

TECHNICAL SCIENCES

CHARACTERISTICS OF WINDS IN THE TERRITORY OF NAKHCHIVAN AUTONOMOUS REPUBLIC

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Abstract

The article views the characteristics of mountain-valley winds in the territory of the Nakhchivan Autonomous Republic and the processes of the emergence of instant gusts of these winds.

Depending on the complex geographical conditions of the region, the characteristics of mountain-valley winds, their curvilinear flow around mountain valleys and narrow passages, and the dynamics of wind speed were analyzed, and the results of scientific research conducted to determine the current wind potential of Nakhchivan Autonomous Republic were shown.

The results of the scientific research conducted on the causes and development of the instant wind gusts in the territory of the Nakhchivan Autonomous Republic have been shown. The impact of sudden wind gust on the environment was analyzed.

The researches carried out fully confirm the existence of the instant wind gust in the territory of Nakhchivan Autonomous Republic and how dangerous it is.

Keywords: mountain-valley winds, instant wind gust, shower, thunderstorm, vortex, air temperature, relief of the area.

INTRODUCTION

In the Autonomous Republic of Nakhchivan, the winds move along the valleys in a meandering form, and move towards the exit to the valley through narrow passages.

As the territory of Nakhchivan Autonomous Republic is located in a hollow, the winds in summer and winter have a mountain-valley characteristic. During the day, the winds blow from the valley to the mountains, and at night from the mountains to the valley.

Mountain-valley winds have a curved shape due to the influence of the mountain topography. These winds are formed when air flows down the curved slopes of mountain ranges [1].

These types of air currents are present in all valleys and have their local characteristics in each mountainous region.

However, in the Nakhchivan depression, this type of strong air flow shows itself so sharply that the climate of these areas is called a dry and

sharp continental climate. At night, the cold air flow coming down from the slopes of the surrounding mountains causes the temperature to drop sharply (10-15 °C). At night, the temperature is 10-15 °C different from daytime.

The surface of the territory of Nakhchivan Autonomous Republic is split up into deep valleys by the rocks of the Deraleaz-Zangazur mountain range, and the speed of wind current decreases in these valleys (Fig. 1.).

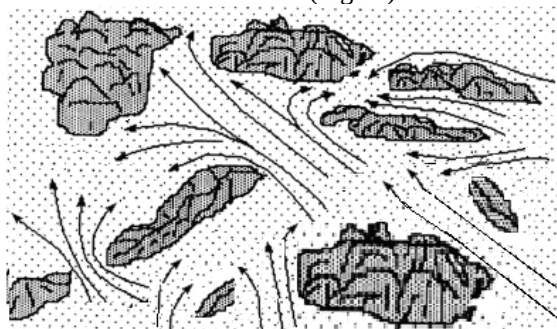


Fig. 1. The movement of the air stream through the valleys.

When the wind current is directed from valley to creek, maximum windspeed is concentrated in a relatively narrower juncture. Kazimov M and Aliyev M

note in their article: "In Nakhchivan, the winds move in a winding manner through the valleys, encounter obstacles in their way through narrow passages, and some of

these wind currents flowing around the obstacles move in a whirlpool towards the valley” [4,p.145] In the meanwhile, an interaction Table 1

№	The names of the regions	Altitude A (m.e.a.)	Pressure mm. mercury column.	Density Kg g c ² /m ⁴
1	Nakhchivan city	850	700,0	1,16
2	Babek region	850 - 1000	700,0 - 675,0	1,16 - 1,13
3	Julfa region	1000 - 2000	675,0 - 600,0	1,13 - 1,03
4	Shahbuz region	1500 - 3000	635,0 - 530,0	1,08 - 0,93
5	Ordubad region	1500 - 3000	635,0 - 530,0	1,08 - 0,93
6	Sharur region	800	710,0	1,17
7	Kangarli region	840 - 830	720,0	1,18
8	Sadarak region	750	720,0	1,18

between density and speed of wind and cross-sectional zone of valley.

Changes in air density and pressure in the Nakhchivan depression (up to 3 km high) are shown in Table 1:

EXPERIMENTAL PROCESS

The mountains in the territory are Ardichdag, Kükudag, Validag, Goydag, Ilanlıdag, Darıdag, etc. causing the currents of the wind to flow beside these

mountains and causing extra external pressures on structures.

In case wind flow meets a barrier, the fast current of wind escapes from the surface of the barrier and the wind pressure tumbles abruptly.

After the observations made in Julfa and Ordubad regions, it was determined that the fast air current approaches the mountain ranges of the Zangezur that obstructs its flow and gathers before these mountains, and it is accompanied by an increase in vorticity in the air flow (Figure 2.):

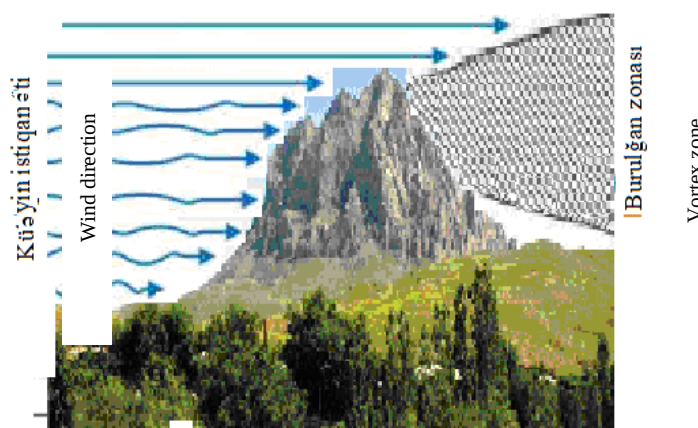


Fig. 2. Formation of vortex force

When the air flow tries to pass over the top of the mountain, the part facing the mountain stops and creates a vortex. Other parts of the air stream continue their movement from the right and left of the mountain, go around the mountain, move to the side of the mountain where there is no wind, and a small vortex is formed behind the mountain. This movement of the air flow causes an increase in pressure.

At this time, the wind pressure is ascertained by the formula shown below:

$$Q = K V$$

Here: Q – shows pressure of wind , (H/m2);

V – shows speed of wind , m/s;

K– is a coefficient that depends on the form of obstacles.

RESULTS AND DISCUSSIONS

The research carried out on the study of winds in the territory of the Nakhchivan Autonomous Republic was conducted on the basis of the study of the indicators of the wind conditions, local climate and meteorological conditions of the area [2].

For this purpose, in order to obtain information about winds in days, months and a year, a table of repetitions of wind speed and direction has been drawn up. Average monthly and annual wind speeds in 2022 are shown below (table 2. a, b):

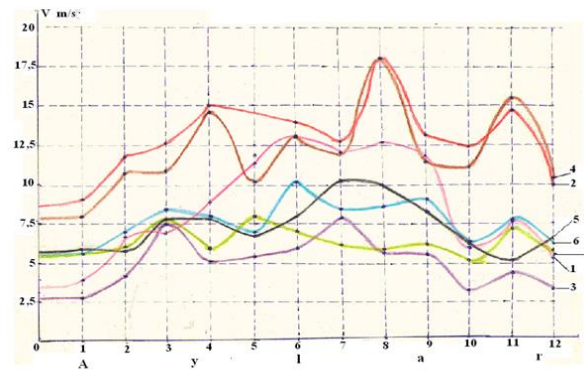
Table 2. a

№	Names	Average monthly wind speed, m/s											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1	Nakhchivan city	4,03	6,7	7,06	9,06	11,5	15,1	12,2	12,6	11,9	6,0	7,7	5,3
2	Julfa city	9,1	11,7	12,6	15,0	11,8	14,2	12,75	18,1	13,5	12,0	14,7	10,0
3	Sharur city	2,84	4,25	7,5	5,2	5,8	6,1	8,3	5,75	5,7	3,5	4,5	3,5
4	Shahbuz city	8,0	10,8	11,0	14,6	10,1	13,1	11,7	18,0	11,5	11,2	15,5	10,1
5	Bichanak (Shahbuz reg.)	6,9	6,7	7,7	7,8	6,8	7,9	10,6	10,0	8,3	6,5	5,3	6,7
6	Ordubad city	6,1	7,2	8,5	8,1	7,0	10,5	8,3	8,7	9,1	6,4	7,6	6,3
7	Agdara (Ordubad reg.)	6,1	6,3	8,2	6,1	8,3	7,1	6,3	6,0	6,5	5,2	7,1	5,4

Table 3.2.1. b

№	The names of the regions	Average annual wind speed, m/sec.
1	Nakhchivan city	8,95
2	Julfa region	13,0
3	Şərur region	5,2
4	Şahbuz region	12,2
5	Bichanak (Shahbuz reg.)	7,6
6	Ordubad region	7,8
7	Agdara (Ordubad reg.)	6,55

Below is the graph of average annual wind speeds in the regions of Nakhchivan Autonomous Republic (Fig. 3):



1. Nakhchivan city, 2. Julfa region, 3. Sharur region, 4. Shahbuz region, 5. Bichanak, Shahbuz region 6. Ordubad region, 7. Aghdara, Ordubad region.

Figure 3. Graph of average annual wind speeds in regions of Nakhchivan Autonomous Republic.

Analysis of wind rose in Nakhchivan Autonomous Republic showed that west and north-west winds prevail in the area. In the hot season, there is an increase in the calm state of the wind.

For the assessment of the wind energy resources of the Nakhchivan Autonomous Republic, for the first time, a cadastre of the territory was drawn up by us and the territory was divided into three zones:

Julfa and Ordubad cities, Nasirvaz, Aghdara villages of Ordubad region, Batabat passage of Shahbuz region, Kuku village were included in the first active, wind-rich zone. This active zone has large wind energy reserves.

The second middle zone includes the city of Nakhchivan, the village of Kermachatag of Shahbuz region, the village of Lekatag of Julfa region, the slopes

of Ilanli mountain, etc. can be entered. Analysis of winds in the second middle zone showed that medium-speed winds prevail here.

The third zone includes Sharur, Sadarak and Kangarli regions. In this zone, the wind speed varies steadily from 2 m/s to 3 m/s.

When the areas are divided into zones, the recurrence of winds and the potential of wind energy resources in the area were taken into account. This necessity is reflected in the study of the wind energy resources of the region, in the determination of wind zones, in the use of potential energy and in the analysis of the ecological potential of wind (Figure 4.)

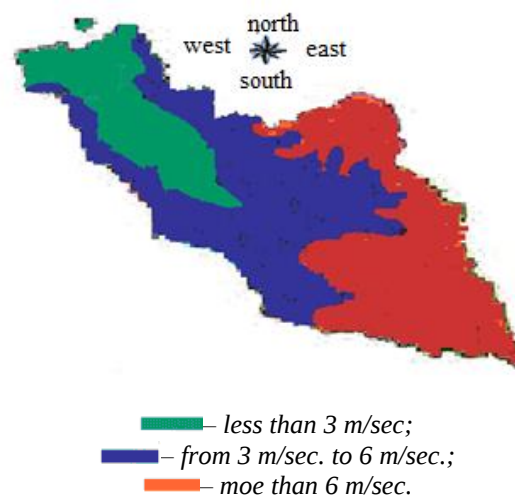


Fig. 4. Division of wind energy resources of Nakhchivan MR into zones.

In the summer months, strong and sharp wind bursts occur mainly in the mountainous areas of the area. These eruptions are formed at the Deraleyaz-Zangazur heights (2500-3500), passing through deep valleys and moving rapidly down the slopes and river basins.

The basis of the wind blast is the front of cold air. Reaching the earth's surface from the mountains, it intercepts the warm, low-density air and spreads in all directions. The speed of this wind burst depends on its deviation and vorticity.

In Batabat, Shahbuz region and Lekatag, Julfa region, wind bursts are accompanied by shower and lightning.

Wind blast is defined by the formula below:

$$G = 1 + g \frac{\sigma_x}{X}$$

Here: X – maximum wind speed during (T);

g – is the highest (peak) wind factor;

σ_x – value of mean square deviation;

G is the moment of explosion.

The magnitude of wind bursts is determined by the following formula:

$$L_x = 0,25 \cdot V_{3600} \cdot G_{xx} / \sigma_v^2$$

Here: G_{xx} – wind density at zero frequency;

σ_v – mean square deviation of wind speed,

V_{3600} – wind burst to occur within one hour.

The results of the conducted researches showed that when the air temperature was +35 °C and more (the temperature was measured in the shade between 1000 and 1800 hours), clouds saturated with ice particles accumulated in the mountains, and wind bursts accompanied by thunder and torrential rains occurred. These wind bursts created wind currents acting as a destructive force on the earth's surface (Table 4.)

Table 4.

Months	Ave rage tempe rature of weat her (°C)	Note
July		–
1	26,4°C	–
2	27,4°C	
3	31,1°C	–
4	32,4°C	–
5	33°C	–
6	33°C	–
7	35°C	Wind blasts, lightning and torrential rains were observed in mountains of Julfa region
8	33°C	Wind blasts, lightning and torrential rains were observed in the mountains of Ordubad region.
9	32,5°C	Wind blasts, lightning and torrential rains were observed in the mountains of Shahbuz region
10	29°C	
11	35°C	Wind blasts, lightning and torrential rains were observed in the mountains and in the city of Nakhchivan Shahbuz region.
12	36°C	–
13	36,5°C	–
14	35,5°C	Wind blasts, lightning and torrential rains were observed in the mountains of Ordubad and Julfa regions.
15	34°C	Wind blasts, lightning and torrential rains were observed in the mountains of Shahbuz region.
16	35°C	Wind blasts, lightning and torrential rains were observed in the mountains of Shahbuz and Julfa regions.
16	35°C	Wind blasts, lightning and torrential rains were observed in the mountains of Shahbuz and Julfa regions.
17	35°C	–
18	36°C	–
19	36,5°C	–
20	35,5°C	Wind blasts, lightning and torrential rains were observed in the mountains of Julfa and Ordubad regions.
21	36,4°C	–
22	38°C	–
23	37,5°C	–
24	36,4°C	–
25	36,5°C	–
26	34,5°C	Wind blasts, lightning and torrential rains were observed, in the mountains of in Shahbuz region.
27	34°C	–
28	33,5°C	Wind blasts, lightning and torrential rains were observed in the mountains of Julfa and in the city of Nakhchivan.
29	30,5°C	–
30	38,5°C	–

31	40°C	–
Avqust		
1	39°C	–
2	37,5°C	–
3	38 °C	Wind blasts, lightning and torrential rains were observed in the mountains of Julfa region.
4	35°C	Wind blasts, lightning and torrential rains were observed in the mountains of Ordubad region.
5	34,5°C	Wind blasts, lightning and torrential rains were observed in the mountains of Shahbuz region.
6	30°C	–
7	31°C	Wind blasts, lightning and torrential rains were observed in the mountains of Julfa and Ordubad districts
8	27°C	–
9	29°C	–
10	31°C	Wind blasts, lightning and torrential rains were observed in the mountains of Julfa and Shahbuz regions.
11	31°C	–
12	32°C	–
13	32,5°C	–
14	33,5°C	–
15	36°C	–
16	37°C	–
17	35,5°C	Wind blasts, lightning and torrential rains were observed in the mountains of Julfa and Shahbuz regions.
18	33,5°C	–
19	35,5°C	–
20	36,4°C	–
21	35,5°C	–
22	38°C	–
23	38°C	–
24	36,5°C	–
25	31°C	Wind blasts, lightning and torrential rains were observed in the mountains of Ordubad and Shahbuz regions.
26	35°C	–
27	33°C	–
28	31°C	–
29	34°C	Wind blasts, lightning and torrential rains were observed in the mountains of Ordubad region
30	32°C	–
31	29°C	–

In the aftermath of the conducted research, it is completely confirmed that these strong blasts of wind in the territory of Nakhchivan MR pose a serious threat. These strong wind blasts 0.5-2 km. at a distance uproot trees and destroy power lines, inflict serious damage to buildings completely destroying the roof coverings of houses. Usually, these strong short-term wind blasts occurred after 17:00 in the mountainous areas of Shahbuz, Julfa and Ordubad regions. Wind blasts were not observed in the areas when the air temperature was +32 °C and lower [3].

The blasts have the power to completely destroy buildings, collapse houses and uproot large trees.

The column of wind blast, which is 300-400 meters in diameter, cloud-shaped, and the lower part is funnel-shaped, reaches the ground and creates a vertical vortex, and moves in a circle on the ground at a speed of 20-30 m/s, creating a disaster in its path [5].

This wind, with a speed of more than 20-25 m/s, hits empty buildings and roofs of houses, breaks timber,

trees, breaks power lines and poses a danger to people, animals and cars.

Thus, our research studies fully confirm that strong wind blasts pose a serious threat in the territory of the Nakhchivan Autonomous Republic.

The article elaborates funnel-shaped vortices and their complications were discussed [6].

CONCLUSIONS

1. The winds blowing in the territory of the Nakhchivan Autonomous Republic, including the "mountain-valley" winds specific to the region, were investigated and their characteristics were studied.

2. Annual average wind speeds in Nakhchivan Autonomous Republic were determined and their cadastres were drawn up.

3. The intensity and dynamics of wind explosions in mountainous areas of Nakhchivan Autonomous Republic were investigated.

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