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Lidar observations of atmospheric boundary layer dynamics and aerosol loading in urban environments

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With the increasing urbanization and industrialization, high concentrations of particulate matter are often found in urban areas. The increase of aerosol concentrations may have significant impacts on the local environment and quality of life, as well as atmospheric processes in the boundary layer (ABL).

Aiming at the study of ABL dynamics and aerosol loading in urban areas, a measurement campaign was performed in Slovenia's capital Ljubljana (15-18 June 2012) and a regional town of Nova Gorica (18-21 June 2012) using a mobile elastic lidar operated in infrared range (1064nm). Throughout the lidar operation, concentrations of PM_{10}, NO_X and meteorological data (temperature, humidity, air pressure and wind speed and direction) were continuously monitored at both lidar sites. In addition, in Ljubljana meteorological radiosondes were launched daily at 2 AM.

As a result of the present study, we obtained temporal development of aerosol loading above Ljubljana and Nova Gorica, which was used to investigate the ABL dynamics. Comparison of the lidar- and radiosonde-derived ABL height in Ljubljana confirmed them to be in a very good agreement. Daily variation of the ABL height was clearly seen from temporal development of lidar returns, showing an average value of 800 m at night and 1500 m at noon. On 18 June 2012, air masses with high content of Saharan dust reached Slovenia, which was observed by lidar both in Ljubljana and Nova Gorica. Ground-based measurements at both locations show that PM_{10} concentrations exceeded the 3-year average for a factor of two. In Ljubljana, the presence of Saharan dust was first observed during the night and within the ABL (at about 1800 m), with a large entrainment zone of about 1200 m. In Nova Gorica, Saharan dust was fist observed at 4 km and was found to descend due to gravity at a rate of about 100 m per hour.