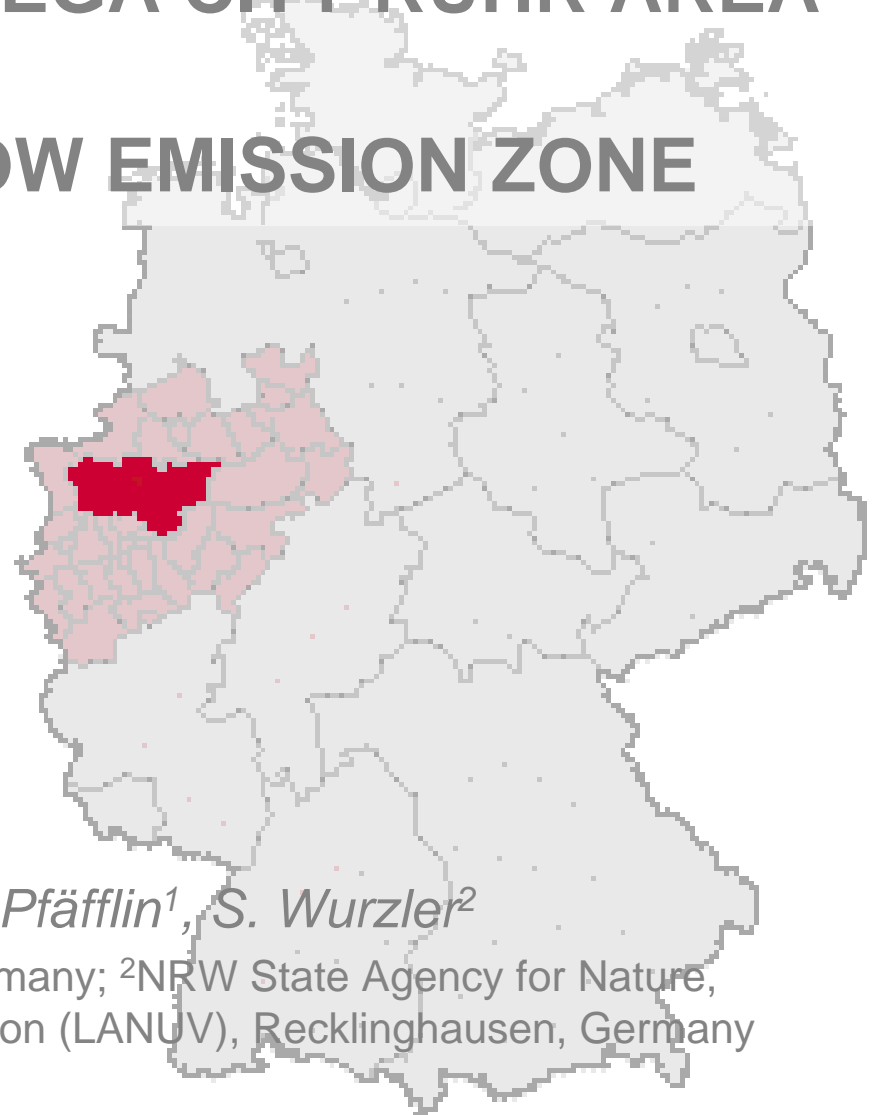


# AIR QUALITY ASSESSMENT IN THE EUROPEAN MEGA CITY RUHR AREA EFFECTS OF A LOW EMISSION ZONE



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## Content

- area of investigation
- methods
- procedure
- current situation
- effects of Low Emission Zone
- conclusions

Area of Investigation  
Methods  
Procedure  
Current Situation  
Effects of  
Low Emission Zone  
Conclusion

## The Ruhr Area

the biggest megalopolis in Germany

- more than 5.3 million inhabitants
- area of about 4400 km<sup>2</sup>
- conglomerate of several overlapping major cities e.g.
  - Essen: European Capital of Culture 2010
  - Duisburg: main European centre of integrated steel production and the biggest inland port of the world
- density of population 1200 inh./km<sup>2</sup>
- high traffic density
- heavy industry



# Challenges for Air Quality Planning

## Area of Investigation

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Conclusion

- difficulties to meet the limit values of the EC air quality directives, particularly the annual average for NO<sub>2</sub> and the number of exceedance days for PM10
- especially residents of street canyons with high traffic density are exposed to poor air quality
- many plans and programmes are required

## Challenges for Modelling

Area of Investigation

Methods

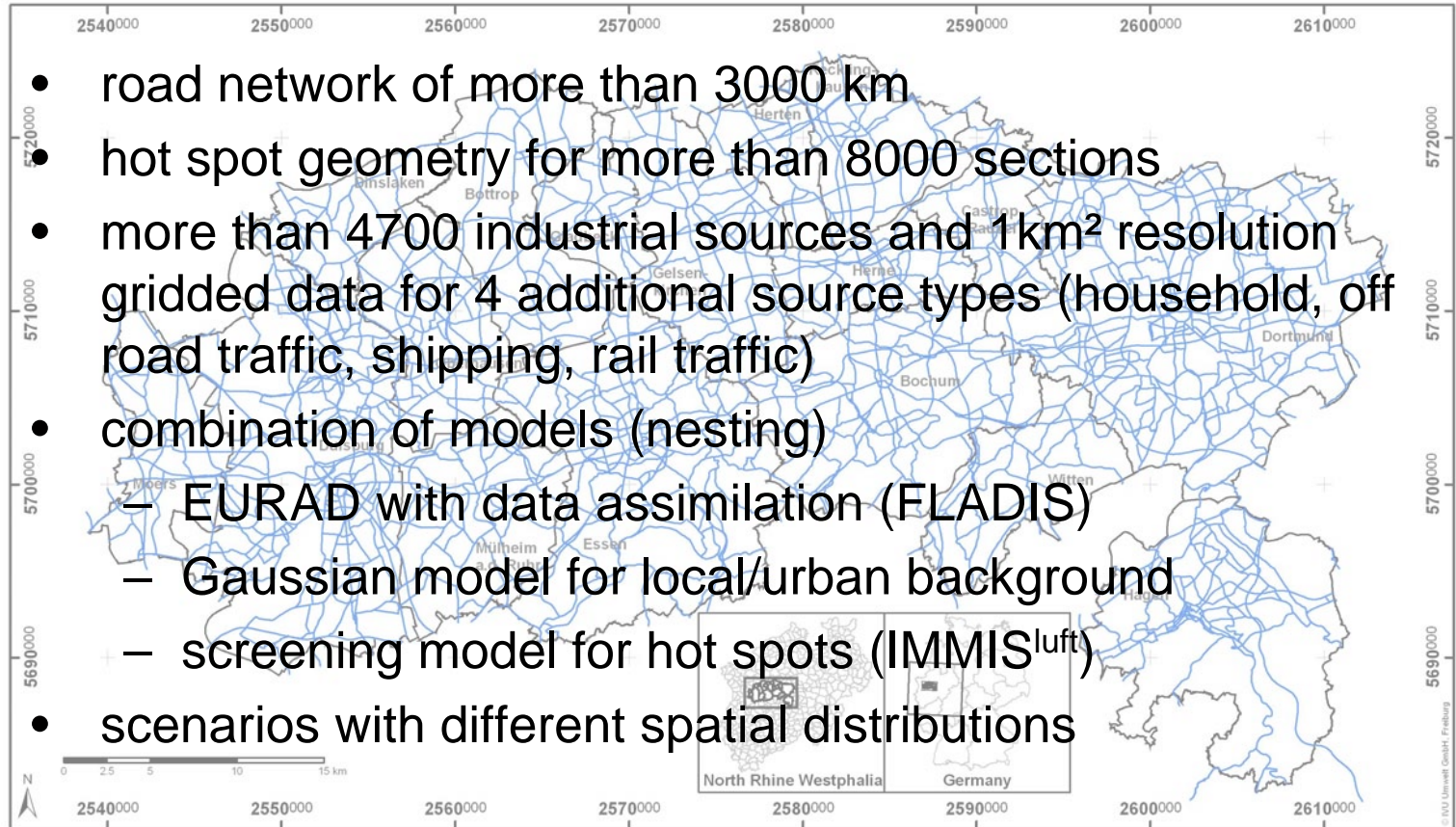
Procedure

Current Situation

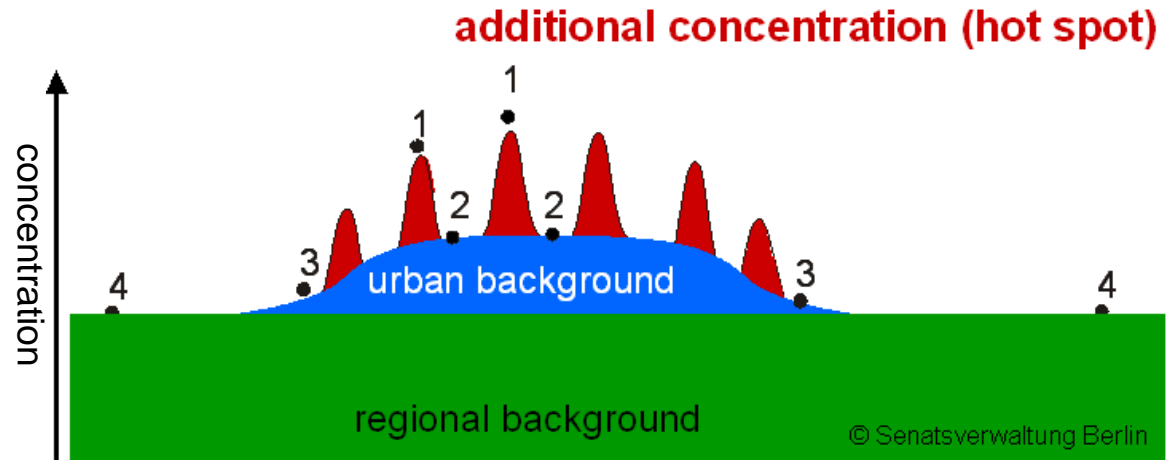
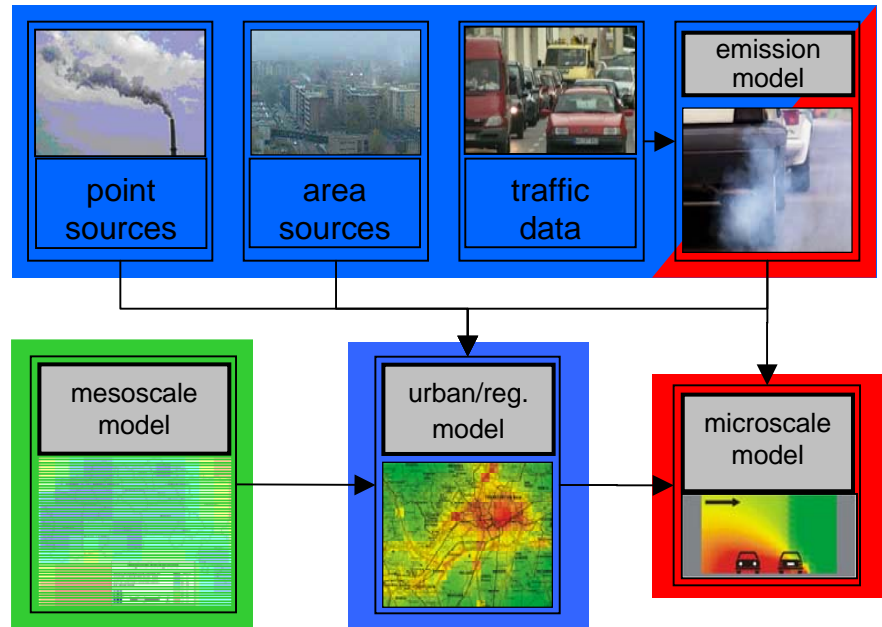
Effects of  
Low Emission Zone

Conclusion

- road network of more than 3000 km
- hot spot geometry for more than 8000 sections
- more than 4700 industrial sources and 1km<sup>2</sup> resolution gridded data for 4 additional source types (household, off road traffic, shipping, rail traffic)
- combination of models (nesting)
  - EURAD with data assimilation (FLADIS)
  - Gaussian model for local/urban background
  - screening model for hot spots (IMMIS<sup>luft</sup>)
- scenarios with different spatial distributions



# Methods of Air Pollution Modelling



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# Background Concentration

Area of Investigation

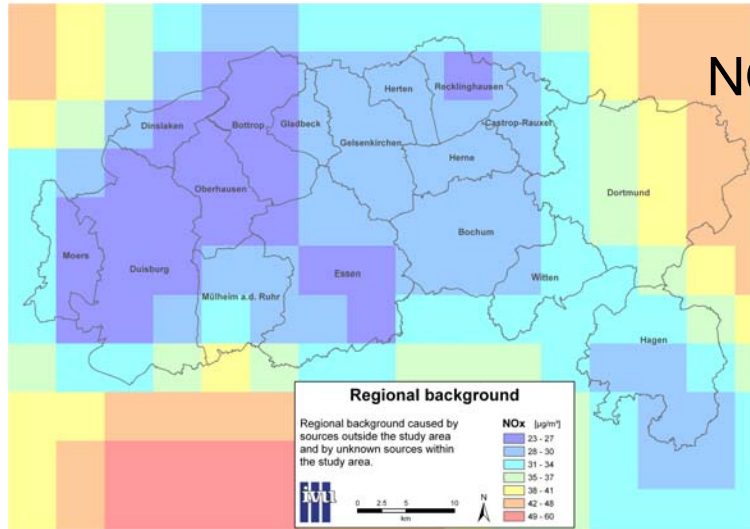
Methods

Procedure

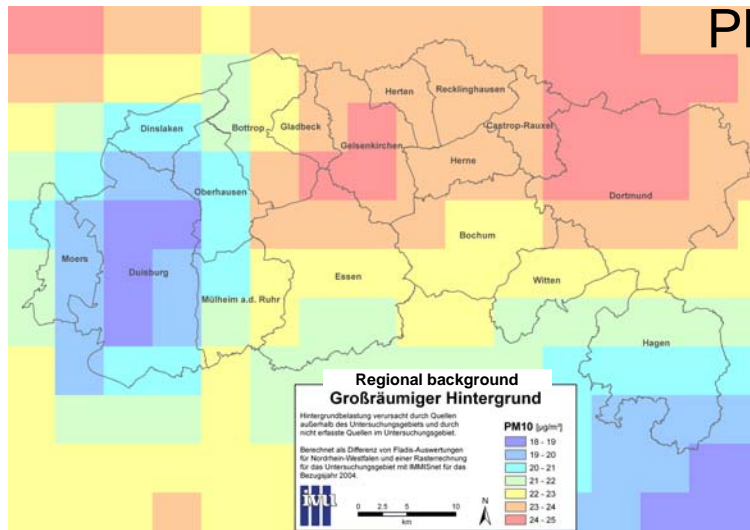
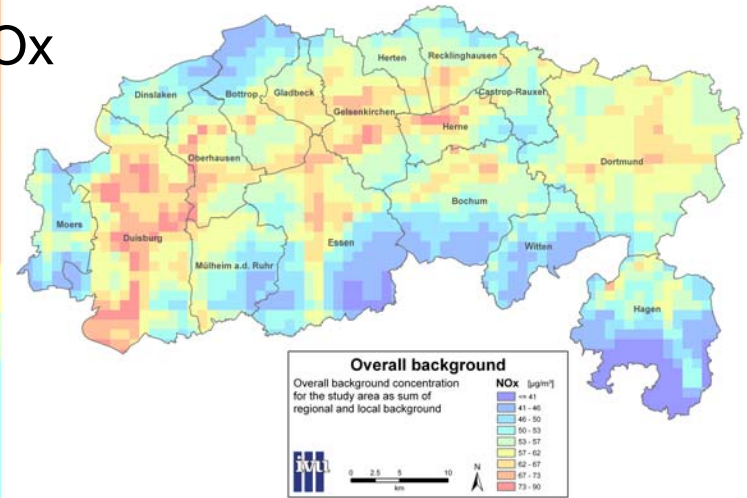
Current Situation

Effects of Low Emission Zone

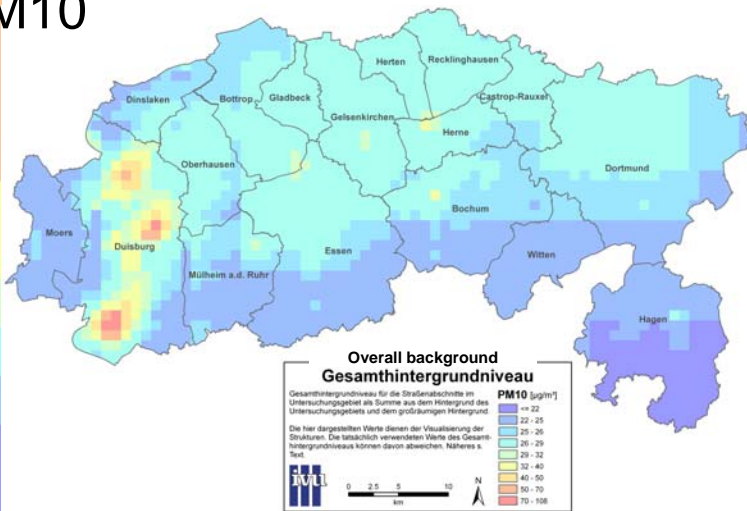
Conclusion



NOx



PM10



## Screening Method

- input road network and 3D geometry of building structure
- GIS based algorithms to identify and derive road sections with homogeneous building geometry
- compute concentrations in road sections with screening model IMMIS<sup>luft</sup>
- air quality in 8044 street sections





## Screening Model IMMIS<sup>luft</sup>

- simplification of CPB dispersion model to identify hot spots based on
  - traffic data
  - street geometry and
  - simplified meteorology respectively dispersion conditions

- around 100 licenses in Germany;  
in use in big cities e.g. Berlin, Hamburg, Munich, Cologne
- validated several times (published)
- HARMO 12 - Poster H12-42  
(session 1, part 2, Tuesday 12:20)

QUALITY CONTROL IN DISPERSION MODELING:  
Validation of a screening model for PM<sub>10</sub> and NO<sub>2</sub>

Area of Investigation

Methods

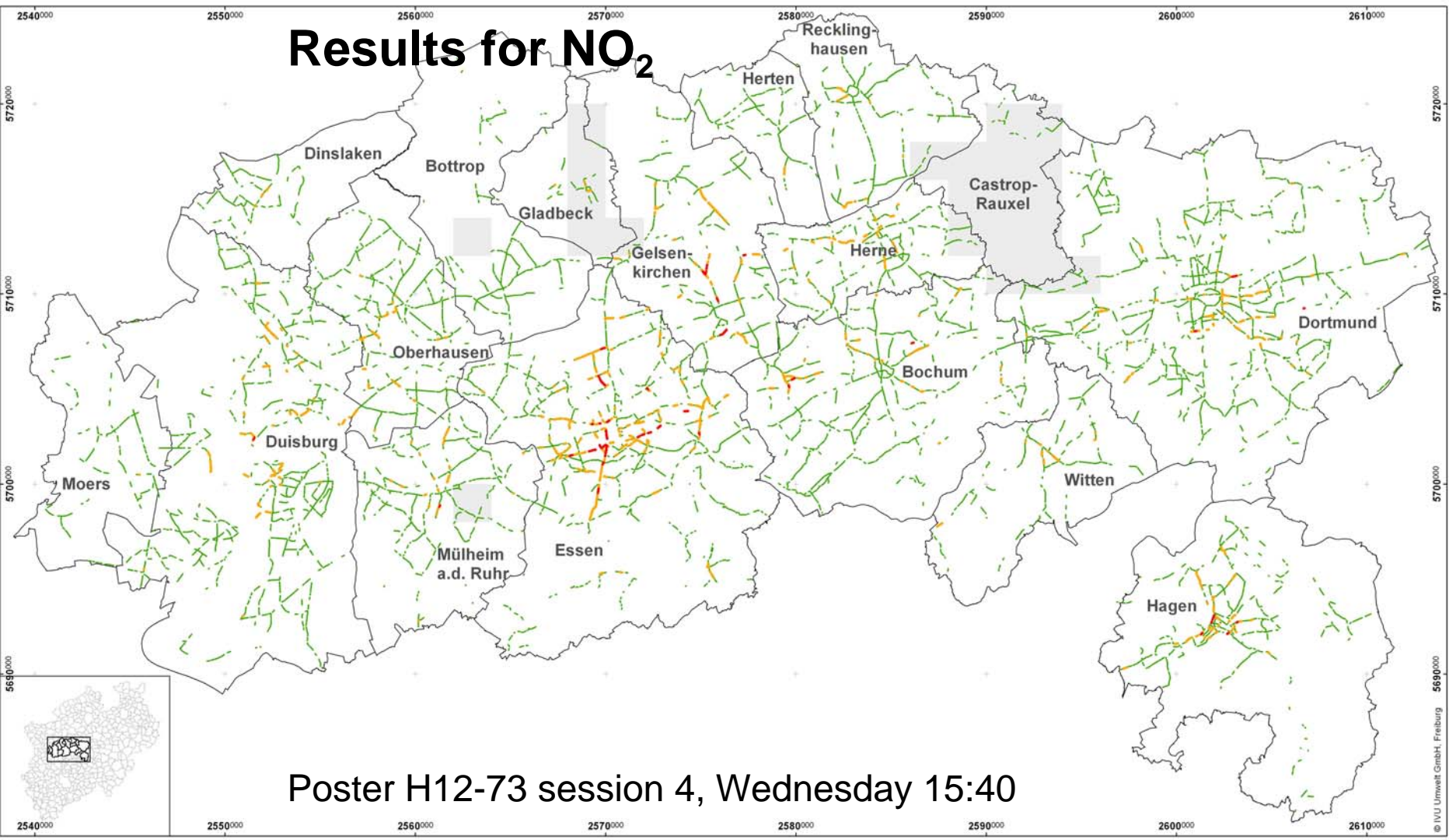
Procedure

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## Results for NO<sub>2</sub>



Poster H12-73 session 4, Wednesday 15:40

**IVU**  
 "Traffic light map Ruhr area"  
 Status: October 2007  
 Created by: IVU Umwelt GmbH, 79110 Freiburg  
 Contracting body: LANUV Nordrhein-Westfalen

Data basis:  
 - Emission inventory of LANUV NRW, Stand 2000-2004  
 - Major road network NRW with emission data  
 - LoD1 building model NRW  
 - Calculations mit IMMIS  
 - Calculations of regional background with FLADIS

**Annual mean value of air quality in inhabited street sections**

NO<sub>2</sub> [ µg/m<sup>3</sup> ]

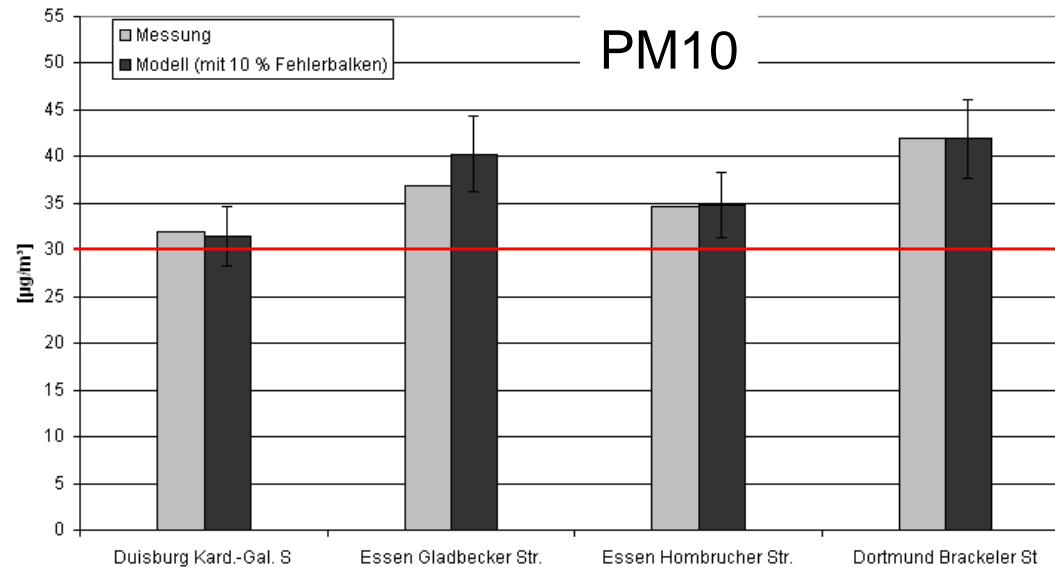
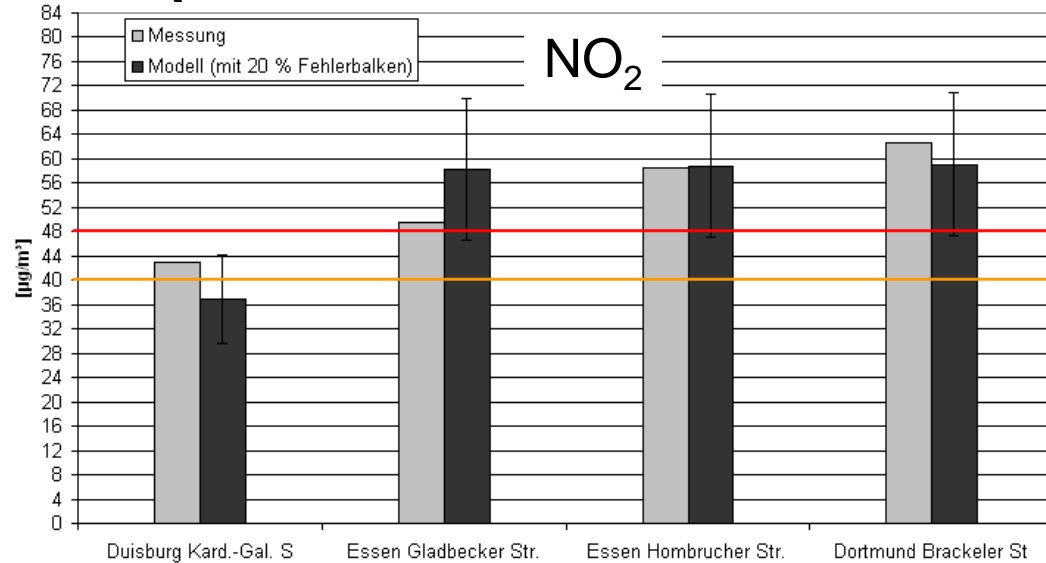
- < 40.5
- > 40.5 - 48.5
- >= 48.5

Municipal boundaries  
 known areas with incomplete or missing building data

0 2.5 5 10 15 km

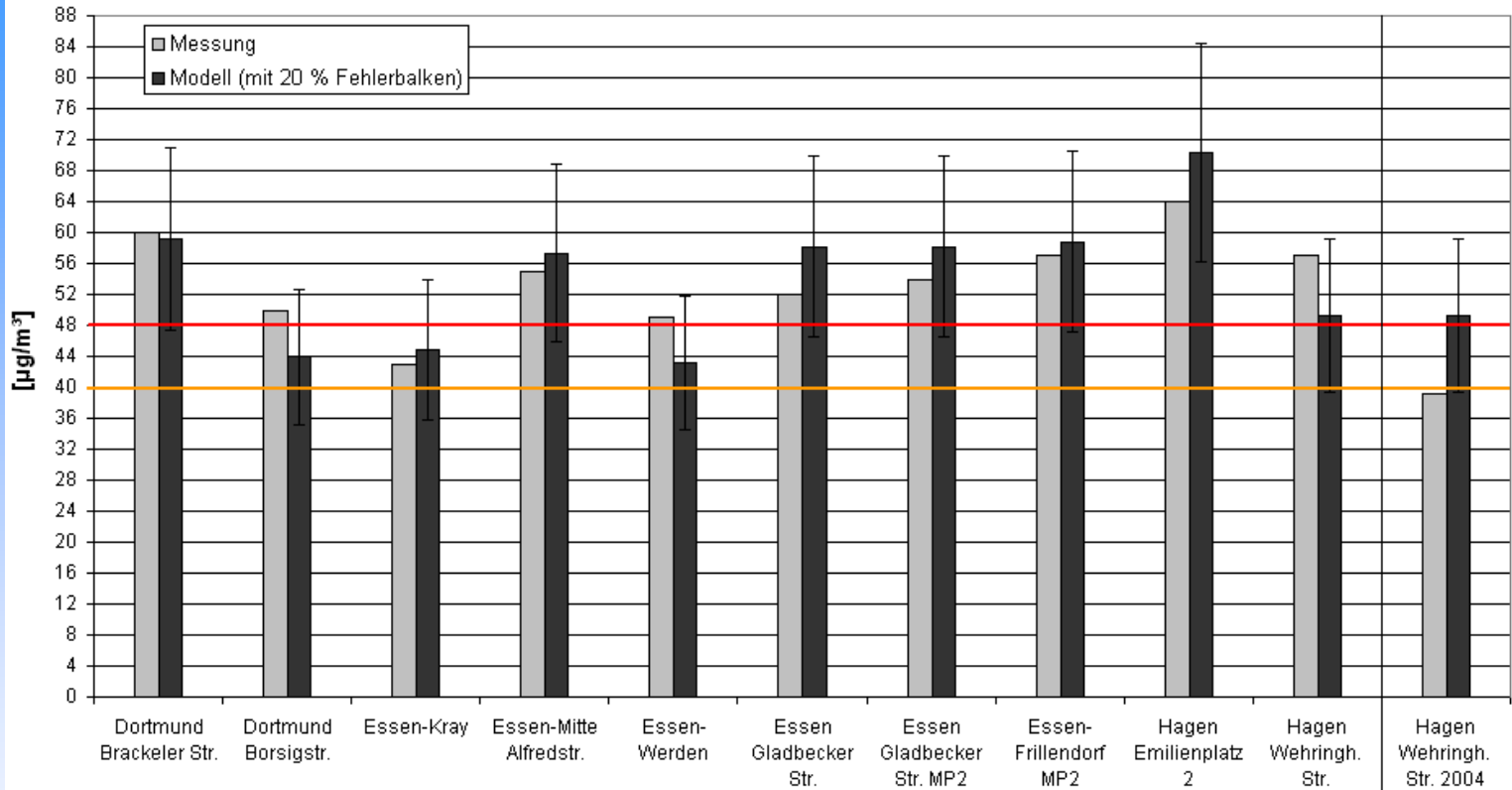
N

# Validation (Reference Measurement Stations)

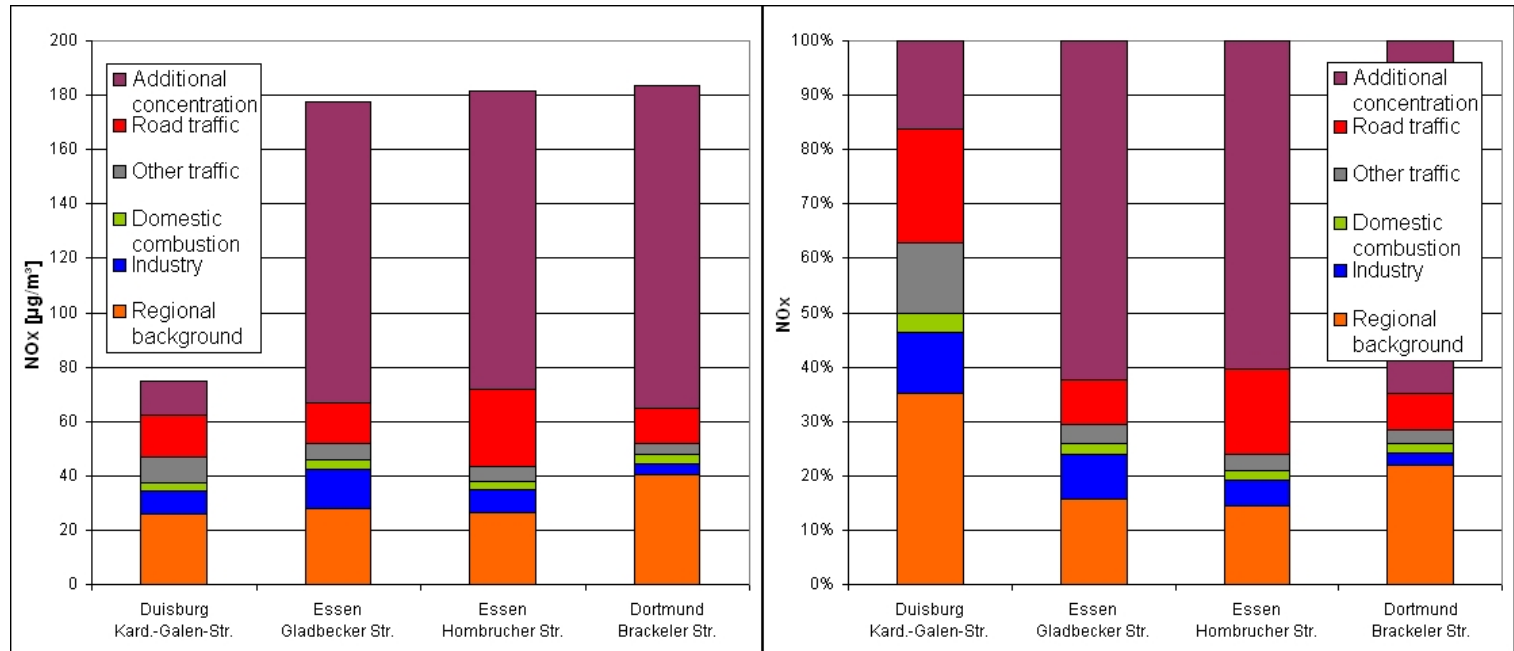


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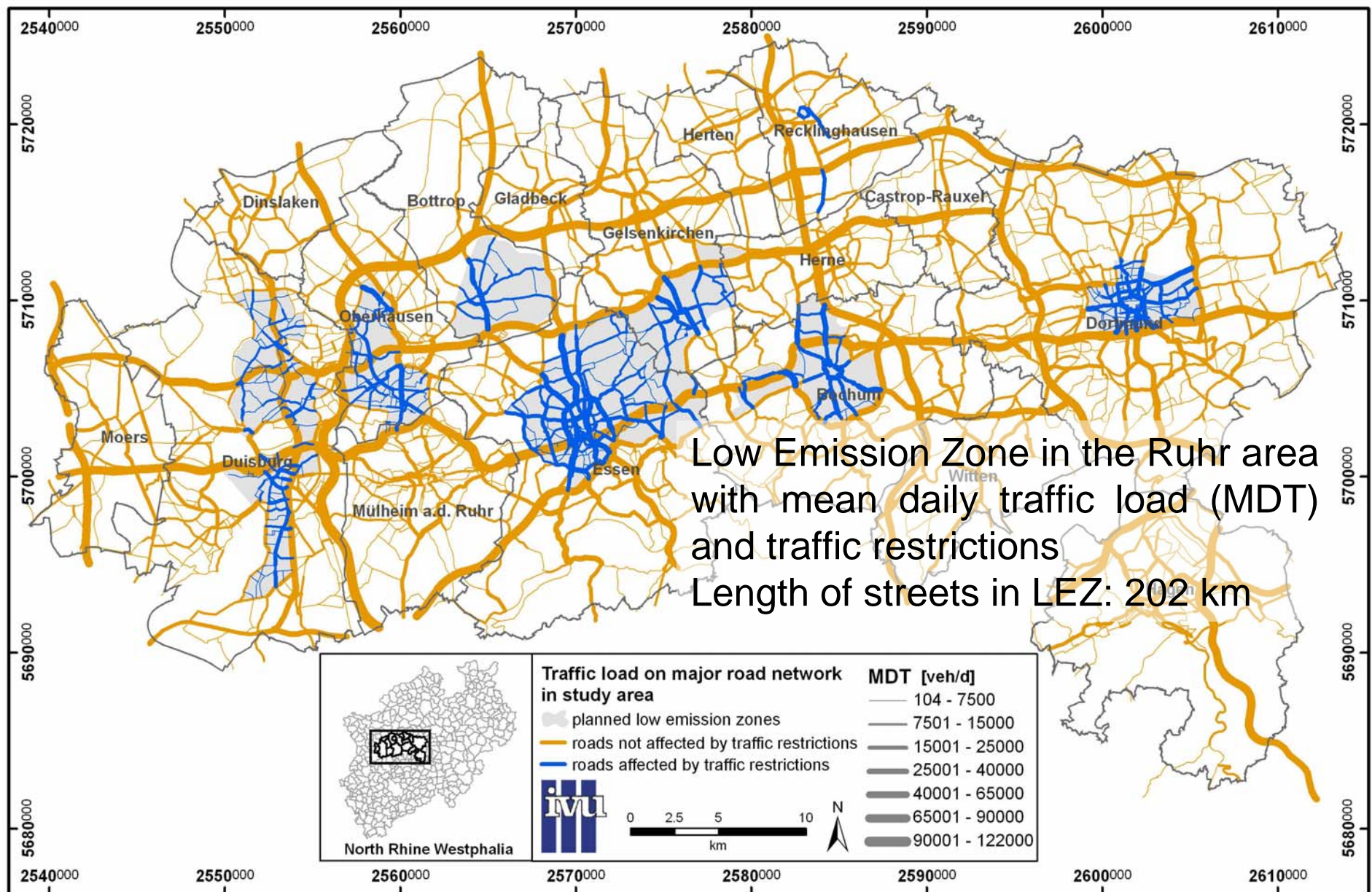
# Validation (Diffusive Samplers for NO<sub>2</sub>)



# Source Apportionment



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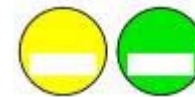
# How Effective are Low Emission Zones?

## 4 Low Emission Zone scenarios

- two categories of banned vehicles
- minimum maximum estimation:  
min: banned vehicles will be replaced with newer vehicles  
max: traffic reduction by banned vehicles



Entrance Free



EURO 1 replacement

EURO 1 traffic reduction

EURO 1 + 2 replacement

EURO 1 + 2 traffic reduction

# Effects of LEZ

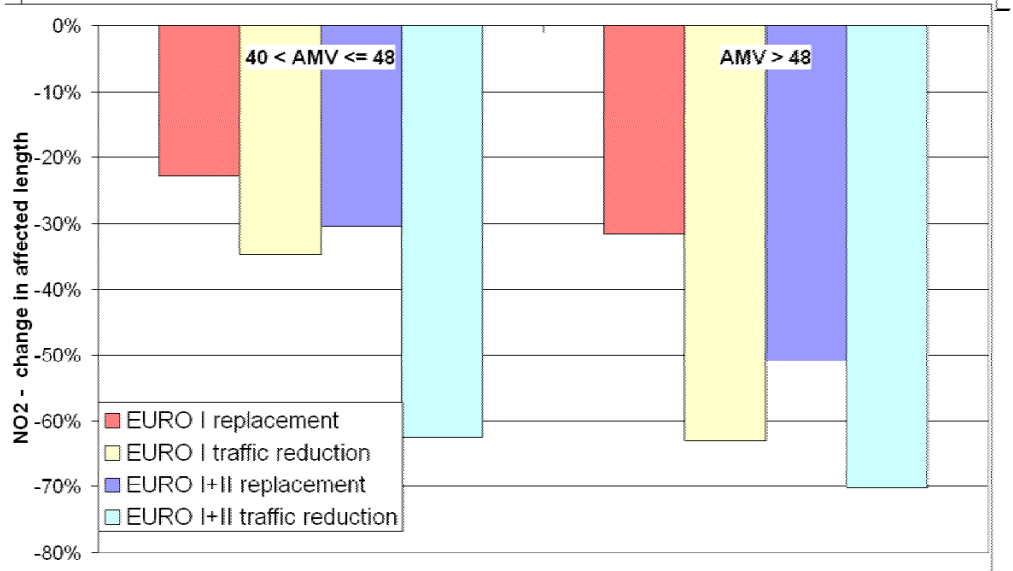
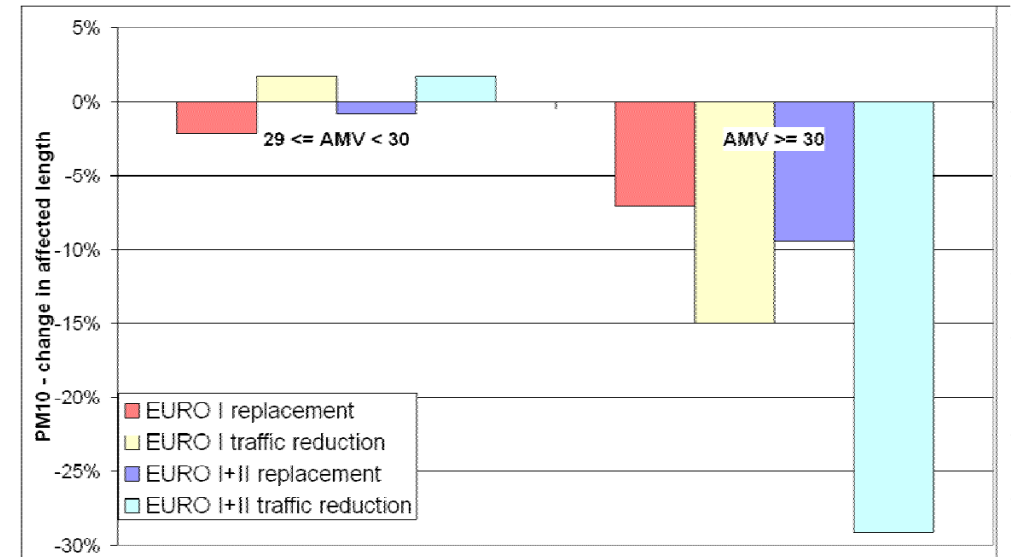
Change in affected length of sections

which are

below PM10-limit value or above

or which are

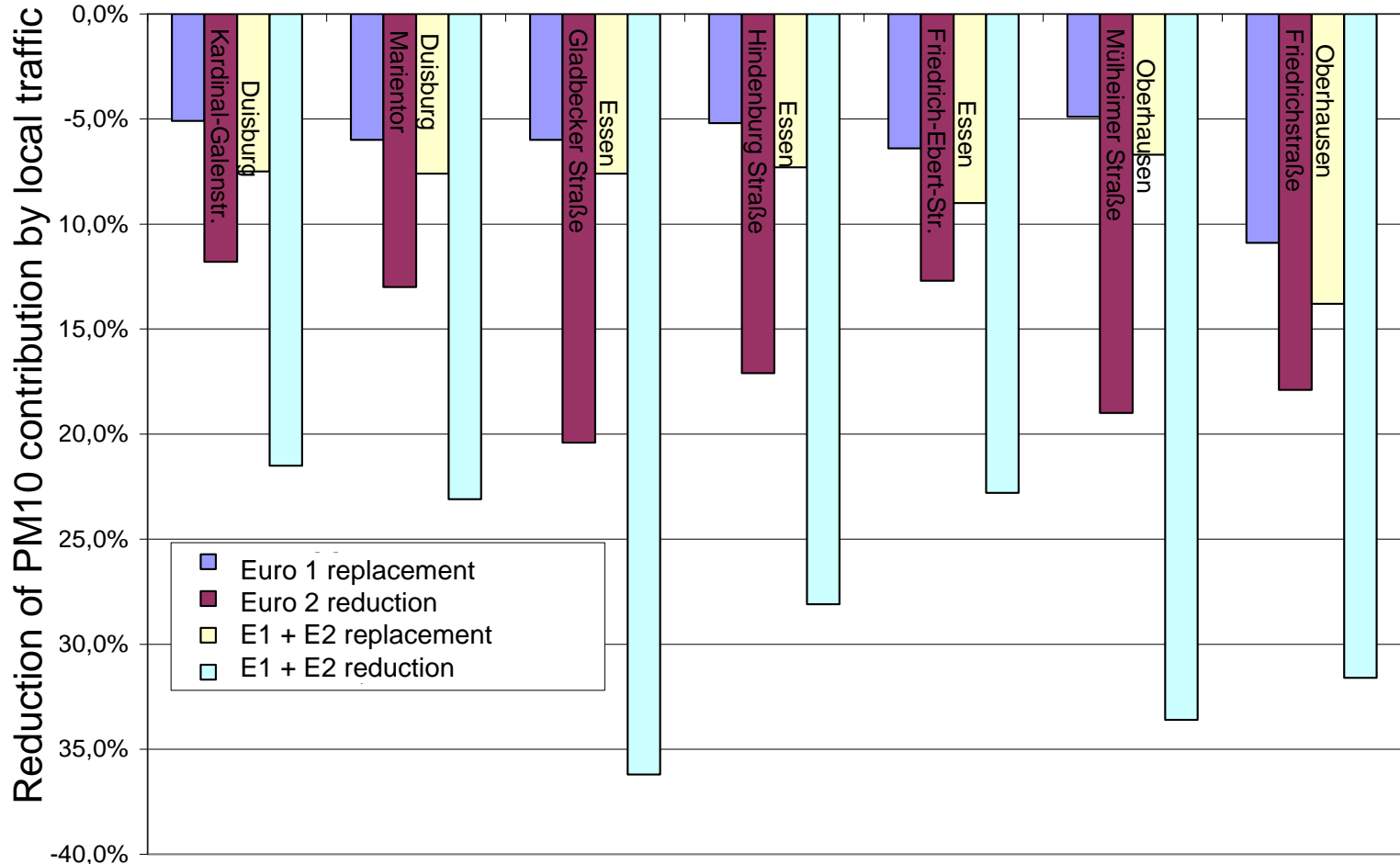
between NO<sub>2</sub> limit+tolerance or above limit value



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# Reduction of PM10 Contribution by Local Traffic at Selected Hot Spots



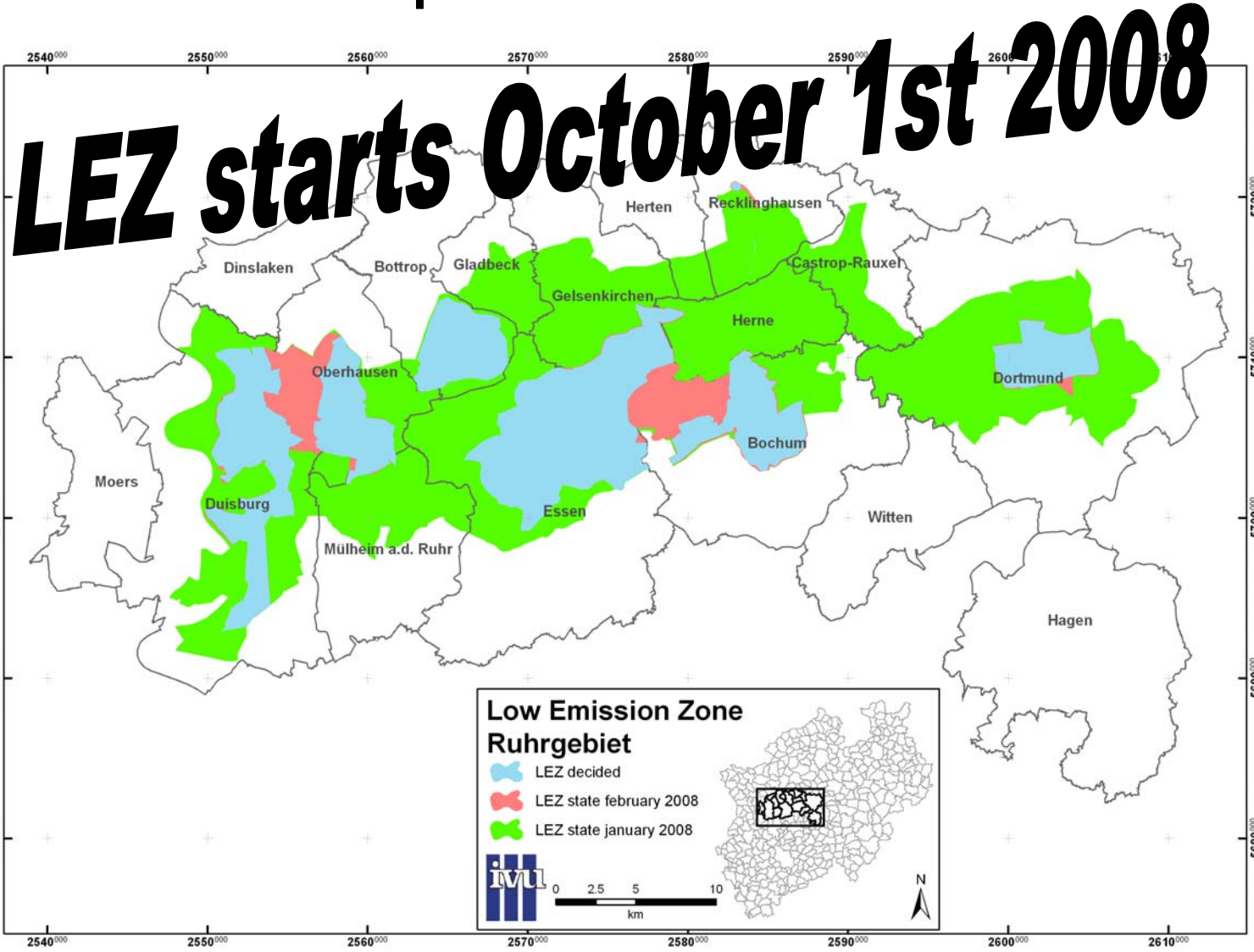
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## Conclusion

- achieving the objectives of EU air quality guidelines is a challenge for densely populated areas
- modelling the situation in such an area needs powerful tools and models
- the recent situation compared to limit values for NO<sub>2</sub> and PM10
  - shows problems for hot spots and
  - shows that hot spots are well distributed over the entire area
- LEZ provides the opportunity to reduce PM10 and NO<sub>2</sub> concentration in hot spots on a regional scale

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# Political Development of LEZ

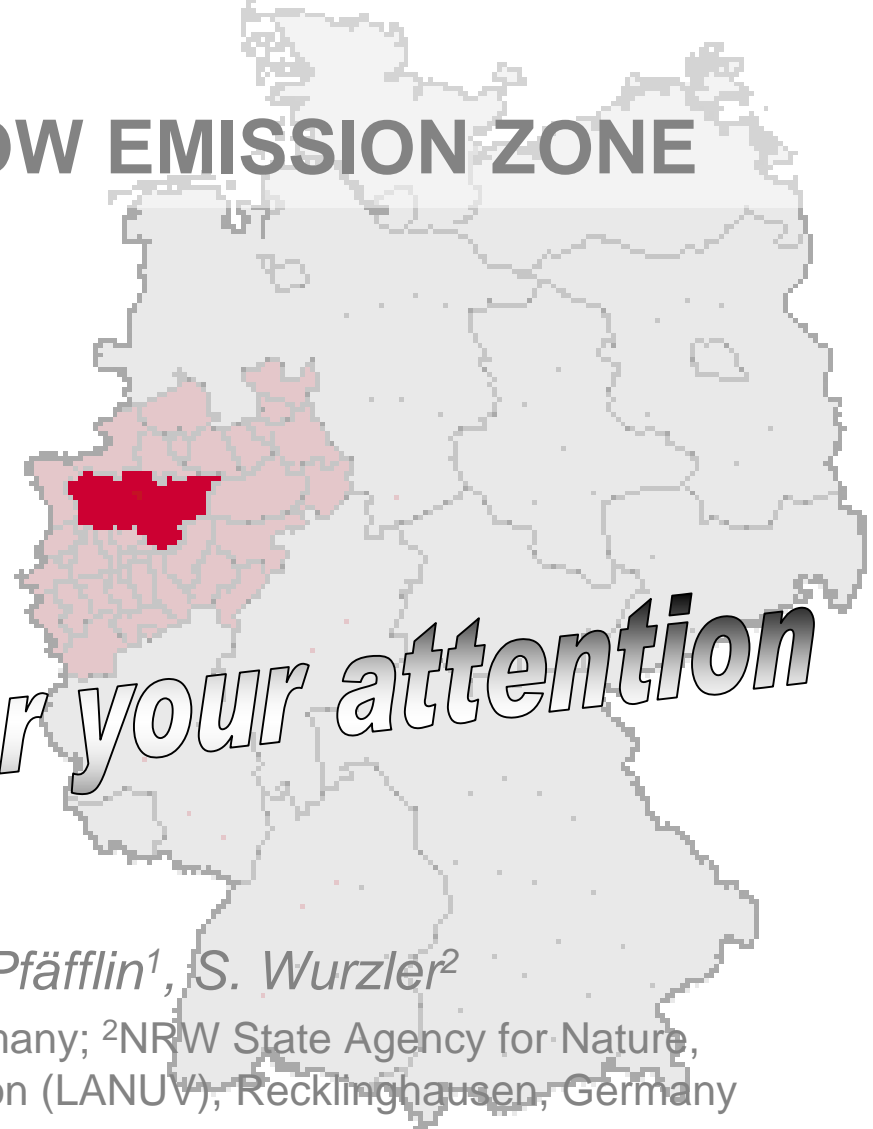


slide 19

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# AIR QUALITY ASSESSMENT IN THE EUROPEAN MEGA CITY RUHR AREA

## EFFECTS OF A LOW EMISSION ZONE



*Thank you for your attention*

V. Diegmann<sup>1</sup>, F. Pfäfflin<sup>1</sup>, S. Wurzler<sup>2</sup>

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