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Decadal trends in aerosol chemical composition at Barrow, Alaska: 1976–2008

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Abstract. Aerosol measurements at Barrow, Alaska during the past 30 years have identified the long range transport of pollution associated with Arctic Haze as well as ocean-derived aerosols of more local origin. Here, we focus on measurements of aerosol chemical composition to assess (1) trends in Arctic Haze aerosol and implications for source regions, (2) the interaction between pollution-derived and ocean-derived aerosols and the resulting impacts on the chemistry of the Arctic boundary layer, and (3) the response of aerosols to a changing climate. Aerosol chemical composition measured at Barrow, AK during the Arctic haze season is compared for the years 1976–1977 and 1997–2008. Based on these two data sets, concentrations of non-sea salt (nss) sulfate ($SO_4^=$) and non-crustal (nc) vanadium (V) have decreased by about 60% over this 30 year period. Consistency in the ratios of nss $SO_4^=$/ncV and nc manganese (Mn)/ncV between the two data sets indicates that, although emissions have decreased in the source regions, the source regions have remained the same over this time period. The measurements from 1997–2008 indicate that, during the haze season, the nss $SO_4^=$ aerosol at Barrow is becoming less neutralized by ammonium (NH_4^+) yielding an increasing sea salt aerosol chloride (Cl^-) deficit. The expected consequence is an increase in the release of Cl atoms to the atmosphere and a change in the lifetime of volatile organic compounds (VOCs) including methane. In addition, summertime concentrations of biogenically-derived methanesulfonate (MSA^-) and nss $SO_4^=$ are increasing at a rate of 12 and 8% per year, respectively. Further research is required to assess the environmental factors behind the increasing concentrations of biogenic aerosol.

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