To what extent does the choice of an emissions inventory matter when doing chemical data assimilation in a global CTM?

R. Pommrich [1,2]***, Jean-Luc Attié*** [2]***, Béatrice Josse*** [1]***, Laaziz El Amraoui*** [1]***, Marine Claeyman*** [1,2]***,***

Philippe Ricaud[1,2]***, Vincent-Henri Peuch***[1]

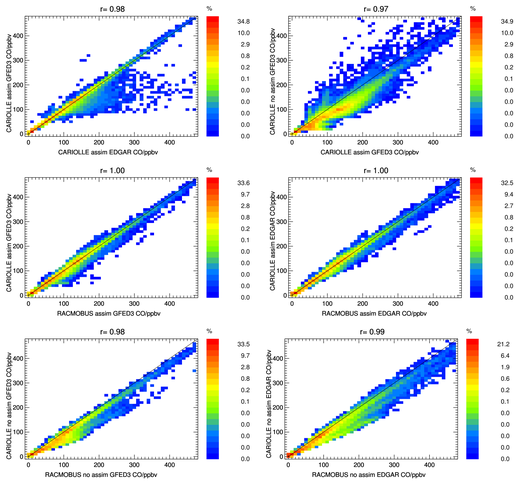
[1] *CNRM, Météo-France, Toulouse, France,* [2] *Laboratoire d'Aèrologie, Toulouse, France*

❶ Abstract

Emission inventories are needed in chemistry-transport models to prescribe the sources of trace gases in the atmosphere. Each inventory has its own approaches and specialties, its own variabilities in space and time, and therefore a different influence on the model outputs. As an illustration, we consider here the influence of two different biomass burning emissions datasets on simulations with MOCAGE, the global chemistry and transport model of Météo-France: we have considered the biomass burning part of the emission inventory EDGAR version 4.1 (*Dentener 2006*) on the one hand, and GFED version 3.1 (*van der Werf 2010*) on the other hand. We performed assimilation of CO data from the MOPITT instrument on the TERRA platform (version 3) in two configurations of MOCAGE differing only by the biomass burning emissions. The assimilation technique used is 3D-FGAT, which is implemented using the PALM software of CERFACS; the assimilation system itself is well-validated and has been used for several studies in the troposphere as well as in stratosphere (*Semane 2007, El Amraoui 2008, Claeyman 2011*). This study takes only CO into account, a quite well-understood tracer for biomass burning. To validate the results of the assimilation runs with independent data we compare with measurement (CO, O_3) taken within the MOZAIC project. The overall aim of our study is to assess the impact the assimilation of MOPITT data has on model results, and if this critically depends (or not) upon the choice of a given biomass burning inventory.

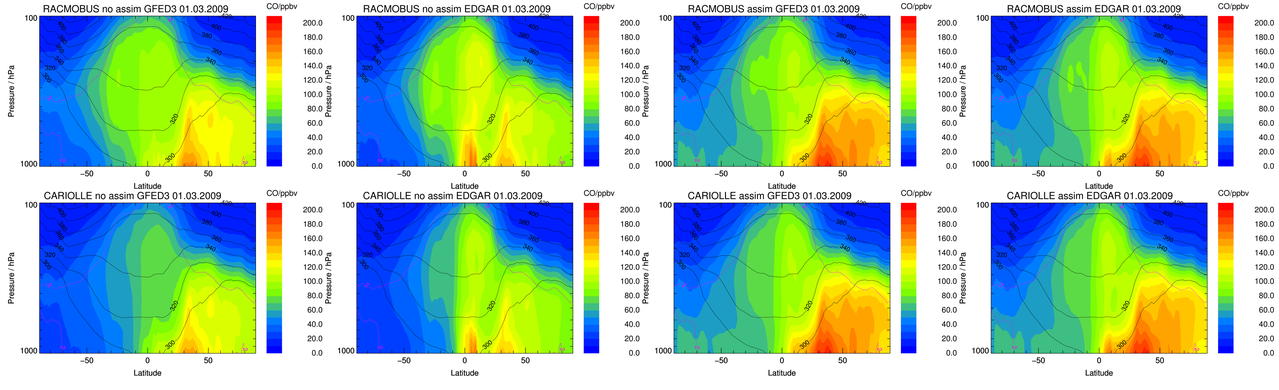
The results shown are from the 01.03.2009, after 2 months of simulation. ❷ shows the zonal mean of CO, the first row for the simulation with RACMOBUS, a complete tropospherical chemical scheme (*Dufour 2004*), the second row for the simulation with CARIOLLE, a linear chemical scheme (*Claeyman 2010*). The first two columns show the pure model runs, differing in the used emission repository, GFED left, EDGAR right. The last two columns show the assimilation runs, with the same order as before. In ❸ the correlation between the results of different experiments are shown. The color bar show the probability for a value in both data sets. First row left panel shows the comparison between two assimilation experiments with different emission repositories, the right panel shows the correlation of a pure model run with an assimilation run using the same emission repository. The plots below show per row correlations of results of pure models runs and assimilation runs, respectively.

❸ Correlation

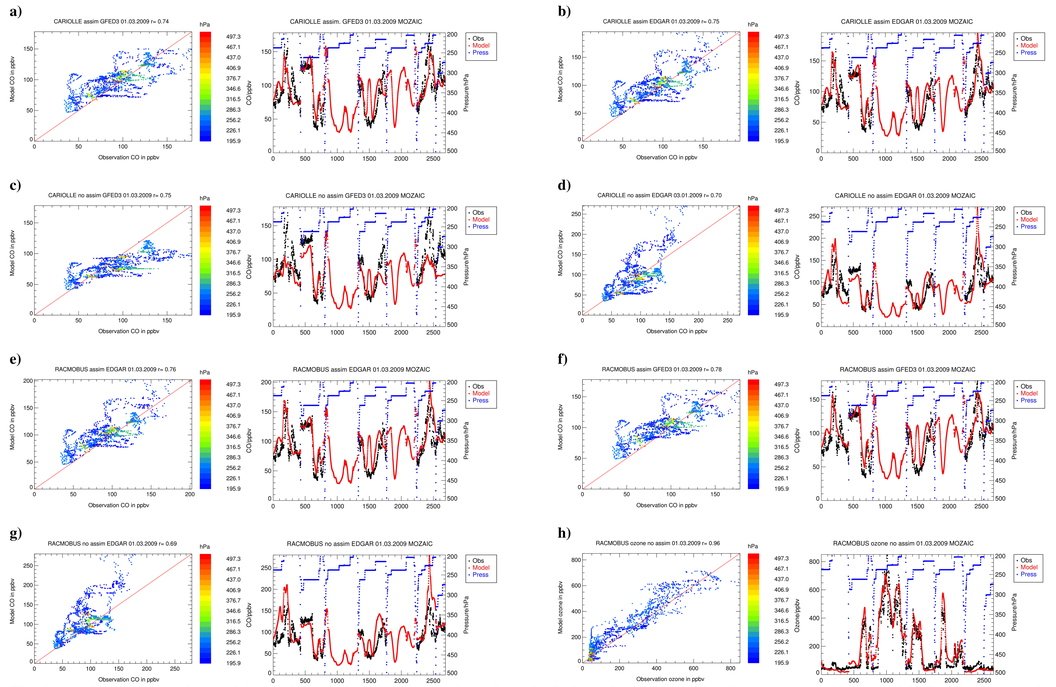


On the left side are experiments with the linear chemical scheme shown, on the right side those with the full tropospherical chemical scheme. From top to bottom are the correlation plots of results of assimilation experiments and pure model runs with GFED and EDGAR as emission inventory shown. ❹ show a comparison of the simulations with measurement from the MOZAIC project. Details are written there. ❺ gives a summary.

❷ Zonal mean CO



❹ Comparison with MOZAIC



This figure shows the correlation (left panels) and the direct comparison along the flight paths (right panels) of measurements from the MOZAIC project and analyses for CO (a)–g)) and O_3 (h)) for the 1. March 2009. In the correlation plot the pressure is color coded. The x-axis in the flight path plots is the running number of the measurement. – Around measurement 1500 occurs a maximum in the analysis not seen in the measurements. This is remarkable because apart from that the values in the analysis follow quite well the measurements. The good agreement in O_3 as well as the appearance in measurements from other instruments (not shown) hints to a problem in the CO measurements of MOZAIC.

❺ Summary

- When doing data assimilation of CO the coverage of MOPITT allows to compensate the shortcomings of the much simpler chemistry in a linear scheme. There are very little differences (<5%) between the analyses.
- A detailed scheme offers yet other species like O_3 useful for interpretation.
- Studying the difference in the tropics, GFED3 is more constistent with MOPITT analysis. The emissions from EDGAR between 0°N and 10°N are weekened.
- The anthropogenic emissions for northern midlatitudes are probably too low by $\approx 20\%$.
- Southern hemisphere CO in the analysis compared to the free run are problematic, this is propably due to an issue in the MOPITT CO data.
- The agreement of the analyses with measurements from MOZAIC is quite well, apart from one remarkable event.

Claeyman et al. (2009), A linear CO chemistry parametrization in a chemistry-transport model: evaluation and application to data assimilation, Atmos. Chem. Phys., 10, 6097–6115.
Claeyman et al. (2011), A geostationary thermal infrared sensor to monitor the lowermost troposphere: O3 and CO retrieval studies, Atmos. Meas. Tech., 4, 297–317
Dentener et al. (2006), The global atmospheric environment for the next generation. Environ. Sci. Technol., 40, 3586–3594.
Dufour et al. (2004), Observed and modelled "chemical weather" during ESCOMPTE, Atmos. Res., 74, 161–189.
El Amraoui et al. (2008), Investigation of dynamical processes in the polar stratospheric vortex during the unusually cold winter 2004/2005, Geophys. Res. Lett., 35, L03803
Semane et al. (2007), An observed and analysed stratospheric ozone intrusion over the high Canadian Arctic UTLS region during the summer of 2003, Q. J. R. Meteorol. Soc., 133 (S2), 171-178
Van der Werf et al. (2010), Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997–2009), Atmos. Chem. Phys., 10, 11707–11735.

This study is part of the POGEQA project, funded by RTRA/STAE in France (http://www.fondation-stae.net/).