The CityZen project
Bridging the scales with focus on megacities

Michael Gauss
(Norwegian Meteorological Institute)
and the CityZen team

Markus Amann, Bertrand Bessagnet, John Burrows, Rita Cesari, Cathy Clerbaux, Stefano Decesari, Massimo D'Isidoro, Maria C. Facchini, Ahmed Fahmy, Ann M. Fjaeraa, Sandro Fuzzi, Michael Gauss, Evangelos Gerasopoulos, Claire Granier, Angelika Heil, Øivind Hodnebrog, Øystein Hov, Min Hu, Ivar S.A. Isaksen, Hermann Jakobs, Maria Kanakidou, Mehmet Karaca, Tayfun Kindap, Mustafa Kocak, Nilgun Kubilay, Zbigniew Klimont, Kathy Law, Alberto Maurizi, Frédérik Meleux, Michael Memmesheimer, Nikos Mihalopoulos, Mihaela Mircea, Paul Monks, Agnes Nyiri, Jacques Pelon, Michael Petrakis, John Remedios, Andreas Richter, Laurence Rouïl, Martin Schultz, Guillaume Siour, Sverre Solberg, Frode Stordal, Tove Svendby, Francesco Tampieri, Alper Unal, Mihalis Vrekoussis, Christos Zerefos, Yuanhang Zhang

Project acronym: CityZen

megaCITY - Zoom for the Environment

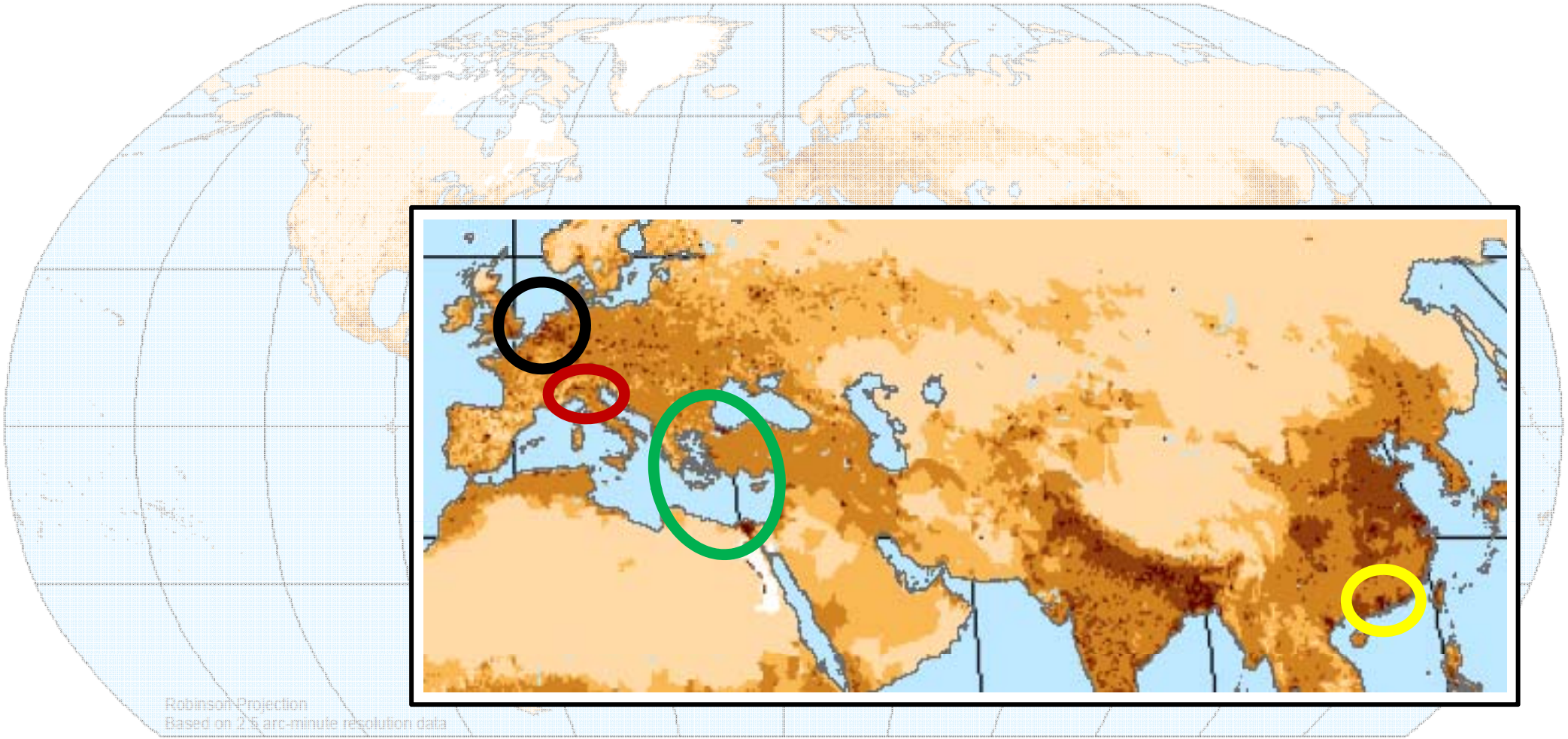
Total budget: ~ 4 m€

Duration: 3 years (started autumn 2008)

Sister project: MEGAPOLI

The World: Population Density, 2000

GPW [v3]



Gridded Population of the World

Persons per km^2

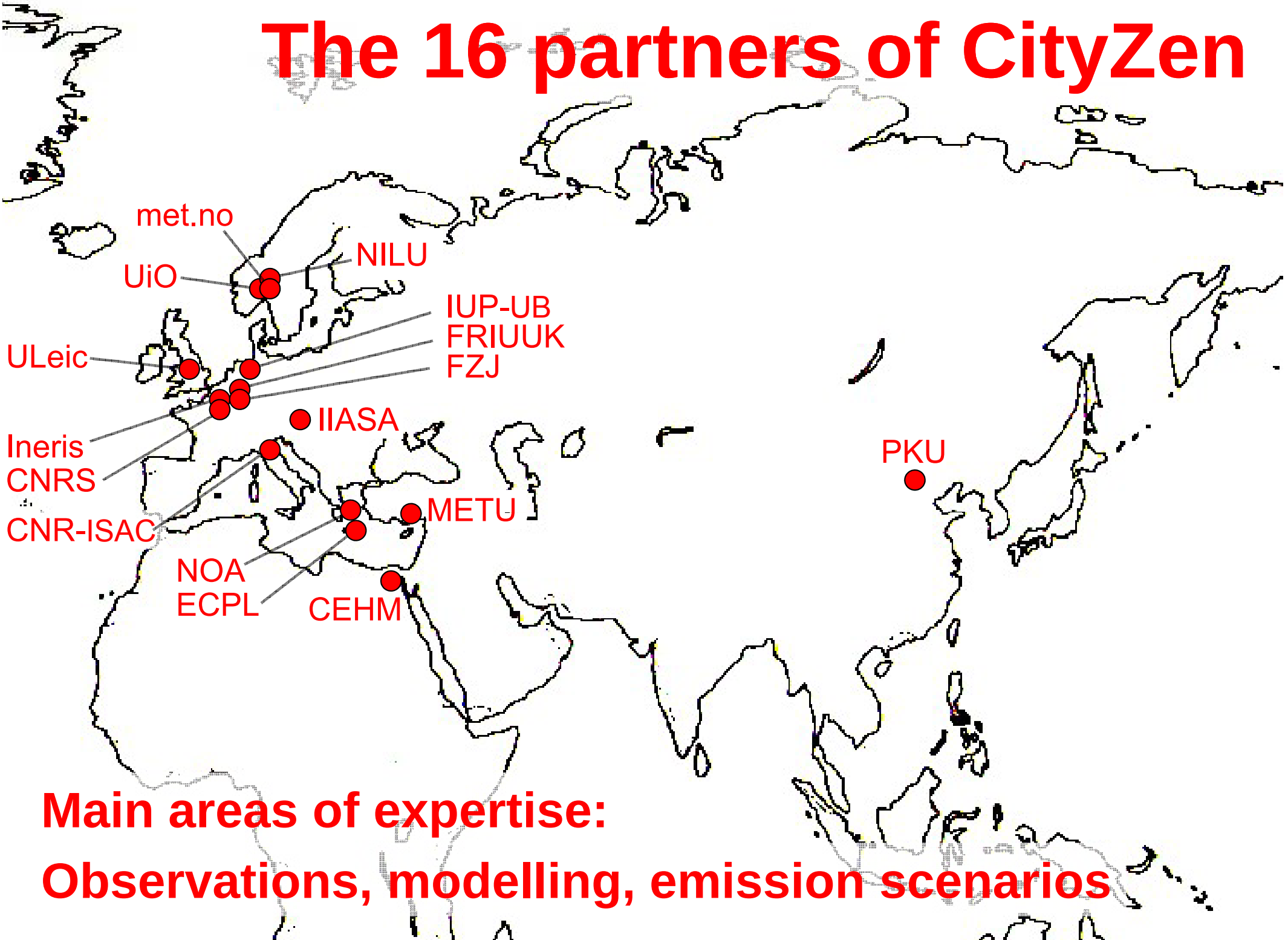
- 0
- 1 - 4
- 5 - 24
- 25 - 249
- 250 - 999
- 1,000 +

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:

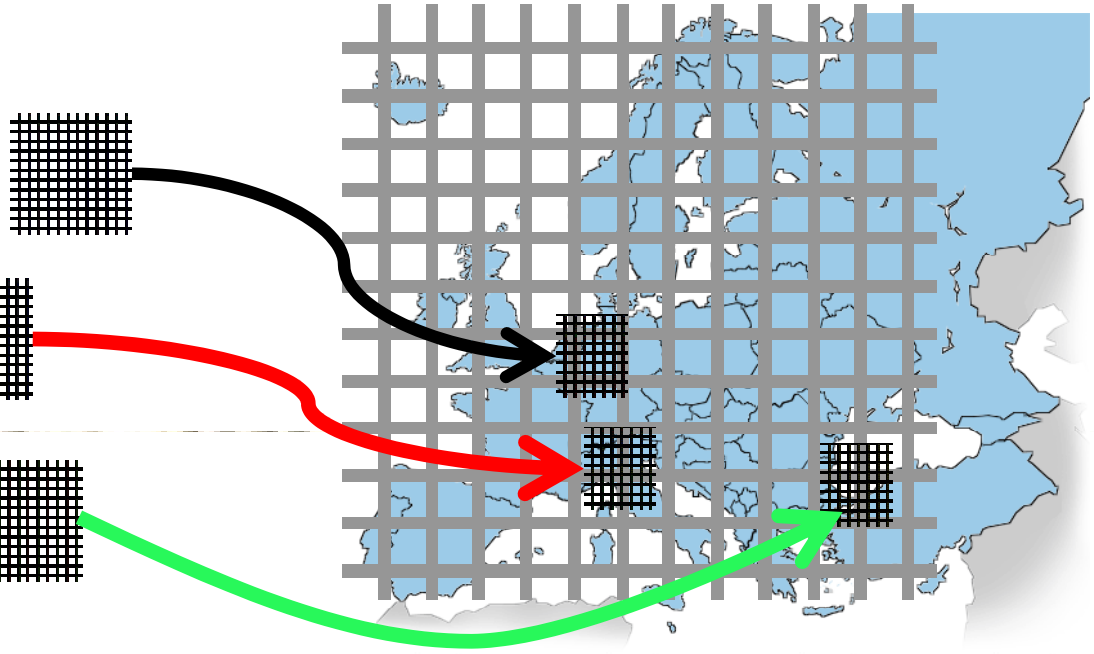
Observations, modelling, emission scenarios

The main 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

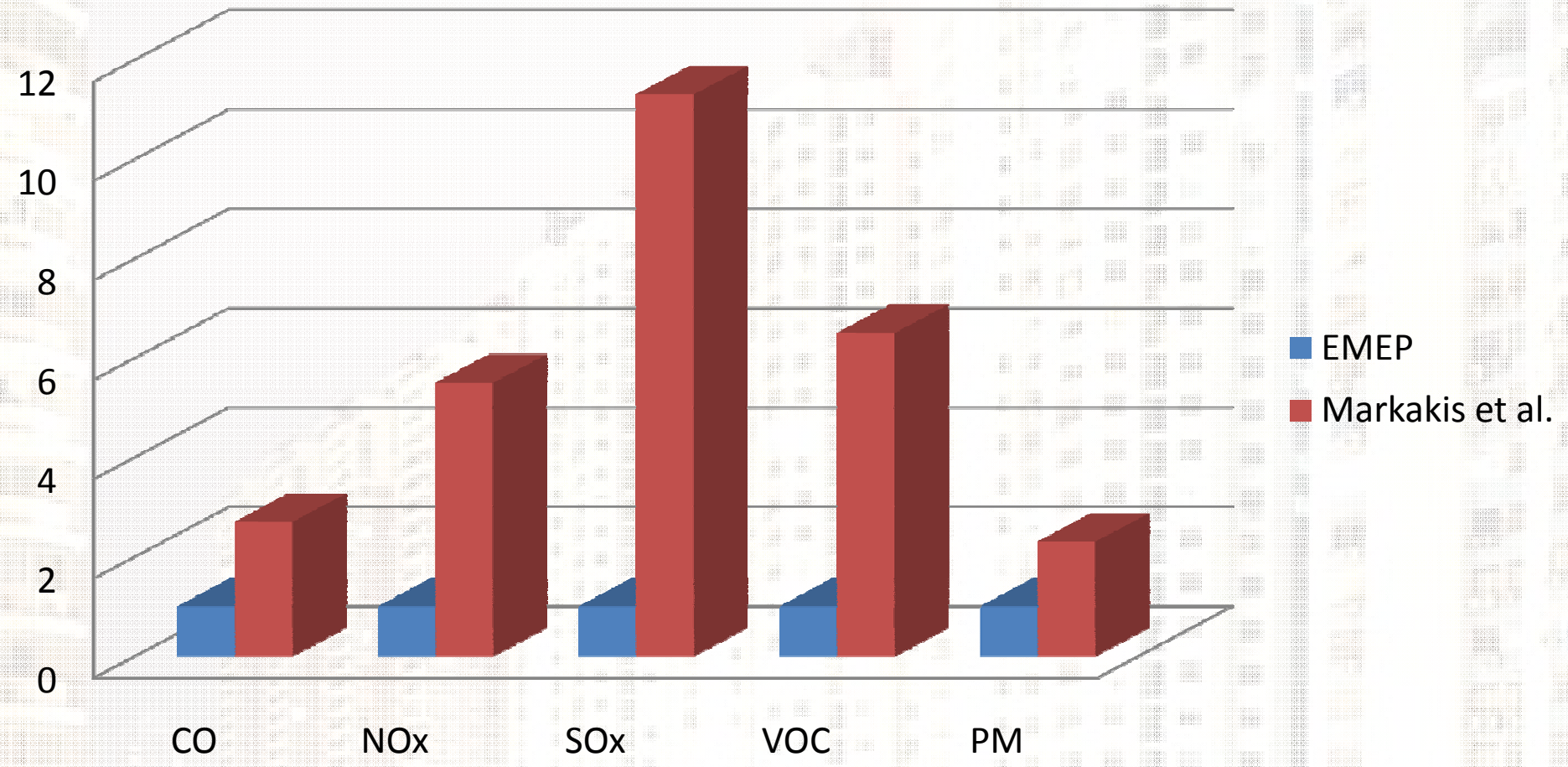
Emission inventories in CityZen

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



- 1998-2007 **global**: based on EDGAR and the RCP scenarios produced for IPCC-AR5: CNRS
- **Future** projections, including mitigation options: IIASA, CNRS
- Possible cooperation with MACC and MEGAPOLI

Emissions in Istanbul (EMEP emissions = 1)



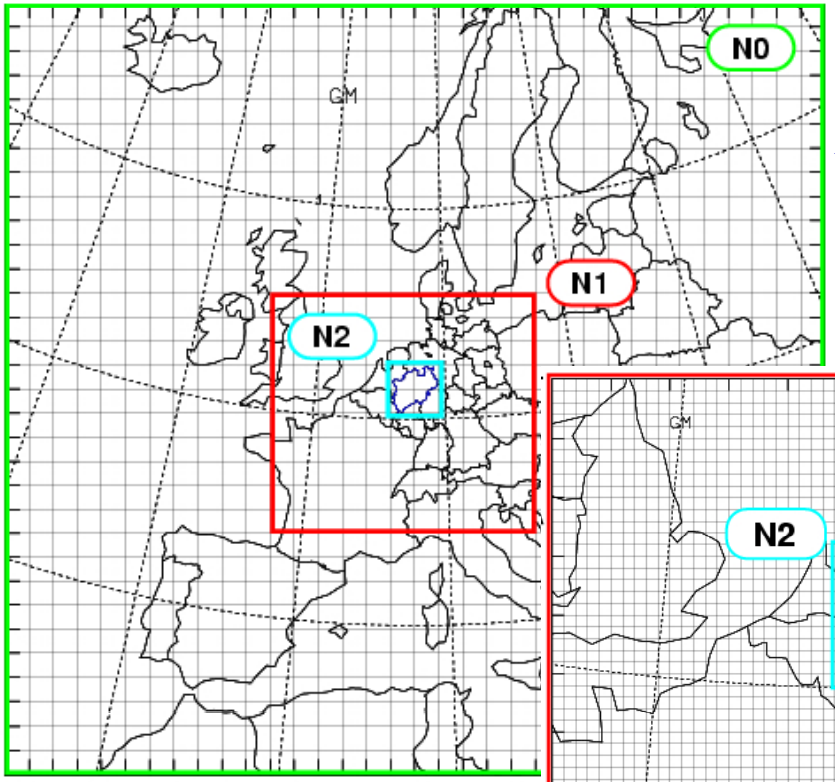
Based on data from **Markakis, K., U. İm, A. Unal, D. Melas, O. Yenigün, S. İncecik: Compilation of a GIS based high spatially and temporally resolved emission inventory for the Greater Istanbul area**, Science of the Total Environment, 2009, submitted.

Models participating in CityZen

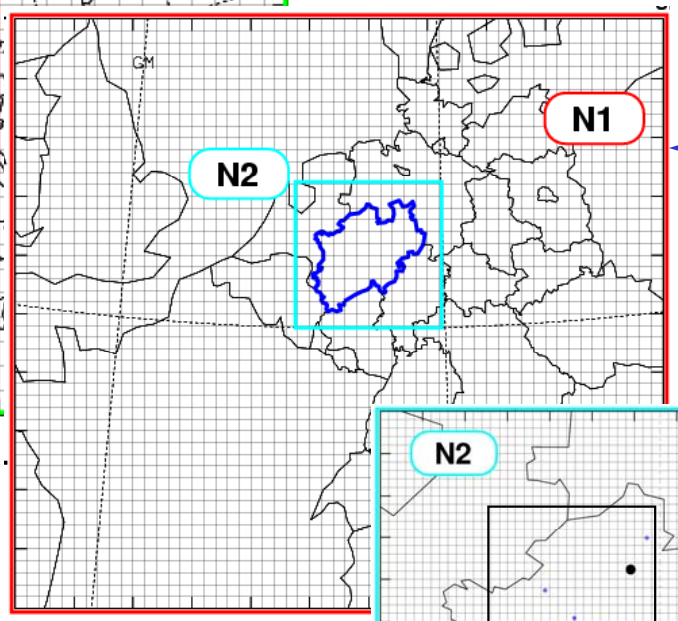
- Global scale:
  - MOZART, *ECHAM5-HAMMOZ*, EMEP, OsloCTM2, *CAM-Oslo*, TM4-ECPL (~1°×1° resolution)
- Regional scale:
  - CHIMERE, EMEP, EURAD, *BOLCHEM*, Models-3/CMAQ, WRF-Chem (~0.5°×0.5° resolution)
- Local scale:
  - CHIMERE, EMEP, EURAD, *BOLCHEM*, Models-3/CMAQ, WRF-Chem (~10×10 km^2 resolution and finer)


nesting and zooming
dot com

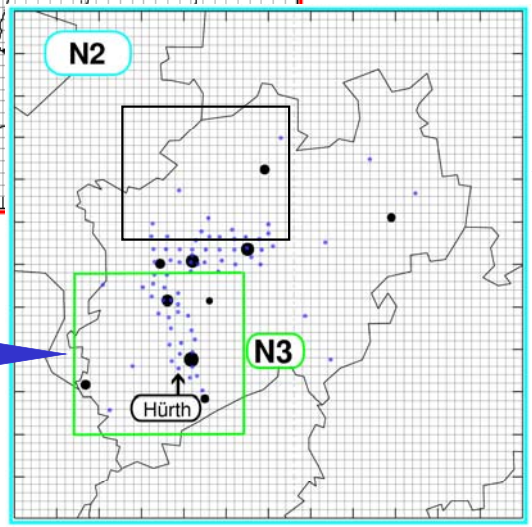
Nesting over Rhine/Ruhr: The EURAD system



Europe
ds = 125 km



Central Europe
ds = 25 km



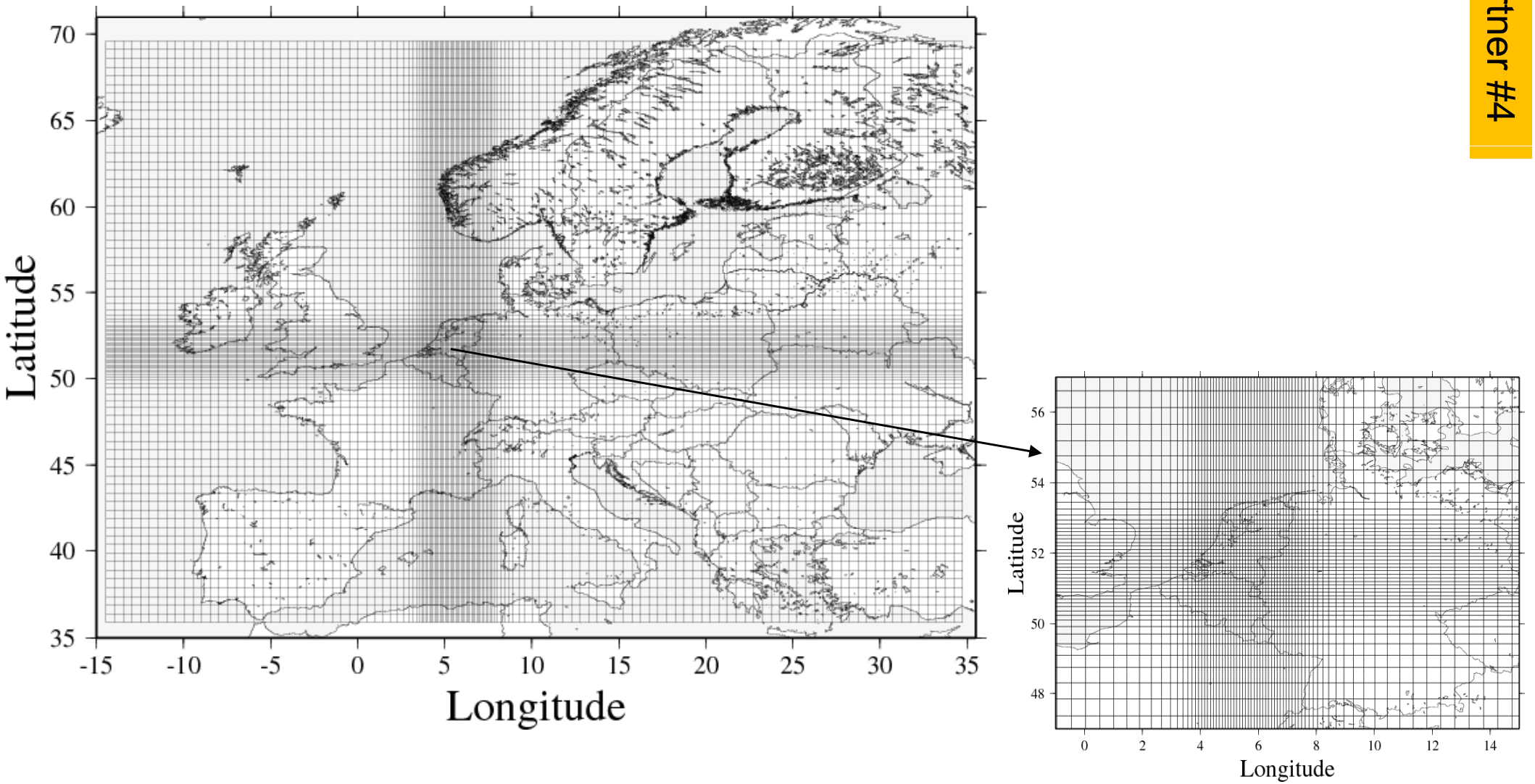
NRW
ds = 5 km

Urban
ds = 1 km

Zooming over BeNeLux: The CHIMERE model

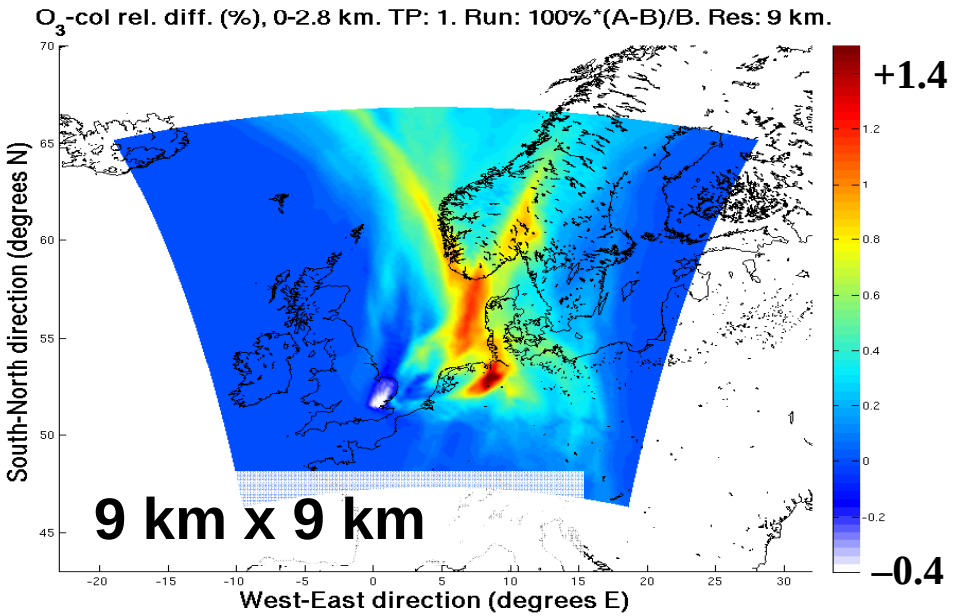
INERIS – partner #4

Refine the grid from 0.5° to 0.1° resolution over a specific region



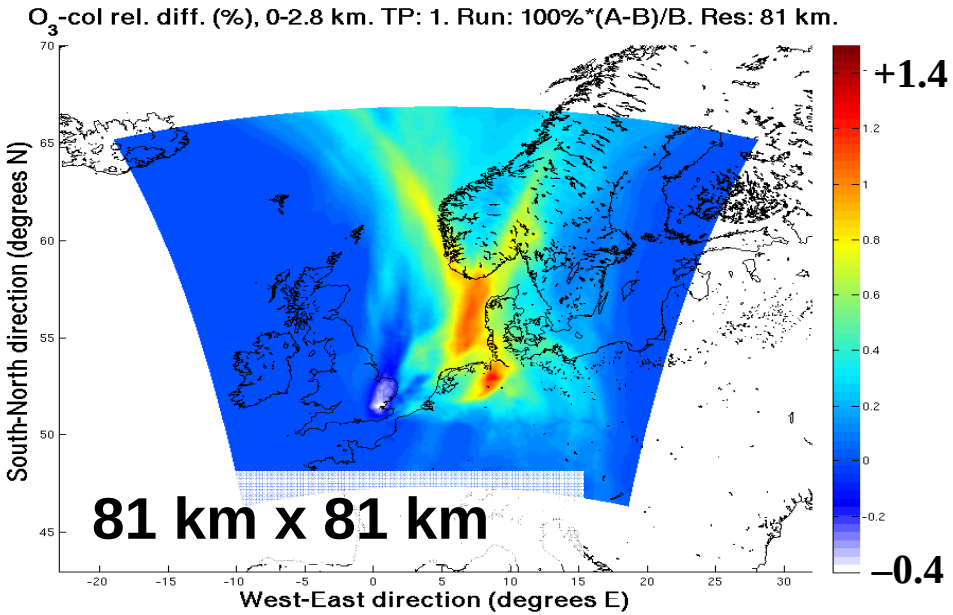
Guillaume Siour (INERIS/LISA/ADEME), Bertrand Bessagnet (INERIS)
Laurent Menut (LMD/IPSL-CNRS), Frédérik Meleux (INERIS), Laurence Rouïl (INERIS)

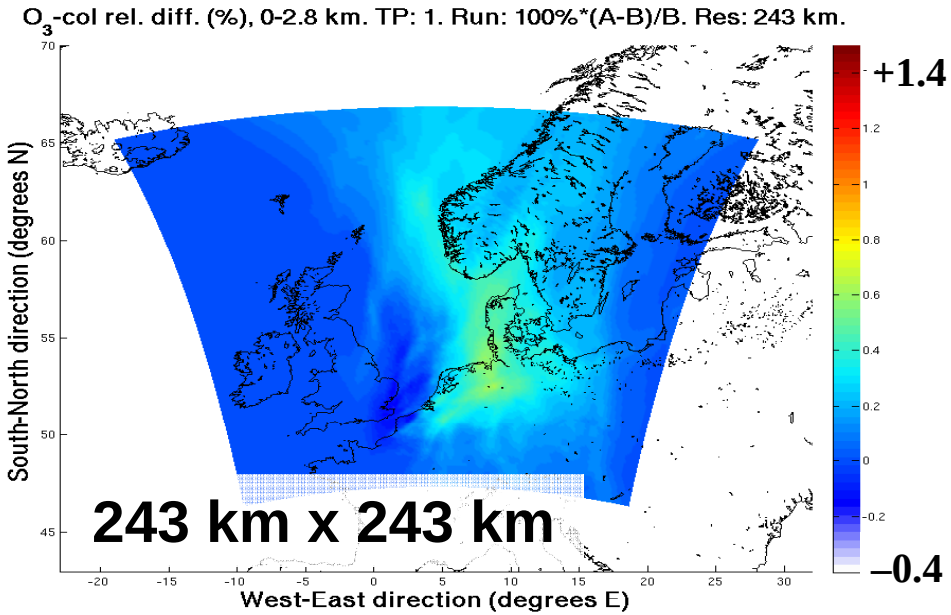
Nesting over London: The WRF-Chem model



O_3 changes caused by London emissions (%)

July 23 – August 1, 2003





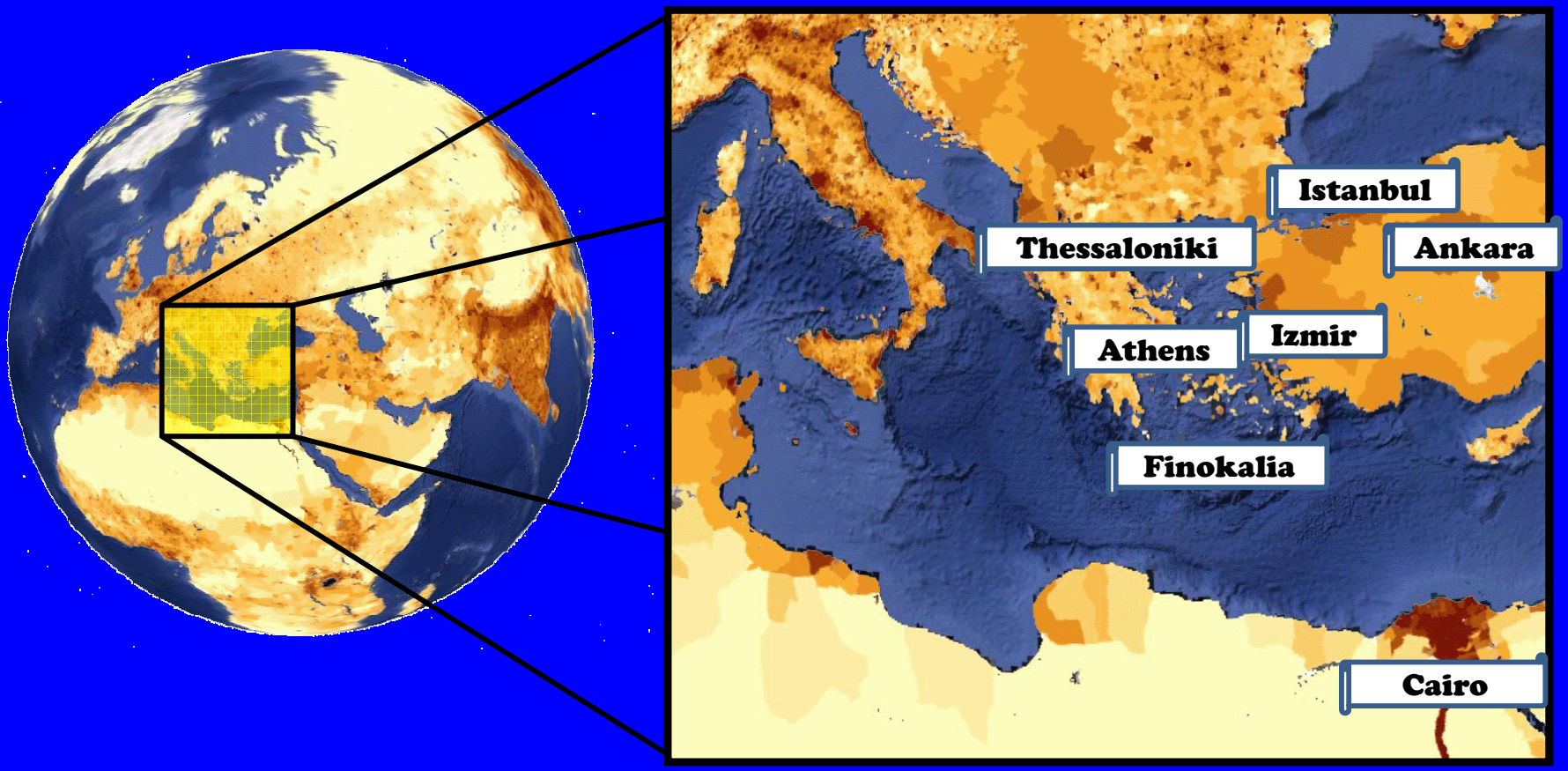
Øivind Hodnebrog (UiO), Frode Stordal (UiO), Terje Berntsen (UiO)

Measurements in CityZen

- Satellite
  - GOME, SCIAMACHY, GOME-2, OMI, ... : IUP-UB
  - TOMS, MODIS : ECPL
  - IASI, ACE, CALIPSO : CNRS
- Ground-based
  - CityZen partners in the four selected hotspot regions to provide continuous measurement data and field campaign results

The Eastern Mediterranean hot spot region: Location and population density

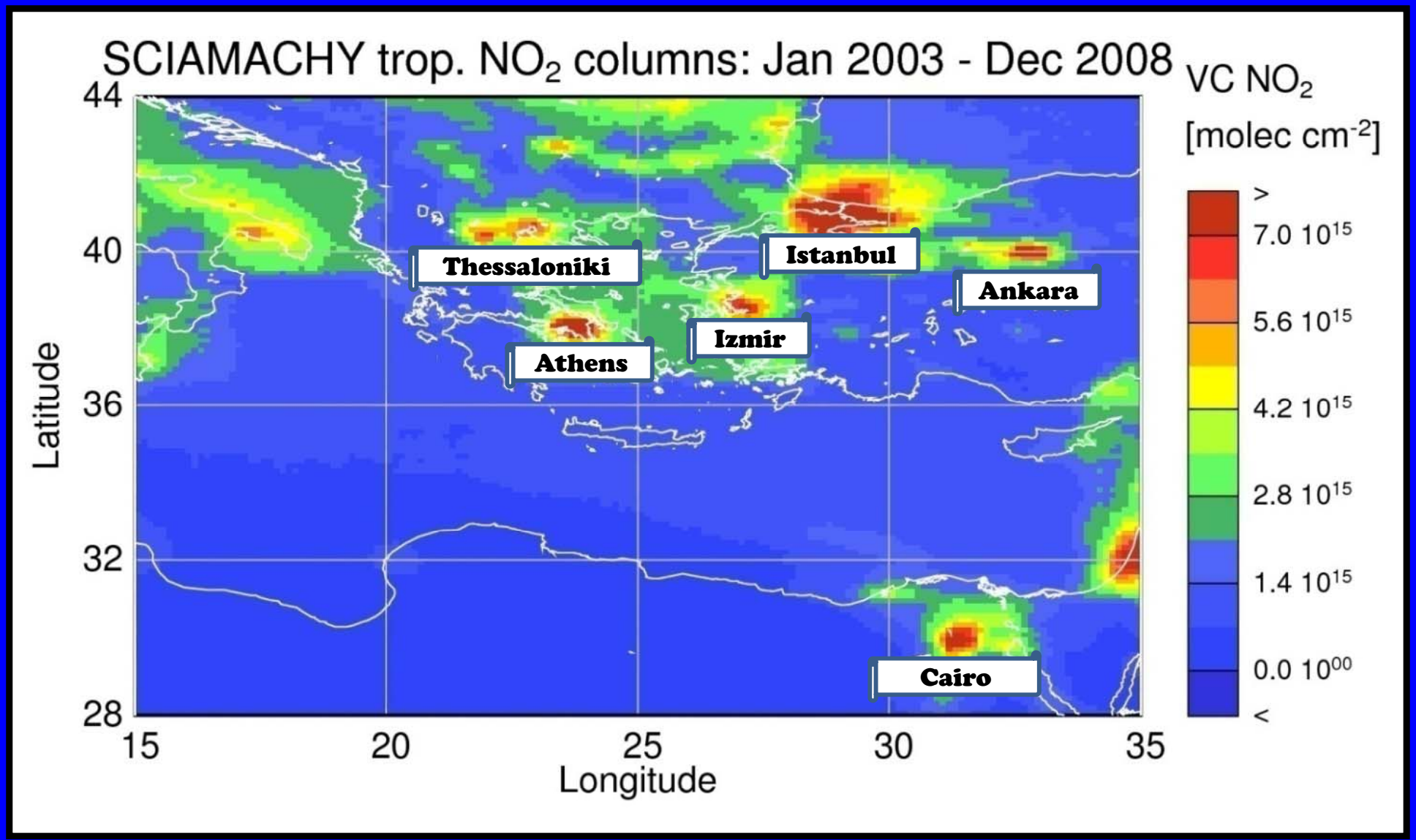
Large cities / Megacities



Mihalis Vrekoussis , 2009

Results

Satellite picture (SCIAMACHY)

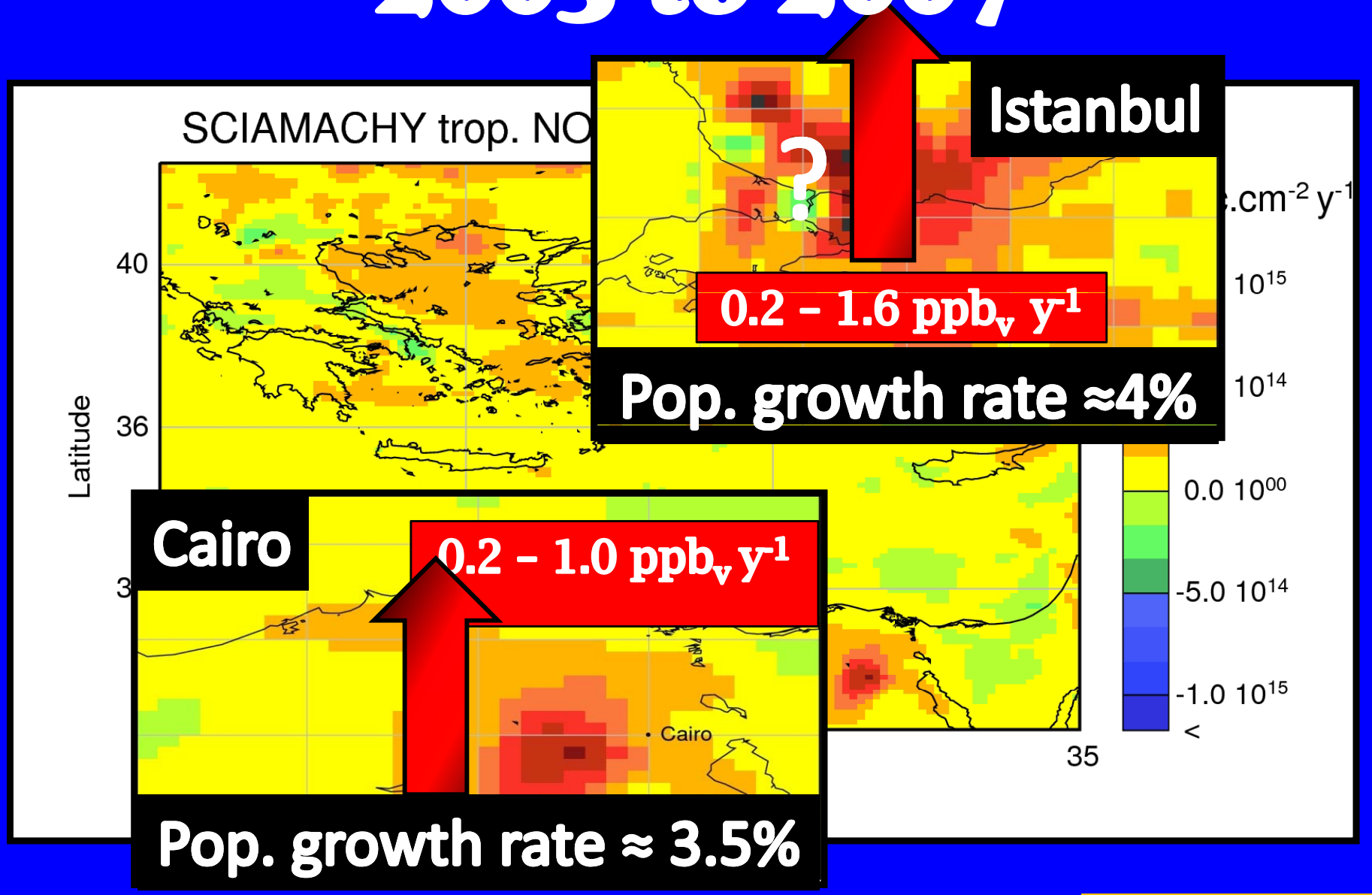


Mihalis Vrekoussis , 2009

IUP-UB – partner #5

Trends

Linear regression of VCD_{NO_2}: 2003 to 2007

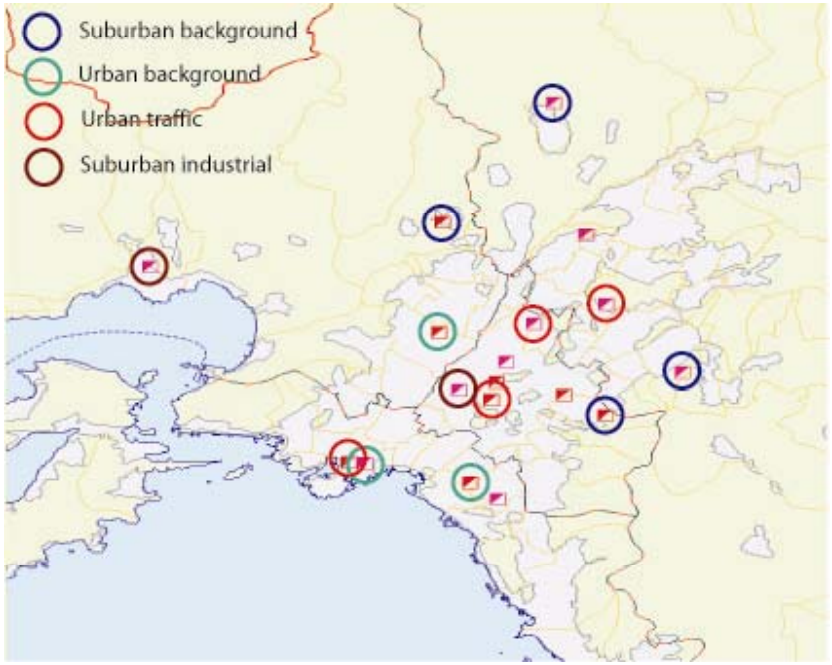


Mihalis Vrekoussis , 2009

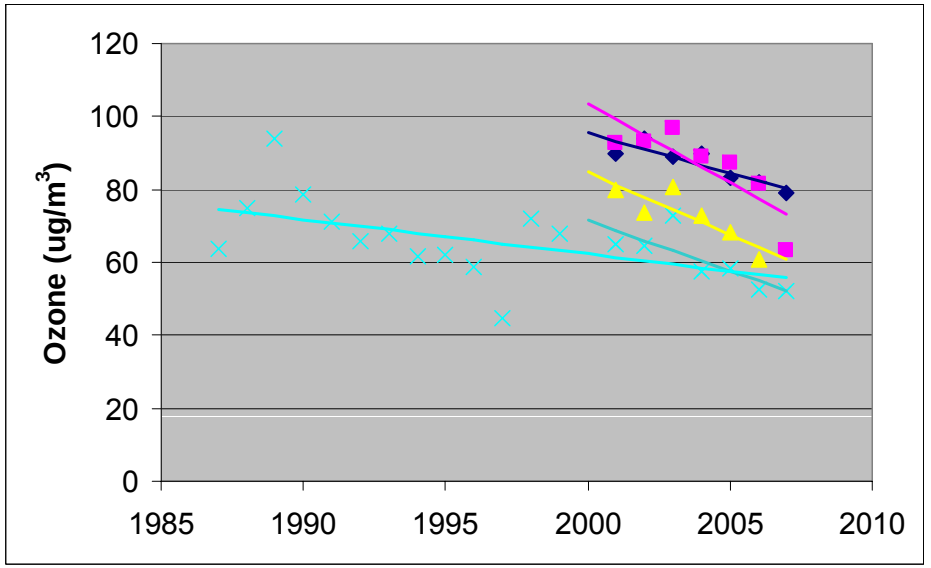
IUP-UB – partner #5

Ozone trends in Athens (from annual average values)

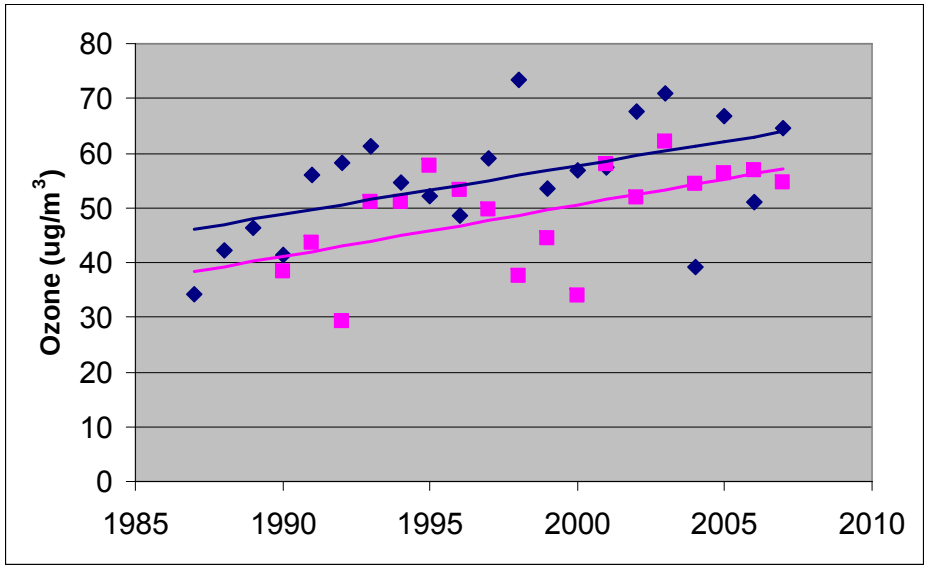
INSTITUTE OF ENVIRONMENTAL RESEARCH AND SUSTAINABLE DEVELOPMENT
NATIONAL OBSERVATORY OF ATHENS



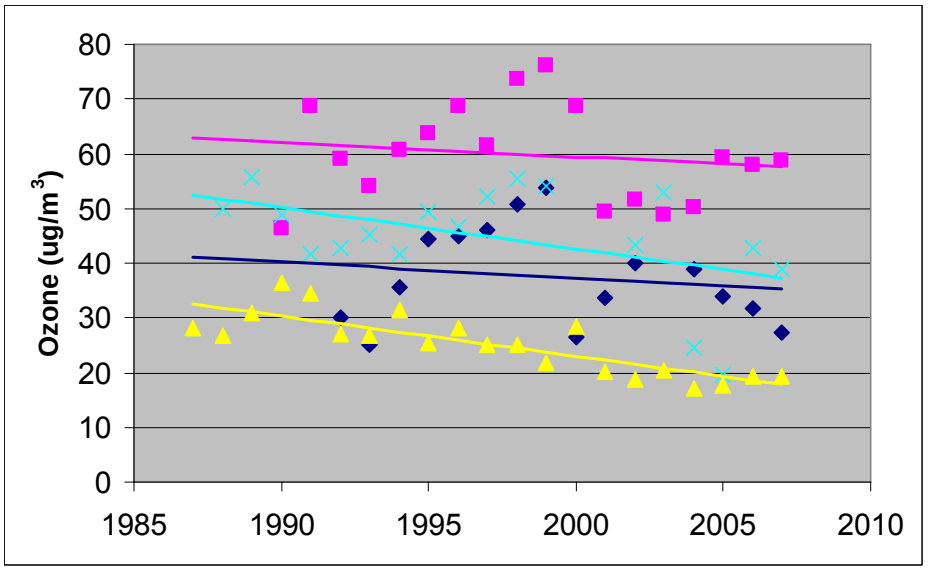
Suburban background stations



Urban background stations



Urban traffic stations

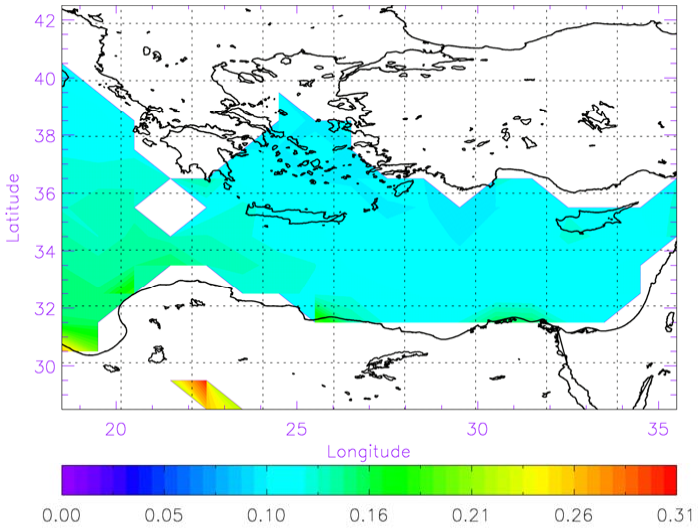


National Observatory of Athens, Dr. Evangelos Gerasopoulos

NOA – partner #14

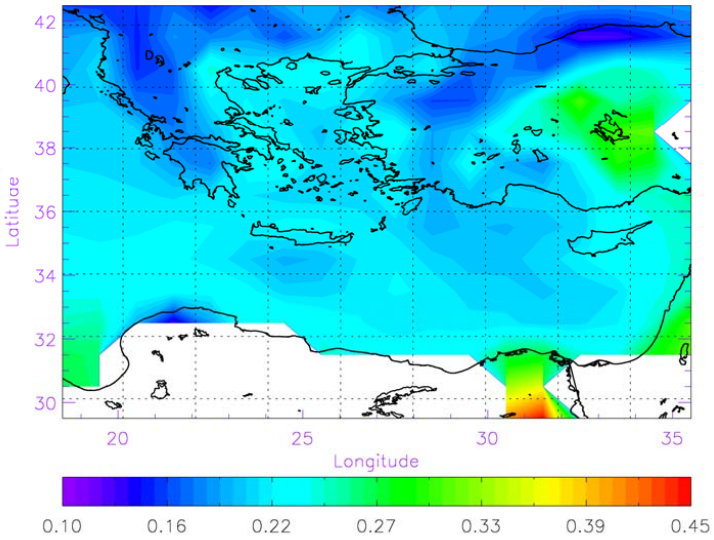
ANNUAL MEAN AOD

TOMS (1980-2000)

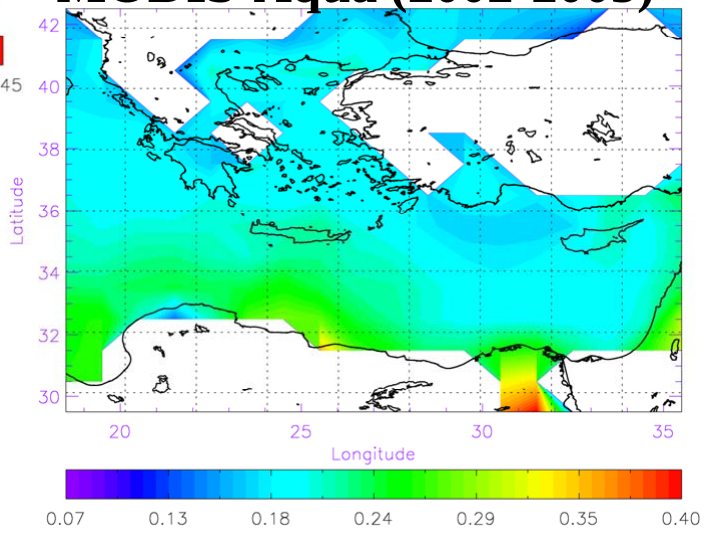


Synergistic use of MODIS and TOMS Aerosol Optical Depth (AOD) observations

MODIS-Terra (2000-2005)



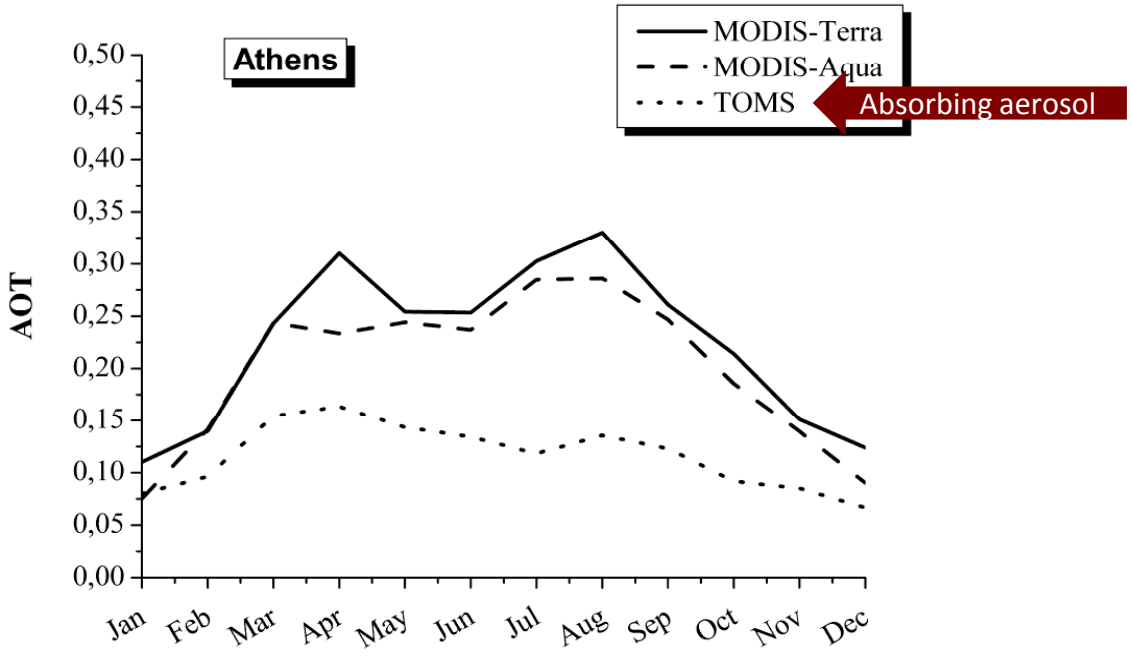
MODIS-Aqua (2002-2005)

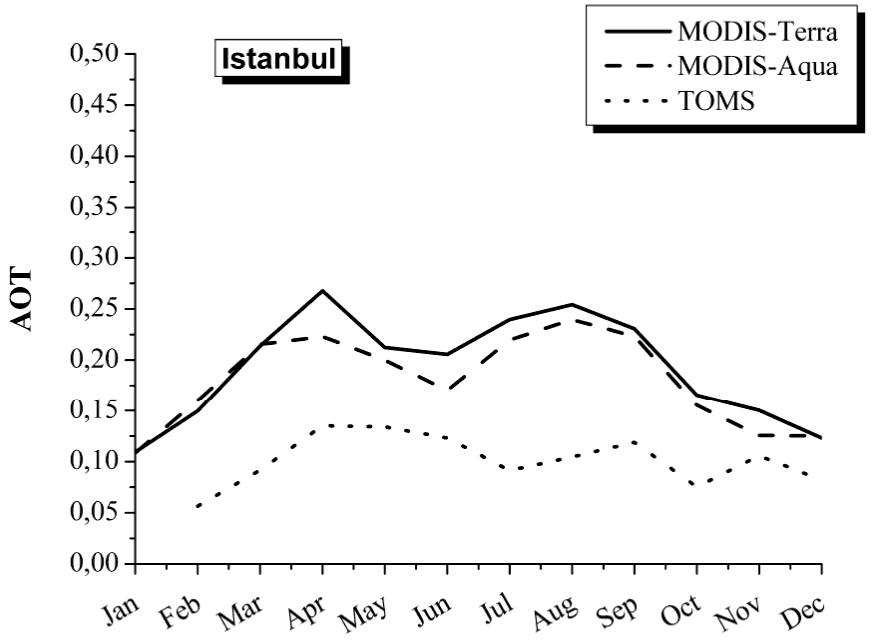


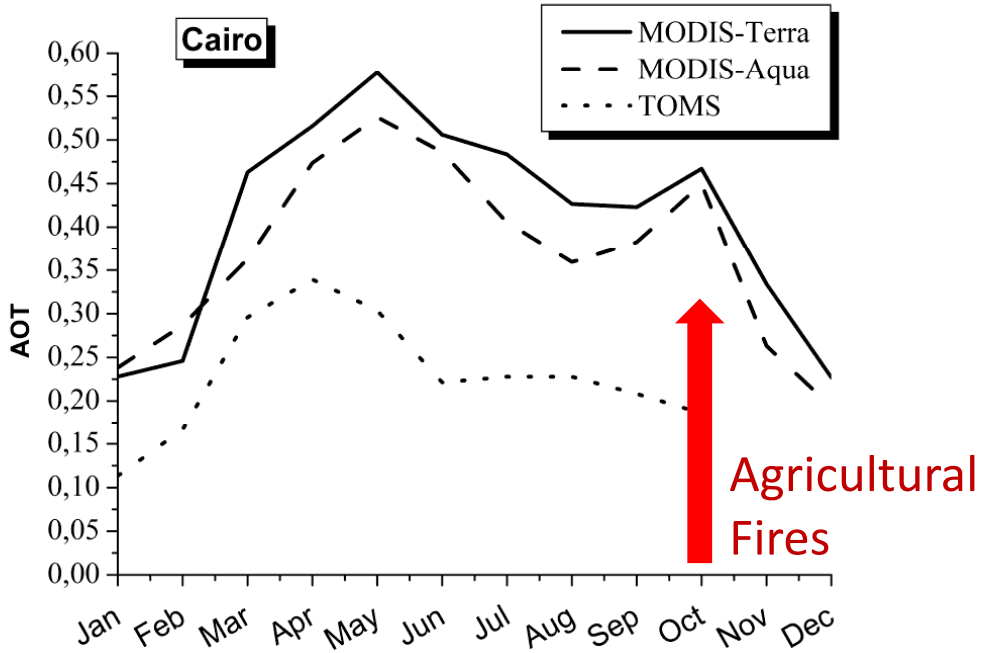
Hatziannastassiou, Gkikas, Mihalopoulos et al., JGR 2009

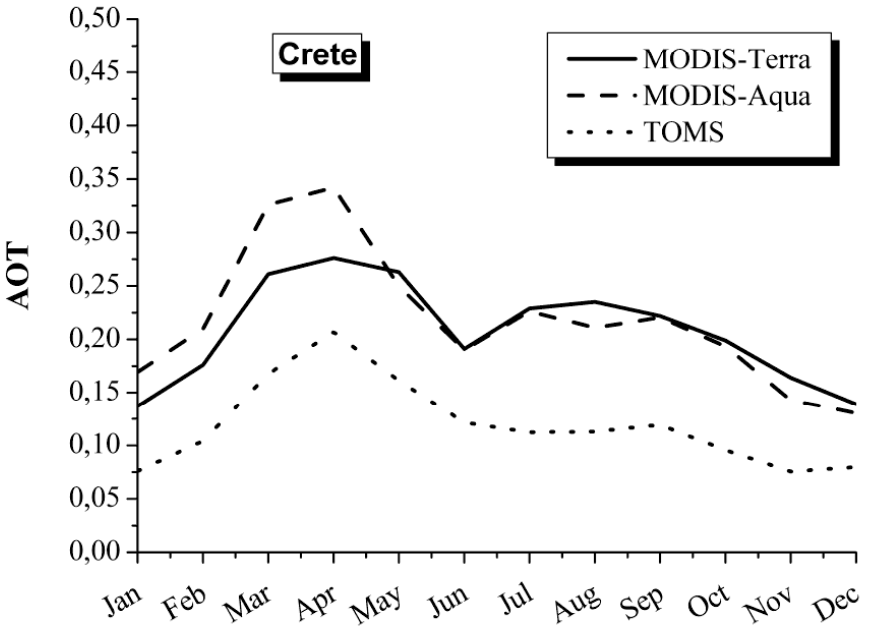
ECPL – partner #9

Anthropogenic pollution = MODIS - TOMS









ECPL – partner #9

Hatziannastassiou, Gkikas, Mihalopoulos et al., JGR 2009

What's new? – The way forward

- focus on
  - scale-interactions, non-linearities
  - AQ-climate interactions, mitigation scenarios
- what makes a megacity special?
  - heat island effects, chimney effects, population exposure, infrastructure, living habits
- integrated use of observations and modeling
- collaboration encouraged
- … see also http://wiki.met.no/cityzen/start