

Section 2

Climatic Data

Introduction

The Natural Resources Conservation Service is charged with management of not only soil, but all five SWAPA resources (soil, water, air, plants, animals), and human considerations. SWAPA management requires an understanding of the resources, as well as interactions between resources. Many concerns about the resources can be addressed through climate information and specific climatic data.

Climate is an important factor driving the agriculture of a given region (along with soils, water available for irrigation, societal influences, economics, others). Under many situations, climate is THE determining factor which defines which crops can be grown in an area.

This publication concerning climatic data is oriented to the NRCS role in American agriculture and natural resource conservation. It describes the NRCS National Water & Climate Center (NWCC) and its network of liaisons in each NRCS state office.

Climatic Data Element Descriptions, Measurement Methods

AIR TEMPERATURE - Temperature is a measure of the hotness or coldness of air. It is measured on some definitive temperature scale. Two scales are commonly used. The Fahrenheit and Centigrade temperature scales establish the freezing of water at 32/0 degrees respectively and boiling point at 212/100 degrees respectively. The Fahrenheit scale is used most frequently in the US and Centigrade throughout the rest of the world. Air temperature is usually measured with either a liquid-in-glass maximum and minimum thermometer mounted in a vented, wooden box or with an electronic sensor.

EVAPORATION - Evaporation is the physical process by which a liquid is transformed to a gaseous state. Evaporation is influenced by solar radiation, air temperature, vapor pressure, wind, and possibly atmospheric pressure. Evaporation varies with latitude, altitude, season, time of day, and sky condition. Accurate evaporation readings requires careful maintenance of an evaporation pan which contains water. The water depth is measured daily and adjusted for any precipitation which may occur.

PRECIPITATION - Precipitation refers to all forms of water, liquid or solid, that fall from the atmosphere and reach the ground. Precipitation includes, but is not limited to, rain, drizzle, snow, hail, sleet, and ice crystals. It is one of the most basic data elements collected by any climate station. Dew, frost and rime are excluded, since they are a result of water vapor in air condensing or freezing onto a surface.

The standard U.S. precipitation gage has an eight inch diameter mouth and height of about 30 inches. Non-recording gages simply collect precipitation; amount of precipitation must be measured by an observer. Recording gages have instrumentation which records the time, duration, and intensity of precipitation. Most recording gages store information on a paper strip, which is generally changed weekly by an observer. Precipitation intensity and duration, useful information for many NRCS design activities, can be derived from information gathered by precipitation gages.

The biggest factor in precipitation measurement error is wind. Strong winds during precipitation events can cause considerable differences between measured and actual precipitation. Measurement errors can also result from small amounts of dew, frost, and rime accidentally included in the total measured precipitation. Even with careful placement, all gages underestimate the real precipitation, particularly with snowfall.

NEW SNOW - New snow is the incremental amount of snow that has fallen since the last snow depth observation. Delineating between new snow and old snow presents a challenge. A snow board (generally a sheet of plywood) can provide an artificial surface at the top of the existing snow. Snow boards are laid on top of old snow when there is any possibility of new snow falling. After each observation of new snow, the board is cleaned and placed in a new location. Board placement and measurement location are the greatest source of error in determining new snow.

SNOW DEPTH - Snow depth is the actual depth of snow on the ground at the time of measurement. Snow depth is usually measured daily and determined to the nearest whole inch with a calibrated stick, such as that used with the 8-inch non-recording rain gage, or a ruler or yardstick. Snow should be measured in several locations and averaged to avoid errors induced by drifted snow.

SNOW WATER EQUIVALENT - The water equivalent of snow is the depth of water that would be obtained by melting the snow cover. Water equivalent of snow is continuously measured (weighed) by recording gages which are winterized with an antifreeze solution. For non-recording gages, the snow catch collected by the standard rain gage (with the funnel and small tube removed) is melted by adding a known amount of warm water. The total amount is then measured and the added amount of warm water subtracted to yield the observed water equivalent. Most snow water equivalent measurement errors are associated with not selecting a representative location or the mechanics of subtracting water added to the total catch.

SOIL TEMPERATURE - Soil temperature measures the hotness or coldness of soil. Soil temperature is very important to the agricultural industry. Most seeds require a certain soil temperature in order to germinate. Soil temperatures are commonly measured at 2, 4, 8, 20, 40, 60, and 120 inches with the 4 inch reading being the most frequently observed. Readings are usually observed and recorded daily. Maximum, minimum, and current temperatures are generally recorded above 8 inches. At greater depths, where temperature changes more slowly, only the current temperature is normally recorded. Different species of plants have specific soil temperature ranges in which they will grow.

SOLAR RADIATION - INCOMING - Incoming solar radiation is the total electromagnetic radiation emitted by the sun striking the earth. Much solar radiation is absorbed by air molecules, reflected back into space, or refracted as it passes through the atmosphere. A pyrliometer measures the direct solar radiation that passes through the atmosphere unimpeded. It consists of an enclosed radiation sensing element with a small aperture through which the direct solar rays enter. A pyranometer measures the combined incoming direct solar radiation and diffuse sky radiation. It is mounted such that it views the entire sky. Both instruments can be connected to electronic recording devices to collect the measurements. Solar radiation sensors must be cleaned regularly and exposed properly to accurately measure solar radiation.

WIND - Wind is the motion of air relative to the surface of the earth. Wind speed and direction, the two primary elements, are usually measured with an anemometer and wind vane, respectively. Wind speed is generally measured in miles per hour; direction is measured in degrees to the nearest ten(s) (10 to 360) with 360 degrees being north, 90 degrees being east, 180 degrees representing south, and 270 degrees being west. Wind measurement accuracy is primarily influenced by sensor height and nearby objects.

Climate Station Metadata

Climate Stations are locations at which climatic data are gathered. Biographical and index information describing the climatic station, called "Metadata", are used in conservation applications and resource evaluations.

STATION ID - Identification number for the climate station assigned by the agency responsible for the particular station.

STATION NAME - The full name of the climate station as recognized by the agency responsible for the climate station.

STATION LATITUDE - Latitude defines a site's location based on its relative distance from the equator going toward the North or South poles. Station latitude is measured in degrees, minutes, and seconds, with 0 degrees being on the equator, and 90 degrees north or south being the North and South Poles, respectively. The latitude of a particular climate station is determined by the agency managing the station and is generally recorded to the nearest minute.

STATION LONGITUDE - Longitude defines a sites relative distance, up to 180 degrees, west or east of a North-South line running through Greenwich, England. The longitude of a particular station is determined by the agency managing the station. Measurement is generally made to the nearest minute.

STATION ELEVATION - The elevation of a climate station is usually measured in feet above mean sea level.

Climatic Element

A climatic element is a measured parameter which helps to specify the climate of a specific location or region, such as precipitation, temperature, wind speed and humidity. Descriptive terminology for climatic elements are:

ELEMENT NAME - The full description of the element being referenced at the climate station (i.e. maximum temperature).

ELEMENT ID - Is a shortened identifier for the element, usually 4 characters in length (i.e. TMAX(maximum daily temperature), TMIN(minimum daily temperature), PRCP(precipitation, etc).

ELEMENT DURATION - The interval between measurements of a data element. Common data element durations available for the station could include monthly, daily, or hourly.

Climate Data Measurement Networks

National Weather Service Cooperative Station Network

Cooperative stations generally record daily precipitation and/or maximum and minimum temperature. Several other weather parameters may also be observed, such as evaporation, wind movement, and soil temperature.

Natural Resources Conservation Service (NRCS)

The NRCS operates an automated network of approximately 600 stations in the western U.S. called [SNOTEL](#) (SNOWpack TELemetry). Beginning October 1st these stations report accumulated seasonal precipitation, snow water equivalent, and temperature (maximum, minimum, current and average) daily. This network was established in the late 1970s to support water supply forecasting. It uses meteorburst technology to transmit data from remote sites to data gathering locations. SNOTEL augmented and partially replaced the cooperative network of manual snow courses that NRCS acquired and established the mid 1930s.

National Water & Climate Center/Climatic Data Access Network

The Natural Resources Conservation Service's [National Water & Climate Center](#) was created to provide the climatic data analyses needed by NRCS employees and offices to perform conservation activities. Each state and national center has been assigned a Climatic Data Liaison (CDL) to deliver climatic data to field offices as well as other offices in the state requiring climatic data. These Climatic Data Liaisons make up what is

known as the Climatic Data Access Network (CDAN). CDAN provides a corp of knowledgeable individuals to assist NRCS field offices in the analysis of climatic data.

The mission of NWCC/CDAN is to access, obtain, evaluate, manage, and disseminate the climatic data needed to support agency programs and activities nationally. The Vision of NWCC/CDAN is "A dynamic, agency-wide climate service network -- providing data and analyses required for integrated ecosystem management."

A wide variety of daily, monthly, and annual data are available through NWCC/CDAN, including air and soil temperature, evaporation, wind movement, snow depth, snow water equivalent and precipitation. Climatic interpretations (probabilities and statistical summaries) for temperature and precipitation, growing season and construction information, rainfall frequency, and information for agronomic and engineering models are available through the Network.

Climate Glossary

The following lists terms which provide descriptive information for climatic datasets:

ALBEDO - The ratio of the amount of radiation reflected by a body to the amount of radiation incident upon it; expressed as a percentage.

CLIMATE - the synthesis of weather, or averaging of weather conditions over a given time period.

DEGREE DAYS, COOLING - A value used to estimate the energy requirements for air conditioning of homes and buildings. One cooling degree day is given for each degree the daily mean temperature is above 75 degrees Fahrenheit.

DEGREE DAYS, GROWING - Growing degree days (GDD) measures the day to day accumulation of the difference between the average daily temperature and a threshold temperature for a specific crop. GDD's give an indication of the amount of heat available for crop growth.

DEGREE DAYS, HEATING - A value used to estimate the energy requirements for heating homes and buildings. One heating degree day is given for each degree the daily mean temperature is below 65 degrees Fahrenheit.

DEWPOINT - The temperature to which air is cooled for water vapor to begin condensing.

DRIZZLE - Very small, numerous, and uniformly dispersed water drops that may appear to float while following air currents. Unlike fog droplets, drizzle falls to the ground.

DURATION - the period or time increment to which an observed or computed value applies.

EVAPORATION - Evaporation is the physical process by which a liquid is transformed to a gaseous state.

EVAPOTRANSPIRATION (ET) - The combined processes of evaporation and transpiration.

FOG - A visible collection of minute water droplets suspended in the atmosphere near the earth's surface. Fog reduces visibility below one kilometer (0.62 miles).

FREEZE - A freeze occurs at any time the surface air temperature reaches 28 degrees or less. This temperature causes damage to most vegetation except certain species which are resistant to freezing.

FREEZE FREE PERIOD - Freeze free period is the number of consecutive days where the air temperature does not fall below 28 degrees Fahrenheit.

FREEZE, KILLING - A killing freeze occurs at or below 24 degrees Fahrenheit and causes permanent damage to almost all vegetation.

FROST - Frost is the process of deposition of frozen atmospheric water vapor on surfaces whose surface air temperature is below 32 degrees Fahrenheit. A frost can occur at any time the surface air temperature falls to 32 degrees Fahrenheit or less. This temperature may cause damage to very young vegetation or vegetation that has no resistance to frost. Most fruit falls in this category.

FROST FREE PERIOD - Frost free period is the number of consecutive days where the surface air temperature does not fall below 32 degrees Fahrenheit.

GROWING SEASON - Growing Season is the number of consecutive days where the temperature has not gone below an index temperature for specific vegetation. If vegetation is more resistant to cold temperatures the index temperature would be lower. The index temperatures used in growing season analysis usually include 24, 28, and 32 degrees Fahrenheit.

GROWING SEASON PERIOD - Growing Season Period is the period of time, beginning date and ending date, that defines the period that the temperature has not dropped below the index temperature.

HAIL - Precipitation in the form of balls or irregular lumps of ice with a diameter of 5 mm or more, always produced by convective clouds, nearly always cumulonimbus.

HUMIDITY, RELATIVE - A measure of the amount of water in the air compared to the amount of water vapor the air has the potential to hold. (Note: the potential of air to

hold water changes with air temperature. Therefore, relative humidity can change as air temperature changes without an actual change in the amount of water vapor.)

INDEX TEMPERATURE - A temperature which denotes the beginning of a specific event such as 28 degrees Fahrenheit. The 28 degree temperature denotes a freeze that can damage plants.

NORMAL - "Normal" is an average of any of the climatic elements calculated for a specific time period. The beginning and ending years of the normal period are established by the World Meteorological Organization. This organization has defined the current standard averaging period for "Normals" as 1961 through 1990. Normals have been established as the standard period that will be used in analysis of climatic data to allow for comparable descriptive information representative of average conditions over the time period.

PERIOD OF RECORD - The time interval during which meteorological and climatic data have been gathered at a climatic station.

PRECIPITATION - Precipitation refers to all forms of water, liquid or solid, that fall from the atmosphere and reach the ground. Precipitation includes, but is not limited to, rain, drizzle, snow, hail, grapple, sleet, and ice crystals.

PROBABILITY - Probability is a statistical process that provides for the analysis of data to determine the potential of an individual value to occur at a specified time, in a given year, or in a given period of time. An example might indicate that a certain value has a 10 percent chance of occurrence in any year, or that the value has a chance of returning once in a period of ten years.

RAIN - Precipitation in the form of liquid water drops which have diameters greater than 0.02 in (0.5 mm).

SLEET - A type of precipitation consisting of transparent or translucent pellets of ice 5 mm or less in diameter. Sleet forms when raindrops fall through a layer of below-freezing air near the earth's surface.

SNOW WATER EQUIVALENT - The water equivalent of snow is the depth of water that would be obtained by melting the snow cover.

SOLAR RADIATION - The total amount of energy emitted by the sun.

SOLAR RADIATION, INCOMING - Incoming solar radiation is the total electromagnetic radiation emitted by the sun striking the earth.

TEMPERATURE - Temperature is a measure of the internal energy of molecular motion in a substance.

THRESHOLD TEMPERATURE - A temperature that denotes the boundary condition for a specific event. For example, a crop specific temperature below which the growth of that crop is minimal.

TRANSPIRATION - The process by which water in plants is transferred to the atmosphere as water vapor.

WEATHER - the instantaneous or short-term state of the atmosphere.

WIND - Wind is the motion of air relative to the surface of the earth.
