

## ***Interactive comment on “Aircraft measurements of High Arctic springtime aerosol show evidence for vertically varying sources, transport and composition” by Megan D. Willis et al.***

### **Anonymous Referee #3**

Received and published: 24 September 2018

Summary: This very well-written paper presents vertical profiles of various atmospheric constituents (gas and aerosol phase) measured during an airborne field campaign in the Arctic. The authors utilize air mass history modelling data to suggest that long range transport brings in aerosols and gases from lower latitudes at high altitude and subsequently these transported species subside to lower levels of the atmosphere. Their conclusion is that relying solely on long-term, surface-based in-situ measurements in the Arctic may lead to underestimation of some species in the Arctic troposphere.

Science comments: Obviously, long-term surface measurements don't tell the whole story, particularly in the Arctic, but I do think it would be worthwhile for the authors to

C1

reiterate towards the end of the manuscript that the surface measurements can provide value in terms of context/representativeness for at least lower altitude measurements. For example, as the authors note, 2008 was an anomalous year and not necessarily representative of Arctic climatology (P11, line34 –P12, line2). I realize the authors note this on P3, lines24-25, but could be noted again later.

Related to the comment above – many of the species measured on the aircraft are also measured at the surface at Alert. How do the surface measurements compare to the lowest potential temperature airborne measurements? Could those surface data (or some statistically appropriate summary of the surface data) be overlaid on the relevant plots (i.e., Figures 2, 4, and 6)? Something like this is done in Figure S4 for CO for the middle and lower polar dome, but it seems like the authors could place a symbol (or box-whisker) on the profile plots in the main manuscript showing the surface values of various parameters for April 2015 or April 7-13 2015 or the median over all Aprils or ...

I found the discussion of PES a bit confusing. PES is given in units of seconds (P10, line 3), but on page 11, line 26 the authors talk about PES indicating that air masses had residence times of at least 10 days. I'm not sure how one goes from PES values on order of 50 s (scale in Fig 5) to 10 days. I didn't see a reference to explain this, so it'd be helpful if the authors could either provide a reference or explain the relationship a little more clearly. Perhaps the scale in Fig 5 is actual log(seconds)?

Technical/editing comments:

P9, line 34: providing a time-resolved information → providing time-resolved information

P10, line 2: provide approximate altitude or pressure range the 10 vertical levels in FLEXPART-ECMWF correspond to. Are the vertical bins evenly spaced?

P11, line 28: observations indicates → observation indicates

P13, Figure 3: give indication of latitude values, the outer circle is 30 N but what are

C2

inner circles?

P14, line 13: cannot distinguishing→ cannot distinguish

P14, lines 16-17: first sentence of paragraph is unclear. I think it is missing something?

P15, Figure 5: say what boxes whiskers represent is it 5,25,50,75,95 percentiles or ??  
and say represent dots in each 0.2 fraction of time interval.

P16, Figure 8: should 'gaussian' be capitalized?

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-628>,  
2018.