



## **Modelling air quality levels in the Netherlands (background /regional)**

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Ewald Korevaar

[www.mobilisation.nl](http://www.mobilisation.nl)

ewald@mobilisation.nl

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## **Mobilisation for the Environment**

- International operating firm
- Outside NL: Work for several eastern and south-eastern European Countries / EU
- offers services in a broad range of disciplines in the fields of environmental management, including air quality calculations and assessments
- Netherlands: involved in several court procedures related to spatial planning, environmental permitting and nature permitting

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## Our experience

Several project related to air quality, e.g.:

- Air quality calculations for construction of the Amsterdam Metro station 'Vijzelgracht' (Municipality of Amsterdam)
- Air quality calculations for the court procedure against new highway A4 between The Hague and Rotterdam (NGO)
- Emission and deposition calculations for court procedures against Cement company Enci Maastricht
- Assessment of the air quality calculations related to court procedure against the elevation of the maximum speed at the A10 Highway near Amsterdam (Friends of the Earth)

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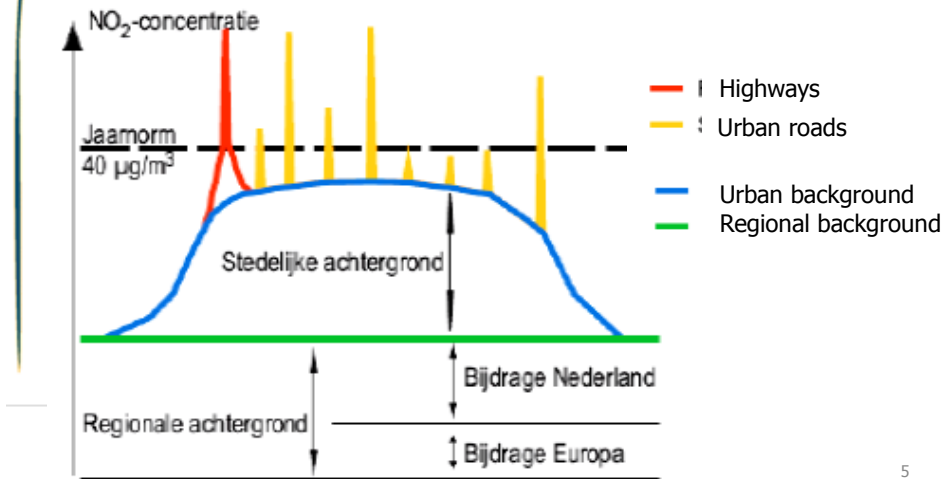
## Origin of air quality levels

- Air quality levels, e.g. along urban roads, have different types of origin:
  - Regional background
    - Sources situated in the Netherlands
    - Sources outside the Netherlands
  - Urban contribution ('urban background')
    - Highways, other road, industrial facilities, farms, etc.
  - Local contribution
    - The road itself

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## Origin of air quality levels



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## Structure of the presentation

- Why modelling?
- Determining background concentrations (regional levels) air quality in the Netherlands (blue and green lines previous figure)
- Determining future (background) concentrations in the Netherlands
- Lessons learned

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## Why modelling air quality?

- Measuring everywhere is 'impossible'
  - Ambient air quality shall be assessed at all locations except those listed in paragraph 2 (Annex III of the air quality directive)
- Forecasting future levels of air quality
- Assessment of measures (effects of air quality)
- Assessing the effects of government decisions (permitting, planning)
- Financial reasons (measuring is usually expensive)

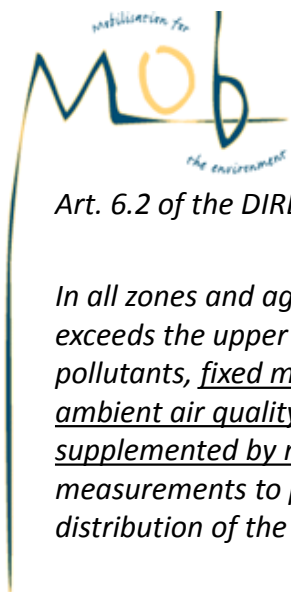
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## Why measuring?

- 'Checking' the outcomes of the models
- Input for modelling
- Calibration of models
- Confidence of the public
  - measured data are 'true', outcomes of models are 'debatable'
- Requested by the Ambient Air Directive

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# DIRECTIVE 2008/50/EC

Art. 6.2 of the DIRECTIVE 2008/50/EC

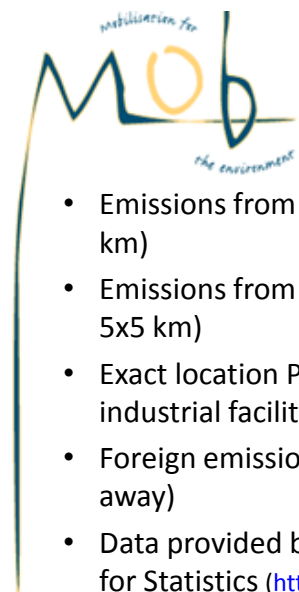
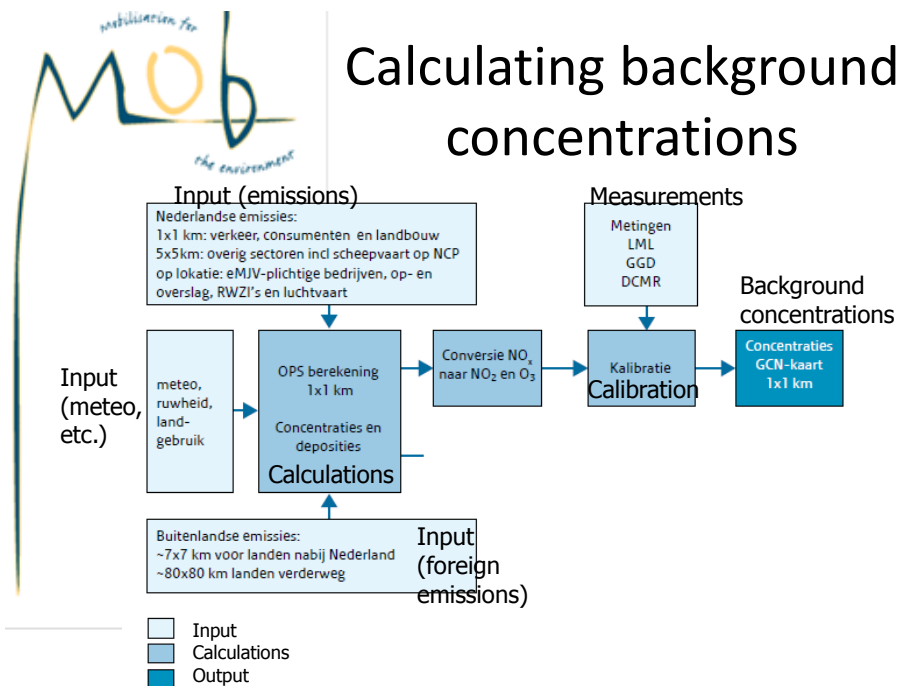
*In all zones and agglomerations where the level of pollutants (...) exceeds the upper assessment threshold established for those pollutants, fixed measurements shall be used to assess the ambient air quality. Those fixed measurements may be supplemented by modelling techniques and/or indicative measurements to provide adequate information on the spatial distribution of the ambient air quality.*



## Requirements for modelling

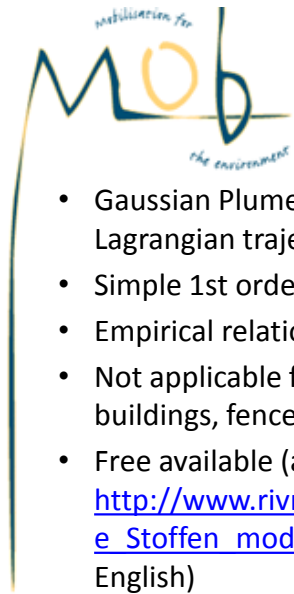
A. Data quality objectives for ambient air quality assessment

	Sulphur dioxide, nitrogen dioxide and oxides of nitrogen and carbon monoxide	Benzene	Particulate matter (PM <sub>10</sub> /PM <sub>2.5</sub> ) and lead	Ozone and related NO and NO <sub>2</sub>
Modelling uncertainty:				
Hourly	50 %	—	—	50 %
Eight-hour averages	50 %	—	—	50 %
Daily averages	50 %	—	not yet defined	—
Annual averages	30 %	50 %	50 %	—



## Input

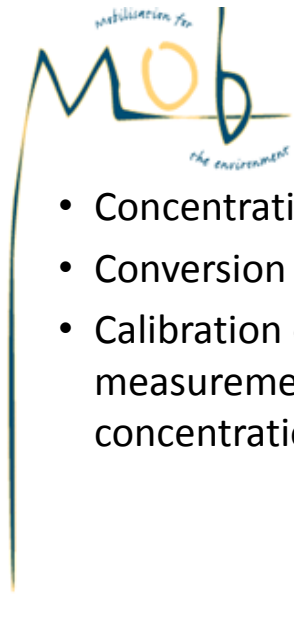
- Emissions from traffic, households, agriculture (resolution 1x1 km)
- Emissions from other sectors, including shipping (resolution 5x5 km)
- Exact location PRTR-companies, airports and some other industrial facilities
- Foreign emissions (7x7 km close to NL and 80 x 80 km further away)
- Data provided by the Env. Protection Agency / Central Bureau for Statistics (<http://emissieregistratie.nl/erpubliek/bumper.en.aspx>)
- Meteo data, roughness of landscape, land-use



## OPS Model

- Gaussian Plume model for short distance to source; Lagrangian trajectory model for longer distances
- Simple 1st order chemistry
- Empirical relation for conversion of NO<sub>x</sub> to NO<sub>2</sub>
- Not applicable for hilly terrains, complex situations (e.g. high buildings, fences)
- Free available (after registration)  
[http://www.rivm.nl/Onderwerpen/O/Operationele\\_Prioritaire\\_Stoffen\\_model/rops/rfd](http://www.rivm.nl/Onderwerpen/O/Operationele_Prioritaire_Stoffen_model/rops/rfd) (website in Dutch, model in English)
- Model description <http://www.rivm.nl/media/ops/OPS-model.pdf> (English)

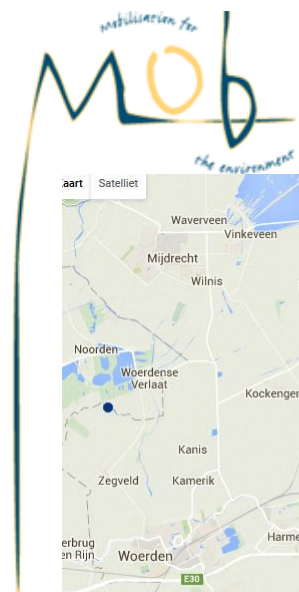
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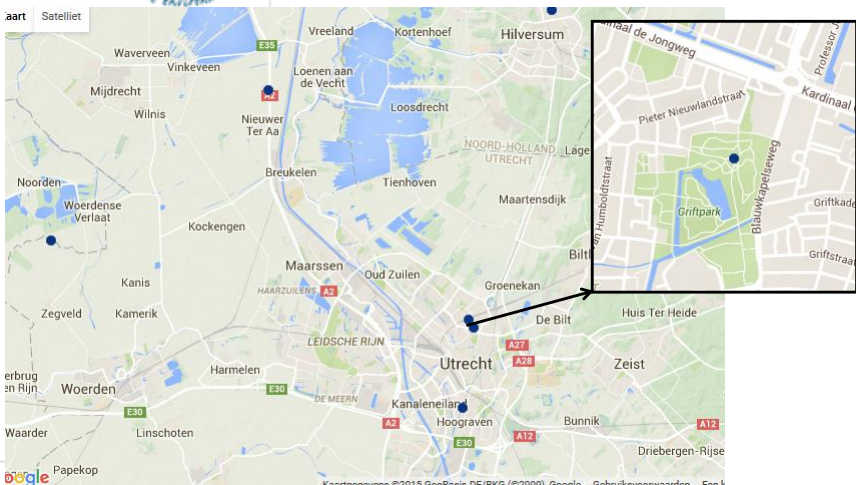
## Calculating and calibrating

- Concentrations are calculated for 1x1 km area
- Conversion of NO<sub>x</sub> to NO<sub>2</sub> and O<sub>3</sub>
- Calibration of the results with the outcomes of measurements of the background concentration in rural and urban areas

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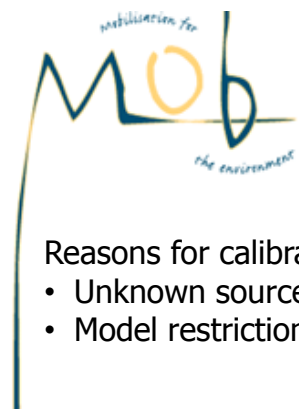


# Measuring stations



<http://www.lml.rivm.nl/meetnet/index.php>

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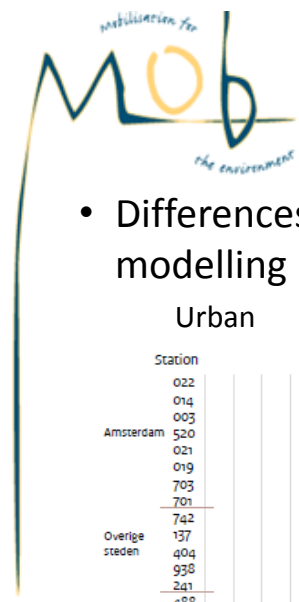
# Calibration PM

- Reasons for calibration:
- Unknown sources (sea salt, soil dust, tyre debris)
  - Model restrictions / faults / imperfections

	Kaarten voor 2014	Kaarten voor 2015-2030
NH <sub>4</sub>	Factor 1,2 <sup>a,f</sup>	Factor 1,3 <sup>c,f</sup>
NO <sub>3</sub>	Factor 1,5 <sup>a</sup>	Factor 1,6 <sup>c</sup>
SO <sub>4</sub>	Factor 2,7 <sup>a</sup>	Factor 3,0 <sup>c</sup>
PM <sub>10</sub>	Constante van 7,8 µg m <sup>-3</sup> <sup>b</sup>	Constante van 8,7 µg m <sup>-3</sup> <sup>c</sup>
PM <sub>2,5</sub>	Constante van 2,6 µg m <sup>-3</sup> <sup>b,e</sup>	Constante van 2,9 µg m <sup>-3</sup> <sup>d,e</sup>

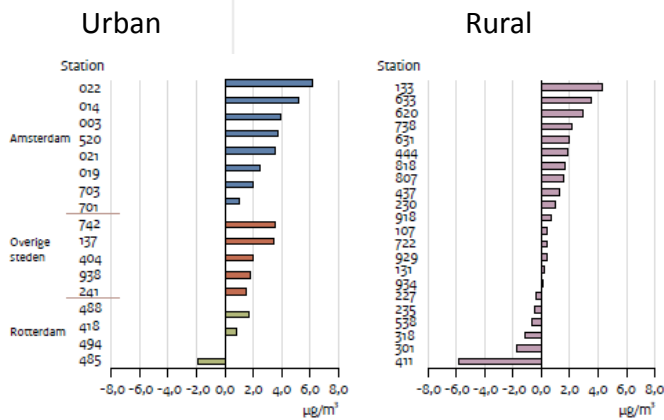
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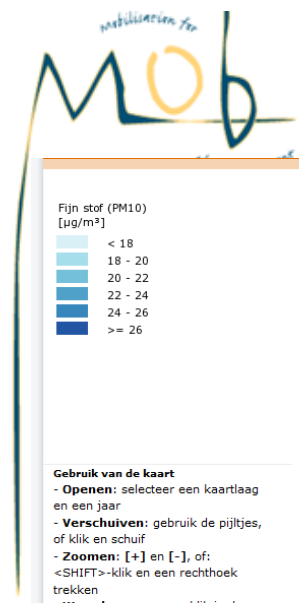


# Calibration NO2

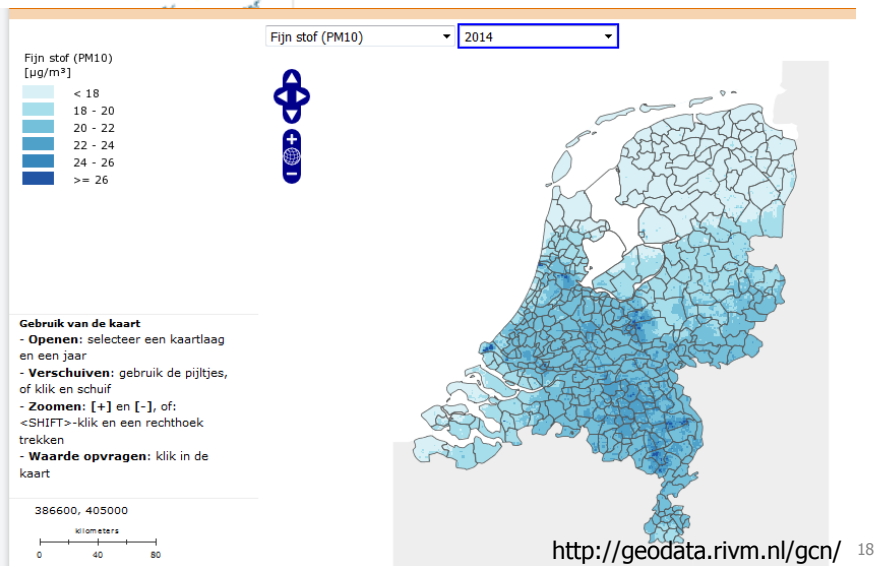
- Differences between measuring (vertical) and modelling (horizontal), before calibration



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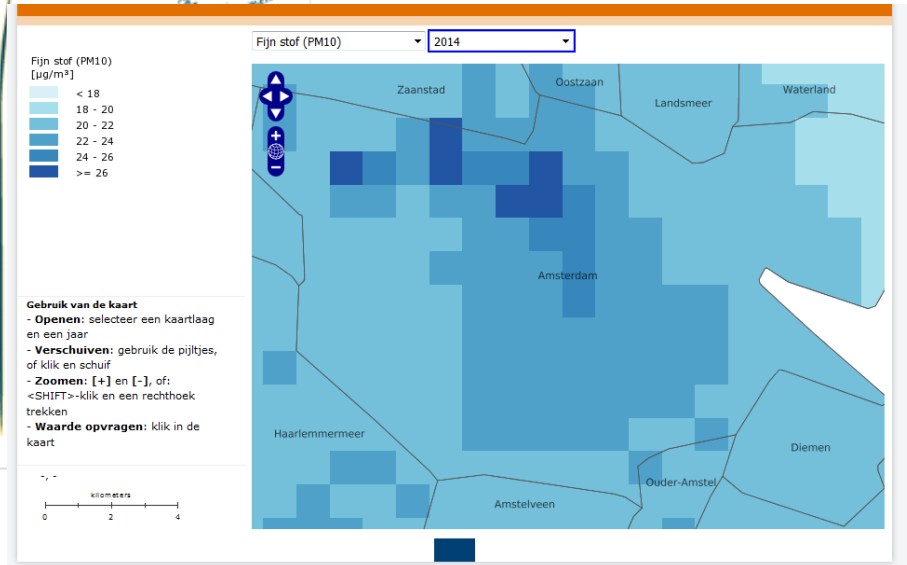


# Results PM10

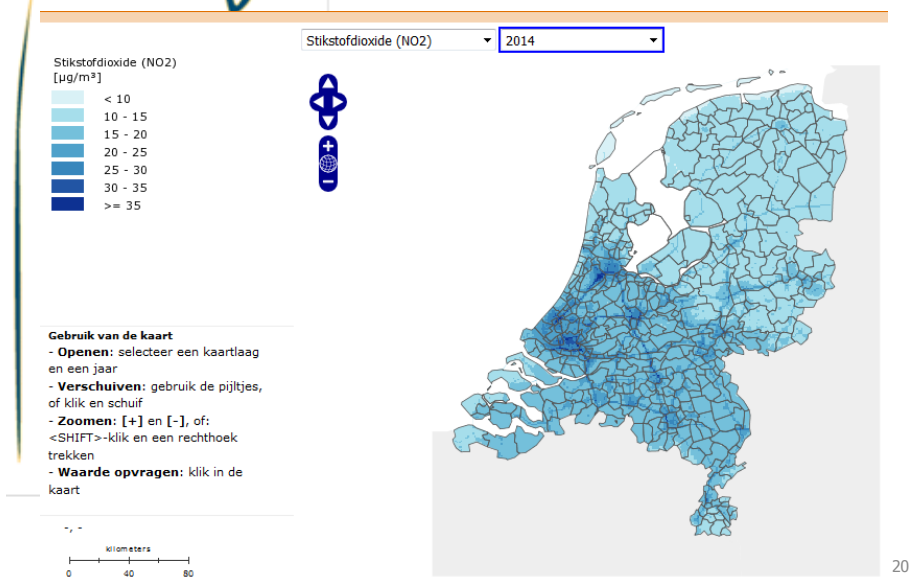




## In detail (Amsterdam)

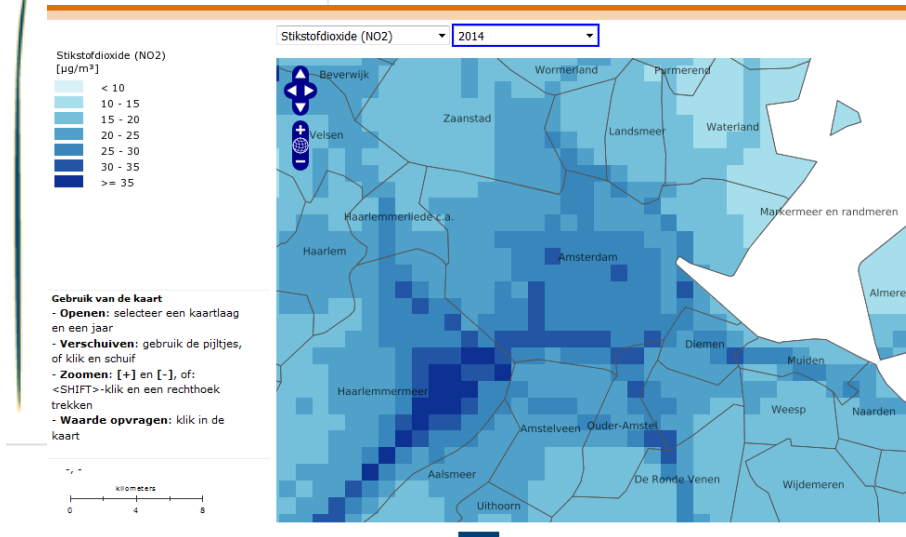


## Results NO2

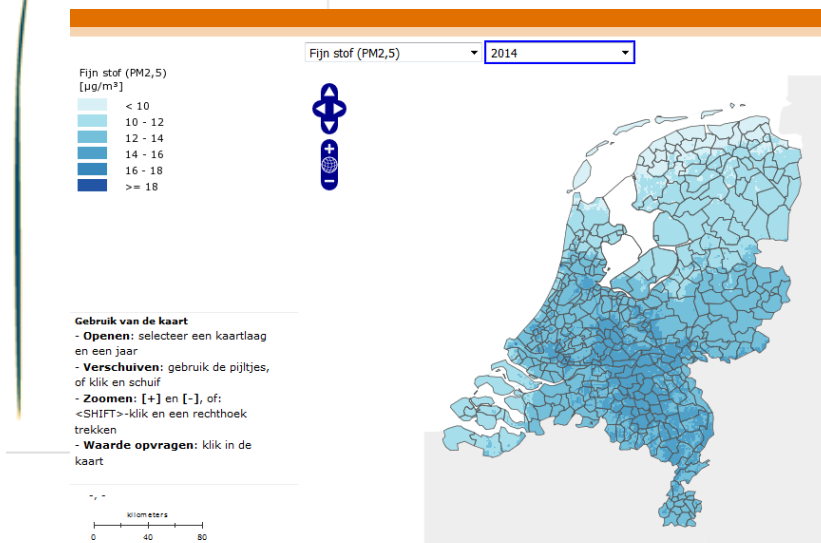


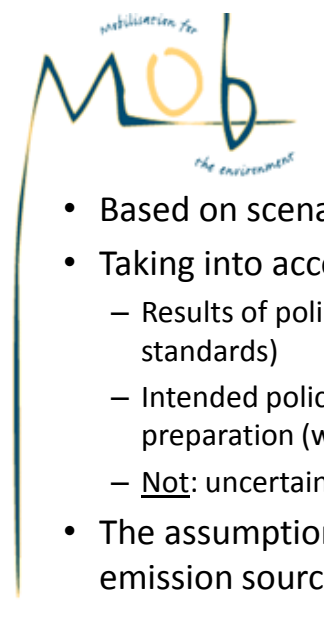


## In detail (Amsterdam / Schiphol airport)



## PM<sub>2,5</sub>

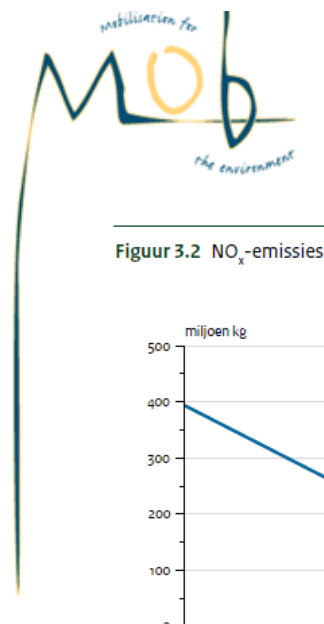




## Background concentrations (future)

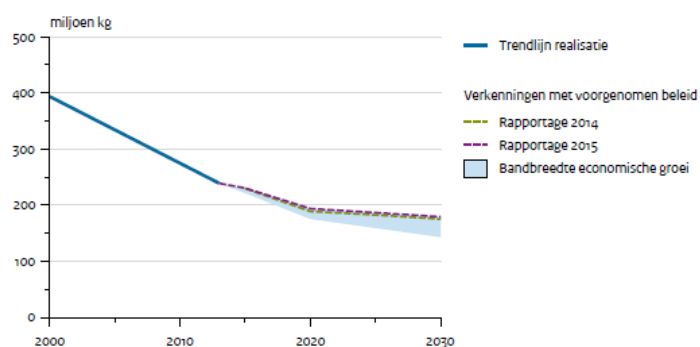
- Based on scenario high economic growth: 2,5 %/yr
- Taking into account
  - Results of policy decisions already made (e.g. Euro standards)
  - Intended policy decisions: results of policy decision in preparation (which are expected to be made)
  - Not: uncertain policy
- The assumptions are incorporated into the different emission sources

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## NO<sub>x</sub> (future)

Figuur 3.2 NO<sub>x</sub>-emissies

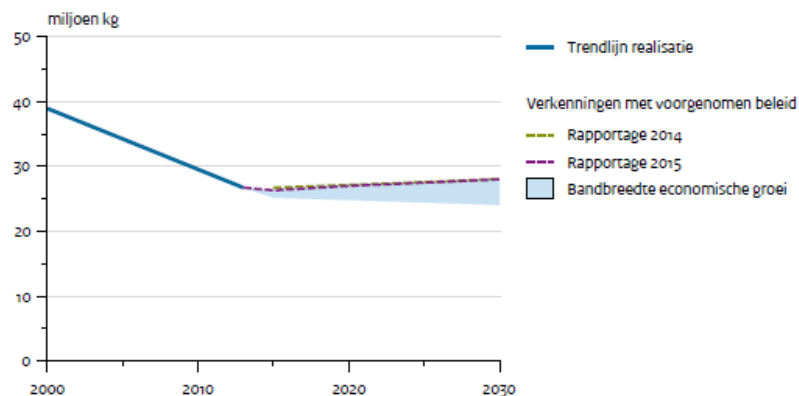


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## PM10 (future)

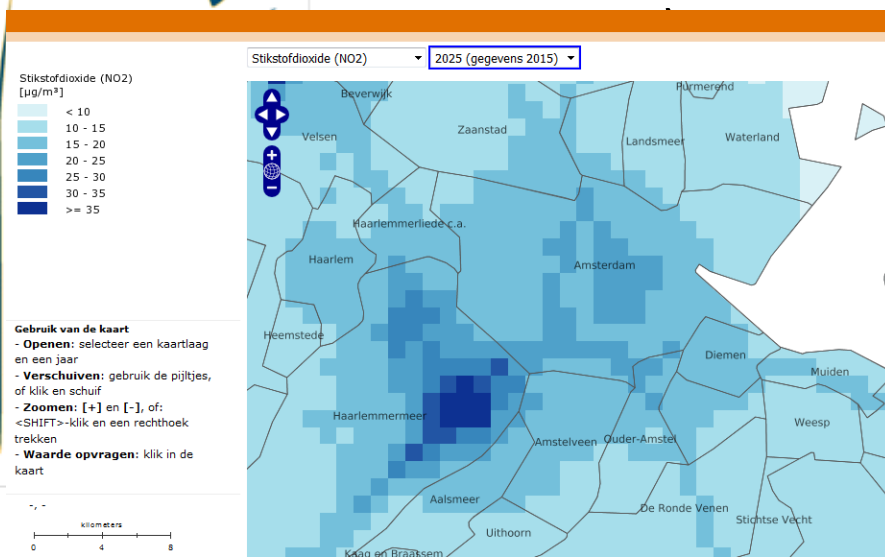
Figuur 3.3 Primair PM<sub>10</sub>-emissies

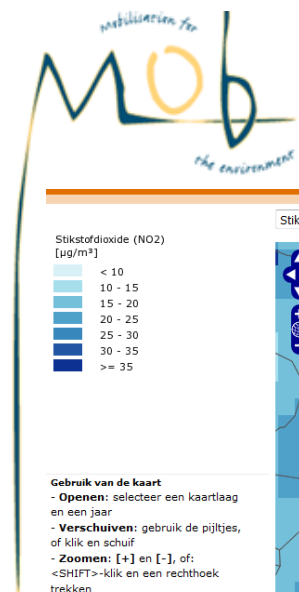


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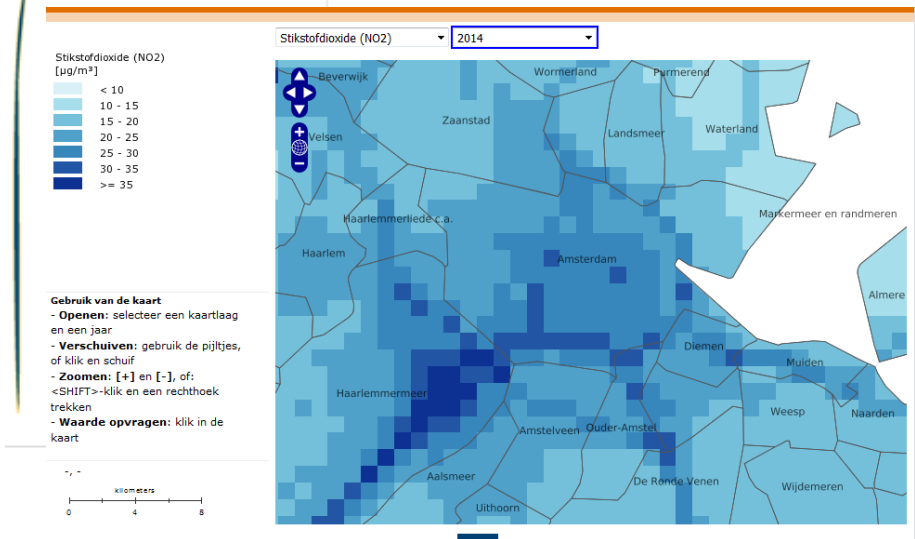


## In detail 2025 (Amsterdam / Schiphol)

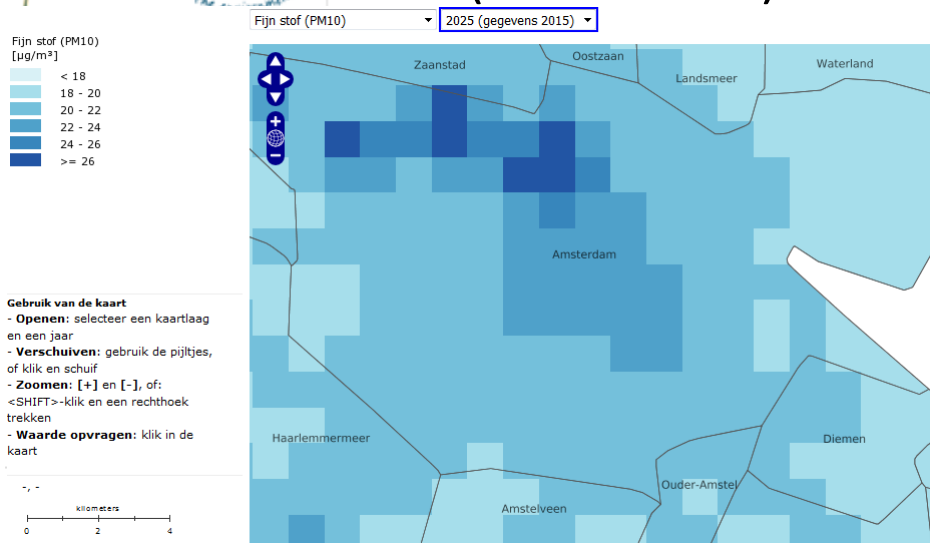




# In detail (Amsterdam / Schiphol airport)

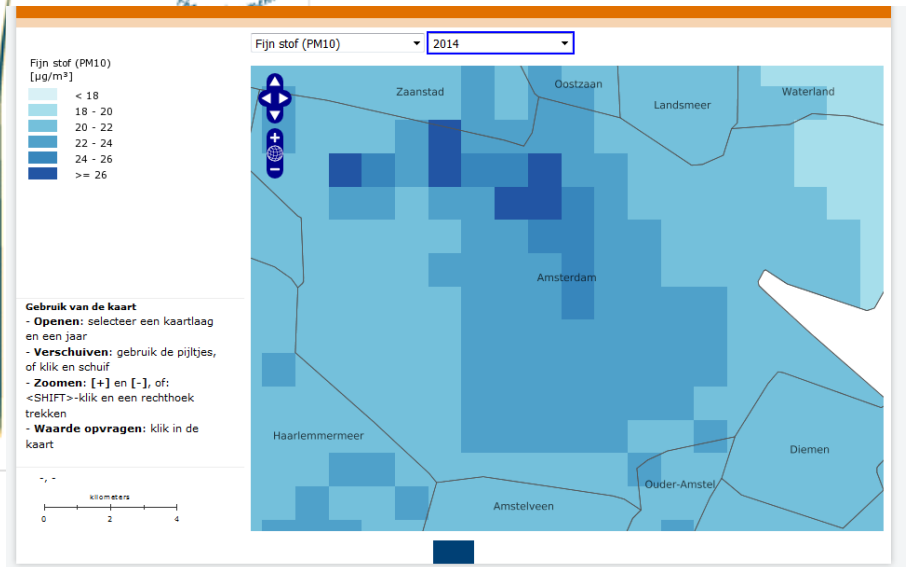


# PM10 (2025) in detail (Amsterdam)





## In detail (Amsterdam)



## Lessons learned / to learn

- Importance of collecting right data, improving the quality of data (process!)
- Don't be afraid to make assumptions
- Calibrate to correct for unknown sources, imperfect data and model imperfections/faults
  - Modelling cannot be done without measuring
- Uncertainties / deviations are inherent to modelling
- Choose model(s), which are not too complicated (not too many variables)
- Define and publish the background concentration, that should be used for calculations (uniformity, legal certainty)
- Regularly updates (in the Netherlands once a year).