



MEGACITIES AND POLLUTION PLUMES

*Emission export
and impact of shape and density*

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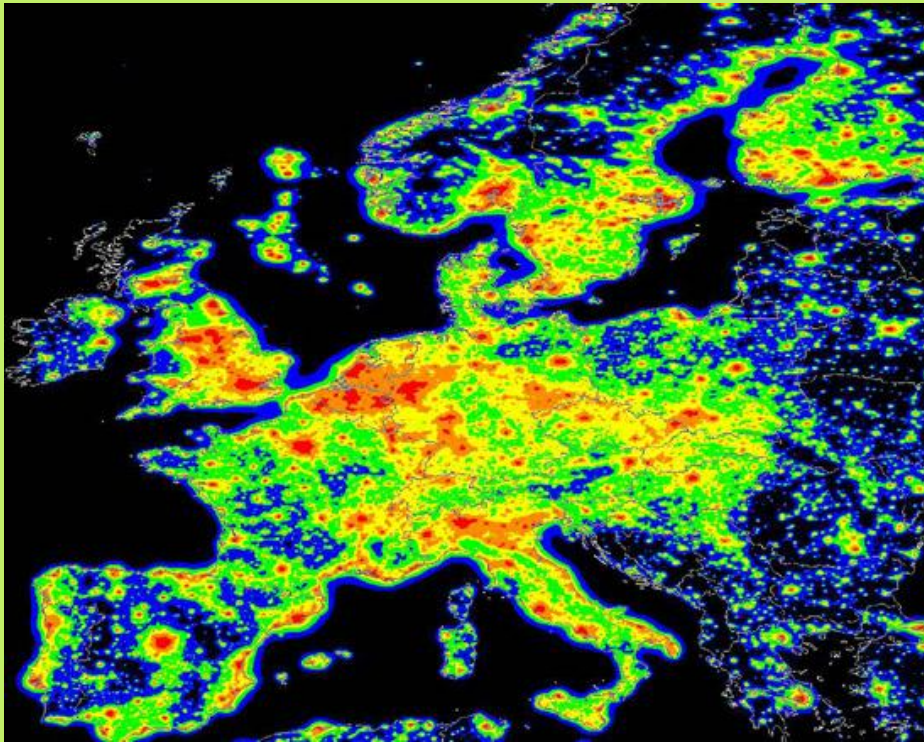
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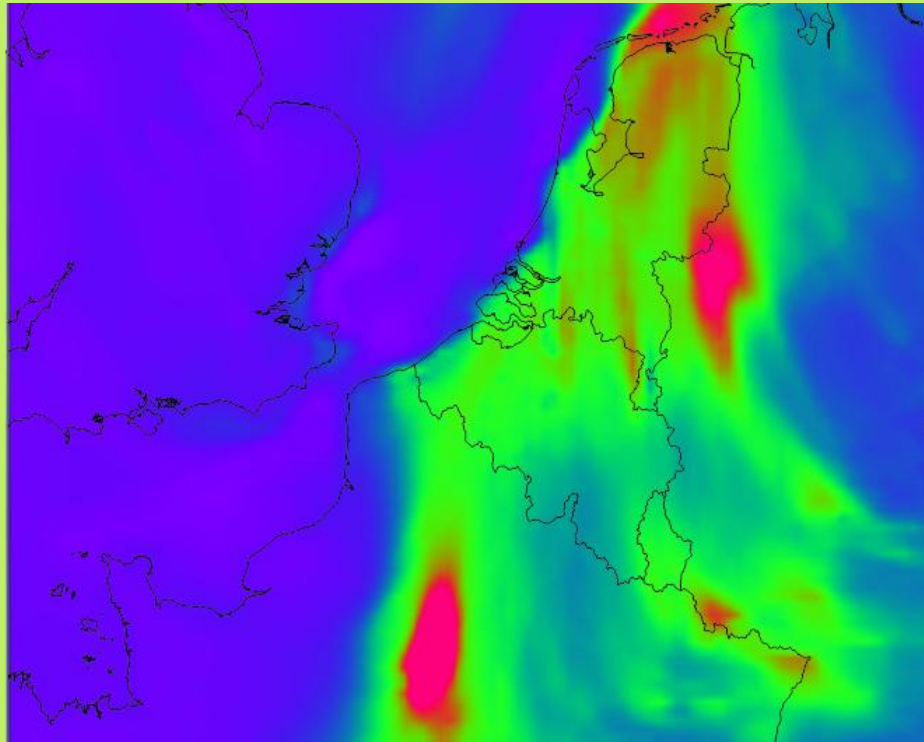
Air Quality Management

What is
the influence
of megacities
– and their properties –
on regional pollution and
continental export?



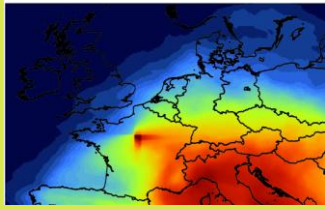
▶ Light pollution in Europe

*Institut des Sciences et Technologies de la pollution
lumineuse*

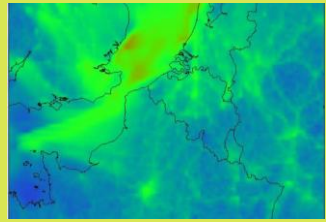


- ▶ Ozone concentration
AQM simulation

Is the release of pollutants dependent on the city shape and extent ?



Megacity impact
on continental pollution
and other cities



Influence of megacity
shape on pollutant export
and production

Model approach



Global model:
*LMDZ, INCA,
Gocart*

Meteorological model :
MM5

GLCF

Anthrop. emis
EMEP, MPOLI

Biog. emis
MEGAN

Landuse

Boundary conditions

Emissions

Meteorology

- Deposition : resistance scheme (Wesely, 1989)
- Transport : transport scheme (Vanleer, 1979)
- Chemistry : Melchior (Lattuati, 1997), SAPRC07 (Carter, 2010)

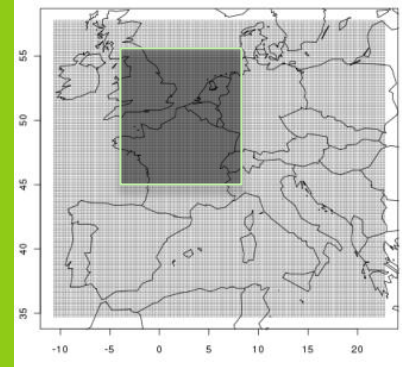
Chimere

The CHIMERE model:

Production: Emissions+Chemistry+Transport+Diffusion

Loss: Chemistry+Transport+Diffusion+Deposition

Simulation realization :
CHIMERE continental-scale (0.16°x0.16° resolution)
SAPRC07-A chemical scheme
MEGAPOLI emissions
Summer 2005 (3 months)
Zoom on Northern Europe (city plumes)



- Deposition : resistance scheme (Wesely, 1989)
- Transport : transport scheme (Vanleer, 1979)
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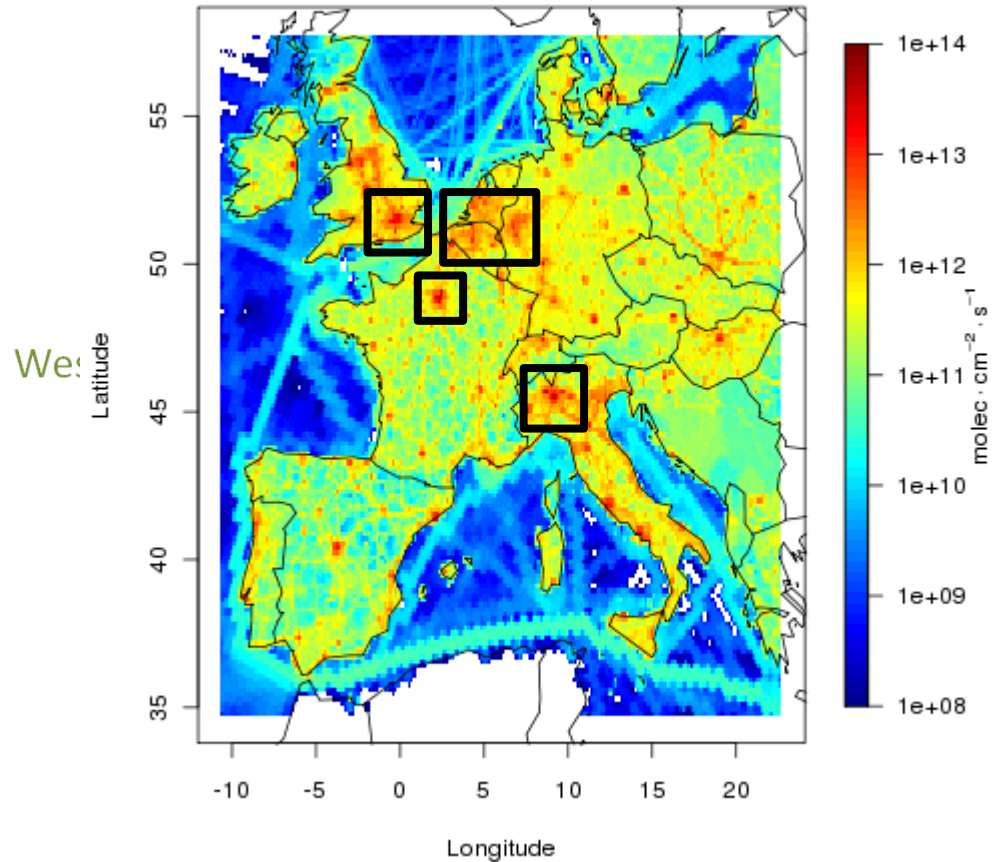
Megacity and continental pollution

Transport of city tracer towards the continent

- Same reactivity as CO
- Same emissions as CO
- No chemical production
- Study of $[CO \text{ tracer}]/[real \ CO]$

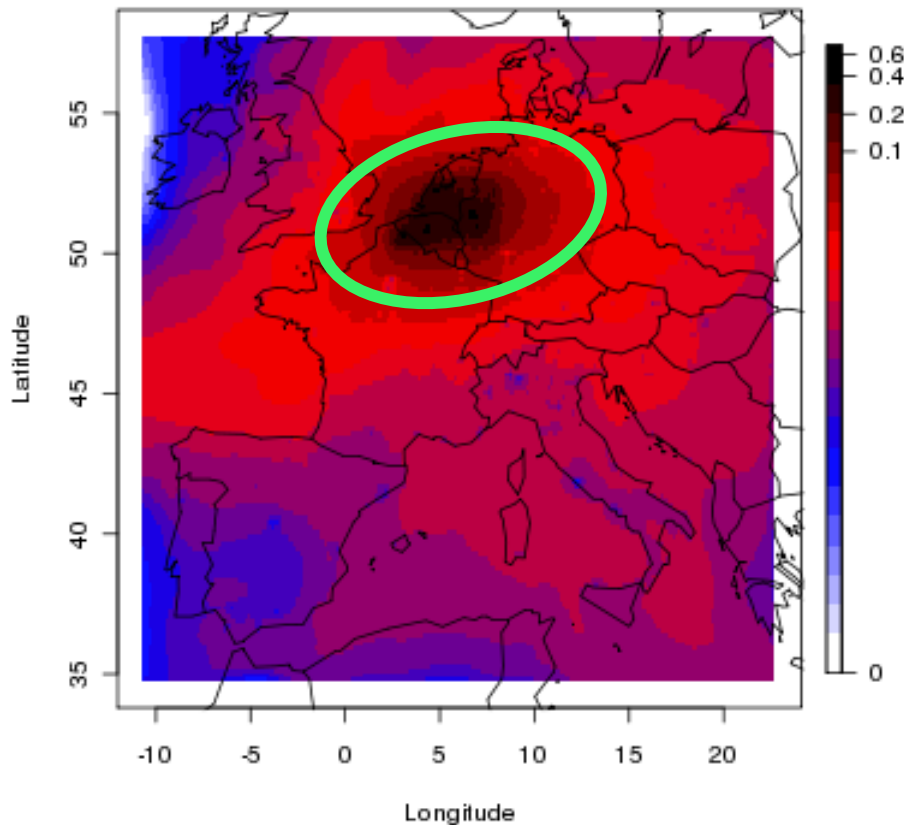
Flux calculations

- At each cell boundary
- For all species
- Inside solver

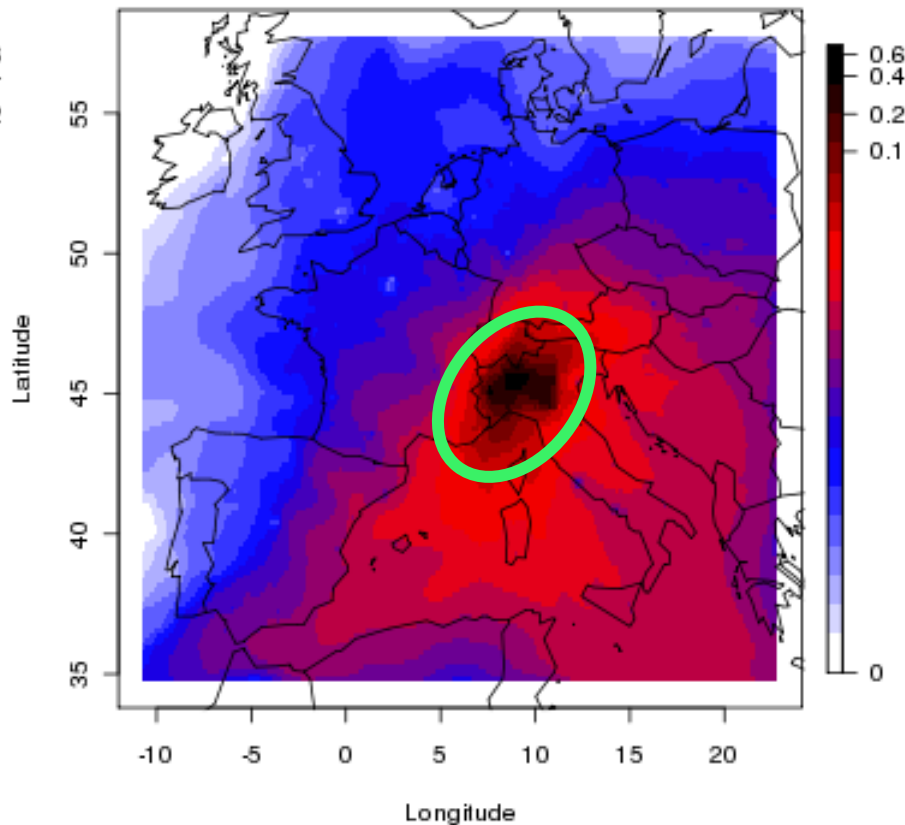


CO tracer – continental transport

CO BeNeLux

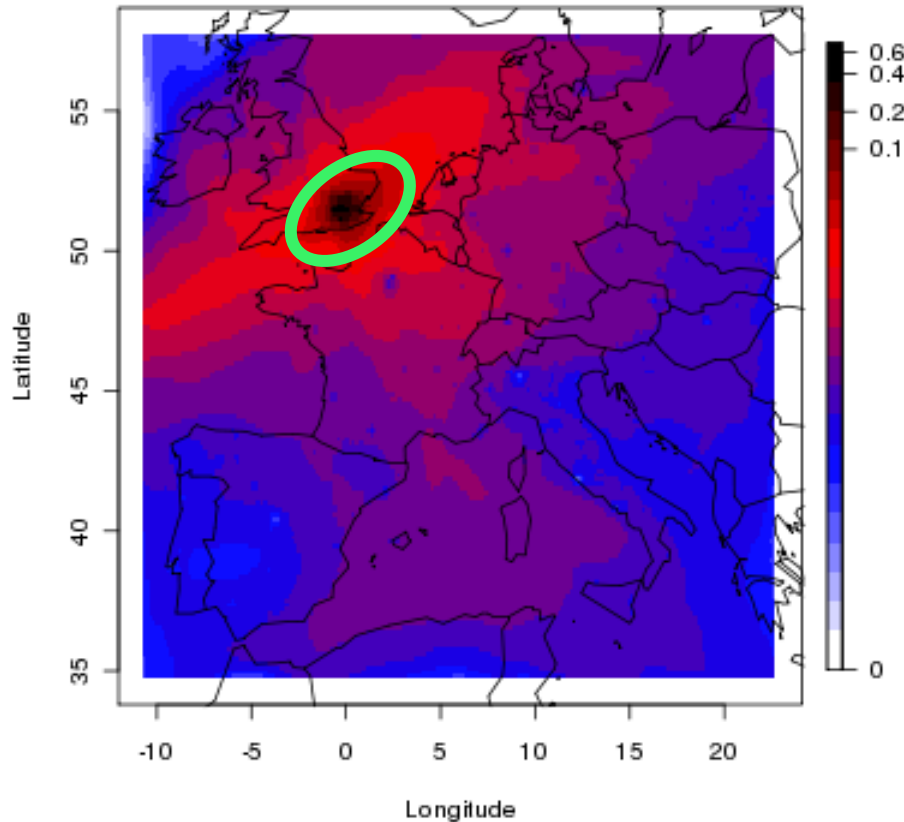


CO Po

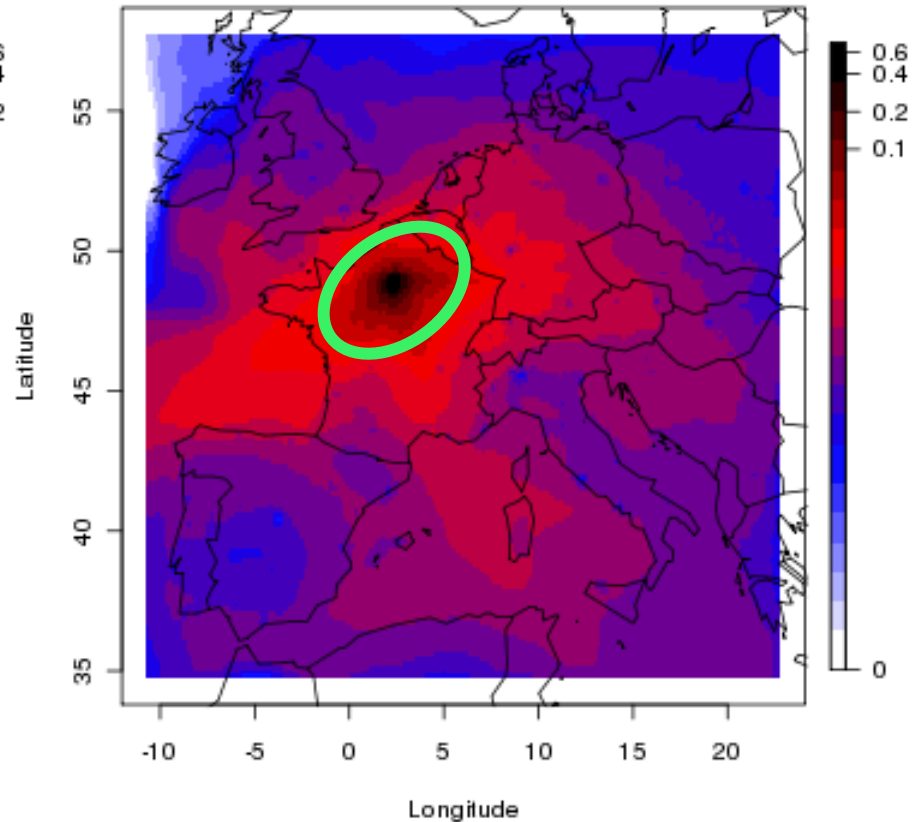


CO tracer – continental transport

CO Londres



CO paris



CO tracer – continental transport

City emissions contribute by

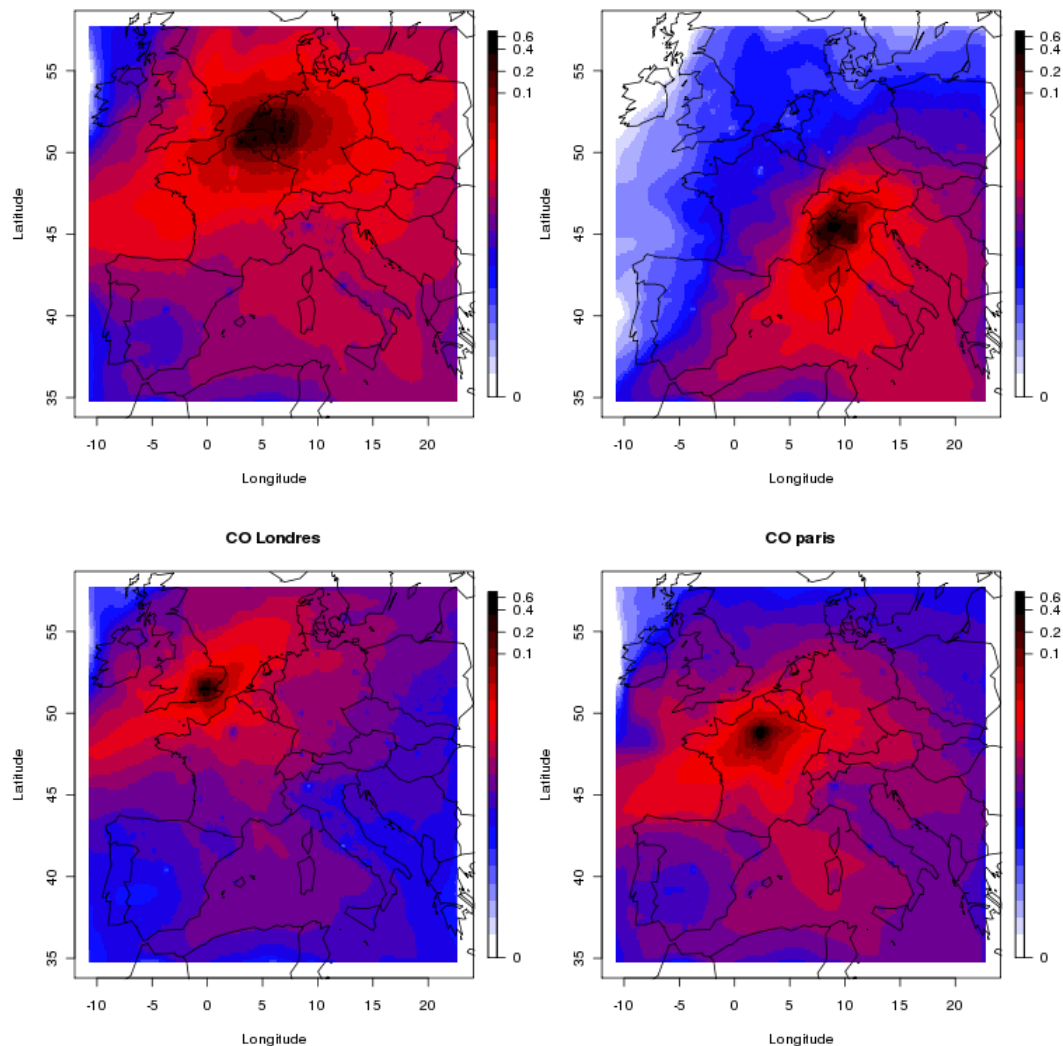
- 80% to local CO
- *more than 10% to CO over 100s kms*

Importance on impact surface

- *Topography and circulation*
- *City extent*

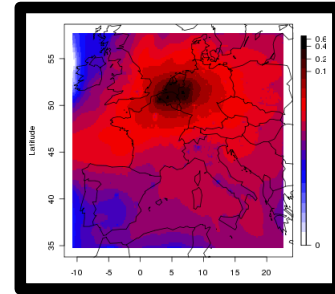
Interactions between cities

- *Secondary pollution*
- *Reactive primary species*

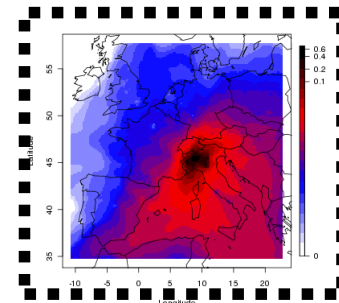


Pollutant export

6 major pollutants
10 years of simulation



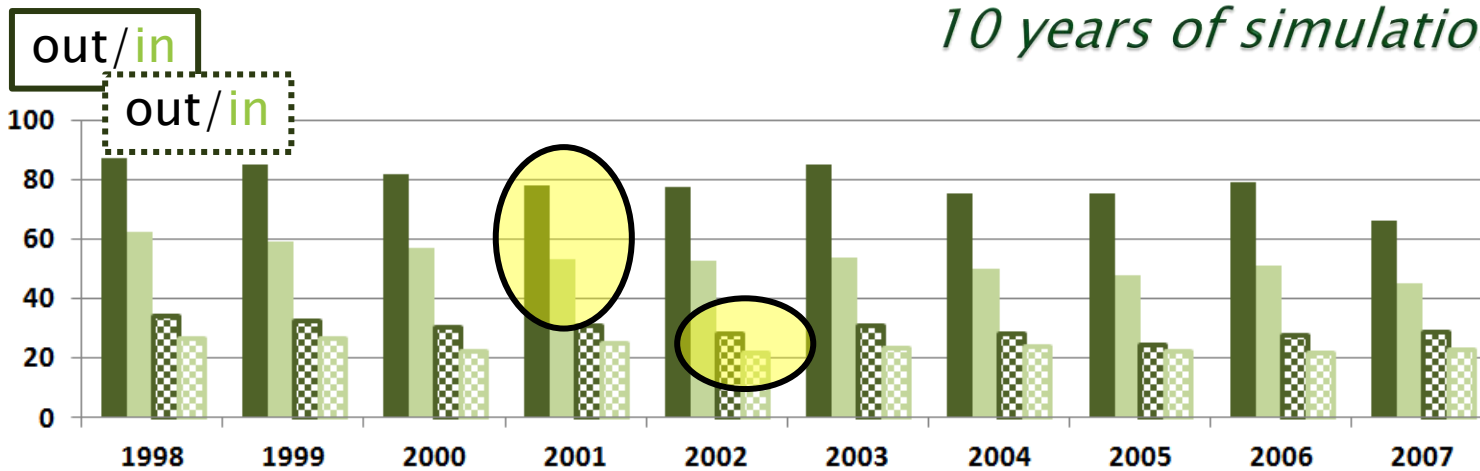
BeNeLux



Milan

NO_x

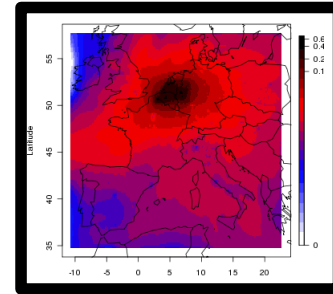
O₃



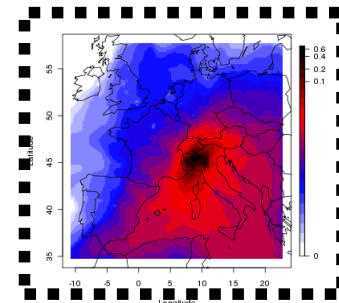
Recirculation
Chemistry

Pollutant export

6 major pollutants
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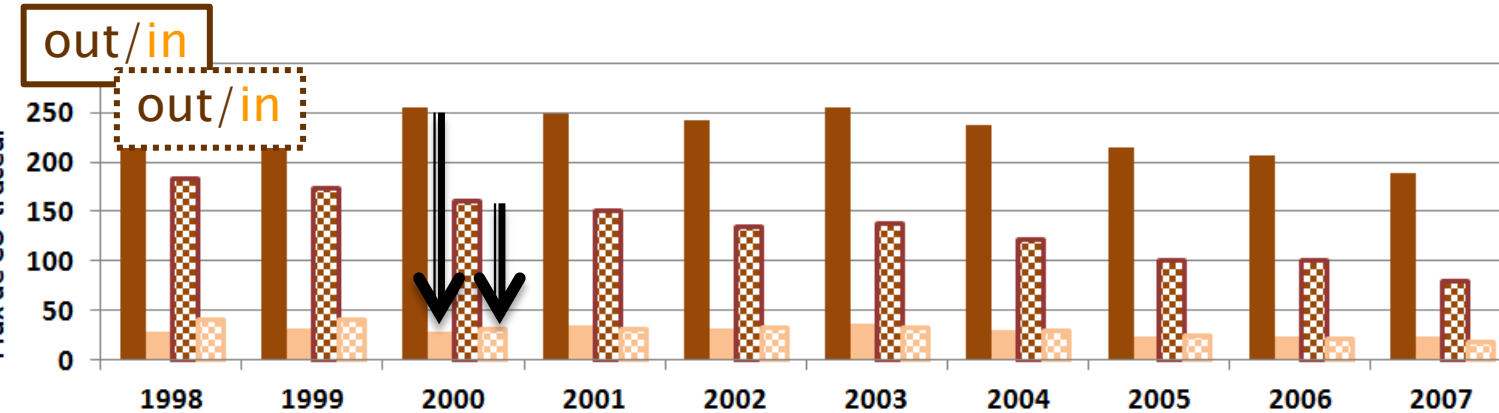
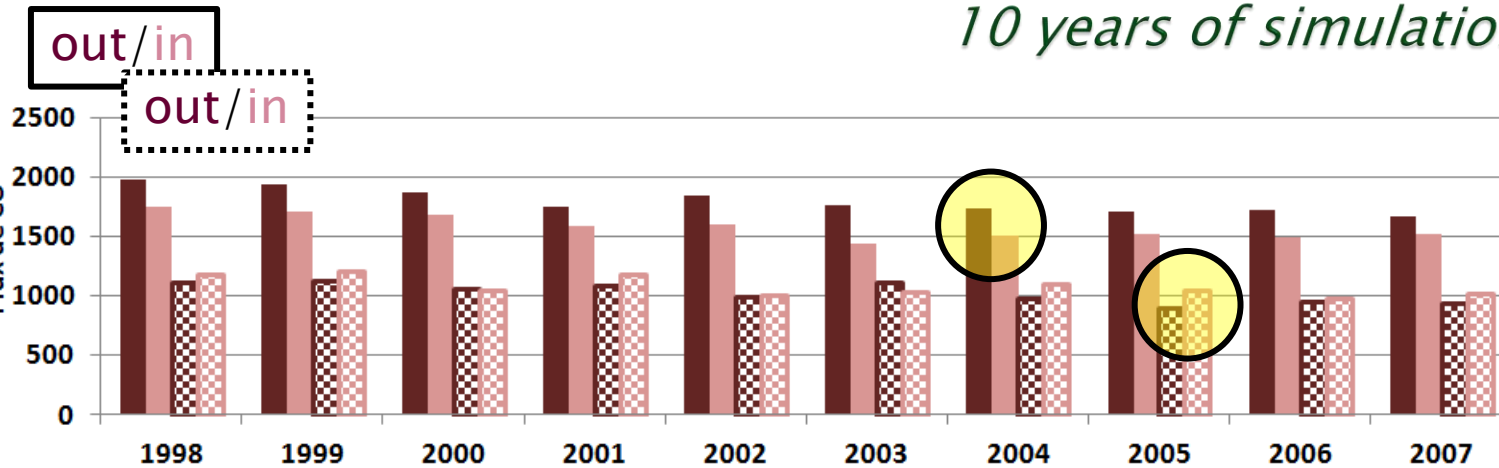
BeNeLux



Milan

CO

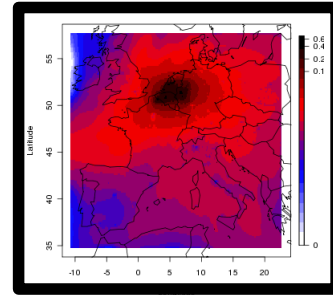
CO tracer
(primary)



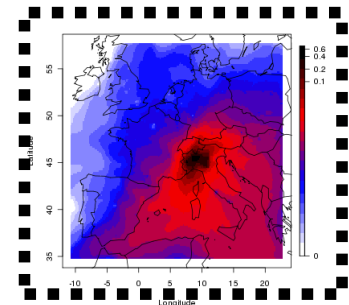
Intensity of
import fluxes
vs export
fluxes

Pollutant export

6 major pollutants
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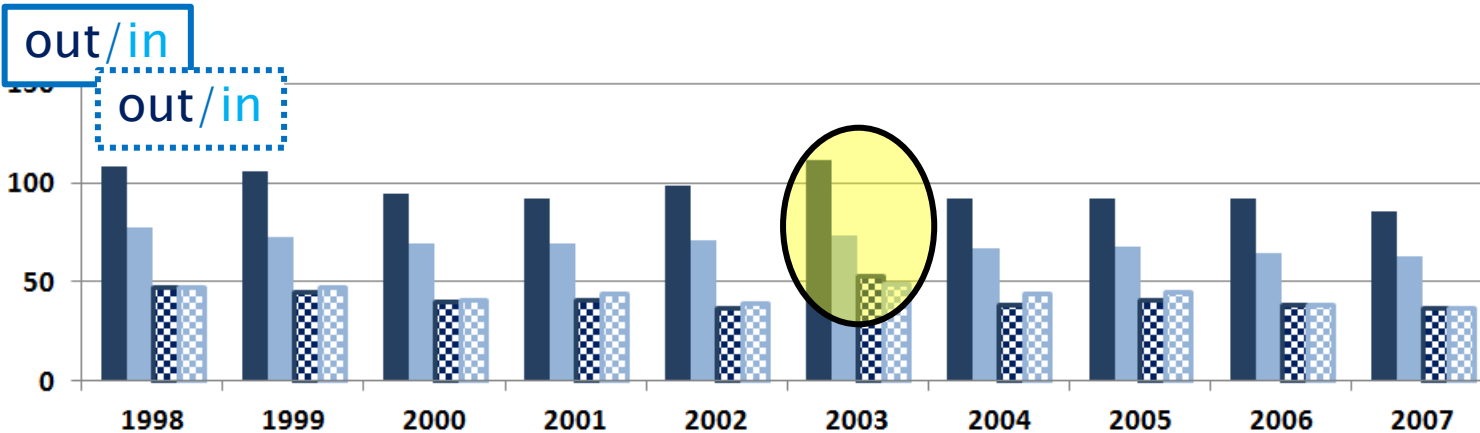
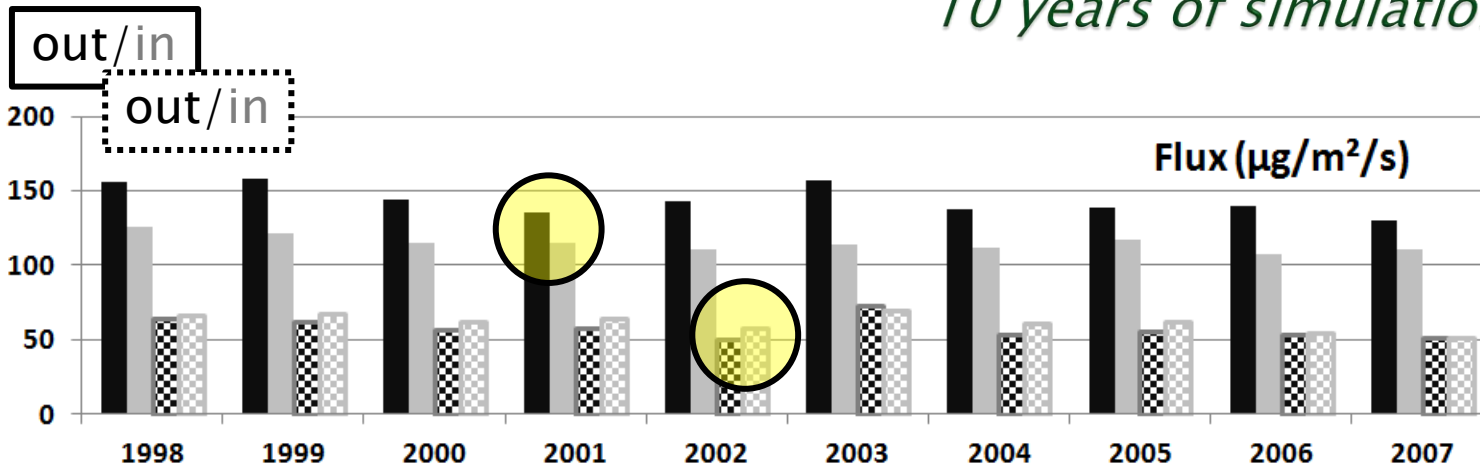
BeNeLux



Milan

PM10

PM2.5



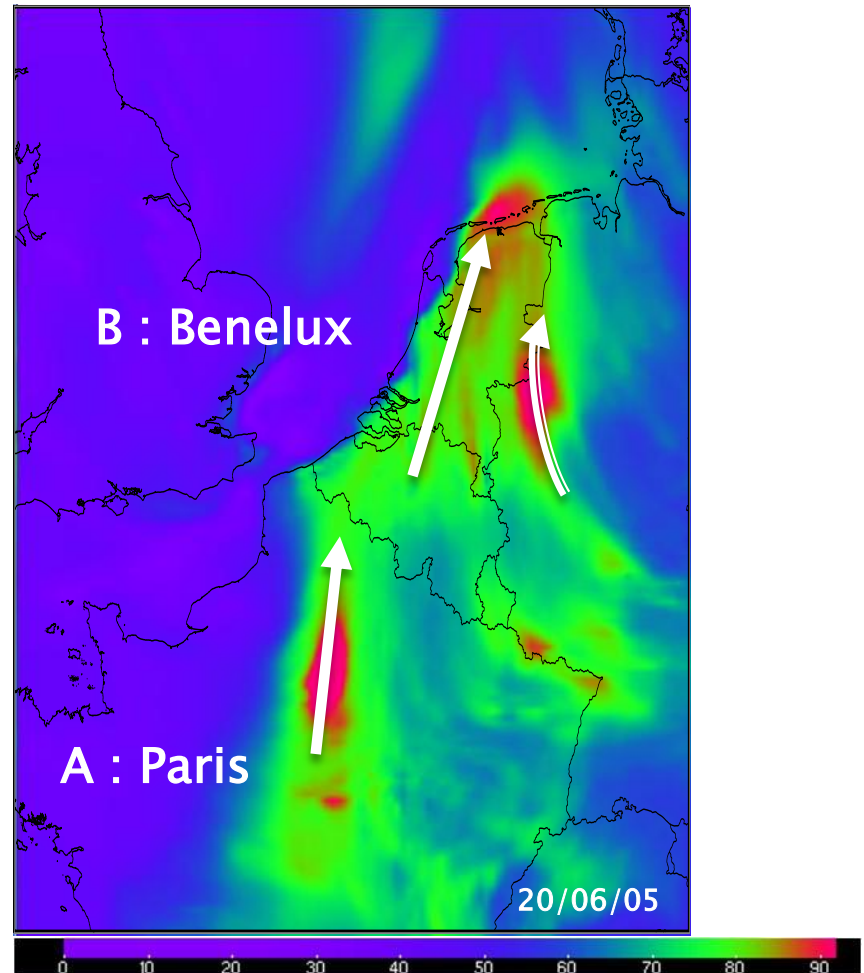
Importance of biogenic aerosol production

Megacity plumes

Oxidant production – Impact of city shape

Characterization of city
pollution plumes

Development of a
complete chemical tracer
approach

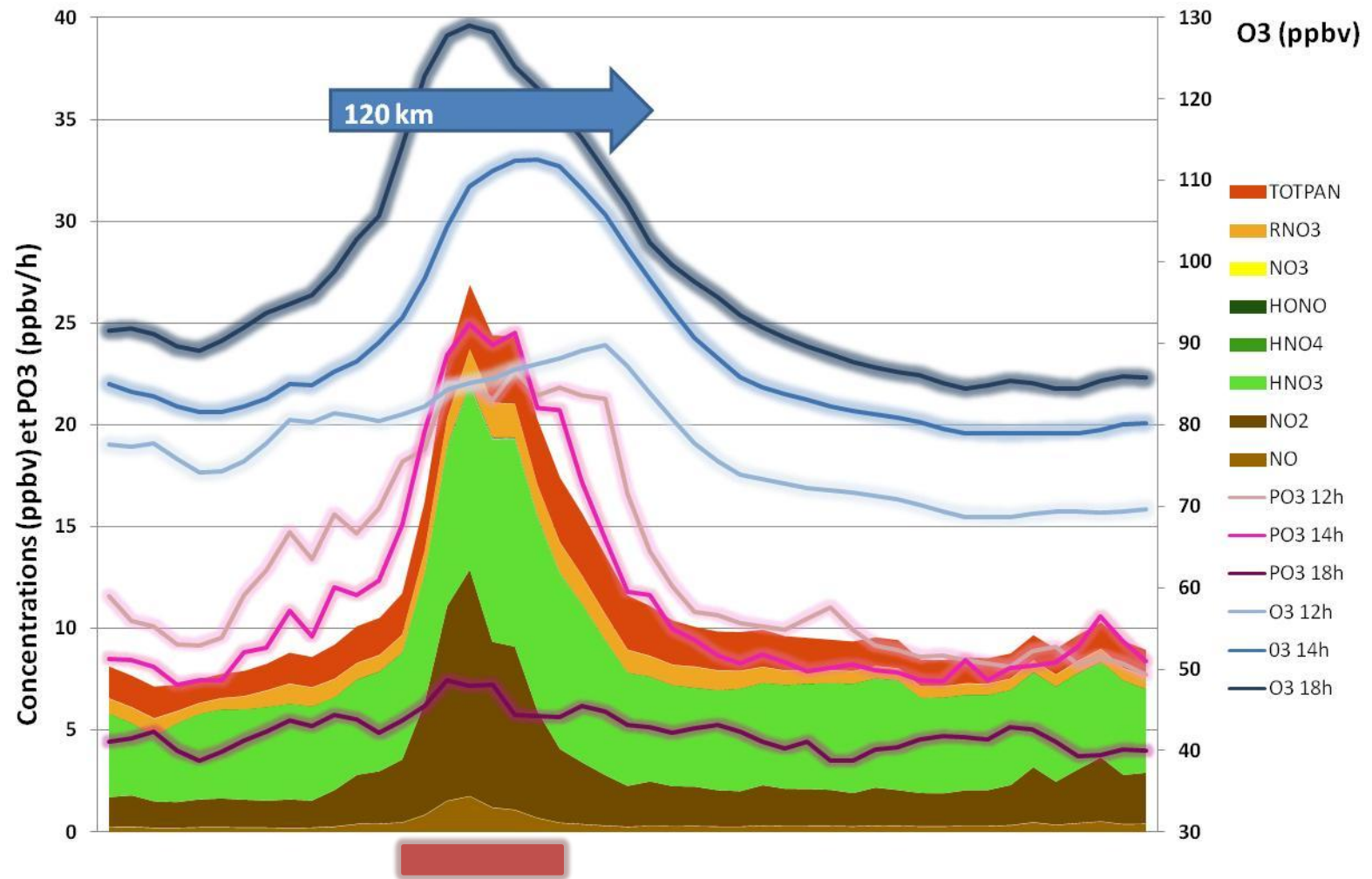


Megacity plumes

Oxidant production – Impact of city shape

20/06/2005
14h

A : Paris



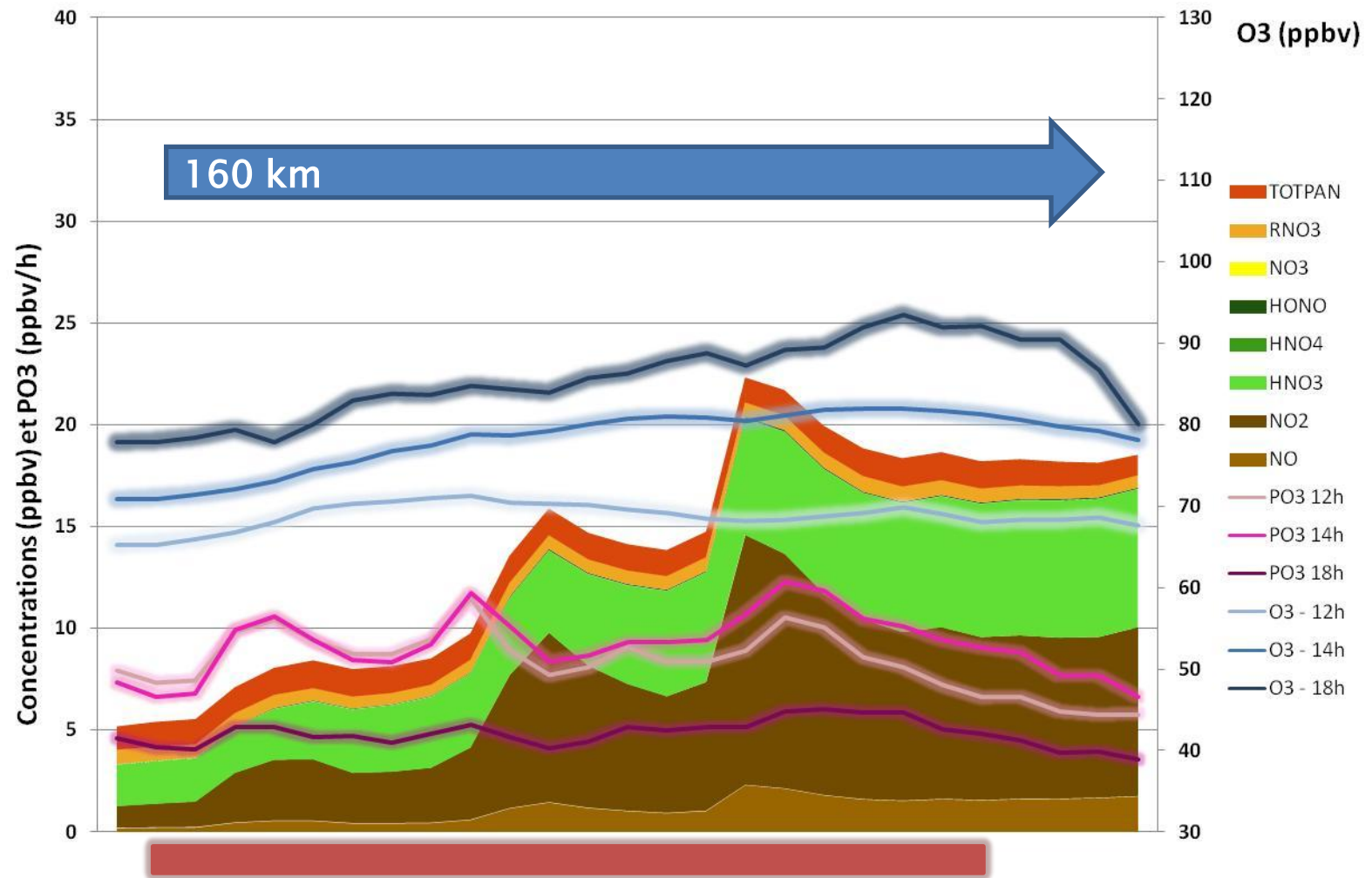
Megacity plumes

Oxidant production – Impact of city shape

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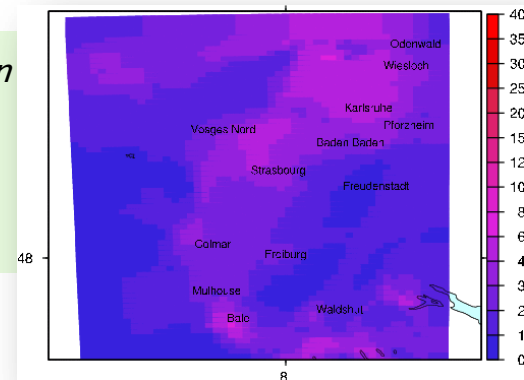
B : Benelux



Megacity plumes

I. Coll, Air Pollution Conference (2006)

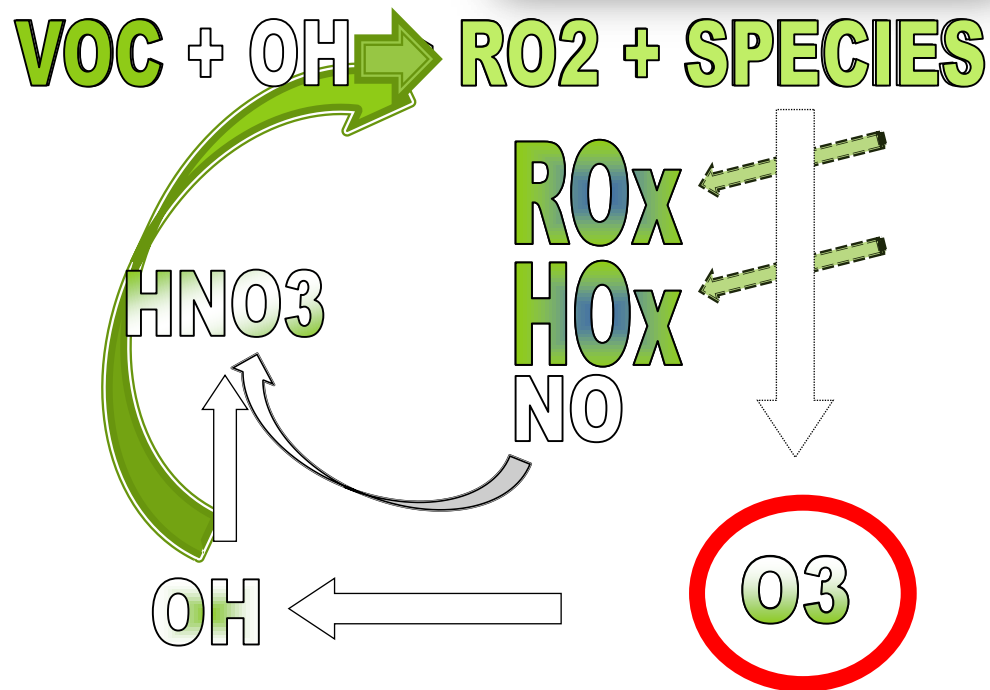
Oxidant production – Impact of city shape



► Chemical tracer approach

Quantify the part of each VOC in ozone production without perturbing the system

Identify the location where every VOC is oxidated and where its products are transported

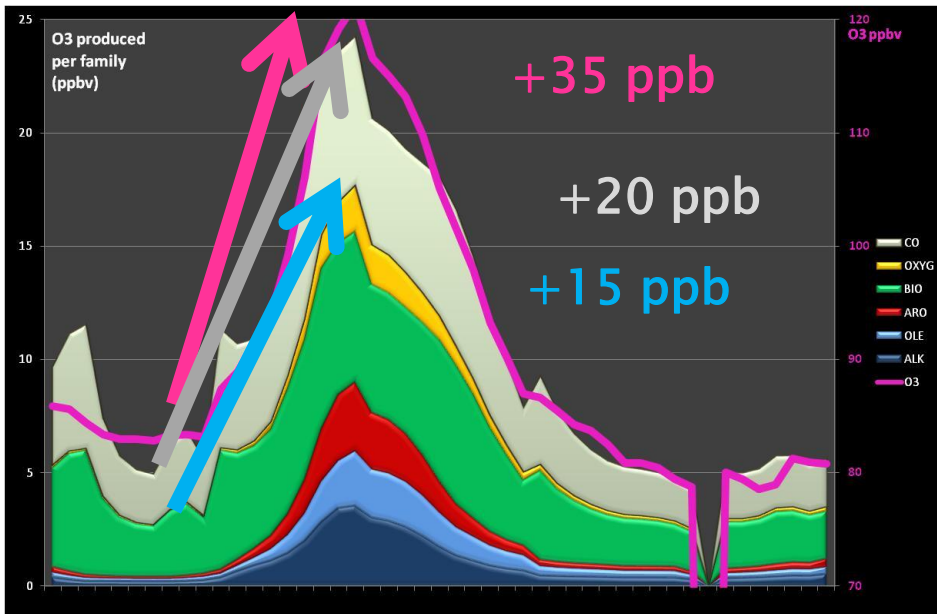


Megacity plumes

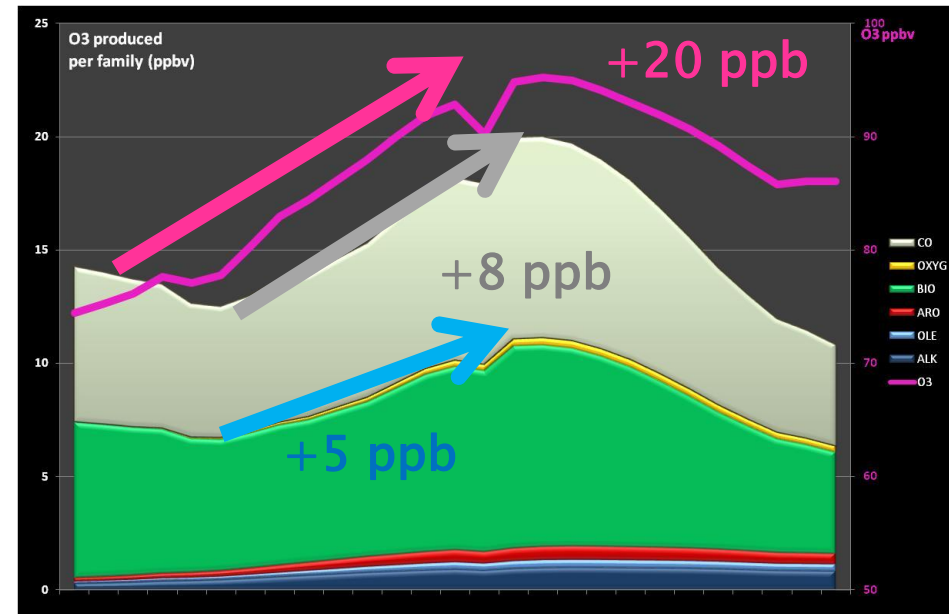
Oxidant production – Impact of city shape

20/06/2005
14h

Paris



Benelux

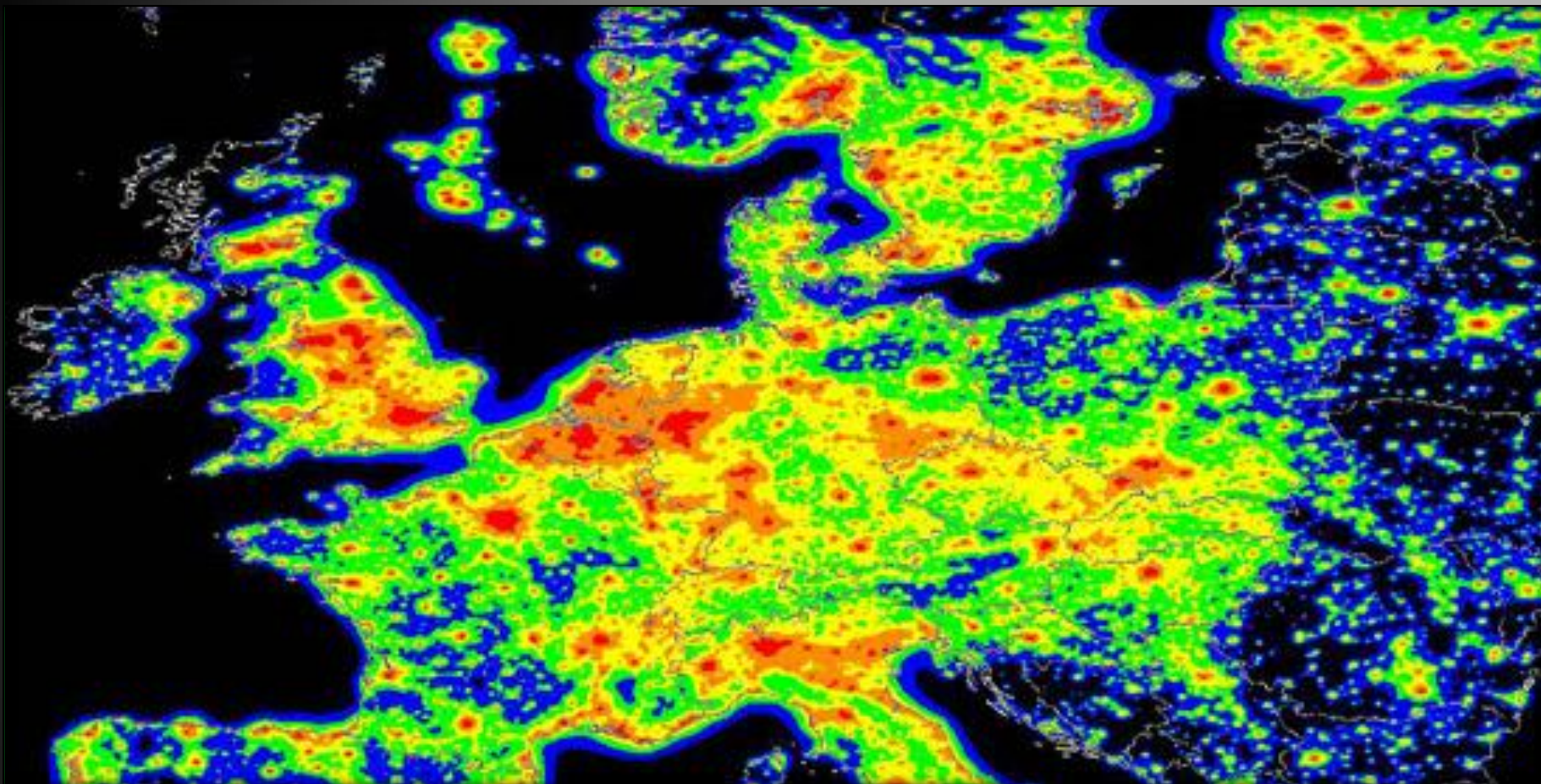


Role of CO

Other precursors

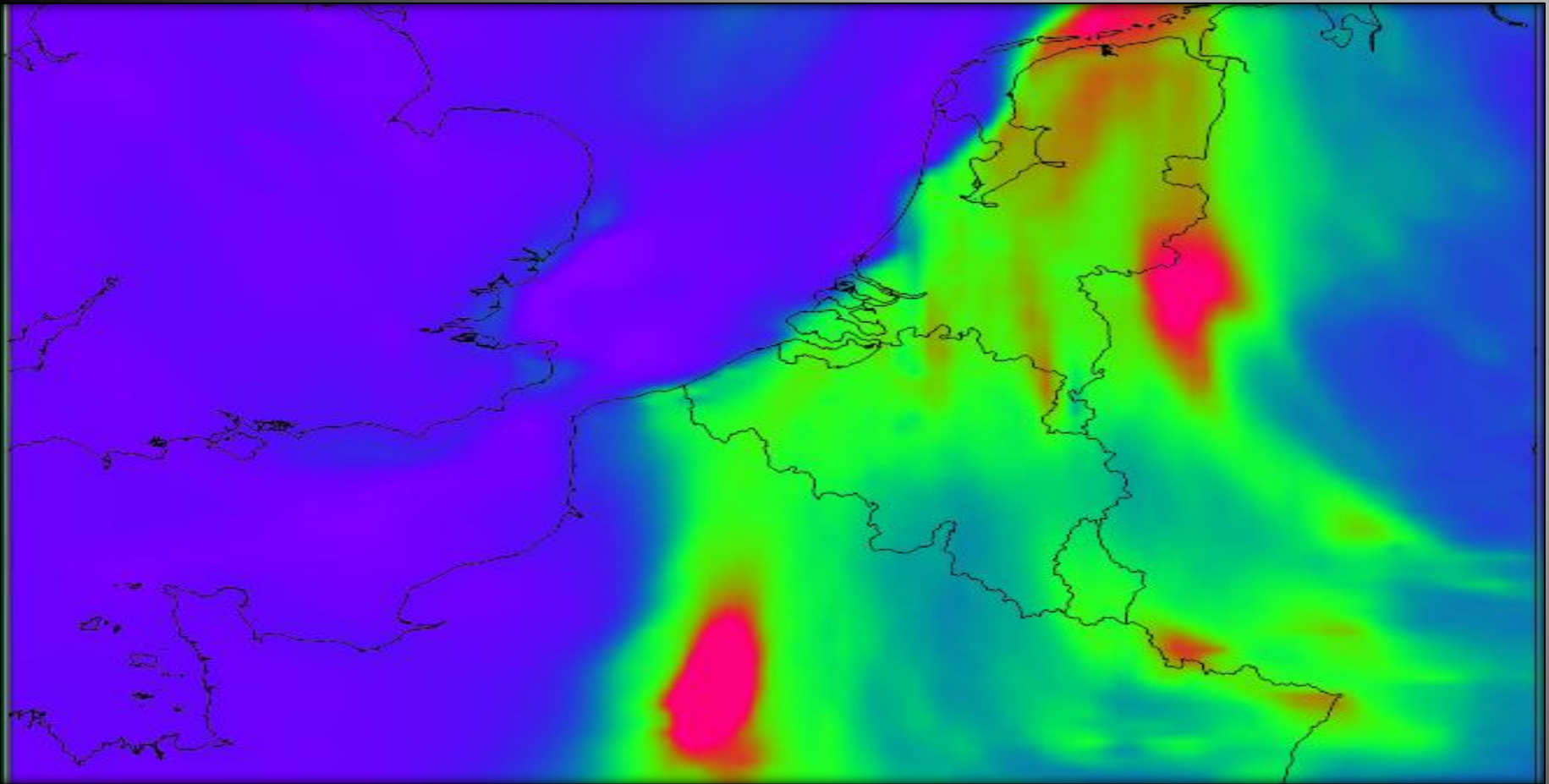
Role of transported precursors ?

- From aloft
- From the boundaries / other cities



The influence of **megacity structure** on regional pollution is a critical parameter for pollutant **transport pathways** and for local to regional **ozone management**. >>

Role of **location** in Europe is also critical



As expected, chemical outflows are very sensitive to the **extent of urban areas** (NO_x supply) >>>

Tracers are a very promising method for the identification of the **species most participating in O₃ production** at various scales of the **distance of impact** of reactive primary pollutants
CO / boundary conditions

Thanks for your attention