QOS 2021

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Online Meeting

QUADRENNIAL OZONE SYMPOSIUM

[D_89] Monitoring of surface ozone in the Moscow region

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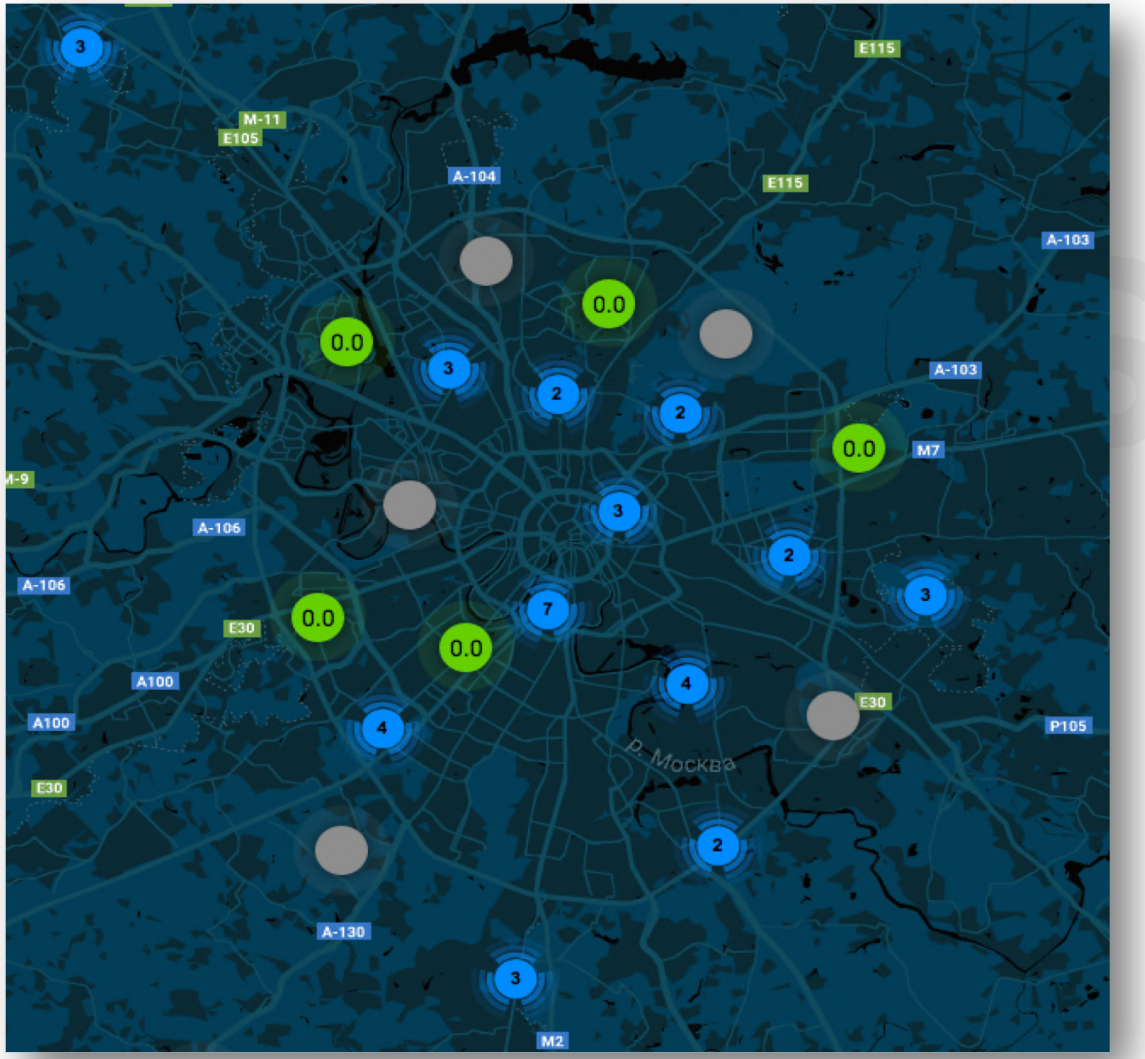
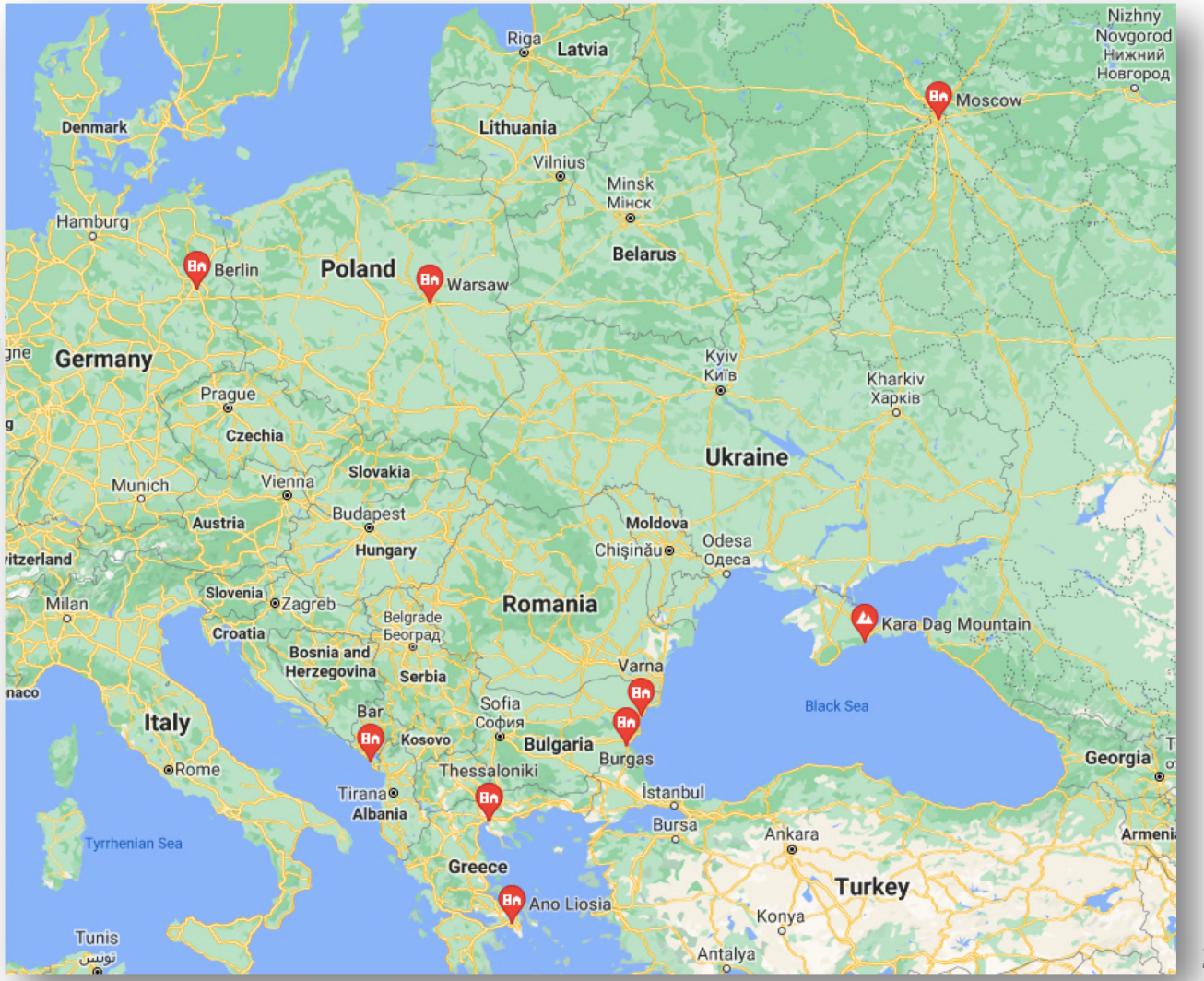
Initial data

Regular monitoring of surface ozone in the Moscow region is currently carried out at 17 urban and traffic stations. We focus our research also on episodes of hazardous to health ozone concentrations. The conditions for the formation of such episodes were explored in Moscow and European capitals, in the Black Sea region and in the Balkans.

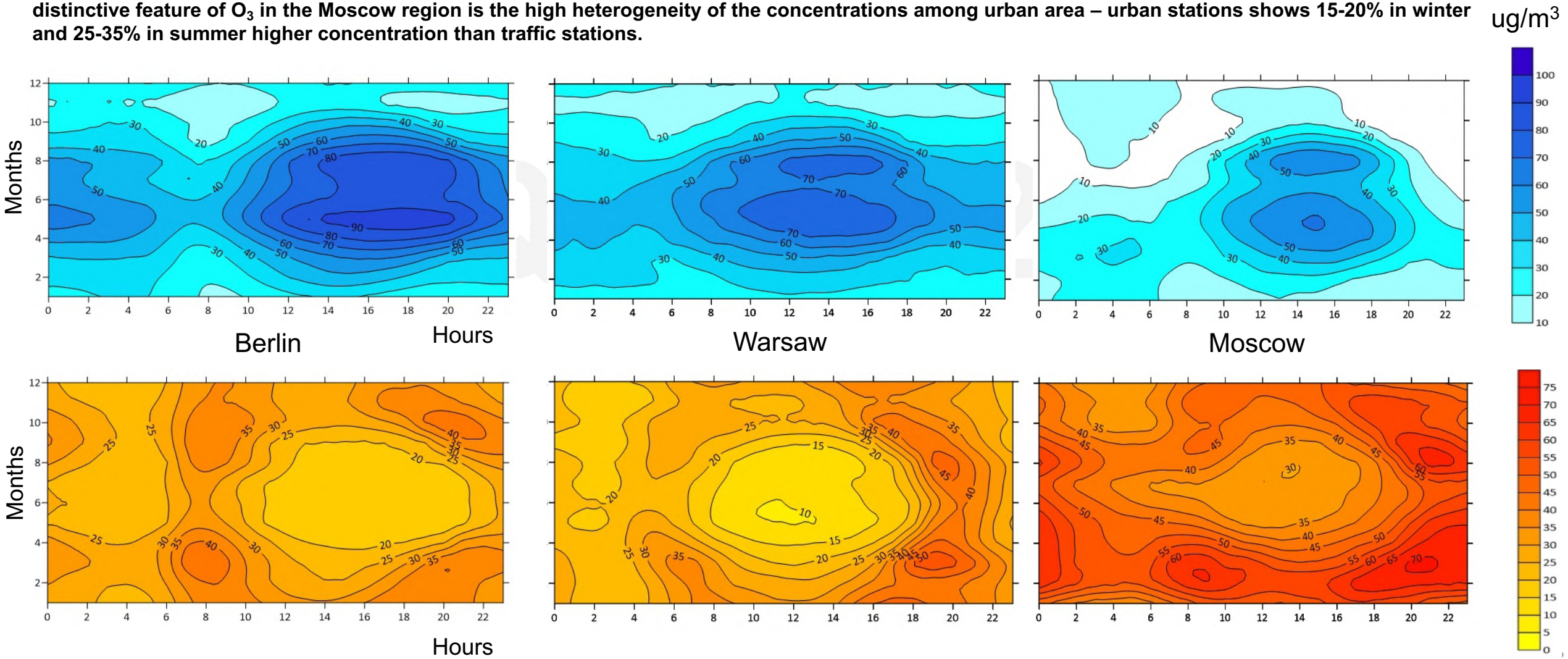
O_3 measurements in Moscow, Mosecomonitoring network:





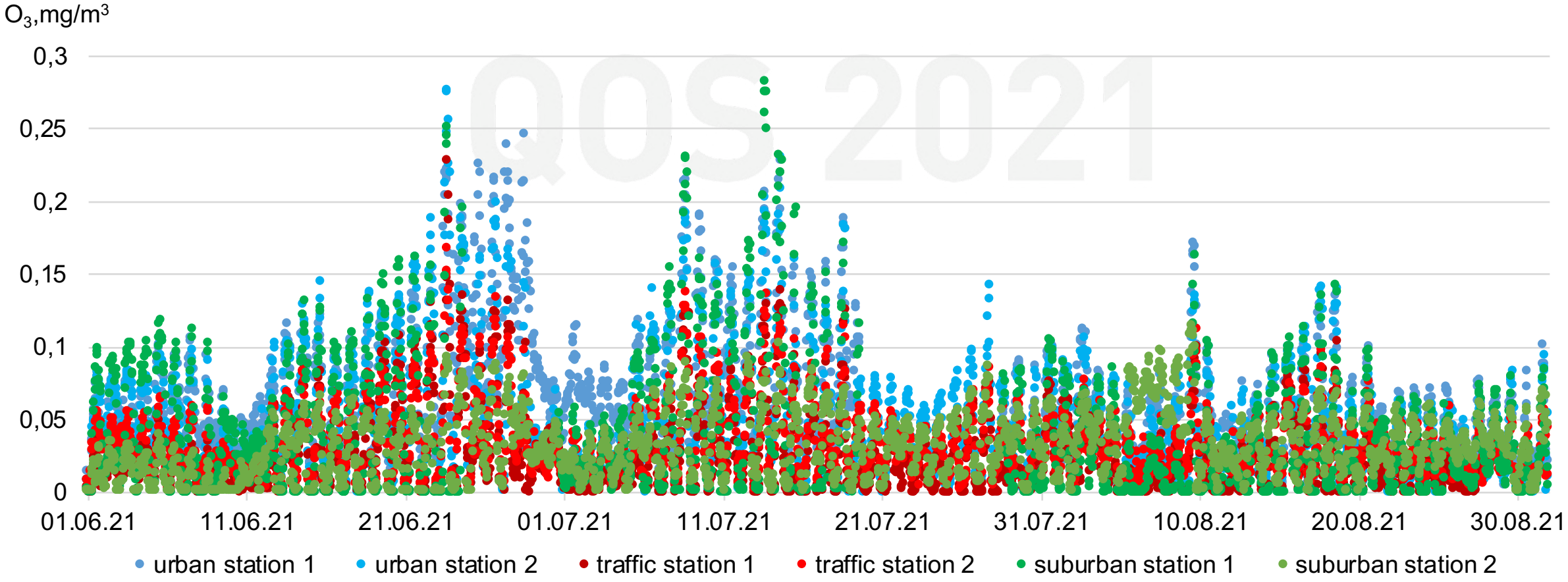
Average seasonal-daily variability of Ozone in Moscow

Average seasonal-daily variability of ozone in Moscow is similar to temporal variability of O_3 in European metropolitan areas and differs in the seasonal extrema values. The annual O_3 maximum appears in April-May, the monthly average is 50-55 µg/m^3 in Moscow and about 15-20 µg/m^3 more in Central European capitals. The spring O_3 maximum appears after the annual maximum of total ozone due to the activation of stratospheric-tropospheric exchange, but its formation depends on weather conditions. It was less than usual during the COVID-19 pandemic in spring 2020 due to abnormally cold weather in Moscow – daily maximum was about 110 µg/m^3. The secondary annual O_3 maximum did not form in Moscow in summer 2020 due to rainy weather either. A distinctive feature of O_3 in the Moscow region is the high heterogeneity of the concentrations among urban area – urban stations shows 15-20% in winter and 25-35% in summer higher concentration than traffic stations.



Moscow, summer 2021

Dry and hot weather was observed in Moscow in the summer 2021 . The average air temperature in Moscow in June 2021 was 20.5 °, anomaly is + 3.9 °. New daily temperature maximums were recorded several times, a new maximum of the month (+ 34.8 °) was recorded on June 23. 62mm of rain fell in a month, which is 83% of the norm. The average July temperature is + 22.2 °, anomaly is + 4.0 °. The amount of rainfall in July was 43mm, which is only 46% of the norm. 2 long-lasting episodes with high ozone concentrations were observed in Moscow in summer 2021.

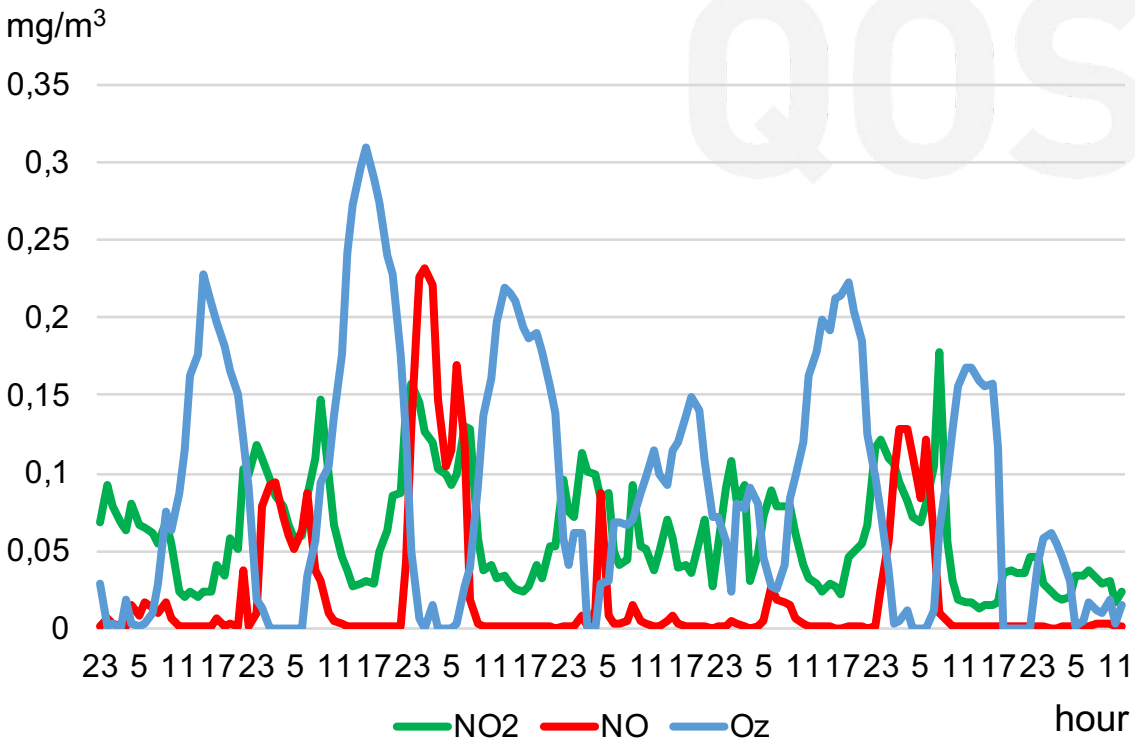


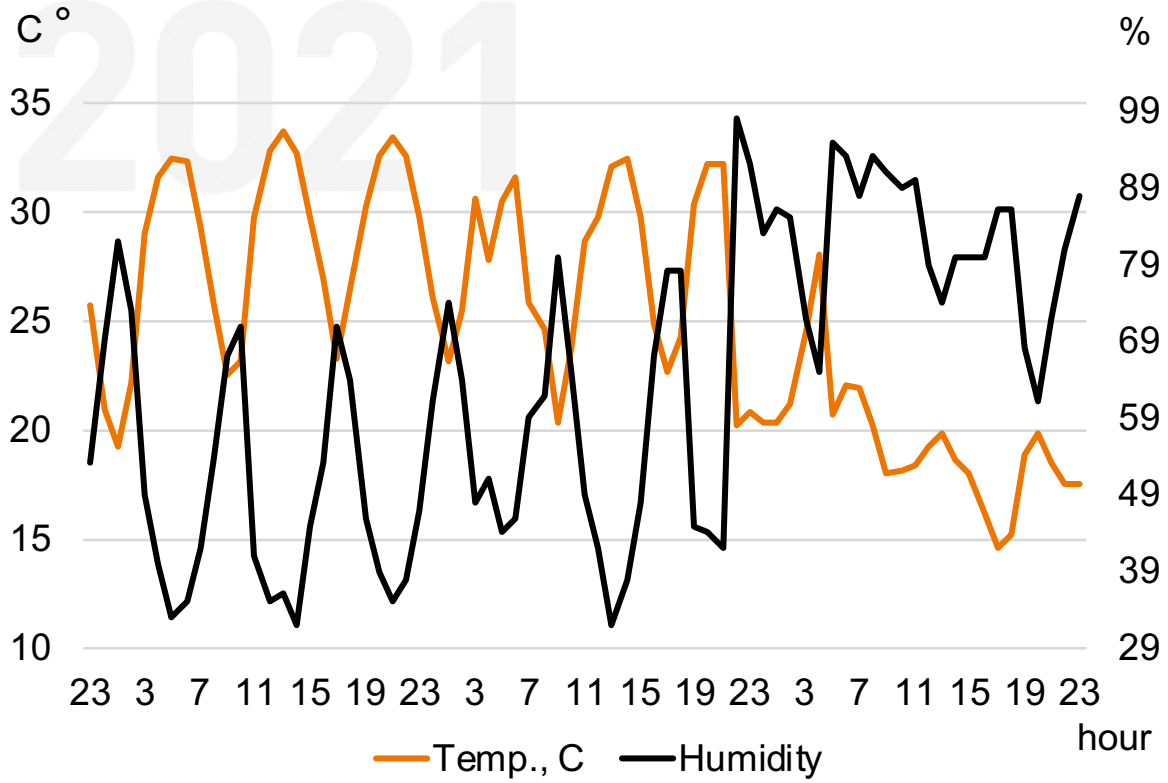
Ozone first type episodes

Ozone episodes of the first type are formed in hot, dry and calm weather conditions as a result of photochemical ozone production during O_3 precursors concentrations in air increase.

2 long-lasting episodes with high ozone concentrations were observed in Moscow in summer 2021. The maximum concentrations reached 309 ug/m³.

Ozone episode on June 23-29, 2021:



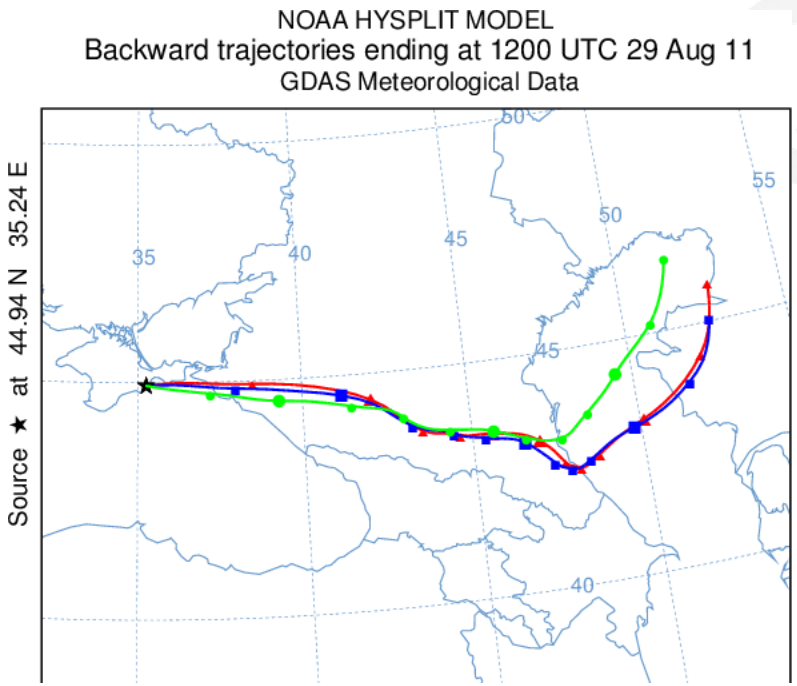


Second type of ozone episodes is associated with long-range transport of air masses containing large amount of ozone.

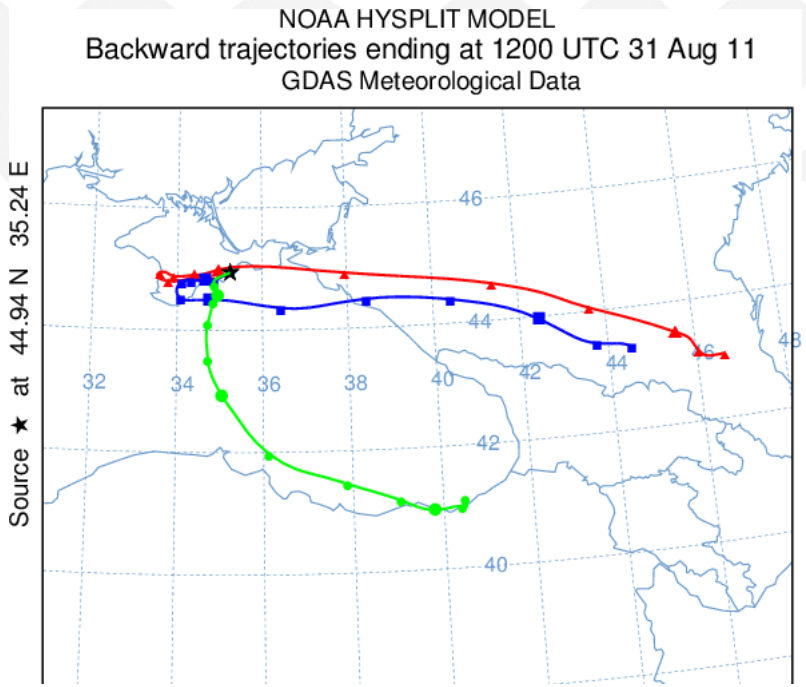
An example is the large-scale ozone episode in late summer 2011, when extremely high O_3 levels (160-200 μg/m^3) were recorded at coastal monitoring stations in Bulgaria, Greece, Montenegro and Crimea. The analysis of synoptic situation and air masses trajectories showed th at the abnormally hot and dry weather in the southern latitudes and, apparently, inflow of hydrocarbons from the oil and gas production si tes of the Caspian region, which the air mass that came to the Crimea and the Balkans moved above, created favorable conditions for the photochemical production of ozone in the lower troposphere.

Trajectories of air masses arrived in Crimea:

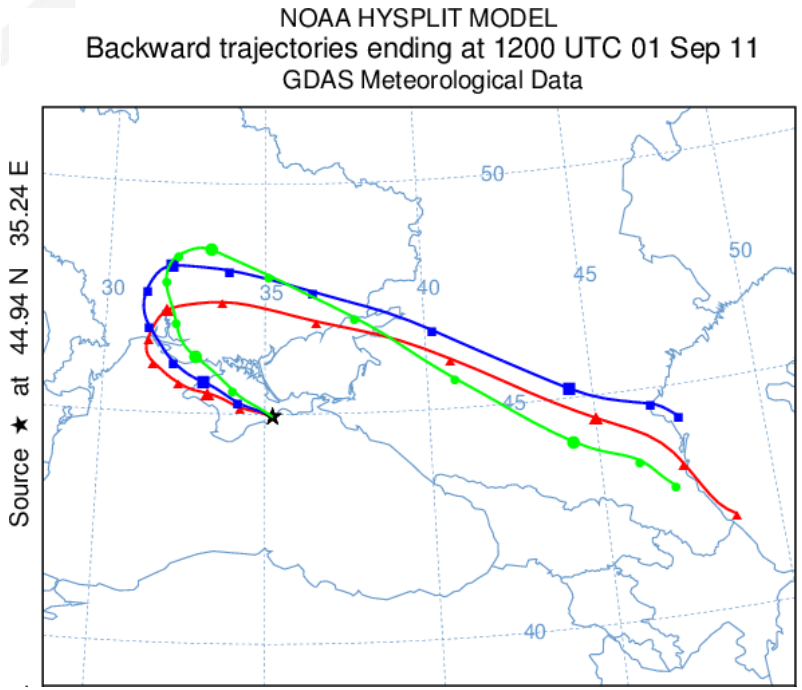
0,8 km 1 km 1,5 km



Beginning of the episode



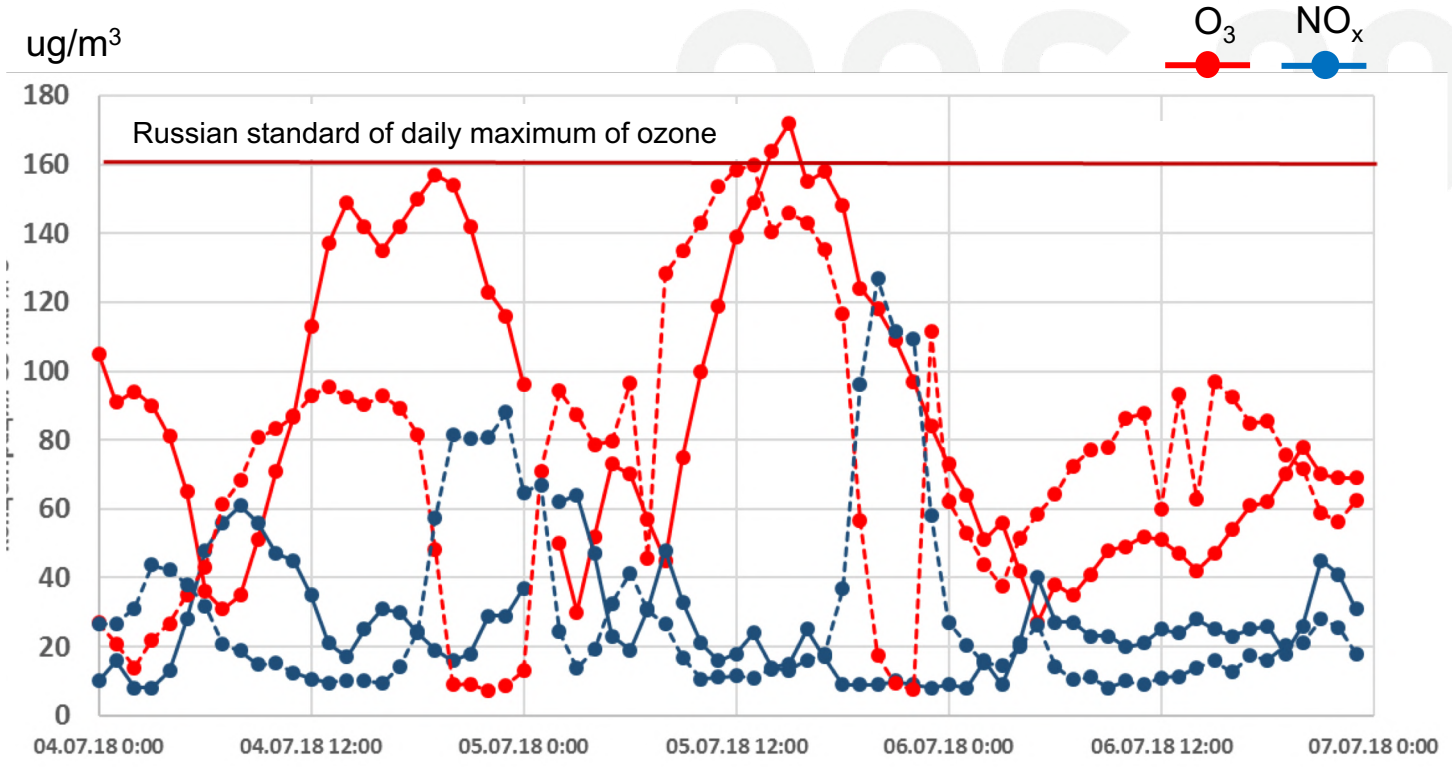
Extreme ozone level

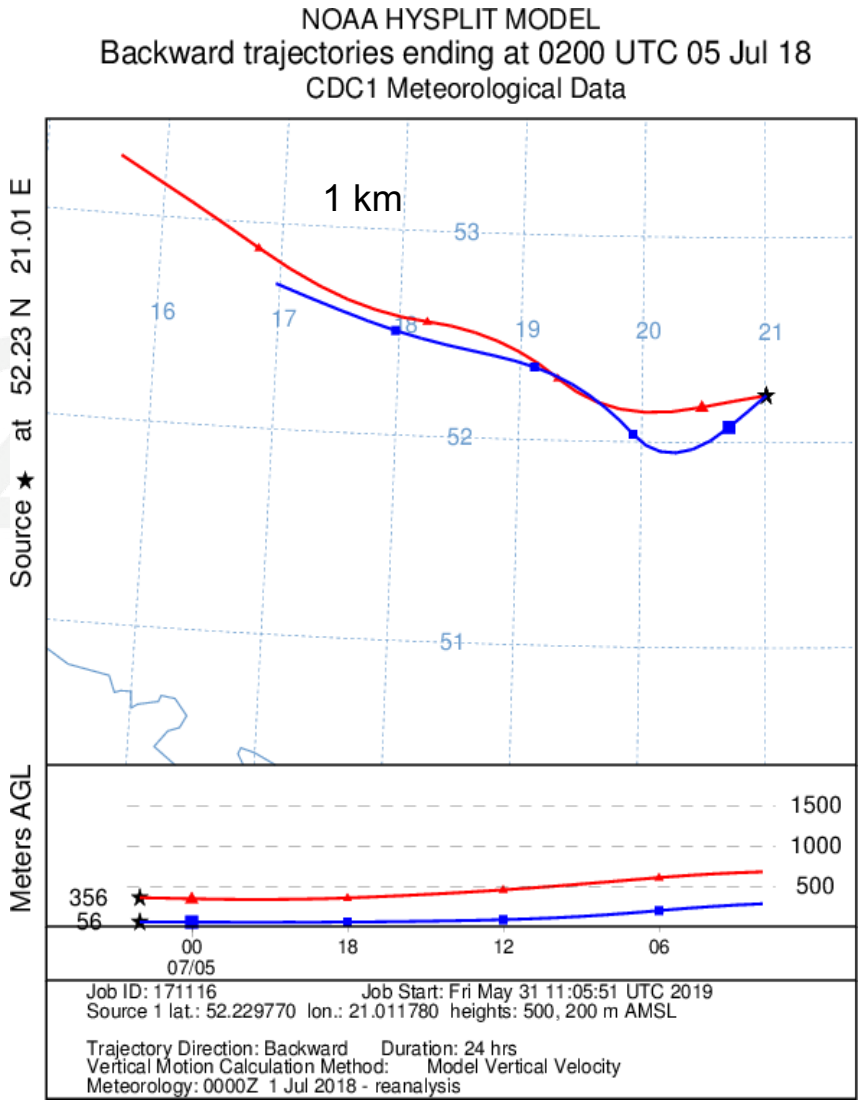


Before the end of the episode

Second type of ozone episodes is associated with long-range transport of air masses containing large amount of ozone.

Another example is the ozone episode in July 2018 in Warsaw – O_3 level increased to 1 60 µg/m^3 due to the long-range transport of ozone from Germany where its level increa sed to 172 µg/m^3 the day before. High O_3 concentrations can be observed at nighttime during such episodes of O_3 advection.





Ozone concentrations forecasting

In order to forecast O_3 concentrations in Moscow we use chemistry-transport model (CTM) CHIMERE (2013b version). Calculations are made at 2.2 km grid, preliminarily adapted for the region EMEP emissions database and forecasts of the Cosmo-Ru2.2 meteorological model are used as input data. T he model deviations of daytime O_3 concentrations in the warm season are 10-30 μg/m^3 while standard deviations are 8-25 μg/m^3. Before the use of the post-processing routine CHIMERE overestimates the daily maximum of O_3, but at the same time it predicts the tendency of concentrations increase in ozone episodes well.

O_3 forecast for Moscow city, June 25, 2021 8 am: