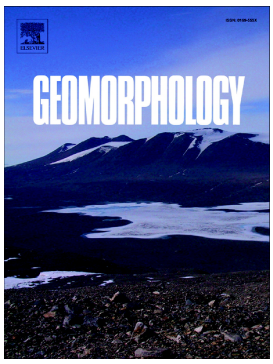

Assessing glacial modification of bedrock valleys using a novel approach

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Assessing glacial modification of bedrock valleys using a novel approach

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Abstract

Analysis of valley cross sections is an established technique for evaluating the effects of glacial erosion. Here, we present a semiautomated approach for assessing glacial modification of bedrock valleys by quantifying morphological variability in valley cross sections extracted in bulk from digital elevation models (DEMs). This method can be tailored to derive cross sections of user-specified width and spacing and can generate cross-sectional data sets of multiple orders of magnitude. We demonstrate the technique by extracting ~27,000 cross sections from the Sierra Nevada, California, and computing measures of valley morphology including a form ratio, a quadratic curve fit, and a power law curve fit for each cross section. In addition, we introduce a novel metric, the V-index, which is calculated by comparing valley cross-sectional area to that of an ideal V-shaped cross section and is, thus, an expression of the deviation from an ideal V-shaped form. Statistical comparisons of the different measures suggest that the V-index is a robust alternative to traditional morphological measures because it can accommodate irregular valley cross sections and discriminate between glacial and nonglacial forms. We document the distribution of valley forms throughout the Sierra Nevada using the V-index to identify range-scale patterns in cross-sectional morphology and to investigate the role of lithology on glacial modification of bedrock valleys.