

## Dangerous regions of blizzard in georgia

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Received: 12 May 2019; accepted: 27 July 2019

### ABSTRACT

Blizzards will do essential damage to the mountain and alpine regions of Georgia. Blizzards especially damages agriculture, is caused the uneven redistribution of snow and are created the bare sections of the pastures, which cause the freezing of winter cultures and the erosion of soil. In the regions, where winter pastures are arranged, blizzards frequently disrupts the normal mode of the feeding of animals and hampers wintering cattle. In this study the observational data of 85 meteorological stations and posts during the period of 1966-2017 are used. Most reliable are data during the period of 1966-1992. In 1993 the majority of alpine meteorological stations were closed; therefore period 1993-2017 was illuminated only by data of separate stations. The materials of the archive of the institute of hydrometeorology of Georgian technical university, data National Environmental Agency, literature data and climatic reference books also were used. Blizzards dangerous regions of Georgia are revealed and the corresponding map of division into districts is built. The dependence of a change in the blizzards on the height of locality is investigated.

**Keywords:** Mountain and alpine regions, Dangerous meteorological phenomena, Blizzard, Observational data, Agriculture, Meteorological station.

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### Introduction

Blizzard is the transfer of snow by the wind of a sufficient force. Blizzard disrupts the uniformity of snow cover and causes the appearance of cornices, snowdrifts and other unstable forms of snow-accumulation [1]. Blizzards prevents the functioning of all forms of transport, is caused the destruction of the lines of communications and power transmissions, it creates emergency situations and frequently causes human victims.

Blizzards especially damages agriculture. High winds and friable structure of snow cover cause the uneven redistribution of snow and create the bare sections of the pastures, which cause the freezing of winter cultures and the erosion of soil. In the regions, where winter pastures are arranged, blizzards

frequently disrupts the normal mode of the feeding of animals and hampers wintering cattle [2].

The direction of blizzards dangerous winds is caused by the atmospheric processes, during which occurs the formation of blizzards. For the conditions of Georgia the winds with western and eastern components are such flows, although the relief introduces some correctives. The significant part of the blizzards is caused by the western processes, which cover almost entire territory of Georgia. In western Georgia they are accompanied by snow-falls, in the remaining regions surface blizzards can be formed. Wind speed upon the eastern intrusions is substantial less which respectively decreases snow-storm danger. During the eastern processes the blizzards covers entire eastern Georgia and significant part of the southern Georgian upland, in the

rare case it can be extended in the alpine regions of western Georgia.

The nature of blizzards is caused by the set of the conditions: a quantity of solid precipitation, speed and wind direction, the changeability of weather, the configuration of relief and the connected with it protection of relief. The intensity of blizzards to a considerable degree depends on speed of wind, stability of snow cover, dimensions of snowy particles, temperature and humidity of air [3].

Studies of blizzards in Georgia were begun in the 70-years of past century [4, 5], whereas in recent years with our participation were executed several articles on the base of contemporary data [2, 3, 6]. As a result were established laws governing allocation of frequencies, duration and intensity of blizzards for the territory of Georgia, the basic regions and periods of their propagation, meteorological regime of blizzard [3, 5].

Present article is the logical continuation of these studies and sets development and characteristic blizzards dangerous regions of Georgia as a goal in order to grant the data about the territorial distribution, the intensity, the repetition, the duration and the direction of snow-transfer to the interested persons from the state and the quotient of sectors.

## Materials and methods

In this study observational data of 85 meteorological stations and posts during period 1966-2017 are used. Most reliable data are during period 1966-

1992. In 1993 the majority of alpine meteorological stations were closed; therefore period 1993-2017 was illuminated only by data of separate stations.

The materials of the archive of Institute of hydro-meteorology of Georgian technical university, data of the National Environmental Agency, literature data and climatic reference books were used also [4, 7, 8].

In a study the approved methods of climatological data processing, and also the methods of the mathematical statistics and probability theory are used.

## Results and discussion

Table 1 depicts the average and maximum values of the number of blizzards days in different regions of the country with the indication of the height of the position of points.

It should be noted that in 90 years of past century the network of meteorological stations, which previously counted about 300 meteorological stations and posts, were practically destroyed. Thus, observations of different meteorological phenomena after this period, including of observation of blizzards, were conducted only at several stations, that, of course, it does not give the complete picture of the distribution of the number of days with the blizzards. However, the statistics from 1966 through 1992 is complete and can be examined in the form of united continuous network, which in the totality makes it possible for us to analyze the number of days with the blizzards in Georgia in the last 50 years.

**Table 1 .** Average annual and maximum number of days with the blizzards in the regions of Georgia (1966-1917)

Samegrelo-Zemo Svaneti				
Location	Average	Max	Region Center	Height above s.l., m
Местиа	2.1	16	Mestia	1500
Racha-Lechkhumi, Kvemo Svaneti				
Zeskho	12.3	27	Lentekhi	1800
Mamisoni Pass	146.3	235	Oni	2854
Мцхета-Мтиანети				
Kazbegi alpine	129	346	Stepantsminda	3665
Kazbegi	17.8	86	Stepantsminda	1750
Cross Pass	39	70	Stepantsminda	2380
Imereti				
Korbouli	13.7	33	Sachkhere	790

Mta-Sabueti	29.5	105	Kharagauli	1248
Kakheti				
Tsivi-Tura	8.3	68	Sagarejo	1990
Shida Kartli				
Ermani	28.9	64	Java	2220
Samtskhe-Javakheti				
Tskhratskaro	90.4	163	Borjomi	2462
Paravani	42.9	117	Ninotsminda	2073
Aragvi	17.3	74	Akhalkalaki	1669
Efremovka	24.9	90	Ninotsminda	2110
Guria				
Bakhmaro	27.46	135	Chokhatauri	1926
Kvemo Kartli				
Manglisi	7.2	36	Tetritskaro	1200
Abkhazeti				
Gagra Pass	29	73	Gagra	2432
Adjara				
Goderdzi Pass	78.8	162	Khulo	2025

It follows from Table, that the distribution of blizzards in the regions of Georgia has heterogeneous nature. From a quantitative point of view, taking into account the average and maximum num-

bers of days with blizzards, the regions of Georgia can be divided into 3 groups: less blizzards dangerous, blizzards dangerous and especially blizzards dangerous regions (Fig. 1).

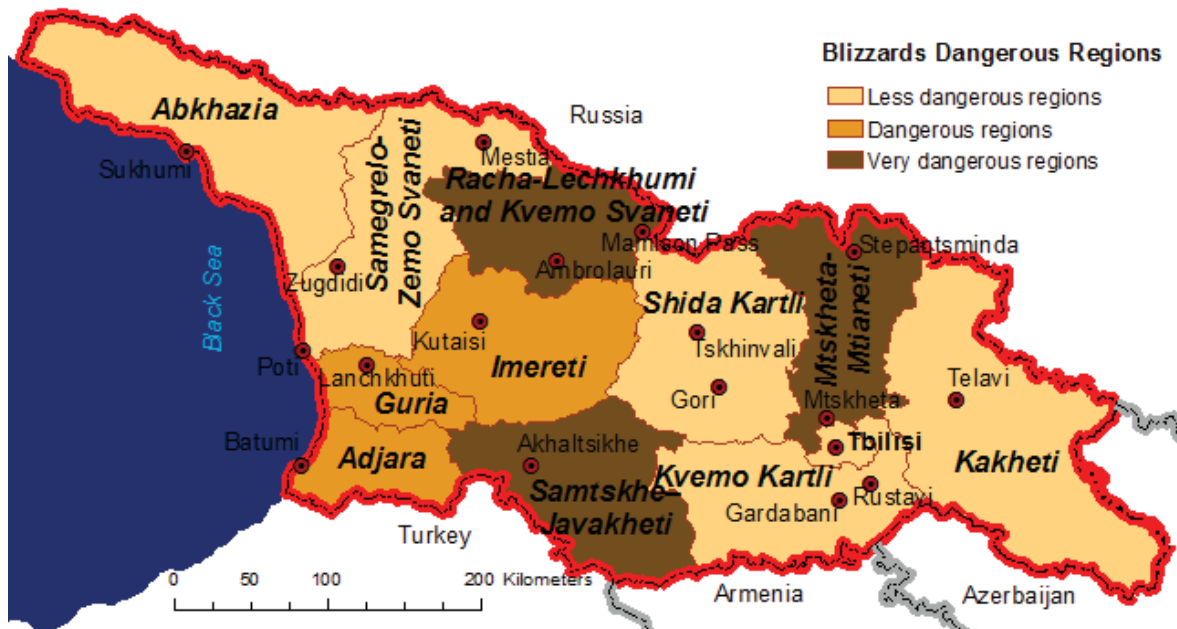


Fig. 1. Blizzards dangerous regions of Georgia

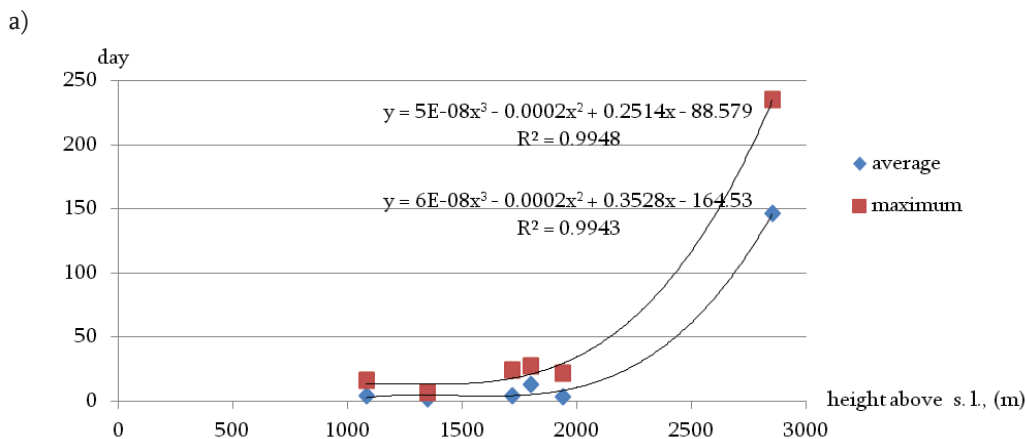
It is evident from Fig.1. that the Samegrelo-Zemo Svaneti region including alpine settlements of region, are less dangerous under the conditions of blizzards. The majority of blizzard is observed here, in the Mestia municipality, where their average annual number does not exceed 2 days, but the maximum of is equal to 16 days. Other regions are also less than blizzards dangerous. In particular in Kakheti on the Gombori ridge the maximum number of days with the blizzards composes 68 in the year, although on the remaining part of the territory of Kakheti the blizzard is rare phenomenon. In Shida Kartli is separated the Java municipality, where the average annual number of days with the blizzards composes 29, and maximum - 64. In Kvemo Kartli the blizzard is rare phenomenon, in Manglisi the average annual number of days with the blizzards composes only 7, and maximum - 36 days. Abkhazeti as a whole also is not characterized by blizzards activity, although the Gagra ridge can be considered as the separately blizzards dangerous region, where the average and maximum number of days with the blizzards they are 29 and 73 days respectively.

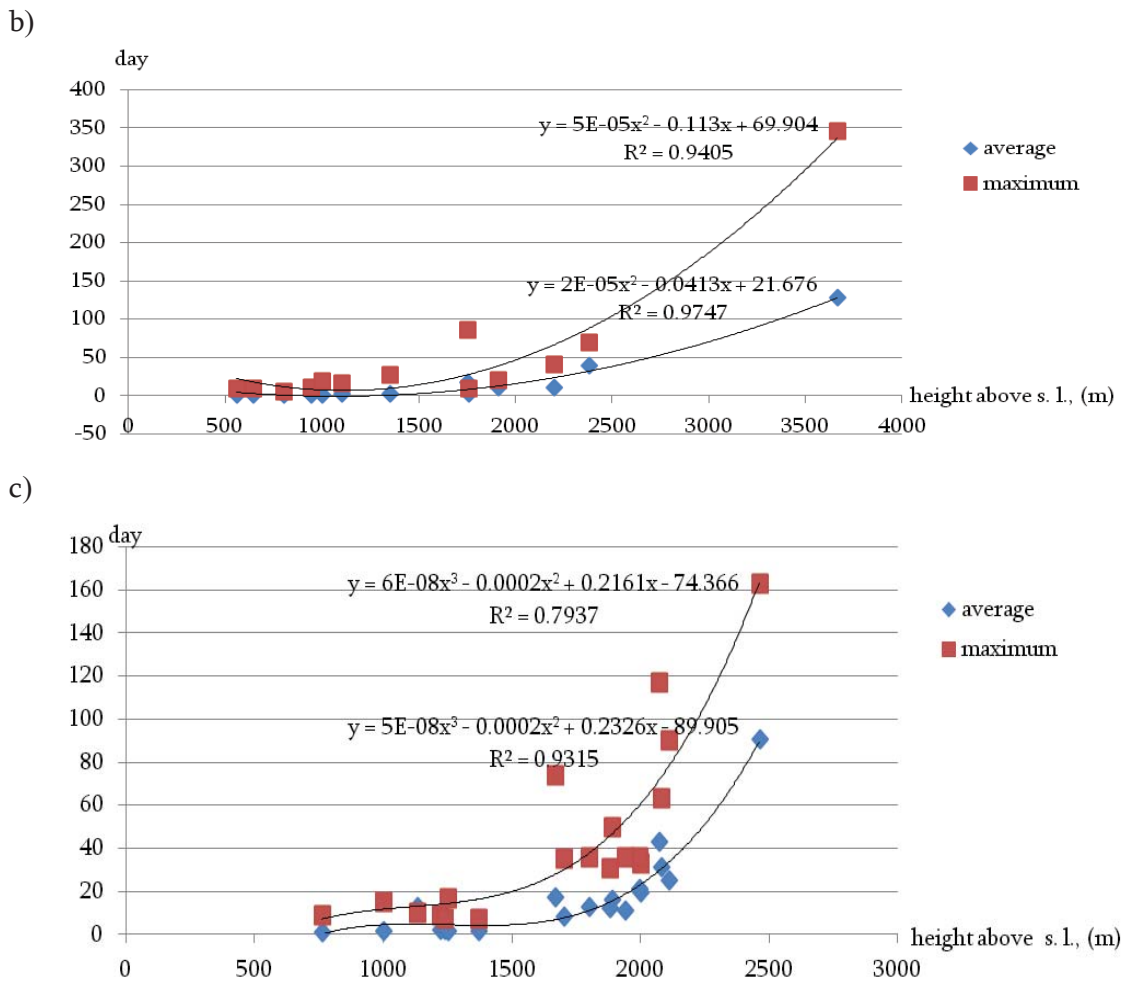
Blizzards dangerous regions include Imereti, Guria and Adjara. High mountain region of Imereti is characterized by blizzards activity, in particular the Sachkhere and Kharagauli regions. In Korbouli (Sachkhere municipality) at the height of 790 m the maximum number of days with the blizzards composes 33. In Mta-Sabuyeti (Kharagauli municipality) in the course of year is fixed 105 days with the blizzards. Frequent blizzards are noted also in the high mountain region of Guria. For example, into Bakhmaro (Chokhatauri municipality) the maximum number of days with the blizzards in the year reaches 135. Also, is separated blizzards activity in the mountain regions of Adjara. On the Goderdzi Pass (Khulo municipality) the average annual num-

ber of days with the blizzards composes 80, and maximum reaches 162 days. On 11 November of 2015 on the Goderdzi Pass the lifesavers from the hearth of snow they took out 7 automobiles as a result of which they saved 30 people.

By especially blizzards dangerous regions on the territory of Georgia are Racha-Lechkhumi, Mtskheta-Mtianeti and Samskhe-Javakheti. Especially separated are Lentekhi and Oni municipalits in Racha-Lechkhumi region. On the Mamisoni Pass the average annual number of days with the blizzards composes 145, and the maximum number of days reaches 235. In Mtskheta-Mtianeti by blizzards activity is separated the Stepantsminda municipality, in particular Djvari Pass and Kazbegi alpine. In the latter of them the average annual number of days with the blizzards composes 145, and maximum - 340. Complex situation occurred on 4 January of 2016 years, when after closing of Georgian Military Road in the section of Kobi-Gudauri, about 150 machines remained with the blizzards and the 17 degree frost. The most blizzards dangerous region is Samtskhe-Javakheti. By blizzards dangerous activity it is especially separated the Javakheti upland, Borjomi, Ninotsminda and Akhalkalaki municipality. Here the average annual number of days with the blizzards exceeds 100 days. For example, into Tskhratskaro the average annual number of days with the blizzards composes 160. 5 and on 6 January 2015 years the lifesavers saved from the blizzards approximately 200 people, unfortunately one person passed away.

A significant effect on formation and development of blizzard has orography, in particular the height of locality. In Fig. 2 are represented the dependences of a change in the number of days with the blizzards on the height of locality in the separately blizzards dangerous regions, and also their approximating polynomials and coefficients of determination ( $R^2$ ).





**Fig. 2.** Dependence of a change in the average and maximum number of days with the blizzards on the height of the locality: a) Racha-Lechkhumi, b) Mtskheta-Mtianeti, c) Samtskhe-Javakheti

It follows from Fig.2 that with an increase in altitude of locality increases the number of days with blizzards, also, in the alpine zone, at the heights more than 2000 m, in Kazbegi (3665 m) and on Mamisoni Pass (2850 m), blizzards are noted almost throughout year.

The represented polynomials make it possible to estimate the annual number of days with the blizzards in the dependence on the height of locality.  $y$  - annual number of days with blizzards,  $x$  - height above sea level. Equations completely satisfactorily describe a change of the number of days with the blizzards in the dependence on the height of locality. According to the coefficients of determination the contribution of the height of locality in a change in the number of days with the blizzards in Racha-Lechkhumi and Mtskheta-Mtianeti is especially high and composes 94-100%. Coefficient of determination is somewhat less in the region of Samtskhe-Javakheti, which in all probability,

is caused by the variety of relief and topographical-climatic conditions.

It should be noted that the number of days with blizzards depends not only on the height of locality, but also from other factors, including from the topographical-climatic conditions, the special features of micro relief and so forth [6]. The aforesaid data of table 1 confirm for example, in Korbouli at the height of 800 m the average annual number of days with the blizzards composes 14, and into Zeskho, at the height of 1800 m the number of days with the blizzards is less 12 days.

## Conclusion and recommendations

The majorities regions of Georgia are not blizzards dangerous.

Blizzards are dangerous in Racha-Lechkhumi, Mtskheta-Mtianeti and Samtskhe-Javakheti. In these regions the alpine regions, where the blizzards

are noted throughout year, are separately blizzards dangerous.

As is known, mountain landscape occupies the significant part of the territory of Georgia; therefore the development of mountain regions has vitally important value for our country. For the development of different segments of the economy, including agrarian sector, in the mountain and alpine regions of Georgia, it is important to in proper time liquidate damage substituted by different dangerous meteorological phenomena, including by blizzards, to take all possible precautionary measures in order to minimize damage from the blizzards and to create safe medium in this respect. Also is important conducting effective measures for the purpose of control of blizzards for the uninterrupted functioning of the automobile, railroad and aviation transport junction of Georgia, which first of all provides for the installation of meteorological stations in the blizzards dangerous regions, in particular in the crossing sections, which will ensure observations of the blizzards and other dangerous meteorological phenomena in the continuous regime, thanks to which will become possible with the high accuracy in forecasting of the areas of blizzards and other phenomena, and conducting preventive measures.

## Acknowledgment

This work was supported by Shota Rustaveli National Science Foundation of Georgia (SRNSFG) [Grant number YS17-49].

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