EGU2020-5223
https://doi.org/10.5194/egusphere-egu2020-5223
EGU General Assembly 2020


# Estimation of temporally high-resolution recharge in a Mediterranean large karst aquifer system considering climate change

**Paul Hepach**[1], Jakirullah Nooruddin[2], Edoardo Bucchignani[3], Martin Sauter[4], and Irina Engelhardt[1]

[1]Hydrogeology Department, TU Berlin, Berlin, Germany
[2]Bayreuth Center of Ecology and Environmental Research, University of Bayreuth, Bayreuth, Germany
[3]CIRA Meteo System and Instrumentation, Caserta, Italy
[4]Department of Applied Geology, Georg-August-University Göttingen, Göttingen, Germany

Karstified aquifers respond rapidly to hydrological events, such as heavy rain storms or draughts. Our ability to predict the response of the aquifer after such events strongly depends on i) temporal and spatial resolution of the available monitoring data and ii) suitable modelling approaches to assess recharge at the respective level of detail. The study catchment, the Western Aquifer Basin (WAB), is Israel´s most important source for freshwater supply. The recharge area of the WAB has an area of 1,812 km$^2$. Recharge is characterized by high spatial variability in topography and a high variability in precipitation and temperature, land use, and vegetation. Precipitation also shows a seasonal variability: while annual precipitation mainly occurs during the winter months accompanied by floods in the otherwise dry wadis (October to March, ca. 90 %), summer periods (April to September) are hot and dry, and precipitation decreases to nearly zero.

We employ SWAT to simulate the large-scale hydrological water balance (evapotranspiration, recharge, run-off) in the recharge area of the WAB on a daily and monthly temporal resolution. The SWAT model uses a SRTM DEM from NASA, soil maps from FAO, soil properties of the Harmonized World Soil Database, and land use maps from the ESA CCI project covering the time period from 1992 to 2015. These datasets are merged in SWAT into 361 Hydrologic Response Units with unique characteristics in soil, land use, and slope, respectively. The calibration of soil water balance model with SWAT-CUP employs monthly actual evapotranspiration and daily surface runoff data. Run-off was measured in hydrometric stations between 2004 – 2015. Evapotranspiration with a spatial resolution of 500 m x 500 m is obtained from the MODIS satellite mission and covers a period between 2001 and 2013 with individual time steps of 8 days. Calculated long-term groundwater recharge is compared with spring discharge measured during the period 1990 – 2013. Climate projections have been obtained with the RCM COSMO-CLM at resolution of 8km, under the IPCC RCP4.5 scenario, nested into the MENA-CORDEX domain.

The calibrated water balance model allows for scenario analysis for predicted shifts in climate until 2050 to address the impact of climate change on groundwater recharge. In addition to an increase in temperature, fewer but more extreme rainfall events are to be expected. Furthermore, the

effect of future land use changes, such as expansion of farm land or urban areas, on recharge depth are analyzed. Finally, simulated high-resolution recharge provides an updated estimate for the currently developed groundwater flow model of the aquifer system. SWAT provides daily recharge for the equivalent porous medium model of the WAB, simulated by MODFLOW. One of our challenges is the calculation of recharge in the hilly region i) characterized by steep slopes and ii) vadose zones of several 100 meters of thickness. Our investigations are expected to provide information on the impact of shifts in climate and global changes on recharge processes and to illustrate the effect of short-term hydrologic events on water resources in large carbonate aquifers under Mediterranean climate.