by Andres Thorarinsson

PLOTTING THE FUTURE

Data interpretation using a weather data management system

Three case studies from Iceland demonstrate how data can be compiled in an easy and simple way for different weather types

There are a huge amount of dataloggers across the world, most returning data as a time series. The interpretation of all this data can be overwhelming, with specialists analyzing a myriad of graphs, creating reports in spreadsheet programs, and at the same time trying to correlate sensor readings and examine and process the results.

Here, examples are given of how to discover meaningful results in a simple way by using tools built into a powerful and complete Vista Data Vision (VDV) data management system.

Case study one

An ambient weather station is situated close to a heavy industrial park, measuring all requested parameters – NO, NOx, NO_2, PM2.5, PM10, SO_2, and H_2S, (Figure 1). There is a debate among experts as to whether all the measured elements could come from heavy industrial air pollution or from something else. As it happens, a wind sensor is an integral part of the weather station. Therefore it is possible to correlate the H_2S sensor readings with wind direction using an XY plot, and the results prove interesting (Figure 2).

The XY plot reveals the science and truth about the origin of H_2S sensor readings with wind direction; when H_2S sensor readings are giving high values, the wind direction proves it is either from 140° or 60°. This is unexpected and cannot be a coincidence. The geothermal area of Brennisteinsfjöll in Iceland is 16km away in the direction 140°, and the geothermal area Nesjavellir is 40km away in the direction 60°. This information is extremely useful and makes it easier to understand the sensor readings for H_2S, as well as readings from all the other sensors.

Case study two

Another ambient weather station is also located close to the now infamous volcano Eyjafjallajökull, which last erupted between

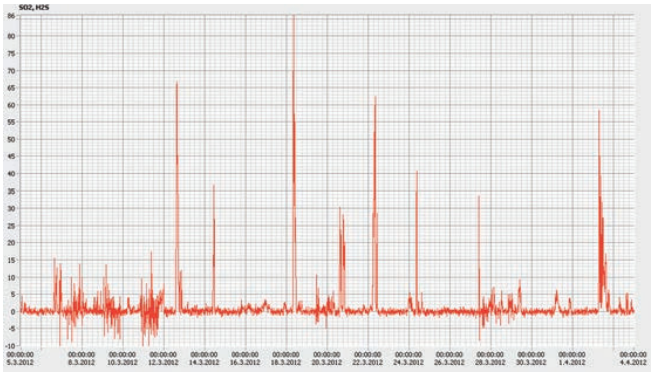

Figure 1: Trend line for H_2S; 10-minute data for March 2012. Several high readings are seen

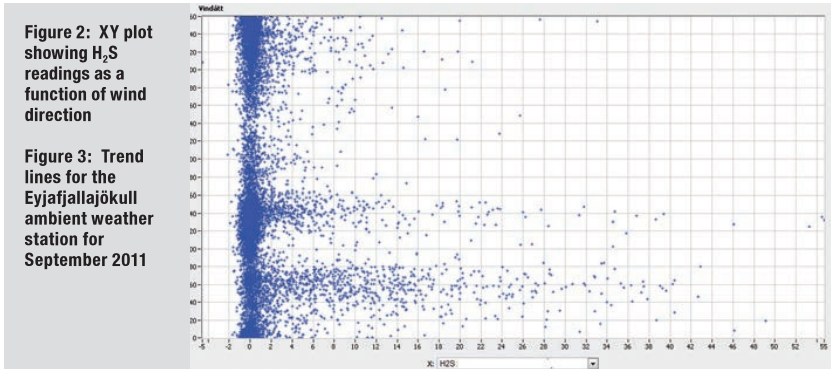

Figure 2: XY plot showing H_2S readings as a function of wind direction

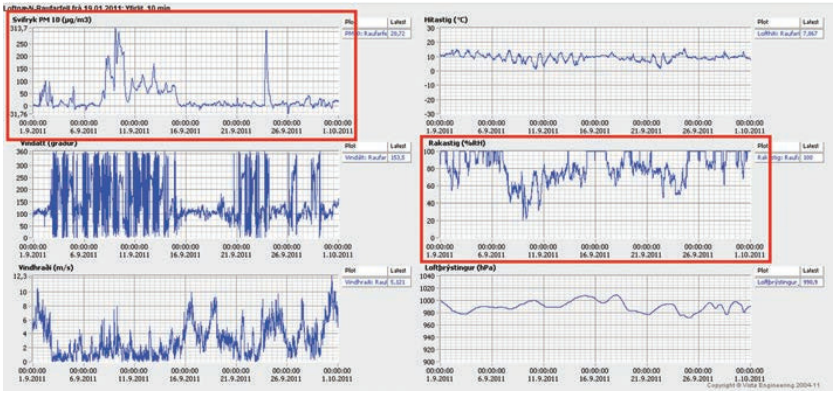

Figure 3: Trend lines for the Eyjafjallajökull ambient weather station for September 2011

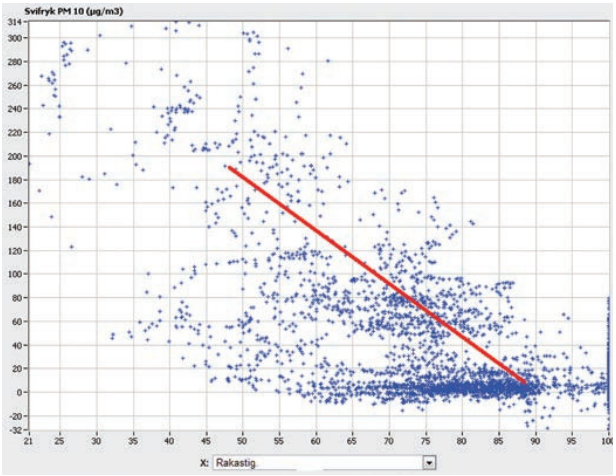

Figure 4: XY plot showing the correlation between dust particles sized PM10 ug/m³ in air, and air humidity in %RH

Right: Ash causing mid-day darkness close to the Eyjafjallajökull volcano after the eruption in 2010

April 14 and May 23 in 2010. There was a huge amount of volcanic ash pumped into the air, which caused massive disturbance to air traffic over the North Atlantic and across Europe. It has been almost two years since the eruption ended, but the area is still troubled by dust in the air.

The ambient weather station is equipped with a dust particle monitor for particles sized PM10 ug/m³, as well as wind sensor, air temperature sensor, and an air humidity sensor (see trend lines in Figure 3).

The weather station returns the data as six graphs with trend lines. The trend lines for the dust are upper left, showing several peaks. As dust in the air is unpleasant, it is useful for the local public to understand when to expect higher airborne dust concentrations. After some trial and error, there is some correlation (see Figure 4).

The XY plot reveals the truth; the dryer the air, the more the dust is concentrated. This is nothing new – just plain common sense. However, it is only when the sensor data is actually plotted in this way that it becomes clear that this remains scientifically true. But this correlation is not perfect as two parameters are missing in this case study: wind direction and windspeed. When correlation between dust particles and wind direction is plotted, the behavior becomes clearer; that is, the highest concentration of dust is measured when wind is blowing from the east or west, for instance alongside Eyjafjallajökull.

Case study three

This case study is an example of a groundwater level sensor that has been hanging in its 6m-long vented cable for some years. It shows the lowest level of water for late autumn and highest level for early spring – some 1.7m higher.

The Geokon vibrating wire water level sensor also has a built-in temperature sensor and the temperature readings are logged. This makes it possible to study the correlation between the water level and the water temperature, which might give some indication as to where from the top level of the groundwater is coming from. The trend lines for one year show that the summer has been dry (sinking ground water level), and that the temperature variation is as little as 1.2°C for the entire year.

So why does this behavior occur? By looking at precipitation data for the area, it seems as though surface water drips through the leaky ground layers in less than 24 hours; therefore during rainy periods, the groundwater rises quickly and water temperature rises by 0.2°C. These case studies demonstrate how XY plots give valuable information. ▮

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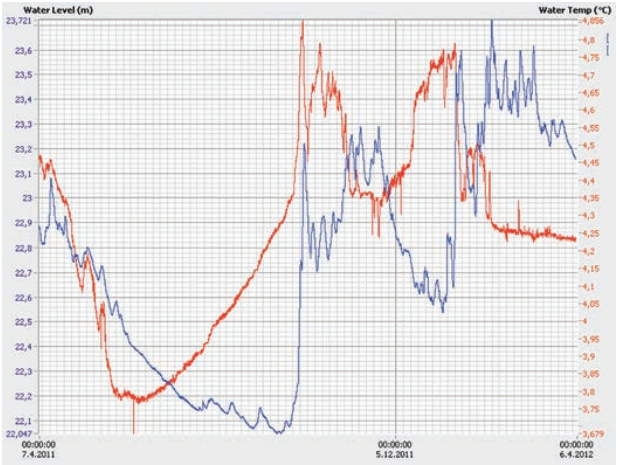

Figure 6: A graph showing one year of trend lines for groundwater level and the groundwater temperature. The time period is from April 2011 to April 2012

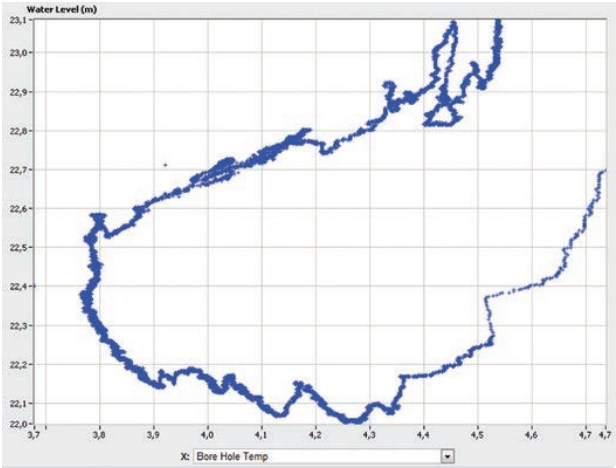

Figure 7: XY plot for the six-month period from April to September 2011, showing groundwater level vs. groundwater temperature