XVIII IEA World Congress of Epidemiology
VII Brazilian Congress of Epidemiology

Epidemiology in the construction of health for all:
tools for a changing world

XVIII Congresso Mundial de Epidemiologia
VII Congresso Brasileiro de Epidemiologia

Epidemiologia na construção da saúde para todos:
métodos para um mundo em transformação

Porto Alegre – 20 to 24 September 2008

Climate change and health

Mudanças climáticas e saúde

Carlos Corvalan - PAHO

Chistovam Barcellos –Fiocruz

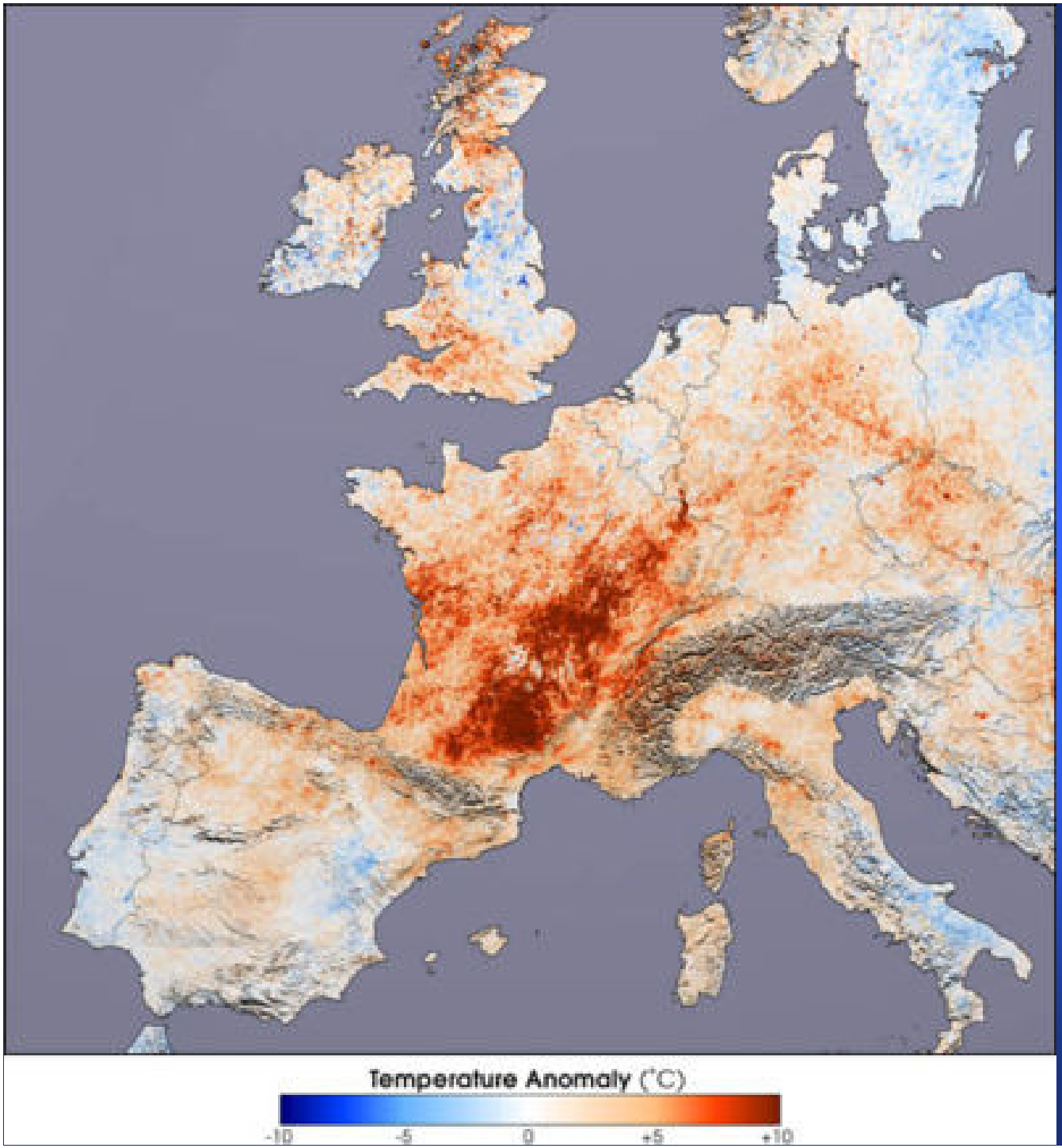
Carlos Nobre - INPE

Nelson Gouveia – DMP-FMUSP

Climate change and health

"Energy crisis: health and climate impacts"

Nelson Gouveia
Departamento de Medicina Preventiva
Faculdade de Medicina
Universidade de São Paulo



2003 heat wave in Europe

excess deaths:

France – 14,802

UK – 2,139

Italy - 1,094

- Understand differences in population susceptibility

- Asses population **adaptation** to climate change

- Understand the nature of vulnerable populations

Table 2 Threshold and slopes of temperature-mortality relationships

City	Threshold (°C) with 95% CI		Percentage increase in mortality for each °C decrease in temperature below 'cold threshold' (95% CI)[c]	Percentage increase in mortality for each °C increase in temperature above 'heat threshold' (95% CI)[c]
	Lower (cold[a])	Upper (heat[b])		
Ljubljana	17 (7–20)	17 (7–20)	0.43 (−0.78 to 1.65)	3.12 (1.26–5.02)
Bucharest	22 (20–22)	22 (20–22)	0.85 (0.44–1.25)	3.30 (2.35–4.26)
Sofia	16 (15–17)	16 (15–17)	0.93 (0.37–1.49)	2.88 (2.11–3.65)
Delhi	19 (.–39)[d]	29 (8–30)	2.78 (0.66–4.94)	3.94 (2.80–5.08)
Monterrey	17 (13–19)	31 (31–33)	4.70 (3.04–6.40)	18.8 (13.0–25.0)[e]
Mexico City	15 (14–15)	18 (8–21)	6.90 (5.70–8.11)	0.77 (0.14–1.39)
Chiang Mai	19 (.–20)[d]	28 (17–.)[d]	84.3 (48.1–129)[e]	2.39 (−0.49 to 5.35)
Bangkok	29 (29–30)	29 (29–30)	4.09 (1.27–6.98)	5.78 (3.52–8.09)
Salvador	23 (.–30)[d]	23 (20–27)	−12.8 (−34.7 to 16.4)	2.48 (0.93–4.05)
São Paulo	21 (18–22)	23 (19–23)	2.47 (1.78–3.16)	3.46 (2.62–4.31)
Santiago	16 (14–20)	16 (14–20)	2.53 (1.44–3.62)	1.04 (0.28–1.81)
Cape Town	17 (15–22)	17 (15–22)	3.82 (2.08–5.60)	0.47 (−0.31 to 1.24)

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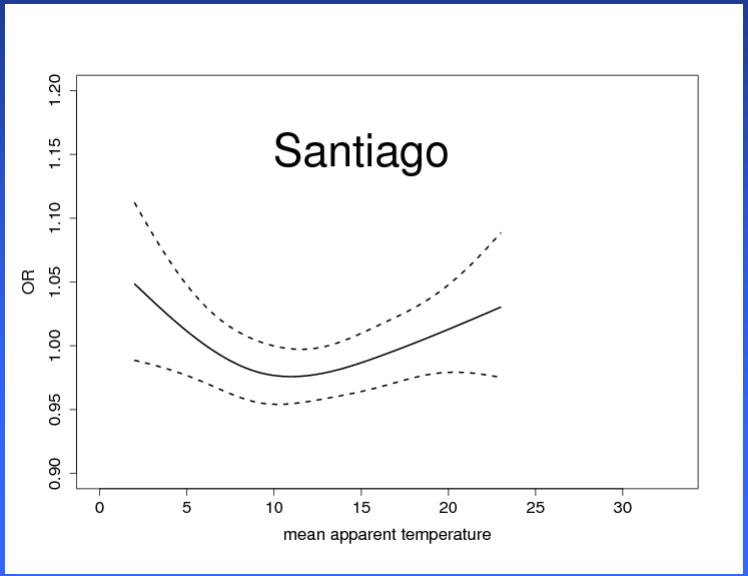
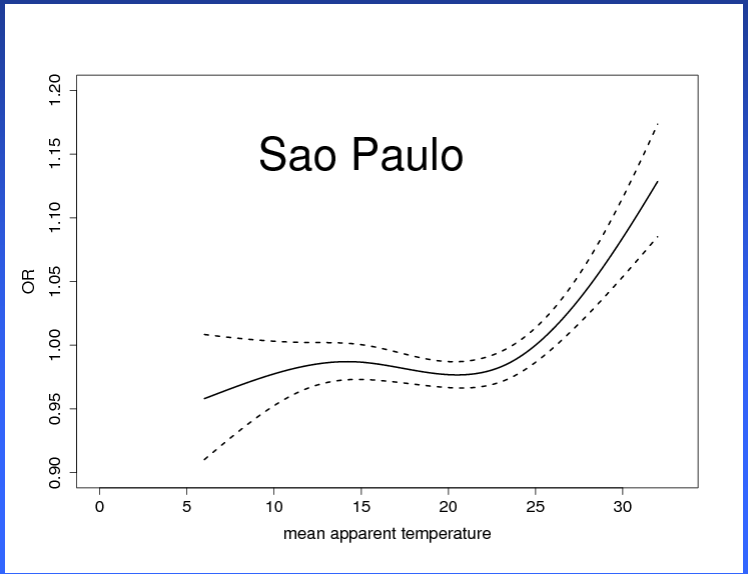
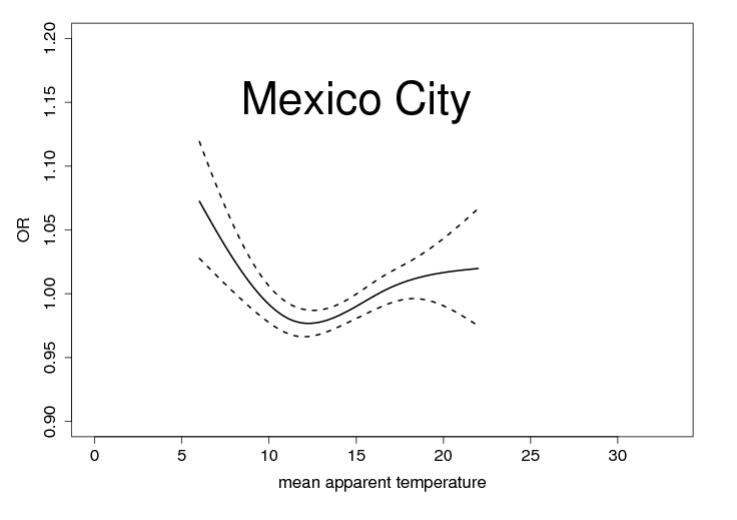
Exposure-response curves for mean apparent temperature and risk of mortality







Int. J. Epidemiol. 2008, 37: 796-804

Percent increase in risk of mortality at the 95th percentile of mean apparent temperature compared to the 75th percentile (95% confidence interval) by sex, age, and educational attainment

	Santiago	São Paulo	Mexico City
Sex			
Male	1.98 (-3.42, 7.68)	4.59 (1.76, 7.50)	0.78 (-1.54, 3.15)
Female	1.65 (-3.90, 7.50)	4.25 (1.25, 7.34)	1.75 (-0.57, 4.13)
***Education* (≥21 years)**			
None	0.58 (-16.00, 20.34)	7.45 (0.78, 14.56)	1.30(-2.86, 5.64)
Primary	2.15 (-3.16, 7.76)	6.01 (2.70, 9.43)	1.81 (-1.50, 5.23)
Secondary	7.11 (-4.25, 19.83)	4.67 (-2.29, 12.13)	1.29 (-1.34, 3.98)
University	1.04 (-6.64, 9.36)	5.28 (-3.16, 14.45)	5.50 (-0.82, 12.21)
Age			
0 to 15 years	-7.65 (-23.92, 12.10)	-0.82 (-6.44, 5.13)	-2.53 (-7.17, 2.33)
16 to 64 years	1.10 (-5.80, 8.53)	3.32 (-0.05, 6.80)	-0.34 (-3.06, 2.46)
≥65 years	2.69 (-2.06, 7.88)	6.51 (3.57, 9.52)	3.22 (0.93, 5.57)

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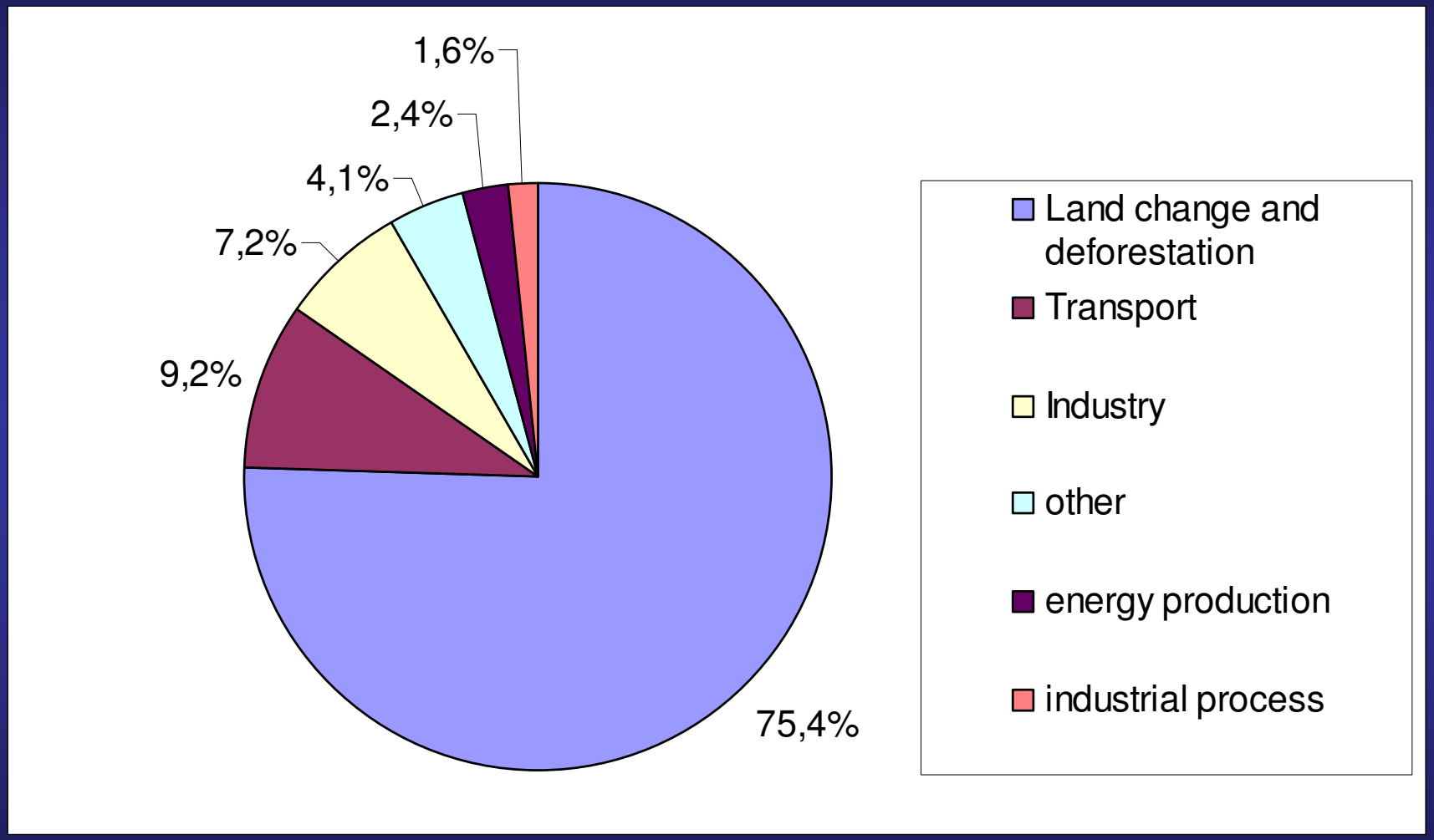
Total GHG Emissions in 2000

(includes land use change)

country	Billion TCO_2	% of word total
USA	5.4	15.9
European Union (25 countries)	3.8	11.3
China	3.4	9.9
Indonesia	2.9	8.4
Brazil	**1.7**	**5,0**
Russian Federation	1.6	4.7
Japan	1.3	3.7
India	1.0	2.9
Germany	0.86	2.5
Malaysia	0.82	2.4

Source: The Climate Analysis Indicators Tool – CAIT
World Resources Institute

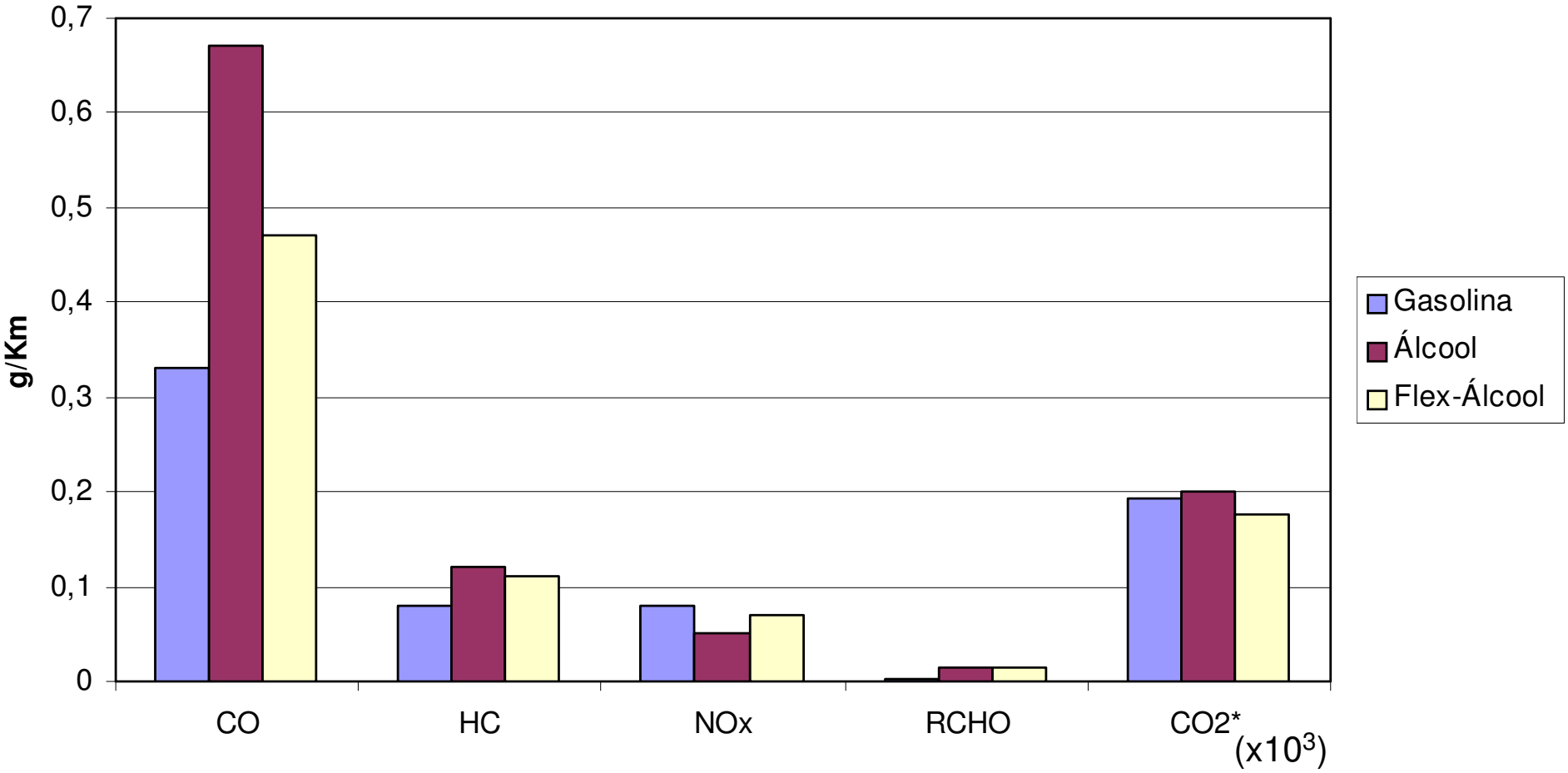
CO_2 Emissions in Brazil, by sector



Source: Inventário de Emissões, Ministério de Ciência e Tecnologia, 2006

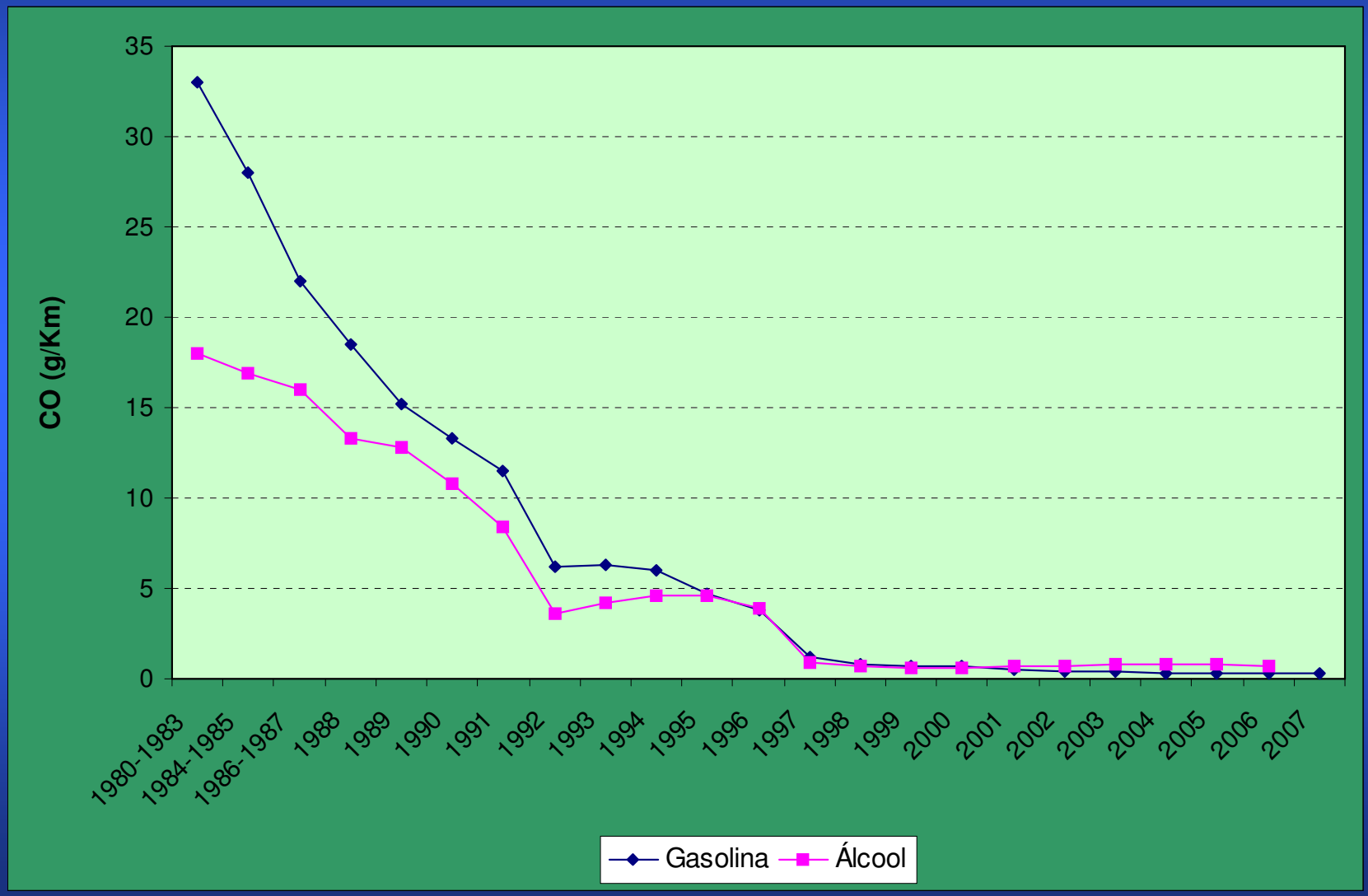
Biofuels on the rise

Emission factors for new vehicles, Brazil, 2006



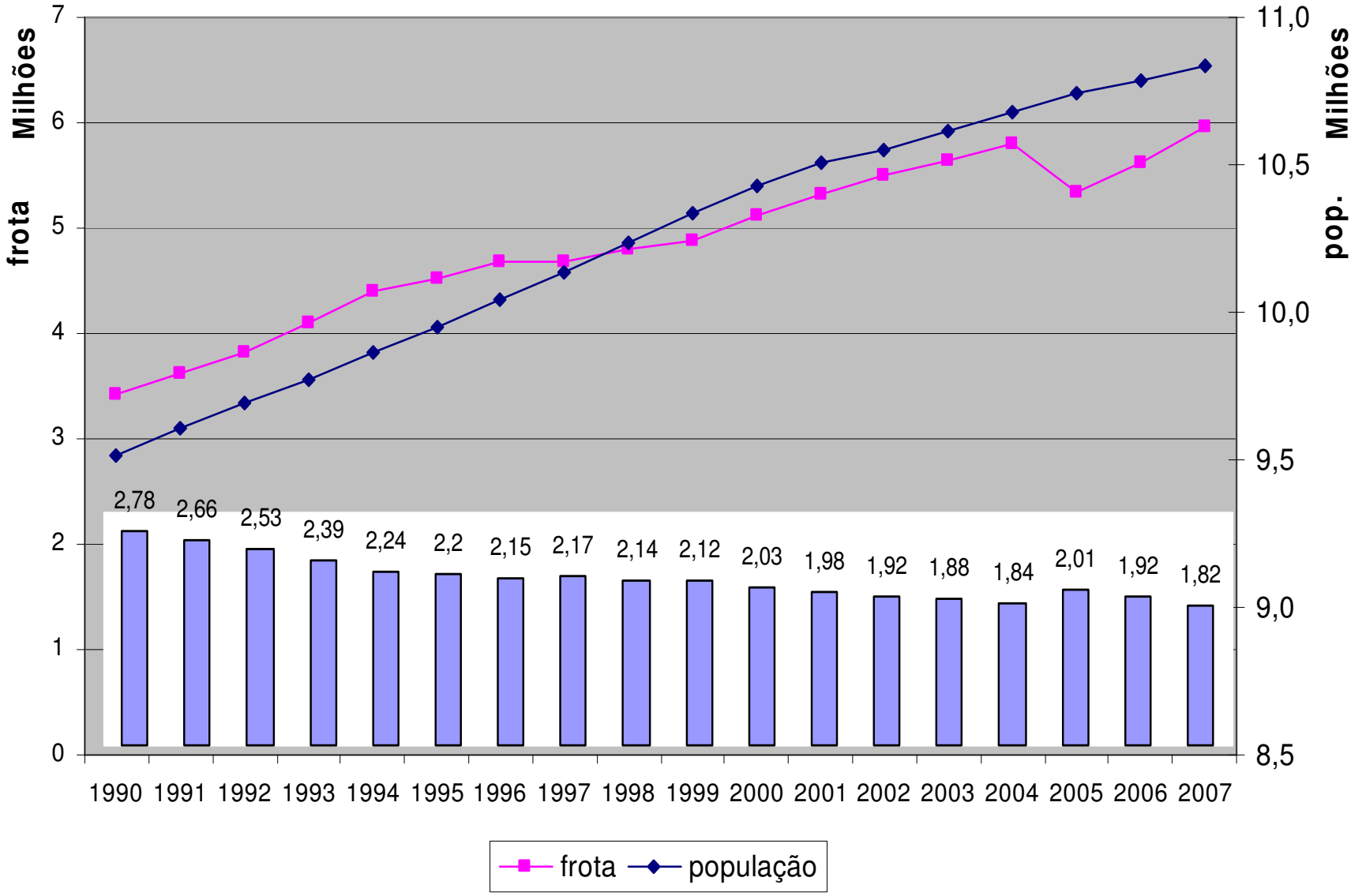
Source: CETESB, 2008

Emission factors for new vehicles, Brazil, 1980-2007



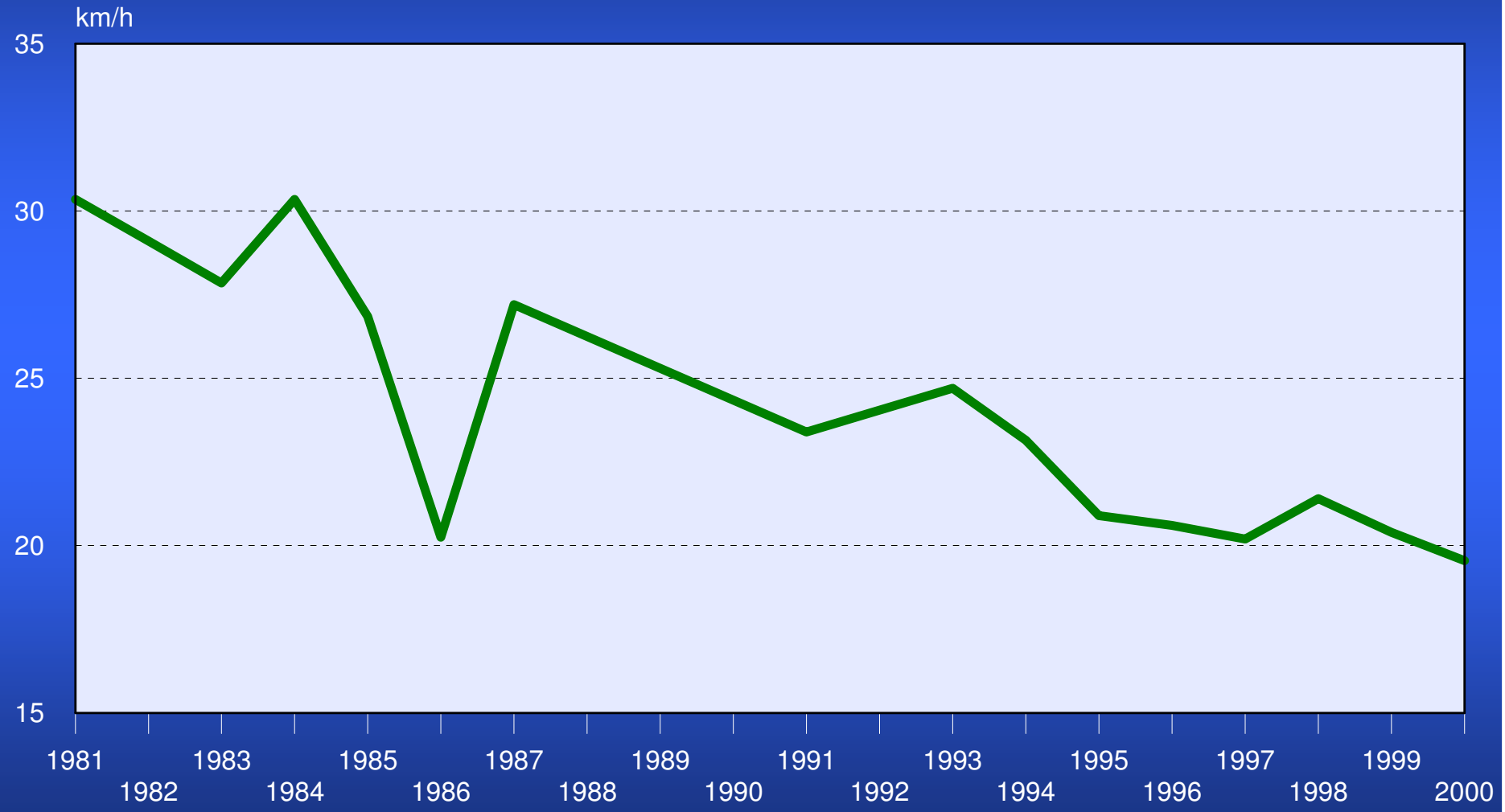
Fonte: Cetesb, 2008

Vehicle fleet and motorization index, São Paulo, 1990-2007

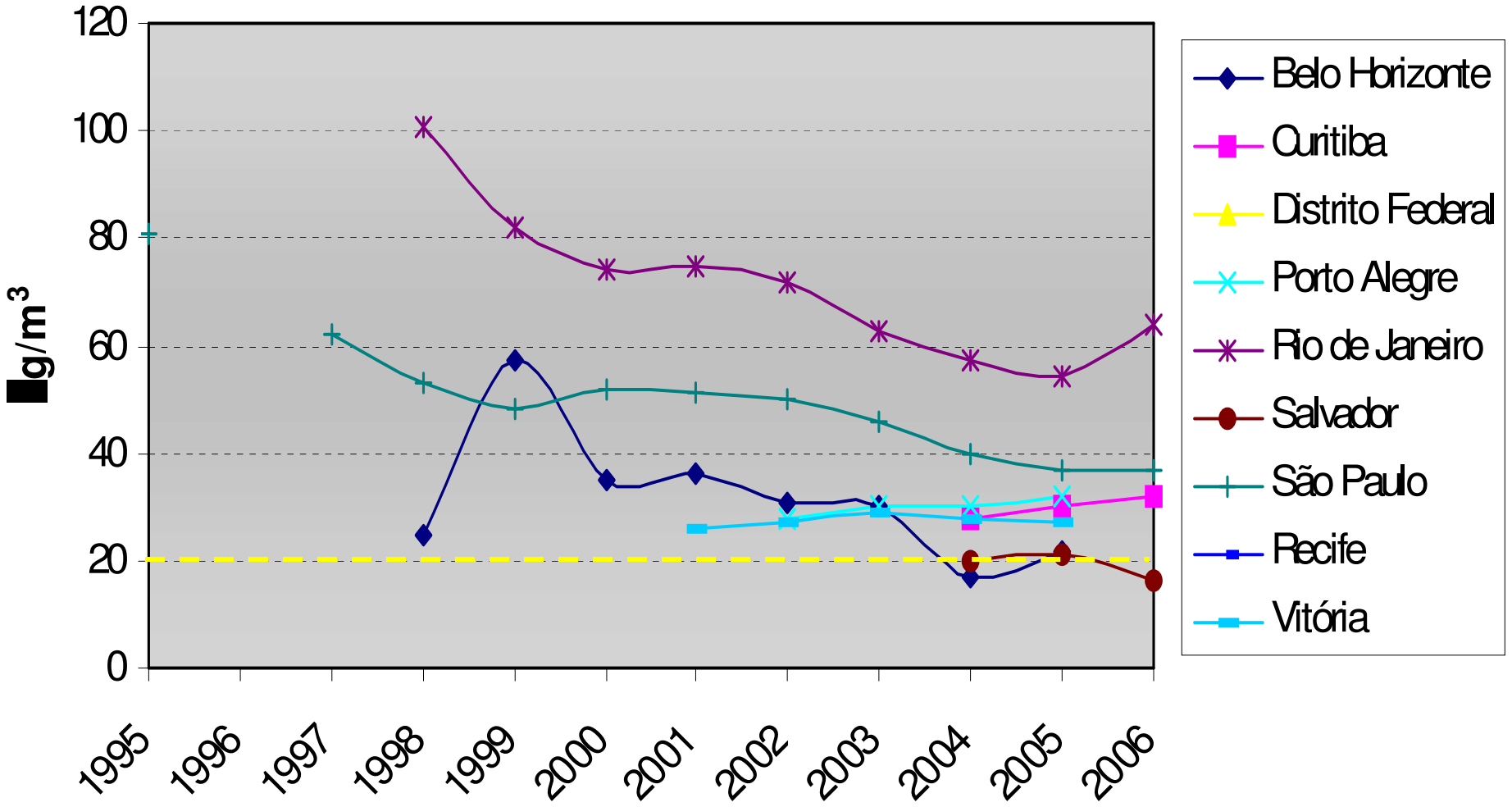


Source: CET; SEADE; DETRAN-SP

Average speed of the vehicle fleet in São Paulo, 1981-2000



PM_{10} concentration (annual mean) in selected metropolitan regions in Brazil, 1997-2006



Source: Marcilio I, Gouveia N. Cad. Saúde Pública 2007, 23:S529-S536

Climate change and health

Mudanças climáticas e saúde

1- Carlos Corvalan - PAHO

Environmenta change – new threats to public health

2- Chistovam Barcellos –Fiocruz

Climate change and health inequalities

3- Carlos Nobre – INPE

Climate change and its impacts in Brazil