Evaluating soil physical properties and their spatial variability in a headwater catchment

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Soil-bedrock interface is a Critical Zone for various hydrogeomorphic processes such as flow paths, developing groundwater, and slope stability. Soil-bedrock is an important parameter which it is in contact with the hydrosphere, is composed of chemically and physically altered or weathered rocks. The soil-bedrock interface is hard to be measured and estimated in hydrogeomorphic and pedological studies, even for small catchment areas. The processes that control the formation and thus the present-day depth to the bedrock are, however, poorly quantified and few predictive model exists. Our estimates of soil depth geometry are based on very sparse measurements and mostly rely on empirical relationships or correlations. Nowadays, there is a scarcity in the methodologies to define the spatial distribution and soil properties of this parameter on the slopes. Several direct and indirect measurement methods have been used to estimate depth to bedrock. Examples of direct measurement methods include rod penetrometers, excavated pits and Knocking Cone Penetration Test (KCPT). This last measurement device is particularly promising as it can help delineate soil stratigraphy and layers with contrasting hydraulic properties. In recent years, efforts have been made in order to understand the mechanisms/processes leading to the initiation and propagation of landslides and debris flows and to develop new approaches for soil depth estimation model. In particular, the 2009 landslide and debris flow disasters, in which rapid flows of rock boulders, soil and organic material sweeping down the narrow channels of Hofu city, Yamaguchi prefecture - Japan, caused loss of life and innumerous damages have been the focus of the studies. In this work, we present a detailed field investigation of a small catchment area in natural forested region of the Hofu city, Japan. We developed methods for analyzing depth of soil-bedrock interface and soil physical properties using the Knocking Cone Penetration Test (KCPT). Our findings show, the high spatial variability for the formation of soils vertical profiles possibly relate to recurrences of landslides and subsequences of formation of soil by weathering granite.

Keywords: Soil Depth , Soil Properties , Field investigation, Knocking Cone Penetration Test (KCPT)

