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Deformed river basins of the Himalaya

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Identification of the controls on basin morphology in mountain belts is needed to understand how landscapes evolve under changing conditions. Although river basins vary enormously in area, many of their morphological relationships, such as Hack's law, are scale invariant irrespective of mountain type. This suggests that, in most mountain belts, the fundamental process(es) that control basin morphology are also scale invariant and therefore largely insensitive to variations in tectonic activity. However, river basins in the Himalaya are anomalously wide when compared with basins developed on the flanks of other semi-linear ranges.
We present a detailed study of Himalayan river basin morphology to determine how the evolution of this orogen may have influenced the shape of these unusual basins. We investigate, in particular, the statistical geometric properties of basins, such as the length, width and area of basins, with respect to the scale and the location of the basin within the mountain belt. Our results show that the anomalously wide basins found over much of the Himalaya have a limited scale range and distribution. These data therefore provide an indication of the significant control that the evolution of this mountain range has had on basin morphology at the local scale.
The fact that these catchments have departed from what is perceived as a stable scaling relationship implies that, while their rivers can incise at a rate broadly comparable to the rate of rock uplift, their drainage divides can not migrate fast enough to reconfigure in response to tectonic shortening. As a result, long-term crustal shortening has significantly deformed the river network within the central and western Himalaya.