SBC LTER Precipitation Measurement Protocol

General Notes

The SBC LTER has installed 8 precipitation gauges and plans to install 7 additional gauges with the purpose of collecting precipitation data at high temporal resolution. These data supplement precipitation data obtained from the National Climatic Data Center, Santa Barbara County Public Works Department, and the Ventura County Flood Control. The precipitation data are required to model the discharge of water, associated solutes and sediments from land to ocean.

Precipitation Measurement

Precipitation is measured using two types of tipping bucket rain gauges. The Qualimetrics model 6011B Tipping Bucket Rain Gauge has an 8 inch diameter orifice, a sensitivity and resolution of 0.1mm, and an accuracy of 0.5% at a rainfall rate of 0.5 inches/hour: <http://www.allweatherinc.com/html/precipitation.html>. The Sutron model 5600-0425-2 Stainless Steel Tipping Bucket Rain Gauge has a 7.87 inch diameter orifice, a sensitivity and resolution of 0.2mm, and an accuracy of 2% at a rainfall rate of 2 inches/hour: <http://www.sutron.com/products/sensors/rainfall/5600-0425.htm>. Wind induced error causes 2-10% losses of precipitation catch for rain (Sevruk et al., 1994).

Gauge locations were determined based on the need for precipitation data in watersheds with insufficient rain gauge coverage, ground elevation and site accessibility. Guidelines from the *Guide to Meteorological Instruments and Methods of Observation* (World Meteorological Organization, 1996) and the *Federal Standard for Siting Meteorological Sensors at Airports* (OFCM, 1994) were used for selecting the gauge locations. Surrounding objects and vegetation are no closer to the gauge than a distance equal to two times their height above the gauge orifice. The gauges are mounted on a horizontal steel plate welded to a steel pole. The pole was placed in a 1 m deep hole that was then filled with concrete. The height of the gauge orifice is generally 1 to 1.3 m (National Weather Service, 2000), but, in some cases, it is 2 m to protect the gauge from wildlife. Wind shields were not used due the fact that the SBC LTER study area receives no significant precipitation as snow (OFCM, 1994). Not using an Alter wind shield increases the undercatch during typical rainfall by 1% (Duchon et al, 2001).

Every few months during the rainy season (October to April), the tipping bucket rain gauges are visually inspected for damage, cleaned of debris and re-leveled if necessary. The gauges are field calibrated once a year before the beginning of the rainy season. If the gauge does not meet manufacturer specifications, it is returned to the lab for further calibration and repair.

Data Loggers

Two types of data loggers are used to record tips from the tipping bucket rain gauges. For sites with easy access, HOBO Event Loggers are used: <http://www.onsetcomp.com/Products/Product_Pages/HOBO_Event/1855_HEvent.html>. The Event Logger records the time for every tip. The data are then be downloaded in the field using a laptop computer.

For remote sites, the gauges are installed with Intermountain Environmental, Inc.'s CR205 spread spectrum radio with an integrated mini-logger: <http://www.inmtn.com/commremote2.htm#rftelemtry>. The data logger is programmed to record

the number of tips that occurred in the preceding minute. The system includes a battery recharged by a solar panel and an antennae which allows data to be retrieved remotely from another spread spectrum radio connected to a laptop computer.
Data from both types of loggers are post-processed to give mm of precipitation per 5 minute interval.

Precipitation Chemistry
Precipitation samples are collected at three sites for Ionic Nutrient Analyses and Conductivity. The samples are collected with a 10 inch diameter high-density polyethylene (HDPE) funnel directed into a 2L HDPE bottle. Both the funnel and bottle are rinsed three times with deionized water prior to collection. All collectors are accompanied by a 4 inch diameter Tenite graduated rain gauge which measures rain fall event totals up to 11 inchces.

References

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Sevruk, B. and Zahlavova, L., 1994. Classification system of precipitation gauge site exposure: evaluation and application, *International Journal of Climatology*, 14:681-689.

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