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

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Results of analysis of variations of sum light ions concentration \((N, \text{cm}^{-3})\) and their connections with radon \((\text{Rn}, \text{Bq/m}^3)\), galactic cosmic rays intensity \((Q, \text{imp/hour})\) and content of sub-micron aerosols by diameter \(\geq 0.1\) micron \((S, \text{cm}^{-3})\) in surface boundary layer of Tbilisi city are given.

Measurements of radon, ions and aerosols were conducted 4 times a day at height 3 floor of the building of the cloud chamber of Institute of Geophysics (8 meters above the level of soil, 41.754° N, 44.927° E, the height -450 m above sea level), into 9, 12, 15 and 17-18 hour. The neutron component of galactic cosmic rays was measured by neutron monitor continuously (Cosmic Rays Station of Institute of Geophysics). The data about daily mean values of the investigated parameters for 2010 year without taking into account weather conditions (356 days, from 9 to 17-18 h) are analyzed. The results in tables 1-4, fig. 1-11 and two block - diagram are given.

The statistical characteristics of daily mean values of \(\text{Rn}, Q, S\) and \(N\) in Tbilisi in table 1 are presented. The minimally necessary level of the sum light ions content for the favorable influence on the health \((1000 \text{ cm}^{-3}\) and more) are observed: year - not more than 35 % of the measurements cases, cold period – 23%, warm period – 46 %.

Average values of the sum ions and sub-micron aerosol concentrations in the week-days and weekends (table 2) respectively comprise - \(N\): year – 899 and 967 (the difference is significant), cold season – 798 and 911 (the difference is significant), warm season –998 and 1021 (the difference is no significant); \(S\): year – 2834 and 2402 (the difference is significant), cold season – 3048 and 2461 (the difference is significant), warm season –2622 and 2343 (low significant difference).

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- The weak direct effect, almost absence of effect or strongly feedback effect of intensity of ionizing radiation \((\text{Rn}, Q)\) with the light ions content in atmosphere in Tbilisi are revealed (table 3, fig. 1-6, 11).
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- The connection of the \(N\) and \(S\) takes the reverse classical form (table 3, fig. 7). Under the normal conditions the concentration of light ions always directly depends on the intensity of the ionizing radiation (fig. 8-10).
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- For year and cold period variations of \(\text{LgN}\) by variations of \(\text{Rn}\) and \(\text{LgS}\) are mainly caused (table 4). In the warm period variations of \(\text{LgN}\) practically do not depend on variations of \(\text{Rn}\) and weakly depend on variations of \(\text{LgS}\).
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- In the strongly polluted cities and the localities the ionizing radiation (radon, cosmic rays, gamma radiation) instead of the well-known effect of an increase of the concentration of light ions (or air electrical conductivity) can lead to the inverse effect, their decrease. This phenomenon in Tbilisi was discovered (Tbilisi type of smog). Moreover, for radon - for all periods of year with weaker inverse correlation into the warm half-year. For the cosmic rays - weak direct connection during the year and in the cold period, and reverse - into the warm half-year. The well-known balance equation relating the formation and disappearing of light ions \(N\) taking into account the influence of the ionizing radiation on the formation of secondary aerosols can take the form: \(\frac{dN}{dt} = q - \alpha' N' - BS N + \beta' S(q)N\), where: \(q\) is the intensity of ion formation, \(\alpha'\) - recombination coefficient, \(S\) - usual aerosol concentration, \(S(q)\) - secondary aerosol concentration as \(q\) function, \(B\) and \(\beta'\) - coefficient of the capture of light ions by usual and secondary aerosols respectively. Depending on the nature of the connection between \(q\) and \(N(q)\) under the conditions of the strongly contaminated atmosphere (similar to Tbilisi) negative correlation between \(q\) and \(N\) is completely possible (left and right block - diagram).