American Journal of Biomedical Science & Research

www.biomedgrid.com

ISSN: 2642-1747

Review Article

Water Resources of Tajikistan: Anomalous Phenomena of the Glacier Zone of the Fedchenko Glacier(Continued, Part Three)

Davlyatov Rashid Rakhimovich[1*], Raufov Rakhmatullo Negmatovich[2] and Kulmatova Lutfiya Safarovna[3]

[1]*Bobochon Gafurov St. 13/1, Agency for Hydrometeorology of the Committee for Environmental Protection under the Government of the Republic of Tajikistan*

[2]*Ph.D. associate professor, Tajik State Pedagogical University named after Sadriddin Aini, Tajikistan*

[3]*Graduate Student, Tajik State Pedagogical University named after Sadriddin Aini, Tajikistan*

***Corresponding author:** Davlyatov Rashid Rakhimovich, Bobochon Gafurov St. 13/1, Agency for Hydrometeorology of the Committee for Environmental Protection under the Government of the Republic of Tajikistan

To Cite This article: *Davlyatov Rashid Rakhimovich*, Raufov Rakhmatullo Negmatovich and Kulmatova Lutfiya Safarovna, Water Resources of Tajikistan: Anomalous Phenomena of the Glacier Zone of the Fedchenko Glacier (Continued, Part Three). Am J Biomed Sci & Res. 2026 31(1) AJBSR.MS.ID.004013,* **DOI:** 10.34297/AJBSR.2026.31.004013

Received: April 16, 2026; **Published:** May 12, 2026

From the Author: Mountainous regions often experience natural disasters associated with nival-glacial phenomena-avalanches, mudflows, ice-falls, outburst floods, and the movement of glacier surges.

In this article, I would like to continue the story of the Fedchenko Glacier and its glacial basin. I will focus on the surge periods of its large left tributary, the Bivachny Glacier (Figure 1).

Figure 1: Fedchenko Glacier (Author's Archive).

Abstract

Global warming has reached the heights of the Pamirs. White snows and centuries-old ice of natural glaciers are already clearly receding under the onslaught of a warm temperature background, and now the real question is how long the glacial reserves will last in Tajikistan. It is not difficult to count and calculate. Many climatic models are used to compile graphs and tables. Scientific materials are being written with realistic forecasts for a period of up to a hundred years. However, as you know, long-term forecasts are a thankless job, which in real time looks more like a bluff.

In real time, we can say that studying glaciers is still a big time consuming, dangerous, and sometimes-impossible job. Finding enthusiasts in this field of science is becoming increasingly difficult. The routes of the first expeditionary groups of Russian and Soviet scientists made it possible to study the terrain, mountainous terrain, the location of glaciers and rivers. Many mountains passes and unnamed glaciers, large glaciers in the Pamirs are now named after the discoverers N.I. Kosinenko, N.L. Korzhenevsky, A.P. Fedchenko, I.G. Dorofeev, Y.I. Belyaev, etc. Yes, we now have a geographical map on which we can read the name of the mountain passes and their heights. In book catalogs, we will find the name of the glaciers. And what can we say about climate change and its impact on the high-mountainous zone of the Pamirs - the center of glaciers, where powerful glaciers are concentrated. Let us look at the big Fedchenko glacier.

Keywords: Global Warming, Glacier Pulsation, Glacier Degradation, Average Air Temperature, Precipitation Amount, Excessive Humidity, Micro-climate

Introduction

As is well known, a glacier leaves behind moraine deposits, the boundaries of which, their composition, and structure allow us to reconstruct past glacial periods, during which the glacier repeatedly "advanced," but is currently retreating rapidly and losing its ice mass. Currently, the glacier's mass balance is negative, meaning the glacier's glaciation zone does not receive sufficient precipitation to restore and maintain its mass. This means that during nearly two months of warm weather-July and August-the Fedchenko Glacier loses so much ice that it cannot fully recover in the remaining ten months of the year. But is everything so critical? We can only acknowledge the gradual and slow melting of our glaciers in Tajikistan, which, with their enormous reserves of frozen fresh water, are the lifeblood of the people living in the valleys.

Conducting periodic monitoring of Tajikistan's glaciers with ground expeditions is a challenging task. And restoring and resuming meteorological observations at one of Tajikistan's main meteorological stations, the N.P. Gorbunov station (Fedchenko Glacier), located at an altitude of 4,169 meters above sea level, is currently considered impossible. The meteorological station, built in the 1930s, has now been mothballed for over thirty years. Once a powerful center for observing and monitoring meteorological processes in the heart of the glaciated, high-altitude and inaccessible Pamirs, it is gradually falling into disrepair. But nature is unstoppable! A short warm season gives way to a long, cold Arctic period. And now, in the high-altitude glaciated zone, virtually no one is conducting meteorological observations. However, life in this icy metropolis goes on as usual, and we are simply wasting precious time studying ongoing events. One such event is glacier pulsation, which has its own periodicity and occurs regardless of ongoing climate change [1-7].

I would like to continue the story of my research, and this time I will talk about the left tributary of the Fedchenko Glacier.

Bivachny Glacier

Bivachny Glacier (38°56′43″ N, 72°09′49″ E) is considered a complex glacier. It covers an area of 100 km2 and is 30.1 km long. The mouth of the glacier rises to 3,450 meters above sea level. The first observations in the Pamir Mountains can be considered visual, and credit must be given to those who left behind records of their travels. In 1878, V.F. Oshanin discovered the largest Central Asian glacier, which he named after A.P. Fedchenko, and in 1880, G.I. Petrov conducted the first instrumental survey of this glacier's tongue. The research largely consisted of compiling rudimentary maps, marking objects within visual range. The first records of the discovery of the Bivachny Glacier, a left tributary of the Fedchenko Glacier, date back to 1908. Subsequent expeditions, conducted during the Soviet era, used hand-held instruments, which again helped partially record changes. Photographic and aerial surveys of the mountainous terrain were among the innovations of the Soviet era. In modern times, space technology has come to the aid of mountain glacier research, enabling constant monitoring of glacial processes on glaciers in the high Pamirs. In the 1970s, this played a key role in developing methods for interpreting glacier movements using satellite imagery, which proved essential in the creation of the Instructions for Compiling the Catalog of Surge Glaciers of the USSR. A new method for studying glaciers using remote sensing emerged. It was thanks to this that another massive glacier surge was recorded in the Fedchenko Glaciation Zone, specifically its left tributary, the Bivachny Glacier.

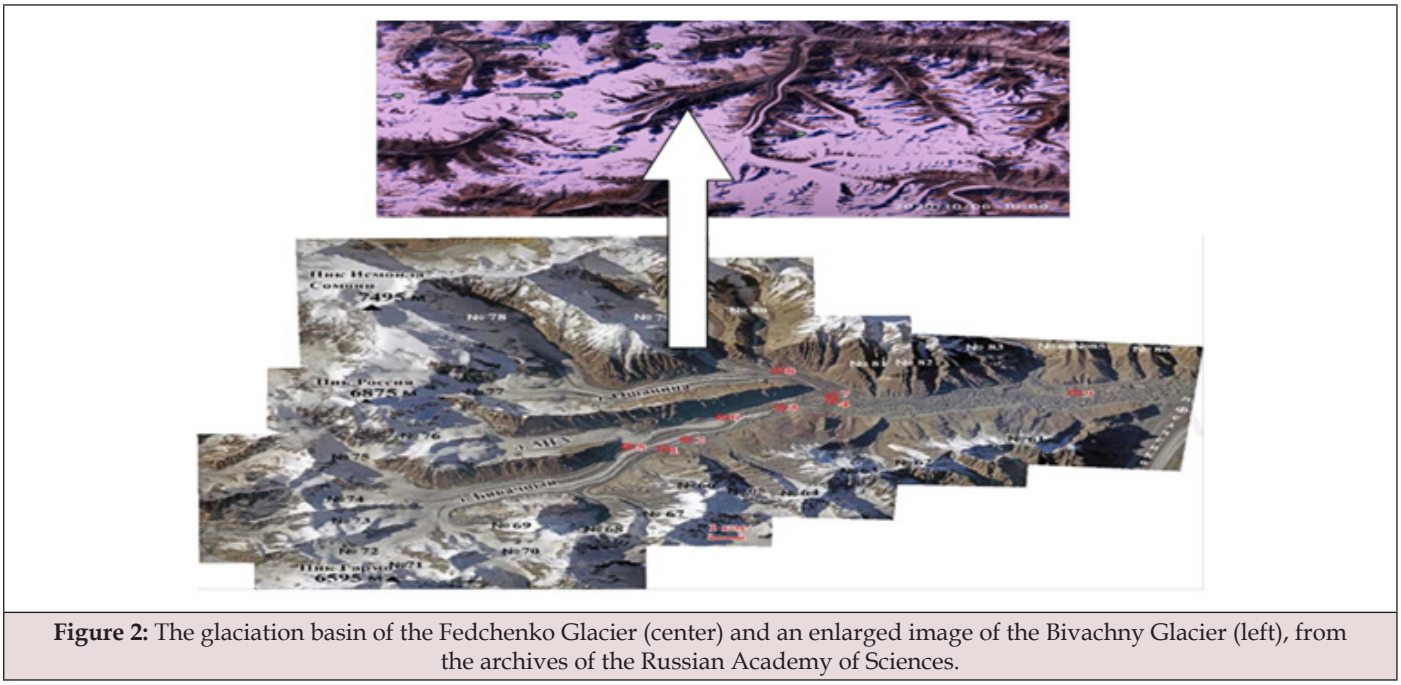

Figure 2: The glaciation basin of the Fedchenko Glacier (center) and an enlarged image of the Bivachny Glacier (left), from the archives of the Russian Academy of Sciences.

It was established that from 2000 to 2007, the "dead ice" zone expanded and advanced far down the gorge. Given the information accumulated by that time regarding the shrinkage of the entire glacial complex of the Pamirs, activation of the lower zone of the Bivachny Glacier tongue seemed unlikely. Here, I'd like to note that, while working on expeditions in the 1980s, I observed the melting of the left tributary and the separation of its tongue from the main "ice body" of the Fedchenko Glacier-a distance of four kilometers. However, by September 2014, the Bivachny Glacier's active front had already traveled these four kilometers and merged with the Fedchenko Glacier. This movement of the Bivachny Glacier is noteworthy, as it occurred during a period of global warming and the massive melting of large and small glaciers in Tajikistan. This begs the question: "Where did the glacier get such strength?" (Table 1).

The interaction between the main trunks and tributaries of the smaller glaciers within its glaciation zone plays a crucial role in the evolution of Bivachny Glacier. The influence of the tributaries depends on many factors, including the relative thickness of the main trunk and tributaries, their confluence, and the angle at which they merge with the main flow. Thus, minor and major movements of the glacier system within the Bivachny Glacier basin have been monitored, and these movements have been halted 3-4 kilometers beyond the reach of the main "ice body" of Fedchenko Glacier. However, historical evidence dating back to 1927 includes a note by glaciologist N.L. Korzhenevsky, who visually observed and described the activation of the Bivachny Glacier: "Its ice tongue was greatly bulged, and on its surface was a large mass of loose rock material, which it carried to the surface of the Fedchenko Glacier." This expedition was quite fortunate; they observed the pulsation of the Bivachny Glacier and also recorded its contact with the main "body" of the Fedchenko Glacier.

Here, a brief analysis of the data preserved in the scant research materials is possible. Despite the numerous surges of the small glaciers in the Bivachny basin, it experienced two major ice surges over the course of less than a century, and the ice slide from the left tributary reached the main "ice body" of Fedchenko. From the author's diary: The Fedchenko Glacier basin is covered in snow almost year-round, and research is only possible in July and August, when the mountain Arctic summer begins. This is a period of relative calm, with virtually no precipitation. The snow cover and ice melt naturally due to summer temperatures and a nearly constant warm wind. Daytime temperatures near the weather station do not exceed 14°C, and at night they do not drop below 0°C (Figure 2).

In August 2015, during the 3rd International Pamir Geophysical Expedition (HEIGE) led by UNESCO, I visited the Fedchenko Glacier for the fourth time as a National Expert. This time, I filmed my observations from the helicopter window. The scene: "The helicopter approaches the mouth of the Fedchenko Glacier. Based on the ground markers, I notice that the edge of the glacier tongue has not retreated significantly, and the water flowing from beneath it, the Seldara River, joins the Belyankiik River, forming the Muksa River. The mouth of the glacier tongue is covered with a continuous layer of rocky debris, which slides down the glacier body in multi-kilometer-long moraine streams.

A special point of my observation was the Bivachny Glacier, where, according to available information, another pulsation and active ice movement occurred. In 2014, the Bivachny Glacier again connected with the main Fedchenko ice body. My focus was on the connection "knot." I filmed from a helicopter window, at a distance of 500 meters. The "black tongue" of ice sliding down the gorge completely covered it with a massive mass of ice for a distance of 4-5 kilometers, and indeed reached the main Fedchenko ice body. Part of the Bivachny Glacier's "shock" kinetic wave crossed the glacier junction by more than 200 meters. I note that no active impact of the left "glacial flow" on the main "ice body" of the Fedchenko Glacier was observed. The sliding and movement of both glaciers is proceeding without any significant incidents. No accumulation of water in spontaneous reservoirs occurred. The observed feature, the "glacial tongue" of Bivachny, was completely covered with rocky material and sand. The predicted event of a "strong" impact and ice shear in the main body of Fedchenko Glacier, which would disrupt the subglacial hydrological structure and cause the formation of a spontaneous water dam, was not confirmed. This was one of the visual studies that confirmed the movement of Bivachny Glacier. It's worth noting that the latest surge in ice pulsations occurred against the backdrop of ongoing global warming, but what triggered the massive ice discharge from the left tributary of the Fedchenko Glacier? Many questions remain. One might say: "Once again, we weren't prepared to investigate this using all available methods!".

I also noticed changes at the N.P. Gorbunov weather station. A significant amount of snow remained in the surrounding area, but it was melting slowly. At the second snow measurement site, a large snow field had formed that hadn't melted for at least the last 8-10 years. Its subglacial structure was visible. The Kashal-Ayak Pass, which connects with the Academy of Sciences Glacier, was also covered in a 20-30 cm thick layer of snow. On the opposite right side of the Fedchenko Glacier, small unnamed glaciers, based on visual assessment, have also been active for at least the past ten years. This was evident by the "ice waves" that formed on the glacier plateau. According to my surviving diary entries, the ice was already actively melting in August of the 1980s. Numerous streams of glacial water flowed through the glacier's "body," joining to form a powerful torrent. The glacier itself emitted the sounds of grinding and cracking ice breaking. Particularly at night, the entire area around the weather station was filled with the "groan" of breaking ice and the turbulent flow of the icy river, disappearing into the depths of the "ice body."

Thirty years later, I had a strange feeling that was hard to describe right away. A little later, it seemed to me that the noise of the turbulent water flow and the grinding of breaking ice were gone. The Fedchenko Glacier seemed dormant. A blanket of snow still hid the glacier's ice body. It was interesting to conduct visual

observations, as I hadn't been to the meteorological station for thirty years, and the changes I observed were so noticeable. Back at my work station in Dushanbe, reviewing extensive footage, I decided to analyze when the extensive snow accumulation in the Fedchenko Glacier area began, triggering the rapid movement of smaller glaciers and the Bivachny Glacier itself. I had to conduct meteorological monitoring of data from the N.P. Gorbunov station (Lat. 39° 01/N; Long. 79° 25/E; Fedchenko Glacier), which is stored in the archives of the Agency for Hydrometeorology. An isolated region of the high Pamirs, which serves as the reservoir for Tajikistan's hydrological system. The meteorological station was opened in 1934 and operated until 1995. It is currently closed.

The graph shows the long-term trend of average daily annual temperatures, with a clear upward trend in the "average daily annual temperature." These values are expressed in degrees Celsius. As the table shows, the annual temperature trend has gradually increased over 60 years, but still remains significantly below freezing. This was good news, confirming that the Fedchenko Glacier regulates its own climate processes and maintains its relative "cold pole" in the remote Pamir region (Figure 3).

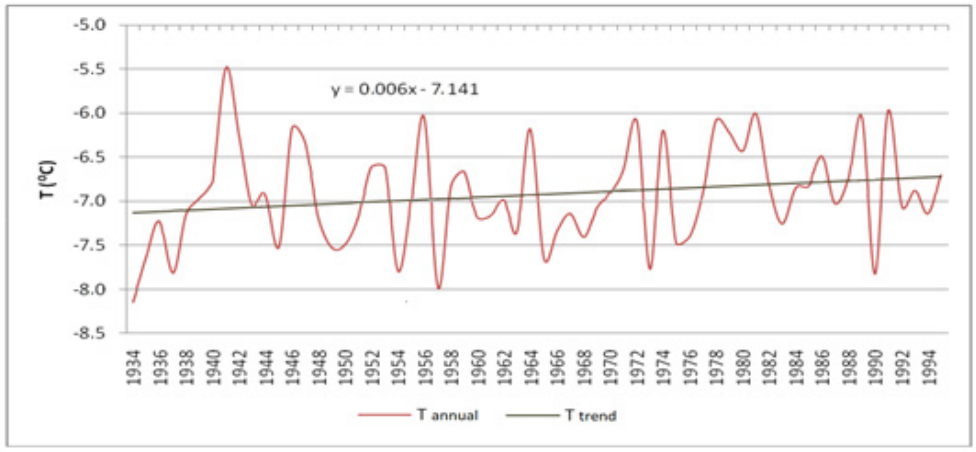

Figure 3: Interannual variability and trend of average annual daily temperature in the glacier zone of the N.P. Gorbunov meteorological station on the Fedchenko glacier, 1934-1994 (Note: geographic coordinates of the station: 39.01˚N, 79.25˚E, barometer zero altitude P = 4162 m, synoptic code 38862).

The amount of precipitation has also shown an increasing trend over the past 60 years, and this is clearly visible in the graph provided: Winter in the area of the meteorological station is characterized by a harsh climate and lasts for 11 calendar months; snow melting begins only in July. Polar autumn begins on the Fedchenko Glacier in the third ten-day period of August, and the first snow falls in the first ten-day period of September. No rain is observed. The total number of days with precipitation per year is 220-240. The only month without precipitation is August. The temperature in summer does not rise above 140°C, and in winter it drops to -240°C. A southwesterly wind of 8-10 m/s constantly blows at the meteorological station. During snowfall, a strong wind prevails, with gusts reaching up to 48 m/s (recorded in 1985). New snow cover at the meteorological station begins to be observed in September and continues until the end of July. The relative ice movement (slide) in the area of the meteorological station (1984-1986) per year was 230-250 meters in the central part of the glacier plateau and 150-170 meters at the edges. It's worth noting that the overall width of the glacier in the area of the meteorological station is 2 kilometers. In 2015, the glacier slide, from a visual point of view, became practically "dead." Looking at the ice "body" of Fedchenko Glacier, it seemed as if it were "sleeping," covered in a blanket of snow. And, most surprisingly, spontaneous lakes filled with water from melted snow began to form on the "ice plateau." The small glaciers in the area of the meteorological station not only retained their original appearance, but also increased their mass and area – this was noticeable by the frozen waves of ice that did not connect with each other, as if showing us the chronology of annual growth (Figure 4).

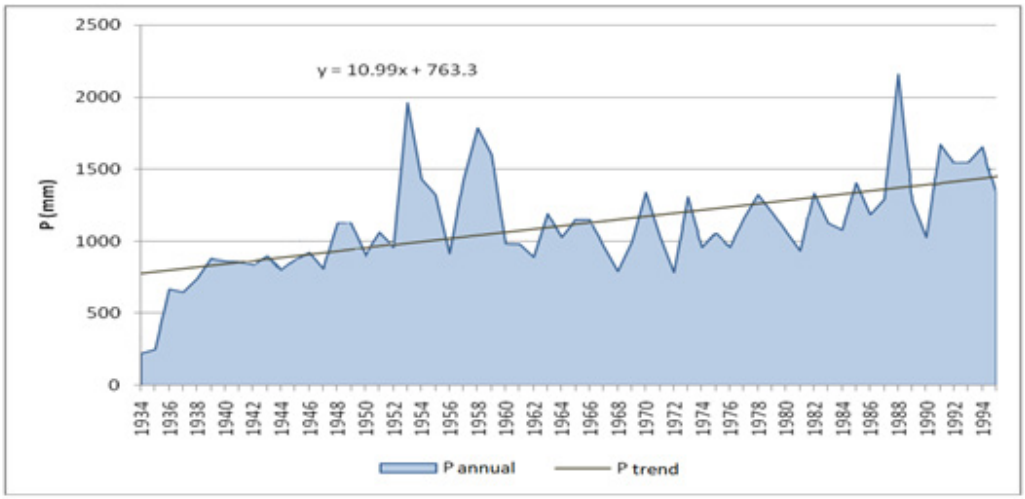

Figure 4: Interannual variability and trend of annual precipitation in the glacier zone of the N.P. Gorbunov meteorological station on the Fedchenko Glacier, 1934-1994.

Conclusion

In conclusion, I would like to say that the glaciation center in Tajikistan, with the Fedchenko Glacier, remains completely unknown. In the absence of meteorological, glaciological, and actinometry data collected in the last century, it is difficult to predict the future development of glaciation and its impact on hydrological flow. This ambiguous situation will continue to introduce instability in predicting future glacier surges in the Fedchenko basin, which can be assumed to have their own chronological timeframe. Another surge in activity in the left tributary of the Bivachny Glacier basin occurred, but what did it tell us? The next surge should not be expected for at least another hundred years! Whether this is a significant or insignificant value, in the modern study of the Earth's cryosphere, is currently difficult to predict. Therefore, we can simply record that in 2014, another ice surge occurred on the Fedchenko Glacier, which did not result in any significant natural phenomena.

References

1. Catalog of glaciers of the USSR. Central Asia, Amu Darya for 1960-1988. Leningrad: Gidrometeoizdat. 14(3).
2. Archive of the Hydrometeorology Agency.
3. Davlyatov RR (2015-2016) Chronological diary of observations 1984-1987.
4. A. Kayumov (2014) Third National Communication of the Republic of Tajikistan.
5. VB Aizen (2015-2016) Technical report of the 3rd International Pamir Geophysical Expedition 2015-2016.
6. Osipova GB, Tsvetkov DG (2003) Priroda. No 4: 3-12.
7. VM Kotlyakov, LV Desinov, VA Rudakov (2015) Ice and Snow. No 2(130).