

Near-Surface Ground Temperature Monitoring for Permafrost Detection in Laya, Bhutan

Technical Report (Version 1)

10 October – 27 October 2025



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Members of the Permafrost Team 2025: Dago Retty, Sonam Wangchuk, Arun Puri, and Tshewang Jamtsho (from left to right). Photo by Dago Retty.

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1. Background

The cryosphere includes all the frozen water on Earth, such as ice caps, glaciers, sea ice, snow, and permafrost. In Bhutan, the cryosphere—primarily glaciers, snow, and likely permafrost—is an integral part of people's livelihoods. People use cryosphere-originated meltwater for drinking, irrigation, and hydropower generation. Moreover, people live with cryosphere-related hazards such as ice and snow avalanches, landslides, and debris flows, which are likely exacerbated by ongoing climate change.

Understanding the cryosphere, its changes, and monitoring is crucial to realizing the importance of the cryosphere and minimizing the adverse effects of cryosphere-related disasters in Bhutan. Permafrost (sub-surface earth materials that remain consistently at or below 0°C for a period of two or more consecutive years, Figure 1), in particular, is the least understood cryosphere component in Bhutan. For instance, the 2021 landslide in Mo Chu basin that claimed ten lives highlights [1] the need to monitor and understand permafrost dynamics in Bhutan in the context of hazards (Figure 2). In 2024, International Centre for Integrated Mountain Development and National Centre for Hydrology and Meteorology initiated permafrost research in Bhutan by installing 19 near-surface ground temperature sensors in Shodug Valley, headwaters of Thim Chu River [2].

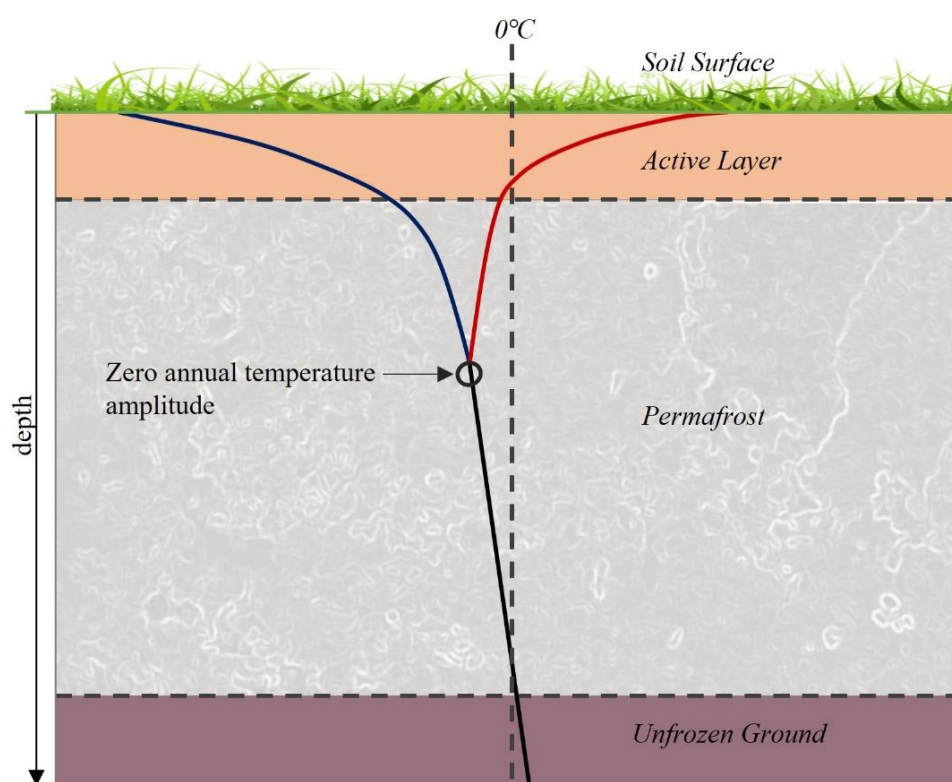


Figure 1: A typical permafrost ground structure and temperature profiles.

Measuring near-surface ground temperature (NSGT), often with networks of miniature data loggers (Figure 3), can help us understand how permafrost, rock glaciers, and seasonally frozen soils are responding to warming conditions and affecting lives and livelihoods of mountain communities. The NSGT records can also reveal the timing and depth of ground freezing and thawing, processes which directly influence regional water availability, slope

stability, and the health of mountain ecosystems. Although direct, in-situ observations in the remote and rugged mountains are rare and challenging, NSGT measurements can provide vital local evidence to validate and complement broader-scale satellite observations of permafrost extents (Figure 4 & 5) [3], [4], [5], [6].

This field report provides comprehensive information on the networks of GeoPrecision miniature data loggers deployed during the fieldwork from 10th October and 27th October 2025. The data will be used to detect early signs of permafrost thaw, assess related hazards, and improve predictions of landscape stability. In addition, the information will be used to inform climate adaptation and resilience strategies in Bhutan.

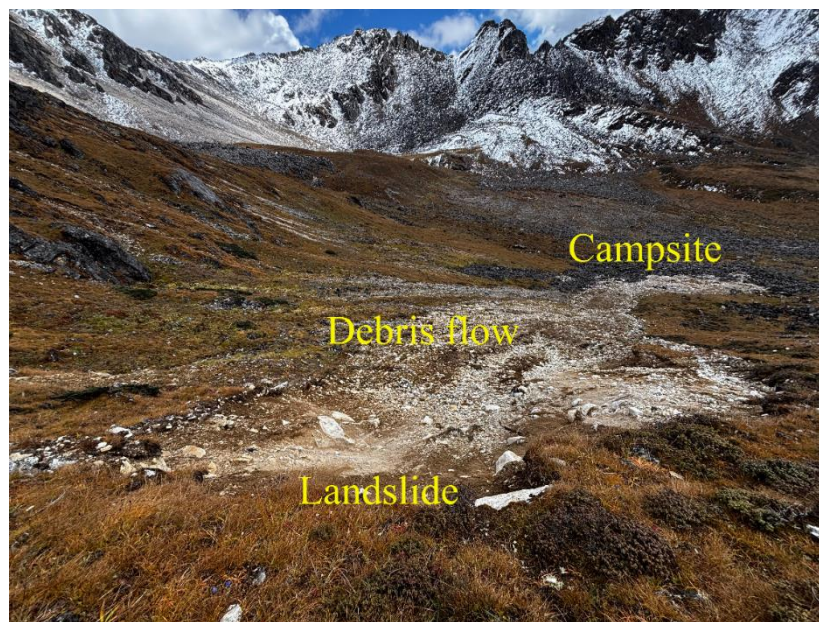


Figure 2. Landslide–debris flow that claimed 10 lives of Cordyceps collectors in 2021, Laya, Bhutan.

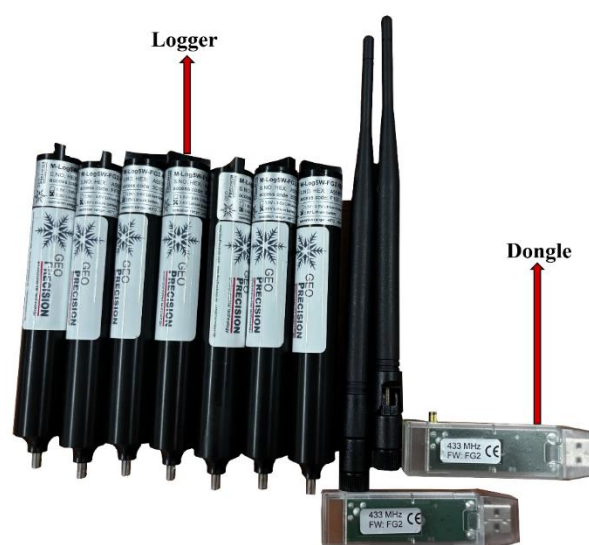


Figure 3: GeoPrecision miniature data loggers (20 numbers) procured by the National Centre for Hydrology and Meteorology (NCHM), Bhutan.

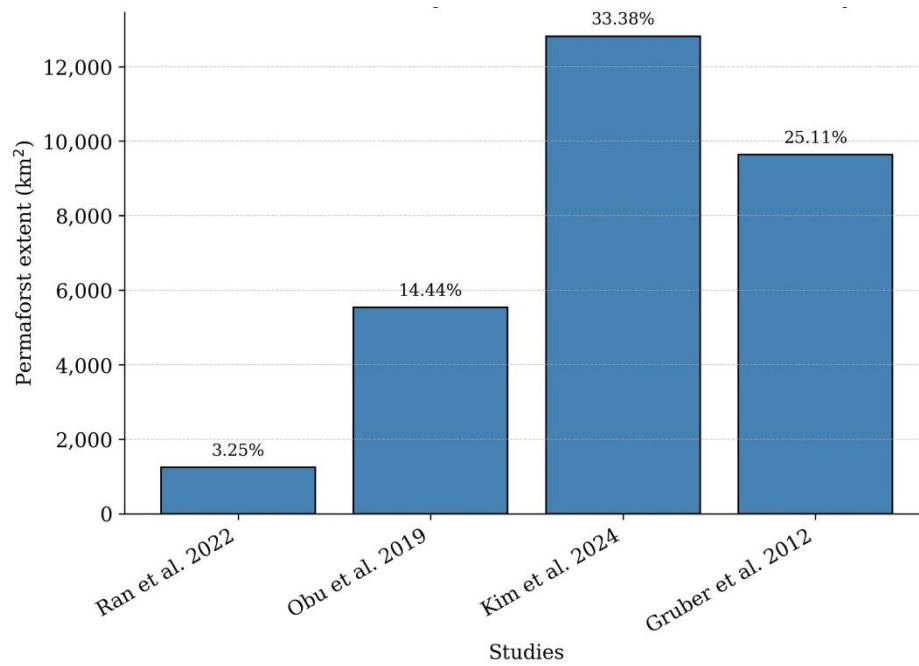


Figure 4. Permafrost extent in the Bhutan Himalaya by different studies.

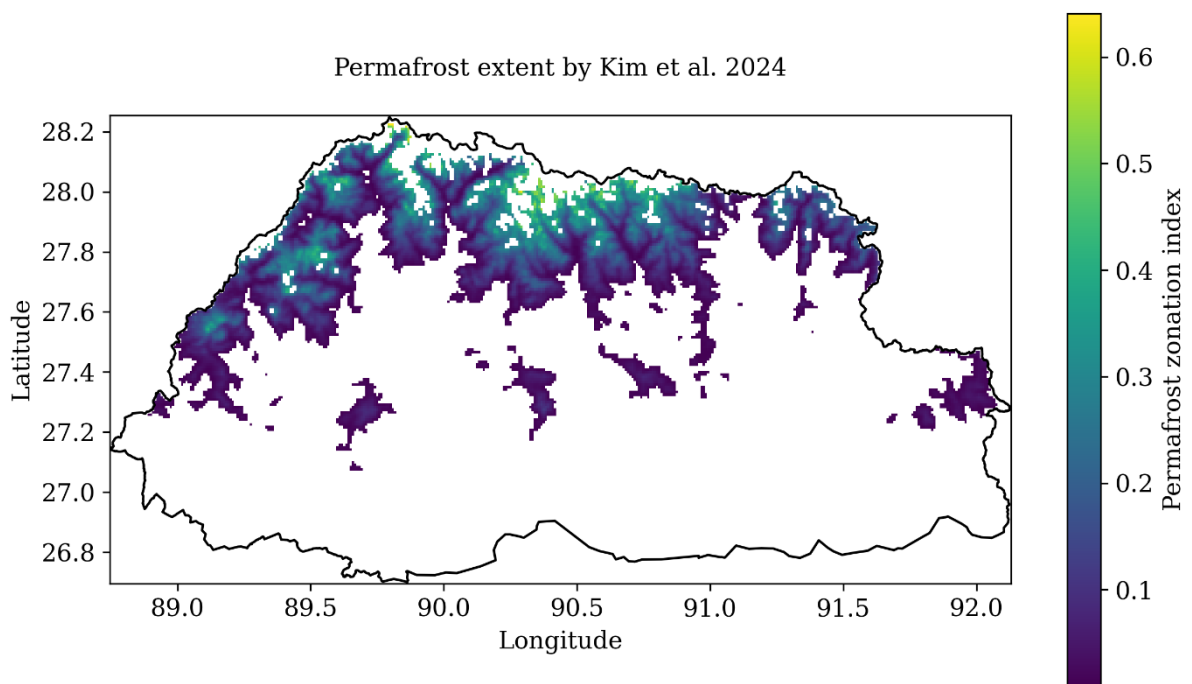


Figure 5. Permafrost extent map in Bhutan by Kim et al (2024).

2. Objectives

The objectives of the fieldwork were:

- To deploy 19 near-surface ground temperature sensors (GeoPrecision) in the headwaters of the Mo Chu basin, with a particular focus on the 2021 landslide site.
- To initiate long-term monitoring of permafrost conditions and assess their stability, especially in areas critical for Cordyceps collection and community livelihoods.
- To strengthen collaborative partnerships between NCHM and ICIMOD in advancing permafrost research.
- To enhance the capacity of NCHM staff in permafrost monitoring and ground temperature data collection methods.

3. Field site

The site is located in the high-altitude alpine catchment of Redrukzhi, approximately three days walk from Laya in the northern Himalayas of Bhutan. Situated within the Mo Chu sub-basin of the Punatshangchu Basin, the catchment lies north of Thimphu, between latitudes 27°55'30"N and 27°59'30"N, and longitudes 89°32'E and 89°36'E. The Redrukzhi catchment has steep, rugged and highly dissected topography. Elevation ranges from approximately 3,400 meters on the lower valley floor to 5,203 meters at its highest point, with the northern ridgeline reaching around 5,100 meters above sea level.

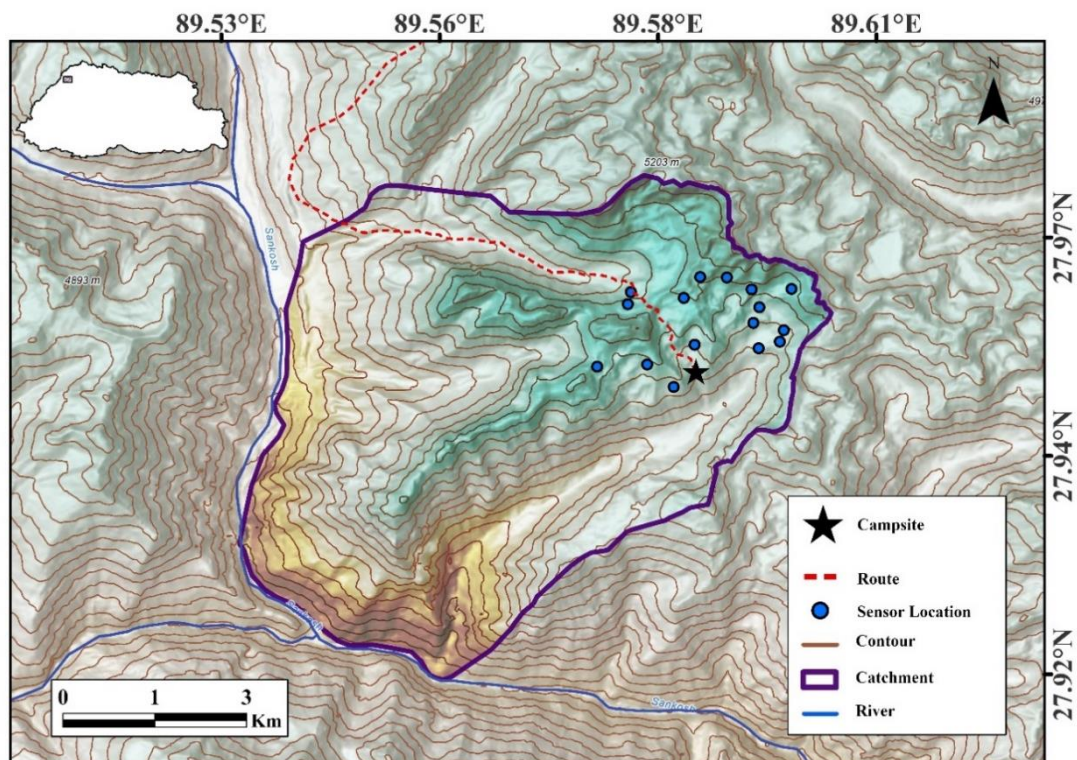


Figure 6. Site where 19 miniature data loggers were deployed, Redrukzhi, Laya, Bhutan

4. Methodology

4.1 Site

We selected homogeneous sites in terms of soil composition, texture, compactness, and surface land cover (e.g., a minimum area of 3×3 pixels on Landsat 9 imagery).

4.2 Accessibility

We selected locations that allowed for maintenance and calibration while ensuring observer safety, taking into account potential avalanche and rockfall hazards.

4.3 Topographic variables

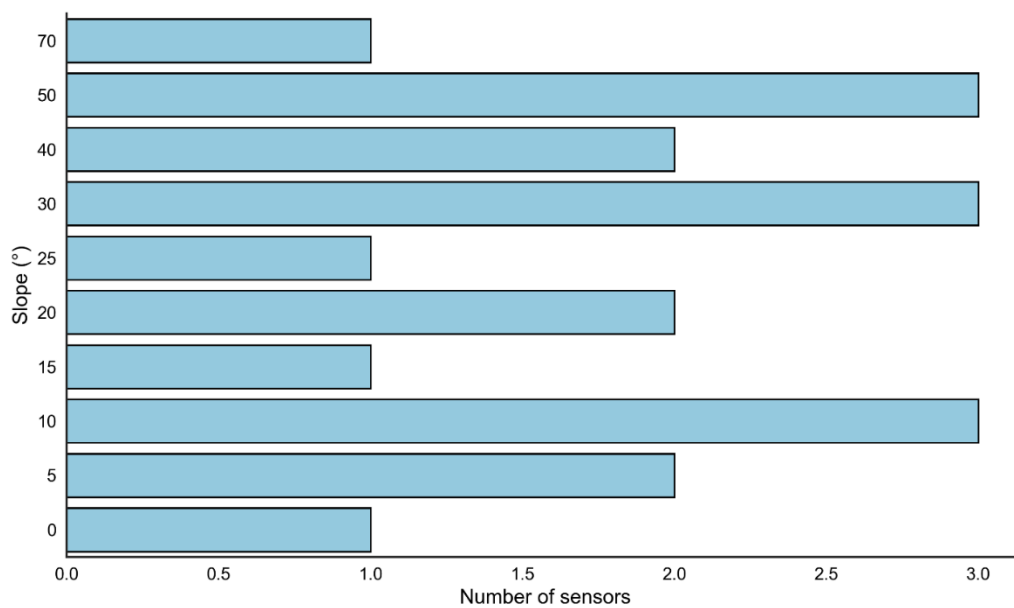


Figure 7. Distribution of sensors with respect to slope.

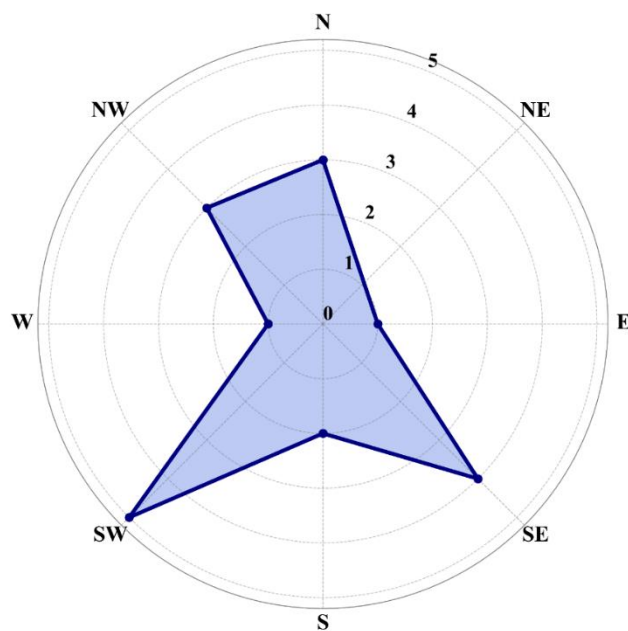


Figure 8. Distribution of sensors with respect to aspect.

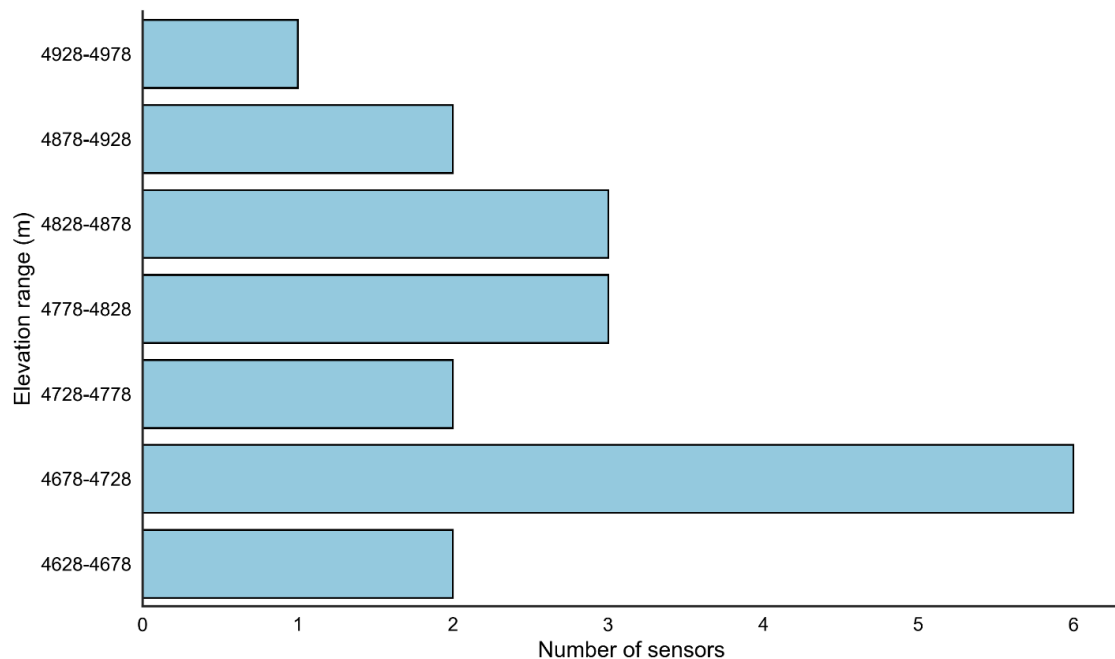


Figure 9. Distribution of sensors with respect to elevation.

4.4 Launching sensor

We deployed sensors at the site and configured the datalogger to record time in Coordinated Universal Time (<https://www.timeanddate.com/worldclock/timezone/utc>).

4.5 Site naming convention

We followed the site naming convention as follows:

County-Local Name-Permafrost Conditions-Date

Example: BT-RD-HPP1-YYYY-MM-DD

4.6 Geolocation format & accuracy

We used decimal format for latitude and longitude to precisely geolocate sites. We listed latitude first, followed by longitude, both expressed in decimal degrees with a minimum of four decimal places. (e.g. 28.2053, 85.5975). The horizontal accuracy of the location was within one to three meters.

4.7 Unit of measurement

All temperature measurements were recorded in degrees Celsius (°C).

4.8 Data recording interval

Data logging was configured at 30-minute intervals to capture diurnal temperature variations while optimizing memory capacity and battery life.

4.9 Soil depth

Fourteen sensors were installed at a depth of 20 cm below the ground surface to reduce potential disturbances caused by livestock and human interference (Figure 10 a). Two sensors were installed at a depth of 3 cm and 20 cm in the same location (Figure 10 b, Annex Form 1). Three sensors were installed at a depth of 3 cm, 20 cm, and 50 cm, close to the 2021 landslide area to facilitate modelling thermal properties of the ground (Figure 10 c, Annex Form 6).

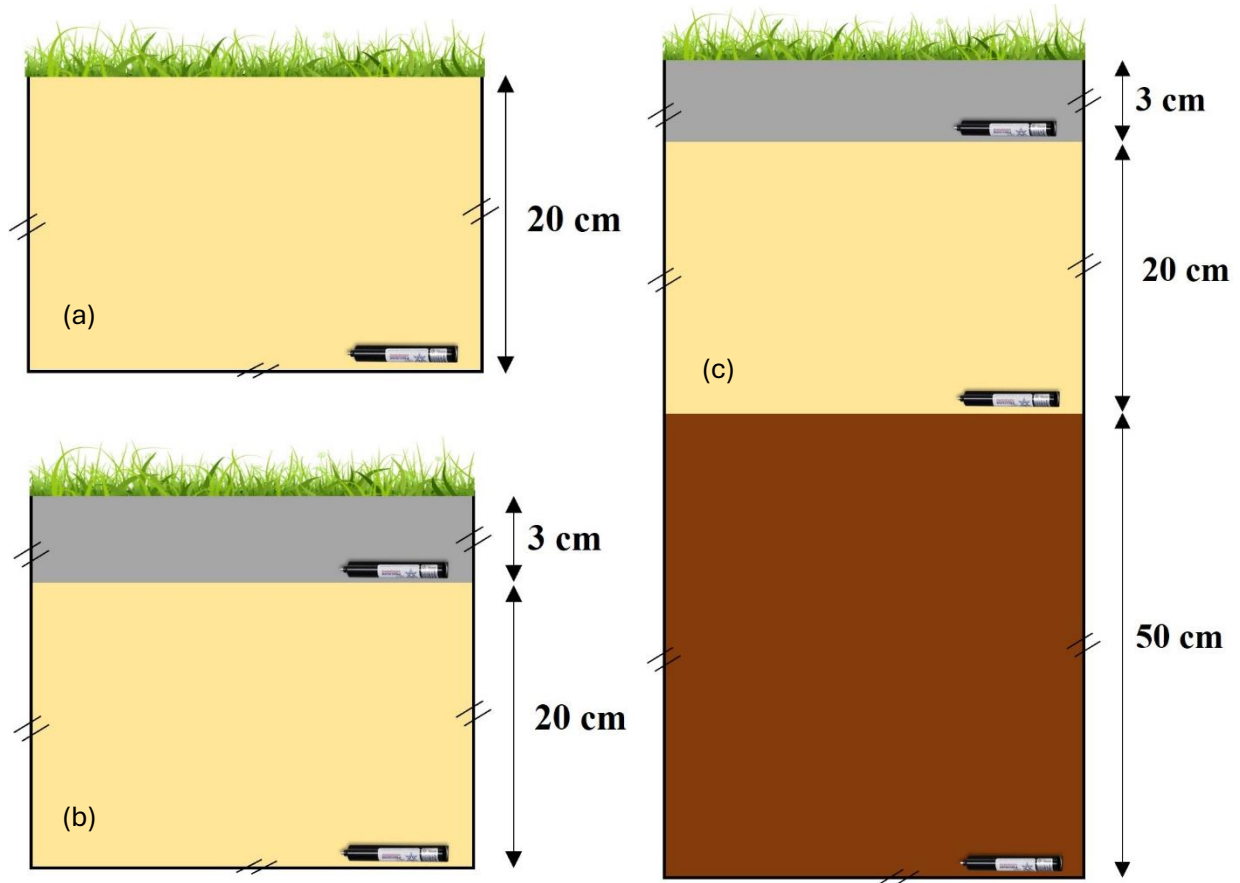


Figure 10. Sensors at different soil depths.

4.10 Backfill material

We buried sensors using the soil that has been dug out. We ensured that the soil layer, backfill material and compaction closely matched the surrounding undisturbed ground.

4.11 Securing logger

Sensors were secured using fishing line, leaving a 3–5 cm segment visible above ground to facilitate future maintenance and recovery.

4.12 Photographic documentation

To ensure consistent site documentation, each monitoring site was photographed with clearly visible benchmarks and manually applied paint reference markers.

4.13 QField App

The QField mobile application (<https://qfield.org/>) was utilized for field navigation and for selecting appropriate locations for sensor deployment.

5. Preliminary results from loggers A551EB (3 cm) and A551EF (20 cm)

The data collected over four days (14–18 October 2025) at two depths, 3 cm and 20 cm, indicated that the near-surface (3 cm) temperature was slightly lower on average than the temperature at 20 cm depth, with mean values of 1.65 °C and 2.04 °C, respectively.

During daytime, the 3 cm temperature rose significantly above the 20 cm temperature due to direct solar heating of the surface layer. In contrast, during nighttime, the shallow layer cooled rapidly and becomes much colder than the 20 cm depth, which retains heat longer.

The diurnal temperature amplitude at 3 cm was much larger compared to 20 cm. The 20 cm temperature signal was noticeably damped, reflecting the insulating effect of the overlying material and the slower rate of heat transfer with depth. The damping at 20 cm was a result of heat diffusion in soils. The near-surface temperatures responded quickly to diurnal forcing, while deeper layers (20cm) respond more slowly appearing the signal attenuated (reduced amplitude) and phase-shifted (delayed).

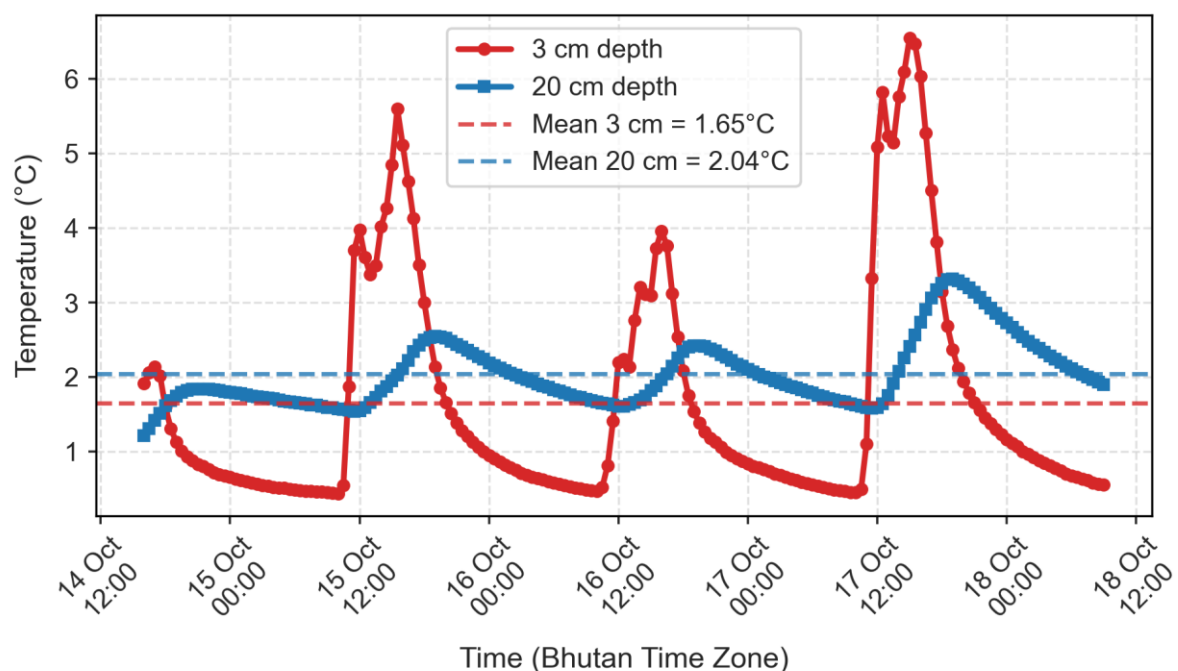


Figure 11. Ground temperature measurements at two depths (3 cm and 20 cm).

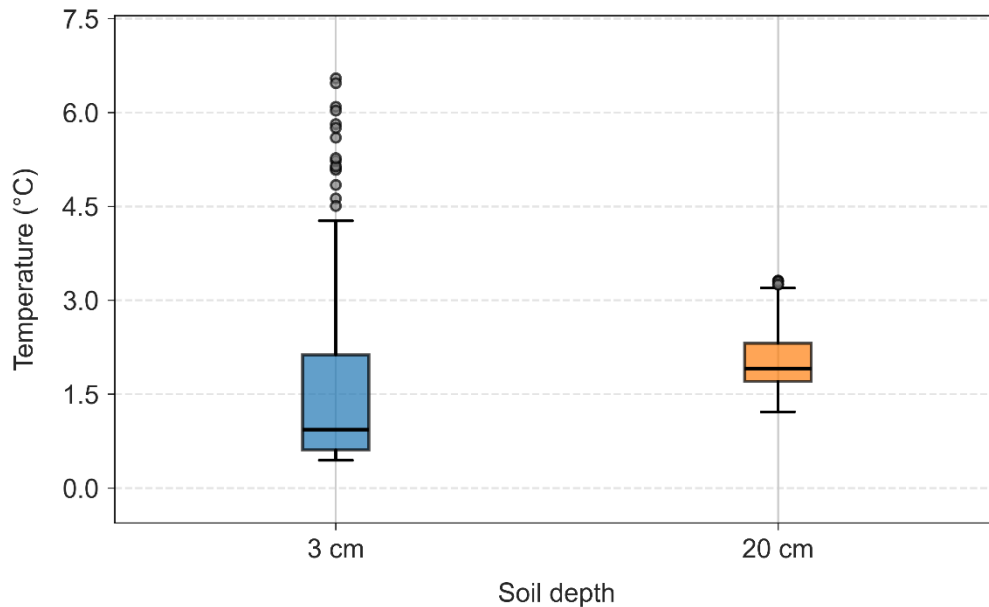


Figure 12. Ground temperature distributions at 3 cm and 20 cm depths.

6. References

- [1] BBS, “Landslide claims ten lives, Laya.” Accessed: Oct. 28, 2025. [Online]. Available: <https://www.bbs.bt/151711/>
- [2] Kuensel, “NCHM Launches Study to Assess the Presence of Permafrost in Bhutan.” Accessed: Oct. 28, 2025. [Online]. Available: <https://lib.icimod.org/records/dzbzn-jb142>
- [3] Y. Ran *et al.*, “New high-resolution estimates of the permafrost thermal state and hydrothermal conditions over the Northern Hemisphere,” *Earth System Science Data*, vol. 14, no. 2, pp. 865–884, 2022, doi: 10.5194/essd-14-865-2022.
- [4] K. Y. Kim, R. Haagensohn, P. Kansara, H. Rajaram, and V. Lakshmi, “Augmenting daily MODIS LST with AIRS surface temperature retrievals to estimate ground temperature and permafrost extent in High Mountain Asia,” *Remote Sensing of Environment*, vol. 305, p. 114075, 2024, doi: <https://doi.org/10.1016/j.rse.2024.114075>.
- [5] S. Gruber, “Derivation and analysis of a high-resolution estimate of global permafrost zonation,” *The Cryosphere*, vol. 6, no. 1, pp. 221–233, 2012.
- [6] J. Obu *et al.*, “Northern Hemisphere permafrost map based on TTOP modelling for 2000–2016 at 1 km² scale,” *Earth-Science Reviews*, vol. 193, pp. 299–316, Jun. 2019, doi: 10.1016/j.earscirev.2019.04.023.

Annex

Data Collection Form for GeoPrecision Logger

Form No: 1

Name: Dago Retty

Affiliation: ICIMOD

Date: 14/10 /2025

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-HPP1-25-10-14 BT-RD-HPP2-25-10-14	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551EF (20 cm) A551EB (3 cm)	
4	Access code	FF1D 3C1C	
5	Latitude	27.96529	DD
6	Longitude	89.57987	DD
7	Elevation	4793	m
8	Launch date & time	Date: 14/10 /2025 Time: 16:07 Time: 16:09	Local
9	Data recording date & time	Date: 14/10 /2025 Time: 09:07 Time: 09:09	UTC
10	Aspect	North	
11	Slope	10	degrees
12	Sensor depth	20 3	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	- At the time of installation, there are snow patches, and shrubs. - The soil is moist, and mineral type. - Sensor is towards the east with at a distance of 9.1m from the marker. - Photo taken towards the marker facing in west direction. - During configuration, the time deviation was 0 sec for both the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 2****Name : Arun Puri****Affiliation : NCHM****Date : 14/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-HPP3-25-10-14	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F9	
4	Access code	319C	
5	Latitude	27.96373	DD
6	Longitude	89.57948	DD
7	Elevation	4825	m
8	Launch date & time	Date:14/10 /2025 Time: 16:41	Local
9	Data recording date & time	Date: 14/10 /2025 Time: 10:40	UTC
10	Aspect	North	
11	Slope	0	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• At the time of installation, there are snow patches, shrubs, surrounded by boulders. The soil is moist, and mineral type. • In terms of microtopography it is almost south. • Sensor is towards the east with at a distance of 2.74m from the marker. • During configuration, the time deviation was -1sec. • Photo is taken, towards North direction.	



Data Collection Form for GeoPrecision Logger**Form No: 3****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-MPP1-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F6	
4	Access code	35DC	
5	Latitude	27.95813	DD
6	Longitude	89.59613	DD
7	Elevation	4628	m
8	Launch date & time	Date: 15/10 /2025 Time: 09:39	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 03:39	UTC
10	Aspect	North-West	
11	Slope	15	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• At the time of installation, there are no snow patches, but the sensor is surrounded by shrubs. The soil is moist, and mineral type. • Sensor is towards the North-West at a distance of 10m from the marker. • During configuration, the time deviation was -2sec. • Photo was taken, towards south-west direction.	



Data Collection Form for GeoPrecision Logger**Form No: 4****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-HPP4-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551E8	
4	Access code	3D5C	
5	Latitude	27.95896	DD
6	Longitude	89.59880	DD
7	Elevation	4687	m
8	Launch date & time	Date: 15/10 /2025 Time: 10:42	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 04:42	UTC
10	Aspect	North-West	
11	Slope	5	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• At the time of installation, there are little snow patches, but the sensor is surrounded by scattered boulders and it is placed at rock–soil interface. The soil is moderately dry. • Sensor is towards North at a distance of 2.1m from the marker. • During configuration, the time deviation was -1sec. • Photo was taken, towards North direction.	



Data Collection Form for GeoPrecision Logger**Form No: 5****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-MPP2-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551EC	
4	Access code	FE5D	
5	Latitude	27.96043	DD
6	Longitude	89.59933	DD
7	Elevation	4692	m
8	Launch date & time	Date: 15/10 /2025 Time: 11:15	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 05:15	UTC
10	Aspect	South	
11	Slope	10	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• At the time of installation, there are no snow patches, but the sensor is placed at well-drained, coarse-textured soil combined with coarse aggregates and surrounded by scattered surface boulders. • Sensor is towards south at a distance of 7.1m from the marker. • During configuration, the time deviation was -1sec. • Photo was taken, towards North direction of the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 6****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP1-25-10-15 BT-RD-LPP2-25-10-15 BT-RD-LPP3-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F0 (50 cm) A551F8 (20 cm) A551ED (3 cm)	
4	Access code	375C F15D 3E9C	
5	Latitude	27.96136	DD
6	Longitude	89.59544	DD
7	Elevation	4700	m
8	Launch date & time	Date: 15/10 /2025 Time: 12:40 Time: 12:45 Time: 12:48	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 06:15 Time: 06:45 Time: 06:48	UTC
10	Aspect	South-West	
11	Slope	50	degrees
12	Sensor depth	50 20 3	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• At the time of installation, sensor is placed at well-drained, coarse-textured mineral soil and surrounded by shrubs. • Sensor is towards south-west from the marker. • The sensor was installed approximately 40 m to the left of the 2021 landslide scarp, when viewed from the downslope direction. • During configuration, the time deviation was -1sec for all the three sensors. • Photo was taken, towards South-west direction of the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 7****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP4-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F5	
4	Access code	349C	
5	Latitude	27.96334	DD
6	Longitude	89.59619	DD
7	Elevation	4752	m
8	Launch date & time	Date: 15/10 /2025 Time: 13:34	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 07:34	UTC
10	Aspect	East	
11	Slope	30	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor is sited in shrub–boulder terrain at the boundary between a boulder field and a soil-dominated surface. • Boulders are prominent and occur as compacted clusters on one side; the opposite side is mineral soil supporting low shrubs and mosses. • Sensor is placed towards south-west at a distance of 1.37m from the marker. • During configuration, the time deviation was -2sec. • Photo was taken, towards South-west direction of the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 8****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-HPP5-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F4	
4	Access code	F45D	
5	Latitude	27.96567	DD
6	Longitude	89.60030	DD
7	Elevation	4863	m
8	Launch date & time	Date: 15/10 /2025 Time: 14:34	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 08:34	UTC
10	Aspect	North-West	
11	Slope	25	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor was installed within a rock- and boulder-dominated surface under seasonal snow cover. • At installation, the housing was backfilled with coarse gravel and partially covered by snow. No fine-earth (soil) matrix is present. • Sensor is placed towards south-west at a distance of 3.49m from the marker. • During configuration, the time deviation was -1sec. • Photo was taken, towards South-west direction of the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 9****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP5-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551E9	
4	Access code	FD9D	
5	Latitude	27.96562	DD
6	Longitude	89.59522	DD
7	Elevation	4845	m
8	Launch date & time	Date: 15/10 /2025 Time: 15:34	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 09:34	UTC
10	Aspect	South	
11	Slope	70	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• At the time of installation, there are no snow patches, but the sensor is surrounded by shrubs and it is soil dominated. The soil is moist, and mineral type. • Sensor is placed towards south at a distance of 1.34m from the marker. • During configuration, the time deviation was -1sec. • Photo was taken, towards north-west direction from the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 10****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP6-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551EA	
4	Access code	FCDD	
5	Latitude	27.96715	DD
6	Longitude	89.59207	DD
7	Elevation	4925	m
8	Launch date & time	Date: 15/10 /2025 Time: 16:14	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 10:14	UTC
10	Aspect	South-West	
11	Slope	30	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor is installed on a mixed substrate co-dominated by boulders and moist mineral soil, positioned at the soil–boulder boundary near the site marker. • Sensor is placed towards south at a distance of 56cm from the marker. • During configuration, the time deviation was -1sec. • Photo was taken, towards west direction at a distance of 56 cm from the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 11****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP7-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F3	
4	Access code	361C	
5	Latitude	27.96720	DD
6	Longitude	89.58867	DD
7	Elevation	4932	m
8	Launch date & time	Date: 15/10 /2025 Time: 16:50	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 10:50	UTC
10	Aspect	West	
11	Slope	20	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor is installed on a mixed substrate co-dominated by boulders, moist mineral soil, and gravel. • Sensor is placed towards west at a distance of 1.35m from the marker. • During configuration, the time deviation was -1 sec. • Photo was taken, towards west direction from the sensor.	



Data Collection Form for GeoPrecision Logger**Form No: 12****Name : Arun Puri****Affiliation : NCHM****Date : 15/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP8-25-10-15	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F7	
4	Access code	F51D	
5	Latitude	27.96452	DD
6	Longitude	89.58661	DD
7	Elevation	4911	m
8	Launch date & time	Date: 15/10 /2025 Time: 17:21	Local
9	Data recording date & time	Date: 15/10 /2025 Time: 11:21	UTC
10	Aspect	South-West	
11	Slope	20	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor was installed within a boulder-dominated area; it is seated in moist mineral soil and buried beneath coarse rock/gravel. • Sensor is placed towards south-west at a distance of 1.5m from the marker. • During configuration, the time deviation was 0 sec. • Photo was taken, towards north-east direction of the marker.	



Data Collection Form for GeoPrecision Logger**Form No: 13****Name : Arun Puri****Affiliation : NCHM****Date : 16/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP9-25-10-16	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551FA	
4	Access code	30DC	
5	Latitude	27.95321	DD
6	Longitude	89.58531	DD
7	Elevation	4665	m
8	Launch date & time	Date: 16/10 /2025 Time: 09:49	Local
9	Data recording date & time	Date: 16/10 /2025 Time: 03:49	UTC
10	Aspect	South-West	
11	Slope	40	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [☒] No [☐] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor is sited in mixed rock–soil terrain with grasses only and no snow. It is positioned at the soil–boulder boundary but embedded in moist mineral soil free of rock or gravel inclusions. • Sensor is installed towards south-west at a distance of 1.65m from the marker. • During configuration, the time deviation was -2 sec. • Photo was taken, towards north-east direction of the marker.	



Data Collection Form for GeoPrecision Logger**Form No: 14****Name : Arun Puri****Affiliation : NCHM****Date : 16/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-MPP3-25-10-16	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F1	
4	Access code	F79D	
5	Latitude	27.95581	DD
6	Longitude	89.57556	DD
7	Elevation	4855	m
8	Launch date & time	Date: 16/10 /2025 Time: 11:06	Local
9	Data recording date & time	Date: 16/10 /2025 Time: 05:06	UTC
10	Aspect	South-East	
11	Slope	5	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor is sited in a soil-dominated microsite with low shrub and moss cover, with no snow present at the time of installation. The substrate is moist mineral soil lacking coarse rock or gravel inclusions, providing good probe contact and minimal thermal shading from vegetation. • Sensor is installed towards south-west at a distance of 1.71m from the marker. • During configuration, the time deviation was -1 sec. • Photo was taken, towards south-west direction from the marker.	



Data Collection Form for GeoPrecision Logger**Form No: 15****Name : Arun Puri****Affiliation : NCHM****Date : 16/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP10-25-10-16	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551F2	
4	Access code	F6DD	
5	Latitude	27.95609	DD
6	Longitude	89.58194	DD
7	Elevation	4776	m
8	Launch date & time	Date: 16/10 /2025 Time: 12:12	Local
9	Data recording date & time	Date: 16/10 /2025 Time: 06:12	UTC
10	Aspect	South-West	
11	Slope	40	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Dr. Sonam Wangchuck, ICIMOD	
14	Site description and remark (if any)	• The sensor is sited in a shrub- and moss-covered area with scattered surrounding boulders. • The substrate is moist mineral soil containing coarse aggregates (gravel), ensuring firm seating. • Sensor is installed towards south-west at a distance of 1.2m from the marker. • During configuration, the time deviation was -2 sec. •	



Data Collection Form for GeoPrecision Logger**Form No: 16****Name : Arun Puri****Affiliation : NCHM****Date : 16/10 /2025**

Sl.No	Parameter Name	Descriptions	Unit
1	Sensor name	BT-RD-LPP11-25-10-16	
2	Sensor type	GeoPrecision M-Log5W-FG2	
3	Serial number	A551EE	
4	Access code	3FDC	
5	Latitude	27.95858	DD
6	Longitude	89.58798	DD
7	Elevation	4726	m
8	Launch date & time	Date: 16/10 /2025 Time: 14:25	Local
9	Data recording date & time	Date: 16/10 /2025 Time: 08:25	UTC
10	Aspect	South-West	
11	Slope	30	degrees
12	Sensor depth	20	cm
13	Photographs	Yes [x] No [] Name & Affiliation: Tshewang Jamtsho, NCHM	
14	Site description and remark (if any)	• The sensor is installed within a boulder-only substrate, with no soil or snow present at the site. It is buried 20 cm deep among small gravel and boulder fragments. • Sensor is installed towards south-west at a distance of 1m from the marker. • The photograph was taken in north-west towards the marker. • During configuration, the time deviation was -2 sec.	

