Seasonal Cycles of Aerosol Properties across the North Slope of Alaska: Sources and Distributions from Utqia■vik (formerly Barrow) to Oliktok Point

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Recent studies indicate that negative aerosol radiative forcing in the Arctic has appreciably offset greenhouse gas warming and sea ice loss (Najafi et al. 2015, Gagne et al. 2015). At the same time, net forcing yields a warming of the Arctic region that is still much greater than the global average due to Arctic Amplification mechanisms (Serreze and Barry 2011). The radiative forcing potential of aerosol is dictated by the source and evolution after emission, horizontal and vertical spatial distributions, and co-occurrence with surface cover and solar geometry, which have a high degree of variability at high latitudes. Characterizing aerosol property distributions relative to source is essential for predicting future Arctic climate system responses to other anthropogenic changes.

Here, we assemble aerosol measurements from a range of platforms and locations to assess how aerosol sources and properties distribute horizontally, vertically and temporally from the relatively pristine site of Utqia■vik to Oliktok Point on Prudhoe Bay. Airborne data are contextualized in a long-term, seasonal analysis of ground-based *in situ* and remote sensing observations of aerosol properties to evaluate the sources of aerosol in the boundary layer as compared to the free troposphere, and implications for the radiative forcing of aerosol is presented. Our findings establish patterns of aerosol properties consistent with known sources and transport patterns across the North Slope: more numerous, smaller particles surrounding Oliktok Point, likely from oil extraction activities; biomass burning aerosol aloft from long-range transport originating in boreal forests; and seasonal cycles of properties near the surface that reflect changing sources as surface cover and circulation pattern vary throughout the year.

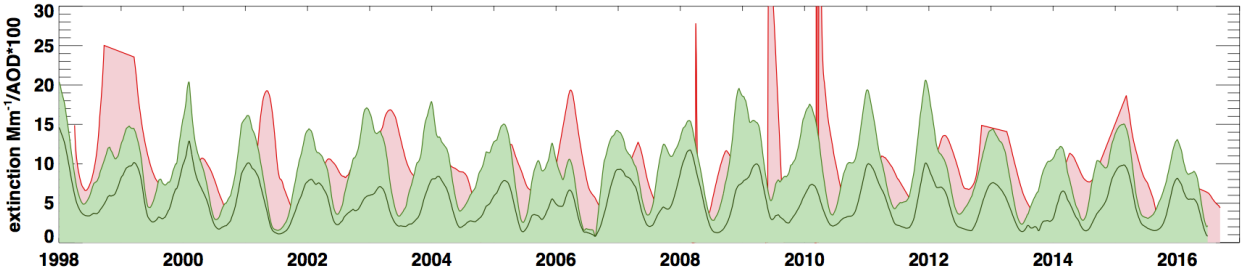

Figure 1. Seasonal cycles of ambient column (red) and dry surface (green) aerosol extinction at Utqia■vik, AK showing a persistent offset in the maximum each year. (Green: aerosol light extinction at 500 nm for particles < 10 μm measured in situ at the surface with a two month smoothing function; Dark Green line: extinction for particles < 1 μm; Red: aerosol optical depth at 500 nm with a three month smoothing function).