

Responses to reviewer's comments for “Model and proxy evidence for coordinated changes in the hydroclimate of distant regions over the Last Millennium”

We are grateful to the reviewers for their comments and suggestions, all of which have been helpful for improving the manuscript. We respond to each of the comments in our thorough replies below, providing in gray the comments from each review and in black our responses.

Reviewer 1:

The authors resolved all points raised by the reviewer concerning the first submission. The manuscript does not have the traditional Results and Discussion sections. Instead, the Results section has various subsections in which the results and discussion are clearly separated. For this paper, I find this structure useful and clear. Hence, I suggest publishing the manuscript after the following two minor details have been addressed:

R1C1

1. Arrows in Fig. 1 are still difficult to understand. Do they just indicate the direction of change? But does their varying length have a meaning? Please add at least some explanation to the figure caption.

Arrows in Fig. 1 only indicate the direction of the change. The arrow length is arbitrarily selected to improve the visualisation of the figure.

This has been clarified in the figure caption: “The current position of the ITCZ in July and January, the ITCZ changes in the transition from MCA to LIA in the Indian Monsoon region (C1.ITCZ), Eastern Pacific (C2.ITCZ), East Africa (C3.ITCZ) and Western Pacific (C4.ITCZ), the boundary between low and high pressures in the pattern of NAM and SAM, and the changes in this boundary in the transition from MCA to LIA (C.NAM and C.SAM) are shown within the map, according to the references included in Table 1. Arrows only indicate the direction of the changes, and not their magnitude.”

R1C2

2. Sec. 4.4 page 20: when you discuss the distant teleconnection, you should be a bit cautious and discuss the limitations of LMR and PHYDA. Both are based on fields from climate models and use the climatological covariance of the underlying models. Although using some covariance localization, they allow for distant observations to influence distant regions, which are teleconnected through the model covariance. This is why I would expect them to be in line with simulations. Only the drought atlases would be really independent reconstructions.

Indeed, the results of Fig. 8a and Fig. 8b are significantly impacted by the climatological covariance of the models. The last paragraph of section 4.4 has been reworded, to emphasize this limitation of the analyses based on PHYDA and LMR:

“The correlations for the PHYDA and LMR shown in Fig. 8a and Fig. 8b are impacted by the climatological covariance of the model used for the data assimilation. However, if the correlations are computed for the CESM-LME (Fig. 8c) without any data assimilation, only positive correlations associated to the impact of temperature in the PDSI are obtained, showing that a certain impact of the proxies may also be present in the results for the PHYDA and LMR. The fact that the PHYDA and LMR respectively emphasize the variability in the Pacific and Atlantic basin also shows that the regional variability given by the proxies is consistent with the spatial patterns from the models.”

Reviewer 2:

I am happy that the reviewers have addressed my points, so my recommendation is to accept the paper for publication.

R2C1

My only comment is that the green colors on figure 5 (and several of the figures in the appendix) all look quite similar to me - so I wonder if it would be possible to bring out the differences in the agreement more by changing the color scale slightly.

The color scale of Fig. 3 to Fig. 5 was selected to use the colors of Fig. 1 as maximum value of the scale. This leaves indeed little room for the intermediate colors. However, this approach was preferred to a larger color scale decoupled from Fig. 1, since the conclusions are mostly extracted from the sign of the differences and the comparison of this sign with that from reconstructions of Fig. 1, rather than from the exact value of the PDSI differences.