Response to the reviews on "Discussion on key challenges facing the application of the conductivity mass-balance (CMB) method: a case study of the Mississippi River Basin" by Hang Lyu et al.

We highly appreciate again for extensive and generous comments on the manuscript and his/her generally positive impression of our work. Here we briefly respond to the points raised by his remarks.

1. Sensitivity analysis for the conductivities of baseflow and surface runoff In the manuscript, the takeaway messages from the sensitivity analysis I can get are that the baseflow index is more sensitive to the conductivity of baseflow sensitivity (BFsc) than the conductivity of surface runoff (SRsc). This conclusion has been mentioned in several case studies. The contribution of your study is to explain the uncertainty of BFsc and SRsc in the uncertainty of the baseflow index. However, when someone adopts the CMB method for baseflow separation, the concerns are how big the BFI errors are when BFsc and SRsc are over- or under-estimated by a certain percentage. For instance, in the sensitive analysis of Zhang et al. (2013), (which you labelled as 2012 in your paper, correct it for your next revision), if BFsc had been underestimated by 20%, BFI would have been overestimated by 26%. Overestimation of BFsc, however, would have less impact on BFI compared with the underestimation of the same parameter. In my view, your sensitivity analysis is good but still needs a step forward.

Author's response:

Thank you for your advice. We have conducted a supplementary analysis to investigate that how big the BFI errors are when BFsc and SRsc are over- or under-estimated by a 10%. And it can be proved that although underestimation or overestimation of SC_{BF} of the same degree, the former one has more impact on BFI. This has been discussed in the revised manuscript (Line 222-228, Page 9 and Line 406-407, Page 18). On the other hand, the cited literature of Zhang et al. has been correct to be 2013.

2. Groundwater pumping impacts on baseflow and conductivity should be discussed. The authors did a great job in the revised version to provide sufficient discussion on the human impacts on baseflow. A short paragraph of the groundwater pumping impacts on baseflow and conductivity are needed. For instance, groundwater pumping can reduce groundwater discharge to stream and/or induce stream infiltration to the aquifer, leading to streamflow depletion (Gleeson and Ritcher, 2018).

Author's response:

Thanks for your advice. Groundwater pumping can reduce groundwater discharge to stream and affect the hydraulic connection between groundwater and surface water, then invalidates the application of the CMB method. When a well is pumped at a constant rate, initially most of the groundwater comes from storage, eventually reaching the river, inducing a leakage of stream water to adjacent aquifer and depleting streamflow significantly (Bredehoeft and Kendy, 2008; Gleeson and Ritcher, 2018). This change in relationship between groundwater and surface water renders CMB method less applicable. These have been discussed in the revised manuscript (Line 370-374, Page 17 and Line 342, Page 16).

3. Editorial changes in the revised manuscript.

a. Figure 1

Can you show the location in North American or the USA for the readers to locate the watershed as HESS is an international journal?

b. 99th percentile

In your manuscript, you used different standards for ranking, i.e., increasing and decreasing. I understand that this is a more consistent expression and also related to the physical meaning of baseflow and surface runoff conductivity. However, this will also cause confusion as readers may think you are using the same ranking order. I suggest you use the 99th and 1st percentile.

c. Figure 3,

Can you make your points bigger?

d. Figure 6

Do not fill the boxes in figures as this overlaps the streamflow data.

e. Figure 7

No legend is provided in the figure.

Thanks for the Editorial changes. The Figure 1,3,6,7 have been modified, please see the corresponding picture in the article, and the method name of determining the parameter SC_{RO} has been changed to 1st percentile method.