Energy conservation, emission reduction and environmental protection

Some insights on air quality and urban systems – Potential cooperation between Shandong and Bavaria

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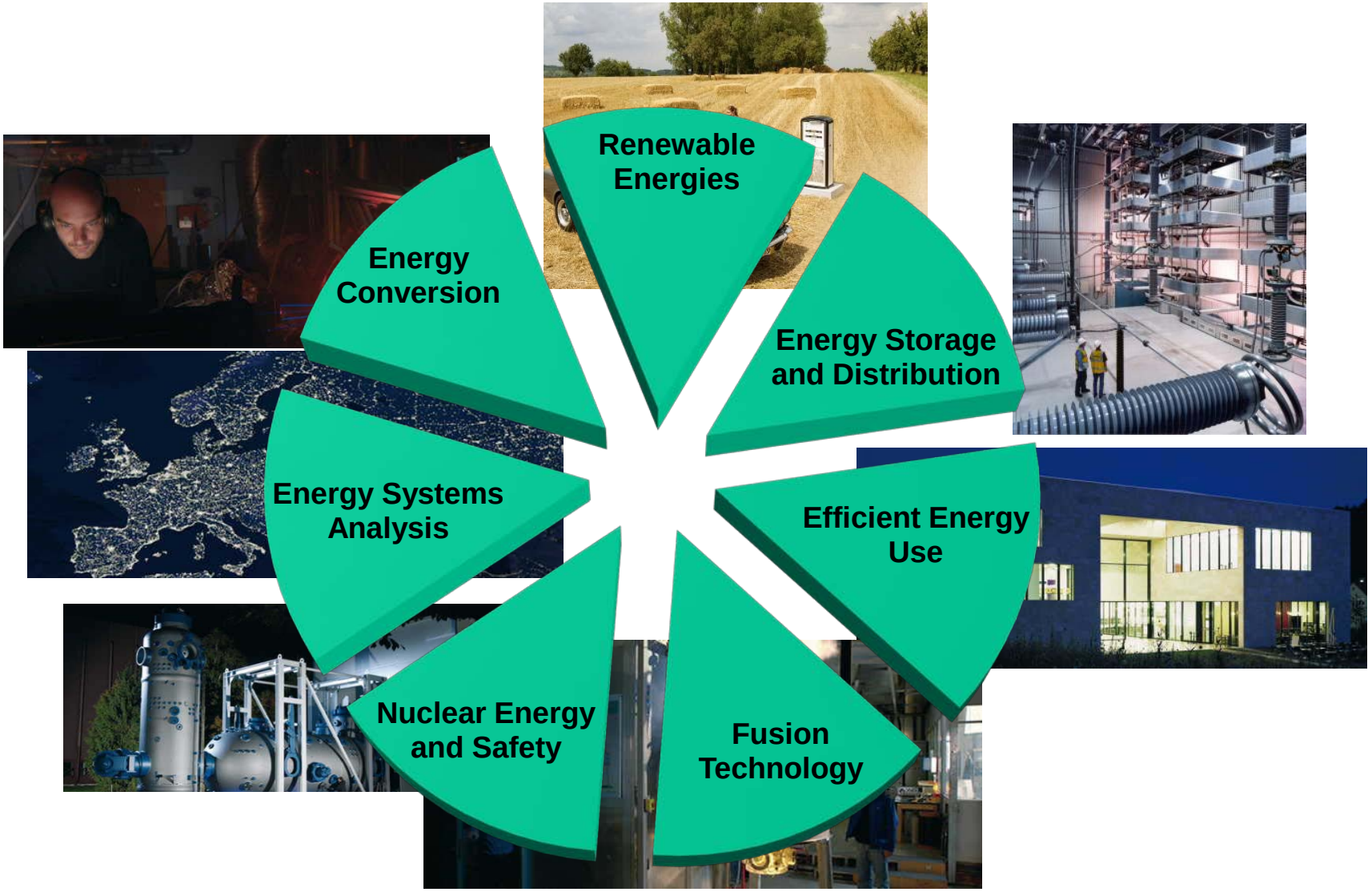
KIT Portfolio

260 km

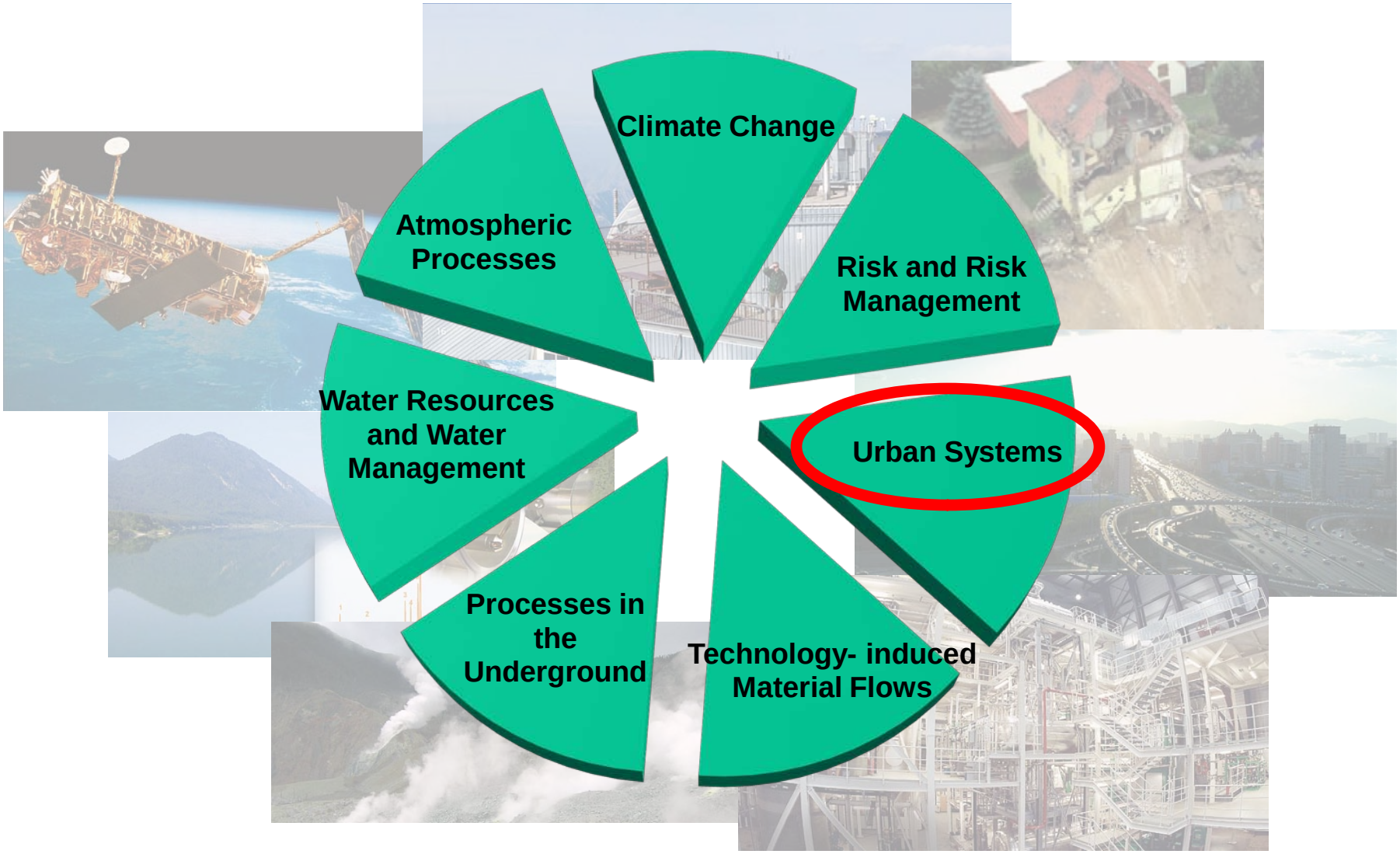
KIT - Centres

- Energy
- Climate and Environment
- Nano and Micro Scale Science
- Astroparticle Physics

KIT Center Energy



KIT Center Climate and Environment



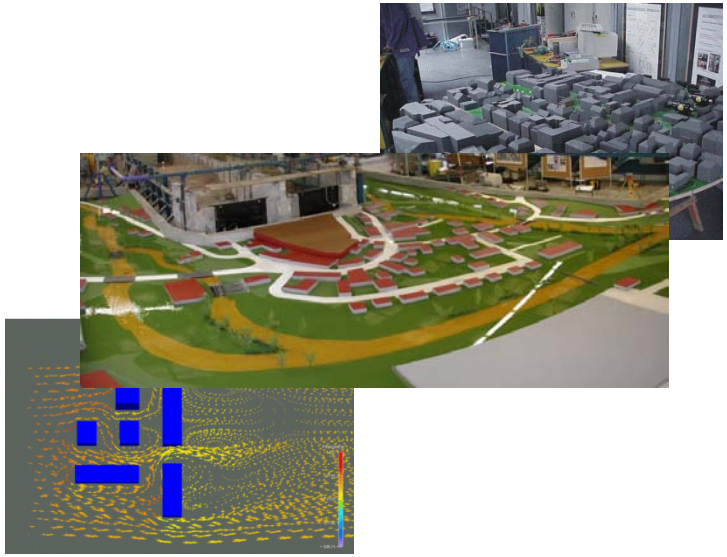
Topic: Urban Systems within the Center of Climate and Environment

Speaker PD Dr. Stefan Norra & Dr. Peter Suppan

- **Climate Change, Natural Disasters, Environmental Pollution**
- **Ecosystems**
- **Atmosphere and Urban Climate**
- **Management of Water Resources, Material Flows, and Energy Flows**

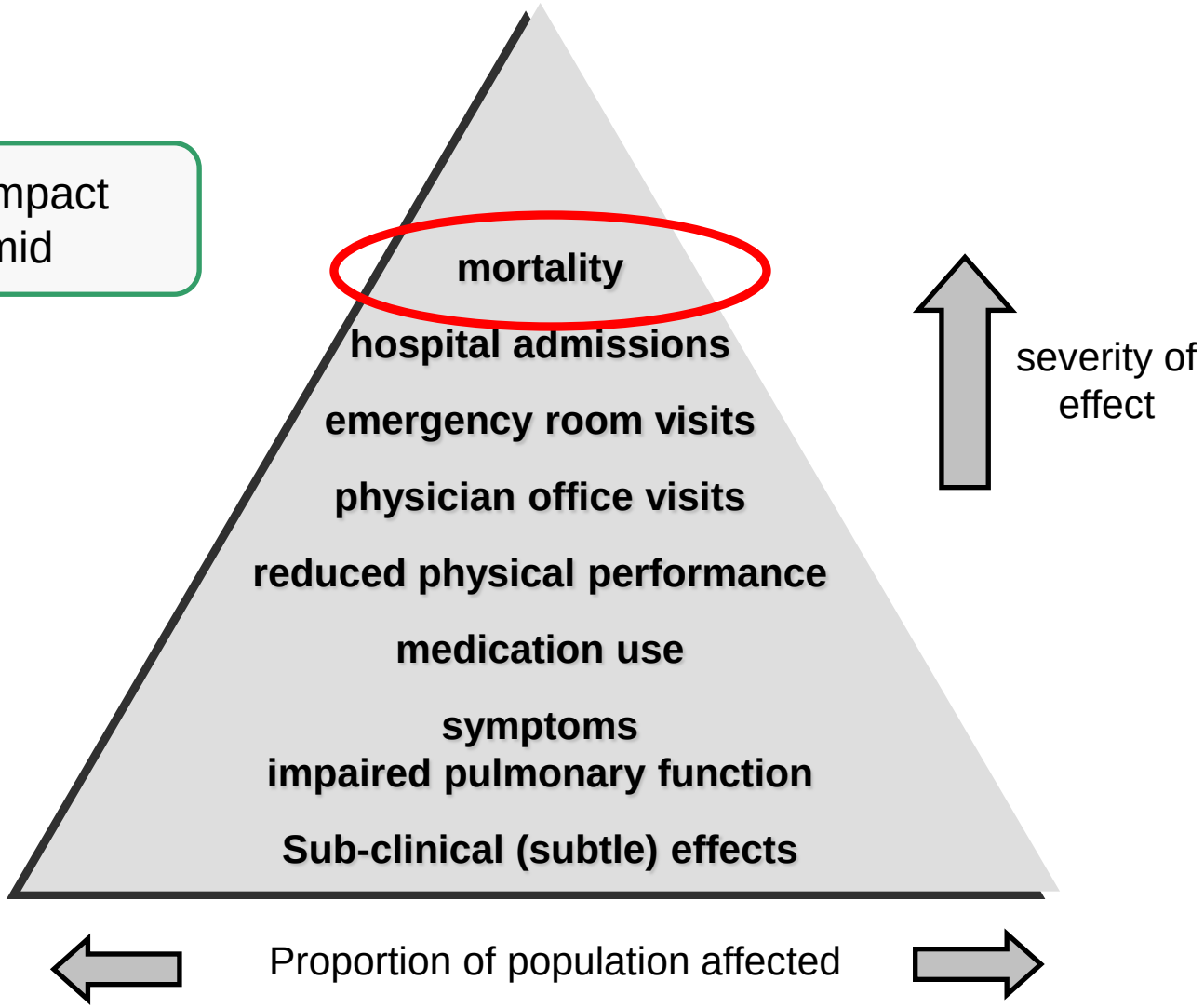
- **Infrastructure**
- **Social Vulnerability**
- **Urban Development Scenarios**

Health impact



Driving Force: Health Impact

Health Impact Pyramid



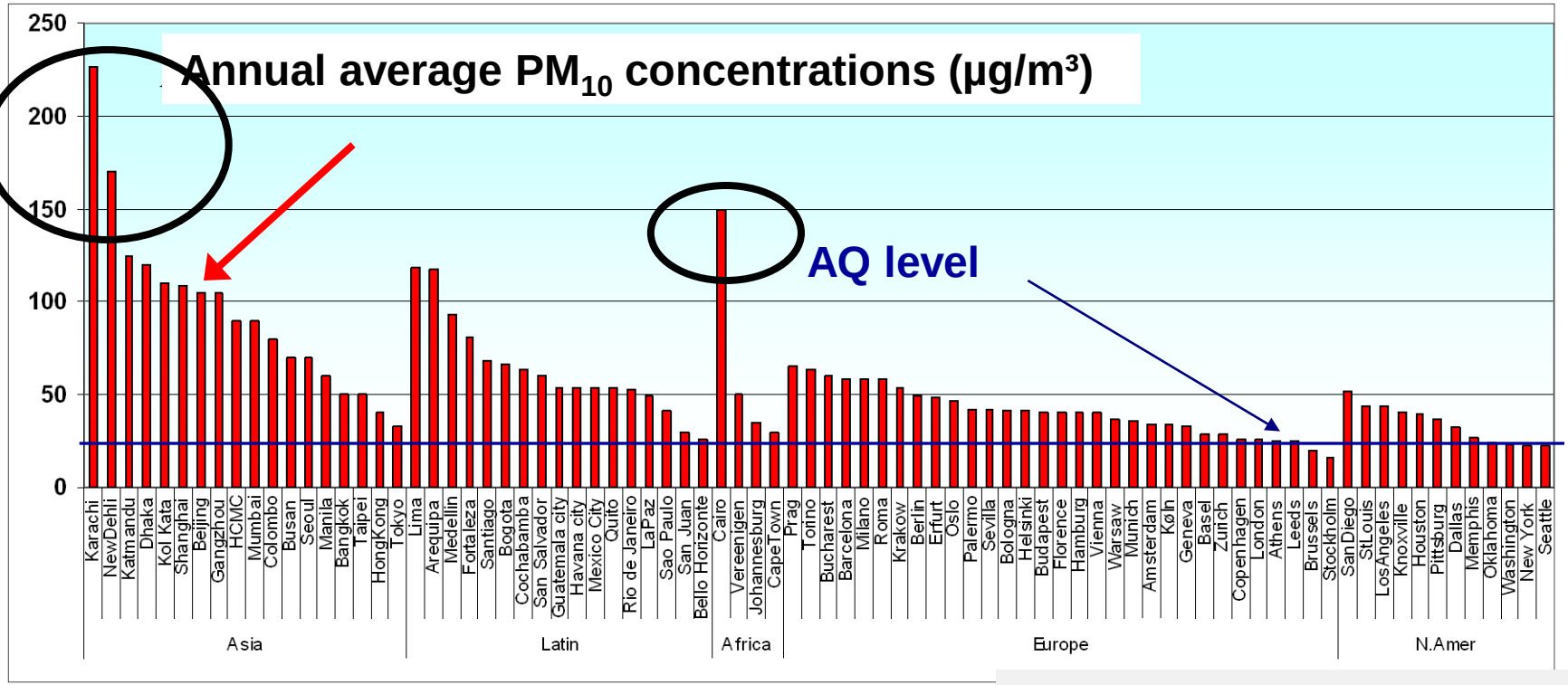
Mortality rates on PM_{10} increase

Region	Percentage change	Reference
Asia	0.49% (0.23-0.76)	HEI, 2004
Europe	0.60% (0.40-0.80)	Katsouyanni, 2001
Latin America	0.61% (0.16-1.07)	PAHO, 2005*
United States	0.21% (0.09-0.33)	Dominici, 2003
Worldwide	0.65% (0.51-0.76)	Stieb, 2002

Source: PAN American Health Organization, 2005

* Based on studies in Mexico City, São Paulo, Santiago de Chile

Economical Benefit



M. Krzyzanowski, H-G. Mucke, WHO

Reduction benefit is 10 times higher as for ozone, e.g. Mexico City about $2 Bill.

Molina and Molina, 2002

Reasons & Risks

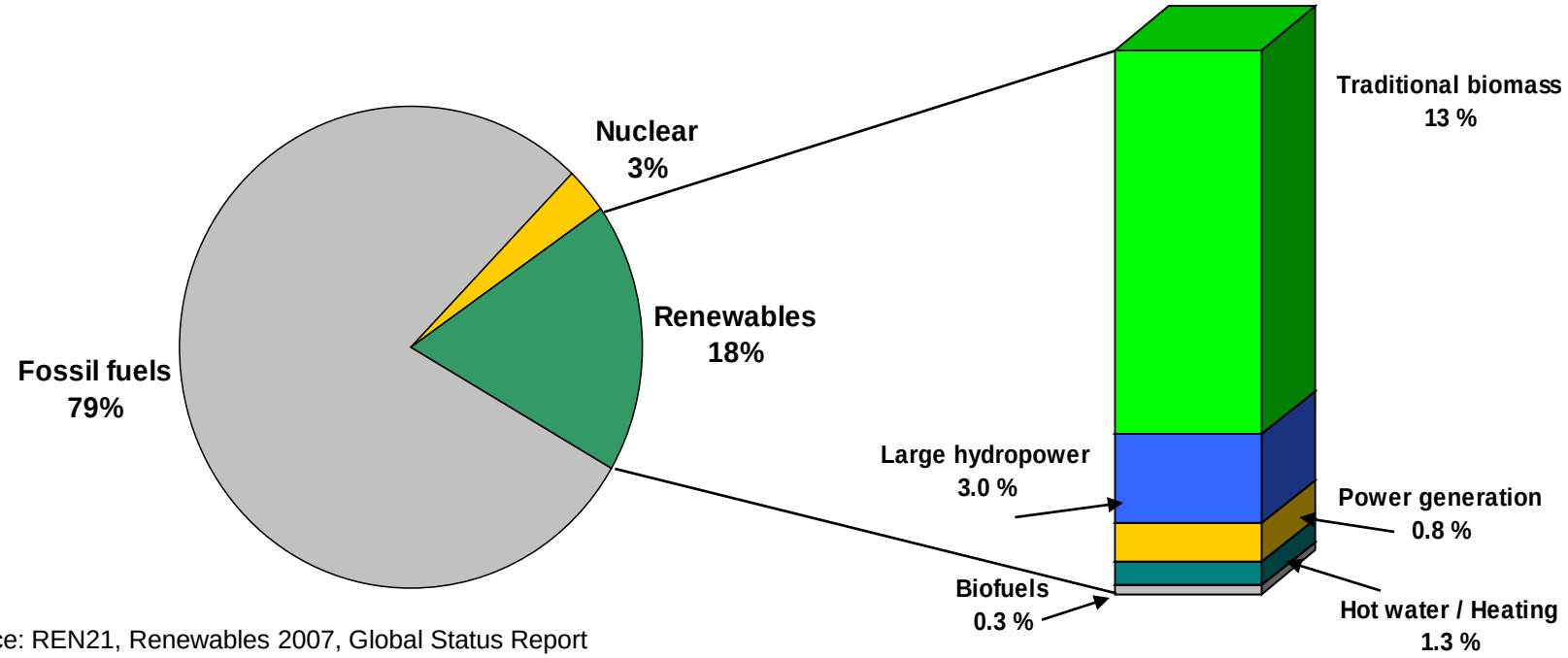
- Living space
- Social structure
- Land use
- Mobility
- Environment
- Energy
- **Air quality**
- **Well-Being / Health**

Climate Change

Problem area: Energy

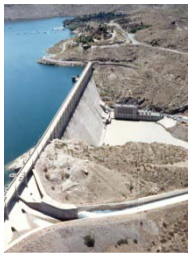
- **Energy demand development**
  - Key system drivers: population and economic growth
  - World energy demand until 2030: 50 % increase
  - APEC (Asia Pacific Region) energy demand until 2030: 100 % increase
  - Breakdown to national level demands
- **Development of energy supply**
  - Supply security
  - Decrease in CO_2 emissions
  - Focus on renewable energies

Global final energy consumption

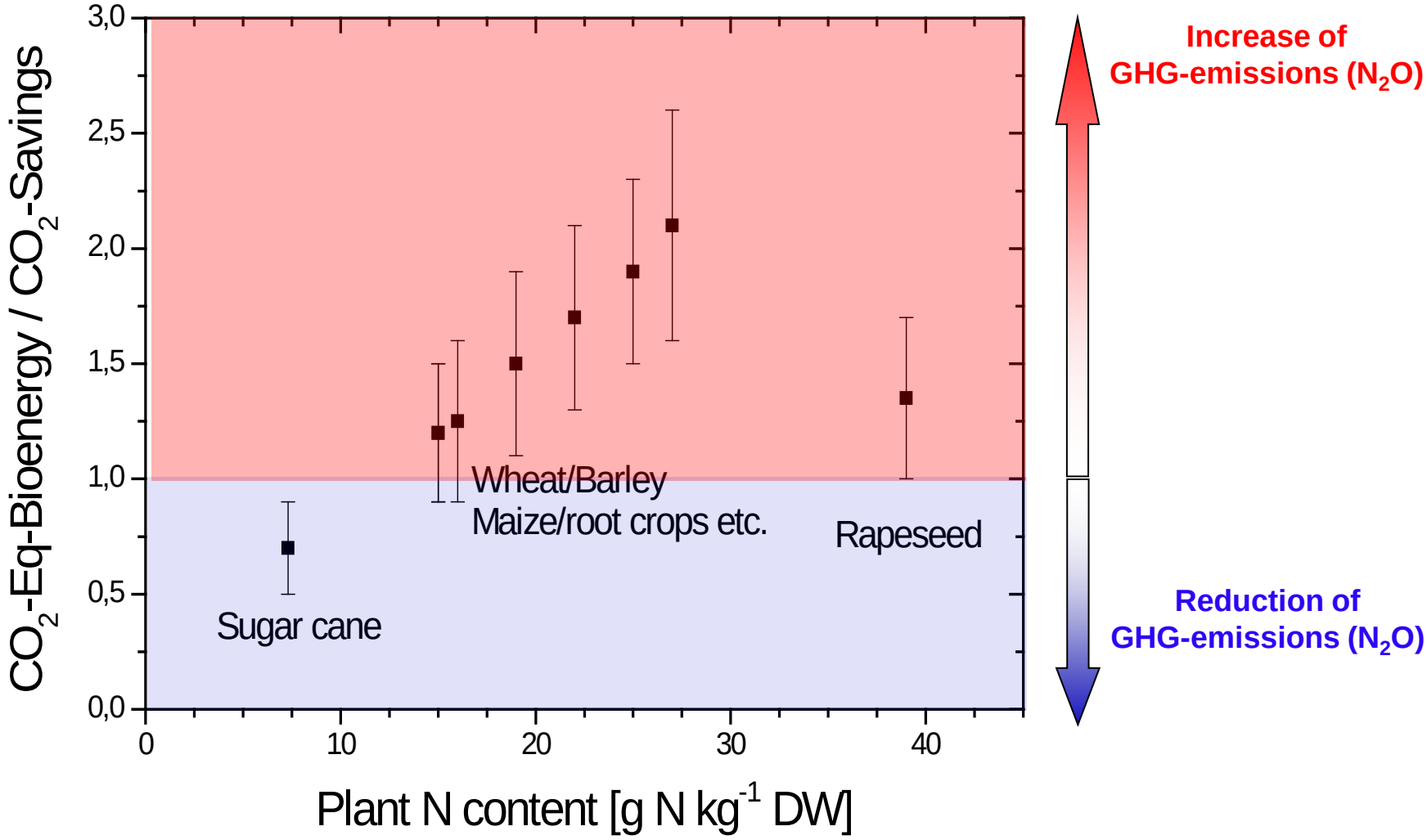


Source: REN21, Renewables 2007, Global Status Report



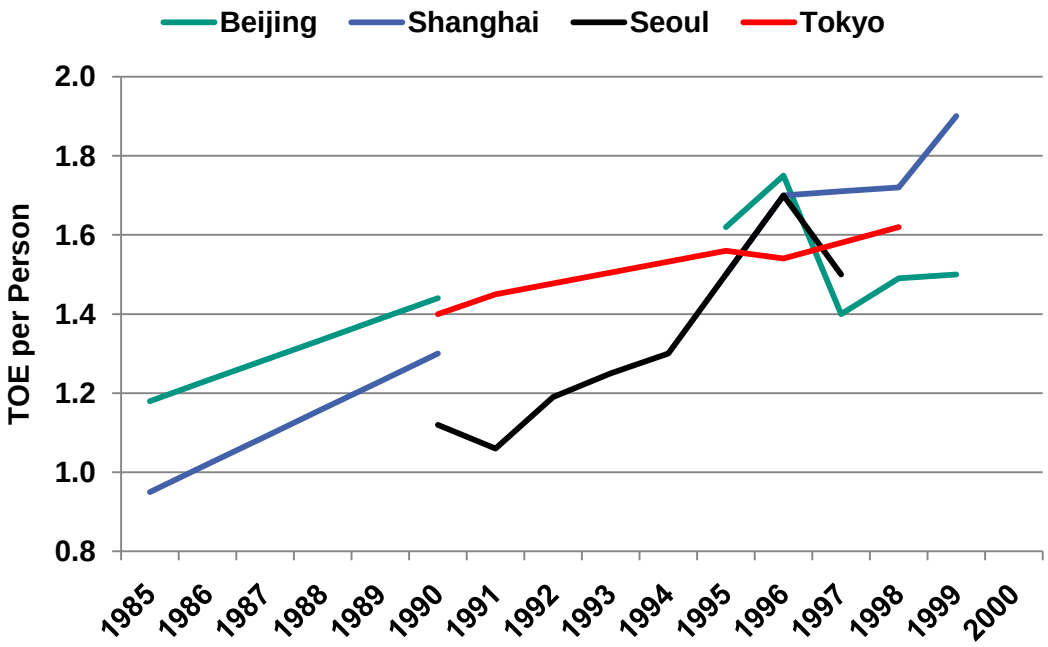
Bioenergy from N+Plants



Crutzen et al., 2008

Urban energy distribution

	Industry	Transport	Residential	Commercial
Beijing	62%	8%	17%	13%
Shanghai	80%	10%	7%	3%
Seoul	18%	25%	37%	20%
Tokyo	11%	37%	22%	30%

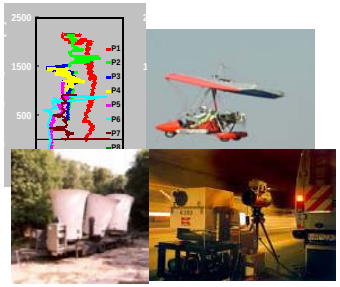


Source: APERC 2007, Shobhakar Dhakal (2004). Urban Energy Use and Greenhouse Gas Emissions in East Asian Mega-cities

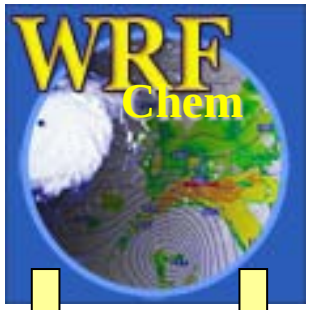
Integrated Approach

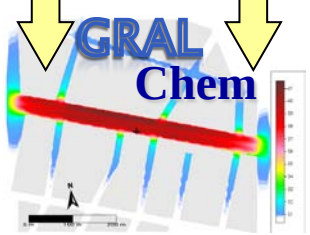
Urban Development

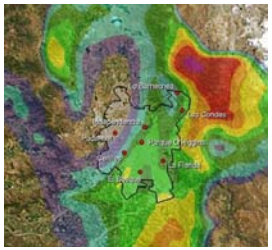
Measurement Data



Traffic Data







Air Quality

Scenario

Indicator

Mortality

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Subclinical Effects

Health Impact

Stakeholder

Sampling Strategies

Optical remote sensing:
Ceilometer von Vaisala LD40 or CL31
wave length: 855 or 910 nm
range: 4000 m
Resolution: 15 or 5 m

Münkel, C., "Mixing height determination with lidar ceilometers - results from Helsinki Testbed," Meteorol. Z. 16, 451-459 (2007).

Emeis, S., Schäfer, K., Münkel, C.: Observation of the structure of the urban boundary layer with different ceilometers and validation by RASS data. Meteorol. Z. 18, 2, 149-154 (2009)

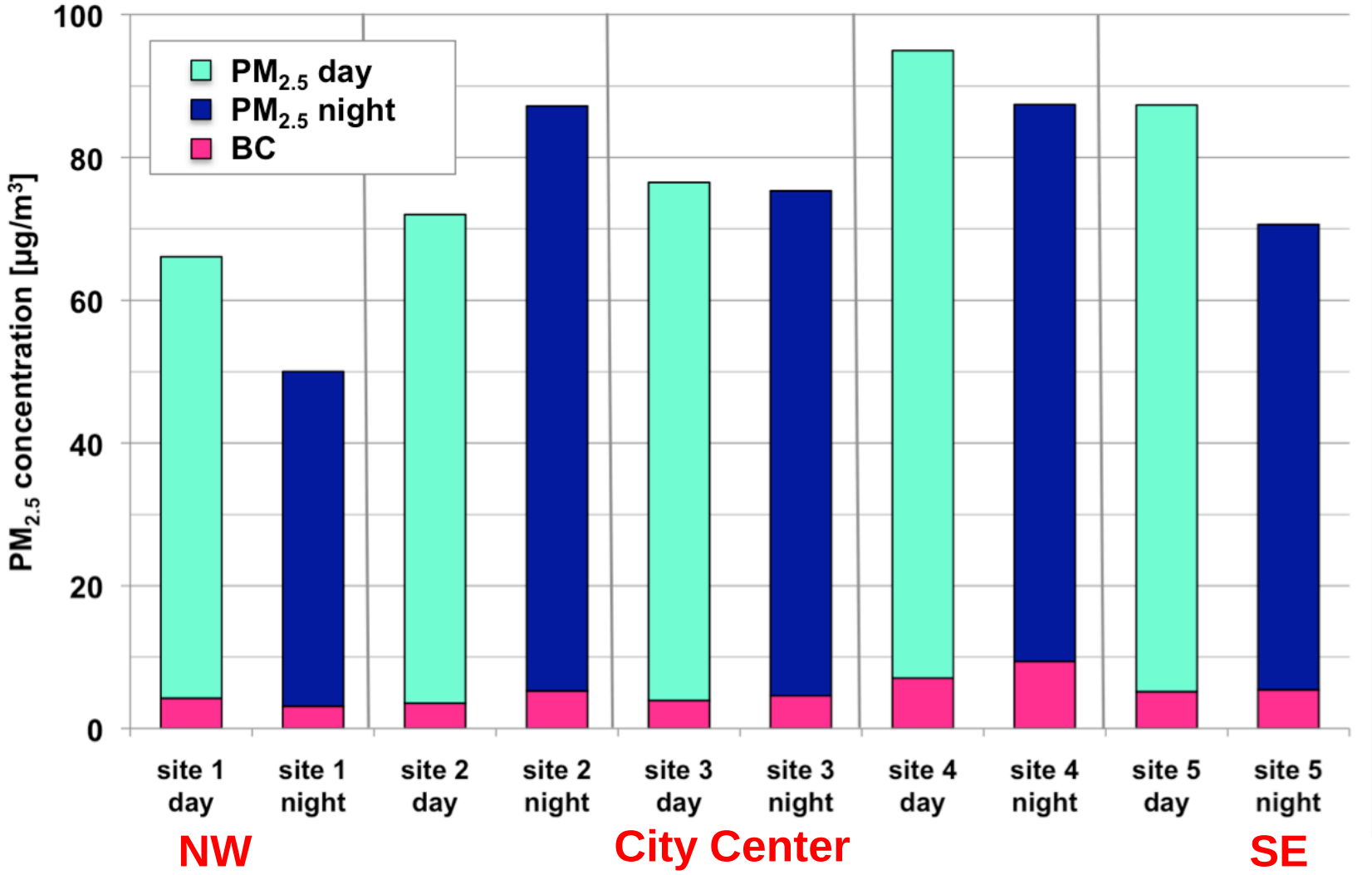
Sampling Strategies

passive: Sigma 2 for particles between 2.5 and 80 µm

active: MV-Sampler for PM2.5

Sampling Sites

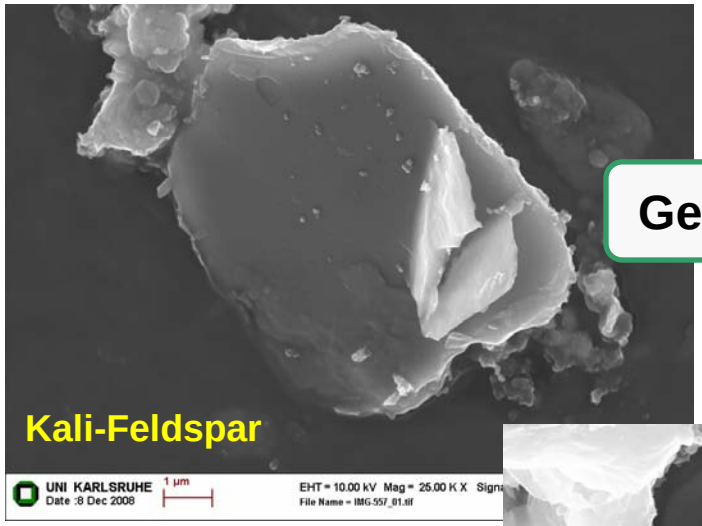
Spatial distribution – $PM_{2.5}$ and BC (soot)



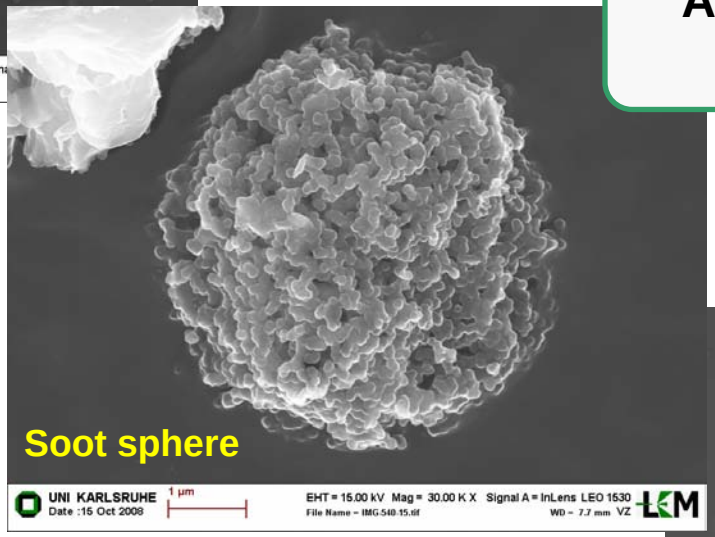
SEM Images

Karlsruhe Institute of Technology

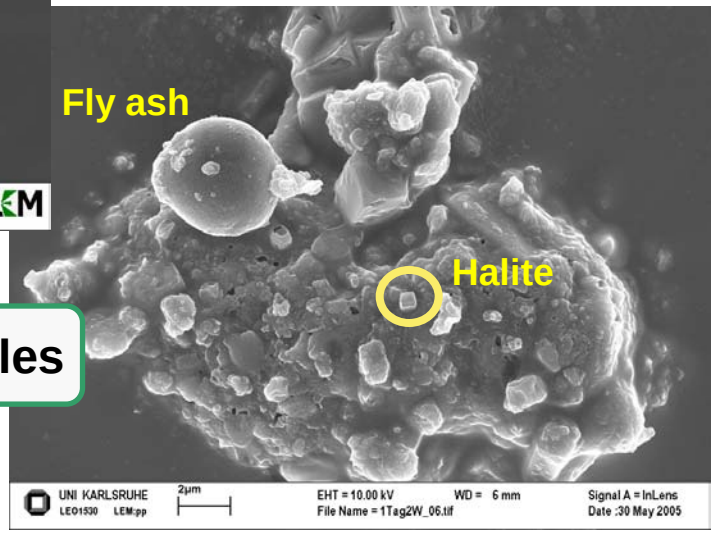
Geogenic particles



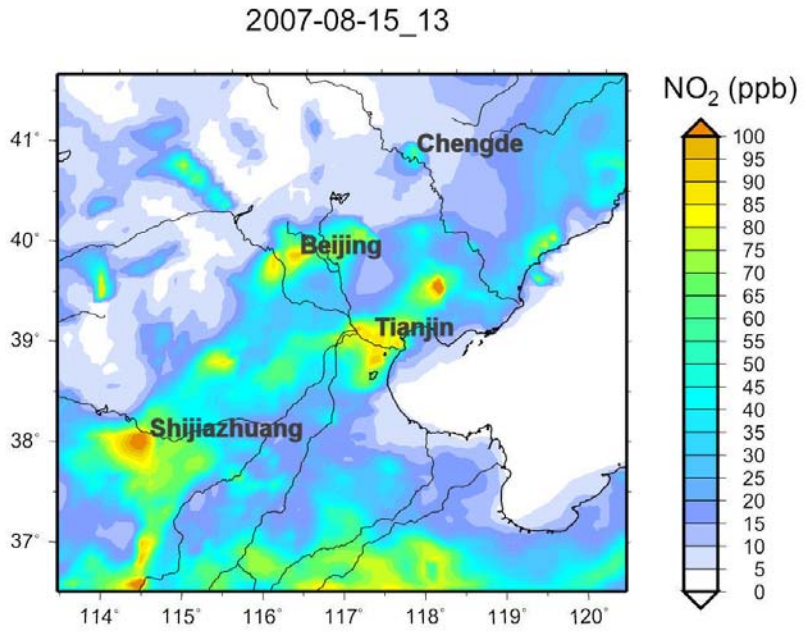
Anthropogenic particles

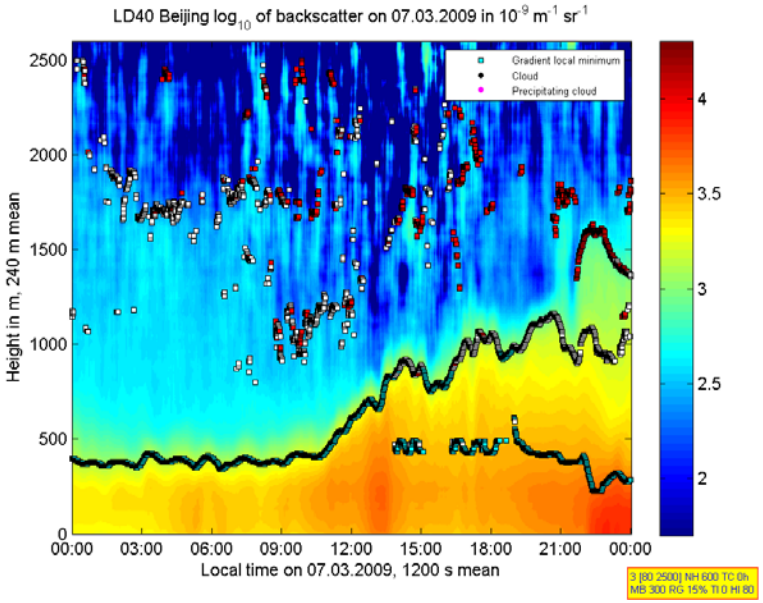


Connected particles



Measurements / Simulations

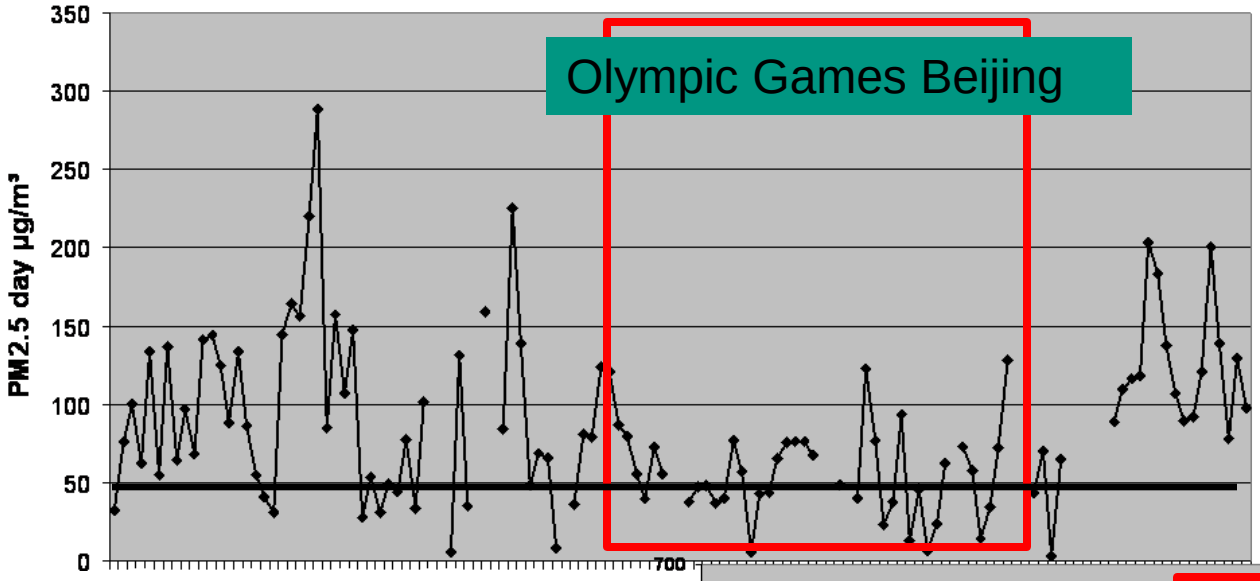




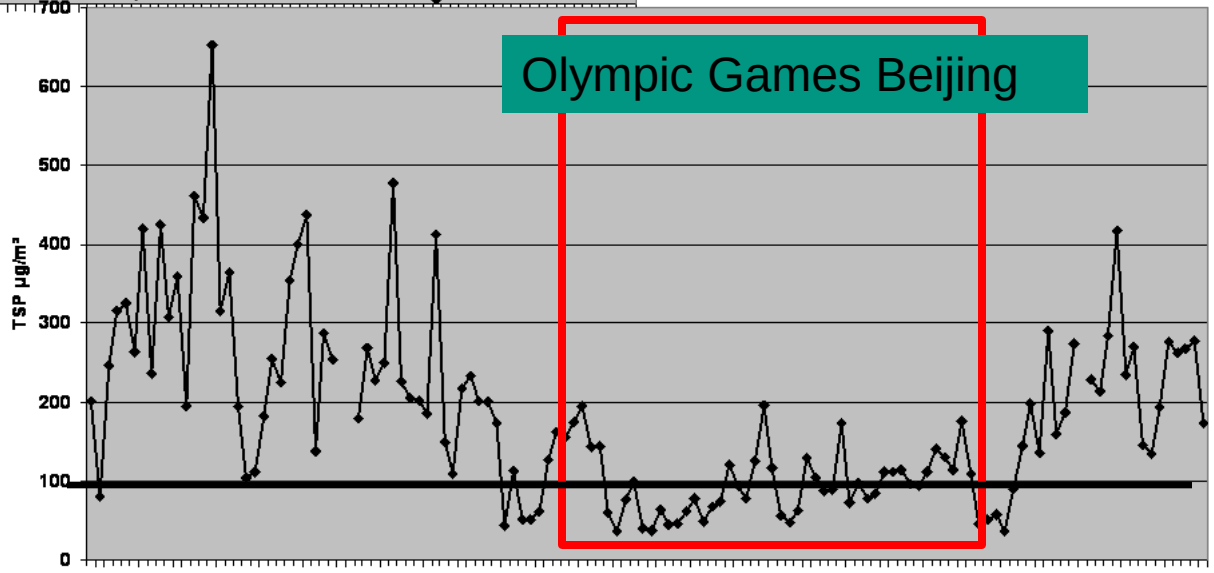
Air Quality Modelling in the greater area of Beijing (in co-operation with CAS-IAP)

Measurements of Mixing layer height based on a Ceilometer (IMK-IFU, Vaisala) at CAS-IAP

Emission Reduction Strategies



Time Period:
15.10.2007 – 01.02.2009



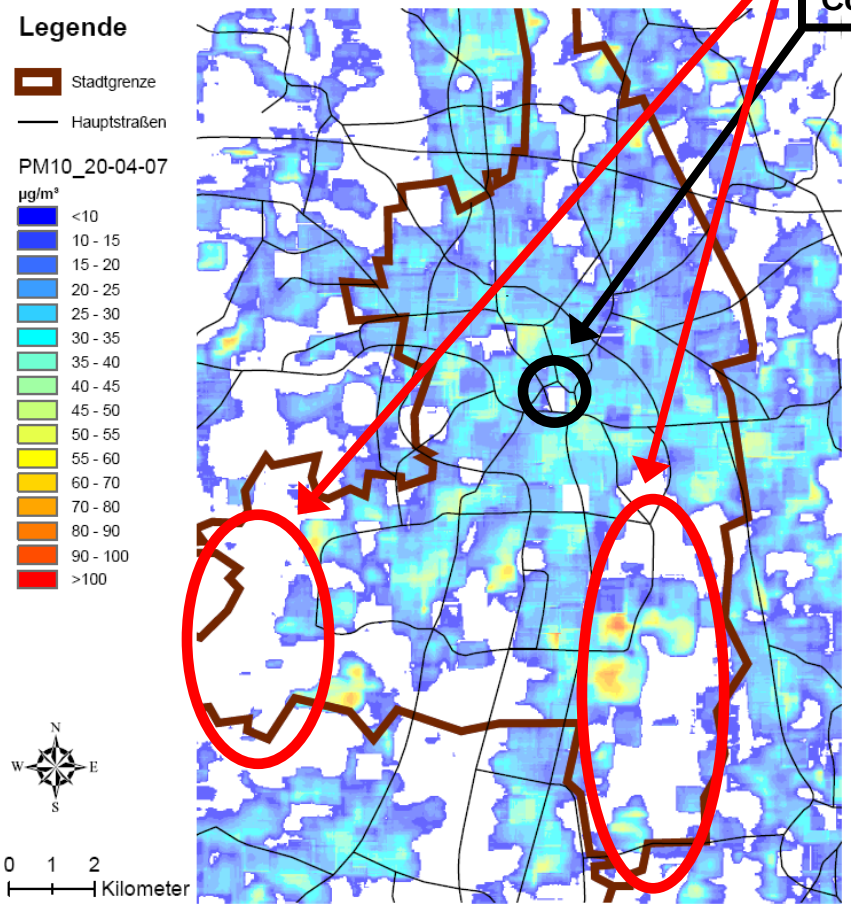
Integrated Measurement / Simulation concept

Karlsruhe Institute of Technology

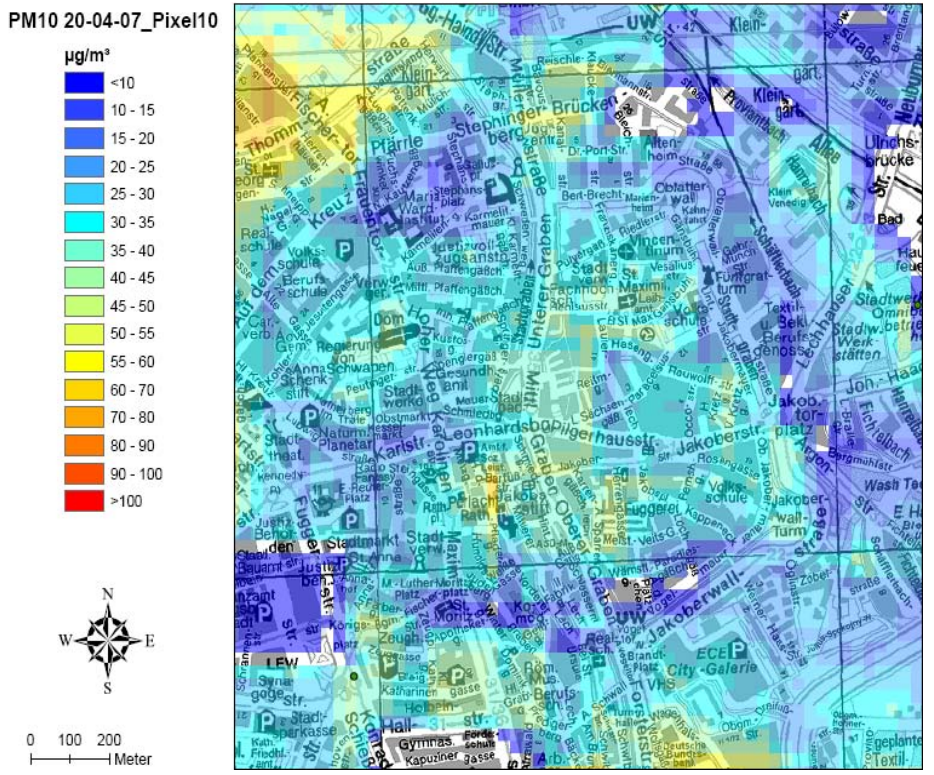
Agricultural areas and woodland

Construction Changes, bright metal roofs

PM_{10} over Augsburg in April 2007



PM_{10} over the City Center of Augsburg in April 2007



Master-Thesis: Stefanie Schrader

Conclusions

- Air quality issues need an holistic and interdisciplinary approach
- In order to understand the complex system of a mega city, further process studies have to be done in each discipline
- Link between the fields of land-use, energy, transportation, air quality, climate change and health demonstrates the interaction and tackles central problems in a mega city
- Air quality and health impact assessment studies are essential prerequisites for mitigation and adaptation strategies and for reducing e.g.
  - environmental risks (air pollution, congestion, waste, ...)
  - social risks (spatial segregation, health problems, …)
  - costs (healthcare system, transportation, production, ...)

Co-operations and Partners

- **Chinese Academy of Sciences (CAS), Beijing**
  - Prof. Yuesi Wang
  - Dr. Xin Jinyuan
- **China University of Geosciences (CUG), Beijing**
  - Prof. Cen Kuang
- **China University of Mining and Technology, Beijing (CUMTB)**
  - Prof. Longyi Shao
- **Chinese Research Academy of Environmental Sciences (CRAES), Beijing**
  - Prof. Chai Fahe
  - Prof. Chen Yizhen
- **German Meteorological Service (DWD), Freiburg**
  - Dipl.-Ing. Volker Dietze
  - Dipl.-Ing. Mathieu Fricker
- **Helmholtz Center Munich (HMGU)**
  - Prof. Dr. Annette Peters
  - Dr. Jürgen Schnelle-Kreis
- **Qingdao Research Academy of Environmental Sciences (QRAES)**
  - Prof. Sun Hekun

Capacity Building

in cooperation with Prof. Longyi Shao (CUMTB) and Prof. Yuesi Wang (CAS-IAP)

Rongrong Shen, full CSC PhD Student (4 years)

- aerosol measurements with the focus on source apportionment

Ruiguang Xu, full CSC PhD Student (4 years)

- air quality modeling with the focus on aerosol composition and distribution

Ling Hong, sandwich (IAP-CSC-HGF) PhD Student (4 years)

- air quality measurements with the focus on remote sensing techniques (SODAR, contactless)

Yu Yang, full CSC PhD Student (1 year)

- aerosol measurements with the focus on source apportionment / optical depth

Thank you very much for your attention

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SINO-GERMAN COOPERATION
QINGDAO SUMMIT

….and thank you for the invitation and welcome to Germany

International Bureau (IB) of the Federal Ministry of Education and Research (BMBF) of Germany

Qingdao Research Academy of Environmental Sciences