Impact of Aerosol Contamination for Radiative Forcing to the Atmosphere Over Kyiv According to Lidar Campaign and Sun Photometer Observations

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The report presents the results of 3-months lidar observations in Kyiv, Ukraine. The lidar campaign took place in July-September 2015. The Laboratory of Optics of the Atmosphere, University Lille1, provided the CIMEL370 lidar. During the campaign, the first observations of spatial variation aerosol particles in the atmosphere over Kyiv have been provided. For this work, lidar measurements were validated with the sun photometer of the AERONET network. Both instruments were located at the Main Astronomical Observatory of the National Academy of the Science of Ukraine to avoid the impact of different meteorological conditions or sources of the plumes. Simultaneous lidar and sun photometer observations were chosen for analysis. The extinction coefficient and aerosol optical thickness for three months were considered to study the altitude aerosol particles distribution. The observations showed a spatial distribution of the main aerosol concentration during normal aerosol conditions for Kyiv (industrial aerosols from fabrics, cars, some mineral dust) and nontypical conditions as impacting wildfires from the North part of Ukraine.

The extinction coefficient and aerosol optical thickness retrieval have been used for radiative forcing calculation with radiative transfer model GAME. The code GAME was also provided by the Laboratory of Optics of the Atmosphere, University Lille1, and modified for current needs. These results were compared with radiative forcing results of the AERONET. This station has been providing aerosol measurements since 2008. In addition, in this report the trend of radiative forcing for July–September and yearly trends of changing radiative forcing, aerosol optical thickness, and Angstrom Exponent are discussed.

A large base of AERONET station observations provided enough data (aerosol optical thickness, Angstrom exponent, single scattering albedo, refractive index, and others) to analyze the main types of aerosols. Using this information cluster analysis of dominant pollutions particles were done. Maps of air mass transport and satellite images confirmed possible sources of aerosol particles. With the GIOVANNI platform and MODIS observations, the main pollutants for July-September were dedicated.

According to the result of the lidar campaign, permanent observations of AERONET network and MODIS satellite data, the information about the spatial distribution of particles, main kinds of aerosols, and their possible sources have been retrieved.