SESSION 3. ENVIRONMENT DEGRADATION AND POLLUTION

ON THE INFLUENCE OF LANDSCAPE ON THE CONTENT OF LIGHT AEROIONS IN DIFFERENT REGIONS OF GEORGIA

Avtandil Amiranashvili[1*], Teimuraz Bliadze[1], Victor Chikhladze[1], Nino Japaridze[2] Ketevan Khazaradze[3]

[1] Mikheil Nodia Institute of Geophysics of Ivane Javakhishvili Tbilisi State University;
[2] Tbilisi State Medical University;
[3] Georgian State Teaching University of Physical Education and Sport, Tbilisi, Georgia
**avtandilamiranashvili@gmail.com*

Abstract

The importance of study of the light ions content in the atmosphere is well known. The content of light ions in the atmosphere plays important role in molding of the physiological state of population.

In this work some results of studies of the influence of landscape on the ionizing state of air environment in different regions of Georgia in recent years carried out. The data about the content of aeroions in Tbilisi and some locations of Western Georgia with different types of landscape (urban, forest, park, gorge, waterfalls, the coast of rivers, etc.) are represented. In particular, it is shown that even in the limits of the strongly contaminated city the landscape has vital importance for creating the medium ecologically favorable for human health (Tbilisi National Botanical Garden, territory of Tbilisi Sea, etc.). The results of work can find practical application for the development of health resort- tourist industry in Georgia.

Keywords: light ions, landscape, bioclimate, ecology, health resorts and tourism

Introduction

The formation of ions mainly occurs as a result of the ionizing radiation (cosmic rays, gamma radiation of soil, radon and the short-lived products of its decay) [1]. Sometimes in the limited spaces there are other natural and anthropogenic sources of ionization (hydro-ionization, ionizations with the thunderstorms, etc.) [2,3]. The disappearances of ions it occurs due to their recombination, attachment to the aerosol particles, and also adhesion to different surfaces [1,4,5]. Accordingly, the content of aeroions, besides natural ionization, is determined by weather conditions, ecological state of the surface atmosphere, by nature of landscape [1, 4-7].

The content of light ions in the atmosphere plays the significant role in molding of the physiological state of people and, simultaneously, it is the indicator of the air purity [1]. Under the "good weather" condition, the minimally necessary level of the sum light ions content for the favorable influence on the health of people is $\approx$1000 cm^{-3} and more. If the sum light ions concentration is $\approx$600 cm^{-3} and less, the following negative physiological action on the human organism are observed: fatigue, weakening attention, retarding of reactions, worsening in the memory, headache, the disturbance of the regime of blood pressure, etc. Air, saturated by the high content of ions (4500 cm^{-3} and more), possesses therapeutic properties - optimization of blood pressure, positive influence on the course of the diseases of respiratory organs, bronchial asthma, antiseptic action, etc. The very high concentrations of light ions (100000 cm^{-3} and more) negative affect the health of people [1,2, 8,9]. Therefore, during the determination of ecologically unfavorable and favorable environments for the health of people special attention is paid to the analyses of the content of light ions in air. In particular, special attention is paid to the places with the waterfalls, fountains, national parks, preserves, forests, alpine regions, mountain gorges, the coast of rivers and sea, the tectonic breakings (increased concentration of radon), karstic caves, etc., where the ionization level of air can be suitable for the sessions of ionotherapy [10-12]. Some results of the analysis of distribution of light aeroions content on the territory of western Georgia, and also generalization of early studies [1-6,10,11], are represented below. The role of landscape in shaping of the ecological conditions of locality is shown.

Materials and methods

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, 41.72º N, 44.79º 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 [1].

Mobile studies with the aid of the portable ions counter of the production of firm "AlphaLab, Inc." are conducted (20 populated points of Tbilisi, 462 measurements; some health resort – tourism locations of Tbilisi, 270 locations of Western Georgia, etc., single measurements).

The following designations will be used below: n (+) - concentration of positive light ions, n (-) - concentration of negative light ions, n = n (+) + n (-) – sum light ions concentration. For purposes of the savings of place the dimensionality of the light ions concentration (cm-3) in the figures is omitted. In the work the data of measurements 2007-2015 are used.

For the data analysis standard statistical methods are used. Designations - conventional. The maps of the distribution of the aeroions content with the aid of the "Google Earth" program are built.

Results and discussions

Results of investigations on the Fig. 1-4 and in Tab. clearly are presented.

Fig. 1-3 depicts maps of the distribution of values of n on the territories of Western Georgia, populated parts of Tbilisi city and Tbilisi Botanical Garden. In the Tab. the statistical characteristics of sum light ion concentration in air in Western Georgia and Tbilisi are presented. Fig. 4 the renovated block diagram of the content of light aeroions in different health resort- tourist regions of Georgia is presents, given earlier in the work [2].

Fig. 1. Content of sum light aeroions in 270 locations of Western Georgia.
At the top of the picture is a scale from 400 to 3200 cm^{-3}.

Western Georgia (Fig. 1, Tab. 1). Low concentrations of aeroions (n≈600 cm^{-3} and less) only in certain parts of cities Sachkhere, Tskaltubo, Zestafoni and Vani were observed (1.5 % of cases). The sum light ions content for the favorable influence on the health of people (n ≈1000 cm^{-3} and more) in 93.7 % of cases were observed. Populated part of Tbilisi (Fig. 2, Tab. 1). On average, unfavorable for human health concentrations of light aeroions in five points of Tbilisi were observed (Pekini str.; Varketili, near the metro station; Vake, G. Svanidze str.; near the metro station "Avlabari"; Heroes Square) - 23.8 % of cases. The values of n for the

favorable influence on the health of people in six points of Tbilisi were observed (Lilo; stationary point of measurement; Vazisubani; Chichinadze str.; Moscow av.; Zemo Ponichala) -28.6 % of cases. Tbilisi Botanical Garden (Fig. 3, Tab.1). On the territory of the Tbilisi Botanical Garden of low values of n (≈600 cm^{-3} and less) was not observed.

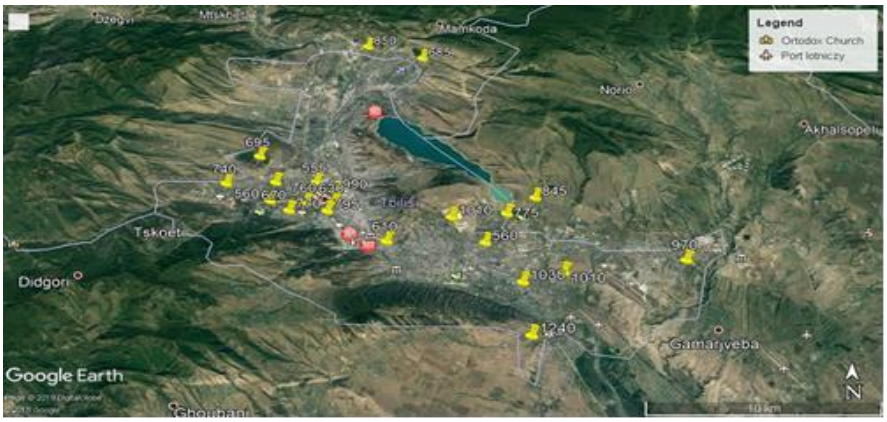

Fig. 2. Average content of sum light aeroions in 21 locations of populated part of Tbilisi.

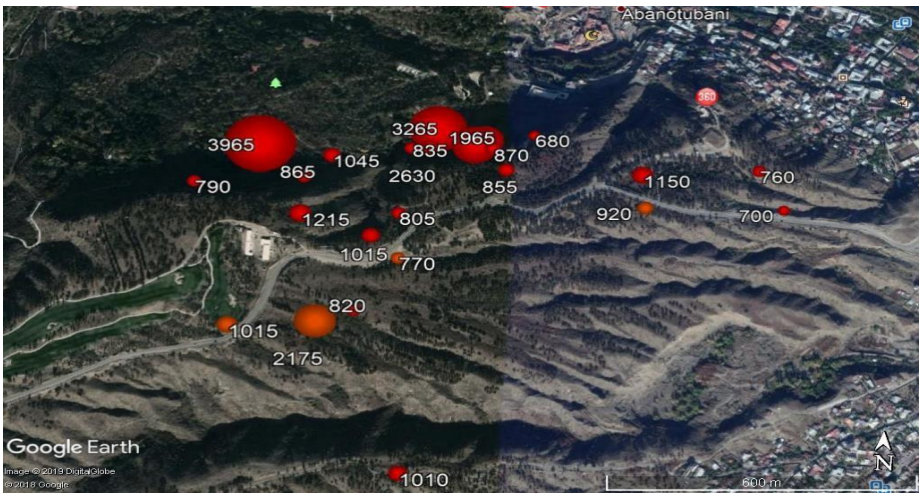

Fig.3 Sum light aeroions concentration in 25 locations of Tbilisi Botanical Garden.

Table 1

The statistical characteristics of sum light ion concentration in air in western Georgia and Tbilisi

Location/ Parameter	Western Georgia (Fig.1)	Tbilisi (Fig. 2)	Tbilisi Botanical Garden (Fig. 3)
Min	450	556	680
Max	3250	1237	3965
Average	1878	797	1277
Range (Max-Min)	2800	680	3285
St Dev	541	186	856
C_v=100·St Dev/Average,	28.8	23.3	67.1
n≈600 cm^{-3} and less, %	1.5	23.8	0
n≈1000 cm^{-3} and more, %	93.7	28.6	48.0

The values of n ≈1000 cm^{-3} and more in 12 points were observed – 48 % of cases. The high concentrations of sum aeroions near the main waterfall with the height of 24 m (2630 cm^{-3}), the small waterfall (3965 cm^{-3}) and also under the Tamara bridge near the river Tsavkisi (3265 cm^{-3}) are observed.

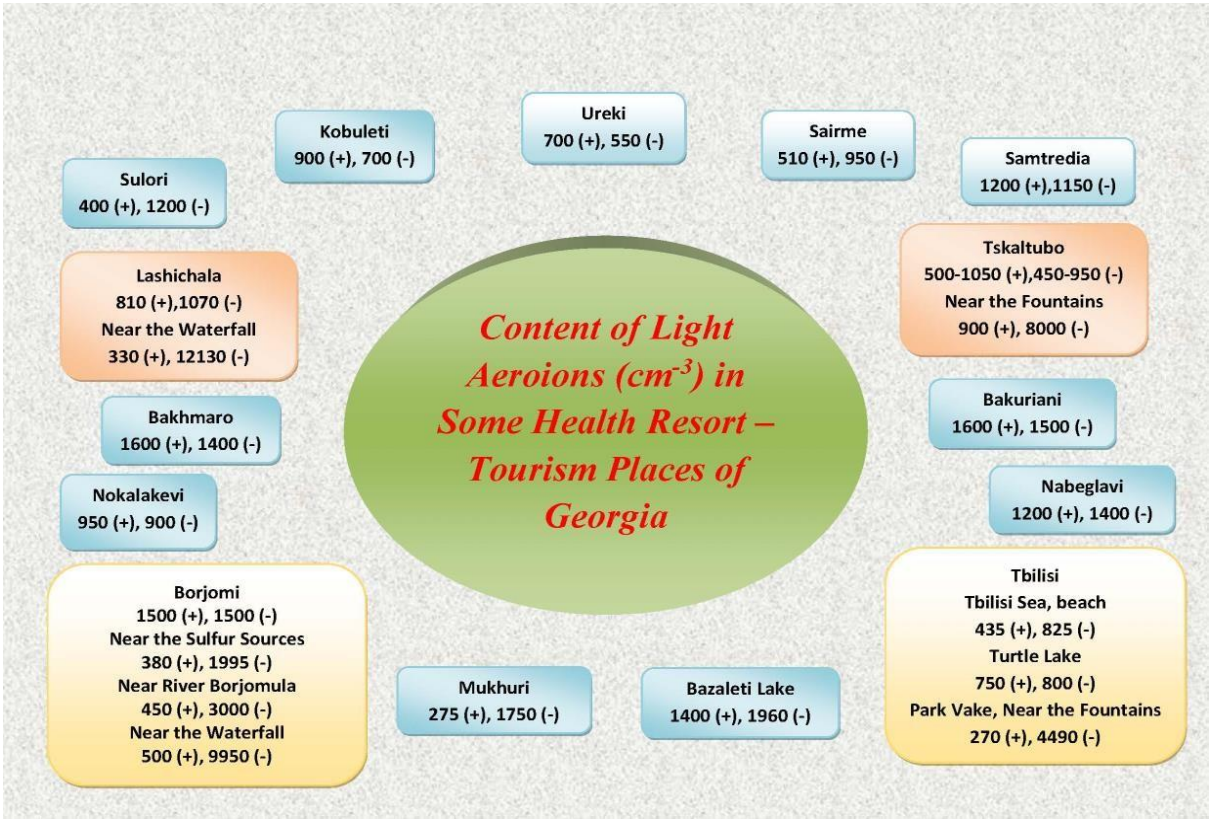

Fig. 4. Positive and negative light aeroions concentration in some health resort – tourism places of Georgia.

As it follows from Fig. 1-3 and Tab., ecological conditions in Western Georgia are much better than in the populated part of Tbilisi city (the average content of the values of n respectively are 1878 cm^{-3} and 797 cm^{-3}, the repetition of the values of n≈600 cm^{-3} and less corresponding are 1.5% and 23.8%). At the same time, in the separate districts of Tbilisi city the favorable for the health of people ecological conditions are observed, similar to the conditions in different health resort- tourist regions of Georgia (Fig. 4).

Thus, even in the conditions of urban landscape it is possible to find places with the acceptable ecological conditions for leisure, rehabilitations and treatment of people (forest and park zones, near the rivers, waterfalls, fountains, etc.).

Conclusions

The landscape of locality, together with other factors, plays important role in shaping of the ecological state of medium in the aspect of the ionization of air. The analysis of obtained data testifies not only about the need of retaining of natural landscapes (waterfalls, national parks, preserves, forests, alpine regions, mountain gorges, the coast of rivers and sea, the tectonic breakings, karst caves, etc.), but also adoption of measures for an artificial improvement in the ecological state of medium (increase in the areas of forests, the building of fountains, the creation of parks, the rehabilitation of those existing and the search for new recreational zones, etc.).

In the future we provided the continuation of studies in this direction.

Acknowledgements

Major portion of the works is executed within the framework of projects “Assessment of radon-hazard potential, residential exposure, lung cancer and COPD in West Georgia”, (Project STCU-3992, 2007-2009,

36 Month) and "Mitigation of negative action of photochemical smog on the living environment – important factor of the sanitation of ecological state of Tbilisi city", (Georgian National Science Foundation Grant NGNSF/ST08/5-437, 2009-2012, 36 Month)".

References

[1] Amiranashvili A., Bliadze T., Chikhladze V., Photochemical smog in Tbilisi. Monograph, Trans. of Mikheil Nodia institute of Geophysics, vol. 63, 160 p., Tbilisi, 2012, (in Georgian).

[2] Amiranashvili A., Bliadze T., Chikhladze V., Machaidze Z., Melikadze G., Saakashvili N., Khatiashvili E., Tarkhan-Mouravi I., Sikharulidze Sh., Nakaidze T., Tavartkiladze M., New data about the aeroionization characteristics of the territory of national botanical garden of Georgia as the factor of the expansion of its sanitation properties for the visitors, Journ. of Georgian Geophysical Soc., Iss. (B), Physics of Atmosphere, Ocean and Space Plasma, vol.16b, 24-30, Tbilisi, 2013.

[3] Amiranashvili A.G, Bolashvili N.R., Chikhladze V.A., Japaridze N.D., Khazaradze K.R., Khazaradze R.R., Lezhava Z.L., Tsikarishvili K.D., Some new data about the bioclimatic characteristics of the village of Mukhuri (Western Georgia). Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v.18B, 107-115, Tbilisi, 2015.

[4] Amiranashvili A., Bliadze T., Chankvetadze A., Chikhladze V., Melikadze G., Kirkitadze D., Nikiforov G., Nodia A., Comparative characteristics of light ions content in the urban and ecologically clean locality in Georgia, Proc. of the 14th Int. Conf. on Atmospheric Electricity, Rio de Janeiro, Brazil, August 07-12, 2011, http://www.icae2011.net.br/.

[5] Amiranashvili A., Some results of study of variations of light ions concentration and their connections with the ionizing radiation and sub-micron aerosol content in air under the conditions of Tbilisi city. Proc. of 15th Int. Conf. on Atmospheric Electricity, Norman, Oklahoma, USA., 15-20 June 2014, http://icae2014.nwc.ou.edu/

[6] Bliadze T.G., Chikhladze V.A., Japaridze N.D., Khazaradze K.R., Khazaradze R.R., Melikadze G.I., Varamashvili N.D., Vepkhvadze S.G., Some Bioclimatic Indices of the Health Resort-Tourist Complex of Bazaleti Lake (Georgia). Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v.18B, 116-123, Tbilisi, 2015.

[7] Kudrinskaya T. V., Kupovykh G. V., Redin A. A., Studying the Ionization of Atmospheric Surface Layer in Different Geophysical Conditions. Russian Meteorology and Hydrology. Vol. 43, Issue 4, 258–263, 2018.

[8] Tammet H., Atmospheric Ions, Proc. 12th Int. Conf. on Atmospheric Electricity, Versailles, France, 9-13 June, 2003, vol.1, 275-178, 2003.

[9] Sanitarily and Hygiene Standards of the Permissible Ionization Levels of Air of Production and Public Compartments, (СНиП 2152-80), (in Russian).

[10] Amiranashvili A.G., Chikhladze V.A. Saakashvili N.M., Tabidze M.Sh., Tarkhan-Mouravi I.D., Bioclimatic characteristics of recreational zones – important component of the passport of the health resort – tourist potential of Georgia, Trans. of the Institute of Hydrometeorology at the Georgian Technical University, vol. 117, 89-92, Tbilisi, 2011.

[11] Saakashvili N.M., Tabidze M.Sh., Tarkhan-Mouravi I.D., Amiranashvili A.G., Melikadze G.I., Chikhladze V.A., To a Question About the Organization of Ionotherapy at the Health Resorts of Georgia. Modern Problems of Using of Health Resort Resources, Collection of Scientific Works of International Conference, Sairme, Georgia, June 10-13, 2010, ISBN 978-9941-0-2529-7, 168-174, Tbilisi, 2010, (in Russian).

[12] Slepykh V.V., Povolotskaya N.P., Korshunova Z.V., Terre N.I., Fedorov V.A., Ionization background of the trees and plants of Kislovodsk park. Voprosy kurortologii, fizioterapii I lechebnoy fizicheskoy kul'tury, ISSN: 0042-8787, eISSN: 2309-1355, N 3, 37-39, 2006, (in Russian).