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Terrain analysis and the modeling of catchment architecture

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Topography is an important land surface attribute for hydrology that, in the form of Digital Elevation Models (DEMs), is widely used to derive information for the modeling of hydrologic processes. Much of this analysis is conditioned upon the model for the topographic representation of downslope flow. The D-infinity multiple flow direction model provides an effective representation of topographic downslope flow that balances consideration of grid bias and numerical dispersion. This paper will present some new methods for deriving catchment properties from DEMs that provide information on the organization and connectivity of flow paths useful for hydrologic modeling and catchment characterization. Functions implementing the new methods extend the general recursive method for deriving contributing area from the D-infinity multiple flow direction model which apportions flow between downslope grid-cell neighbors based on the slope vector. A new weighted flow distance to stream function averages the "weight" moving through multiple flow paths from each point in the domain to the stream or other downslope reference point. This is an example of a general function which can specifically be used to estimate potential for sediment and nutrient filtering by streamside vegetation, by specifying vegetation cover as the weight. This function can also be used to provide a definition for connectivity in the context of multiple flow paths and identify areas that are connected to streams. New functions that examine elevations on upslope and downslope flow paths can determine the average rise to ridge and drop to stream which together determine hillslope position useful for soil depth modeling. A new avalanche runout function determines the

zone with downslope gradient greater than a critical angle (alpha) and is useful for mapping avalanche or potential landslide hazards. These new functions exploit a general methodology for working with the D-infinity flow direction model for defining a general class of tools useful in terrain analysis.