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Climate of the Past Discussions

Interactive comment on "On the importance of initial conditions for simulations of the Mid-Holocene climate" *by* H. Renssen et al.

H. Renssen et al.

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Author's reply to referee #2

The comments of the referee are gratefully acknowledged.

Please find a detailed reply to all comments below.

Referee's comment (1): First, it is not clear at all whether ECbilt-Clio 2 had several stable states. The very high variability exhibited around 6k precisely manifests a very small hysteresis width, if any. The argument of the authors is a bit weak here: (p. 320): "In a transient experiment [...] this bistability was revealed by [...] an unstable phase that lasted from 7.5 to 5.5". If the states had been stable, the models would not have oscillated between these two states.

Reply: We agree with the referee that our discussion about the different states in

ECBilt-CLIO2 was not clear. Renssen et al. 2003 constructed a stability diagram for the ECBilt-CLIO2 result following the procedure proposed by Brovkin et al. (1998). This stability diagram (Fig. 3 in Renssen et al. 2003) is based on sensitivity experiments for 6 ka that were run for 100 years with fixed 100% desert or 100% grass vegetation in the Sahara/Sahel region, followed by 100 years in which the vegetation was allowed to evolve freely. The analysis revealed that at 6 ka, both desert and green states were potentially stable, in addition to an intermediate unstable state. Stochastic variations in precipitation were able to induce pronounced transitions between the green and intermediate states from 7.5 to 5.5 ka. To clarify this issue, we have rephrased and extended the involved paragraph in Section 3.

Referee's comment (2): The problem remains however relevant: is the 6K climate a viable target for GCMs if it is so highly variable and unstable, as suggested by ECBilt-Clio 2. ECBilt Clio 3 shows that, yes, the 6K climate is stable and unique. Referee's comment (3): Why would ECBilt-Clio 3 be more reliable than ECBilt-Clio 2? The reference given at http://www.knmi.nl/onderzk/CKO/differences.html does not list so clearly the differences between versions 2 and 3.

Reply: ECBilt-CLIO3 has a number of improvements (please read our response to minor point 2 of referee #1) and has been re-tuned, resulting in a somewhat different climate over Africa. Although comparisons with data shows that in general ECBilt-CLIO3 simulates a more realistic modern climate than ECBilt-CLIO2, we cannot be certain that the sensitivity for Holocene forcings is more correct in version 3 than in version 2. So that is why we stress that the presented result is model-dependent, leaving the possibility that in reality the 6 ka climate was not as stable as suggested by our results obtained with ECBilt-CLIO-VECODE3. We have added a sentence (in the revised manuscript) in the concerning paragraph to clarify this point.

Referee's comment (4): Page 321: The authors say that: "if we assume that our inferences about the indiscernible influence of initial conditions are reasonable, it would imply that the PMIP2 protocol for 6ka experiments is valid". The inferences are certainly

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reasonable, but are they correct? Can they be generalised to higher-resolution 3-D? Fully answering this question is probably not possible, but the authors are expected to better discuss the elements that could potentially invalidate their conclusions: Influence of the Laurentide Ice Sheet (freshwater flux, impact on monsoon, etc.)? Model resolution? Processes not taken into account? Influence of multi-centennial variability etc.

Reply: As suggested, we have discussed some of the model's weak points in a new paragraph at the end of Section 3. The uncertainty related to the Laurentide Icesheet is now discussed in Section 2.

Referee's comment (5): 600 years are needed to reach a quasi equilibrium. What is the error made by only doing 100 or 200 years of spin-up, as most GCMs do?

Reply: The error made depends on the used initial state. If we assume that the adjustment of the deep ocean is more or less linear (as suggested by Figure 1a), the error made by doing 200 years of spin-up would be about two-thirds of the difference between the used initial state and the final 6 ka equilibrium state. This general statement is now added to the last paragraph of Section 3.

Interactive comment on Clim. Past Discuss., 2, 315, 2006.