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Climate of the Past Discussions

Interactive comment on "Robustness of the Atlantic-Pacific flow reversal in the early miocene" *by* E. Bernsen and H. A. Dijkstra

Anonymous Referee #2

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GENERAL COMMENTS

The study by Bernsen & Dijkstra investigates the robustness of a hypothesized Atlantic-Pacific flow reversal through the Central American Seaway in the early Miocene based on an earlier model study. Using the MOM4 ocean general circulation model, the direction and strength of the flow in the seaway is tested under different scenarios for the continental configuration, bottom topography, and climate forcing. Within the range of parameters tested, the flow reversal at the Oligocene to Miocene transition is found to be robust in the model.

The response of ocean circulation to different continental configurations and bathymetry in the past has been a topic of much research, both with climate models and with proxy data. In particular, it is interesting to understand the possible climatic

implications of significant reorganizations of past ocean circulation. Therefore, this study is a welcome contribution to the field.

One major weakness of the manuscript is its lack of discussion of relevant literature. Very few references are included from previous model and proxy studies on the topic, except for ample self-citations. This is true both in the introduction of the problem and in the discussion of the results. Before the manuscript is ready to be published in climate of the past these sections need to be improved, in addition to taking the following specific comments into account:

SPECIFIC COMMENTS

1) Is the latitudinal position, width, depth and length of the seaways in question such that the flow through is geostropically controlled? In particular, in the thethys seaway friction could be important approaching a hydraulically controlled flow. This issue needs to be discussed and documented.

2) What is the baroclinic structure of the flow through the different seaways? In the manuscript only the depth integrated flow is discussed, whereas the ocean model resolves the the vertical structure of the flow. This should be discussed, as it is likely that there is a transition between eastward and westward flow at depth in the tropical seaways. This is particularly important when the bathymetry through the channel is changed, and it is expected that the results using Godfrey's Island rule will differ from that of the ocean model.

3) The applied wind stress is crucial for the results presented. How does the applied wind stress change between the two experiments (Oligocene versus Miocene) and how sensitive are the results to the pattern of the wind stress? The main results show little sensitivity to the strength of the wind stress. However, if the zonal structure of the wind changes the flow in the seaways could change and perhaps even reverse. This should be discussed/tested in a revised version of the manuscript.

4) How sensitive are the results to the use of fixed surface forcing for temperature and salinity? Previous model studies have shown that the use of relaxation boundary conditions gives very different results as compared to simulations forced with fixed heat and moisture fluxes, or to fully coupled simulations. This should be discussed.

TECHNICAL COMMENTS (page.line)

2494.5-10: Check equation numbering.

2494.24 & 2497.24: Why is there such a significant difference between the flow through the Panama Seaway in the model and when using Godfrey's Island rule? Discuss possible causes.

2498.1-5: Is there geological evidence for a more southward position of the tip of South Africa? In general there is very little, if any reference to geological proxy data.

2500.1-5: Check notation, lambda in equations not defined.

Figures 3, 5, 6, 7, 8, 9: Use a different monotonic colorbar which clearly shows change from negative to positive values. E.g. blue - red only, not red-green-blue etc.

Figure 6a, b, d and similar: Use color for line graphs (in addition to difference in structure). It is very hard to discern which is which as it is now.

Interactive comment on Clim. Past Discuss., 6, 2483, 2010.