Aerosol optical properties and distribution during the extreme Arctic pollution event in spring 2006

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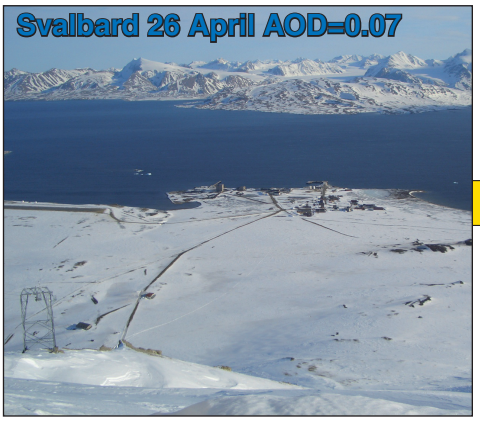
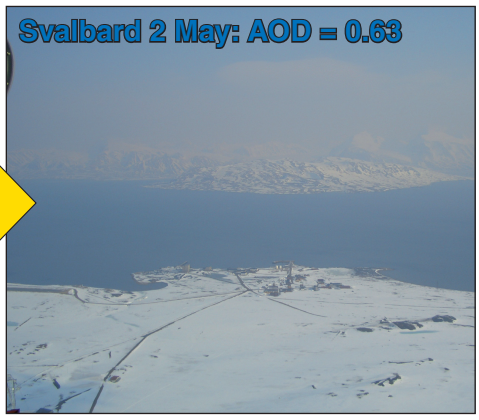


Spring 2006

- Agricultural fires in Eastern Europe
- Extensive transport of pollution across Scandinavia into the Arctic region (Stohl et al. 2007).
- Record high air-pollution levels at the Zeppelin observatory at Ny-Ålesund (78º 54'N, 11º 53'E)
- Maximum levels on 3-5 May 2006
- Radiative forcing and single scattering albedo of the event is calculated based on AOD from MODIS and observations, observed aerosol profiles, size distributions, chemical compositions of the aerosols at Ny-Ålesund *



Aerosol Optical Depth, AOD

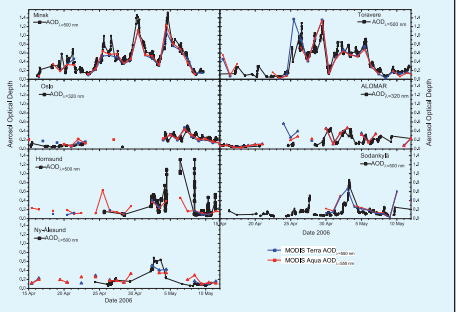
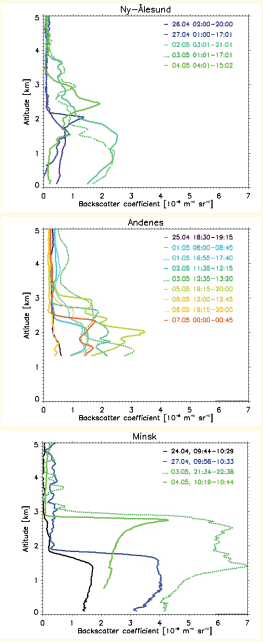


Figure 1: Comparison of 1° x 1° grid averaged MODIS AOD and AOD from the ground based stations in the period 15 April – 15 May 2006.

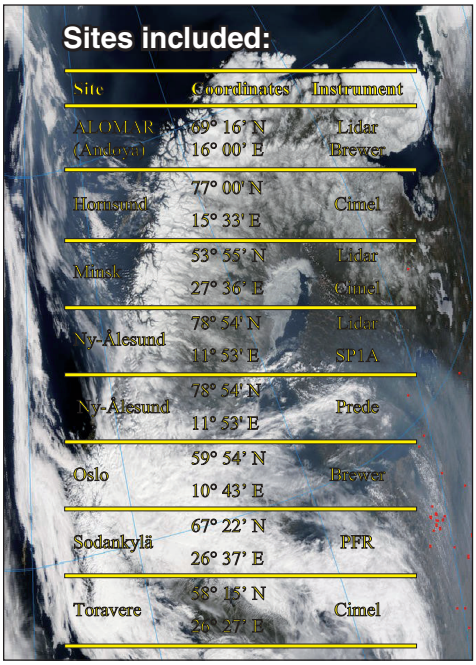
The AOD from MODIS aboard both the Terra and Aqua satellites is used in the radiative forcing calculations. Thus a comparison of these data and the available ground based AOD at the different locations is required. The agreement between the ground based AOD and MODIS AOD under non-snow conditions are very good at all sites



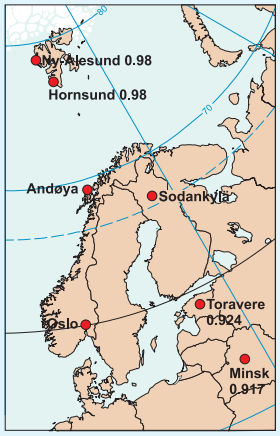
Aerosol properties

Ångstrøm exponents was in the range from 1.7 - 2.1 during the most intense period, indicating small aerosols. The volume size distributions from AERONET inversion products showed 3 modes in Toravere and Minsk, and 2 modes at Hornsund; the largest mode is missing in Hornsund.

The vertical distribution of the aerosol backscatter coefficients from the EARLINET sites are shown to the left and the top layer are around 3 km in Minsk and 2 km at Ny-Ålesund.



Single scattering albedo, SSA



- The SSA increases with time and distance from the source.
- The SSA in Ny-Ålesund is calculated with Mie theory based on the chemical composition and is in agreement with the SSA retrieved from the AERONET station at Hornsund.

Figure 3: The mean SSA retrieved from AERONET for the period 15 April - 15 May.

Radiative forcing

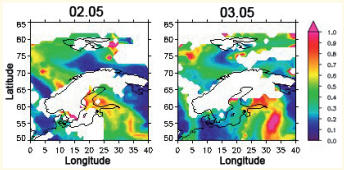
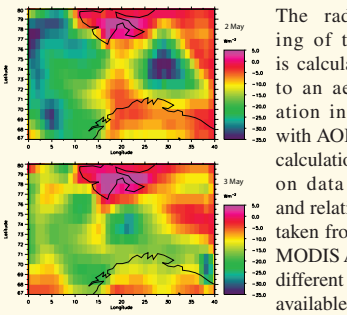


Figure 4: MODIS AOD from 2 and 3 May.



The radiative forcing of the episode is calculated relative to an aerosol situation in the spring with AOD=0.05. The calculations are based on data for clouds and relative humidity taken from ECMWF, MODIS AOD and the different observations available.

Figure 5: Radiative forcing of the episode

Conclusions

- Very high AOD values at all sites: max between 0.68-1.52
- Reduced aerosol radius as the distance to the source is increasing
- Increased single scattering albedo from 0.91 to 0.98 as the air mass are transported towards the Arctic
- Radiative forcing: Strong cooling effect of the aerosols above the sea in the Arctic region. This will probably dominate the positive values obtained above snow/ice

Acknowledgements

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* Work based on Myhre et al (2007).

References

Myhre, C. Lund, et al., Regional aerosol optical properties and radiative impact of the extreme smoke event in the European Arctic in spring 2006, Accepted for publication in *Atmos. Chem. and Phys Disc*, June 2007

Stohl, A., et al.: Arctic smoke – record high air pollution levels in the European Arctic due to agricultural fires in Eastern Europe in spring 2006, *Atmos. Chem. Phys.*, 7, 511--534, 2007.