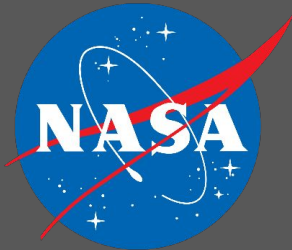
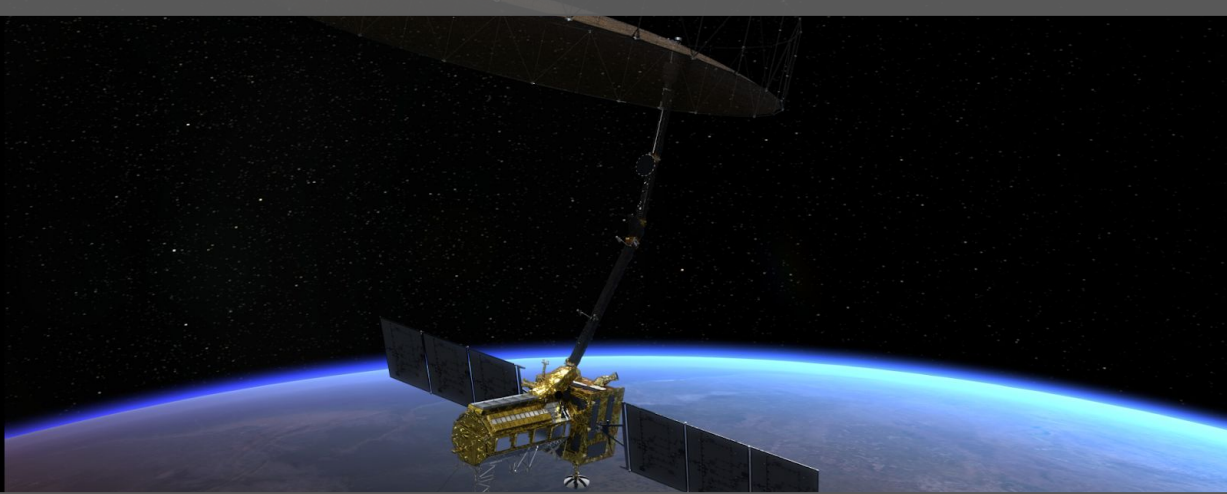


NASA distributed active archiving centers & cloud computing

Tools and services for working with “big” NASA data like Sentinel-1 and NISAR



Developed by:
The NISAR mission
ASF's Ingest and Archive, Discovery, Tools and OpenScienceLab Teams

Presented by:
Dr. Joseph H. Kennedy, Staff Scientist, ASF



NASA DAACs

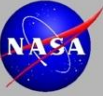
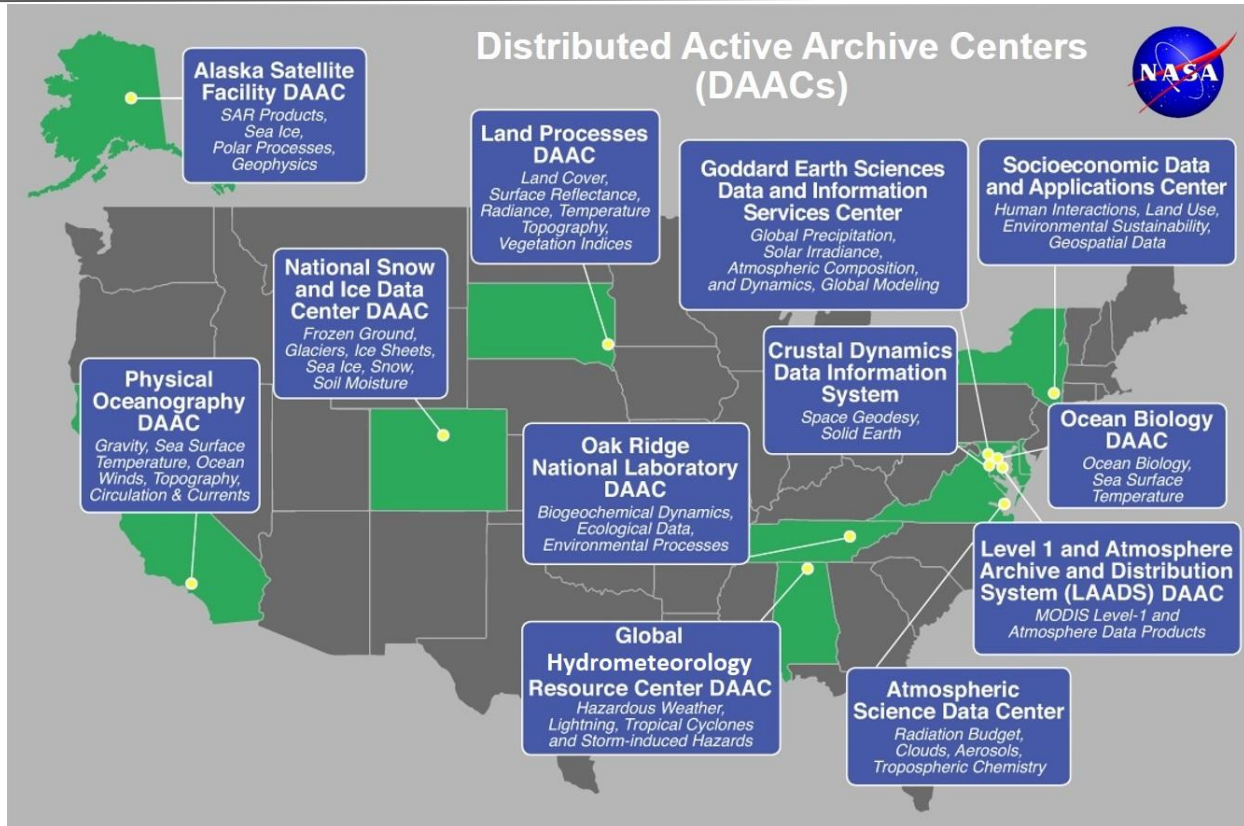
DAACs are custodians of EOS **mission data** and ensure that data will be **easily accessible to users**.

Reliable, robust services to:

- Discipline community
- X-discipline users

User engagement:

- Chief Scientist
- User Working Group
- User Support



The NASA Alaska Satellite Facility (ASF) DAAC

Working with JPL as part of the NISAR Family

- **ASF is a NASA Distributed Active Archive Center for SAR data**
 - Established in 1991 as the prime U.S. downlink and processing center for SAR data
 - Operates 4 antennas for command uplink and data downlink of NASA and non-NASA remote sensing satellite systems
 - First DAAC distributing data from AWS in 2016
- **Currently, ASF is housing about 22PB of SAR data in its archives, most of which is in AWS Cloud → all data available on “spinning disks” for immediate download**



SCAN ME

46 years of SAR data (since '78)
<https://search.asf.alaska.edu>



NISAR DAAC (L0 - L2 data)



Host of
Global Sentinel-1 Archive

Visit ASF @ <https://asf.alaska.edu>



Working with big NASA data
Joseph H Kennedy, Alaska Satellite Facility

With Up to 50PB/Year, NISAR Will Bring Unprecedented Data Volumes

**ASF SAR DATA
ARCHIVE**

2014

1PB

**ASF SAR DATA
ARCHIVE**

2024

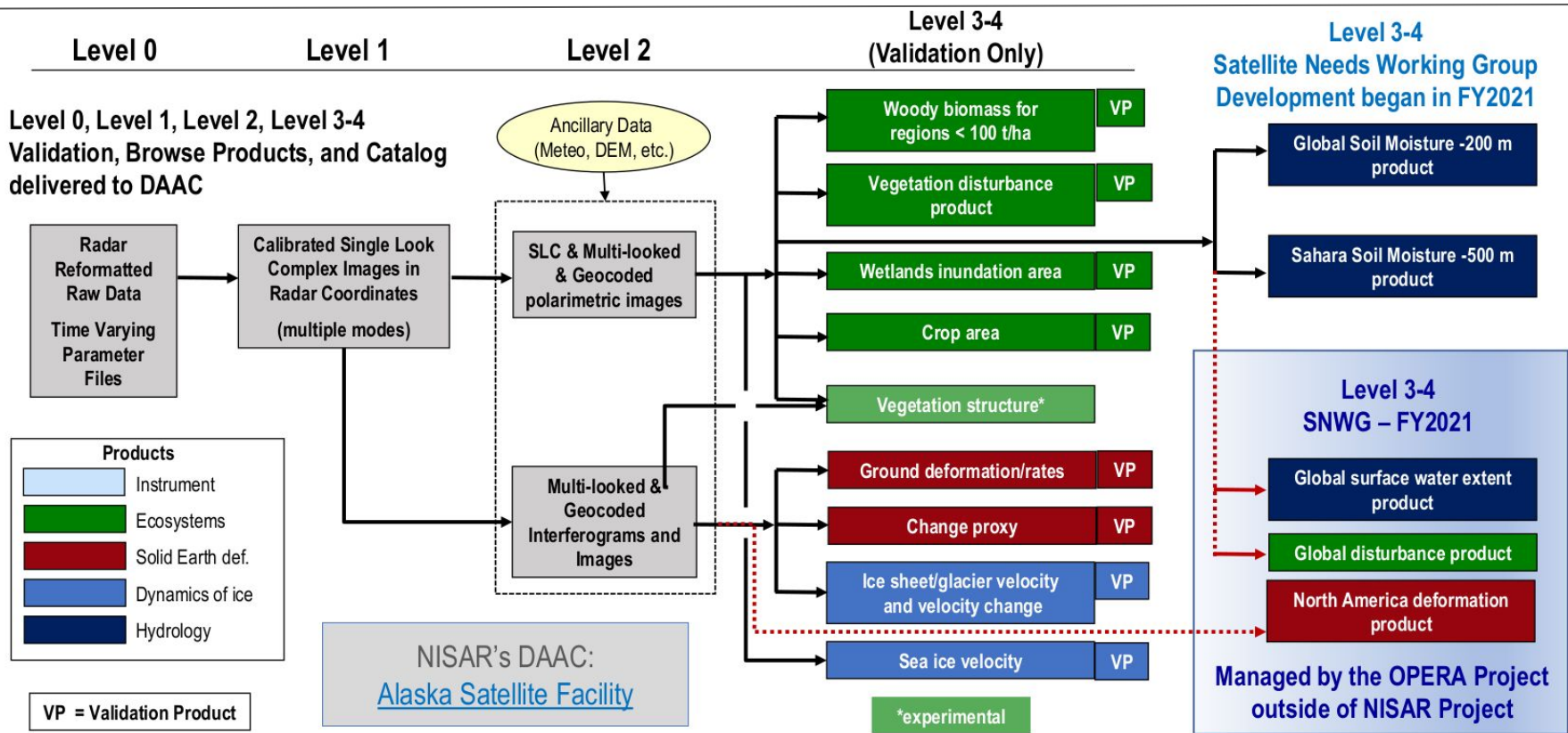
22PB

**ASF SAR DATA
ARCHIVE**

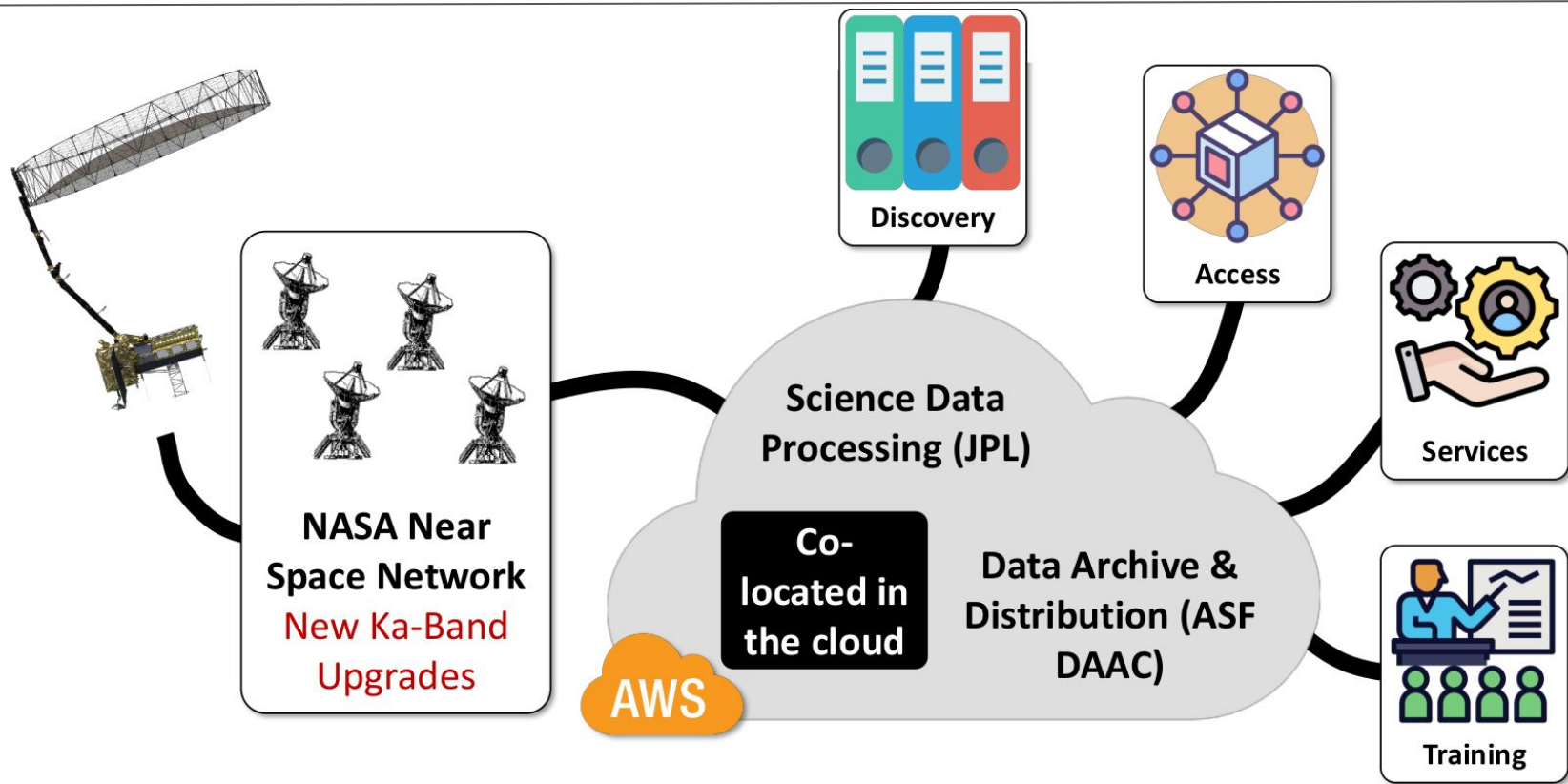
2028

~180PB

NISAR Mission Data Products



Working with Big NASA Data





Discovery

ASF Data Search Vertex

Search Type: Geographic Search | Dataset: Sentinel-1 | Filters: ... | SEARCH | 250 of 15,928,271 Files

On Demand | Downloads | Help | Sign in

Search all ASF

Map View | Zoom | Layers | Area of Interest | Opacity: 100%

lat 00.0° | lon 00.0°

- Search & discover ASF's holdings over your AOI
- Use our baseline and SBAS tools to configure **your perfect InSAR stack**
- Submit Sentinel-1 scenes for **on-demand** processing to RTC or InSAR
- **Download** data for additional processing using convenient interface options

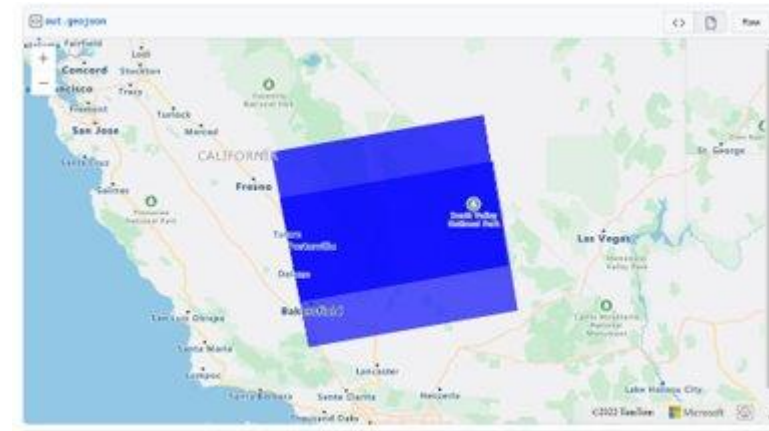


Discovery - ASF Search Python Package

```
$ conda install -c conda-forge asf_search
$ # or: python -m pip install asf_search
$ python
>>> import asf_search as asf
>>> wkt = 'POINT(-117.599330 35.769500) '
>>> search_results = asf.geo_search(
    intersectsWith=wkt,
    start='2019-06-10',
    end='2019-07-21',
    platform=asf.SENTINEL1,
    flightDirection=asf.ASCENDING,
    processingLevel=asf.SLC,
    beamMode=asf.IW,
)
```



<https://docs.asf.alaska.edu/>





Discovery - Earthdata Search and Earthaccess

```
$ conda install -c conda-forge \
    earthaccess
```

```
$ # or: python -m pip install...
```

```
$ python
```

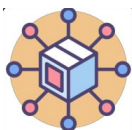
```
>>> import earthaccess
```

```
>>> results = earthaccess.search_data(
    short_name='ATL06',
    bounding_box=(-10, 20, 10, 50),
    temporal=("1999-02", "2019-03"),
    count=10
)
```

The screenshot shows the Earthdata Search web application. The search results are for 'ATL06/ICESat-2 L3A Land Ice Height V006'. The results table shows 10 granules with their respective start and end times. A map on the right shows the search area in the North Pacific Ocean, with a bounding box of approximately (-10, 20, 10, 50). The interface includes a search bar, filters, and a map view.

<https://search.earthdata.nasa.gov/>

<https://earthaccess.readthedocs.io/>



Data Access

High Performance Data Access No Matter Your Access Pattern



High-bandwidth data download capabilities

10PB/
month

ASF DAAC supports distribution of up to 10PBs per month

AWS

Direct Cloud Bucket Access

Use temporary AWS access keys to get direct access to NISAR in AWS S3.

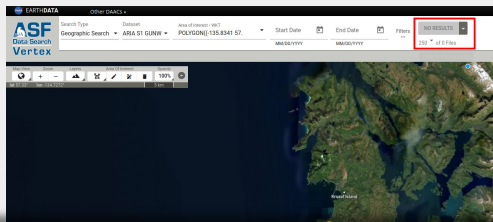
- fast in-region network bandwidth
- facilitates open-source cloud-native tools such as Xarray, GDAL, and Earthaccess.



Services - On Demand “virtual archive”

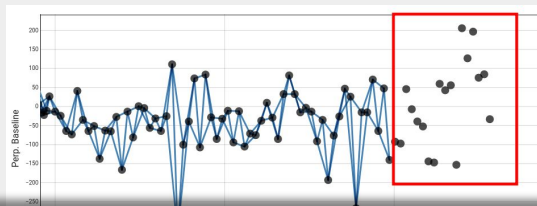
Spatial gaps

User: There are no data products covering my area of interest



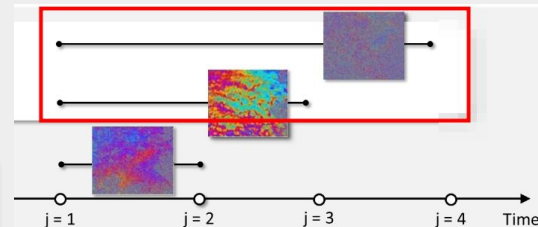
Temporal gaps

User: I want to know what happens after the end of standard production



“Dataset” gaps

User: I would like interferograms for more neighbors



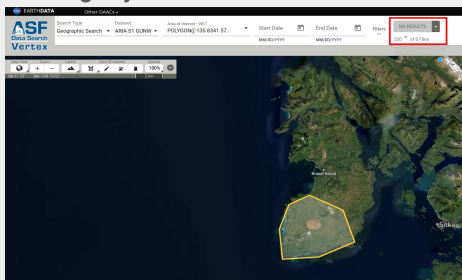
Mission/Project	Dataset	Level	Spatial gaps	Temporal gaps	Dataset gaps
NISAR	RSLC	1	no	no	N/A
	RIFG	1	yes	no	yes
	RUNW	1	no	no	yes
	ROFF	1	yes	no	yes
	GSLC	2	no	no	N/A
	GOFF	2	yes	no	yes
	GUNW	2	no	no	yes
	GCOV	2	no	no	N/A
	SM	3	no	no	maybe



Services - On Demand “virtual archive”

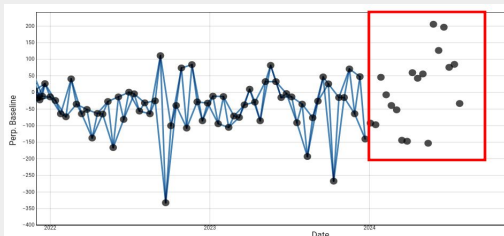
Spatial gaps

User: There are no data products covering my area of interest



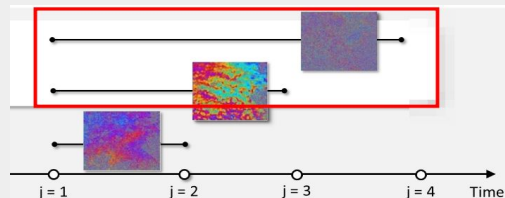
Temporal gaps

User: I want to know what happens after the end of standard production



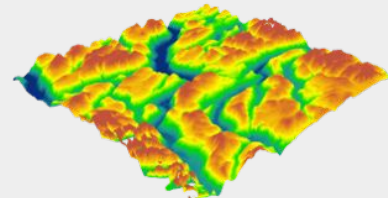
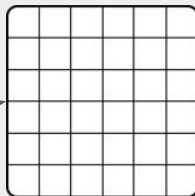
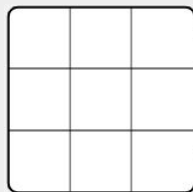
“Dataset” gaps

User: I would like interferograms for more neighbors



Custom Products

User: I want a different resolution



User: I want to use a different DEM



Preparing users for the cloud

AWS

Direct Cloud Bucket Access

Use temporary AWS access keys to get direct access to NISAR in AWS S3.

- fast in-region network bandwidth
- facilitates open-source cloud-native tools such as Xarray, GDAL, and Earthaccess.

A lot of users: Cloud is *hard*

- New/unfamiliar technologies
- Budgeting
- Paying
- Permissions and access
- Data and computing patterns change
- Etc.



Services - OpenScienceLab

Server Options

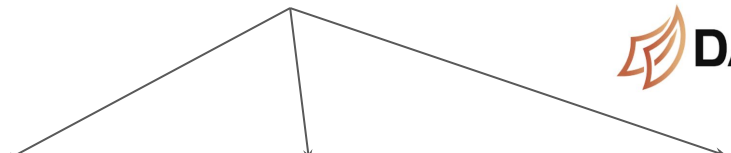
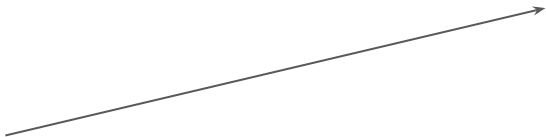
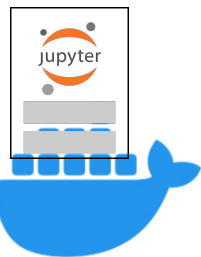
SAR 1

JupyterLab - RAM Guarantee: 6G. RAM limit: 16G. CPU limit: 8. Storage: 500G.

SAR 2

JupyterLab - RAM Guarantee: 32G. RAM limit: 96G. CPU limit: 8 cpus. Storage: 500 GiB.

Start





Services - OpenScienceLab

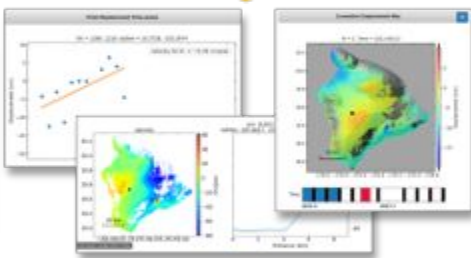
Custom JupyterHub environments alongside ASF's data archives

- Fast in-region SAR data transfer
- Custom user conda environments
- Persistent storage volumes
- Library of SAR data recipe notebooks
- Flexible compute environments (“laptop” to HPC)
- Fully deployable to user cloud account or local machine

Download SAR Data Into OpenSARLab



Analyze Data and Develop New Algorithms In Jupyter Notebooks



Share Easily Reproducible Results With Colleagues



More than just a JupyterHub: Pre-installed with a wealth of open-source SAR tools and pre-loaded with ready-to-use SAR Science Workflows

OSL is **preparing community** to efficiently access & **work with NISAR data** by hosting SAR classes & research projects

Ideally suited to **host large trainings** since it is **accessible from anywhere** and can **scale** to accommodate any class size.





(Not ASF) Services - CryoCloud

GOAL: **Simple** and **cost effective** managed cloud environment for **transitioning** and training new users in cloud workflows and **developing** **community best practices**



CryoCloud JupyterBook



CryoCloud

CryoCloud JupyterHub



ICESAT-2



COLORADO SCHOOL OF
MINES

cryointhecloud.com



Open source communities **without boundaries**



Empowering our communities to do what they do best

Please contact us with your data access and potential on-demand processing needs

- Data and services
 - How can we meet *your* needs?
- Education
 - Resources?
 - Potential HackWeeks?
 - Tutorials/Data recipes?
- Consulting
 - Cloud best practices?
 - Cloud budgeting?
 - Grant support?



Contact: jhkennedy@alaska.edu

Postscript

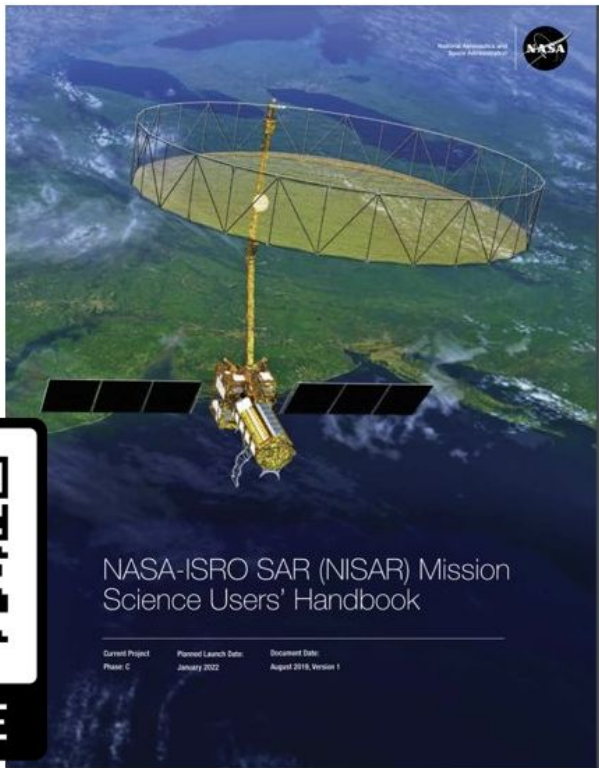
Link to these slides:

<https://docs.google.com/presentation/d/1HbT0CmpXrp488Qzjp6u7UQG6LJxnwGZDnAeNBC01YrE/edit?usp=sharing>



Training

NISAR Science User's Handbook



SCAN ME

Become an Early Adopter

- learn about NISAR and its data; join quarterly telecons; discover opportunities for collaboration!

Apply here:

- <https://nisar.jpl.nasa.gov/engagement/application-sign-up>





Training

Access to NISAR sample products now to start building your science workflows

The screenshot shows a web browser window displaying the NISAR Sample Data Product Suite page. The browser address bar shows 'nisar.jpl.nasa.go...'. The page header includes the NASA Jet Propulsion Laboratory logo and 'NISAR NASA-ISRO SAR MISSION'. A large QR code is overlaid on the page with the text 'SCAN ME' below it. The main content area is titled 'NISAR Sample Data Product Suite' and contains introductory text and a 'Featured Resources' section with an 'Artist Rendering of NISAR' image.

LOB RRSD	Level 0 unfocused raw SAR data	[Date 1]	[Date 2]	[link]
L1 RSLC	Level 1 Focused SAR image in range-doppler coordinates (zero-doppler steered)	[Date 1]	[Date 2]	[link]
L1 RIFG	Level 1 phase-wrapped interferogram in range-doppler coordinates (zero-doppler steered)	[Date 1-2]		[link]
L1 RUNW	Level 1 phase-unwrapped interferogram in range-doppler coordinates (zero-doppler steered)	[Date 1-2]		[link]
L1 ROFF	Level 1 pixel offsets in range-doppler coordinates (zero-doppler steered)	[Date 1-2]		[link]
L2 GSLC	Level 2 Focused SAR image in geocoded coordinates	[Date 1]	[Date 2]	[link]
L2 GUNW	Level 2 phase-unwrapped interferogram in geocoded coordinates	[Date 1-2]		[link]
L2 GOFF	Level 2 pixel offsets in geocoded coordinates	[Date 1-2]		[link]
L2 GCOV	Level 2 SAR covariance product in geocoded coordinates	[Product]		[link]
L3 SM	Level 3 Global Soil Moisture Product	[Product]		[link]

Working with big NASA data
Joseph H Kennedy, Alaska Satellite Facility



Training



methods/coseismic/Coseismic

gitlab.com/nisar-science-algorithms/solid-earth...

```
ax.set_ylabel('LOS displacement [m]')
ax.set_title(f'Site {site_id} at [{gps_obj.site_lon:.6f}, {gps_obj.site_lat:.6f}]')
plt.show()
```

Out [22]:

```
calculating station lat/lon
reading time and displacement in east/north/vertical direction
fit parameters (constant, linear velocity, step) [-0.05169331  0.01141413 -0.01639276]
```

Site RAMT at [-117.684378, 35.338714]

NISAR Science Algorithms - Git

gitlab.com/nisar-science...

Why GitLab Pricing Contact Sales Explore Sign in Get free trial

NISAR Science Algorithms

NISAR Science Algorithms

Subgroups and projects Shared projects Inactive

Q Search

Name

A	Applications	0	0	3
C	Cryosphere	1	3	3
E	Ecosystems	1	0	13
S	Soil Moisture	0	1	5
S	Solid Earth	0	2	4



Training

2024 Technical Short Course: InSAR Processing and Analysis (ISCE+)

NSF USGS NASA
GAGE SAGE
Operated by EarthScope

Login

HOME / CALENDAR / EVENT DETAILS

2024 Technical Short Course: InSAR Processing and Analysis (ISCE+)

DATE(S): AUGUST 5-9, 2024
LOCATION: VIRTUAL

REGISTRATION IS NOW CLOSED

This 5-day course will cover basic & advanced InSAR theory, InSAR processing with the JPL/Caltech InSAR Scientific Computing Environment (ISCE), methods for mitigating noise in InSAR data, access the ARIA standard InSAR product and prepare them for time-series analysis using ARIA-tools, InSAR time-series analysis with the MintPy software, pixel offset

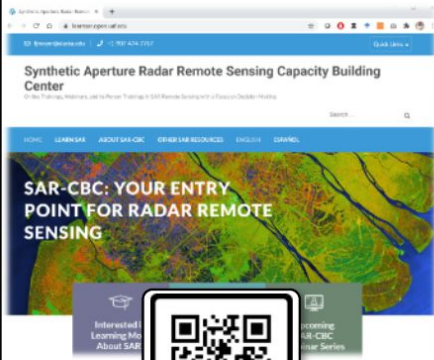


Recordings on
YouTube



Training

SAR-CBC is Funded by NASA
Applied Sciences



SCAN ME

Information on project
partners and activities

edX Professional Certificate
“Synthetic Aperture Radar:
Applications”



SCAN ME

Online 3-course
certificate program

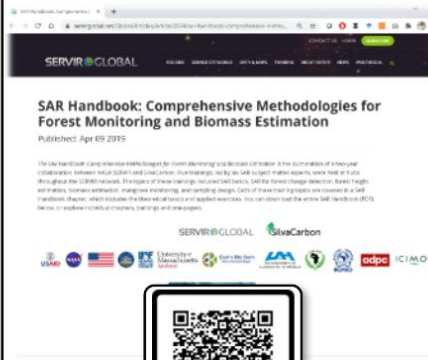
NASA Applied Remote
Sensing Training



SCAN ME

Virtual trainings on all
things remote sensing

The SAR Handbook



SCAN ME

Free-and-open book on
SAR Remote Sensing