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# Regional aerosol optical properties and radiative impact of the extreme smoke event in the European Arctic in spring 2006

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Abstract. In spring 2006 a special meteorological situation occurred in the European Arctic region giving record high levels of air pollution. The synoptic situation resulted in extensive transport of pollution predominantly from agricultural fires in Eastern Europe into the Arctic region and record high air-pollution levels were measured at the Zeppelin observatory at Ny-Ålesund (78°54' N, 11°53' E) in the period from 25 April to 12 May. In the present study we investigate the optical properties of the aerosols from this extreme event and we estimate the radiative forcing of this episode.

We examine the aerosol optical properties from the source region and into the European Arctic and explore the evolution of the episode and the changes in the optical properties. A number of sites in Eastern Europe, Northern Scandinavia and Svalbard are included in the study. The observations show that the maximum AOD was from 2–3 May at all sites and varies from 0.52 to 0.87, and the corresponding Ångstrøm exponent was relatively large. Lidar measurements from Minsk, ALOMAR (Arctic Lidar Observatory for Middle Atmosphere Research at Andenes) and Ny-Ålesund show that the aerosol layer was below 3 km at all sites the height is decreasing from the source region and into the Arctic. For the AERONET sites included (Minsk, Toravere, Hornsund) we have further studied the evolution of the aerosol size. The single scattering albedo at Svalbard is provided for two sites; Ny-Ålesund and Hornsund. Importantly the calculated single scattering albedo based on the aerosol chemical composition and size distribution from Ny-Ålesund and the AERONET measurements at Hornsund are consistent. We have found strong agreement between the satellite daily MODIS AOD and the ground-based AOD observations. This agreement is crucial for accurate radiative forcing calculations. We calculate a strong negative radiative forcing for the most

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polluted days employing the analysed ground based data, MODIS AOD and a multi-stream model for radiative transfer of solar radiation. During this specific pollution event the forcing reached values as low as $-35$ W m$^{-2}$ in the region. For comparison, the direct forcing of a corresponding aerosol layer with a typical AOD of 0.05 for the season is around $-5$ W m$^{-2}$.

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