European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

Examples of applications of sensors-systems for urban air quality monitoring in France

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Overview of urban AQC in FRANCE: legislation

In FRANCE, everybody has the rights to inhale an air that does not affect his health and to be informed about the air quality he breathes

⇨ **Law on Air and the Rational Use of Energy**

Law n°96-1236 of December, 30 th 1996, Official Journal L220-1, January 1st 1997.

↳ **Codified by the French Environment code**

↳ **18 decrees by law application**

Duties:

Air Quality Monitoring ***Quality objectives definition*** ***Public information***

National policy implementation about monitoring, prevention and information on the air

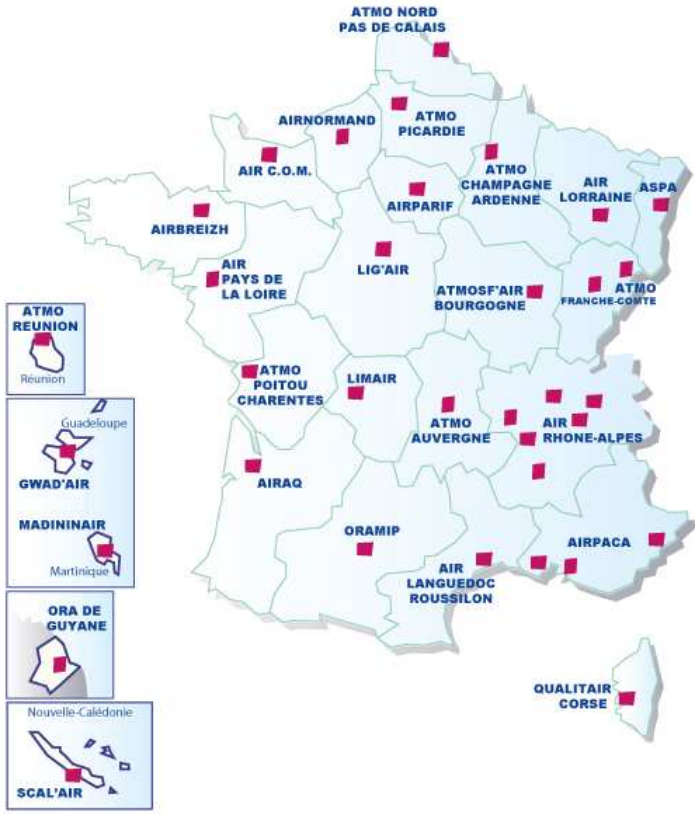
Ecology, Sustainable Development and Energy Ministry

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Ministère de l'Écologie, de l'Énergie, du Développement durable et de l'Aménagement du territoire

Overview of urban AQC in FRANCE: organization

26 associations, accredited for Air Quality control (AASQA)



- ⇨ **Air quality monitoring & information**
- ⇨ **Dissemination of results & forecasting**
- ⇨ **Local authorities information**

Scientific support :

LCSQA

(Central Laboratory for Air Quality monitoring)

LNE

Le progrès, une passion à partager

Mines de Douai

LILLE EUROREGION

INERIS

maîtriser le risque pour un développement durable

Monitored pollutants & recommendations

European directives ⇨ French rules

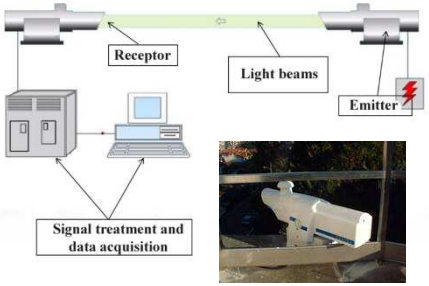
Pollutant	Limit value	Quality Objective	Information threshold	Alert threshold	Critical level	Target Value
NO_2	40 µg/m³ (year) 200 µg/m³ (hour)	40 µg/m³ (year)	200 µg/m³ (hour)	400 µg/m³ (during 3 hours)		
NOx					30 µg/m³ (year)	
SO_2	125 µg/m³ (year) 350 µg/m³ (hour)	50 µg/m³ (year)	300 µg/m³ (hour)	400 µg/m³ (during 3 hours)	20 µg/m³ (year)	
CO	10 000 µg/m³ (daily maximum during 8 hours)					
O_3		120 µg/m³ (daily maximum during 8 hours)	180 µg/m³ (hour)	240 µg/m³ (hour)		120 µg/m³ (daily maximum during 8 hours)
C_6H_6	5 µg/m³ (year)	2 µg/m³ (year)				
PM 10	40 µg/m³ (year) 50 µg/m³ (hour)	30 µg/m³ (year)	50 µg/m³ (day)	80 µg/m³ (day)		
PM 2.5	27 µg/m³ (year)	10 µg/m³ (year)	20 µg/m³ (year)			

Directive 2008/50/CE of European Parliament and Council - may 21th 2008; decree n°2010-1250 21 oct 2010 French Environmental Code (articles R221-1 to R221-3)

AQC network facilities

Analyzers

Passive sampling



*DOAS**

*TEOM***

Beta gauge

Gaseous pollutant monitoring — *PM measurement*

(Source: Atmo Aquitaine –FRANCE)

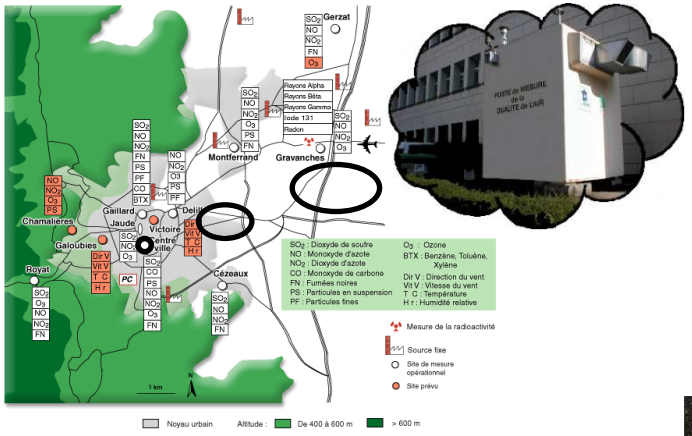
AQC facilities (Source: AirParif –FRANCE)

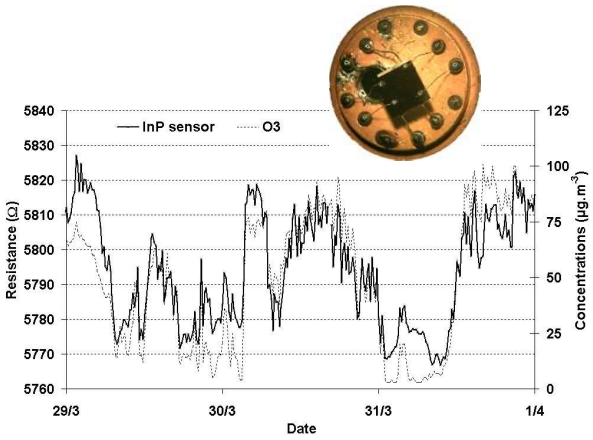
** Differential Optical Absorption Spectroscopy*
*** Tapered Element Oscillating Microbalance*

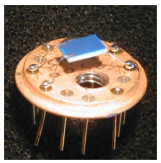
Gas sensors for urban AQC: our experience

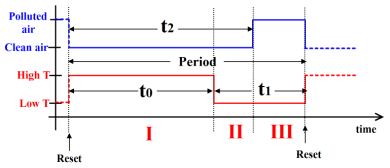
AQC station : sensors vs analyzers

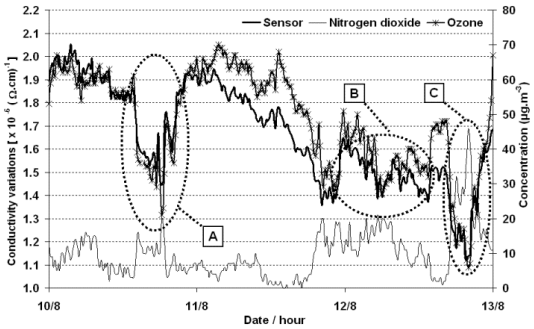
↳ Collaboration with Atmo Auvergne

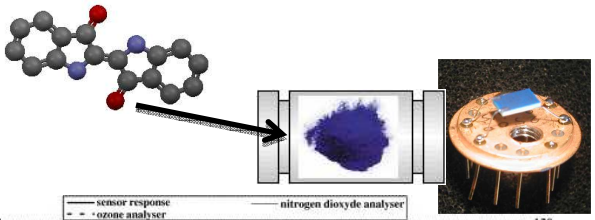


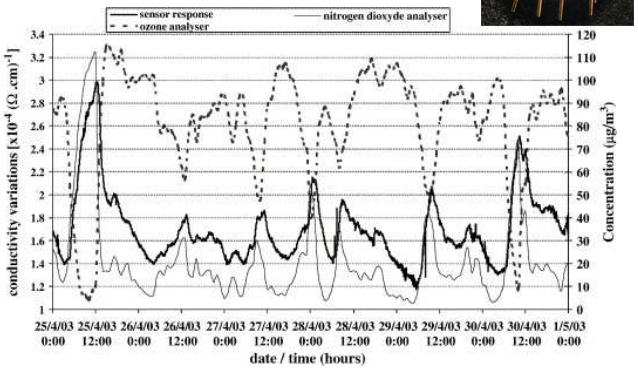












O_3 monitoring

NO_2 monitoring

cost
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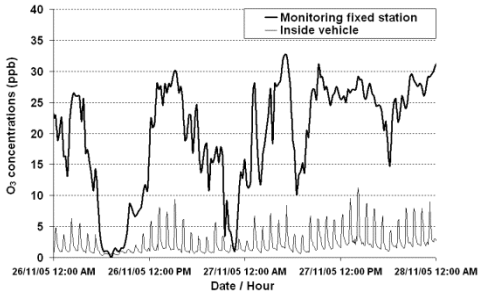
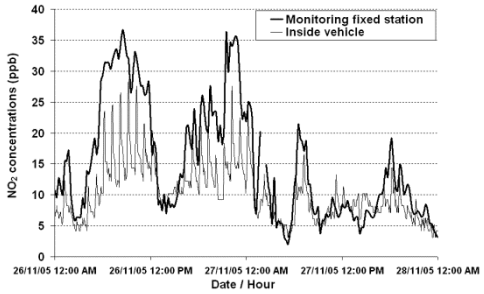
Mat. Sc. & Engineering :C, Vol. 26 (2006), 186-195.
Thin Solid Films 490 (2005) 28–35

Gas sensors for urban AQC: our experience

Pollution measurements in urban bus

Preliminary investigations





NO_2 predominant !

Sensor measurements

Underestimated passenger exposure by AQC stations

cost
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Sensors and Actuators B 130 (2008) 908–916

Gas sensors for urban AQC: marketing study

⇨ Consecutive to our patent deposition

N°: FR 08 03006 Date : 02/06/2008

N°: PCT/FR2009/000612 Date : 27/05/2009

Use of carbon nanomaterial as a filtration material impervious to O_3

Marketing Study about Gas Microsensors for Air Quality Control

LE MARKETING INDUSTRIEL QVADRIVM

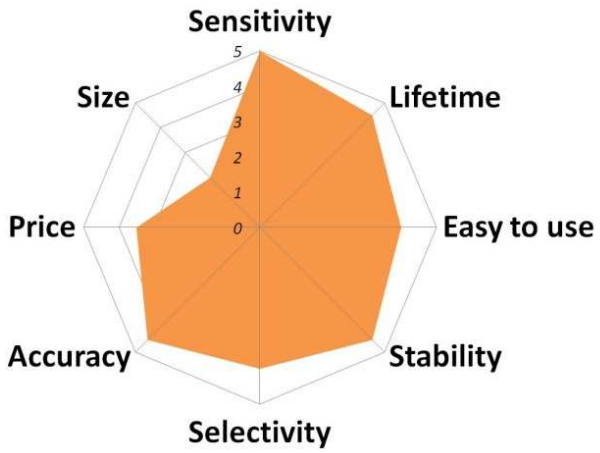
Gas sensors for urban AQC: marketing study

Outdoor (AQC network)

Application: pollution monitoring in urban conditions

Evolution: additional solutions complementary to analyzers
Specific campaigns of measurements

Expected characteristics



Guidelines:

1. Price = 5€ / sensor
   = 100-1000€ max
   with electronic unit
2. Selectivity
3. Lifetime
4. Certification required

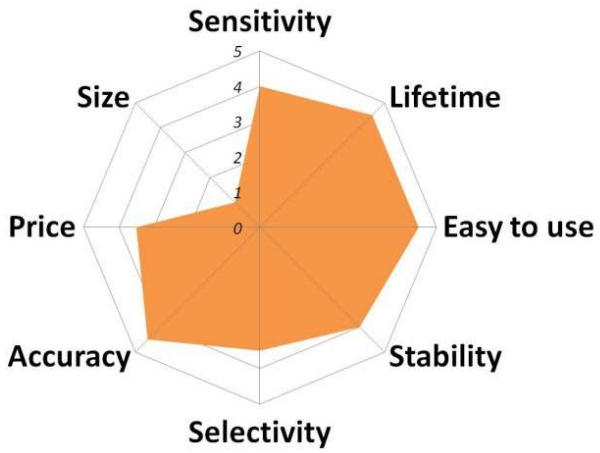
Gas sensors for urban AQC: marketing study

In confined environment (park, tunnel…)

Application: pollution monitoring for air extraction control

Evolution: Substitution or additional solutions to analyzers
Secure work areas

Expected characteristics



Guidelines:

1. Price = 5€ / sensor
   = 1000€ max
   for autonomous system
2. Sensor lifetime

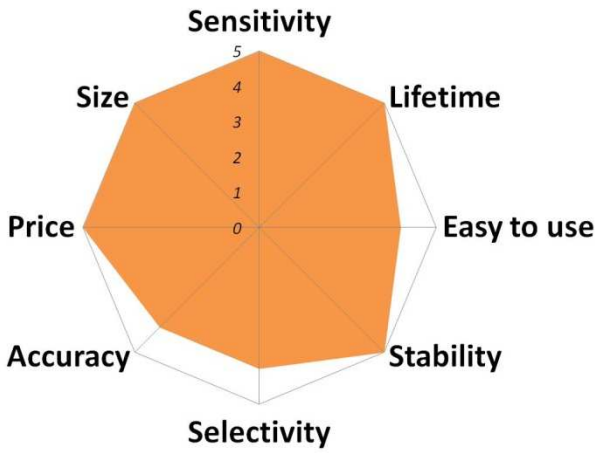
Gas sensors for urban AQC: marketing study

Automotive industry (passenger compartment)

Application: CO and NO_2 monitoring for driver security (Renault)

Evolution: option extended to all cars (Renault)

Expected characteristics



Guidelines:

1. Price = 5€ / sensor
2. Small size
3. Sensor lifetime = car lifetime
4. Fast response

Gas sensors for french urban AQC : conclusions

- **Good opportunities with AQC Associations**
  - ⇨ in agreement with specifications
  - ⇨ previous experiences with microsensors
  - ⇨ certification required
- **Attractive for monitoring in confined environments**
  - ⇨ limited to few pollutants
  - ⇨ sensor must be competitive / analyzers
- **Partial interest from Automotive sector**
  - ⇨ already implemented in premium cars
  - ⇨ low cost devices and dependent from legislation

Gas sensors for urban AQC in France: outlooks

⇨ Some local networks = open to sensors technology

⇨ Validation of device in real-conditions

⇨ Technological monitoring on microsensors

⇨ Open to measurements campaigns with sensors

⇨ Technological monitoring on microsensors defined in the Program for Air Quality Monitoring (PSQA)