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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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Although we spend almost 3 pages outlining the Ensemble Kalman filter (EnKF) optimization methodology, the full details and equations of the EnKF methodology are not included here, prompting the comment; "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." However, having revisited the existing text, we do not believe that any substantial extension of this section is either justified or required. All the details and development, testing, and application of the EnKF is published and cited in the text. Importantly, EnKF has been already used in a near identical optimization - of the climate component of the GENIE-1 model rather than the biogeo-

chemistry - see Hargreaves et al. [2004]. This, we certainly do not rely upon anything about the EnKF that is 'unpublished' or not fully described elsewhere, so there really should be no need to have to just 'trust' the authors - the methodology is fully available in the cited literature. What we have done though is to add some additional test summarizing and highlighting the primary papers containing the EnKF description and method development (twin testing) [Annan et al., 2005] and subsequent application to climate optimization of the GENIE-1 model [Hargreaves et al., 2004].

The Referee is right in that in any application of this model to 'long' time-scales that there are important implications of the organic carbon cycle (sep. PO4) currently being configured as a closed system. We have added some additional discussion of this and outline the in-progress and planned developments to this model which will address both the sink of phosphate (sedimentary burial) and the source (weathering). We have also made it clearer that in the companion paper currently under consideration at GBC, the model is extended to have an open system with respect to calcium carbonate (although still closed for organic carbon and PO4).

We at least partially agree with the comment regarding what it means when we claim that the model is "efficient" - it certainly is compared to other 3-D GCM based models (either off-line or on-line). However, it is also true to say that the GENIE model is sufficiently numerically expensive to prevent application to some of the longest (e.g., 1-10 Myr or Phanerozoic) time-scale questions and that box models must still be relied upon to address these. We have clarified our original statements and include some explicit discussion regarding the time-scale realms of applicability and non-applicability of the model.

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