

Swiss TPH



Swiss Tropical and Public Health Institute  
Schweizerisches Tropen- und Public Health-Institut  
Institut Tropical et de Santé Publique Suisse

Department of Epidemiology & Public Health

## **Introduction to FOCUS EVENT**

# **How to regulate ambient nanoparticles**

**Prof. Nino Künzli, MD, PhD**

**Deputy-Director Swiss Tropical and Public Health Institute Basel**

Head Departement of Epidemiology and Public Health

**President of the Swiss Federal Commission for Air Hygiene (FCAH)**

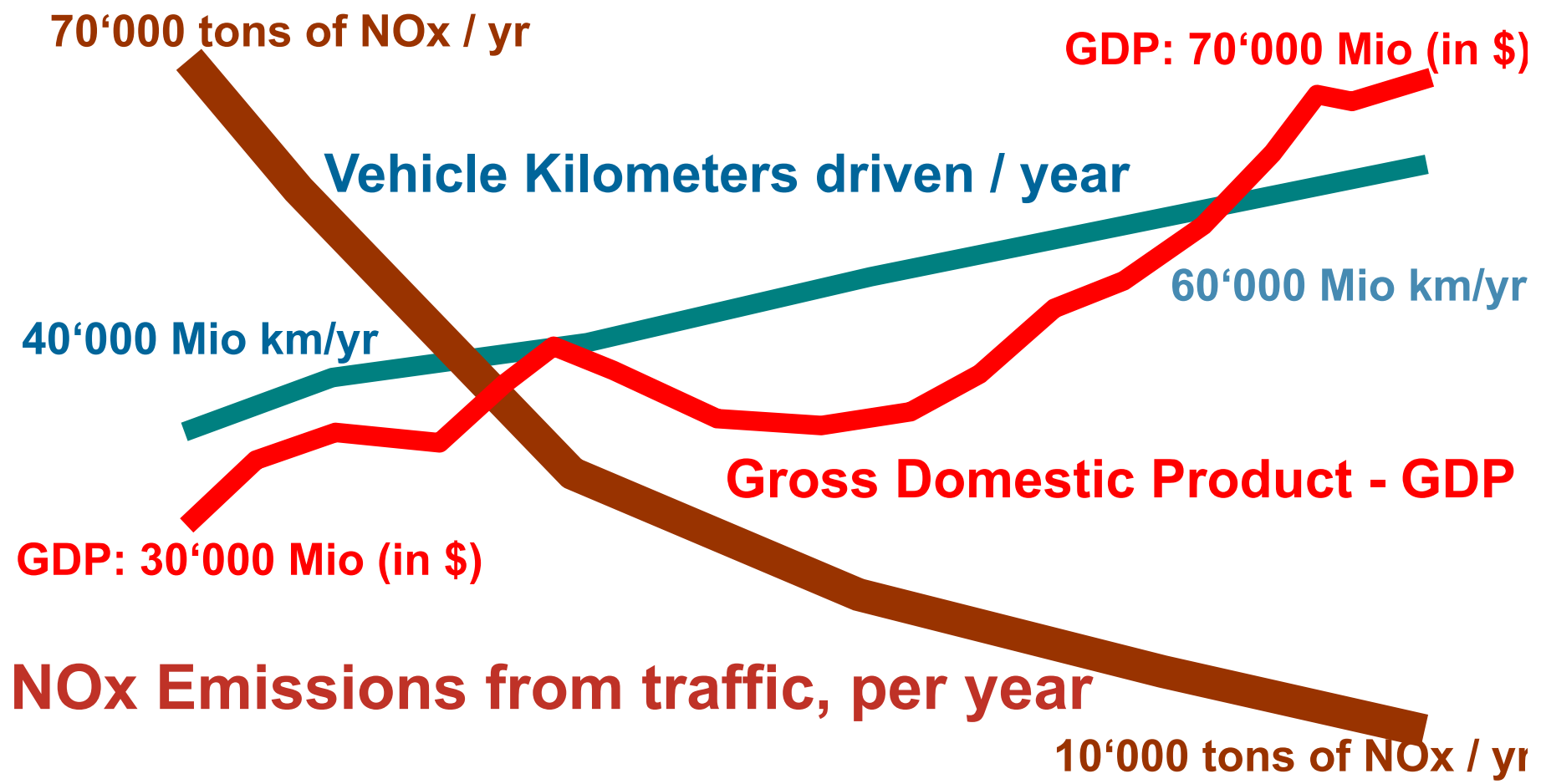
**(Eidgenössische Kommission für Lufthygiene – EKL)**

**16<sup>th</sup> ETH Conference on Combustion Generated Nanoparticles**

**Wed June 27th 2012 – ETH Zurich**

**Swiss TPH is an associated Institute of University of Basel**

# Switzerland, 1990 - 2010

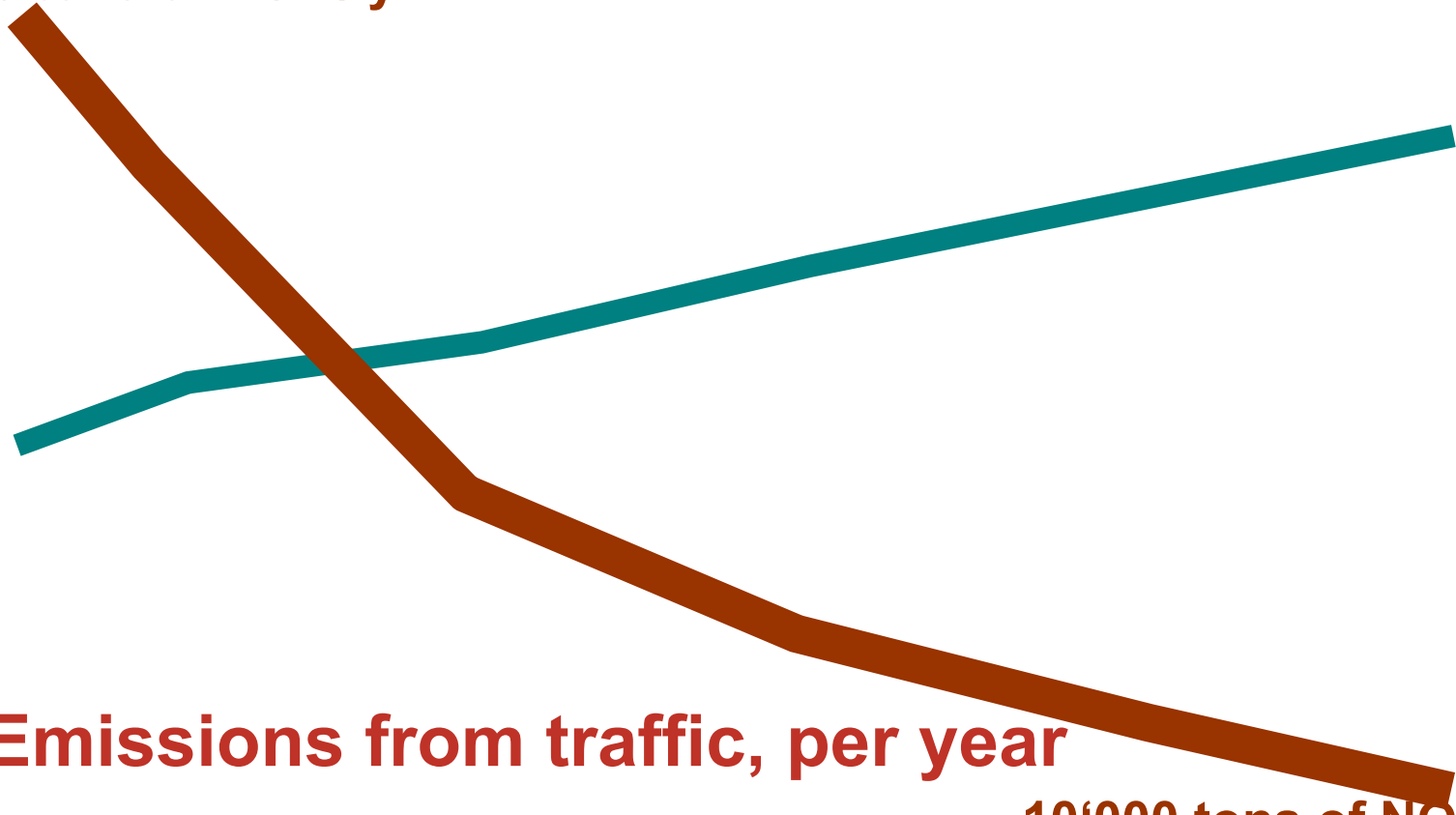


# Switzerland, 1990 - 2010

70'000 tons of NOx / yr

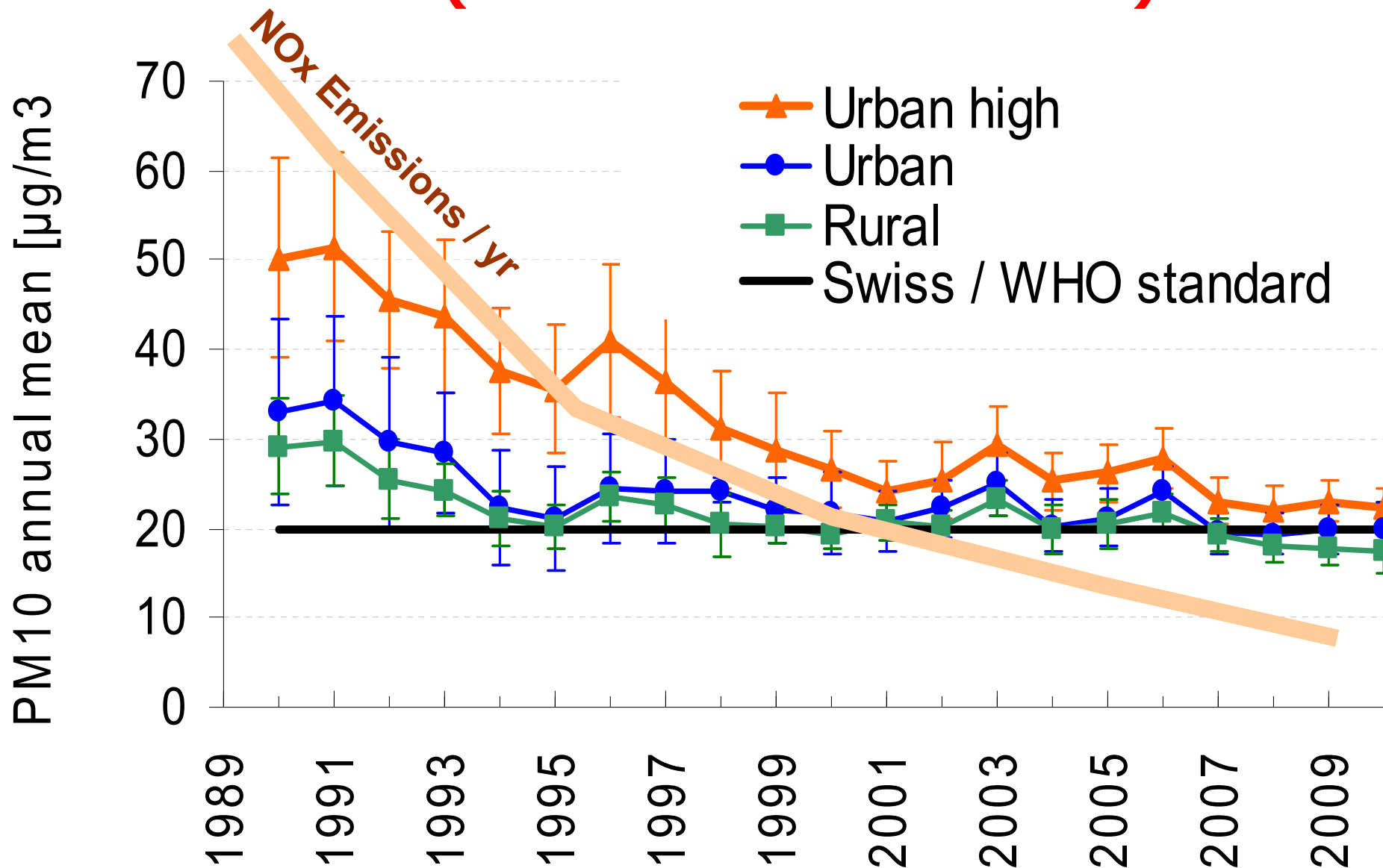
**NOx Emissions from traffic, per year**

10'000 tons of NOx / yr



# Switzerland, 1990 - 2010

## Air Pollution (PM10 concentrations)



**Decrease in PM10 was paralleled by improvement in health – shown in two Swiss land-mark studies:**

# SCARPOL

(in children)

Less bronchitis

# SAPALDIA

(in adults)

Less bronchitis

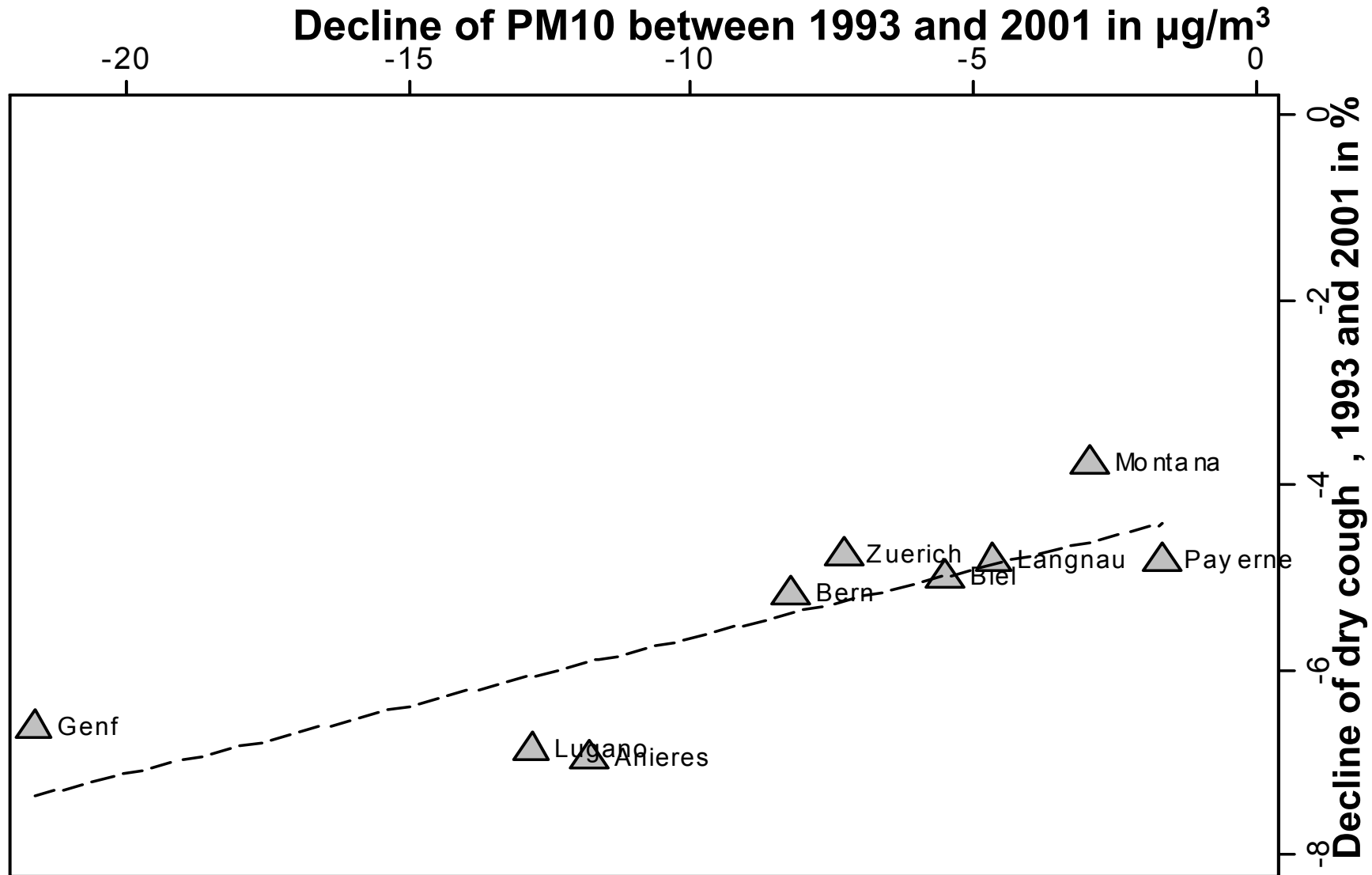
Slower aging of lung function

Fewer new cases of asthma

**Primary funding: Swiss National Science Foundation**

# Change in prevalence vs. change in PM<sub>10</sub> Across nine Regions of SCARPOL School Children Study

Bayer-Oglesby et al., Env Health Perspect, 2005



## **... Time to regulate ambient nano-particles?**

- Discuss rationale to promote additional, source specific regulations to protect people from adverse effects of ambient nanoparticles. They shall contribute to a discussion on how the gaps of the current policy framework may be closed.

## Input information

- Presentations at ETH Conference – in particular also the Health Session
- In-put presentations after lunch
  1. N. Künzli: Swiss approach 2012/2013
  2. Michal Krzyzanowski: WHO and EU approach
  3. Xavier Querol: UFP and BC trends
  4. Robert Gehrig: Measurement techniques
  5. Peter Bruckmann: Revision EU Air Quality Directive
- Theses

**Enjoy the lunch!**



# Panelists (Moderator: Prof. Peter Gehr)

Swiss TPH 

Baltensperger Urs / PSI, Switzerland

Burtscher Heinz / FHNW, Switzerland

Bruckmann Peter / State Office for Environment, North Rhine  
Westphalia, Germany

Cassee Fleming / RIVM The Netherlands

Costa Dan / EPA USA.

Gehrig Robert / EMPA Switzerland

Konstandopoulos Athanasios / CERT/CPERI, Greece

Krzyzanowski Michal / World Health Organization, Germany

Künzli Nino / Swiss Tropical and Public Health Institute,  
Switzerland

Oberdörster Günther/ University of Rochester U.S.A.

Querol Xavier/ Institute of Environmental Assessment and  
Water Research, Spain

Strahl Peter / Swiss Federal Office for the Environment

**Enjoy the lunch!**

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# Regulating Ambient Nanoparticles?

**Prof. Nino Künzli, MD, PhD**

**Deputy-Director Swiss Tropical and Public Health Institute Basel**

Head Departement of Epidemiology and Public Health

**Chair of Social and Preventive Medicine University Basel**

**President of the Swiss Federal Commission for Air Hygiene (FCAH) (Eidgenössische  
Kommission für Lufthygiene – EKL)**

**Prepared for**

**Focus Event 2012: How to regulate ambient nanoparticles  
16<sup>th</sup> ETH Conference on Combustion Generated Nanoparticles**

**Wed June 27th 2012 – ETH Zurich – Session 13:30-15:10**

**Swiss TPH is an associated Institute of University of Basel**

# Current PM and NOx regulation

(not shown: SO<sub>2</sub>, Ozone and others;  
„minimizing rule for EC)

|                    | PM10      |           | PM2.5      |            | NO <sub>2</sub> |           | 1hr |
|--------------------|-----------|-----------|------------|------------|-----------------|-----------|-----|
|                    | 1 yr      | 24hr      | 1yr        | 24hr       | 1yr             | 24hr      |     |
| <b>Switzerland</b> | <b>20</b> | <b>50</b> | <b>---</b> | <b>---</b> | <b>30</b>       | <b>80</b> |     |
| <b>EU</b>          | 40        | 50        | 25         | ---        | 40              | ---       | 200 |
| <b>California</b>  | 20        | 50        | 12         | 65         | ---             | ---       | 470 |
| <b>WHO</b>         | 20        | 50        | 10         | 25         | 40              |           | 200 |

# **Swiss Federal Commission for Air Hygiene (FCAH) (Eidgenössische Kommission für Lufthygiene - EKL)**

**Künzli Nino, Prof. Dr. med. et PhD (President)**

**Ammann Christof, Dr. sc. nat.**

**Baltensperger Urs, Prof. Dr. phil. II**

**Braun Sabine, Dr. phil. II**

**Colombo Luca, Dr. phil. II ETHZ**

**Dubas Françoise, Ph.D.**

**Flückiger Alexandre, Prof. Dr. iur.**

**Gehr Peter, Prof. em. Dr. phil. nat.**

**Gehrig Robert, Dr. sc. techn. ETH**

**Gygax Hans, Dr. sc. nat.**

**Künzler Peter, PD Dr. phil. et phil. hist.**

**Leikauf Bernhard, Dr. rer. nat.**

**Nejedly Gerrit, Dr. phil. nat.**

**Probst-Hensch Nicole, Prof. Dr. phil. II et PhD**

**Secretary: Dr. Peter Strähl**

**(Swiss Federal Office for the Environment)**

## **Question to clarify by 2013 by the Federal Commission**

If all sites in Switzerland are in compliance with

**PM10 annual mean  $\leq 20$**

**AND**

**NO2 annual mean  $\leq 40$**

... do we still expect adverse health effects due to outdoor air pollution?

If so...

- Is it sufficient to lower the standards of the currently regulated pollutants

OR

- **Do we need to regulate other MARKERS OF AMBIENT AIR QUALITY?**

## **Considerations in air quality standard setting**

- Laws to protect public health
- Scientific evidence for adverse effects
- Appropriate marker for health relevant air quality
- Technology to measure regulated marker of air quality
- Sensitivity of regulated marker to policy-related changes in air quality
- Regulatory tools to improve air quality

## Primary issues to clarify in Swiss regulations:

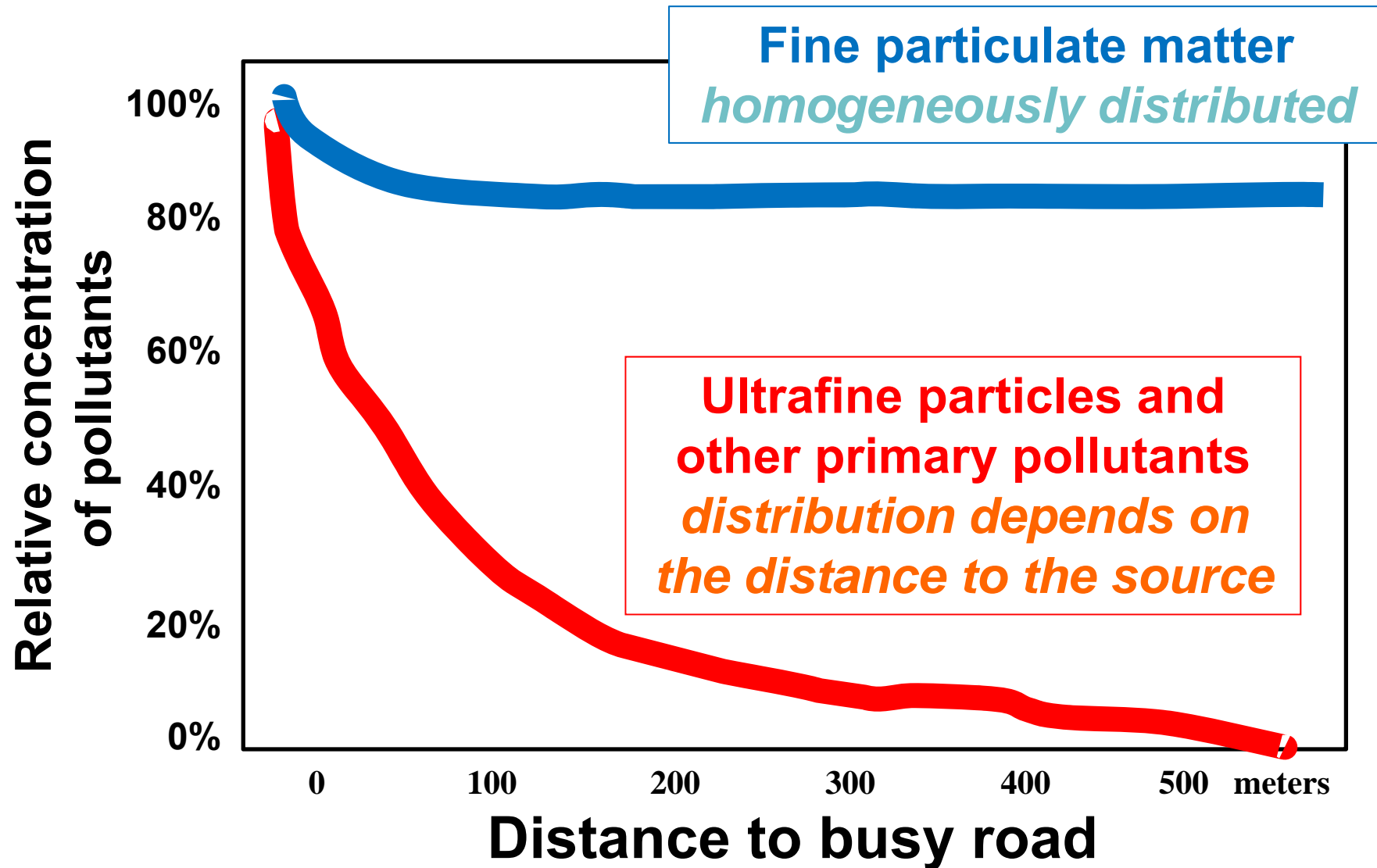
1. Is PM10 still a useful proxy also for PM2.5, as in the past?
2. **What about local near-road TRAFFIC RELATED AIR POLLUTANTS (nano-sized ultrafine particle number or its mass, elemental carbon / black carbon etc.)?**
  - **Are there effects on health occurring independently of those due to the regulated pollutants?**
  - **To what pollutants / markers can those be ascribed to?**
  - **Can those be measured and effectively be monitored?**
  - **Are those NOT SENSITIVE to planned / implemented regulatory frameworks?**
  - **Do those require new / different policies?**
3. What about wood smoke related pollution? Do we need a separate source specific air quality marker?



## Traffic-related near-road pollutants

- Are there effects on health occurring independently of those due to the regulated pollutants?
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# Traffic proximity and exposure

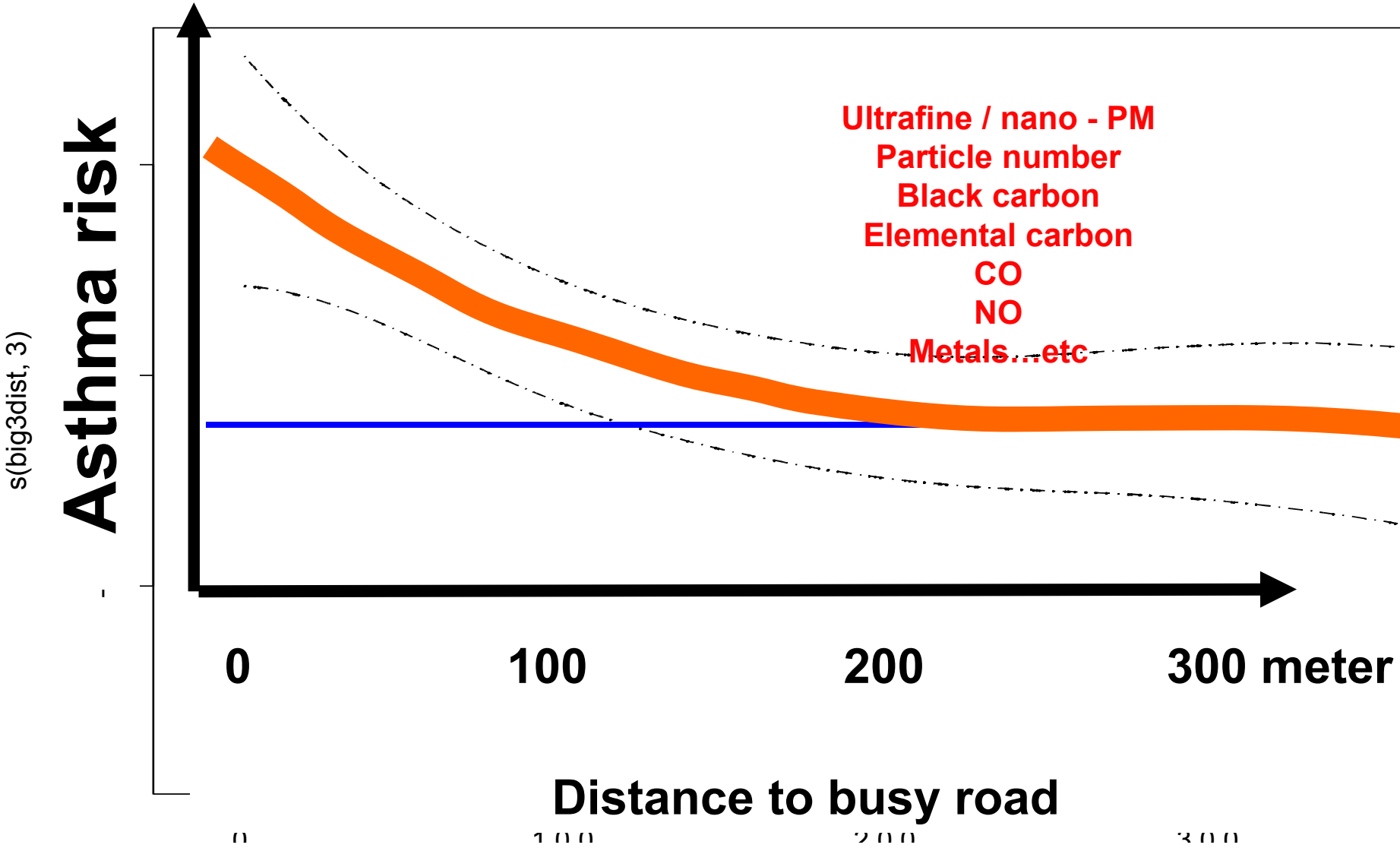


(Laura Perez presentation)

# Risk to develop asthma as a child depends on residential proximity to major roads

## Example of Southern California Children's Health Study

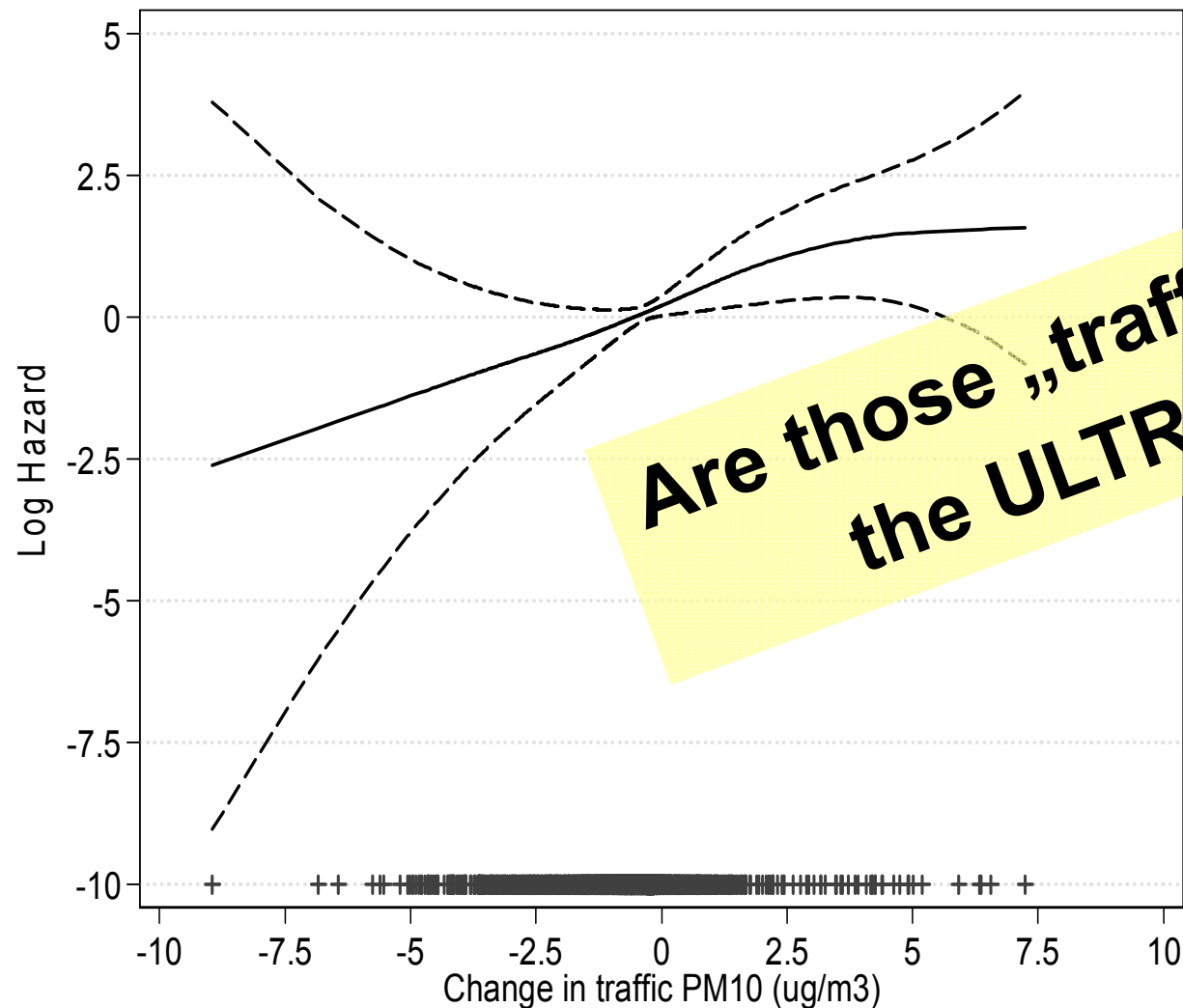
(McConnell et al, EHP 2006)



**(modelled) traffic-related PM are associated with new-onset of asthma in Swiss adults**

**– but ambient PM10 are NOT associated**

**Künzli et al, SAPALDIA Study, Thorax 2009**



## Several recent reviews conclude:

- Living close to busy roads is a cause for the development of childhood asthma (incidence)
- Urban background pollution (such as PM2.5) are unlikely to be associated with new onset of asthma

**Epidemiological example for evidence of independent and different health effects of „near-road“ pollution versus urban background pollution (PM2.5; PM10)**

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## **Long list of candidates...**

- Ultrafine particle mass concentration
- Ultrafine particle number
- Particle surface area
- Oxidative potential of PM
- Soot / elemental carbon / black carbon / diesel particles...
- Metals
- CO
- NO

## **Experimental evidence for independent effects of ambient ultrafine particles**

### Animals:

- No substantial lung inflammation
- UFP may enhance allergen response
- Enhance the progression of atherosclerosis (Araujo et al)
- Autonomic control in the heart of rats
- Brain inflammation

### Humans:

- Negative studies on lung function and airway inflammation
- Some positive studies on vascular function, cardiac repolarization, heart rate variability, blood coagulation



# Epidemiological evidence for Ultrafine particles

## Acute effects

Suggestive but inconsistent associations for mortality & morbidity

Pulmonary effects

Cardiovascular effects

## Long-term effects

?

How to interpret „traffic proximity“ studies?

**Are those effects independent from those due to PM10, PM2.5, NO2 etc...?**  
**→ remember presentations 26.6.2012 by Prof.es Bert Brunekreef and Klea Katsouyanni**

## From Prof. Klea Katsouyanni:

### UFP and morbidity outcomes: respiratory

| Publication            | Specific outcome<br>Lag (Location)        | PNC effect<br>% incr(95% CI)                        | PM <sub>10</sub> effect %<br>incr(95% CI)  |
|------------------------|---|---|--|
| Andersen et al<br>2008 | Resp hosp adm. >65yrs<br>0-4 (Copenhagen) | <b>4.0</b> per 3907/cm <sup>3</sup><br>(0.0, 7.0)   | 6.0 per 13µg/m <sup>3</sup><br>(2.0, 9.0)  |
| Halonen et al<br>2009  | Asthma+COPD*<br>1 (Helsinki- 7yrs)        | <b>1.7</b> per 2467/cm <sup>3</sup><br>(-1.4, 3.4)  | NA   |
| Halonen et al<br>2009  | Pneumonia hosp a<br>1 (Helsinki- 7yrs)    | <b>1.6</b> per 2467/cm <sup>3</sup><br>(-0.7, 4.1)  | NA   |
| Branis et al<br>2010   | Resp hosp adm<br>1 (Prague- 1yrs)         | <b>2.3</b> per 1000/cm <sup>3</sup><br>(0.0, 4.9)   | NA   |
| Atkinson et al<br>2010 | Resp hosp adm >65yrs<br>4 (London- 6yrs)  | <b>1.3</b> per 10166/cm <sup>3</sup><br>(-0.1, 2.7) | 0.7 per 14µg/m <sup>3</sup><br>(-0.2, 1.5) |

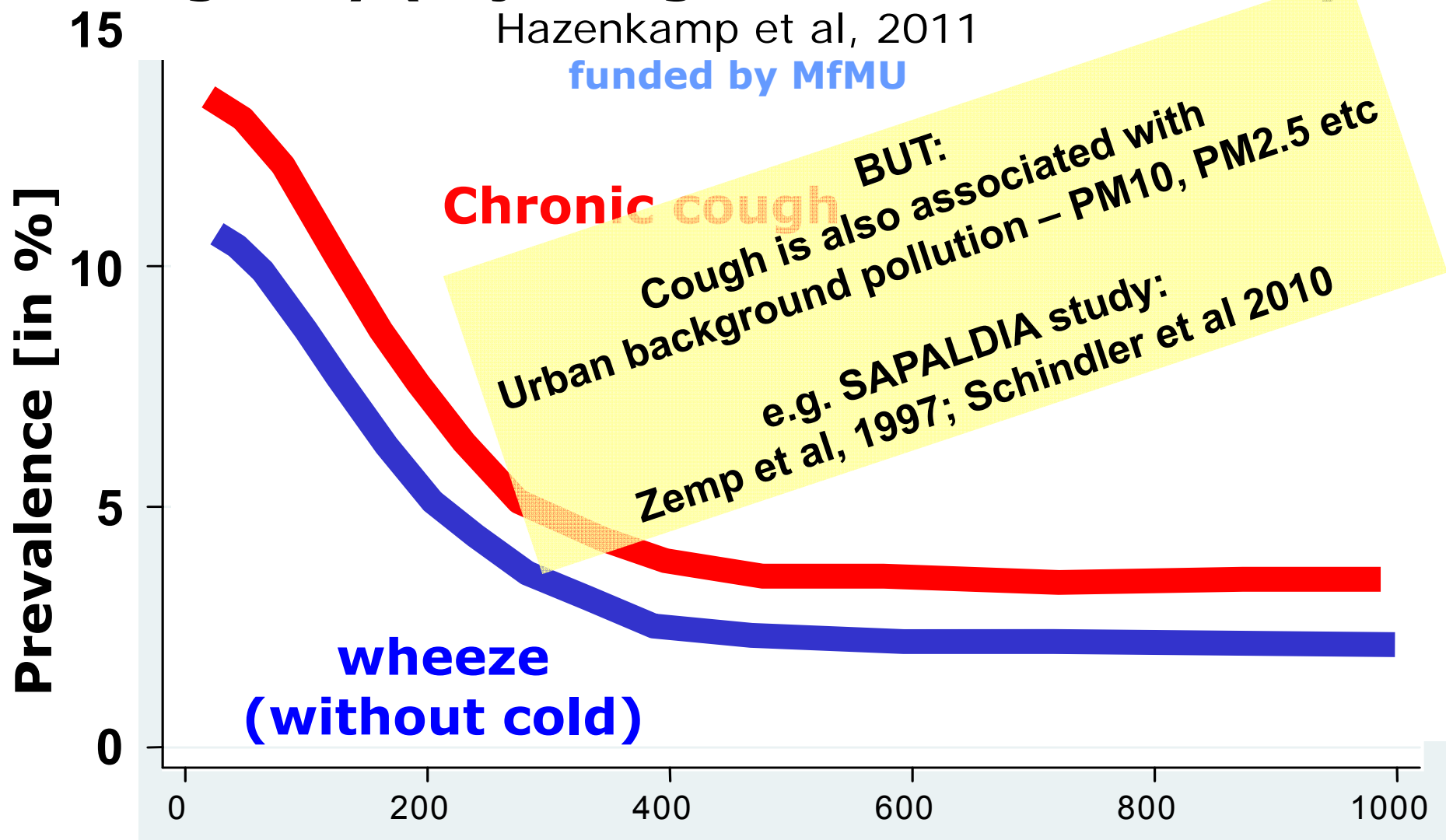
**Total number concentrations of PM (6-700nm size)  
are not independently associated with hospital  
admissions in the elderly in Copenhagen**  
Anderson et al, OEM 2008

| Pollutant  | IQR <sup>†</sup> | One-pollutant model <sup>‡</sup> | Two-pollutant models                |
|--|------------------|----------------------------------|-------------------------------------|
|  |                  |                                  | NC <sub>tot</sub> +PM <sub>10</sub> |
| RD hospital admissions (age ≥65 years) <sup>††</sup> |                  |                                  | n = 564                             |
| NC <sub>tot</sub>                                    | 3907             | 1.04 (1.00 to 1.07)**            | 1.00 (0.96 to 1.05)                 |
| PM <sub>10</sub>                                     | 13               | 1.06 (1.02 to 1.09)**            | 1.05 (1.01 to 1.10)**               |

# Frequency of cough and wheeze is most frequent in Swiss adults living close to the highway (adjusting for other risk factors)

Hazenkamp et al, 2011

funded by MfMU



**Chronic cough**

**BUT:**

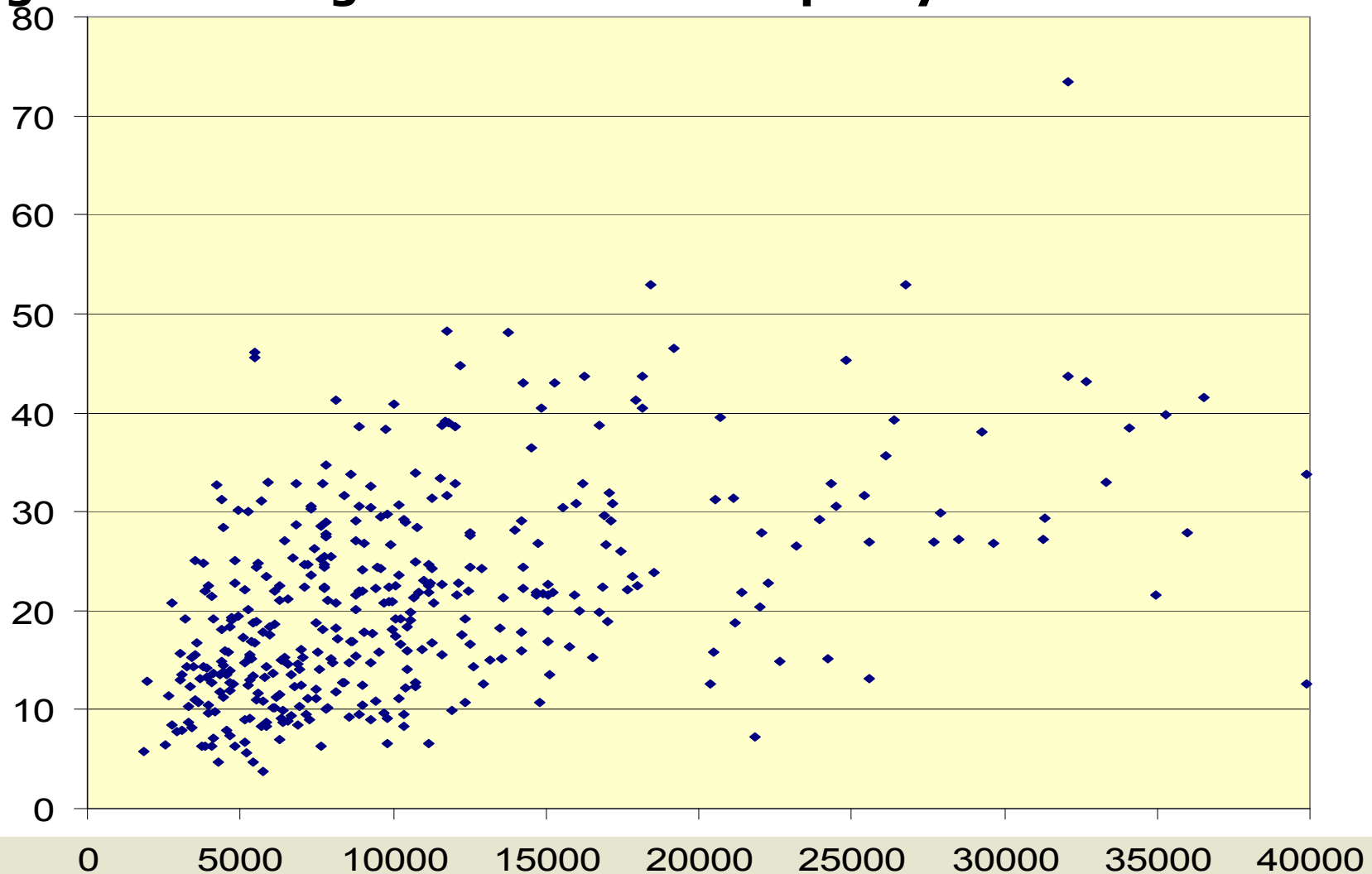
Cough is also associated with Urban background pollution – PM10, PM2.5 etc  
e.g. SAPALDIA study:  
Zemp et al, 1997; Schindler et al 2010

**wheeze  
(without cold)**

**Residential distance to highway (in meters)**

# Spatial correlation of UFP and NO<sub>2</sub> measurements in the Girona area (Spain)

preliminary results suggest low correlation (0.5) of long-term averages... → NO<sub>2</sub> not a proxy for UFP



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→ Dr. Robert Gehrig

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## Questions to clarify

1. Do policies that reduce ambient concentrations of

- NO<sub>2</sub>
- PM<sub>10</sub>
- PM<sub>2.5</sub>

not reduce the „near-road“ pollutants?

2. Do policies that minimize elemental carbon (EC) necessarily reduce the „near-road“ pollutants?

3. Do emission standards (e.g. EURO VI) not necessarily reduced the „near-road“ pollutants?

**→ Prof. Xavier Querol on trends UFP / BC**



## Traffic-related near-road pollutants

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→ **Do they require new / different policies?**

**→ Depends on answer to previous questions**

**Thank You !**  
**Nino.Kuenzli@unibas.ch**