Answer to Anonymous Referee #1

Green – reviewer's comments
Black – authors' reaction to comments

Interactive comment on "Synchronous starphotometry and lidar measurements at Eureka in High Canadian Arctic" by K. Baibakov et al.

Anonymous Referee #1
Received and published: 20 March 2015
We thank the Anonymous Referee #1 for the thoughtful comments and questions. Our answers are given in a comment-by-comment fashion below.

Unless otherwise indicated, section numbers refer to both the submitted and revised manuscripts (in other words those sections whose numbering did not change between the submitted and revised versions of our manuscript)

The paper deals with synchronous measurements of star-photometry and lidar at the High Arctic Place at Eureka (Canada). Generally, it is well-structured and written. The paper shows the last advances in star-photometry that is being quite useful for the retrieval of nighttime AODs, and is of particular interests for aerosols studies at high- latitudes places such as the Arctic places. Nighttime measurements are needed to better understand aerosol dynamics and aerosol processes. Also, the author present novel measurement of combining star-photometry / lidar to evaluate cloud screening procedures in an environment where thin-stable clouds has an important relevance in the optical depth. Overall, I recommend its final publication in Atmospheric Measurement Techniques after some minor considerations.

In section 4.1.5 you say that Spectral Deconvolution Algorithm (SDA) is used. Can you specify which range of wavelengths do you use as inputs to the algorithm?
The SDA was applied to starphotometry data in range: 419.9-862.3nm. We updated the section on the SDA accordingly.

In Table 1 and in section 4.5.1 (Page 2031, line 27) you define τf', τc' and τa' as the fine mode, coarse mode and aerosol optical depth derived from integrating the lidar profiles that have been partitioned into aerosol (assumed fine mode) and cloud segments using the βthr classification scheme. Which is the wavelengths of βthr? Is it taken into account the wavelength difference in the comparisons with SDA obtained by star-photometry?
β_{thr} is at the lidar (CRL) 532nm channel data. This channel is quite close to the commonly chosen SDA reference wavelength of 500nm. Extrapolations based on starphotometer Angstrom exponent calculations showed that differences in optical

depths between 500 and 532nm were usually negligible compared to other uncertainties in the analysis.

Page 2024, line 22: It seems to be a typo as there is no Table 4 in the manuscript.
Text was changed to refer to the proper table.

Section 4.3.1.: Have you characterize the effect of the blinking in your star-photometry measurements? It could be a source of uncertainty especially for low exposure times.
As mentioned in section 4.1.1, for each measurement we use an average of several exposures (3 or 5) each lasting 5-6 seconds. This approach minimizes scintillation effects. The two-star method (TSM) is particularly prone to horizontal inhomogeneity because of its differential nature. TSM is thus intended mostly for calibration purposes on particularly clear and calm nights with the one-star method (OSM) being used at other times. No changes were made to the text with respect to this issue

In section 5, I assume that all the star-photometry data are after applying the cloud-screening algorithm. I am right? Please clarify in the text.
No, most of the data in Section 5 was not cloud screened. We wanted to present process level analysis of different events (time scales ~ minutes), including clouds and ice crystals which would normally be taken out by a cloud screening algorithm. Added a paragraph in Section 4.1.6 (revised section 4.1.7) and a brief remark at the beginning of Section 5 to clarify this aspect.

If you have a Raman lidar system, why are you working with elastic-backscattered signal and using Klett method? Raman measurements can provide independent extinction and backscattering measurements and you would avoid the assumption of lidar ratios.
Given the observed low aerosol concentrations at Eureka, the Raman signal return was simply too weak and noisy to be useful for the purposes of this paper. Long integration times would render process-level (time scale ~ minutes) analysis difficult or impossible. Furthermore, we do not currently have an overlap correction for the Raman signals so this would have affected the extinction (and consequently AOD) retrieved from the lowest altitudes. Text was added to the manuscript to clarify this aspect.

Graphs quality should be improved. I can provide some examples:
Graph 5: It is not clear what you present in the lidar color plot. Also, what is the orange and blue color in graphs a.3? Please clarify.
Presumably by "lidar color plot in Graph 5" the reviewer means pane 2 of Figure 5. These are the same types of plots as in the previous figures. Added to caption: "Same pane description as in Figure 2b.".

As for the legend in pane 3 (orange and blue colors), we added an explicit color key in the revised manuscript

Moreover, y-axis in Figure 5.b is wrong. Please revise. These things apply for the other graphs.
We presume the reviewer refers to pane 2 of Figure 5. The y-axis is correct: it represents vertical distance in km. The y-axes of all other panes in Figure 5 are also correct.

Graph 6: It is difficult to understand if you represent only night time data. It seems that you connect by a line the last value of the night with the first of the following night. I am right? I recommend skipping the line when there are no measurements. This suggestion applies for the rest of graphs.
The lines joining different nights of data were eliminated in Figure 4 and 6.

Minor changes Page 2014, Line 19: change “course” by “coarse”
Fixed

BIBLIOGRAPHY Pérez-Ramírez, D., Lyamani, H., Olmo, F.J., and Alados-Arboledas, L., (2011) Improvements of star photometry for aerosol characterizations, Journal of Aerosol Science, 42, 737-735.
Thank you, we are aware of this paper. No changes were made to the text since the general starphotometer references in the Introduction were felt to be sufficient in terms of an overview of starphotometry