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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Analysis of global and regional CO burdens measured from space between 2000 and 2009 and validated by ground-based solar tracking spectrometers" *by* L. N. Yurganov et al.

Anonymous Referee #2

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General Comments

This manuscript is composed of two parts. First, comparisons of AIRS and MOPITT products for CO total column are performed, using ground-based FTS data as 'truth'. The results are used to develop a time-dependent correction for the MOPITT product, which appears to exhibit an upward bias drift. The second part of the paper is a global analysis of AIRS and MOPITT products along with 'bottom-up' CO inventories for 2008. In particular, this analysis considers whether a global drop in CO concentrations found in both AIRS and MOPITT products during 2008 is more likely the result of a drop in

biomass burning emissions or anthropogenic emissions.

While the topic of the paper is scientifically relevant and interesting, serious problems with the methodology make the paper unacceptable. While it is conceivable that the authors could revise the paper to address these concerns, much of the analysis included in the current draft should be discarded and replaced. Essentially, the paper would need to be rewritten.

Major Revisions

Throughout Section 2, the authors compare CO total column products for MOPITT (Version 3), AIRS (Version 5), and seven ground-based FTS instruments. However, these comparisons are not truly quantitative since they do not account for the different vertical sensitivities (averaging kernels) and different a priori dependences of the different products. The authors seem to recognize this problem in Sec 2.2 (p.6): "No efforts were made to reconcile the different vertical sensitivity functions (averaging kernels) of AIRS and MOPITT. To do this would require additional information on the "true" vertical stratification of CO." However, if it is recognized that AIRS and MOPITT products fundamentally measure different quantities (and neither actually measures the true total column), then it is simply not correct to interpret differences between the two products (or differences with FTS products) as a retrieval 'bias' associated with either instrument.

This problem casts doubt on nearly everything that follows in the paper. For example, the apparent 'seasonal bias' (p. 8) could quite possibly just be the result of seasonal variability of the retrieval averaging kernels (because of seasonally varying thermal contrast conditions). Possible remedies to this problem might include (1) the use of in-situ profile data at a variety of sites (or perhaps from multiple field campaigns) instead of the FTS data, or (2) the use of chemical transport models to simulate the true profile shape at each FTS station (to quantify expected retrieval differences due to averaging kernel and a priori effects). In any case, the quantitative validation of satellite trace gas products must account for the retrieval averaging kernels and a priori de-

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pendence. The work by Rodgers and Conner ('Intercomparison of Remote Sounding Instruments', JGR, vol. 108, doi:10.1029/2002JD002299, 2003) describes generally accepted methods for quantitatively comparing remote sensing products from different instruments.

Another major limitation of the paper is the focus on the MOPITT V3 product instead of the newer V4 product. On Nov. 30, the authors presented new results on the ACPD discussion webpage that indicate that the apparent bias drift in the MOPITT V3 product is substantially smaller in the MOPITT V4 product. Since the MOPITT team considers the V4 product superior to the V3 product, the paper's focus should be primarily on the V4 product. The V3 product might be relevant for historical reasons, but should not be used as the basis of new scientific analyses.

Minor Revisions

p. 6, line 6: Actual examples (plots) of the FTS's 'vertical sensitivity' function should be provided. How much of an error to the true total column can be attributed to smoothing error?

p. 6, line 14: Does the 'target uncertainty' for the MOPITT and AIRS products include the effects of smoothing error, or does it only represent instrument error?

p. 7, line 3: No reason is given for using different indices for information content to represent MOPITT and AIRS products. DOF is the generally accepted standard index for information content. Why not just use DOF for both MOPITT and AIRS?

p. 8, line 3: What are typical DOF values for the MOPITT and AIRS products?

p. 11, line 15: The sentence beginning 'Since 2000 ...' is not clear – is there a clear justification for assuming that OH concentrations do not vary from year to year? If there is a long-term trend in OH concentrations, won't that affect the simulated CO burden?

p. 11, line 20: What is the correlation coefficient? The phrase 'good correlation' should be quantified.

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Interactive Comment