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Discussions

Interactive comment on "Cross-validation of bias-corrected climate simulations is misleading" *by* Douglas Maraun and Martin Widmann

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Authors argue that cross-validation of the free-running bias corrected climate model simulations is misleading. The main argument is that the remaining bias depends on the realizations of internal variability in the observations and climate model. Authors provide a good discussion about the limitations of cross validation in bias correction of free-running climate models.

To partly agree with the main point of the manuscript, cross-validation on independent data of free running climate models can become misleading. While this is not a well spread opinion it is not however a new concern. Drawbacks of split sample test in bias correction have been discussed in (Grillakis et al. 2017), where we mention that the

remaining bias of the validation period in split sample is a function of (i) the bias correction methodology's deficiency and (ii) the climate model deficiency itself to describe the validation period's climate, in aspects that are not intended to be bias corrected (i.e. long term modes of variability).

To further analyze the effect of "internal variability" on which authors attribute the remaining biases, it actually splits into two different and well defined reasons:

a) The first is how well synchronized to the observations can a free-running model be, in terms of multiyear modes of variability (such as PDO AMO etc). This is mainly random in a free-running model, as authors also discuss in the manuscript. However, it would be mentioned here that even a "perfect" model would not synchronize to the observations due to imperfections in the initial conditions, spin up effect, etc.

b) The second is that climate models are not able to precisely reproduce statistically these large scale modes as in reality they are not perfect. In that case, the remaining bias is related to the deficiency of the climate model to reproduce these multiyear persistencies, which would affect the results of cross validation, even in the case of a "synchronized" to the observations climate model run.

In (a), and by using a large period of data (times larger PDO AMO etc modes), cross validation will work well for calibration on the odd and validation on the even years (see Minville et al. 2014). This cross validation type would cancel out the synchronization issue of a "perfect" model.

In (b) the cross validation (again, using a large period of data) will reveal the weakness of the bias correction methodology to adjust the effect of the multiyear modes of variability. Considering that in typical bias correction applications, where $\sim$30 years of historical data are used for calibration to correct $\sim$100years of precipitation ahead (Grillakis et al. 2017), this is something that we expect from a bias correction method.

To summarize the above and before condemning the cross-validation in bias correction,

two more questions should be answered:

a) Is the cross-validation misleading regardless the length of the calibration- validation periods and the type of the holdout method?

b) Is the cross-validation inadequate to reveal the weaknesses of the bias correction method to adjust multiyear modes' effect on precipitation?

Other comments: âĂć Authors do not refer to the version of EOBS data. Older versions of the dataset exhibit "no data" periods in the region of Turkey, that may be the source of the increased relative changes in Figure 1b. Also the EOBs dataset should be acknowledged according to the terms of use (http://surfobs.climate.copernicus.eu/dataaccess/access_eobs.php#datafiles) âĂć P6-L16: Figure 2 shows averages, so do you mean "simulated average"?

References

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