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Identifying climate forcing on suspended sediment transport in the high Pamir Mountains

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Climate, tectonics and erosion interact in a feedback loop to shape mountain ranges. The importance of individual aspects varies based on time-scale and regional settings. In rainfall-runoff dominated regions, like the southern margin of the Himalayas, rainfall is a good predictor for short-term erosion rates. This is because rainfall provides reliable estimates for river flow, which evacuates sediments out of the orogen. However, at geological time-scales, todays rainfall patterns often fail to explain regional erosion variability. Consequently, climatic forcing on erosion is assumed to play a subordinate role at such long time-scales.
We present recent suspended sediment analyses based on historic time-series data in the Pamir Mountains. In this high mountain environment the dominance of winter precipitation causes extensive snow cover and glaciation. The resulting runoff regime is nival-glacial and shows a temporal decoupling of precipitation and runoff. With the aid of a hydrological model, we demonstrate 1) why mean annual precipitation and temperature are irrelevant climatological parameters for erosional studies in such an environment, and 2) why knowledge about intra-annual dynamics of climatological parameters are key to still utilize precipitation and temperature as surrogate for climate. The spatial information about melting and runoff processes from the hydrological model allows to discriminate the spheres of different erosional processes and their meaning for landscape evolution. Derived interactions between climate and sediment transport through the hydrological model might help illuminate the role of climate in regions, where the climate system in the past was like the one in the Pamirs today.