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Remarkable land subsidence in plain aquifers of Iran: evidence from two decades of InSAR observations

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Land subsidence due to overdrafting of the groundwater resources for industrial and agricultural purposes is a common problem in many countries [1,2]. In Iran decades of groundwater overexploitation and the resulting anthropogenic processes have contributed to substantial subsidence in developed groundwater basins that have important consequences for hazards management [3].

In this study spatiotemporal patterns of deformation over the last two decades at two selected areas of Tehran, the capital sate of Iran with 12 million inhabitants, and Rafsanjan Plain, Iran's centre of pistachio cultivation in the southeast, are investigated using time-series interferometric synthetic aperture radar (InSAR) method. The groundwater supplies in both regions have been depleted over the past decades, partly due to uncontrolled immigration and rapid population growth and partly due to increased extraction for industry and farming activities. We develop velocity maps of both plains using SAR data acquired from a variety of sensors including Envisat, ALOS, TerraSAR-X and Sentinel-1.

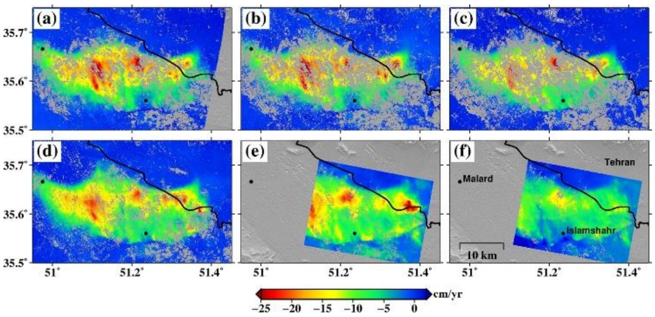

Figure 1*:* Examples of multi-sensor land subsidence velocity map in Tehran, Iran derived from SBAS time-series analysis. (a,b,c**) Envisat (**d**) ALOS, (**e**) TerraSAR-X VV polarization, (**f**) TerraSAR-X HH polarization.**

After obtaining the spatiotemporal characteristics of ground deformation, the cross-correlations among ground surface subsidence, tectonic regime and time-series of underground water level are analysed in detail for a better understanding of relation between different factors contributing to land subsidence process. Our results indicate that from 2002 to 2016 both areas in Tehran and Rafsanjan have been influenced by significant amount of subsidence, at locations exceeding 20 cm/yr. The two-dimensional deformation maps, calculated using ascending and descending InSAR observations suggest that much of the observed deformation is vertical. However, significant localized horizontal deformations are also observed in InSAR maps, in particular in areas close to pre-existing quaternary faults. A thorough understanding of history of ground subsidence in developed groundwater basins through InSAR analysis, in particular the invaluable opportunity provided by the new Sentinel-1 mission to capture 2D deformation in near real-time plays a significant role for properly evaluating the risk of subsidence hazards.

References:

[1] Amelung F et al. (1999) Geology 27: 483-486.
[2] Galloway DL et al. (1998) Water Resour. Res 34: 2573-2585.
[3] Motagh M et al. (2008) Geophys Res Lett 35: doi. 10.1029/2008GL033814.
[2] Galloway DL et al. (1998) Water Resour. Res 34: 2573-2585.
[3] Motagh M et al. (2008) Geophys Res Lett 35: doi. 10.1029/2008GL033814.
1] Amelung F et al. (1999) Geology 27: 483-486.
[2] Galloway DL et al. (1998) Water Resour. Res 34: 2573-2585.
[3] Motagh M et al. (2008) Geophys Res Lett 35: doi. 10.1029/2008GL033814.