

Interactive comment on “Equatorial insolation: from precession harmonics to eccentricity frequencies” by A. Berger et al.

Anonymous Referee #2

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This is an important paper which Climate of the Past should publish. The authors provide a new approach to looking at insolation variations in the tropics. From their calculations they show that there are periodicities at about 100 kyr, ~11 kyr and 5.5 kyr. This new vision of tropical insolation is extremely important and I fully support the publication of this paper with some minor amendments suggested below.

Despite being extremely supportive of this paper there are some comments which I have. These do not relate to the calculations, nor the science (which are both excellent), but rather the interpretation and presentation of these novel results.

1. One of my main problems which the manuscript is it refers to the 100 kyr cycle. However, the excellent results of the authors clearly show a double peak (see Figure

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5) at 95 kyr and 123 kyr. Now when the paper is making clear statements concerning the difference between ~ 11 kyr and 5.5 kyr cycles, it seem inappropriate to merger two cycles which are 28 kyrs apart. What I think the authors are referring to is the average 100-kyrs length of the last 8 glacial-interglacial cycles. But even this is full of problems as these glacial-interglacial cycles occur between 87 kyrs and 119 kyrs (Raymo, 1997; Maslin and Ridgwell, 2005). This needs to be clarified, because what the authors have found is a strong expression of eccentricity in the tropics, i.e., 95 and 123 kyr cycles, not a source of the 100-kyr climate cycles which have occurred after the Mid-Pleistocene Revolution.

2. In the conclusion the authors attempt to find support for their 11 kyr and 5.5 kyr cycles in the palaeoclimate records. This is the weakest part of the paper and does need some additional work. For example the problem with the Hagemberg et al (1994) paper is the cycles between 10-12 kyr could be very miss-leading as they could be recording the time-transgressive Heinrich events. H-events have a quasi-periodicity ranging from 16 kyr down to 7 kyr, which averages out at about 12 kyr which mimics the half precessional signal. For example Heinrich (1988) original suggested a half precessional cycle, which we now believe to be incorrect.

3. What I suggest would be more important is for the authors to discuss why at the moment there is very little evidence for the 11 kyr and 5.5 kyr. For from undermining the paper I think this discussion would strengthen the scientific merit of the work. At the moment there seems to be a growing body of evidence that suggests the tropics, particularly for moisture availability, is controlled by precession. Palaeoclimate evidence comes from both South America and Africa (de Menocal 1995; 2004; Maslin et al. 2000; Bush et al., 2002; Trauth et al., 2003; Clement et al., 2004; Cruz et al. 2005; Wang et al., 2005) as well as strong evidence from the Mediterranean and Indian Ocean for precessional control over the monsoons (e.g., Clemens et al., 1991; Hall et al., 2003; Rohling et al., 1998). What I would like to see in the conclusion or even in the discussion section is why we have found the ~ 20 kyr cycle in the tropics

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but not the 11 kyr and 5.5 kyr. Is this because we are not looking for them and have become focused on just ~20 kyr cycles? If so then this paper is a very important contribution to tropical studies. Or is it that moisture at the tropics is controlled by shifting in the monsoon which are ultimately controlled by the sub-tropics which are dominated by the full precessional mode (see Ruddiman 2006 QSR)?

This is one of the most novel orbital forcing paper I have read in a long time and I am fully support its publication in *Climate of the Past*. I am sure the minor changes suggested will be easy for the authors to complete and look forward to seeing this paper published. I would also like to point out that this paper could have much wider implications than the authors acknowledge. If we imagine tropical climate boundary conditions are controlled by glacial-interglacial cycles and millennial-scale ice rafting events. And the seasonality is controlled by precession, half-precession and quarter-precession, then the climate of the tropics should be extreme dynamic and ever changing. This may provide a reason why evolution is most evident in the tropics (including early humans) and diversity is extremely high (e.g., rainforests). Just a radical thought to end the review.

Bush, M.B., Moreno, E., de Oliveira, P.E., and Colinvaux, P.A. 2002. Orbital-forcing signal in sediments of two Amazonian lakes. *J. Paleolim.* 27. 341-352.

deMenocal, P. Plio-Pleistocene African Climate. *Science* 270, 53-59 (1995).

deMenocal, P. African climate change and faunal evolution during the Pliocene-Pleistocene. *Earth and Planetary Science Letters* 220, 3-24 (2004).

Clement, A.C., Hall, A. & Broccoli, A.J., 2004. The importance of precessional signals in the tropical climate. *Climate Dynamics*, 22, 327-341

Clemens, S., Prell, W., Murray, D., Shimmiel, G. and Weedon, G. Forcing mechanisms of the Indian Ocean monsoon. *Nature* 353, 720-725 (1991).

Cruz, F.W. S. J. Burns, I. Karmann, W. D. Sharp, M. Vuille, A. O. Cardoso, J. A. Ferrari,

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P. L. Silva Dias, O. Viana 2005 Insolation-driven changes in atmospheric circulation over the past 116,000 years in subtropical Brazil. *Nature* 434, 63-66

Maslin, M.A., and S.J. Burns, 2000 Reconstruction of the Amazon Basin effective moisture availability over the last 14,000 years. *Science*, 290, 2285-2287.

Maslin, M.A. and A. Ridgwell "Mid-Pleistocene Revolution and the eccentricity myth" Special Publication of the Geological Society of London, 247, 19-34 (2005)

Trauth, M.H., Deino, A., Bergner, A.G.N. & Strecker, M.R. 2003. East African climate change and orbital forcing during the last 175 kyr BP. *Earth and Planetary Science Letters* 206, 297-313.

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