EGU22-7236, updated on 19 Aug 2022
https://doi.org/10.5194/egusphere-egu22-7236
EGU General Assembly 2022

Application of remote sensing big data in landslide identification

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Landslides are general natural disasters in the world. Knowledge on the landslide distribution is fundamental for landslide monitoring, disaster mitigation and reduction. Traditional in-situ observations (e.g., leveling, GPS, extensometer, inclinometer) usually have high accuracy, but they are expensive and labor intensive and may also involve risks in the field. Alternatively, remote sensing data can capture the regional land surface features and thus are efficient in landslide mapping. Recent studies on landslide identification mainly rely on the pixel-based or object-oriented classification using optical images. Nonetheless, landslide activities are governed by multiple processes including the topography, geology, land cover, catchment, precipitation, and tectonics (e.g., dynamic shaking or aseismic creeping). Remote sensing data and products are beneficial to extract some of these critical parameters on a regional scale. Rapid development of machine learning algorithms makes it possible to systematically construct landslide inventory by interpreting multi-source remote sensing big data. The populous California suffers from high risks of landsliding. The United States Geological Survey (USGS) compiles the landslide inventory in the State and reports that California has about 86k landslides. Steep slope in the costal ranges, wet climate in the northern California, youthful materials at the surface from active tectonics of the San Andreas Fault and secondary fault systems, dynamic and aseismic movements instigated from the faults all contribute to high landslide susceptibility in California. In May 2017, the steep slopes at Mud Creek on California's Big Sur coast collapsed catastrophically. During January and February in 2019, several landslides occurred on the southern part of Santa Monica Mountains. In January 2021, a large debris flow hit the Rat Creek in Big Sur due to extreme precipitation. In addition, a fairly complete collection of remote sensing data and products are available in California. Here we use machine learning methods to refine landslides in California using remote sensing big data, including elevation, slope, and aspect derived from SRTM digital elevation models (DEM), the normalized differential vegetation index (NDVI) derived from Landsat 8 OLI images, the hydrometeorological observations, the nearest distance to rivers and faults, the geological and land cover maps, as well as Synthetic Aperture Radar (SAR) images. We will use the archived landslide inventory for model training and testing. We plan to further explore the critical variables in determining landslide occurrences and the inferred triggering mechanisms.