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Statistical Characteristics of Aerosol Pollution of Atmosphere in Three Points of Tbilisi in 2017-2018

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ABSTRACT

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) in 2017-2018 are represented. The data of National Environmental Agency of Georgia about the hourly values of PM2.5 and PM10 are used. In particular, it is obtained that the greatest average annual values of PM2.5 on the A. Tsereteli av. were observed (24.9 μg/m³, the range of the change: 0-440 μg/m³), smallest - on A. Kazbegi av. (16.6 μg/m³, the range of the change: 0-494 μg/m³). The greatest average annual values PM10 also on. A. Tsereteli av. were observed (57.2 μg/m³, the range of the change: 0-553 μg/m³), smallest - in Varketili (37.4 μg/m³, the range of the change: 0-319 μg/m³).
It is obtained, that the value of the linear correlation coefficient between the hourly values PM2.5 and PM10 on all points sufficiently high and changes from 0.77 to 0.89. The value of the correlation coefficient between the hourly values of PM2.5 between the points changes from 0.64 to 0.73, and PM10 - from 0.49 to 0.60.
The correspondence of values of PM2.5 and PM10 at the indicated points of Tbilisi city to the standards of WHO is examined.

Key Words: atmospheric aerosols, particulate matter, PM2.5, PM10

Introduction

At the M. Nodia Institute of Geophysics for many decades has been conducting research on atmospheric aerosols (including radioactive ones) and their properties [1,2]. In particular, some theoretical studies of the structure of atmospheric aerosols, their optical properties, distribution in the atmosphere, etc. are presented in [3–9]. The results of experimental laboratory studies of the processes of washing out aerosols, their ice-forming properties, etc. are presented in [10, 11]. Particular attention is paid to full-scale studies of mineral and secondary aerosols (stationary monitoring of solid particles and secondary aerosols in the surface atmosphere [10, 12-17], aircraft research of mineral aerosols in the lower troposphere [1,2,18-20], mobile monitoring of aerosols in Tbilisi [15], data analysis of stationary ground-based remote and satellite monitoring of the aerosol optical depth of the atmosphere [15,21-29], radar monitoring of large dust formations in the atmosphere [30,31]).

In recent years, in Georgia, the Environmental Agency, in accordance with international standards, began monitoring particulate matter with a diameter of ≤2.5 μm (PM2.5) and ≤10 μm (PM10). This paper presents the results of a statistical analysis of hourly data of PM2.5 and PM10 values at three points in the city of Tbilisi in 2017 and 2018.

Study area, material and methods

Study area – three locations of Tbilisi. In Table 1 coordinates and locations of air pollution measurements points in Tbilisi are presented.

Table 1

Coordinates of air pollution measurements points in Tbilisi

No	Location	Location, Abbreviation	Latitude, N°	Longitude, E°	H, m
1	**Varketili**	**VRKT**	41.699947	44.871611	518
2	**A. Kazbegi av.**	**KZBG**	41.724767	44.752956	467
3	**A. Tsereteli av.**	**TSRT**	41.742539	44.779069	423

The hourly 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- December 31, 2018

The data analysis with the use of standard statistical methods was conducted [32]. The following designations will be used below: Mean – average values; Min – minimal values; Max - maximal values; Range = Max-Min; St Dev – standard deviation; σ_m - standard error ; Cv = 100·St Dev/Mean, coefficient of variation (%); Count - the number of measurements; R – coefficient of linear correlation; 99% Low and 99% Upp – 99% confidence interval of lower and upper calculated level accordingly. The difference between the mean values of PM with the use of Student's criterion was determined (level of significance α is not worse than 0.1).

In the correspondence with the standards of the World Health Organization maximum permissible concentration (MPC) composes: annual mean for PM2.5 - 10 μg/m³ and for PM10 - 20 μg/m³ [33].

Table 2 verbal description of the level of aerosol pollution of the atmosphere (so-called PM Index) depicts [Air quality index - http://air.gov.ge/en/pages/11/11].

Table 2

PM Index

Pollutants	Good	Fair	Moderate	Poor	Very Poor
PM2.5 **Particle less than 2.5 μm, μg/m³**	0-10	10-20	20-25	25-50	50-800
PM10 **Particle less than 10 μm, μg/m³**	0-20	20-35	35-50	50-100	100-1200

Results and discussion

Results in Tables 3-5 and Fig. 1-2 are presented.

Data analysis of PM2.5 values (Table 3, Fig. 1)

As it follows from Table 3, mean annual values of PM2.5 in each year of observations at all three stations differ from each other (α≤0.1). In 2018 in comparison with 2017 mean annual value of PM2.5 in Varketili they did not change, whereas in two remaining points the level of the air pollution somewhat decreased. The smallest mean annual values of PM2.5 are observed on A. Kazbegi av. (17.3 and 16.6 to μg/m³ respectively into 2017 and 2018), and greatest - on A. Tsereteli av. (24.9 and 22.8 μg/m³ respectively into 2017 and 2018).

Range of a change in the hourly values of PM2.5 in two years of observation - from 0 to 494 to μg/m³. Changeability in the time of hourly values of PM2.5 is sufficiently high (Cv changes from 68.5 to 91.3 % in 2017 and from 72.3 to 80.7 % in 2018).

The value of the coefficient of linear correlation between the observation points into 2017 and 2018 covers the range 0.64÷0.73 (or, in the correspondence with the Chaddock scale correlation - "noticeable"). For all three points of measurement both into 2017 and in 2018 the average annual values of PM2.5 are above maximum permissible concentration for the indicated type of aerosols in the correspondence with the standards of WHO [33].

Table 3

Statistical characteristics of hourly values of PM2.5 at three points of Tbilisi in 2017 and 2018 (μg/m³)

Parameter	**PM2.5**					
Year	**2017**			**2018**		
Location	**VRKT**	**KZBG**	**TSRT**	**VRKT**	**KZBG**	**TSRT**
Mean	18.9	17.3	24.9	18.8	16.6	22.8
Min	0	0	0	0	0	0
Max	214	494	247	166	283	440
Range	214	494	247	166	283	440
St Dev	17.2	14.5	17.0	14.9	13.4	16.5
σm	0.20	0.16	0.20	0.16	0.15	0.18
Cv (%)	91.3	83.7	68.5	78.9	80.7	72.3
Count	7749	7751	7513	8483	8400	8434
99% Low	18.4	16.8	24.3	18.4	16.2	22.3
99% Upp	19.4	17.7	25.4	19.2	17.0	23.3
	Correlation Matrix			**Correlation Matrix**		
VRKT	1	0.64	0.73	1	0.64	0.71
KZBG	0.64	1	0.64	0.64	1	0.72
TSRT	0.73	0.64	1	0.71	0.72	1

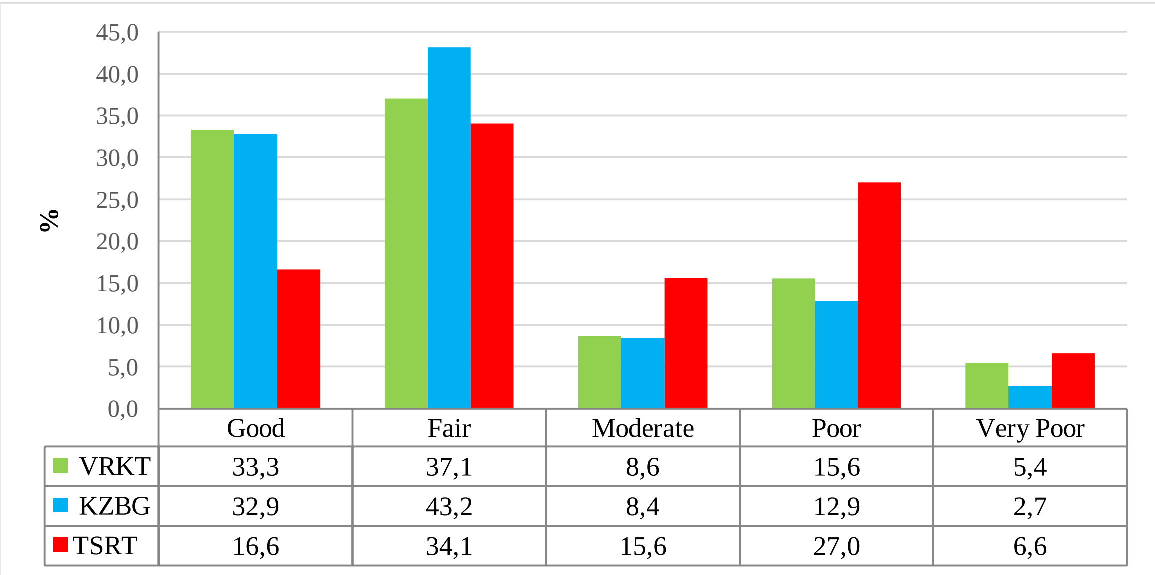


Fig.1. Repetition of PM2.5 Index in three point of Tbilisi in 2017-2018 (%)

Fig. 1 presents the data about the repetition of hourly values of PM2.5 in two years of measurements for three points of Tbilisi into the correspondence with the scale of PM Index (Table 2). As follows from this Fig. the repetition of values of PM2.5 in the range "Poor÷ Very Poor" is following: in Varketili - 21 %, on A. Kazbegi av. - 15.6 %, on A. Tsereteli av. - 33.6 %.

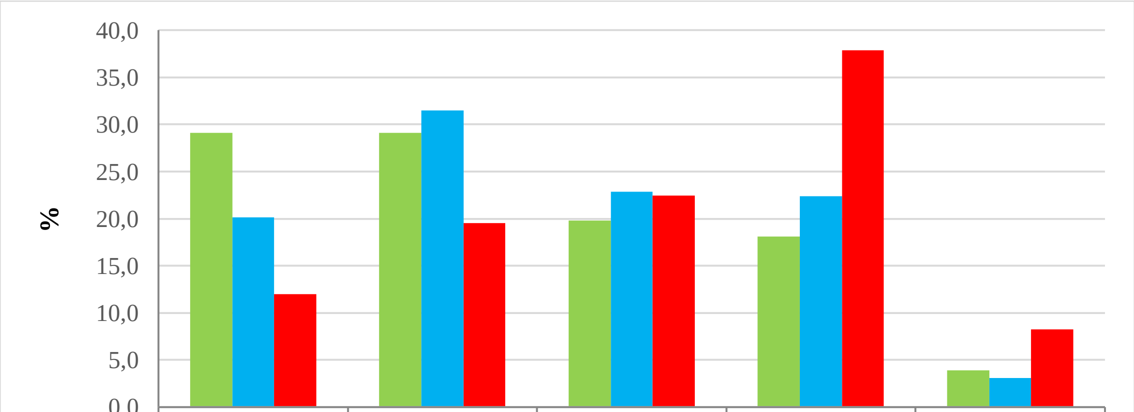
Data analysis of PM10 values (Table 4, Fig. 2)

The statistical characteristics of hourly values of PM10 for three points of Tbilisi in Table 4 are presented. As it follows from this Table, mean annual values of PM10 in each year of observations at all three stations differ from each other ($\alpha \le 0.1$). In 2018 in comparison with 2017 mean annual values of PM10 in Varketili and on A. Kazbegi av. somewhat grew, whereas on A. Tzereteli av. - they decreased. The smallest mean annual values of PM10 are observed in Varketili (37.4 and 38.1 μg/m^3 respectively into 2017 and 2018), and greatest - on A. Tsereteli av. (57.2 and 51.2 μg/m^3 respectively into 2017 and 2018).

Table 4

Statistical characteristics of hourly values of PM10 at three points of Tbilisi in 2017and 2018 (μg/m³)

Parameter	**PM10**					
Year	**2017**			**2018**		
Location	**VRKT**	**KZBG**	**TSRT**	**VRKT**	**KZBG**	**TSRT**
Mean	37.4	39.8	57.2	38.1	42.1	51.2
Min	0	0	0	0	0	0
Max	258	835	540	319	792	553
Range	258	835	540	319	792	553
St Dev	29.7	28.4	36.7	27.5	35.9	33.7
σ_m	0.34	0.32	0.42	0.30	0.39	0.37
Cv (%)	79.4	71.4	64.2	72.2	85.2	65.7
Count	7749	7751	7513	8483	8399	8434
99% Low	36.5	38.9	56.1	37.3	41.1	50.3
99% Upp	38.2	40.6	58.3	38.8	43.1	52.2
	Correlation Matrix			**Correlation Matrix**		
VRKT	1	0.54	0.58	1	0.49	0.60
KZBG	0.54	1	0.60	0.49	1	0.51
TSRT	0.58	0.60	1	0.60	0.51	1



	Good	Fair	Moderate	Poor	Very Poor
VRKT	29,1	29,1	19,8	18,1	3,9
KZBG	20,1	31,5	22,9	22,4	3,1
TSRT	11,9	19,5	22,4	37,9	8,2

Fig.2. Repetition of PM10 Index in three point of Tbilisi in 2017-2018 (%)

Range of a change in the hourдн values of PM10 in two years of observations - from 0 to 835 μg/m^3. Changeability in the time of hourly values of PM10 (as PM2.5), also the sufficiently is high (Cv changes from 64.2 to 79.4 % in 2017 and from 65.7 to 72.2 % in 2018).

The value of the coefficient of linear correlation between the observation points into 2017 and 2018 covers the range 0.49÷0.60 (or, as in the case with PM2.5 – "noticeable" correlation).

For all three points of measurement both into 2017 and in 2018 the mean annual values of PM10 (as PM2.5) are above maximum permissible concentration for the indicated type of aerosols in the correspondence with the standards of WHO [33].

Fig. 2 presents the data about the repetition of hourly values of PM10 in two years of measurements for three points of Tbilisi into the correspondence with the scale of PM Index (Table 2). As follows from this Table the repetition of values of PM10 in the range "Poor ÷ Very Poor" are following: in Varketili - 22 %, on A. Kazbegi av. - 25.5 %, on A. Tsereteli av. - 46.1 %.

The comparison of the data about the repetition of hourly values of PM2.5 and PM10 shows that the level of the air pollution by both types of aerosols in the range "Poor ÷ Very Poor" in Varketili is approximately identical (21 and 22 % respectively), whereas on A. Kazbegi av. and A. Tsereteli av. the level of air pollution by particles with the diameter ≤2.5 μm, it is lower than by coarse dispersed aerosols (respectively: 15.6 and 25.5 % on A. Kazbegi av. and 33.6 and 46.1 % on A. Tsereteli av..

Table 5

Linear correlation between PM2.5 and PM10 at three points of Tbilisi in 2017 and 2018

Year	**2017**			**2018**		
Location	**VRKT**	**KZBG**	**TSRT**	**VRKT**	**KZBG**	**TSRT**
R	0.89	0.77	0.79	0.87	0.79	0.85

Finally, Table 5 presents the data about coefficients of linear correlation between the hourly values of PM2.5 and PM10 for each point of measurement. As it follows from this Table, values of R in 2017-2018 cover the range 0.77÷0.89 (or, in the correspondence with the Chaddock scale correlation – "strong").

Conclusion

As is known, air pollution in Tbilisi leads to a considerable increase in the mortality of the population of this city [15]. Last studies showed that Georgia (after Serbia) is found in the second place in Europe according to the indices of mortality because of air pollution [https://www.cei.int/ansa/76693]. Therefore, 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.

References

[1] Kirkitadze D., Nikiforov G., Chankvetadze A., Chkhaidze G. Some Results of Studies of Atmospheric Aerosols in M. Nodia Institute of Geophysics in the Recent Three Decades. Trans. of Mikheil Nodia Institute of Geophysics, ISSN 1512-1135, vol. 66, Tbilisi, 2016, pp. 178-185, (in Russian).

[2] Amiranashvili A. G. Boleslovas Styra. 105 Years from the Birthday. His Role in the Formation, Development and Modern Evolution of Nuclear Meteorology in Georgia. Journal of Georgian Geophysical Society, ISSN 1512-1127, Jssue B. Physics of Atmosphere, Ocean and Space Plasma, Vol. 20 B, 2017, Tbilisi, 2017, pp. 73-87.

[3] Gorchakov G.I., Emilenko A.S., Kartsivadze A.I., Metreveli D.M., Sidorov V.N. Variation of Submicron Aerosol Structure. Proc. 9th Int. Conf. on Atmospheric Aerosols, Condensation and Ice Nuclei, Budapest, Hungary, 3-8 September, vol.1, 1984, p. 159-163.

[4] Amiranashvili V. Numerical Calculation of the Spectral Aerosol Optical Depth Using Data on Integral Irradiance of the Direct Solar Radiation. Abstr. IUGG 99, 19-30 July 1999, Birmingham UK, p. A.236.
[5] Amiranashvili V. Modelling of Solar Radiation Transfer in the Atmosphere with Allowance to Aerosol Diffusion. J. Aerosol Sci., Vol. 30, Suppl 1, Pergamon Press, 1999, p. S625-S626.
[6] Tavartkiladze K, Shengelia I., Amiranashvili A., Amiranashvili V. The influence of relative humidity on the optical properties of atmospheric aerosols, J.Aerosol Sci, Pergamon, vol.30, Suppl.1, 1999, S639-S640.
[7] Surmava A., Gigauri N., Gverdtsiteli L., Intskirveli L. Numerical Modeling of Zestafoni City Dust Distribution in Case of Background Western, Light Air, Gentle and Fresh Breezes. Trans. of Mikheil Nodia Institute of Geophysics, ISSN 1512-1135, vol. 69, Tbilisi, 2018, pp. 182-191, (in Georgian).
[8] Surmava A. A. Numerical Modeling of Zestafoni City Dust Dispersion in case of Western Wind. Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 21(2), Tbilisi, 2018, pp. 21-26.
[9] Surmava A., Gigauri N., Kukhalashvili V., Intskirveli L., Mdivani S. Numerical Modeling of the Anthropogenic Dust Transfer by Means of Quasistatic and Non-Quasistatic Models. International Scientific Conference "Natural Disasters in Georgia: Monitoring, Prevention, Mitigation". Proceedings, ISBN 978-9941-13-899-7, Publish Hous of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 134-137.
[10] Amiranashvili A.G., Gzirishvili T.G. Aerosols and Ice Crystals in the Atmosphere. Tbilisi, Metsniereba, 1991, 113 p. (in Russian).
[11] Gzirishvili T.G., Khorguani V.G. About Secondary Ice Crystal Production. Proc. 10-th Int. Conf. Cloud Phys. Bad-Homburg, FRG, 1988, p. 254-256.
[12] Kharchilava D.F., Lomaia O.V., Bukia G.N. The Conditions of Aerosols Formation and Accumulation in Cities. Proc. 3th Int. Aerosol Conf., Kyoto, Japan, Pergamon, vol. 2, 24-27 September, 1990, p. 986-989.
[13] Amiranashvili A.G., Chikhladze V.A., Kharchilava J.F., Buachidze N.S., Intskirveli L.N. Variations of the Weight Concentrations of Dust, Nitrogen Oxides, Sulphur Dioxide and Ozone in the Surface Air in Tbilisi in 1981-2003, Proc. 16th International Conference on Nucleation&Atmospheric Aerosols, Kyoto, Japan, 26-30 July 2004, pp. 678-681.
[14] Amiranashvili A., Bliadze T., Kirkitadze D., Nikiforov G., Nodia A., Kharchilava j., Chankvetadze A., Chikhladze V., Chochishvili K., Chkhaidze G.P. Some Preliminary Results of the Complex Monitoring of Surface Ozone Concentration (SOC), Intensity of Summary Solar Radiation and Sub-Micron Aerosols Content in Air in Tbilisi in 2009-2010. Trans. of Mikheil Nodia Institute of Geophysics, ISSN 1512-1135, vol. 62, Tbilisi, 2010, pp. 189-196, (in Russian).
[15] 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).
[16] Amiranashvili A., Chargazia Kh. Intra-Annual and Seasonal Variations of Sub-Micron Aerosols Concentration and their Connection with Radon Content in Surface Boundary Layer of Tbilisi City. Bulletin of the Georgian National Academy of Sciences, vol. 10, N 2, 2016, p. 72-78.
[17] Bliadze T.G., Kirkitadze D.D., Tchankvetadze A. Sh., Chikhladze V.A. Comparative Analysis of Air Pollution in Tbilisi and Kutaisi. International Scientific Conference „Modern Problems of Ecology", Proceedings, ISSN 1512-1976, v. 6, Kutaisi, Georgia, 21-22 September, 2018, pp. 157-160.
[18] Styra B., Amiranashvili A. Aerosol Distribution above Georgia Investigations. Institute of Physics of the Academy of Sciences of the Lithunian SSR, Atmospheric Physics, ISSN 0135-1419, vol. 8, Vilnius, Mokslas, 1983, pp. 18-24, (in Russian).
[19] Amiranashvili A.G., Gzirishvili T.G., Kartsivadze A.I., Nodia A.G. Aircraft investigations of the distribution of aerosols in the lower troposphere. Proc. 9th Int. Conf. on Atmospheric Aerosols, Condensation and Ice Nuclei, Budapest, Hungary, 3-8 September, vol.1, 1984, p. 148-153.
[20] Amiranashvili A., Amiranashvili V., Chochishvili K., Kirkitadze D. The Distribution of Aerosols over the Georgian Territory in the Lower Troposphere, Journal of Georgian Geophysical Society, ISSN 1512-1127, Jssue B. Physics of Atmosphere, Ocean and Space Plasma, Vol. 8 B, 2003, Tbilisi, 2004, pp. 70-76.
[21] Amiranashvili A., Amiranashvili V., Tavartkiladze K. Dynamics of the Aerosol Pollution of the Atmosphere in Georgia in 1956-1990, J.Aerosol Sci, Pergamon, vol.30, Suppl.1, 1999, S667-S668.
[22] Amiranashvili A.G., Amiranashvili V.A., Kirkitadze D.D., Tavartkiladze K.A. Some Results of Investigation of Variations of the Atmospheric Aerosol Optical Depth in Tbilisi, Proc. 16th Int. Conf. on Nucleation&Atmospheric Aerosols, Kyoto, Japan, 26-30 July 2004, pp. 416-419.
[23] Amiranashvili A.G., Amiranashvili V.A., Gzirishvili T.G., Kharchilava J.F., Tavartkiladze K.A. Modern Climate Change in Georgia. Radiatively Active Small Atmospheric Admixtures, Institute of

Geophysics, Monograph, Trans. of M.Nodia Institute of Geophysics of Georgian Acad. of Sci., ISSN 1512-1135, vol. LIX, 2005, 128 p.
[24] Amiranashvili A.G., Amiranashvili V.A., Kirkitadze D.D., Tavartkiladze K.A. Connection Between Atmospheric Aerosol Optical Depth and Aerosol Particle Number Concentration in the Air in Tbilisi, Proc. 17th Int. Conf. on Nucleation&Atmospheric Aerosols, Galway, Ireland, 13-18 August 2007, pp. 865-870.
[25] Amiranashvili A.G., Amiranashvili V.A., Kirkitadze D.D., Tavartkiladze K.A. Weekly Distribution of the Aerosol Pollution of the Atmosphere in Tbilisi, Proc. 17th Int. Conf. on Nucleation&Atmospheric Aerosols, Galway, Ireland, 13-18 August 2007, pp. 756-760.
[26] Amiranashvili A.G., Tavartkiladze K.A, Kirilenko A.A., Kortunova Z.V., Povolotskaya N.P., Senik I.A. Dynamics of the Aerosol Pollution of Atmosphere in Tbilisi and Koslovodsk. Trans. of the Institute of Hydrometeorology, Georgian Technical University, ISSN 1512-0902, 2013, vol. 119, pp. 212-215, (in Russian).
[27] Stankevich S. A., Titarenko O., V., Amiranashvili A., G., Chargazia Kh., Z. Analysis of the Atmosphere Aerosol and Ozone Condition Over Tbilisi Using Satellite Data and Ground Truth Measurements. 14th Ukrainian Conference on Space Research, Uzhgorod, September, 8-12, 2014, Abstracts, Kyiv, 2014, p. 161.
[28] 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, ISSN: 1512-1127, v.17b, 2014, pp. 26-37.
[29] Stankevich S., Titarenko O., Amiranashvili A., Chargazia Kh. Determination of Atmospheric Aerosol Optical Depth over Territory of Georgia during Different Regimes of Cloudiness Using the Satellite and Ground-Based Measurements Data. Bulletin of the Georgian National Academy of sciences, v. 9, No. 3, 2015, pp. 91-95.
[30] Amiranashvili A.G., Chikhladze V.A., Mitin M.N. Preliminary Results of the Analysis of Radar and Ground-Based Monitoring of Dust Formation in Atmosphere Above the Territory of Eastern Georgia on 27 July 2018. Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 21(2), Tbilisi, 2018, pp. 61-69.
[31] Berianidze N., Javakhishvili N. Mtchedlishvili A. About The Possibility of using the “METEOR 735CDP10” Radar for Monitoring Volcanic Formations, Dust Storms and Smoke from Large Fires in Atmosphere in South Caucasus. International Scientific Conference “Natural Disasters in Georgia: Monitoring, Prevention, Mitigation”. Proceedings, ISBN 978-9941-13-899-7, Publish Hous of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 182-186.
[32] Kobisheva N., Narovlianski G. Climatological processing of the meteorological information. Leningrad, Gidrometeoizdat, 1978, 294 p., (in Russian).
[33] 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

2017-2018 წლებში ატმოსფეროს აეროზოლური დაბინძურების სტატისტიკური მახასიათებლები თბილისის სამ პუნქში

დ. კირკიტაძე

რეზიუმე

წარმოდგენილია აეროზოლების წონითი კონცენტრაციების სტატისტიკური მახასიათებლები (PM2.5 და PM10) ქალაქ თბილისის სამ პუნქტში (ა.ყაზბეგის პრ., ა.წერეთელის პრ. და ვარკეთილი) 2017-2018 წლებში. გამოყენებულია გარემოს დაცვის ნაციონალური სააგენტოს მონაცემები PM2.5 და PM10 -ის საათობრივი მნიშვნელობების შესახებ. კერძოდ მიღებულია რომ PM2.5-ის მაქსიმალური საშუალოწლიური მნიშვნელობები დაიკვირვებოდა პუნქტში

ა.წერეთელის პროსპექტზე (24.9 მკგ/მ³, ცვლილების დიაპაზონი: 0-440 მკგ/მ³), მინიმალური - ა.ყაზბეგის პროსპექტზე (16.6 მკგ/მ³, ცვლილების დიაპაზონი: 0-494 მკგ/მ³). PM10 -ის მაქსიმალური საშუალოწლიური მნიშვნელობები დაიკვირვებოდა აგრეთვე პუნქტში ა.წერეთელის პროსპექტზე (57.2 მკგ/მ³, ცვლილების დიაპაზონი: 0-553 მკგ/მ³), მინიმალური-ვარკეთილში (37.4 მკგ/მ³, ცვლილების დიაპაზონი: 0-319 მკგ/მ³). მიღებულია, რომ წრფივი კორელაციის კოეფიციენტის მნიშვნელობა PM2.5 და PM10-ის საათობრივ სიდიდეებს შორის ყველა პუნქტზე საკმაოდ მაღალია და იცვლება 0.77-სა და 0.89-ს შორის. წრფივი კორელაციის კოეფიციენტის მნიშვნელობა პუნქტებს შორის PM2.5 საათობრივი სიდიდეებისა იცვლება 0.64-დან 0.73-მდე, PM10-ისა -0.49დან -0.60 მდე.
განხილულია PM2.5 და PM10-ის მნიშვნელობების შესაბამისობა მჯო-ს ნორმებთან თბილისის სამ პუნქტში ჰაერის აღნიშნული დამაბინძურებლებისთვის.

Статистические характеристики аэрозольного загрязнения атмосферы в трех пунктах Тбилиси в 2017-2018 гг.

Д.Д. Киркитадзе

Резюме

Представлены статистические характеристики весовых концентраций аэрозолей (PM2.5 и PM10) в трех пунктах города Тбилиси (пр. А. Казбеги, пр. А. Церетели и Варкетили) в 2017-2018 гг. Использованы данные национального агентства по окружающей среде о часовых значениях PM2.5 и PM10. В частности, получено, что наибольшие среднегодовые значения PM2.5 наблюдались в пункте на пр. А. Церетели (24.9 мкг/м^3, диапазон изменения: 0-440 мкг/м^3), наименьшие – на пр. А. Казбеги (16.6 мкг/м^3, диапазон изменения: 0-494 мкг/м^3). Наибольшие среднегодовые значения PM10 наблюдались также на пр. А. Церетели (57.2 мкг/м^3, диапазон изменения: 0-553 мкг/м^3), наименьшие – в Варкетили (37.4 мкг/м^3, диапазон изменения: 0-319 мкг/м^3). Получено, что величина линейного коэффициента корреляции между часовыми значениями PM2.5 и PM10 на всех пунктах достаточно высокая и меняется от 0.77 до 0.89. Величина коэффициента корреляции между часовыми значениями PM2.5 между пунктами меняется от 0.64 до 0.73, а PM10 – от 0.49 до 0.60.
Рассмотрено соответствие значений PM2.5 и PM10 в трех пунктах города Тбилиси нормам ВМО.