Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-529-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Nanoparticle Growth by Particle Phase Chemistry" *by* Michael J. Apsokardu and Murray V. Johnston

Anonymous Referee #1

Received and published: 22 September 2017

"Nanoparticle growth by particle phase chemistry," by Apsokardu and Johnston, describes a model in which ultrafine aerosol particle growth is represented by a combination of condensation and particle-phase reactions (here modeled as dimer formation). The ability to model the growth of nucleated particles to sizes that allow them to become cloud condensation nuclei is necessary in order to assess the potential impacts of new particle formation on cloud properties, and thus climate. Because of this, the subject of this manuscript is of value to the atmospheric chemistry community and appropriate to publish in ACP.

I guess my first reaction upon reading this paper is one of déjà vu. The authors devote no text to describing the rich history of modeling the growth of particles from a few nanometers to CCN-relevant sizes, but in fact there have been several papers devoted

Printer-friendly version

Discussion paper

to this. The one that is most similar to the current manuscript is a paper by Vesterinen et al., entitled "Effect of particle phase oligomer formation on aerosol growth" (https://doi.org/10.1016/j.atmosenv.2006.10.024). From what I can tell – and admittedly I didn't spend nearly as much time reading this paper as the authors should – the model described in that 2007 paper does an excellent job with the organics and particle-phase reactions, with the added benefits that the study by Vesterinen et al. (a) provides a sensitivity study of the effect of the dimer formation rate constant; (b) compares modeling results to chamber studies; (c) includes the rate of monomer formation and, I think, includes the possibility that SVOC may evaporate; and (d) provides a hypothesis for uptake that involves the formation of an organic liquid layer onto an ammonium sulfate seed. The main difference between the two studies is that the current one includes the uptake of ammonia and sulfuric acid, whereas the earlier one assumes an ammonium sulfate seed particle. Here is an opportunity for the authors to distinguish themselves from this earlier work, but in doing so they need to acknowledge the prior work and provide an explanation for why this builds upon existing models and how their results compare. There are likely other attempts at modeling growth to CCN size, but the reader would not get a sense that anything has been done in this area considering the scarcity of discussion of prior work by the authors.

In addition, the authors provide a fairly terse interpretation of the modeling results and no quantitative comparisons of their results to observations. In my view this is a major weakness of the manuscript. The system under study – ultrafine aerosol particle growth from terpene oxidation and on ammonium sulfate seed particles, is one of the most widely studied chemical systems, both in lab and in the field. The fact that no data are directly compared to modeling results is, in my view, a missed opportunity that does nothing to validate the assumptions that went into the development of the model.

In summary, this manuscript should acknowledge prior studies and discuss how their results both compare to and improve upon understanding of those earlier models. In

addition, some comparison of lab or field data seems like a reasonable thing to do for any new model presented to the community. At the very least, the authors could perform a calculation similar to that of Vesterinen et al. and turn off ammonia and sulfuric acid and study organic uptake and particle-phase reaction chemistry onto ammonium sulfate seed particles.

Minor points:

Title: Since the size range covered here is sub-100 nm diameters, then it would seem natural to use the accepted term “ultrafine aerosol particle” rather than “nanoparticle.”

The authors cite their own studies often exclusively when several other seminal studies have contributed significantly to developing current understanding. Examples include “Nanoparticle composition and growth rate are dominated by organic matter,” and the “growth rate of nanoparticles by sulfuric acid and base is predicted by condensational growth model,” both of which had a history of important breakthroughs prior to the work of Bzdek and Pennington (here are just a few):

Nanoparticle growth from sulfuric acid and ammonia: http://onlinelibrary.wiley.com/doi/10.1029/2005JD005935/abstract

Nanoparticle growth from sulfuric acid and organics: http://onlinelibrary.wiley.com/doi/10.1029/2005GL023827/pdf

Nanoparticle growth from organics: http://onlinelibrary.wiley.com/doi/10.1029/2007GL032523/full

---

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-529, 2017.

Printer-friendly version

Discussion paper