The manuscript “Combining airborne in situ and ground based lidar measurements for attribution of aerosol layers” focuses on investigating different layers present in the troposphere up to 3500 m. For this purpose, they combine aerosol particle size distribution data recorded on board of a research airplane with ground-based High Spectral Resolution Lidar (HSRL), radiosonde profiles and air-mass back trajectory analysis within the BAECC campaign which took place in Southern Finland 2014. The data is presented for two main case studies recorded at the same location but with differing meteorological conditions. The presence of several lofted layers was seen and compared to findings from the back trajectory analysis.
I recommend the paper for publication in ACP after the following comments have been addressed:

Response to comments from Anonymous Referee #2

We thank the referee for the constructive comments to help us to improve the manuscript. Below please find our answers to the comments.

Comments:
P4, Chapter 2.1- HSRL: what is the minimum altitude that can be measured?
Added to the text: ‘The HSRL instrument provides profiles from around 50 m up to 30 km in altitude.’

Full overlap between the transmitted laser beam and the telescope is reached at around 3 km, however values below this altitude can be used qualitatively down to the minimum altitude with their uncertainty increasing as the overlap decreases. Note that the retrieved backscatter coefficient and lidar depolarization ratio values are usually less affected by the overlap issue as they are derived by taking ratios of two channels (ie combined and molecular channels, combined and cross polarization channels), assuming all channels follow similar paths in the detection chain.

P4, line 32: What type of RH sensor was employed and what is the expected uncertainty?
Added to the text: a relative humidity sensor (Rotronic HygroClip-S, accuracy 0.8 % at 23 °C)

P5, Chapter 2.2: It is stated that the SMPS data is corrected for elevated RH in the ambient with a certain GF. Is this correction implemented as a function of height, meaning that for each altitude the actual RH that was measured was used to determine the GF?
-Yes. Added to text: The correction for GF was implemented as a function of height for the SMPS data.
What about the influence of elevated RH on the optical properties? It is not stated in the paper which index of refraction was used to determine the optically measured size distribution! As a correction for the SMPS is introduced I would strongly suggest to also apply a correction to changes in the index of refraction of the particles and adjust the actual size range measured by the OPS.
-Index of refraction for water droplets (1.334) was used for OPS measurements.
During Case Study I, the relative humidity values were lower than 50 %, so that any changes in refractive index are expected to be minor. During Case Study II, it is true that RH values were much higher at some altitudes, and that this may induce some changes in the refractive index that is assumed constant for the OPS data. However, we have no chemical composition measurements from the aircraft from which the real refractive index could be determined, hence we may introduce more errors by varying the refractive index. In this study we are more concerned with identifying that there are significant differences in the aerosol size distribution from layer to layer, for which we believe our simple assumption of a single refractive index is still appropriate.

Figures 2&7: Could you add lines for the different layers in the plots depicting the back-scatter cross sections? It is not very clear where the boundaries were chosen.
- Lines were added to the left most panels of figures 2 and 7.
The text was modified: The ambient size distributions were then grouped by similarities in the size distribution and taking into account the layer boundaries found in the HSRL data.

P7, line 9: Where can the mentioned depolarization be seen?
Added to the text: Fig 1b

P8, Chapter 3.1.3: Which data was used for the HYSPLIT trajectories (GDAS etc.?) and what resolution was employed? These two things can have a strong influence on the analysis.
- Added to the text: The National Center for Environmental Prediction (NCEP) Global Data Assimilation System (GDAS) dataset with 1 degree resolution was used for the meteorological input to the model.

P8, line 30: "close to surface" – I am a bit confused by this statement as from Fig. 5d the lowest height visible is around 1000 m, and I would not refer to that as "close to surface". Could you rather state the actual altitude range? Such phrasing is also used later, and I would suggest changing that as well (for blue lines).
-Modified as suggested

P9, lines 12-15: Can some possible reasons for the not-matching altitudes between HYSPLIT and the measurements be pointed out?
- Added to the text: Errors in trajectories (particularly in the vertical) arise from the difficulties that the meteorological models providing the wind fields have in accurately representing vertical motion, turbulence and other sub-grid scale features (Stohl et al., 2001, Riddle et al., 2006, Hoffmann et al., 2016).

Riddle, E. E., P. B. Voss, A. Stohl, D. Holcomb, D. Maczka, K. Washburn, and R. W. Talbot (2006), Trajectory model validation using newly developed altitude□controlled balloons during the International Consortium for Atmospheric Research on Transport and Transformations 2004 campaign, *J. Geophys. Res.*, 111, D23S57, doi:10.1029/2006JD007456.

Stohl, A., L. Haimberger, M. P. Scheele, and H. Wernli. "An intercomparison of results from three trajectory models." *Meteorological Applications* 8, no. 2 (2001): 127-135.

L. Hoffmann, T. Rößler, S. Griessbach, Y. Heng and O. Stein, Lagrangian transport simulations of volcanic sulfur dioxide emissions: Impact of meteorological data products, *Journal of Geophysical Research: Atmospheres*, **121**, 9, (4651-4673), (2016).

P9, line 26+27: What is meant here by "the smaller size range"? I am also confused by the change mentioned for 10th of April. What is it referred to? I cannot see a clear difference between the lines in Fig. 4B?
-This paragraph is rephrased to be clearer: For particles smaller than 300 nm, the shape of the size distribution and the number concentrations changed from day to day.
For particles larger than 300 nm, while the number concentration varied, the shape of the distribution remained similar across all 3 days.

Specific comments: - changed as suggested
P2, line 3: change “vary” to “varies”
P4, line 23: change “stainless tube” to “stainless steel tube”
P5, line 4: change “campaigns” to “campaign”
P5, line 20: add “the” before “Cessna”
P10, line 2: change to “air masses of two different origins and heights intersected. The panels of Fig. 5 demonstrate the
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