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Preservation of climate signal in catchment sediment yield: when, and when not

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Sediment yield from catchments is driven, at least in part, by external factors such as climate and tectonics which supply the energy that enables entrainment and transport of sediments. It is therefore often expected that the temporal variations in sediment yield reflect the temporal variations in these external driving forces. Recent research, however, has shown that autogenic controls from within the catchment can, in some cases, affect the transmission of the external signal. Specifically, spatially variable responses to the same external input, occurrence of threshold events, and temporary storage and release of sediments can create lags and peaks in the sediment yield, thereby diluting, obscuring or completely shredding the external signal. At the same time, however, it has also been shown that, in other cases, the external signal can be transmitted through the catchment and is thus well recorded in the catchment sediment yield. This then begs the question: under what conditions is the external signal preserved in the sediment yield, and under what conditions is it not?
This study uses computer simulation to address that question in the context of climate signals. It is hypothesized that main characteristic for a catchment's ability to autogenically affect the sediment yield signal is its spatial variability (of topography, vegetation, soil properties, ...), whereas the main characteristic of the external signal is its temporal variability (amplitude and wavelength). This hypothesis is tested using a set of 31 different catchments (15 with different topographies and no vegetation cover, and 16 with the same topography but with different assumed vegetation covers), which are subjected to a range of different rainfall scenarios over a 300-year simulation period, using the CAESAR landscape evolution model. It is expected that the sediment yield in the more homogeneous catchments will preserve the signal from all rainfall scenarios, whereas the more heterogenous catchments will only preserve those climate signals with higher amplitudes or larger wavelengths.