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Jordan River
GLOWA

Modeling water resources and variability in the Lower Jordan River Basin: Learning from the present for the future

Key findings

TRAIN-ZIN, a hydrological model developed for semi-arid areas, supports water management decisions by providing spatially-distributed estimations of all water balance and wadi runoff elements (Gunkel & Lange 2012).

An application in the Lower Jordan River Basin (LJRB) provides an inaugural basin-wide view of the availability of water resources without human intervention. By analyzing the natural variability in the basin given by a wet, an average, and a dry season, the two most significant findings are:

- Percolation and surface (wadi) runoff are highly variable in extreme events and considerably reduced during drought years. In contrast, the amount of water lost by evaporation is more constant.
- Present-day variability is so high that variability of future seasons will likely be within the same range, even under climate change conditions. A combination of the results from present-day climatic variability with present and future water demand can therefore be used to optimize water management in the region.

Overview and Objectives

The TRAIN-ZIN model combines physically-based and conceptual approaches to incorporate all dominant hydrological processes of a semi-arid area. Its routines include interception, evapotranspiration, snow melt and sublimation, overland flow generation, runoff concentration and channel routing. It allows for continuous modeling at a high temporal and spatial scale, including both wet and dry periods.

Input to the model consists of grids, time series, and parameter values; the user controls the model setup via a text file. The main outputs of the model are daily maps or basin averages of all water balance components (rainfall, evapo-transpiration, surface runoff, percolation). Additionally, hydrographs at any location in the basin are calculated, taking into account channel transmission losses. This information is not only valuable on its own, but can serve as a base for water management strategies.

Research Methods

The application of TRAIN-ZIN to the LJRB combines all available data at its broadest temporal and spatial resolution (5-7 min, 250 x 250 m^2) and ben-

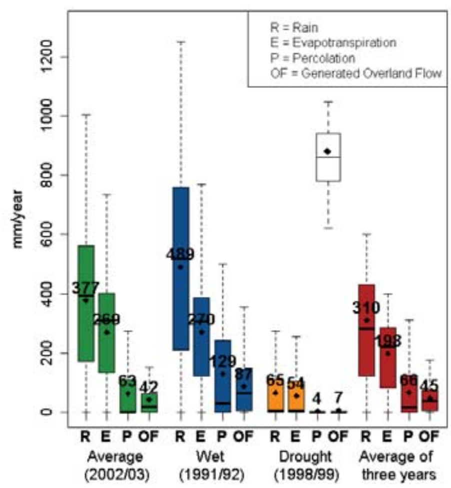

Figure 1: Variability of seasonal water balance components in the 250 x 250 m^2 pixels of the Lower Jordan River Basin.

Teams of researchers from Germany, Israel, Jordan and the Palestinian Authority work on how best the hazards posed by global change to the future of the Jordan River basin can be faced and overcome.

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The GLOWA Jordan River project is part of a larger research initiative launched by the German Federal Ministry of Education and Research under the title "Global Change and the Hydrological Cycle".

http://nbn-resolving.de/urn:nbn:de:bsz:21-opus-68881

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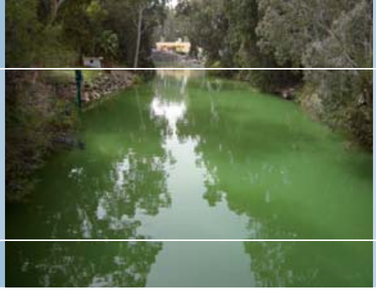

efits from high-resolution rainfall radar data. Estimates of natural seasonal water availability are delivered excluding anthropogenic impacts, i.e. human abstractions, diversions and sewage disposals. Three hydrological years are simulated: a drought (1998/99), an average season (2002/03) and a wet extreme (1991/92). Seasonal water balance components range considerably, both in space and in time (Figure 1).

Since gauged stream flow data is rare and, if available, reflects only a heavily altered regime including abstractions and diversions, model results had to be checked against long-term estimates of natural wadi runoff volumes. These estimates differ substantially, but modeled volumes lie within their range (Figure 2).

Model outputs are representative only of the investigated seasons, but represent the non-linear behaviour of semi-arid systems. On the one hand, surface runoff generation and water percolation are significantly reduced during droughts due to a more constant seasonal evapo-transpiration loss. On the other hand, runoff generation and percolation occur mainly during single high magnitude events. Potential evapo-transpiration rates are high in the LJRB, but actual evapo-transpiration differs between areas and seasons and is strongly limited by available precipitation. This pattern is an important consideration in designing land-use scenarios or sustainable water management approaches.

Conclusions

By choosing extreme seasons in terms of rainfall, our simulations span the entire present-day climatic variability and can be seen as benchmark for climate change scenarios. Combined with estimates of present and future water demand, this information can be the base for adaptive water management.

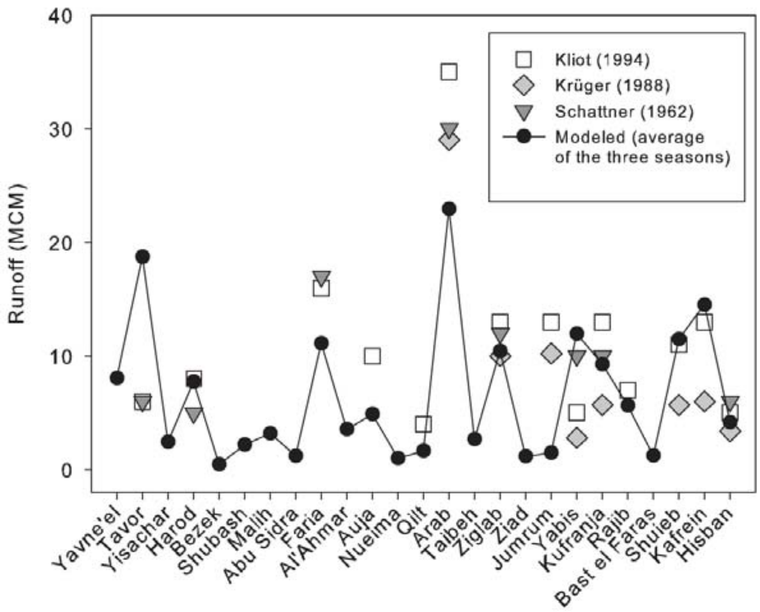

Figure 2: Simulated wadi runoff (average of the three seasons) compared to long-term literature values (Kliot 1994, Krüger 1988, Schattner 1962).

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GLOWA JR Briefings present relevant scientific results of the GLOWA Jordan River project concerning the effects of climate and global change in the Jordan River basin.

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