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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Perturbation of the European free troposphere aerosol by North American forest fire plumes during the ICARTT-ITOP Experiment in summer 2004" *by* A. Petzold et al.

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Response to Reviewer #1

Reviewer #1 raises various specific questions. Those questions concerning a more clear description in the text will be considered in the paper revision process. They are not discussed in detail in this reply. The questions of more general relevance will be discussed in the following.

(1) Plume location and characterisation

Figure 1 simply gives an overview over the plume encounters so that the reader gets an

idea where the plumes were observed. It is not intended to give a more precise location of the plume encounters inFig.1. This information will be added to Table 1. FLEXPART backward analyses are used to estimate the contribution of smoke aerosols to the observed plume. We agree that the used arguments should be softened. Fig. 3 gives an overview map of the plume event based on FLEXPART CO, using a constant ratio for calculating BC columnar loads. Particularly, it shows the part of the plume which was probed by the Falcon. Fig. 3 just highlights the fact that the Falcon was not probing the core of the plume. We agree that Fig. 3 may also be shown as a FLEXPART CO plot. However, we discuss smoke plume events and give good arguments below why we think that an emission ratio of BC to CO is applicable. So a horizontal plume map given in BC columnar load seems appropriate to us. The information on the FLEXPART parameters requested by the reviewer will be added to the revised manuscript.

(2) Particle size distributions

Size distribution parameters are summarised in Table 6. Values given here show that indeed count median diameters of the accumulation mode (Mode 2 in Table 6) are increasing with increasing plume age. At least data for plumes of three different ages are available, see Table 6. They are plotted in Figure 11 together with data taken from Dentener et al. (2006). However, three data points do not allow for a plot of size distribution vs. plume age. The statement of narrowing particle size distributions and increasing CMD with increasing plume age is drawn from the data taken from Dentener et al. (2006) and our data. Dentener et al. report a plot similar to our Fig. 11 numerical data were reported to us by private communication. Part of the data shown in Fig.11 are listed also in Table 6, labelled as Dentener et al.(2006). Our observations are supported by a very recent paper by Müller et al. (2007). They demonstrate that particle growth levels off after approximately ten days of transport time. This in turn means that our observations are still within the particle growth time within a smoke plume. The comparison of our data with the results from Müller et al. will be discussed intensively in the paper revision for ACP.

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(3) Determination of FT background values

The entire section 3.2 will be rewritten. The suggestions of reviewer #1 will be considered carefully.

(4) Particle chemical composition

During this experiment, chemical composition was not measured on board of the Falcon. Some conclusions are drawn based on the calculation of PM2.5 from size distribution data and from the conversion of aerosol absorption into black carbon. The ambiguity of the conversion of absorption to black carbon mass is reflected in the use of apparent BC, following Andreae and Gelencser (2006). However, if we want to draw conclusions from our smoke plume observations on the export of black carbon mass from fire regions in North America to Europe, we have to convert the measured absorption to black carbon mass. The proposed conversion offers one approach with an estimated uncertainty of the order of 20%. Sticking to absorption coefficient data would not permit a determination of the export efficiency. Section 3.4 discussed possible effects of increased density and increased absorption efficiency. The representation in Fig. 7 will be considered. Conclusions concerning chemical composition are based on various assumptions which need better clarification. PM2.5 was inferred from size distributions only will all limitations of this approach. However, there is no other way of determining PM2.5 values from airborne measurements. The lack of alternatives may justify the use of this method. The uncertainty in the export efficiency also requires a more detailed discussion which will be part of the paper revision. Nevertheless, the discussion in Section 10 already focuses on the values of $>$ 70% for the bulk of the data. The export efficiency is related exclusively to the ratio of BC to CO. The ratio of BC to PM 2.5 is not considered because of its larger uncertainty.

References

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