

Weather Clim. Dynam. Discuss., author comment AC2
<https://doi.org/10.5194/wcd-2022-52-AC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Reply on RC2

Astrid Fremme et al.

Author comment on "Model-simulated hydroclimate in the East Asian summer monsoon region during past and future climate: a pilot study with a moisture source perspective" by Astrid Fremme et al., Weather Clim. Dynam. Discuss.,
<https://doi.org/10.5194/wcd-2022-52-AC2>, 2022

Here we provide a reply in the open discussion to the comments made by reviewer #2:

Reviewer: This manuscript aims to examine how the hydroclimate of the Yangtze River Valley changes along different climates, from the last glacial maximum to the present, and then under a future projection scenario. This fact is based on the comparison of the moisture sources for the target region. The authors used two model outputs from climate models CAM5.1 and NorESM1-M and ran the FLEXPART model trying to obtain the moisture sources for the Yangtze River Valley. ERA-I was also used.

While the exercise of using the different datasets to run de FLEXPART model is novel, there are several major concerns about the modeling, the data used, calculation, comparison, and interpretation that lead to many doubts to this reviewer; many of them related to the robustness of the statistical analysis of this work.

I believe substantial modifications are necessary and thus I would reject this manuscript if no major changes are made.

Reply: We are grateful for the reviewer's thorough critical comments. Here we outline how we will address these issues in a revision of the manuscript.

Reviewer: My main comments and reasons for this decision are:

- *My biggest concern is the robustness of the statistics. Throughout the paper, there is no statistical analysis for the comparison of the simulations carried out for the present time (control period). It is needed an annual and seasonal comparison between the dataset used and derived variables from the FLEXPART outputs for the control periods. A visual comparison of the obtained fields, which are shown in the manuscript as maps, is not sufficient to conclude whether the moisture sources are similar or not. A statistical study is necessary. Typical statistics are used in this type of analysis: mean absolute error (MAE), root mean square error (RMSE), Pearson's correlation (R), Bias (B), standard deviation (STD), and coefficient of determination and variation.*

Reply: We agree that adding quantitative, statistical information about the differences between the different results will strengthen the manuscript, and greatly enhance the visual interpretation of the results. In the revised manuscript, we will back up the current

visual impression using the MAE and Bias. In addition, we will consider using the standard deviation to quantify inter-annual and seasonal variations within different datasets.

- *My other big comment is about the selection of the length of the period to compare. What is the reason for the selection of these 10 years (in the table appears that is 5 years...)? Does decadal variability play some role in the results obtained? The author comment that the period is neutral, but in the selected period as control exists a strong ENSO event, 1997-98, and during the decade the sign of the Pacific Oscillation (POD) was the same, and it is known that the East Asia Monsoon precipitation is affected by ENSO, but the POD strengthens this relationship when positive. The Indian Ocean Dipole, which is the role of this mode over the region? If the hydroclimate variability and changes along the time (past-present-future) of a region where the EASM affects is the goal of this paper, it needs to be into account as the other modes commented. The authors should use 30 years as usual for climatological studies.*

Reply: The reviewer raises a valid point here. In this context, we consider it useful to provide some context on the data availability and the computational requirements of our method. First, we use 10-year FLEXPART and WaterSip runs as a basis for the moisture source analysis based on the climate model runs, the 5 years listed in Table 1 where used initially, but later on in the study extended to 10 years. In the process of extending the time period from 5 to 10 years, we unfortunately included the 97/98 ENSO event, as also noted by reviewer #1. For the revision, we will explore shifting/extending the analysis period for the present-day as far as possible. However, an extension to 30 years analysis time is currently beyond the computational resources available to the authors, since it would essentially triplicate the already large computational demands of this analysis method. The large computational demand is a consequence of the offline trajectory calculations. Essentially, the trajectory model requires 3h three-dimensional output data from a climate model to trace air mass motion with the trajectories. Climate model data at this time resolution are rare and extremely large, and therefore for example not part of regular CMIP archiving. We will however explore if an extension of the present-day period in the NorESM1-M to a longer period is feasible, to allow for a first-order statistical assessment of the 97/98 ENSO event on the moisture source diagnostics. In the revisions, we will also comment in more detail about the role of ENSO and POD in the study region. Some of these aspects will also become part of a critical discussion of limitations of this study.

- *To resolve these issues, it is necessary to extend the study period as much as possible, compare a longer period, and do statistical analysis.*

Reply: We will address these points in the revised manuscript, as outlined in our answers to point 1 and 2 above.

Overall, a more critical discussion of the limitations and uncertainties of the study seems necessary.

Without these questions (methodological and analytical issues) resolved, this reviewer cannot consider this manuscript for publication at this stage.

Other aspects need more attention by the authors:

- *The input data for running FLEXPART model have different characteristics in terms of vertical and horizontal resolution. Is the number of particles modeled the same in the different experiments? If they are the same, the model preconditions are different, and this fact could affect the results and the interpretation of the field comparison. This needs to be checked and explained in the manuscript.*

Reply: As specified in Sec. 2.2, we continuously release 50'000 particles in the higher-resolution CAM5.1 simulations, and 25'000 particles in NorESM1-M. Since the particles always represent the entire mass in the target area, albeit with a different contribution per trajectory, the main difference beyond a certain, large number of trajectories will be to provide more spatial detail of the moisture source information. While we do not expect the number of trajectories that we apply to play a major role for the overall results of the analysis, we will perform a check that this expectation is justified. In either case, we will raise these important issues as part of the revised discussion section. We will also revise the manuscript to better highlight that the coarser resolution in the NorESM1-M model runs is one of the potential factors to explain differences between the moisture sources obtain from the different models.

- *The authors comment that the thresholds in WaterSip were changed, and the selected RH% , for instance, was determined for NorESM dataset. Why not other data or reanalysis? Could this affect the outputs of the model when used for the future? The diagnostic for the imposed thresholds was done only for one year! Which year? Why this one? If the year selected was another, could the threshold change? ... How this affect the results?*

Reply: The thresholds were determined originally for the reanalysis, and here we essentially cross-check that the same thresholds are meaningful to apply with the climate model data. The sensitivity to the RH threshold, as detailed in Appendix A1 and A2 were tested for the year 2022 of the CTL simulation, as stated in the figure captions. Testing the threshold sensitivity on the basis of all 25'000, continuously released trajectories for each 3h time-step of year 2002 does provide a sufficient basis to robustly evaluate the threshold sensitivity. It is not obvious to us how and why the impact of this parameter could change more substantially by year than the already large sensitivity displayed in Fig. A2. In the end, a lower threshold will lead to a larger total precipitation. However, with the focus of the offline diagnostic being on the moisture source regions for the Lagrangian precipitation estimate Π (Sec. 3.2), the location and relative contribution of the moisture source regions themselves are hardly sensitive to the RH threshold.

- *Only one emission scenario, RCP6.0, was used in the study. Why? RCP6.0 represents an intermediate scenario, and it is not very used in climate change studies. What about RCP8.5?*

Reply: As mentioned in our reply to comment #2, the offline moisture source diagnostic is a computationally very demanding diagnostic method, that requires specific output for running the trajectory model. Such output was made available specifically from within the EVA e-science project, and only a RCP6.0 is currently available. A re-run with a different, more pessimistic climate scenario would be interesting, but is beyond, and we argue also beyond scope for this first trial of moisture source diagnostics with climate model output.

Many of the comparisons in the manuscript, such as those derived from figure 3, etc..., were in absolute values. 1.0 mm/day seems a small quantity, but it is not small if the variables to compare have a range from 4 to 8mm/day. Better in %.

Reply: We will thoroughly check that the units are meaningful and interpretable.

There are many typo errors in the manuscript (table, figures, captions, ...). Please check the manuscript carefully when the revision is done.

Reply: We will carefully check for typos throughout the manuscript before resubmission.

This review has further comments on the results and their interpretation, but these are not necessary at this stage of the review until the above is resolved.

