

Interactive comment on “Climate and African precipitation changes in the mid-Holocene simulated using an Earth System Model MIROC-ESM” by R. Ohgaito et al.

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Main suggestions:

The paper tries to cover too many topics, ranging from global climate to N Africa climate to carbon budget to ocean streamfunctions to salinity and so on. As a result, the text is too long and there is an excessive number of figures (30). The authors should decide what is their primary focus and remove all unnecessary text/figures.

Often changes between 6k and 0k are mentioned but no mechanisms for the changes are described.

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The writing needs some improvement.

MECHANISMS

At numerous points in the paper, changes in the climate system are reported/mentioned but no mechanisms are offered. Please explore deeper.

For example. . .

On page 3279, explain why the monsoons shift northward.

On page 3279, explain the mechanisms for these vegetation feedbacks.

On page 3280, why does ocean coupling enhance the monsoons?

On page 3281, how does the ocean play a major role in monsoon change?

On page 3282, how does vegetation amplify the monsoon?

See Notaro et al. (2011 J. Climate) for a study of vegetation feedbacks on the global monsoons.

On page 3288, why are the monsoons stronger? Due to a warmer mid-high latitude continent? Are they responding to springtime warming of the land (pre-monsoon thermal gradient)?

On page 3289, why does soil moisture decline over Eurasia/N America? (also, how many soil layers in the model?)

Why doesn't SST increase over the N Pacific/Atlantic in JJAS in Fig. 10, since insolation increases?

On page 3293, did global LAI increase at 6k versus 0k? I recommend plotting LAI to check.

On page 3294, it doesn't look to me like the model even simulates the North American monsoon at that spatial resolution.

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On page 3298, why is ENSO's amplitude weaker at 6k?

On page 3300, how do vegetation feedbacks enhance the mid-high latitude warming?

On page 3301, what specifically was learned from comparing the 2 models? It seems the models only slightly differ in climate and their differences are small and can not be attributed in most cases.

On page 3301, where are the models going wrong in their inability to spread vegetation deeper into the Sahara at 6k?

WRITING

The writing needs further editing to improve the grammar and readability.

Some examples:

On page 3278, change “using paleoclimate simulations” to “through paleoclimate simulations”. Also change “by paleoclimate simulations” to “through paleoclimate simulations”.

On page 3278, regarding “6 ka precipitation change”, make it clear that you are comparing 6 ka to modern.

On page 3279, reword “lake status data”.

On page 3280, the discussion of Kutzbach's paper is unclear.

On page 3281 and elsewhere, avoid saying “warm SST” or “cold SST” (or “warm temperature” etc. . .). It is more accurate to say “anomalously low/high SST”.

On page 3282 and elsewhere, it is better to say “studies” rather than “works” (also change “work” to “study”).

On page 3282, change “strong monsoon” to “stronger monsoon”.

On page 3282, explain the global monsoon idea.

On page 3283, when you state “differences in MIROC-ESM”, do you mean differences between MIROC-ESM and MIROC3?

On page 3283 and elsewhere, add a comma at times when introducing a model name. For example, use “transportation component, sSPRIANTARS”. On page 3284, use “chemistry module, CHASER, is. . .”.

On page 3283, why is the stratosphere coupled to the land surface?

On page 3284, why discuss Table 2 before Table 1?

Throughout the paper, try to make the text more concise. For example, on page 3284, change “performed sets of simulations in time-slice experiments” to “performed time-sliced experiments”. Also, avoid describing a figure in the text, since that is the job of the figure captions. For example, on page 3285, you mentioned that the change in insolation is shown in Figure 1. The caption states that. In the text, just make your scientific point and then refer to the figure (e.g. at 6k, seasonality is enhanced in the NH [Fig. 1]).

On page 3285, change “In MIROC3 simulation” to “In the MIROC3 simulation”.

On page 3285, reword “prescribed SSTs, which are the climatologies. . .”.

On page 3286, exactly how long are the sensitivity runs? If 15-20 years, are they long enough given decadal variability?

On page 3287, either use scientific notation for all carbon #s or for none of them. The model #s use scientific notation and the observations do not.

On page 3288, regarding “less warming over North America”, is that less warming compared to what?

On page 3288, regarding “slightly lower net temperature changes”, these changes in temperature are lower than what?

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On page 3288, change “recoreds” to “records”.

On page 3288, regarding “changes in the meridional heat transport”, is that 6k vs 0k?

Throughout the paper, the authors begin discussing changes in different variables without any introduction on why they are now focused on that variable. For example, on page 3288, meridional heat transport is suddenly discussed with no explanation on why they are considering it.

On page 3289, change “to Walker circulation” to “to the Walker circulation”.

On page 3289, change “divergences” and “convergences” to singular.

On page 3289, make it clear that you are looking at “peak latitudes of precipitation” as an indicator of the ITCZ.

On page 3290, reword “cooler change”.

On page 3290, when you state “are generally slightly cooler”, do you mean the mean SST state is cooler, or there is a larger decline in SST?

Adding wind vector anomalies onto Figure 12 might help make the point of the wind driving the ocean anomalies.

On page 3291, what is meant by “sea ice expansions and convection sites... in 0 ka”? Please reword.

On page 3292, what is the observed strength of the Atlantic meridional overturning?

On page 3292, please reword “flip-flop”.

On page 3293, which months are meant by “local summer”?

On page 3293, some statements are unnecessarily vague/lack confidence. For example, the monsoon “seems a little earlier” (is it earlier?) and the difference in wind “may lead to more moisture convergence” (does it?). These things can be verified with the model output.

On page 3298, change “El nino” to “El Niño” and change “nino3 indexes” to “Niño3 indices”.

On page 3299, can a statistical test be applied to statistically compare the strength of 2 correlations to show if they are really different?

On page 3299, can you quantify how much of enhancement that the change in LAI causes?

On page 3300, how specifically does N Australian precipitation change?

In Table 1, why doesn't MIROC3 have any physics listed?

In Tables 1-2, sometimes the first letters are capitalized and other times, they are not.

In Table 3, “0 ka + 6000. . .” is confusing.

In Figure 7, correct the spelling of “positions” in the title.

In Figure 10a, is sea ice playing a role off NE Asia?

For figure 18, you are plotting “vertical motion”, not “convective activity”.

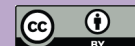
For all difference plots (e.g. Fig. 18), t-tests should be applied.

For figure 19, you are showing a percentage, not a ratio as the caption implies.

For figure 26, I would remove the contours, which make it noisy, and perhaps start the color bar at +/- 0.1. Why not include an observed map? Why in MIROC3 at 6k is the local correlation between tropical E Pacific SST and precip in the same area not stronger?

ADDITIONAL

On page 3286, what reanalysis product is being used? It is not sufficient to evaluate a GCM's temperature/precipitation against a reanalysis product. One should use a gridded observational dataset (CRU, Univ. of Delaware, etc. . .). Reanalysis pre-

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precipitation is model-derived. Also, the model's performance (e.g. mean climatology, correlations with NINO3, etc. . .) should be shown in the figures so the reader knows the strengths/weaknesses of the model. How well does it simulate the seasonal cycle of N African precip for example?

The paper text is quite lengthy. You should remove discussions that are not critical to the focus topic. For example, is the discussion of salinity or carbon budgets on page 3287 needed? On page 3291, streamfunction is suddenly discussed with no explanation why you are looking at it. Is it critical to the study or can it be removed to shorten the paper? Same issue with salinity on page 3291. Perhaps remove section 5.3.1.

When comparing two patterns, it is a good idea to include a spatial correlation. For example, on page 3289, rather than just saying that the two maps have a "general resemblance", you can perform a spatial correlation and quantify the comparison. On page 3290, rather than just saying the "pattern of cooling is similar", quantify with a spatial correlation. Also true for the "patterns of change are common" on page 3291.

There is an excess of figures in the article, some of which are discussed by only a couple of sentences (e.g. Figure 17. . . minimal discussion of the wind changes shown here). I recommend removing probably 10 figures:

Remove figure 2. . . the text description of the spinup is sufficient.

For figure 6. . . what are the units? Is this figure needed?

For figure 12. . . is this annual? Is this figure needed?

Remove figure 14. . . the text description and also figure 13 suffice.

For figure 15. . . the DJF is never discussed, so either remove or discuss the NAO/AO implications.

Remove figure 19. . . figure 20 shows the same info.

Remove figure 22... figure 19 shows the same info.

Regarding figure 25, I would either state the #s in the text and eliminate the figure, or replace the figure with something else, like a histogram. Does the frequency of ENSO events change? (check with power spectrum).

For many figures, including Figure 28, if the 2 models generally agree, it is sufficient to show 0k and 6k from just one model (especially if your discussion is focused on 6k versus 0k and not MIROC3 versus MIROC-ESM for that particular figure).

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