

Dinner Speak hold on Tue night, 24.6.2014 at the
18th ETH Conference on Combustion Generated Nanoparticles

Nino Künzli, MD PhD
Deputy Director Swiss Tropical and Public Health Institute (SwissTPH);
Head Swiss TPH Department of Epidemiology and Public Health and
Professor of Social and Preventive Medicine at the University Basel
Swiss TPH, Basel, Socinstrasse 57
Nino.Kuenzli@unibas.ch
<http://www.swisstph.ch/>



Dear guests,

It is a great honour to deliver this Dinner Speak... although I am also a bit puzzled about this task. When we were young we were taught not to speak while we are eating - but that is exactly what Dr. Mayer asked me to do. Was the purpose of this offer that you can eat without speaking while I should speak without eating? But this brings up another conflict as we have also been educated to not eat while some one holds a speech. Anyway, ultimately I could not refuse the offer given that this year is really a special moment for this conference, turning 18 years. To resolve the conflicts, I will speak but take the freedom to be brief!

It means something - 18 years – at least in this country! With age 18 we celebrate the start of our lives as an independent adult. It is the final step of leaving childhood behind. So let us declare that the Conference on Combustion related Nanoparticles has become an adult! 18 years means freedom! Everything goes with 18 – there is no further limit for anything. Indeed, we have no other age limits – such as age 21. We get ultimate freedom - including the right to buy wine to toast for the 18th anniversary. So what should our wishes be while congratulating the Conference to becoming an independent adult? I would like to propose five wishes.

First, I very much hope that the most welcome and important funders and supporters of this conference do not misunderstand this step into independence as an invitation to stop their support. Indeed, at least here in Switzerland, parents can claim financial responsibility in the tax declaration for children up to age 26 if they are not economically independent, namely if they are still learning and studying. Is this not exactly what we do at this conference every year, we study, we learn from each other, share, disagree and challenge us, identify gaps of knowledge? That is indeed what this conference is all about – since the first year. 18 years ago Prof. Czerwinski and Prof. Kittelson disagreed on how to properly measure nanoparticles – thus, Prof. Siegmann and Dr. Mayer joined the debate and agreed to organize what became the first Conference in 1997. Before welcoming the Conference as an adult, let us applaud these fathers of this event – at least the three who can still be with us - and let us ask the three to stand up!

Second, I wish the conference keeps its most appreciated view on *application* also as an adult. It is not just about particle research for the sake of research but indeed it engages in the *application* of knowledge to use science to get a healthier air and, in fact, to get rid of the problem that we study! This is by no means a self-evident commitment and we should not take it for granted. Indeed some adults tend to become more selfish, dedicated to

serving their own interest only. The conflict of interest is in essence to not necessarily apply knowledge and to not resolve problems as this could ultimately mean that we will not need this conference anymore! Imagine a world where particles have been eliminated, eradicated! Many of us would lose their jobs and those in the room who have so far “unsuccessfully retired” because of their continued engagement in this field, such as Prof. emeritus Peter Gehr and others, they would be forced to truly retire or find a new dedication once particles had disappeared.

Third, I suggest to continue and to keep up the spirit of interdisciplinary cross-talk to line the engineers, the aerosol scientists, the modellers, the policy makers, the health researchers, the technicians and all others up with the goal of finding solutions to the benefit of a sustainable society – which means a society that does well in terms of social, economic *and* environmental circumstances. Why we should continue to go for these values is clear: social conditions, the economy, *and the environment* are fundamentally important drivers of peoples’ health. Please remember this message when you read the next headlines claiming that some newly detected gene or biomarker will revolutionize the health of the public and provide the ultimate key to “personalized medicine”. These overstatements will never be the answer to the key health issues. We do need a healthy environment and it is great if the conference continues to be dedicated to this as well.

Fourth, it is also great how this conference became increasingly international and this should be kept high up. Switzerland made major improvements in terms of pollution control – but we are obliged to not lose a global perspective. Billions of people continue to live in extremely polluted areas and we have to discuss and promote solutions that are applicable to their future development as well. It is great to see representatives of almost 30 countries this year. The globalized world calls for an exchange across cultures and countries and we need to share our experience and strategies with those from the most polluted places in the world. Yes I know, right now, during the World Cup in Brazil, the world has other ranking criteria than air pollution. But if pollution would predict the results of the games of tonight, England, and Japan will for sure be out of the game while Greece, the Ivory Coast, and Columbia may compete for the top ranks in the pollution scale. And India, China, Iran, Turkey, Eastern Europe, and Africa were just lucky to not play tonight; they would certainly beat the tonight’s competitors in an air pollution based ranking!

Fifth, and last but not least, I would really hope that the conference will keep its open spirit in considering air pollution a complex non-linear problem, thus, I hope the conference will never lock itself in any ivory tower. It was visionary of the funders to put the nanoparticles at stage, for sure. I hope though the Conference continues to acknowledge the complexities of the world of particles and air pollution. Particles change in size, form, origin, colours, surface, and health effects, and people differ in susceptibilities. If we would lock ourselves in an ivory tower for nanoparticles alone, we would miss the bigger picture. I say this in particular from a health perspective to emphasize that nano-sized ambient particles are not “more dangerous” or “less dangerous” than other size fractions. There is no “magic bullet” in the mixture of unhealthy air! Nanoparticles are though very relevant too, they are toxic as well, thus, emissions should be reduced! But public health does not need a lobby against the ultrafine particles *alone* but a lobby for clean air to protect peoples’ health.

Thank you for your attention and enjoy the dinner



New Proposal of Swiss Federal Commission for Air Hygiene (FCAH) on how to Regulate Ambient Particulate Matter

Prof. Nino Künzli, MD, PhD

**Deputy-Director Swiss Tropical und Public Health Institute, Basel
(SwissTPH)**

Prof. of Public Health, University Basel, Medical Faculty

President of the Federal Commission for Air Hygiene (FCAH)

Eidgenössische Kommission für Lufthygiene (EKL)

Prepared for 18th ETH Conference on Combustion generated Nanoparticles

Session 7: Legislation

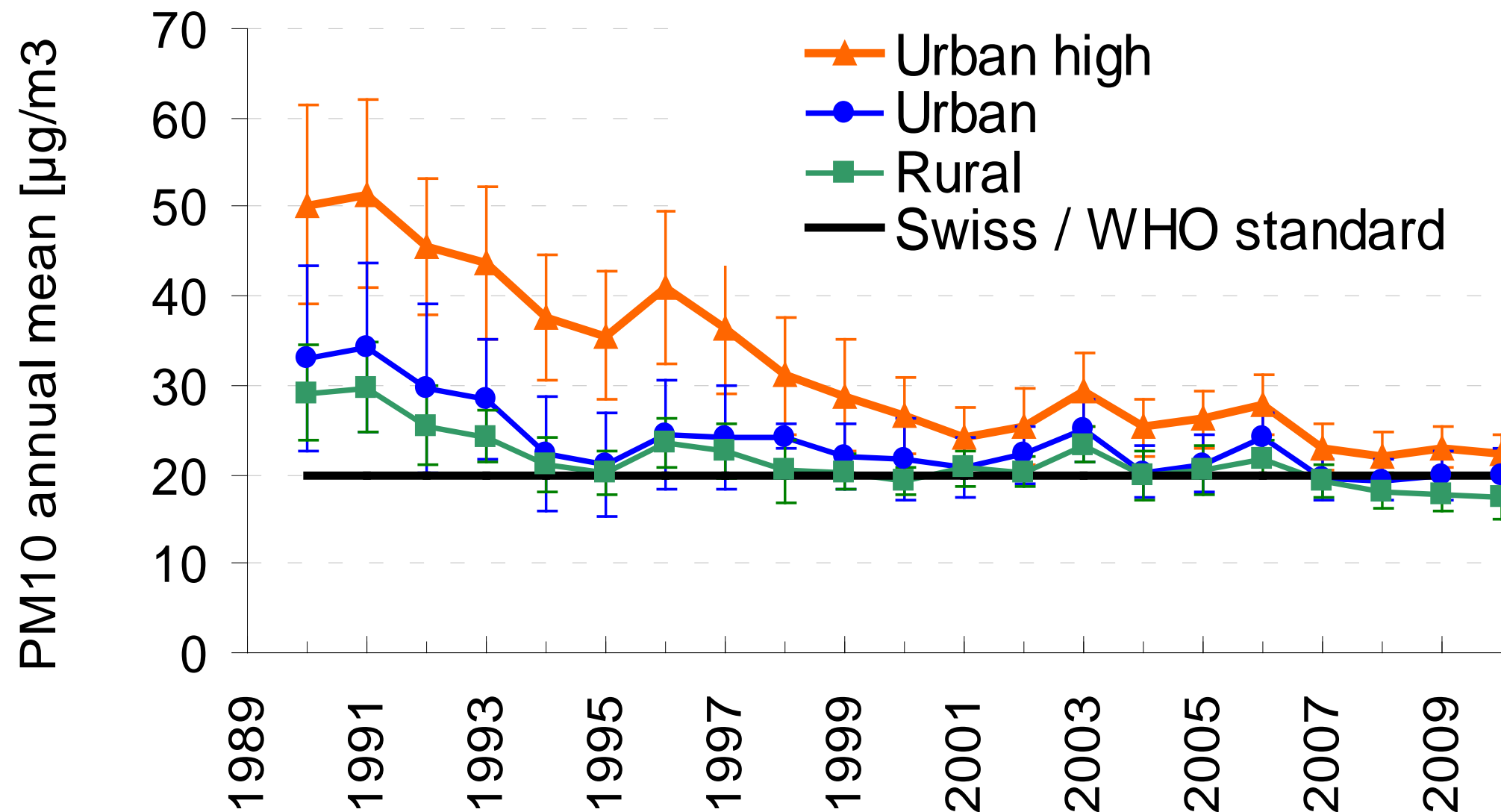
Wed 25.6.2014 – 10:40h



- ❑ Federal Commission for Air Hygiene (FCAH) advises Swiss Government on air quality directives (LRV)
- ❑ Basis: Swiss Environmental Law (Umweltschutzgesetz - USG) (since 1983)
- ❑ Precautionary principle to protect public health – including health of most susceptible
- ❑ Last evaluation of standards: 2006
- ❑ 2013: Re-evaluation of directives for **particulate matter** in light of new research findings
- ❑ Clean air policies of Switzerland so far: successful

Switzerland, 1990 – 2010

Air Pollution improved due to policies
(example: particulate matter - PM10 - concentrations)



Current PM-related air quality standards in Switzerland

Inhalable Particulate matter (PM10)	20 µg/m ³	Annual mean
	50 µg/m ³	24-h-mean; maximum exceedance allowed per year
Lead (Pb) in PM10	500 ng/m ³	Annual mean
Cadmium (Cd) in PM10	1.5 ng/m ³	Annual mean

Getting close to full compliance

in full compliance since many years



1. Keep both: «24-hr» and «annual mean» PM10 standards;
2. Add new «annual-mean» Standard for PM2.5:
10 $\mu\text{g}/\text{m}^3$ (WHO Guideline value)
3. Cut EC, a key marker of combustion related PM:

minimize EMISSIONS to reduce EC to 20% of current levels

Rational discussion 1



- ❑ Short-term and long-term effects are partly independent (different mechanisms, different sub-groups affected, different susceptibilities etc.)
- ❑ PM2.5 and coarse particles (PM2.5-10) and PM10: partly different / complementary effects (different locations of deposition etc.)

Remember:
Human beings are NOT engineered...



... there is NO «MAGIC BULLET»

ORIGINAL ARTICLE

Coarse and fine particles but not ultrafine particles in urban air trigger hospital admission for asthma in children

Anne Iskandar,¹ Zorana Jovanovic Andersen,² Klaus Bønnelykke,¹
Kutlar et al,³ Klaus Kaae Andersen,² Hans Bisgaard¹

Check out LUDOK Poster at ETH conference
(Kutlar et al)
LUDOK = literature data base for air pollution and health (including for ultrafine particles!)
<http://ludok.swisstph.ch>

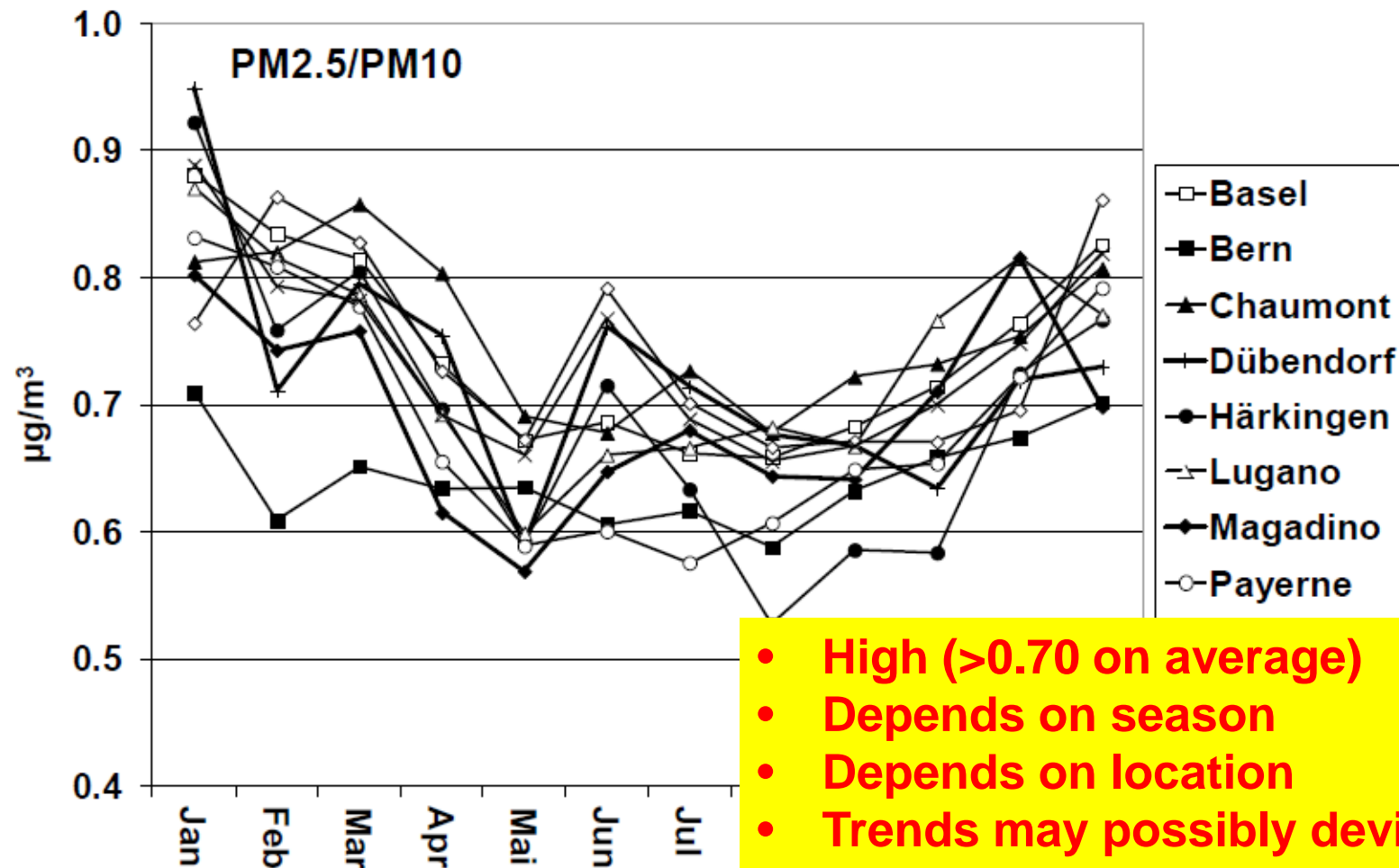


- ❑ Short-term and long-term effects are partly independent (different mechanisms, different sub-groups affected, different susceptibilities etc.)
- ❑ PM2.5 and coarse particles (PM2.5-10) and PM10: partly different / complementary effects (different locations of deposition etc.)
- ❑ PM2.5/PM10-ratio depends on season, location, time
- ❑ PM2.5 and PM10 not necessarily affected by the same (future) policies

→ Requires policies that are sufficiently specific for health effects AND policies

- Short-term AND long-term standards (PM10)**
- PM2.5. AND PM10 standards (long-term)**

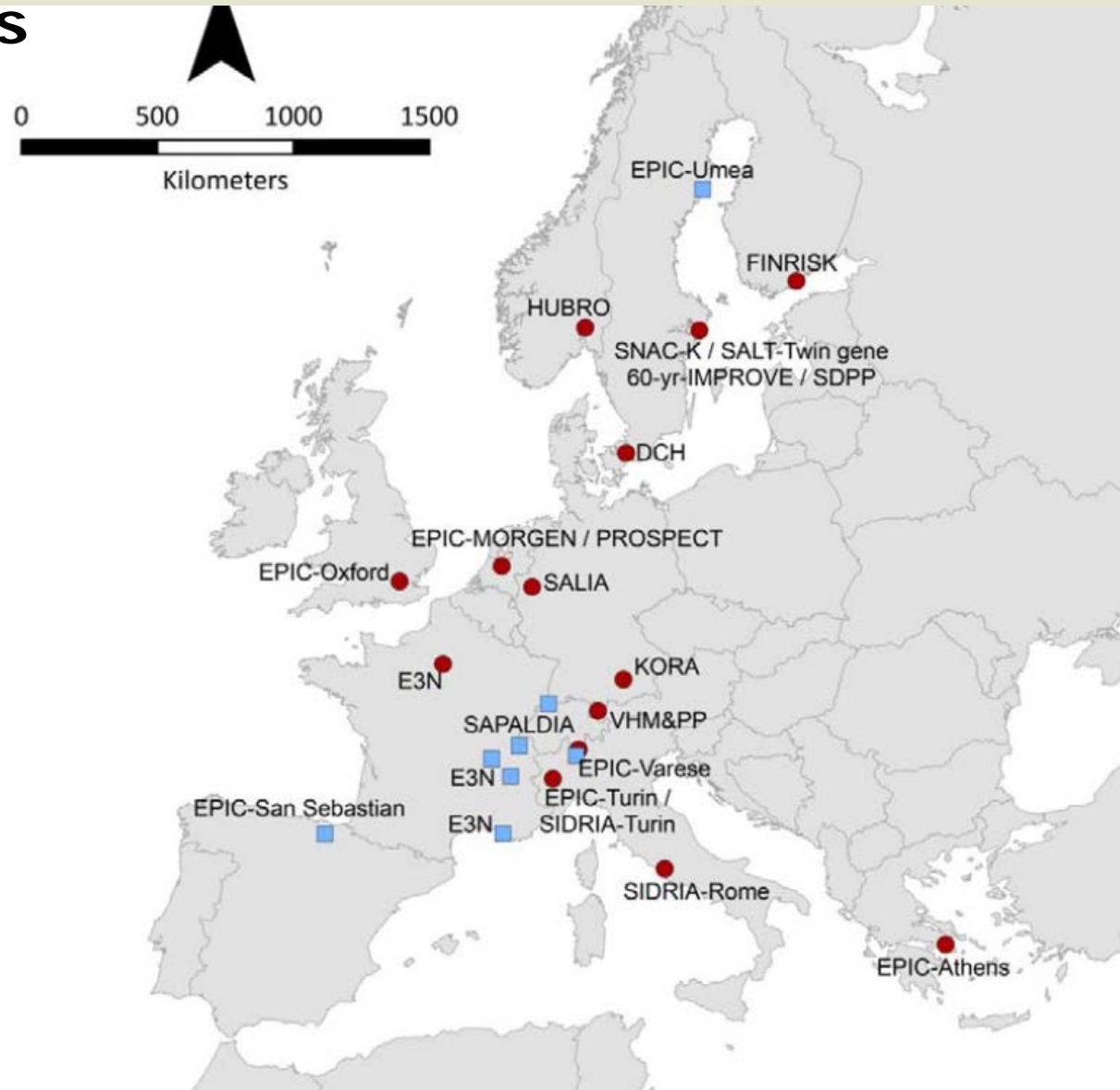
The PM2.5/PM10 ratio in Switzerland



Quelle: NABEL-Messnetz BAFU/Empa (Gehrig 2013)

- High (>0.70 on average)
 - Depends on season
 - Depends on location
 - Trends may possibly deviate in the future
- The current «indirect regulation» of PM2.5 through PM10 Standards is not a good strategy for the future
(despite high temporal PM2.5-PM10 correlation >0.9)

Most recent European research (ESCAPE project with 22 cohorts) fully confirms that long-term exposure to PM_{2.5} is associated with mortality also at very low concentrations



Distribution of home outdoor PM2.5 among participants of 19 cohort studies and association between 5ug/m3 contrast in PM2.5 and mortality rates (ESCAPE Study)

(Beelen et al, Lancet 2013)

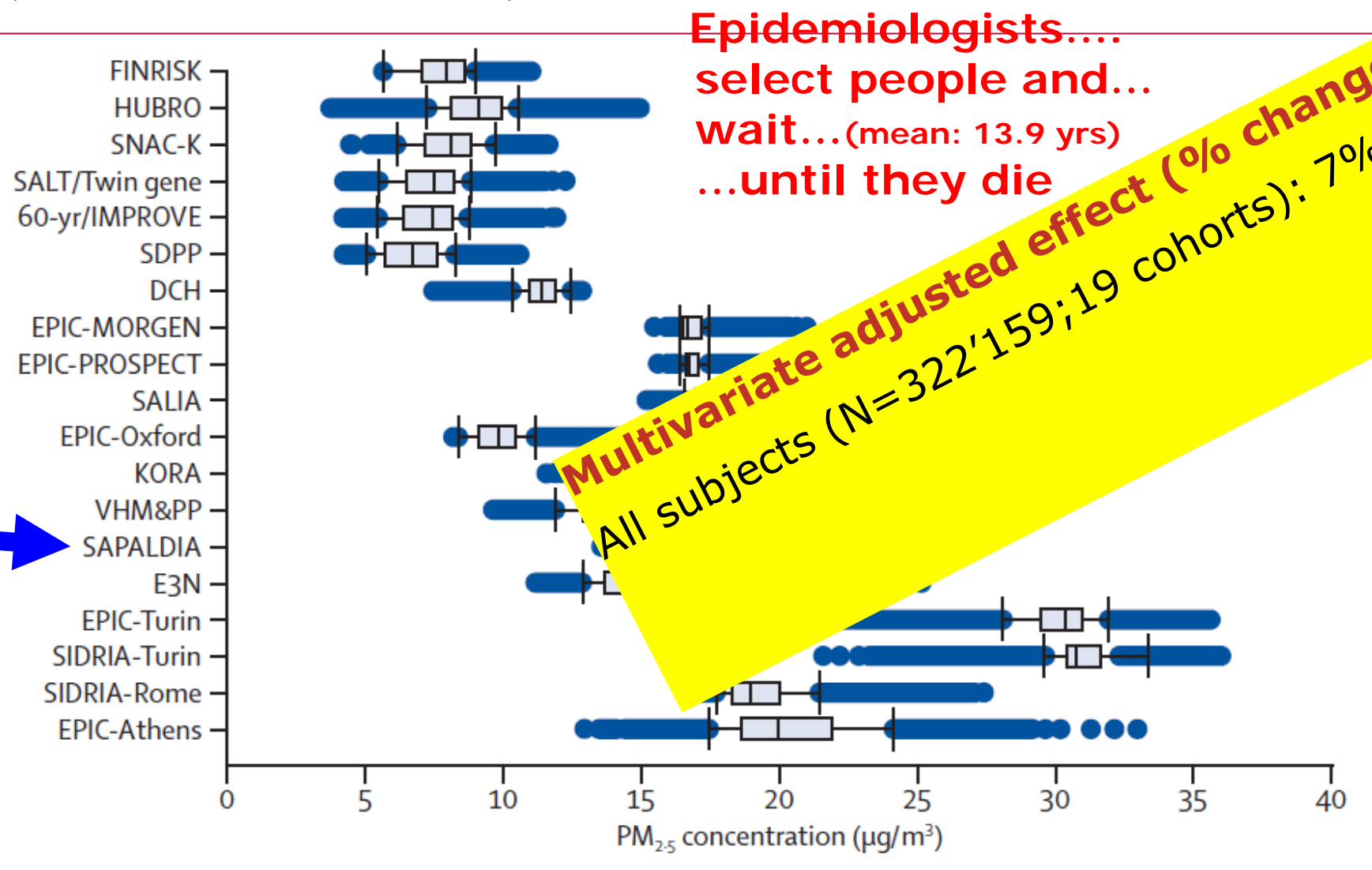
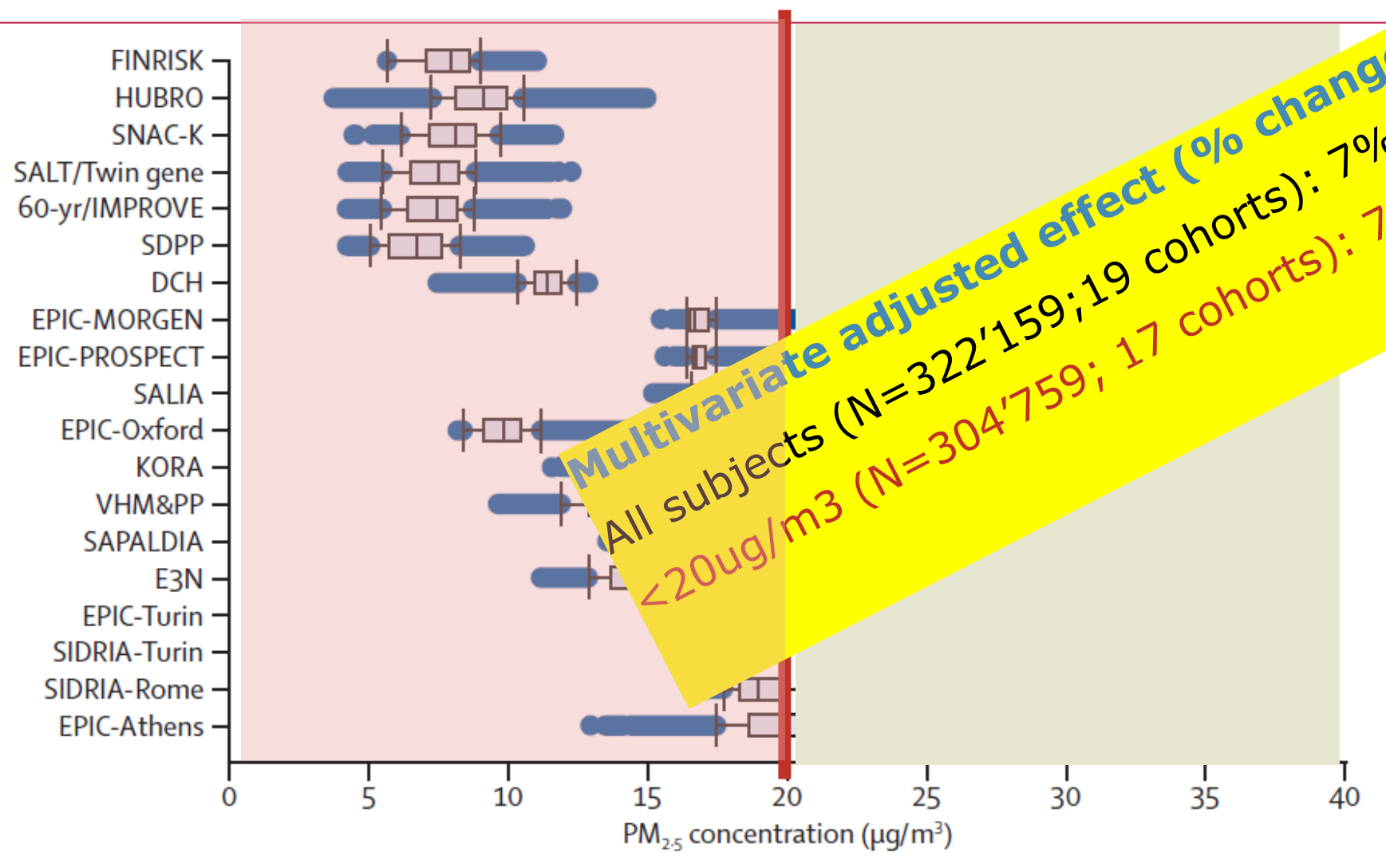


Figure 1: Description of exposure to PM_{2.5} concentration (µg/m³) at participant addresses in each cohort

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Multivariate adjusted effect (% change in death)

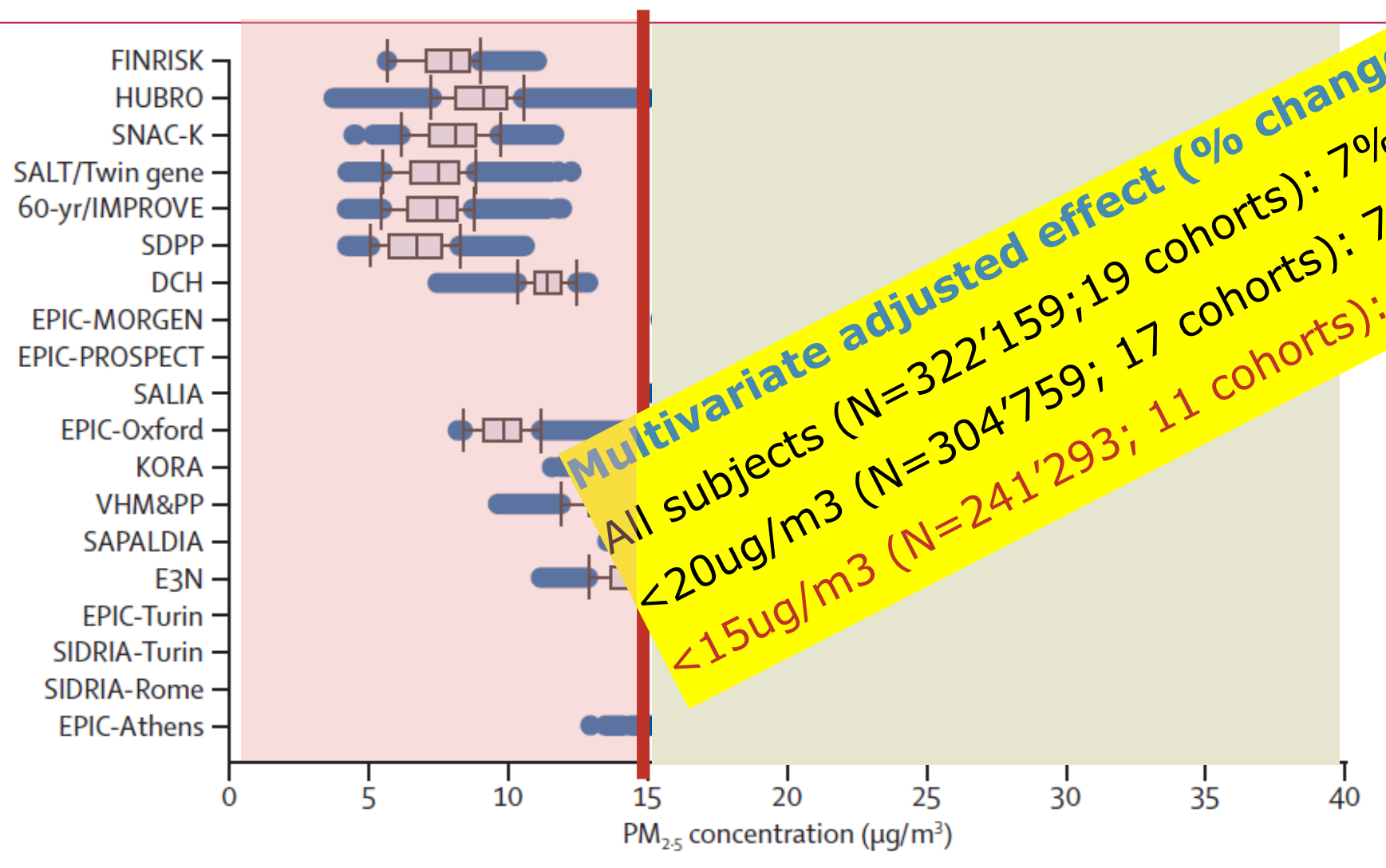
All subjects (N=322'159; 19 cohorts): 7% (2 to 13%)

<20ug/m³ (N=304'759; 17 cohorts): 7% (1 to 13%)

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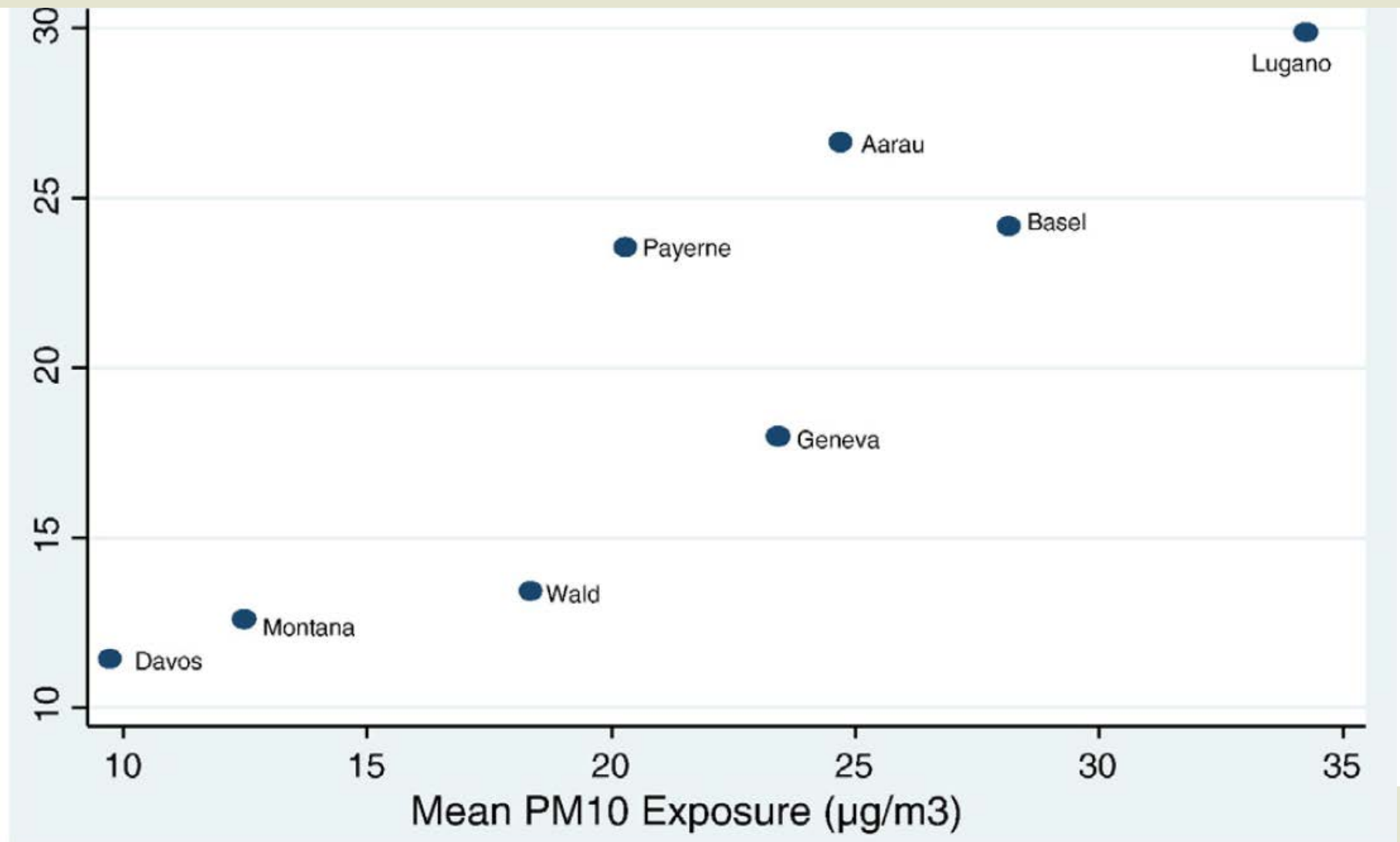
Multivariate adjusted effect (% change in death)

All subjects (N=322'159; 19 cohorts): 7% (2 to 13%)
<20ug/m3 (N=304'759; 17 cohorts): 7% (1 to 13%)
<15ug/m3 (N=241'293; 11 cohorts): 4% (-2 to 11%)

Figure 1: Description of exposure to PM_{2.5} concentration (µg/m³) at participant addresses in each cohort

Multivariate adjusted association between doctors diagnosed diabetes prevalence and home outdoor level of PM10 in the swiss SAPALDIA study

Eze et al, Env Int 2014





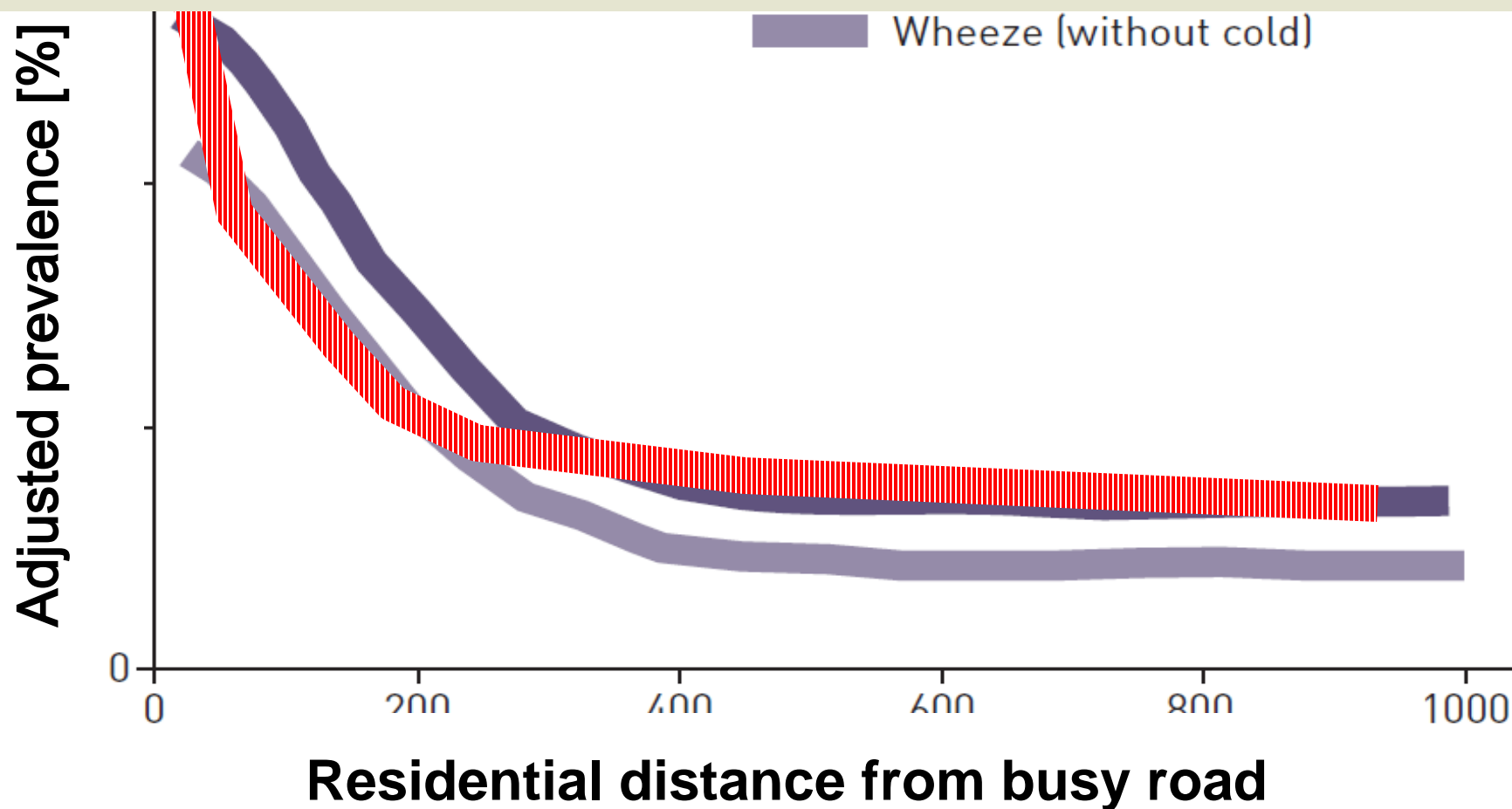
☐ **Need for policy action is clear due to toxic effects**

- ☐ Soot and ambient PM are considered carcinogens; nano-PM (UFP) are toxic (cells, arteries, brain etc.)... -

Adjusted prevalence of chronic cough depends on residential distance from highway

(Swiss survey based on ~1'800 adults, age 15-70)

ERS Lung White Book 2013 – from Hazenkamp et al, Env Health 2011 – online open access





- ❑ Need for policy action is clear due to toxic effects
- ❑ Soot and ambient PM are considered carcinogens; nano-PM (UFP) are toxic (cells, arteris, brain etc.)... - **BUT:**
- ❑ Difficult to chose «near-source» marker of pollution based on health research (mixture) – science does not provide direct answers!
- ❑ No international monitoring standards established (except for EC: soon adopted). No standard for UFP / particle number
- ❑ Monitoring and regulating UFP (location, time windows etc.) very complicated → risk for endless debates on «how to do» and for «network manipulations» instead of taking ACTION



Particle number concentration at a highway side with very high traffic (Härkingen, Switzerland): Particle Number heavily depend on wind direction (PNC 10-500 nm)

		During down-wind conditions		During up-wind conditions	
		Winter		Winter	
10–100 nm	#/cm ³	37 929		10 250	
100–500 nm	#/cm ³	3 401		2 530	
10–500 nm	#/cm ³	41 331		12 779	
Anteil <100 nm		92 %		80 %	

**No matter how the wind blows... :
these toxic particles should
NOT be emitted into the air we breath...!**

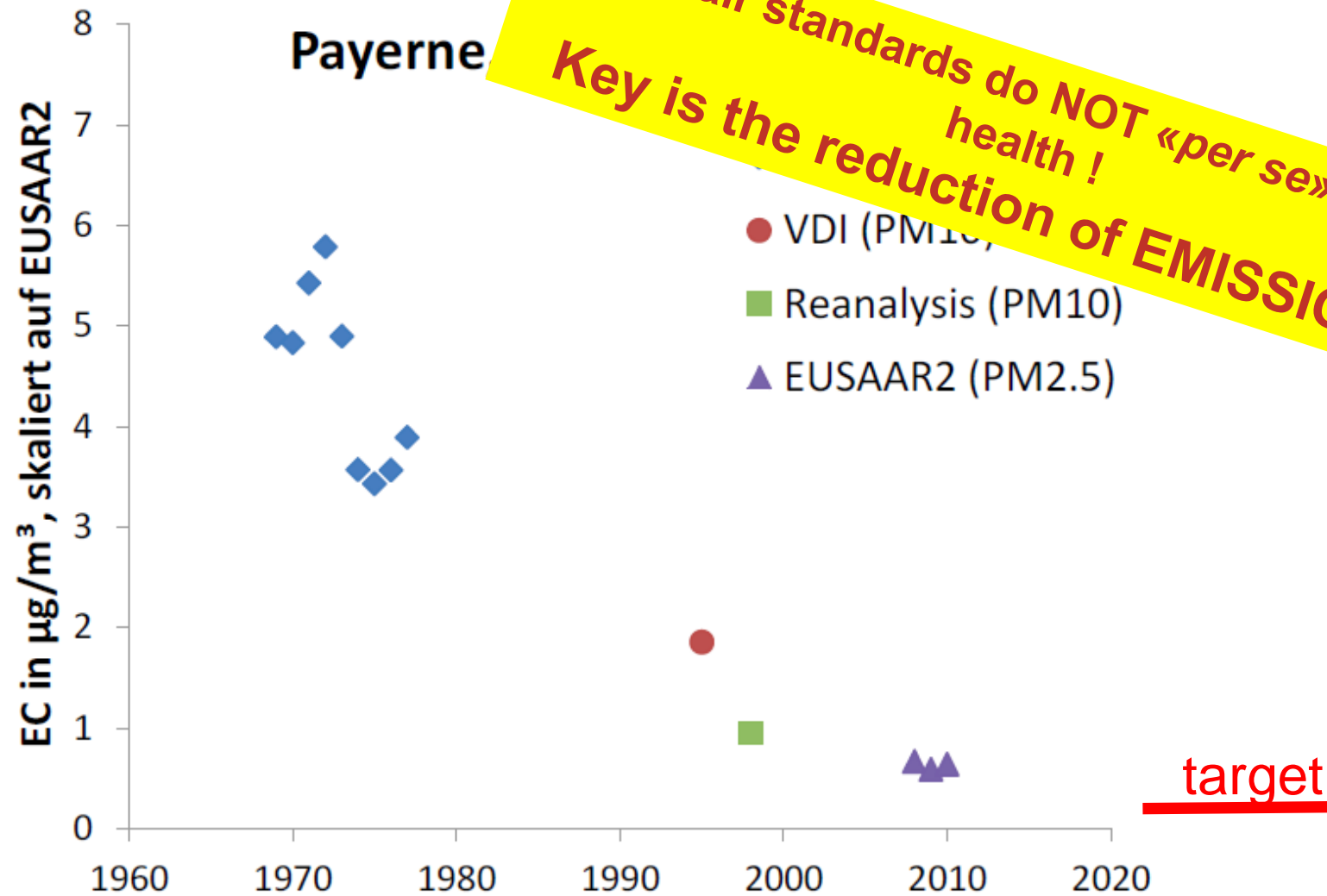


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 - ❑ Monitoring and regulating UFP (location, time windows etc.) extremely complicated → risk for endless debates on «how to» and for «network manipulations» instead of taking ACTION
 - ❑ Carcinogens must be «as low as acceptable» ; 1 case per 1Mio. exposed is considered «acceptable»
 - ❑ «minimizing strategy» has been successful in the past
- **FCAH proposes rigorous reductions of EC EMISSIONS + monitoring of EC, UFP and other near-source pollutants instead of setting new standard values**

Example of successful minimization policy

EC concentrations (annual means) at a rural site (Payerne) - same applies to urban sites

alle auf das heute aktuelle EUSAAR2-Verfahren



Clean air standards do NOT «per se» improve health !
Key is the reduction of EMISSIONS !

Policy actions: better IMPLEMENTATION of available or decided strategies...

Swiss TPH



- ❑ Best available technology for all emitters
- ❑ Euro-6-Emissions, Polluters-Pay-Incentives, Emission limits for construction machines, boats, Diesel train engines, retro-fit of buses and ski slope machines with particle filters
- ❑ Rigorous emission targets for agriculture and industrial machines, stationary engines (power stations / WKK, diesel emergency power stations) and heating systems (wood)
- ❑ Equal PN emission target for diesel and gasoline engines
- ❑ Wood combustion: promote only modern and large systems; burn polluting biomass (old wood, furniture etc.) in large facilities only.
- ❑ Government should promote international standardization of measurements (EC, OC, PN, PAH etc.) and continue monitoring at federal stations (follow trends)
- ❑ Emission targets for motor cycles

Many EC reduction strategies are likely to reduce particle number concentration (PNC) in Switzerland as well...

Correlation of PNC with other markers at NABEL Stations)

PM2.5	0.41	
PM10	0.43	
NO2	0.49	
EC	0.61	(Härkingen: 0.69)



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Thank you for your attention

Swiss TPH



Members of the Swiss FCAH:

Künzli Nino, (Präsident); Ammann Christof, Baltensperger Urs, Braun Sabine, Colombo Luca, Dubas Françoise, Flückiger Alexandre, Gehr Peter, Gehrig Robert, Gygax Hans, Künzler Peter, Leikauf Bernhard, Nejedly Gerrit, Probst-Hensch Nicole

Ad hoc working group members for the PM report:

Kutlar Meltem, Rapp Regula, Strähl Peter, Zürcher Fritz

Nino.Kuenzli@unibas.ch

Les poussières fines en Suisse 2013

Un état des lieux dressé par la Commission fédérale de l'hygiène de l'air



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Commission fédérale de l'hygiène de l'air CF

