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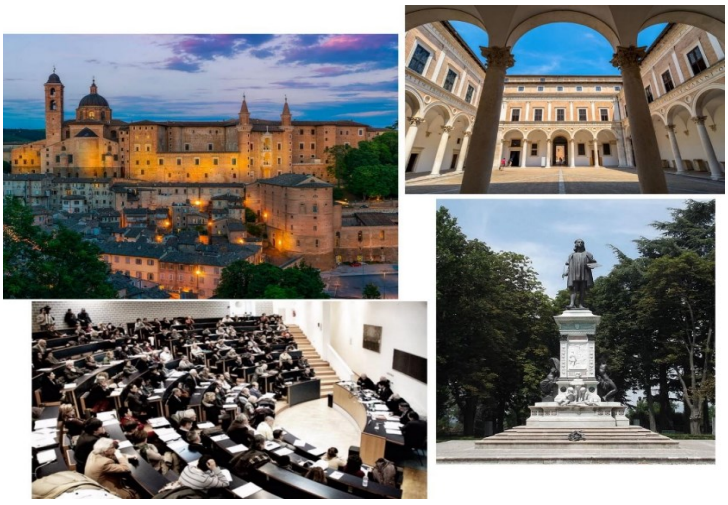

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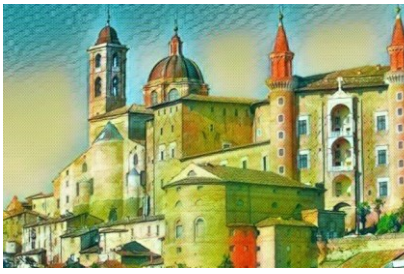

Sessione 1: Monitoraggio (parte 1)

Multitemporal monitoring of land subsidence through high precision topographic levelling and persistent scatterer interferometry: an Italian case study from Massaciuccoli Lake

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The Massaciuccoli Lake is considered a morphological sensitive area due to documented subsidence phenomena resulting from the combination of several causes among which the geological and environmental setting, the climate conditions, and the overexploitation of underground water can be mentioned.
The present research focused on the evaluation of ground displacements in the southern part of the Massaciuccoli Lake area, where, spatially, the terrain is majorly occupied by agricultural fields and farms.
In the multitemporal monitoring two main methodologies were applied: high precision topographic levelling and persistent scatterer interferometry (PSI). The latter was carried out by using SNAP (provided by the European Space Agency, ESA) and StaMPS (developed by Stanford University, University of Iceland, Delft University, and University of Leeds) open-source tools.
The high precision levelling was aimed at evaluating the vertical component of the ground deformation by measuring differences in elevation between benchmarks. Geometric levelling surveys were executed in three properly installed benchmark network and repeated every four months. This frequency was chosen because suitable to monitor the phenomenon of ground deformation in relation to seasonal changes, especially connected to rainfalls. Leveling surveys were performed by using a digital level and 3 m long invar staffs with a standard deviation of ±0.4 mm/km. In order to check the altimetric stability of the reference starting points of each leveling network, a topographic survey was carried out in static modality by using Global Navigation Satellite Systems (GNSS). The GNSS survey was corrected by post-processing the data in respect to contemporary observations of a geodetic control polygon, consisting of three permanent GNSS stations of the HxGN SmartNet network. The multitemporal analysis of ground displacements measured by levelling surveys allowed to compare the differences in elevation respect to reference values defined at the first levelling loop.
These topographic measurements were coupled with a satellite radar imagery analysis carried out by utilising Sentinel-1A and 1B data, in both ascending and descending orbits. The chosen methodology is the Persistent Scatterers Interferometry (PSI) which uses natural or artificial targets that are considered stable over time in terms of radiometric response and, therefore, recognizable in radar images. Theoretically, the PSI allows to evaluate quantitatively and qualitatively the possible variations in distance of individual elements (pixels) along the so-called Line of Sight (LOS) between the satellite sensor and the element on the ground. The results obtained by the PSI analysis, which considered a time span of about three years, were compared with that from the high precision topographic levelling and other public data available online.
The results obtained by the two methodologies (high precision topographic levelling and PSI) came out highly comparable and allowed us to defined areas characterised by similar ground deformation trends.

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