Supplement of Atmos. Chem. Phys., 18, 11599–11622, 2018
https://doi.org/10.5194/acp-18-11599-2018-supplement

Atmospheric Chemistry and Physics
Open Access

Supplement of

Seasonality of aerosol optical properties in the Arctic

Lauren Schmeisser et al.

Correspondence to: Lauren Schmeisser (lauren.schmeisser@gmail.com)

Comparison of Aethalometer and Reference Absorption Instrument

Figure S1 shows comparison of the absorption coefficients from the Aethalometer (σ_0) and reference absorption instrument (σ_{ap}). Generally, the absorption coefficients from the different instruments compare well at each station. ALT, TIK and BRW show the best agreement between the instruments.

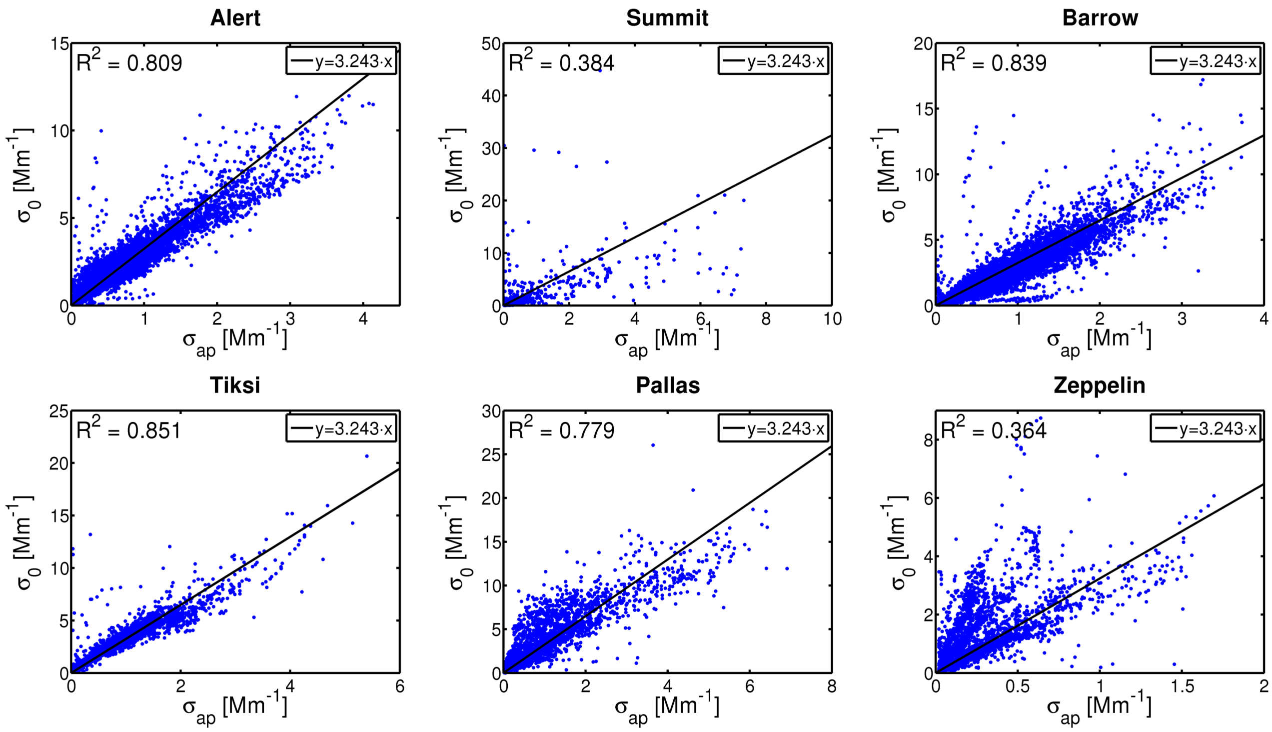

Figure S1. Scatter plots comparing Aethalometer and reference absorption data, σ_0 and σ_{ap}, respectively, for each of the six Arctic monitoring stations. Regression coefficients are noted in the top left of each plot. A reference line of y=3.243x is shown in black on each plot.

Absorption Ångström Exponent Seasonality

Absorption Ångström exponent represents the wavelength dependence of the aerosol absorption coefficient. This intensive aerosol optical property depends on aerosol composition, so different aerosol types have unique ranges of AAE values. AAE is computed using the following equation:

$$AAE = -\frac{\log(\sigma_{a1}) - \log(\sigma_{a2})}{\log(\lambda_1) - \log(\lambda_2)} \tag{S1}$$

where σ_{a1} is the light absorption coefficient at wavelength λ_1, and σ_{a2} is the light absorption coefficient at the wavelength λ_2.

Figure S2 shows seasonality of absorption Ångström exponent (AAE) at 5 sites in the Arctic. AAE climatologies have not previously been reported for stations in the Arctic. AAE values are not available at SUM, since SUM only has measurements from a 1 wavelength Aethalometer AE16. Two of the Arctic stations, PAL and TIK, have notable seasonality in AAE values. PAL has highest AAE values in the winter and spring, and lowest AAE values in the summer and fall. TIK, on the other hand, has lower AAE values in the spring and early summer, and higher values of AAE in the fall. These changes in AAE statistics throughout the year suggest that these sites might measure different aerosol compositions depending on the season; however, the range in AAE values is fairly minimal.

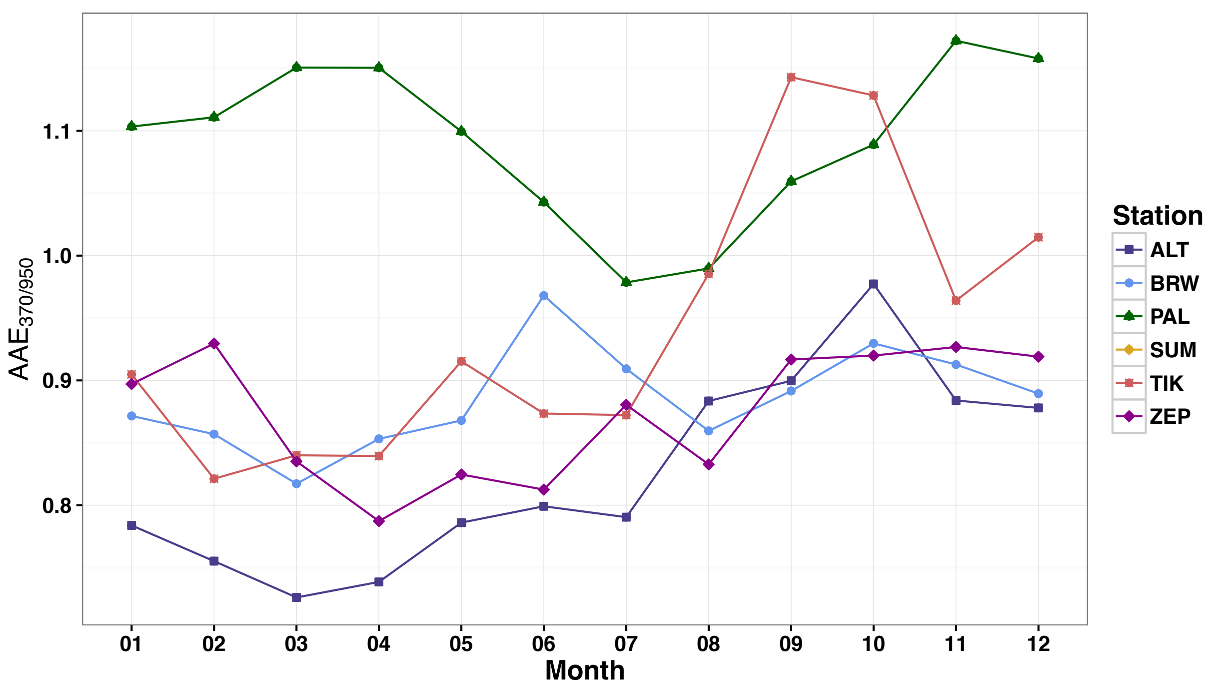

Figure S2. Seasonality of absorption Ångström exponent (AAE) at all sites, except for SUM (which only has a 1-wavelength Aethalometer AE16). Plot shows monthly medians of hourly average AAE at the 370nm/950nm wavelength pair.

Systematic Variability of Aerosol Asymmetry Parameter and Scattering Coefficient

Figure S3 shows the systematic variability of median aerosol asymmetry parameter (g) varying with scattering coefficient (σ_{SP}) at all of the Arctic sites. At all stations (with the exception of PAL) there are increasing g values with increasing σ_{SP}. This generally means that as scattering increases, particles tend to be larger. Conversely, the cleanest days when scattering is lowest tend to be dominated by smaller particles. The increasing g with increasing σ_{SP} is consistent with aging. Furthermore, the observed systematic variability is consistent with the decrease in SAE with increase in σ_{SP} at BRW, though this is not the case at other stations. This further confirms the idea presented in the main manuscript that the specific shape of the aerosol size distribution at each site is important in determining the unique seasonality of g and SAE at each of the Arctic stations, since each of these parameters depends more strongly on different parts of the aerosol size distribution. At PAL, where g does not change much with σ_{SP}, or even decreases slightly with increasing σ_{SP}, it is consistent with the observed increase in SAE with σ_{SP}."

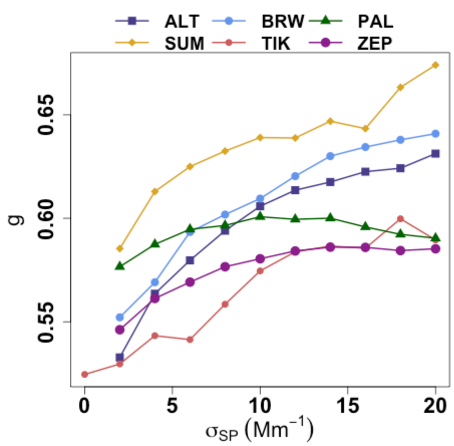

Figure S3. Systematic variability of median aerosol asymmetry parameter varying with scattering coefficient at each of the six Arctic monitoring stations.