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Combined analysis of polarimetric SAR data and optical imagery for rapid landslide mapping in vegetated areas

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Rapid mapping of the extent of the affected area as well as type and grade of damage after a landslide event is crucial to enable fast crisis response, i.e., to support rescue and humanitarian operations. Change detection between pre- and post-event very high resolution (VHR) optical imagery is the state-of-the-art in operational rapid mapping of landslides. However, the suitability of optical data relies on clear sky conditions, which is not often the case after landslides events, as heavy rain is one of the most frequent triggers of landslides. In contrast to this, the acquisition of synthetic aperture radar (SAR) imagery is independent of atmospheric conditions. SAR data-based landslide detection approaches reported in the literature use change detection techniques, requiring VHR SAR imagery acquired shortly before the landslide event, which is commonly not available. Modern VHR SAR missions, e.g., Radarsat-2, TerraSAR-X, or COSMO-SkyMed, do not systematically cover the entire world, due to limitations in onboard disk space and downlink transmission rates. Here, we present a fast and transferable procedure for mapping of landslides in vegetated areas, based on change detection between pre-event optical imagery and the polarimetric entropy derived from post-event VHR polarimetric SAR data. Pre-event information is derived from high resolution optical imagery of Landsat-8 or Sentinel-2, which are freely available and systematically acquired over the entire Earth's landmass. The landslide mapping is refined by slope information from a digital elevation model generated from bi-static TanDEM-X imagery. The methodology was successfully applied to two landslide events of different characteristics: A rotational slide near Charleston, West Virginia, USA and a mining waste earthflow near Bolshaya Talda, Russia.