DustIQ DATA REDUCTION

Background
DustIQ measures and stores a new soiling measurement every minute to be in-line with the 2017 IEC solar park monitoring recommendations.

Since soiling accumulation is a slow process it doesn't always make sense to poll , store and display data gathered every minute. It certainly is not needed to calculate an average to reduce noise and improve the accuracy.

The way the DustIQ works with its Optical Soiling Measurement system allows it to work independently of the fluctuating sun. One can easily have many hours or even days of exactly the same value for soiling ratio.

Like the other systems available the DustIQ will notice and consequently report less meaningful values when there is dew, frost or rain on the panel. These data points should be ignored or removed.

Raw data example #1
The graph below is based on one DustIQ with two sensors. All minute values logged together with a time stamp for about 6 months produced about 14 MB of raw data. In general 99 % of the logged data is overhead for slowly changing soiling.

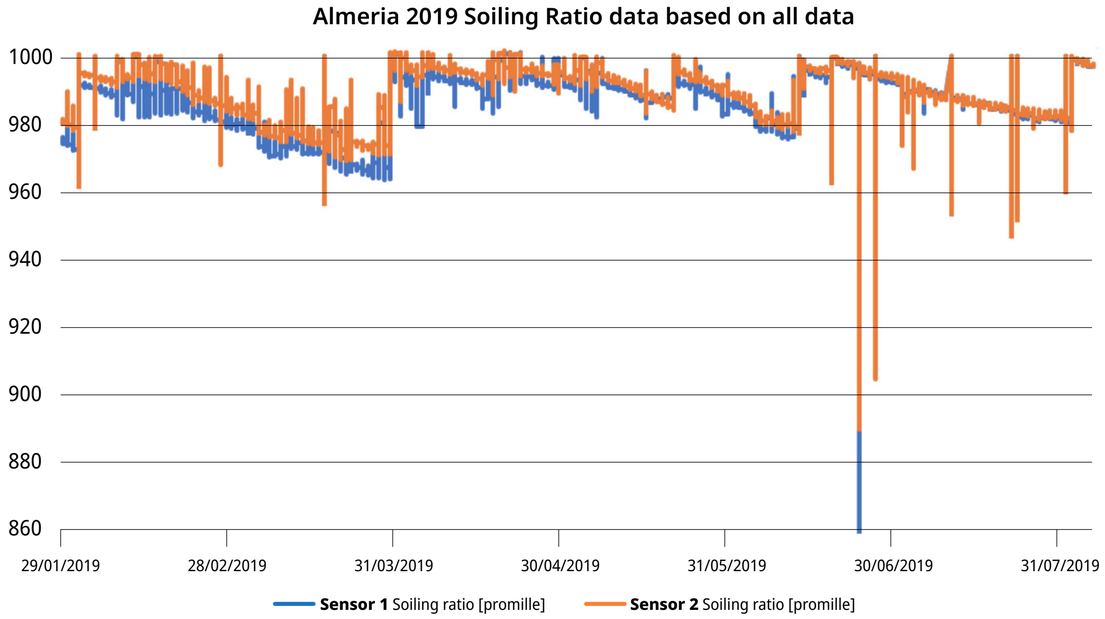

Figure 1. Raw data with 2 cleaning cycles and rain, dew and wind events

The y-axis shows the DustIQ Soiling Ratio in ‰ , 'per mille' or 'promille' and is percentage x 10.
The above graph is not easy to interpret, nor is it a good basis for the cleaning decision.

Data reduction example #1
When only the 14:00 hr measurements are selected (arbitrary time in the afternoon with for sure no dew) the file size goes down to 15 kB and the graph is much more clear.

The DustIQ has two independent sensors that, when installed vertically, will give different soiling readings as soiling seldom is completely uniform.

In the first few months the top sensor #2 had more soiling than sensor #1 and it is expected that a nearby real PV module would have the average soiling. A reason for the bottom sensor being cleaner is the run-off of morning dew that will take away some of the soiling.

The graph clearly shows the cleaning by personnel (the big steps), rain events (the smaller steps) and the wind and dew picking up a bit of the dust.

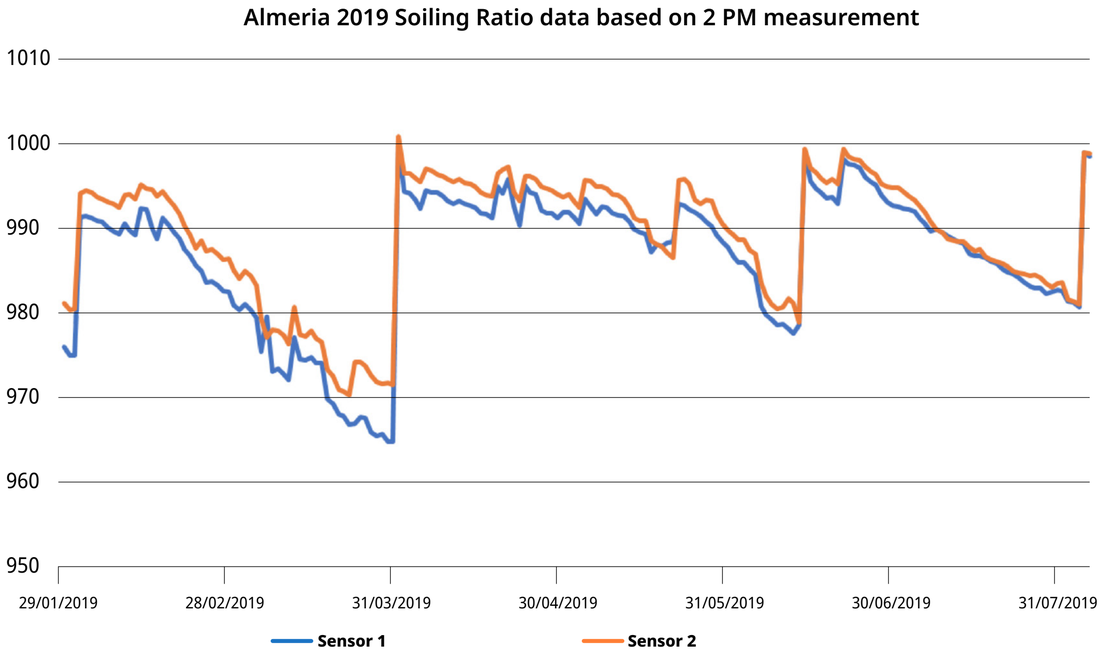

Figure 2. Reduced data set from Almeria

> “Another way of reducing data and removing noise is to combine weather station data”

Raw data example #2
The graph below is based on roughly 6 weeks of 1-minute data gathered on a very dusty location in Saudi Arabia where there's also a lot of evening, night and morning dew and even the occasional rain. With squinted eyes one could see a trendline but this trendline is hard to quantify.

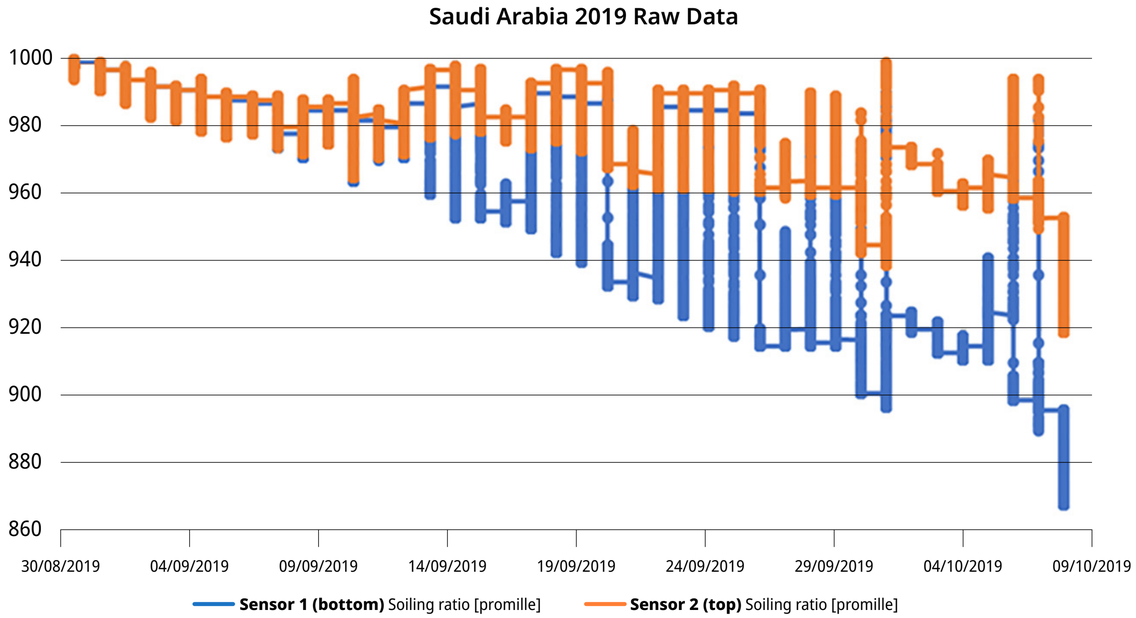

Figure 3. Raw data from Saudi Arabia

Data reduction example #2
By just using the 14:00 o'clock measurements again the data set is reduced dramatically and the trendline clearly visible.

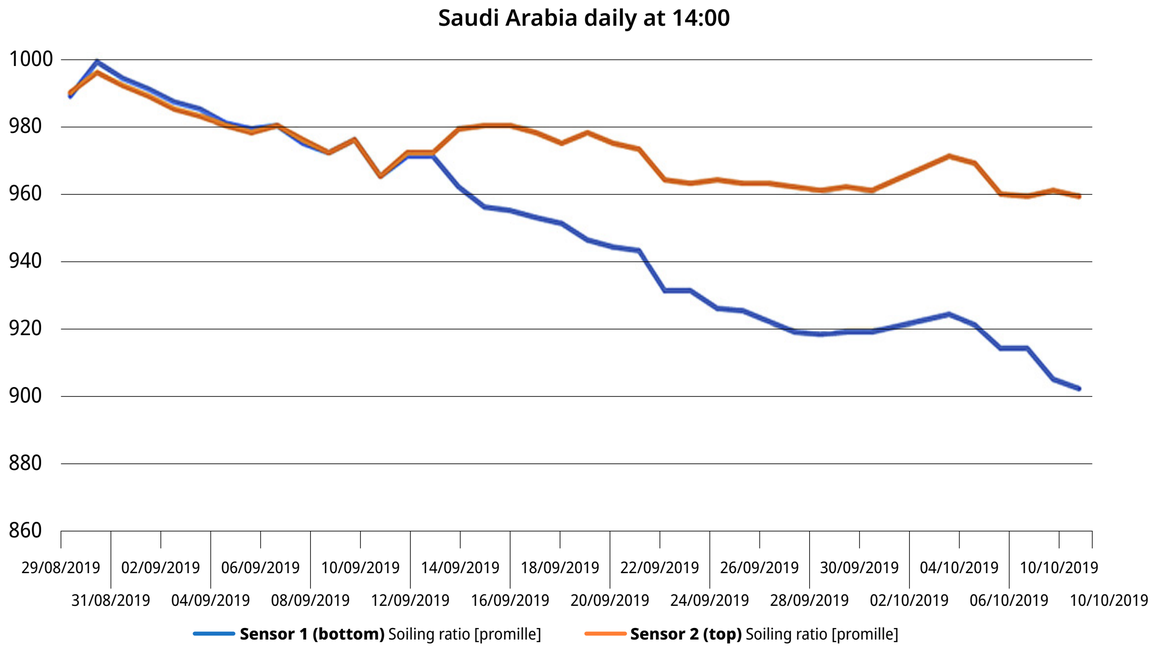

Figure 4. Reduced data set from Saudi Arabia

It is noticeable that the top sensor is much cleaner than the bottom sensor.

A reason could be that the top sensor is cleaned by dew run off and that the soiling ends up on the bottom sensor.

Local observations substantiate this assumption and even though this particular site really has a lot of dew, the run-off effect is a common feature seen at more sites.

Another way of reducing data and removing noise is to combine weather station data on the dew point and precipitation and remove all DustIQ data when the PV panel temperature is about 3 °C lower than the dew point temperature or when there is precipitation. An all-in-one weather station like the Lufft WS600 can help in determining the thresholds for removing DustIQ data.