Air Quality Modelling: Case Studies

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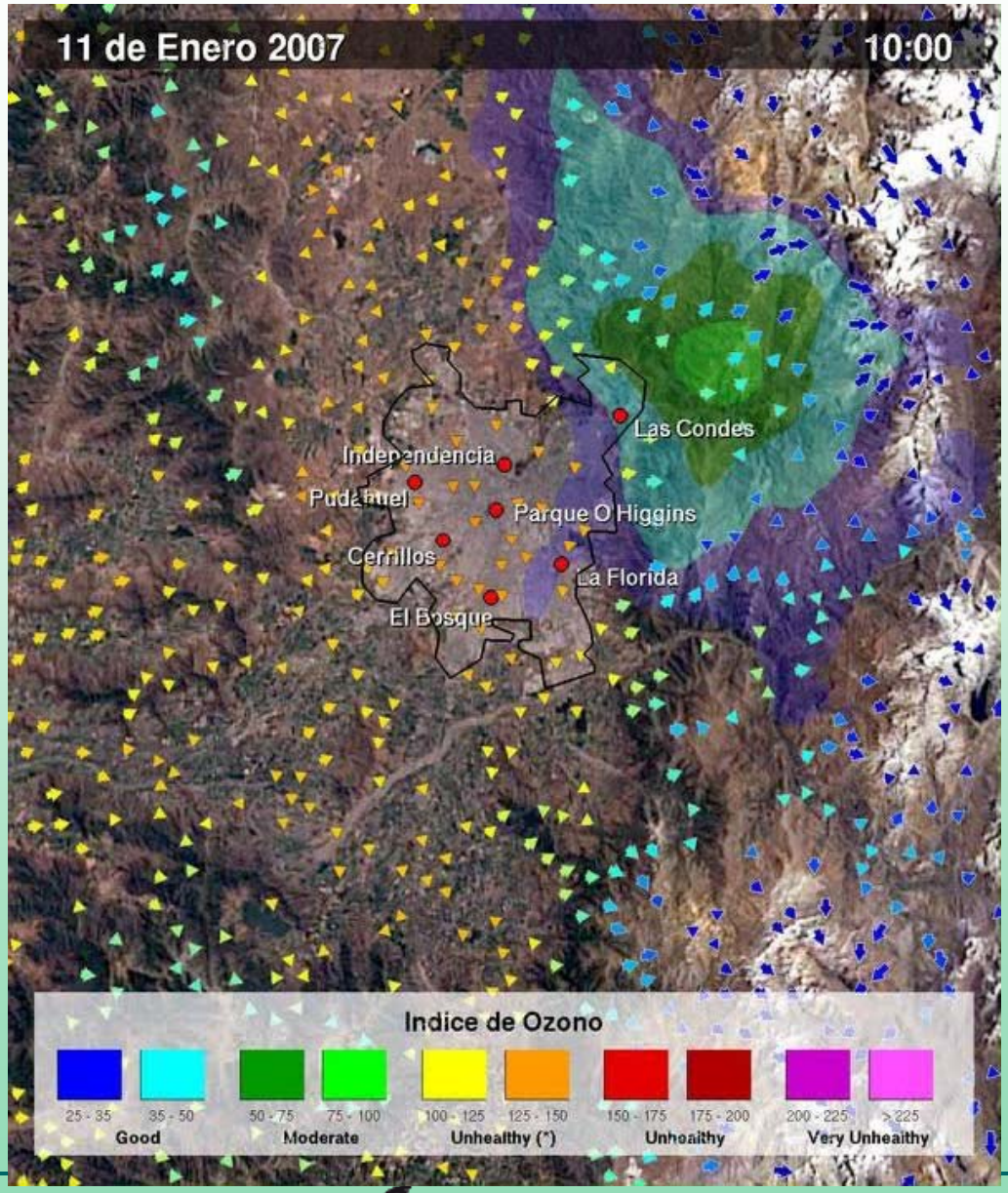
Case studies & Applications

- Simulation of Episodes, Validation, Comparison, Strategies and Scenarios
  (→ Mexico City, Santiago de Chile, Beijing, Munich, Augsburg, Berlin)
- Long Time Simulations
  (→ alpine region)
- Operational Forecast of O_3 und PM_{10}
  (→ Southern Germany, Bavaria, Southern Austria)
- Climate-Chemistry Simulations
  (→ Southern Germany, Mexico)

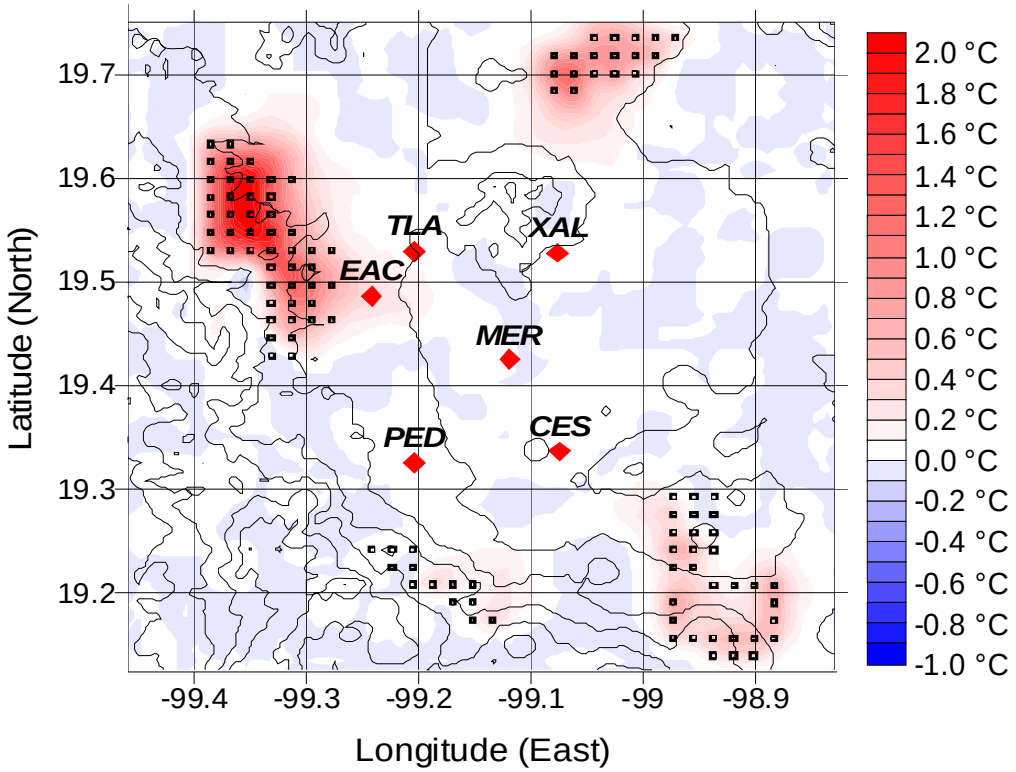
Ozone exposure

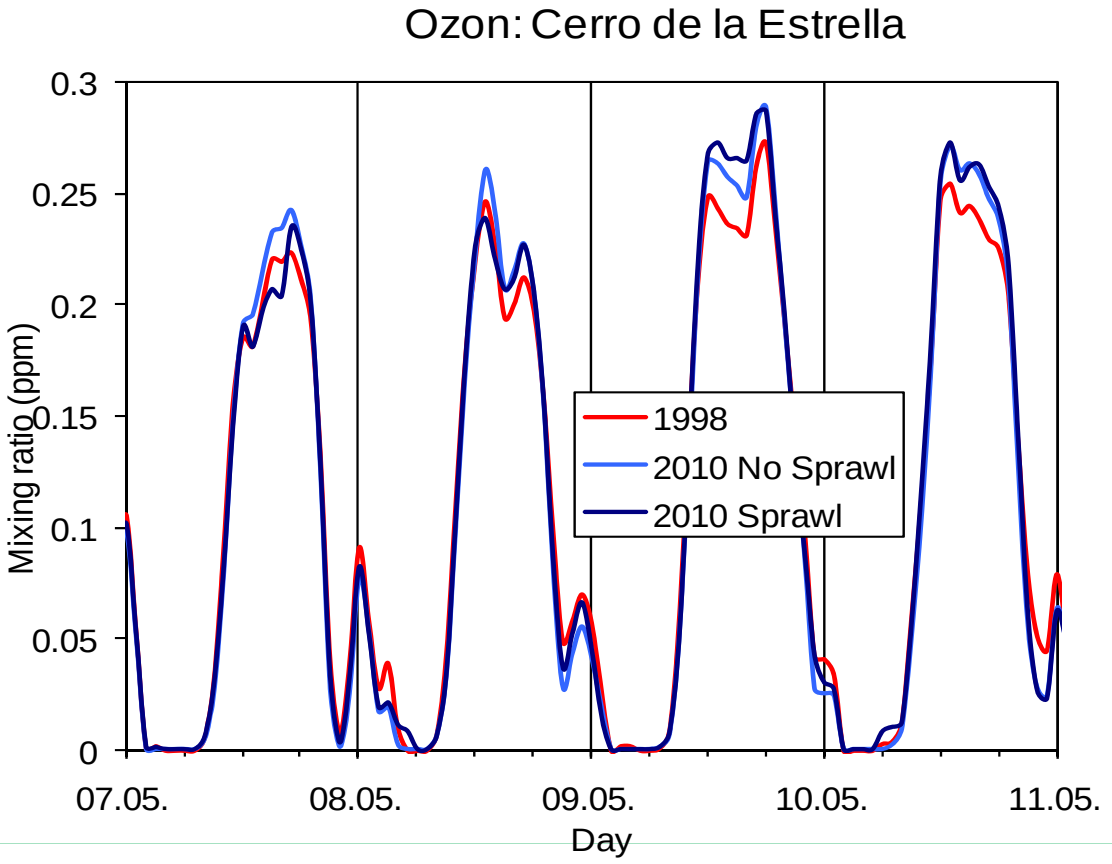
Santiago de Chile



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

Land use change





Mexico City

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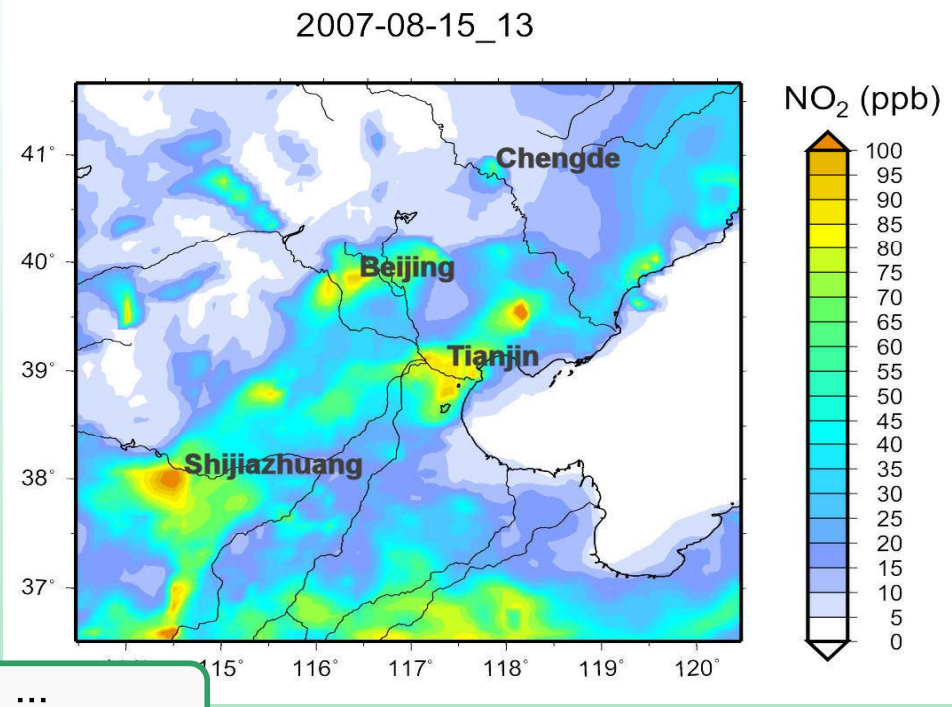
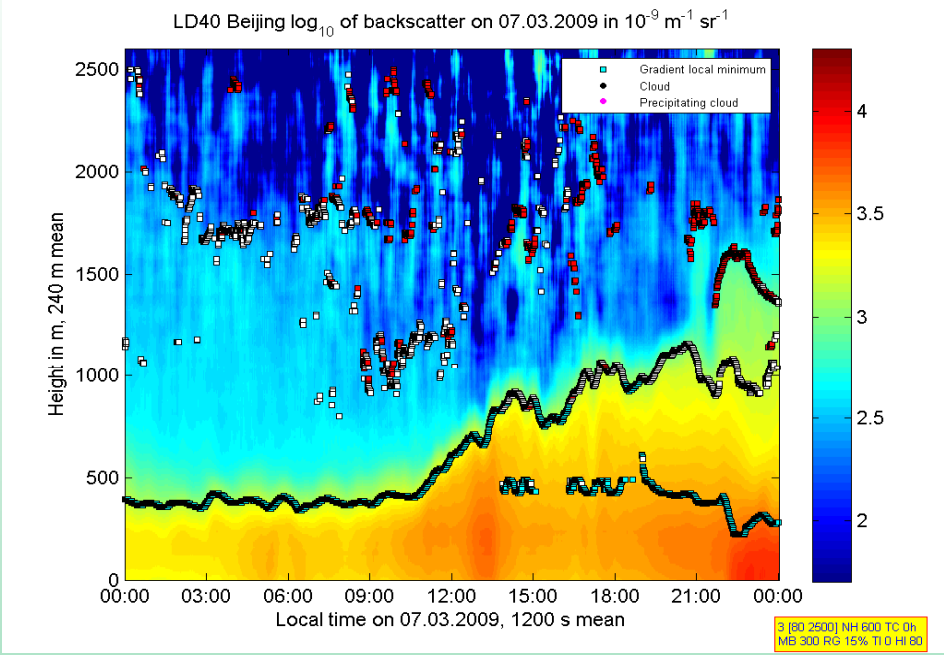
Integrated measurements and air quality simulations in Beijing



Beijing



Air quality modeling for the greater area of Beijing / Tianjin (in cooperation with CAS-IAP)

Measurements of the mixing layer height (IMK-IFU, CAS-IAP, Vaisala,) in Beijing

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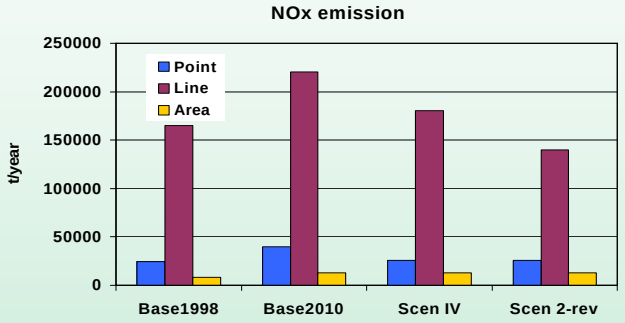
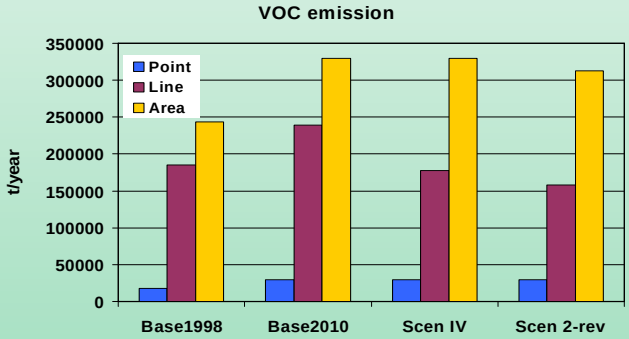
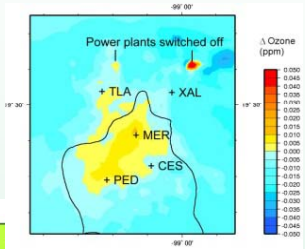
Adaptation Strategies

e.g. Mexico City

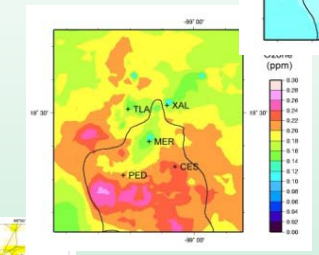




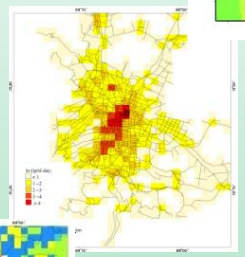
Basic information on present emissions and emissions of reduction measures

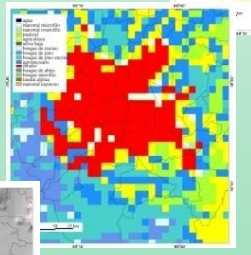


O_3-difference in 2010

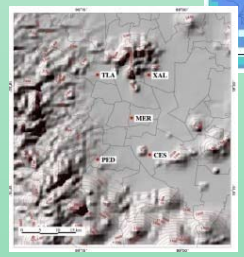


O_3-concentrations in 2010





NOx Emissions



Land use

Topography

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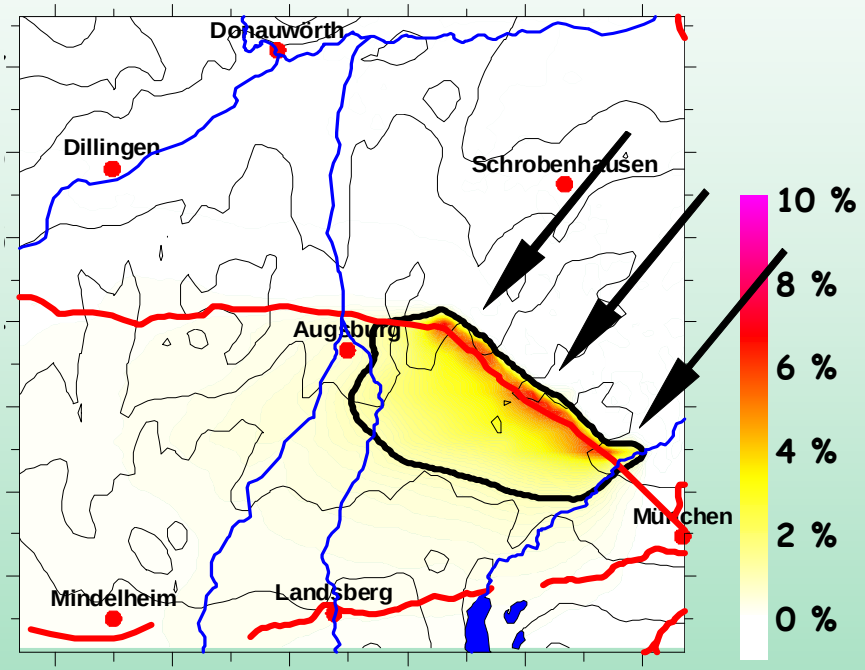
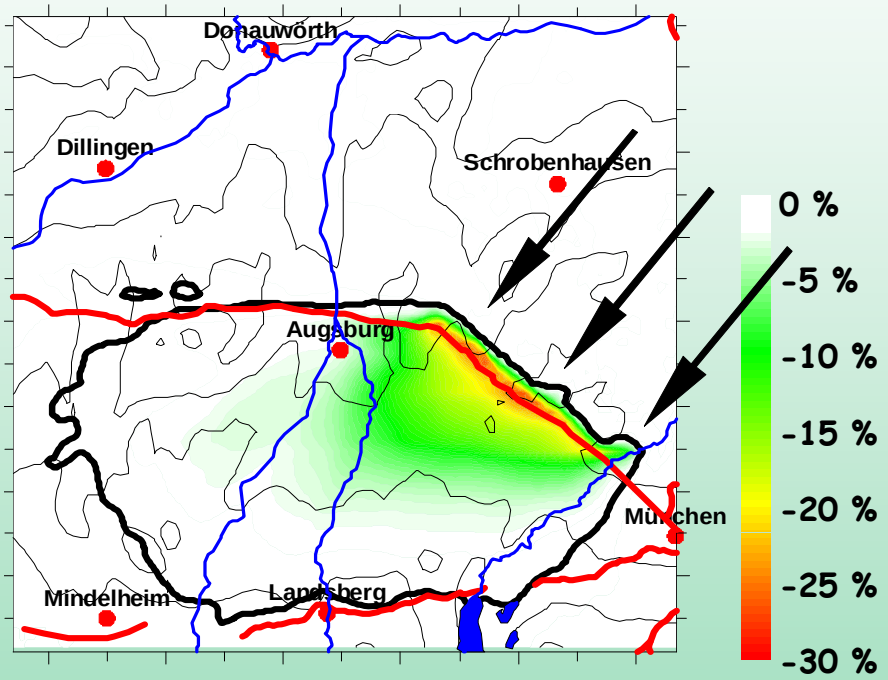
Emission Strategies



O_3 change



NO_2 change

Setup: 27-9-3-1 km grid
4 days period
Southern Germany

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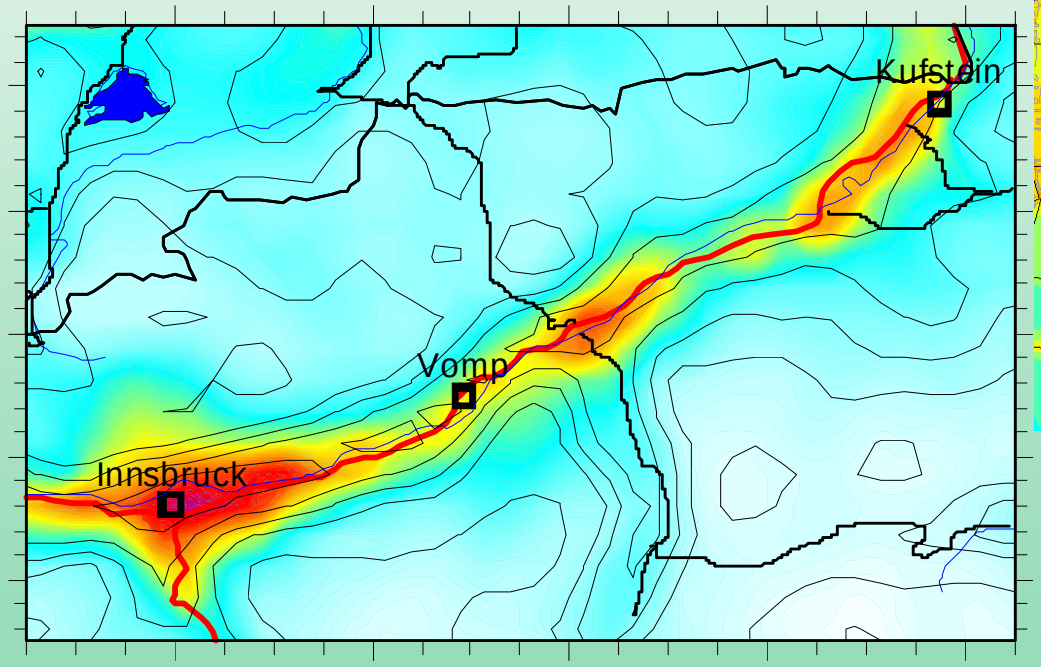
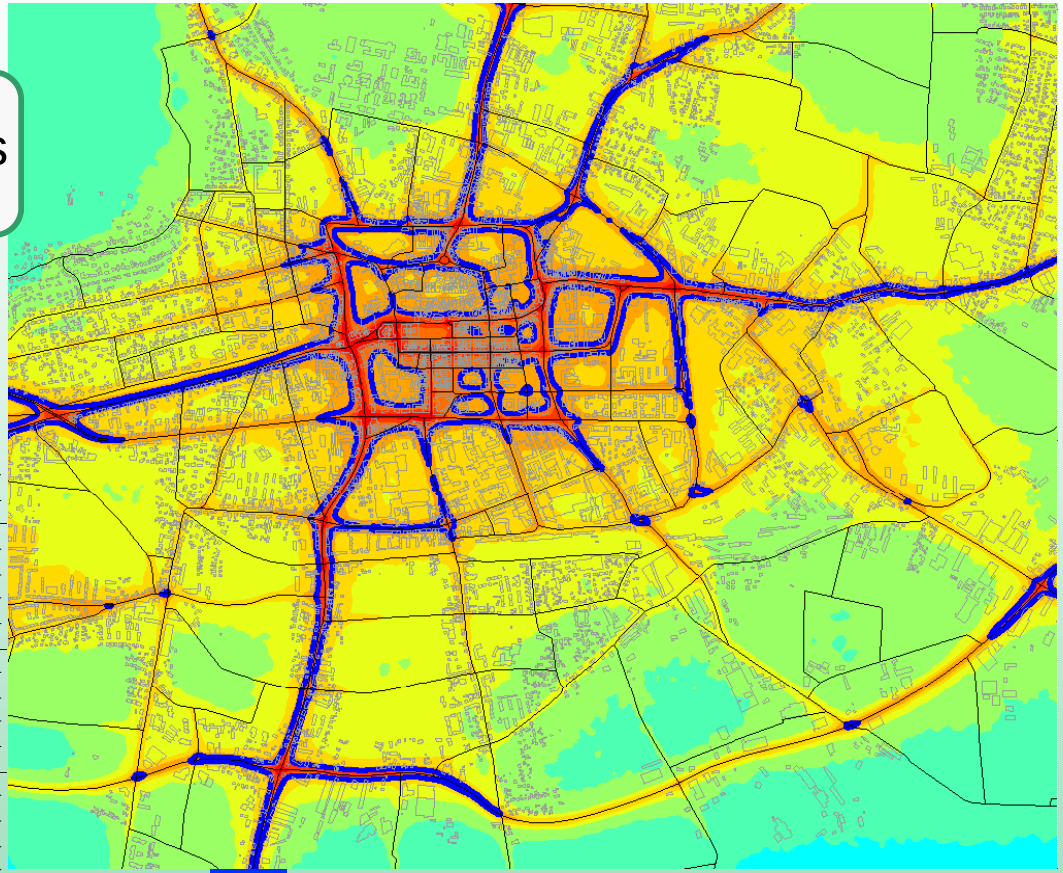
Crossover of scales

Threshold exceedances

Simulations on the meso scale e.g. NO_2 with MCCM





Source: EU-LIFE Project
Klagenfurt Graz Bozen

KAPA GS

Simulations on the micro scale e.g. NO_2 with GRAL

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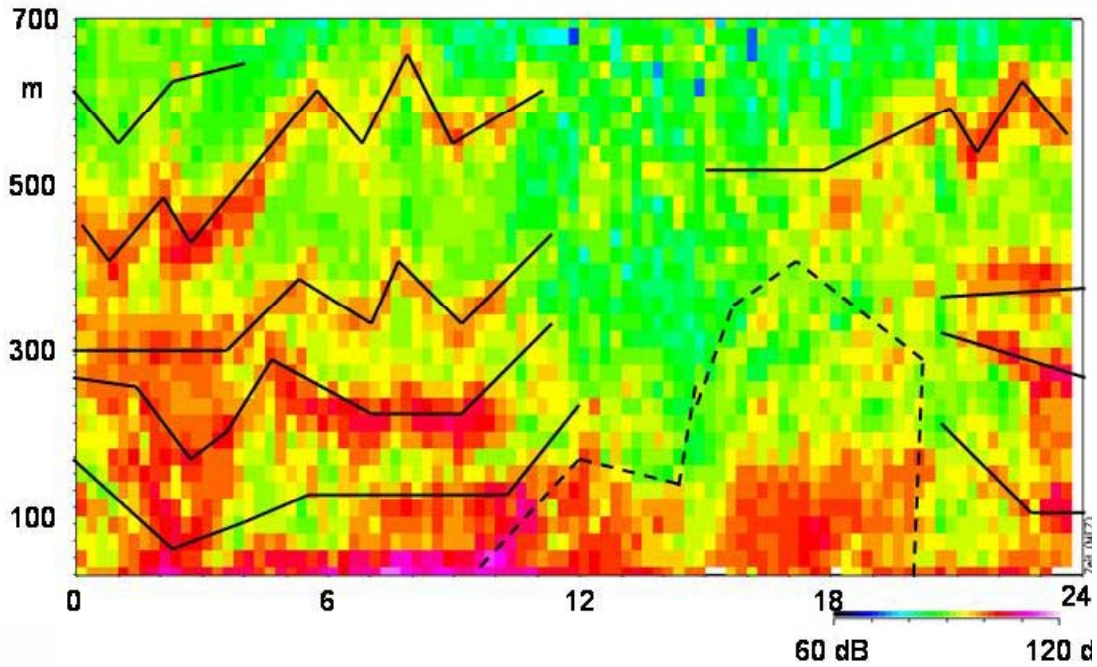
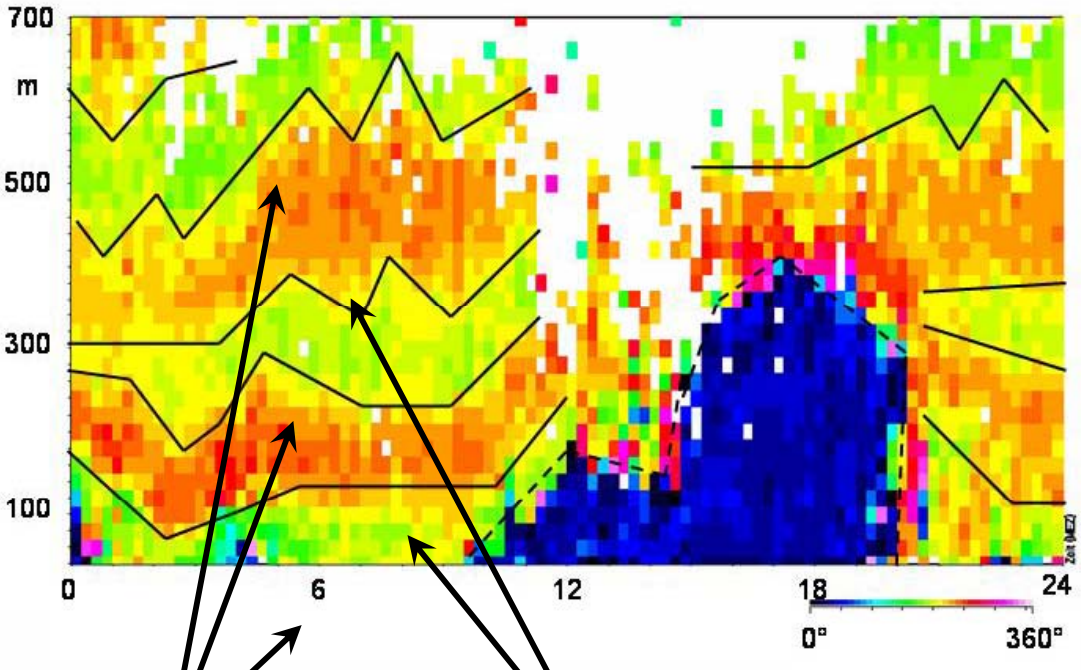
Crossover of scales - vertical

Back scatter intensity



Wind direction

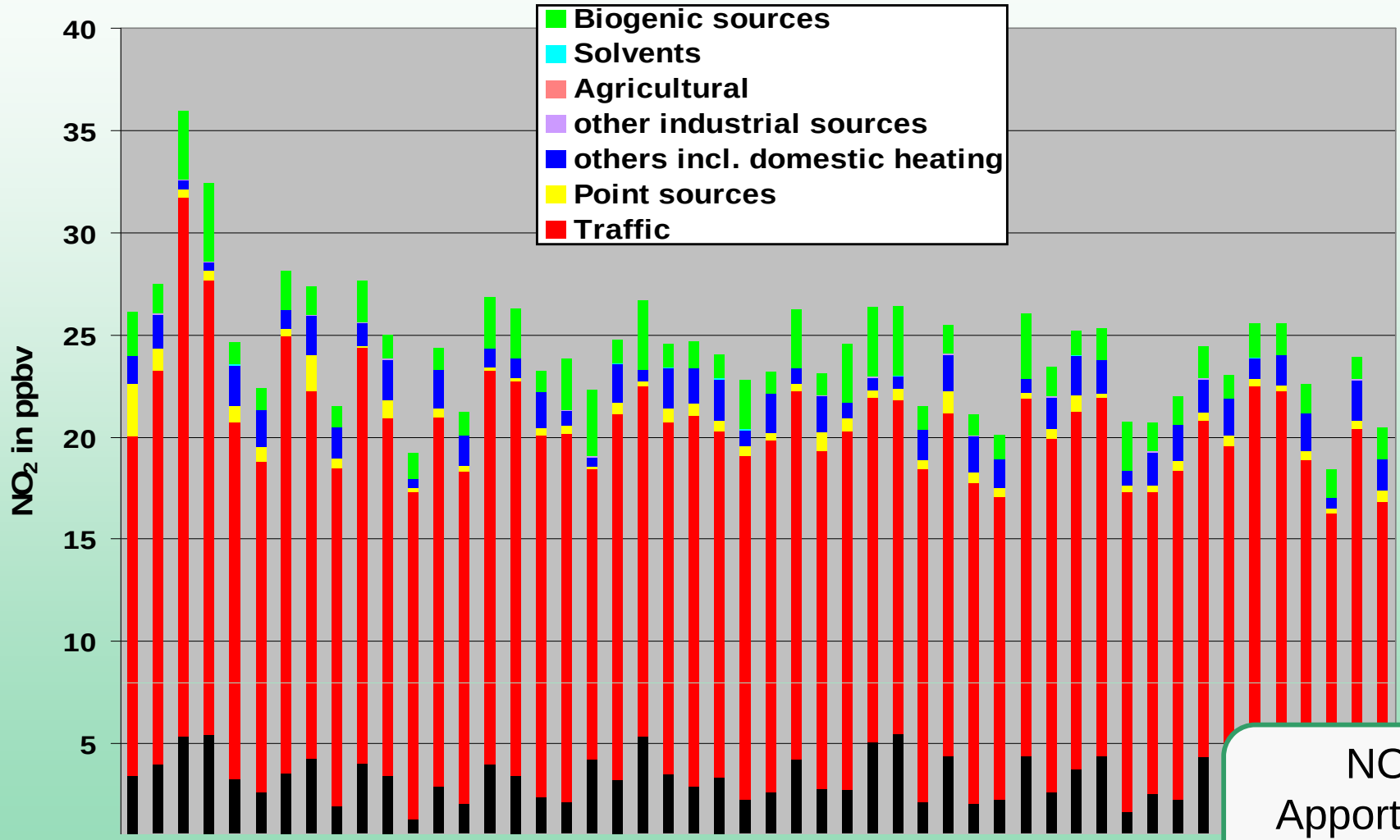


SODAR Measurements in an Alpine valley (Winter time)

°

230°

Source Apportioment



NO_2-Source Apportioment in the greater Area of Munich

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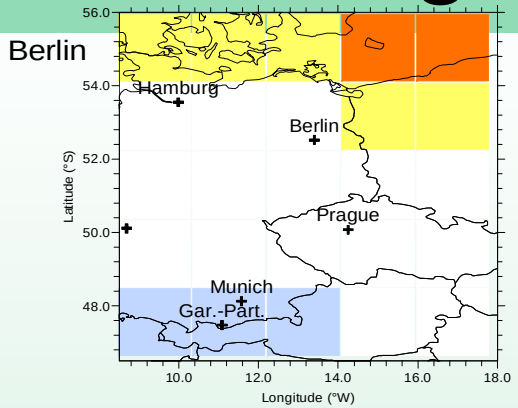
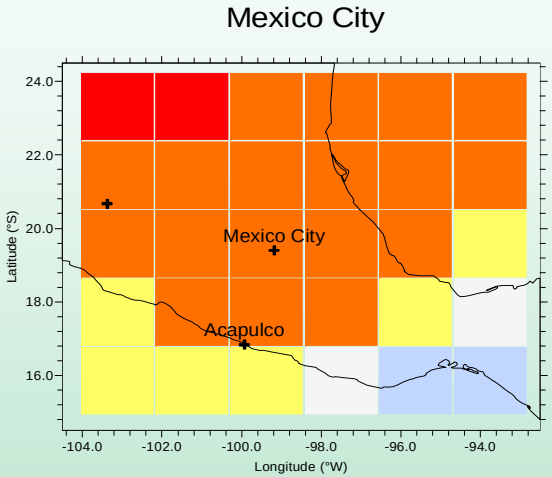
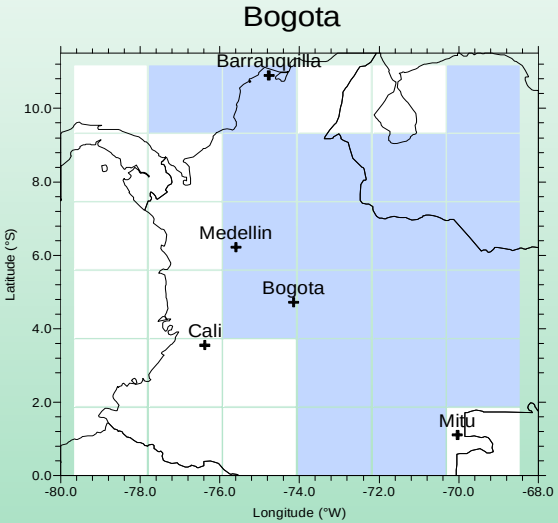
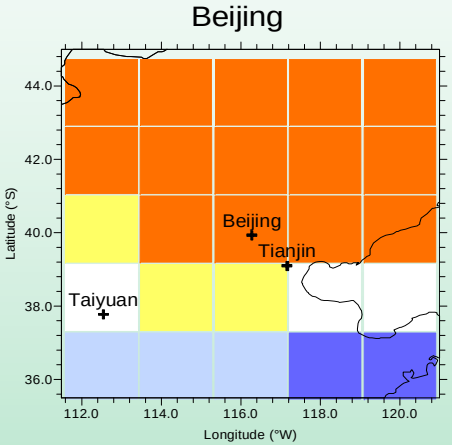
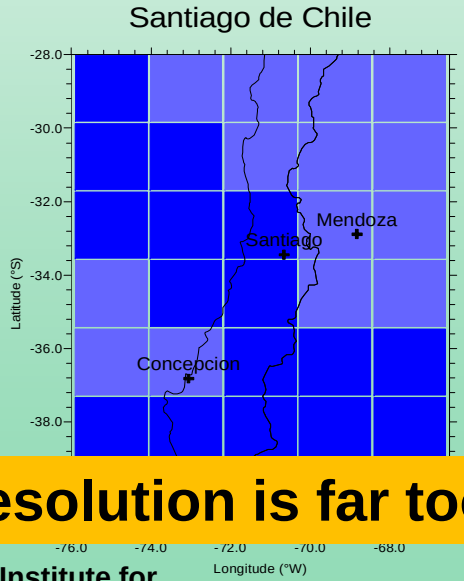
Climate Change











ECHAM5 - A1B scenario
Future (2071-2100) - Present (2001-2030)

Temperature Change in °C

- 4.0 to 4.5
- 3.5 to 4.0
- 3.0 to 3.5
- 2.5 to 3.0
- 2.0 to 2.5

Global climate change indicators for urban regions

Resolution is far too coarse for regional assessment studies!

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Summary

- **Air quality modeling is necessary ……**
  - ✓ on the micro- as well as on the meso scale
  - ✓ will give information on all 3-dimensions
  - ✓ validation tool also for emission inventory
  - ✓ is an important tool for assessment studies (e.g. emission strategies and adaptation scenarios)
  - ✓ gives important feedbacks on the regional as well as on the urban region (rural/urban interaction)
  - ✓ is a basic prerequisite for the assessment of health impact studies

Remarks and Outlook

- Models / Modeling tools are only a part of a integrative description/assessment of the air quality
- Measurements are the second leg of the description/assessment of the air quality
- Simulation results are only good as their input
- Diversity of models against community models

Future topics:

- Closer link between measurements and simulations
- Coupled regional climate-chemistry-simulations
- Coupling with models from the bio- and hydrosphere as well as with epidemiological models

Thank your very much for your attention

Cooperation Partner:

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Rainer Schmitz, Ricardo Muñoz	*Universidad de Chile , Santiago de Chile (UdC)*
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Annette Peters, Josef Cyrys	*Helmholtz Zentrum München (HMGU)*