

## ***Interactive comment on “The contribution of plume-scale nucleation to global and regional aerosol and CCN concentrations: evaluation and sensitivity to emissions changes” by R. G. Stevens and J. R. Pierce***

**Anonymous Referee #2**

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The paper discusses the implementation of the Predicting Particles Produced in Power-Plant Plumes (P6) parameterisation, described previously by Stevens & Pierce in 2013, within the GEOS-Chem-TOMAS global model.

This is a valuable contribution in terms of recognising the importance of sub-grid scale processes in accurately determining quantities that are important on the global scale. However, the authors are aware that at this stage “the differences in annually averaged aerosol size distributions due to the treatment of sub-grid sulphate at the measurement

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sites examined here are too small to unambiguously establish P6 as providing better agreement with observations”.

The paper is well written, interesting and certainly within the scope of ACP; I would recommend publication, once the below (very minor and mainly technical) issues are addressed.

Specific / Minor Comments:

p 21476, line 5: “Currently. . . .”, I see what you mean but this sentence is confusing, I would suggest rewording.

p 21477, line 1 (and line 3): this is a slightly ambiguous way of describing the ranges, do you mean increased by between 23 and 53% (otherwise this could be misinterpreted as increased by 23% to become 53%; that wouldn't make sense here but this is a point that is applicable to all quoted ranges)

p 21477, line 2: there is a missing “the” between “over” and “global”

p 21477, line 17: I suggest replacing “uncertain inputs” with “parameters”

p 21477, line 27: what do you mean when you say “used before”? In a previous study of theirs, or others? Or the range you discussed earlier?

p 21480, line 10: either remove “it” or add “is” before “overwritten”

p 21481, lines 13 – 18: very long sentence, I'd consider splitting this up for readability – in any case, replace “with” with “which” on line 17

p 21481, lines 20 - 23: You might want to rephrase this slightly, unless I have misunderstood – if “the SAM-TOMAS model has been shown to predict well the number and size of aerosol formed in coal-fires power plant plumes” then why is P6 needed?

p 21482, lines 11 – 13: I think this is something you show in Stevens & Pierce (2013)? I'd cite that here unless you are drawing this conclusion from Section 4?

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p 21483, line 27: do you mean co-located, rather than correlated?

p 21484, line 3 – 16: add somewhere here the size of particle being produced at these new particle formation rates

p 21484, line 28: what do you mean by “actual SO<sub>2</sub> emissions”? maybe just remove “actual” from this sentence, or clarify that you mean the global total, in contrast to the decreasing emissions from power plants in the US

p 21486, line 28: correct the spelling of simulations

p 21488, line 10: you could add here that although these previous studies suggest the formation of anthropogenically controlled SOA, the mechanism for this is not known, i.e., it's not just that you didn't include it in P6

p 21496, line 24: should this be condensation sink?

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 21473, 2014.