BRIEFING / 20

January 2010

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Key findings

1. Understanding was gained of the dominating runoff generation process* in a typical arid region.
2. Event based (Fig. 1) and continuous rainfall-runoff modeling was successfully completed.
3. The annual runoff volume ranges between 0.24 to 1.5 Million Cubic Meters (MCM). This is the first accurate measurement of this kind using a physically-based rainfall-runoff model confirmed by observed values.
4. Some localized areas contribute more than others to runoff (partial area contribution), e.g. only 10% of the entire catchment contributed 73% of the generated runoff (Fig. 1).
5. Large transmission losses take place while the water flows from the upper section to the catchment outlet.
6. The TRAIN-ZIN model successfully answered the following questions:
   How much water
   (a) is lost by evapotranspiration;
   (b) percolates to the groundwater;
   (c) naturally flows as runoff in the ephemeral streams. This accurate assessment of seasonal water behavior balances the amount of precipitation in the entire Faria catchment (Fig. 2).

* Hortonian (HOF) and/or saturation excess overland flow (SOF)

Hydrological modeling in a typical arid catchment: Wadi Faria, West Bank, Palestine

Introduction

Understanding runoff generation mechanisms is a basic challenge for hydrologists seeking to understand the evaluation and quantification of water resources in arid and semi-arid catchments. In Faria catchment, located in the northeastern part of the West Bank, Palestine, hydrological modeling has been carried out only to a limited extent. Also, the rainfall-runoff processes in the Faria catchment were modeled with limited hydro-meteorological and spatial data.

Objectives

The primary goal was to obtain reliable estimates of naturally available surface water resources in the Faria catchment, one of the catchments contributing to the Lower Jordan River Basin (LJRB). For this purpose, an up to date process-oriented and physically-based distributed rainfall-runoff model (TRAIN-ZIN) was applied. Three years of monitoring rainfall and runoff combined with thorough field campaigns (e.g., measuring infiltration rates, (Fig. 3) are considered the cornerstones for the success of the model application. The coupled TRAIN-ZIN model was first calibrated and validated for selected single events, and then applied in a continuous mode for entire rainy seasons 2004/05, 2005/06 and 2006/07 (the period from the first of October till the end of April). During these three seasons, we provide answers to the following questions:

1. What are the active runoff generation processes in arid and semi-arid regions (HOF and/or SOF)?
2. Which data should be collected and how to acquire data in the field-work period? What is the quality of the data (spatial data and attribute data)?
3. How can we provide improved estimations of catchment initial conditions (e.g., soil moisture content, infiltration rate, hydraulic conductivity)?

Conclusions

Despite of difficulties, limitations and uncertainties associated with obtaining observations and measured parameters, this study came up with optimistic results for the simulation of single events and entire seasons in a continuous mode. Subsequent to the successful calibration, validation and application of the coupled TRAIN-ZIN model for the Faria catchment, it can be concluded that the model proved its applicability for a typical arid catchment with parameters determined directly in the field and through calibration. Rainfall characteristics (mainly the rainfall intensity) and the initial soil

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 in the Hydrological Cycle”.

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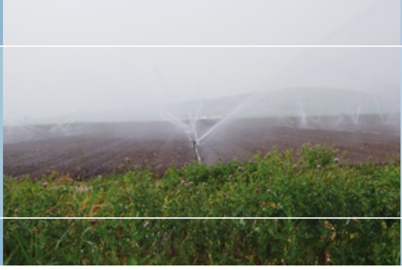


moisture content are the main parameter that controlled the runoff generation processes (HOF and/or SOF) that took place in the Faria catchment. The determination of parameters controlling runoff generation (mainly the infiltration rate) directly in the field is of great importance for model calibration and application.

Through the analyses of the model output, a determination of the main runoff contributing areas and the main runoff generation process is possible. The seasonal water balance, which can be obtained from the coupled TRAIN-ZIN model, can be utilized to develop best management practices for managing the scarce water resources in the region, under current and future global change conditions.

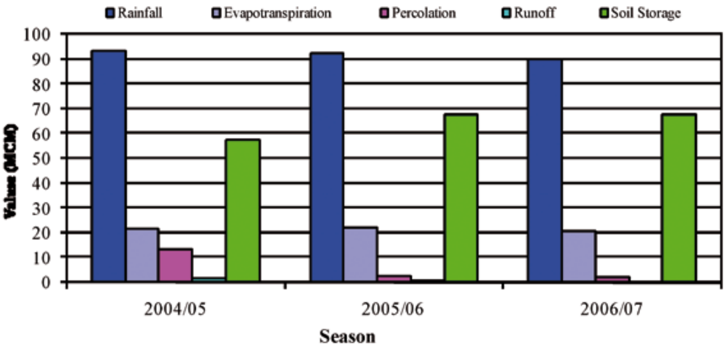

Figure 2: Seasonal water balance.

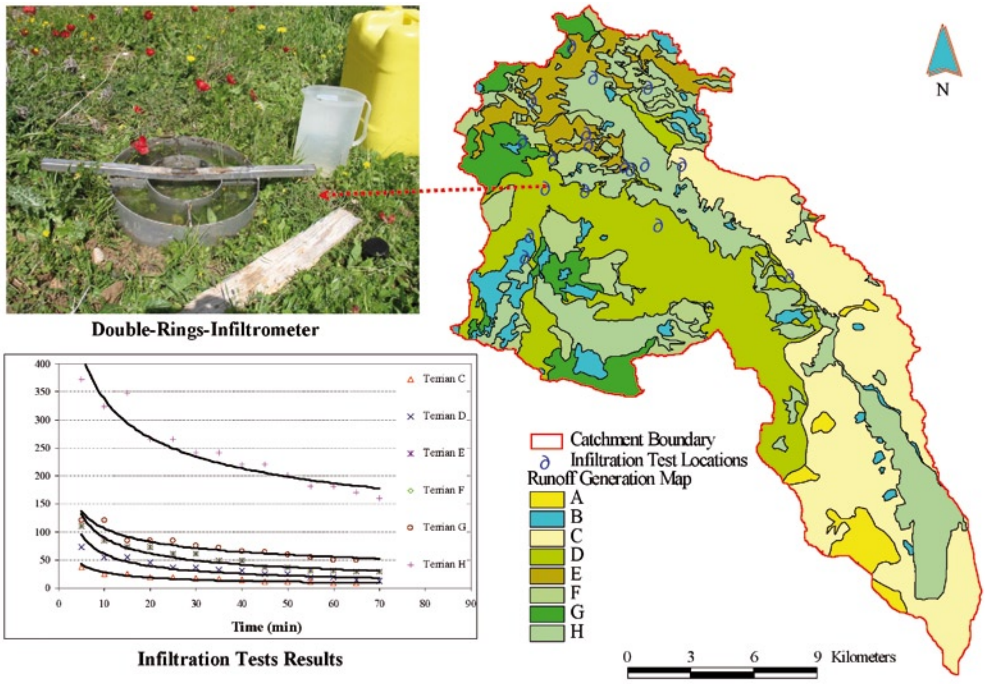

Figure 3: Runoff generation map with the measured infiltration rates at different locations inside the Faria catchment.

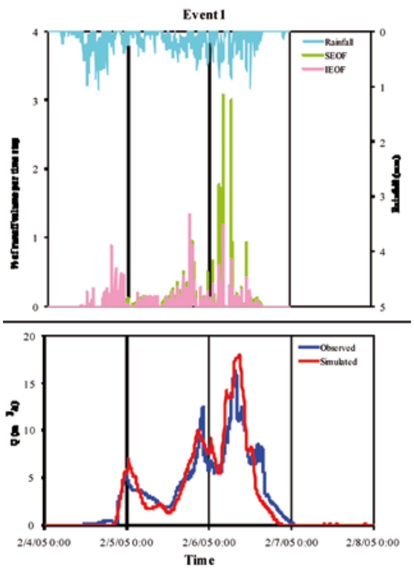

Figure 1: Simulation of Event 1 (4-6/2/2005), Al-Badan sub-catchment: rainfall, runoff generation mechanisms, IEOF / SEOF (upper part) and observed / simulated runoff (lower part).

References

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