

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

Anonymous Referee #1

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André Berger and co-authors discuss the spectral properties of mean daily irradiation in tropical latitudes as function of orbital parameters. They show that the double maximum, which characterises the seasonal cycle of daily irradiation in the tropics, reveals not only a 100 ky cycle, but also periods at 11 ky and 5.5 ky. These periods are related to the eccentricity and the precession of the earth’s orbit around the sun.

The impact of this result is not immediately obvious. The authors indicate that the glacial-interglacial cycles might originate in the tropics instead of in the high latitudes. They cite at least one paper in which atmospheric and oceanic teleconnections between the tropical ocean and the North Atlantic are suggested. Clearly, the tropics which cover half of the world play a major role in the climate system. Hence I would argue that it is the energy gradient between low and high latitudes which fuels the gen-

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eral circulation in the atmosphere and ocean. In this sense, the dynamics of glacial-interglacial cycles cannot be understood without the tropics.

But whether tropics or high latitudes are the key for a trigger of glaciation cannot be understood by looking at orbital forcing only. Instead, models of the natural earth system are needed to understand the processes and feedbacks in the system. I am a little bit surprised that André Berger, one of the protagonists of earth system models does not touch this topic, and I would like to suggest that the authors include a few critical sentences on this topic.

Just to start the discussion: By using an earth system model of intermediate complexity, Claussen et al (GRL, 2006) showed that an atmosphere-ocean-vegetation model in which inland ice masses and greenhouse gas concentrations are kept constant, yields a clear response to climatic precession. If only atmosphere and ocean are coupled, then the amplitude of global mean temperature at climatic precession is reduced, and the eccentricity dominates the temperature variability. The reason for that behaviour is - in their model - a response of the meridional overturning circulation which mediates the impact of the climatic precession at high latitudes in the global mean.

In summary, Berger and co-authors have submitted an interesting contribution to the topic of orbital forcing which deserves further discussion. The paper is clearly written; hence I am glad to recommend its publication in *Climate of the Past*.

Minor comments:

1. page 3: the parameter omega-tilde is not defined. I would just skip the related sentence.
2. - " - , the sentence following the bullets contains typos (SS instead of SE, a lambda and a WS is missing).
3. page 7: last para, line 3: as informative as (instead of: as informative than)

Finally, just a minor historical note on the first sentence of the Introduction: Perhaps

Murphy was the first to suggest that cold boreal summers - instead of cold, long winters according to Croll - trigger glaciation. But Milankovitch did not seem to be aware of Murphy's work; instead, he refers to the work by Köppen and Wegener published in 1924. Köppen and Wegener, in turn, refer to earlier findings by the Austrian climatologists Penck and Brückner.

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