Analysis Report

Moisture sensor analysis

This analysis shows the comparison performed between the Parrot Flower Power soil sensors and the WeMakeThings Chirp moisture sensors with the Smart Citizen Kit. Three sensors of each type were co-located and measuring data for several days. The aim was to check how the Chirp moisture sensors behave.

Sensor setup

The sensors were co-located in the same pot during several days:

The WeMakeThings Chirp sensors were normalised by measuring in dry air and summerged in water, using the procedure described here.

Sensor readings

Below there is a list with the reading from each sensor.

Parrot Flower Power:

- Air temperature (degC)
- Light (lux)
- Fertilizer level
- Soil moisture (raw and calibrated)
- Water tank level (n/a)

Smart Citizen + Chirp

- Air temperature and humidity (degC - %rh)
- Light (lux)
- Noise (dBA)
- Barometric pressure (kPa)
- Air quality metrics: eCO2 (ppm), tVOC (ppb) and PM2.5 (ug/m3)
- Soil moisture (raw and calibrated)

Sensor data

Below, there is a time series comparison of the sensor. The sensor tagged as 10261 had an electric problem and it did not measure moisture continuously.

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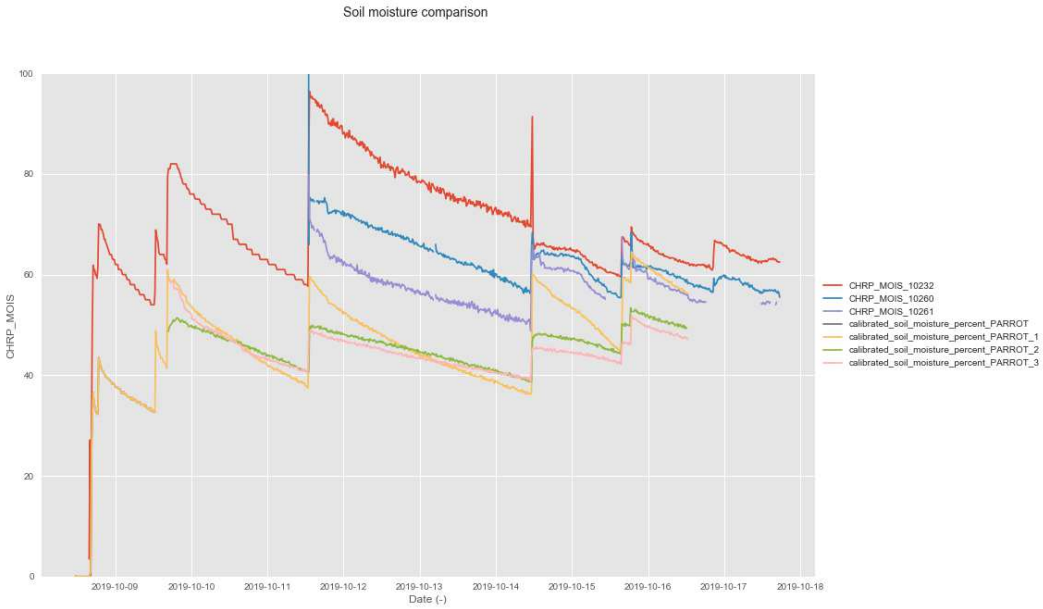

Sensor Correlation

The sensors show a high level of correlation among all of them. However, we can see that there are different clusters of data for different days. This is somehow normalised after the 15th/Oct, when the first watering took place in the pot.

The correlation between the Chirp readings is between 0.77 and 0.92. While the correlation between the Parrot readings is higher and more stable, of 0.95. Both sensors show a clustered behaviour during the first period, with respect to the second, which it is probably due to the different distribution of water before the first watering event.

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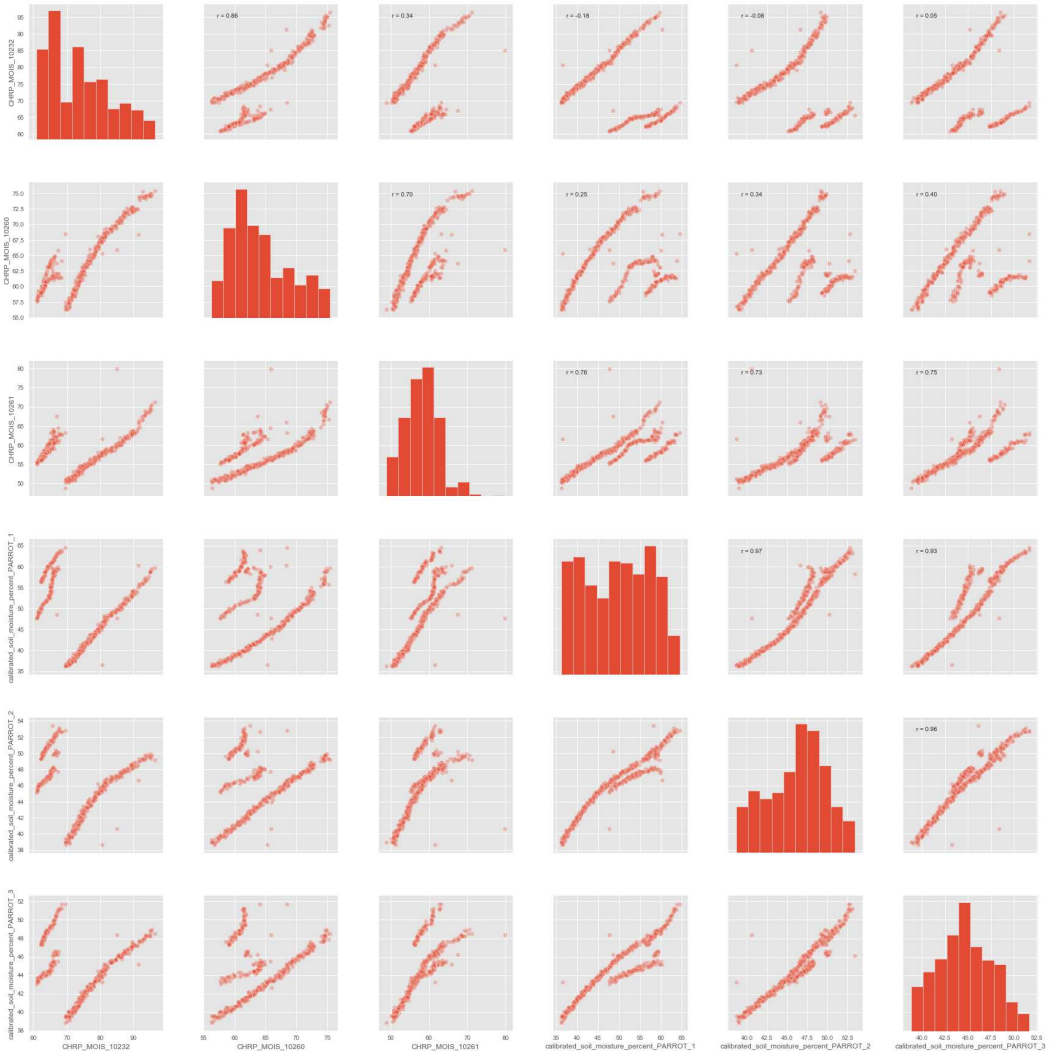

When substracting the data prior to 15/Oct:

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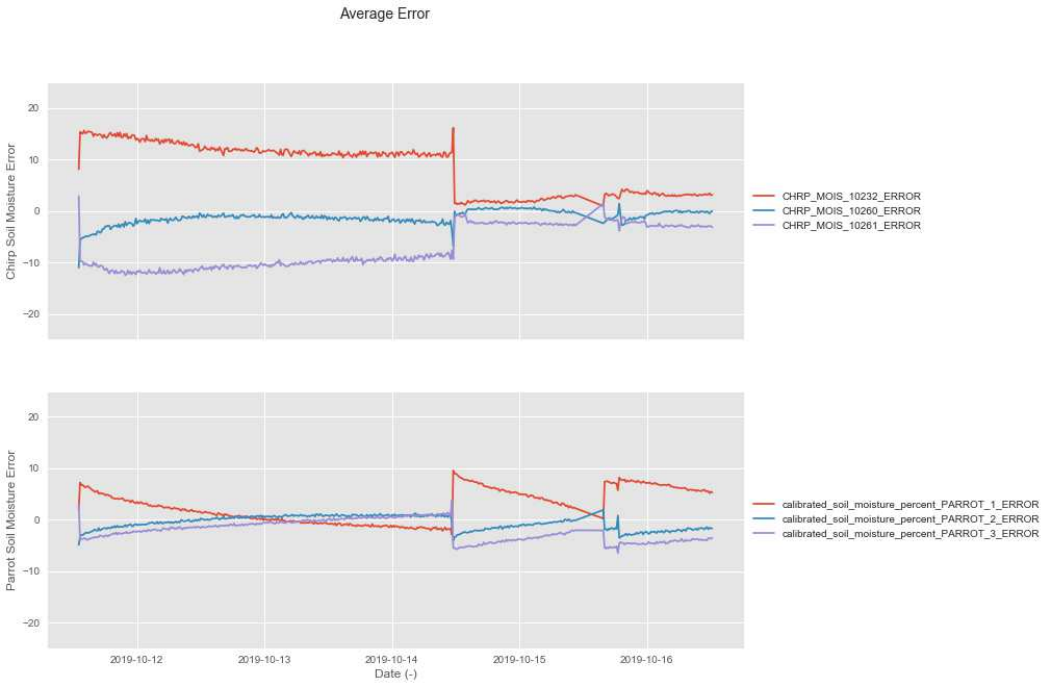
Sensor dispersion

The errors below were calculated by first averaging each type of sensors (average of the three chirps on one hand, and average of the three parrots on the other), and then substracting each individual sensor to the corresponding average.

Even if the parrot sensor show a higher and more stable correlation, is seems that the chirp sensor has a lower bias. Nevertheless, these conclusions are very limitted and the amount of data is not enough to make great assumptions.



Conclusions

Both sensors show a good behaviour and the values can be correlated with good R2 scores. The approach for this low-cost sensors, in general, should be more qualitative than quantitative (analyse the trends rather than the absolute values), since their values appear to differ between sensors, even when normalised. The errors don't seem to behave in the same way for both types of sensors, which is probably due to their position in the pot. Nevertheless, besides the actual values, all the sensors seem to read the watering events.

In the particular case of the Chirp sensor, the sensor seems to be fairly normalised with simply a two calibration values (water and air) as a first approach. The errors are contained within 5%rh after the 15/Oct, when the sensors seem to stabilise after the first watering event. However, as seen above, and as mentioned in different manuals, the sensor might need to have a O(2) fit (polynomial), to catch real behaviour in the soil.

A more complex design for an irrigation system might need to take into account a better calibration procedure (for instance, shown here.