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Natural Tracers in the Hydrological Cycle of a Small Mountainous Watershed

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Uhlirska ($1.78\ km^2$), is a typical watershed with the crystalline bedrock forming Cambisols as 60% of the area of the Czech Basin. It is situated in a humid mountainous region where soils are typically shallow and highly permeable with preferential pathways. As a result of these facts, outflow caused by storms can be of a quick response and high magnitude. Monitoring of the hydrological processes in the soil profile, such as soil suction, soil moisture and instant subsurface outflow detected the instabilities typical for the preferential flow. Based on the observations performed, it becomes evident that the soil profile plays dominant role in the rainfall-runoff transformation. To obtain other components of the hydrological cycle, the site is accompanied with the climatic station recording barometric pressure, air temperature at several elevations, soil temperature, net radiation, wind speed and air humidity on a continuous basis.

Quantitative measurements however lack the information about the nature of the transformation in space and time. Therefore additional techniques are utilized. As a supplement to geophysical measurements performed earlier, showing the bedrock is decayed and significantly fractured a new multi-electrode resistivity tomography was employed. The watershed scale measurements are aimed to depict the closer image of the examined subsurface in terms of the aquifer dimension and water bearing fractures as well as intact bedrock.

Due to the fact that the behavior of flow of water in the heterogeneous porous media and highly heterogeneous hydrogeological structure is not fully understood, a targeted study employing the stable oxygen isotope ^{18}O and the silica as SiO_2 variation in the hydrological processes is in progress. These activities cover the sample collection of rainfall, snowmelt, snow cover, subsurface stormflow, groundwater, soil water from

suction lysimeters and the stream outflow at two gauging stations. Silica is not sampled in the meteoric water (snowmelt and rainfall) assuming not to be present. Based on the measurement and analyses performed, preliminary conclusions are being drawn. Soils on the hillslopes exhibit limited transformation effect. On contrary to glacial sediments in the valley aquifer contain a large amount of water, serving as a significant buffer for mixing water of the varying signature of ^{18}O during the seasons. Analyzing geochemical and isotope data, the hypothesis of the dominant impact of the subsurface outflow on the watershed streamflow has been supported. Quick subsurface outflow from the soil profile and the outflow from the watershed show similar dynamics based on the analyses of water quantity and its dynamic and concentration of the selected natural tracers.

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