

Interactive comment on “Mechanisms for synoptic transport of atmospheric CO₂ in the midlatitudes and tropics” by N. Parazoo et al.

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Thanks to Referee #2 for comments and recommendation for ACP publication.

Response to Specific Comments:

1) The first comment helps to enhance the readability of the paper. In the ACPD draft, the introduction emphasizes how weather might play a role in creating synoptic variations of CO₂ at the surface, and describes what is known dynamically and biologically in carbon science, with less focus on why this is important for carbon scientists. In my revisions I have included several paragraphs at the beginning describing why synoptic variations are important and why it is important to understand mechanisms that create synoptic variations.

2) The second comment asks for recommendations for modelers based on results of

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the study. The experiments in the paper imply which mechanisms are important for reproducing observed variations, but these implications are never outlined in the Conclusions. My revisions include these recommendations, in particular that our experiments suggest that moist convective transport is an important control on synoptic variations in the tropics and that modelers need to represent moist convection properly in order to reproduce observations.

One comment asks for an explanation of why some sites do not capture the observed frontal CO₂ climatology. These types of explanations help to elucidate on some of the model weaknesses. Note that many continuous observations over mountains were available at the time of this study, but excluded because these locations are difficult to simulate using a global model. For this reason, only continental and remote locations are analyzed. Mismatches between the observations and model are still to be expected, however, at these time scales using a coarse resolution global scale model. For one, the often extreme heterogeneity of the landscape is not resolved by SiB3, and although the small scale interactions between plants and the atmosphere are not captured, the general agreement between model and observations at different locations across the continent suggests that the net effect is. The amplitude of variations is affected by exclusion of long term terrestrial sinks in SiB3 (annual balance is assumed in our simulations) and crops (which play a major role over North America), and dynamical weaknesses that result from low model resolution, such as mesoscale processes along fronts. Phase mismatches tend to occur near mountains in these simulations, which are also not properly resolved. Representation error also plays a role in the timing of variations, since no attempt is made to interpolate between model grid points to the coordinate of the observations of interest. These explanations are included in our revisions.

We agree that the analysis is weakened by the use of one tropical site. Additional sites would help to contrast observed variations across South America (and Africa) and help to understand if the statement that moist convection dominates over advection can be

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generalized across the tropics (or not). In order to analyze and understand day-to-day variations within the boundary layer, more continuous and reliable (well-calibrated) hourly observations are essential. Although these observations, if they existed, would make conclusions in the paper more robust, I believe that the analysis we have performed has been very useful for comparing and contrasting synoptic variations in the tropics and midlatitudes, and for the sake of the modeling community, has helped to clarify modeling strengths and weaknesses and where future modeling improvements should focus.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 12197, 2008.

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