

Interactive comment on “Sensitivity of global cloud condensation nuclei concentrations to primary sulfate emissions parameterizations” by G. Luo and F. Yu

Anonymous Referee #2

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This paper studies the impact of primary sulfate emissions (sub-grid gas-to-particle formation in SO₂ plumes) on simulated global cloud condensation nuclei (CCN) concentrations. The study presents a number of sensitivity studies varying the fraction and size distribution of primary sulfate and reports impacts on CCN and total particle number amongst other variables. Uncertainty in the fraction and size distribution of primary sulfate is known to be a substantial uncertainty in simulated CCN concentrations. As one of the most comprehensive studies of how this uncertainty impacts CCN it will be of interest to the community. I suggest that the paper should be published within ACP after the issues raised below have been dealt with.

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P27696 (abstract): Other studies have also treated the condensation of low-volatility SOA on nucleated particles (e.g., Spracklen et al., 2006, 2008; Pierce and Adams, 2009). See also P27699 L8.

P27696, line 20 Change “0.2” to “0.2%”.

P27696, Line 22-23. I think this line is misleading without clarification. It is difficult to ensure that you are comparing like-with-like studies (see comments below). For example, a reason for the lower sensitivity in earlier models simulations is that they only treated sulfate (Adams & Seinfeld, 2003) or sulfate and sea-salt (Spracklen et al., 2005b).

P27697, Line 22. I don't think this is accurate. At least Makkonen et al. (2009) did not make this assumption (see Stier et al. (2005) for a description of the assumed sizes).

P27698. L3-L21. The first two studies (Adams and Seinfeld, 2003; Spracklen et al., 2005b) did not include carbonaceous aerosol. It is therefore not too surprising that these 2 studies predict a much larger impact of primary sulfate on CCN (because the baseline CCN in these studies was comparatively low). The authors should state that this is the reason.

P27698, L21. It is not obvious which numbers are compared to give a factor 6. I think care has to be taken here to try and compare like-with-like studies. It would be expected that early studies that only included sulfate aerosol would calculate a much larger sensitivity to primary sulfate than later studies which included many other primary aerosol sources.

Spracklen et al., GRL, (2008) is incorrect in reference list.

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