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Interactive Comment

Interactive comment on "Optical, microphysical, mass and geometrical properties of aged volcanic particles observed over Athens, Greece, during the Eyjafjallajökull eruption in April 2010 through synergy of Raman lidar and sunphotometer measurements" *by* P. Kokkalis et al.

Anonymous Referee #1

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General comment.

The paper presents an interesting study of the effect of the Eyjafjallajökul volcanic aerosol plume over Greece. In this work the authors retrieve different aerosol properties using both active and passive remote sensing. Particularly they approach the retrieval of the aerosol microphysical properties using a synergetic procedure that combines active (lidar) and passive (radiometer) remote sensing. The use of state of the art

Raman lidar also allows the retrieval of independent extinction and backscatter coefficient profiles. In this way lidar ratio profiles are also derived. The authors check their results, derived from experimental measurements and the use of retrieval procedures, against simulations performed using FLEXPART. They obtained interesting results with a good level of agreement: They also put in evidence the discrepancies that come from the uncertainties of the methodologies, but also from the particular features and constrains of them. In this sense, while FLEXPART only simulates the volcanic plume the real condition measurements include other effects like local aerosol sources. The paper is well written, the methodology is presented with appropriate references that complete the description offered in the paper. The different sources of information are analyzed and discussed leading to interesting results. This is a valuable contribution to the atmospheric science and particularly to the remote sounding of the atmosphere using lidar and a synergic combination of radiometer and lidar. Some particular comments that require some justification/correction are included bellow.

Particular comments.

In section 2 the authors present details on the instrumentation and methodology, particularly they discuss about the uncertainties in the retrieval of optical and microphysical properties. Nevertheless, along the text they present results with more significant figures than appropriate. Particularly, I disagree about the decimal figure in the lidar ratio values presented along the manuscript. If the authors assume an uncertainty of the order 5-10 %, that I consider really optimistic, it has no sense to express lidar ratios with a decimal figure.

In section 2.4 the authors mention typical values for lidar ratios in the fine and coarse fraction. They must include the wavelength for this spectral quantity. The title of section 2.5 is a little bit confusing. In this section the authors present the methodology used in the microphysical retrieval based on the use of optical properties derived from Raman lidar measurements. The title must reflect appropriately this aspect. Furthermore, the authors must add additional comments on the limitation of this technique concerning

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the retrieval of microphysical properties of coarse particles.

In section 3.1, the first paragraph must be clarified; the mixing of volcanic particles with desert dust particles was not a general situation for Europe during May as evidenced by Navas-Guzman et al. (2013). In their study over the Iberian Peninsula, these authors showed that the volcanic plume arriving to the Iberian Peninsula presented small contribution of volcanic ashes, that allowed for the retrieval of microphysical properties of the volcanic aerosol using optical properties based on Raman lidar profiles.

As a general comment I invite the authors to revise their presentation of quantitative results, particularly when they present an average value followed by an indication of uncertainty. In these cases the use of uncertainties with two significant figures is appropriate only in some circumstances (i.e: 1.57+-0.25) but it is inappropriate in other cases (i.e see page 5331, where 1.92+-0.90 must be 1.9+-0.9, or 1.11+-0.71 must be 1.1+-0.7).

In table 1, the number of decimal figures is not appropriate. I understand that the authors include for every layer the average and the standard deviation of the appropriate quantity. But considering their discussion on the error bars of the variables included in the methodology section it is a little confusing express Angström exponents with more than one decimal figure, Lidar ratios with any decimal figure or AOD more accurate than those corresponding to the whole vertical column.

I have the same concern in reference to the way the authors present their results on aerosol concentration in page 5333. Taking into account the uncertainties associated to the procdure used in the computation of this quantity it would be more appropriate to write 11+- 4 microgram/m3 and 8.8 +-0.7 microgram/m3, expressing the peak value as 52 microgram/m3.

In page 5337 the following statement must be reworded: “As discussed before, the increasing sphericity of the volcanic aerosols is probably linked to both mixing with water vapor and locally produced anthropogenic particles, especially in a city like Athens.” I suggest to change to: “As discussed before, the increasing sphericity of the volcanic aerosols is probably linked to mixing with locally produced anthropogenic particles and subsequent hygroscopic growth, especially in a city like Athens.”

In page 5337 correct the reference: Dubovik et al., 2006.

In page 5338 the authors mention the effective radius. Is this computed for one of the modes (fine or coarse) or for the whole range of radii used in the retrieval. What range of radii is considered in the retrieval?

References

Navas-Guzmán, F., D. Müller, J. A. Bravo-Aranda, J. L. Guerrero-Rascado, M. J. Granados-Muñoz, D. Pérez-Ramírez, F. J. Olmo, and L. Alados-Arboledas (2013), Eruption of the Eyjafjallajökull Volcano in spring 2010: Multiwavelength Raman lidar measurements of sulphate particles in the lower troposphere, J. Geophys. Res. Atmos., 118, doi:10.1002/jgrd.50116.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 5315, 2013.