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Atmospheric Measurement Techniques
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Discussions

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

Anonymous Referee #1

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GENERAL REMARKS

The manuscript describes the prototype development and testing of a dual-wavelength backscatter instrument applicable to airborne measurements of aerosol particles and cloud elements. The instrument is theoretically and experimentally tested for its capabilities to separate mineral dust and volcanic ash from water droplets. The theoretical studies are limited to Mie theory and therefore to spherical particles. Experimental investigations include cement, test dust and volcanic ash particles and water droplets.

The design of the instrument described here is a straightforward development of existing instruments and technologies. There is a need for this kind of instruments in particular for the potential use as routine volcanic ash particle detectors to be deployed

aboard in-service aircraft. In that respect, the manuscript makes a significant contribution to the field. Before being acceptable for publication in AMT, two major topics should be discussed in depth.

The main concerns apply to the incomplete reference to former work and to the limitation of theoretical investigations to Mie theory, although all particles relevant for this instrument will be highly irregularly shaped.

1| Former work on instruments of that type, in particular by Beswick et al. (2014) on the Backscatter Cloud Probe (BCP) which is quite similar to presented design, and then by Rosen and Kjome (1991) and Groß et al. (2013) on the use of multi-wavelength information for classifying aerosol particles should be discussed adequately. In particular, the differences and similarities to the BCP instrument should be highlighted.

2| The theoretical evaluation of the instrument used Mie theory and thus assumed spherical particles only. However, all considered aerosol types (mineral dust, volcanic ash) are irregularly shaped. In addition, the theoretical evaluation is limited to water droplets whereas volcanic ash particles in the atmosphere may be embedded in cirrus clouds, but not water clouds. This topic is not discussed but may have a major influence on the determined capabilities of the instrument.

A first impression of expected effects may be gained form an intercomparison of the theoretically expected response ratio of the instrument to different aerosol types and the measured values shown in Fig. 6. Since the respective size distributions were recorded, this intercomparison should be straightforward.

Another aspect refers to the fact that in the case of irregularly-shaped particles, the angular distribution of scattered light depends not only on the particle geometry but also on the orientation of the particle with respect to the scattering geometry of the instrument. Since the instrument detects scattered light over a very narrow angular range, this issue is of high relevance and should be discussed in detail. See also the paragraph on page 8713, lines 10 – 17. Here, the application of the T-Matrix method

(Mishchenko, 1990) may be appropriate. Codes are available from Mishchenko's website.

3| Key references describing physical and optical properties of volcanic ash particles during the Eyjafjallajökull eruption should be referenced, in particular Schumann et al. (2011) and Turnbull et al. (2012) for size distributions, and Weinzierl et al. (2012) for optical properties and visibility.

SPECIFIC COMMENTS

1| The title seems incomplete, how about: "Dual-wavelength light scattering technique for selective detection of volcanic ash particles"?

2| Page 8715, line 12: This sentence seems incomplete, please check.

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