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A METHOD FOR IDENTIFYING AND MONITORING LANDSLIDES USING SENTINEL-1 IMAGERY AND PERMANENT SCATTERER ANALYSIS

Abstract

The development of Interferometric Synthetic Aperture Radar (InSAR) technology has revolutionized the field of geosciences, providing unprecedented capabilities for earth observation. This is particularly critical in the context of landslides - a phenomenon that is induced as a result of natural or anthropogenic factors, which can potentially cause devastating consequences. Thus, the development of advanced remote sensing techniques to facilitate the timely detection and monitoring of landslides is of paramount importance. This study aims to explore the efficacy of InSAR technology, employing specifically the Sentinel-1 SAR Single Look Complex (SLC) data, in precise monitoring of land displacement with a special focus on landslide detection. This work introduces a method that amalgamates Permanent Scatterer (PS) analysis with Sentinel-1 SAR SLC data, aiming to achieve considerably higher accuracy in measurements. The comprehensive methodological framework includes data acquisition, preprocessing, interferogram generation, coherence analysis, PS analysis, and displacement measurement. This holistic approach is specifically tailored to focus on potential landslide locations by using PS analysis that greatly boosts the effectiveness of the integration of InSAR technology. Once the PS analysis has been completed, the method provides identification and delineation of offset points. The identified displacement points undergo a meticulous examination through a specialized algorithm, which is explicitly designed to evaluate the coherence and stability of these points. Upon the completion of this algorithmic processing, the outcome is the derivation of points that have been rigorously filtered. Each of these points is then imported into a Geographic Information System (GIS) framework where distributions are systematically generated. Then, the method performs a detailed analysis of the time series data associated. A color palette is applied based on the displacement magnitudes where its intensity of red reveals the levels in displacement, which allows for a more detailed and visually accessible interpretation of the spatial distribution of landslides through time. Consequently, this work offers a cardinal contribution toward ensuring significant enhancements to the remote sensing application developments in the realm of geosciences, specifying a robust methodological framework that enables early detection, quantification, and monitoring of land surface deformation due to seismic activities. Most significantly, they enable the identification of localities at risk that are still stable, facilitating early warning and avoidance of untoward outcomes commensurate with a triggered landslide.