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# Applications of miniature sensors to indoor air quality

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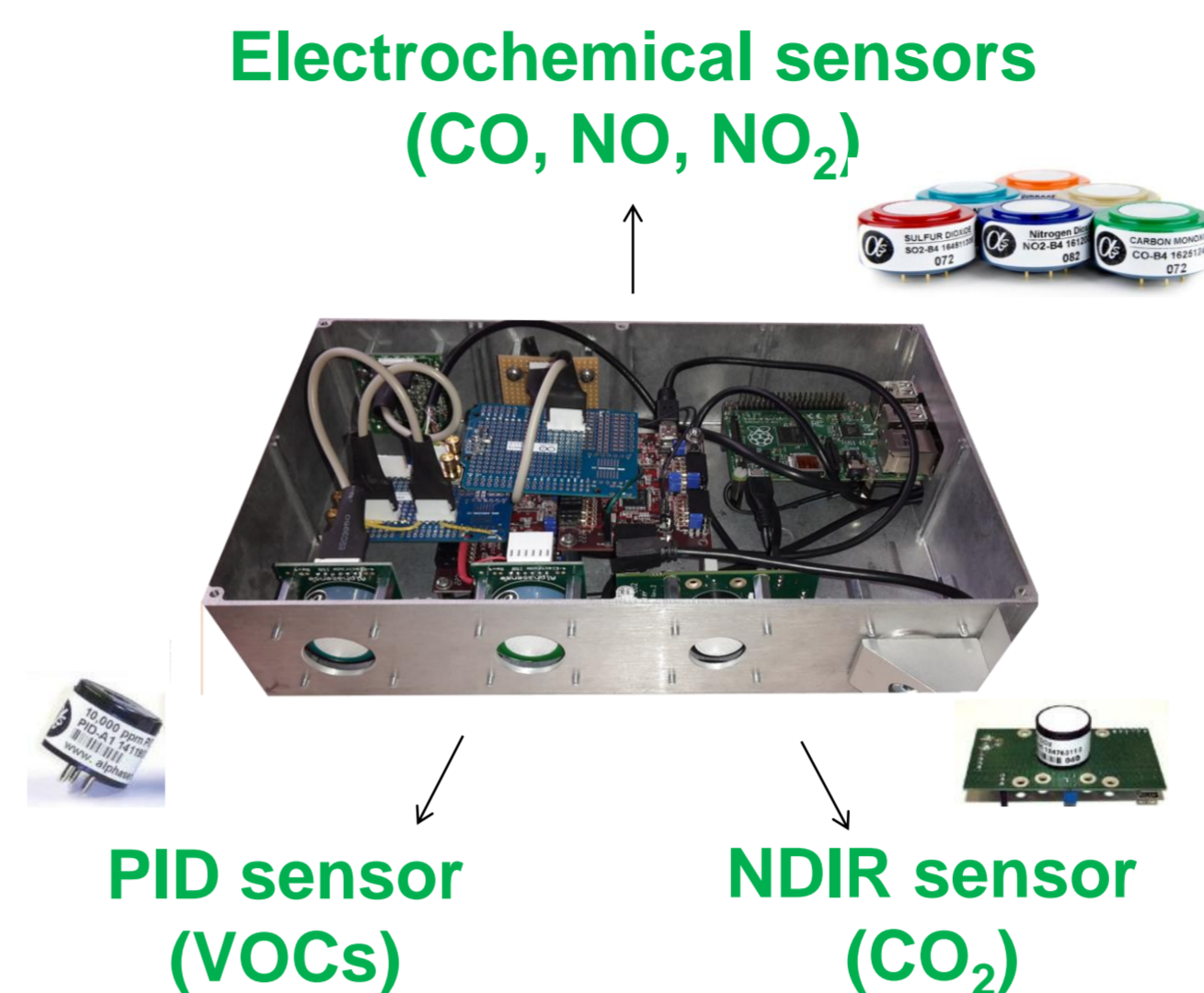
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## Indoor air quality (IAQ)

- Time spent in indoor environments > 80 %
- Numerous indoor emission sources
- Pollution patterns different from outdoors
- VOCs concentration higher (2 to 10 times) than outdoors
- Estimated cost of indoor air pollution in France: ~19 billion €/year
- French Thermal Regulation 2012:
  - Primary energy consumption below 50 kW/m<sup>2</sup>/an
  - High thermal insulation and airtightness
  - Controlled ventilation systems

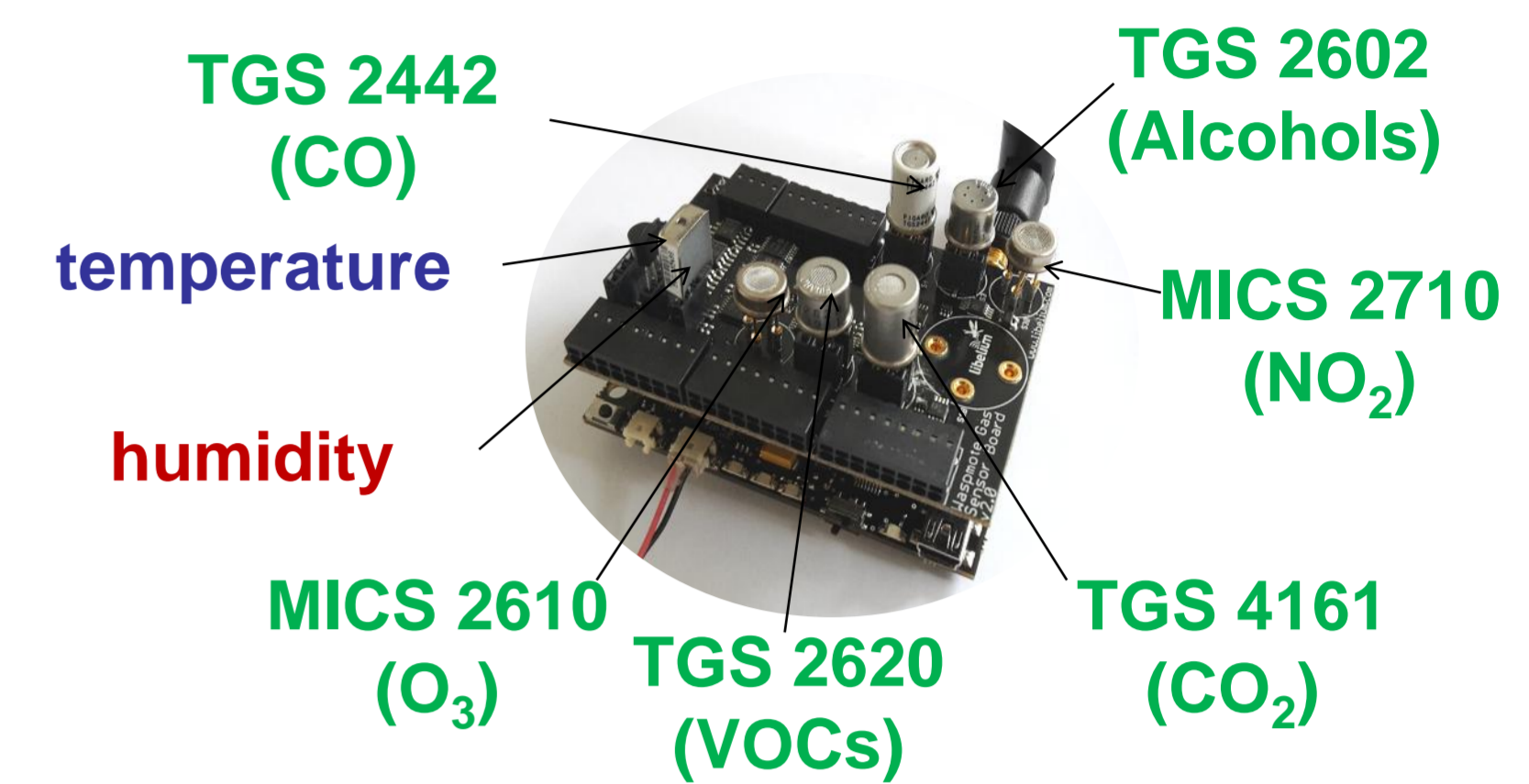
## Our sensors

### Specific sensors



SensorBox with 3 electrochemical sensors, 1 NDIR and 1 PID sensors

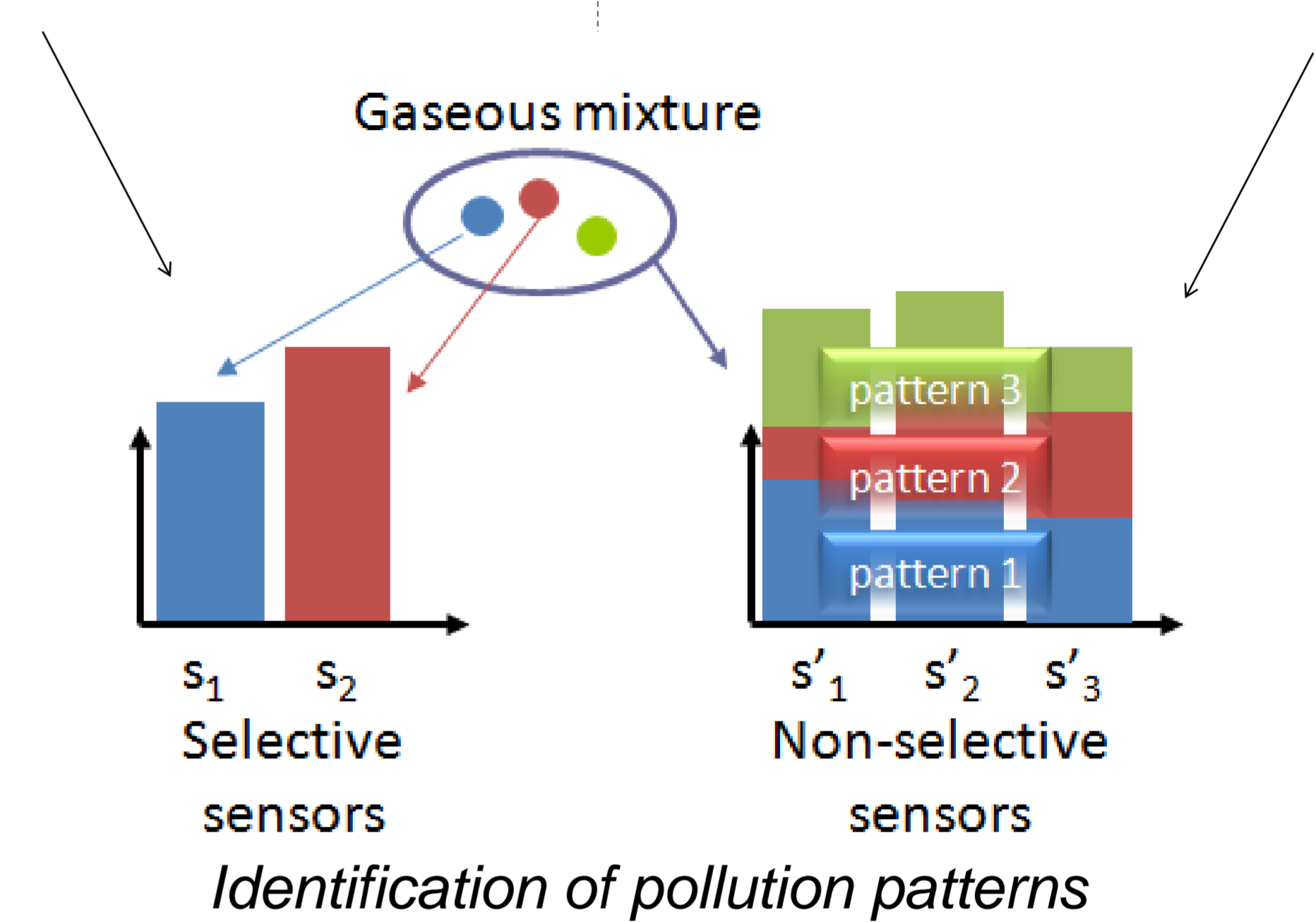
### Non-specific sensors



Array of 6 sensors metal-oxide semi-conducting materials = electronic nose

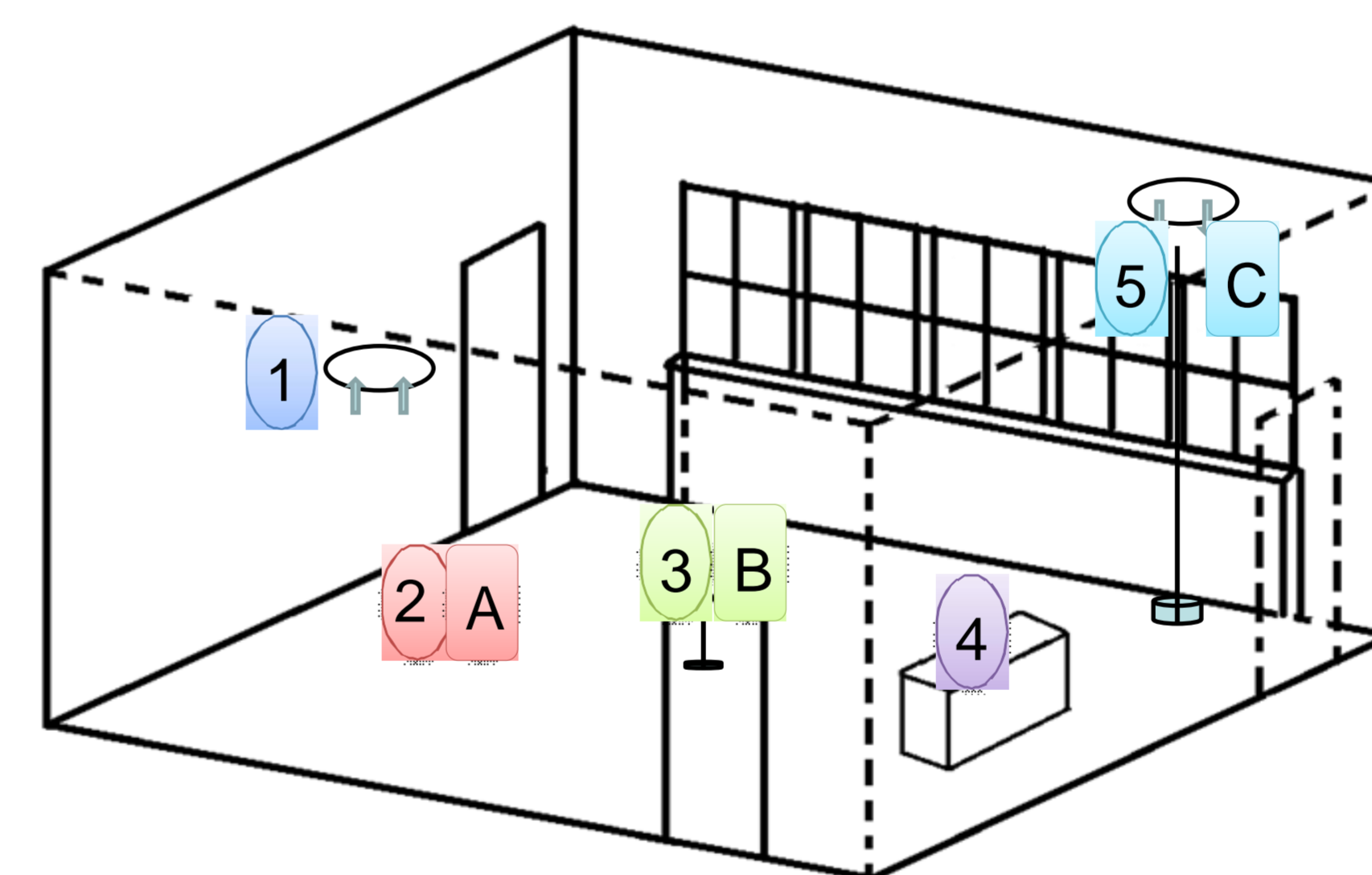
## Real-time monitoring of indoor pollutants?

- Standard air quality systems, such as online gas analyzers or chromatographs : bulky, noisy, heavy, expensive...
- Alternative method: **electronic gas sensors networks** : small, easy to use, low cost , short response time
- Questions: qualitative/quantitative, sensitivity, accuracy, calibration, interferences, data treatment...?



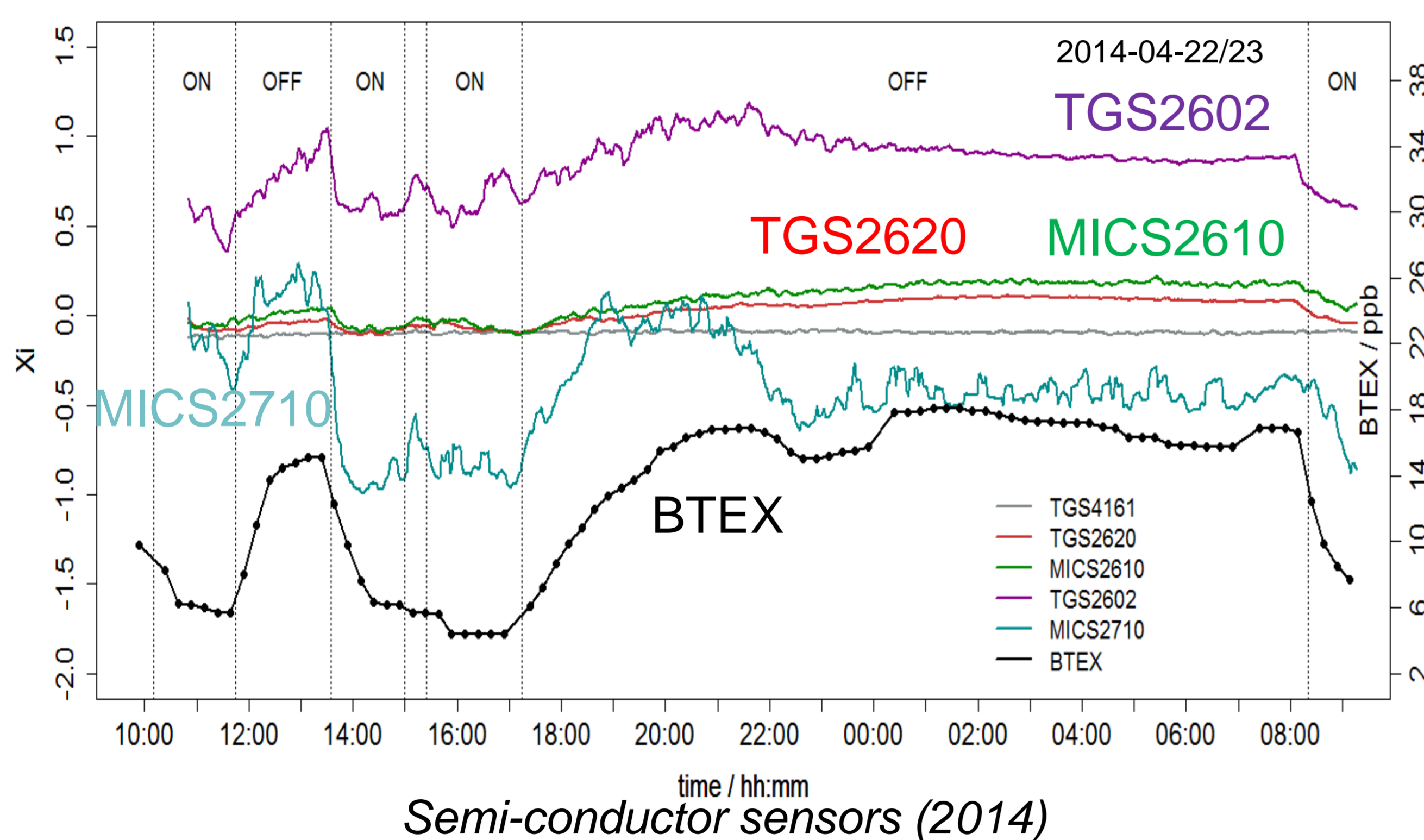
## Characterization of indoor air quality in a low energy school building

- Mermaid program:** Experimental and Modeling Characterizations of Indoor Air Quality in Low Energy Public Buildings
  - Identification of the main pollutants in LEPB
  - Highlighting of sources and sinks of pollutants
  - Influence of environmental conditions, type of materials ...
  - Model development considering physical and chemical processes
- 140 m<sup>3</sup> classroom of a Low Energy Junior High School in North of France during **2 intensive measurement campaigns** (April-May 2014 and February-March 2015)

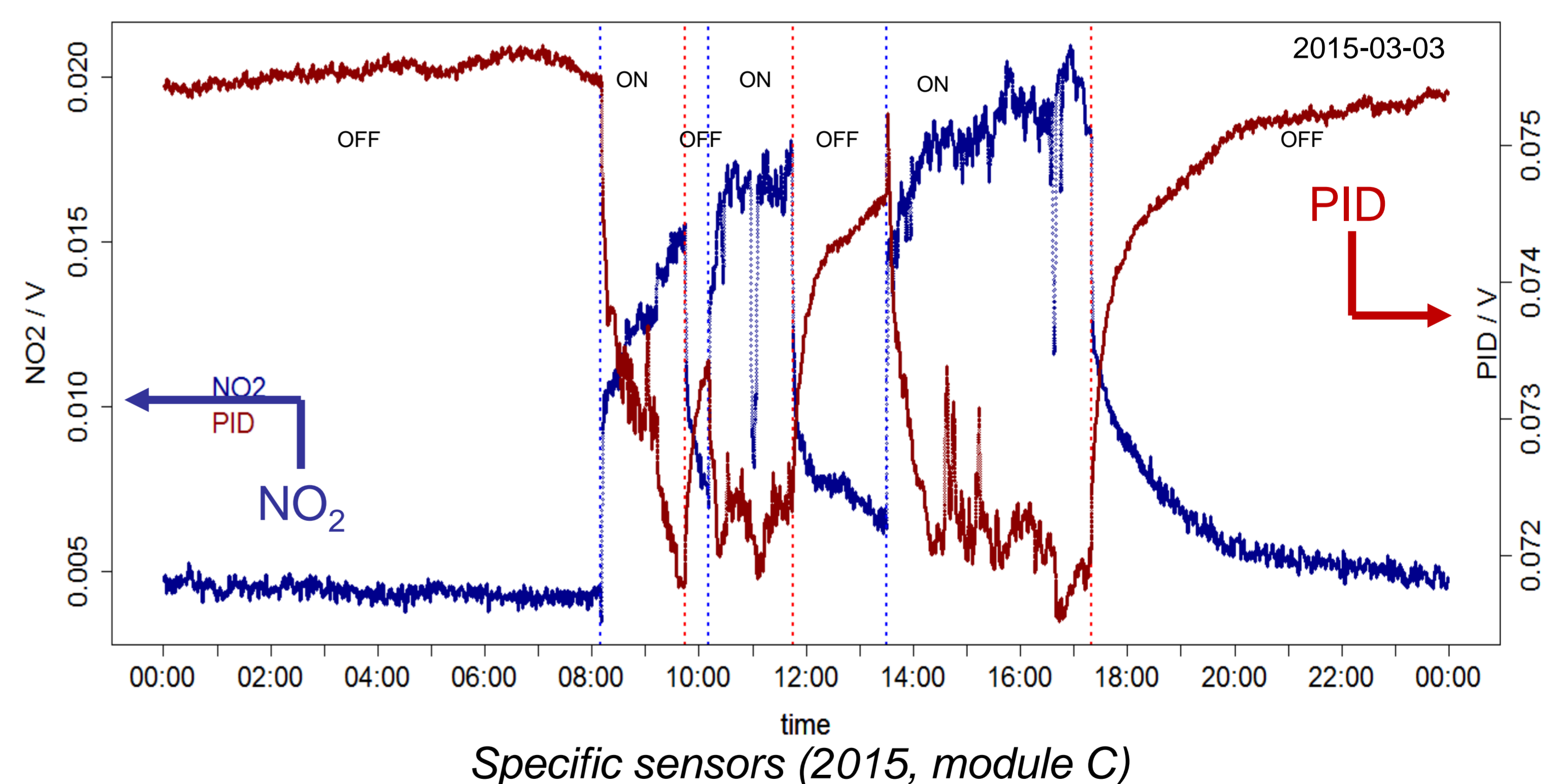


- 5 semi-conductor systems (1 to 5)
- 3 electrochemical devices (A to C)
- 1: ceiling/extraction
- 2&A: on the floor
- 3&B-4: 80 cm above the ground
- 5&C: ceiling/ventilation

Installation of the sensors in the classroom (2015)



Semi-conductor sensors (2014)



Specific sensors (2015, module C)

## Conclusions

- Sensors data agree with data from reference analyzers
- Real time measurements of indoor and outdoor pollutants
- Impact of ventilation status on IAQ

## To do ...

- Best combination of selective and non-selective sensors ?
- Data treatment to extract pollutant signature ?