Implications of the subjectivity in hydrologic model choice and parameter identification on the portrayal of climate change impact

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Abstract. Climate change studies involve several methodological choices that impact the hydrological sensitivities obtained, including emission scenarios, downscaling techniques and modeling approaches. Among these, hydrologic model structure selection (i.e. the set of equations that describe catchment processes) and parameter identification are particularly relevant and usually have a strong subjective component. This subjectivity is not only limited to engineering applications, but also extends to many of our research studies, resulting in problems such as missing processes in our models, inappropriate parameterizations and compensatory effects of model parameters (i.e. getting the right answers for the wrong reasons).
The goal of this research is to assess the impact of our modeling decisions on projected changes in water balance and catchment behavior for future climate scenarios. Additionally, we aim to better understand the relative importance of hydrologic model structures and parameters on the portrayal of climate change impact. Therefore, we compare hydrologic sensitivities coming from four different models structures (PRMS, VIC, Noah and Noah-MP) with those coming from parameter sets identified using different decisions (objective function, multiple local optima and calibration forcing dataset). We found that both model structure selection and parameter estimation strategy (objective function and forcing dataset) affect the direction and magnitude of climate change impact signal. Additionally, the relative effect of subjective decisions on projected variations of catchment behavior depends on the signature measure analyzed. Finally, parameter sets with similar values of the objective function may not affect current and future changes in water balance, but may lead to very different sensitivities in hydrologic behavior.