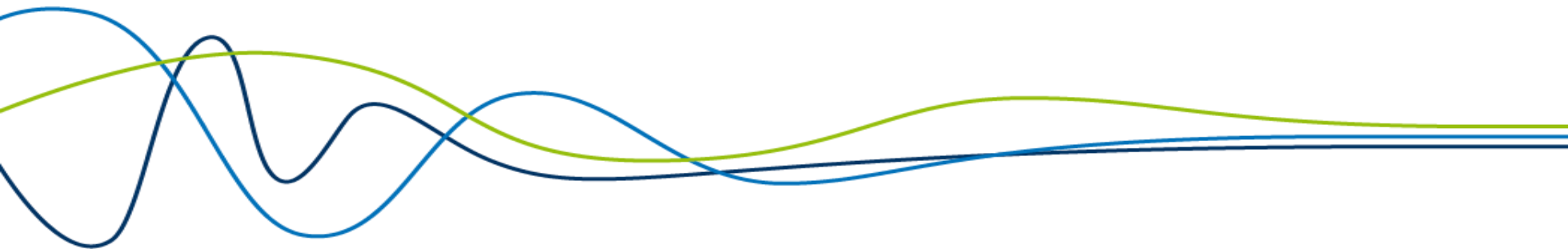




Webinaire - 23 & 24 juin 2020



The strategic challenges of air quality measurement using hybrid and energy-efficient solutions



Serge S. AFLALO, PhD / VP Sales & Marketing
June 23rd, 2020

Measure & monitor air quality anytime & anywhere ... a vital need!

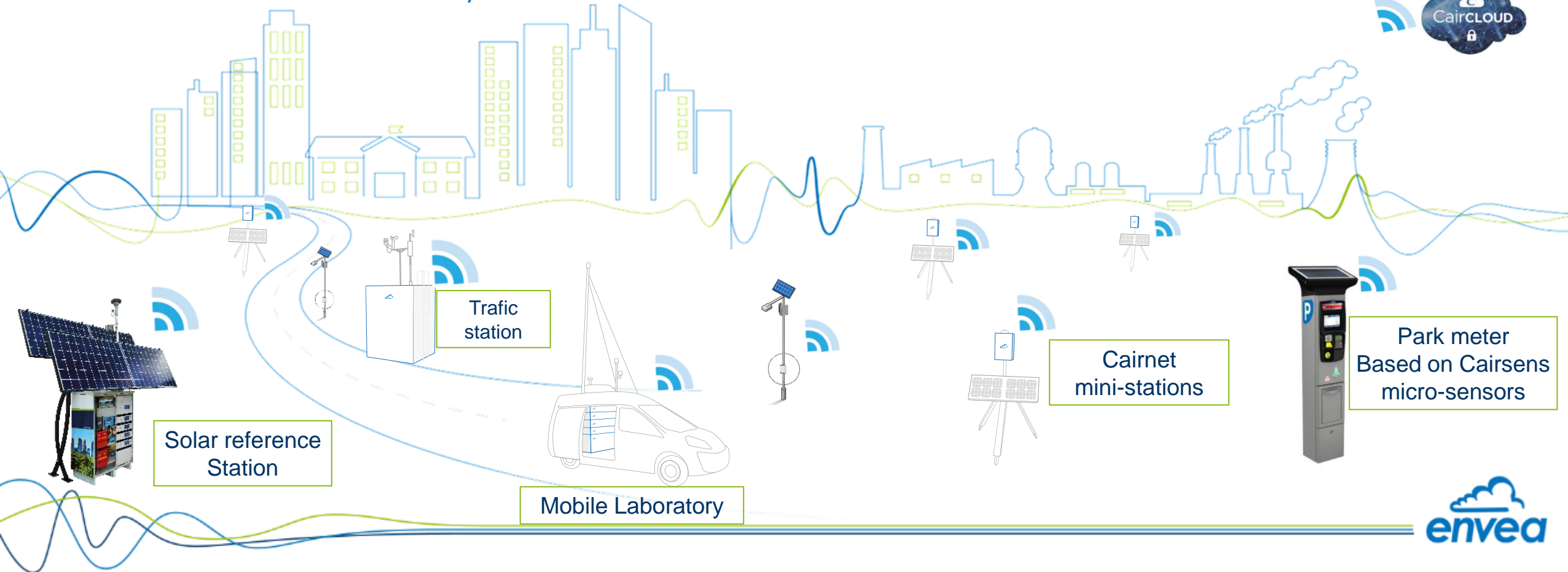
- The pollution caused by urban activities (PM_{10} & $\text{PM}_{2.5}$, SO_2 , NO_2 , O_3 , ...) as well as by industrial activities (H_2S et NH_3) is harmful to health.
 - › Olfactory and breathing discomfort
 - › Negative impacts on health increasing with exposure time and exposure level
- Integration of industrial sites in urban areas / house building in rural areas
 - › Residents' intolerance to all kinds of nuisances
 - › Growing impact on population health
 - › A challenge for industries, cities and local environmental authorities

Are there stricter, more efficient and cost-efficient ways to manage and control diffuse pollutant emissions?



A hybrid approach: Focus on solar energy

- ✓ Multi-parameter reference stations complemented by mini-stations based on micro-sensors
 - ✓ Autonomous in energy (solar panels & high-power rechargeable batteries)
 - ✓ Adaptable / embeddable to urban infrastructure (smarts cities)
 - ✓ Wireless communication, real-time data in the Cloud



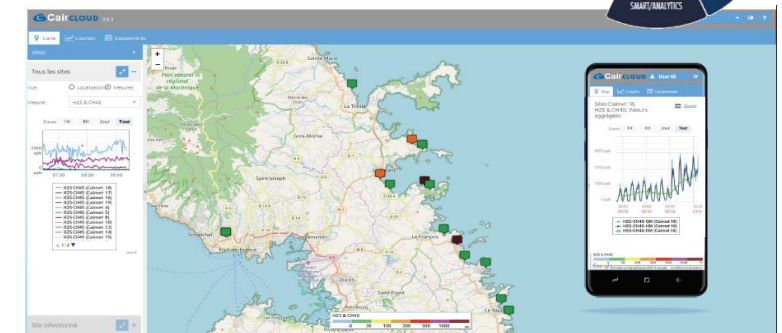
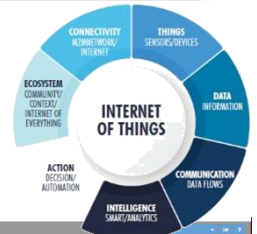
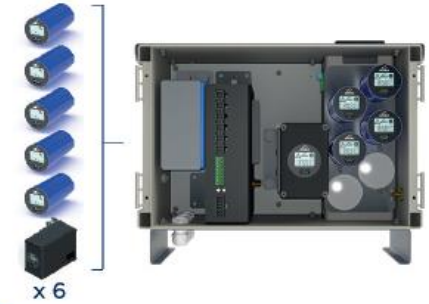
A global solution for air quality monitoring

- ✓ **Reference measurements** for air quality monitoring systems: more than 40 years of expertise
- ✓ « **Indicators** » **micro-sensors technology**: more than 13 years of expertise
- ✓ **Environmental data processing software**: more than 25 years of expertise



Cairnet mini-station: An efficient and cost-effective solution

- Ambient air quality monitoring mini-station
 - ✓ Measures **up to 6 pollutants (gas & Particulate Matter)** + temperature, humidity & atmospheric pressure
 - ✓ **100% autonomous:** Solar energy & embedded battery + cellular communication (3G, 4G ...)
 - ✓ Accuracy and reliability of the measurement improved by **dynamic sampling**
 - ✓ 1-minute measurements, ready to use
 - ✓ No hardware installation: All data available in the Cloud!



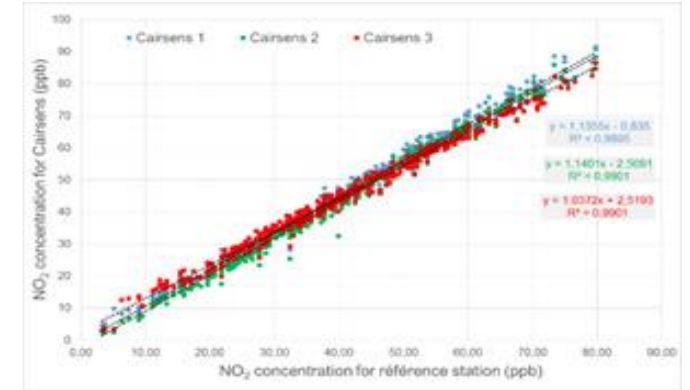
Cairsens micro-sensors: advanced technology

- Electrochemical for most of gases (PID for nmVOC), laser scattering light for particulate matter (PM)
- Dynamic sampling & conditioning
 - ✓ Low consumption & reliable dedicated micro-fan
 - ✓ Air moisture buffer (patented) to increase measuring accuracy in wet condition
- Advanced & high sensitivity electronics
 - ✓ Able to measure nA with electronic noise filtering
 - ✓ Very low consumption : < 15 mA
- Embedded data acquisition and signal treatment
 - ✓ Reliable and accurate technology
 - ✓ Management and compensation according to the sensor aging



Cairsens micro-sensors: advanced metrological qualification

- Calibrated in ENVEA's metrological laboratory with the use of certified Reference AQMS monitors
 - ✓ Dedicated laboratory & metrological bench
 - ✓ Calibration of 100% of micro-sensors
 - ✓ Several calibration points carried out within the measuring range
 - ✓ Automatic validation procedure for an allowed accuracy range
- Every sensor is shipped with its calibration certificate



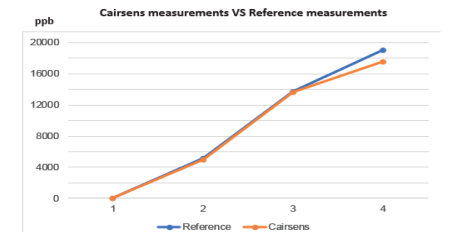
Calibration certificate

Cairsens S/N: CAV02000006615
Gas: NH3
Measuring range: 0-25 ppm
Firmware: V1.52

Measurement (ppb)	
Reference	Cairsens
1	0
2	5182.5
3	13774.7
4	19009.6

Reference apparatus: AC32M S/N 1852
Calibration bench: Cairpol

Calibration Date: Dec 12, 2019
Calibrated by: CL
Controlled by: ABD



This product is in accordance with ENVEA's QHSE policy and its measurements comply with the European directives 2008/50/EC

- Measurements of specific pollutants with comparable results to reference methods

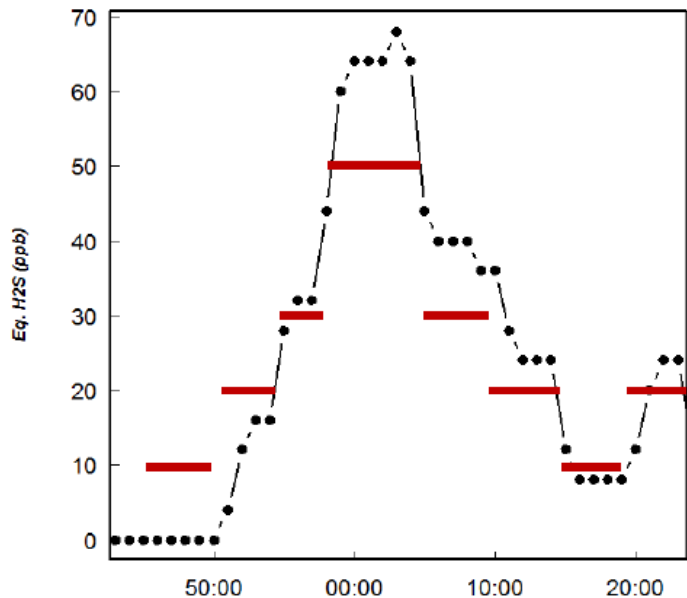


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Cairsens micro-sensors – Metrological validation

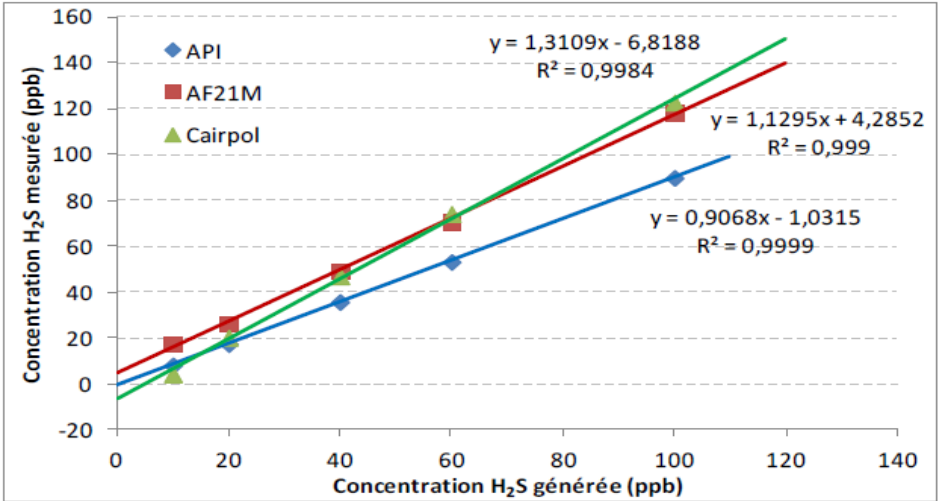
Bench (laboratory) tests



H2S equivalent levels measured by the **Micro-Sensors Cairsens** - **black dots** - during its exposure to a **controlled atmosphere of H2S** - **red bars** - generated by dilutor / standard gas cylinder system

- Different concentration levels tested on low range - 10 to 70 ppb: very good response of the sensor with high sensitivity.
- Repeatable and reliable metrological performances:

Detection limit	Response Time	Deviation of the measurement	Repeatability
10 ppb	> 1 min.	> 10 ppb	4 ppb



Linearity of H2S measurements: linear regression lines obtained for **Cairsens** (in green) and the reference analyzers T101 (in blue), AF21M (in red)

* : source LCSQA « Ammonia and sulphur compounds monitoring – olfactive nuisances » 2014



Cairsens micro-sensors: Established references...

- ✓ A complete range of reliable and proven micro-sensors:
 - Industrial & institutional
 - US EPA / Joint Research Center EU
 - Air Quality Monitoring Dept. of AQMD USA (AQ-SPEC)



CAIRSENS

US EPA

.....Excellent linearity.....

.....Excellent precision.....

.....Highly similar trends to reference monitors.....

EU JRC (Joint Research Center)

.....The Data Quality Objective of indicative method of the European Directive is met by the Cairsens O₃/NO₂.....

.....Accuracy about 20 % while the DQO is 30 %.....

Low power consumption AQMS reference station: The first autonomous air quality monitoring solar station

An ambitious challenge for ENVEA:

Create a reference station (**certified analyzers**)
fully autonomous, powered by green energy such
as solar panels, wind turbines, etc..

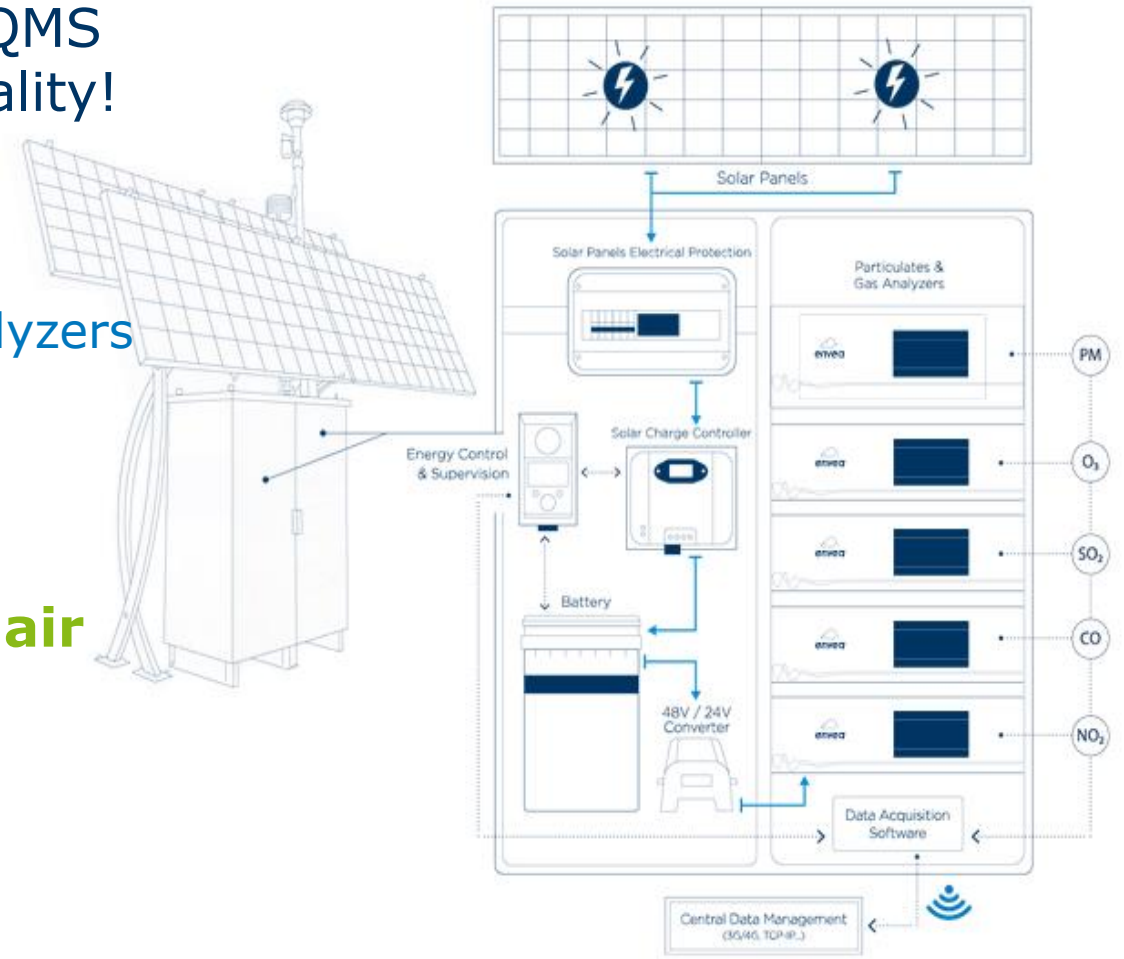
- Reference analyzers: US EPA, EU QAL1, LCSQA...
 - ✓ Reliable measurements anytime (24 hours a day) & anywhere
- A fully autonomous power source
 - ✓ Solar panels and / or batteries



www.solar-aqms.com

Low power consumption AQMS station: Technical challenge for reference analyzers

- Significant power consumption reduction of AQMS analyzers without reducing measurements quality!
 - ✓ Suitable for **24Vdc** power supply
 - ✓ Ultra-low energy consumption:
 - ➔ **300 W/h** only for 5 gas and particles analyzers
 - VS more than 1.300 W/h required for 1 « traditional » reference
- Supports temperatures up to +50°C **without air conditioning**



Low power consumption AQMS station: Laboratory evaluation test

➤ Test of the temperature influence on the measurement in a climatic chamber

- ✓ Test at 10, 20, 30 et 40°C ± 5°C
- ✓ Generate gas concentration (see table 2) : standard cylinder+ gas mixer MGC101.
- ✓ Each analyser was tested with zero air in order to measure the influence of temperature at the zero point and at 80% F.S.

Table2: Gas concentrations generated for the tests

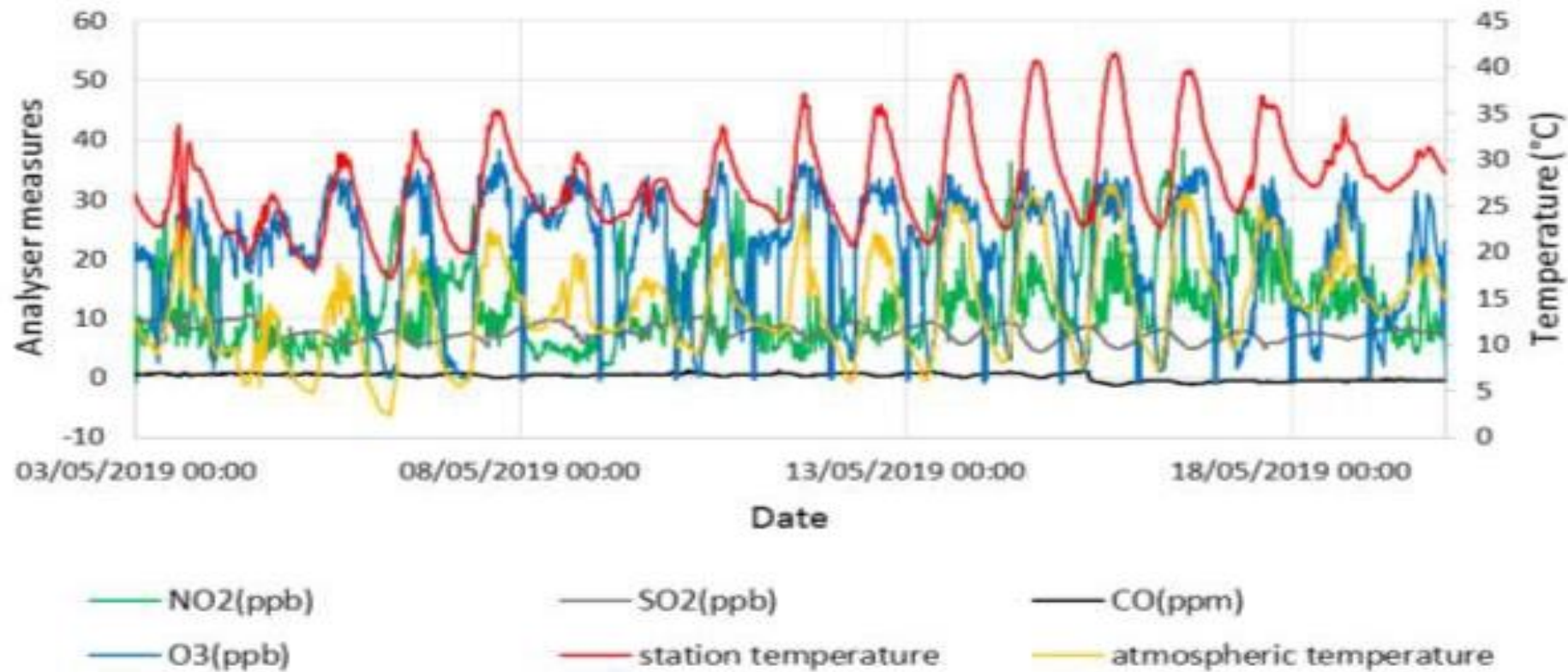
analyser	Measure range	Gas measured	Gas concentration 1	Gas concentration 2
CO12e	50 ppm	CO	0 ppm	30 ppm
O342e	500 ppb	O3	0 ppb	400 ppb
AF22e	1 ppm	SO2	0 ppb	800 ppb
AS32M	1 ppm	NO2	0 ppb	800 ppb
AC32e	1 ppm	NO2	0 ppb	800 ppb

Result

Table 3: Influence of the temperature on the analyzers measurements

Analyser	Drift for 30°C		Drift for 1°C	
	At 0 ppb	At span point	At 0 ppb	At span point
CO12e	-180 ppb	700 ppb	-6 ppb	20 ppb
		2.33 % of the measured value		0.08 % of the measured value
O342e	0.44 ppb	-2.49	0.015 ppb	-0.083 ppb
		-0.62 % of the measured value		-0.02 % of the measured value
AF22e	-4.49 ppb	-29.85 ppb	0.15 ppb	-1 ppb
		-3.59 % of the measured value		-0.12 % of the measured value
AS32M	0.41 ppb	3.84 ppb	0.014 ppb	0.13 ppb
		0.48 % of the measured value		0.016 % of the measured value
AC32e	0.23 ppb	12.77 ppb	0.01 ppb	0.43 ppb
		1.55 % of the measured value		0.05 % of the measured value

Low power consumption AQMS station: Field evaluation test

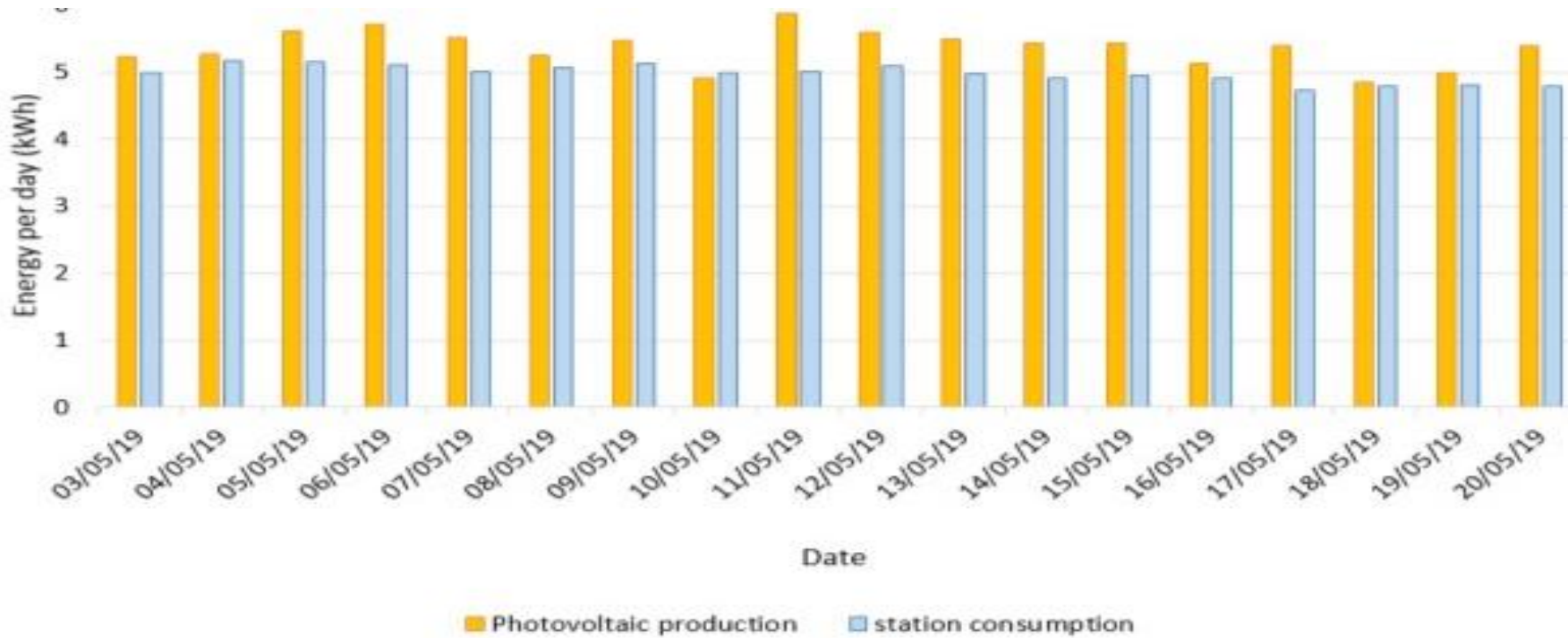


- Measurement of SO₂, CO, O₃ and NO₂ during May 2019 in Poissy (France).
 - ✓ Even when the temperature inside the station rises to +40 °C, no failures were observed

<https://solar-aqms.com/>

Low power consumption AQMS station: A pilot station on trial

24h of a day / 365 days a year

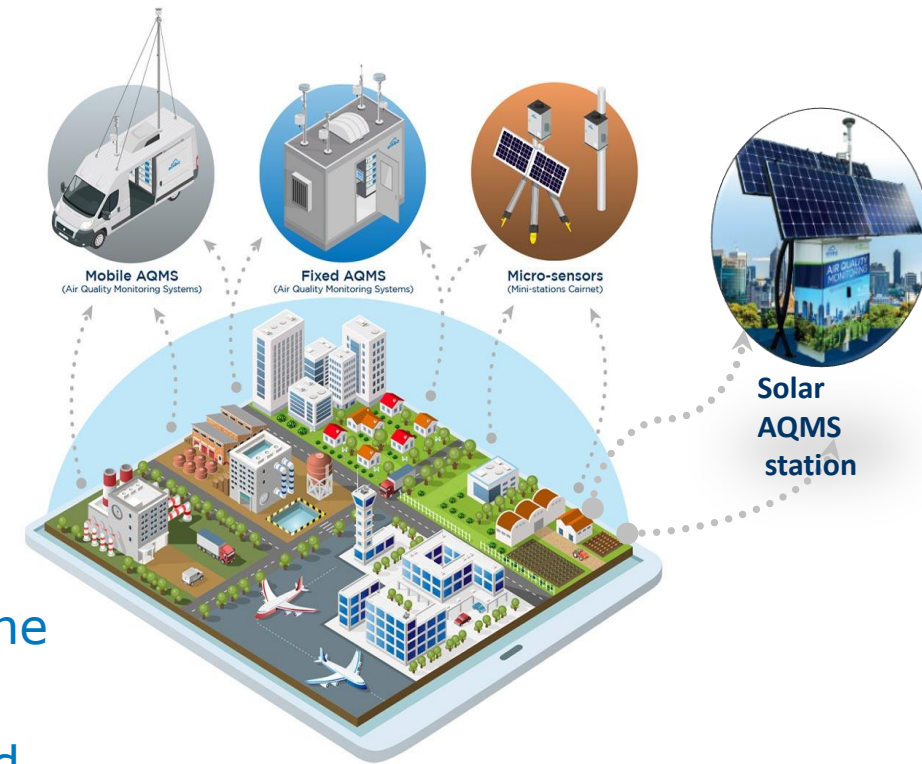


<https://solar-aqms.com/>

- Power consumption and photovoltaic production during the month of May 2019 in Poissy
 - ✓ Optimized photovoltaic consumption and production: **P < 5000 Watt/day**
 - ✓ The power production is limited to the needed energy, however, it can be adapted to the world region of use, as well as the measurement period (winter / summer).

« Hybrid » monitoring networks: Micro-sensors combined with reference stations

- Micro-sensors: a significant and additional data and information source
 - ✓ Precise and reliable data to feed, for example, a mathematical dispersion model
 - ✓ Indicative measurement \neq Reference measurement
 - ✓ No certification / No approvals
- Combined solution of « Solar » reference stations and micro-sensor-based stations
 - ✓ This is possible through reduced power consumption of the analyzers!
 - ✓ Simultaneous air quality mapping of an industrial site and a city (traffic and background area)
 - ✓ Reduction of micro-sensor uncertainties caused by environmental conditions
 - ✓ Low cost for high efficiency monitoring network



<https://www.envea.global>



Two case studies

WWTP: Real-time odors monitoring & emissions impact

- Context: Several odor sources to be monitored on real-time basis to prevent olfactory nuisances

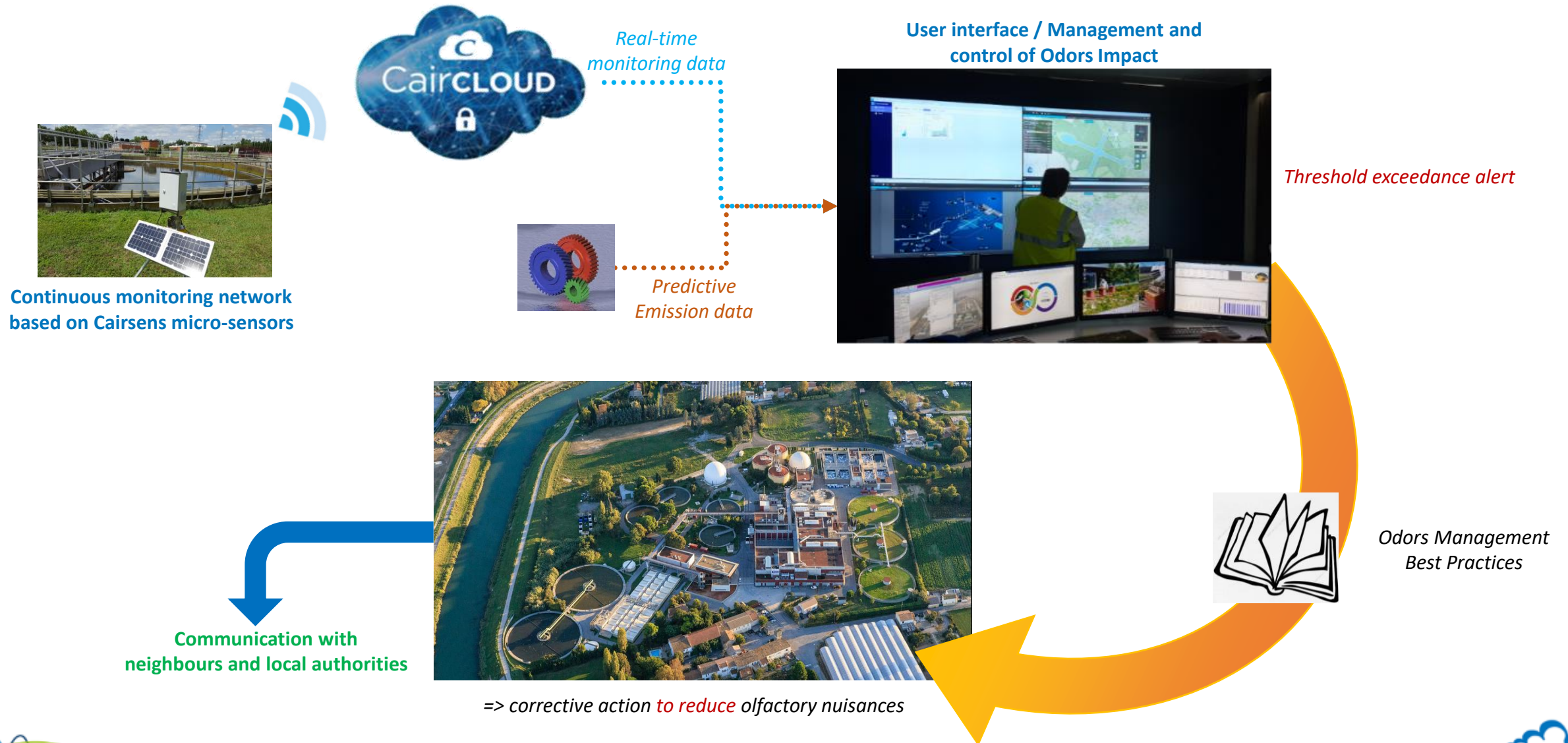


Waste Water Treatment Plant

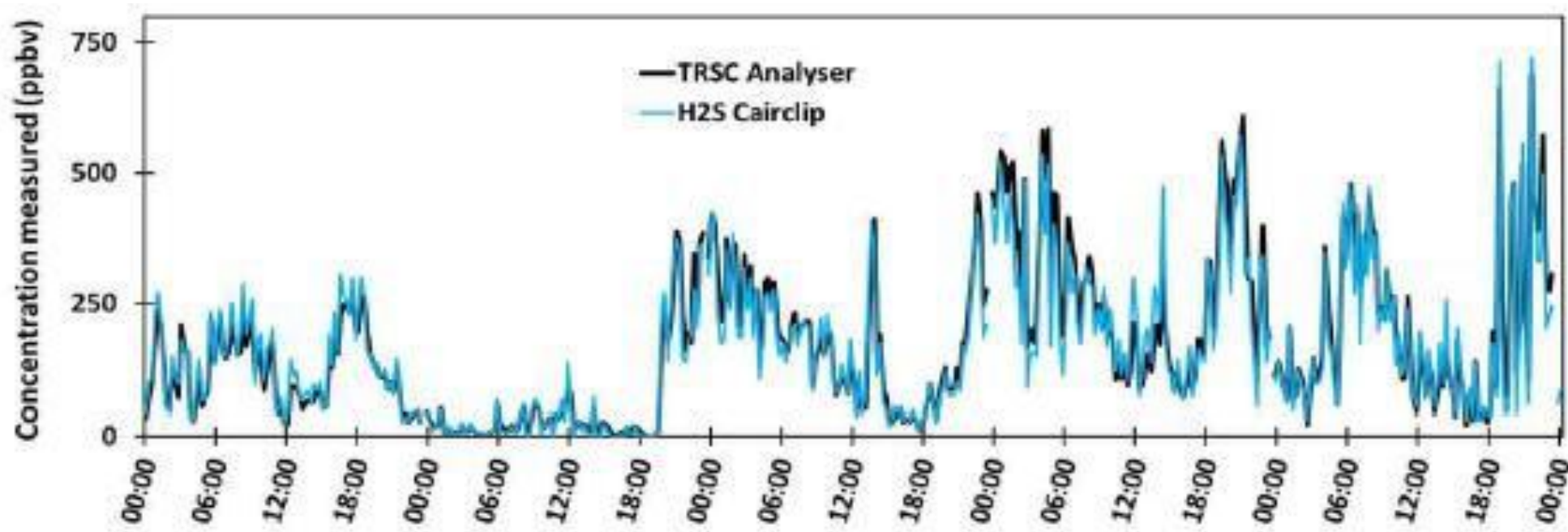
✓ Monitored Parameters: H_2S / CH_4S + NH_3 (and in some cases nmVOC)

Typical application: Complete network of several Cairnet mini-stations based on Cairsens + CairCloud

WWTP: Real-time odors monitoring & emissions impact



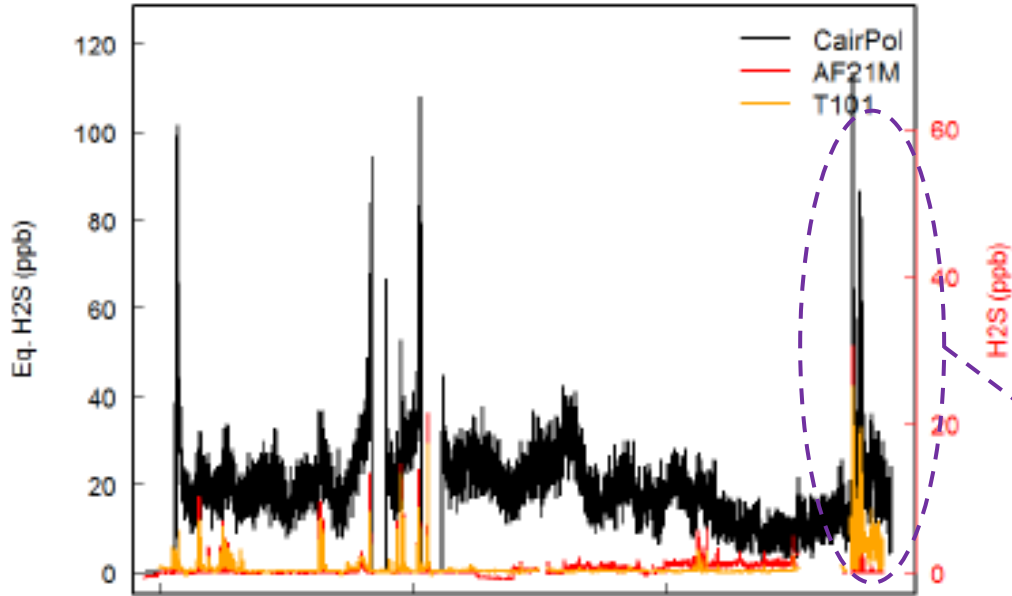
Field measurements of Cairsens Vs References analyzers



H₂S measurement by **Cairsens** (blue curve) VS a TRS analyzer (black curve) on industrial site for 5 days

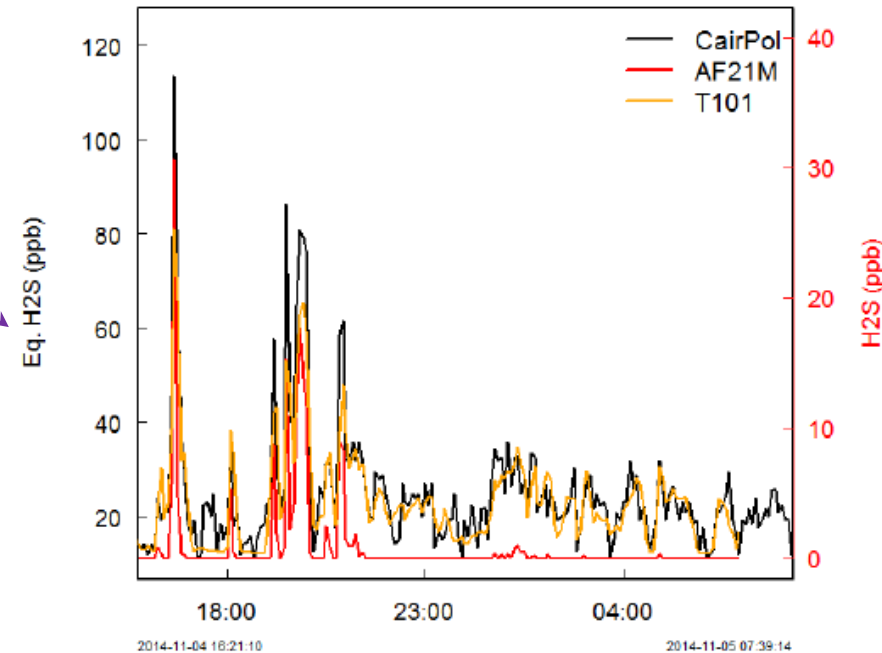
Field measurements of Cairsens Vs References analyzers

- Field tests during 1 month



Field measurement of H₂S at equivalent concentrations by the Cairsens (black curve) and the reference AF21M (red curve) / T101 (orange curve)

- Good correlation measurement of the micro-sensor with the Standard Reference analyzers (T101 & AF21M)

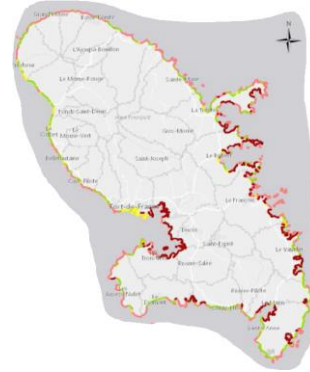


- A very close temporal correlation with the reference analyzer.

Seaweed algae decomposition & health problems

Context:

- Massive spread of red seaweed (Sargassum algae) affecting Atlantic coast and French Antilles



Martinique & Guadeloupe under high observation

- Decomposition leads to olfactory nuisance and sanitary issues, a major health problem to survey

Solution:

- ✓ Complete monitoring & alert network of 42 Monitoring stations (Gwadair / Madininair)
- ✓ Monitored parameters: H_2S + CH_4S / NH_3

Seaweed algae decomposition & health problems

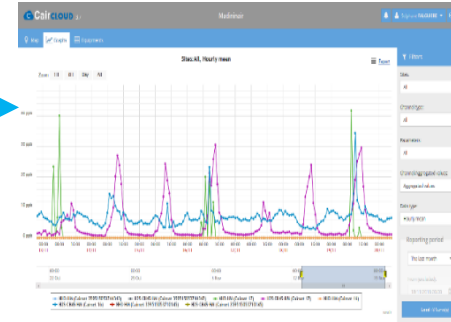


Continuous monitoring network
based on Cairsens sensors



Real-time
monitoring data

Caircloud User interface -
Odour Impact monitoring



Local Air Quality
Monitoring Authorities



Reference data



Communication with citizens
and municipalities



Actions taken by municipalities :
recovery and composting

New name
New vision
New website

www.envea.global

ANY QUESTIONS ?

"USE THE CHAT OR YOUR MICROPHONE "

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