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Thesis · December 2021

DOI: 10.13140/RG.2.2.36252.00648

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Surface ozone concentration over Russian territory in 2020-2021

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The results of surface ozone monitoring in various regions of the Russian Federation in 2020-2021 are presented. Surface ozone studies in Russia are carried out at two dozen stationary research stations. These stations are located in areas that differ significantly in climatic and meteorological conditions for ozone production, transport and deposition in the surface atmosphere: in megalopolises and their suburbs, in small cities, rural background plains, mountain areas and coastal regions.

The results of a comparative analysis of annual variations of 1-hour maximum daily and average daily concentrations are presented. In 2020, the P80(1h) percentile (an analogue to P93.2(8h)) at all stations in the Russian Federation did not exceed the level of 120 μg/m^3 which is set in the EU as the target value. The average annual ozone concentration for all stations in Russia included in the analysis was ~80 μg/m^3.

The analysis of a ratio of 1-hour maximum and average daily concentrations averaged over the year allowed to estimate the relative contribution of the local production and the baseline level to the surface ozone concentration for each station. The highest baseline concentrations were observed in the high mountains (North Caucasus), the lowest in megacities (Moscow, St. Petersburg). The rural and background areas were characterized by intermediate levels. The maximum photochemical ozone production was observed in megalopolises, and the minimum - in the areas of nature reserves.

A form of the statistical distribution of 1-hour surface ozone concentrations in annual series is very specific for regions with different regimes of ozone production and baseline level and could be used for classification of the region type.

To study the long-term variability of the surface ozone concentration the circadian character of its diurnal variations was taken into account. The long-term course of the diurnal ozone variations main parameters (the daytime production, the minimum nighttime level, and nighttime maximum) averaged over different time intervals were analyzed:. The specifics of their long-term variations for different types of region (megapolis, background, rural, mountain reserve), as well as their relationship with the ambient air temperature, has been investigated.

At a number of the Russian monitoring stations there was a significant decrease (more than 2 times) in the levels of surface ozone concentration in 2020 as compared to both previous years and 2021. These differences were observed when using various methods for analyzing annual series: statistical distribution of data, daily courses, maximum daily values, comparison of baseline ozone level and daily production. The difference in temperature regimes in the studied years were taken into account. The possible reasons for this significant decrease in the ozone concentrations may be related both to the cyclical atmospheric processes and to the decrease in anthropogenic air pollution in 2020 due to the COVID-19 pandemic and lockdown around the world. However, in a number of regions of the Russian Federation (KaraDag, Tomsk), there was no significant decrease in surface ozone concentration in 2020. The observed phenomena require additional research.