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Hydrology and Earth System Sciences Discussions

Interactive comment on "Effects of climate model radiation, humidity and wind estimates on hydrological simulations" *by* I. Haddeland et al.

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1. It is mentioned several times in the manuscript that the output from climate models is corrected with respect to precipitation and temperature. The method used for this correction, however, is not described. Since there are other studies dealing with this topic, a detailed explanation in this manuscript is not necessary, but a short summary of the possible procedures in one or two sentences would certainly be useful for the reader.

Response: The bias correction performed on climate model precipitation and temperature prepared for WATCH was designed to adjust all moments of the probability distribution function of intensity for a specific variable, see Piani et al. (2010) for de-

tails (referenced in the text). We agree that this short summary will be useful for the reader, as well as some information on other possible procedures. Bias correction of climate model outputs for use in hydrological models, in particular precipitation and temperature, has often been performed based on the delta change method, or by a more sophisticated statistical bias correction method. Dynamical approaches, in which a regional climate model is nested within a general circulation model have also been used, as well as combinations of dynamical and statistical approaches.

2. The notation of equation 1 seems a bit misleading to me. It would be better to put the bar directly above the variable, e.g. ÂŕVwfd(m), to make clear that it is a mean value over several years for a certain month.

Response: We understand the reviewer's point, and will be happy to change the notation according to the reviewer's suggestion.

3. Although the method for bias correction given in equation 1 seems reasonable, it would be nice to have a reference for this method. The references given for the bias correction of precipitation and temperature (e.g. Wood et al., 2004; Piani et al., 2010; Themeßl et al., 2010) seem to use different methods. The method used in Sperna Weiland et al. (2010) for bias correcting precipitation seems to be identical to the one used in this manuscript, this should be mentioned.

Response: Equation 1 is analogous to the frequently used "delta change" method (Hay et al., 2000). Also, in a possible future version of the paper we suggest acknowledging that the method is similar to the Sperna Weiland et al. (2010).

4. It should be pointed out that, by using long-term mean monthly values to bias correct the climate forcing variables, a possible trend in the correction function is neglected. This means that for the 2071-2100 scenarios, the correction factor might have a different value than for the 1971-2000 scenarios. Although it is mentioned briefly in the text, this source of uncertainty should be stated more clearly.

Response: True. In this study, correction factors calculated from the long-term historical relationship (1960-2000) are used for the entire simulation period (1960-2100). It is hence assumed that the mean bias of the model does not change with time, and possible historical and future trends in the correction functions are neglected. Depending on the climate model's ability to represent physical processes in the climate system, the relationship between modelled and observed values might be different at the end of the century than today. Also, climate models tend to simulate variations in surface radiation to a lesser degree than measurements suggest (Wild, 2009). Hence, the assumption that the mean bias of the models does not change with time includes uncertainties that should be noted.

5. At the end of section 3.2. several basins are mentioned that do not appear in figure 2. If the analyses illustrated in figures 4 and 5 have also been made for these additional basins, it would be nice to have an overview of the results (e.g. a table with all basins, the mean evapotranspiration/runoff of a basin and the improvement in percent from original to bias corrected climate model forcing for each hydrological model).

Response: The reviewer is right; the analyses are performed for more basins than illustrated in Figure 2. The basins originally included in Figure 2, 4 and 5 are representative for the results, though, and the number of basins included in the figures were kept to a fairly low number on purpose. However, we see the point of including results from all basins that are mentioned in the text. We suggest adding an extra figure including mean annual ET results for all basins mentioned in the text (see supplement), and to include these basins also in Figure 2 (basin overview), and in Figure 8. In addition, we suggest including MPI-HM results in the new figure and in Fig 8 so that all simulation results for these basins are presented in Figures (instead of a Table as suggested by the reviewer). Yukon was mentioned in the text, but we suggest excluding it since Mackenzie is very close geographically, and the findings there are very similar to the Yukon ones. The number of basins included in Figs 4 and 5 we suggest keeping as it was, though. The reasoning behind this is that those included illustrates the main

findings, and there is limited additional information to achieve by including them all in all figures. The figures in question can be found in the supplement.

6. Figures 4 and 5 are hard to read, it would be better if the bias corrected variables from ECHAM and IPSL were represented by symbols (e.g. filled black triangles and dots) instead of dashed lines.

Response: See comment to reviewer #1

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/8/C5130/2011/hessd-8-C5130-2011-supplement.pdf

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