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Comparison of physically based models for debris flow initiation - A case study in the Tikovil river basin of The Western Ghats of Kerala, India

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Debris flows, also referred to as mudflows are a common type of fast-moving landslide that generally occurs during intense rainfall on water saturated soil. The study attempts to compare various off the shelf models available for the distributed assessment of debris flow initiation. The models compared are STARWARS+PROBSTAB from the Department of Physical Geography, University of Utrecht, SHALSTAB from Department of Earth and Planetary Science, University of California and Stillwater Sciences, Berkely, TRIGRS from USGS and SINMAP from Utah State University. STARWARS+PROBSTAB and TRIGRS incorporate assessments of transient ground water conditions while SINMAP and SHALSTAB assumes steady state ground water conditions. All the selected models use infinite slope model assumptions to assess slope stability and work in a GIS environment thus making the results comparable in a spatial domain. Physically based models are generally data intensive and most often sufficient data is lacking to utilize the full capability of these models in the developing countries as in India. However with parameters estimated from remote sensing data, literature and derivatives of related data, such models are valuable tools in getting clearer insights into the processes involved. This demands an evaluation of various open access models so as to establish their relative applicability in data deficient conditions. Debris flows are increasingly a concern in Kerala, the south western state of India. The plateau margins of highland Kerala (The Western Ghats) have all prereq-

uisites of an active erosion zone where the natural terrain setup is conducive to slope failure/mass movements. Rainfall during two monsoons (South West and North East) that are effective in the state is identified as the primary trigger of debris flows. Previous studies identify two days rain in excess of 300mm during a continuous steady rainy period may induce landslides in critical areas indicating a temporal pattern of occurrence of debris flows. Earlier research in the Tikovil River basin of the Western Ghats concluded that the date of debris flow initiation is a result of persistence of ground water conditions favouring failure than the occurrence of an extreme rainfall event in a given day, implying the role of antecedent moisture content in the soil. Though much of the slope instability is observed along regions experiencing long term and short term landuse/landcover changes, they are not completely a result of anthropogenic interference. Most of these events are part of the geomorphic evolution of the terrain. However destruction caused by them includes several lives and the financial cost cumulates to millions of dollars necessitating a process understanding of the phenomena so as to establish the temporal and spatial probability of occurrence. The paper intents to elaborate an effort as part of an ongoing research work for which the final results are awaited. The data available from preceding research works pertaining to Tikovil river basin is used here to assert the advantages of carrying out a physically based (deterministic) assessment of slope instability. The relative benefits of a dynamic assessment of debris flow initiation to that of a steady state method is established through the study. Dynamic methods prove to be superior for the process understanding of the phenomena and to evaluate its spatio-temporal probability, while steady state methods are better for a quick estimation of the spatial probability of the hazard.