EGU22-5096
https://doi.org/10.5194/egusphere-egu22-5096
EGU General Assembly 2022

Detecting natural and anthropic effects on displacements and water level changes: a combined observation from rain gauges, piezometers and CGNSS

Massimo Nespoli[1], Nicola Cenni[1], Maria Elina Belardinelli[1], and Marco Marcaccio[2]
[1]ALMA MATER STUDIORUM University of Bologna, Department of Physics and Astronomy (Sec. Geophysics), Bologna, Italy (massimo.nespoli2@unibo.it)
[2]Agenzia Regionale Prevenzione e Ambiente (ARPAE) dell'Emilia-Romagna, Direzione Tecnica, Bologna, Italy

The Po Plain (Northern Italy) has largely subsided due to natural processes and human activities. In particular, in order to reduce subsidence, in the Bologna metropolitan area a politic decision in 2010, imposed a significant reduction of civil water supply from groundwater withdrawal wells. The study area is characterized by an excellent monitoring activity which provides a good spatial and temporal distribution of data coming from continuous GNSS sites, piezometers and rain gauges.

In the present work we analyze both GNSS and piezometric data by means of the Principal Component Analysis (PCA). The results of the analysis are then compared with the rainfall time series measured by rain gauges. Thanks to the PCA analysis we can identify: i) a clear increase in the water level following the withdrawal decrease started in 2010 and ii) an anthropic induced surface displacement, which is smaller in magnitude than that induced by rainfall variations. Without the PCA analysis, such a small, but still significant, anthropic effect on vertical displacements would have remained hidden in the raw time series.

Our analysis reveals a decrease of about 4 mm/y of vertical velocity in some GNSS sites closest the withdrawal wells. We also found that on large time scales (> 1 month), the vertical displacement induced by rainfall strongly depends on the geological setting: in the mountains a water level increase causes subsidence (elastic response), whereas in the Po Plain it causes uplift (poro-elastic response). Thanks to the PCA analyses, the combined observations of different kind of instruments (GNSS, piezometers and rain gauges) and a basic knowledge of the geological context, we can correctly identify both the anthropic and natural signals on the data.