

## QCRadV5 Readme

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**NOTICE:** The QCRad methodology is the result of research by Dr. Charles N. Long. These programs and data products are made available to you with the understanding that at the minimum you will clearly acknowledge the work, and where appropriate include NOAA colleagues as co-authors, as part of any presentation of results (including manuscripts for publication, talks, and posters). A Journal paper reference is given at the end of this document.

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### Notes on inputs for the QCRad V2.0 code:

This executable is compiled to run under Win95/98/200/XP/Vista/Win7-8. Should you need to run under any other operating system, I can provide the FORTRAN77 code, but I cannot help you in compiling it for your operating system as I have no expertise and in the past some have reported such things as Unix compilers not actually conforming to FORTRAN77 standards.

### NOTE that the compiled code can only handle ASCII input files!

Data files must be in rows and columns, each row starting with a date/time stamp and followed by the input measurements in any order. Files can have any number of header lines before the data starts, but none after the data starts.

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### Date/Time stamps:

The only format acceptable as a "real" number for date/time is *YYYYMMDD.hhmmss*

Otherwise, the values must be integers with the following allowable formats:

**For the date:**

*YYYYMMDD/YYYY MM DD/YYYYJJJ/YYYY JJJ*

where *YYYY* is the 4-digit year, *MM* is the month, *DD* is the day of the month, and *JJJ* is the Julian day. *YYYYMMDD* and *YYYYJJJ* means these are one integer, *YYYY MM DD* means they are three separate integers.

**For the time:**

*hhmm/hh mm/hhmmss/daymin*

where *hh* is the hour of the day (0-23), *mm* is the minute of the hour (0-59), *ss* is the seconds of the minute (0-59), and *daymin* is the minutes past midnight (0-1439). *hhmm*, *hhmmss*, and *daymin* are one integer, *hh mm* is two separate integers.

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**Recommended inputs:**

- total (global) SW down (from unshaded pyranometer) (W/m<sup>2</sup>)
- diffuse SW down (from shaded pyranometer) (W/m<sup>2</sup>)
- direct SW (or Direct Normal SW) (W/m<sup>2</sup>)
- upwelling SW (W/m<sup>2</sup>)
- downwelling LW (from pyrgeometer) (W/m<sup>2</sup>)
- upwelling LW (from pyrgeometer) (W/m<sup>2</sup>)
- Air temperature (Deg. C, or Deg. K or Deg. F)
- relative humidity (or other ambient moisture measurement such as vapor pressure, etc.)
- air pressure (mb or Kpa)
- LW down pyrgeometer case temperature (Deg. K or Deg. C)
- LW down pyrgeometer dome temperature (Deg. K or Deg. C)
- LW down pyrgeometer detector flux (in W/m<sup>2</sup>)
- LW up pyrgeometer case temperature (Deg. K or Deg. C)

LW up pyrgeometer dome temperature (Deg. K or Deg. C)

LW up pyrgeometer detector flux (in W/m<sup>2</sup>)

The more of the above variables available, the better the data can be quality assessed (and the more cloud information can be retrieved from the data using the Radiative Flux Analysis methodology). Other variables (for example wind speed and direction) can be "carried through" to the output files, though they are not tested.

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### **QCRad outputs:**

The output data files contain a header line, then the output data in rows starting with a date/time stamp, and followed by the variables in columns. The column headers and their meanings are as follows:

Date	date in YYYYMMDD format, based on input time (UTC/LST/etc.)
Time	time of day in hhmm format,, based on input time (UTC/LST/etc.)
BESW (W/m <sup>2</sup> )	Best Estimate SW, sum of direct plus diffuse if both pass QC tests, else global SW if available
GSW	total (global) SW from unshaded pyranometer (W/m <sup>2</sup> )
DIF	measured downwelling diffuse SW (W/m <sup>2</sup> )
DIR	measured downwelling direct SW (W/m <sup>2</sup> )
SWup	upwelling SW from pyranometer (W/m <sup>2</sup> )
LWdn	downwelling LW from pyrgeometer (W/m <sup>2</sup> )
LWup	upwelling LW from pyrgeometer (W/m <sup>2</sup> )
Ta	air temperature (K)
VPrs	vapor pressure (mb)
RH	Relative Humidity (%)
Prs	station pressure (same units as input)
LWdTc	Downwelling LW pyrgeometer case temperature (K)
LWdTd	Downwelling LW pyrgeometer dome temperature (K)
LWdTc	Upwelling LW pyrgeometer case temperature (K)

LWuTd Upwelling LW pyrgeometer dome temperature (K)

qc1 through qc19 are quality testing flags, one for each test performed. See "QC\_Rad3\_flg\_key.pdf" for details.

**NOTE:** If QC1, QC2, or QC3 flag value is set to "10" or greater, then that SW value was either "missing" or tested "bad" and the value was replaced by adding or subtracting the other two SW components to calculate the value. This calculated value is then tested just as the original value would have been, and might then be set to "bad" if the testing is not passed. The second digit (<10 value) represents the "normal" test flagging as described in "QC\_Rad3\_flg\_key.pdf."

gflg type of IR loss correction applied to global SW, none/full dry/full moist/detector dry/det moist (0/1/2/3/4)

dflg type of IR loss correction applied to diffuse SW, none/full dry/full moist/detector dry/det moist (0/1/2/3/4)

Z Solar zenith angle (degrees)

AU Earth-Sun distance in astronomical units

ClrSW estimated clear-sky total downwelling SW, from user-set power law coefficient settings in configuration file

DifCorr IR loss correction applied to diffuse (shaded) SW measurements

GSWCorr IR loss correction applied to global (unshaded) SW measurements

There may be other variables that are "carried through" from the input files as set by the user in the configuration file.

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**NOTE:** The term "pyrgeometer detector flux" refers to the pyrgeometer signal (typically mV) times the sensitivity factor (or divided by the calibration factor). This value is what Dutton et al. 2001 call the instrument "netIR" in their diffuse correction paper.

**Dutton et al. Reference:**

Dutton, E. G., J. J. Michalsky, T. Stoffel, B. W. Forgan, J. Hickey, D. W. Nelson, T. L. Alberta, and I. Reda, 2001: Measurement of broadband diffuse solar irradiance using current commercial instrumentation with a correction for thermal offset errors. J. Atmos. and Ocean. Tech., 18(3), 297-314.

**Other relevant references:**

Long, C. N., and Y. Shi, (2008): An Automated Quality Assessment and Control Algorithm for Surface Radiation Measurements, TOASJ, 2, 23-37, doi: 10.2174/1874282300802010023.

Long, C. N. and Y. Shi, (2006): The QCRad Value Added Product: Surface Radiation Measurement Quality Control Testing, Including Climatologically Configurable Limits, Atmospheric Radiation Measurement Program Technical Report, ARM TR-074, 69 pp., Available via <http://www.arm.gov>.