by Andres Thorarinsson

DATA WITH A VISION

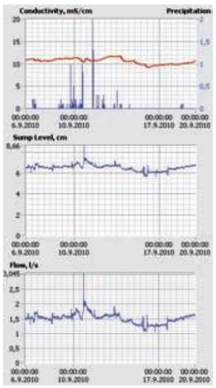
Weather data in industrial applications

Icelandic case studies focusing on the use of weather data figures from different segments of industry

Mainly occupied with instrumentation and data loggers, data collection and its management, Vista Engineering runs engineering services in Reykjavik, Iceland. Over the years a great number of different types of field stations have been added to the collection of stations the company serves. These include: weather stations, ambient air monitoring, harbor weather, industrial sites, building energy-efficiency programs, heated football fields, warehouses, sewer systems and more. The prime tool for study of weather data as well as industrial data is the VistaDataVision application.

When studying collected data, organizations strive to present it in such a way that meaningful information may be read, and correct conclusions drawn. As the company is fortunate to have data from so many field stations at its fingertips, it is easy to run all kinds of correlation tests in order to better understand the situation, and to draw fresh conclusions that make better sense.

Here are three cases where industrial data becomes meaningful when correlated with weather data. Weather data is purely data from standard weather stations equipped with wind sensor, temperature sensors, precipitation gauge, etc; industrial data is data from municipal systems, buildings and other similar activities.



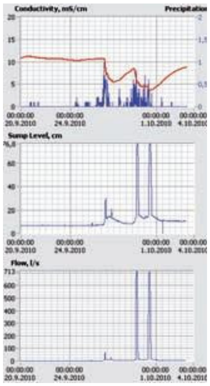
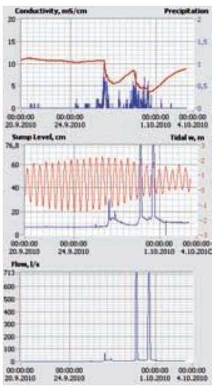


Figure 1 (left): Precipitation and normal operation

Figure 2 (right) : Strange behavior showing excess water level



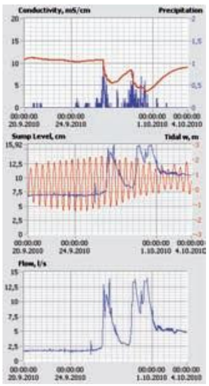


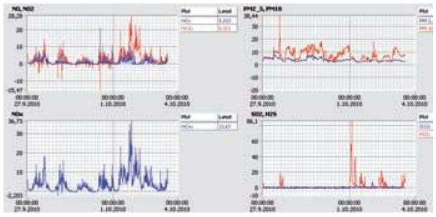
Figure 3 (left) : There is back-pressure during high tide

Figure 4 (right) : Automatic limitation of maximum level and new calculated maximum flow

Case one: landfill site drain

There is a landfill site that is not far from the Icelandic seashore and has been in use for several years. This is a clean and well looked-after operation. The landfill site needed drainage for precipitation, and the drain pipe is led downhill to a small sampling sump where discharge flow is measured using V-notch and water level sensors. Most of the time the water level above the V-notch is steady, and its 6cm head equals 1.5 liters/sec (Figure 1). During precipitation the amount of water increases as it should. Every now and then the water level increases up to almost 80cm and

"There is an automatic weather station in the area between the ambient air measuring site and the industrial site"



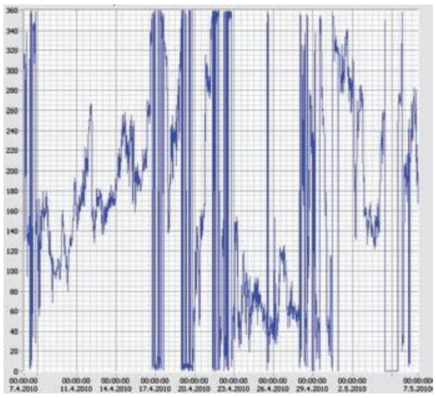


Figure 5 (Top): Ambient air monitoring station – one week of sensor readings

Figure 6 (below): Wind direction data time series is plotted on a time axis

therefore the calculated flow becomes 700 liters/sec, which is impossible (Figure 2).

Where did all the water come from? What is happening? Is this a sporadic sensor fault? How may it be traced?

As a first trial, the measurement readings from a nearby harbor sea tidal sensor were added to the graph of 'sump level' (Figure 3). It was at this point that all became clear: the tidal wave is to blame; or perhaps the faulty design of the small sampling sump and its outlet. The theory was that during a high tidal wave, there is back-pressure on the outlet from the small sampling sump, which lowers the capacity of the outlet pipe. Therefore during and after precipitation and high tide, there is more water than can get through; as a result

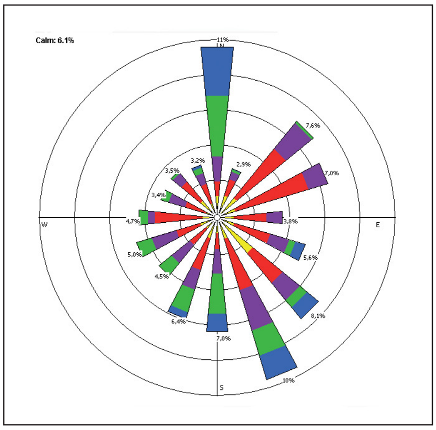


Figure 8: Wind direction data plotted on a wind rose. Now the wind direction distribution becomes clear – as close as it gets

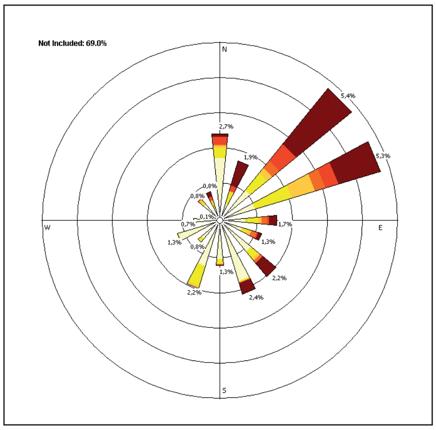


Figure 9: H_2S plotted on wind rose. Clearly most is coming in from NE, perhaps from the city and perhaps from a geothermal site

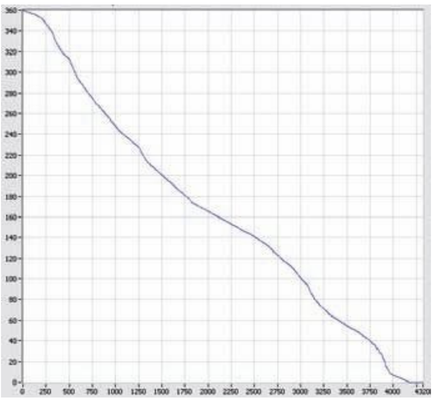


Figure 7: The sort-by-size graph shows that wind direction measurements are almost equally distributed over the range of 0-360°

the water level in the sump rises. This is evident in Figure 3, with two large peaks and a smaller one a few days earlier. This theory was checked on-site and proved to be correct. A quick correction included automatic limitation of maximum level reading to 15cm, which results in maximum calculated flow of 11 liters/sec (Figure 4). This was done on the fly for new as well as all older measurements, so, the older fault has now been corrected.

Case two: air pollution on wind rose

There is an ambient air monitoring station not far from a large industrial site. The monitoring station is equipped with instruments for measuring NO, NOx, NO_2, SO_2, H_2S, PM2.5 and PM10; readings are taken automatically every 10 minutes. Readings indicate air pollution, and there are those among the public who would like to point to the industrial site as the culprit. Unfortunately there is no wind sensor at the ambient monitoring site and therefore there is no direct indication of where the polluted air is coming from. The question is: where does the air pollution come from?

Luckily there is an automatic weather station in the area between the ambient air measuring site and the industrial site, making records every 10 minutes. Data from

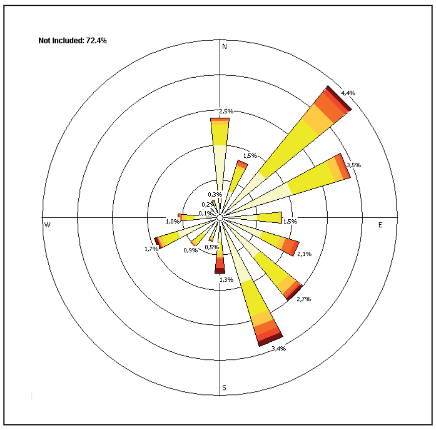


Figure 10 : NO plotted on wind rose, mainly originating from E part of the horizon, e.g. the nearby city and a highway

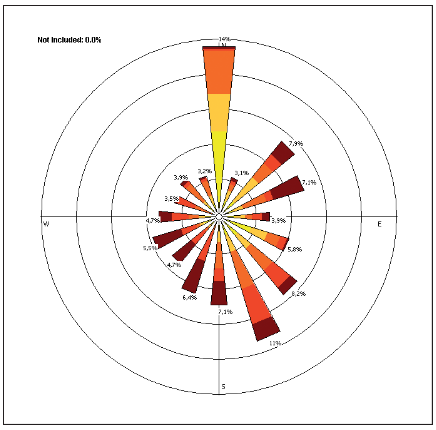


Figure 11: PM10 plotted on wind rose. Harbor is to N, city to NE, highway to S, industrial site to WSW

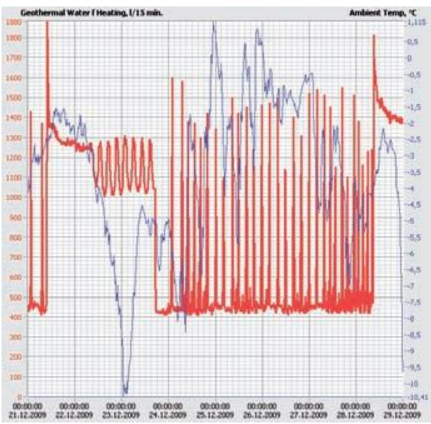


Figure 12: High school, showing large fluctuations in heating load due to unbalance in heating control systems

Figure 13: Office building, with good balance between heating and outdoor temperature; the colder outside the more heating is needed and vice versa