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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "Dual-wavelength light scattering for selective detection of volcanic ash particles" *by* Z. Jurányi et al.

**Z. Jurányi et al.**

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We would like to thank Referee #2 for taking the time to read and comment on our manuscript which helped us to improve it.

Specific Comments:

1. No mention is made of the instruments response to ice crystals. It would be useful to understand if the instrument will be able to discriminate between ice and ash as can be encountered in the atmosphere.

Answer: We refer here to our answer for Referee#1 on the 2nd part of general comment 2.



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2. The work is somewhat limited by the use of mie theory which assumes that the particles are spherical. Whilst this factors mentioned in line 26 some theoretical calculations showing that the discrimination will still work should be included.

Answer: We refer here to our answer for Referee#1 on the 1st part of general comment 2.

3. Despite the fact the lasers will be highly polarized no mention is made of the instruments polarization response. For example the laser diode used at 660nm could have a polarization ratio of 100 to 1. It is also likely that the 2750nm laser is also polarized again this is not mentioned in the text. This aspect is critical in defining the scattering cross sections used. Some calculations should be performed to demonstrate if this effect is important. At the scattering angles involved this effect could be as large as one or two orders of magnitude in measured signal. Ideally such calculations should be made using both a spherical mie theory model and a non-spherical model.

Answer:

The referee is right, some discussion has to be added about the incident light polarization. We do know that the 660 nm laser is highly polarized, and we do not have information on how much the IR laser is polarized. The angle of polarisation during the experiments were not controlled and this is the reason why we have chosen to do the theoretical calculations with assuming unpolarised light. This might seem incorrect, however for the particle size range in question the polarization of the incident light does not have a large influence. The figure below illustrates this where the R ratios for water and volcanic ash are calculated not only for incident unpolarized light but also for both parallel and orthogonal polarizations. Therefore, we think that it is justified to simplify the calculations to incident unpolarised light.

The following text was added to the manuscript:

“The choice of doing the calculations with unpolarised incident light might not be cor-



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rect since lasers often emit highly polarised light. However, for our selected size and wavelength ranges we found that the polarisation has only a limited influence on the R values, and this is the reason why the effect of the polarisation was not considered and investigated further."

4. Ideally the instrument should be calibrated this could be achieved by the use of spherical par-ticles of known refractive indices. The authors should consider using calibration glass beads for this purpose. This would allow the absolute detector responses to be derived as the Mie theory response is known.

Answer: we have not calibrated the instrument in the presented laboratory experiments which only aimed to test the new idea of dust particle differentiation. We plan to calibrate the next version of the instrument with monodisperce aerosol particles, however due to position-dependent incident laser intensity (Gaussian laser profile) this problem is not straight forward. A possible solution of this problem is nicely discussed in Beswick et al. (2014).

The text reads now: "The size dependence of the single particle scattering at the visible wavelength can be used for particle sizing. However, the incident laser power inhomogeneity (laser profile) is a problem. Applying a similar inversion algorithm as done for the BCP (Beswick et al., 2014) is a possibility to make particle sizing possible in the future."

5. It would be helpful to clarify if the APS size measurements of the water droplets were made with the same length and diameter of pipe that was used to transport the aerosol to the new instrument, the particle size distribution between these two measurements may be skewed if this is not the case.

Answer: yes, the same tubing was used to transport the water droplets to both instruments, and the same aerosol flow was used as well. Of course, we cannot exclude that inside the APS some additional evaporation happened which influenced the measured number size distribution. The following test was added to the manuscript:



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“In order to minimize evaporation artefacts during the water droplet number size distribution measurements sampling lines with equal particle residence times were used to deliver the droplets from the nebulizer to the instruments.”

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 8701, 2015.





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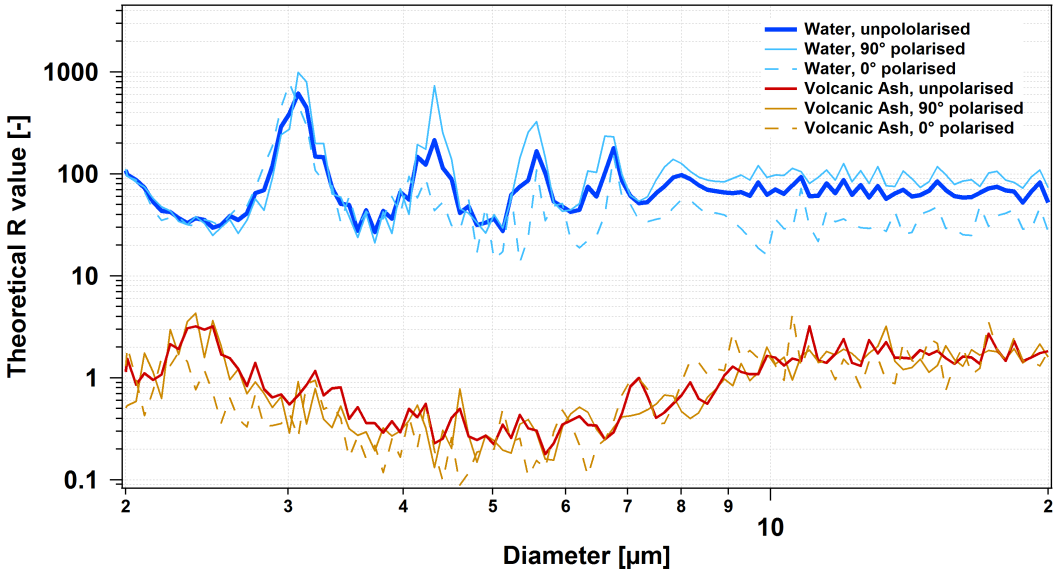


**Fig. 1.** The R values for water and volcanic ash as function of the particle diameter considering different incident light polarisations.



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