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VARIABILITY OF MONTHLY MEAN VALUES OF PM2.5 AND PM10 IN THREE POINTS OF TBILISI FROM JANUARY 2017 TO MAY 2020. PANDEMIC OF CORONAVIRUS COVID-19 AND PM2.5/10 IN SPRING 2020 IN TBILISI.

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Summary: The statistical characteristics of the weight concentrations of aerosols (particulate matter PM2.5 and PM10) 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 PM2.5 and PM10 are used. In particular, it is obtained that the greatest average values of PM2.5 during entire period of observations on the A. Tsereteli av. were observed (23.2 mcg/m³), smallest - on A. Kazbegi av. (16,8 mcg/m³). The greatest average values of PM10 during entire period of observations also on. A. Tsereteli av. were observed (50,5 mcg/m³), smallest - in Varketili (37,4mcg/m³).
It is obtained, that the value of the linear correlation coefficient between the mean monthly values of PM2.5 and PM10 on all points changes from 0.52 to 0.95. The annual mean of PM2.5 and PM10 for all of measurements points are higher, that maximum permissible concentration according to the standards of the World Health Organization.
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 decrease of the level of aerosol pollution of atmosphere is studied.

Key words: Atmospheric aerosols, particulate matter, PM2.5, PM10.

Introduction

In Georgia for many decades has been conducting research on atmospheric aerosols (including radioactive ones) and their properties [1-7]. In recent years, in Georgia, the Environmental Agency, in accordance with international standards, began monitoring particulate matter with a diameter of ≤2.5 mcm (PM2.5) and ≤10 mcm (PM10). Some results of this monitoring in [8,9] are presented. This paper is a continuation of previous studies and in it the results of a statistical analysis of mean monthly data about PM2.5 and PM10 values at three points in the city of Tbilisi from January 2017 to May 2020 is presented.

Study area, material and methods

Study area – three locations of Tbilisi (A. Kazbegi av. – KZBG, A. Tsereteli av. – TSRT, Varketili – VRKT). Coordinates of these locations of air pollution measurements points in [8] are presented.

The data of Georgian National Environmental Agency about the dust concentration (atmospheric particulate matter - PM2.5 and PM10) 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.

In the correspondence with the standards of the World Health Organization maximum permissible concentration (MPC) composes: annual mean for PM2.5 - 10 mcg/m³ and for PM10 - 20 mcg/m³ [10].

Results and discussion

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

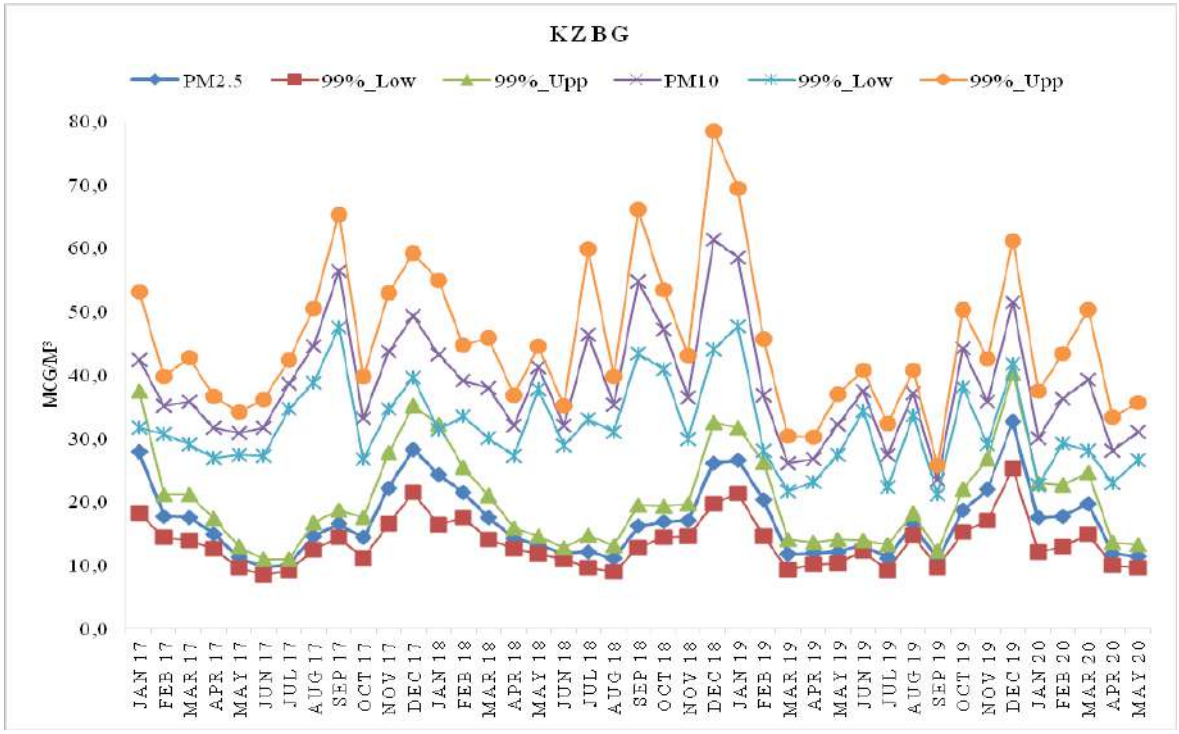

Fig. 1. Monthly mean values of PM2.5 and PM10 and their 99% confidence intervals on the A. Kazbegi av. from January 2017 to May 2020.

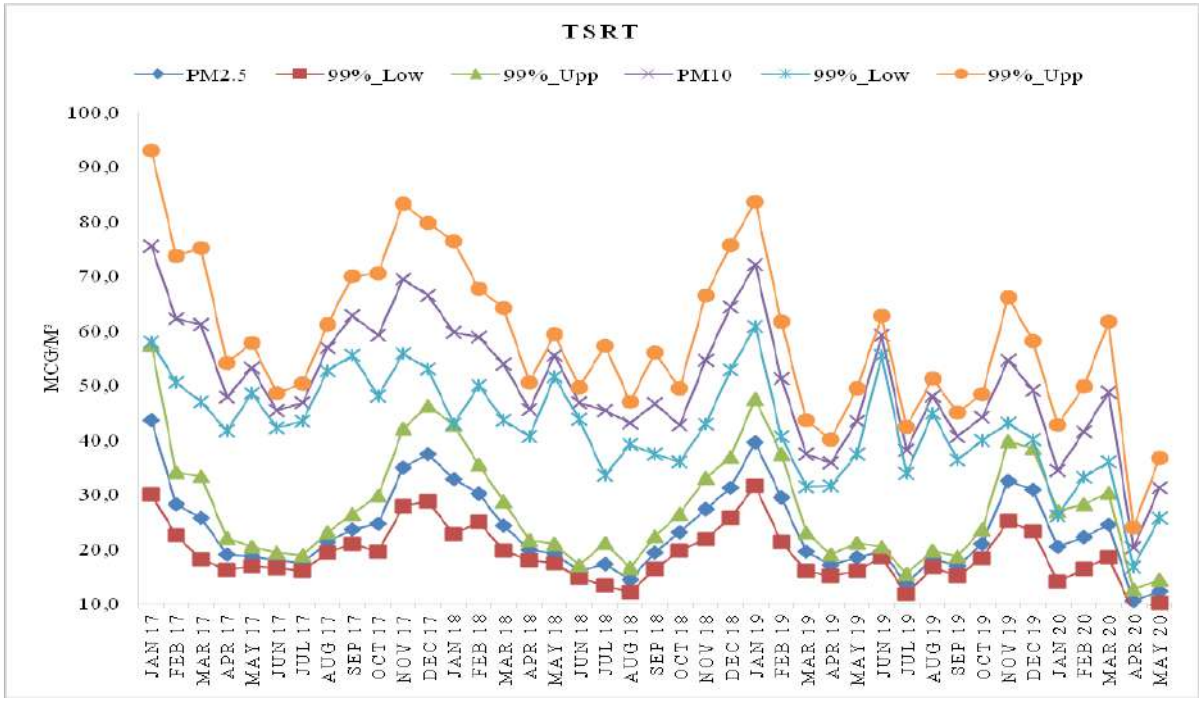

Fig. 2. Monthly mean values of PM2.5 and PM10 and their 99% confidence intervals on the A. Tsereteli av. from January 2017 to May 2020.

In fig. 1-3 data about monthly mean values of PM2.5 and PM10 and their 99% confidence intervals on the three points of measurements in Tbilisi sity from January 2017 to May 2020 are presented.

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

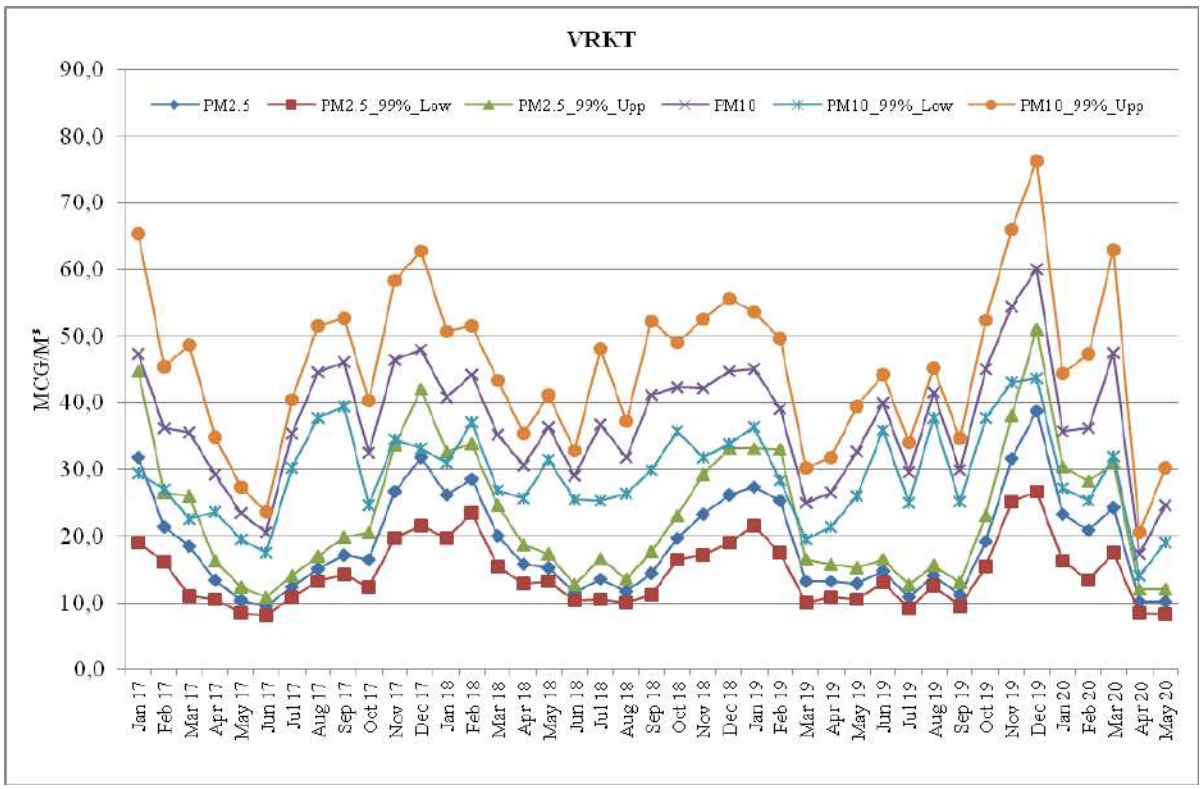

Fig. 3. Monthly mean values of PM2.5 and PM10 and their 99% confidence intervals in Varketili from January 2017 to May 2020.

Table 1. Statistical characteristics of the monthly mean values of PM2.5 and PM10 at three points of Tbilisi from January 2017 to May 2020 (mcg/m³).

Location	**KZBG**	**KZBG**	**TSRT**	**TSRT**	**VRKT**	**VRKT**
Parameter	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**
Max	32.7	61.2	43.6	75.5	38.9	60.1
Min	9.6	23.4	10.5	20.3	9.5	17.3
Range	23.1	37.8	33.1	55.2	29.4	42.8
Mean	16.8	38.5	23.2	50.5	18.9	37.4
St Dev	5.7	9.1	7.6	11.5	7.4	9.2
Cv, %	33.9	23.6	32.8	22.8	39.3	24.6
	Correlation Matrix (R)					
KZBG, PM2.5	1	0,64	0,89	0,61	0,95	0,80
KZBG, PM10	0.64	1	0.56	0.59	0.52	0.71
TSRT, PM2.5	0.89	0.56	1	0.82	0.89	0.72
TSRT, PM10	0.61	0.59	0.82	1	0.58	0.61
VRKT, PM2.5	0.95	0.52	0.89	0.58	1	0.83
VRKT, PM10	0.80	0.71	0.72	0.61	0.83	1

The statistical characteristics of the monthly mean values of PM2.5 and PM10 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 values of PM2.5 changes from 9.5 mcg/m^3 (VRKT) to 43.6 mcg/m^3 (TSRT); the monthly mean values of PM10 changes from 17,3 mcg/m^3 (VRKT) to 75.5 mcg/m^3 (TSRT).

The greatest average values of PM2.5 during entire period of observations on the A. Tsereteli av. were observed (23.2 mcg/m^3), smallest - on A. Kazbegi av. (16,8 mcg/m^3). The greatest average values of PM10 during entire period of observations also on. A. Tsereteli av. were observed (50.5 mcg/m^3), smallest - in Varketili (37.4 mcg/m^3).

The annual mean of PM2.5 and PM10 for all of measurements points are higher, that maximum permissible concentration according to the standards of the World Health Organization.

The values of the linear correlation coefficient between the mean monthly values of PM2.5 and PM10 on all points changes from 0.52 to 0.95 (table 1).

As is known, 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 PM2.5 and PM10 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 decrease of the level of aerosol pollution of atmosphere are presented below.

Table 2 presents the data about relative changeability of monthly mean values of PM2.5 and PM10 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 PM2.5 and PM10 at three points of Tbilisi city from March through May 2020 with respect to their mean values into 2017-2019, %.

Location	**KZBG**	**KZBG**	**TSRT**	**TSRT**	**VRKT**	**VRKT**
Parameter	**PM2.5**	**PM10**	**PM2.5**	**PM10**	**PM2.5**	**PM10**
100·[Mar 20/(Mean_Mar_17-19)-1],%	26.5	17.9	5.4	-3.9	40.3	48.9
100·[Apr 20/(Mean_Apr_17-19)-1],%	-14.0	-6.8	-43.6	-52.9	-27.8	-39.8
100·[May 20/(Mean_May_17-19)-1],%	-6.3	-10.4	-34.9	-38.4	-21.2	-20.2

As it follows from table 2, during April and May 2020 is noted the considerable decrease of values of PM2.5 and PM10 in comparison with their mean values in the same months into 2017-2019.

In particular, it comprises this decrease: April - PM2.5 - from 14 to 43.6 %, PM10 - from 6.8 to 53.9 %.

Let us note that during March 2020 in comparison with the foregoing three year period was noted or the weak changeability of values PM2.5 and PM10 (TSRT: 5.4 and -3.9 %), or considerable increase (KZBG and VRKT: 17.9-48.9%)

Conclusion

Over the long term is planned the more detailed study of the aerosol pollution of the atmosphere, in particular, conducting the statistical analysis of monthly, daily, day and night variations in the values of PM2.5 and PM10 for Tbilisi and other cities of Georgia.

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