Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-1181-RC1, 2018


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Transport of Canadian forest fire smoke over the UK as observed by lidar" *by* Geraint Vaughan et al.

**Anonymous Referee #1**

Received and published: 16 February 2018

General: The paper presents interesting observations of Canadian fire smoke over UK and is appropriate for APC. It brings together different observations of ground-based and spaceborne lidars on smoke layers. However, the paper is a bit lengthy. There is a good chance to make it more compact (see my detailed comments) and thus more interesting for a broader aerosol science community. Minor revisions are required.

Details:

Abstract: How much is 'weak depolarization'? Please provide numbers .... <5%... ?

Introduction: The paper of .... Alados-Arboledas, L., D. Müller, J. L. Guerrero-Rascado, F. Navas-Guzmán, D. Pérez-Ramírez, and F. J. Olmo (2011), Optical and microphysical properties of fresh biomass burning aerosol retrieved by Raman lidar, and star-and



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Discussion paper

sun-photometry, Geophys. Res. Lett., 38, L01807, doi:10.1029/2010GL045999. . .. should be included in the references. . .

Wandinger (JGR, 2002) was probably one the first who analyzed Canadian smoke lidar data (measured in 1998), and Mattis (GRL 2003, JGR 2008) also from the Leipzig lidar group studied many smoke layers from North America, and Murayama (GRL, 2004) made Raman lidar observations in Siberian smoke. . .

2. Instrumentation: The description of the Capel Dewi Raman lidar is very long. This is a lidar application paper so that so many lidar instrumental details are not needed. It is sufficient to mention the measurement channels and the products you can derive.

The same is true for the Raymetrics lidar systems, too much technical information which is not needed.

3 Retrieval. . .

Basic lidar equations (2) and (3) are not needed!

Figure 4 is not needed. Figure 3 is fine, to give an example of basic profiles of lidar products. Figure 4 is not needed, but triggers the question: Why do you not use just modeled, ECMWF or GDAS, temperature and pressure profiles in the lidar data analysis. These profiles are usually more appropriate than radiosonde data because the model data consider all the available radiosonde information and are available at model grid points close to the lidar site and for the given lidar measurement period.

4 Results. . .

Figure 5 is ok.

Figure 6: It is sufficient to show the 23 May case only.

Figure 7: I would remove this figure! At least, I do not need it to understand the paper and to get the main message of the paper.

Figure 8: I would show Figure 8b only, and symbols should be larger and different (circles, squares, triangles. . .), please use more contrast rich colors, orange, blue, green, red.

Figure 9: I would show Figure 9b only. Again use large and different symbols and contrasting colors.

Figure 10b is sufficient, same comments regarding colors and symbols as above.

Concerning depolarization ratio at 355 nm, and the potential interpretation with respect to smoke, please check the Burton et al. paper (ACP 2015 paper, triple wavelength depol ratio ). They measured a Canadian smoke layer with 355 nm particle depol ratio of 21% whereas they found only 15% at 532 nm and less than 2% at 1064 nm.

Burton, S. P., Hair, J. W., Kahnert, M., Ferrare, R. A., Hostetler, C. A., Cook, A. L., Harper, D. B., Berkoff, T. A., Seaman, S. T., Collins, J. E., Fenn, M. A., and Rogers, R. R.: Observations of the spectral dependence of linear particle depolarization ratio of aerosols using NASA Langley airborne High Spectral Resolution Lidar, Atmos. Chem. Phys., 15, 13453-13473, https://doi.org/10.5194/acp-15-13453-2015, 2015.

5 Origin of aerosols

The discussion is very long, can be shortened easily. Please focus on the main messages.

Is Figure 12 needed? We have trajectories in Figure 13 and all the convincing spaceborne observations in Figs. 16, 17, 18, and 19!

Figure 14! To my opinion, the figure is not needed.

This is to my opinion a lidar paper, so I would skip Figure 15 and all the lengthy explanations of AI.

Figure 16 is nice. Please save space by a compact and optimized arrangement of the color scales.

Figure 17 is fine as well. There is a thick (attenuating) smoke layer and low depolarization ratio. Please be very accurate in the description: CALIOP is providing volume linear depolarization ratios, please state that always clearly, and this quantity can vary strongly because of the changing total/Rayleigh backscatter ratio. . ... if we would have the particle linear depolarization ratio (instead of the volume depolarization ratio) then we would probably have always the same values. . .. But it is clear, and this an interesting aspect, the smoke particle depolarization ratio is significantly smaller than the one for cirrus. Thus, the particle depolarization ratio can be nicely used to distinguish between cirrus and smoke at, e.g., 10 km height were both can be present at the same time. . ..

Figure 20. . .! I do not see much. I would remove this figure.

At the end, the ground-based and spaceborne lidar observations of smoke are the highlight of the paper. And these measurements should be presented in a more condensed form. That would improve the paper. However, feel free to accept or reject my comments to the figures.

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