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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling particle nucleation and growth over northern California during the 2010 CARES campaign" *by* A. Lupascu et al.

Anonymous Referee #3

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Summary:

In this manuscript, the authors present a modeling study using the WRF-Chem model v.3.5 to model the formation and subsequent growth of freshly nucleated particles observed during the CARES field campaign using various nucleation parameterizations. Notable model results include the observation that while nucleation and growth can account for up to 20 – 30% of CCN concentrations, the magnitude of the modeled CCN concentration is not very sensitive to the particular nucleation parameterization. Notable model developments include the extension of the aerosol microphysical model (MOSAIC) to include a nucleation mode at 1 nm and the use of budget diagnostic terms

to investigate the impact of nucleation/growth on various processes (sources/sinks) that impact the aerosol number concentration. This manuscript is recommended for publication after the authors respond to the following minor questions/comments.

Comments:

1. P. 19733, l. 7: Please include a citation to the work of (Ehn et al. 2014) in which the role of low volatility oxidized organic vapors in the condensational growth of nucleation mode aerosol in the ambient.

2. P. 19735, l. 10: Were there any measurements of SO2 at the ground sites or on-board the G1?

3. P. 19735, l. 26: Were any size distribution measurements made by the G1 FIMS (fast integrated mobility spectrometer) used in this study? To what extent do the FIMS measurements indicate the growth of nucleation model aerosol aloft?

4. P. 19736, l. 2: While a CPC does measure particle concentrations through optical techniques, the cut-sizes for the CPCs mentioned refer to the particle Kelvin diameter, not the optical diameter. Please revise.

5. P. 19737, l. 7: To what extent do these modeled initial/boundary conditions for the aerosol size distribution (specifically the aerosol surface area that controls aerosol scavenging) agree with their observed ground/aloft counterparts?

6. P. 19739, l. 25: Please revise ". Metzger et al" to ", Metzger et al".

7. P. 19741, l. 2 – 8: Please provide more detail regarding this "linear regression method" and why/how it was used to estimate growth times. Also, with a growth time estimate of 0.74 hours from 1 to 40 nm, does that indicate a growth rate of 52 nm/hr? Also, how do you account for the impact of time and size-dependent growth rate/scavenging in the Kerminen/Kulmala parameterization that itself assumes a constant growth rate?

8. P. 19744, l. 8 – 12: To what extent is the lack of nucleation model aerosol at the smallest size bins in the SMPS due to transport of freshly formed aerosol from aloft down to the ground level? If nucleation is happening aloft, that could contribute to the result that the modeled number concentrations using the explicit nucleation schemes tend to over-estimate the measured number concentrations.

9. P. 19747, l. 25 – 28: How does the simulated H2SO4 compare with the H2SO4 proxy (calculated from measured SO2)?

10. P. 19755, l. 8 – 11: How do the observed/simulated CCN number concentrations compare with the measurements made in the study of (Mei et al. 2013) in which CCN activity of organic aerosol at the T1 site was studied?

11. P. 19760, l. 21: Do the authors mean "39nm - 10μm" for the size range of the default 8 size mode in MOSAIC?

References:

Ehn, M., Thornton, J. A., Kleist, E., Sipilä, M., Junninen, H., Pullinen, I., Springer, M., Rubach, F., Tillmann, R., Lee, B. (2014). A large source of low-volatility secondary organic aerosol. Nature 506:476-479.

Mei, F., Setyan, A., Zhang, Q., Wang, J. (2013). CCN activity of organic aerosols observed downwind of urban emissions during CARES. Atmos. Chem. Phys. Discuss. 13:9355-9399.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 19729, 2015.