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Calibration of TETIS-SED model by using check dams sedimentation volumes with different temporal resolutions. Application to a Mediterranean medium size basin (Rambla del Poyo, Spain).

Gianbattista Bussi and Félix Francés
Universidad Politécnica de Valencia, Insitute of Water Engineering and Environment, Valencia, Spain (gbussi@upvnet.upv.es)

In the last years, erosion and sediment yield models have significantly improved their performances, thanks to an increasing knowledge of the erosion and transport processes. Nevertheless, there exist some significant limitations to their use. Shortage of data is perhaps the most important one, since sediment discharge continuous monitoring is very rare, and detection of high erosion and deposition zones is almost non-existent. The lack of this kind of data, fundamental for model calibration and validation, is often the cause of disappointing model results. A way to compensate for the lack of sediment discharge records is to use solid volumes deposited into reservoirs or ponds as a measure of the sediment volume accumulated during a fixed period, taking into account the sediment trap efficiency of the retention structure and the dry bulk density of the deposited mass.
In this work, a conceptual distributed erosion and sediment yield model (TETIS-SED) is used to simulate the sediment cycle in a Mediterranen catchment. Sedimentation volumes of nine small check dams are used for the calibration of the sediment submodel.
The TETIS-SED model is a distributed conceptual model resulting from the integration of TETIS hydrological model with the erosion and sediment yield model CASC2D-SED. The modified Kilinc and Richardson (1973) equation is used to determine the upland sediment transport by grain size from one cell into the next one. Sediment by size fraction is routed in the channels and the Engelund and Hansen (1967) equation is used to compute the transport capacity in one dimension. The TETIS-SED model calibration is carried out by adjusting up to nine hydrological coefficients and three sediment coefficients (correction factors). The three sediment correction factors calibrate respectively the hillslope sediment discharge generated by sheet and rill erosion, the gully erosion capacity and the channel erosion capacity.
In this work, the TETIS-SED model has been applied to a medium Mediterranean catchment (Rambla del Poyo, Spain, 180 km2). The hydrological submodel has been calibrated with streamgauge data, both with fine and coarse time scale (5 minutes and daily). The erosion and sediment yield submodel has been calibrated trying to reproduce the solid volume accumulated in nine small check dams homogeneously distributed in the headwater basin. The simulation period starts from the check dams construction date (beginning of '90s) until 2009. The time resolution problem has been faced by comparing the results of different time-scale simulations: daily time-step, 5 minutes time-step and variable time-step (5 minutes during medium to intense events and daily during droughts and low intensity events). In order to determine the amount of sediments trapped into the ponds, trap efficiency of each check dam is computed by using a recently developed model, the STEP (Sediment Trap Efficiency model for small Ponds, Verstraeten and Poesen, 2001), and sediment dry bulk density is calculated according to Lane and Koelzer (1943) formula.
This work shows that the sedimentation volumes of small dams or ponds can provide valuable data for model calibration and validation. The model provides a satisfactory reproduction of the observed solid volumes and helps to understand the spatial heterogeneity of the sediment transport all over the watershed.