Geosci. Model Dev. Discuss., 7, C1003–C1006, 2014
www.geosci-model-dev-discuss.net/7/C1003/2014/

Geoscientific Model Development Discussions

Interactive comment on "An efficient method for discerning climate-relevant sensitivities in atmospheric general circulation models" *by* H. Wan et al.

H. Wan et al.

hui.wan@pnnl.gov

Received and published: 27 June 2014

We appreciate the referee's comments and suggestions. Our responses to the specific points are listed below.

1. Better to revise the title as "Ensemble of shorter simulations: An efficient method for discerning climate-relevant sensitivities in atmospheric general circulation models"

In the revised manuscript the title is changed into "Short ensembles: An efficient method for discerning climate-relevant sensitivities in atmospheric general circulation models".

2. P2175, L8-11: Another example is the sensitivity of monsoon precipitation to convection schemes. The traditional numerical experiments need several sets of computationally-expensive long-term integrations:

Chen, H. et al., 2010: Performance of the New NCAR CAM3.5 in East Asian Summer Monsoon Simulations: Sensitivity to Modifications of the Convection Scheme. Journal of Climate, 23, 3657-3675

Zhou T., and Z. Li, 2002, Simulation of the east Asian summer monsoon by using a variable resolution atmospheric GCM, Climate Dynamics,19:167-180

6. P2195, L23-28: Yes, the simulation of aerosol impacts on Asian monsoon tradition- ally takes long-time of integration and the integration should cover at least the whole monsoon season:

Song, F. et al. (2014), Responses of East Asian summer monsoon to natural and anthropogenic forcings in the 17 latest CMIP5 models,Geophys.Res.Lett.,41,doi:10.1002/2013GL058705

Corresponding sentences in the last paragraph of the manuscript are revised:

"For example, if one were interested in identifying how seasonal features such as the Asian summer monsoon responded to anthropogenic and natural forcings (e.g., Ganguly et al., 2012; Vinoj et al., 2014; Song et al., 2014), or to changes in model formulation (e.g., Zhou and Li, 2002; Chen et al., 2010), it might be possible to generate realizations of few-month simulations, and use ensemble averages to remove multi-year and multi-decade scale noise that would otherwise require hundreds of years of simulations."

3. For Example-1, viz. the comparison of 30 and 4 minutes time steps, it would be better to add some comparisons to the observations. As a climate modeler, I am interested to the skills of two simulations: which one is more close to the observation? I understand that the satellite measurement may not be enough

in time interval to provide the observational evidences, at least a discussion is needed. Or at least the results of reference simulation can be compared to the satellite cloud, as what has been done in previous papers of CAM5 evaluation.

The theme of this paper is the ensemble method rather than the performance of the CAM5 model. We thus believe the suggested comparison with observation is out of the scope of the present paper. A detailed characterization of the time step sensitivity in CAM5 will be reported elsewhere.

4. Similar as Figure 2 and Figure 6, could you please add a figure of precipitation and examine the well-known double ITCZ bias? Nearly all climate modelers should have interests to this.

Although the cause of the double-ITCZ bias is not yet well understood, previous studies have shown that the geographical distribution of tropical precipitation is strongly connected to the large-scale circulation, moisture, heat and momentum budgets, as well as model performance in regions away from the precipitation biases (e.g., Ma et al., 1996; GFDL, 2004; Hwang and Frierson, 2013). The time scales associated with these planetary-scale features are presumably on the order of months or longer. The 3-day ensembles presented in our paper are therefore not expected to be able to capture the ITCZ biases. Indeed, the 5-yr simulations indicated that a shorter (4 min) time step leads to a slight increase of precipitation in the SPCZ in boreal winter, while the 3-day ensembles does not reveal statistically significant differences in this region.

In the revised manuscript we added the following sentences to Sect. 5 ("Conclusions and discussion"):

"(The strategy discussed in this paper using few day simulations certainly has limitations. It cannot be used as formulated here to investigate modes of climate variability or feedback mechanisms that operate on time scales of months to years, thus could not replace long-term simulations when long time scales are important.) For example, in the time step sensitivity experiments discussed in Sect. 3, while the 5 yr simulations

reveal an increase of DJF precipitation in the South Pacific Convergence Zone (SPCZ) when time step is shortened (not shown), the ensemble simulations do not indicate statistically significant differences in this region. This is probably because systematic changes in the SPCZ involve feedbacks from the large-scale circulation which can not sufficiently spin up in just a few days."

References:

Ma, C. C., C. R. Mechoso, A. W. Robertson, and A. Arakawa (1996), Peruvian stratus clouds and the tropical Pacific circulation: A coupled ocean-atmosphere study, J. Clim., 9, 1635–1645.

GFDL (2004): The New GFDL Global Atmosphere and Land Model AM2–LM2: Evaluation with Prescribed SST Simulations. J. Climate, 17, 4641–4673. doi: http://dx.doi.org/10.1175/JCLI-3223.1

Hwang, Y.-T. and D. M. W. Frierson. Link between the double intertropical convergence zone problem and cloud biases over the Southern Ocean. Proc. Nat. Acad. Sci, 110. 4935-4940. 2013, doi: 10.1073/pnas.121302110

5. The ensemble size of shorter simulation should be highlighted in both abstract and summary part. This may provide a useful guide for climate modelers who may follow your method in their studies.

The abstract and conclusions are revised as suggested.

Interactive comment on Geosci. Model Dev. Discuss., 7, 2173, 2014.