Multi-year Measurements of Black Carbon Aerosol over Barrow and Ny-Alesund in the Arctic

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The sources of black carbon (BC) and sulfate aerosols (major components of "Arctic haze") over Arctic regions are the subject of intense scientific debate. However, the measurements of absolute BC mass concentration (M_{BC}) over Arctic region are rather sparse. This study presents the first-ever simultaneous measurements of BC aerosol mass concentrations (M_{BC}) using a continuous soot monitoring system (COSMOS) over Barrow (71° 19'N, 156.6° 37'E) and Ny-Ålesund (78° 55'N, 11° 56'E) in the Arctic during three year period from April 2012 to July 2015 and August 2012 to July 2015, respectively as part of the GRENE Arctic Climate Change Research project.. We estimated an error owing to scattering by sea-salt aerosols being erroneously interpreted as absorption in COSMOS measured M_{BC} and found to be about 20 % (or < 5 ng m^{-3}) over Barrow and Ny-Ålesund. M_{BC} data are then utilized to elucidate the temporal variation of BC aerosols at both sites. These data are also compared with concurrent measurements of absorption coefficient (b_{abs}) obtained from a particle soot absorption photometer (PSAP) and Continuous Light Absorption Photometer (CLAP) to provide the long term seasonality in M_{BC} (using M_{BC} - b_{abs} correlation) to validate model simulation with accurate measurements of absolute M_{BC} over the Arctic regions. Results do not exhibit a strong diurnal variability in M_{BC} over Barrow and Ny-Ålesund. However, the seasonal variation of M_{BC} for both sites observed are markedly different and significant being highest every year in winter (46.34 ±29.81 ng m^{-3} and 24.97 ±27.18 ng m^{-3}) and lowest in summer (8.96 ± 9.90 ng m^{-3} and 4.97 ± 5.73 ngm^{-3}) over Barrow and Ny-Ålesund, respectively. Interestingly, M_{BC} in Barrow was about 2-times higher than Ny-Ålesund which is in contrast with other similar observations. These data sets will be further useful in validating climate models used to assess the effects of BC aerosols on the climate in the Arctic.