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Cellular modelling of muddy floods occurring in dry valleys: Advances and challenges

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Runoff and soil erosion have been successfully modelled since many years using distributed, hydrological, expert-rules and physics methods, but these are especially carried out at small scales and none can simulate muddy floods occurring at large scales according to local rules. Conversely, Cellular Automata (CA) models fail to replicate real discharges because they use relatively simple rules based on abstractions of hydrological process. In this work, we present the framework provided for identifying processes that are fundamental to simulate complex muddy floods phenomena in dry valleys. Within the Geographical Cellular Automata model RUICELLS (Runoff routIng on CELLular MeSh), environmental variables are progressively implemented in the cellular routing scheme. Several simulations highlight influence of controlling factors of first and second orders playing a key role on these floods from local to global scales. The morphological components have a major influence at the catchment scale whereas land use data aggravate topographic efficiency at the local scale. The violence and brutality of several muddy floods in some sub-catchments result from the conjunction of high rainfalls, high morphological potential and cultivated areas prone to generate high sediment content. This approach confirms the possibility of simulating the global behaviour of environmental systems through local rules using a far simpler solution and also underlines the importance of morphological forcing on muddy floods occuring in dry valleys.