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Global hotspots of river erosion under global warming

Thomas Reichler (1) and Piret Plink-Bjorklund (2)

(1) University of Utah, Atmospheric Sciences, Salt Lake City, United States (thomas.reichler@utah.edu), (2) Colorado School of Mines

Extreme precipitation plays a significant role for river hydrology, flood hazards and landscape response. For example, the September 2013 rainstorm in the Colorado Front Range evacuated the equivalent of hundreds to thousands of years of hillslope weathering products. Although promoted by steep topography, the Colorado event is clearly linked to rainfall intensity, since most of the 1100 debris flows occurred within the highest rainfall contour. Additional evidence for a strong link between extreme precipitation and river erosion comes from the sedimentary record, and especially from that of past greenhouse climates. The existence of such a link suggests that information about global rainfall patterns can be used to define regions of increased erosion potential. However, the question arises what rainfall criteria to use and how well the method works. A related question is how ongoing climate change and the corresponding shifts in rainfall might impact the results. Here, we use atmospheric reanalysis and output from a climate model to identify regions that are particularly susceptible to landscape change in response to extreme precipitation. In order to define the regions, we combine several hydroclimatological and geomorphological criteria into a single index of erosion potential. We show that for current climate, our criteria applied to atmospheric reanalysis or to climate model data successfully localize known areas of increased erosion potential, such as the Colorado region. We then apply our criteria to climate model data for future climate to document how the location, extent, and intensity of erosion hotspots are likely to change under global warming.