

**Setup of an internet enabled Davis Vantage Pro2 weather station
using a Raspberry Pi
"Zeist – Hoge Dennen"
October 2014**

<http://www.sluitertijd.org/station-zeist-hoge-dennen>
r.sluiten@gmail.com



Introduction

My simple weather station with wireless outside temperature/humidity sensor broke down. I wanted to invest in something more reliable. Because I am interested in crowd sourcing and citizen science I decided to invest in a weather station that could connect to the Internet. The configuration should be able to send the data to the Weather Observation Website (WOW) of UK Metoffice. This way I obtained hands-on experience with a personal weather station. As I had quite some questions about things that were not entirely clear, I share this "how to" on this website.

Weather station

There are many weather stations available on the market with different price levels. I did not do an extensive side by side comparison but choose Davis because this brand is used by many (semi) professional users world wide and still fitted within my €1000,- budget.

Davis has two types of weather stations: the larger and more expensive Vantage Pro2 (VP2) and the smaller Vantage Vue. Because in the future I would like to measure wind on the roof of my house I decided to buy the VP2 with separable anemometer. Other advantages of the VP2 are the ability to add more sensors like UV and solar radiation, a larger rain funnel, better availability of spare parts and a little bit more advanced console. Although Davis states that the sensors in the Vue and VP2 differ not really, the tipping bucket in the VP2 appears to have a more

professional design. On the other hand, the VUE is far more compact and has a higher Woman Acceptance Factor (WAF).

I have the wireless VP2 that is solar powered. During the day a capacitor is charged to provide energy during night for the wind sensors, rain sensor and combined temperature and humidity sensor. A lithium battery provides backup energy for periods with little sun. It is said the lithium battery should last for at least 3 year. The air pressure sensor is located indoor in the console.

Three C batteries power the console, however when using the IP-data logger you need to use the (included) AC-adapter. In that case the batteries are used as backup (lasting maximum one day?). When you need to service the weather station you have to put the console in setup mode to prohibit erroneous readings of wind and rain. Prolonged use of the console backlight (few minutes) can heat up the console and influence the sensor readings in the console (indoor humidity, indoor temperature and air pressure).

Location

The weather station is located in a sheltered back garden between houses, brushes and trees. This is far from optimal compared to professional reference weather stations but very interesting for research of high-resolution local climate. The ground level is 5 m above sea level. Temperature, relative humidity and rain are measured at 150 cm above ground level. Wind speed and wind direction are measured at 225 cm above ground level. The VP2 is installed on a 260 cm steel pole with a 42mm diameter. The VP2 can out of the box connect to poles with diameters ranging from 32 mm to 44 mm. Poles can be obtained at most weather stations shops and at dedicated (cheaper) pole-shops on internet. My local DIY-shop did not sell them. I installed the pole 70 cm deep in the ground. I will measure wind for one year at 225 cm and after that year move the anemometer to the chimney of my house. For this I have to extent the standard 12m wind cable with a 30m cable. The connections between these cables seem not be entirely waterproof and should be made at a "relatively dry" location. If you extend the wind cable more than 42 meters the reading of the maximum wind speed is affected¹.

Data logger

Davis sells data loggers with serial, USB and IP interfaces. I have the WeatherlinkIP datalogger (6555) directly connected to my wired LAN. The (older) documentation I found on internet does not clearly mention that it also works with the Vue, but the newer documentation delivered with the IP data logger states that it works with the Vue. The advantages of the more expensive WeatherlinkIP data logger compared to the USB version are that it automatically sends every minute data to the Weatherlink

¹ According to Davis: At 140' (42m), maximum speed is 175mph (78m/s). At 240' (73m), maximum is 140 mph (62m/s). At 340' (103m), maximum is 70mph (31m/s). The accuracy of the reading below the maximum length of 42m is not affected.

website without intervention of a (power consuming) PC with Weatherlink software. Moreover the use of the Weatherlink website is free with the WeatherlinkIP while with the USB version you need a paid license on a yearly basis. Using the WeatherlinkIP you have more flexibility of the placement of console, PC and optional Raspberry Pi (see next section).

From the Weatherlink software you can download the data to your Mac on PC, change settings in the console (like resetting cumulative rain) and setup the data logger interval. When you set a new archive interval all data in the logger is erased (read it out before!).

The storage capacity of the ring-memory is as follows:

1 Minute Archive Interval:	42 hours
5 Minute Archive Interval:	8 days
10 Minute Archive Interval:	17 days
15 Minute Archive Interval:	26 days
30 Minute Archive Interval:	53 days
60 Minute Archive Interval:	106 days
120 Minute Archive Interval:	213 days

When the ring memory is full the oldest records are overwritten.

As I have other ways to store my data (see next section) I use the data logger with a 1 hour archive interval providing a backup that I don't have to read out manually too often from my PC. Setting the archive interval does not affect the (one minute) interval of the data that is directly send to the Weatherlink website and does not affect the interval external loggers (Raspberry Pi) can request data in real time from the data logger. However in case of data interruption the Meteohub software (next section) automatically reads out the data logger memory to fill in the missed data records. With my configuration the 5-minute data in the Meteohub is temporarily replaced with 1-hour data in case of data-disruption. For long-term climatology this is not an issue.

The data logger obtains an IP-address through DHCP by default. You can access an interface through a web browser by typing the assigned IP-address. The only thing you can change here is selecting DHCP or static IP-address.

Data dissemination to weather networks

WeatherlinkIP

The WeatherlinkIP data logger automatically sends data to the Weatherlink website every 60 seconds without intervention of a PC with Weatherlink software. After (simple) registration of the data logger this data can be viewed on the Weatherlink website and by the Davis App. The data is also stored on the website according to the set archive interval. The online storage capacity should be 4 times the storage of the data logger (i.e. 212 days for the 1 day storage interval). From the Weatherlink software the online data can be downloaded. However, some statistics

cannot be calculated by the software on the basis of online data. On the Weatherlink website you can configure that data is automatically posted on the weather networks Citizen Weather Observation Programme (CWOP), Weather Underground and Globe project. The Globe project is for educational purposes (schools, universities) and not really suitable for individuals. To access other weather networks you need the Weatherlink software on PC or Mac or dedicated hardware like a Raspberry Pi with data logger software.

Raspberry Pi

To post weather data on weather networks I use a Raspberry Pi model B² with Meteohub Software³.

A Raspberry Pi is inexpensive, compact and has a power consumption of only 3.5 Watt. I use a Raspberry Pi compatible 32GB Transcend SD card⁴ and a 1A AC-adapter. The SD card provides enough storage for a period far longer than the lifetime of all weather station components except the steel pole (provisional estimate > 40 years).

I use the very reasonably priced Meteohub software⁵ that provides all functionality I need: a.o. a functional interface, graph creation, automatic upload to weather networks and websites and error logging. Installation is easy by downloading an image from the website and writing this image to the SD card. Suse Studio Imagewriter (suggested by the Meteohub install guide) did not recognize my SD Card on a Windows7 system so I used ImageUSB⁶.

After powering up, the interface is accessible through a web browser without any interaction with the Linux OS. Data can be accessed through a network share.

The Meteohub accesses the WeatherlinkIP⁷ every minute and computes 5 minute, 10 minute, hourly, monthly etc. data from it. Every 1-5 minutes (depending on the data type and need) Meteohub posts the data on the Weather Observation Website (WOW), Weather Underground, Het Weer Actueel, CWOP and my own website. Each weather network has its own registration process. Registration on CWOP involves several steps and takes around 1.5 days. For WOW, be careful to provide the right coordinates of the weather station directly at the beginning: if you change it afterwards only a few meters a new station (or three in my case) is created automatically which can only be manually removed by the people

² http://en.wikipedia.org/wiki/Raspberry_Pi

³ http://wiki.meteohub.de/Main_Page

⁴ Type TS32GSDHC10 see: <http://www.raspberry-pi.co.uk/2012/06/07/compatible-sd-cards/>

⁵ The demonstration version of Meteohub is fully functional for a certain period depending on the release of a new version. The demonstration version is limited to the creation of one graph and can send data to weather networks only every three hours.

⁶ <http://www.osforensics.com/tools/write-usb-images.html>

⁷ During setup in Meteohub the IP-address of the WeatherlinkIP has to filled in as follows (for example): 192.168.178.25:2222

from the WOW helpdesk. Het Weer Actueel asks you to test your weather station for 2 months before you start posting data.

An interesting free alternative for Meteohub is WEEWX⁸, which also supports WOW.

The only issue I have with this configuration is that if you access the WeatherlinkIP by the Weatherlink PC software to download data while Meteohub is requesting data, the download process is disturbed and data in the logger becomes corrupted. In that case resetting the data logger by setting the interval rate again and/or restarting the entire console and data logger by removing the batteries and AC-adapter may solve the issue. The issue can be overcome by temporarily turning off logging in Meteohub during Weatherlink PC download

Costs

The table below gives an indication of the costs of my configuration and an alternative configuration: a minimum "WOW enabled" Davis Vantage Vue without the extras. The table is based on the average price in web shops in the Netherlands.

Vantage Pro2 - Zeist Hoge Dennen	€	Minimum WOW enabled configuration	€
Davis Vantage Pro2 (incl. console)	529	Davis Vantage Vue (incl. console)	335
6555IP Data logger	255	6510USB Data logger	149
Mounting (ground + roof)	44	Mounting (ground)	36
Raspberry Pi (incl. case, AC adapter)	48	Raspberry Pi (incl. case, AC adapter)	48
32 Gb SD card	16	8 Gb SD card	8
Meteohub License	59	WEEWX (free open source)	0
Wind cable 30 m extension	39		
Total	990	Total	576

⁸ <http://www.weewx.com/>