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Hydrogeomorphic edge-detection and delineation of landscape functional units from high-resolution LIDAR DEMs

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A new method for delineating hydrogeomorphic elements from high-resolution digital elevation models (DEMs) is presented. Two case studies are discussed to illustrate the delineation and typological characterization of hydrologic response units in the Boreal Shield regions of central and northwestern Ontario, Canada. Briefly, two-dimensional edge-detection is used to identify boundaries defining abrupt changes in expected hydraulic gradient, modelled using the
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$alpha_d$ index of landscape drainage potential. These boundaries effectively discretize the landscape into structural and functional units exhibiting hydrological and/or biogeochemical similarity. The technique is robust, scale-adaptive and reasonably parameter insensitive. Moreover, thresholding and classification of landscape elements is accomplished using
textitphysically-based geomorphic indices such as the topographic wetness index, the
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$alpha_d$ index of landscape drainage potential, and a topographically derived index of mean residence time. We propose hydrogeomorphic edge-detection as a way to improve the spatial characterization of Boreal Shield landscapes and to improve conceptualization of hydrologic and biogeochemical processes in field- and model-based watershed ecosystem research.