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# *Interactive comment on* "Effect of varying experimental conditions on the viscosity of $\alpha$-pinene derived secondary organic material" *by* J. W. Grayson et al.

**Anonymous Referee #1**

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This short paper describes a nice addition to the literature on the viscosity of a-pinene particles. It follows and extends the group's previously reported poke-and-flow technique. Several significant conclusions are reached that highlight the importance of relative humidity and SOA production conditions. The paper is well written, of appropriate length and easy to read. I recommend publication once the following comments and questions have been addressed satisfactorily.

Major comments The first line of the abstract is too strong. Aerosol viscosity is not currently used in predictions of the impact of SOA on climate, visibility and health. Potentially it could be in the future but it is not obvious what benefits it will bring. The laboratory conditions need to be related to atmospheric conditions. How does the range of SOA mass concentrations used compare to atmospheric concentrations? What does this suggest the viscosity of atmospheric a-pinene will be? A similar discussion should be provided for the O3 concentrations used. Another recent study, Hosny et al. 2015, investigated the differences between water soluble fractions and whole SOM samples. The results between the two studies should be contrasted. What is the effect of different particle sizes on the 'experimental flow time'? The particles studied were in the size range of the 50-70 microns, the corresponding changes in particle surface area and volume will be larger. Should the experimental flow time scale with diameter, surface area, or volume? Or is it size independent? If it is dependent on size has a correction been applied to the reported 'experimental flow time' to account for the different sized particles?

Minor comments

P32970 L16 – insert "many of" into position # in "Despite the importance of SOM particles, # their physical properties. . ."

P32972 L8 – understanding the effect of RH on viscosity. It's not obvious how the RH is affecting the viscosity. Is the water acting as a gas phase reactant? Maybe reacting with Criegee intermediates? Or is acting in the particle phase affecting the ageing of the particles? Previous work has shown that RH can have a significant effect on particle phase processing e.g. Gallimore et al. (2011). Here the water can act as both a reactant and phase modifier. A small discussion should be included. P32975 L24 - Fig 4 not Fig 3 P32976 L9 – how long were the particles re-equilibrated with the flow cell temperature after coming out of the freezer? Was the time sufficient to ensure that the particle was at equilibrium? P32976 L15 – a one point calibration for relative humidity seems risky? Provide more details. P32976 L21 – oligomerization – what would be the mechanism for this under a non-oxidising atmosphere? P32981 L20 – "are not inconsistent" change to "consistent" if it is.

References:

Gallimore, P. J., et al. "Importance of relative humidity in the oxidative ageing of organic aerosols: case study of the ozonolysis of maleic acid aerosol." Atmospheric Chemistry and Physics 11.23 (2011): 12181-12195.

Hosny, N. A., et al. "Direct imaging of changes in aerosol particle viscosity upon hydration and chemical aging." Chemical Science (2016).

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