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Airborne DOAS measurements of aerosol extinction and NO_2 profiles in Arctic: two cases studies and their transport interpetation

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We present airborne DOAS measurements of aerosol extinction and NO_2 tropospheric profiles measured over the sea along the North coast of Norway during the POLARCAT-France spring campaign. The DOAS instrument was installed on the French Safire ATR-42 aircraft and measured scattered light spectra in near-limb geometry using a scanning telescope. This configuration achieves both high sensitivity and fine vertical resolution when the plane performs vertical soundings. Profile retrievals are based on the maximum a posteriori method, for which we compare a linear and a logarithmic approach. We use O4 slant column measurements to derive the aerosol extinction at 360 nm. The result is compared with extinction calculated from simultaneous in-situ measured size distribution. Two soundings are presented, one performed on 8 April 2008 at 71°N, 22°E and a second on 9 April 2008 at 70°N, 17.8°E. The first profile shows aerosol extinction and NO_2 in the marine boundary layer with respective values of 0.04±0.005 km^{-1} and 1.9±0.3 x 10^9 molec/cm^3. A second extinction layer of 0.01±0.003 km^{-1} is found at 4 km altitude. During the second sounding, clouds prevented retrievals below 3 km altitude but a layer with enhanced extinction (0.025±0.005 km-1) and NO_2 (1.95±0.2 x 109 molec/cm3) is clearly detected at 4 km altitude.

From CO and ozone in-situ measurements complemented by FLEXPART retroplume products, we interpret the measurements in the free troposphere as, for the first sounding, a mix between stratospheric and polluted air from Northern Europe and for the second sounding, polluted air from Central Europe containing NO_2. Cold temperatures in the troposphere enabled the transport of this short-lived compound. Considering the boundary layer measurements, modeled source regions indicate closer sources, especially the Kola Peninsula smelters, which can explain the NO_2 enhancement not correlated with a CO increase at the same altitude.