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Earthquake induced landslide hazard: a multidisciplinary field observatory in the Marmara SUPERSITE

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Earthquake-triggered landslides have an increasing disastrous impact in seismic regions due to the fast growing urbanization and infrastructures. Just considering disasters from the last fifteen years, among which the 1999 Chi-Chi earthquake, the 2008 Wenchuan earthquake, and the 2011 Tohoku earthquake, these events generated tens of thousands of coseismic landslides. Those resulted in amazing death toll and considerable damages, affecting the regional landscape including its hydrological main features.
Despite a strong impetus in research during past decades, knowledge on those geohazards is still fragmentary, while databases of high quality observational data are lacking. These phenomena call for further collaborative researches aiming eventually to enhance preparedness and crisis management.
As one of the three SUPERSITE concept FP7 projects dealing with long term high level monitoring of major natural hazards at the European level, the MARSITE project gathers research groups in a comprehensive monitoring activity developed in the Sea of Marmara Region, one of the most densely populated parts of Europe and rated at high seismic risk level since the 1999 Izmit and Duzce devastating earthquakes.
Besides the seismic threat, landslides in Turkey and in this region constitute an important source of loss. The 1999 Earthquake caused extensive landslides while tsunami effects were observed during the post-event surveys in several places along the coasts of the Izmit bay.
The 6th Work Package of MARSITE project gathers 9 research groups to study earthquake-induced landslides focusing on two sub-regional areas of high interest. First, the Cekmece-Avcilar 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.
A multidisciplinary research program based on pre-existing studies has been designed with objectives and tasks linked to constrain and tackle progressively some challenging issues related to data integration, modeling, monitoring and mapping technologies.
Concerning the on-shore area, this program includes the refined analysis of the seismic site response, the permanent multi-parameter ground monitoring of a representative unstable slope as well as the in-depth slope stability analysis based on the stress-strain dynamic numerical modelling approach. Hyperspectral and Dinsar imagery technologies are also deployed to complete inventory and observational information. The development of a dynamic GIS tool featuring capabilities to integrate and process very different types of data, and up-date susceptibility maps based on near to real-time rainfall-seismic shaking input, is currently undertaken. Moreover, the research is gaining high profit of a vast drilling program undertaken by the Istanbul Metropolitan Area, aiming to yield a detailed geological and geotechnical characterization of the slopes. Also included in the objectives is to test a landslide early warning system.
As regards the selected off-shore area, high resolution geophysical marine surveys are being conducted to complete its geomorphological description to help in mapping possible incipient mass movements. This is especially expected to provide better-constrained input for both laboratory testing and numerical modeling of tsunami scenarios thank to a unique lab-scale tsunami channel.