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Regional scale monitoring results of surface deformation in the Transcarpathian Region

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One of the main objectives of the GeoSES* project to investigate dangerous natural and anthropogenic geo-processes and aim hazard assessment using space geodetic technologies and concentrating on the Hungary-Slovakia-Romania-Ukraine cross-border region. The monitoring of such natural hazards and emergency situations (e.g. landslides and sinkholes) are also additional objectives of the project. In the framework of the presented project, our study utilizes one of the fastest developing space-borne remote sensing technology, namely InSAR, which is an outstanding tool to conduct large scale ground deformation observation and monitoring. According this, we utilized ascending and descending Sentinel-1 Level-1 SLC acquisitions since 2014 until 2021 over the indicated cross-border area, focusing the Transcarpathian Region.

We also present an automated processing chain of Sentinel-1 interferometric wide mode acquisitions to generate long-term ground deformation time-series. The pre-processing part of the workflow includes the migration of the input data from the Alaska Satellite Facility (ASF), the integration of precise orbits from S1QC, as well as the corresponding radiometric calibration and mosaicing of the TOPS mode data, furthermore the geocoding of the geometrical reference. Subsequently all slave acquisition have been co-registered to the geometrical reference using iterative intensity matching and spectral diversity methods, then subsequent deramping has been also performed. To retrieve deformation time series from co-registered SLCs stacks, we have implemented multi-reference Interferometric Point Target Analysis (IPTA) using single-look and multi-look phases using the GAMMA Software. After forming differential interferometric point stacks, we conducted the iterative IPTA processing. According this both topographical and orbit-related phase component, as well as the atmospheric phase, height-dependent atmospheric phase and linear phase term supplemented with the deformation phase are modeled and refined through iterative steps. To retrieve recent deformations of the investigated area, SVD LSQ optimization has been utilized to transform the multi-reference stack to single-reference phase time-series such could be converted to LOS displacements within the processing chain. Involving both ascending and descending LOS solutions also supports the evaluation of quasi East-West and Up-Down components of the surface deformations. Results are interpreted both in regional scale and through local examples of the introduced cross-border region as well.

* Hungary-Slovakia-Romania-Ukraine (HU-SK-RO-UA) ENI Cross-border Cooperation Programme (2014-2020) "GeoSES" - Extension of the operational "Space Emergency System"