Joint high resolution climate-hydrology simulations for the Upper Jordan Catchment

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Sufficient freshwater availability is a central prerequisite for agricultural and industrial development in the water scarce environment of the Eastern Mediterranean and Middle East. Political peace in the region is strongly linked to the satisfactory compliance of increasing water demands. Sustainable management of water resources requires scientific sound decisions on future freshwater availability, in particular under global climate change and increasing greenhouse gas emissions.

Facing these grand challenges, the impact of climate change on water availability in the Upper Jordan River catchment (UJC) is investigated within the framework of the GLOWA-Jordan river project (http://www.glowa-jordan-river.de). A focus is set on the Upper Jordan in this study as it provides $1/3^{rd}$ of freshwater resources in Israel. This is achieved by high resolution coupled regional climate – hydrology simulations. Two 30 year time slices (1960-1990 and 2070-2100) of the global climate model ECHAM4 (emission scenario B2) were dynamically downscaled using the non-hydrostatic meteorological model MM5 in nesting steps with resolutions of 54 km and 18 km. The meteorological fields in turn are used to drive the hydrological model WaSiM applied to the UJC which has an area of about 850 km^2. The hydrological model computes in detail the surface and subsurface water flow and water balance in a horizontal resolution of 90 m and dynamically couples to a 2-dim numerical groundwater model.

The ability of the hydrological model to describe the observed river discharges in this hydrogeologically extremely complex region is discussed. The impact of predicted atmospheric change on terrestrial water availability (flow components, evapotranspiration, groundwater recharge, etc.) is shown. Results of the joint regional climate-hydrology simulations indicate mean annual temperature increases up to 4.5˚C and 25% decreases in mean annual precipitation in the mountainous part of the UJC. Total runoff at the outlet of the catchment is predicted to decrease by 23%, and is accompanied by significant decreasing groundwater recharge.

An additional focus will be on the analysis of changes in dry spells and drought risks in the region.