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Ocean Science Discussions

Interactive comment on "The low-resolution CCSM2 revisited: new adjustments and a present-day control run" *by* M. Prange

Anonymous Referee #3

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Overview:

In this study, the author improves one serious deficiency in the simulation of present-day Atlantic meridional overturning circulation (MOC) by the low-resolution version of NCAR CCSM2. The simulated present-day climate by the modified model is also described. The method used to improve the Atlantic circulation is, however, rather ad-hoc. As the author notes, it is not clear which modification among several lines of changes is critical for the improvement. Nevertheless, the substantial improvement is demonstrated. While the simulation is improved, this does not necessarily mean that the model is improved for reasons such as the use of regional flux adjustments. It is essentially a re-tuning. The overall presentation is fairly clear including figures, and newly simulated present-day climate is described extensively. This paper does not, however,

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raise or answer in-depth scientific questions, and it is very technical. The paper is probably useful for some CCSM users, but I am not sure whether the technical paper like this is within the scope of the journal. With the condition that the editor recognizes that the paper is well within the scope of the journal, this paper may be acceptable with minor revisions.

Major comments

1. As written above, no in-depth scientific questions are raised and answered.

2. I am not personally convinced to choose this modified model (CCSM2/T31x3a) with flux adjustments over CCSM3/T31 without flux adjustments just to save a maximum of about 20% computational expense. As the author concludes, however, this is a users' choice after all.

3. It would be useful to show the difference in bathymetry before and after the modification near the area of changes.

4. In Fig. 4, is it possible to display actual amount of freshwater flux adjustment used rather than just area?

Minor points:

1. A realistic Atlantic MOC is achieved in CCSM2/T31x3a with a substantial weakening of AABW northward intrusion. Also the overturning cell seems to be too shallow. While these points are stated in text, it may also be useful to re-state in the conclusion as a caution for potential model users.

2. In Fig. 9 (top), there is a strong sinking around 40°N, in addition to 60°N. This seems to be seen more or less in all versions of CCSM2 and CCSM3, but most pronounced in CCSM2/T31x3a and CCSM3/T31. I do not recall that other models show this. It might be useful to state this difference with other models, and even better if the author can provide some insight.

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3. CCSM3/T31 does not require flux adjustments while CCSM2/T31x3a appears to do. Does this mean that the atmospheric component of CCSM3/T31 is better than CCSM2/T31x3a in simulating the hydrological cycle? Does this also mean that it is better to use CCSM3/T31 if one wants to study paleoclimatic hydrological cycles? This question is probably beyond the scope of the paper, but some readers may wonder if such an interpretation is implied.

4. p. 1308: Difference in global average values between observations (1950-1999) and 1990 present-day control is not necessarily considered as errors. The former represents rapidly changing climate while the latter represents the equilibrium solution. The difference in spatial patterns is important, but root-mean-square error may not necessarily mean “error” if it includes global-mean bias.

5. p. 1311: In discussion, the author describes the reaming model deficiencies as “most of these shortcomings are well known as typical problems Ě climate models”. I would like to just point out that the Atlantic MOC problem could also be “typical problems” for low-resolution ocean model. There is a risk to tune the model if the problem were due to the resolution: a risk of getting a right answer for wrong reasons.

6. p. 1313-1314: The author argues that flux adjustments are used only for limited regions and thus the model behaves like a non-flux-corrected model. It is “particularly crucial when ENSO dynamics are considered”. The spectral behavior of ENSO simulation is not, however, realistic in this model. In addition, the side effect of uniformly distributed freshwater fluxes in the Pacific is not investigated, and thus this statement sounds a bit speculative.

Interactive comment on Ocean Sci. Discuss., 3, 1293, 2006.