

A Campbell meteorological station will be installed at the main field site. A representative schematic is shown below.



The tripod can be extended up to 6 feet in height. The legs are individually adjustable and the base diameter can be extended up to 6 feet. No digging into the ground is required as the tripod rests on the ground surface and can be held in place using rocks set upon the tripod feet.

Instrumentation on the Campbell station will include the following:

1. Campbell 107 temperature probes. The probe uses a thermistor to measure temperatures from  $-35^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  with a relatively small margin of error ( $\leq \pm 0.2^{\circ}\text{C}$  to  $60^{\circ}\text{C}$  and  $\leq \pm 0.4^{\circ}\text{C}$  down to  $-35^{\circ}\text{C}$ ). The 107 probes will be used to measure ambient air temperatures.
2. SR50 Sonic Ranging Sensor. This sensor measures the distance to a target by emitting a 50 kHz ultrasonic pulse and measuring the time until the pulse is echoed back to the sensor. We will use the SR50 sensor to measure snowdepth so that we can monitor the thickness of the snowpack on the ground. The SR50 has a measurement range of 0.5-10 meters and is accurate to  $\pm 1$  cm or 0.4% of the distance to the target, whichever is greatest.
3. R.M. Young Wind Monitor. This wind monitor measures wind speed and direction. The wind monitor can measure windspeeds ranging from 0 to 60 m/s (130 mph). These measurements are necessary to characterize the atmospheric conditions above the snowpack.
4. LI200X Pyranometer. This pyranometer measures incident solar radiation using a silicon photovoltaic detector. The LI200X operates over a wavelength range of  $\sim 400$ -700 nm. We will place one LI200X on our meteorological station to measure incoming solar radiation and will also place sensors along a transect within the snowpack to measure the amount of radiation that is transmitted through the snow at depth.
5. Hobo Pro dataloggers will measure relative humidity as well as air temperature at the field site. The relative humidity measurement is necessary for characterizing

the atmosphere-snow boundary layer and the air temperature measurement is for redundancy with the Campbell 107 temperature measurement.

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In addition to the Campbell meteorological station, we will also use several sensors to monitor conditions within the snowpack. These small dataloggers will be mounted on a PVC pole which is a maximum of 5 feet in height. The pole will be stabilized using a tripod and again, no digging into the ground is required.

1. Hobo TidBit dataloggers will measure temperatures along a transect through the snowpack to determine the thermal profile of the snow deposit. The Hobo Tidbit dataloggers are waterproof and operate from -20°C to +50°C.

#### HOBO TidBit Logger

The Hobo Stowaway TidBit Logger monitors temperature for up to five years. The Hobo Stowaway TidBit is battery operated and uses optic communications for launch and data readout. The logger is completely encased in epoxy and thus can be used underwater.

*Size/Weight:* 1.2" x 1.6" x 0.65" / 0.8 oz



2. Hobo Pendant dataloggers will be used to monitor both temperature and light within the snowpack at depth. The logger is battery operated and is waterproof.

*Size/Weight:* 2.3" x 1.3" x 0.9" / 0.6 oz



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An autonomous digital camera may also be installed at sites within the Park which would allow for visual monitoring of the site even when no humans are present. This camera can either be mounted to the meteorological station tripod or secured to a tree overlooking the site of interest.

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A snow lysimeter may be installed at the main field site to measure the amount of snowmelt. This consists of two 1m x 1m polyethylene pans with 0.25m sidewalls which rest on the ground surface. The meltwater is collected in four equally spaced drains in the bottom of the pan; 5cm PVC pipe carries the flow via gravity to a tipping bucket gauge (mounted on the meteorological station tripod) to record the data with the Campbell datalogger. All instrumentation rests on the surface of the ground and no subsurface digging is required.