

Slow-Moving Landslides in Central Nepal: Strategy for Mass Processing of InSAR Time Series

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Abstract:

This presentation will outline the methodology and processing strategy designed to analyze large batches of SAR images over the Central Nepal region, an area characterized by complex terrain and dynamic environmental conditions. The study addresses the challenges posed by the vast volume of SAR data, diverse acquisition modes, steep Himalayan topography, dense vegetation, seasonal variations, and the high velocity of ground displacement. To overcome these challenges, we developed an automated processing chain using the AMSTer Toolbox (Derauw et al., 2020 ; d'Oreye et al., 2021; Smittarello et al., 2022). This chain is capable of handling extensive Sentinel-1 archives (as well as ERS, ENVISAT, TSX, PAZ, ALOS... for smaller portions of the region) and rapidly processing new data provided as soon as they become available. The processing chain is also prepared for the upcoming NISAR L-Band mission. SAR images are read and transformed into a native format (consistent across all sensor types). Several combinations of interferometric pairs are then selected based on various Perpendicular (Bp) and/or Temporal baseline (Bt) criteria. Each selected interferometric pair is processed to generate, among other results, a geocoded displacement map using a grid common to all acquisitions. Finally, all deformation maps are inverted using the MSBAS method (Samsonov and d'Oreye, 2012) to extract the mean linear velocity maps and deformation time series in Line of Sight (LoS) and/or vertical and horizontal components. The entire process is fully automated, computationally optimized, and self-evaluating, from data download up to the display and sharing of results on a dedicated webpage. Given the rapid deformation rates observed, our approach emphasizes the use of short spatial baselines. While this introduces a risk of bias from fading signals (Ansari et al., 2021), we evaluate the trade-offs involved. We will explore the impact of different Bp/Bt selection criteria on the quality of the InSAR time series results, and assess the effect of coherence threshold filtering on the ground deformation time series. Additionally, the presentation will evaluate the effectiveness of ionospheric, geodetic, and tropospheric corrections in refining displacement measurements and improving geocoding, utilizing Sentinel-1 ETAD products (Gisinger et al., 2022). We will also investigate the feasibility of 3D inversions (Samsonov et al., 2020) for selected landslides to provide deeper insights into their kinematics. The processed data are structured and made accessible to support future development and application of Machine Learning-driven tools in landslide detection, tracking, and monitoring.

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