34-year Trends in Aerosol Chemistry in Relation to Aerosol Acidity at Alert, NU, Canada

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Trends in aerosol chemistry, including 20 aerosol components and equivalent black carbon (EBC) over 34 years at Alert, Canada, shed some light on the changing chemical nature of the Arctic haze, due to changes in source influence on the Arctic troposphere (Sharma et al., 2019 submitted). Here we focus only on the changes in aerosol acidity due to changes in concentrations of sulfate, ammonium, and neutralization potential to form ammonium sulphate. Figure 1 shows that trends in concentrations of sulfate, nitrate, and aerosol acidity (H^+) have decreased over 34 years at a surface measurement site Alert, Canada. A decrease in anthropogenic Eurasian emissions in the early 1990's resulted in decreasing trends in (a) sulfate, (b) ammonium, and (c) H^+, but an increase in trends in (d) nitrate have been related to a decrease in acidity, and partitioning more nitrate onto aerosol. Arctic aerosol is becoming less acidic. The increasing neutralization potential Figure 1(e) shows that sulfur oxide (SO_x) emissions are decreasing faster than ammonia (NH_3) emissions in the Eurasian region. The similar results measured at Alert also indicate that the presence of ammonium improves the neutralization process. This change in atmospheric neutralization and an increase in the formation of ammonium sulfate hydrate might have climate implications.

Sharma, S., L. Barrie, E. Magnusson, G. Brattstrom, R. Leaitch, A. Steffen and S. Landsberger (2019), Multi-Decadal trends in lower tropospheric Arctic Aerosol chemistry, Equivalent Black Carbon, Ozone and Mercury at Alert, Canada. Submitted to J. Geophysical Res.

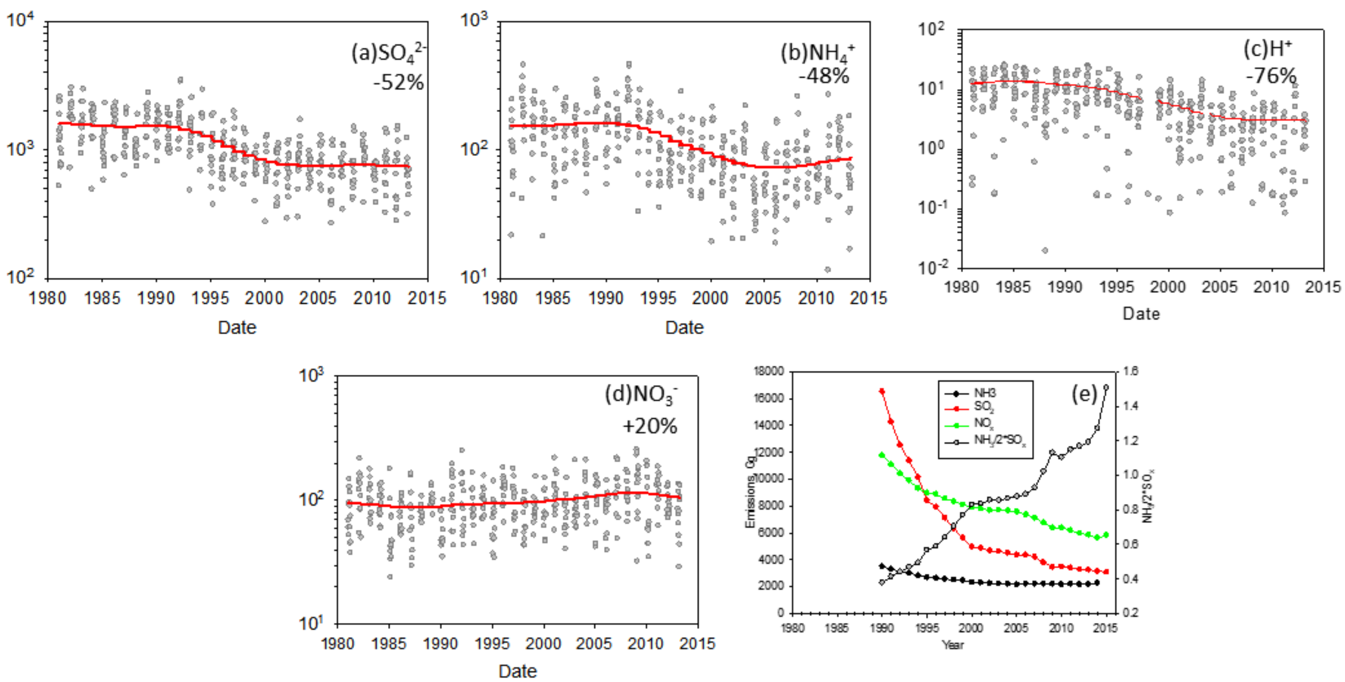

Figure 1. Trends in aerosol concentrations of (a) sulfate, (b) ammonium (NH_4^+), (c) H^+, (d) nitrate (NO_3^-) and emissions of NH_3, SO_x, nitrogen oxide (NO_x), and equivalence ratios of NH_3 and SO_x emissions.