



Climate-related vertical ground movements measured by GPS and gravity in Northeastern Italy

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Hydrological mass variations are known to play a major role in the seasonal height and gravity variability. On longer time scales, climate-related variations of GPS height and gravity have not yet been clearly identified mainly because of the limited temporal extent of most of the continuous series and for the lack of information on spatial and temporal variability of groundwater storage. Continuously recording GPS stations with relatively long time series are available in northeastern Italy. This area is affected by both natural and human-induced subsidence; the natural rate decreases from the southern part, where even exceeds 2 mm/yr towards the north. At local scale, anthropogenic effects may enhance significantly the natural tendency. Additionally, the coastal areas are threatened by rising sea level. We have studied GPS height, gravity and hydrological time series by using the Empirical Orthogonal Functions and Singular Value Decomposition analyses. Significant common patterns in the spatial and temporal variability of these parameters have been identified. In particular, hydrology-induced variations are clearly observable starting 2002 in the southern part of the Po Plain for the longest time series, and from 2005 over the whole area. Observing and modeling long- and short-period signals in the height and gravity time series allows to better understand and quantify subsidence. This knowledge is important because of the relevant societal impacts of this phenomenon.