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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The effect of empirical-statistical correction of intensity-dependent model errors on the climate change signal" *by* A. Gobiet et al.

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Response to Referee # 1

"The manuscript analyses the role of bias correction in ENSEMBLES regional scenarios on the temperature response. Contrary to the so-called delta-method, quantile mapping modifies the mean model response. With an original linear approach, the authors show that the new response is more reliable than the un-corrected model response. As quantile mapping (or similar methods) is a "necessary evil" for driving impact models, this study is a major contribution to the climate impact community. The

presentation is clear, with relevant citations. I recommend the manuscript for publication with minor corrections:"

Thank you for your very encouraging and constructive comments! We added our responses below your original comments:

"1. page 6 line 23 (and also title): it is clear that the approach can be extended to daily min and max temperature. But the application to precipitation is not as straightforward as the authors claim. Indeed the model error is generally: too many drizzle days and underestimated heavy precipitation. The notion of "error slope" is not adapted. Perhaps precipitation can be replaced by its logarithm or another function, but I hardly see a linear approach as in the present study. In addition, some models at some locations produce less rain days than in the observation, making quantile mapping not applicable (but applicable with a probabilistic approach). Precipitation correction is very important for impact studies (even more than temperature correction in many applications). Indeed, the sign of the response may be reversed after correction, because both the sign of the error and the sign of the response may change from low to high precipitation. I suggest to specify in the title that this study is devoted to temperature, to state in the perspectives that this approach could be extended to other variables, and I encourage the authors to prepare a second paper on precipitation correction."

We agree that the application of QM to precipitation has several specific issues and that our results for temperature cannot automatically be assumed to be valid for precipitation as well. To avoid such misinterpretation, we changed the text as suggested by the referee: a) The title was adopted and reads now: The effect of empirical-statistical correction of intensity-dependent model errors on the temperature climate change signal. b) Similar modifications were applied to the first sentence of the abstract and the last paragraph of the introduction. c) On page 6 (section 2.2), the relevant sentences read now: In the following, we show the results for daily mean temperature, but the analysis of daily minimum and maximum temperatures gives very similar results. The application of our analysis to other parameters like, e.g., precipitation is basically

straight forward, but the linearization applied in section 4 can be expected to be less appropriate for precipitation than for temperature. Further investigation is needed to fully reveal the effect of QM on the precipitation CCS. The major motivation for focusing on temperature here is its relatively simple error characteristic and its significant climate trend, which facilitates the demonstration of the effect of QM on the CCS.

“2. page 8 line 15: noisy tails (a funny typo)”

Thanks, corrected.

“3. page 17, line 9: you can mention that the new centennial reanalyses (NOAA and ECMWF) offer a good test bed for this time-invariance”

We added this information on page 6 (section 2.1), where the assumption of time-invariant model errors is discussed the first time. The respective sentences read now: However, in a strict interpretation, the results and conclusions of this study are only valid under the assumption of time-invariant model errors and it is still issue to further investigation to determine the severity of this restriction. Although such investigation is outside the scope of our study, we want to mention that the new centennial re-analyses of ECMWF (ERA-20C) and NOAA-CIRES (V2c) offer a promising new test-bed for the investigation of the long-term stability of model error characteristics.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 5671, 2015.