



Soil Moisture and Streamflow Relationship in Forested Hillslope: A Perspective on their Hysteretic Behavior.

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The hysteretic behavior between soil moisture and streamflow has received only little attention in the context of hillslope hydrological processes, despite the overarching role it plays in the understanding of the temporal and spatial dynamics of hillslope responses. In this study, hydro-meteorological data were collected daily on bi-hourly basis from 2009 to 2013 over 56 soil moisture measuring points at various depths (10, 30, and 60 cm) with 147 distinct storm events chosen for investigation. A bivariate analysis approach was implemented to characterize 8,232 hysteretic behaviors between streamflow and soil moisture with a view to exploring its patterns and uniformities using data obtained in the following timescale - the whole period of campaign, seasonally and storm event. In addition, hydrological control features such as antecedent soil moisture, rainfall intensity and duration, soil depth and hillslope positions were examined to establish the degree of control it poses on hillslope responses. Our investigation showed three dominant responses – clockwise, counter-clockwise and no response. Clockwise response which implied that streamflow peaked before soil moisture, governed the entire period of campaign with the frequency of responses significantly decreasing as depth increases, except for some downslope points located around the riparian zone. Furthermore, distinct variation in the hysteretic behavior of the hillslope under seasonal timescale was observed, with clockwise responses dominating summer and fall season whereas counter clockwise responses prevailed in the spring season. Our findings further reveals that antecedent soil moisture condition and soil depth were the major drivers that influenced the general response of the hillslope.