# Finding the right solutions: Concawe's $NO_x$ /$NO_2$ Source Apportionment Tool

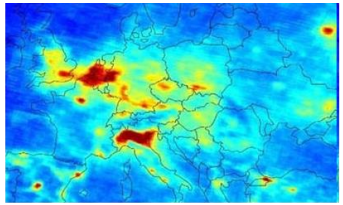
Bino Maiheu, VITO

## OUTLINE

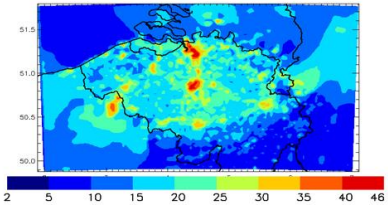
- Air quality at multiple scales
- Importance of local source apportionment
- Introducing the Concawe EU-wide $NO_2/NO_x$ source apportionment tool
- Analyses and discussion
- Conclusions and outlook

- Air quality is a multi-scale phenomenon
- Strong spatial variability depending on location type

Continental scale:
Regional hotspots

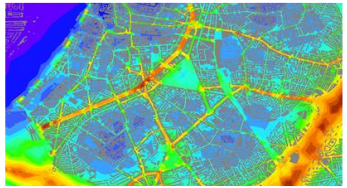


Regional scale:
City hotspots

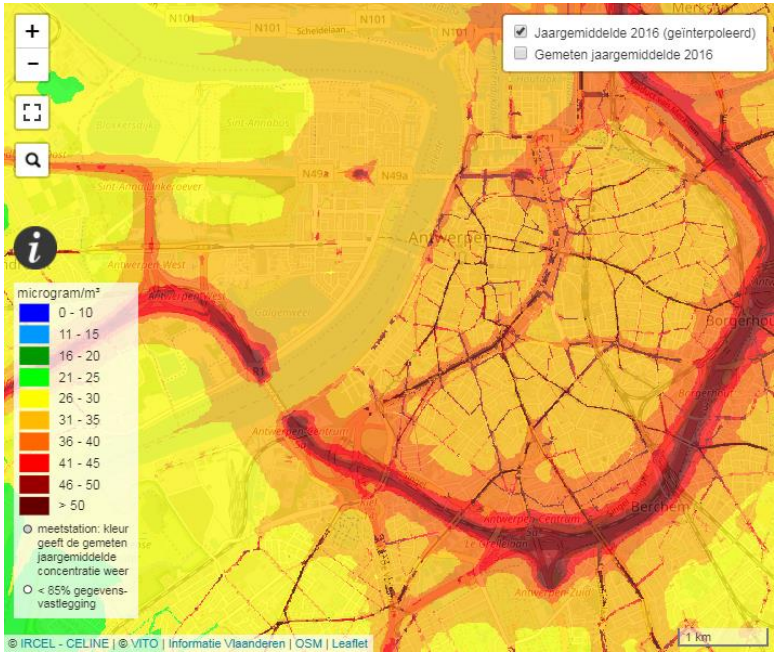



Urban scale:
Highway hotspots

Local scale:
Steet canyon hotspots



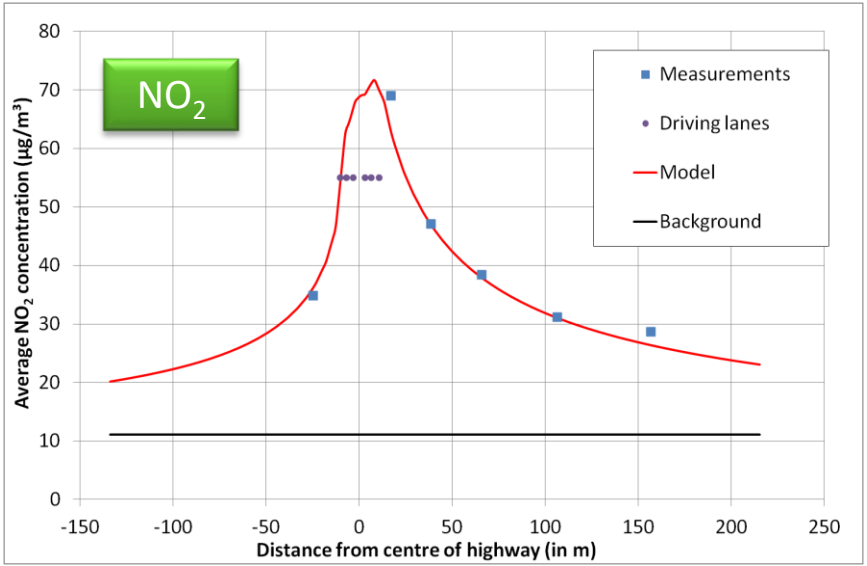
# SPATIAL VARIABILITY IN THE CITY



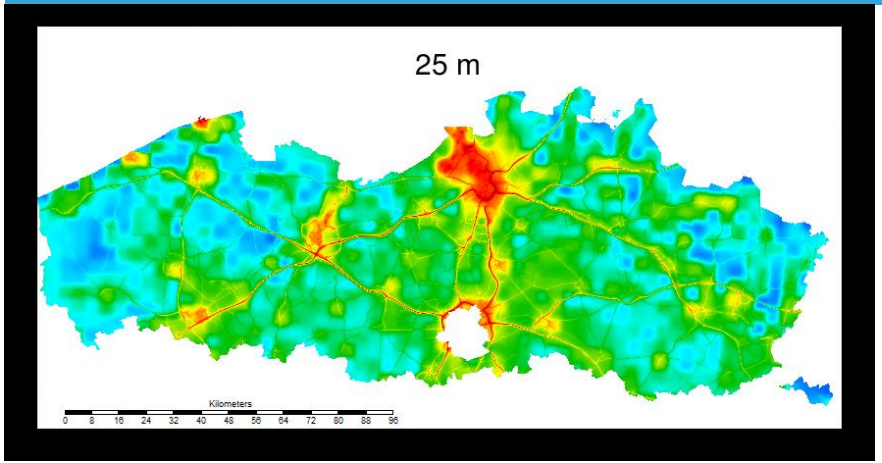

See :
https://www.youtube.com/watch?v=ujB6s5FW4lU

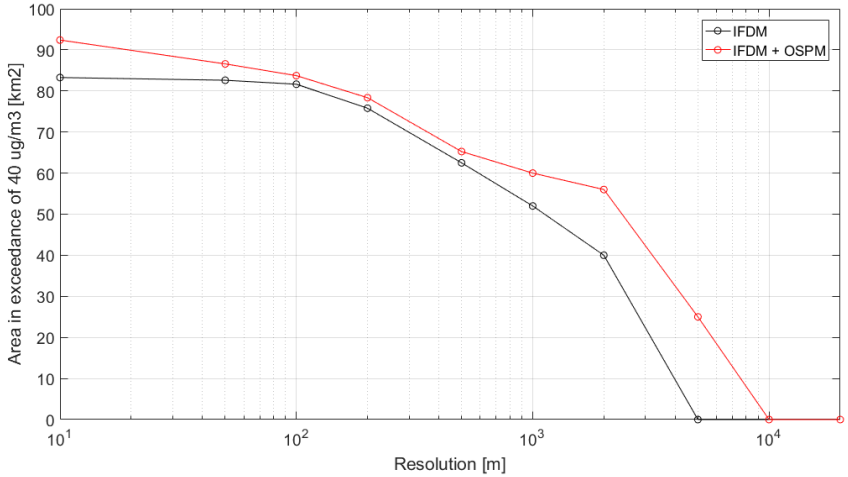
# ROAD SIDE GRADIENTS

- ATMOSYS Highway campaign E40
- April 2012 until February 2013

# IMPLICATIONS OF SPATIAL SCALE

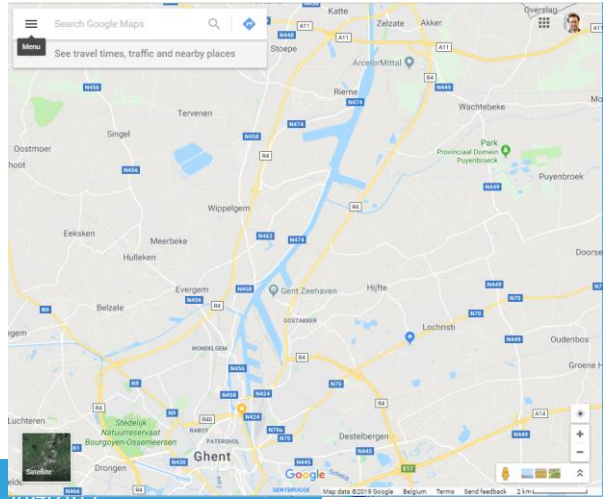


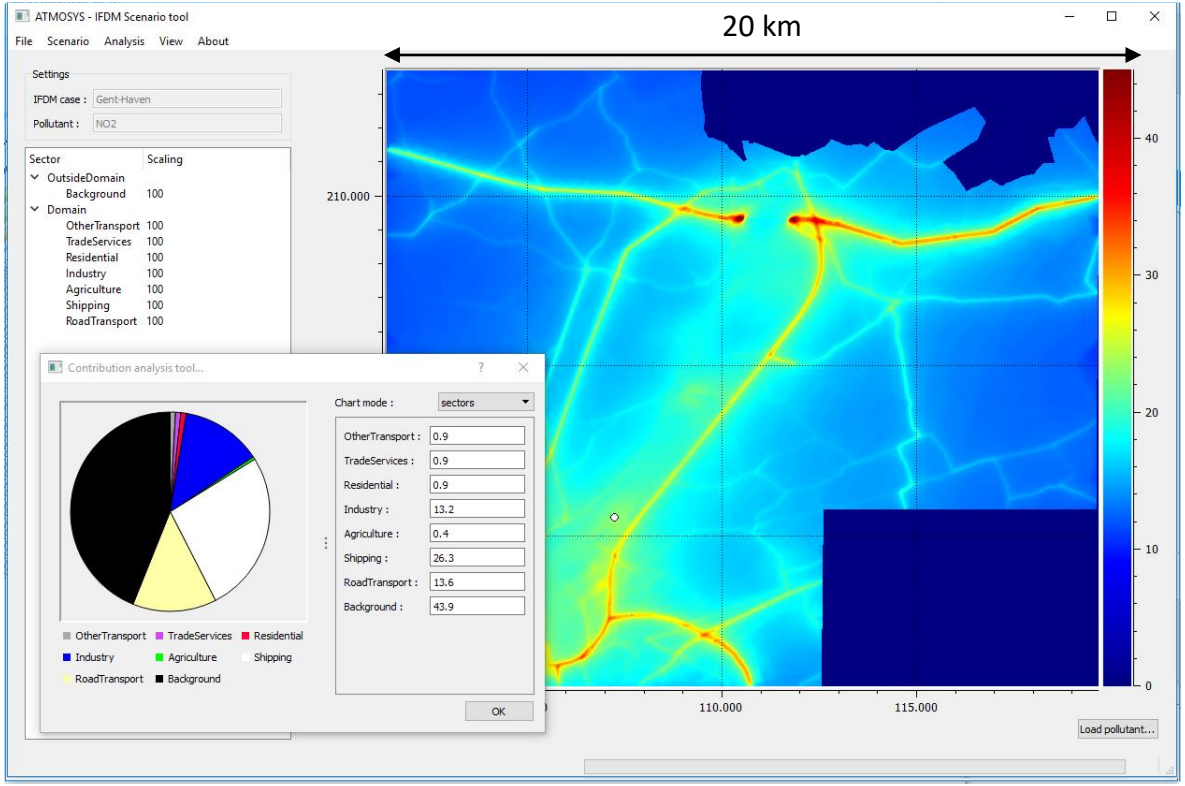




Appropriate methods to resolve spatial scale !

# LOCAL SOURCE CONTRIBUTIONS

- Harbour of Ghent
- Local $NO_x$ SA using bottom up emission data



## CONCAWE $NO_2/NO_x$ SOURCE APPORTIONMENT TOOL

- **Aim :** EU wide source contribution tool for $NO_2/NO_x$
- Taking background sectors into account
- With detailed split of traffic sector : vehicle types, fuel types, EURO norms
- Sufficiently high resolution
  - Trade-off : ~~canyons~~, limited to major roads
  - DG-ENV service contract (070201/2015/SER/717473/C.3) Improved methods for $NO_2$ exposure : http://ec.europa.eu/environment/air/publications/models.htm
  - http://maps.atmosys.eu/eu-no2/
  - Kernel dispersion method
- Methodological + ICT challenges

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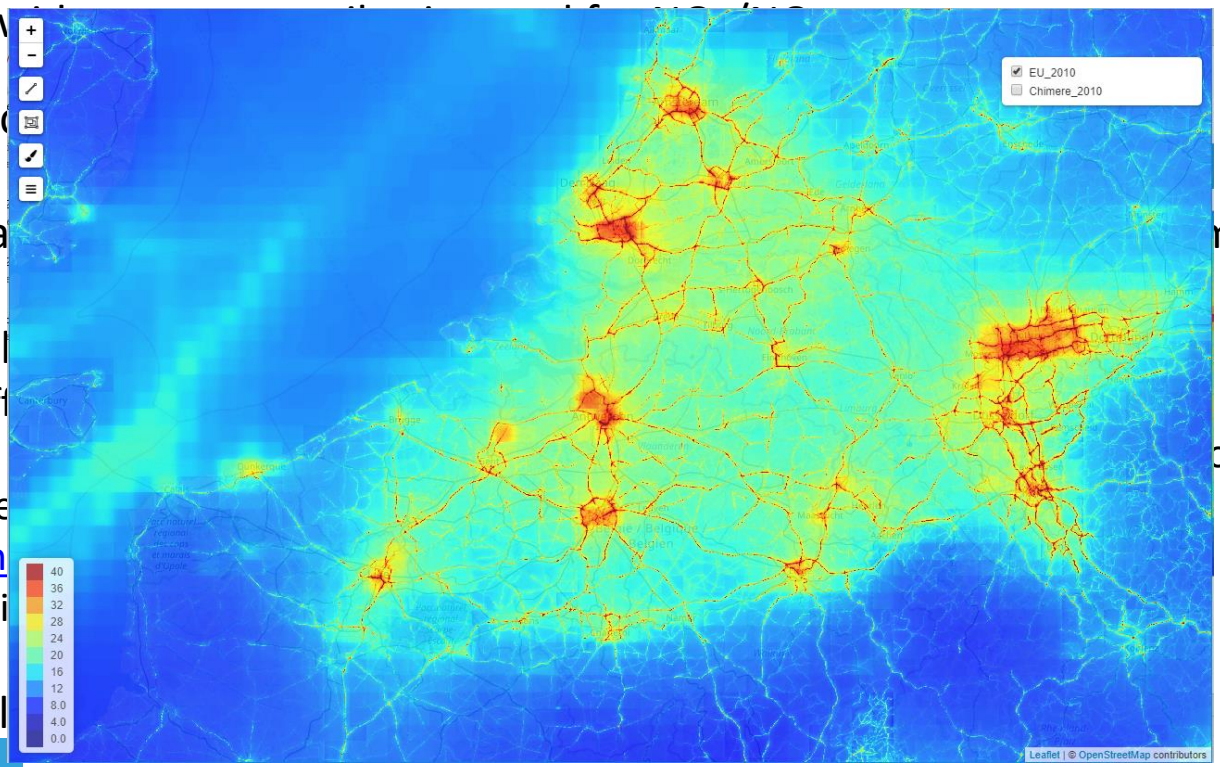
- Methodol



## BRIEF METHODOLOGY

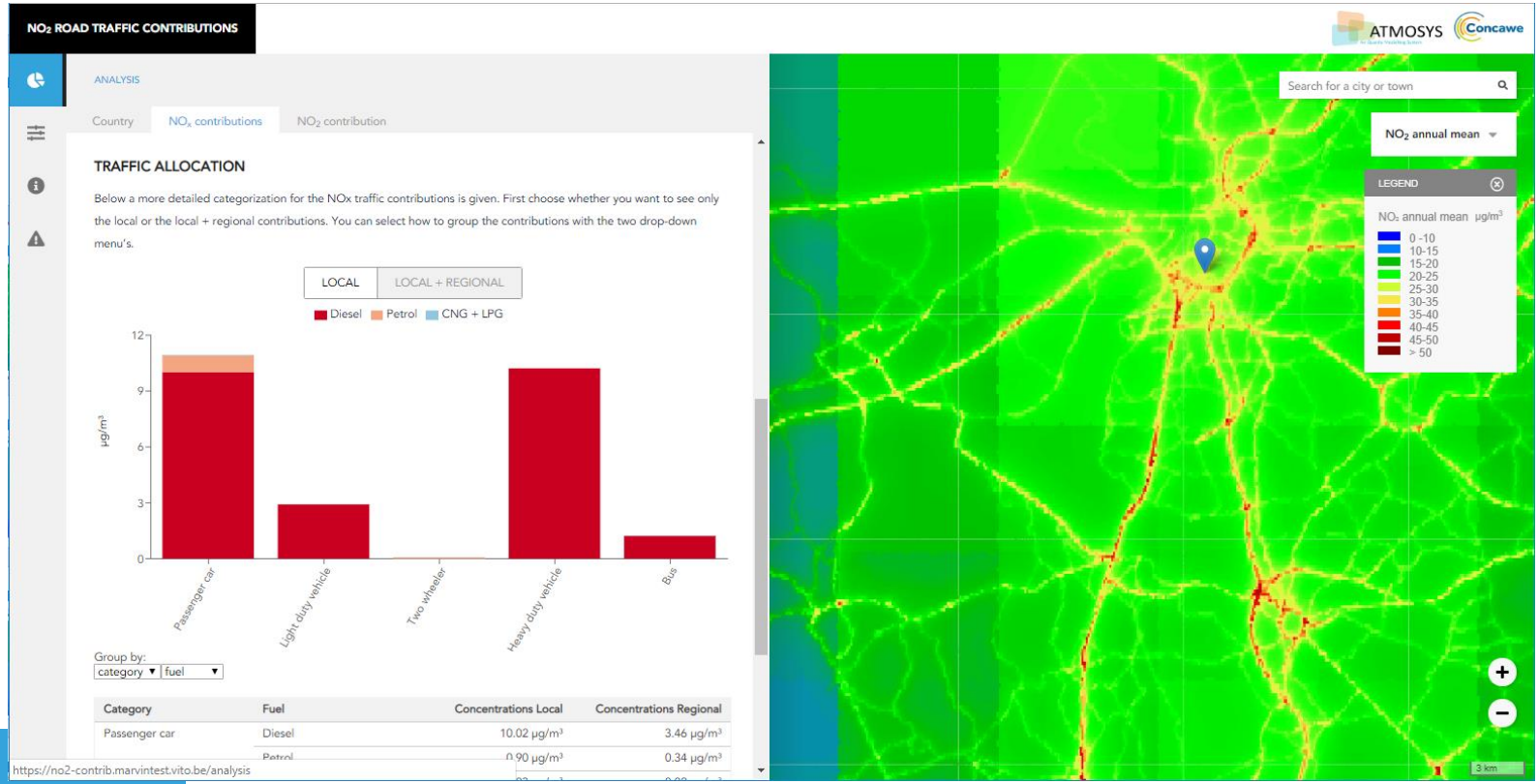
- **Vehicle categories** :
  - *Types* : Passenger Cars, Bus, Heavy Duty, Light Duty & 2-wheelers
  - *Fuel types* : CNG, Diesel, Petrol
  - *EURO norms* : Pre 4, EURO 4, 5, 6
- **Background $NO_x$ source allocation**
  - Starting from CAMS $NO_2/NO_x$ annual averaged map for 2015
  - Using SHERPA screening tool (JRC) : http://aqm.jrc.ec.europa.eu/sherpa.aspx
  - "Local" contribution : emitted within SHERPA 7x7 km cell

- **Emission preprocessing and mapping**
  - Fleet composition : COPERT-V (2014)
  - FASTRACE traffic emission model
  - Mapping traffic intensities : total vkm redistribution OpenStreetMap & Pop. map (JRC GHSL)

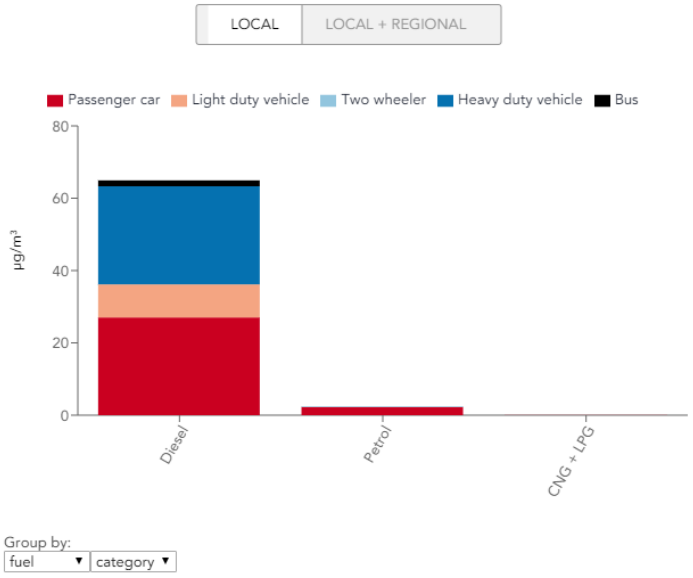
copert

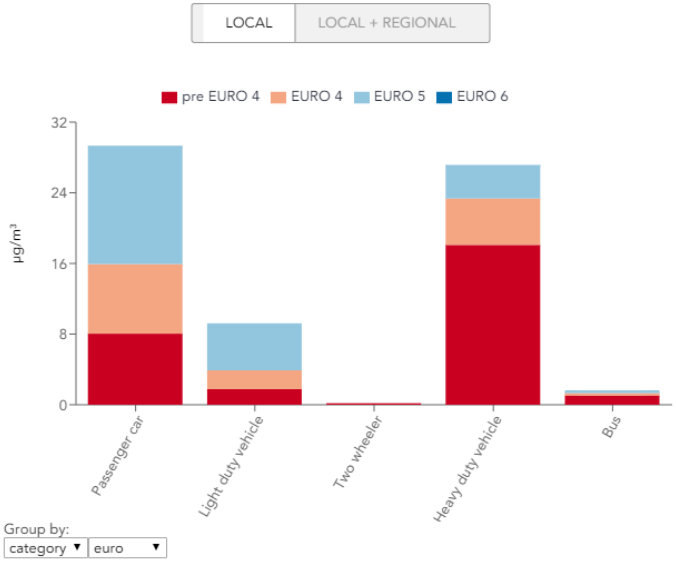

- **High resolution dispersion modelling**
  - Using kernel dispersion method developed in DG-ENV service contract

# TOOL OVERVIEW : $NO_X$ CONTRIBUTIONS



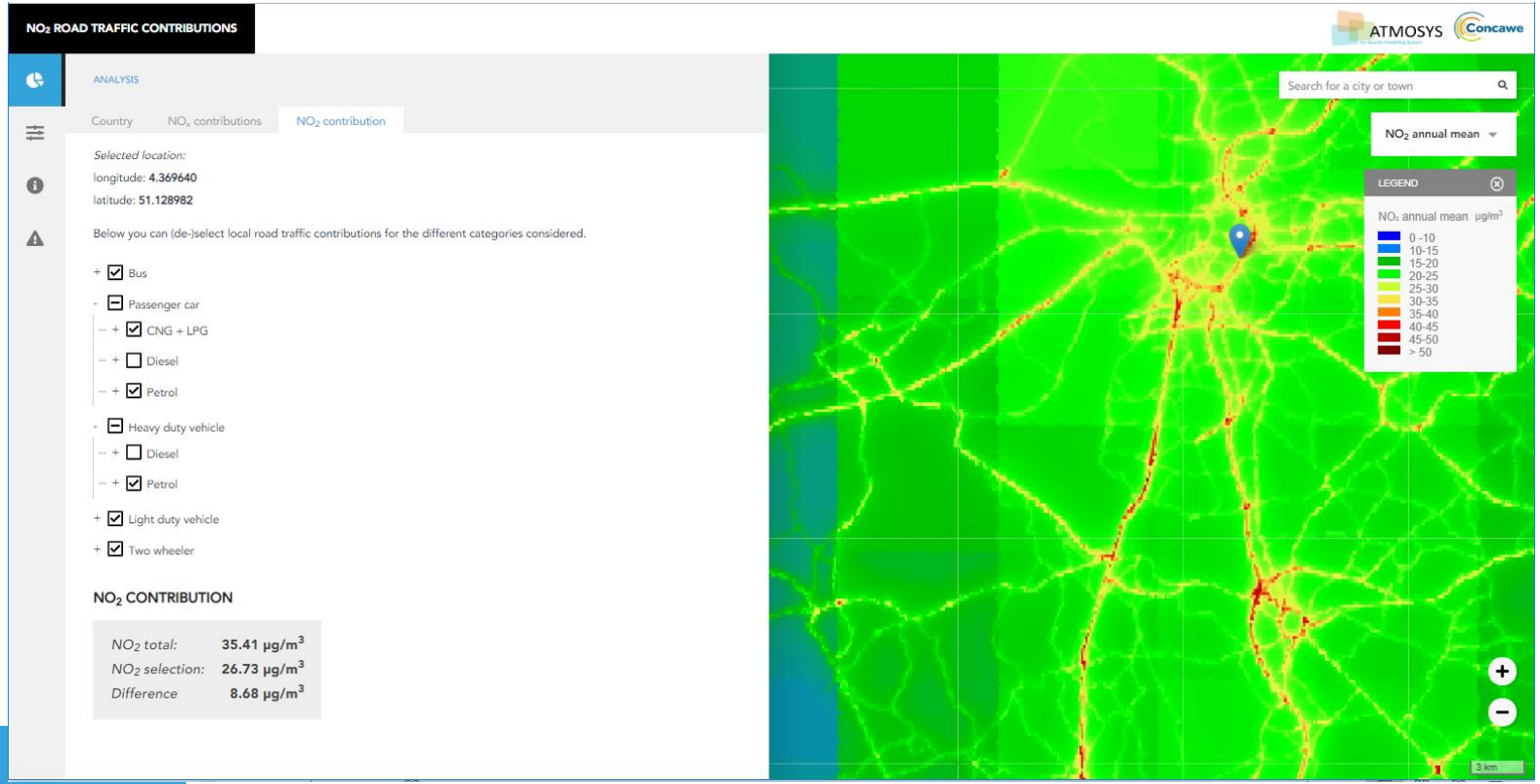
# TOOL OVERVIEW : $NO_X$ CONTRIBUTIONS



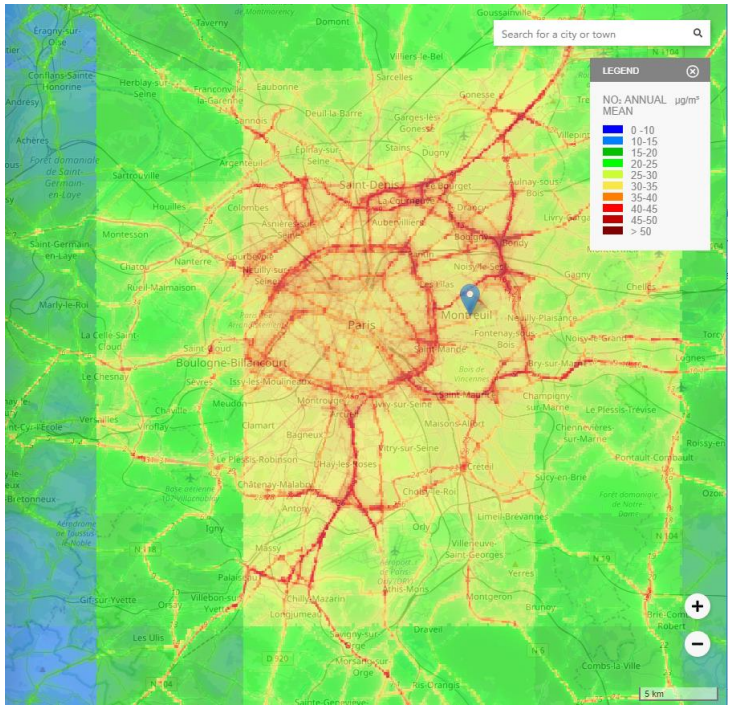



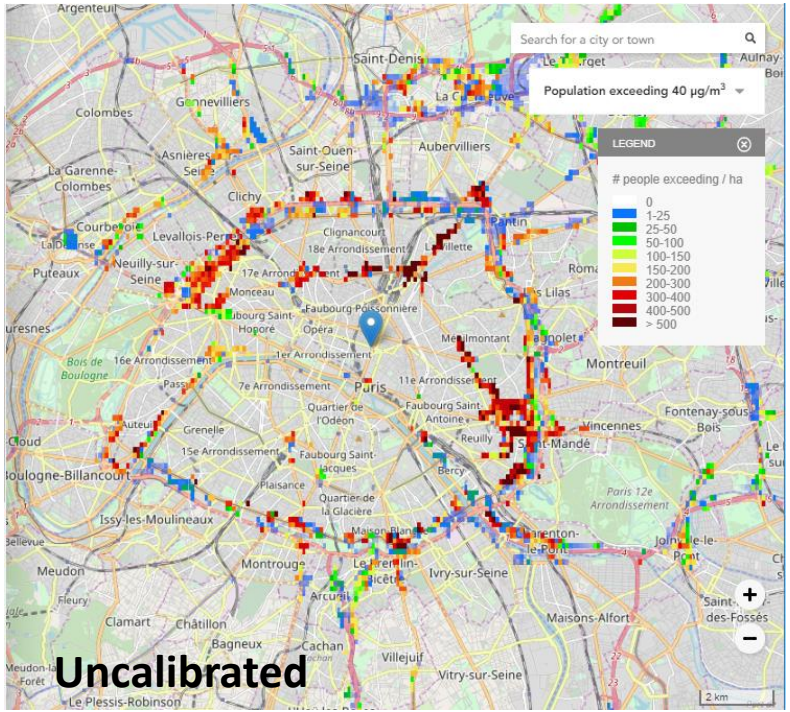

- Dynamic grouping of vehicle types, fuel types and EURO norms

# TOOL OVERVIEW : IN-SITU $NO_2$ ANALYSIS



# SPATIAL DISTRIBUTION OF POPULATION EXPOSURE CONTRIBUTIONS



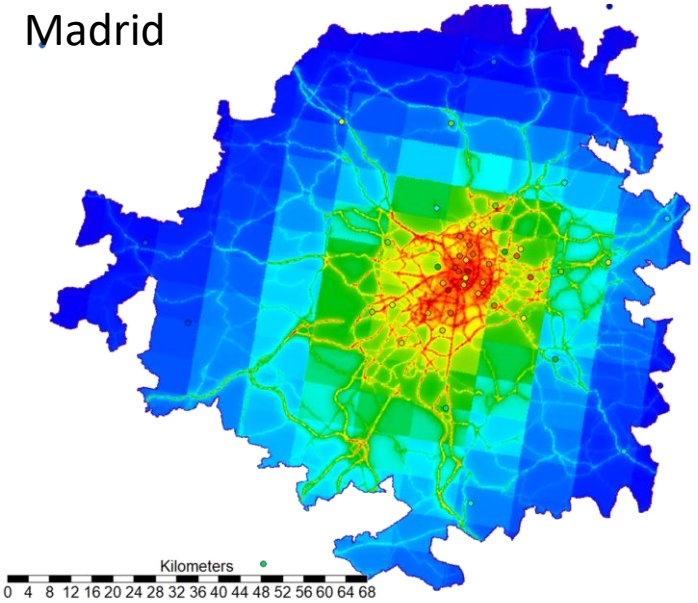




Population map : http://data.jrc.ec.europa.eu/dataset/jrc-ghsl-ghs_pop_eurostat_europe_r2016a

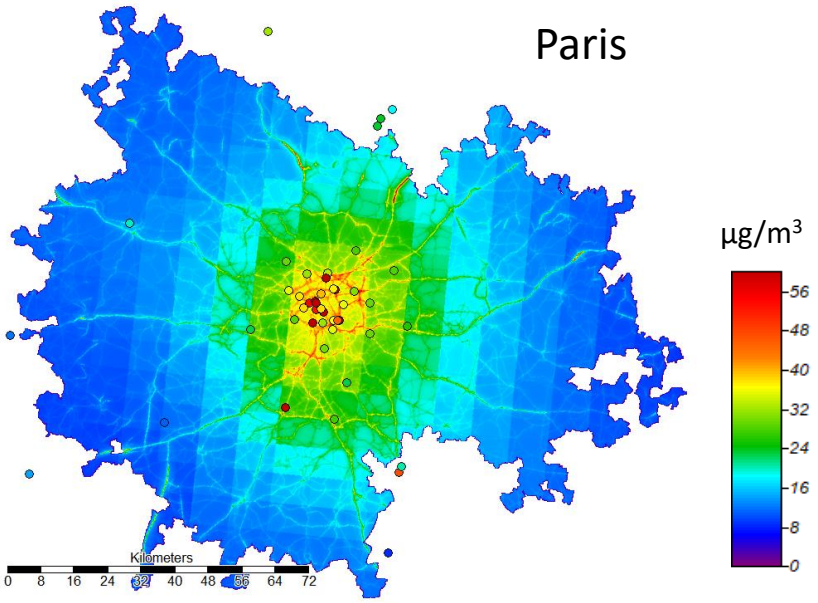
## VALIDATION

- Using EEA annual mean $NO_2$ (e-Reporting)

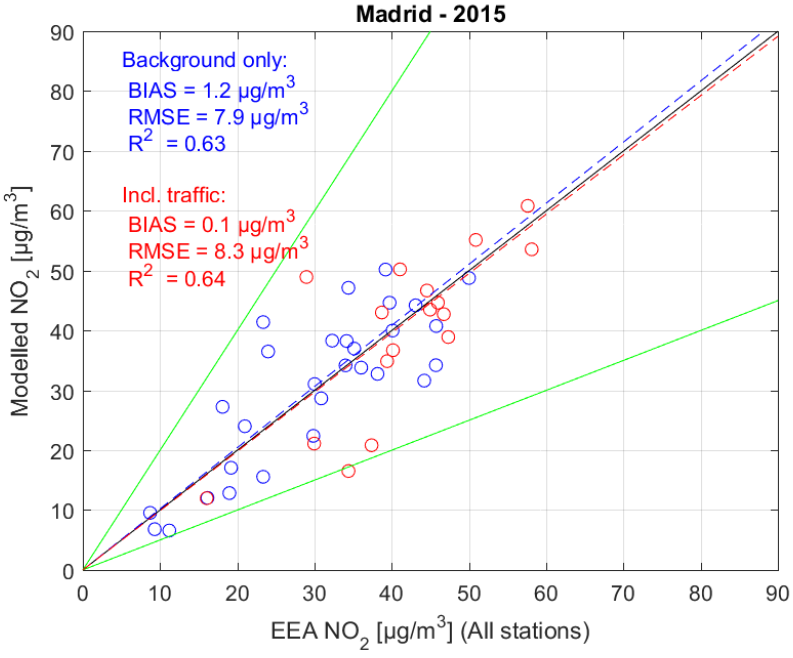
Madrid

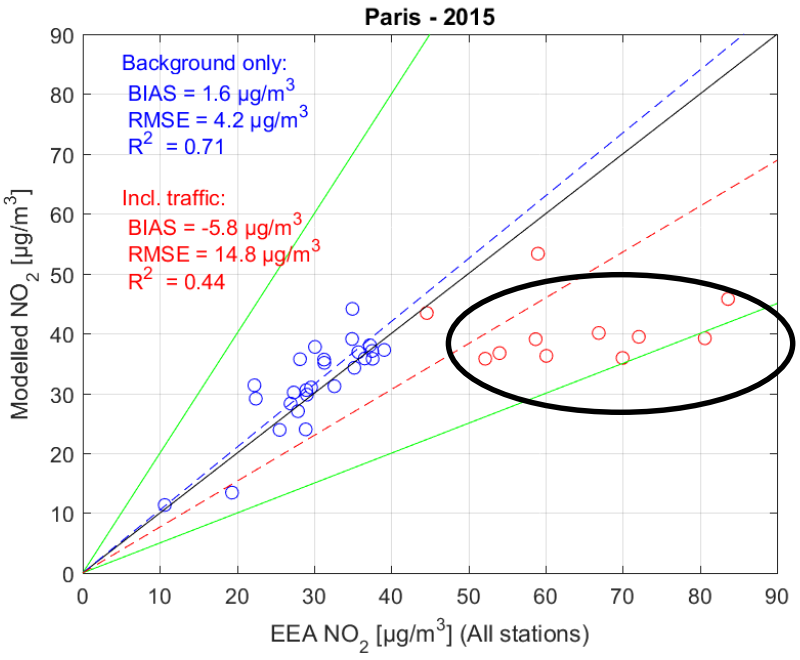



Paris



# EXAMPLE VALIDATIONS



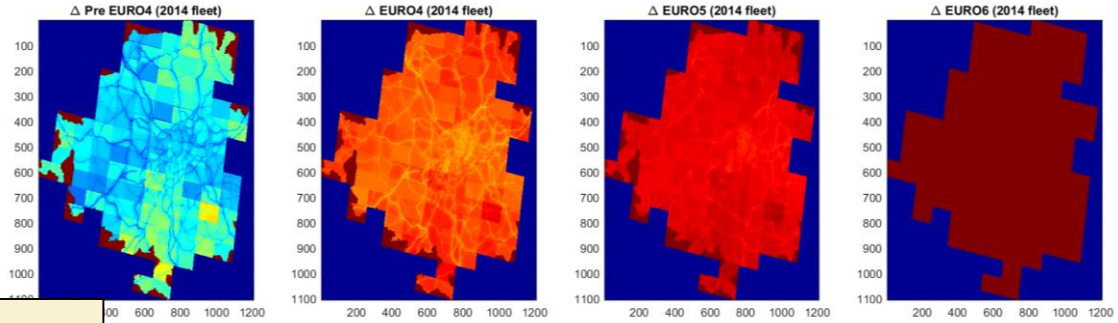
## TOOL USABILITY

- Investigate the **contribution of certain vehicle or fuel types** (such as diesel cars) to the $NO_x$ and $NO_2$ concentrations at a resolution of 125 x 125 m
- This **both for local** (within the 7x7 km SHERPA grid cell) **and for the total concentrations**, taking into account a regional contribution as well
- Get a feeling for the **distribution of the concentration w.r.t. the distribution of population** due to the high resolution approach
- Get a feeling for **concentration gradients** near roads though resolution still limited
- Get a feeling for the **fleet composition** and the share of e.g. diesel cars

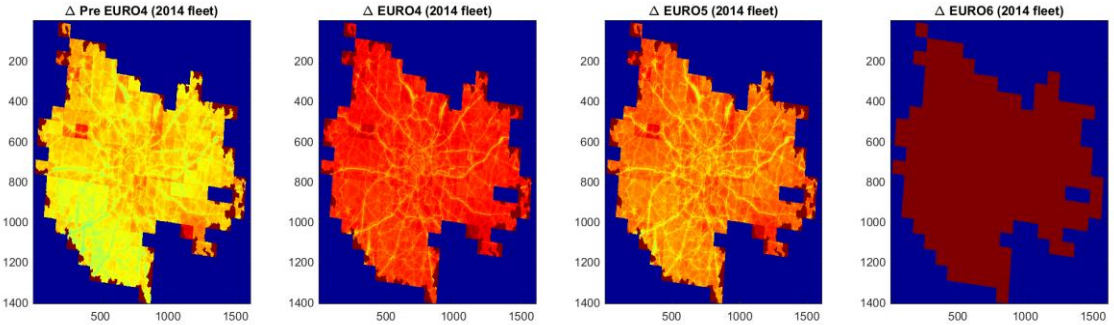
- **Offline analyses** (no aggregation functionality in the tool yet)

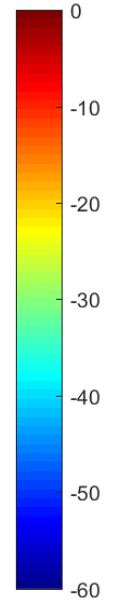
# OFFLINE ANALYSES: CONTRIBUTION OF DIFFERENT EURO NORMS ON $NO_2$ CONCENTRATIONS

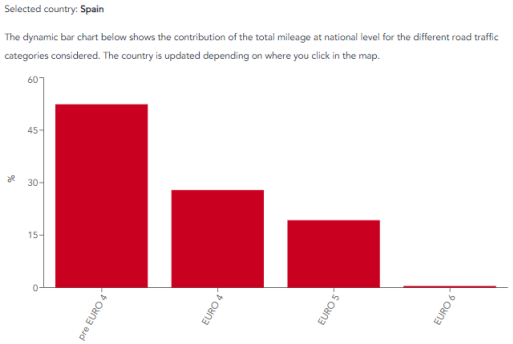
Madrid




Paris




# EXPOSURE ANALYSIS USING EU-WIDE APPROACH

- $NO_2$ exposure analysis for selected cities
- Calibration required using observations for indicated cities

| City | Total population in selected area | Population > EU AQ LV (40 µg/m³) | | Pop. weighted mean $NO_2$ [µg/m³] |
|---|---|---|---|---|
| Antwerp* | 1,000,619 | 38,812 | 3.9% | 30.11 |
| Brussels | 2,430,236 | 4,371 | 0.2% | 23.35 |
| Paris | 11,609,243 | 4,795,574 | 41.3% | 36.83 |
| Berlin | 4,821,544 | 323,379 | 6.7% | 25.96 |
| Munich | 2,637,660 | 108,752 | 4.1% | 26.69 |
| Milan | 4,762,667 | 3,596,664 | 75.5% | 44.95 |
| Madrid | 6,425,663 | 2,686,404 | 41.8% | 35.84 |

Significant differences
Caution : EU-wide approach

* Only one traffic station
Calibrated using traffic stations / uncalibrated

## DISCUSSION & OUTLOOK

- Strong **variability** of urban air quality
- Importance of **local source apportionment** for making **right decisions**
- EU-wide tool to better understand contributions to local traffic-related air pollution

- Clearly doesn't replace local assessment

- Continue improving
  - Update using most recent COPERT data (Feb. 2019 release)
  - Better account for recent changes in fleet composition
  - Improve traffic disaggregation & coupling with background
  - Calibration using $NO_2$ observations