Year-Round Measurements and Interpretations at Greenland Environmental Observatory at Summit (GEOSummit)

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Long-term year-round sampling of the Arctic atmosphere and surface snow provide insight to the relationship between aerosol and snow chemical compositions. Ongoing research at the Greenland Environmental Observatory, Summit Station (GEOSummit) includes high temporal resolution year-round measurements of snow accumulation and spatial variability, IC and ICP-MS trace-element measurements of surface-snow and snow-pit samples, DRUM aerosol size and S-XRF elemental composition, and other meteorological and snow properties. These measurements allow for a better understanding of the timing and magnitude of the seasonal cycles in elemental concentrations that are deposited and preserved in the snow pack, some of which have not been previously reported. These records were analyzed using a multivariate factor analysis model called Positive Matrix Factorization (PMF) to identify unique source factors representative of sea salt, dusts, and other potential sources such as biomass burning. These source factors exhibited distinct seasonal cycles with significant year-to-year variability. Snow accumulation rates were concurrently measured, thereby aiding the evaluation of wet and dry deposition as well as quantifying the inter-annual variability in snow accumulation. In addition, using the Lagrangian Particle Dispersion Model (LPDM) FLEXPART, source regions of specific events that transport pollution or dust from North America and/or Asia can be identified. Continuous longer-term records are necessary for evaluating links between aerosol and snow chemistry to geophysical processes with multi-year periodicities (e.g. AO, AMO, etc). Future plans include continuing research measurements at GEOSummit (5-yr continuation proposal submitted) to better characterize elemental concentrations in snow and aerosols, annual to decadal variability in snowfall, and connections with atmospheric circulation and transport.

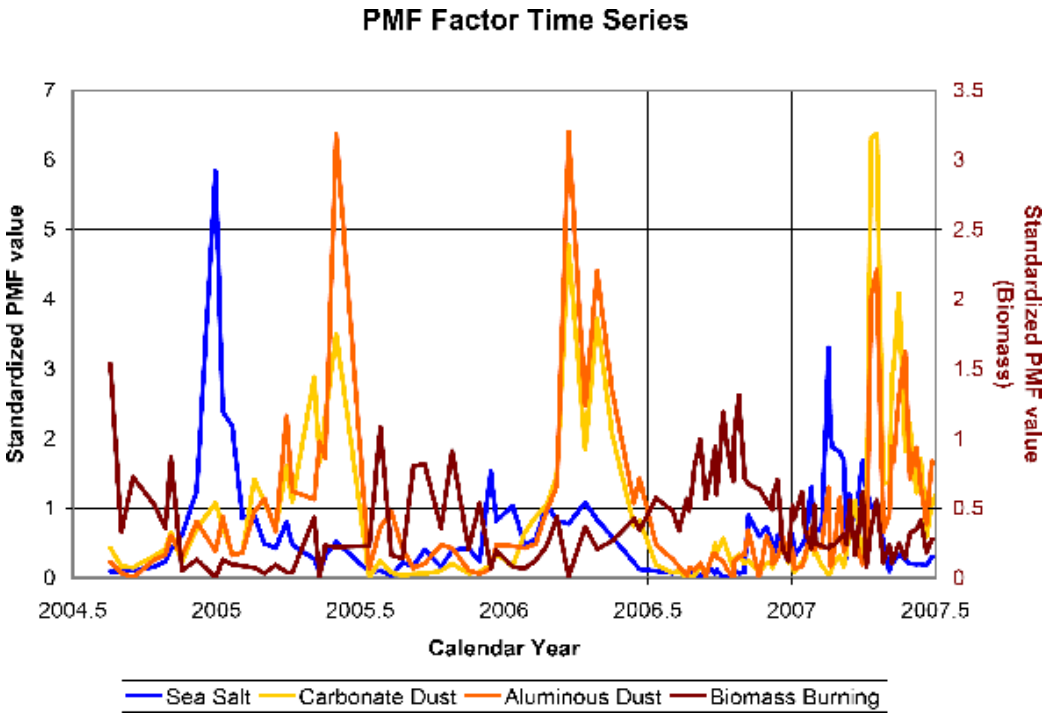

Figure 1. Time series of PMF source factors attributed to sea salt, carbonate dust, aluminous dust, and biomass burning. Note the strong seasonality and inter-annual variability of the source factors.