Reviewer Comments

C1. In the revised manuscript, the authors have addresses most of my previous comments/concerns. The only significant change that I would suggest is to replace the plots in Figure S3 with continuous time series of meteorological observations (e.g., temperature, relative humidity, surface pressure, wind speed/direction) for the field study period, i.e., July 18 – Sept. 12, instead of during filter sampling periods only. The continuous time series is more useful for providing synoptic context and discerning different air masses influencing the measurements. It can also relate better to the continuous PM mass observations shown in Figure 5.

R1. Continuous time series for the suggested variables are provided in the Supplement. However, after examining the continuous time series, we find that they do not improve our understanding of the air masses influencing filter measurements. We believe our discussion provides a comprehensive assessment of the meteorology and air masses affecting filter samples during our study.

C2. It is perhaps worth noticing that July 26 could be a good case when the site may be influenced by the Prudhoe Bay Oil Fields emissions, as the back-trajectories, particularly the low-level one, shown in Figure S1, circling around the oil field before arriving at the measurement site. The fact that the water-soluble ions are dominated by sulfate and nitrate may also corroborate this suggestion. Another case of possible interest may be August 27 – the 5-day back-trajectories suggest possible influence of biomass burning pollutants from northern Canada. Does the chemical mass analysis show any indication of biomass burning influence for this day?

R2. We agree it is likely that emissions from the Prudhoe Oil Field and biomass burning were sources of ions and metals at our site. However, identifying these sources is challenging since many ions detected in the filters are from several sources in the environment (e.g., sulphate is from anthropogenic and natural sources). Furthermore, identifying biomass burning sources is also challenging because we did not detect potassium in our samples (a common tracer for biomass burning) and other tracers (e.g., levoglucosan) were not targeted. Nevertheless, we discuss these possibilities in the revised paper.

Page 11, lines 296–305

"Lower molar ratios of Cl^-/SO_4^{2-} in aerosol filter samples could be attributed to non-oceanic sources of SO_4^{2-} (i.e., natural and anthropogenic combustion sources). For example, SO_4^{2-} in $PM_{2.5}$ at Tuktoyaktuk may have originated from natural sources, such as the biogenic emission and subsequent oxidation of dimethyl sulphide from the ocean (Bates et al., 1987). In addition, sulfur emissions from **the Prudhoe Oil Fields and the** ignition of lignite in the Smoking Hills (Radke and Hobbs, 1989) **were** likely **sources** of SO_4^{2-} in $PM_{2.5}$ at Tuktoyaktuk, according to air mass back trajectories (Figs. S1 and S2). **Another** source of SO_4^{2-} in $PM_{2.5}$ at Tuktoyaktuk may include anthropogenic emissions from the combustion of fossil fuels (e.g., vehicles, aircraft, boats, etc.) (Leaitch et al., 2018; Willis et al., 2018). Other ions characteristic of combustion were also identified in aerosol filter samples from Tuktoyaktuk, such as NO_3^- and NH_4^+, possibly from the emission and oxidation of nitrogen oxides (NO_x) and emissions of ammonia during fossil fuel combustion from local, **regional (e.g., Prudhoe Oil Fields),** and long-range sources."

Page 11, lines 281–286

"In addition to marine sources, Cl^- and Br^- can originate from biomass burning. **Keene et al. (2006) identified** hydrochloric acid (HCl), chlorine (Cl_2), hypochlorous acid (HOCl), bromine (Br_2), and hypobromous acid (HOBr) as products of biomass burning, which could have been the

source of either Cl^- measured in the fine mode or Br^- measured in the coarse mode at Tuktoyaktuk. **While we are unable to confirm this source in our study, it is conceivable that biomass burning in northern Canada was a possible source of aerosol particles at Tuktoyaktuk (e.g., 27 August, Fig. S2).”**