Climate change impacts model parameter sensitivity
What does this mean for calibration?

Lieke Anna Melsen[1]
Björn Guse[2,3]
contact: lieke.melsen@wur.nl

INTRODUCTION

Hydrological models are used for long-term projections to study the impact of climate change on river discharge

Calibration of these models is often guided by sensitivity analysis; the three to five most sensitive parameters are calibrated

But parameter sensitivity is known to vary across climates

Does climate change impact parameter sensitivity, and does that interfere with the calibration strategy for long term projections?

METHODS

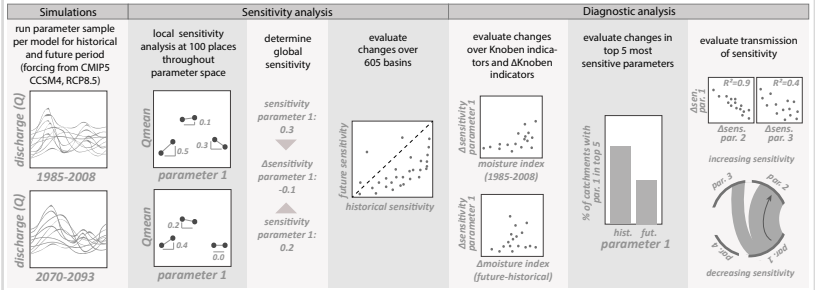

Figure 1. 3 hydrological models (SAC, VIC, HBV, Fig. 2) were run for a historical (1985-2008) and a future period (2070-2093) for 605 basins in the US. The models were forced with GCM CCSM4.0 (CMIP5), RCP8.5. For both periods, parameters were sampled for a global sensitivity analysis. Parameter sensitivity over both periods was compared to evaluate changes in sensitivity. Changes are evaluated against aridity, seasonality, and fraction of precipitation falling as snow. Special attention was paid to changes in the top 5 most sensitive parameters per catchment per model, as these are usually selected for calibration.

RESULTS

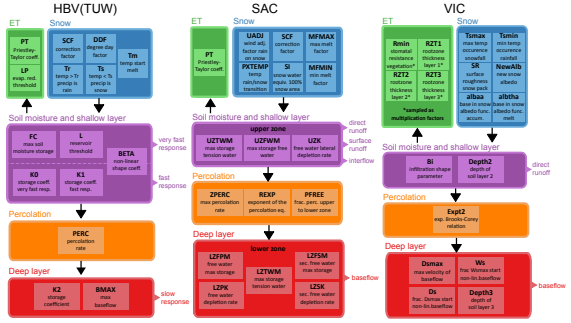

Figure 2. Simplified representation of the model structure of the three models employed in this study. All the parameters that are displayed are included in the sensitivity analysis.

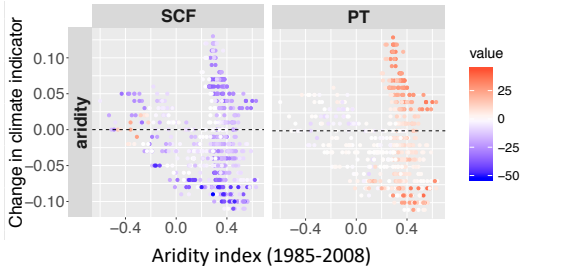

Figure 3. Change in sensitivity for two parameters of the SAC model, against aridity index and change in aridity index. Historical sensitivity is expressed in dot size, change in colour: red indicates an increase in sensitivity, blue a decrease.

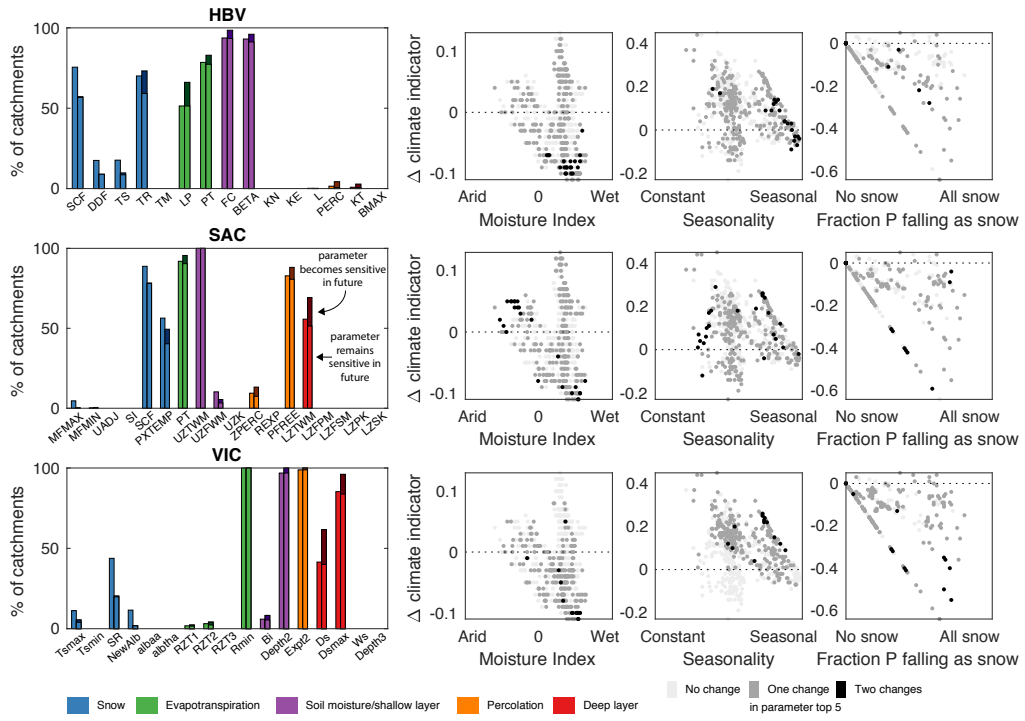

Figure 4. Impact of change in parameter sensitivity on top 5 position, where top 5 refers to the five most sensitive parameters per basin - generally the parameters that are calibrated. The left panels show how often a parameter appears in the top 5 both historically and in the future. The right panels relates the number of changes in the parameter top 5 to climate and climate change indicators.

CONCLUSIONS

Parameter sensitivity changes within a plausible climate change rate. Consistent among the three investigated models, snow parameters decrease in sensitivity in the future. The parameters increasing in sensitivity in the future differ per model.

In about half of the investigated catchments, at least one and max two parameters in the top 5 most sensitive parameters change. In the other half of the catchments, the top 5 remains unchanged.

Parameters that enter the top 5 in the future need extra care in calibration. Suggestions:

- Calibrate on a historical period that mimicks future sensitvity
- Sample the value of this parameter to account for future predictive uncertainty
- Calibrate this parameter on data related to the process it represents rather than to discharge observations to which it currently is not sensitive enough.

[1]Hydrology and Quantitative Water Managemement, Wageningen University, Wageningen, the Netherlands
[2]GFZ German Research Centre for Geosciences, Section Hydrology, Potsdam, Germany
[3]Christian-Albrechts-University of Kiel, Institute of Natural Resource Conservation, Department of Hydrology and Water Resources Management, Kiel, Germany