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Biogeosciences Discussions

Interactive comment on "Marine geochemical data assimilation in an efficient Earth System Model of global biogeochemical cycling" *by* A. Ridgwell et al.

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This ms presents a description of an improved "EMIC" type model of the global ocean. The 3-D model has moderate horizontal and somewhat low vertical resolution, and captures a number of important biogeochemical processes. The authors provide a reasonably adequate description of the core model components. The description of the calibration procedure using an optimization approach with a Kalman filter is less clear. While space may not permit much attention to this issue, the current description relies almost entirely on other references, as there is relatively little information about how the process is carried out. Except for someone who is well versed in this particular methodology, there is insufficient information to do other than "trust" the authors. I don't doubt that they can be trusted on this point, it's just that it would be nice to have a better

picture of what they are doing.

The biogeochemical function of the model seems very much in line with recent literature. The fundamental module is the P model, that employs Michaelis-Menton type uptake kinetics. The model is by definition P-limited, so all follows from this equation. The POC model is also similar to previous work, either exponential or power law relationships that are derived from assuming either 1^{st} or zero order decomposition kinetics. A single function may not capture the significant differences in C export from different plankton communities (i.e. diatom- vs coccolith-dominated), but that is a detail here. The model has no inputs or output of biogeochemical components – it is a closed system, which may limit its ability to respond to certain kind of perturbations. For example, P remineralization from benthic environments is O_2 dependent, and P trapping can occur – but not here. At shorter time scales this won't be much of a problem since the residence time of P is 10^4 years. At the longer end of the time scales they propose to treat with he model this becomes more important.

The carbonate chemistry model seems simple and clever, and looks useful in predicting CO_2 changes.

While the authors describe the model as being "efficient" and it certainly is, model runs are still slow for some purposes. 1 hour CPU time per 1000 years is still a real limitation for some kinds of studies. However, this represents real improvement, and can only get better with better with time. Increase vertical resolution would allow the OMZ to be modeled, but at the cost in increased clock time and would then require an explicit realization of the N cycle to be useful.

Overall, this looks to be a very nice development that will be particularly useful for studying the response of the C cycle on time scales of 10^3 - 10^4 years.

Interactive comment on Biogeosciences Discuss., 3, 1313, 2006.