Atmos. Chem. Phys. Discuss., 7, S8036–S8039, 2007
www.atmos-chem-phys-discuss.net/7/S8036/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Air pollution during the 2003 European heat wave as seen by MOZAIC airliners" *by* M. Tressol et al.

Anonymous Referee #2

Received and published: 29 December 2007

This paper gives interesting insight in the vertical distribution of pollutants and meteorological parameters over Western Europe during the summer 2003 heat wave, obtained from an important data set of MOZAIC profiles over Frankfurt. Important results are that lower tropospheric CO and ozone levels are significantly enhanced with respect to climatology during the first half of August, due to the combined effect of accumulation of European surface emissions and additional fire emissions especially over Portugal, giving rise to photochemical ozone production.

The paper is well written, well argued and well illustrated. As said before, obtained results are important and novel. The analysed data set offers indeed a unique opportunity to study the vertical structure of pollutant profiles during heat wave 2003. Simulations with a lagrangian particle model are appropriate to analyse the profiles. In the following I will make several remarks which intend to strengthen the analysis of the vertical structure of pollutants.

Major remarks :

PBL height and analysis of vertical profiles with respect to PBL height :

The analysis of the PBL height impact on vertical profiles should be made clearer.

The spatial and temporal variability of PBL height over the analysis period should be illustrated by a dedicated figure to allow the reader to fix ideas about its influence on vertical distributions. Especially the strong differences during the three sub-periods within August 2 to 14 should be illustrated.

PBL heights calculations (as here using ECMWF input data and the Richardson number concept) are always very uncertain. How does this uncertainty affect the results? Are these heights consistent with the MOZAIC temperature and humidity profiles? On the other hand, analysis of vertical profiles of CO and ozone could help to validate PBL height calculations. In particular, strong vertical variability would indicate a position outside of the well mixed boundary layer. This should be more explored, especially to confirm differences in the PBL heights between the three sub-periods.

In the discussion at the end of section 5.3, about the impact of fire emissions on the PBL pollutant concentrations (page 15931 , $>$ line 16), PBL height is a missing element in order to understand why observed CO fire peaks a given altitude should be captured within the PBL.

Subsidence within the troposphere (section 5.1) In section 5.1 , stratospheric transport to the middle troposphere is addressed. In addition, it would be important to question if downward transport of upper tropospheric ozone down to the middle and lower troposphere was an important process. In fact, in addition to the temperature, dryness, and low wind heatwave anomaly, a “subsidence anomaly” can be expected, with important effects on vertical ozone profiles. This point could easily be analysed

ACPD

7, S8036–S8039, 2007

from the already performed particle calculations.

Other remarks :

Section 2.2 Flexpart simulations

Page 15918, line 14 , industrial CO emissions : What is the horizontal resolution of CO emissions? I assume that the emission diurnal variation is not taken into account? Effects also depend on when emission tracers are released in the particle model. Day time emissions would then be underestimated, which would have an effect for local CO simulations. Averaging between underestimated night time and overestimated day time emissions is not perfect, because during night vertical mixing is weak and horizontal transport in lowest layers is slower. Please briefly discuss or mention these points.

Page 15918, line 25 ,fire CO emissions : : How are fire distributions distributed vertically, uniformly between 0 and 3.5 km height? What is the uncertainty in fire emissions and how does it affect conclusions of this study? Comparison with other CO fire emission estimations would be helpful to derive an order of magnitude for this uncertainty.

3. Meteorological situation

page 15921, line 8 “These anomalous features, i.e. high temperatures, low wind speeds leading to large residence times, and dry air in a clear sky, make environmental conditions very favourable for ozone formation.” Dry air in itself is not enhancing photochemical ozone production in the boundary layer, as could be understood from the above sentence : in the free troposphere, low water vapour decreases ozone loss more than ozone formation (though its effect on the radical budget) and thus enhances net photochemical ozone production. However, in the boundary layer, the relationship is inverse, because the major ozone loss terms are dry deposition and transport and not photochemistry. In this case, water vapour enhances net photochemical ozone build-up.

5. Origins of ozone and CO maxima during the heat wave

ACPD

7, S8036–S8039, 2007

Interactive Comment

EGU

CO profile observations and simulations.

Despite limitations in the CO simulations, comparison with observations should be discussed, in terms of absolute values and not only correlations. This makes sense for observations with predominant European emissions and biomass burning origins, which should be captured by the simulations. Is the order of magnitude of fire CO correctly estimated ?

Isn’t the impact of NA emissions with respect to EU emissions overestimated due to neglecting the chemical CO sink ?

Figures :

Figure 3 : The middle and the right graph are the same, one is wrong !

Figure 4 : It is not clear what is shown here : what is the colour bar standing for ? For an emission sensitivity or for a residence time ? Or is it the preferred location of particles during their 10 day travel ? The vertical dependence is also not clear, in particular the relationship between the 0 – 3 km column and particles above 500 hPa, between 800 a,d 500 hPa and below 800 hPa.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 15911, 2007.