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Interactive comment on "Interannual climate variability seen in the Pliocene Model Intercomparison Project" *by* C. M. Brierley

Anonymous Referee #1

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Interannual climate variability seen in the Pliocene Model Intercomparison Project

This paper explores several aspects of interannual variability in the PlioMIP ensemble of model simulations. The primary focus is on ENSO variability, and the author finds a surprisingly coherent response in terms of the simplest of metrics – the El Nino 3.4 shift in anomaly variability between the Pliocene and modern. however, other metrics show a spread of response across the ensemble.

The paper is very interesting and generally well written. I do have some queries but I am sure these can be addressed relatively easily.

When I started reading this, I wondered how likely it was to see a coherent shift in just one of the metrics considered. I note that this is discussed later in the paper, but

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my own calculations differ from those of the author: 8/9 of the models go in the same direction. I calculate that the chances of this are 1 in 2^6 = 1/64. There are many MIPS, so maybe not surprising that one of them shows a 1/64 response!! Also, many indices are inspected here – the chances of at least one of them showing a significant trend across several models is not actually that small! If a physical mechanism is identified that could explain the signal seen, then this would be more acceptable, but without a physical mechanism one is left wondering how much is just random variations!

P3788 mentions reduced gradients, but should reference current discussion of how robust this is – see O'Brien et al (2014) and Pagani (2014).

Zhang, Z., Yan, Q., and Su, J. Z.: Has the problem of a permanent El Niño been resolved for the mid-Pliocene, Atmos. Oceanic Sci. Lett., 5, 445–448, 2012b. 3789, 3790, 3791, 3792, 3801, 3803 – **READ**

P3789, line 20 "Zhang et al. (2012b) posit an elegant solution to these questions". Not clear what 'these questions' actually are.

My understanding is that at one of the PlioMIP meetings, there was an agreement that any paper which used as-yet-unpublished model outputs, would include as co-authors those members of PlioMIP who had produced the model outputs. As such, I was surprised that this was a single-author paper, because as far as I am aware, the variability in the model SST fields has not previously been published.

Bonan et al (PhD thesis, University of Leeds) carried out a rather extensive study of ENSO in the mid-Plicoene – would be worth citing their findings and explaining how your work builds on their work.

P3791, line 10 It is not clear if the lengths of the simulations given are the entire model simulations length, or the length of the analyses. The table should include the length of the whole simulation as well as the analyses.

P3791, line 19. Nee to define N3 and N4, before defining Nct and Nwp.

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P3791, line 25. Is the 5-month smoothing really a 5-year smoothing, if SSTA is defined for each month? This section would probably benefit from some equations.

P3792, line 22. (Visualisation of SST time series would be normalised solely by the preindustrial standard deviation. Not sure what 'Would be' means here. Would if what?

Section 2.2. The analysis is described in words, but many aspects would benefit from equations, e.g. Lanzcos low-pass filter, Dipole Mode index, PCA, "smoothed and tapered periodogram".

P3793, line 16: "each property is investigated independently of the others.". Not sure what this means.

P3793, line 18 – reference Figue 1a here.

P3793, again, give some equations to define the 4 'moments'.

Give 4 panels in figure 1 names (a,b,c,d) and reference the individual panels.

P3794, line 21-26 – somewhat confusing section.

P3795 – line 10 – not sure what the 'ensemble average power spectrum' really means – is it meaningful to average power spectra? Or is it the spectra of the average variability? (maybe even less meaningful!).

Figure 3 – ensemble average structure is discussed – but is there any change in structure for any ensemble member?

Figure 4 – is 'change in variance' Plio-Preind or Preind-Plio?

P3796, line 26 – I would contest that these runs are 'in equilibrium'.

P3797, line 8 – typo 'referred as to'.

P3797, line 22 – "Because of potential model biases, the most appropriate mode is determined from visual comparison of the model-derived EOFs to those found from the detrended ERSST observations.". Not sure what this means – what is 'appropriate'

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and how is this found from a ‘visual comparison’.

P3798, line 21 – Good Questions!

P3799, line 6 – typo “cycle that” to “cycle than”

P3800, line 4 – this seems a bi of a cop-out! Many studies explore modern ENSO teleconnections and I don’t see why a similar analysis could not be carried out here. It would be of considerable interest!

P3800 top – not sure I agree with this probability! Especially as so many metrics were examined (see earlier comment).

P3801 – Bonan et al carried out a factorisation which partitioned possible changes into either CO2, orography, ice, or vegetation. Their work may give some insights to the causes of change?

P3802 top – again, ‘observed’ plicoene W-E gradient is equivocal, O’Brien et al.

Interactive comment on Clim. Past Discuss., 10, 3787, 2014.