

We thank the reviewers for their insightful feedback. We have substantially revised the manuscript as a result. Mainly, we revised and coordinated almost all of the figures and improved upon the writing quality of the text based on the suggestions provided. We also revised the source classifications and redid any calculations resulting from such changes, all of which are reflected in the manuscript.

Reviewer 2

This paper presents measurements of aerosols made during the U.S. Department of Energy Atmospheric Radiation Measurement (ARM) program's Fifth Airborne Carbon Measurements (ACME-V) campaign along the North Slope of Alaska during the summer of 2015. The paper focuses on how local oil extraction activities long-range transport influence aerosols and trace gases in the North Slope of Alaska. The authors should try to go beyond presenting the measurements and use the data in a clearer way to demonstrate the scientific conclusions that can be made using the data. This paper is within the scope of ACP and should be published following after the authors address the following comments:

1. I agree with reviewer #1 that the authors should rethink how to present the data in a less superficial way in addition to showing the data as a function of the flight number. I don't object to showing these figures (Figs. 3, 7 and 9) as long as the data is shown again in a more synthetic way later in the paper, allowing the authors to draw more clear conclusions from the measurements.

Please see response to major comment 1 from reviewer 1.

2. The choice for the classification parameters and thresholds values in Table 2 should be more clearly justified. Have these been chosen using the Hysplit analysis?

These are partially based on HYSPLIT analyses, but additionally on thresholds from previous work, and visual assessment of the proximity to known sources and vertical profiles. We added a new paragraph at the end of section 2.4 (was section 2.3) describing Table 2 classifications and how they were derived. In order to follow details on characterization of the fire locations, we moved what was section 2.3 to the end of the methods, after we discuss supporting satellite data.

3. The way that Hysplit has been run should be more clearly described and justified. Even though the authors reference another paper for the description of the Hysplit runs, there is not enough information to fully understand how Hysplit was run. I assume this was run in backward mode from the measurement locations, but this is not clear. The reason for the choice of the five locations in the active fire region is also not clear. I also cannot fully understand Figure 2d and Figure 6d.

The new paragraph describing the source classifications now provides justification for the HYSPLIT dispersion analysis. Dispersion simulations are automatically run in forward mode since it simulates emission and transport of particles from a point source. We added more detail in this section describing what information the HYSPLIT dispersion model provides, which also clarifies what is shown in Figures 2a and 5a (were 2d and 6d), in addition to provided more detail on what the model output is. The five locations were chosen based on equal spacing within the highest density of fires determined from the satellite analyses from the entire study time period. This is now stated in the aerosol dispersion modelling section (2.4; was section 2.3).

4. The reason for showing the data as column averaged values in Figures 2 and 6 needs to be justified. Don't we lose information by showing the data in this way? The main advantage of using aircraft data is that we know where the aerosol layers are vertically. The information we can learn from the altitude of the aerosol layers should be a clearer part of this analysis.

The purpose of the maps in Figures 2 and 5 (was Figure 6) is to show, qualitatively, the spatial variability in the parameters and to demonstrate the locations impacted by Prudhoe Bay and the fires. Also, the column averaged data in Figure 2 is for altitudes < 500 m AMSL. For Figure 5 (was Figure 6), data are restricted to < 5000 m AMSL to show the vertical extent of the fire impacts. These parameters are shown as vertical profiles of the 1-second measurements in the following figures, thus any information that may be lost in Figures 2 and 5 are shown elsewhere. However, the conclusions discussed for these figures are supported by the vertical analyses.

5. The MODIS detected fire hotspots should be shown on Figure 5 relative to the fire size or fire radiative power, such that more active fires can be identified vs. less active fires.

Fire size and radiative power information is not available from the thermal anomaly data we used. Additionally, we used the fires as a qualitative approach to evaluate when and where these sources were present, and used the spatial density of the data to determine where HYSPLIT dispersion simulations should be initiated. Evaluation of fire properties is outside the scope of our manuscript.

6. The influence of oil exploration is not clear to me. Is the location of oil exploration activities known? The discussion of oil exploration influenced air that was sampled should be clarified. The discussion of long range transport also needs to be developed, as noted by reviewer #1.

This should be evident now given the additional paragraph describing the source classifications. Additionally, previous work by Gunsch et al. (2017) and Kolesar et al. (2017) clearly demonstrate how oil exploration from Prudhoe Bay is an influence on the North Slope. The locations of the oil activities (i.e., the active oil wells) is provided in Figure 1 and now include access date of the data. Please see response to reviewer 1's comment regarding long-range transport.

7. The authors should review the manuscript writing to clean up the writing style and typos before resubmission.

Done.