Advantages and limitations of SAR interferometry for large rock instabilities

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Abstract: Long-term, wide-area monitoring of slope movement is essential for understanding landslide dynamics and evolution. Satellite SAR interferometry is a key technology for this, now entering an advanced operational stage due to the increased availability of satellite data. Its ability to cover large areas with high spatial resolution and detect sub-millimeter deformations, using an archive of data that goes back years, has made it a widely used tool for detecting and monitoring large, slow-moving alpine rock instabilities. However, this technique also faces inherent challenges in alpine terrain. These include (i) no data for steep, complex slopes where the satellite's view is obstructed, (ii) reduced or complete loss of displacement information over vegetated areas and during periods of snow cover, (iii) difficulty detecting ground movement that occurs along a north-south direction, and (iv) a satellite revisit time that is often too slow to capture the rapid acceleration of a slope just before it fails. To reduce these limitations, we can combine radar data from different satellite frequencies and platforms and use complemenary processing approaches. This integrated approach enhances performance, particularly in vegetated areas and for faster-moving landslides. In order to review potential and limitations of current satellite SAR data for the assessment of the state of activity of slow-moving landslide, we exemplary present results over large alpine rock alpine slope instabilities in Switzerland and Italy (e.g., Moosfluh, Kleines Nesthorn, Monte Mater, Val Canaria, Brienz/Brienzauls). Our presentation will conclude with an outlook on recent advances, including the use of terrestrial platforms, very-high resolution data, and mid-inclination satellite orbits to enhance the monitoring capabilities.