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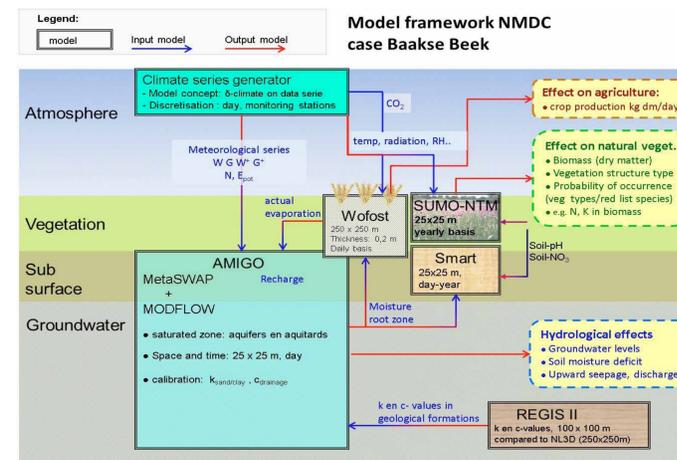
A climate robust integrated modelling framework for regional impact assessment of climate change

Introduction

Decision making towards climate proofing the water management of regional catchments can benefit greatly from the availability of a climate robust integrated modelling framework, capable of a consistent assessment of climate change impacts on the various interests present in the catchments. In this study we coupled a regional dynamic groundwater model with a very high spatial resolution (25x25 m²) with a crop growth model and nature valuation model for the 267 km² Baakse Beek-Veengoot catchment in the east of the Netherlands. Computations were performed for regionalized 30-year climate change scenarios developed by KNMI for precipitation and reference evapotranspiration according to Penman-Monteith.

Methods

The modelling framework consists of the model codes MODFLOW (groundwater flow), MetaSWAP (vadose zone), WOFOST (crop growth), SMART2-SUMO2 (soil-vegetation) and NTM3 (nature valuation). MODFLOW, MetaSWAP and WOFOST are coupled online (i.e. exchange information on time step basis). Thus, changes in meteorology and CO₂-concentrations affect crop growth and feed-backs between crop growth, vadose zone water movement and groundwater recharge are accounted for. The model chain MODFLOW - MetaSWAP - WOFOST-generates hydrological input for the ecological prediction model combination SMART2-SUMO2-NTM3.



Stakeholders

Besides technical issues, also a stakeholder analysis was performed to get insight into how the models, their results and the uncertainties are perceived, how the modelling framework and results connect to the stakeholders' information demands and what kind of additional information is needed for adequate support on decision making.

Results

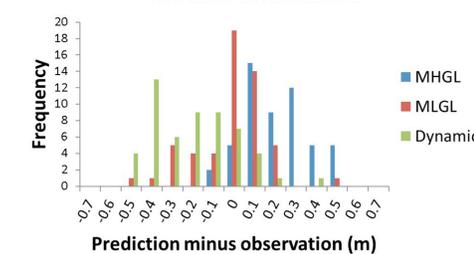
Results of the MODFLOW-MetaSWAP-WOFOST model on groundwater levels have been validated against data from 54 piezometers (table). The mean highest groundwater levels are underestimated compared to measured values.

Prediction minus observation

	MHGL [m]	MLGL [m]	Observations
Nature areas	0.18	-0.04	27
Agriculture	0.18	-0.10	27
Total	0.18	-0.07	54

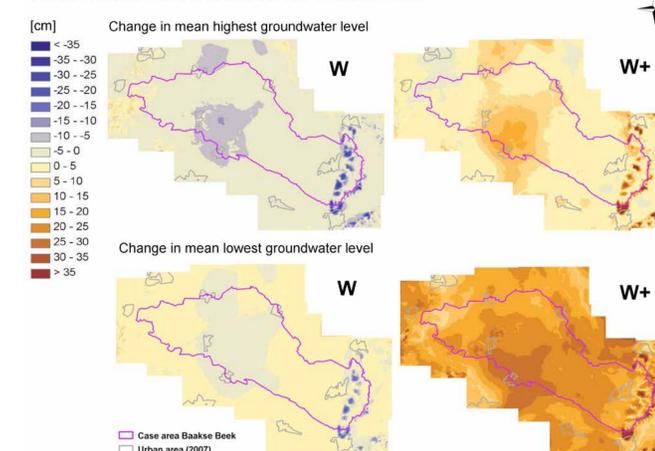
MHGL = Mean Highest Groundwater Level, MLGL = Mean Lowest Groundwater Level

Model Performance

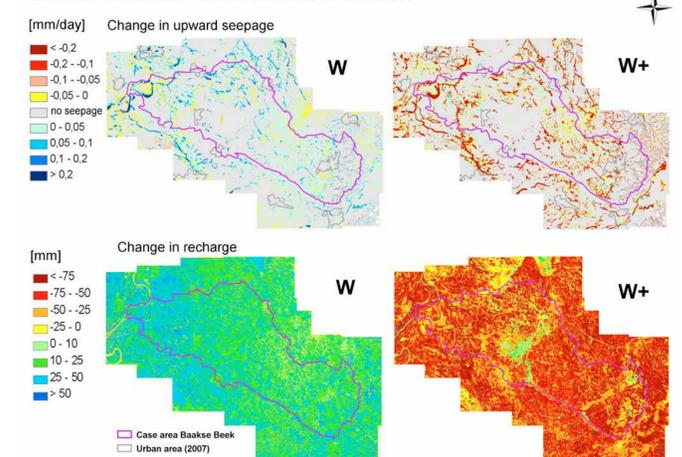


The hydrological impact for the climate scenarios is shown in mean highest and mean lowest groundwater level, upward seepage and recharge.

Climate scenario versus reference situation



Climate scenario versus reference situation



Conclusions

1. The W+ scenario shows the biggest impact on hydrology with a lowering of approximately 20 cm of the mean lowest groundwater levels. Despite an increase in winter precipitation the dry conditions during the summer also affect the mean highest groundwater levels.
2. The climate scenarios with a changed air circulation pattern show a decrease in upward seepage compared to the reference situation, which may hamper the objectives set for groundwater dependent nature conservation areas.
3. Especially the W+ scenario results in dry conditions during the growing season with a significant increase in the soil moisture deficit.
4. Stakeholders indicated that the spatial resolution of the hydrological model and the output it produces mostly fit well with their information demands. More information is desired by farmers and the water board on parameters indicating flood risk.



Impression of the Baakse beek catchment. The map shows location of the catchment area in the Netherlands

< Classification of the four KNMI '06 climate scenario's

