Atmos. Chem. Phys. Discuss., 10, C1484–C1486, 2010
www.atmos-chem-phys-discuss.net/10/C1484/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Direct radiative effect of aerosols emitted by transport: from road, shipping and aviation" *by* Y. Balkanski et al.

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Received and published: 12 April 2010

We would like to thank the reviewer 2 for his useful comments and for the corrections that were suggested.

1. Table 1. Compare the AOD from traffic emissions to the total anthropogenic AOD as for instance reported in Schulz et al We have added this comparison to Table 1.

2. Please, add to table 1 the atmospheric residence time of the aerosol components. DONE.

3. P 1667-1670: Please, describe the radiation schemes in a way, which makes clearer what the differences are. E.g. the Reading radiation code follows the two-stream delta-Eddington approximation; what about the INCA code? For the radiative code coupled

to INCA the same two-stream approximation called delta Eddington is used to treat the phase function following Joseph et al. (1976). We have reorganized these lines to have the similar descriptions for the three radiative codes used in the paper.

4. According to the figure caption, Figure 4 displays the radiative forcing separately for each of the chemical aerosol components assuming internal mixture of BC, OC, SO4 and water. Please, explain the method to separate the forcings. The assumptions about the mixture affect the hygroscopicity and the radiative forcing. Is it really meaningful to quantify a fictional forcing of the chemical components, which add very likely in a non-linear way? The reviewer is right. We cannot treat the hygroscopicity in the same way for an internal and an external mixture. When aerosol components (BC, OC and SO4) are considered separately, the wet diameter of the aerosol is the same one as in the case of the internally mixed aerosol. We then determine the optical properties of the individual components from a look-up table which accounts for the ambient relative humidity in the model gridbox. We have modified the text to explain this treatment of the aerosol optical properties.

5. P 1672, ln 1-4: "The much higher value obtained in the case of the UiO model can mainly be explained by the higher burden". The normalized radiative forcing of aviation as calculated by the UiO model is higher by a factor of two compared to the other models. This indicates also differences in the assumptions about hygroscopicity and/or optical properties. Why are the normalized forcings between the models and the emitters that different? The normalized radiative forcings are presented in Table 3 for all three models. For road and ships they differ by less than 20%. The BC distribution from aviation is present at higher altitudes than for the emissions from roads and shipping. We therefore expect that the normalized radiative forcing would be higher. This is what the UiO and LSCE models are showing. The load of BC from aviation is about 0.01% of the total anthropogenic as can be seen from the new Table 1. To investigate further the difference of a factor of two in normalized radiative forcing, we would need to have more precision on the radiative forcing itself which is minute (only a few hundredth of

mW m-2). One way would be to scale the emissions from aviations be a factor of 100 or 1000, this would then allow to better compare these forcings. This is beyond the scope of the paper.

6. Chapter 3.2: Two factors contribute to the negative forcing of ship emissions, the higher amount of SO2 emissions compared to road traffic emissions and the low surface albedo over sea. Is it possible to separate these effects? This is a very good suggestion. The way I would address it would require an additional simulation where instead of emitting ship aerosol and aerosol precursors over the ocean, the same amount would be emitted with the same latitudinal distribution but over continental areas with a higher albedo than oceanic surfaces. I plan for such simulation in the near future and if the reviewer wants to share the results I would be happy to do so with him/her.

7. Traffic accounts for more than 10% of all greenhouse gas emissions. It would be very instructive to contrast the greenhouse gas effect of traffic emissions with the aerosol effects. We now include this comparison.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 1659, 2010.