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Geoscientific Model Development Discussions

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Interactive comment on "Paleo calendar-effect adjustments in time-slice and transient climate-model simulations (PaleoCalAdjust v1.0): impact and strategies for data analysis" *by* Patrick J. Bartlein and Sarah L. Shafer

Anonymous Referee #1

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1 Summary Statement

This paper is a valuable contribution both in terms of raising awareness for the calendar definition problem in simulations with different orbital configurations and providing computer programs (plus source code) for easy conversions of climate model output data from the traditional fixed calendar system to angular-aligned equivalent monthly mean values. The support of NetCDF CF-conform model data will enable climate modelers and users of paleoclimate model data to provide or calculate on their own these

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angular-based monthly mean climate data.

The examples and figures shown in this article serve the purpose of illustrating the cause of the problem. More so, the authors apply the angular-based calendar definition to present-day climate data to highlight the pure bias resulting from the shift in the seasons when orbital changes in precession (plus eccentricity) shift the longitude of the perihelion.

The article is well-written, and most figures are easy to comprehend. A few exceptions, where improvements should be made in the text /figure, I would like to point out.

Overall, I have only minor comments and a few critical points to raise in the following section.

2 Specific comments

Line 30-32: I believe you meant to express just the opposite relationship here. Closer to the sun, the Earth covers a wider angle in the same amount of time (Kepler's 2nd law), and therefore a 90-deg angle will be passed in a shorter time when Earth is near the Perihelion point.

Line 36-40: A citation to previous literature on this topic should be added.

Line 43-46: Could you cite some examples from the literature, or else point out that you'll demonstrate this here in the later sections.

Line 57-68: I appreciate that you mention the other methods, too. It would have been nice to see differences between your method and the method of Chen et al (2011) later in the text, too. Their code (and I believe Pollard and Reusch (2002), too) could be tested on the reanalysis data set, too.

Section 2: You mention the 360-day and 365-day calendar years, it would be worth

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pointing out that the default code and the shown results are all (?) based on 365-day calendar. Or was it with the actual leap-year calendar, since you worked with reanalysis data.

Line 119 and Fig.3: The color scale in the Figure is truncated at 10 Wm^{-2}, but the text describes values up to 35 Wm^{-2}. Please consider an update of the color scale range in the Figure. This may also apply for other figures. Please revisit the color scales and make sure that the range covers the actual value range of the data.

Line 127: Here I feel that it is possible to give a more precise value than 10Wm^{-2}, given the range of the color scales in the Figures 7-9.

Lines 254-269: The description of the effects of the biases in the transient simulation is done well. However, in the discussion section (or here in this paragraph) the authors should discuss the implications for real-world paleoclimate studies. Two things come into my mind: (a) most often paleoclimate studies use seasonal mean data rather than single month data, (b) for proxy model comparisons and interpretation of time series signals one could as: 'Does it matter in the end?' Most likely one does encounter seasonal rather than single month responses in proxies, and processes within the climate system are often analyzed (at least at first) by season rather than single months. I still find it appropriate to present the monthly mean results here, but the practical points of view should also be highlighted.

Section 4:

I got a bit confused with the technical definition of start day of a year. What is actually determining the first day of a calendar year? Astronomically, vernal equinox for example would make sense, but here I believe it is defined more on technical grounds by the default application and historical developments in climate models? That is, in the present-day calendar we call Jan 1st the first day in a year, which is a certain longitude position of the Earth in its orbit around the sun. Please mention or explain the basis of the definition start day.

Line 369: the equation is for a variable with physical units of time. On the right-hand side, is the variable phi (an angle in degrees) correct?

Line 373: “fixed at 80 days after the beginning of the model year”

I am not sure if that is clear to all readers, it got me thinking again, what is actually better: To describe the begin of the year as fixed relative to the vernal equinox point, and defined via a longitude angle; or from a modeler’s perspective where we are used to think of years starting Jan 1st, and vernal equinox is somehow flexible and can be set to a specific day in the year.

Line 373: better if you mention here the actual sub-routine that is to be used with the 365-day calendars.

Section 5: Can you briefly mention which libraries and versions (I think of udunits, netcdf) you used and recommend in connection with the code?

3 Figures

Figure 2: Can you add the summer solstice as a point in the figure? It could be helpful to have in this figure. One question I have though, since there is a little problem:

When you compare Dec and Jan the color code switches from plus (blue) to minus (red) colors. At a day in the year 180 days before (after) summer solstice (SS) [in a 360-day calendar] it becomes meaningless to talk about closer and farther relative to SS. An anomaly of one day brings that day closer to SS and at the same time farther away from SS. Can you please explain once more how the reader should interpret the color code in Figure 2? And maybe explain if that has implications on the definition of anomalies shown in Figure 3-5, or not?

Figure 3 (and following Fig 4,5):

Why is it that all but the Dec months show consistent color coding with Figure 2? In Fig. 3 the December months clearly stand out because they do not vary in terms of anomalies over the past 150,000 years. I also find it inconsistent with the maps in Figure 11.

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