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Results of a multidisciplinary study in the Marmara Supersite, on-shore area: Büyükçekmece landslide

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The MARsite project (Nov 2012-Avril 2016), one of the three SUPERSITE concept FP7 projects, deals with the definition of new directions in seismic hazard assessment through focused earth observation in the Marmara Supersite. This project gathers different research groups in a comprehensive monitoring activity developed in the Sea of Marmara Region. This region is one of the most densely populated parts of Europe and rated at high seismic risk level since the 1999 Izmit and Duzce devastating earthquakes.
The 6th Work Package of MARsite project offered a very valuable frame to undertake simultaneous and complementary scientific investigations and studies to get deeper insight in the seismic and rainfall landslide topic, ranging from methodology to hazard assessment tool. This package focused on two sub-regional areas of high interest.
First, the Avcilar-Beylikdüzü peninsula, located westwards of Istanbul, is a highly urbanized concentrated landslide prone area, showing high susceptibility to both rainfalls while affected by very significant seismic site effects. Second, the off-shore entrance of the Izmit Gulf, close to the termination of the surface rupture of the 1999 earthquake, that shows an important slump mass facing the Istanbul coastline.
For the on-shore area, after refining the landslide inventory of the peninsula, one of the nine inventoried rototranslational landslides was chosen as pilot site, the Büyükçekmece landslide. This landslide has a continuous activity and a composite mechanism (including several secondary sliding surfaces); it moves at low velocity and involves sandy and clayey deposits of a local Cenozoic Succession damaging several infrastructures, such as buildings and roads.
Various geophysical campaigns were carried out and then a field temporary multi-parameter monitoring was set up, composed of GPS-RTK, two seismic probes, thermometer, rain-gauge, moisture, etc.. Hyperspectral and Dinsar imagery technologies were also deployed to complete inventory and observational information.
In order to analyze the slope stability conditions under seismic shaking, not-conventional pseudostatic slope stability analyses as well as numerical simulations via a finite difference code were performed. These last studies took advantage from the reconstruction of a detailed engineering-geological model on the basis of extensive geological and geomorphological field campaign and a vast drilling program undertaken by the Istanbul Metropolitan Area.
According to these numerical simulation results the landslide mass has a high sensitivity to seismic waveforms enriched in low frequencies (<1.5Hz) causing the computed probability of reactivation to increase up to 58%.
Based on the in situ multi-parametric monitoring system, the landslide moves continuously toward W; a double-net groundwater flow is revealed by the piezometer monitoring and preliminary co-relations between pore water pressures and rainfalls are evident in a seasonal and monthly time interval respectively.