



Biomass burning aerosols measured with in-situ and remote sensing instruments in Kuopio, Finland during the Russian forest fires in 2010

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During June-August 2010, intensive forest fires took place in the western parts of Russia, near Moscow. The smoke from the fires and associated pollutant gases and aerosol particles had a considerable effect on air quality and visibility over large region. We studied the characteristics of these biomass burning aerosols with in-situ and remote sensing instruments located in Kuopio.

The smoke transported long distances with air masses, and during several days, it was observed in Kuopio, Finland, 900 km Northwest from Moscow, where the Puijo observation tower is located. The Puijo station provides continuous data on particle and cloud droplet size distributions, optical properties of particles, various weather parameters and concentrations of some trace gases. Furthermore, Kuopio has several sites for air quality monitoring (PM, SO₂, NO_x, etc.). In addition to the in-situ measurements, data from various remote sensing instruments were available for the smoke episode. An AERONET site is located in Kuopio, while MODIS and CALIOP provide additional information with a larger spatial coverage.

Preliminary results show increased aerosol concentrations in Kuopio during July and the beginning of August. The highest concentrations were detected on the 29th of July and on the 8th of August. During these days the particle mass concentration (PM_{2.5}) was 50 µg/m³, which is approximately 8 times more than on an average day. Moreover, black carbon concentrations increased in a similar manner from 100 ng/m³ to 2000 ng/m³. The plume days were also clearly visible in the CO measurements. For other trace gases (NO₂, NO, O₃), the local sources seemed to dominate the concentrations.

AERONET and MODIS measurements also detected the increased aerosol concentrations. The AOD values from the instruments are in good agreement during the studied episode. The correlation coefficient for the AODs is 0.99. The highest AOD values are 1.4 and 1.5 for AERONET and MODIS, respectively. These values are much higher than average values (around 0.1-0.2) in this region. However, on the 8th of August, MODIS retrieved AODs larger than 5 from the center of the biomass burning plume, thus the elevated concentrations measured at Kuopio are modest in comparison. Remote sensing measurements were also compared with in-situ data. The PM_{2.5} and AERONET AOD data show an excellent agreement during the studied period. The correlation coefficient between the instruments is 0.86. Vertical profiles of attenuated backscatter (532 nm) from CALIOP shows that the smoke was lifted up to 5 km by the time it reached Finland, the thickest part of the plume being between 2 and 5 km. Therefore, the surface concentrations of aerosols were not as large in Kuopio as in the vicinity of Moscow.

These results give a versatile picture of the 2010 biomass burning plumes from Russia and how they affect air quality over 1000 km away from the actual fires.