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A GIS-based method to correct sediment yield gauges in large river basins by considering dams and time

H. Schäuble, M. Hinderer

Institute of Applied Geosciences, University of Darmstadt (holger.schaeuble@gmx.de)

Sediment yield is strongly affected by man-made sinks like dams and reservoirs. Depending on hydrologic conditions a dam traps up to 100% of the sediment. This value usually referred to as trap efficiency also changes with respect of time. A dam which had been in operation from the beginning of a gauging period traps more sediment than one which had been in operation a few years only. During the 20th century the number of large dams has been increased to a mean density of 50 dams per 100.000 km2. According to their number, their specific locations and trap efficiencies the overall trap efficiency of a large river basin has changed from year to year. Thus sediment yield gauges taken at the outlet mainly reflect dam history and less the processes which do control soil erosion and sediment transport. Present-day large-scale sediment yield models are thus not well suited to predict sediment yield in ungauged basins. They are based on multiple regression analyses where dam-biased sediment yield gauges were correlated with controlling factors like relief, climate, soil or vegetation cover. To provide reliable sediment yield data a new GIS-based method was developed with which flow accumulation can be computed by considering sinks and their time-dependent retention behaviour. This enables a modeller to correct given values of sediment yield by the time-dependent influence of all dams in the river basin. We applied the developed method on sediment yield gauges and updated the specific sediment yield in t/km2/yr for all major US river basins. It can be shown that the sediment yield of the Mississippi basin must be raised from 70 t/km2/yr (database value) to 240 t/km2/yr (corrected value). For other river basins the multiplier for the specific sediment yield reaches values up to 26.