Integrated Water Resources Management in the Lower Jordan Rift Valley

Sustainable Management of Available Water Resources with Innovative Technologies

SMART

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Data acquisition report for the input parameter of JAMS

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INTRO

The goal is to develop the hydrological model J2000g for the simulation of groundwater recharge in the scale of the transboundary model. The model allows a physical-based modelling of the water budget of regional catchment areas. The idea is to quantify groundwater recharge per time and to get the information about process of groundwater recharge for a special time period. The hydrological model J2000g is a simplified process-oriented distributed rainfall-runoff model to calculate temporally aggregated and spatially distributed hydrological variables (Krause and Hanisch 2009; Krause et al. 2010). The model uses the hydrological response unit concept and can be used without further adaption of model.

METHOD

The mentioned input data for JAMS is spatially organized in hydrological response units (HRU), which leads to a spatially discriminated output. The HRU mesh builds a raster of defined scale, and therefore, it is necessary to up- or downscale the input data, e.g. satellite scenes, aerial photographs and field data.

Beside the simulation of the hydrological process, which control the runoff formation and concentration in the upper meso - and macro scale, the model contain routines for the regionalisation of punctual data of climate- and precipitation data's. Further the calculation of real crop evaporation is integrated in the model and allows a spatial distributed calculation of evaporation of different land covers. Special influences of the simulation have the characteristic of the relief, specific soil and vegetation parameter. J2000g use input parameters such as slope, aspect, land cover, altitude and soil type (Figure 1). The parameter soil can be further divided by specific physical conditions such as field capacity, thickness, hydraulic conductivity and possibility of capillary rise of water. For land cover, additional floral characteristics like stomata resistance, root depth and growth height and leaf area index define the value.

Additionally variable impacts like pre moisture of the area can be consider during the modelling.

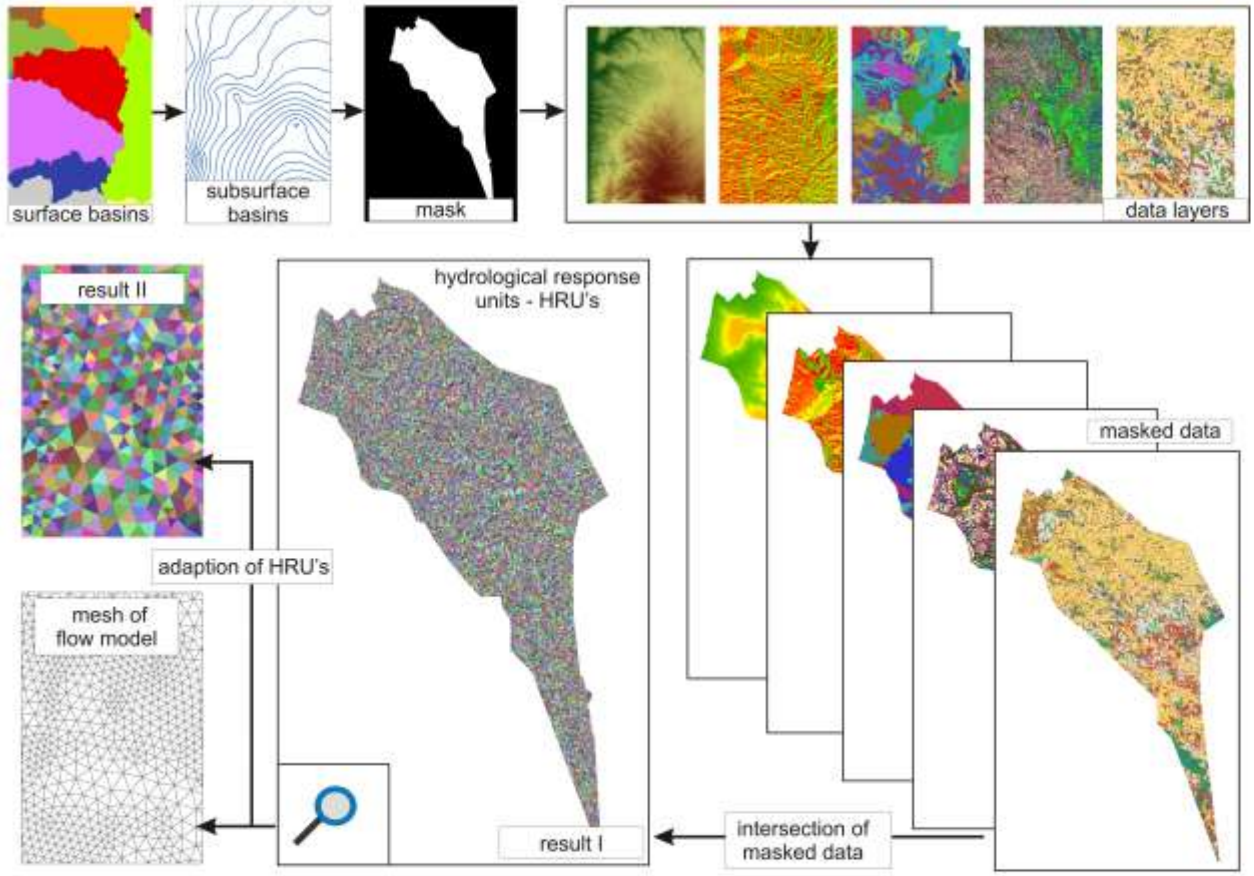

Figure 1: Different input parameters of the soil moisture model J2000g.

DATA ACQUISITION FOR THE INPUT PARAMETER OF J2000G

The procedures of the data acquisition for the input parameter of J2000g are in the right time frame. In order to use J2000g, climatic driving information with spatially distributed parameters describing the catchment is needed. Therefore existing meteorological rain and climate station in Israel and Jordan will be complete by installation of other 12-13 tipping buckets. Until today tipping buckets were installed in Jerusalem, Jericho, Metzoke Dragot and Ein Gedi. In cooperation with the Hydrological Survey of Israel and MEKOROT another 6 tipping buckets will be installed between October and November 2011 in the area of West bank. The cooperation enables us to use the network of tipping buckets of the Hydrological Survey of Israel. The combination of all rain station provides good information of distribution of precipitation along the western part of the Lower Jordan Valley. The installation of other 2-3 tipping buckets is projected in Jordan in November 2011. Focus areas are Ajlun region, treatment plant of Fuheis and city of Jarash.

Because of calibration and validation of the model the installations of hydrological station were started in the flume of Jericho in the spring season 2011. Further installation will follow.

For the hydrological model setup although data (vegetation, topography, soils and land cover) are necessary to gather for the project area. The topography was described by GIS derived slope, aspect and altitude. Land cover information were characterised by soil and vegetation types and the type of land cover, which were obtained by remote sensing techniques. Topographical parameters (slope, aspect and altitude) were obtained from a digital elevation model (25 x 25 m). The classification of slope was carried out according to Tilch et al. (2002) to distinguish dominant runoff generation processes (0°-5° groundwater recharge, 5°-15° delayed interflow, 15°-30° quick interflow, 30°-90° quick interflow and surface runoff). The aspect was divided by 45° steps into four classes.

Land cover information for the scale of the study area will be split in a north and in a south part. The scenes of the northern part bas on Landsat 7 images from May 2009. Landsat 7 images from March 2009 and April 2010 complete the southern part. The final classification of the Landsat images is projected in October / November 2011. On the bas of previous classification the representative class types should contain: 1) urban (dense; light); 2) agriculture (cultivated; non cultivated); 3) water; 4) bare soil; 5) rocks; 6) shrubs; 7) coniferous forest; 8) deciduous forest; 9) grassland (normal; hill grass (very light) and 10) olive orchards.

Parameterisations of soil physical properties based on the soil map classification of Israel (Dan et al. 1976; Ravikovitch 1969) and National Soil Map of Jordan (Ministry of Agriculture, Jordan, 1994) (Fig. 2). 15 different soil classifications units (soil types) were dedicated in the project area. The challenge was to unify the information of the different soil maps in one soil map (Fig. 2). The average soil depth and field capacity of each soil unit was estimated by results of field trips and from literature values (Bashan et al. 1995, Dan 1980, Dan et al. 1983, Ministry of Agriculture Jordan 1994, Mimi et al. 2009, Singer 2007, Smith et al. 1985). The USDA taxonomy 1975 of National Soil Map of Jordan hindered the parameterisation of the map. Therefore a diploma student modified the soil map in the catchment area of Zarqa in Jordan and used a topographic approach for a new soil map (Schulz 2011). The approach was successful implemented in the model J2000g in the diploma thesis. It is to consider that the approach should general used on the Jordanian site in place of National Soil Map of Jordan.

Vegetation specific parameters like leaf area index or stomatal resistance were estimated from literature values (Acherar and Rambal 1992, Baldocchi et al. 2004, Breuer et al. 2003, Heilmeier et al. 2007, Kergoat, 1998, Körner, 1994, Niinemets et al. 2005, Lambin 1999, Rhizopoulos and Mitrakos, 1990, Schulze et al. 1994, Dorman and Sellers 1989, Wilson and Henderson-Sellers 1985, Zeng 2001).

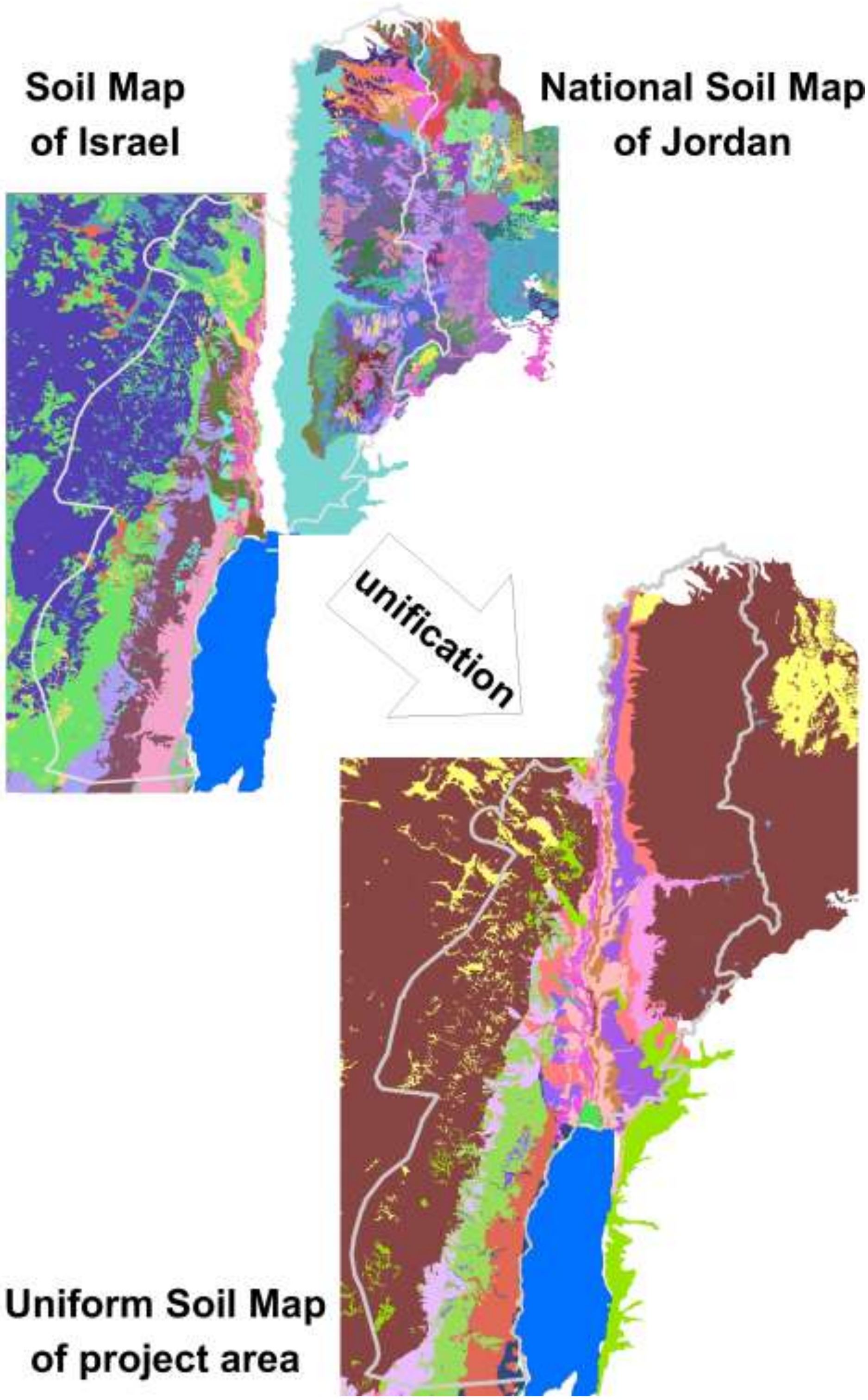

Figure 2: Unification of the different soil maps of Israel and Jordan

The infiltration capacities for geological units (hgeo) were derived from Berndtsson & Larson (1987) and from infiltration tests during filed trips.

A diploma thesis (Schulz 2011) and a submitted article (Rödiger et al. 2011) are generated at the Helmholtz Centre for Environmental Research in the framework of the deliverable 401.

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