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Interactive comment on "Development and Application of a Backscatter Lidar Forward Operator for Quantitative Validation of Aerosol Dispersion Models and Future Data Assimilation" *by* Armin Geisinger et al.

Anonymous Referee #1

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General comments:

The study introduces a lidar forward operator in order to simulate the expected lidar observations corresponding to output from a dispersion model such as COSMO-ART, allowing for more direct comparison between the model output and lidar observations from instruments such as CALIOP or automated ceilometer lidar systems. Rather than using a fixed lidar ratio, the new forward operator calculates the scattering properties of the particle mixture specified by the dispersion model. The COSMO-ART simulation of the 2010 Eyjafjallajökull eruption is used as a case study.

The computationally efficient method for calculating the aerosol scattering properties, backed up by sensitivity studies, and the flexibility of the resulting model make this work an important contribution. The writing style is very clear, but could be more succinct: some of the background information seems unnecessarily detailed and detracts from the focus of the study.

Specific comments:

Page 2, lines 1-24. This discussion of different dispersion models and different lidar configurations doesn't come up much later in the manuscript. Is it possible to tie the most relevant aspects more closely to the focus of the study, and omit the rest?

Page 3, lines 1-12. Does each of these lidar forward operators simulate CALIOP, a ground-based lidar network, or both?

Pages 4-11. The equations that are not new to this study should have sources cited; the better-known aspects of lidar physics can probably be described more briefly.

Page 8, lines 2-7. Likewise, the substitution of sums for integrals in the numerical computation is straightforward enough that I'm not sure we need the steps spelled out explicitly.

Page 10, line 11. For Fig. 1, can you overlay the track of the CALIPSO overpass you show in Fig. 3? It would be helpful to connect the overhead and profile views of the ash plume.

Page 18, lines 1-6. The "missing" ambient boundary-layer aerosol seems as if it would also make quantitative comparison very difficult.

Technical comments:

Page 1, line 20. By "aerosol cloud movements" do you mean the movement of aerosol and clouds, or of aerosol plumes?

Page 5, lines 3-5. This sentence is unclear.

Page 7, line 1. Should be "Mie scattering-related"

Page 10, line 10. "Spatial extent"

Page 17, line 1. "Predominantly"

Page 17, line 4. Should be "This may be important information"

Page 20, line 16. "A comparison of the volcanic ash signal"; "was too high"

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Discussion paper