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Long-term climate database, Reynolds Creek Experimental Watershed, Idaho, United States

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Abstract. A 33 year (1964–1996), climatic database has been developed for three climate stations on the Reynolds Creek Experimental Watershed located near the north end of the Owyhee Mountains in southwest Idaho. The longest records (1964–1996) are for daily maximum and minimum air temperature. The length of record for other weather elements that include hourly air temperature, relative humidity, dew point temperature, vapor pressure, solar radiation, wind speed and direction, barometric pressure, and daily class A pan evaporation varies, but, in general, the record is from 1974–1996. These data can be accessed from the U.S. Department of Agriculture, Agricultural Research Service, Northwest Watershed Research Center database through the anonymous ftp site: ftp.nwrc.ars.usda.gov.

1. Introduction

Weather elements, such as air temperature and solar radiation and their spatial and seasonal variations, are basic to all hydrologic and natural resource studies. The U.S. Department of Agriculture (USDA), Agricultural Research Service, Northwest Watershed Research Center (NWRC) operates a climate network as an integral part of the hydrologic studies on the Reynolds Creek Experimental Watershed (RCEW). The experimental area is a 239 km^2 watershed located in the Owyhee Mountains of southwest Idaho [*Slaughter et al*., this issue].

A 33 year (1964–1996) climatic database has been developed for three climate stations on the RCEW (Table 1). The locations of the three climate stations can be found on Plate 3a of *Slaughter et al*. [this issue]. Climate station locations on the watershed are referenced to a grid as described by *Seyfried et al*. [2000]. The longest records (1964–1996) are for daily maximum and minimum air temperature at station 076x59. Daily maximum and minimum air temperatures are available from 1967 through 1996 for the other two climate stations. The length of record for other climate elements that include hourly air temperature, relative humidity, dew point temperature, vapor pressure, solar radiation, wind speed and direction, barometric pressure, and daily class A pan evaporation varies, but, in general, the record is from 1974 through 1996. For a more detailed discussion of each of these climate elements, see *Hanson et al*. [2000].

2. Reynolds Creek Experimental Watershed Climate Network

2.1. Air Temperature

The NWRC database contains maximum and minimum daily air temperatures that were obtained from Belfort Instrument Company recording hygrothermographs housed in National Weather Service medium-sized weather shelters located at each of the three climate stations. These records were listed by hand from the hygrothermograph charts with each day ending at midnight mountain standard time (MST). The collection of these data started in 1964 at weather station 076x59 as shown in Table 2 and continued through the early 1980s. After the early 1980s, hourly and daily maximum and minimum air temperatures were measured and recorded electronically at the three climate stations by Yellow Springs Instruments, YSI thermal linear networks. Hourly data are the average temperature of the hour prior to the time that the temperature values were recorded.

Prior to the electronic temperature records, missing daily maximum and minimum air temperature values were estimated using regression equations that were developed from temperature records from all available climate stations located on the RCEW. Temperature records from only three of these climate stations are included in this data set. Hygrothermograph data were used to estimate most of the missing electronic records, and regression equations were used when hygrothermograph data were not available. There is no record of which data have been estimated in any of the data sets.

2.2. Relative Humidity, Dew Point Temperature, and Vapor Pressure

Hourly average relative humidity from December 5, 1984, through September 30, 1996, was measured and recorded electronically at 127x07. The sensor was housed in a Gill-type shield mounted 3 m above the ground. At 176x14, hourly relative humidity was measured electronically in an aspirated shield mounted 3 m above the ground from February 24, 1983, through September 30, 1996. Texas Electronics linear voltage differential transducer based relative humidity systems were used at both of these stations until July 1991 when VAISALA HMP 35 units were installed at both sites.

Hourly dew point temperatures at climate station 076x59 are available for June 18, 1981, through September 30, 1996. These data were measured by a Honeywell lithium chloride–treated dew cell with a nickel thermometer that was housed in an aspirated shield mounted 1 m above the ground.

Climate variables, relative humidity, dew point temperature and vapor pressure, are listed as available in Table 2, but, as discussed above, only relative humidity was measured at cli-

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Table 1. Location, Elevation, and Annual Summary of Air Temperature, Wind Speed, and Class A Pan Evaporation of the Three Weather Stations on the Reynolds Creek Experimental Watershed

Weather Station	Location		Elevation		Mean Annual Daily Air Temperature			Mean Wind Speed, m/s	Mean Seasonal Class A Pan Evaporation, mm
	Easting, m	Northing, m	GPS, m	DEM,[a] m	Maximum, °C	Minimum, °C	Average, °C		
076x59	520,367	4,783,418	1207	1202	15.6	2.1	8.9	1.80	1,255
127x07	521,742	4,776,189	1652	1653	12.1	3.7	7.9	3.05	1,082
176x14	519,693	4,767,923	2097	2097	8.8	0.7	4.7	3.81	795

[a]DEM is digital elevation model.

mate stations 127x07 and 176x14, and only dew point temperature was measured at climate station 076x59. The other two weather variables at each station were calculated using the measured data and standard conversion equations [*Marks et al*., 1999]. Missing hourly relative humidity and dew point temperature values were estimated from regression relationships that have been developed between climate stations used in this database and data from other climate stations located on RCEW that are not available in this database.

2.3. Solar Radiation

At each of the climate stations, hemispherical short-wave radiation was measured with Eppley precision spectral pyranometers (model number PSP1) sensitive to wavelengths from 0.285 to 2.8 μm. Hourly solar radiation is available in the database from June 18, 1981, December 14, 1984, and February 24, 1983, through September 30, 1996, for climate stations 076x59, 127x07, and 176x14, respectively. Each of the pyranometers was checked and calibrated by the manufacturer on a routine schedule.

Hourly radiation data were checked for outliers using clear-sky radiation calculated using a version of the Lowtran-7 radiation transfer model [*Kneizys et al*., 1988] that was corrected for solar geometry and terrain effects [*Dubayah*, 1990]. Missing hourly radiation at each site was then estimated using data from either of the other sites that were in operation and the simulated clear-sky value.

2.4. Wind Speed and Direction

Average hourly wind speed in meters per second was recorded at the three climate stations from the mid-1980s through September 30, 1996 (Table 2). Anemometers were mounted 2 and 9.1 m above the ground at climate station 076x59, 2 m above the ground at climate station 127x07, and 3 m above the ground at climate station 176x14. The anemometer was mounted higher at climate station 176x14 so that it was approximately 2 m above the snowpack during the winter months.

Various kinds of three-cup, switch-closure-type anemometers were used at climate stations 127x07 and 176x14 and at the 2 m above ground anemometer at 076x59. The anemometer used depended on what equipment was available and the type of recording units that were being used to record and transmit the hourly data. F421C anemometers were used most of the time at these stations until May 1994 when MET ONE (model 013) anemometers were installed at each of the stations. All of the wind speed and direction data from the 9.1 m above ground unit at climate station 076x59 were obtained from a R. M. Young propeller-type anemometer. The various anemometers had threshold wind speeds from 0.5 to 1 m/s. The wind speed data have not been adjusted for any threshold value.

Wind vanes of various types were used at each of the three climate stations to indicate the hourly, instantaneous wind direction in degrees from north. The wind vanes were mounted 9.1, 2, and 3 m above the ground at climate stations 076x59, 127x07, and 176x14, respectively.

There are missing records in both of the hourly wind speed and wind direction data sets from each of the three weather stations. Two percent of the hourly wind speed and direction data are missing in the climate station 076x59 record, 1% of the data are missing in climate station 127x07 record, and 2% of the wind speed and 3% of the wind direction data are missing in climate station 176x14 record. Some of the missing records in both the speed and direction data sets were estimated by interpolation for periods of less than 5 hours.

Table 2. Sensor Height Above Ground and Starting Date of Climate Record for the Three Weather Stations on the Reynolds Creek Experimental Watershed

	Station Sensor Height, m			Station Record Begins		
	076x59	127x07	176x14	076x59	127x07	176x14
Daily maximum/minimum air temperature[a]	1.5	1.5	1.5	Jan. 1, 1964	Jan. 1, 1967	Jan. 1, 1967
Hourly air temperature, dew point, relative humidity, vapor pressure, solar radiation[a]	1.0	3.0	3.0	June 18, 1981	Dec. 5, 1984	Feb. 24, 1983
Hourly wind speed and direction[a]	2.0 9.1	2.0	3.0	May 15, 1986	Dec. 5, 1984 Aug. 23, 1985	Feb. 24, 1983
Daily class A pan evaporation, mm				March 22, 1974	April 21, 1977	June 14, 1974

[a]Temperature and dew point are given in degrees Celsius; relative humidity is a percentage; vapor pressure is given in kPa; solar radiation is given in W/m^2; wind speed is given in m/s; and wind direction is given in degrees.

2.5. Class A Pan Evaporation

Stainless steel class A pans that were fabricated locally were used to measure evaporation at each of the three climate stations on the RCEW each summer starting in the mid 1970s through 1996 (Table 2). The level of water in the pans was maintained between 5.1 and 7.6 cm below the rim of the pans by automatically filling them from stored water. The pans were equipped with stilling wells and float-driven recorders to measure the depth of water in the pans until the measurement system was converted to electronic transducers in 1993. The transducers were located in stilling wells at 0.6 m below the ground surface to minimize the effects of wind-induced waves in the pans that affected transducer output and to minimize changes in transducer output due to air temperature variations.

Missing records were estimated using regression equations that had been developed for total daily pan evaporation between climate stations or from equations developed by *Hanson* [1989]. Each daily class A pan evaporation record ends at midnight MST.

2.6. Barometric Pressure

Hourly values of barometric pressure were measured at climate station 076x59 using a Vaisala PTA 427 series barometric pressure transmitter, and the data were stored electronically in the NWRC database from February 12, 1987, through September 30, 1996. These data have been checked for outliers, but missing records could not be estimated. Approximately 4% of the hourly pressure readings are missing from the record.

3. Data Availability

Climate data are available from the anonymous ftp site ftp.nwrc.ars.usda.gov maintained by the USDA Agricultural Research Service, Northwest Watershed Research Center in Boise, Idaho, United States. A more complete description of the climate data is given by *Hanson et al*. [2000] and is also available in electronic form on the same ftp site. A detailed description of data formats, access information, licensing, and disclaimers is presented by *Slaughter et al*. [this issue].

4. Examples of Data Use

Hanson [1989] found that the mean seasonal class A pan evaporation was 1255, 1082, and 795 mm for climate stations 076x59, 127x07, and 176x14, respectively. The seasonal, daily evaporation rates were very nearly the same at the two lower-elevation climate stations 076x59 and 127x07, so the longer season at climate station 076x59 was the reason for greater total seasonal pan evaporation at that site. At climate station 176x14 the mean daily pan evaporation rate was less than at the other two sites, and the season was shorter at this highest-elevation site, resulting in less mean seasonal pan evaporation. These data were used to develop equations based on mean daily air temperature, total daily solar radiation, and daily wind run to estimate daily pan evaporation at each of the three climate sites.

Temperature data from three climate stations were use to determine if time of observation (TOB) had the same effect on average daily temperature at each location and if average temperature computed from 144 observations per day was the same as average temperature computed using the mean of the daily maximum and minimum temperature [*Hanson*, 1991]. No consistent differences between sites were found; however, in the spring and fall, average daily temperatures differed by as much as 1°C between 0600 and 1600 TOB. Average daily temperatures computed from 10 min interval data, ending at TOB, were as much as 0.8°C less than the average computed from daily maximum and minimum values for 0800 through 1900 TOB.

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