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Using high resolution satellite multi-temporal interferometry for landslide hazard detection in tropical environments: the case of Haiti

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Synthetic aperture radar (SAR) multi-temporal interferometry (MTI) is one of the most promising satellite-based remote sensing techniques for fostering new opportunities in landslide hazard detection and assessment. MTI is attractive because it can provide very precise quantitative information on slow slope displacements of the ground surface over huge areas with limited vegetation cover. Although MTI is a mature technique, we are only beginning to realize the benefits of the high-resolution imagery that is currently acquired by the new generation radar satellites (e.g., COSMO-SkyMed, TerraSAR-X). In this work we demonstrate the potential of high resolution X-band MTI for wide-area detection of slope instability hazards even in tropical environments that are typically very harsh (eg. coherence loss) for differential interferometry applications. This is done by presenting an example from the island of Haiti, a tropical region characterized by dense and rapidly growing vegetation, as well as by significant climatic variability (two rainy seasons) with intense precipitation events.
Despite the unfavorable setting, MTI processing of nearly 100 COSMO-SkyMed (CSK) mages (2011-2013) resulted in the identification of numerous radar targets even in some rural (inhabited) areas thanks to the high resolution (3 m) of CSK radar imagery, the adoption of a patch wise processing SPINUA approach and the presence of many man-made structures dispersed in heavily vegetated terrain. In particular, the density of the targets resulted suitable for the detection of some deep-seated and shallower landslides, as well as localized, very slow slope deformations. The interpretation and widespread exploitation of high resolution MTI data was facilitated by Google EarthTM tools with the associated high resolution optical imagery. Furthermore, our reconnaissance in situ checks confirmed that MTI results provided useful information on landslides and marginally stable slopes that can represent a considerable hazard to the local population and infrastructure. The case of Haiti suggests that in the future MTI applications can become increasingly more important in cases where little or no conventional monitoring is feasible because of limited funds.

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