RECTIFIER EFFECT IN AN ATMOSPHERIC MODEL WITH DAILY BIOSPHERIC FLUXES

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ABSTRACT
The synoptic scale atmosphere-biosphere interaction can cause anomalies of ~10 ppm with length scale of ~1000 km in the monthly averaged surface CO_2 concentration. These anomalies may contribute to the errors and uncertainties of CO_2 inversion estimates.

INTRODUCTION
Inversion studies [e.g. *Gurney et al*. 2002] showed that an important uncertainty in the flux estimates is the interaction between the atmosphere and the biospheric fluxes or the 'rectifier effect'. Recent studies have shown that supplementing the baseline flask CO_2 data with continuous CO_2 measurements at baseline and continental sites could yield inversion results with greater spatial/temporal resolutions. However, continuous CO_2 measurements at continental sites show strong interaction between the atmospheric mixing and the biospheric fluxes on many time scales including diurnal, synoptic and seasonal time scales. The synoptic scale interaction is the subject of this study.

RESULTS AND DISCUSSIONS
This study investigates the atmosphere-biosphere interaction on the synoptic time scale using the Biome-BGC [*Thornton et al*., 2002] and NIES (National Institute of Environmental Studies) transport models [*Maksyutov and Inoue*, 2000] We used two global biospheric source distributions from Biome-BGC. One represents the daily fluxes with Biome-BGC driven by NCEP (National Centers of Environmental Prediction) daily averaged data from 1990 to 1999 (the fluxes for each year were adjusted to yield a neutral biosphere), and the second source distribution is the mean monthly fluxes averaged from year 1990 to 1999 (used as the reference in this study). These biospheric fluxes were then transported in the NIES transport model with NCEP wind data from year 1990 to 1999. Thus the biospheric flux and transport are consistent as they both used the NCEP meteorological data. The difference in the atmospheric CO_2 concentration produced by these two source distributions represents the effect of coupling between the atmosphere and biosphere with daily variations in the biospheric fluxes.

Figure 1 shows the typical spatial and temporal variations of the monthly averaged CO_2 difference at the surface (σ=0.93). The magnitude of the difference in CO_2 is approximately 10 ppm. These variations are comparable to the mean seasonal cycle. The anomalies are typically centered over landmasses and have length scale of ~500-1000 km with little continuity over different months. The smaller scale features have shorter lifetime (~ 1 month). The annually averaged CO_2 difference is about one order of magnitude smaller while still showing large interannual variations and similar spatial features, Figure 2.

These results show that the synoptic scale rectifier effect on the CO_2 concentration is significant on the monthly timescale and has some effect on the annual time scale. Thus the synoptic scale rectifier effect may contribute to the errors and uncertainties of CO_2 inversion estimates by models without the synoptic scale interaction of the atmosphere and biosphere.

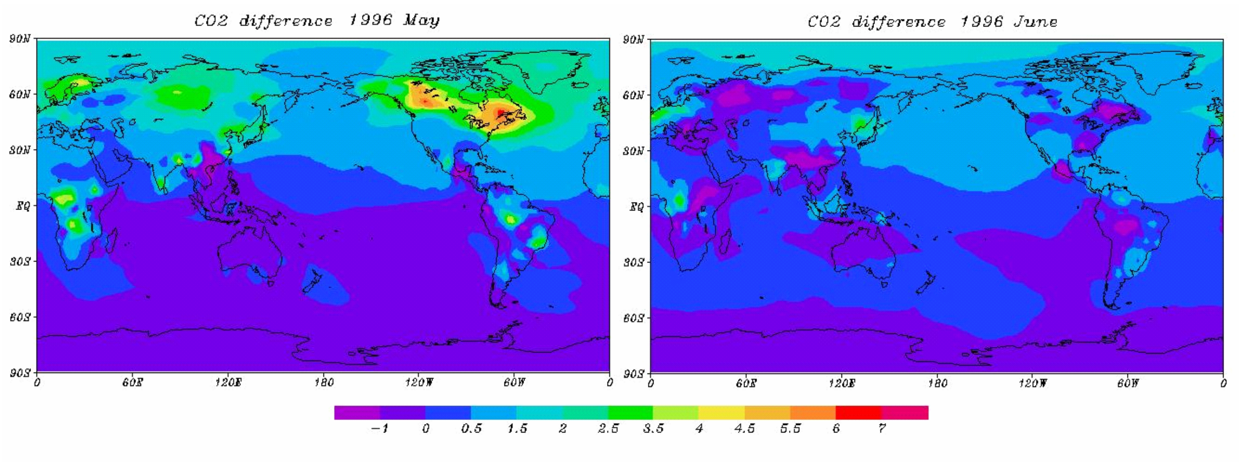

Fig. 1. Monthly averaged CO_2 difference for (a) May 1996, and (b) June 1996. Unit is ppm.

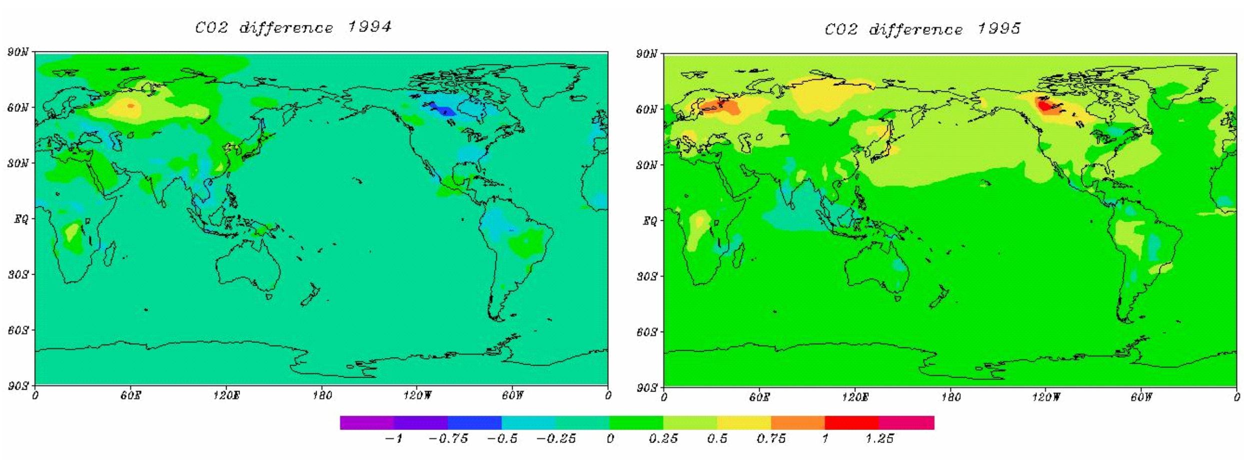

Fig. 2. Annually averaged CO_2 difference for (a) 1994, and (b) 1995. Unit is ppm.

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