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Advance InSAR techniques for the characterization of deep seated gravitational slope deformation

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SqueeSAR™ SAR interferometry is one of today's most advanced technologies for surface deformation analysis, capable of overcoming most of the limitations of conventional differential radar interferometry. It exploits long temporal series of satellite radar data, acquired over the same area of interest at different times, to identify "natural radar targets" where very precise displacement information can be retrieved. Thanks to its capability in detecting millimetre level displacements over long time periods and large areas, SqueeSAR™ can be considered complementary to conventional geological and geomorphological studies in landslide detection and monitoring, supporting the effectiveness of landslide inventories at regional scales. The availability of surface displacement time series for all radar targets identified also makes it possible to change the scale of analysis from regional to local, allowing in depth studies into the evolution of single instability phenomena, supporting the design of traditional monitoring networks, and even verifying the efficiency of remedial works. SqueeSAR™ analysis is particularly suitable for the study of Deep-seated Gravitational Slope Deformation (DSGSD) characterised by large extents and slow surface displacement (ranging from a few millimeters to tens of millimeters per year). A detailed case study of the DSGSD at Berceto (Parma, Italy) is presented here. By processing satellite SAR data from 1992-2000 and combining the results obtained both from ascending and descending acquisition geometries it was possible to obtain the vertical and E-W components of surface displacement. The results of the analysis suggested that the model describing the evolution of the DSGSD at Berceto is nevertheless more complex than previously expected. Further investigations (geophysical surveys and borehole analysis) were carried out in order to gather additional subsurface data. Moreover, a new ground based monitoring system was designed in order to integrate the results obtained from satellite radar interferometry and improve knowledge of the landslide dynamics. In this paper, the results obtained from applying the SqueeSAR™ technique are presented. A correlation with the results of the geophysical investigations are proposed, with a preliminary interpretation of the surface displacement trends on the upper part of the slope.