Models – Repositories of Knowledge
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What are the key parameters for soil hydrological models in climate impact studies under different settings?

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Abstract As climate models become more and more accurate and climate change becomes less deniable, a demand for applications of various impact models grows stronger. The impact on groundwater budget is often calculated by numerical models, such as SWAP and HYDRUS, using the Penman-Monteith-equation for potential and actual evapotranspiration and the Richards equation (using van Genuchten-Mualem-parameter) for water movement in the vadose zone. On the one hand, using such a detailed model has the advantage to identify seasonal shiftings in the soil water budget; on the other hand applying those models to the meso-scale has the drawback of a high data demand. To show whether an impact model is reliable enough to explain the impact of climate change on the target parameter (e.g. groundwater recharge) its sensitivity to parameter variation has to be tested. Sensitivity studies can also indicate which parameters can be neglected and which need to be investigated in more detail. Two calibrated SWAP models have been applied to estimate the impact of climate change on the water budget for an upland and a polder location. While the first site is a typical groundwater recharge area, the latter is a ditch-drained area where permanent groundwater discharge occurs. For both sites, climate projections from two regional climate models (CLM and REMO) driven by the general circulation model ECHAM5 have been used. The results from two realizations of the SRES CO2-scenarios A1B, B1 and A2 as well as the C20 reference period were available. Instead of using the data directly, two different bias correction methods were applied: a linear bias correction method and the so-called quantile mapping method. The Cramér-von Mises criterion has been applied to show which method is applicable for each site. Afterwards, two sensitivity tests were conducted. The Model-Scenario-Ratio (MSR) has been applied to identify the effect of parameter uncertainty on the relative impact of climate change on the oil water budget. The Scenario-Uncertainty-Ratio (SUR), which we adapted from the MSR, identifies whether the impact of the parameter uncertainty or the climate change impact is stronger. As a result we see that different hydrological settings show different parameters to be sensitive in terms of water budget. While crop and meteorological parameters are sensitive for the upland site, soil and drainage parameters are shown to be more important for the polder site. The study shows that process-oriented model-codes can be applied to meso-scale, if an appropriate sensitivity study is carried out to identify parameters that can be neglected for regionalization.

Key words climate change impact assessment; SWAP; groundwater recharge; BIAS correction methods; sensitivity