The best is the enemy of good: Do we need alternative metrics?

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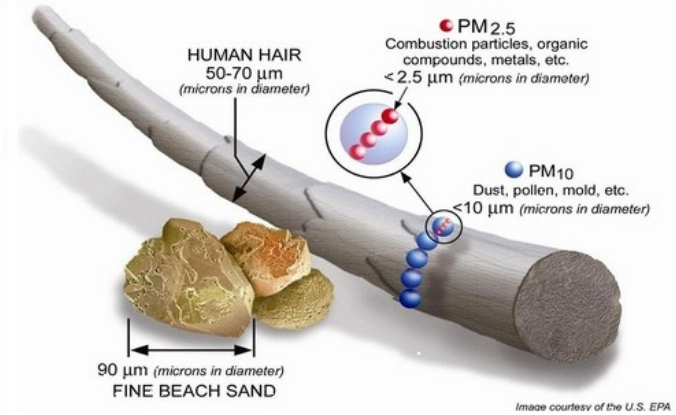

Prof. Dr. Barbara Hoffmann MPH
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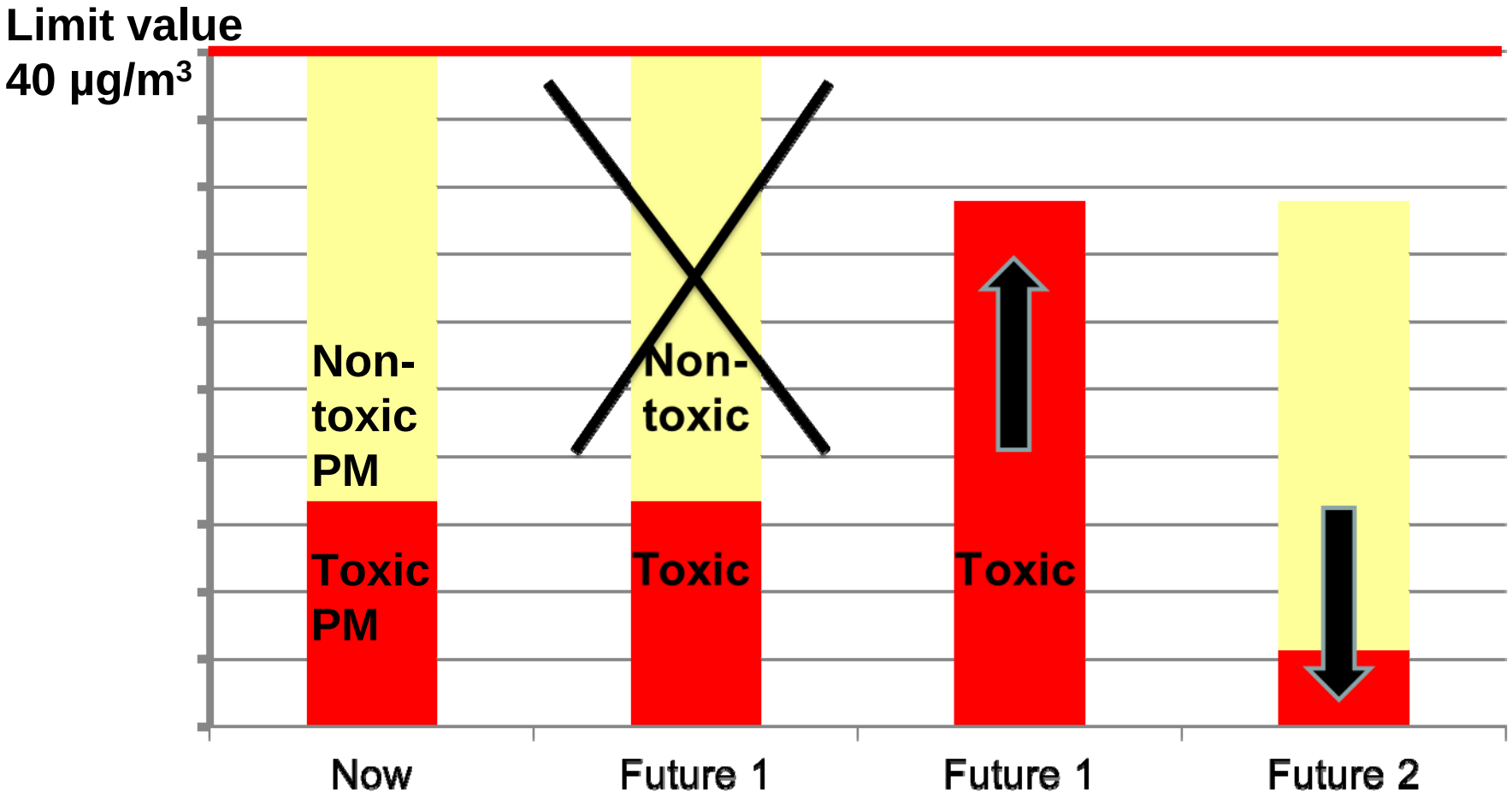
Duisburg, March 5, 2013

Mitglied der Leibniz-Gemeinschaft

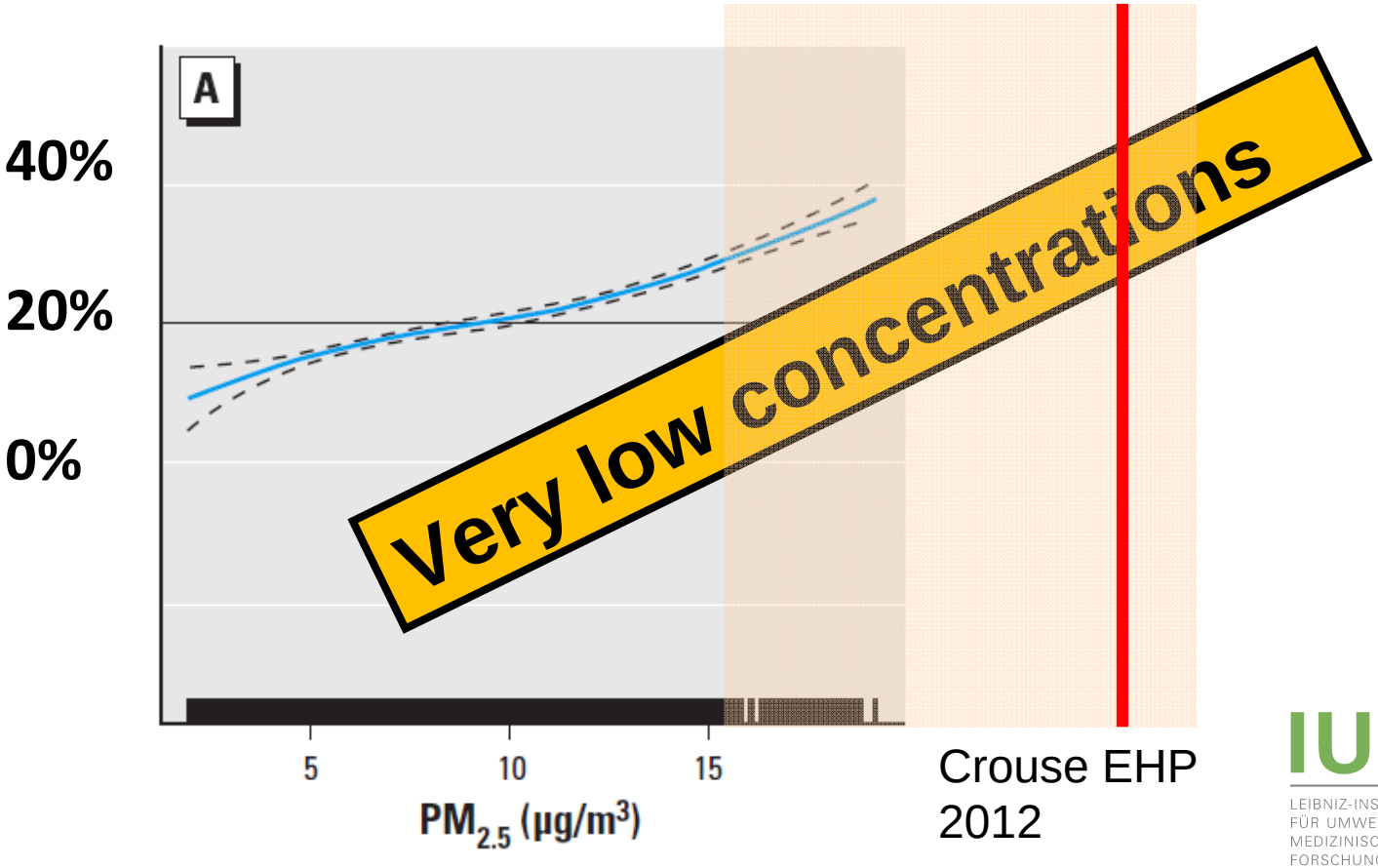

PM

Motivation


Limit value
40 µg/m³
Non-toxic PM
Toxic PM
Non-toxic
Toxic
Toxic
Now
Future 1
Future 1
Future 2

The best is the enemy of good: What we measure now

Total non-accidental mortality is associated with size-specific mass (PM2.5) in 2.1 million Canadians



Crouse EHP 2012

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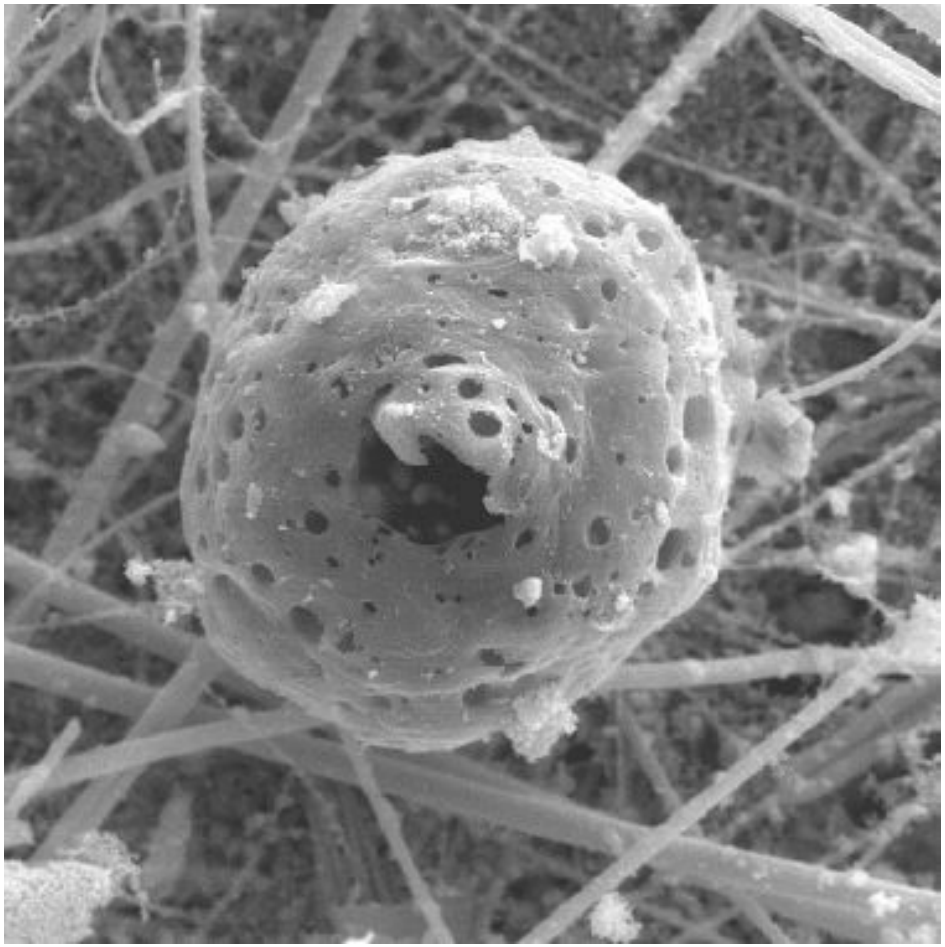
The best is the enemy of good: What could be better?



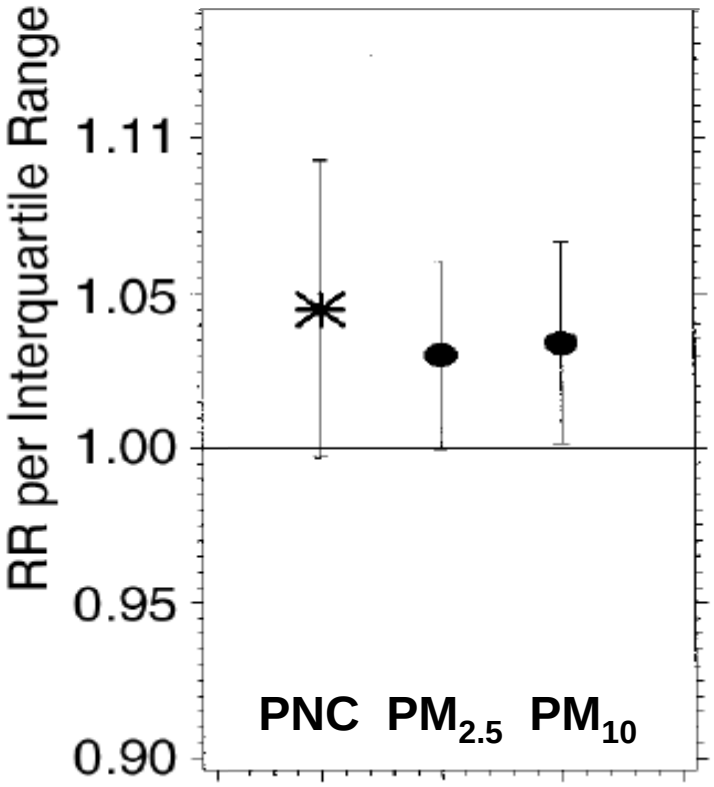
Candidates are:

Size, number?

Surface area?

Chemistry - Source?

Erfurt: UFP (measured as number concentration) are related to daily mortality…



Wichmann et al. HEI 2000

and UFP/PNC are related to

hospital readmis

after ac

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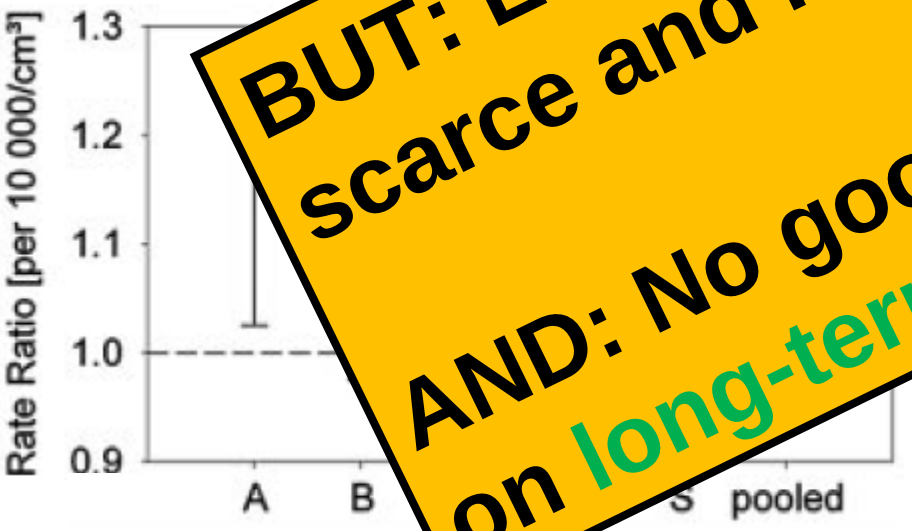
troke

BUT: Evidence is still scarce and mixed

AND: No good evidence on long-term effects yet!



Von Klot et al. Circulation 2005

	utant model R (95% CI)]
	1.21 (1.04–1.41)*
$_{10}$	1.08 (0.98–1.19)
NO_x	1.11 (0.95–1.30)
CO	1.10 (0.92–1.32)

Andersen et al. EHJ 2010

Mass-specific surface area

- Important, because it increases reactive surface and enhances adsorption of toxic chemicals
- Some toxicologic evidence, model particles
- Practically **no epidemiological** evidence

Coarse particles ($PM_{2.5-10}$)

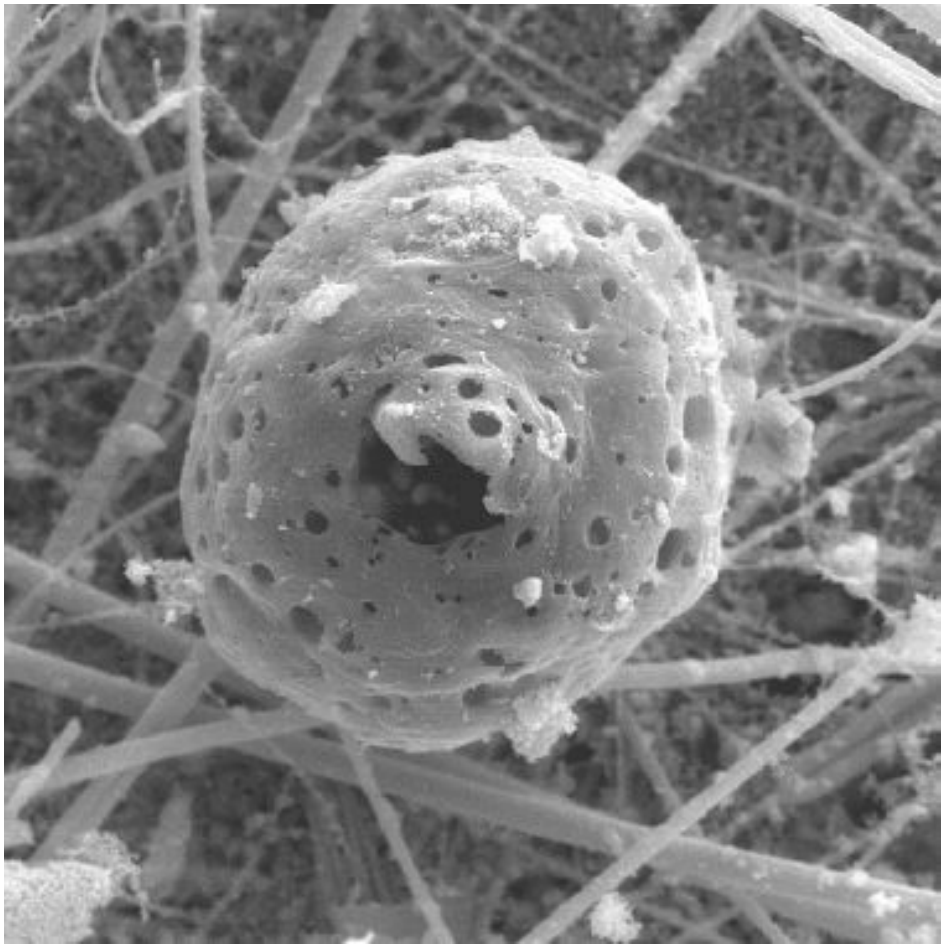
US EPA ISA 2009

„Suggestive evidence on short-term effect, not sufficient evidence on long-term effects“

- Exposure estimation by substraction suffers from double measurement error
- Coarse particles infiltrate less indoors, have a higher spatial variability than $PM_{2.5}$
- Composition of coarse can vary substantially betwee

Since then:
evidence on short-term effects

The best is the enemy of good: What could be better?



Candidates are:

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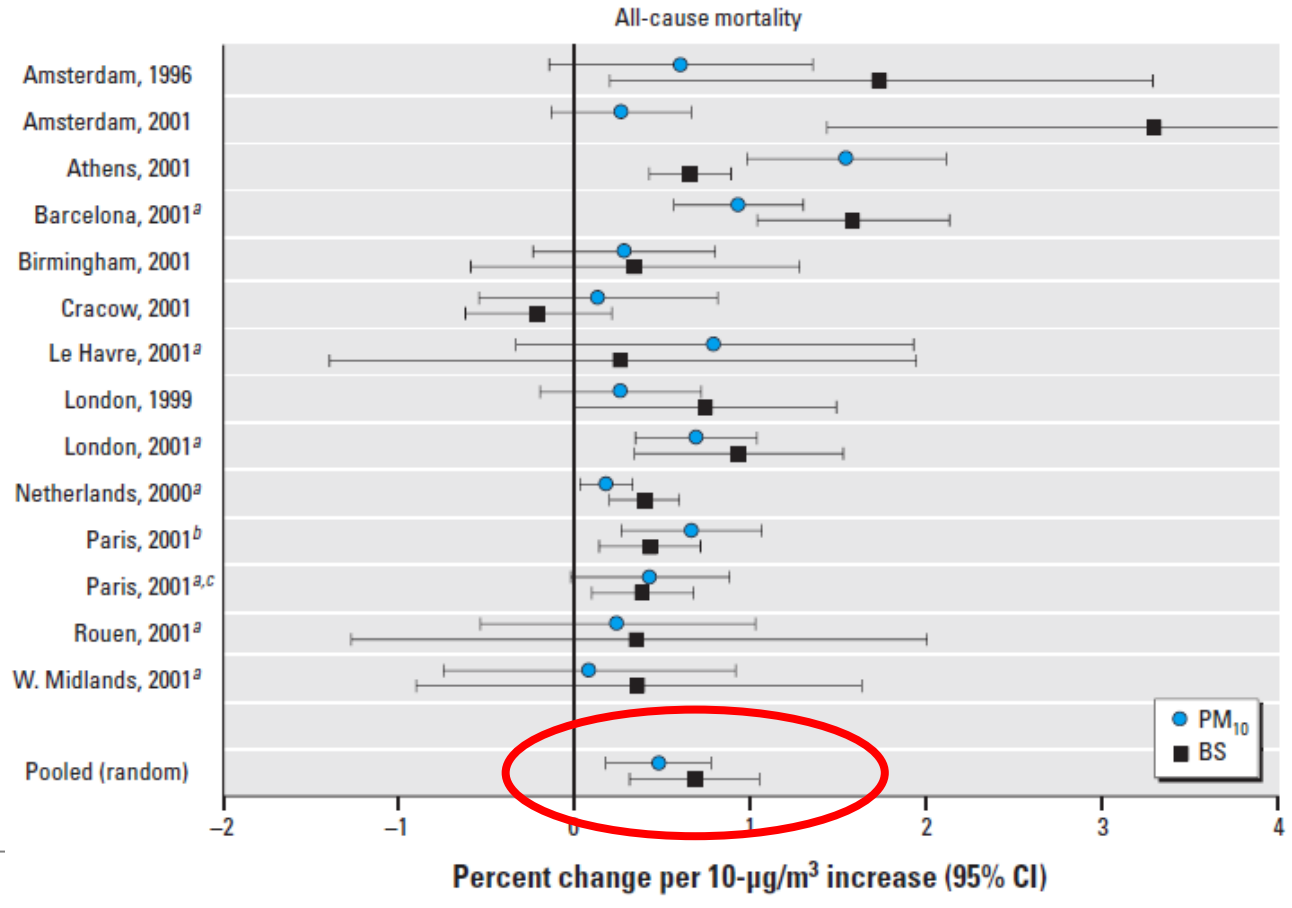
Black Carbon as an Additional Indicator of the Adverse Health Effects of Airborne Particles Compared with PM_{10} and $PM_{2.5}$

Nicole A.H. Janssen,[1] Gerard Hoek,[2] Milena Simic-Lawson,[3] Paul Fischer,[1] Leendert van Bree,[4] Harry ten Brink,[5] Menno Keuken,[6] Richard W. Atkinson,[3] H. Ross Anderson,[7] Bert Brunekreef,[2,8] and Flemming R. Cassee[1]

Review, EHP 2011

Short-term effects



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Review, EHP 2011

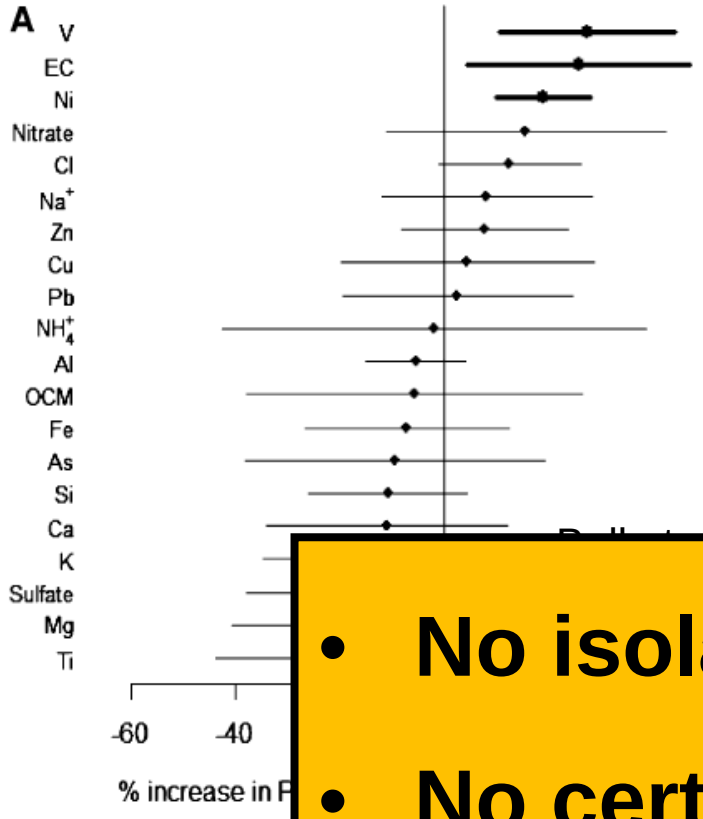
Long-term effects

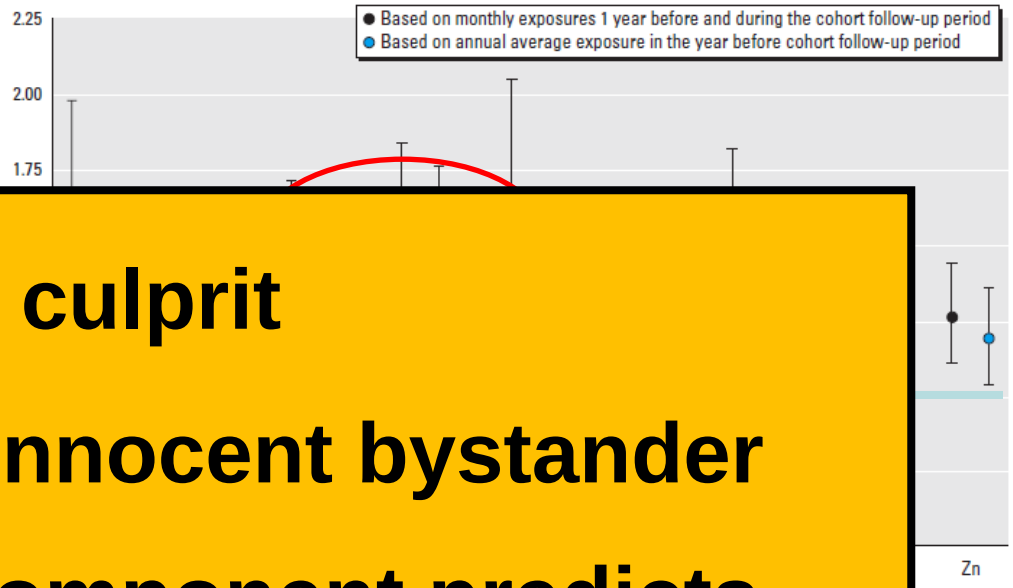
Reference	Cause	RR (95% CI) PM	RR (95% CI) EC
	Other	[illegible]	[illegible]
Smith et al. 2009	All causes	1.006 (1.002, 1.010)	1.06 (1.01, 1.11)
	Cardiopulmonary	1.012 (1.006, 1.018)	1.11 (1.03, 1.19)
Pooled effect (random)[f]	All causes	1.007 (1.004, 1.009)	1.06 (1.04, 1.09)

„Useful to evaluate health risks of air quality dominated by primary combustion emissions “

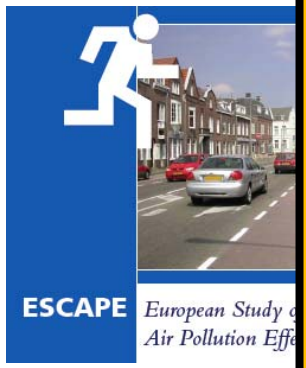
Research activities on (elemental) Components

Ostro et al. EHP 2010





- **No isolated culprit**
- **No certain innocent bystander**
- **No single component predicts consistently better than total mass**



European Study
Air Pollution Effe

Improving our knowledge on transport pollution and health

Program

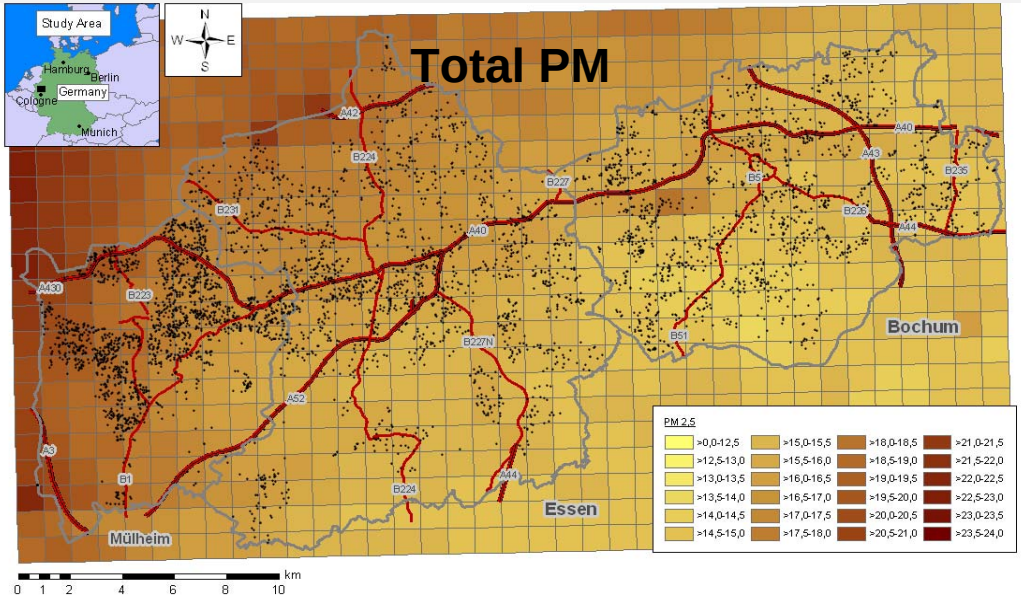
MEDIZINISCHE FORSCHUNG

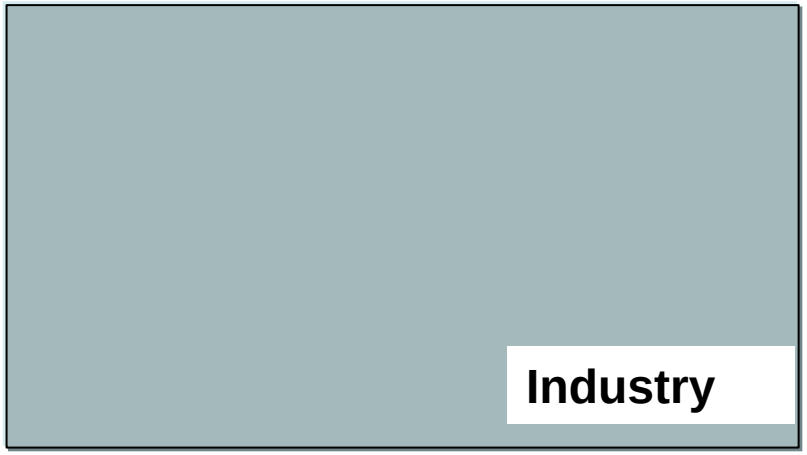
Source-specific PM in the Heinz Nixdorf Recall Cohort Study

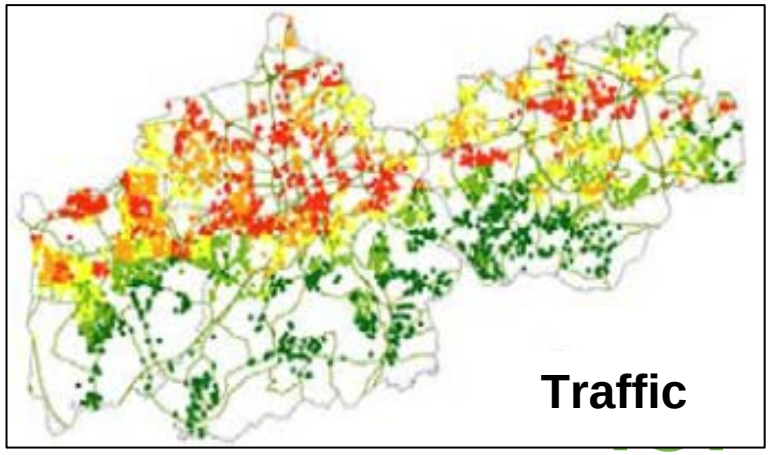
- Ongoing population-based prospective cohort-study, start in 2000
- Random sample of 4814 participants, aged 45-75 years
- Baseline exam (2000-2003)
- Annual questionnaire-based follow-up
- First follow-up exam (2006-2008)
- Second follow-up exam ongoing

Exposure model

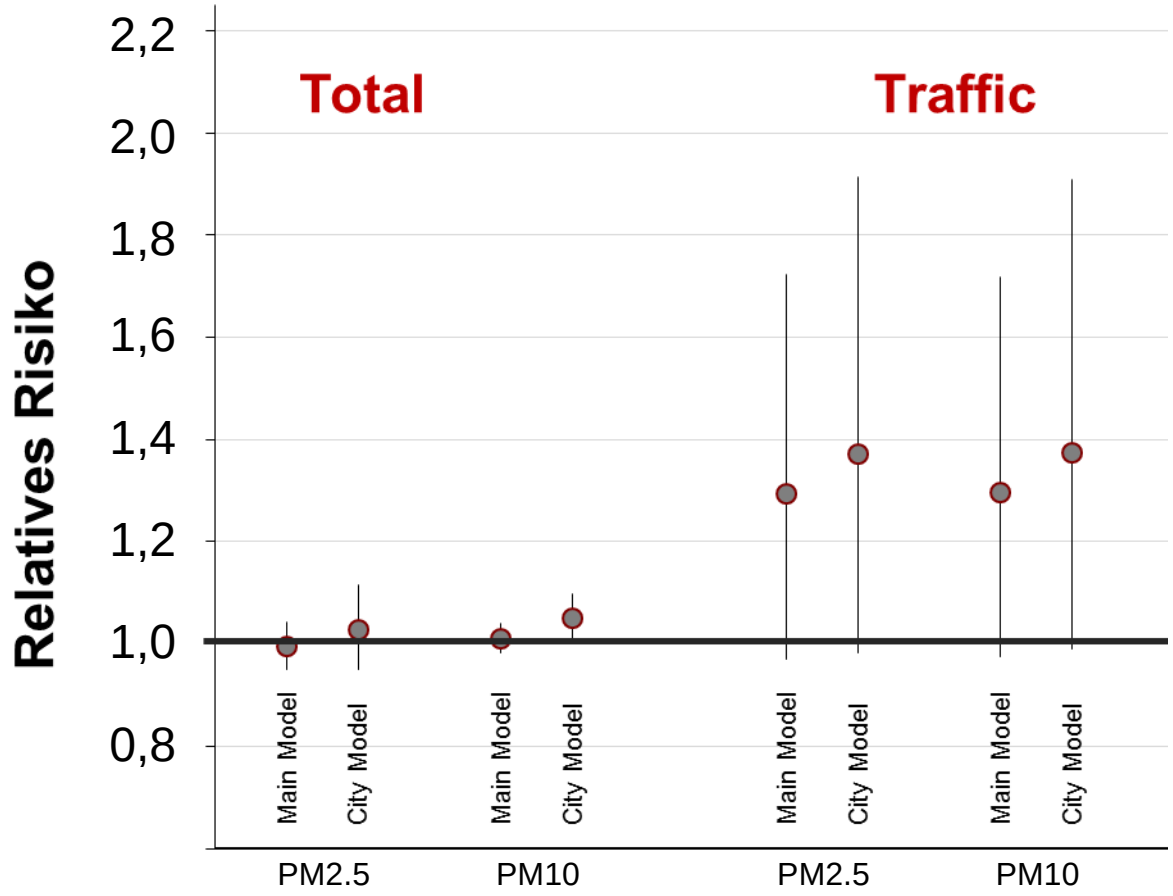
- **Chemistry-Transport Model (EURAD, RIU Cologne)**
- **Source-specific PM**







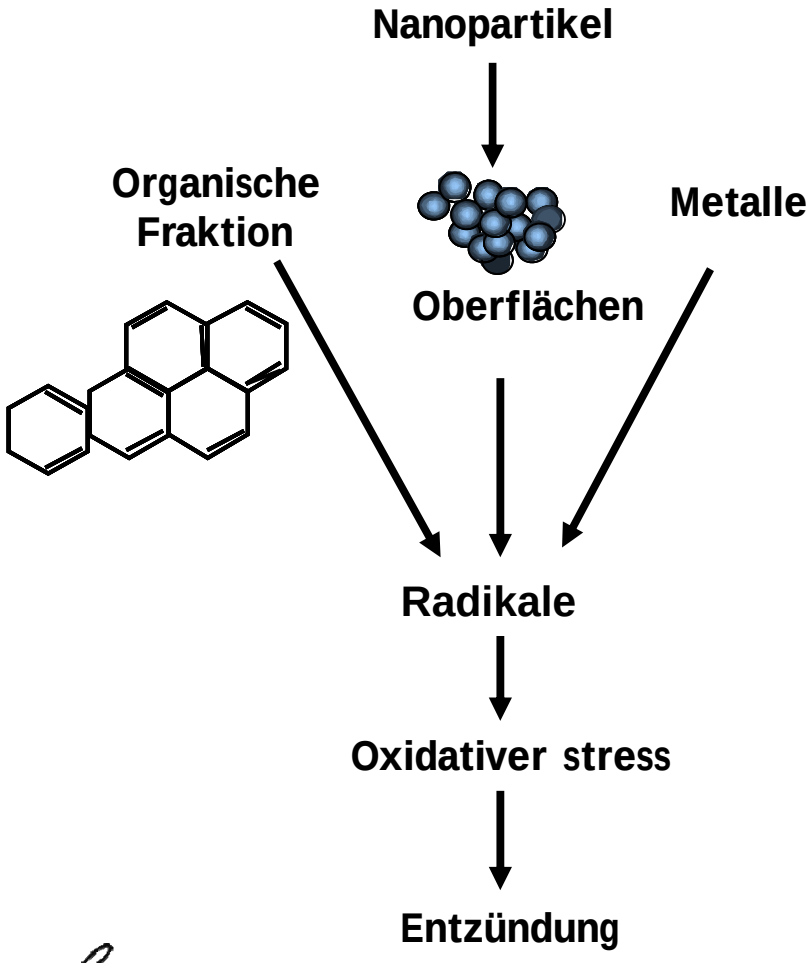
Newly developed diabetes mellitus



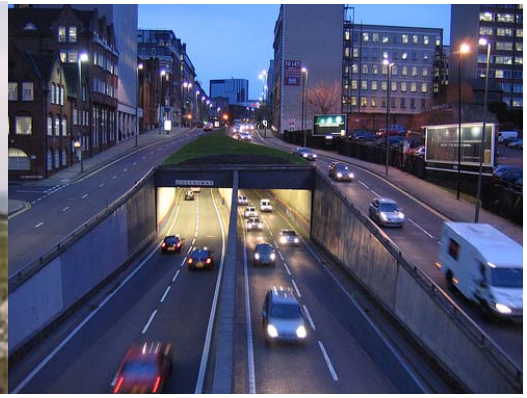
Weinmayr et al. In Vorbereitung

Main Model: adj. Für Alter, Geschlecht, Lebensstil; City Model = Main Model + nSES + Stadt

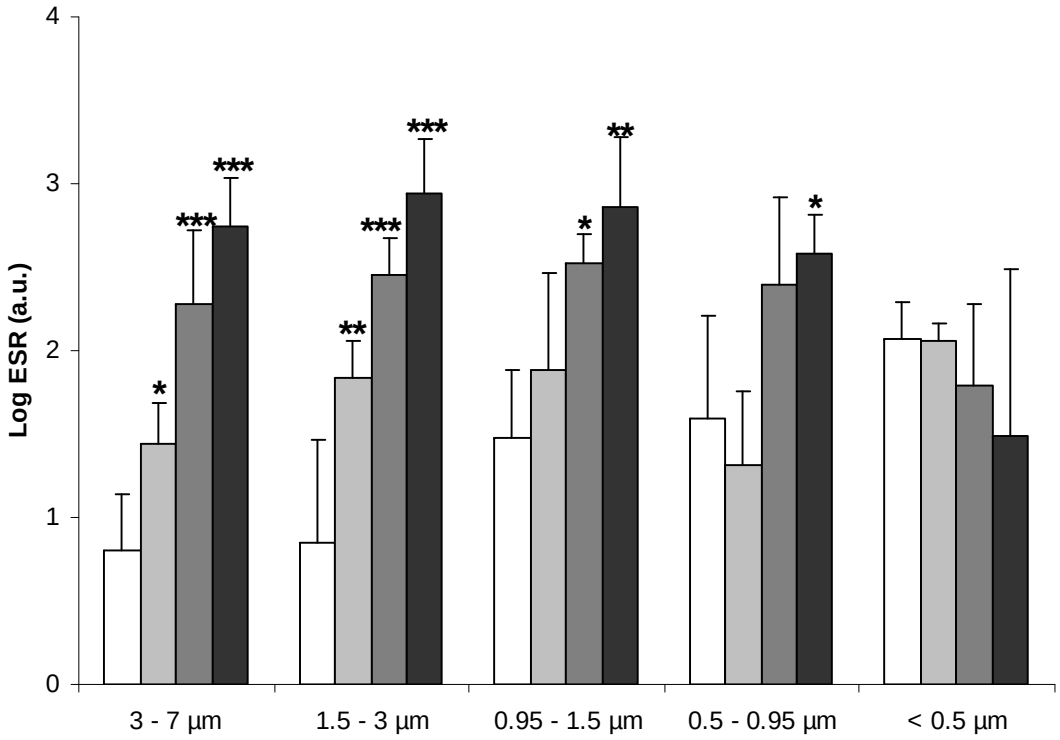
Newcomer: Oxidatives Potential



Mace Head Research station, Connemara, Ireland west coast



Queensway underpass (A38), Birmingham, UK



Wessels et al. (2010) Environ Sci Technol, Dank an Roel Schins für die Überlassung der Folien!

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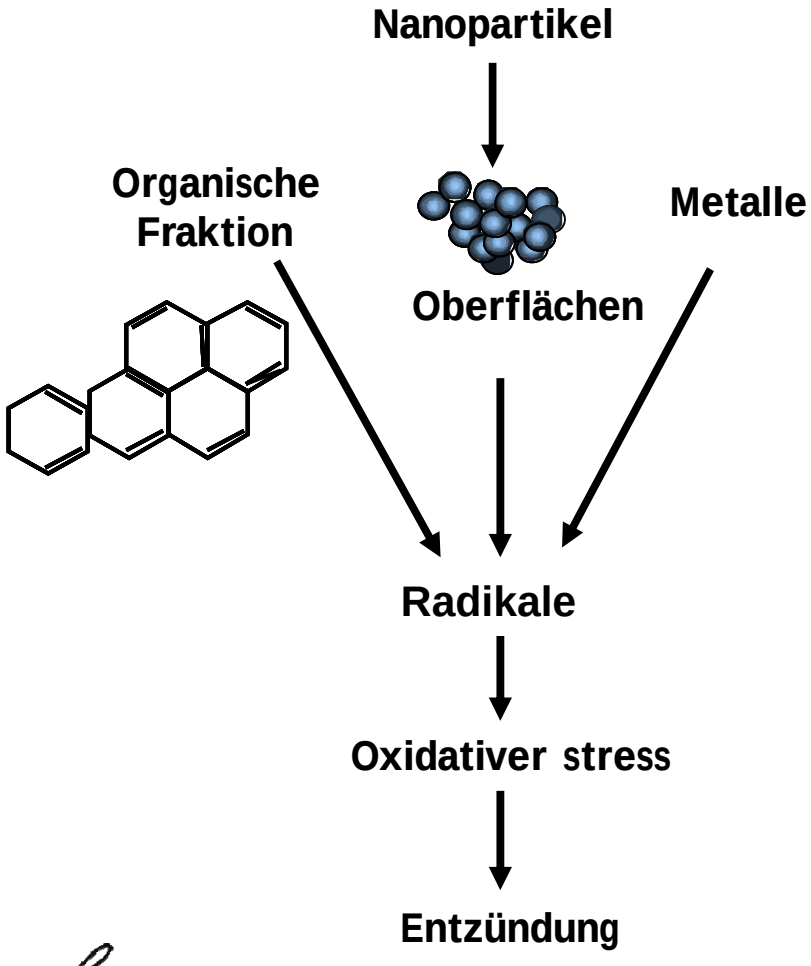

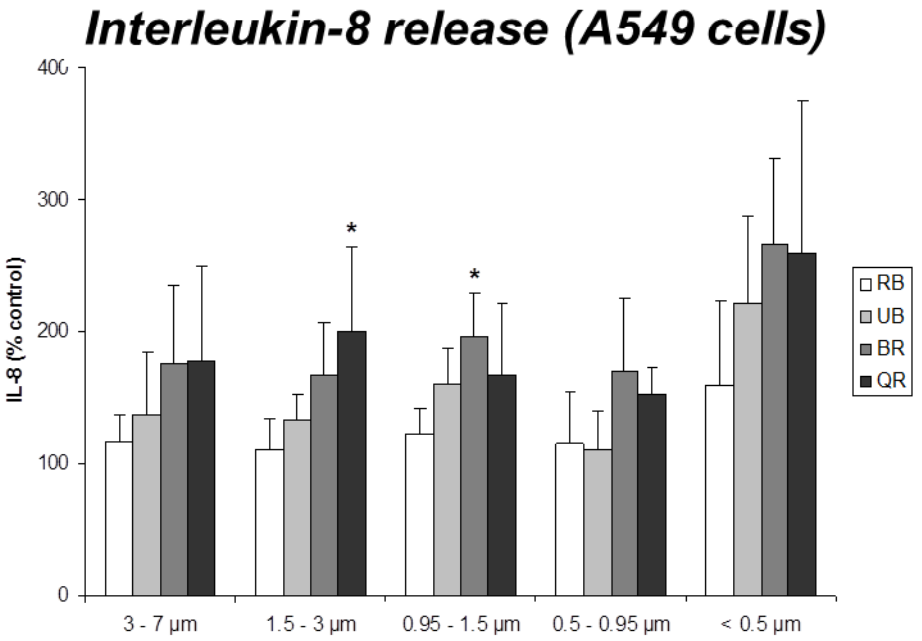

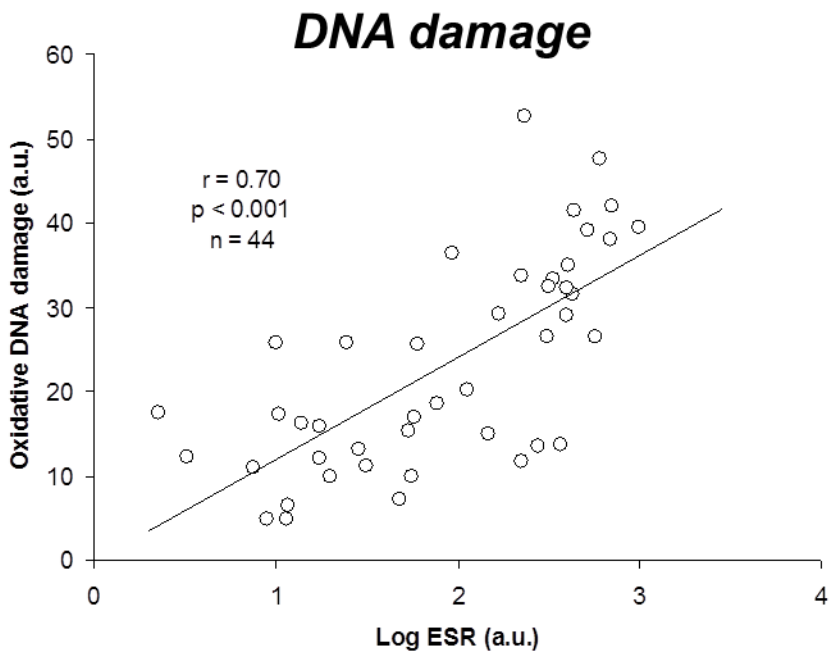

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The best is the enemy of good: Do we need alternative metrics?

US EPA ISA 2009:

„…not sufficient evidence to differentiate those constituents (or sources) that are more closely related to specific health outcomes.“

WHO REVIHAAP 2013:

„…some components **may be** more harmful than others“

The best is the enemy of good: Do we need alternative metrics?

What we need Part 1 (regulation)

- **Source-specificity**: i.e. BC for better estimation and regulation of near road exposures

What we need Part 2 (science)

- **UFP / PNC / components spatially resolved measurements**
- Candidate for research activities: **Oxidative potential**

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Thank you very much for your attention

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