
UMEÅ UNIVERSITET

Luftföroreningar och hälsoeffekter?

Lars Modig
Doktorand, Yrkes- och miljömedicin
Umeå universitet

- Fordonsavgaser / Exponering
- Hur studerar man hälsoeffekter
- Lite resultat
- Exempel på epidemiologisk studie
- Tillämpning
- Slutsatts

Trafikens luftföroreningar – inte bara avgaser

- *Förbränningsavgaser: ”*ultrafina” partiklar, kolväten (PAH, bensen mm), CO, NOx
- *Slitagepartiklar:* partiklar av vägmaterial, däck, bromsbelägg (mest ”grova”)
- *Sekundärt bildade föroreningar:* ozon, nitrat, sulfat (”fina partiklar”)

- Partiklar är i fokus

Hur kan man studera sambanden mellan hälsa och fordonsavgaser

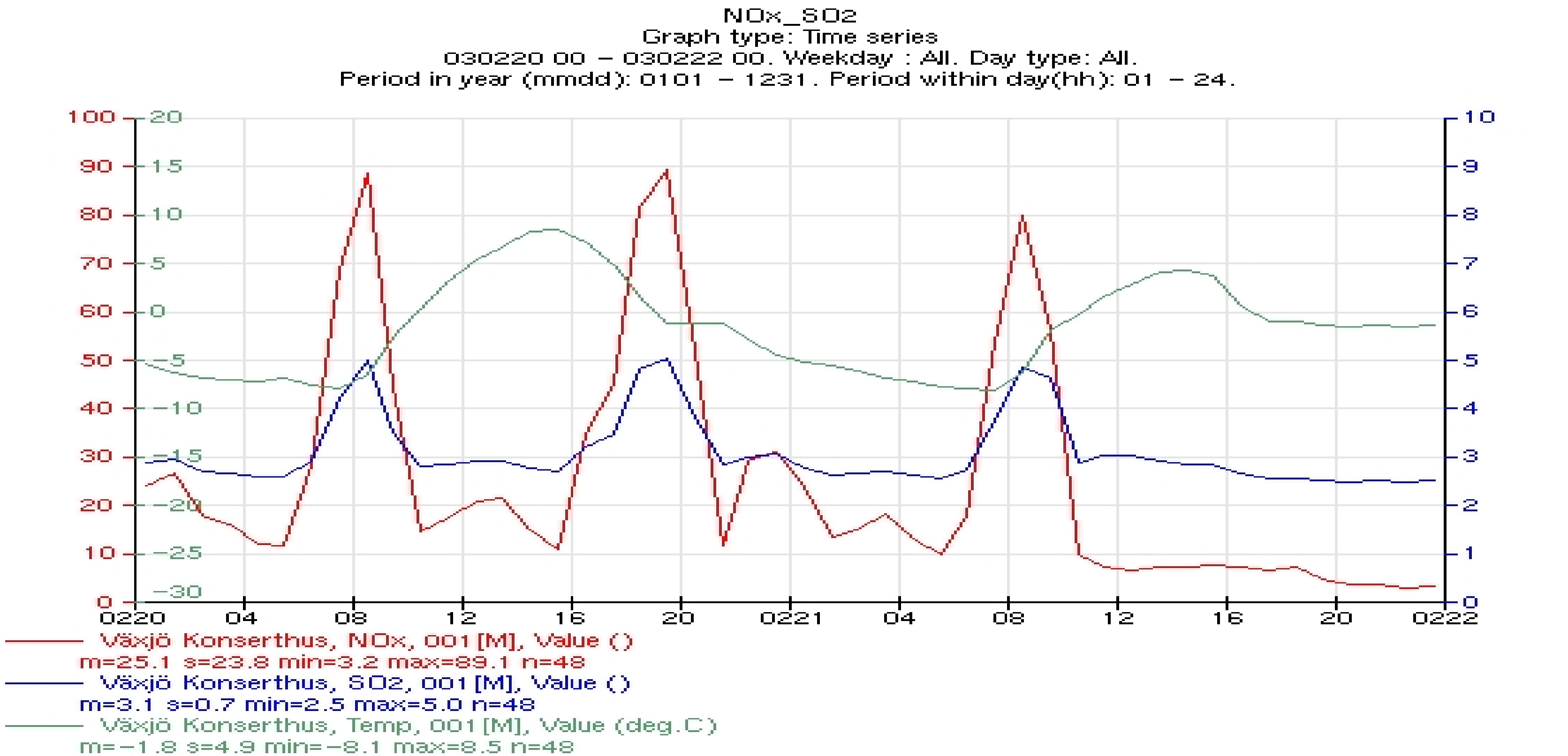
- Experimentella studier
  - Exponeringsstudier
    - Människor
    - Djur
- Epidemiologiska studier
  - Korttidsstudier
    - Tidsseriestudier, panelstudier
  - Långtidseffekter
    - Tvärsnittsstudier
    - Fall-kontrollstudier
    - Kohortstudier
- Barn alt Vuxna

Exponering i epidemiologiska studier

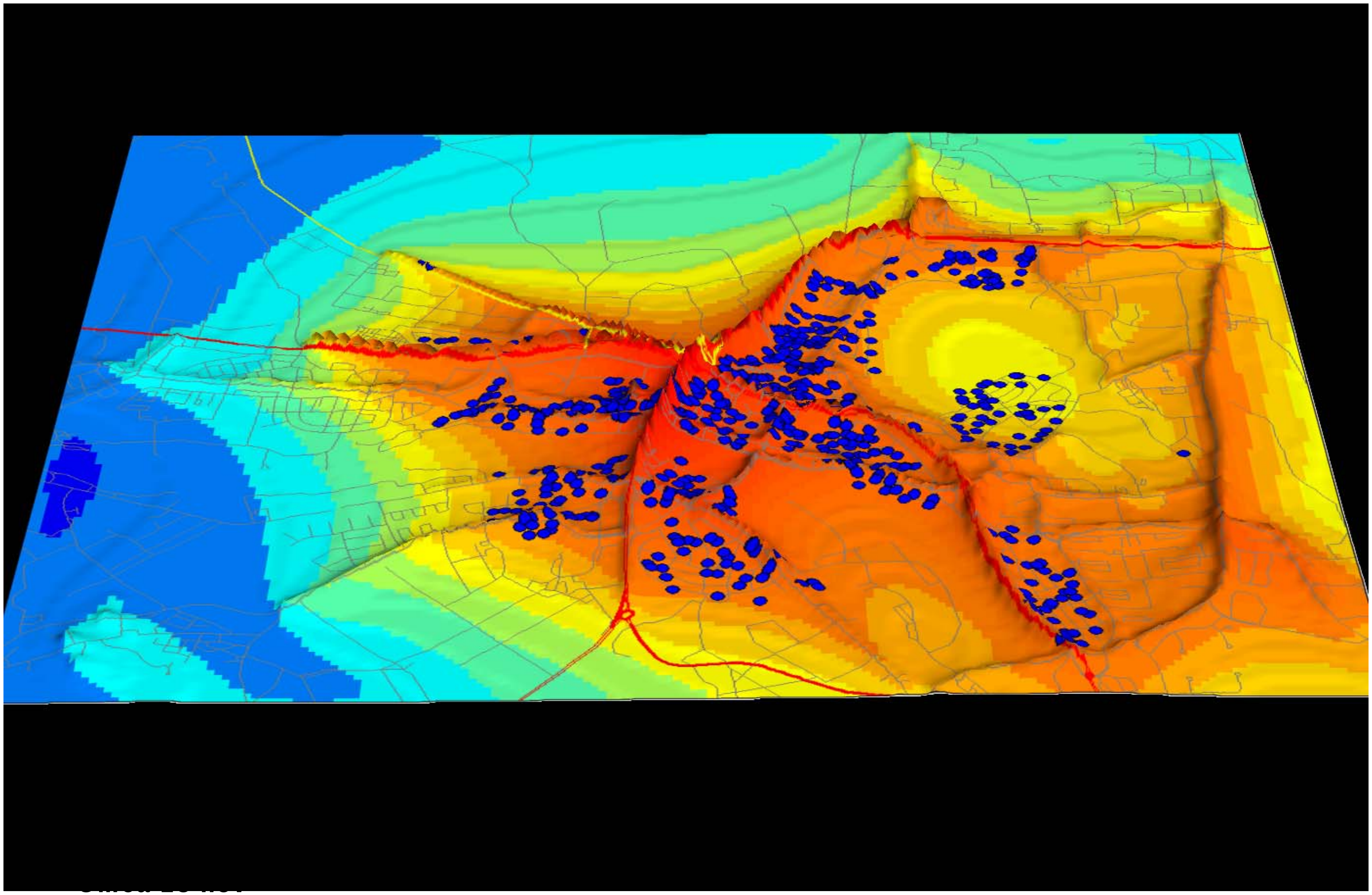
- Beror av studie design
- Representativa exponeringsmått
  - Specifika ämnen
  - Indikatorer
    - Specifika ämnen (NO_2 vanlig)
    - Andra typer av mått (avstånd, summering osv)
    - Spridningsmodeller/Land use regression
- Trenden går mot högre upplösning

Indikatorer

- Är indikatorer
- Kan spegla olika ämnen/källor



Gradienter i beräknad årsmedelhalt (NO_2) för 1500 Umebor i en enkätstudie

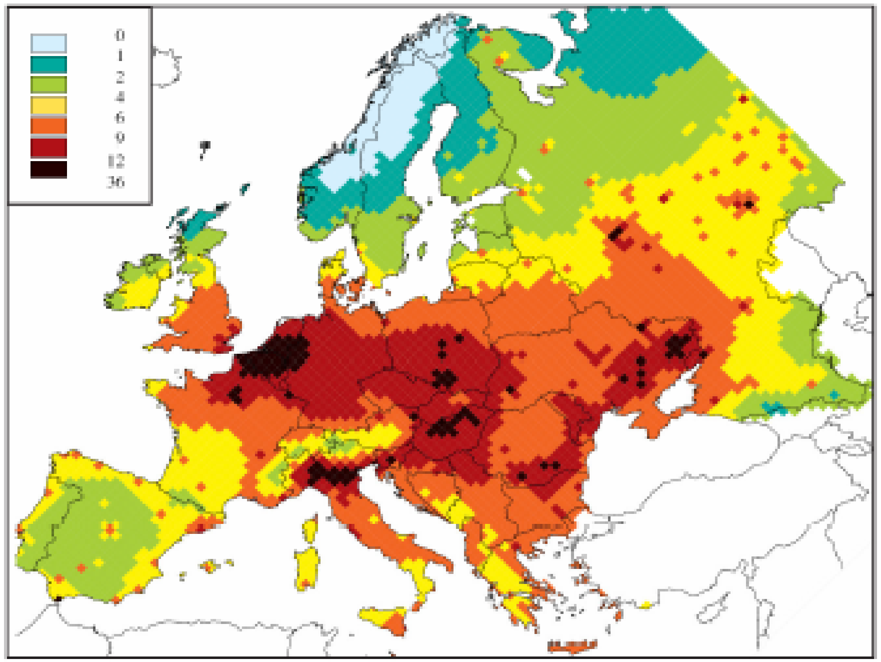


Luftföroreningar är ett känt folkhälsoproblem

- **Hårda och mjuka utfall**
  - Dödlighet
    - Hjärt-kärl, Lungsjukdom, Cancer
  - Sjuklighet
    - Försämring av Astma, Hjärt-kärl
    - Uppkomst av Astma/Allergi
    - Försämring av Lungfunktion/tillväxt
    - Foster/Graviditet
    - Medicinering
  - Störning

EU beräknar antal dödsfall pga partiklar (PM2.5) till 350 000 per år

Loss in life expectancy attributable to exposure to fine particulate matter - 2000



Loss in statistical life expectancy that can be attributed to the identified anthropogenic contribution to PM2.5 (months), for the emissions of the year 2000. Calculation results for the meteorological conditions of 1997.
Source: IIASA

CAFE:s 3300 döda/år i Sverige är lägre än skattat av Forsberg et al (Ambio, 2005;34:11-19) ca 3500 döda/år pga regional halt samt

1800 döda/år pga tätortsbidrag

Bertil Forsberg, Hans-Christen Hansson, Christer Johansson, Hans Areskoug, Karin Persson and Bengt Järvholm

Comparative Health Impact Assessment of Local and Regional Particulate Air Pollutants in Scandinavia

The ongoing program Clean Air for Europe (CAFE) is an initiative from the EU Commission to establish a coordinated effort to reach better air quality in the EU. The focus is on particulate matter as it has been shown to have large impact on human health. CAFE requested that WHO make a review of the latest findings on air pollutants and health to facilitate assessments of the different air pollutants and their health effects. The WHO review project on health aspects of air pollution in Europe confirmed that exposure to particulate matter (PM), despite the lower levels we face today, still poses a significant risk to human health. Using the recommended uniform risk coefficients for health impact assessment of PM, regardless of sources, premature mortality related to long-range transported anthropogenic particles has been estimated to be about 3500 deaths per year for the Swedish population, corresponding to a reduction in life expectancy of up to about seven months. The influence of local sources is more difficult to estimate due to large uncertainties when linking available risk coefficients to exposure data, but the estimates indicate about 1800 deaths brought forward each year with a life expectancy reduction of about 2–3 months. However, some sectors of the population are exposed to quite high locally induced concentrations and are likely to suffer excessive reductions in life expectancy. Since the literature increasingly supports assumptions that combustion related particles are associated with higher relative risks, further studies may shift the focus for abatement strategies. CAFE sets out to establish a general cost effective abatement strategy for atmospheric particles. Our results, based on studies of background exposure, show that long-range transported sulfate rich particles dominate the health effects of PM in Sweden. The same results would be found for the whole of Scandinavia and many countries influenced by transboundary air pollution. However, several health studies, including epidemiological studies with a finer spatial resolution, indicate that engine exhaust particles are more damaging to health than other particles. These contradictory findings must be understood and source specific risk estimates have to be established by expert bodies, otherwise it will not be possible to find the most cost effective abatement strategy for Europe. We are not happy with today's situation where every strategy to reduce PM concentrations is estimated to have the same impact per unit change in the mass concentration. Obviously there is a striking need to introduce more specific exposure variables and a higher geographical resolution in epidemiology as well as in health impact assessments.

INTRODUCTION

The WHO review project, initiated by the EU Commission Clean Air for Europe (CAFE), on health aspects of air pollution in Europe confirmed that exposure to particulate matter (PM), despite the lower levels we see today, still poses a significant risk to human health (1, 2). In particular, the long-term effect on mortality is a serious impact. The review further concluded that it has not been possible to establish a causal relationship between PM-related health effects and one single PM component, even though a number of epidemiological and toxicological studies suggest that some types of emissions are more strongly associated with health effects, especially motor vehicle exhausts and other combustion products. Despite these indications, the WHO reports do not propose any source or compound-specific risk coefficients for PM. The lack of source-specific relative risks have also resulted in the recommendation by a WHO expert meeting to use one single risk coefficient for anthropogenic PM in the CAFE assessment built on the RAINS model (http://www.iiasa.ac.at/rains/index.html). This simple approach is in line with the APHEIS health impact assessment focusing on PM in 26 Eu-

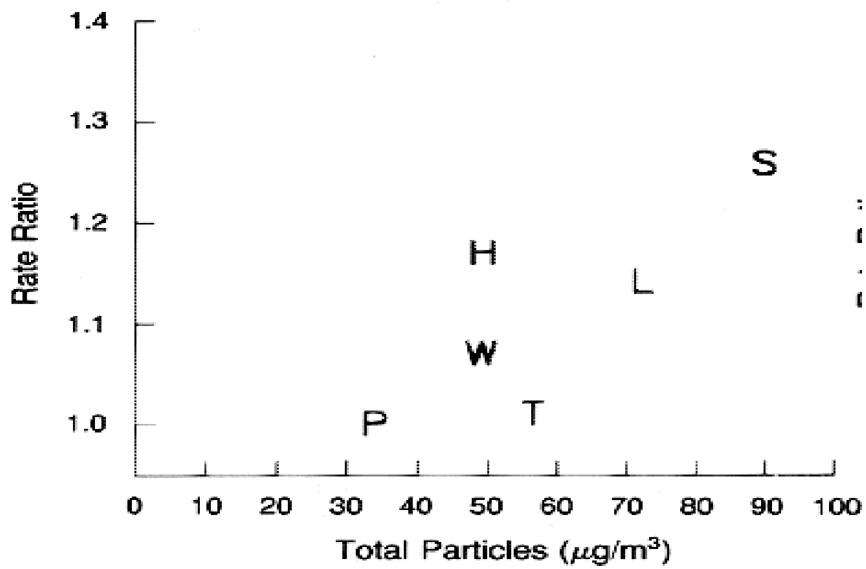
AIM

Due to the lack of data about how different PM components act in a complex mixture, experts still do not judge it possible to precisely quantify the contributions from the main sources and components, to the effects on human health (1, 2). Thus, PM in health impact assessments is usually handled as a uniform pollutant, regardless of the contribution from different sources, and assuming the same effect on mortality. This is probably not a correct assumption, but is a pragmatic compromise while waiting for sufficient knowledge that will allow the use of indicators other than particle mass and/or source specific relative risks. The aim of this study is to describe the level of mortality in Sweden today and in the near future will be affected by regional and local PM when using this common assumption.

PM10 CONCENTRATIONS

Concentrations of PM10 in Sweden are mainly measured by two different networks. The main network consists mainly of

U.S. Six Cities study



P=Portage, WI
T=Topeka, KS
W=Watertown, MA
S=Steubenville, OH
H=Harriman, TN
L=St. Louis, MO

Source: Dockery D, et al. An Association between Air Pollution and Mortality in Six U.S. Cities, NEJM 1993; 329 (24):1753-1759.

Andningsorganens sjukdomar och fordonsavgaser

TABLE 3. Associations of Residential Levels of Air Pollution During the First Year of Life With Peak Expiratory Flow (L/min) at age 4 yr (n = 2565)

	No.	Traffic-PM_{10}[a] Point Estimate (95% CI)	Traffic-NO_x[a] Point Estimate (95% CI)	Heating-SO_2[a] Point Estimate (95% CI)
All subjects[b]	2565	−5.36 (−10.67 to −0.053)	−3.08 (−6.84 to 0.68)	−2.07 (−7.28 to 3.14)
Girls[c]	1251	−5.73 (−11.73 to 0.29)	−3.33 (−7.80 to 1.14)	−4.51 (−10.70 to 1.68)
Boys[c]	1314	−5.00 (−11.03 to 1.04)	−2.81 (−7.36 to 1.73)	0.47 (−5.79 to 6.74)

[a]Effects (L/min) are calculated for a difference in the source-specific air pollution level from the 5th to 95th percentile range in the cohort (6 $\mu g/m^3$ for PM_{10}, 44 $\mu g/m^3$ for NO_x, and 3 $\mu g/m^3$ for SO_2).

[b]Adjusted for sex, age, height, and municipality.

[c]Adjusted for age, height, and municipality.

- Nordling et al 2008

Meteorologisk spridningsmodell

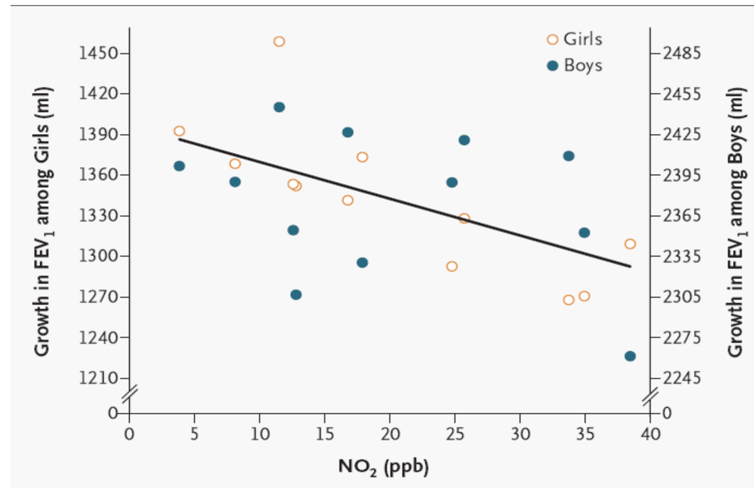


Figure 2. Community-Specific Average Growth in FEV_1 among Girls and Boys During the Eight-Year Period from 1993 to 2001 Plotted against Average Nitrogen Dioxide (NO_2) Levels from 1994 through 2000.

Gauderman et al 2004

Slutsats

- Höga halter av fordonsavgaser utanför hemmet ökar risken för nyinsjuknande i astma bland vuxna
- Medelhalten var 18 µg/m^3 (NO_2), max 45
  All effekt under miljökvalitetsnormen!

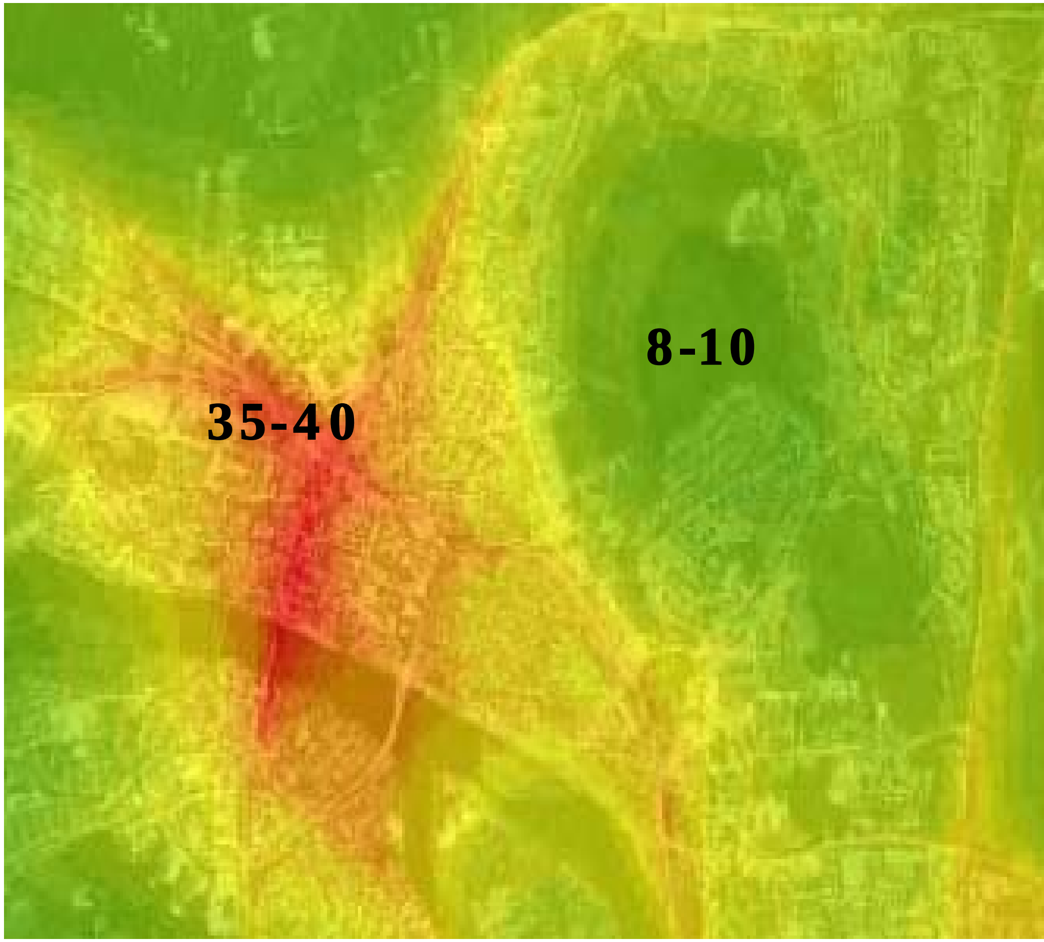
Hur kan resultaten från epidemiologiska studier tillämpas

Umeå som exempel?

-Skillnad mellan högsta och lägsta ca 25 µg/m3

-Oddskvoten för 1 µg/m3 ökning är 1.037

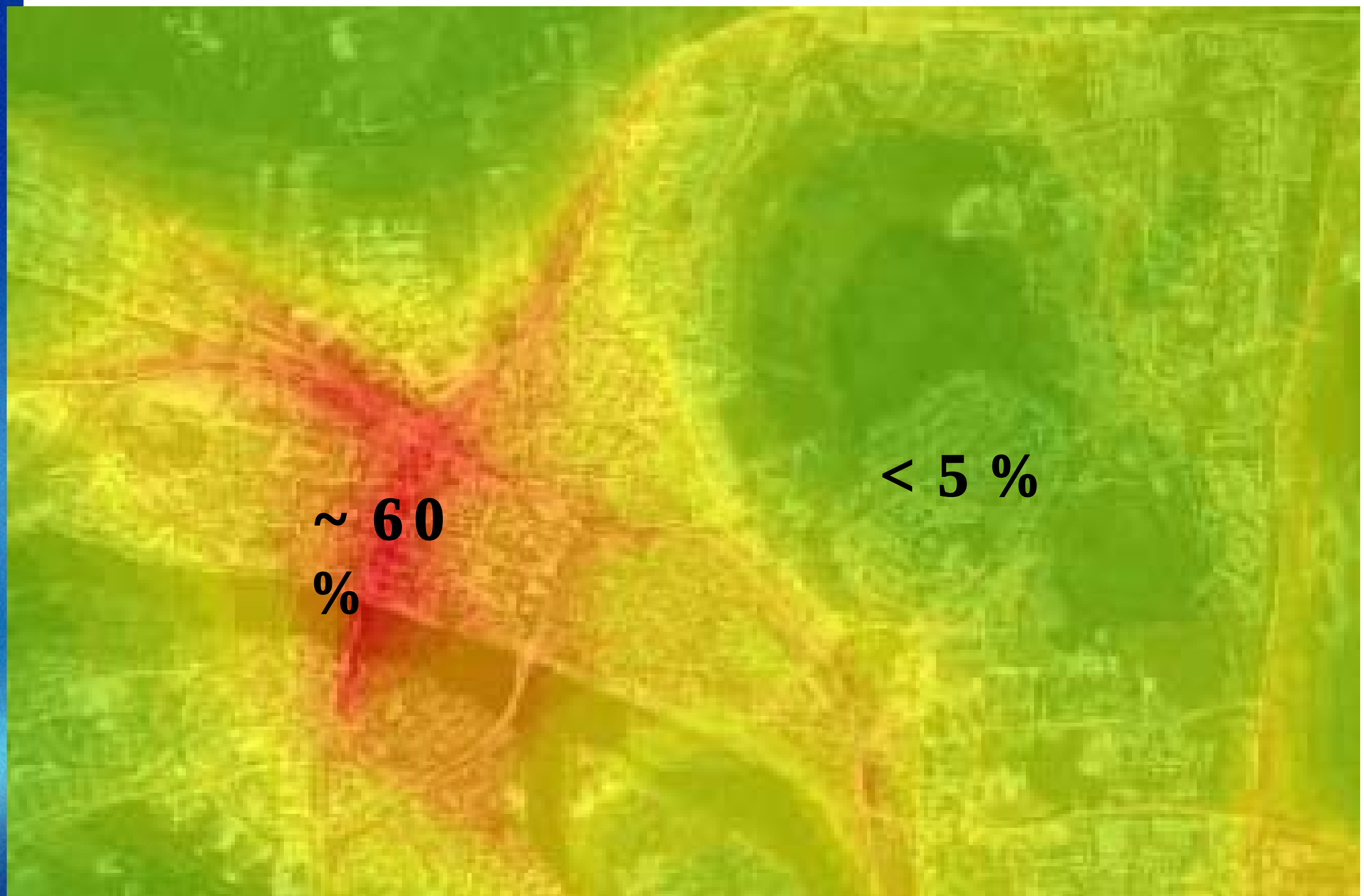
-För 25 µg/m3 är oddskvoten ca 2.5.



NO2-medelvärden i Umeå (µg/m3)

Vilken betydelse för hälsan kan förväntas?

Andel mycket besvärade av avgaser utanför bostaden

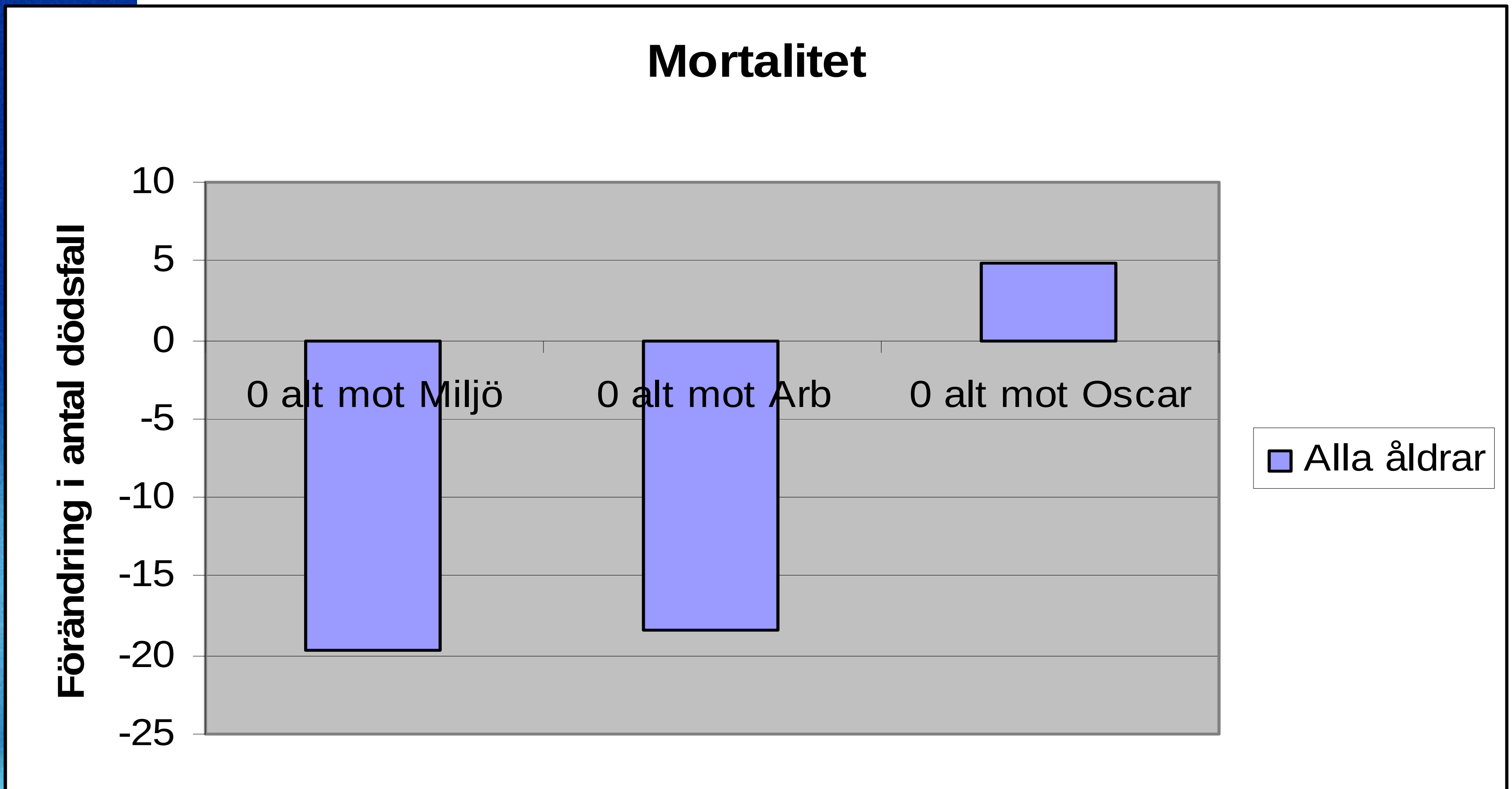


Göteborgs åtgärdsprogram för NO_2

- **Befolkningsexponering**
  - Befolkningsexponeringen beräknades som halten i varje ruta*befolkningen i motsvarande ruta
  - Summan dividerat med totala befolkningen ger en befolkningsviktad medelhalt för resp alternativ
  - Alternativen jämfördes med noll-alternativet
  - För exempel ar2006mpa var skillnaden 0.5µg/m^3

- **Dos-respons**
  - En ökning av NO_2 halten med 1 µg/m^3 ökar mortaliteten med 1.2%
  - Baseline mortalitet 3276 dödsfall per år
- **Kvantifiering**
  - Exempel: 3276*(0.50*0.012)= 19.65 extra dödsfall

Resultat mortalitet



Vad verkar för att minska hälsoeffekterna?

- WHO guidelines
- EU Luftkvalitetsdirektiv
- Svenska miljökvalitetsnormer
- Regionala miljömål
- Lokala miljömål
- Nationell/regional/lokal samhällsplanering

- Tröskelnivåer kan oftast inte påvisas – normnivåer är kompromisser

Slutsatser

- Trafikföroreningar har samband med många olika typer av hälsoeffekter
- Normer är idag *inte* baserade på ”säkra nivåer”
- Trafikföroreningar i svenska städer leder till flera tusen förtida dödsfall per år
- Hälsoeffekter/befolkningsexponering bör diskuteras i planering och MKB, inte bara halter

Avslutande kommentarer

- Validerade spridningsmodeller
  - Kräver mätningar
- Trender viktigt för att visa på effekter av åtgärder
- Folkhälsoperspektivet är viktigt när det gäller exponering och effekter
- Folkhälsoperspektivet borde få större utrymme i planer och MKB

- Tack för mig!
- Lars.modig@envmed.umu.se