

Progress Report

Long-Term Monitoring of Gangotri Glacier, Garhwal Himalaya

(April – June 2024)

by

Dr. Amit Kumar (Scientist C, Nodal Person)

Dr. Litan Kumar Mohanty (Project Scientist)

Vineet Singh (Project Assistant)



**Wadia Institute of Himalayan Geology, 33, General
Mahadeo Singh Road, Dehradun, Uttarakhand**

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Background

The Himalayan Mountain Range contains thousands of glaciers of varying properties, spread over 37000 km² and a stretch of 2400 km from East to West. The glacier inventory by the Geological Survey of India indicates there are 9575 glaciers in the Indian Himalayan Region (IHR). It is a well-established fact that changes in the glaciers are a key indicator of climate change; recent observation shows that snow accumulation is reducing while the ablation is increasing in the Himalayas.

However, there are only a handful of ground-based studies on Himalayan glaciers. Therefore, the Department of Science and Technology (DST) has given the Wadia Institute of Himalayan Geology (WIHG), Dehra Dun the mandate to monitor Himalayan Glaciers. Presently, Uttarakhand State Disaster Management Authority (USDMA) has sponsored a project entitled “Long-term monitoring of Gangotri Glacier, Garhwal Himalaya” to WIHG (Letter no. 1765/XVIII-B-1/21-12(5)/2021 dated 21.12.2021) for which the funds were allocated in March 2022.

The approved objectives of the project are the following:

- Mapping and monitoring of the Gangotri group of glaciers.
- Mapping and monitoring of glacial lakes in the Gangotri group of glaciers.
- Monitoring of meteorological (temperature, rainfall and snowfall) and hydrological (water level/discharge and sediment transfer) parameters throughout the year and identification of extreme events.
- Risk assessment of glacial hazards (GLOF, debris flow, flash floods, etc.) using an integrated approach i.e. meteorological, hydrological, seismological and satellite data.
- Dissemination of information to the local administration with regard to any emanating threat from the glacial hazards.

WIHG has carried out the following tasks during the April to June (3 Months) 2024.

1. The two watch and wards, who were previously engaged, are currently stationed in Bhojbasa and will remain engaged to report ongoing activities monitor the instruments, and maintain the base camp during winters and summers (**Figure 1A & B**). Permission from the forest department Uttarakashi has already been granted for this.
2. The instruments installed in October 2023 are functioning well during this period, as reported by the watchmen from time to time. The installation of a Manual Observatory to gather various parameters of rain and temperature will be completed before October 2024.
3. It has been observed that proper fencing is required to protect the instruments from tourists and visitors. Since the instruments are sensitive, a letter requesting permission to set up temporary fencings at Bhojwasa and Chirbasa has been sent to the concerned authorities of Gangotri National Park and the district administration (**Figure 1C & D**).
4. The Utilization Certificate for the last financial year has been submitted to USDMA in the required format, and a request for the release of funds under the next grant has been made.
5. The tender to establish connections via a VSAT satellite for real-time data acquisition will be done in September 2024. The purchase of the required high-resolution satellite data is currently in progress.



Figure 1: (A) Photograph showing the base camp covered with seasonal snow during the first week of April and May 2024. (B) Tents of tourists near the Automatic Weather Station, Broadband Seismic Stations, and around the base camp. (C, D) The snout of the Gangotri Glacier, with debris flowing in front, originated from the Meru Glacier in 2017.

6. The watch and wards visited the Gangotri Glacier between April and May 2024. The discharge of the Bhagirathi River began to increase in the first week of April. The channel originating from the Meru Glacier has started discharging water into the mainstream Bhagirathi. Significant debris remains around the snout of the Gangotri Glacier following the debris event in 2017. The existing channel from Raktavan directly merges with the Bhagirathi near the glacier's snout (**Figure 2**).
7. The Chaturangi Glacier, a tributary of the Gangotri Glacier, has retreated. During the monsoon, the drainage from the Chaturangi Glacier becomes more pronounced, contributing substantial meltwater through a sub-glacial channel to the Gangotri Glacier. This additional meltwater accelerates the ice melt in the Gangotri Glacier, which could become a cause for concern in the future (**Figure 2**).
8. The glacier basin was 99.82% covered with snow up to the base camp on 10th April. By 27th May, this coverage reduced to 73%, meaning 27% of the snow melted in just 47 days. It is expected to decrease further to 67% by 12th June 2024, indicating an additional 6% melt over 16 days (**Figure 3**).
9. The passage highlights a significant and relatively rapid reduction in snow cover in the glacier basin over a short period, with specific percentages of melt calculated for different time intervals. This could indicate accelerated snowmelt due to rising temperatures, seasonal changes, or other environmental factors.

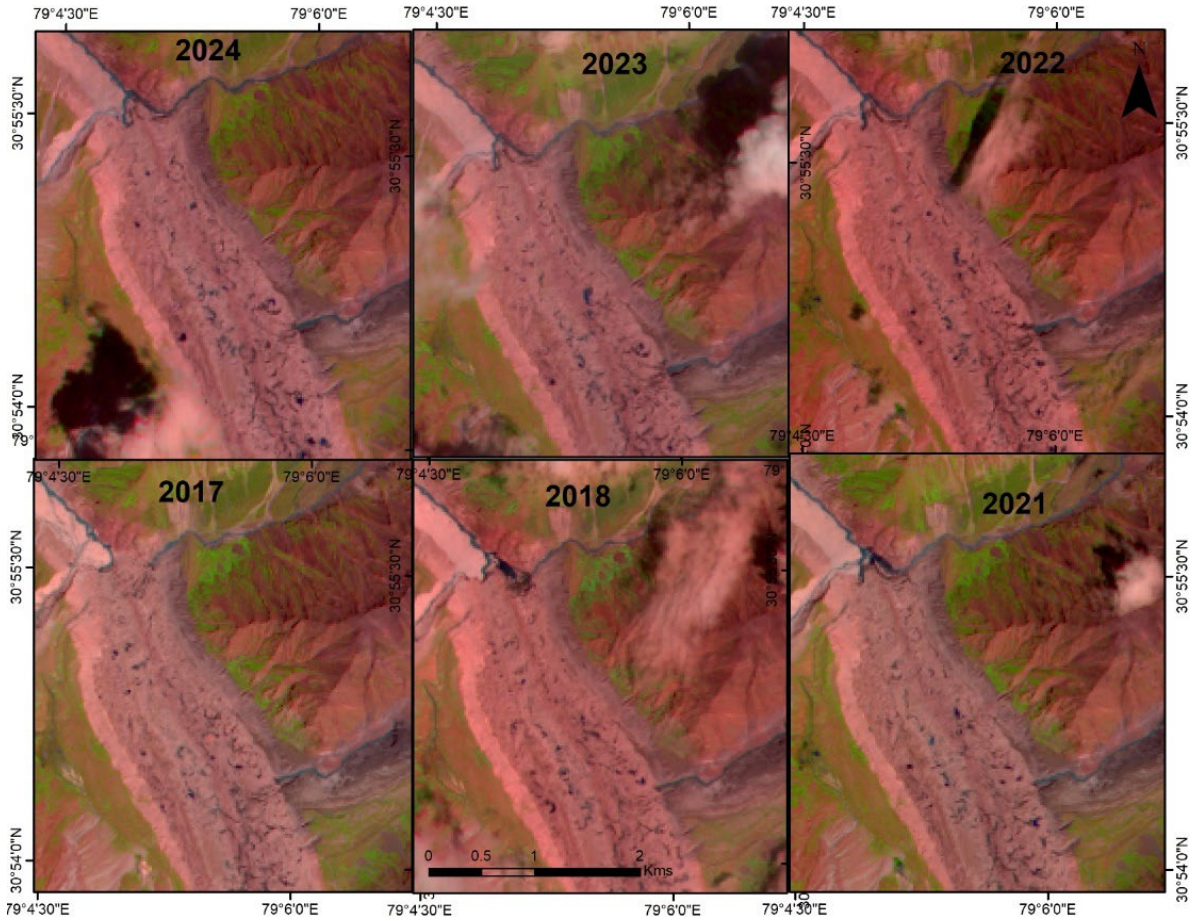


Figure 2: Satellite images showing the positions of the snout of the Gangotri Glacier and meltwater streams emerging from the Chaturangi and Meru Glaciers since 2017.

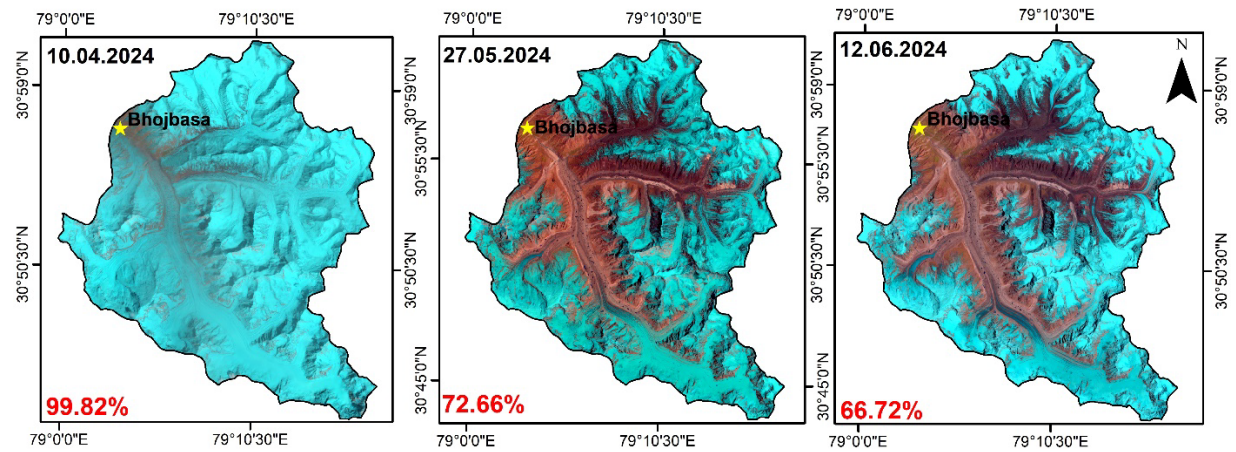


Figure 3: Satellite images showing the distribution of seasonal snow cover up to Bhojwasa in Gangotri Glacier basin from April to June 2024. Sentinel-2A and Landsat imageries were used for monitoring.

‘Based on field visits and observations from satellite imagery, the team did not detect any indications of recent debris flow, instances of river water damming, or the formation of glacial lakes around the snout (Gomukh). This suggests that there have been no significant changes in the landscape that could potentially impact the region's stability or pose threats to nearby communities or infrastructure during this period.