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Study of the 3D displacement field in Lorca (Murcia, Spain) subsidence area

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González and Fernández (2011) revealed that the Alto Guadalentín Basin, located in southern Spain, is affected by the highest subsidence rates measured in Europe (about 10 cm/yr) as a direct consequence of long-term aquifer exploitation. They used ERS and ENVISAT radar data spanning the 1992 – 2007 period. They identify a delayed transient nonlinear compaction of the Alto Guadalentín aquifer due to the 1990–1995 drought period. González et al. (2012) evaluated the relationship between crust unloading due to groundwater overexploitation and stress change on regional active tectonic faults in the same in relation with the May 2008 Lorca earthquake. Bonì et al. (2014) extended these previous studies using advanced DInSAR techniques and ALOS PALSAR (2007–2010) and COSMO-SkyMed (2011–2012) radar images for the time period 1992–2012. Additionally, the satellite measurements provide locally comparable results with measurements acquired by two permanent GNSS stations located in the study area. Furthermore, new geological and hydrogeological data were collected and analyzed in order to assess aquifer system compressibility and groundwater level changes in the past 50 years. The comparison of these data with advanced DInSAR displacement measurements allowed for a better spatial and temporal understanding of the governing mechanisms of subsidence due to overexploitation of the Alto Guadalentín aquifer system. But even though the aforementioned achievements have been reached, all regional studies of the area to date are based on satellite radar interferometry using just ascending or descending acquisitions, without any combination among them to obtain vertical and horizontal (E-W) components. Therefore, only the regional LOS displacement field is known and it is assumed to correspond to vertical displacement. However, it is important to obtain the 3D motion field in order to perform a correct interpretation of the observations, as well as to carry out an advanced numerical model of the aquifer evolution, to be consider for sustainable management plans of groundwater resources and hazard assessments. With this objective, a GNSS network has been defined and various surveys have been carried out in November 2015, July 2016 and beginning of 2017. The results, showing the regional 3D displacement field associated to the exploitation of the aquifer are described and compared with the InSAR ones. First results (Prieto et al., 2016) confirm previous observations (e.g. Bonì et al., 2015) and suggest that the ad-hoc establishment of small-medium GNSS networks, represent a valuable technique for the spatio-temporal monitoring of the 3D displacement field of areas subjected to extensive groundwater extraction.

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