EGU2020-19101
https://doi.org/10.5194/egusphere-egu2020-19101
EGU General Assembly 2020

Evaluating the effects of climate change for groundwater quantitative status in Denmark

Annesofie Jakosben, Hans Jørgen Henriksen, Ernesto Pasten-Zapata, Torben Sonnenborg, and Lars Troldborg
GEUS, Hydrology, Denmark (aja@geus.dk)

By use of transient and distributed groundwater-surface water flow models, simulated time series of stream discharge and groundwater level for monitoring networks, groundwater bodies and river reaches have been analysed for a historical period and four different future scenarios toward 2100 in two large-scale catchments in Denmark. The purpose of the climate scenarios has been to qualify the existing knowledge on how future climate change most likely will impact hydrology, groundwater status and Ecological Quality Elements (EQR- Ecological flow in rivers). Another purpose has been to identify whether foreseen climate changes will be detected by the surface water and groundwater monitoring networks, and to which degree the River Basin Management Plan measures for supporting the goal of good quantitative status are robust to the projected changes in water balance and ecological flow. The developed hydrological models were run with climate inputs based on selected RCP4.5 and RCP8.5 climate model runs (RCP8.5 wet, median, dry and RCP4.5 median). Changes in groundwater quantitative status and ecological flow metrics were calculated based on 30-year model runs driven by RCP8.5 for 2071-2100 (RCP4.5 for 2041-70) and compared to 1981-2010.

Overall the four scenarios results in very significant water balance changes with increased precipitation: 3% to 27%, evapotranspiration: 6% to 17%, groundwater recharge: 0% to 49%, drainage flow: 0% to 71%, baseflow: 0% to 31% and overland flow: 16% to 281%. For one catchment an increase in abstraction of 23% to 171% due to an increase in irrigation demand by 36% to 113% is foreseen. The results have wide implications for groundwater flooding risks, quantitative status and ecological flow metrics. Most sensitive is changes in ecological flow conditions in rivers for fish, showing a relative high probability for decreased state for 10-20% of the reaches for the RCP8.5 wet and dry scenarios due to more extreme hydrological regimes toward 2071-2100. Maximum monthly runoff is increased for winter months by 100% for RCP8.5 wet and median scenarios and around 10% for RCP8.5 dry scenario. Annual maximum daily flows is simulated to increase by up to a factor of five, and late summer low flows decreased.

Impacts on groundwater levels and water balances of groundwater bodies will be significant, with increased seasonal fluctuations and also increased maximum and decreased minimum groundwater levels for 30 year periods for 2071-2100 compared to 1981-2010.

More rain, both when we look back on historical data and when we look forward with latest

climate projections will result in more frequent flooding from groundwater and streams in the future. At the same time, the temperature and thus evapotranspiration rises. This means that in the long term we will have increased challenges with drought and increased irrigation demands on sandy soils while evapotranspiration will also increase on the clayey soils. This will result in greater fluctuation in the flow and groundwater levels between winters and summers, and between wet and dry years, challenging sustainable groundwater abstraction and maintaining good quantitative status of groundwater bodies.