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Physically-based modelling of sediment transfers at the catchment scale

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The aim of this work is to simulate hydraulic transfers and upstream erosion sources in steep and erodible mountain watersheds with a physically-based model. In such environments, immature debris flows and shallow landslides can be the largest sources of sediments transported at the outlet. To simulate these phenomenon, a gravity-driven erosion model and a 1D vertical infiltration model have been developed in the TELEMAC 2D computation code. In this new erosion model, the motion of the granular flow is described with a fully dynamic system and a Coulomb-like bottom friction treatment. The debris flow model is first evaluated to experimental channel data (Iverson et al. 2010). Then, the model is confronted to field data on a real catchment (Draix, in the Southern French Alps). First, the initial soil moisture in the infiltration model is successfully calibrated in order to simulate six different rainy events. Then, the new erosion model is applied at the catchment scale (about 1 km^2). The results of the simulations show that the sediment fluxes at the outlet are well reproduced, as are the total volumes exported. The parameters used in the model for each event are also consistent with the discharge/concentration relationships measured, and the origin of the sediments arriving at the outlet in the model corresponds well to the interpretations made from the measurements (Mathys 2006).