Ground movements associated with thermal water production from the Buda Thermal Karst (Hungary) by PS-InSAR

Eszter Békési¹, Gyula Grenérczy², Sándor Frey², Péter Farkas², Jan-Diederik van Wees¹,³, and Peter Fokker¹,³
¹Utrecht University, Utrecht, Netherlands (e.bekesi@uu.nl)
²Geo-Sentinel Ltd., Budapest, Hungary
³TNO Utrecht, Netherlands

Interferometric Synthetic Aperture Radar has been used worldwide for investigating ground deformation due to subsurface extraction processes. However, in the Central and Eastern European region, no such studies are available so far. We present a case study for the Buda Thermal Karst demonstrating the effectiveness of satellite-based monitoring of the region. Budapest (and the whole territory of Hungary) is well-known from balneology for centuries. Thermal baths in Budapest mainly utilize water discharging from carbonate reservoirs. Hot springs in the area are commonly located along fault zones controlling the groundwater flow systems. We investigate ground deformation in the vicinity of the Buda Thermal Karst by Persistent Scatterer time series analysis based on Sentinel-1 data for the period of 2014-2018. Results show that surface movements associated with the extraction of thermal water and groundwater recharge and discharge exist. Inverse geodetic modeling based on various deformation sources embedded in an elastic half-space is applied to infer for reservoir processes and properties and fault structures controlling fluid pathways. The modeling results are jointly interpreted with geological and hydrogeological models of the area. The satellite-based monitoring together with the modeling results allow a better understanding of the characteristics of fluid flow systems in the area and the dynamics of geothermal reservoirs under production. Such information can be of high importance for the sustainable production of thermal water in the future.