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Atmospheric composition trends and changes in ABL parameters in Moscow region

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Analysis of the long-term CO total column (TC) measurements, AOD and meteorological data in Moscow and surrounding provinces for different time-periods and seasons from 1998 to 2018 years is presented. Additionally averaged surface concentrations of key pollutants and characteristics of their inter-annual variability for Moscow territory based on Mosecomonitoring (MEM) network were used to estimate the changes in air quality. Trend estimates based on spectroscopic ground-based datasets of OIAP were compared with changes in wind speed and temperature trends obtained by use of Obninsk meteorological mast (OMM) data and datasets of sounding station no. 27612 (Dolgoprudny) as well as life-time of temperature inversions in Moscow and Zvenigorod obtained using acoustic sounding (SODAR) data.

Positive trends (0.2-1.2 %/yr depending on time-period) of wind speed in boundary layer of Moscow (Dolgoprudny, Moscow outskirts, sounding station no. 27612, layers 0-500 and 500-1000 m) were obtained for winter months of 1998-2017. In Obninsk (small town of Kaluga province) changes in wind speed were insignificant in any season and time-period after 1998. The decrease in recurrence of calm days (– 7%/yr) and anthropogenic CO column (– 6.8 %/yr) in Moscow was found for time-period after 2007. Decrease in CO TC as well as improvement of air quality in Moscow through changes in multiplicative pollution index (MPI) is partially connected with increase of car engines quality, progress in fuel quality, and improvement of pollutant removal conditions in Moscow.

Trends of CO TC in Moscow and in surrounding regions differ in their sign after 2007: decrease with the rate 1.0-2.8 %/yr for Moscow for different seasons of 2008-2018 and increase in Zvenigorod and Obninsk with the rate 0.3-0.7 %/yr for summer and autumn months were found.

AOD trends have been found as negative for Moscow and Zvenigorod (AERONET measurements) and for Europe (MODIS observations) for the same time-periods and seasons.

Significant increase of air quality in Moscow in last decade due to not only pollutant emissions reduction but also impact of "climatic factor" such as improvement of boundary layer ventilation.

To study global and regional tendencies in CO an additional analysis of other station measurements (Peterhof, NDACC European stations), as well as AIRS satellite data was carried out. It has confirmed the transition of CO to the stage of accumulation over majority of European regions after 2007.

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