Forest change as a proxy for landslide occurrence - a Sentinel 2 based spatio-temporal landslide detection approach for two test sites

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Landslides represent a major threat to humans and result in high costs for the society. Landslide inventory maps depict the areas of past slope instabilities and are a valuable information source for authorities, spatial planners and risk managers. However, existing inventories are rarely complete, especially in sparsely populated and/or areas difficult to access. Previous work based on change detection and using approaches that automatically map distinct landslide events exploiting remote sensing data has shown promising results. The aim of this study was to test the applicability of multi-temporal change indices derived from Sentinel-2 (S2) for landslide detection for two landslide-prone study sites in Italy and China: South Tyrol and Longnan, respectively.

The methodical approach was built upon a change vector analysis applied to annual cloud-free S2-composites at 10m spatial resolution to extract land-cover disturbances. Landslide areas in the time period 2015-2019 were analyzed on the basis of already known landslide location points, downslope-oriented moving windows and supervised classifications using the Receiver Operating Characteristic (ROC) curve. Subsequently, time-series analysis was applied to the detected landslide-affected areas and to derive temporal breakpoints (i.e. the timing of the landslide occurrence). Finally, applying a multi-temporal revegetation analysis, we accounted for false positives originating from agricultural activities or artefacts on single images. Our findings highlight that out of the 67 already known landslide locations in South Tyrol, only 9 (13.4\%) were detectable by means of S2 data. Major challenges resulted from similar spectral characteristics of landslides and other land cover disturbances (especially tree logging). However, larger landslides were detectable both spatially and temporally by means of the multi-temporal change detection approach. By applying a quantitative accuracy assessment for the independent test site in Longnan, China, we are currently assessing the transferability and suitability of the developed approach for efficient spatial-temporal landslide mapping over large areas.