Annual cycle of Background Aerosol at Troll Station, Antarctica

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The aerosol monitoring program at Troll Antarctic atmospheric observatory (Queen Maud Land, 72°01′S, 2°32′E, 1309 m a.s.l.) includes the aerosol scattering coefficient at 450, 550, and 700 nm (TSI 3563 nephelometer) and the particle number size distribution (0.03 µm < Dp < 0.8 µm, Differential Mobility Particle Sizer, DMPS) (Hansen *et al.*, 2009). The time series of both instruments, collected since Feb. 2007 (see Figure 1), show a distinct annual cycle of the aerosol properties associated with background air masses, i.e. those not corresponding to peaks of any origin. Comparison of the aerosol scattering coefficient measured by nephelometer and calculated from the DMPS measurements by Mie-theory assuming an (NH4)2SO4 composition show a correlation coefficient of ~0.8, confirming a common origin of both annual cycles. The same annual cycle in background aerosol scattering coefficient as found at Troll can be detected in corresponding data collected at South Pole atmospheric observatory. This shows that that the annual cycle of Antarctic background aerosol properties is a large scale phenomenon.

Using the Lagrangian transport model FLEXPART and ground-level ozone data collected at Troll, it is demonstrated that the air masses associated with background aerosol loadings at Troll originate from the upper troposphere / lower stratosphere UT/LS) region and descend over the Antarctic continent. Further, the aerosol property annual cycle includes a cycle of total aerosol particle volume. FLEXPART is used also to calculate the integral solar irradiance the background air masses received prior to arriving at Troll. It is demonstrated that the observed annual cycle in Antarctic background aerosol properties is consistent with the assumption of a production of aerosol volume in Antarctic UT/LS air that is limited by solar irradiance, i.e. photochemical production.

The observed annual cycle in Antarctic UT/LS aerosol is suggested as benchmark test for natural aerosol processes for climate models in order to improve the distinction between natural and anthropogenic aerosol.

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Hansen, G. et al. (2009): Polar Res. **28**(3), 353–363

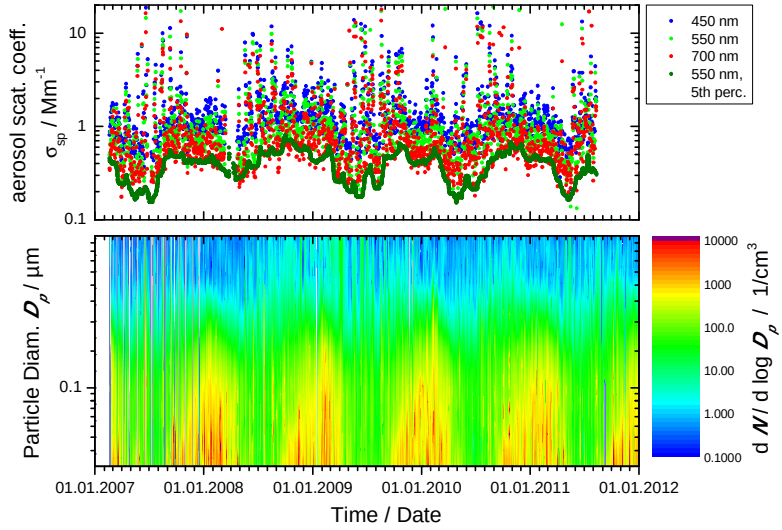

Figure 1: Troll 2007 - 2011 time series of aerosol scattering coefficient (450, 550, 700~nm, daily averages, upper panel) and particle number size distribution (PNSD, lower panel). Upper panel also contains time series of the 550~nm aerosol scattering coefficient running 4 week 5th percentile (dark green) to underline the background annual cycle. The PNSD is plotted as colour contour surface plot time series.