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Interactive comment on “Optimization of the seasonal cycles of simulated CO₂ flux by fitting simulated atmospheric CO₂ to observed vertical profiles” by Y. Nakatsuka and S. Maksyutov

Anonymous Referee #1

Received and published: 29 June 2009

Nakatsuka and Maksyutov estimate CASA model parameters using atmospheric CO₂ concentration data from different sources. Results demonstrate sensitivity to the rate of vertical mixing, consistent with (Stephens et al. 2007). The study was interesting and the conclusions supported, but a number of minor improvements should be made to place the study in context to optimize its value.

The study focuses on both data sources and parameter estimation, and the interaction is complex. It would be helpful to state more clearly the findings of previous research in the introduction (especially p. 5935 and 5936) to, critically, better describe how this study represents an improvement to previous work. The change that would improve the

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paper the most would be a full discussion of improvements to vertical mixing models given that the NIES model used was co-developed by the co-author. See e.g. page 5944: it says mostly that the mixing model is insufficient; more valuable would be suggestions for how this can be improved. The readers have been convinced that vertical mixing models represent a substantial problem for quantifying the carbon cycle (e.g. Stephens et al. 2007), but a proactive discussion would detail the necessary improvements.

Why is winter northern mid-latitude vertical mixing a particular problem? Erroneous sensible heat flux estimates for vegetation covering snow?

Methods: A brief CASA description would be forthcoming so as not to continuously refer to future sections. Include a couple of sentences on the model and what it does. Is CASA really designed to have zero NEP on the grid-cell basis (p. 5942, 21)

The formulation of equations 6 and 7 and equations like it have always concerned me; they don't follow Leibig's Law and there is little mechanistic reason to assume, for example, that light use efficiency is sensitive to the product of temperature and water stress.

Is subtracting 30 the correct formulation in equation 8? (Depends on the reference temperature)

I like the approach to optimize on E_{max} given that it has (likely) been assumed constant in previous CASA studies, but there is far more literature on this important issue (e.g. (Zhu et al. 2005)) and there are more models than CASA. Please expand the scope of the discussion on E_{max} to enhance its applicability of studies using CASA and/or other models.

References: Stephens BB et al. (2007) Weak Northern and Strong Tropical Land Carbon Uptake from Vertical Profiles of Atmospheric CO₂. Science 316:1732-1735 Zhu W, Pan Y, He H, Yang M, Long Z, Yu D (2005) Simulation of Maximum Light Use Effi-

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ciency for Different Vegetation Types. IEEE Transactions on Geoscience and Remote Sensing 5:3070-3073

Interactive comment on Biogeosciences Discuss., 6, 5933, 2009.

BGD

6, C948–C950, 2009

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