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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Microphysical simulations of new particle formation in the upper troposphere and lower stratosphere" *by* J. M. English et al.

J. M. English et al.

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Dear Assigned Reviewer #2: Please see your comments below with our responses. We have attached the modified paper as a pdf supplement that includes your suggestions as well as the other two reviewers.

Assigned Reviewer #2, anonymous: The paper examines aerosol microphysics and particle formation in the upper troposphere and lower stratosphere. The CARMA microphysics model is coupled to the WACCM GCM and 3 different nucleation schemes are tested. The study concludes that coagulation is more important than nucleation for controlling aerosol number concentrations at sizes greater than 10 nm. Modelled

size distributions and number concentrations are compared against observations. It is suggested that Van der Waals forces are needed in the coagulation scheme to best match the observations. The paper is within scope of ACP. The paper is well written and presents results that will be of interest to the community. I recommend publication in ACP after the following minor comments have been addressed.

P12445, Line 13. Do you include oceanic DMS emissions (P12450, L23 suggests that you do not) or volcanic S emissions? In particular volcanic S emissions could have a big impact on aerosol in the UT/LS. If volcanic S emissions are not included this at least needs some discussion of how this will likely impact your results.

Authors' Response: No, we don't. DMS emissions are about 20% of SO2 emissions, so the contributions should be relatively minor. Also, our comparisons to observations occur in time periods of relative volcanic quiescence ($\sim$1995 to 2005), so the contributions from SO2 from volcanoes should be relatively minor. Nevertheless, it is true that they will have a contribution, so we've added at line 110-112: "The model does not include emissions of dimethylsulfide or volcanic SO2, which are large natural sources of sulfur to the UTLS, but minor contributions to total UTLS aerosol. We compare with data from a period with relatively little volcanic activity."

P12453, L21. Underprediction of aerosol surface area and volume will mean that your model will have lower aerosol condensation sink than in reality. How will this impact your results? What are the likely reasons for this underprediction? I guess that some possibilities are missing S sources, lack of organics and lack of carbonaceous aerosol sources.

Authors' Response: We would agree with the above statements, except that we overpredict aerosol mass vs observations (Fig 6c); therefore we have written at line 335: "The comparisons are made with coordinates of CO and N2O, respectively, rather than geographic location, so this discrepancy may be due to differences between modeled and observed geographic locations or errors in the observations."

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P12457, L22. Could the underprediction in the tropics be due to lack of natural aerosol emissions (volcanic S, biomass burning)? The order of magnitude underprediction of aerosol number in the tropics for particle sizes greater than 12 nm needs some additional discussion.

Authors' Response: We agree, and have added at line 451-455: "The discrepancy at larger sizes may be due to the model treating only sulfates and not other types of aerosols, such as organics or biomass burning products. The under-prediction could also be due to uncertainties in the emission of gaseous precursors, particularly dimethylsulfide or volcanic emissions, which we do not have in our model."

P12457, L24. DeïňĄne the conditions for STP and spell out acronym. Clarify whether all model and observations are reported at STP

Authors' Response: We have added at line 449: "...Standard Temperature and Pressure (STP) (273 K, 1013.25 hPa)...". We have also added a note that Fig. 13 was corrected for STP. These were the only 2 comparisons at STP.

Thanks for helping us improve this paper.

Sincerely, Jason English, Brian Toon, Michael Mills, and Fangqun Yu

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/11/C6800/2011/acpd-11-C6800-2011-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 12441, 2011.