Weather station software

Fine Offset WH-1080 and WH-1081

Greg "groggy" Lehey grog@lemis.com grog@FreeBSD.org grog@NetBSD.org Ballarat, 18 May 2010

Weather observation devices

- Old style: thermometer, hygrometer, barometer and rain gauge.
- Digital devices start with inside/outside thermometer and inside hygrometer.
- Cost: about \$30.
- Wireless versions include outside hydrometer, cost about \$40.
 - All of these are standalone devices.



Greg Lehey, 18 May 2010

Computer connected devices

- All include outside thermometer, hygrometer, barometer and wind gauge.
- Other features may be inside measurements and sunshine detectors.
- Used to be quite expensive.
- Older devices usually have async serial interfaces.
- Newer devices from China are much cheaper, have USB interface.



Greg Lehey, 18 May 2010

WH-1080 and WH-1081

- Made by Fine Offset.
- Marketed under many names.
- One of many products.
- WH-1080 has DCF receiver, not useful in Australia.
- WH-1081 has no DCF receiver, sold in Australia.
- Available on eBay for prices between \$115 and \$280.
- Search for Weather stations USB.
- Available from JayCar for currently \$179

WH-1081 features

- External unit with wireless transmitter.
- Not clear if two can coexist.
- Thermometer, resolution 0.1°.
- Hydrometer, resolution 1%.
- Wind speed gauge, resolution 0.1 m/s.
- Wind direction measurement, resolution 22.5°.
- Appears to report only in increments of 45°.
- Rain gauge, resolution 0.3 mm.



WH-1081 external unit



WH-1081 internal unit



WH-1081 internal unit

- Includes USB interface to computer.
- Displays temperatures, percentage humidity, air pressure, wind speed and direction.
- Displays some kind of rainfall average.
- Attempts weather forecast.
- Includes clock.
- Touch screen communication.
- Very low contrast.
- Pretty much useless as a display.



Software

- Supplied with Easyweather software, runs on Microsoft only.
- Not supported out of the box by any free software.
- Steve Woodford adapted earlier code to *wview*.
- Only works on *wview* release 4.
- I adapted it to *wview* release 5.



Weather web sites

- A couple of world-wide weather sites on the web.
- CWOP (Citizens Weather Observer Program), http://www.wxqa.com/
- Not investigated yet.
- Wunderground seems less US-centric. http://www.wunderground.com/
- Has map feature.



Wunderground Dereel weather

-		Wea	ther Station History	Weather Undergroun	d - Mozilla Firefox		
<u>E</u> ile <u>E</u> dit <u>V</u> iew Hi	istory Bookmarks <u>T</u> ool	ls <u>H</u> elp					1
Back Forward 🔻	Reload Stop Newsfox http://www.wunderground.com/weatherstation/WXDailyHistory.asp?ID=INICTORI124						<u> </u>
	etting Started My eBa	y Summary Hom	e page Greg's dia	ry Greg's photos	Category links	Greg's random links cvr2 MythWeb	
Helsinki,	History for IVICT						
Finland	Dereel, Dereel, VICT	ORIA - Current	Conditions				
Linkoping, Sweden	Daily Summary f	or May 14, 2010				Dereel	
Jngskar, Sweden	« Previous Day	May	▼ 14 ▼ 2010	View	Next Day »		
unkeswell, Inited	Daily	Weekly	Monthly	Yearly	Custom	Temperature: 11.6°C Humidity: 88% Dew Point: 9.6°C	
lingdom		Current:	High:	Low:	Average:	Rainfall: NA Pressure: 1019.3m	
allarat, Victoria	Temperature:	11.6 °C	12.1 °C	7.9 °C	9.5 °C	Add PWS Stickers to your website!	
heoaks, lictoria	Dew Point:	9.6 °C	10.4 °C	7.8 °C	9.2 °C	Attention PWS Owner:	
ollinsville, TX	Humidity:	88%	99%	87%	98%	Add a webcam to your weather	- 1
Edit My	Wind Speed:	1.3km/h /	1.6km/h	-	0.4km/h	station!	
Favorites	Wind Gust:	3.2km/h/	4.8km/h	1.00	-	In addition to enabling real-time	
	Wind:	SSE	(*)	-	SW	updates with RapidFire, station owne can now associate a webcam to their	.rs r
VunderPhotos Congratulations	Pressure:	1019.2hPa	1021.6hPa	1019.5hPa	-	station ID.	
to Trigirl for	Precipitation: 0.0mm					View an example of a station with RapidFire and webcam enabled	
winning the Smithsonian	Statistics for the res	st of the month:				Webcam Signup Page	
Magazine photo contest!	High:			Low:	Average:	Local PWS Map:	
CONTROL	Temperature:	22.5 °C		-0.1 °C	Average: 11.6 °C		-
	Dew Point:	16.1 °C		-4.0 °C	9.3 °C	↑ Map Satellite Hybrid	
and the second se	Humidity:	99.0% 70.8km/h from the North 70.8km/h from the North		51.0%	9.3 C 86.8%	Trans and an owned and a	
	Wind Speed:			51.0%	30.8% 3.5km/h	Carlos Ra Carlos	
Browse All	Wind Gust:				3.56.11/11		
Photos	Wind:				- SSW		
/underMap				-	55W	2 Dereel	
tite	Pressure: Precipitation:	1027.0hPa 22.9mm		1006.7hPa	-		
Captor	reapitation. 22.3mm						
Contraction of the second seco	, I	IVICTORI124 V	Street and Street Ro &				
View	55	Temperature Dew Point			٦ <u>.</u>		
WunderMap	50 -		with		- 13		
Website	45				7	Bats ciences Pty Ltd Terms of Use	
Website Weather Maps	40	2345678	8 10 11 moon 1 2 3	4 5 6 7 8 9 10 11	4		
Solar Calculator	in Hg	Barometric Pressure			hPa	View Interactive WunderMap	
Forecast Flyer Community Chat		od onen, rtessure			1	About This PWS:	
Education	30.2				- 1023		
Astronomy						Lat: S 37 ° 49 ' 2 " (-37.817 °) Lon: E 143 ° 44 ' 27 " (143.741 °)	
Print This Page	30.1	2 3 4 5 6 7 8 1	8 10 11 macen 1 2 3	4 5 6 7 8 9 10 11	1019	Elevation (ft): 1242	
WIT News Blog					track.	Hardware: WH-1080	•
waiting for stationda	ata.wunderground.com					A 10	12/0

Wundermap Ballarat area

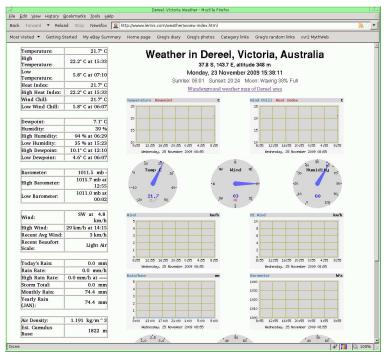
Interactive Radar & Weather Stations Select a Location: Full Address Search Go Bald \wedge Local Map Terrain Satellite Hybrid Ne Radar 255 AM UTO Region * Cree ¥ Blakeville Stations Lake Continent ź Bolwarrah ake + Burrumbeet Dales Lake Station Temp. Place -Black Hill ldsm Wadouree Brown Hill Bunding Ballarat 94852 10° C Alfredton Ballarat Gree 10 Chepstowe Canadian Delacombe IVICTORI94 10° C Ballan Snake Sebasto Mt Clear IVICTORI124 11° C Dereel Valley Magpie Mt Helen Mount Helen, IVICMTHE3 10° C Smythesdale VIC. Pittong Fiskville Skipto 11° C Linton Sheoaks Aws 94863 IVICTOBI86 12° C -Teesdale Нарру Mt Doran Valley Garibaldi Mt Wallace Enfield Grenville Mannihadar Map Legends: Beremboke Flaine Bradvale Morrisons NEXRAD Radar: Willowvale Mt Mercer Cargerie Mixed Durdidwarrah Rain Frozen Illabarook Light Heavy Light Heavy Heavy Light Meredith Rokewood Staughton Brisbane Ranges Weather Stations: Junction Vale National Park Corindhap 5mph 10mph 30°F 40"F Mt Bute Wallinduc 30 Calm N <5mph Anakie Baks wind coming from Rokewood Steiglitz Color Temp Sheoaks 60°F (60) Currently Bamganie Temperature Selected -NW 15mph Werneth 40 60 80 100 1201 Maude Lethbridge 10 20 40 SIC Berrybank Duverney Shelford Barunah Park Cresst Barunah Plains POWERED BY Wingeel Map data @2010 Map@ata Sciences Pty Ltd - Tern 1999

wview(1)

- Written for a limited number of serial-connect weather stations.
- Thinks in American units, makes a half-hearted, inaccurate attempt to display metric units.
- Continually changing.



wview(2)



wview (3)

- Runs a number of processes.
- Emetic code.
- Communication by the Three Ugly Sisters (MSG, SEM, SHM).
- Stores readings in (undocumented) custom format (version 4) or *sqlite* (version 5).
- Frequently hangs, difficult to get started again.



Greg Lehey, 18 May 2010

Hardware issues: WH-1081 (1)

- No documentation of interface from manufacturer.
- Flaky interface.
- Frequently returns invalid data.
- Game of catch-up recognizing invalid data.
- Doesn't like NiMH batteries.



Hardware issues: WH-1081 (2)

- Code we got was written for *libusb*, first version (0 or 1, depending).
- Code had "just growed" and did all sorts of undocumented things.
- No easy way to get incorrect readings out of the *wview* database.



Powercor to the rescue

- We have frequent power failures.
- On 11 November 2008, had a 5 hour failure.
- One computer and inside unit of weather station damaged.
- Many invalid readings.
- Couldn't remove them from the record.
- Decided to write something more malleable.



Greg Lehey, 18 May 2010

My code (1)

- Still evolving.
- Uses web browser as primary display.
- USB interface based on Steve Woodford's code.
- One process reads the data and stores in a MySQL database.
- One process generates data for the web pages.



My code (2)

- Cron jobs synchronize data from remote weather stations and generate graphs.
- One process sends reports to Wunderground.
- No CWOP support (yet).



WH-1081 internals

- 64 kB memory.
- 32 byte "pages", addressed by USB code
- 16 byte entries containing weather information.
- All entries related to metric units.
- Page 0 contains magic numbers and a pointer to current page.
- Page 1 contains absolute and relative pressure.
- Rest unknown or unused.
- Purpose of pressure information in page 1 is unclear.



WH-1081 accuracy

- Temperature accuracy seems to be OK.
- Pressure measurements seem to have a random offset.
- Appears to be a frequent problem with weather stations.
- Wind speed measurements appear to be very low.
- No way to confirm.



Greg Lehey, 18 May 2010

WH-1081 accuracy: rain gauge

- Measures in units of 0.3 mm.
- Doesn't match well with my manual rain gauge.
- Vibration or wind might cause too high a reading.
- Spiders nest in the gauge, obstructing the buckets and causing too low a reading.



Greg Lehey, 18 May 2010

Rain gauge (1)



Rain gauge (2)

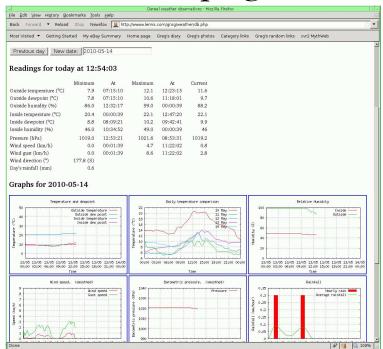


OS-related problems

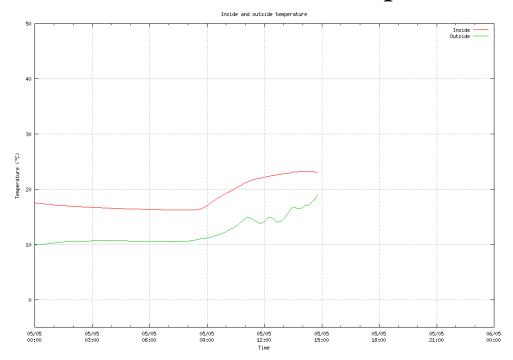
- FreeBSD often returns ENODEV reading the device.
- Problem is not recoverable. Process must stop.
- New process normally works OK.
- Sometimes takes up to a minute.
- *libusb* returns bogus error indications under Linux.
- Not investigated further.



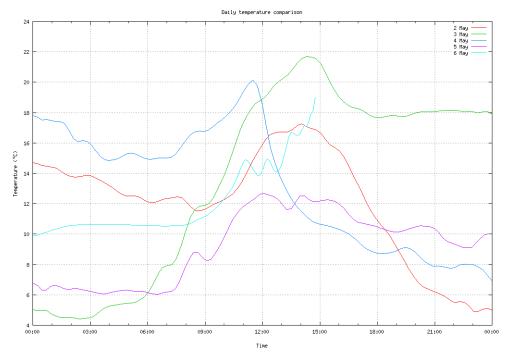
Main page



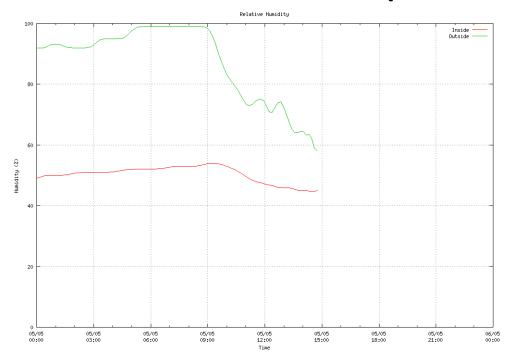
Inside and outside temperature



5 day comparison

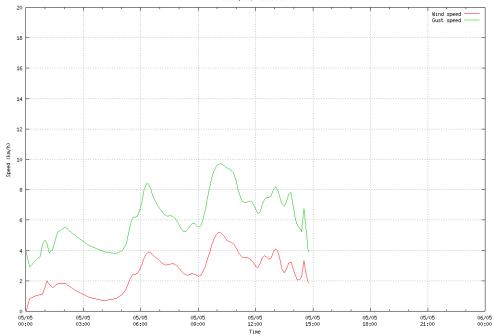


Relative humidity

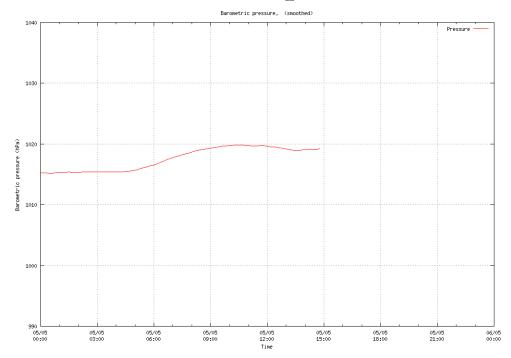


Wind speed

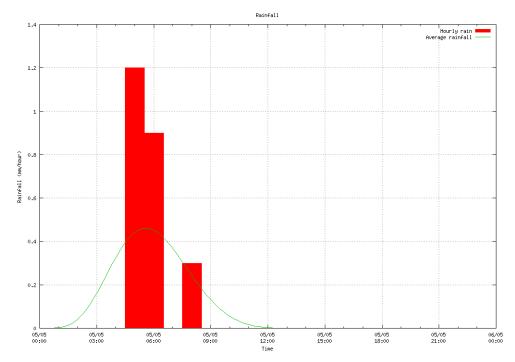
Wind speed, (smoothed)



Barometric pressure

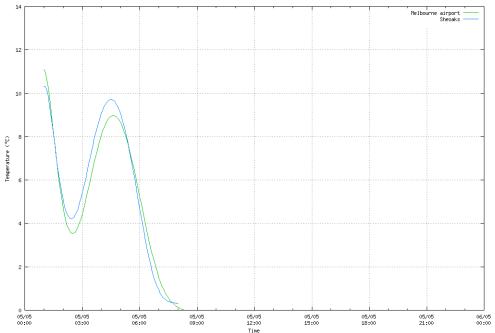


Rainfall

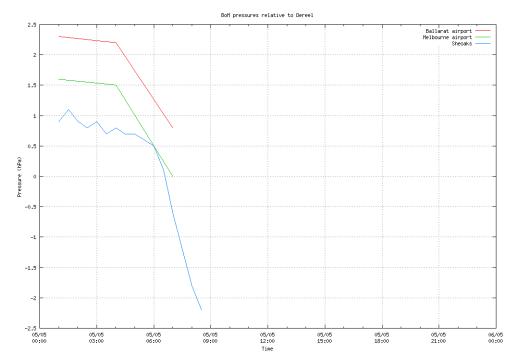


Temperatures: BoM and Dereel





Pressures: BoM and Dereel

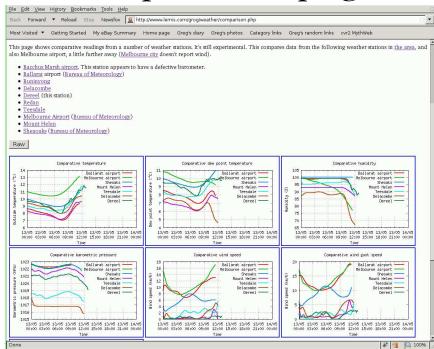


Comparisons page

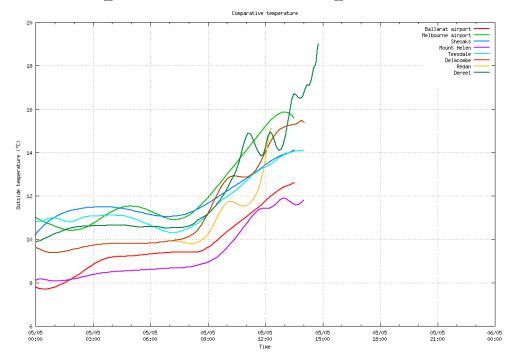
- These measurements leave some questions open.
- Is my data correct? How do I know?
- How does the weather here differ from the surrounding area?
- Thus the comparisons page.
- Already helped calibrate the barometer.
- Currently only for current day.



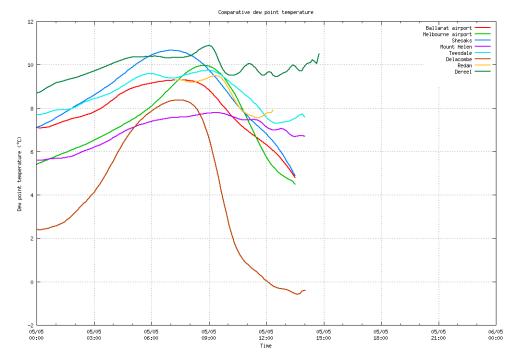
Comparisons page



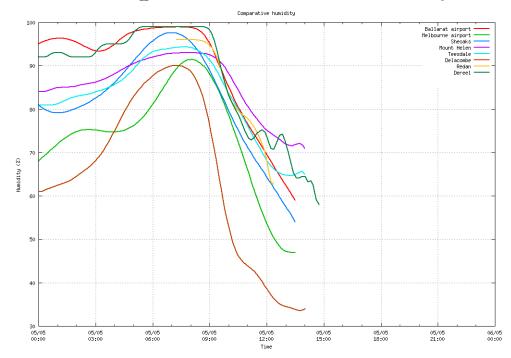
Comparisons: temperatures



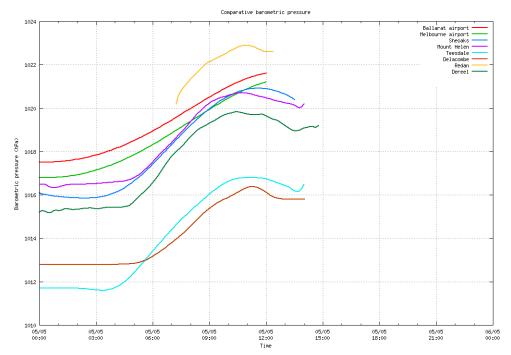
Comparisons: dewpoint



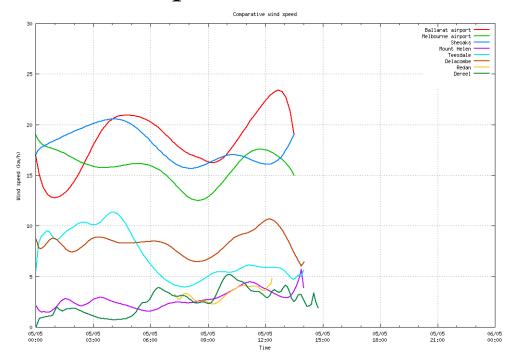
Comparisons: humidity



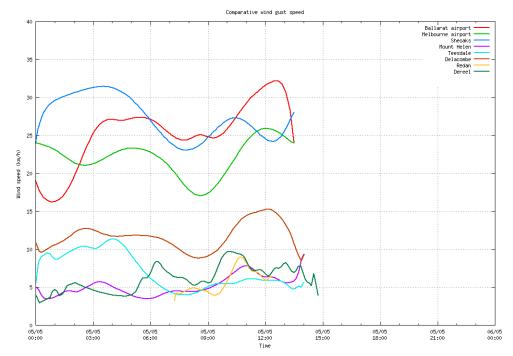
Comparisons: barometric pressure



Comparisons: wind



Comparisons: wind gust



To do

- Lots of things.
- Replicate MySQL database to remote site.
- Find a more general way of generating graphs (also known as "I *hate* gnuplot").
- Fix myriads of bugs.
- Think out more features.
- Make it easy for other people to install.



Greg Lehey, 18 May 2010

References: external

- Manufacturer Fine Offset http://www.foshk.com/en/products/show.asp?id=41
 - *wview* software http://www.wviewweather.com/

References: my site

- These slides at http://www.lemis.com/grog/Papers/WH-1080.pdf
 - Power outages at http://tinyurl.com/powercor
 - My code at http://www.lemis.com/grog/programs/WH1080.tar.gz
- Dereel weather observations at http://tinyurl.com/dereel-weather