

## **Soil–landscape delineation to define spatial sampling domains for hillslope hydrology**

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#### Abstract

Soil hydrological properties are highly variable in space. Field measurements of these properties are costly and error prone. As spatially distributed approaches become increasingly important in current hydrological and ecological modeling, an appropriate field sampling scheme to effectively capture spatial variability of hydrological processes becomes essential. A terrain-based slope classification system was applied to delineate the hillslope into representative hydrological domains. This model assumes that there are hydrological landscape units (LUs) along the hillslope in which distinct sets of hydrological and pedological processes occur. Possible water and material flows over the hillslope were first interpreted using a continuity equation of mass flow over the surface, and subsequently included in a terrain analysis. The developed terrain index is able to characterize the hydrological processes, accommodating both continuous and discrete concepts. The model was tested against the intensive soil moisture data at the Tarrawarra catchment, Australia [Water Resour. Res. 34 (1998) 2765]. The delineated soil–LUs explain up to 73% of the average soil moisture variation when it is combined with other terrain parameters (surface curvature, upslope contributing area and slope aspect). Soil moisture at each LU shows significantly different variance characteristics when

compared with other units, and the delineation procedure reduces the spatial variation of soil moisture within each LU. Random permutation and bootstrapping techniques indicate that stratified random sampling based on the delineated hillslope units significantly reduces the number of samples needed to estimate the average soil moisture and the overall error of estimation.

**Author Keywords:** Catena; Stratified random sampling; Soil hydrological properties; Soil–landscape analysis; Hydrological modeling



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