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Hydrology and Earth System Sciences Discussions

Interactive comment on "Validation of two precipitation data sets for the Rhine River" *by* C. S. Photiadou et al.

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We would like to thank the anonymous referee for the comments. We retrieved all comments from the text of the anonymous reviewer and numbered them to be able to reply to each comment individually. Please, find our response to the review comments below.

1. "This paper compares two precipitation data sets, referred as CHR08 and E-OBS. The comparison is done by forcing the HBV conceptual hydrological model with the two precipitation data sets and evaluating model performance statistics. The authors show that overall CHR08 provides a better performance than E-OBS."

Reply: The aim of the paper is twofold: The first is to assess the effect of the extended precipitation dataset CHR08 vs. CHR and EOBS-V4 vs. CHR on the extreme value estimation in the Rhine River. The CHR dataset routinely used up to now covers 1961-1995 and an increase in length will be valuable. The E-OBS V4 dataset has even a longer length (1950-2009) and therefore is potentially interesting consider as replacement of CHR or CHR08 (also because it is quite difficult and time consuming to get longer time series for a river basin that covers several countries).

The extension of the CHR and the use of E-OBS show the benefits of choosing longer data sets of precipitation (Figure 3). The extension in length for the CHR08 reduces the uncertainties in 100 yr return periods of 10-day maximum precipitation by 4%. E-OBS reduces this uncertainty by 6%, due to the longer data record.

The second goal is to assess how HBV-96 performs while using these two extended precipitation data sets. To do this performance analysis we compared the hydrological behaviour in terms of extremes (low flows, high flows) and mean flow. Another precipitation data set (ERA-Int) was added for further reference. It is shown that CHR08 has a good agreement with the observed discharges in the winter months, while in the summer months E-OBS is performing better. CHR08 has an overall better performance in the statistical analysis. As stated in the discussion, page 5482, line 20, both data sets could be considered as reference data sets for future use in bias correction studies. We did not conclude that CHR08 outperformed E-OBS, but merely that both of the data sets are performing well.

2. "I understand that it is difficult to compare two potentially uncertain data sets, without knowing where the truth lies. But in my opinion, the way this is done by the authors does not allow to draw any meaningful conclusion. Although I think it is a good idea to use a hydrological model and observed discharge to compare the two data sets, the comparison needs to be as objective as possible. Here, the comparison is not objective because the HBV has been calibrated only using CHR08. In addition, there not seem to be a validation period. A minimum set-up for the paper to be valuable is: - To split

the data series into calibration – validation. - To calibrate and validate the HBV model using BOTH rainfall products, i.e. CHR08 and E-OBS."

Reply: We acknowledge the fact that our methodology might be eligible for some issue of objectivity. We would like to take this opportunity and clarify/defend our methodology. Firstly, as stated in the methodology section, page 5472 and line 25, the calibration of the HBV-96 model was made using only the CHR precipitation and temperature data set, for the period 1961-1995, and not CHR08. Thus, the CHR-calibration serves as reference for both extended data sets. A significant part of the 5 overlapping years between CHR and CHR08 shown in Fig 2 is from newly constructed precipitation data sets (for the all three major catchments: German, Moselle and Swiss). The authors decided not to proceed with extensive calibration because validating/calibrating/improving HBV-96 is not the primary goal of this paper. Instead, we assess the usefulness of two new extended precipitation data sets for hydrological applications and as reference data sets for bias correction methods, given their extended length and their ability to represent extremes events for precipitation and modeled discharges. Calibrating the HBV-96 model with the E-OBS set will probably lead to a slightly better performance of HBV-96, but even using the current CHR-based calibration CHR08 and E-OBS are performing quite well, both in the extremes and the annual cycle. Their similar performance is not entirely striking as most E-OBS precipitation gauges are also used in CHR. The higher gauge density used to generate CHR apparently does not lead to a clear outperformance of this dataset, other than a slight improvement of the spatial variability as indicated by the statistics of the sub-basins (table 1).

Since our aim is not to evaluate the performance of HBV or recalibrate the HBV model itself, we don't feel it's necessary to split the timeseries in calibration – validation sets. Also recalibration of HBV-96 with either CHR08 or E-OBS is not within the scope of this manuscript. Furthermore, the operational version of the HBV model (calibrated with the CHR data set) is also used by Te Linde et al., 2010 and Van Pelt et al., 2009. In Van Pelt et al., 2009, bias corrected outputs of precipitation and temperature from a RCM are

used to force the HBV model and compare the produced discharges with observations. In Te Linde et al., 2010, the effectiveness of flood management measures for the river Rhine assuming an extreme climate scenario for the year 2050, is examined. The HBV model is forced with resample meteorological data to obtain long discharge series of 10000 years. In the revised version of the manuscript, the introduction and the methodology sections will be refreshed to clarify the purpose of the paper and explain in more detail the chosen procedure.

3. "The authors could remove all the details that are not relevant for the objective of the paper. For example, all the details on climate models and correction factors given in the introduction. The acknowledgment of the limitations of the study (laming wrong correction factors for poor model performance) at the end of the discussion section is not very appropriate..."

Reply: The details on the climate models in the introduction section refer to studies concerned with hydrological responses to project climate changes using different input data. We show the significance that the quality and length of forcing data could have in climate change studies. These paragraphs will be revised. The paragraph in the introduction concerning HBV (page 5470, line 11) focuses on the input data sets used in studies and how they can influence the model performance, irrespective of the type of the model structure. We introduced the correction factors for the HBV-96 model in the model description (page 5472, line 20, where it is presented as a general statement about the set-up of HBV) and bring it up again in the discussion at page 5482 line 5. We agree with the referee that this statement should be incorporated in the model description section, and the relevant section will be rephrased.

4. "There are all other details that need to be corrected, such as wrong units of discharge, which is a flux and is given in mËĘ3, but I will come back to these when the authors will provide a significantly revised paper."

Reply: We apologize for the wrong unit of discharge and the corresponding plots will

be corrected.

References:

Te Linde, A.H., Aerts, J.C.J.H. and Kwadijk, J.C.J.: Effectiveness of flood management strategies on peak discharges in the Rhine basin, Journal of Flood Risk Management, 3: 248-269. doi: 10.1111/j.1753-318X.2010.01076.x., 2010.

Van Pelt, S.C., Kabat, P., Ter Maat, H.W., Van den Hurk, B.J.J.M., Weerts, A.H.: Discahrge simulations performed with a hydrological model using bias corrected regional climate model input, Hydrol. Earth Syst. Sci., 13, 2387-2397, doi: 10.5194/hess-13-2387-2009, 2009.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 5465, 2011.