

Interactive comment on “The last glacial maximum locations of summer-green tree refugia using simulations with ECHAM3 T42 uncoupled, ECHAM5 T31 coupled and ECHAM5 T106 uncoupled models” by K. Arpe et al.

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M. F. Sanchez Goñi (Referee)

1- Atmospheric conditions in Europe during the LGM The cold air outbreaks between the Alps and the Pyrenees are not specific for the LGM, they also occur now a days. They are called Mistral winds and are often connected with the development of the Genua cyclone, e.g. H. Pichler and R. Steinacker, 1987: On the synoptics and dynamics of orographically induced cyclones in the Mediterranean, Meteorology and Atmo-

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spheric Physics, 36,108-117. Although it is a quite common feature, it does not project into seasonal means of e.g. the 850hPa temperatures in present-day analyses of observations. It is hardly surprising that the simulations for the present and for the LGM do not show them. It is, however, astonishing how detailed contour lines were drawn in Kuhlemann et al. (2008) from such few data on which they are based. As the authors do not tell if these cold air outbreaks are more common during LGM than NOW there is no point in going into the daily archives to make statistics of this phenomenon. We have not included this reference as we cannot see any connection with our investigation.

2- Contradiction between temperatures simulated by models and estimated by transfer Functions

We included only few sites used by Peyron et al in our study, i.e. sites 5, 15, 18, 19 and 22, for the same reason. Even though we have been rather strict in choosing the sites we have included here (with a chronology quality criterion), the chronological control of many sites remains too poor to allow distinguishing between LGM and the Heinrich events. Indeed the studies of both Peyron et al and the present study suffer from the relatively poor chronologies of most LGM sites. We agree with you that there probably lies the solution to reconcile the results of the two studies.

3- Temperature of the warmest month

We looked at the paper more carefully. We have now removed this paragraph.

4- Marine pollen sequences versus vegetation in the adjacent continent We have now used this information. It fits very well.

Minor comments - Non-modellers would need a more detailed explanation of the differences between coupled and uncoupled ECHAM models. We have now added a comment in the text.

- The authors say that the 4,000-yr time window between 23 and 19 ka is coeval with the lowest stand of sea level after Yokoyama et al.(2000). However, recent studies suggest

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an earlier date, 26 ka, for the maximum global ice extension (Peltier & Fairbanks, 2006). We have now mentioned that but it does not change anything

- Please give the meaning of the following abbreviations: ECMWF and MPI. ECMWF has been added now, MPI was already in the introduction.

- Authors should discuss results from the marine pollen sequence of the Galician margin, MD99-2331, presented by Naughton et al (2007). Data from this and the other Iberian sequences strongly support the occurrence of refugium zones for summer-green trees during the LGM, and this not only in the south but also in north western Iberia. The connection between the marine sites off Portugal and the possible tree growth in Galicia and the upper Tejo river is now included in the light of the Naughton paper.

- In the conclusion, the authors encourage the usage of climate model simulations for identifying potential refugia in other regions of the planet. It would be appropriate here to emphasise also the need for new high quality data to constrain better the model simulations. Yes, we do it now. You are quite right.

- Figure captions: o Figure 1: Please replace "Annual mean SST differences between LGM" by "Annual mean SST differences between LGM and the present (NOW)."

done

o Figure 3: What does "dam" mean? And please replace "LGM<NOW" by "LGM-NOW". It says now: darker shading for LGM - NOW values < 0. However we are not sure if it is better than the original. dam= geopotential decameters

Figure 7: I do not see on the map the symbol Xs. I only identify circles, triangles and crosses. Yes, we improved the plot.

References Fletcher, W.J. , Sanchez Goñi, M.F. (2008) Orbital and sub-orbital scale climatic impacts on vegetation of the western Mediterranean basin over the last 48,000 years. *Quaternary Research* 70: 451-464. Now used. Kageyama, M., Combourieu-

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Nebout, N., Sepulchre, Peyron, O., Krinner, G., Ramstein, G., Cazet, J-P. (2005) The Last Glacial Maximum and Heinrich event 1 in terms of climate and vegetation around the Alboran Sea: a preliminary model-data comparison. *C.R. Geosciences* 337: 983-992. We have not included these references as we do not deal with the Heinrich events. But we use Kageyama M., Laîné A., Abe-Ouchi A., Braconnot P., Cortijo E., Crucifix M., de Vernal A., Guiot J., Hewitt C.D., Kitoh A., Kucera MMarti., O., Ohgaito R., Otto-Bliesner B., Peltierj W.R., Rosell-Melé A., Vettorettij G., Weberl S.L., Yu Y.: MARGO Project Members, 2006. Last Glacial Maximum temperatures over the North Atlantic, Europe and western Siberia: a comparison between PMIP models, MARGO sea-surface temperatures and pollen-based reconstructions. *Quaternary Science Reviews* 25, 2082–2102, 2006.

Naughton, F., Sanchez Goñi, M.F., Desprat, S., Turon, J-L., Duprat, J., Malaizé, B., Joli, C. Cortijo, E., Drago, T., Freitas, M.C. (2007). Present-day and past (last 25 000 years) marine pollen signal off western Iberia. *Marine Micropaleontology* 62: 91-114. Yes, it fits very well and is now included

Peltier, W.R., Fairbanks, R. G. (2006).Global glacial ice volume and Last Glacial Maximum duration from an extended Barbados sea level record. *Quaternary Science Reviews* 25: 3322-3337. Has now been mentioned but has no impact on our paper

Turon, J.-L., Lézine, A.-M., Denèfle, M. (2003) Land-sea correlations for the last glaciation inferred from a pollen and dinocyst record from the Portuguese margin. *Quaternary Research* 59: 88-96. It is included but concentrates mainly on Heinrich events and not used in this context.

please note that we plan to make some colour figures. We have also uploaded the manuscript with the suggested changes from both reviewers (supplement)

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/6/C504/2010/cpd-6-C504-2010-supplement.pdf>

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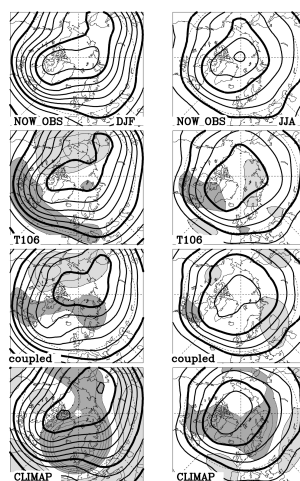


Fig. 1. fig. 3

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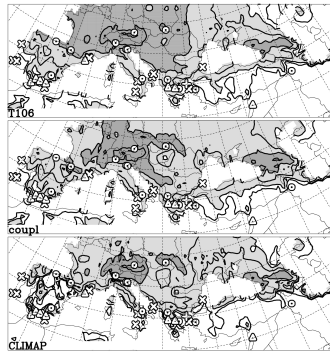


Fig. 2. fig. 7

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