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Investigating thickness and physical properties of forest soil along headwater hillslopes by hole drilling method

Xiaole Han (1,2) and Jintao Liu (1,2)

(1) State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, Hohai University, Nanjing, China(hanxiaole90@163.com), (2) Department of College of Hydrology and Water Resources, Hohai University, Nanjing,China

Mountain torrents along headwater hillslopes usually occur during heavy rainfall and bring damage to people's lives and properties. Thus, the mechanism for flood generation process in mountain areas must be well studied. Soil acts as an important factor controlling this process. However, systematic studies the spatial distribution of soil properties, including soil thickness, bulky density, texture and infiltration rate along headwater hillslopes are rarely obtained. Therefore, the objective of this study is to explore the variation trend of these soil properties in a 3-D perspective. To do this, a total of 39 probe measurements were made by using a 70-mm-diameter gasoline vibrating drill in a small catchment (0.42 hectare). Measurements were made by push the gasoline drill into the soil until the bedrock was encounted. Then, the drill was pushed out from the soil and the undisturbed soil was obtained. The main results of the experiment show that: (a) soil thickness decreased significantly from the valley to the ridge (e.g., the maximum soil thickness in the valley and ridge are 164cm and 81 cm, respectively). (b)Vertically, taking borehole #1 as an example (148cm deep), the saturated hydraulic conductivity decreased significantly from 1.5 mm/min (0cm deep) to 0.01 mm/min (140cm deep). Spatially, the saturated hydraulic conductivity at same depth increased with the elevation increasing. (c) Particle size analysis indicated that the soil clay content increased with increasing sampling depth. To conclude, our study reveals the spatial distribution of soil properties which can help us to explore flowpaths and store in three-dimensional at hillslope scale and develop a parsimonious 3-D physics-based model to simulate hillslope hydrological response.