Study of Arctic aerosol particle properties from ATR-42 aircraft in situ measurements during POLARCAT campaign conducted in 2008 during arctic summer.

B.Quennehen[a], A. Schwarzenboeck[a], J-F Gayet[a], C.Gourbeyre[a], F. Doussière[a], A.Stohl[b], K.Law[c], G.Ancellet[c]

[a] *Laboratoire de Météorologie Physique, Université Blaise Pascal/CNRS, Aubière, France*

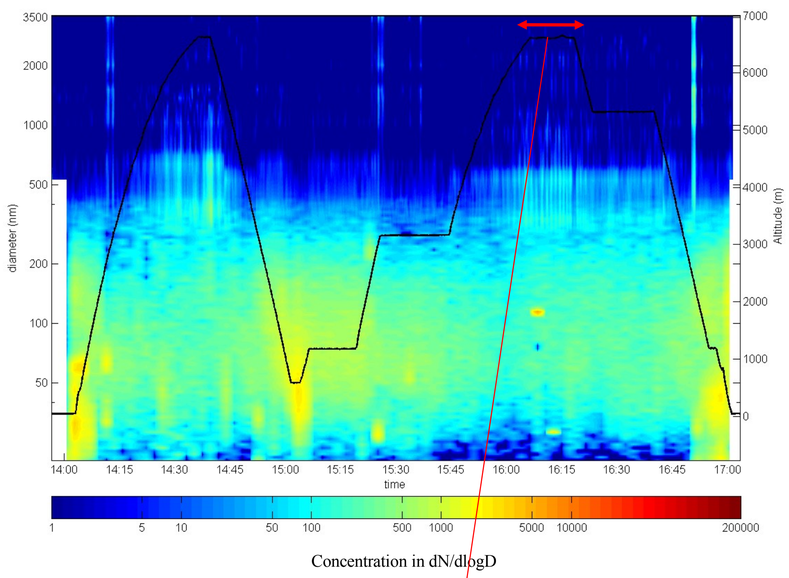
[b] *Norwegian Institute for Air Research, Kjeller, Norway*

[c] *Laboratoire Atmosphère, Milieux, Observations Spatiales, Université Pierre et Marie Curie/IPSL, Paris, France*

The POLARCAT project aims to quantify the contribution and impact of trace gases and aerosols transported to the Arctic region. Within the frame of this project, the French ATR-42 research aircraft, equipped particularly with in-situ and remote sensing instrumentation, was deployed during 2 measurement campaigns in 2008. While during the spring campaign the ATR-42 has been flying out of Kiruna, Sweden, the summer campaign was operated out of Kangerlussuaq, Greenland. Both campaigns aimed to characterize anthropogenic pollution plumes transported (from North America, Siberia) to the Arctic.

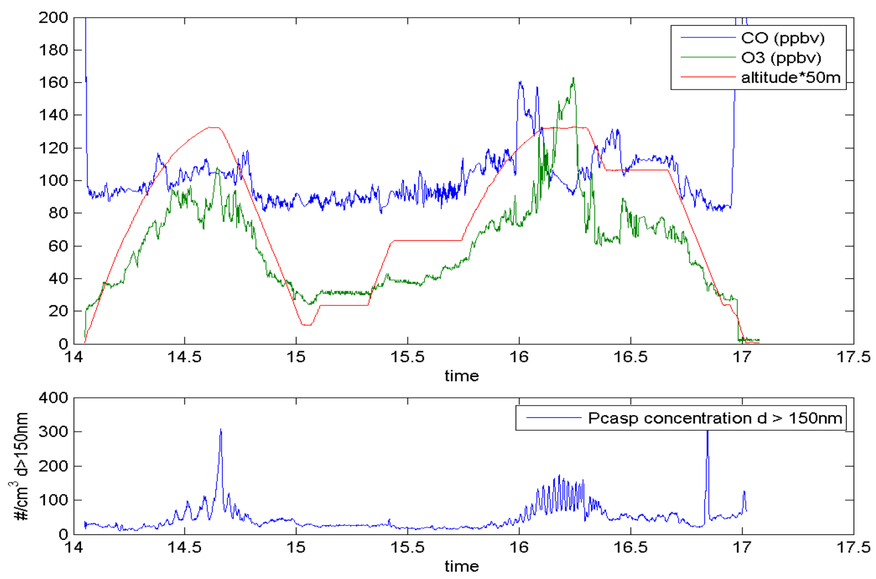
This study presents primarily in-situ measurements of aerosol physical and optical properties for the summer campaign. In particular, complete aerosol size distribution measurements (20 nm to 3 µm in diameter) have been performed next to measurements of absorption and scattering coefficients. In addition, complementary measurements of aerosol chemical in situ properties and aerosol remote sensing have been performed on board the same aircraft.

Flexpart products are used to determine in-situ measured aerosol origins and composition (at least for forest fires and anthropogenic pollution) and, thus, helping to better interpret correlation between aerosol, CO, and Ozone in-situ measurements.

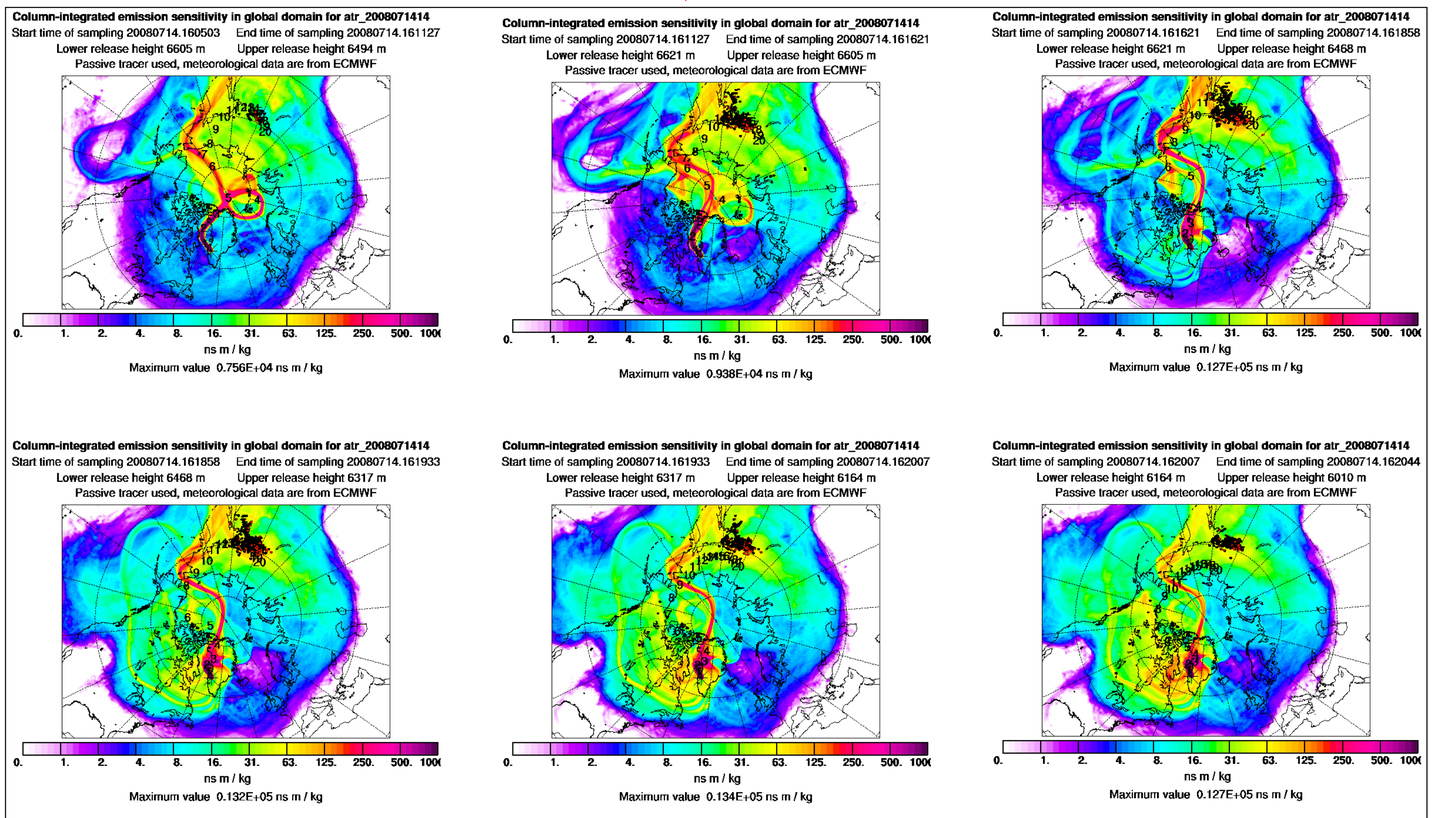


Aerosol size distribution, 14 July 2008, flight n°82 where higher concentration in large particle appear in high altitude due to biomass burning plumes.

1. Physical aerosol properties and transport



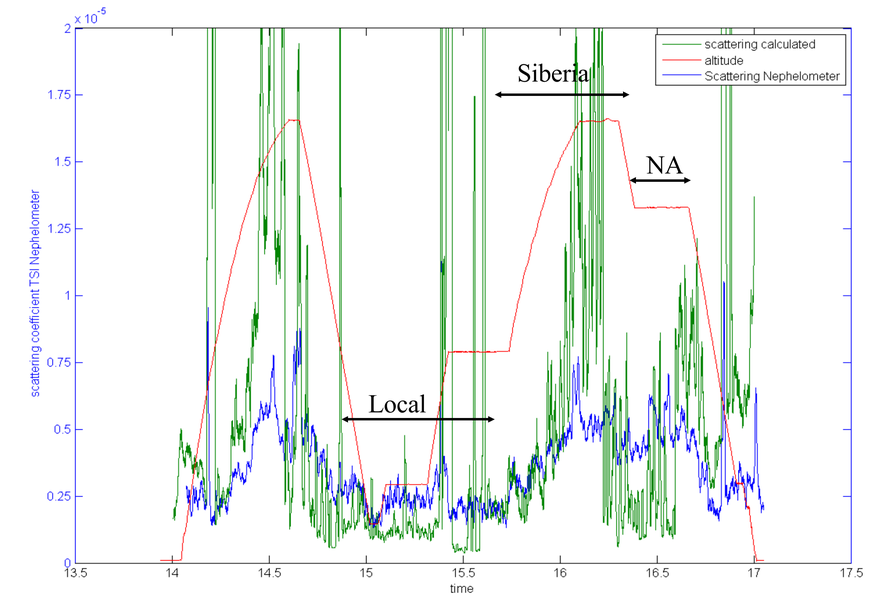
CO and O_3 profiles and large particle concentration (diameter > 150nm). Ozone peak are in good agreement with air mass origins and accumulation mode's particle concentration increase



Figures on top are Flexpart passive tracer column integrated emission sensitivities. Red and black dots represent forest fires. These figures show how Siberian biomass burning plumes are transported to Greenland after passing over the pole. The above Flexpart figures are calculated for the second flight leg, the figures are pretty similar for the first one. Aerosol, CO, and O_3 profiles on the left figure are in good agreement with air mass origins, especially for the second leg where an Ozone peak appear, which can't be explain only by natural production.

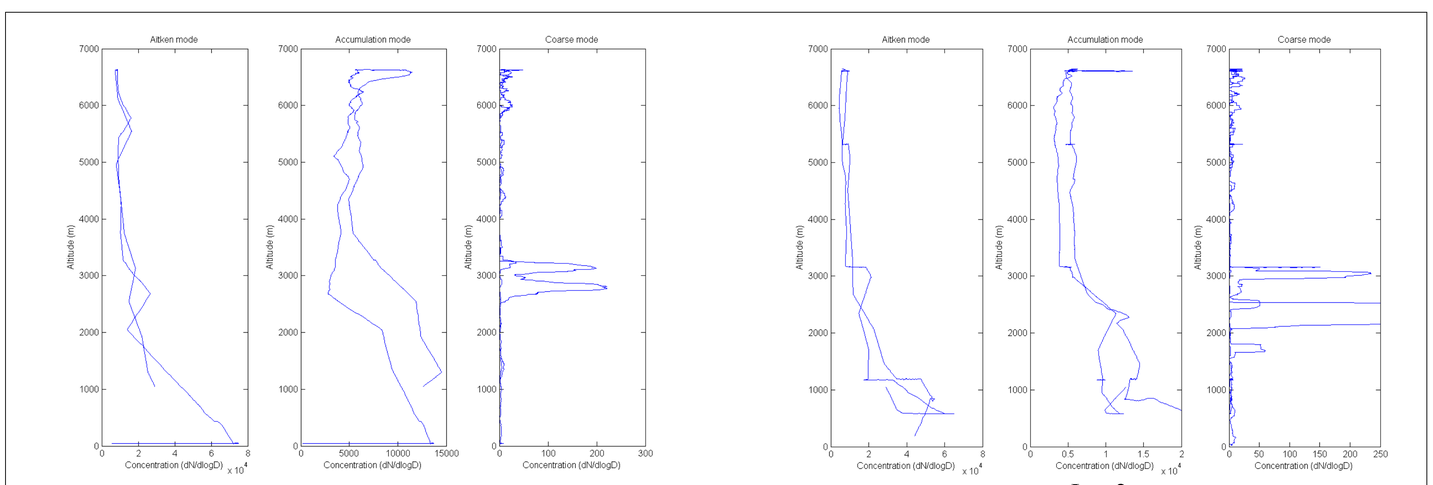
For both legs, Aïtken (20-100 nm), accumulation (100-1000 nm) and coarse (1-3,5 µm) mode concentrations have been plotted as a function of altitude on bottom figures. Accumulation mode concentrations increase at the highest altitude corresponding to biomass burning air masses.

2. Optical aerosol properties



Scattering coefficient measured by the TSI nephelometer (blue curve) and calculated from aerosol size distribution (green curve). The red curve is the ATR's flight altitude. This is a NOT a final result.

Black arrows express different air mass origins which are particularly dependent on flight altitude. To estimate the scattering coefficient, one specific (humidity dependent) refractive index has been used.



Leg 1 Leg 2

For each leg, the left, center and right figure are respectively, Aïtken, accumulation and coarse mode as a function of altitude

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