

Interactive comment on “A new multi-variable benchmark for Last Glacial Maximum climate simulations” by Sean F. Cleator et al.

Anonymous Referee #1

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This paper uses quantitative estimates for climate parameters derived from pollen spectra from a number of previously published compilation studies for the Last Glacial Maximum (LGM). It combines these estimates with climate model output and a new approach to determining the impact of lower LGM CO₂ on plant water use efficiency (as LGM CO₂ was lower than today). The latter step is important because it changes the estimate of moisture availability from that which results from simply applying the pollen transfer function approach, because the transfer functions are effectively ‘calibrated’ for pre-industrial CO₂ levels. The output from the study is a new global map of changes in a number of temperature and moisture parameters at the LGM compared to pre-industrial conditions. The study suggests that some parts of the world previously considered ‘drier’ based on pollen assemblages, may well have been ‘wetter’ when the

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CO₂ effect is considered. The approach also delineates the (large) areas of the planet where there is insufficient observational data to make an estimate of LGM conditions.

This is a relatively short paper that relies heavily on previously published work for data and methodology, which makes it hard to review in a very detailed fashion, because there is not much data included. The results presented are simply a number of global maps, with very little data in the text or supplementary information. As the previous studies have passed peer review this does not bother me too much, and the paper is clearly and well written. Hence I am happy to recommend publication with minor technical corrections.

A couple of points to consider: The definition for the LGM given here is 21 ± 1 ka, and this appears to be because previous work has used this temporal extent. However it is different from, for example, to the range used by Annan and Hargreaves (cited in the paper) of 21 ± 2 ka, and recent work on sea level (Ishiwa et al. 2019) suggest the ‘real’ LGM was 19.1-19.7 ka, with a plateau prior from 20.4-25.9ka, both pushing out past the time interval use in this study. I don’t think there is anything in particular to be done about this – just to think about. . .

Ishiwa, T., Yokoyama, Y., Okuno, J.I., Obrochta, S., Uehara, K., Ikehara, M. and Miyairi, Y., 2019. A sea-level plateau preceding the Marine Isotope Stage 2 minima revealed by Australian sediments. *Scientific reports*, 9(1), p.6449.

Again, a general point I guess, that the paper refers to several new studies since the Bartlein paper on which the analysis is based, and there are more. It would be nice to think these could be assimilated into a future dataset to maybe close some of the large ‘no data’ holes in the results. . .

Small things (in fact a laudably small number of small things): L59: change to ‘lower, atmospheric aerosol. . .’ L321: comma after ‘however’ (I think?)