

## ***Interactive comment on “A regional climate palaeosimulation for Europe in the period 1500–1990 – Part 1: Model validation” by J. J. Gómez-Navarro et al.***

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Review of "A regional climate palaeo-simulation for Europe in the period 1500-1990 – Part 1: model validation" by Gomez-Navarro et al.

General comments

The authors present a well-structured analysis of a regional climate model for the European region spanning the period 1500-1990 AD. Thereby, they concentrate on model evaluation and clearly show and discuss the gain with respect to the driving global model. Such modeling and the presented analysis is still rather new in paleoclimatology which make this paper certainly a valuable contribution to Climate of the

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Past. Still there are some shortcomings which need consideration prior to publication. The paper seems to be written in a rush resulting in numerous errors which I tried to list in the comments. The paper could also gain by a shortening (see partly suggestions below). Additionally, most of the figures need revisions. Overall I recommend publication after minor revisions.

Comments (not sorted by importance)

General: There is an issue with using the correct time throughout the text.

1804,I4: The models are not coupled. Coupling means that they exchange fluxes of mass, momentum and energy, but in the current study ECHO-G data is just used as boundary condition. So please clarify this throughout the text! With this respect please change “coupled model MM5-ECHO-G” just to “MM5 model forced by ECHO-G” (do not forget the figure captions!).

1804,I4: “Both models are ...”

1804,I6: “The simulation is assessed ...”

1804,I11: “. . . last five centuries is analyzed showing that the mean temperatures reflects the influence of the external forcing. However, contrary to the results obtained under climate change scenario conditions, higher-order momenta seasonal temperature and precipitation are hardly affected by changes in the external forcing. “

1804,I17: Please reformulate and split the sentence starting with “Although the physical mechanisms. . . ” to increase readability.

1804,I22: “. . . 2007). In particular over extra-tropical regions the uncertainty is impornat to consider as high internal climate variability may mask ...”

1804,I25: “Comparing proxy-based . . . simulations is proposed as a mean . . .”

1805,I2: “Such a comparison can furthermore. . .”

1805,I19: This sentences needs clarification, maybe split into two and state what a regional model could represent more realistically.

1805,I24: This statement needs a reference. In particular as large scale circulation patterns are assumed to be to some extent realistically represented in global models and imprinting just regional models. This is also shown in this manuscript, when discussing some of the biases.

1805,I27: "This period is subject. . ."

1805,I28: The reconstruction of "Pauling et al. 2006" is not very trustworthy, as it uses all proxies (also temp. sensitive proxies) to reconstruct precipitation. I suggest to use Casty et al. (2007, Climate Dynamics) and add Kuettel et al. (2010, Climate Dynamics).

1806,I1: What is meant by "web"?

1806,I2: Please remove bracket.

1806,I3: Please remove "very long" – this is not needed.

1806,I5: were -> are

1806,I8: Again replace Pauling with the aforementioned publications.

1806,I10: Please rephrase this sentence.

1806,I12: can not -> cannot.

1807,I8: You showed/discussed also higher moments so I suggest to write: "... relates to higher moments such as variance (or standard deviation) and skewness of a climate variable. In this context, Murphy (1999) argued that ..."

1807,I12: "... climate models also improve the variance ..."

1807,I15: "Another aspect of the added value is the importance of its spatial distribution (Kanamitsu and DeHann 2011). These authors demonstrated that ..."

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1807,I19: "This issue is demonstrated ..."

1807,I22: Maybe "... Thus, we exploit areas where ... as well as where ... " reads better.

1808,I6: "with the conclusions and an outlook."

1808,I9: "For this study, a regional simulation of the European climate is performed for the period 1501–1990 AD. ..."

1808,I19: "... tropical regions to allow for a better representation of ENSO and related phenomena and 20 vertical levels."

1808,I22: "is applied"

1808,I23: "The model is driven by estimates of three external forcing types: greenhouse gas (GHGs) concentrations in the atmosphere, long-term variations in total solar irradiance (TSI), and the global radiative forcing of stratospheric volcanic aerosols. The last two effects are included by an effective solar constant. A full description of this simulation and the external forcing is found in Zorita et al. (2004, 2005, and references herein).

1809,I4-I13: This paragraph is partly a repetition and should be shortened.

1809,I14-18: Again a repetition, please remove.

1809,I28: the acronym SAT needs to be introduced.

1809,I3 to 1810,I2: I think this could be strongly reduced as the authors already refer to Zorita et al on page 1809,I2. So why presenting the stuff so detailed?

1810,I1: "... considered. To avoid ..."

1810,I6: "... domains are employed ..."

1810,I14: "... is chosen ..."

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1810,I15: "... is selected ..."

1810,I21 "... is used. ..."

1810,I22: IP is not introduced.

1811,I3: "for comparison. "

1811,I6: "The model skill of reproducing a realistic climate is assessed to highlight the improvement of the regional climate simulation over the global model, but also to identify possible important deficiencies. Therefore, several climate variables of the simulation are compared with the CRU ... reference period. The statistics of the seasonal series of SAT and precipitation are analyzed in Sect. 3.1. Additionally, the analysis of Probability Distribution Functions (PDFs) is presented in Sect. 3.2."

1811,I14: "A first assessment of the skill of the MM5 given by ECHO-G is performed for the observed climate in the period 1960–1990 (hereafter referred as the reference period). We specifically focus on seasonal mean values and variability of SAT and precipitation. For this purpose we have used the CRU data base (Harris et al., 2012).

1811,I20: has been -> is

1812,I19: "In this season, the strongest precipitation coincides with orography (see Fig. 2), and the high resolution of the RCM is able to reproduce this behaviour to a large extent. ..."

1812,I24: "Please note that the 45 km resolution of the model still cannot capture high-resolution orographic features such as valleys, ... "

1813,I1: To assess further the origin of the model biases in the RCM, the driving ECHO-G simulation is investigated. The warm bias in winter is already present in the ECHO-G simulation ..."

1813,I5, typo: "an improvement"

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1813,I6: "seems to be caused"

1813,I8: "as illustrated the mean sea level pressure (MSLP) pattern by in Fig. 5. The flow ..."

1813,I12: "domain, causing advection of warm air masses to the biased area in winter. The anomalous ..."

1813,I25: "We also evaluate the variability ..."

1813,I29: "differences are tested"

1814,I1. Maybe a line break after "maps." might help here.

1814,I10: "where the model overestimates the variability, although ..."

1814,I14: "Nevertheless, the pattern is ... amount, is identified. "

1814,I17: "In the next step the simulated and observed long-term trends are analyzed. For this statistics we consider a longer period ..."

18014,I22: "are tested"

1814,I28: "two physical explanations for this difference.

1814,I28: It is not clear to which simulations you referring to ?

1815,I1: "... aerosol concentrations that would affect last part of the simulation."

1815,I5: "... This can be clearly seen in the simulated NAO index (Fig. 1). It has to be noted ..." The sentences inbetween are repetitions and not needed.

1815,I10: "such as precipitation,"

1815,I12: cannot ... if the model is perfect.

1815,I16: "is again traced back to the intensification of the zonal circulation"

1815,I17-I21: This discussion should be removed as it is not important for the paper.

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1815,l24: "data base are found"  
1815,l26: You need to give at least on reference here.  
1816,l10-l12: Please split into two sentences to increase readability.  
1816,l15: "is considered"  
1816,l17: "Each PDF is calculated "  
1816,l20: "are selected"  
1816,l25: "simulations is illustrated by comparing GCM and RCM results"  
1817,l3:" where the differences between both models are small" this remains unclear which models do you refer to ?  
1817,l4: "is explained by "  
1817,l15: The discussion about the bimodality of IP is unclear. What du you mean with different behavior in parts of IP. I thought you assess the mean over the entire region so how a sub region could affect then the PDF?  
1817,l21: "by regional and the global models resembles the observations" This is also a general weakness of the current manuscript as it is often unclear to which simulation the authors refer to so please clarify this throughout the manuscript.  
1817,l29: "does not result in a large difference due "  
1818,l1: "driving model leading to an overestimation"  
1818,l13: "that is addressed with "  
1818,l16/l17: "we calculate . . . We select "  
1818,l22: "PDFs are calculated "  
1818,l24: "are tested"

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1819,l7: "We analyze whether . . ."  
1819,l13: "are calculated"  
1819,l14: "are smoothed"  
1820,l21: " The opposite behavior is also found "  
1820,l23: "there is not a clear"  
1821,l2: "which is clearly recognized"  
1821,l7: "In this study we illustrate the added. . ."  
1821,l14: ". . . model. Two biases are striking: The amplitude of the annual cycle of temperatures is underestimated and there is overestimation of precipitation in Northern Europe. This deficiency seems. . ."  
1821,l19: "Still, the model accurately reproduces the variability"  
1821,l22: "although part of this difference is attributed to the higher spatial resolution of the observational dataset. The comparison of the simulated and observed trends . . . period shows that the model tends to overestimate . . ."  
1822,l1: "absent in the observations showing instead a negative"  
1822,l17: Why only at decadal scales? Why do you assume this?  
1822,l21: reformulate this paragraph – it mainly is a repetition, just write the main conclusions. Please be aware of the time problem avoid "have/has been"!  
1823,l3: Remove the sentence start with "We have . . ." and reformulate this paragraph.  
Fig1: There is no scale for NAO given, please include.  
Fig.2-4,6-9: The authors use a lot of space where no information is presented, mainly due to projection. So I suggest using a different projection on only show the part where data is plotted.

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Fig.3-4,6-7: As the authors show the difference between model and CRU the mean for the model is not necessary. You may add the difference ECHO-G versus CRU to highlight the gain of the regional model!

Fig. 8,9: Please add also ECHO-G to highlight the gain of MM5.

Fig.10,11: There are not labels for the y-axes.

Fig.12,13: Just an idea: You have Cru data so you may include the observation in the panels by e.g. green contours.

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