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VARIABILITY OF MONTHLY MEAN VALUES OF SURFACE OZONE CONCENTRATION (SOC) IN THREE POINTS OF TBILISI FROM JANUARY 2017 TO MAY 2020. PANDEMIC OF CORONAVIRUS COVID-19 AND SOC IN SPRING 2020 IN TBILISI.

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Summary: The statistical characteristics of the surface ozone concentration (SOC) in three points of Tbilisi city (A. Kazbegi av., A. Tsereteli av. and Varketili) from January 2017 to May 2020 are represented. The data of National Environmental Agency of Georgia about the mean monthly values of SOC are used. In particular, it is obtained that the greatest average values of SOC during entire period of observations in Varketili were observed (68.1 mcg/m³), smallest - on A. Tsereteli av. (42.7 mcg/m³). It is obtained, that the value of the linear correlation coefficient between the mean monthly values of SOC on all points changes from 0.83 to 0.96.
The influence of limitation on the movement of truck transport in Georgia during April and May 2020 in connection with the pandemic of coronavirus COVID-19 to the increase of the level of SOC is studied.

Key Words: surface ozone concentration, ecology

Introduction

Atmospheric ozone is one of the most important species defining the quality of life [1-3]. Therefore, special attention in many countries of world, including in Georgia, is paid to studies of surface ozone concentration (SOC) [4-10].

The ozone concentration in the atmospheric surface layer, varies widely depending on photochemical processes, horizontal advection, intrusions of stratospheric air, vertical mixing, dry and humid deposition, etc.

In recent years, the Environment Agency has been monitoring surface ozone concentrations in Georgia in accordance with international standards. This paper presents the results of a statistical analysis of monthly mean data of SOC values at three points in of Tbilisi from January 2017 to May 2020.

Study area, material and methods

Study area – three locations of Tbilisi (A. Kazbegi av. – KZBG, A. Tsereteli av. – TSRT, Varketili – VRKT). Coordinates of this locations of air pollution measurements points in [10] are presented.

The data of Georgian National Environmental Agency about the surface ozone concentration in three points of Tbilisi city are used [http://air.gov.ge/reports_page]. Period of observation: January 1, 2017-May 31, 2020.

The data analysis with the use of standard statistical methods was conducted. The following designations will be used below: Mean – average values; Min – minimal values; Max - maximal values; Range = Max-Min; St Dev – standard deviation; Cv = 100·St Dev/Mean, coefficient of variation (%); 99% Low and 99% Upp – 99% confidence interval of lower and upper calculated level accordingly; R – coefficient of linear correlation.

Results and discussion

Results in fig. 1-3 and table 1 are presented.

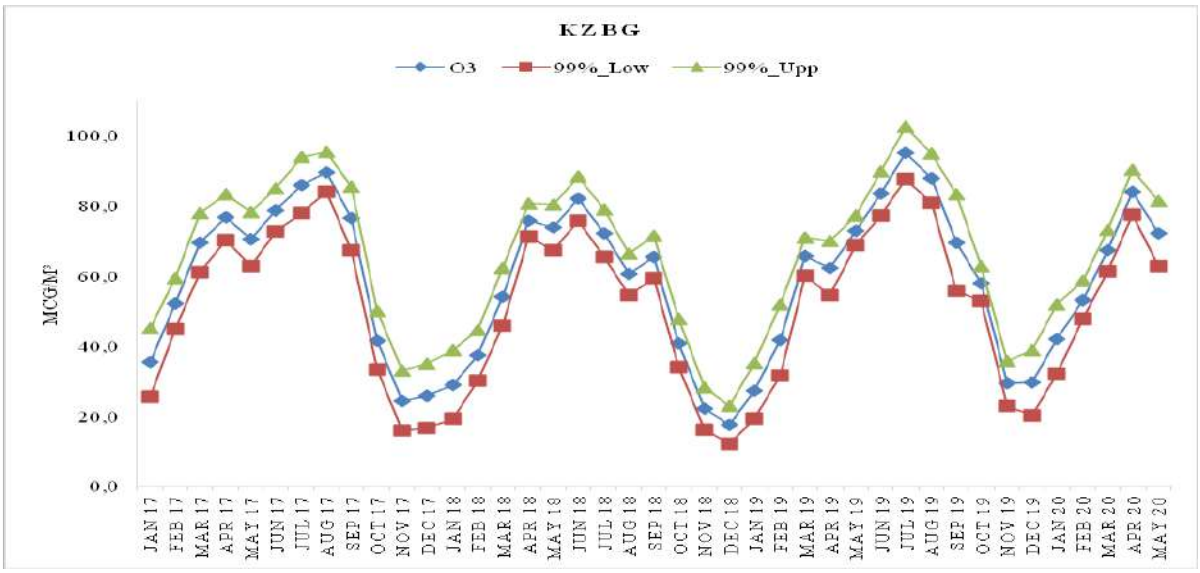

Fig. 1. Monthly mean values of SOC and their 99% confidence intervals on the A. Kazbegi av. from January 2017 to May 2020.

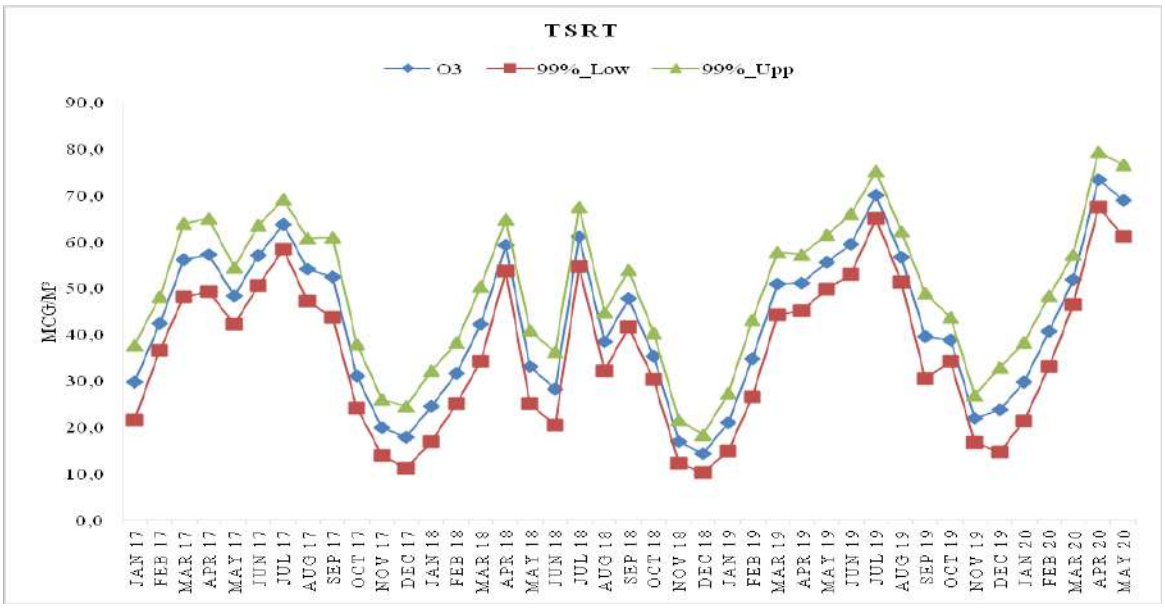

Fig. 2. Monthly mean values of SOC and their 99% confidence intervals on the A. Tsereteli av. from January 2017 to May 2020.

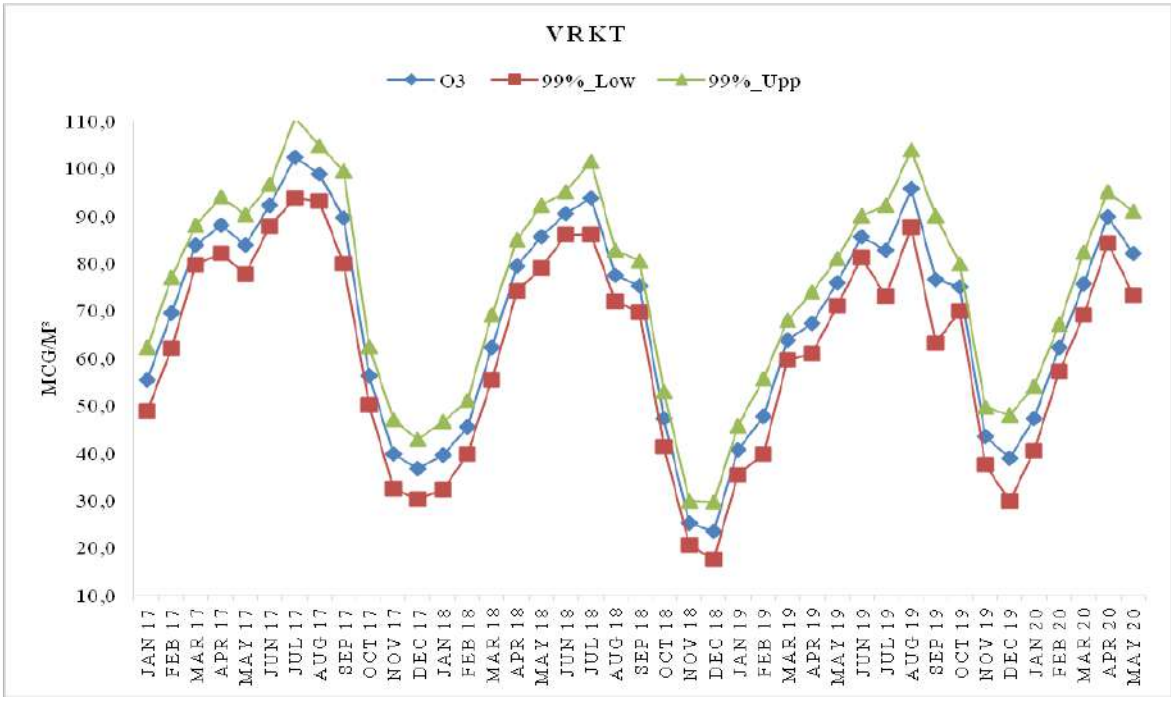

Fig. 3. Monthly mean values of SOC and their 99% confidence intervals in Varketili from January 2017 to May 2020.

In fig. 1-3 data about monthly mean values of SOC and their 99% confidence intervals on the three points of measurements in Tbilisi sity in 2017-2019 are presented.

As follows from these figures, the intra-annual distribution of SOC in Tbilisi as is wave-like - an increase in the warm half-year, a decrease in the cold season of the year.

Table 3. Statistical characteristics of the monthly mean values of SOC at three points of Tbilisi from January 2017 to May 2020 (mcg/m³).

Parameter	KZBG	TSRT	VRKT
Max	95.1	73.4	102.3
Min	17.4	14.3	23.6
Range	77.7	59.1	78.7
Mean	58.5	42.7	68.1
St Dev	22.1	16.1	21.7
Cv, %	37.8	37.8	31.8
	Correlation Matrix (R)		
KZBG	1	0.88	0.96
TSRT	0.88	1	0.83
VRKT	0.96	0.83	1

The statistical characteristics of the monthly mean values of SOC for three points of Tbilisi from January 2017 to May 2020 in table 1 are presented. As it follows from this table and fig. 1-3 the monthly mean value of SOC changes from 14.3 mcg/m^3 (TSRT) to 102.3 mcg/m^3 (VRKT).

The greatest average values of SOC during entire period of observations in the Varketili were observed (68.1mcg/m³), smallest - on A. Tsereteli av. (42.7 mcg/m³).

The values of the linear correlation coefficient between the mean monthly values of SOC on all points changes from 0.83 to 0.96 (table 1).

In connection with the pandemic of coronavirus COVID-19 in Georgia were introduced the limitations in the movement of truck transport (from 17 to 27 April 2020 - complete ban, from 28 April through 28 May 2020 - the permission of the movement of passenger automobiles, from 29 May 2020 - the permission of the movement of buses) [https://ren.tv/news/v-mire/687151-vlasti-gruzii-zapreshchaiut-dvizhenie-avtomobilei-iz-za-koronavirusa, ttps://www.ekhokavkaza.com/a/30578567.html, https://yandex.ru/turbo/s/vz.ru/news/2020/5/22/1040797.html].

The preliminary studies of the influence of these limitations on the daily content of SOC in Tbilisi in the indicated period of time are given to [11].

Data about influence of limitation on the movement of truck transport in Georgia during April and May 2020 in connection with the pandemic of coronavirus COVID-19 to the increase of the level of SOC are presented below.

Table 2 presents the data about relative changeability of monthly mean values of SOC at three points of Tbilisi city from March through May 2020 with respect to their mean values into 2017-2019.

Table 2. Relative changeability of monthly mean values of SOC at three points of Tbilisi city from March through May 2020 with respect to their mean values into 2017-2019, %.

Parameter	KZBG	TSRT	VRKT
100·(Mar 20/(Mean_Mar_17-19)-1),%	6.7	4.1	8.2
100·(Apr 20/(Mean_Apr_17-19)-1),%	17.2	31.5	14.5
100·(May 20/(Mean_May_17-19)-1),%	-0.5	51.0	0,2

In particular, as it follows from table 2, during April 2020 is noted the considerable increase of values of SOC in comparison with their mean values in the same month into 2017-2019 (from 14/5 % - Varketili, to 31.5 % - Tsereteli).

Conclusion

Over the long term is planned the more detailed study of variations of surface ozone concentration in Tbilisi and other cities of Georgia, identifying the links between SOC and other air pollutants, etc.

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References

1. Kharchilava J. Some Results of Investigations of Atmospheric Ozone in Georgia. // Trans. of M. Nodia Institute of Geophysics, ISSN 1512-1135, vol. LXIX, 2018, pp. 211-219 (In Russian).
2. Amiranashvili A., Bliadze T., Chikhladze V. Photochemical smog in Tbilisi. // Monograph, Trans. of Mikheil Nodia institute of Geophysics, ISSN 1512-1135, vol. 63, Tbilisi, 2012, 160 p., (in Georgian).
3. WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. Global update 2005 Summary of risk assessment. // World Health Organization, 2006, 22 p., http://apps.who.int/iris/bitstream/handle/10665/69477/WHO_SDE_PHE_OEH_06.02_eng.pdf;jsessionid=48F380E7090ADBB4A166AC7A8610624A?sequence=1
4. Kharchilava J., Amiranashvili A. Studies of Atmospheric Ozone Variations in Soviet Georgia. // Results of Researches on the International Geophysical Projects, SGC, Moscow, 1998, 114 p. (in Russian).
5. Amiranashvili A., Amiranashvili V., Chikhladze V., Kharchilava J., Kartvelishvili L. The statistical analysis of average seasonal, semi-annual and annual values of surface ozone concentration in Tbilisi in

1984-2003. // Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, ISSN 1512-1127, vol. 12B, Tbilisi, 2008, pp. 45–48.
6. Stankevich A.S., Titarenko O.V., Amiranashvili A.G., Chargazia Kh. Z. Determination of Distribution of Ozone Content in Lower Troposphere and Atmospheric Aerosol Optical Thickness over Territory of Georgia Using Satellite Data and Ground Truth Measurements. // Journal of the Georgian Geophysical Society, Issue (B). Physics of Atmosphere, Ocean, and Space Plasma, v.17b, 2014, pp. 26-37.
7. Stankevich S., Titarenko O., Amiranashvili A., Chargazia Kh. Modeling of Ozone Content Distribution in Lower Troposphere over the Territory of Georgia Using the Data of Satellite and Ground Observations. // Bulletin of the Georgian National Academy of sciences, vol. 9, No. 2, 2015, pp. 54-58.
8. Kekenadze E., Kharchilava J., Chkhaidze G., Senik I. Comparative Analysis of the Surface Ozone Concentration in Tbilisi and at Kislovodsk High Mountain Station. // Int. Sc. Conf. "Natural Disasters in Georgia: Monitoring, Prevention, Mitigation". Proc., ISBN 978-9941-13-899-7, Publish House of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 150-154
9. Lagidze L., Matchavariani L., Svanadze D., Khomasuridze G. Influence of Meteorological Factors on Ecological Conditions of the Atmosphere in Tbilisi, Georgia. // J. Environ. Biol., 41, 2020, pp. 391-395.
10. Kekenadze E.N. Statistical Characteristics of Surface Ozone Concentration in Three Points of Tbilisi in 2017-2018. // Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 22(2), 2019, pp. 63 - 67.
11. Amiranashvili A.G., Kirkitadze D.D., Kekenadze E.N. Pandemic of Coronavirus COVID-19 and Air Pollution in Tbilisi in Spring 2020. // Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 23(1), 2020, pp. 57-72.