

## A BRIEF OVERVIEW OF RESEARCH CONDUCTED BY M. NODIA INSTITUTE OF GEOPHYSICS, TSU TOGETHER WITH MEDICAL ORGANIZATIONS IN THE FIELD OF “HEALTH OF THE POPULATION OF GEORGIA AND ENVIRONMENT” OVER THE PAST 10 YEARS

•<sup>\*</sup>Japaridze N., •<sup>\*\*</sup>Khazaradze K., •<sup>\*\*\*</sup>Chkhitunidze M., •<sup>\*\*\*\*</sup>Revishvili A.

*\*Tbilisi State Medical University, Tbilisi, Georgia*

*\*\*Ministry of Internally Displaced Persons from Occupied Territories, Labour, Health and Social Affairs of Georgia, Tbilisi, Georgia*

*\*\*\*Georgian State Teaching University of Physical Education and Sport, Tbilisi, Georgia*

*\*\*\*\*Mikheil Nodia Institute of Geophysics of Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia  
njaparidze@moh.gov.ge*

*Abstract: A brief overview of research conducted by M. Nodia Institute of Geophysics, TSU together with Tbilisi State Medical University and Ministry of Internally Displaced Persons from Occupied Territories, Labour, Health and Social Affairs of Georgia in the field of “Health of the Population of Georgia and Environment” over the past 10 years.*

*Key words: Bioclimatology, medical meteorology, environment and human health, Covid-19.*

### Introduction

It is known that generally, the human health is primarily affected by the lifestyle (50 – 55%), then – by the environment (25 – 30%), and finally – by heritage and medical care. Additional anthropogenic or natural (various types of geophysical disasters, epidemics, pandemics, etc.) significantly increase the level of the above risk factors of stress on the biosphere, affecting human health and life [1-4; <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200327-sitrep-67-covid-19.pdf>].

M. Nodia Institute of Geophysics, TSU for many decades, together with various medical organizations, has been conducting research into the connection of different natural and anthropogenic (meteorological, climatic, geophysical, space, anthropogenic atmospheric pollution, etc.) factors with the health of the population of Georgia. Over the past 10 years, this research has been successfully continued together with Tbilisi State Medical University and Ministry of Internally Displaced Persons from Occupied Territories, Labour, Health and Social Affairs of Georgia within the framework of the National Scientific Project "Research of natural and anthropogenic characteristics and phenomena in Georgia with the aim of creating safe ecosystems and supporting sustainable economic development" (2014-2023). As part of this program, a number of studies have also been carried out to study the bioclimatic potential of Georgia in terms of promoting the development of the resort and tourism industry.

During the Covid-19 pandemic, a number of works were carried out on statistical analysis of various components of the pandemic (infection cases, infection rate, death cases) in Georgia. A comparison was also made of the epidemiological situation in Georgia with neighboring countries and in the world. For Georgia it was regularly carried out interval forecasting of infection cases, infection rate, death cases (ten-day, two-week and monthly).

A brief overview on these researches is presented below [4-35].

## Results and discussion

The meteorological, bio meteorological, bioclimatic, geophysical and other parameters, which sufficiently affect the human beings, are the followings:

Separate meteorological and geophysical elements, space weather parameters and its combinations: air temperature, humidity, wind speed, atmospheric pressure, cloud cover, solar activity (Wolf's number), the geomagnetic fields, atmospheric electricity, thunderstorms, solar radiation, the cosmic rays, radioactivity, light ions, aerosols, ozone, other air toxic admixtures and etc. [ 1-4, 10,13,19,21].

Different simple thermal indices involve more than one climatological parameter and consider the combined effects (air equivalent- effective temperature EET, Equivalent temperature (TEK), Wet-bulb-globe temperature (WBGT), Tourism Climate Index (TCI), Holiday Climate Index (HCI) [ 8,9,11,12,14-16, 22,23] and others.

Typically, these indices have a scale with corresponding categories that are easy for the population to understand ("Sharply Coldly", "Comfortably", "Warmly", "Unfavorable", "Very Good", "Ideal", etc.) [16].

The effects of the action of environmental factors on human health have different scales - from minute, hour, day, decade and month to the seasonal and annual [1-4].

For example, in the works [12] results of studying the connection of average-daily values of equivalent-effective temperature in Tbilisi with the mortality of the population of this city from the cardiovascular diseases are represented. It is obtained that the dependence of mortality on EET takes the classical form - the decrease of mortality from the gradation "Sharply Coldly" to "Comfortably" with further increase to the gradation "Warmly".

It is found [13] that the relationship between the average monthly air temperature in Kutaisi (Georgia) and such indices of the health of population as the total number of emergency medical calls, cases of hospitalizations and deaths has the form of a third power polynomial. In general, in the warm months there is a decrease of the total number of emergency medical calls, cases of hospitalizations and deaths. In the hot months, there is a worsening in these indicators of health, comparable to the cold months of the year (increase of the emergency medical calls, cases of hospitalizations and deaths). The similar results were obtained for the Kakheti region [19].

The comparative analysis of the connection of eight simple thermal indices and Tourism Climate Index (TCI) with the monthly mortality of the population of Tbilisi city apropos of cardiovascular diseases in [16] is represented. The values of simple thermal indices were calculated with the use of mean monthly and mean monthly for 13 hour data of meteorological elements. Between all studied simple thermal indices practically direct functional connection with the coefficient of linear correlation not lower than 0.86 is observed. The connection of simple thermal indices with the TCI is nonlinear and takes the form of third power polynomial. The possibility of using the standard scales and categories of the indicated indices as the bioclimatic indicator in monthly time scale is studied. As a whole, all indices adequately correspond to the degree of the bioclimatic comfort of environment for the people - with an increase in the level of comfort the mortality diminishes. Most representative for this purpose is Misenard air effective temperature in 13 hour [16].

Results of study on connection of Holiday Climate Index (HCI) and its components and components ratings with public health (on example of Tbilisi - mortality by cardiovascular diseases and Kakheti Region of Georgia - ambulance calls, hospitalization, total mortality) in [22] are presented. It is shown that, in general, all indicators adequately correspond to the degree of bioclimatic comfort of the living environment for people. In particular, the relationship between HCI and mortality in Tbilisi has the form of a second-degree polynomial, and in Kakheti - a third-degree polynomial. At the same time, with an increase in the degree of bioclimatic comfort to the category "Very good", there is a tendency for a decrease in mortality. With the transition to the "Excellent" category, there is a slight increase in mortality. A similar result for some components of the HCI and the ratings of these components was obtained. It is proposed to make adjustments in determining the degree of comfort of bioclimatic index scales for the population, taking into account local social and climatic conditions.

The results of a study of the effect of the annual changeability of air temperature, surface ozone concentration and neutron component of galactic cosmic ray intensity on the mortality of the population of Tbilisi city in 1984-2010 are presented in the work [10]. In particular, it was found that within the variation range the contribution of

the studied parameters to mortality variability is as follows: a random component of air temperature - 8.5%, real values of surface ozone concentration and cosmic ray intensity - 20.9% and 16.5%, respectively. Results of study of influence of variations of the annual intensity of neutron component of galactic cosmic rays on the mortality of the population of Georgia in 1995-2014 in [21] are presented. In particular, the previously obtained results on a direct correlation between the intensity of cosmic rays and total mortality of the population have been confirmed [10]. However, as it turned out, an increase in the intensity of cosmic rays mainly increases the mortality rate of the male part of the population of Georgia. The mortality rate of women is very weakly dependent to the galactic cosmic rays influence.

The works [7,17,20,35] present the results of a study of variations in monthly fluctuations in mortality from cardiovascular diseases in Tbilisi, the variability of mortality in Georgia and its regions in different seasons and periods of the year.

The results of work on the bioclimatic zoning of the territory of Georgia (including for assessing the bioclimatic potential of the resort and tourism industry) are presented in [5,6,8,9,11,14,15,18,22,23].

In [5] some new data about the bioclimatic characteristics (Tourism Climate Index and light ions content in air) of the village Mukhuri (Western Georgia), useful for the development of the health resort-tourist potential of this locality are represented. It is shown that for the development of mass tourism the months from March through November are favorable. The results of measurements of light ions concentration in air near the bank of river Khobistskali, in Shurubumu karstic cave and forest showed the prospect of development in the indicated locality ionotherapy. It is noted that all months of year are suitable for the therapeutic and preventive tourism.

In [6] data about equivalent-effective temperature of air (EET), content of light ions in air and chemical composition of water in Bazaleti Lake (Eastern Georgia) are represented. It is shown that in the hottest months (July, August) in Bazaleti Lake in comparison with Tbilisi the more comfortable for human health thermal conditions is observed. The content of light ions in air in Bazaleti Lake and in the limits of several hundred meters from it is above minimally necessary for the health of people, whereas in Dusheti ions concentration is less minimally necessary. The data about the chemical composition of water in the lake and in the spring, which is located in several kilometers from the lake, do not indicate the essential deflections from the standards for the drinking water.

Results of the statistical analysis of the mean monthly data about the values of air effective temperature on Missenard (ET) in two diametrically opposite located on the latitude geographical regions of Georgia: autonomous republic of Adjara (below Adjara) and Kakheti region (below Kakheti) in [15] are represented. The period of a study: 1961-2010. Values of ET expected according to the data of four meteorological stations of Adjara (Batumi, Kobuleti, Khulo, Goderdzi crossing) and Kakheti (Telavi, Dedoplistskaro, Kvareli, Sagarejo). The intra-annual distribution of values of ET is studied, their repetition on the categories of ET is obtained, detailed information about the categories of mean monthly values of ET, and also their upper and lower levels 99% of confidence interval is given, etc.

Results of a statistical analysis of monthly average of the values of air effective temperature on Missenard (ET) in Batumi from 1956 to 2015 in [22] are presented. The intra-annual distribution of ET values in three time periods was studied: 1956- 1985, 1956-2015, 1986-2015; their repetition of occurrence by ET categories in the specified time periods was obtained, etc. The influence of climate change on ET values was revealed. In particular, it is shown that in 1986-2015, compared with 1956-1985, the repetition of ET values for the category "Very cold" decreased from 1.7% to 1.1%, "Cold" - decreased from 23.9% to 22.8%, "Cool" - increased from 35.0% to 35.8%, " Comfortable " - decreased from 22.2% to 17.8%, " Warm " - increased from 12.5% to 13.9%, "Hot" - increased from 4.7% to 8.6%. The results of the study can find practical application for planning the development of the resort and tourism industry in Adjara, taking into account climate change.

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 work [18] 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.

During the Covid-19 pandemic, a number of works were carried out [25-32]. In particular, in these works results of a statistical analysis of the daily data associated with New Coronavirus Covid-19 infection of confirmed (C), recovered (R), deaths (D) and infection rate (I) cases of the population of Georgia in the period of pandemic are presented. It also presents the results of the analysis of forecasting of the values of C, D and I (decade, two weeks, monthly). The information was regularly sent to the National Center for Disease Control & Public Health of Georgia and posted on the Facebook page <https://www.facebook.com/Avtandil1948/>.

The comparison of data about C and D in Georgia with similar data in Armenia, Azerbaijan, Russia, Turkey and in the world is also carried out.

In the post-Covid-19 period, studies of the influence of various bioclimatic indices on the spread of this infection have begun and will continue [33,34].

For example, in [33] the results of a study of the influence of diurnal values of separate components of simple thermal indices (temperature and air relative humidity, wind speed) on the infection positivity rate with coronavirus COVID-19 (IR) of the population of Tbilisi from September 1, 2020 to May 31, 2021 are presented. It was found that IR values are inversely correlated with air temperature and wind speed, and positively correlated with air relative humidity. The effect of four different thermal indices (air effective temperature and Wet-Bulb-Globe-Temperature) on the IR values averaged over the scale ranges of their categories was studied. It has been found that an increase of the air effective temperature leads to a decrease of the IR values. In the latter case, the level of significance of the relationship between thermal indices and IR values is much higher than in the case of the relationship between IR and separate components of these indices.

The results of a study of the influence of diurnal values of Angstrom Fire Index (AFI, temperature and air relative humidity combination) on the infection positivity rate with coronavirus COVID-19 (IR) of the population of Tbilisi from September 1, 2020 to May 31, 2021 in [34] are presented. It was found that an increase in AFI values (reduction of fire danger) leads to an increase in IR. Thus, with the "Low" fire danger category, the IR value averaged 11.5%, and with the "Extreme" category - 3.5%. The relationship between the AFI and IR values has the form of a second power polynomial. Thus, AFI also manifests itself as a bioclimatic indicator. In the future, it is planned to compare AFI values with various indicators of human health.

Taking into account new data, an assessment was made of the effect of the Covid-19 pandemic on the mortality rate of the population of Georgia and its regions [35]. It is shown, that the Covid-19 pandemic (2020-2021) has had a significant impact on the population mortality. In particular, during the period with the Covid-19 pandemic compared to the period without the pandemic (1994-2019, 2022), the average mortality to 1000 population (M) in Georgia increased from 12.4 to 14.9 (by 2.5 units). The smallest increase in M values was observed in Tbilisi (from 11.4 to 13.3, by 1.8 units), the largest – in Racha-Lechkhumi and Kvemo Svaneti (from 21.0 to 28.8, by 7.8 units). Data on the differences in average annual mortality in Georgia and its regions for different time intervals (including taking into account the impact of Covid-19 pandemic) are also presented [35].

## Conclusion

In the future, it is planned to continue joint research into the influence of various natural and anthropogenic factors on the health of the population of Georgia.

## References

- [1] Amiranashvili A., Bliadze T., Chikhladze V. Photochemical smog in Tbilisi. // Monograph, Trans. of Mikheil Nodia institute of Geophysics, ISSN 1512-1135, vol. 63, Tb., 2012, 160 p., (in Georgian).
- [2] Amiranashvili A.G. Increasing Public Awareness of Different Types of Geophysical Catastrophes, Possibilities of Their Initiation as a Result of Terrorist Activity, Methods of Protection and Fight with Their Negative Consequences. // Engaging the Public to Fight Consequences of Terrorism and Disasters. NATO Science for Peace and Security Series E: Human and Societal Dynamics, vol. 120. IOS Press, Amsterdam•Berlin•Tokyo•Washington, DC, ISSN 1874-6276, 2015, pp.155-164. <http://www.nato.int/science>; <http://www.springer.com>; <http://www.iospress.nl>
- [3] Kartvelishvili L., Tatishvili M., Amiranashvili A., Megrelidze L., Kutaladze N. Weather, Climate and their Change Regularities for the Conditions of Georgia. // Monograph, Publishing House “UNIVERSAL”, Tbilisi 2023, 406 p., <https://doi.org/10.5-2340/mng.9789941334658>
- [4] Japaridze N., Khazaradze K. Studies in the Field of the Influence of Natural and Anthropogenic Environmental Factors on Human Health in Georgia: Current Status and Planned Works. // Int. Sc. Conf. “Natural Disasters in Georgia: Monitoring, Prevention, Mitigation”. Proc., ISBN 978-9941-13-899-7, Publish House of Iv. Javakishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 201-204. [http://109.205.44.60/bitstream/123456789/8671/1/47\\_Conf\\_NDG\\_2019.pdf](http://109.205.44.60/bitstream/123456789/8671/1/47_Conf_NDG_2019.pdf)
- [5] 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, Tbilisi, 2015, pp. 107-115.
- [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, 2015, pp.116-123. <https://openjournals.ge/index.php/GGS/article/view/1755>
- [7] Amiranashvili A., Chargazia Kh., Chikhladze V., Japaridze N., Khazaradze K. The monthly variations in mortality from the cardiovascular diseases in Tbilisi. // Georgian Medical News, No 5 (242), 2015, pp. 53-59.
- [8] Amiranashvili A., Japaridze N., Kartvelishvili L., Khazaradze K., Khazaradze R. Tourism climate index in some locations of Georgia. Report. First Caucasus Mountain Forum: Bridging Science and Practice for Sustainability. Tbilisi, Georgia 28 November – 1 December 2016. <http://caucasus-mt.net/events/CMF>
- [9] Amiranashvili A. G., Japaridze N. D., Kartvelishvili L. G., Khazaradze R. R. Tourism Climate Index in Telavi (Eastern Georgia). The Questions of Health Resort Managing, Physiotherapy and Rehabilitation, International Collection of Scientific Articles, Vol. I, ISSN 2449-271X, Tbilisi, 2016, p. 76-81.
- [10] Amiranashvili A.G., Bakradze T. S., Berianidze N.T., Japaridze N.D., Khazaradze K.R. Effect of Mean Annual Changeability of Air Temperature, Surface Ozone Concentration and Galactic Cosmic Rays Intensity on the Mortality of Tbilisi City Population. Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v.19B, Tbilisi, 2016, pp. 135-143.
- [11] Amiranashvili A.G., Japaridze N.D., Kartvelishvili L.G., Khazaradze K.R., Matzarakis A., Povolotskaya N.P., Senik I.A. Tourism Climate Index of in the Some Regions of Georgia and North Caucasus. Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v. 20B, 2017, pp. 43–64.
- [12] Khazaradze K.R. Comparative Analysis of Mean-Daily Value of Air Equivalent Effective Temperature in Tbilisi and Kojori. // Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v. 20B, 2017, pp. 65–72. [http://www.dspace.gela.org.ge/bitstream/123456789/7105/1/JGGS\\_20B\\_2017\\_5.pdf](http://www.dspace.gela.org.ge/bitstream/123456789/7105/1/JGGS_20B_2017_5.pdf)
- [13] Amiranashvili A.G., Japaridze N.D., Kartvelishvili L.G., Khazaradze K.R., Khazaradze R.R. Effects of Variations of the Monthly Mean Air Temperature on the Population Health of Imereti Region of Georgia. International Scientific Conference „Modern Problems of Ecology“, Proceedings, ISSN 1512-1976, v. 6, Kutaisi, Georgia, 21-22 September, 2018, pp. 38-41. [http://dspace.gela.org.ge/bitstream/123456789/7278/1/Kut\\_2018\\_1.5.pdf](http://dspace.gela.org.ge/bitstream/123456789/7278/1/Kut_2018_1.5.pdf)
- [14] Amiranashvili A.G., Japaridze N.D., Kartvelishvili L.G., Khazaradze K.R., Kurdashvili L.R. Tourism Climate Index in Kutaisi (Georgia). International Scientific Conference „Modern Problems of Ecology“, Proceedings, ISSN 1512-1976, v. 6, Kutaisi, Georgia, 21-22 September, 2018, pp. 227-230. [http://dspace.gela.org.ge/bitstream/123456789/7330/1/Kut\\_2018\\_2.19.pdf](http://dspace.gela.org.ge/bitstream/123456789/7330/1/Kut_2018_2.19.pdf)
- [15] Amiranashvili A., Japaridze N., Kartvelishvili L., Megrelidze L., Khazaradze K. Statistical characteristics of the monthly mean values of air effective temperature on Missenard in the Autonomous Republic of Adjara and Kakheti (Georgia). Trans. of Mikheil Nodia institute of Geophysics, ISSN 1512-1135, vol. 69, Tb., 2018, pp. 118 – 138, (in Russian). [http://dspace.gela.org.ge/bitstream/123456789/7509/1/IG\\_T\\_69\\_2018\\_Red\\_13.pdf](http://dspace.gela.org.ge/bitstream/123456789/7509/1/IG_T_69_2018_Red_13.pdf)
- [16] Amiranashvili A.G., Japaridze N.D., Khazaradze K.R. On the Connection of Monthly Mean of Some Simple Thermal Indices and Tourism Climate Index with the Mortality of the Population of Tbilisi City Apropos of Cardiovascular Diseases. Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 21(1), Tbilisi, 2018, pp.48 -62. <http://www.jl.tsu.ge/index.php/GGS/article/view/2489>

- [17] Japaridze N., Khazaradze K. Changeability of Mortality in Georgia in Different Seasons and Periods of Year into 1993-2017. // Int. Sc. Conf. "Natural Disasters in Georgia: Monitoring, Prevention, Mitigation". Proc., ISBN 978- 9941-13-899-7, Publish House of Iv. Javakhsishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 205-208. [http://www.dspace.gela.org.ge/bitstream/123456789/8672/1/48\\_Conf\\_NDG\\_2019.pdf](http://www.dspace.gela.org.ge/bitstream/123456789/8672/1/48_Conf_NDG_2019.pdf)
- [18] Amiranashvili A., Bliadze T., Chikhladze V., Japaridze N. Khazaradze K. On the Influence of Landscape on the Content of Light Aeroions in Different Regions of Georgia. Proc. Intern. Multidisciplinary Conf. "Actual Problems of Landscape Sciences: Environment, Society, Politics", September 9-13, 2019, Tbilisi, Georgia, ISBN 978-9941-13-868-3, Tbilisi, 2019, pp. 117-121, [http://dspace.gela.org.ge/bitstream/123456789/8597/1/Amiranashvili%20etc.\\_Act\\_Probl\\_Lands\\_Science\\_2019.pdf](http://dspace.gela.org.ge/bitstream/123456789/8597/1/Amiranashvili%20etc._Act_Probl_Lands_Science_2019.pdf)
- [19] Khazaradze K.R., Chkhitunidze M.S., Japaridze N.D. Effects of Variations of the Monthly Mean Max Air Temperature on the Population Health of Kakheti Region of Georgia. // Int. Sc. Conf. „Modern Problems of Ecology“ Proceedings, ISSN 1512-1976, v. 7, Tbilisi-Telavi, Georgia, 26-28 September, 2020, pp. 356-359. <http://www.dspace.gela.org.ge/handle/123456789/8836>
- [20] Khazaradze K.R., Chkhitunidze M.S., Japaridze N.D. Changeability of Annual Values of Mortality as Whole in Georgia and Kakheti Region from 1993 to 2018. // Int. Sc. Conf. „Modern Problems of Ecology“ Proceedings, ISSN 1512-1976, v. 7, Tbilisi-Telavi, Georgia, 26-28 September, 2020, pp. 360-363. <http://dspace.gela.org.ge/handle/123456789/8837>
- [21] Amiranashvili A., Bakradze T., Ghlonti N., Khazaradze K., Japaridze N., Revishvili A. Influence of Variations of the Annual Intensity of Galactic Cosmic Rays on the Mortality of the Population of Georgia. International Scientific Conference „Natural Disasters in the 21st Century: Monitoring, Prevention, Mitigation“. Proceedings, ISBN 978-9941-491-52-8, Tbilisi, Georgia, December 20-22, 2021. Publish House of Iv. Javakhsishvili Tbilisi State University, Tbilisi, 2021, pp. 163 - 166.
- [22] Amiranashvili A.G., Revishvili A.A., Khazaradze K.R., Japaridze N.D. Connection of Holiday Climate Index with Public Health (on Example of Tbilisi and Kakheti Region, Georgia). Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 24 (1), 2021, pp. 63-76. DOI: <https://doi.org/10.48614/ggs2420212884>
- [23] Amiranashvili A., Japaridze N., Kartvelishvili L., Khazaradze K., Revishvili A. Changeability the Monthly Mean Values of Air Effective Temperature on Missenard in Batumi in 1956-2015. Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 25(2), 2022, pp. 49-58. DOI: <https://doi.org/10.48614/ggs2520225960>
- [24] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. Twenty weeks of the pandemic of coronavirus Covid-19 in Georgia and neighboring countries (Armenia, Azerbaijan, Turkey, Russia). Preliminary comparative statistical data analysis. // Int. Sc. Conf. „Modern Problems of Ecology“, Proc., ISSN 1512-1976, v. 7, Tbilisi-Telavi, Georgia, 26-28 September, 2020, pp. 364-370.
- [25] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. Analysis of twenty-week time-series of confirmed cases of New Coronavirus COVID-19 and their simple short-term prediction for Georgia and neighboring countries (Armenia, Azerbaijan, Turkey, Russia) in amid of a global pandemic. // medRxiv preprint doi: <https://doi.org/10.1101/2020.09.09.20191494>, 2020, 13 p. Europe PMC, <https://europepmc.org/article/ppr/ppr213467>
- [26] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. The Statistical Analysis of Daily Data Associated with Different Parameters of the New Coronavirus COVID-19 Pandemic in Georgia and their Short-Term Interval Prediction from September 2020 to February 2021. // medRxiv preprint doi: <https://doi.org/10.1101/2021.04.01.21254448>, 2021, 18 p.
- [27] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. The Statistical Analysis of Daily Data Associated with Different Parameters of the New Coronavirus COVID-19 Pandemic in Georgia and their Short-Term Interval Prediction in Spring 2021. // medRxiv preprint doi: <https://doi.org/10.1101/2021.06.16.21259038>, 2021.
- [28] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. The Statistical Analysis of Daily Data Associated with Different Parameters of the New Coronavirus COVID-19 Pandemic in Georgia and their Two-Week Interval Prediction in Summer 2021. // medRxiv preprint, 2021, doi: <https://doi.org/10.1101/2021.09.08.21263265>, 2021, 20 p
- [29] Amiranashvili A., Khazaradze K., Japaridze N., Revishvili A. Analysis of the Short-Term Forecast of Covid-19 Related Confirmed Cases, Deaths Cases and Infection Rates in Georgia from September 2020 to October 2021. // Int. Sc. Conf. „Natural Disasters in the 21st Century: Monitoring, Prevention, Mitigation“. Proceedings, ISBN 978-9941-491-52-8, Tbilisi, Georgia, December 20-22, 2021. Publish House of Iv. Javakhsishvili Tbilisi State University, Tbilisi, 2021, pp. 167 - 171.
- [30] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. The Statistical Analysis of Daily Data Associated with Different Parameters of the New Coronavirus COVID-19 Pandemic in Georgia and their Monthly Interval Prediction from September 1, 2021 to December 31, 2021. 22 p. // Europe PMC plus. Preprint from medRxiv, 16 Jan 2022, DOI: 10.1101/2022.01.16.22269373, PPR: PPR443384
- [31] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. The statistical analysis of daily data associated with different parameters of the New Coronavirus COVID-19 pandemic in Georgia and their monthly interval prediction from January 1, 2022 to March 31, 2022. 20 p. // Preprint from medRxiv, 21 Apr 2022, medRxiv 2022.04.19.22274044; doi: <https://doi.org/10.1101/2022.04.19.22274044>
- [32] Amiranashvili A.G., Khazaradze K.R., Japaridze N.D. Comparative Analysis of Reported Deaths Cases Associated with the New Coronavirus COVID-19 Pandemic in the South Caucasus Countries (Armenia, Azerbaijan, Georgia) from March 2020 to May 2022. // medRxiv 2022.04.19.22274044; doi: <https://doi.org/10.1101/2022.04.19.22274044>

- [33] Amiranashvili A., Japaridze N., Kartvelishvili L., Khazaradze K., Revishvili A. Preliminary Results of a Study on the Impact of Some Simple Thermal Indices on the Spread of COVID-19 in Tbilisi. // Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 25(2), 2022, pp. 59–68. DOI: <https://doi.org/10.48614/ggs2520225961>
- [34] Amiranashvili A., Bliadze T., Japaridze N., Khazaradze K., Revishvili A. Angstrom Fire Index as a Bioclimatic Indicator (Using the Example of the Impact on the Spread of Covid-19 in Tbilisi). // Int. Sc. Conf. "Geophysical Processes in the Earth and its Envelopes", Proceedings, Publish House of Iv. Javakhishvili Tbilisi State University, November 16-17, Tbilisi, 2023.
- [35] Japaridze N., Khazaradze K., Chkhitunidze M., Revishvili A. Mortality Variability in Georgia in 1994-2022. // Int. Sc. Conf. "Geophysical Processes in the Earth and its Envelopes", Proceedings, Publish House of Iv. Javakhishvili Tbilisi State University, November 16-17, Tbilisi, 2023.