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Hydrology and Earth System Sciences Discussions

Interactive comment on "The effect of downscaling on river runoff modeling: a hydrological case study in the Upper Danube Watershed" *by* T. Marke et al.

T. Marke et al.

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The authors would like to thank reviewer 1 for contributing to the improvement of our manuscript.

——————— Comment: ———————

I have basically one general concern about the skill of the models is assessed. This assessment is mostly accomplished by comparing the simulated and observed climatological annual cycles of hydrological variables, like the mean discharge and quantiles of the discharges. One can see that this measure of skill discriminates between the

different model set-ups, and thus this assessment is pertinent, in the sense that it is a logically a necessary condition. But I think that this type of comparisons are not sufficient, since the annual cycle contains relatively few degrees of freedom, even more so if the possible biases are statistically corrected. A more stricter test, and one that might be more meaningful to assess the model skill to simulate future changes, is to compare the time evolution of the simulated and observed discharges through the period 1972-2000, separately for winter and summer (or alternatively for the discharge season). This comparison could take simply the form of the correlations between observations and simulations (n=29) or more sophisticated measures, such as the ratio of variances, etc. For the case in which the simulations are driven by the global model ECHAM5, this is indeed not possible, but for the simulations driven by ERA40 this would be possible and would also give more information about the model skill. Figure 7 (a) displays this type of calculation, but not exactly. For instance, any reasonable model would produce an annual cycle more or less similar to the observations, and thus days belonging to the observed discharge season will roughly agree with days in the simulated discharge season. Much more informative would be a similar Figure in which the days have been disaggregated by season, in which the reader could see that summer days with observed high (or low) discharge have been correctly simulated. Perhaps the authors could include this type of information for some cases that they deem important.

——————— Response: ———————

The reviewer suggests to compare the time evolution of the simulated and observed discharges over the period 1972- 2000, separately for winter and summer (or alternatively for the discharge season) in addition to considering the performance in terms of a reproduction of the (mean) seasonal cycle of hydrological conditions in the catchment considered. To do so, the reviewer suggests to correlate discharge simulations to discharge observations separately for the different months of the year. This is a very important point required to assess the quality of the hydrological simulations. As pointed out by the reviewer, it is however not possible for the meteorological boundaries of the

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ECHAM5 model. The reason is given by fact that the global climate model ECHAM5 reproduces climate only in a statistical manner (mean conditions over climatological periods in the order of 30 years). Hence, a comparison of meteorological/hydrological model results to meteorological/hydrological observations e.g. for individual days or months is not feasable. A reasonable way to still evaluate the monthly performance is to consider the mean monthly conditions over a climatological period of time, which has been done in the presented paper. In case of ERA40 reanalysis data, the approach proposed by the reviewer is possible and has already been put into practice in the framework of a different publication. A very thourough analysis of the performance of the presented hydrometeorological model chain including the different downscaling approaches has recently been carried out and published in:

Marke, T., Mauser, W., Pfeiffer, A. and Zängl, G.: A pragmatic approach for the downscaling and bias correction of regional climate simulations: evaluation in hydrological modeling, Geosci. Model Dev., 4, 759–770, 2011.

The analysis in Marke et al. (2011) compares simulated and observed discharge at a daily basis. In addition to a comparison for the whole year, daily discharge simulations in the Upper Danube Watershed are separately evaluated for the different months of the year giving very detailed information on the performance on a monthly basis. According to this publication, averaging the performance over all months of the year leads to a mean performance that compares well to the overall performance resulting from a consideration of daily conditions over the whole year. These circumstances suggest that the downscaling functions together with the ERA40 meteorology allow for a comparatively accurate simulation of discharge in the catchment considered. Furthermore, this approach systematically excludes that the goodness of performance is biased by the seasonal course that is included in discharge observations and simulations. We have added the respective information to the updated version of the manuscript. As the hydrometeorological model chain applied has been evaluated for ERA40 boundaries as detailed as possible in the publication cited in the previous paragraph, but

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also to apply criteria that can be applied for all combinations of global boundary conditions and RCMs, such evaluations are not part of the current study. The current paper focuses on the analysis of the influence of different statistical downscaling methods, different dynamical downscaling approaches (=RCMs) and different global boundaries (ERA40 and ECHAM5) on the results of the hydrometeorological model chain. The publication Marke et al. (2011) has been cited in the paper of discussion. However, it was maybe not clear that it includes very detailed information on the validation of the model chain. We have corrected this in the updated version of the manuscript making it easier for the reader to find the information requested by reviewer 1. Moreover, we have added information on the options and limitations for evaluation as connected to the different meteorological boundary conditions, making clear the reasons why the applied evaluation approaches have been chosen (see manuscript, p. 5).

——————— Comment: ———————

I think that the reference to Houghton et al. is out of date.

——————— Response: ———————

The reviewer is absolutely right, we have inserted a newer reference in the updated version of the manuscript (see manuscript, p. 5 and p. 25).

We hope to have adressed your comment adequately and would like to thank you again for your valuable suggestions! Your endeavors are highly appreciated!

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 6331, 2011.