# Glaciers in the Jeruy River basin

SUMMARY FROM THE 2017-2018 SURVEY REPORT

According to the latest data, the glaciation of Central Asia accounts for 15,761 $km^2$ of territory. In the mountains of the Kyrgyz Republic there are 7,820 glaciers with a total area of 8,169 square kilometers (4.2 % of the entire territory) with an ice volume of 650 $km^3$. Currently, the Kyrgyz Republic is experiencing an increase in surface runoff of rivers due to increased melting of glaciers. According to scientists, this trend will continue in the next decade, then a decrease in the runoff is predicted by 2100. The consequences of this process can lead to insufficient water supply, reduction of energy potential and productivity of land resources not only in our republic, but also in the Central Asia region as a whole.

Glaciers are sensitive to the slightest changes in climate, and therefore are one of the main indicators of global climate change in individual regions and on a global scale.

The survey of glaciers in the Jeruy River basin was conducted during 2017-2018. The purpose of the survey was to obtain reliable characteristics of the glaciers before the start of commercial development of the Jeruy deposit. The survey was conducted by leading glaciologists of the Agency for Hydrometeorology under the Ministry of Emergency Situations of the Kyrgyz Republic (Kyrgyzgidromet).

Information about previous surveys, except for surface data on the number of glaciers for the catalog of glaciers of the USSR in 1968, is not available in the archive materials of the Kyrgyz Republic.

According to the 1968 Catalog of the Glaciers of the USSR, nine glaciers were located in the Jeruy River basin, which were given numbers from 163 to 171 (Fig. 1). The size of the glaciers ranged from 0.1 $km^2$ (glaciers No. 164 and 171) to 1.7 $km^2$ (glacier No. 168). Thus, there were no large glaciers in the Jeruy River basin, and the average area of the indicated glaciers was 0.61 $km^2$, the median was 0.4 $km^2$.

The closest to the Jeruy deposit quarry is glacier No. 163, the distance from which to the industrial site at an altitude of 3,500 m is 3 km. Glacier No. 168, located at a distance of 5.5 km from the site, was chosen as representative.

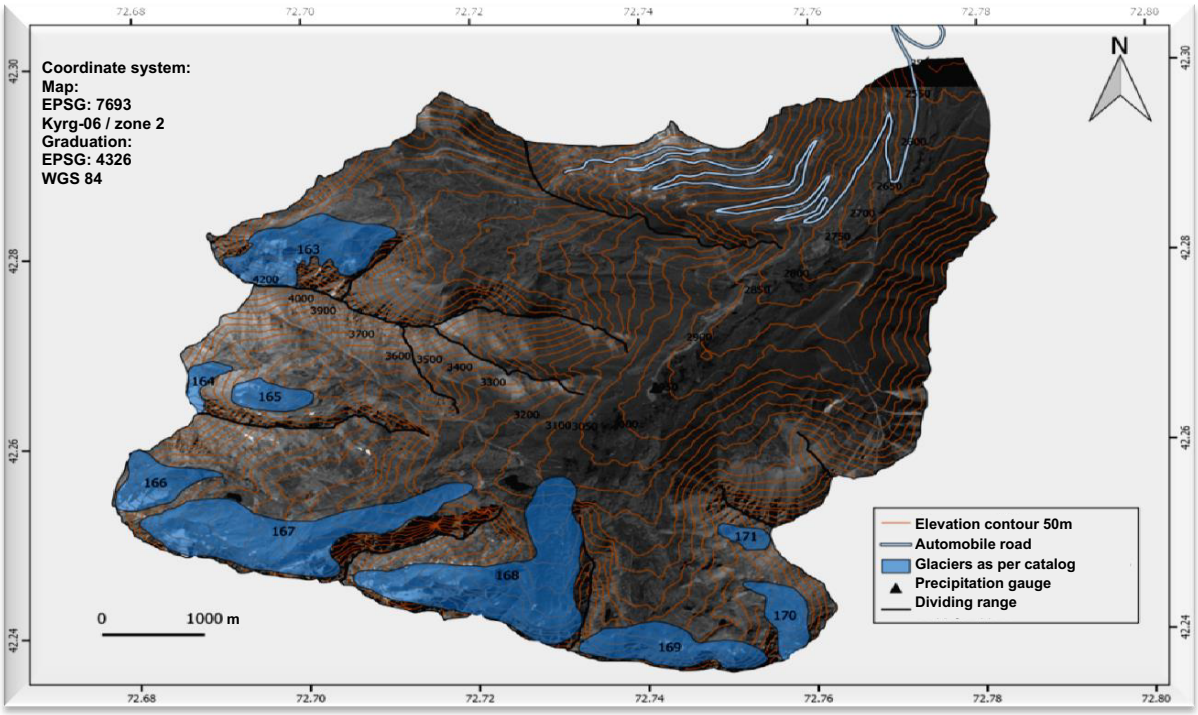


Fig. 1. Glaciers of the Jeruy River basin as per the 1968 Catalog of the Glaciers of the USSR.

According to the publication of Tobias Bolch in 2007, glaciers ranging in size from 0.1 to 2 km$^2$ in the northern Tian Shan from 1955 to 1999 lost from 20 to 70 % of their area, and this is the size of the surveyed glaciers in the Jeruy River basin.

A comparison of data from the catalog of glaciers of the USSR and high-resolution satellite images taken in 1968 shows a significant discrepancy in the presented areas of glaciers.

Table 1: Areas of glaciers in the Jeruy River basin as per catalog of glaciers of the USSR and space images of 1968.

| Glacier | Glacier area as per catalog | | Area as per 1968 image, km$^2$ | Difference, km$^2$ | Difference, % |
|---|---|---|---|---|---|
| | Total, km$^2$ | Open part, km$^2$ | | | |
| **163** | 0.8 | 0.7 | 0.76 | 0.06 | 8.57 |
| **164** | 0.1 | 0.1 | 0.11 | 0.01 | 10.00 |
| **165** | 0.2 | 0.1 | 0 | -0.1 | -100.00 |
| **166** | 0.4 | 0.4 | 0.21 | -0.19 | -47.50 |
| **167** | 1.5 | 0.7 | 0.7 | 0 | 0.00 |
| **168** | 1.7 | 0.7 | 0.2 | -0.5 | -71.43 |
| **169** | 0.4 | 0.1 | 0.06 | -0.04 | -40.00 |
| **170** | 0.3 | 0.2 | 0.07 | -0.13 | -65.00 |
| **171** | 0.1 | 0.2 | 0 | -0.2 | -100.00 |
| **Total** | **5.5** | **3.2** | **2.11** | **-1.09** | **-34.06** |

The difference between the total area of glaciers of the Jeruy River basin indicated in the catalog of glaciers of the USSR and the area determined by the 1968 satellite images was 1.09 $km^2$, in relative terms – 34 %.

It was not possible to determine the reason for this difference in glacier area. It can be assumed that the glaciers of the Jeruy River basin, due to their small size, were not a priority in the catalog of glaciers of the USSR, as indicated by the absence of schematic plans of these glaciers in the catalog.

And the two glaciers listed in the catalog, namely No. 165 and No. 171, were not found at all either on the 1968 satellite images, or on the 2017 images, or during field surveys.

As a result, in order to compare the areas of historical and current characteristics of glaciers, the areas determined by the 1968 satellite images were taken as historical data, and glaciers No. 165 and No. 171 were excluded from the survey program as nonexistent.

Table 2: Glacier areas determined from 1968 and 2017 satellite images

| Glacier | Area as per 1968 satellite image, $km^2$ | Area as per 2017 satellite image, $km^2$ | Absolute difference, $km^2$ | Relative difference, % |
|---|---|---|---|---|
| **163** | 0.76 | 0.43 | -0.33 | -43.42 |
| **164** | 0.11 | 0.05 | -0.06 | -54.55 |
| **166** | 0.21 | 0.09 | -0.12 | -57.14 |
| **167** | 0.7 | 0.41 | -0.29 | -41.43 |
| **168** | 0.2 | 0.14 | -0.06 | -33.33 |
| **169** | 0.06 | 0.01 | -0.05 | -83.33 |
| **170** | 0.07 | 0.01 | -0.06 | -85.71 |
| **Total** | **2.11** | **1.14** | **-0.97** | **-45.97** |

As can be seen from the comparative table, the areas of glaciers in the Jeruy River basin have significantly decreased in size over the past half-century. The smallest glaciers No. 169 and No. 170 have undergone the greatest changes, with a decrease in size of more than 80 %.

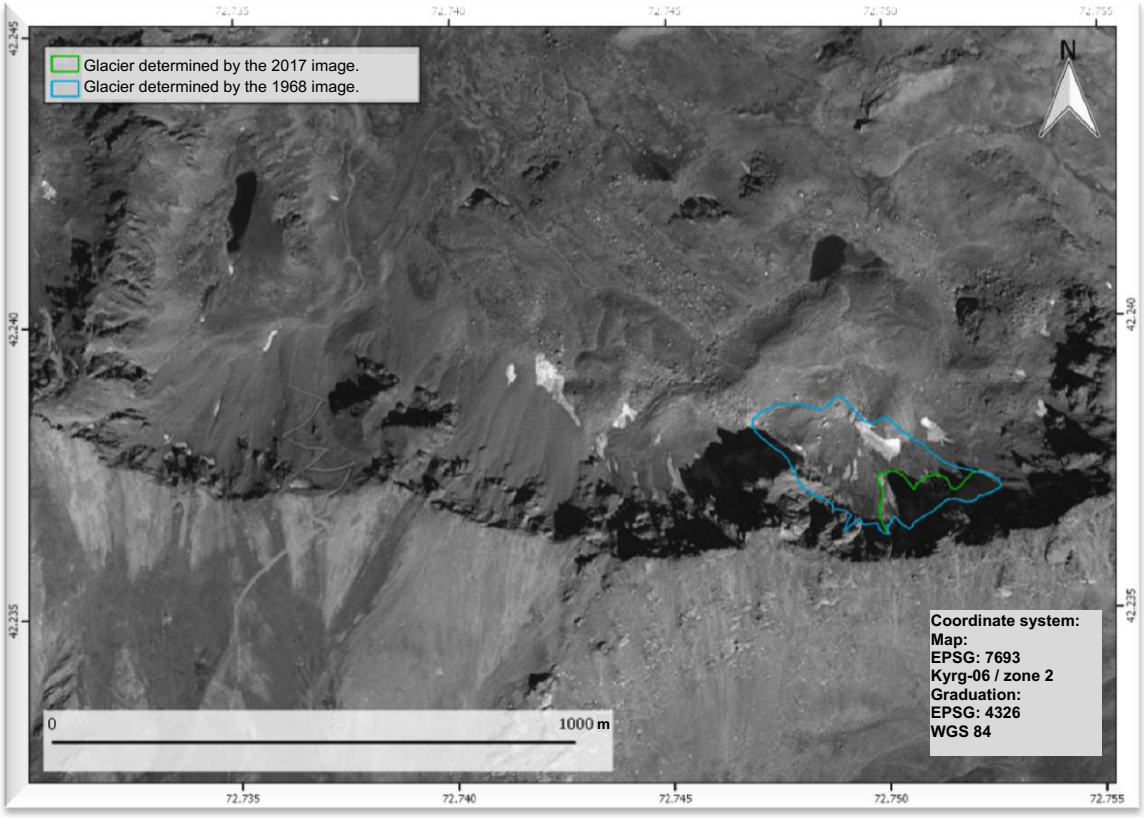


Fig. 2. Comparison of the boundaries of glacier No. 169 as determined from the 1968 and 2017 satellite images.

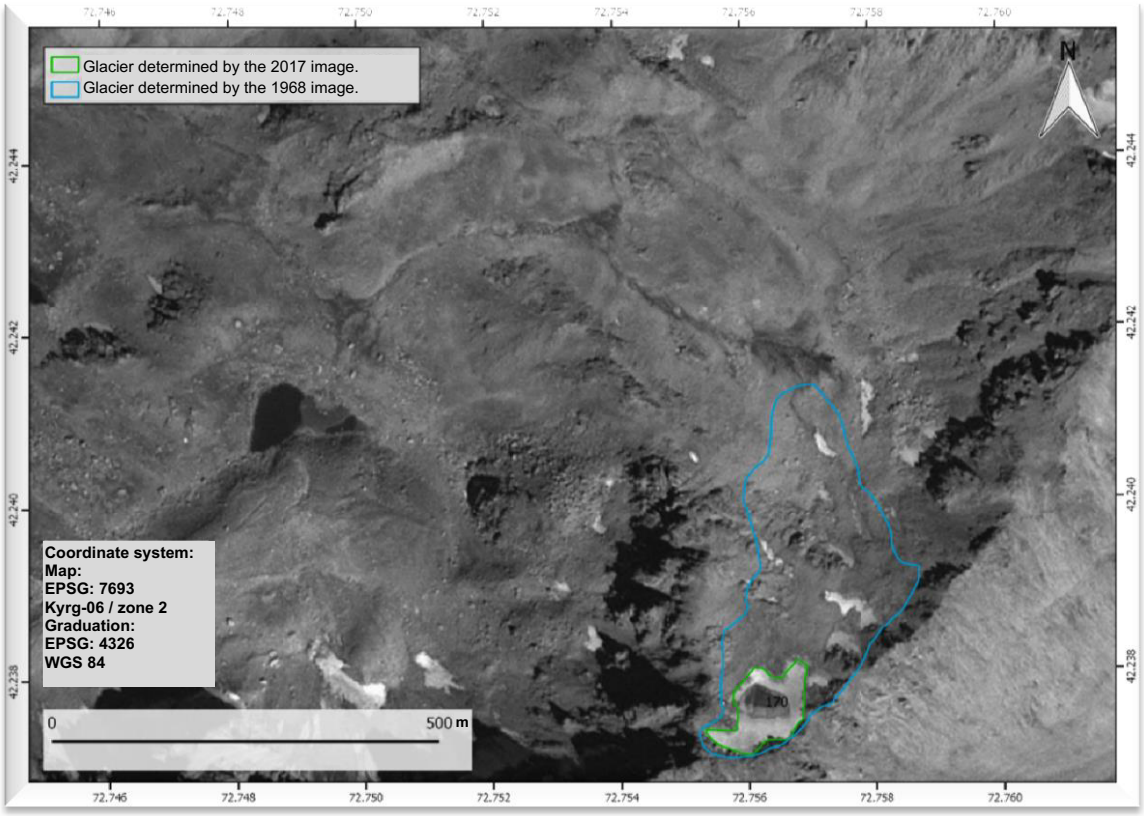


Fig. 3. Comparison of the boundaries of glacier No. 170 as determined from the 1968 and 2017 satellite images.

The areas of each of the largest glaciers, No. 163 and No. 167, decreased by almost 0.3 $km^2$, more than 40 %.

The relative area of glacier No. 168 has changed less than the areas of the others. Between 1968 and 2017, the glacier lost only a third of its area.

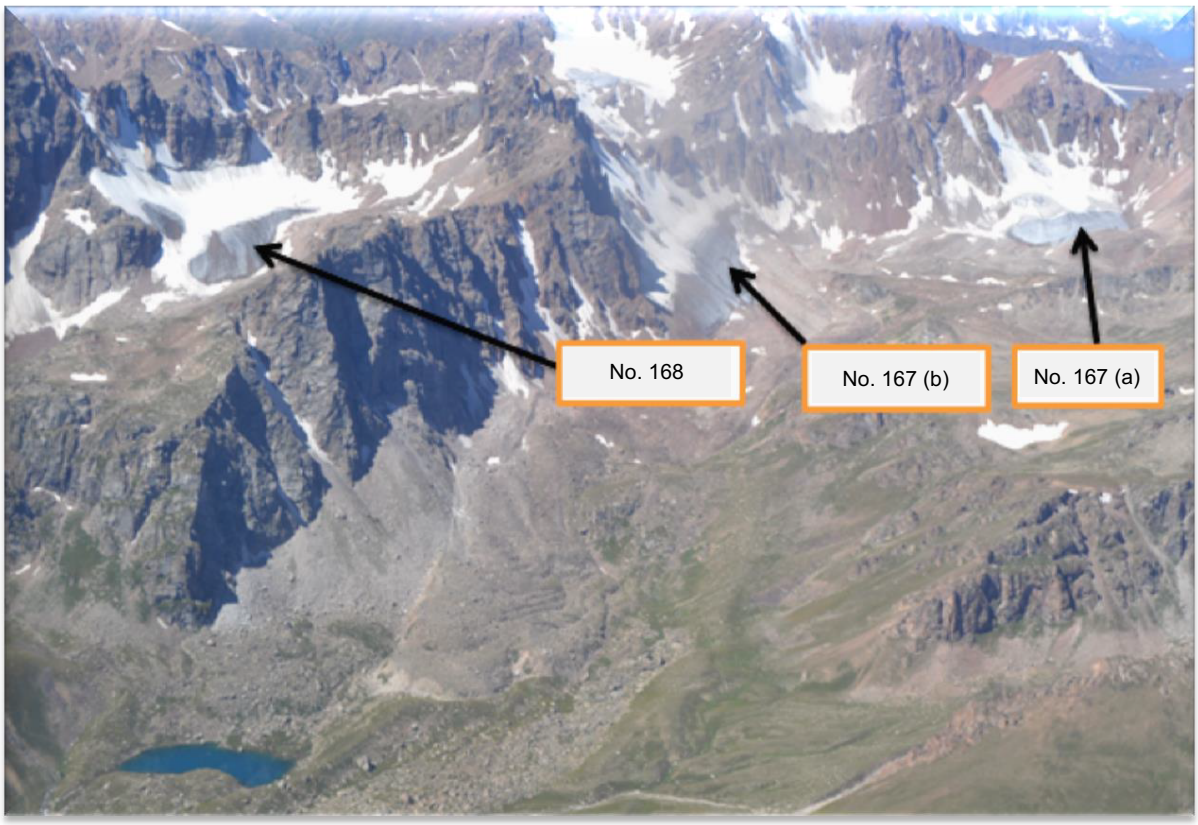


Fig. 4. Glaciers No. 167 and No. 168

Thus, while **mountain glaciers are moving back almost throughout the middle latitudes of the northern hemisphere, the glaciers of the Jeruy River basin are no exception.**

In total, from August 1968 to August 2017, the area of glaciers of the Jeruy River basin has decreased by almost 1 square kilometer, which is more than 45 % in relative terms.

If such a trend continues, the complete disappearance of small glaciers in the Jeruy River basin will occur within the next few years, and the largest glaciers – within decades.

Fig. 5. General view of the southeastern composition. Start of the Jeruy River catchment basin

Fig. 6. Glacier No. 167. August 2018


Fig. 7. Glacier No. 168. August 2018

Fig. 8. Mountain lake below the corrie-valley glacier No. 168

Fig. 9. Climbing glaciers No. 167 and No. 168


Fig. 10. Hydrological-meteorological-glaciological survey of glacier No. 168. August 2018

Fig. 11. Installation of ablation stakes

Fig. 12. Survey of glacier No. 163