Program: RAWS 1 min GPS.CR1

```
'CR1000
'Created by Joe O'Brien, USFS Athens Rx Fire Science Laboratory

'Declaring Variables and Units
Dim NMEASent(2) As String * 90
Dim AirTC_2
Dim SPkPa
Dim Twg
Dim Twpg
Dim Vpg
Dim SVp
Dim Twch
Dim VpgVpd
Dim Top
Dim Bottom
Dim N_2
Dim AirTC_3
Public BattV
Public PTemp_C
Public GPSData(15)
Public TRHData(2)
Public WSData(3)
Public N(8)
Public Rain_mm
Public SlrW 'solar radiative power
Public SlrMJ 'solar radiative energy (J)
Public LWmV 'Leaf moisture raw data
Public LWMDry 'Leaf Moisture percent time dry
Public LWMCon 'Leaf Moisture percent time contaminated
Public LWMWet 'Leaf Moisture percent time Wet
Public TdC 'Dew point in degrees C
Public TwC 'wet bulb temp C
Public SVPWPa 'Saturation vapor pressure
Public Vp 'vapor pressure kPa
Public VPD 'vapor pressure deficit
Public FuelT_C 'Fuel temp C
Public FuelM 'Fuel moisture %
Public Soil_Moisture '
Public PA_uS 'Fuel Moisture raw data
Public BP_kPa 'barometric pressure kPa

Alias GPSData(1)=Latitude_A
Alias GPSData(2)=Latitude_B
Alias GPSData(3)=Longitude_A
Alias GPSData(4)=Longitude_B
Alias GPSData(5)=Speed
Alias GPSData(6)=Course
Alias GPSData(7)=MagVar
Alias GPSData(8)=FixQual
Alias GPSData(9)=NumSats
Alias GPSData(10)=Altitude
Alias GPSData(11)=PPS
```

```
53   Alias GPSData(12)=SecSinceGPRMC
54   Alias GPSData(13)=GPSReady
55   Alias GPSData(14)=MaxClockChange
56   Alias GPSData(15)=NumClockChange
57   Alias TRHData(1)=AirTC
58   Alias TRHData(2)=RH
59   Alias WSData(1)=WindDir
60   Alias WSData(2)=WS_ms
61   Alias WSData(3)=WSDiag
62   Alias N(1)=SmplsF
63   Alias N(2)=Diag1F
64   Alias N(3)=Diag2F
65   Alias N(4)=Diag4F
66   Alias N(5)=Diag8F
67   Alias N(6)=Diag9F
68   Alias N(7)=Diag10F
69   Alias N(8)=NNDF
70
71   Units BattV=Volts
72   Units PTemp_C=Deg C
73   Units Rain_mm=mm
74   Units SlrW=W/m^2
75   Units SlrMJ=MJ/m^2
76   Units LWmV=mV
77   Units LWMDry=Minutes
78   Units LWMCon=Minutes
79   Units LWMWet=Minutes
80   Units TdC=Deg C
81   Units TwC=Deg C
82   Units SVPWPa=Pa
83   Units Vp=kPa
84   Units FuelT_C=Deg C
85   Units FuelM=%
86   Units PA_uS=uSec
87   Units BP_kPa=kPa
88   Units Latitude_A=degrees
89   Units Latitude_B=minutes
90   Units Longitude_A=degrees
91   Units Longitude_B=minutes
92   Units Speed=knots
93   Units Course=degrees
94   Units MagVar=degrees
95   Units FixQual=code
96   Units NumSats=count
97   Units Altitude=meters
98   Units PPS=microseconds
99   Units SecSinceGPRMC=seconds
100  Units GPSReady=count
101  Units MaxClockChange=milliseconds
102  Units NumClockChange=count
103  Units AirTC=Deg C
104  Units RH=%
```

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```
Units WindDir=degrees
Units WS_ms=meters/second
Units WSDiag=unitless
Units VPD=kPa

'Define Data Tables
DataTable(Minute,True,-1)
  DataInterval(0,1,Min,10)
  'The following TableFile instruction causes new data to be copied to an optional removable
  'drive (SC115 or USB mass storage) when it is plugged into the datalogger.
  'This TableFile instruction has no effect unless a removable drive is plugged into the datalogger
  TableFile("USB:"+Status.SerialNumber+"Minute",8,-1,0,0,Hr,0,0)

 Sample(1,Latitude_A,FP2)
  Sample(1,Latitude_B,FP2)
  Sample(1,Longitude_A,FP2)
  Sample(1,Longitude_B,FP2)



Average(1,AirTC,FP2,False)
  Average(1,RH,FP2,False)
  WindVector(1,WS_ms,WindDir,FP2,False,300,0,0)
  FieldNames("WS_ms_S_WVT,WindDir_D1_WVT,WindDir_SD1_WVT")
  Maximum (1,WS_ms,FP2,False,False)
  Totalize(1,Rain_mm,FP2,False)
  Average(1,SlrW,FP2,False)
  Average(1,TdC,FP2,False)
  Average(1,VPD,FP2,False)
  Average(1,FuelM,FP2,False)
  Average(1,FuelT_C,FP2,False)
  Average(1,BP_kPa,IEEE4,False)
EndTable

DataTable(Hourly,True,-1)
  DataInterval(0,60,Min,10)
  'The following TableFile instruction causes new data to be copied to an
  'optional removable drive (SC115 or USB mass storage) when it is plugged
  'into the datalogger. This TableFile instruction has no effect unless a
  'removable drive is plugged into the datalogger.
  TableFile("USB:"+Status.SerialNumber+"Hourly",8,-1,0,0,Hr,0,0)
   Sample(1,Latitude_A,FP2)
  Sample(1,Latitude_B,FP2)
  Sample(1,Longitude_A,FP2)
  Sample(1,Longitude_B,FP2)

Minimum(1,BattV,FP2,False,False)
  Average(1,AirTC,FP2,False)
  Sample(1,RH,FP2)
  WindVector(1,WS_ms,WindDir,FP2,False,60,0,0)
  FieldNames("WS_ms_S_WVT,WindDir_D1_WVT,WindDir_SD1_WVT")
  Maximum (1,WS_ms,FP2,False,True)
```

```
157    Totalize(1,Rain_mm,FP2,False)
158    Average(1,SlrW,FP2,False)
159    Totalize(1,LWMDry,FP2,False)
160    Totalize(1,LWMWet,FP2,False)
161    Average(1,FuelT_C,FP2,False)
162    Average(1,FuelM,FP2,False)
163    Sample(1,BP_kPa,IEEE4)
164  EndTable
165
166  DataTable(Daily,True,-1)
167    DataInterval(0,1440,Min,10)
168    'The following TableFile instruction causes new data to be copied to an
169    'optional removable drive (SC115 or USB mass storage) when it is plugged
170    'into the datalogger. This TableFile instruction has no effect unless a
171    'removable drive is plugged into the datalogger.
172    TableFile("USB:"+Status.SerialNumber+"Daily",8,-1,0,0,Hr,0,0)
173    Sample(1,Latitude_A,FP2)
174    Sample(1,Latitude_B,FP2)
175    Sample(1,Longitude_A,FP2)
176    Sample(1,Longitude_B,FP2)
177    Average(1,AirTC,FP2,False)
178    Maximum(1,AirTC,FP2,False,False)
179    Minimum(1,AirTC,FP2,False,False)
180    Maximum(1,RH,FP2,False,False)
181    Minimum(1,RH,FP2,False,False)
182    WindVector(1,WS_ms,WindDir,FP2,False,1440,0,0)
183    FieldNames("WS_ms_S_WVT,WindDir_D1_WVT,WindDir_SD1_WVT")
184    Totalize(1,SlrMJ,IEEE4,False)
185    Maximum(1,SlrW,FP2,False,False)
186    Totalize(1,LWMDry,FP2,False)
187    Totalize(1,LWMCon,FP2,False)
188    Totalize(1,LWMWet,FP2,False)
189    Average(1,FuelT_C,FP2,False)
190    Maximum(1,FuelT_C,FP2,False,False)
191    Minimum(1,FuelT_C,FP2,False,False)
192    Average(1,FuelM,FP2,False)
193    Maximum(1,FuelM,FP2,False,False)
194    Minimum(1,FuelM,FP2,False,False)
195  EndTable
196
197  'Main Program
198  BeginProg
199    'Main Scan
200    Scan(5,Sec,1,0)
201      'Default CR1000 Datalogger Battery Voltage measurement 'BattV'
202      Battery(BattV)
203      'Default CR1000 Datalogger Wiring Panel Temperature measurement 'PTemp_C'
204      PanelTemp(PTemp_C,_60Hz)
205      'GPS16X-HVS GPS Receiver measurements 'Latitude_A', 'Latitude_B', 'Longitude_A', 'Longitude_B',
206      'MagVar', 'FixQual', 'NumSats', 'Altitude', 'PPS', 'SecSinceGPRMC', 'GPSReady', 'MaxClockChange
207      'The datalogger clock will be synchronized to GPS time.
208      GPS(GPSData(),Com1,0*3600,500,NMEASent())
```

```
209     'HygroVUE5/HygroVUE10 Digital Temperature & Relative Humidity Sensor measurements 'AirTC' and '
210     SDI12Recorder(TRHData(),3,"0","M!",1,0,-1)
211     VPD=Vp-(SVPWPa/1000)
212     'WindSonic4 Two Dimensional Sonic Wind Speed & Direction Sensor measurements 'WindDir', 'WS_ms'
213     'Get data from WindSonic4
214     SDI12Recorder(WindDir,7,"0","R0!",1,0)
215     If WindDir=NAN Then
216       Move(WS_ms,2,WindDir,1)
217     EndIf
218     'Set diagnostic variables as needed
219     Move(SmplsF,8,0,1)
220     Select Case WSDiag
221     Case=0
222       SmplsF=1
223     Case=1
224       Diag1F=1
225     Case=2
226       Diag2F=1
227     Case=4
228       Diag4F=1
229     Case=8
230       Diag8F=1
231     Case=9
232       Diag9F=1
233     Case=10
234       Diag10F=1
235     Else
236       NNDF=1
237     EndSelect
238     'TE525/TE525WS Rain Gauge measurement 'Rain_mm'
239     PulseCount(Rain_mm,1,16,2,0,0.254,0)
240     'CS301 Pyranometer measurements 'SlrMJ' and 'SlrW'
241     VoltSe(SlrW,1,mV250,5,1,0,_60Hz,1,0)
242     If SlrW<0 Then SlrW=0
243     'Calculate total flux
244     'The multiplier to calculate total flux was calculated by Short Cut
245     'and based on a program execution rate (scan rate) of 5 Seconds.
246     'If you change the program execution rate outside of Short Cut with the CRBasic Editor
247     'you will need to recalculate this multiplier. See the sensor manual for more details.
248     SlrMJ=SlrW*2.5E-05
249     'Calculate flux density
250     SlrW=SlrW*5
251     'LWS Dielectric Leaf Wetness Sensor measurement 'LWmV'
252     BrHalf(LWmV,1,mV2500,10,1,1,2500,False,10000,_60Hz,2500,0)
253     'Determine Minutes Dry 'LWMDry', Minutes Wet or Contaminated 'LWMCon', and Minutes Wet 'LWMWet'
254     LWMDry=0
255     LWMCon=0
256     LWMWet=0
257     If LWmV<274 Then
258       LWMDry=0.08333333
259     Else
260       If LWmV>=284 Then
```

```
261           LWMWet=0.08333333
262         Else
263           LWMCon=0.08333333
264         EndIf
265       EndIf
266       'Dew Point and Wet-Bulb calculation prep
267       AirTC_2=AirTC
268       SPkPa=101.325
269       SatVP(SVp,AirTC_2)
270       Vp=RH*SVp/100
271       'Dew Point calculation 'TdC'
272       DewPoint(TdC,AirTC_2,RH)
273       If TdC>AirTC_2 OR TdC=NAN Then TdC=AirTC_2
274       'Find Wet-Bulb 'TwC'
275       Top=AirTC_2
276       Bottom=TdC
277       For N_2 = 1 To 25
278         Twpg=Twg
279         Twg=((Top-Bottom)/2)+Bottom
280         WetDryBulb(Vpg,AirTC_2,Twg,SPkPa)
281         VpgVpd=Vpg-Vp
282         Twch=ABS(Twpg-Twg)
283         If VpgVpd>0 Then
284           Top=Twg
285         Else
286           Bottom=Twg
287         EndIf
288         If Twch<0.01 OR N_2=25 Then ExitFor
289       Next
290       TwC=Twg
291       'Saturation vapor pressure calculation 'SVPWPa'
292       AirTC_3=AirTC
293       SatVP(SVPWPa,AirTC_3)
294       SVPWPa=SVPWPa*1000
295       'CS205 Fuel Temperature Sensor measurement 'FuelT_C'
296       Therm107(FuelT_C,1,8,1,0,_60Hz,1,0)
297       'CS506 Fuel Moisture Sensor measurement 'FuelM' and 'PA_uS'
298       If TimeIntoInterval(0,1,hr) Then
299         PortSet(8,1)
300         PeriodAvg(PA_uS,1,mv2500,7,0,0,100,10,1,0)
301         PortSet(8,0)
302         If PA_uS <= 17.7 Then
303           FuelM=7.6298*PA_uS-130.0904
304         Else
305           FuelM=0.0406*PA_uS^2+3.7685*PA_uS-73.7974
306         EndIf
307       EndIf
308       'CS100 Barometric Pressure Sensor measurement 'BP_kPa'
309       If TimeIntoInterval(59,60,Min) Then PortSet(4,1)
310       If TimeIntoInterval(0,60,Min) Then
311         VoltSe(BP_kPa,1,mV2500,1,1,0,_60Hz,0.2,600)
312         BP_kPa=BP_kPa*0.1
```

```
313         PortSet(4,0)
314       EndIf
315       'Call Data Tables and Store Data
316       CallTable Minute
317       CallTable Hourly
318       CallTable Daily
319     NextScan
320   EndProg
```