The exposition of vehicle drivers and passengers to toxic air contaminants

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INSERM U644 – University of Rouen - France

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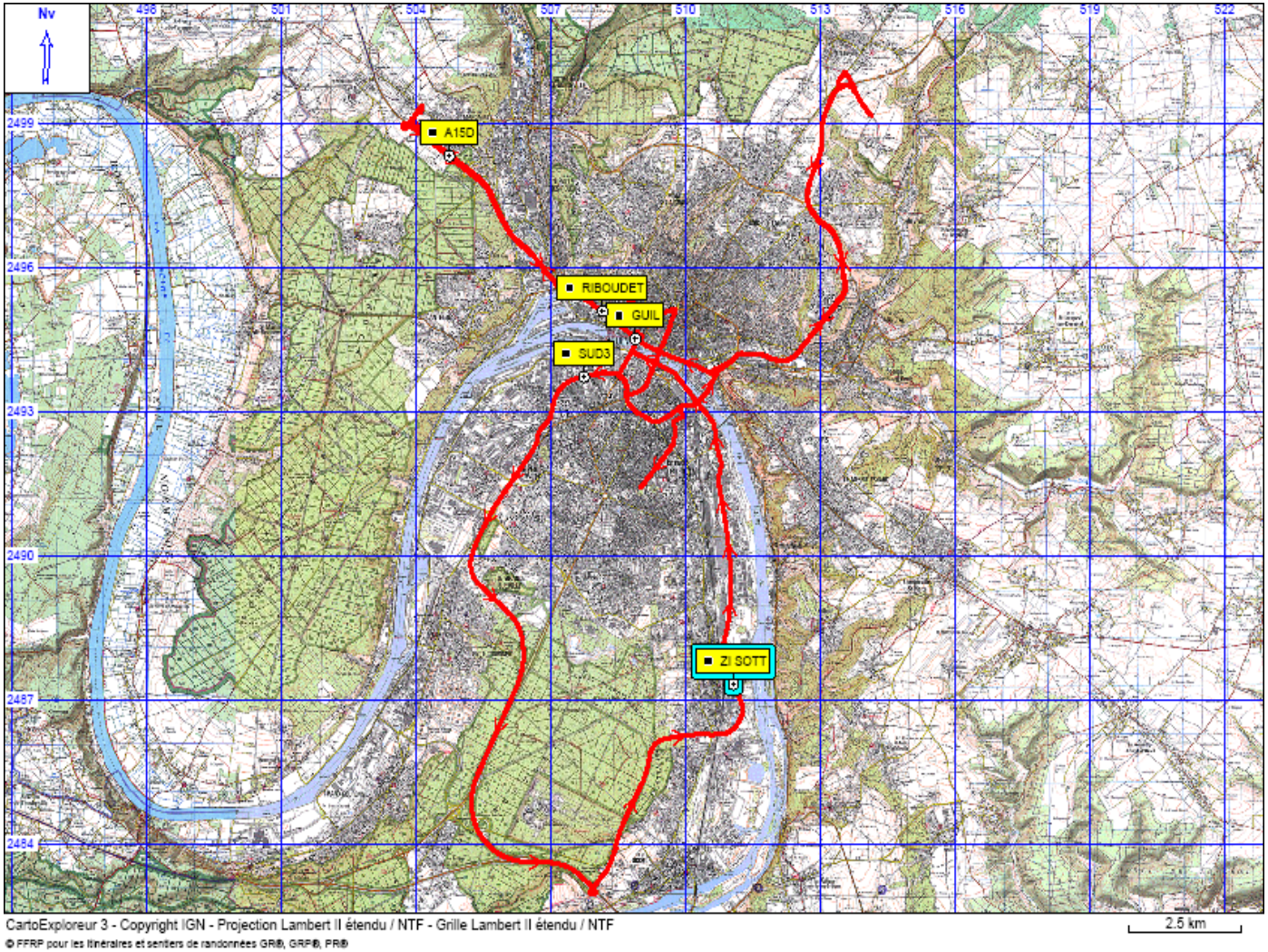
CERTAM
AIR NORMAND
OBSERVATOIRE DE LA QUALITE DE L'AIR



Route (72 km)
ROUEN City Area

N=50

Twenty sections
Trafic typology
Infrastructure typology
Urban arcitecture typology

Air Normand Monitoring network data
5 places with NO2 diffusion tubes

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Pollutant Measurements

NOx-NO-NO_2 : Chemiluminsecence (Environnement SA)
T32M combustion analyser (Dual chambers)
AC31M Environmental Analyser (Mono Chamber)

Ozone : O42M UV detection (Environnement SA)

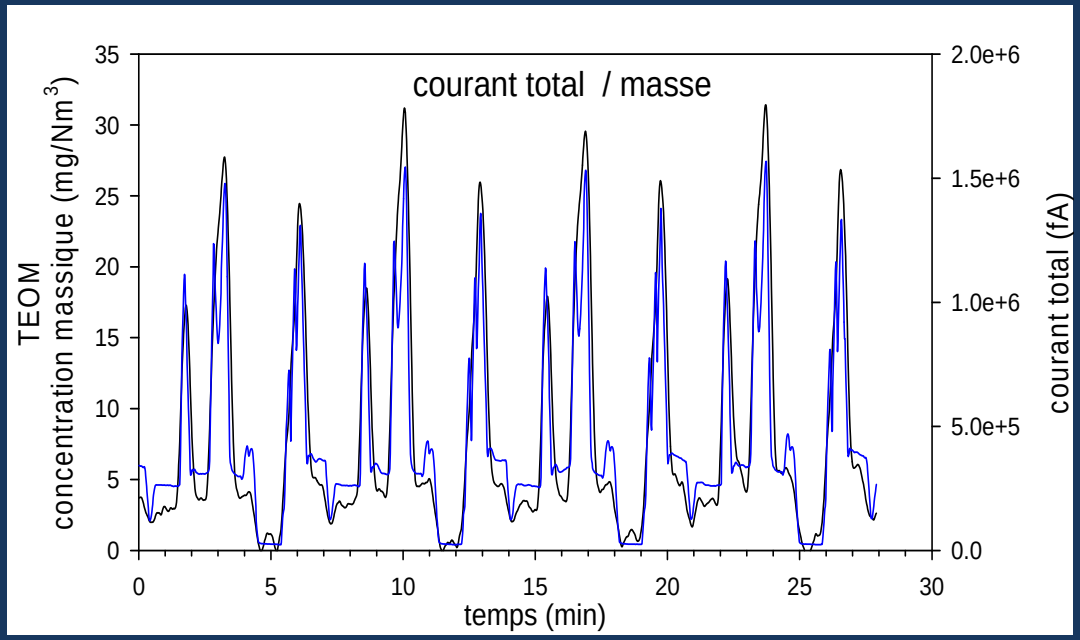
PM : P-Track Condensation counter (TSI)
ELPI (Dekati) number and estimated PM1
TEOM (Head PM10, PM2.5, PM1)
Black Smoke – Filtromat (Environnement SA)

Other Recordings

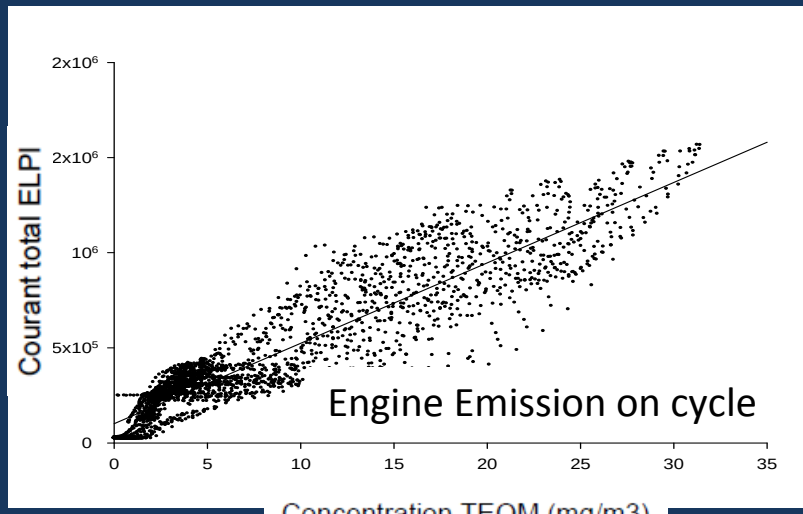
Video : 1 image/second
GPS : localization, Instant speed, road slope
Automated route section analysis based on GPS milestones

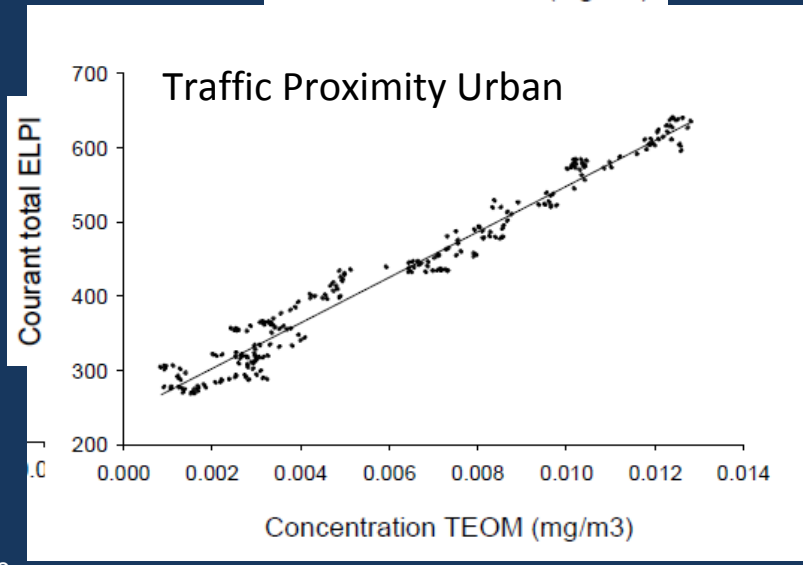
PM1 mass estimates based on Correlation Between Total current ELPI and PM1 mass TEOM

Based on an analogy to the Dekati Etaps apparatus principle, correlation between ELPI total current and the actual mass measured with TEOM PM1



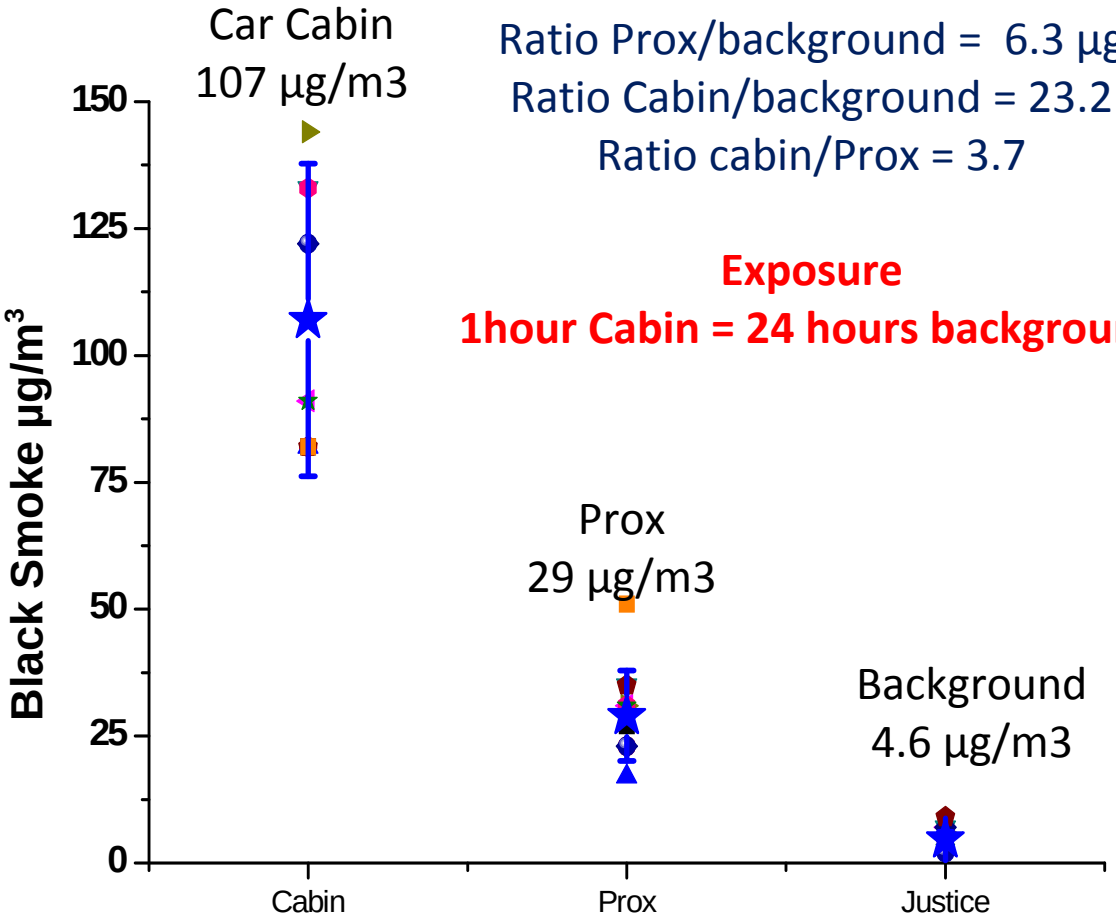
Engine Emission on cycle





A very good linear correlation over a wide range of concentrations allows direct mass estimation in the traffic

Black Smoke



Ratio Prox/background = 6.3 µg
Ratio Cabin/background = 23.2
Ratio cabin/Prox = 3.7

Exposure
1hour Cabin = 24 hours background

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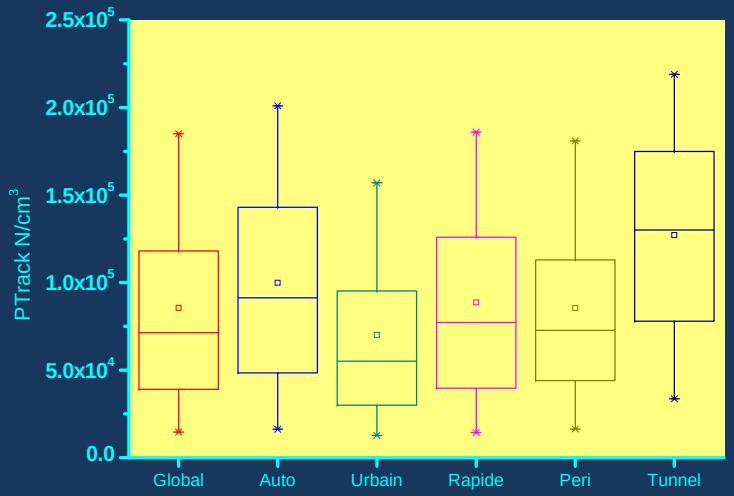
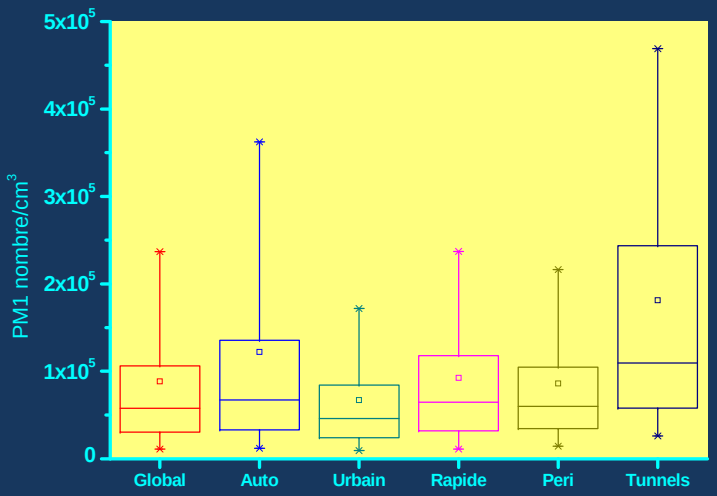
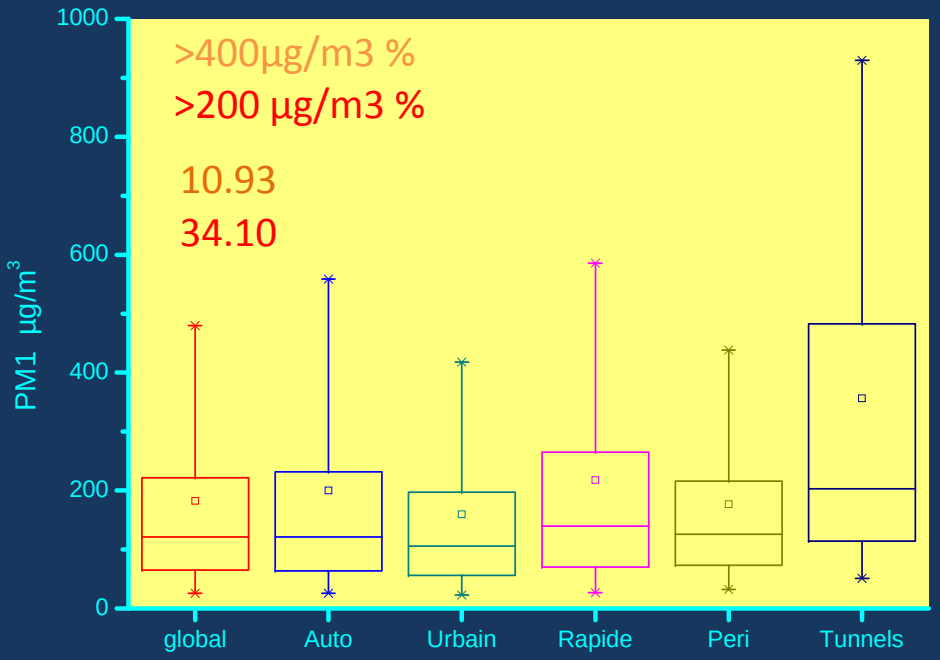
Particulate Matter PM1 Agglo Rouen







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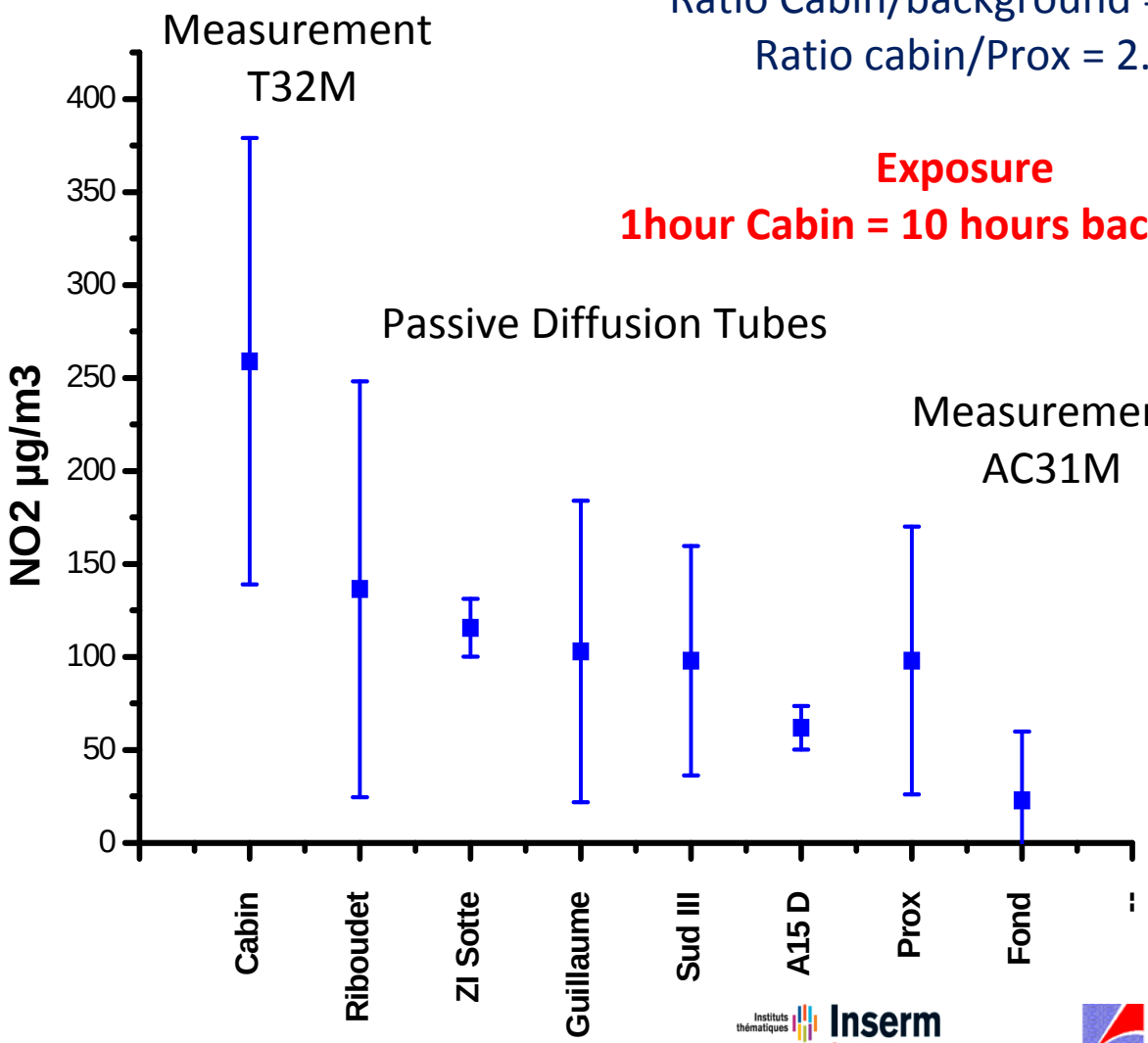
NO_2 Comparison Cabin and Fixed sites

Ratio Prox/background = 6.3 µg
Ratio Cabin/background = 11.2
Ratio cabin/Prox = 2.6

Exposure
1hour Cabin = 10 hours background



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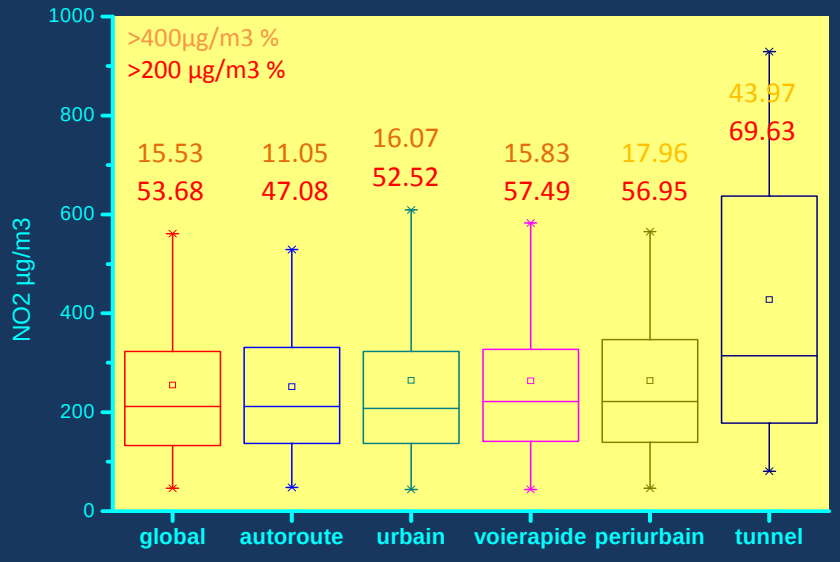
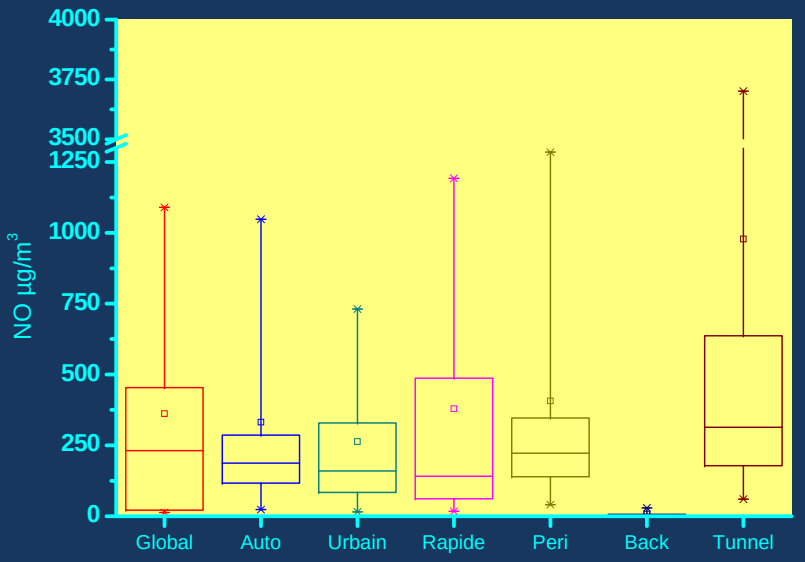
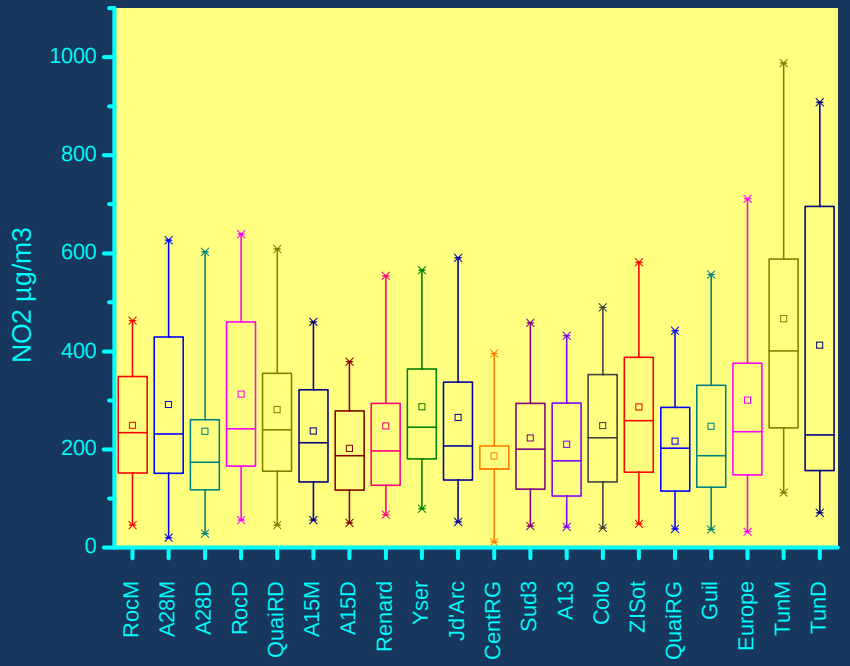
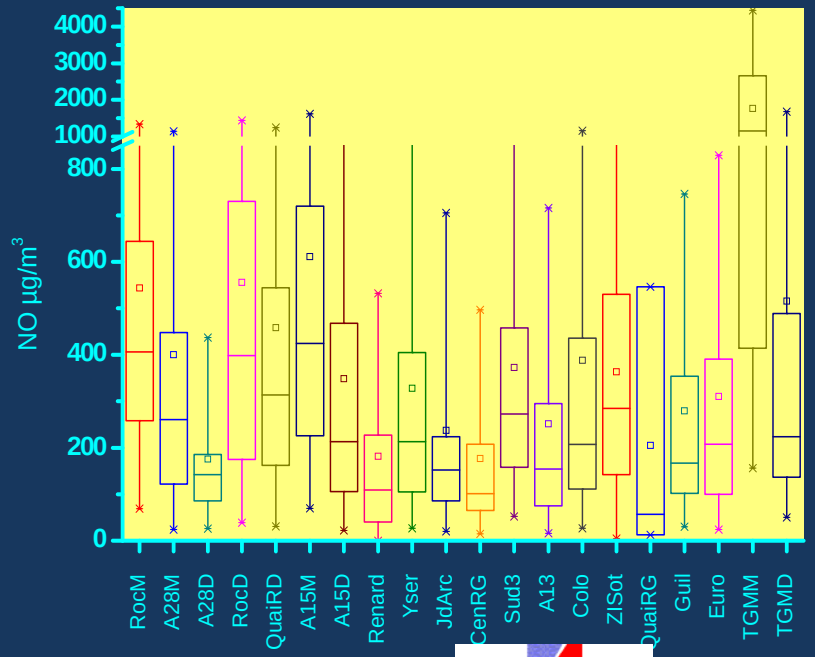
Nitrogen Oxides Agglo Rouen

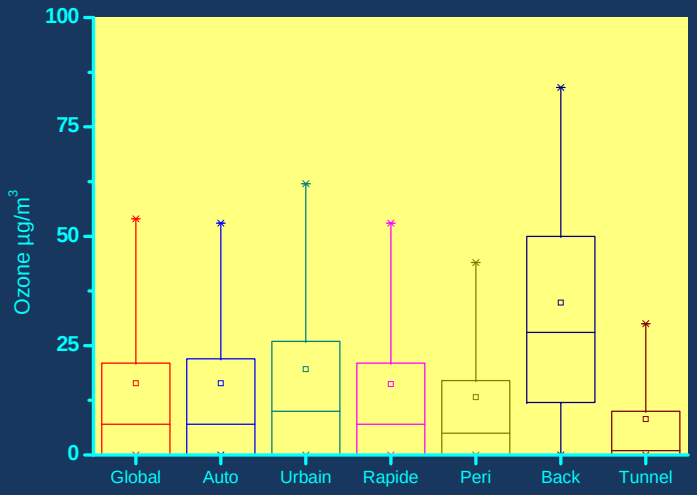


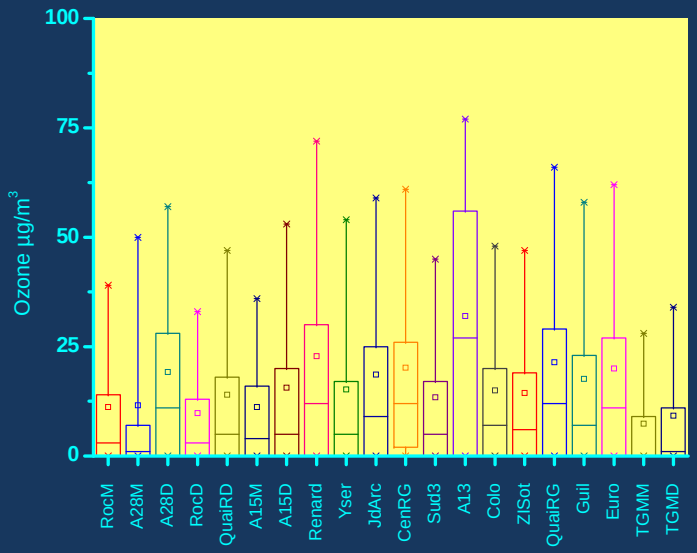






OZONE Agglo Rouen





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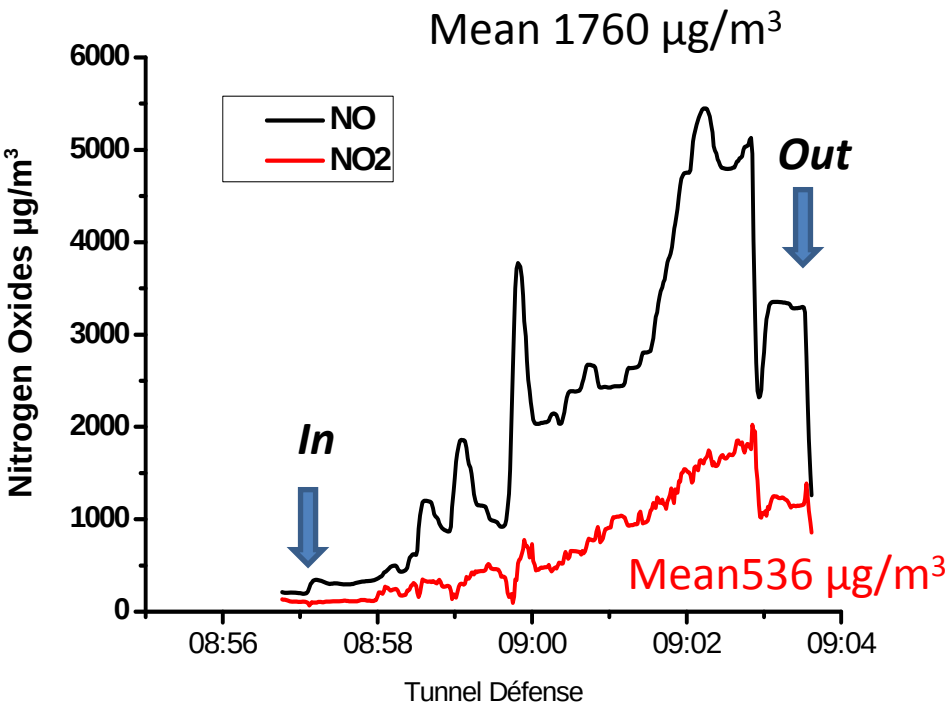
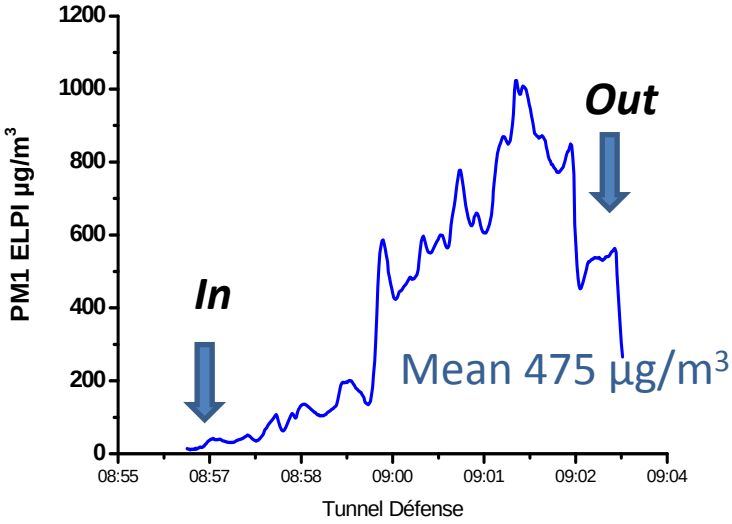
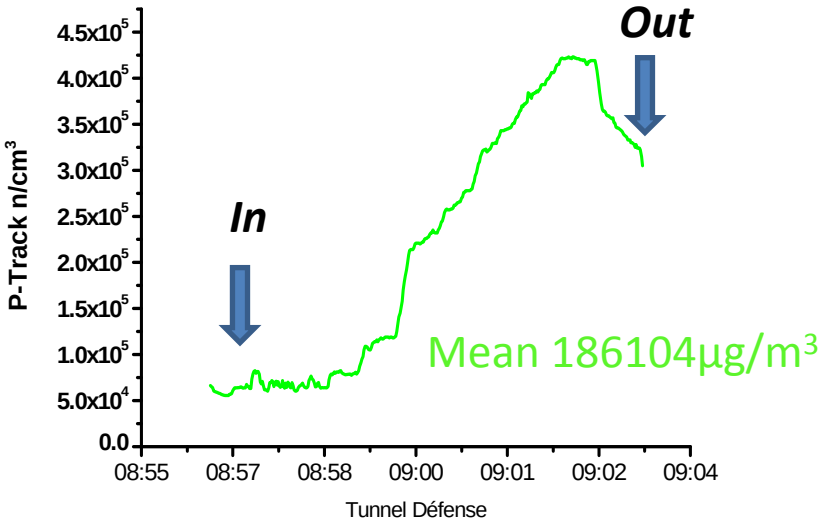
Two Specific Situations

Tunnel Profile (La Défense Paris, 4.5km)
Technology (A CRT equipped city Bus)

Impact of Confinement
Example of the Tunnel "La Défense"







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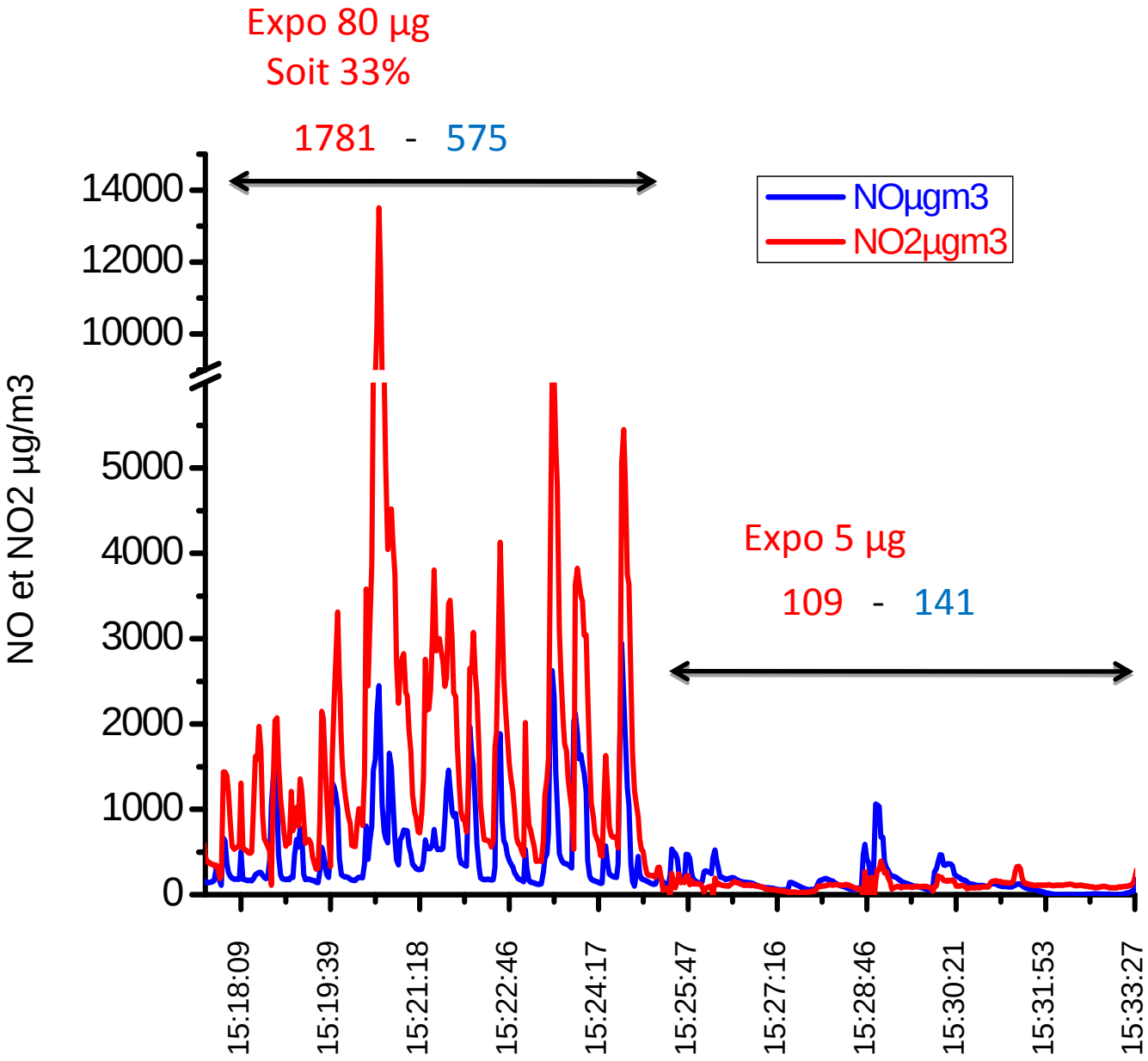
Following a Euro3 City Bus
NO, NO2, Particle/cm3

DPF type CRT
30%RME



WHO RECOMMANDATIONS

NO_2

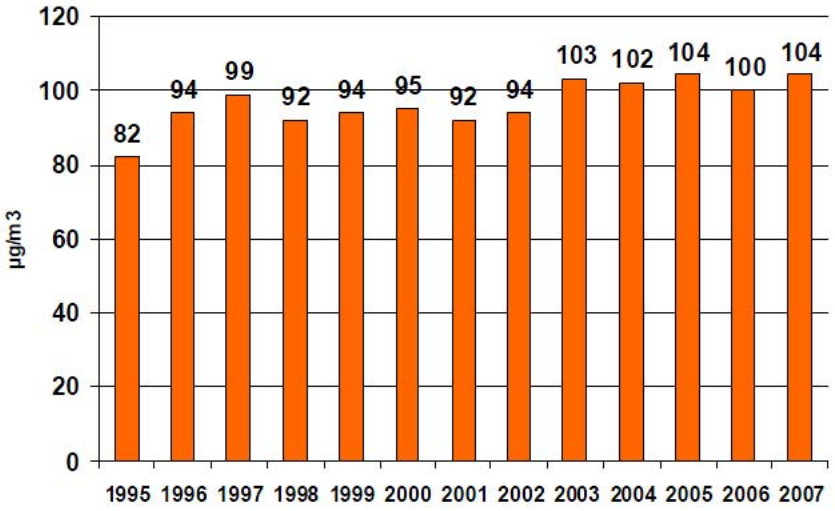
Information and recommandations to sensitive persons	200 µg/m3 hour mean
Population Alert	400 µg/m3 hour mean
Air Quality objective	40 µg/m3 annual mean
2007 Limit values for human health protection	230 µg/m3 hour mean not to exceed more than 18 hours/year
	46 µg/m3 annual mean
Limit Values for plant protection	30 µg/m3 annual mean for the sum of NO and NO2 concentrations
Occupationnal limit NL-Germany	980 µg/m3 15 minutes

PM_{10}

PM10 Information and recommandations to sensitive persons	80 µg/m3 24 hour slipping mean
Population Alert	125µg/m3 24 hour slipping mean
Air Quality objective	30 µg/m3 annual mean
2007 Limit values for human health protection	50 µg/m3 daily mean not to exceed more than 35 days/year
	40 µg/m3 annual mean
Occupationnal limit	No convergence of available data

O_3

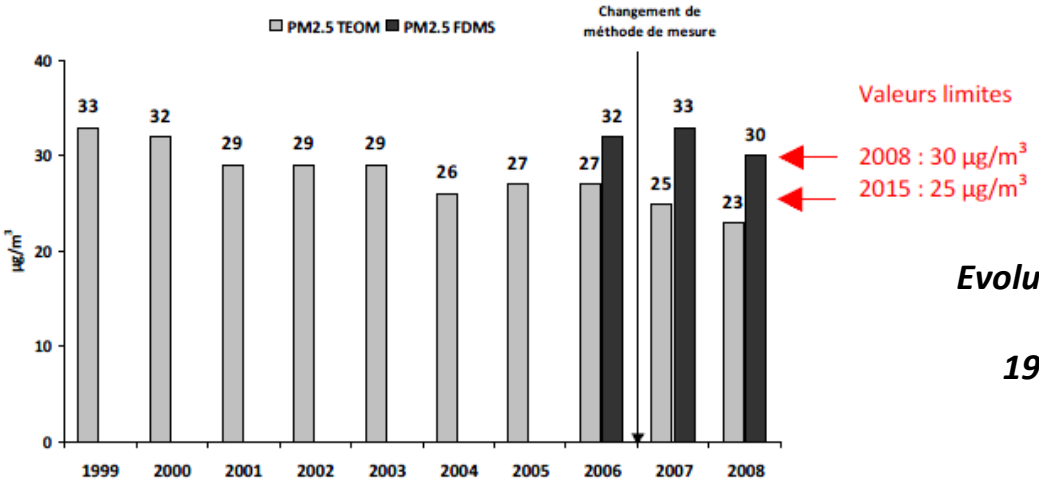
Information and recommandations to sensitive persons	180µg/m3 hour mean
Population Alert	240 µg/m3 hour mean over 3 consecutive hours
	300 µg/m3 hour mean over 3 consecutive hours
Progressive emergency Actions	360 µg/m3 hour mean



Evolution NO2
1995-2007
+27%

Objectif de qualité actuel et valeur limite en 2010

Evolution of NO2 annual mean concentration in the Traffic site "Porte d'Auteuil" Paris

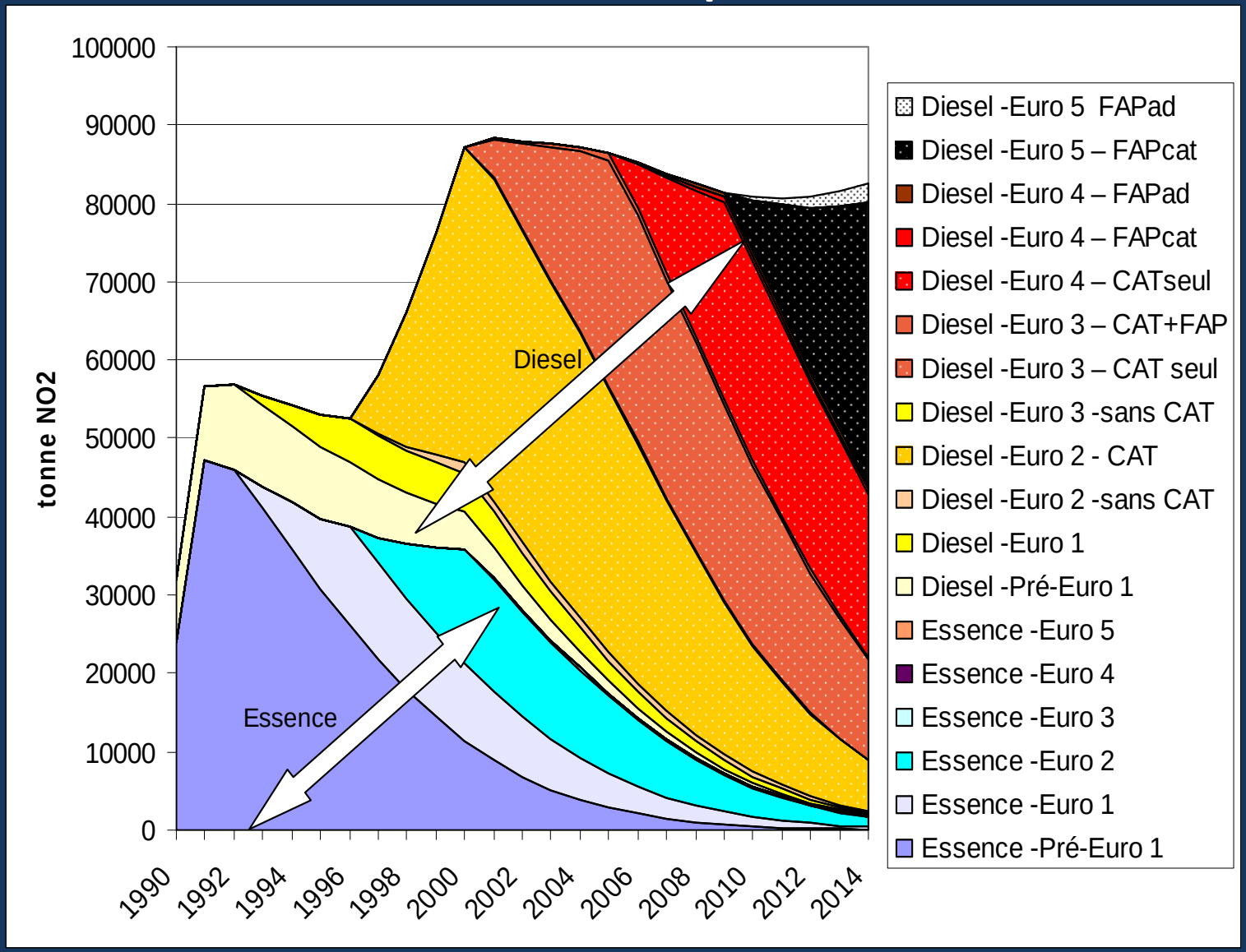


Evolution PM2.5
TEOM
1999-2008
-30%

Data adapted from 2007-2008 reports

Evolution of PM2.5 annual mean concentration in the Traffic site "Porte d'Auteuil" Paris

NO2 Emissions from light duty vehicles in France Past and Prospective



Source : Ademe – CETE Nord Picardie-AFSSET

French park NO_2 emissions, Euro 5 emissions > by 10% to Euro 4 catalysed DPF 80/ addditivated DPF 20

CONCLUSIONS

Car Cabin does not protect from traffic generated Pollution
Huge dynamic of in cabin pollutant concentrations
1 hour inside car cabin = up to 50% of daily exposure PM or NO2
High dependence of pollutant exposure on the preceeding vehicle technology

Each Hour spent inside a car corresponds to
1 hour excess of both NO2 and PM WHO guideline limits

The wide introduction of DPF on cars will reduce traffic generated PM exposure

The NO2 issue will last longer than the PM Issue and may still deteriorate for at least the next 10 - 15 years

Contribution to exposure budget Not Yet taken into account by epidemiology studies
A major concern for a vast majority of the population

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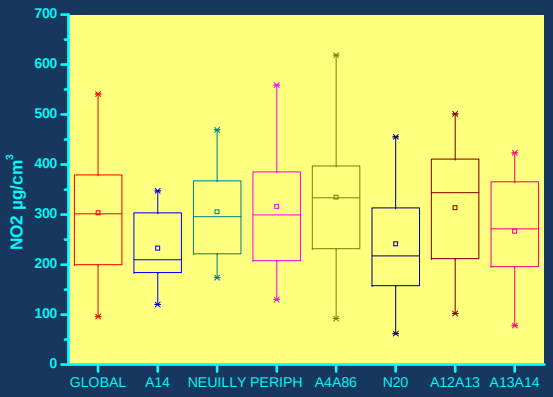
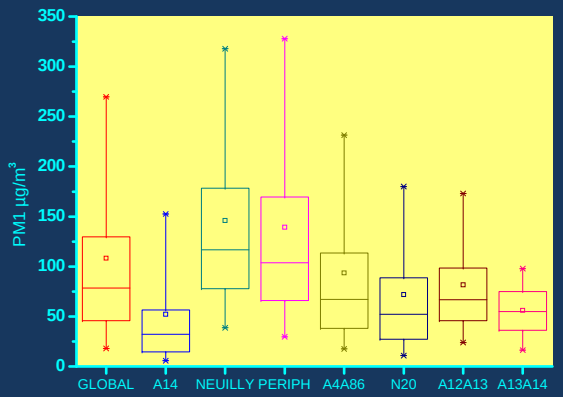
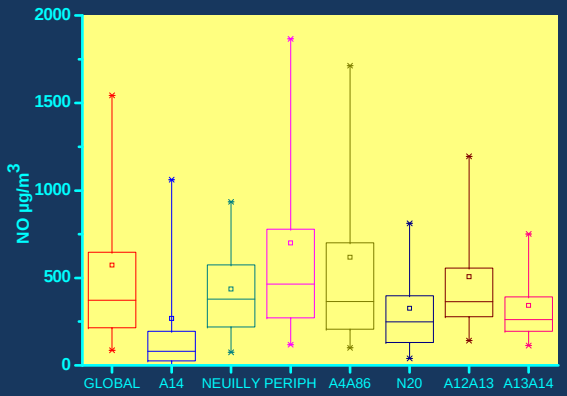
Michel Bobbia
Jérome Cortinovis
Sébastien Lemeur
Benjamin Pietruszewski

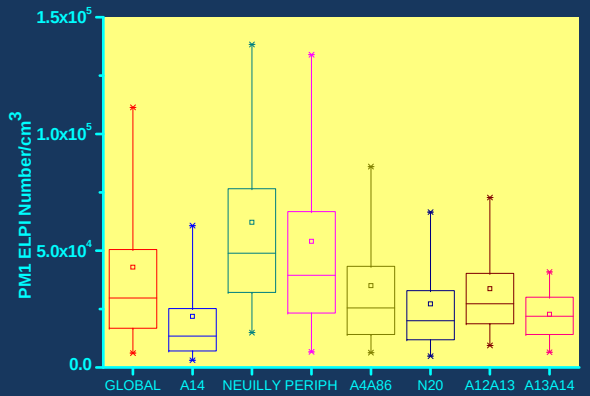
Frédéric Dionnet
Frantz Gouriou
David Preterre
Tiphaine Brunel

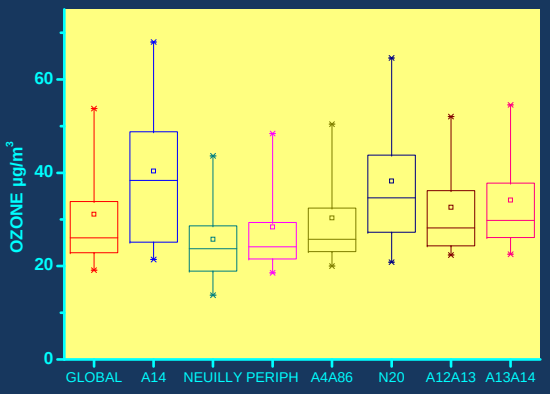
Pollutant Ile de France (Agglo Paris)

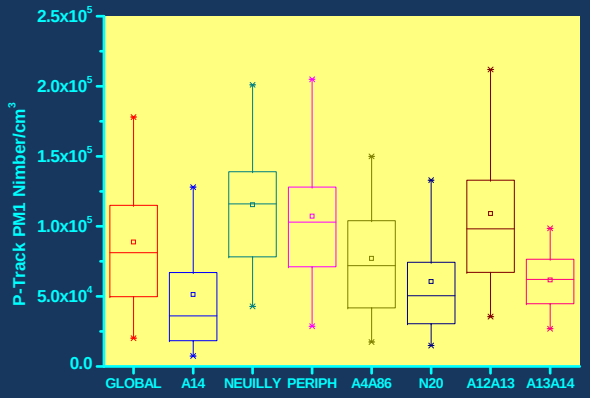












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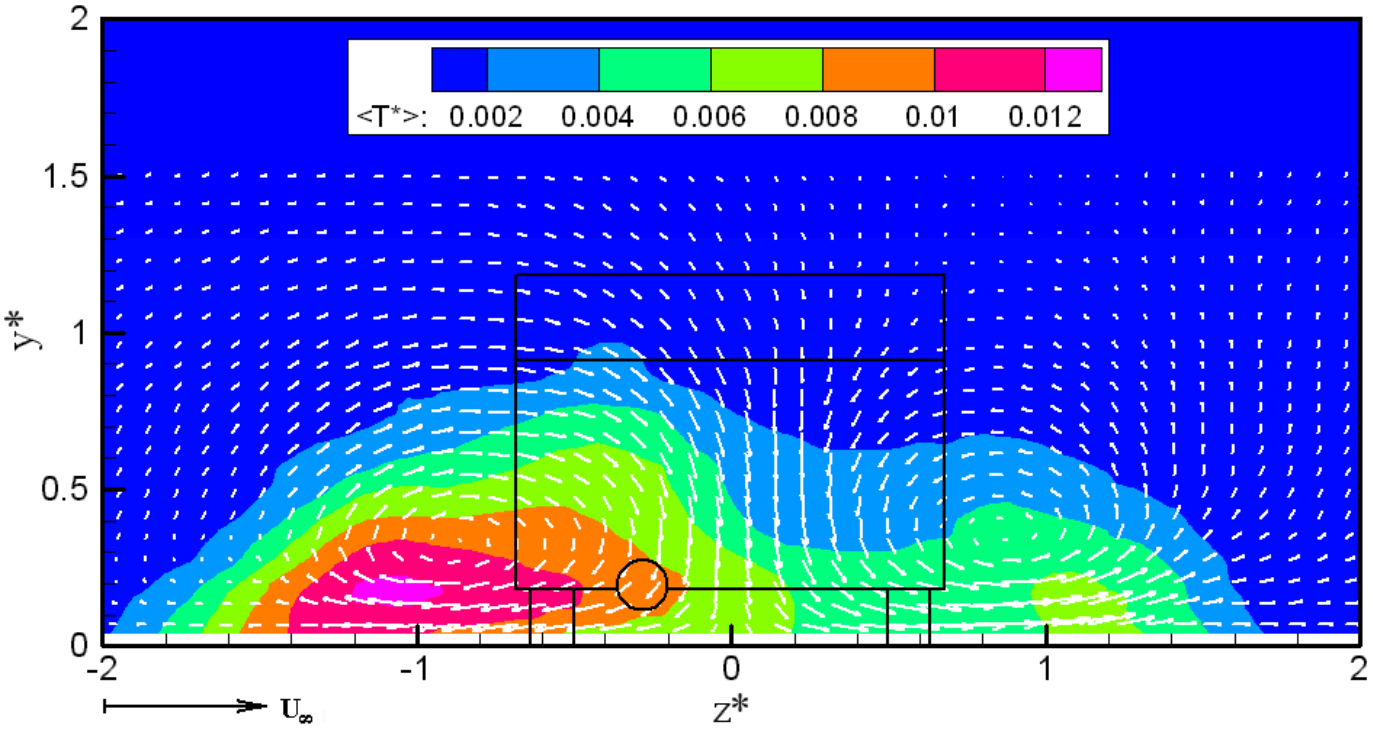
Comparaison de technologies sur véhicules lourds

Evolution NO, NO2, nombre de Particules

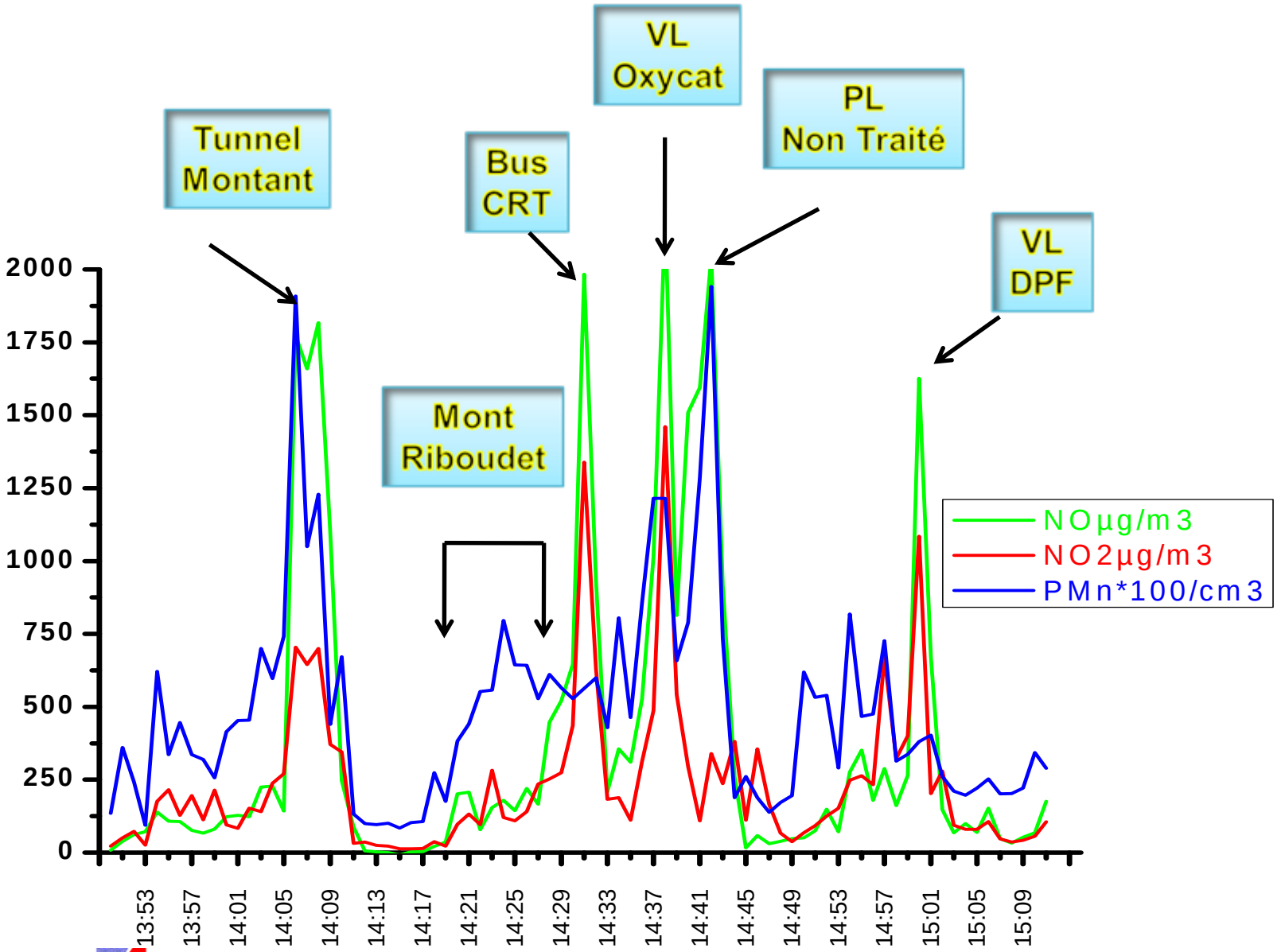
FAP type CRT
Diester



Champs de concentrations derrière un véhicule
Plan vertical situé à une distance égale à 5 fois la longueur du véhicule soit 20 m pour un véhicule de 4m de long
Concentration 1 = polluant à l'émission
On notera un facteur de dilution de 100 dans le sillage et de 1000 à deux largeurs de véhicules à droite, ce que pourrait être une station de mesure de proximité
Il y a donc un facteur 10 de concentrations entre sillage et station de proximité!

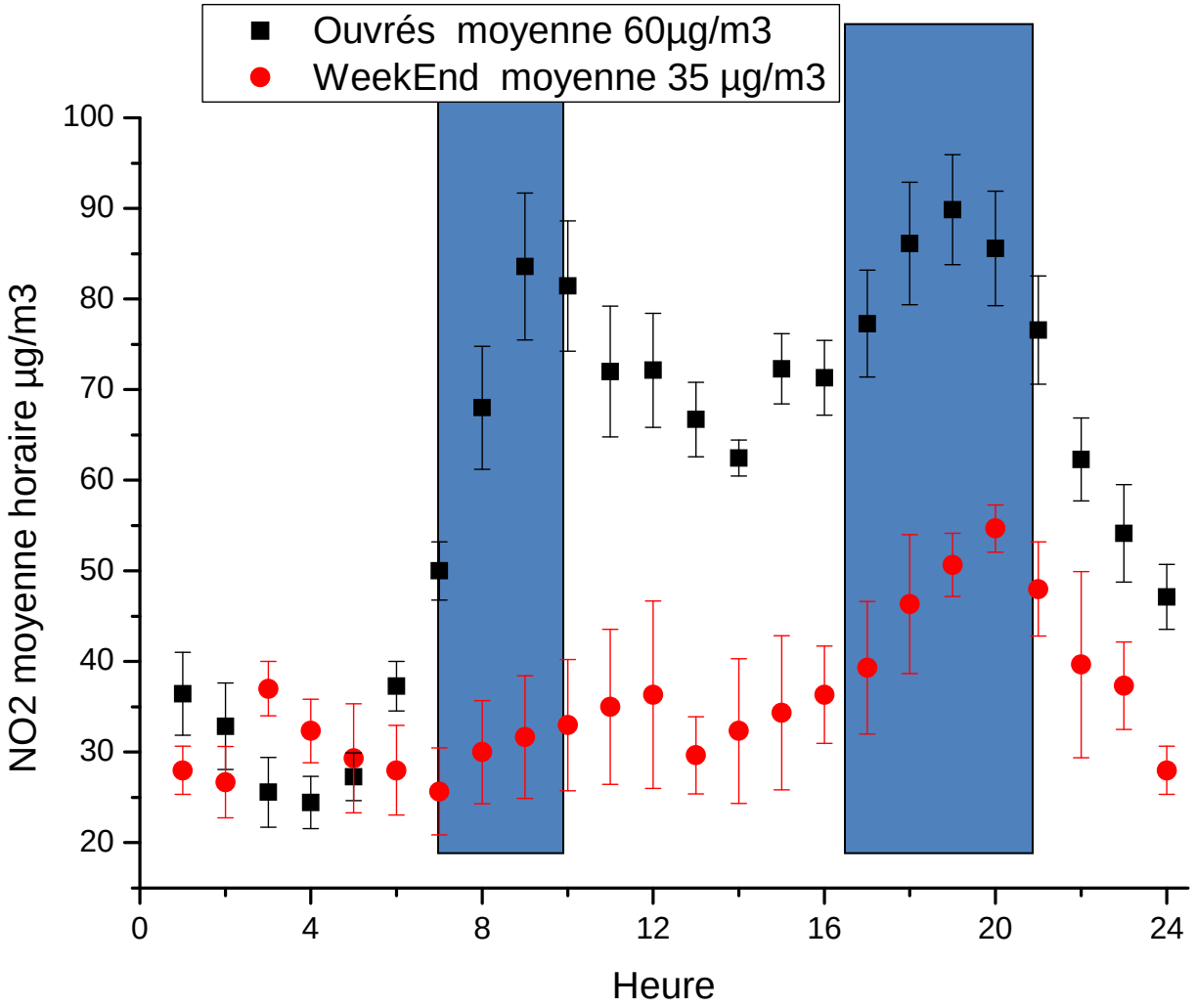
D'après Kevin Gosse Thèse de doctorat d'université de Rouen 2005 Laboratoire CORIA CNRS UMR6614

Concentration Dynamics and Preceding Vehicle Technology



Données du 14 octobre au 24 octobre 2006

Réseau Air Normand Station Rouen Guillaume le Conquérant



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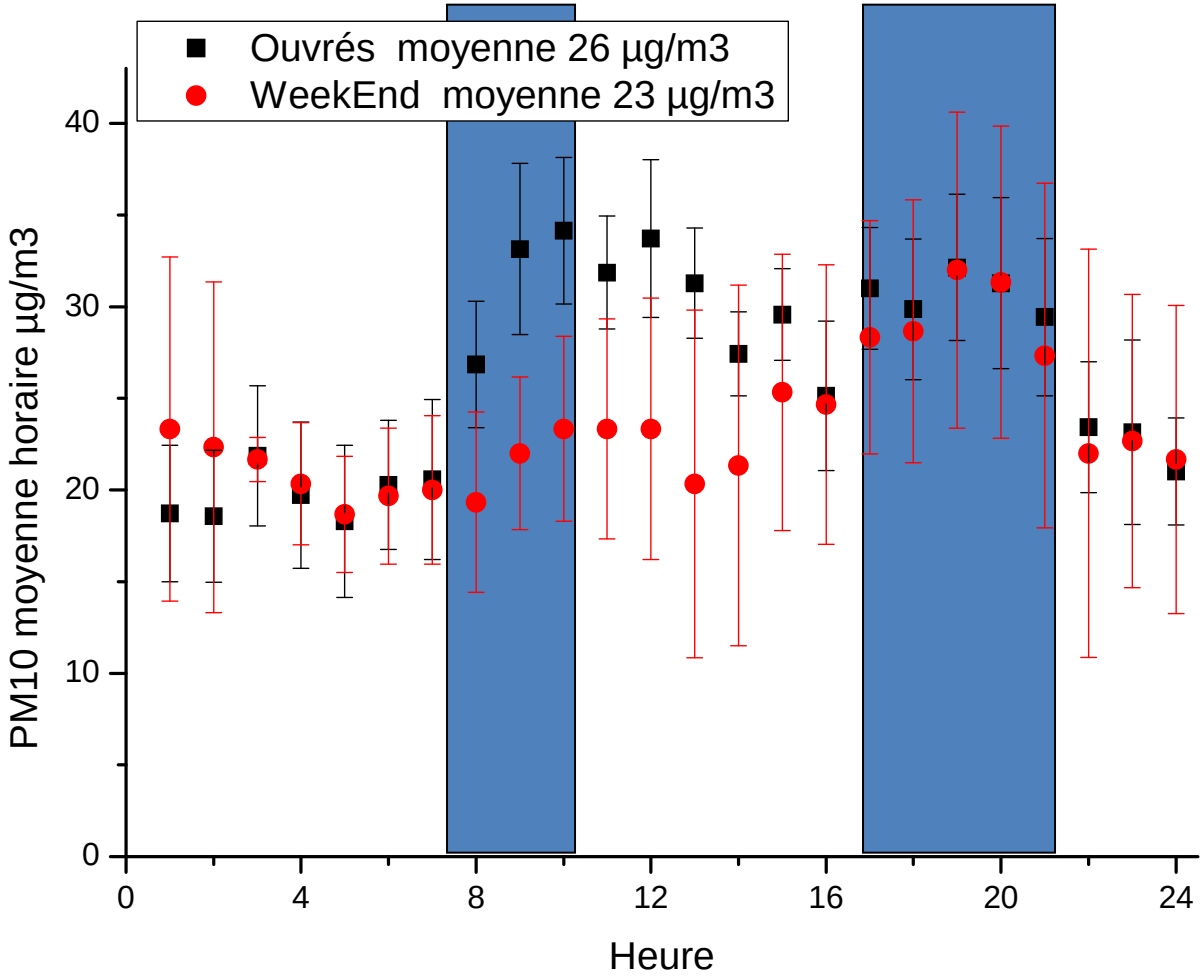

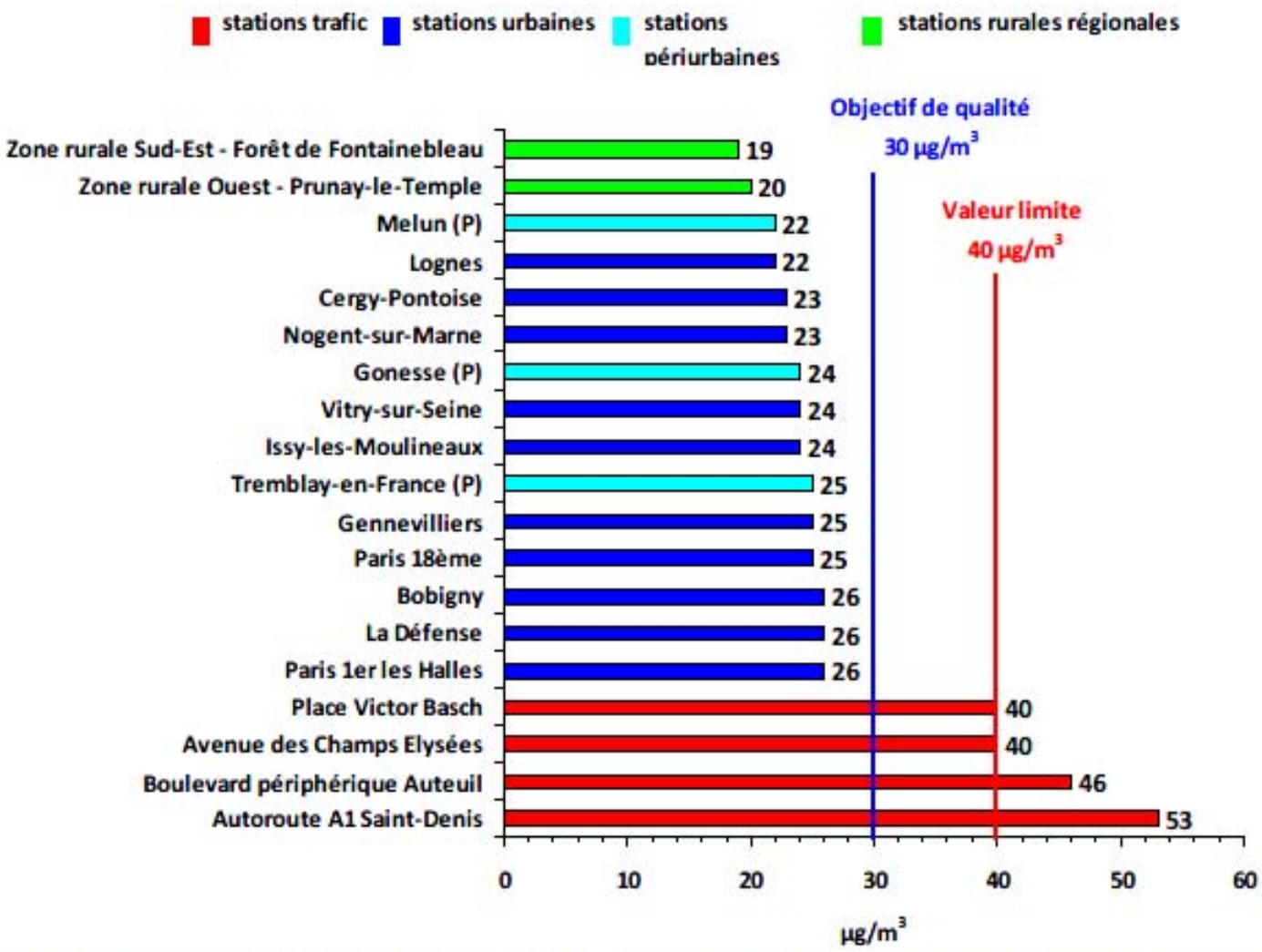

Figure 55 : concentrations moyennes annuelles de particules PM10 en Ile-de-France en 2008