

Interactive comment on “The origin of the European “Medieval Warm Period”” by H. Goosse et al.

H. Goosse et al.

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1/ In our study, we are using the presently available proxy records and forcing reconstructions as well as one of the most complex models that could be used to make the ensemble of simulation required in the present framework. Nevertheless, we agree with the Referee that there are large uncertainties in the forcing used (in particular, we are indeed obliged to impose very simple scenario for land-use change because of the lack of more precise information) and in the model response to those forcings. Furthermore, the model has a coarse resolution (as well as some simplified physics) which limits the interpretation of model results at European scale. Actually, in the model, Europe is covered by about 30 (6x5) grid points. These limitations will be stated more clearly in the next version of the manuscript, including in the abstract. In particular, the last paragraph of section 6 will be extended and moved to the section "conclusions".

2/ In the next version of the manuscript, we will modify the references in the introduction as suggested by the Reviewer (attribution studies lines 4-5 and some reconstructions line 8 instead of the review paper of Jones and Mann, 2004). We agree that it is inappropriate to talk about "contrasting trends" at European and global scale. We simply wanted to say that regional and hemispheric scales could display different behaviour. As it can be misleading, the words 'By contrast' will be removed in the next version of the manuscript. However, we would like to avoid starting the second paragraph of the introduction with 'Similarly' since we state in the first paragraph that at hemispheric scale the '20th century has been likely the warmest period of the past thousand years'. At regional scale, we cannot say that a similar statement is valid. We prefer to modify the first sentence as well as the last one of this paragraph to avoid giving the feeling to the reader that we know very well the temperature variations during the past millennium.

3/ Model weaknesses will be detailed in the next version of the manuscript (in the first paragraph of the conclusion and in the abstract) and we will replace 'T21-3 level' by mentioning that the model has a resolution of 5.6 degree in latitude, 5.6 degree in longitude and 3 levels in the vertical.

4/ A figure describing the main forcing will be included in the next version of the manuscript as suggested by the reviewer. Unfortunately, a figure with all the ensemble members (more than 100 lines on a panel) would not be very clear or useful. We will however modify the description of the meaning of "ensemble mean" and "ensemble range" in the next version of the manuscript.

5/ We agree with the Reviewer that the approximation used to derive the scenarios for land-use change are very crude (including group H scenario). This was mentioned clearly in the submitted manuscript, section 2. In the next version of the manuscript, we will include this clarification in the abstract and conclusions.

6/ We will use in the next version of the manuscript "continental" scale instead of "large

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scale" for the reconstructions of Luterbacher et al. and Guiot et al.

7/ The method used to select the best pseudo-simulation is discussed in detail in Goosse et al. (2006) and we did not want to repeat this information in the submitted manuscript, therefore we cite the corresponding study for further details. Overfitting of the model output is not a problem at European scale with the proxy used here since, when one proxy is removed (or when a continental scale reconstruction is removed), the best pseudo simulation remains similar. This uncertainty was included in the discussion and shown in Figure 2. The overfitting to one record would induce a large change in the best pseudo-simulation if this record was removed from the procedure. Such problems are described in Goosse et al. (2006) when only 4 records are used to constrain model results at hemispheric scale.

8/ Indeed, this could appear natural to find an analogue to the observed evolution (as measured by proxy records) in an ensemble of 125 simulations but actually this is not necessary trivial. Figure 5 illustrates a reasonable agreement for the proxy used here but it could be sometimes very difficult to find in the ensemble a good analogue to some proxies for some periods. For instance, the agreement with the reconstruction of Guiot et al. (2005) is not very good for the first half of the millennium. To our point of view, the best pseudo simulation could be considered as a reconstruction of past changes since we are using data to estimate those changes although the method used to derive the reconstruction from the available data is not a statistical one, as in presently available reconstructions like those of Luterbacher et al. (2004) and Guiot et al. (2005), but based on model results. Nevertheless, we agree with the referee and, in order to avoid confusion, we will avoid using reconstruction for the best pseudo-simulation in the next version of the manuscript.

9/The reconstruction of Luterbacher et al. (2004) only used Low Countries (i.e. Belgium and Netherlands) (Van Engelen et al., 2001; Shabalova and Van Engelen, 2003) for a couple of winters in the 16th century and for one winter (1739/1740) the temperature anomalies provided by Brazdil (1996). So, there is only a small data overlap

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between the regional/local proxy and the reconstruction of Luterbacher et al. (2004), considering the large amount of data used by Luterbacher et al. Tests without those common data indicate that removing them does not modify qualitatively our conclusions concerning the validity of the method.

10/ In the next version of the manuscript, we will modify the first paragraph of section 4 and suppress the sentence "Those model results are in very good agreement with a land area European (25W to 40E and 35N to 70N) temperature reconstruction (Luterbacher et al., 2004) covering the last 500 years".

11/ This paragraph discusses that there is a good agreement between the best pseudo-simulation and Luterbacher et al. (2004) while the agreement with Guiot et al. (2005) is lower. The best pseudo-simulation shows that when constrained in the same way by those two reconstructions (and by additional proxies), the selected simulation is closer to Luterbacher et al. (2004) than to Guiot et al. (2005). To our point of view, this was not an expected result. The text will be modified in the next version of the manuscript to make this point more clear.

12/ The section 5 is devoted to the interpretation of model results. In the next version of the manuscript, we will add "simulated" or "in the model" when a confusion is possible. We consider that the manuscript will be clearer if, in the next version, we include the cautions about the interpretation in the section "conclusions" rather than in this section.

13/ We agree that this paragraph is not clear. The dominant forcing is the one caused by the increase in greenhouse gases when comparing the periods 1801-1825 and 1976-2000. We simply meant that the anomaly induced by solar and volcanic forcing has the same sign as the one associated with this dominant forcing. As suggested by the Referee, we will mention that the period 1801-1825 is a period with strong volcanic activity and negative TSI anomaly.

14/ As those conclusions are supported by both model results and proxy based reconstruction, we consider that both can be used to derive the conclusion whether the

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method used is precisely mentioned.

15/ We will delete this part in the next version of the manuscript.

16/ Indeed, we have to be cautious as we only have a few proxy records and as models and forcing have large uncertainties. This will be mentioned clearly in the first paragraph of the conclusion in the next version of the manuscript. Nevertheless, using all the available information, we propose a reasonable interpretation of past temperature change in Europe. In the future, the new information could be compared with our results and then allow refining our conclusion or maybe show that some of our results are not valid.

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