Environmental Issues in Urban Agglomerations

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Overview

- ✓ Problems and challenges of urban agglomerations
- ✓ Specific fields of investigation
- ✓ Risk-Habitat-Megacity concept

Urban agglomerations

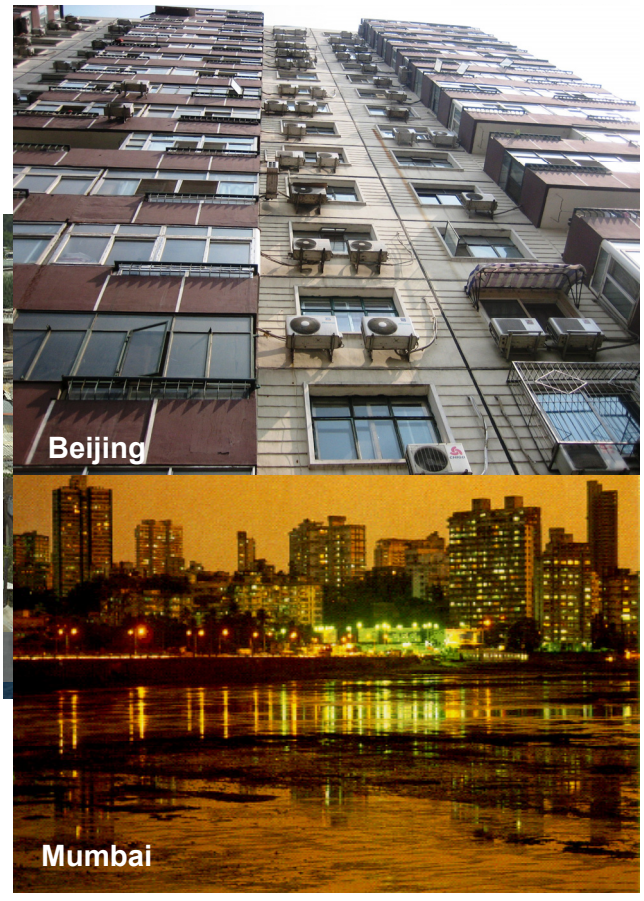
- In **1974** a UNEP and WHO declaration concerning air pollution was released
- In order to reduce human exposure and health risks in **1992** a EU-report about a more effective planning on energy requirements and transportation was published
- Since **2007** more than 50 % of worlds population live in urban agglomerations

Definition: Mega-city comprise 10 Mill. people

1975: 3 MC **2005**: 20 MC **2015**: 22 MC (4 > 20 Mill.)

Problems & Risks

- Living space
- Social structure
- Land use
- Energy
- Mobility
- Environment
- Air quality
- Health



Reasons & Challenges

- Employers, living room, education, health care, …
- Economic & financial centers, transportation junction
- Drivers of growth
  - São Paulo: about 10 % of the population produce about 40 % of the GNP but consume about 60 % of the energy (2003)

Aerem corrumpere non licet

Law by Lyon authorities in 1627

Air pollution as the most significant environmental challenge, followed by congestion issues

(Survey with 500 megacity - „stakeholders“)

but

„The environment matters, but may be sacrificed for growth“

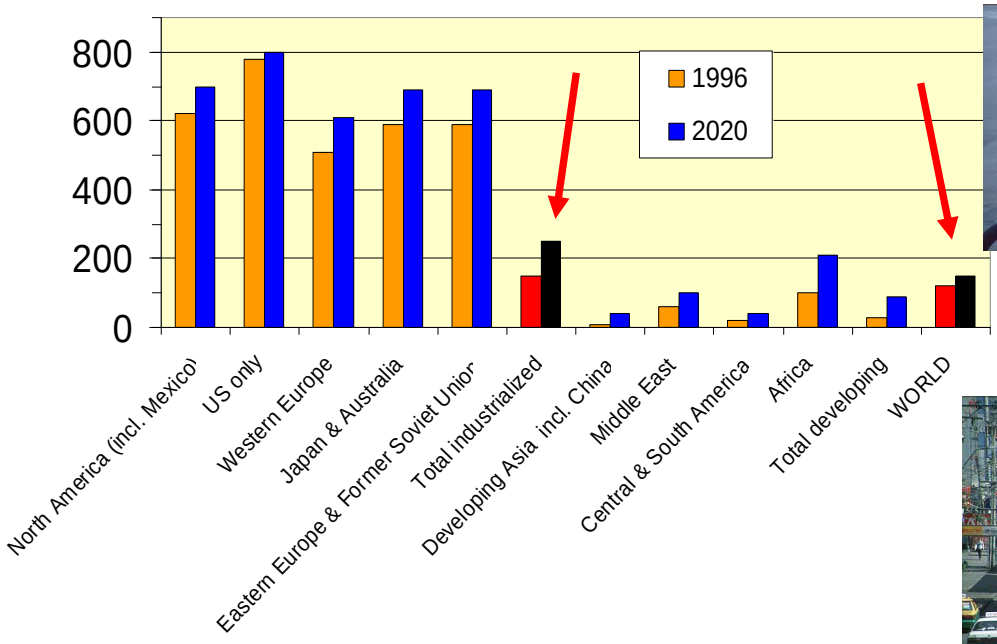
Siemens, 2007

Air pollution and Megacities ?

- **Land use change**
  - Change of atmospheric composition
- **Energy sources and traffic**
  - Increase / Change of Emissions
- **Climate change**
  - Feedback mechanisms (aerosols, radiation)
- **Impact on quality of life and health**
  - Strategies and abatement measures

Problem area: Traffic (I)

Vehicles per 1000 people



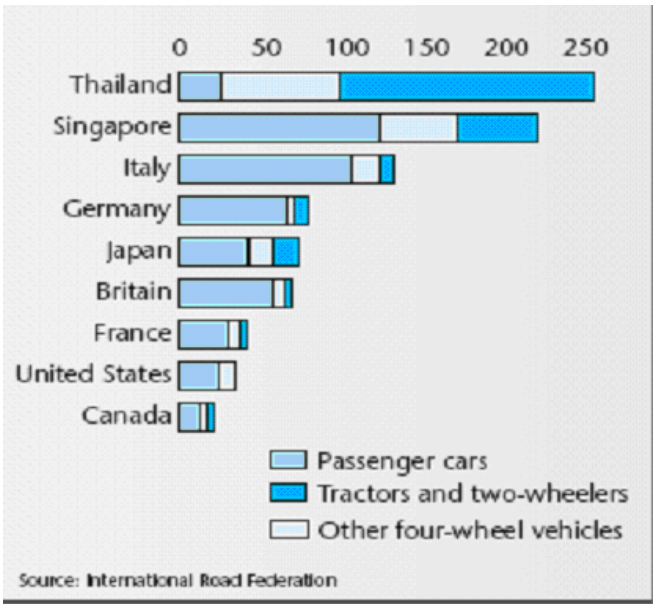
Fleet composition in 1996 and 2020

Source: US Dept.of Energy, 2000

Problem area: Traffic (II)

Dehli	Vehicles (Mill)	Street length (km)
1971	0.18	8380
2001	3.46	28508
Factor	19.2	3.4

Vehicles per kilometer, 1996



Related health problems

areas with high vs low levels of exposure		asthma & allergies	bronchitis
domestic heating attributed emissions	Leipzig	10 %	50 %
traffic attributed emissions	Leipzig	70 %	0 %
	Mendoza	120 %	30 %

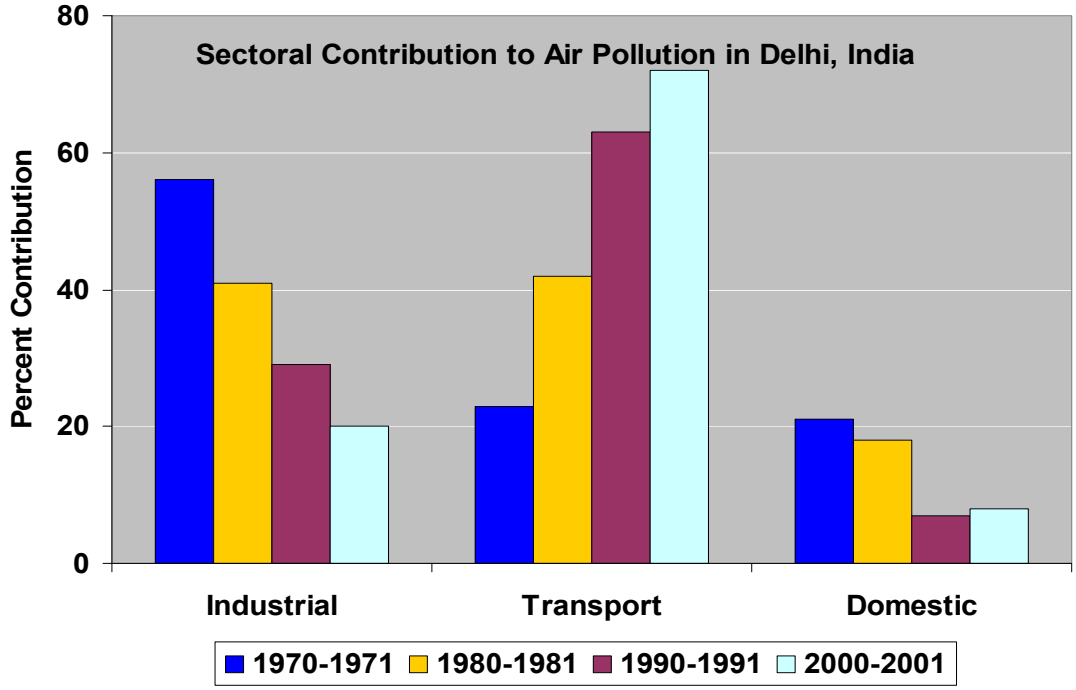
Source: U. Franck (UFZ) - 2006

Emissions: cities versus countries

		CO Emissions per citizen (kg/person)	Citizen (Mill.)
Megacities	Beijing	253	10.0
	Shanghai	167	13.2
	Los Angeles	166	11.8
	Moscow	131	10.1
	Mexico City	101	18.1
OECD countries	Portugal	110	10.0
	Belgium	101	10.3
	Hungary	73	10.0
	Czech R.	63	10.3
	Netherlands	43	15.9

Source: Gurjar-Lelieveld, New Directions - Mega Cities and Global Change, AE 39 (2005)

Sectoral emissions



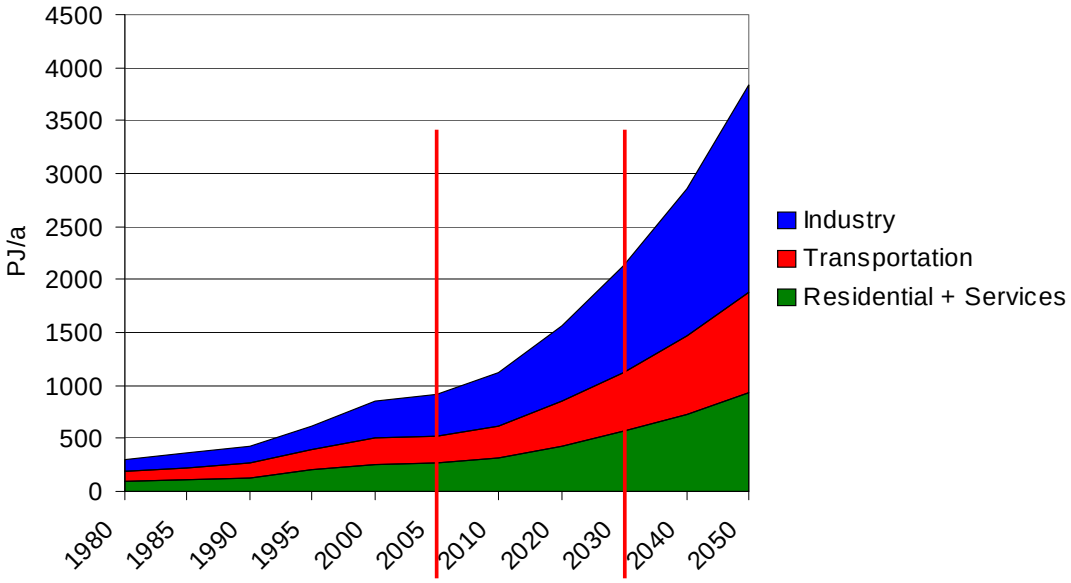
Source: University of Hertfordshire, Atmospheric Science Research Group (ASRG)

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

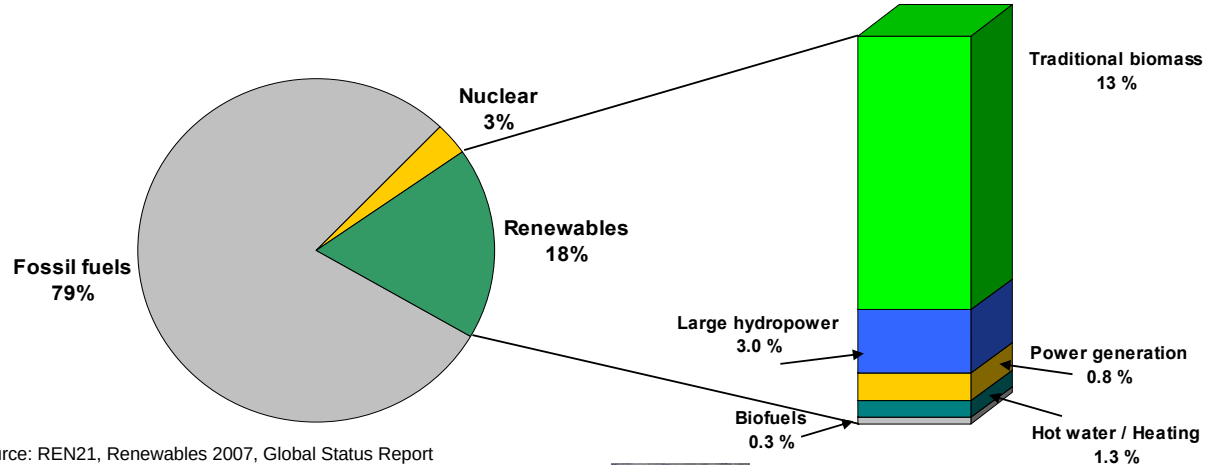
Energy demand Chile



Source: Simon, DLR (2008)

Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

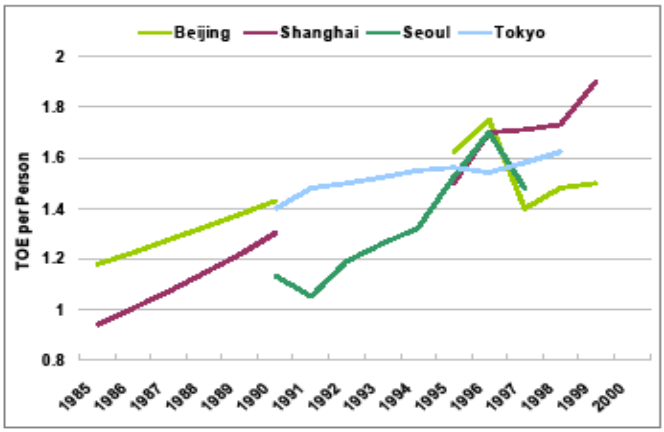
Global final energy consumption



Source: REN21, Renewables 2007, Global Status Report

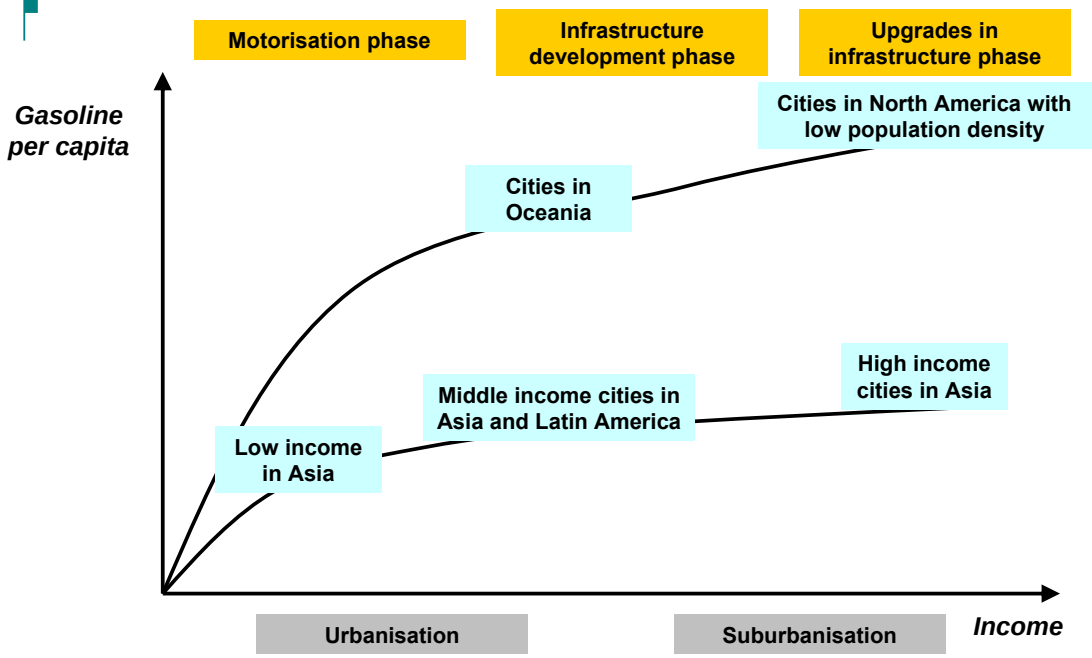
Urban energy use

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



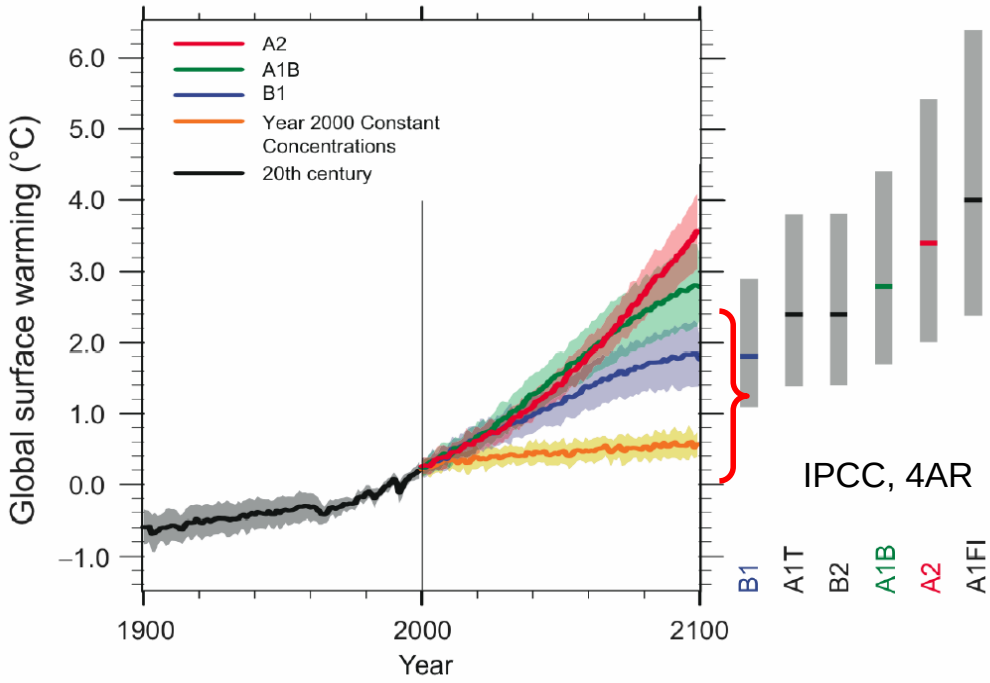
Source: APERC 2007, Shobhakar Dhakal (2004). Urban Energy Use and Greenhouse Gas Emissions in East Asian Mega-cities

Development & energy consumption



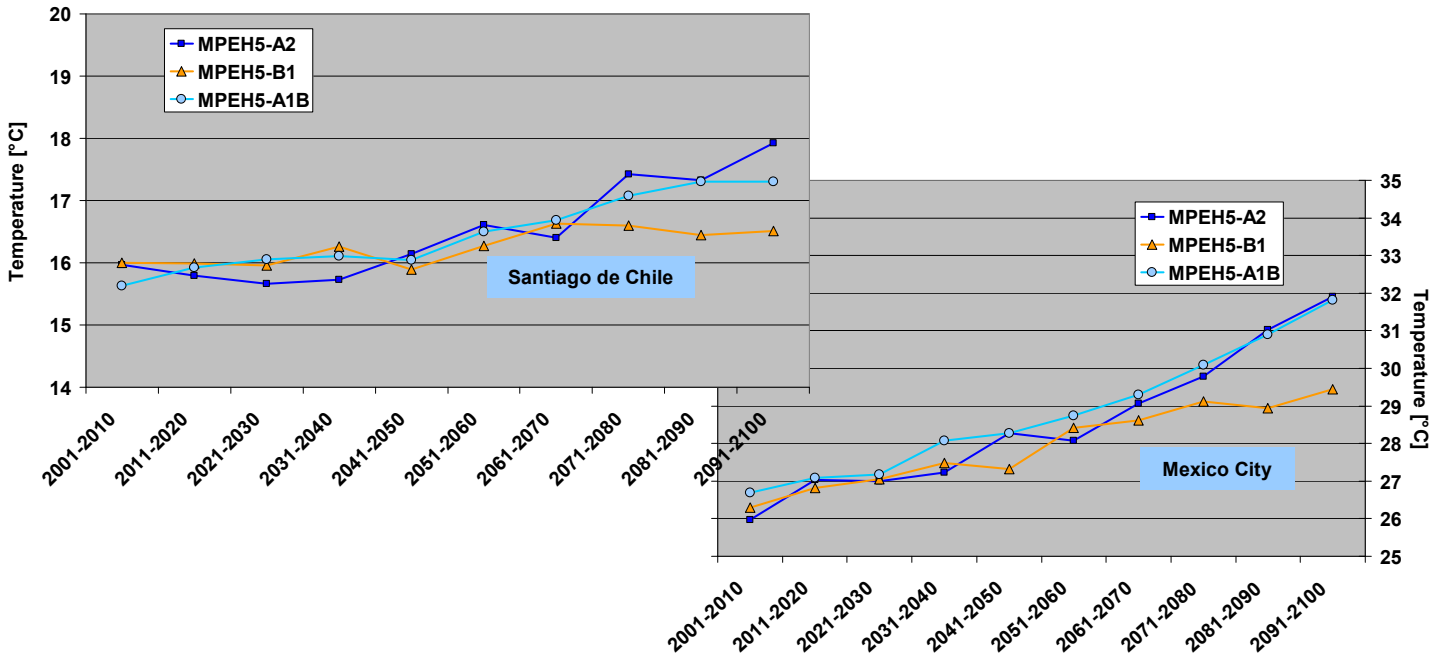
Source: Global Energy Futures and Human Development: A Framework for Analysis", Lawrence Livermore National Laboratory, 1997

Problem area: Global climate change

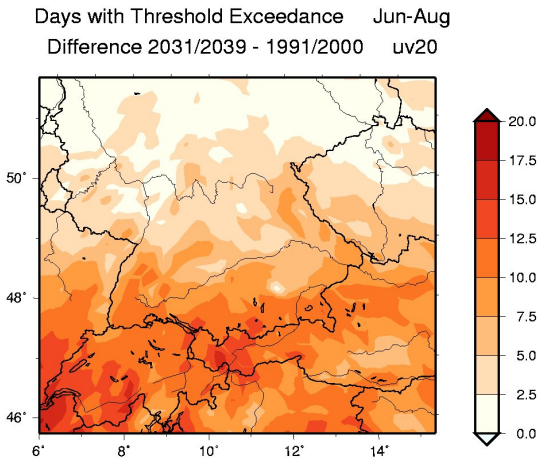


Even optimistic scenarios: 2.5°C ↑

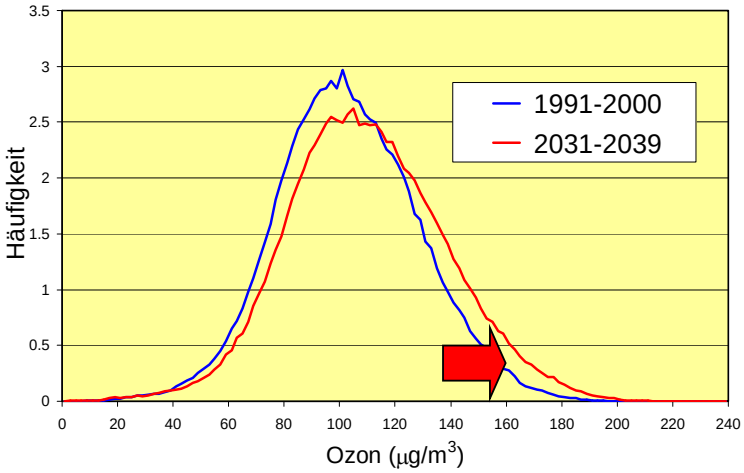
“Regional” temperature change



Regional climate-chemistry simulations



Future threshold exceedances



O_3 maxima distribution

Source: R. Forkel (IMK-IFU) - 2006

HGF Initiative on “Risk Habitat Megacity”

Partners

- **Helmholtz centres**
  - German Aerospace Centre (DLR)
  - Forschungszentrum Karlsruhe (FZK)
  - Helmholtz Centre for Infection Research (HZI)
  - GeoForschungsZentrum Potsdam (GFZ)
  - Helmholtz Centre for Environmental Research (UFZ)
- **Latin America**
  - United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL)
  - Universidad de Chile
  - Pontificia Universidad Católica de Chile
  - Pontificia Universidad Católica de Valparaiso
- **“Anchor city“: Santiago de Chile**
- **Duration: July 2007 – June 2013**

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Risk Habitat Megacity

Objectives

- Sustainable and trend setting development
- Characterizing of risks, driving factors and consequences
- Development of strategies and instruments for risk management
- Integration of science and experience
- Implementation of solutions

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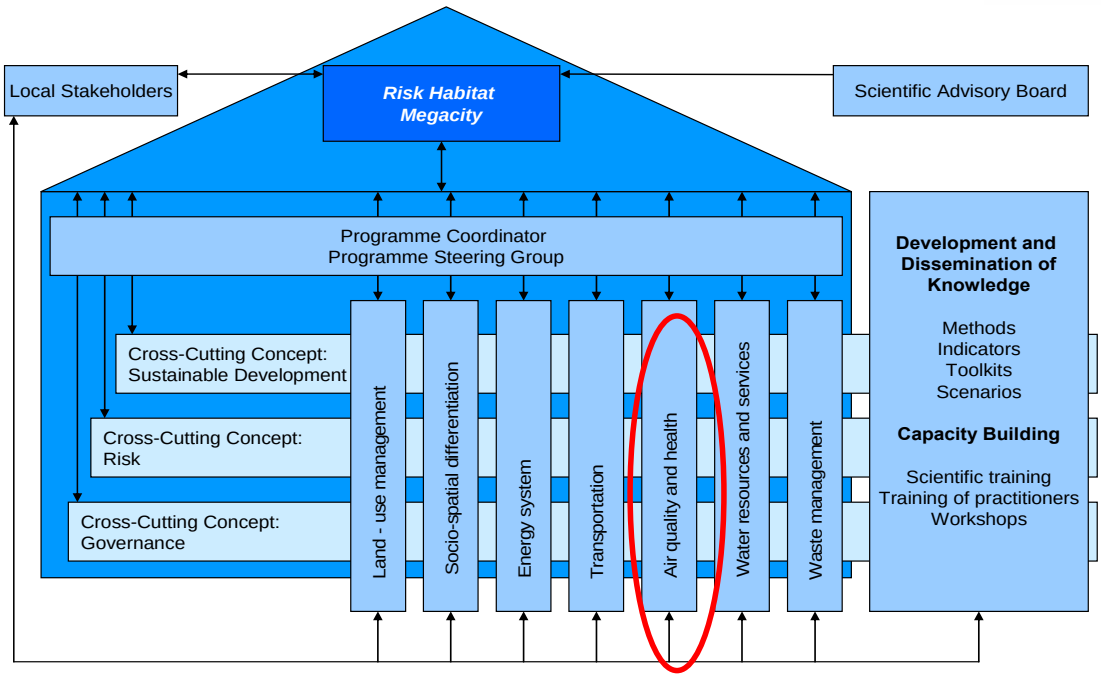
Risk Habitat Megacity

Peter Suppan, Institute for Meteorology and Climate Research (IMK-IFU)

Integration



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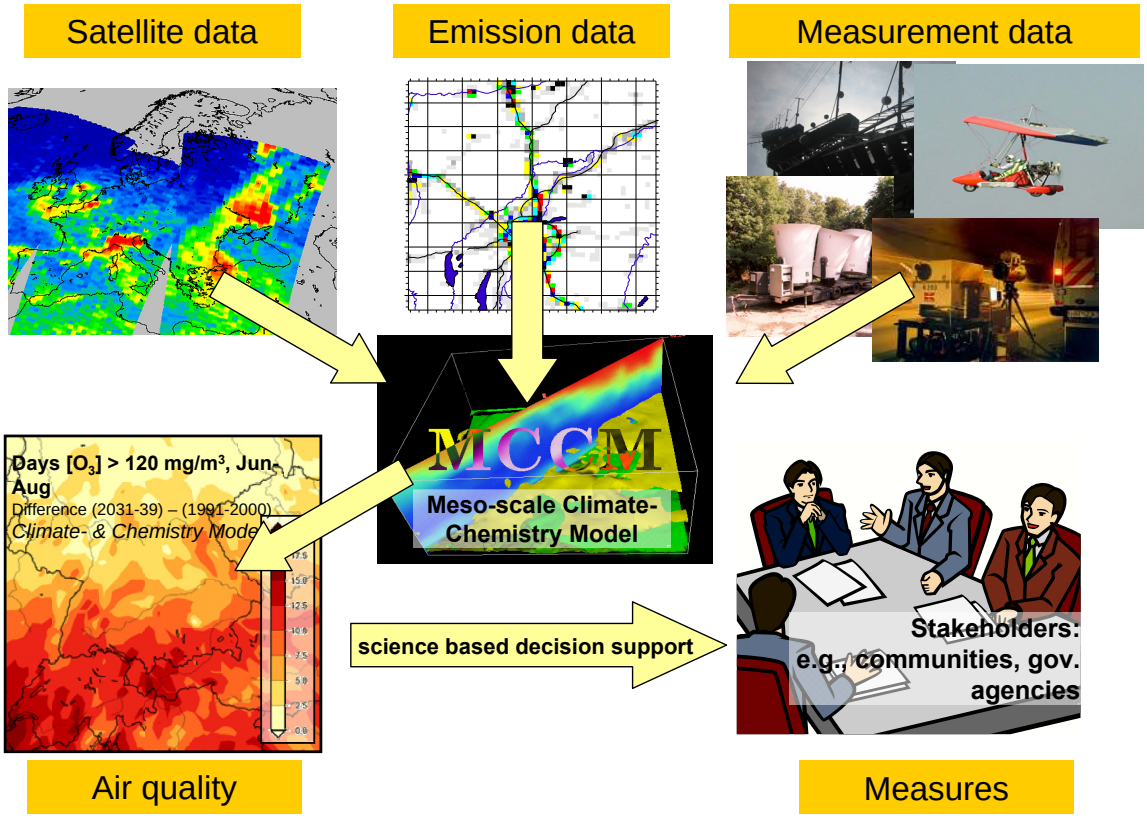
Risk Habitat Megacity

Peter Suppan, Institute for Meteorology and Climate Research (IMK-IFU)

EPS/DPG Joint Session „Energy and Environment“, Darmstadt, 13th March 2008

Methodology



Conclusions

- Environmental issues need an holistic approach
- In order to understand the system, further process studies have to be done in each discipline
- Link between energy consumption, transportation, air quality and health demonstrates the interaction and tackles central problems in a megacity
- 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, ...)

Thank you very much for your attention

Co-operations

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Agustín García, Gerardo Ruiz	*Universidad Nacional Autonoma de Mexico*
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Michael Hagen	*Fondo Nacional de Salud - FONASA*
Sonja Simon	*System Analysis and Technology Assessment - DLR*
Frank Baier	*German Remote Sensing Data Center – DFD-DLR*
Ulrich Franck, Olf Herbarth	*Helmholtz Centre for Environmental Research - UFZ*