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Comment

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

Y. Balkanski et al.

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We would like to thank the reviewer 3 for his useful comments and for the corrections that were suggested.

The current study is compared with one other that has considered transport subsectors, Fuglestad et al. (2008), and finds the new radiative forcings to be much larger than the previous results. However more effort could be made to explain the difference. It seems to occur mostly in the road subsector. Please explain whether the difference is due to emissions, burden (lifetime), or optics/radiative forcing. Note however that there is a recent publication by Unger et al. PNAS (2010) that includes these subsectors as well. How do results here compare with that study? An older study from that group also estimated total transport sector forcing by aerosol species (Koch et al., JGR 2007), so

C1487

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Interactive Discussion

Discussion Paper



the net aerosol transport-sector direct forcing could be compared. This publication had not appeared at the time of submission of our manuscript, we now compare our results to those of Unger et al (2010) in Table 4

Line 85. Is the Fuglestvedt estimate direct effect only? Then here you should change to: “are much more negative than the direct forcing estimated by Fuglestvedt et al. [2008]” DONE.

In the Introduction, which study corresponds to the $+3\text{mWm}^{-2}$ mentioned in the Abstract? Presumably it is Fuglestvedt again, however this should be clarified, probably in line 85. The estimate of $+3 \pm 11 \text{ mWm}^{-2}$ comes from the work of Fuglestvedt et al., 2008 as is explained in Table 1. We have now make a clear reference to this estimate and put it in its context.

Lines 93-94 Here please add some clarification of what “the three models” are: “This paper is organized as follows: section 2 gives a description of the emission inventories, the aerosol parameterisations and of the radiation codes used by each of the three models.” DONE.

Lines from 133: The Novakov and Bond discussion probably does not belong in the road traffic discussion and certainly not with the Kohler study description. They seem to pertain to fossil fuel more broadly. We deleted these lines.

Lines 144-146: Clarify in the text: Are the loads total species or BC? We changed ‘black carbon’ to ‘load of black carbon’ in order to avoid any confusion.

Lines 155-156: You compare fuel consumption in the inventories, how do emissions for the species compare? Not all authors report emissions for BC, OC and SO₂, this information is needed for such comparison. Instead, several authors estimate emissions of these species based upon fuel consumption, and apply emission factors to their inventories. From the three references we cite: Corbett and Kohler, 2003; Eyring et al., 2005 and Endresen et al., 2007. Only Eyring et al., 2005 give emission numbers for all three

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Discussion Paper



aerosols or aerosol precursor. We hence refer to the comparison in fuel consumption to express that the differences in aerosol or aerosol precursor emissions scales with fuel consumption if one assumes the same emission factor for these species.

Section 2.3 How do the IEA-based emissions compare with Hendricks et al? We infer a total global emission of BC from aircrafts of 5.3 GgC yr⁻¹ for the fleet in 2000. In comparison, Hendricks et al. established a total global emission of BC from aircrafts of 4.7 GgC yr⁻¹ for the fleet of 1992. This comparison was added to the text.

Lines 225-227 are out of place in this paragraph. Recommend moving them to the previous paragraph. DONE.

Section 2.4 Again there should be some brief introductory mention of the models and radiation schemes that are being used before the descriptions. This is now done

Line 270. Please end this section with a brief summary of the comparison of the two radiation treatments.

Line 284. Please include the conversion time for BC. We have now included that the conversion time is 1.1 day.

Line 295. What are the assumed emitted sizes for BC? Perhaps a different size assumption would allow consistency among density, refractive index and absorption. In this paper a lognormal size distribution with geometric radius of 0.0118 μm and standard deviation of 2.0 was assumed for emitted BC particles. A test was done with a geometric radius of 0.04 μm and standard deviation of 1.5, the discussion of how it improves consistency can be found page 1384 in Myhre et al. (2009).

Myhre, G., Berglen, T. F., Johnsrud, M., Hoyle, C. R., Berntsen, T. K. et al.: Modelled radiative forcing of the direct aerosol effect with multi-observation evaluation, *Atmos. Chem. Phys.*, 9(4), 1365-1392, 2009.

Line 353 Fix this sentence. Done.

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Line 409 Clarify, respective to what? Done, we were referring to the three models.

Line 417 Would the narrower range be due to a single emission inventory? The reviewer is correct and we added a sentence to point this out.

Lines 456, 458, property rather than properties Done.

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

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C1490

