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Climate of the Past Discussions

Interactive comment on "Model study of the circulation of the Miocene Mediterranean Sea and Paratethys: closure of the Indian Gateway" *by* A. de la Vara et al.

Anonymous Referee #2

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General comments

In general the paper by de la Vara et al. is a promising manuscript but is at times difficult to follow due to lengthy sentences. It is not clear from the beginning what the aim of this study is. The content of this paper is within the aim of CPD. In its current form I do not recommend this paper for publication. The title of this paper is kind of misleading. It lets the reader believe that this paper advances our knowledge about the Miocene Mediterranean and Paratethys. This modeling study is based on present-day boundary conditions using a paleo Mediterranean bathymetry. There are plenty of modeling studies that the authors could have used to provide adequate Miocene boundary conditions from AGCMs/OGCMs and/or fully coupled models. It is not clear why the authors use

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present-day boundary conditions at first and then are trying to justify their results using different approaches to simulate Miocene boundary conditions. There are many global studies for the Miocene that could have been used to provide more adequate boundary conditions, e.g.:

* Bice, K.L., Scotese, C.R., Seidov, D. and Barron, E.J. (2000) Quantifying the role of geographic change in Cenozoic ocean heat transport using uncoupled atmosphere and ocean models. Palaeogeography, Palaeoclimatology, Palaeoecology, 161, 295-310.

* Butzin, M., Lohmann, G. and Bickert, T. (2011) Miocene ocean circulation inferred from marine carbon cycle modeling combined with benthic isotope records. Paleoceanography, 26 (1), 1-19, PA1203.

* Haupt, B. J. and D. Seidov (2012). "Modeling geologically abrupt climate changes in the Miocene: Potential effects of high-latitudinal salinity changes." Natural Science 4(3): 149-158.

* Hamon, N., P. Sepulchre, V. Lefebvre, and G. Ramstein (2013) The role of East-Tethys seaway closure in the middle Miocene climatic transition (ca. 14 Ma) http://www.clim-past-discuss.net/9/2115/2013/cpd-9-2115-2013.pdf

* Micheels, A., A. A. Bruch, et al. (2007). "A Late Miocene climate model simulation with ECHAM4/ML and its quantitative validation with terrestrial proxy data." Palaeogeography, Palaeoclimatology, Palaeoecology 253(1-2): 251-270.

* von der Heydt, A. and H. A. Dijkstra (2008). "The effect of gateways on ocean circulation patterns in the Cenozoic." Global and Planetary Change 62(1-2): 132-146.

* You, Y., M. Huber, et al. (2009). "Simulation of the Middle Miocene climate optimum." Geophys. Res. Lett. 36(L04702): 1-5.

Specific comments: ==========

* Page 4391, lines 18-24: The authors point out at the end of this paragraph a major

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weak point of this study. I am aware that other authors were criticized for not having a true open boundary to the Indian Ocean. Thus, the heading of this section could also say “closed-ocean boundaries”

* Page 4391, lines 25-28: The authors use a salinity of 35 from top to bottom but prescribe on the following page a more realistic temperature profile. The use of a vertical homogenous salinity distribution does not seem to be realistic. Why do they use exactly a salinity of 35?

* Page 4392, lines 1-5: The authors prescribe a vertical temperature profile for a paleo simulation suing a present-day profile. Can we assume that the vertical water mass distribution was similar? The authors point out at in their conclusions that the closure of the Indian Gateway has changed the water mass composition in the Indian Ocean meaning it must have been different from present-day boundary conditions. A citation and/or discussion could provide more insight.

* The authors use as salinity unit psu. That unit is not supposed to be used anymore. It should simply say something like the salinity is 35.

* Page 4320, lines 20-26: The authors neglect the wind field. It is know that both wind regime and also for example Monsoon

* Page 4394, line 22: replace “deep” by “depth”

* Page 4394, line 22-26: The authors discuss the transport at the AG and IG. A discussion how realistic the transports are using sponge layers that are fairly close to the area of interest.

* Page 4395, lines 1-18: How do the authors determine a realistic inflow/out flow regime for the Miocene if the use present-day boundary conditions? Relaxations coefficients also determine the solution and should be discussed here.

* Page 4399, lines 4-22: I have already asked this question but would like to repeat that there are many studies showing that the bathymetry of the Miocene has a far

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reaching impact on climate and ocean circulation. Thus, I am surprised that the authors get similar results when they swap their present-day boundary conditions for idealized Miocene boundary conditions. Why wouldn't they use it from the beginning and then compare it to perhaps one present-day simulation

* Page 4404, line 7-8: correct "stablishment" to "establishment"

* Page 4408: lines 4-6: The given statement may be true but can it be concluded from a regional model? The statement that the closure of the Indian Gateway may have an effect of the buildup of the EAIS cannot be drawn from this regional study.

* Section References: The references are to be outdated. There are newer studies and credits should be given.

* Table 3: The "average temperature inflow" for AG and the "heat transport inflow" seem to go hand in hand, i.e., increase in temperature means an increase in "heat transport inflow". This is not true for "Shallow IG". The temperature hits a minimum but the heat transport stays high. Are the 16.09 and/or 3.360 the correct values?

In summary, I find the study put forward interesting. However, the forcings and results should be evaluated against Miocene proxy data and modeling studies before the manuscript can be considered for publication.

Interactive comment on Clim. Past Discuss., 9, 4385, 2013.