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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurements of Pollution In The Troposphere (MOPITT) validation through 2006" *by* L. K. Emmons et al.

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We thank the reviewer for the constructive comments on our paper. We have included additional text and a figure to the paper to quantify the influence of the instrumental drifts on the CO retrievals (as detailed below in item 5). The correction to Figure 2 and suggestion for Table 2 will be included in the revised paper.

A revised manuscript has been prepared that includes changes addressing the comments of both reviewers. These changes include:

1) The last sentence of the abstract has been revised; new text: The impact of an instrumental drift is illustrated through retrieval simulations.

2) A paragraph has been added to the introduction discussing the precedence and importance of satellite validation papers (in response to Reviewer 2):

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Interactive Discussion

Discussion Paper

This paper follows the precedent of publishing scientific papers on the validation of satellite observations (e.g. Clerbaux et al., 2008; Livesey et al., 2008; Warner et al., 2007; Heue et al., 2005; Sussmann and Buchwitz, 2005; Sussmann et al., 2005). Validation papers such as these do not necessarily contain new scientific results. The goal is to compare measurements in the most scientifically rigorous manner possible, often across spatial and temporal scales, and account for representativeness in each dataset. In addition, taking into account differences in vertical sensitivity is non-trivial. This paper covers a wide variety of validation exercises covering diverse geographical and seasonal cases including both monitoring and intensive field campaigns. The MOPITT observations are the longest global record of tropospheric CO and are used widely by the scientific community, therefore communicating this information to the community is essential.

3) A few sentences have been added to the last paragraph of the introduction outlining the paper:

Details of the in situ measurements used in this validation study are presented in the next section. Section 3 gives the details of the validation comparisons and presents the results. Section 4 discusses the possible causes of bias and illustrates the impact of a drift in the MOPITT instrument on the bias with time.

4) The description of Table 2 in the last paragraph of Section 3 has been modified to reflect the new column in the table:

The mean biases for each year for the long-term NOAA sites (leaving out Virginia), the field campaign data, and all of the MOZAIC data are given in Table 2.

5) A sensitivity test was performed to quantify the impact on the retrievals of including in the Forward Model the change in the pressure-modulation cell. A description of this test has been added to Section 4 (replacing the last paragraph of that section) and Figure 7 added, illustrating the results:

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The MOPITT retrieval algorithm incorporates a fast radiative transfer model based on prescribed instrument parameters, including the pressures and temperatures of the length- and pressure-modulation cells. For the MOPITT Version 3 algorithm, the assumed instrument parameters were based on pre-launch values measured in a laboratory. Over the duration of the MOPITT mission, drifts have been observed in the pressures and temperatures of the modulation cells. Because these drifts lead to discrepancies between the actual instrument state and the assumed state used for developing the fast radiative transfer model, these long-term instrument drifts can potentially lead to drifts in both the Level 1 radiances and resulting retrievals.

The magnitude of the retrieval biases resulting from long-term drifts in the MOPITT length- and pressure-modulation cells have been estimated through retrieval simulations. These simulations explicitly quantify the effect of exploiting a static radiative transfer model (based on fixed instrument parameters for one point in time) to process radiances produced by the instrument with perturbed instrument parameters. For these simulations, the retrieval algorithm incorporated a radiative transfer model based on MOPITT instrument parameters averaged over 2006. Radiances were simulated over a set of test atmospheres for two dates representing both an 'early-mission' date (Dec. 2, 2002) and a much more recent 'late-mission' date (Feb. 1, 2008). Comparisons of the simulated retrievals with the 'true profiles' (processed appropriately with the averaging kernels as in Eq. 1) for the two dates yields an estimate of the effect of changing instrument parameters on long-term retrieval bias drift.

Results of these simulations are shown in Fig. 7. These simulations were performed with the soon-to-be-released Version 4 product, which exploits a ten-level grid, with retrieval levels every 100 hPa. For the early-mission simulations, retrieval biases are typically negative and largest in the mid-troposphere. At 600 hPa, the mean retrieval bias is approximately -3 ppbv. For the late-mission date, retrieval biases are typically positive and largest in the upper troposphere. At 300 hPa, the mean retrieval bias is approximately 3 ppbv. For the current study, however, the most important statistic is the *difference in retrieval biases for the two dates. Inspection of the figure shows that at all levels, the bias drift over the period of a little more than five years is positive (i.e., biases increase with time) with a maximum drift in the upper troposphere of approximately 5 ppbv. Thus, this simulation study indicates that long-term changes in the instrument cell parameters produce a retrieval bias drift on the order of 1 ppbv/yr in the upper troposphere, and somewhat weaker bias drift in the lower and middle troposphere.*

6) Some previously missing, and additional, references are included in the revised manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 18091, 2008.