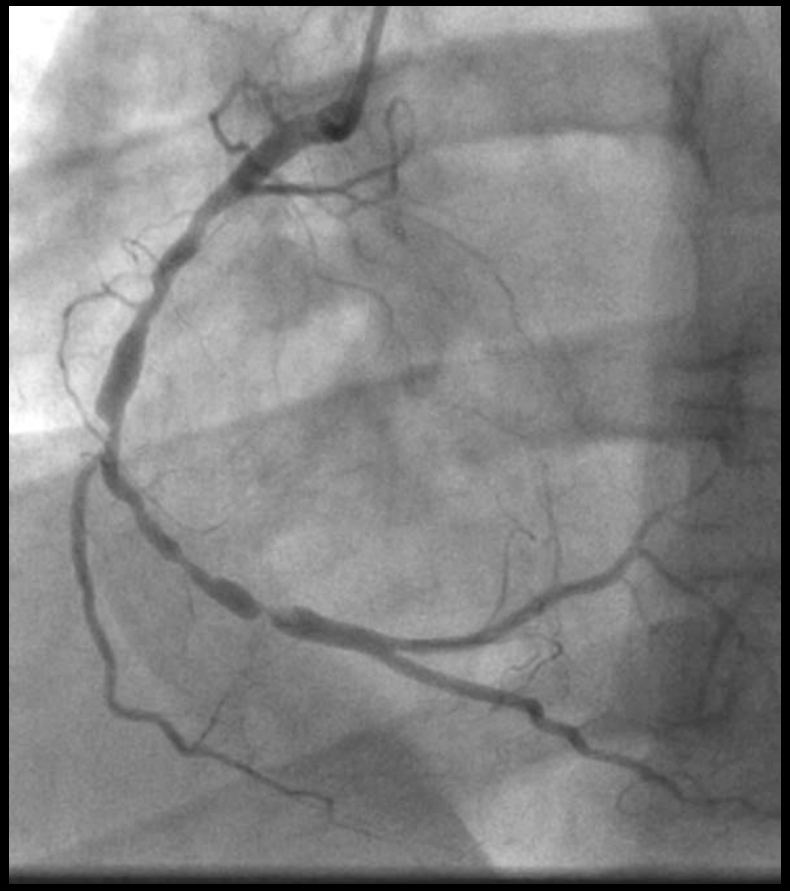
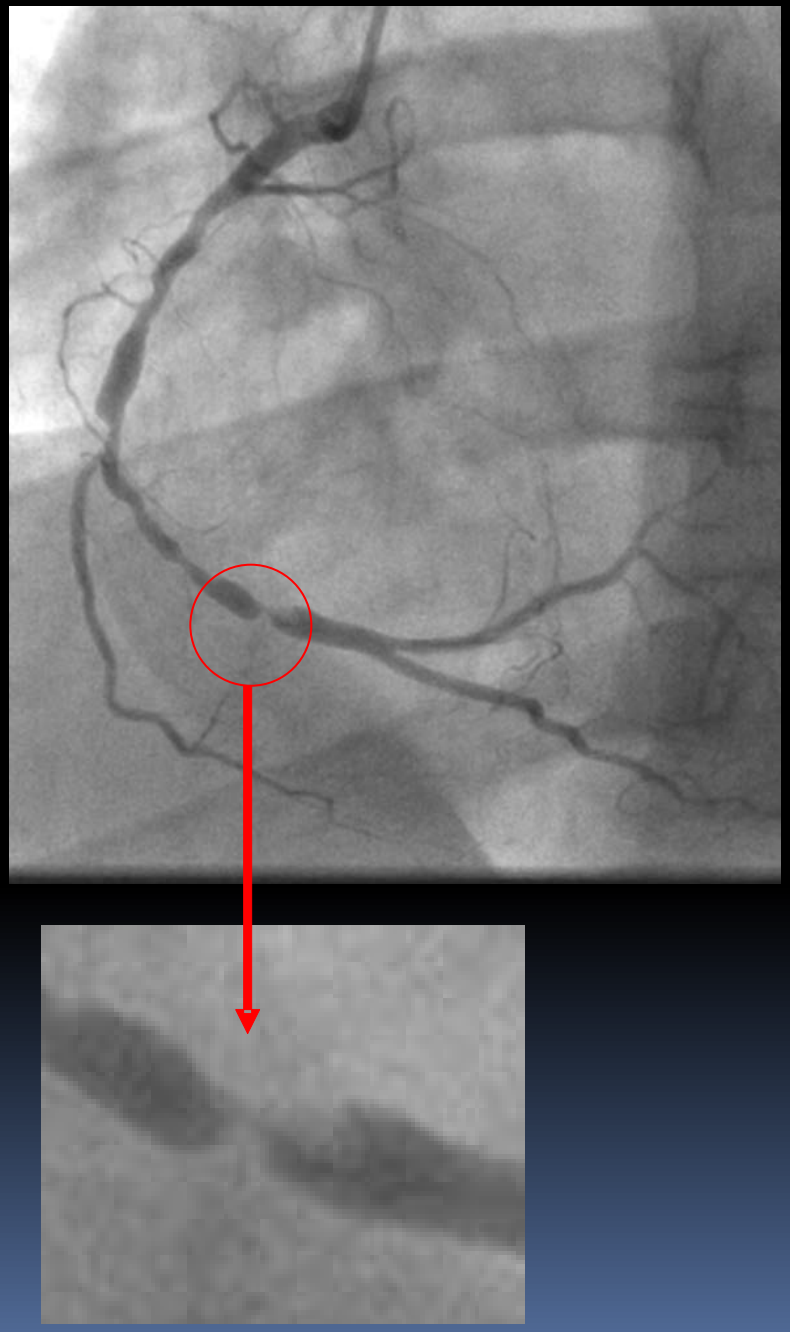
Université de Montréal

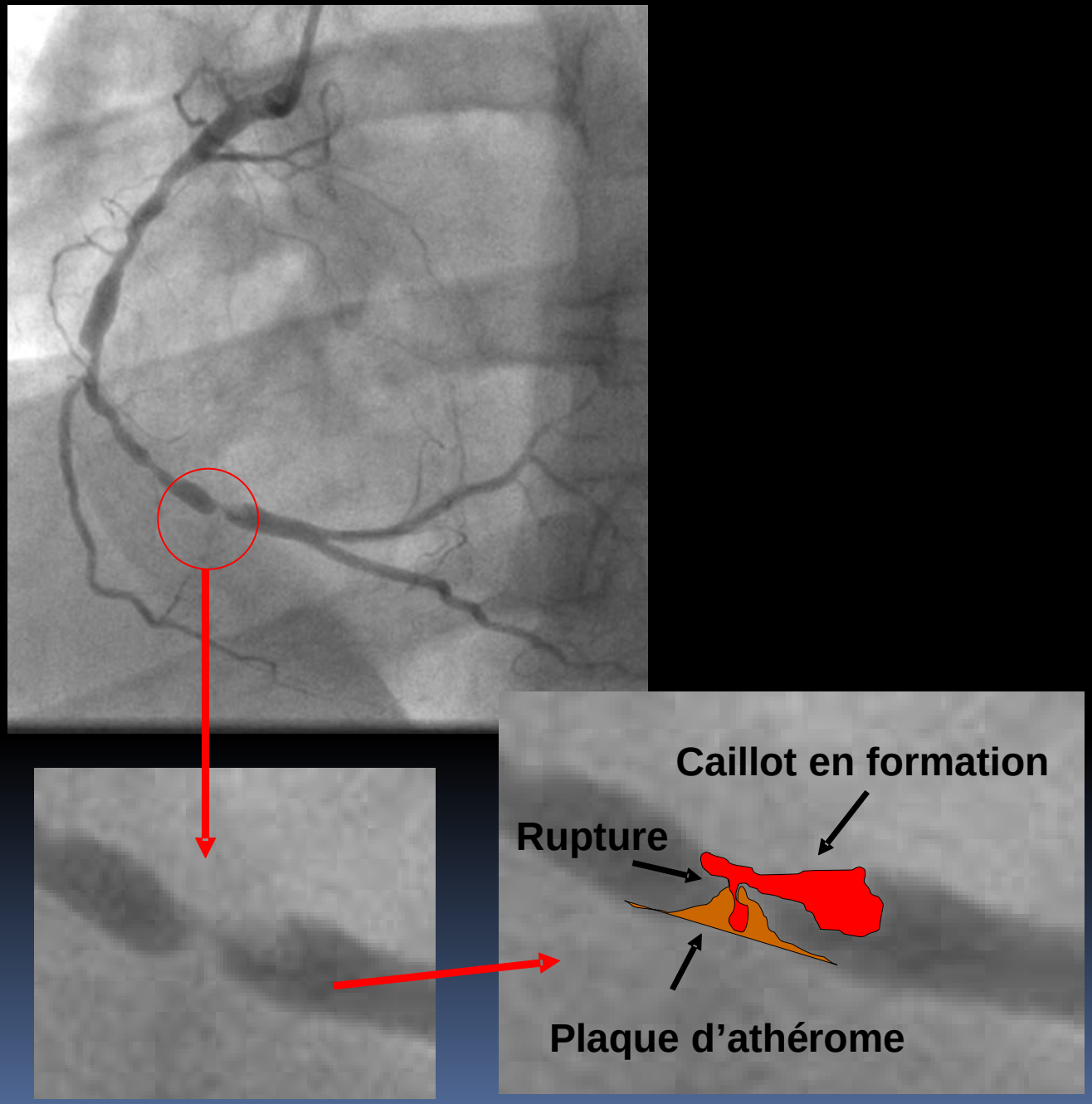
Environnement et Santé cardiaque

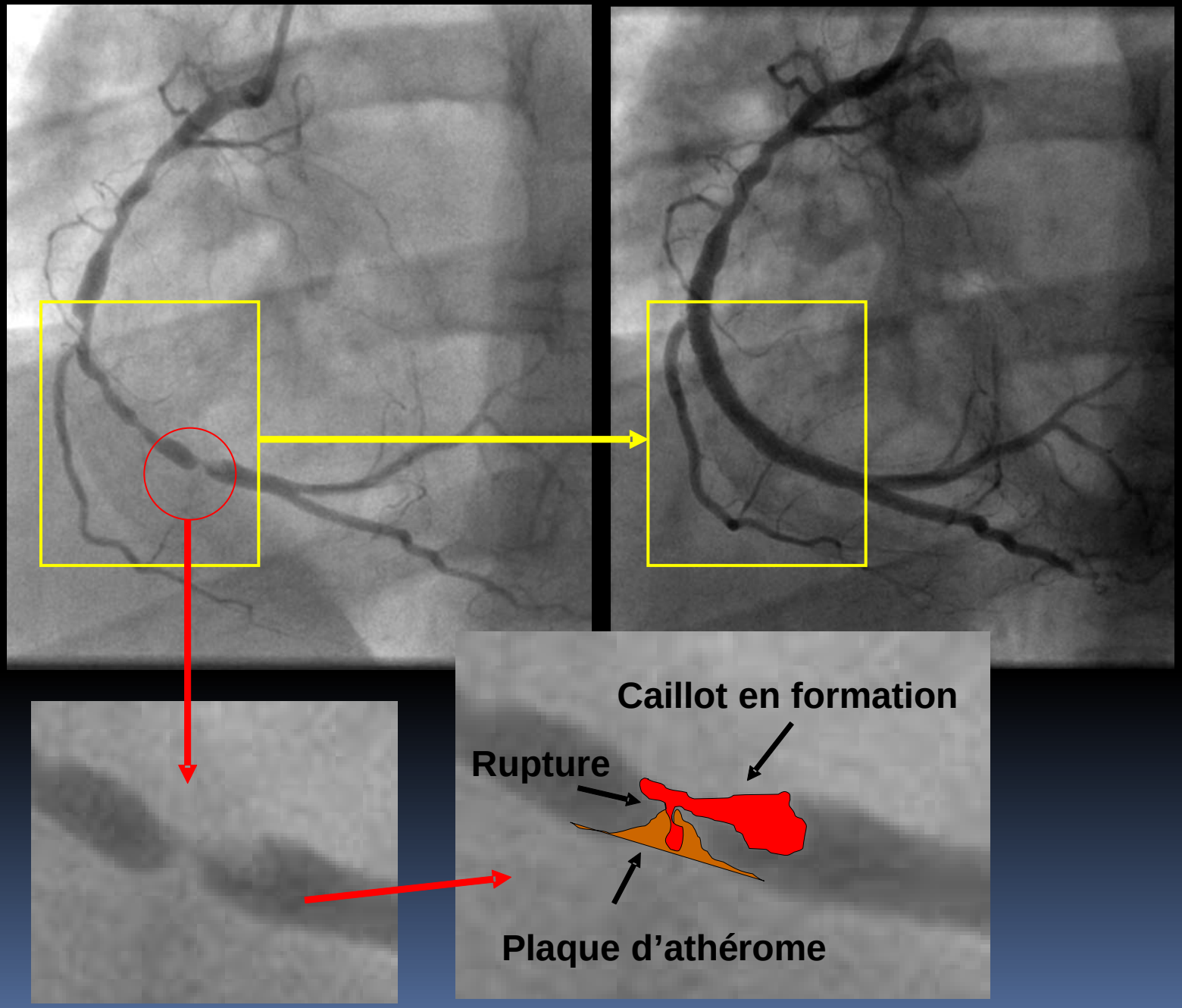
François Reeves MD FRCPC

Cardiologue d'Intervention, CHUM et Cité de la santé de Laval
Professeur agrégé de médecine
Affectation conjointe au Département de santé environnementale
Faculté de médecine
Université de Montréal

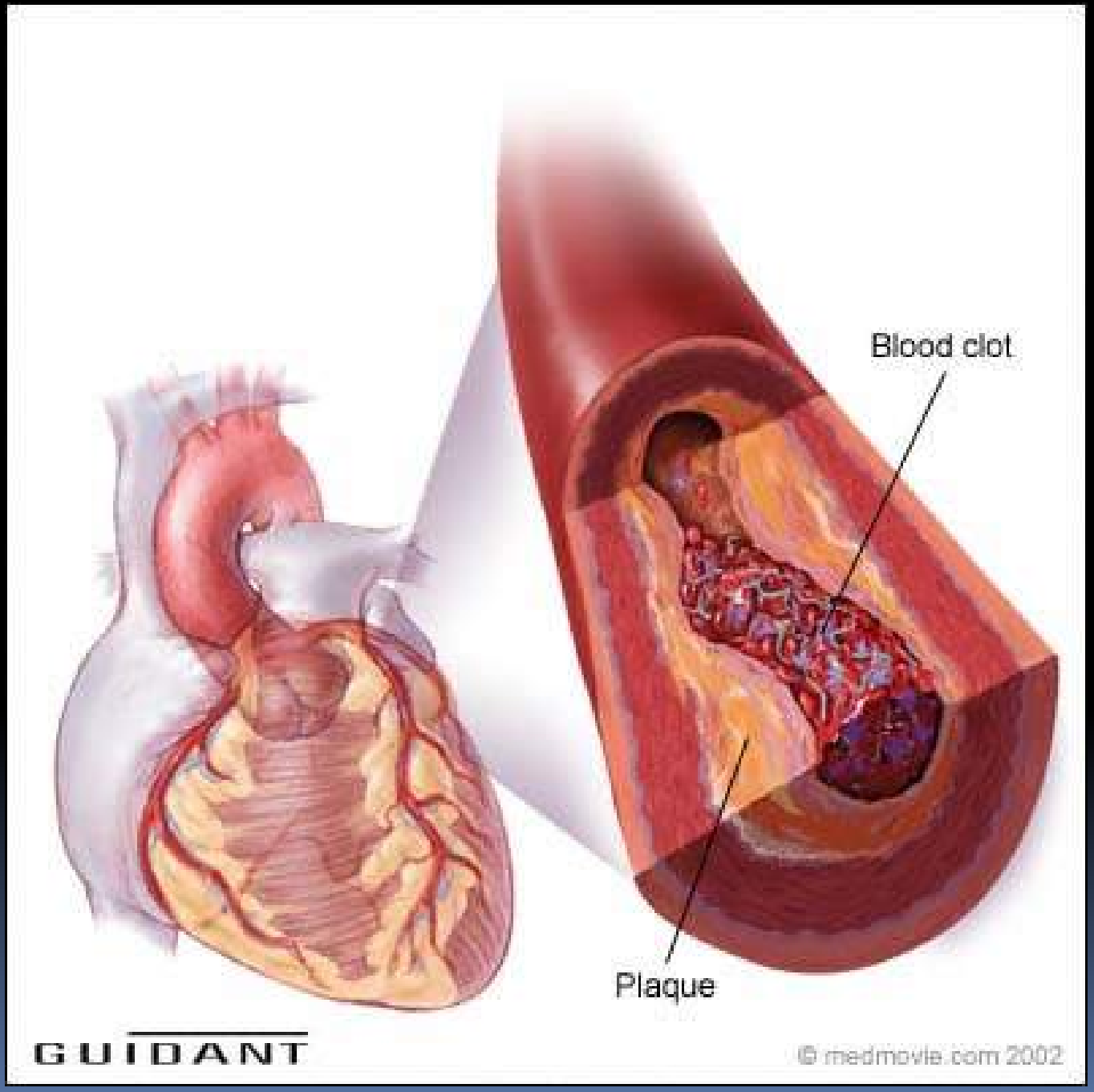


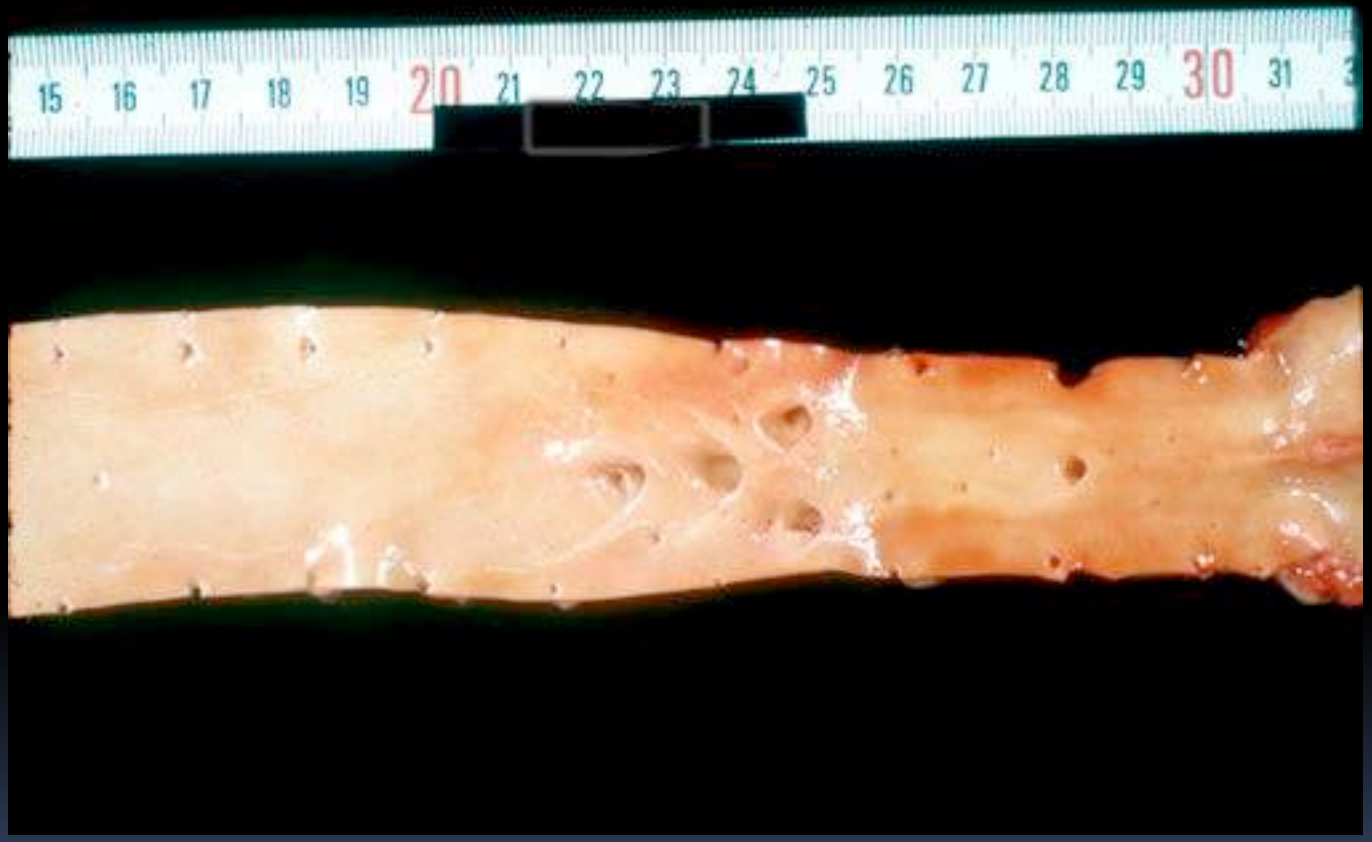



Caillot en formation
Rupture
Plaque d’athérome


Caillot en formation
Rupture
Plaque d'athérome

Athérosclérose ?


Blood clot
Plaque
GUIDANT
© medmovie.com 2002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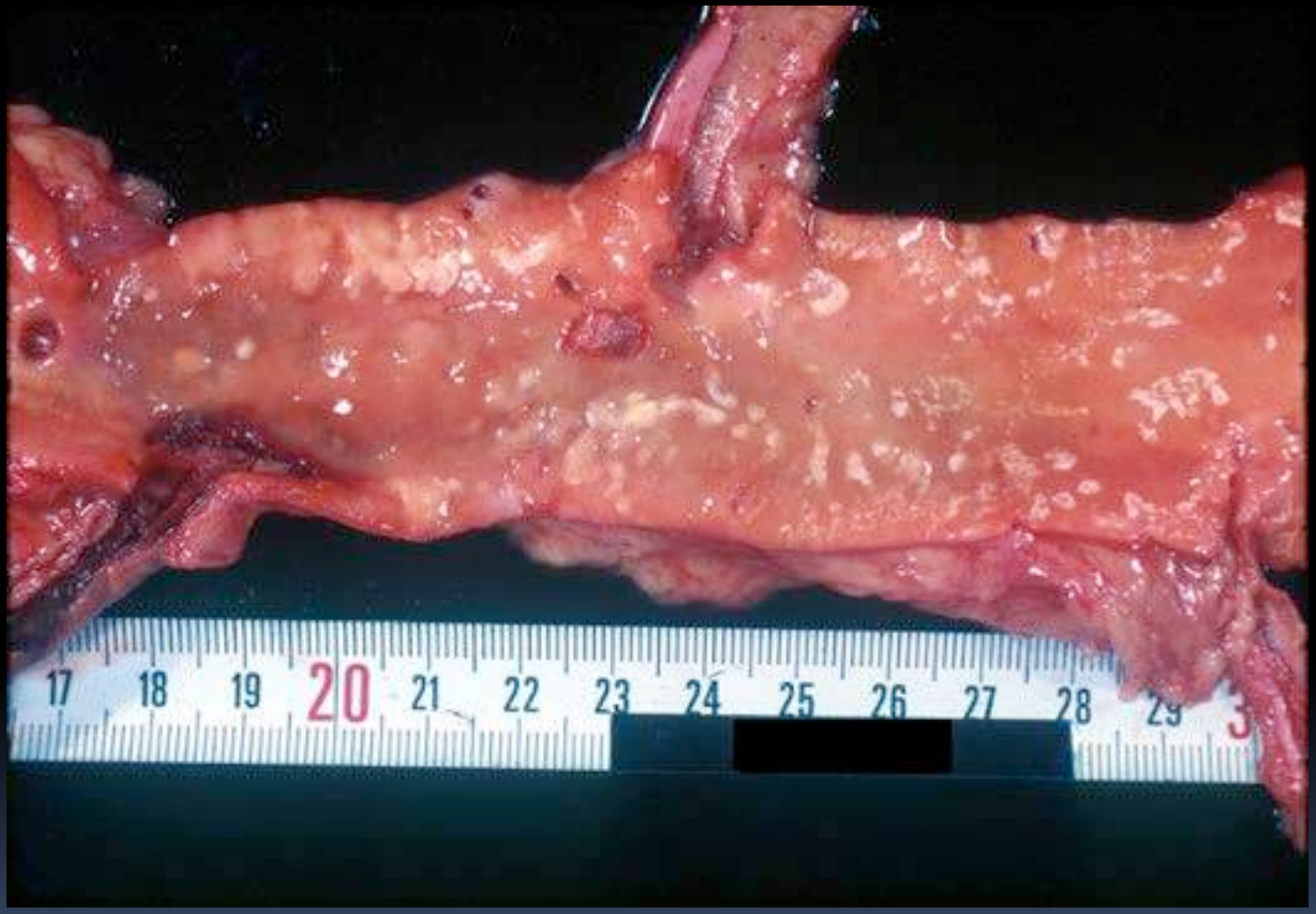
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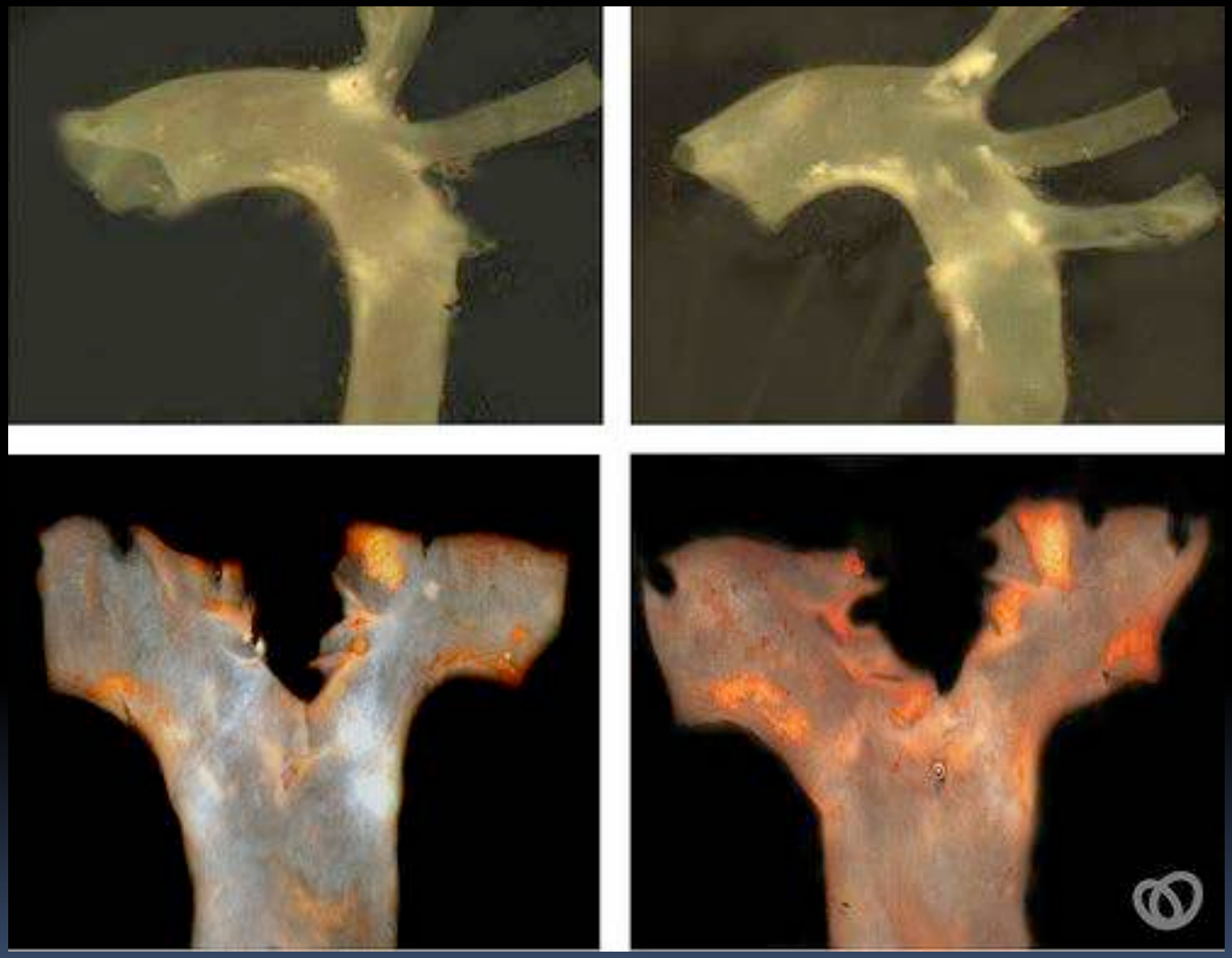


Pourquoi l'athérosclérose ?

The Framingham Heart Study

1948-2011

- ✓ Hérédité
- ✓ Cholestérol
- ✓ Hypertension
- ✓ Diabète
- ✓ Tabac
- ✓ Obésité
- ✓ Sédentarité
- ✓ Stress

Pourquoi l'athérosclérose ?

1948

The Framingham Heart Study

little was known about the general causes of heart disease and stroke, but the death rates for cardiovascular disease have been increasing steadily since the beginning of the century and had become an American epidemic.

Pourquoi l’athérosclérose ?

1948

The Framingham Heart Study

American epidemic

Pourquoi l’athérosclérose ?

The Framingham Heart Study

Framingham n’a pas tout dit

Pourquoi l'athérosclérose ?

La maladie cardiaque
est rare chez l'animal

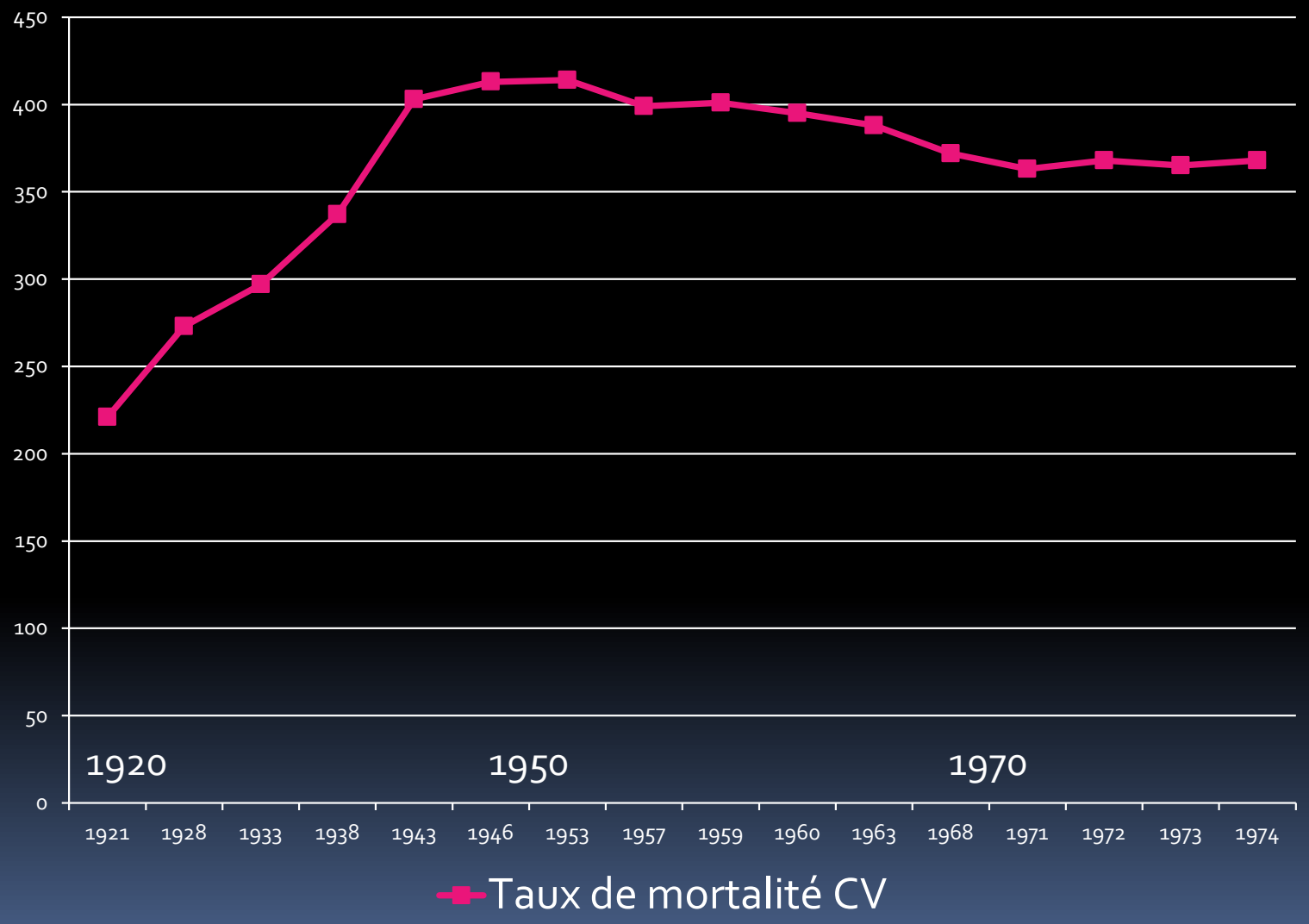
Pourquoi l'athérosclérose ?

La maladie cardiaque
était rare chez l'humain

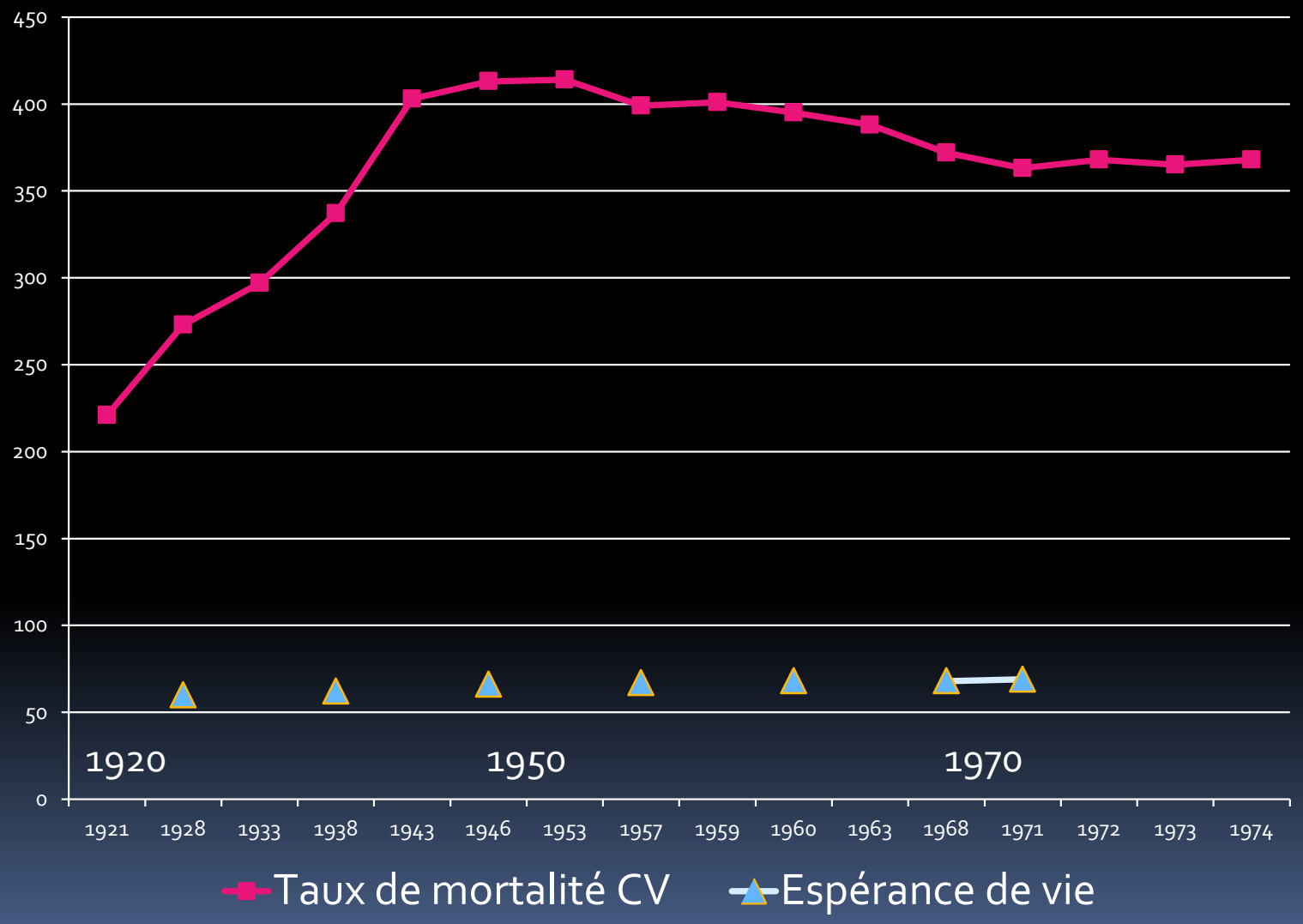
Pourquoi l'athérosclérose ?

La maladie cardiaque explose lors des révolutions industrielles

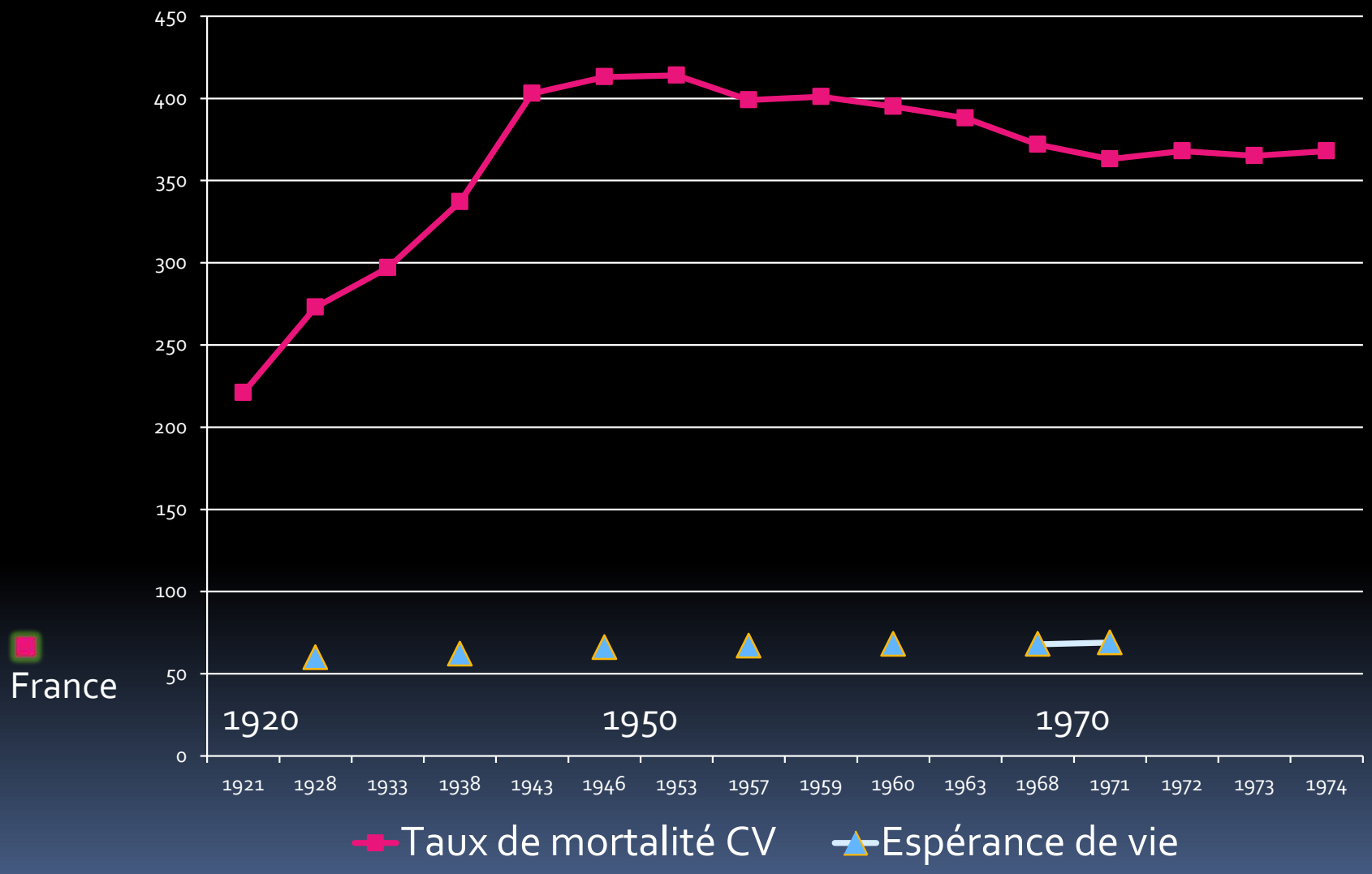
Mortalité CV Canada 1920-1975



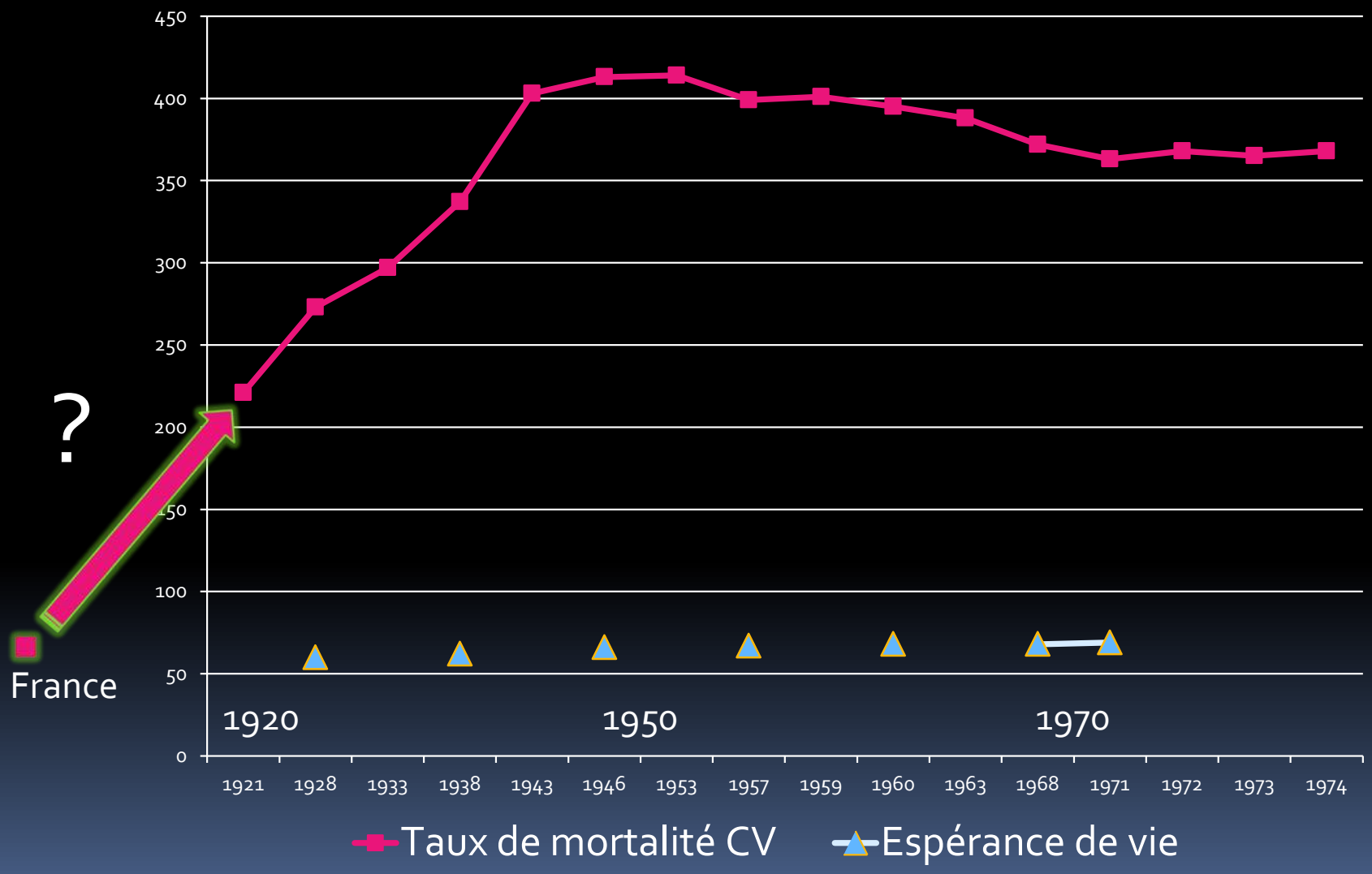
Mortalité CV Canada 1920-1975



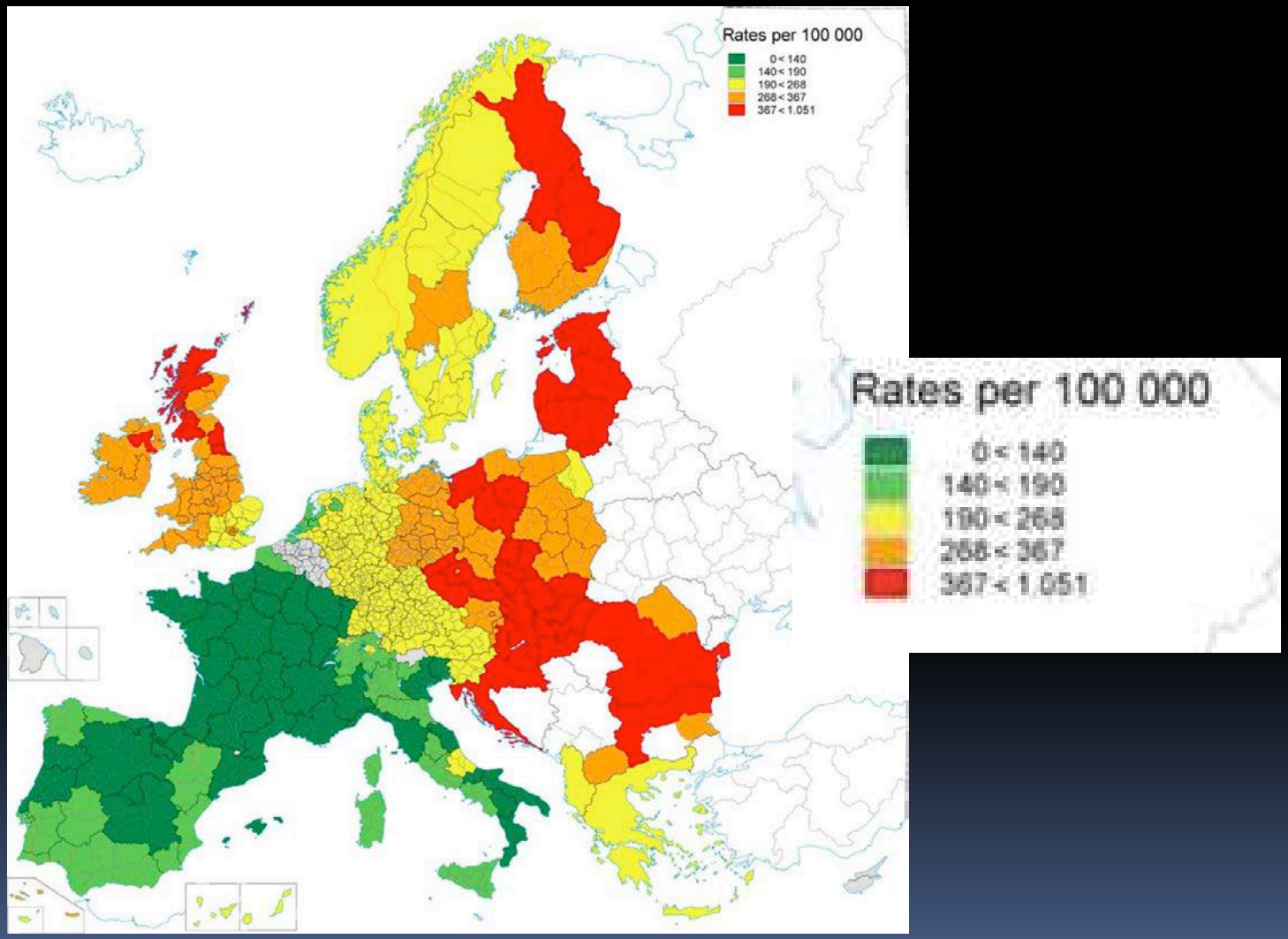
Mortalité CV Canada 1920-1975



Mortalité CV Canada 1920-1975



Mortalité cardiovasculaire - hommes de 45-74 ans. Europe 2000



« An update on regional variation in cardiovascular mortality within Europe ».
European Heart Journal 2008 doi : 10.1093/eurheartj/ehm604.

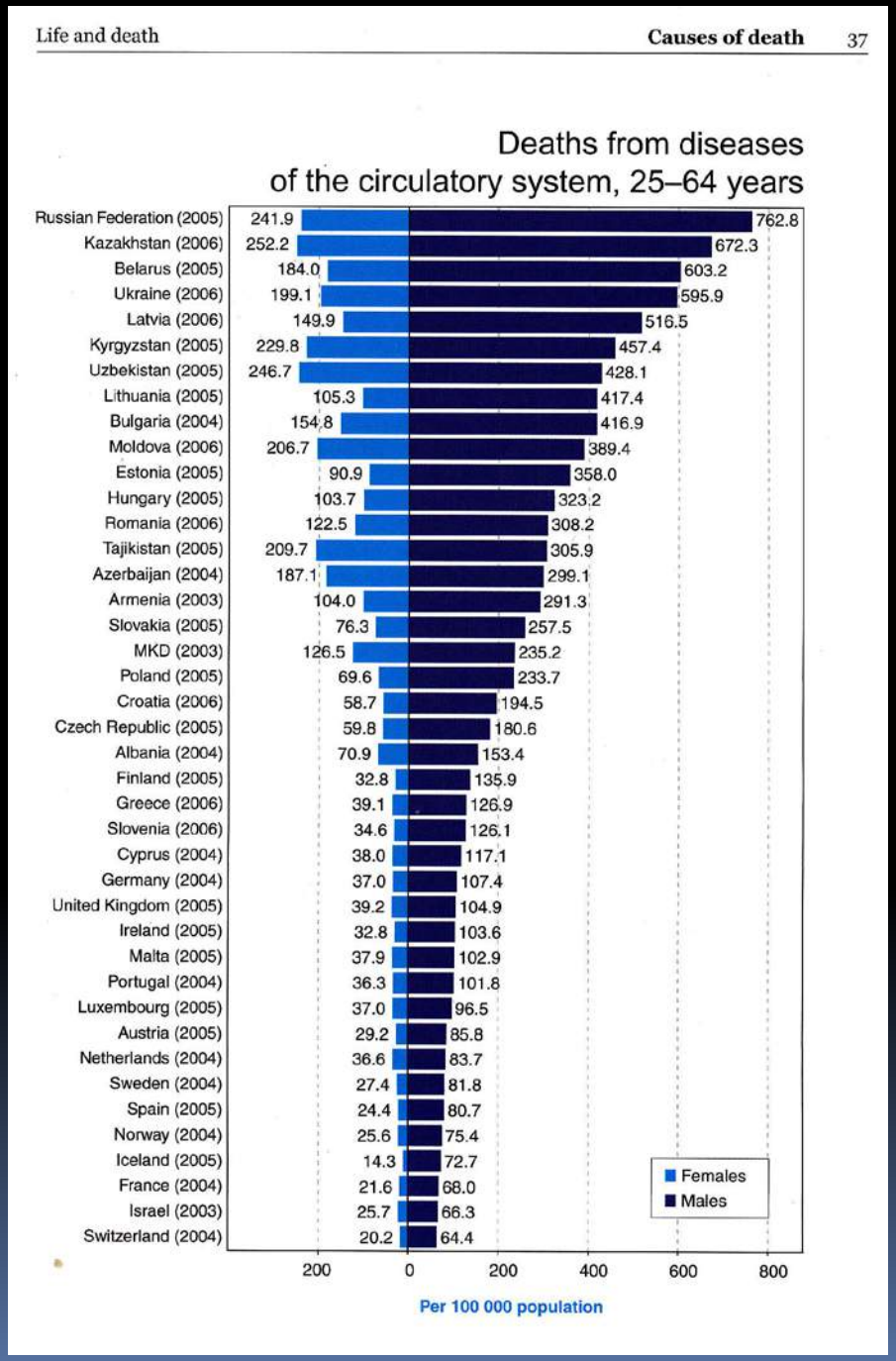
OMS 2008

Russie

Pologne

Autriche

Suisse



Décès par 100,000

OMS 2008

Russie

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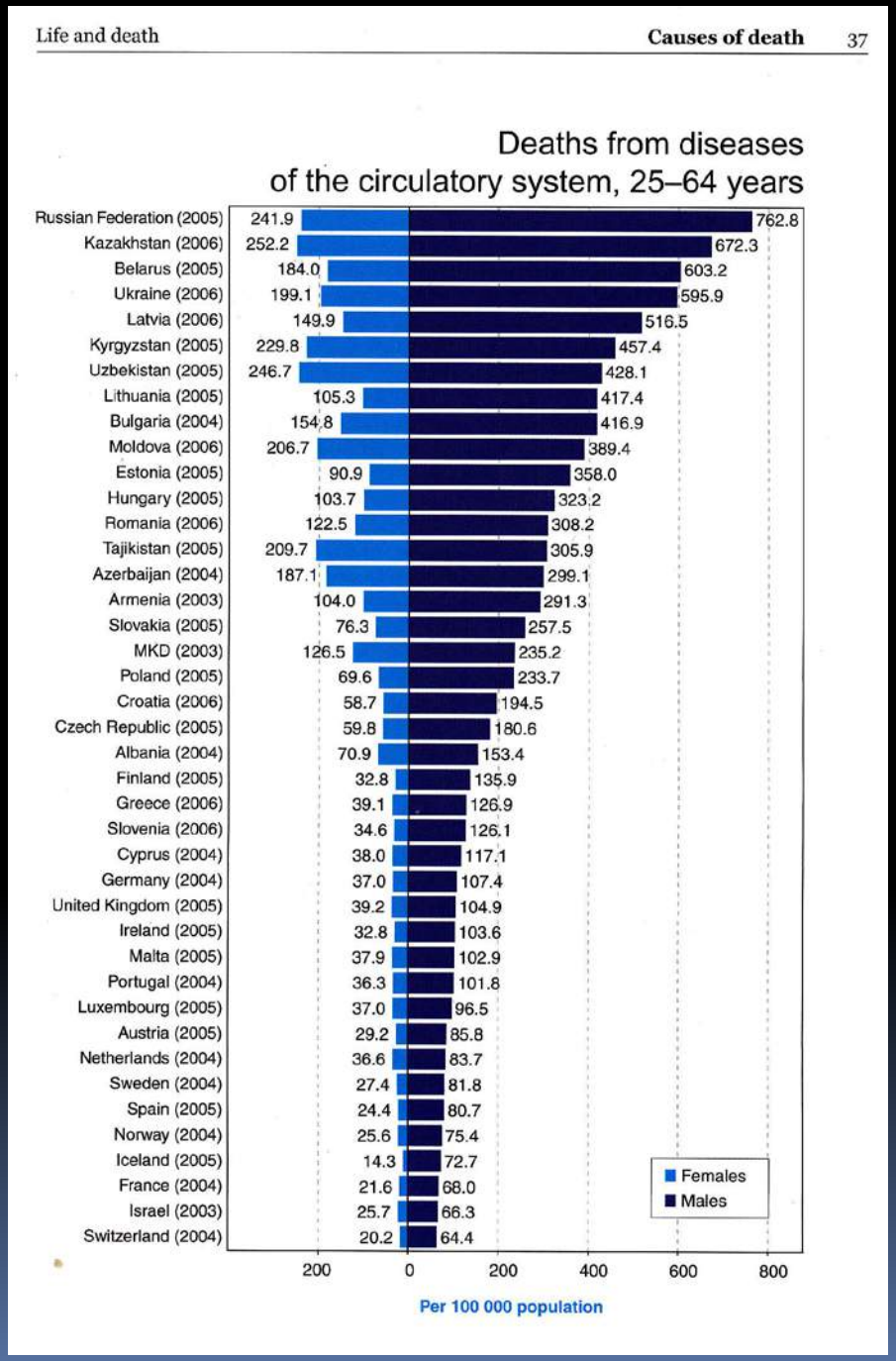
Autriche

Suisse



750

500

400

300

200

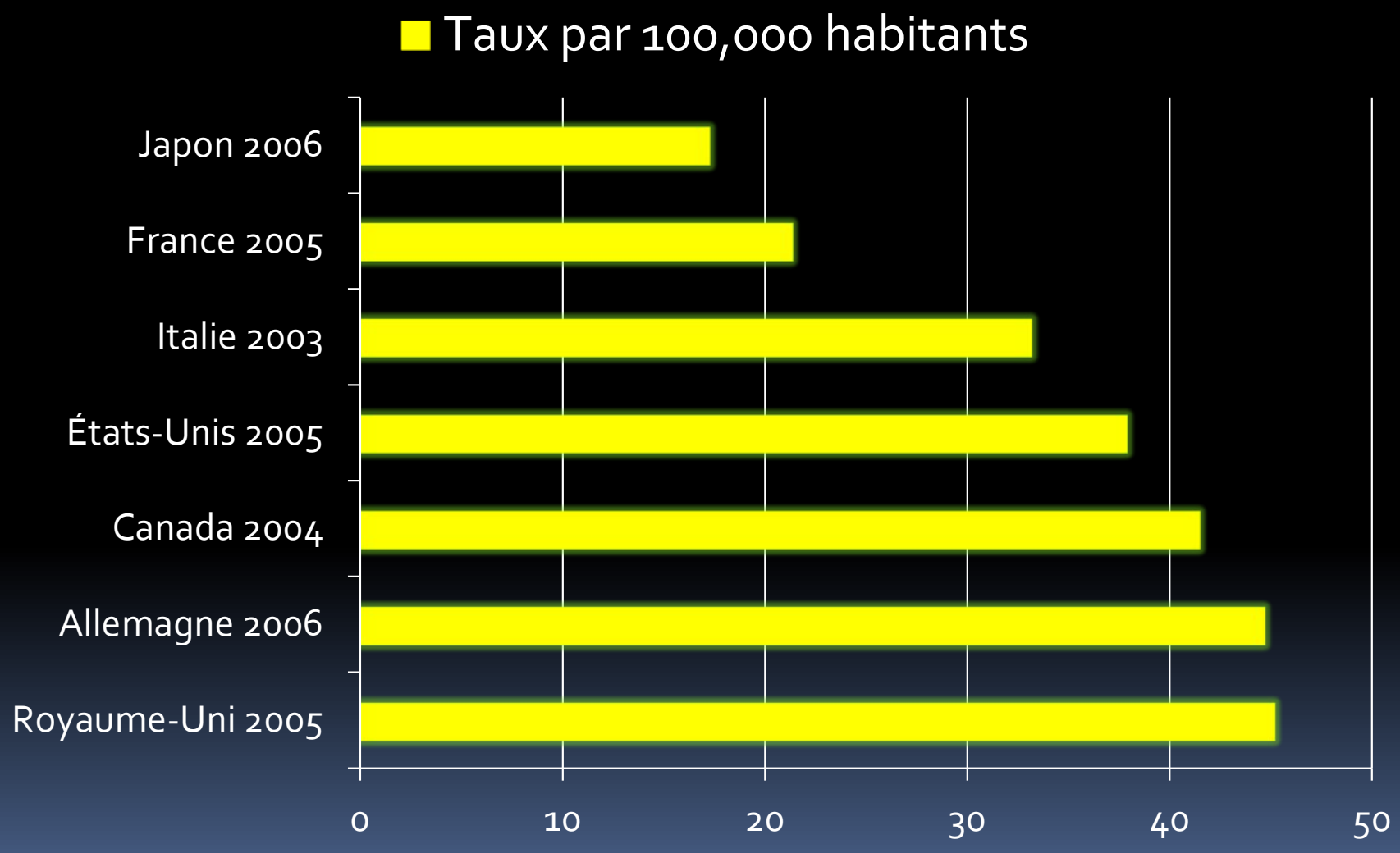
100

60

Décès par 100,000

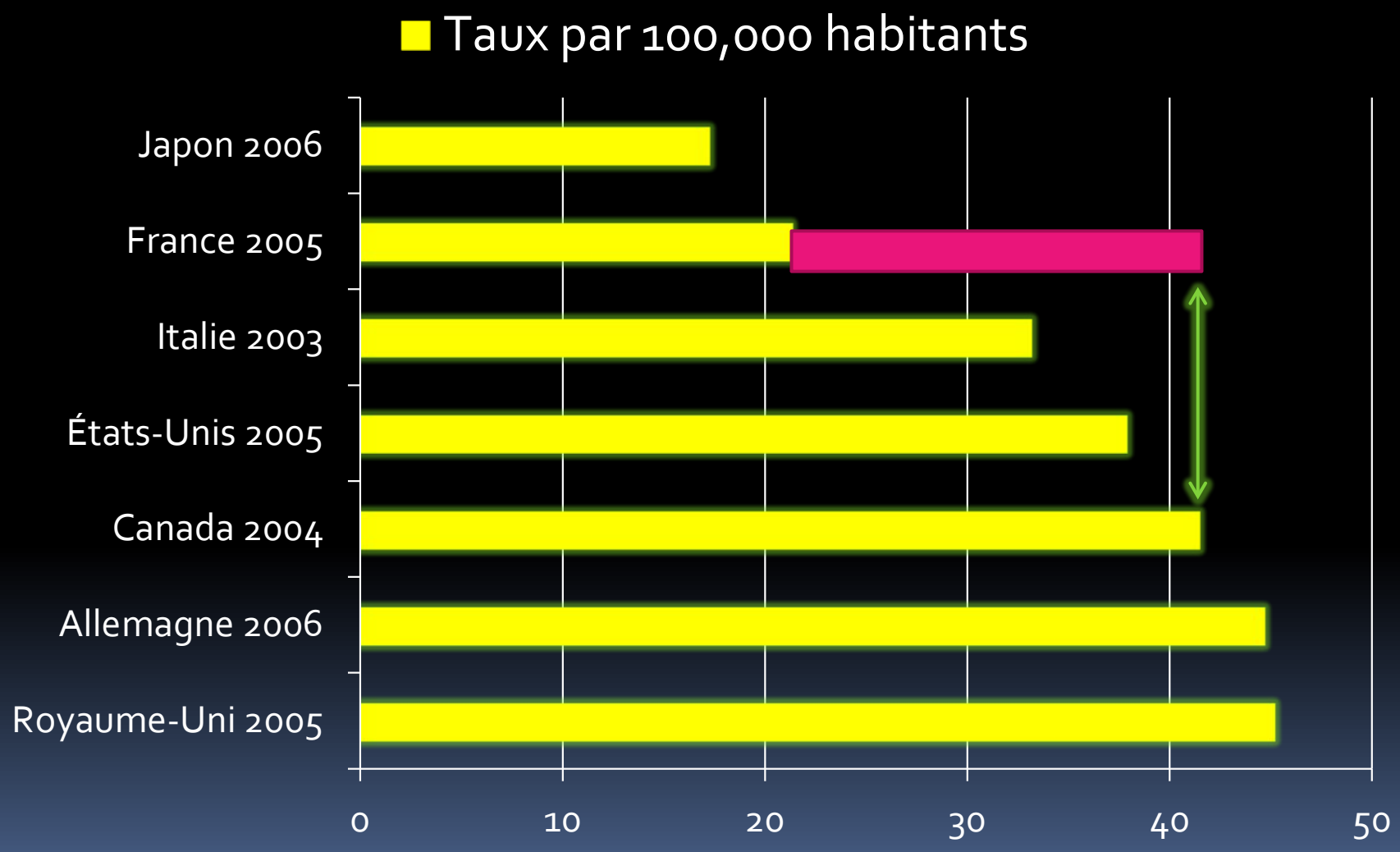
OCDE

MORTALITÉ PAR INFARCTUS

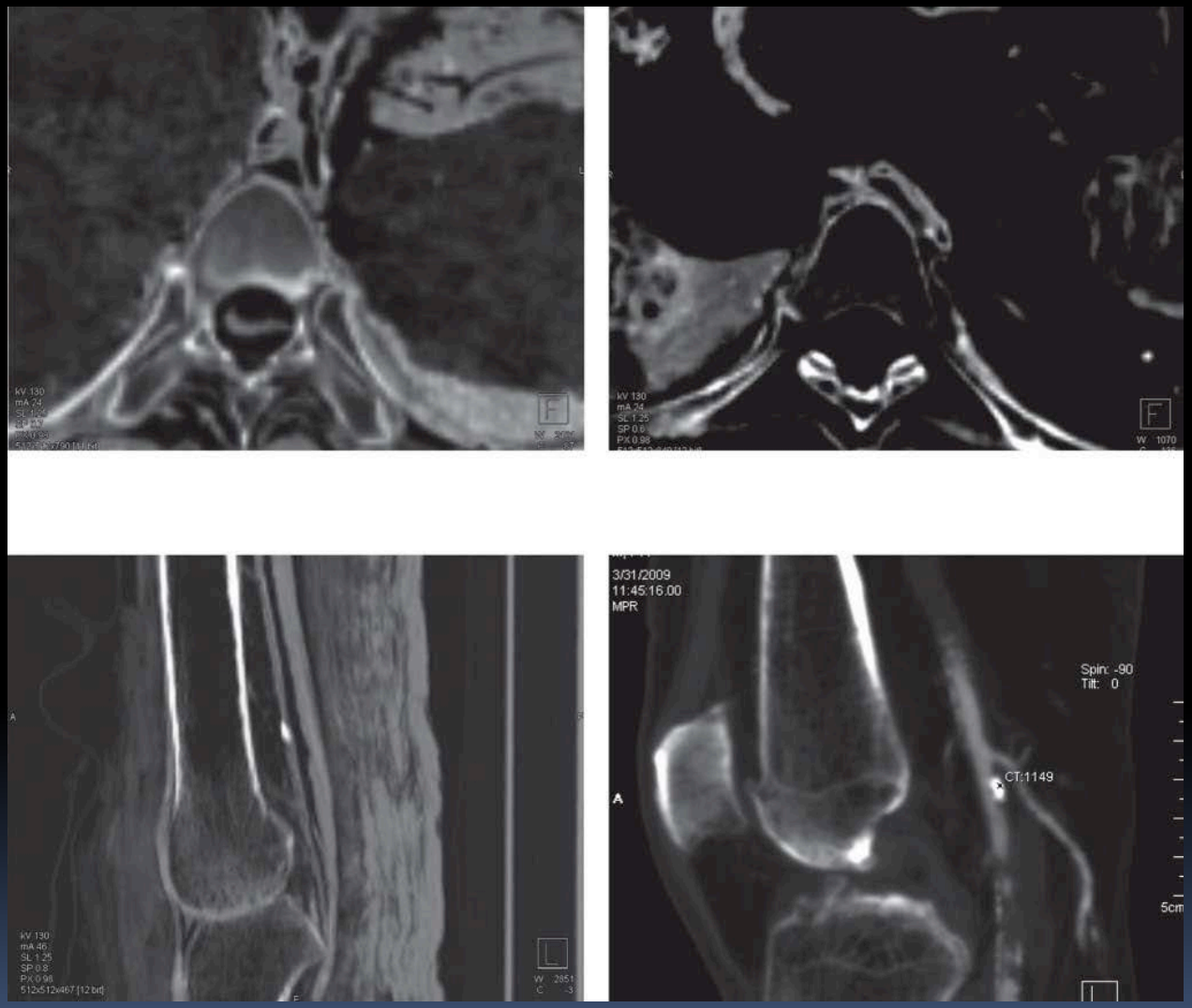


OCDE

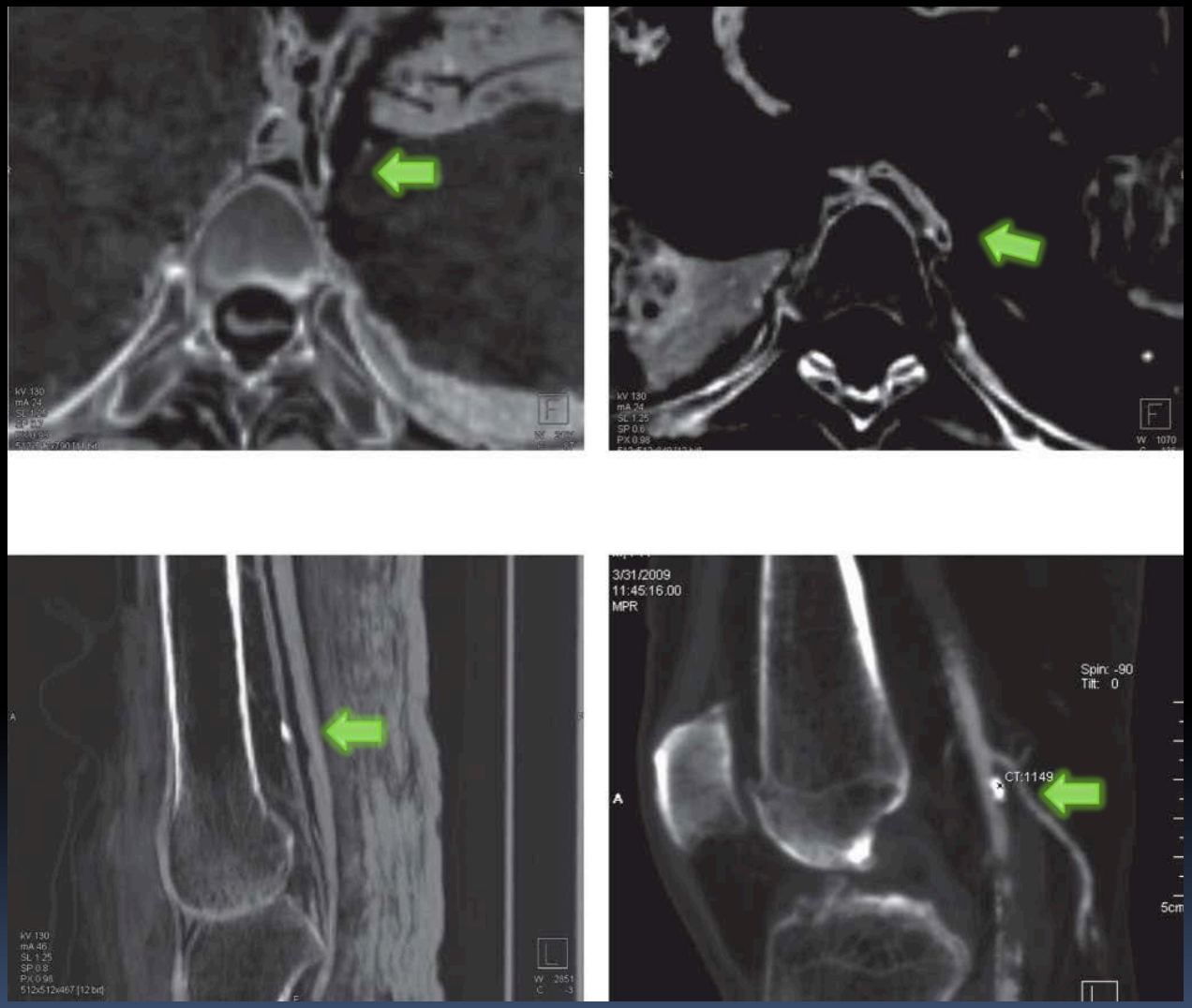
MORTALITÉ PAR INFARCTUS



PHILIPS



Computed tomographic assessment of atherosclerosis in ancient Egyptian mummies .
A. Allam, R.C.Thompson, L.S. Wann et al. *JAMA 2009 302 : 2091-2093.*



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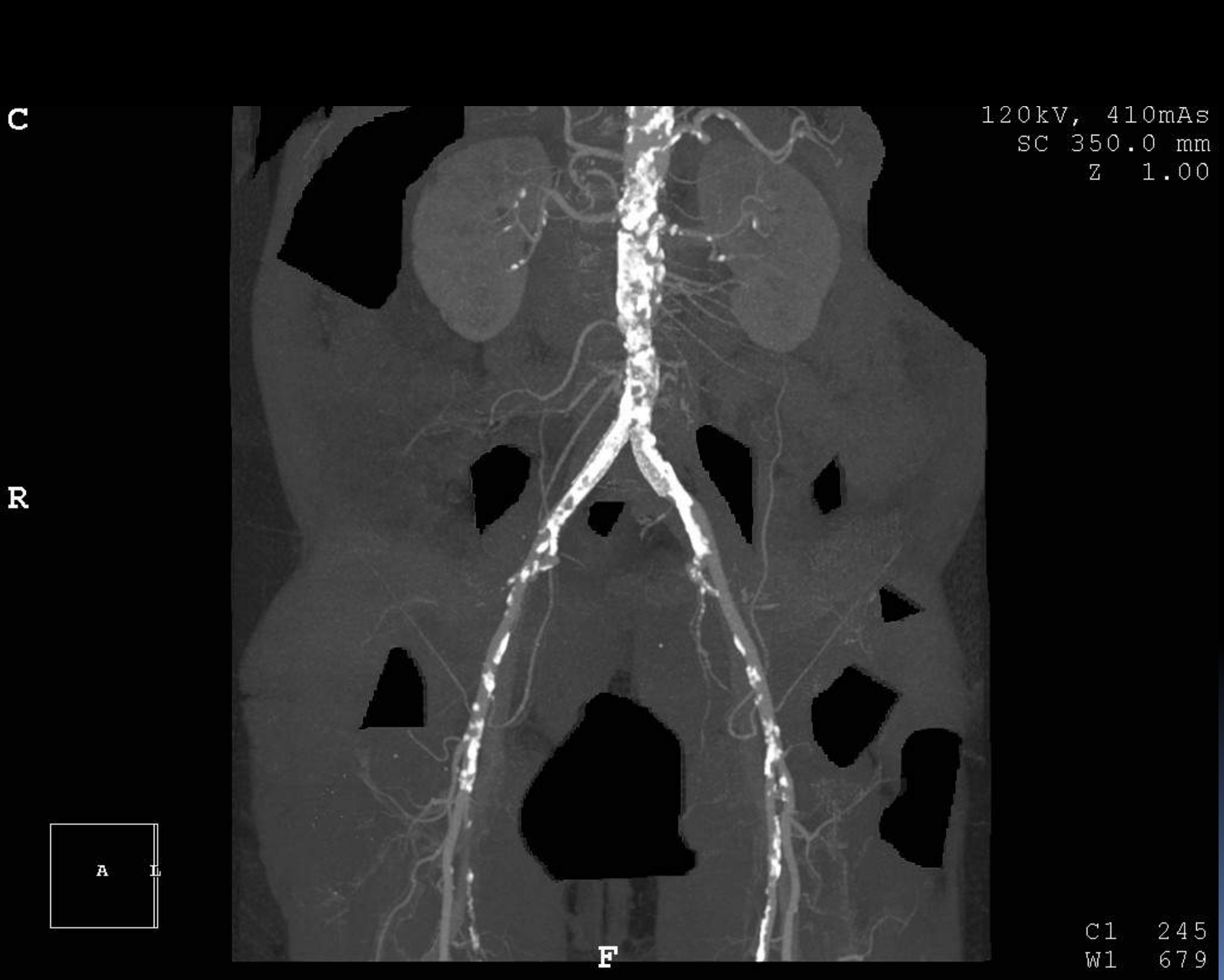
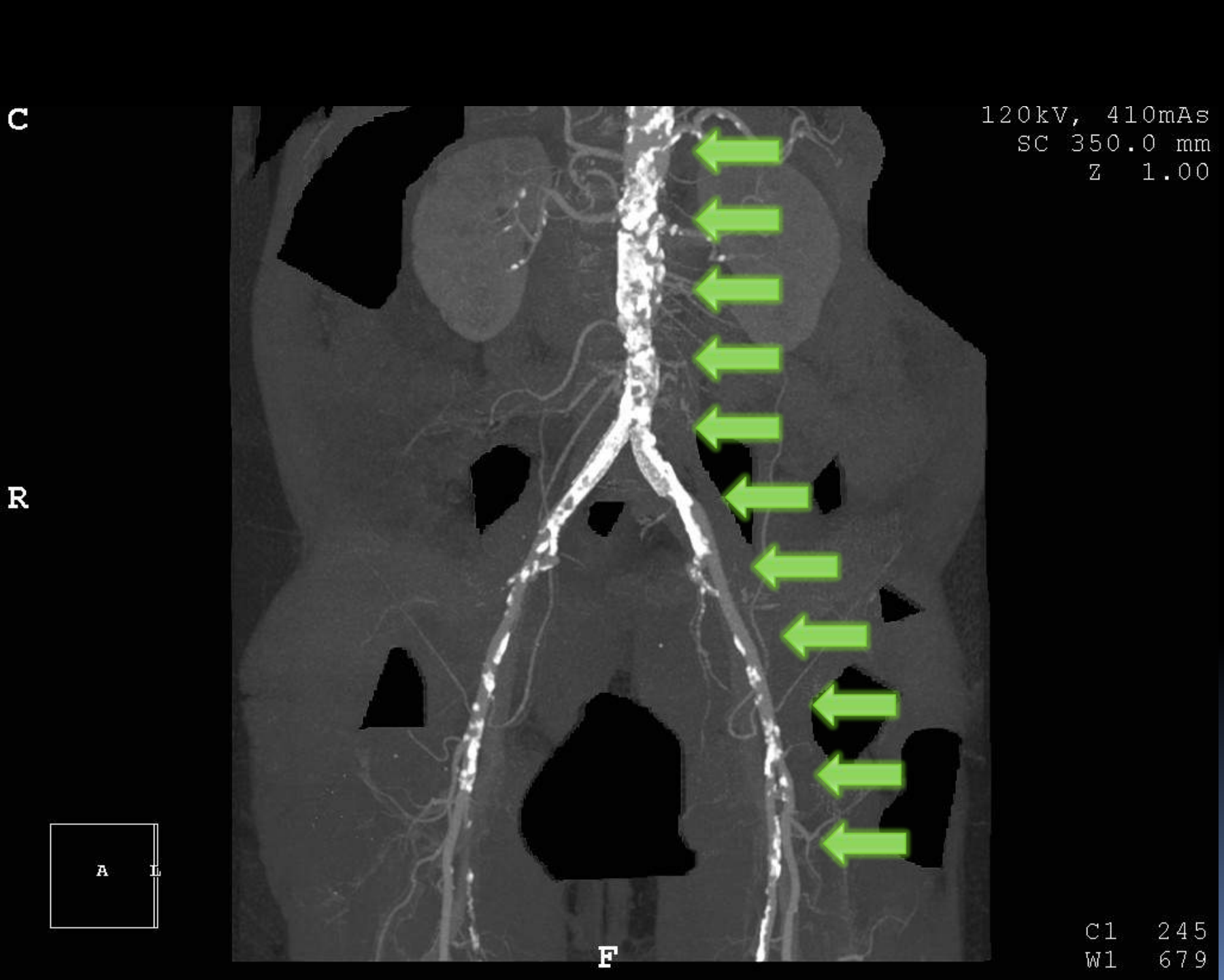

C
R
A
L
F
120kV, 410mAs
SC 350.0 mm
Z 1.00
C1 245
W1 679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Inflammation and Infection Do Not Promote Arterial Aging and Cardiovascular Disease Risk Factors among Lean Horticulturalists.

Gurven M et al. *PLoS ONE* 4(8): e6590. doi : 10.1371/journal.pone.0006590, 2009.

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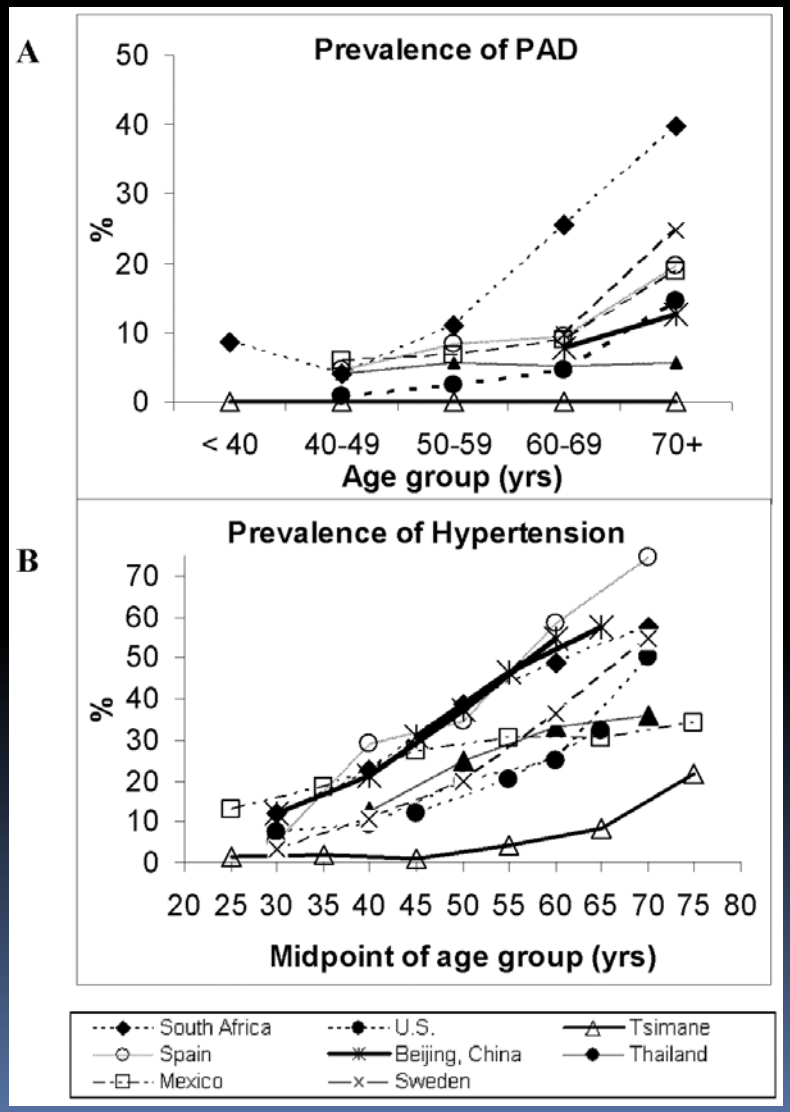

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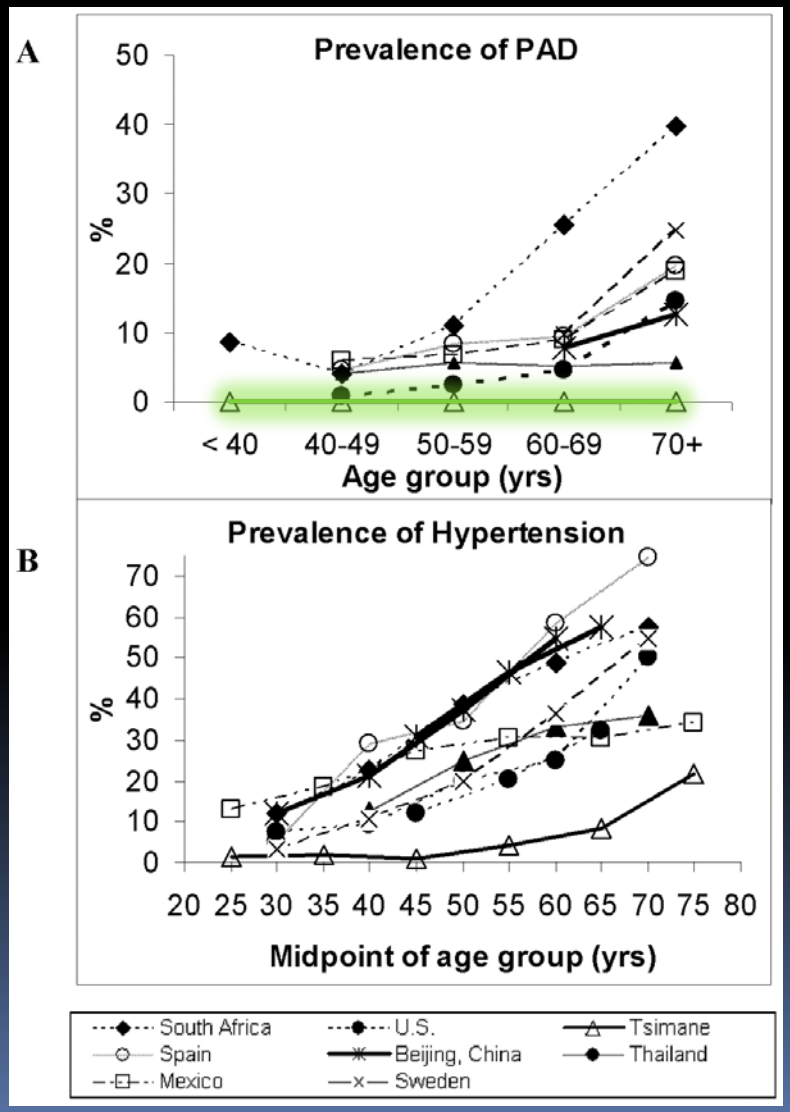

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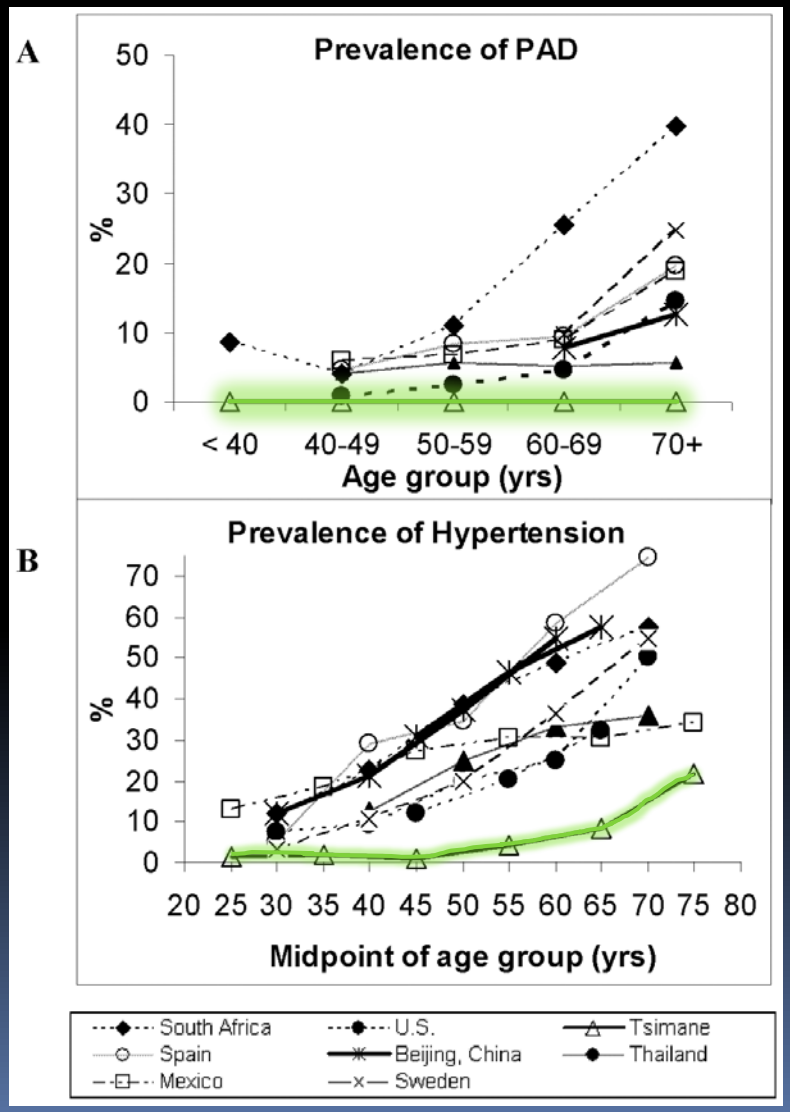
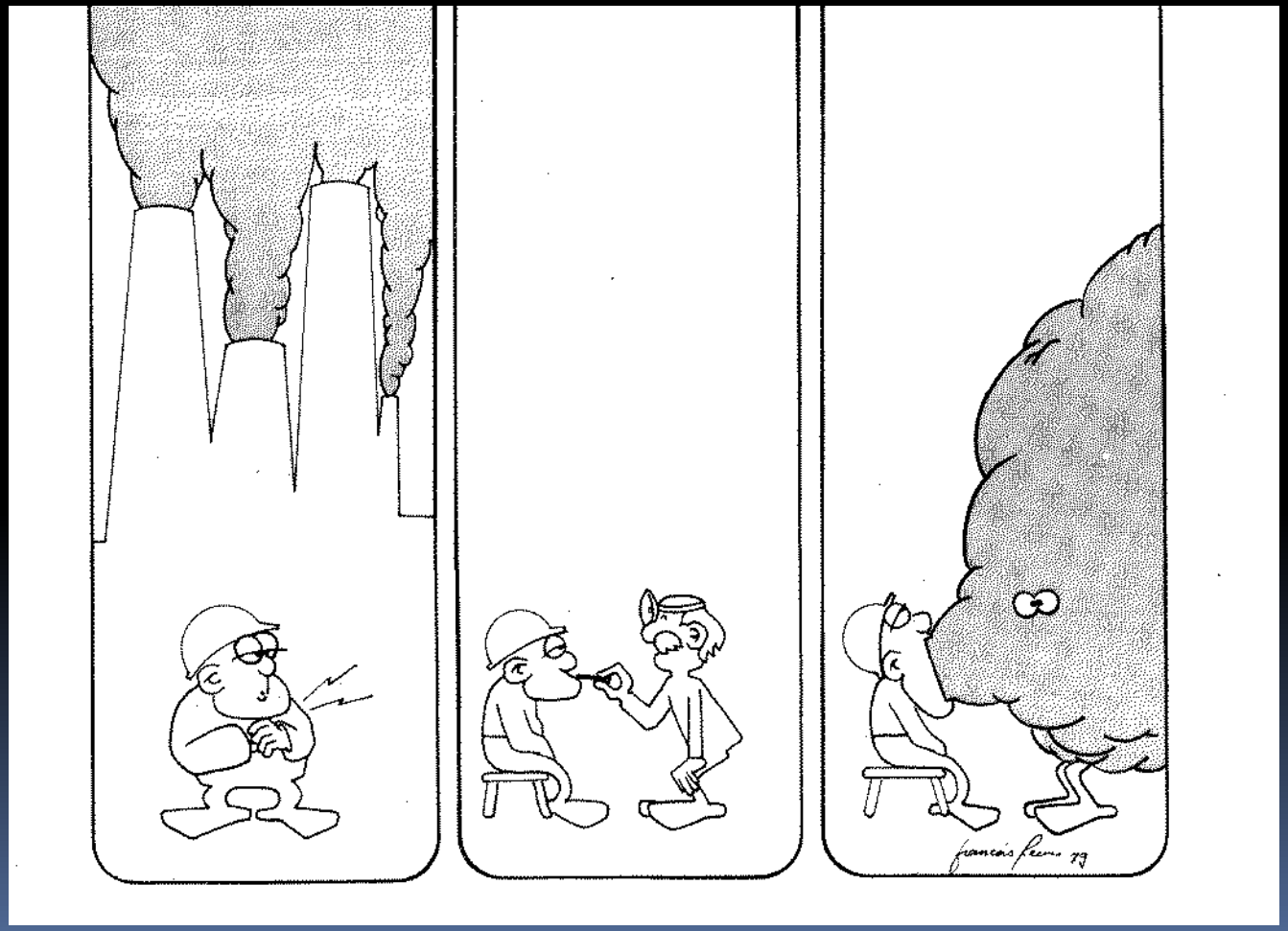


La cardiologie est une spécialité environnementale



Pourquoi l'athérosclérose ?

3 triades

- **Ce que l'on est (CHD)**
  - Cholestérol, hypertension, diabète
- **Ce que l'on fait (SOT)**
  - Sédentarité, obésité, tabac
- **Ce qui nous entoure (EAU)**
  - Environnement, alimentation, urbanisme

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Nos échanges avec l'environnement

Interface solide/ liquide/ gaz

- Ce qu'on mange
- Ce qu'on boit
- Ce qu'on respire

- 1 kilo
- 2 kilos
- 20 kilos

Révolution industrielle

- Nano-agresseurs alimentaires
- Nano-agresseurs aériens

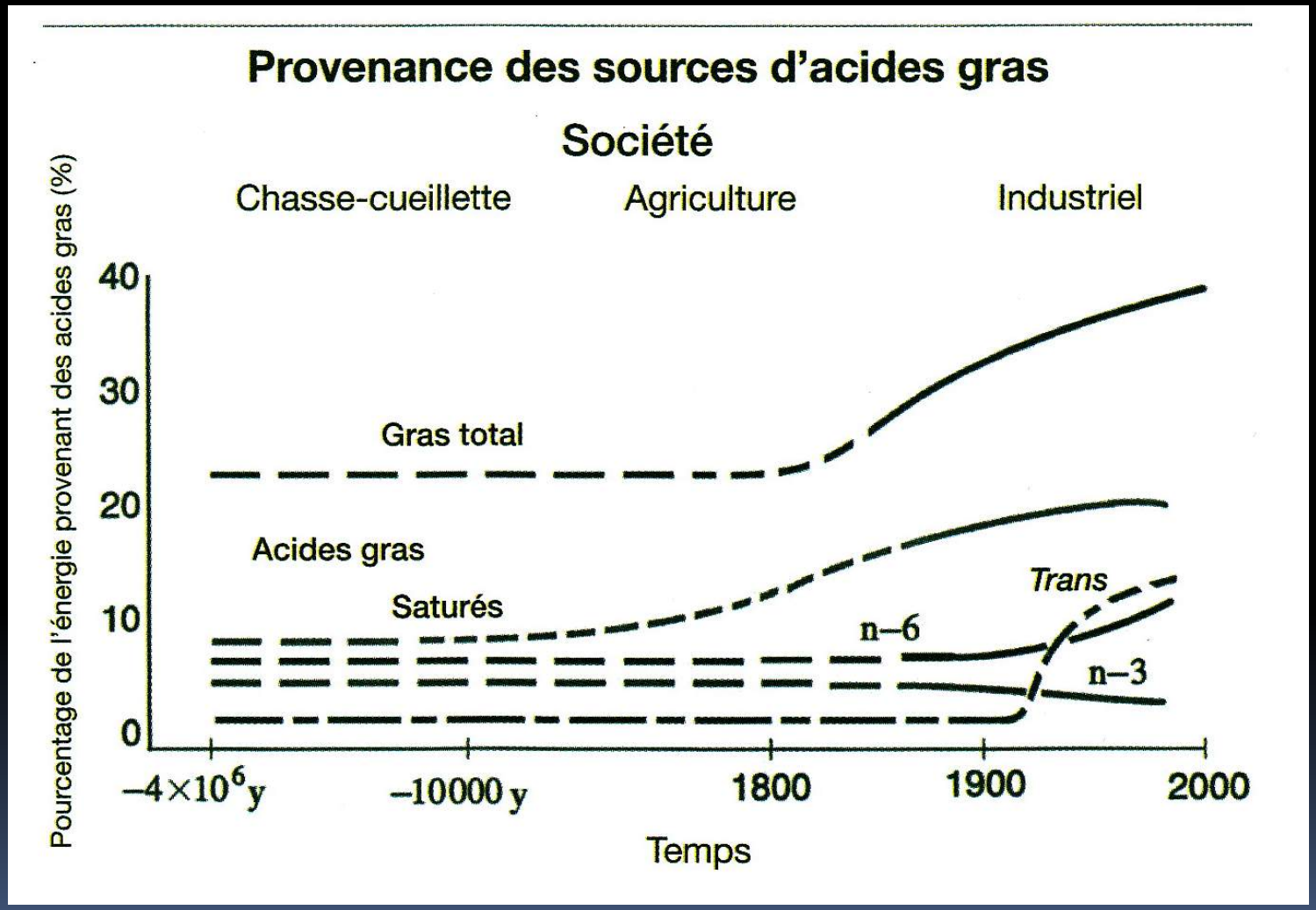
Révolution industrielle

- Nano-agresseurs alimentaires
  - Gras trans
  - Sel
  - Sirop fructose-glucose
  - Acide phosphorique
  - Pesticides
- Nano-agresseurs aériens

Révolution industrielle

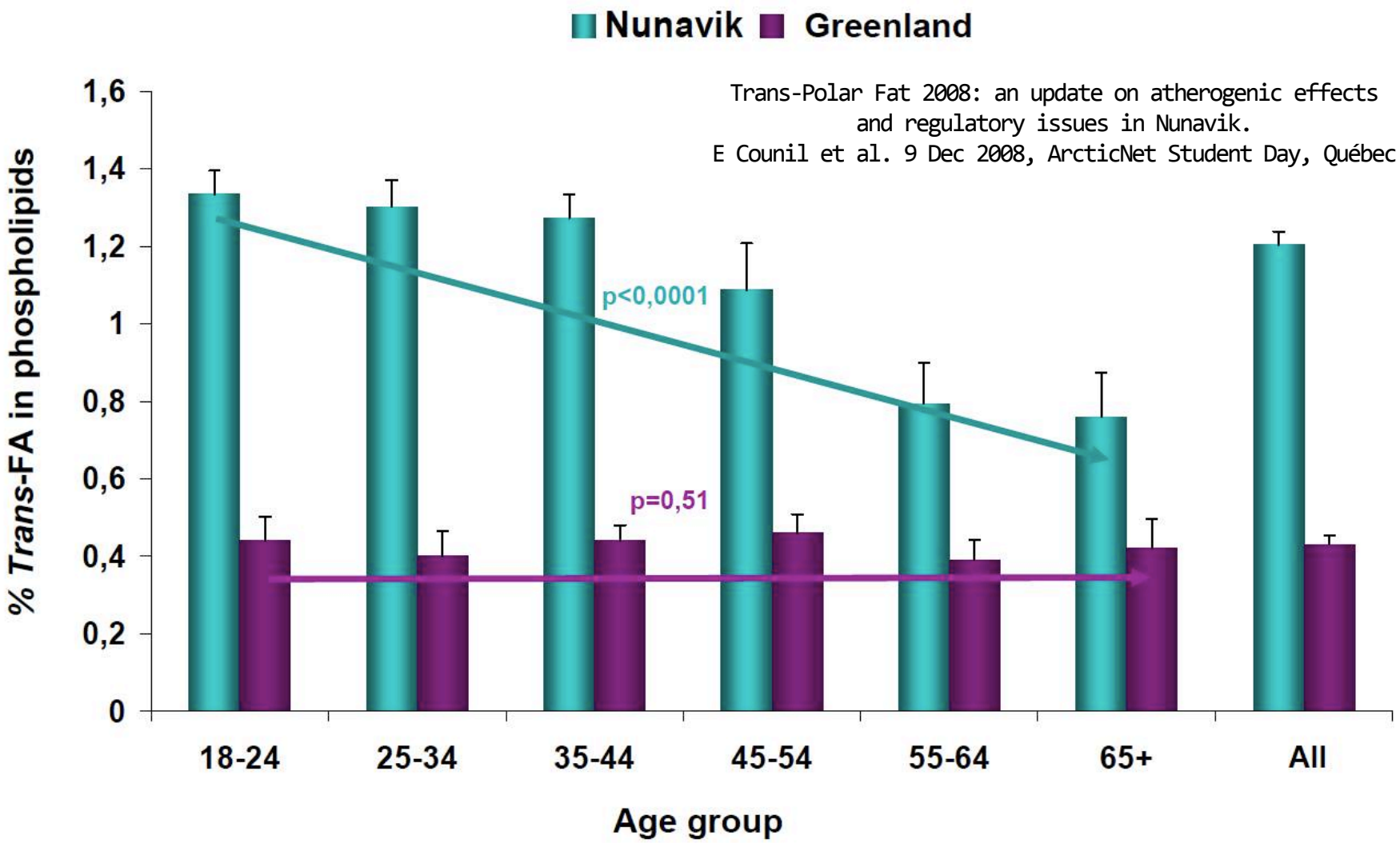
- Nano-agresseurs alimentaires
  - Gras trans
  - Sel
  - Sirop fructose-glucose
  - Acide phosphorique
  - Pesticides
- Nano-agresseurs aériens
  - CO
  - NO_2, SO_2
  - Particules fines
  - COV
  - Ozone
  - Plomb

Gras trans



Éric Dewailly. « Les gras trans, vous connaissez ? Cet environnement qui nous rend malades ». *Le spécialiste*, décembre 2009. Vol 11, no 4 : 31.

Gras trans


Nunavik
Greenland
Trans-Polar Fat 2008: an update on atherogenic effects
and regulatory issues in Nunavik.
E Counil et al. 9 Dec 2008, ArcticNet Student Day, Québec
% Trans-FA in phospholipids
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
p<0,0001
p=0,51
18-24
25-34
35-44
45-54
55-64
65+
All
Age group

Sodium et Gomorrhe

- Canada: 3,500 à 5,000 mg de sodium par jour
- Besoins: 1,500 mg
- Sources
  - Sel de table : 10 %
  - Sel naturel des aliments : 15 %
  - Alimentation industrielle : 75 %

Sodium et Gomorrhe

- Diminuer de 3 gr l'apport quotidien de sel (1,2 g de Na) préviendrait annuellement (USA)
  - 75 000 infarctus
  - 45 000 AVC
  - 75 000 décès

Projected effects of diatery salt reductions on future cardiovascular disease.
KB Domingo et al. NEJM, 2010, 362 (7): 590-597.

Fructose-glucose

- De 1970 à 1997, la consommation de soda par habitant a crû de 86 % aux Etats-Unis, (de 83 litres à 155 litres).
- De 1977 à 1994, la quantité de sucre ajouté par personne passait 235 kilocalories à 318.
- La prévalence de l'obésité croissait de 112 %.

Lenny R. Vartanian, Marlene B. Schwartz et Kelly D. Brownell.
« Effects of soft drink consumption on nutrition and health : a systematic review and meta-analysis ».
American Journal of Public Health 2007 97 : 667-675.

Fructose-glucose

- Les sodas augmentent l'appétit, diminuent la satiété et reprogramment les personnes avec un haut besoin de sucre dans leur alimentation.

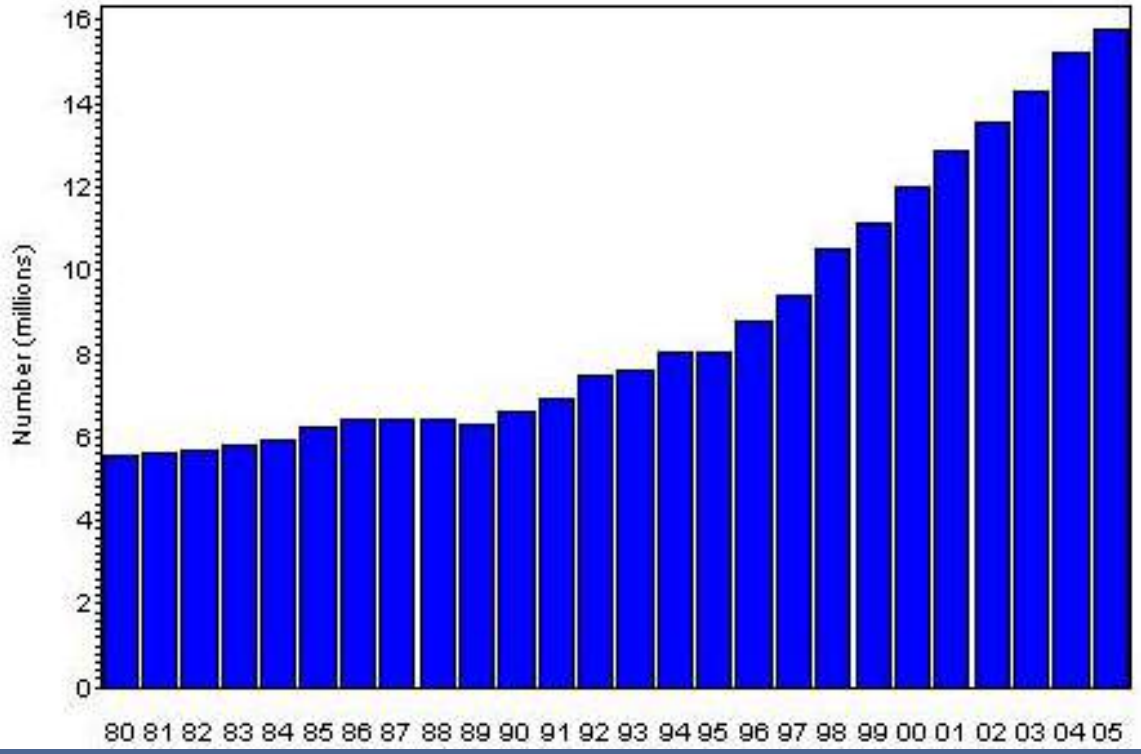
- Le fructose (principal sucre des sodas, issu du maïs) favorise la synthèse de graisse (lipogenèse), ne stimule pas l'insuline (donc favorise le diabète) ni la leptine, cette hormone qui donne le signal de satiété.

Lenny R. Vartanian, Marlene B. Schwartz et Kelly D. Brownell.
« Effects of soft drink consumption on nutrition and health : a systematic review and meta-analysis ».
American Journal of Public Health 2007 97 : 667-675.

Principal impact de l'obésité
EXPLOSION DU DIABÈTE

Number (in Millions) of Persons with Diagnosed Diabetes, United States, 1980–2005

Diabetes is becoming more common in the United States. From 1980 through 2005, the number of Americans with diabetes increased from 5.6 million to 15.8 million. As the detailed tables show, people aged 65 years or older account for approximately 38% of the population with diabetes.



United States

THE REVISES

The North Carolina family fights the effects of abundance with exercise

GRAINS AND OTHER STARCHY FOODS
$17.92

DAIRY
$14.51

MEAT, FISH AND EGGS
$54.92

FRUITS AND VEGETABLES
$41.07

CONDIMENTS
$12.51

SNACKS AND DESSERTS
$21.27

PREPARED FOOD
$24.27

FAST FOOD
$71.61

RESTAURANTS
$6.15

BEVERAGES
$77.75

FOOD EXPENDITURE FOR THE WEEK
$341.98

Mexico

THE CASALESES

A weakness for pricey soft drinks distorts their tight food budget

GRAINS AND OTHER STARCHY FOODS
$15.76

DAIRY
$26.81

MEAT, FISH AND EGGS
$42.81

FRUITS, VEGETABLES AND NUTS
$44.21

CONDIMENTS
$9.37

SNACKS AND DESSERTS
$6.27

PREPARED FOOD
$4.79

BEVERAGES
$39.07

FOOD EXPENDITURE FOR THE WEEK
$189.09

Révolution industrielle

- Nano-agresseurs alimentaires
  - Gras trans
  - Sel
  - Sirop fructose-glucose
  - Acide phosphorique
  - Pesticides
- Nano-agresseurs aériens
  - CO
  - NO_2, SO_2
  - Particules fines
  - COV
  - Ozone
  - Plomb

IPCC

1988

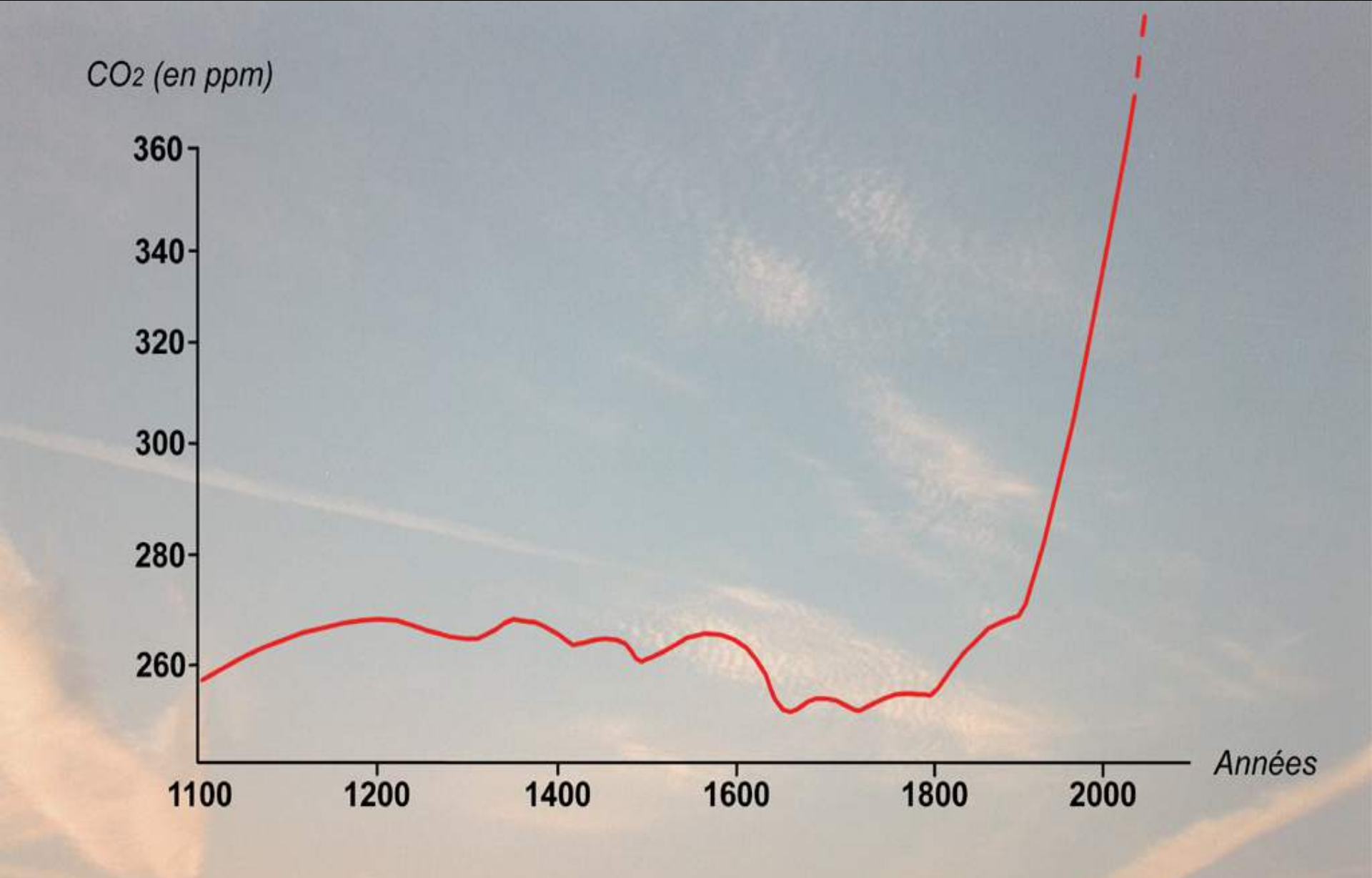
INTERNATIONAL PANEL ON CLIMATE CHANGE

GIEC

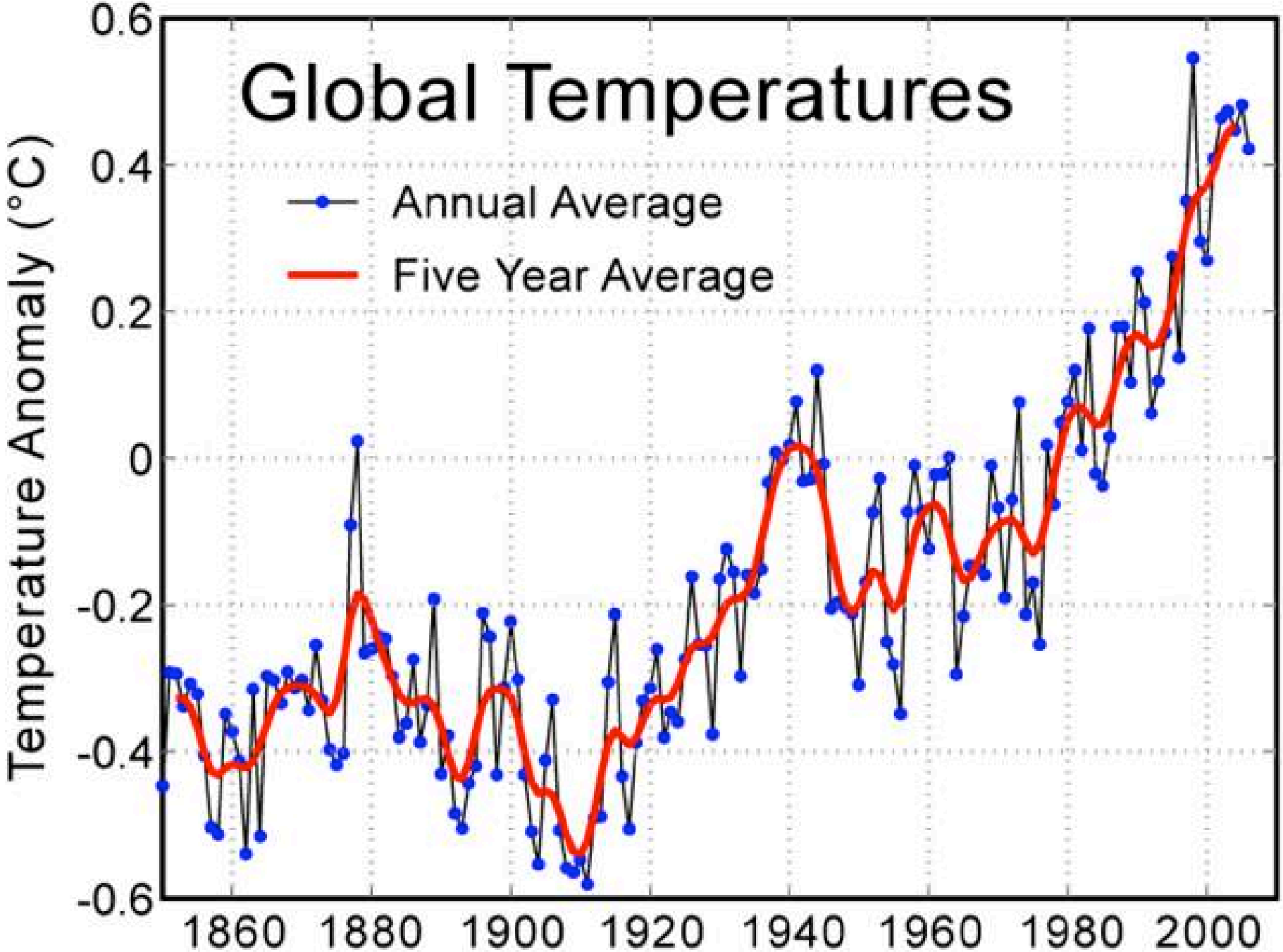
GROUPEMENT INTERNATIONAL D'ETUDES SUR LE CLIMAT

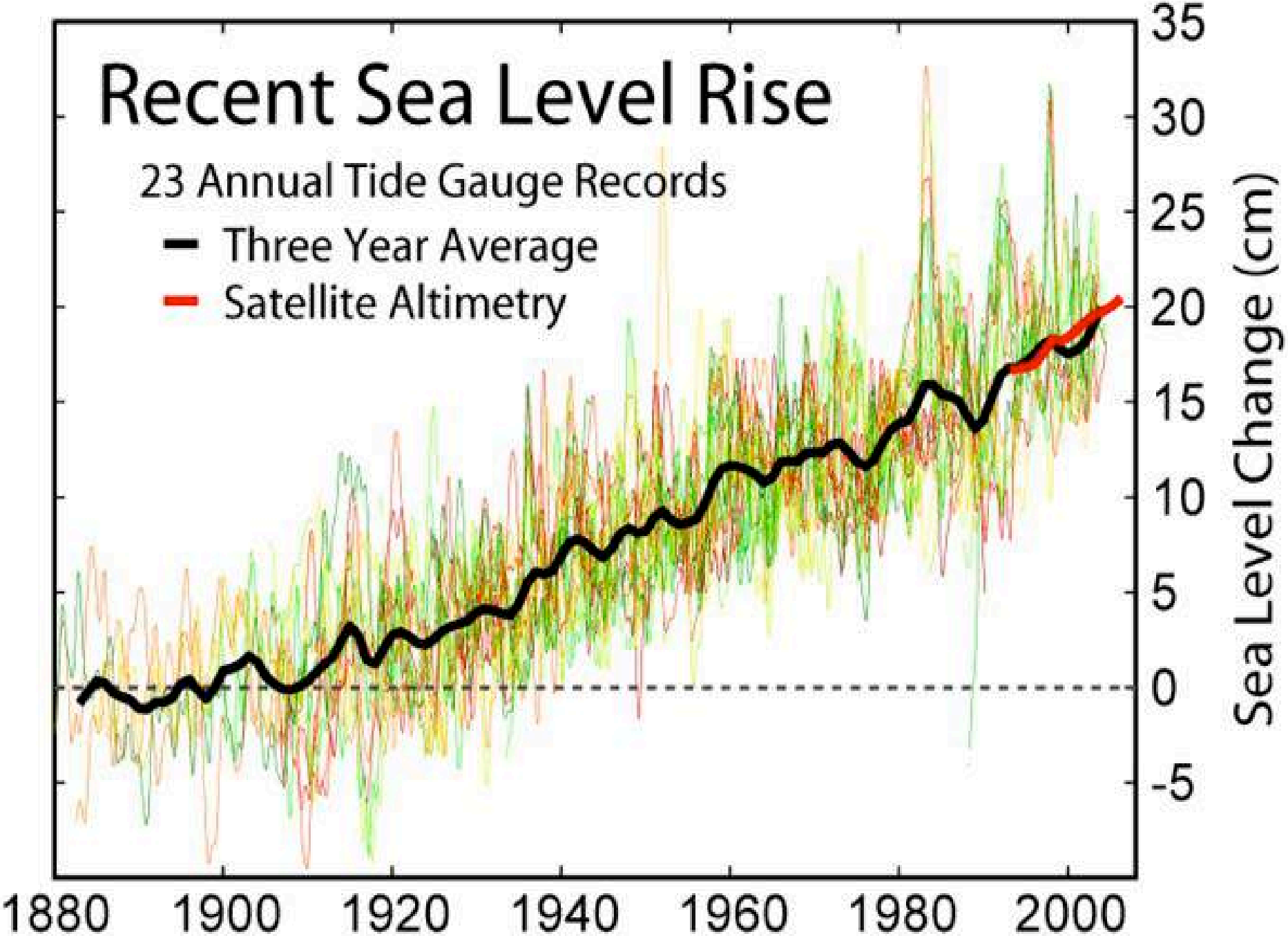
www.ipcc.ch

On a brûlé près de la moitié du pétrole



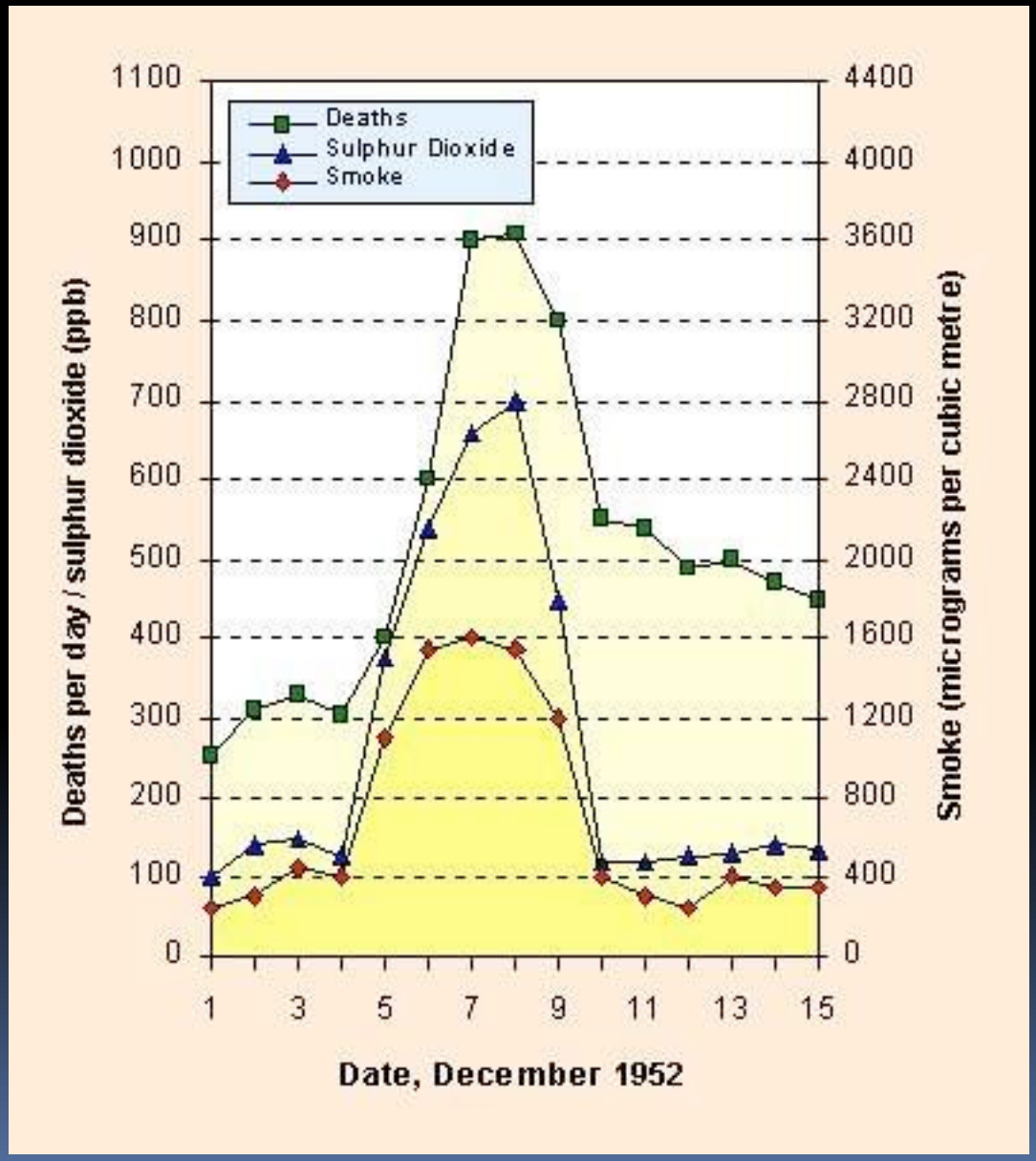
Concentration du gaz carbonique dans l'atmosphère depuis 1000 ans

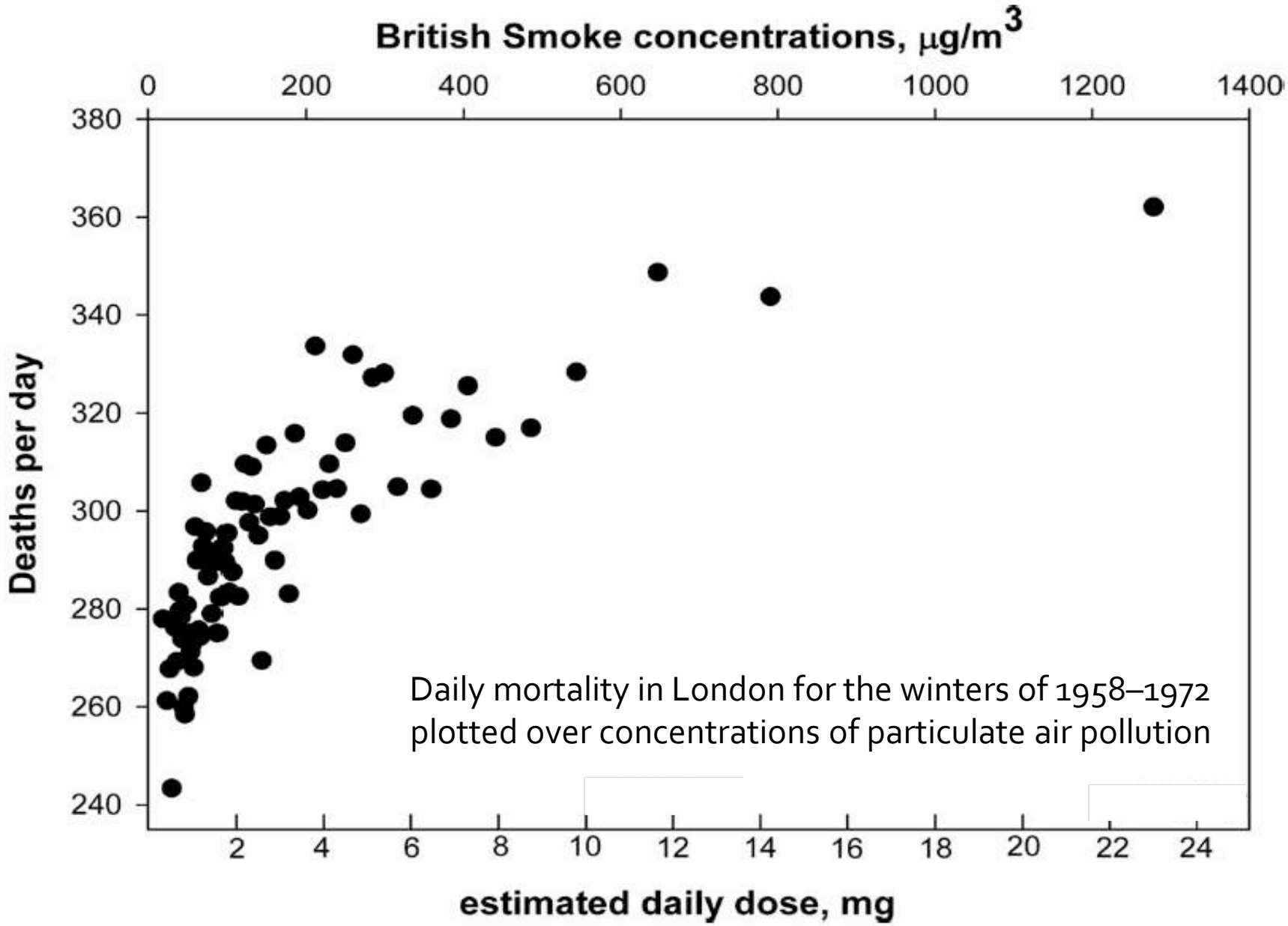

Global Temperatures
Annual Average
Five Year Average
Temperature Anomaly (°C)
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1860
1880
1900
1920
1940
1960
1980
2000


Recent Sea Level Rise
23 Annual Tide Gauge Records
Three Year Average
Satellite Altimetry
35
30
25
20
15
10
5
0
-5
Sea Level Change (cm)
1880
1900
1920
1940
1960
1980
2000

Great London Smog, décembre 1952

"Great London Smog » : 12 000 décès excédentaires





Daily mortality in London for the winters of 1958–1972 plotted over concentrations of particulate air pollution

Circulation September 15, 2009

The New England
Journal of Medicine

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Volume 329 DECEMBER 9, 1993 Number 24

AN ASSOCIATION BETWEEN AIR POLLUTION AND MORTALITY IN SIX U.S. CITIES

DOUGLAS W. DOCKERY, SC.D., C. ARDEN POPE III, PH.D., XIPING XU, M.D., PH.D., JOHN D. SPENGLER, PH.D., JAMES H. WARE, PH.D., MARTHA E. FAY, M.P.H., BENJAMIN G. FERRIS, JR., M.D., AND FRANK E. SPEIZER, M.D.

Abstract *Background.* Recent studies have reported associations between particulate air pollution and daily mortality rates. Population-based, cross-sectional studies of metropolitan areas in the United States have also found associations between particulate air pollution and annual mortality rates, but these studies have been criticized, in part because they did not directly control for cigarette smoking and other health risks.

Methods. In this prospective cohort study, we estimated the effects of air pollution on mortality, while controlling for individual risk factors. Survival analysis, including Cox proportional-hazards regression modeling, was conducted with data from a 14-to-16-year mortality follow-up of 8111 adults in six U.S. cities.

Results. Mortality rates were most strongly associated with cigarette smoking. After adjusting for smoking and other risk factors, we observed statistically significant and robust associations between air pollution and mortality. The adjusted mortality-rate ratio for the most polluted of the cities as compared with the least polluted was 1.26 (95 percent confidence interval, 1.08 to 1.47). Air pollution was positively associated with death from lung cancer and cardiopulmonary disease but not with death from other causes considered together. Mortality was most strongly associated with air pollution with fine particulates, including sulfates.

Conclusions. Although the effects of other, unmeasured risk factors cannot be excluded with certainty, these results suggest that fine-particulate air pollution, or a more complex pollution mixture associated with fine particulate matter, contributes to excess mortality in certain U.S. cities. (N Engl J Med 1993;329:1753-9.)

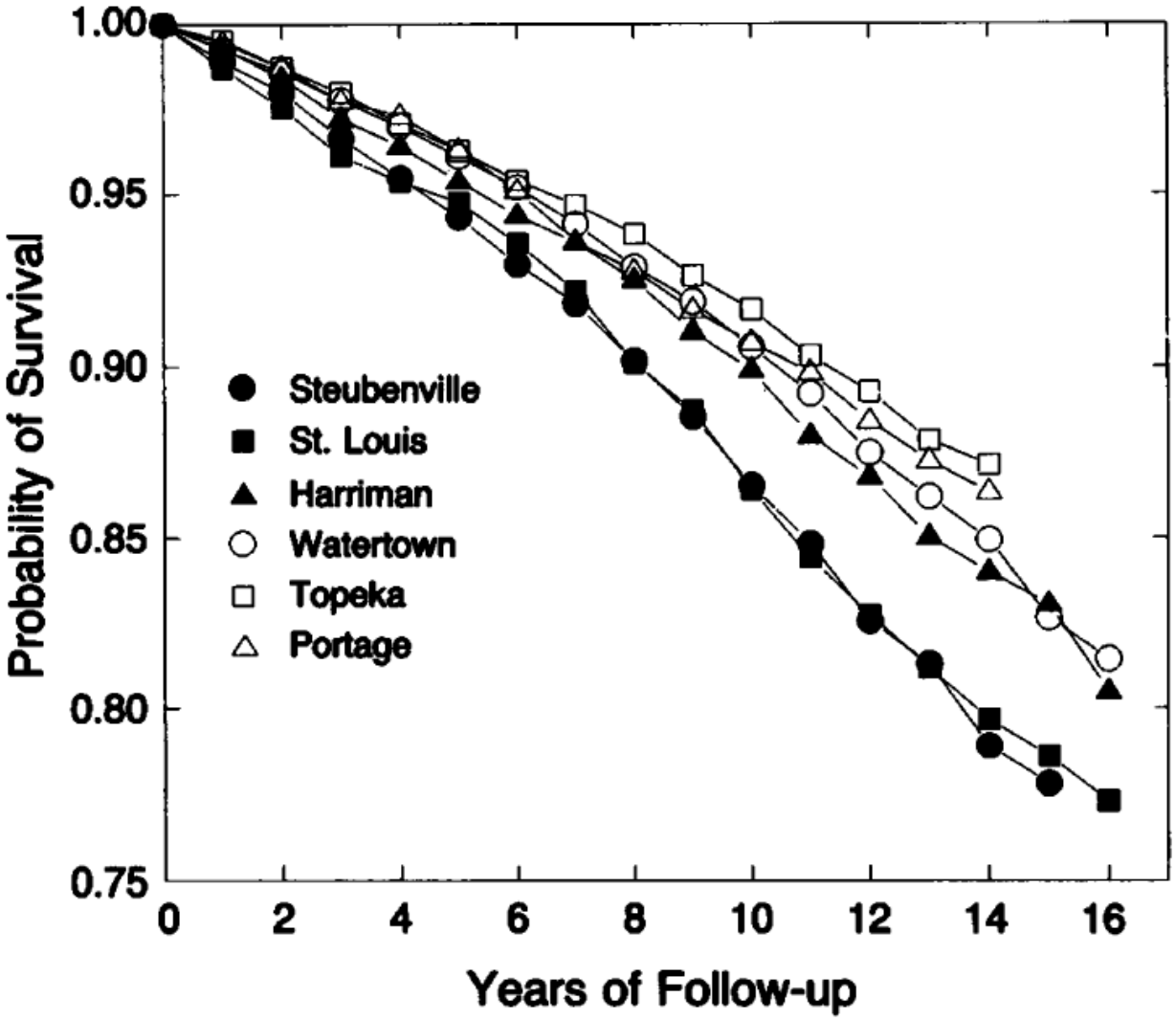
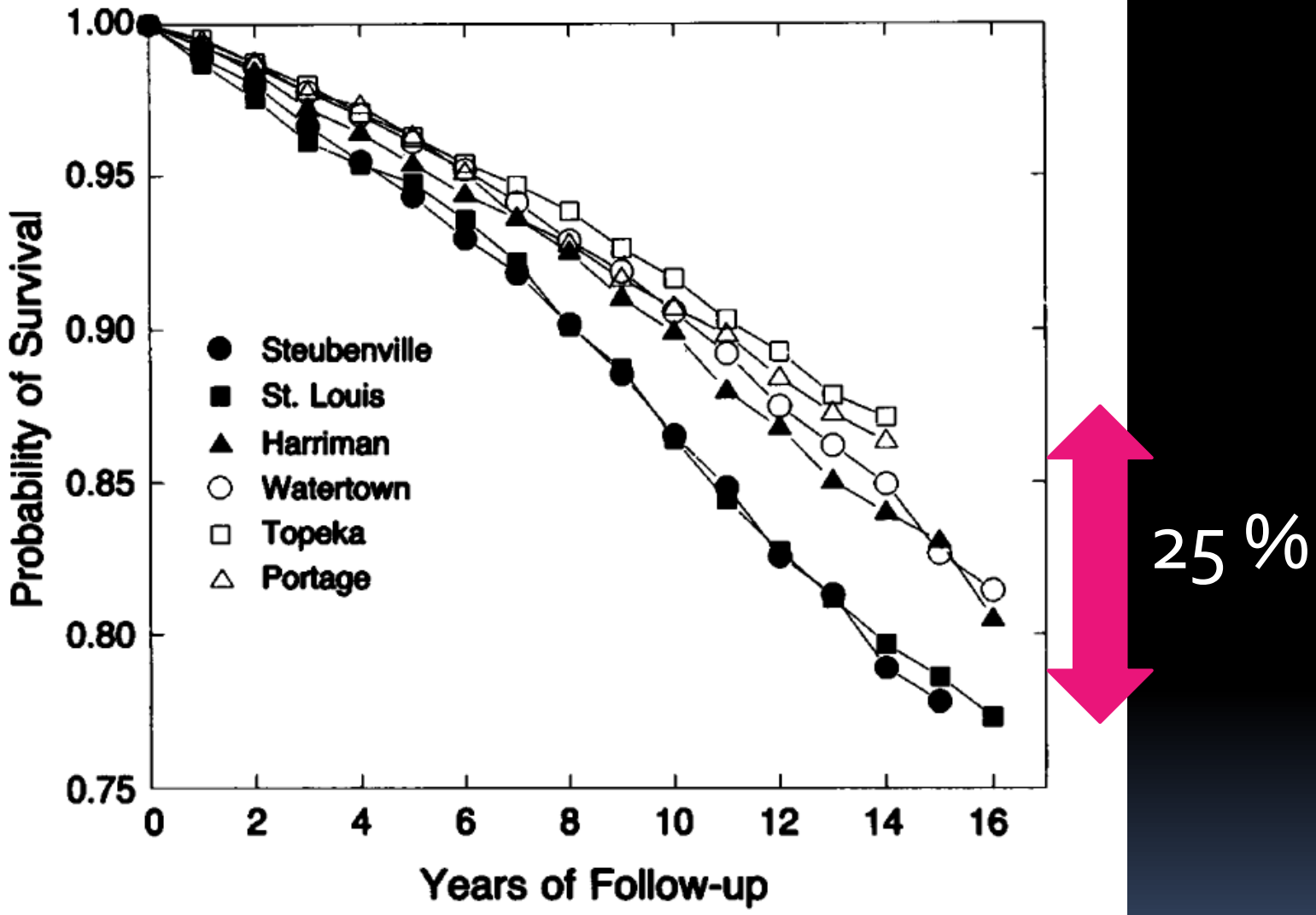


Figure 2. Crude Probability of Survival in the Six Cities, According to Years of Follow-up.



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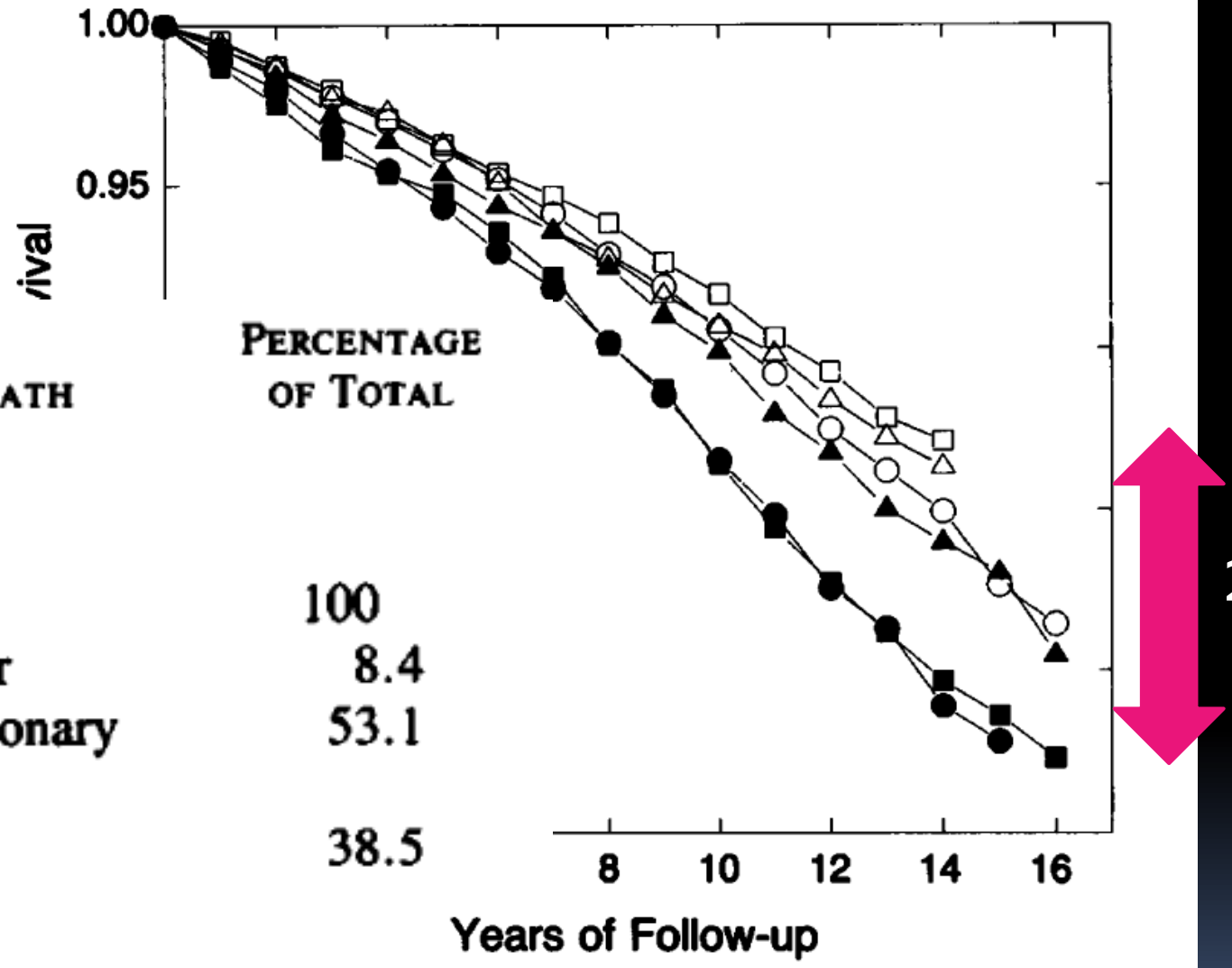


Cause of Death	Percentage of Total
All	100
Lung cancer	8.4
Cardiopulmonary disease	53.1
All others	38.5

Figure 2. Crude Probability of Survival in the Six Cities, According to Years of Follow-up.

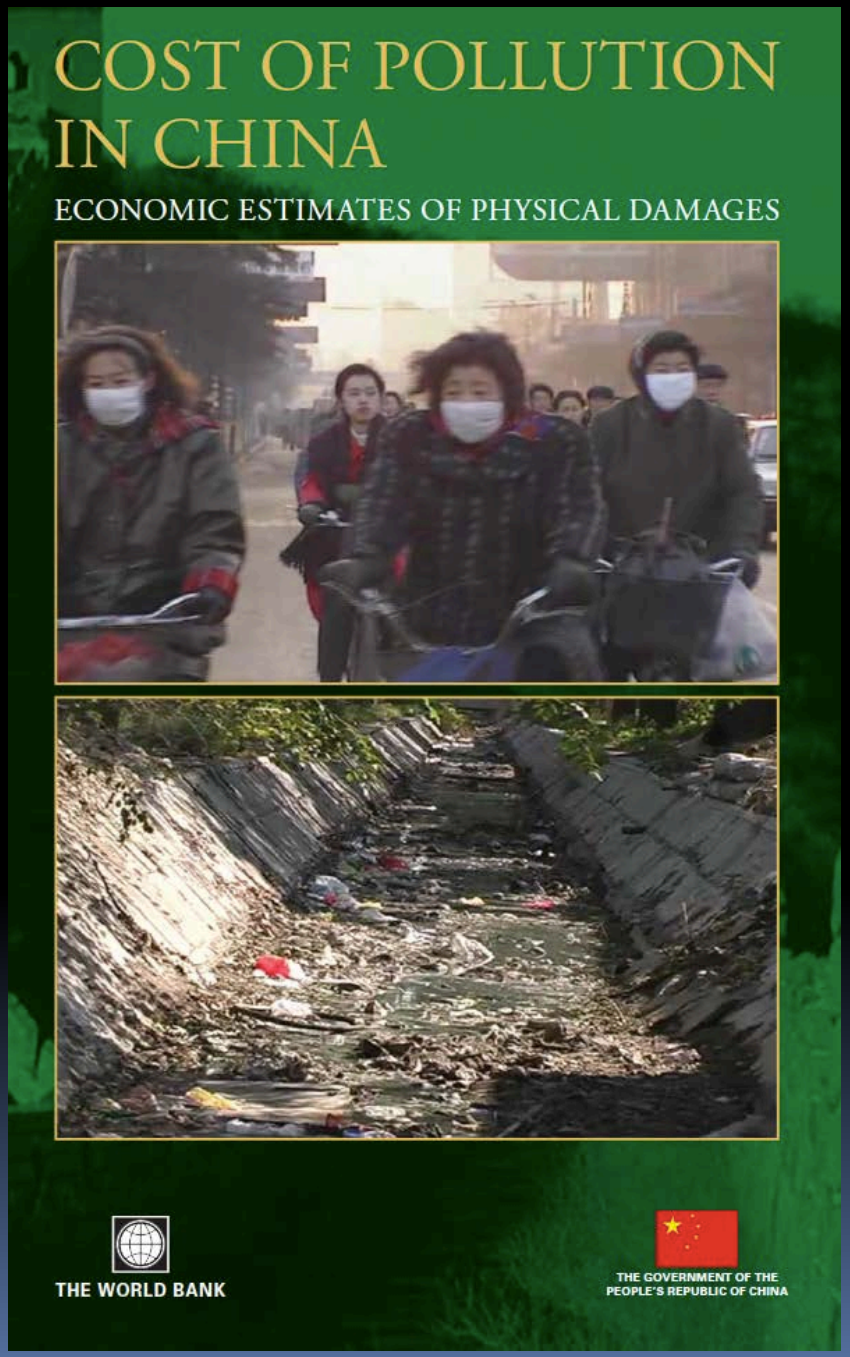
Beijing, sans et avec smog

Cardiovascular Disease and Olympic Games in China

John D. Cantwell, MD[a,b,*]

American Journal of Cardiology, 2008

- *In China*
  - *heart disease, stroke and cancer now account for 66% of deaths in aged >40*
  - *compared with 16 % a half century ago.*



L'air tue 2 millions de personnes par année

Mise à jour le lundi 26 septembre 2011 à 14 h 40 HAE

Commenter 10 | 3 | +1 1 | Recommander 64 | Partager | T+

(archives)

Les maladies causées par la pollution de l'air tuent chaque année au moins deux millions de personnes dans le monde, montre un rapport de l'Organisation mondiale de la santé (OMS).

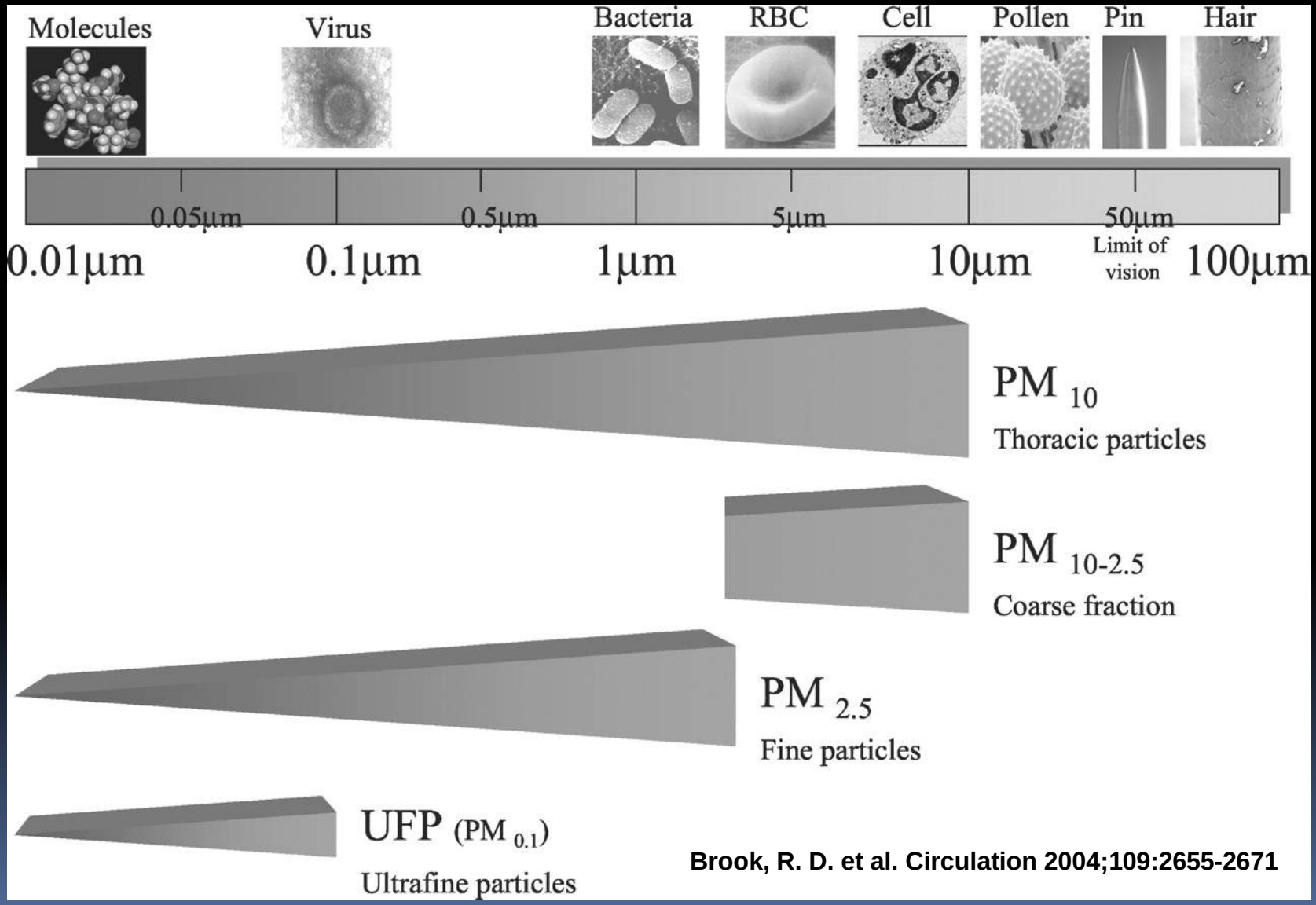
OCDE 2010-2050

Air : Impact santé

(cardiovasculaire et pulmonaire)

- 1ère cause de ✝ prématurés
- Particules fines
  - Hausse de 1 M à 3,6 M ✝
- Ozone au sol :
  - Hausse de 380 000 à 800 000 ✝

Particules fines des combustibles fossiles



Brook, R. D. et al. Circulation 2004;109:2655-2671

Circulation 2009;120:924-927

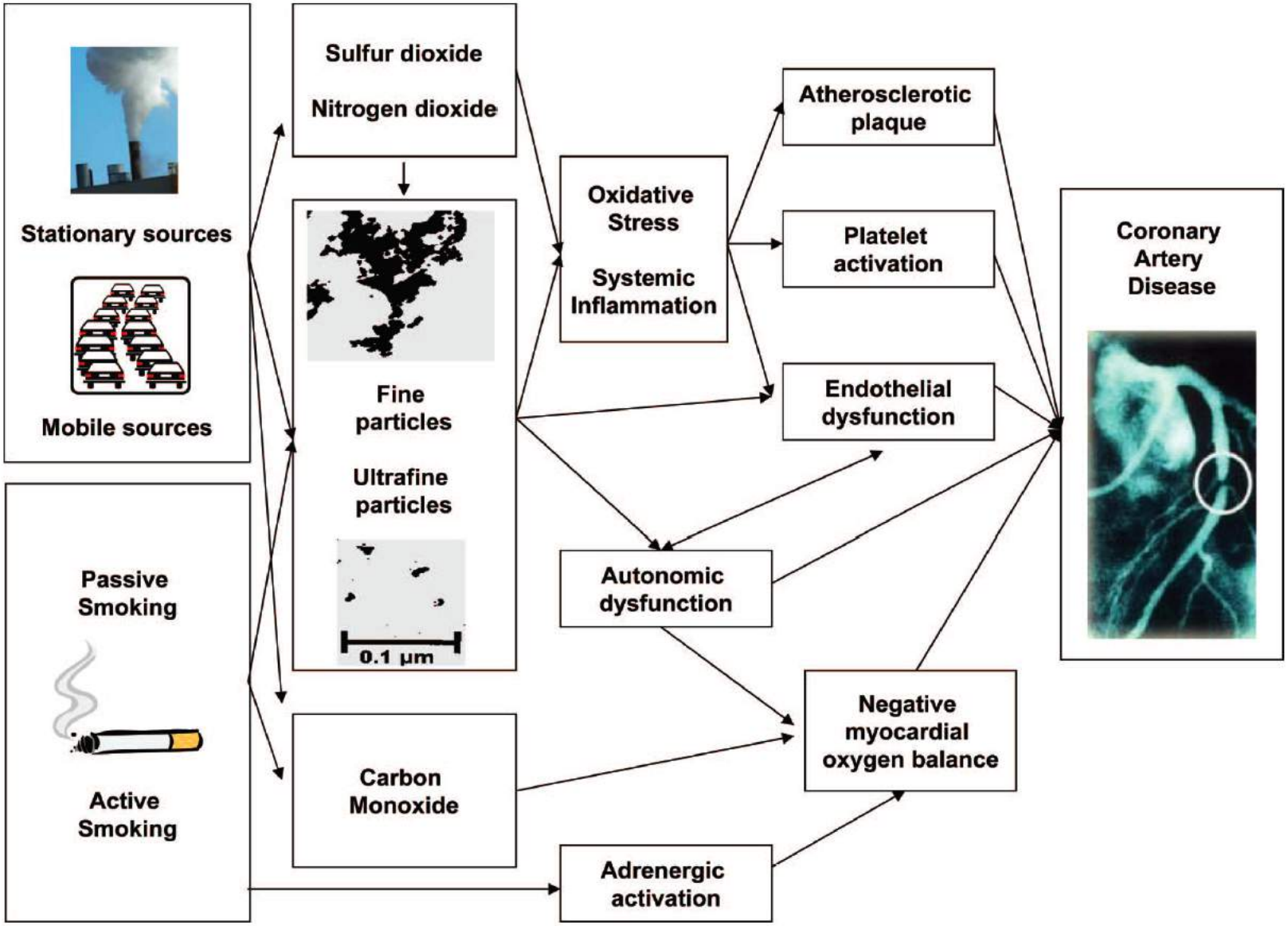
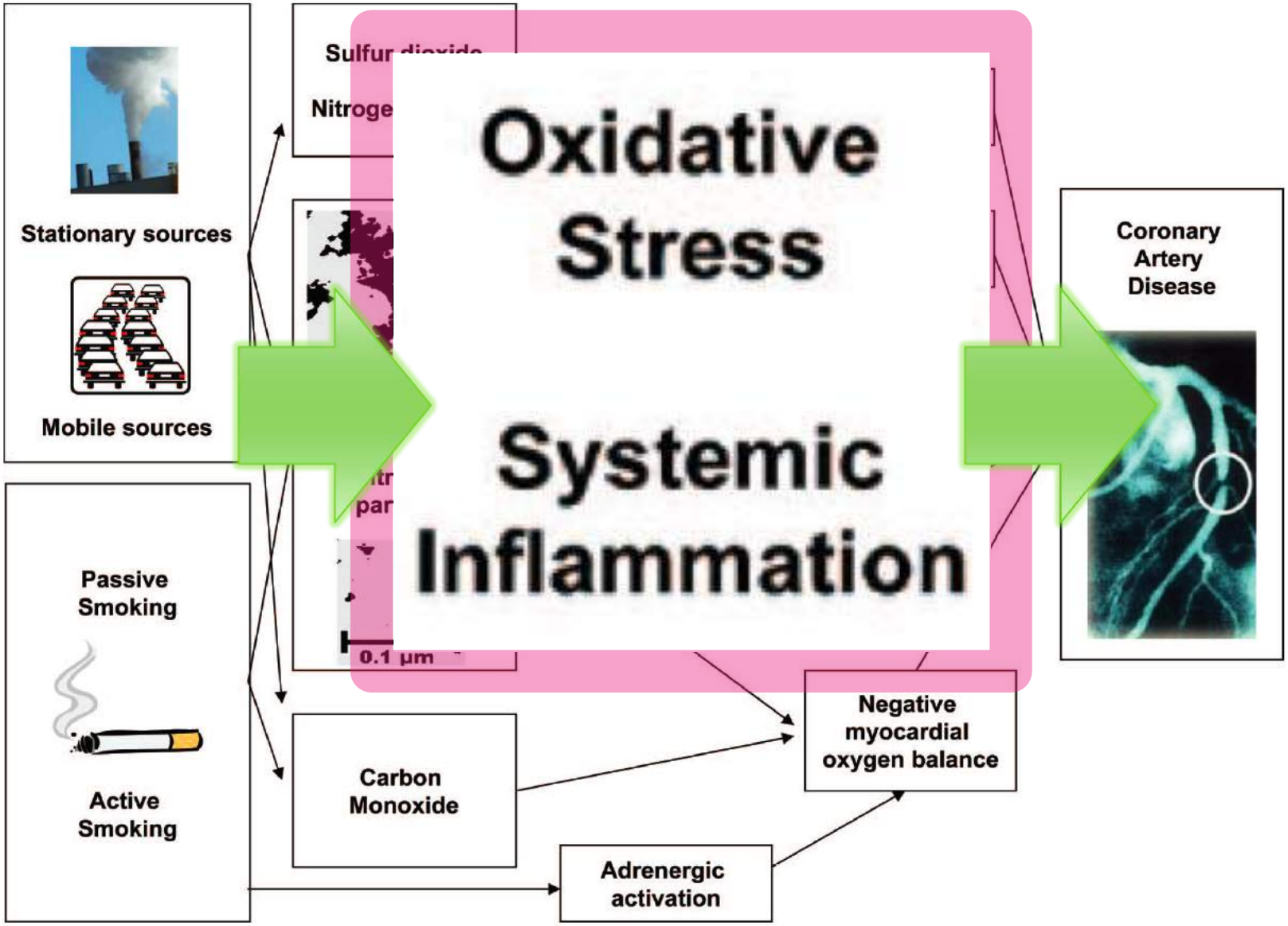


Figure. Overview on pathomechanism linking ambient air pollution,[4] secondhand smoke,[7] and active smoking to acute coronary syndromes.

Circulation 2009;120:924-927



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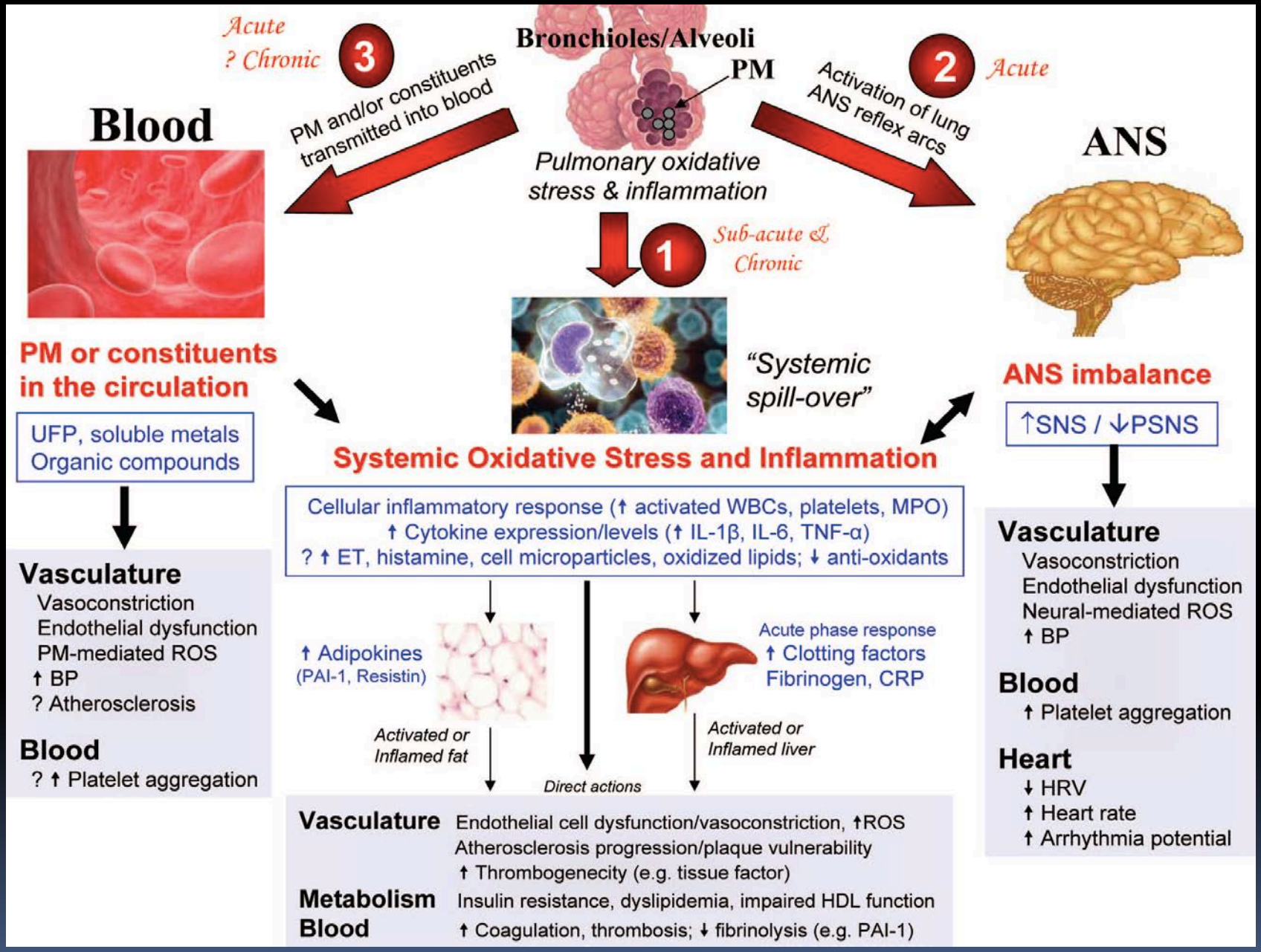


Brook et al; Particulate Matter Air Pollution and CVD. Circulation 2010. 121; 2331-2378

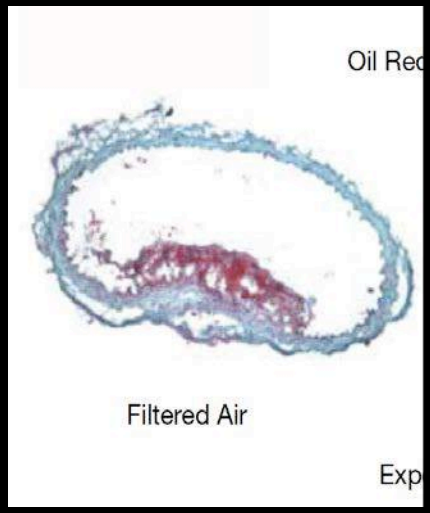
Le rat des villes et le rat des champs

Jean de la Fontaine

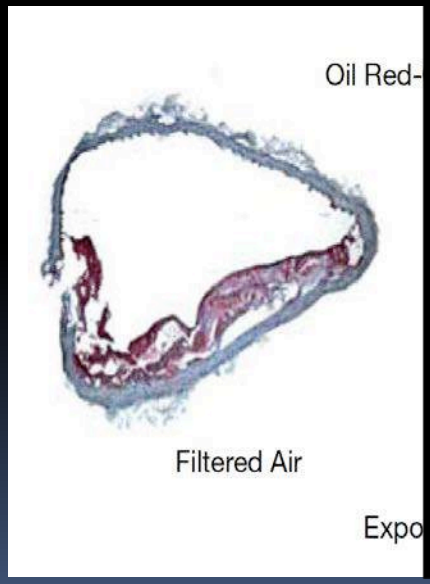
revu par Valentin Fuster, MD, PhD, FACC

Air filtré

Diète normale



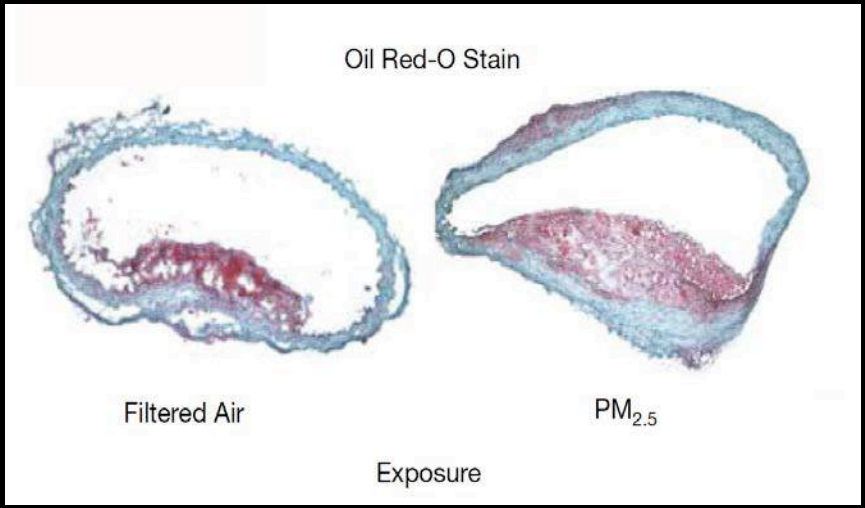
Diète grasse



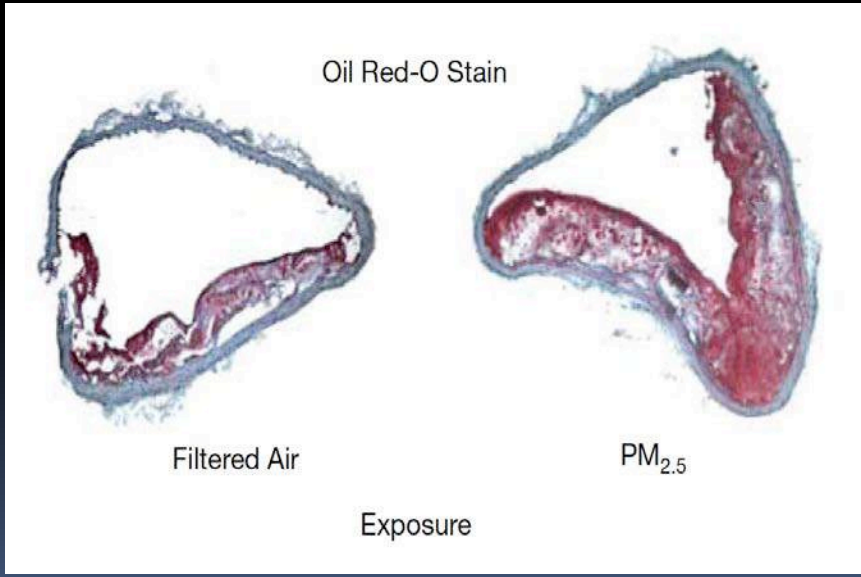
Long-term Air Pollution Exposure and Acceleration of Atherosclerosis and Vascular Inflammation in an Animal Model. JAMA 2005. 294: 3003-3010

Air filtré Air pollué

Diète normale



Diète grasse



Long-term Air Pollution Exposure and Acceleration of Atherosclerosis and Vascular Inflammation in an Animal Model. JAMA 2005. 294: 3003-3010

Plus de 500 publications scientifiques nous apprennent que

- Plus le taux de polluants monte, plus monte le taux de
  - Calcifications artérielles
  - Thrombophlébites
  - Arythmies malignes et mort subites
  - Infarctus aigus
  - AVC
  - Hausse de complications diabétiques

Pollution et maladie cardiaque

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

Residential Exposure to Traffic Is Associated With Coronary Atherosclerosis

B. Hoffmann, S. Moebus, S. Möhlenkamp, A. Stang, N. Lehmann, N. Dragano, A. Schmermund, M. Memmesheimer, K. Mann, R. Erbel, K.-H. Jöckel and for the Heinz Nixdorf Recall Study Investigative Group

Circulation 2007;116;489-496; originally published online Jul 16, 2007;
DOI: 10.1161/CIRCULATIONAHA.107.693622
Circulation is published by the American Heart Association. 7272 Greenville Avenue, Dallas, TX 72514
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- Allemagne (Rhur) 00-03 4494 personnes
  - Plus on vit près d'une voie polluée, plus on augmente le dépôt de calcium dans les artères
  - Hausse de 63 % de calcifications à moins de 50 m

Pollution et maladie cardiaque

THE LANCET
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ARTICLES

Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study

Gerard Hoek, Bert Brunekreef, Sandra Goldbohm, Paul Fischer, Piet A van den Brandt

- Hollande 86-94 4492 personnes
  - Plus on vit près d'une voie routière polluée, plus on augmente la mortalité CV
  - Hausse de 95 % à moins de 50 m

Pollution et maladie cardiaque

Increased Particulate Air Pollution and the Triggering of Myocardial Infarction
Annette Peters, Douglas W. Dockery, James E. Muller and Murray A. Mittleman
Circulation 2001;103;2810-2815
Circulation is published by the American Heart Association. 7272 Greenville Avenue, Dallas, TX 72514
Copyright © 2001 American Heart Association. All rights reserved. Print ISSN: 0009-7322. Online ISSN: 1524-4539

- Boston 95-96 772 infarctus
  - Pic de pollution: déclencheur d'infarctus
  - Hausse de 48 % dans l'heure
  - Hausse de 69% dans les 24 heures

Pollution et maladie cardiaque

The NEW ENGLAND JOURNAL of MEDICINE

Exposure to Traffic and the Onset of Myocardial Infarction

Annette Peters, Ph.D., Stephanie von Klot, M.P.H., Margit Heier, M.D.,
Ines Trentinaglia, B.S., Allmut Hörmann, M.S., H. Erich Wichmann, M.D., Ph.D., and Hannelore Löwel, M.D.,
for the Cooperative Health Research in the Region of Augsburg Study Group

- Augsburg 99-01 700 infarctus
  - Exposition au trafic urbain lourd augmente le risque d'infarctus
  - Hausse de 292 % dans l'heure de l'exposition

Pollution et maladie cardiaque

HEART

Effects of air pollution on the incidence of myocardial infarction

K Bhaskaran, S Hajat, A Haines, et al.

Heart 2009 95: 1746-1759 originally published online July 26, 2009
doi: 10.1136/hrt.2009.175018

- 26 articles liant polluants et infarctus aigus
  - 19 en aigu
  - 7 en chronique
- Hausse de 10 µg/m3 PM2,5 entraîne une hausse de 5-17 % d'infarctus

Pollution/Hospitalisation MCAS

Long-Term Exposure to Traffic-Related Air Pollution and the Risk of Coronary Heart Disease Hospitalization and Mortality

Wen Qi Gan, Mieke Koehoorn, Hugh W. Davies, Paul A. Demers, Lillian Tamburic, and Michael Brauer

- Vancouver
  - 450 000 sujets 1994-2002
  - Hausse de 0,75 µg/m3 PM :
    - Hausse de 3% hospitalisation MCAS
    - Hausse de 6 % de mortalité CV

Pollution et arythmies malignes

ehp ENVIRONMENTAL HEALTH PERSPECTIVES
ehponline.org

Association of Air Pollution with Increased Incidence of Ventricular Tachyarrhythmias Recorded by Implanted Cardioverter Defibrillators

Douglas W. Dockery,[1,2] Heike Luttmann-Gibson,[1] David Q. Rich,[1] Mark S. Link,[3] Murray A. Mittleman,[4,5] Diane R. Gold,[1,2] Petros Koutrakis,[1] Joel D. Schwartz,[1,2] and Richard L. Verrier[1,5]

[1]Department of Environmental Health, Harvard School of Public Health, Boston, Massachusetts, USA; [2]Channing Laboratory, Brigham and Women's Hospital and Harvard Medical School, Boston, Massachusetts, USA; [3]New England Medical Center, Tufts University, Boston, Massachusetts, USA; [4]Department of Epidemiology, Harvard School of Public Health, Boston, Massachusetts, USA; [5]Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA

- Boston 1995-2002 203 pts/défibrillateur
  - Hausse de 60% de tachycardie ventriculaire dans les 3 jours suivant un pic de pollution

Pollution et arythmies malignes

JACC
JOURNAL of the AMERICAN COLLEGE of CARDIOLOGY

Driving and Implantable Cardioverter-Defibrillator Shocks for Ventricular Arrhythmias

Results From the TOVA Study

- Étude TOVA 1,188 pts/défib 31 villes
  - Dans l'heure suivant une sortie en automobile: deux fois plus de décharges de défibrillateurs pour arythmies malignes.

Pollution et AVC

Stroke
Journal of the American Heart Association

Associations of Fine and Ultrafine Particulate Air Pollution With Stroke Mortality in an Area of Low Air Pollution Levels

Jaana Kettunen, Timo Lanki, Pekka Tiittanen, Pasi P. Aalto, Tarja Koskentalo, Markku Kulmala, Veikko Salomaa and Juha Pekkanen

Stroke 2007;38;918-922; originally published online Feb 15, 2007;
DOI: 10.1161/01.STR.0000257999.49706.3b
Stroke is published by the American Heart Association. 7272 Greenville Avenue, Dallas, TX 72514
Copyright © 2007 American Heart Association. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

- Helsinki / 1 million d'habitants
- 1998 à 2004 / 3265 décès par AVC
- Une élévation d'un quartile de FP et de CO entraîne dans les 24 heures une hausse de 8.5 % d'AVC mortels

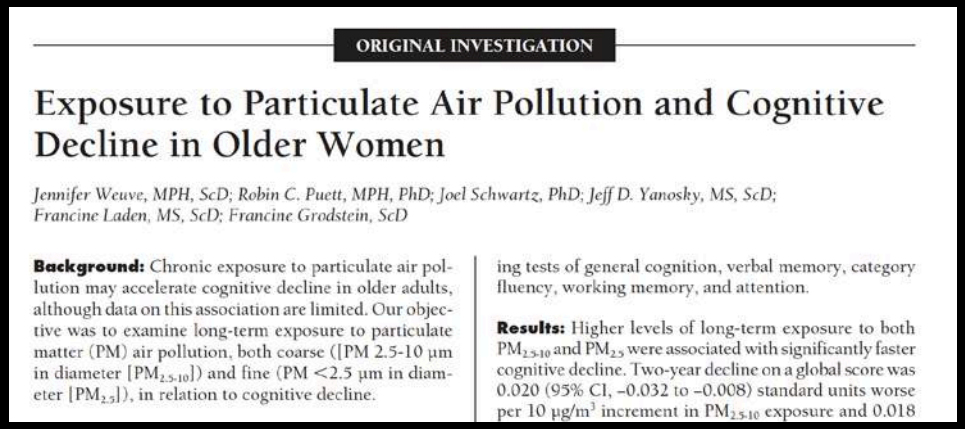
L'alzheimer

Pierre Foglia
La Presse

Je me souviens de ma première chronique sur la maladie d'Alzheimer - cela fait sûrement plus de 30 ans. C'était une dame pas encore légume, confuse mais charmante. C'était rue Bernard, dans un vieil appartement. Son mari était là, qui me tombait sur les nerfs, un vieux beau avec un petit foulard au cou noué sur le côté. Il m'avait ramené au journal dans une auto sport.

- Ça m'*énarve* quand je demande pourquoi tant d'Alzheimer et qu'on me fait une réponse arithmétique : parce qu'il y a de plus en plus de vieux.
- Je vous demande d'où ça vient, d'où ça sort, pourquoi cette «atrophie cérébrale diffuse».

Pollution et démence



ORIGINAL INVESTIGATION

Exposure to Particulate Air Pollution and Cognitive Decline in Older Women

Jennifer Weuve, MPH, ScD; Robin C. Puett, MPH, PhD; Joel Schwartz, PhD; Jeff D. Yanosky, MS, ScD; Francine Laden, MS, ScD; Francine Grodstein, ScD

Background: Chronic exposure to particulate air pollution may accelerate cognitive decline in older adults, although data on this association are limited. Our objective was to examine long-term exposure to particulate matter (PM) air pollution, both coarse ([PM 2.5-10 μm in diameter [$PM_{2.5-10}$]) and fine (PM <2.5 μm in diameter [$PM_{2.5}$]), in relation to cognitive decline.

ing tests of general cognition, verbal memory, category fluency, working memory, and attention.

Results: Higher levels of long-term exposure to both $PM_{2.5-10}$ and $PM_{2.5}$ were associated with significantly faster cognitive decline. Two-year decline on a global score was 0.020 (95% CI, −0.032 to −0.008) standard units worse per 10 μg/m^3 increment in $PM_{2.5-10}$ exposure and 0.018

- Chaque hausse de 10 μg/m^3 de particules fines:
  - Baisse de 2 % du score mental
  - Équivalent à un vieillissement cérébral de 2 ans

Pollution et hypertension

- B. Urch, J.R. Brook, D. Wasserstein et al. « Relative contributions of PM2.5 chemical constituents to acute arterial vasoconstriction in humans ». *Inhalation Toxicology* 2004 16 : 345–352.

- B. Urch, F. Silverman, O. Corey et al. « Acute blood pressure responses in healthy adults during controlled air pollution exposures ». *Environmental Health Perspectives* 2005 113 (8) : 1052–1055.

- C.R. Bartoli, G.A. Wellenius, E.A. Diaz et al. « Mechanisms of inhaled fine particulate-induced arterial blood pressure changes ». *Environmental Health Perspectives* 2009 117 : 361–366.

- Robert D. Brook. « You are what you breathe : evidence linking air pollution and blood pressure ». *Current Hypertension Reports* 2005 7 : 427-434.

Pollution et diabète

- Incidence plus élevé de diabète dans les milieux pollués
  - Alan H. Lockwood. « Diabetes and air pollution ». *Diabetes Care* 2002 25 : 1487-1488.
- Pic de pollution: les diabétiques subissent deux fois plus d'infarctus et de mortalité cardiovasculaire que les non-diabétiques
- Effet synergique pollution-diabète
  - T.F. Bateson et J. Schwartz. « Who is sensitive to the effects of particles on mortality ? A case-crossover analysis ». *Epidemiology* 2004 15 : 143– 149.
  - A. Zanobetti et Joel Schwartz. « Are diabetics more susceptible to the health effects of airborne particles ? ». *American Journal of Respiratory Critical Care Medicine* 2001 164 (5) : 831– 833.
  - A. Zanobetti et A. Schwartz. « Cardiovascular damage by airborne particles : are diabetics more susceptible ? ». *Journal of Epidemiology* 2002 13 : 588– 592.

Pollution et Obésité

American Journal of Epidemiology Advance Access published April 13, 2012

American Journal of Epidemiology
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DOI: 10.1093/aje/kwr455

Original Contribution

Association of Childhood Obesity With Maternal Exposure to Ambient Air Polycyclic Aromatic Hydrocarbons During Pregnancy

Andrew Rundle*, Lori Hoepner, Abeer Hassoun, Sharon Oberfield, Greg Freyer, Darrell Holmes, Marilyn Reyes, James Quinn, David Camann, Frederica Perera, and Robin Whyatt

* Correspondence to Dr. Andrew Rundle, Department of Epidemiology, Mailman School of Public Health, Columbia University, 722 West 168th Street, Room 730, New York, NY 10032 (e-mail: agr3@columbia.edu).

Initially submitted August 1, 2011; accepted for publication November 9, 2011.

Modèle cardio-environnemental

Modèle cardio-environnemental

Taux de pollution d’un milieu

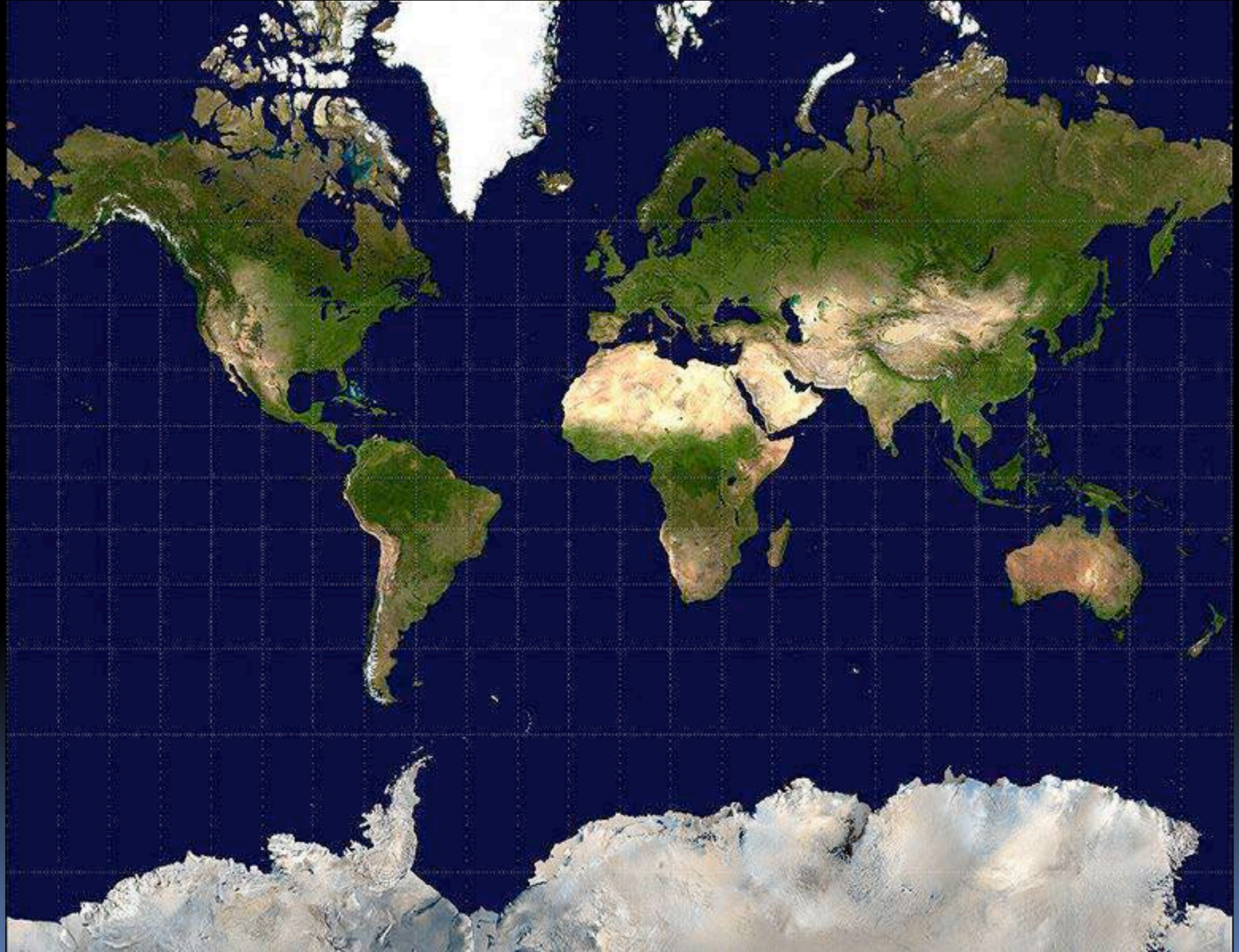
=

Taux de mortalité cardiovasculaire

Alfred Lothar Wegener

1880-1930

Théorie de la dérive des continents



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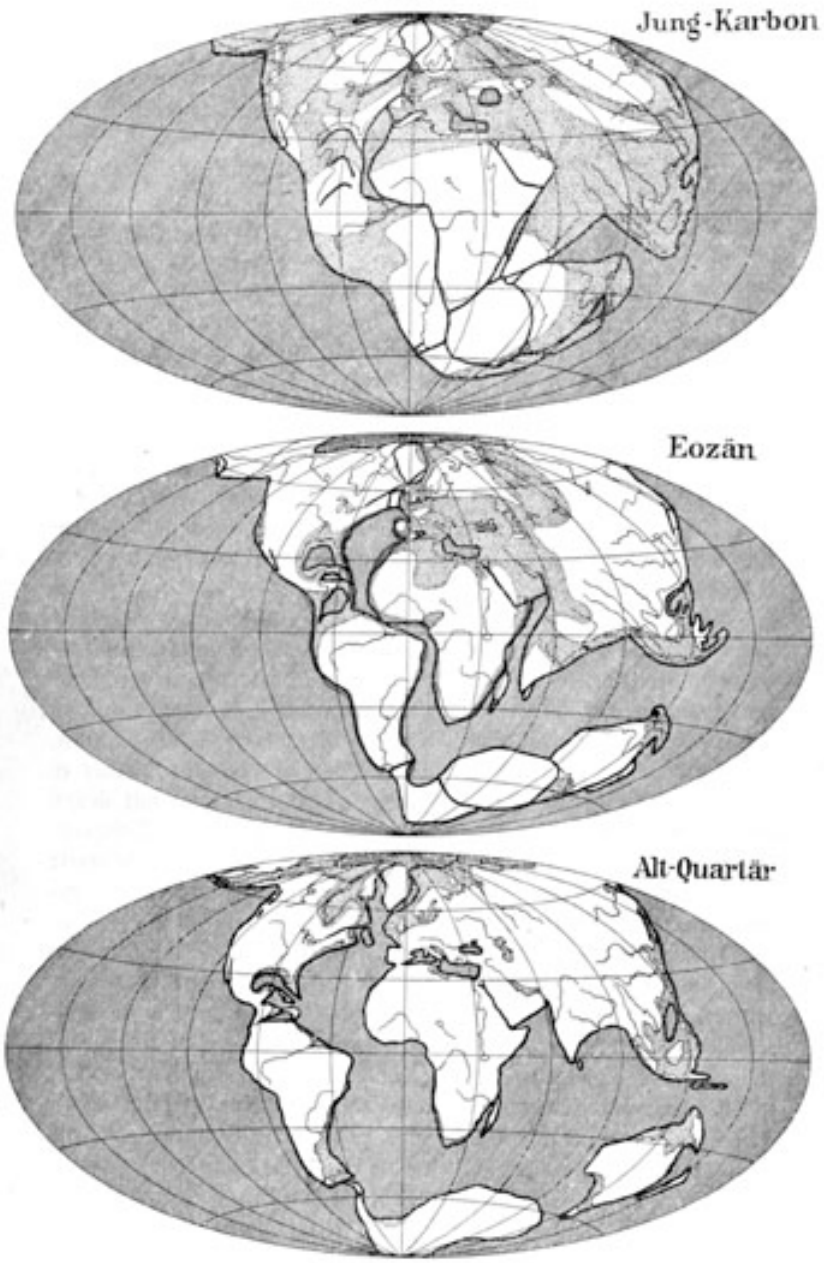
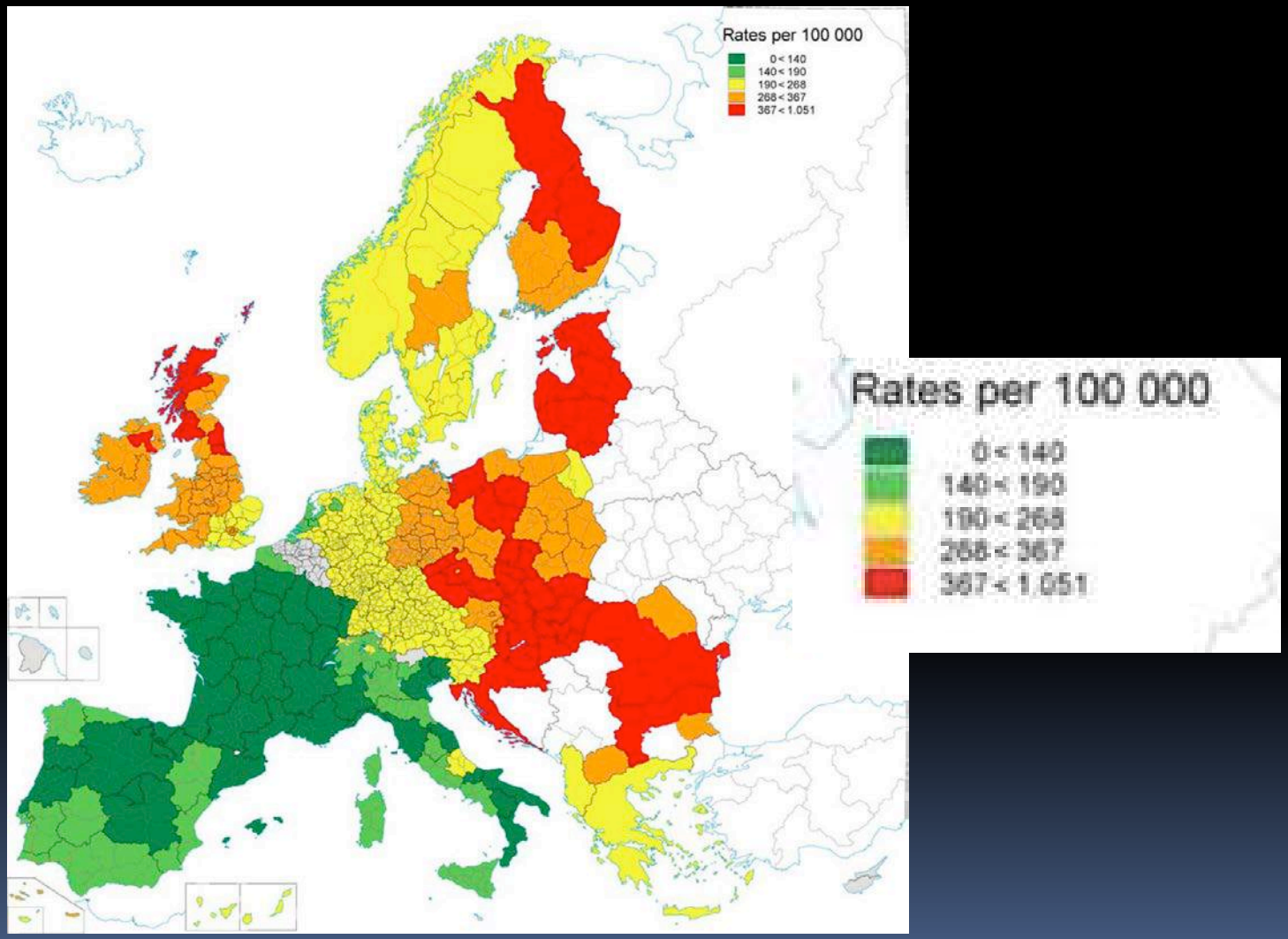


Rekonstruktionen der Erdkarte nach der Verschiebungstheorie für drei Zeiten.

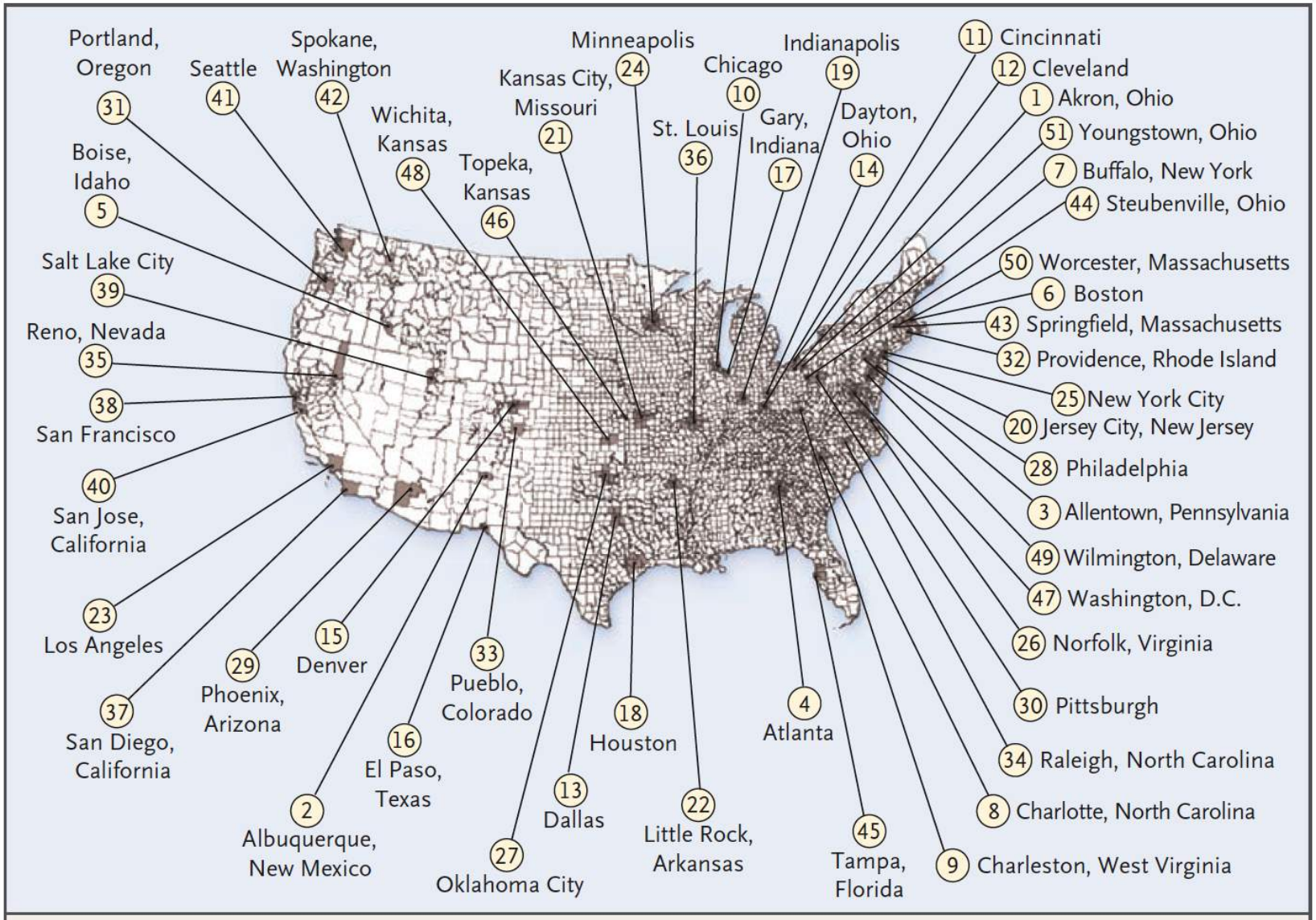
Schraffiert: Tiefsee; punktiert: Flachsee; heutige Konturen und Flüsse nur zum Erkennen. Gradnetz willkürlich (das heutige von Afrika).

Un modèle cardio-environnemental

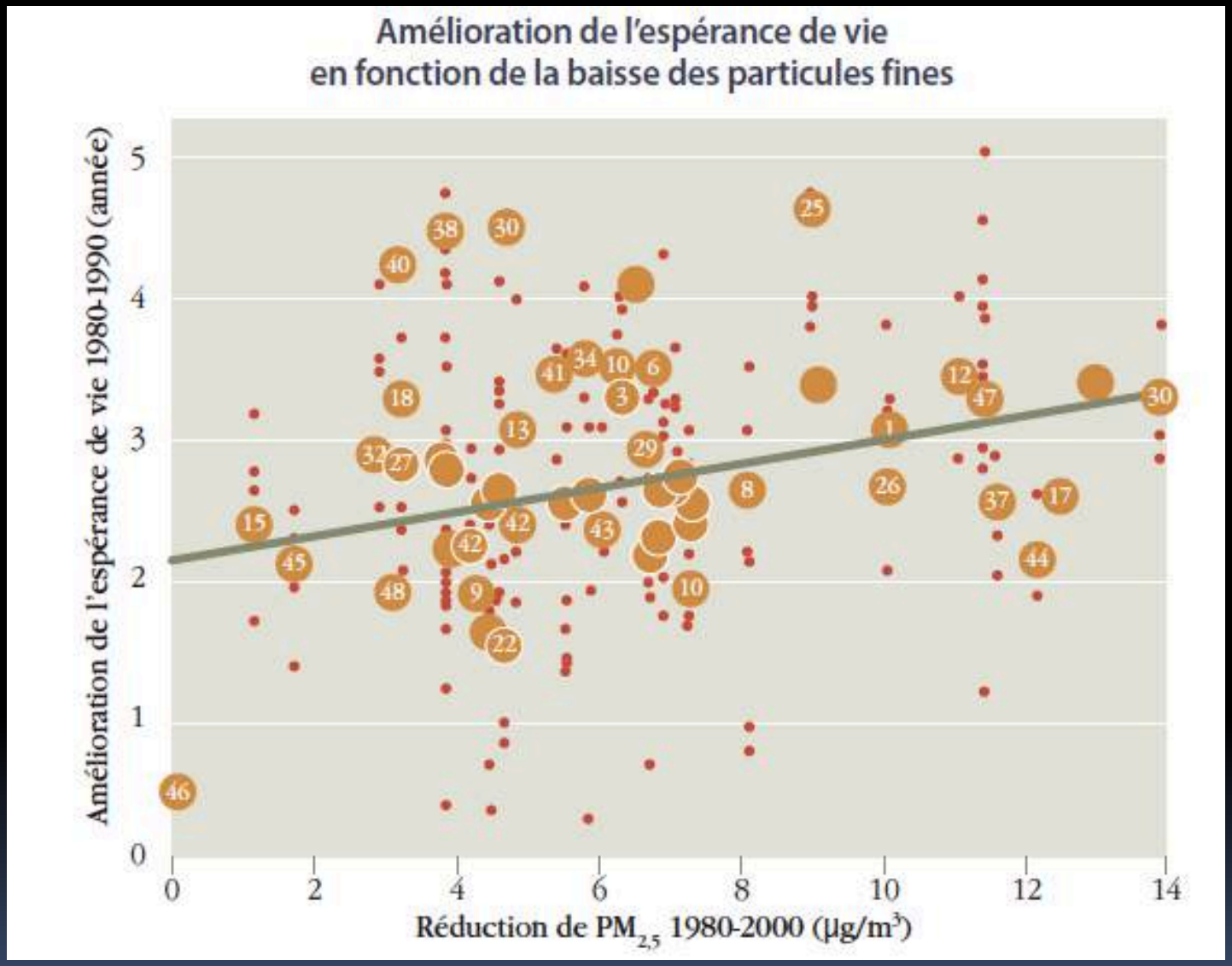
Mortalité cardiovasculaire - hommes de 45-74 ans. Europe 2000



« An update on regional variation in cardiovascular mortality within Europe ».
European Heart Journal 2008 doi : 10.1093/eurheartj/ehm604.



Fine-particulate air pollution and life expectancy in the United States .
C. Arden Pope III, Majid Ezzati et Douglas W. Dockery.
New England Journal of Medicine 2009 360 : 376-86.



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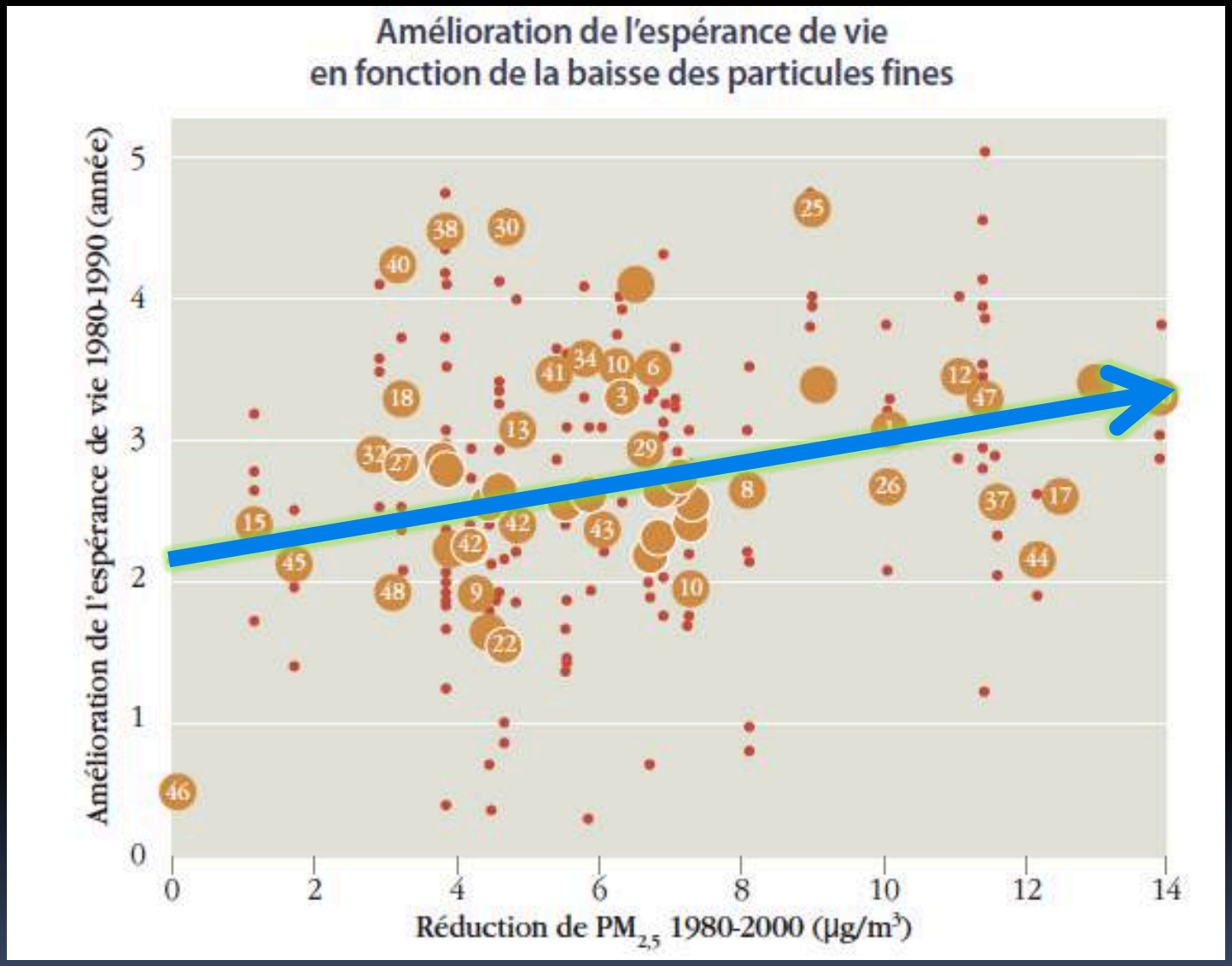
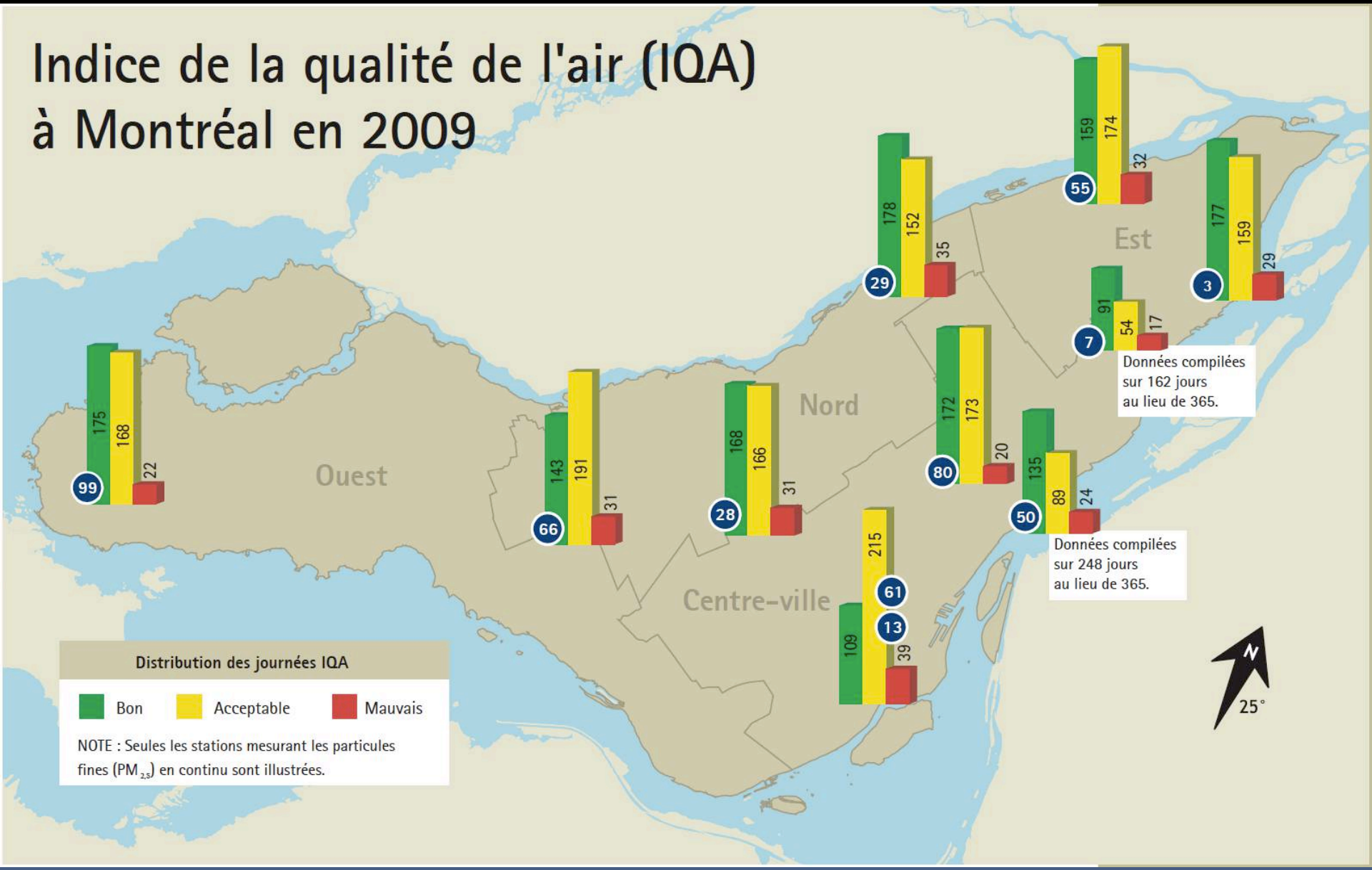
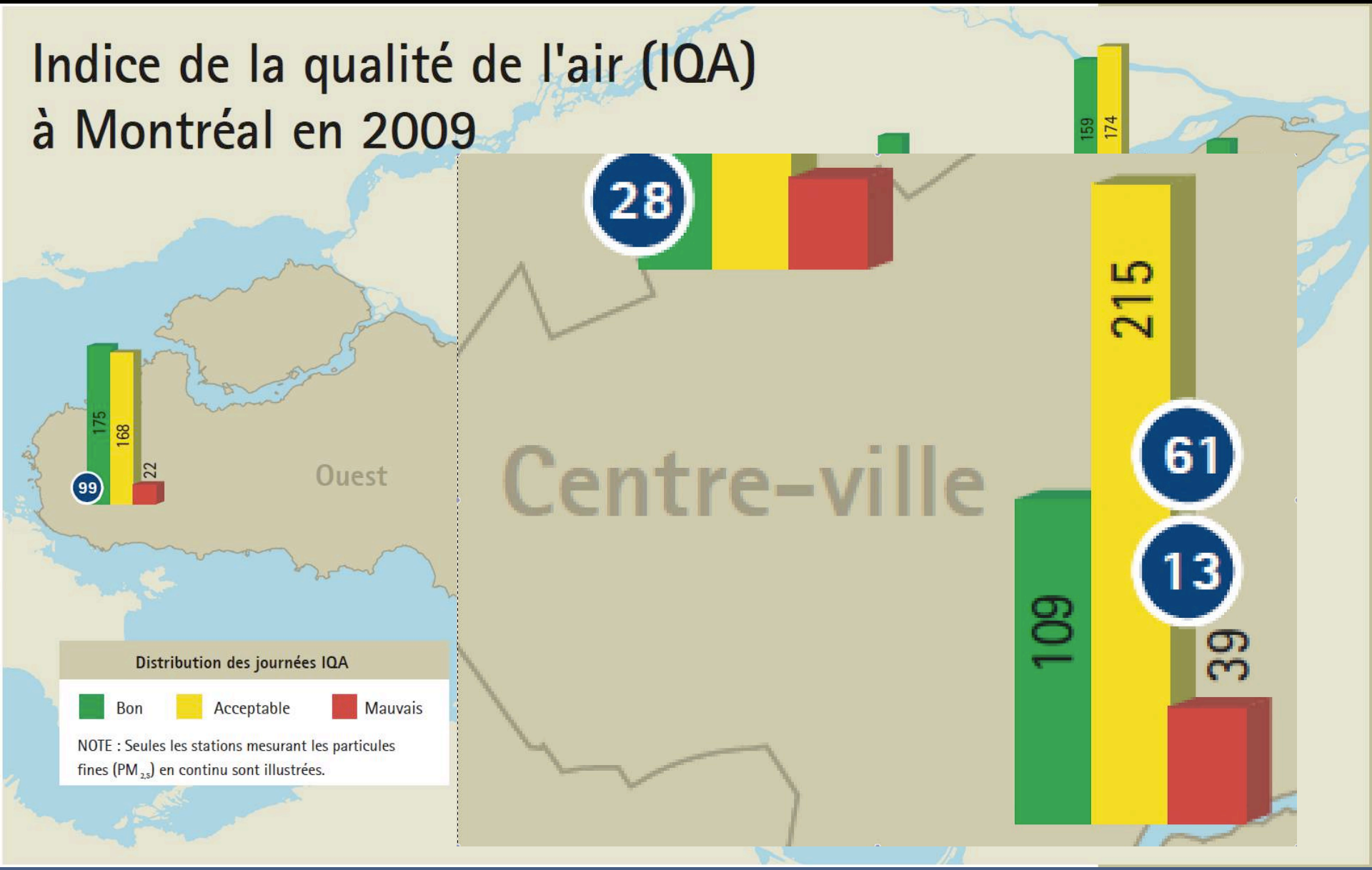


Fine-particulate air pollution and life expectancy in the United States .
C. Arden Pope III, Majid Ezzati et Douglas W. Dockery.
New England Journal of Medicine 2009 360 : 376-86.

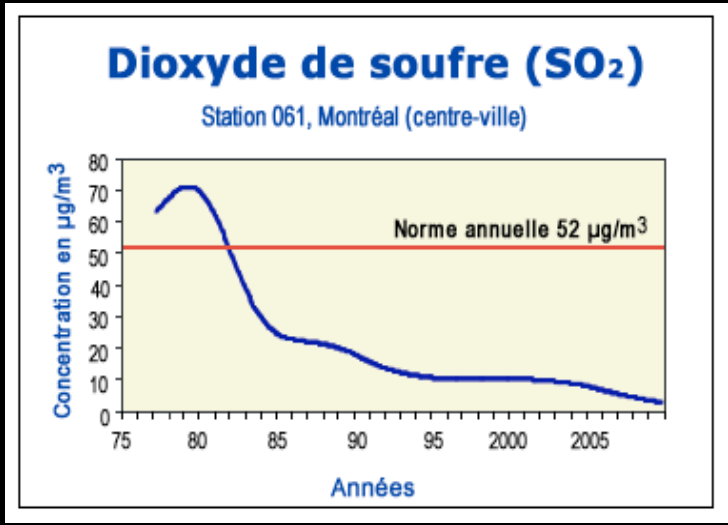
Indice de la qualité de l'air (IQA) à Montréal en 2009

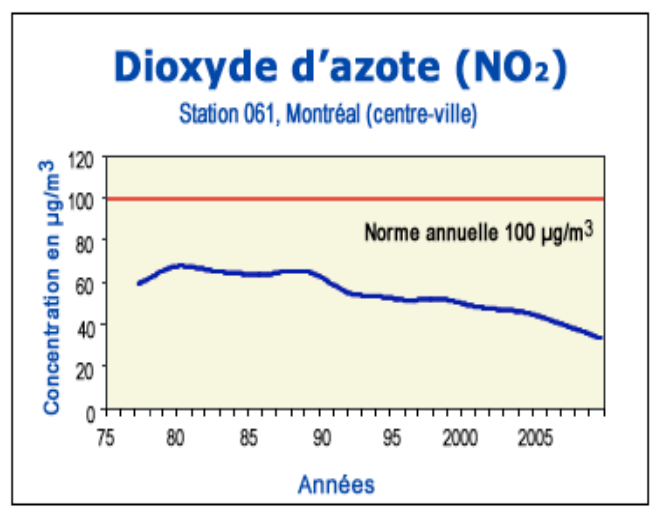


Indice de la qualité de l'air (IQA) à Montréal en 2009

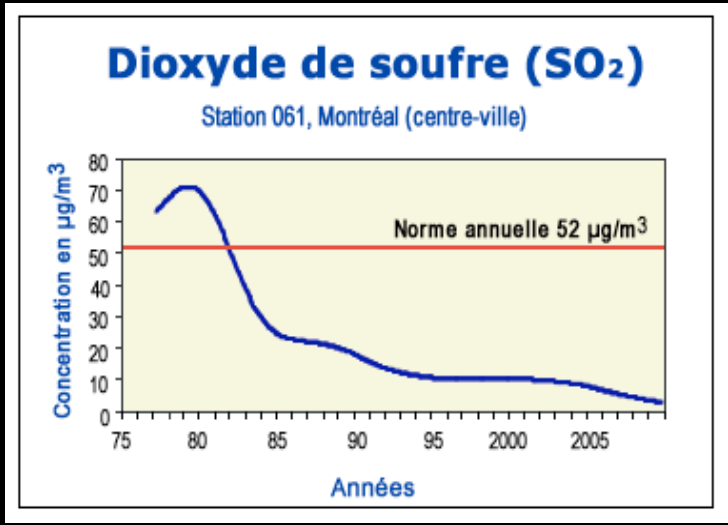


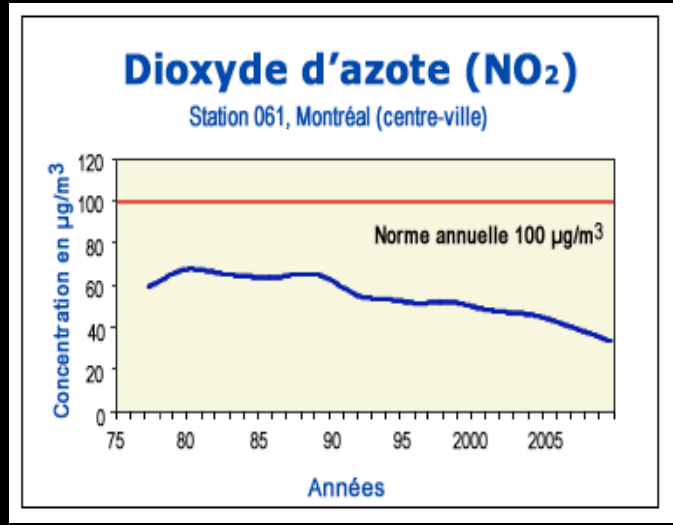
Montréal 1980-2009 RQSA

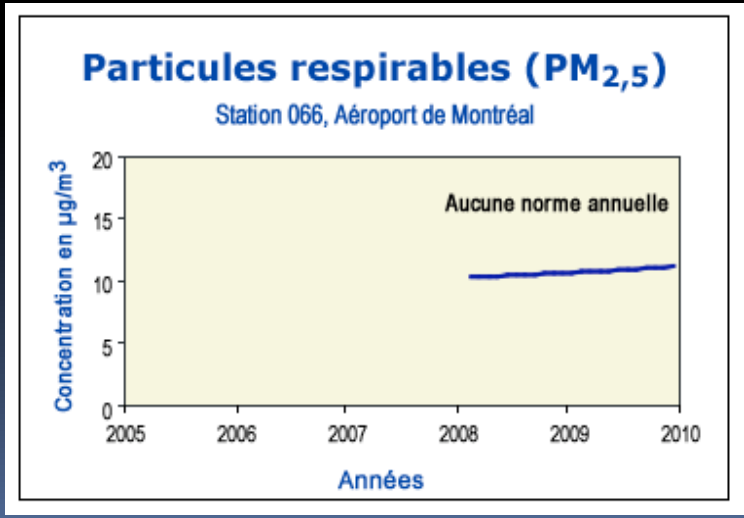


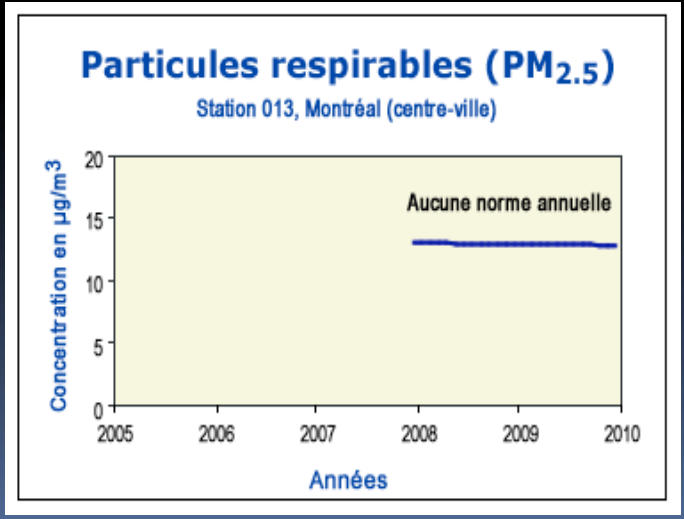


Montréal 1980-2009 RQSA







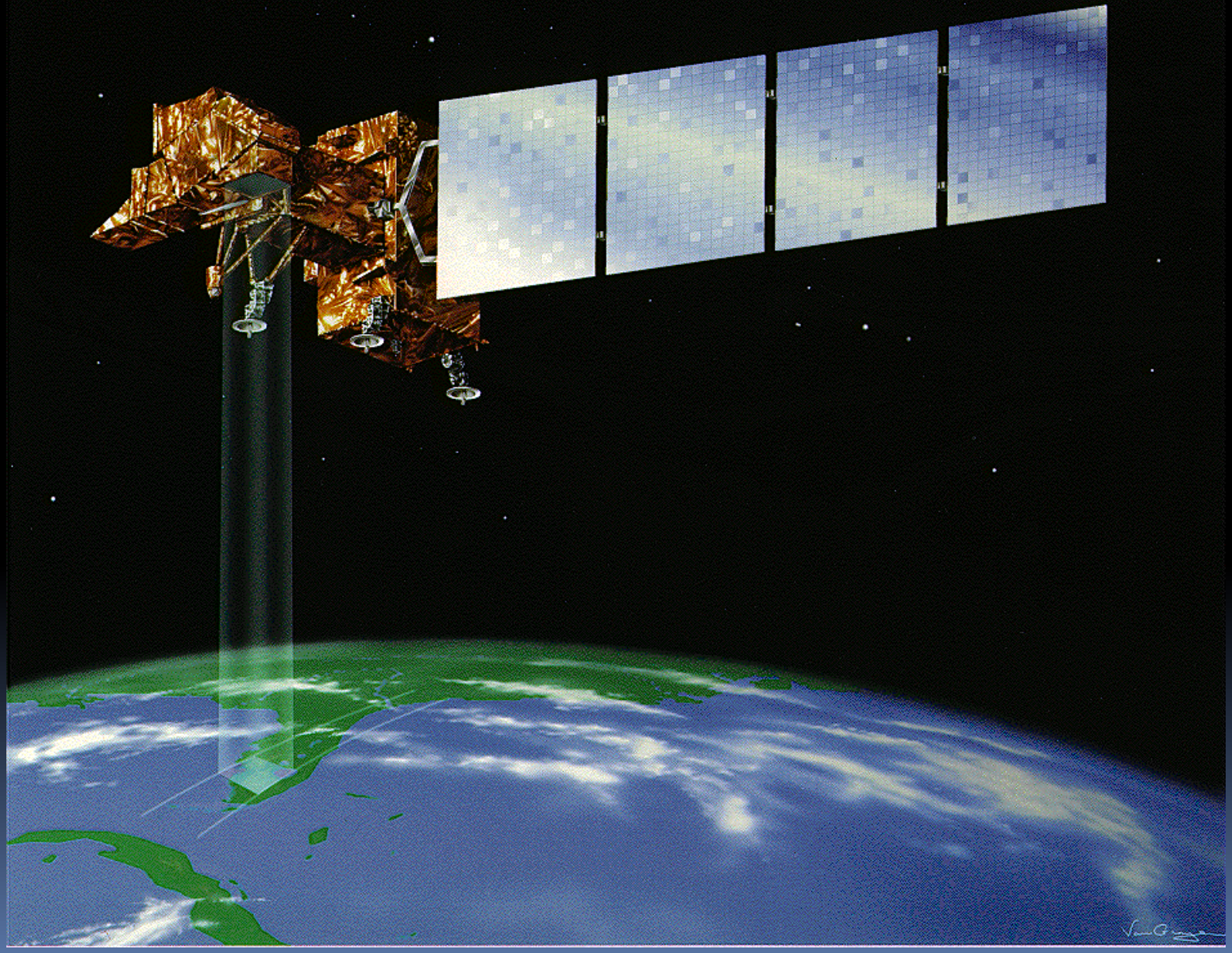


Impact de la pollution au Canada

- 20,000 décès
- 5 à 11 000 décès cardiovasculaires/an
- 33 à 67 000 hospitalisations CV
- 1,5 millions de jours d'hospitalisation CV
- 9,1 milliards de dollars

David R.Boyd, Stephen J. Genuis
Envir. Research, 2008, 106:240-249.

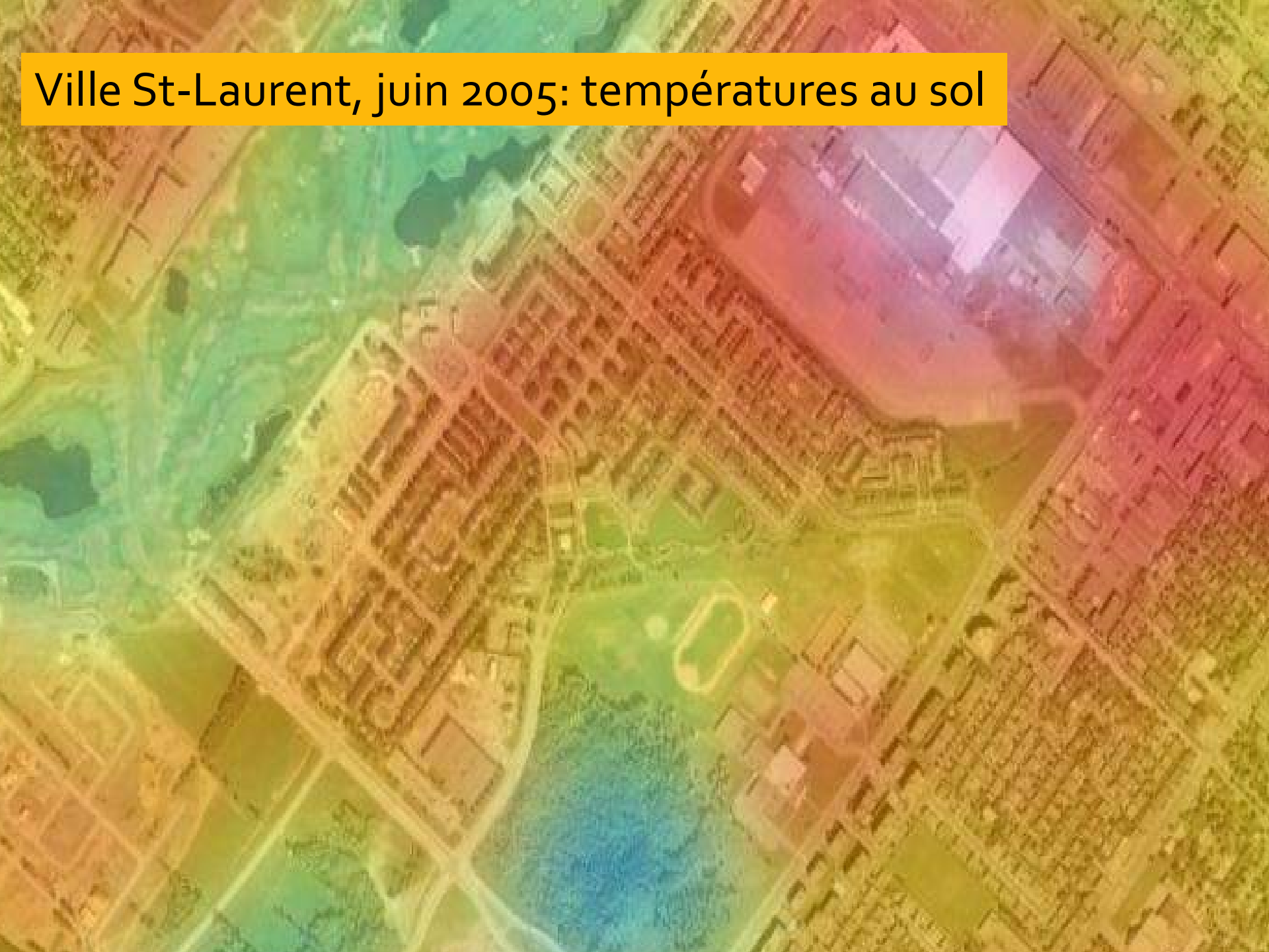
Îlots de chaleur urbains: étude Biotopes



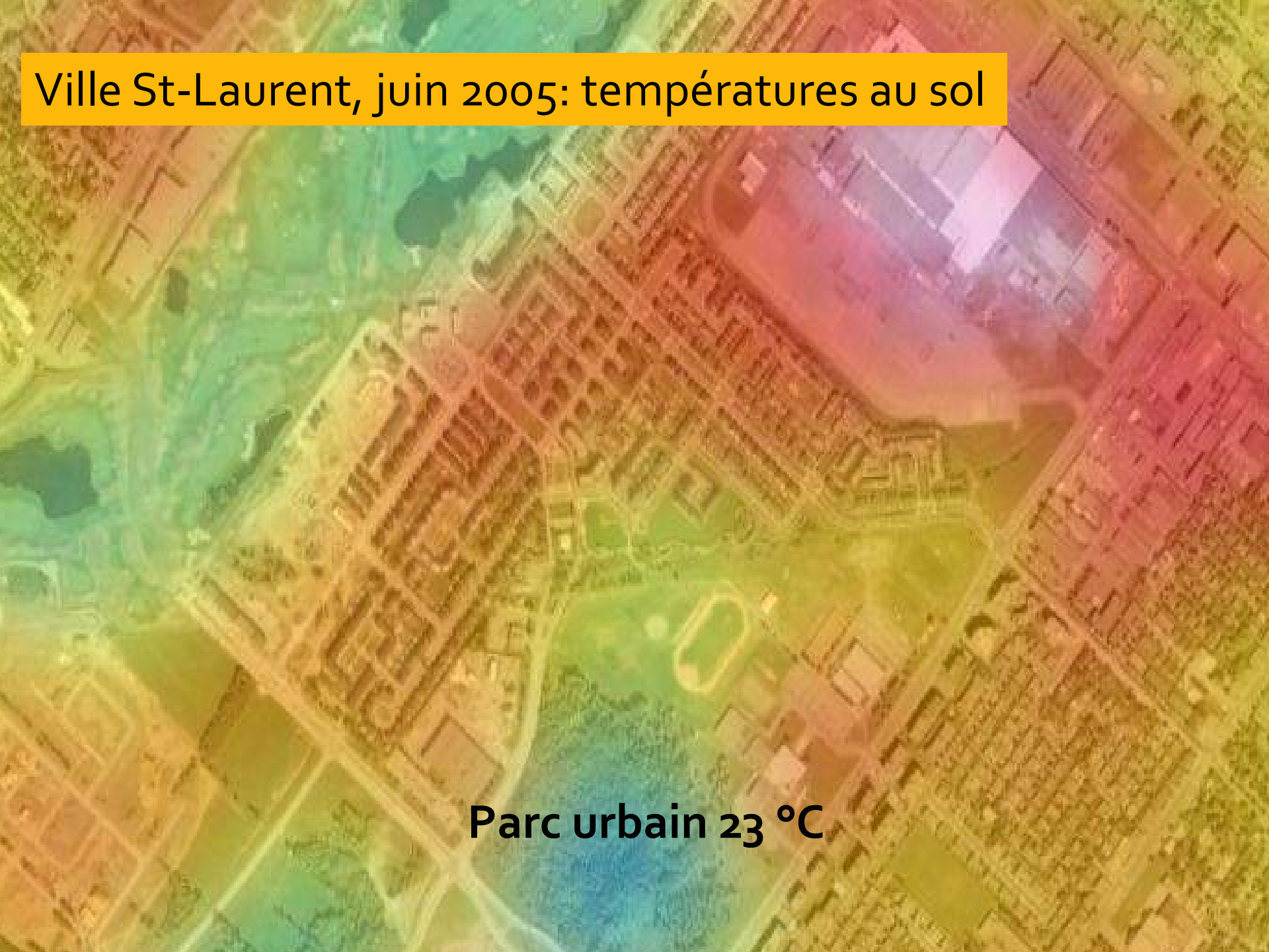
Étude BIOTOPES

François Cavayas	Département de géographie de l'Université de Montréal
Yves Baudouin	Département de géographie de l'UQAM
Yann Vergriete	Institut de recherche en biologie végétale
Guy Garand	CRE de Laval
Norman King	Direction Santé Publique

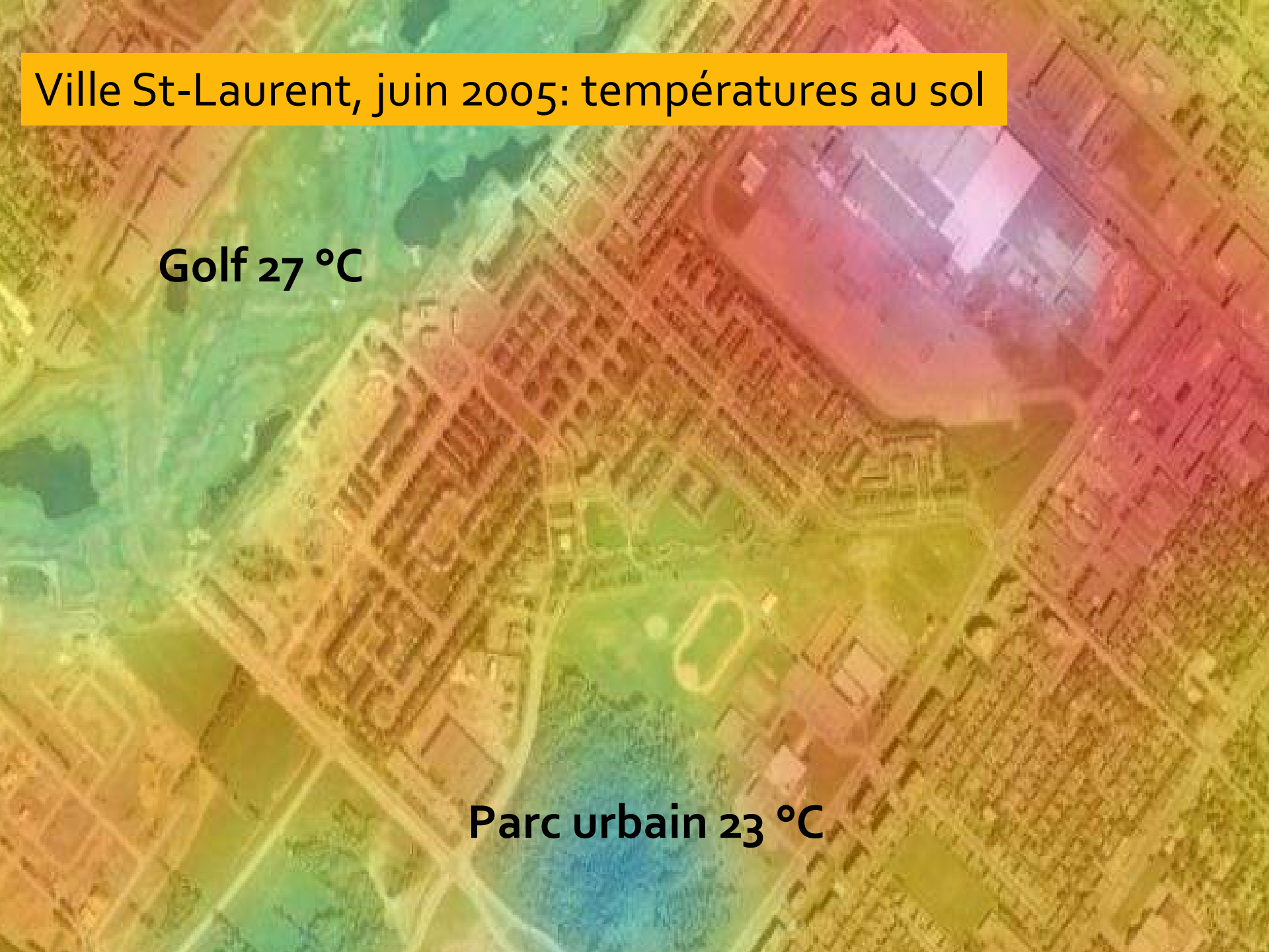
Ville St-Laurent, juin 2005: températures au sol



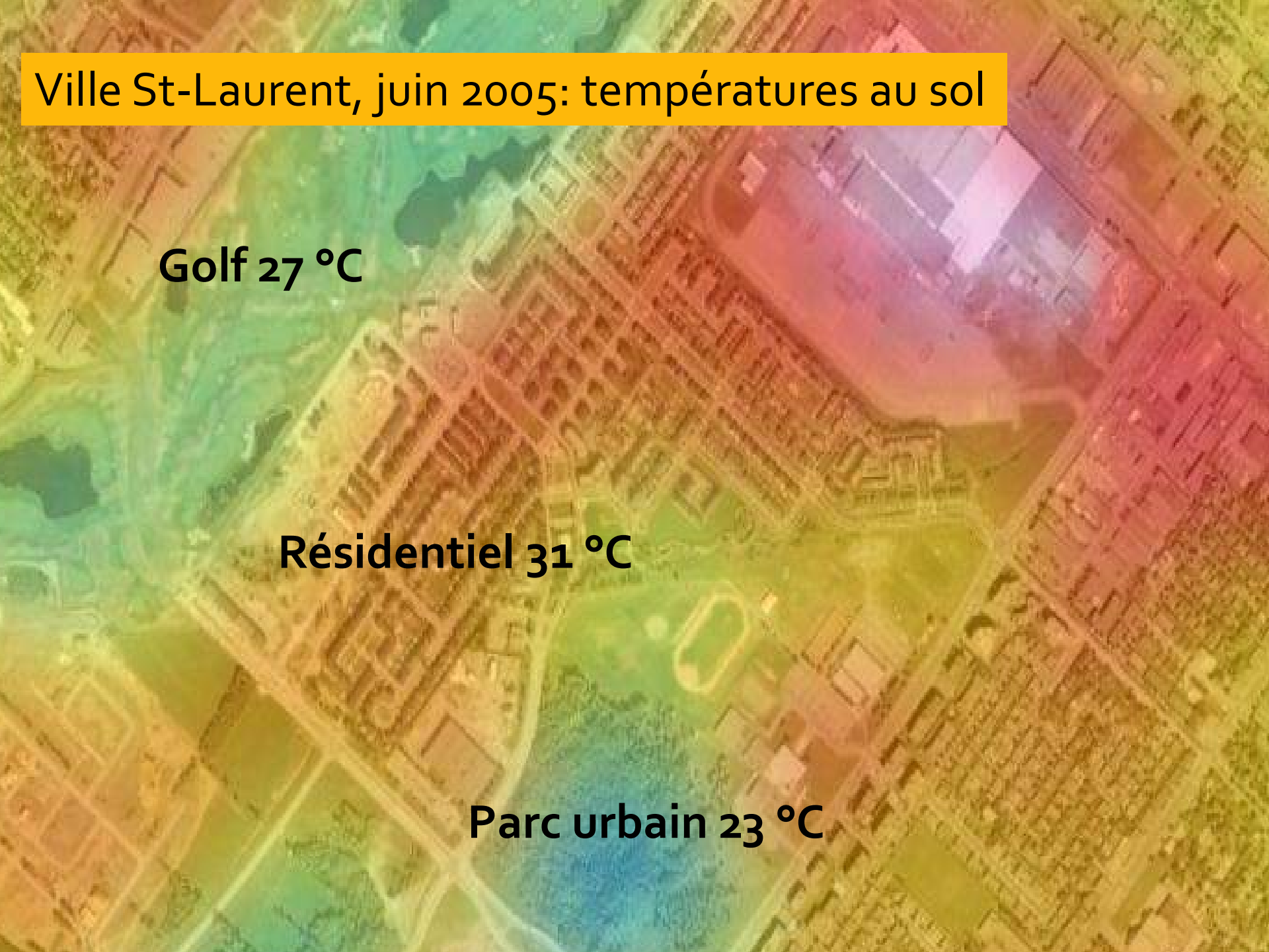
Ville St-Laurent, juin 2005: températures au sol



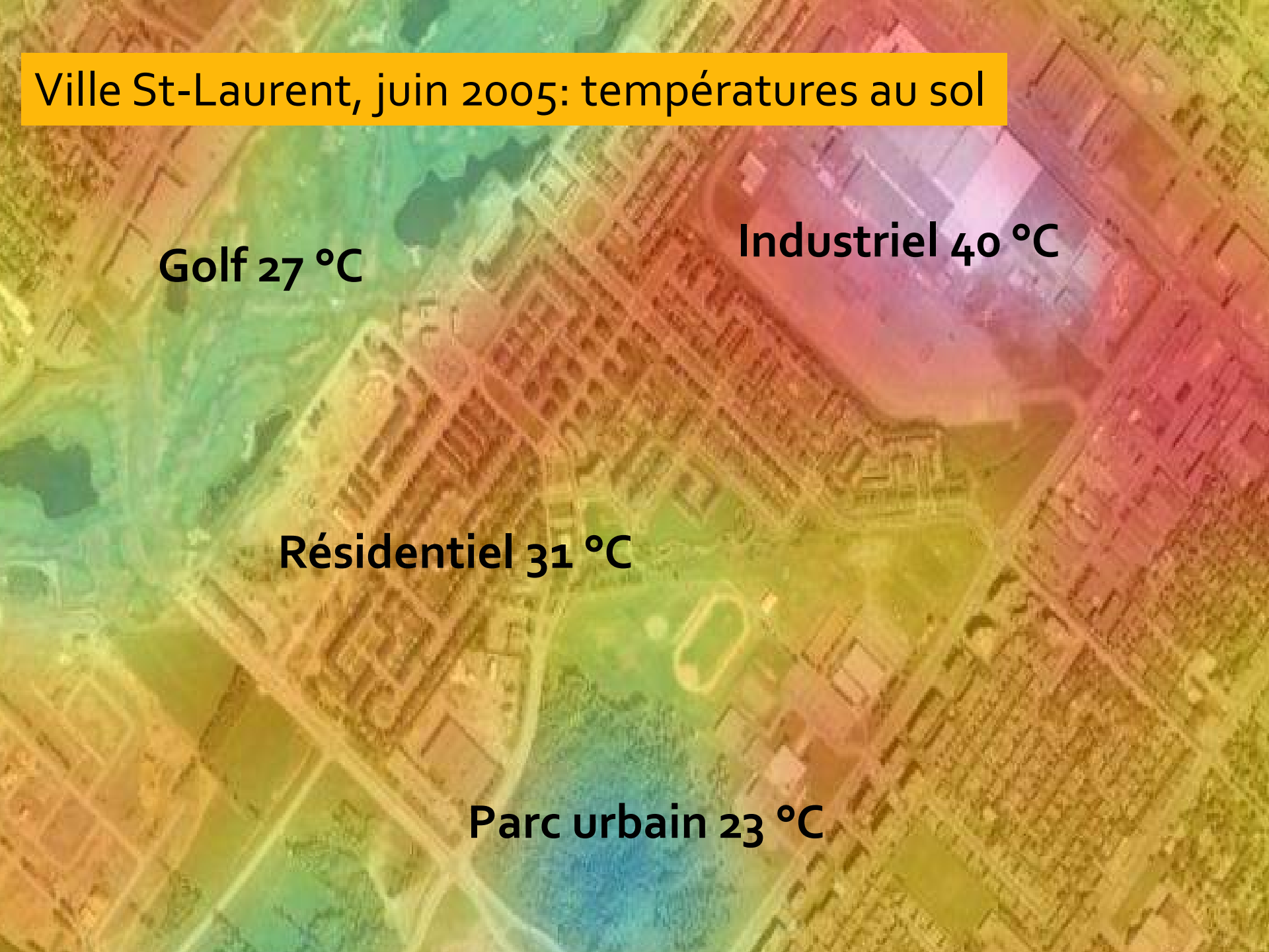
Ville St-Laurent, juin 2005: températures au sol

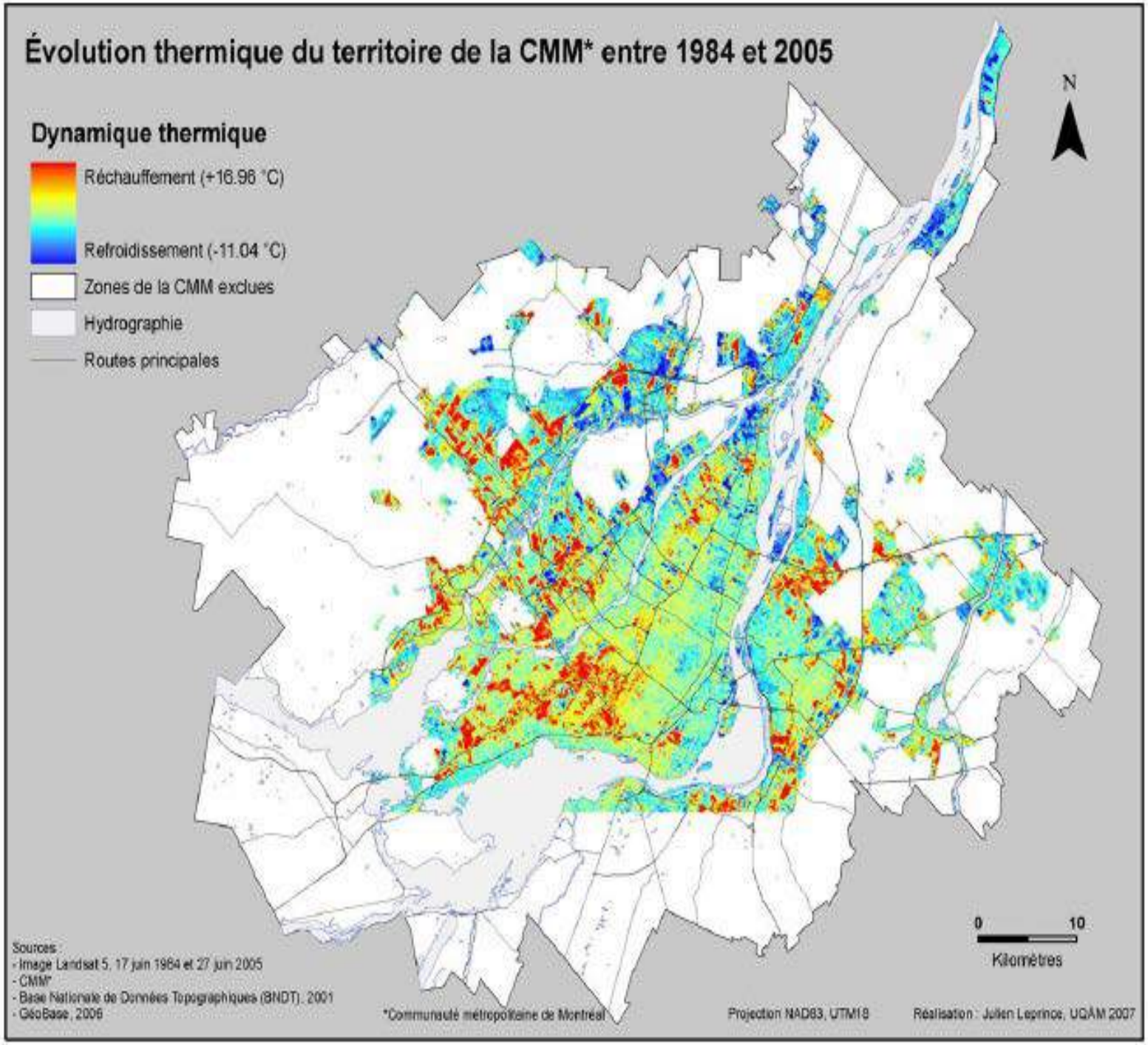


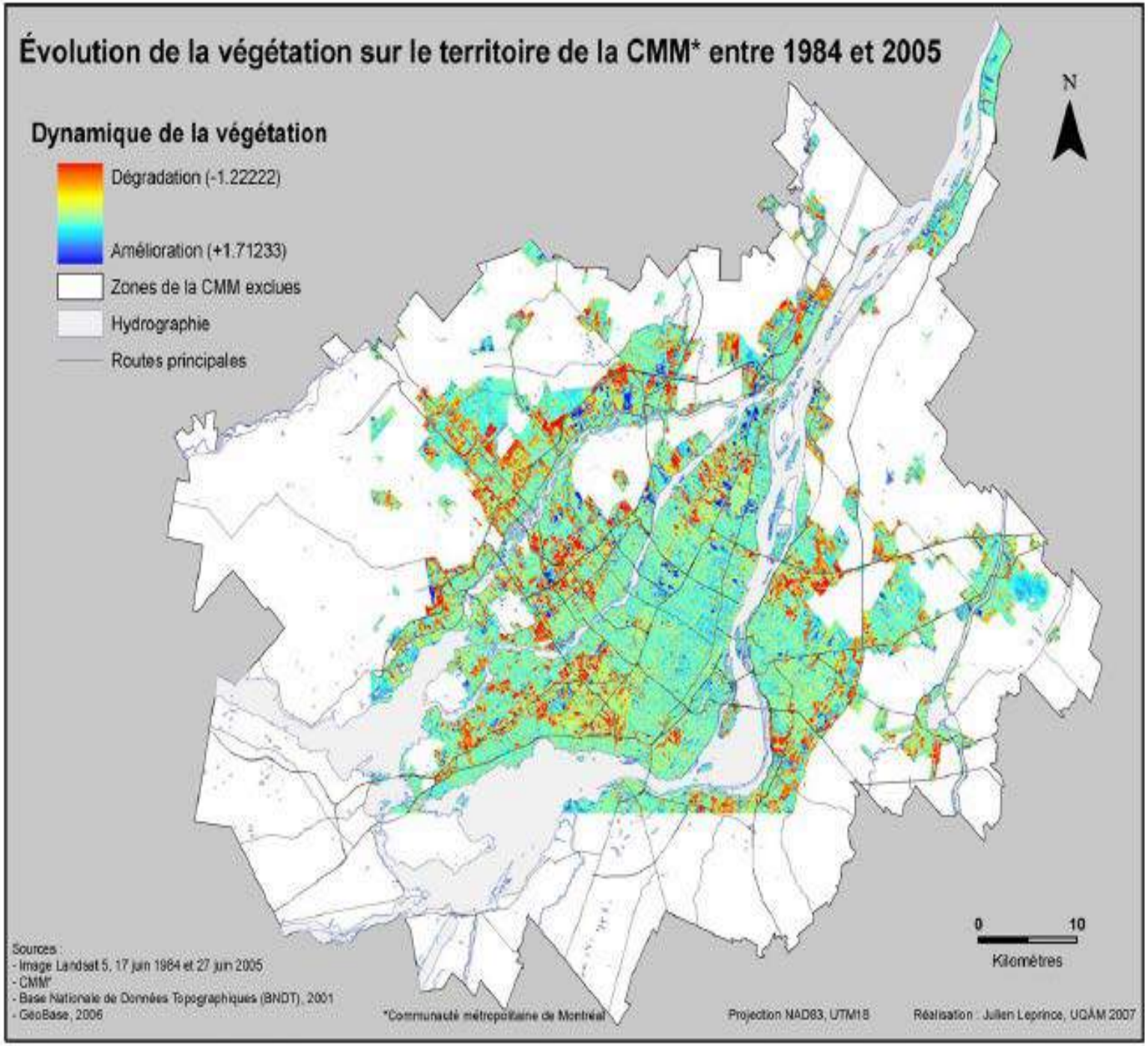
Ville St-Laurent, juin 2005: températures au sol



Ville St-Laurent, juin 2005: températures au sol




Évolution thermique du territoire de la CMM* entre 1984 et 2005
Dynamique thermique
Réchauffement (+16.96 °C)
Refroidissement (-11.04 °C)
Zones de la CMM exclues
Hydrographie
Routes principales
N
0
10
Kilomètres
Sources :
- Image Landsat 5, 17 juin 1984 et 27 juin 2005
- CMM*
- Base Nationale de Données Topographiques (BNDT), 2001
- GéoBase, 2006
*Communauté métropolitaine de Montréal
Projection NAD83, UTM18
Réalisation : Julien Leprince, UQÀM 2007


Évolution de la végétation sur le territoire de la CMM* entre 1984 et 2005
Dynamique de la végétation
Dégradation (-1.22222)
Amélioration (+1.71233)
Zones de la CMM exclues
Hydrographie
Routes principales
N
0
10
Kilomètres
Sources :
- Image Landsat 5, 17 juin 1984 et 27 juin 2005
- CMM*
- Base Nationale de Données Topographiques (BNDT), 2001
- GéoBase, 2006
*Communauté métropolitaine de Montréal
Projection NAD83, UTM18
Réalisation : Julien Leprince, UQÀM 2007

Canicule 2003 en Europe

- 70 000 morts en Europe
- 17 000 en France, surtout région parisienne
  - L'espérance de vie en France recule pour la 1ère fois

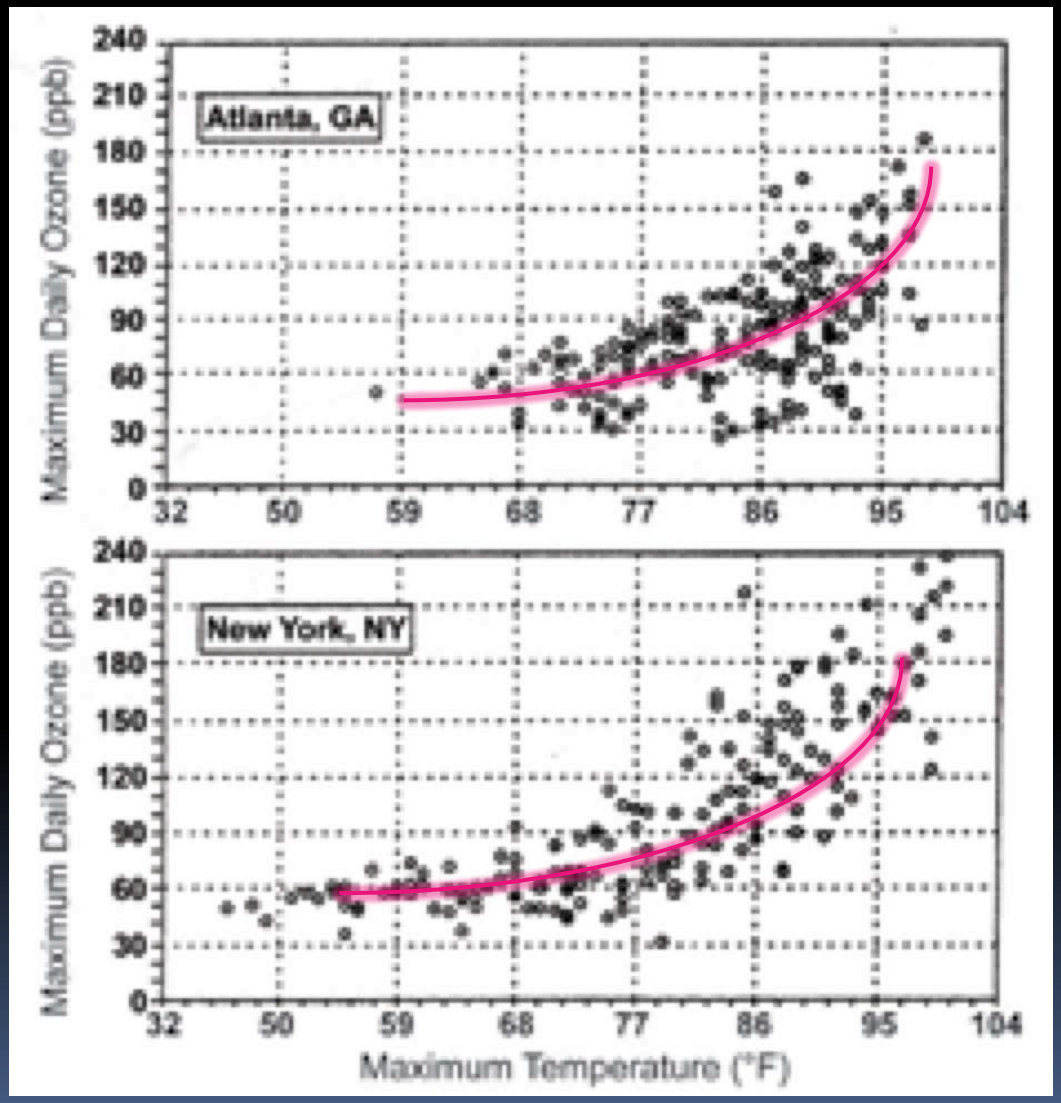
Canicule 2003 en Europe

- 70 000 morts en Europe
- 17 000 en France, surtout région parisienne
  - L'espérance de vie en France recule pour la 1ère fois

CONJONCTION CHALEUR-SMOG

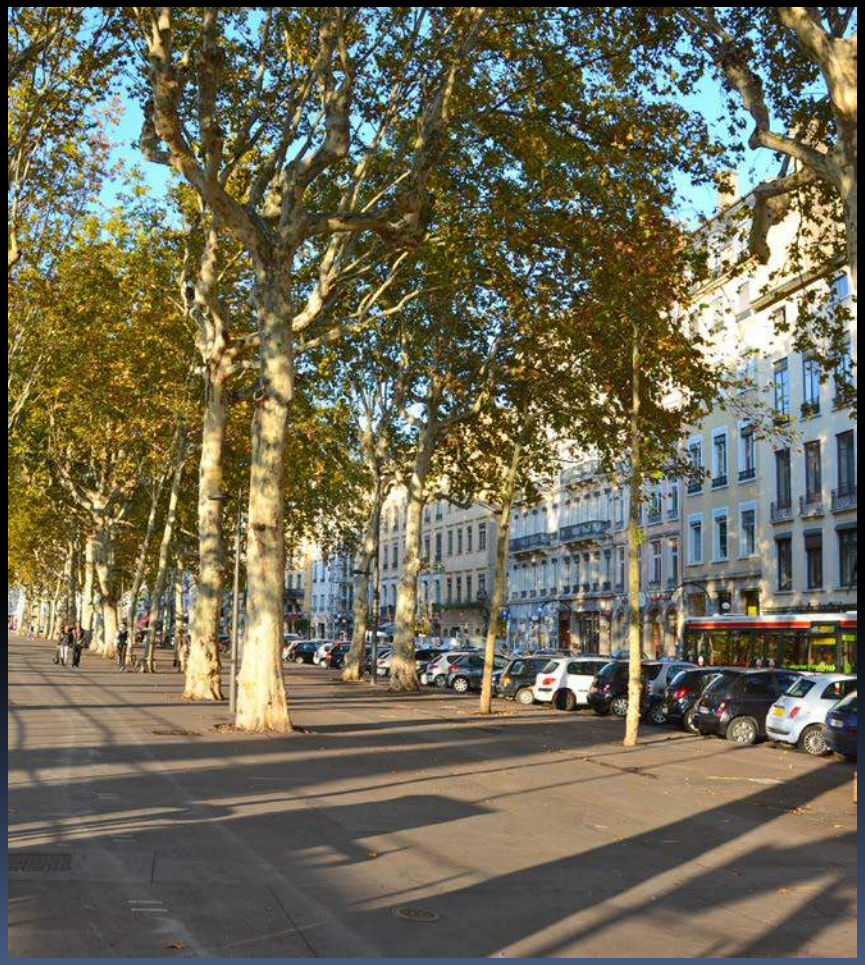
- 72 % des décès sont causés par:
  - Complications cardiovasculaires
  - Infarctus, défaillance, arythmies
- Décès concentrés en région urbaine

Température et toxicité des polluants



US Global Climate Change Program Research, 2009

Coeur et milieu



THE LANCET
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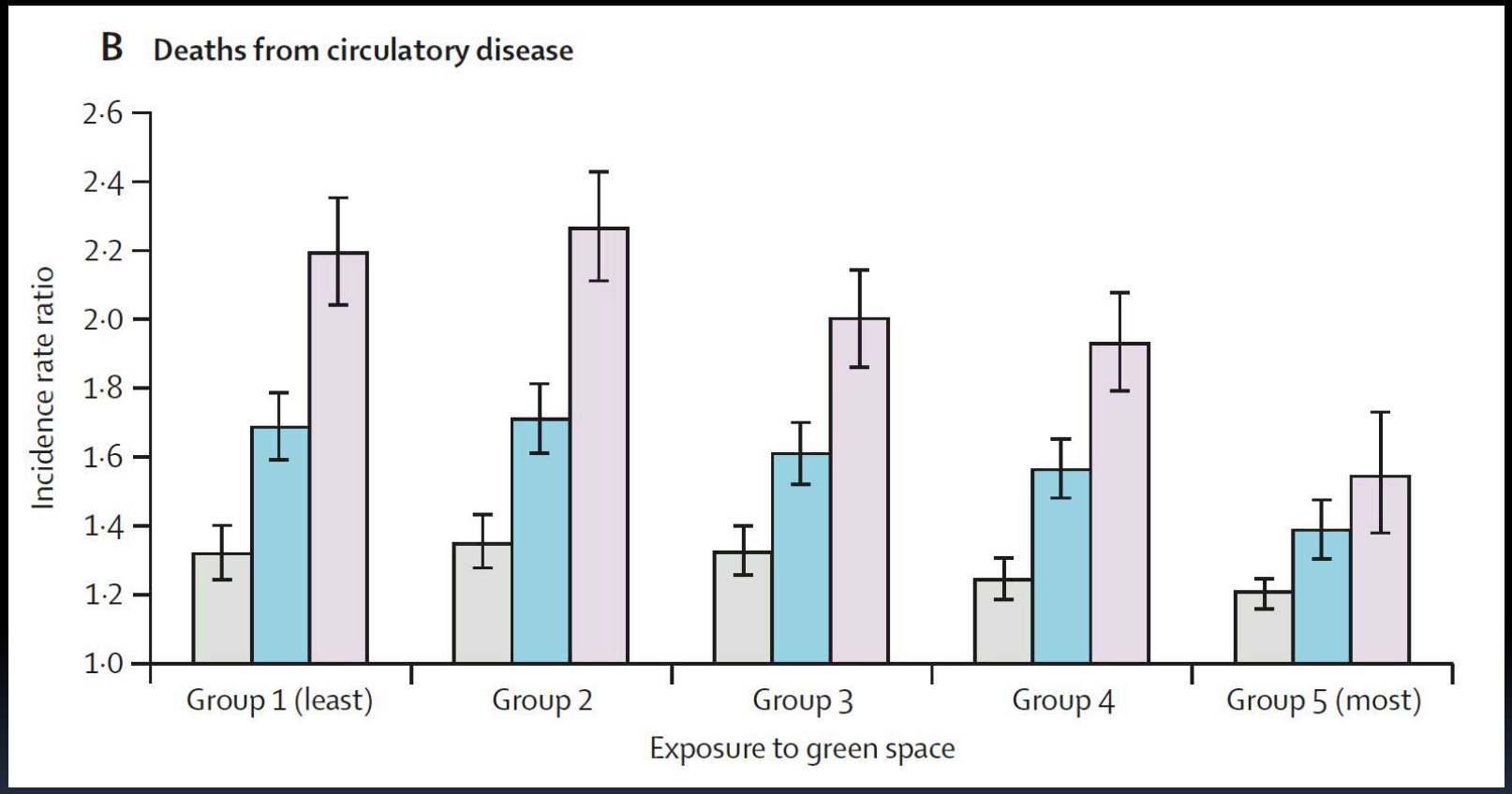
Effect of exposure to natural environment on health inequalities: an observational population study

Richard Mitchell, Frank Popham

Lancet 2008; 372: 1655–60

- ✓ 2001-2005
- ✓ 40 millions de citoyens britanniques non retraités
- ✓ 360 000 certificats de décès
- ✓ 4 quartiles selon le revenu
- ✓ 5 quintiles selon l'exposition aux milieux verts



Effect of exposure to natural environment on health inequalities; an observational population study. R Mitchell, F Popham. Lancet, nov 2008

Milieu minéralisé vs vert

Milieu minéral

- 219 % de plus de mortalité cardiovasculaire chez les défavorisés

Milieu vert

- 154 % de plus de mortalité cardiovasculaire chez les défavorisés

Milieu minéralisé vs vert

Réduction de moitié de l'écart de mortalité cardiovasculaire lié au niveau économique

Milieu minéral

- 219 % de plus de mortalité cardiovasculaire chez les défavorisés

Milieu vert

- 154 % de plus de mortalité cardiovasculaire chez les défavorisés

Shinrin-yoku

The term *Shinrin-yoku* (taking in the forest atmosphere or forest bathing) was coined by the Japanese Ministry of Agriculture, Forestry, and Fisheries in 1982. It can be defined as making contact with and taking in the atmosphere of the forest: a process intended to improve an individual's state of mental and physical relaxation [13]. *Shinrin-yoku* is considered to be the most widespread activity associated with forest and human health.

Environ Health Prev Med (2010) 15:18–26
DOI 10.1007/s12199-009-0086-9

SPECIAL FEATURE

The Trends on the Research of Forest Bathing in Japan, Korea and in the World

The physiological effects of *Shinrin-yoku* (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan

Bum Jin Park · Yuko Tsunetsugu · Tamami Kasetani · Takahide Kagawa · Yoshifumi Miyazaki

Received: 18 July 2008 / Accepted: 6 April 2009 / Published online: 2 May 2009
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Table 1 Measured physiological parameters and subjective evaluation

Autonomic nervous activity	Pulse rate, systolic blood pressure, diastolic blood pressure
	Heart rate variability (HRV)
	HF component (parasympathetic nervous activity)
	LF/HF or LF/(LF + HF) (sympathetic nervous activity)
Endocrine system activity	Salivary cortisol concentration
Immune system activity	Salivary immunoglobulin A concentration

Fig. 2 Change in salivary cortisol concentration after forest viewing and walking. Mean ± standard deviation (SD); ** $p < 0.01$; p-value by t test

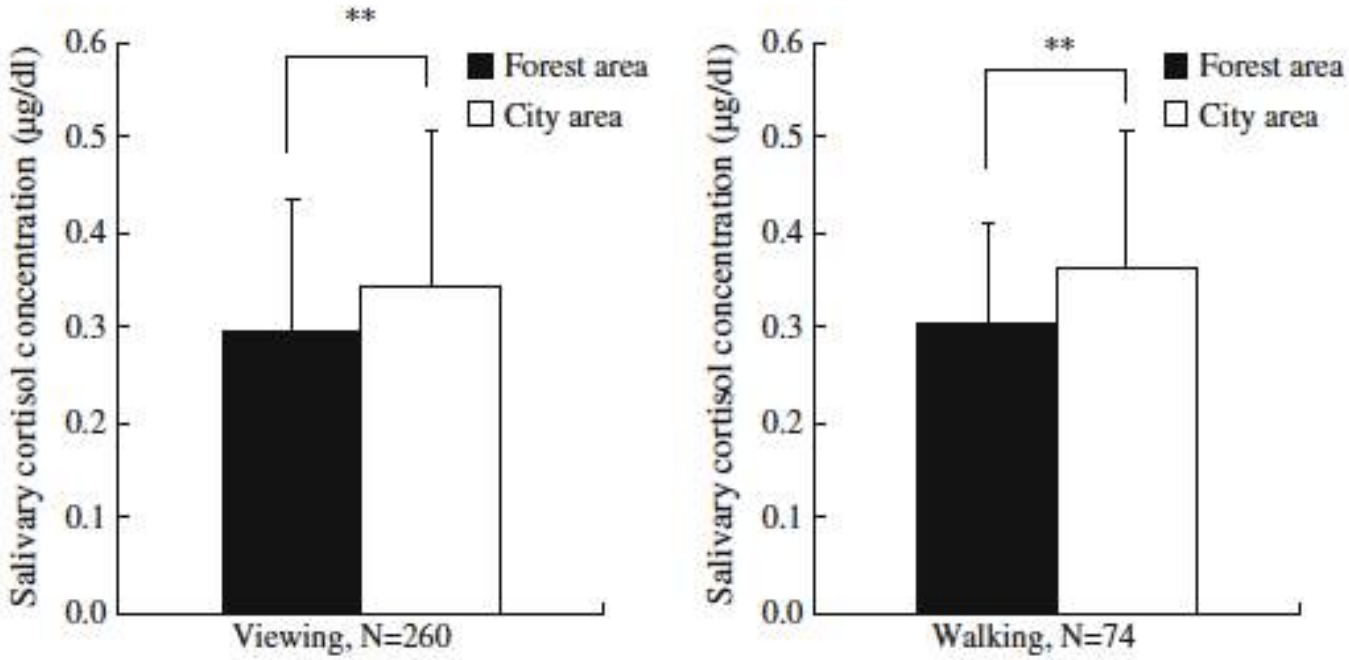


Fig. 3 Change in pulse rate after forest viewing and walking. Mean ± SD; ** $p < 0.01$; p value by t test

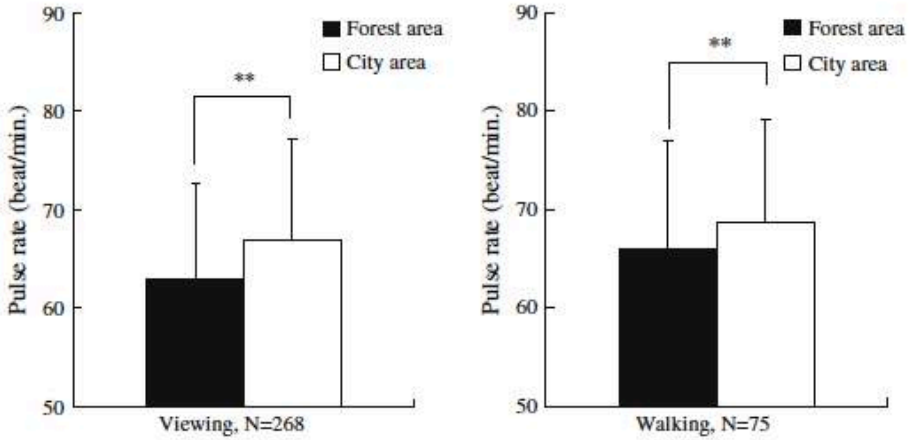


Fig. 4 Change in systolic blood pressure after forest viewing and walking. Mean ± SD; ** $p < 0.01$; * $p < 0.05$; p value by t test

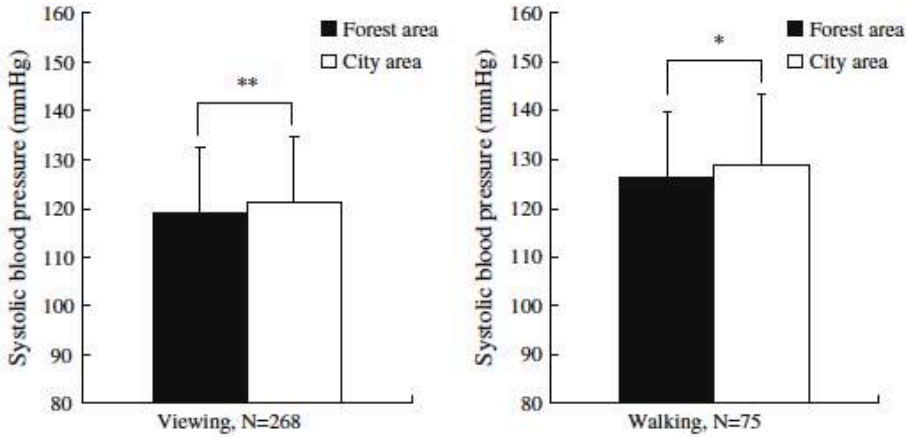
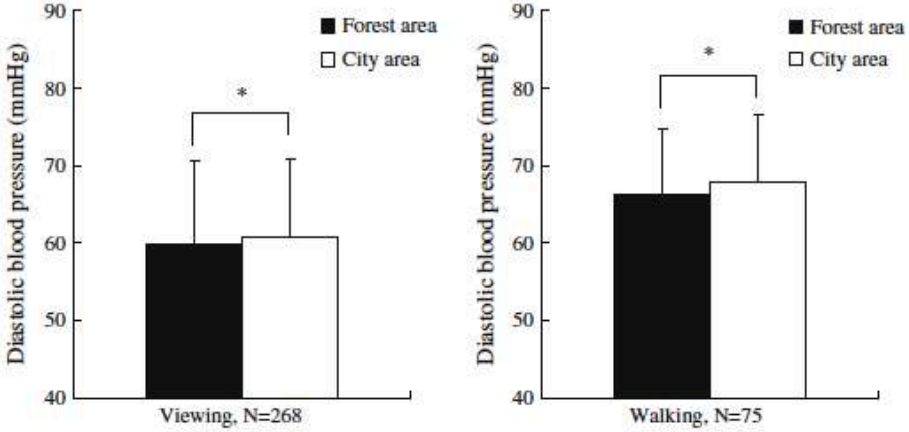


Fig. 5 Change in diastolic blood pressure after forest viewing and walking. Mean ± SD; * $p < 0.05$; p value by t test



Si une Cité élimine

Dans la nourriture

- ✓ High Fructose Corn Syrup
- ✓ Gras trans
- ✓ Excès de sel
- ✓ Acide phosphorique

Dans l'air

- ✓ Particules fines
- ✓ SO_2 - NO_2
- ✓ CO - COV
- ✓ Ozone

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Cette cité peut s'attendre à une diminution de 25 à 75 % de la prévalence de la maladie vasculaire

Cardiologie clinique
Cardiologie d’intervention
Cardiologie préventive

Cardiologie clinique
Cardiologie d'intervention
Cardiologie préventive

Cardiologie environnementale: Prescription verte

Cardiologie clinique
Cardiologie d'intervention
Cardiologie préventive

Cardiologie environnementale: Prescription verte

Université de Montréal

Chaire de cardiologie environnementale