

Geography

Climate of Imereti in 2010 against a Background of Global Warming

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ABSTRACT. Research carried out over the last two decades revealed that since 1990s the response of the Kutaisi climate to global warming has a well manifested tendency to temperature rising. Deviation of mean temperature from the norm makes 0.7-1.2°C. In 2010, when monthly deviation of temperature increased from 0.2°C to 5.7°C, it was the hottest weather since 1966. According to the data of WMO the mentioned year along with 2005 and 1998 years holds a position of the hottest year at a global scale. Such anomalous pattern was connected with the synoptic situation, when the heat wave dominating in Europe and Russia, reached Georgia. The situation was aggravated by the strong foehnic circulation dominating in the gorge of river Rioni. © 2015 Bull. Georg. Natl. Acad. Sci.

Key words: global warming, climate change, vulnerability, deviations from norm, heat wave, ecologic adaptation, social-economic adaptation.

Climate change is recognized as one of the greatest global challenges facing humanity. The interest to its versatile aspects greatly increased recently. This is conditioned by the fact that global warming is not only an ecological but also a social-economic problem.

Research carried out over the last two decades shows that with 90% probability global warming must be evoked by the human impact on atmosphere [1]. Therefore the Framework Convention on Climate Change (UN FCCC) was signed on the United Nations Conference on Environment and Development (also referred to as Rio Conference or Earth

Summit) held in Rio de Janeiro in 1992. The main target of the convention is stabilization of concentration of glasshouse gases in the atmosphere at such a level that can protect climatic systems from anthropogenic intervention. It imposes different responsibilities to different participant countries to overcome these changes [2].

Georgia ratified the above mentioned convention in 1994 and Georgian scientists thoroughly studied the main characteristics of climate, evaluated the trends of climate change in Georgia and determined the degree of its vulnerability. The results of these studies were included in the Initial (1999) and Sec-



Fig. 1. Distribution of mean air temperature in Kutaisi during the period of 1950-2010.

ond (2009) National Communications on Climate Change to the UN FCCC. One of the most important conclusions of both communications is that current global warming has a clearly expressed mosaic nature in Georgia, which is a country characterized by diverse climate.

On the basis of the methods used in the National Communications, as well as the works of the famous Georgian climatologists – M. Kordzakhia [3], I. Tsutskiridze [4], Sh. Javakhishvili [5], E. Elizbarashvili [6, 7], and the materials of the latest observations (1890-2012) against the background of global warming we studied the character of air temperature distribution - the main parameter conditioning global warming - in one of the regions of Georgia – Imereti, located in the western part of the country [1, 3].

Since 90s of the 20th century in contrast to Colchis Lowland global warming has a clearly expressed tendency to the increase in the region under study. Considering the above mentioned fact the present work aimed to establish and analyze the reasons of anomalous high annual temperature – 17.3°C registered in Kutaisi in 2010.

For evaluation of changes in climatic zones the key representative stations were chosen, where continuous series of information were available. Kutaisi

is recognized as such a station in West Georgia. According to climatic zoning it is representative of humid climatic zone with warm winter and hot summer embracing part of Colchis, plains and the lowlands of Imereti and the zone of hills and hillocks. Considering these facts Kutaisi as well as Tbilisi turned out by 1.2°C warmer than the corresponding characteristic territory [4]. This means that the mean air temperature is $\approx 13.5^{\circ}\text{C}$ on the representative territory with average altitude 200 m.

Regular monitoring of air temperature in Kutaisi started since 1885. Comparatively continuous data are available since 1928 and the series is absolutely continuous since 1950. The graph of temperature fluctuation within the mentioned period is presented in Fig. 1. The Figure shows that the response of climate to global warming in Kutaisi since 1990s has a clearly manifested upward trend and the value of deviation of mean annual temperature from the norm even exceeds 0.7-1.2°C. Extremely warm and cold years were identified. Number of warm years (35) two times exceeds number of cold years (17). Within the time interval between 1890 and 2000 years the 1966 year is distinguished when mean annual temperature reached unusually high value in all meteorological stations of Georgia and the mean annual temperature 16.5°C was

Table 1. Indices of deviations from the long-term norm of air temperature in 2010

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
+3.3	+3.2	+0.8	-0.2	+1.1	+3.2	+2.8	+4.6	+3.6	+0.2	+3.4	+5.7	+2.6

registered in Kutaisi for the first time.

After the anomalous 1966 year particularly high annual temperature was registered in 2010. Within this year deviations from the mean temperature reached from +0.2°C up to +5.7°C every month. April was the only exception with -0.2°C deviation (Table 1).

How can such increase of mean annual temperature in Kutaisi be explained in comparison with the long-term norm?

According to the data of WMO, extremely durable and intense heat wave was established in East Europe in 2010. It was especially strong in European part of Russia. Moderately mild weather in the Arctic region caused decline of the volume of sea ice. This phenomenon was extremely negative to the Arctic. Characteristic of global atmospheric circulation was mainly the activation of El-Niño the (warm phase of El-Niño). Besides, the zone of high pressure dominated over the whole north Atlantics and especially its eastern part and the Icelandic minimum was weakened. Exactly those variations were responsible for climate change in the North hemisphere. Summer was unbearably hot in Russia, +5°C deviation from the norm was registered. Air temperature exceeded +40°C even in Moscow region. This was the hottest summer in European part of Russia for the last 130 years. High temperature caused forest fires in Russia. During several weeks European Russia was covered with smoke and strong smog [5].

Heat wave established in Europe and south regions of Russia reached Georgia. The situation was aggravated by strong foehnic circulation established in the gorge of the river Rioni, which is known to

cause sharp increase of temperature. In our opinion, it was due to the coincidence of the above mentioned processes that 2010 was anomalously hot in Imereti, especially Kutaisi.

According to the data of WMO the year of 2010, along with 2005 and 1998 occupies the place of the hottest year in Europe as well as in the south Caucasus since 1850. That year (2010) turned out to be warmer than expected according to the linear trend predicted since 1900 [5].

Such high temperatures against the background of absence of precipitation and lack of moisture cause draughts duration of which in conditions of current global warming increased from several days even up to three months in Georgia. In the mentioned year precipitation was only 18 mm less in Kutaisi compared with long-term norm. In other words, the increase of temperature was not accompanied by the decrease of sum of precipitation, but in 2010 sharply contrasting uneven distribution of precipitation took place. In November only 9 mm precipitation fell, while long-term norms for this month was from 137 mm up to 161 mm. Thus, the 2010 year can be regarded as anomalous also by the precipitation distribution.

It can be said as a conclusion that climate changes revealed in the region against the background of global warming are expressed mainly by rising of the mean temperature, sharply uneven distribution of precipitation during the year and frequent showers (rainfalls). The climate change in 2010 shows that extremely cold and hot periods might recur which should be taken into consideration when talking about the strategy of adaptation to global warming.

გეოგრაფია

2010 წლის კლიმატი იმერეთში მიმდინარე გლობალური დათბობის ფონზე

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უკანასკნელი ორი ათეული წლის განმავლობაში ჩატარებული კვლევები ცხადყოფს, რომ მიმდინარე გლობალურ დათბობაზე კლიმატის რეაგირებას ქუთაისში 1990-იანი წლებიდან გამოკვეთილი მატების ტენდენცია ახასიათებს და ტემპერატურის ნორმიდან გადახრის საშუალო სიდიდე 0,7-1,20 შეადგენს. 1966 წლის შემდეგ ქუთაისში უკიდურესად ცხელი იყო 2010 წელი, როდესაც ყოველი თვის ტემპერატურის გადახრა 0,20-დან 5,70-მდე გაიზარდა. ეს წელი WMO-ს მონაცემებით ყველაზე ცხელი წლის ადგილს იკავებს მსოფლიო მასშტაბით 2005 და 1998 წლებთან ერთად. ასეთი ანომალური სურათის შექმნა დაკავშირებული იყო იმ სინოპტიკურ სიტუაციასთან, რომლის დროსაც ევროპასა და რუსეთის სამხრეთ რაიონებში გაძლიერებულმა სიციხის ტალღამ მოაღწია საქართველომდეც, რასაც დაემატა რიონის ხეობაში გაბატონებული ძლიერი ფიონური ცირკულაციაც.

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