Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2015-1017-RC2, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Regional and global climate response to anthropogenic SO_2 emissions from China in three climate models" *by* M. Kasoar et al.

Anonymous Referee #2

Received and published: 7 March 2016

This manuscript is a very valuable contribution to the timely research topic of the local and remote climate impacts of regional anthropogenic aerosol emission changes. The authors have done a thorough job in analyzing the causes behind the different temperature responses to an identical aerosol emission perturbation in three climate models. The results provide important new knowledge to guide further research, as well as highlight the dangers of using single models or simple proxy measures (such as precursor emissions) to estimate climate impacts. I recommend the manuscript to be published after the following minor comments have been addressed.

1) Only temperature (and no other climate) responses are addressed, and this should be reflected in also in the title.

2) The descriptions of the three models in section 2.1 should be harmonized. It is especially important to provide the readers with a detailed enough summary of the aerosol and sulfur cycle treatments in each model – currently quite little is told about CESM1 and GISS-E2 aerosol/sulphur. The treatment of aerosol-cloud interactions within each model should also be briefly summarized.

3) P5L12: What does 'mass based' scheme mean in this context when modes and bins are also treated? P5: Is aerosol microphysics (condensation, coagulation, etc.) treated in CLASSIC?

4) P6L9-10: Does this mean that chemistry is solved online? The formulation here seems overly complicated.

5) P7L1: 'aerosol-coating of dust': Dust is an aerosol particle itself; do you mean (secondary) coating of dust?

6) How different are the control climates between the different models? Would you expect this to impact your results?

7) P7L27: Are the runs restarted from an earlier simulation? 50-year spin-up by itself doesn't seem sufficient for a coupled model.

8) P10: Both HadGEM and CESM1 simulate H2O2 and O3 oxidation pathways in the aqueous phase, so including both pathways cannot be an explanation to fast conversion to SO4 in HadGEM. This should be explicitly stated.

9) P16L6-8: Do you refer to sulphate aerosol above cloud top here? Simulated cloud distributions can have large impacts also in other ways, e.g. the background aerosol amount (clean/polluted) has large impacts on indirect effects, which start to saturate at high aerosol concentrations.

10) P16L20-21: Can you speculate which dynamical processes cause the increase in cloudiness when sulphate is removed? Based on 2nd indirect effect one would assume decreased cloudiness.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2015-1017, 2016.