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Variability of the Soil Moisture Regime with Soil Depth and Topography: examples from a small watershed and a hillslope transect.

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Relationship between the spatial patterns of soil moisture pressure head, soil depth and topography is very important to understand the dynamics of infiltrated rain water into the soil matrix. Infiltrated water determines the formation of saturated zone and accounts for nearly all the water that is delivered to the stream channel system on undisturbed steep forested hillslopes. We analyzed the spatial variability of soil moisture pressure head in a small catchment (0.2 ha) and along a heavily instrumented hillslope transect (~25 m) within a roaded catchment in the Fudoji experimental watershed, Shiga, Japan. We monitored these variations at different depths on 51 observation nodes within the two sites from the soil surface to the soil-bedrock interface for more than six month period. Pressure head at each observation node was measured using tensiometers connected to a pressure transducer and a data logger (CR-10X). A 2D analysis of the pressure head propagation from the hillslope transect in response to precipitation was done. The result shows that saturated zone starts to develop from the shallow mid slope to the relatively deeper lower slope and expands progressively to the upper slope with increase in precipitation. The saturation zone tend to deplete quickly in the shallow mid slope and tends to last longer in the deeper bottom slope section of the hillslope transect. Results from systematically installed observation nodes on the small catchment shows a spatially organized soil moisture variation with depth in a relatively flat area especially at a mid slope location. The formation of saturated zone along this flat zone is due to total depth of water stored in the soil profile throughout the drying and wetting season which is governed by difference in soil depth. The saturated zone at a 2.3 m deep observation node sustained throughout the monitored period. However, the shallow observation node above the catchment outlet shows a higher peak pore water pressure than the observation node placed at the soil-bedrock interface at the same location. These phenomena could be attributed to a steeper local surface topography. The variation in soil depth and topography caused the differences in soil moisture condition between upslope, mid slope and lower slope sections of the experimental sites. As a result the changes in topography and soil depth dictate the routing of infiltrated water to downslope sections and thus the amount of water stored in the soil profile.

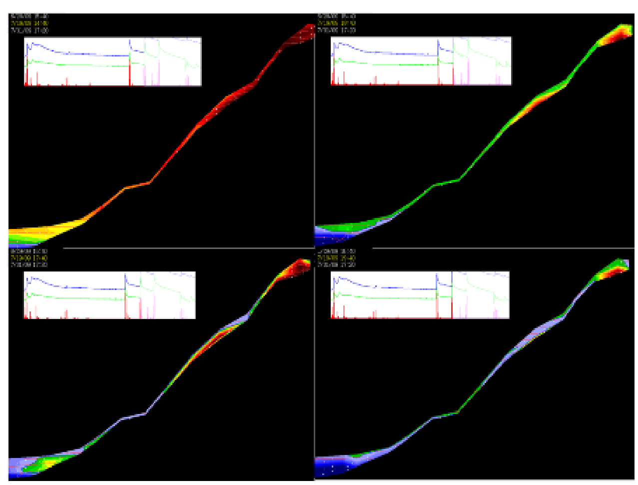

Fig.1 Pressure head propagation along a hillslope transect in response to change in soil moisture.