

PERFORMANCE OF PORTABLE AUTOMATIC WEATHER SYSTEM AND ITS SENSOR PACKAGES USED ON THE NARADU GLACIER, HIMALAYAS

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ABSTRACT

The performance of meteorological equipment used to make extensive weather monitoring of cold regions like the Naradu Glacier and others of the Himalayas, during 1993 and 1994 are discussed. The system has remote operation for data acquisition and transmission provided by the battery operated data logger. The systems overall performance is good and is suitable for mountainous areas for monitoring climate and water resources.

1. INTRODUCTION

The Himalayan mountains are difficult but interesting areas of research for climate and water resources conditions, since they possess glaciers and have rugged topography. As such they are unapproachable and inhospitable. A central problem in these regions is lack of reliable and complete data on meteorology. Until recently, weather monitoring in the area has always taken conventional forms using dry bulb and wet bulb, maximum and minimum thermometers, snow and rain gauges etc. Development of automatic weather instruments with sensor packages has been the basis for successful scientific monitoring of hydro-meteorological data in remote areas. One such portable weather system with different packages has been tested on the Himalayan glaciers like the Kidarnath glacier (Sept. 15 to Sept. 23, 1993), Dokriani glacier (Nov. 3 to Nov. 20 1993). The instrument was installed on the Naradu glacier in July, 94 at an altitude of 4,500 meters near the snout and it is working satisfactorily since then. Details of routine operations of the equipment is given in a latter part. Here some of the specialised aspects of performance of sensors and data logger are dealt with.

2. THE RECEIVING SENSOR PACKAGES

The weather system has a package of sensors used to obtain accurate measurements of air temperature, rain-snowfall etc. These packages transmit the input into the data logger. The following packages are provided in the system:

1. Wind speed and wind direction sensor.
2. Relative humidity-temperature sensor.
3. Rain and snow gauge sensor.
4. Pyranometer.
5. Soil/rock temperature probe.
6. Solar panel
7. Batteries 6, 9, and 12 volts.
8. Data logger Model DT-50

2.1 Combined Wind Speed and Wind Direction Sensor

This unit is manufactured from epoxy coated stainless steel and is capable of measuring wind speeds upto 200mph. The output is 0-10 V, over the entire range is 0 to 200 and 0 to 360 for wind speed and wind direction respectively.

2.2 Air Temperature Sensor

This unit employs a PT100 platinum RTD that is installed in a $\frac{7}{8}$ inch OD tube that is attached to a weather proof enclosure. It is intended for installation in the harshest environment for use with a radiation shield for optimum protection from solar radiation and winds. The output of this unit is 0-20 mA, temperature range -58°F to -150°C .

2.3 Solar Pyranometer

It is a silicon photodiode sensor mounted in a weather proof anodized aluminum case with acrylic defuser. This unit covers the special range of radiation 400-1100 millimicrons. This unit has mv output.

2.4 Propane Heated Snow Gauge

The propane heated snow gauge is used to obtain accurate measurements of snowfall in remote areas (Fig. 1). The system is fully automatic and is designed to provide trouble free operation throughout

the entire winter. This instrument consists of a standard 12" diameter snow gauge which has been modified with the addition of platinum chamber directly beneath the sensor and a heat riser which connects the catalytic heater to the sensor interior, thus directing heat only to the gauge nozzle area and maintaining a moderate temperature inside the gauge. The catalytic heater is located in a heater enclosure directly below the gauge. The temperature range to -20°C .

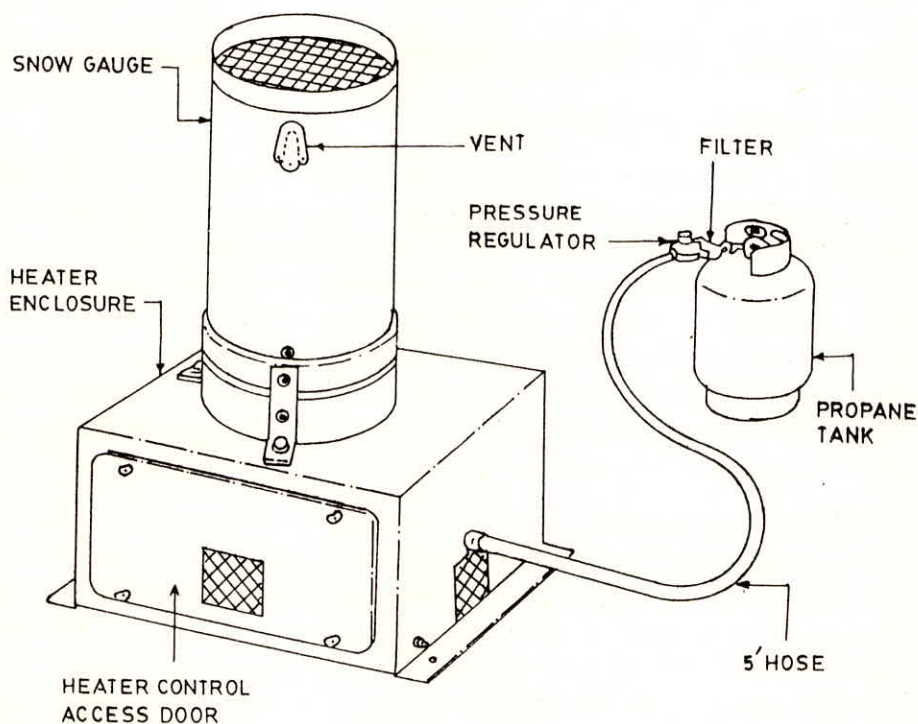


Fig. 1 Propane Heated Snow Gauge

2.5 Rain Gauge

The rain gauge consists of a standard 8" diameter cylindrical gauge. It is fully automatic and is heated internally by a 12v battery. There is a filament inside the rain gauge cylinder to provide the necessary heat to the instrument.

2.6 Solar Panel Package

This package is designed for the aforementioned sensor to provide continuous power with less than three hours of full sunshine per day

without draining the battery below 80 percent of charge. This unit contains 6, 9, 12 volt batteries and a solar panel of 12v at 30 Watt.

2.7 Gel Cell battery

It is a 12 volt dc., 72 amp per hour rechargeable gelcell battery. It is intended to be used with solar panels to provide constant and reliable power for remote meteorological observations. It has a low self discharge rate, operating at -70°F to 122°F and has a weight 54 lb.

3. THE TRANSMITTING SENSOR PACKAGE

3.1 Data Logger Model DT 50

Data Taker 50 is a microprocessor based battery powered data logger which measures inputs from most sensor types. Data manipulation includes statistical functions including calculations and sensor calibration. The unit has 10 single channels and is battery powered with an internal memory capacity of 11,000 readings expandable to 1,70,000 readings by the use of a credit card size memory card. It has resolution of one second and two seconds per day. The reliable operation from -70°F to 150°F is assured. The unit has 16 bit resolution and a sampling rate upto 25 samples per second.

The data logger is covered with a waterproof jacket, connected with the above sensors and is housed in an environmentally rugged weather proof enclosure along with the batteries. The functioning of the data logger has been found to be satisfactory. Initially a few problems arising from the flow of current and looping by conducting material used in the instrument lead to linearisation errors. The problem was overcome by recharging the battery to 12 volts followed by the recharging automatically by the solar panel. By this mode the power supply to the whole unit could last for six months as observed in the field. In order to minimise battery consumption the sleep mode in the data logger should be activated.

In the light of first hand experience of AWS the following recommendations are made:

1. The instrument should be permanently installed at desired sites on suitable platforms for better and purposeful functioning of the instrument. Frequent movement of the instrument causes technical snags in the circuitry of the instrument.

2. Proper setting (alignment) of the solar panel assures dependable voltage to the equipment as well as providing regular recharging for the 12 volt battery system in the field where normal power supplies are not available. This also ensures regular power supply to the instrument for about six months at a stretch.

Date 11/03/1993
 Time 11 : 30 : 00
 Wind Speed 0 MPH
 Wind Direction 0 degrees
 Air Temperature 9999.9°C
 Rel. Humidity 9999.9%
 Solar Radiation 0 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 12 : 00 : 00
 Wind Speed 2 MPH
 Wind Direction 223 degrees
 Air Temperature 6.0°C
 Rel. Humidity 62%
 Solar Radiation 133 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 12 : 30 : 00
 Wind Speed 0 MPH
 Wind Direction 301 degrees
 Air Temperature 6.3°C
 Rel. Humidity 63%
 Solar Radiation 188 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 13 : 00 : 00
 Wind Speed 5 MPH
 Wind Direction 271 degrees
 Air Temperature 6.4°C
 Rel. Humidity 74%
 Solar Radiation 112 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00

Date 11/03/1993
 Time 13 : 30 : 00
 Wind Speed 2 MPH
 Wind Direction 255 degrees
 Air Temperature 6.4°C
 Rel. Humidity 62%
 Solar Radiation 112 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 14 : 00 : 00
 Wind Speed 4 MPH
 Wind Direction 267 degrees
 Air Temperature 6.0°C
 Rel. Humidity 66%
 Solar Radiation 70 W/m
 Inter. Radiation 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 14 : 30 : 00
 Wind Speed 1 MPH
 Wind Direction 276 degrees
 Air Temperature 5.5°C
 Rel. Humidity 62%
 Solar Radiation 67 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00

Date 11/03/1993
 Time 15 : 00 : 00
 Wind Speed 7 MPH
 Wind Direction 212 degrees
 Air Temperature 4.6°C
 Rel. Humidity 66%
 Solar Radiation 54 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 15 : 30 : 00
 Wind Speed 10 MPH
 Wind Direction 277 degrees
 Air Temperature 4.5°C
 Rel. Humidity 62%
 Solar Radiation 69 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 16 : 00 : 00
 Wind Speed 8 MPH
 Wind Direction 285 degrees
 Air Temperature 5.7°C
 Rel. Humidity 60%
 Solar Radiation 52 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 16 : 30 : 00
 Wind Speed 4 MPH
 Wind Direction 295 degrees
 Air Temperature 4.7°C
 Rel. Humidity 63%
 Solar Radiation 24 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 17 : 00 : 00
 Wind Speed 3 MPH
 Wind Direction 223 degrees
 Air Temperature 3.7°C
 Rel. Humidity 62%
 Solar Radiation 23 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 17 : 30 : 00
 Wind Speed 6 MPH
 Wind Direction 284 degrees
 Air Temperature 3.5°C
 Rel. Humidity 61%
 Solar Radiation 20 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 18 : 00 : 00
 Wind Speed 3 MPH
 Wind Direction 274 degrees
 Air Temperature 2.8°C
 Rel. Humidity 61%
 Solar Radiation 12 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches

Date 11/03/1993
 Time 18 : 30 : 00
 Wind Speed 5 MPH
 Wind Direction 271 degrees
 Air Temperature 2.2°C
 Rel. Humidity 61%
 Solar Radiation 8 W/m
 Inter. Rainfall 0.00 inches
 Inter. Rain/Snow 0.00 inches
 Accum. Rainfall 0.00 inches