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The effect of weather variability on hydrology and erosion in the Pamir Mountains

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The Pamir Mountains (Pamirs) provide a unique climatological and geomorphological setting to investigate processes of mountain shaping. The two main atmospheric circulation systems in this region, the Westerlies in the western part, and the Indian summer monsoon in the south-eastern part, provide variable amounts of moisture. Strong inter-annual variations in moisture supply in other key-meteorological parameters suggest a very variable climate. Deflection of winds at the orogene margins and advective precipitation results in a strong precipitation gradient with moist margins and an arid central and eastern part. This gradient is generally accompanied by higher glaciation and more incised valleys at the margins and weak glaciation and preserved plateaus in the central and eastern parts.

These differences seem to indicate a strong influence of precipitation and glaciation on erosion and mountain shaping, especially in the north-western part. However, recent studies utilizing cosmogenic nuclide (CN) techniques to derive basin-wide erosion rates revealed only weak correlations of modern climate with basin-wide erosion rates (integrated over $\sim$1000 years). Independent analyses of historical suspended sediment yield (SSY) data for several rivers in the Pamirs show a similar distribution of high and low erosion rates compared to the CN method. However, CN-based erosion shows factor 3 to 30 higher erosion rates than SSY.

We address this discrepancy by adopting a distributed hydrological model that we feed with state-of-the-art regional climate model, and remote sensing data. The model provides us with daily high spatial-resolution data of individual water components that allow to investigate effects of weather and weather variability on water mobilization. Based on the SSY analysis we infer individual water components responsible for sediment mobilization. We combine these findings in a coupled hydrology-erosion model approach to elucidate the complex underlying mechanisms that drive mountain shaping from a short-term meteorological -rather than a climatological- point of view.