



Subsidence in the alluvial plain of Florence-Prato-Pistoia: the case history of Prato's alluvial fan

G. De Rosa, P. Farina

Department of Earth Sciences, University of Florence

The objective of this research is to realize a map of the areas subject to subsidence, caused both by human and natural factors, within the alluvial plain of Florence-Prato-Pistoia. The method proposed involves the integration within a GIS of satellite radar interferometry data, that permits the measurement of ground deformations with millimetric precision, with geologic and hydrogeologic data. The technique used was the Permanent Scatterers (PS), based on the processing of satellite data collected by SAR systems. The analysis of approx. 20 000 scatterers acquired by the European satellites ERS1 and ERS2 in the decade 1992-2002, and processed by Telerilevamento Europa (TRE), a spin-off of the Polytechnic University of Milan, allowed the mean velocity of each one to be calculated. The largest vertical displacements recorded by the PS are located on the Bisenzio River fan, in the Municipality of Prato. The 4000 PS in this area highlight a classic alluvial fan morphology and show that the displacements increase with decreasing elevation along the fan axis. Three zones with differing displacement rates were identified that vary from a subsidence rate of 2-3 mm/yr near the fan apex to 7-14 mm/yr in the distal portion.

The reconstruction of the piezometric surface in the area of the fan and the analysis of different thematic maps lead us to believe that there is a link between the lowering of the water table and the movements of the PS.

It is likely that the water table in Prato is strongly affected by pumping: subsurface flow in the entire area has a centripetal direction, centered on a wide area in which the piezometric surface is depressed to 10 m below sea level. Moreover, pumping is continuous throughout the year, with the exclusion of the month of August, when the local factories shut down, and clearly exceeds the recharge rate. The reconstruction

of the piezometric surface also highlights the importance of the Bisenzio River in recharging the groundwater notwithstanding the marked water table depression along the central axis of the fan.

From the analysis of wells with records spanning 1992-2002, a general lowering of the water table can be observed for the entire area with exception of a single well that is located very close to the Bisenzio River.

Moreover the vertical displacement rate recorded with the PS where compared to the mean water table lowering rate determined from the well and piezometer records. The results indicate that there is a strong correlation between the two.