Clim. Past Discuss., 5, C733–C735, 2009
www.clim-past-discuss.net/5/C733/2009/

Climate of the Past Discussions

Interactive comment on "The importance of paleoclimate modelling for improving predictions of future climate change" *by* J. C. Hargreaves and J. D. Annan

A. Ganopolski (Referee)

andrey@pik-potsdam.de

Received and published: 29 September 2009

The paper addresses the question of how different paleoclimate simulations can help to better constrain future climate model projections. For this end the authors used results of an ensemble of simulations of Holocene and LGM climates performed with an AGCM coupled to a slab ocean model. The authors found that the correlation between LGM and 2xCO2 climates in general is much higher than between mid-Holocene and 2xCO2. However for certain regions statistically significant correlation exists also between mid-Holocene and 2xCO2 simulations. The paper is well-written and its result contributes to the efforts to validate and better constrain climate models.

Major comments

The authors considered the level of correlation between climate simulations as a measure of usefulness of past climate simulations for constraining future predictions. This is overoptimistic: the existence of such correlation is a necessary but not sufficient condition. It is natural that climate models show correlation between 2XCO2 and LGM simulations. However the relationship (e.g. the slope of regression) between LGM and 2xCO2 climate changes can still be very different for different models. For example, both the CLIMBER-2 and the MIROC3.2 models show a strong correlation between tropical LGM cooling and climate sensitivity but for a given range of "observed" LGM cooling very different ranges of climate sensitivities will be derived from these two models. It is also not very surprising that there is a correlation between changes in monsoon precipitation in the mid-Holocene and 2xCO2 experiments. But it also would not be surprising if in some models such correlation will be negative and some models positive which would preclude a possibility to use paleoclimate information to constrain even the sign of precipitation changes in the future. Therefore the existence of correlations found in the study cannot be presented as "evidence that the paleoclimate epochs can provide some independent validation of the models" (Abstract). At best, this is only an indication that paleoclimate modeling may provide some information for model validation. To demonstrate the "importance of paleoclimate modelling" one has to show that paleoclimate data provide similar constraints for different climate models. Ideally it would be necessary to perform ensembles of simulation with all existent climate models. As a minimum, one should perform an ensemble of simulations which mimics very different climate models in terms of climate sensitivity, hydrological sensitivity, climate feedbacks, etc. Since the ensemble of simulations performed with the MIROC3.2 model falls outside the "IPCC range" for climate sensitivity, obviously, the authors cannot claim that their ensemble mimic other "IPCC models". Another specific feature of the MIROC3.2 model family is that it has consistently higher sensitivity to an increase than to a decrease of CO2 concentration. At the same time, it is known that some other models have an opposite behavior. In a view of these limitations, I would

formulate the main message of this modeling exercise in a more modest manner. I also believe that the title of the manuscript is overambitious for such technical paper.

Specific comments

Abstract (11,12). It is not clear what the authors meant under "strong results" and "weak results". Is it about strong/weak correlations?

Abstract(14) Which areas are meant here, and why only these areas should be "improved"?

Method (p. 2057) I would suggest to clarify for the readers the issue related to the use Q-flux because not very many workers ever used this approach. I would also give for comparison (with 2 W/m2) a range of Q-flux disbalances for the whole ensemble used in Annan et al. (2005).

Method (p. 2057, l. 26,27) I do not understand how Q-flux constraint can increase climate sensitivity. Probably, the authors mean here average (over the ensemble) climate sensitivity.

Discussion (p. 2067, l. 18-19). "the T42 version of MIROC3.2 does not share. . ." Please clarify what do you mean here. Does it mean that T42 has a smaller disbalance than T21 version for the same climate sensitivities? And what do the authors mean under "moderate climate sensitivity" for the MIROC3.2 model?

Fig. 7 and 8 Change "b" to "c" and "c" to "d" in the figures.

Interactive comment on Clim. Past Discuss., 5, 2053, 2009.