

## ***Interactive comment on “The representation of location by regional climate models in complex terrain” by D. Maraun and M. Widmann***

### **Anonymous Referee #1**

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### **General comments**

The manuscript addresses the important issue of local representativeness when applying bias correction of RCM data with observed gridded data. Especially in statistical downscaling this has been often discussed, as there are several studies known that show the limitation of local representativeness (e.g. Brinkmann 2002) and it is widely current practice not to use only one grid cell from RCM or GCM output.

Maraun and Widmann suggest a new, very simple and straightforward correlation based approach to test for local representativeness and show its application in Europe by correlating E-OBS with one RCM at the inter-annual time scale. They found

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in general a good representativeness in Europe and some areas with a poor quality, especially in leeward positions of mountains in winter. They concluded these areas are not only affected by wrong marginal distributions, but also by the wrong weather and hence argue for a non-local bias correction, or at least for an application of their test for local representativeness prior to bias correction such as quantile mapping.

The manuscript is mainly well written and structured and very concise. The formulas are clear and correct. The figures mainly well graphed, excluding Figure 2 (see below). The study is relevant also in the hydrological sector as many climate change impact assessment studies applied bias correction methods or data that is based upon bias correction. The general framework is new and merely nicely laid out. Hence, this paper is in general suitable for publication in HESS.

*Although I really like the simple and straightforward approach, I have two overall concerns about the example chosen and about the temporal focus on winter and summer. And I have one smaller remark on the interpretation of the results and the discussion.*

Thus, this study has some limitation in my opinion concerning:

1. The choice and analyses of local example
2. The lack of addressing the issue of representativeness over different seasons
3. Some general remarks on the interpretation of the results and the conclusions

To 3) The main result I got from looking at Figure 1 and Figure 3 and 4 is that in many cases in winter (DJF) local representativeness is high and that non-local bias correction can (only) improve the correlation in some small parts over Europe (Figure 3, center). I agree that this problem is generally linked to leeward mountain areas in winter and summer, but not all leeward areas are affected (e.g. Scandes). This is

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good news! This means that bias correction methods can be applied to many parts in Europe without the necessity for non-local correction. For sure, in summer this is different due to the internal climate variability and climate model limitations. Still, the improvement by non-local correlation is clear but spatially limited. Hence, I would prefer a less “dramatic” argumentation in the discussion section on the need for testing local representativeness. Even more as climate change signals are not systematically deteriorated, but due to model limitations and internal climate variability.

To 1 and 2) I have to admit that I find the choice of the example “Domodossola”, grid box 46°07' N, 8°15' E , suboptimal. This is mainly due to two reasons:

First, looking at the climate chart for “Domodossola” one sees that DJF is not a very relevant season for this location as it is mainly influenced by southerly flows in spring and autumn, as well as convective rainfall in summer. The observed correlation to the northwards grid box is hence more an exception than the typical situation. (Not to speak about the similarity in the correlation to the dry inner-alpine and very humid grid cells in Switzerland – indication the wrong representation of topography and weather within the climate model). Maybe observations in the Aosta valley (approx. one or two grid boxes away from the author’s choice) might be more appropriate.

Second, the longitudinal cross section irritates me as it crosses three different precipitation regions. Why not have a latitudinal cross section if you intend to investigate the lee effect – at least in addition. Hence, I suggest to use a slightly different grid box that more clearly expresses leeward effects and to extend the analysis to all seasons. The latter would also allow discussing the need for temporally changing representativeness.

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### **Specific comments**

Page 3012, line 24. I would add the trend here.

Page 3013, 5-7: Is this not widely known and accepted not to use only one grid cell but choose among different neighboring grid cells?

Page 3014, line 9: apart instead of away?

Page 3015, line 12-21: Please expend the description of the cross-validation to clarify its application and its effect on correlations quality

Page 3017, line 3-4: not only internal climate variability but also model limitation to represent convective precipitation

Page 3017, line 10: why against the real world topography? Have you corrected the difference in topography and if yes, how?

Page 30178, line 14: Domodossola lies only temporally in the rain shadow of the Alps – see also general comments

Page 3017, line 15-17: “here we additionally show that ...” Please clarify how you conclude that the whole weather does not cross the mountain change. So far, this holds only true for the mean precipitation in the DJF season.

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Page 3017, line 5-28 and Figure 2: Figure is tiny, especially the right panel, grey and blue lines are hardly distinguishable; color saturation is a nice idea but does not enhance readability. Please also mark in the left panel which cells you are referring to (there are 11 but only 9 in the right panel). Figures should be aligned and properly. North-south section would be a helpful add on.

Page 3018, line 21: add “in summer and winter”

Page 3020 ff: In most cases in Europe it is (in summer and winter for the example RCM) not necessary to check for representativeness

Page 3020, line 8. Typo in therefore

Page 3021, line 20 ff: The discussion of the results in a more general context is – in my opinion a little too far from the study and can be shortened

Page 3021, line 25 ff: see also Brinkmann, 2002, 21: 27–42 Climate Research

Page 3021, line 5-8. But see recent paper by Haerter et al. GRL, 2015, doi: 10.1002/2015GL063188

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