

Heterogeneity of Soil Moisture and Its Impacts on the Mountainous Watershed Hydrology in Northwest China

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Abstract : Heterogeneity of soil hydraulic properties directly affects hydrological processes at different scales. Understanding heterogeneity of soil hydraulic properties such as soil moisture is therefore essential for modeling watershed ecohydrological processes, particularly in hard to access, topographically complex mountainous watersheds. This study maps spatial variations of soil moisture by in situ observation network that consists of sampling points, zones, and tributaries, and monitors corresponding hydrological variables of air and soil temperatures, evapotranspiration, infiltration, and runoff in the Upper Reach of the Heihe River Watershed, a second largest inland river (terminal lake) with a drainage area of over 128,000 km² in Northwest China. Subsequently, the study uses a hydrological model, SWAT (Soil and Water Assessment Tool) to simulate the effects of heterogeneity of soil moisture on watershed hydrological processes. The spatial clustering method, Full-Order-CLK was employed to derive five soil heterogeneous zones (Configuration 97, 80, 65, 40, and 20) for soil input to SWAT. Results show the simulations by the SWAT model with the spatially clustered soil hydraulic information from the field sampling data had much better representation of the soil heterogeneity and more accurate performance than the model using the average soil property values for each soil type derived from the coarse soil datasets. Thus, incorporating detailed field sampling soil heterogeneity data greatly improves performance in hydrologic modeling.

Keywords : heterogeneity, soil moisture, SWAT, up-scaling

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