Modeling hydrological processes of sand-storage dams on different scales

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In Kitui and Machakos (Kenya) many hundreds of sand-storage dams have been constructed in the last 25 years. The basic principle of such dams is that water is stored sub-surface instead of at the surface for livestock, irrigation and domestic use. The sub-surface reservoirs are recharged through flash floods. Spatial and temporal distribution of the rainfall events has a large impact on effective recharge of dam storage. Local testimonies suggest that in areas with dams the natural water system is influenced considerably, up to effects on local groundwater sources and wells. However, to explain this influence is not straightforward. Interactions between a dam and its local groundwater system are quite complex to estimate, let alone how a network of several dams influences the regional groundwater system on the long run (10 to 15 years). These questions are important from a scientific and applied perspective. Modeling hydrological processes of (networks of) dams will help answering them. This paper will discuss modeling in relation to two issues: how to estimate the robustness of sand-storage dams under climate change (determining suitability of the technology in other regions) and how to assist allocating available resources to different use(r)s. In an earlier study it was estimated that the superficial groundwater system above the bed rock (when assumed impermeable) cannot explain regional effects of dams. Thus, the deeper groundwater needs to be taken into account, particularly the influence of the bed rock on dam hydrology. It needs to be established how interactions between dam reservoir, riverbanks and bed rock can be understood, both for single dams as for small networks of dams. This paper discusses first results of these two modeling efforts to study these interactions. To be able to compare and exchange results the same modeling environment (Modflow) was applied for the two cases.