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Characterization of aerosol particle episodes in Finland caused by wildfires in Eastern Europe

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Abstract. We studied the sources, compositions and size distributions of aerosol particles during long-range transport (LRT) $PM_{2.5}$ episodes which occurred on 12–15 August, 26–28 August and 5–6 September 2002 in Finland. Backward air mass trajectories, satellite detections of fire areas and dispersion modelling results indicate that emissions from wildfires in Russia and other Eastern European countries arrived in Finland during these episodes. Elemental analyses using scanning electron microscopy (SEM) coupled with energy dispersive X-ray microanalyses (EDX) showed that the proportions of S-rich particles and agglomerates (agglomeration was caused partly by the sampling method used) increased during the episodes, and they contained elevated fractions of K, indicating emissions from biomass burning. These aerosols were mixed with S-rich emissions from fossil fuel burning during transport since air masses came through polluted areas of Europe. Minor amounts of coarse Ca-rich particles were also brought by LRT during the episodes, and they probably originated from wildfires and/or from Estonian and Russian oil-shale-burning industrial areas. Ion chromatography analysis showed that concentrations of sulphate (SO_4^{2-}), total nitrate (NO_3^-+HNO_3(g)) and total ammonium (NH_4^++NH_3(g)) increased during the episodes, but the ratio of the total amount of these ions to PM_{10} concentration decreased, indicating unusually high fractions of other chemical components. Particle number size distribution measurements with differential mobility particle sizer (DMPS) revealed that concentrations of particles 90–500 nm increased during the episodes, while concentrations of particles smaller than 90 nm decreased. The reduction of the smallest particles was caused by suppressed new particle formation due to vapour and molecular cluster uptake of LRT particles. Our results show that emissions from wildfires in Russian and other Eastern European countries deteriorated air quality of very large areas, even at distances of over 1000 km from the fire areas.

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