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Dominant runoff processes, conceptual models and meso-scale regionalization

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In hydrological modeling the use of detailed soil data is sometimes troublesome, since often these data are hard to obtain and, if available at all, difficult to interpret and process in a way that makes them meaningful for the model at hand. Intuitively the understanding and mapping of dominant runoff processes that occur in the soil shows high potential for improving hydrological models. In this study a labor-intensive methodology to assess dominant runoff processes is simplified in such a way that detailed soil maps are no longer needed. Nonetheless, there is an ongoing debate on how to integrate this type of information in hydrological models. The various strategies can be grouped in either a top-down or bottom-up approach. This study tries to synthesis these two approaches. First, dominant runoff processes (DRP) are mapped for meso-scale basins using the permeability of the substratum, land-use information and the slope in a GIS. During a field campaign the processes are validated and for each DRP assumptions are made concerning their water storage capacity. The latter is done by means of combining soil data obtained during the field campaign and soil data obtained from the literature. The approach defines eight different DRP and can be considered as bottom-up. Second, several parsimoniously parameterized conceptual hydrological models are used that incorporate certain aspects of the DRP. The result of these models are compared with a benchmark model in which the soil is represented as only one lumped parameter to test the contribution of the DRP in hydrological models. The modeling approach can be considered as top-down. The proposed methodology is tested for 15 meso-scale river basin located in Luxembourg. The main goal of this study is to investigate if integrating dominant runoff processes, which have a high information content concerning soil characteristics, with hydrological models allows the improvement of simulation results. The proposed methodology could thus enhance hydrological predictions in basins where conventional soil data (i.e. soil maps) is lacking.