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Climate of the Past Discussions

Interactive comment on "On the sensitivity of the Devonian climate to continental configuration, vegetation cover and insolation" *by* Julia Brugger et al.

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Brugger et al. present several Devonian paleoclimate simulations with a coupled Earth system model of intermediate complexity. The authors describe and compare different steady-state experiments, characterized by different continental configurations, solar constant, CO2 concentration and orbital configuration. In this short comment, I focus on their sensitivity analysis of Devonian climate (at 380 Ma) to orbital forcing.

Brugger et al. document a very low sensitivity of the Devonian climate to orbital forcing, reporting only 0.6 degrees C difference in mean annual global temperature between their coldest and warmest simulation. In a similar sensitivity analysis, my coauthors and I found a 7 degrees difference in mean annual global temperature between the coldest and warmest orbit (De Vleeschouwer et al., 2014, Global and Planetary Change). The authors attribute this order of magnitude discrepancy “to the slab ocean model used by De Vleeschouwer et al. (2014)” in contrast to the dynamical ocean model that is used in their study, in which meridional ocean heat transport can vary on orbital time-scales. I agree with the authors that this difference in model setup plays a role and could explain part of the discrepancy. However, the authors do not mention potential differences in (continental) snow-albedo positive feedback mechanisms on the Gondwanan continent, which in my opinion is far more important. The extent of the seasonal snow cover on the Gondwanan continent turned out to be a major and powerful positive feedback mechanism in the De Vleeschouwer et al. (2014) simulations. However, this important aspect of the climate system is not discussed in the manuscript by Brugger et al. Hence, I strongly suggest that the authors look into the response of continental snow and ice to orbital forcing, and discuss their role in the Devonian climate system.

I am also surprised by the perfect symmetry in Figure 5. This symmetry implies that precession does not influence mean annual global temperature at all. This is –to say the least- unexpected given the asymmetry in continental configuration and the large difference in heat capacity between oceans and continents. The authors recognize the importance of an asymmetrical continental configuration on page 13, writing “the strong southward shift of the continents amplifies the stronger seasonal insolation at the South Pole for higher obliquity values, resulting in higher global annual mean surface temperatures”. If this is true for obliquity, one should ask why the model does not simulate higher global annual mean surface temperatures when the precessional configuration is such that the Earth is close to the Sun (at perihelion) during austral summer. In order to be able to better assess this remarkable result, I would like to see a map showing the surface temperature difference between a precession maximum and minimum (difference between [e = 0.069; ω = 90] and [e = 0.069, ω = 270]) for JJA, DJF and the annual mean.

Minor comment:

Page 4, line 6. The total amount of insolation received by the Earth over a year varies only to a very small extent with eccentricity forcing. Changes in the spatial and temporal distribution of insolation is by far the more important aspect of orbital forcing. I would suggest to mention those in order of importance.

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