A Space-based Geofluids Observatory for New Mexico

Ronni Grapenthin[1], Alex Rinehart[2], Shari Kelley[3], Mark Person[1] and Emily Graves[1]

[1]Dept. Earth and Environmental Science, New Mexico Tech, rg@nmt.edu
[2]Aquifer Mapping Program, New Mexico Bureau of Geology
[3]New Mexico Bureau of Geology

Sustainable use of groundwater resources and a detailed understanding of aquifer structure, dynamics and long-term evolution are of importance to all aspects of human life, particularly in arid regions with limited recharge. Aquifers are generally monitored via hydraulic head changes in monitoring wells. Similarly, hydrocarbon production and reinjection of brine byproducts are often reported and monitored but, just like groundwater estimates, they are limited to point observations, limiting insight into reservoir dynamics. Assessments of geofluid storage capacities, heterogeneities in their structure and composition, and evolution necessarily involve a large degree of interpolation between observation points based on often uncertain geologic data; frequently requiring extrapolation.

Space geodetic measurements such as GPS, radar interferometry (InSAR), and satellite gravimetry (GRACE) have long been used to study motion induced by effects in the hydrosphere such as groundwater pumping and aquifer recovery. The measurements quantify elastic and permanent deformation due to pore pressure changes and mass redistributions. The most promising strategy for future basin and sub-basin scale geofluid studies is a combination of InSAR and GRACE time series due to freely available data and global coverage.

Here we present an outlook on a project to characterize New Mexico's geofluid activity due to municipal and irrigation pumping, hydrocarbon production, brine reinjection and magma transport and develop methods to better quantify subsurface mass and volume changes via InSAR and GRACE integration. Capabilities of the methods are presented as an example of InSAR-mapped surface deformation in the Buckman well field near Santa Fe. Here, we reveal decadal-scale aquifer dynamics using 25-years of InSAR data, which in combination with recent ground water temperature observations and conceptual modeling, reveal structural complexities. Furthermore, we present initial analyses of GPS and InSAR observations for the Mesilla Basin around Las Cruces, NM, where we exploit irrigation pumping as a basin-wide pump test for basin characterization in a tectonically relatively stable environment.

Keywords:

Hydrogeodesy, InSAR, Aquifer, deformation, subsidence

2019 New Mexico Geological Society Annual Spring Meeting
April 12, 2019, Macey Center, New Mexico Tech campus, Socorro, NM