Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "New particle formation from sulfuric acid and ammonia: nucleation and growth model based on thermodynamics derived from CLOUD measurements for a wide range of conditions" *by* Andreas Kürten

Anonymous Referee #1

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This manuscript presents a new-ish model of nucleation and growth (modified from a previous model to allow for evaporation of the smallest acid-base clusters), and this model is used to estimate thermodynamic parameters of the small clusters by getting the model to match measurements of nucleation rates from CLOUD measurements. The manuscript is suited for ACP and is mostly ready for publication, but I have some comments that I would like to be addressed before final publication.

How important is the role of coagulation in these simulations? If I understand correctly, one of the motivations for having a model of the broad size distribution is to include co-

agulational losses of early clusters, but coagulation was not discussed beyond stating that it was part of the model at the end of the introduction.

L153-156: From context, I'm pretty sure you're talking about the sulfuric acid / DMA system here, but it be good to be explicit such that the readers know you aren't talking about the sulfuric acid / ammonia system. "For the reason, the sulfuric acid / dimethylamine system can be..."

L160: Is the upper diameter limit of 295 nm set because the particles in the CLOUD experiments did not grow larger than this? If not, what is the reason for this limit? In the atmosphere, particles larger than this size can contribute a significant amount of the condensation and coagulation sinks.

Section 2: Personally, I think about how nucleation impacts the size distribution and how the size distribution feeds back on nucleation. I have a basic qualitative understand about how dS and dH relate to evaporation rates, but not a complete understanding. I certainly expect that some readers will have thought about nucleation thermodynamics a lot and won't need to see any background; however, I doubt that I'll be alone in wanting to see a short section describing the mathematical relationship between the thermodynamic parameters and the evaporation rate. At a minimum please reference where we can find this discussion.

L408-411: So in the real atmosphere (without walls), the straight line is appropriate? Or I supposes it is then the coagulation sink to determine the non-linearity of the curve?

L443-450: Does it matter that the model is overpredicting when the overpredicted J1.7 values are 1E-4 cm-3 s-1 and slower? There rates are trivial. This may be worth noting, even though it's good to discuss that it is an overprediction.

Figure 6 and associated discussion: These are growth rates for which size of particle? Do the lines converge for larger particle sizes?

L464-465: Why couldn't a parameterization be made for growth rates? Overall, I'm

a bit confused to all of the discussions throughout about parameterizations not being able to do various things. Parameterizations can do anything you want so long as you have the data to make them.

L548: When mapping between concentrations and mixing ratios, what pressure (and temperature) as you assuming? For a given mixing ratio, the corresponding concentration is about 5x smaller in the tropical upper troposphere than in the boundary layer.

L553-554: Are the growth rates throughout the dry particle growth rates? RH can greatly impact the wet particle growth rates.

L640: Is this ratio of 4 representative of the mean error or the mean bias?

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