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Statistical characteristics of surface ozone concentration in Ruispiri in 2006-2009

Avtandil G. Amiranashvili, Jumber F. Kharchilava, Victor A.Chikhladze

Mikheil Nodia Institute of Geophysics, 1, M. Alexidze Str., 0193, Tbilisi, Georgia,
avto_amiranashvili@hotmail.com

Abstract

Some results of the statistical analysis of the data observation about surface ozone concentration (SOC) in Ruispiri (East Georgia) during the period with 2006 for 2009 are presented. In total 1220 days of continuous measurements of SOC from 9 till 23 o'clock are analysed (18300 hourly values of SOC). In particular, the annual variation of monthly average values of SOC is studied, distribution functions of hourly values of SOC for three periods of time (year, warm and cold half-year) are received. Daily variation of SOC, and also mean hourly speeds of its change for the specified periods of time is studied. Correlation of hourly values of SOC with each other, and also with mean values of SOC(9-17) and SOC(9-23) are considered. It is shown, that in daily variation of SOC there is a presence autocorrelation both for mean annual values of SOC, and for mean SOC in warm and cold half-year. Correlation and linear regression connection between SOC(9-17) and SOC(15) are steady enough in time and, in particular, can be used for estimations daily mean values of SOC at rare hourly measurements. The weekly variation of SOC is studied. It is received, that in cold half-year SOC in the weekends is more, than in the week-days. By data for a year and warm half-year this effect it is not observed.

1. Introduction

In Georgia the investigations of the atmospheric ozone (total ozone, ozone vertical distribution and surface ozone concentration) are begun almost 55 years ago. Since 1980 to the present in Tbilisi and Ruispiri are conducted the regular measurements of surface ozone concentration with the use of the OMG-200 type ozonometer [1,2]. So, for this time it has been studied: time variations of the surface ozone in several regions of Georgia and their dependence on the atmospheric processes [1, 3-7]; variations of surface ozone in Georgia and conditions for appearance of photochemical smog [1, 3, 8]; effect of ozone on local climate [3,6]; influence of ozone on secondary aerosols formation [3, 9]; surface ozone and ecosystem [1, 8, 10]; surface ozone in city and country [11-13], etc.

The given work is continuation specified above researches. Some results of the statistical analysis of data about surface ozone concentration of last years (2006-2009) in a countryside (Ruispiri, East Georgia) are presented more low.

2. Data and method

The regular measurements of surface ozone concentration (SOC) with the use of the OMG-200 type ozonometer are conducted. Place of measurements: village Ruispiri (East Georgia, Kakheti region). The region of a study is located at a distance 60 – 80 km to east from the powerful source of an anthropogenic pollution of the atmosphere, from city Tbilisi.The period of observation: 2006-2009. In total 1220 days of continuous measurements of SOC from 9 till 23 o'clock are analysed (18300 hourly values of SOC).

The analysis of data was conducted with the aid of the methods of statistical analysis [14-16]. The following designations will be used below (besides those pointed out above and well-known): SOC(15) – hourly surface ozone concentration for 15 o'clock, etc.; SOC(9-17) - mean surface ozone concentration for period from 9 till 17 o'clock, etc.; Range - variational scope; σ - standard deviation; σ_m - standard error (68% - confidence interval of mean values); C_v - coefficient of variation (%); A - coefficient of skewness; K - coefficient of kurtosis; 95%(+/-) CONF - ±95% confidential interval; α – two-sided level of

significance; R - coefficient of linear correlation; R^2 – coefficient of determination; F - calculated distribution function (%); X – gradations of the distribution function. For SOC value of X changes from 0 to 107 mcg/m^3, the grouping interval: 0-10, >10-20,…, >100-110 mcg/m^3. The estimation of difference between the investigated parameters (calculated and empirical distribution functions, average) was evaluated according to Kolmogorov - Smirnov and Student's criterions. Warm period - period from April till September, cold period - period from October till March. For simplicity of a statement the dimension of SOC (mcg/m^3) and hourly velocity of SOC (mcg/m^3·hour) more low in the text is passed.

The analysis is carry out without taking into account a weather condition.

3. Results

The results of the statistical analysis of the SOC in Ruispiri are represented in table 1-3 and in fig. 1-10. In table 1 statistical characteristics of SOC(15), SOC (9-17) and SOC (9-23) for three periods of time (year, warm and cold half-year) in Ruispiri in 2006-2009 are presented.

Table 1 Statistical characteristics of SOC in Ruispiri in 2006-2009

Statistics	Year			Warm period			Cold period		
Variable	SOC (15)	SOC (9-17)	SOC (9-23)	SOC (15)	SOC (9-17)	SOC (9-23)	SOC (15)	SOC (9-17)	SOC (9-23)
Mean	53.8	46.2	42.8	50.4	43.9	40.9	58.0	49.1	45.0
Min	14	13.1	11.4	15	13.1	12.3	14	13.2	11.4
Max	107	101.4	97.9	100	98.4	96.4	107	101.4	97.9
Range	93	88.3	86.5	85	85.3	84.1	93	88.2	86.5
Median	51.0	44.1	40.3	48.0	41.8	38.9	57.0	46.3	42.3
Mode	49.0	35.9	34.2	38.0	35.9	35.3	59.0	51.9	45.7
σ	18.8	16.8	15.8	16.6	15.3	14.4	20.3	18.0	17.0
σ_m	0.5	0.5	0.5	0.6	0.6	0.6	0.9	0.8	0.7
95%(+/-) Conf	1.1	0.9	0.9	1.3	1.2	1.1	1.7	1.5	1.4
C_v(%)	35	36	37	33	35	35	35	37	38
Range/Mean (%)	173	191	202	169	194	205	160	180	192
A	0.51	0.57	0.61	0.48	0.54	0.58	0.35	0.48	0.54
K	-0.21	-0.18	-0.10	-0.18	-0.13	-0.02	-0.50	-0.44	-0.38
count	1220	1220	1220	666	666	666	554	554	554
Correlation Matrix (R)									
SOC15	1	0.97	0.95	1	0.96	0.95	1	0.97	0.95
SOC(9-17)	0.97	1	0.97	0.96	1	0.97	0.97	1	0.97
SOC(9-23)	0.95	0.97	1	0.95	0.97	1	0.95	0.97	1

Values of the indicated parameters change within the following limits: ***Year*** - SOC(15) from 14 to 107 (mean value – 53.8, median – 51.0, mode – 49.0); SOC (9-17) - from 13.1 to 101.4 (mean value – 46.2 median – 44.1, mode - 35.9); SOC (9-23) - from 11.4 to 97.9 (mean value – 42.8, median – 40.3, mode - 34.2); ***Warm period*** - SOC(15) from 15 to 100 (mean value – 50.4, median – 48.0, mode – 16.6); SOC (9-17) - from 13.1 to 98.4 (mean value – 43.9 median – 41.8, mode - 35.9); SOC (9-23) - from 12.3 to 96.4 (mean value – 40.9, median – 38.9, mode - 35.3); ***Cold period*** - SOC(15) from 14 to 107 (mean value – 58.0, median – 57.0, mode – 59.0); SOC (9-17) - from 13.2 to 101.4 (mean value – 49.1 median – 46.3, mode - 51.9); SOC (9-23) - from 11.4 to 97.9 (mean value –45.0, median – 42.3, mode - 45.7). Thus, in cold period values of SOC are more, than in warm period.

The greatest variations for the SOC (9-23) in cold period is observed (C_v = 38 %), the smallest – for SOC(15) in warm period (C_v = 33 %). Thus the values of C_v changes slightly. The values of σ, σ_m and 95%(+/-) Conf change accordingly in the following limits: 14.4 - 20.3 (SOC(9-23) in warm period and SOC(15) in cold period); 0.5 - 0.9 (all SOC in year and SOC(15) in cold period) and 0.9 - 1.7 (SOC(9-

17) and SOC(9-23) in year and SOC(15) in cold period). The relative range (Range/Mean) changes from 160 % (for SOC(15) in cold period) to 205 % (for SOC(9-23) in warm period).

In the general population the distribution functions of the all indicated parameters has right-hand asymmetry (A is more than 0.3). The coefficient of linear correlation between the values of SOC(15), SOC (9-17) and SOC (9-23) are very high (R is 0.95 and more).

The annual distribution of mean monthly values of SOC(15), SOC(9-17) and SOC(9-23) in fig. 1 are presented.

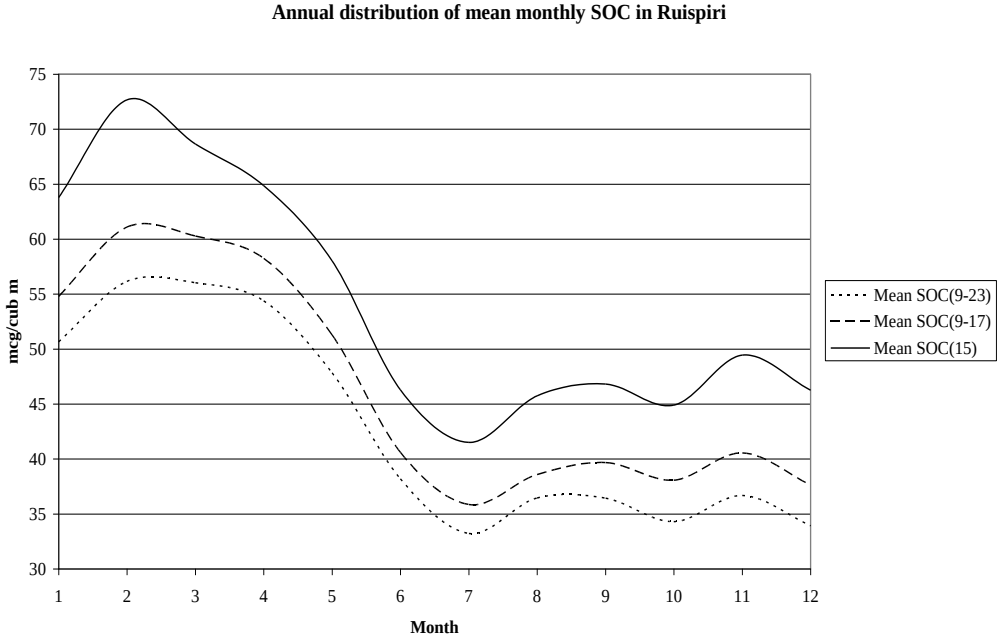

Fig. 1

As follows from fig. 1 max values of the indicated parameters in February are observed (72.7, 61.1 and 56.2 accordingly), min – in July (41.5, 35.9 and 33.2 accordingly). The annual distribution of the indicated parameters are synchronous. It also is well seen from fig. 2, on which correlation between monthly mean values of SOC(15), SOC(9-17) and SOC(9-23) are presented.

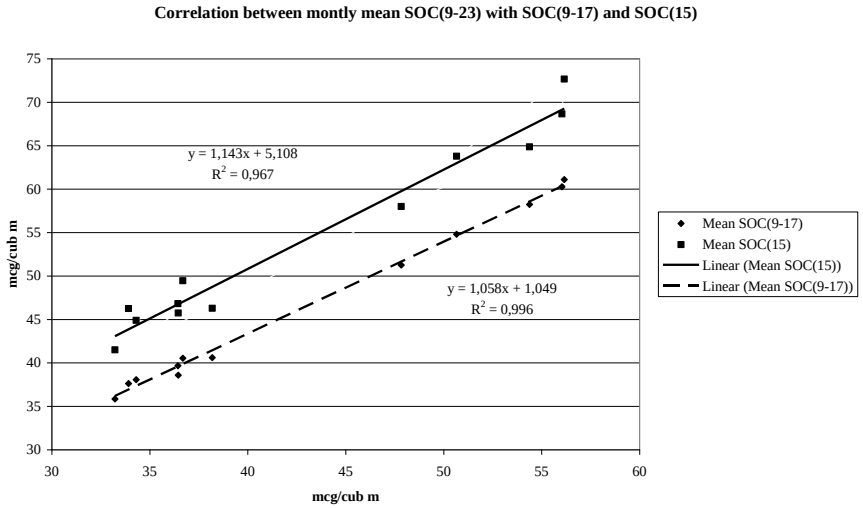

Fig. 2

As follows from fig. 2 the values of R for pairs of indicated parameters is very high and nearly to 1.

The distribution functions of hourly values of SOC for year, warm and cold periods in fig. 3 are presented. In table 2 the coefficients of indicated distribution function are presented.

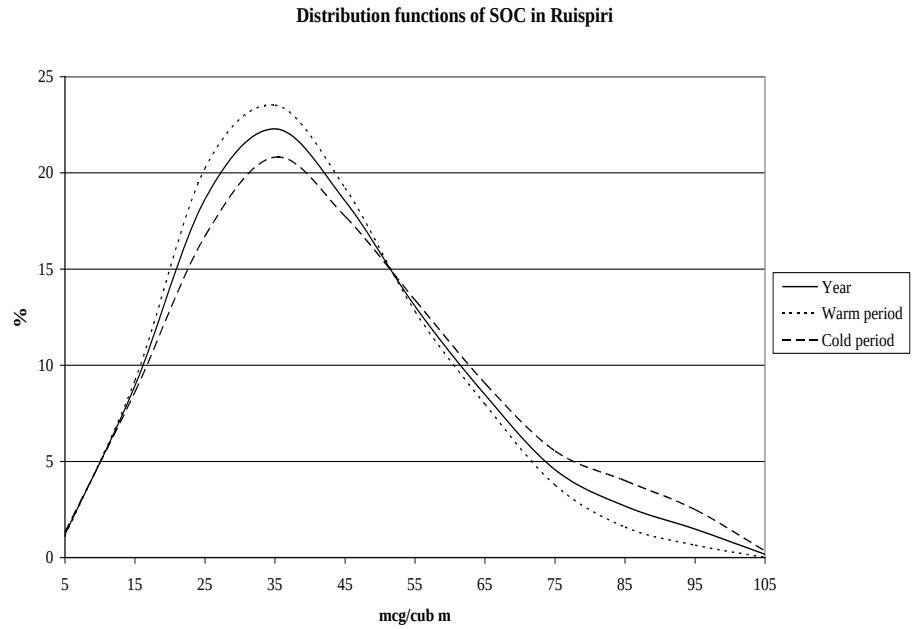

Fig. 3

Table 2 Coefficients of distribution function of SOC in Ruispiri in 2006-2009

Period	Year		Warm period		Cold period	
Distribution function	$F = a \cdot X^b \cdot exp(-c \cdot X)$					
Coefficient	Value	95% (+/-)	Value	95% (+/-)	Value	95% (+/-)
a	0.002628	0.001741	0.001262	0.000915	0.006086	0.00569
b	3.586903	0.255077	3.936284	0.282001	3.182162	0.354867
c	0.106403	0.00686	0.119026	0.007797	0.091717	0.009173
R^2	0.998		0.998		0.995	
Kolmogorov-Smirnov criterion, α - level	0.01		0.01		0.01	

For all indicated periods the calculated distribution functions take the following form (α –level of Kolmogorov-Smirnov criterion is not of worse 0.01): $F = a \cdot X^b \cdot exp(-c \cdot X)$. Max repetition of hourly values of SOC for all indicated periods fit on interval 30-40 (21.9 % for year, 23.4 % for warm period and 20.1 % for cold period). Repetition of SOC for interval 0-10 are: 0.5 % for year, 0.39 % for warm period and 0.64 % for cold period, and repetition for interval 100-110 are: 0.66 % for year, 0.43 % for warm period and 1.08 % for cold period.

Daily variation of mean SOC for 3 above indicated periods of year are presented in fig. 4. As follows from this figure max of SOC in 15 hour are observed for all periods of year (53.8 for year, 50.4 for warm period and 58.0 for cold period). Min of SOC in 9 hour are observed for all periods of year also (32.5 for year, 31.6 for warm period and 33.5 for cold period). It is interesting to notice, that the mean SOC in cold period from 9 till 17 o'clock and from 20 till 23 o'clock is more, that in warm period (α -level of Student's criterion is not of worse 0.05). From 18 till 19 o'clock mean SOC for both indicated periods of year is equal. Difference between mean SOC in cold and warm periods equals: for 9^h – 6.0 %, for 10^h – 9.0%, for 11^h – 12.1%, for 12^h – 14.0%, for 13^h – 15.6%, for 14^h – 16.5%, for 15^h – 15.1%, for 16^h – 11.1%, for 17^h –

5.3%, for 20^h – 3.2%, for 21^h – 11.8%, for 22^h – 14.4%, for 23^h – 15.5 %). So the greatest difference between mean SOC in cold and warm periods in 13, 14, 15 and 23 o'clock are observed (more that 15 %).

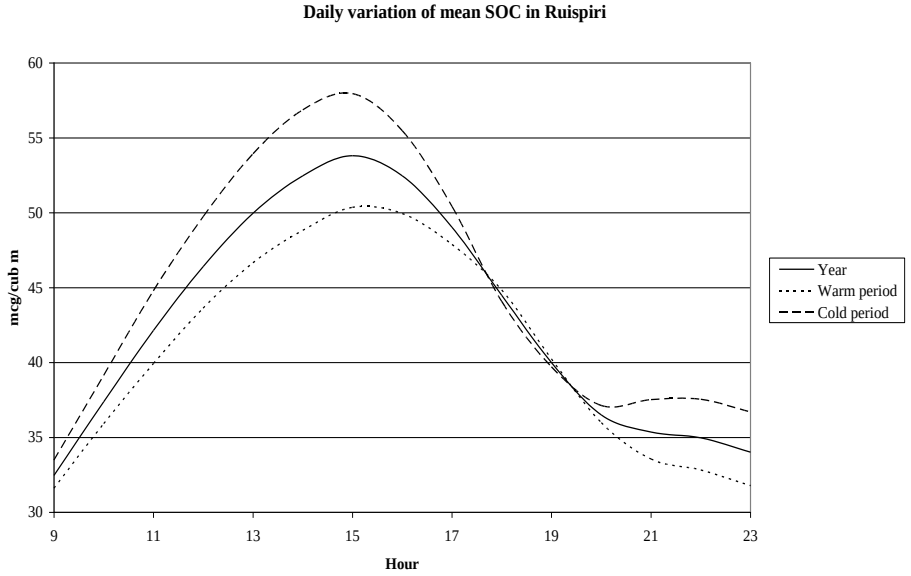

Fig. 4

In fig. 5 mean hourly velocity of SOC for year, warm and cold periods are presented.

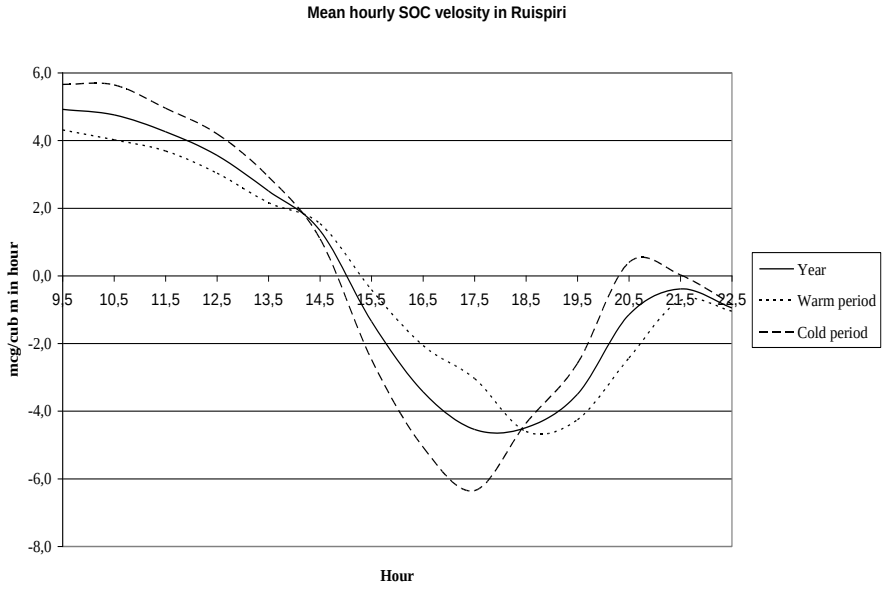

Fig. 5

As follows from fig. 5, for all indicate periods of year mean hourly velocity of SOC from 9 till 15 o'clock are positive, but from 15 till 20 o'clock and from 22 till 23 o'clock – negative. From 20 till 22 o'clock hourly velocity of SOC are negative for year and warm period, and positive or 0 for cold period. Max velocity of SOC growth between 9 and 10 o'clock are observed (4.9 for year, 4.3 for warm period and 5.7 for cold period) and min - between 14 and 15 o'clock (1.3 for year, 1.5 for warm period and 1.1 for cold period). Max velocity of SOC decrease between 17 and 18 o'clock for year (-4.5) and cold period (-6.3), and between 18 and 19 o'clock for warm period (-4.6) are observed.

The correlation field of hourly SOC for year in fig. 6 is presented.

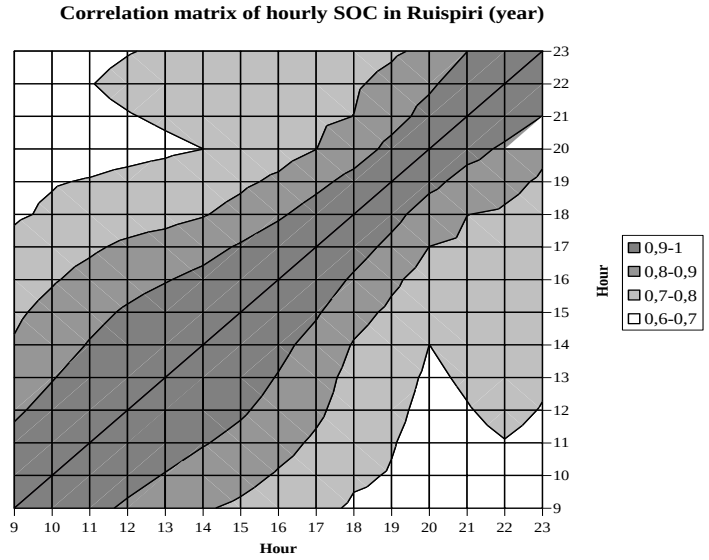

Fig. 6

From fig. 6 show, that values of R are enough high (more that 0.6). Repetition of R are: 20 % for 0.6 <R≤ 0.7, 36.2 % for 0.7 <R≤ 0.8, 21.9 % for 0.8 <R≤ 0.9 and 21.9 % for 0.9 <R≤ 0.98.

In the next figure more detailed correlation curves between SOC(15) and hourly SOC between 9 and 23 o'clock for 3 indicate periods of year is shown.

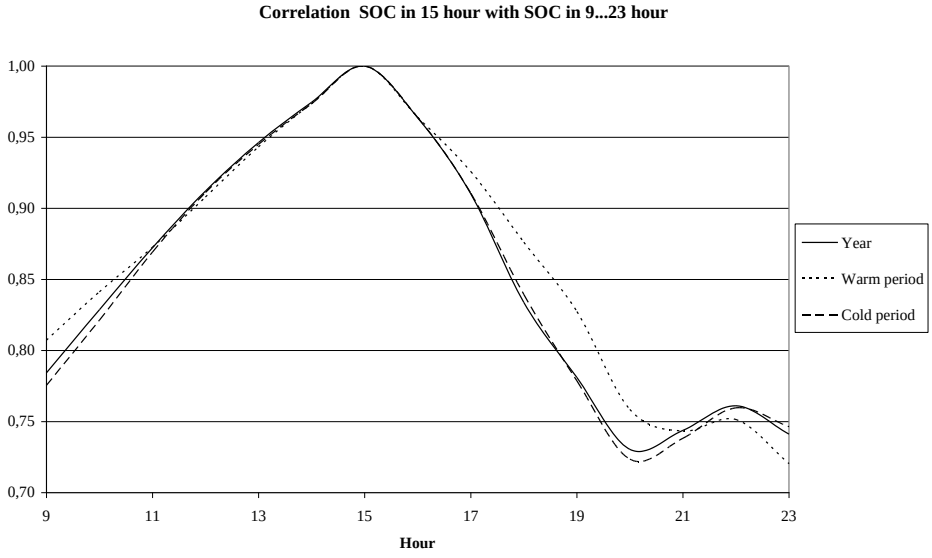

Fig. 7

Values of R changes from 0.72 (pair SOC(15) – SOC(23) for warm period and pair SOC(15) – SOC(20) for cold period) to 0.97 (pair SOC(15) - SOC(14) for all indicated periods). Values of R between SOC(11) and SOC(15) equal 0.87 for all indicated periods. For an example in fig. 8 the connections between SOC(11) and SOC(15) are presented.

Regression equation between mentioned parameters take the following form:

$$SOC(15) = 0{,}951 \cdot SOC(11) + 13.73$$

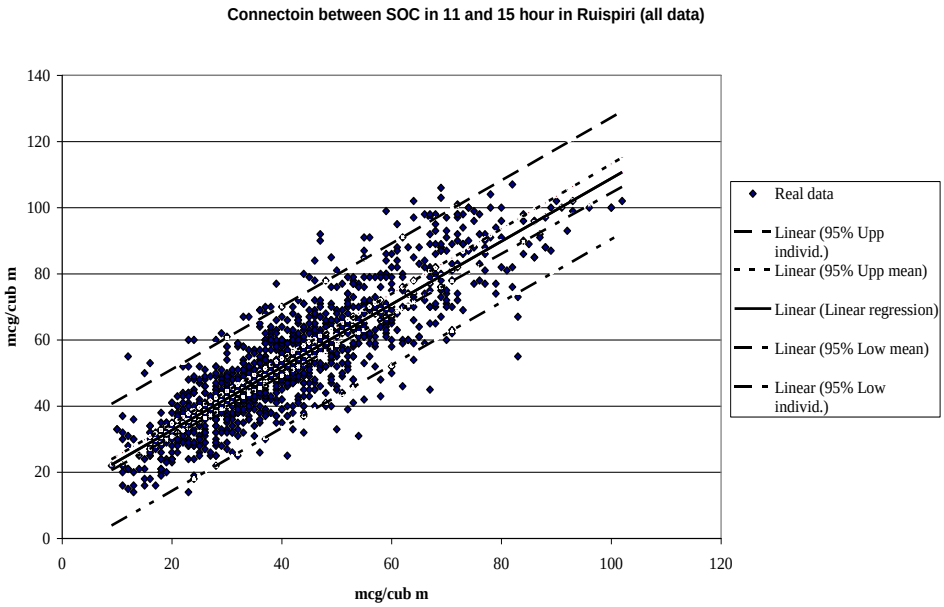

Fig. 8

Autocorrelation functions of daily variation of mean SOC for year, warm and cold periods in fig. 9 are presented.

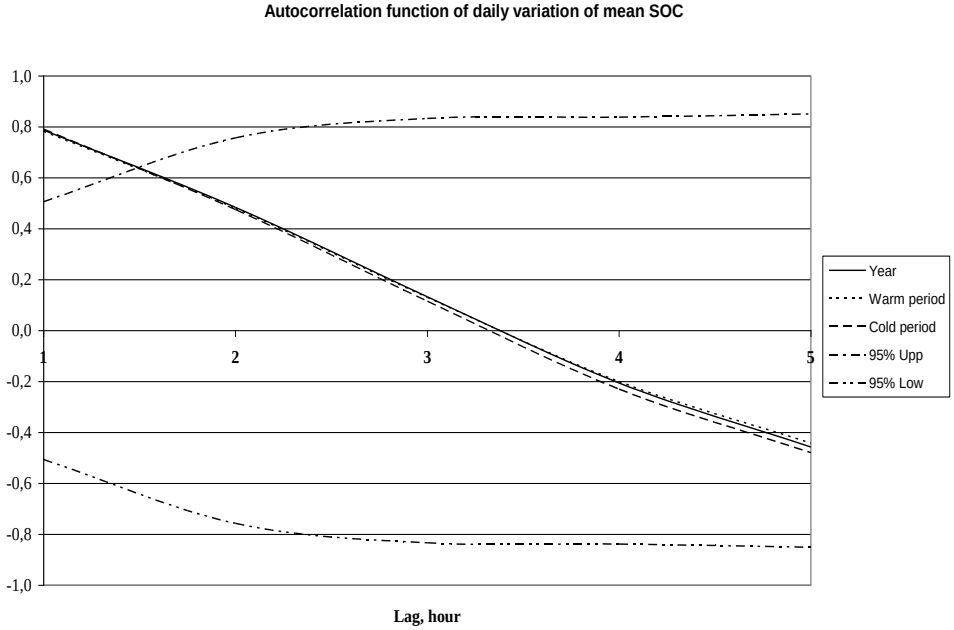

Fig. 9

As shows from fig. 9 values of autocorrelation coefficients for all indicated periods a little differ from each other. Significant values of autocorrelation coefficients take place at a Lag = 1 hour (0.78-0.79). For a Lag = 2 hour and Lag = 5 hour values of autocorrelation coefficients are less significant (0.48 and -0.48).

It is necessary to notice, that above indicated connection under any conditions of weather take a place. After selection of data on weather types will probably spend forecasting SOC by results of measurements for previous time.

As it has been noted above, the region of a study is located at a distance 60 – 80 km to east from the powerful source of an anthropogenic pollution of the atmosphere, from city Tbilisi. Therefore it is interesting to study the sensitivity of daily variations of SOC to the changeability of the air pollution. For this purpose we carried out the analysis of the data about SOC in Ruispiri during the week-days and weekends.

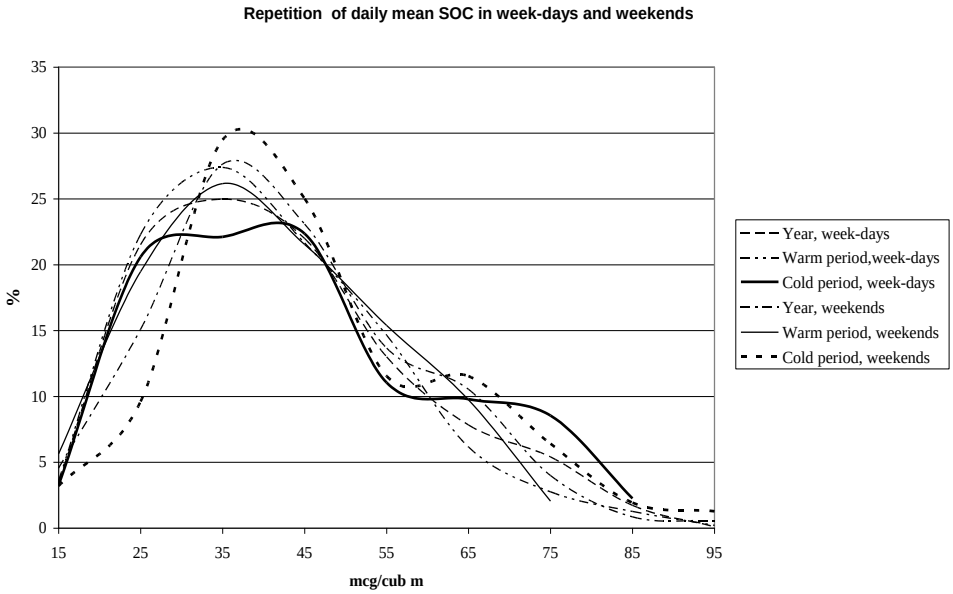

Fig. 10

In fig. 10 repetition of SOC(9-23) for week-days and weekends for 3 periods of year are presented. The analysis of this fig. shown, that only for cold period between repetitions for week-days and weekends take place a difference (α –level of Kolmogorov-Smirnov criterion is 0.15). In table 3 statistical characteristics of SOC in Ruispiri for week-days and weekends (cold period) are presented.

Table 3 Statistical characteristics of SOC in Ruispiri in 2006-2009 for week-days and weekends (cold period)

	Cold period			
	week-days	weekends	week-days	weekends
Parameter	SOC (9-17)	SOC (9-17)	SOC (9-23)	SOC (9-23)
Mean	48.4	50.8	44.4	46.4
σ	18.3	17.2	17.1	16.6
count	398	156	398	156
(α -level of Student's criterion	0.15		0.2	

As follows from this table and fig. 10 in cold period in the weekends SOC (9-17) and SOC (9-23) are more, than in the week-days. By data for a year and warm half-year this effect it is not observed.

4. Conclusion

The detailed statistical analysis of hourly values of surface ozone concentration in Ruispiri in 2006 - 2009 is presented. The analysis is carry out without taking into account a weather condition. Further in process of accumulation of data this analysis will be spent taking into account meteorological conditions.

References

[1] J. Kharchilava , A. Amiranashvili – Studies of Atmospheric Ozone Variations in Soviet Georgia, Results of Researches on the International Geophysical Projects, SGC, Moscow, 1988, p.p.1-114 (in Russian).
[2] A.G. Amiranashvili – National Report on Existing and Planned Activities Relating to Ozone Research and the Monitoring. Calibration and Archiving of Measurements; and on UV-B Monitoring and Initiatives Aimed at the Prevention of UV-B and Sun-Related Injuries in Georgia, Report of the 6th meeting of the ozone research managers of the parties to the Vienna Convention for the protection of the ozone layer, Vienna, Austria, September 19-21, 2005, 48, 129-133.
[3] A.Amiranashvili, V. Amiranashvili, T.Gzirishvili, J. Kharchilava, K. Tavartkiladze - Modern Climate Change in Georgia. Radiatively Active Small Atmospheric Admixtures, Institute of Geophysics, Monograph, Transactions of M.Nodia Institute of Geophysics of Georgian Academy of Sciences, ISSN 1512-1135, vol. LIX, 2005, p.p.1-128.
[4] K. Tavartkiladze, N. Begalishvili, J. Kharchilava, D. Mumladze, A. Amiranashvili, J. Vachnadze, I. Shengelia, V. Amiranashvili – Contemporary climate change in Georgia. Regime of some climate parameters and their variability, Monograph, Tbilisi, ISBN 99928-885-4-7, 2006, 177 p., (in Georgian).
[5] A.G. Amiranashvili, V.A.Chikhladze, J.F. Kharchilava, N.S.Buachidze, L.N. Intskirveli -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, 678-681.
[6] V. Chikhladze – The results of studies of variations of surface ozone concentration in Tbilisi in 1984-2003, Transactions of Institute of Geophysics of Georgian Academy of Sciences, ISSN 1512-1135, vol. LVIII , 2003, 182-186, (in Russian).
[7] A. Amiranashvili, V. Amiranashvili, V. Chikhladze, J. Kharchilava, L. Kartvelishvili - 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 Spase Plasma, ISSN 1512-1127, vol. 12B, Tbilisi, 2008, pp. 45 – 48.
[8] A. Amiranashvili, V. Amiranashvili, A. Davituliani, A. Nodia, J. Kharchilava, V. Chikhladze, L. Chelidze – Photochemical smog in the atmosphere of Tbilisi and its influence on the people health , Ecological problem of Tbilisi, 2002, 147-152, (in Georgian).
[9] A.G. Amiranashvili, V.A. Amiranashvili, T.S. Bakradze, V.A. Chikhladze, N.Ya. Glonti, J.F. Kharchilava, I.I. Tuskia - On the influence of cosmic rays on the secondary aerosols formation in the atmosphere, 7th Int. Conference "Problems of Geocosmos", Abstract, 26 - 30 May, 2008, St. Petersburg, Russia.
[10] A. Amiranashvili, V. Amiranashvili, R. Gogua, T. Matiashvili, A. Nodia, J. Kharchilava, A. Khunjua, V. Chikhladze, K. Tavartkiladze, V. Gabedava - The estimation of the risk of some meteorological-geophysical factors for the health of people under the conditions of Eastern Georgia (based on the example to Tbilisi), Proc. 3th Int. Conf. "State and the conservation of air pond and water-mineral resources of health resort- recreational regions ", Kislovodsk, Russia, 21-24 April 2003, 74-76, (in Russian).
[11] J. Kharchilava, A. Amiranashvili, V. Chikhladze – Some results of studies of the surface ozone concentration in Ruispiri and Tbilisi in 2002 year, Proc. 3th Int. Conf. "State and the conservation of air pond and water-mineral resources of health resort- recreational regions ", Kislovodsk, Russia, 21-24 April 2003, 37-38, (in Russian).
[12] J. Kharchilava, V. Chikhladze, M. Kharchilava – Variability of surface layer ozone concentration in Tbilisi and in a countryside, Transactions of the Institute of Hydrometeorology of Georgian Academy of Sciences, ISSN 1512-0902, vol. 108, 2002, 52-58, (in Georgian).
[13] J. Kharchilava – Changing surface ozone concentration in city and country in dependence on season and weather conditions, Proceedings of Mikheil Nodia Institute of Geophysics , ISSN 1512-1135, vol. LX , Tbilisi, 2008, 270-277, (in Russian).
[14] N. Kobisheva, G. Narovlianski - Climatological processing of the meteorological information, Leningrad, Gidrometeoizdat, 1978, 294 p., (in Russian).
[15] M.G. Kendall - Time-series, Moscow, 1-200, 1981, (in Russian).
[16] E. Forster, B. Ronz - Methods of correlations and regressions analysis, M., "Finance and Statistics", 1983, 304 p., (in Russian).

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Статистические характеристики концентрации приземного озона в Руиспири в 2006-2009 гг

Автандил Г. Амиранашвили, Джумбер Ф. Харчилава, Виктор А. Чихладзе

Резюме

Представлены некоторые результаты статистического анализа данных наблюдений за концентрацией приземного озона (КПО) в Руиспири (Восточная Грузия) в период с 2006 по 2009 гг. Всего проанализировано 1220 дней непрерывных измерений КПО с 9 по 23 час. (18300 часовых значений КПО). В частности, изучен внутригодовой ход среднемесячных значений КПО, получены функции распределения часовых значений КПО для трех периодов времени: год, теплое и холодное полугодия. Изучен суточный ход КПО, а также средние ежечасные скорости ее изменения для указанных периодов времени. Рассмотрены корреляционные связи часовых значений КПО друг с другом, а также со средними величинами КПО(9-17) и КПО(9-23). Показано, что в суточном ходе КПО имеется наличие автокорреляции как для средних годовых значений КПО, так и для средних в тёплое и холодное полугодия. Корреляционные и линейные регрессионные связи между КПО(9-17) и КПО(15) достаточно устойчивы во времени и, в частности, могут быть использованы для оценок среднедневных значений КПО при редких часовых измерениях. Изучен недельный ход КПО. Получено, что в холодное полугодие КПО в выходные дни выше, чем в будние. По данным за год и в теплое полугодие этого эффекта не наблюдается.

2006 – 2009 წლებში ს. რუისპირში მიწისპირა ოზონის კონცენტრაციის სტატისტიკური მახასიათებლები

ავთანდილ გ. ამირანაშვილი, ჯუმბერ თ. ხარჩილავა, ვიქტორ ა. ჩიხლაძე

რეზიუმე

ნაშრომში წარმოდგენილია 2006-2009 წლების პერიოდში აღმოსავლეთ საქართველოს სოფელ რუისპირში მიწისპირა ოზონის კონცენტრაციაზე (მოკ) დაკვირვების მონაცემების სტატისტიკური ანალიზის ზოგიერთი შედეგები. სულ გაანალიზებულია მოკ-ის 9-დან 23 საათამდე უწყვეტი გაზომვების მქონე 1220 დღე (მოკ-ის 18300 საათობრივი მნიშვნელობა). კერძოდ, იყო შესწავლილი მოკ-ის საშუალოთვიური მნიშვნელობების შიდაწლიური სვლა, მიღებულია დროის სამი პერიოდისთვის (წელიწადი, ცივი და თბილი ნახევარწლები) მოკ-ის საათობრივი მნიშვნელობების განაწილების ფუნქციები. შესწავლილია მოკ-ის დღეღამური სვლა, და აგრეთვე, მითითებული პერიოდებისთვის მისი ცვლილების საშუალო საათობრივი სიჩქარის მნიშვნელობი. Gგანხილულია მოკ-ის საათობრივი მნიშვნელობების ერთი-მეორესთან, და აგრეთვე მოკ(9-17) და მოკ(9-23) საშუალო სიდიდეებთან კორელაციური კავშირები. ნაჩვენებია, რომ როგორც მოკ-ის საშუალო წლიურ, ასევე ცივ და თბილ ნახევარწლებში, საშუალო მნიშვნელობებისთვის მოკ-ის საშუალო დღეღამურ სვლაში ადგილი აქვს ავტოკორელაციის არსებობას. მოკ(9-17) და მოკ(9-23) შორის კორელაციური და წრფივი რეგრესიული კავშირები დროში საკმაოდ მდგრადებია და შეიძლება კერძოდ, გამოყენებული იქნას იშვიათი საათობრივი გაზომვებისას მოკ-ის საშუალო დღიური მონაცემების შესაფასებლად. შესწავლილია მოკ-ის კვირეული სვლა. მიღებულია, რომ უქმე დღეებში მოკ-ის მნიშვნელობა ცივ ნახევარწელში უფრო მაღალია, ვიდრე სამუშაო დღეებში. წლიური და ცივი ნახევარწლის მონაცემებით აღნიშნული ეფექტი არ დაიკვირვება.