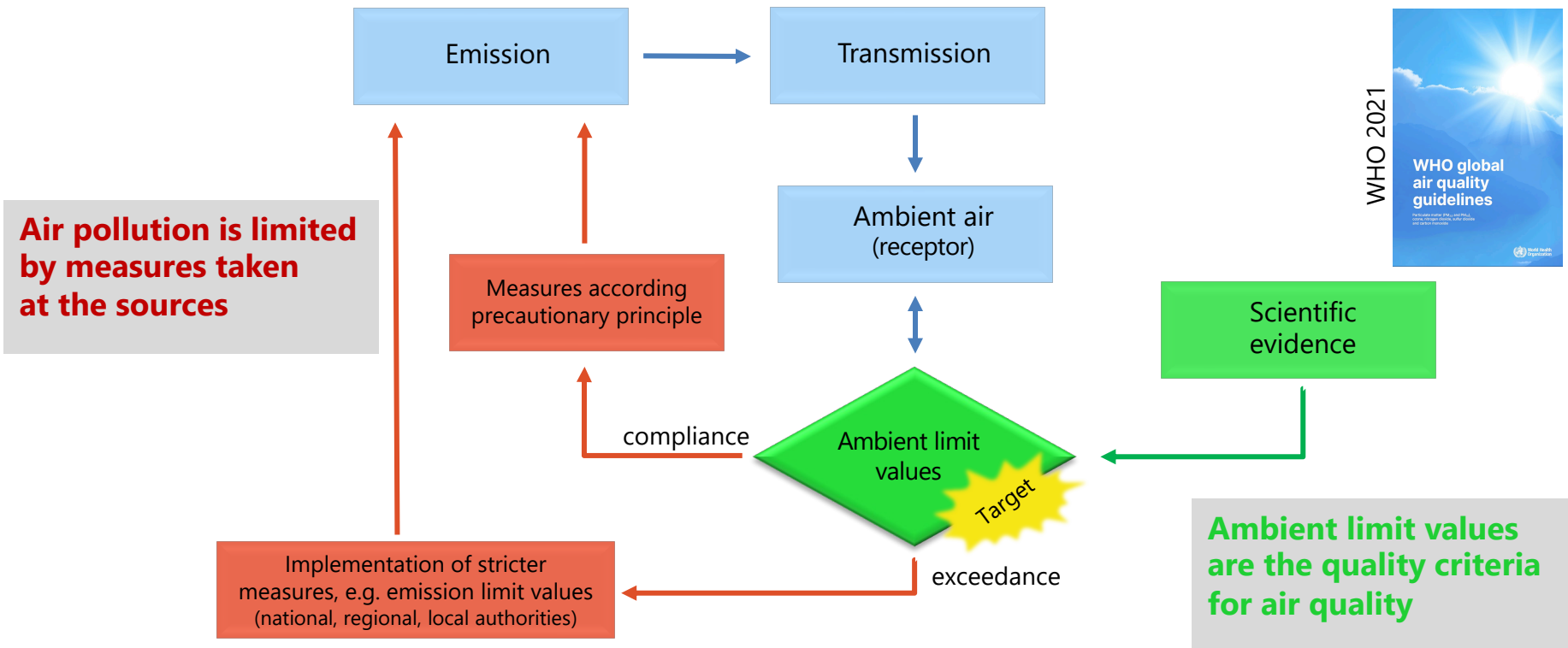


# On the effects of past and future ambient air regulations on air quality in Switzerland

**Christoph Hueglin**

Air Pollution and Environmental Technology Lab.

Empa

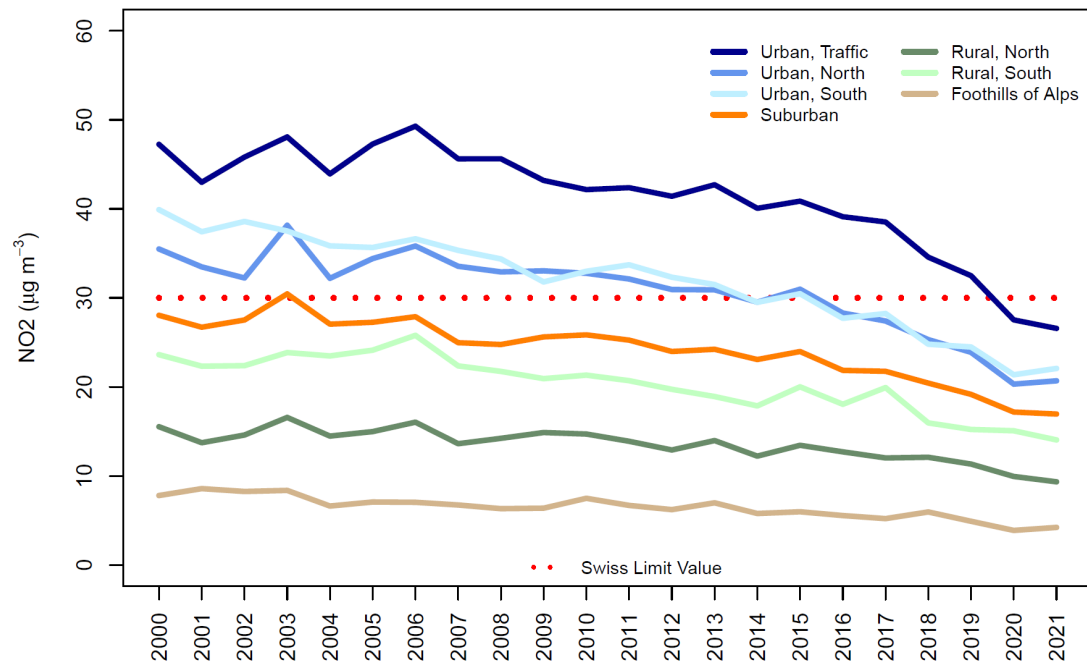


For Criteria Air Pollutants, e.g.

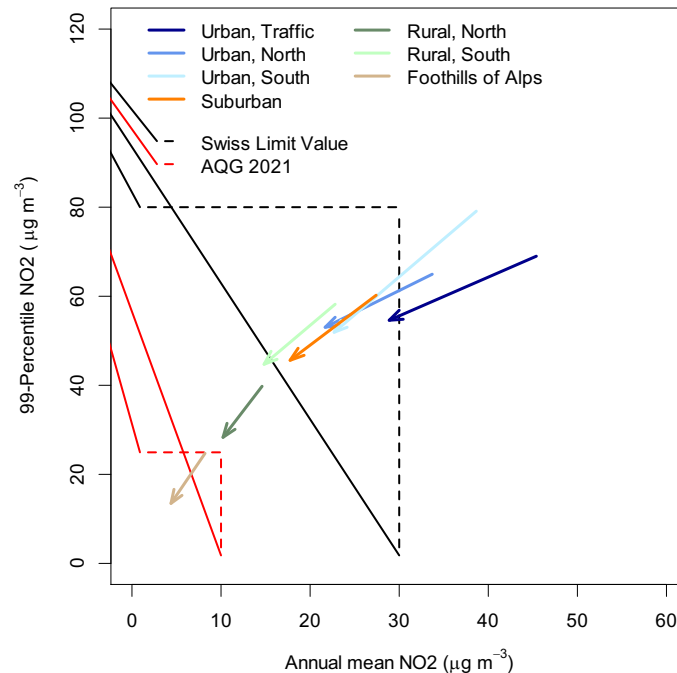
- Nitrogen Dioxide (NO<sub>2</sub>)
- Particulate Matter (PM<sub>10</sub>, PM<sub>2.5</sub>)
- Ozone (ground level)
- Sulfur Dioxide (SO<sub>2</sub>)
- Carbon Monoxide (CO)
- Lead (Pb)
- ...

**There are many more air pollutants  
– without ambient regulation !**

Annual mean values in Switzerland, data from NABEL network



Change 2000-2021

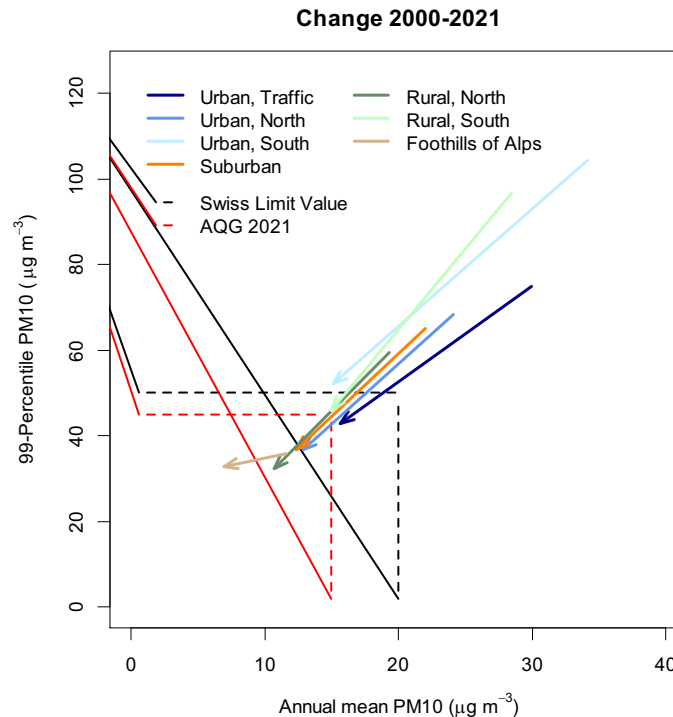
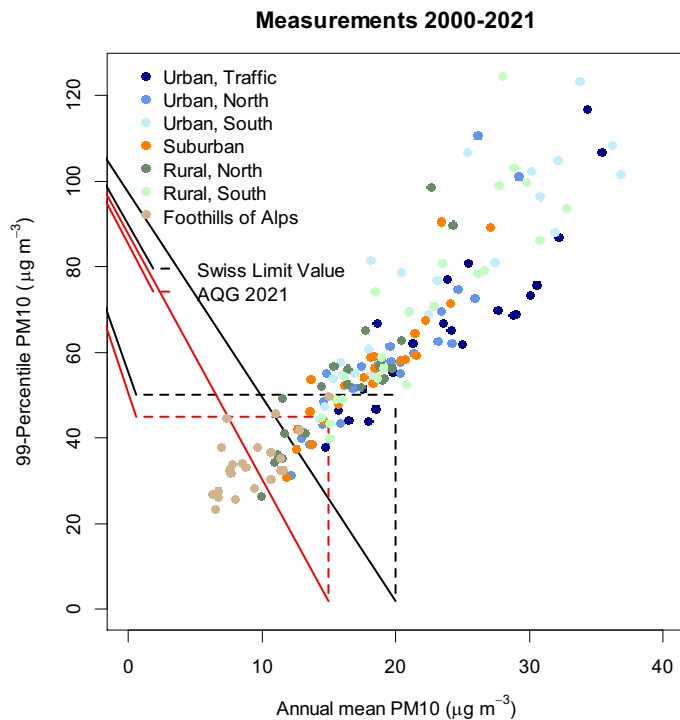


- short-term and long-term concentrations are correlated
- abatement measures had equally positive effect on short-term and long-term concentrations

- Compliance with AQG 2021 requires continuing efforts

# Effect of regulations for PM<sub>10</sub> to date

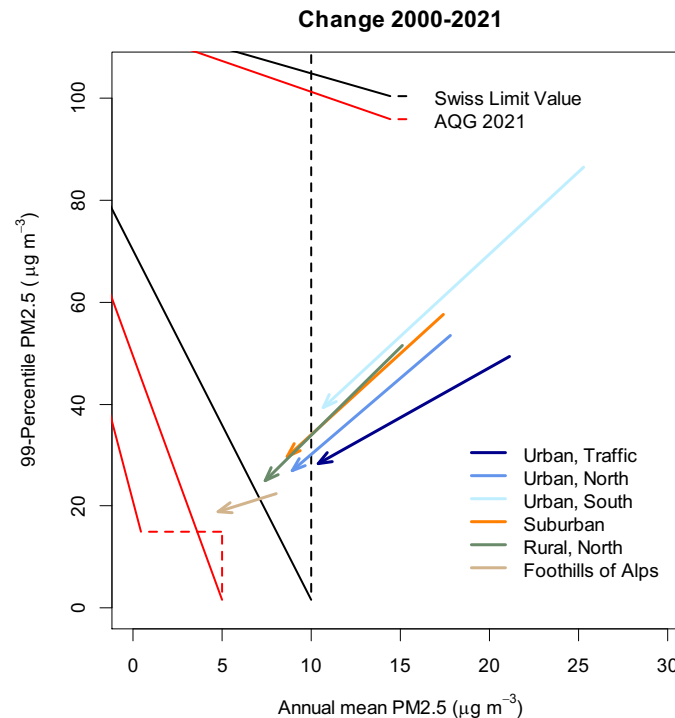
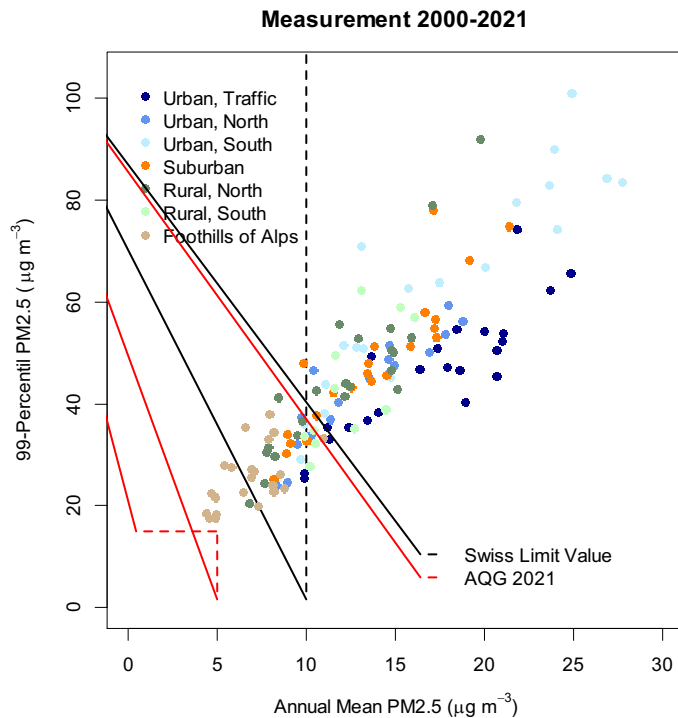
Switzerland, data from NABEL network



– On a good way (and motivation) to achieve compliance with AQG 2021

# Effect of regulations for PM<sub>2.5</sub> to date

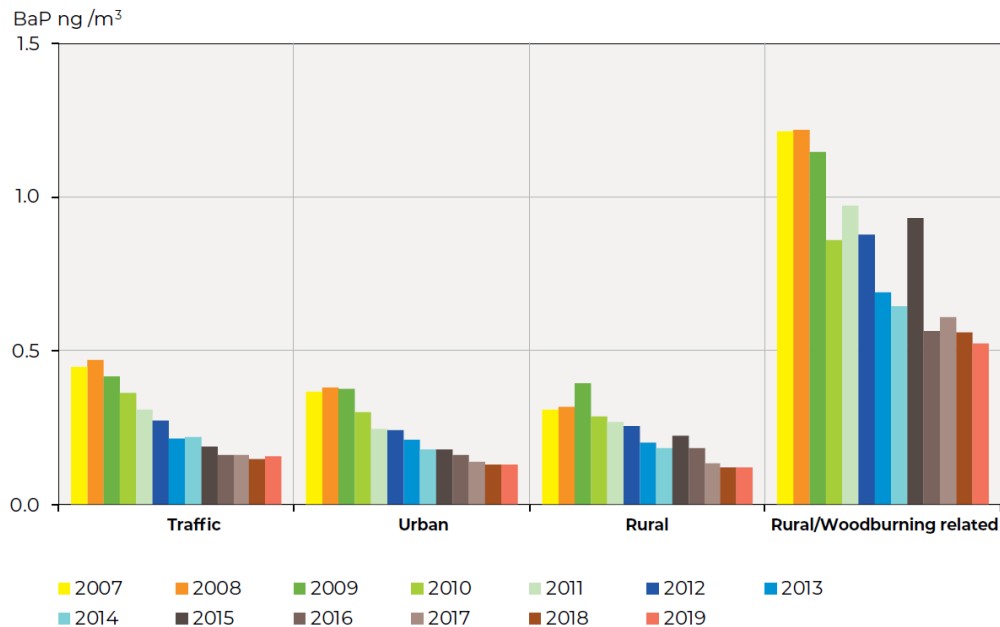
Switzerland, data from NABEL network

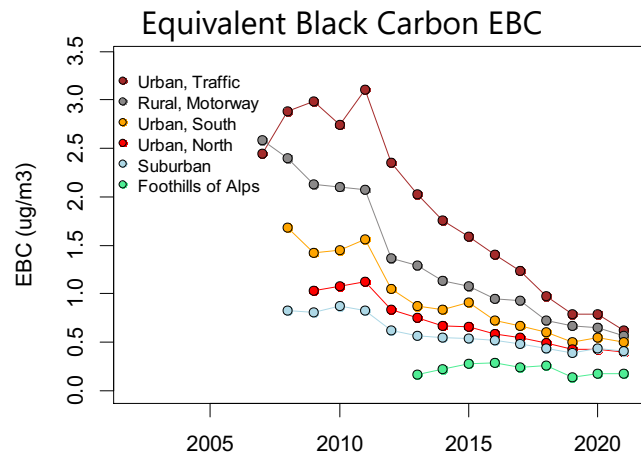


- Compliance with AQG 2021 requires continuing strong efforts !
- Verification of compliance with the AQGs is doable but metrologically challenging

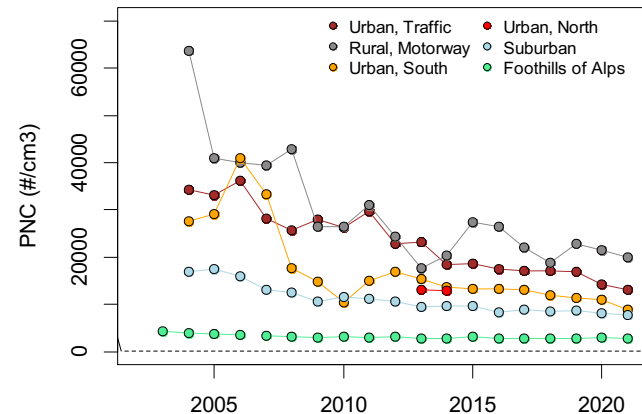
## Benzo[a]Pyrene in Switzerland 2007-2019 (data from NABEL and cantonal sites)

(from: Human health effects of polycyclic aromatic hydrocarbons as ambient air pollutants, WHO, 2021)

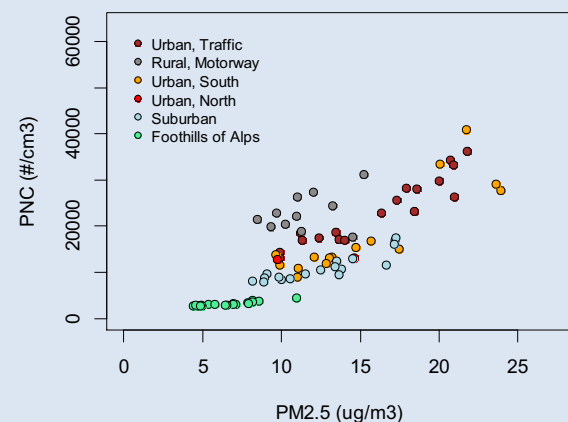
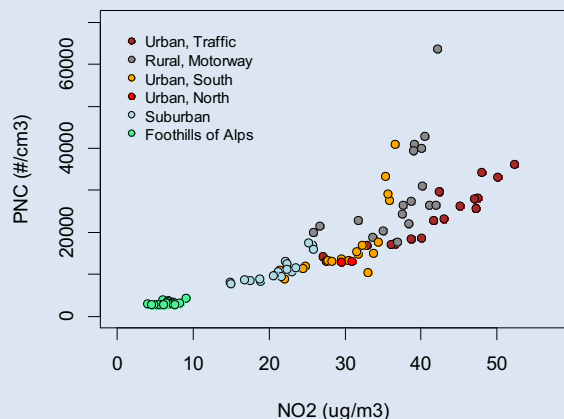
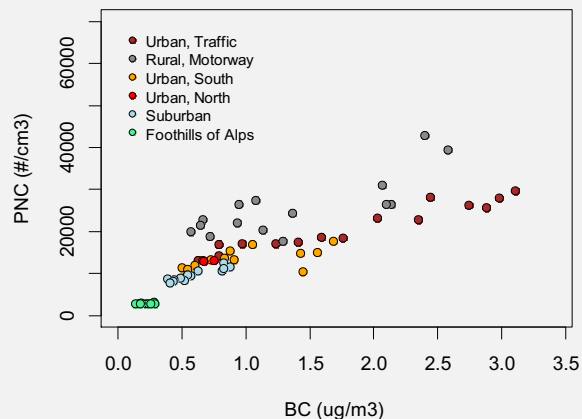




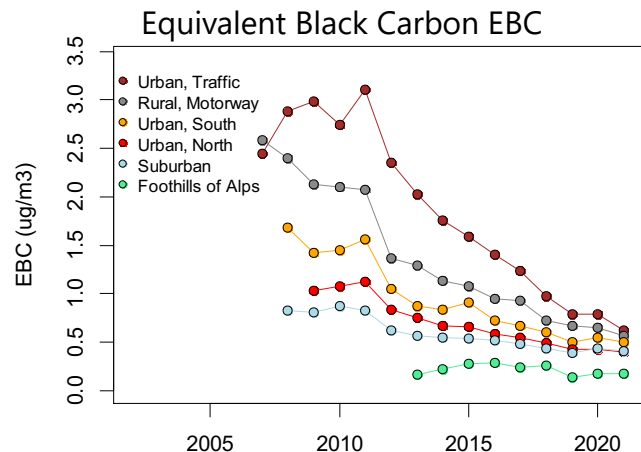
### Particle number concentration PNC (size range 4nm – 3μm)



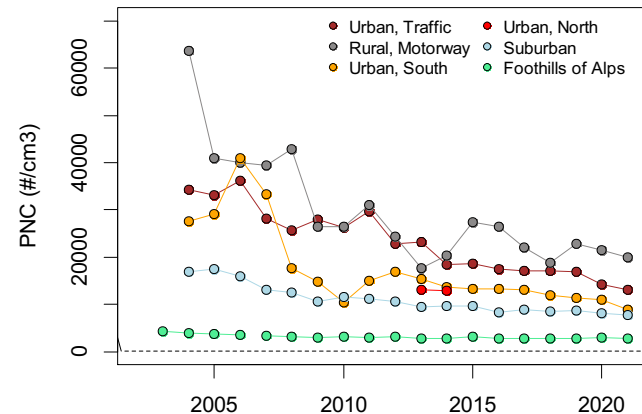
### Annual mean concentrations



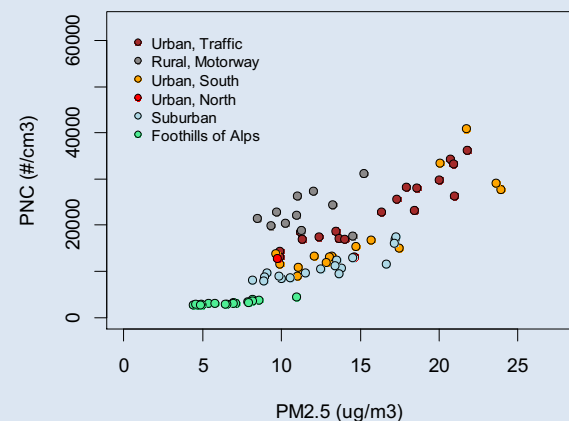
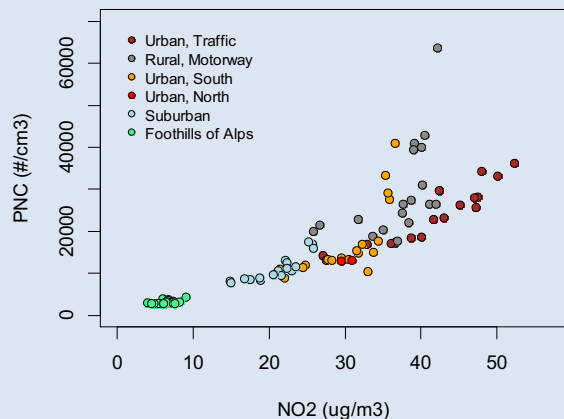




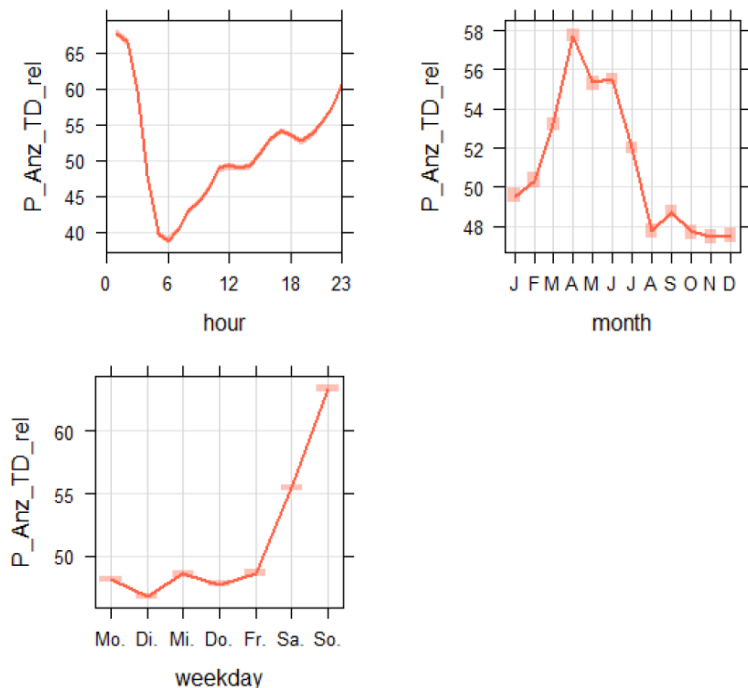
### Particle number concentration PNC (size range 4nm – 3μm)



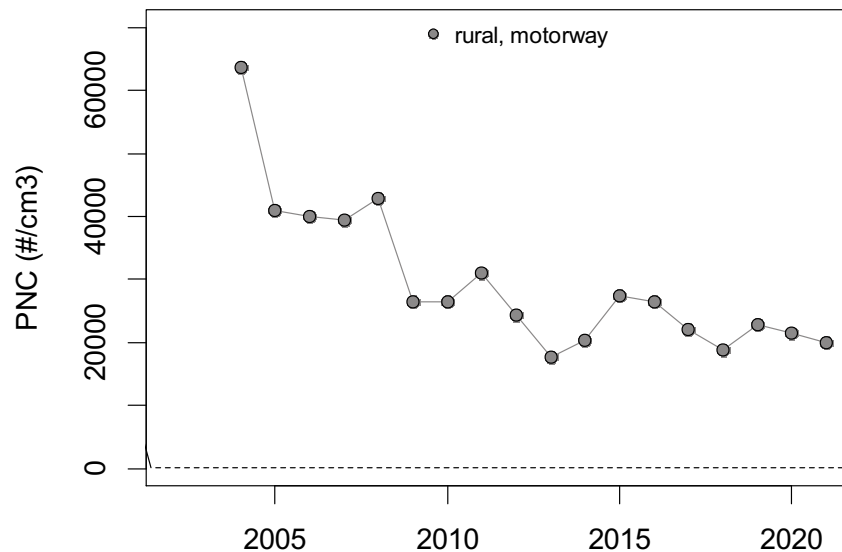
- **There is often a relationship between air pollutants with and without ambient limit values (e.g. same sources)!**
- **Measures targeting at the ones often have a positive effect on the others (at least in the past)**



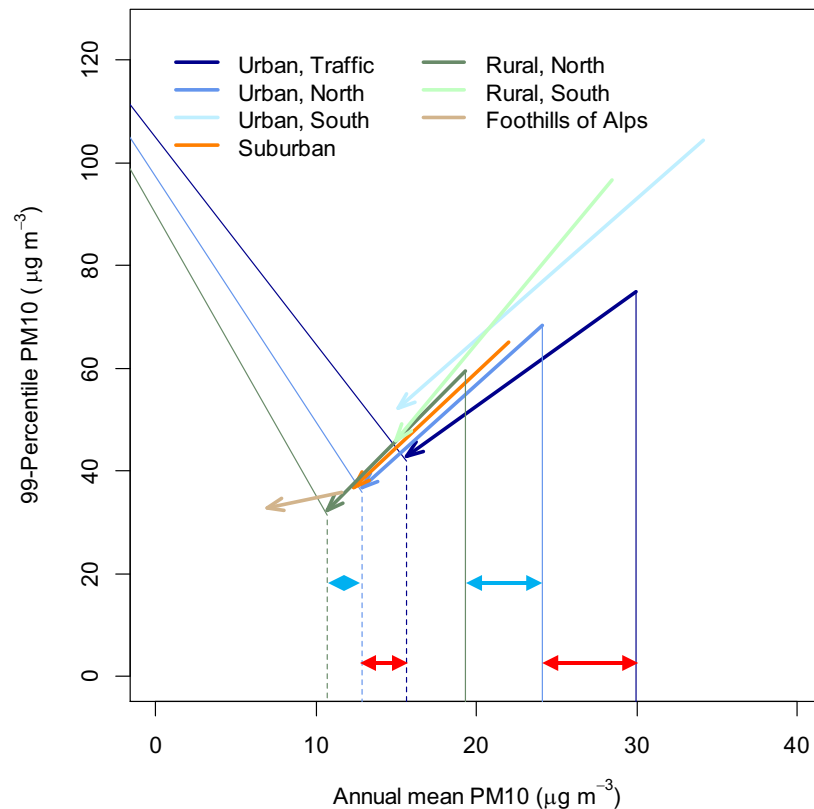
Percentage heat resistant particles (300°C) at rural motorway site  
(data from 2013-2020)



Particle number concentration PNC (size range 4nm – 3 $\mu$ m)



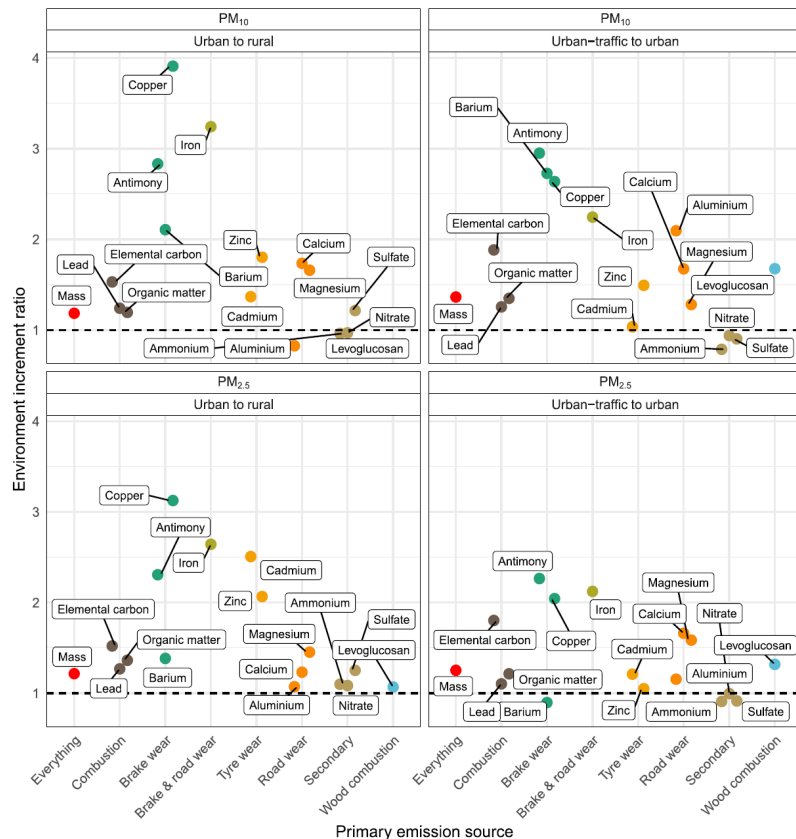
- Efforts to improve air quality must continue!
- Air pollution control policies should incorporate new scientific findings



Urban to Rural Gradient

Urban-Traffic to Urban Gradient

Urban to rural and urban-traffic to urban increment ratios for selected species in PM<sub>10</sub> und PM<sub>2.5</sub> (Grange et al., Atmos. Environ. X, 2021)



Overview on NEEs e.g.

AIR QUALITY EXPERT GROUP

Non-Exhaust Emissions  
from Road Traffic

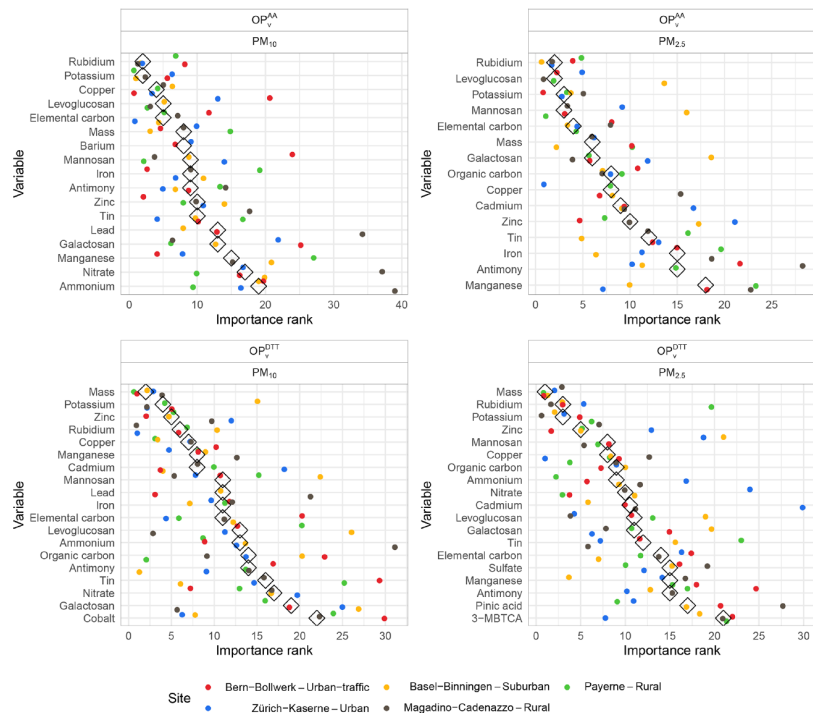


Prepared for:  
Department for Environment, Food and Rural Affairs;  
Scottish Government; Welsh Government; and  
Department of the Environment in Northern Ireland

Defra (2019)  
<https://uk-air.defra.gov.uk/assets/reports/cat09>

# Oxidative Potential (OP) of Particulate Matter PM

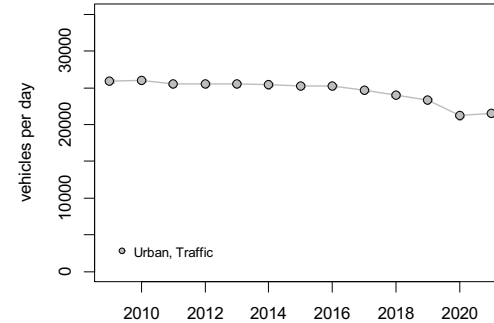
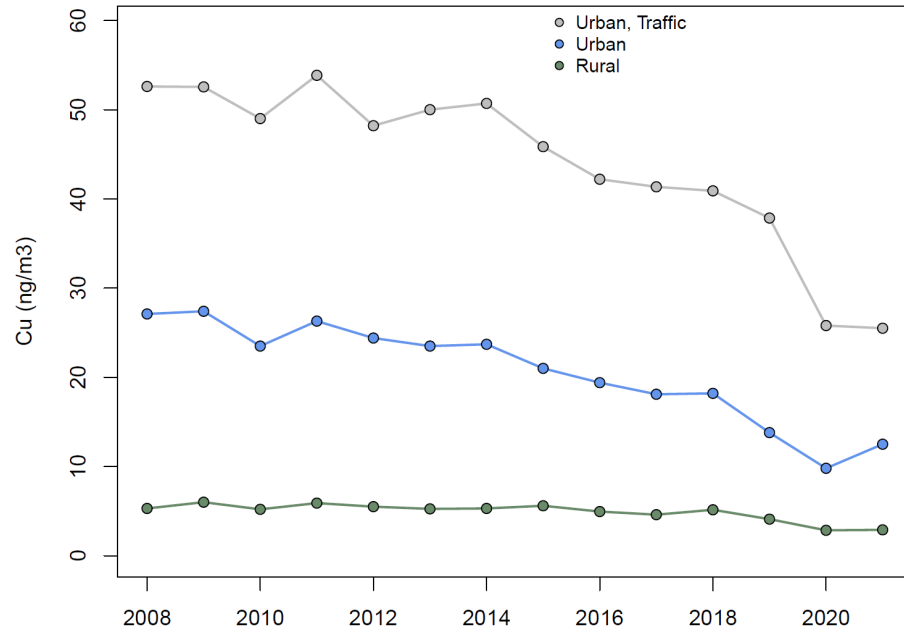
- Transition metals and other constituents of PM are known to be capable of generating reactive oxygen species (ROS) that can cause oxidative stress (e.g. Verma et al. EST, 2015; Zhang et al. EST, 2021)
- The potential of PM to generate ROS is called OP and can be tested in the lab by different acellular assays



Grange et al., ACP (2022)

See also e.g.:





United States Environmental Protection Agency

Environmental Topics
Laws & Regulations
Report a Violation
About EPA

National Pollutant Discharge Elimination System (NPDES)
CONTACT US

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Forest Roads
Industrial Wastewater
Municipal Wastewater
National Pretreatment Program
Pesticide Permitting
Stormwater
Water Quality Trading
NPDES Technical Resources

## Copper-Free Brake Initiative

On January 21, 2015, EPA, states, and the automotive industry signed an agreement to reduce the use of copper and other materials in motor vehicle brake pads. The agreement calls for reducing copper in brake pads to < 5 percent by weight in 2021 and 0.5 percent by 2025. In addition to copper, this voluntary initiative reduces mercury, lead, cadmium, asbestos fibers, and chromium-salt salts in motor vehicle brake pads.

The initiative will decrease runoff of these materials from roads into the nation's streams, rivers, and lakes. Copper from stormwater runoff can affect fish, amphibians, invertebrates, and plants.

- Memorandum of Understanding on Copper Mitigation in Watershed and Waterways - Copper-free brake pad agreement between EPA, states, and automotive industry representatives

This initiative includes:

- education and outreach to bring about the nationwide reduction in brake pads of copper and the other materials,
- testing friction materials and constituents for alternatives,
- marking and labeling friction material packaging and product,
- providing reporting registrars' and agents' contact information to manufacturers, suppliers and other industry entities, and
- working towards achieving the goals in the copper-free brake Initiative within specified timeframes.

For more information about the copper-free brakes initiative, visit [Copper-Free Brakes](http://www.copperfreebrakes.org) (<http://www.copperfreebrakes.org>)



## Status today:

- In Switzerland (and likely elsewhere), implemented regulations had positive effects on wide range of different air pollutants (those with and those without ambient limit values)
- WHO AQG report (2021) tells us that air quality is not good enough in most places today, so that public health is not adequately protected in most places

## Future:

- The efforts to comply with ambitious ambient limit values (such as the evidence based recommendations by WHO 2021) need to continue
- Emissions of air pollutants that are known to be particularly harmful should be reduced or better avoided (independent of ambient regulations, we generally know the sources)



# Thank You !

Thanks to NABEL Team at Empa und BAfU

