



Upscaling of point soil moisture observations to spatial averages in a gully catchment of the Loess Plateau

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A gully catchment of the Chinese Loess Plateau geographically constitutes two components: hillslopes and gullies. The complex topography of gully catchments especially gullies leads to the difficulty of measuring in situ soil moisture content. Based on soil moisture datasets (0-20, 20-40, 40-60 and 60-80 cm) from 2010-2012 in the Yuanzegou catchment of the Loess Plateau, this study attempted to estimate spatial mean soil moisture of hillslopes, gullies and the whole catchment from one single hillslope location for each layer, by coupling time stability analysis with observation operators. The soil moisture datasets in 2010 and 2011 were used for time stability analysis and development of observation operators. The datasets in 2012 were used for validation. The results showed that soil moisture of hillslopes exhibited considerable time stability and the degree of time stability increased with depth. Topography (slope angle and position) was the main factor affecting time stability at surface layer (0-20 cm) while clay content was main factor at subsurface layers. The spatial averages of hillslopes were accurately estimated from that of the time-stable location for each depth. Furthermore, spatial averages of gullies and the whole catchment were accurately estimated from the same single hillslope location through the developed observation operators. The validation analysis indicated that the time-stable location and the developed observation operators were temporally robust.