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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chinese SO_2 pollution over Europe – Part 2: Simulation of aerosol and cloud condensation nuclei formation" *by* V. Fiedler et al.

V. Fiedler et al.

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Author response to referee #2

We thank referee #2 for the helpful recommendations and comments. We have considered all comments and in consideration of the comments we have made major revisions of the paper draft. We also included: (a) new AEROFOR and FLEXPART model simulations; (b) soot particle coating by H2SO4/H2O; (c) aerosol particle activation including also soot particles; (d) light scattering and absorption by modeled aerosol particles. Therefore the paper text has also been changed a lot. To find new parts and

results easier in the text, we mention here in our author comments in brackets always the sections in the manuscript the comment refers to.

Major points:

1. Now an extensive analysis of the occurrence of clouds is included in the revised paper draft (Section 3, forth paragraph ff.). The analysis is based on satellite data and an analysis using ECMWF data and the LAGRANTO model. The paper by Newell at al. 1999 has been cited (introduction).

2. The measurement flight was part of the INTEX-B campaign. This is now clearly mentioned. Citing of previous work has been greatly extended and work of the INTEX-B Pacific missions has been considered (introduction and section 2, first paragraph).

3. An extensive discussion of the lack of activation of grown sulfuric acid aerosol particles (due to RHW$<<$100%) during most of the high-altitude travel of the plume has been included (section 8). Additional aspects (visibility degradation and sulfuric acid induced enhancement of light absorption by soot) have been included (sections 6 and 7).

Specific points:

1. A summary of the experimental results (paper 1) and additional figures have been included in the revised paper draft (section 2). Concerning the air parcel trajectory characteristics see also point 3 a.

2. Information on the modes of pre-existing particles is now included (section 4, second paragraph ff.).

3. The AEROFOR model simulation starts only after the initial ascend to 9000 m altitude. During the following upper troposphere travel there were no clouds in and above the plume parcel. The description of the model initialization is now described in more detail (section 4).

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3a. In part 1 of this paper we mentioned that the transport of the polluted air mass from East Asia to Europe most likely occurred in the following way: an analysis of satellite pictures suggests a lifting of the polluted air mass in a cyclone over the central East Asia coast region on 25 April 2006, which moved further to the ocean south east from Japan on 26-27 April. Convection in the cold air over China on 25 April is less probable and could also not explain the Japanese source contribution. The most probable scenario therefore is the lifting in the warm conveyor belt over China on 25-26 April and later also over Japan. Therefore, at the beginning of the simulation the air parcel under consideration was lifted to 8 km (≈335 hPa). The transit time of the air parcel from East Asia to Europe was about 8.5 days. Further analyses of satellite cloud top pressures showed that the air parcel under consideration traveled always with exception of two very short periods above clouds after lifting to 9 km (Figures 6 and 7 and section 3). Therefore no cloud related effects were taken into account for the model runs. But increased OH production due to underlying clouds (sensitivity study).

3b. Our measurements were part of INTEX-B (section 2).

3c. The initial particle concentrations and mode parameters base on measurements by de Reus et al. 2001 and Raes at al. 1997. The paper are cited in the new paper version (section 4, paragraph 2 and 3).

4. See discussion of the new Figure 7 (section 3, paragraph 4 ff.).

5. The discussion of particle activation has been changed in response to the referees comment (section 8).

6. Grid lines are now included (Figure 8 and figures in the supplementary material). The corresponding discussion of particle growth has been clarified (section 5 and Figures 9 and 10).

7. The description of the sensitivity studies has been changed (section 5, paragraph 5). The result of the AEROFOR model simulation (e.g. the particularly strong influence

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of initial SO2 and dilution) has now been clearly pointed out.

8. This part of the discussion of the AEROFOR model simulations has been completely revised.

9. The whole text has now been modified a lot, so also these passages.

10. Now, we have clearly pointed out that RHW=100% was never reached in the plume parcel during the simulation period (26 April-3 May). We have also included forward-simulations (starting on 3 May 12.00 UTC, the day of our measurements) to the supplementary material indicating that the plume parcel traveled at high altitudes for another 8 days (Supplementary material). Only hereafter, it descended to about 2000 m altitude over the West Pacific. Only then, upon an eventually occurring moderate updraft, aged particles may have experienced activation. Additional effects of plume sulfuric acid have been included in the revised paper draft (sections 6 and 7). These include visibility degradation by sulfuric acid aerosols on 1 May when the plume parcel experienced a moderate ascend and when RHW increased to 58% and substantial hygroscopic particle growth occurred. These additional aspects also include soot particle coating by sulfuric acid and its effect on light absorption.

Technical points:

1. All technical comments are applied.

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