Hydrol. Earth Syst. Sci. Discuss., 11, C4756–C4760, 2014
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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Inter-comparison of statistical downscaling methods for projection of extreme precipitation in Europe" *by* M. A. Sunyer et al.

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Received and published: 30 October 2014

Anonymous Referee #2 Received and published: 19 September 2014 The paper evaluates and compares 8 different statistical downscaling methods applied to 11 catchments in Europe using the ENSEMBLE projections. The study focused on extreme precipitation with return period of 1 and 5 years. The work is particularly useful for estimating hydrological impacts using climate model projections. I recommend moderate revision before it can be published.

General comments:

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Interactive Discussion
Discussion Paper

1. The discussion or results lacks critical thinking and interpretation. It largely discusses the figures in text but does not always provide reasons. Sometimes, the authors are speculating, e.g. “This is likely due to the fact that in Europe, extreme precipitation from convective storms occurs more frequently during summer, and this has a larger influence on the outputs from the RCMs and SDMs due to their higher spatial resolution.“ Do they know for sure extreme precipitation from convective storms occurs more frequently during summer in Europe and on what scales, daily, hourly? This needs to be supported by scientific evidence or citations.

- We agree that more interpretation of the results would improve the paper. We now discuss and provide interpretation when possible to a few key results (in agreement with the comments from reviewer #1). These are: the discussion on the difference between the climate change signal obtained from the downscaled series and the uncorrected RCMs (this has been added in page 6185 and 6189 and in agreement with the discussion in comment 16); the fact that some bias correction methods do not improve the performance of the uncorrected RCMs (this has been added in page 6191 and 6192 and in agreement with the discussion in comment 22); and discussion of the similarities and differences of the downscaling methods (discussion added in the summary and conclusions section). Regarding the convective storms in summer, we have added a few references addressing daily extremes over Europe and the fact that RCMs tend to perform worse in summer due to the difficulties in representing convective storms:

Fowler, H. J. and Ekström, M.: Multi-model ensemble estimates of climate change impacts on UK seasonal precipitation extremes, Int. J. Climatol., 29, 385–416, doi:10.1002/joc.1827, 2009. Frei, C., Schöll, R., Fukutome, S., Schmidli, J. and Vidale, P. L.: Future change of precipitation extremes in Europe: Intercomparison of scenarios from regional climate models, J. Geophys. Res., 111, D06105, doi:10.1029/2005JD005965, 2006. Hofstra, N., Haylock, M., New, M. and Jones, P. D.: Testing E-OBS European high-resolution gridded data set of daily precipitation and surface temperature, J. Geophys. Res., 114, D21101, doi:10.1029/2009JD011799, 2009.

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Lenderink, G.: Exploring metrics of extreme daily precipitation in a large ensemble of regional climate model simulations, Clim. Res., 44, 151–166, doi:10.3354/cr00946, 2010.

2. The conclusion is not very useful after lots of work put in the comparison of 8 different statistical downscaling methods. The authors state in the conclusion: “we recommend the use of a set of statistical downscaling methods as well as an ensemble of climate model projections.”. But the authors also state: “There is not a tendency in the performance of the bias correction methods depending on the mean and extreme precipitation regime. It also shows that the differences between the methods and the performance of the bias correction methods depends on the catchment studied.” It does not provide any insight to people who want to conduct impact studies and need to choose downscaling methods for a river catchment. If the methods do not show much difference, why should we use a set of downscaling methods? And if we do have the research capacity to use several of them, what should we do with the set of different methods? E.g. Do we use the mean value? Are certain types of downscaling methods more suitable for certain catchments? It seems the authors have rushed to the conclusion without critical thinking and interpretation of the results.

- We have now extended the discussion on the selection of downscaling methods. It is difficult to point to a specific best method as it depends on several factors, but we have pointed out some issues that arise from the use of some methods (such as BCM, BCMV, CFM,...), which implies that they should not be selected for some specific applications. For example, in the case of BCMV it might lead to unrealistic precipitation events; CFM does not account for the fact that the change in extreme precipitation might be different than the change in mean precipitation; and BCM is in many cases not able to improve the representation of extremes compared to the uncorrected RCMs. Even if methods do not show large differences, if they are based on different assumptions they should be included in the ensemble of methods. When possible, we recommend using an ensemble of methods to be able to assess the uncertainty in extreme

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precipitation projections.

3. The paper is full of acronyms (names of catchments and methods) which make it very hard to follow.

- We agree that there are many acronyms in the paper and that in some cases it might be difficult to follow for the reader. In the revised version of the manuscript, the acronyms for the catchments will not be used anymore. However, the acronyms for the statistical downscaling methods have been kept.

Specific comments: 4. 6169-23: 'up to half' is not strictly correct according to Figure 3. In the conclusion, authors use 'at least 30%' instead of 'up to half'. The former is better.

- The variance explained by the SDMs ranges from 30% to slightly more than 50%. It has now been made clearer in the text that at least 30% and up to approximately 50% of the total variance is due to the statistical downscaling methods used.

5. 6170-18: 'approximately 25km' but EURO-CORDEX is at a finer resolution.

- True. It has been clarified in the text that the new EURO-CORDEX simulations have a higher spatial resolution (11 km) than most of the RCMs available which often have a resolution of approximately 25 km.

6. 6171-15: 'Wetterhall et al. (2012) Conditioning model output statistics of regional climate model precipitation on circulation patterns' provides another interesting comparison, worth adding to the literature review.

- Wetterhall et al. (2012) provides an interesting comparison of downscaling methods. Their results showing that it was not possible to reject the hypothesis that all the SDMs perform equally well is interesting and relevant for this paper. This study has been included in the literature review in page 6171.

7. 6172-8: Hundecha et al., 2014. Is this already accepted or published?

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- The paper was submitted in September 2014.

8. 6172-24: ‘where most extremes occur’. Throughout the paper, authors have not defined the extreme precipitation. Is it based on return period or percentile?

- The season with more occurrences of extremes is estimated using the Extreme Precipitation Index. First the extreme events for the observational data sets are obtained using the 1 year return period threshold for the whole period. Then the season with more extremes is estimated from this extreme value series. Throughout the paper extremes are defined as described in the section “Extreme Precipitation Index”. This has been clarified in the text in page 6172.

9. 6173-5: ‘while the other catchments use’, change to ‘while the remaining use’

- Corrected for “while the remaining ones use”.

10. 6176-11: ‘closed from’ change to ’closed form’

- Corrected.

11. 6181-16/24: (i) and (iii) should be (1) and (3)

- Corrected.

12. 6184-3: ‘three source’ should be ‘three sources’

- Corrected.

13. 6193-9: ‘for higher return levels’. There are only 1 and 5 years return levels presented in this study, so this should be ‘for the higher return level, 5 years’.

- Corrected

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 6167, 2014.