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Physically-based model derived thresholds of sediment disasters for impact-based rainfall forecasts

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Rainfall-induced sediment disasters are catastrophic events that occur compounded during extreme precipitation. Territorial early warning systems (Te-LEWS) are necessary to predict these disasters. The warning information is disseminated based on thresholds derived from the correlation between rainfall magnitude and disaster occurrences. Nations that established successful Te-LEWS have maintained historical rainfall records and corresponding landslide occurrences that result in the precise derivation of early warning thresholds. In contrast, countries newly establishing Te-LEWS face difficulties setting the thresholds due to a lack of precise information on rainfall magnitude and historical landslide occurrences. In India, the India Meteorological Department (IMD) provides impact-based forecasts of rainfall that may induce landslides based on daily, 3-day cumulative and longer antecedent thresholds. However, thresholds correlating landslides with continuous monitoring through hourly/sub-hourly rainfall observations, which are the basis of the nowcast in real time, still need to be developed. Here, we present a framework for predicting landslide occurrences, i.e., shallow landslides, debris slides, and debris flows, using hourly rainfall. Using the framework, we analyse case studies of extreme precipitation-induced landslides in the Himalayas and Western Ghats, India. Through this, catchment-wise early warning thresholds are derived. This study opens avenues to improve the precision of impact-based rainfall forecasts for landslides.