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Sensitivity of the initiation of debris flow to initial soil moisture

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The initiation of debris flows is commonly attributed either to fluidization as a result of rainfall induced landslides or to gully erosion induced by concentrated run-offs. A series of flume tests have been performed to show how the initial soil moisture influences the initiation of debris flows. At the start of each experiment, surface run-off was generated over loose granular deposits, triggering debris flows. These experimental debris flows enacted different scenarios according to the small variations among the initial soil moistures. In the loose granular deposits with initial soil moistures ranging from 1% to 5%, most run off water could infiltrate and trigger a landslide, which accelerated within one second to speed over 1 ms-1 and then transformed into a debris flow. In the same soil deposits with initial moistures >5% or <1%, the debris flow was initiated by slow gully erosion with episodic events of damming and breaching due to small-scale landslides occurring on the side-slopes of the erosion valley. The slope failures were not triggered by positive pore pressure but by a decrease in suction due to the wetting of the soil. This suction decrease in initially unsaturated slopes explains why the transformation of these slope failures into debris flows are due not only to an increase of pore pressure leading to soil liquefaction, which is one of the expected triggering mechanisms, but also to a loss of the cohesive strength of the soil.

Keywords: debris flow, soil moisture, initiation