An R Script Which Calculates Insolation (Available Solar Energy) from Online Solar Radiation Records Stored on the Weather Underground Web Site

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I operate a Davis Vantage II Plus weather station which automatically uploads data to the Weather Underground web site every five minutes. One of the sensors on my station is a solar radiation sensor which measures solar power in units of Watts per square meter. A colleague of mine wants to know how much solar energy is available for conversion by solar panels which are located close to the weather station.

I wrote an R script1 which downloads solar radiation from HTML tables on the Weather Underground web site. Insolation is then calculated using the following formula.

$$Whm^{-2} = \sum_{i=1}^{n-1} \frac{(x_{i+1} + x_i)}{2}(t_{i+1} - t_i)$$

Where

Whm^{-2} is insolation in units of Watts-hours per square meter

$\frac{(x_{i+1}+x_i)}{2}$ is the average solar radiation during the i^{th} time slice, where x is measured in Watts per square meter

$(t_{i+1} - t_i)$ is the length of the i^{th} time slice where t is measured in hours

Note that this formula calculates accumulated solar energy on a horizontal surfaces. Solar panels angled to face the sun will collect more energy.

Weather Underground provides a solar calculator which indicates how much energy is theoretically available at any geographic location. Unfortunately, it is not clear what is assumptions are made (clear sky?, optimally angled solar panels?, etc).

Listing 1: solar.R

```
# Aubrey Moore (aubreymoore@guam.net) 2012-12-15
#
# This R script calculates daily insolation in units of kWh per
# square meter using data scraped from tables on the Weather
# Underground web site and writes the data to a CSV file.

# Change these values before running.
stationID = "KGUYIGO2"
start.date = as.Date("2012-11-01")
end.date = as.Date("2012-11-30")
fileName = "NOV2012.csv"

dailyInsolation = function(stationID, date){
  require(XML)
  date = as.Date(date)
  url = paste("http://www.wunderground.com",
    "/weatherstation/WXDailyHistory.asp?",
    "ID=", stationID,
    "&day=", as.numeric(format(date, format = "%d")),
    "&year=", as.numeric(format(date, format = "%Y")),
    "&month=", as.numeric(format(date, format = "%m")),
    sep=""
  )
  data <- readHTMLTable(url, which=6)
  names(data) <-gsub(" ",".", names(data))
  # Calc time slices in hours
  h = strptime(data$Time, "%H:%M")
  time.slice.h = as.numeric(diff(h)/60)
  y = data$Solar.Radiation
  y = as.numeric(gsub(" watts/m\\^2", "", y))
  # Calc average watts per sq m during each time slice
  watts.m2 = numeric(0)
  for (i in 1:(length(y)-1))
    watts.m2[i] = (y[i]+y[i+1])/2
  # Integrate
  Wh.m2 = round(sum(watts.m2 * time.slice.h, 0))
  return(data.frame(date, Wh.m2))
}

for (date in seq(start.date, end.date, by="1 day")){
  if (date == start.date){
    d = dailyInsolation(stationID, as.Date(date, origin="1970-01-01"))
  } else {
    d = rbind(d, dailyInsolation(stationID, as.Date(date, origin
        ="1970-01-01")))
  }
  print(paste(as.Date(date, origin="1970-01-01"), "has been processed."))
}
d
write.csv(d, fileName)
```