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Climate of the Past Discussions

Interactive comment on "Late Pliocene lakes and soils: a data – model comparison for the analysis of climate feedbacks in a warmer world" *by* M. J. Pound et al.

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This article examines the potential importance of lakes and soil types and their associated climate feedbacks in a warmer than present world and is a welcome addition to the climate feedbacks field in a palaeo-context. The authors have produced a synthesis of lakes and soil data from the late Pliocene and transformed the data onto the HadCM3 climate model grid. These are used as boundary conditions for the model. A sensitivity analysis shows that soil type has the most notable affect on temperature while lakes have more of an affect on precipitation. A combination of both results in a better model-data fit through their associated climate feedbacks and, therefore, in-

dicates that soil type and lake distribution should be considered when modelling past climate. The authors bring new insights into additional feedbacks operating in the climate system, in the context of the Pliocene. New boundary conditions which intend to be used in future PlioMIP projects have also been produced. As a result, this article fits well within the remit of Climate of the Past and I would potentially recommend this article for publication. However, I have a number of concerns with the manuscript in its present form, which I outline in detail below.

1. Inceptisols and Entisols are stated as not included in the soil synthesis. Firstly, it is important to include a description of what these actually represent –Climate of the Past has a wide readership that may not be familiar with such terminology! What might the effect of omitting these types of soils be considering they cover a large proportion of the Earth today? What are the properties that might change the climate (e.g. albedo values)?

2. The model description set-up is quite limited. Was TRIFFID run in dynamic or equilibrium mode? This could make a difference to the spin-up of the model in terms of vegetation type. Trees for example take more than a thousand years to equilibrate typically and therefore equilibrium mode is normally required due to computational expense. More details are required, especially if other groups wish to reproduce your results using the boundary conditions you have produced. Please also include information about the albedo of the lakes.

3. Although the changes in vegetation/precipitation/temperature are described in this paper when Pliocene lakes and soils are included there is very little discussion of the mechanisms that are actually operating. Why is the precipitation greater in certain regions when lakes are included? You need to explain this in terms of the atmospheric-land surface dynamics that are occurring. Quite a few inferences are made where the results could be examined in more depth i.e.

albedo changes can be plotted along with energy balance maps over the regions of interest.

4. A separate plot to show non-linearity when wet lakes and soils are included together compared with when they are separately included is needed. It may also be useful to perform a statistical analysis to determine whether the presence of realistic soils and lakes is more important in different regions.

5. Although the authors describe the changes in vegetation for their different sensitivity experiments it is essential to include some quantitative results of the changes. For example instead of just stating shrubs expanded, include the percentage increase in shrub in a particular region. It is very difficult to see in the current figure.

6. The discussion merits a section on using the Pliocene biome reconstruction by Salzmann et al. (2008) to determine soil type in regions where there is no data. It is my understanding that this reconstruction was created using data from BIOME4. Therefore, your results from BIOME4 have inherently been influenced by the fact that the boundary conditions are no full independent of this model.

7. Although the authors state quite clearly there has been an improvement in the regional data-model comparison for the Pliocene when realistic soils and lakes are included there is no quantitative evidence of this in the manuscript. Could the authors compare their temperature and precipitation patterns with available late Pliocene data and show statistically that there is closer match when realistic soils and lakes are included compared with the control?

8. It would be beneficial to include a statement about future avenues of research such as using a surface water scheme model (e.g. HYDRA) coupled to a climate model to understand the implications of a two-way feedback on Pliocene climate.

Other comments:

P3176, line 12: "...seasonal increases in [precipitation] the Northern Hemisphere..." – this is vague. Do you see this over all of the Northern Hemisphere? Figure 4 does not show this.

P3179, line 1-2: Please include a sentence of why you want to include these new boundary conditions (too improve the model-data mismatch) and what you are going to compare your results with.

P3180, line 18: Remove "due to"

P3182: Please put a clarification of why you do not include the dry-lake scenario in your modelling. It would have been interesting to see the sensitivity of the climate to this uncertainty.

P3188, line 25-: Have you looked at the standard deviation of the precipitation differences over South America to demonstrate model variability?

P3191, line 9-10: It is important to show that the distribution of soils and lakes is different than today by including maps of present distribution.

Figure 2: The colour scale for the lakes map is quite difficult to interpret when printed. Please make this clearer.

Figure 3: The colour scale is saturated at the lower end when printed. Please modify. The figure caption needs to state that these are anomalies, whether they are significant and what the reference climatology to which the anomalies are calculated.

Figure 4: Again when printed the colour scale is saturated at the upper and lower bounds. Please also state that these are anomaly plots.

Figure 5: It is very difficult to distinguish the differences between these sub-plots (see point 4 above). In particular, the synergy of Pliocene soils and lakes feedbacks is not clear compared with when only one of these land surface attributes

is changed. I suggest alongside these plots also showing difference plots of Leaf Area Index. This way it will be easier to see where obvious changes in vegetation occur.

Interactive comment on Clim. Past Discuss., 9, 3175, 2013.