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# ***Interactive comment on “Validation of the poke-flow technique combined with simulations of fluid flow for determining viscosities in samples with small volumes and high viscosities” by J. W. Grayson et al.***

## **Anonymous Referee #2**

Received and published: 22 March 2015

### General comments:

This paper describes a method for determining the viscosity of small amounts of materials aimed at studying the viscosity of secondary organic material (SOM) derived from the oxidation of volatile organic compounds. The properties of SOM in general and the viscosity in particular have become the topic of intense research recently. For example, viscosity influences such important processes such as gas-to-particle partitioning, heterogeneous chemistry and water uptake and cloud condensation nuclei or

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ice nuclei activation. The technique and, thus, the manuscript is in principle suitable for publication in *Atmos. Meas. Tech.*, because of the current research in the area of atmospheric aerosols described above, although I could also see the manuscript in a general physical chemistry or analytical chemistry journal.

Overall, the paper text and length, the figures and tables are all appropriate. However, given that a preliminary validation of the technique has been described already in a previous publication, the additional scientific information and the calibration procedure described in the current manuscript is somewhat limited. For example, the data in Fig.4 show that the error bars with the new technique are larger and the range of measured viscosity is smaller than previous techniques. I think the authors should present more data at higher viscosity for a better validation and a more convincing statement of the usefulness of the technique.

Major scientific comments:

(1) The viscosity range measured in this paper to show the suitability of the technique is  $10^3$ - $10^5$  Pa s, which I think is pretty limited, and the subsequent sentence stating 'we expect this approach to also be valid at higher viscosities' seems a bit too optimistic and not convincing to me. (P.881, L22-23 and P.888, L26-27) The investigated viscosity range of two orders of magnitude seems even smaller when the uncertainty in the individual measurements of the same magnitude is considered. It did not become clear to me, what limiting factors are responsible for this small viscosity range. At some point, it is stated that it is due to the lack of reference materials in the high viscosity range (p.881). It is not the uncertainty of the required parameters as given in tables 1 and 2, they are responsible for the error bars shown in Fig.4b, correct? The lower limit is due to the time resolution of the digital camera, but I guess this is not so important as other techniques also work in this area, e.g. the moving-bead technique developed by the same group. However, at the upper limit it appears to be the sticking of the viscous material to the needle, at least for the sucrose-water particles. I am not convinced that this will be much different for water-soluble SOM. What are the arguments for the

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expectation of the authors that it should not occur? If this were really the latter case, maybe a different needle material would be helpful. For example, a needle with a hydrophobic coating may be better suited for studies with hydrophilic materials such as sucrose-water; and an amphiphobic coating, i.e. a coating that is simultaneously hydrophobic and oleophobic, may be suitable for both hydrophilic mixtures and oils.

Minor and technical comments:

(2) P.879, L.27: remove comma after 'milligram scale'

(3) P.880, L.15-17: this sentence is somewhat confusing. Please rewrite, so that the seemingly contradicting threshold of  $10^8$  Pa s is removed.

(4) P.882, L.25: remove comma after 'sharp'

(5) P.884, L.7-13: I did not understand how particles with a diameter of 40-70 micrometer can be produced using a pipette. Please provide more details so that others can reproduce the procedure.

(6) P.885, L.22-26: Do I understand it correctly that the jagged and wavy geometry only appeared in the simulations, but NOT in the actual experiments? If yes, please state this more explicitly. Could this have to do with concentration gradients within the particles?

(7) P.889, L.4-7: Can you do sensitivity studies with different support materials with different surface properties? These materials may produce different contact angles, which may affect their slip length, so that maybe the corresponding uncertainty can be reduced (just an idea).

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