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Geodetic Observation and Analysis of Land Deformation in Northwest of Iran

Mohammad Mohseni Aref (1,2) and Ergin Tari (1)

(1) Istanbul Technical University, Civil Engineering Faculty, Geomatics Engineering Department, Istanbul, Turkey (aref15@itu.edu.tr), (2) Potsdam University,Institute of Geosciences, Potsdam,Germany(mohseniaref@uni-potsdam.de)

Interferometric Synthetic Aperture Radar (InSAR) is a powerful geodetic technique to produce a relatively high spatial and temporal resolution of ground deformation measurement for the hydrologic application. In this study, We use integration of ground-based observations obtained from precise leveling and GPS techniques and Satellite-based observation from InSAR time series to determine land uplift and subsidence in Northwest of Iran. The C-band SAR data includes Sentinel 1 A/B images acquired between 2014 and 2018 and ENVISAT ASAR images acquired between 2004 and 2010 for both ascending and descending orbits. The L-band dataset consists of ascending ALOS1 PALSAR images between 2006 and 2011. We map the InSAR time series using persistent Scatterer (PS-InSAR) and Small Baseline Subset (SBAS) approach by StaMPS Software to overcome the temporal or spatial decorrelation over a very large area including Urmia lake basin. The increasing demands of groundwater consumption due to anthropogenic activity affect most of the aquifers in Northwest of Iran including Salmas, Khoy, Tasuj, Shabestar and Tabriz basins, and lake Urmia. Lake Urmia, one of the largest permanent hypersaline lake in the world plays important roles in the environment and socio-economic life of the region. It has been shrinking for a long time and deals with serious difficulties due to climate and anthropogenic factors. Our results contain InSAR time series, continuous GPS measurements and leveling around the lake show significant land subsidence rate in some groundwater reservoirs between 2004 and 2018. The trend of the land subsidence is estimated to be approximately between 5 and 15 cm/year for some of the developed aquifers which interact with Urumia lake. The contribution of strike-slip faults interseismic deformation pattern is removed from the hydrological deformation field by implementing single screw dislocation models in the elastic half-space model. The relation of deformation rate, groundwater level changes in piezometers, the water level in the lake using satellite altimetry reveals the complexity of this water resources system. Land subsidence in Salmas confined aquifer associated with groundwater depletion and mechanical soil properties is simulated using finite element method and based on Biot's consolidation theory. We evaluate our simulation result by comparing the spatial and temporal behavior of land subsidence derived by InSAR time series analysis.