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# Distributed modelling of water resources in the Lower Jordan River Basin - from present day variability to suitability for new water sources

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The Middle East is characterized by a high temporal and spatial variability of rainfall. As a result, water resources are not reliable and severe drought events are frequent, worsening the natural water scarcity. Single high magnitude events may dominate the water balance of entire seasons – a fact that is poorly represented in the assessments of available water resources that are normally based on long term averages. Therefore, a distributed hydrological model with a high temporal and spatial resolution is applied to the Lower Jordan River basin (LJRB). The focus is hereby to capture the variability of rainfall and to investigate how this signal is amplified in the hydrological cycle in this arid and semi arid environment.

Rainfall variability is addressed through a volume scanning rainfall radar providing precipitation data with a resolution of 5 minutes for entire seasons that serves as input to a conceptual hydrological model. The raw radar data recorded by a C-Band system was pre-corrected by a multiple regression approach prior to regionalization to the LJRB, ground truthing with rainfall station data and conditional merging. Despite certain uncertainties, the data documents the accentuated rainfall variability in the entire LJRB. In order to include the full range of present rainfall variability, one average and two extreme seasons (wet and dry) are studied. Hydrological modelling is undertaken with a new modelling tool created by coupling two hydrological models, TRAIN and ZIN, complementing each other in respect to the addressed processes and water fluxes. The resulting modelling tool enables conceptual modelling of the processes relevant for semi-arid / arid environments with a high temporal and spatial resolution.

The model is applied to the large scale LJRB (16,000 $km^2$) in order to simulate all components of the water balance for three rainy seasons representing the present climate variability. Under given conditions of low data availability, the results give a basin wide view on the availability of surface water resources without human intervention with a high resolution in time (5 min) and space (up to 250 x 250 $m^2$). The scarcity of water resources in many areas within the region is illustrated and detailed maps of the water balance components reveal spatial pattern of water availability characterizing the different potentials of regions or sub basins for water management options. Moreover, comparing different climate conditions provides valuable information for water management, including insights into the relation between green and blue water. For instance, runoff generation and percolation react stronger to changes in precipitation than evapotranspiration and the changes in runoff and percolation are considerably higher than the differences in rainfall between the three years. This amplification of rainfall variability by the hydrological cycle is significant for water management. Based on the results for current conditions, the impact of different scenarios and management options is analyzed, e.g. the effect of land use changes or the suitability of different regions for rainwater harvesting, one of the urgently needed new water sources.