Health effects of ambient air pollution

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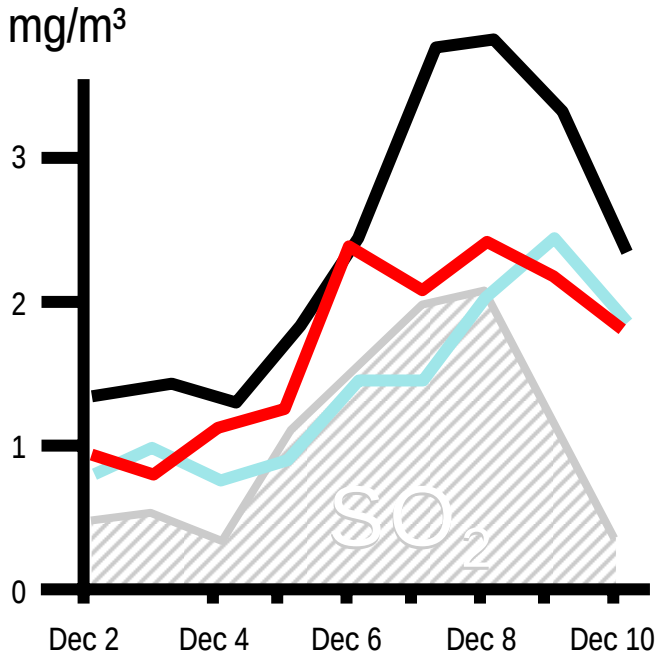
London 1952

- **Increased pollution levels**
  - → SO_2 **5** times normal
  - → Soot **4** times normal
- **Mortality**
  - → **4000-12000** extra cases
  - → **3** times normal
- **Pulmonary disease**
  - → **2,5** times normal
- **Cardiovascular disease**
  - → **1,5** times normal

Piccadilly 7 dec 1952

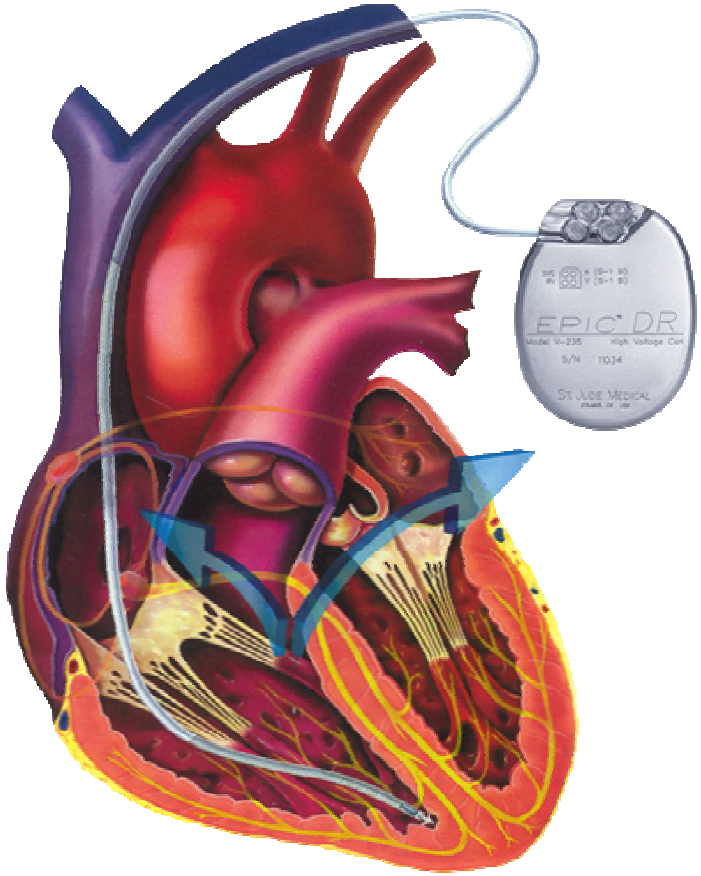


Short-term effects by air pollution on cardiovascular and respiratory endpoints

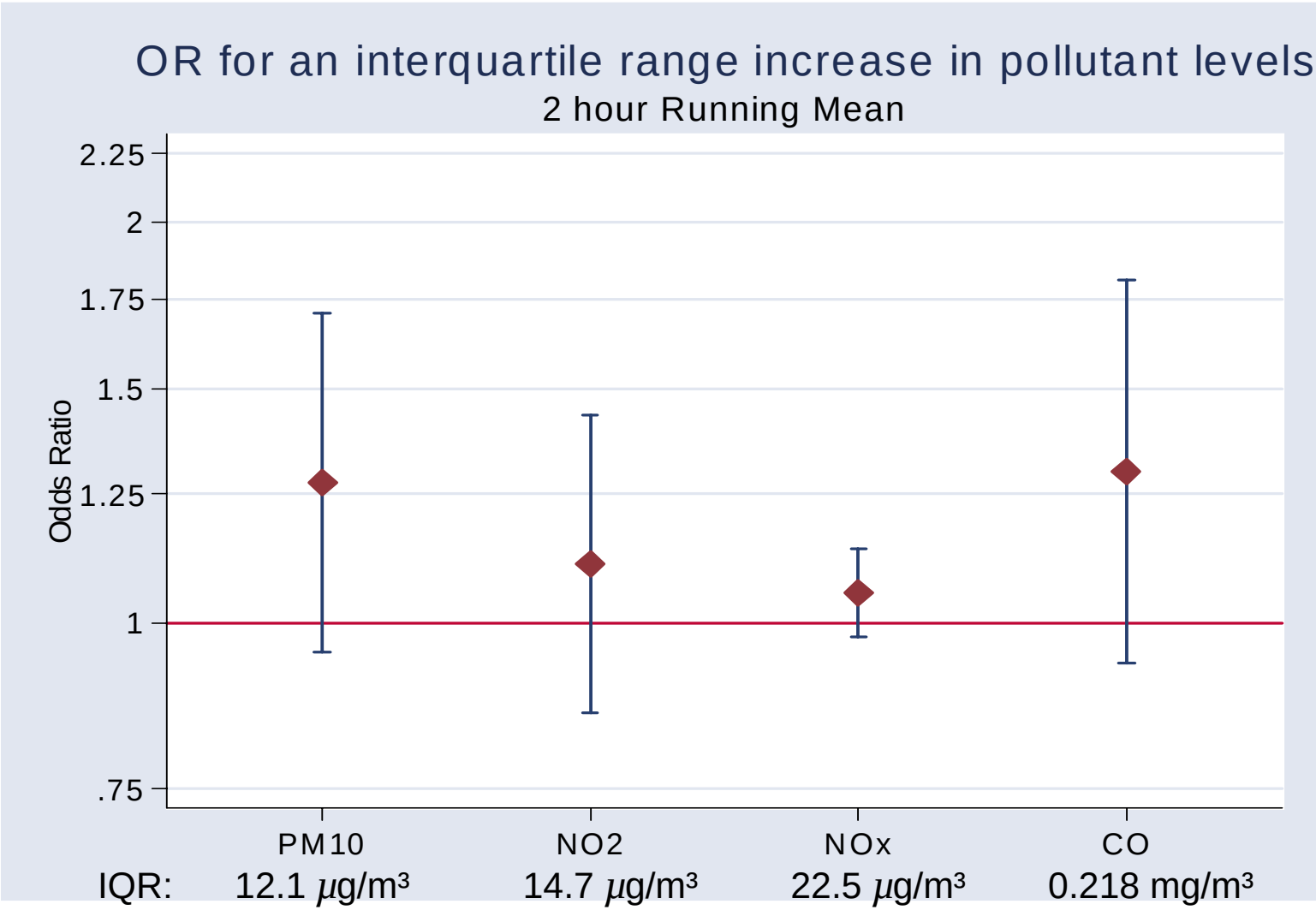
- Mortality
- Morbidity
- Cardiac arrythmia
- Inflammation

Air pollution and Life-threatening Ventricular Arrythmias

- 179 ICD patients, Gothenburg and Stockholm
- 93 Ventricular arrythmias in 61 patients
- PM10 levels
  - → 18 µg/m³ Mean hourly levels Stockholm
  - → 21 µg/m³ Mean hourly levels Gothenburg
- Case-crossover design



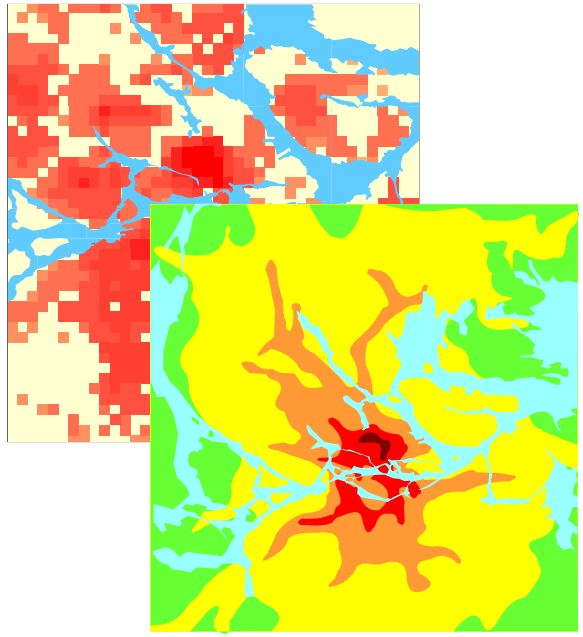
Risk of myocardial infarction in relation to air pollution levels during preceeding 2h



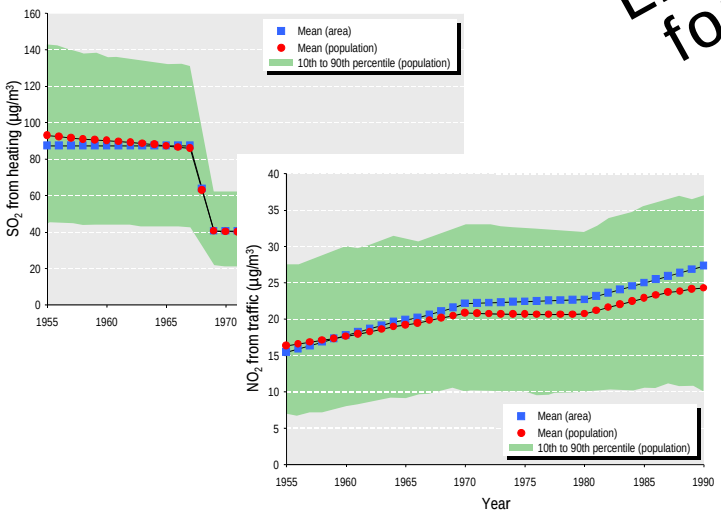
Long term exposure to air pollution

Residential history for study subjects

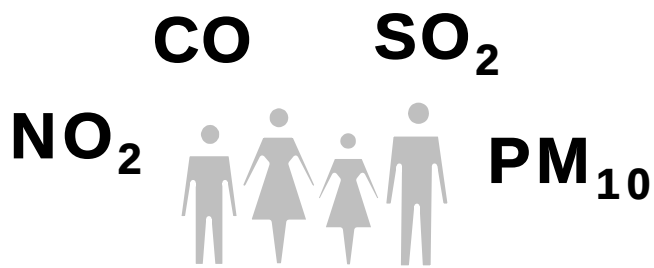
Geocoding and linking co-ordinates to dispersion models

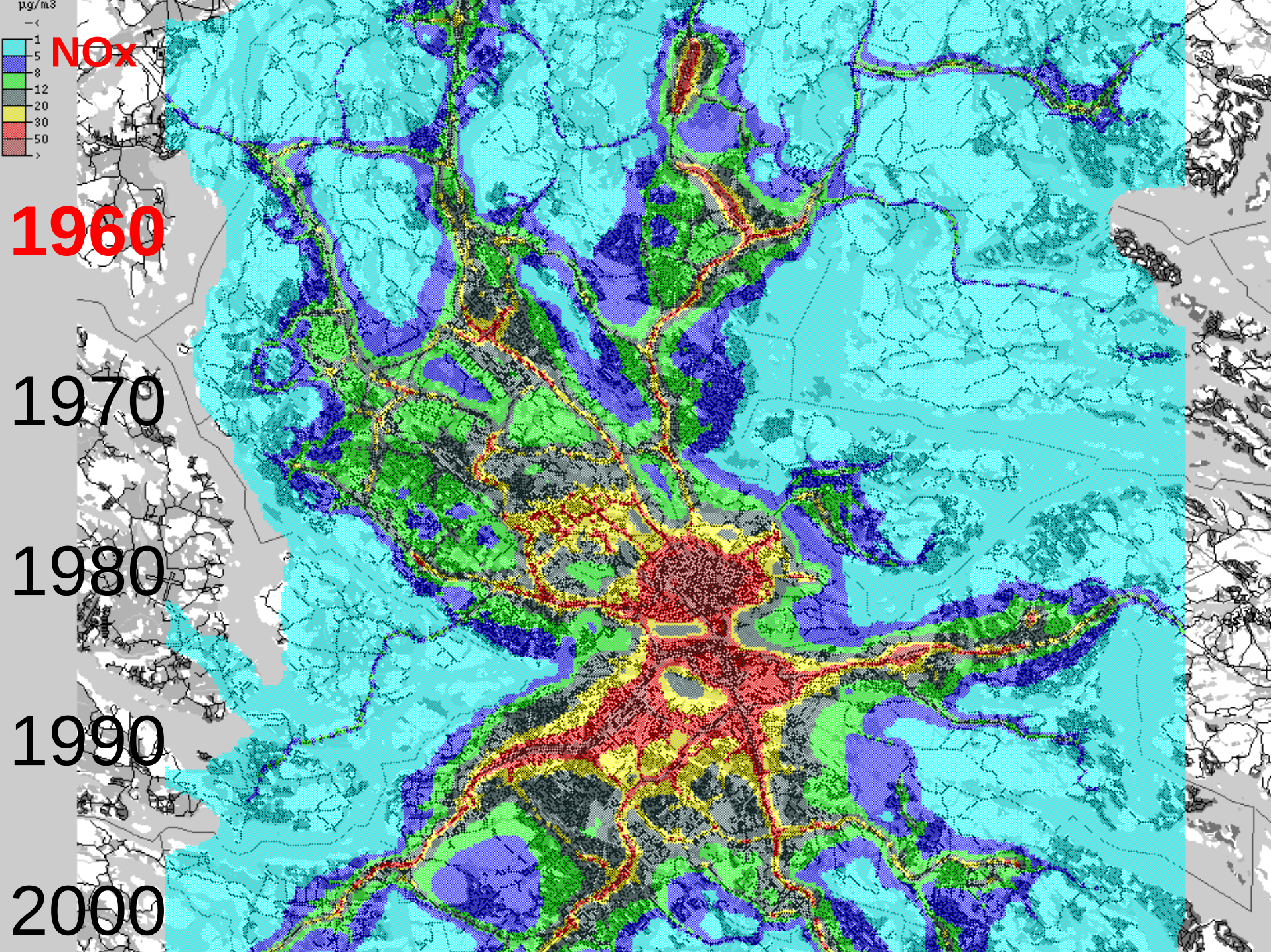


Linear interpolation for years between EDBs



Emission databases (EDB)
1960, 1970, 1980, 1990, 2000

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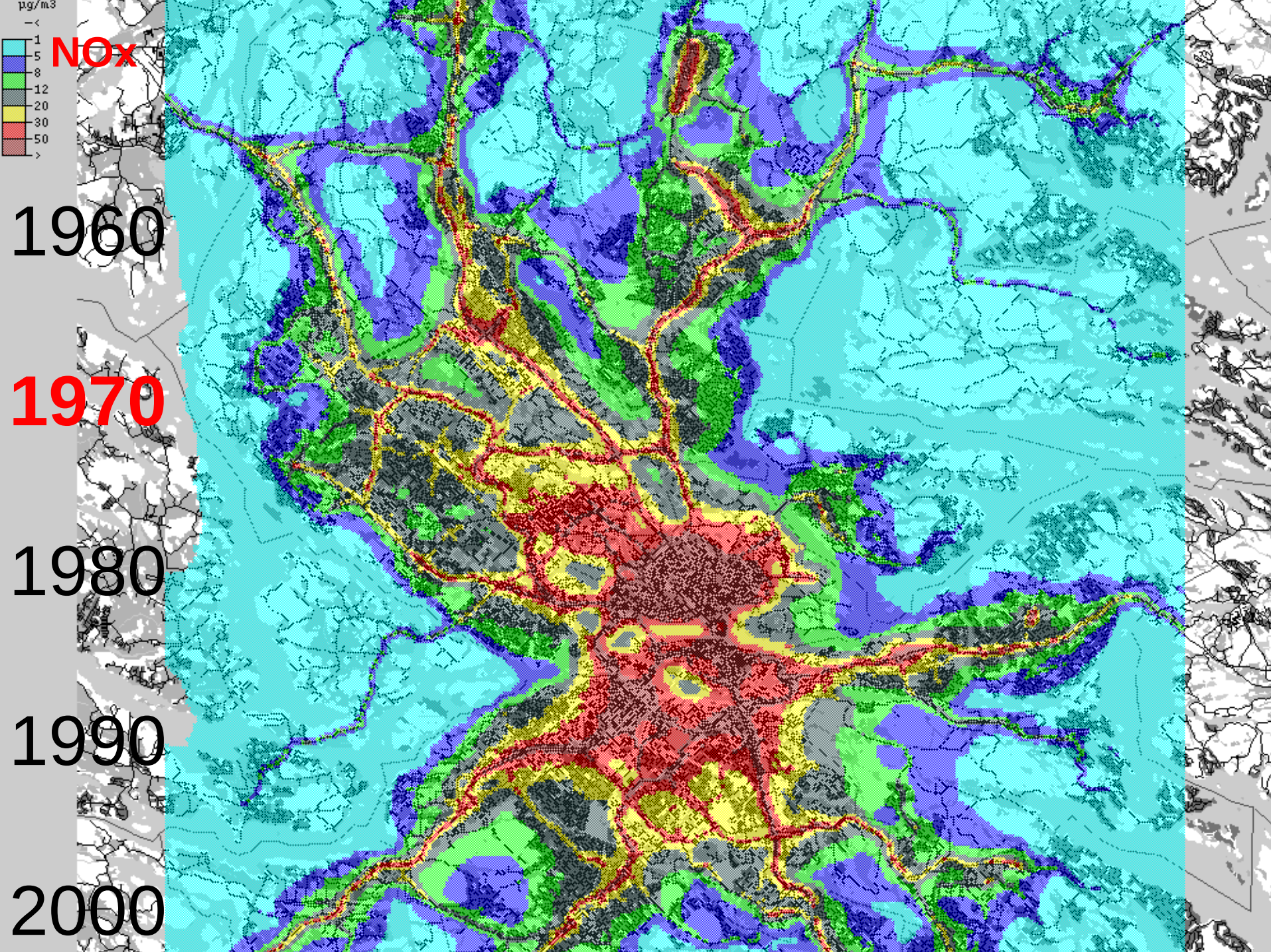
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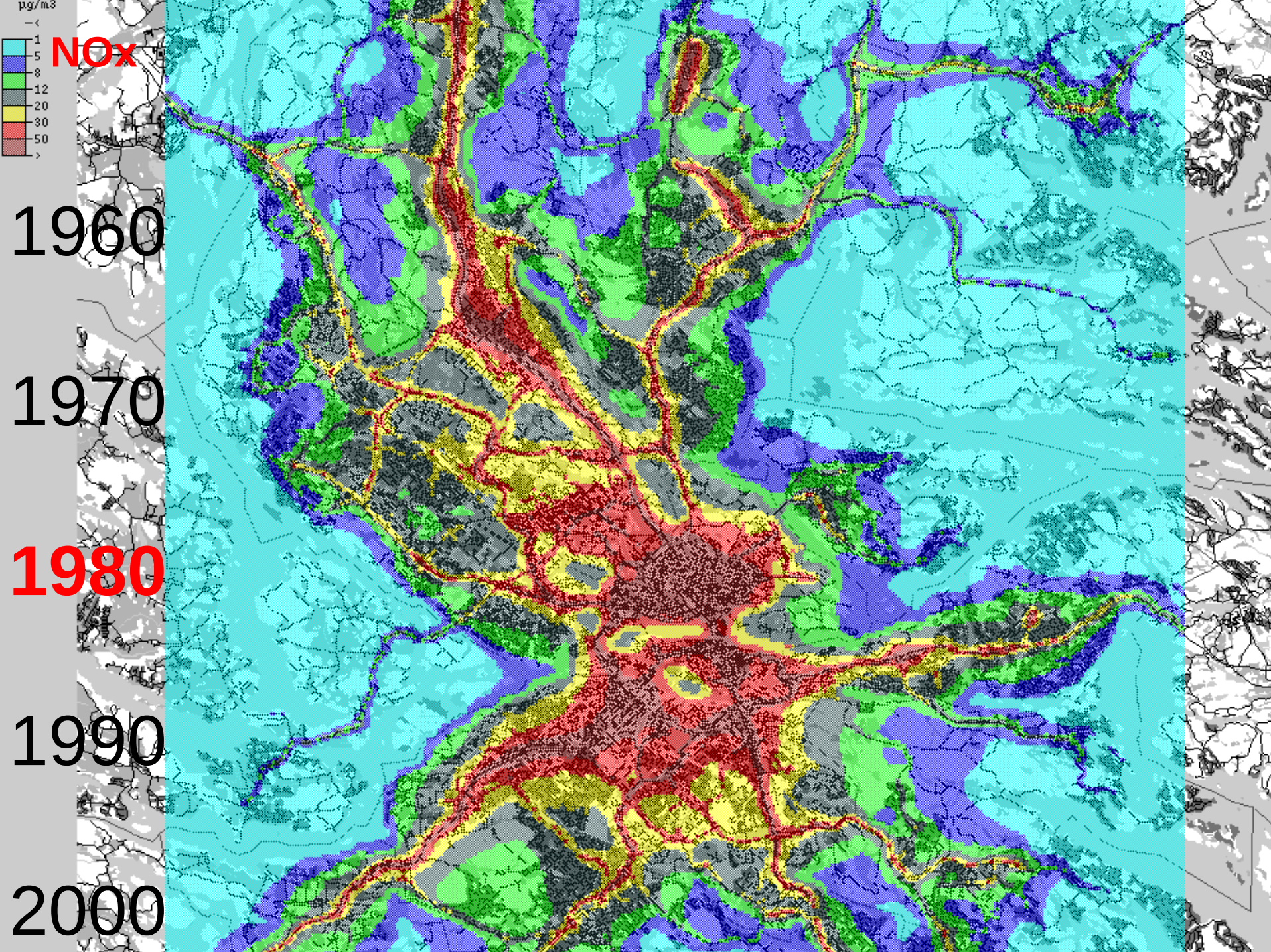
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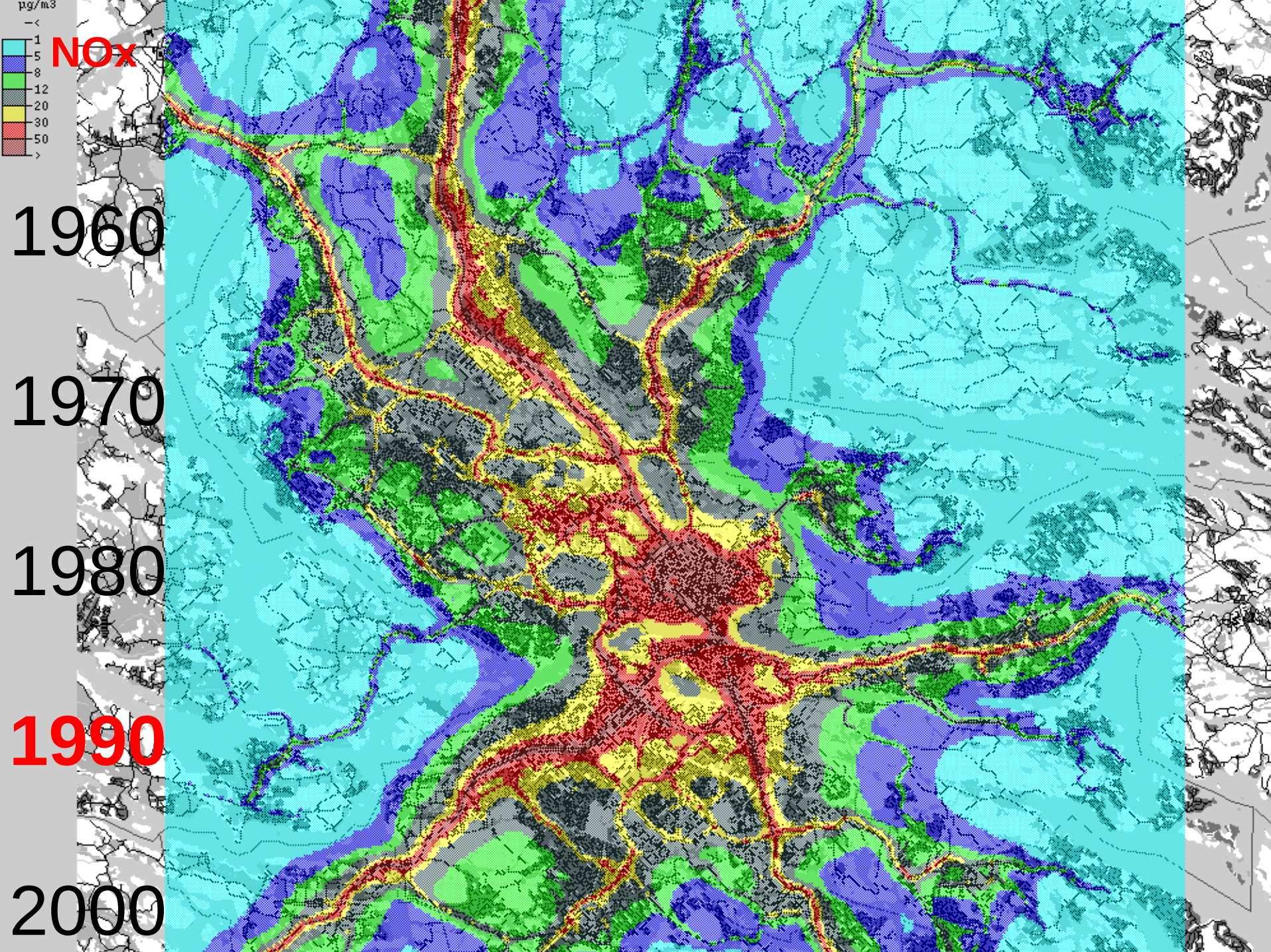
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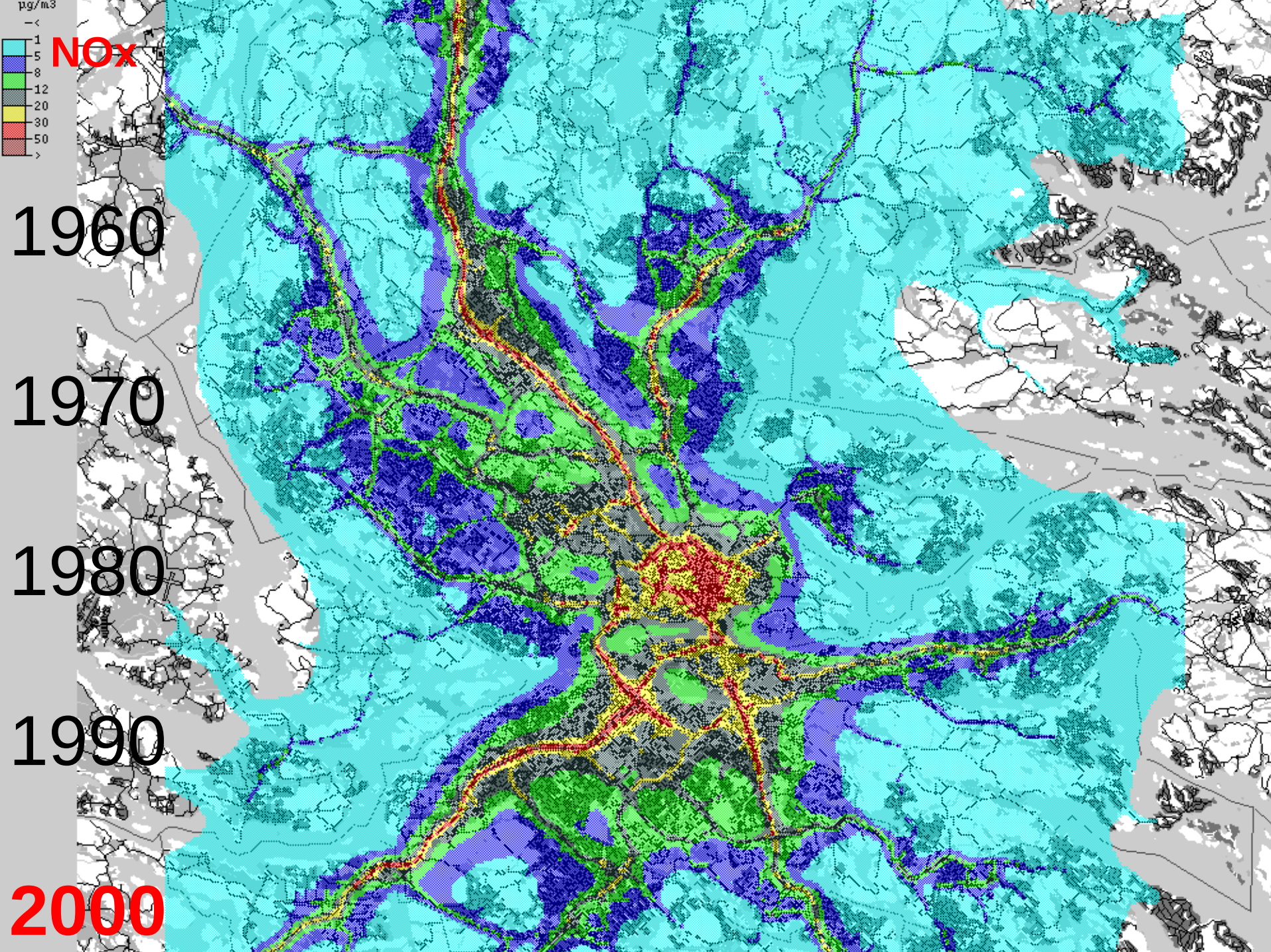
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Long-term exposure to air pollution and cardiac effects

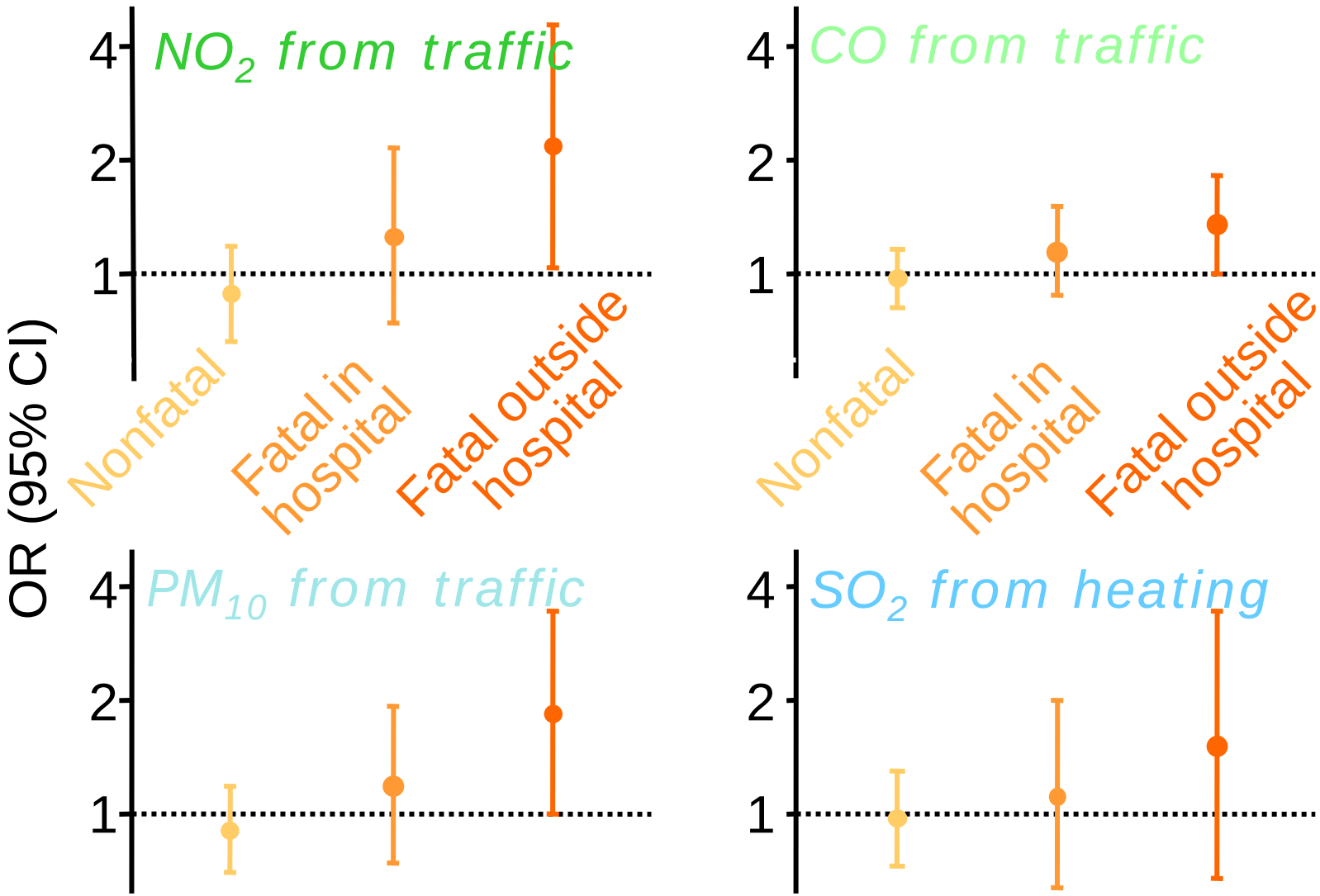
- ✓ Population-based case-control study in Stockholm County 1992-1994
- ✓ All first-time myocardial infarction cases 45-70 years old
- ✓ Controls matched on age, sex, and hospital catchment area
- ✓ Risk factors for MI from questionnaire, telephone interview and health examination (n=4,067)
- ✓ Source-specific air pollution exposure during each year between 1960-1994

Relative risk for MI and air pollution exposure

Source-specific air pollution exposure	All cases		Fatal cases	
	OR	(95% CI)	OR	(95% CI)
NO_2 from traffic	0.99	(0.76-1.30)	1.51	(0.96-2.37)
CO from traffic	1.04	(0.89-1.21)	1.22	(0.98-1.52)
PM_{10} from traffic	1.00	(0.79-1.27)	1.39	(0.94-2.07)
SO_2 from heating	1.03	(0.78-1.36)	1.24	(0.77-2.02)

ORs calculated for a change in pollution level from the 5th-95th percentile.
Adjusted for age, sex, hospital, smoking, physical inactivity, diabetes, socioeconomic status.

Risk of non-fatal MI, fatal MI in or outside hospital in relation to air pollution exposure



*Adjusted for age, sex, hospital, smoking, socioeconomic status, physical inactivity, diabetes

Air pollution and airway disease in preschool children

1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

Exposure questionnaire and dust 4089 100%

1 year symptom questionnaire 3925 96%

2 year symptom questionnaire 3843 94%

4 year follow up

Questionnaire	3720	91 %
Dust	3610	88 %
PEF	2966	73 %
Blood and spec IgE	2614	64 %

Transient wheeze

Late onset wheeze

Persistent wheeze

Peak Expiratory Flow

Sensitisation to specific IgE's

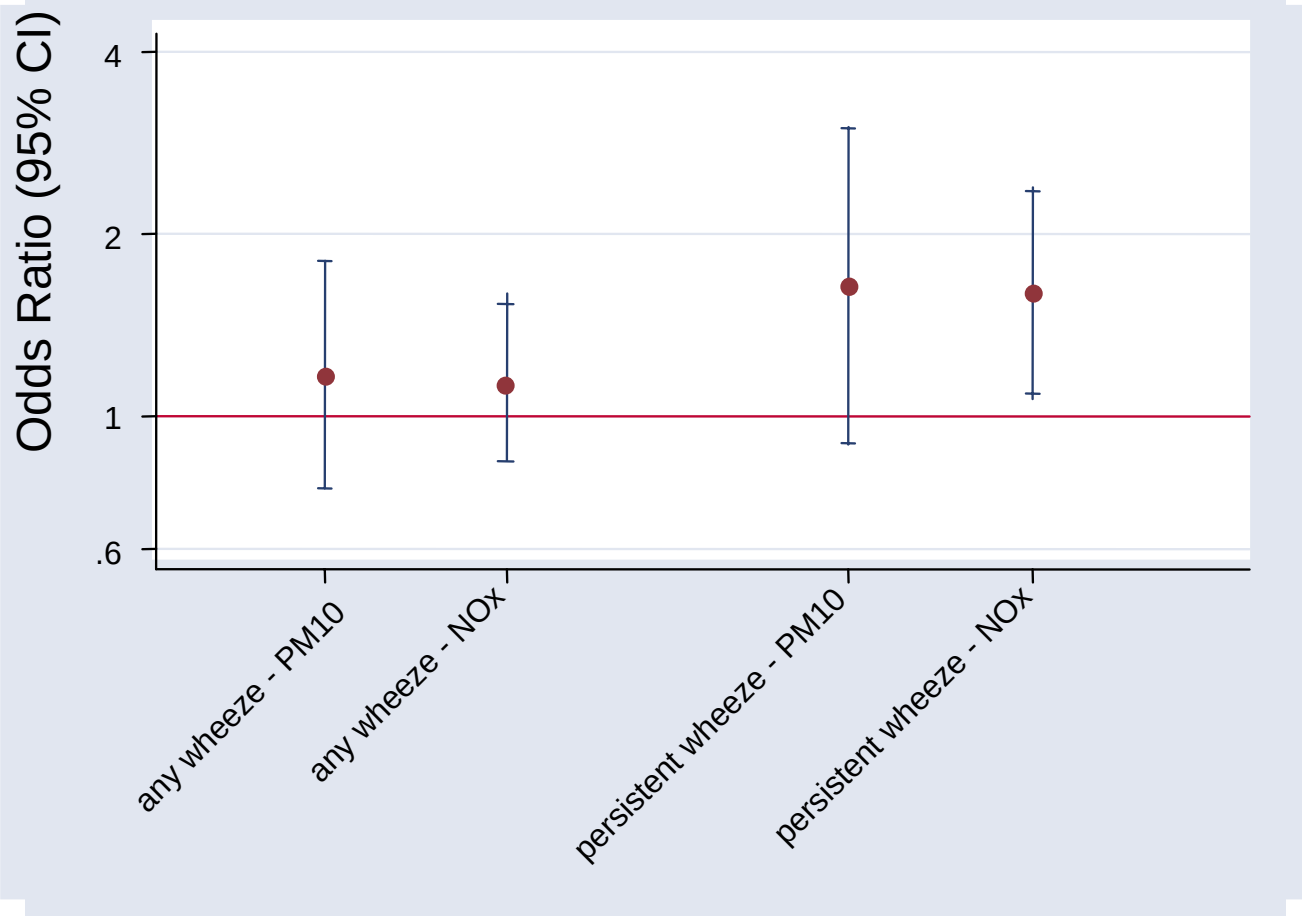
Peak Expiratory Flow in relation to air pollution exposure

Mean PEF: 169 l/min, SD 29 l/min

Effect on PEF (l/m)	**Traffic-PM_{10}**	**Traffic-NO_x**
Point estimate (95%CI)*	-5.36 (-10.67, -0.05)	-3.08 (-6.84, 0.68)

*Adjusted for sex, age, height and municipality

Wheeze in relation to air pollution exposure

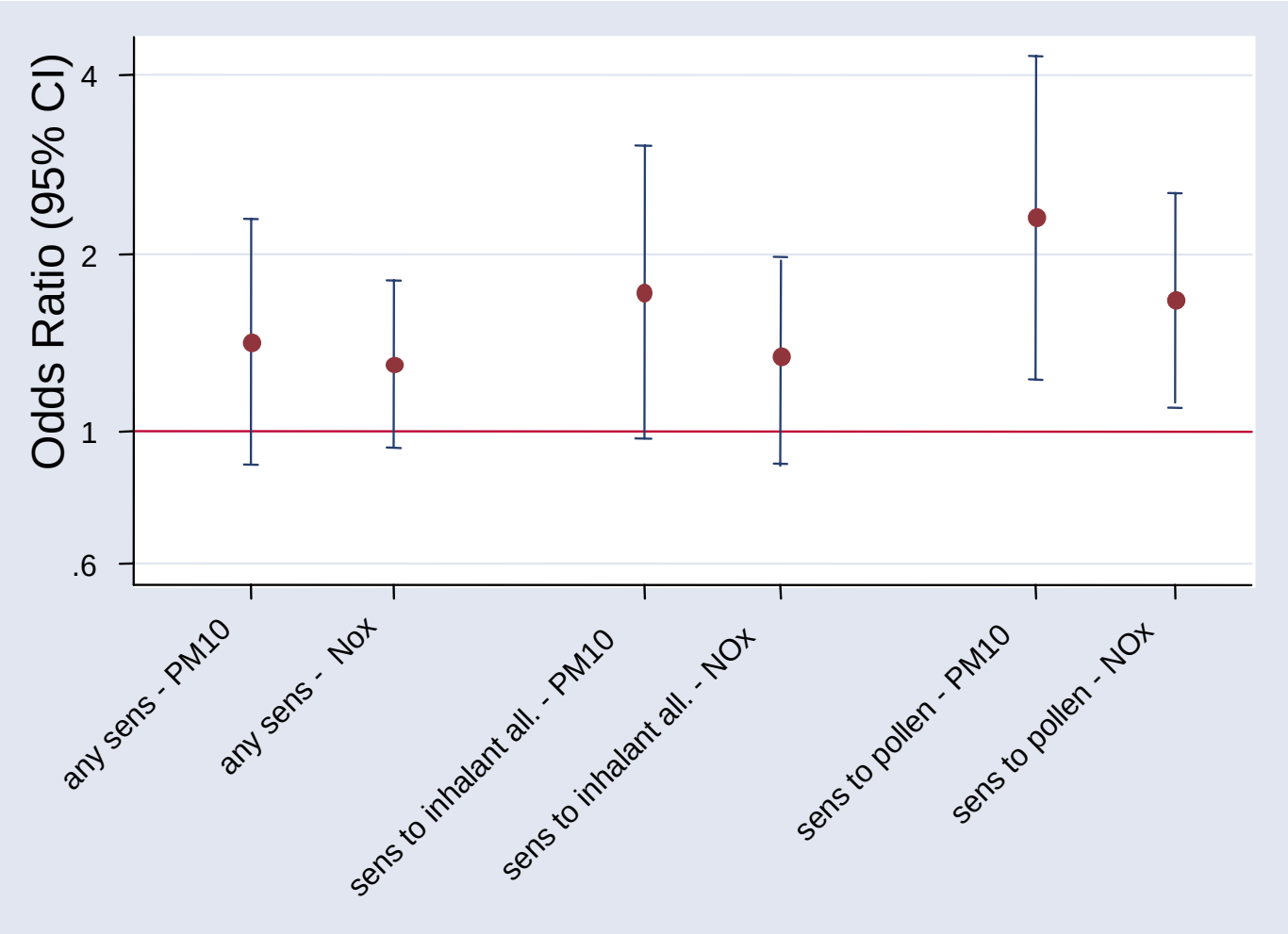


Exposure 1:st year of life.

Outcome up to 4 yrs of age

Adjusted for municipality, socioeconomic status, heredity, mother's smoking during pregnancy and in infancy, year that house was built, damp or mould in the home at birth and sex of the child

Sensitization in relation to air pollution exposure



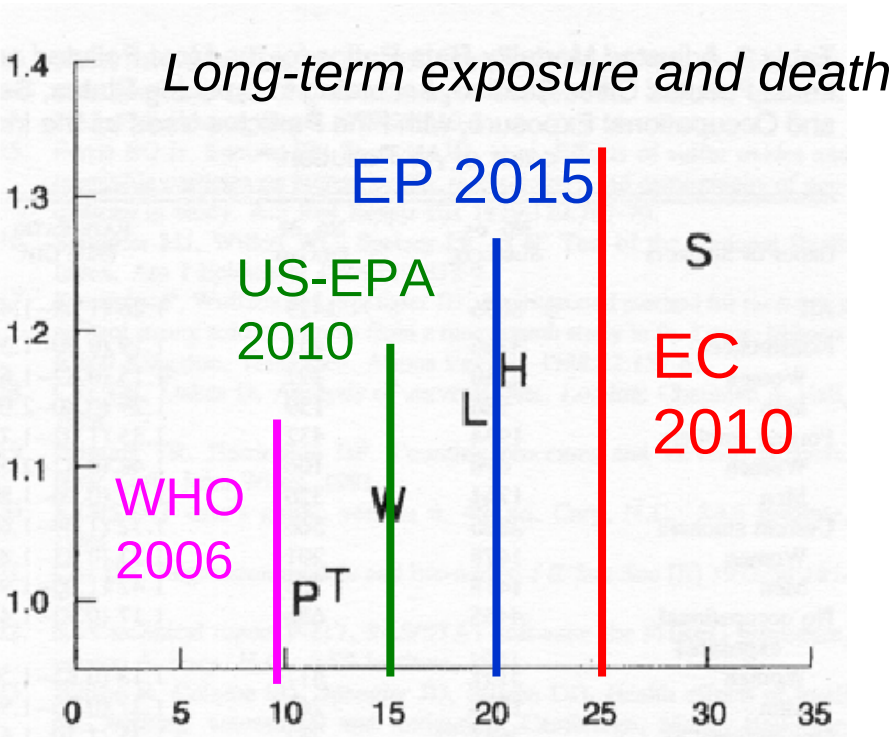
Exposure 1:st year of life.

Outcome up to 4 yrs of age

Adjusted for municipality, socioeconomic status, heredity, mother's smoking during pregnancy and in infancy, year that house was built, damp or mould in the home at birth and sex of the child

Air pollution guidelines in relation to exposure-response relationships in epidemiological studies

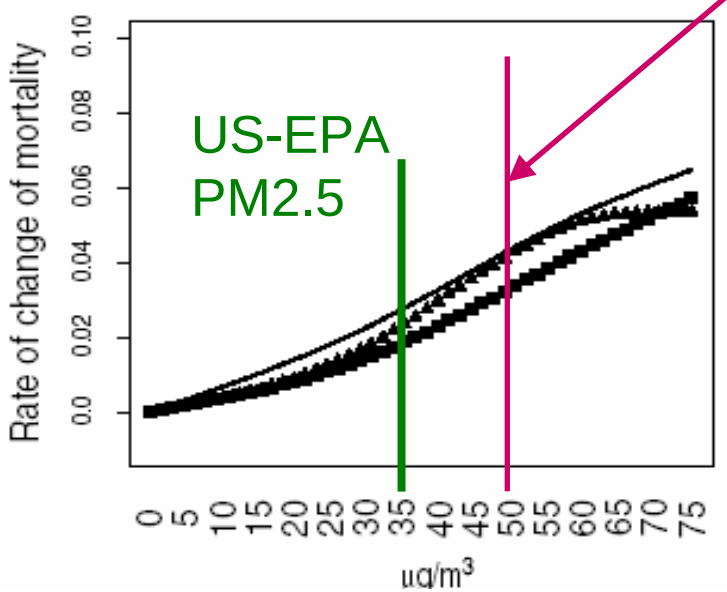
MKN for PM10, WHO 2006



Fine particles (PM2.5)

Dockery et al, NEJM 1993

Short-term exposure and death in cardiovascular disease



Fine and coarse particles (PM10)

Daniels et al, Am J Epidemiology 2000

Conclusions

- Air pollution exposure assessment
  - → Complex mixtures, exposure characterisation difficult
- Short-term effects
  - → Mortality, previous cardiac disease marks increased susceptibility, inflammation, arrythmia
- Long-term effects on lung cancer
  - → Long induction-latency period
- Long-term cardiac effects
  - → Cardiac death, myocardial infarction
- Long-term respiratory effects in adults and children
  - → Lung function, symptoms, sensitisation
- Guidelines and limit values
  - → WHO, US-EPA, EU