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Trajectory analysis of carbonaceous aerosol transfere from boreal forests fires in central Siberia using the FLEXPART model.

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The main sources of carbon-containing aerosol on the territory of central Siberia are fires of boreal forests [1]. Biomass combustion products largely consist of elemental (EC) and organic carbon [2]. Since 2006, the background station ZOTTO (Zotino Tall Tower Observatory) has been operating in central Siberia to study the atmospheric composition of boreal ecosystems [3]. To estimate the contribution of forest fires to the total black carbon content in the atmosphere, we performed a trajectory analysis of the plume propagation from the fire centres to the observation point, as well as a comparison of experimental and model values.

Three years (2012, 2016, and 2019) were chosen for the assessments because the highest values of mass concentrations from ZOTTO station data for the last 12 years were observed then. Thermal anomalies from NASA FIRMS data from MODIS satellite were considered as sources of black carbon. The input meteorological data were selected as data of the operational global analysis of NCEP FNL. Forward black carbon trajectories were constructed using the Lagrangian dispersion model of atmospheric transport FLEXPART (FLEXible PARTicle dispersion model). The obtained values of mass concentrations were compared with local experimental data of EC mass concentrations and aerosol absorption coefficient. In addition to the local data from the station, the MERRA-2 reanalysis data were used (surface EC mass concentrations were considered).

The analysis resulted in high values of correlation coefficients (about 0.85) between mass concentrations from FLEXPART results and experimental values, as well as good qualitative agreement between the time periods of elevated values for the aerosol absorption coefficient and reanalysis data. The best coincidences are observed in the seasons with the most powerful fires, which suggests that fires are the predominant source of black carbon in the atmosphere during these periods.

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