# The Seamless SAR Archive (SSARA) Project and Other SAR Activities at UNAVCO
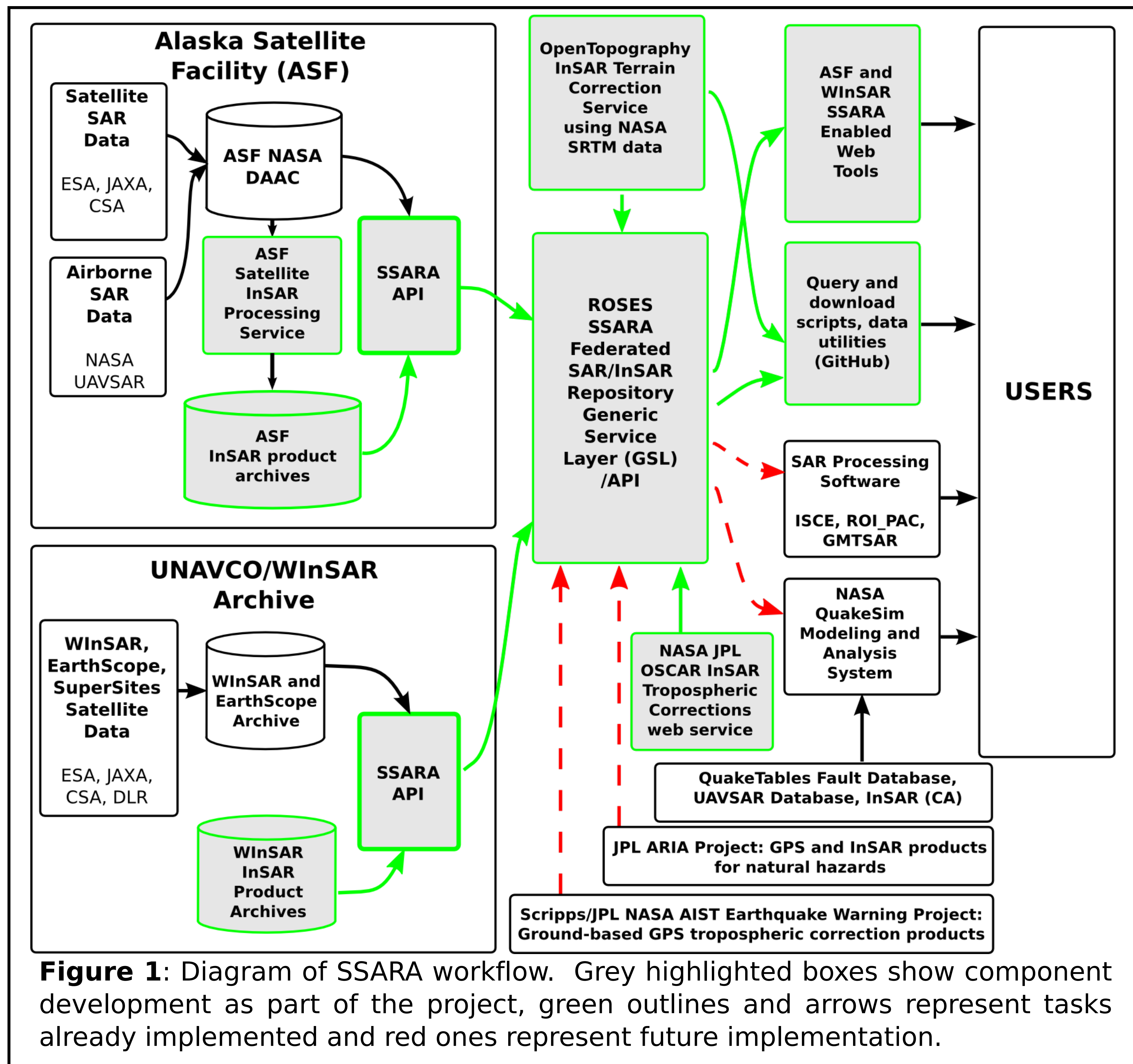
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**ABSTRACT:** The seamless synthetic aperture radar archive (SSARA) implements a seamless distributed access system for SAR data and derived data products (i.e. interferograms). SSARA provides a unified application programming interface (API) for SAR data search and results at the Alaska Satellite Facility and UNAVCO (WInSAR and EarthScope data archives) through the use of simple web services. A federated query service was developed using the unified APIs, providing users a single search interface for both archives. Interest from the international community has prompted an effort to incorporate ESA's Virtual Archive 4 Geohazard Supersites and Natural Laboratories (GSNL) collections and other archives into the federated query service. SSARA also provides Digital Elevation Model access for topographic correction via a simple web service through OpenTopography and tropospheric correction products through JPL's OSCAR service. Additionally, UNAVCO provides data storage capabilities for WInSAR PIs with approved TerraSAR-X and ALOS-2 proposals which allows easier distribution to US collaborators on associated proposals and facilitates data access through the SSARA web services. Further work is underway to incorporate federated data discovery for GSNL across SAR, GPS, and seismic datasets provided by web services from SSARA, GSAC, and COOPEUS.

## Seamless SAR Archive (SSARA) Project



**Figure 1**: Diagram of SSARA workflow. Grey highlighted boxes show component development as part of the project, green outlines and arrows represent tasks already implemented and red ones represent future implementation.

The SSARA API enables users to search and download from multiple archives:
- SAR data granules from the archives at ASF, UNAVCO/WInSAR and Supersites
- Corresponding DEMs from Open Topography and tropospheric data from JPL
- Standardized InSAR data products from archives at ASF and WInSAR/UNAVCO
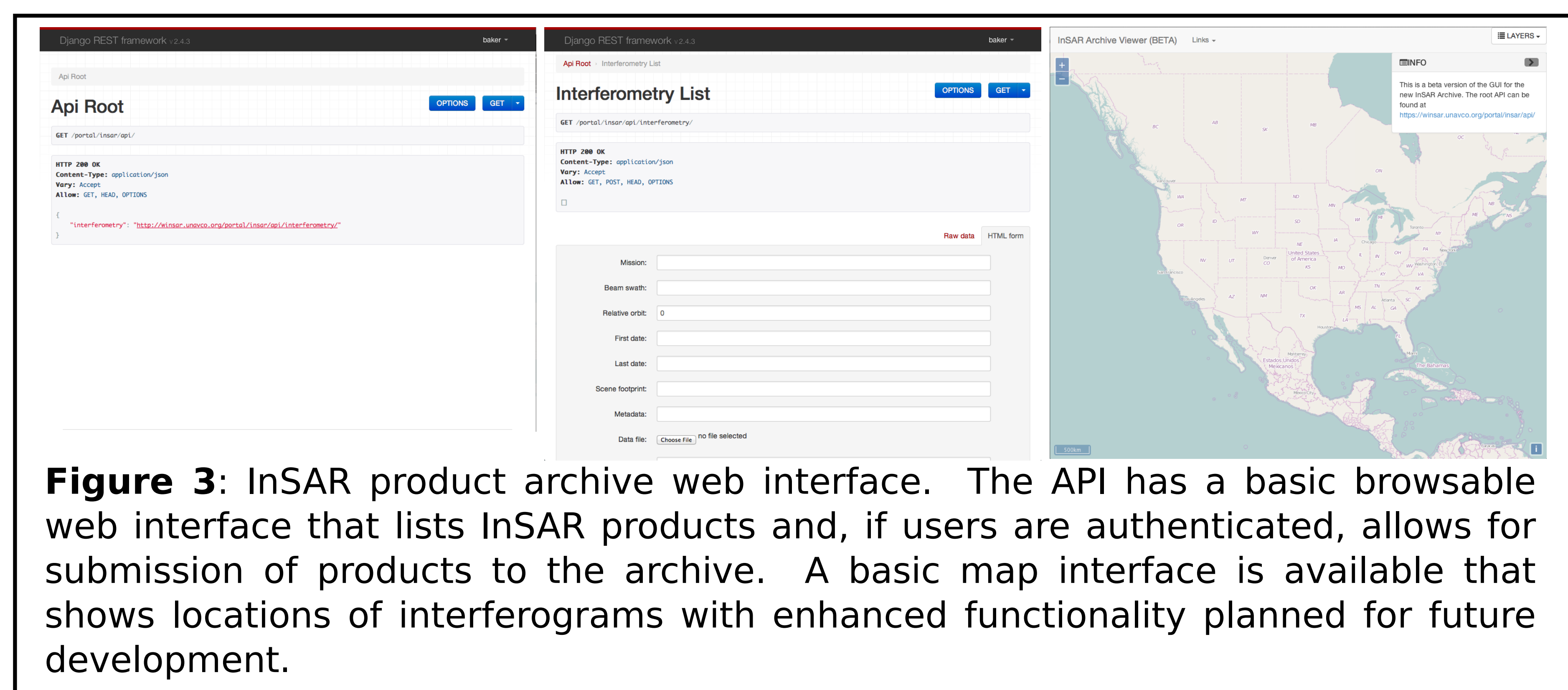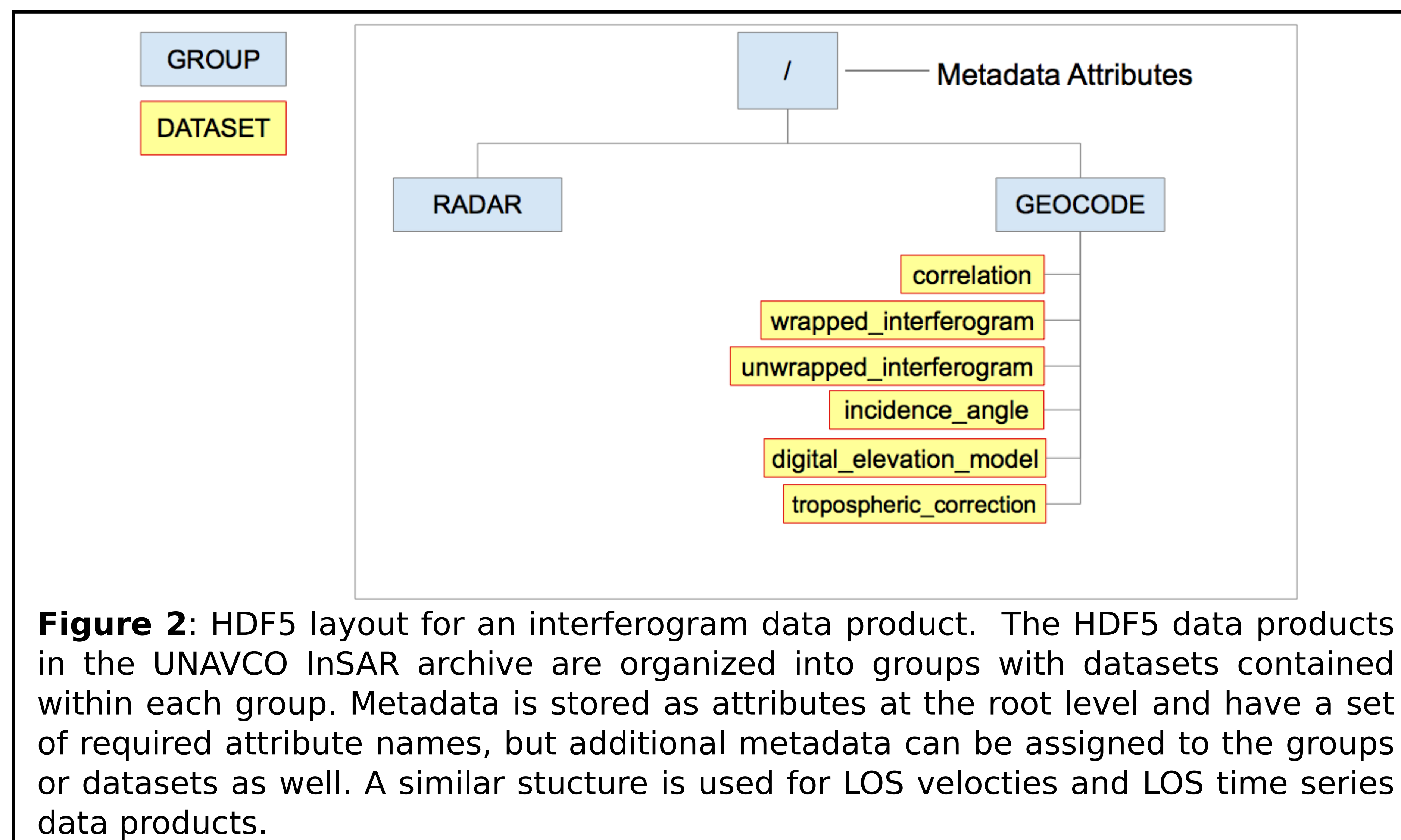
### SSARA Resources
**SSARA Web Services:** http://web-services.unavco.org/brokered/ssara
**SSARA GitHub Repo:** https://github.com/bakerunavco/SSARA
**SSARA GitHub WIKI:** https://github.com/bakerunavco/SSARA/wiki

**DEM Service (OpenTopo):** http://ot-data1.sdsc.edu:9090/otr/getdem
**Tropospheric Service (JPL OSCAR):** http://oscar.jpl.nasa.gov

## UNAVCO InSAR Product Archive

Under the NASA-funded seamless SAR archive (SSARA) project (Figure 1) led by UNAVCO [Baker et al., 2014], a user-contributed InSAR archive for interferograms, time series, and other derived data products has been developed at UNAVCO. The InSAR archive is based on a standard HDF5 data format and provides storage, distribution, and sharing of research results within the geodesy community. The hierarchical data format release 5 (HDF5) [HDF Group, 2014] is the preferred format for InSAR data products because it provides a more robust set of features for storing data. HDF5 has been adopted by the Alaska Satellite Facility (ASF) and is also used in InSAR time series analysis software packages such as GIAnT from Caltech [Agram et al., 2013]. When dealing with a single geocoded interferogram, netCDF or HDF5 work equally well for storing the data. With more complicated scenarios such as stacks of interferograms or distribution of both geocoded and radar geometry interferograms, the hierarchical data features of HDF5 become important, in particular the ability to create groups within a single HDF5 file. The standard HDF5 data products (Figure 2) provide all the necessary datasets and relevant metadata in a single file for distribution. Support for reading and writing HDF5 is available in many programming languages (C/C++, Fortran, Python, Java), and Matlab versions 7.3 and higher use an HDF5-based format for their MAT-file storage, thus providing native reading and writing of HDF5 files.



**Figure 2**: HDF5 layout for an interferogram data product. The HDF5 data products in the UNAVCO InSAR archive are organized into groups with datasets contained within each group. Metadata is stored as attributes at the root level and have a set of required attribute names, but additional metadata can be assigned to the groups or datasets as well. A similar structure is used for LOS velocities and LOS time series data products.



**Figure 3**: InSAR product archive web interface. The API has a basic browsable web interface that lists InSAR products and, if users are authenticated, allows for submission of products to the archive. A basic map interface is available that shows locations of interferograms with enhanced functionality planned for future development.

The API also allows for command line submission of data products using curl. Below is an example curl syntax:

```
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 can be read from the HDF5 file directly.
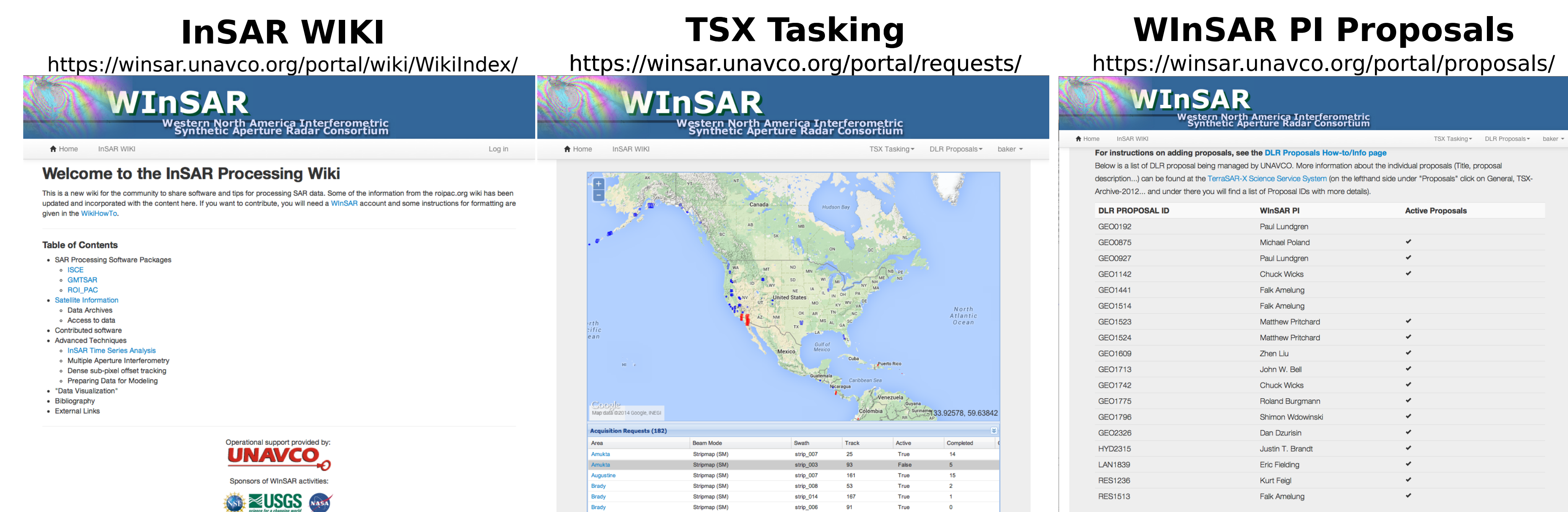
### InSAR Archive Resources
**InSAR Products:** https://winsar.unavco.org/portal/insar/
**InSAR API:** https://winsar.unavco.org/portal/insar/api
**InSAR GUI:** https://winsar.unavco.org/portal/insar/gui
**Sample HDF5 data converters available on SSARA GitHub Repo**

## WInSAR Portal
### https://winsar.unavco.org/portal
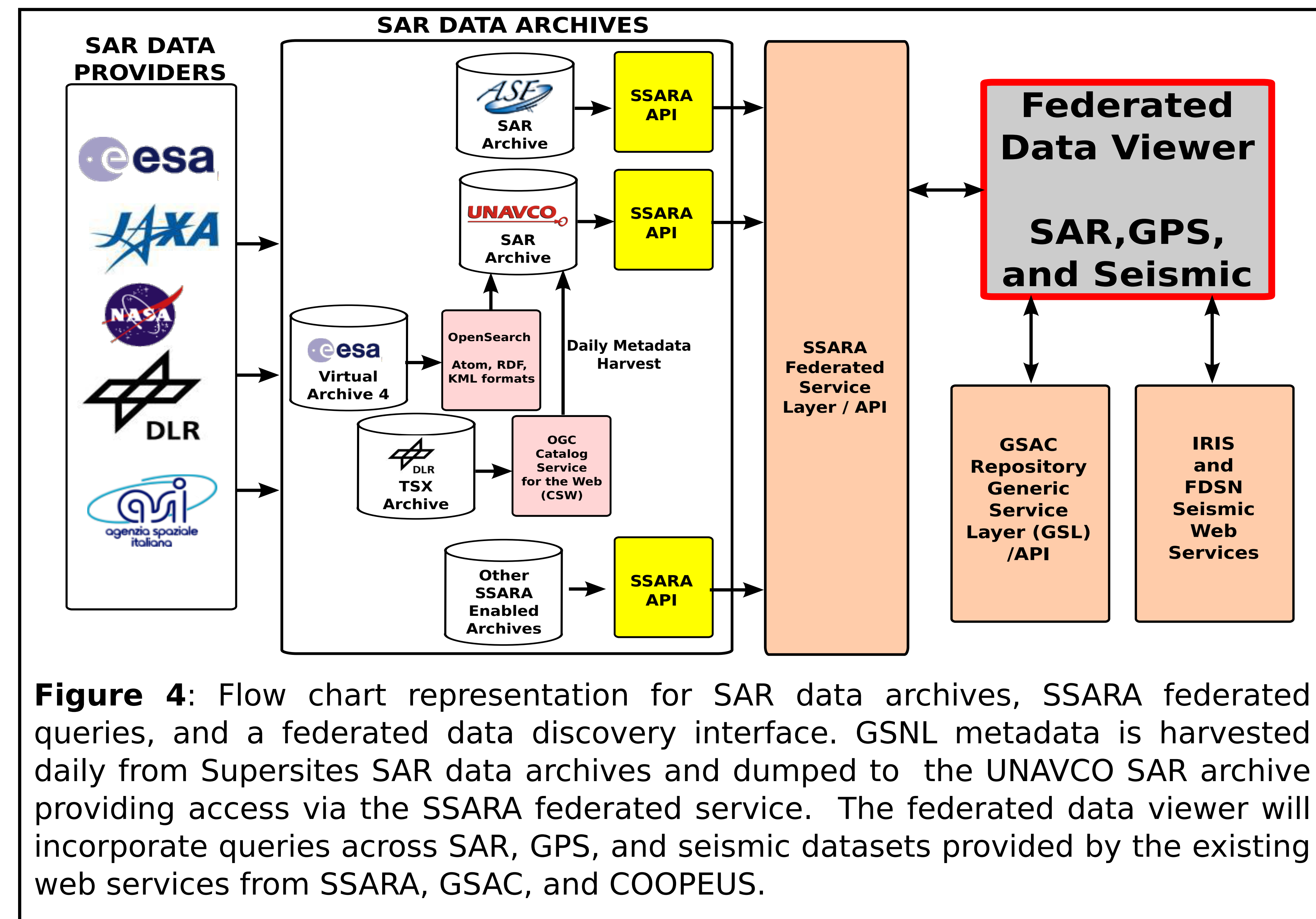


The WInSAR portal provides an InSAR WIKI for the community, management of proposals for WInSAR PIs, tracking of TerraSAR-X tasking for WInSAR and Supersites, and user management and password reset. Most resources within the portal require login for access. The WIKI is a replacement for the old roipac.org and has been extended to include information for more InSAR processing software (ROI_PAC, ISCE, GMTSAR). Read-only access to the WIKI is provided, but login is required for editing or adding content. The TerraSAR-X tasking page shows WInSAR (blue footprints) and Supersites (red footprints) tasking areas and a table with number of successful and canceled orders. Full WInSAR members can request tasking for new areas. UNAVCO also manages DLR proposals for Full WInSAR member PIs. Data is automatically downloaded from DLR and made available to collaborators on each proposal through the UNAVCO SAR archive interfaces.

## Supersites SAR Data Integration and Federated Data Viewer



**Figure 4**: Flow chart representation for SAR data archives, SSARA federated queries, and a federated data discovery interface. GSNL metadata is harvested daily from Supersites SAR data archives and dumped to the UNAVCO SAR archive providing access via the SSARA federated service. The federated data viewer will incorporate queries across SAR, GPS, and seismic datasets provided by the existing web services from SSARA, GSAC, and COOPEUS.

### References
Baker, S., Baru, C., Bryson, G., Buechler, B., Crosby, C., Fielding, E., Meertens, C., Nicoll, J., and Youn, C.: Seamless Synthetic Aperture Radar Archive for Interferometry Analysis, Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XL-1, 65-72, doi:10.5194/isprsarchives-XL-1-65-2014, 2014.

The HDF Group. Hierarchical Data Format, version 5, 1997-2014. http://www.hdfgroup.org/HDF5/.

P. S. Agram, R. Jolivet, B. Riel, Y. N. Lin, M. Simons, E. Hetland, M. P. Doin and C. Lassere, New Radar Interferometric Time Series Analysis Toolbox Released, Eos Trans. AGU, 94, 69, 2013.