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Unsupervised geomorphometric feature selection based on intrinsic dimension estimation

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The geomorphometric analysis of digital elevation models (e.g., Florinsky, 2017) tends to produce high-dimensional datasets, i.e. characterized by a high number of input features. This is first related to the high number of morphometric variables and local statistical metrics (e.g., roughness indices) available for computation. Another contributing factor is related to the spatial-scale dependency of geomorphometric attributes, which can be computed considering different spatial-scale related parameters. For example, the resolution and smoothing of the input topography, the characteristics of the search window, and other distance-related parameters influence the calculation of the selected geomorphometric attributes.
Given the high dimensionality of geomorphometric datasets, the detection of redundant and relevant features plays a pivotal role both in unsupervised (e.g., landscape segmentation) as well as in regression problems (e.g., landslide susceptibility mapping). From this perspective, the recently developed estimator of intrinsic dimension (ID), based on a generalization of Morisita Index (Golay & Kanevski, 2015), and the development of a related ID-based algorithm for redundancy minimization (Golay & Kanevski, 2017) represent promising and intuitive tools.
The application of ID-based concepts and algorithms in geomorphometry opens a multitude of research pathways to be explored. In this first exploration, the feature selection algorithm is tested on typical morphometric variables and various surface roughness indices (Trevisani & Rocca, 2015).

References
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