WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

AGENDA

1. Welcome from the WInSAR Executive Committee: Kristy Tiampo
2. Welcome and update from the UNAVCO President: Rebecca Bendick
3. Introduction: Kristy Tiampo
4. Report on WInSAR activities at UNAVCO: Chris Crosby

5. Update from NASA: Gerald Bawden
6. Update from ESA: Pierre Potin
7. Update on NISAR and ISCE: Paul Rosen
8. Update on GMTSAR: David Sandwell
9. Update from ASF: Franz Meyer and Wade Albright
10. Update from GEO Supersites: Stefano Salvi
11. Update on UAVSAR: Yunling Lou
12. Update from JAXA: Shin-ichi Sobue

WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Who we are and what we do

WInSAR is a group of InSAR users and researchers that coordinate InSAR activities in North America. Our mission is to:

- advocate for opening access to SAR data
- plan and sponsor training courses for the community
- distribute and maintain software, search tools and data products
- advise on policies and best practices
- maintain an archive of SAR data for North America

The Executive Committee:

Kristy Tiampo (Chair), Estelle Chaussard (Vice-Chair), Eric Hetland, David Bekaert (Secretary), William Barnhard, Gareth Funning (ex-officio)

winsar.unavco.org

WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Training courses, 2020

InSAR Data Interpretation and Analysis for Nonspecialists

- Our 1 day short course to be held at EGU in May was cancelled
- Targeted at 'end users', how to use processed InSAR data for their research; available online

InSAR Processing and Theory with GMTSAR

- Multi-day short course, online, June-July 2020

InSAR Theory and Processing (ISCE)

- Multi-day short course, online with ASF support, August 2020

Future courses

- Several versions of InSAR for Nonspecialists and/or ARIA Tools and Time Series Processing
- Investigating expansion of multi-day short courses to other locations

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Western North America Interferometric Synthetic Aperture Radar Consortium

WInSAR Executive Committee Election Results, 2021-2022

- Chair: Eric Lindsey

- Members:
  - David Bekaert
  - Estelle Chaussard
  - Katia Tymofyeyeva
  - Ann Chen

WInSAR Operations Update

Christopher Crosby

AGU WInSAR Business Meeting - December 14, 2020

GAGE National Science Foundation's Geodetic Facility for the Advancement of Geoscience

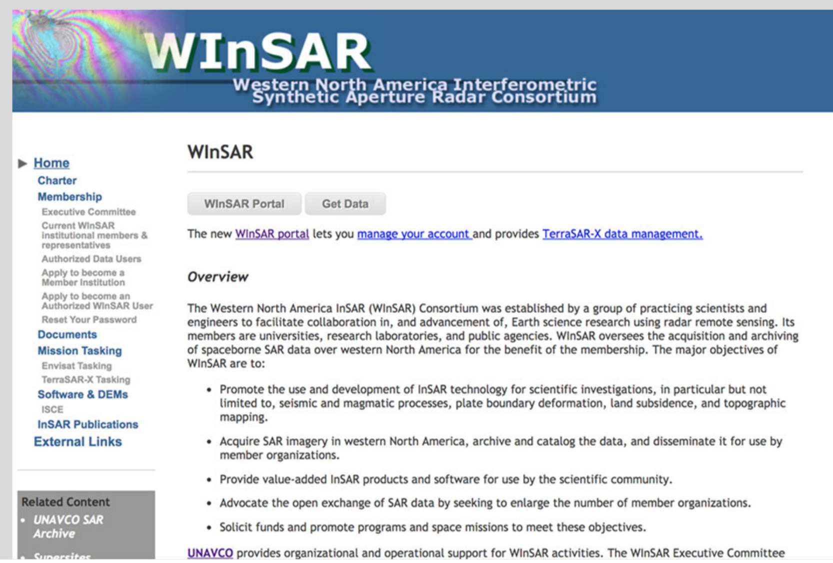
UNAVCO

WInSAR operated by UNAVCO under GAGE (Geodetic Facility for the Advancement of Geoscience (GAGE)) Cooperative Agreement. *Oct. 2018 – Sept. 2023*

WInSAR funded ~1 FTE in GAGE, supported by NSF & NASA

Activities

- Project management and Executive Committee support
- Archive operations & maintenance
- Tasking, data ordering, data ingest
- Website/portal and user community support
- ISCE software access management
- Community short course support



The WInSAR Community

313 WInSAR Institutional Members (10 new member institutions in 2020) =**1866 Registered Users** (+194 in 2020)

Data:

181+ TB of data available for download

3,773 ALOS-2 wide swath scenes = 126+ TB

Recent updates:

1. **Institutional Representative clean-up:**
   In preparation for 2020 EC election, asked Full category reps to verify that their affiliation is correct. 46% response rate. Please review:
   https://winsar.unavco.org/membership/institutions/

   Email changes to: winsar@unavco.org

2. **Staff changes:**
   Scott Baker departed UNAVCO September 2020.

   Matt Beckley, geodetic imaging data engineer now handling SAR data operations.

WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Membership ▾ Resources ▾ Data ▾ Software ▾ PI Proposals ▾ crosby ▾

Membership: Institutional Representation

There are three classes of WInSAR Institutional Members: **Full Member** — U.S. institutions; **Adjunct I Member** — institutions in Canada and Mexico; **Adjunct II Member** — all other institutions.

There are 313 WInSAR Institutional Members. The representatives names and emails are shown.

Institution	Representative	Category	ISCE
AGH University	Katarzyna Mirek	Adjunct II	✔
Academia Sinica	Yunung Lin	Adjunct II	
Addis Ababa University	Elias Lewi Teklemariam	Adjunct II	✔
Aligarh Muslim University	Mohammad Suhail	Adjunct II	
Appalachian State University	Scott Marshall	Full	✔
Applied GeoSolutions	Nathan Torbick	Adjunct II	✔
Arizona State University	Ramon Arrowsmith	Full	✔
Autonompus University of Mexico State (UAEM)	Norma Davila	Adjunct I	✔
Baylor University	Vincent Cronin	Full	
Blacknest AWE	Stuart Nippress	Adjunct II	✔
Bogazici University	Semih Ergintav	Adjunct II	✔
Bogor Agricultural University	Bambang Trisasongko	Adjunct II	✔
Boise State University	Hans-Peter Marshall	Full	✔
Bournemouth University	Andrew Ford	Adjunct II	✔
Brian Conway	Brian Conway	Full	
British Geological Survey	Ekbal Hussain	Adjunct II	
CICESE, Division de Ciencias de la Tierra	Javier A. G. Ortega	Adjunct I	✔
CSIR-Fourth Paradigm Institute	Tejpal Singh	Adjunct II	✔
CSIRO	Zheng-Shu Zhou	Adjunct II	✔
California Institute of Technology	Mark Simons	Full	
California State Polytech. Pomona	Jascha Polet	Full	
California State University, Fresno	Clement Ogaja	Full	
California State University, Sacramento	David Shimabukuro	Full	✔
Carleton University	Derek Mueller	Adjunct I	✔
Carnegie Institution for Science	Helene Le Mevel	Full	✔
Central South University	Bing Xu	Adjunct II	✔

InSAR Product Archive

Developed in 2014-2015 during SSARA project.

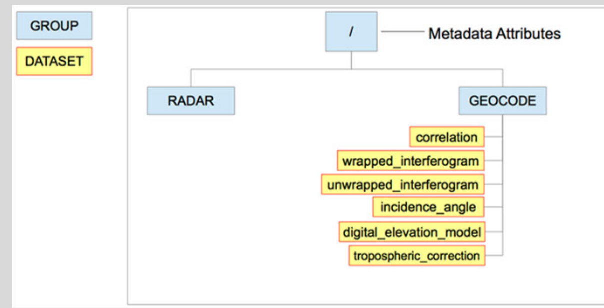
Community-contributed InSAR archive for interferograms, time series, and other derived data products: https://winsar.unavco.org/portal/insar

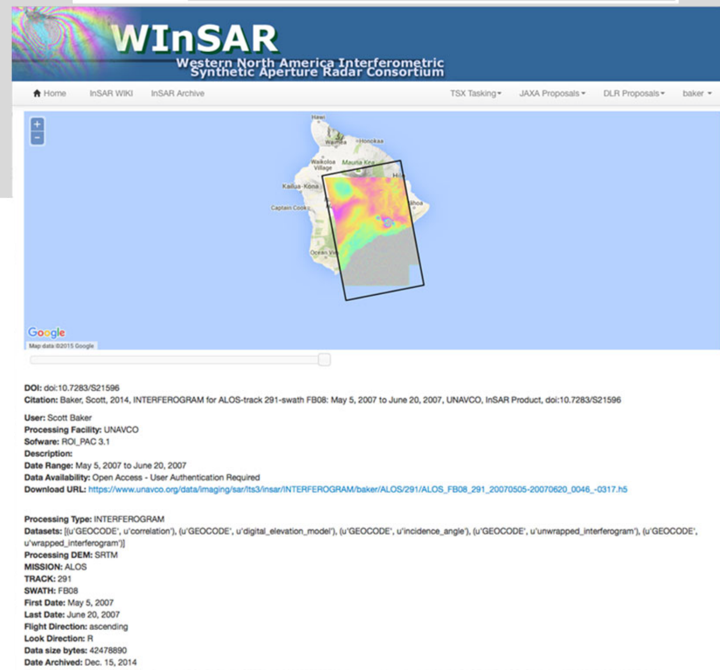
HDF5 format is used for the data products. Example converters for ROI_PAC, ISCE, and GMTSAR provided on SSARA GitHub repository

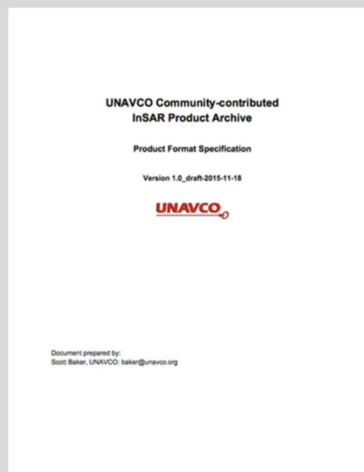
REST interface for uploading interferograms: https://winsar.unavco.org/portal/insar/api/

Datasets receive DOI =
use archive for FAIR data compliance
when submitting publications.

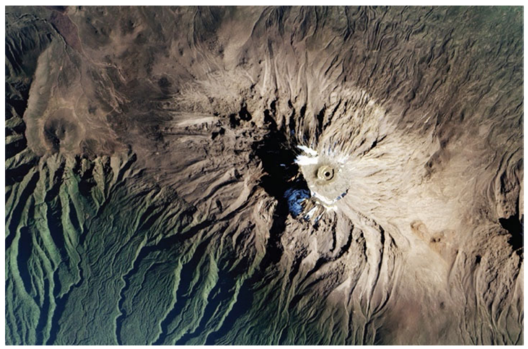
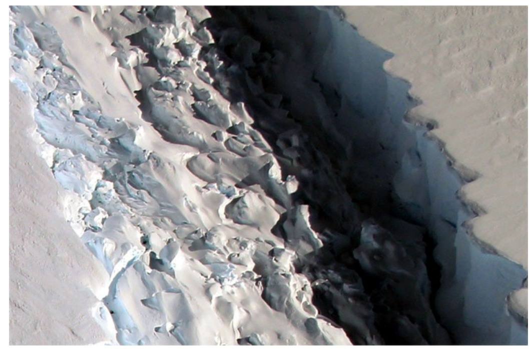
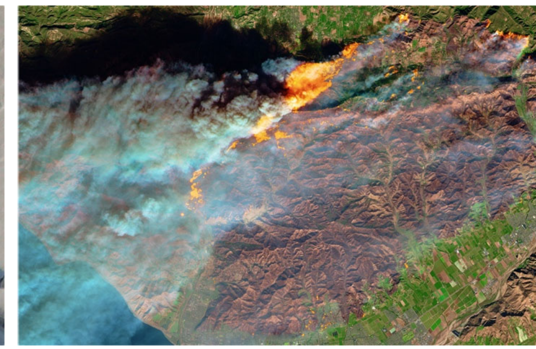
HDF5-EOS Format







SCIENCE

NASA Brief to WInSAR

Western North America Interferometric Synthetic Aperture Radar Consortium

AGU100 ADVANCING EARTH AND SPACE SCIENCE

Gerald Bawden

Earth Science Division, NASA HQ

December 14, 2020

Changes at NASA HQ

- Karen St.Germain – New Director of Earth Science Division (ESD)
  - *Background in cryosphere*
- Sandra Cauffman – Returns to her Deputy Director of Earth Science
- Kevin Reath – Earth Surface and Interior (ESI) Deputy Program Manager

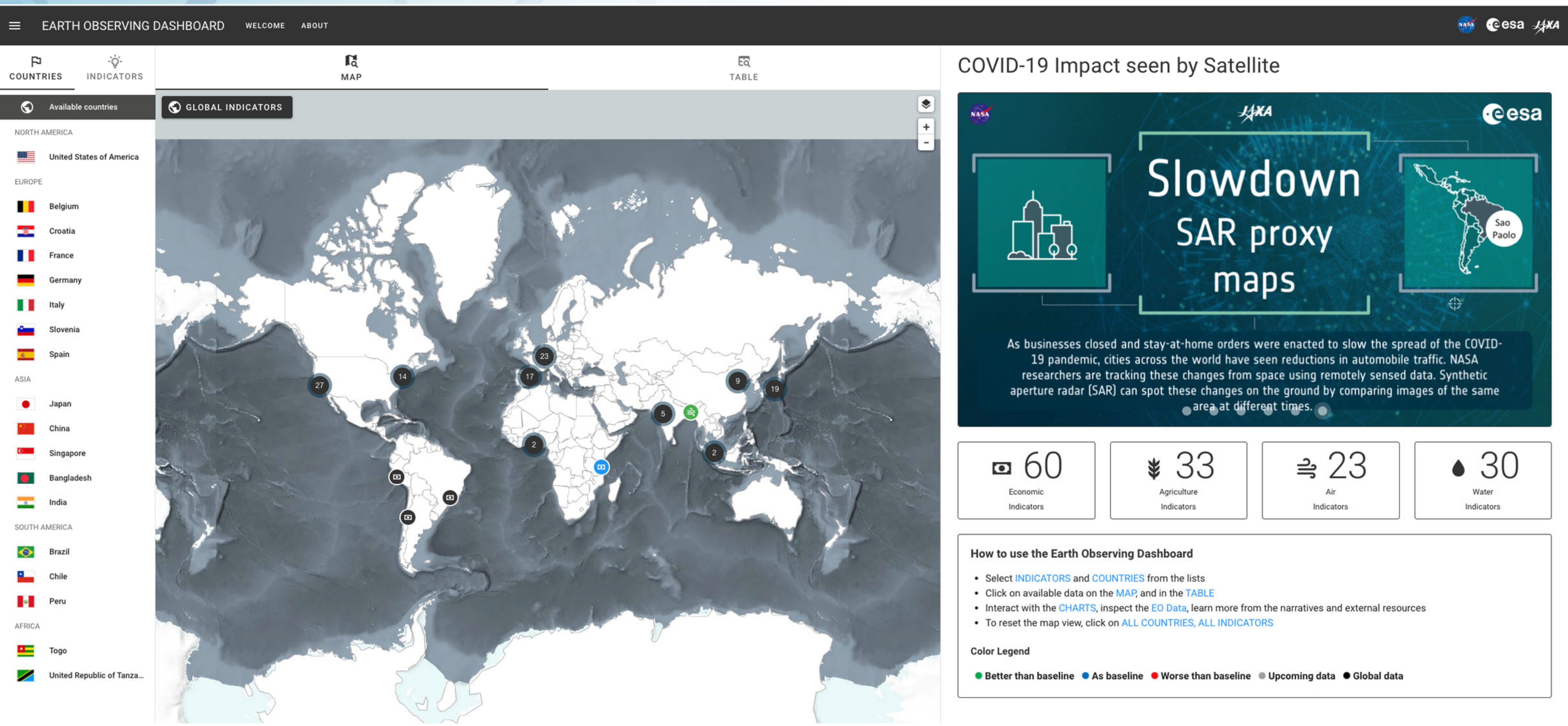
Upcoming NASA Opportunities

- FINESST (graduate student research) deadline February 4, 2021
- ESI ROSES solicitation – anticipated February 14, 2021

JAXA-NASA L-SAR Cooperation

- NASA and JAXA are finalizing data agreement for ALOS-2 and exploring ALOS-4
- More in Shin-ichi Sobue's presentation

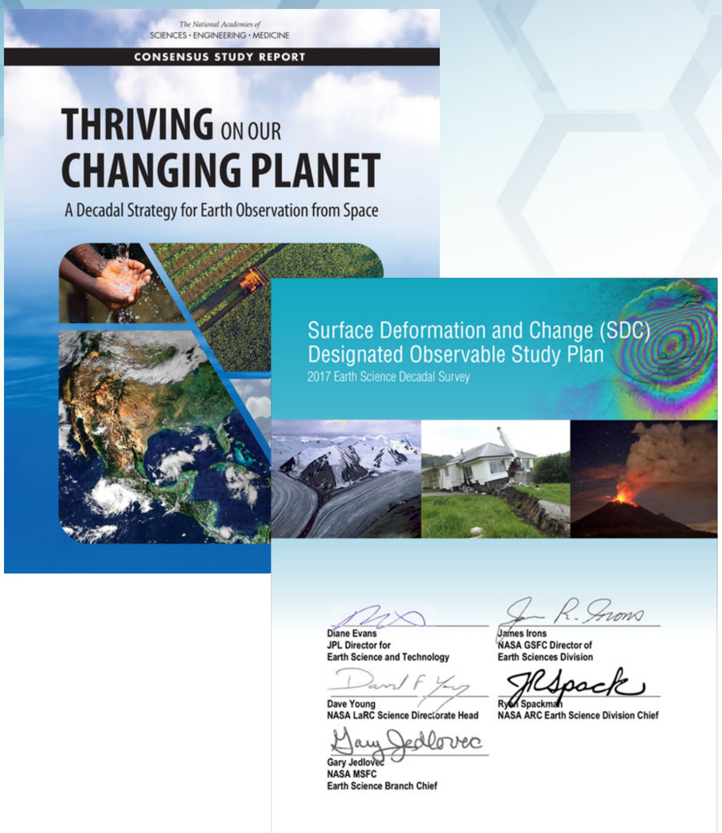
ESA-JAXA-NASA Collaboration on COVID-19
eodashboard.org



NISAR Launch Date Delayed
Launch Date is now January 2023*

- COVID-19 has impacted both NASA and ISRO
  - Facility closures and restarts with limited staffing
  - Reprograming the timing of the some of the system integration and testing elements have lessen the overall schedule delay.
- NASA/JPL & ISRO have agreed to a new schedule plan that realistically results in a launch not later than late January 2023
  - Engineering delays and COVID-19 impacts have both contributed to delays
  - *Eclipse launch blackout from Oct 2022 to Jan 2023
- L-SAR is fully integrated and in test; hardware is performing well.
- S-SAR is on a parallel integration and testing with L-SAR – delivery to JPL planned for early January 2021.
- More in Paul Rosen's presentation

Decadal Survey Designated Observable Surface Deformation and Change Architecture Study Underway



Instrument

- Interferometric Synthetic Aperture Radar (InSAR) with ionospheric correction
- Estimated cost cap: $500 million – encourages partnership

Science and Applications Objectives

- Measure and track land and ice surface deformation: *geodetic measurements (SAR phase)*
  - Solid Earth surface dynamics from earthquakes, volcanoes, land subsidence and landslides, tectonic plate deformation
  - Cryosphere dynamics associated with ice sheets, glaciers, sea ice and permafrost
- Plus, assess non-geodetic observables not emphasized in the DS: *radiometry/SAR backscatter*
  - Hydrology: soil moisture, surface water extent, aquifers
  - Ecosystems: biomass, disturbance, events
  - Applications: i.e. oil spills, agriculture, infrastructure

Study Duration

- Five years – Approaching the halfway point of the study period in early 2021
- SDC's launch window will likely be in the late 2020s to early 2030s

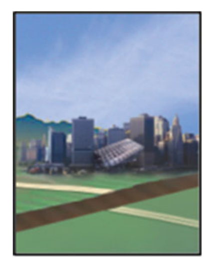
Get Involved!

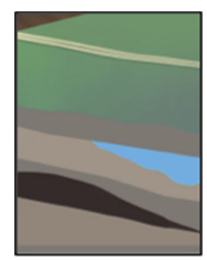
https://science.nasa.gov/earth-science/decadal-sdc

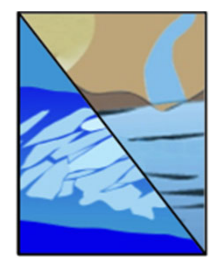
sdc-study@lists.nasa.gov


Solid Earth


Ecosystems

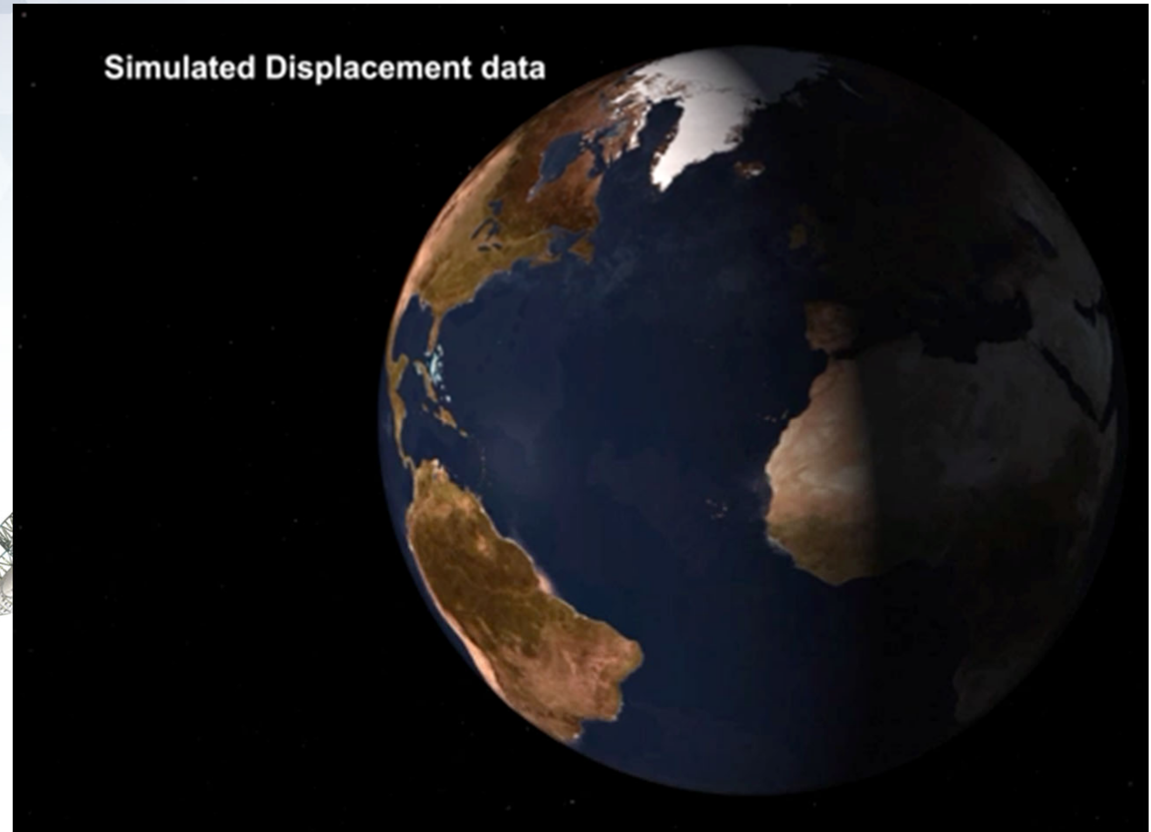

Geohazards

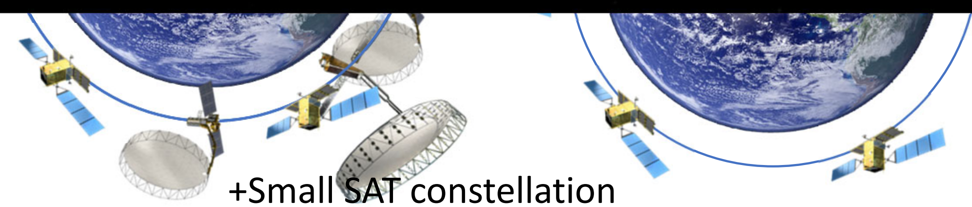

Hydrology


Cryosphere

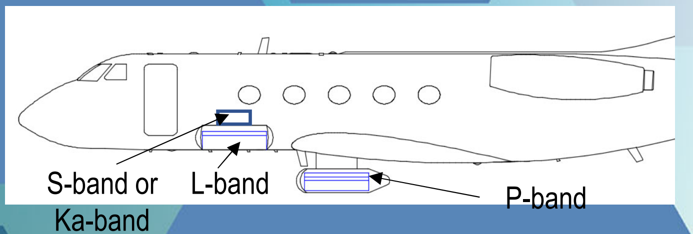
Candidate Architectures

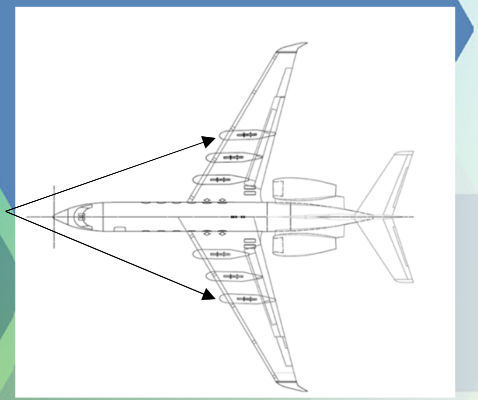
- The **performance tool** is **ready**, and our **SATM** is **nearly complete**.
- We have our first set of **architectures ready** for assessment
- In parallel, we have developed a model for commercial systems:
  - Probability that a given capability will be available
  - Probability that NASA tasking will be given priority
  - Cost of data





Note: Graphic of DLR's Tandem-L used to represent wide-swath future systems
Note: Graphic of ASI's CSK used to represent (relatively) small SAT SAR systems





UAVSAR

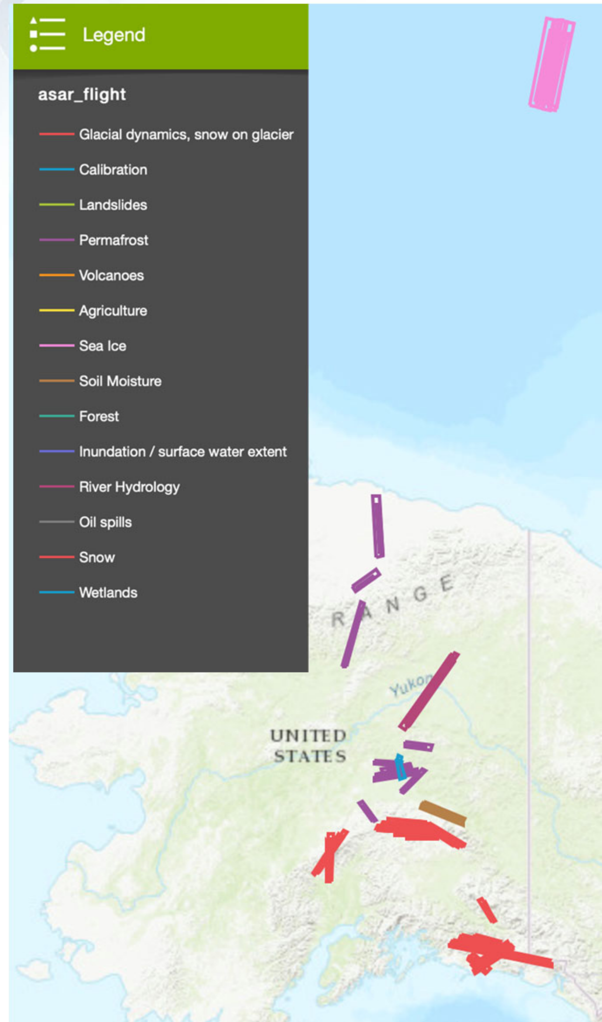
- Grounded from March to September 2020
  - COVID-19
- Flights have resumed… backlog of science flights
- Currently fly 2 days a week… pilot shortage and COVID-19 related issues
- Held a UAVSAR NextGen Workshop
  - Report in preparation
- Supported ASAR activities

- More in Yunling Lou's presentation

NASA-ISRO L- and S-band SAR Campaign over North America (Dec. 2019)

Motivation and Scope

- The campaign acquired over North America L- and S-band Synthetic Aperture Radar (SAR) data from Space Research Organization (ISRO) Airborne Synthetic Aperture Radar (ASAR) instrument mounted on NASA's Gulfstream III aircraft
- The antenna pod and navigation package for the NASA UAVSAR radar system were utilized, allowing the aircraft to fly over predetermined path with precision
- The imagery is needed by the US to develop and refine algorithms in advance of launch of NASA ISRO Synthetic Aperture Radar Mission (2022)
- The data are relevant and useful to NASA Earth science research and application areas: cryosphere, ecosystems, natural hazards, solid Earth, ocean science, terrestrial hydrology, agriculture, oil spills, and infrastructure.
- Phase 2 and 3 campaigns are TBD. Hopefully, they will be in March/April of 2021 and in July/July 2021 to align with SMAPVEX. Original goal was to collect data in 3 seasons.



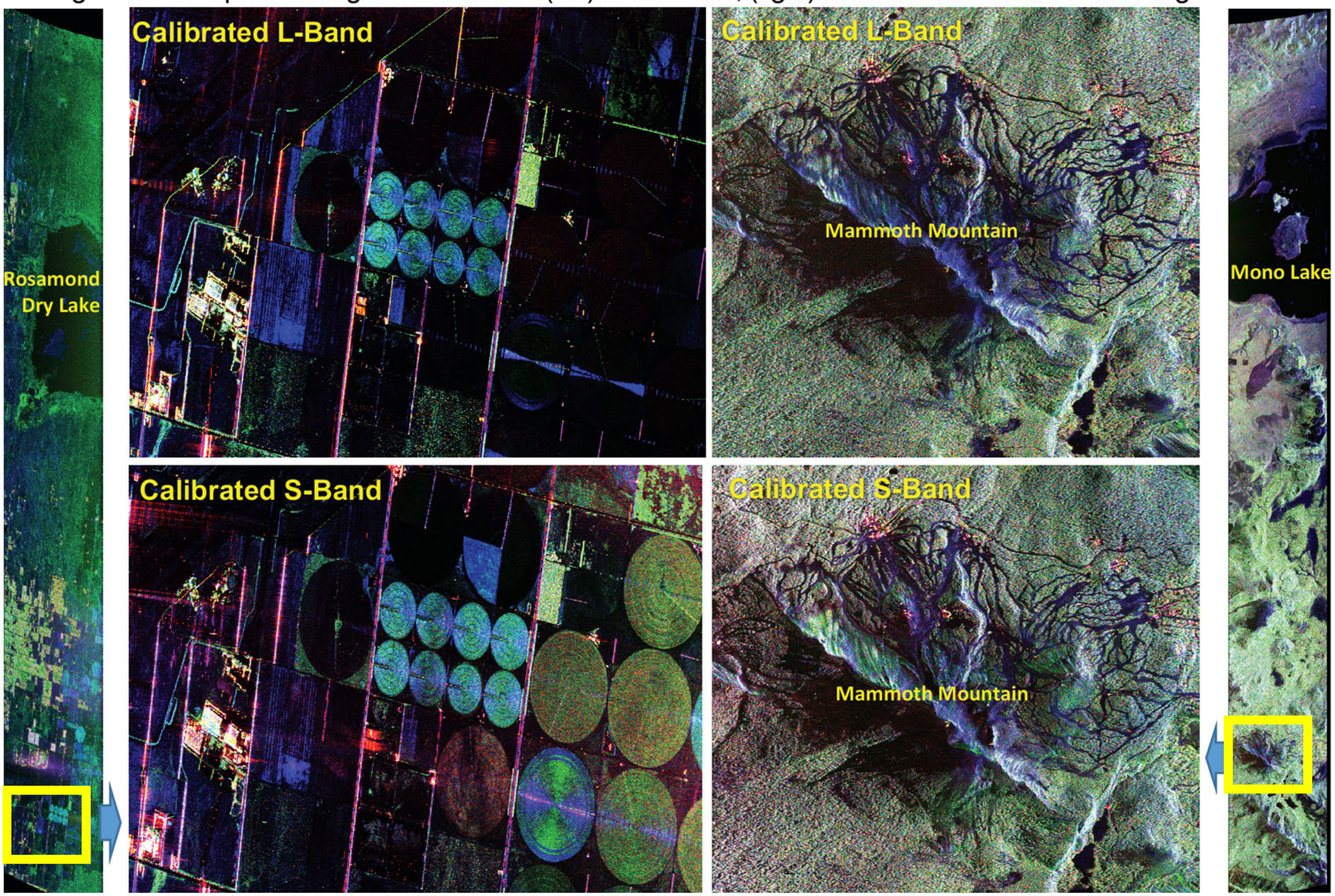
NASA-ISRO campaign flights over Alaska

NASA-ISRO campaign flights over western United States

NASA-ISRO L- and S-band SAR Campaign over North America (Dec. 2019)

First Calibrated Results of ASAR Campaign

Yamaguchi Decomposed Images : L & S-band (left) Rosamond ; (right) Mammoth Mountain- RGB image: EVEN VOLUME SURFACE



NASA G-III environment differences necessitated an update to the ASAR ground processor. Necessary changes and calibrations were made

- Five sets of L&S band Qpol data strips have been processed and shared with the science teams.
- Expecting distribution of data from remaining successful acquisitions to begin from October 2020

Satellite Needs Working Group Analysis
Proposed Activities Identified in the 2018-19

Activities Currently in the President's 2021 Budget for NASA

ID #	Summary of Proposed Activity
# 1	Global NISAR 200 m soil moisture product – proposed in SNGW17-18 cycle
# 2	Global Surface Water Extent – products from 8 satellites
# 3	Water quality assessment using OLCI
# 4	Land Surface Change Detection - optical & radar products
# 5	Land Surface Deformation Detection
#6	Radiation & clouds observations at SatCORPS
#7	Atmospheric composition using GEOS-5
# 8	Low latency freeboard & ice thickness over the Great Lakes from IceSat-2
# 9	Animal Tracking

Proposed Activity # 5
Land Surface Deformation Detection

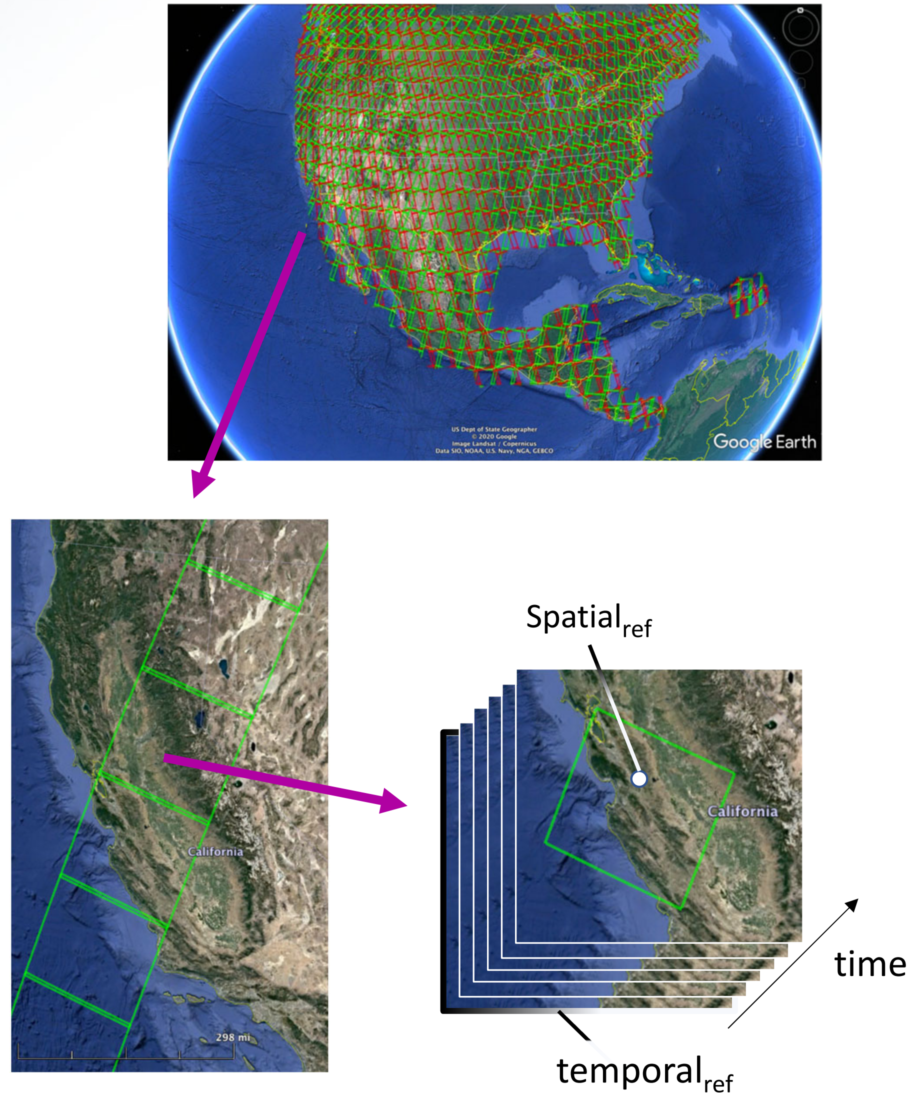
- Background: Knowing where and when the land surface moves/deforms is vital to: mitigate the loss of life associated with catastrophic natural hazards; protect critical infrastructure by identifying structural and land surface instabilities; assess the long-term stability of restoration and mining sites; understand/mitigate triggered hazards following major fires and other natural disasters; and assess urban development near or beneath unstable rock.
- Proposed Activity: *NASA would implement a North America and US Territories land surface deformation detection product (i.e. landslides, sinkholes, land subsidence, permafrost motion, volcanic unrest, earthquakes, and others) using the Sentinel 1 C-band radar imagery* that is mirrored at the Alaska Satellite Facility. The product would be improved when data from NISAR becomes available, enabling the ability to detect land surface deformation in more challenging regions such as dense vegetation and steep topography where the Sentinel-1 C-band data will have limited applicability. The European Space Agency is developing a similar product for Europe.

A North American Displacement Product

"Surface displacement is the rapid or gradual movement of Earth's surface in response to natural and anthropogenic processes acting on various spatial temporal scales"

Description:

- ❑ North America (up 200 km into Canada, up to and including Panama) + US territories
- ❑ Products dating back to Mid 2014
- ❑ Frame based (250 x 250 km), i.e. ground swaths of satellite
- ❑ Fine spatial resolution (<30 m) with up to weekly temporal sampling
- ❑ **Satellite derived:**
  - ✓ **SAR (Sentinel-1, NISAR)**
- ❑ A product for Sentinel-1, a product for NISAR
- ❑ Product features:
  - ❑ GIS friendly formatting
  - ❑ Line-of-sight displacement relative to a spatial location and a reference time
  - ✓ Qualitative layers
  - ✓ Meta data information (e.g. algorithm, sensors, etc.)



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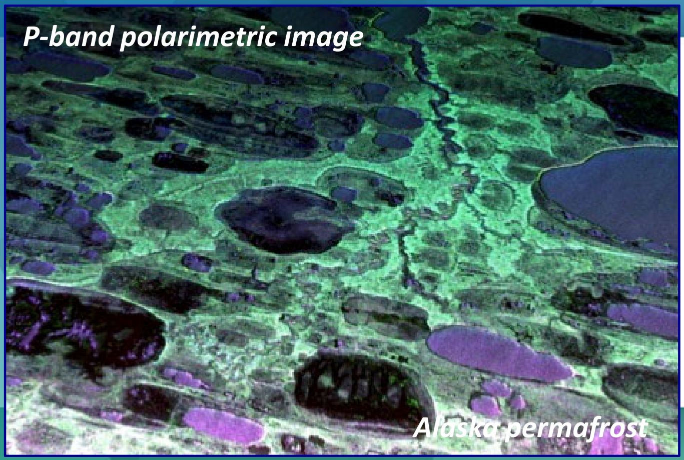
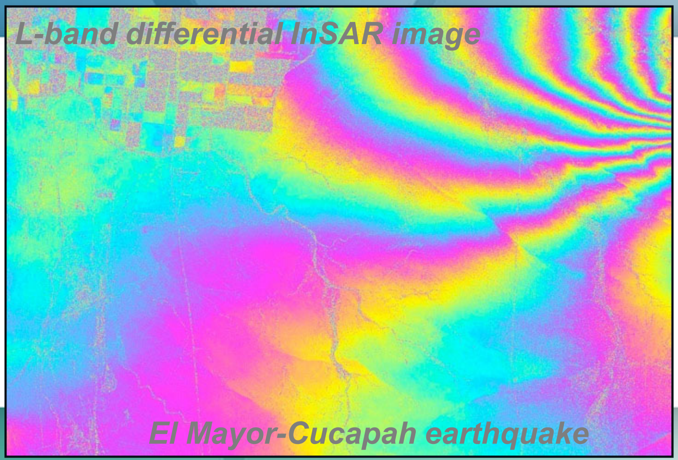
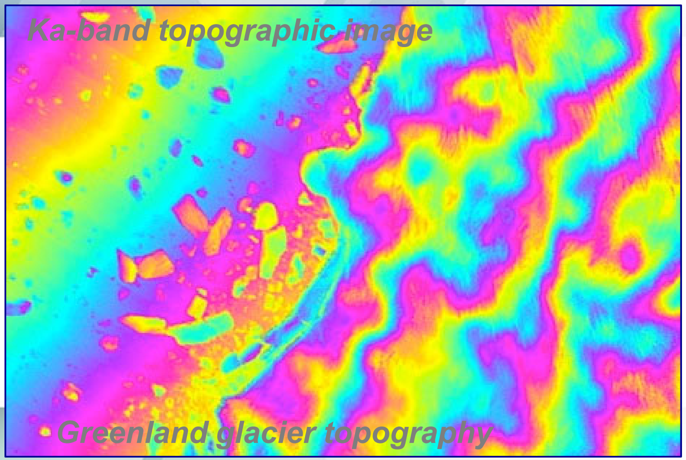






Questions

Gerald.Bawden@NASA.gov

→ RADAR VISION FOR COPERNICUS

Sentinel-1 Mission Status

Pierre Potin, Sentinel-1 Mission Manager, ESA

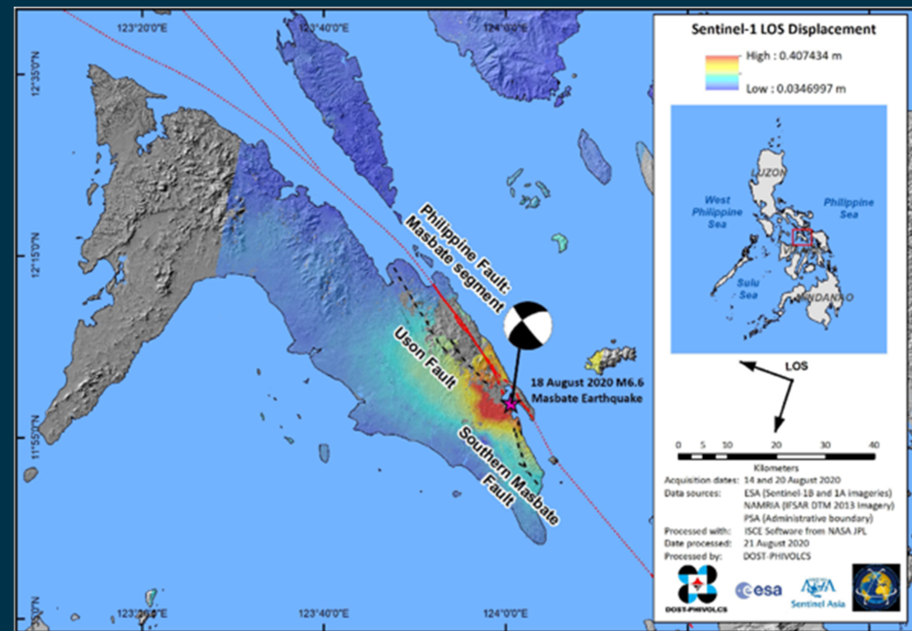
WINSAR meeting, 14 December 2020

Sentinel-1 mission status in short

- Despite the critical situation in Europe due to the COVID-19 crisis, important efforts have been and are still being made to ensure the continuity of the S1 mission operations, which remain nominal
- Routine provision of Sentinel-1 data to operational services and users worldwide
- Sentinel-1 contribution to emergency activations continues to be very high, for flood monitoring in particular
- Good health of both Sentinel-1A and Sentinel-1B satellites, no significant degradation observed

  ➔ confirmed by the Satellite In-Orbit Performance meeting of 10-11 Nov 2020

- Sentinel-1 is operated close to its full mission capacity (i.e. difficulty to accommodate additional observations)

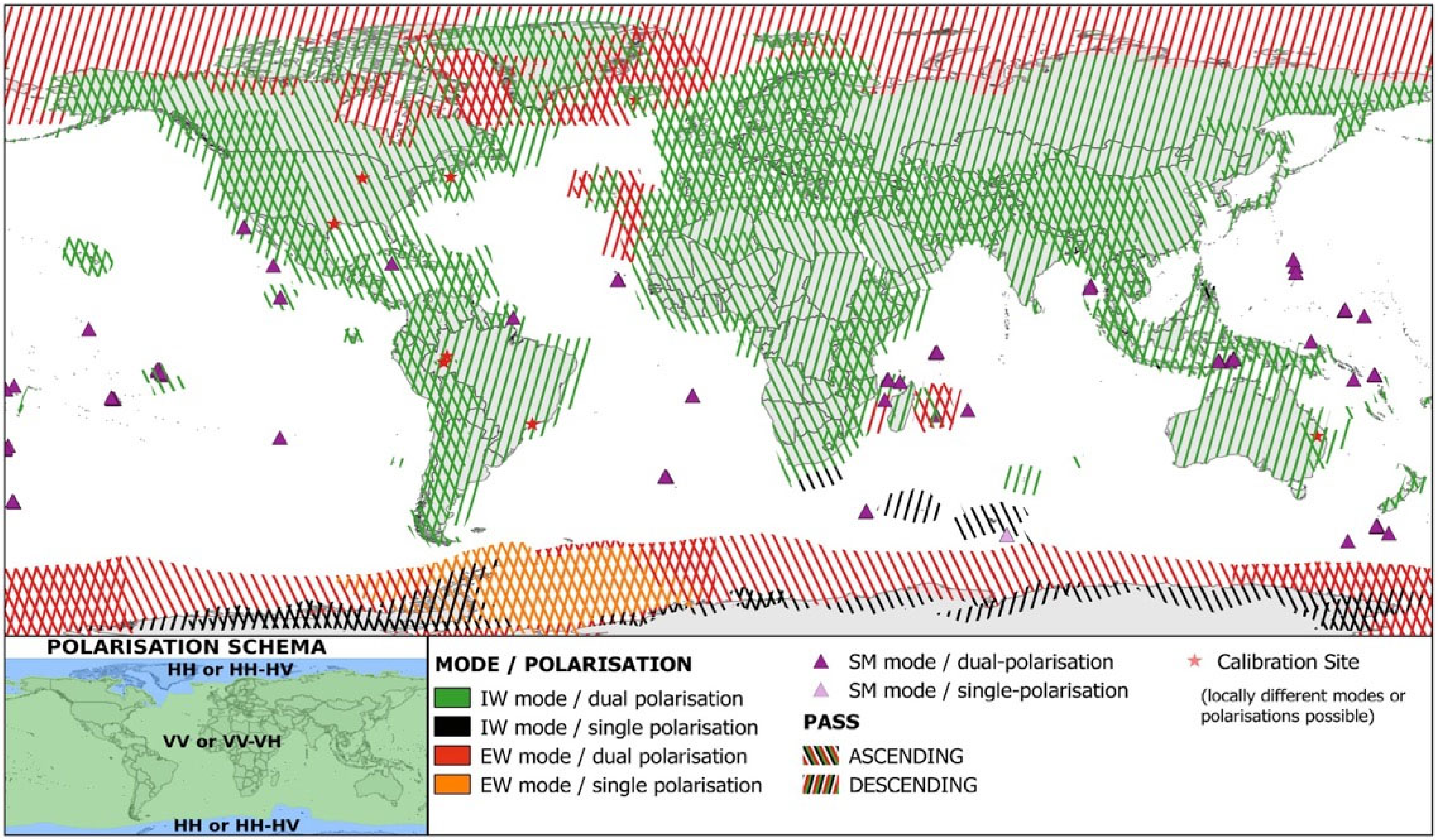


Charter call 771 (19 August 2020) related to the M6.6 earthquake of 18 August 2020 near Masbate, Philippines Ground deformation map based on 6-day S1 interferogram (14-20 August 2020) Line-of-sight deformation of up to 20-30 cm

Sentinel-1 Constellation Observation Scenario: Mode - Polarisation - Observation Geometry

sentinel-1

validity start: 05/2019



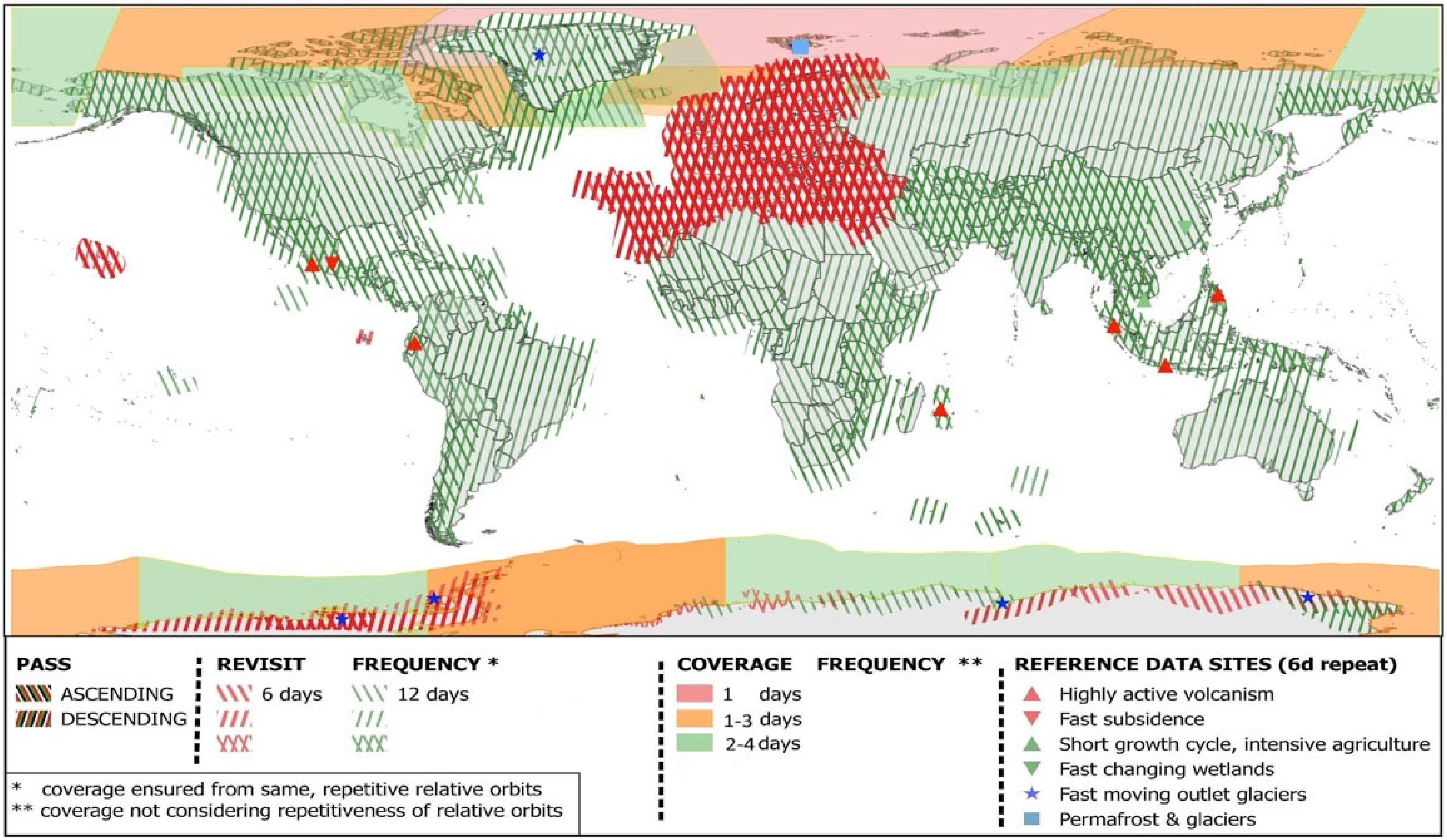
Starting May 2019, no major changes since then…

This map is related to SAR High Rate modes only. Wave mode operated by default over open oceans (not shown)

Sentinel-1 Constellation Observation Scenario: Revisit & Coverage Frequency

sentinel-1

validity start: 05/2019

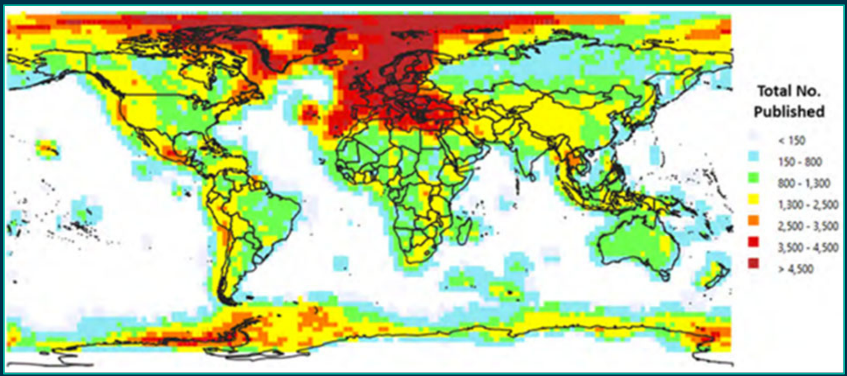


esa

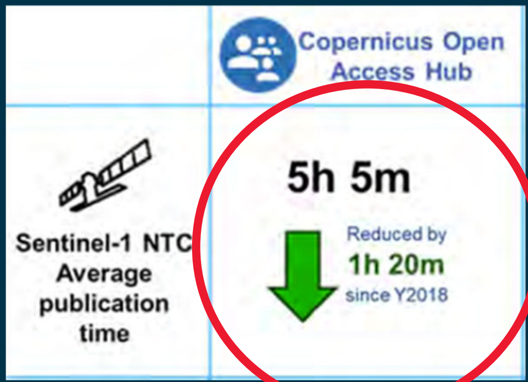
Starting May 2019, no major changes since then…

This map is related to SAR High Rate modes only. Wave mode operated by default over open oceans (not shown)

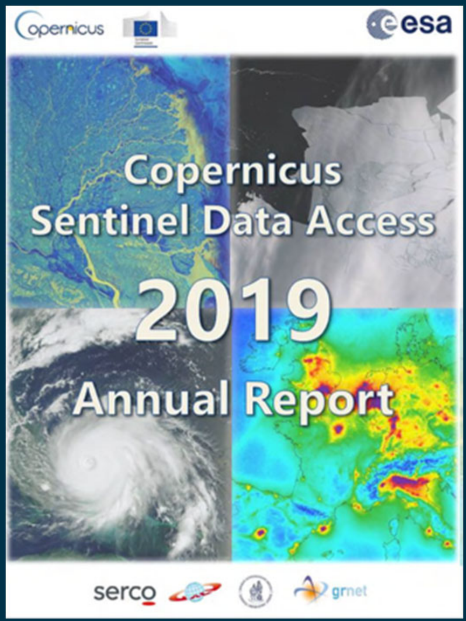
Sentinel Data Access 2019 Report
Examples of Sentinel-1 data product / user statistics



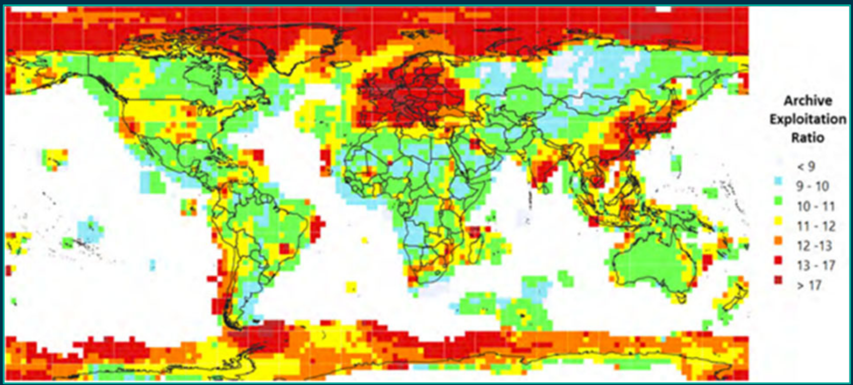
Heatmap of Sentinel-1 products (excluding OCN) published since the start of operations till end 2019



Average publication timeliness on the Open Access Hub during Y2019



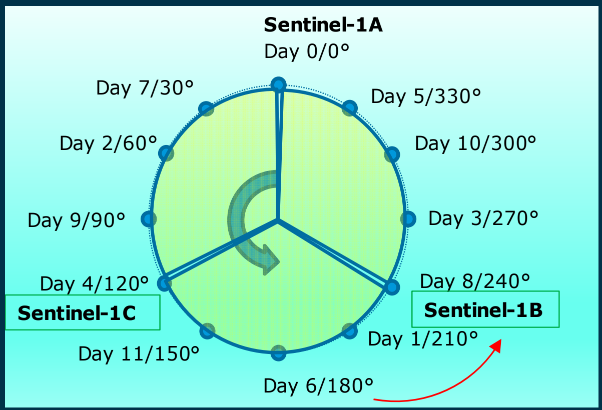
https://scihub.copernicus.eu/reportsandstats/



Heatmap showing the archive exploitation ratio for Sentinel-1 L0 and L1 NTC products (excluding WV mode) during Y2019

Sentinel-1 constellation of 3 satellites (to be decided) – Orbital configuration / phasing Options

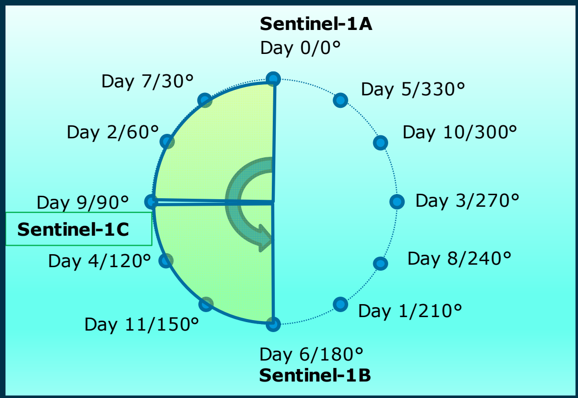
Option 1: (0°, **120°**, 240°)



1C insertion, 1B relocation, 1A as is
=> **improved Revisit and Repeat-pass**

- Three satellites phasing (0°, **120°**, 240°)
- Revisit time sequence: (0-**4**-8) within the 12 days repeat cycle
- Max. Revisit time is **3.5** days at equator (comprised between **3.5** and **1.5** days for Europe and Mediterranean area)
- Repeat-pass time interval is **4** days

Option 2: (0°, **90°**, 180°)

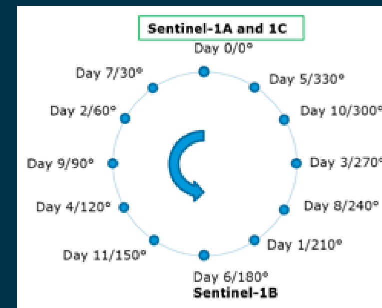


1C insertion, 1A and 1B as are
=> improved overall Revisit

- Three satellites phasing (0°, 9**0°**, 180°)
- Revisit time sequence: (0-6-**9**) within the 12 days repeat cycle
- Max. Revisit time is **5.5** days at equator (comprised between **5.5** and **1.5** days for Europe and Mediterranean area)
- Systematic repeat-pass time interval remains **6** days (and 3 days but not regular)

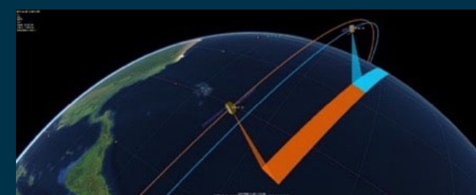
Sentinel-1 constellation of 3 satellites
Feedback from C3S => 2 alternative options proposed

C3S, the Copernicus Climate Change Service, for ice sheet and glacier monitoring activities, has proposed two new options:



Option 3: Sentinel-1 A & C in <u>Pursuit Monostatic</u> configuration

- For instance Sentinel-1C is placed TBD (~ 300) seconds ahead of Sentinel-1A
- This configuration allows S1C and S1A acquisitions to be performed under the same viewing geometry while having identical acquisition modes activated;
  Acquisitions of S1C and S1A form Interferometric Pairs (Pursuit Monostatic Acquisitions) with almost no temporal decorrelation, can be used to generate DEMs



Option 4: Sentinel-1 A & C in Repeat Pass Configuration with <u>1 day interval</u>

- Sentinel-1C is placed 1 day behind/before Sentinel-1A in the same orbital tube.
- Sentinel-1A and 1B stay in current configuration (6 days repeat, same orbital tube)

This configuration allows the following InSAR Pairs:

- S1A & S1C → image pair with 1 day interval (as ERS 1/2 Tandem)
- S1A & S1B → image pair with 6 day interval (current mode)
- S1B & S1C → image pair with 5 day interval

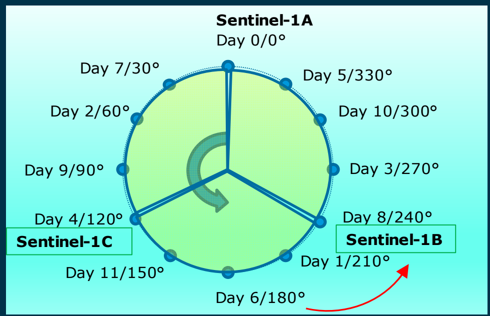
Sentinel-1 constellation of 3 satellites
Copernicus Services Feedback Summary

(ESA interpretation based on provided feedback)

	Option 1 (0°, 120°, 240°)	Option 2 (0°, 90°, 180°)	Option 3 S1A & S1C in Pursuit Monostatic configuration	Option 4 S1A & S1C with 1- day repeat pass
CEMS	+++		N/A	N/A
CMEMS	+++			
CLMS – Pan-European & Global	++	+		
CLMS - CGMS	+	+	N/A	N/A
CSS - EMSA	+++			
CSS – SEA	+	++	N/A	N/A
C3S			+	++
Total	*13*	*4*	*1*	*2*

"N/A": related services did not provide feedback on options 3 & 4, as subsequently proposed by C3S

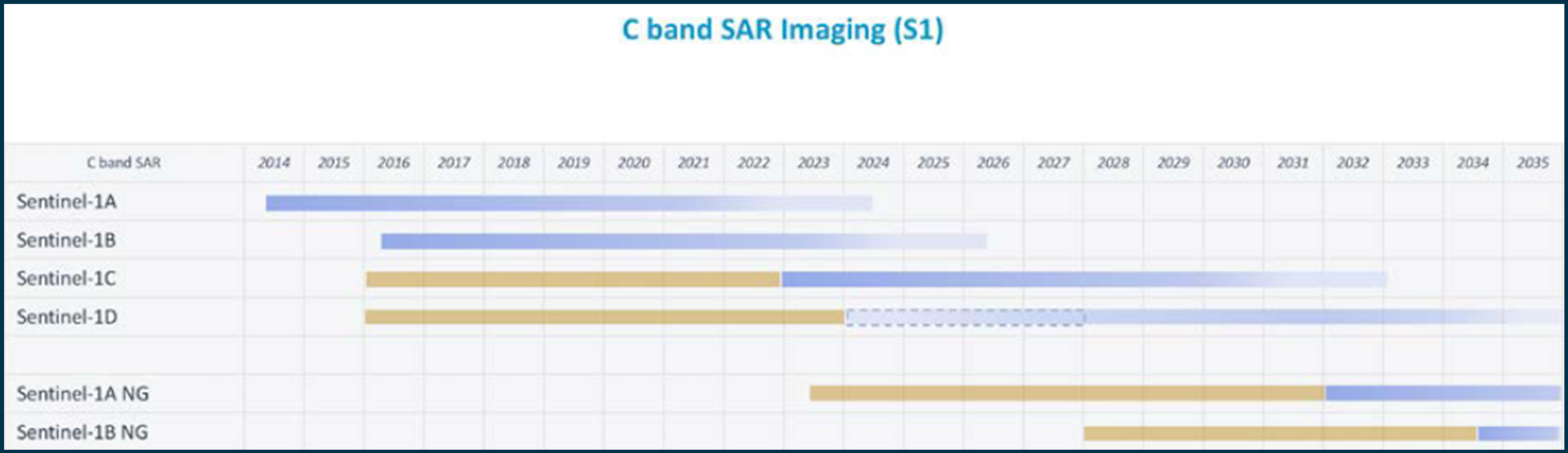
⇒ **A large majority of Copernicus Services support Option 1, ie orbit configuration (0, 120, 240)**



⇒ **Option 3 or 4 might be envisaged for a limited period of few months following S1C commissioning**

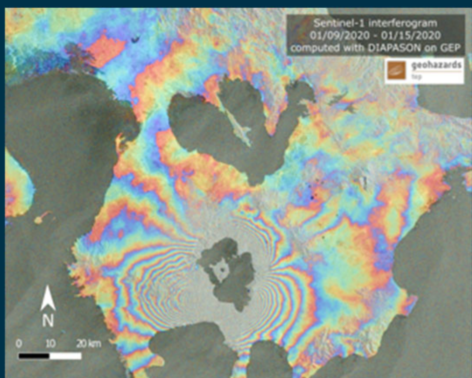
⇒ **Programmatic decision to launch and operate the C-unit to be taken in the course of 2021**

Copernicus Sentinel SAR missions - Plans

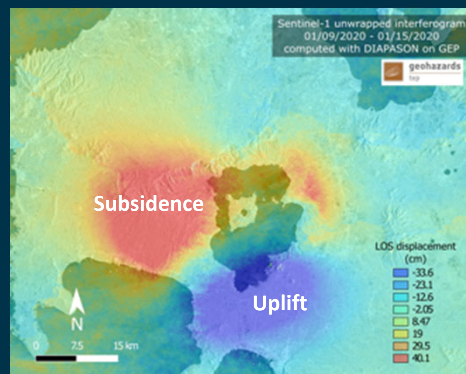


Thank you for your attention !

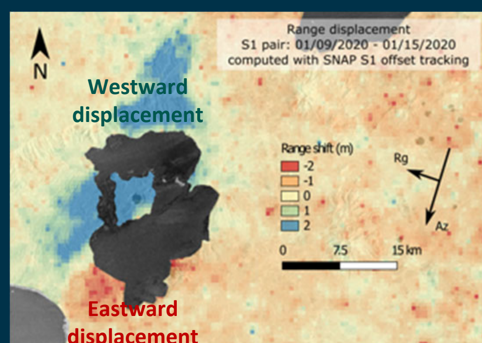
Taal Volcano (Philippines) eruption and ground deformation



Sentinel-1 Interferogram (acquisitions of 9 and 15 January 2020)
Copyright: Contains modified Copernicus Sentinel data (2020) / processed by ESA / F. Provost with DIAPASON on Geohazards TEP

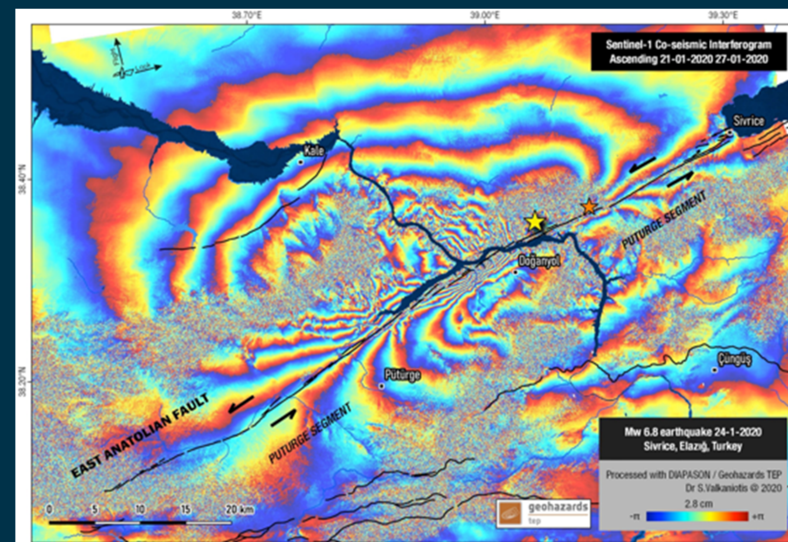


Sentinel-1 Unwrapped Interferogram (acquisitions of 9 and 15 January 2020)
Copyright: Contains modified Copernicus Sentinel data (2020) /
processed by ESA / F. Provost with DIAPASON on Geohazards TEP



Range displacement based on offset tracking (Sentinel-1 acquisitions of 9 and 15 Jan 2020)
Copyright: Contains modified Copernicus Sentinel data (2020) /
processed by ESA / F. Provost with SNAP

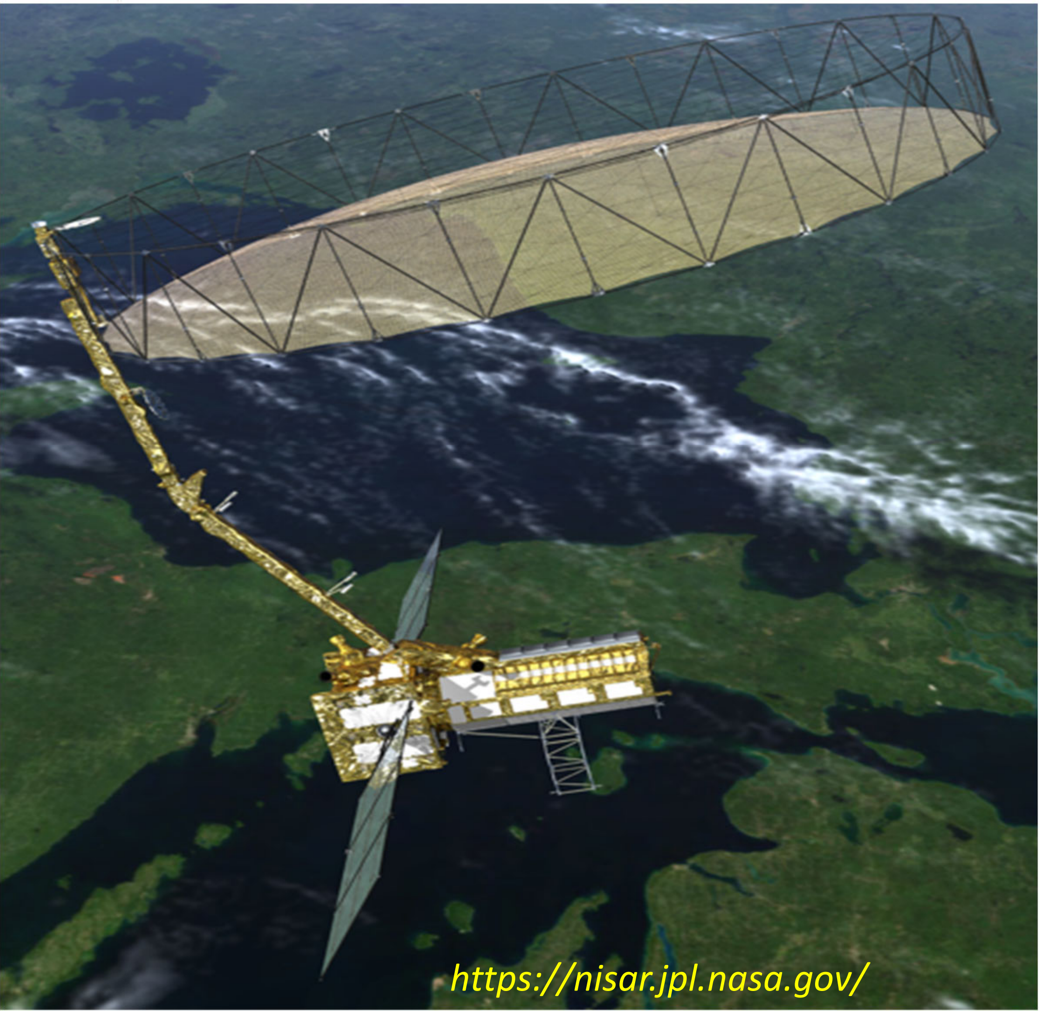
Mw 6.8 earthquake in Turkey, 24 Jan



Sentinel-1 Interferogram (acquisitions of 21 and 27 January 2020) showing more than 30 km of rupture along the main trace of Puturge fault segment, East Anatolian Fault.
Copyright: Contains modified Copernicus Sentinel data (2020) /
processed by Dr. S. Valkaniotis with DIAPASON on Geohazards TEP

Indian Space Research Organisation

Jet Propulsion Laboratory
California Institute of Technology



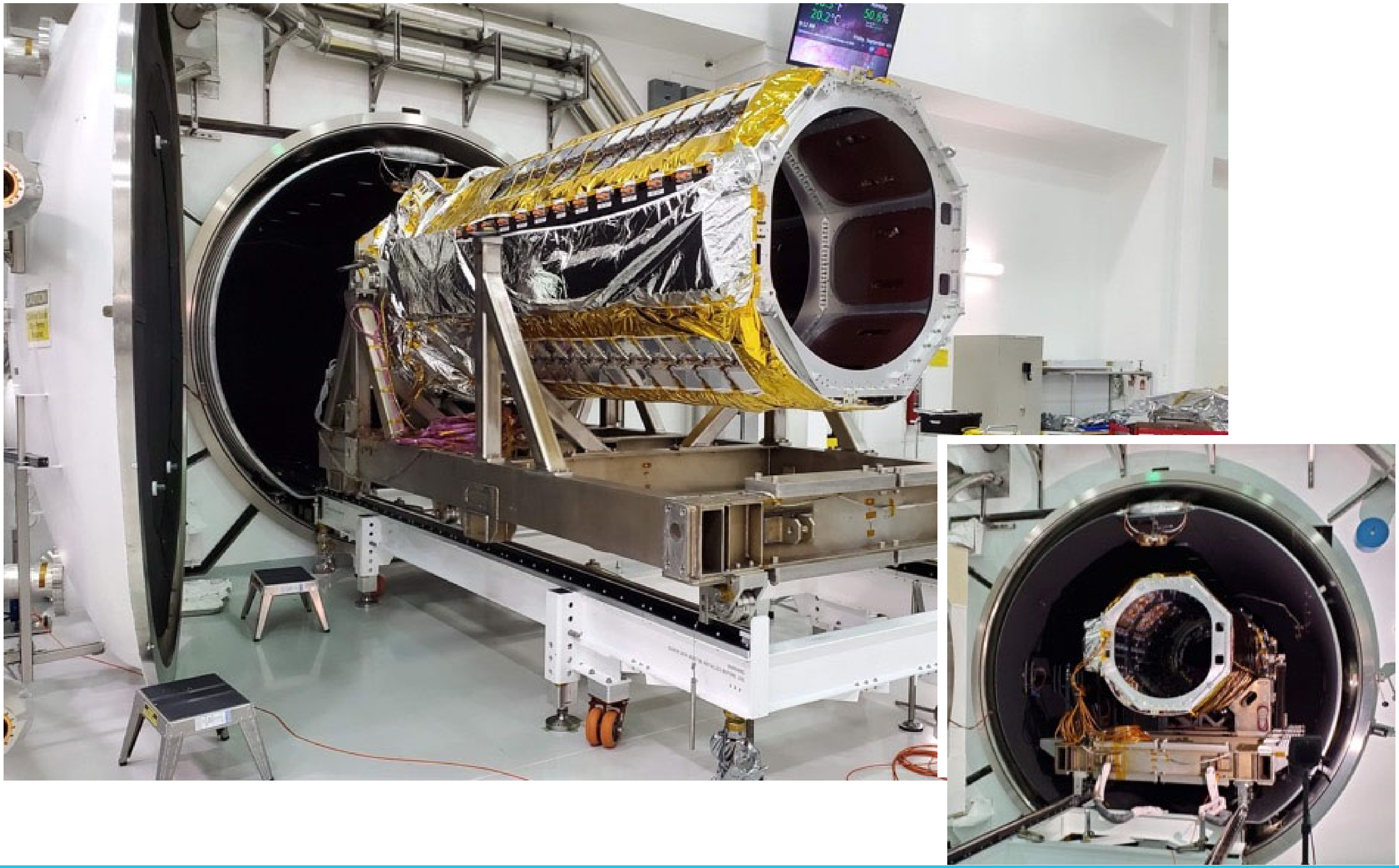
Uniquely Capturing the Earth in Motion

An Update on the NASA-ISRO SAR Mission and ISCE

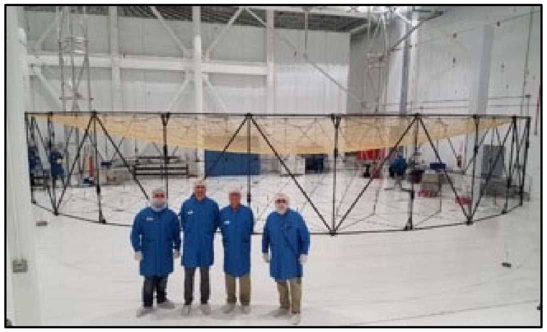
Paul Rosen, NISAR Project Scientist
Jet Propulsion Laboratory
California Institute of Technology

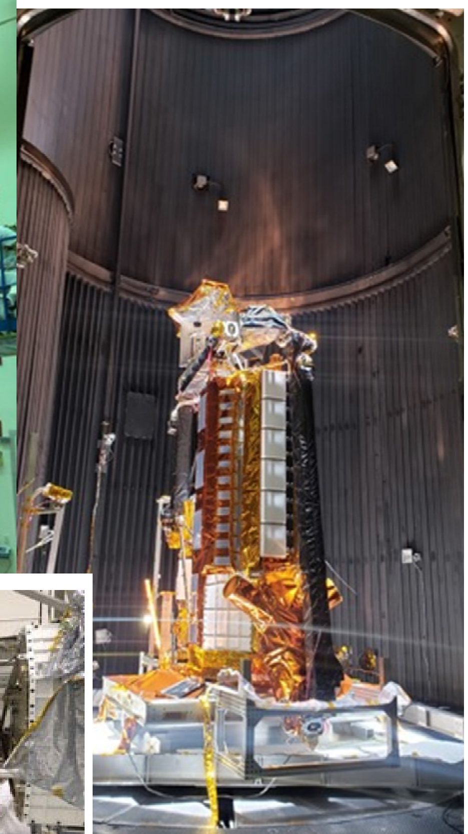
December 14 2020
WinSAR Business Meeting at Fall AGU 2020

L-SAR is in Thermal Vacuum Performance/Calibration



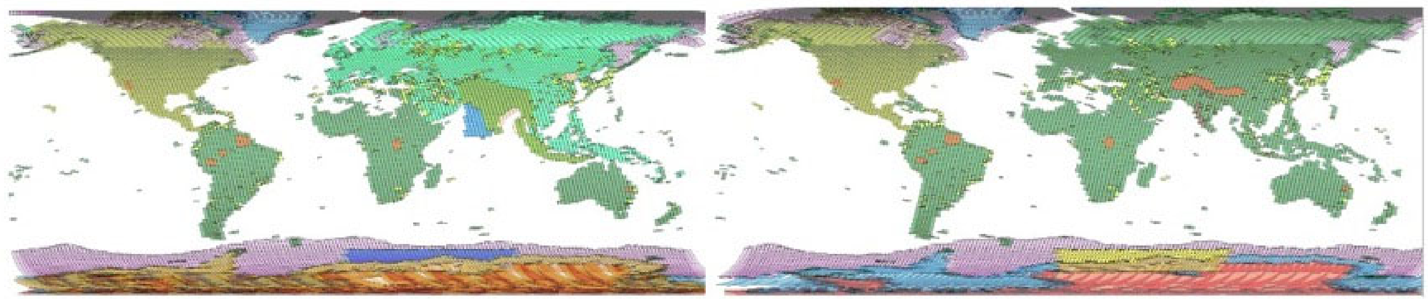
Reflector & Boom Successfully Completed Thermal Vacuum First Motion Test on DTM

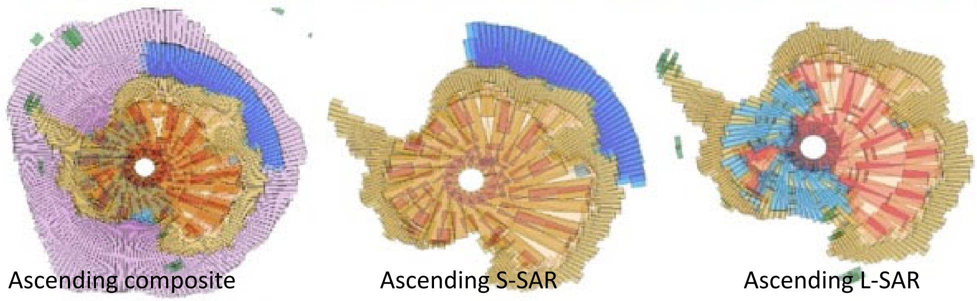




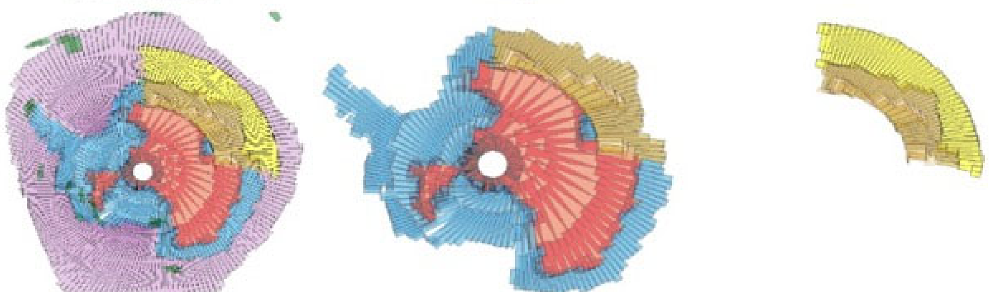
Current Planned Coverage

Cycle 000





Ascending composite | Ascending S-SAR | Ascending L-SAR



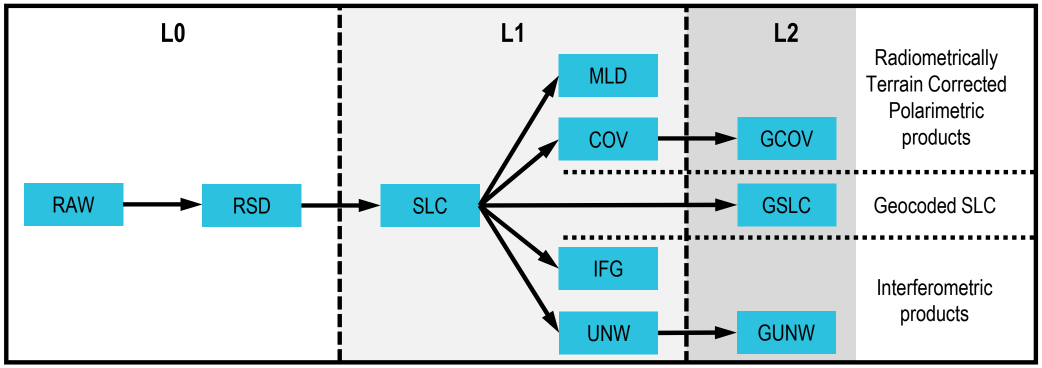
Descending composite | Descending L-SAR | Descending S-SAR

N.America is covered ascending and descending (drk-yellow)
Plan 337: L-SAR QQP 40+5

- Non-EU urban areas are observed (lt-yellow) at L-SAR 40+5 DP
- Current plans have significant work done in Antarctica to collect an ISRO S-SAR mosaic every cycle and to lower L-SAR Data Volume using lower-rate full-swath modes as compared to previous plans (e.g. 325)
- Plan to update plan every 6 months

SDS Summary

- Ingest 35 Tbits (4.4 TB) of raw data per day on average
- Automatically generate L-SAR L0a, L0b, L1, and L2 science products (> 70TB/day)
  - Generate S-SAR L0 science product for data downlinked through NASA Ka-band
- Perform bulk reprocessing twice during mission
  - 8 months of data after L2 product validation at 4x rate
  - 12 months of data at end of mission at 3x rate
  - Anticipate assessing additional processing / reprocessing options before launch
- SDS makes data available to NASA/ISRO project users and DAAC
- Sample products derived from UAVSAR data, processed like NISAR, are available
  - https://uavsar.jpl.nasa.gov/science/documents/nisar-sample-products.html
- Open source (github) ISCE3 software already available and is beginning to support these workflows and products

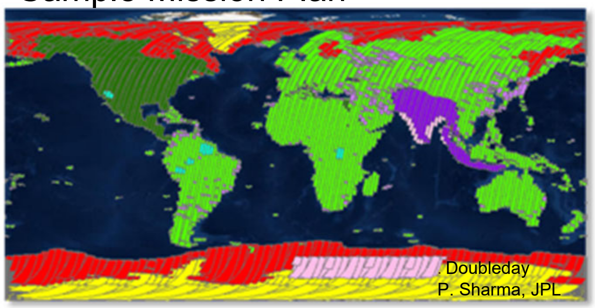


A few more words on ISCE

- ISCE 2 is still maintained on github
- ISCE 2 is the basis for the UNAVCO training short course
- ISCE 3 on public github has limited functionality and is soon to be updated from the JPL internal version being developed for NISAR by the project team
  - Supports geocoded, radiometrically terrain correction, interferograms, backprojection, GPU processing
  - Still will be more limited than ISCE 2 since it mainly supports NISAR needs as shown on previous page
- Anticipate that ISCE 2 and ISCE 3 will co-exist for a year or two
  - ISCE 3 for NISAR product workflows and some stack functionality
  - ISCE 2 for other sensor support and more back-end workflows
  - Compatibility tools and utilities will likely be developed to allow interchange of products
- Packaging of tools in docker containers and binders

NISAR Science Performance and V&V Healthy Margins

Sample Mission Plan



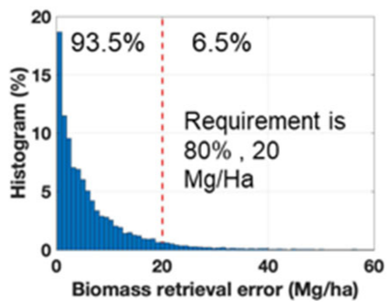
Persistent updated measurements of Earth

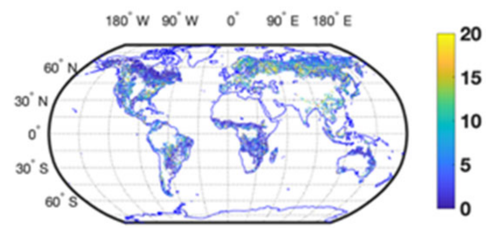
- Science Performance Tool now using as-built instrument measurements
- Performance metrics have been stable throughout Phase C
  - Solid Earth and Biomass metrics shown at right
  - Also metrics for Glacier velocity and disturbance

Solid Earth Performance	Coverage Req.	Coverage Est.	Uncertainty Req.	Uncertainty Est.	Status
Level 1 in mm	70%	82.5%	3.5 * (1+sqrt(L))	3.01 * (1+sqrt(L))	OK - OK
Coseismic (660) in mm	70%	81.0%	4 * (1+sqrt(L))	3.11 * (1+sqrt(L))	OK - OK
Transients (663) in mm	70%	86.6%	3 * (1+sqrt(L))	2.32 * (1+sqrt(L))	OK - OK
Active (658) in mm/yr	70%	93.7%	2	1.47	OK - OK
PermaFrost in mm	80%	84.9%	4 * (1+sqrt(L))	2.40 * (1+sqrt(L))	MARGIN-OK

Level 2

0.1 km < L < 50 km) Meets requirements with > 10% margin / < 10% margin



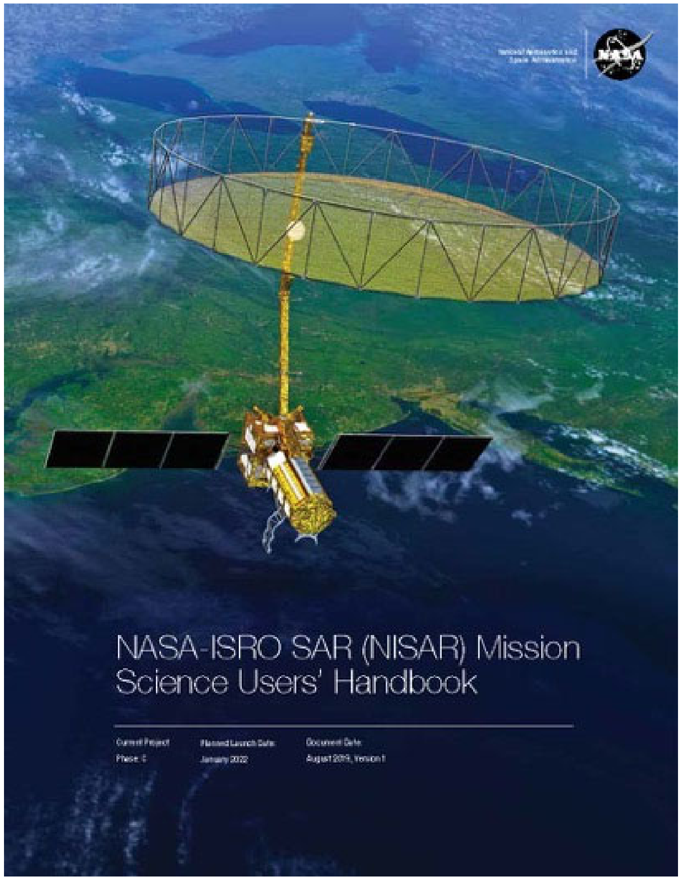


Sample Biomass Metrics

- Science will participate in V&V by interactive process with Radar and Mission Systems engineering to update instrument performance with mission plan in performance tool estimates.

NISAR Summary

- NISAR is science driven to address key questions in solid earth, ecosystems, and cryospheric sciences
- Global L0-L2 product suite of interferometric and polarimetric products, *free and open*
  - *Sample products available from UAVSAR in 2020*
  - *Distributed from ASF DAAC*
- An integrated urgent response request system, with automated mission systems response mechanisms
- Launch Oct 2022 - Jan 2023 timeframe
- ***NISAR Science Workshop in the works!***
  - ***~August 2021 if in-person is possible***



GMTSAR Progress https://github.com/gmtsar/gmtsar/wiki/GMTSAR-Wiki-Page

- Developers: Xiaohua (Eric) Xu, David Sandwell, Paul Wessel, Leonardo Uieda, Robert Mellors, Meng (Matt) Wei, Katherine Guns, and Anders Hogrelius
- Funding:
  Final year of funding
  NSF Cyberinfrastructure
- Software distribution:
  github; homebrew; macports
- Newish features:
  Split spectrum ionosphere
  Solid Earth tide correction (GMT)
  Integer ambiguity resolution
- Planned Features:
  Ocean loading tide correction
  Parallel sbas and xcorr
  Automated testing
- UNAVCO short course:
  Virtual, July, 2020

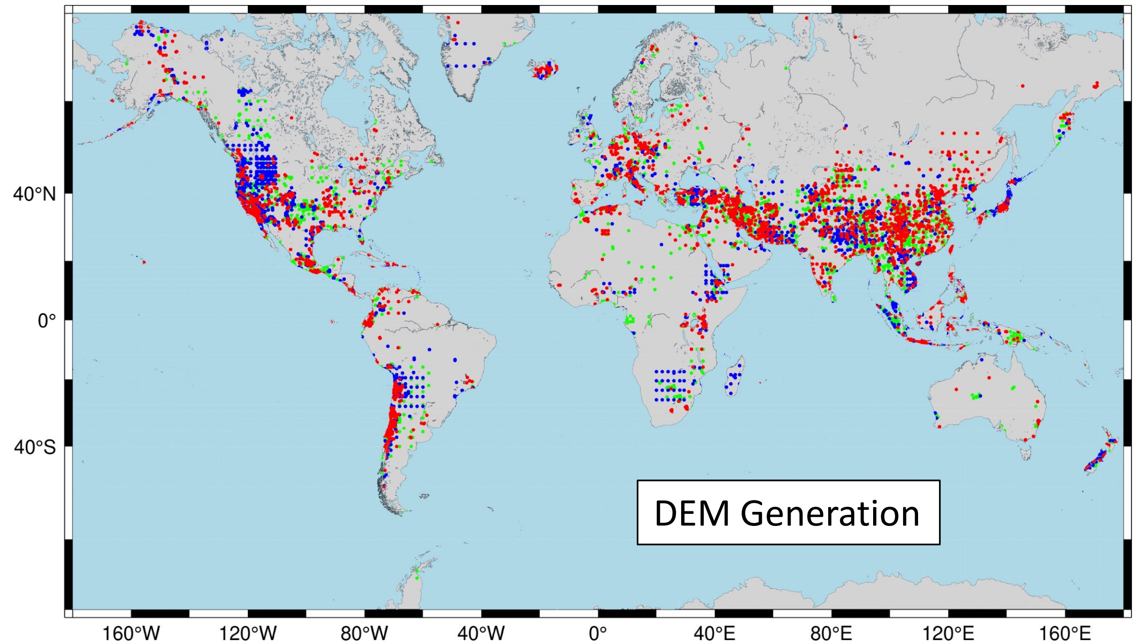
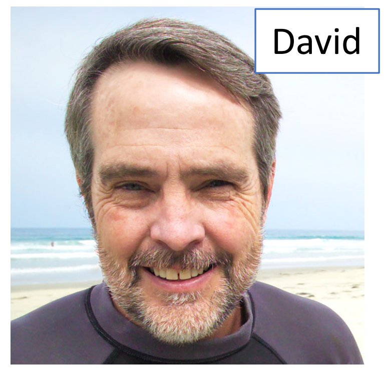
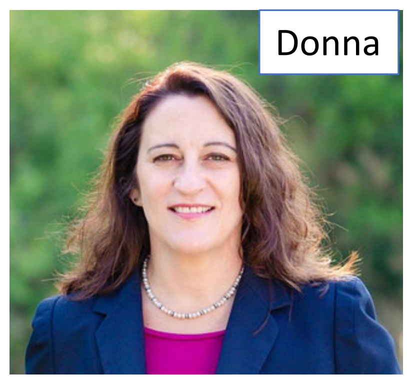


Table 1. Summary of Metrics for NSF

metric	year 1	year 2	year 3
committed changes to GIT	90 **82**	120 **54**	120
citations calendar year	30 **42**	40 **81**	50
DEM Generation	5000 **7821**	7000 **5591**	9000
short course registrants	40 **29**	45 **154**	45

UNAVCO GMTSAR -2020
Instructors/Staff
154 Students





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DVI#Ghsxw|#Gluhfwru

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  - Doo#Vhqwlqho04#qrz#lq#wkh#HVGLV#forxg
    - Qr#V4#rq0suhplvhv#dw#DVI
  - DZV#Zhvw#wr#fr0orfdwh#zlwk#QLVDU
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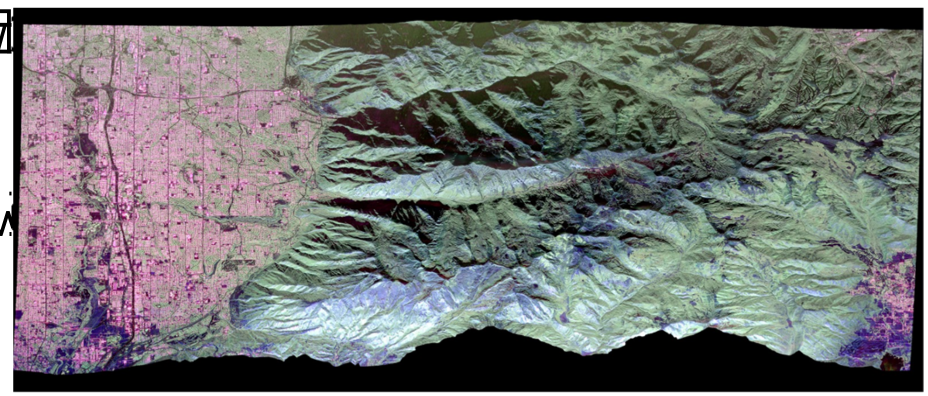

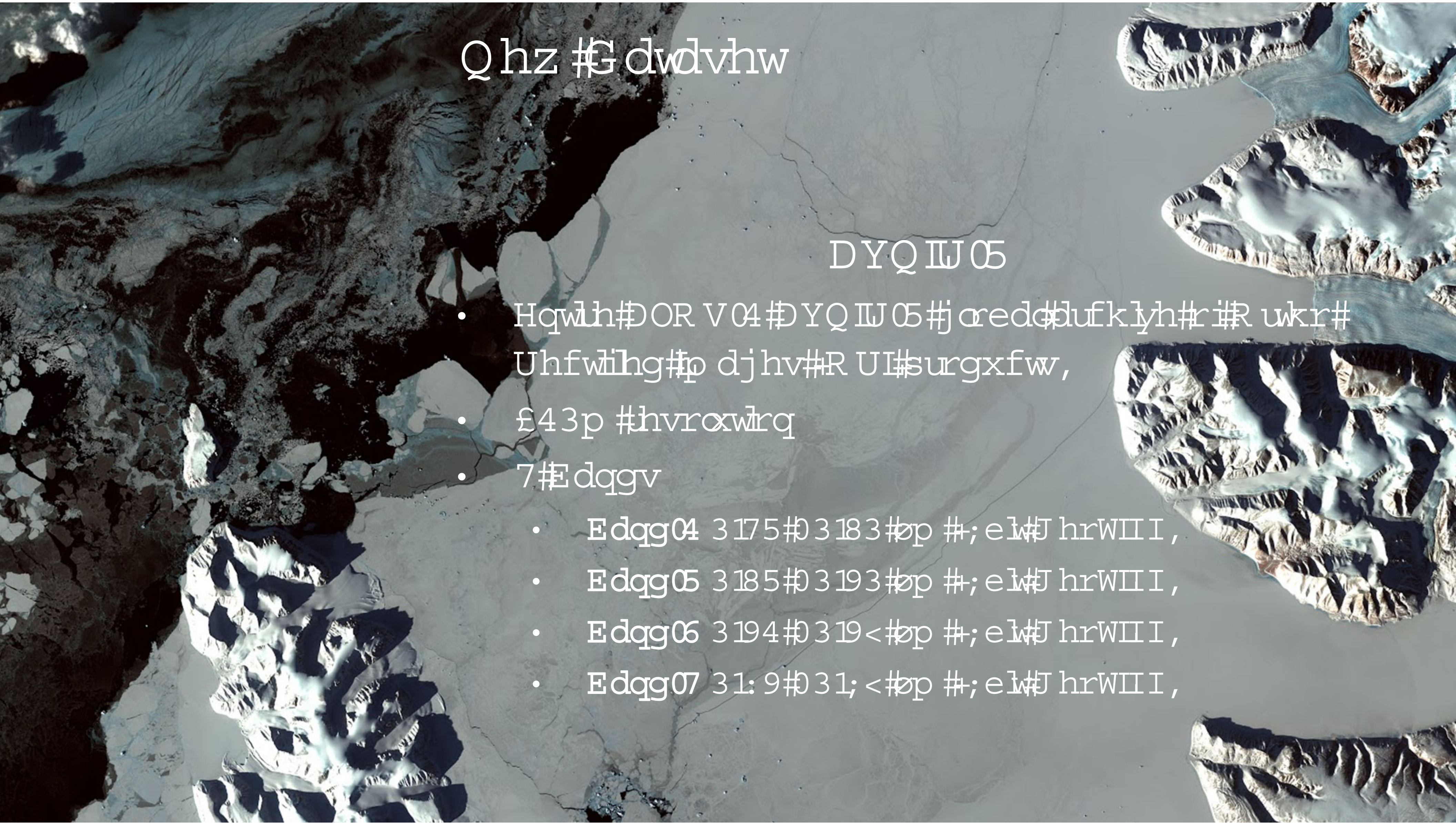
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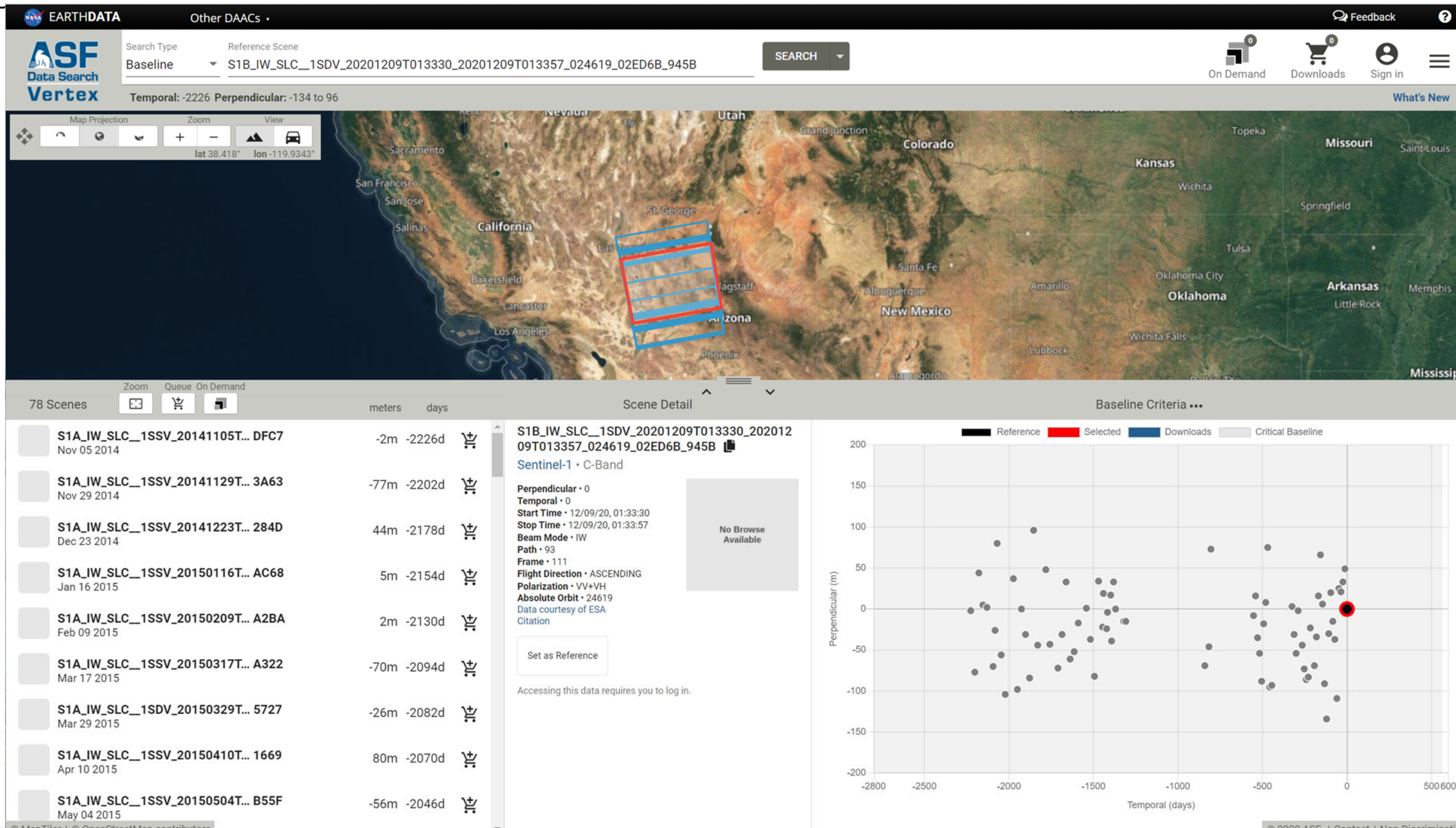

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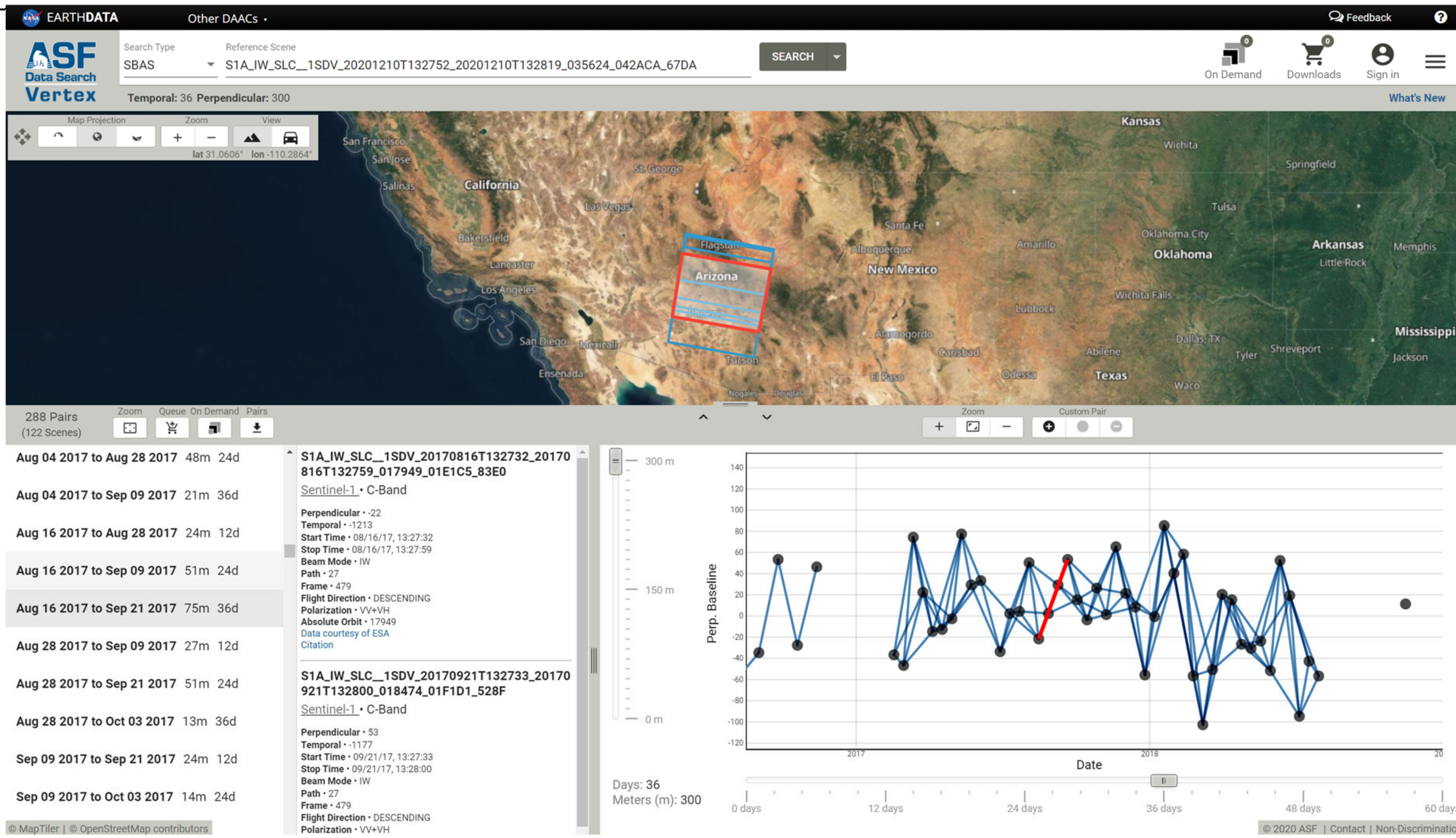

Wade Albright, ASF Deputy Director

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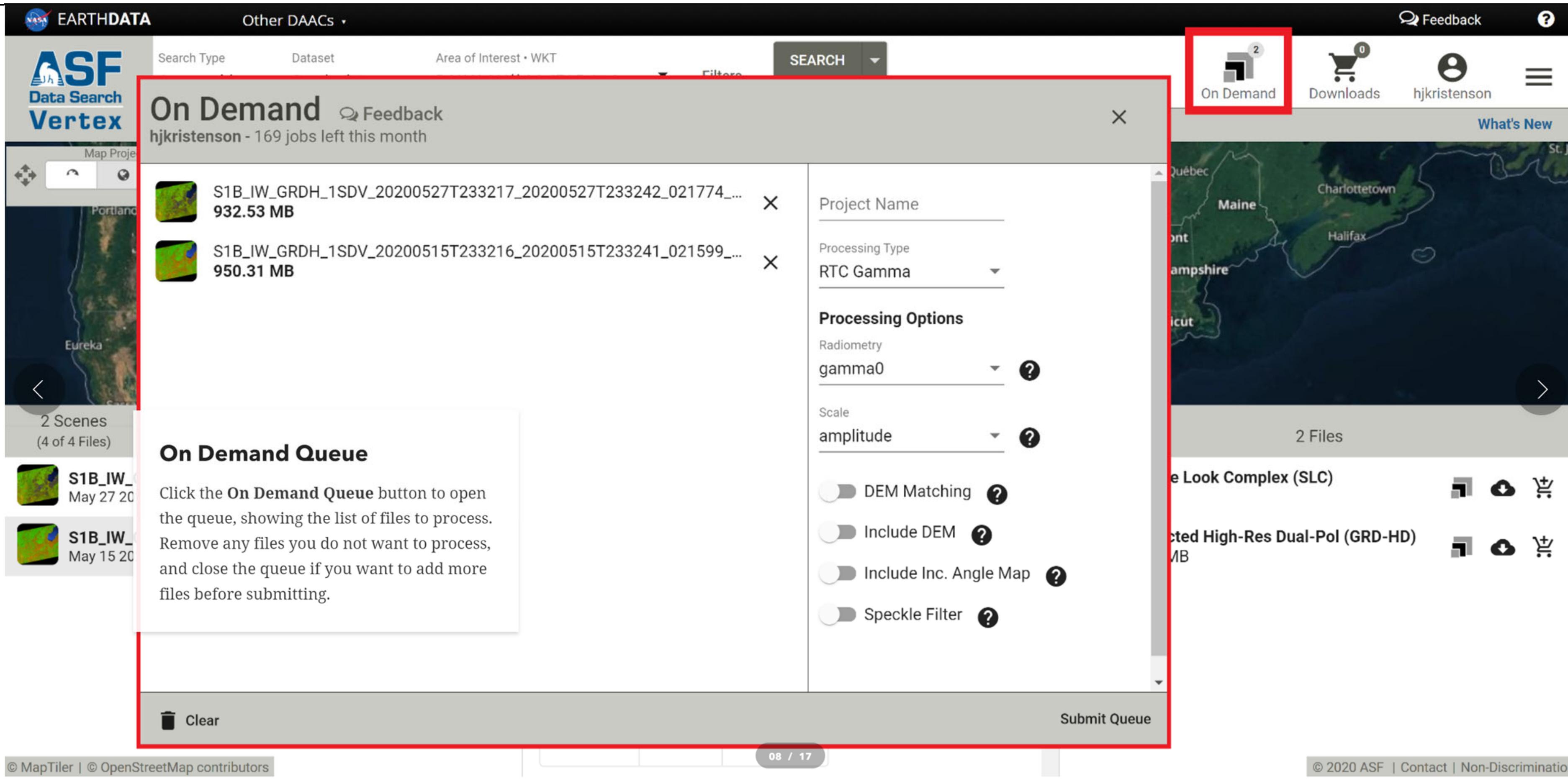

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  - Vhyhudo#prqwkv#ri#suhsdudwlrq

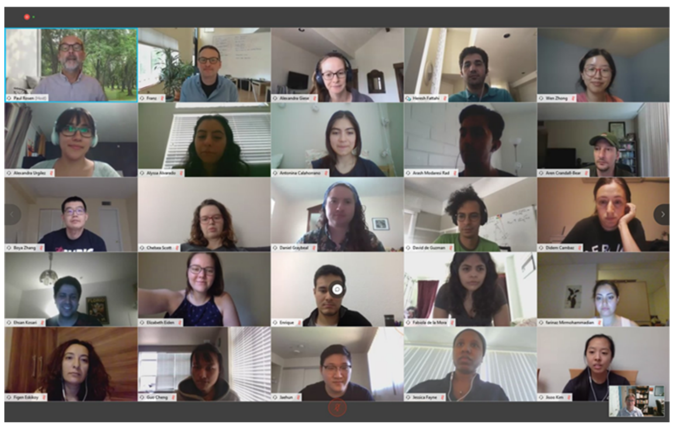
As of Dec 11: >2,100 enrolled learners

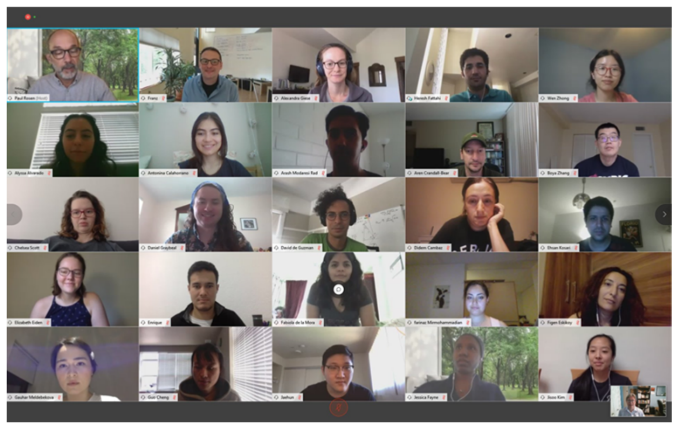
Wade Albright, ASF Deputy Director

Recent SAR Training Activities

Aug 2020: Support of UNAVCO/WInSAR InSAR Course

- **Week-long virtual UNAVCO InSAR Training "2020 InSAR Processing and Time-Series Analysis for Geophysical Applications: InSAR Scientific Computing Environment (ISCE), ARIA Tools, and MintPy"**
  - Instructors: F.J Meyer (UAF), P. Rosen, D. Bekaert, H. Fattahi (all JPL), S. Baker (UNAVCO), G. Funning (UC Riverside), P. Agram (Descartes Labs)
  - Approximately 400 applicants that were screened down to 100 seats.
  - **Facilitated by the project's OpenSARLab environment**.
  - More information available here.



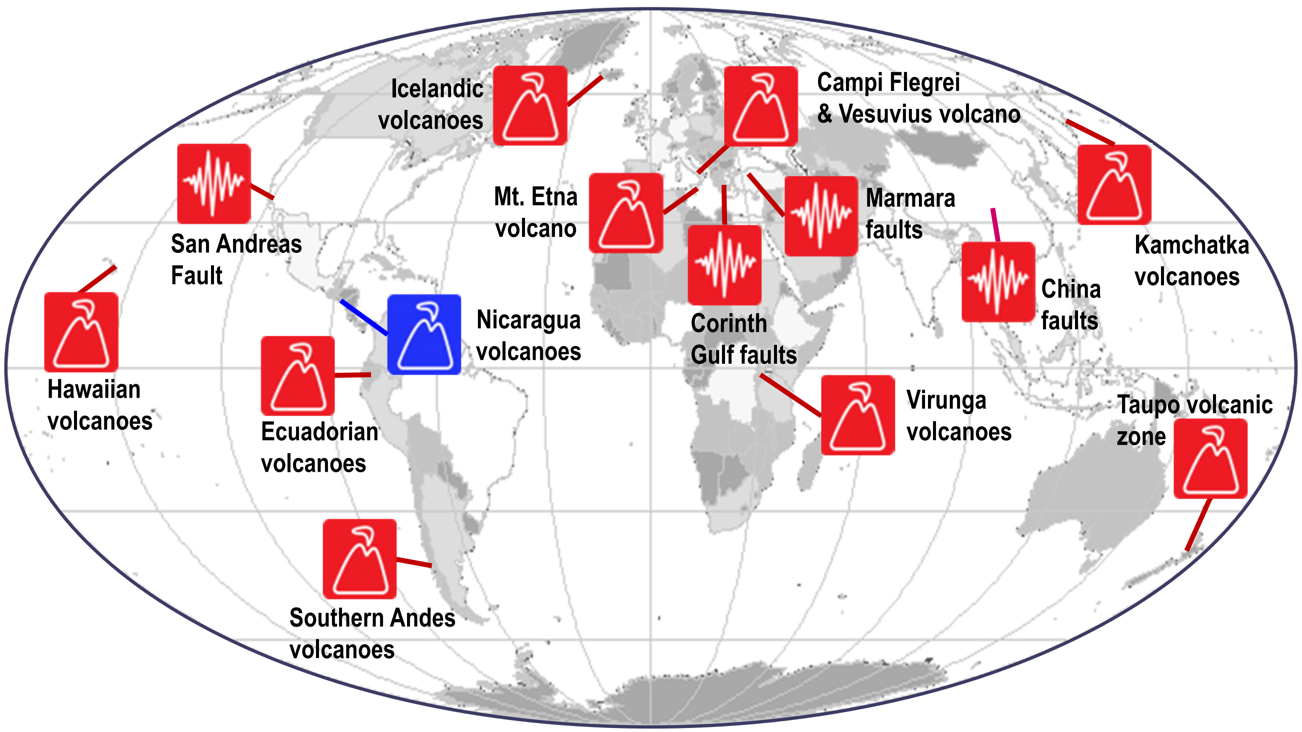


Updates from the GEO Geohazard Supersites initiative

Stefano Salvi
Chair of the GSNL Scientific Advisory Committee

WinSAR meeting @ AGU 2020

The Supersite network in 2019

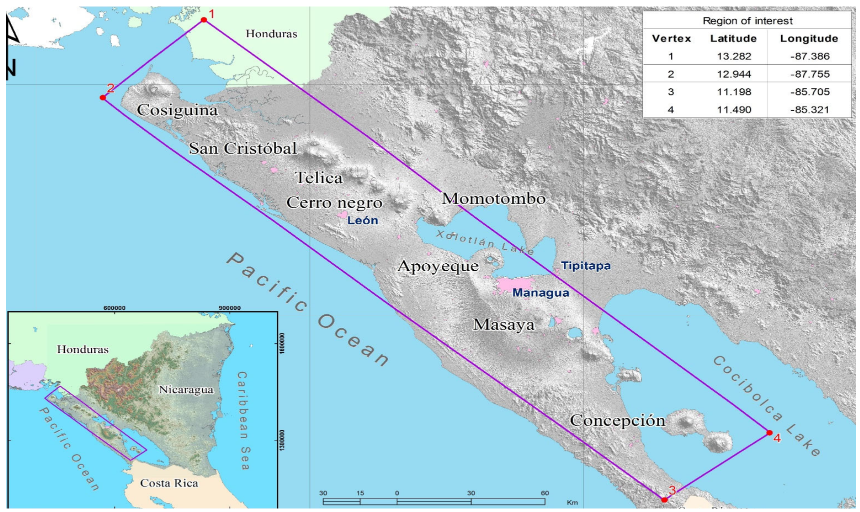


geo-gsnl.org

Progress

1. Established a Volcano Supersite in Russia (Kamchatka)
2. Established an Earthquake Supersite in Central China
3. Evaluating a Volcano Supersite proposal for Nicaragua (see later)
4. Most Supersites produced a good amount of scientific research using the CEOS data (see Supersite biennial reports on geo-gsnl.org)
5. Information from Supersite data has been crucial for managing volcanic crises: White Island, NZ; Reykjanes peninsula, IS; Mt. Etna, IT.
6. We maintain cloud computing resources for less developed Supersites (presently used only by Ecuador)
7. The ESA-GEP is becoming our data distribution platform: 9000+ CSK data; TSX data discoverable, Pleiades data to be shared soon.

Nicaragua volcano Supersite proposal



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Impact of the COVID-19 pandemia on GSNL

- No impact on initiative management and EO data acquisition
- Variable impact on ground data acquisition, with most of the monitoring networks operational, although with reduced maintenance
- Large impact on field activities and scientific data acquisition, which have been strongly reduced or totally halted for a few months
- The relative value of EO data for volcano/fault monitoring has increased

UAVSAR Update

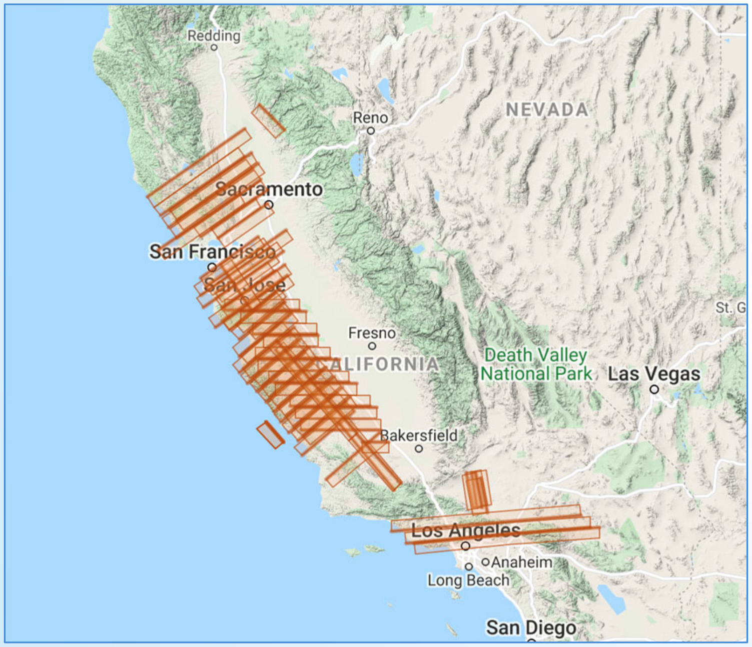
Experimental optical/SWIR imager
Limited science flights due to COVID
Developing NextGen UAVSAR concept

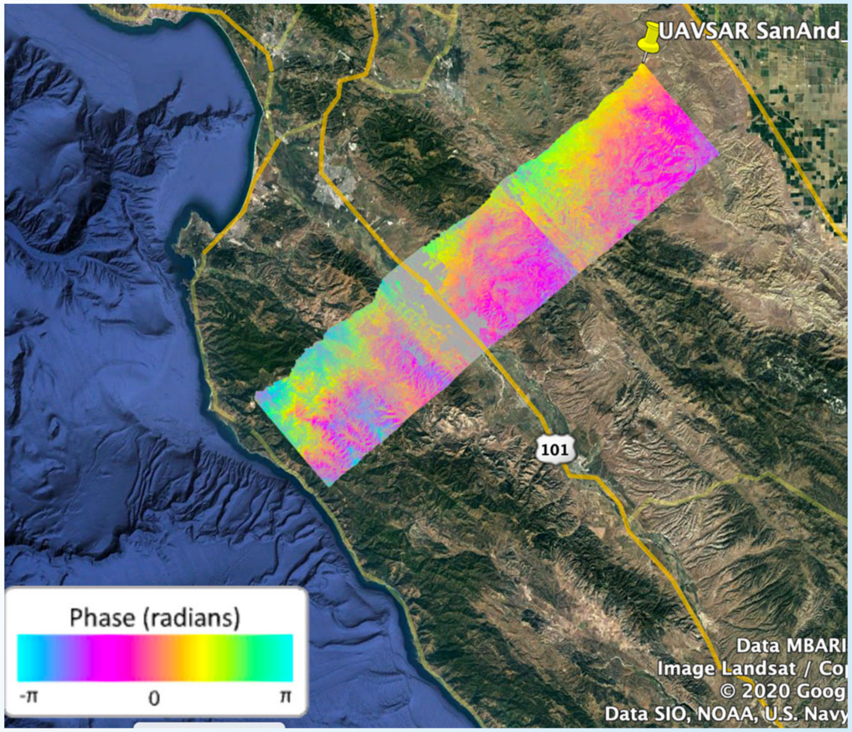
UAVSAR Project Manager: Yunling Lou

WINSAR Meeting, December 13, 2020

San Andreas Fault Monitoring with L-band InSAR

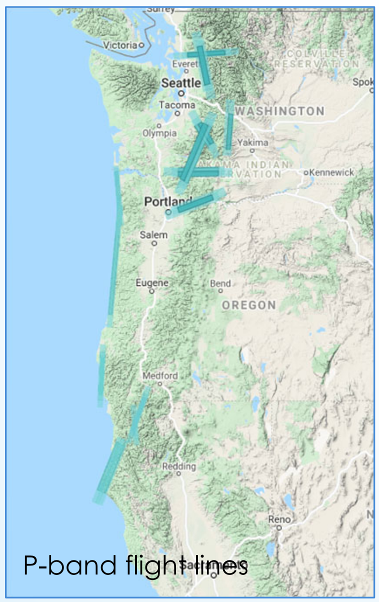
- Imaged Central San Andreas Fault in Sep/Oct 2020
- Also imaged LA Basin and N. California together with the QUAKES SWIR imager (PI: A. Donnellan) for fire mapping to
  - Reconstruct topography with SWIR imager
  - Assess post-fire landslide and debris flow risks
  - Monitor long term forest regrowth



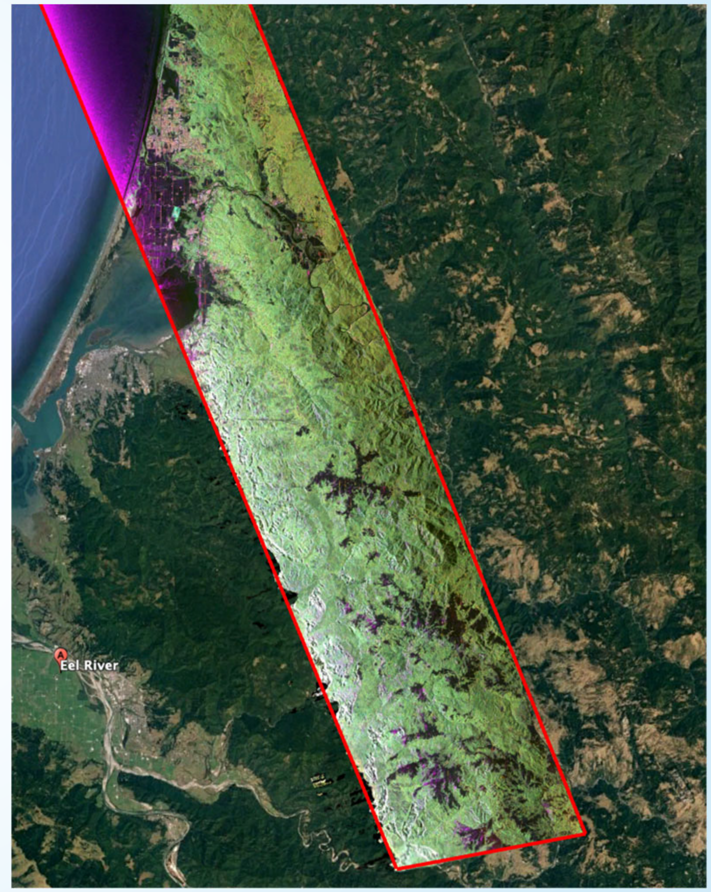


Deep-Seated Landslide Study with P-band PolInSAR

- Began monthly/bi-monthly observation of select landslide-prone forested sites in October 2020 (PI: Zhong Lu)
- Will utilize DInSAR for land displacement and PolSAR for soil moisture retrieval
- Will be able to compare Eel River site with L-band results
- L-band landslide study in the Eel River region continues (PI: E. Fielding, et al.)



P-band flight lines

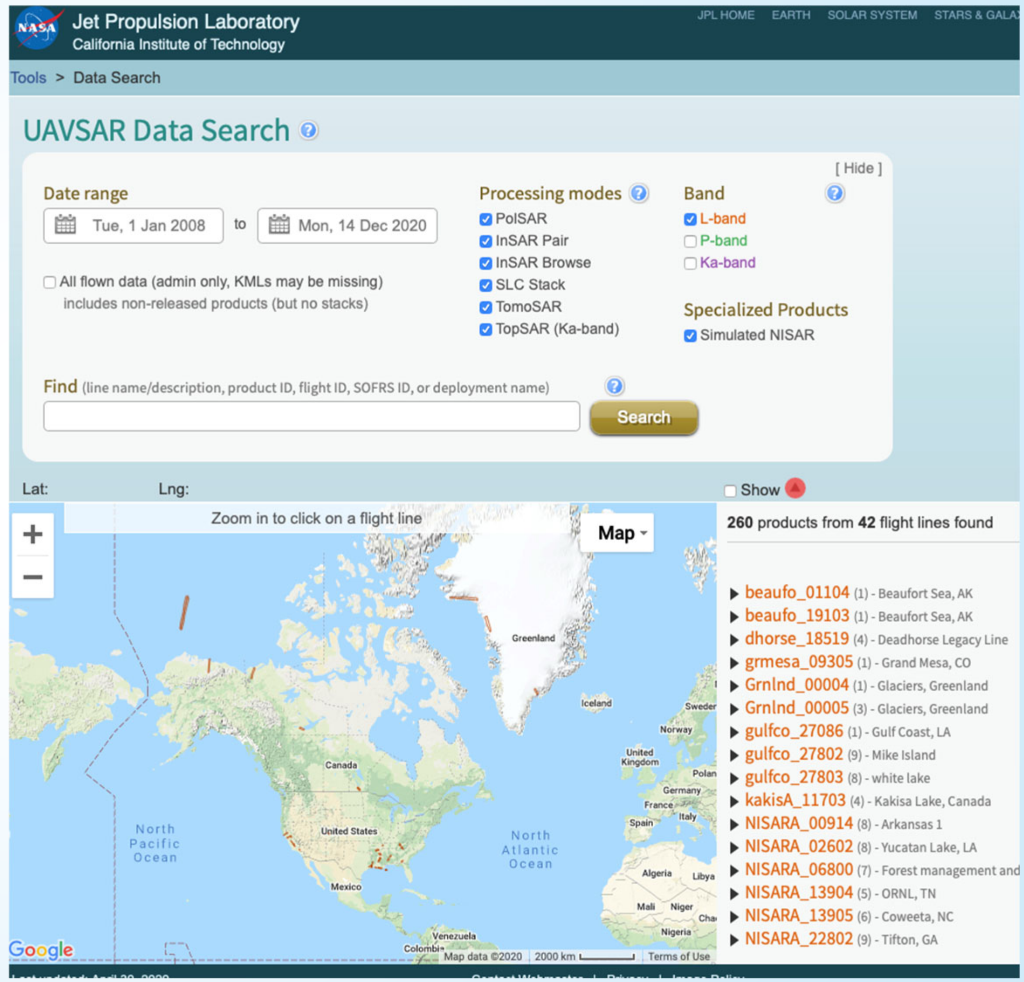


P-band polarimetric color composite near Eel River acquired on October 27, 2020.

Simulated NISAR Products

Emulate NISAR data characteristics and deliver products in NISAR data format to facilitate the science community on algorithm testing and tuning in preparation for the NISAR mission data

- Add additive noise to convert the UAVSAR $NE\sigma_0$ to NISAR ranges
- Sub-band UAVSAR 80 MHz SLC data in range to 20, 40 or 5 MHz sub-bands
- Deliver RSLC products in HDF5 files
- Data can be downloaded from UAVSAR website
- Working with ASF to ingest and host these products at ASF very soon



UAVSAR-NextGen Vision

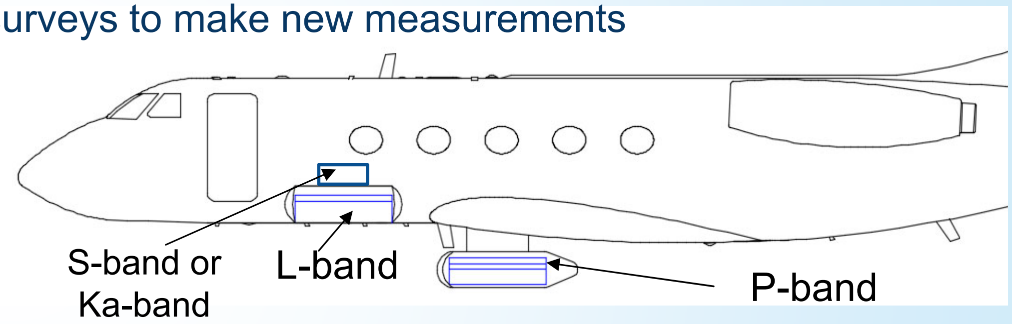
Conducted NextGen workshop in May 2020

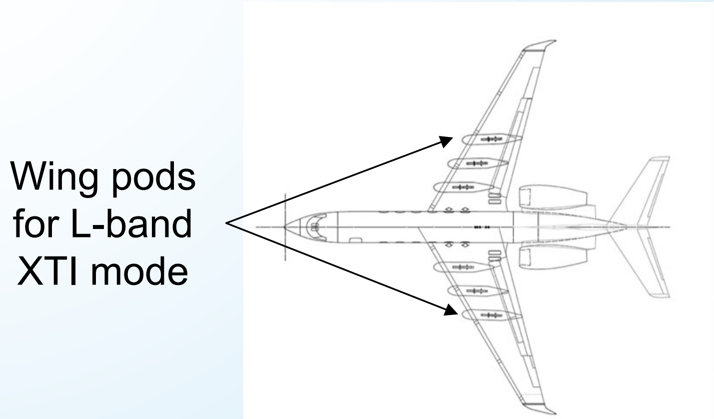
NextGen Objectives

- Ensure robustness of current capabilities
- 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

Configurations

- Simultaneous P- and L-band repeat-pass PolInSAR for vegetation structure and soil moisture studies
- Simultaneous L- and S-band repeat-pass PolInSAR to simulate/cross-calibrate with NISAR
- L-band single-pass cross track InSAR (XTI) for Digital Terrain Model generation
- Operate on G-III and G-V, and other platforms with comparable performance
- Coincident stereo optical imager





JAXA’s ALOS L-SAR mission series

Shin-ichi Sobue

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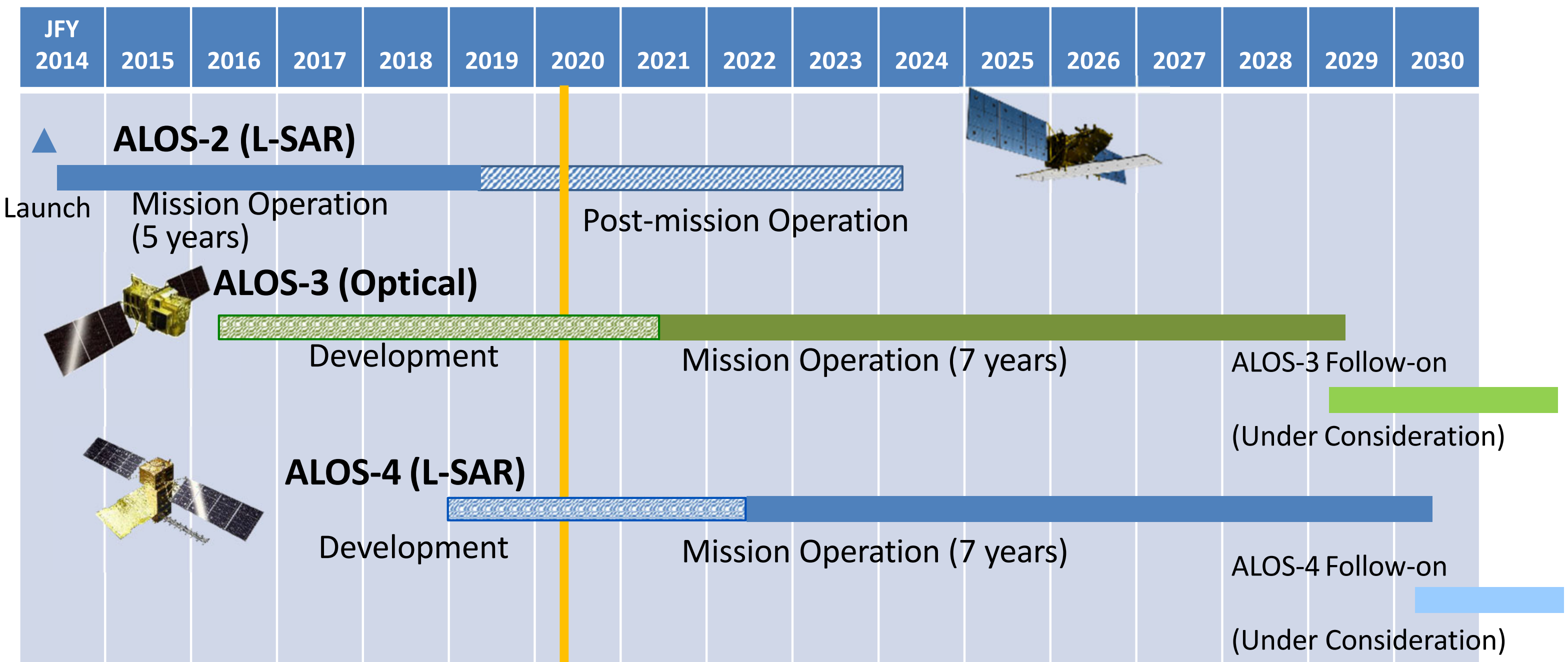
ALOS-2 Project manager

Japan Aerospace Exploration Agency (JAXA)

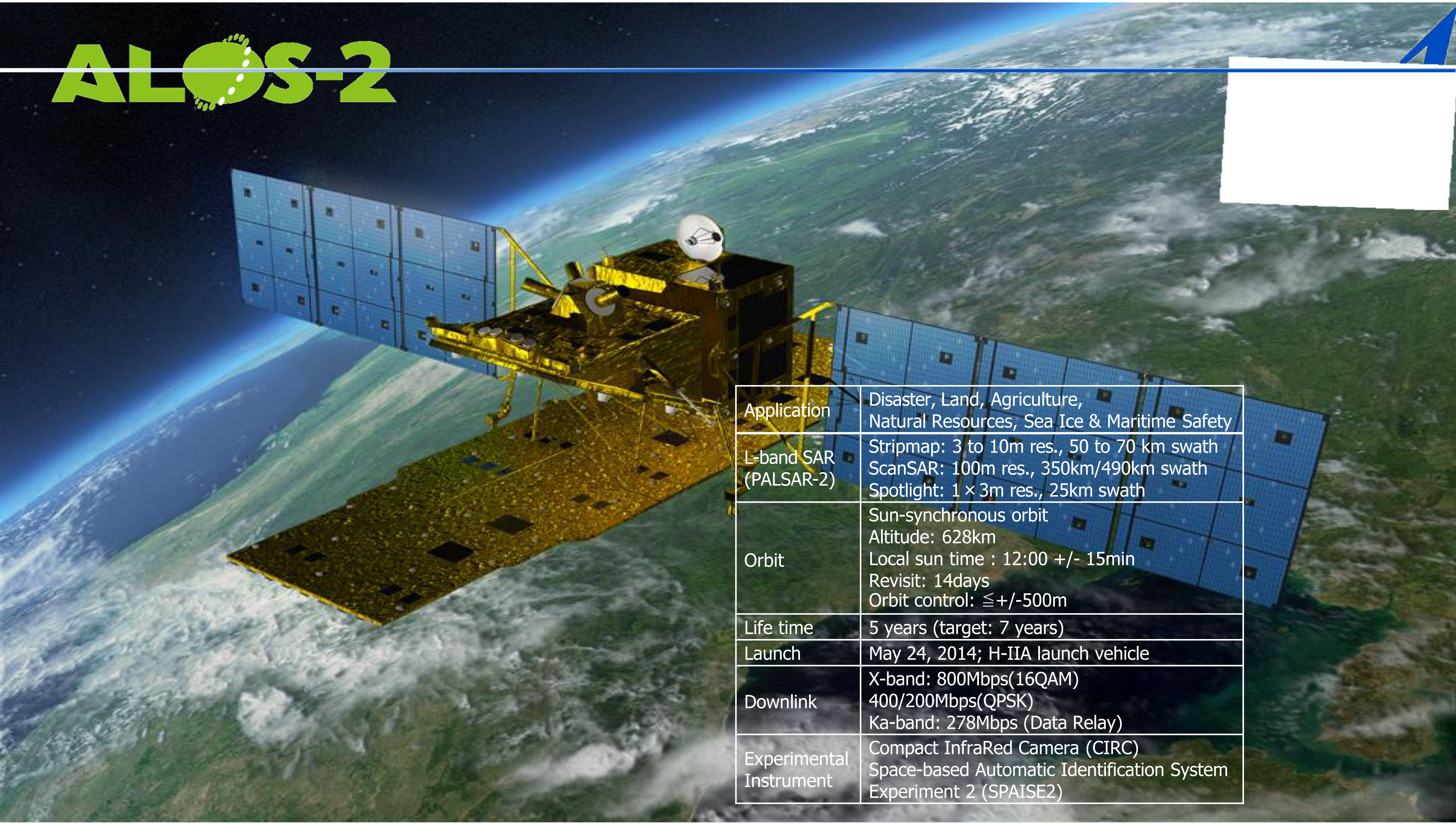
December 15, 2020

Continuous Observations by ALOS Series

- ✓Assurance of <u>safety and security of citizens</u>, *i.e.* disasters monitoring and management, land deformation monitoring, national developing management, foods and natural resources, environmental issues in global etc.
- ✓Enhancement of commercial use of Earth observation data, *i.e.* <u>National Spatial Data infrastructure (NSDI)</u> and <u>new applications.</u>

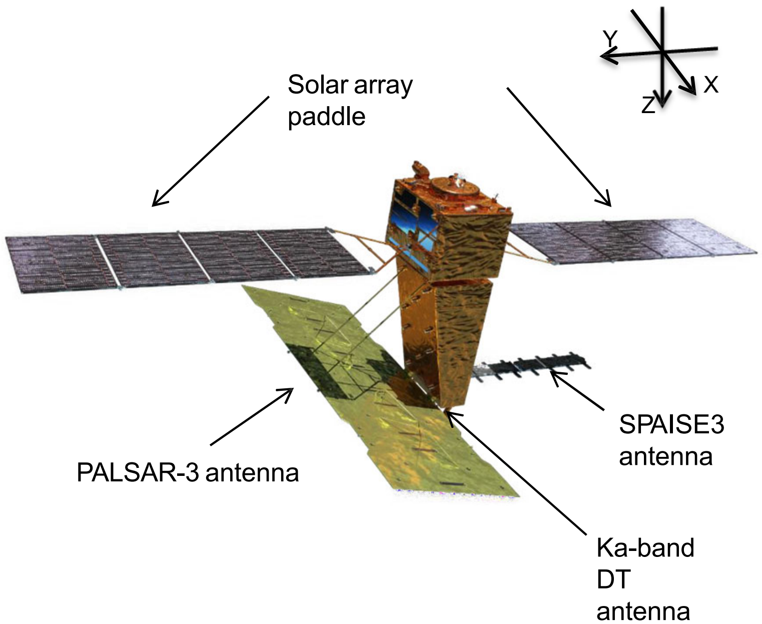


ALOS-2



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-4 Overview



Launch	**JFY2022~ by H3 launch vehicle**
Orbit	**Same orbit as ALOS-2** ✓ Sun-synchronous sub-recurrent orbit ✓ Altitude: 628 km ✓ Inclination angle: 97.9 degree ✓ Local sun time at descending: 12:00 ± 15 min. ✓ Revisit time: 14 day (15-3/14 rev/day)
Lifetime	**7 years**
Size	X 10.0 m x Y 20.0 m x Z 6.4 m
Satellite Mass	~2,990 kg
Downlink	**1.8/3.6 Gbps (Ka-band)**
Mission Instruments	- **PALSAR-3** (Phased Array type L-band Synthetic Aperture Radar-3) - **SPAISE3** (SPace based AIS Experiment 3)
Prime contractor	Mitsubishi Electric Corporation

ALOS-4 Mission Objectives

1. **Precise monitoring** of land deformation and subsidence using **InSAR**

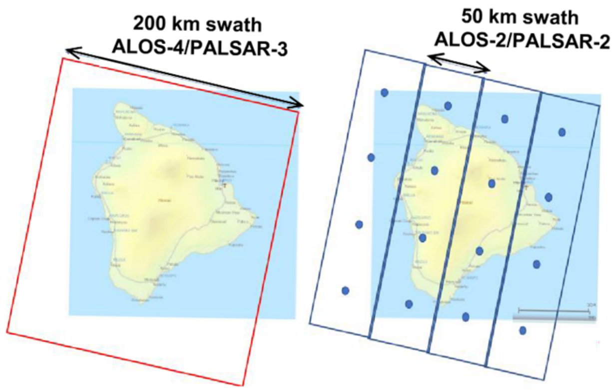
2. **Continuation** and **enhancement** of **ALOS-2 mission** (all-weather disaster monitoring and forest monitoring, etc.)

3. Exploring **new applications** such as large infrastructure monitoring using **InSAR time series analysis**

4. **Marine monitoring** by **SAR** and Automatic Identification System for ships (**AIS**)

ALOS-4 Mission Objectives

- **Precise monitoring** of land deformation and subsidence using **InSAR**

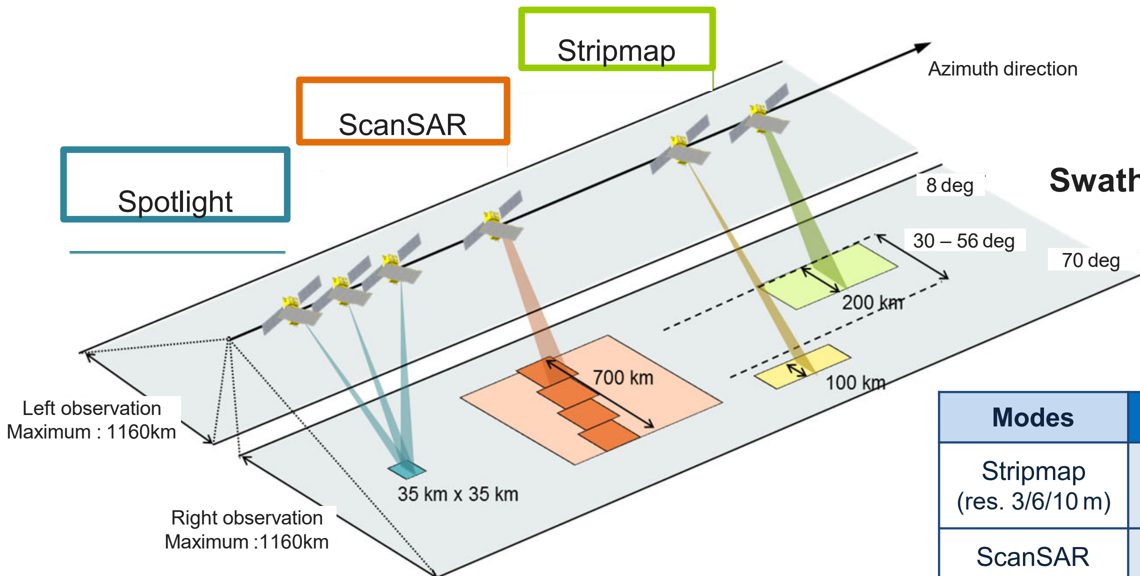


Coverage over Hawaii island

- More frequent observation
  - ✓ High resolution + wide swath width
- Mutual interference with PALSAR-2
  - ✓ The same orbit and observation geometry as ALOS-2
- Orbit control is performed autonomously and its accuracy is within +/- 500 meters.
- Improved orbit determination accuracy
  - ✓ ~3 m (RMS) for onboard orbit
  - ✓ ~0.1 m (RMS) for offline orbit

PALSAR-3 Observation mode

ALOS-4



Swath width of PALSAR-3/2

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

*single look

ALOS-4 Basic Observation Scenario (BOS) development plan

ALOS-4

As of 15th Dec., 2020

CY	2020	2021				2022	
	Oct.-Dec.	Jan.-Mar.	Apr.-Jun.	Jul.-Sep.	Oct.-Dec.	Jan.-Mar.	Apr.-Jun.
ALOS-4 Basic Observation Plan	Study and Simulation on Basic Observation Scenario (BOS)						
			△BOS Ver.1 (TBD)				
				Coordination and Simulation			
							△ BOS Ver.2 (TBD)

JAXA-NASA L-SAR cooperation

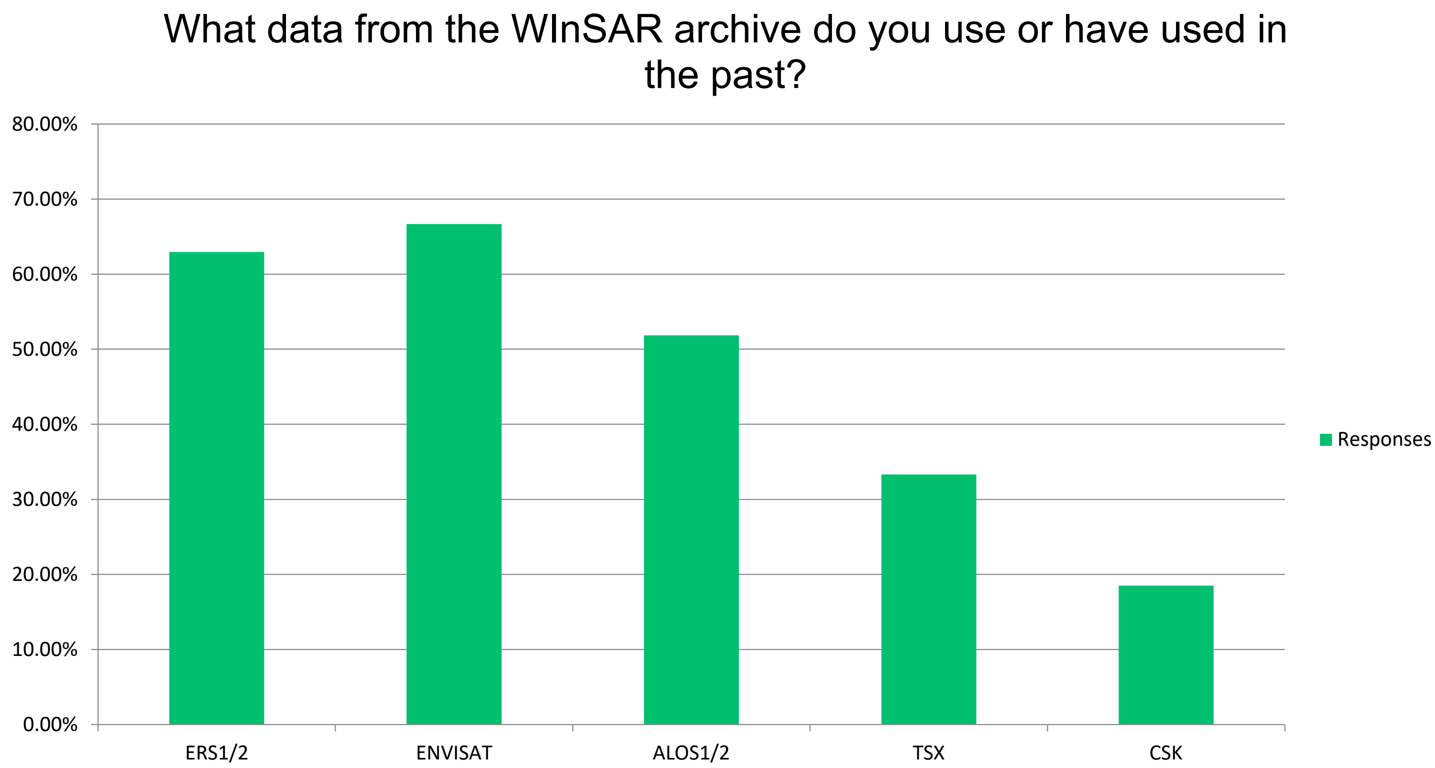
- ALOS PALSAR/AVNIR-2 and ALOS-2 ScanSAR data mirroring at ASF
- ALOS-2 research and application cooperation (with US UAVSAR etc.)
- ALOS-2 disaster monitoring cooperation
- Feasibility study of ALOS-4 PALSAR-3 direct reception at NISAR ground stations

ALOS/ALOS-2 mass processing for O&F

		CY 2020				CY 2021			
		1Q Jan Mar	2Q Apr Jun	3Q Jul Sept	4Q Oct Dec	1Q Jan Mar	2Q Apr Jun	3Q Jul Sept	4Q Oct Dec
ALOS 	AVNIR-2 (10 m)	Data Processing →				▲ Global			
		Data Distribution (Open and Free) →							
	PALSAR FBS, FBD (10 m)	Data Processing →				▲ Global (L1.1+ L2.2)	Data Distribution (O&F) →		
ALOS-2 	PALSAR-2 ScanSAR (25m)	Preparation →	Data Processing (L1.1 + L2.1) →						

Discussion on the future of WInSAR: Survey

Question 1:

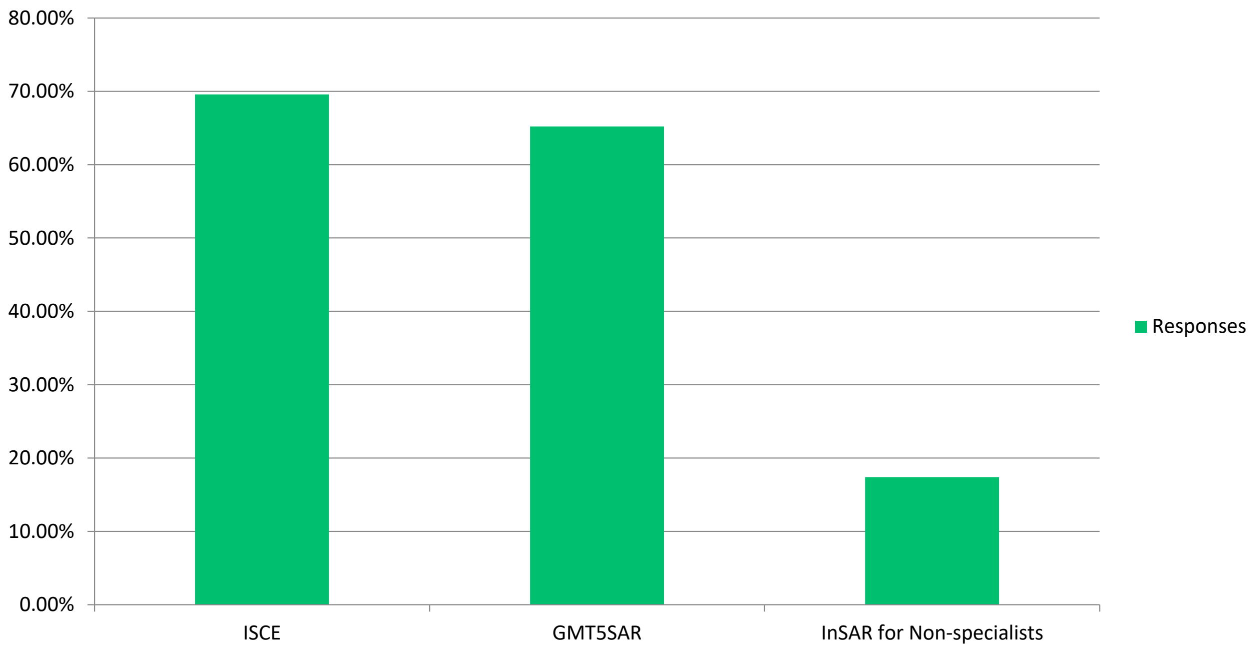


WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Discussion on the future of WInSAR: Survey

Question 2:

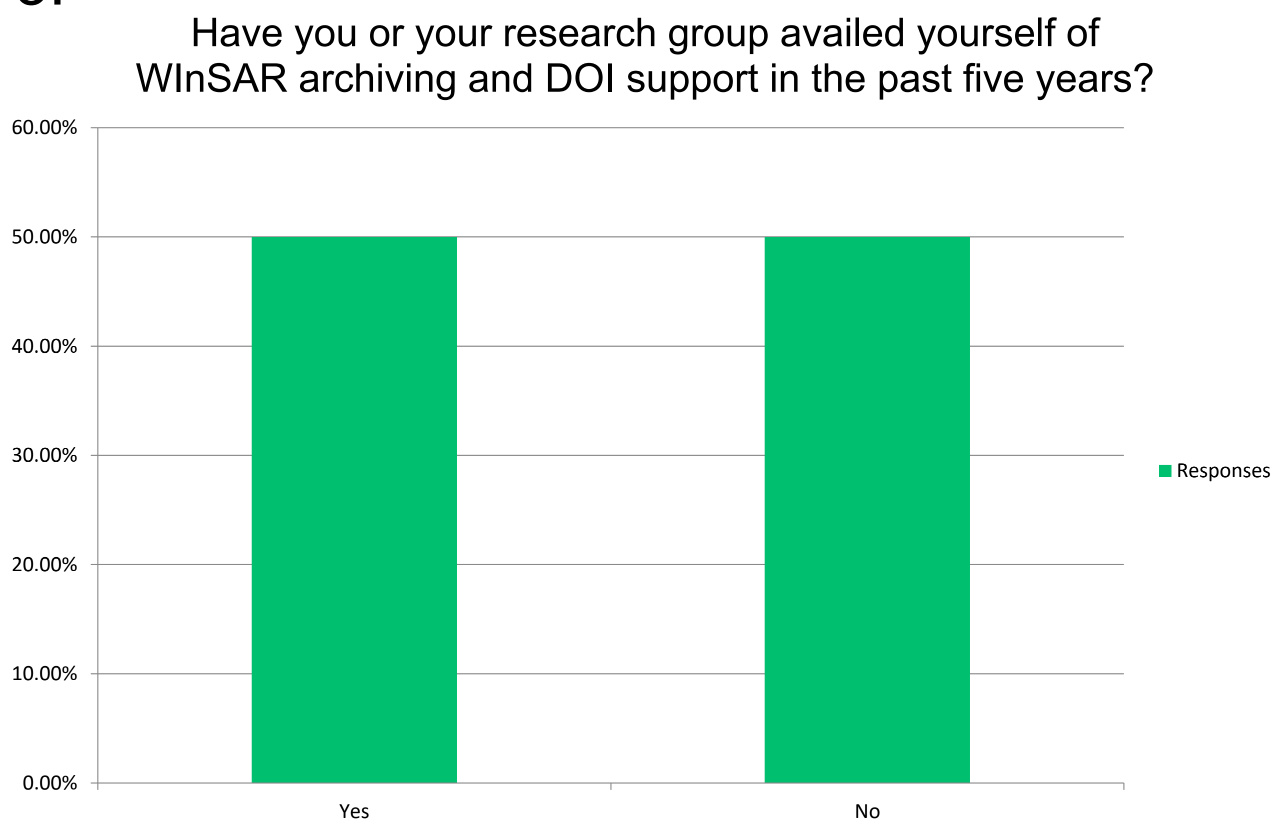
Have you or your research group attended or accessed the WInSAR short courses in the past five years, including the recorded session?



WInSAR
Western North America Interferometric
Synthetic Aperture Radar Consortium

Discussion on the future of WInSAR: Survey

Question 3:



WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Discussion on the future of WInSAR: Survey

Question 4:

What do you think are the most valuable functions that WInSAR provides to the community today?

1. Data: Archiving data, data access, providing assistance with new programmed data acquisitions; data sharing (both data archives and DOI for publishing data); organization and archiving of proprietary data; ALOS-2 PI data sharing. Support from a capable, prepared staff.

2. Education: WInSAR-UNAVCO short courses; course organization and curating online courses. Providing a forum and voice for the InSAR research community, particularly in the US, while providing links to the international community. Coordinate and stimulate community InSAR forum. The annual WInSAR business meeting is probably the best single informational event for developments in InSAR for the wider community. On-boarding young scientists with SAR data.

3. Advocacy: Advocating for the interests of the US scientific community, both with NASA and foreign satellite agencies with the primary goal of ensuring data access.

WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Discussion on the future of WInSAR: Survey

Question 5:

What role(s) do you think WInSAR should provide in the future to support the SAR community?

1. Data: Continue and expand proprietary dataset archiving, DOI generation and PI data sharing. Provide higher-level products/processing, including time series products. Assist with streamlining of data access; coordinate research activities. Better outreach and education on data holdings and services. Uncertainty was expressed about the continuing role providing North American data access for the larger community.
2. Education: Expand and increase short courses with the goal of broader community literacy and education on best practice in an on that topic. Expand virtual courses and webinars. Educate the community on cloud data access and computing.
3. Advocacy: Continue as a collective voice for the InSAR research community. Advocate for community standards, including data standardization, benchmarking of processing methods, integration with ionospheric correction programs. Establish a consensus platform to share their codes and processed data.
4. Specifics: Facilitate a community produced textbook on the theory of SAR/InSAR. Advocate for, and potentially organize, a US-based conference similar to FRINGE. Develop an intermediate-level workshop.
5. Develop opportunities for diversity and inclusion in the InSAR community and profession.

WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Discussion on the future of WInSAR: Survey

Question 6:

Is there anything else you would like to add about WInSAR's future role?

1. Data: InSAR-specific archiving of contributed user data is going to be more important and not easy elsewhere. Stay committed to ongoing data access support for high-level users.
   - Consider broadening scope to include optical imagery and support for image differencing.
   - Potentially consolidate WinSAR's data holdings with Alaska Satellite Facility.
2. Education: Continue offering technical training to students and increase education in SAR literacy to the broader community.
3. Advocacy: WinSAR has played a very important role in promoting InSAR use and processing.
   - Continue to push for open data access.
   - Adapt to new circumstances - new missions, new priorities, etc.
   - Organize on-line meetings to acquire feedback on user needs and provide to current and/or future leadership.
   - Should WInSAR remain a North American organization or should it become bigger? This would reach more users (Worldwide Interferometric Synthetic Aperture Radar – WwInSAR; International SAR Service - ISS).

Open discussion