

**REPRODUCTION OF TRAFFIC POLLUTION IN A TEST BENCH  
TO EXPOSE A WHOLE CAR TO REPRODUCIBLE SCENARIO OF  
URBAN POLLUTION: IAQ DEVICES AND/OR STRATEGIES  
ASSESSMENT**

**UNECE VIAQ GROUP 23rd session, November  
9th**

# CERTAM, MULTIDISCIPLINARY TECHNOLOGICAL RESEARCH CENTRE



OVER 30 YEARS EXPERTISE IN  
POLLUTANT METROLOGY  
BETTER UNDERSTANDING OF  
PHYSICAL AND BIOLOGICAL  
PHENOMENA

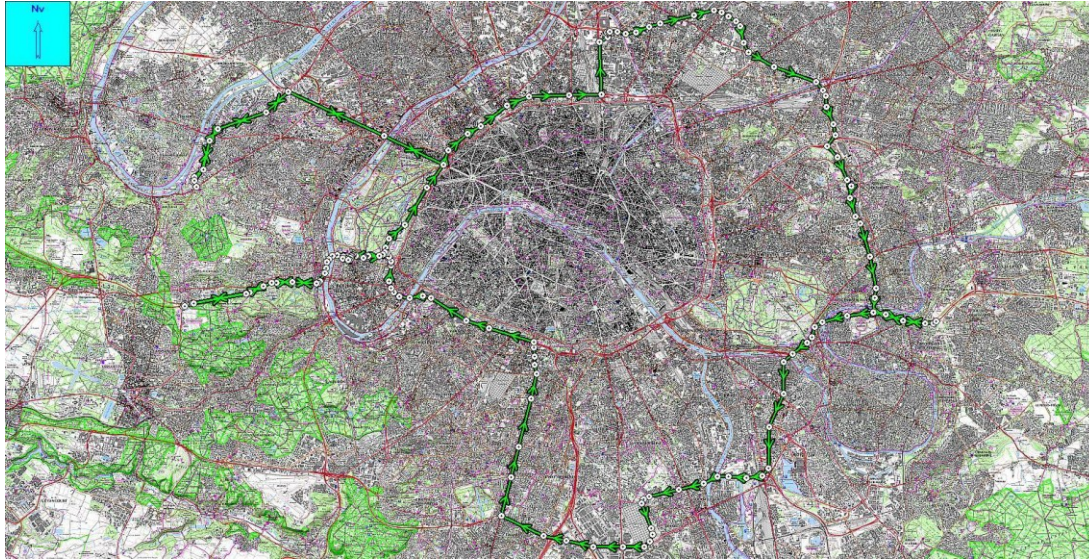
UNECE VIAQ GROUP 23rd session, November 9th



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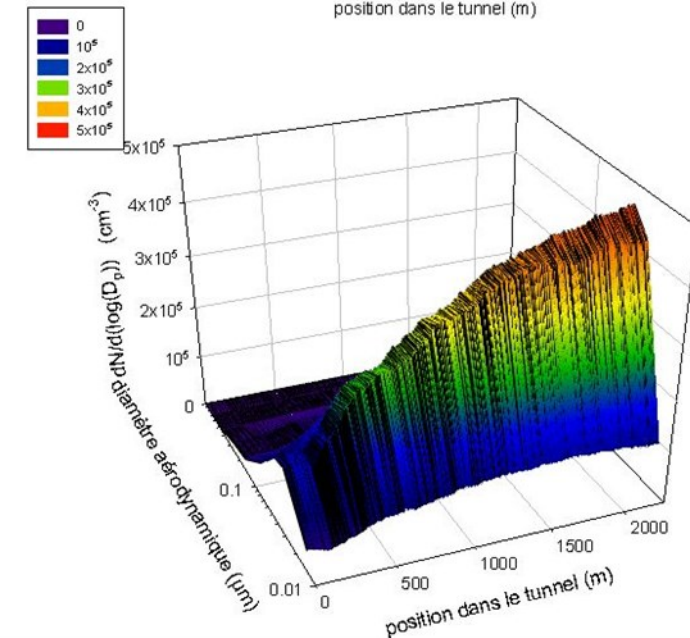
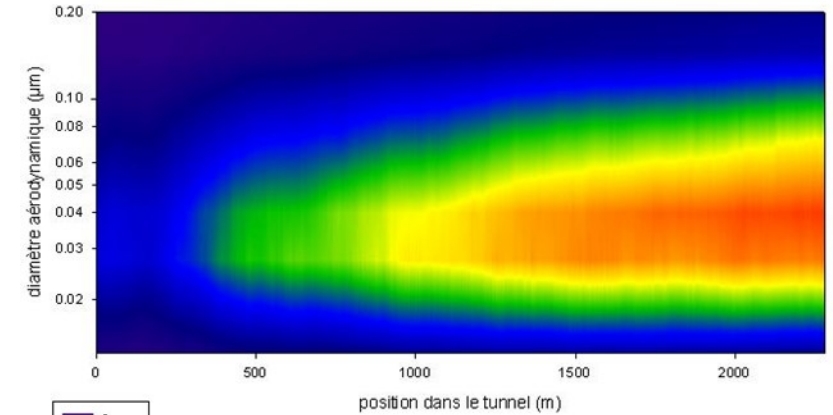


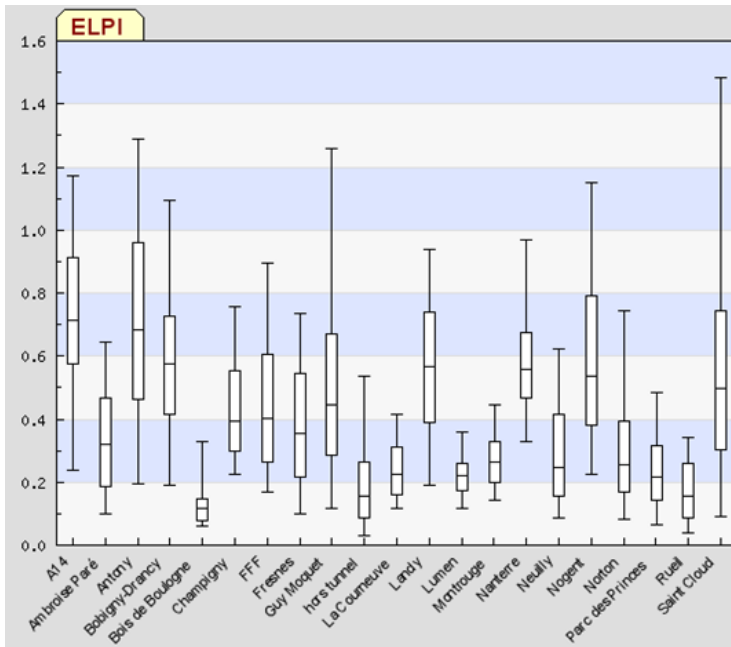
## ⇒ « AIRTURIF » RESEARCH PROGRAM (2009-2012)



⇒ MORE THAN 10000KM DRIVEN IN PARIS

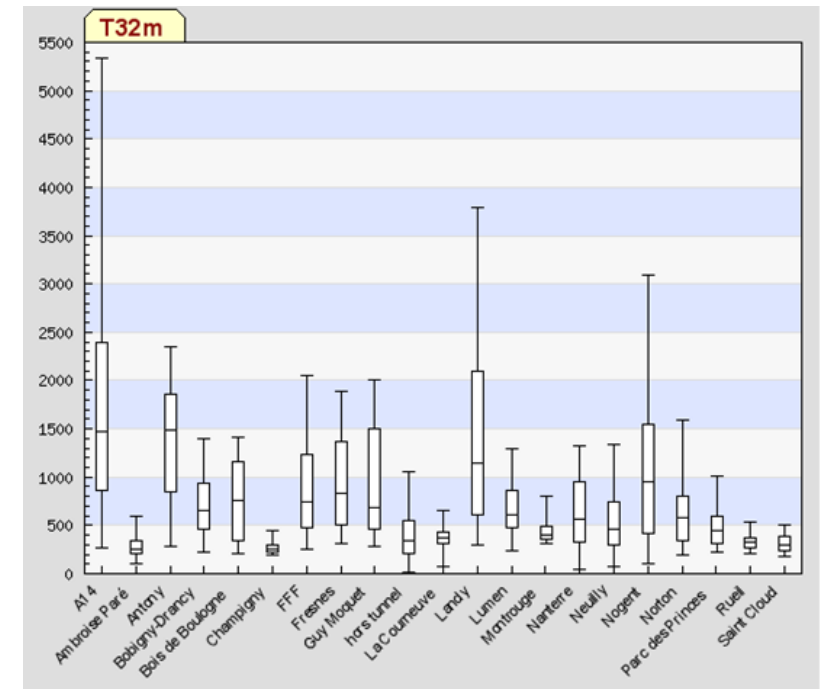
⇒ STUDY FOCUSED ON THE 20 LONGEST TUNNELS IN ILE-DE-FRANCE





**PM1 « IN-CABIN » MEASUREMENT  
WITH DEKATI ELPI**

**HIGH VARIABILITY OBSERVED ON ROADS  
DUE TO VARIOUS TRAFFIC CONDITIONS,  
DIFFERENT DIRECT EMITTERS, WEATHER  
CONDITIONS ...**



**NOx « IN-CABIN » MEASUREMENT  
WITH DUAL-CHAMBER CLD ANALYSER**



## ⇒ Dedicated Test Cell for pollutant generation and mixing: Diesel and Gasoline sources

- Dilution tunnel feeded with filtered T- and RH- regulated air up to 1000m<sup>3</sup>/h flowrate
- Temperature regulation: from RT up to 90°C
- Relative Humidity regulation: up to saturation (@temperature less than 45°C), up to 12% (@90°C)
- Pollutant concentration dependent control loop to adjust raw exhaust sampling (usually PM1)
- Possibility of injection of pollutant of interest using Mass Flow Controllers , CEM (Controlled Evaporator and Mixer) and/or aerosol generator
- Online analysis: environmental analysers, size spectrometers, mass spectrometer

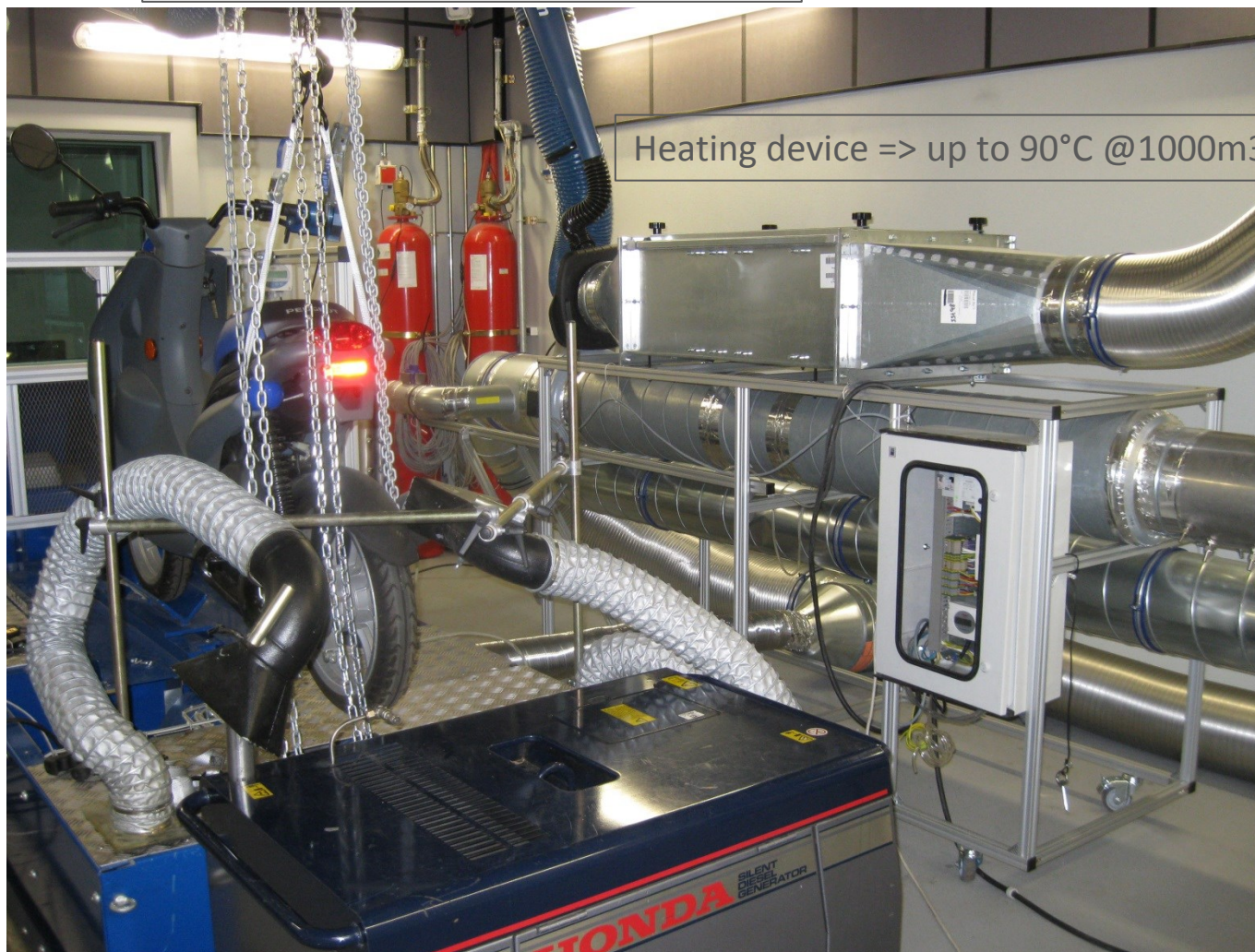
## ⇒ Reproducible generation: steady-state or dynamic cycling mimicking traffic conditions

## ⇒ Tests on whole vehicle: seeding through the wind screen/through the windows (IAQ decontamination protocol evaluation)

Filtered T and HR regulated dilution air

Gasoline exhaust generator

Diesel exhaust generator



Heating device => up to 90°C @1000m3/h

Isotherm water vapor injection:  
Up to 12% HR @90°C – 1000m3/h

PID control loop for:

- T
- HR
- Flowrate

PID control loop based on a pollutant measurement to handle raw exhaust injection and global dilution (currently PM1 )

- Vehicle is setup aside of the test cell
- Diluted emission partial flowrate is derived from the test cell (should be  $>$  of vehicle HVAC capacity) and led to the vehicle windscreen.
- Vehicle ICE can be operated for HVAC and/or Air Conditionner operation
- Pollutant sampling points are located just before the HVAC on the bottom of the windscreen (External Pollution), in the outlet of the air vents (Incoming Pollution) or at the head rest of passenger/driver (People exposure)

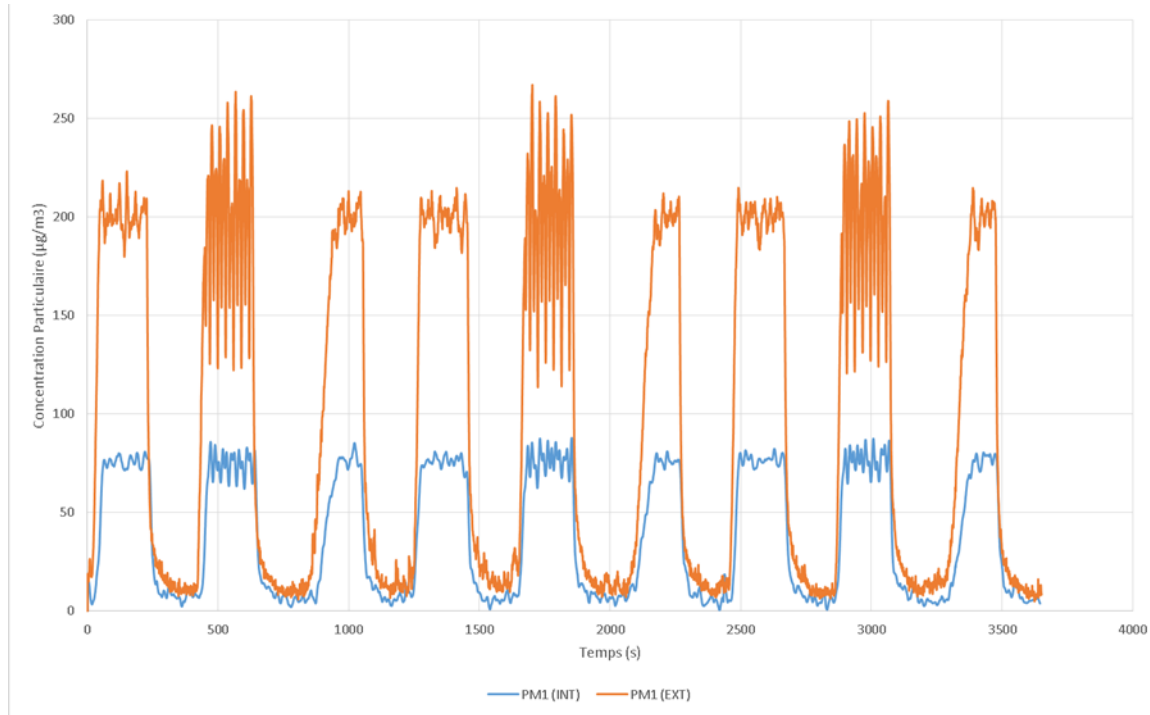


- Either same analyser for Int/Ext measurement with switching operation
- Or two analysers for direct upstream/downstream evaluation



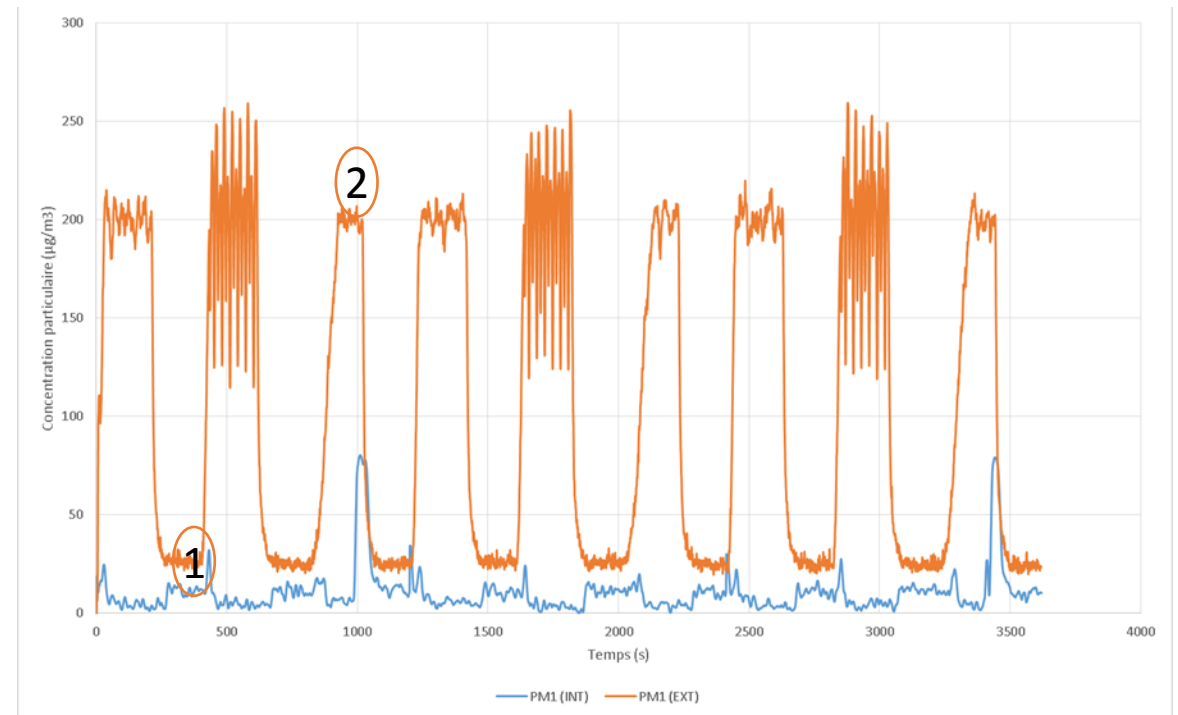
## Filtration efficiency

- Upstream/downstream HVAC



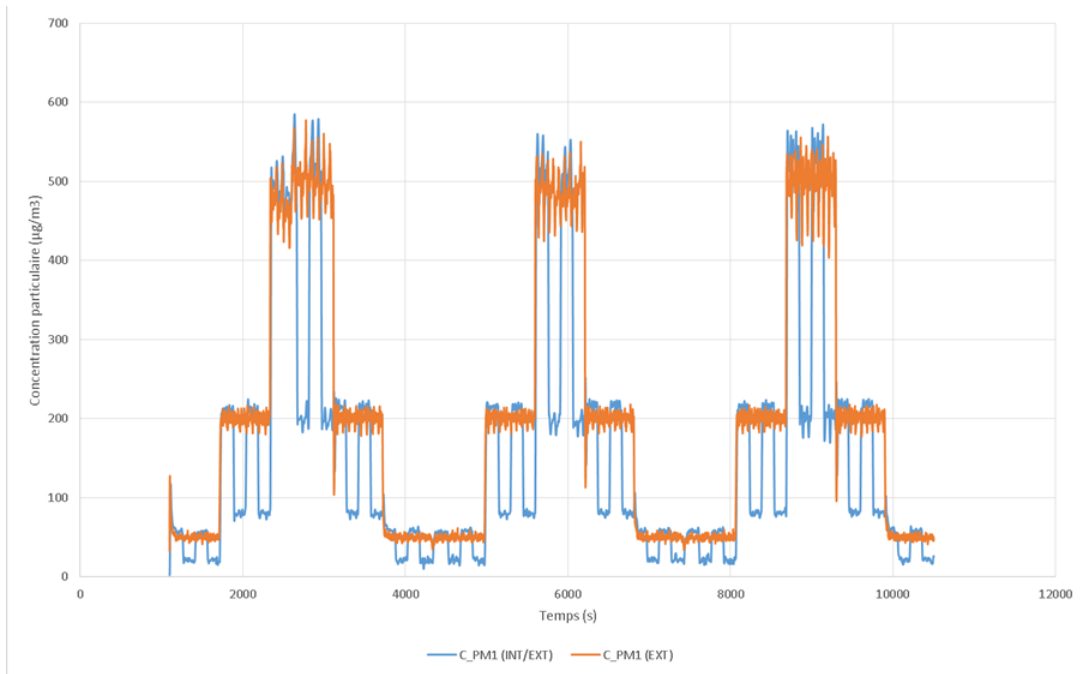
## Air Quality Sensor Evaluation

- Upstream/downstream HVAC



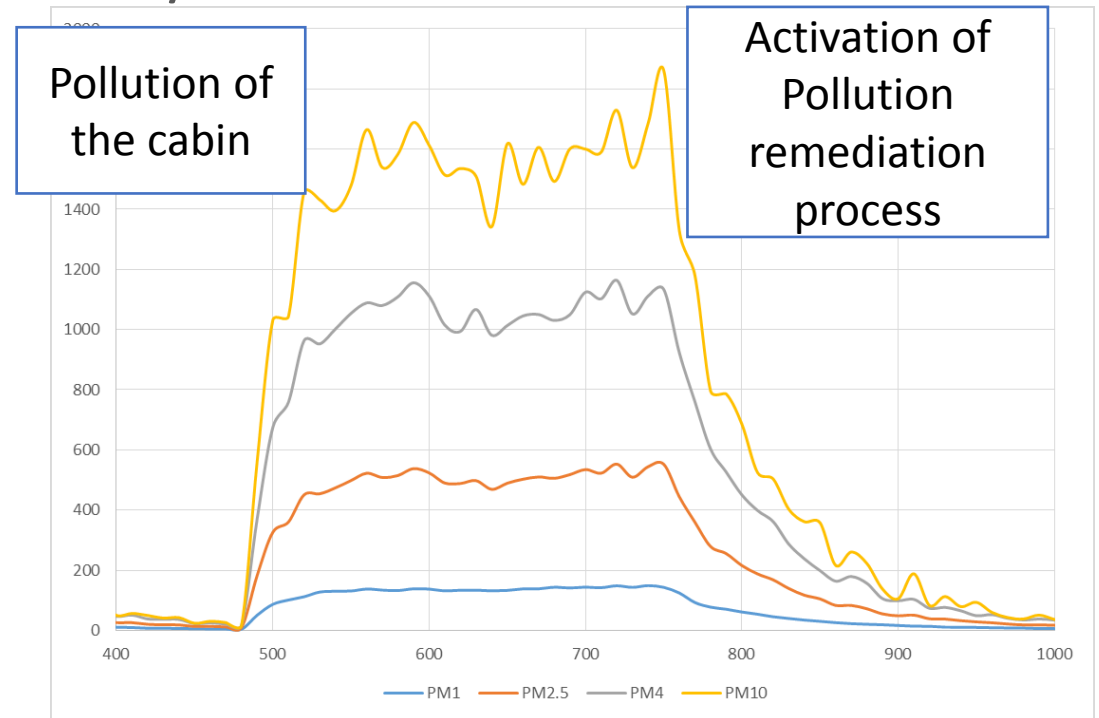
1. Detection of pollutant increase => closing external air vents
  2.  $d(\text{Pollutant})/dt$  near 0 => opening external air vent while still being in high pollution condition
- => Improvement of algorithm needed

## Static setpoints (IN<->OUT measurement)

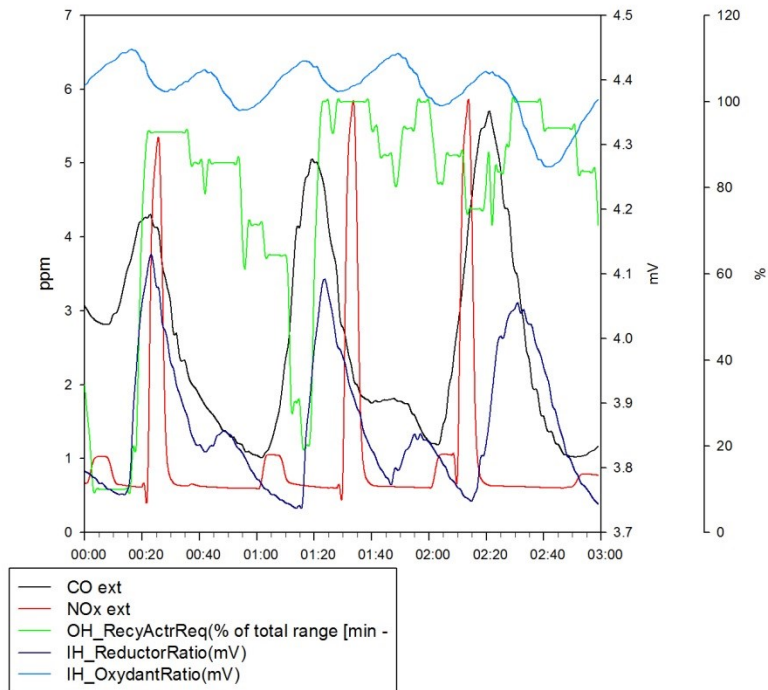


## In-cabin Pollution detection/remediation

- Measurement at the level of driver/passengers headrests and/or inside air vents



## Sensor evaluation vs pollutant mix



Sensors are usually responsive to

- A class of gases (oxidant, reductor)
- Types of PM

There is a need to understand how they react to different pollutant mix which may elicit counterbalancing responses and then an inadequate action on VIAQ effectors

