



Ground deformation monitoring by using the Permanent Scatterers Technique: the example of the Oltrepo Pavese (Lombardia, Italy)

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The aim of the study is to test the Permanent Scatterers Technique for detecting and monitoring ground displacement in the Oltrepo Pavese territory (Northern Italy, southern Lombardia), which could be representative of similar geological contexts in the Italian Apennines. The Oltrepo Pavese, which extends for almost 1100 km², is characterized by a complex geological and structural setting, with outcropping rocks consisting of sedimentary formations with a dominant clay component. These characteristics make the Oltrepo Pavese particularly vulnerable to hydro-geological risk: shallow and deep landslides and swelling/shrinkage of the clayey soils. Landslides are the most serious geological hazard in the area and they cover 17% of the total territory. Complex landslides, usually affecting clayey formations, represent the typical slope instability phenomena and several areas have been subjected to a risk assessment according to Italian law (L. 267/98). Failure mechanisms of lateral spreads could be possible in correspondence of fractured rigid plate lying on a deformable clayey substratum. Clayey soils exhibiting volume changes, shrinkage on drying and swelling on wetting, result in severe damage to overlying structures, particularly to low-rise buildings, roads and buried lifelines. In order to monitor and manage the hydrogeological risk related to landslides and other phenomena in the Oltrepo Pavese area the Regione Lombardia decided to apply the Permanent Scatterers Technique. The PS technique, developed by Politecnico of Milano, overcomes the main limits of conventional interferometric approaches to surface deformation detection due to temporal and geometric decorrelation, thus allowing to identify individual radar benchmarks (Permanent Scatterers) where very precise displacement measurements can be carried out. More than 90,000

PS have been identified by processing SAR images acquired on both descending and ascending orbits by the ESA-ERS satellites from 1992 to 2001. The information coming from the interferometric analysis has been integrated within the landslide inventory map and the damaged building inventory map. Some test sites were selected. Permanent Scatterers have been analysed in order to extract information to be integrated with traditional method (multi-temporal analysis of aerial photos, geological and geomorphologic field surveys, geotechnical analysis of the soils). The advantages and constraints of the applicability of the PS technique in the Oltrepo Pavese are discussed in relation with the geological, geomorphological e geotechnical features of the area.