Air Quality Station

The Air Quality Station will allow your city to monitor key pollution parameters through Artificial Intelligence. More granularity to measure AQI in the city

Cities require Reference Air Quality stations to monitor key pollution parameters. These stations have high costs and their size is significant. A higher spatial granularity is needed with a much larger number of reference stations spread throughout the city. **Libelium can solve** this by providing smarter Air Quality Stations that can be distributed in the key points of the smart city.

We make the difference

✓ GRANULARITY:
Affordable, small and accurate stations, so that its deployment can cover more of the city's key areas.

✓ TESTS & RESULTS:
Take a look at the most recent studies we published and discover how the trained algorithm lead us to get the best R^2 and MAE in the market.

✓ TWO CALIBRATION OPTIONS:
To apply the Artificial Intelligence models, Air Quality Station needs to be calibrated first. We offer two types of calibration options.

Gases, particle matter, noise level and weather station

LTE

Radio: LTE (4G)

Machine learning algorithms applied

1. Parameters that can be measured

Air Quality Station allows you to measure the most relevant pollutants and key parameters required in every air quality project.

- **Particulate matter (PM2.5, PM10).**
- **Different gases: CO, NO_2, NO, O_3, SO_2.**
- **Weather Station: Wind and compass, precipitation, temperature, humidity and pressure or solar radiation.**
- **Noise Level.**

2. The Air Quality Station that learns

Co-location calibration against Reference Station:
With this process you will obtain the most accurate results. You must get access to a reference station

Step 1:
Co-location phase: Air Quality Station will be deployed next to the reference station to collect data for 1 month. This is needed in order to calibrate Air Quality nodes against scientific reference stations.

Step 2-3:
Data from the Reference station will be sent to Libelium Cloud through a CSV file. Meanwhile, all data gathered by Libelium Air Quality Station has been collected in the cloud.

Step 4:
Then the calibration process starts in the Model Factory section from our Cloud. This is where Artificial Intelligence takes part, allowing the user to start predictive models.

Step 5:
Once the AQS node has been calibrated and trained it is ready to be deployed.

***Remember that you can calibrate against the reference station more than one AQS node at the same time.**

Calibration against Golden node:

This phase is interesting in case the project requires a large number of Air Quality Stations. In this way, it is possible to calibrate the remaining nodes with the node that was calibrated against the Reference Station in phase 1 (now called Golden Node).

Step 1:
Co-location phase: Your Air Quality Station previously calibrated against Reference Station is now named Golden Node.

Step 2:
Collect data during the training period

Step 3:
Import reference data to Libelium Cloud

Step 4:
Generate a new model

Step 5:
Deploy the calibrated Air Quality station device

A "golden node" is an Air Quality Station node previously calibrated by co-location process. This means that a first "Co-location" phase must be completed prior defining the device as "golden node".

Apply universal models: optimal accuracy with less effort:

There are many barriers to accessing a reference station. That is why at Libelium we provide an alternative option for those users who do not have access to reference stations. The collected data layer from different locations analyzed in the recent studies allowed us the design of a generic artificial intelligence model for air quality prediction. Moreover, Libelium Air Quality Station's universal model continues to learn and train itself from all Air Quality Stations deployed and placed next to reference stations, so it will become richer, more dynamic and more accurate.

Step 1:
Different Libelium Air Quality Stations were deployed near Reference Stations and the collected data from the Reference stations will be sent to Libelium Cloud to shape the universal model.
Step 2:
Now your Libelium Air Quality Station can work with the calibration against the universal model.

3. Air Quality Station + Libelium Cloud

Data extracted from Scientific Reference Air Quality station is used in Artificial Intelligence (AI) model automation specifically for every project.

Libelium Cloud is the new software platform that allows the management of an IoT project from the beginning to the end.

TECHNICAL FEATURES

MECHANICAL SPECIFICATIONS	Dimmensions	271 x 170 x 120 mm
	Weight	2.152 Kg
	IP Grade	IP65
	Operating temperature	-30 °C to +45 °C
GENERAL SPECIFICATIONS	Loop time	1, 5, 10, 15, 30, 60 min (1 min default)
	Transmission time	5 min to 1 hour (5 min default)
	Libelium Cloud	Remote parameter configuration
	Smart Devices App	Desktop application for parameter configuration and firmware upgrade
CONNECTIVITY	Wireless communications	LTE
	GPS	GPS, BeiDou, Galileo and GLONASS
	SIM card	Libelium SIM included
POWER SPECIFICATIONS	Power supply	100-240 VAC, 50/60 Hz 0.35A
	Internal battery	2200 mAh, Li-SOCl2 battery
SENSORS	Gas sensors	SO_2, O_3, NO, NO_2, CO
	Temperature	Internal & External
	Humidity	Internal & External
	Particulate matter	PM1, PM2.5 and PM10
	Weather Station	Wind, compass, precipitation, temperature, humidity, pressure and solar radiation
	Noise	Class 2 soundmeter IEC 61672
CERTIFICATIONS	CE (Europe)	
	UKCA (United Kingdom)	
	FCC (USA)	
	IC (Canada)	

KEY METRICS

Parameter	Resolution	Operating Range	Temperature Range	Humidity Range	R^2	Accuracy (MAE)	90% Confidence	Life Cycle
CO	1 µg/m³	0 to 1000 ppm	-30 to 50 °C	15 to 90 %	>0.75	40 µg/m³	80 µg/m³	> 2 years
NO	1 µg/m³	0 to 20 ppm	-30 to 40 °C	15 to 85 %	>0.8	5 µg/m³	11 µg/m³	> 2 years
NO_2	1 µg/m³	0 to 20 ppm	-30 to 40 °C	15 to 85 %	>0.7	7 µg/m³	15 µg/m³	> 2 years
O_3	1 µg/m³	0 to 20 ppm	-30 to 40 °C	15 to 85 %	>0.85	9 µg/m³	14 µg/m³	> 2 years
SO_2	1 µg/m³	0 to 100 ppm	-10 to 50 °C	15 to 90 %	>0.3	1 µg/m³	2 µg/m³	> 2 years
PM1	1 µg/m³	0 to 1000 µg/m³	-10 to 50 °C	0 to 95 %	TBD	TBD	TBD	> 2 years
PM2.5	1 µg/m³	0 to 2000 µg/m³	-10 to 50 °C	0 to 95 %	TBD	TBD	TBD	> 2 years
PM10	1 µg/m³	0 to 10000 µg/m³	-40 to 125 °C	0 to 95 %	TBD	TBD	TBD	> 2 years
TEMPERATURE	0.01 °C	-40 to 125 °C	-40 to 125 °C	0 to 100 %	>0.9	1 Celsius	2 Celsius	> 5 years
REALITIVE HUMIDITY	0.01%	0 to 100 %	-40 to +85 °C	0 to 100 %	>0.85	5%	10%	> 5 years
PRESSURE	0.03 Pa	300 to 1250 hPa	-30 to 50 °C	0 to 100 %	>0.95	0.4 hPa	0.8 hPa	> 5 years

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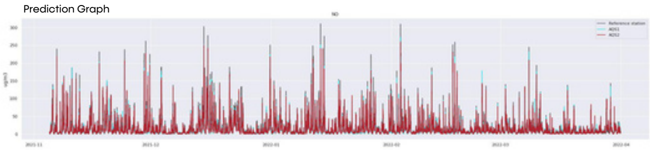
TESTS & RESULTS

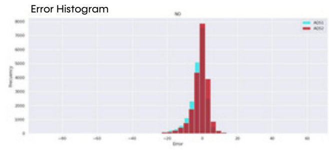
We run a test in Q42021 + Q12022 in Terrasa- Spain (1) and Zaragoza- Spain (2) on which you can check the high results we have obtained in these co-location studies we developed to improve our machine learning algorithms:

CARBON MONOXIDE (CO):

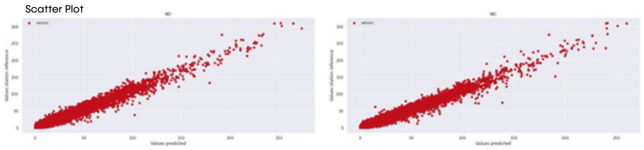
Prediction Graph



Error Histogram



Scatter Plot

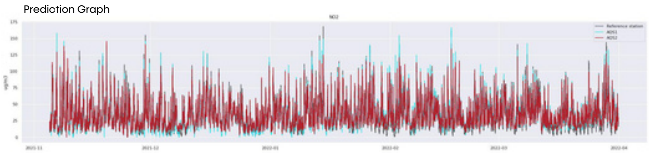


Metrics

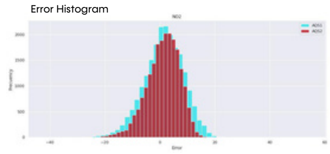
Device	R^2	MAE	Confidence
AQS1 Terrasa	N/A	N/A	N/A
AQS2 Terrasa	N/A	N/A	N/A
AQS1 ZGZ Roger de Flor	0.80	42.41	89.34
AQS1 ZGZ Jaime Ferrán	0.70	24.97	51.43
AQS2 ZGZ Jaime Ferrán	0.80	24.59	49.12

NITROGEN MONOXIDE (NO):

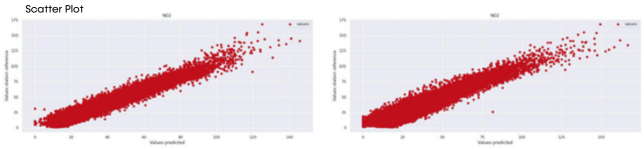
Prediction Graph



Error Histogram



Scatter Plot

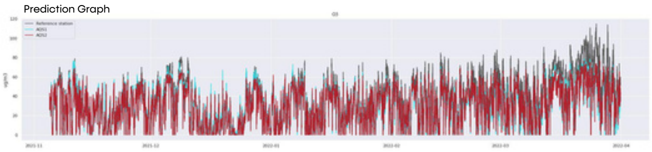


Metrics

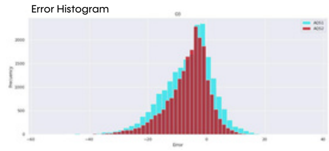
Device	R^2	MAE	Confidence
AQS1 Terrasa	0.96	3.31	7.52
AQS2 Terrasa	0.96	3.36	7.38
AQS1 ZGZ Roger de Flor	0.89	6.33	14.20
AQS1 ZGZ Jaime Ferrán	0.63	5.08	11.18
AQS2 ZGZ Jaime Ferrán	0.71	4.12	9.11

NITROGEN DIOXIDE (NO_2)

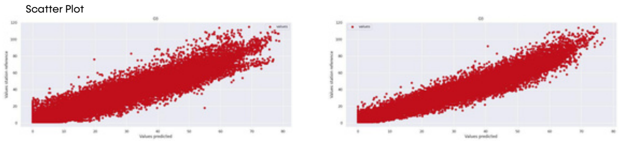
Prediction Graph



Error Histogram



Scatter Plot

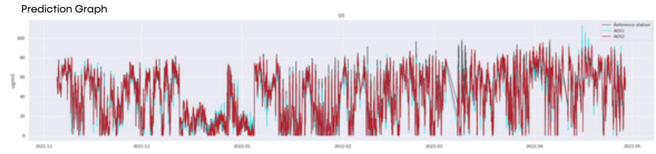


Metrics

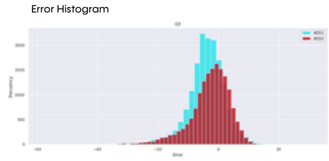
Device	R^2	MAE	Confidence
AQS1 Terrasa	0.90	5.63	11.66
AQS2 Terrasa	0.94	4.39	8.96
AQS1 ZGZ Roger de Flor	0.71	7.91	16.31
AQS1 ZGZ Jaime Ferrán	0.67	4.70	10.70
AQS2 ZGZ Jaime Ferrán	0.62	5.11	11.47

OZONE (O_3)

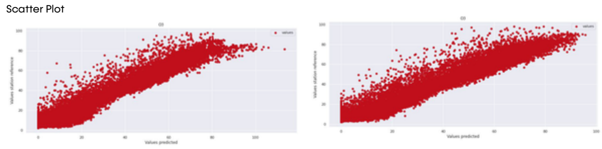
Prediction Graph



Error Histogram



Scatter Plot



Metrics

Device	R^2	MAE	Confidence
AQS1 Terrasa	0.87	6.40	13.63
AQS2 Terrasa	0.92	4.93	10.79
AQS1 ZGZ Roger de Flor	0.87	7.03	12.17
AQS1 ZGZ Jaime Ferrán	0.93	4.59	9.97
AQS2 ZGZ Jaime Ferrán	0.92	5.01	10.57

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