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Climate of the Past Discussions

Interactive comment on "Pliocene Model Intercomparison (PlioMIP) Phase 2: scientific objectives and experimental design" *by* A. M. Haywood et al.

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We thank the reviewer for their helpful comments on this manuscript.

We are happy to clarify the points raised.

The minor comments are reasonable and will be accounted for in the revision with the following exceptions/alterations. 1. Regarding Table 3, we think that this table works well in conjunction with the experimental design sheets provided in Supplement 1. Both Table 3 and Supplement 1 should be referred to before implementation of the boundary conditions begins. 2. We will modify the lakes figure to show a modern lake distribution. 3. We do not wish to show a figure of critical regional LSM differences. The target LSM

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is provided in the netcdf file and we would like modelling groups to refer back to this data set as a whole to check the fidelity of their Pliocene LSM versus our boundary condition rather than simply concentrating on parts of it.

We now address the more significant comments of the referee.

1) There are two experiments in the core. One pre-industrial (either the CMIP6 pre-industrial if a CMIP group or a PMIP pre-industrial) and one Pliocene experiment for MIS KM5c. The selection of MIS KM5c for the target for PlioMIP2 modelling was partly based on its close similarity to modern insolation at the top of the atmosphere as well as its relative stability (compared to other warm peaks) in insolation forcing 20,000 years +/- of the time slice itself. Therefore, for simplicity we have specified that all modelling groups run with modern orbital parameters (same as the local pre-industrial control run). This is stated in the manuscript and reinforced in the experimental design sheets which can be found in Supplement 1.

2 and 3) Three options exist for the choice of LSM in the Pliocene experiments and is stated in the manuscript. If the enhanced boundary condition package is implemented groups will need to be able to change the LSM in many locations around the world. If this is too difficult groups have the option of modifying their modern LSM just to account for the critical gateway changes from modern (e.g. a closed Bering Strait and Canadian Archipelago). If this is also too difficult groups can simply use their local modern LSM. The choice must be fully documented in each modelling group's boundary condition and initial science description paper in this volume.

4) We recognise that altering soils will represent a challenge. Within PlioMIP we are not simply working towards an ever refined intercomparison of models but also making sure that the models in question have good representations of Pliocene boundary conditions. This challenge was faced and overcome before with the implementation of altered vegetation cover in PlioMIP1 and in the same way we recognise that the implementation of the soils dataset will vary from group to group and due to the differ-

CPD
11, C1602–C1604, 2015

ences between each model it is not practical for us to create a translation matrix for each model. Our key advice is to document the approach and do as much as is reasonable to capture the essence of the boundary condition change in the soil data set without creating any discontinuity in the approach to soil implementation used within the pre-industrial control experiment.

We state on pages 4018 and 4019 that "In PlioMIP Phase 2 all modelling groups should implement the Pound et al. (2014) data sets for global lake (Fig. 5) and soils distribution (Fig. 6). The colour (for albedo) and texture translations for the nine soil orders used in the modelling of Late Pliocene soils and lakes are provided to guide the implementation of soil type and distribution in models. This translation is based upon the definition of 5 soils with the HadCM3 (Table 2). Groups may implement the 10 Pliocene soils using whatever method they deem most appropriate for their model. This may be by applying the provided Pliocene soil properties directly in their Pliocene simulation (i.e. as an absolute), or by calculating an anomaly from the provided modern soils data, and adding this to the local modern control soil properties. Alternatively, groups may choose to develop a regression of the provided modern soil properties with their local modern control soil properties, and then apply the resulting regression formulae to the provided Pliocene soil properties." We anticipate differences in implementation, which will need to be documented.

5) We use the Pound et al. (2014) data set for the global distribution of lakes. Please refer to Pound et al. (2014) in CP for further information. Whilst the data compilation for Lakes was of course hoped to be as comprehensive as possible it is very unlikely that the geological record has perfectly preserved evidence for total lake distributions everywhere. So we appreciate that the lakes distribution will be incomplete but we contend that the implementation of a partial lakes distribution is better than assuming that no lakes existed at all (as we did in PlioMIP1).

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