AWS INSTALLATION AT SINTAPHU, LAYA

2023-2024

Cryosphere Services Division

National Center for Hydrology and Meteorology

2024

Table of Contents

List of Figures

1.Introduction

The National Center for Hydrology and Meteorology (NCHM), is an autonomous scientific and technical organization, which plays a pivotal role in generating, analyzing, and providing vital data related to weather, climate, water resources, and the cryosphere. As the nodal agency, the NCHM ensures that these data are accessible for public use, governmental planning, and research.

To collect and efficiently provide accurate and reliable data, the NCHM implements numerous activities aimed at enhancing its monitoring capabilities. Among these activities is the installation and operation of Automatic Weather Stations (AWS), which serve as essential tools in the monitoring and analysis of weather conditions. These AWS units are equipped with sophisticated sensors that measure critical meteorological parameters such as wind speed, wind direction, air temperature, humidity, precipitation, and more. The collected data are automatically logged into NCHM's centralized database, transmitted via 4G SIM modem where they are utilized for various purposes, including real-time weather forecasting and climate trend analysis.

Emphasizing the importance of high-altitude weather data, particularly in studying the cryosphere and its interaction with regional and global climate systems, the Cryosphere Services Division (CSD) has undertaken efforts to enhance data collection at greater elevations. With financial support from the Green Climate Fund (GCF), the division procured and installed advanced AWS systems specifically designed for deployment in high-altitude regions. One notable achievement under this initiative was the installation of an AWS at Sintaphu, Laya, a remote and challenging site, between February 20 and March 12, 2025. This installation marks a significant milestone in NCHM's mission to expand its meteorological network and further its capacity to deliver precise, comprehensive weather and climate information.

2.Objectives:

The primary objective of this fieldwork was to complete the civil works and successfully install an Automatic Weather Station (AWS) with a snow Depth Sensor at the high-altitude site of Sintaphu,Laya. This effort aimed to support long-term meteorological monitoring and contribute to the national cryosphere research.

3.Site Description

The AWS installation site is located at 28.18284°N, 89.82464°E, at an elevation of 4,529 m a.s.l., at the headwater of the Mo Chhu sub-basin.

The journey from the basecamp to the site takes approximately one hour for an average hiker. The route consists of rugged and sloppy terrain, and transportation of supplies to the site must be carried out by laborers from the basecamp.

4.Installation Activities

4.1Foundation

The team began the civil works by marking out and clearing the site, then after the excavations were carried out, the team laid the foundation for fencing posts, door, weighing rain gauge and a 3 meters mast pole, on which sensors, a solar panel and data logger box were mounted. Laying foundation involved earth work excavation, hand packed stone soiling and concreting, as specified in the drawing. Additionally, the team excavated 2 numbers of 1sqm and 1 meter depth earthing.

Technical specifications

- 14 post excavations:0.3mx0.3mx0.4m
- Mast and weighing rain gauge:0.5mx0.5mx0.8m
- Stone soiling:0.1m thickness
- Clear concrete cover:0.2m thickness

- Concrete mix: 1:3:6
- Water to cement ratio:0.5

Figure 1:Left-Earthwork Excavation; Right-Hand-Packed Stone Soiling

Figure 2:Earthing

4.2Concreting Work

After curing the concrete laid for the clear cover, the team hoisted various components and fixed centering, including strutting and propping. The concrete was then transported, poured and cured by directly spraying the water onto the laid concrete. The concreting process involved the use of admixtures to accelerate the setting of the concrete, given the challenges of concrete setting at higher altitudes. The dosage of admixtures was applied according to the instruction provided. Due to the unavailability of raw materials at the site, all necessary transportation, including sand, water, and aggregates, was arranged from the basecamp.

Figure 3:Left side-fixing centering; Right Side-Mixing Concrete

4.3 Fencing

G.I. welded mesh was used for the fencing. Before attaching the welded mesh, the fencing posts and prefabricated door were painted with aluminum paint and thoroughly dried. Subsequently, the G.I. welded mesh was fixed to the fencing posts. Fencing work involved stretching, fixing and cutting G.I welded mesh to the fencing post.

Figure 4:Left Side-Fencing work; Right Side-Applying aluminum paint

4.4 Sensor Wiring and Piping

To ensure the proper arrangement and protection of the sensor wires, high-density polyethylene (HDPE) pipes were laid underground. The wires were layered inside the piping system to shield them from environmental exposure and physical damage.

Figure 5:Left Side-Burying pipe underground; Right Side-Piping the wires

5. Equipment and Sensor Configuration

The AWS system installed at Sintaphu includes several meteorological instruments, each with specific operational purposes and installation guidelines.

5.1 WindObserver/Anemometer 70/75

Figure 6:WindObserver

The WindObserver is a robust unit with immovable Transducer arms, measuring wind speed and direction.

Operation

The WindObserver calculates the time taken for ultrasonic sound pulses to travel between transducers positioned on different axes; North to South and East to West. It compares the time taken for the pulses to travel in both directions on each axis. For instance, if the wind blows from South to North, the sound pulse travels faster from South to North than it does from North to South. Based on the time differences in pulse travel across the axes, the WindObserver accurately determines both the wind direction and speed.

Installation and Orientation

The WindObserver was mounted vertically with the cable exit at the bottom, placed above all other sensors, ensuring no obstruction in airflow and turbulence. It was aligned to point North, using the North Spar, which is marked with a red dot for accurate orientation.

5.2 SHM30 Snow Depth Sensor

Figure 7:Snow depth sensor

The snow depth sensor measures snow depths up to 10 meters with mm precision.

Operation

Snow Depth sensor emits modulated visible laser light and measures distance to an object.

Installation and Orientation

The sensor was mounted facing away from the sun to minimize glare interference. It was tilted and assembled at an angle of 30° away from the mast, pointing towards the ground.

5.3 Relative Humidity and Temperature Sensor RHT175

Figure 8:Relative Humidity and Temperature Sensor

The Relative Humidity and Temperature probe is designed to measure air relative humidity and air temperature, it is an ultralow power consumption microprocessor-controlled probe ideally suited to operate on solar power and battery backups.

Installation and Orientation

The RHT sensor is well protected inside the radiation shield. This shield provides air ventilation and minimizes heating of the sensor from direct solar radiation. It is mounted below the snow depth sensor and positioned 180 degrees apart from the solar radiation sensor, parallel to the WindObserver sensor.

Figure 9:Radiation shield

5.4 Pressure Sensor MSB181

Figure 10:Pressure Sensor

The Pressure sensor provides ±0.3 hPa accuracy pressure reading. This high-level precision makes it highly reliable for meteorological observation and scientific applications. It operates within the temperature range of -40°C to 60°C, making it functional in various weather conditions.

Installation and Orientation

The pressure sensor is sensitive to mounting orientation, due to its operating principle. The sensor's diaphragm has some mass and is affected by gravitational acceleration. To ensure optimal accuracy, the sensor was mounted directing the pressure output downward.

5.5 CMP6 Pyranometer

Figure 11:Solar radiation sensor

The pyranometer measures the total incoming solar radiation (shortwave) on the plane surface within the wavelength of 0.285 to 2.80 micrometers.

This range covers most of the shortwave solar radiation, including:

- Ultraviolet (UV) Radiation: ~0.1 – 0.4 μm
- Visible Light Spectrum: ~0.4 – 0.7 μm
- Near-Infrared (NIR) Radiation: ~0.7 – 2.80 μm

The sensor is based on Thermopile, which responds to the total power absorbed by the black surface coating.

Installation and Orientation

The pyranometer was secured with the bolts to a solid and stable mounting stand. The sensor was leveled using spirit level to ensure proper alignment of the thermopile surface for the accurate measurement of radiation. The instrument was oriented so that the signal lead points toward the nearest pole, minimizing the heating of the electrical connections.

5.6 Total Rain Weighing Sensor 405

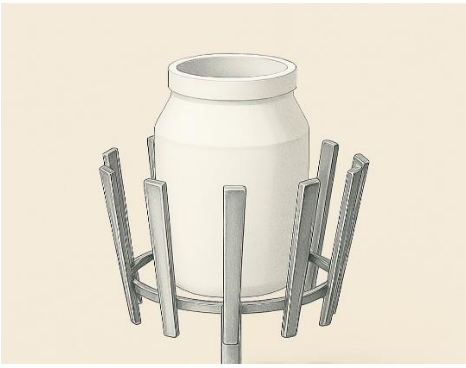


Figure 12:Rain Weighing Sensor

Total Rain weighing Sensor TRWS measures all precipitation within a wide temperature range, harsh wind and snow conditions.

Operation

The rain weighing gauge measures total weight of the precipitation fallen into the bucket and calculates one minute sum of precipitation.

It provides following output

- One minute rain intensity
- Rain indication and duration
- Total Weight

Installation and Orientation

The Total Rain Weighing Sensor was placed 1.5 meters away from any obstacles to prevent rain droplets from such obstructions from entering.

We prepared the base with 3* screw-bold M8 and put TRWS on the base and screwed the nut, followed by aligning the TRWS in horizontal position and tightening the fixing female screws.

5.6 Other Equipment

Lightning Arrestor

The lightning arrestor was mounted at the topmost part of a pole, serving as a crucial protective component for sensors and other equipment. It effectively diverts electrical surges caused by lightning strikes, preventing damages.

Solar Panel

The solar panel was positioned at 30 degrees from the vertical position facing the sky ensuring maximum exposure to the sun. It charges the battery and ensures the continuous supply of power.

Data logger

The data logger collects and stores data from the sensors and transmits to the center database through 4G sim modem (77110529). It also monitors whether a station is operational and transmits data to the center database through verifying communication links between the station and the central database.

Antenna

Antenna plays a crucial role in ensuring reliable communication when using a 4G sim modem. It enhances the signal strength and improves coverage especially at an area where network reception is weak. It ensures continuous and efficient data transmission by facilitating the reception and transmission of data over the cellular networks.

Battery

The battery plays an important role in ensuring reliable power supply to the instrument.

Terminal Board

The terminal board serves as a hub for electrical connections between various sensors, data logger and other equipment. It facilitates data transfer between sensors, data loggers and external communication devices and helps in regulating and distributing the power supply.

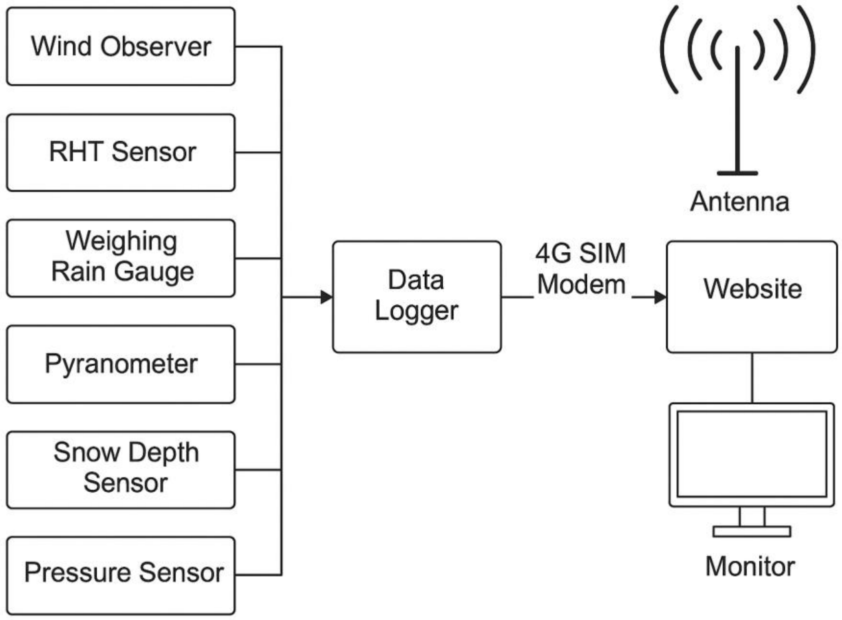
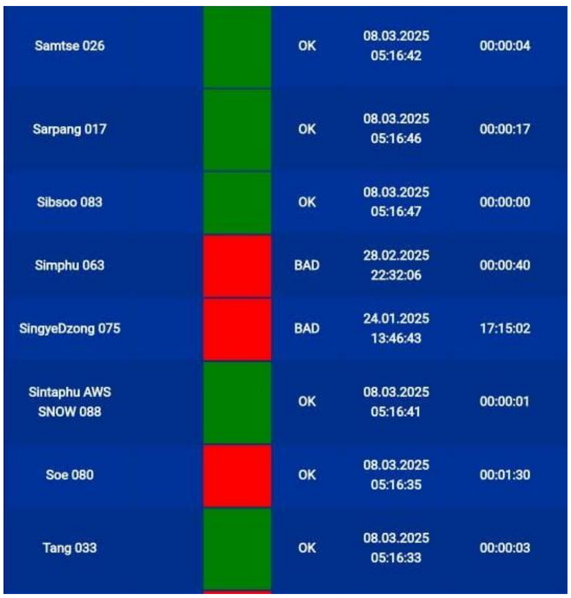


Figure 13:AWS block diagram

6. Testing and Validation

The Sintaphu AWS became operational on 8th March, 2025. Following its activation, the system underwent validation procedures. All sensors were tested for signal output and operational accuracy. Real-time data transmission to the central server was successfully confirmed. Most sensors showed nominal values consistent with field conditions. However, the snow depth sensor displayed a negative bias, likely caused by incorrect initialization of the reference plane during first-time setup. Electrical grounding continuity was checked using a digital multimeter, and the resistance level was verified to be within safety limits using a grounding resistance meter.

Figure 14:Terminal Board



Samtse 026		OK	08.03.2025 05:16:42	00:00:04
Sarpang 017		OK	08.03.2025 05:16:46	00:00:17
Sibsoo 083		OK	08.03.2025 05:16:47	00:00:00
Simphu 063		BAD	28.02.2025 22:32:06	00:00:40
SingyeDzong 075		BAD	24.01.2025 13:46:43	17:15:02
Sintaphu AWS SNOW 088		OK	08.03.2025 05:16:41	00:00:01
Soe 080		OK	08.03.2025 05:16:35	00:01:30
Tang 033		OK	08.03.2025 05:16:33	00:00:03

Figure 15:AWS Updates on database

7.Conclusion and Recommendations

The successful completion of the AWS installation at Sintaphu represents a significant advancement in high-altitude climate monitoring infrastructure. With all sensor operational and communication systems in place, the station is expected to provide reliable data for both scientific and operational purposes except for snow depth sensors giving negative depth.

To maintain optimal and reliable performance, it is recommended to conduct a recalibration visit, particularly for the snow depth sensor.

8.Electrical Circuit Connection

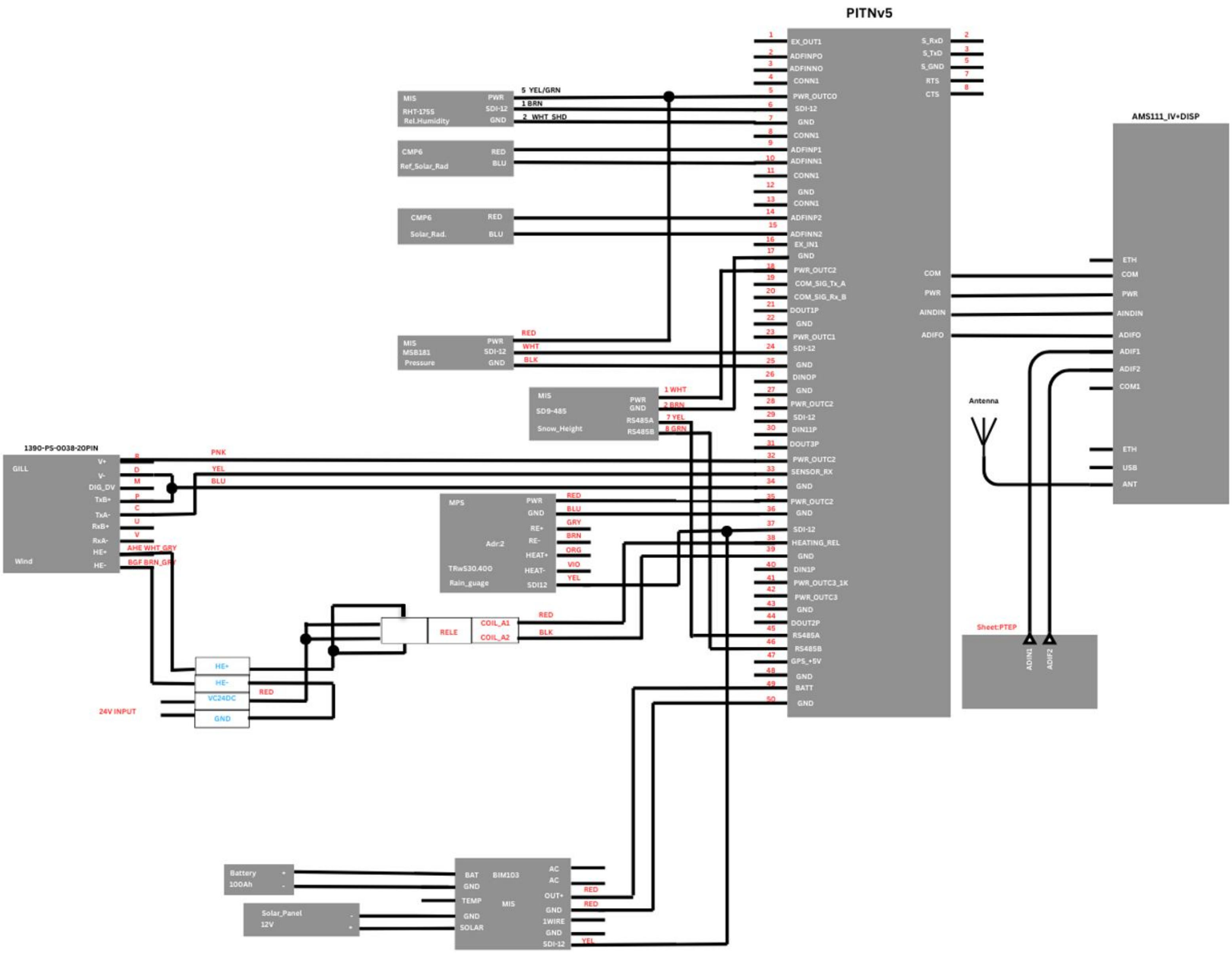


Figure 16:Electrical Circuit Connection