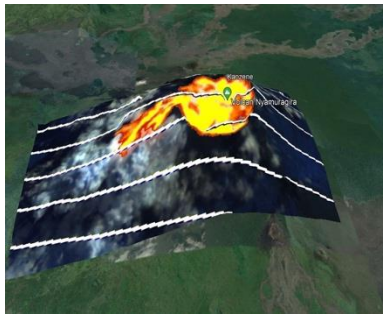
As of 2023: 13 Supersites and 1 Natural Laboratory + 1 Event Supersite.

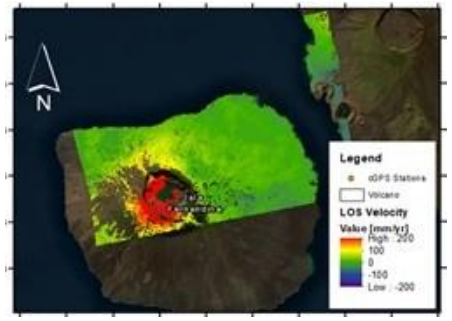
All together they receive 3-4000 images per year (X, L-band SAR, VHR optical) which become open for scientific research, together with local ground data. In most cases, the EO data are fundamental for operational hazard monitoring.

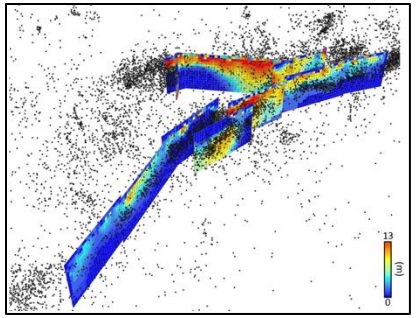
GSNL is constantly seeking support to develop scientific/monitoring capacities at the 3 Supersites in developing countries (Ecuador, Nicaragua, D.R. Congo).

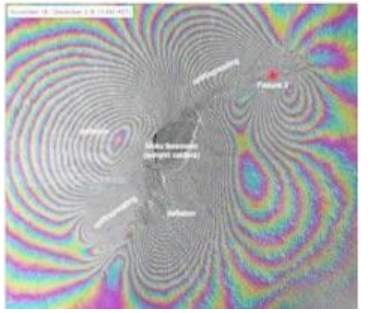
If EarthScope is able to help, we can discuss the possible ways.

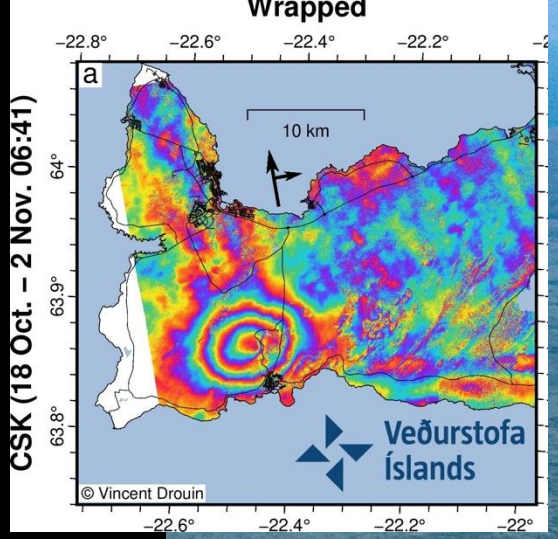












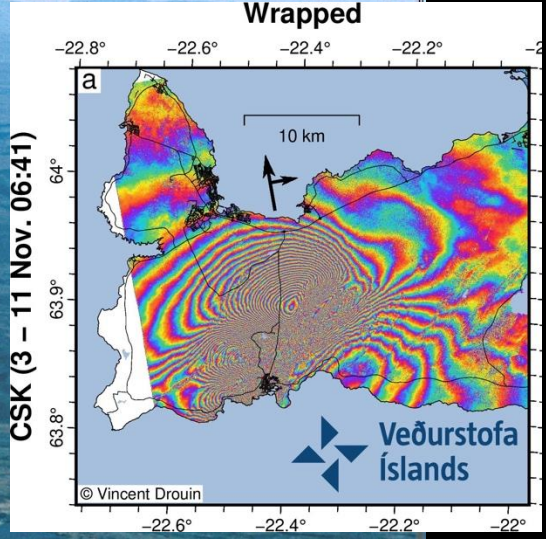
Reykjavík

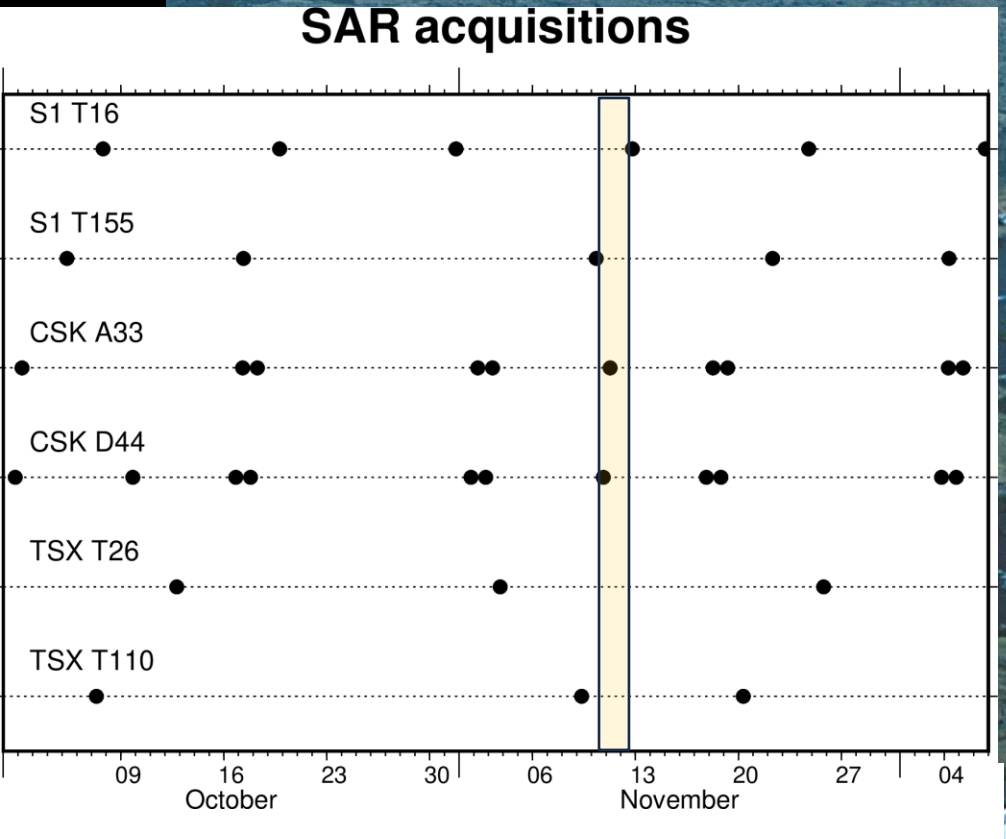
Fagradalsfjall

Area of inflation/deflation

Svartsengi
(Blue Lagoon)

Grindavík





Approximate surface projection of dike in November 2023

Icelandic Volcanoes Supersite

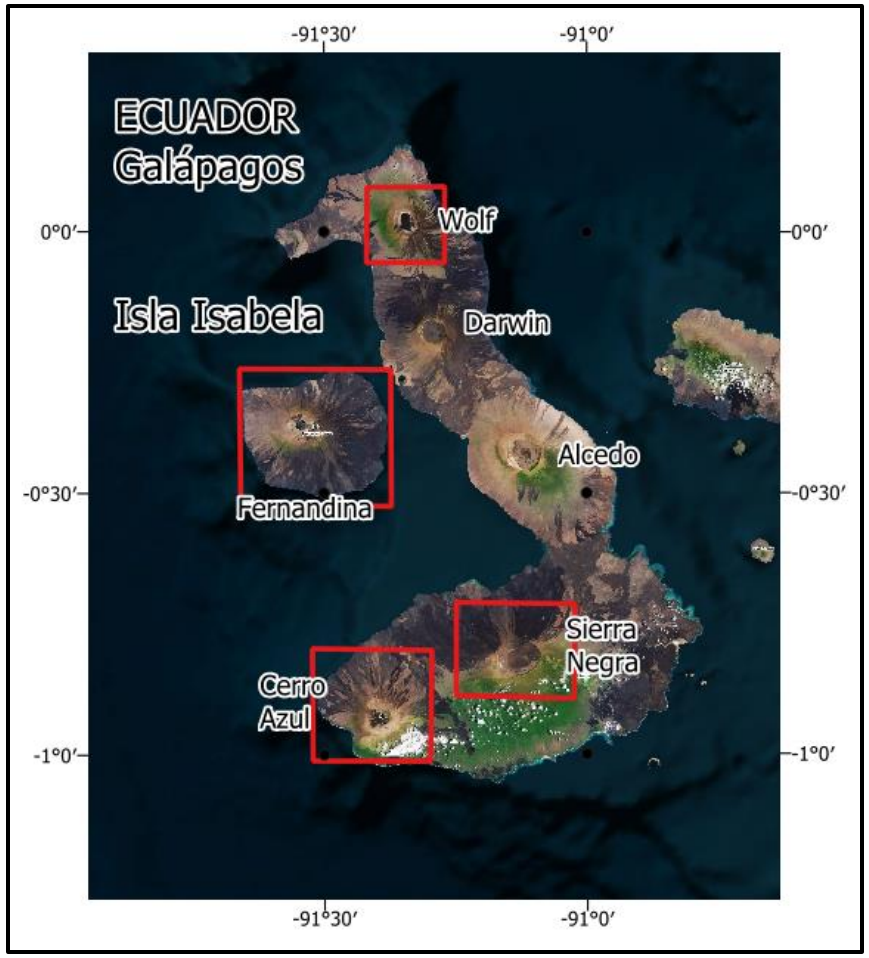
Photo: Oddur Sigurdsson
Icelandic Meteorological Office

Ecuadorian Volcanoes Supersite_2024

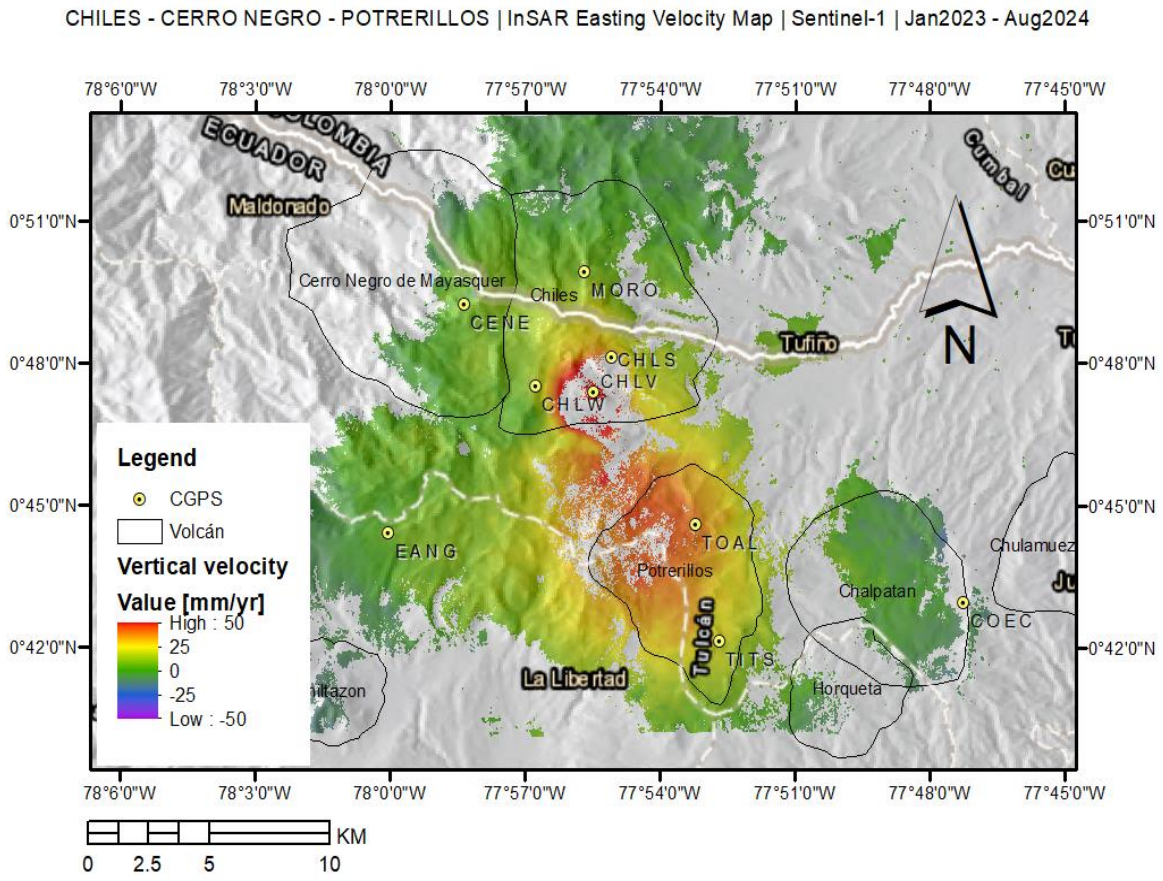
P. Mothes & M. Yepez
IG-EPN (2024)

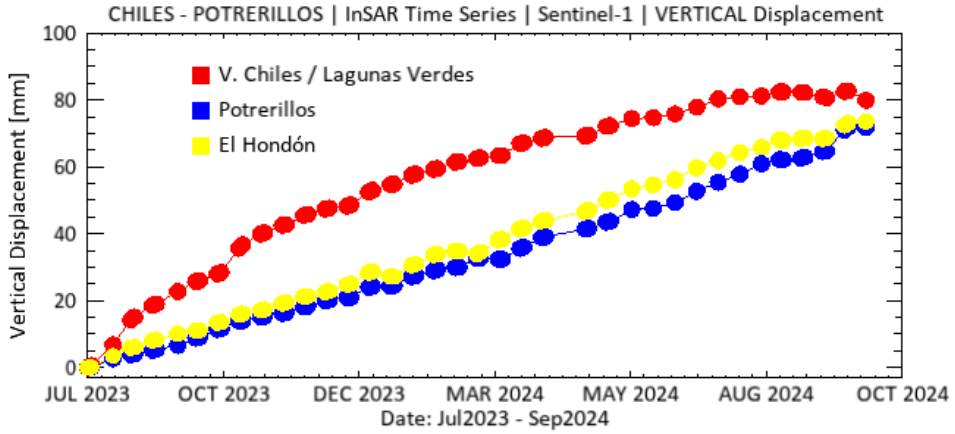
Volcanoes monitored on the Continent with InSAR.

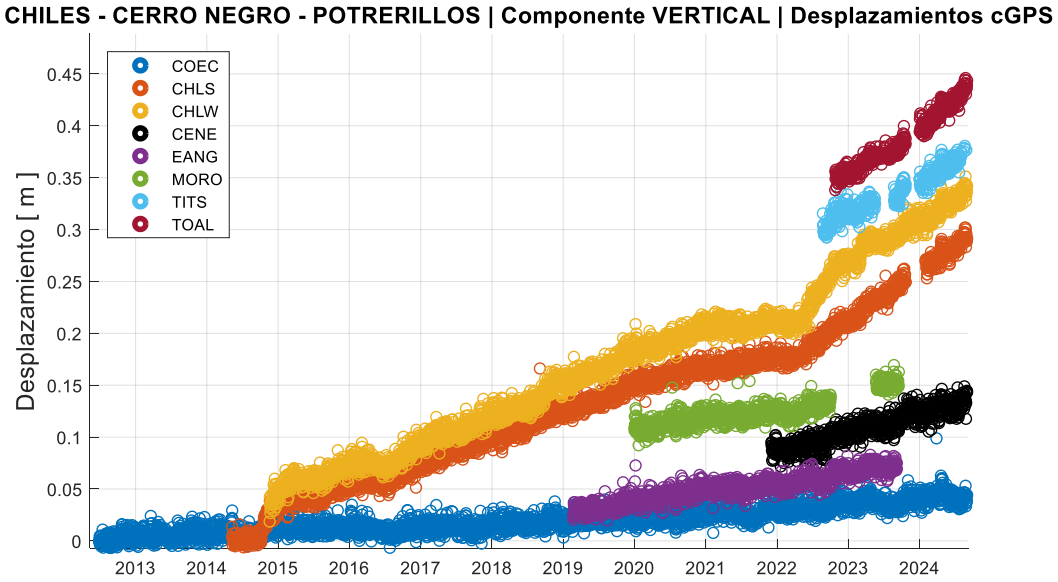
Volcanoes monitored in the Galapagos Islands with InSAR



CHILES – CERRO NEGRO Volcanic Complex | InSAR Velocity Map | Sentinel1 | Vertical Decomposition







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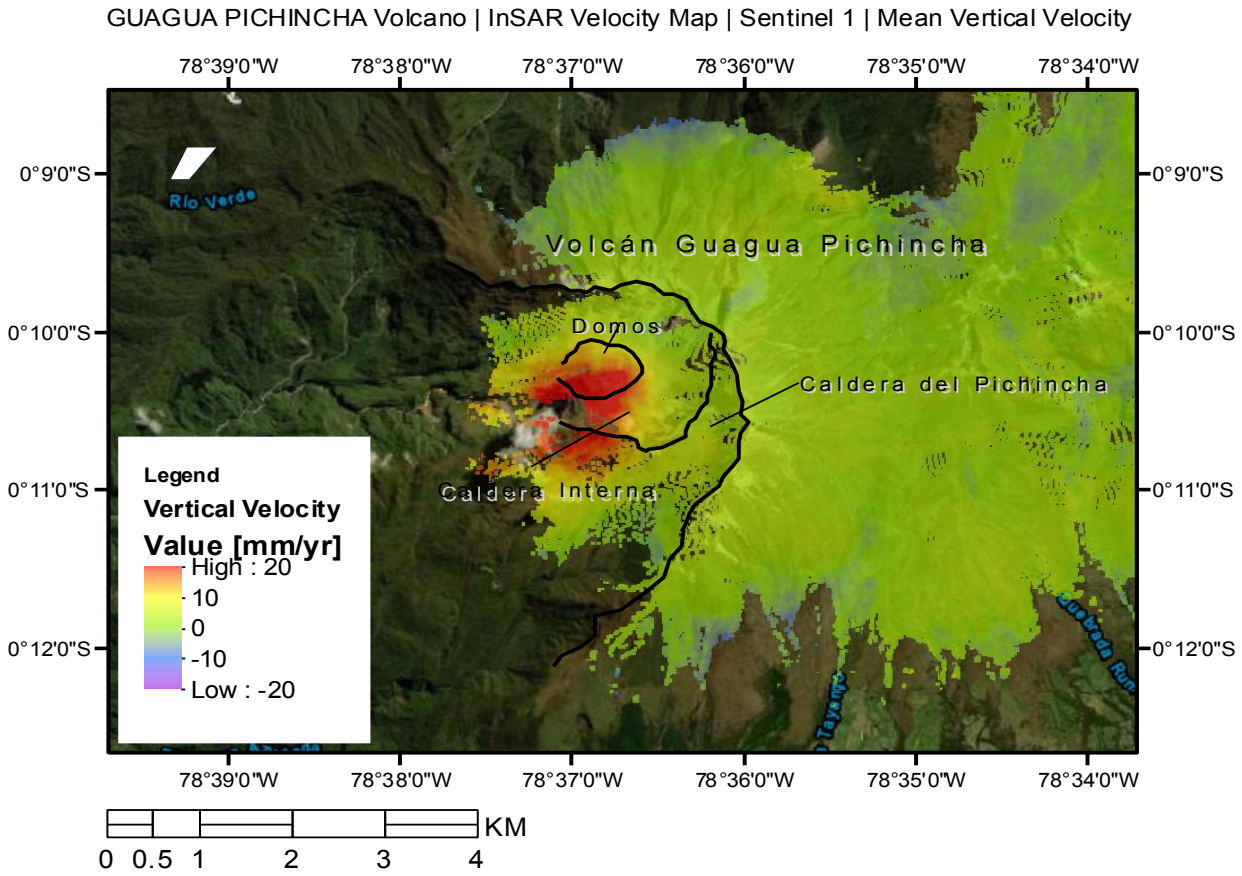
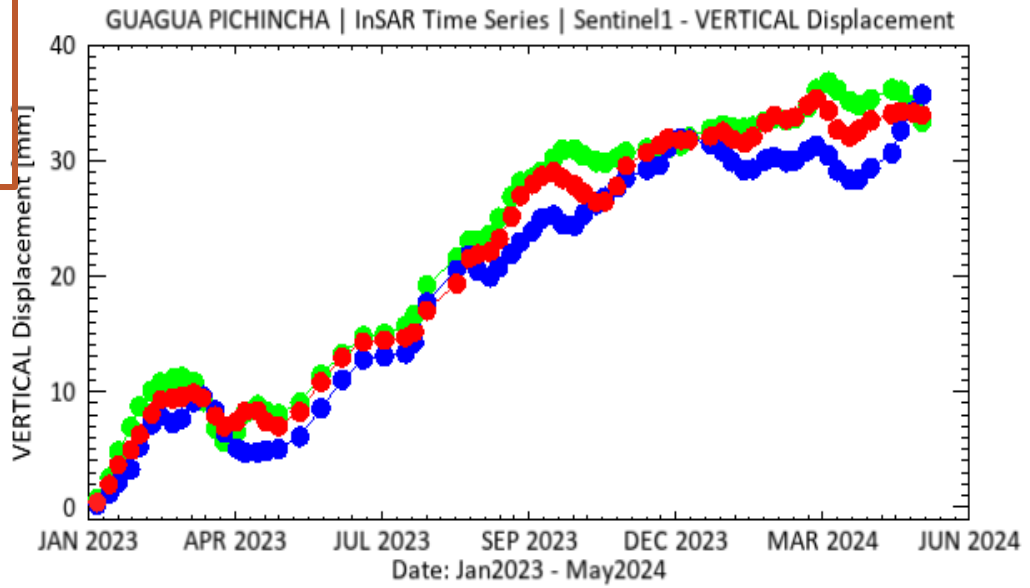
GUAGUA PICHINCHA Volcano | InSAR Velocity Map, | Sentinel 1
Vertical Velocity Decomposition





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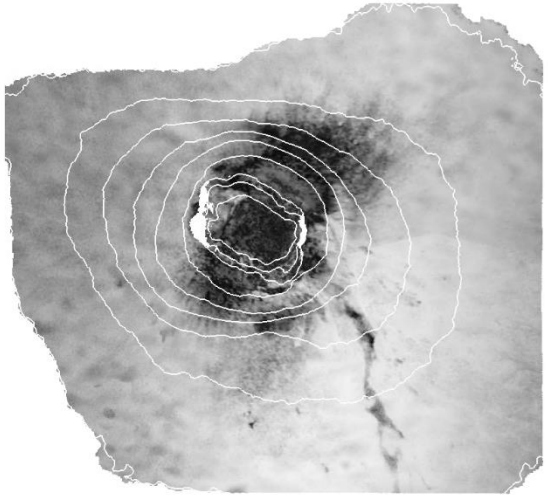
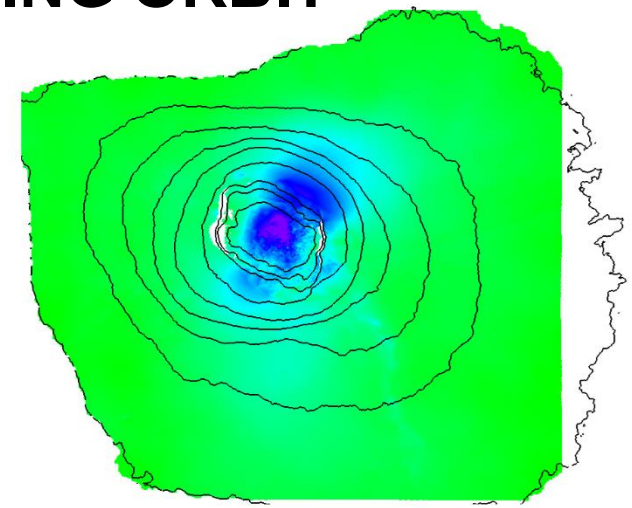
FERNANDINA INSAR TIME SERIES- Eruption in March, 2024
DESCENDING ORBIT

a)



b)



c)

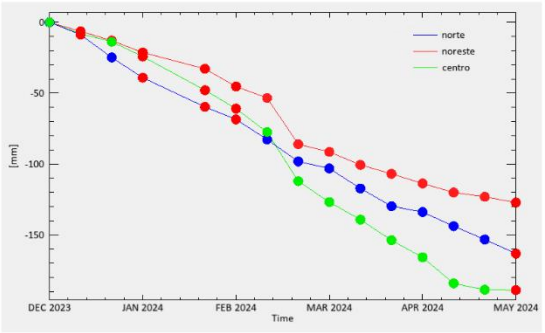


Fig 1. a) Coherence map, black color shows low coherence related to big changes, computed in SARSCAPE software.
b) velocity map, blue and purple color shows deflation related to eruption on march 2024 .
c) Time series shows deflation; however, the magnitud of deflaction is afected by co-eruptive deformación. (by Santiago Aguaiza, IG-EPN)

Questions?

Thank you for coming!