

MADIS and APRSWXNET/CWOP: Free Automated Near Real-Time QC for Your Met Data

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4 Nov 09

Background

MET Field QC: Important but labor intensive

Wind is critical data -- also failure prone, difficult to audit

Enter MADIS:

NOAA's Meteorological Assimilation Data Ingest System [!!]

MADIS ingests data from many non-NOAA/NWS Mesonet stations

Creates a spatially dense met data set to assist with forecasting

Usually small, privately operated or DOT related stations

Generally do not have routine QC

MADIS applies buddy-system QC checks to these data

Models data for each station based on nearby stations

Generates modeled minus measured error data in real time

http://madis.noaa.gov/madis_sfc_qc.html

But...

Modeled QC results are not readily accessible in a user friendly form

They are out there if you know a few tricks and secrets...

You have to be submitting your data thru a MADIS network

MADIS Meteorological Surface Text/XML Viewer:

<http://madis-data.noaa.gov/public/sfcdumpguest.html>

```
var TD    total stns  5101 # non-missing obs  4868
          Station  Elev(m) Lat(N)  Lon(E)  Grid I  Grid J  ObTime  Provider  TD  QCD QCA QCR
          V-TD    D2257   25.00 42.46867 -70.9088  0.000  0.000 20091102_0347 APRSWXNET  275.716675 S 59 0
var RH    total stns  5101 # non-missing obs  4868
          Station  Elev(m) Lat(N)  Lon(E)  Grid I  Grid J  ObTime  Provider  RH  QCD QCA QCR
          V-RH    D2257   25.00 42.46867 -70.9088  0.000  0.000 20091102_0347 APRSWXNET  67.000000 S 59 0
var T     total stns  5101 # non-missing obs  5026
          Station  Elev(m) Lat(N)  Lon(E)  Grid I  Grid J  ObTime  Provider  T   QCD QCA QCR
          V-T     D2257   25.00 42.46867 -70.9088  0.000  0.000 20091102_0347 APRSWXNET  281.483337 S 59 0
var DD    total stns  5101 # non-missing obs  5059
          Station  Elev(m) Lat(N)  Lon(E)  Grid I  Grid J  ObTime  Provider  DD  QCD QCA QCR
          V-DD    D2257   25.00 42.46867 -70.9088  0.000  0.000 20091102_0347 APRSWXNET  0.000000 S 35 0
var FF    total stns  5101 # non-missing obs  5059
          Station  Elev(m) Lat(N)  Lon(E)  Grid I  Grid J  ObTime  Provider  FF  QCD QCA QCR
          V-FF    D2257   25.00 42.46867 -70.9088  0.000  0.000 20091102_0347 APRSWXNET  0.447040 S 51 0
var FFGUST total stns  5101 # non-missing obs  4047
          Station  Elev(m) Lat(N)  Lon(E)  Grid I  Grid J  ObTime  Provider  FFGUST QCD QCA QCR
          V-FFGUST D2257   25.00 42.46867 -70.9088  0.000  0.000 20091102_0347 APRSWXNET  2.682240 S 19 0
```

MADIS Meteorological Surface Data Providers:

http://madis.noaa.gov/mesonet_providers.html

U.S. Air Force Academy

Alaska Department of Transportation

Alaska Mesonet

U.S. Army Aberdeen Proving Grounds

Citizen Weather Observers Program **APRSWXNET**

NOAA Air Resources Laboratory/Field Research Division

AWS Convergence Technologies, Inc.

Anything Weather Network

Colorado Avalanche Information Center

Colorado Department of Transportation

Colorado E-470 Public Highway Authority

DCNet

Florida Dep of Transportation

Florida Mesonet

Georgia Dep of Transportation

Goodland WFO Miscellaneous

GLOBE Program

Gulf of Maine Ocean Observing System

ESRL/GSD Ground-Based GPS

Hydrometeorological Automated Data System

Great Lakes

Iowa Dep of Transportation

Iowa Environmental Mesonet

Indiana Dep of Transportation

Boulder WFO Miscellaneous

Idaho Transportation Department

Kansas Dep of Transportation

Kentucky Transportation Cabinet [and so on...]

Enter CWOP: Citizens Weather Observing Program
aka APRSWXNET

A public - private partnership to allow anyone to submit met data
Originally created for amateur radio packet met data feeds
CWOP is one of the many networks that submit data to MADIS

CWOP value added:

Takes MADIS QC and repackages it into an accessible format

User friendly, “push” email system

Daily, Weekly, Monthly quality summaries and diagnostics
for core surface obs: Temp, RH/DP, BP, Wind

==> Makes YOUR data available to NOAA/NWS and many others

SLT Met systems can take advantage of CWOP QC

ID problems quickly and at no cost

Supplements, not replaces, traditional SLT Met QC

May allow reduction in field checks/audits??

CWOP is easy to join - no red tape [at least on their end...].

Data is transferred by internet; timestamp is time of transmittal

Data intervals 5 to 15 minutes, not hourly

Simple, fixed ASCII reporting format required

Many wx logging systems support CWOP/APRSWXNET reporting

Case Study: CAMNET Wx at Acadia NP, Schoodic Peninsula

Limited on-site resources

Remote site, 1.5 hour drive from NWS Acadia HQ

Unique marine microclimate

<http://tinyurl.com/findu-dw2257>

Last report from **DW2257** received 5 minutes 26 seconds ago

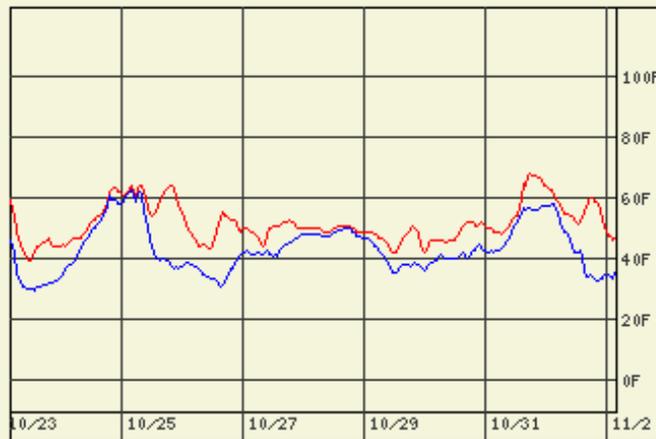
Wind Calm Gusts to 6.0 MPH Temp 47F Humidity 66% Dewpoint 36F Pressure 1022.8 mb

[Visit this station's homepage.](#)

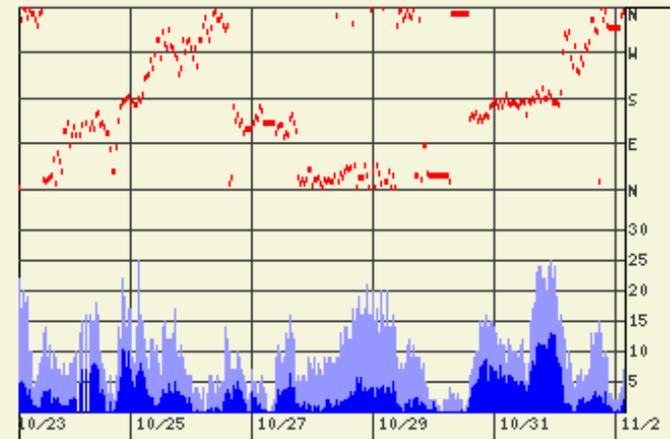
Findu Station History

Historical Data (Last 10 days) [12 hours](#) [1 day](#) [2 days](#) [3 days](#) [5 days](#)

Temperature/Dew point



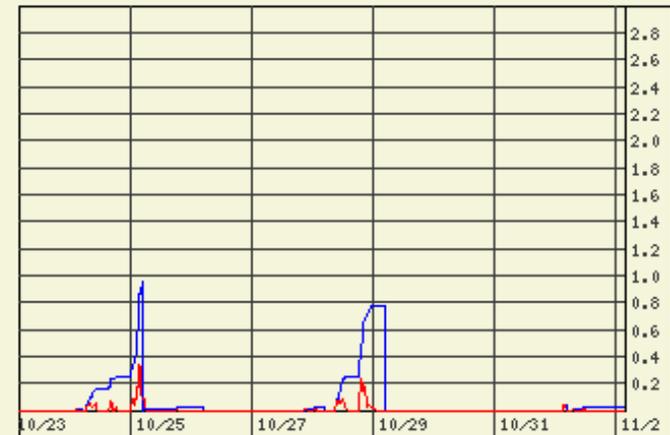
Wind (MPH)



Barometer (millibars)

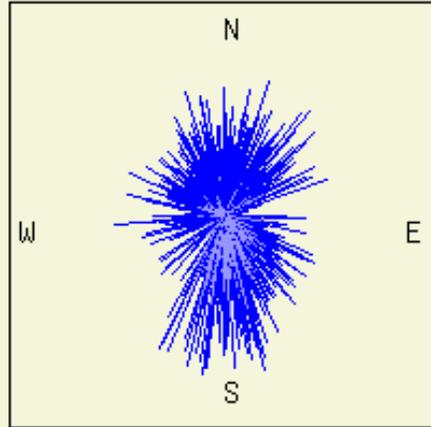


Rain (inches)

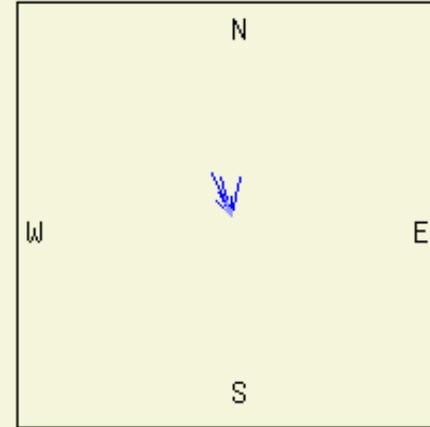


Rain displayed depends on what is being sent from the station, may be cumulative, last hour, last 24 hours, or since midnight

Wind Distribution (last 240 hours)

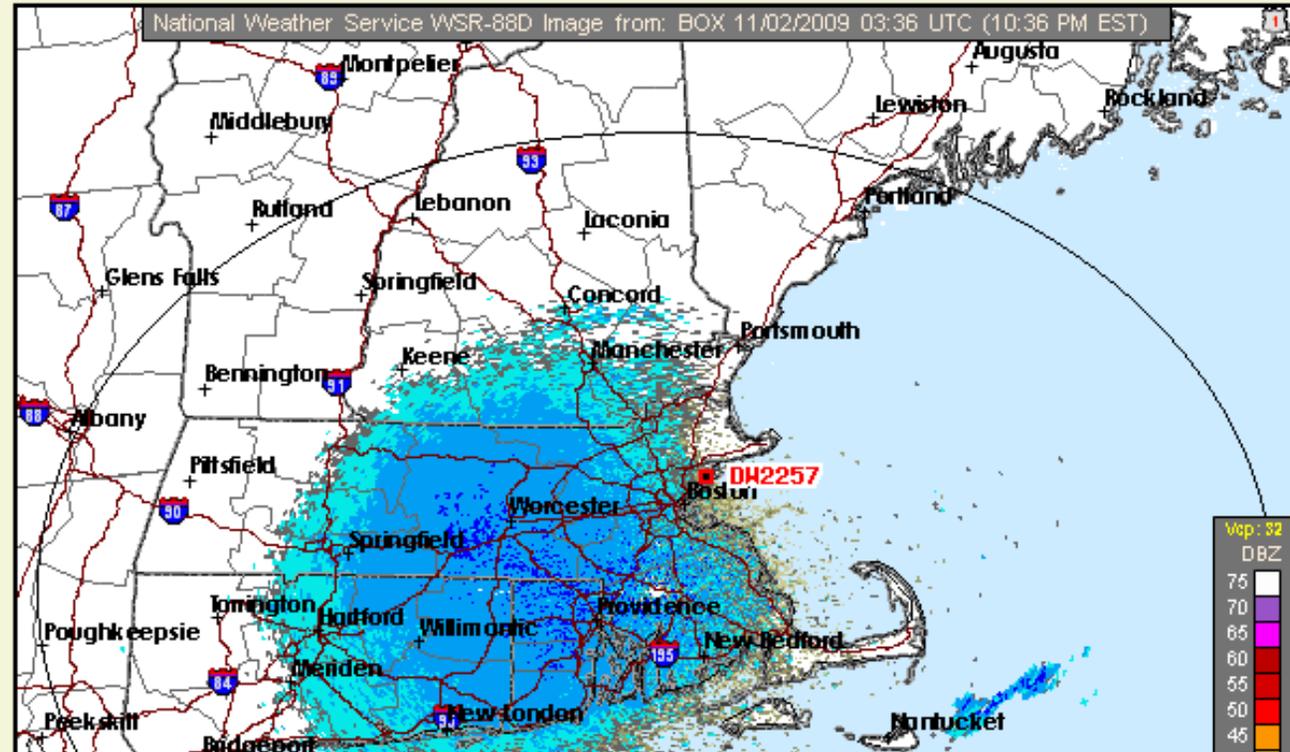


Wind Distribution (last 2 hours)



Times and dates in UTC

Station Location



Example of Normal Monthly Summary

<http://weather.gladstonefamily.net>

Date	UTC	Alt (mb)		Temp °F		Dew Pt. °F		Wind Dir degrees		Speed knots	
31-Oct-09	Errs	0/96		0/96		0/96		1/96		1/96	
31-Oct-	Mnt	+0.3	0.34	-1	1.39	+1	1.17	+0	66	+1.4	1.9

1st row, daily 'Errs': # of samples failing QC / total # samples for date

'Mnth' row: summary for preceding month

'mean | standard-deviation' for each observation during month

Mean error value: 'analysis - observed'

if observed value > modeled value, error is negative

Case Study:

May 2009 -- Monthly Summary for Acadia-SERC, DW2258

Date	UTC	Alt (mb)	Temp °F	DewPt °F	Wind Dir	Speed knts
31-MAY-2009	1802	1005.3 +0.18	52 +6.62	48 -1.91	211 -25	7.0 -0.8
31-MAY-2009	1817	1005.2 +0.28	51 +7.62	47 -0.70	178 +8	7.0 -0.8
31-MAY-2009	1832	1004.9 +0.58	52 +6.62	48 -1.76	198 -12	7.0 -0.8
31-MAY-2009	1847	1005.0 +0.48	52 +6.62	47 -0.50	200 -14	9.6 -3.4
31-MAY-2009	Errs	0/96	7/96	0/96	1/96	1/96
31-MAY-2009	Smry	+0.3 0.26	+1 3.60	-0 2.28	-27 60	-0.4 1.8
31-MAY-2009	Week	+0.4 0.35	+0 3.08	-0 2.55	-21 57	-1.1 2.6
31-MAY-2009	Mnth	+0.3 0.35	+1 3.21	-0 2.46	-17 49	-0.9 2.6

First 4 rows are “flagged” individual report interval data; **Temp too low.**

==> But -- DP is derived; T/RH are measured, so T is OK! [sea breeze]

Rows 5-6 are error count and bias/stdev for the day (31 May).

Last 2 rows are bias/stdev for the week and month; Note wind dir error!!

Acadia-SERC CAMNET Wind direction error -- Case Study:

Reviewing a few months of QC reports indicated a chronic error of $\sim 25^\circ$

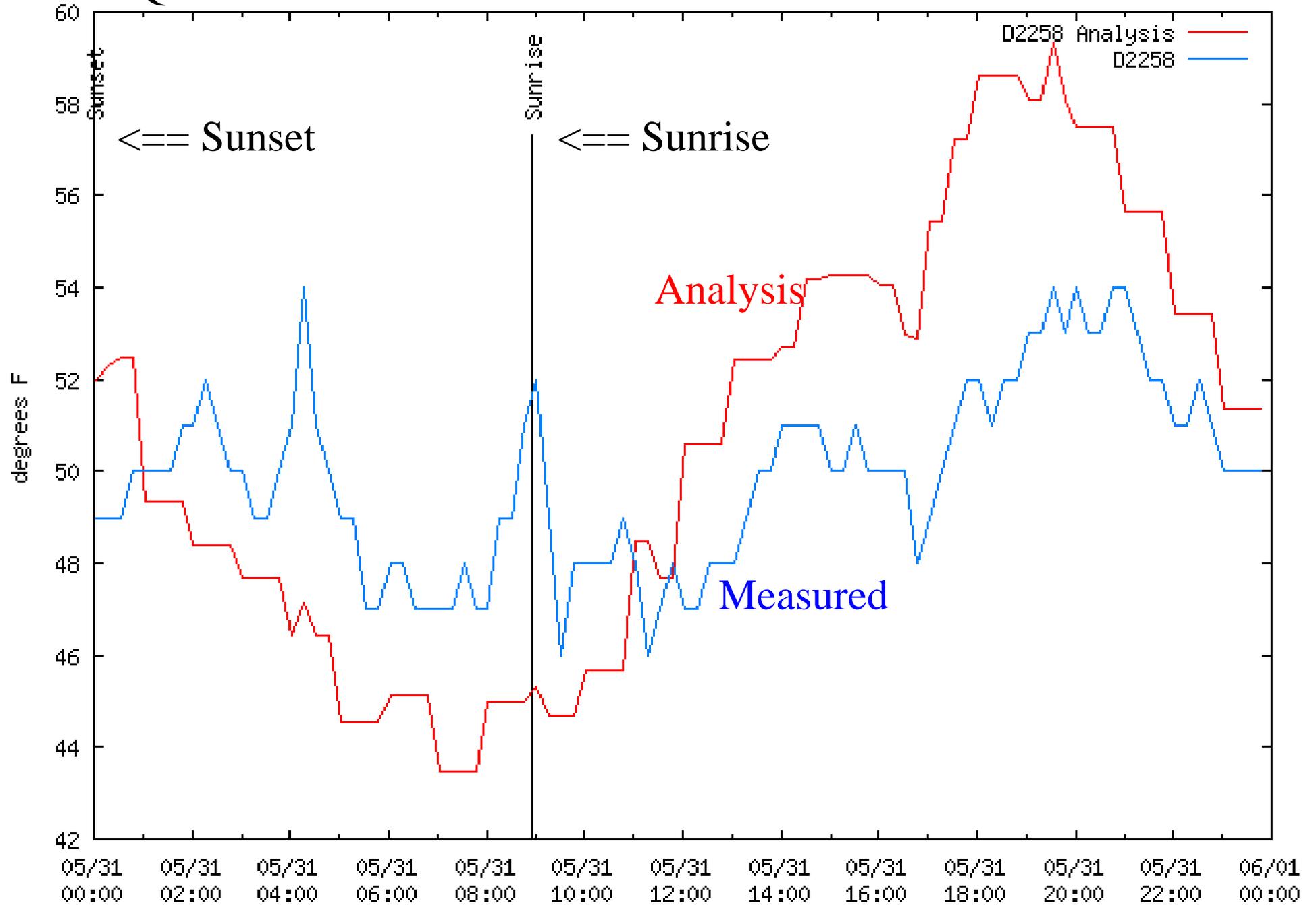
NPS staff confirmed the error (it was ~ 25 deg) and corrected the sensor.

All this from a couple of hundred miles away...

CWOP QC reports provide a paper trail for when a sensor goes bad!

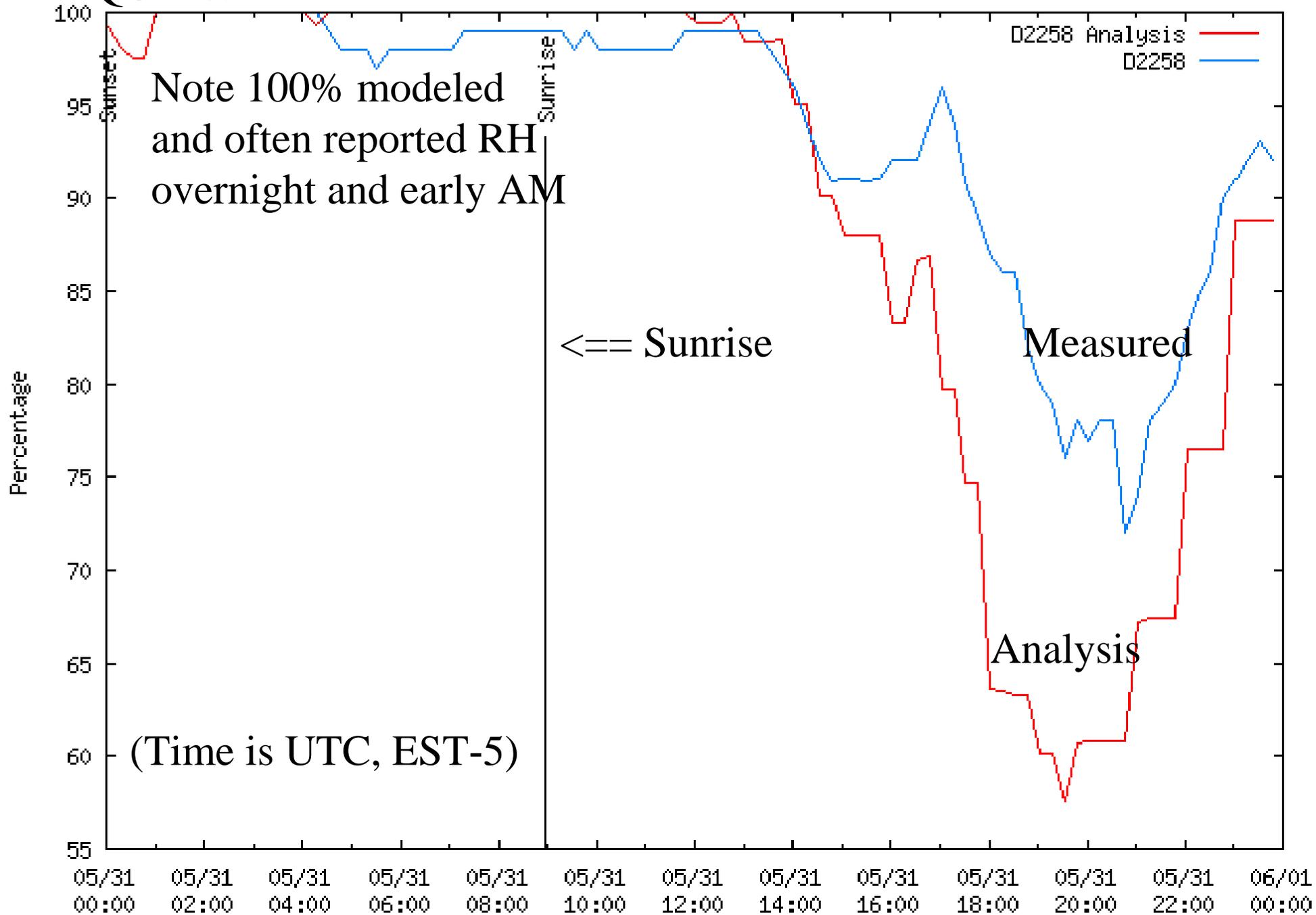
Would have been caught sooner if I had realized the value of the info in the weekly and monthly summary CWOP QC emails...

TEMP QC 5/31/09: Temperature for D2258 on 2009-May-31 (time in UTC)



RH QC Plot

Relative Humidity for D2258 on 2009-May-31 (time in UTC)



View of Mt. Desert Island, Acadia NP
from the Schoodic Peninsula. Wx station (DW2258)

7:00 am EDT, 5/31/09 (www.hazecam.net)





Cadillac Mt. - Acadia NP, from SERC, 7 miles distance
Clear Day, Native Camnet pic resolution
[first US land to see morning sun!]



CWOP Information for DW2258 (D2258) in Winter Harbor, ME US

The following information is known about DW2258. If you think that any information is incorrect, then please follow the instructions for correcting that data item.

It is *possible* that this page will report a problem where no problem exists. If you believe that this has happened, then please contact me (address at the bottom of this page) and explain *clearly* why you think this page is in error. Note that any changes that you make may take a few days to show up here, so please give it a week before commenting.

Registered Location

Latitude: 44° 20' 10" N (deg min sec), 44.3362° (decimal), 4420.17N (LORAN)
Longitude: 68° 3' 43" W (deg min sec), -68.0620° (decimal), 06803.72W (LORAN)
Elevation: 36 meters (118 feet) -- validated against 28 meters (91 feet) from NED 1/3rd arc-second: Eastern Contiguous U.S.
Location: Winter Harbor, ME US
County: Hancock, ME
Forecast Office: [Caribou \(CAR\)](#)
Station type/software: [Davis Vantage Pro 2 with Weatherlink](#)
Website: http://home.comcast.net/~g_allen/History_Monitor.htm

The site location should be at the mark shown -- or very close. Clicking within the map area (or you can drag the 'DW2258' marker) will display the latitude/longitude of that point.

If the displayed location (or elevation) *of the weather observing location* is incorrect, please drag the marker to the right location (or click in the right location), and then [send the updated information](#). Please note that we are trying to spot either the Stevenson Screen (or equivalent) or the location where the barometric readings are taken.

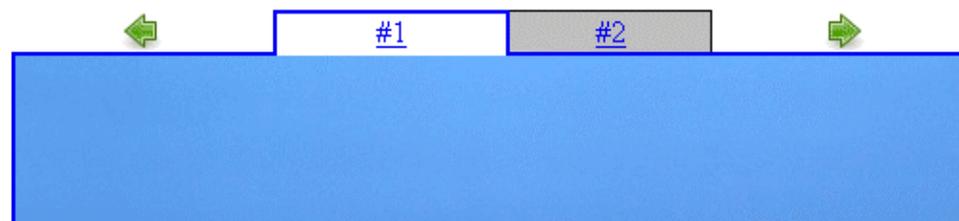
NOTE: The *Registered Location* is the location that the station owner provided when they signed up with CWOP.

The station (or view from the station) is shown here. You can choose the view direction to see the surroundings. Other information (and somewhat larger images) can be found by clicking on the picture.

You can try to find photographs from the area surrounding the site marker by clicking on [Find nearby photographs](#). (There may be some)



[Larger](#) [Smaller](#) [Google Earth](#) Show 1 no-data sites.



Example of APRS/CWOP encoded ASCII data packet:

@212018z4228.12N/07054.53W_089/003g013t061r000p007P007h00b10010.Dvs

ASCII character “@”,

24 hour clock date and time in the following format: Day of Month, Hour, Minute, where each value is a 2 digit number.

Lower case “z”,

Latitude/longitude “position” string: 4903.50N/07201.75W_.

Scalar average wind direction (in degrees) over one minute (reported as 000 if the average wind speed is zero);

Forward slash “/”,

Sustained one-minute wind speed (in mph);

Lower case “g”,

Gust (peak wind speed in mph in the last 5 minutes);

Lower case “t”,

Temperature (in degrees Fahrenheit). Temperatures below zero are expressed as -01 to -99;

Lower case “r”,

Rainfall (in hundredths of an inch) in the last hour,

Lower case “p”,

Rainfall (in hundredths of an inch) in the last 24 hours,

Upper case “P”,

Rainfall (in hundredths of an inch) since midnight,

Lower case “h”,

Humidity (in %. 00 = 100%), omitted if missing;

Lower case “b”,

Barometric pressure (in tenths of millibars/tenths of hPa), omitted if missing;

The letter “L”, (upper case if solar radiation is below 1000, lower case if between 1000 and 1999), omitted if missing,

Solar Radiation (in watts per square meter) last 3 digits (see above), omitted if missing,

Character string inside the quotes (including the leading period): “.Xxx“ to indicate what device is sending data.

Carriage Return character then Line Feed character

Parting Thoughts:

Submitting data to yet another place is not the preferred way to go...

AIRNow could incorporate the MADIS QC feature into their system

- for SLT sites reporting met data to AIRNow
- incentive for agencies to report met

AN already submits SLT met data to MADIS

AN would extract the QC error info and make it available to agencies

- in a user friendly format
- could have a “push on error” function

This AIRNow effort not currently funded; cost is modest.

For more CWOP - MADIS information:

Daily QC graph for DW2257 (my other CWOP station, at my home):

<http://weather.gladstonefamily.net/qchart/D2257?date=20091026>

Site status page including quality rating:

<http://weather.gladstonefamily.net/site/D2257>

Quality checking information: <http://www.wxqa.com/>

WXQC Mailing list:

<http://weather.gladstonefamily.net/mailman/listinfo/wxqc>

CWOP Sign-up info: <http://www.wxqa.com/SIGN-UP.html>

MADIS Web Services Portal: <http://madis-data.noaa.gov/index.html>

NOAA contact: Russell Chadwick Russell.B.Chadwick@noaa.gov

CWOP contact: Dave Helms dave@cwop.info