

UNAVCO Annual Report

**FACILITY SUPPORT OF THE
WINSAR ARCHIVE FOR
CRUSTAL DYNAMICS RESEARCH**

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Annual Report for FY2010 (1 June 2010 to 31-May 2011)

EAR-0733437 UNAVCO Facility Support of the WInSAR Archive

1.0 Executive Summary

The activities of the Western North America InSAR (WInSAR) Archive and Consortium during the third year of Grant EAR-0733437 are described in this report. This Grant funds the UNAVCO Facility to operate the WInSAR Archive, including data acquisition mainly through purchase of SAR data, and archiving and distribution of InSAR archive data to the WInSAR Consortium members and data users. The Grant also funds an archivist to handle data and metadata archiving and data ordering; and a software developer to enhance the underlying archiving software and the user interface for data search, access, and delivery to the WInSAR community. The WInSAR Archive leverages the data purchased or acquired mainly from the European Space Agency (ESA) to maximize the number of users and the potential for exciting science results to be generated based on the data. The WInSAR Consortium membership has grown to 72 US Members and 24 Adjunct members from around the globe. The membership meets annually at the Fall American Geophysical Union meeting to conduct business and to elect the WInSAR Executive Committee.

During the report period, an additional 2,141 scenes were obtained from the European Space Agency and were archived and made available to WInSAR membership. The membership picked up 5,964 scenes during the report period.

WInSAR scientists have utilized the WInSAR archive to produce nearly 40 publications since last year's annual report; these publications detail innovations in WInSAR analysis methods and their application to a wide range of Earth science problems.

2.0 PI Science Investigations

The Western North America InSAR (WInSAR) Consortium is a collection of universities and public agencies created to manage the acquisition and archiving of spaceborne InSAR data. WInSAR is a collective organization coordinating the interests of many scientists in different fields. We concentrate primarily on geophysical investigation and modeling of shallow crustal processes such as earthquakes and volcanoes, but consortium members have ongoing research in hydrology, cryospheric studies, vegetation science, and oceanography, as well as sponsoring research in as yet untested application areas.

Technically, most of our innovation has been in the development of new data analysis methods and their application of geophysical problems. In particular, we have pioneered the use of advanced modeling and inverse methods, quantifying detailed deformation fields in order to learn about processes at depth in the crust. Much of our work involves numerical and analytical modeling of deformation phenomena, and now is moving toward incorporating extensive time series analysis into data reduction methods.

Covering the breadth of several fields and incorporating large numbers of radar scenes leads to the large volume of data acquired under this proposal.

The main purpose of WInSAR is to facilitate research in these many areas using pools of shared data, enabling science to be accomplished without requiring each individual proposer to request data for each investigation. This approach saves considerable effort on the part of data providers in servicing requests from the U.S. research community, as WInSAR catalogs and maintains data for all consortium members. WInSAR's approach is also helpful for U.S. sponsoring agencies, as data requests are coordinated and internally peer-reviewed for adherence to WInSAR's goal of facilitating basic research, reducing the need for the agencies to conduct extensive reviews of many disparate requests.

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. The technique of spaceborne Interferometric Synthetic Aperture Radar (InSAR) provides an excellent means of observing deformation over broad areas. WInSAR members have used InSAR data for the following primary objectives:

- o Monitor strain accumulation and release along the North American/Pacific Plate Boundary with an emphasis on the San Andreas Fault Zone.
- o Monitor the deformation of volcanic systems in the western US.
- o Monitor crustal deformations at selected sites in the Basin and Range province and along the Baja California peninsula.

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. Increasingly, WInSAR members are also exploring InSAR data from actively deforming regions world-wide, and we expect that both the scope and membership of WInSAR will become increasingly global.

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.

As part of the research and development efforts of WInSAR members we have; promoted 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; provided value-added InSAR products and software for use by the scientific community; and advocated the open exchange of SAR data by seeking to enlarge the number of member organizations.

3.0 WInSAR Consortium

3.1 Executive Committee

The WInSAR Executive Committee (EC) holds regular teleconferences that include UNAVCO staff. With advice from UNAVCO on operational implications, the EC makes decisions regarding the use of WInSAR funds and the operational priorities for UNAVCO. WInSAR telecon notes are posted on the UNAVCO WInSAR website (<http://winsar.unavco.org>) "Documents" section, which also contains links to reports on InSAR research by WInSAR scientists to space agencies.

UNAVCO hosted the WInSAR Annual Business Meeting at AGU. In December, 2010, the bi-annual election of Executive Committee members was held. The new committee membership is as follows: Eric Fielding, JPL, Chair; Rowena Lohmann, Cornell University, Vice-Chair; David Schmidt, University of Oregon, Secretary; Rob Mellors, Lawrence Livermore National Laboratory, Member; Shimon Wdowinski, University of Miami, Member; Falk Amelung, University of Miami, Ex-officio. Matt Pritchard, Cornell University, is the UNAVCO Board liaison to the WInSAR Executive Committee.

3.2 Membership

Institutional membership stands at 96, including 72 full members (US institutions), 5 Adjunct 1 members (North American institutions outside of the US), and 19 Adjunct 2 Members (rest of the world). With approval by the EC, thirteen new full members and four Adjunct 2 members were added during the report period. There are 236 data users.

4.0 UNAVCO Data Support

The UNAVCO Facility provides administrative, operational, and data support to the WInSAR Consortium as described in the WInSAR Charter. During 2010, the European Space Agency revised their policy for data use for scientific purposes, eventually waiving data acquisition (tasking) fees and costs associated with ordering archived data. For the report period, all of the budget utilization was for operational costs, including activities of a data archivist to order and archive data and software development to enhance the archiving and distribution of WInSAR data. No funds were expended for direct data costs. Early in 2011 the WInSAR Executive Committee voted to redirect unused data purchase budget towards infrastructure investments to include storage and processing hardware upgrades, development of an Application Programming Interface, database and

web upgrades, and expansion of capacity to handle additional SAR platform data types. The sponsors approved this plan for utilization of the budget, along with phasing the expenditures to support operations through September, 2013.

Major activities during the report period included:

- ordering data and handling data deliveries
- enhancing software for archiving data
- enhancing software for data access and distribution through the WInSAR website
- data user support for finding and accessing data
- participation in facilitating data sharing following significant earthquake events worldwide.

4.1 Data Holdings

WInSAR data holdings at UNAVCO include 12,209 scenes available to the users through the UNAVCO WInSAR search website (<http://winsar.unavco.org/search.php>).

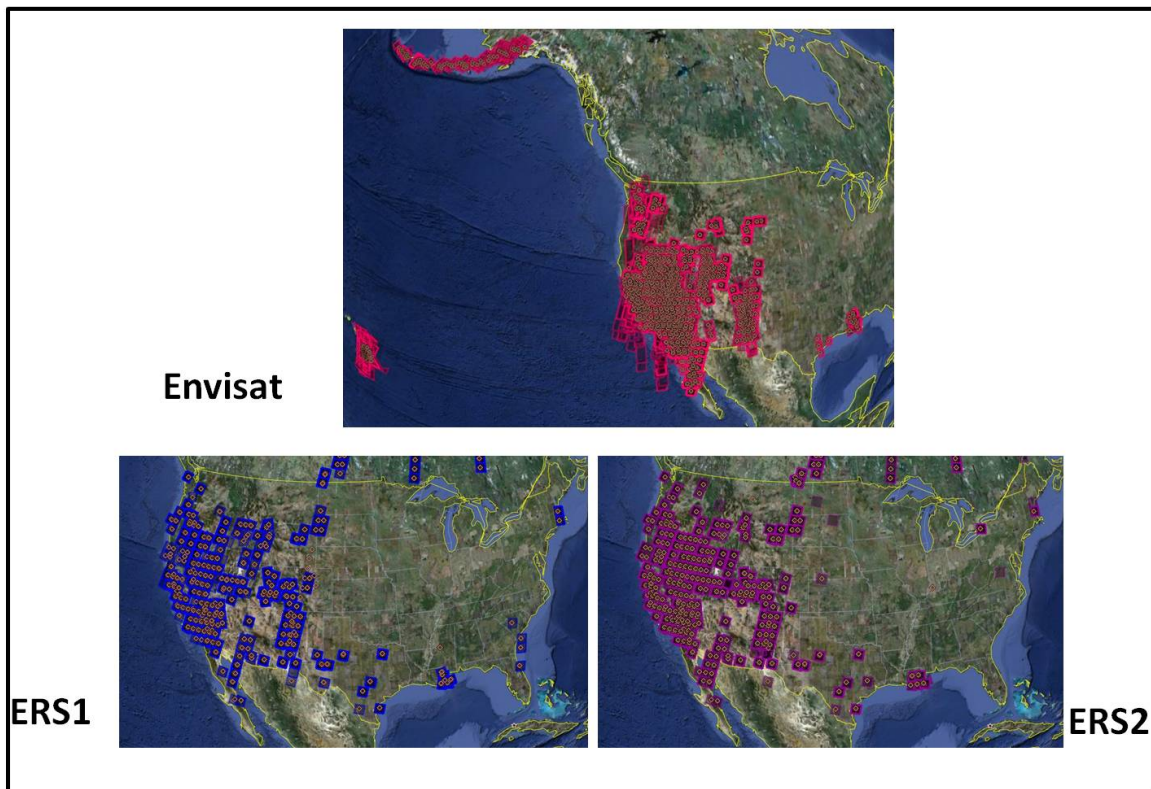


Figure 1. Google Earth images of data holdings in the WInSAR Archive for the ESA Envisat, ERS1, and ERS2 missions.

Figure 1 shows Google Earth images of the SAR scene footprints for WInSAR holdings. Table 1 shows the total holdings within in each mission.

Table 1. WInSAR holdings by mission through 30 April 2011.

Satellite Mission	Scenes	Size, Gigabytes
ERS1	2,247	455
ERS2	5,421	909
ENVISAT	4,361	833
Total	12,209	2197

Placement of orders to ESA and downloads and ingests are executed regularly. During the report period, holdings for WInSAR to increase by 23% due to regular orders. Table 2 shows the data ordered and received during the report period. In addition to ordering archived scenes, UNAVCO executed regular tasking orders to add to data available for ordering from ESA.

Many WInSAR users are particularly interested in the ALOS PALSAR data pool at the Alaska Satellite Facility for their research. For the previous report period, UNAVCO worked to facilitate WInSAR scientists' ability to search the data pool catalog by holding metadata from the data pool in the WInSAR database. During this report period this service was suspended because ASF began providing significantly improved access to this information through their URSA interface.

Table 2. Data orders for May 2010-April 2011.

Satellite Mission	Scenes	Size, Gigabytes
ERS1	129	27
ERS2	289	48
ENVISAT	1,723	296
Total	2,141	371

For achieving the goals of WInSAR, UNAVCO has cultivated a strong, respectful relationship with ESA. This has helped to ensure continued special pricing for data ordered by UNAVCO for WInSAR scientists. With the approval of the WInSAR Executive Committee, as a favor to ESA and the Group on Earth Observations, during the current report period, a Supersites event page was assembled for the 2011 Tohoku-Oki earthquake.

Additional support to GEO Supersites included data ordering of approximately 5000 scenes from ESA with upload to the Level3 cloud storage server provided by ESA; initiation of an e-mail listserv; and numerous enhancements to the Supersites home page.

4.2 Data Pickups

Data pickups by WInSAR data users during the report period are summarized in Table 3. The table does not reflect a separate process for synchronizing large quantities of data with several of the former WInSAR peer nodes that occurs on a regular basis.

Table 3. Data pickups by WInSAR users for May 2010-April 2011.

Satellite Mission	Scenes	Size, Gigabytes
ERS1 & 2	1,754	288
ENVISAT	4,219	519
Total	5,964	807

4.3 WInSAR Data Management Software and Web Site

UNAVCO continues to enhance the information and user interfaces for WInSAR users. The WInSAR web site at UNAVCO is the focal point for the membership to gain information about WInSAR activities, for users to search and gain access to data holdings, and for users to place order requests. During the report period, the documents area of the website was kept updated with reports, proposals, and summary presentations by WInSAR scientists.

The WInSAR Archive operates through a Mysql database, PHP website software, data ingestion scripts (to store metadata in the database catalog, making the holdings searchable), and miscellaneous data management scripts. A key component of the archiving process is the Mysql database, which holds metadata about WInSAR data holdings, ESA's track and frame information, WInSAR order requests, and WInSAR users and members.

The ingestion software, which handles metadata extraction from incoming data files for storing in the database, must continually be updated as the data providers make changes in data formats or data file naming.

With the reprogramming of the data funds for WInSAR, UNAVCO has embarked on a major infrastructure improvement effort to include development of an API for data search and access and related software, database, and website enhancements.

5.0 Science Publications by WInSAR Researchers Since 2005

5.1 Publications Since Yr 2 Annual Report

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