SENSOR DEPLOYMENT AND SITING REQUIREMENTS: CRN STATIONS

Adapted from: *U. S. Climate Reference Network Site Information Handbook*

A publication of the National Oceanic and Atmospheric Administration (NOAA) and National Climatic Data Center (NCDC)

Revision January 2003

Original Document Available at
ftp://ftp.ncdc.noaa.gov/pub/data/uscrn/site_info/CRNSiteInfobook.pdf

Sensor Deployment Requirements

All sensors are placed on an instrument tower at 1.5 meters (4.5 ft.) above the surface of the ground.

Three temperature sensors each are enclosed in aspirated solar radiation shields: a cup anemometer (wind speed), a pyranometer (solar energy), and an infrared (IR) thermometer (ground, skin, surface temperature).

Special considerations will be made for areas with considerable snowfall and snow depth.

General Site Selection Factors

Consider the factors below when exploring and examining the suitability of the general geographic location, as well as the specific instrument site:

- Regionally and Spatially Representative. Stations will be distributed to ensure that all major nodes of regional climate variability are captured while taking into account large-scale regional topographic factors.

- General location sensitive to measuring long term climate variability and trends. The site location is representative of the climate of the region, and is not heavily influenced by unique local topographic and mesoscale/microscale features/factors.

- Reasonably high probability of Long Term Site Stability and surrounding area. Minimize risk of man made encroachments over time and/or the chance the site will close due to the sale of the land or other factors. Stations located on government (federal, state, local) land or at colleges (granted/deeded land with land use restrictions) often provide a higher stability factor. This criterion also includes the need for USCRN deployment and maintenance personnel to have reasonably convenient access to the site. A review of

recent (last ten years) and possible future population growth patterns in the area is a part of the overall evaluation process.

- Avoid high-risk sites: Flood Plains (low areas adjacent to river basins, estuaries, and coastal offshore barrier islands/beaches); Extreme/above average frequency of tornado incidents; Enclosed locations that may “trap” air and create unusually high incidents of fog, cold air advection, etc.; Vicinity of orographically induced winds, such as Santa Ana and Chinook; Complex meteorological zones, such as adjacent to an ocean or other large bodies of water; and persistent periods of extreme snow depths (e.g., several meters/tens of feet). Digital topographic maps and a climatological profile of the area will be examined as part of the overall site evaluation and selection process. When available, aerial photographs are very useful.

- Proximity (within a few tens of kilometers) to an existing or former observing site with a relatively long period of record (decades) of daily maximum and minimum temperature and precipitation is highly desirable. The historical data (metadata) record and observational data from these sites should be of sufficient quality and detail to permit reasonable processing of the data to account for changes with a high degree of confidence (i.e., documented vegetation and terrain changes, changes in the location of the station and/or instruments, type of instruments described, the observation time, the observing practices, etc.).

- Site is located in the vicinity of other similar observing systems, which are operated and maintained by personnel with a knowledge, understanding, and appreciation for the purpose of climate observing systems.

- Avoid endangered species habitats and sensitive historical locations of a sensitive nature.

- AC power source available nearby. However, in some cases solar panels may be an alternative to achieve the use of an otherwise desired location.

- Relatively easy year round access by vehicle for installation and periodic maintenance.

Classification Scheme for Selecting Appropriate Sites

The most desirable local surrounding landscape is a relatively large and flat open area with low local vegetation in order that the sky view is unobstructed in all directions except at the lower angles of altitude above the horizon. The area occupied by an individual instrument site is typically about 18 m x 18 m (~60 ft x ~60 ft). Local environmental and nearby terrain factors have an influence on the "quality of a measurement." The selection of a USCRN instrument site will be the result of a balance between competing demands, such as those highlighted above and an assessment of the “quality of measurements” guidelines outlined below.

There will be many sites that are less than ideal. The USCRN will use the classification scheme below to document the "meteorological measurements representativity" at each site. This scheme, described by Michel Leroy (1998), is being used by Meteo-France to classify their network of approximately 550 stations. The classification ranges from 1 (best) to 5 (worst) for each measured parameter. The errors for the different classes are estimated values.

Temperature/Humidity

Class 1: Flat and horizontal ground surrounded by a clear surface with a slope below 1/3 (<19º). Grass/low vegetation ground cover <10 cm high. Sensors located at least 100 meters (m) from artificial heating or reflecting surfaces, such as buildings, concrete surfaces, and parking lots. Far from large bodies of water, except if it is representative of the area, and then located at least 100 meters away. No shading when the sun elevation >3 degrees.

Class 2: Same as Class 1 with the following differences. Surrounding Vegetation <25 cm. Artificial heating sources within 30m. No shading for a sun elevation >5º.

Class 3 (error 1ºC): Same as Class 2, except no artificial heating sources within 10m.

Class 4 (error >/= 2ºC): Artificial heating sources <10m.

Class 5 (error >/= 5ºC): Temperature sensor located next to/above an artificial heating source, such a building, roof top, parking lot, or concrete surface.

Precipitation

One factor to consider is an area surrounded by uniform obstacles of about the same height. Wind speed is a significant factor that affects the accuracy of measuring liquid and frozen precipitation. Often, a wind shield is placed around the precipitation gauge to improve the accuracy of the "catch." Wind speed (no direction) at USCRN sites is measured at a height of 1.5m, near the height of the gauge orifice.

Class 1: Flat horizontal ground surround by a cleared surface with a slope below 1/3 (<19º). Any obstacle must be located at a distance of at least 4 times the height of the obstacle. An obstacle is an object seen from the precipitation gauge with an angular width of =/>10 degrees.

Class 2 (error 5%): Same as Class 1, except an obstacle is located at a distance of at least 2 times its height.

Class 3 (error 10% to 20%): Ground with a slope below 1/2 (<30º). Any obstacle is located at a distance of at least its height.

Class 4 (error >20%): Ground with a slope >30º. Obstacles located at a distance less than

their height.

Class 5 (error > 50%): Obstacles overhanging the gauge.

Solar Radiation

Class 1: Flat horizontal ground with a slope of the terrain <2º. No obstacles within 100 meters.

Class 2 (error 10%): Slope of the terrain <5º. Obstacles within 100m and an angular height >7º but <10º.

Class 3 (error 15%): Slope of the terrain <7º. Obstacles within 100m and an angular height =/>10º.

Class 4 (error 20%): Obstructions that would obstruct a significant portion of direct radiation.

Class 5 (error 30%): Obstacles overhanging the sensor or near a building.

Wind Speed (note: no direction measurements for CRN)

Defined for wind sensor at a height of 10m. USCRN measures wind speed only (no direction0 at a height of 1.5m.

Class 1: Sensor located at a distance of at least ten (10) times the height of the obstacle (elevation angle <5.7º). Object considered an obstacle if seen at angular width >10º. Obstacle is below 5.5m height within a 150m radius and 7m within a 300m radius. Wind sensor located a minimum distance of 15 times the width of thin nearby obstacles (i.e. mast, tree with angular width <10º). Surrounding terrain relief change </= 5m within a 300m radius.

Class 2 (error 10%): Same as Class 1 except terrain change </= 5m within a 100m radius.

Class 3 (error 20%): Same as Class 1 except no obstacles within five times the height of the nearby obstacles (elevation angle <11.3º). Wind sensor located a minimum distance of 10 times the width of thin nearby obstacles. Terrain change </= 1m within a 10m radius.

Class 4 (error 30%): Same as Class 3 except no obstacles within 2.5 times the height of the nearby obstacles (elevation angle <21.8º).

Class 5 (error >40%): Obstacles within 2.5 times the height of the nearby obstacles.

Class 6 (error >50%): Obstacles with a height >10m, seen with an angular width greater than 60º are within a 20m distance.