Inter-comparison of REBS Q*7.1 Net Radiometer Performance Characteristics

Kenisha Ford
Spelman College

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Mentor: Randal Mandock, Gerald Grams

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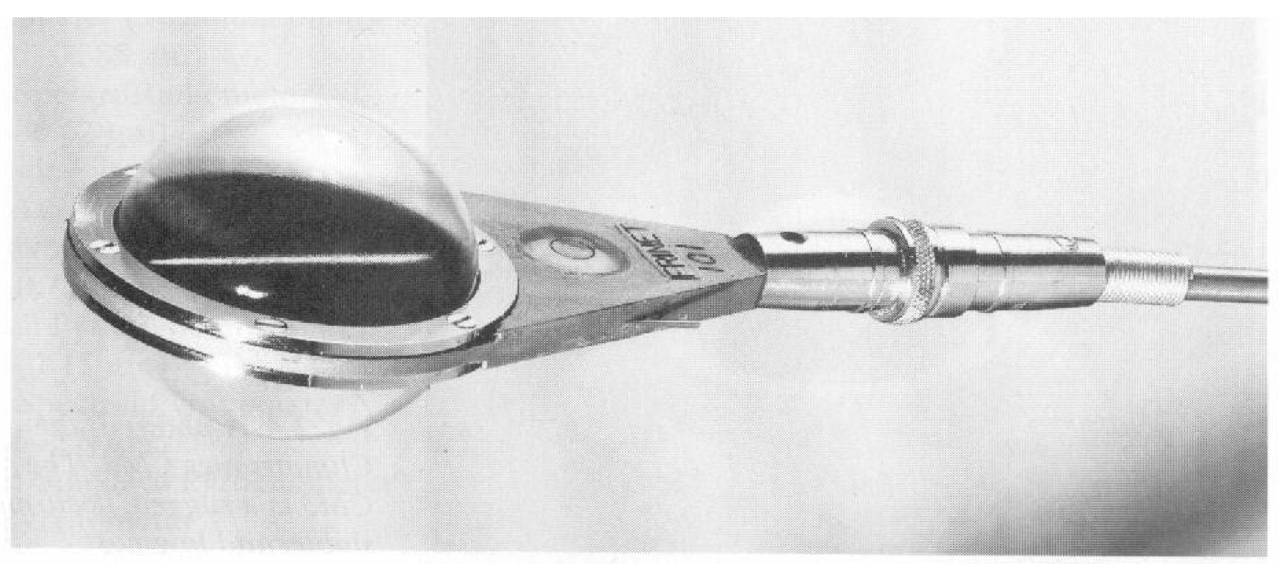
Introduction

Incoming shortwave radiation consists of a direct beam and diffuse solar radiation. Shortwave radiation can be defined as wavelengths from 0.25 to 4 micrometers (?m). Incoming longwave radiation mainly consists of longwave atmospheric radiation and is defined as wavelengths from 4 to 100 ?m. The sum of the incoming shortwave and longwave radiation is incoming total hemispherical radiation. Outgoing shortwave radiation consists of reflected solar radiation. Outgoing longwave radiation consists of terrestrial longwave radiation. The sum of outgoing shortwave and longwave radiation is outgoing total hemispherical radiation. Net radiation is defined as



incoming total hemispherical radiation minus outgoing total hemispherical radiation. Net radiation is the energy the surface retains for heating soil and air, plant growth and evaporation or water. Evapotranspiration (water evaporated from surface vegetation and soil) closely relates to net radiation in humid conditions. In this case, net radiation is the most useful term in evapotranspiration research. In arid region, advection (the transference of heat by horizontal currents of air) is more pronounced and net radiation measurements alone are not sufficient to determine water use. They must be combined with other variables for good estimates of evapotranspiration. The instrument used to measure net radiation is called a Net Radiometer. The Net Radiometer contains a high output 60 junction thermopile with a nominal resistance of 4 ohms and linear calibration. It generates a millivolt signal proportional to the net radiation level..

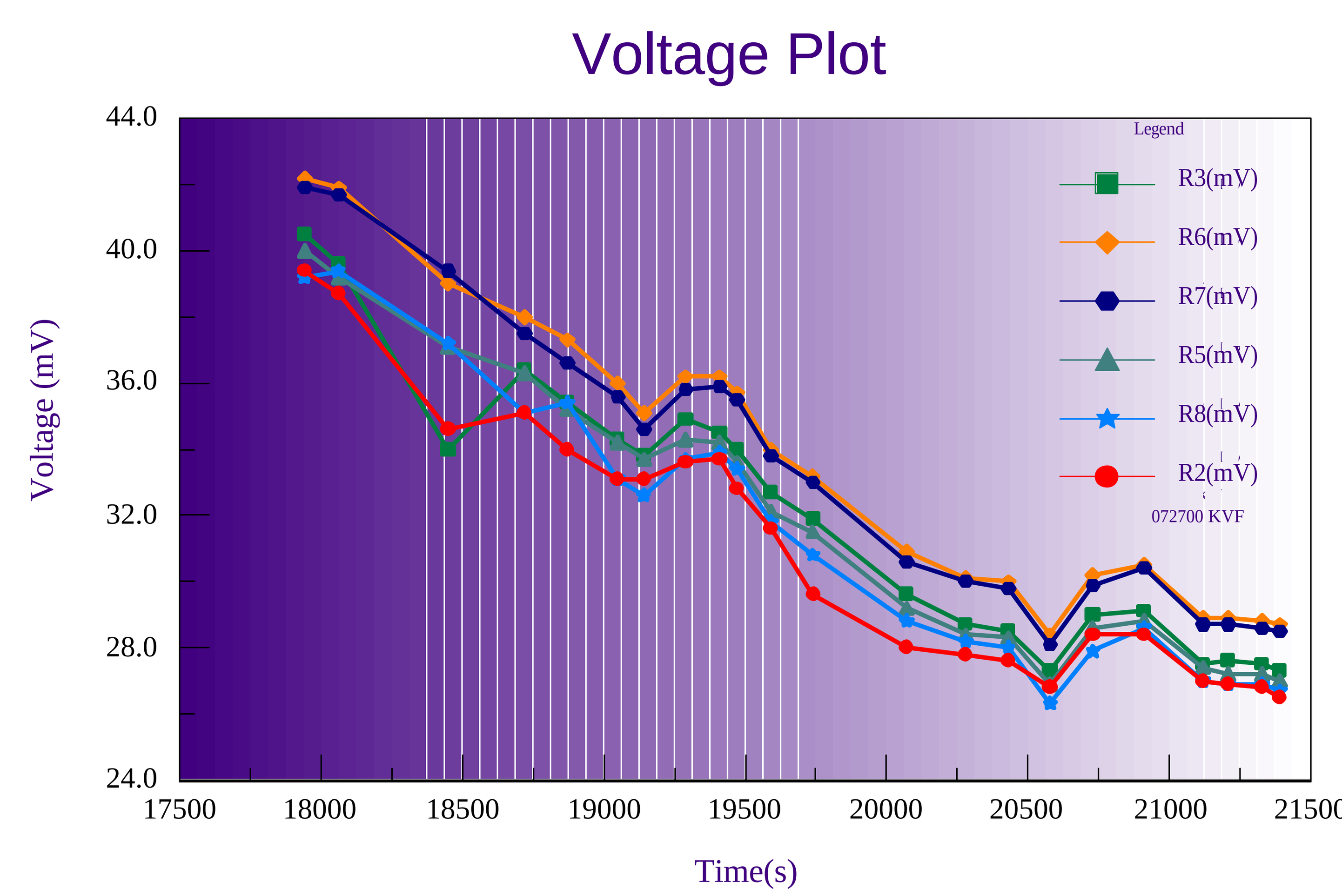
Approach

Six Net Radiometer were set up in a line, connected to a multimeter and readings taken in millivolts (mV) about every 2 minutes. Each Radiometer has its own calibration factor and the net radiation for each was calculated using the equation:

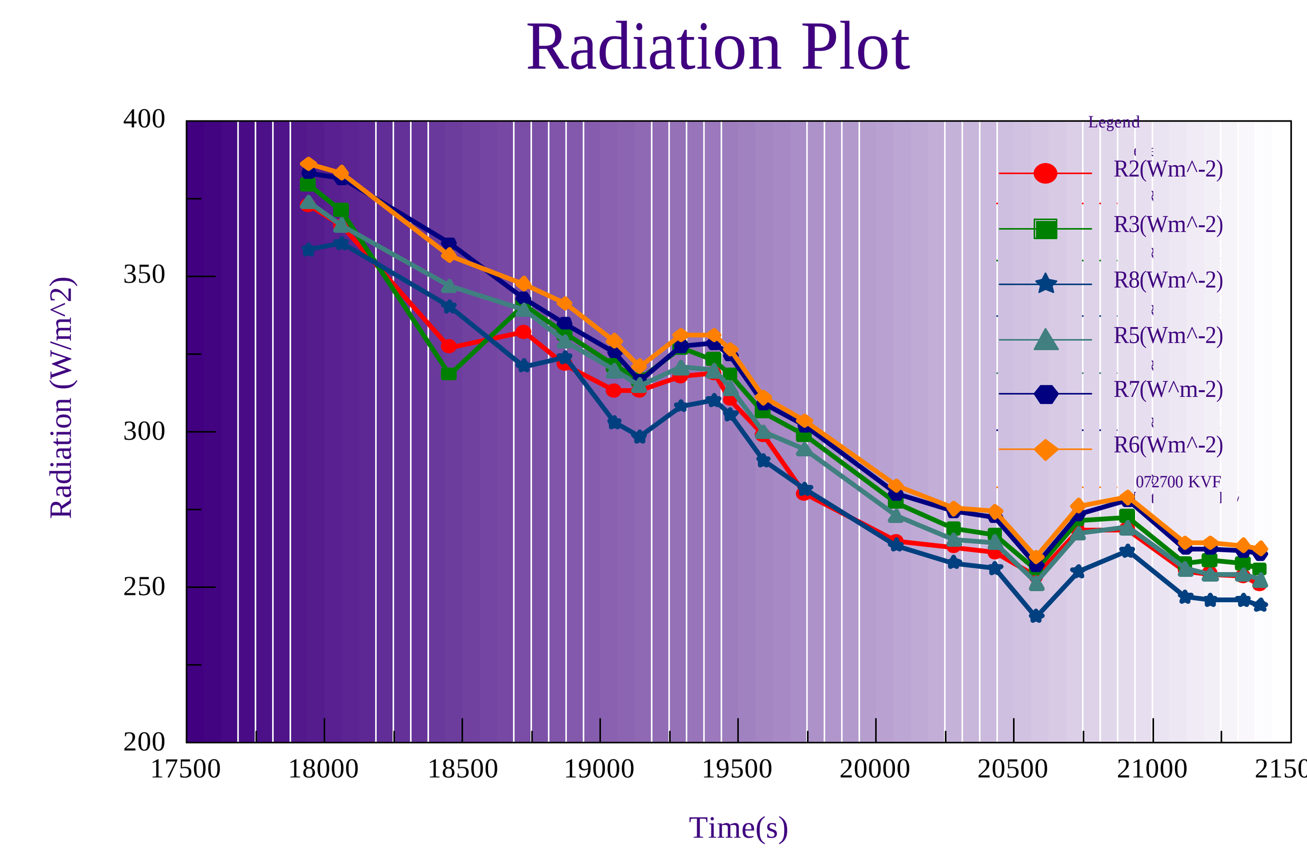
$$\mathbf{Q^* = V_t F_p}$$

where Q* is the Net Radiation Level with units W m^{-2}, V_t is the Thermopile Voltage in mV, $F_p$and is the Calibration Factor with units (W $m^{-2}mV^{-1}$).

Results



A graph of the voltages for the 6 devices is shown above. The results are displayed in the above table and in graphical form, on the bottom right figure



Conclusion

The above graph shows the variation of the output of six net radiometers operated at the same level above ground for a one-hour period from 5 PM to 6 PM on the afternoon of July 27, 2000. With the exception of a period near the beginning of each curve when a number of small rapidly changing clouds were present, all curves show the same basic shape as a function of time, increasing together or decreasing together as sky conditions changed. Since the radiation values for all of the curves appear to differ by a fixed amount from one curve to the next, we can conclude that a systematic difference from one radiometer to the other exists. By taking the radiometer represented by the yellow curve as a reference radiometer, we can compute an average difference between the points on the yellow curve and the points on each of the other curves. By simply adding the difference calculated for each radiometer to their respective measurements, it is clear that all curves obtained in that way would be expected to lie on top of each other when the average difference for each individual radiometer was added to its measurements. This result means that we could reasonably expect any of the instruments operated at a given time and location to obtain identical results when it's correction constant was applied. This is important for studies in which the instruments are operated at different levels above the surface. This means that any differences observed for instruments operated at different levels were associated with differences in atmospheric radiation and not with the instruments.