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Global Open Source Tools to Support Landslide Hazard and Impact Assessments

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Harnessing the power of remotely sensed data for landslide hazard assessment is critical for enabling regional and global applications. Open-source tools can expand the reach and utility of these assessments to motivate new studies and support the community. This work presents a suite of open-source tools designed to characterize the potential occurrence, impacts and locations for rainfall-triggered landslides across the globe.

The Landslide Hazard Assessment for Situational Awareness (LHASA) model provides a suite of capabilities that consider landslide hazard leveraging primarily satellite and model products. LHASA Version 2 uses a machine learning model to bring in dynamic variables as well as additional static variables to better represent landslide hazard globally. Global rainfall forecasts are also being incorporated to provide a 1-3 day forecast of potential landslide activity, which ultimately will provide increased awareness for large storm systems that may cause landslide impacts in already susceptible areas. Finally, a new component of the LHASA model will account for the impact of recent burned areas to indicate areas where the cascading impacts of debris flows may be present. In addition to estimates of landslide hazard, this suite of tools incorporates dynamic estimates of exposure including population, roads and infrastructure to highlight the potential impacts of rainfall-triggered landslides. The ultimate goal of LHASA Version 2.0 is to approximate the relative probabilities of landslide hazard and exposure across different space and time scales to inform hazard assessment retrospectively over the past 20 years, in near real-time, and in the future.

A complementary component of the suite of landslide tools is an open-source algorithm to map landslide locations. We have developed a Python-based landslide mapping framework known as the Semi-Automatic Landslide Detection (SALaD) system that uses Object-based Image Analysis and machine learning. For production of event-based inventories, SALaD was modified to include a change detection module (SALaD-CD). This system can be used with both commercial high

resolution optical data as well as publicly available data including Landsat and Sentinel to rapidly provide distribution of landslide locations based on limited training. Building event-based inventories is both fundamental to training the LHASA model regionally and globally as well as to support the disaster management community. In total, this suite of tools and capabilities provide a foundation to improve and support situational awareness of landslide hazards and their impacts at local to global scales and at days to decades. Information on all these capabilities is available at: https://landslides.nasa.gov.