

Quelccaya AWS – metadata for Air Temperature (CRN-compatible shield)

Location: Quelccaya Ice Cap summit (5,680 m), Cordillera Vilcanota of southern Perú, at 13.9°S and 70.8°W

Tower: interconnected aluminum tubing arranged in an equilateral triangular array, extending into the glacier and supplemented annually to accommodate accumulation. Cabling between tubes allows annual adjustment to keep tower plumb (vertical). Horizontal tower members are spaced approximately 1.5 m apart. See image below.

Radiation Shield: Met One, Inc. model 076B, compatible with that used by NOAA CRN (U.S. Climate Reference Network). Complete specifications and performance information can be found on the CRN and Met One websites (<http://www.ncdc.noaa.gov/crn/> and <http://www.metone.com>). Housed within the shield are two 12-volt DC-powered fans (Papst 4212) to aspirate the air temperature sensor; only one fan is active at any point in time, under datalogger control. To verify proper rotational speed of the fan, the datalogger records average speed each hour. Typically the fan moves $\sim 100 \text{ ft}^3/\text{min}$ through the shield.

Temperature Sensors: Housed within the radiation shield are Platinum Resistance Thermometers (PRTs) made by Thermometrics Corporation. As with the shield, these are also USCRN compatible. The manufacturer's stated repeatability and stability are better than $\pm 0.01^\circ\text{C}$ per year, with an accuracy of $\pm 0.04\%$ over the full specified range or -60° to $+300^\circ\text{C}$ (yet Quelccaya range is only $+2$ to -12°C). Four PRTs were calibrated and installed within the shield in June 2007, operating until May 2010. These were replaced by 3 new, calibrated PRTs in May 2010, along with a fourth PRT of a different design. The original 4 probes were recalibrated in July 2010. Temperature at the station is also measured by two other systems, and an intercomparison is underway.

Measurement Height: All air temperature measurements – with the various sensors – are made at the same height above the glacier surface. However, this height varies seasonally due to snow accumulation and ablation at the site, as tracked by two ultrasonic sensors mounted on horizontal arms extending from the tower. As annual accumulation of >4 m has been observed, the height must be adequate to insure that the sensors are not buried. For the ~ 3 year period of record, mean measurement height was 3.64 m, with a minimum and maximum of 2.44 and 4.87 m, respectively. In general, measurement height slowly increases from May or June through October, and then decreases during the wet season. Annual raising of the tower typically occurs in June, and results in an abrupt, ~ 1.5 m increase in measurement height. A preliminary investigation indicates that this increase has minimal impact on air temperature measurement, likely because the temperature gradient at this location is not pronounced higher than ~ 2.5 m above the snow. Wind speed at the station averages ~ 4 m/s.

Period of Record: Air temperature measurements are currently available for the interval 1 July 2007 through 31 May 2010, as hourly or monthly means. Without telemetry, data are only collected when the station is visited.

Measurement Processing: Under datalogger control, the measurement interval is 10 seconds. Values are averaged and recorded for each sensor every 5 minutes. The hourly means currently available are the result of averaging the 5-minute mean for each sensor, and then averaging these values. Prior to these computations, each 5-minute series was inspected graphically, as were differences between each possible pair of 5-minute means.

Figure. Quelccaya Ice Cap automated weather station at ~15:00 local time on 4 June 2010. Air temperatures are measured in the white shield, here highlighted by within the red oval. The lower shielding disk is 51 cm in diameter. Measurement height at the time was ~4.5 m. This view is looking approximately to the northeast.

