Comparative Characteristics of Light Ions Content in the Urban and Ecologically Clean Locality in Georgia

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ABSTRACT: The results of the stationary and expeditionary investigations of the light ions content in surface boundary layer in the urban and ecologically clean locality for different regions of Georgia are represented. Stationary studies are carried out in Tbilisi by the use of Gerdien type ions meter from June of 2009 four times a day. Mobile studies are conducted with the aid of the portable ions counter of the production of firm "AlphaLab, Inc." from 2007. Work represented the data about of light ions content in the most pollution city of Georgia - Tbilisi (stationary point of measurement and 20 points in different city locations), and also in more than 300 points of Western Georgia at the heights from 3 to 2000 m above sea level (city, rural locality, health resort zones, the coast of Black sea, etc.). In particular, in different points of measurement the summary content of light ions changes from 100-200 to more than 3500 cm^{-3}. As a whole, under the "good weather" condition, the minimally necessary level of the light ions content for the favorable influence on the health (1000 cm^{-3} and more) is characteristic practically for all points of measurements in Western Georgia. In Tbilisi for the stationary point of the measurements of such cases not more than 30 % (without taking into account weather conditions). The distribution of the light ions content in Tbilisi city has very irregular nature and considerably depends on the level of air pollution, conditions of ventilation, etc.

1. INTRODUCTION

The light ions concentration in the atmosphere in many respects defines the ecological state of medium both itself and being the indicator of the purity of air in the aspect of aerosol pollution. Therefore the importance of the study of the light ions content in the atmosphere is well known [Tammet, 2003; Sheftel et al., 1992]. Regular observations of the parameters of atmospheric electricity (including air electrical conductivity) in Georgia after the Soviet Union decay were ended. In recent the experimental investigations of the content of light ions in air years in Georgia were renewed [Amiranashvili et al., 2008, 2010; Saakashvili et al., 2010]. This work represented some results of study of light ions content in the most pollution city of Georgia - Tbilisi and also in Western Georgia (region with the large health resort- tourist potential).

2. METHOD AND DATA DESCRIPTION

Light ions concentration (cm^{-3}) measurements in Tbilisi were conducted 4 times a day at height 3 floor of the building of the cloud chamber of the Institute of Geophysics (stationary point of measurement, 8 meters above the level of soil, 41.754º N, 44.927º E, the height - 450 m above sea level), into 9, 12, 15 and 18 hour (in the winter season - 17 hours), and in 20 points in different city locations. Stationary monitoring by Gerdien's type instruments was conducted. Mobile studies in Tbilisi and Western Georgia with the aid of the portable ions counter of the production of firm "AlphaLab, Inc." are conducted.

Work gives the results of measurements for Tbilisi from June 2009 through May 2010, and for Western Georgia (more than 300 points of measurements at the heights from 3 to 2000 m above sea level - cities, rural localities, health resort zones, the coast of Black sea, etc.) from 2007 through 2009. The analysis of data is carried out without taking into account weather conditions.

3. RESULTS

The results in table 1 and fig. 1-3 are given. As follows from table 1 the daily mean sum light ions concentration in Tbilisi for stationary point of measurement varied from 215 cm^{-3} to 2516 cm^{-3}. The daily mean value of n is 872 cm^{-3}. The daily mean value of coefficient of unipolarity varied from 0.7 to 1.8. The daily mean value of $n(+)/n(-)$ is 1.21.

Table 1 Statistical characteristics of light ions concentration in Tbilisi (stationary point of measurement)

Hour	9	12	15	17-18	Daily mean
Parameter	Sum light ions concentration, n = n(+) + n(-), cm^{-3}				
Max	2838	2795	2279	2967	2516
Min	215	215	129	129	215
Average	811	871	926	873	872
St Dev	373	393	400	409	327
Hour	Correlation Matrix				
9	1	0.63	0.48	0.52	0.79
12	0.63	1	0.63	0.56	0.85
15	0.48	0.63	1	0.61	0.83
17-18	0.52	0.56	0.61	1	0.82
Daily mean	0.79	0.85	0.83	0.82	1
Parameter	Coefficient of unipolarity, n(+)/n(-)				
Max	2.33	2.5	2.86	2.71	1.8
Min	0.33	0.41	0.11	0.4	0.7
Average	1.18	1.19	1.23	1.24	1.21
St Dev	0.30	0.31	0.33	0.33	0.17

The linear coefficient of correlation R between of n in different time of measurement varied from 0.48 to 0.63. The value of R between daily mean value of n and n in different time of measurement changes insignificantly (0.79 - 0.85).

The data about the repetition of positive and negative concentration of light ions in Tbilisi and Western Georgia are shown in fig. 1. As follows from fig. 1 in Western Georgia in different points of measurement the summary content of light ions changes from 100-200 cm^{-3} to more than 3500 cm^{-3}. The greatest repetition of n(+) and n(-) to Tbilisi falls to range 400-500 cm^{-3}, and in Western Georgia - to range 700-800 cm^{-3}.

As a whole, under the "good weather" condition, the minimally necessary level of the light ions content for the favorable influence on the health (1000 cm^{-3} and more) is characteristic practically for all points of measurements in Western Georgia. In Tbilisi for the stationary point of the measurements of such cases not more than 30 % (without taking into account weather conditions).

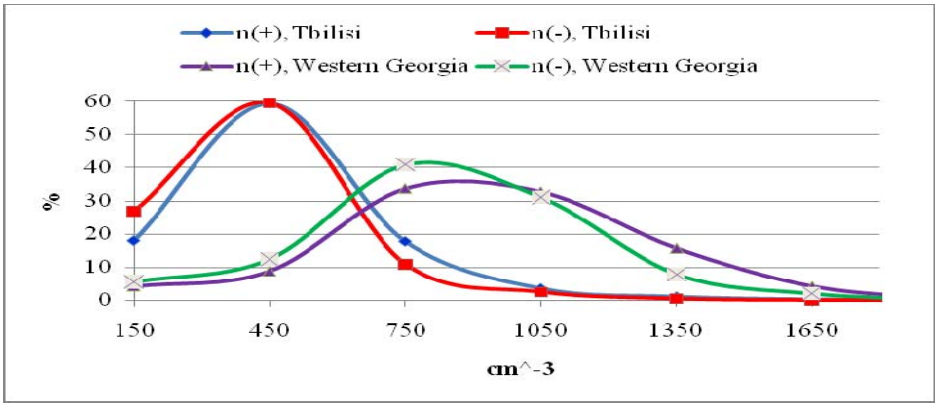

Fig. 1

Repetition of light ions concentrations in Tbilisi and Western Georgia

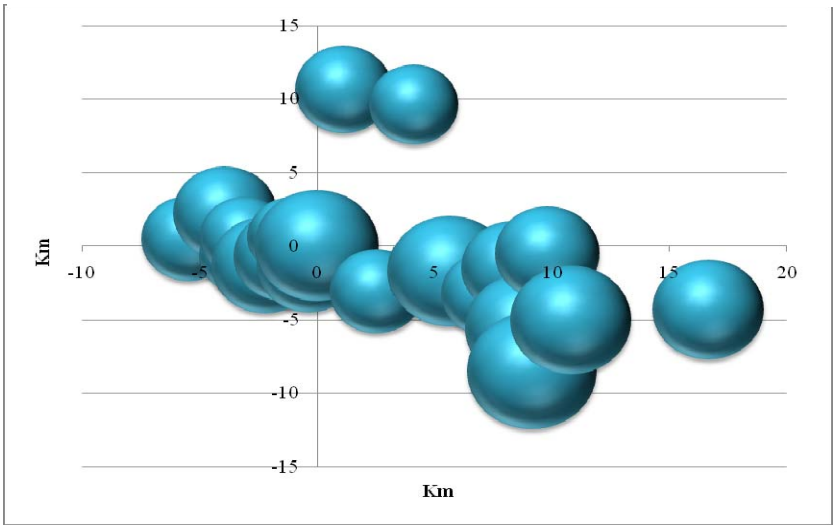

Fig. 2

Distribution of sum light ions concentration in 21 location of Tbilisi (relative units)

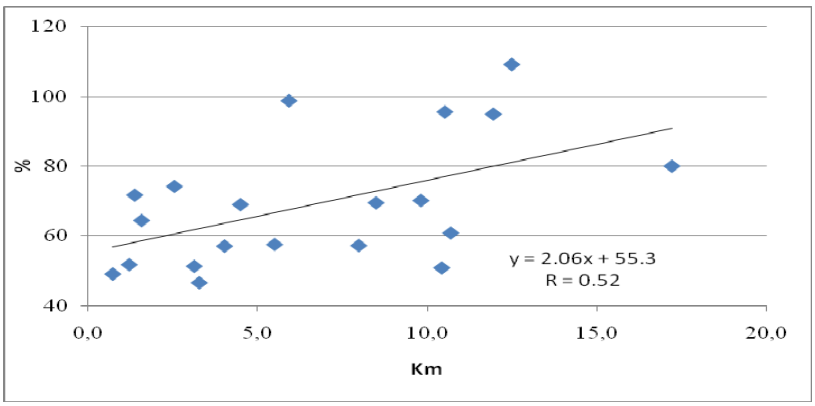

Fig. 3

Correlation between relative sum light ions concentrations and distance from stationary point of measurement

The distribution of the light ions content in Tbilisi city has very irregular nature and considerably depends on the level of air pollution, conditions of ventilation, etc. For example, fig. 2 depicts the spatial distribution of values of n in different places for Tbilisi, normalized at the values to n in the stationary point of measurement. As a whole, the concentration of light ions grows with an increase in the distance from the stationary point of measurement, located in the relatively clean place for the center section of the city (fig. 3). At the same time, even near from the stationary point of measurement (at a distance of 0.7-1.6 km), the relative concentration of light ions varies from 49 to 72 % (fig. 2, 3).

4. CONCLUSIONS

In Georgia the experimental investigations of the light ions concentration in air after almost 20- year interruption are renewed. In the future we plan the continuation of these studies from the point of view of the problems of atmospheric electricity, ecology, medicine, development of health resorts and tourism, etc.

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