NH20: Toward Understanding Landslide Process: Multi-parameter/Sensors Approach for Monitoring, Early Warning, and Physical Mechanisms

Bridging Empirical and Physical Approaches for Landslide Monitoring and Early Warning

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Rainfall-triggered landslides typically occur and are evaluated at local scales, using slope-stability models to calculate coincident changes in driving and resisting forces at the hillslope level in order to anticipate slope failures. Over larger areas, detailed high resolution landslide modeling is often infeasible due to difficulties in quantifying the complex interaction between rainfall infiltration and surface materials as well as the dearth of available in situ soil and rainfall estimates and accurate landslide validation data. This presentation will discuss how satellite precipitation and surface information can be applied within a landslide hazard assessment framework to improve landslide monitoring and early warning by considering two disparate approaches to landslide hazard assessment: an empirical landslide forecasting algorithm and a physical slope-stability model. The goal of this research is to advance near real-time landslide hazard assessment and early warning at larger spatial scales. This is done by employing high resolution surface and precipitation information within a probabilistic framework to provide more physically-based grounding to empirical landslide triggering thresholds.

The empirical landslide forecasting tool, running in near real-time at http://trmm.nasa.gov, considers potential landslide activity at the global scale and relies on Tropical Rainfall Measuring Mission (TRMM) precipitation data and surface products to provide a near real-time picture of where landslides may be triggered. The physical approach considers how rainfall infiltration on a hillslope affects the in situ hydro-mechanical processes that may lead to slope failure. Evaluation of these empirical and physical approaches are performed within the Land Information System (LIS), a high performance land surface model processing and data assimilation system developed within the Hydrological Sciences Branch at NASA's Goddard Space Flight Center. LIS provides the capabilities to quantify uncertainty from model inputs and calculate probabilistic estimates for slope failures.

Results indicate that remote sensing data can provide many of the spatiotemporal requirements for accurate landslide monitoring and early warning; however, higher resolution precipitation inputs will help to better identify small-scale precipitation forcings that contribute to significant landslide triggering. Future missions, such as the Global Precipitation Measurement (GPM) mission will provide more frequent and extensive estimates of precipitation at the global scale, which will serve as key inputs to significantly advance the accuracy of landslide hazard assessment, particularly over larger spatial scales.