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Climate of the Past Discussions

CPD

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Interactive Comment

Interactive comment on "Distinct responses of East Asian summer and winter monsoons to orbital forcing" *by* Z. Shi et al.

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By comparing both geological data and simulated results with obliquity and precession, the authors show that the East Asian summer monsoon is mainly dominated by precession signal as many previous studies have shown, but the winter monsoon responds more to obliquity, a result claimed to be "not mentioned before". The finding that the East Asian summer monsoon and winter monsoon responding differently to precession and obliquity is very interesting.

General Remarks:

1. I advise to replace everywhere "orbital" by "astronomical" because obliquity is related to the rotation of the Earth about its axis which is more than orbital. I know it is a

common mistake that I also do sometimes.

2. section 3.1 gives a good description of the geological records and the climate model responses for the EA summer and winter monsoons. Section 3.2 attempts to give a description of the difference between situations where NH summer occurs at perihelion (mimimum precession or maximum NH summer insolation) and similar situations where NH summer occurs at aphelion (maximum precession or minimum NH summer insolation). You also give a description of the difference between the situations related to maximum obliquity (or maximum insolation in high latitudes of the summer hemispheres) and situations where obliquity is minimum. In both cases, the selection of these particular astronomical situations does not prevent to have both precession and obliquity acting on the climate model system through daily insolation. This makes the interpretation of figures4-7 difficult because they all contain responses to both precession and obliquity. How is the average made over the 12 precession cycles or the 7 obliquity cycles eliminates/dampens respectively the obliquity or precession influence? How to explain that a high obliquity vs a low one generates cool summer in northern Asian between 80E-160E (Fig4b) and also cool winter (Fig4d) of the same magnitude? Fig 4a and 4c related to precession situation are easier to explain as a direct effect of precession itself. I do not know any insolation parameter having a behavior like figures 4b and 4d along the latitudes. This let me conclude that obliquity might play a minor role or that strong feedback mechanisms are acting. Please clarify.

3. It is generally accepted and recalculated many times that: (1) daily insolation is primarily a function of precession with the obliquity signal being more important in high than in low latitudes. It is forgotten that obliquity remains however less important than the precession signal in high latitudes. (2) the total irradiation over a period of time during the year (seasons) is only a function of obliquity but this is only true for non-calendar period of time (Berger et al 2010, QSR).

However, such a primary and different role played by precession vs obliquity was first calculated and discussed in length in Berger (1978, Long term variations of caloric insolation resulting from the Earth orbital elements, Quaternary Research, 9, 139-167. in particular pages 142-160). It was as well summarized in Berger (1988, Milankovitch theory and climates, Review Geophysics, 26(4), 624-657) where it is also clearly stated that “the latitudinal gradient of extraterrestrial insolation is characterized by a periodicity of 40 ka whereas for the absorbed insolation it exhibits a higher frequency which corresponds to a period in the range of 21 ka”. For a full study about the latitudinal gradient, see Tricot and Berger (1988, Sensitivity of present day climate to astronomical forcing, in ‘Wanner H and Siegenthaler U (eds), Lecture notes in Earth science, vol 16, Springer Verlag, 132-152). How do you take into account this difference between extraterrestrial insolation and insolation available at the surface in your conclusions? Please refer to these publications where you speak about the influence of precession and obliquity in daily insolation and in latitudinal gradient.

4. Please comment about the FOAM model in particular its resolution and the possible bias induced by the accelerated technique in an atmosphere-ocean coupled system.

5. The Asian summer low is used as a summer monsoon index. Why not use the land/ocean pressure contrast as claimed to be at the origin of the summer monsoon in the first page.

6. Very few comments are made about the feedbacks. For example, as the winter monsoon is driven by the Siberian high, the remnant effect of summer insolation might be very important for explaining the response of the high latitudes in winter during which the energy is quite low (Yin and Berger, 2011, Climate Dynamics).

Other remarks:

Page 945, lines 7-8: The partition of insolation and ice sheet influence on the East Asian monsoon is discussed in Yin et al 2009 (Climate of the Past). Page 945, line 18: please specify “owing to its dominant role in the DAILY insolation (Berger, 1978, Quaternary Research), . . .” Page 947, line 2: “for our purpose, . . .”, please remind your purpose which I assume is only looking in the precession and obliquity bands because

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in your model the ice sheets are prescribed and therefore it is not expected to see the 100 ka cycle. Page 947, line 18: "....The calendar effect...", please explain this effect because what you give is the origin of this effect (the length of the seasons). Page 948, bottom: please comment on the phase relationship between the geological data and the simulated pressure which might not reflect the reality because only time-dependent insolation was used to drive the model (no greenhouse gas, no ice sheet).

Page 951-952: in section 4, mechanisms are looking for to explain the dominant obliquity signal in winter monsoon. I have nothing against using the latitudinal gradient (meridional insolation difference) but what about the total irradiation received during a given season. In winter, there is very low energy in high latitudes, therefore the daily insolation might play a less important role as compared to the accumulated energy during a given season which is function of obliquity only (Berger et al 2010). Can you comment on the advantage of using the latitudinal gradient instead of the total energy over a given season? Is your model providing results in favor of one or the other? In section 4, the physical processes suggested by the authors need to be justified using their model results.

In Fig 8: Although I find back the insolation values of figure 8 for 30N June and 20S December using Berger (1978, JAS), I can not find your values for 50N December insolation. Please give the reference of the paper used for calculating the insolation values (same remark holds for obliquity and precession used in figures 2 and 3). More importantly, why do you use the ratio between 20S and 50N instead of the latitudinal gradient (20S minus 50N)? In the first case, you get an obliquity signal as in fig8 blue curve, but in the second case you would get a precessional signal. Please comment.

Interactive comment on Clim. Past Discuss., 7, 943, 2011.