Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37866

Multi-year aerosol mass-concentration measurements at Eureka, NU, Canada: Characteristics of extreme and episodic coarse-mode events

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The Arctic is a rapidly changing region and aerosols are key contributors to this change. However, the Arctic's remote nature makes aerosol observation challenging, such that limited in-situ measurements are available. With rising interest in extreme aerosol events, like dust storms, long-term aerosol datasets are needed. The continuous nine-year dataset of size-resolved aerosol number concentration at the Polar Environment Atmospheric Research Laboratory (PEARL) (80°03'11"N 86°24'59"W) on Ellesmere Island in the Canadian Arctic Archipelago provides a unique opportunity to characterise episodic extreme aerosol events. Measurements were collected with a Scanning Mobility Particle Sizer (SMPS) and an Optical Particle Counter (OPC). Episodically elevated mass concentrations of aerosols with a diameter larger than five µm were observed, especially in April, May and October. At these times, aerosol mass concentrations were greater than 10 µg/m3, highlighting the greater frequency of extreme events during the shoulder season relative to other months. An analysis of the extreme events was conducted using a k-means algorithm, which led to a classification of the daily average particle size distribution into 6 distinct clusters. The clusters were characterized as being recurring or episodic. The episodic clusters exhibited large modal diameters (greater than 3.2 µm, likely due to mineral dust and/or sea spray emissions), and were observed principally during the spring and fall. The monthly mean mass concentrations measured in years with episodic events were significantly higher (by a maximum of 6-fold in October) than during years with no episodic events. These results highlight the key role extreme coarse-mode events in controlling the inter-annual variation of monthly mean aerosol mass concentrations. The findings point to the importance of long-term in-situ observations in the identification of extreme aerosol events.