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Flows dynamics and its influence on process-based erosion modeling

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Most existing erosion models implicitly assume that runoff is generated due to infiltration excess, i.e. Hortonian overland flow. However, at catchment scale the dynamics is more complex because there exist others water sources and process involved, for example, translatory, return, and macropore flow, which can move slowly from soil towards to catchment outlet. Therefore, those must be included in studies of flow dynamics and description of erosion process. Because an error at representation of water sources can lead to errors on erosion process modelling, when slowly movements, are the main contributor at catchment outlet. Thus, we aim to investigate the role played by water sources in the catchment and how it may affect the process-based erosion models performance. The study was conducted in Arvorezinha catchment, Brazil, and has a drainage area of ca. 1.23 km^2. Currently, the catchment is characterized by the cultivation of tobacco, especially through the minimum cultivation system. Accumulated rainfall is measured in a rain gauge and used as a reference to adjust the measurements of two pluviograph. Monitoring of water discharge (Q) and suspended sediments concentration (SSC) is performed in the outlet of the catchment through a Parshall flume with a limnigraph and turbidimeter, respectively. Using dissolved silicon concentration (DSi) the hydrograph can be separated into two components: i) surface runoff, i.e. fast movement water (new water) and ii) groundwater+soil water, i.e. slow movement water (old water). Twenty-six samples were collected during subsurface+base flow conditions to characterize DSi in groundwater+soil water from 9/7/2011 to 9/7/2012. Sampling during events started on 10/01/2011 and lasted until to 10/26/2013, in total six rainfall events to characterize surface runoff. An aliquot of each sample (sediment + water) was collected and filtered through a 0.22 μm porosity. The determination of DSi content was through an ICP-OES. Modeling of the erosion process (sediment yield-SY) was performed using the Limburg Soil Erosion Model (2.01 version). A manual calibration procedure was used, and its procedure was repeated for both approaches: with and without runoff separation. For the six rainfall events evaluated, 62% of the hydrograph is formed by groundwater+soil water, especially in autumn-winter and with low-medium magnitude (up to Q = 800 L.s-1). Runoff separation by DSi was essential for obtaining the correct estimation of surface runoff volumes. Furthermore, the effect of dilution during the events was observed, i.e. as Q increases, DSi concentration decreases. Hydrossedimentological monitoring quantifies the sediment at the catchment outlet, which is the result of sediment from soil detachment in the catchment, carried by surface runoff and diluted in the flows that move slowly in outlet (subsurface and base flow). On the other hand, erosion process modeling done by the LISEM model is based only on sediment transported by surface runoff. Since the model simulates only surface flow, the dilution effect does not occur and thus SSC and SY are simulated incorrectly. Therefore, it is essential to consider different sources of water on the occurrence of runoff events, because the dynamics of the sediment is directly influenced by those.