Mobilité Urbaine et Qualité de Vie (MoUVie) : sondage (vertical) en ville

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Journée Scientifique OCAPI
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LATMOS

Chaire d'excellence UPMC « Mobilité et qualité de vie en milieu urbain » : MoUVie

programme pluridisciplinaire qui vise :

- à mesurer les émissions fortement hétérogènes des polluants atmosphériques (gaz ou aérosols),
- à analyser et à simuler les mécanismes dynamiques et chimiques qui régissent la variabilité de leur concentration dans l'atmosphère d'une ville comme Paris
- et à évaluer leur impact à court terme sur la santé des citadins, en ciblant notamment les groupes à risque, et à poser les bases pour l'étude des effets à long terme.

Analyse de l'hétérogénéité et de l'impact sanitaire de la pollution atmosphérique urbaine

- Instruments (*sondage vertical / développements / climat*)
- Campagnes de mesures (*Paris et région / Périodes ou saisons différentes, émissions variées – Nox, O_3, aérosols, COV, écoles*)
- Modélisation (*qualité de l'air, exposition*)
- Expositions à la pollution (*relations expositions/indicateurs sanitaires, calculs d'impact*)


Sounding atmosphere

Scientific context for air pollution measurements :

- Pollutants (or precursors) measured at regional scale by satellite (and very few sites), but measurements poorly sensible to boundary layers
- Pollutants (or precursors) measured at local scale, at the surface, on a limited number of sites
- Difficulties to estimates origin of pollution (regional versus local).

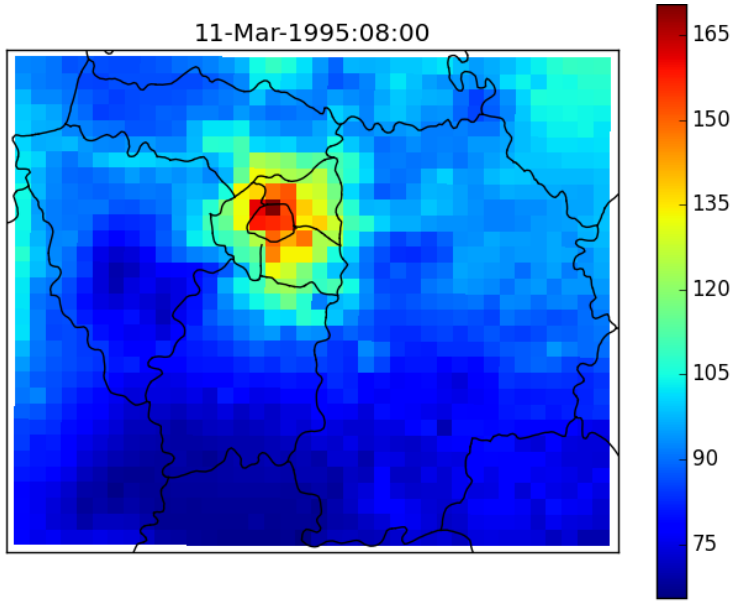
→ Measurements in the boundary layer helpfull to document/understand import and export of pollutants

→ Measurements at the "street" or "source" scale helpful to verify how modeling predict human exposition to pollutants

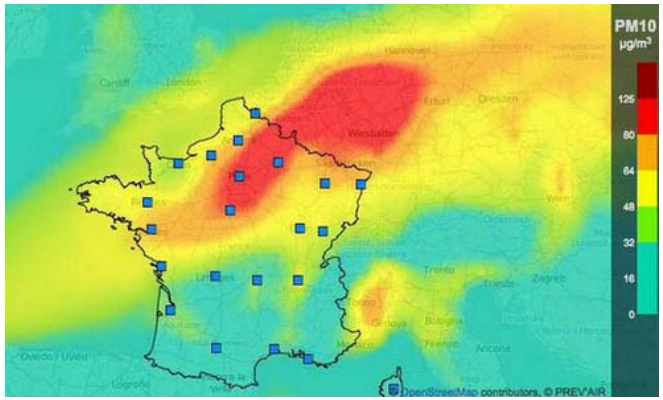
→ Portable instruments could help to estimate exact exposition to pollution

Sounding city atmosphere

Regional scale

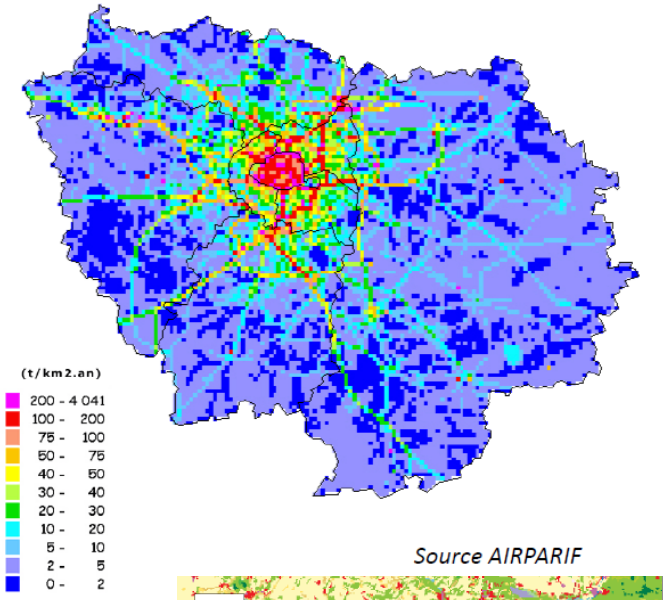


Chimere

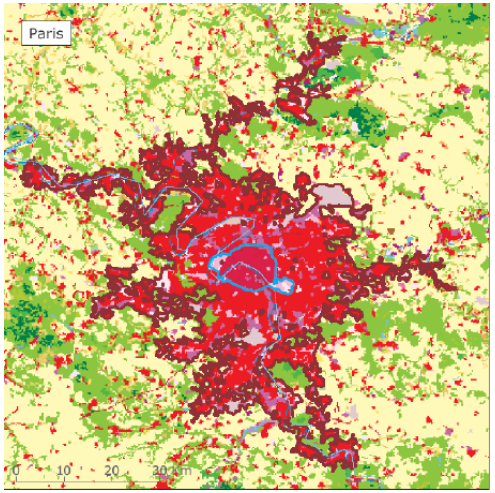


PREV'AIR

Local Scale



Source AIRPARIF

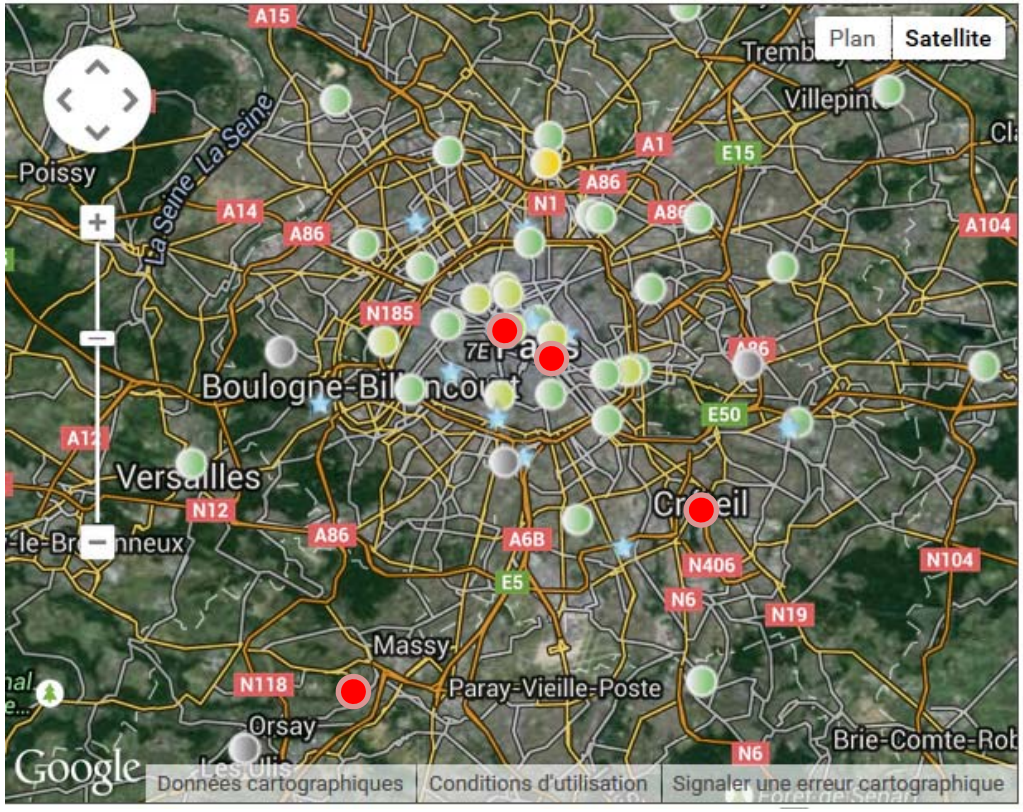


Sounding city atmosphere

- Existing Network
  - AASQA (Airparif)
  - IPSL (Qualair, SIRTA, OASIS, Eiffel Tower, ….)
  - Campaign (Megapoli, PARTICULES, …)
- Vertical sounding difficult in city, and poorly covered yet

→How to improve vertical Coverage ?

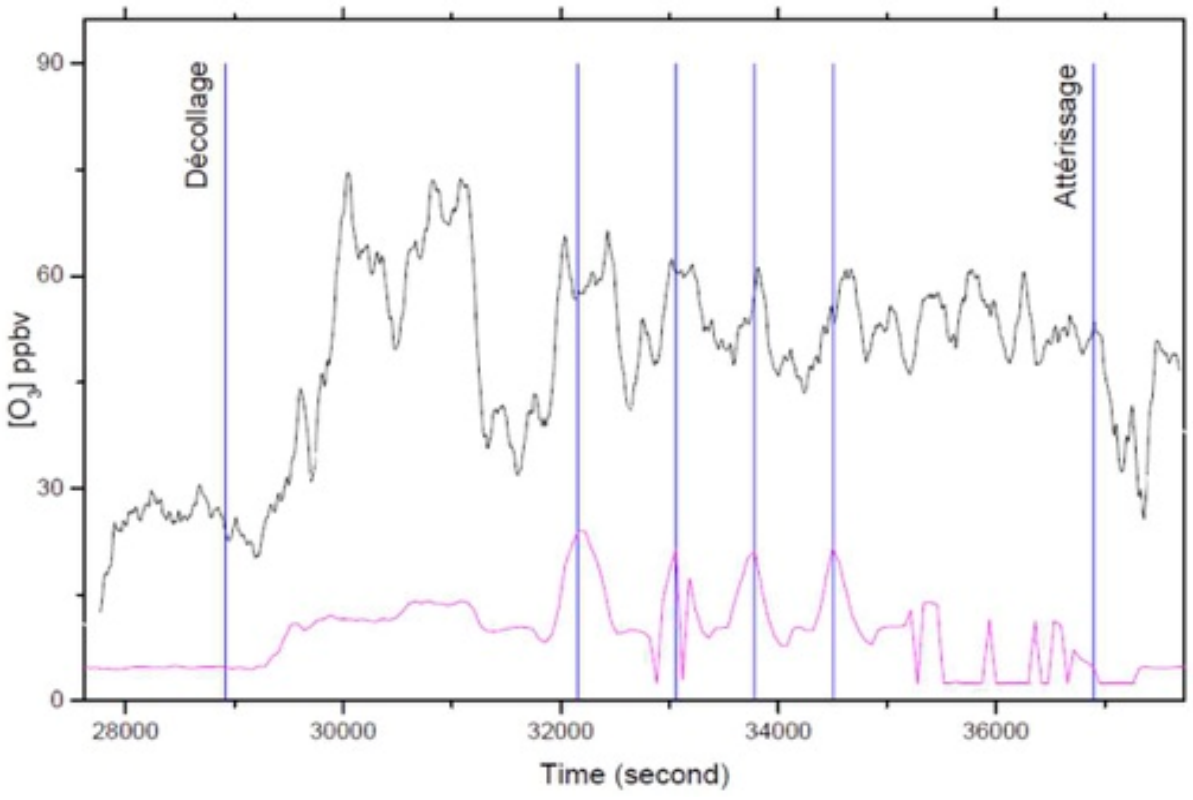
- Airship
- Aviostat
- Outdoor lifts
- Instrumented masts
- Tethered balloons
- Drones
- Tethered drones
- Individual remote sensors



Sounding city atmosphere

Airship for vertical sounding ?

- Test flights on 18 jully 2014.
- Difficult to deployed
- Towards a compact and permanent Arishipp (drone) ?

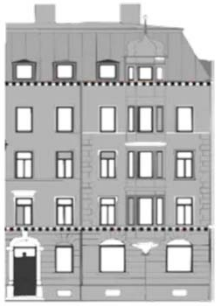


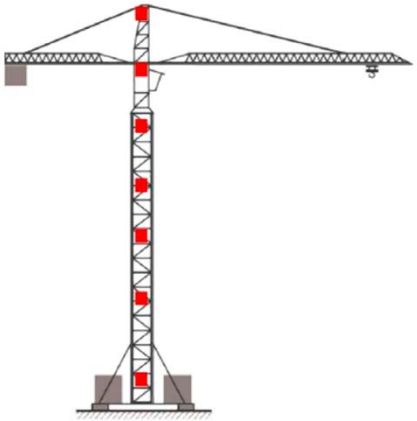
Sounding city atmosphere : instrumented cart

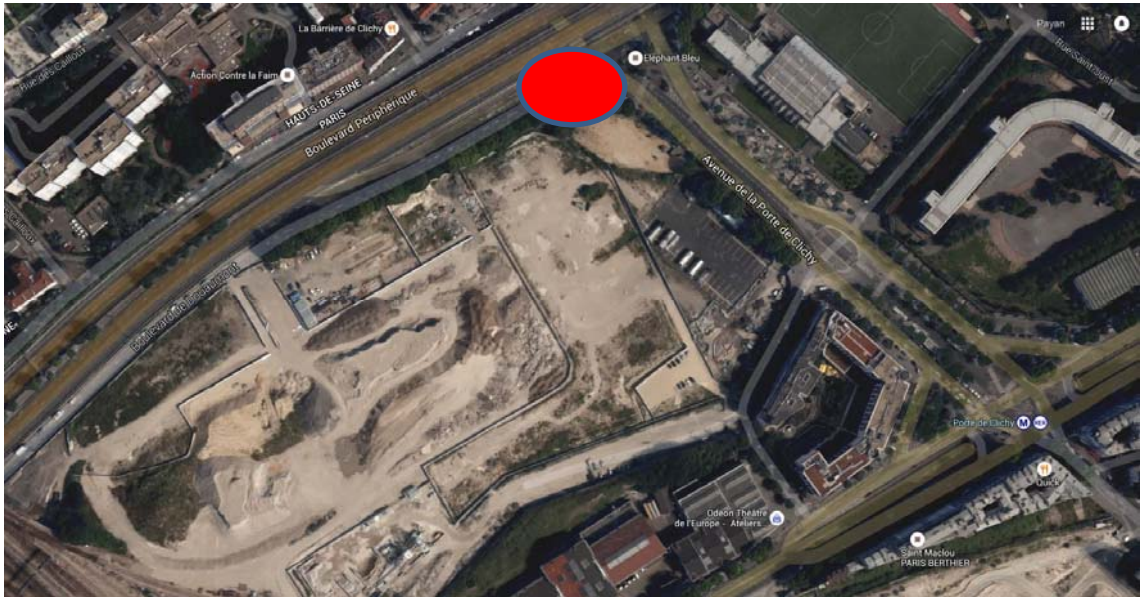
- Remote sensors with poor accuracy, biais, time drift
  - need to be compared frequently for calibration.
  - Reference instrument to be available for calibration
- Integrations of several reference instruments in a cart at LATMOS :
  - Portable ozone analyzer (POM)
  - Ozone analyzer (Environement SA)
  - Aerosol counter (DUSMATE)
  - Portable aerosol analyzer (OSIRIS)
  - NOx analyzer (AC32M)
  - LOAC (LPC2E)
  - Aerosol count and mass (AEROCET MetOne)
  - Formaldehyde analyzer (Environmental Sensors)
  - Ultrafine particles (P-Trak)

Sounding city atmosphere

- Crane based sounding







Sounding city atmosphere

- Campaigns at/around schools
  - Towable nacelle
  - Instrument setup (reference)
  - Remote sensors
  - Home sensors (?)

Remote sensors for air quality monitoring

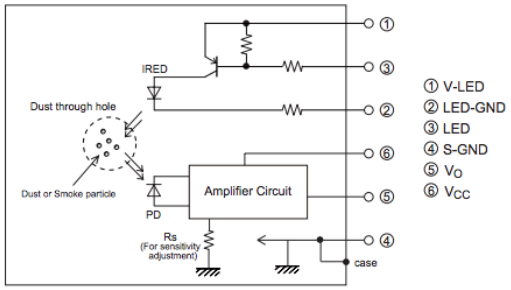
Various remote sensors available

- Several epidemiology studies based on remote sensors use
- Only few parameters measured
- Today, possibility to developed multiple parameters compact sensors.
- Example of sensors :
  - Home made (PMClab)
  - Collaborative (PlumeLab)
  - Commercial (Azimut, Cambridge, …)
- Key points
  - Autonomy
  - Mass and volume
  - Data storage/transfer
  - Measured parameters (position, T, P, U, O3, NOx, COV, PM)
  - Mobility behavior

Low-cost air quality sensors

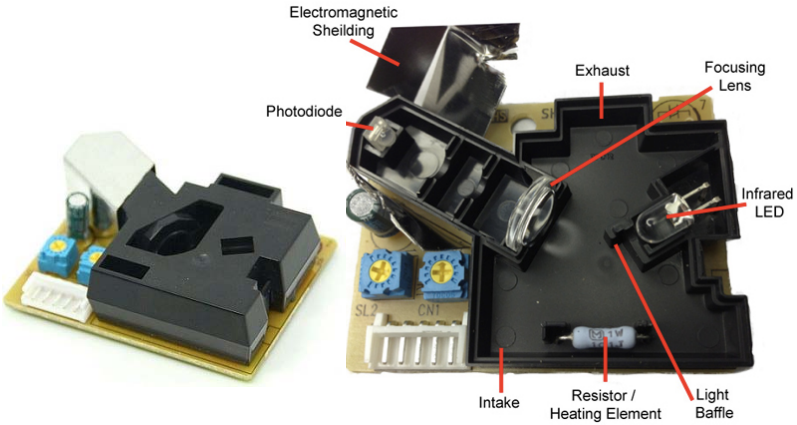
1) dust/particle sensors (mostly light scattering)

SHARP GP2Y1010AU0F



11.95$ @ SparkFun

SHINYEI PPD42



http://www.takingspace.org/make-your-own-aircasting-particle-monitor/

15.90$ @ SeeedStudio

2) gas sensors

MQ7 Carbon Monoxide sensor

4.75$ @ SainSmart

Detection Zone:10 to 1000ppmm

MQ131 Ozone sensor

10PPB-2PPM Ozone

28.59$ @ SainSmart

MG811 CO2 sensor

57.41$ @ SainSmart

low-cost wireless data-logging using a smartphone





sensors

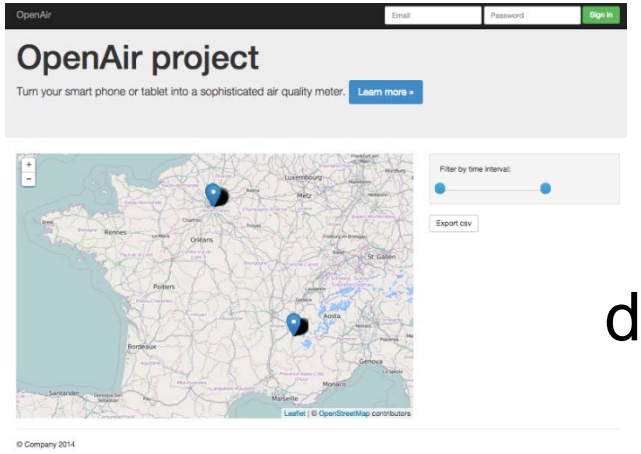
data

Bluetooth Low Energy (RFDuino)

mobile application written in HTML/CSS/**JavaScript** and **deployed** in **iOs** and **Android**

APACHE CORDOVA™


iOs Android



data → time & GPS (smartphone)

data + time & GPS ←

Web Server

real time maps / CSV export

Sounding city atmosphere : instrumented cart

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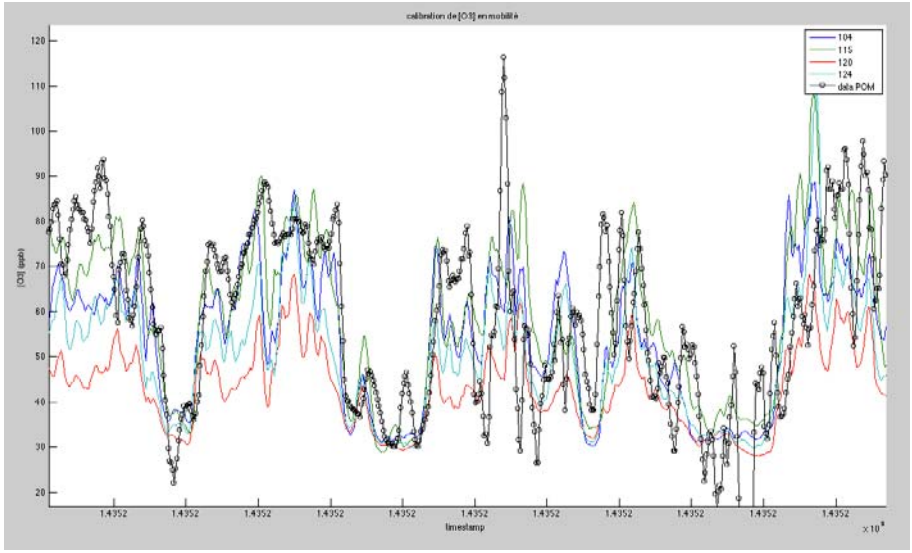
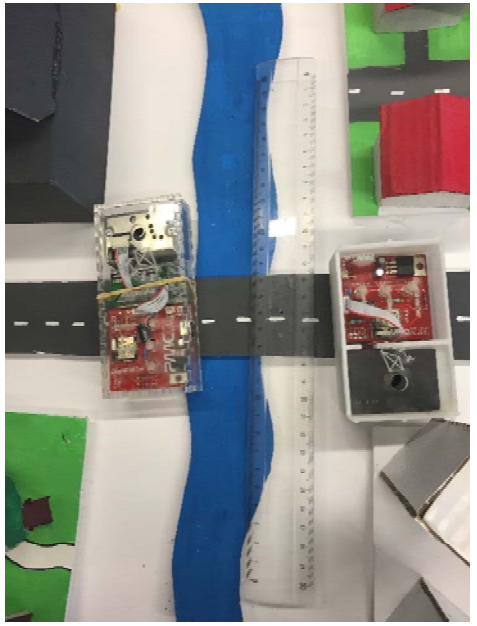
Sounding atmosphere : remote sensors

- Calibration/validation of remote sensors :
  - Comparison (static) with simulation chambers facility
  - Comparison (mobile) of a sensors package with our instrumented cart along several path in Paris (street, buildings, subway, …).
  - Analysis of sensor use by " informed users" (UPMC students)
  - Analysis of the data for calibration protocol definition to apply during Arctic campaigns



Test of ozone remote sensors during a walk in Paris



PMCLab aerosol remote sensors

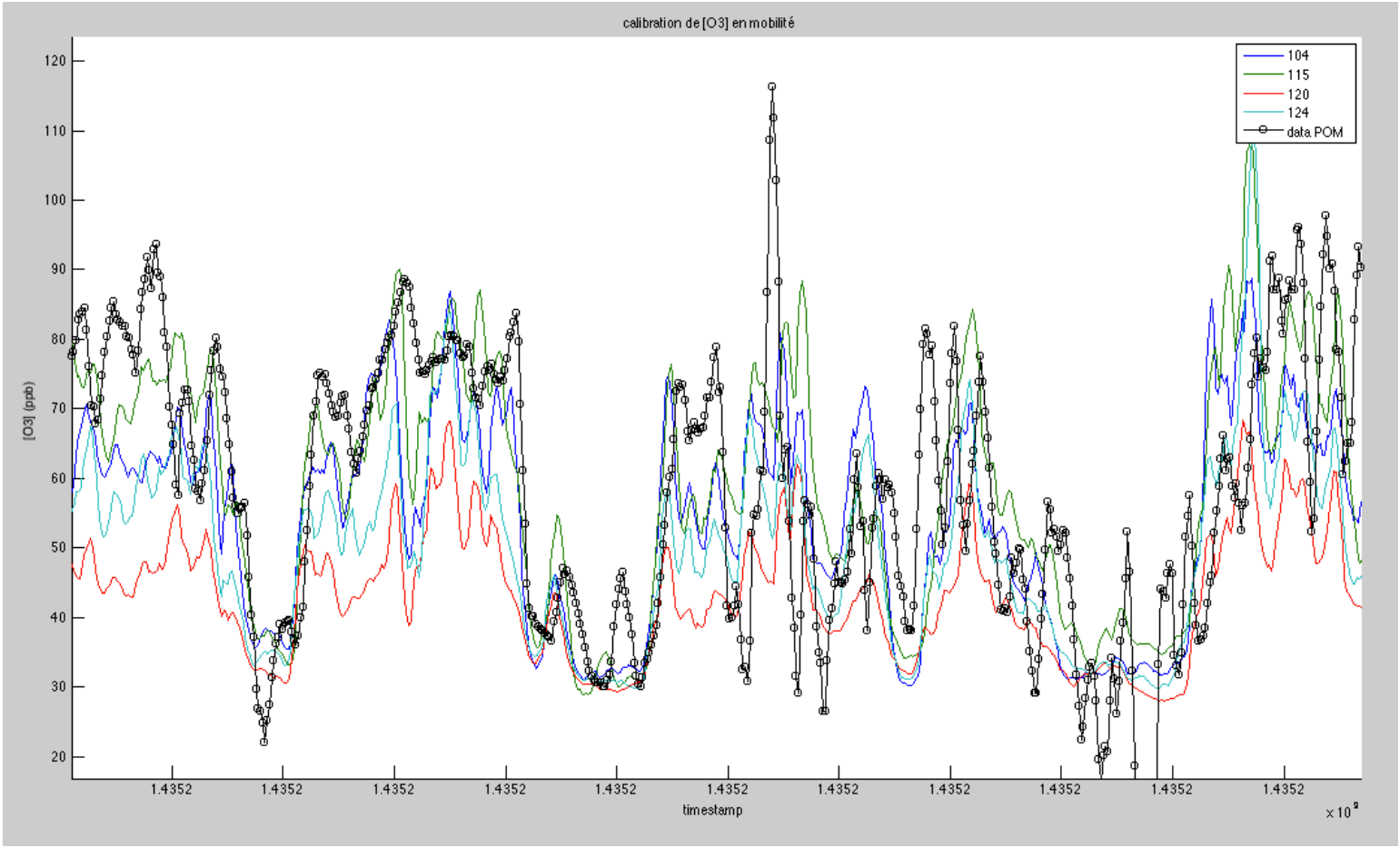
Atelier MoUVie

- Semaine du 4 juillet
- Environnement Ubain :
  - Mesure pollution
  - Son
  - Modélisation
  - Épidémiologie, Santé

Backup

Sounding city atmosphere

- Remote sensors calibration/validation study



Sounding city atmosphere

- Light Optical Aerosol Counter