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Interactive comment on “Large methane releases

lead to strong aerosol forcing and reduced cloudiness” by T. Kurtén et al.

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We thank the referee for his/her work and constructive comments.

Answers to general comments:

Since the lifetime of methane is quite long (around 10 years in the reference scenario, more in the 10x and 100x scenarios) compared to the timescales for mixing in the troposphere (weeks to months for mixing across one hemisphere, and at most a year or two for mixing across the equator), the global radiative forcing will not change significantly depending on the location of the emission sources. From the point of view of this study, simply multiplying the CH_4 concentration everywhere by the same number

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is thus sufficient. Very large methane emissions in e.g. permafrost areas may naturally have large local effects (e.g. due to extreme oxidant depletion and the ensuing effects on air chemistry and cloud formation), and these could be an interesting subject for further study in another paper.

Answers to detailed comments:

1)The effect of using future emission scenarios is difficult to assess, or to answer briefly. As SO_2 emissions are expected to decrease in the future, the effects of oxidant changes on CDNC might be somewhat smaller than when using present-day emissions. In a study in preparation (Makkonen et al., 2011), a 90 percent decrease in sulfur emissions would decrease average CDNC from roughly 220 to 170 cm^{-3} . However, the effects will depends strongly on how much, and in what locations, sulfur emissions are reduced.

2)The climatologies are based on the years 1956-2000 in ECHAM and year 2005 in GLOMAP.

3)Yes, the aerosol forcing refers to the indirect forcing (aerosol indirect effect) only. This will be clarified in the revised manuscript.

4)The 1D model will be mentioned in the introduction of the revised manuscript, as suggested.

5) The unclear sentence will be revised to: “The forcing was evaluated as the difference between calculations for (1) the scenarios with enhanced methane (10x and 100x CH_4) and (2) the reference scenario. In the reference scenario, O_3 concentrations were kept at their present-day values. In the 10x and 100x CH_4 scenarios, the O_3 concentration in each grid cell (x,y,z) was multiplied by the annual mean fractional change in the O_3 concentration predicted by the TOMCAT model for the location, while everything else was kept unchanged.”

6)Subscripts “ CH_4 ” will be added to the “tau” symbols as suggested.

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7) The forcing values from Schmidt and Shindell 2003 and Shindell et al 2009 will be given in the text, as suggested.

8) The figures will be revised to have the same color scale.

New references given here: Makkonen, R., Asmi, A., Kerminen, V.-M., Boy, M., Arneth, A., Hari, P. and Kulmala, M. Air pollution control and decreasing new particle formation lead to strong climate warming, manuscript submitted, 2011.

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