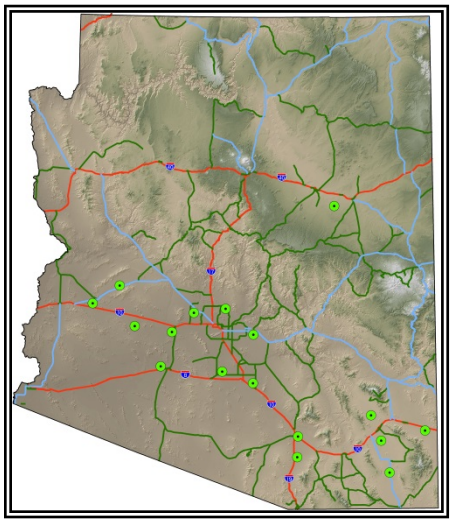
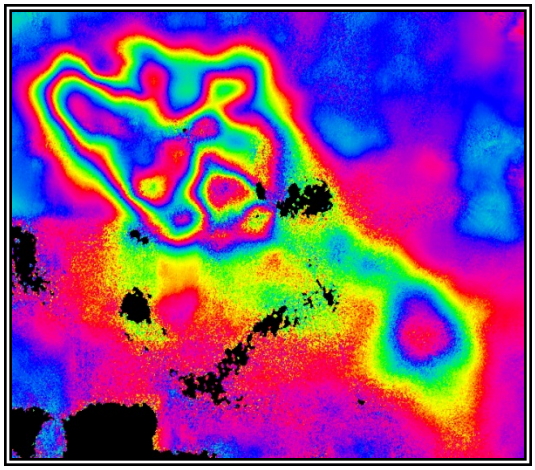
Fact Sheet

Interferometric Synthetic Aperture Radar (InSAR) Program
ADWR's Satellite Based Land Subsidence Monitoring Program

ADWR's InSAR program started in 2002 with the awarding of a three year NASA Earth Science grant in cooperation with the University of Texas at Austin Center for Space Research and the Vexcel Corporation. ADWR and its cooperators developed the InSAR program during the three years of the grant. In 2005, ADWR began collecting and processing monthly level 0 raw SAR data from the European Space Agency and Canadian Space Agency SAR satellites, producing time-series interferograms for the greater Phoenix and Tucson metropolitan areas. The InSAR coverage has been greatly enhanced around Central and Southern Arizona, collecting regularly scheduled SAR data for Maricopa, Pinal, Pima, La Paz, Navajo, and Cochise counties. Through these efforts, ADWR has identified and now monitors more than twenty-five individual land subsidence features around Arizona which cover an area greater than 1,200 square miles. Numerous state, county, and local government entities understand the importance of InSAR and utilize the data as an important resource into their own monitoring efforts. As a result, these groups have entered into agreements with ADWR, providing annual contributions to the InSAR program, ensuring that SAR data are collected, processed, and analyzed for those areas critical to each group's monitoring efforts.



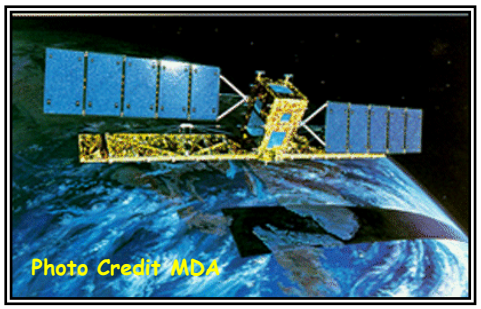
Active Land Subsidence Areas in Arizona Based on ADWR InSAR



Hawk Rock Area 2010 - 2014 Interferogram

Synthetic Aperture Radar (SAR) is a side-looking, active (produces its own illumination) radar imaging system that transmits a pulsed microwave signal towards the earth and records both the amplitude and phase of the back-scattered signal that returns to the antenna. Interferometric Synthetic Aperture Radar (InSAR) is a technique that utilizes interferometric processing that compares the amplitude and phase signals received during one pass of the SAR platform over a specific geographic area with the amplitude and phase signals received during a second pass of the platform over the same area but at a different time. InSAR techniques, using satellite based SAR platform data, can be used to produce land surface deformation products with centimeter scale vertical resolution, 30 meter pixel resolution, and covering areas of 100 square kilometers

ADWR has used SAR data from the European Space Agency's ERS-1, ERS-2, and Envisat satellites, the Canadian Space Agency's RadarSat-1 satellite, the Japanese Aerospace Exploration Agency's ALOS-1 satellite, and MDA's Radarsat-2 satellite. All of these satellites, except the ALOS-1 satellite, utilize the C band which has a wavelength of approximately 5.6 centimeters. One downfall of the C band is that areas where the land surface has been disturbed (i.e. bodies of water, snow, agriculture areas, areas of development, etc) tend to have poor coherence and often have decorrelation problems.



MDA Radarsat-2 Satellite

Fact Sheet

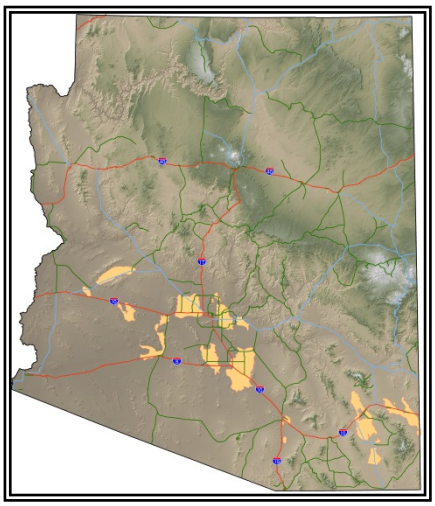
Monitoring the State's Water Resources

InSAR – ADWR's Satellite Based Land Subsidence Monitoring Program

European Space Agency Sentinel-1A Satellite

Decorrelation occurs when the phase of the received satellite signal changed between satellite passes, causing the data to be unusable. The ALOS-1 satellite uses the L band wavelength (26 centimeters) which helps improve coherence, reducing the amount of decorrelation. As of July 2014, the only satellite being utilized by ADWR is the Radarsat-2 satellite; the other satellites listed above are no longer operational. Two new InSAR satellites were recently launched by the European Space Agency (Sentinel-1A) and by the Japanese Aerospace Exploration Agency (ALOS-2). ADWR plans on utilizing both satellites for InSAR data once they are operational.

ADWR has been using InSAR to determine the spatial extent, deformation rates, and time-series history of those land subsidence features identified around the State. InSAR is very cost effective due to its resolution and the large area covered by each satellite frame. Engineers, hydrologists, geologists, and scientists greatly benefit from the InSAR data to identify and evaluate areas of subsidence, uplift, earth fissures, faults, and many other geologic features. InSAR data are used by those involved in the fields of: water resources, structural engineering, geological engineering, hydrological engineering, land planning, and surveying.



Active Land Subsidence Areas in Arizona Based on ADWR InSAR

ADWR has entered into Inter-Government Agreements with the following government entities to help fund the costs (satellite programming and data acquisition costs, InSAR processing software maintenance, and upgrade/support of the required servers and storage devices) associated with the InSAR Program:

Flood Control District of Maricopa County
Pinal County Flood Control District
Metropolitan Domestic Water Improvement District
Arizona Department of Transportation
Arizona State Land Department
Central Arizona Project

The following groups have also made contributions to the InSAR program through a donation:

Salt River Project
City of Phoenix
City of Scottsdale
Cochise County Flood Control District
City of Mesa
Community Water Company of Green Valley
Petrified Forest National Park
Arizona Geological Survey