

# **UNAVCO**

## **SAR Archive and Community Support Activities at UNAVCO**



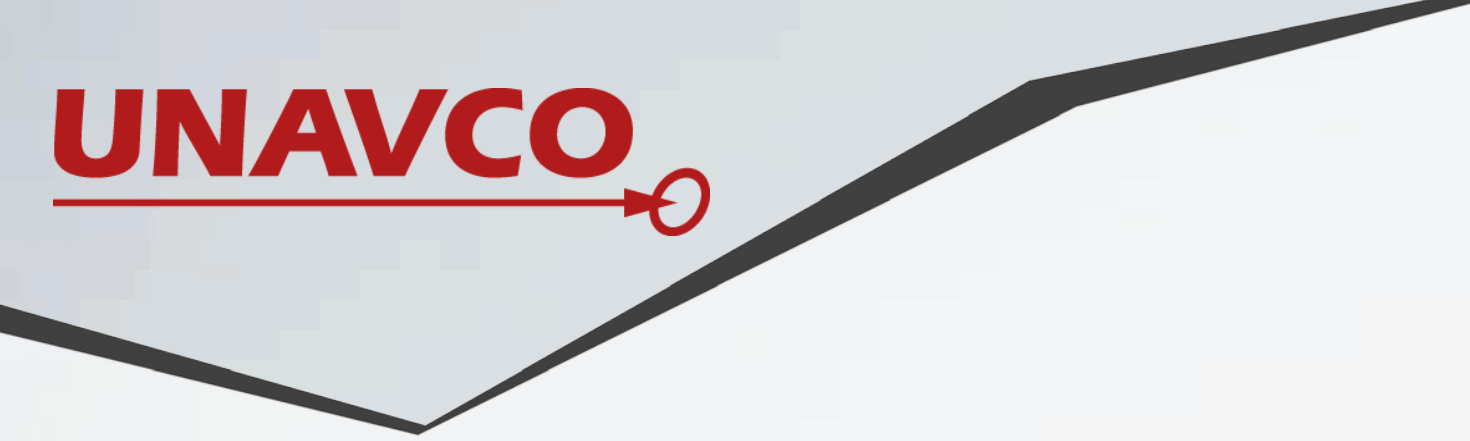
Scott Baker<sup>1</sup>, Chris Crosby<sup>1</sup>, Charles Meertens<sup>1</sup>, Eric Fielding<sup>2</sup>, Gwen Bryson<sup>3</sup>, Brian Buechler<sup>3</sup>, Jeremy Nicoll<sup>3</sup>, Chaitanya Baru<sup>4</sup>

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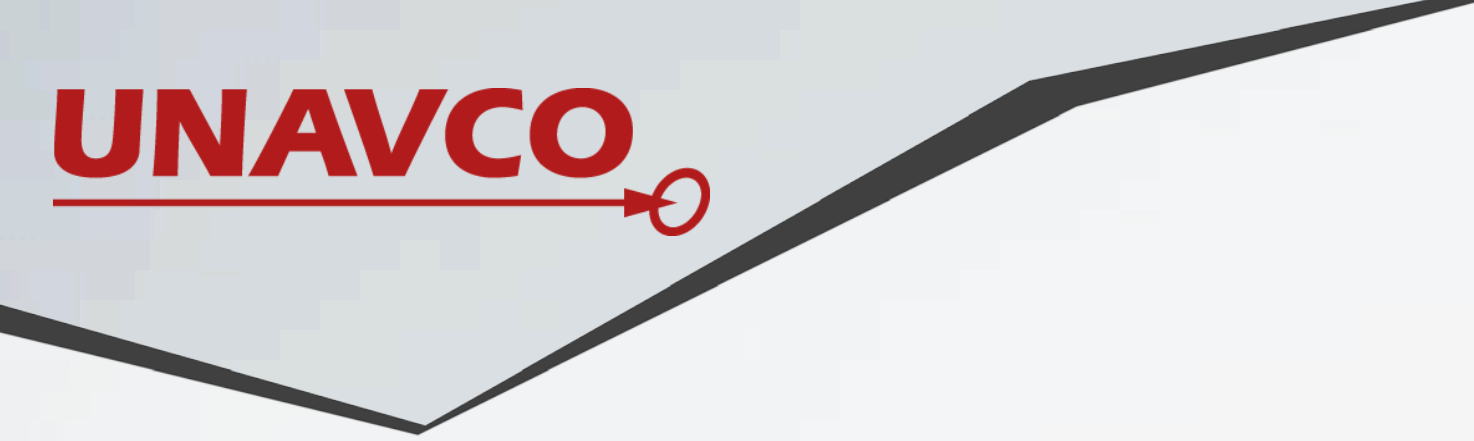
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<sup>4</sup>San Diego Supercomputer Center, UC, San Diego, La Jolla, CA, USA



# What is UNAVCO?

- UNAVCO, a non-profit university-governed consortium, facilitates geoscience research and education using geodesy.
- Under a 2013 award from the National Science Foundation (NSF), UNAVCO operates the National Earth Science Geodetic Facility, known as the Geodesy Advancing Geosciences and EarthScope (GAGE) Facility. UNAVCO provides supporting services that include:
  - 1 The Plate Boundary Observatory (PBO), an integrated set of geodetic networks (cGPS, real-time GPS, borehole strainmeters, tiltmeters and seismometers, and metpacks) that forms the world-class geodesy component of EarthScope,
  - 2 a facility that provides engineering, instrumentation, and data services to NSF-funded investigators who use terrestrial and satellite geodetic technologies (e.g., TLS, GPS, and InSAR) in Earth science research as well as Geosciences more broadly,
  - 3 network operations to support NSF-funded community GPS networks for Earth, atmospheric, and polar science applications, and the NASA's Global GNSS Network (GGN), and
  - 4 PI planning support and core programs to advance geoscience education resources and geodesy community engagement.



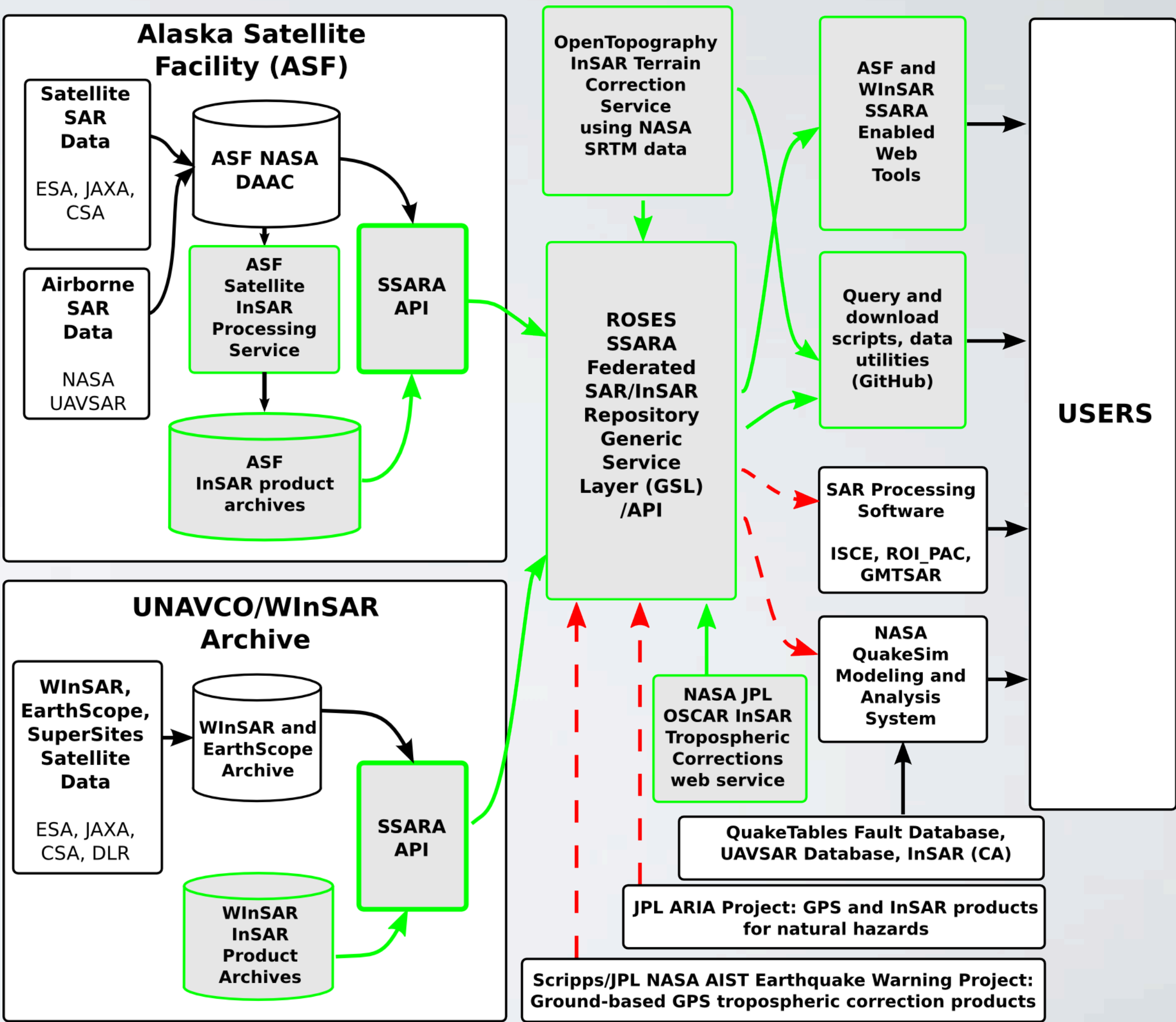
# Outline

- Seamless SAR Archive (SSARA)
- UNAVCO SAR archive and WInSAR support
- Geohazards Supersites and Natural Laboratories (GSNL) support

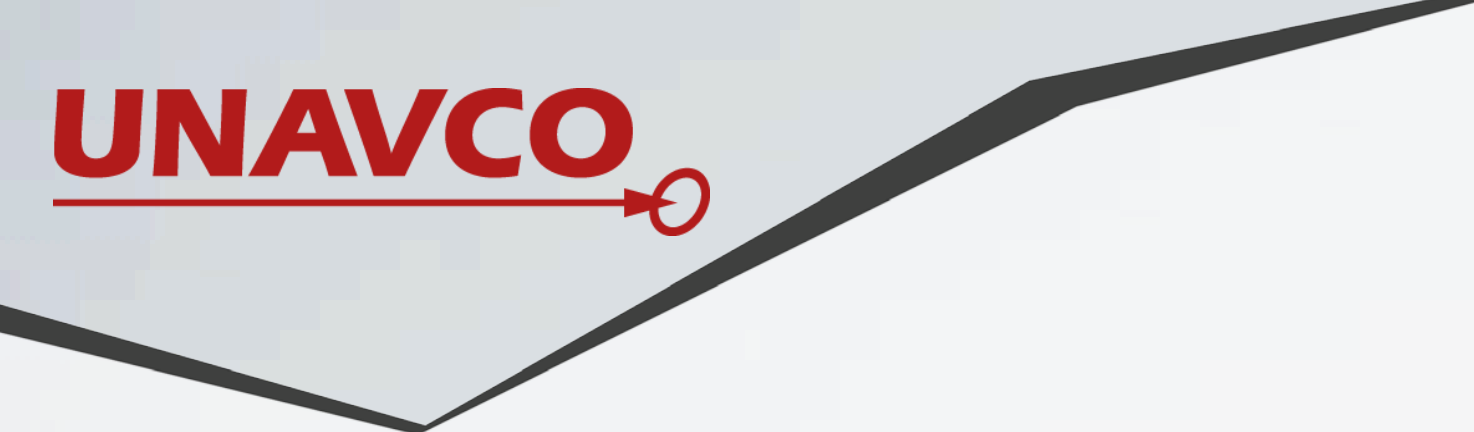


# What is SSARA?

- NASA funded project between UNAVCO, ASF, JPL, and SDSC/OpenTopography.  
NASA ROSES ACCESS project NNX12AF62A
- Develop and implement a federated metadata query and data product download capabilities from SAR archives at ASF and UNAVCO/WInSAR
- Define and implement new QC parameters and products to enhance the usability of data from these existing NASA-funded collections
- Develop standard formats for image products such as interferograms, tropospheric measurements, and terrain corrections
- Implement a web services enabled terrain correction service using NASA SRTM data at OpenTopography
- Enhance ASF SAR interferogram processing service to access distributed SSARA data collections, utilize terrain correction service and generate enhanced QC products
- Establish processed data products archive (interferograms and QC products) at ASF and UNAVCO

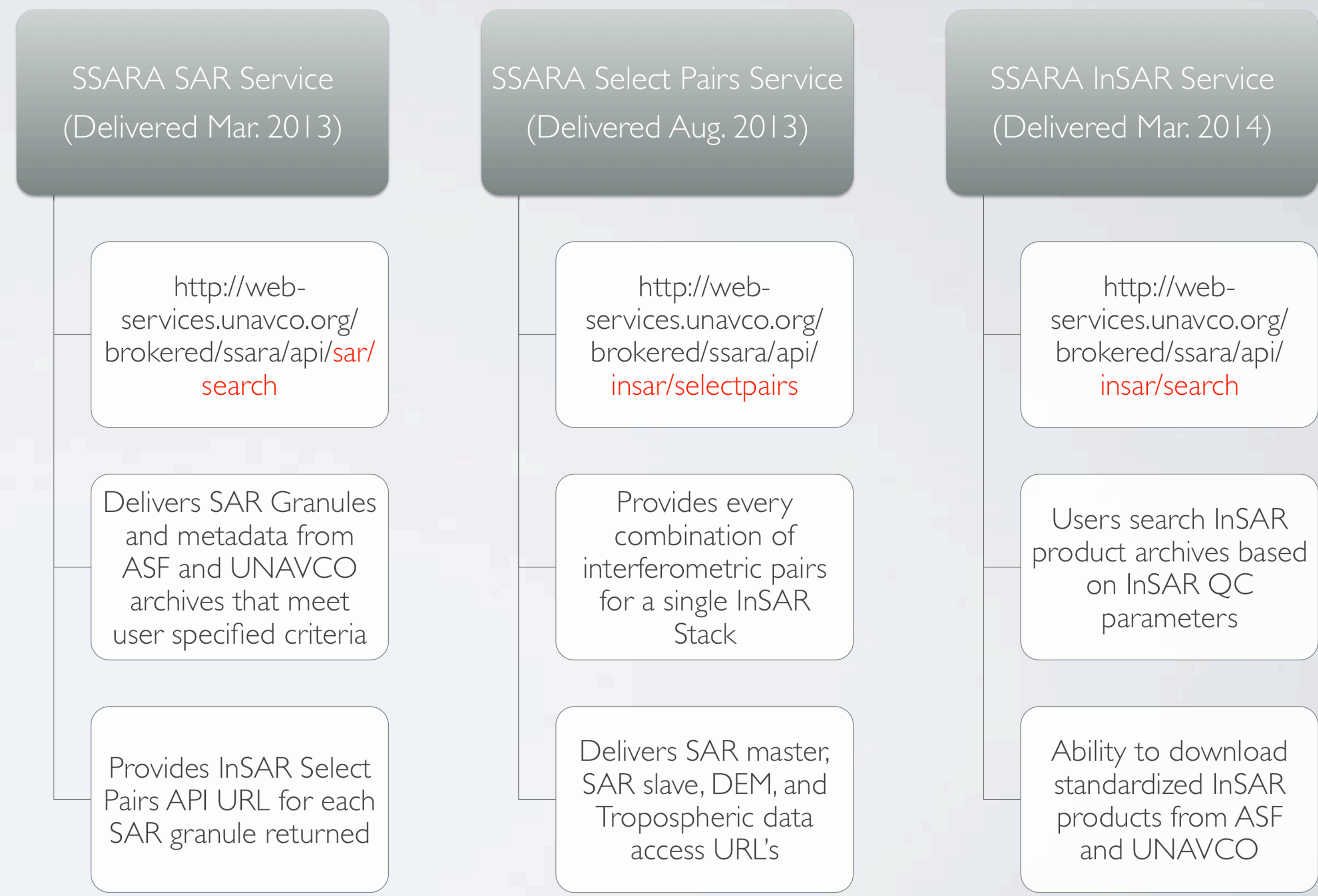






# SSARA API

- Initial development was on searching for SAR data and providing a unified, consistent API between UNAVCO and ASF
- Further API development and enhancements added more InSAR specific keywords and quality control parameters (Doppler centroid, faraday rotation, InSAR stack size, and perpendicular baselines).
- To facilitate InSAR processing, the federated query service incorporated URLs for DEM (from OpenTopography) and tropospheric corrections (from the JPL OSCAR service) in addition to the URLs for SAR data.
- The federated query service provides relevant QC metadata for selecting pairs of SAR data for InSAR processing and all the URLs necessary for interferogram generation.





# SSARA API

## Searching for data

## Web Service Root URL:

<http://web-services.unavco.org/brokered/ssara/>

## Command Line Client and Utilities:

<https://github.com/bakerunavco/SSARA>

- Automated downloads from UNAVCO, ASF, and ESA  
Virtual Archive 4 (via secp)
- HDF5 converter for InSAR product archive
- DEM converted for ROI\_PAC and ISCE

```
git clone https://github.com/bakerunavco/SSARA.git
```

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5

Star

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Fork

0

Seamless SAR Archive project repository — Edit

37 commits

1 branch

0 releases

2 contributors

branch: master ▾

[SSARA](#) / +

Update to VA4 downloading

**bakerunavco** authored on Feb 9

latest commit 554e9c2d50

<a href="#">data_utils</a>	Updated to support downloads from Virtual Archive 4	a month ago
<a href="#">README.md</a>	Updated to new URL	3 months ago
<a href="#">password_config.py</a>	Updated to support downloads from Virtual Archive 4	a month ago
<a href="#">ssara_federated_query.py</a>	Update to VA4 downloading	a month ago

[README.md](#)

## Seamless SAR Archive (SSARA) project

<> Code

Issues

1

Pull requests

0

Wiki

Pulse

Graphs

Settings

HTTPS clone URL

You can clone with [HTTPS](#), [SSH](#), or [Subversion](#).

## New web GUI for searching

<http://web-services.unavco.org/brokered/ssara/gui>

Seamless SAR Archive (SSARA) Federated Query

+

-

Query Form

Search

Platform:

Absolute Orbit:

Relative Orbit:

Frame:

Start Date:

End Date:

Beam Mode:

Swath:

Flight Direction:

Look Direction:

Polarization:

Processing Level:

Collection:

Max. Results: 1000

Min. Doppler:

Max. Doppler:

Min. Faraday:

Max. Faraday:

Min. Baseline:

Max. Baseline:

Min. Stack Size:

Max. Stack Size:

Intersects:

Search

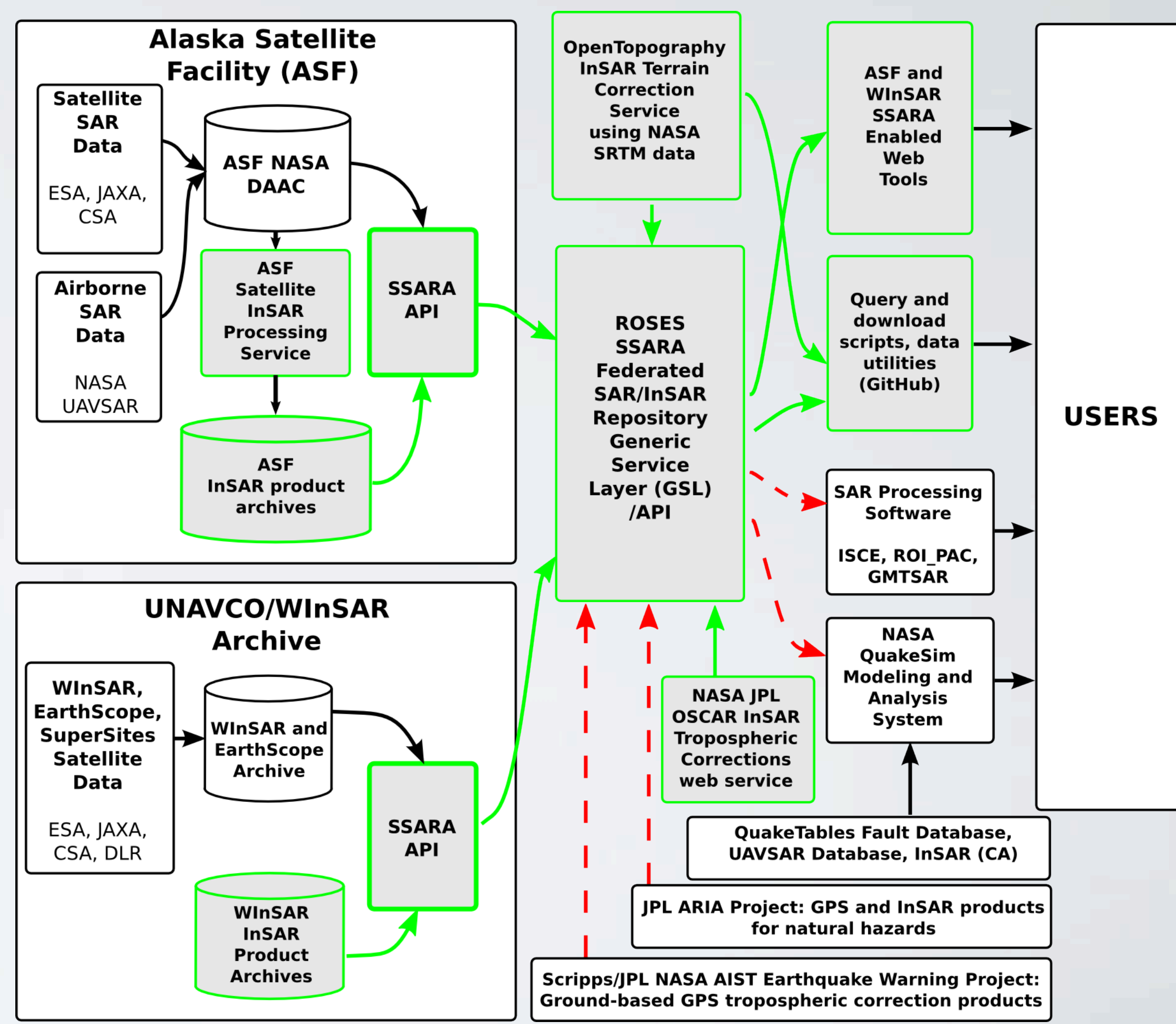
Results

Collection	Platform	Absolute Orbit	Start Time	Stop Time	Relative Orbit	First Frame	Final Frame	Beam Mode	Swath	Flight Direction	Location



# Key Benefits of SSARA

- Provides common search terms and results
- One search location for all SAR data. Researchers/scientists have a single interface to search for SAR data and higher level products.
- Users can easily see what data is “available”, but still need to have credentials to access data at each archive
- More time is spent doing science with the data rather than searching for data







# UNAVCO SAR Archive

<http://www.unavco.org/data/imaging/sar/sar.html>

- The UNAVCO SAR archive has over 140,000 scenes totaling over 25 TB
- Data are organized into collections that allow access control based on user authorization
- ERS-1/2, RADARSAT-1, ENVISAT (Limited to North America). These are the EarthScope and WInSAR data collections
- Organization and distribution of TerraSAR-X for WInSAR PIs. Each proposal has its own collection with limited user access
- Some Supersites data (CSK, RSAT-2 for Hawaii and Sinabung) organized into collections as well

UNAVCO

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SEARCH

Community Projects Instrumentation **Data** Software Science Education

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**Data**

• Help with Data

**Imaging Data**

**SAR Data**

• SAR Data Collections

• SAR Archive Status

• Apply for SAR Data Access

• SAR Data Search GUI

• SAR Data Search API

• Login Help

**Related Links**

• [WInSAR website](#)

• [Supersites website](#)

• [Seamless SAR Archive \(SSARA\) Project](#)

• [SAR Satellites](#)

• [SAR Software](#)

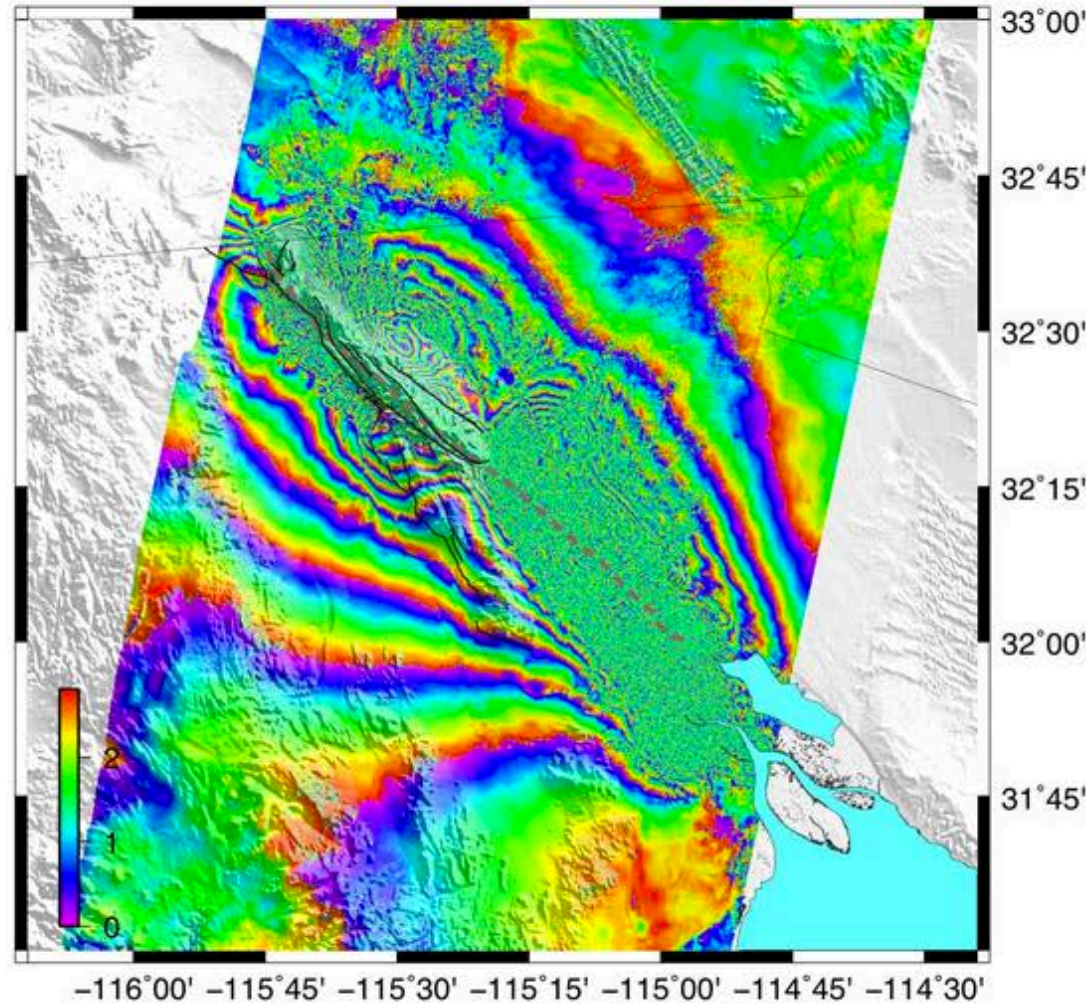
**Synthetic Aperture Radar (SAR) Data**

The Synthetic Aperture Radar (SAR) data at the UNAVCO Data Center includes satellite-transmitted and received radar scans of the Earth's surface. SAR data, analysed using Interferometric SAR (InSAR) techniques, can be used to model millimeter-to-centimeter scale deformation of the Earth's surface over regions tens of hundreds of kilometers across. These displacement fields are becoming essential guides for studies of tectonics, earthquake focal mechanisms, volcano behavior, hydrology, and public safety related to Earth hazards.

The SAR archive of the UNAVCO Data Center has several [SAR data collections](#), including SAR data acquired by the WInSAR consortium and the GeoEarthScope project — the data for the latter now organized into the EarthScope ESA and CSA SAR collections. Each collection corresponds to specific data access which must be approved.

The off-site [Supersites](#) SAR archive (which is not a UNAVCO archive) has data supplied by the European Space Agency (ESA) that can be searched using the UNAVCO SAR API or GUI tools. UNAVCO also provides key operational support to Supersites, on behalf of the Group on Earth Observations (GEO), the European Space Agency (ESA), and [WInSAR](#).

Researchers interested in obtaining SAR data from the UNAVCO SAR archive must [apply for SAR data access](#), and those interested in obtaining SAR data from Supersites must register with ESA as described at [Supersites](#).



InSAR interferogram of ground deformation along the San Andreas fault, from ESA Envisat data, by Yuri Fialko, University of California, San Diego, et al. (Click for full size.)

Sponsors and Partners for UNAVCO SAR activities





# WInSAR Support

- UNAVCO provides data archiving and operational support for WInSAR. Distribution of the ISCE software is provided to WInSAR members.

See <https://winsar.unavco.org/> for more information

## Functionality provided by the WInSAR Portal

- <https://winsar.unavco.org/portal>

- User management (registration, password reset...)

- TSX tasking management (also for Supersites)

- PI proposal management

- InSAR wiki

**WInSAR**  
Western North America Interferometric  
Synthetic Aperture Radar Consortium

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Member Institution  
Apply to become an  
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TerraSAR-X Tasking  
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**WInSAR**

[WInSAR Portal](#) [Get Data](#)

The new [WInSAR portal](#) lets you [manage your account](#) and provides [TerraSAR-X data management](#).

**Overview**

The Western North America InSAR (WInSAR) Consortium was established by a group of practicing scientists and engineers to facilitate collaboration in, and advancement of, Earth science research using radar remote sensing. Its members are universities, research laboratories, and public agencies. WInSAR oversees the acquisition and archiving of spaceborne SAR data over western North America for the benefit of the membership. The major objectives of WInSAR are to:

- Promote the use and development of InSAR technology for scientific investigations, in particular but not limited to, seismic and magmatic processes, plate boundary deformation, land subsidence, and topographic mapping.
- Acquire SAR imagery in western North America, archive and catalog the data, and disseminate it for use by member organizations.
- Provide value-added InSAR products and software for use by the scientific community.
- Advocate the open exchange of SAR data by seeking to enlarge the number of member organizations.
- Solicit funds and promote programs and space missions to meet these objectives.

[UNAVCO](#) provides organizational and operational support for WInSAR activities. The WInSAR Executive Committee acts as an [Advisory Committee](#) of the [UNAVCO Board of Directors](#). UNAVCO's operational support includes membership administration, financial management, data management and archiving, and software tools for data exploration and access.

**Motivation**

The western part of North America is the focus of intensive scientific research into a variety of plate boundary processes including earthquakes, volcanism, mountain building, and micro-plate tectonics. For example, the characterization and more complete understanding of the plate boundary deformation system, and its relationship to the occurrence of earthquakes, is a rich scientific problem that may ultimately lead to a reduction in seismic risk. Other natural processes that induce surface deformation such as land subsidence induced by water or oil extraction are also at work in western North America. The technique of spaceborne Interferometric Synthetic Aperture Radar (InSAR) provides an excellent means of observing deformation over broad areas. It is capable of 10's of meters spatial resolution at monthly or greater intervals. InSAR has proven to be a powerful tool to characterize large-scale deformation associated with active faults. It also can resolve small-scale deformation features such as shallow creep, postseismic and interseismic deformation. And it is an ideal tool for measuring land subsidence and improving digital terrain models.

**Data**

WInSAR data is now stored at the [UNAVCO SAR Archive](#) as one of several SAR data collections. At the UNAVCO SAR Archive you'll find tools to search, access, and order (request additions to) the WInSAR data collection(s). You can simultaneously search and potentially access other SAR data collections held at UNAVCO (depending on your data access privileges). WInSAR helps coordinate requests for data acquisition and for data purchase, aiding individual investigators by simplifying interactions with data providers.





# WInSAR Portal - InSAR Wiki

- This new wiki will replace the old roipac.org wiki
- Support pages for ROI\_PAC, GMTSAR, ISCE
- Other software, possibly Doris and Sentinel Toolbox
- Advanced techniques: Time series analysis, MAI, pixel tracking
- Improvements and added functionality will be implemented as funding and time allows

The screenshot shows the homepage of the WInSAR InSAR Wiki. The header features a blue banner with a colorful SAR interferogram on the left and the text "WInSAR Western North America Interferometric Synthetic Aperture Radar Consortium" on the right. Below the banner is a navigation bar with links for "Home" and "InSAR WIKI", and a "Log in" link on the far right. The main content area has a heading "Welcome to the InSAR Processing Wiki" followed by a paragraph explaining the wiki's purpose and linking to a "WikiHowTo" page. Below this is a "Table of Contents" section with a list of topics: SAR Processing Software Packages (including ISCE, GMTSAR, and ROI\_PAC), Satellite Information, Data Archives and Access to data, Contributed software, Advanced Techniques (including InSAR Time Series Analysis, Multiple Aperture Interferometry, Dense sub-pixel offset tracking, and Preparing Data for Modeling), "Data Visualization", Bibliography, and External Links. At the bottom, there is a section for "Operational support provided by:" featuring the UNAVCO logo, and "Sponsors of WInSAR activities:" featuring logos for NSF, USGS, and NASA.

**WInSAR**  
Western North America Interferometric  
Synthetic Aperture Radar Consortium

Home InSAR WIKI Log in

## Welcome to the InSAR Processing Wiki

This is a new wiki for the community to share software and tips for processing SAR data. Some of the information from the roipac.org wiki has been updated and incorporated with the content here. If you want to contribute, you will need a [WInSAR](#) account and some instructions for formatting are given in the [WikiHowTo](#).

### Table of Contents

- SAR Processing Software Packages
  - [ISCE](#)
  - [GMTSAR](#)
  - [ROI\\_PAC](#)
- [Satellite Information](#)
- [Data Archives and Access to data](#)
- Contributed software
- Advanced Techniques
  - [InSAR Time Series Analysis](#)
  - Multiple Aperture Interferometry
  - Dense sub-pixel offset tracking
  - Preparing Data for Modeling
- "Data Visualization"
- Bibliography
- External Links

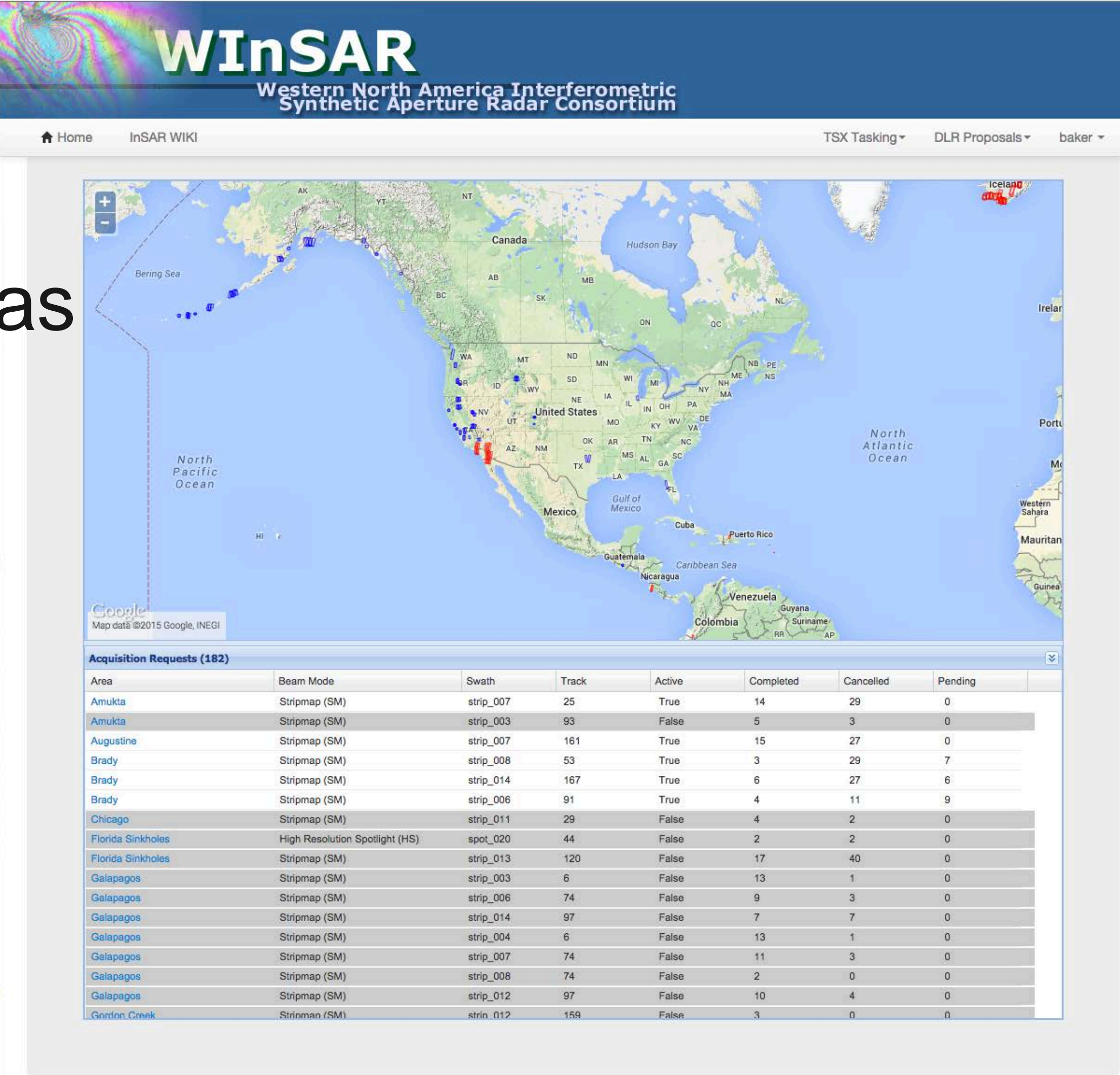
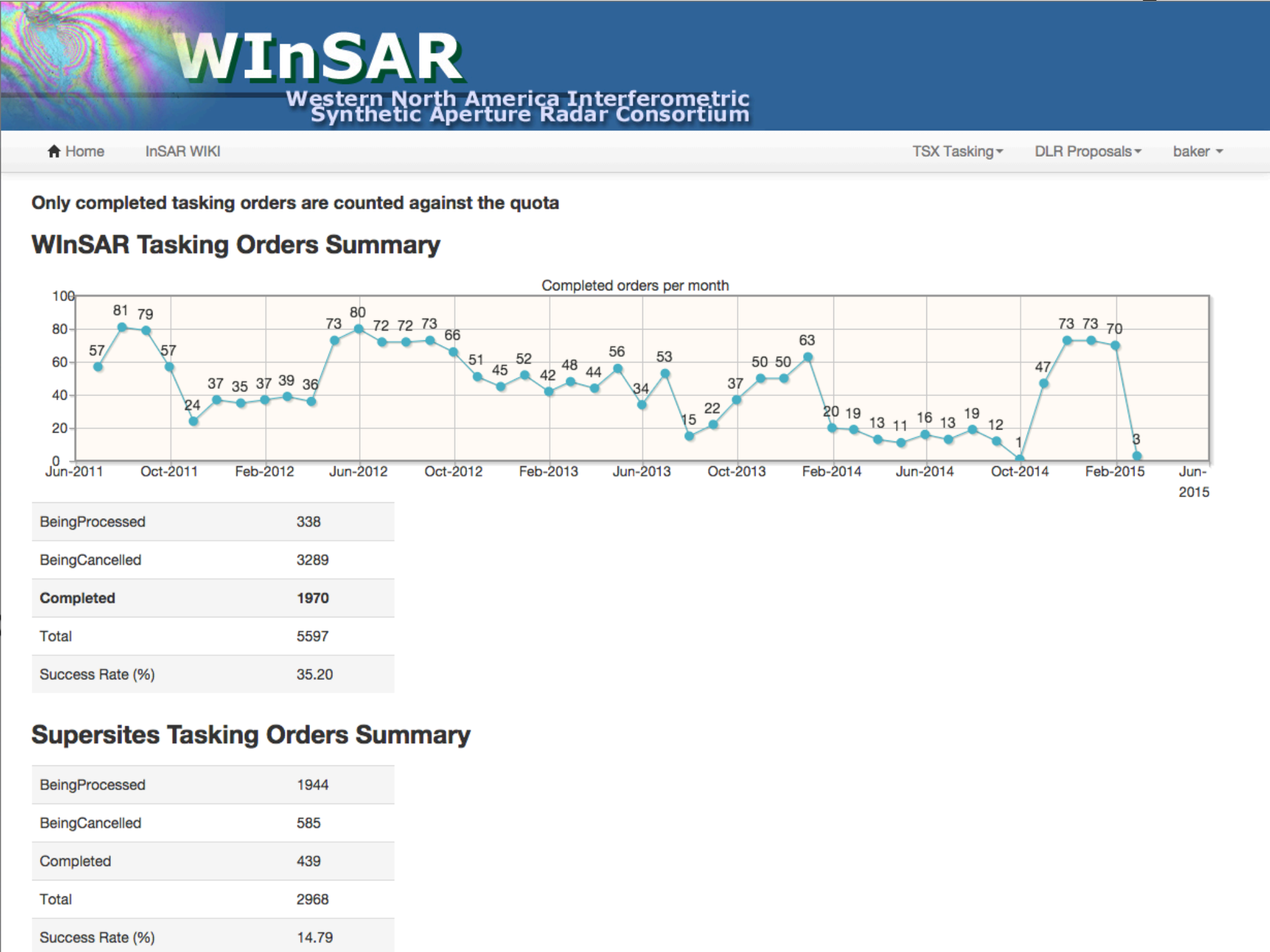
Operational support provided by:  
**UNAVCO**

Sponsors of WInSAR activities:  
  

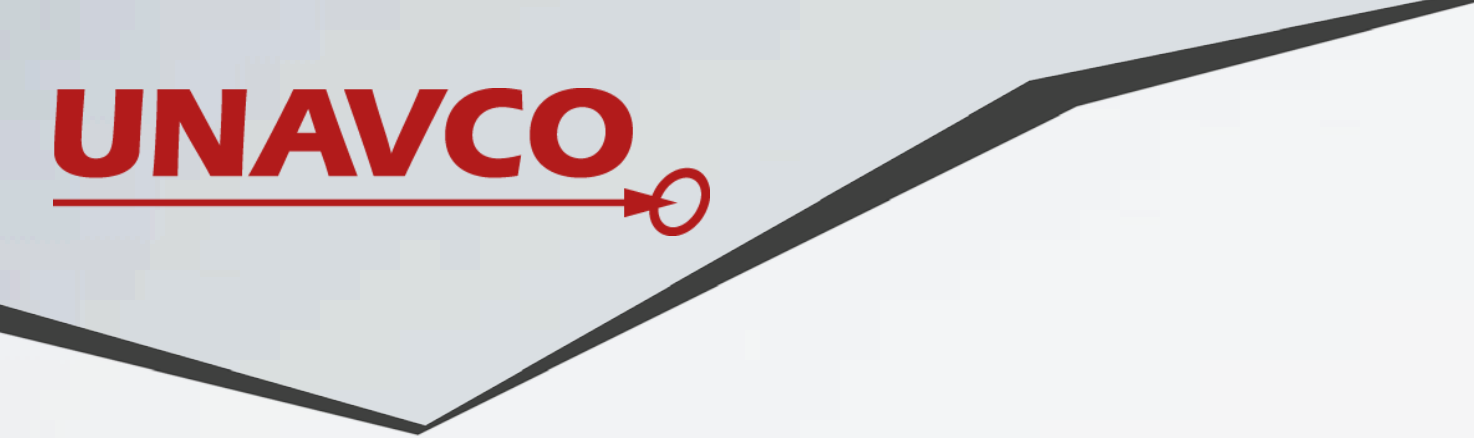


# WInSAR Portal - TSX tasking

- Coordination of TerraSAR-X background tasking
- Tracks success for individual tasking areas and provides an overall summary








# WInSAR Portal - PI proposal management

- Automated data download and distribution for WInSAR PIs and Co-PIs of DLR TSX proposals.
- Access limited to those listed on the license agreement.
- New sources of data:
- Similar interface is planned for ALOS-2
- COSMO Sky-Med science proposals could be managed in a similar way. This is already being done for the Hawaii Supersites data.




Western North America Interferometric  
Synthetic Aperture Radar Consortium

HomeInSAR WIKITSX TaskingDLR Proposalsbaker

For instructions on adding proposals, see the [DLR Proposals How-to/Info page](#)

Below is a list of DLR proposal being managed by UNAVCO. More information about the individual proposals (Title, proposal description...) can be found at the [TerraSAR-X Science Service System](#) (on the lefthand side under "Proposals" click on General, TSX-Archive-2012... and under there you will find a list of Proposal IDs with more details).

DLR PROPOSAL ID	WInSAR PI	Active Proposals
GEO0192	Paul Lundgren	
GEO0875	Michael Poland	✓
GEO0927	Paul Lundgren	✓
GEO1142	Chuck Wicks	✓
GEO1441	Falk Amelung	✓
GEO1514	Falk Amelung	✓
GEO1523	Matthew Pritchard	✓
GEO1524	Matthew Pritchard	✓
GEO1609	Zhen Liu	✓
GEO1713	John W. Bell	✓
GEO1742	Chuck Wicks	✓
GEO1775	Roland Burgmann	✓
GEO1796	Shimon Wdowinski	✓
GEO2326	Dan Dzurisin	✓
HYD2315	Michelle Sneed	✓
LAN1839	Eric Fielding	✓
RES1236	Kurt Feigl	✓
RES1513	Falk Amelung	✓



Western North America Interferometric  
Synthetic Aperture Radar Consortium

HomeInSAR WIKITSX TaskingDLR Proposalsbaker

Below are details for your proposal: **GEO1441**

PROPOSAL	USERNAME	PASSWORD	Active
GEO1441			True

Product File Name	DLR Delivery	Download Requested	Download Finished
dims_op_oc_dfd2_451391047_1.tar.gz	Nov. 4, 2014, 2:56 p.m.	Nov. 4, 2014, 5 p.m.	Nov. 4, 2014, 5:08 p.m.
dims_op_oc_dfd2_451390419_8.tar.gz	Oct. 30, 2014, 4:08 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 2:53 a.m.
dims_op_oc_dfd2_451390419_7.tar.gz	Oct. 30, 2014, 4:06 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 2:01 a.m.
dims_op_oc_dfd2_451390419_6.tar.gz	Oct. 30, 2014, 4:06 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 2:53 a.m.
dims_op_oc_dfd2_451390419_5.tar.gz	Oct. 30, 2014, 4:04 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 2:01 a.m.
dims_op_oc_dfd2_451390419_4.tar.gz	Oct. 30, 2014, 4:02 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 2 a.m.
dims_op_oc_dfd2_451390419_3.tar.gz	Oct. 30, 2014, 4:01 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 1:58 a.m.
dims_op_oc_dfd2_451390419_2.tar.gz	Oct. 30, 2014, 3:58 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 1:55 a.m.
dims_op_oc_dfd2_451390419_1.tar.gz	Oct. 30, 2014, 3:57 p.m.	Oct. 31, 2014, 1:49 a.m.	Oct. 31, 2014, 2:02 a.m.
dims_op_oc_dfd2_451391011_1.tar.gz	Oct. 24, 2014, 3:59 p.m.	Oct. 25, 2014, 2 a.m.	Oct. 25, 2014, 3:34 a.m.
dims_op_oc_dfd2_450977349_2.tar.gz	Oct. 21, 2014, 3:50 p.m.	Oct. 22, 2014, 2 a.m.	Oct. 22, 2014, 3:45 a.m.





# WInSAR Portal - Interferogram Archive

- Developed under the SSARA project to provide a 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 and GMTSAR provided on SSARA GitHub repository

- REST interface for uploading interferograms (LOS velocities and LOS time series support in development)

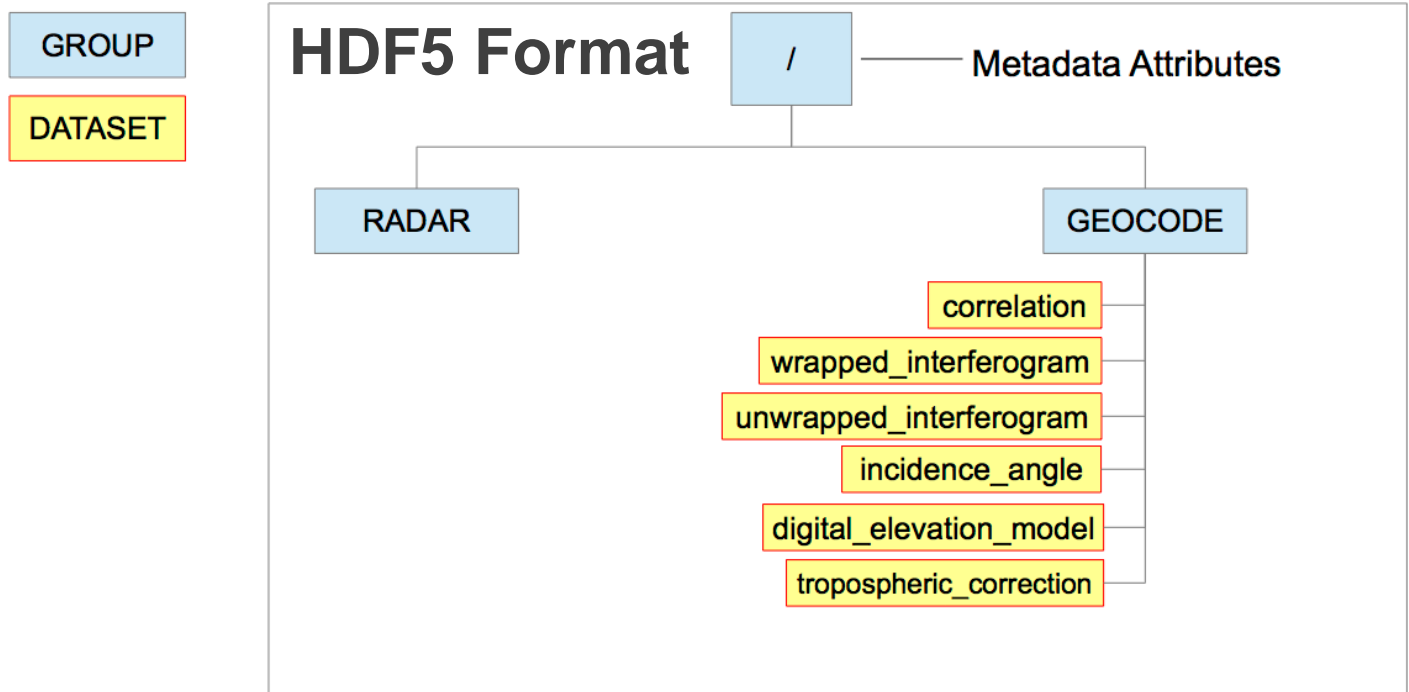
- <https://winsar.unavco.org/portal/insar/api/>

- Data can be uploaded from the command line using cURL:

`curl -i -F data_file=@DATA_FILENAME -u USERNAME:PASSWORD`

- <https://winsar.unavco.org/portal/insar/api/interferometry/>

Users only need to provide the "data\_file" parameter via POST method along with their login credentials since all necessary metadata is read from the HDF5 file directly.



Django REST framework v2.4.3 baker ▾

Api Root

**Api Root** OPTIONS GET ▾

GET /portal/insar/api/

HTTP 200 OK  
Content-Type: application/json  
Vary: Accept  
Allow: GET, HEAD, OPTIONS

```
{
  "interferometry": "http://winsar.unavco.org/portal/insar/api/interferometry/"
}
```

Django REST framework v2.4.3 baker ▾

Raw data HTML form

Mission:

Beam swath:

Relative orbit:

First date:

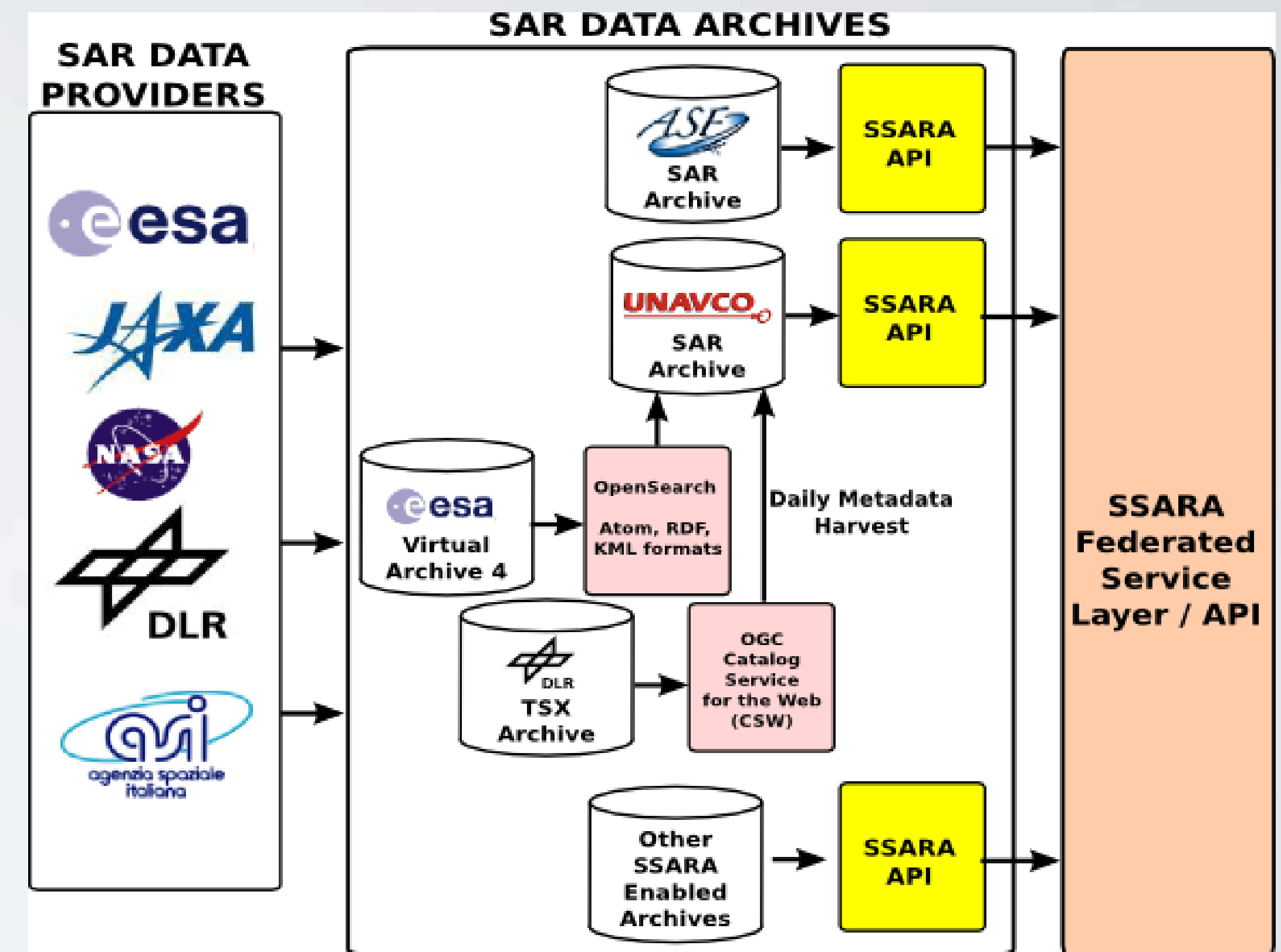
Last date:

Scene footprint:

# Geohazard Supersites and Natural Laboratories

## •GSNL SAR Data Integration with SSARA

- Daily harvest of metadata from ESA Virtual Archive 4 and DLR TSX Archive using OpenSearch and OGC CSW protocols.
- Metadata is stored in the UNAVCO SAR database as Supersites VA4 and Geohazard.Supersite.TerraSAR-X\_SSC collections and queries are available using the SSARA federated query service
- Integrated the secp download client into SSARA for automated downloads from ESA Virtual Archive 4. Work is in progress to incorporate download from DLR TSX Archive.
- SSARA clients can be utilized directly in the Supersites Exploitation Platform (SSEP) for InSAR data processing

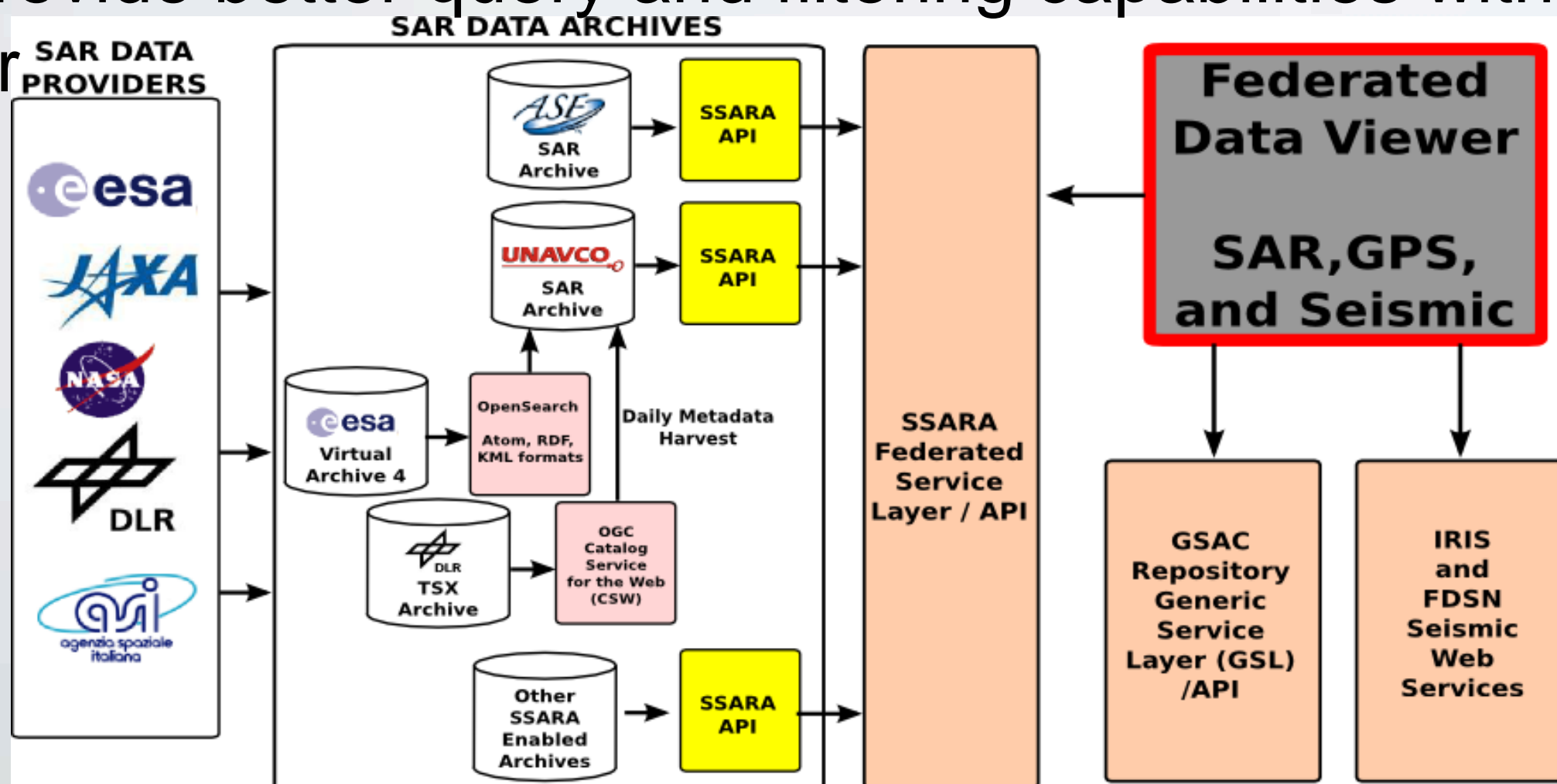
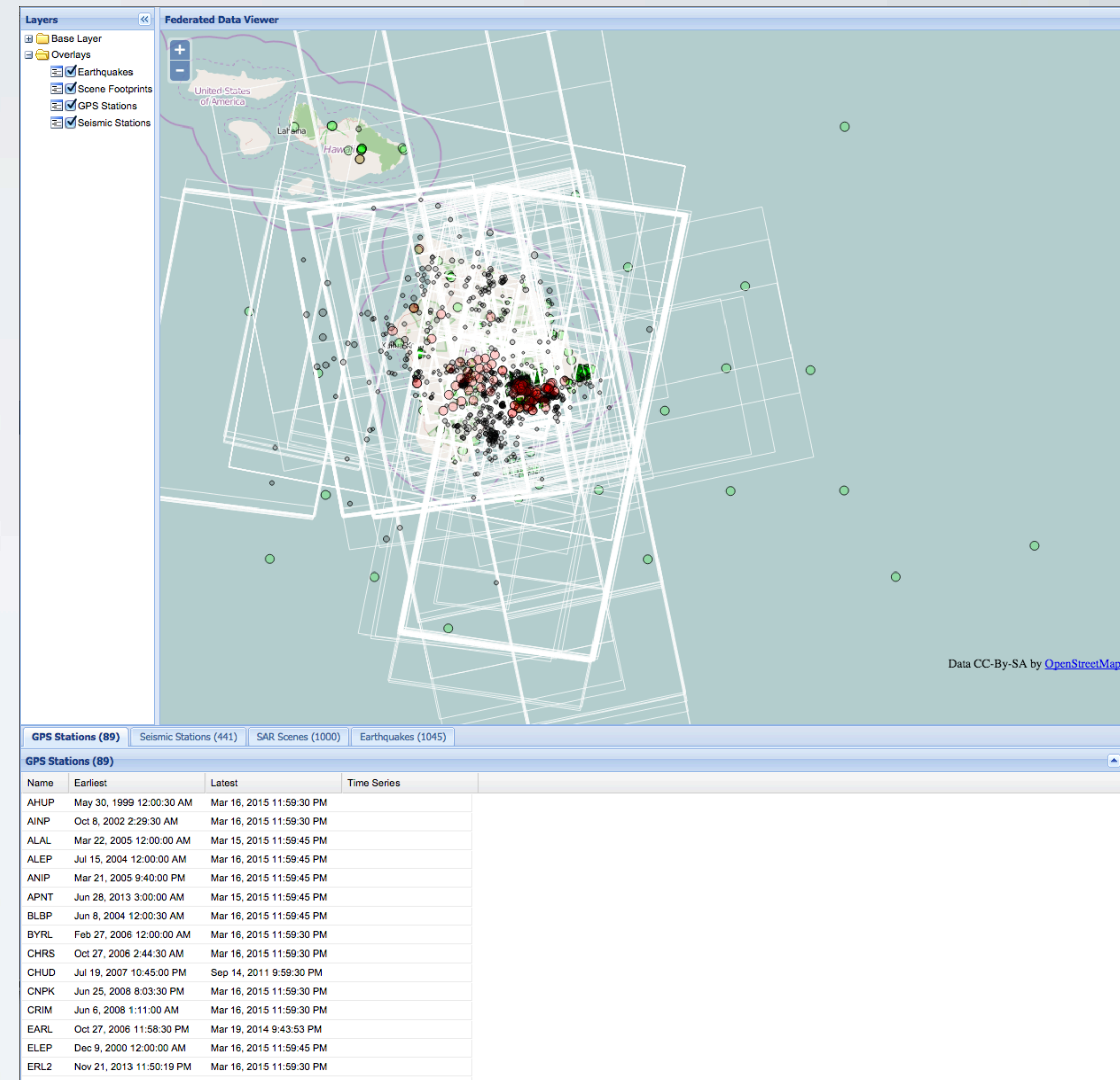


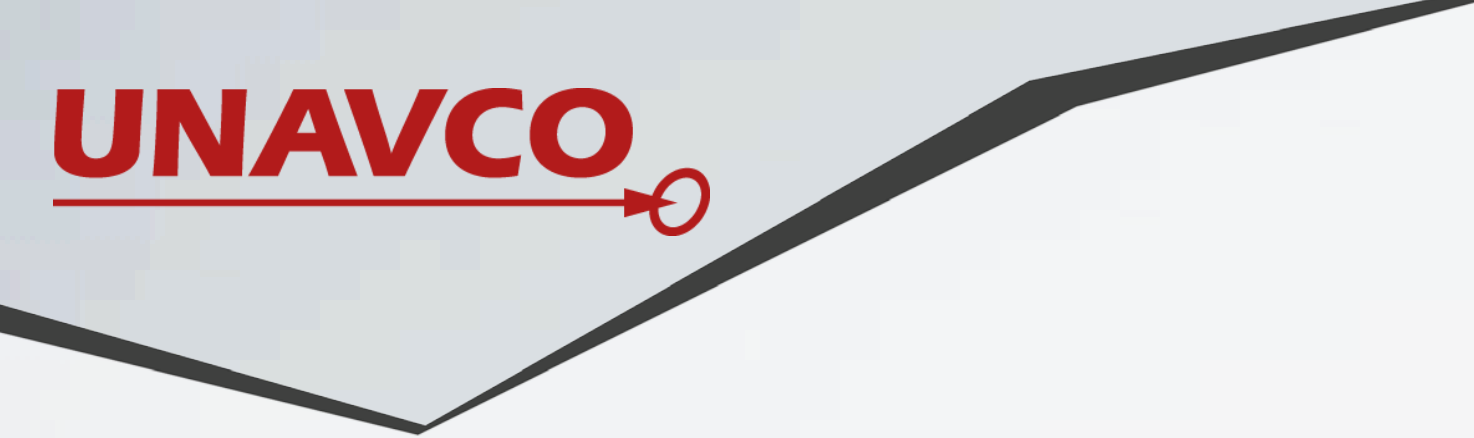


# Geohazard Supersites and Natural Laboratories

## GSNL Federated Data Viewer

- UNAVCO developed a prototype viewer incorporating queries across SAR, GPS, and seismic datasets
- The viewer uses the existing web services (SSARA, GSAC, and COOPEUS) to display available data for the defined Supersites
- Further development will incorporate other data sources (optical and other in situ data) with established web services and provide better query and filtering capabilities within the viewer





# Acknowledgements

The work presented was funded under the following awards:

- **GAGE: NSF EAR-1261833**
- **EarthScope Comprehensive SAR Archive: NSF EAR-0952375**
- **NASA Rose Access SSARA project: NNX12AF62A**