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Long Range Transport of Aerosols into the Canadian High Arctic

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We have carried out a series of aerosol measurements at the Polar Environment Atmospheric Research Laboratory (PEARL), which is located at (80o N; 86o W) in the Canadian high Arctic. PEARL is at 610m above sea level, so it is within the free troposphere most of the time and is therefore ideally suited for measurements of long range transport into the Arctic. The measurements were made using an aerosol mass spectrometer (AMS; Aerodyne Research Inc.) which was designed to ensure that sample integrity was maintained while sampling air at temperatures that average -40 C in the winter and can be as low as -55 C. Aerosol mass concentration, size and chemical composition were measured. The following aerosols were measured with the indicated detection limits: sulfate (0.003 μg m-3), undifferentiated organics, (0.04 μg m-3) and nitrates (0.002 μg m-3). Ammonium (0.02 μg m-3) was not detected for most of the time.
This presentation will report long term trends as well as shorter episodes of increased mass concentrations that lasted from several hours to a few days. These were investigated using both statistical correlations to identify common origins. We associate short episodes of high sulfate mass concentration with air parcels having anthropogenic origins and for these cases, we used Lagrangian modelling with FLEXPART to identify the source regions. In all cases, the source regions for these were located at latitudes below about 60o N. Most of these lower-latitude footprints were on land, but sulfate emissions from shipping in the Atlantic were also detected. These results demonstrate that there is direct transport of polluted air into the high Arctic on a time scale of 2–3 weeks. Sources of the polluted air include a wide variety of industrial, resource extraction and petroleum related activity as well as from large population centres at latitudes as low as about 40o N.