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Quantitative assessment of interrelations between groundwater dynamics and InSAR-derived land subsidence

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Recent development in radar technology makes interferometric synthetic aperture radar (InSAR) technique a valuable contributer to hydrogeological applications especially in mapping, monitoring and simulating groundwater flow, aquifer-system compaction and land subsidence. In this context, the research aims to quantify and model groundwater level changes with respect to InSAR derived subsidence observations.
In order to study the relation between land subsidence and groundwater fluctuations five corner reflectors have been placed in the fields around Delft University of Technology. These reflectors serve as permanent scatterers in an InSAR experiment monitoring the phase changes as a result of intentional displacements of the reflectors. To determine the height of the corner reflectors in an independent way, precise leveling was carried out from 2003 to 2008. Besides the leveling, the groundwater level has been monitored in the wells near each corner reflector (from 2005 to 2008). The ground displacement at each reflector was calculated for the five year period and was compared to water level changes. The measurements reveal that ground displacement follow the seasonal changes of groundwater level. Using Terzaghi's consolidation theory, the specific skeletal storage coefficient of aquifer is calculated for three of the corner reflector sites and land subsidence at corner reflector 3 site is modeled using Processing Modflow's (PMWIN) interbed storage package. After the simulation, some errors are presented between observed and simulated values of subsidence. At this stage, the study focuses on the sources of these errors. The possible factors are considered to be anomalies in precipitation and/or evaporation values, fluctuation of groundwater between different lithologies having distinct characteristics, and change in soil moisture content of the unsaturated zone. In order to detect the effect of the unsaturated zone, consolidation characteristics of soils at each corner reflector site will be investigated. Comparison between the storage coefficients of the lab – observed saturated sample and the one obtained from the field – observed data ($\Delta b/\Delta h$) will provide us with some information about the possible effects of unsaturated zone in compaction process.