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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aircraft measurements over Europe of an air pollution plume from Southeast Asia – aerosol and chemical characterization" *by* A. Stohl et al.

Anonymous Referee #2

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General Comments

This article presents the clearest evidence to date of anthropogenic pollution transport directly from East Asia to the upper troposphere over Europe. A sound modelling strategy employing CO tracers is used to attribute elevations in CO concentrations observed near Europe to Asian emissions. No stone is left unturned, and I think that fewer figures would suffice to convince the reader that the pollution is indeed Asian (see specific comments). The paper moves on to discuss the characteristic composition of the Asian plume and to present clear evidence of mixing with stratospheric air as the plume heads southeastwards over Europe. Richardson number is calculated from an

aircraft profile to demonstrate that turbulence is likely to occur below the tropopause and a tropopause fold, mixing the Asian pollution with stratospheric air. Some salient observations are made on aerosol size spectra in the plumes. Although this is one transport event, there is some discussion of those features that might be typical of transport from Asia. Although beyond the scope of this paper, it would only be possible to move away from case specifics and make more concrete general conclusions by simulating chemical and aerosol transformation using a numerical model.

The scientific approach is excellent, although not especially original, and the presentation is clear. However, the paper would benefit from discussing fewer figures.

Specific Comments

1. Section 2.1: the second paragraph was not very clear. It would be better to discuss PSAP and FSSP after the instruments associated with the aerosol size spectrum, rather than mention everything in the first sentence.
2. Section 3 and elsewhere: “backside of the trough” -> “rear of the trough”
3. Omit Fig.1 since so similar to Fig.3g.
4. Omit Fig.6 and discussion in Section 4.1 since they only distract from the main story of the paper.
5. Section 4.2.1: Burma -> Myanmar
6. Section 4.2.2: Why do the simulations using GFS data perform worse. Is the resolved ascent too slow associated with lower resolution of the parent NWP model?
7. Fig.8 (10): On left axis would be better to replace 100 (120) with 0 at the bottom of the top three panels.

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8. Fig.9: At this size it is almost impossible to distiguish the black and red dots for fire counts.

9. Section 4.3.1: It seems dangerous to state that dO3/dCO "measures" the number of O3 molecules formed per CO molecule emitted when mixing clearly has such a major influence near the tropopause. These conjectures are too speculative without running a photochemical model.

10. Section 4.4: Some of the conjectures in this section were rather sketchy. In particular, do you have any further evidence for new particle formation in the "cloud-free FT" air mass and suppression in the Asian plumes (as opposed to different but unexplained origins)?

    Although the correlation coefficient between accumulation mode number concentration and CO was lower for air mass II, is this really to do with cirrus cloud encounters? Strong linear correlations are typically associated with regions of mixing between air masses. The cluster of points near CO 170ppbv is associated with the centre of the plume where concentrations are rather homogeneous and the edges of this feature are extremely sharp. These features would reduce the correlation. The only "mechanism" required to explain the isolation of the high CO points (even more obvious in Fig.12) is a very weak mixing rate relative to the horizontal shear on the flanks of the jet carrying the plume.

11. Fig.18: Show the size spectra side by side or use only the volume density.

12. Section 5: "Trace gas correlations between CO, NOy and O3 were all positive" for flight A. Only air mass III on flight B was similar.

    I suggest removing speculation about reduced small particles in Asian plumes due to high concentrations in the accumulation mode.

    I would omit the last two sentences concerning ozone of "stratospheric origin" at Zugspitze. There are many candidate processes to account for this and it is too

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speculative to relate to mixing of pollution into the stratosphere.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 12611, 2006.