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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Application of SCIAMACHY and MOPITT CO total column measurements to evaluate model results over biomass burning regions and Eastern China" *by* C. Liu et al.

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Dear Jos de Laat,

Many thanks for your valuable comments and suggestions!

In this direct answer, we can not address all details (for some of the replies quite comprehensive additional work has to be done), but want to give a brief feedback on the

main points (see below).

a) Additional validation (in reply to bullet 4) This is a good point. We will include the validation exercises from the PhD thesis of Cheng Liu in the revised version of the paper. Moreover, we will add comparisons for additional FTIR ground-based stations.

b) justification and test of the normalisation with MOPITT over the ocean (general comment) Many thanks for the suggestion to include also not-normalised data! The spatial distributions of the not-normalised CO VCDs for different years shows very similar spatial patterns, but are shifted by a time-dependent offset (see figures below). These findings clearly indicate that the normalised CO VCDs over land mainly reflect the information content of the SCIAMACHY observations (e.g. Fig. 7). The effect of the normalisation is to remove the offset, which varies with latitude and season (as also found in other studies, see e.g. Buchwitz et al., 2005, Gloudemans et a., 2009). In the revised version of our manuscript we will add this information and discuss in more detail the potential errors introduced by our normalisation procedure.

c) Justification and test of the new cloud correction (bullet 5) Below we show sensitivity studies of the dependence of the CO VCD on cloud top height for cloud fraction <20%. These studies clearly show that the CO retrievals are systematically affected by the cloud shielding effect. The magnitude of the shielding effect is in rough agreement with Fig. 5 in our manuscript (although the results in Fig. 5 also depend on the details of the prescribed CO profile). It should be noted that – as expected – the shielding effect is much stronger for larger cloud fractions. The importance of the cloud effect was also mentioned in previous studies (e.g. Buchwitz et al. 2006a); the shown results also agree with atmospheric radiative transfer simulations. We will add this information in the revised version of our manuscript.

d) Quantitative comparisons without correct profile information? (mainly bullet 4 but also bullet 1) In our paper different data sets are compared. We are convinced that without information about the (relative) shape of the true CO profile, such comparisons

must be seen as semi-quantitative. Although satellite observations in the near IR in principle are sensitive to the whole atmospheric column, the sensitivity is not completely independent of altitude, especially due to the effects of clouds. When cloudy observations are included (e.g. in a time-averaged data set), satellite observations systematically underestimate the true CO VCD. Thus, if biases between different data sets are found, this does not necessarily mean that those data sets disagree. This should be kept in mind, especially when ground-based FTIR data are used for validation of SCIAMACHY CO VCDs. Moreover, as a final consequence, this leads to the unpleasant but unavoidable conclusion that validation exercises without information on the true (relative) profile shape can in a strict sense only be interpreted in a semi-quantitative or qualitative way.

References

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Gloudemans, A. M. S., de Laat, A. T. J., Schrijver, H., Aben, I., Meirink, J. F., and van der Werf, G. R.: SCIAMACHY CO over land and oceans: 2003-2007 interannual variability, Atmos Chem Phys, 9, 3799-3813, 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 1265, 2011.

Fig. 1) Yearly averages without normalisation and without cloud correction

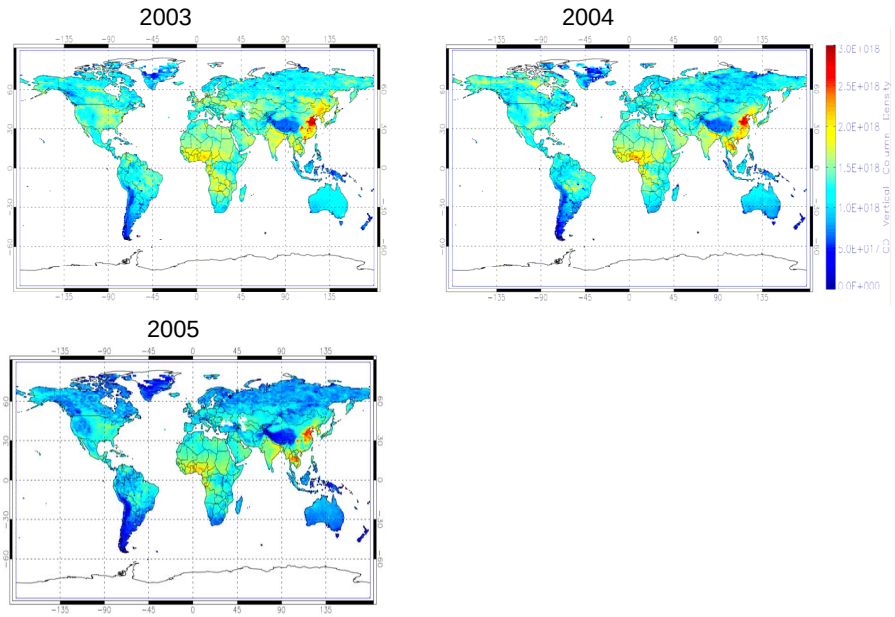

Fig. 1.

Fig. 2) Yearly averages with normalisation and without cloud correction

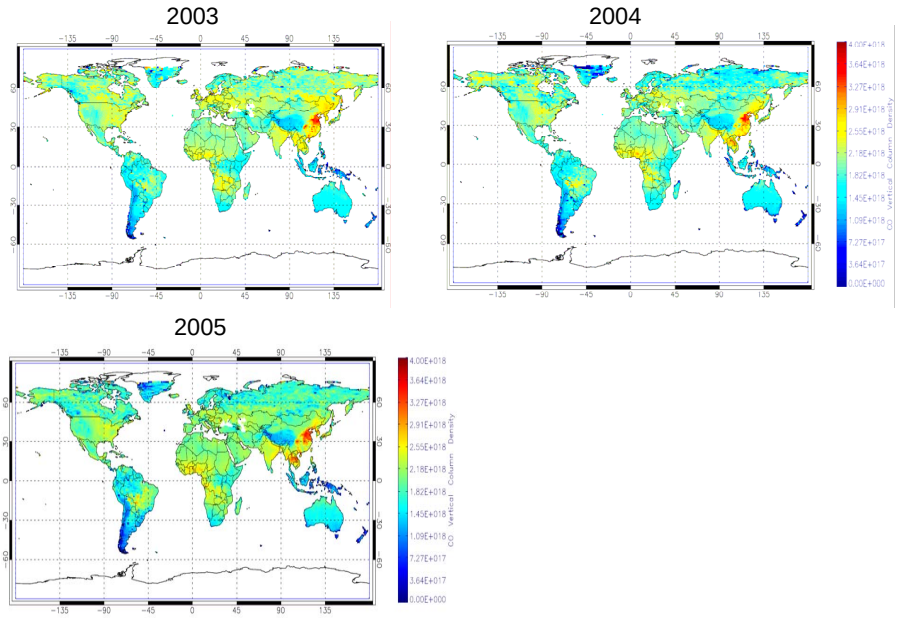

Fig. 2.

Fig. 3) Yearly averages with normalisation and with cloud correction

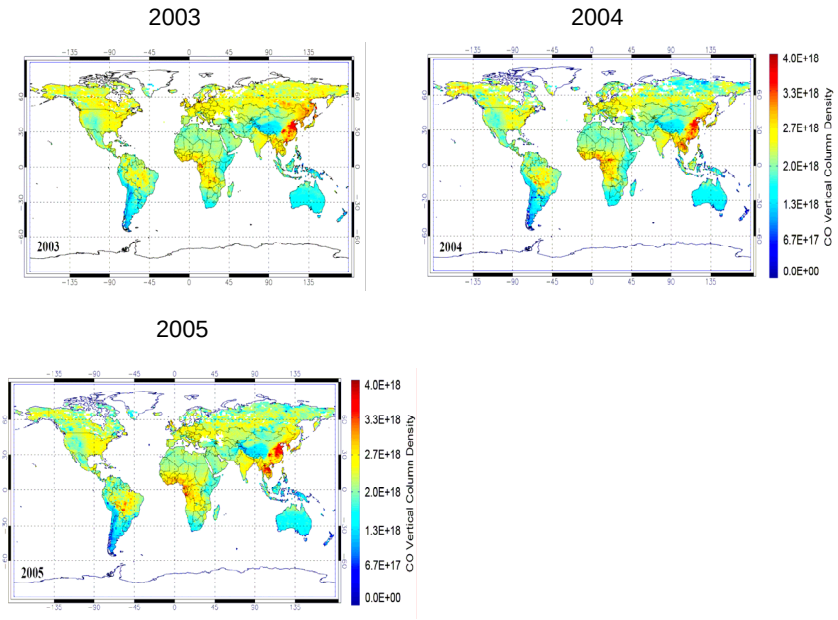

Fig. 3.

Fig. 2 Dependence of the CO VCD on cloud top height

(Jan-March)

(only measurements with cloud fraction <20%)

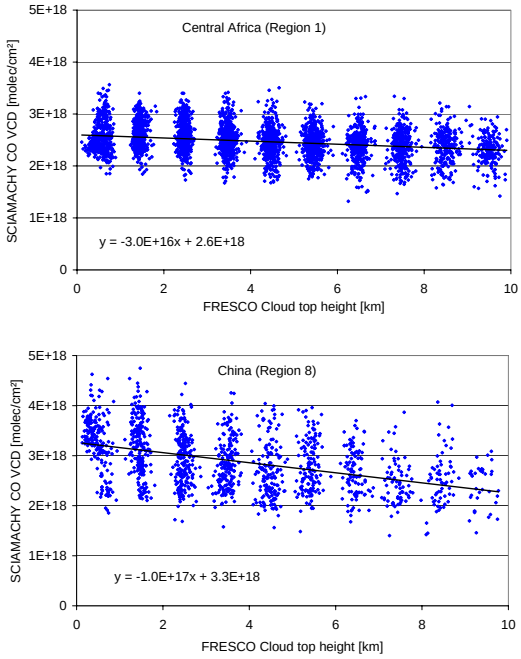

Fig. 4.