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Monitoring of Landslide Deformation with GPS and Kalman Filter in Avcilar District of Istanbul, Turkey

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Abstract

The Avcilar district of Istanbul is situated between Kucukcekmece and Buyukcekmece Lakes in the north-west of Marmara region, Turkey and is very close to North Anatolian Fault Zone (NAFZ). The main goal of this study is to determine and analyze the spatial and temporal behavior of the surface displacement of active landslide in the region and also is to investigate how the changes of an observed deformation variations among Global Positioning System (GPS) stations depends on the duration of the observing session. A network consisting of 12 sites has been surveyed during four relatively short time intervals from November 2007 to May 2009 using GPS. The GPS data set collected on every epoch for each site during 10 hours was used for reliability analysis and comparison of independent baseline components as an additional way to assess the quality of the GPS solutions. For this purpose, the data were subdivided into 2, 4, and 6 hours data sets.

In this study we processed the GPS data of four campaigns using Bernese 5.0 GPS Software. The network was minimally constrained by fixing the ITRF 2005, epoch 2007.910 coordinates of ISTA site (located at 41.104o N, 29.019o E), since ISTA is the single far-site to the deformation field of the landslide area in our baseline solutions and the contributions to the deformation field are very small. The kinematic deformation model has been applied to determine the time dependent landslide movement parameters of the sites using the Kalman filter technique and a precise determination of the past and present kinematics behavior of the landslide. The results correlated with the available landslide maps of the study region and indicate that each site has statistically different temporal behavior and significant relative motions according to ISTA site. Hence, the study area seems the most active area in the north of Marmara region under the these chaotic landslide movements.

Key words: GPS, Landslide Deformation, Kalman Filter, Marmara Region