**Seamless Synthetic Aperture Radar (SAR) Archive (SSARA) for Interferometry Analysis**

Program: NASA ROSES 2011 ACCESS "Advancing Collaborative Connections for Earth System Science"

**Annual Report Period:** Y2

**Project Team**:
UNAVCO: Charles Meertens (PI), Christopher Crosby, and Scott Baker
Jet Propulsion Laboratory **(**JPL**):** Eric Fielding (Co-PI)
Alaska Satellite Facility (ASF): University of Alaska, Fairbanks: Jeremy Nicoll (Co-PI), Gwen Bryson, Brian Buechler
San Diego Supercomputer Center (SDSC), University of California, San Diego: Chaitanya Baru (Co-PI), Choonhan Youn

**Summary of Accomplishments (Limit 2,000 characters)**

- Joint software development sprint by ASF, JPL, OpenTopography, and UNAVCO teams implemented SSARA InSAR archive at ASF with BETA products delivered through the SSARA API.
- Release of BETA products for Supersite InSAR stacks processed at ASF.
- New InSAR product keywords have been implemented in the ASF and SSARA API's: masterStart/masterEnd, slaveStart/slaveEnd, minPercentCoherence, minPercentTroposphere, minPercentUnwrapped
- An InSAR product coverage map and specification guide have been published
- Presented and demonstrated SSARA in a special topics session at the UNAVCO science workshop: Science powered by WInSAR – Achievement and opportunities of accessible InSAR data
- Requested and received No Cost Extension to add project duration and enhanced scope of work.
- Joint software development sprint by ASF, JPL, OpenTopography, and UNAVCO teams implemented SSARA InSAR processing service at ASF, using products delivered through the SSARA API.
- Outlined and prototyped InSAR product and metadata contents and formats.
- Identified Supersite InSAR stacks to begin processing for prototype archive at ASF.
- Prepared poster and made presentations on SSARA at AGU and the WInSAR business meeting.
- Joint software development sprint by ASF, JPL, OpenTopography, and UNAVCO teams made enhancements to SSARA API and to end point services.
- New keywords were added to ASF, UNAVCO, SSARA APIs: Baseline, Faraday rotation, Stack size, Doppler
- SAR, DEM, and Troposphere product search and download URLs are now delivered to users via the SSARA API
- Newest ROI PAC processor installed on test at ASF in preparation for future SSARA processing
- Initial implementation of SSARA metrics tracking: http://www.unavco.org/ws/brokered/ssara/metrics

- Abstract written and submitted for AGU annual meeting; SSARA presentations made at Southern California Earthquake Center (SCEC) annual meeting and ALOS-2 PI Workshop.
- Held second year face-to-face project coordination and planning meeting in Boulder, CO at UNAVCO.
- Deployed production version of SSARA federated query (http://www.unavco.org/ws/brokered/ssara/sar/search)
- Created Github page for SSARA (https://github.com/bakerunavco/SSARA)
- Developed SSARA command line client and added to Github (ssara_federated_query.py)
- Drafted HDF5 format justification for InSAR products
- Presented and demonstrated the SSARA federated query at GMTSAR and ROI_PAC Short Courses at UNAVCO.

**Current Progress Description (Limit 2,000 characters)**

The past quarter of SSARA work was highly productive, highlighted by the following accomplishments:

1. The sprints this quarter were split into two short sprints of two weeks each. The teams from ASF and UNAVCO implemented the prototype of an InSAR product archive with the release of beta products. The first sprint concluded with a review on February 7th, 2014 and the second sprint concluded with a review on March 20th, 2014.

Deliverables:

a. SSARA InSAR service is operational and sample InSAR products are available for download via the API:
   https://www.asf.alaska.edu/sar-data/insar/download-data
b. Added InSAR product keywords and product download to the ASF and SSARA API's
c. An InSAR product coverage map and specification guide have been published:
   https://www.asf.alaska.edu/sar-data/insar/coverage-map
   https://www.asf.alaska.edu/sar-data/insar/product-guide
d. Updated and added InSAR/SSARA to new ASF web presence:
   https://www.asf.alaska.edu/sar-data/insar/
e. Installed latest version of ROI_PAC at ASF and determined and implemented a standard set of processing options for the processing service.
f. Implemented SSARA InSAR processing service at ASF, using products delivered through the SSARA API. Service uses ROI_PAC for processing and uses the SSARA API to access SAR scenes, terrain, and tropospheric correction inputs.
g. Initial implementation of SSARA metrics tracking:
   http://www.unavco.org/ws/brokered/ssara/metrics
h. SAR, DEM, and Troposphere product search and download URLs are now delivered to users via the SSARA API
i. The production version of SSARA federated query service (http://www.unavco.org/ws/brokered/ssara/sar/search) enables a federated query of SAR data from both the ASF and UNAVCO SAR archives. Associated with this release, a Github page for SSARA (https://github.com/bakerunavco/SSARA)

code, command line clients, and other resources was established. A Python-based SSARA command line client was developed and is available via the project Github (ssara_federated_query.py).

2. Meeting presentations made and abstracts submitted in the past year:

SSARA work presented and services demonstrated in a special topics session at the UNAVCO science workshop: *Science powered by WInSAR – Achievement and opportunities of accessible InSAR data*

Abstract submitted and accepted to the AOGS 11th Annual Meeting taking place from 28 July to 01 August, 2014 Sapporo, Japan

IG29-A004 *The Seamless Synthetic Aperture Radar (SAR) Archive (SSARA) Project and Other SAR Data Support Activities at UNAVCO.* David Phillips, Scott Baker, Christopher Crosby, Charles Meertens, Eric Fielding, Gwendolyn Bryson, Brian Buechler, Jeremy Nicoll, Chaitanya Baru

SSARA work presented in a poster at the AGU annual meeting:

IN31C-1519. *Federated query services provided by the Seamless SAR Archive project*. Scott Baker; Gwendolyn Bryson; Brian Buechler; Charles M. Meertens; Christopher J. Crosby; Eric J. Fielding; Jeremy Nicoll; Choonhan Youn; Chaitanya Baru 8:00 AM - 12:20 PM; Hall A-C (Moscone South)

The poster has been uploaded to the NASA Earthdata AGU 2013 wiki page:
https://wiki.earthdata.nasa.gov/download/attachments/26542509/SSARA_POSTER_AGU_2013.pdf?version=1&modificationDate=1387492560631&api=v2

SSARA progress and available resources were also highlighted during the WInSAR business meeting and at the UNAVCO exhibit hall booth during AGU.

Southern California Earthquake Center (SCEC) poster presentation:
http://www.scec.org/meetings/2013am/presentations/poster049.pdf

ALOS-2 PI Workshop (http://www.eorc.jaxa.jp/ALOS/en/conf/workshop/alos2_1stpiws_2013sep.htm) presentation on SSARA project made at JAXA: "*Federated archive web services provided by the Seamless SAR Archive (SSARA) project*"

During short courses held at UNAVCO for GMTSAR in June and ROI_PAC in July, S. Baker introduced the SSARA project, and demonstrated the SSARA federated query, ensuring that key users of the new capability are recruited to begin using the service.

3. The SSARA project requested and received a no-cost extension for an additional year (April 1 2014 to March 31, 2015) to accommodate a later than expected project start date due to initial funding delays realized at partner institutions and to finalize remaining project tasks. In addition, the NCE will allow for integration of SSARA

into GEOSS/GEO Supersites and Natural Laboratories (SSNL) international data sharing systems and associated federated query utility.

4. Specific work at JPL on the OSCAR service and integration into SSARA:

Two new services have been added to the JPL Online Services for Correcting Atmosphere in Radar (OSCAR) server that will be included in the results provided to users of the Seamless Synthetic Aperture Radar Archive (SSARA) federated query system. These services will allow users of SAR (Synthetic Aperture Radar) data from SSARA doing interferometric SAR (InSAR) analysis to estimate the atmospheric effects on their data from tropospheric water vapor. Tropospheric water vapor variations are the largest source of errors in InSAR measurements in most areas. The estimates can often be used to correct a major part of the atmospheric effects in InSAR, and can also be used to screen the SAR data in the SSARA federated catalog to exclude the scenes most affected by water vapor variations. The new OSCAR services build upon the existing OSCAR services previously developed under the OSCAR AIST project completed in 2012 (PI Paul von Allmen). One new service calculates the zenith path delay (ZPD) map for a single date of a SAR acquisition derived from the NASA Terra or Aqua MODIS near-infrared precipitable water vapor product, useful for screening and time-series analysis of SAR interferometry data. The second service calculates the zenith path delay difference map (ZPDDM) for a pair of SAR images by taking the difference between the zenith path delay maps for the two dates and times of SAR acquisition. The OSCAR server uses the same JSON (Javascript Simplified Object Notation) syntax as the rest of the SSARA services, making integration straightforward. We also worked closely with the rest of the SSARA team to develop and test the SSARA federated search system. We defined the metadata and data formats that will be used for the InSAR products that will be produced at ASF and also archived at UNAVCO under SSARA.

5. ESDSWG:

C. Crosby initiated review of the Open Geospatial Consortium (OGC) Keyhole Markup Language (KML) Encoding Standard as a candidate NASA Earth Science Data Systems (ESDS) community standard on request of the ESDIS KML technical working group.

**Work Plan for Next Reporting Period (Limit 2,000 characters)**

The updated SSARA work plan includes the following tasks for Y3Q1:

- Integrate SSARA federated query and download into ASF and UNAVCO web tools
- Add federated query and download for InSAR products in ASF and UNAVCO web tools
- Activate ATOM feed of NSAR services

**Schedule Status (Limit 2,000 characters)**

Work is on schedule based on the revised workplan submitted to NASA in association with request for No Cost Extension. We anticipate SSAR technical work will be complete in Y3Q3, with final documentation and reporting and SSARA/SSNL implantation completed by early in Y3Q4

**Delays/Problems Experienced (Limit 2,000 characters)**

Based on the revised project work plan, SSARA activities are currently on schedule. As noted above, a No Cost Extension was requested and received, and the SSARA workplan was revised and expanded to align with extended project duration and enhanced scope of work.

**Corrective Actions/Recovery Plan (Limit 2,000 characters)**

**Technology Readiness Level Assessment (Limit 2,000 characters)**
TRL = 5

**Comments (Limit 2,000 characters, or about 200 words)**