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Climate of the Past Discussions

Interactive comment on "The Southern Hemisphere semiannual oscillation and circulation variability during the Mid-Holocene" *by* D. Ackerley and J. A. Renwick

Anonymous Referee #2

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Review of

The Southern Hemisphere semiannual oscillation and circulation variability during the Mid-Holocene

By D. Ackerley and J. A. Renwick

General: this paper describes the representation of the southern hemisphere semi-annual oscillation (SAO) in six coupled AOGCM's in the present and Mid-Holocene climate.

The SAO is a phase-locked circulation oscillation representing the twice-yearly con-

traction and expansion of the SH circumpolar pressure trough, which has pronounced influence on the modern climate of SH mid latitudes (New Zealand, Australia) and high latitudes (coastal Antarctica). In recent decades, the SAO has shown to undergo significant decadal weakening and strengthening. Although the basic underlying mechanism driving the SAO (the twice yearly peak in the latitudinal insolation gradient) is well understood, the decadal variability in the SOA has not yet been satisfactorily explained.

Technical quality: the technical quality of the paper is good: it is well written with clear (albeit somewhat too many) figures.

Scientific quality: this paper starts out by describing how well the SAO is represented in six PMIP2 models by comparing it to monthly mean NCEP/NCAR reanalysis fields. It turns out that, unfortunately, the SAO is not well represented in these models. The spring maximum in baroclinicity is far too weak in all models and even absent in most. This results in a springtime SLP gradient that is strongly underestimated, by 10 hPa in the ensemble mean, and in some models completely absent with a phase that differs between observations and models by one to several months.

The paper describes in, sometimes exhaustive, detail the model biases in representing the modern SAO in time and space. After reading the paper I was left with the conclusion that the models do not simulate the modern SAO well, and that changes in the mid-Holocene SAO are relatively minor with respect to the modern climate, but have a well-defined seasonal cycle, but I have not learnt WHY this is so.

This is because too little attention is paid to the potential physical causes of the model shortcomings and changes for the Mid-Holocene. I would have liked to see less qualitative description of biases and changes, and much more interpretation. As it stands now, the paper more reads like a model evaluation report.

E.g., questions that I would like to see addressed are: why is only the springtime baroclinicity underestimated? Do the models have problems with faithfully representing the shortwave radiation balance, or perhaps can the problems be traced back to ocean

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surface temperature through inaccurate representation of the large-scale ocean circulation? What is the role of atmospheric static stability? Is there an effect of sea ice or perhaps model horizontal resolution? I realize that the authors cannot perform sensitivity tests with the models, but surely more model parameters are available as output to check (some of) these assumptions?

Even though the Mid-Holocene runs do show a coherent patterns of decreased/increased SAO amplitude in autumn /spring, unfortunately no attempt is made to couple this change to physical processes.

The lack of physical interpretation and the abundance of qualitative descriptions makes this a tough paper to read. In summary, therefore, I would like to urge the authors to bring more balance in description of the biases and changes on the one hand and the physical explanations on the other, before submitting a revised version.

Interactive comment on Clim. Past Discuss., 6, 185, 2010.