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Climate of the Past Discussions

Interactive comment on "Modeling geologically abrupt climate changes in the Miocene" *by* B. J. Haupt and D. Seidov

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I was asked to review the manuscript "Modeling geologically abrupt climate changes in the Miocene" by Haupt and Seidov and I also missed the deadline. I am in agreement with Jerry, Ellen, and the anonymous reviewer's comments, and will add general comments of my own. However, I recommend that the authors go back to the drawing board and undertake a major revision of the study/manuscript, paying particular attention to reviewer suggestions related to what we already know about Miocene climate and to getting the "facts" correct.

This paper seeks to understand the role of fresh water forcing and/or sea ice on Miocene climate. Testing the hypothesis that freshwater input from Antarctica to the Southern Ocean is important in Miocene climate evolution is relevant, especially in

light of Holbourn et al's (Nature, 2005 and EPSL, 2007) reinterpretation of Shevenell et al.'s middle Miocene Mg/Ca paleotemperature data from the Southern Ocean (Science, 2004) as a salinity signal.

There is every reason to expect meltwater from Antarctica during the Miocene Climatic Optimum and the transition at ~14 Ma; likely this is orbitally forced. Indeed, we see evidence of meltwater from Antarctic continental shelf bathymetry/geomorphology (again, here are some references that could have been useful), and it is possible that this meltwater played a role in cooling and ice growth between ~15 and 14 ma. This is where models can help, because currently the data do not help us to understand anything about the volume of meltwater, its influence on Southern Ocean temperatures (Shevenell et al., 2004; Shevenell et al., 2008, and papers by Billups and Lear), stratification (see Sigman's thoughts on this in their 2004 Nature paper on Polar Stratification in a cold climate), SCW production, and WSDW influence on Antarctica. Thus, there is an interesting scientific question here, based on a gap in our current data-based understanding of the middle Miocene.

I would suggest that the authors reframe their study to reflect our current knowledge of the Middle Miocene (climate, continental configuration, orbits). They should choose one time interval during which to focus their efforts, one where we know meltwater may play an important role in climate. Might I suggest the transition from the Miocene Climatic Optimum to the time of middle Miocene cooling (16.5-13 Ma or 15 to 14 Ma, even), when we know that Antarctic glaciers made a transition from wet based to cold based (work of A. Lewis and others)? This might make for a more focused and meaningful study.

Although I cannot comment on the details of the model used in this manuscript, I, like the other reviewers, think that the omission of the Tethys is a critical issue that needs to be resolved, or acknowledged. I also wondered why the model was run with the current orbital configuration, when we know the orbital configuration of the middle Miocene, and there has been quite a discussion of an orbital trigger for middle Miocene

cooling (Shevenell, Holbourn, and others). Now, I am a little bit of a black sheep in this respect, but I think the jury is still out on CO2 forcing of middle Miocene warmth and/or cooling. But, I think we can constrain CO2 levels (a bit, maybe) in this time interval, and maybe in the model. It seems to me that it should be important to a modeler to set up realistic data-based boundary conditions under which they could conduct such a study of climate feedbacks. I am not a modeler, so this may not be possible with this type of model.

As for the discussion of ocean temperature results, I think there is enough data out there to determine if your results are even realistic. Alternatively, these data would suggest that your initial uniform 4°C ocean might be unrealistic. What are the implications for your results, if your boundary conditions are not based in reality?

Interactive comment on Clim. Past Discuss., 6, 2687, 2010.