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Influence of bedrock topography on the runoff generation under use of ERT data

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Subsurface topography has been identified to play a major role for the runoff generation in different hydrological landscapes. Sinks and ridges in the bedrock can control how water is stored and transported to the stream. Detecting the subsurface structure is difficult and laborious and frequently done by auger measurements. Recently, the geophysical imaging of the subsurface by Electrical Resistivity Tomography (ERT) gained much interest in the field of hydrology, as it is a non-invasive method to collect information on the subsurface characteristics and particularly bedrock topography. As it is impossible to characterize the subsurface of an entire hydrological landscape using ERT, it is of key interest to identify the bedrock characteristics which dominate runoff generation to adapt and optimize the sampling design to the question of interest.

For this study, we used 2D ERT images and auger measurements, collected on different sites in the Attert basin in Luxembourg, to characterize bedrock topography using geostatistics and shed light on those aspects which dominate runoff generation. Based on ERT images, we generated stochastic bedrock topographies and implemented them in a physically-based 2D hillslope model. With this approach, we were able to test the influence of different subsurface structures on the runoff generation. Our results highlight that ERT images can be useful for hydrological modelling. Especially the connection from the hillslope to the stream could be identified as important feature in the subsurface for the runoff generation whereas the microtopography of the bedrock seemed to be less relevant.