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Discussions

Interactive comment on "Contributions of dust and biomass-burning to aerosols at a Colorado mountain-top site" *by* A. G. Hallar et al.

Anonymous Referee #2

Received and published: 19 September 2015

The paper presents a long-term data-set of AOD and scattering data collected at the Storm Peak Laboratory in Colorado, at about 3200 m above sea level. The analysis focused mostly on dust and biomass burning smoke. Overall the paper is clear, very well written and provides a useful dataset that could be important for understanding decadal changes in the Western United States. I therefore suggest the paper to be published. I would appreciate some clarifications and maybe some mostly minor changes.

General comments:

1. The authors refer to the availability of absorption measurements, but then do not use the data in the analysis (see specific comments below). If absorption data are available even only for specific time-periods and if they are available for different wave-

lengths then the data could also be used to reinforce (or reject) some of the findings and interpretations in this paper. The absorption together with the scattering data could be used to provide single scattering albedo data, a parameter of interest to the community and used for radiative forcing calculations.

2. Maybe CALIOP data (even only for specific, limited events) could be used to support the interesting discussion about the vertical distribution of the aerosols?

3. I think most of the discussion on the vertical distribution is focused on dust, but can the authors discuss also the biomass burning smoke vertical distribution? Could they use CALIOP here as well for selected events to strengthen the analysis?

4. The nephelometer should also be able to measure the back-scattering, I believe. If so, it could be interesting to present also the backscattering fraction data as that is an important parameter for radiative forcing calculations and the community could benefit from sharing these data.

Specific comments:

- Introduction, line 23: I wonder if the word "define" in "... to define future climate change" is the most appropriate here. Maybe "...to predict..." would be better?

- Introduction, page 21301, line 4: ad U.S. as in "... U.S. Clean Air Act..."

- Methodology, page 21305, line 17: the authors mention "absorption instrument". Maybe I missed it, but what instrument do they refer to? Using also the absorption data – if available – would add great value to the paper and help with the identification of smoke and dust, if data are available at different wavelengths. Why were the data not used? Please clarify.

- Methodology, page 21306, lines 17-19: this sentence is unclear to me.

- Methodology, page 21307, line 9: how was the response measured, please provide some detail.

- Methodology, page 21307, line 20: how does the receiver Lambertian response degrade over time? Maybe explain briefly possible degradation processes.

- Methodology, page 21308, line 10: explain why the nephelometer needed to be zeroed so frequently and how long each zero lasted.

- Methodology, page 21309, line 5: explain why this pair of wavelengths was chosen.

- Results, page 21312, line 11: I am not sure I understand the rationale behind choosing a least square fit here. Why this specific fit? What is the purpose? This choice might need some explanation.

- Results, page 21312, line 15: I would consider showing these AOD data even if they do not show a trend.

- Results, page 21313, lines 16-19: here for example the availability of absorption data could help distinguishing more accurately dust from biomass burning if data are available for different wavelengths (see comment above on absorption data).

- Results, page 21316, lines 5-9: In this context the authors might be interested in the paper by Yang, W., A. Marshak, A. B. Kostinski and T. Várnai (2013). "Shape-induced gravitational sorting of Saharan dust during transatlantic voyage: Evidence from CALIOP lidar depolarization measurements." Geophysical Research Letters 40(12): 3281-3286.

- Discussion, page 21319, line 3: Could you also analyze CALIOP data at least for some episode to better understand the vertical distribution of the aerosol?

- Discussion, page 21319, lines 7-8: I could not find the paper by "Uno et al. 2009" in the reference list, please make sure it is included.

- Conclusions, page 21321, line 9: If the dust layers are often above the $\sim$3200 m of the station, will that still impact the vistas in the Intermountain west?

- Figure 2: as mentioned earlier, I am not sure I understand the rationale behind the

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cubic polynomial fits. What are the reasons and purpose for them? Also the fit details (fit parameters) should be provided.

- Figure 3. The x axis label fonts (top and bottom) might be too small to be clearly visible in ACP, similarly for the y axis labels. The lines, especially the dashed lines (vertical as well as the standard deviations) are too thin, when printed they are difficult to see at all, I think that when the plots will be edited for ACP they will be even smaller and that might make it very difficult to see the lines, I would suggest increasing the thickness substantially. It might help also to increase the symbol size. In the caption, the authors refer to an Ångström exponent of 1.3 and wrote that it is identified by a dashed vertical line, do they mean horizontal line? Also for scattering the line does not seem to be dashed on my screen.

- Figure 4: The authors might want to consider enlarging the fonts of the top graph to make it more consistent with the bottom panel. Especially the legend might be difficult to read on a normal ACP format. Also please consider to use a consistent spelling for the Ångström exponent in the different figures, captions and text; in some points it is Ångström, in other it is Ångstrom, in this figure on the y axis it is Angstrom.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 21299, 2015.

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