**Climate
of the Past
Discussions**

Interactive
Comment

Interactive comment on "Climatic conditions for modelling the Northern Hemisphere ice sheets throughout the ice age cycle" *by* A. Abe-Ouchi et al.

A. Abe-Ouchi et al.

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Reply to the anonymous referee #1

First of all thank you very much for the valuable comments. In the following I would like to answer to the Referee comments referring the first referee (Lev Tarasov) as LT and the Annonymous Reviewer= AR.

(1) Major comments (1-1) p310 and Fig1a, AR points out that there is a lack of information unless the effect of ice sheet alone is shown. The figure of LGMfull - LGM nice is added following AR. Also following AR, we add a table to show the numerical values as requested in the revised paper. We agree that it is useful. We apologize the confusion but by replacing the letter "Fig. 1d" by "Fig.1e" on the line 16 of page 312. I hope the

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correction of this typo-mistake answers the question AR had here.

(1-2) AR suggests a detailed explanation for Fig.2 or omittng it. We agree that it needs clarification and some discussion on the lapse rate in the model as pointed out also by LT. We are adding a discussion on it in the revised paper. We noticed the way of presentation is not good in the submitted manuscript and agree that it needs to be revised. It gave misunderstanding that the evaluation of lapse rate was a priority. Therefore we will omit the sentence in the abstract and in the conclusion about the "constant lapse rate" and rather treat the constant lapse rate as an "assumption" or a working hypothesis for simplicity and a first order representation of lapse rate effect which is comparable to other works. I hope Fig.2 is useful for the justification of the assumption.

(1-3) The points that are mentioned by AR are totally reasonable and it should be clarified by correcting the name of experiments listed in table1. I would like to apologize of the misprint in table 1 and thank AR for pointing it out .

(1-4) I agree with the referee AR and add the explanation of YASSN05.

(1-5) I agree that we should mention that ICE5G is used in the new PMIP2 in the revised text. As explained to LT, although ICE5G is desirable, when we started the series of high resolution GCM runs (T106) described in 3.1 and 3.2, only ICE4G was available and we have already used quite a lot of time for the high resolution runs which can not be all replaced by ICE5G because of the expensive computer time (one run of T106 10 years takes more than a month CPU, waiting time is more). We would like to mention the importance of using ICE5G in future in the revised text. Although it is desirable, as shown in Fig. 4c using our PMIP2 result, we think the point would not be changed but should be proved in future in another work, which is discussed in the revised paper.

(1-6) It is true that the LGM and present is due not only to CO_2 but also to orbital parameters although the orbital paramters' difference between LGM and present is known to be small. This is mentioned in the revised paper.

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(1-7) I follow the referees AR and LT to add information of the observation by adding a time series of sea level change in the figure. We add more explanation in the revised text about the comparison between the model result and observation.

(2) Minor remarks. (2-1) Discussion is added to the revised text to discuss that the bed rock at present are not necessary in equilibrium as suggested by AR.

(2-2) p306: we add the sentence to explain the geothermal heat flux may be underestimated as AR suggested.

(2-3) Explanation of the reference state are added as AR requires.

(2-4) p.308 the word "periodical boundary condition" should be replaced by "periodic boundary condition". We are sorry for the wrong English word. We mean by just the value f(x) equals f(x+a) in one dimensional for example for simplicity ("a" is 360 deg longitude for example.)

(2-5) p311 line 11: AR (minor 5) suggest to refer to Kageyama and Valdes(2000) and Roe and Lindzen (2001). We agree and follow the suggestion in the revised text

(2-6) Caption of Fig4. Yes, "same as Fig.1" means "same as Fig,1a".

(2-7)Section 4: we add more explanation for the equations such as (9) and (10). The gamma-area is a fixed coefficient and area is a variable, which should be clarified in the text. Variable "href" is a reference topography elevation (not necessarily "ice sheet elevation", which is just the case for Greenland in Northern Hemisphere, sorry!).

(2-8) p317, l6: we correct the sentence as AR suggests.

(2-9) Table 2: we correct the unit of the lapse rate as AR suggests

(2-10) Figure 7: We redraw the figure by colors as suggested by LT. Labels are removed but the color bar is added to satisfy the request by AR.

(2-11) Fig.8 and 8b; the thin line is the input of the model (ie. Orbital forcing) but we

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add the explanation in the caption. Also we will add the legend in the figure for better reading as AR suggests.

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