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Atmospheric Chemistry and Physics Discussions

Interactive comment on "

Air pollution control and decreasing new particle formation lead to strong climate warming" *by* R. Makkonen et al.

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Review of "Air pollution control and decrease new particle formation lead to strong climate warming" by R. Makkonen et al.

This paper looks at how aerosol number, cloud condensation nuclei and cloud droplet number concentrations have changes and will change to due anthropogenic pollution and changing climate. The authors use the ECHAM-HAM GCM with online aerosol

microphysics to address these questions. Simulations were performed for 1750, 2000 and 2100. Particular focus is paid to the role of nucleation in maintaining these number concentrations, and simulation are ran for each time period with an without nucleation. The main conclusion of the paper is that there is a significant reduction of the cumulative cooling effect of aerosols between 2000 and 2100.

The paper is well-written and is certainly of interest to the ACP readership. I recommend it be published in ACP once several minor issues are addressed.

- P25995 L7 and P25998 L11: What is your present-day source of SOA? Many global models are on the low end of SOA estimates (10-30 Tg yr-1), while the actual amount may be much more (∼100 Tg yr-1) (Spracklen, D. V., Jimenez, J. L., Carslaw, K. S., Worsnop, D. R., Evans, M. J., Mann, G. W., Zhang, Q., Canagaratna, M. R., Allan, J., Coe, H., McFiggans, G., Rap, A., and Forster, P.: Aerosol mass spectrometer constraint on the global secondary organic aerosol budget, Atmos. Chem. Phys. Discuss., 11, 5699-5755, doi:10.5194/acpd-11-5699-2011, 2011.) The model may be much more sensitive to a 50% future increase in SOA if the present-day SOA was higher in the model. Please comment on this.

- The sensitivity to grid-scale nucleation is tested. What about the sensitivity to primary emissions or sub-grid (plume-scale nucleation)? For example, the ECHAM-HAM model assumes that all sulfuric acid formed in sub-grid anthropogenic SO2 plumes goes into forming large accumulation-mode particles (∼500 nm), which adds aerosol mass, but does little to change aerosol/CCN number concentrations. Nucleation can occur under some conditions in these plumes (Stevens, R. G., Pierce, J. R., Brock, C. A., Reed, M. K., Crawford, J. H., Holloway, J. S., Ryerson, T. B., Huey, L. G., and Nowak, J. B.: Nucleation and growth of sulfate aerosol in coal-fired power plant plumes: sensitivity to background aerosol and meteorology, Atmos. Chem. Phys. Discuss., 11, 24765-24812, doi:10.5194/acpd-11-24765-2011, 2011.). The global effect of plume-scale nucleation is still very uncertain as is the uncertainty in size and mass emission rates of other primary aerosols. Please comment on their potential importance to your

conclusions. I don't think your main conclusion of the strong reduction of cooling will change, however, the exact strength of the reduction may change (not obvious to me whether it would be stronger or weaker).

- P25993 L1: Can you give more detail on what RCPs are?

- P25994 L4: "THE aerosol module is coupled..."

- P25997 L12: There is a missing reference in the "()"

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 25991, 2011.