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Optical properties of different aerosol types in the High Arctic using k-means clustering

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Introduction
The Arctic is a region of particular interest in the field of atmospheric science, as over the past few decades the Arctic has experienced twice the rate of warming compared to the global. The presence of aerosols, and in particular black carbon (BC) aerosols, is widely thought to be at least partly being responsible for this phenomenon. There is a unique opportunity at Villum Research Station (VRS) in northern Greenland to study the changing environment and assess the possible causes and effects of the observed temperature increases. The climate-forcing potential can be quantified by looking into the extinction rate of light by aerosols, which defined by their scattering and absorption properties. These optical properties can be measured alongside particle number and size and corresponding meteorological data in order to assign certain properties to different aerosol types.

Methods
An aethalometer has been used to measure the BC mass concentration based on the absorption of light by aerosols, and their scattering coefficients have additionally been measured with a nephelometer, as well as particle number size distributions with a Scanning Mobility Particle Sizer (SMPS). The time range of August 2017 to August 2018 is covered by available data from all three instruments, and so analysis of this data is the main focus of this project.

Preliminary results and previous work
Data from the aethalometer and nephelometer have been compared and a clear correlation has been observed. A broad peak in winter in both cases shows the presence of Arctic Haze at VRS, which is expected as found by other authors previously. Biomass burning tracers will be investigated for source apportionment and to find instances of local aerosol production. Particle number size distribution data from VRS have previously been grouped using k-means clustering in order to assign chemical and physical properties to the aerosol clusters associated with accumulation modes (Lange et al., Atmospheric Environment, 2018). This study will build on this previous research.

Further research
The vertical profile of BC and particle number concentration will also be measured using unmanned aerial vehicles at VRS from August 2019 and ongoing. Investigating the atmospheric column will give information on radiative forcing and improve knowledge of the aerosol distribution in the troposphere as function of height.

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