MICROCLIMATIC FEATURES IN SMALL TOWNS AND THEIR UNDERLYING CAUSES

Chincharashvili Izolda
Candidate of Geographical Sciences,
teacher of Telavi State School №1 named after King Erekle II.
Home address: 2200 Telavi, Chodrishvili 7, Georgia. Tel.: +995 5(99) 00 84 48, email – izoldachincharashvili@gmail.com
Service address: 2200 Telavi, Chavchavadze Square. 1, Telavi State School №1 named after King Irakli II. email –telavi1@mes.gov.ge

Chautidze Nata
Master of Geography. Geography teacher, public school of Artani village, Telavi district.
Home address: 2200 Telavi, Chodrishvili 7, Georgia. Tel.: +995 5(99) 07 70 16, email – natachautidze90@mail.ru

Beglarashvili Nazibrola
Academic degree, scientific title - Candidate of Geographical Sciences.
Place of work with address - Institute of Hydrometeorology of the Georgian Technical University, 0112 Tbilisi, Ave. D. Agmashenebeli 150g, Tel: 0(322)951966
Home address – 0172 Tbilisi, st. Gobronidze No. 11(D), apt. 136, Tel: +995 555 218688, E-mail – beglarashvilinani@yahoo.com

Pipia Mikhail
Academic degree, scientific title - Candidate of Geographical Sciences.
Place of work with address - Institute of Hydrometeorology of the Georgian Technical University, 0112 Tbilisi, Ave. D. Agmashenebeli 150g, Tel: 0(322)951047
Home address – 0172 Tbilisi, st. Gobronidze No. 11(D), apt. 136, Tel: +995 593 556511, E-mail – m.pipia@gtu.ge

Key words:
Microclimatic features
Air temperature
Wind speed
Relative humidity
"Heat Island"

Atmospheric air pollution has a significant negative impact on human health. Polluted air leads to various diseases and premature death of people. Environmental pollution is especially dangerous for vulnerable groups of the population - children, the elderly and people suffering

from acute and chronic respiratory diseases. Some air pollutants also cause damage to ecosystems. In particular, increases the concentration of nitrogen in water bodies, leads to a deterioration in the condition of forest ecosystems, etc. In addition, air pollution damages cultural and national heritage sites.

Data on the quality of atmospheric air in Georgia will be obtained from the National Air Quality Monitoring Network. To date, there are a sufficient number of automated and non-automated stations in the country (six automated and four non-automated stations). Monitoring stations are located mainly near industrial facilities and transport "hot spots". The results of approximate measurements show that the air quality in large cities It's better in the suburbs and small towns.

Based on the available data, we can conclude that transport (especially in urban areas) and the energy sector are the main sources of carbon monoxide (CO) and nitrogen oxidants (NOx). In particular, according to the "national report on the state of the environment for 2010-2013", 79% of CO and 62% of NOx come from the transport sector, and 20% and 18% of the same pollutants come from the energy sector. The main cause of air pollution associated with the transport sector is the age and technical condition of the existing fleet, the number of vehicles and traffic intensity, the type and quality of fuel, improperly developed public transport, etc. As for the energy sector, CO emissions are mainly due to the consumption of firewood and natural gas in households, while NOx emissions are largely related to natural gas consumed in the same subsector. As a result, we get an increase in temperature. [1] [Third National Environmental Program of Georgia for 2017–2021 (2018), Tbilisi, p.115]

According to the third national environmental protection program of Georgia, since 2000 the number of cars in the country has increased 3.4 times (from 313,700 to 1,081,400). However, 90.9% of vehicles in the country are older than 10 years. [2][Source: Ministry of Environment and Agriculture] As of 2015, one car for 3.5 people arrives in Georgia. The situation is likely to worsen in the next 5 years.

The influence of the cities of Tbilisi, Kutaisi, Batumi and Zestaponi on the formation of the local climate has been discussed in detail several times. [3][Elizbarashvili E., Aladashvili T., Elizbarashvili M., Dzhangulashvili N. (2000), Microclimatic features of Tbilisi, Science and Technology, No. 10-12], [4][Elizbarashvili E.; Elizbarashvili M.; Dzhangulashvili N. (2000), Statistical method, Science and technology for identifying urbanization effects in modern

[1] Third National Environmental Program of Georgia for 2017–2021 (2018), Tbilisi, p.115
[2] Source: Ministry of Environment and Agriculture
[3] Elizbarashvili E., Aladashvili T., Elizbarashvili M., Dzhangulashvili N. (2000), Microclimatic features of Tbilisi, Science and Technology, No. 10-12
[4] Elizbarashvili E.; Elizbarashvili M.; Dzhangulashvili N. (2000), Statistical method, Science and technology for identifying urbanization effects in modern climate change, No. 1-3

climate change, No. 1-3], [5][Elizbarashvili M. (1999) Temperature field of the territory of Georgia; Georgian Academy of Sciences, Institute of Hydrometeorology, Tbilisi] The city of Telavi, neither in terms of the size of the territory and the density of residence, nor in terms of the abundance of industrial facilities and high-rise buildings, is one of the cities that can significantly affect the formation of the local climate. But, its geographical location on the northeastern slope of the Ziv-gombori Ridge and a large range of heights (the difference in heights within the city limits is 300 m.) is of some interest to the investigation of the microclimatic conditions of the city, especially since this issue is often not the subject of study. To explore the microclimatic characteristics of the city of Telavi, we selected 4 points in the central part of the city, of which 1) Point A is located in the north-eastern part of the city, at an altitude of 680 m above sea level.; 2) - point B is in the northern part of the city, at an altitude of 715 m above sea level; 3) - point C is in the city center, at an altitude of 40 m above sea level; 4) - point D is in the southwestern part of the city, at an altitude of 825 m above sea level.

For observations were chosen 2 time intervals: 9 o'clock in the morning, when convective processes in the city have not yet developed and, consequently, the local circulation is less active; and 17 o'clock, when maximum heat is felt.

We drove along the route in two cars and immediately started observing. The time interval between observations at two points did not exceed 15-20 minutes. In order not to affect the results of observations at this time, we have changed the order of observations. This minimized the time interval.

Observations were carried out in the summer of 2019 for air temperature, wind speed and synoptic indicators. (The results are presented in table 1).

table 1 Air temperature ^{0}C

№	Clause	June			July			August			summer average
		by 9 o'clock	by 17 o'clock	Average grade	by 9 o'clock	by 17 o'clock	Average grade	by 9 o'clock	by 17 o'clock	Average grade	
1.	Clause A (1)	19,5	23,4	21,4	26,5	30,9	28,7	25,8	30,2	28,0	26,0
2.	Clause B (2)	19,2	23,4	21,3	24,5	30,2	27,4	24,9	30,8	27,8	25,5
3.	Clause C (3)	18,3	23,5	20,9	24,0	30,2	27,1	24,4	31,5	28,0	25,3
4.	Clause D (4)	17,4	22,0	19,7	22,7	29,2	25,9	24,5	29,8	27,2	24,3

Wind speed m/s.

[5] Elizbarashvili M. (1999) Temperature field of the territory of Georgia; Georgian Academy of Sciences, Institute of Hydrometeorology, Tbilisi

№	Clause	June			July			August			summer average
		by 9 o'clock	by 17 o'clock	Average grade	by 9 o'clock	by 17 o'clock	Average grade	by 9 o'clock	by 17 o'clock	Average grade	
1.	Clause A (1)	1,7	1,7	1,7	1,4	1,6	1,5	1,4	1,9	1,6	1,6
2.	Clause B (2)	1,4	2,0	1,7	1,4	1,4	1,4	1,4	2,0	1,7	1,6
3.	Clause C (3)	1,4	1,4	1,4	_	_	_	1,4	2,3	1,8	1,6
4.	Clause D (4)	1,4	1,9	1,6	1,4	1,4	1,4	1,4	2,0	1,7	1,6

Relative humidity %.

№	Clause	June			July			August			summer average
		by 9 o'clock	by 17 o'clock	Average grade	by 9 o'clock	by 17 o'clock	Average grade	by 9 o'clock	by 17 o'clock	Average grade	
1.	Clause A (1)	52	39	45	52	41	47	55	42	48	47
2.	Clause B (2)	46	37	42	59	45	52	56	40	48	47
3.	Clause C (3)	53	39	46	64	44	54	57	39	48	49
4.	Clause D (4)	54	44	49	68	47	57	56	41	48	51

The table shows that the air temperature in urban conditions decreases with increasing altitude. This change can be described by the following linear regression equation:

$T = a - \gamma H$ (1)

Where T - is the air temperature, γ - - is vertical gradient, H - is the height of the room, and a - is a free element.

(1) statistical parameters of the equation for individual months and in general Summer is indicated in table 2.

Table 2 Statistical parameters

parameter	June	July	August	summer average
a	29,6	40,7	32,0	37,2
γ	0,012	0,019	0,006	0,013

(1) the formula and (2) the statistical parameters presented in the table allow us to determine the average air temperature in the summer months anywhere in the city of Telavi.

During extreme heat, the general pattern of linear temperature decrease depending on altitude is violated. This is especially evident from the 17-hour observations in August (see Table 1). At points B and C, the temperature is higher than at point A at a relatively low altitude. This should be caused precisely by the microclimatic conditions at points B and C - the abundance of buildings, the presence of a massive fence, a large area of paved areas, crowding and the influence of transport.

Figure 1 shows a schematic plan of the city, on which the average summer isotherms are marked with a continuous line, and the isotherms corresponding to the 17-hour observations of August are marked with an intermittent line.

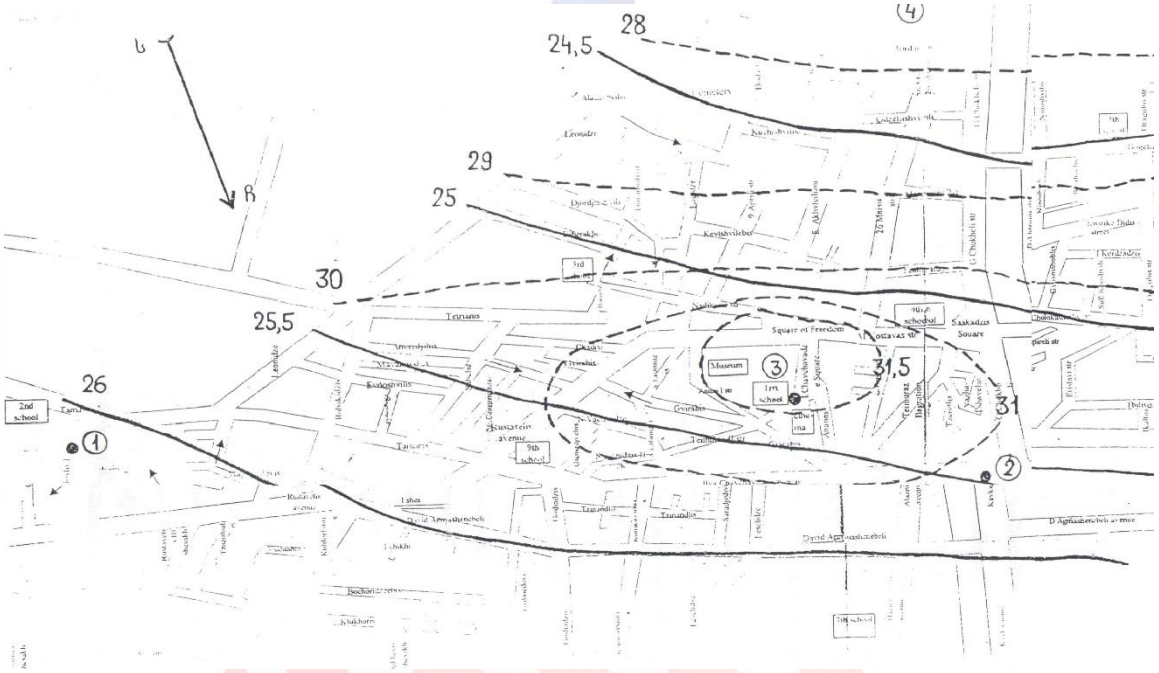

Fig 1. Air temperature

The continuous line is the average isotherms of summer.
The intermittent line is the 17-hour isotherms of August
From the first drawing shows that the average daytime temperature in summer in the central area of the City (Point B) varies between 24-26°. The highest temperatures are observed in the northern part of the City (Point A). The temperature in the City Center (point C) is 25-25.5°. On the streets leading uphill from the city center-the temperature is less than 25°, and near the State University (point D) it drops to 24°.

From the same drawing, it can be seen that during the 17-hour observation period in August, the so-called "heat island" is formed in the center of the city, which includes square of Freedom and I.Chavchavadze and section of Kostava street (point C). The temperature in" heat island " exceeds 31.5°. The temperature is 30-31°. on the vast part of the city territory north of Kostava Street, and on the streets leading south of Kostava street - Chokheli, May 26, E.Akhvlediani, April 9, Lagidze, etc.Sh. Decreases to 29°., and the minimum reaches 28°. in the vicinity of the State University (Point D). At this time, due to the difference in temperature, local circulation is activated and the wind speed reaches the maximum, which is confirmed by the data presented in the results of observations (table 1). On average, the wind speed in selected points in the central district of the city is almost equal.

As for the relative humidity of the air, it varies slightly on the territory of the city and averages 47-51%, with a maximum on the territory of the State University (point D), which should be due to the proximity of the forest.

Despite the fact that Telavi is spread over a small area, microclimatic features are still preserved in the city due to the complex distribution. A similar pattern will be observed in other similar cities.

Microclimatic features in small towns and their underlying causes

Chincharashvili I; Chautidze N; Beglarashvili N; Pipia m.

Resume

Based on the measurements carried out at 4 observation points in the city of Telavi, the microclimatic features of the city have been studied. Maps of isotherms are built for the average summer and for the 17-hour period in August. In the center of the city (point B) there is a "heat island", where the temperature in August exceeds 31.5^0. Temperatures in the north (point A) of this "island" are $30\text{-}31^0$, and in the south on the streets leading uphill (point C) it drops to 29^0 and reaches a minimum of 28^0, in the vicinity of the State University (point D). The presence of such microclimatic features is clearly seen in such a small but difficult-to-disperse city.

References

1. Chincharashvili I. (2009), Climatic resources of the Kakheti region, (Monograph), Tbilisi;
2. Third national program for Environmental Protection of Georgia 2017-2021, (2018), Tbilisi, P..115;
3. Elizbarashvili E., , Aladashvili T., , EelizbarashviliM.,, Jangulashvili N. (2000), Microclimatic features of Tbilisi, science and technology, №10-12;
4. Elizbarashvili E.,; Elizbarashvili M.,. Iangulashvili N. (2000), Statistical method of detecting the effect of urbanization in modern climate change, science and technique, №1-3;
5. Elizbarashvili M. (1999), Temperature field of the territory of Georgia; Georgian Academy of Sciences, hydrometeorogia Institute, Tbilisi.