Geophysical Research Abstracts, Vol. 8, 02072, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02072

Evaluating the use of ocean models of different complexity in climate change studies

A. P. Sokolov, S. Dutkiewicz, P. H. Stone and J. Scott
Massachusetts Institute of Technology, Cambridge, USA
sokolov@mit.edu / Fax: 617-253-9845 / Phone: 617-253-6691

The study of the uncertainties in future climate projections requires large ensembles of simulations with different values of model characteristics which define its response to external forcing. These characteristic include climate sensitivity, strength of aerosol forcing and the rate of ocean heat uptake. The latter can be easily varied over a wide range in an anomaly diffusing ocean model (ADOM). The rate of heat uptake in a three dimensional ocean general circulation model (OGCM) is, however, defined by large number of factors and is far more difficult to vary. Necessity to obtain a realistic ocean circulation places additional constraints, making it impossible to cover the range of values suggested by observations. As a result, a simpler model like an ADOM needs to be used in uncertainty studies.

To evaluate the performance of the ADOM on different time scales we compare results of simulations with two versions of the MIT Integrated Global System Model (IGSM): one with a ADOM and the second with a full three dimensional OCGM. Our results show that through the 20^{th} and 21^{st} century, the version of the IGSM with ADOM is able to reproduce important aspects of the climate response simulated by the version with the OCGM. However, the inability of the ADOM to depict feedbacks associated with the changes in the ocean circulation significantly affects its performance on the longer timescales. In particular, the ADOM overestimates sea level rise due to thermal expansion of the deep ocean. It also rather poorly depicts long term changes in oceanic carbon uptake, leading to under-estimation of the atmospheric CO_2concentrations. Thus, the IGSM version with ADOM can be used to obtain probability distributions of changes in many of the important climate variables through the end of 21^{st} century. On the other hand, studying longer term climate change requires the use of the OGCM.