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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Assimilation of TES CO into a global CTM: first results" *by* N. A. D. Richards et al.

Anonymous Referee #1

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As the title states, this manuscript discusses the assimilation of TES data into a CTM. They also show that assimilation of the TES data improves the comparison of the CTM to MOPITT data.

This manuscript should not be published unless significant revisions are made. My comments are in no particular order.

1) Though the authors use the Geos-Chem model to do a CO-only simulation, an interesting aspect of CO assimilation is how other trace gases react (e.g., OH, NOx, etc.). For instance, CO is the major sink for OH and changes in CO cause a nonlinear response in OH. I would prefer that a full chemistry simulation be done as well for the two-week study period to explore this issue.

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2) The presentation of the model comparison to MOZAIC data is extremely poor. 2a) Please change the x-axis scale in the bottom panel of Figure 3 to -30 to 30 ppbv. As it is now, it's difficult to see the improvement with the assimilation that you discuss. And a vertical line at 0 ppbv difference would help to see at what altitudes improvements occur. 2b) At the end of section 5.2 you say that assimilation gives you an 80% improvement on the MOZAIC/model comparison. The bias appears to be only 10 ppbv, so 80% of a small number is a small number. This is a bit misleading. 2c) How did you average the differences in Figure 3? Are positive biases in some regions canceling negative biases? You only show Vienna and Toronto. Why don't you show vertical profiles in the tropics and southern hemisphere where you see the greatest impacts of the assimilation?

3) MOPITT a) Please explain in the manuscript why assimilation of CO from TES may not improve the model's comparison to MOPITT. Yes, you show that this is true, but is it surprising? How are the TES and MOPITT instruments different, for example, in sensitivity, pieces of information in the vertical, etc.? Do their datasets complement one another? b) The top two panels of Figure 2 probably aren't needed since the biases and correlations can be said in the text. However, the two panels would be of more interest if you could color the points by regions (e.g., northern hemisphere extratropics, tropical Indian Ocean, etc.).

4) You mention that an underestimate of biomass burning emissions is likely the cause of the model's low bias as compared to MOPITT and TES. a) Is your model CO biased low to cruise-altitude MOZAIC data? You plot the takeoff and landing profiles of MOZAIC, so it shouldn't be difficult to compare your model to the cruise-altitude MOZAIC data too. This comparison would be more convincing. b) GEOS-4-DAS meteorological fields are known to have significant problems with excessive tropical rainfall and convection, which could impact the lofting of CO to the middle and upper troposphere of your model. How would this contribute to your model's low bias? A simple plot of observed rainfall (I recommend NASA's GPCP dataset at

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http://precip.gsfc.nasa.gov.) and GEOS-4-DAS rainfall for your two week period would show you that the rainfall in the meteorological fields is excessive. c) Geos-Chem doesn't simulate the chemistry of the stratosphere and the stratosphere-troposphere exchange in the GEOS-4-DAS fields is excessive, so how do you expect to properly simulate the upper troposphere with your model and meteorological fields?

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 11727, 2006.

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