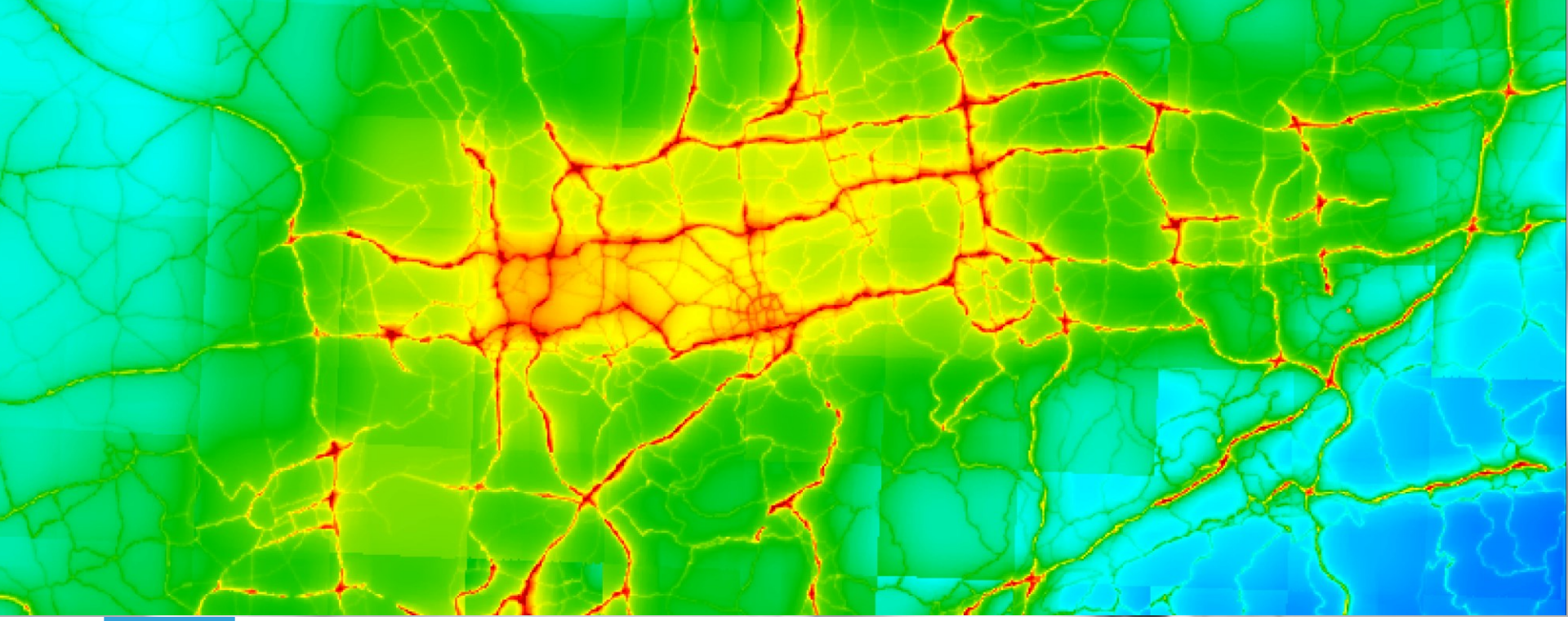


DEVELOPING A METHOD FOR HIGH-RESOLUTION ANNUAL CONCENTRATION ASSESSMENT AND SCENARIO ANALYSIS FOR NO_2 FOR THE WHOLE OF EUROPE

Wouter Lefebvre, Bino Maiheu, Hans Hooyberghs, Stijn Janssen, Lisa Blyth

ASSESSING NO_2-EXPOSURE IN EUROPE

Introduction

- EU Service contract 070201/2015/SER/717473/C.3 for DG ENV – Improved Tools for Assessing NO_2 Exposure
  - Propose methods and tools that are coherent with the exposure metric used when deriving the appropriate exposure response relationships and compatible with currently used integrated assessment modelling tools of the EU.

- Project team
  - VITO
  - King's College London

- What happened in the project…
  - Expert consultation meeting 2016 => recommendations
  - Sensitivity studies w.r.t. exposure assessment => Talk Bino Maiheu tomorrow
  - Implementation & tests improved EU-wide methodology for NO_2 exposure assessment

RECOMMENDATIONS FOR UPDATE OF NO_2 EXPOSURE METHODOLOGY

- Applicable for whole of Europe
- Finer scale than existing chemistry-transport models (CTMs)
- Take into account urban and open street NO_2 increments. Resolution of about 100m.
- Annual averages are most important.
- Sensitive to emission changes, NO_2/NOx-emission ratio, O_3/NO_2/NO background concentrations, meteorology. Scenario analysis.
- Use of ECMWF (European Centre for Mid-range Weather Forecasts) meteorology: resolution not high enough but no better EU-wide data at the moment

Fast…

no LUR…

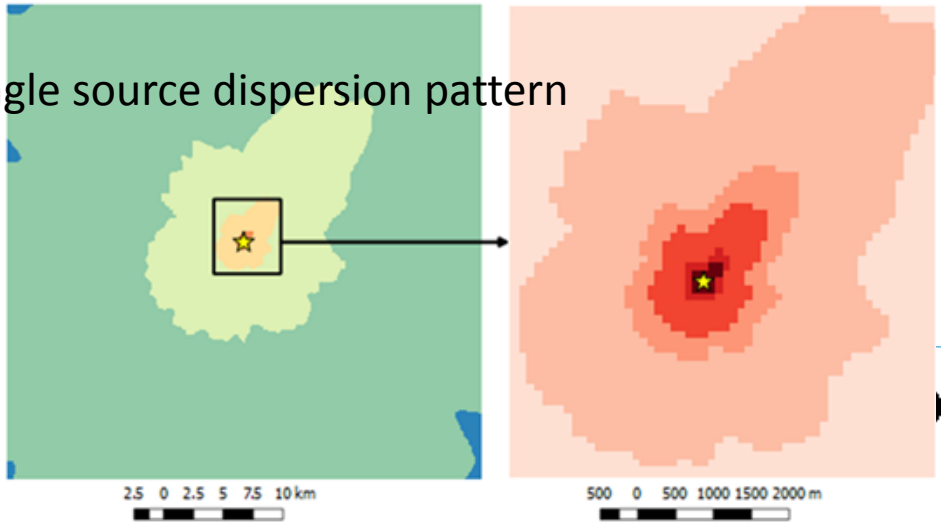
See Presentation of Bino Maiheu tomorrow!

METHODOLOGY

Kernel method

- Gaussian dispersion model (IFDM, Immission Frequency Distribution Model)
  - Often used in policy support in Flanders
- Precomputed single source annual dispersion kernels
  - Different meteo conditions (stability, wind speed …)
  - Point sources
  - Line segments (100m)
  - Unit emission strength
- Apply pattern repeatedly for all sources
- Kernel resolution: 25m

Single source dispersion pattern



METHODOLOGY

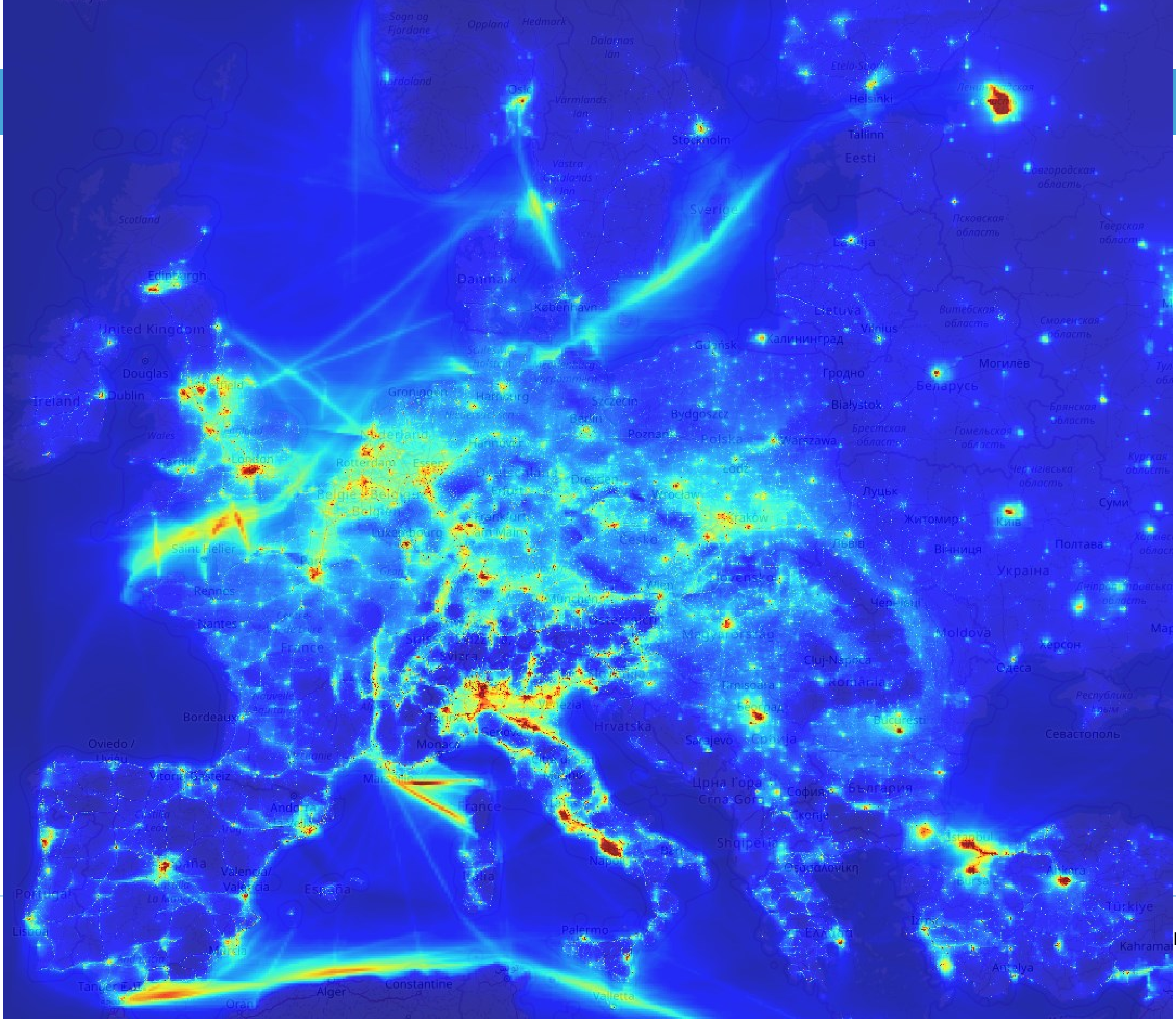
Kernel method

- Road sources: Open Transport Map
  - Up to SecondClass Roads

- Redistribution of Chimere 7x7 km² emissions on road network within grid cell based on proxy.
  - No redistribution between grid cells

- Calculation on annual mean
  - Chemistry on annual mean. Calculation of equilibrium constant => supposed to be constant in grid cell

- Model choice (here IFDM) for calculation of kernels: not essential part of methodology (can be done with other models)


Sogn og Fjordane
Oppland
Hedmark
Dalarnas län
Hordaland
Oslo
Värmlands län
Helsinki
Tallinn
Stockholm
Eesti
Västra Götalands län
Sverige
Scotland
Latvija
Edinburgh
Danmark
København
Lietuva
Vilnius
United Kingdom
Калининград
Gdańsk
Douglas
Могилев
Гродно
Dublin
Ireland
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Szczecin
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Одеса
Timişoara
România
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Venezia
Torino
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Genova
Beograd
Bucureşti
Севастополь
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Црна Гора
Crna Gora
София
България
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İstanbul
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Θεσσαλονίκη
Ankara
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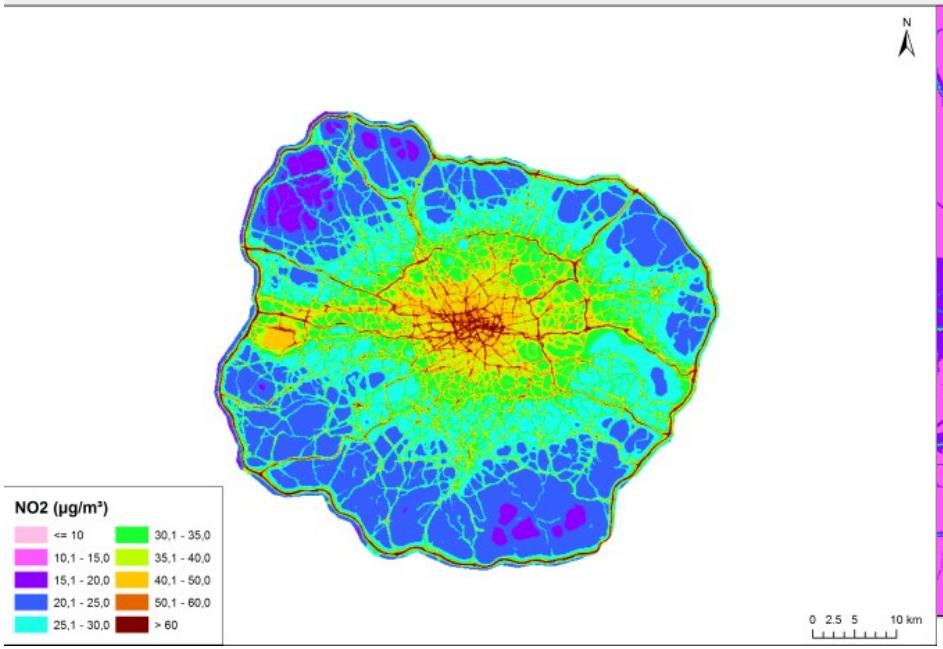
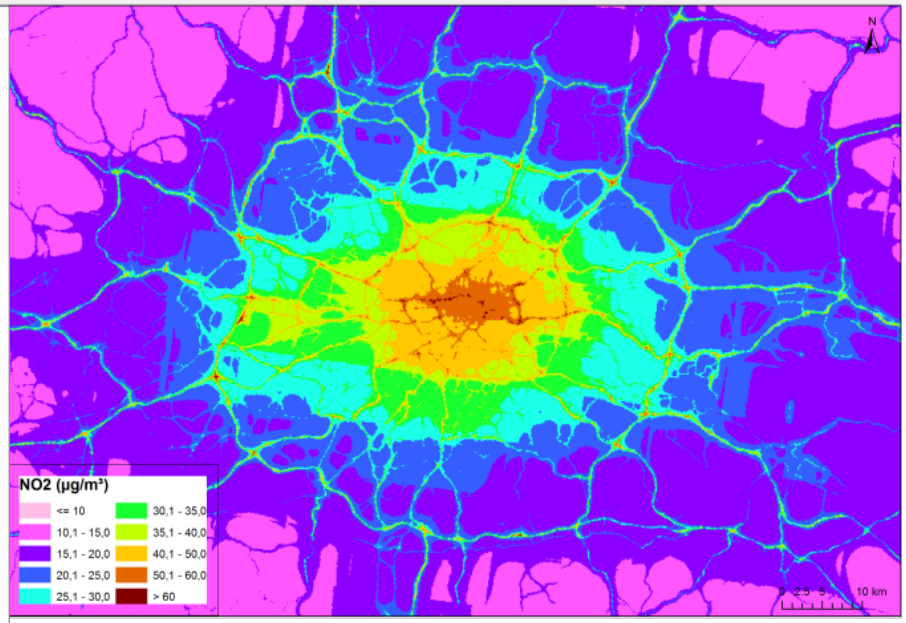
Bursa
Türkiye
Lisboa
Murcia
Palermo
Kahraman
Antalya
Constantine
Alger
Oran
Valletta

APPLICATION

How do the kernel – maps compare to the expert maps based on local knowledge

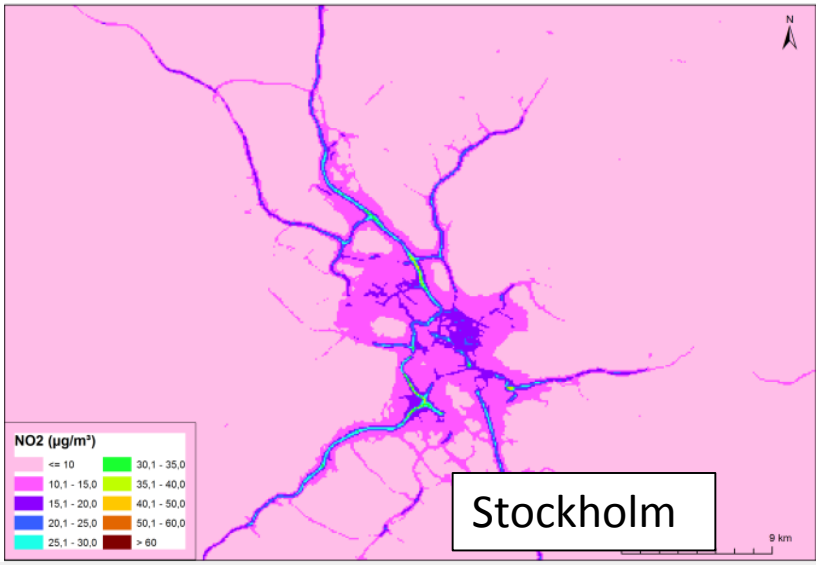
- Produced annual averaged NO_2 maps for major EU cities (few minutes per city)
- Two **different years (2012 vs. 2010)**
- Just comparison to **test feasibility** & obtained patterns using OSM redistribution

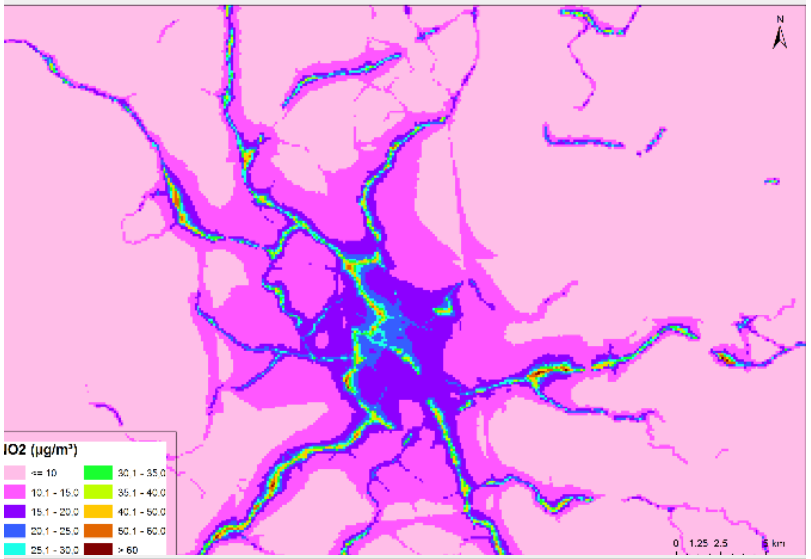


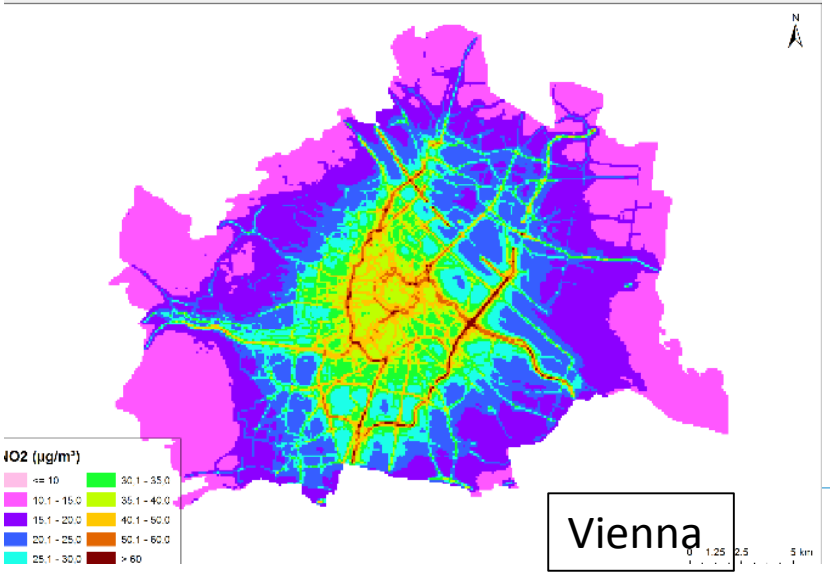


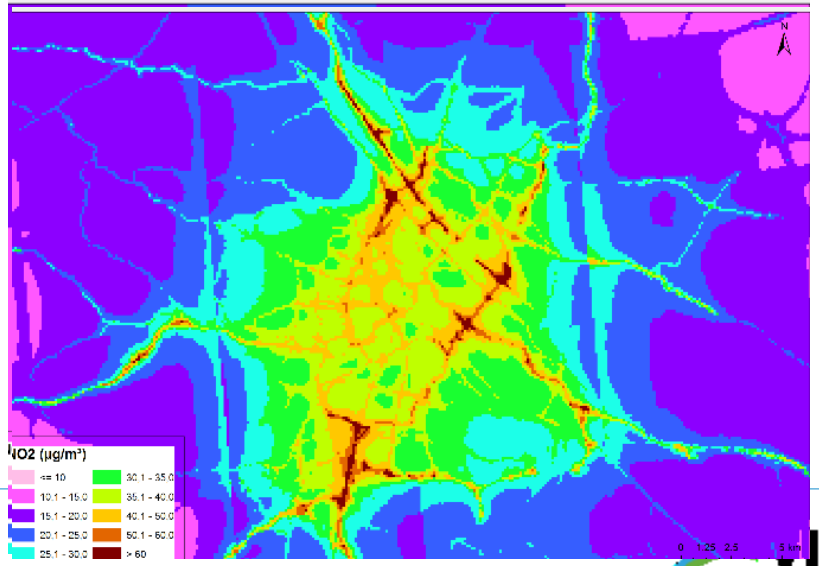
Local maps

Kernel



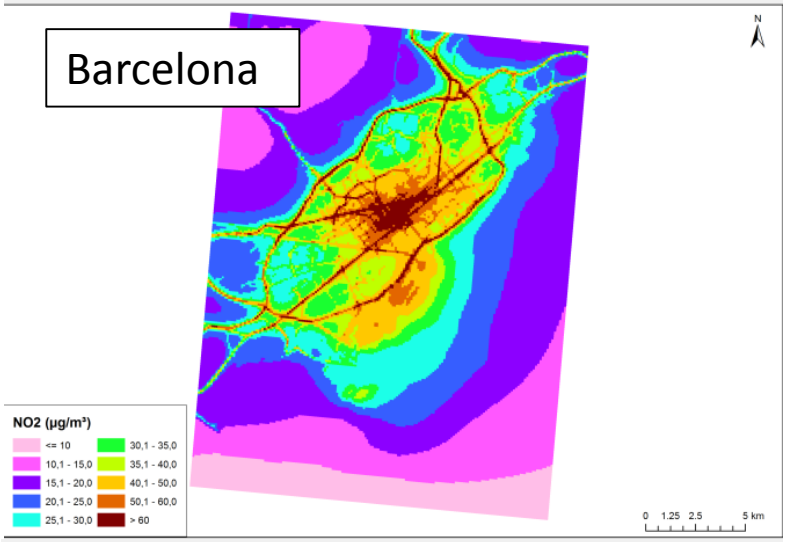


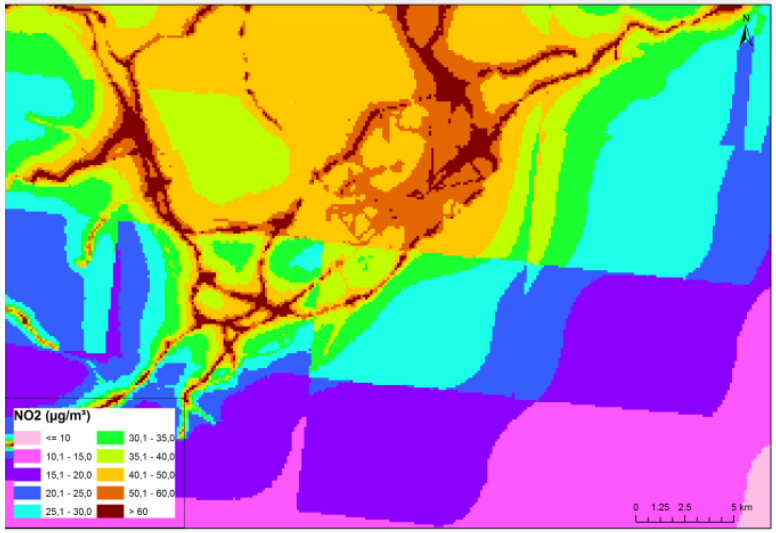


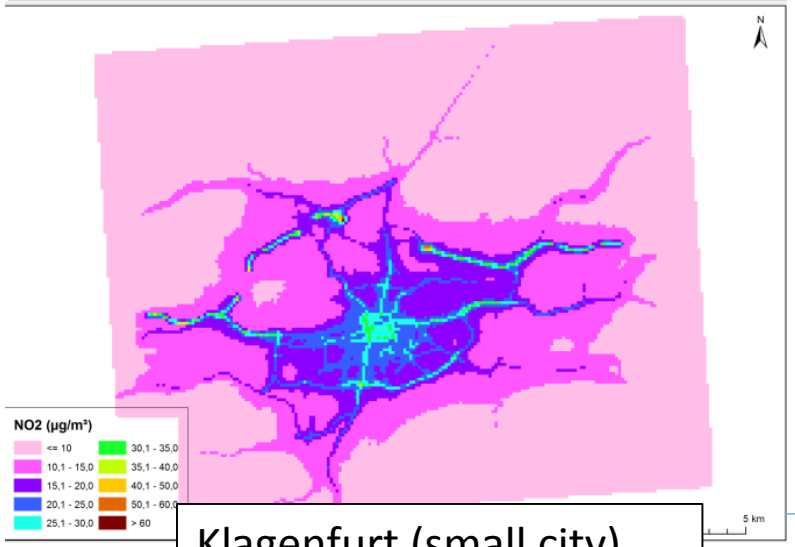


Local maps

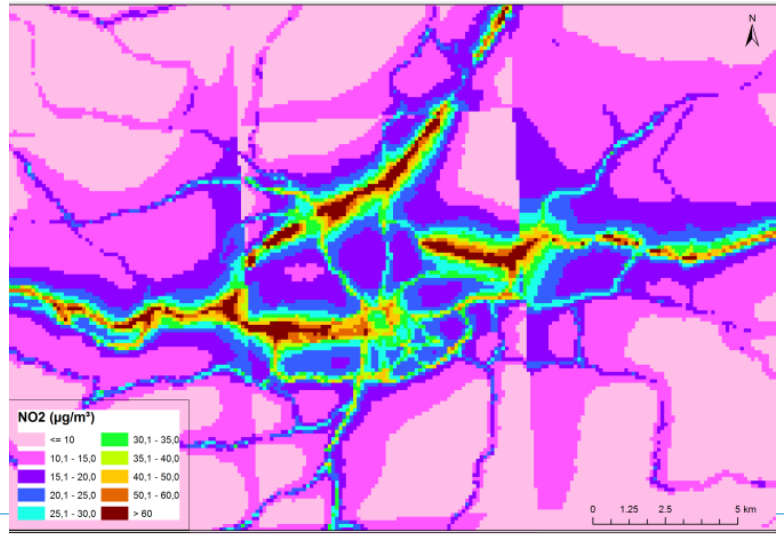
Kernel







Klagenfurt (small city)



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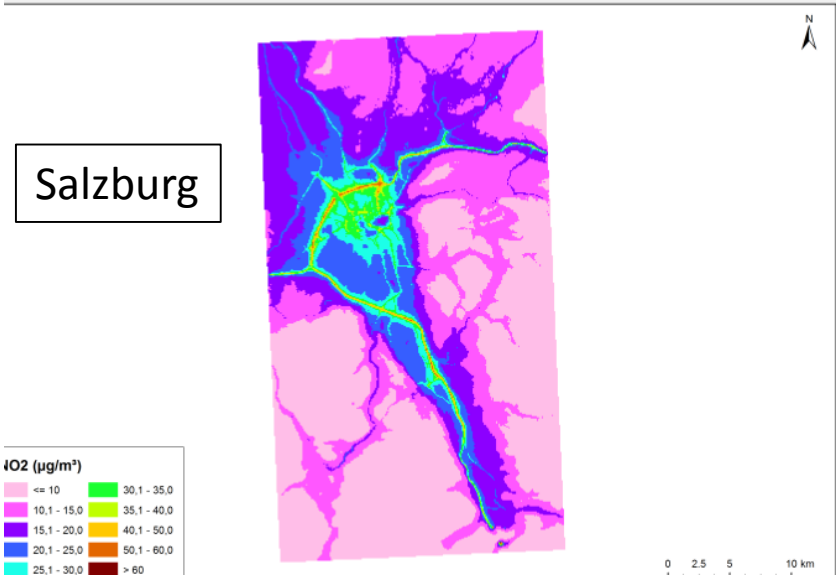
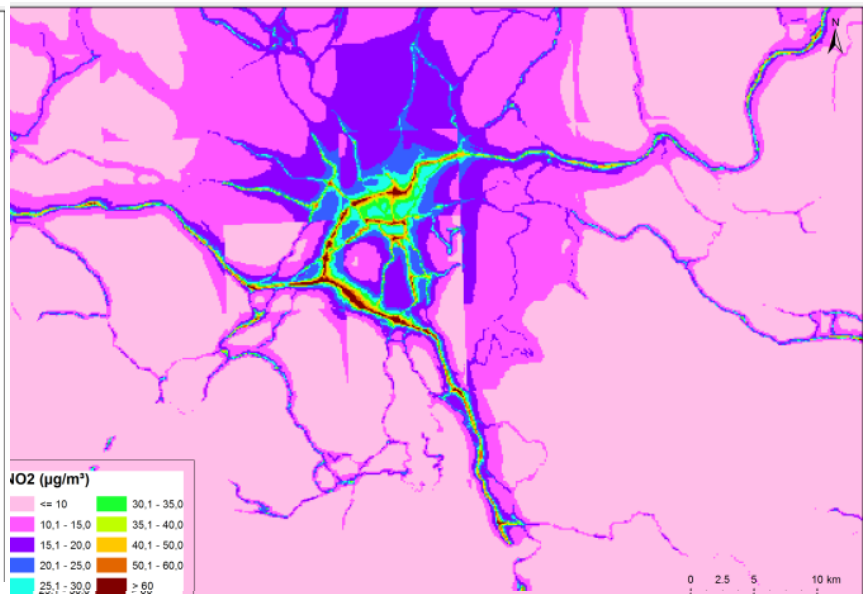
Local maps

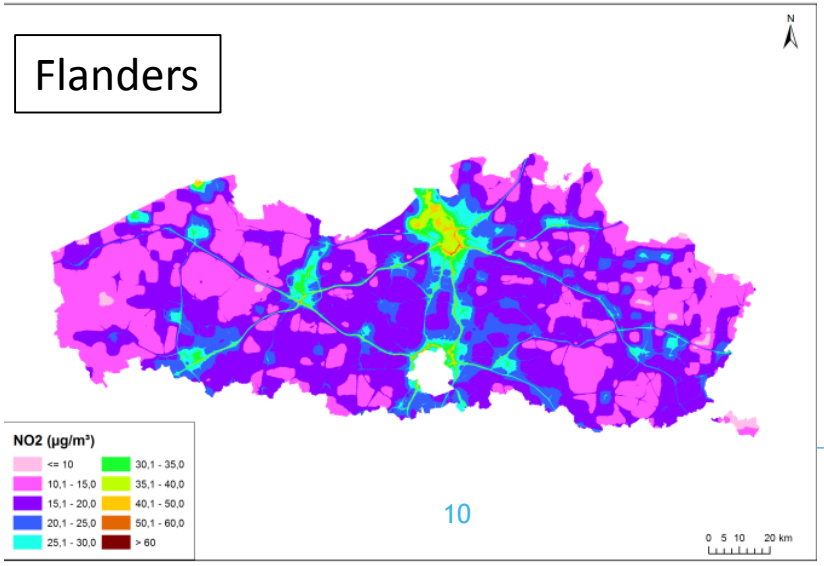
Kernel

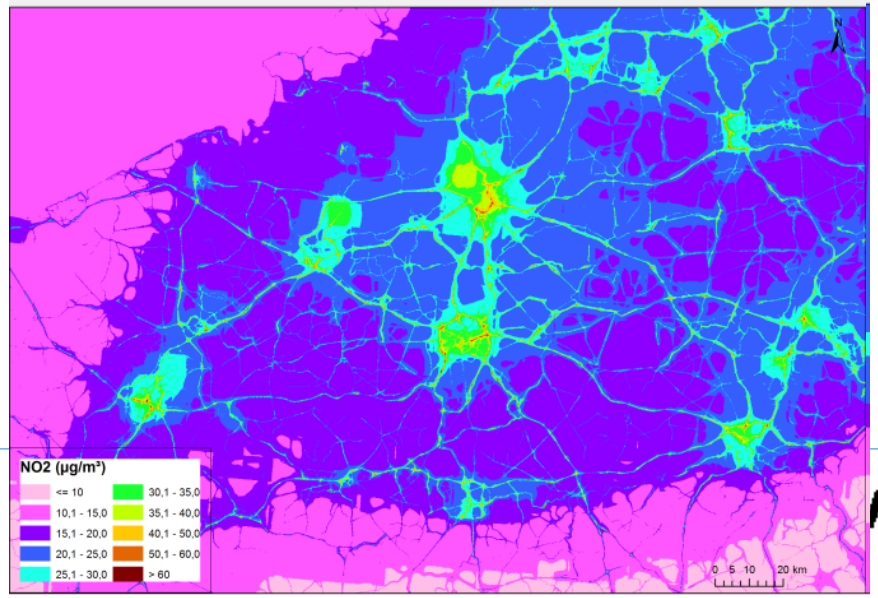
Salzburg





Flanders





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VALIDATION

All EU (Airbase) non-canyon measurement locations (2459), for the year 2010.

No measurement data used in modelling.

Indicator	Inclusive traffic stations		Without traffic stations	
	CHIMERE	CHIMERE + kernel	CHIMERE	CHIMERE + kernel
BIAS	-28%	-19%	-16%	-10%
RMSE	56%	50%	46%	43%
BCRMSE	48%	46%	43%	42%
R^2	0.34	0.43	0.52	0.55
Slope_orthogonal	0.96	1.11	1.49	1.50
Intercept_orthogonal	-6.15	-7.70	-13.44	-12.51
% stations fulfilling the MQO	61%	68%	76%	80%
MQI	2.14	1.89	1.47	1.37

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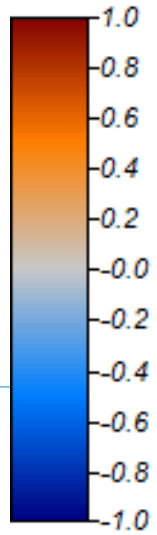
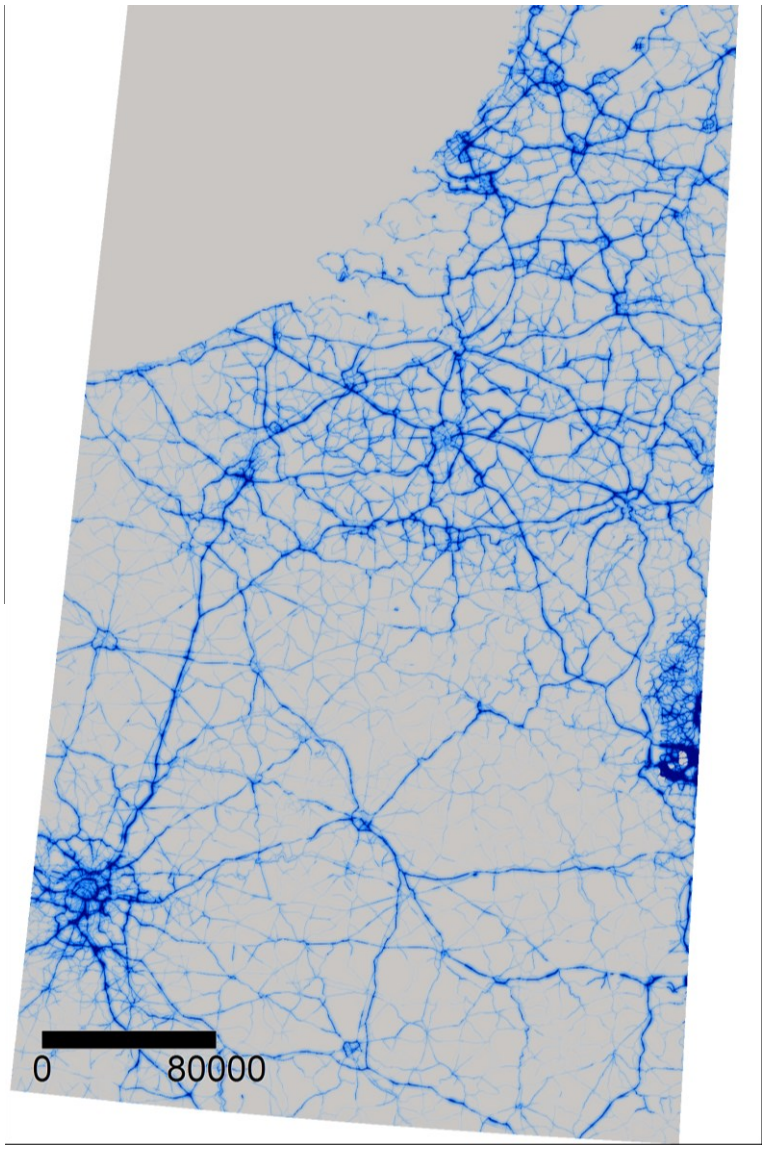
STRENGTHS AND LIMITATIONS

- Generic datasets (open transport maps, open street maps):
  - EU-wide
  - But not as good as local datasets
- Possibility to calculate scenarios:
  - directly on emission changes
    - Low Emission Zones
    - Future years
    - Different fleet compositions
    - …
- Fast calculation (European map at 125m: 3h on 24CPUs)
- Coupling to GAINS -system

(Greenhouse Gas- Air Pollution Interactions and Synergies)





CONCLUSIONS

- Kernel method increases resolution without high calculation time
- Main differences between bottom-up and kernel maps: in the background concentrations