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Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol classification using airborne High Spectral Resolution Lidar measurements – methodology and examples" *by* S. P. Burton et al.

Anonymous Referee #1

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General comments

This is an interesting paper were the authors report on the attempt to determine the origin of sources of atmospheric aerosols by means of airborne Lidar measurements at 532 nm and 1064 nm. The data used in their analysis stem from many field campaigns in various regions of North America which in principle provide a solid basis for such kind of investigation. They show a method to classify aerosol types by comparing the lidar derived parameters from these campaigns such as the extinction-to-backscatter ratio, the backscatter color ratio, the aerosol depolarization for two wavelengths, which

appear to be sensitive for the types of aerosols investigated. The strength in their analyses is certainly the fact that they use HSRL measurements at 532 nm which provide aerosol extinction, aerosol backscatter, lidar ratio and aerosol depolarisation without further assumptions at this particular wavelength. However, I assume that the interpretation of the conventional, non-HSRL measurements at 1064 nm in this context is more uncertain, since it is based on model assumptions. Therefore, a clear analysis on the suitability of the 1064 nm channels for this kind of aerosol classification is certainly mandatory.

Despite the authors mention the first HSRL measurement dated back to the years 1983/1992, the manuscript does not report on the state-of-the-art HSRL measurements. In the meantime new airborne HSRL instruments -other than the LaRC HSRL- with depol. capability at 532 and 1064 nm exist which have been applied in many studies for the measurement of dessert dust, continental aerosol transport, bio mass burning aerosol, etc. A brief discussion of these previous results should be included in this paper.

Further as a reader, I strongly miss a proof/validation of the results by in-situ measurements and/or transport model calculations to infer the origin of the measured air mass. Also the methodology used to establish the aerosol classification based on the lidar measurements using LaRC HSRL is not really transparent to the reader.

A few specific comments

Page 5635, line 28: the argumentation on the use of the two depol. channels for aerosol classification is not obvious and need a better justification. Is this true for all types of aerosols?

Page 5636, line 25: the description of the status of airborne HSRL is not in line with the state-of-the-art instruments

Page 5638, lines 2-13: It is not clear how depolarisation and backscatter coefficients are derived quantitatively at 1064 nm and how the model assumption impact on the aerosol classification for the different types of aerosol

Page 5640, lines 20-24: Why not show the FLPART simulations on order to better justify the source of the aerosols for this particular case.

Page 5641-5644: This subsection on the methodology needs considerable revision. For the reader it is not clear what algorithms already exist and how they work in the particular case. What is the justification of using just 8 aerosol types and what criteria are used to isolate "known aerosol types". The impact of mixing/transport, aging, and signal ambiguity need to be discussed in more detail. Despite a few obvious cases where the origin of the aerosols are more or less "visible" (smoke plumes, strong haze layers, etc.) I would expect that one need an appropriate transport model for such kind of classification.

Page 5647-5665: The authors do not report on adequate validation efforts which are required to prove their conclusions. They should also compare with results from recent airborne HSRL measurements during SAMUM I, II and EUCAARI campaigns.

Others . . .

List of references need to be updated

Many of the figures are too busy and axis labelling not readable

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