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Interactive comment on "A global emission inventory of carbonaceous aerosol from historic records of fossil fuel and biofuel consumption for the period 1860–1997" *by* C. Junker and C. Liousse

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Shortly after the publication of this paper (Junker and Liousse, 2006) on historical emission inventories of carbonaceous particles in ACP Discussions, our results (Jenk et al., 2006) of past anthropogenic and biogenic sources of OC and EC from radiocarbon (14C) measurements in an Alpine ice core were available in ACPD as well. It is obvious that the comparison of both datasets for their overlapping periods (1860-1940) may gain knowledge for the following reasons: the reliability of both datasets would be strengthened in case of general agreement, episodes of missing values for one dataset

could be substituted by the other, and local vs. global impacts may be addressed.

We compared total global BC and OC inventory estimations shown in Table 3 by Junker and Liousse (2006), which are given in Mt from fossil-fuel usage and as percentage of biofuel related to fossil-fuel contributions, with our (Jenk et al., 2006) biogenic/anthropogenic contributions to OC and EC at the Fiescherhorn Glacier presented in Figure 3 and corresponding concentrations of OC and EC from biogenic and fossil sources deduced from Figure 5, which are given as μg/kg water equivalent of the ice.

With some reservations, both datasets are consistent for the overlapping period 1860-1940:

1. The general trend of increasing emissions of all components (fossil EC, biofuel EC, fossil OC, and biofuel/biogenic OC) from the middle of the 19th to the middle of the 20th century is reflected by both approaches.

2. Correlations between modeled inventories and measured concentration in the ice are very good (r2 $>$ 0.95) for all components based on the comparison of the three suitable episodes mentioned in point 9.

3. These correlations result in the following "deposition factors" representing the concentration signal (in μg/kg) for the carbonaceous aerosol related to the global emission inventory (in Mt): 20 μg/kg = 1 Mt, 19 μg/kg = 1 Mt, 10 μg/kg = 1 Mt, and 18 μg/kg = 1 Mt for fossil EC, biofuel EC, fossil OC, and biofuel/biogenic OC, respectively.

4. In spite of the fact that both datasets represent different scales (global vs. mid-European, see point 6, these deposition factors are sensible: the value for both EC fractions are similar, the value for fossil OC is a factor of 2 lower than for EC as a result of the losses of water-soluble OC (WSOC) from the ice core during analysis (see point 8), and the value for biofuel/biogenic OC is a factor of 1.8 higher than for fossil OC indicating the global importance of biogenic OC, which was not considered in the model at all but partially in the ice core (see points 7 and 8).

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5. Contributions from insoluble biogenic OC, which was found in the ice core but unconsidered in the model, can roughly amount 1 Mt per year.

However, this comparison has its limitations:

6. The modeled inventory considers emissions on a global scale, whereas the Fiescherhorn glacier archived carbonaceous particles on a regional (mid-European) scale with possible local impacts.

7. The emission inventory allows only estimations for fossil-fuel and biofuel consumption, but neither for primary nor for secondary biogenic OC formation. Therefore, ambient total OC inventories are underestimated by the model.

8. Carbonaceous particles were extracted by filtration of the melted ice. Consequently WSOC could not be analyzed. Insoluble biogenic OC, on the other hand, was deposited on the glacier and filtered during ice preparation, thus they entered isotopic analysis.

9. Both datasets contain values, which are unsuitable for the comparison. Carbonaceous particles from the ice core seem to be heavily influenced by local emissions from railroad constructions for 1900. The decreased consumption of fossil fuels during the world economic crisis in the 1920s seems to be much more pronounced in the ice core, representing local and mid-European emissions, than on the global scale as shown by the inventory estimation. Consequently, the comparison is conducted on these episodes: 1860, 1880, and 1937.

10. Large differences arise between model and measurement results regarding the relative fossil and biogenic contributions in 1860, especially for OC. Whereas inventory estimation still suggest fossil sources to be more important for OC emissions, radiocarbon determinations reveal that $>$90% of OC originates from biogenic sources or biofuel burning. This underlines that biogenic OC is relevant for the total carbonaceous particle burden during beginning industrialization and even today (Szidat et al., 2004).

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In conclusion, results from apportionment of past sources of carbonaceous particles by radiocarbon measurement support the estimations from inventory modeling. Both studies complement each other by extending the covered time scale. Besides that, the results from the emission inventory enable for our study a conversion from carbonaceous particle concentrations in ice to the more common unit of emission mass. On the other hand, our first direct measurement from an ice archive provides the opportunity to modelers to verify and adjust their estimations. A comparison of the ice core data with the mid-European emission inventory with a higher time resolution than 20 years would improve preliminary results shown here and we'd welcome the submission of these values.

This comment is submitted to the discussion forum of ACP for both papers, e.g. Jenk et al. (2006) and Junker and Liousse (2006), in nearly identical form.

Jenk, T. M., Szidat, S., Schwikowski, M., Gäggeler, H. W., Brütsch, S., Wacker, L., Synal, H.-A., and Saurer, M.: Radiocarbon analysis in an Alpine ice core: record of anthropogenic and biogenic contributions to carbonaceous aerosols in the past (1650-1940), Atmos. Chem. Phys. Discuss., 6, 5905-5931, 2006.

Junker, C., and Liousse, C.: A global emission inventory of carbonaceous aerosol from historic records of fossil fuel and biofuel consumption for the period 1860-1997, Atmos. Chem. Phys. Discuss., 6, 4897-4927, 2006.

Szidat, S., Jenk, T.M., Gäggeler, H.W., Synal, H.-A., Fisseha, R., Baltensperger, U., Kalberer, M., Samburova, V., Reimann, S., Kasper-Giebl, A., and Hajdas, I.: Radiocarbon (14C)-deduced biogenic and anthropogenic contributions to organic carbon (OC) of urban aerosols from Zürich, Switzerland, Atmos. Environ., 38, 4035-4044, 2004.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 4897, 2006.