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Objective extraction of channel heads from high resolution topographic data

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Fluvial landscapes are dissected by channels, and at their upstream termini are channel heads. Accurate reconstruction of the fluvial domain is fundamental to understanding runoff generation, storm hydrology, biogeochemical cycling and landscape evolution. Many methods have been proposed for predicting channel head locations using topographic data, yet none have been tested against a robust field dataset of mapped channel heads across multiple landscapes. In this study, four methods of channel head prediction were tested against field data from four sites with high-resolution (1m) DEMs: slope-area scaling relationships; GeoNet 2.0 [Passalacqua et al., 2010]; a contour curvature technique proposed by Pelletier [2013]; and the DrEICH algorithm, a new method presented by Clubb et al. [in prep]. Our method identifies the change from channel to hillslope topography along a profile using a transformed longitudinal coordinate system. It requires only two user-defined parameters: the m/n value, which can be determined via independent statistical analysis; and the number of linked pixels used to identify a first-order valley. Slope-area plots are traditionally used to identify the fluvial-hillslope transition, but we observe no clear relationship between this transition and the field-mapped channel heads. Of the four methods assessed, Pelletier's [2013] tangential curvature method and the DrEICH method most accurately reproduce the measured channel heads in all four field sites (Feather River CA, Mid Bailey Run OH, Indian Creek OH, Piedmont VA), with mean errors of -11, -7, 5 and -24 meters and 34, 3, 12 and -58 meters respectively. Negative values indicate channel heads located upslope of those mapped in the field. Importantly, these two independent methods, one based on contour curvature and the other based on the geometry of longitudinal profiles, produce mutually consistent estimates, providing two tests of channel head locations based on independent topographic signatures.