

Current Flags

A. Current Flag Summary

The following is a short description of flags currently in use for quality control. The procedures used to test data quality within specific parameters can be found below in the “Current Daily” and “Current Hourly” flag specifications. The current flags fall into two categories:

Severe where

Flag	Description
I	Data value has no meaning/ignore.
M	Missing.
S	Sensor is not in service or data is out of sensor threshold.

Informative where

Flag	Description
A	Historical average.
E, T	Historical average of one of the sensors used to calculate a parameter.
H	Daily data value flagged when corresponding hourly data is flagged M, Q, and S. This flag is not set when the corresponding hourly data is flagged N.
J	Monthly data value flagged when some daily data are missing.
K	Monthly data value flagged when daily data values are flagged.
L	Monthly data value flagged when some daily data are missing and some are flagged.
N	Data value is not collected by this station.
P	Quality test pending.
Q	All quality control could not be performed because a comparison sensor is severe. This flag is not set when the comparison sensor is flagged N.
R	Data is far out of historical limits.
Y	Data is moderately out of historical limits.

B. Current Hourly Flags

The following is a short description of the hourly flags currently in use. Also included are descriptions for the flags and the criteria used to test data quality. It should be noted that the same flag may describe different situations for different weather parameters.

1. Hourly Solar Radiation

Solar radiation data is flagged based on hourly extraterrestrial radiation.

Flag	Description
R	The sun is more than 10 degrees above the horizon and the ratio of measured hourly solar radiation to calculated extraterrestrial radiation is equal to or greater than 1.0. The sun is more than 10 degrees above the horizon and the measured hourly solar radiation is equal to or less than 0 Wm^{-2} . The sun is less than 10 degrees above the horizon and the absolute value of measured hourly solar radiation is equal to or greater than 10.00 Wm^{-2} .
S	Measured hourly solar radiation is less than or equal to -50.00 Wm^{-2} , or is equal to or greater than $4,000 \text{ Wm}^{-2}$. Daylight and solar radiation is constant for 4 hours in a row.
Y	The sun is more than 10 degrees above the horizon and the ratio of measured hourly solar radiation to calculated extraterrestrial radiation is greater than 0.85. The sun is less than 10 degrees above the horizon and the absolute value of measured hourly radiation is equal to or greater than 6.00 Wm^{-2} .

2. Hourly Net Radiation

Hourly net radiation data is flagged based on theoretical extremes, measured solar radiation, vapor pressure, and air temperature.

Flag	Description
N	Net radiation is not calculated for this station.
Q	Solar radiation is severe - flagged S. Two or all three sensors (solar radiation, vapor pressure and air temperature) are missing.
R	Net radiation is less than -100, or equal to or greater than 800. Solar radiation, air temperature or vapor pressure is flagged R.
S	Solar radiation, air temperature or vapor pressure is severe. Net radiation is equal to or greater than to $4,000 \text{ Wm}^{-2}$.

3. Hourly Soil Temperature

Flag	Description
R	Soil temperature is far out of historical range (outside the 99.8% confidence interval).
Y	Soil temperature is moderately out of historical range (outside the 96% confidence interval). Soil temperature drop or rise between this hour and the previous hour is greater than 3 °C, or 5.4 °F.

4. Hourly Air Temperature

Flag	Description
R	Air temperature drop or rise between this hour and the previous hour is greater than 10 °C, or 18 °F. Air temperature is far out of historical range (outside the 99.8% confidence interval).
S	Air temperature is constant for 4 hours in a row.
Y	Air temperature is moderately out of historical range (outside the 96% confidence interval).

5. Hourly Vapor Pressure

Flag	Description
Q	Air temperature or precipitation is severe (either or both are flagged S).
R	Vapor pressure is constant for 4 hours in a row. Actual vapor pressure is equal to or less than 0.00 kPa or actual vapor pressure is greater than 1.05 times the saturation vapor pressure.
S	Vapor pressure is equal to or less than 0.
Y	Relative humidity is less than 50% during an hour with 1.00 mm or more of precipitation.

6. Hourly Wind Speed

Flag	Description
I	Wind speed is equal to or less than 0.447 (1 mph) or wind speed is constant for four hours in a row.
S	Wind speed is equal to or less than 0. Wind speed is equal to or greater than 45 meters per second or 100 mph.

7. Hourly Resultant Wind

Flag	Description
I	Wind speed is flagged I.
Q	Wind speed is severe.
R	Resultant wind is equal to or greater than wind speed.

8. Hourly Wind Direction

Flag	Description
S	Wind direction is less than 0 or greater than 360 degrees.
R	Wind direction is constant for four hours in a row.

9. Hourly Standard Deviation of Wind Direction

Flag	Description
S	Wind direction is severe. Standard deviation of wind direction is between 188 and 189.
R	Wind direction is flagged R. Standard deviation of wind speed is equal to or greater than 180 degrees or less than 0.

10. Hourly Precipitation

Precipitation data is flagged based on extreme values and daytime cloud conditions inferred from the relationship between solar radiation and extraterrestrial radiation.

Flag	Description
R	Precipitation is more than 100 mm (4 inches). Measured solar radiation is greater than 75 percent of calculated extraterrestrial radiation, the sun is 10 or more degrees above the horizon, and the station shows recorded precipitation (precipitation is greater than 0).
S	Precipitation is less than 0.
Y	Measured solar radiation is greater than 65 percent of calculated extraterrestrial radiation, the sun is 10 or more degrees above the horizon, and the station shows recorded precipitation.

11. Hourly Evapotranspiration

ETo quality test is based on net radiation, wind speed, air temperature, and vapor pressure.

Flag	Description
R	One or more of the above listed measurements is flagged R. Wind speed is flagged I.
S	Precipitation is less than 0.
Y	One or more of the above listed measurements is flagged Y.

12. Hourly Relative Humidity

Flag	Description
Q	Air temperature or vapor pressure is severe.
R	Air temperature or vapor pressure is flagged R.
Y	Air temperature or vapor pressure is flagged Y.

13. Dew Point Temperature

Flag	Description
Q	Relative humidity is Q.
R	Relative humidity is R.
Y	Relative humidity is Y.

C. Current Daily Flags

The following is a short description of the daily flags currently in use. Also included are descriptions of the flags and the criteria used to test data quality. It should be noted that the same flag may describe different situations for different weather parameters.

1. Daily Average Solar Radiation

Flag	Description
H	Any hourly solar radiation is flagged M, S, or Q.
R	Solar radiation is greater than historical maximum solar radiation ($R_{sc}(d)$) for that day or solar radiation is equal to or less than 0.

$$R_{sc}(d) = a_0 + a_1 * \cos\left(2 * \pi * \left(\frac{d - a_2}{365}\right)\right)$$

The sinusoidal upper bound $R_{sc}(d)$ was developed using maximum daily solar radiation value for each day of the year (d) over at least a 6 year period. a_0 , a_1 , and a_2 were determined by optimization.

S	Solar radiation is greater than 4,000 watts per square meter or less than -50 watts per square meter.
---	---

2. Daily Average Net Radiation

Flag	Description
R	Net radiation is equal to or less than -20 watts per square meter or net radiation is more than 70% of daily ¹ incident solar radiation. ¹ <i>Daily incident solar radiation is the sum of hourly daylight extraterrestrial radiation divided by 24.</i> Solar radiation, air temperature, or vapor pressure is flagged R.
Y	Solar radiation, air temperature, or vapor pressure is flagged Y.

3. Daily Soil Temperature

Flag	Description
R	Soil temperature is far out of historical range (outside the 99.8% confidence interval).
S	Maximum, minimum, and average soil temperatures are equal. Average soil temperature is less than the minimum soil temperature or maximum soil temperature is less than the average soil temperature.
Y	Soil temperature is moderately out of historical range (outside the 96% confidence interval).

4. Daily Air Temperature

Flag	Description
R	Air temperature is far out of historical range (outside the 99.8% confidence interval).
S	Average, maximum, and minimum air temperatures are equal. Average air temperature is less than minimum air temperature or maximum air temperature is less than average air temperature.
Y	Air temperature is moderately out of historical range (outside the 96% confidence interval).

5. Daily Vapor Pressure

Flag	Description
R	Average vapor pressure is far out of historical range (outside the 99.8% confidence interval).
S	Average, maximum, and minimum vapor pressure values are equal. Average vapor pressure is less than minimum vapor pressure, or maximum vapor pressure is less than average vapor pressure, or minimum vapor pressure is greater than average vapor pressure. Average vapor pressure is equal to or greater than 5 kPa. Average vapor pressure is equal to or less than 0 kPa.
Y	Average vapor pressure is moderately out of historical range (outside the 96% confidence interval).

6. Daily Average Wind Speed

Flag	Description
I	Average wind speed is equal to or less than 0.447 meters per second (1 mph).
S	Average wind speed is less than 0. Average wind speed is greater than 25 meters per second (56 mph).
R	Average wind speed is far out of historical range – or more than 3 standard deviations.
Y	Average wind speed is moderately out of historical range. Average wind speed is moderately out of historical range (outside the 96% confidence interval).

7. Daily Precipitation

Flag	Description
H	One or more hourly precipitation is severe.
R	Daily precipitation is greater than 300 mm (12 inches). Daily precipitation is not equal to total hourly precipitation.
S	Daily precipitation is less than 0 mm. Daily precipitation is greater than 350 mm (14 inches).

8. Daily Reference Evapotranspiration

Flag	Description
E	Any hourly ETo is flagged E.
R	Any hourly ETo is flagged R or T.
H	Any hourly ETo is flagged M or A.

9. Daily Relative Humidity

Flag	Description
Q	Average air temperature or average vapor pressure is flagged S.
R	Average air temperature or average vapor pressure is flagged R.
Y	Average air temperature or average vapor pressure is flagged Y.

10. Daily Dew Point

Flag	Description
I	Average air temperature or average vapor pressure is flagged R.
Q	Average air temperature or average vapor pressure is flagged S.
Y	Average air temperature or average vapor pressure is flagged Y.

11. Daily Wind Run

Flag	Description
I	Average wind speed is flagged I.
Q	Average wind speed is flagged S.
R	Average wind speed is flagged R.

If you have questions, please contact the following:

Bekele Temesgen
Department of Water Resources
Office of Water Use Efficiency
P.O. Box 942836
Sacramento, CA 94236-0001
temesgen@water.ca.gov

Simon Eching
Department of Water Resources
Office of Water Use Efficiency
P.O. Box 942836
Sacramento, CA 94236-0001
seching@water.ca.gov