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Differentiating tectonic and slope anomalies through a multi-scale morphometric analysis of channel gradient indices. The example of the Napa Valley (California, EEUU).

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River longitudinal profiles play a central role in morphometric studies for the evaluation and interpretation of erosional mountain ranges. Gradient variations along longitudinal profiles can be quantified and analyzed by means of the normalized channel steepness (ksn) and the SL index. Even though both indexes come from the well-known power relationship between channel slope and upstream area, the way in what the two indexes are calculated analytically is rather different. Whereas the SL index uses slopes extracted from the topographic longitudinal profile, ksn index uses an integral method that change horizontal distances by the Chi index. This latter methodology reduces the scattering that DEM-extracted slopes introduce in the SL index. In this work we presented a different approach to extract slopes along through the longitudinal profile by reducing DEM noise by taking least squares approximation. Through a multi-scale analysis with different resolution DEMs we demonstrated that both indexes show quite similar results, and that the proposed method considerably improves the results for the SL index. Small-scale anomalies related to slope instabilities can be detected through the analysis of LiDAR elevation data, whilst tectonic-related anomalies, although present in LiDAR, are clearer in 10 and 30m DEMs. Our analysis also proves that tectonic anomalies are quite robust as they can be detected in both indexes for all the analyzed DEMs.