Online personal IAQ monitoring –
personal exposure to indoor air pollutants.

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- Development of small-size, low-cost, pollutant monitoring system adapted to indoor and outdoor environments
- U Lille campus-wide sensor network, can be deployed in other environments
- Research objectives: to understand the drivers of the dynamics of pollution inside buildings (U Lille and other environments), and to quantify the exposure of people
- Educational and awareness tool for students, staff, academics and general public

https://www.apolline.science
Strategies to monitor personal IAP exposure

**Strategy #1 : Personal sensors**
- Size, weight, autonomy, communications are critical factors
- Few sensors inside the device
- Access to indoor and outdoor personal exposure

**Strategy #2 : Fixed indoor air sensors**
- Electrical plug and ethernet available
- Sensor box can be somewhat large
- Access to room/building air concentration, not exposure

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From sensors to data

![Diagram showing the flow from individual sensors, sensing node, communication protocol, and server (storage infrastructure) to delayed or real-time web-based display.](image)
« Wearable sensors » strategy

Do we really want to have sensors on everyone? (would be great also, but...)

24 hours with a sensor

Challenges:
- Discrimination indoor/outdoor: jumps in T, RH, number of satellites...
- Metrology of sensors (changes in T, RH, speed)
- Data transfer
- Autonomy
- Time and space variability
- Inter-individual variability
- Are the sensor people-proof?
Apolline in the subway

Indoor concentrations ~ 5 µg/m³
Outdoor concentrations ~ 10 µg/m³

PM₁₀ Subway concentrations up to 80 µg/m³
PM₁ Subway concentrations up to 50 µg/m³

« Fixed sensors » strategy

Do we really want to have sensors in every room of every building? (would be great, but...)
What inter-dwellings variability?

All investigated environments behave similarly.

Main difference is T and RH, driven by behavior, not by pollution sources.

The « statistical » outliers correspond to pollution episodes driven by activities.

Identification of patterns associated to activities

Self-reported activities: cooking (various methods), some cleaning.

Some events detected but not reported.

« Chemical signature » of activities. Need to construct a database for such signatures.
Sensors and ventilation

Students in their office at the University

CO2 as a proxy to trigger ventilation only when necessary.

From sensors to usable information

Can we / should we analyze the data before transmission?
- Partial information
- Computation power
- Less transmissions
- Energy efficiency

Data analysis: ongoing work, and the key to putting sensors everywhere
Take home messages

• Wearable and fixed sensors allow to monitor or evaluate personal exposure.

• Provided you can fix all technical issues: sensor response, size, weight, autonomy, cost, communication protocols, storage infrastructure...

• Not that much low cost, if you consider putting sensors everywhere, framework infrastructure, calibration and operation, environmental cost

• For exposure, recommendation for a network of wearable sensors / fixed sensors / reference monitoring stations

• Issue #1: make sure what the goal is: exposure characterization, building-related pollution, activity-related pollution, building management, alerting system...

• Issue #2: what are we looking for? Environmental parameters, particles, (speciated) gases, exposure duration, pre-identified events, unexpected events...

• Issue #3: how and when to analyze? Delayed/real-time. Server/on-board sensor. Time-series, classification, artificial intelligence...

https://annex86.iea-ebc.org/
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- the audience