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Interactive comment on "Atmospheric aerosol, gases and meteorological parameters measured during the LAPSE-RATE campaign" *by* David Brus et al.

Anonymous Referee #2

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Review of Atmospheric aerosol, gases and meteorological parameters measured during the LAPSE-RATE campaign, D. Brus et al.

This manuscript presents an overview of the data acquired from copter UAVs that conducted vertical profiles of aerosols, gases and meteorological parameters during the LAPSE-RATE campaign in the summer of 2018. Members from the Finnish Meteorological Institute (FMI) and Kansas State University (KSU) conducted measurements over a period of five days in the San Luis Valley, CO. The FMI copter measurements include vertical profiles up to nearly 900 m AGL of aerosol number concentrations and size distributions, CO2, and meteorological parameters (pressure, temperature, rela-

tive humidity), while KSU copter measurements conducted vertical profiles (up to 150 m AGL) of aerosol size and number distributions. In addition, FMI and KSU conducted ground-based measurements of aerosol and meteorological parameters to compare with the airborne copter measurements.

The data from these flights is readily available from the websites provided in the manuscript.

It is understood that ESSD is dedicated to the publication of datasets; however, key features of the dataset as well as its limits are needed to highlight the utility of the data in future publications. Several issues are described below that the authors should address before publication.

General comments: The authors allude to a number of regional / local sources and meteorological patterns that impact diurnal cycles, changes in aerosol properties, generation of new particle formation events. However, few specific examples were highlighted in the text (farm vehicles), and summary (new particle formation). A few sentences on the defining characteristics of this dataset (for example, temporally with respect to meteorological patterns and vertically with respect to atmospheric structure) would be useful.

Airborne aerosol measurements are a challenge – especially for measurements of particles larger than several micrometers in diameter in a non-isokinetic flow. A description of the KSU inlet has been provided; however, the orientation with respect to the wind and propeller wash is not clear. The stated largest diameter for the N2 and POPS are 17 and 33 um, respectively. The authors need to provide an assessment of sampling biases related to super-micron aerosol particles. I also suggest that authors compare ground-based and airborne measurements for the OPC-N2 and POPS at a range of sizes between 0.3 and 30 um diameter.

Along the same line, when comparing the OPC-N2 between the copter and the ground-based measurements (Figures 2D,E and Figures 3C,D), it appears that the N2 concen-

trations on the copter are systematically at least a factor of two larger than the ground-based measurements. Was there any additional flow control or flow measurements for the OPC-N2? The off-the-shelf version does not provide precise measurement of the air volume for determining the number concentration.

The authors state that hysteresis between ascent and descent profiles was significant. This difference is expected given the high ascent rates (up to 8 m. s-1) and considerably slower descent rates (as low as 2 m.s-1). The authors then suggest using the ascents for the best representation of the vertical profiles with no justification. Given that the ascent rates were faster, the impact of hysteresis on the vertical profile should also be greater. Are there other factors that need to be considered? What is the bias related to the hysteresis? I also suggest showing a figure to illustrate the impact of hysteresis on the vertical profiles.

The figures show time series of averaged values and variability for each flight. However, there are no examples of vertical profiles and no specific comparisons / validations between airborne and ground-based data. Yet, there are some differences between the airborne and ground-based averages that cannot be reconciled in the figures that have been shown. For example, ground-based temperature and relative humidity show no consistent relationship with the airborne observations. I would have expected to see the ground-based temperature similar to the warmest airborne temperature in a well-mixed boundary layer. As mentioned above, the ground-based number concentrations reported by the OPC N2 are consistently less than the airborne values by more than a factor of two. Otherwise, ground-based and airborne measurements of pressure, CPC, and POPS show expected relationships (at least what can be seen from the figures).

In the summary, it would be useful to state the size of the dataset, the format (netCDF), quality-control level, and other important issues (e.g., measurement biases) that users need to take into account when using this data set.

Specific comments: It would be helpful to diameter throughout the text when referring

to the size of the aerosol particles.

Line 67: when introducing the other trace gas measurements CO, NO2, SO2, O2 – the authors need to immediately state these measurements are not included as their concentrations were below the detection limit. I suggest moving lines 73 to 75 to line 67.

Line 72, Was the Gelman filter was added to avoid contamination of aerosol particles in the optical path? Specify the type of Gelman filter.

Line 133: Specify ‘These variables’

Lines 127-133 and Lines 144-149 are nearly identical – I suggest combining and stated that these parameters are the same for both PRKL1 and PRKL2 copters.

Line 155: change ‘Further’ to ‘Furthermore’

Line 160: Was the GMP343 data corrected based on the intercomparison to the PI-CARRO? A few lines later, the authors state that GMP343 suffered from inaccurate pressure compensation. Consequently, the authors recommend the use of the Licor 840A data for CO2 measurements. If this is the case, then why publish the GMP343 dataset?

Line 185: The POPS recorded 16000 cm-3 during passages of farm vehicles, which is well above the maximum concentration limit stated in Table 1. Can the POPS and N2 number concentrations be corrected for high particle concentrations?

Line 197: The authors write ‘preliminary quality control’ – are future updates / data products expected? The datasets published to ESSD should be better than ‘preliminary’.

Line 212: change ‘anc’ to ‘and’

Line 218: change ‘written’ to ‘wrote’

Figure 2F shows systematic biases in the CO2 measurements (as mentioned in a comment above). Why not correct the copter CO2 measurements to the reference Picarro instrument for the final data set?

Figure 3: The times corresponding to the ground-based averages are centered at 0:00, which does not correspond to an average of the times reported in Table 5.

To facilitate comparison of the aerosol measurements in Figures 2 and 3, I suggest combining measurements of the CPCs, OPC-N2 and POPS on a single semi-log plot.

Table 1 needs to specify the instruments used for the ground-based measurements. 'Diameter' needs to be added to the size range.

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