Comment on cp-2021-163

Anonymous Referee #3

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-RC3, 2022

This paper documents in detail the calendar effects on analyses of paleoclimate simulations for the mid-Holocene (MH), the Last Interglacial (LIG) and pre-industrial periods as well as for transient simulations. Indeed, due to the slow variations of the Earth's orbital parameters, the position of seasons is modified within the ellipse, affecting the length of the seasons. This effect has been documented in Joussaume and Braconnot (1997) and more recently in Bartlein and Shafer (2019) but is usually not accounted for. This paper uses the most recent simulations of PMIP4 with coupled models and allows to revisit this question. Indeed, at the time of PMIP1, in Joussaume and Braconnot (1997), sea surface temperatures were prescribed to today, thus including a hidden present-day calendar in past climate simulations. Moreover, the paper presents results from transient simulations. These results deserve to be published although some improvements of the text would help its readability.

- There is a need to better explain how the 90° angular seasons are positioned relative to the vernal equinox which provides the reference for dates (March 21st), the way the seasons are computed is not fully clear in the paper
- Concerning the simulations used, it would be good to summarize the PMIP4 boundary conditions in section 2.2 and explicit whether the three transient simulations use the same boundary conditions and whether they differ or not with PMIP4 for the mid-Holocene.
- The use of angular seasons is indeed more appropriate when comparing seasons from different periods in paleoclimate simulations, however, it would be good to add some elements in the discussion on possible implications for the model-proxy data comparisons.
- Moreover, you have made the choice to define 4 times 90° angular seasons and to compare to pre-industrial, but nothing is said on how you would compare to present-day. In Joussaume and Braconnot (1997), the choice was to use the same angular seasons as used today (even if they are not perfect 90° angles) to ensure consistency with present-day. It could be interesting to add some discussion on the impact of those

different choices.

- In the discussion, it would also be interesting to know if some of the forcing or boundary conditions of simulations may still keep some memory of the present-day calendar (e.g., prescribed vegetation or aerosols) and may add some bias in the analyses.
- The text needs some reading to correct some sentences, some are mentioned below.

Specific comments:

L12: The largest difference occurs in autumn is related to the choice of a fixed date for the vernal equinox, this should be made clearer in this sentence

L16: the conclusion on using monthly data is not clear in the abstract, you should add compared to using daily data

L24: "is highly depends" should be "highly depends"

L25: March 21st and not 31 !

L30: the classical reference is rather to Berger (1978) than 1977

L44: modelling groups and not model groups

L48: I do not think we can say that the MH and LIG are chosen due to their great potential to resemble future scenarios. Please reconsider this statement

L50: receive more insolation in summer and less in winter is only true for the Northern Hemisphere

L83 to L86: a drawing to explain M and E is missing. It could be added at least in the supplementary material

L102: IPSL is the name of the institution not of the model (IPSL-CM)

L132: Sahel and not Sahal

Table 2: mentions that the present-day calendar is not an angular one and should be corrected: could that correction be described ? at least in supplementary ?

L155-156: you compare in the following angular (adjusted) versus calendar (non adjusted), as is chosen on the figures as well, whereas in this sentence you reverse the comparison. Please take care to avoid changing the reference to help the reader.

L180: It is expected to have continents reacting faster than oceans to solar forcing due to the differences in heat capacity.

L312: Use of daily data "can completely erase the bias" is strange, isn't it the definition of what is called the bias in the paper ? I guess you mean that compared to daily data, using monthly data do not completely erase the bias ?

L332: indeed, in Joussaume and Braconnot (1997) the choice is made to use the same seasons as defined today to be compatible with the present-day reference. It would be useful to discuss more the implication of your choice if you want to compare to today.

L352: when considering proxy-data we may have to rather consider bioclimatic indicators which are less dependent on the artificial definition of seasons, eg when considering the growing degree-days

Fig 3: legend of third column is angular minus classical and not classical minus angular