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Testing an approach combining water balance and recession curve analysis to partition catchment storage in hydrological connected and disconnected storage compartments

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The questions of where and how much water is stored in the critical zone are recognized as a key question in hydrological processes research. Answering these questions is particularly challenging at catchment scale, due to the physiographic complexity on the one hand, and related challenges inherent to the required sensor networks on the other hand. From this perspective, we used a combined lumped approach that allows differentiating between two types of catchment storage: a hydrological connected storage (i.e. the storage that contributes to streamflow dynamic) and a hydrological disconnected storage (i.e. the remaining storage balance that describes storage dynamics in the vadose zone). Our approach combined water balance calculation and a recession curve analysis. The water balance calculation describes the total water stored in the catchment, while the recession curve analysis describes the hydrological connected storage. The disconnected storage was derived by subtracting the connected storage from total storage. We applied our combined approach in the forested Weierbach headwater catchment in Luxembourg (0.45 km2). Storage estimates were compared to measurements of a sensor network. Connected storage dynamics were compared to records from wells, whereas disconnected storage was compared to a dense soil moisture monitoring network. Preliminary results gave differences for both methods in their storage representations, ultimately impacting the results of the combined approach. In such circumstances, our approach could not be used to generate time series of disconnected storage. However, our combined approach seemed to be a good way to estimate storage ranges and to define where the water is stored in catchment following their connected or disconnected parts. For example, the connected and disconnected storage values were estimated at 100 mm and 150 mm for the Weierbach catchment, respectively. Furthermore, the combined approach gave information on how the inputs of water are split in connected and disconnected storages. For example, we observed a strong storage threshold effect for the Weierbach catchment. After the wetting period, all new amounts of water were directly transferred to the connected storage. These temporal storage dynamics may have strong impacts on the mixing and transit time of water within a catchment. In a next step, we will apply this approach to the nested catchment set-up in the Attert basin (250 km2 in Luxembourg), which is characterized by different bedrock geology (i.e. sandstone, marls and schist). We aim at determining the role of bedrock geology on storage dynamics and to see if this potential storage variability has an influence on stream geochemistry.