Hydrological models play a crucial role in the projection of future water resources and extremes including drought and high flows under climate change. Parameter calibration is key to whether models could produce reliable simulations. This study focuses on the change of parameter sensitivity based on discharge under climate change through ideal experiments over 605 basins in the U.S. and offers good guidance to modelers about parameter transferability under different climates. This work is novel and clearly organized. However, it still needs some revisions before publication.

General comments:

1. The introduction is too short and did not give a full review of the literature. The authors could add some studies about climate change and its impacts on hydrology, especially in the U.S.. There are only several studies about how climate influences parameter sensitivity that are cited in this study.
2. In this study, the parameter range is defined as full, however, the range of parameters influence the parameter sensitivity analysis. I wonder whether the results are robust regardless of the selected ranges of parameters. Besides, whether the change of parameter sensitivity is related to catchment physical properties like catchment area, elevation, etc. (Saft et al., 2016)?
3. What is the change of precipitation, temperature in RCP8.5 over the selected 605 basins? A deeper analysis of the meteorological forcings is needed and would contribute to understanding the change of parameters and hydrological processes in models under climate change.

Specific comments:

L10: The percentages of catchments with two parameter changes are quite small and negligible.

L35: There is lacking literature reviews about the hydrological parameters under different climates in the introduction. To my understanding, this work is quite relevant to some studies about the temporal transfer of parameters (Coron et al., 2012; Patil and Stieglitz, 2015; Shin et al., 2013).

L75: Why this study selected the output of CCSM? Only one GCM is selected in this

work, however there are significant uncertainties in the outputs of GCMs and some studies used the ensemble to reduce the uncertainties. It is better to compare multiple outputs of GCMs.

L77: What is the specific bias correction method used in this study? And how did you select 605 from 671 catchments derived from CAMELS?

L118: “2.4 Analysis of sensitivity” is similar to “2.3 Sensitivity analysis”. It is better to rename section 2.4.

L158: How meteorological fields are changed in RCP8.5 over the 605 basins is still unclear. It may be better to show the change of meteorological variables before sensitivity analysis.

L175: “there are parameters associated to all four processes besides snow”, here you mean to exclude snow process? And you may change the words as “… expect snow”?

L182-L183: The conclusion is too harsh, as there is no clear correlation between AI and the change of sensitivity.

Figure 4: the labels of the X-axis are all climate indicators, it is better that you use AI, seasonality, and fraction of climate indicators.

Figure 6: The figures could be labeled as “(a), (b), …” and it is not easy to read correspondingly. The strong negative correlation is not quite obvious in Fig 6.

4 Discussion: There are discrepancies among the changes of parameter sensitivity based on HBV, SAC, and VIC. The authors could discuss how model structures affect parameter sensitivity.

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