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Hydrology and Earth System Sciences
Discussions

Interactive comment 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.

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We would like to thank Anonymous Referee #1 for reading our manuscript and for his careful and useful review. Here are our answers to the points raised by his remarks.

1. In Line133, page 5, it has mentioned that "assigning the 99th percentile (ordered by increasing conductivity) of the stream conductivity monitoring record to avoid the impacts of extremely high SCBF estimates on the separation results", please indicate which conditions can cause extremely parameter values? Reply: The main reason of

extremely parameter values are human activities. Human activities can significantly affect stream discharge and water quality, thereby disrupting their natural relationship and causing extreme parameter values, in most cases, there will be a maximum. For example, some monitoring sites located adjacent to reservoirs contribute significantly to increased evaporation and higher conductivity, others located in urban areas may be affected by urban non-point pollution, which significantly increase the composition of groundwater, showing relatively poor inverse correlations between stream conductivity and discharge.

2. The study has applied both the uncertainty estimation methods of BFI proposed by Yang et al. (2019) and Genereux and Hooper (1998) to determine the parameters and the shortest time series in the present study. Why do we use both methods at the same time and what are the differences between themïij§ Reply: The reasons that we use both methods are as follows: firstly, both the methods can be applied to calculate the uncertainties of BFI, the Genereux and Hooper(1998) method is a widely used uncertainty estimating equation, and the recent study of Yang et al.(2019) shows that for time series longer than 365 days, random measurement errors in yk or SCk will cancel each other out, and their influence on BFI can be neglected, considering the mutual offset, the uncertainty in BFI would be halved. So the method should be more accurate when the time series longer than 365 days, but it is not applicable when sampling periods are shorter than 12 months. In our study, different time series (longer or shorter than 365 days) of monitoring data need to be analyzed, so both the methods proposed by Yang et al. (2019) and Genereux (1998) are used at the same time to determine the parameters by different time series.

3. In table1, why not compare the uncertainty results of the various WSCRO determination methods? Reply: The sensitivity analysis results of our study showed that the sensitivity index for SCBF was generally greater than that for SCRO, so more attention has been focused on SCBF to reduce uncertainty in BFI. Typically, several values of SCBF have been determined by yearly dynamic maximum and 99th percentile meth-

ods. However, SCRO is only estimated using the minimum or 99th percentile (ordered by decreasing conductivity) method. WSCBF and WSCRO differs in the calculation of standard deviation. WSCBF is the standard deviation of the SCBF multiplied by the t-value (α =0.05; two-tail) from the Student's distribution, while WSCRO is the standard deviation of the lowest 1% of measured SC concentrations multiplied by the t-value (α =0.05; two-tail), causing that various standard deviations can't be calculated and various WSCRO can't be compared.

4.Fig. 1,3,6,7 should be replaced by more clearer pictures. Reply: By modifying settings, sharp images can be showed clearly now.

5. In the conclusion part, it is suggested that large watersheds in other latitudes and climates should be considered in the future research, so as to compare and verify the conclusions of this study, and to obtain more general guiding methods. Reply: Thank you for your advice. To verify the conclusions, our future studies would be carried out in other large watersheds with different climates, topography and latitudes, maybe in the Australia.

6. In the future research, it is suggested that the results of this method can be used to identify the parameters of other methods to improve the accuracy of separation results of other methods. Reply: Thank you for your advice. Identifying the parameters of other methods using CMB method can balance the accuracy and speed, some researches have also mentioned this (Stewart et al., 2007; Zhang et al., 2013; Lott and Stewart, 2013). For example, "the RDF method only requires the stream discharge data as input and, therefore, is one of the most readily available methods for baseflow separation in longterm studies. However, the parameters for the RDF method are often subjectively determined, resulting in high uncertainties in the baseflow separation estimations. On the other hand, the CMB method is considered to be more objective because it is based on the direct measurements of streamflow conductivity. However, the data required for the CMB method may not be available for long periods. A linkage between the RDF and the CMB methods can be established by using the baseflow data estimated with the

CMB method to calibrate parameters for the RDF model. The calibrated RDF model can then be used for baseflow separation over a longer period when only discharge data are available (Zhang et al., 2013). So this will also be the main research object in the future.

7. Reference format is not consistent. It should follow the guidelines of the Journal. Reply: Following the guidelines of the Journal, reference format has been corrected.

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