Towards a better understanding of hydrologic sensitivity to climate change: impact of hydrologic model choices

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Abstract. Over the last few decades the hydrological community has intensively used the "cascade of uncertainty" paradigm in climate change studies, which considers several sources of uncertainty such as emissions scenarios, different general circulation model (GCM) structures and parameters, distinct GCM initial conditions, several downscaling methods and multiple hydrological model structures. Nevertheless, this approach does not help to advance process understanding or predictive capabilities. Therefore, in this study we assess the hydrologic sensitivity to climate change for three different hydrologic/land surface models (PRMS, VIC and Noah-MP) over a small set of case study basins located in the headwaters of the Colorado River basin, USA. Our goal is to evaluate how hydrologic sensitivities vary across models in terms of 1) the main water balance components, and 2) seasonal changes in individual states and fluxes. Results show that despite all the models predict an increase in ET and decrease in SWE and runoff for a future climate scenario, the partitioning of precipitation into ET and runoff is clearly model-dependent. Noah-MP is the most sensitive model in water balance budget components, and all models reflect very similar seasonal changes in basin-averaged snowpack. Some individual fluxes are more sensitive to changes in climate than others (e.g. baseflow). Ongoing research is focused on parameter perturbation experiments to improve understanding of the relative role of parameters and model structures. Furthermore, future work will help to determine the actual role of model calibration and forcing datasets in climate impact assessments.