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Spatial and temporal interpolation of DInSAR data at different scales

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The present study regards the utilization of multi-pass DInSAR algorithms to the ground displacements monitoring at small and large scales. An integration of in situ and DInSAR data to the elaboration of 2D maps of deformation is proposed. A geo-statistical method for "radar-gauge combination" called Ordinary Kriging of Radar Errors (OKRE) has been used. This algorithm uses the punctual values of a primary variable that is represented by measurements of true deformations, whereas radar is comprised as auxiliary information on the spatial distribution (Erdin, 2013). According to this method, is possible to obtain the interpolated map of deformations by subtracting a radar error map from the original interpolated radar map. In particular, the radar error map is carried out by interpolating the differences between radar and in situ data with the OK interpolator. To this aim, in the present work the available standard spirit levelling and GPS data have been used. Moreover, DInSAR data achieved through two different approaches have been taken into account for the spatial analysis and the error map computation at different scales. Specifically, the Persistent Scatterer Technique (PS-InSAR) and the Small BAseline Subset approach (SBAS) have been used to process the ENVISAT SAR images acquired in the period 2002-2010.
In the SBAS processing chain, it is possible to activate the Disconnected Blocks tool and perform the SAR data "temporal interpolation". Since the estimation of the results in the processing takes into account the coherence threshold on the input images stack and their connection criteria, only the pixels above the threshold that are fully connected in all the images are solved. By activating the Disconnect Blocks tool, the results are estimated also for those pixels that respect the threshold criteria at least in the 60% of the images even in a not fully connected stack. In this way, the spatial coverage is higher but the reliability of the results is has to be carefully verified.

The proposed test site is the Ravenna Province (Emilia Romagna Region, NE Italy), affected by land subsidence of both natural and anthropic origin. In such area, most of the ground deformation is due to the water and gas exploitation from both on and off-shore reservoirs started with the industrial revolution (1950). Actually, the subsidence rate has decreased up to -2 cm/y along the Adriatic Sea coastline near Ravenna but still represents a hazard that causes damage to the structures and infrastructures with important economic losses. In this area small and large scales analyses have been performed: the first includes the entire Ravenna Municipality, the second includes specific sites in the pumping field areas.
Obtained results show the potential and the limitations of using this remote sensing technique as a complementary tool for the subsidence risk management.