

Pollutants of “emerging concern”: Current state of knowledge

Prof. Dr. Annette Peters, Dipl.-Biol, Dr. rer. hum. biol., MSc, FISEE

Director, Institute of Epidemiology, Helmholtz Munich

Full Professor of Epidemiology, Ludwig-Maximilians Universität, München

Adjunct Associate Professor, Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston

Clean Air in Europe for All, Brussels

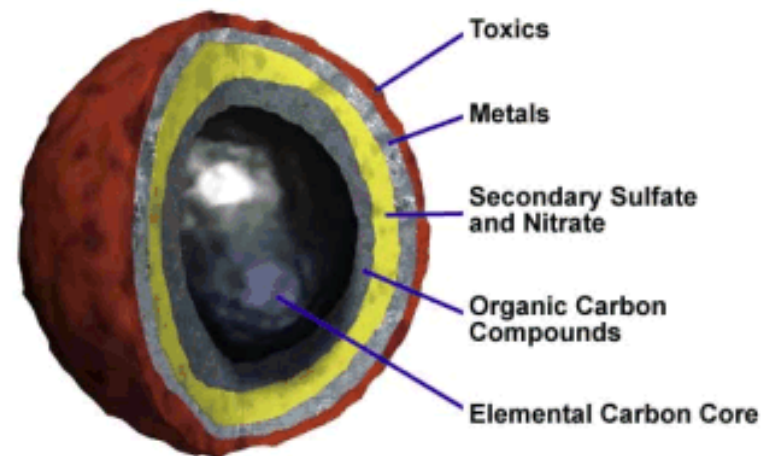
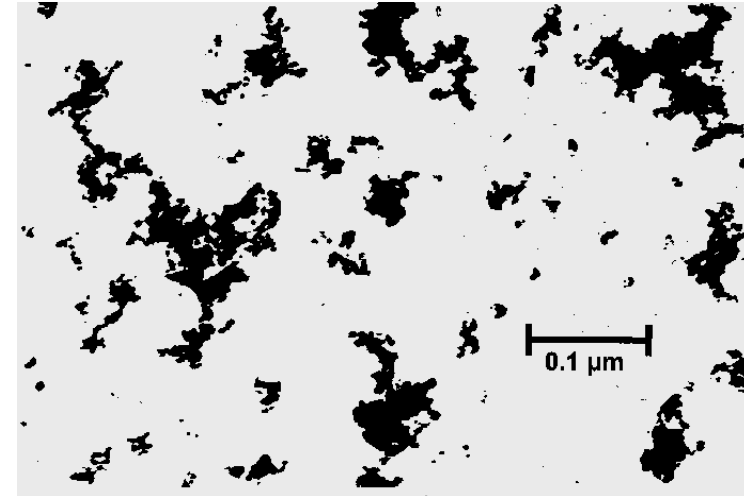
May 24, 2023

Harmful Environment



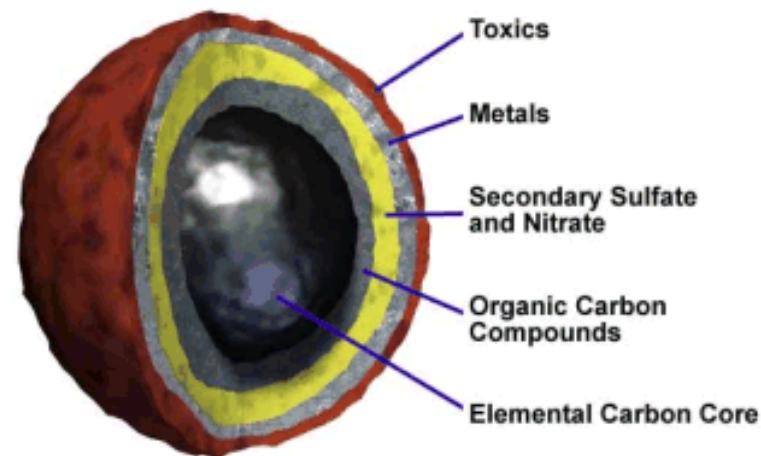
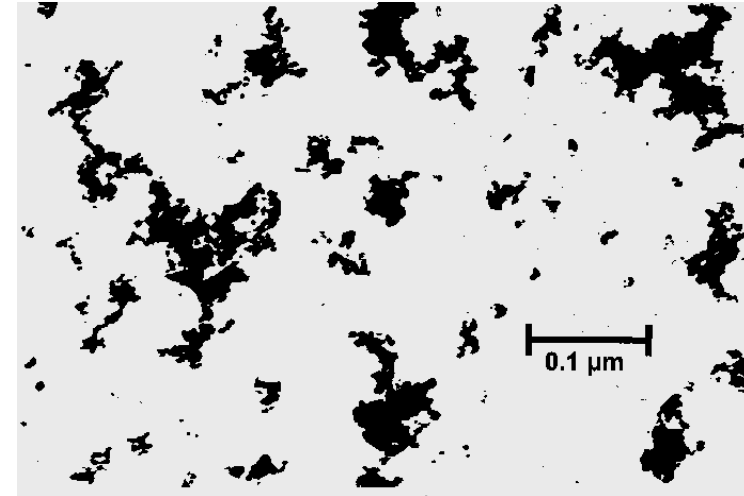
Particle properties related to health effects

- Fine particles
- Coarse particles
- Ultrafine particles
- Particle composition
 - Black carbonaceous particles
 - Secondary organic aerosols
 - Secondary inorganic aerosols



Particle properties related to health effects

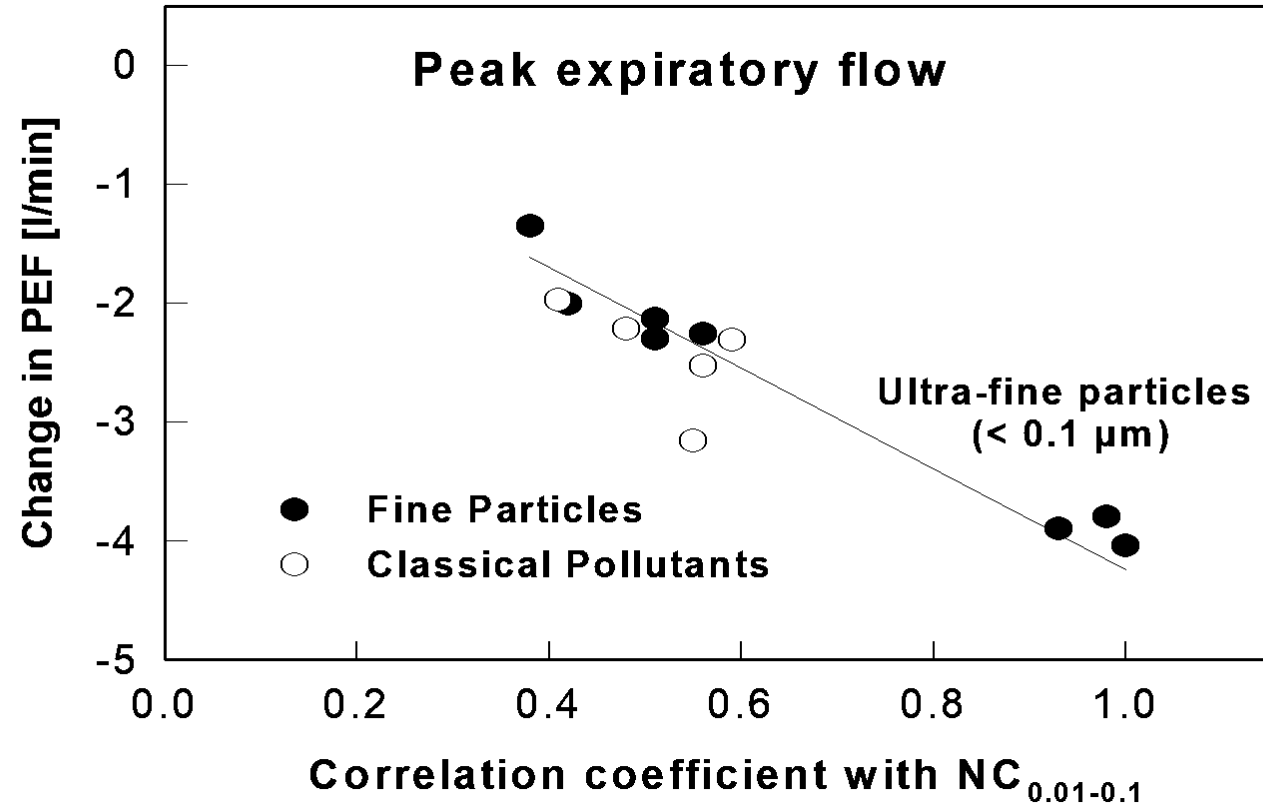
- Fine particles
- Coarse particles
- **Ultrafine particles**
- Particle composition
 - Black carbonaceous particles
 - Secondary organic aerosols
 - Secondary inorganic aerosols



Where it all started: Panel Study in Asthmatics



Decreased lung function on days with high ultrafine particles



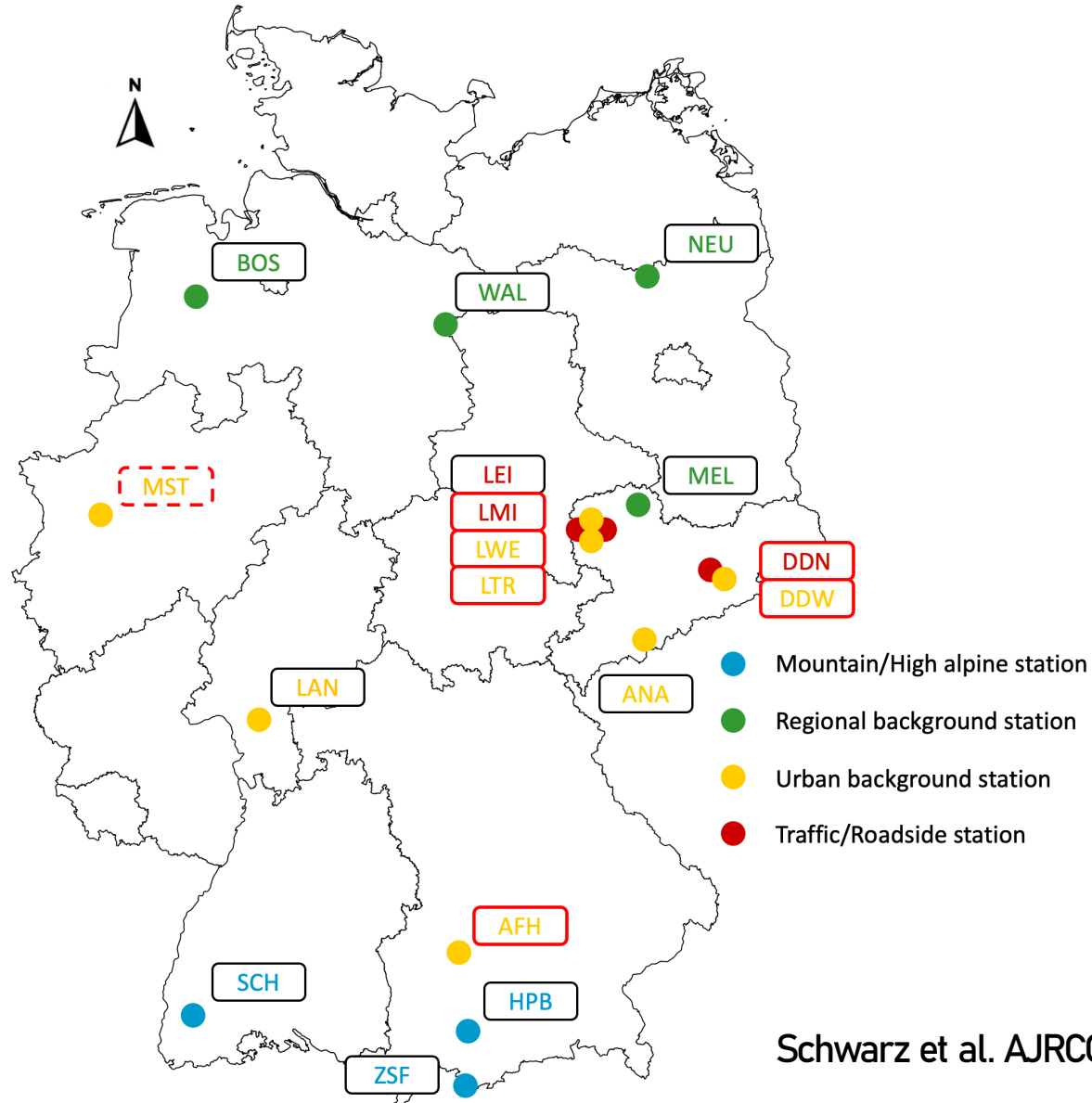
WHO Good Practice Statements: Ultrafine Particles

1. **Quantify ambient ultrafine particles (UFP)** in terms of **particle number concentrations (PNC)** with a lower limit of ≤ 10 nm and no restriction on the upper limit.
2. **Expand** the common **air quality monitoring strategy** by integrating UFP monitoring into the existing air quality monitoring.
3. Distinguish between low and high PNC to guide decisions on the priorities of UFP source emission control. Low PNC can be considered $< 1\ 000$ particles/cm³ (24-hour mean). **High PNC can be considered $> 10\ 000$ particles/cm³ (24-hour mean) or $20\ 000$ particles/cm³ (1-hour mean).**
4. Utilize emerging science and technology to advance the assessment of exposure to UFP for their application in **epidemiological studies** and UFP management.

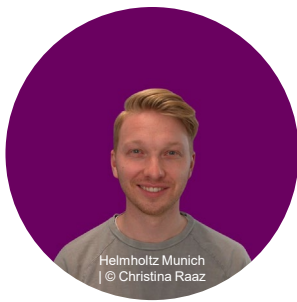


⇒ Daily concentrations of ultrafine particles are linked to mortality

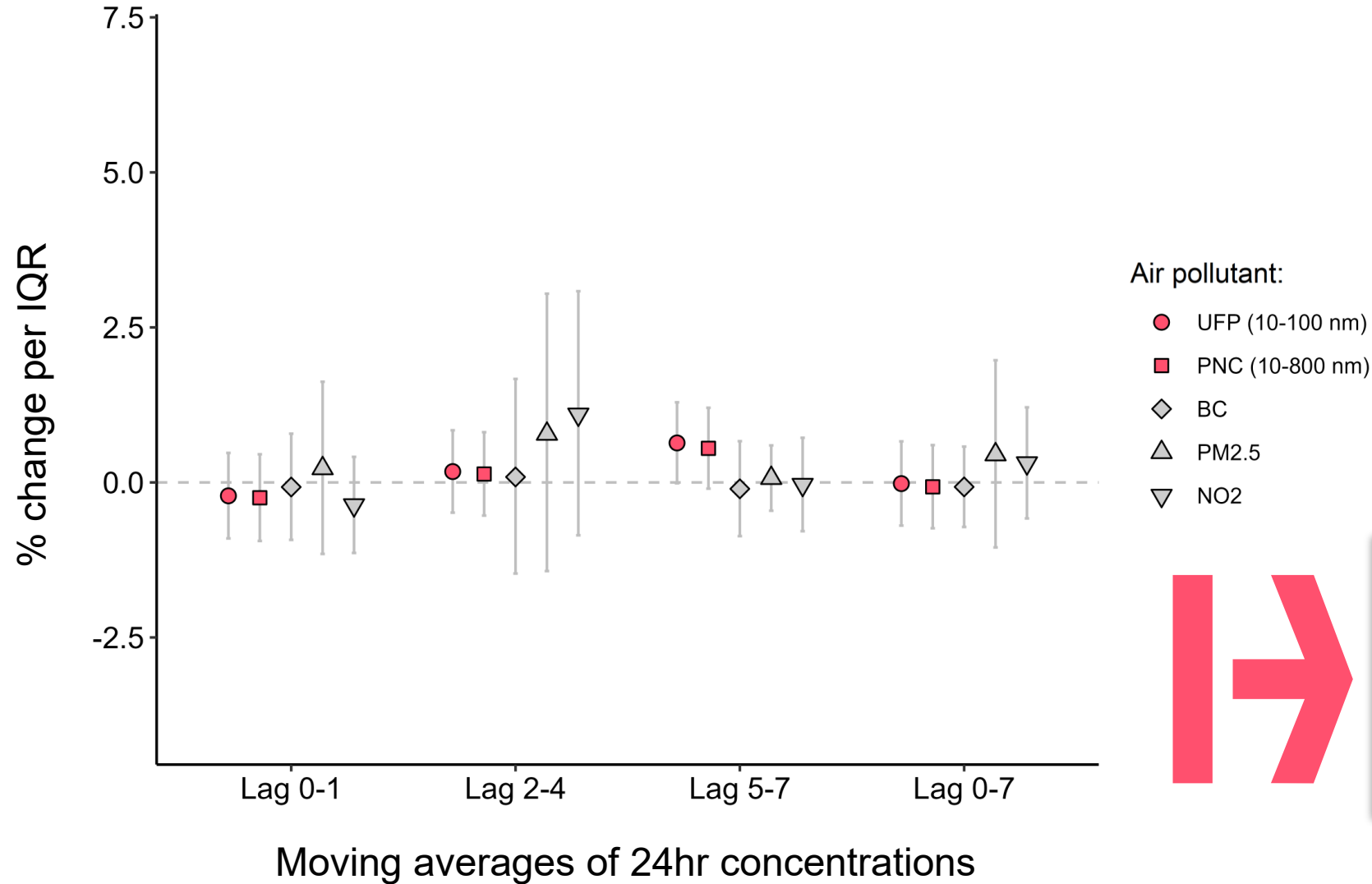
Time-series study of ultrafine particles



- Multi-center epidemiological time series study between 2010 and 2017
- Six stations that were part of the former German Ultrafine Aerosol Network (GUAN)
- Two-stage modelling design:
 - I. Station-specific confounder adjusted Poisson regression
 - II. Novel multi-level meta-analytical approach for environmental research

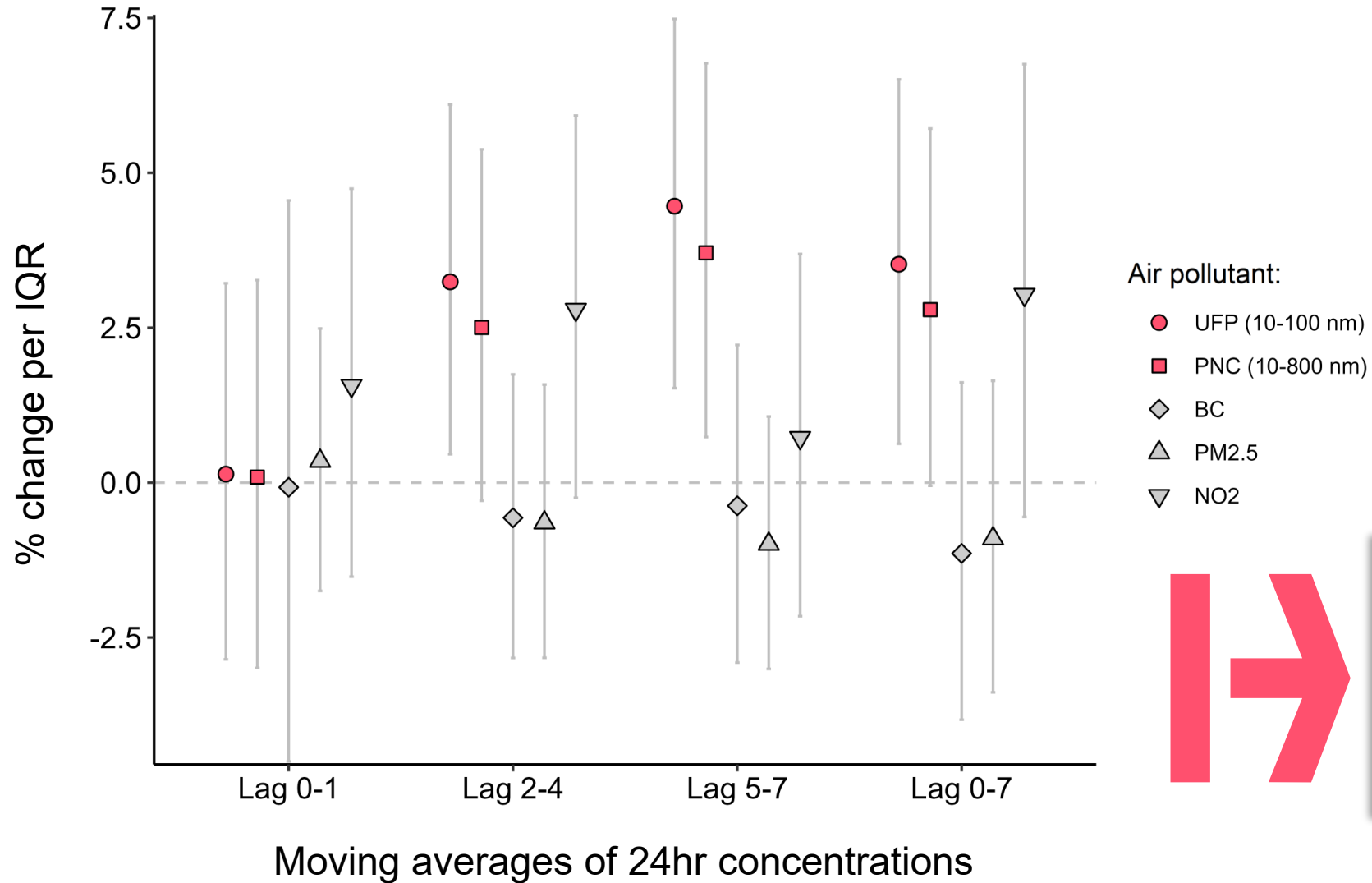


Ultrafine particle effects on natural mortality



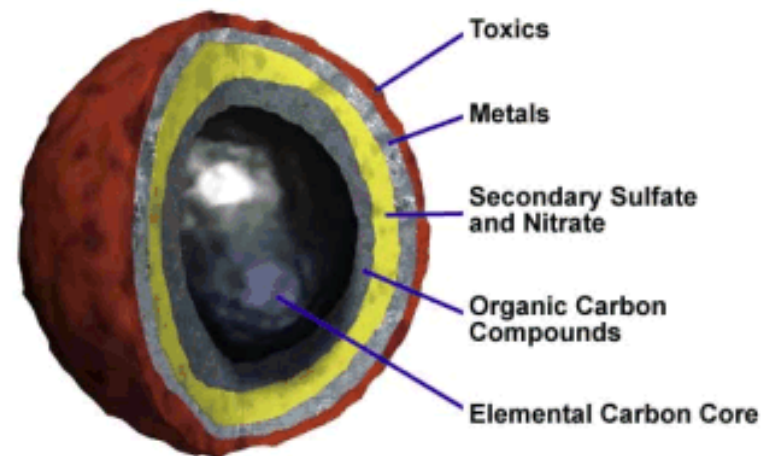
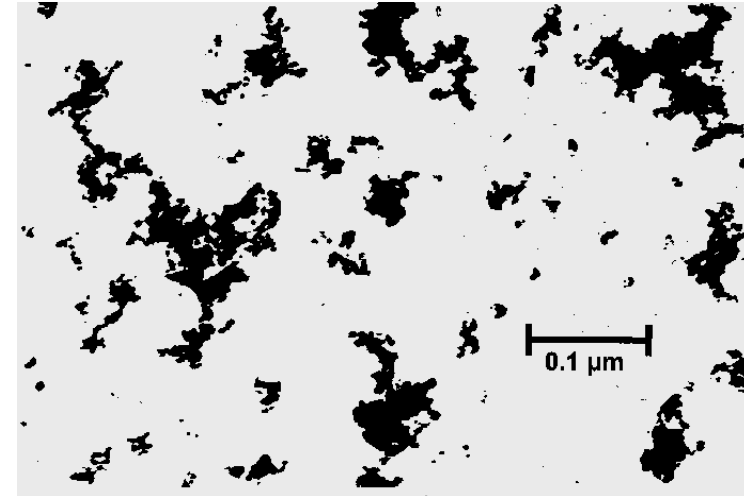
Findings corroborate studies in Erfurt, Germany in the 1990ies

Ultrafine particle effects on respiratory mortality



Particle properties related to health effects

- Fine particles
- Coarse particles
- Ultrafine particles
- **Particle composition**
 - **Black carbonaceous particles**
 - Secondary organic aerosols
 - Secondary inorganic aerosols

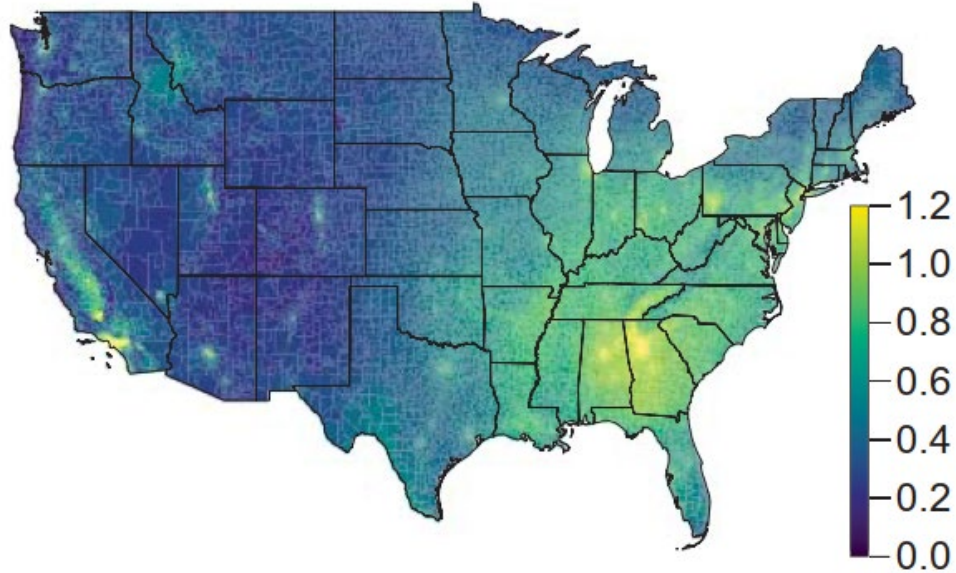


WHO Good Practice Statements: Black / Elemental Carbon

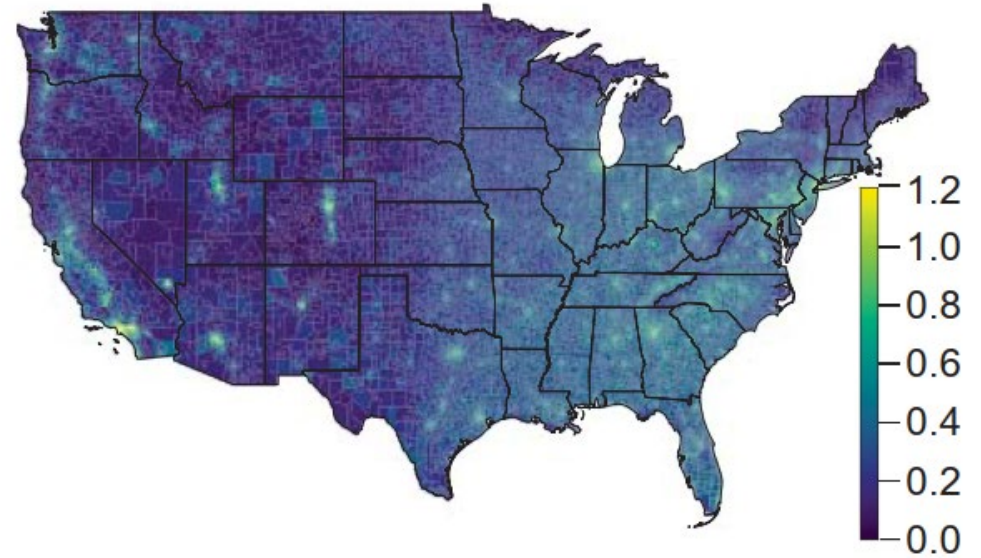
1. Make **systematic measurements of black carbon (BC) and/or elemental carbon (EC)**. Such measurements should not replace or reduce the existing monitoring of pollutants for which guidelines currently exist.
2. Undertake the production of **emission inventories, exposure assessments and source apportionment for BC/EC**.
3. Take **measures to reduce BC/EC emissions** from within the relevant jurisdiction and, where considered appropriate, **develop standards (or targets) for ambient BC/EC concentrations**.



Modelling Black Carbon in the United States

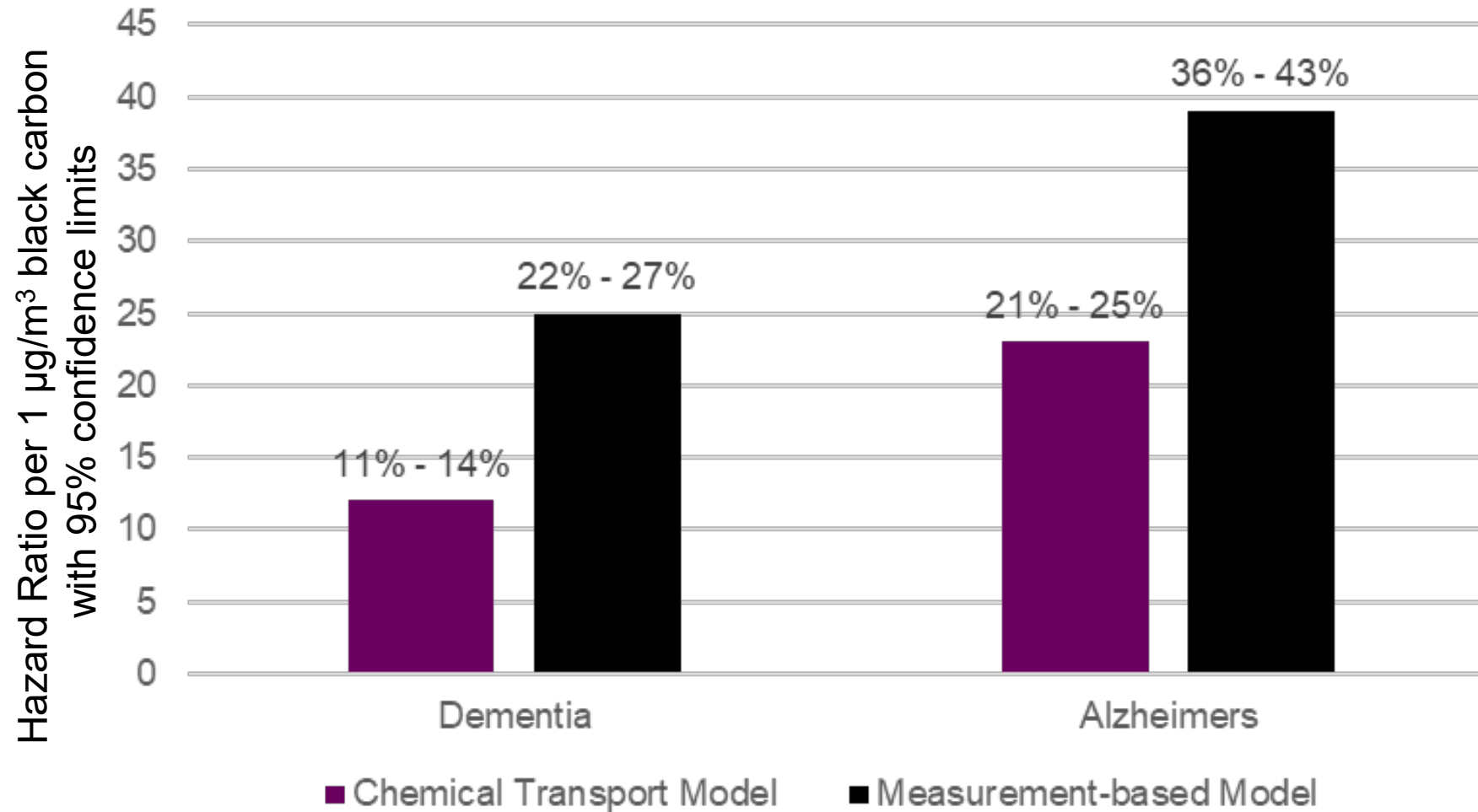


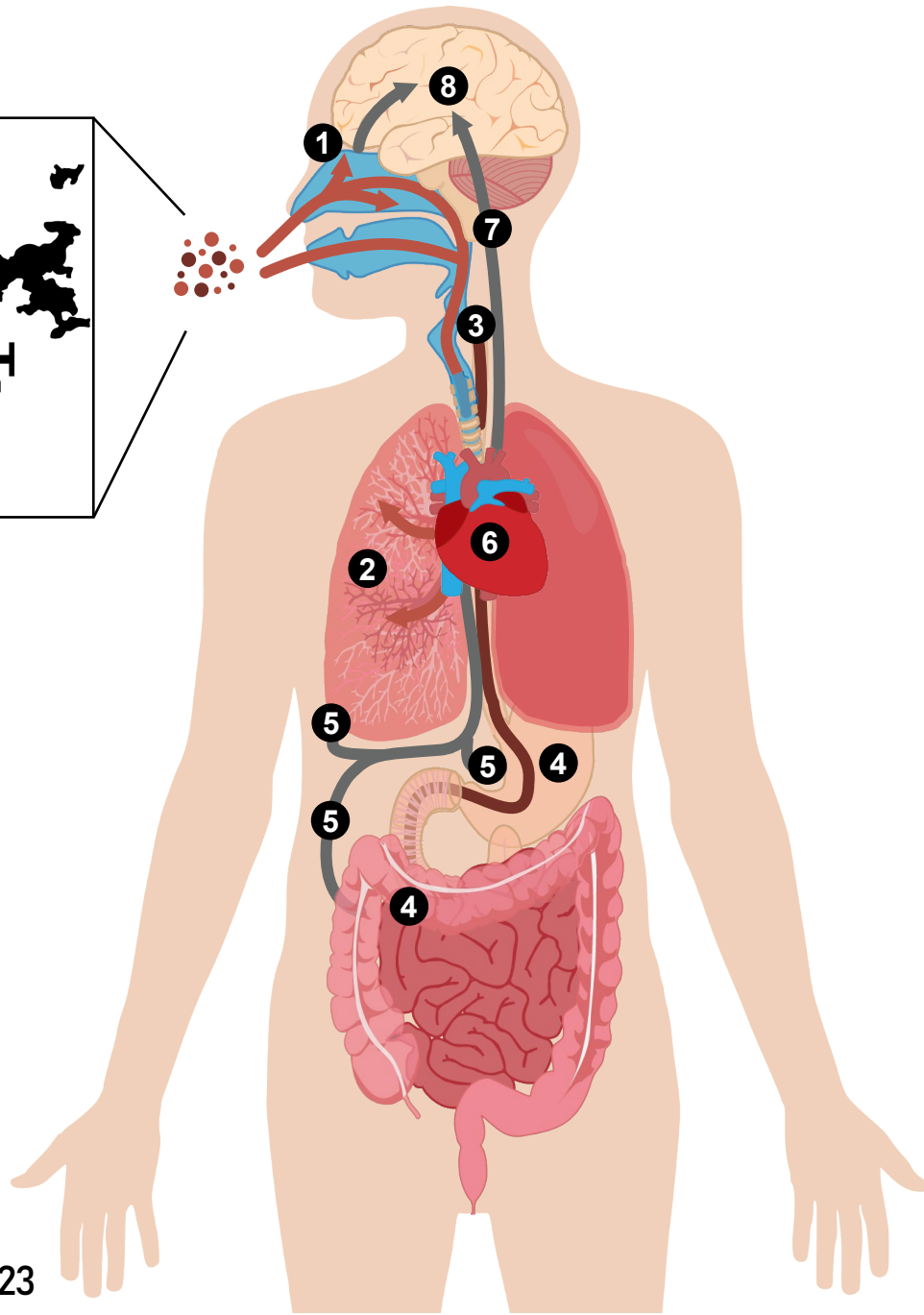
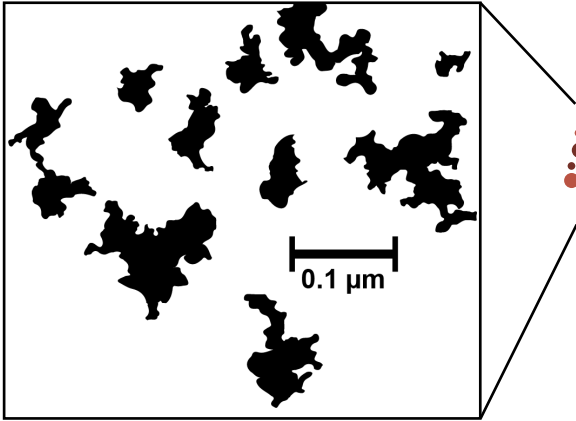
including chemical transport models



including measurement station data

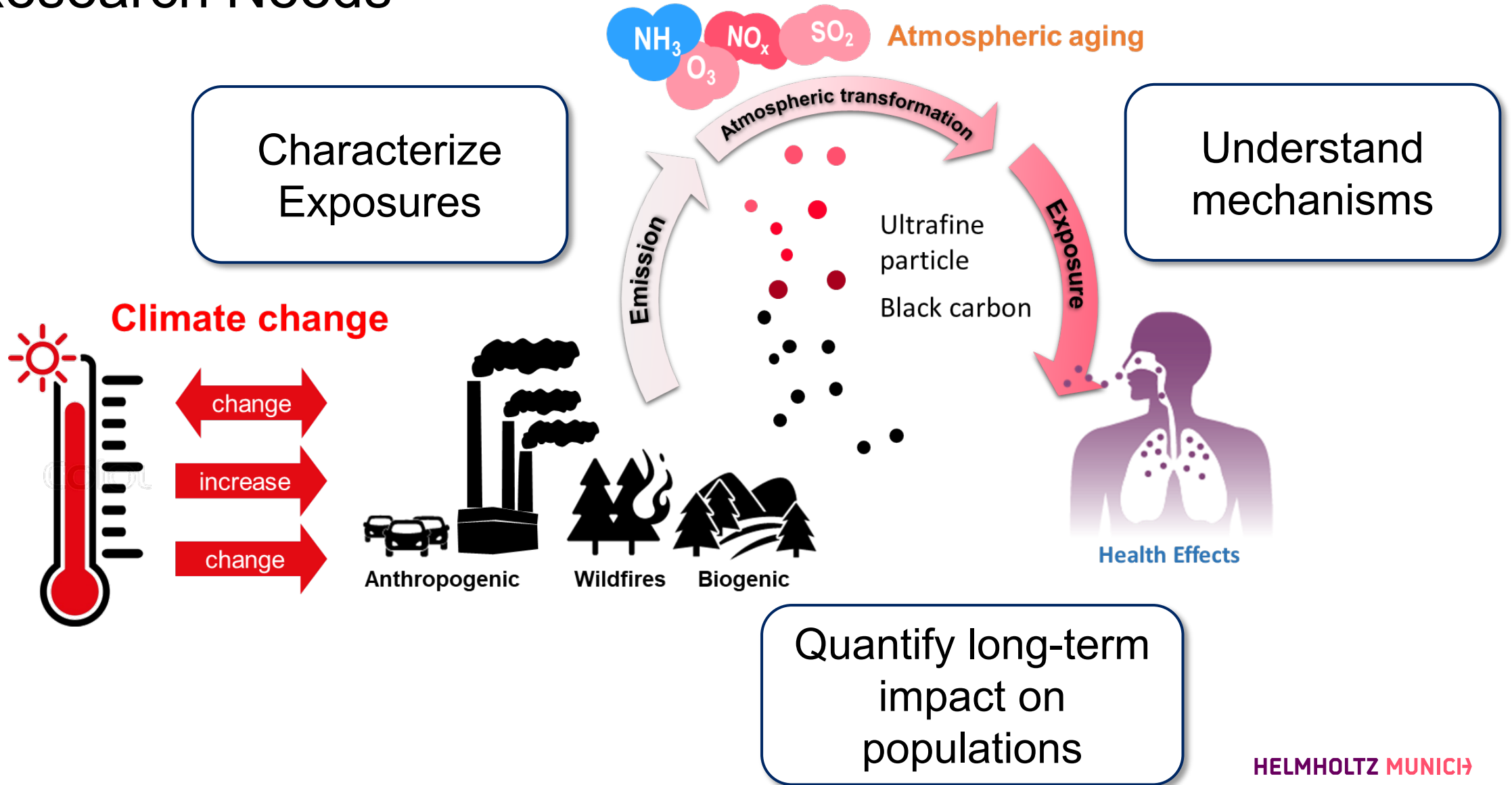
Black carbon and neurodegenerative disease exacerbation



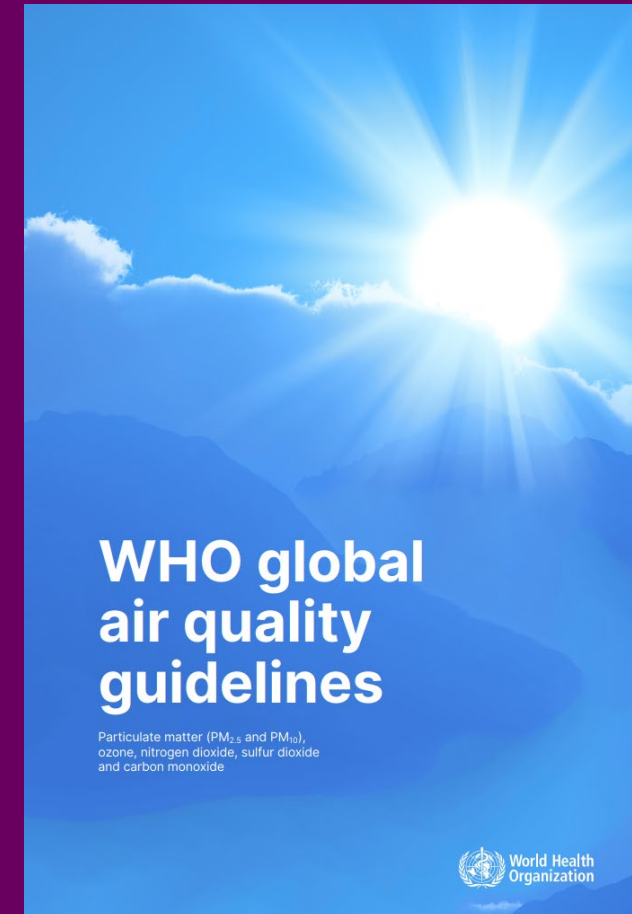


- 1 Ultrafine particles (UFP) deposited in the nasal cavity translocate to the brain via the olfactory nerve
- 2 Particles deposited in the lung activate the immune system
- 3 Particles are swallowed after clearance from the lung or deposition in the upper airways
- 4 Particles reach the gastrointestinal tract
- 5 UFP and constituents translocate into the blood stream
- 6 UFP and constituents passage the heart
- 7 UFP and constituents from different organs reach the brain vasculature
- 8 UFP and constituents induce localized and diffuse inflammatory responses, protein misfolding, glial and vascular dysfunction, and neuronal degradation leading to different forms of dementia

Research Needs



⇒ Quantification and control of ultrafine particles and black carbon is needed





Thank you.