Climate of the Past Discussions

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Comment on cp-2021-163

Anonymous Referee #2

Referee comment on "Calendar effects on surface air temperature and precipitation based on model-ensemble equilibrium and transient simulations from PMIP4 and PACMEDY" by Xiaoxu Shi et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2021-163-RC2, 2022

Calendar effect is a problem in paleoclimate modelling since long. To my knowledge, there are not many studies dedicating to this topic. In this manuscript, the authors investigate the calendar effect on seasonal temperature and precipitation by using the PMIP simulations of the PI, 6ka, 127ka snapshot and the 6-0ka transient experiments. The results could be informative for paleoclimate community and let pay more attention to the calendar problem. In the meantime, some improvements would be needed for clarifications and also to make the manuscript more attractive. Please find my comments and questions here below.

General comments:

1. There are not many studies on the calendar effect in paleoclimate simulations. In addition to Joussaume and Braconnot 1997, Bartlein and Shafer 2019 cited in the manuscript, there are also Pollard and Reusch 2002 (https://doi.org/10.1029/2002JD002126), Timm et al 2008 (https://doi.org/10.1029/2007PA001461) and Chen et al 2010 (https://doi.org/10.1007/s00382-010-0944-6) . These studies and their findings should be mentioned in the manuscript and be compared with.

2. It is unclear for me how the conversion of temperature and precipitation on the classical calendar to those on angular calendar was made. A thorough explanation would be needed in section 2.1. Please also see some of my specific comments.

3. The calendar effect at 6ka and 127 ka was examined using multi-model ensemble. Is the calendar effect on temperature and precipitation similar between individual models qualitatively and quantitatively speaking? Additional analysis on individual model would be interesting. Moreover, how is the calendar effect compared to the difference between

models? For example, the difference between the black and pink lines in Fig.12 appears very small. It is much smaller than the model-model difference. Is such a small effect worth to be mentioned?

4. To which extent is the model-proxy comparison improved when calendar effect is considered? It would be interesting to show the comparison with proxy data before and after the calendar conversion.

5. If I understand well, the calendar effect happens mainly when the seasonal climate between two time slices is compared. Is it worth to consider it when we are interested only in the absolute climate at one given time slice? Does the calendar effect have an influence on the simulated vegetation?

6. In section 3.4, why only analyze the temperature over continents and ice-free continents? I would suggest to add analysis also on temperature over ocean and ice continents, which would be particularly important for Southern Hemisphere.

Specific comments:

Line 25: change "31" to "21"; is there any other reference date that has been used by other model groups? Is there a reason to use March 21 or other date as the reference date?

L32: change "with a periodicity of about 100,000 years" to "with major periodicities of about 400,000 and 100,000 years (Berger, 1978, https://doi.org/10.1175/1520-0469(1978)035<2362:LTVODI>2.0.CO;2; Berger and Loutre, 1991, https://doi.org/10.1016/0277-3791(91)90033-Q)". The 400 ka periodicity is more important than the 100 ka one.

L33: what does "periods of perihelion and aphelion" mean?

L34: 0.0167, 0.0189, and 0.0397 are the values at a given date or an average over a given period? Please make it clear in the manuscript.

L37: with a "major" period of 41,000 years

L39: Note that 19,000 and 23,000 years are the major periodicities of climatic precession, not of astronomical precession. Please clarify it in the manuscript and cite Berger (1978) where these periodicities were calculated for the first time.

L46: Indicating 6ka for MH and 127 ka for LIG could be misleading, because MH and LIG are more than these two dates.

L51: Herold et al 2012 (https://doi.org/10.1016/j.quascirev.2012.08.020) and Nikolova et al 2013 (doi:10.5194/cp-9-1789-2013) are among the early studies on simulating the 127ka climate and describing its insolation pattern, and deserve to be cited here. Please also be more precise about "enhanced seasonal cycles". In Nikolova et al 2013, it is found a larger seasonal contrast in northern hemisphere but a reduced one in the southern hemisphere.

L67: "we perform …" is unclear for me. Please give more explanation.

Section 2.1: Is the calendar conversion method used in this study similar to those used in the five studies mentioned in my major comment 1?

L79: is it necessary to mention "Northern Hemisphere"?

L85: "orbital period" is confusing. I assume T is the number of days in one year.

Equation 2: Please explain what is the principle on which Equation (2) is built.

Equation 3: It is unclear how equation (3) is obtained. Please also give an equation explicitly relating tp to true anomaly.

L94-96: Please be more precise on how each season is defined from the true anomaly that is calculated in equation (3).

L119: you mean " increased summer insolation"?

L124: Please explain what is the delayed effect.

L143: It is unclear how this calculation has been done, and how the dates in table 2 are obtained. More explanation is needed.

L145-146: isn't the velocity always greater at perihelion than at aphelion, whatever at today or any time in the past?

L235: It is good to refer to Rymes and Myers 2001 when use monthly values for calendar corrections, but it would be helpful for the reader if some information is given on how to transform monthly values to daily values.

L280: any idea of why there is a model-dependency of the calendar effect?

Section 4: discussion and conclusion are mixed up, better to be separated.

L297: what does “the phasing of the insolation curve” mean? Does calendar effect have an influence on the phasing between insolation and temperature, precipitation in the Holocene transient simulation?

L330-331: Please explain why a different definition of season is used in this study, is there any advantage?

L352: The analysis of this study shows that the calendar effect is most important in autumn. Then would the model-proxy comparison be significantly affected if proxy records mainly reflect summer temperature?