

For our environment

Umwelt   
Bundesamt

FAIRMODE Technical Meeting – 19-21th June 2017, Athens

# Exceedance modelling and exposition

Dr. Stephan Nordmann

Unit II 4.1 – General aspects of air pollution control

## Statutory regulations – information on exceedance exposure

### **Reporting of an exceedance situation according to implementing decision 2011/850/EC**

*6. Estimate of the surface area where the level was above the environmental objective*

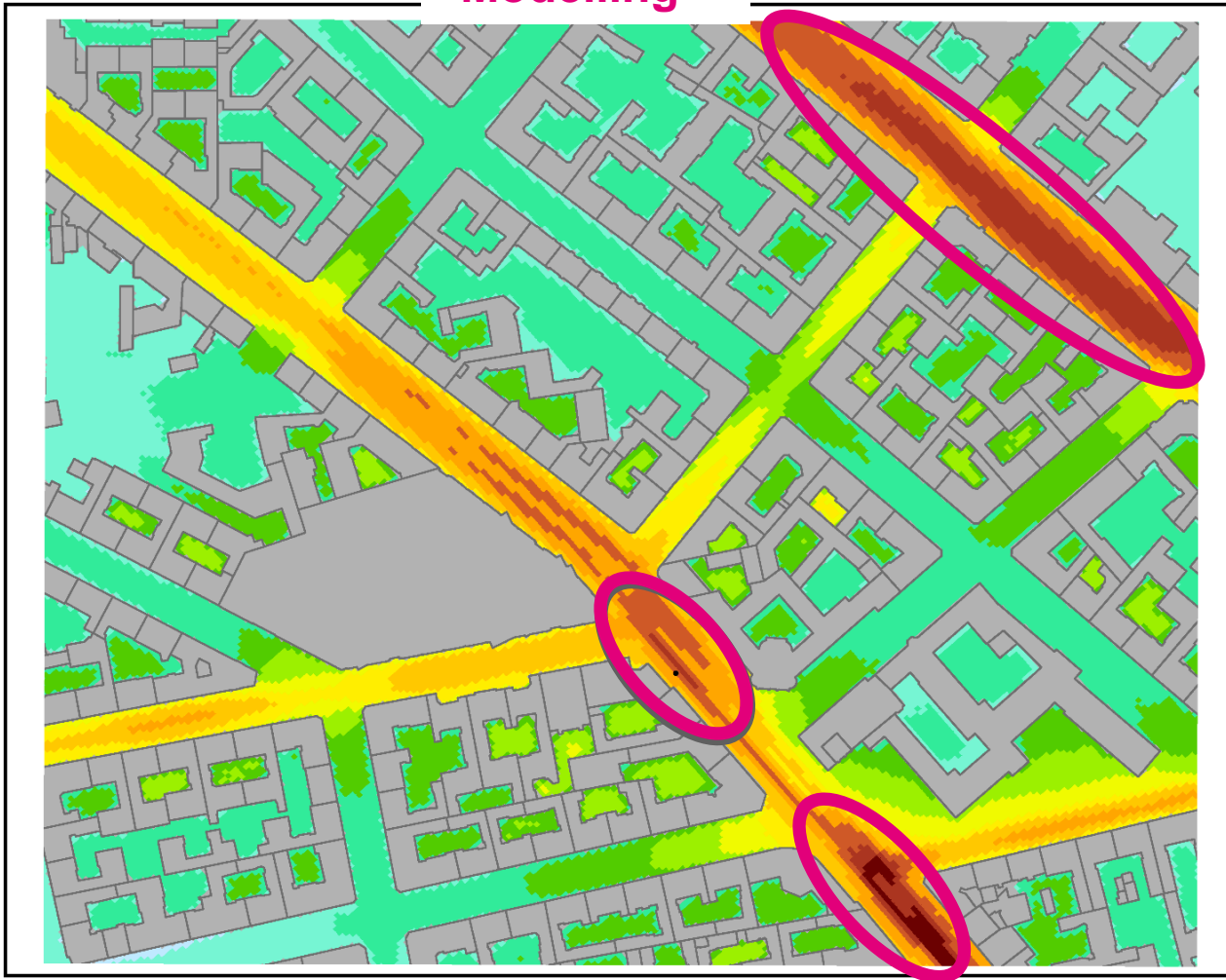
*7. Estimate of the length of road where the level was above the environmental objective*

*10. Estimate of the total resident population in the exceedance area*

*11. Estimate of the ecosystem/vegetation area exposed above the environmental objective*

# Methods for determining exceedance information

## Modelling



## Methods for determining people living in the exceedance area

- Counting residents by using house numbers along the exceedance road segment (residents registration office)

### or Parametrization:

- Assuming a population density depending on the geometry of the street (e. g. Baden-Württemberg, urban areas with buildings at both sides of the road 1,5 residents/m)
- More complex approach also used in noise mapping (e. g. Berlin, estimates by using variables like building height, stay probability, fraction of apartments, ...)

## Proposed approach by UBA

Work step	Method
1. Identification of road segments with limit value exceedance assessment zone	Measurement+Modelling (e. g. Screening)
2. Determination of road length with exceedance	Modelling or simple estimation
3. Determination of the building density along the road	Geometry data+GIS
4. Determination of population density according to 3.	Spreadsheet analysis
5. Determination of the population living at road segments with limit value exceedance using road length and population density	Spreadsheet analysis

## Future perspectives

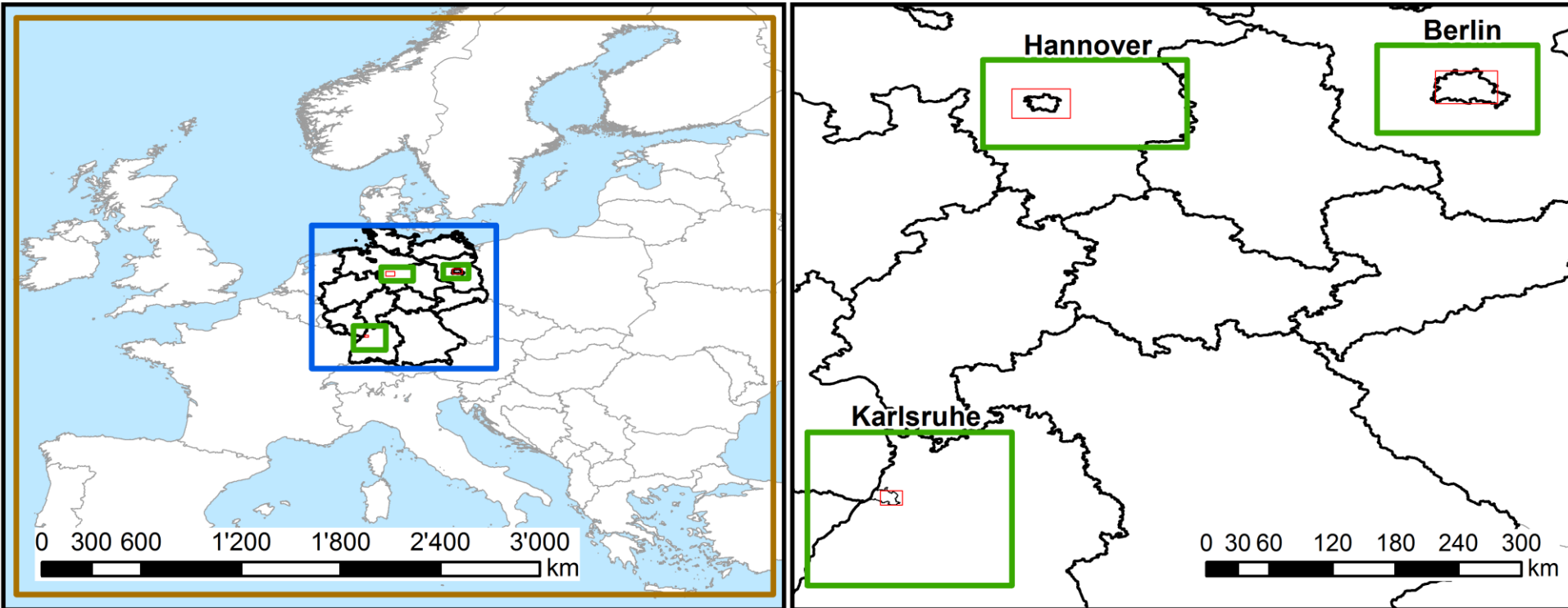
**UBA project** „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations: first steps towards the development of a model based and area related assessment strategy“  
(2015-2017)

**Contractor:** IVU Umwelt GmbH, Freiburg, Germany

**Florian Pfäfflin, Rainer Stern, Volker Diegmann**








**Goal:** New strategy of air quality assessment and determination of exposition by using area averages of pollutant concentration

# UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“




## Urban NO<sub>2</sub> und PM<sub>10</sub> concentrations: development of an area related assessment strategy

### RCG modelling domains

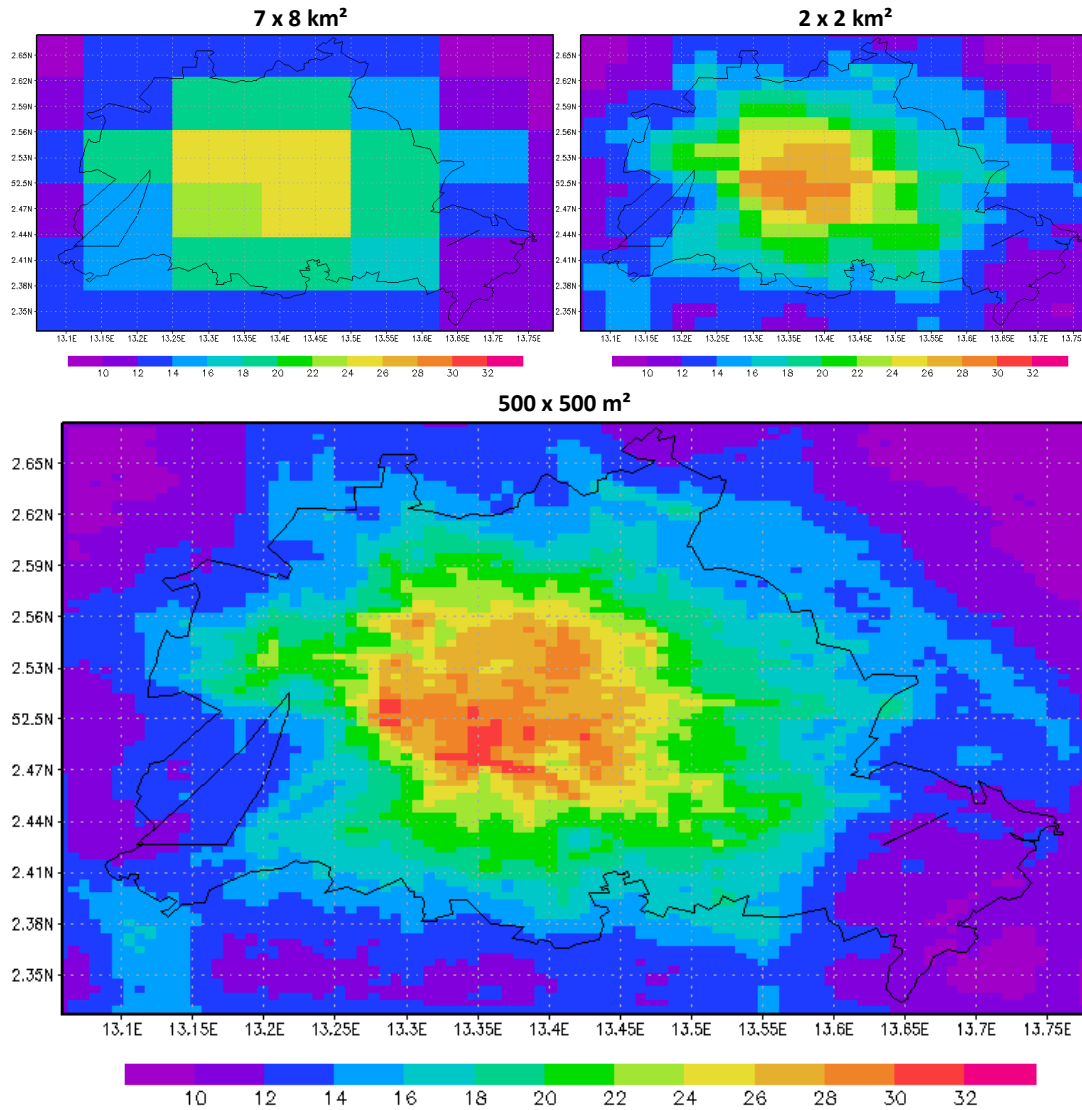
- |   |  |
|---|--|
|  European scale (Nest 0) |  Countries      |
|  National scale (Nest 1) |  Federal States |
|  Regional scale (Nest 2) |  Cities         |
|  Urban scale (Nest 3)    |  |



Representation in a geographic coordinate system  
 © for base data: GeoBasis-DE / BKG 2014

 Cartography:  
 IVU Umwelt GmbH  
 Status: 06.10.2016

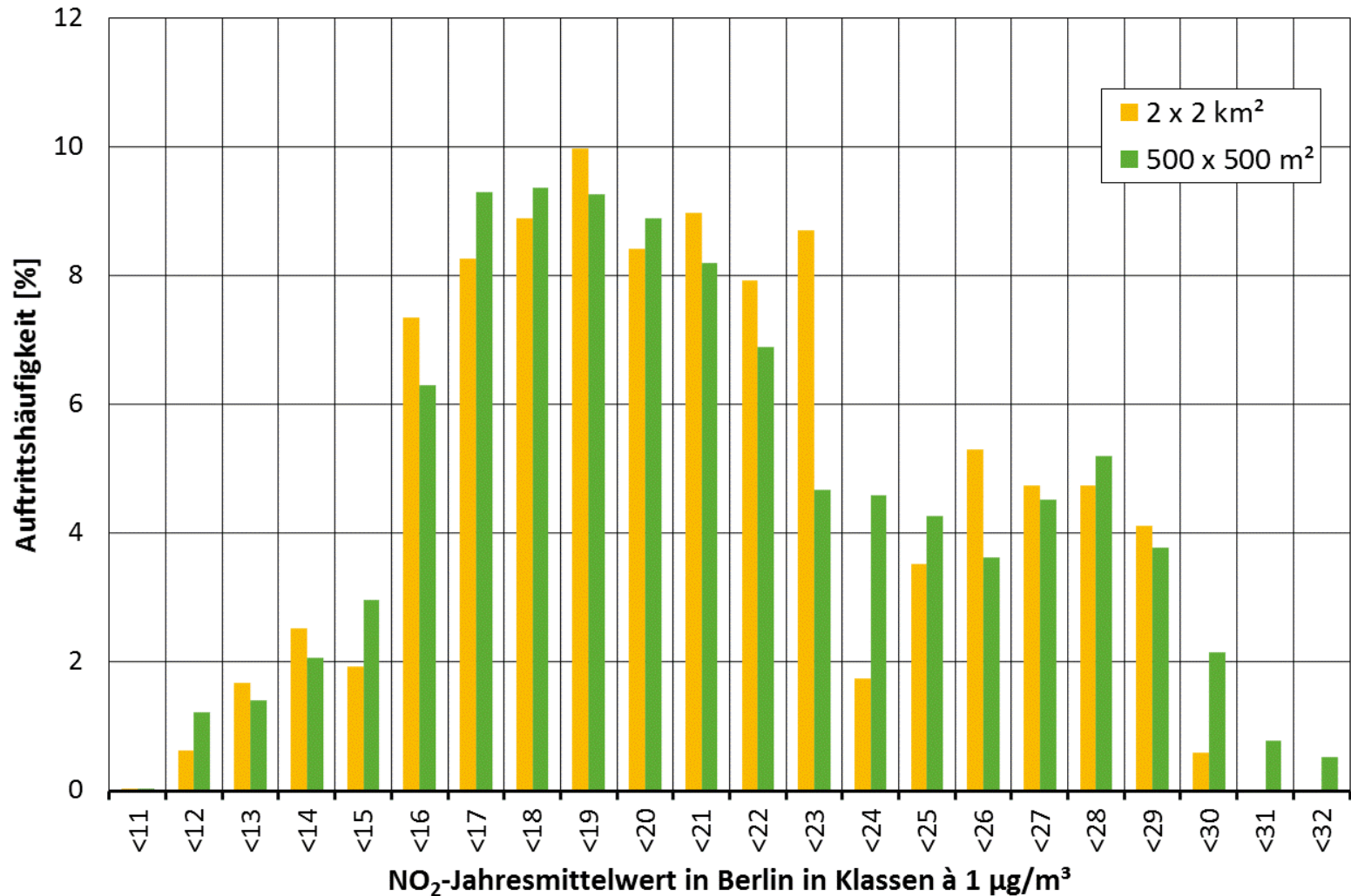
# UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“





# UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“

## Frequency distribution for Berlin CTM results



## UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“

- spatial distribution of concentration within a CTM cell varies  
⇒ influence on exposure ⇒
- modelling of concentration fields within CTM cell (500 x 500 m<sup>2</sup>) RANS-model MISKAM for flow modelling  
coupled with
- Lagrangian particle model LASAT for transport modelling
- horizontal resolution 2.2 x 2.2 m<sup>2</sup>  
evaluation of level 1.5 - 2.2 m above ground
- all known sources of road traffic and domestic combustion

# UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“

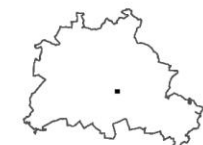


**Urban NO<sub>2</sub> und PM<sub>10</sub> concentrations: development of an area related assessment strategy**  
**Total concentration 2010 for the surroundings of the monitoring station Karl-Marx-Straße in Berlin**

NO<sub>2</sub>  
[µg/m<sup>3</sup>]

≤ 28.0	37.0 - 40.0	49.0 - 52.0
28.0 - 31.0	40.0 - 43.0	52.0 - 55.0
31.0 - 34.0	43.0 - 46.0	55.0 - 58.0
34.0 - 37.0	46.0 - 49.0	58.0 - 61.0

■ Buildings  
 • Monitoring station



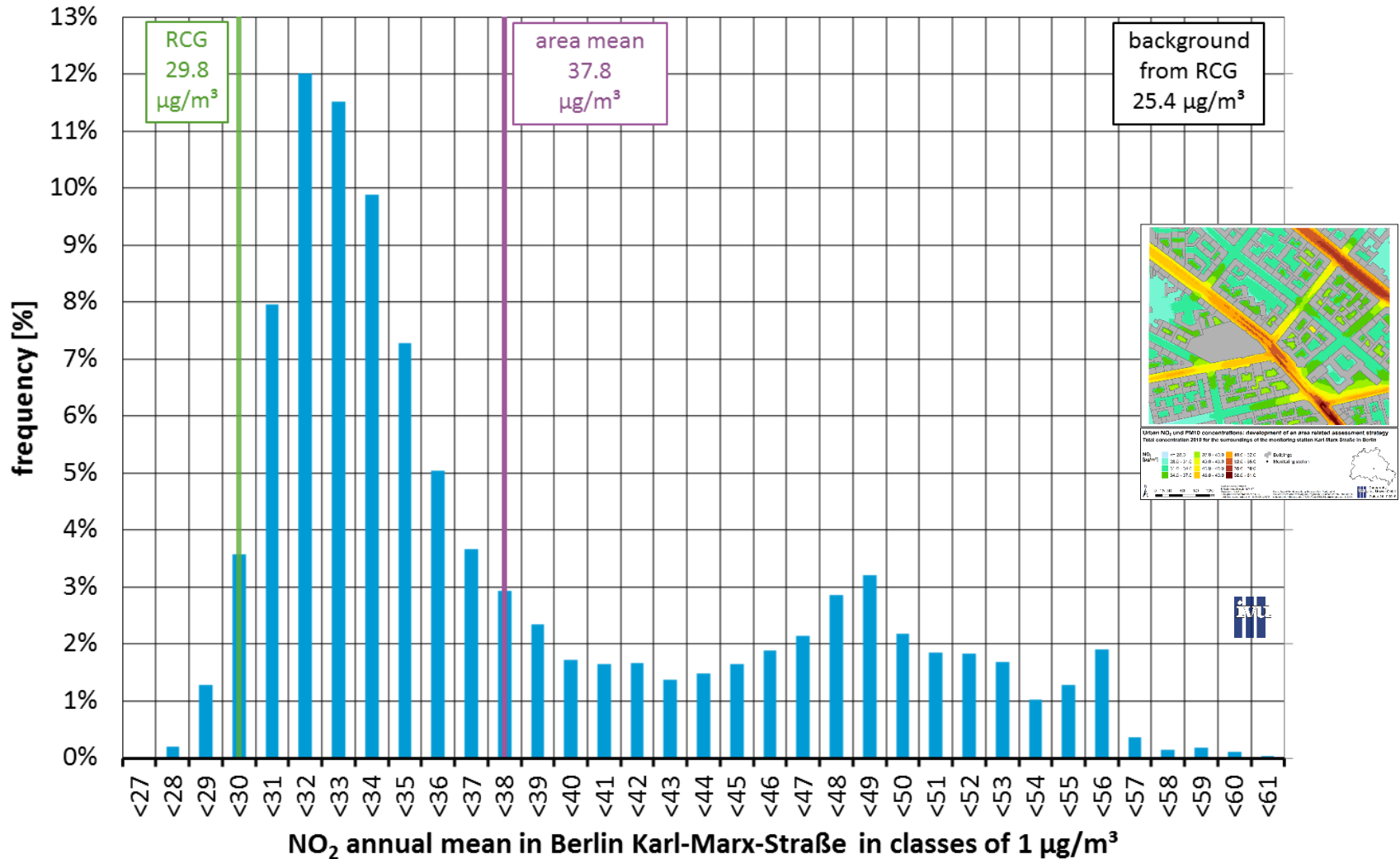
Modelled concentrations:  
 - Emission modelling with MMIS™  
 - Dispersion modelling  
 - background concentrations with RCG  
 - additional concentrations with MSKAM/LASAT

Basis: Data of Senatsverwaltung Berlin and from "Luftqualität 2020/2030: Weiterentwicklung von Prognosen für Luftschadstoffe unter Berücksichtigung von Klimastrategien", UBA-Teile 25/2014, Umweltbundesamt, 2014.

Cartography:  
 IVU Umwelt GmbH  
 Status: 24.10.2016

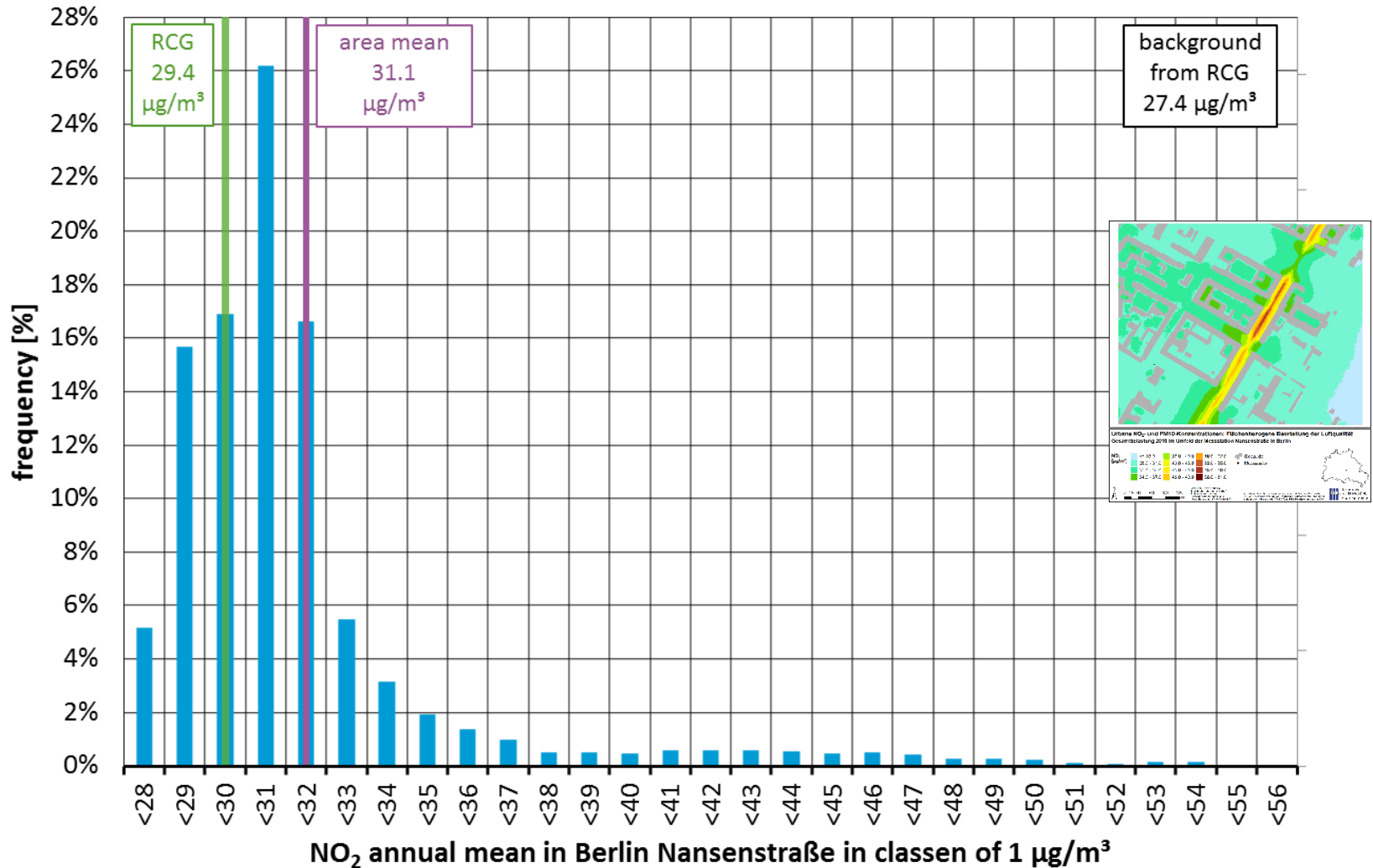
# UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“

Frequency distribution for CTM grid cell with microscale modelling for **hot spot**



# UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“

Frequency distribution for CTM grid cell with microscale modelling for **urb. backgr.**



## UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“

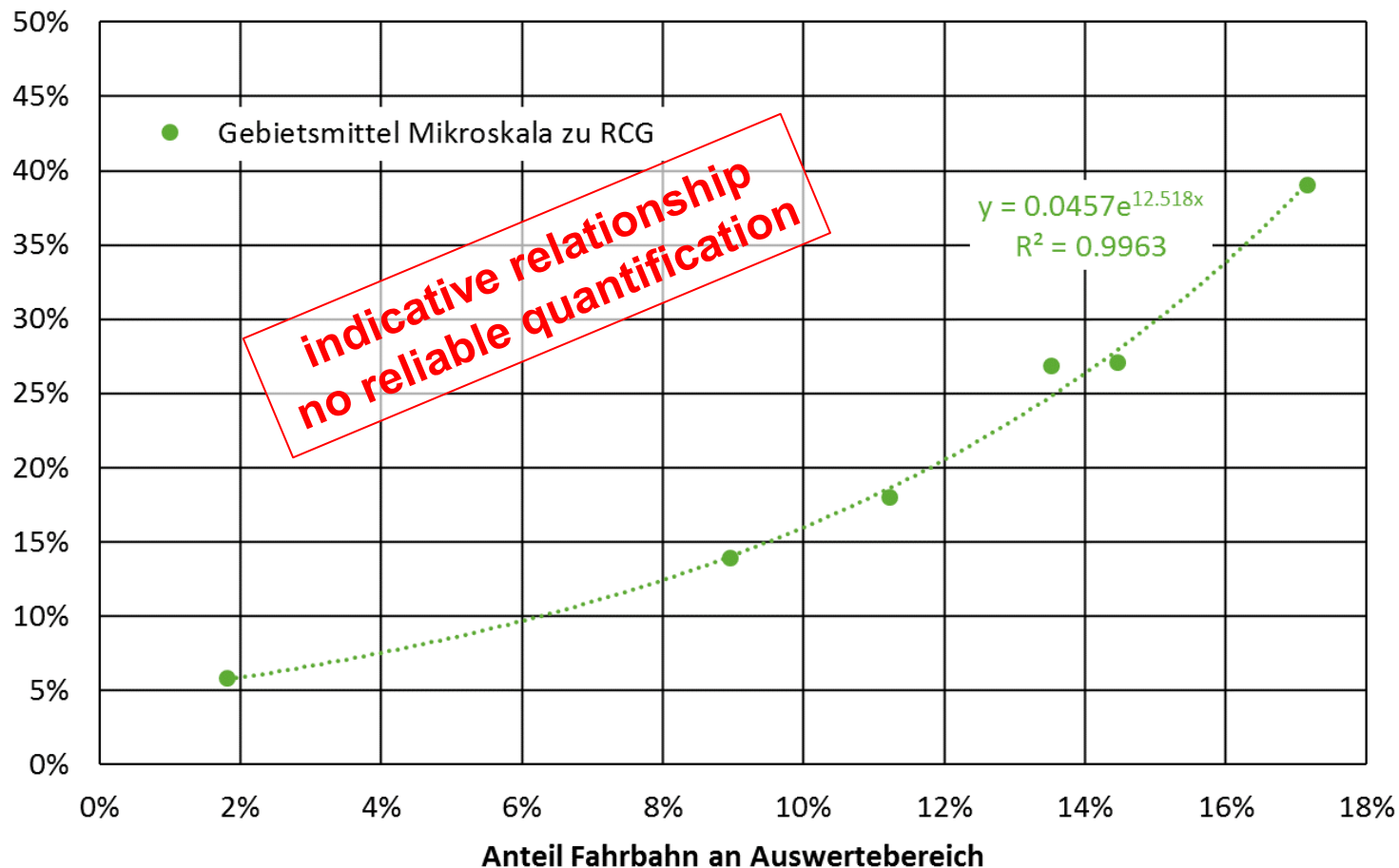
wish: relate micro scale frequency distributions to CTM values

- microscale means on avg. ca. 25 % > CTM grid cell values  
range: 14 – 39 %  
⇒ micro scale mean cannot be easily derived from CTM  
⇒ frequency distributions cannot generally be derived
- sample of 6 too small for reliable quantifications ! ...
- ... however, as indication for further research some hints  
target: “microscale mean  $X$  % > CTM grid cell value” using ...
  - percentage of area covered by roads ?
  - vehicle emissions in CTM cell ?

## UBA project „Urban NO2 and PM10 concentrations“

### First elements of a new strategy to assess AQ

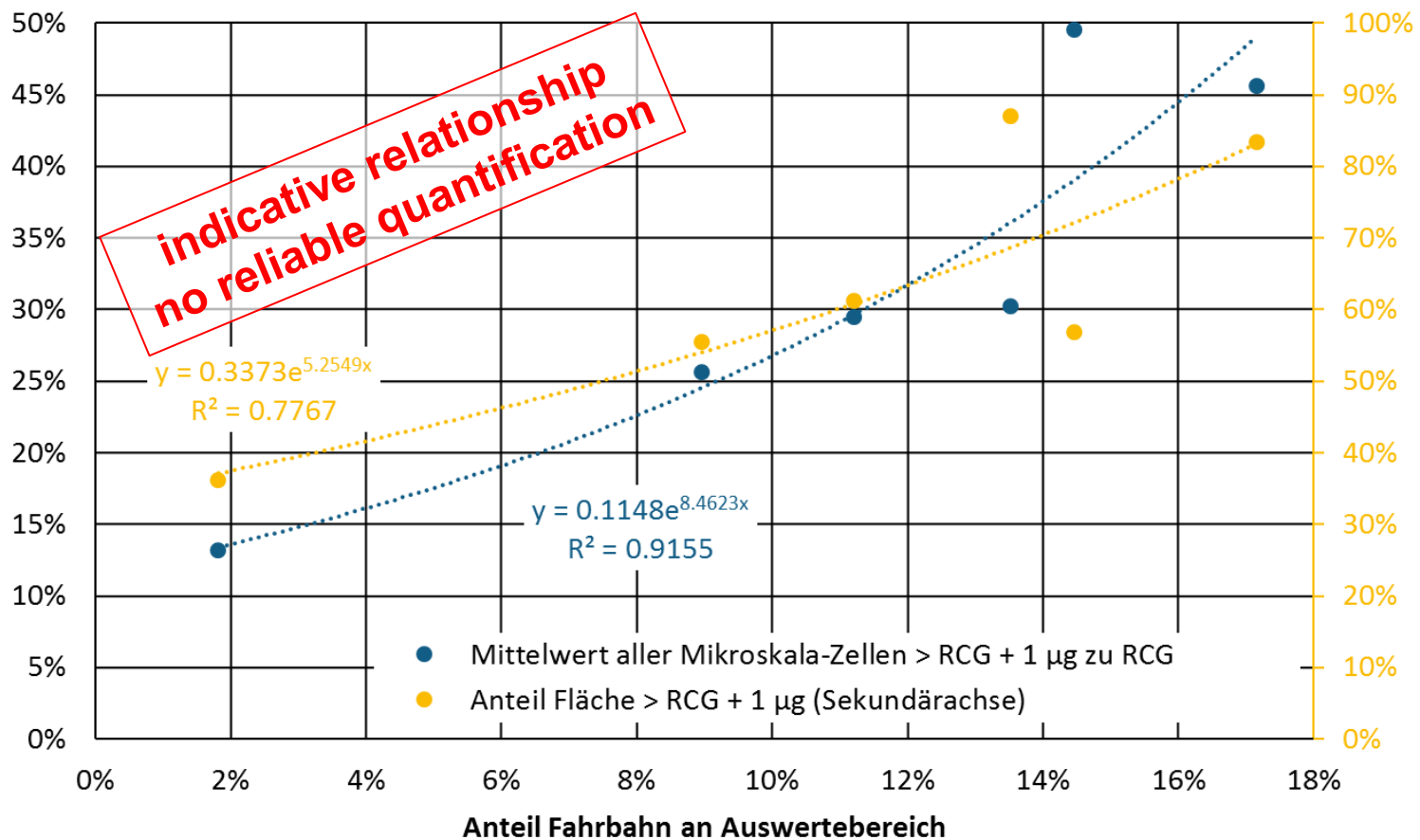
indicative relationship based on road surface area



## UBA project „Urban NO2 and PM10 concentrations“

# First elements of a new strategy to assess AQ

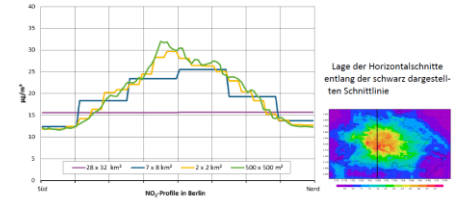
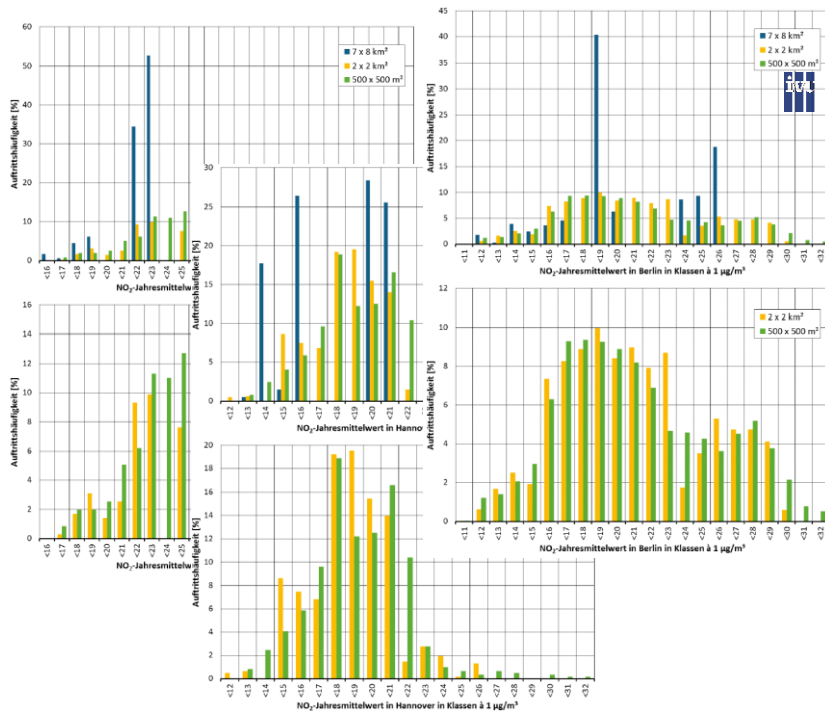
indicative relationship based on road surface area



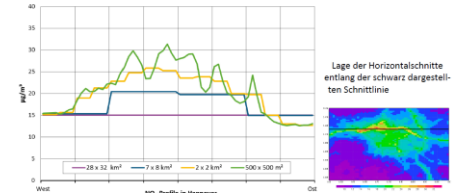
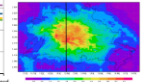


# UBA project „Urban NO<sub>2</sub> and PM<sub>10</sub> concentrations“

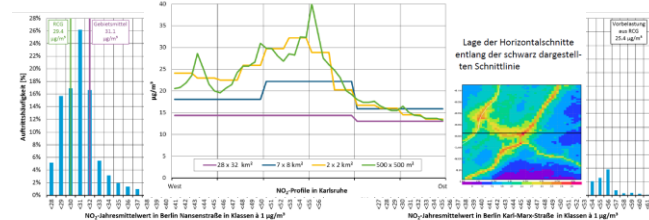
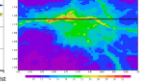
- NO<sub>2</sub> and PM<sub>10</sub>
- CTM results for 3 cities
- 6 micro scale results (2 per city)
- frequency distributions
  - CTM in 3 resolutions
  - micro scale



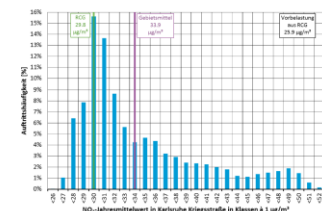
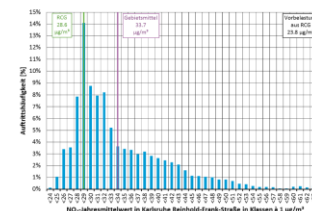
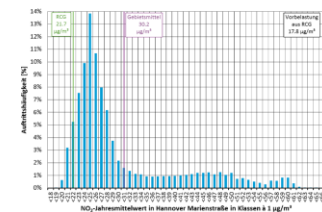
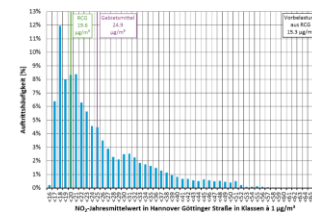
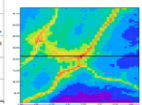
Lage der Horizontalschnitte entlang der schwarz dargestellten Schnittlinie



Lage der Horizontalschnitte entlang der schwarz dargestellten Schnittlinie



Lage der Horizontalschnitte entlang der schwarz dargestellten Schnittlinie



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Thank you for your attention!

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(UBA, II 4.1 - General aspects of air pollution control)