E-noses and integrated measurement networks

24/4/2014 – 2nd Users' Workshop – Graz

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- E-nose: a bioinspired instrument?
- Instrument
- Concept
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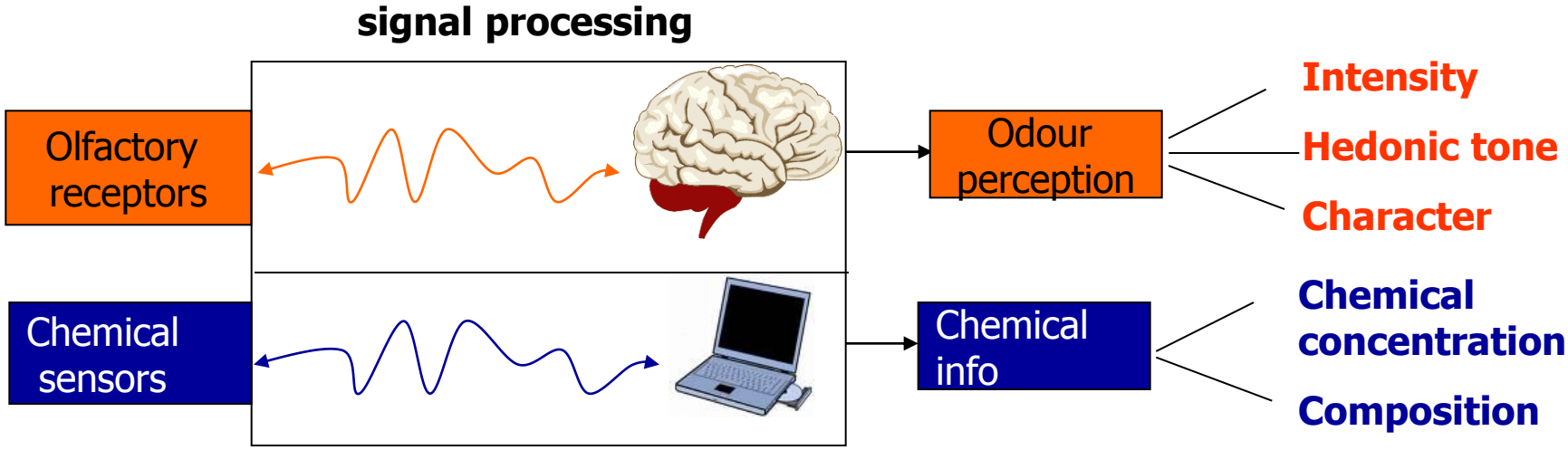
- Objectives

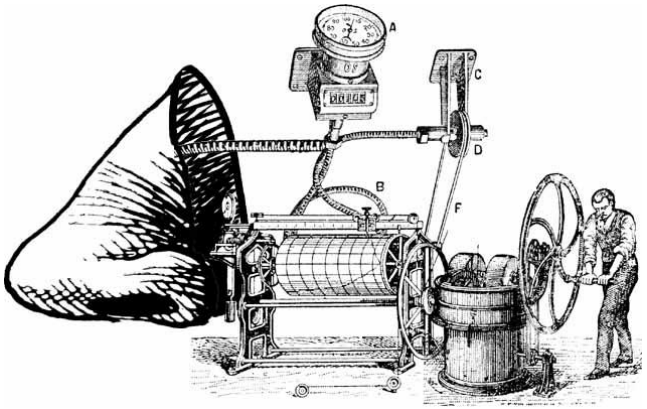
E-nose: a bioinspired instrument ?

- Analogy with the biological system:



- E-nose = instrument with several potentials but with performances far behind the human olfactory system

Instrument



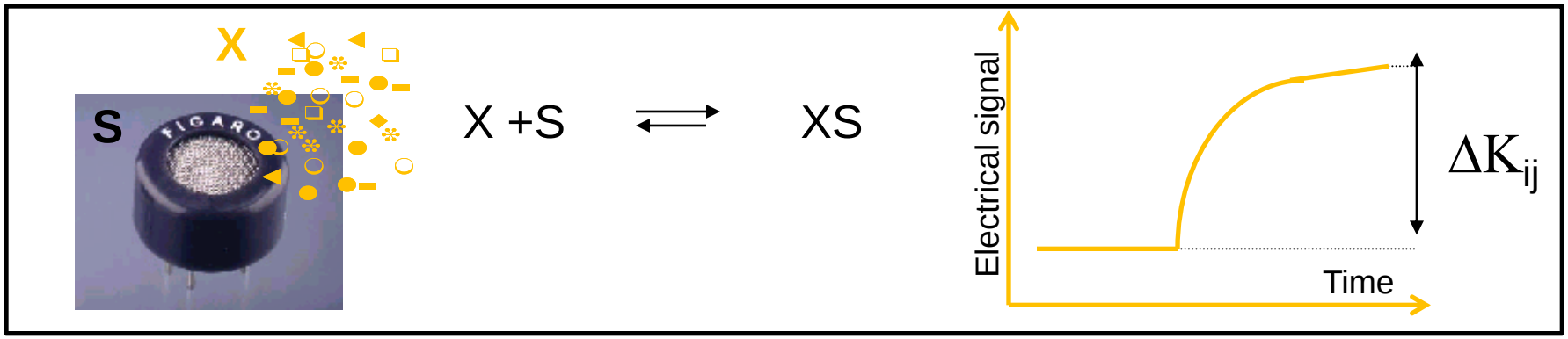
- **Definition**

  “instrument which comprises an **array** of **chemical sensors** with partial specificity and an appropriate **pattern recognition system**,
  capable of recognizing simple or complex odours“

  [Gardner and Bartlett, 1993]

- **Chemical sensors**

  a small element that transforms chemical information into an electrical signal



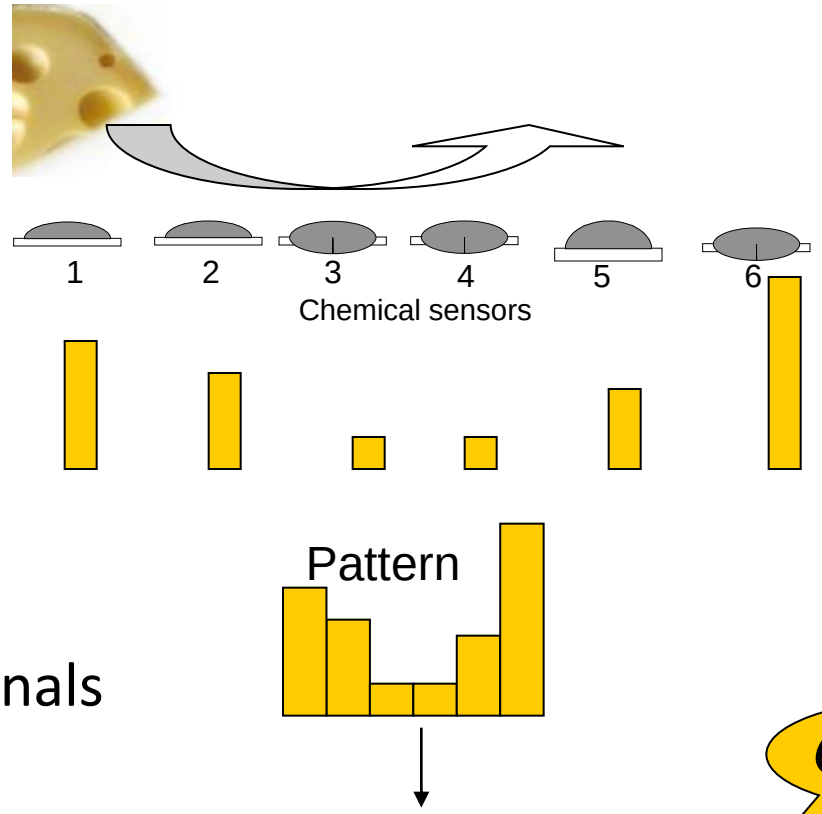
Concept

Odour (j)

Sensors array (i)

Signal of each sensor (Δk_{ij})

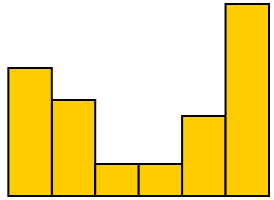
Combination of all the signals



Cheese ?

PATTERN RECOGNITION SYSTEM

Data treatment



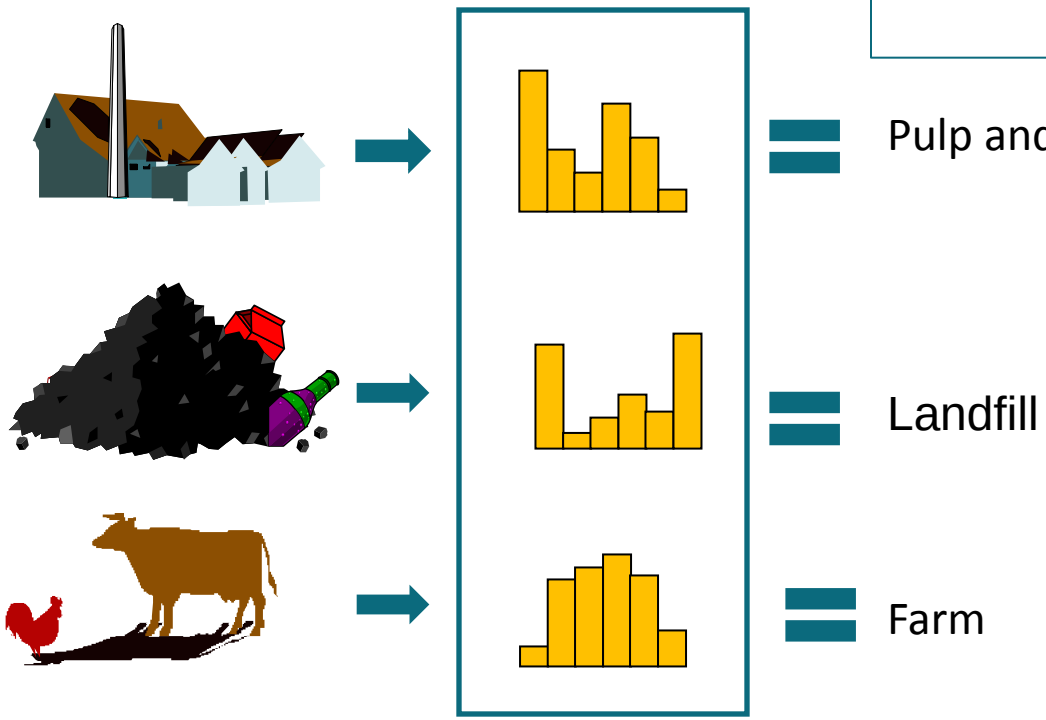
- Relationships between the “pattern” and the input (gaseous mixture) : Multivariate analyses (mathematical and statistical models)

- **Identification**

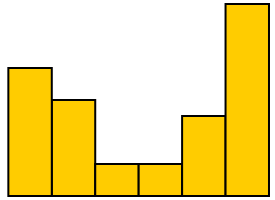
Use of the model to identify the pattern

Learning of the model

many samples of the same source in different conditions



Data treatment



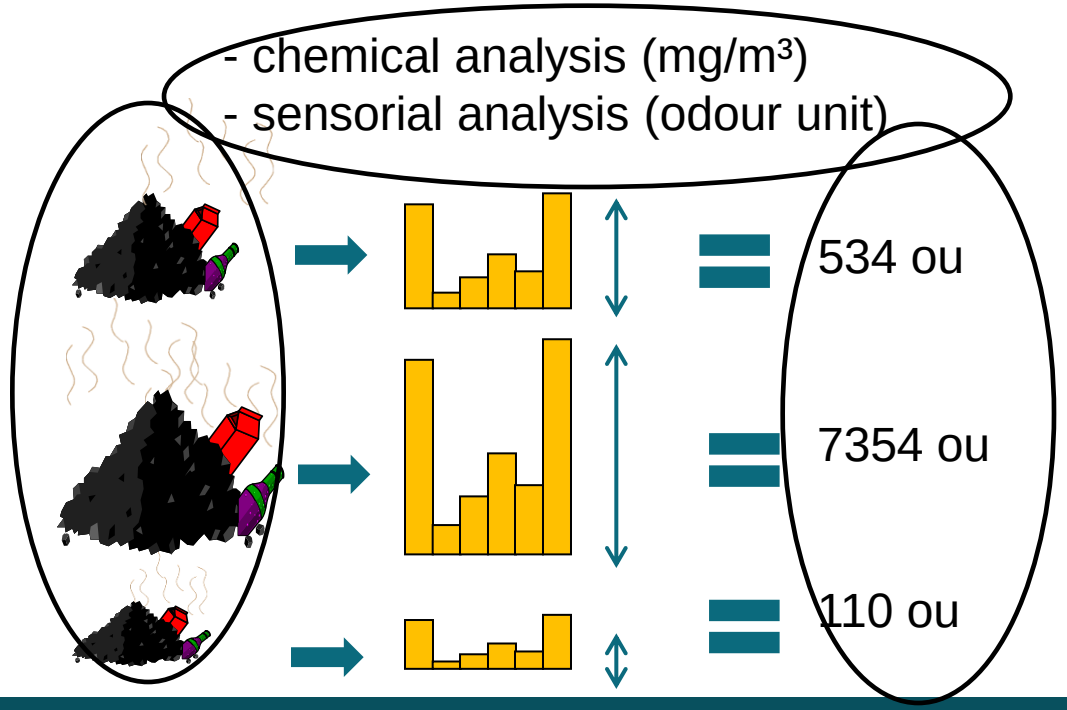
- Relationships between the “pattern” and the input (gaseous mixture) : Multivariate analyses (mathematical and statistical models)

- **Quantification**

Landfill odour : various concentrations

many samples of the same source in different concentrations

<u>Calibration (Learning)</u> :



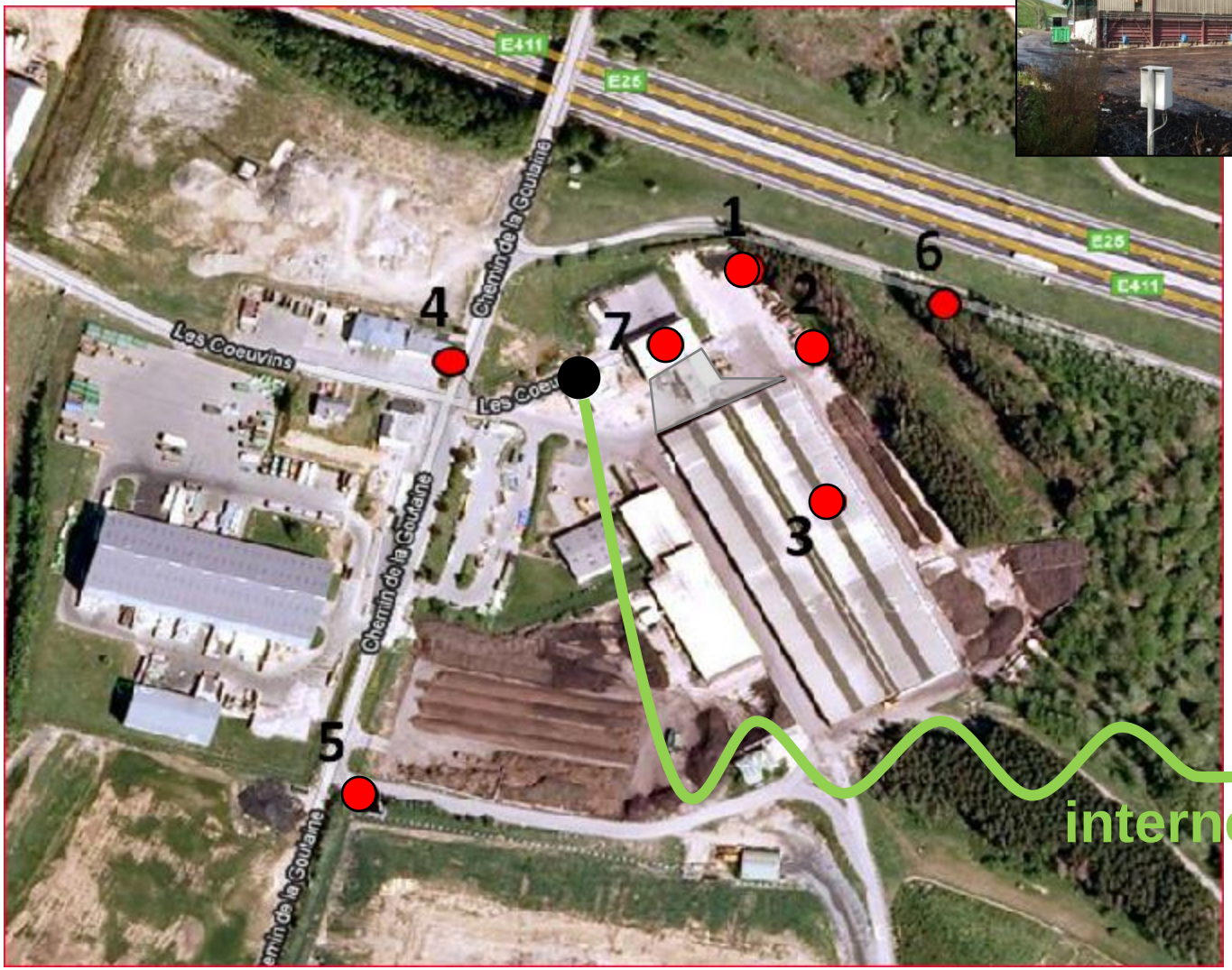
In Situ applications:
Integrated measurement networks

- The case of a landfill.
- The case of a paper mill.
- The case of a pig farm

In Situ application : Ambient odour monitoring Landfill

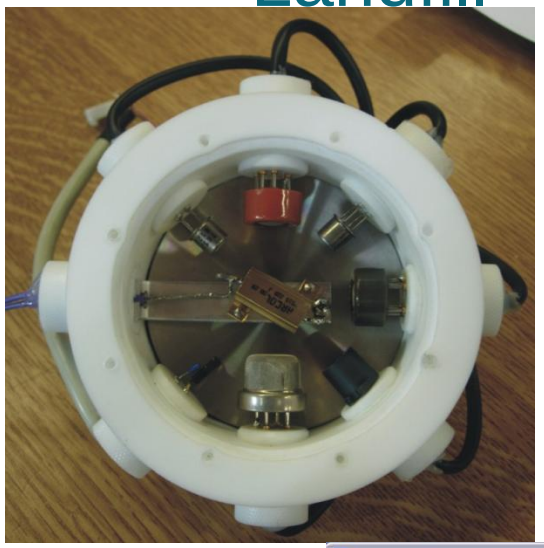
E-nose

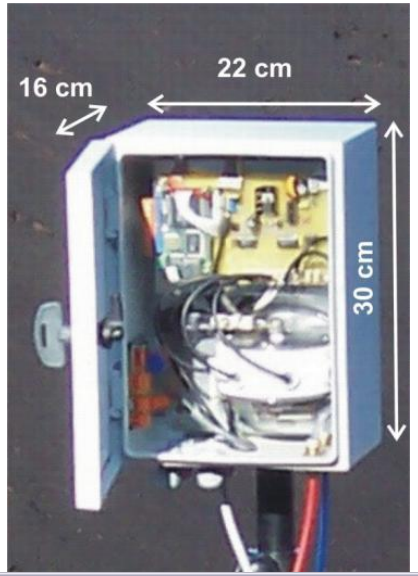
Computer

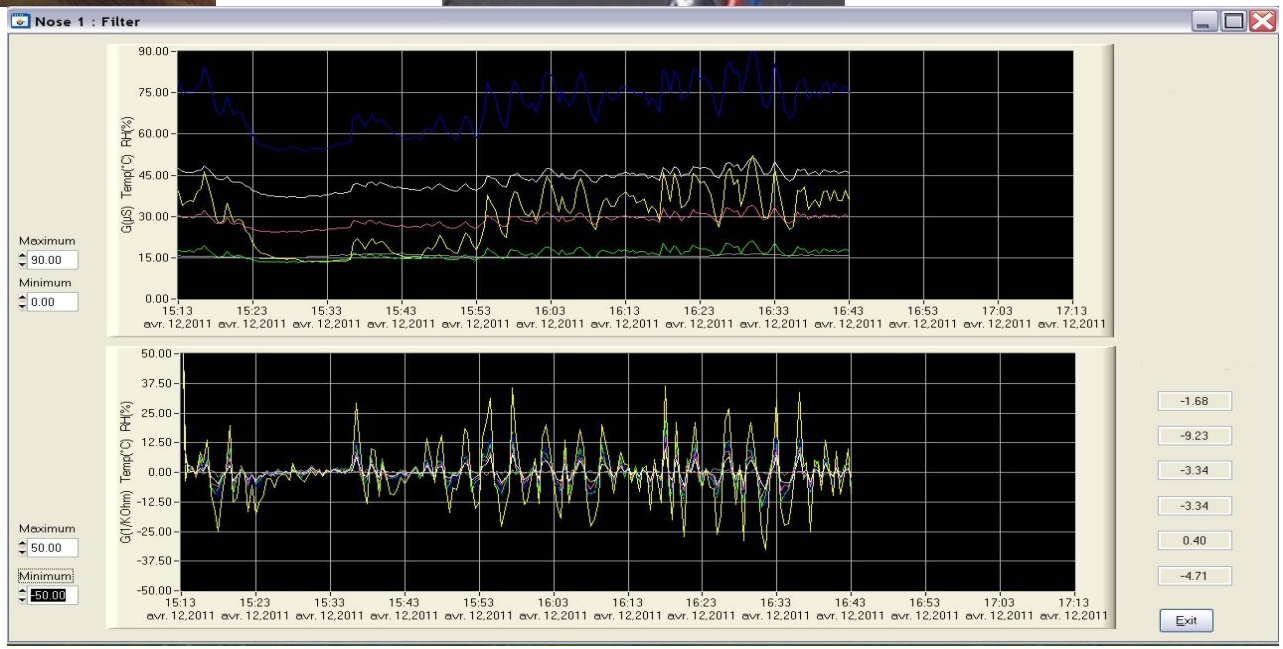


E-nose network control

In Situ application : odour monitoring Landfill



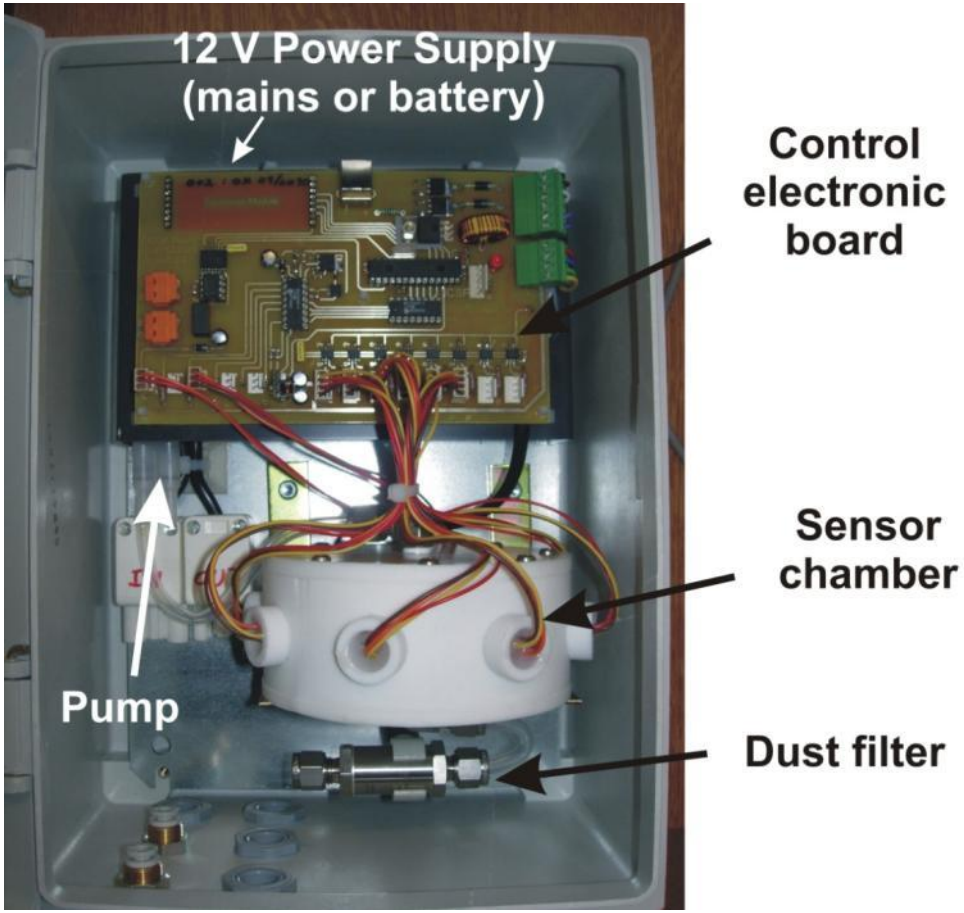




6 sensors Figaro®

+ temperature and humidity.

Simple box, easily accessible for maintenance



Continuous measurement of sensor conductance (no cycling air/sample)

Graphical User interface (LabWindows®) – User-friendly

General analysis

Temperature (°C) 7.6

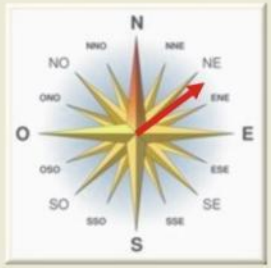
Wind Speed (m/s) 4.1

R. Hum. (%) 40

Wind Direction 50°

Barometer (hPa) 1021

Distance (m) and direction of the odor'smelling. 185



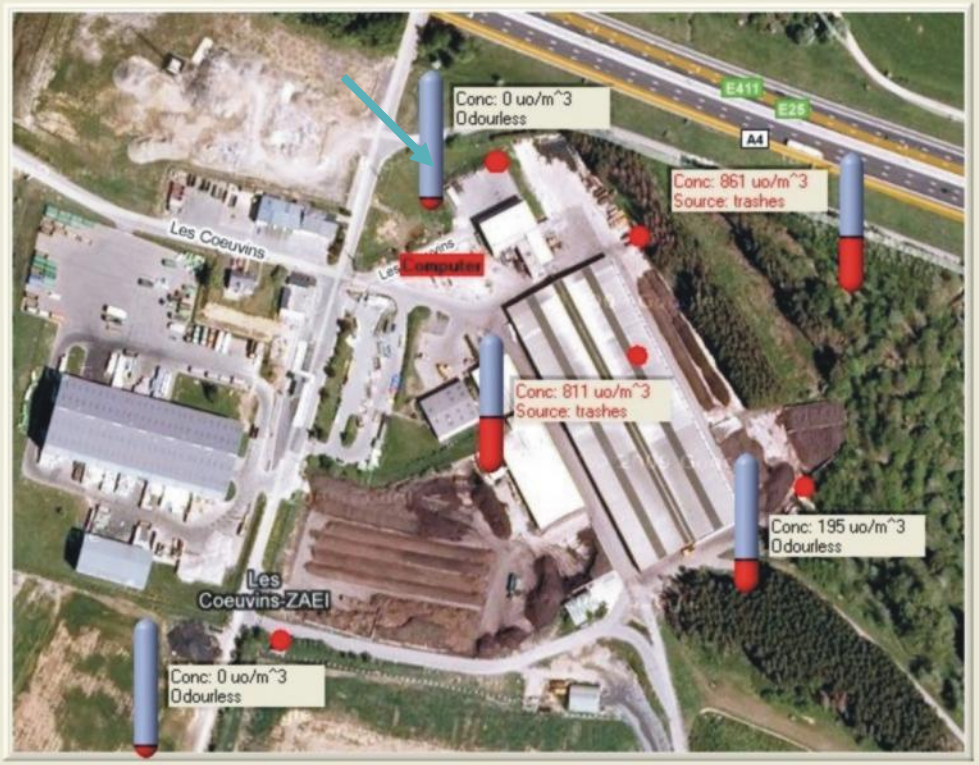
Mean wind Speed (m/s) 4.1

Absolute Humidity (g/m³) 2.6

Solar radiation (W/m²) 280

Lightly unstable

13/04/2010 15:45 Nose 2 - signal increasing
13/04/2010 15:50 Nose 2 - signal decreasing
13/04/2010 16:02 Nose 3 - signal increasing

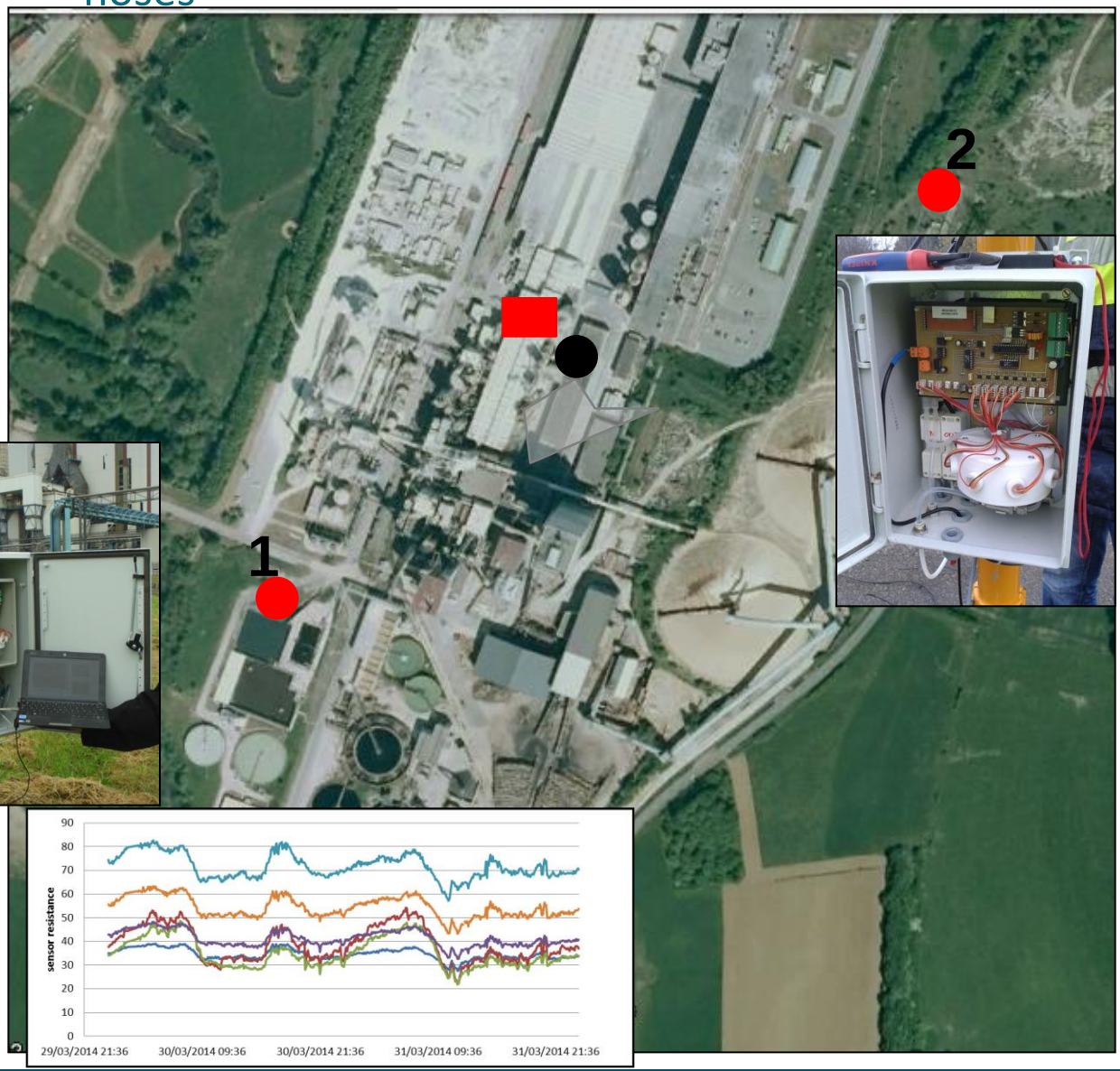


Number of events the last six hours	Nose 1	Nose 2	Nose 3	Nose 4	Nose 5
	2	3	4	0	0

Exit

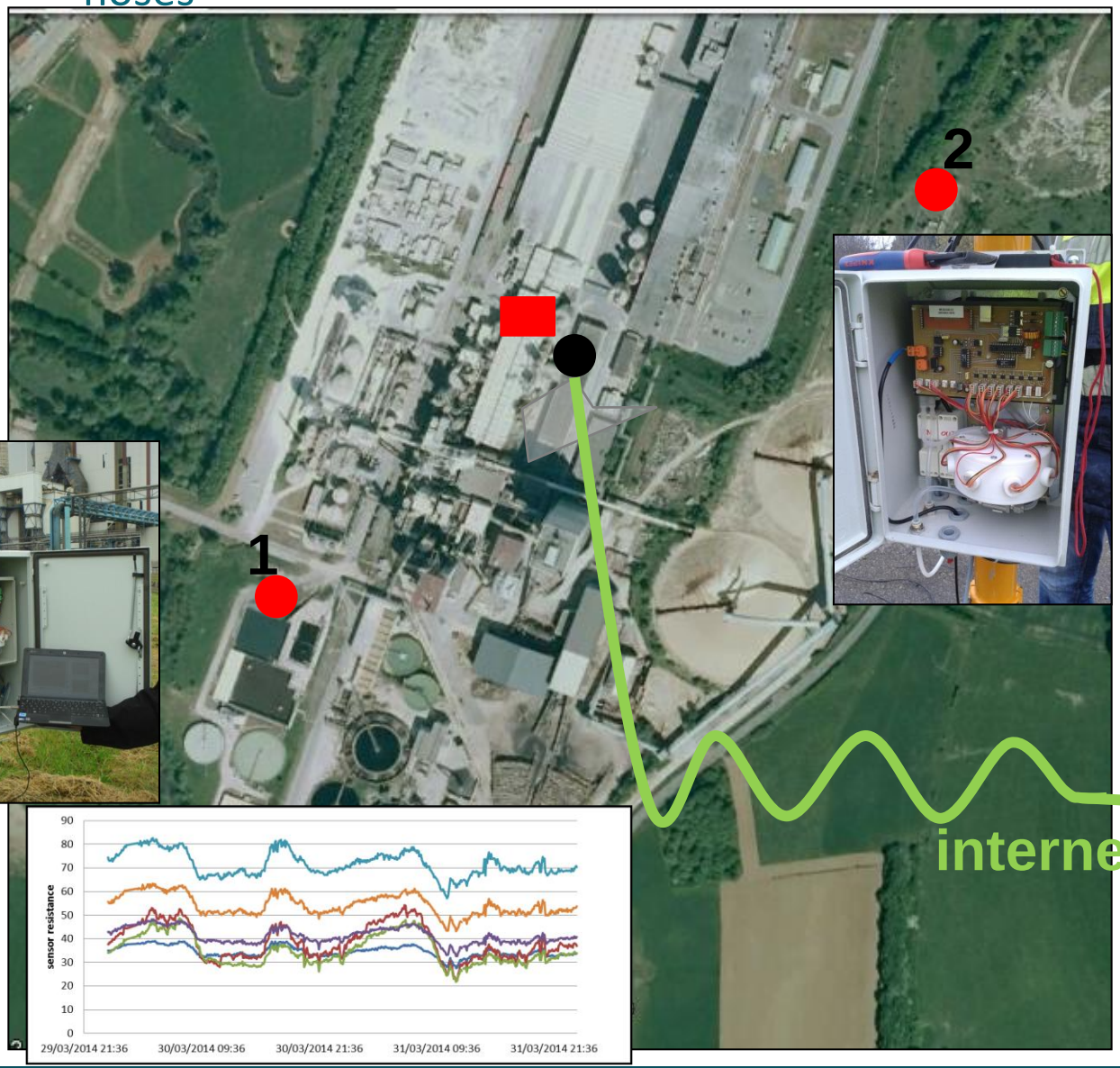
In Situ application : Paper mill

Integrated measurement network – by industrial process variables and e-noses



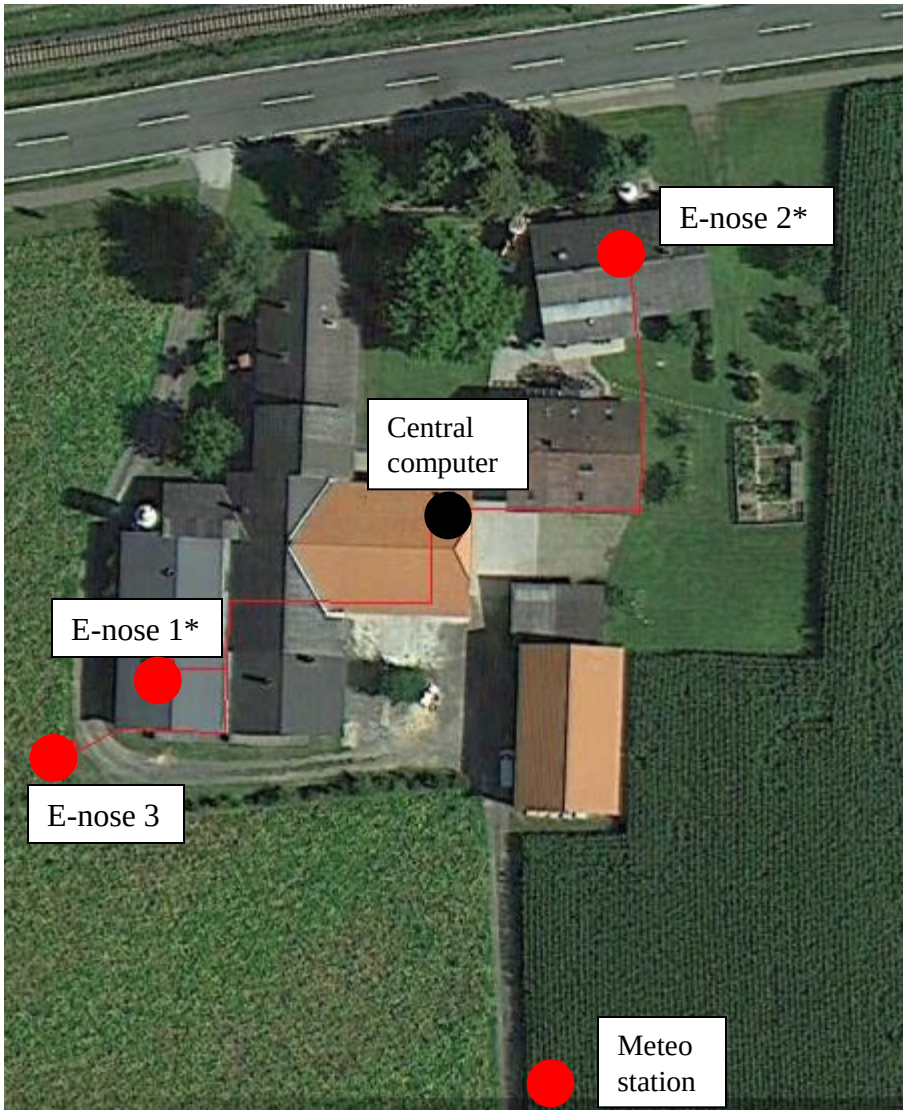
In Situ application : Paper mill

Integrated measurement network – by industrial process variables and e-noses



In Situ application : Pig farm

Odour measurement network at the emission sources and ambient air



E-nose 1 and 2 : odour and flow monitoring into the stacks → monitoring of all odour emissions from the pig farm.

E-nose 3: odour monitoring in ambient air.

In Situ application : Pig farm

Odour measurement network in the emission sources and ambient air

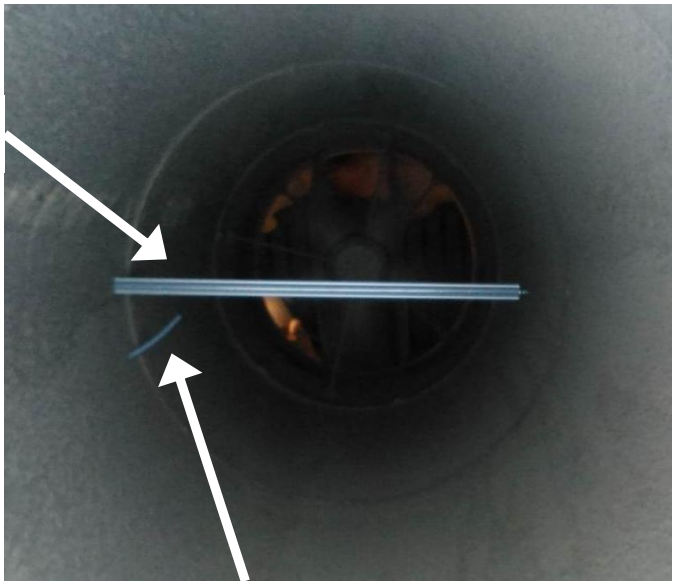
E-nose in the stack

Dust and condensation filter

Temperature/ humidity sensor chamber

Pressure sensor (pitot wing)

Pitot wing



Air sampling

Odour measurement networks: objectives

- Monitoring of the evolution of odour emissions (diffuse or canalized) from a site.
- System of alert in direction of the neighbours
- Quantification of the emissions
- Check the odour concentrations at the limit of the site.
- Check the neighbours complaints

Thanks for your attention

www.**odometric**.be/

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