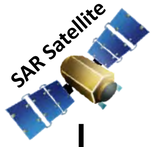
Arizona Department of Water Resources
Land Subsidence Monitoring Program
Interferometric Synthetic Aperture Radar (InSAR)

ARIZONA DEPARTMENT OF WATER RESOURCES

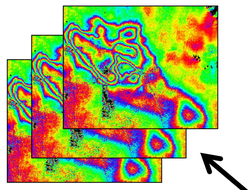
ADWR InSAR Program Overview



End Users
- Water Resource Community
- InSAR Program Cooperators

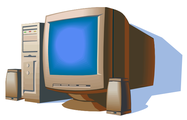
InSAR Applications in Arizona
- Land subsidence monitoring.
- Monitoring seasonal deformation (subsidence and uplift).
- Monitoring natural and artificial recharge events.
- Geological mapping and investigations.
- Locating earth fissures and identifying areas where conditions may exist for earth fissure formation.
- Dam mitigation and land subsidence modeling.

Downlink



End Products

InSAR Data Processed, Analyzed by ADWR

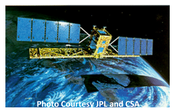


SAR Platforms Used by ADWR

ESA ERS-1

ESA ERS-2

ESA Envisat

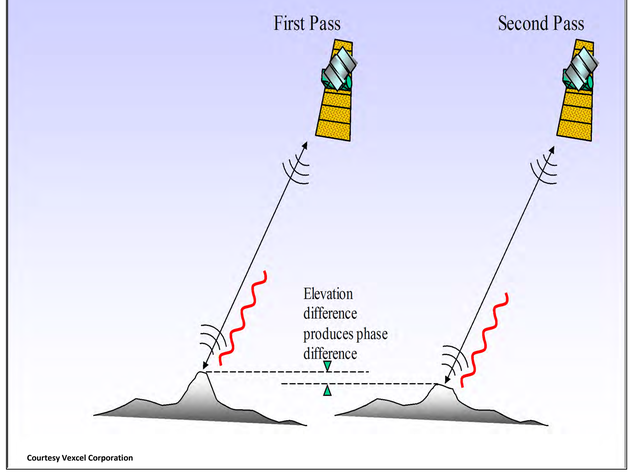


CSA Radarsat-1

JAXA ALOS

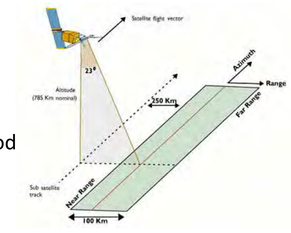
MDA Radarsat-2

Using conventional differential InSAR (DIFSAR), the SAR satellite collects data over the same region at two different times. Elevation changes on the surface create phase changes in the received satellite signal and ground motion is measured.



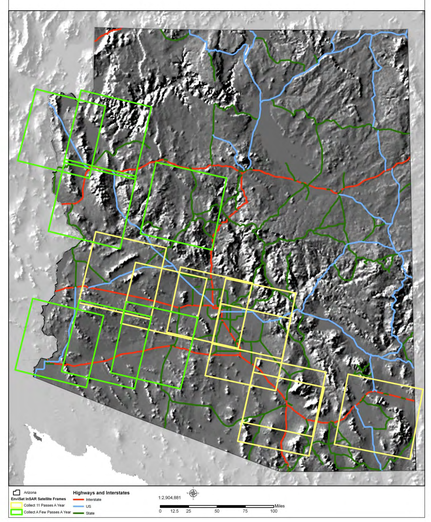
Characteristics of Synthetic Aperture Radar

- Active sensors (day/night/clouds)
- Near circular, polar orbit
- Approximately 100 minutes (4.5 miles/sec) period
- Approximately 800 km altitude
- Approximately 14 orbits/day
- Repeat cycle 8-46 days
- Satellite needs to be tasked
- C-Band Wavelength – 5.6 cm
- L-Band Wavelength – 24 cm
- Precision of 1-3 mm

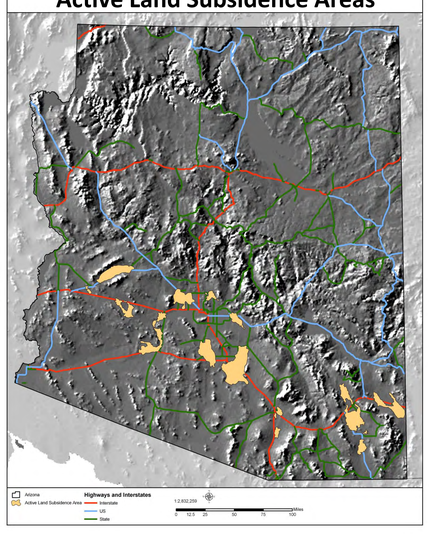


Satellite	Dates	Sponsor	Band	Repeat Orbit
ERS-1	1991-2000	Europe	C	35 Days
JERS-1	1992-1998	Japan	L	44 Days
ERS-2	1995-	Europe	C	35 Days
Radarsat-1	1995-2007	Canada	C	24 Days
Envisat	2002-	Europe	C	35 Days
ALOS	2004-	Japan	L	46 Days
TerraSAR-X	2005-	Germany/Astrium	X	10 Days
Radarsat-2	2007-	Canada	C	24 Days
Sentinel-1	2011	Europe	C	12 Days
DESDynI	2018?	USA	L	8 Days

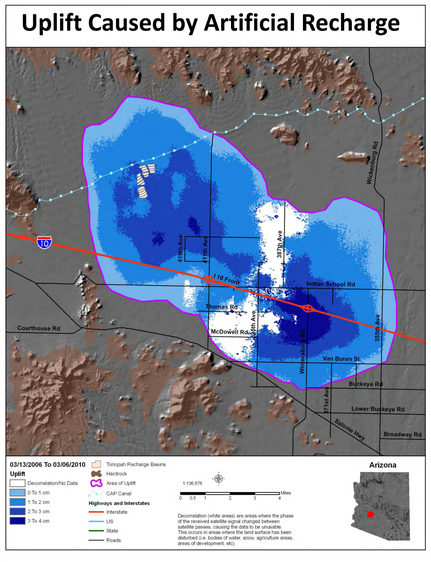
Envisat InSAR Satellite Frames



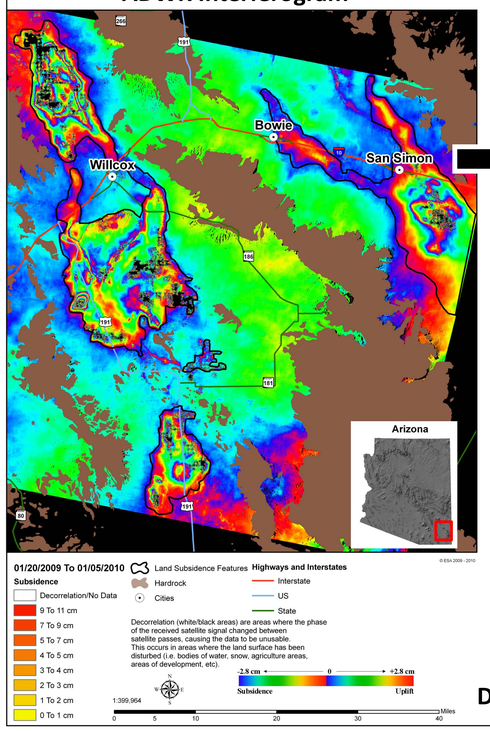
Active Land Subsidence Areas



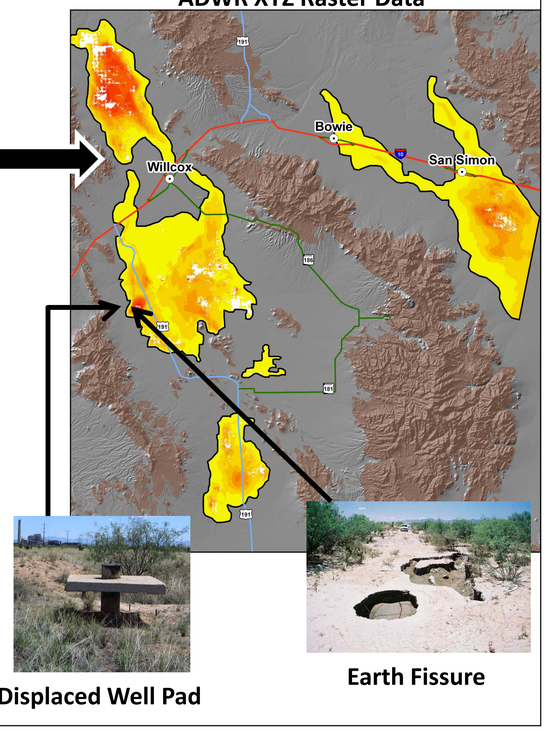
Uplift Caused by Artificial Recharge



ADWR Interferogram



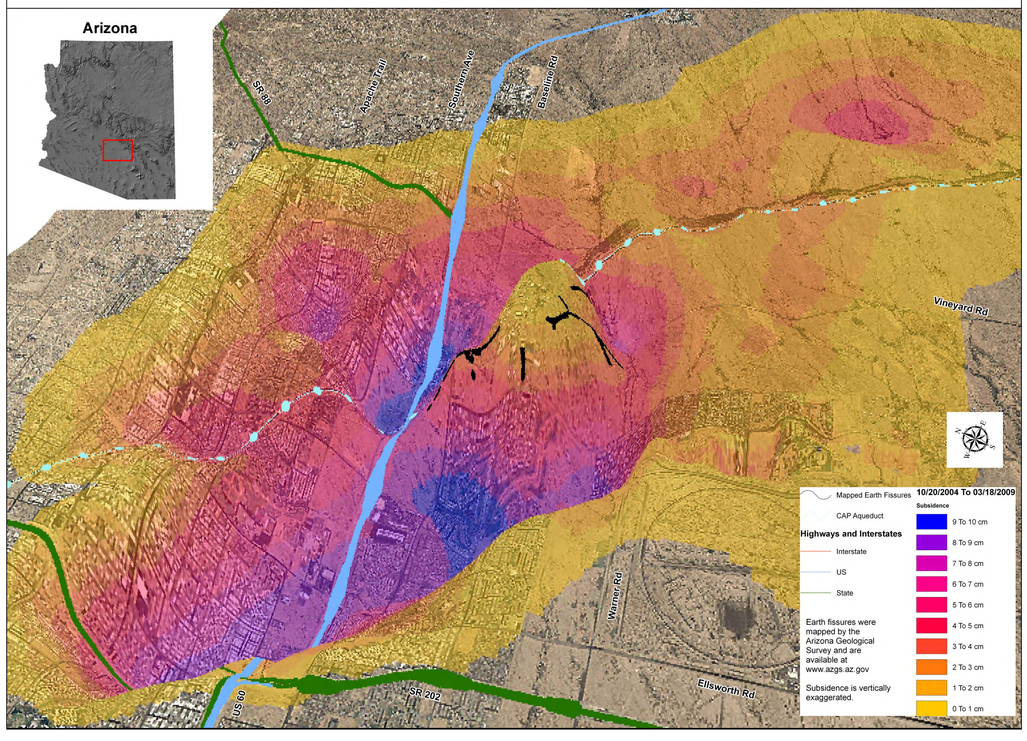
ADWR XYZ Raster Data



Displaced Well Pad

Earth Fissure

3-D View of the Hawk Rock Land Subsidence Feature, East Mesa and Apache Junction Area



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 deformation, faults, and many other geological attributes. InSAR data is used by those involved in the fields of: water resources, structural engineering, geological engineering, hydrological engineering, land planning, and surveying.