CONSEIL SCIENTIFIQUE : ODJ

Air PACA

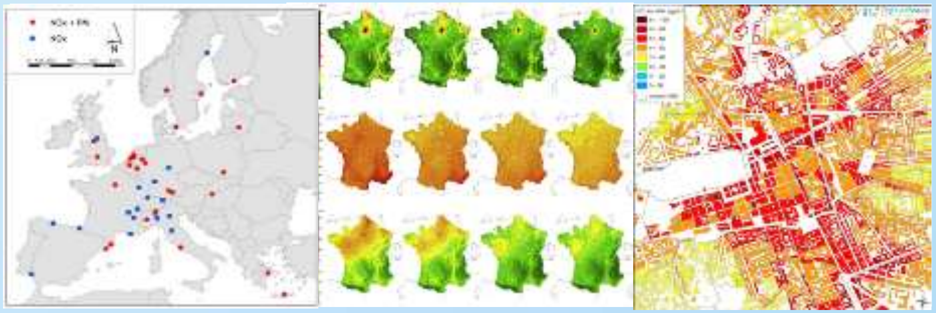
- Olivier Chanel GREQAM : coût de la pollution atmosphérique
- Laurence Pascal-Bensa : InVS PACA CIRSUD : épidémiologie en PACA

- Alexandre Armengaud : 3 projets épidémiologiques
- Yves Noack : fonctionnement du Conseil Scientifique

Air PACA
QUALITÉ DE L'AIR

3 projets épidémiologiques GAZEL, ESCAPE, EQUIT'AERA

Alexandre Armengaud
9 déc. 2015, Air PACA



GAZEL : objectifs

- Objectif : évaluer l'exposition des membres de la cohorte GAZEL à la pollution atmosphérique pour l'étude des impacts sanitaires « long terme »
- Partenaires : InVS, AIR PARIF, AIR RA, ASPA, AIR PACA
- Fede ATMO

Les contraintes techniques

- Les années étudiées : de 1989 à 2008
- Les polluants : concentration moyenne annuelle de NO_2, SO_2, PM10, C_6H_6 et concentration estivale d'O_3
- Localisation des membres de la cohorte au code postal

➢ Recherche d'une méthode optimale pour évaluer la pollution atmosphérique en moyenne annuelle à une échelle spatiale de 2 km sur toute la France (hors Corse et Dom Tom)

GAZEL : méthodologie

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GAZEL : méthodologie

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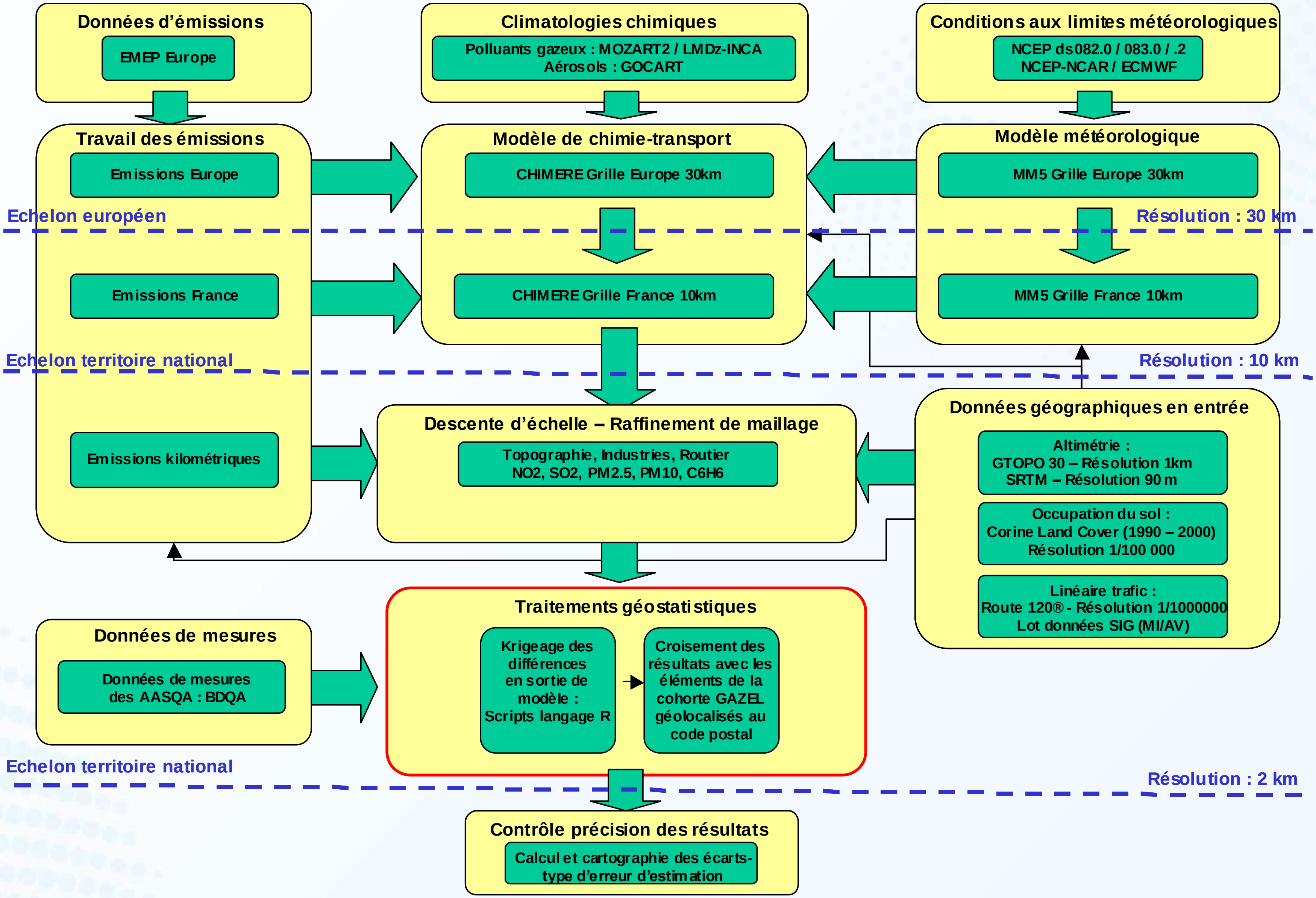
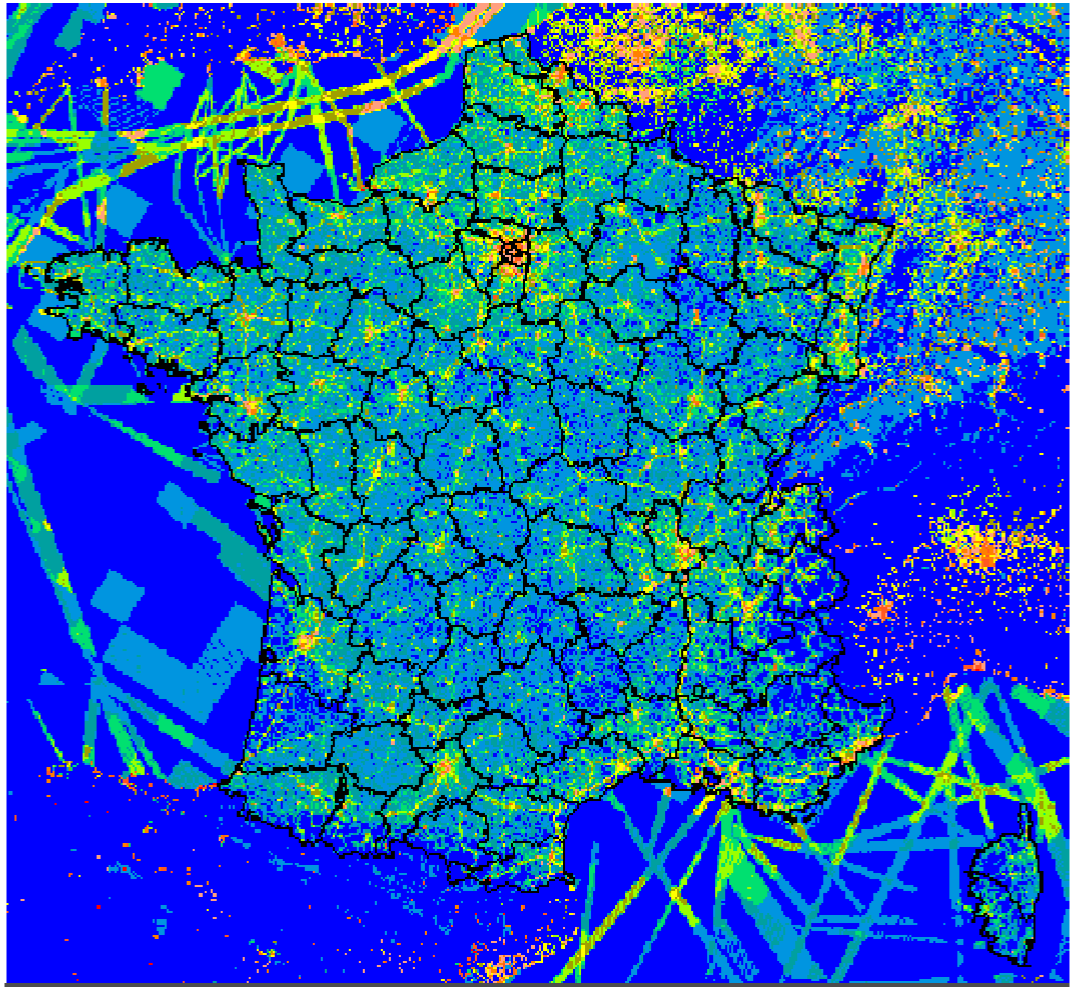


GAZEL : méthodologie

Les émissions liées au trafic routier depuis 1989 (Aide du CITEPA)

GAZEL : résultats

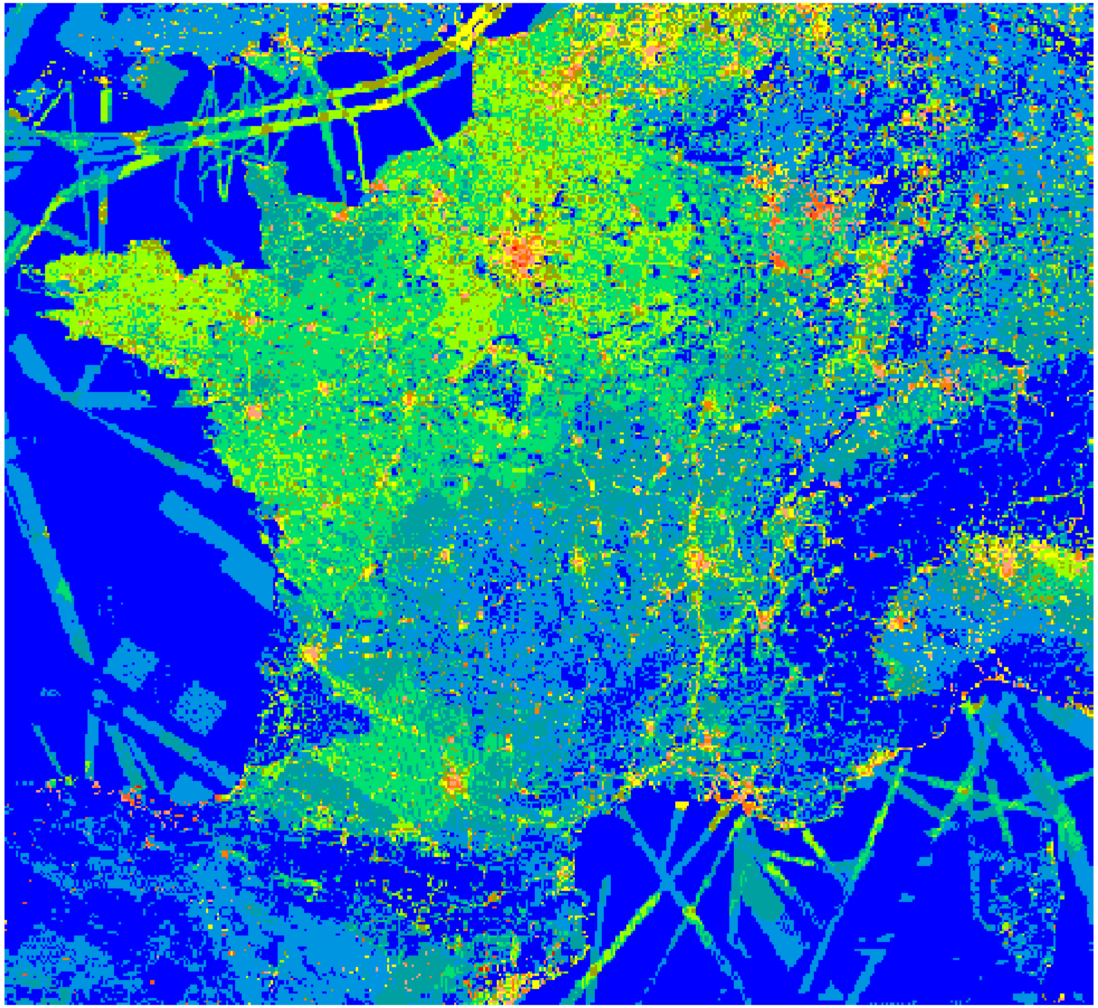


- **Emissions des NO2 en 2007**
- 2 km de résolution

GAZL2 par NO2_2007

65 745 960 -	488 158 440	(66)
21 480 570 -	65 745 960	(638)
10 256 300 -	21 480 570	(2112)
5 896 630 -	10 256 300	(4413)
3 476 680 -	5 896 630	(7462)
2 042 390 -	3 476 680	(11214)
1 114 240 -	2 042 390	(16745)
540 870 -	1 114 240	(22621)
240 080 -	540 870	(45965)
65 630 -	240 080	(80500)
0 -	65 630	(141264)

GAZEL : résultats



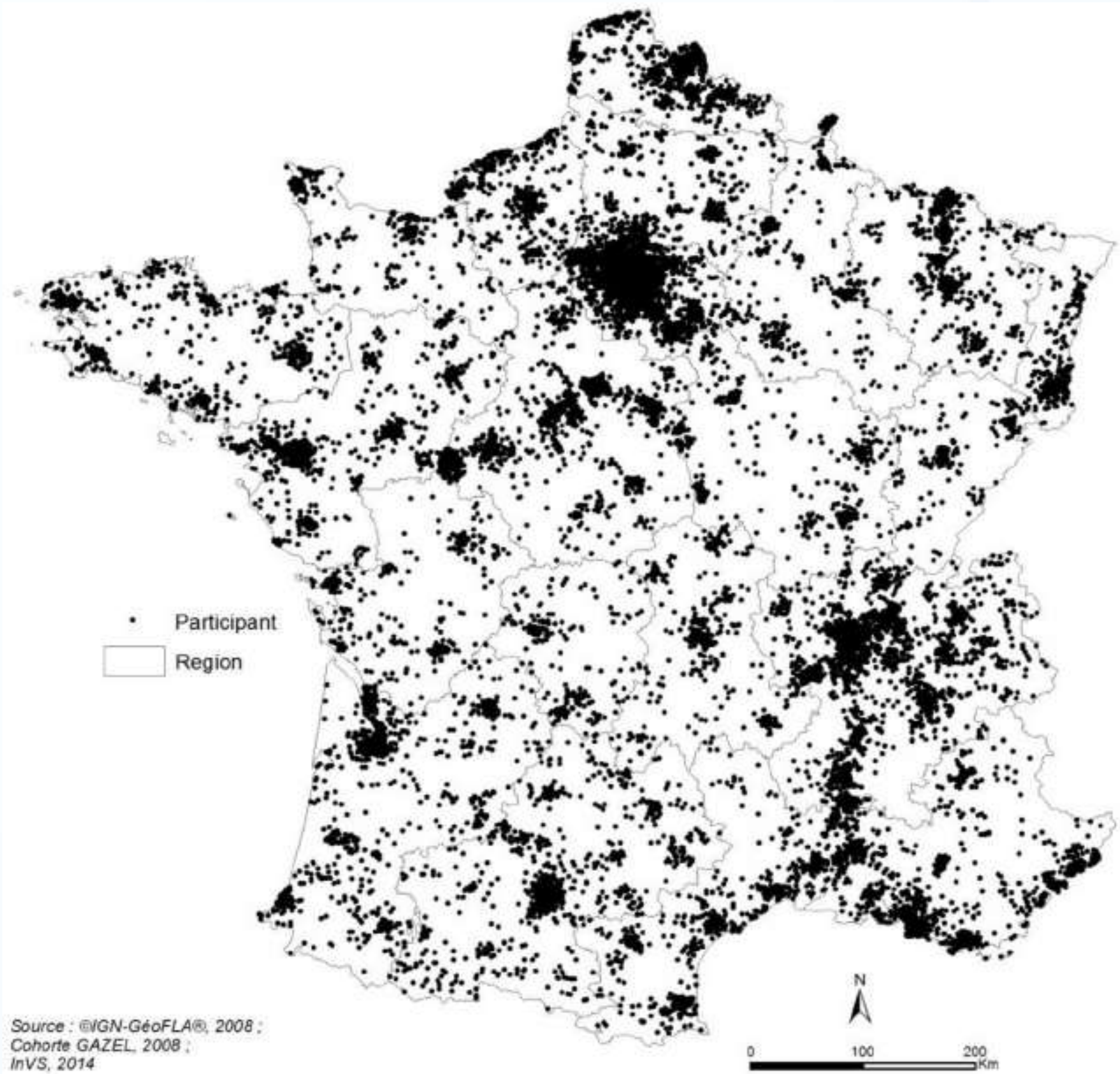
- **Emissions des PM10 en 2007**
- 2 km de résolution

GAZL2 par PM10_2007

1.16668440e+008 - 1.13224403e+009
4.00625000e+007 - 1.16668440e+008
1.98191000e+007 - 4.00625000e+007
1.06542600e+007 - 1.98191000e+007
5.84455000e+006 - 1.06542600e+007
3.25897000e+006 - 5.84455000e+006
1.98599000e+006 - 3.25897000e+006
1.21376000e+006 - 1.98599000e+006
5.80800000e+005 - 1.21376000e+006
1.50720000e+005 - 5.80800000e+005
0.00000000e+000 - 1.50720000e+005

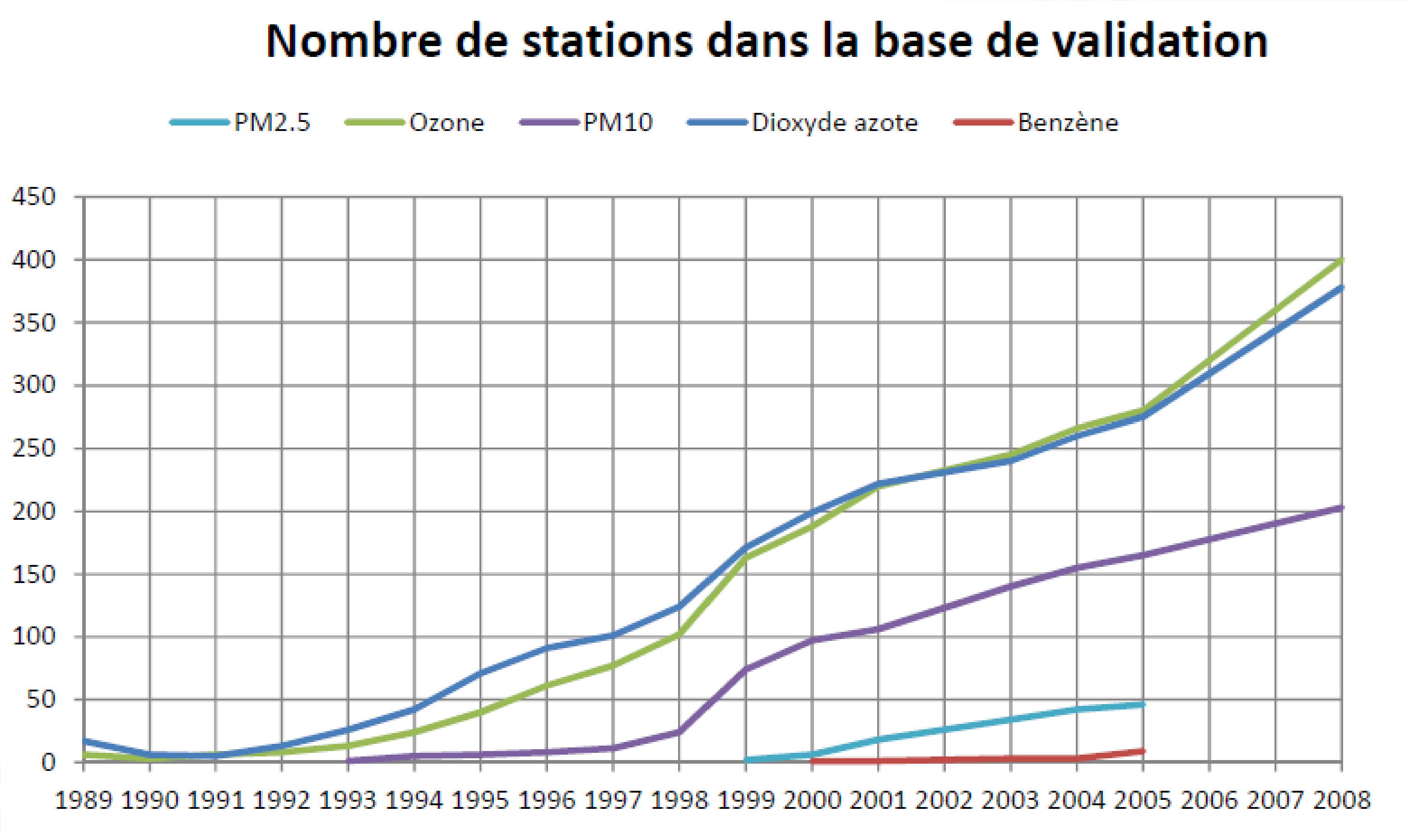
GAZEL :répartition géographique cohorte

Air PACA

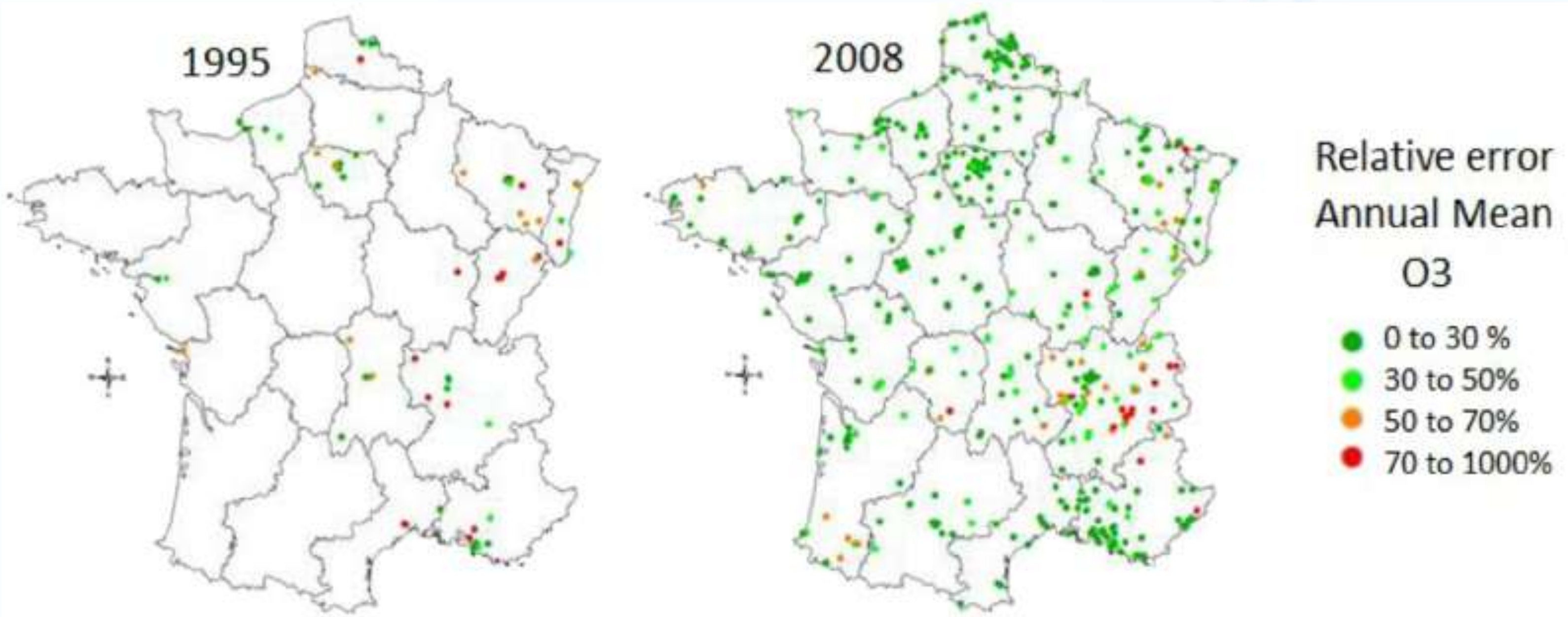


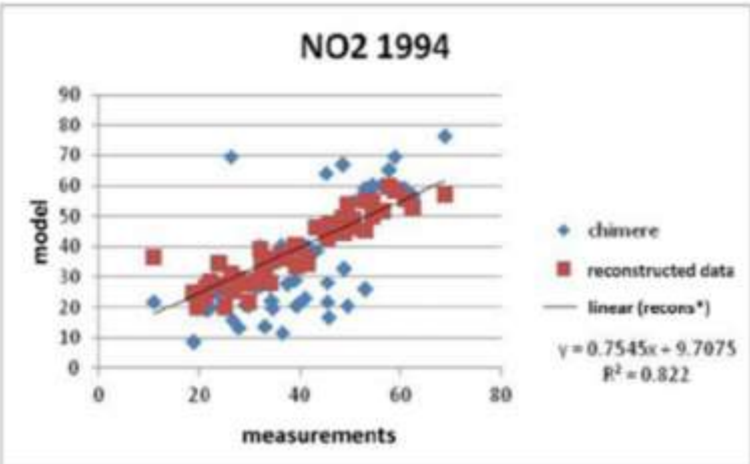
GAZEL :répartition géographique cohorte

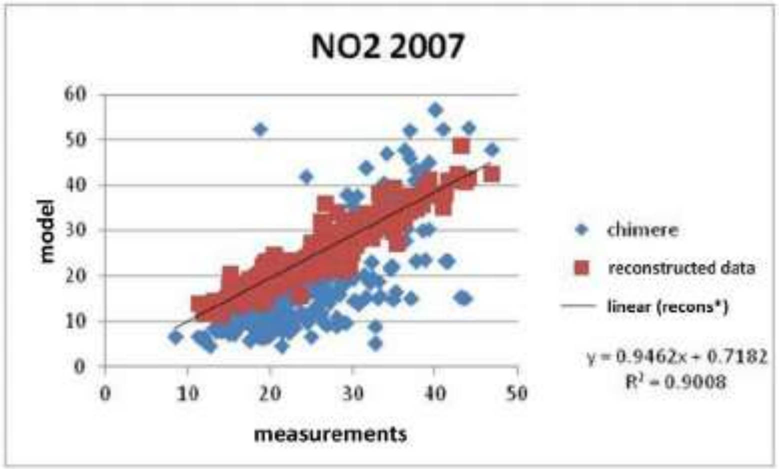
Air PACA



GAZEL :répartition géographique cohorte

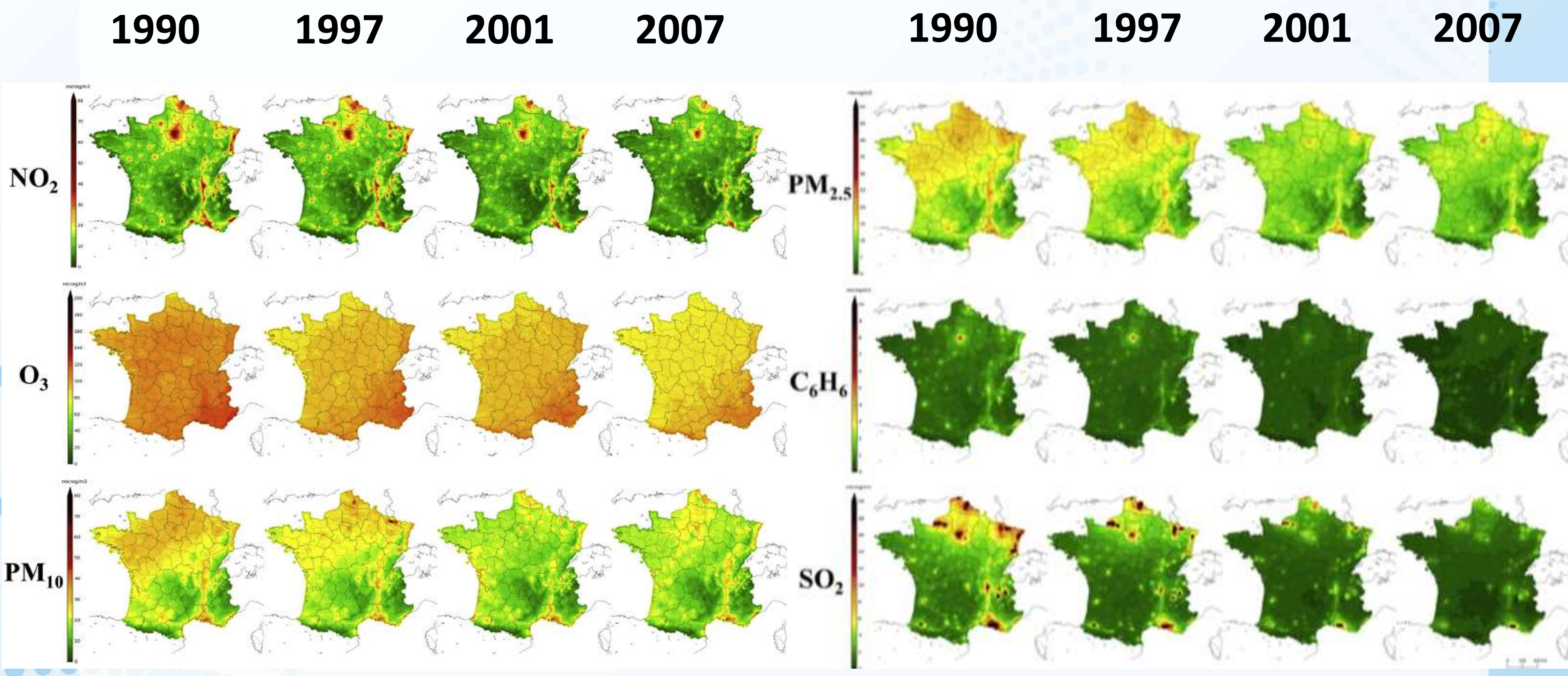






*recons = linear regression of reconstructed data

GAZEL : résultats



GAZEL : publication

Air PACA

Atmospheric Environment 92 (2014) 267–279

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ELSEVIER

ATMOSPHERIC ENVIRONMENT

Retrospective modeling outdoor air pollution at a fine spatial scale in France, 1989–2008

CrossMark

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H I G H L I G H T S

- We model French air quality to assess long-term health effects on large cohort.
- We assess concentrations of six air pollutants at 2 km resolution from 1989 to 2008.
- We use CHIMERE/MM5, mesh refinement, data assimilation and geostatistical analyses.
- We validate data of air quality with French air quality monitoring network.

A R T I C L E I N F O

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Modeling
Long-term
Fine scale
France

A B S T R A C T

Introduction: Exposure to air pollution has been associated to mortality and morbidity in numerous studies. However, few studies assessed retrospectively long-term exposure at a fine spatial scale.
Aims: To contribute to the assessment of long-term exposure to air pollution of participants from the French GAZEL cohort, we estimated atmospheric PM_{10}, $PM_{2.5}$, NO_2, SO_2, C_6H_6 and O_3 levels at 2 km resolution over France, from 1989 to 2008.
Methods: The spatiotemporal concentrations of selected air pollutants were estimated at a fine scale by combining (1) the CHIMERE chemistry-transport model (2) mesh refinement and (3) data assimilation with geostatistical analyzes. Assimilated concentrations were assigned to participants according to their residential zip codes, taking into account residential history.
Results: Despite a decreasing trend in concentrations for all pollutant concentrations, levels remained high in some French regions, especially for PM, NO_2 and O_3.
Annual median concentrations at the cohort participants' zip code of PM_{10}, $PM_{2.5}$, NO_2 and O_3 were decreased from 1989 to 2008 by 27%, 29%, 40% and 16%, respectively. The largest decreases occurred for SO_2 (86%) and C_6H_6 (85%).
Validation showed high correlations between observations and final modeled data (R above 0.75 in 2007) for PM_{10}, NO_2 and O_3.
Conclusion: The modeling process enabled us to assess air pollution over 20 years (1989-2008) at a fine-geographical scale, with acceptable agreement being found between observations and models for all pollutants.

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Despite a decreasing trend in concentrations for all pollutant concentrations, levels remained high in some French regions, especially for PM, NO2 and O3.
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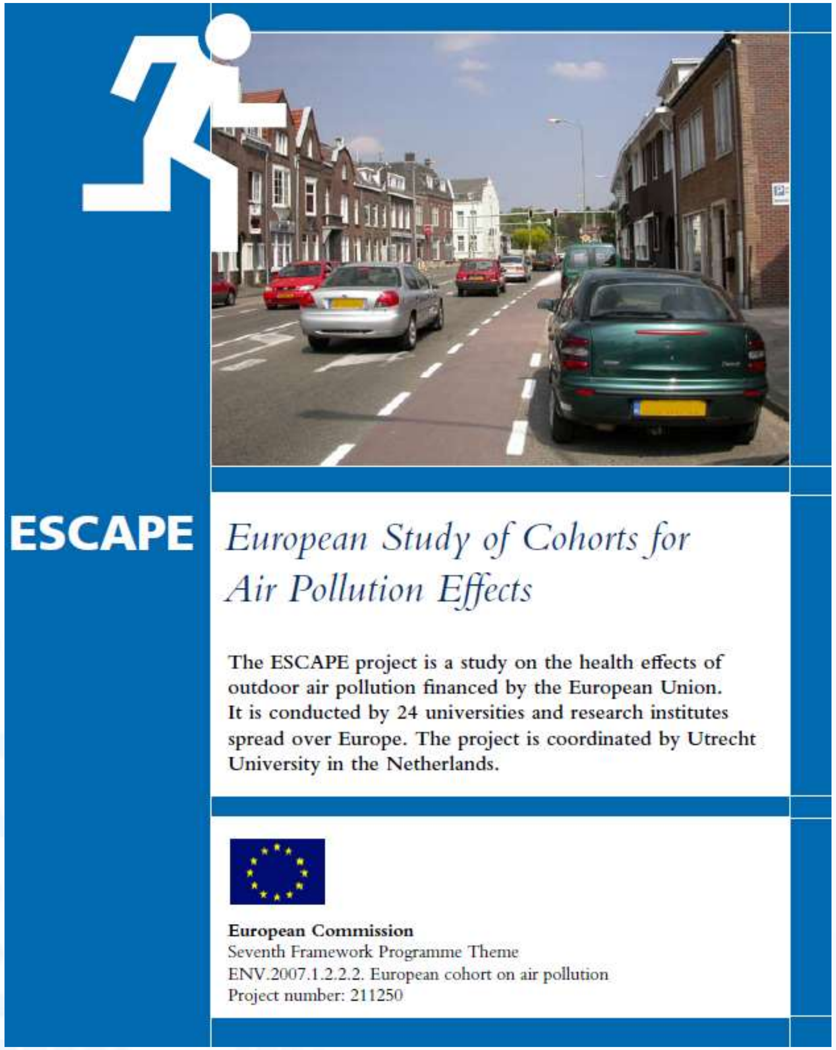
ESCAPE : objectives



ESCAPE

European Study of Cohorts for Air Pollution Effects

The ESCAPE project is a study on the health effects of outdoor air pollution financed by the European Union. It is conducted by 24 universities and research institutes spread over Europe. The project is coordinated by Utrecht University in the Netherlands.

European Commission
Seventh Framework Programme Theme
ENV.2007.1.2.2.2. European cohort on air pollution
Project number: 211250

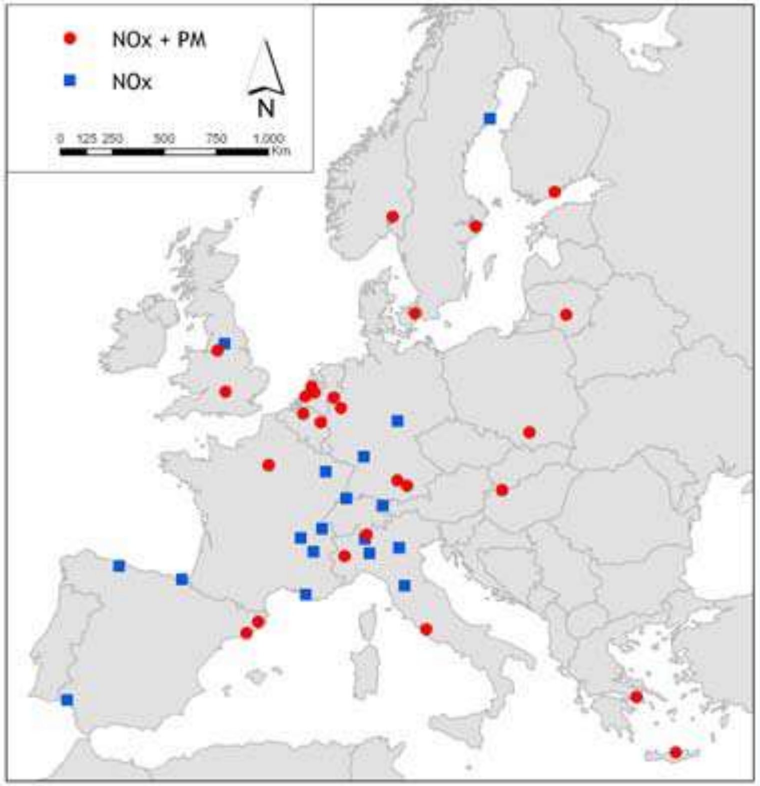
The health effects of air pollution are of great concern to European citizens. It is estimated that air pollution leads to a
marked decrease in life expectancy in many areas.
The health effects of long-term exposure to fine particles and nitrogen
dioxide in the air are still insufficiently understood.
The aims of the ESCAPE project are:

· To measure fine particles and nitrogen dioxide at different locations in 40 areas spread over Europe

· To study the relation between these pollutants and (1) low birth weight, asthma and allergy in children; (2) respiratory
diseases in adults; (3) cardiovascular diseases in adults; (4) mortality and cancer in adults.

The study involves more than 30 cohorts (of children and adults) across Europe, who are being followed up over a
number of years to help understand the factors that affect their health.

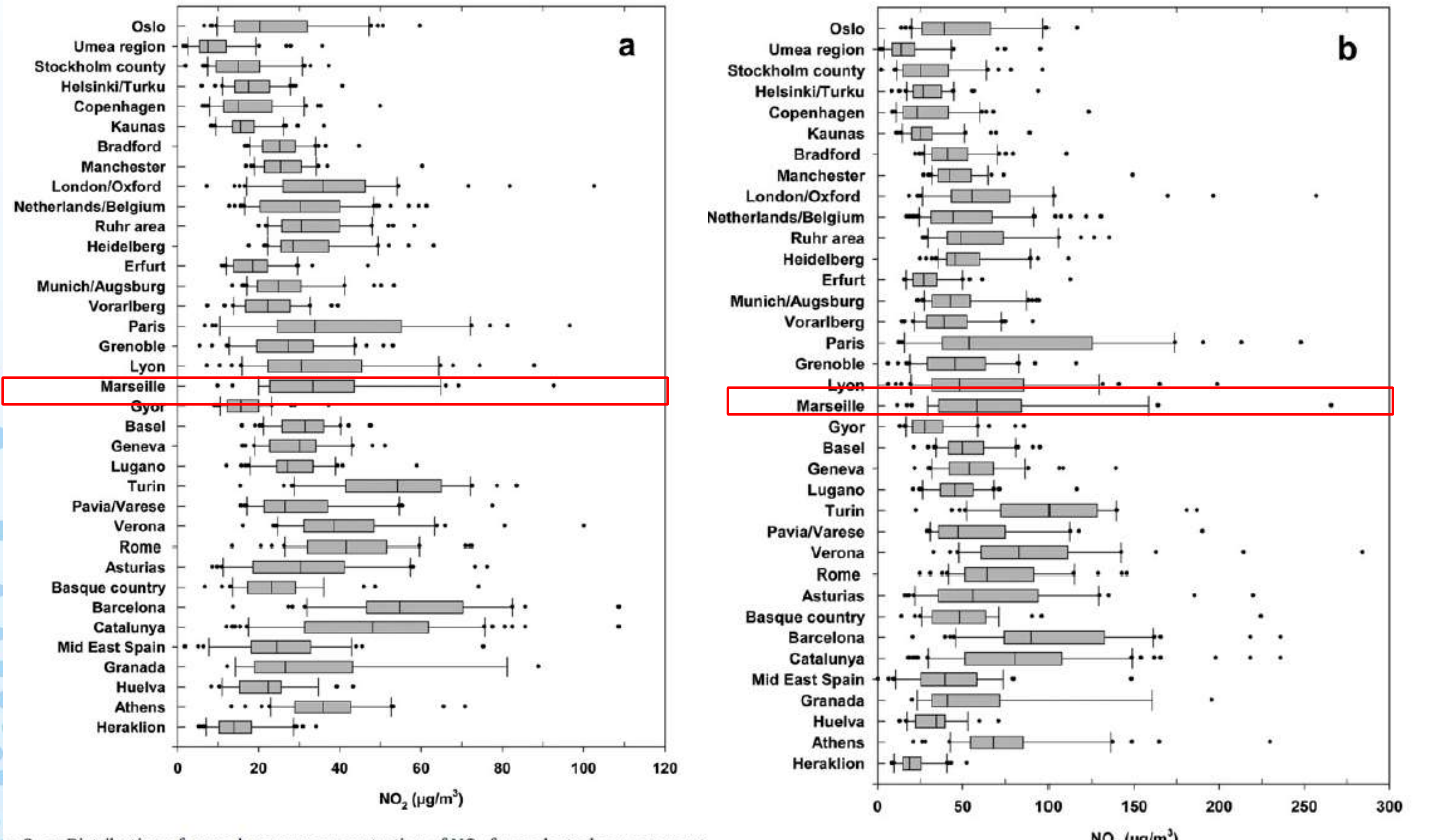
ESCAPE : methodology



Measure fine particles and nitrogen oxides, both of which are produced by combustion processes, especially motor vehicles. Air pollution measurements in outdoor air will be conducted at 20 locations in each study area, selected to represent the rural environment, the urban background, streets with a lot of traffic and locations influenced by other sources (e.g. industry, harbour). At each location a measurement will be conducted over 2 weeks, and this will be repeated 3 times: during winter, summer and spring or autumn.

ESCAPE : results

Air PACA



g. 3. a: Distribution of annual average concentration of NO_2 for each study area separat

ESCAPE : publication

Air PACA

Atmospheric Environment 62 (2012) 374–390

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ELSEVIER

ATMOSPHERIC ENVIRONMENT

Variation of NO_2 and NO_x concentrations between and within 36 European study areas: Results from the ESCAPE study

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[p] Department of Hygiene, Epidemiology & Medical Statistics, Medical School, National and Kapodistrian University of Athens, Greece
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[v] Medical Faculty, Heinrich-Heine University of Düsseldorf, Düsseldorf, Germany
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Abbreviations: CV, Coefficient of Variation; ESCAPE, European Study of Cohorts for Air Pollution Effects; GIS, Geographic information systems; LUR, land use regression; NO_x, nitrogen oxides [μg m^{-3}]; NO_2, nitrogen dioxide [μg m^{-3}]; NO, nitrogen monoxide [μg m^{-3}]; PM, particulate matter; $PM_{2.5}$, mass concentration of particles less than 2.5 μm in size; PM_{10}, mass concentration of particles less than 10 μm in size; RB, regional background site; SOP, standard operating procedure; ST, street site; TRAPCA, Traffic-related Air Pollution and Childhood Asthma; UB, urban background site.

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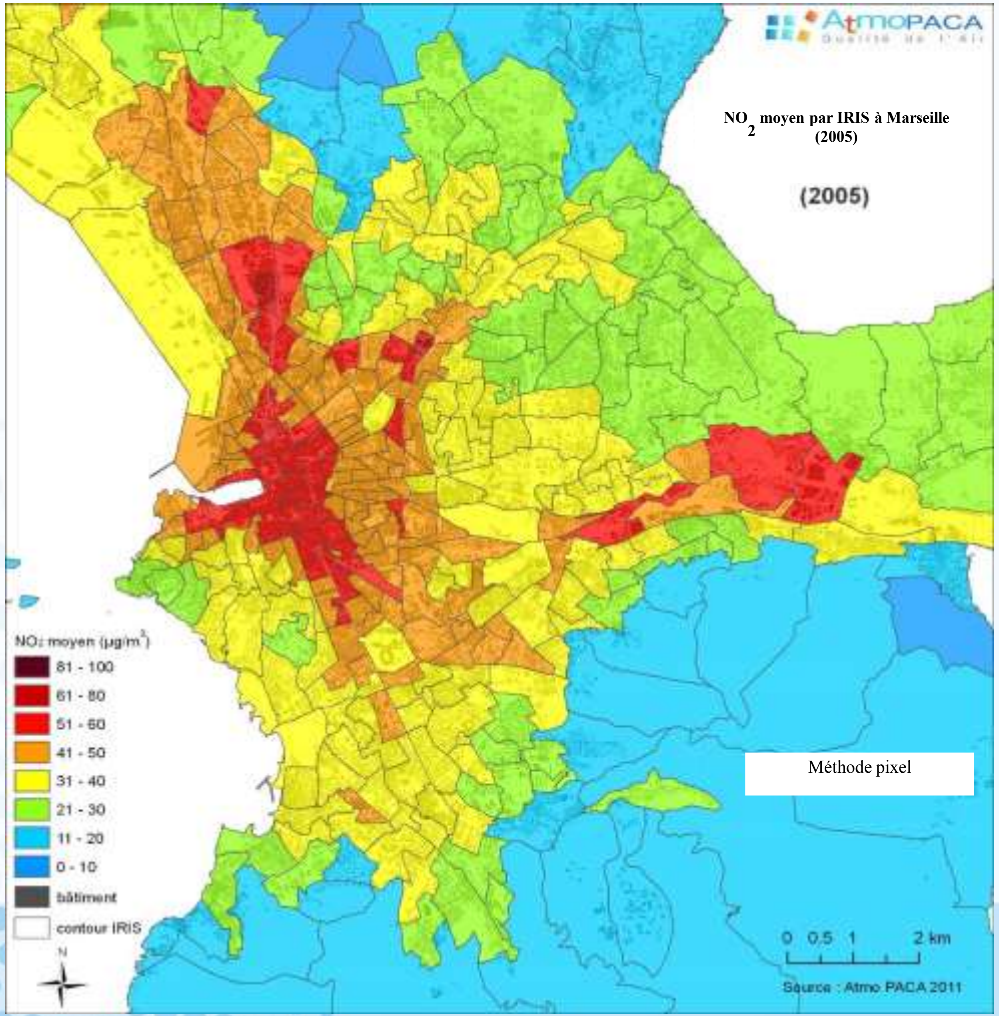
Substantial spatial variability was found in NO2 and NOx concentrations between and within study areas; 40% of the overall NO2 variance was attributable to the variability between study areas and 60% to variability within study areas. The corresponding values for NOx were 30% and 70%. The within-area spatial variability was mostly determined by differences between street and urban background concentrations.
The street/urban background concentration ratio for NO2 varied between 1.09 and 3.16 across areas. The highest median concentrations were observed in Southern Europe, the lowest in Northern Europe.
In conclusion, we found significant contrasts in annual average NO2 and NOx concentrations between and especially within 36 study areas across Europe. Epidemiological long-term studies should therefore consider different approaches for better characterization of the intra-urban contrasts, either by increasing of the number of monitors or by modelling.

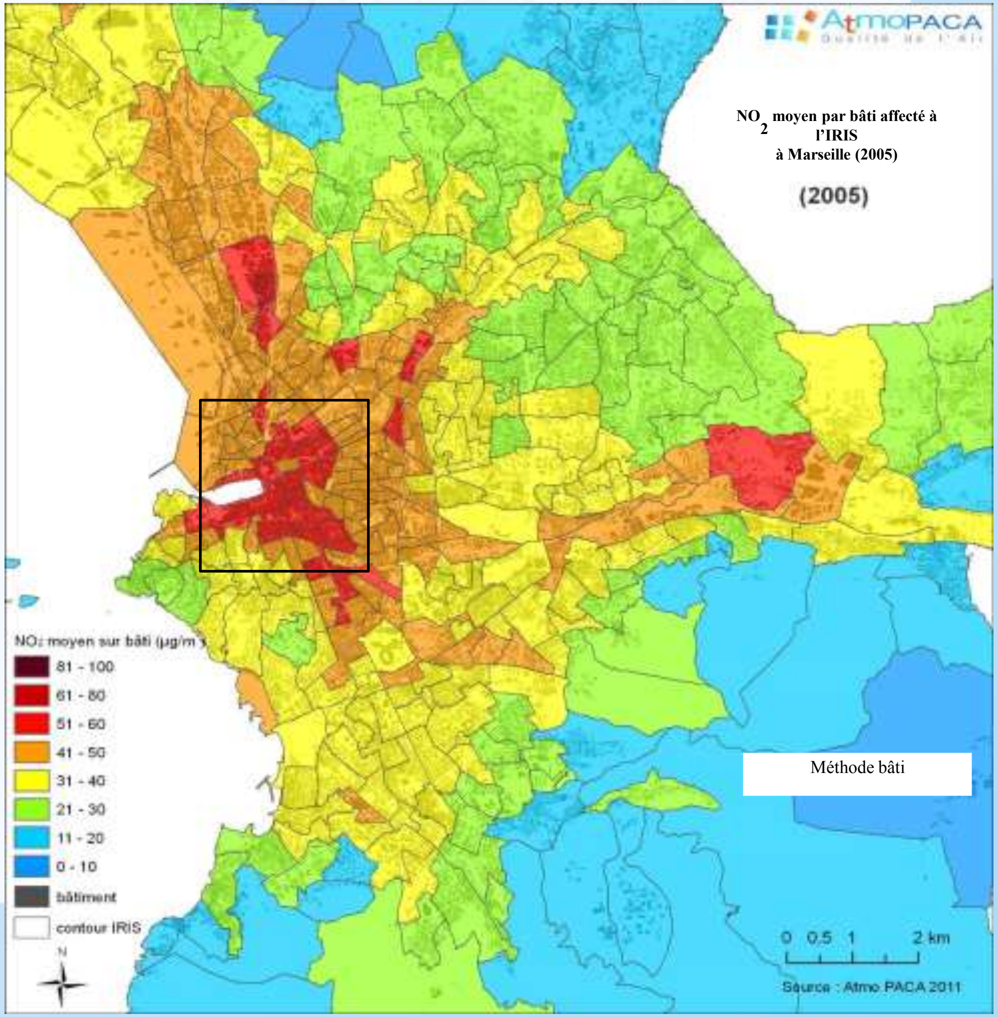
EQUITAERA : objectifs

- Agrégation des valeurs de dioxyde d'azote (NO_2) à l'IRIS
  - Demande de l'EHESP
- Reconstitution des concentrations de NO_2 de 2002 à 2009
- PARIS, LYON, LILLE, MARSEILLE
- Partenaires : EHESP, AIR PARIF, AIR RA, ATMO NPC, AIR PACA
- EHESP : Etude épidémiologique PM10, NO2

EQUITAERA : IRIS

Les résultats à Marseille (2005, résolution spatiale : 20 m)

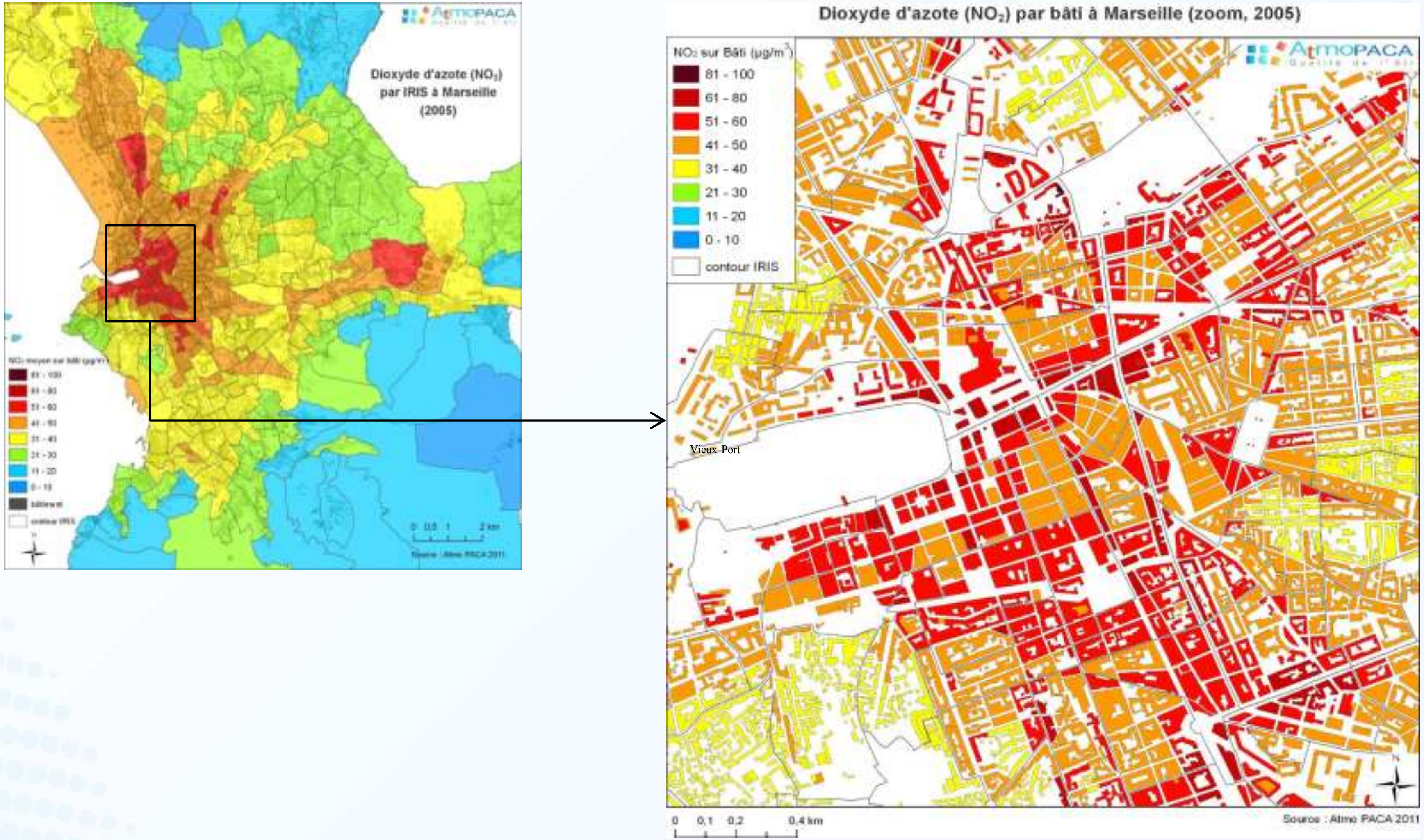




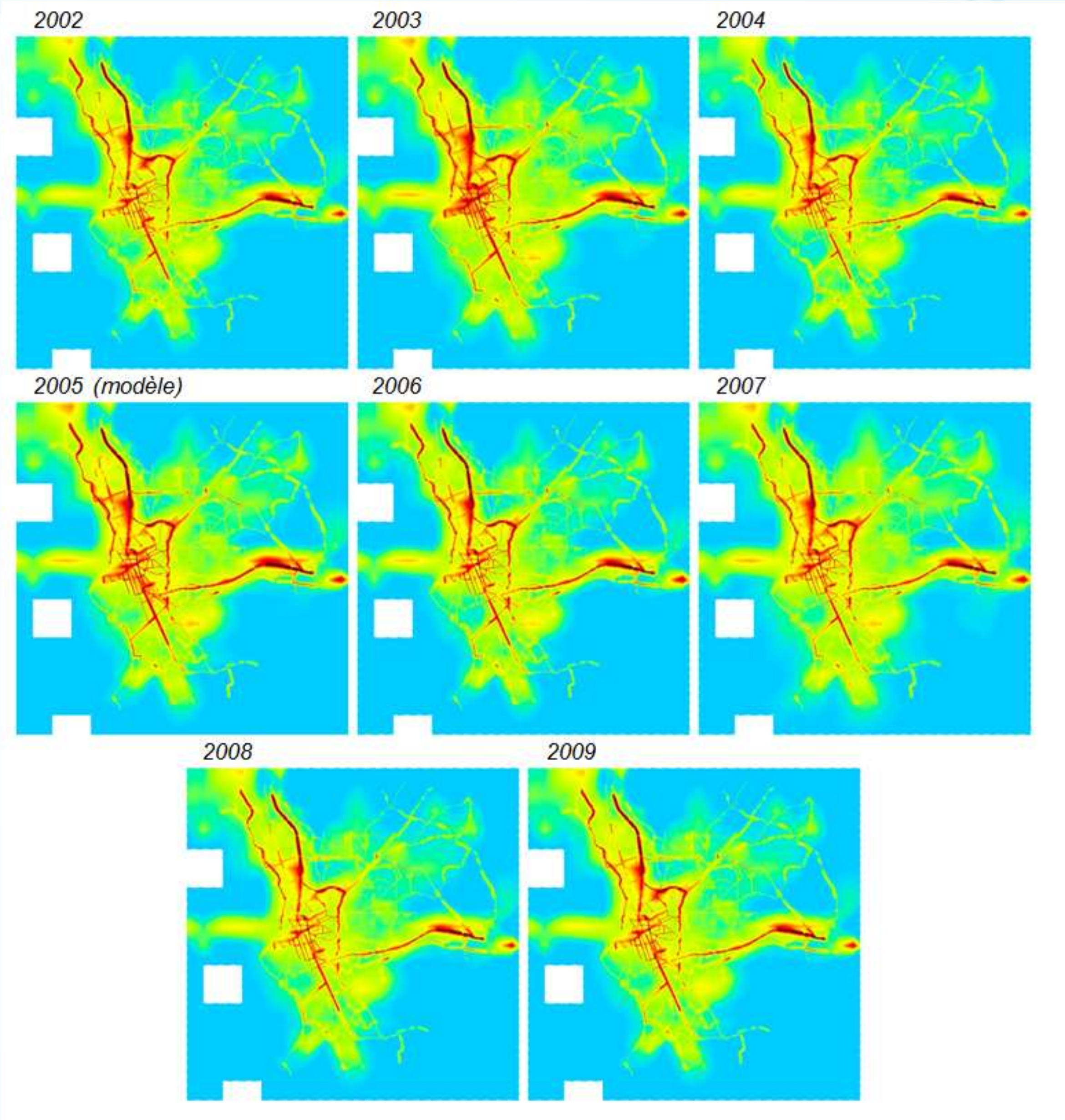
EQUITAERA : IRIS

Air PACA

Les résultats à Marseille (2005, résolution spatiale : 20 m)



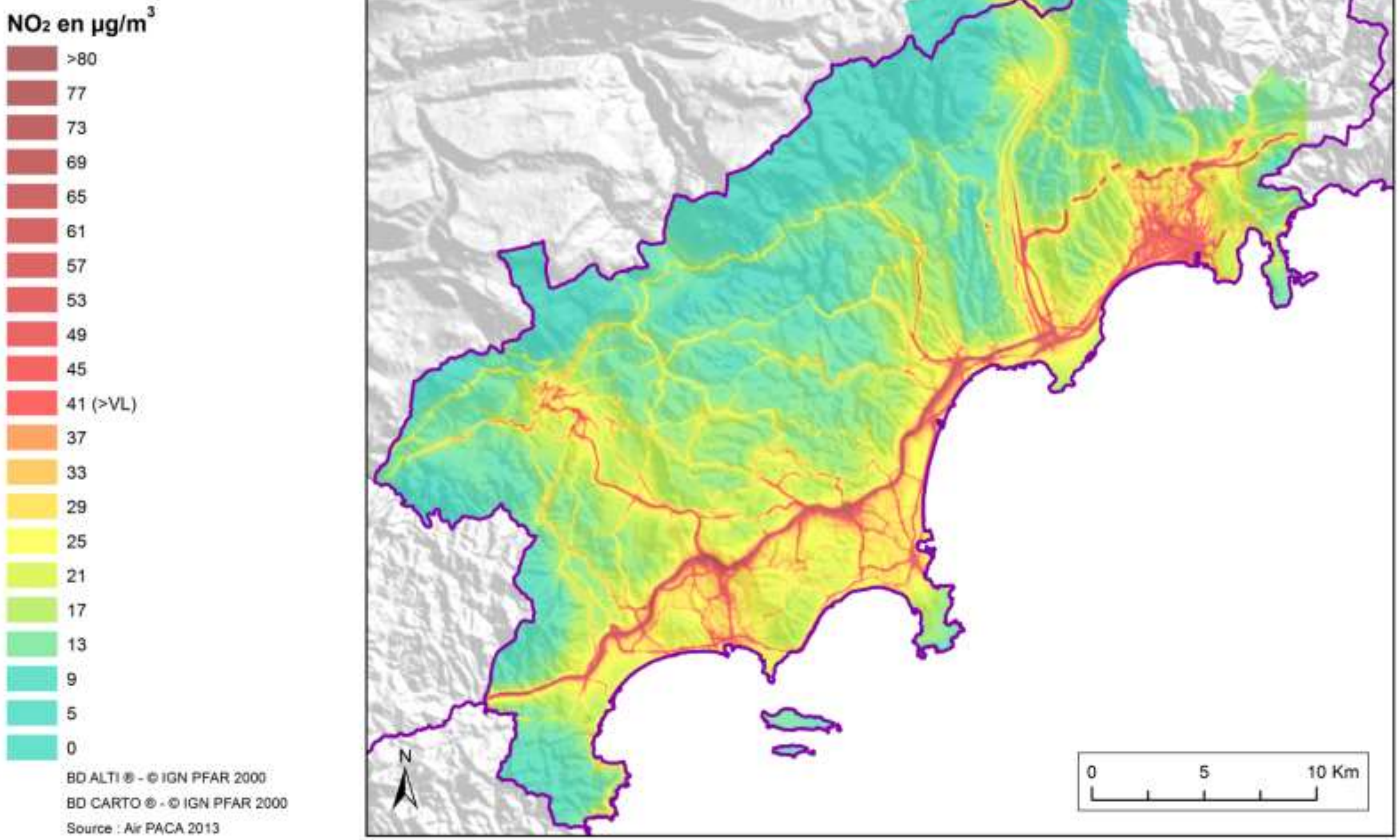
EQUITAERA : NO2 – 2002-2009



Depuis : haute résolution en PACA

Air PACA

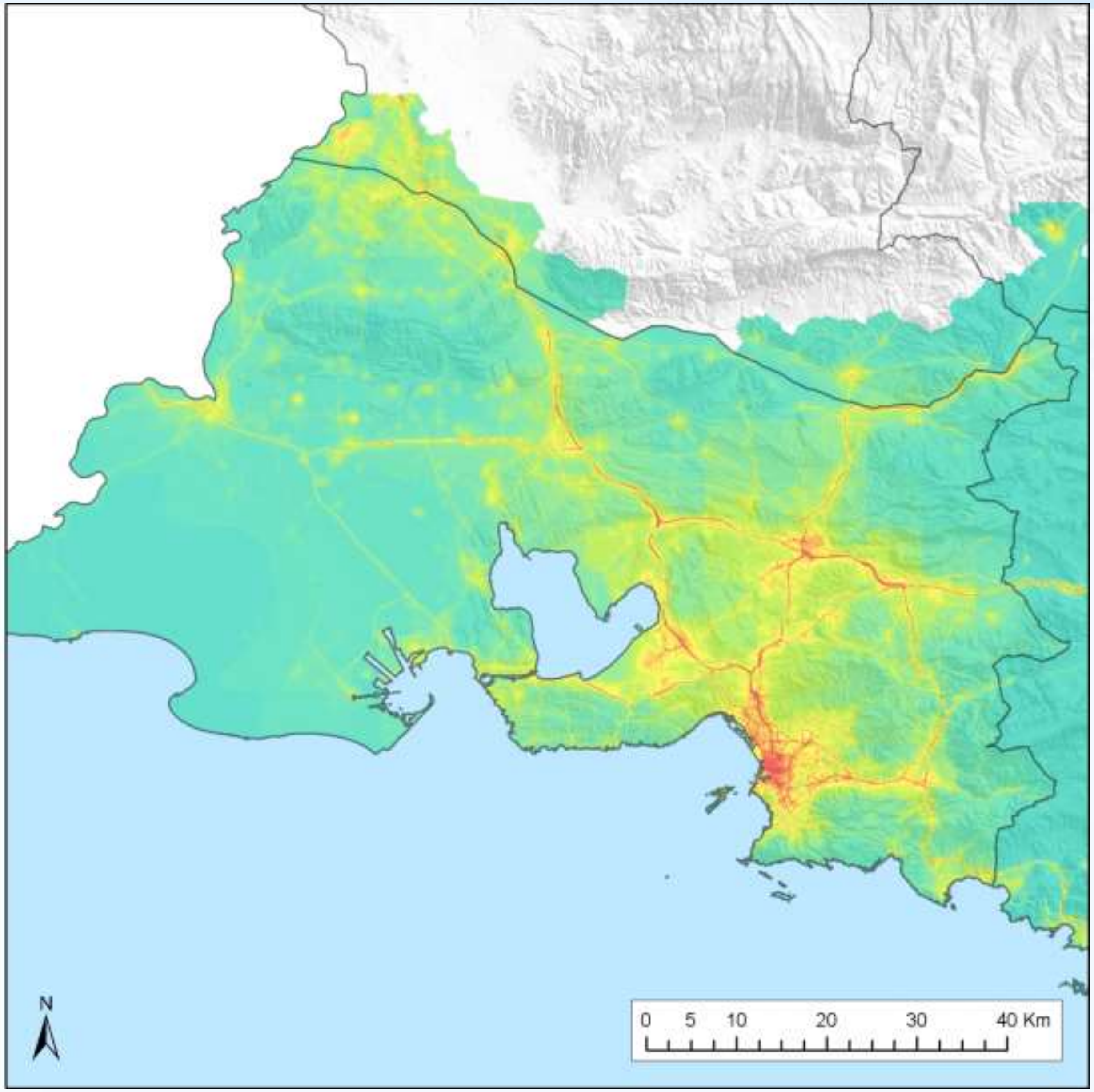
Air PACA
QUALITÉ DE L'AIR



Depuis : haute résolution en PACA

Air PACA

Air PACA
QUALITÉ DE L'AIR



NO_2 en µg/m³

> 80
73
65
57
49
41 (>VL)
33
25
17
9
0

BD ALTI ® - © IGN PFAR 2000

Source : Air PACA 2015

Depuis : haute résolution en PACA

Air PACA

Pour chaque polluant, le calcul se base sur la valeur guide OMS en vigueur pour ce polluant. Petite exception pour l'ozone, qui n'a pas de seuil annuel mais seulement une valeur de 100 µg/m³ en moyenne sur 8h : le seuil utilisé est 100 µg/m³ en moyenne sur 8h à ne pas dépasser plus de 25 fois dans l'année (mélange de la valeur guide OMS et de la valeur cible européenne).

Pour les polluants dont le seuil s'exprime de la manière « *[val] à ne pas dépasser plus de [X] fois par an* », la valeur utilisée pour la normalisation est le percentile correspondant. En effet, un calcul à partir d'un nombre de dépassement pose deux problèmes :

- Des effets de seuils très importants, entrainant des contrastes non représentatifs de la situation réelle.
- Une variabilité nulle sur les zones sans dépassement.

D'après ces principes, les indices annuels par polluant sont calculés de la manière suivante :

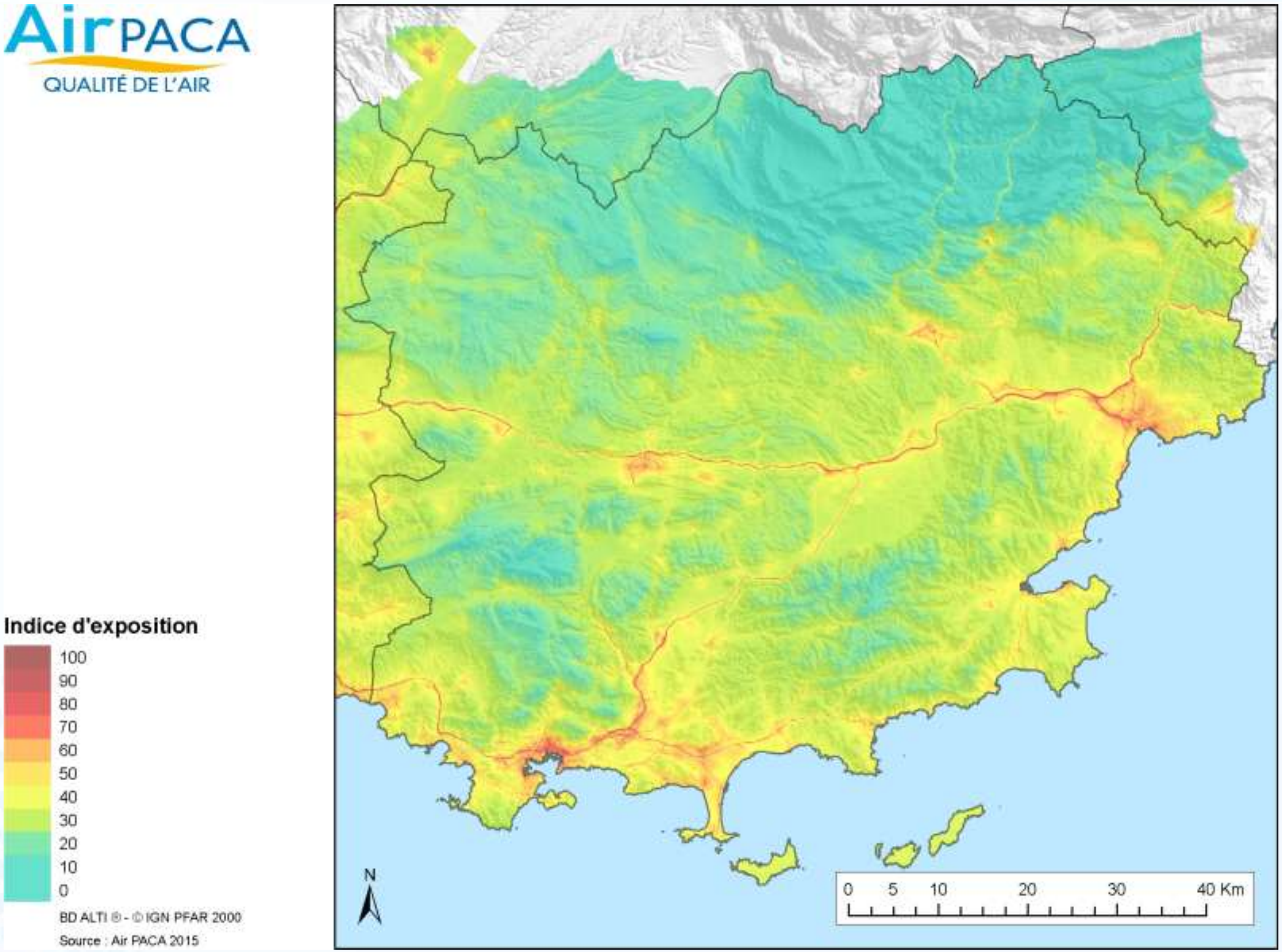
- Si $[P] \leq 2*VR_P$: $X_P = [P]*50/VR_P$
- Si $[P] > 2*VR_P$: $X_P = 100$

Avec comme valeur de référence (VR) :

- PM10 : Valeur guide OMS : moyenne annuelle = 20 µg/m³
- O_3 : Valeur « mixte » : p93.2 des maximums journaliers des moyennes sur 8h = 100 µg/m³
- NO_2 : Valeur guide OMS : moyenne annuelle = 40 µg/m³
- SO_2 : Valeur guide OMS : moyenne annuelle = 20 µg/m³

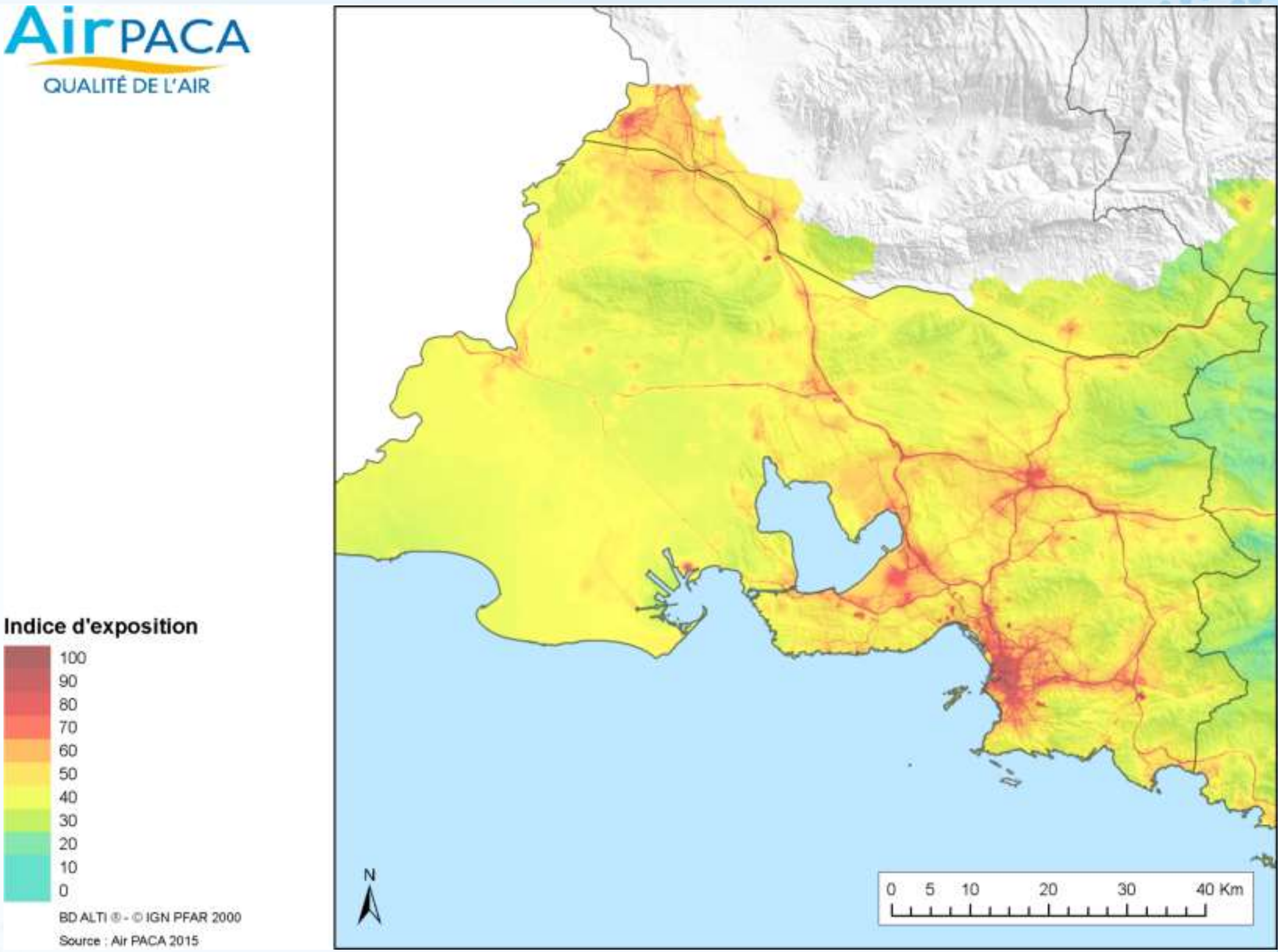
X_{sum} est la somme des 4 X_P, moins 100. Si X_{sum} >100, on affiche uniquement « >100 ».

Depuis : haute résolution en PACA



Depuis

- Progrès cartographie haute résolution
- Départements et villes
- PM10, NO_2, O_3



- PPA
- SCENARII
- EXPOP
- POLIS

- Air PACA est prête pour de nouvelles collaborations AIR & SANTE