INTRODUCING NISAR: NASA'S BIGGEST EARTH OBSERVATION MISSION

Contributors:

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NISAR Is a collaboration of NASA & ISRO

NISAR Implemented & led by

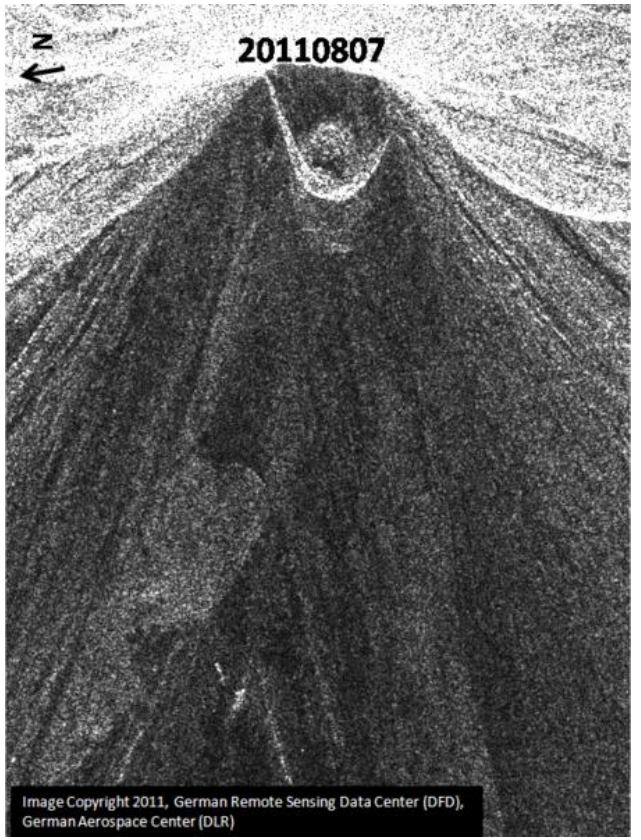
Jet Propulsion Laboratory
California Institute of Technology

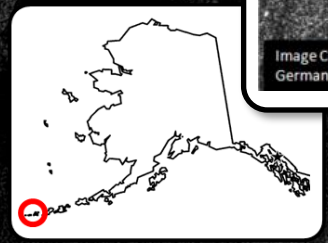
The World Is a Dynamic Place

Synthetic Aperture Radar Data is Weather Independent & Day/Night Capable, hence, it has Great Potential in Earth Observation & Hazard Analysis, especially in the Arctic

Mt. Cleveland

2011 Dome Growth of Mount Cleveland from SAR





Mount Cleveland, Alaska – ALOS PALSAR – © JAXA / ASF

Modern Spaceborn SAR Sensors Provide Cloud-Free Earth Observation Data Free-and-Open, Regularly-Sampled, and on a Global Scale

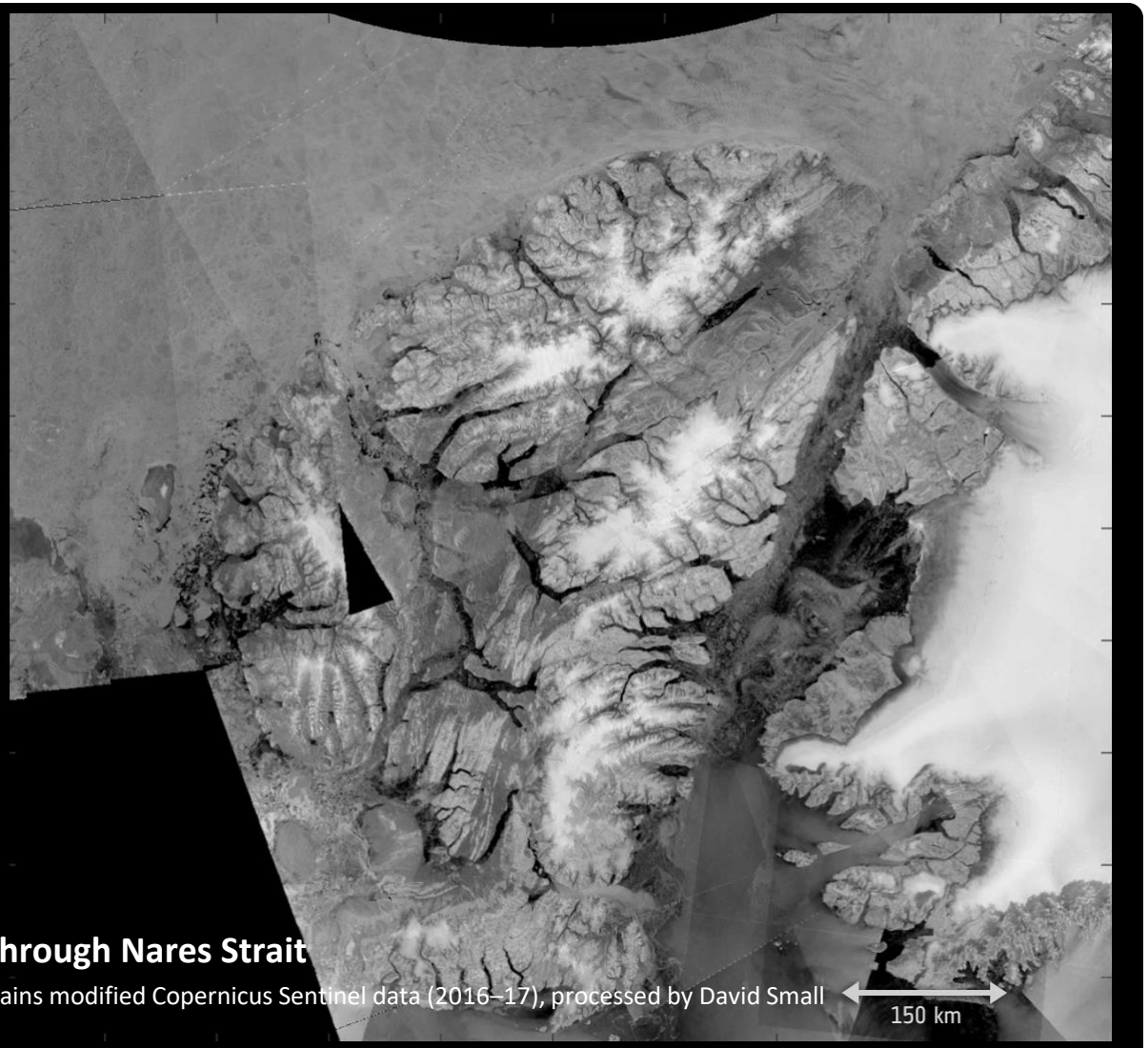
Sentinel-1

esa

Frequency: C-band

Launch Date: 2015 & 16

October 2016
November
December
January 2017
February
March
April
May

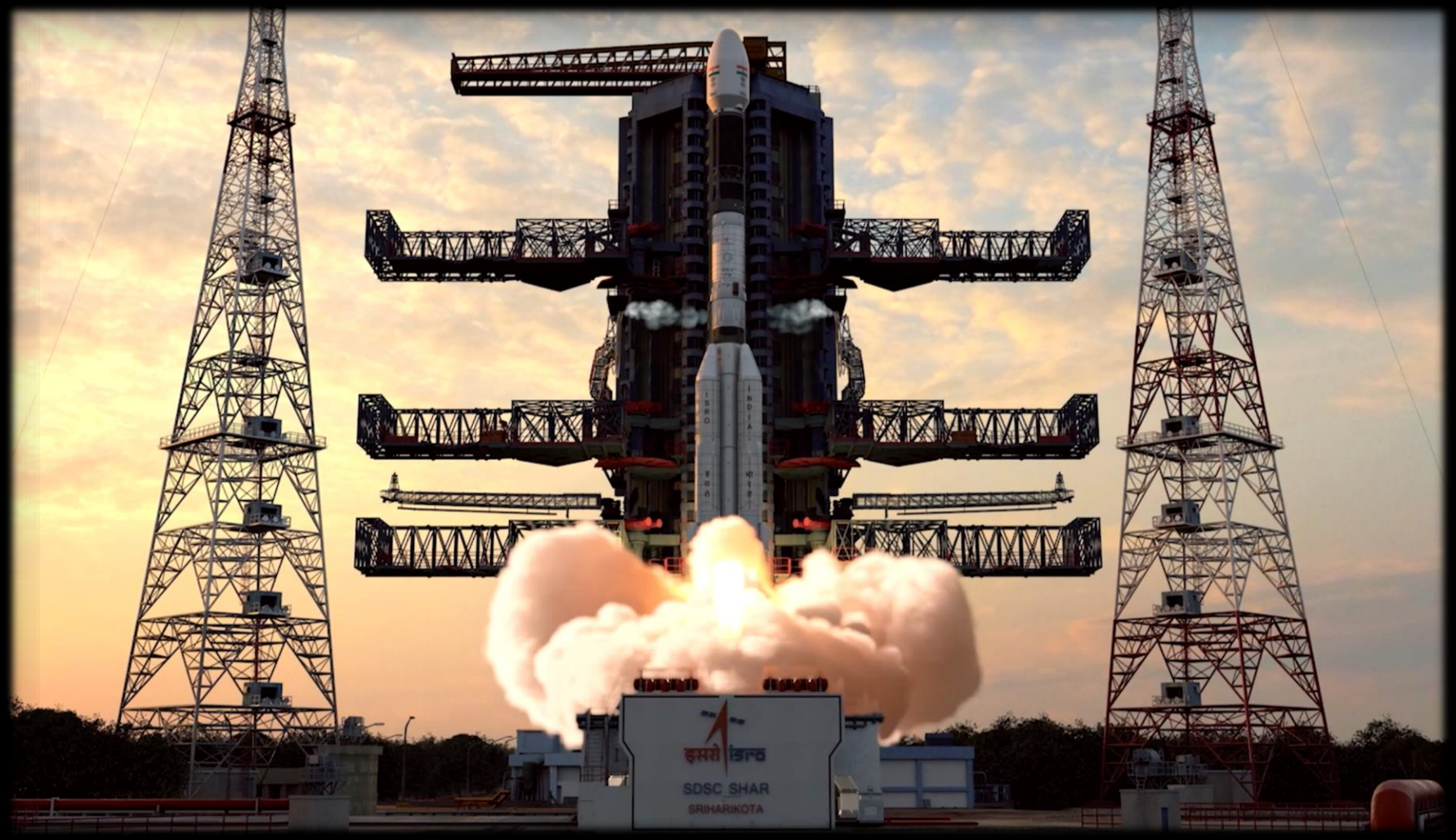


Arctic Sea Ice Export through Nares Strait

July 30 2025, NASA & ISRO Launched NISAR, A Revolutionary New Radar Earth Observation Mission

Launch Location:
Sriharikota India

Launch Vehicle:
GSLV MK II



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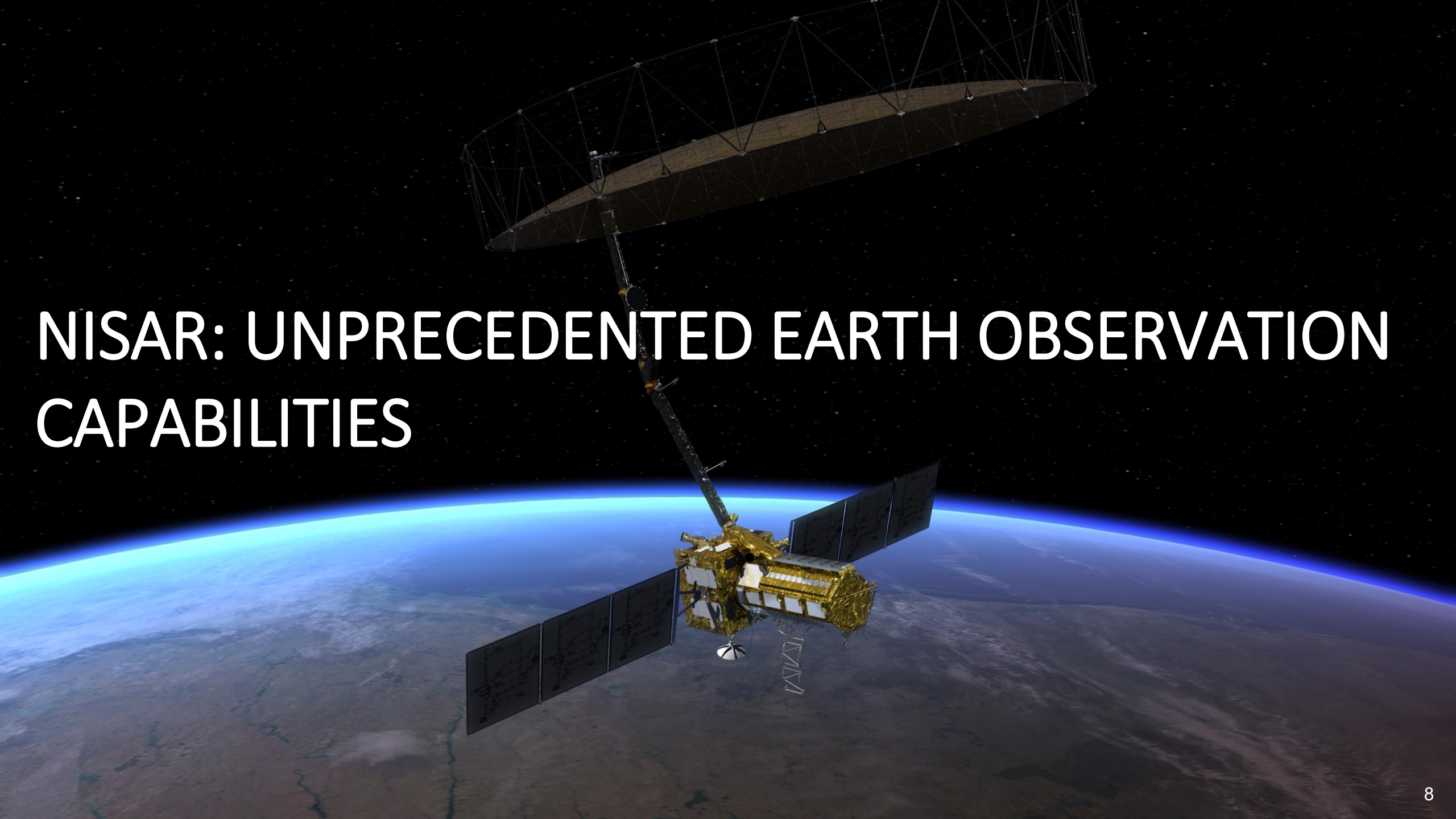
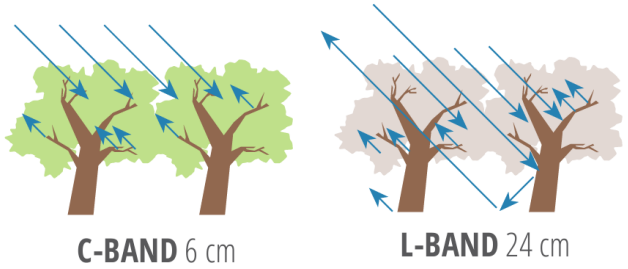


NISAR: UNPRECEDENTED EARTH OBSERVATION CAPABILITIES

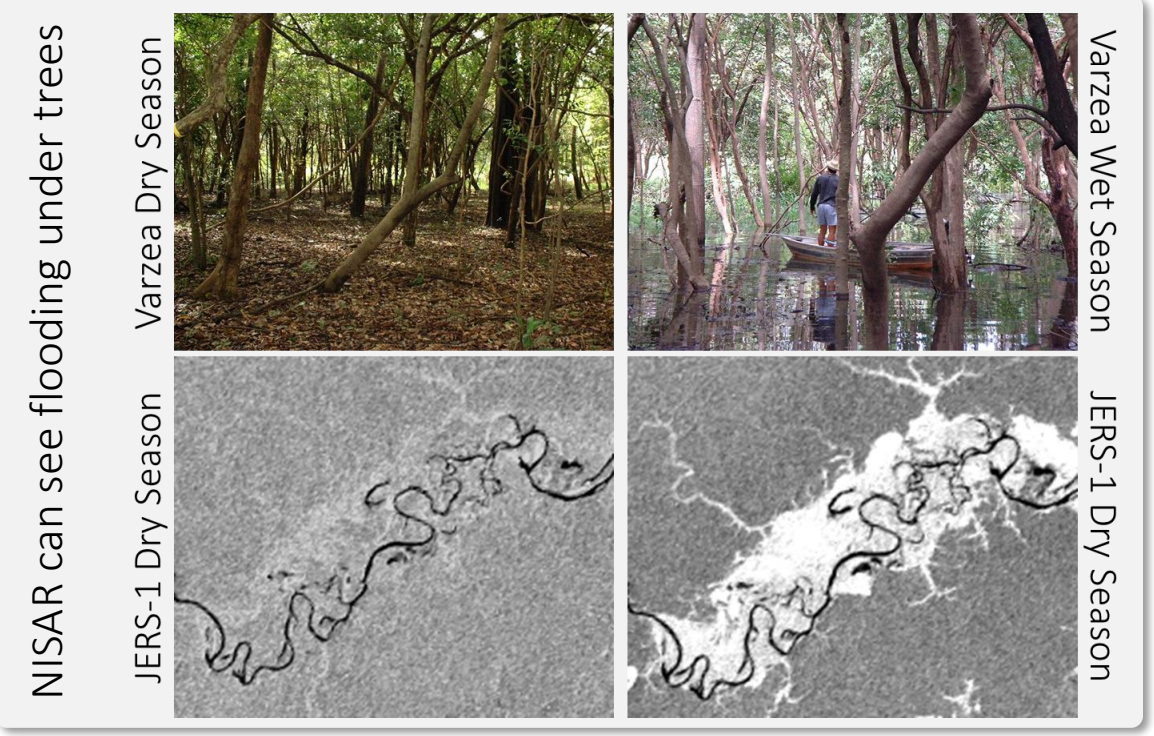
Getting Technical for Just a Minute

NISAR uses **Synthetic Aperture Radar (SAR)** for high resolution imaging

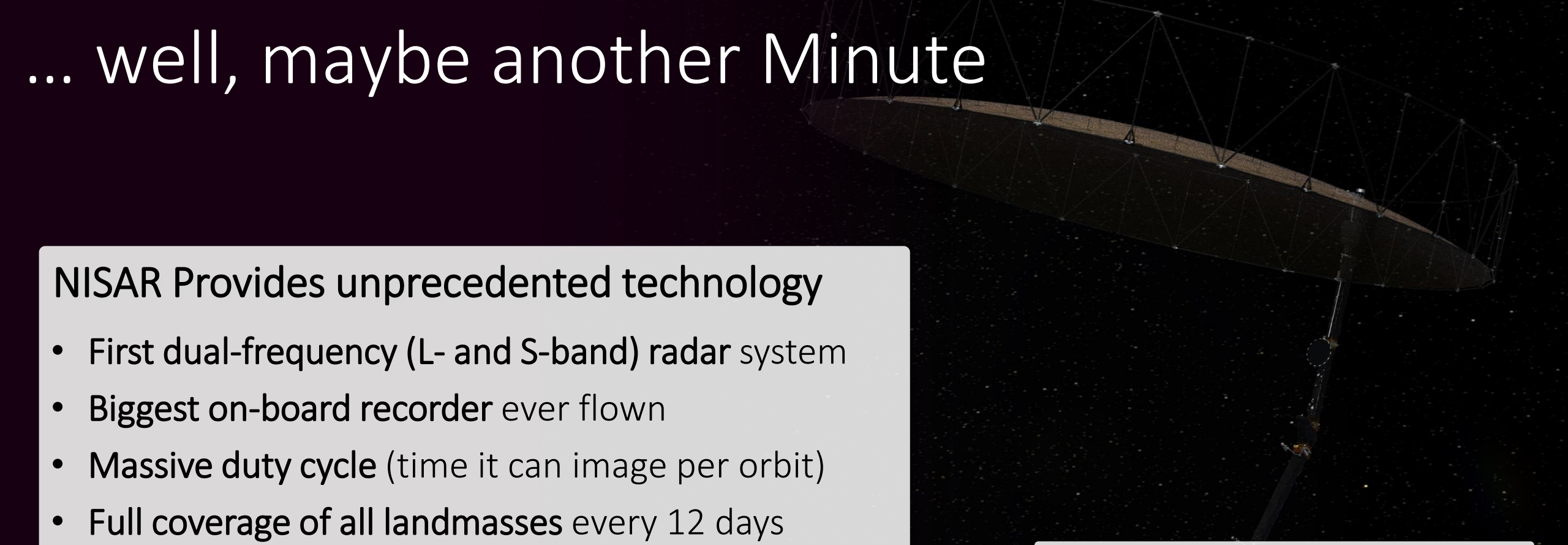
NISAR uses L-Band → NISAR can see things other sensors can't



L-band can penetrate through canopies



… well, maybe another Minute



NISAR Provides unprecedented technology

- **First dual-frequency (L- and S-band) radar** system
- **Biggest on-board recorder** ever flown
- **Massive duty cycle** (time it can image per orbit)
- **Full coverage of all landmasses** every 12 days
- **Left looking** → full and regular Antarctic coverage

- **Free and open data**

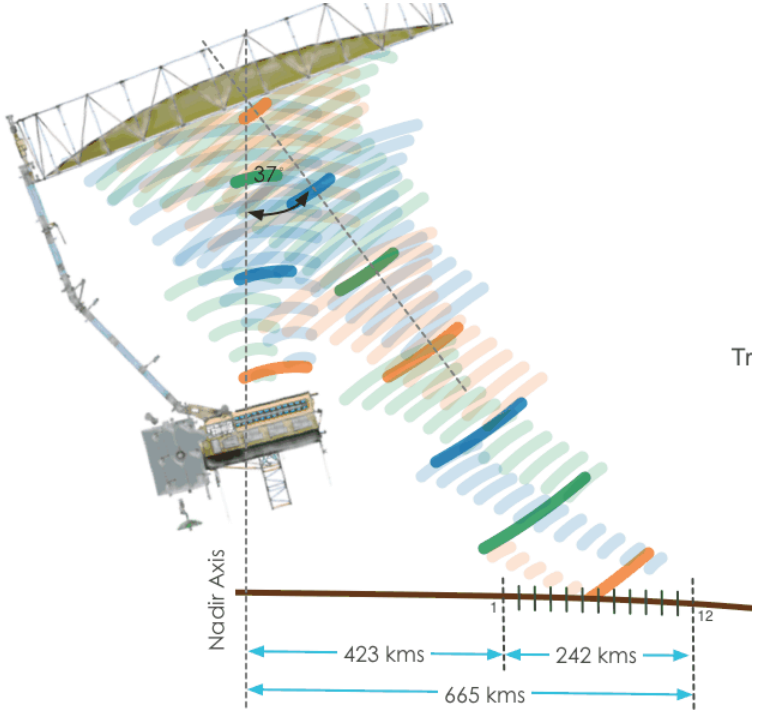
NISAR Is a collaboration of NASA & ISRO

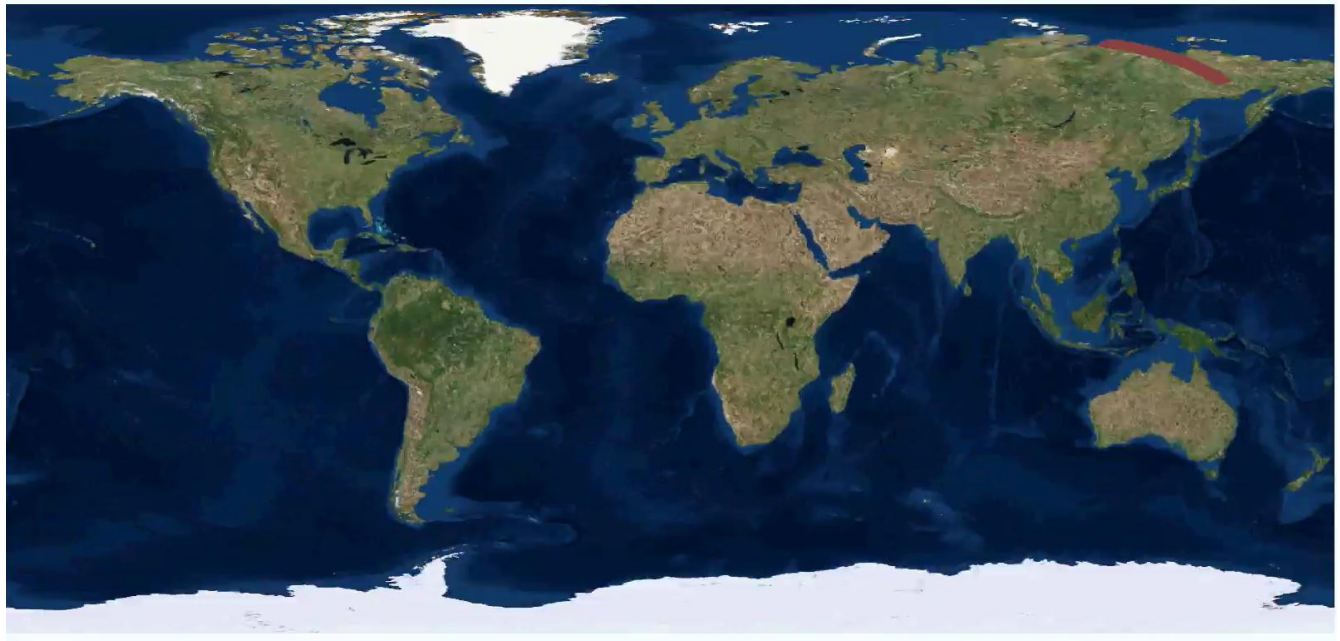
NISAR Implemented & led by

Jet Propulsion Laboratory
California Institute of Technology

… and one more Minute

Modern Imaging Technology for Global Coverage every 12 days

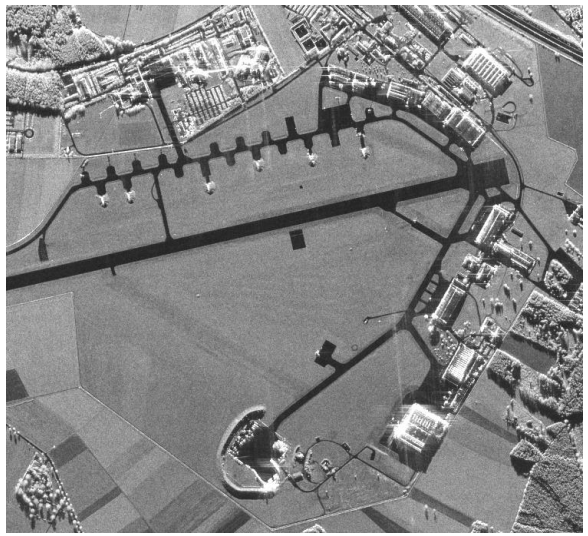




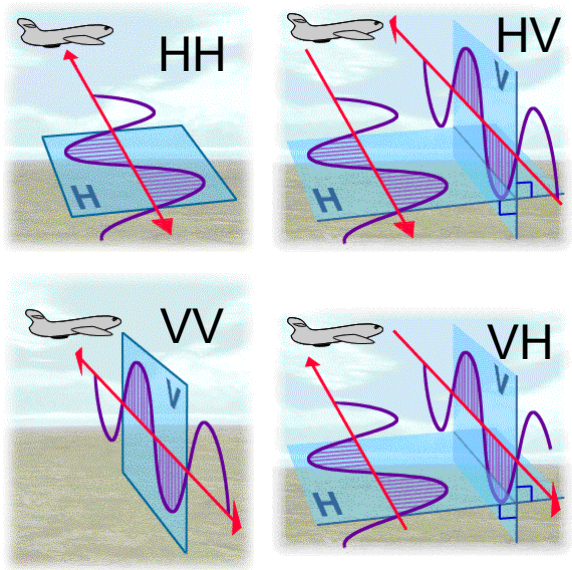
NISAR: More than Just Satellite Images

NISAR System records **Amplitude** and **Phase** of the reflected **polarized** microwave signals

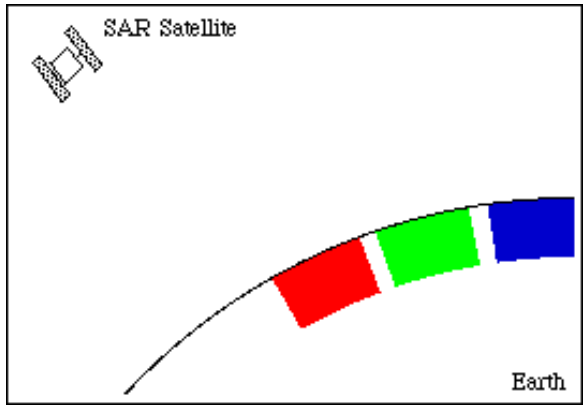
Amplitude forms SAR Image



Polarization for analyzing surface types

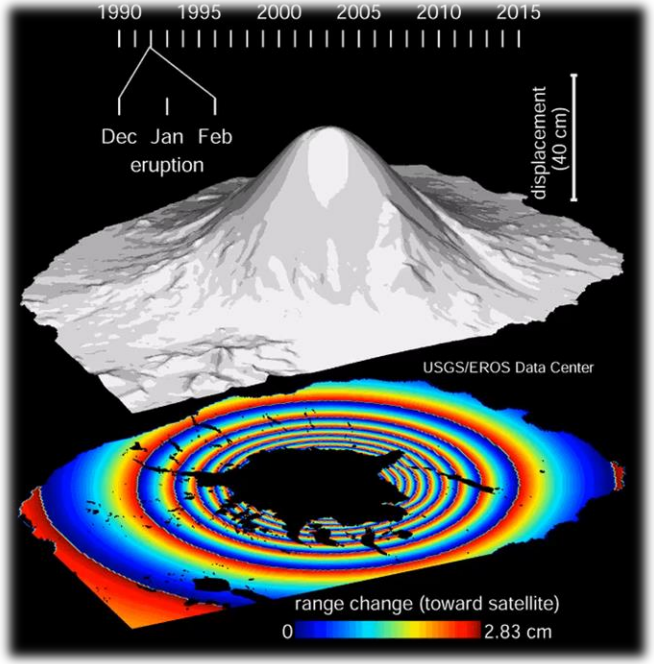


Phase measures the range to objects on ground

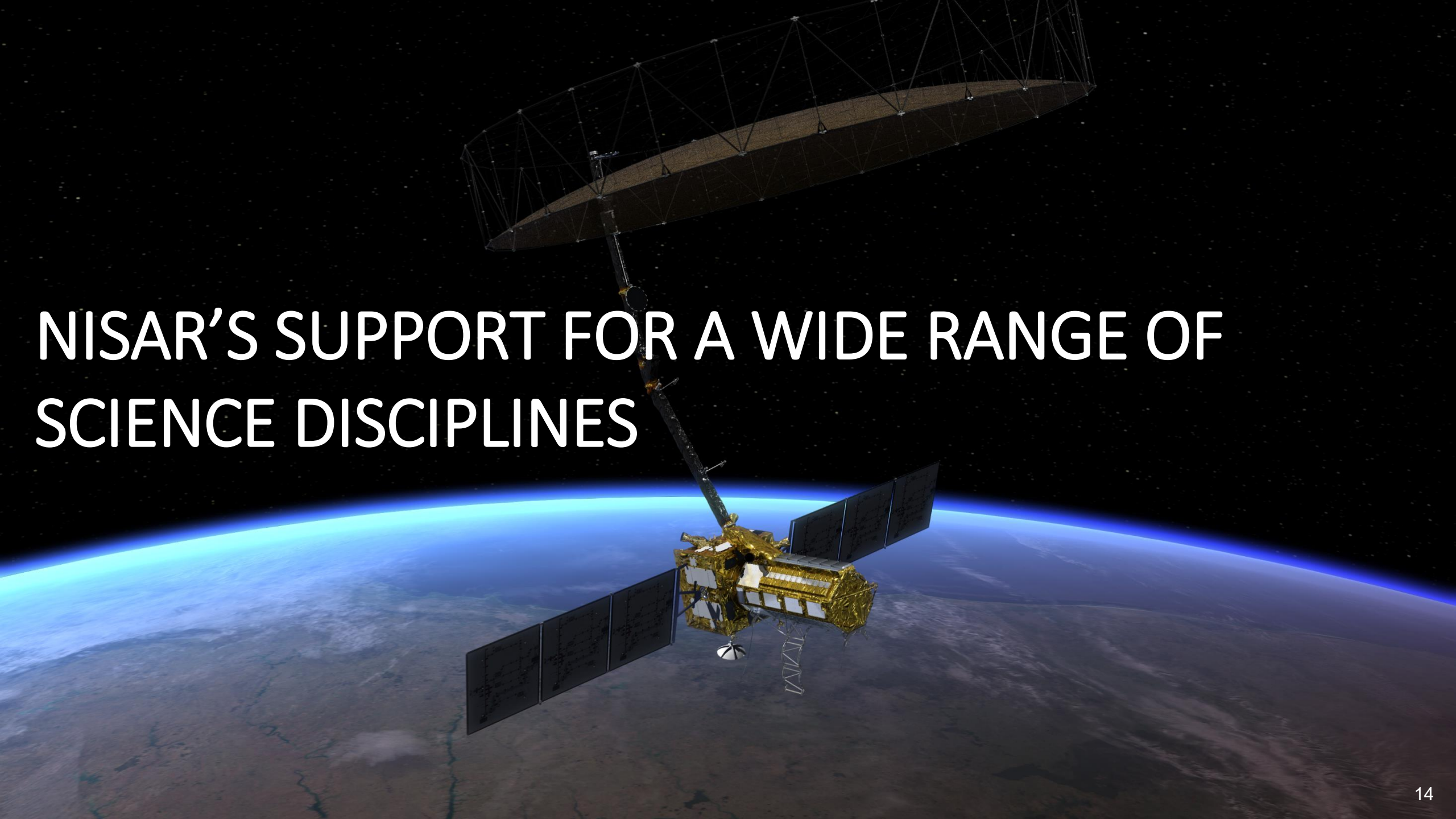


NISAR phase observations can measure surface displacement with centimeter accuracy

Stuff is happening HERE!



These data can help diagnose volcanic activity



NISAR’S SUPPORT FOR A WIDE RANGE OF SCIENCE DISCIPLINES

NISAR Will Provide Important Data for A Wide Range of Disciplines

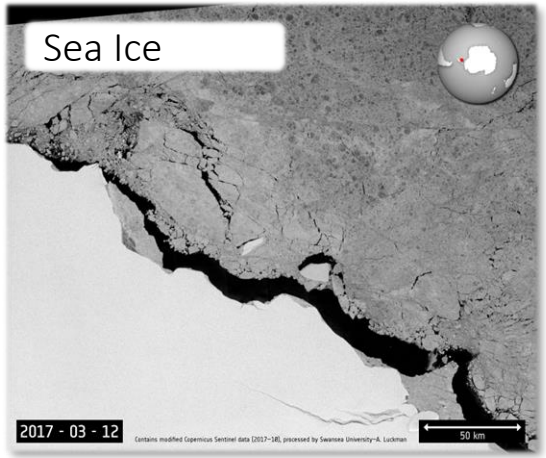
Solid Earth Science

Volcanology

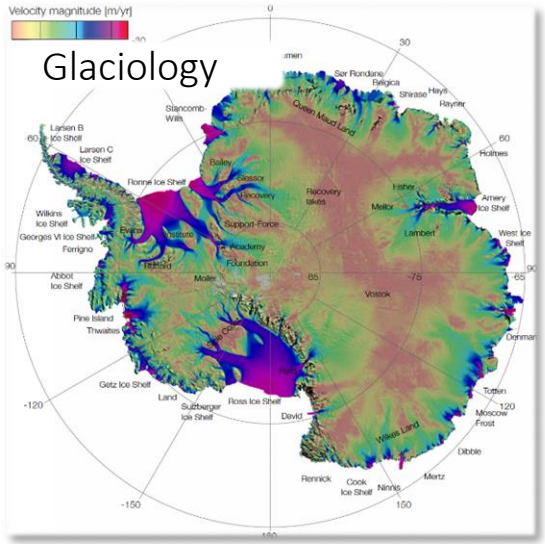
Seismology

Cryospheric Sciences

Sea Ice

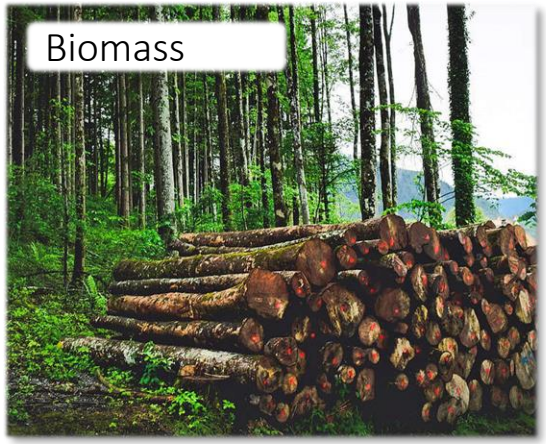


Glaciology



Ecosystems Sciences

Biomass



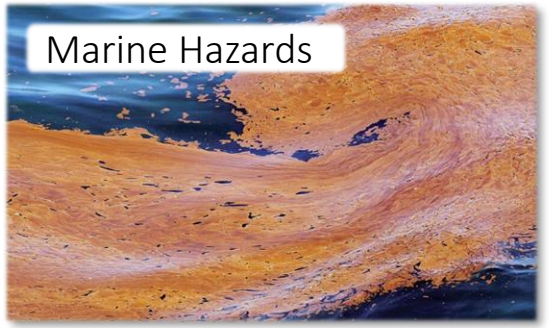
Agriculture

Applications

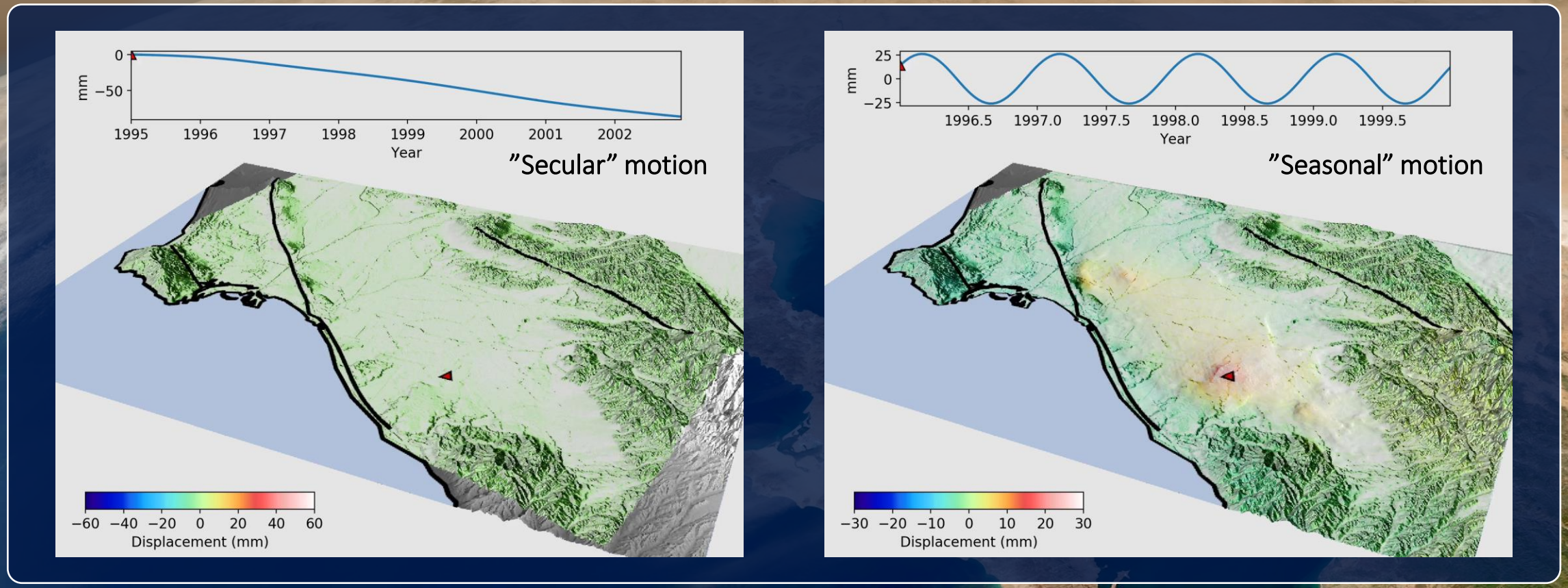
Wildfires

Flooding

Marine Hazards



NISAR **Solid Earth Science**: Insights in Earth's Subsurface



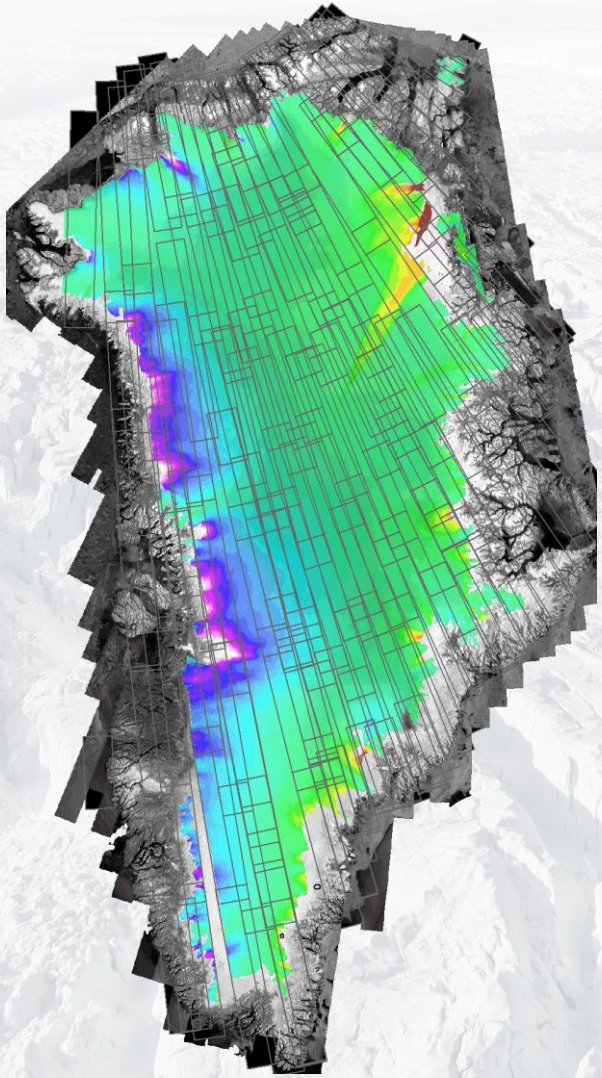
Courtesy: M. Simons, B. Riel (Caltech)

Seasonal ground deformation associated with shallow aquifers used for the majority of groundwater production

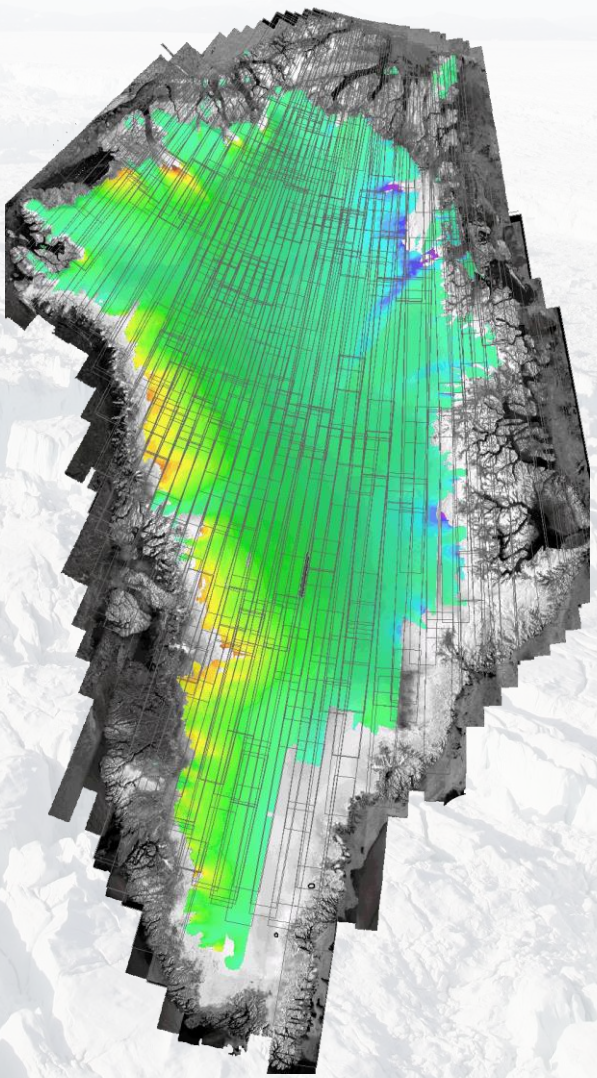
NISAR **Cryospheric Science**: Global Ice Velocity Dynamics

Example: Greenland

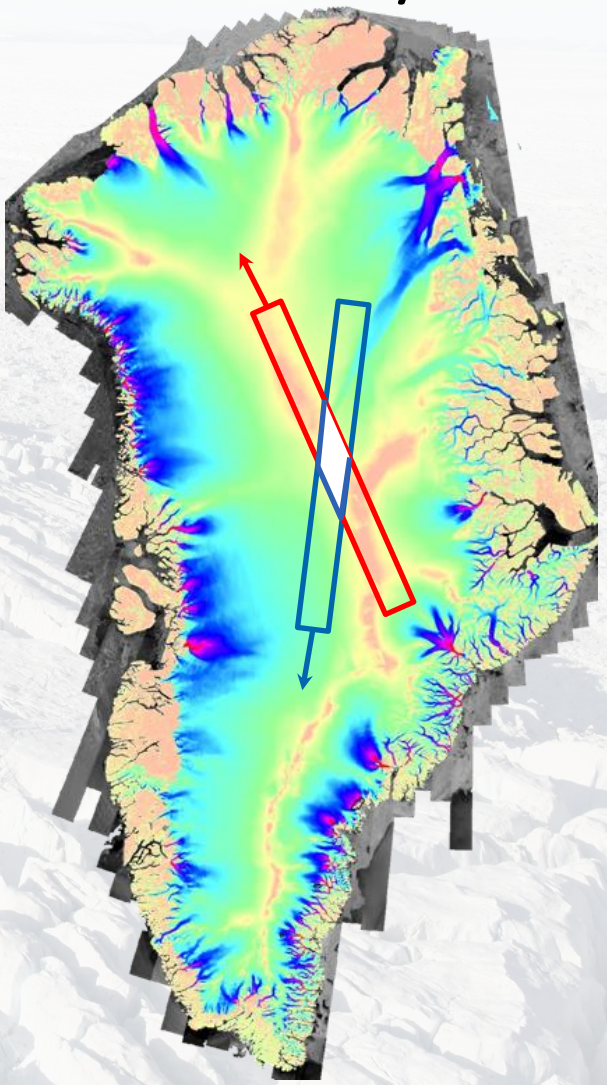
Ascending



Descending



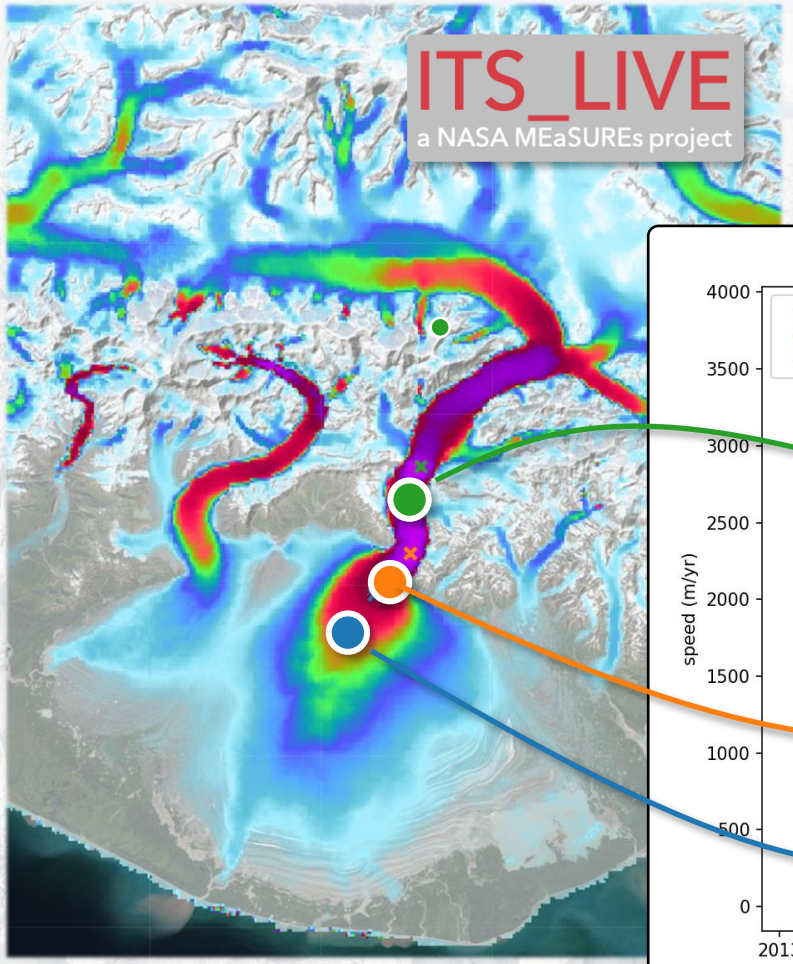
Velocity



Courtesy: I. Joughin (U. Wash/APL)

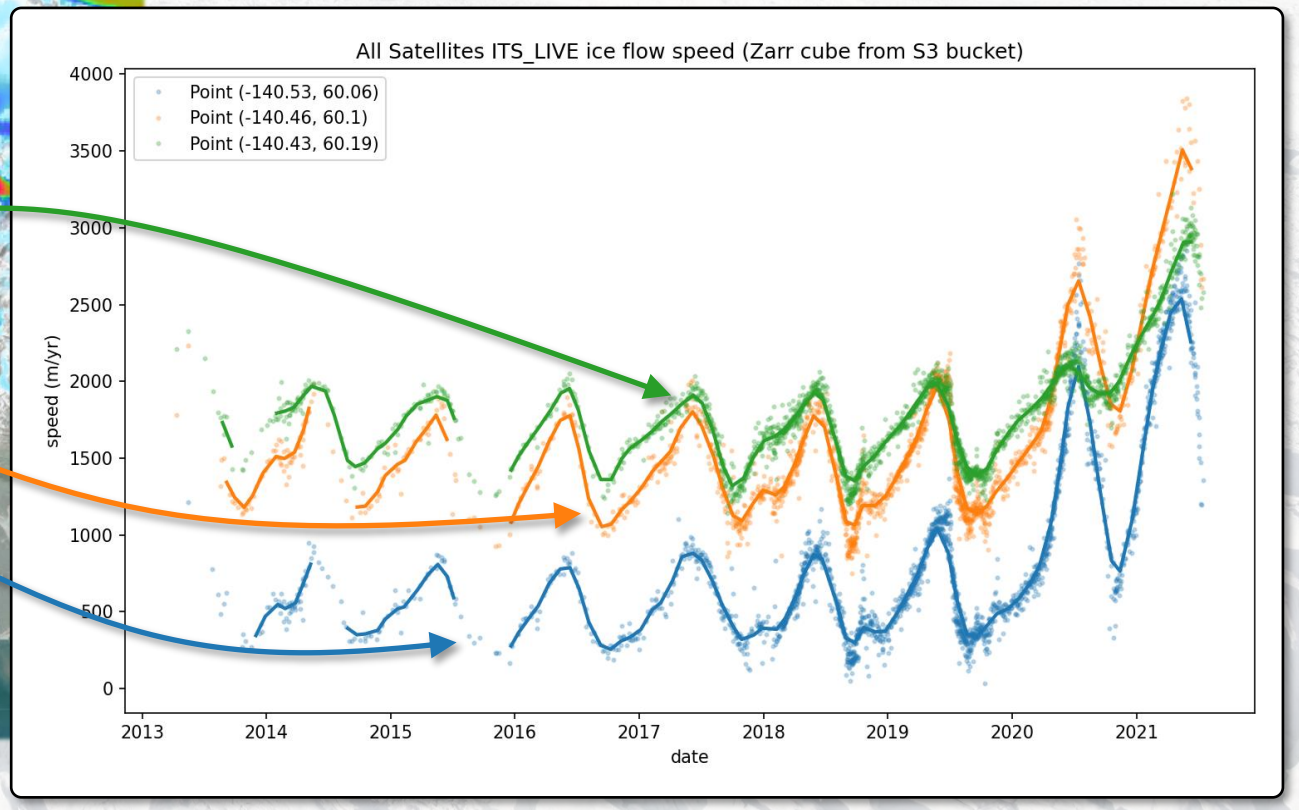
NISAR **Cryospheric Science**: Global Ice Velocity Dynamics

NISAR Provides Velocity Time Series



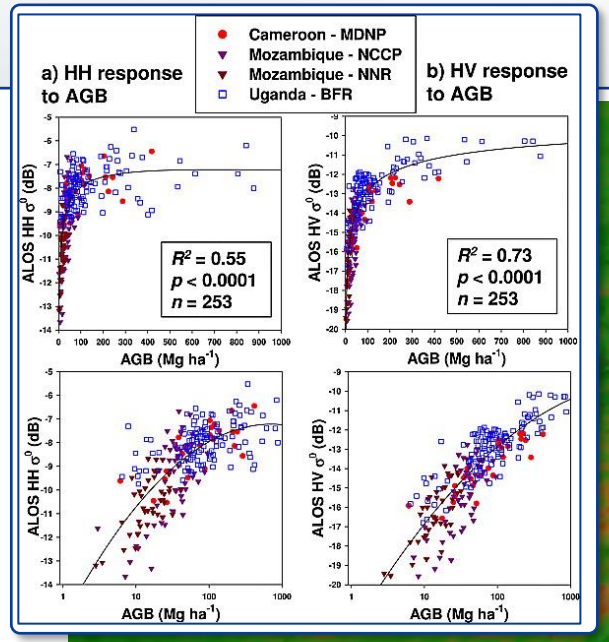
Courtesy: A. Gardner (JPL); Its Live Project is funded by NASA MEaSUREs and led by JPL

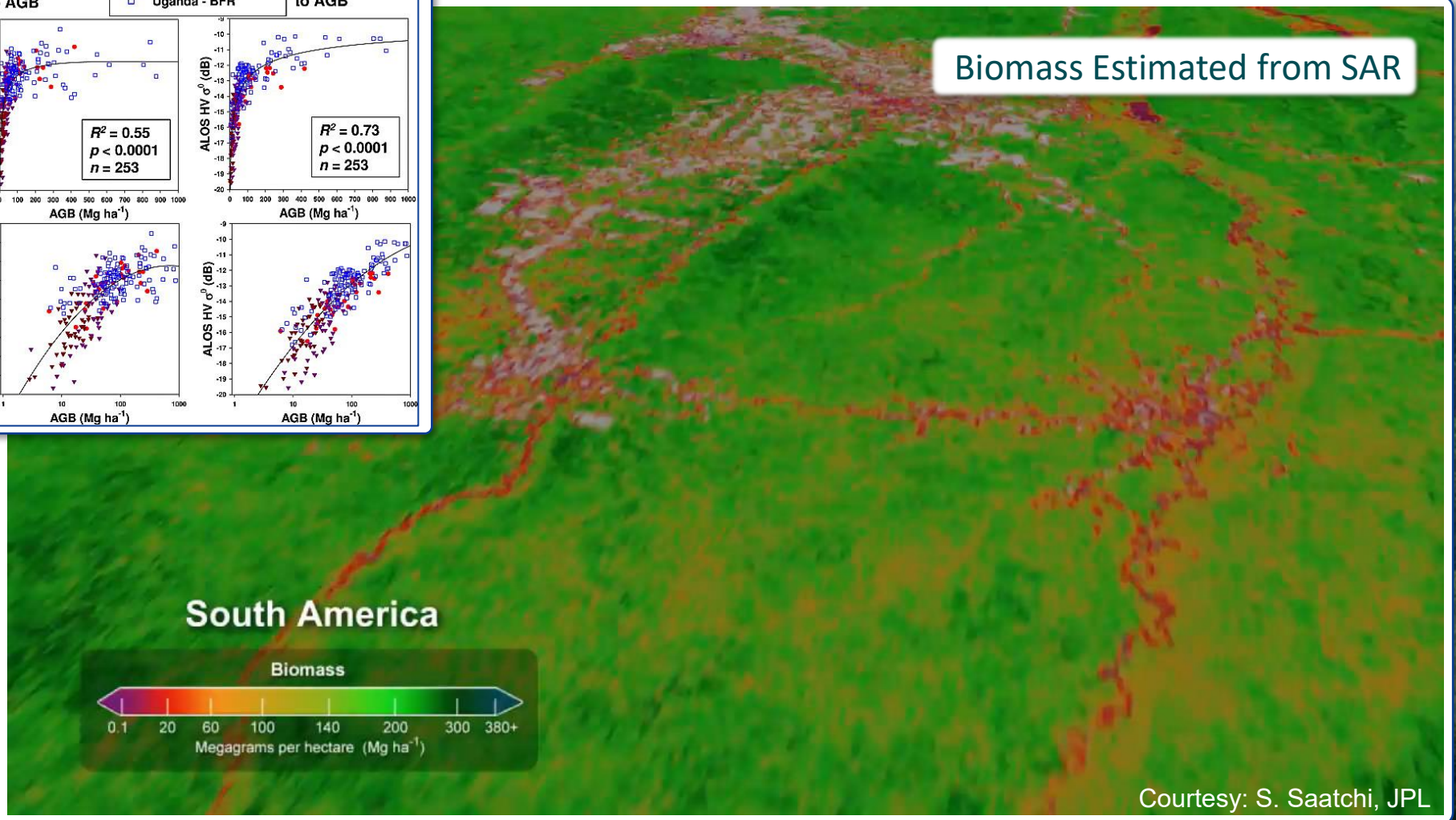
Malaspina Glacier, Alaska



NISAR **Ecosystems Science**: Mapping Biomass and Change

NISAR's Multiple Polarizations Enable Ecosystem Monitoring

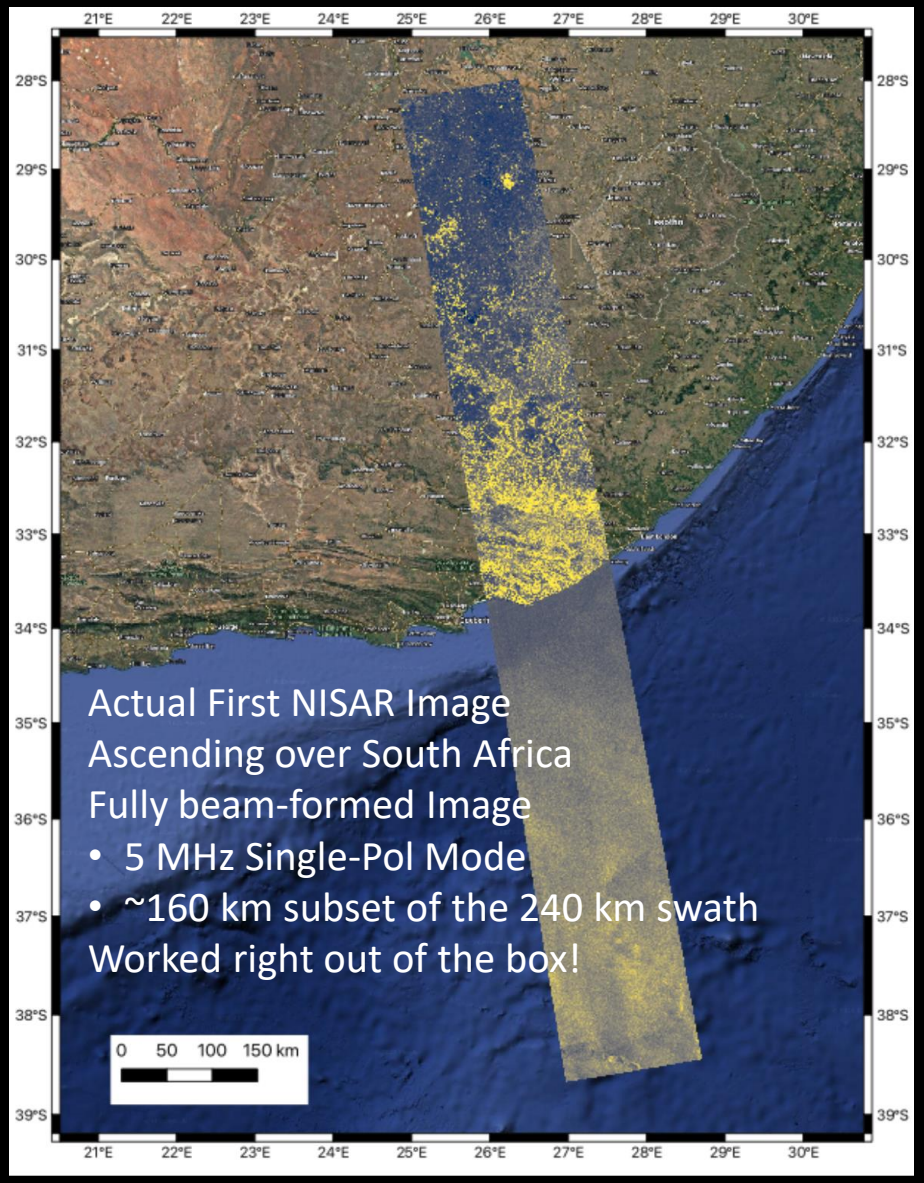


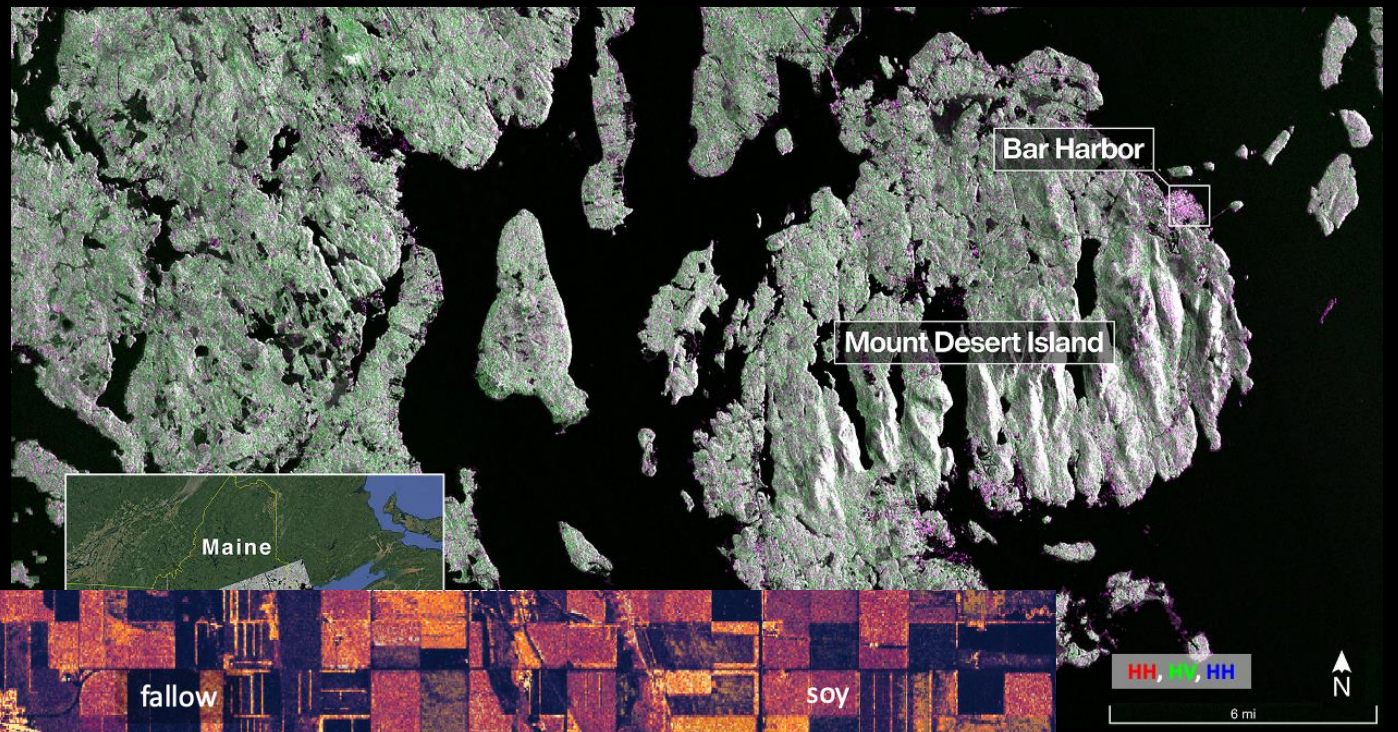


Courtesy: S. Saatchi, JPL


NISAR: FIRST DATA!!!

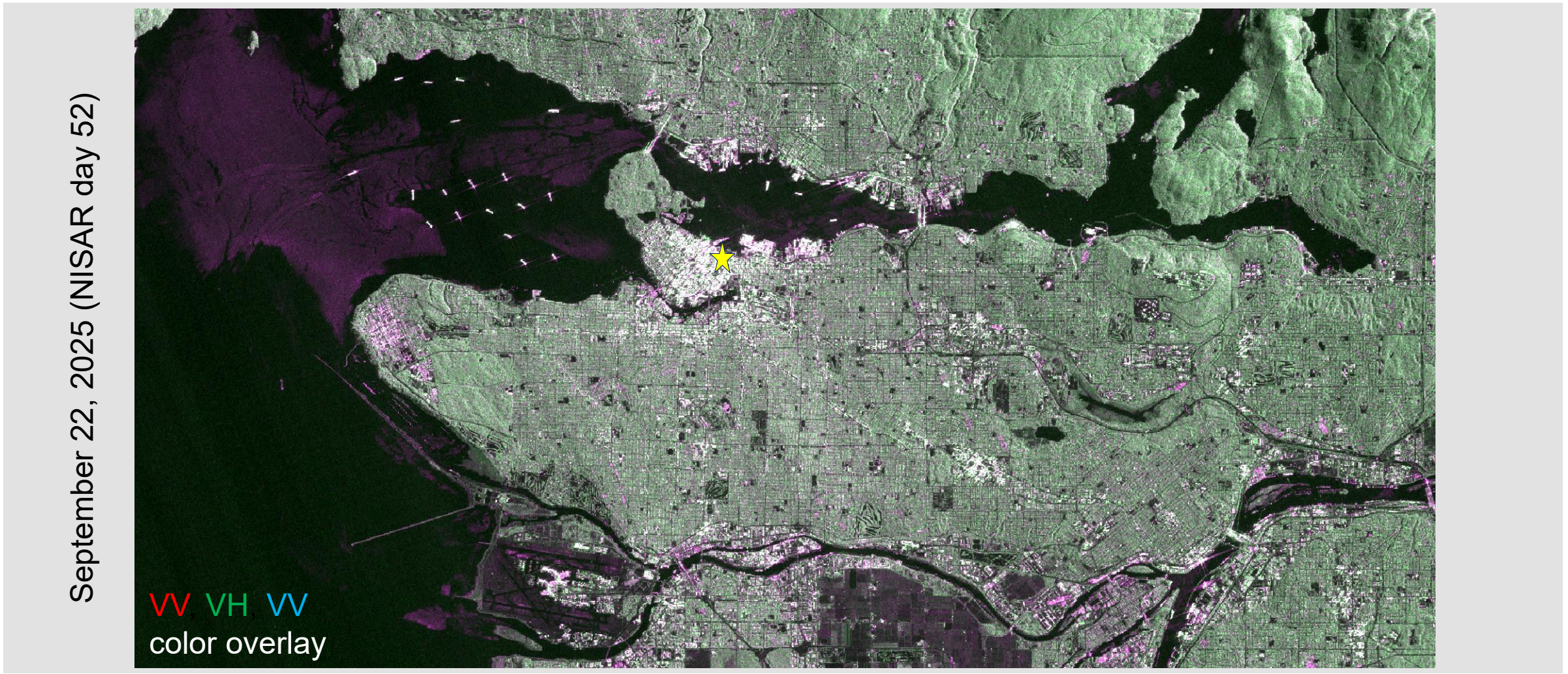
From first-light images to first science results





First released images (Sep 25)

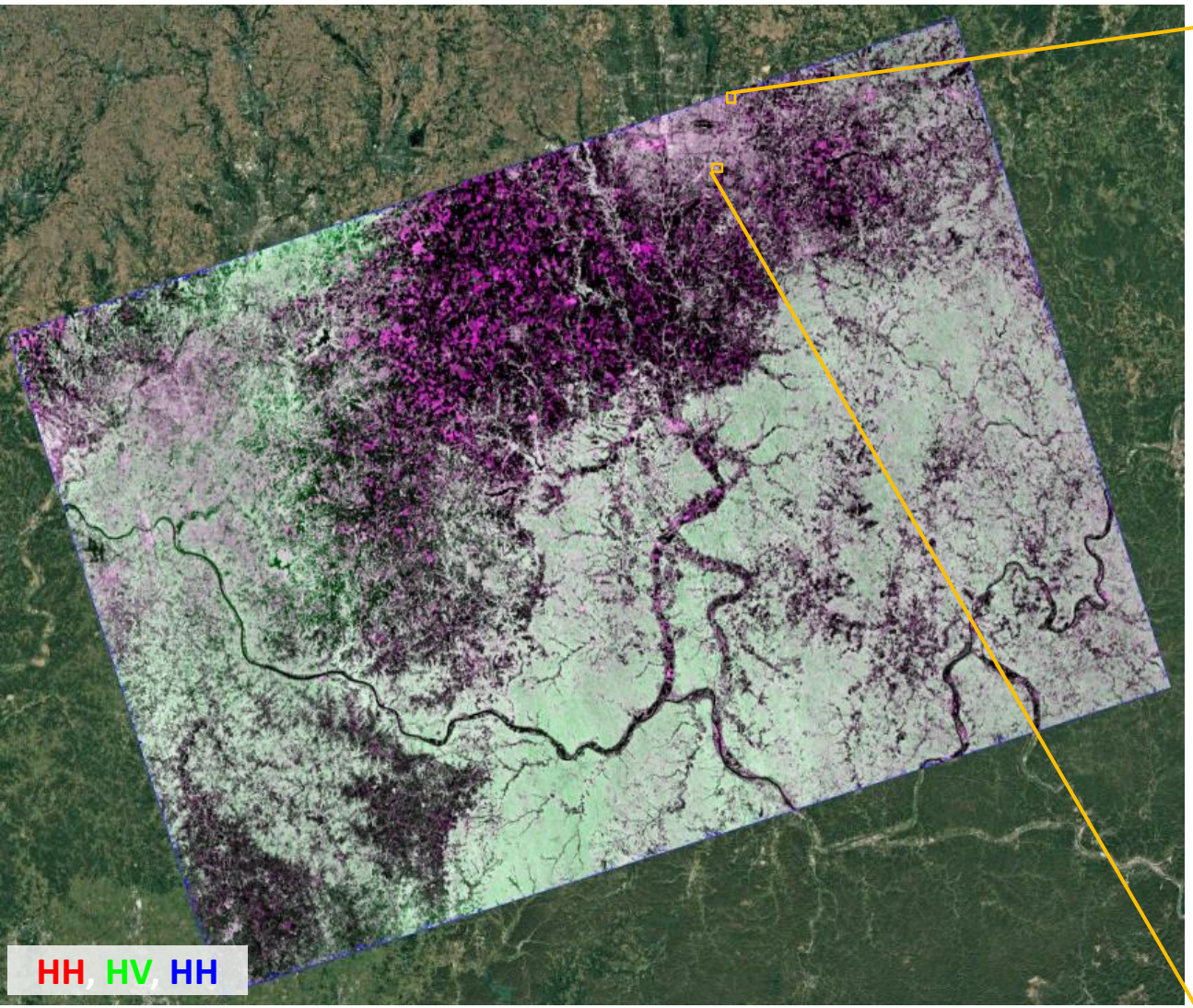
NISAR GCOV Vancouver: Dual Pol VV,VH (20 MHz)



The NISAR images presented in this work are preliminary and have undergone minimal post-launch calibration.

NISAR: Wide-swath, polarization diversity, fine resolution

GCOV product Columbus & Cincinnati, US; dithered-PRF mode (dual-pol, 40+5 MHz)



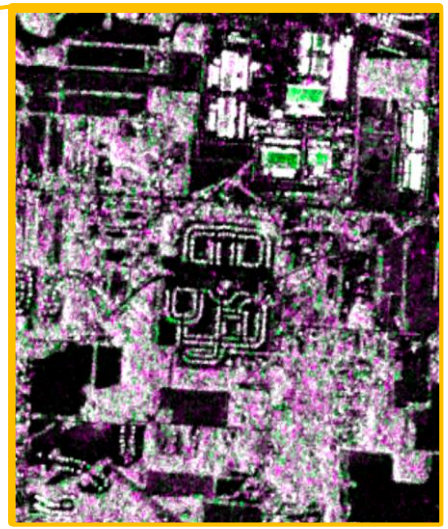
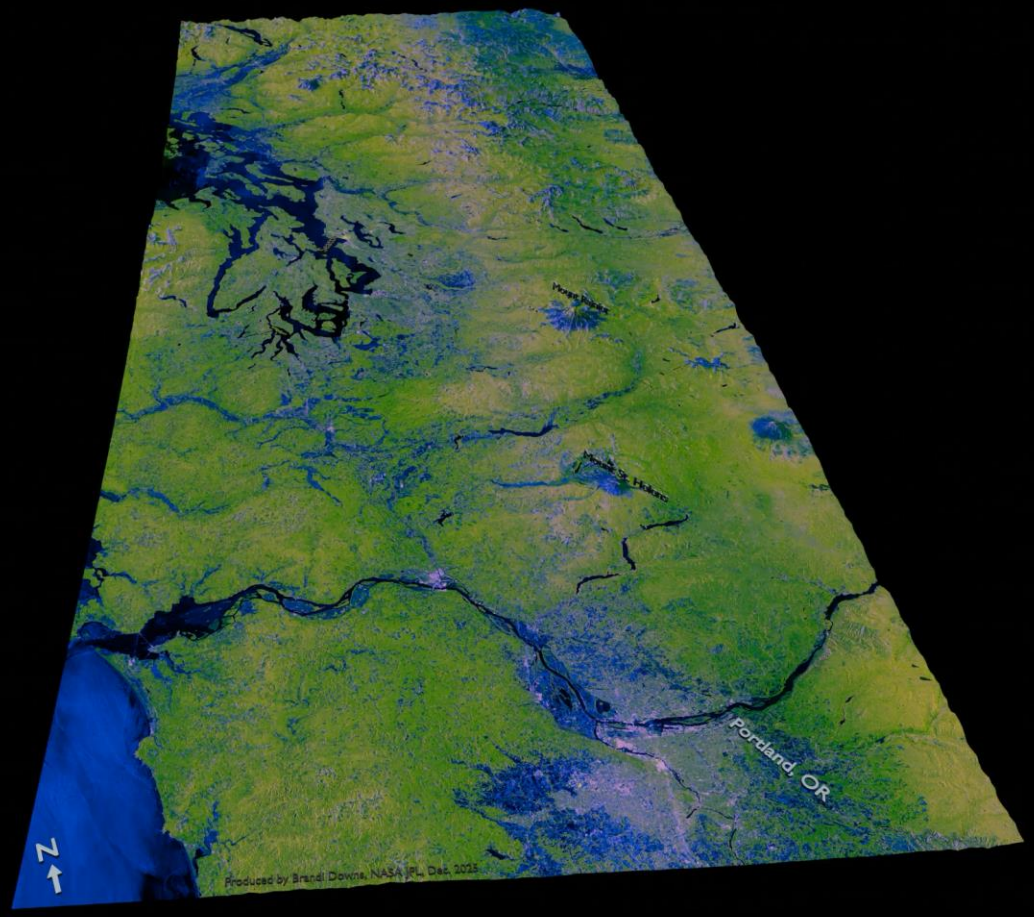
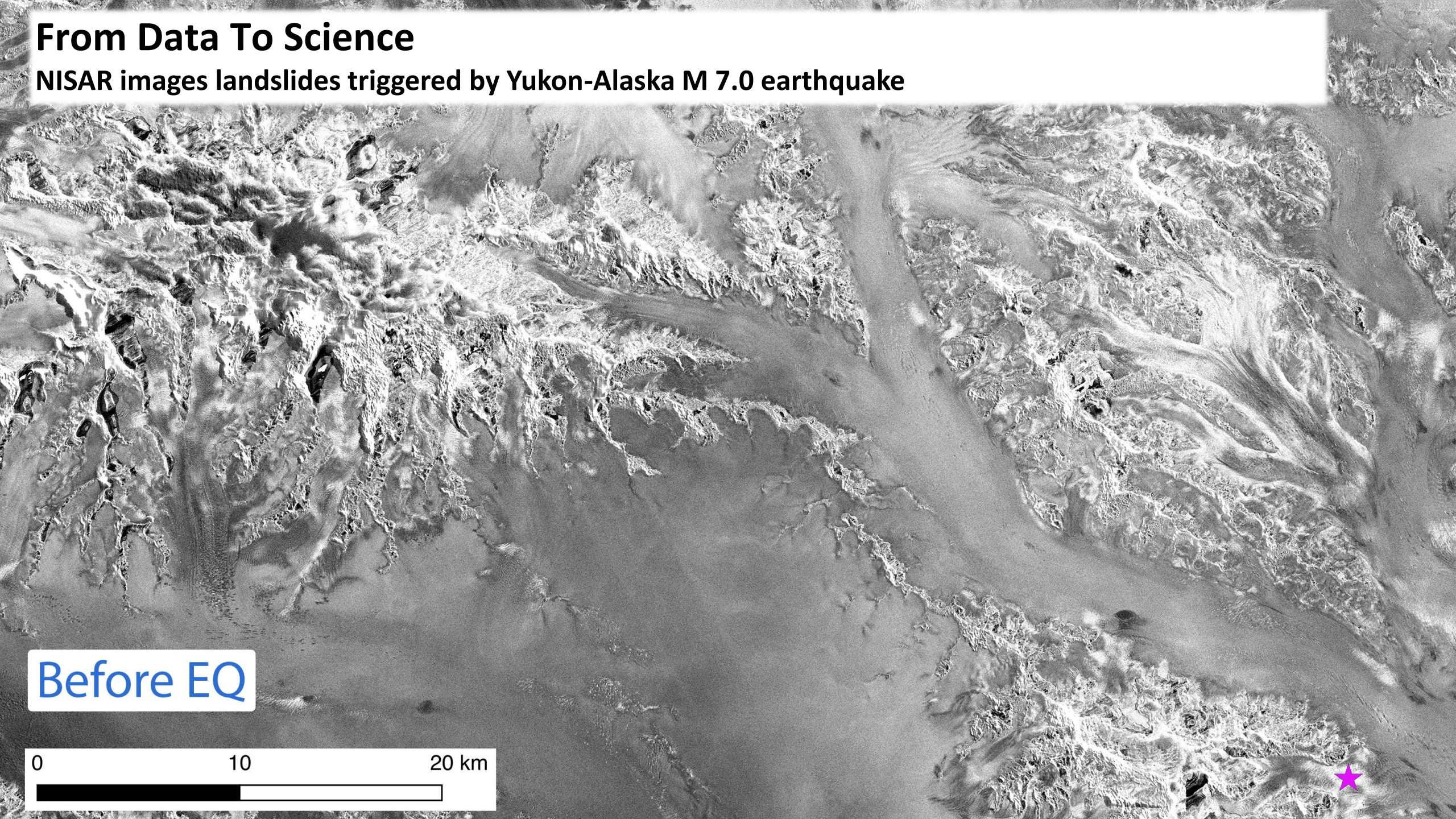



Image © 2025 Airbus
Google Earth


Portland, OR
N
Produced by Brandi Downs, NASA JPL, Dec. 2025

From Data To Science

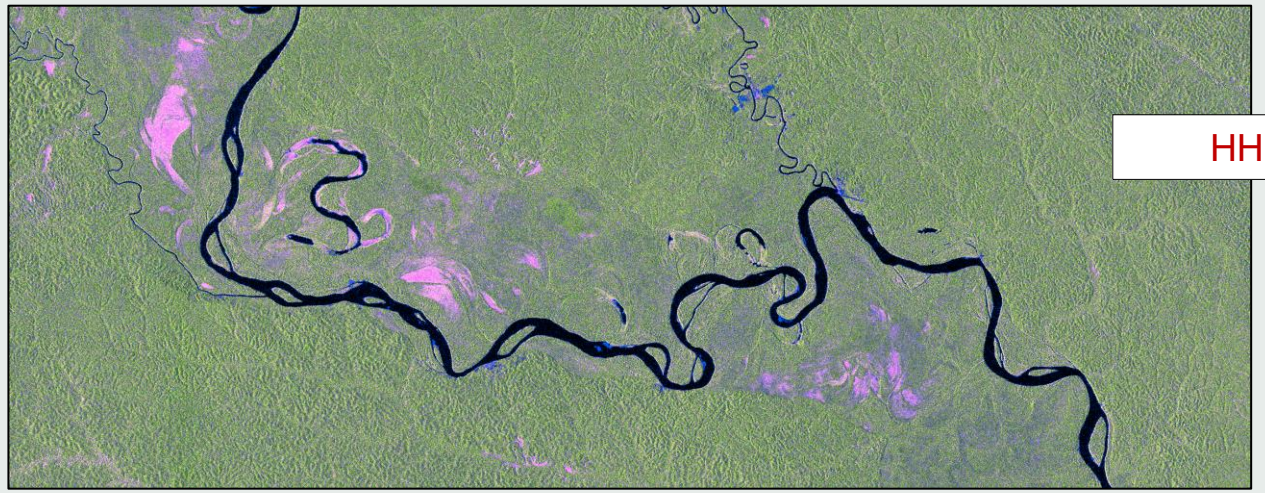
NISAR images landslides triggered by Yukon-Alaska M 7.0 earthquake



From Data To Science

NISAR Inundation Workflows

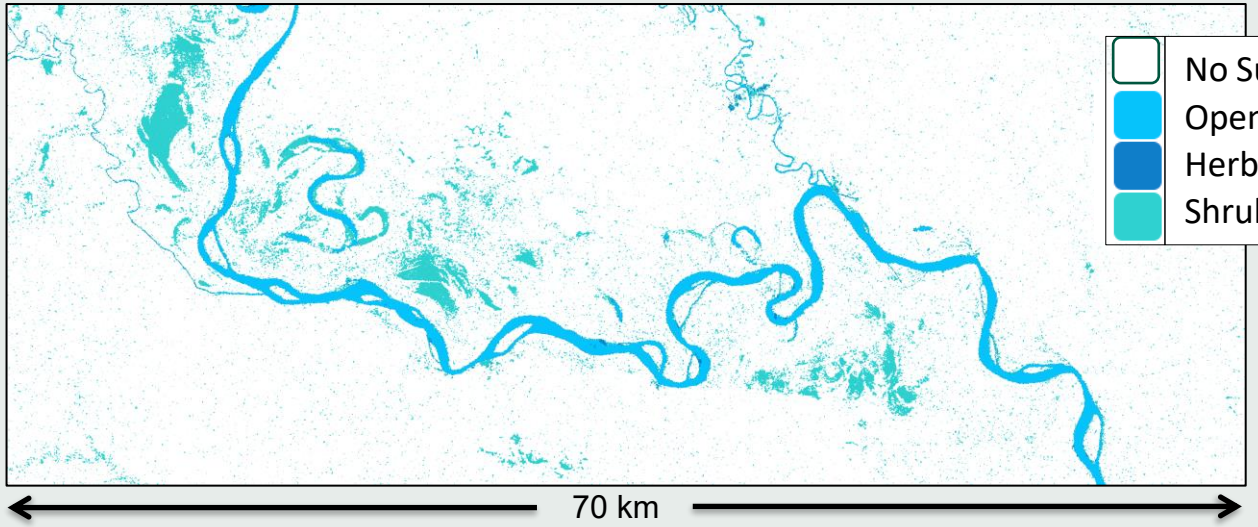
Putumayo river, on the border between Peru and Colombia



HH, HV, HH/HV

NISAR GCOV
Dual-Pol HH & HV (20 MHz)
September 21, 2025

Making science products from NISAR GCOVs



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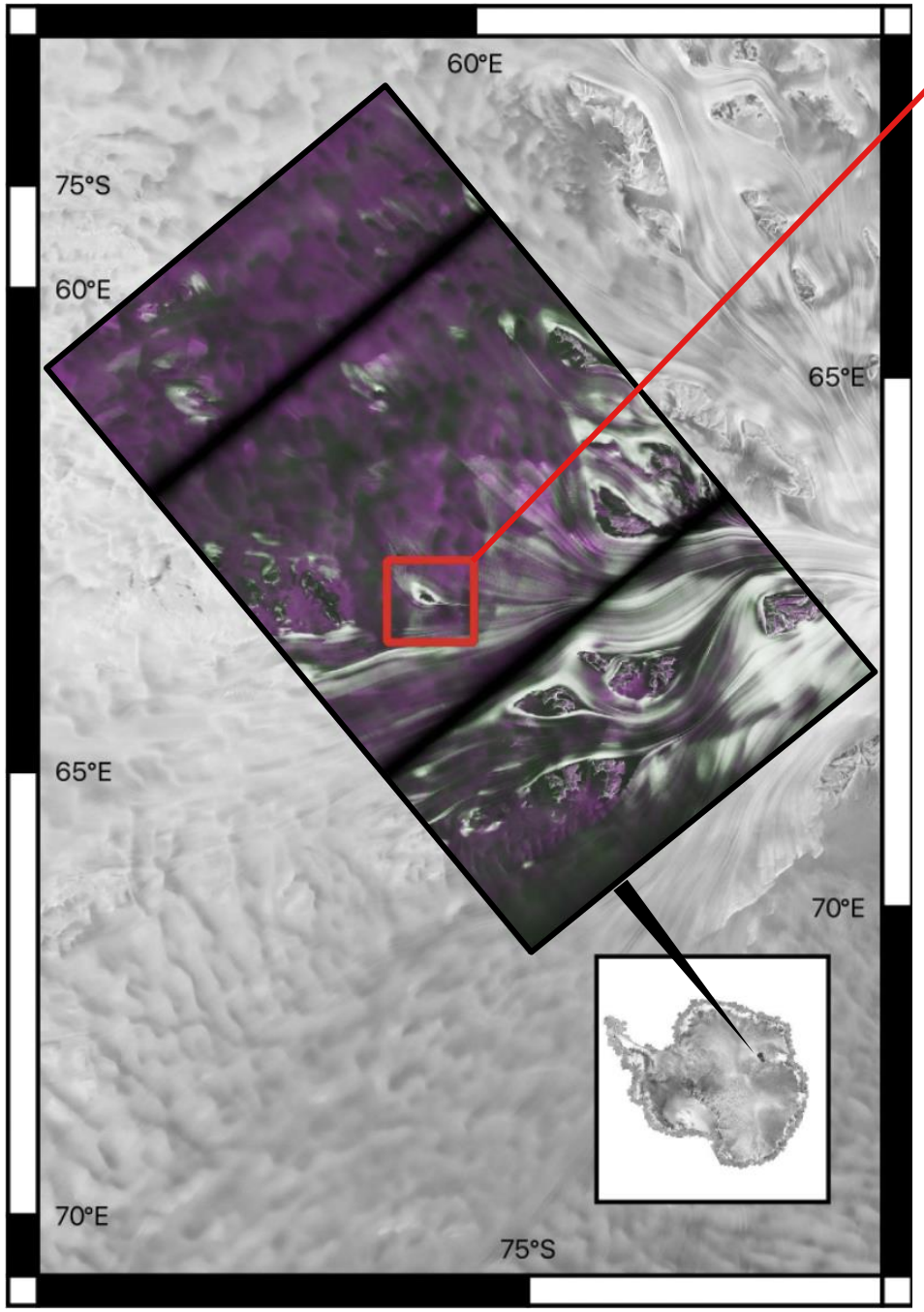
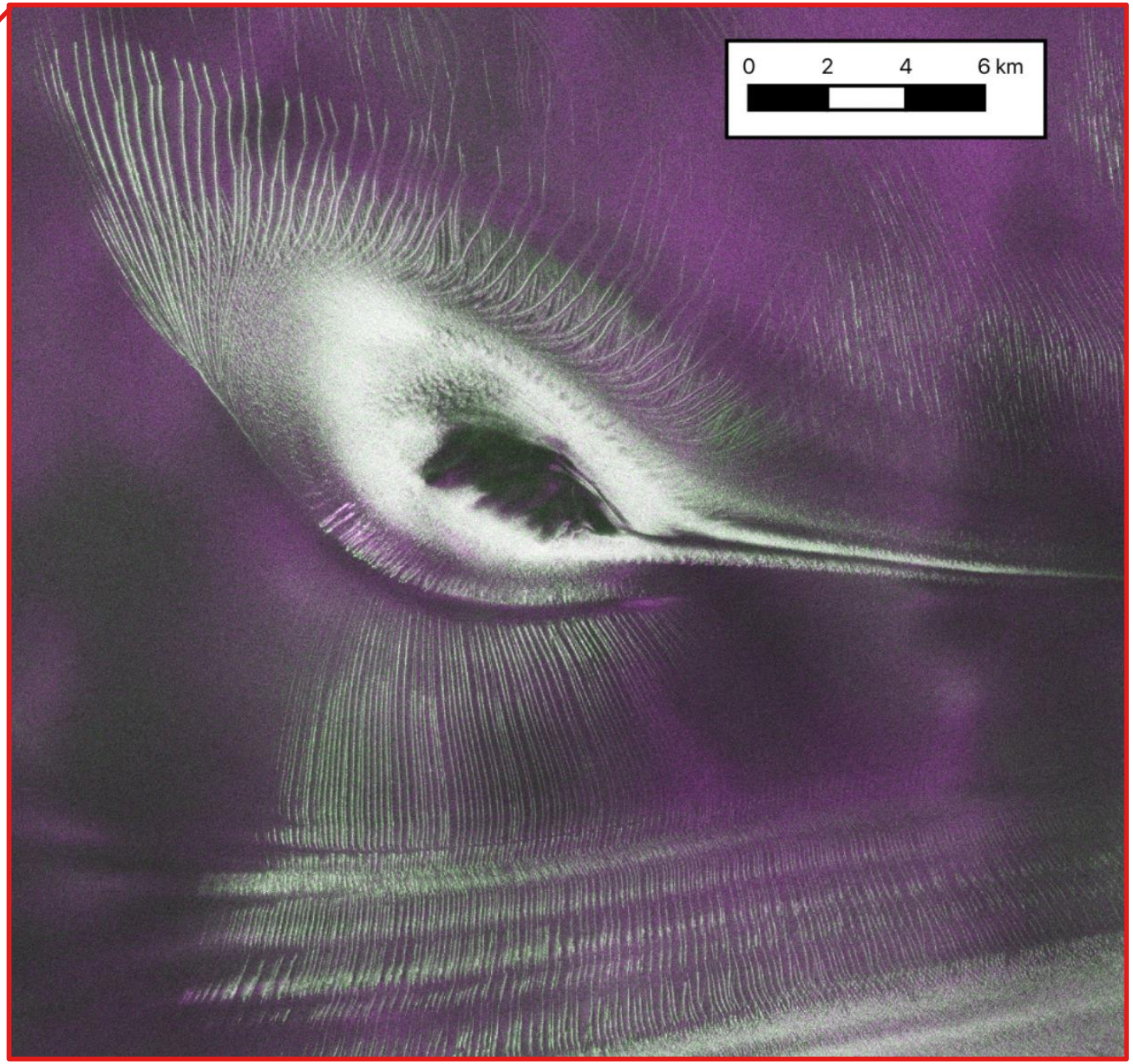

60°E
75°S
60°E
65°E
65°E
70°E
70°E
75°S


0
2
4
6 km

First NISAR InSAR Examples

NISAR co-eruptive interferogram, Ethiopia
11/22 - 12/04

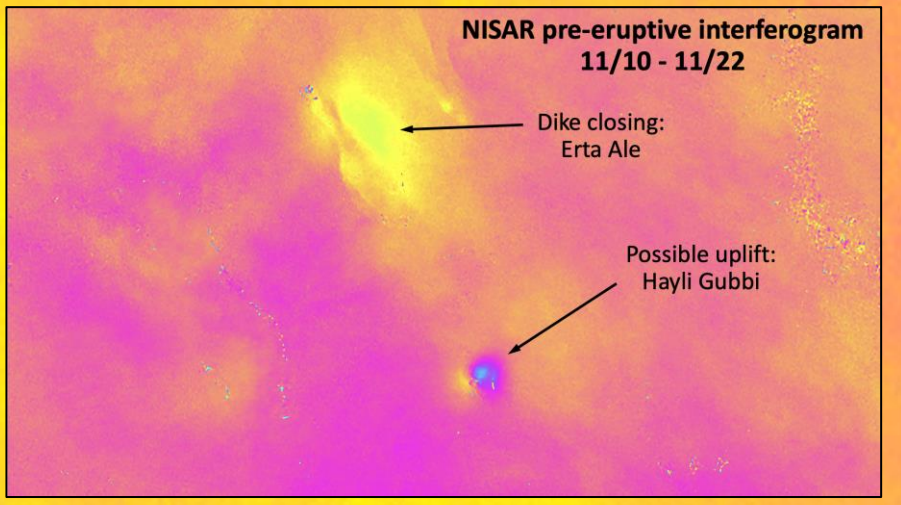
Range change

0 12.1 cm

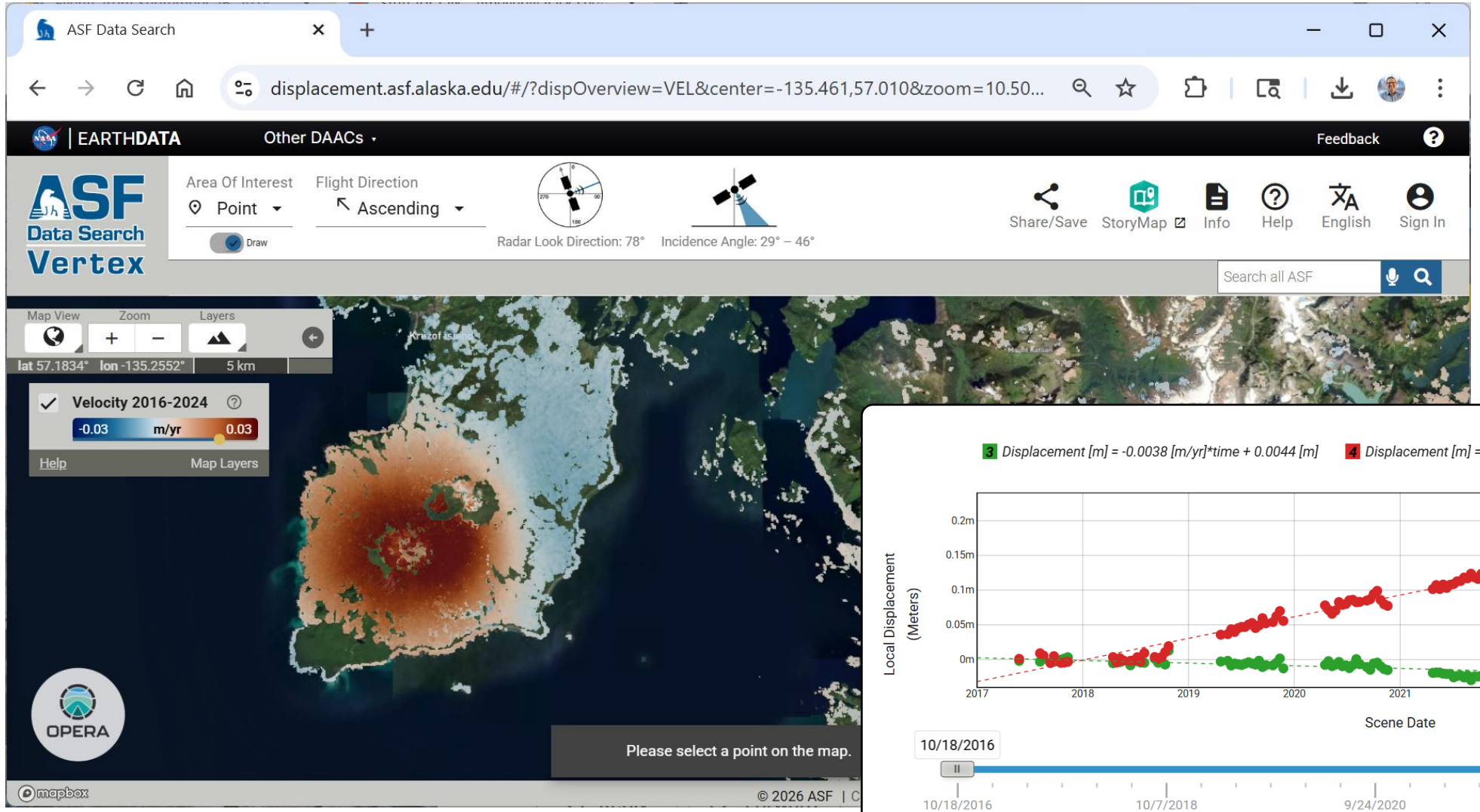
5 km

Dike closing:
Erta Ale

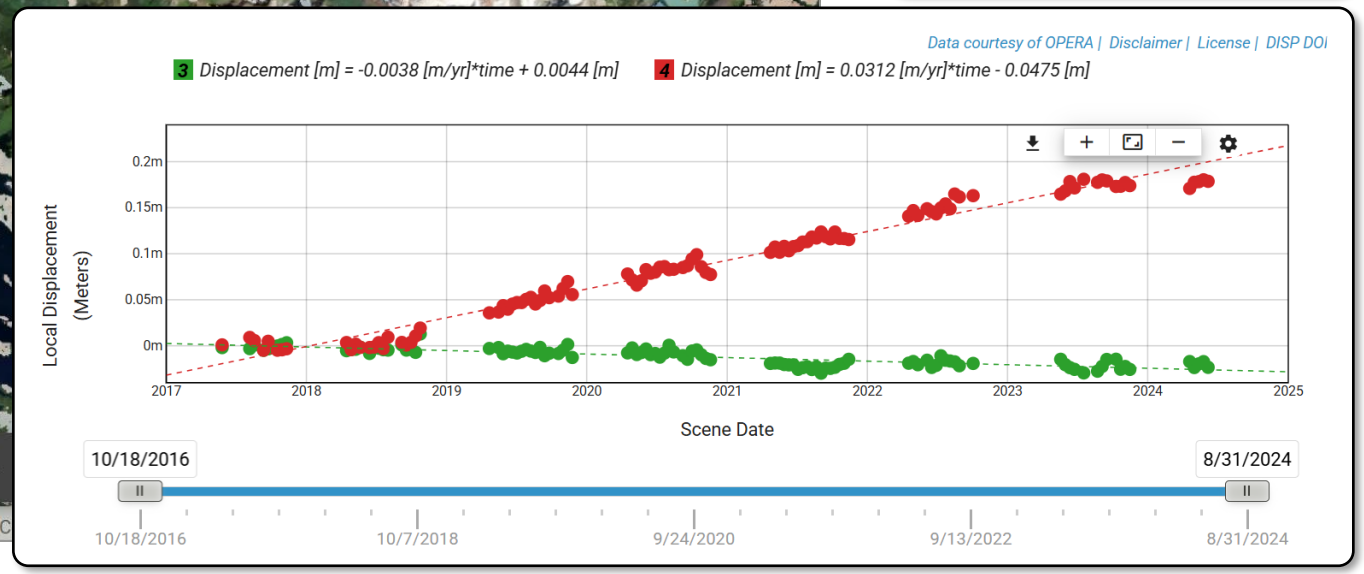
Tephra deposits:
Hayli Gubbi



OPERA: North America Wide Surface Displacements from Sentinel-1 and NISAR



Access the portal at
https://displacement.asf.alaska.edu/

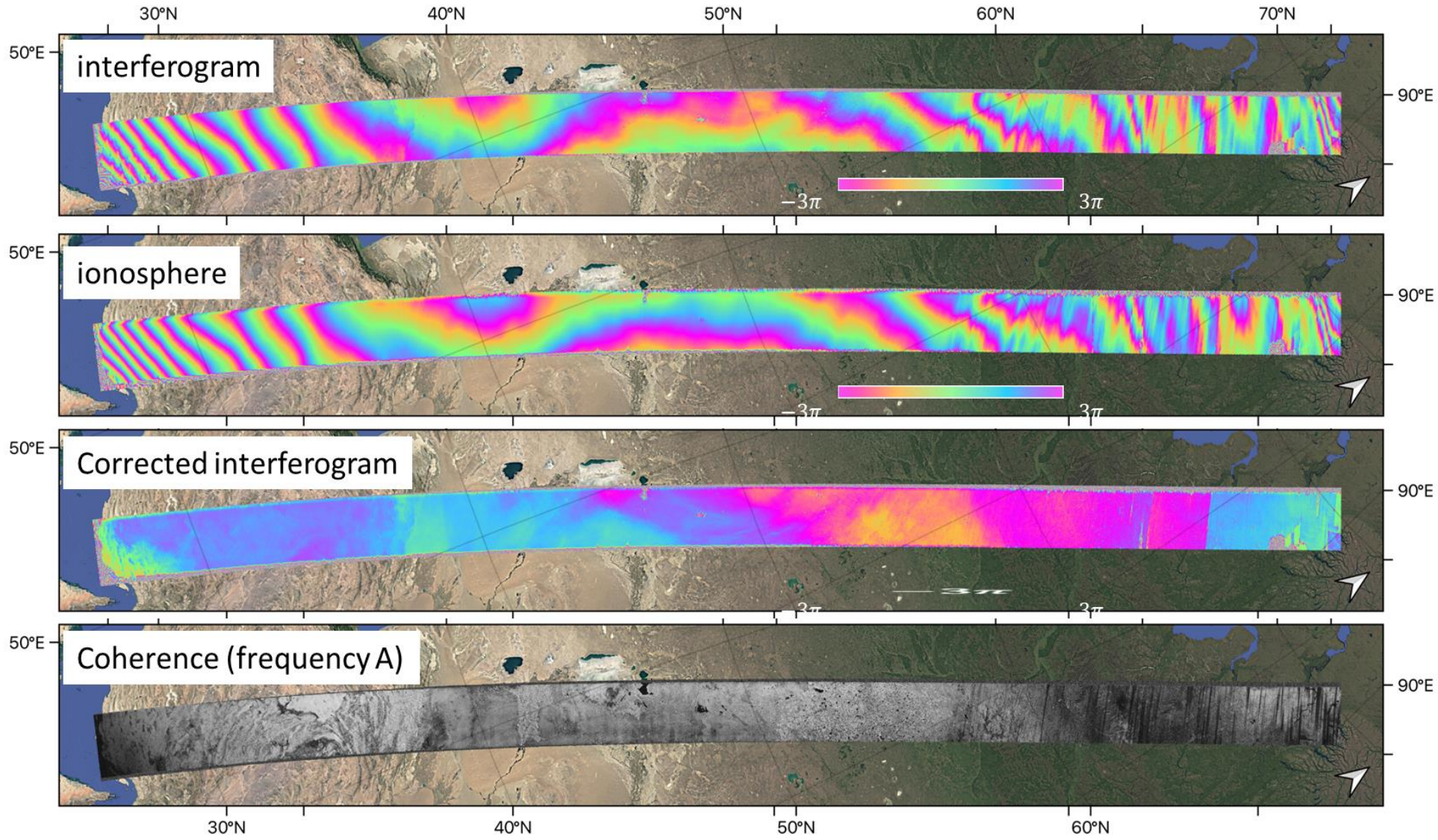


First NISAR InSAR Examples

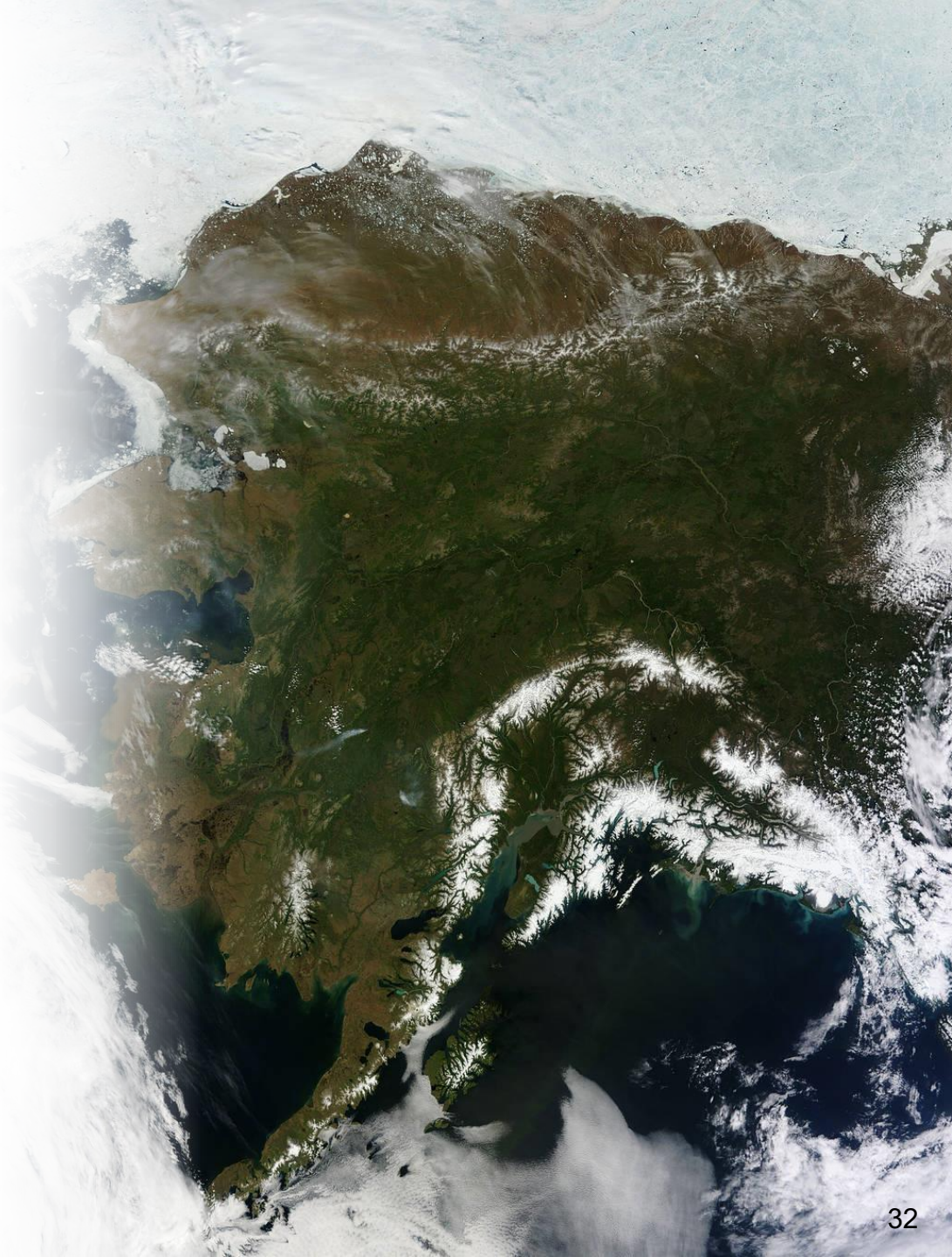
Interferometric Phase with Ionospheric Split-Band Correction

- We are at the peak of solar cycle activity
- Independent observations (GPS, ALOS-2) confirm significant ionospheric activities at high latitudes

The NISAR ionospheric phase estimate can largely explain the observed phase variability in L-band data.



ALASKA'S CONTRIBUTION TO THE NISAR MISSION



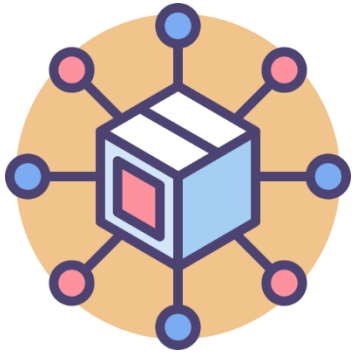
Alaska Satellite Facility

… operates NASA's Data Center For Radar Remote Sensing Data and will be the host of NISAR data

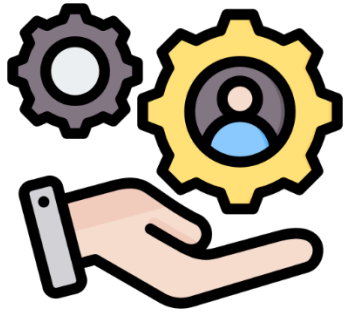
Working with JPL, ASF is an essential part of NISAR

Downlink

Archive



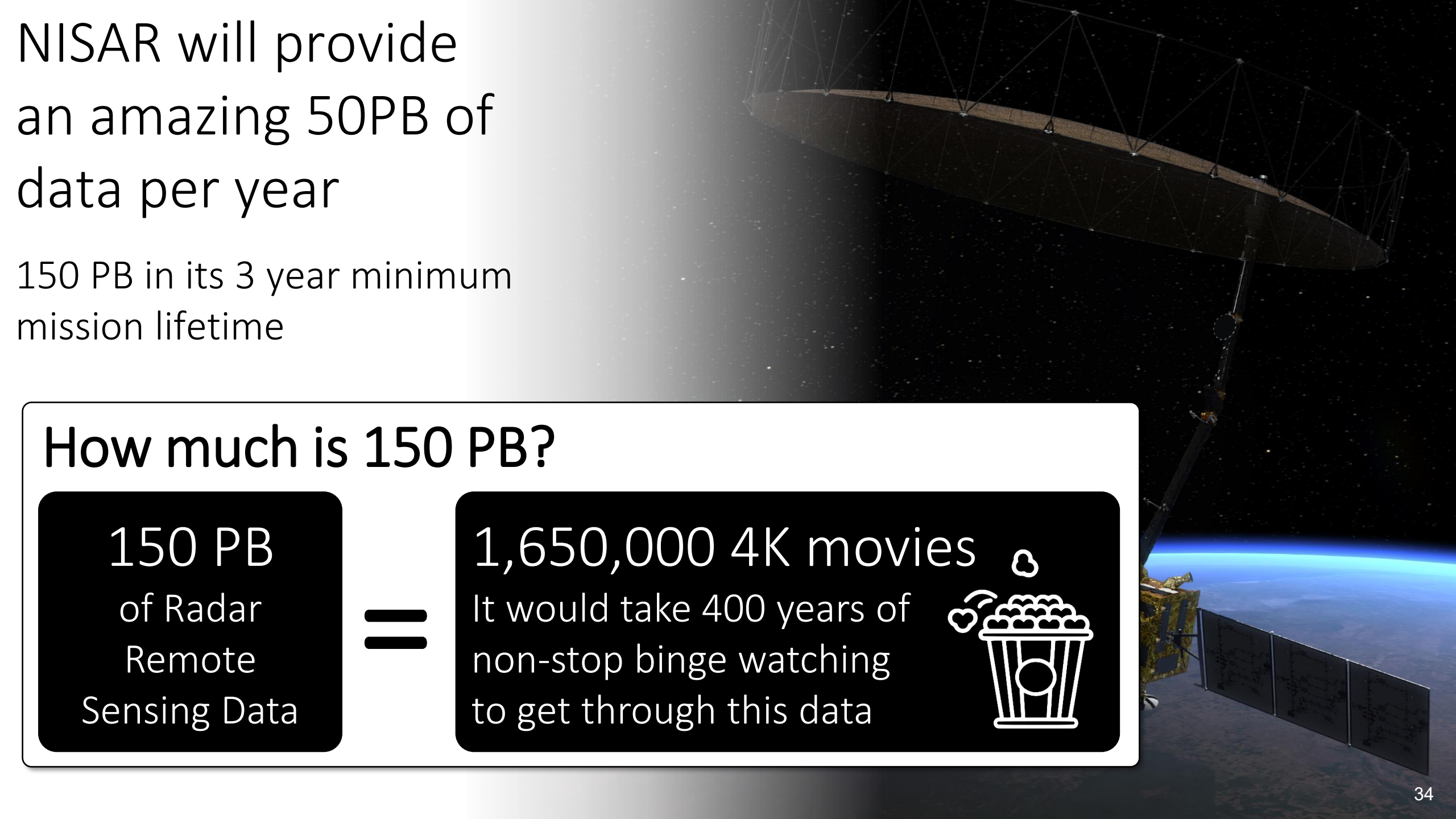
Distribution



Services

NISAR will provide an amazing 50PB of data per year

150 PB in its 3 year minimum mission lifetime



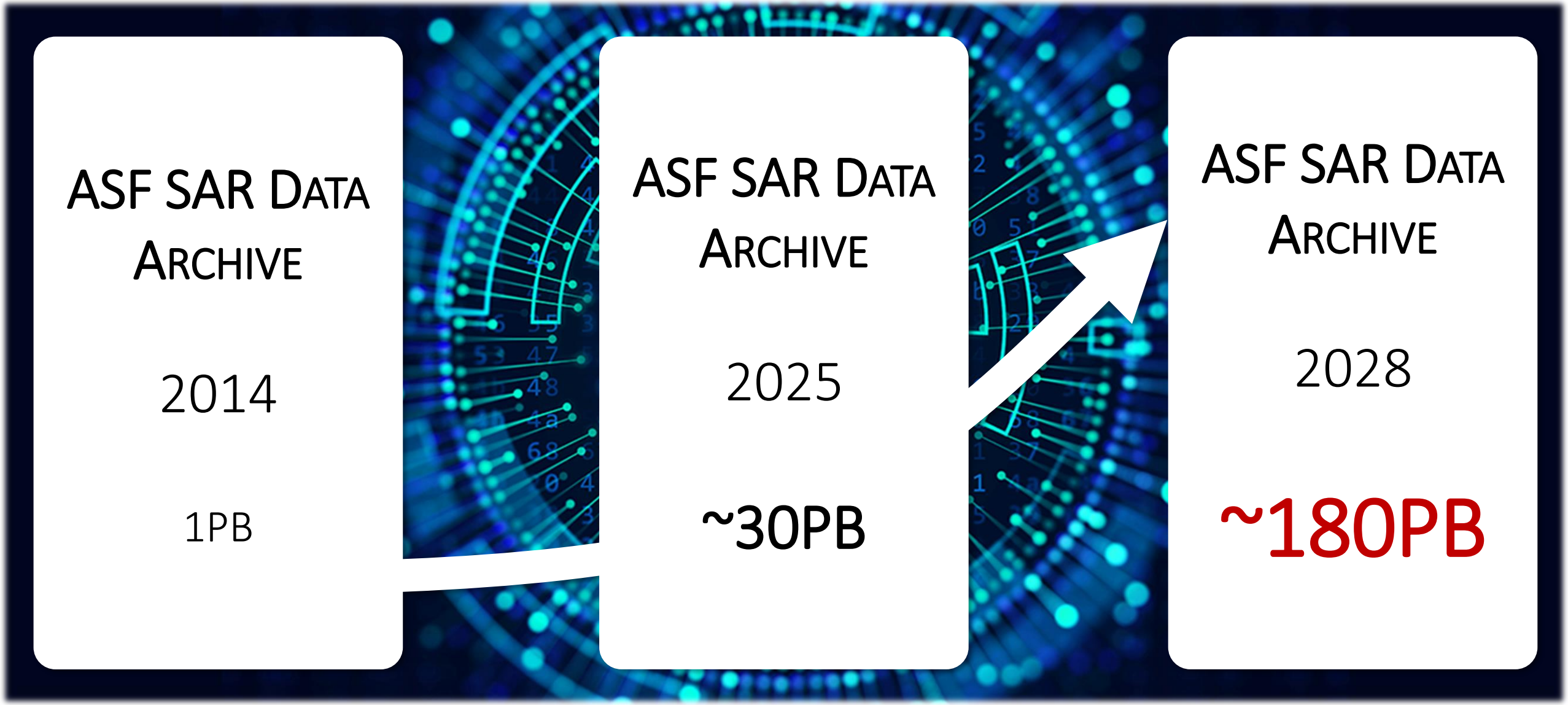
How much is 150 PB?

150 PB
of Radar Remote Sensing Data

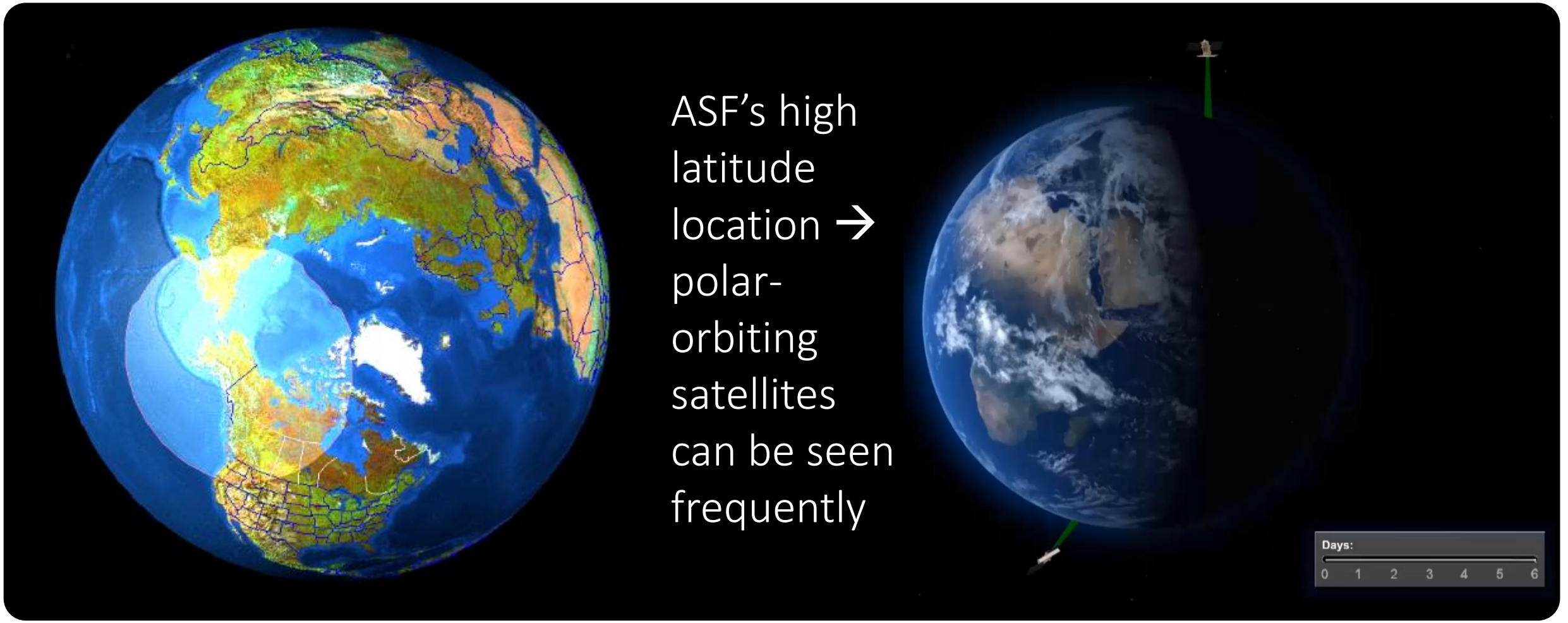
=

1,650,000 4K movies
It would take 400 years of non-stop binge watching to get through this data

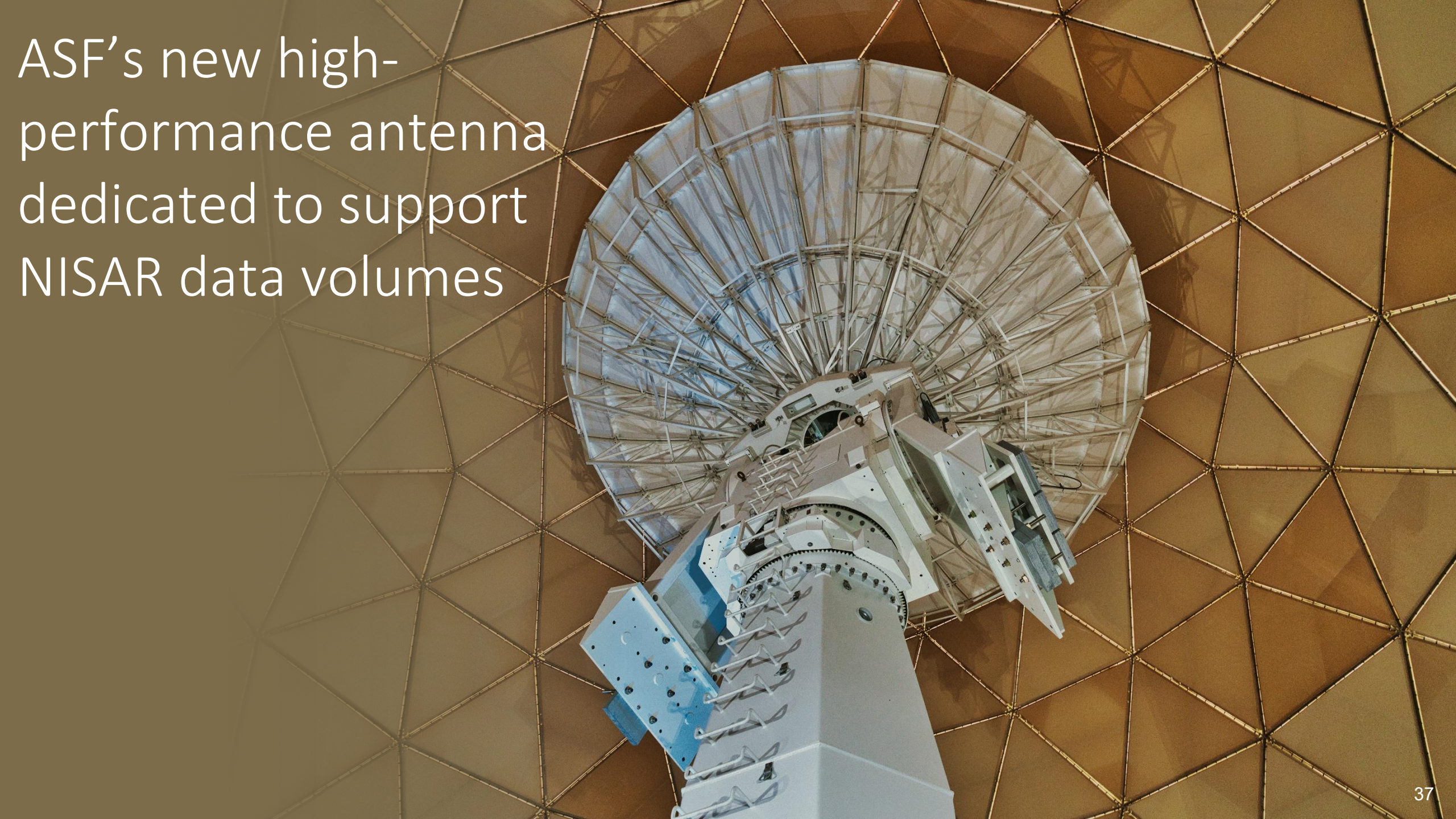
Soon, ASF alone will manage more remote sensing data than the rest of NASA combined → NASA Leaders in Cloud Development



Alaska Provides Space Communication Support for NISAR



ASF’s new high-performance antenna dedicated to support NISAR data volumes



UAF has been part of the NISAR Science Team since 2012

I am lurking here ☺

Validating the NISAR Permafrost Displacement Requirement

- **Goal:** Verify that NISAR data are of good enough quality to map permafrost displacement at the required accuracy
  - **Approach #1 – Direct validation against field data**: Comparing surface displacement measurements from NISAR to field observations at four permafrost field sites
  - **Approach #2 – Noise assessment in non-deforming areas**: Structure function analyzing of NISAR InSAR data over non-deforming areas

Leveling

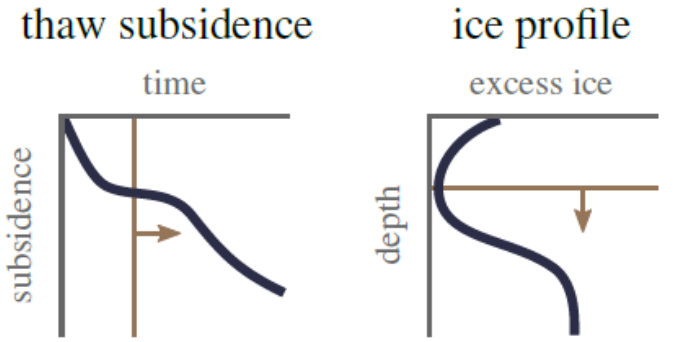
Coring

GNSS

NISAR Science By Alaskans For Alaska

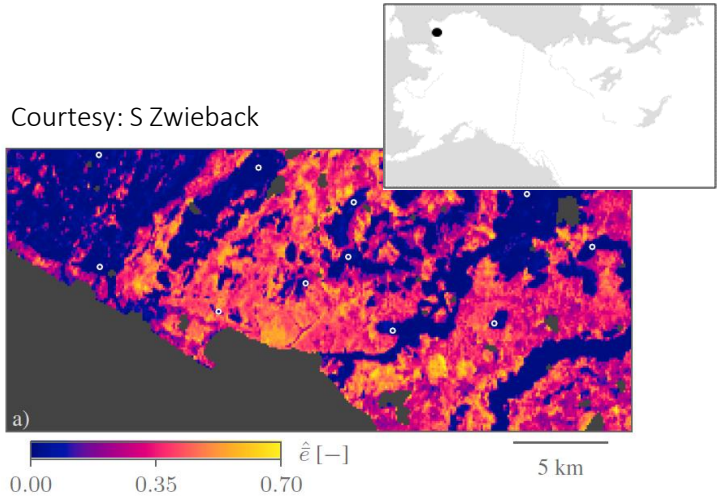
Permafrost Science

Excess ground ice estimation from InSAR

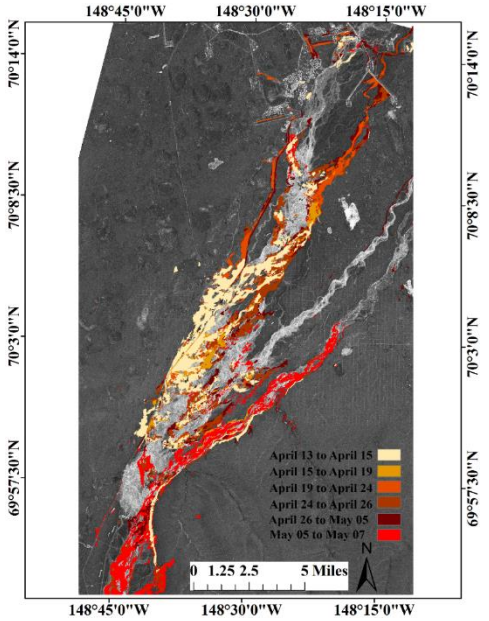


Zwieback et al., in review

Courtesy: S Zwieback

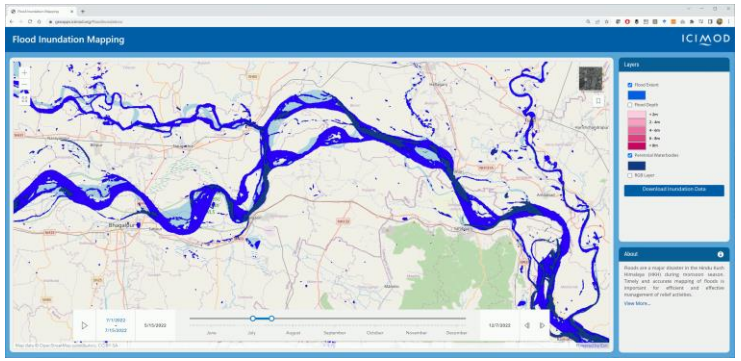


Flood / Fire Monitoring



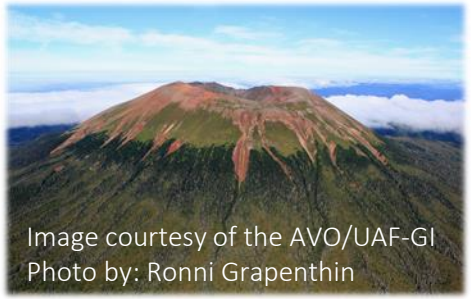
SAR is good at mapping water

2015 Sag River Flooding



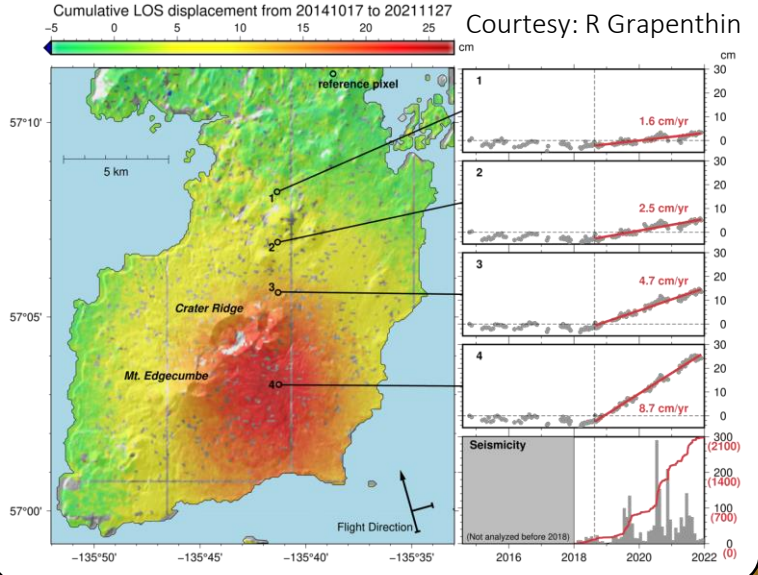
Volcano Science

InSAR monitoring of volcano deformation



2022 Mount Edgecumbe activity

Courtesy: R Grapenthin

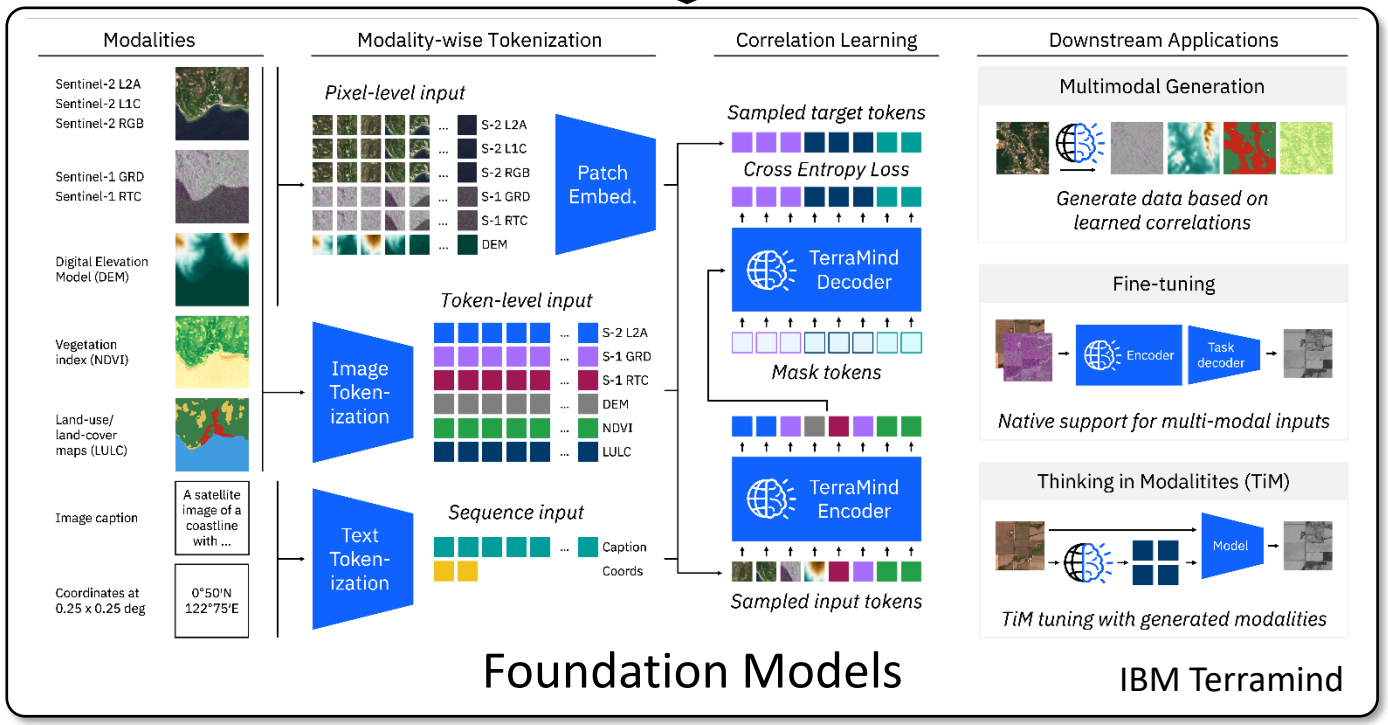


Accelerating SAR Integration into AI Research

Multi-Modal Sensor Fusion

Integrated Earth System Analysis

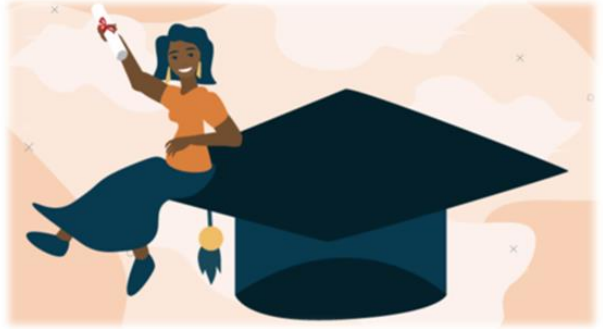
Integrating SAR and InSAR Data



Disaster Management

Forecasting

Training a Global Community of Users



University Courses

Short Courses/Trainings/MOOCs

Webinars

Alaska Grown: Local UAF Grads make NISAR Accessible

Local ASF Hires for NISAR

Alex Lewandowski; Andrew Player; Jake Herrmann; Jacquelyn Smale; William Horn; Rohan Weeden; Matt Perry; McKade Sorensen; Dylan Palmieri; Kim Fairbanks; Nicole Houseweart; Cameron Showalter; Kyle Jones; Jade Brown; De Jour Reed; Jessica Ramos; James Milburn; Josh Jones III; Michael Campbell; Andrew Johnson; Kas Knicely

NISAR is Launched and Ready

Data Will Arrive Soon

Thank you for your attention

Contact: fjmeyer@alaska.edu