Digital Elevation Models and Hydrology

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Abstract. Digital elevation models (DEMs) are a useful data source for the automatic delineation of flow paths, sub watersheds and channel networks for hydrologic modeling. The scale (drainage density) of the flow network, used controls the scale of hillslope and channel model elements and the distinction between hillslope and channel processes. Although field mapping is acknowledged as the most accurate way to determine channel networks and drainage density, it is often impractical, especially for large watersheds, and DEM derived flow networks then provide a useful surrogate for channel or valley networks. There are a variety of approaches to delineating flow networks, using different algorithms such as single (drainage to a single neighboring cell) and multiple (partitioning of flow between multiple neighboring cells) flow direction methods for the computation of contributing area and local identification of upwards curvature. The scale of the delineated network is sometimes controlled by a support area threshold, which may impose an arbitrary and spatially constant drainage density. This paper reviews methods for the delineation of flow networks using grid DEMs. The question of objective estimation of drainage density is addressed and a method based on terrain curvature that can accommodate spatially variable drainage density is presented. The spatial flow field determined from a DEM can also serve as a basis for routing overland and topographically driven subsurface flows useful in water quality, erosion and terrain stability modeling. New DEM derived quantities, such as downslope influence, upslope dependence, decayed accumulation, downslope accumulation and transport limited accumulation are illustrated. The methods presented have been incorporated into software (TauDEM) developed to support hydrologic and water quality modeling and available from http://www.engineering.usu.edu/dtarb/.

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