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Atmospheric Measurement Techniques Discussions

Interactive comment on "Captive Aerosol Growth and Evolution (CAGE) chamber system to investigate particle growth due to secondary aerosol formation" *by* Candice L. Sirmollo et al.

Anonymous Referee #1

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GENERAL COMMENTS

In this manuscript the authors describe the design and evaluation of a portable chamber they have constructed primarily for studying aerosol growth under controlled conditions in outdoor air. It is 1 m3 and consists of a metal frame and Teflon film chamber that is permeable to gases but not particles so that particle growth can be studied under ambient conditions. The chamber walls are transparent to solar radiation, so that the ambient air photochemistry can be reproduced, and the chamber is slowly rotated to reduce losses of particles to the walls. The performance of the chamber was evaluated in a Texas field study by comparing measurements of ambient and chamber

concentrations of various trace gases and VOCs with predictions of a box model, and in general the agreement is excellent. Particle growth rates were measured over a few months by periodically adding seed particles to the chamber and measuring changes size distributions with an SMPS. The results provide valuable new measurements of the magnitude of growth rates and their dependence on particle size, which can provide insight into the growth mechanism, and diurnal and seasonal variations.

Overall, this is a very impressive new apparatus for studying gas and aerosol chemistry and particle growth under authentic atmospheric conditions. It is a major advance in the field and has applications beyond those described here. The manuscript is very clearly written and includes all the details and evaluation measurements one can hope for. I think it should be published in AMT after the following minor comments have been addressed.

SPECIFIC COMMENTS

1. Lines 282-287: The agreement of the curves in Figures 7-9 is obviously very impressive, but do the authors have any idea why at a few times the ambient concentrations significantly exceed chamber concentrations?

2. Lines 316-318: Are the ammonium sulfate seed particles in the chamber dry or deliquesced? Deliquesced ammonium sulfate particles will generally have very low pH ($\sim$1 or so) due to evaporation of ammonia. If the particles are deliquesced do the authors have any idea what ambient ammonia concentrations were? The pH could be estimated using E-AIM, for example. The nature of the seed could have a significant impact on SOA formation and growth via aqueous phase chemistry and acid catalysis. The authors might discuss this issue and offer suggestions on the best seeds to use, depending on measurement goals.

3. Line 388: Can the authors describe what steps were taken to minimize wall charging?

4. Are particle wall losses due mostly to diffusion?

5. Line 417+: I suggest the authors provide some discussion of how gas-wall partitioning of VOC reaction products to the chamber walls can influence measurements of aerosol growth rates and products. It is now well established (e.g., Matsunaga and Ziemann, AST, 2010; Krechmer et al., EST, 2016) that this process has a significant impact on SOA formation and that equilibrium is reached in Teflon chambers on timescales of $\sim$10 min and probably less in this small chamber.

TECHNICAL COMMENTS

1. Line 23: Should be “membrane is”.

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