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Exploting different radar sensors and InSAR techniques for slope instability monitoring

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Recent research has shown that interferometric SAR (InSAR) techniques can be used to monitor slope deformations related to landslide motion under specific image acquisition conditions. Using data pairs with short perpendicular baselines, short time intervals between satellite acquisitions, and correcting the effect of topography on the differential interferogram, reliable measurements of surface displacement can be achieved. Provided coherence is maintained over longer periods (e.g. on non-vegetated sites), it is possible to observe surface displacement of a few cm per year. Indeed, at present the InSAR applications appear most feasible for long-term periodic monitoring of slow and very slow landslides, located on suitably oriented and inclined unstable slopes, and preferably in urban or peri-urban areas that are typically characterised by higher coherence. A major scientific challenge is thus to foster a more effective and practical use of new, rapidly evolving radar technologies, radar data processing and data products within landslide and slope instability investigations. This will require additional studies in different geotechnical test-site settings and hence through them the recognition of potential long-term spatial slope deformation patterns.

In this work we present examples of application of different InSAR techniques to investigate two distinctive landslide problems. In the first case study we used interferometrically derived images, from several radar satellites (RADARSAT, ERS and ENVISAT), to monitor current post-failure motion at the Frank Slide, a 30x 10^6m^3 rock avalanche, in the Canadian Rockies. Our results show small deformation along an existing fault and that parts of the slope are moving differentially during spring

thaw and after rainfall events. During winter freeze the slopes are stable. The InSAR images are also used to locate in-situ field monitors at specific locations, and to plan mitigation strategies.

The second case study regards the instablity of several small hill-top towns located in the Dauno Apennines (Southern Italy). All of these towns have been affected by peri-urban slope failures in the past, even though specific documentation concerning the exact temporal occurrence is rarely available. The situation of these peri-urban slopes has gradually worsened because of residential development over recent decades and the construction of buildings and associated infrastructure has remobilized old, previously dormant, landslides. Considering that the Daunia region is characterised by the widespread presence of vegetation cover (mainly agricultural land and forests) and of isolated small urban centres we adopted a Persistent Scatterer (PS) InSAR approach. The available SAR data cover a period from 1992 to 2000. The first results allowed to detect some slowly deforming areas in two towns. Although the exact geotechnical significance of the temporal deformation trends is still unclear, the location of the moving PS, near slopes susceptible to landsliding, suggests a possible correlation with the landslide events.

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