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## Wide area mapping of ground instabilities from space: InSAR for geotechnical risk assessment and hazard monitoring

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### **ABSTRACT**

Regular monitoring of surface deformation over mine sites is important for providing updated information to managers regarding geotechnical risks related to ground instabilities. This is particularly true in cases where unexpected or accelerating movement patterns are observed, as these trends may have implications related to worker safety within active mining environments, as well as continuity of ongoing operations.

InSAR is an active remote sensing technique that uses radar satellite imagery to precisely measure ground movement. This approach does not typically require any fieldwork or the installation of equipment on the mine site. Measurements are instead obtained remotely based on reflections of the satellite radar signal off existing infrastructure, rocks and bare ground. InSAR has been used for over two decades and has become a standard tool for monitoring surface stability in many different sectors, including underground and open pit/cut mining applications.

In recent years the launch of satellites that collect radar imagery on a more frequent basis, coupled with advances in InSAR processing techniques, means results can be reported to geotechnical departments on a temporal scale that more closely meets the operational needs of mine sites. In some cases, displacement information can now be provided within days, or even hours of a satellite acquisition, making any decisions related to safety or operational concerns based on InSAR information more timely and relevant.

Furthermore, this technology can now be used to monitor fast moving slopes, meaning rates of movement detectable with InSAR now range from millimeters to meters per year.

When employed in combination with real-time, in-situ tools targeted to monitor areas of highest risk, InSAR can help provide geotechnical engineers with a picture of surface stability over the full mine site and surrounding areas.

This paper will describe, in further detail, recently developed InSAR tools that are being used in mine sites throughout the world. Practical examples of InSAR application in a variety of mines sites will be presented, as well as surrounding hazards including landslides.