CityZen – Bridging the scales with focus on megacities

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Michael Gauss, met.no

and the CityZen team

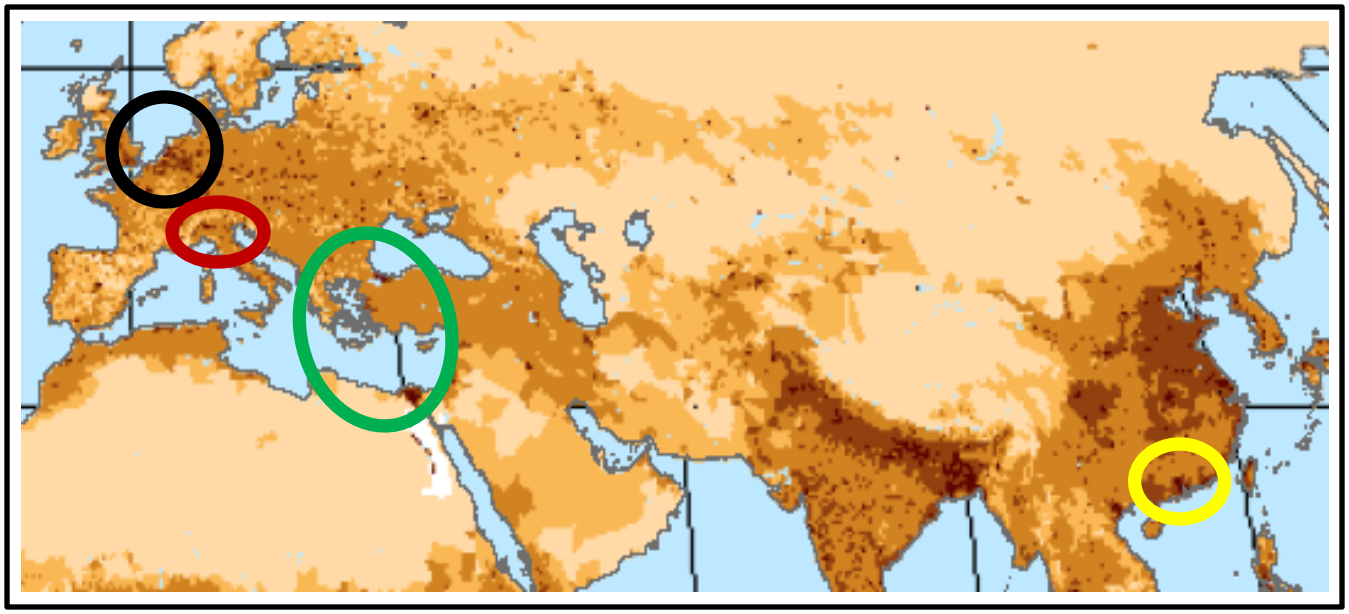
Geneva, 26 February 2010

Outline

- The CityZen project
- Progress during the 1st year
- Contribution and first results from FRIUUK

The World: Population Density, 2000

GPW [v3]



Gridded Population of the World

Persons per km^2

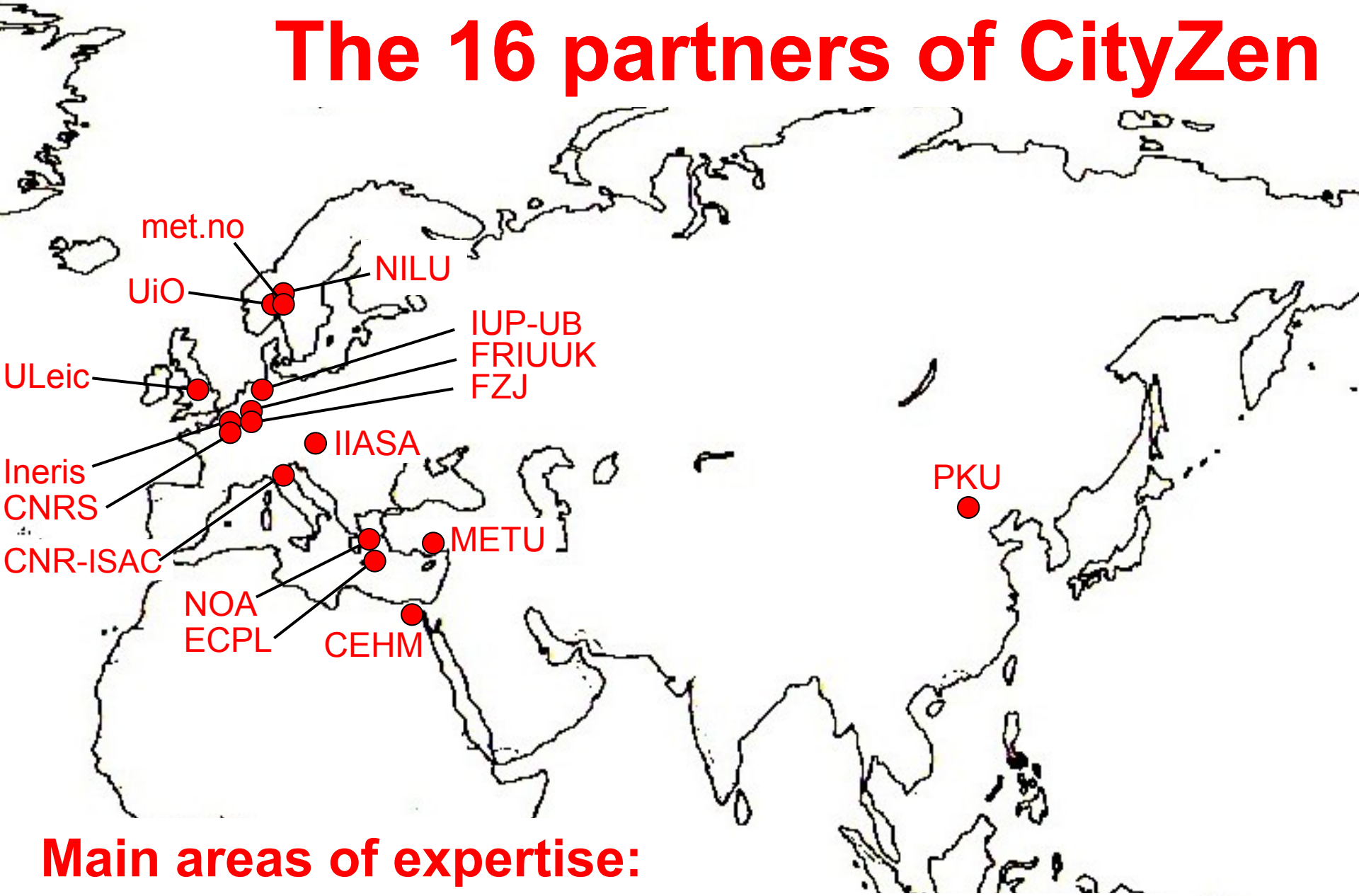
- 0
- 1 - 4
- 5 - 24
- 25 - 249
- 250 - 999
- 1,000 +

SEDAC

CIESIN
Columbia University

Source: Center for International Earth Science Information Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT), Gridded Population of the World (GPW), Version 3. Palisades, NY: CIESIN, Columbia University. Available at: http://sedac.ciesin.columbia.edu/gpw.

The 16 partners of CityZen



Main areas of expertise:

Observations, modelling, emission scenarios

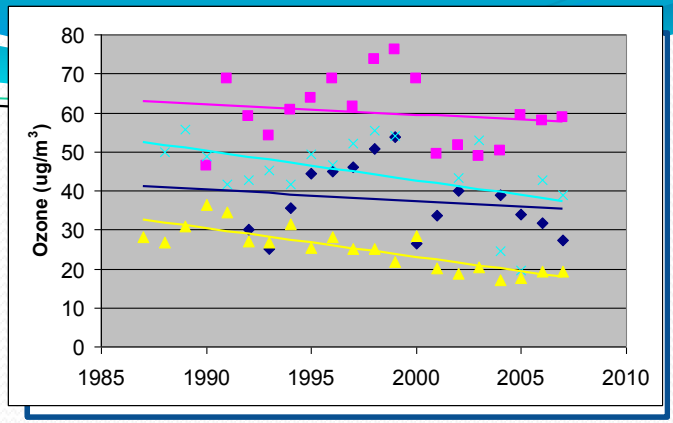
Objectives of CityZen

- Quantify and understand current air pollution in and around selected megacities
- Development of tools to estimate interactions between different spatial scales
- Estimate how megacities influence air quality and climate, locally and globally
- Estimate how megacities are responding to climate change
- Estimate the impact of future emission change, including mitigation options
- Provide technical underpinning of policy work

Progress during the 1st year

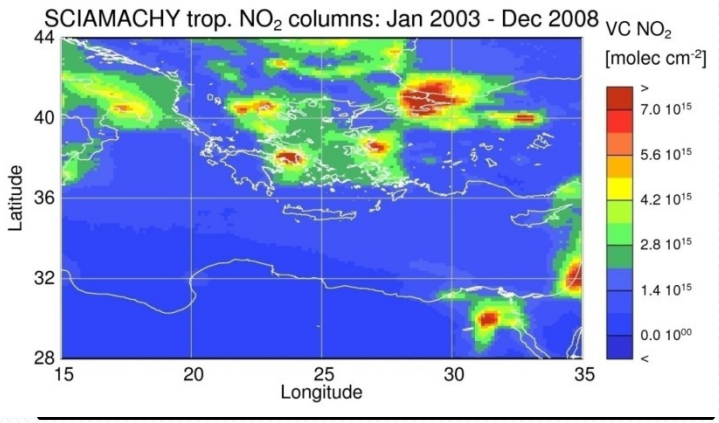
- Observations
- Emission scenarios
- Modeling

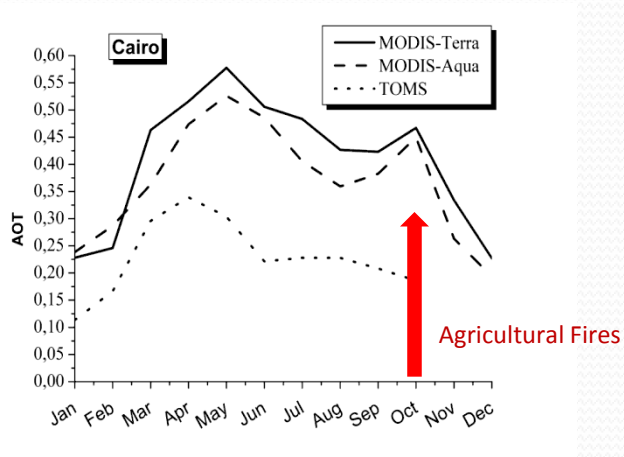
Observations



O_3 at different stations Athens

- Ground-based: new network, and maintenance of existing networks
- Satellites: combining data from different instruments into consistent multi-year data set (GHG now available)
- Detecting trends and megacity signals

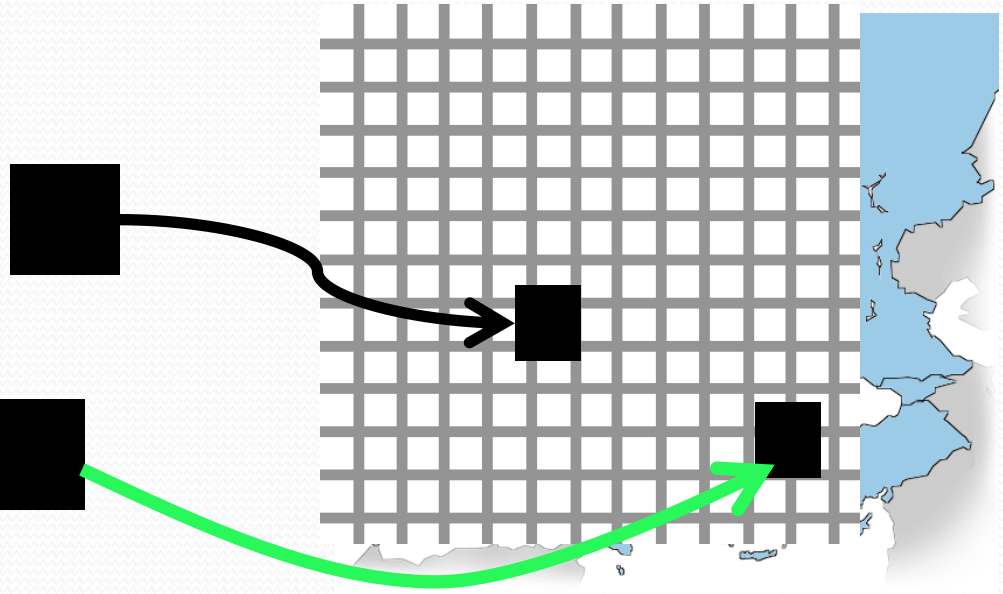




MODIS: anthr.+nat, TOMS: dust(nat.)

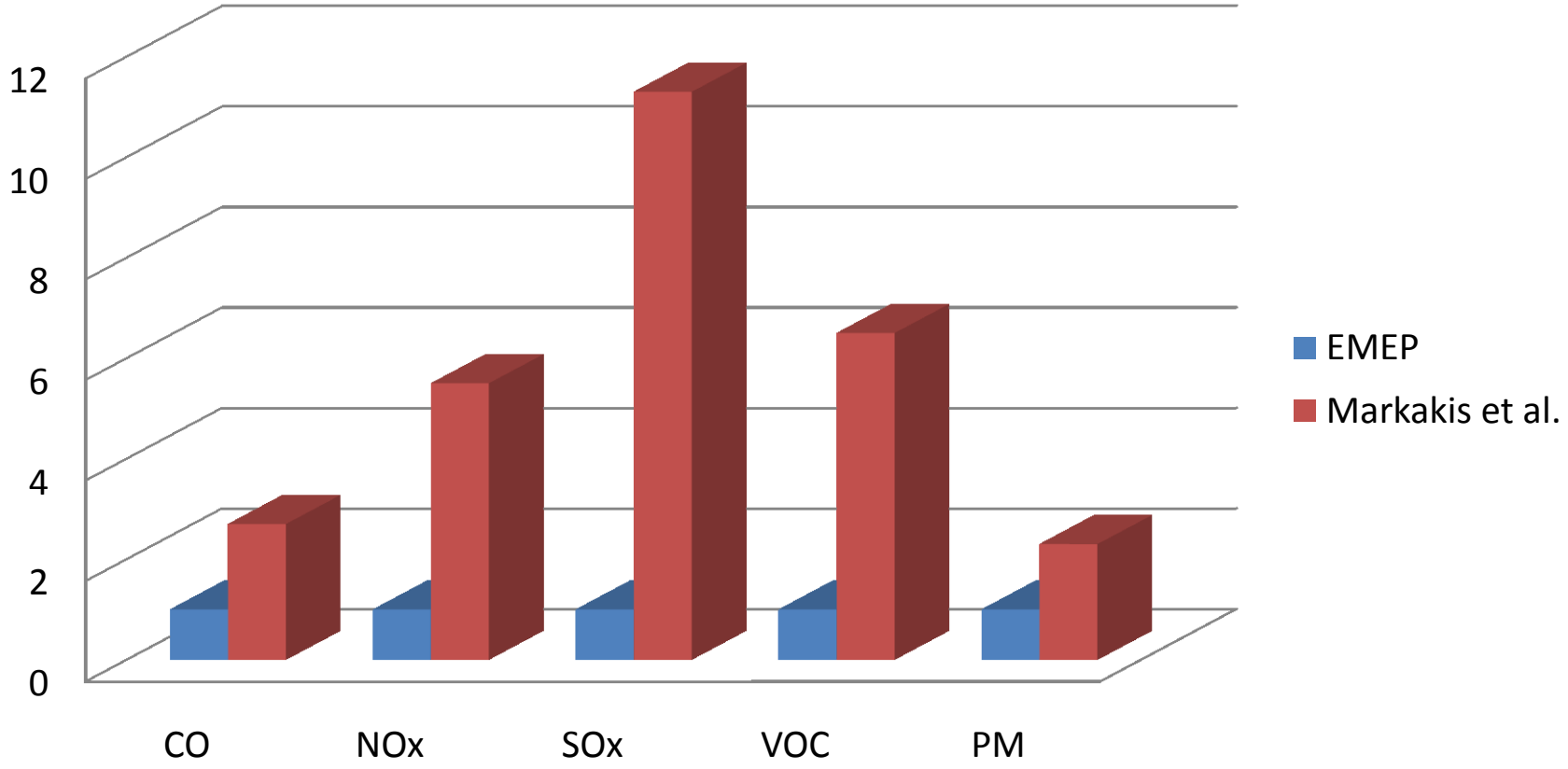
CityZen emission inventories

- 1998-2007 **Europe**: EMEP (50×50 km^2) spatially regridded to 10×10 km^2 using GLOBCOVER data: INERIS (→ "INERIS-EMEP")
- Fine-scale data sets:
  - LANUV (Rhine/Ruhr area)
  - AUTH, Istanbul TU, and Boğaziçi Univ. (Istanbul)



- 1998-2007 **global**: based on the RCP scenarios produced for IPCC-AR5 (0.5°×0.5°) and 'INERIS-EMEP': CNRS
- Not ready yet: 2030/2050 scenarios from IIASA based on RCP scenarios but different assumptions in terms of AQ measures

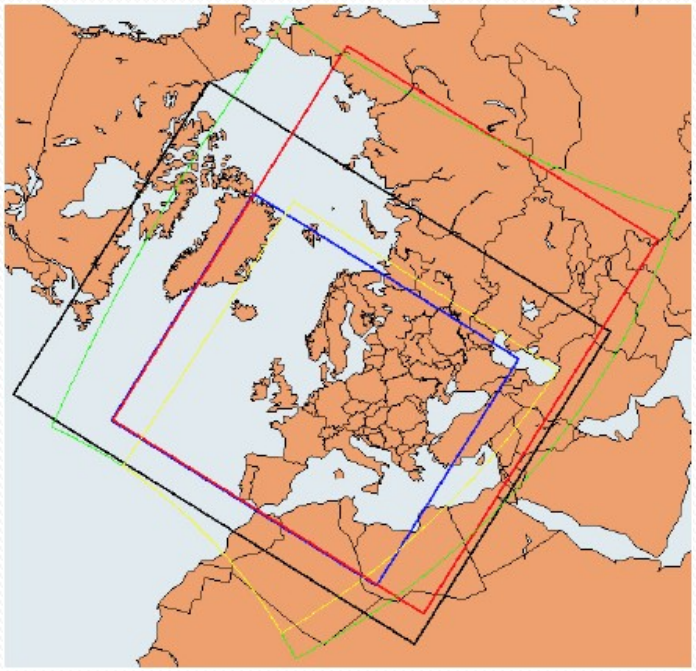
Emissions in Istanbul (EMEP emissions = 1)



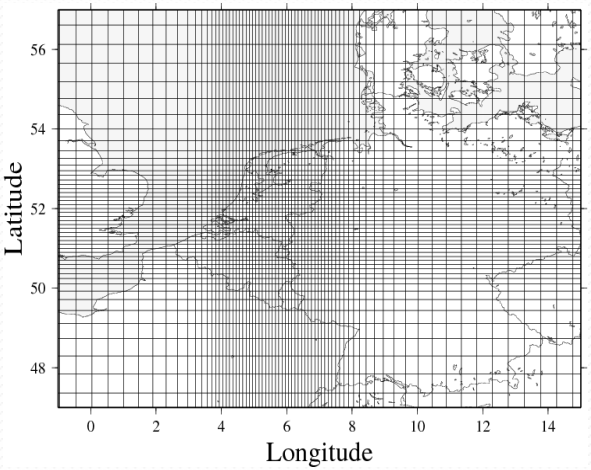
Based on data from **Markakis, K., U. İm, A. Unal, D. Melas, O. Yenigün, S. İncecik: Compilation of a GIS based high spatially and temporally resolved emission inventory for the Greater Istanbul area**, Science of the Total Environment, 2009, submitted.

Modeling

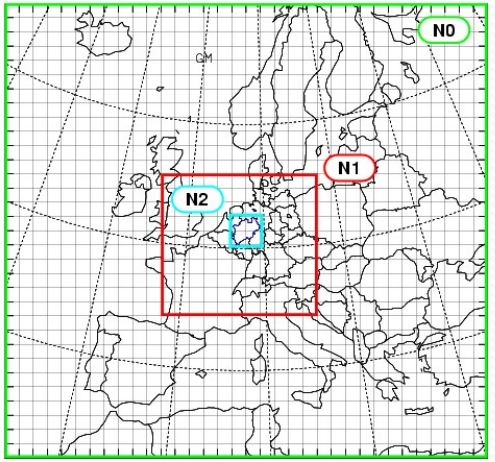
- Nesting approach (FRIUUK)
- Zooming approach (INERIS)
- Nudging (CNR-ISAC)
- Improvement of model resolution with different domains (EMEP)
- Ongoing trend study (all)



- CNR-ISAC have done nudging experiments: Low resolution (European scale) model is nudged towards high resolution output from a smaller domain model within Po Valley



- INERIS have done zooming experiments by gradually increasing grid resolution towards selected hot spot region (BeNeLux)
- FRIUUK have done nesting experiments with 3 different model resolutions (Rhine/Ruhr)



- 10-year trend study led by INERIS with focus on all four selected hot spots, to be presented at EGU

External collaboration

- CityZen – MEGAPOLI
  - IGAC Assessment on the Impacts of Megacities on Air Quality and Climate (many partners from both projects involved)
  - MILAGRO – MEGAPOLI – CityZen
    - Joint megacity session at EGU general assembly in Vienna in May 2010. Welcome!
- Considered:
  - COST ES0602 – MEGAPOLI – CityZen
    - Modeling Paris (measurement campaign)
  - MACC / EuroDelta / … – CityZen
    - Emission scenarios (TNO)

Summary

- Good progress on observational data
- Emission data created for the last decade downscaled from EMEP
- Modeling studies underway
- Mid-term report (Sep 2008 – Feb 2010) being written in February and March 2010
- Please visit http://www.cityzen-project.eu or https://wiki.met.no/cityzen/start

Contribution and first results from FRIUUK, Rhenish Institute for Environmental Research, University of Cologne, Germany

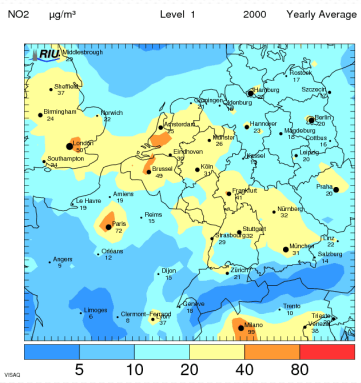
INTRODUCTION, MOTIVATION

- **Development of air quality in Megacities regions in the 2000 – 2009**
- **How important are variations from year to year ?**
- **Focus on BeNeLux NRW-Rhine-Ruhr (as a mega-city like area)**
- **Calculations of horizontal fluxes**
- **Using The EURAD Modeling System**

EURAD Model setup for CityZen

- **4 domains: Europe -> Ruhr area (125 – 1 km gridsize)**
- **All year calculations on all domains for 2000 – 2009**
- **Calculation of annual means, number of exceedances**
- **Horizontal flux calculations**

NO2, Annual Mean, near surface level



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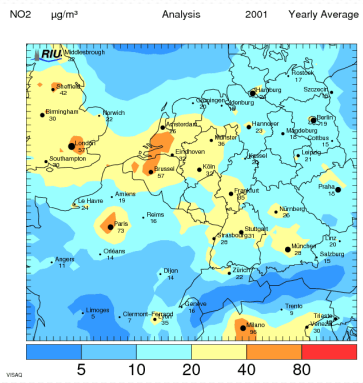

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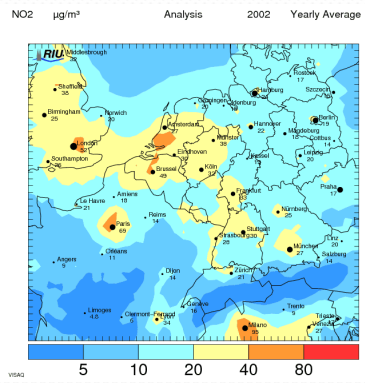

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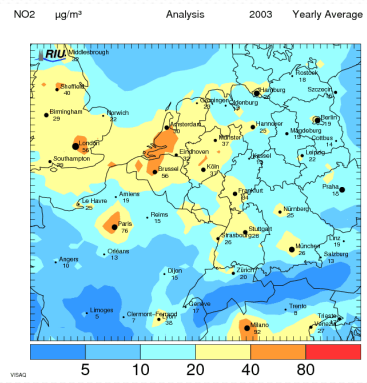

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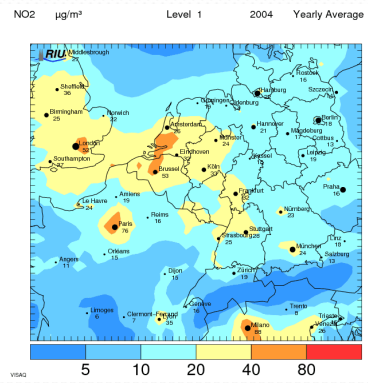

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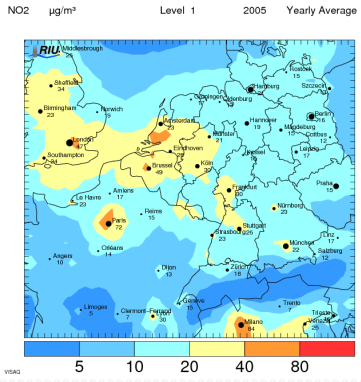

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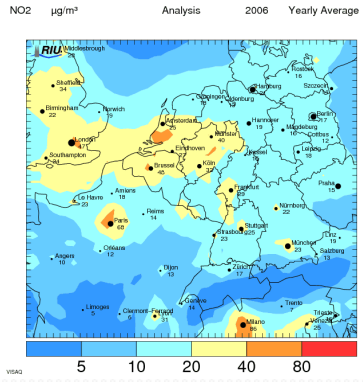

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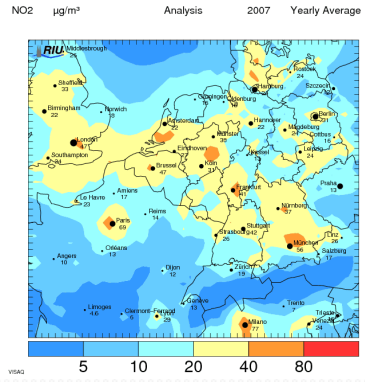

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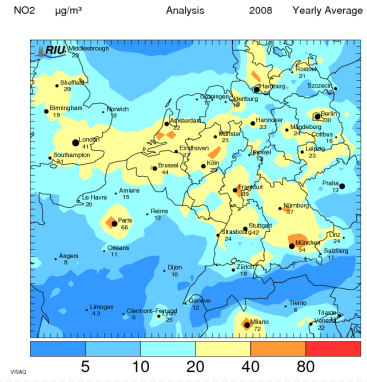

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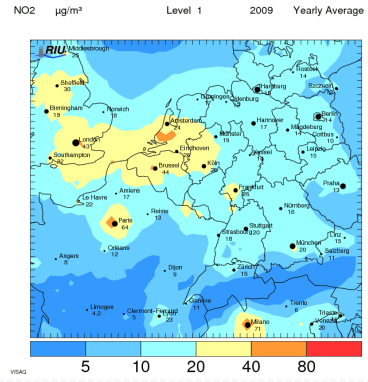
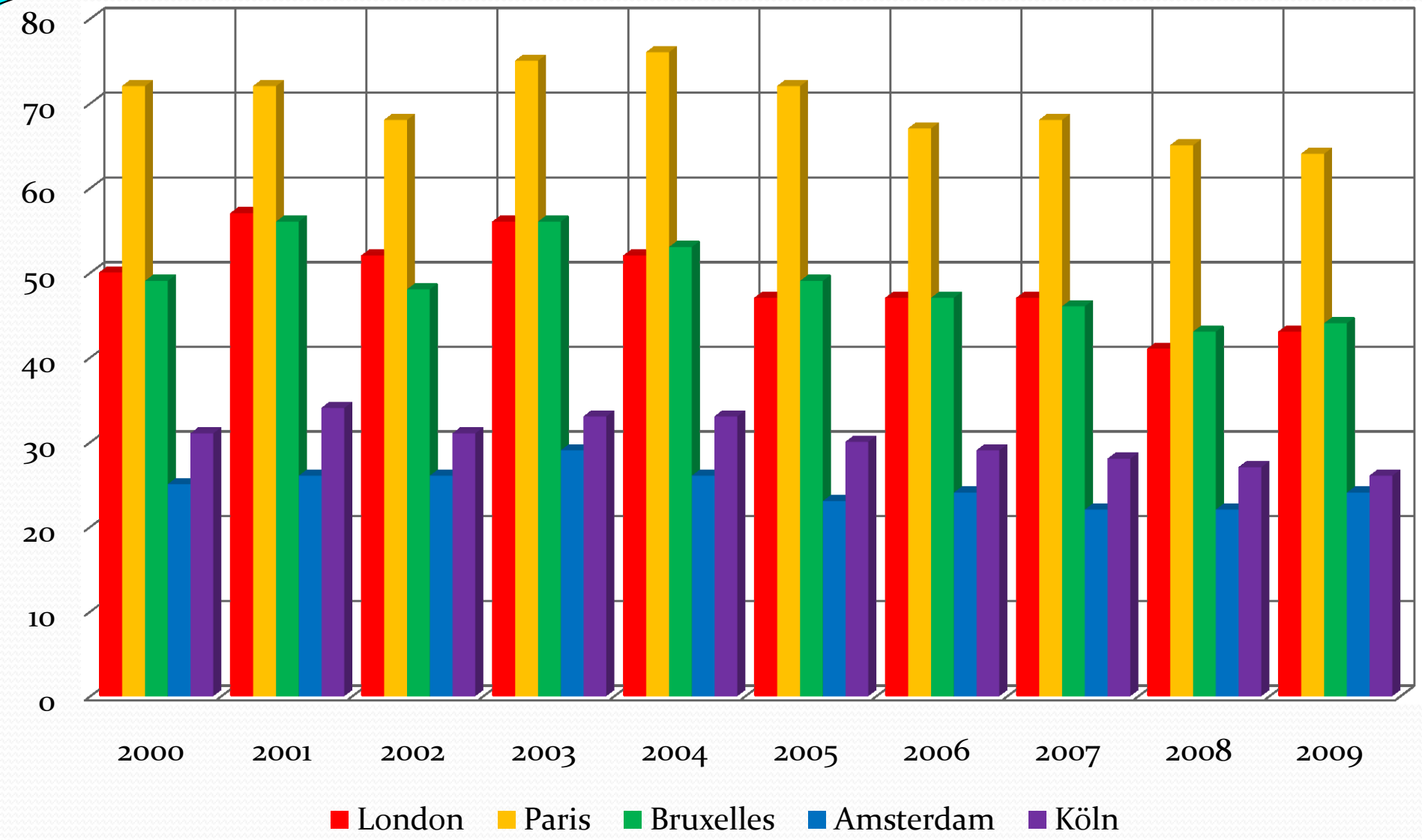
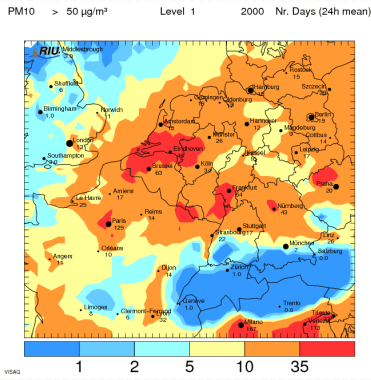


2009

NO_2 Annual Mean



PM10, Nr of days daily mean > 50 µg/m³, near surface level



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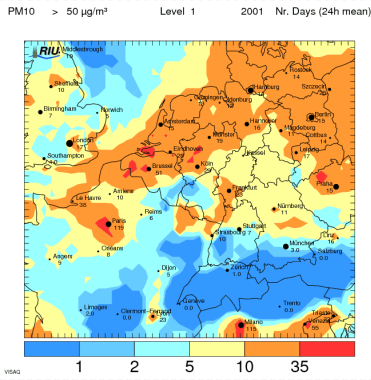

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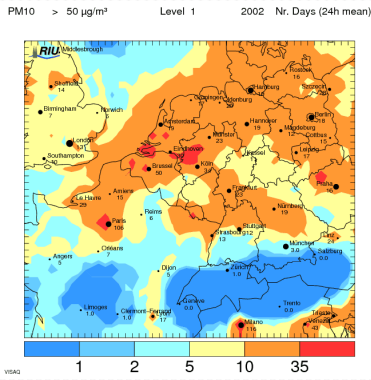

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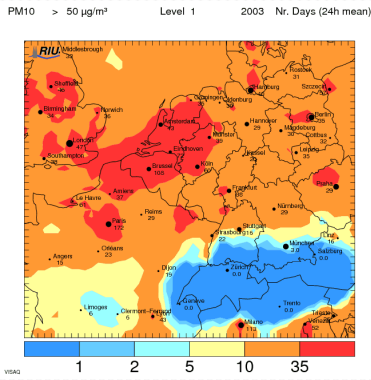

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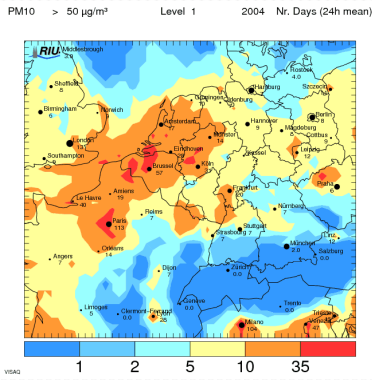

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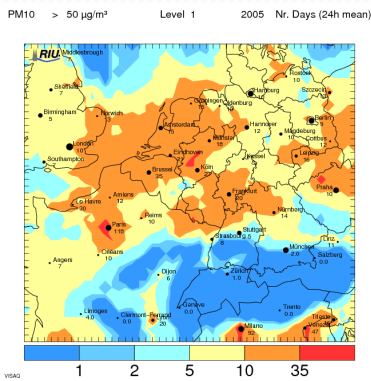

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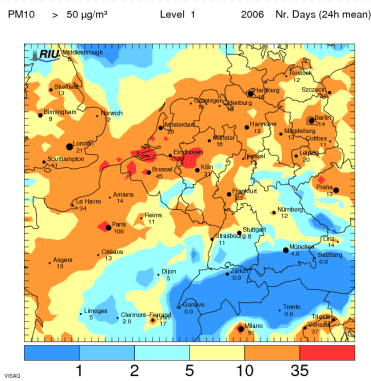

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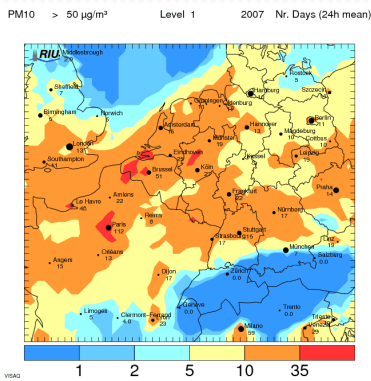
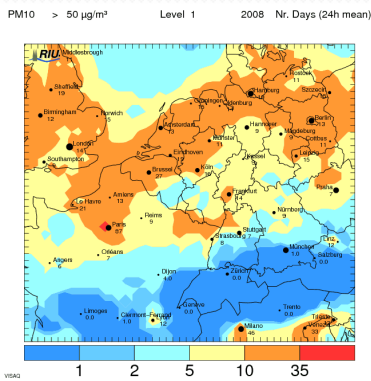


2007



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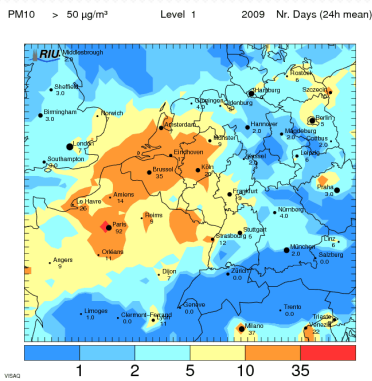

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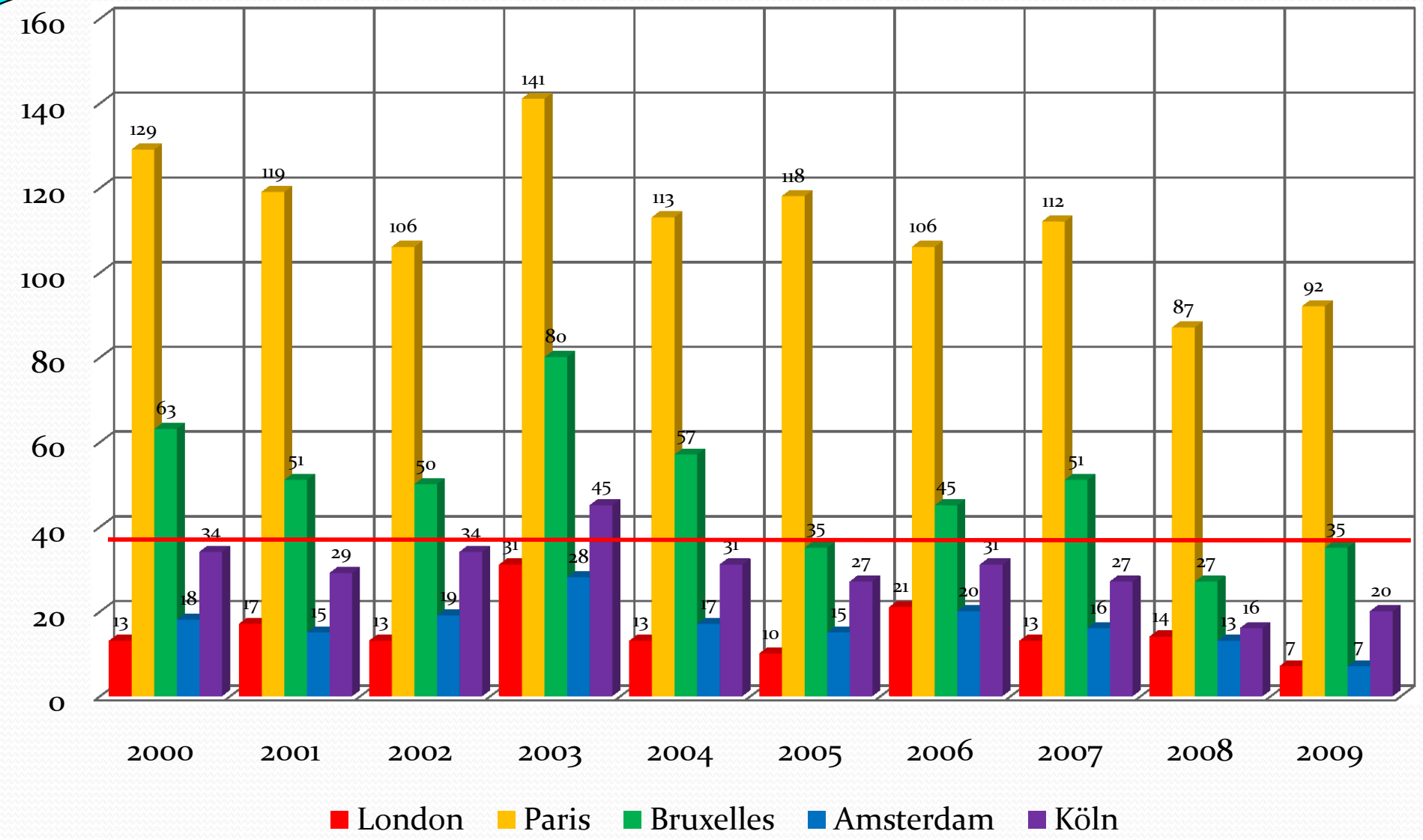
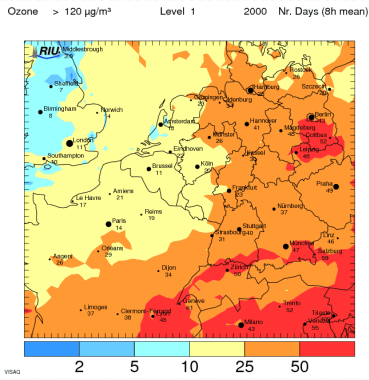
PM10 Nr of Days daily mean > 50 µg/m³



O3, Nr of days 8 hour mean > 120 µg/m³, near surface level



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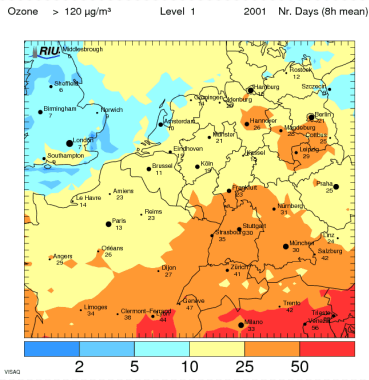

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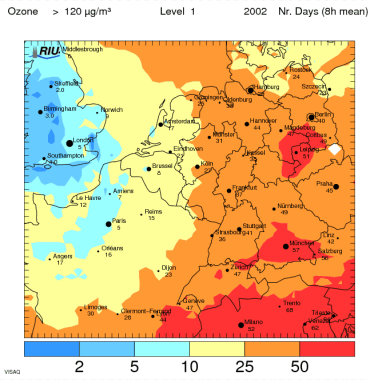

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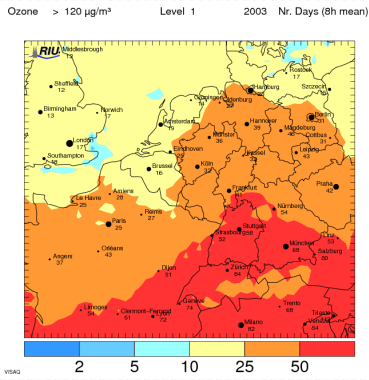

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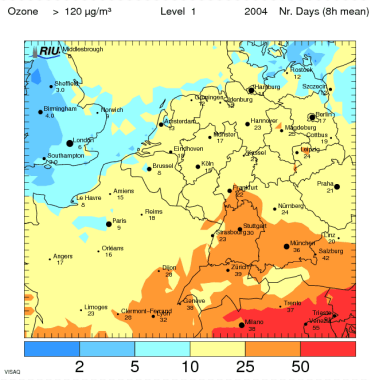

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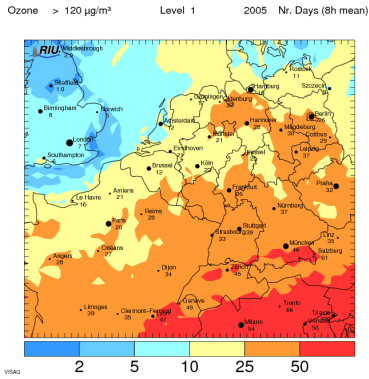

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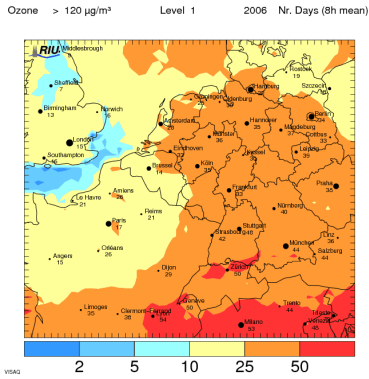

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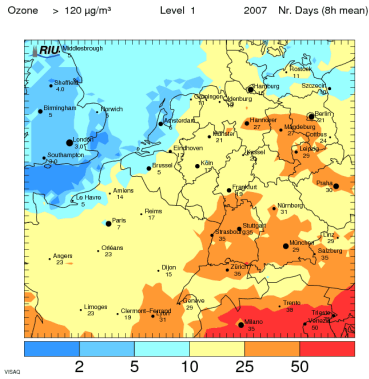
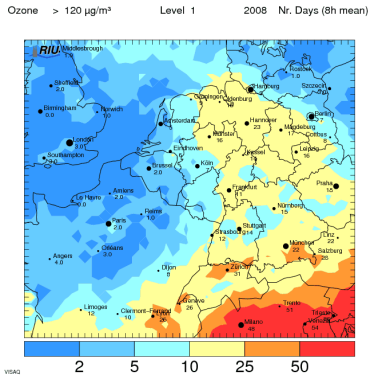
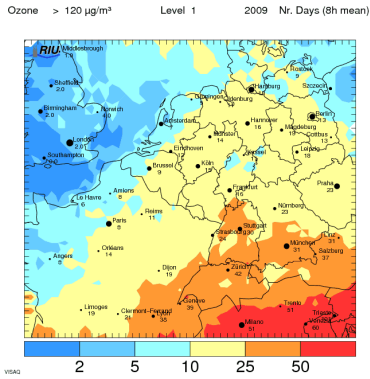


2007

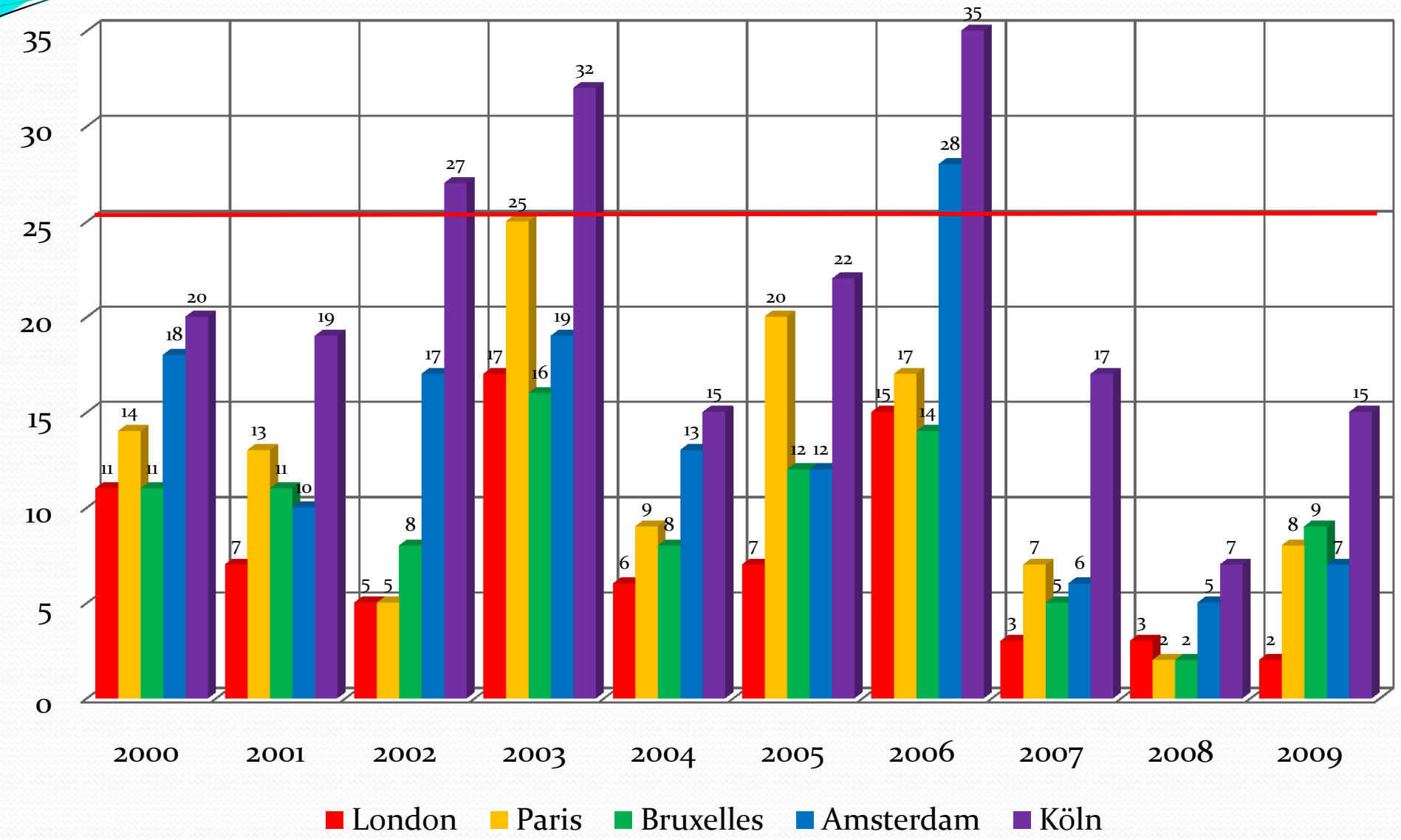


2008



2009

O3 Nr of days 8h mean > 120 µg/m³

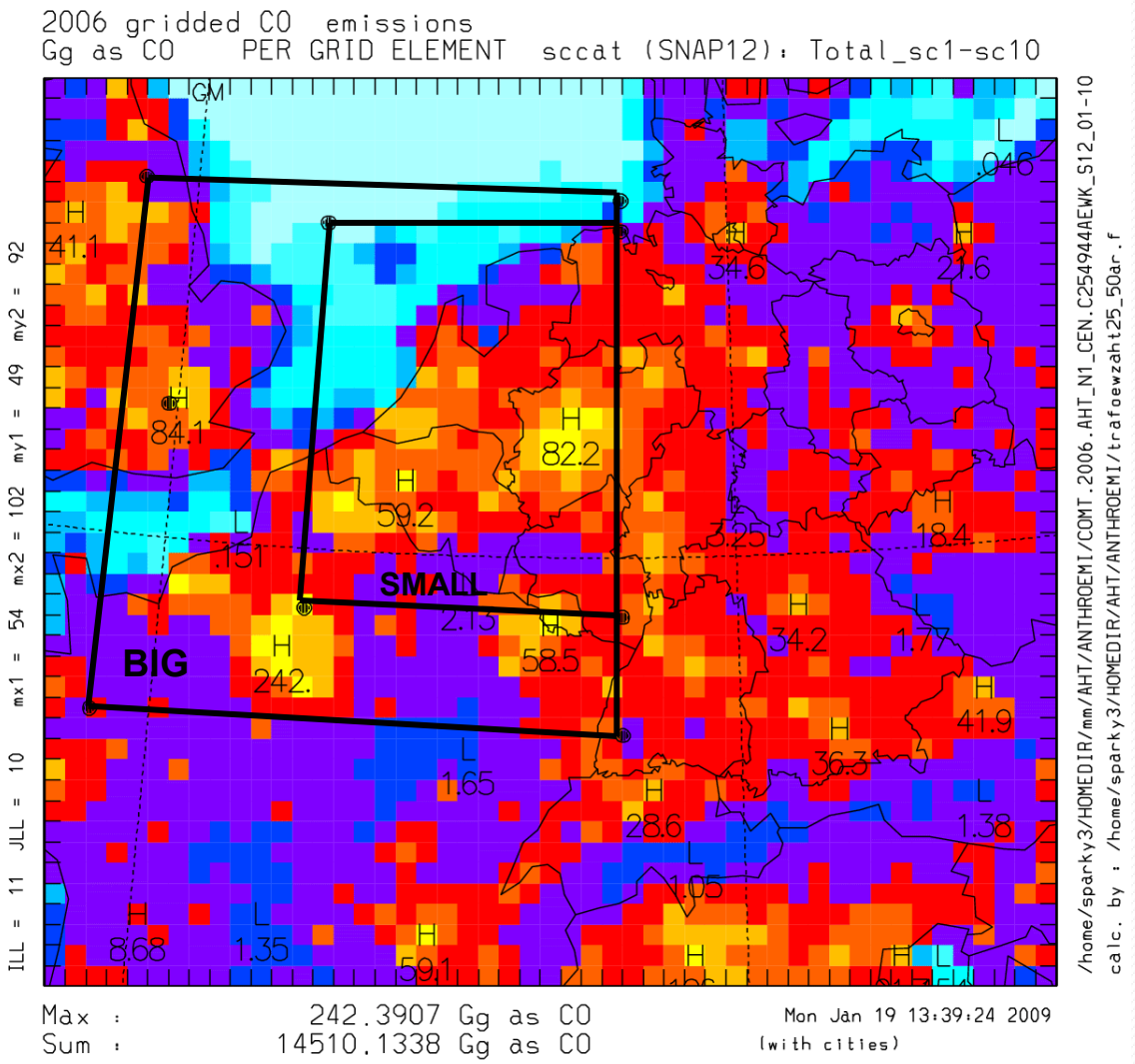


Hot Spot region: BeNeLux/Ruhr

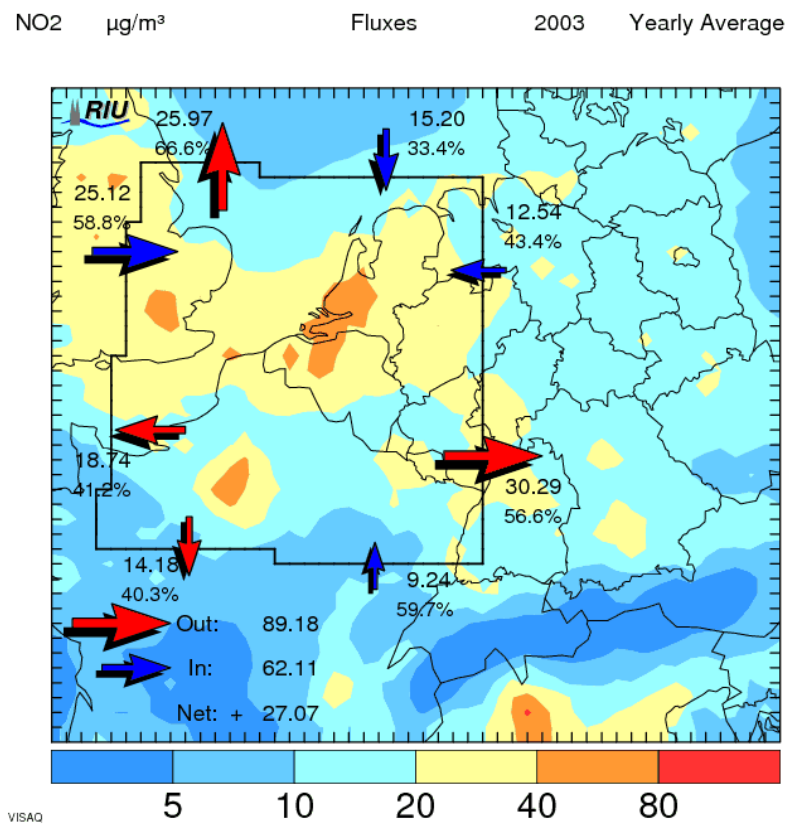
BeNeLux Small

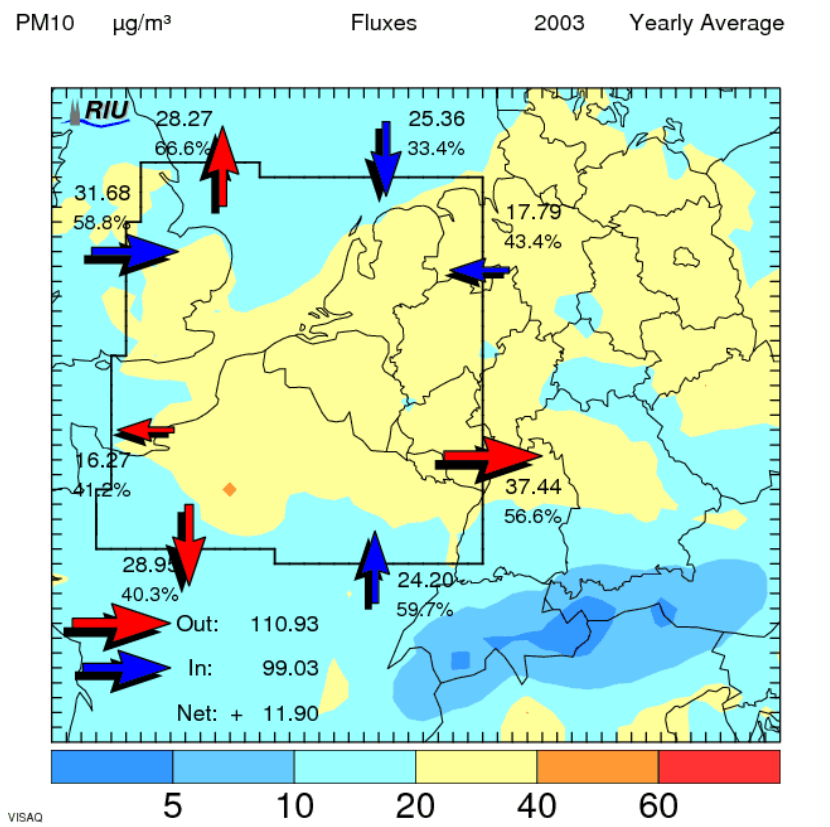
BeNeLux Big

(including London and Paris)



Horizontal fluxes, BeNeLux Big, 2003



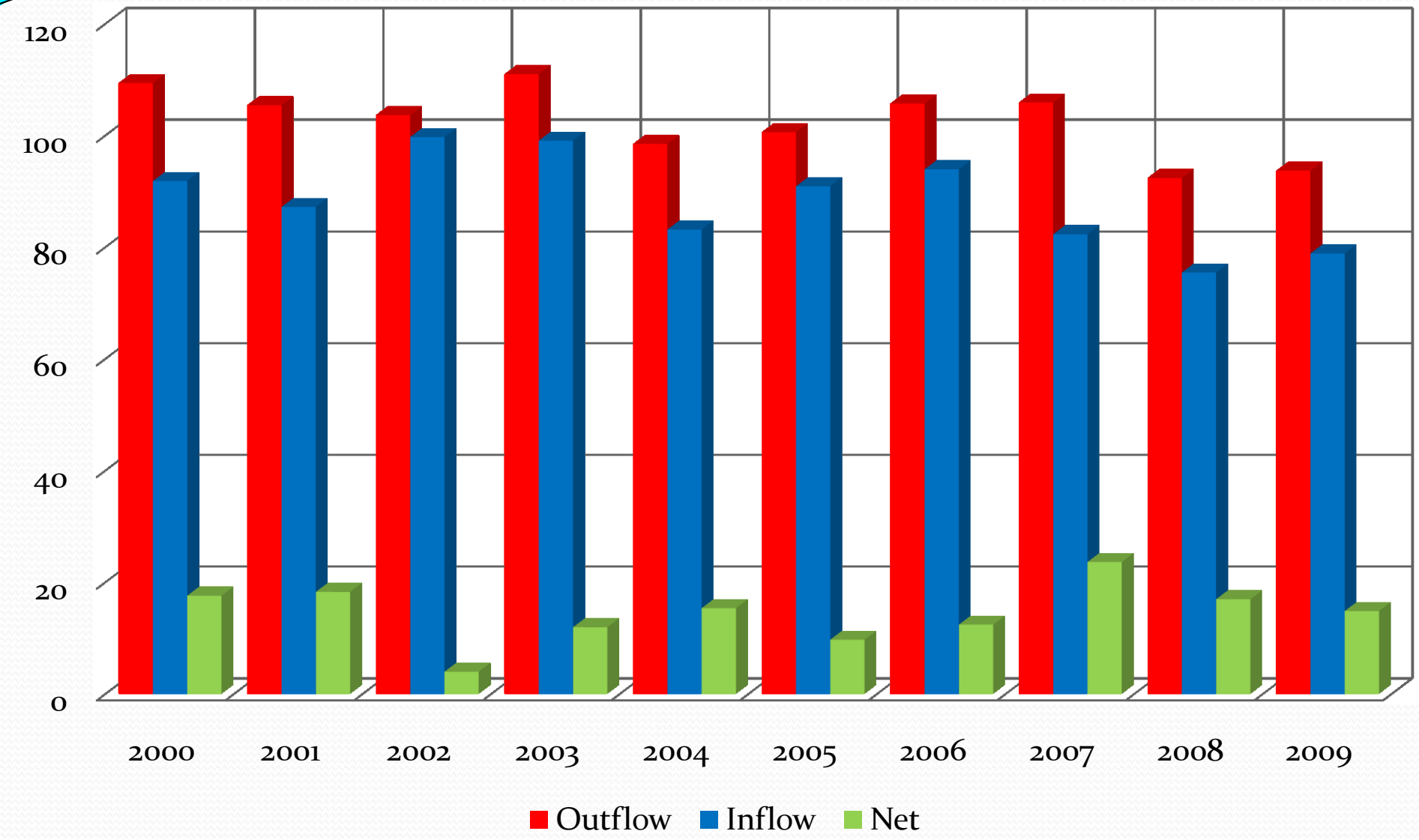


NO_2

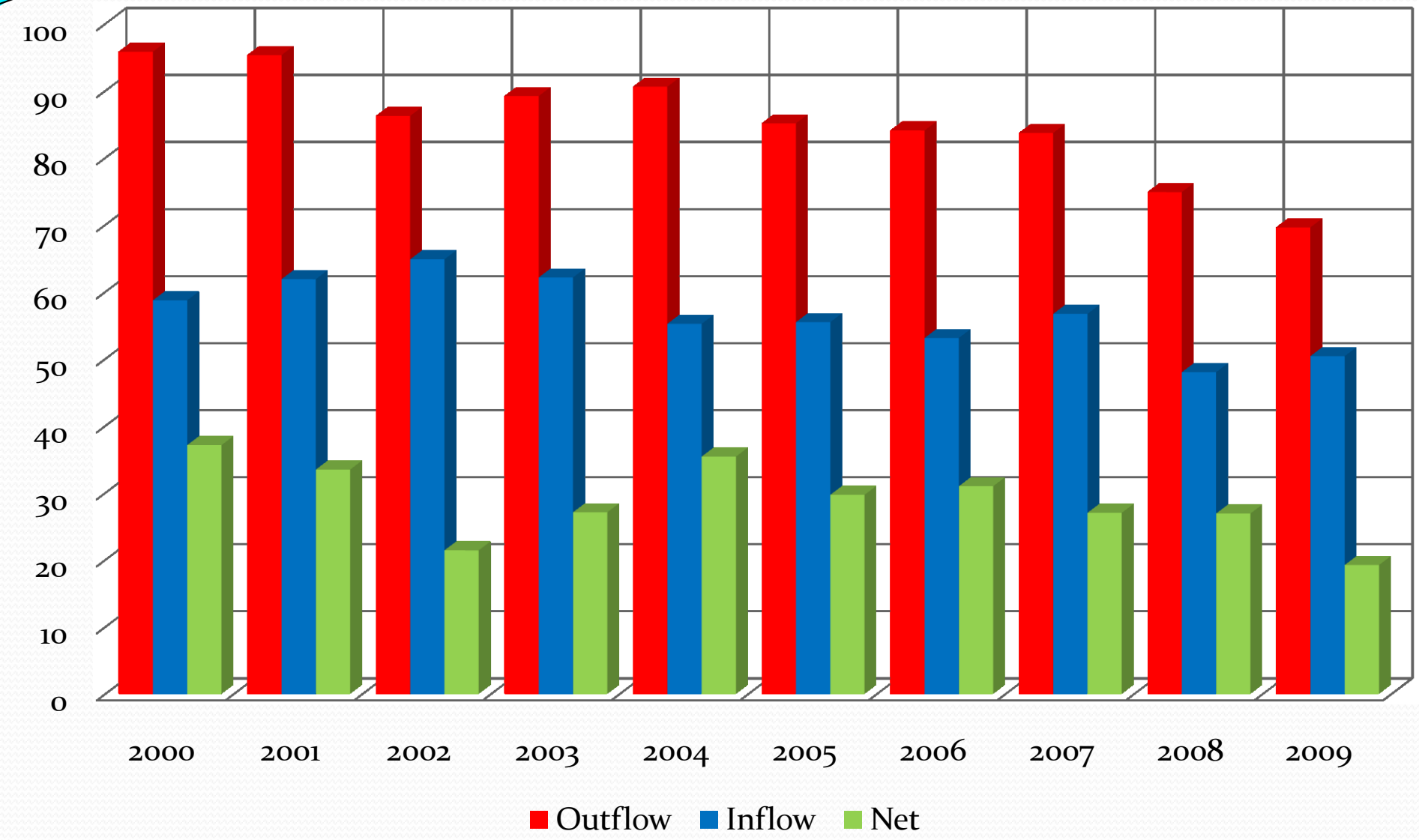
Out/In_{East} (v) = 1.30
Out/In_{East} (F) = 2.11

PM10

PM10 Fluxes (µg/m²s) BeNeLux Large

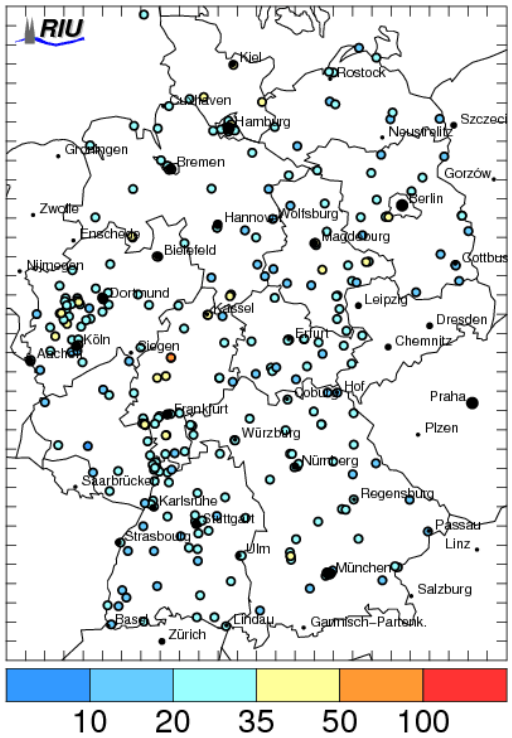


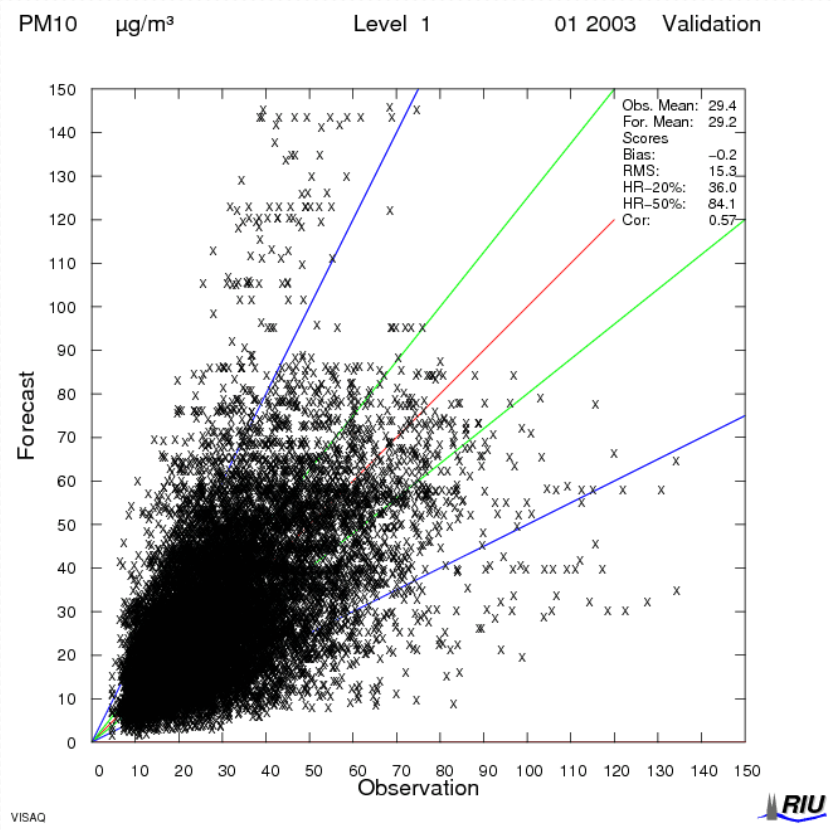
NO_2 Fluxes ($\mu g/m^2s$) BeNeLux Large



A few remarks on observations

• complete observational data set available from UBA/LANUV for more than 350 station within Germany





Outlook

- Model setup for a finer grid European domain to include the other European CityZen hot spots

- Model interaction global -> regional scale