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On the identification of hydrogeological reservoirs in a proglacial catchment and their future groundwater storage

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Rapid glacier retreat leads to the emergence of new rocky landscapes. The common assumption of the presence of bare bedrock underlying glaciers and the closely related assumption that glacier and snow melt manifest themselves essentially as surface runoff, is challenged by the rapid sediment accumulation and the formation of geomorphological landforms where water may be infiltrated and stored. Although some studies have provided rough estimates of groundwater storage and release in high elevation catchments, the actual reservoirs providing baseflow discharge are difficult to identify. While the combined effect of future glacier decline and earlier snowmelt are well recognized, it remains unclear how the rapid hydrogeomorphological transformations will modify the potential groundwater stores.

In this study we will provide results of a case study of a glaciated catchment in the Swiss Alps. Firstly, we will discuss, based on a simple modelling approach, the hydrological functioning of different landforms and show to which extend each hydrological unit is currently contributing to groundwater storage. We will then focus on a detailed assessment of the hydrological dynamics of an outwash plain using a 3D Modflow modelling approach. We will show how such a small fluvial aquifer is connected to other landforms and how it can maintain high storage during much longer time scales than other landforms due to strong river-groundwater interactions. Even though the current storage of the outwash plain is limited, we will discuss how glacier retreat may increase its relative contribution in the future. Finally, we will focus on the remaining unidentified storages in our field study and we will provide some geochemical analysis of their potential location and finally conclude with a summary of the hydrogeological functioning of a rapidly deglaciating proglacial catchment.