**Climate
of the Past
Discussions**

Interactive
Comment

Interactive comment on "Mid-Holocene climate change in Europe: a data-model comparison" *by* S. Brewer et al.

S. Brewer et al.

General comments

1a and 1b): We initially limited the description of the method as it has been previously published (Guiot et al. 1999; Bonfils et al., 2004; Brewer et al., 2006). However, we accept the criticism that a number of non-common methods are used and must be described. We have enlarged and rewritten the method sections, and have described what we aim to achieve with each technique.

1c): i. We believe that the main point of this paper is to offer an objective comparison of a large number of model runs, and that the method proposed achieves this aim. Specific insights come from the comparison between models of different complexity, the increased ability of the PMIP2 models to simulate the climate of southern Europe

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and that the models are able to simulate quite complex patterns of change in a relatively restricted geographical area.

ii. We agree that too much emphasis was placed on this visual comparison in the original paper. However, as the clusters obtained from the projection the model data on the proxy data can be mapped, we have included these figures as they allow a further assessment of model/proxy similarities and differences. We believe that the visual assessment is useful to assess where the data and model fit well (or poorly), as the other measures provided simply single measures of fit. We have now provided a geographical distance estimate as well, in order to have an objective measure of the spatial fit, which was not included in the original paper.

iii. It is not clear what other techniques concerning the proxy data errors that the reviewer is referring to. The method proposed here, Hagamans distance, does not replace the assessment of errors during the estimation of climatic values from proxy data, it simply allows these errors to be included in the comparison step.

iv. We believe the inclusion of a further data-model assessment would overcomplicate any interpretation made in this study. We have instead attempted to give examples in the discussion of where the climate pattern in the model is correctly identified, but geographically displaced (e.g. cluster 2 (Continental) is shifted north in many models; the cool cluster 5 (Western) is well simulated by the PMIP2 models, but frequently shifted to the south).

2a) We have updated the references using those available on the PMIP2 website.

i. As the patterns used in this comparison are based on anomalies from a modern average value, it is difficult to see how these could be compared to variations in modern climatic modes.

ii. We have included references to these studies within the discussion.

2b) Scaling. To reduce the differences of scale, we have used an interpolated set of

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proxy data, and compared each model using values of changes in climatic parameters that are relative to the overall changes simulated by that model. This is intended to provide a method of comparing the sign of climate change, without this being obscured by differences in the magnitude of change. The differences in magnitude of change are now included as a separate comparison between data and model. We believe that the use of gridded data in the cluster analysis overcomes the problems raised here by the reviewer, as this reduces the noise, and provides greater spatial coherence in the reference dataset.

2c) Error

i. We agree that the error from the data is not the equivalent to the model variability. However, these both represent sources of uncertainty when comparing changes in mean climate. We believe that they both may therefore be used to more meaningfully compare data and models. (We have added a short discussion of this to the text.)

ii. The standard deviation comparison is based on the range of climatic change values over the study region, not on the interannual variability. We have described how this ratio is calculated, and have attempted to refer to it as the 'SD ratio' throughout the text to help clarify this.

iii. There is no assumption that these are equal. However, these values provide an extra way to a) test the fit between data and models; b) assess the differences between the models.

3a) We have attempted to condense the more descriptive parts of the text. We have also added to the text, in an attempt to better explain the choice of techniques, and to give a summary of the method used, prior to detailing the individual analyses. However, much of the 'narrative' part of the text is in describing the development of the technique, and we feel that this should be retained.

3b) As we have included a fuller description of the methods, we have removed the

discussion of statistical techniques from the introduction and moved it to the methods section.

3c) Cluster names have been included, based on the geographical location of the clusters (Southeastern, Continental, Northern, Western, Atlantic).

3d) We have attempted to better qualify the results in terms of the fit between models and data

3e) We agree that the description of 'inflated climate changes' was not clear. We have removed this and replaced it with a description of how the comparison is made (given on page 4 in the discussion about scale)

3 f) We have removed the description of the k-means cluster analysis, which was given as 'rote instructions' and added little to the article.

3 g) We have moved these descriptions to the figure captions

3h) We have not carried out a cluster analysis on the modern data, as we do not believe that this adds useful information. The cluster analysis of the fossil data is based on the anomalies, rather than the raw values, in order to obtain patterns of climate change, rather than climate patterns.

3i) The equations for the Hagaman distances are given in Brewer et al 2006, referred to in the text. We do not believe it is necessary to repeat these here.

3j) We have added further detail to the discussion of the cluster analysis.

3k) We have attempted to clarify the abstract

Minor comments

1) We have rewritten this sentence

2) We have changed 'chosen' to 'selected', and explained the basis for selection in the description of data

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3) The text has been changed

4) We have added references to other PMIP2 comparison studies

5) The text has been changed

6) We have added a brief discussion about the problem of scale between data and models

7) The text has been changed

8) We have changed some occurrences of 'should'. However, when describing the capabilities of an ideal comparison method in the introduction, we cannot assume that our method will automatically provide these. We have therefore retained 'should' for this section

9) The text has been changed

10) We have moved this to the caption of figure 5

11) We have checked and added descriptions of acronyms

12) The position of the 'perfect fit' has been added to figure 5

Interactive comment on Clim. Past Discuss., 2, 1155, 2006.

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