

Some Results of the Analysis of Number of Days with Strong Wind in Various Regions of Georgia in 2019-2022

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Abstract

The entire country is at an increased risk of hazardous meteorological events as a result of climate change. This includes a rise in the frequency of strong winds, which represents a substantial challenge to the country's economy. The objective of our research is to identify the locations in Georgia that have seen high wind speeds during the past four years. The research examines the spatial distribution of high-velocity winds (defined as a wind speed equal to or greater than 15 m/s) in specific regions of Georgia throughout the time frame from 2019 to 2022. Analysed and processed wind data from 12 meteorological stations in Georgia. By analysing the data from meteorological stations, we created tables and graphs that display the monthly and station-specific numbers for the frequency of strong winds. The study period has revealed the focal points where high wind development occurs. An analysis is conducted on instances of powerful wind as a hazardous meteorological phenomenon in the region of Georgia. The rise in the frequency of strong winds has garnered significant attention, particularly within the framework of climate change.

Keywords: strong wind, climate, dangerous meteorological events, climate change

Introduction

Strong winds are a hazardous meteorological phenomenon that causes substantial damage to the economies of nations. The strength of the wind is directly proportional to its velocity; the higher the wind velocity is, the more pronounced its negative impact. A wind is classified as strong when its maximum speed is equal to or greater than 15 m/s.

The wind patterns in Georgia are influenced by the overall atmospheric circulation, geographical position, and topography. The complex topography of Georgia, including plains, hills, valleys, and ridges, causes the occurrence of local winds in the lower layers of the atmosphere. These winds have different speeds and directions compared to the general circulation patterns. Furthermore, the uneven distribution of solar radiation on mountainous features leads to significant disparities in their radiation and heat balances, resulting in the formation of local thermal winds with varying speeds and directions [1].

Georgia's diverse topography gives rise to varying climate characteristics, such as wind patterns. In flat regions, the climate tends to be relatively stable, while in mountainous areas, microscale changes occur due to the influence of the local topography, including factors such as orography, steepness, and shading. In the mountainous areas of Georgia, the number of days with strong winds varies from 0.2 (Chrebalo) to 222 (Mount Sabueti) due to the influence of various factors, including general circulation processes, as well as the magnitude and direction of the average and maximum wind speed.

In recent times, numerous studies have focused on investigating strong winds, storms, and tornadoes, leading to the identification of hazardous wind areas throughout the territory of Georgia [2-16]. This research examines the occurrence of strong winds (≥ 15 m/s) in specific regions of Georgia for the period from 2019 to 2022. The study period in various locations of Georgia has allowed for the identification of the focal points of strong wind production, as well as the analysis of the dynamics and trends of strong winds.

Methods and Materials

This part of the paper also includes the study area. All tables should be editable (avoid image files). The title should be written above the table.

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Results

As a result of processing the above data, we compiled a table (Table 1), which allows us to some extent to highlight some regions and municipalities where the threat of strong winds has recently been observed.

Table 1. Average number of days with strong winds in some regions of Georgia in 2019-2022

Region	Month												Annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Akhaltzikhe	0	0	0.5	0	1.3	0.3	1	0	0.3	0	0	0	2.4
Ambrolauri	0	0	1.3	0.8	0.3	1	1	0.3	0	0	0	0.3	5
Bakuriani	16	14.5	5.8	8.8	6.5	10.5	7.8	8.3	2.8	4.5	5.5	8.5	99.5
Bolnisi	0.5	2	0.8	0.8	0	0	0.5	0	0.8	0	0.3	0	5.7
Gori	2.3	2.8	3	3.5	5.8	3	2.5	2.3	1.5	0.8	1.3	1.3	50.8
Mount-Sabueti	1.5	2.5	6.8	2	2.8	2.8	1.8	3.3	3.3	4.8	3	4	38.6
Poti	5.3	2	1.8	1.8	1.8	0.8	0.3	0.8	0.5	3.5	3.8	4.3	24.9
Kobuleti	6.3	5	4.3	2.8	4.5	2	1.8	1.5	3.8	4.3	3.5	3.3	43.1
Kutaisi	8.5	6.5	9.3	5.8	5.8	4.3	3	6.5	5.8	9.8	11.5	12.5	89.3
Sachkhere	0.5	0	0.8	1	0.5	0.5	0.3	0.3	0	0	0	0	3.9
Tbilisi	4.8	5	6	4.8	6.8	3.5	4.8	1.3	2.5	3	3.5	1.3	47.3
Zugdidi	1	0.5	0.5	0	0.8	0.5	0.5	0.5	1	0.8	1.5	0.5	8.1

Out of the 12 districts listed in Table 1, strong winds (≥ 15 m/s), when their number on average does not exceed 10 days per year, are observed only in 5 districts (Akhaltzikhe, Ambrolauri, Bolnisi, Sachkhere, Zugdidi), while in 7 districts (Bakuriani, Gori, Mount-Sabueti, Poti, Kobuleti, Kutaisi, Tbilisi), the average annual number of days of strong wind is more than 24 days, which is a very noteworthy fact.

Based on Table 1, histograms were compiled (Figs. 1, 2), showing the distribution of the average number of days of strong winds both by month (Fig. 1) and by year (Fig. 2) during the study period in some regions of Georgia.

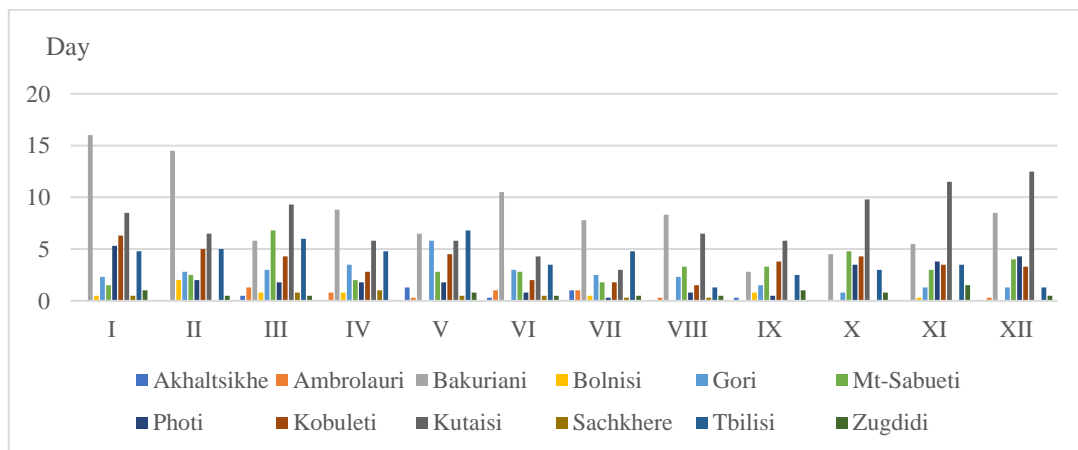


Figure 1. Distribution of the average number of days with strong winds (≥ 15 m/s) by month in some regions of Georgia (2019-2022)

It can be seen from Fig. 1 that the maximum average number of days of strong wind according to months will be observed in January and February (Bakuriani), 16 and 14.5 days, respectively. Additionally, November and December (Kutaisi) stand out, with 11.5 and 12.5 days, respectively. June (Bakuriani) is also characterized by an indicator of more than 10 days.

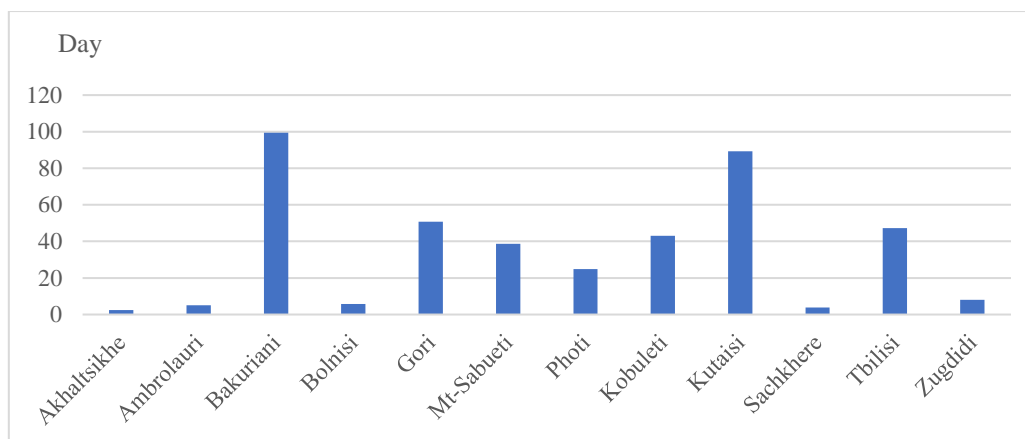


Figure 2. Average annual number of days with strong wind (≥ 15 m/s) in some regions of Georgia (2019-2022)

As is clear from section 2, the Bakuriani area is outstanding, where the average annual number of strong winds for the research period, when the wind speed is greater than or equal to 15 m/s, is almost 100 days. Additionally, Kutaisi is outstanding, where the average annual number of days for the research period is almost 90 days. A high rate of the average annual number of strong wind days is also recorded in the territory of Gori (60 days), Tbilisi (47 days), Mta-Sabueti (39 days) and Black Seaside (Kobuleti 43 days). For the lowest indicator, the Akhaltsikhe and Sachkhere districts stand out here, where the average number of strong wind days is less than 5 during the year.

Discussion

Our research results show that strong winds (≥ 15 m/s) have been common in recent years. In our opinion, this is due to climate change. Since the 1990s, we have been in an active phase of global warming, which has led to the intensification of various dangerous meteorological phenomena, such as drought, hail, frost, and heavy rainfall, including an increase in strong winds. Global warming causes changes in atmospheric circulation processes, so the intensity of strong winds is increasing not only in Georgia but also throughout the world.

Climate change has a significant impact on the increase in strong winds and storms, as evidenced by the number of catastrophic storms and hurricanes recorded in almost every part of the world in recent years. For example:

- In October 2016, Hurricane Matthew killed 877 people in Haiti [19].
- In September 2021, severe flooding caused by hurricane "Ida" killed at least 44 people [20].
- In October 2023, Hurricane "Otis" killed at least 48 people in the Mexican city of Acapulco [21].
- In December 2017, the tropical storm "Tembin" killed more than 180 people in the southern Philippines [22].

In recent years, sudden hurricanes have been recorded in some regions of Georgia. The increasing number of such cases encourages us to deepen research in this direction. Our goal is to study the current situation with hazardous meteorological phenomena in Georgia to facilitate the implementation of appropriate preventive measures throughout the country.

Conclusion

Based on the data from the past four years (2019-2022) in the studied regions of Georgia, the late autumn and winter months of November, December, January, and February stand out in terms of the frequency of strong winds. During this period, there are an average of 11-16 days with strong winds.

Based on the research period, two areas (Kutaisi and Bakuriani) were found with an average yearly occurrence of 90-100 days of strong winds.

Based on the study, the majority of locations in Georgia experience strong winds for more than 24 days per year on average. This might result in higher economic damage in these areas, affecting both infrastructure and agriculture.

Climate change increases multiple natural processes, requiring continuing studies to investigate strong winds and other hazardous meteorological phenomena. This will enhance our capacity to mitigate natural disasters.

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

N.B. is the author of the idea. Performed the analysis of results and supervised the writing of the article. M. P. Analysed the database, participated in the analysis of the obtained results and reviewed the manuscript. N J. participated in the calculations, analysis of the obtained results, and review of the manuscript of the article. I J. participated in the calculations and review of the manuscript of the article.

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