



Air quality impact studies

- An interdisciplinary approach for megacities -

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Overview



- ✓ Problems, risks and facts of urban agglomerations
- ✓ Air quality and related links
- ✓ 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: Megacities comprises 10 Mill. people

1975: 3 MC

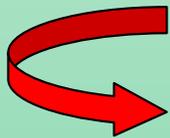
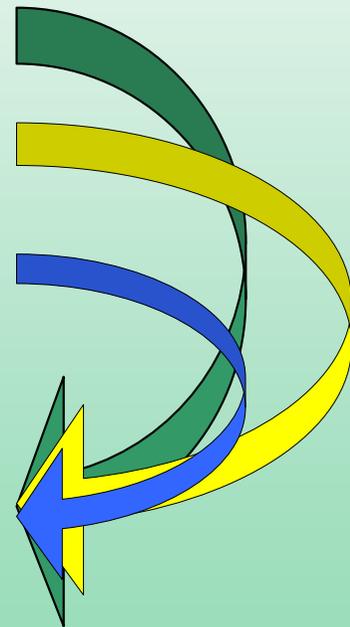
2005: 20 MC

2015: 22 MC (4 > 20 Mill.)



Problems and Risks

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





Facts



Air pollution as the most significant environmental challenge,
followed by congestion issues
(Survey with 500 megacity - „stakeholders“)

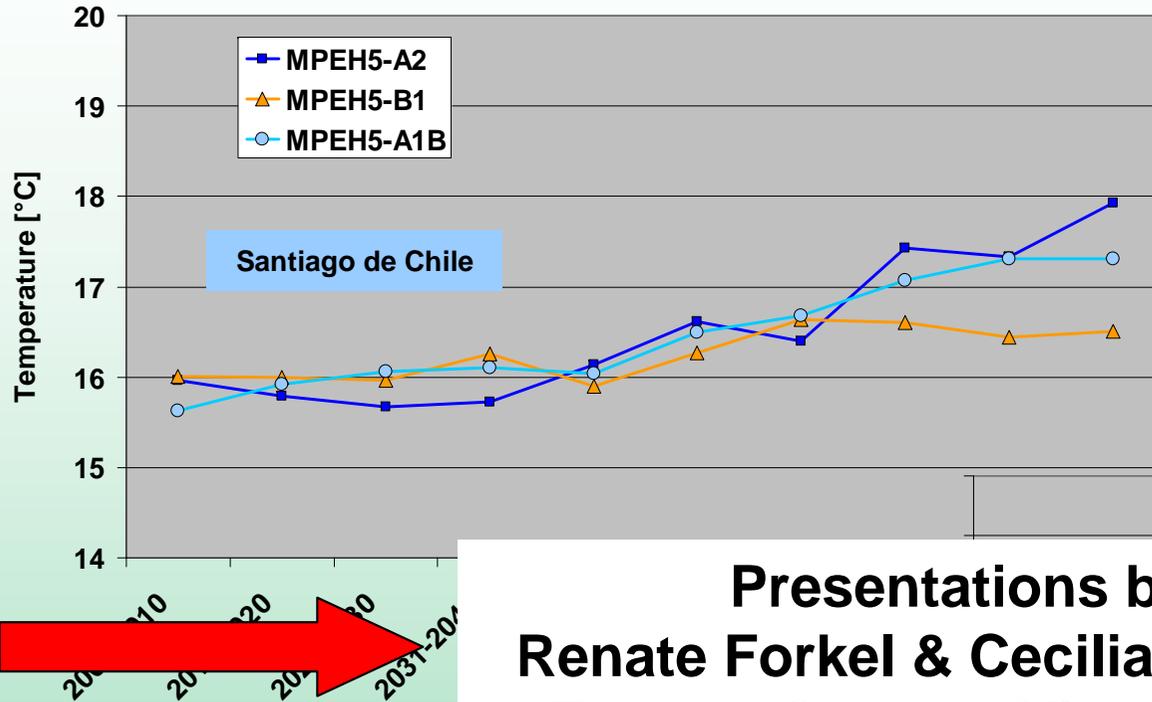
but

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

Siemens, 2007

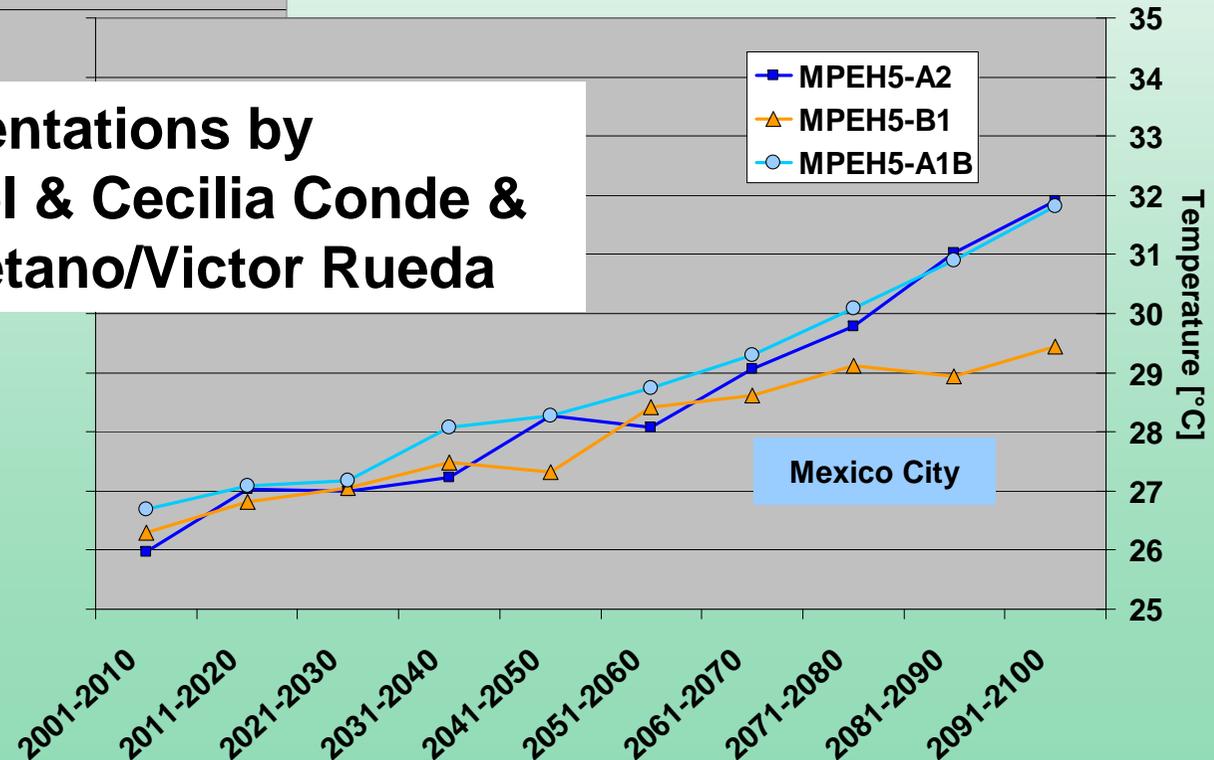
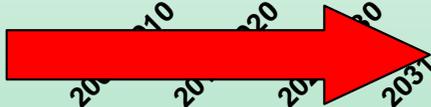


Facts



Climate change impact on megacity regions

Presentations by Renate Forkel & Cecilia Conde & Ernesto Caetano/Victor Rueda





Related Health Facts



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

Presentations by Alvaro Osornio & Irma Rosas & Horacio Tovalin & Ulrich Franck & Alexandra Schneider

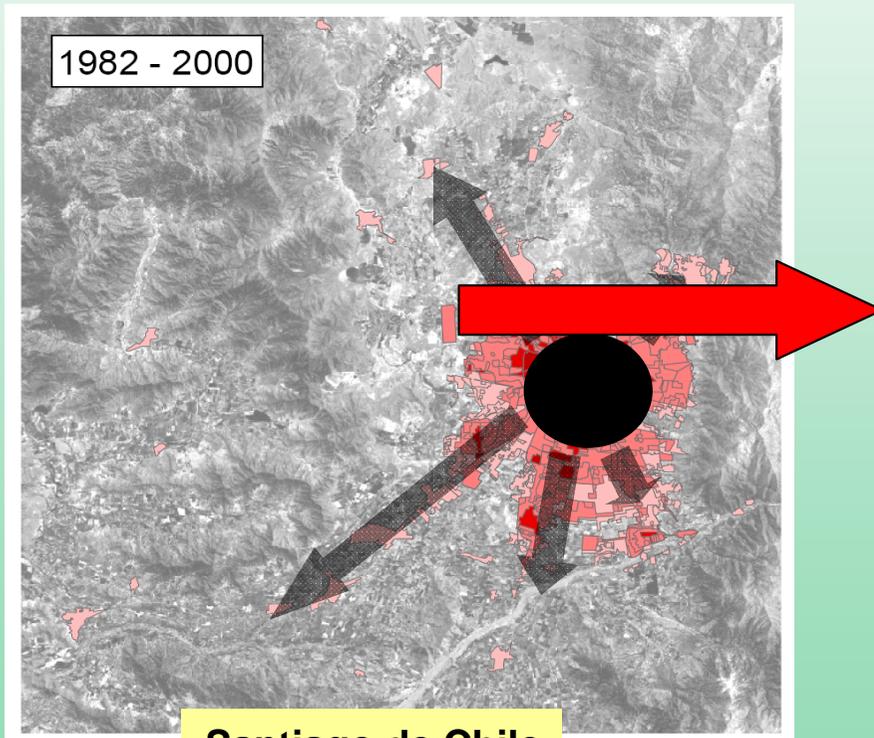


Source: U. Franck (UFZ) - 2006

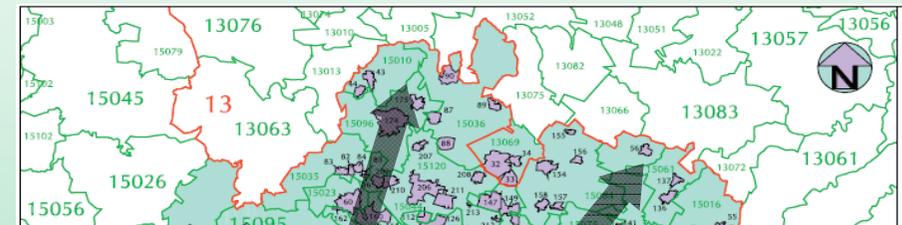
Land Use Change

	Santiago de Chile 2002	Mexico City 2005
Population	6.061.000	19.410.000
Urbanized area (km ²)	641	1800
Population density (p / km ²)	9.500	10.800
Population growth (% / y)	~1,32	~1,28

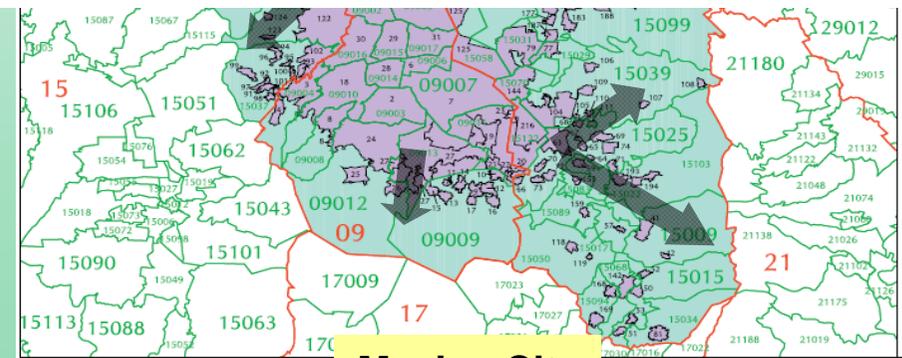
Source:
Poduje 2005 (Santiago de Chile)
APERC 2007 (Mexico City)



Santiago de Chile



Presentation by Manuel Suarez & Javier Delgado

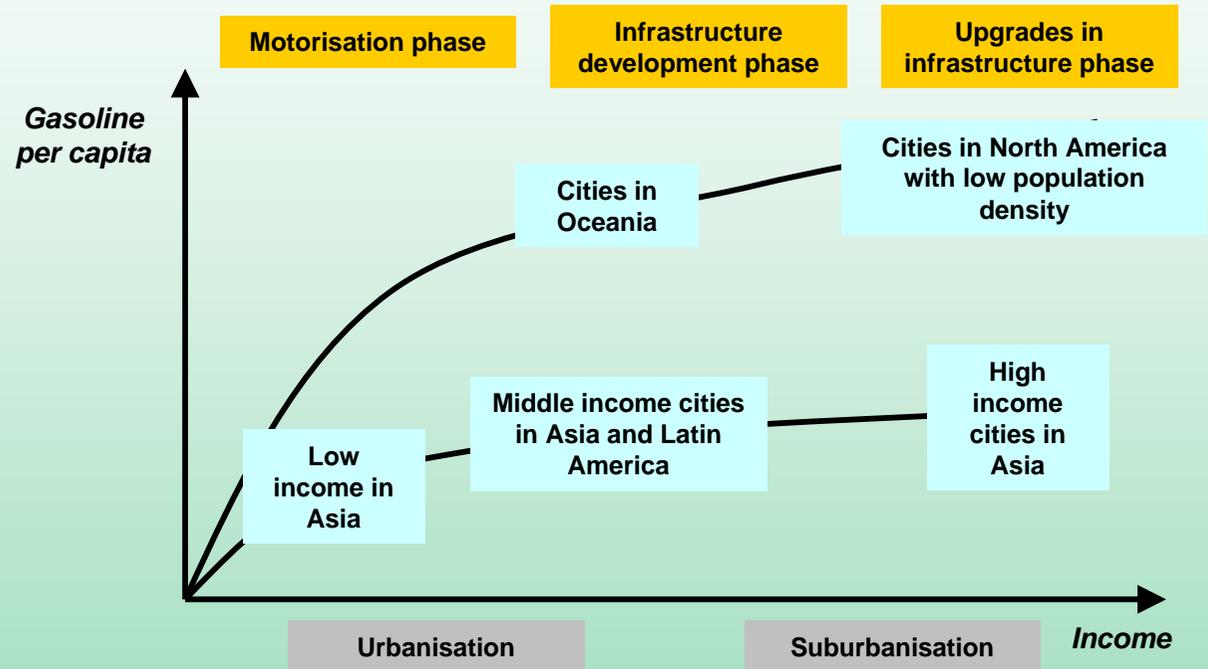


Mexico City

Source: U. Weiland, E. Banzhaf, A. Ebert, A. Kindler, R. Höfer (UFZ)

Energy consumption by sources

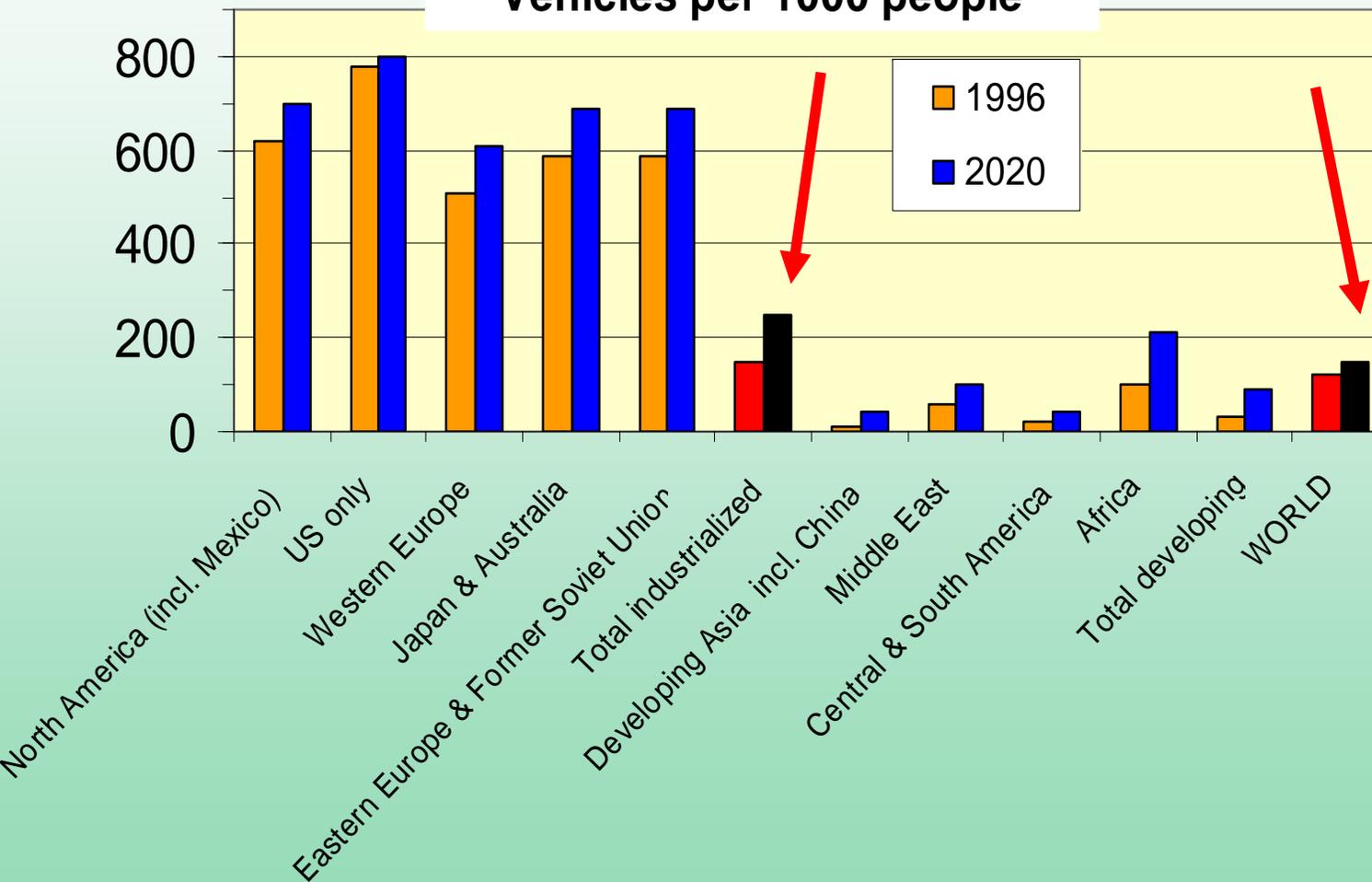
	Industry	Transport	Residential
Beijing	75%	8%	17%
Shanghai	83%	10%	7%
Seoul	38%	25%	37%
Tokyo	41%	37%	22%
Mexico City	38%	44%	18%



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

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

Vehicles per 1000 people



Source: US Dept.of Energy, 2000



Fleet composition in 1996 and 2020

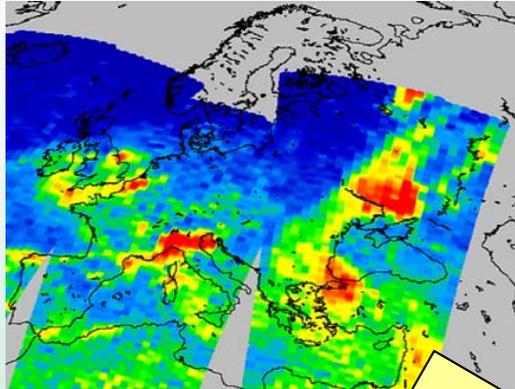




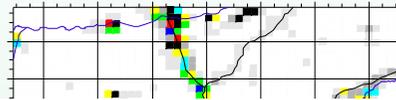
Air Quality Assessment



Satellite data



Emission data



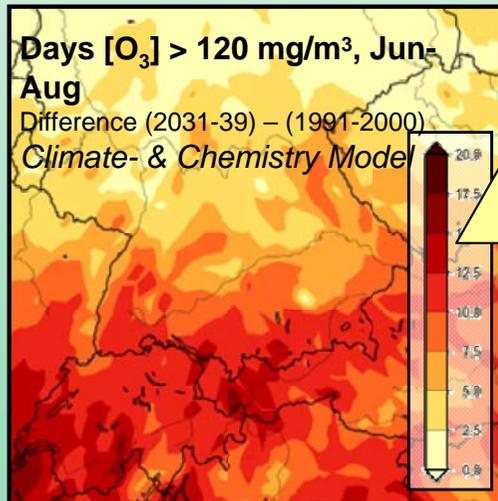
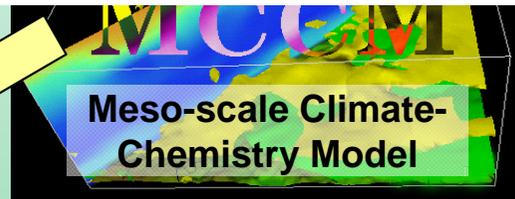
**Presentations by
Rainer Steinbrecher
& Gerardo Ruiz**



Measurement data

**Presentations e.g. by
Michel Grutter & Klaus
Schäfer & Stefan Emeis
&
Peter Wiesen**

**Presentation by
Gerhard Smiatek**



Air quality

science based
decision support

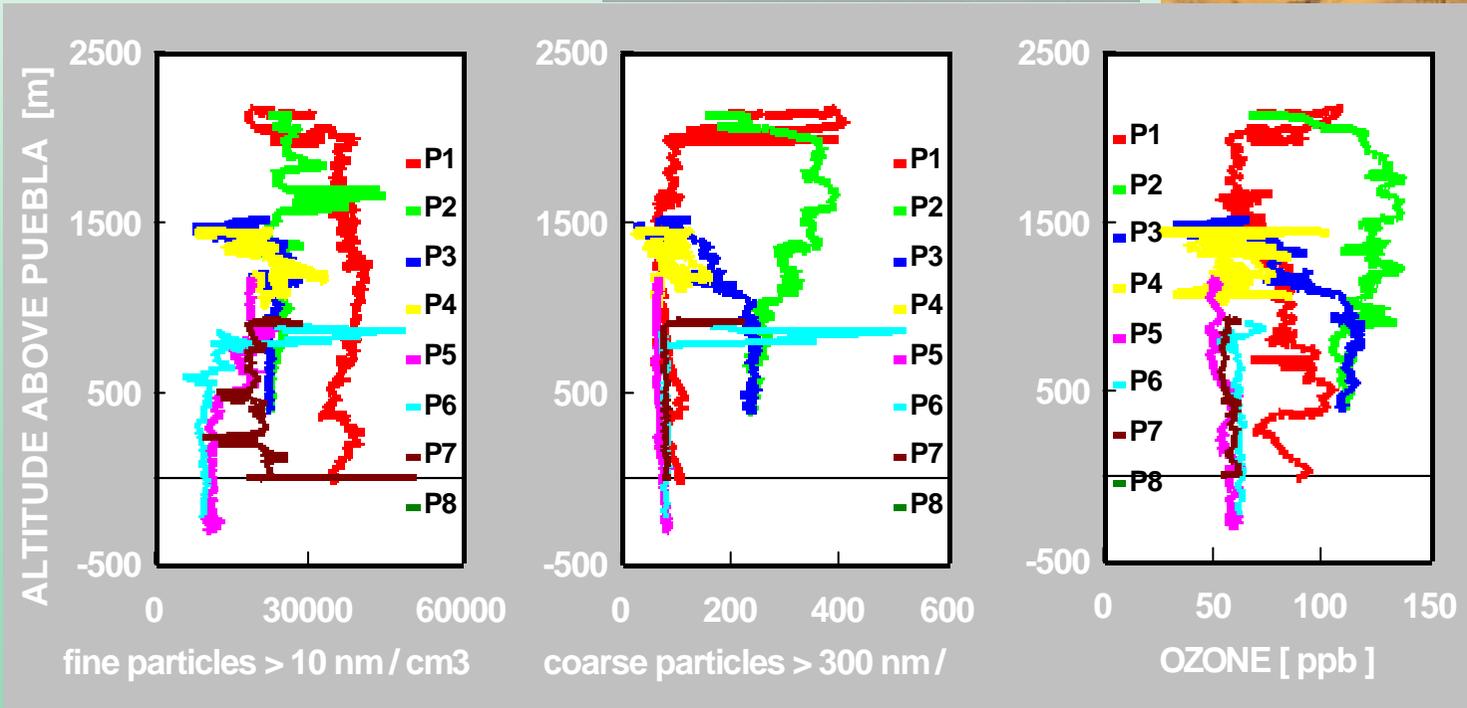
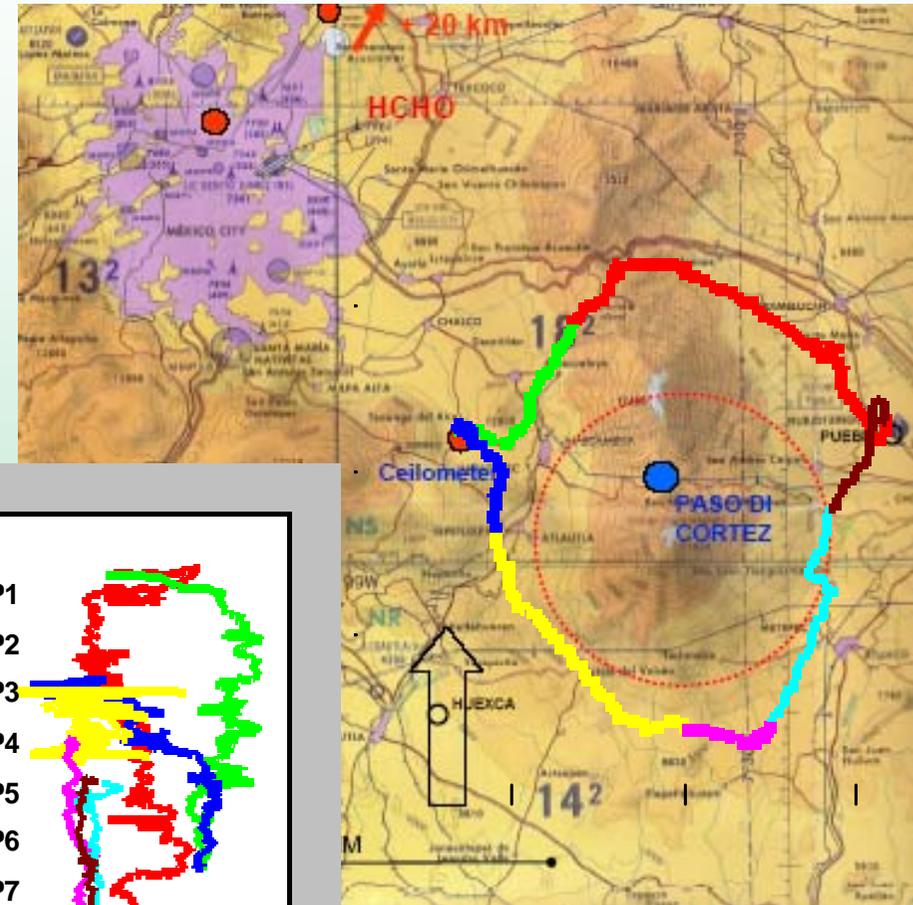


**Stakeholders:
e.g., communities, gov.
agencies**

Measures

Measurements

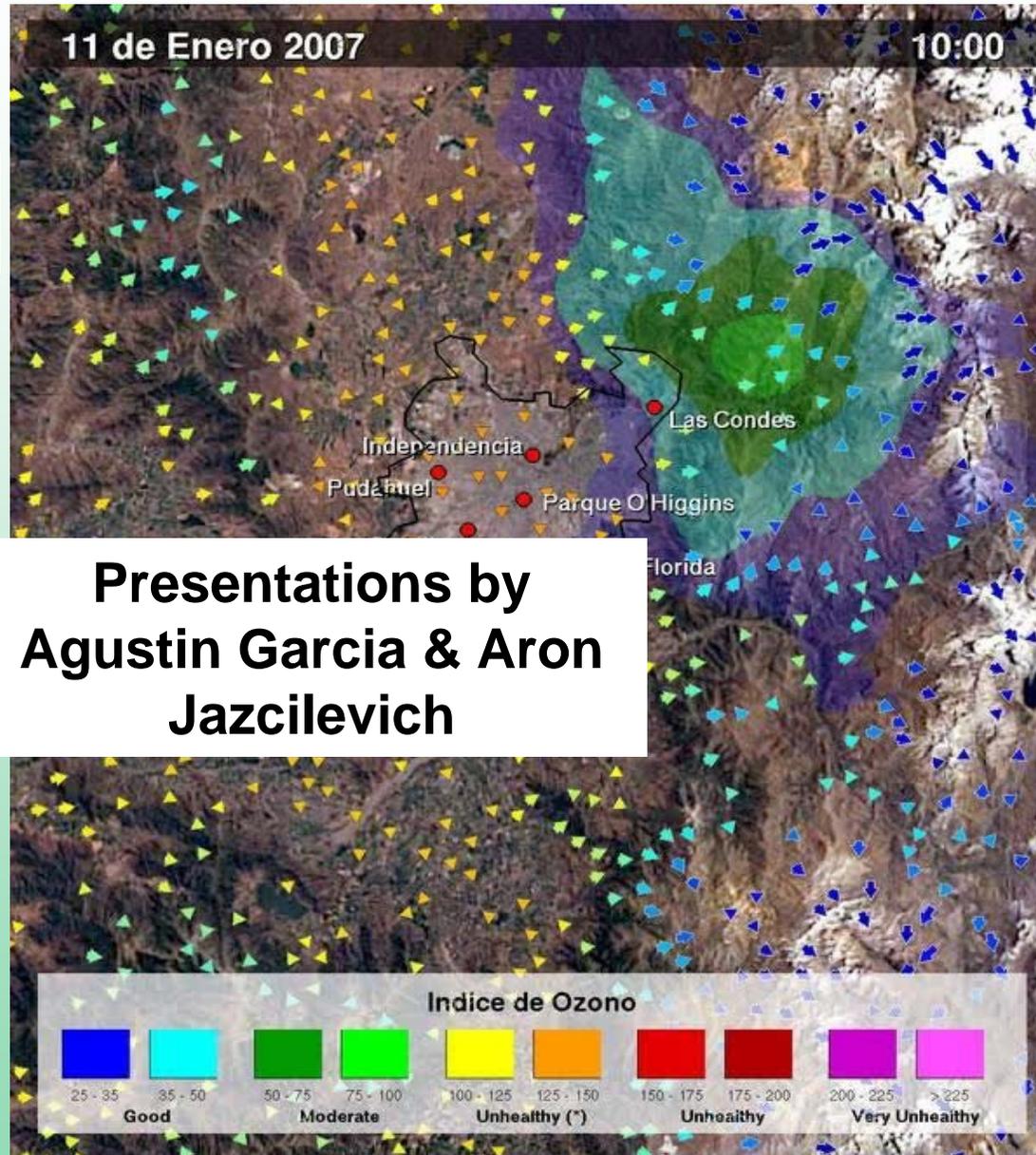
Measurements by a
ultra light aircraft
around Popocatepetl



Source: W. Junkermann, M Grutter,
D. Baumgardner, R: Steinbrecher
(IMK-IFU, UNAM)

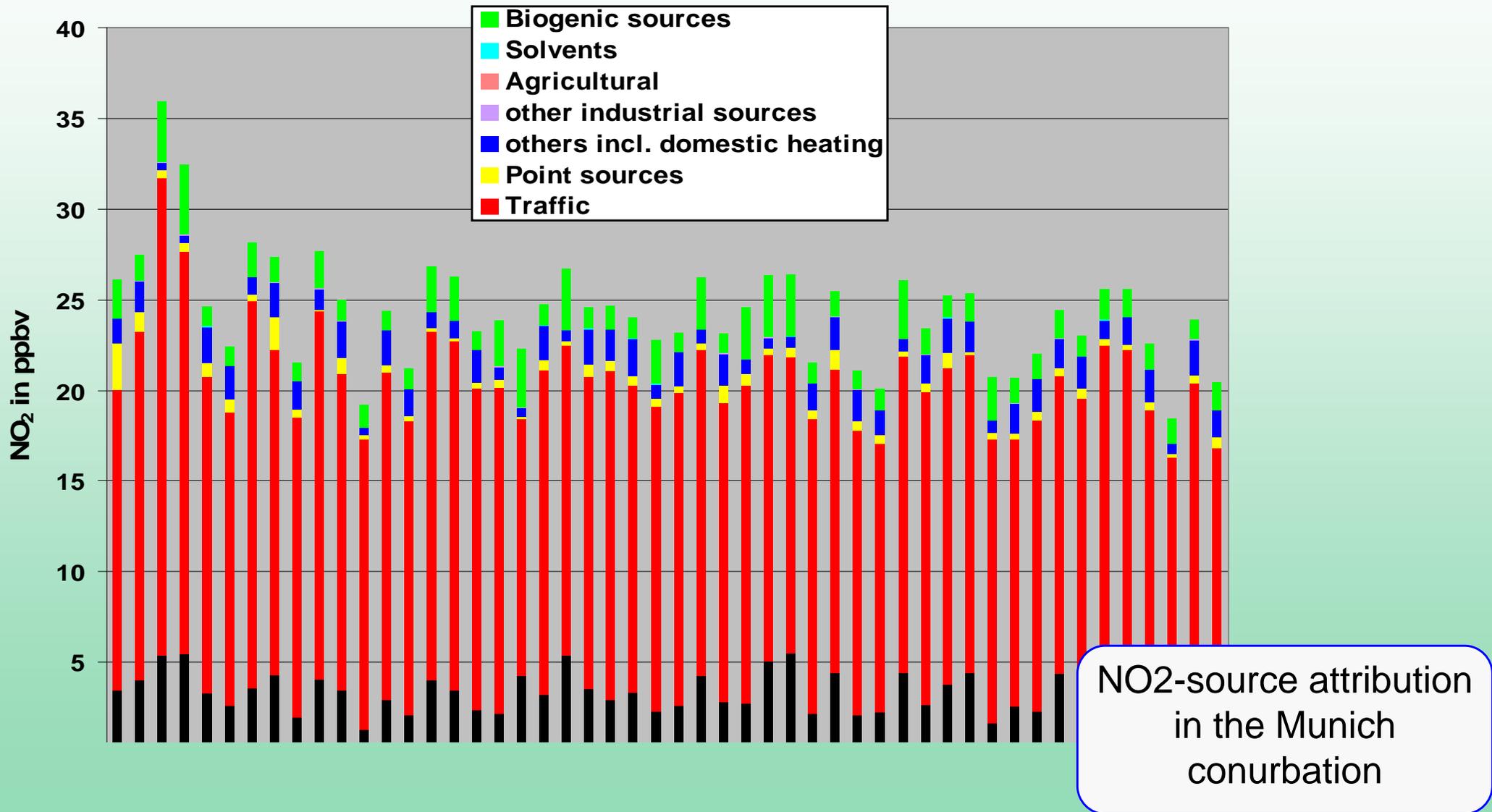
Simulation

Ozone exposure index
- Santiago de Chile -



**Presentations by
Agustin Garcia & Aron
Jazcilevich**

Source:
R. Schmitz (IMK-IFU, UCH)





Risk-Habitat-Megacity

¿sostenibilidad en riesgo?



➤ **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 Valparaíso

➤ **“Anchor city“: Santiago de Chile**

➤ **Duration: July 2007 – June 2013**



Objectives

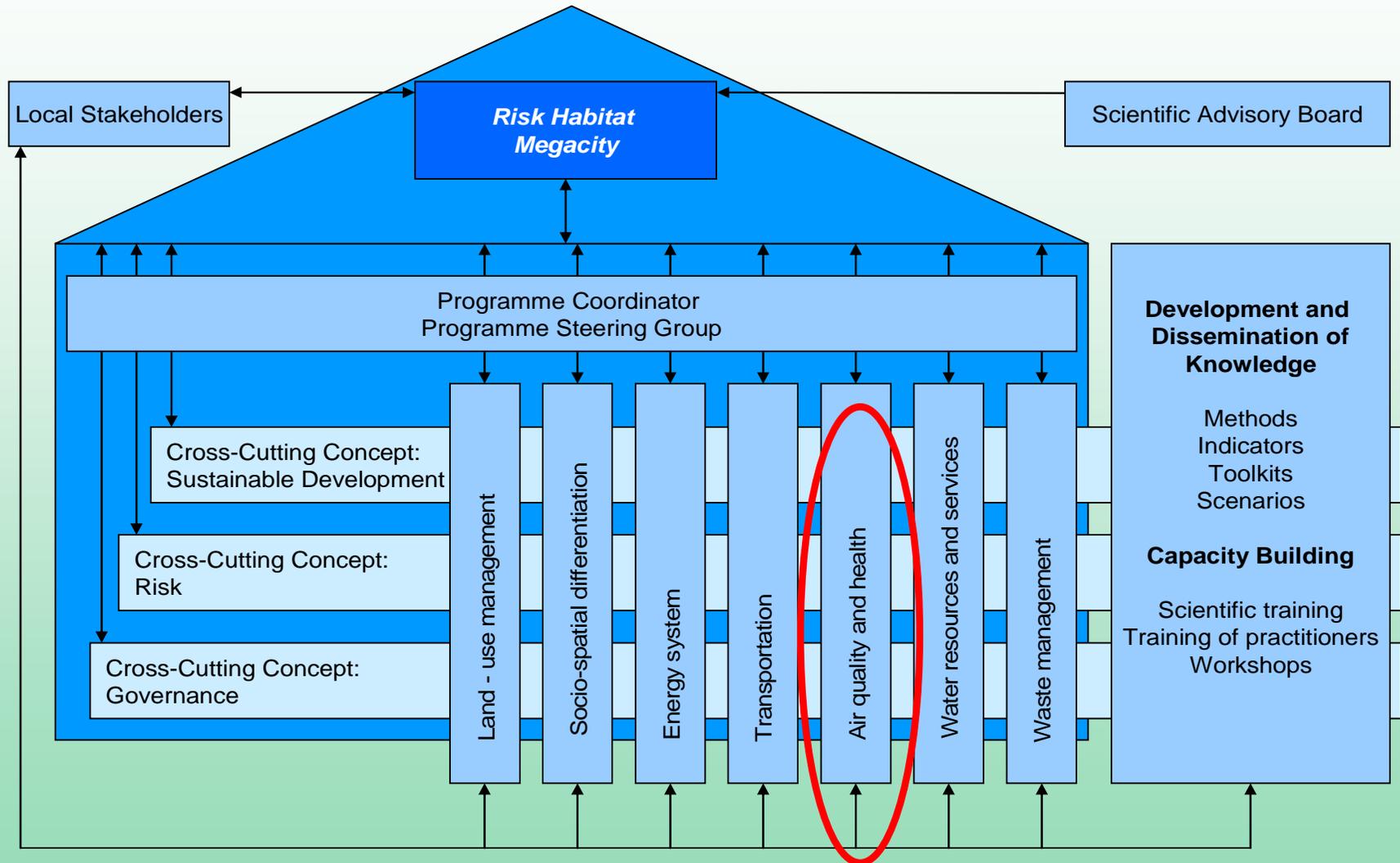


- Contribute to the specification of sustainable objectives for the future development of mega-cities
- Characterize of risks, driving factors and consequences
- Design of strategies and instruments for risk management as key tools for a sustainable urban development
- Investigate on the regional-urban scale based on interdisciplinary research groups
- Develop of a science and experience platform for a technical and science based cooperation
- Exchange and transfer of knowledge

Risk Habitat Megacity
¿sostenibilidad en riesgo?



Architecture



Risk Habitat Megacity
¿sostenibilidad en riesgo?

Goals

Problems

Action



Aggregation, Generalisation, Theory generation

Definition of research questions

Implementation solution

Fields of application

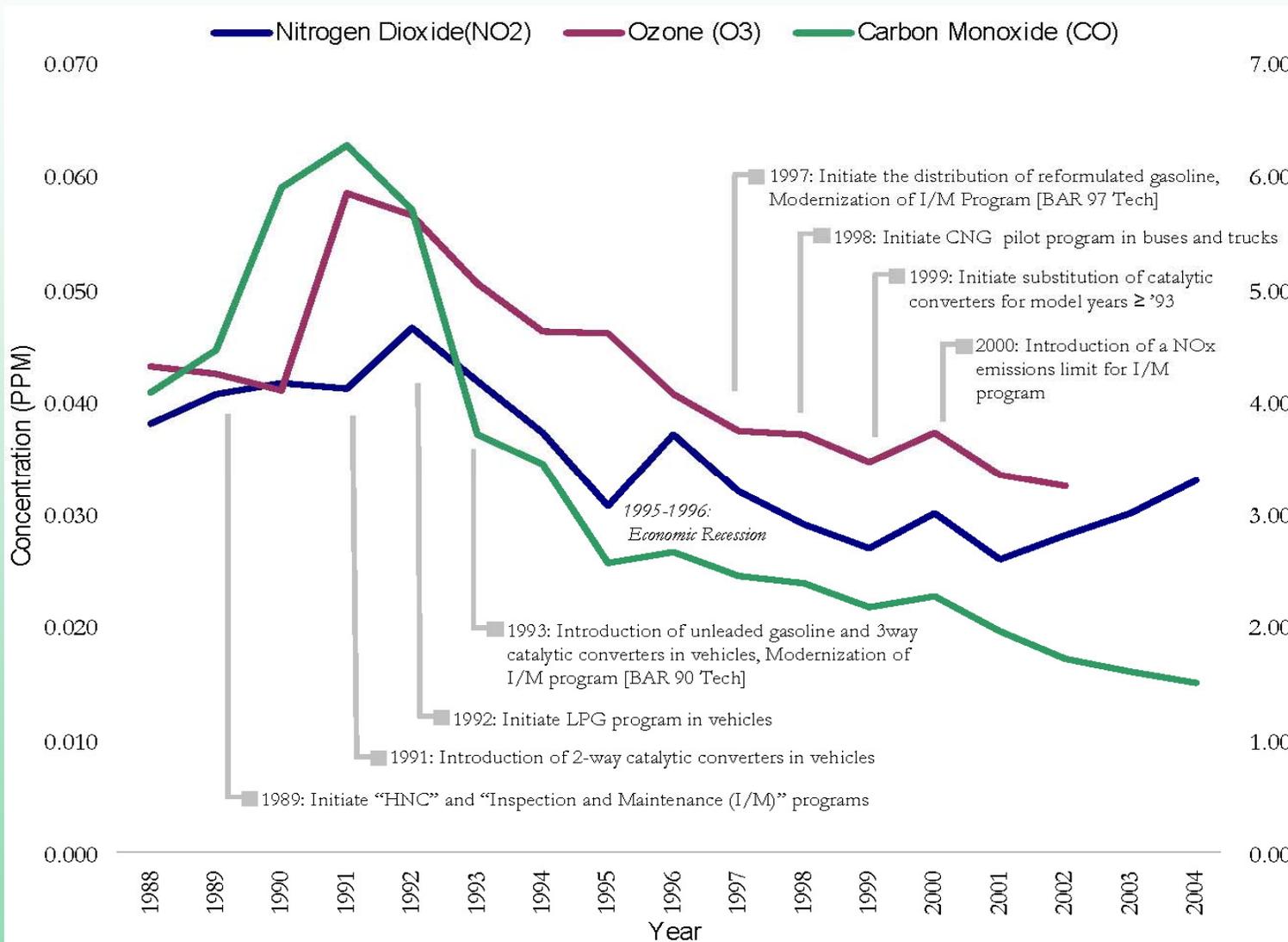
- Land-use management
- Sociospatial differentiation
- Transportation
- Air quality and health
- Waste
- Energy
- Water

- **Integration**
- Disciplines, Actors
- Concepts and Topics
- Methodologies
- Results

Risk Habitat Megacity
¿sostenibilidad en riesgo?



Governance



Air Quality management policies, emission control programs and pollutant trends in Mexico City

Source: APERC (2007): Urban Transport Energy Use in the APEC Regions



Conclusions



- Air quality issues need an holistic and interdisciplinary approach
- In order to understand the complex system of a megacity, 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 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, ...)



Cooperation



- **Memorandum of Understanding (MoU)** between IMK-IFU and the **Universidad Nacional Autónoma de México (UNAM)** about a cooperation in the fields of research and education (e.g. *Air Quality, Climate Change*)
- Establishing of the **International Competence Center for Sustainable Urban Development (ISUD)** in Santiago de Chile (“*capacity building*”; “*multidisciplinary research on Megacities*”; “*applying knowledge*”) between FZK and **Universidad de Chile** in Santiago
- **Contract of Cooperation** between the **Institute of Atmospheric Physics (IAP)** of the **Chinese Academy of Sciences (CAS)** and IMK-IFU about “*Monitoring and Modelling of Air Quality at the Megacity, Beijing*”



Thank you very much for your attention

