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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Large methane releases lead to strong aerosol forcing and reduced cloudiness" *by* T. Kurtén et al.

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Review of "Large methane releases lead to strong aerosol forcing and reduced cloudiness" by Kurtén et al.

This paper explores the response of aerosols and clouds (through changes in aerosols) due to large releases of methane. The main finding is that changes in cloud reflectivity and lifetime in response to the methane increase lead to an additional warming forcing that is on the same order of magnitude as the greenhouse forcing of the methane. This is because the reduction OH concentrations due to the additional methane reduces the amount of aerosol nucleation and growth of ultrafine particles to CCN sizes.

Although predictions of cloud forcings due to changes in aerosols are highly uncertain, I feel the authors do a good job of discussing most of the uncertainties and not overstating their findings. The paper is certainly of interest to the ACP readership and should be published once a few minor comments have been addressed.

General comments

1. It would be interesting to see the variability in the cloud forcing predictions to the methane increase changes due to uncertainties in SOA, nucleation etc.. This doesn't need to be in this paper, but it would be useful in the future.

2. Was there any notable change in the direct forcing? You discuss the moving of aerosol mass from Aitken mode to the accumulation mode (where aerosol forcing per unit mass is more efficient). There could be a small cooling associated with this. I doubt it would cancel much of the indirect forcing, but it might be worth exploring or at least discussing.

Specific comments

Page 9061, line 24: What binary nucleation scheme is used?

Page 9061, line 27: Can you give more details about SOA. What are the annual SOA production rates in each model? Are the products treated as non-volatile and condensed similarly to sulfate? You mention later oxidation via O3 vs OH, are there differences in the SOA yield or other properties based on the oxidant? Since SOA is important for growing ultrafine particles to CCN sizes, these details affect your results and thus should be stated.

Page 9066, line 15: "indicates" should be "indicate".

Page 9066, line 25: Aqueous oxidation of SO2 by H2O2 (rather than O3) is the dominant pathway at low cloud pHs. How is H2O2 affected by the methane release and what effect does it have on the rates of cloud chemistry?

Page 9067, line 2: SOA oxidation via O3 and OH. Does SOA in your model formed by OH have different properties (yield, volatility, CCN activity etc.) than SOA formed by O3? If not, please say that its assumed that OH and O3 creates the same SOA.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 9057, 2011.