

Updated Assessment on Shishper Glacier Surge and Glacier Dam Lake in Hassanabad, Hunza, Gilgit-Baltistan



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1. Executive Summary

Glacier Monitoring Group at Research and Development Division, PMD is regularly monitoring Shishper glacier surge and resultantly developed lake at Hassanabad, Hunza, Gilgit –Baltistan. The Karakoram mountain range is dominated by surging glacier. At times, surging glaciers intercept its water or of surrounding glacier and facilitates formation of glacier dammed lake that may suddenly outburst and result in Glacial Lake Outburst Flooding (GLOF). GLOF may release millions of cubic meters of water stored in the lake that may affect downstream infrastructure up to hundreds of kilometers.

Shishper glacier situated at Hassanabad, Hunza is a surging glacier that intercepted glacier-meltwater from its neighboring glacier named Muchuhur and facilitated the formation of a glacial lake that is at risk to GLOF in coming months. Previously two GLOF events were occurred on June 23, 2019 and May 29, 2020, when Shishper glacier dammed lake was outburst with peak discharges of 5000 and 2900-3500 cusecs respectively that damaged Karakoram Highway (KKH) near Hassanabad by eroding road, and road traffic was hauled for few days.

This brief report details the background of Shishper glacier surge and its dynamics as analyzed by hydro-meteorological data and satellite imagery, moreover, the mitigation strategy is detailed and a future way forward is provided for policy makers.

2. Description of Shishper Glacier

The 12 km long Shishper glacier, covering an area of almost 24.9 km², and originating from Shishper Peak (7611 m.a.s.l.) is situated near Hassanabad Town in Hunza (see Figure 2 a, b). Presently, the snout of Shishper glacier is approximately 4-km away from Karakoram Highway (KKH). The area of Hassanabad hydrological catchment is around 357.5 km². Nearly 28 glaciers of variables size exist in this valley (Figure 2 a, b).

3. Surge History of Shishper Glacier

Shishper glacier is actively surging since year 2016. Up to May 2018 the surge velocity of Shishper glacier was relatively slow, however in May –June 2018 it surged with very high velocity (up to 43.3 meters/day). Meanwhile, terminus of Shishper glacier hit the opposite flank of the mountain named Hachindar Chhish and blocked the passage of glacier melt flows from Muchuhur Glacier (see Figure 2, b) that resulted in the formation of glacier dammed lake in November 2018 (Figure 3). Moreover, since June 2018 the Shishper glacier was surging westward, along with predominant surge in southward direction. However, now the surge of the glacier has almost been stopped (Figure 4).

After June, 2019 GLOF's event winter's low temperature at high elevation facilitated the strong bondage of high compact glacial ice that obstructed flow of water from it. This processes again facilitated the formation of lake that kept on increasing in size till May, 2020 which results in another outburst on 29th May 2020. The estimated lake area before outburst was 0.36km^2 with the volume of 20 million cubic meters (m^3) that outburst with peak discharge of around 2900-3500 cusecs.

4. Updated GLOF Situation of Shishper Glacier (February 2021)

Since May 2020, the melt water from Muchuhur glacier is continuously being drained through pathways developed in Shishper glacier. However, with the winters of 2020-21 and reduced temperatures, the Shishper glacier dammed lake again reformed due to the closure of fissures and pathways in Shishper glacier that were facilitating drainage of melt water from Muchuhur glacier. The size of the lake was estimated to be approximately 94662.6 m^2 and length is almost 650 meters long in direction aligned to water channel (Figure 3 and Figure 4) on 19th February 2021. With the advent of summers and increasing temperature the probability of lake outburst flood from Shishper lake has been increased.

GLOF ALERT

“The area is highly vulnerable due to high probability of GLOF event triggering from Shishper Glacial dammed lake in the wake of increasing temperatures of approaching summers (Figure 5). Thus, the coming 3 to 4 weeks are highly important and Shishper glacier along with lake needs to be monitored continuously to inform about any unforeseen situation.”

5. Recommendations to Support Mitigation Plan

The Research and Development Division of Pakistan Meteorological Department is already watching the meteorological conditions and monitoring the surge dynamics of Shishper glacier and glacier dammed lake formed because of the Shishper glacier surge through Remote Sensing and Geographical Information System techniques. For regular and closely watch of Shishper glacier it is recommended

- i. To install one Automatic Weather Station at a suitable place in Hassanabad.
- ii. To install one water level/ discharge monitoring stations along the river downstream originating from Shishper glacier on temporary basis until the arrival of proposed hydro-meteorological equipment under GLOF-II project.

- iii. The Glacial Lake developed due to Shishper glacier Damming is almost inaccessible due to highly fractured and crevassed ice structure of Shishper glacier. The most appropriate, low cost, and efficient way to minimize the threat of GLOF is to lower down the level of water in lake by pumping water out on Shishper glacier. This technique is called Hydraulic Siphon Technique (HST). This technique could be adopted to lower the level of the water from the lake in addition to other mitigation measures for example, gabion walls etc.

PMD has planned to mobilize the technical team to visit and install Automatic Weather Station during the first week of March 2021. Gilgit-Baltistan Disaster Management Authority is requested to provide the water level gauge and to coordinate with PMD's team accordingly.

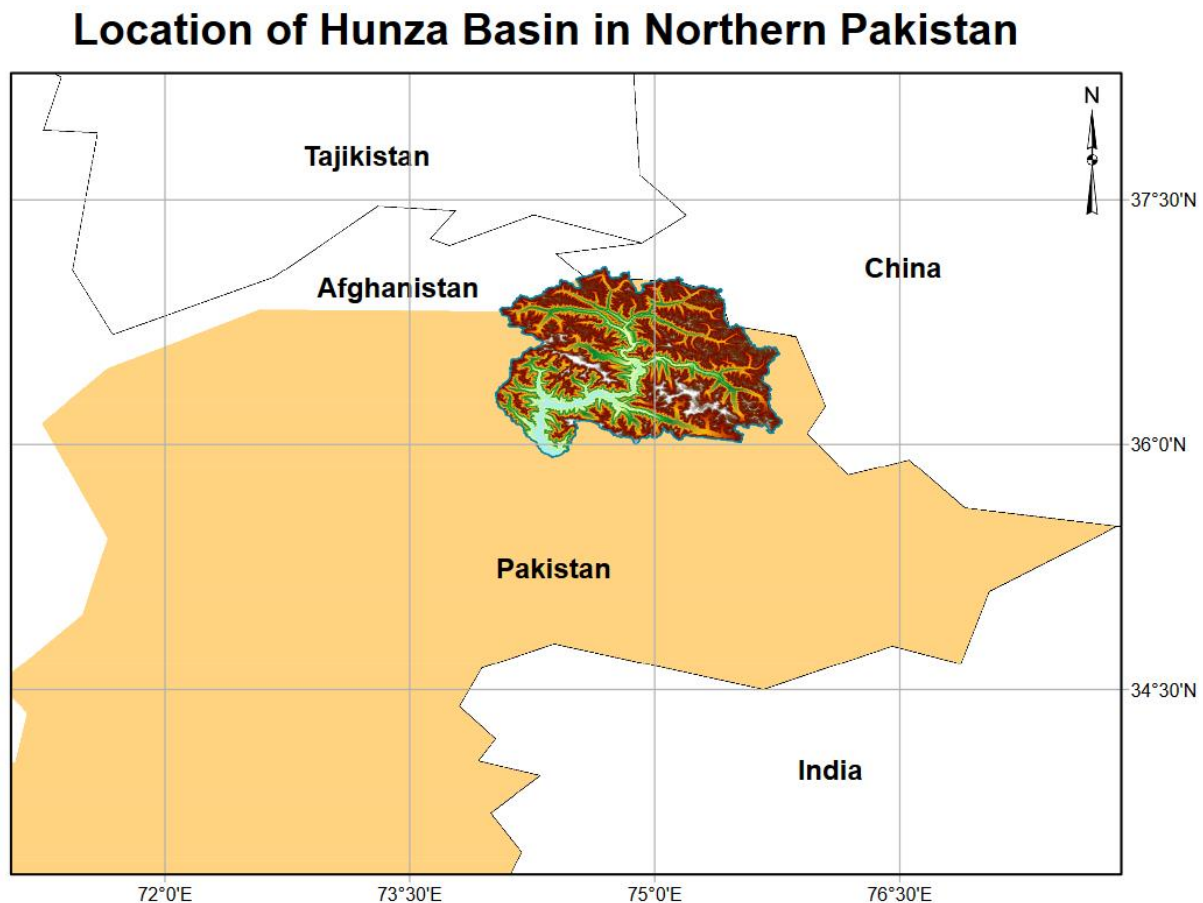
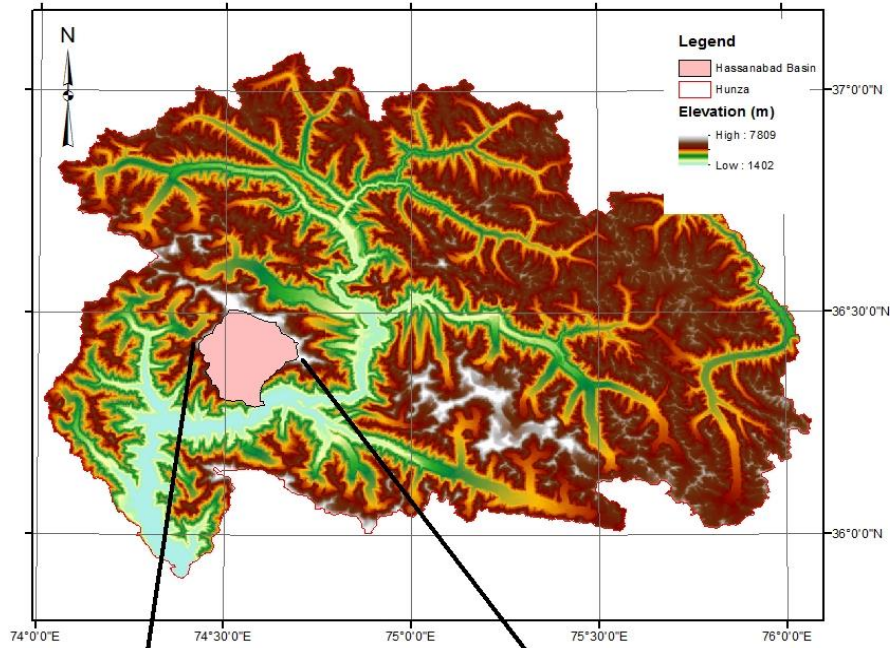


Figure 1: Location of Hunza catchment, with reference to Pakistan boundary and neighbouring countries, is presented. The Hunza catchment covers an area around 13,730 km², and 30% area of Hunza catchment is covered with glaciers. It hosts above one thousand glaciers of variable sizes (~1,180 as estimated by PMD).

Location of Hasanabad in Hunza Basin

(a)



(b)

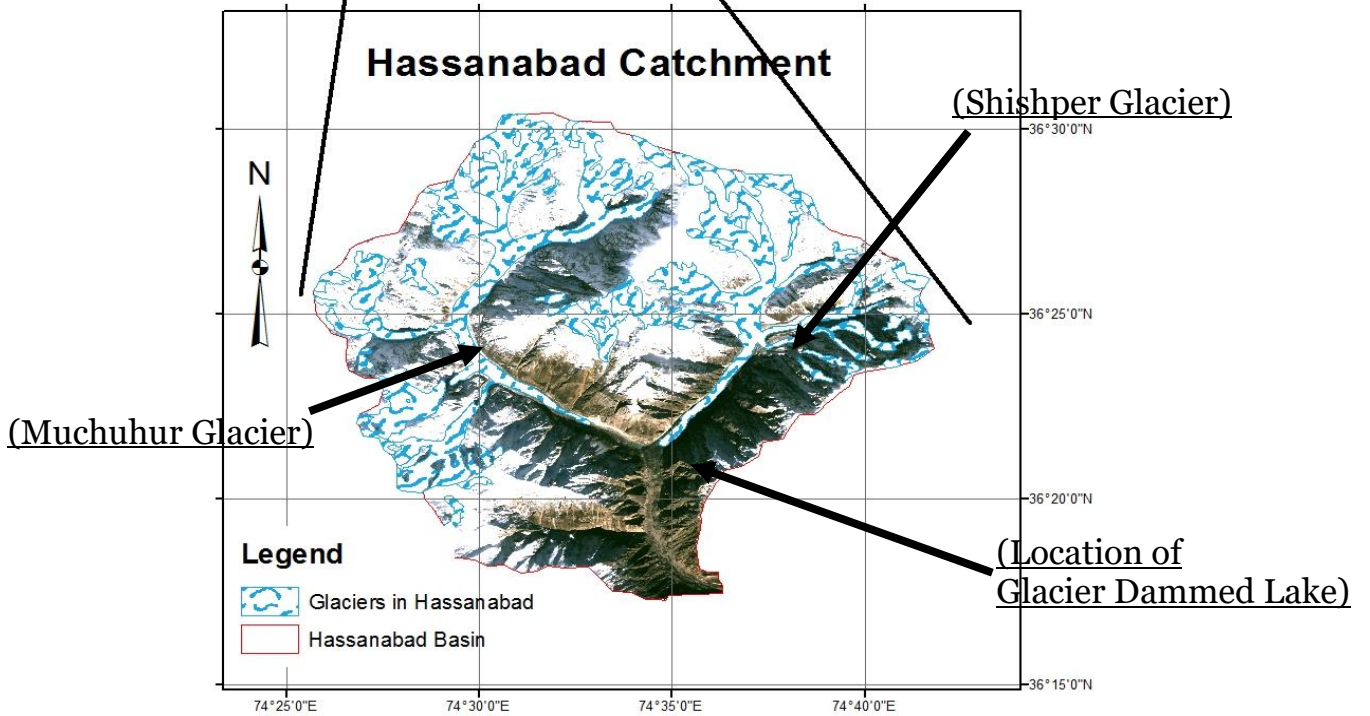


Figure 2: (a) Hunza Catchment is presented. Location of Hassanabad Catchment in Hunza is highlighted. (b) Hassanabad Catchment with locations of Shishper glacier and Muchuhur Glacier. There are around 28 Glaciers of variable sizes in Hassanabad catchment. Presented locations of glaciers terminus are according to Glacier Inventory developed by International Centre for Integrated Mountain Development (ICIMOD) in year 2011.



Re-Formation of Ice-dammed Lake due to Shishper Glacier surge

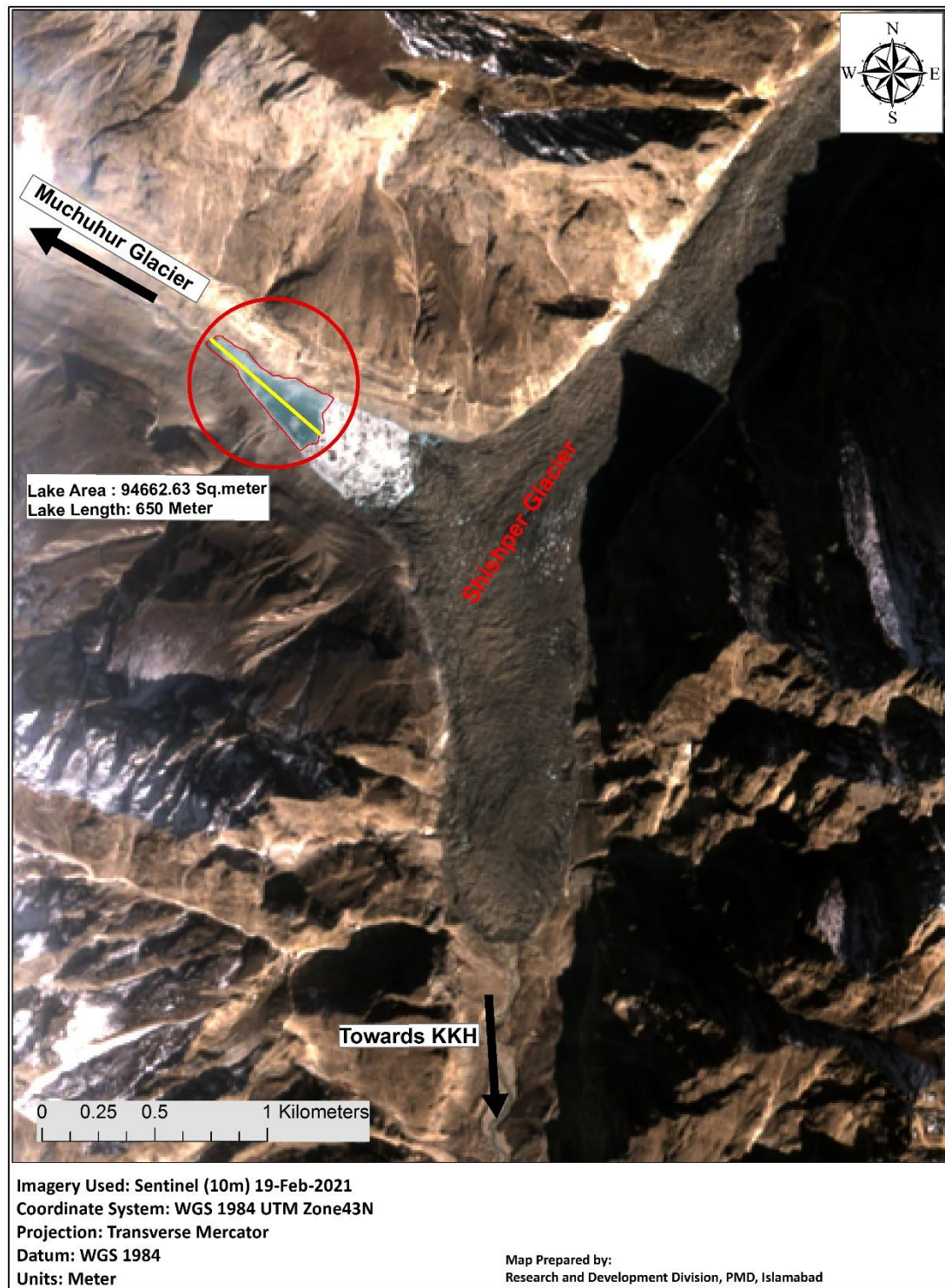
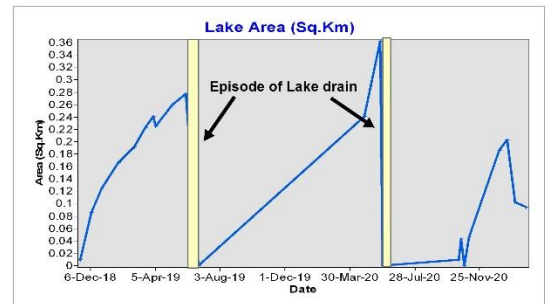
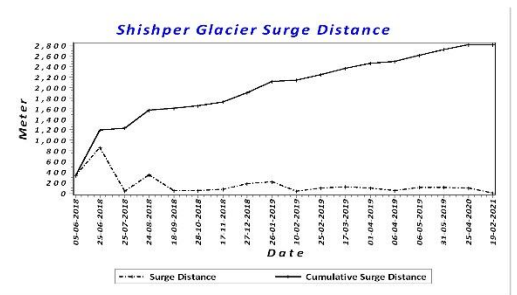
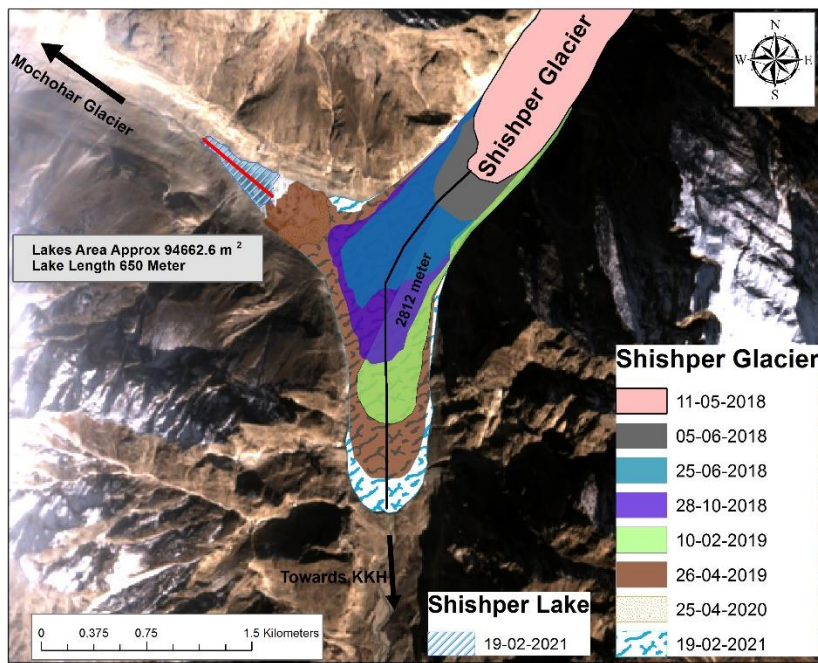


Figure 3: Formation of glacial dammed lake initiated by the blockage of glacier melt water from Muchuhur glacier by Shishper glacier in November 2018. Red circle indicates formation of glacial dammed lake. The lake is 650 meters long in the direction along the water channel and covered an area of approximately 94662.6 m² as per satellite image acquired on 19th February 2021.



Spatio-Temporal Analysis of Surge in Shishper Glacier, Hunza



Imagery Used: Sentinel (10m)
 Image Date: 19-Feb-2021
 Coordinate System: WGS 1984 UTM Zone43N
 Projection: Transverse Mercator
 Datum: WGS 1984
 Units: Meter

Map Prepared by:
 Research and Development Division, PMD, Islamabad

Figure 4: The Analysis of Shishper glacial dammed lake through Sentinel-2 (10m) Imagery using remote sensing technique.

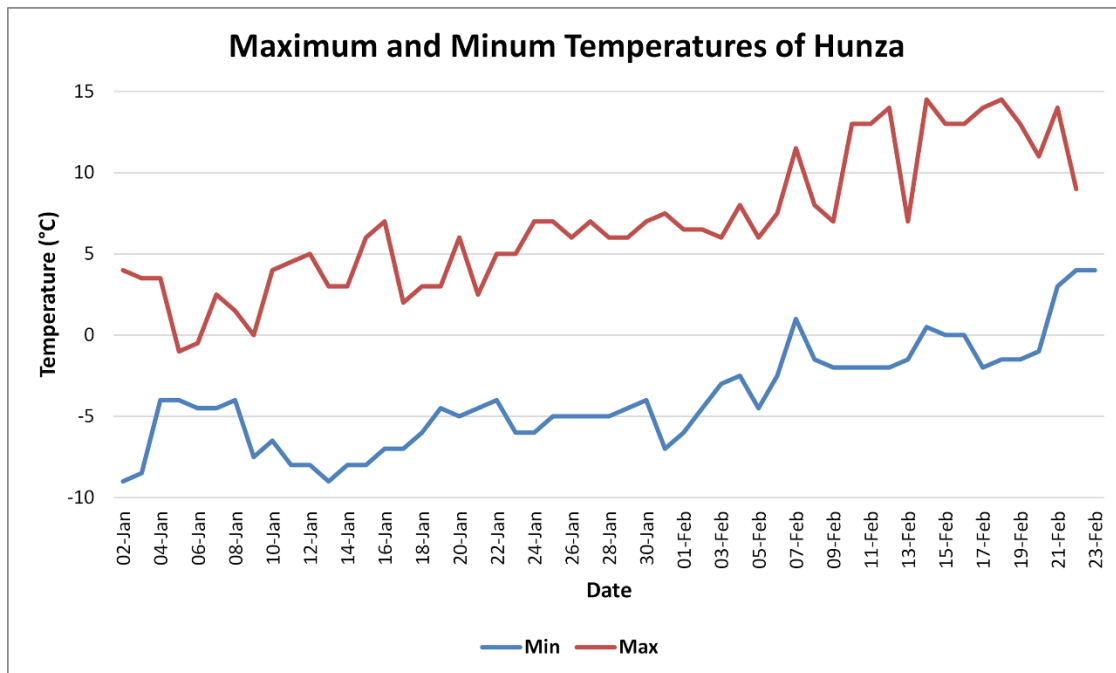


Figure 5: The Maximum and Minimum Temperature of Hunza for the month of January and February 2021. The temperature is increasing with the approaching summers.