The Concawe NO_2 source apportionment viewer

Impact of traffic measures and other sectors on NO_2 pollution

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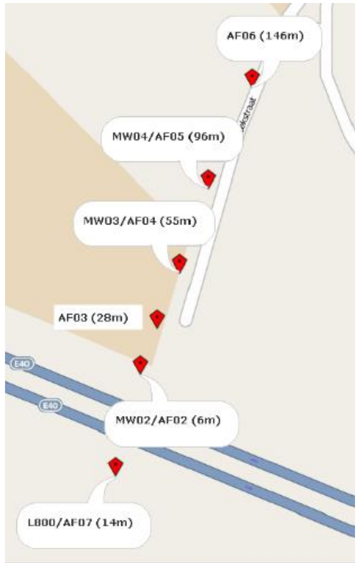
- Motivation: importance of source apportionment
- Objective of the SA viewer
- Methodology
  - Calculation procedures
  - Advantages and limitations
- A live demo of the viewer
  - Some use cases

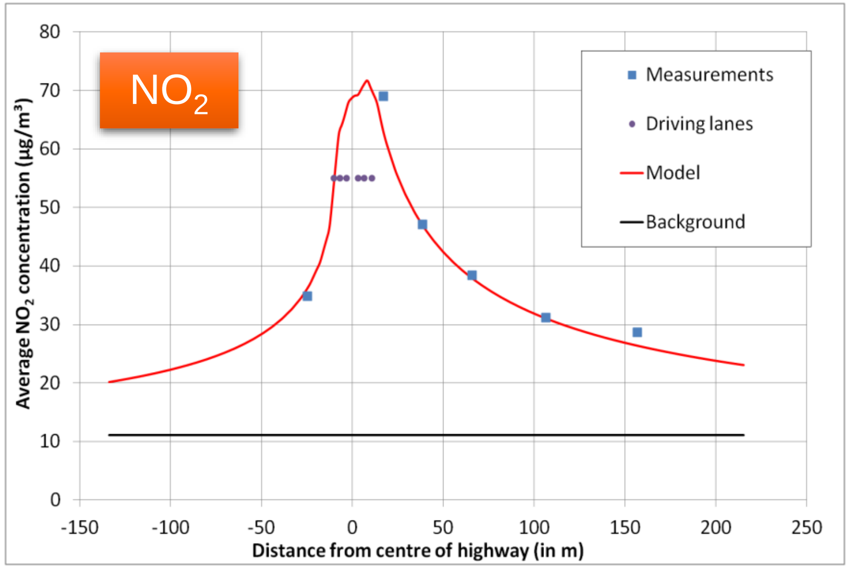
Context

- WHO updated air quality guidelines:
  - NO_2 annual average from 40 → 10 µg/m^3
  - NO_2 24-hour limit of 25 µg/m^3
- Revision of the EU's Ambient Air Quality Directive: align with WHO guidelines
- Stagnating air quality due to recovery after the Corona pandemic

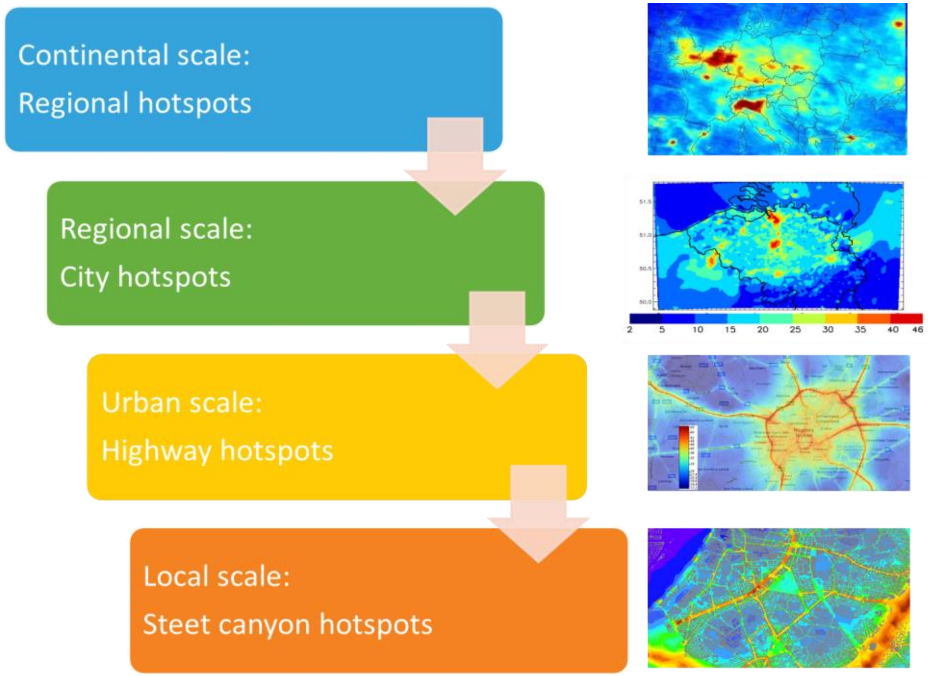
Motivation

- Source Apportionment (SA) is a key element for the assessment of AQ and the design of effective AQ plans.
- SA at EU-wide scale typically uses modelling tools at coarse grid resolution (e.g., 7x7 km^2)
- Traffic-related pollution has a high spatial variability, especially for pollutants like NO_2
- Therefore, methodologies applied at a very high grid resolution are needed to get robust information regarding the contribution of traffic sources.





Lefebvre and Vranckx, VITO ATMOSYS Report (2013)



Objective

- Develop an interactive online viewer to assess the “apportionment” of different sources on NO_2 concentrations
- Applicable for the whole of Europe:
  - @ ~3000 individual monitoring stations in Europe
  - @ ~1000 European cities
- Analyse impact of measures:
  - Urban Access regulation: e.g., “LEZ-like” scenarios
  - Activity changes due to e.g., modal shift, road pricing
  - Introduction of a “new Euro 7 standard”

Methodology

Challenges:

- Model long-distance transport at European scale (Euro 7/VII, traffic measures in big cities)
- High resolution in cities because NO_2 shows strong gradients close to roads

Modelling long distance transport

- Typically done with Chemistry Transport Models (very slow)
- Solution: annual average concentrations at low resolution (7x7km) from the SHERPA source receptor model to model impact of each sector inside and outside each city

High resolution close to roads

- Typically done with Gaussian dispersion model and hourly meteorology (slow)
- Solution: annual average concentrations kernels at 100x100m for typical meteorology all over Europe with the QUARK model.

Methodology: calculation procedure

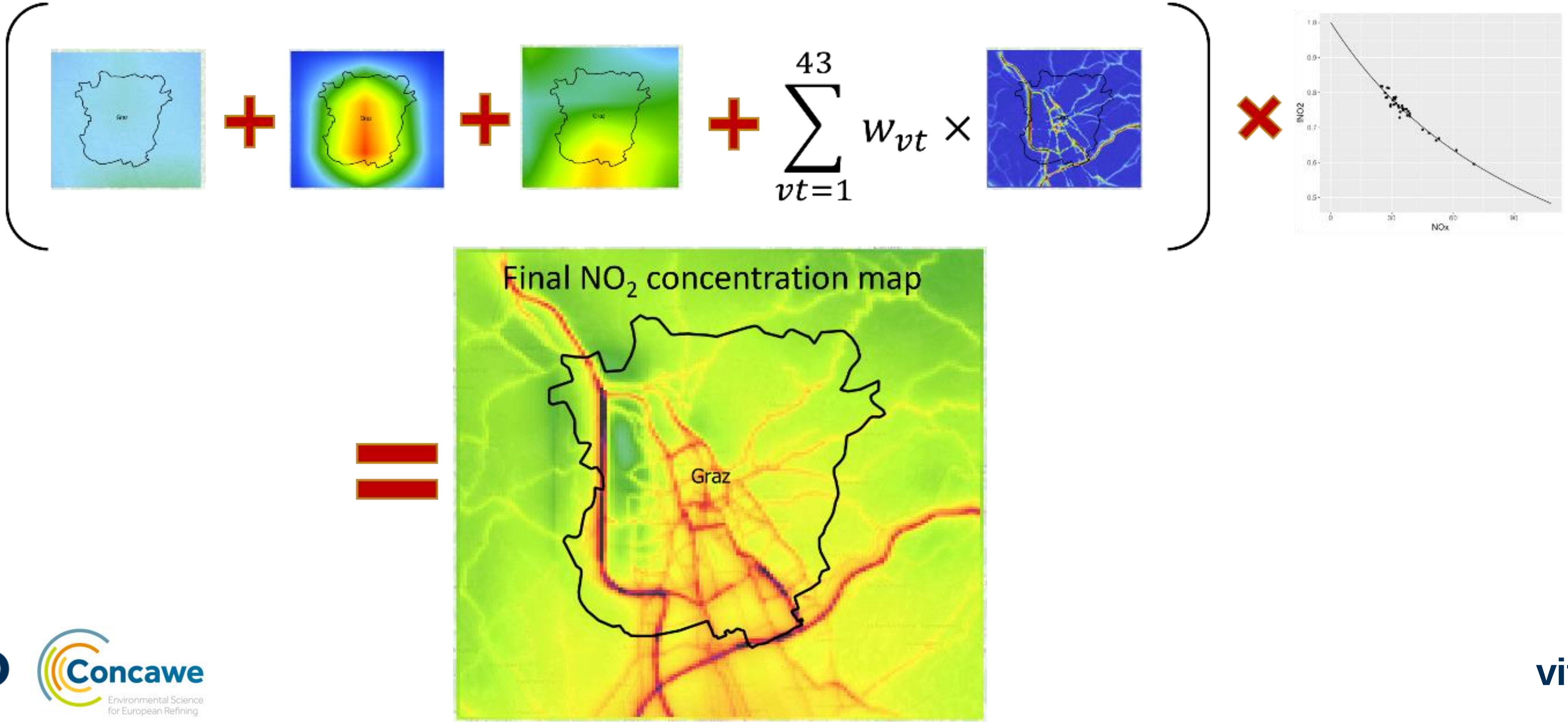
- Pre-calculated layers for all contribution allow calculating user-defined scenarios in a few seconds

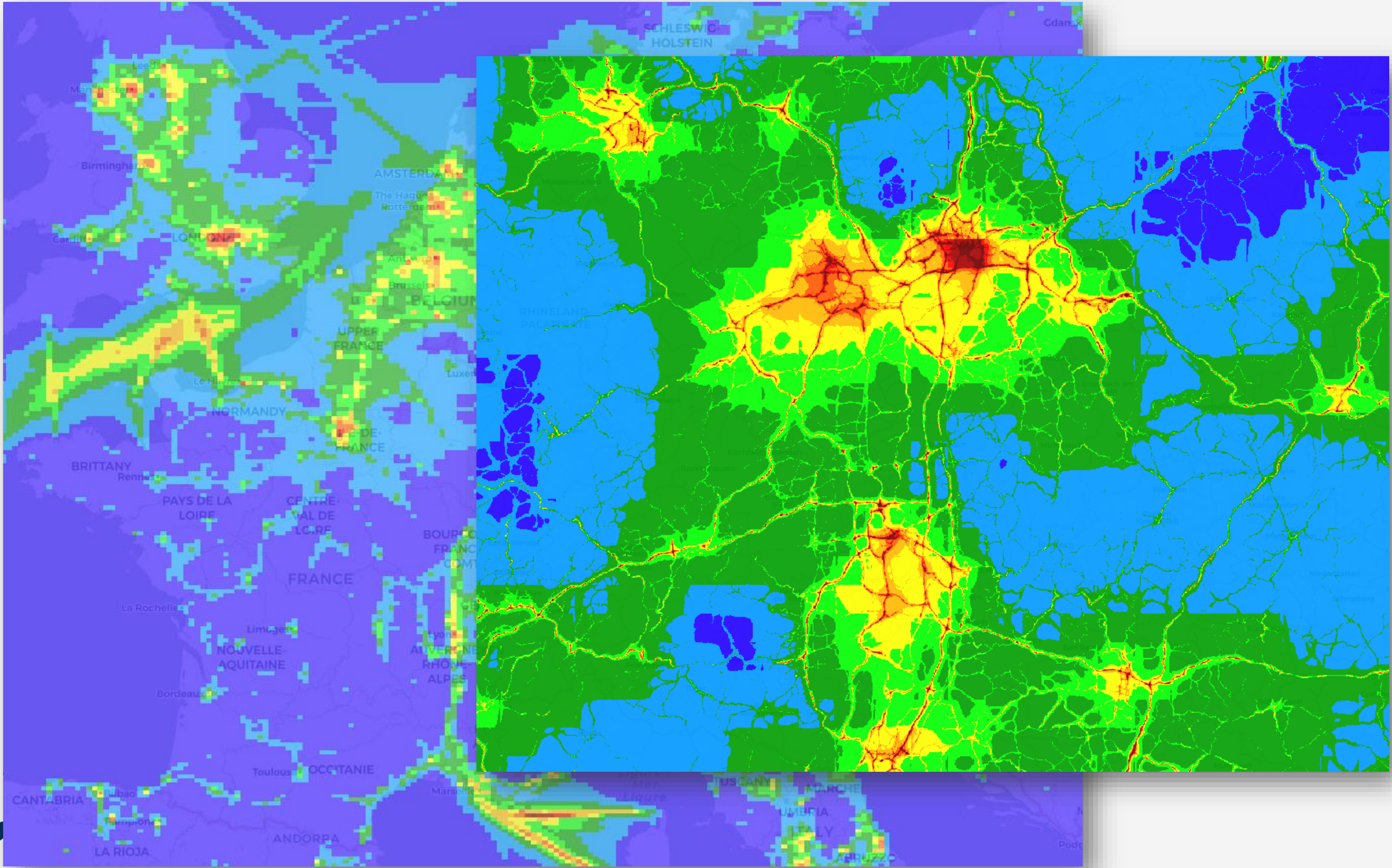
Long-distance low-res impact of 9 non-traffic sectors

Long-distance low-res impact of urban and regional traffic emissions

High-res impact of 42 vehicle types inside the city and all traffic outside

$NO_X \rightarrow NO_2$





SCHLESWIG-
HOLSTEIN
Birmingham
The Hague
Rotterdam
Cardiff
UPPER
FRANCE
NORMANDY
BRITTANY
Rennes
PAYS DE LA
LOIRE
FRANCE
La Rochelle
NOUVELLE-
AQUITAINE
Bordeaux
OCCITANIE
CANTABRIA
LA RIOJA
ANDORRA
TUSCANY
MARCHE

Methodology: strengths and weaknesses

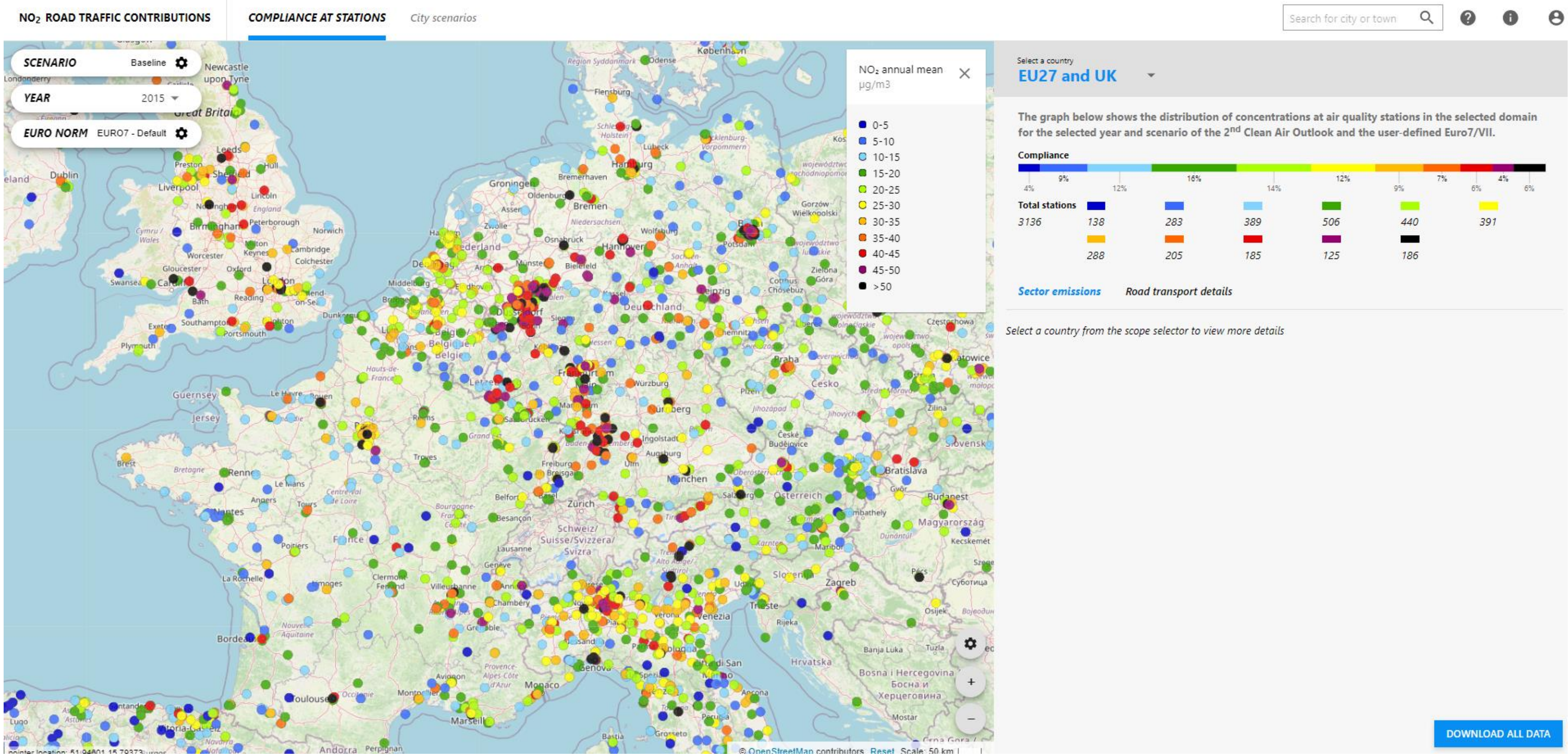
Strengths

- Fast and user-friendly interface
- Impact of 10 sectors can be assessed separately
- Long-distance and local traffic impact is modelled
- High resolution for traffic, low-resolution for other sectors
- NO_2 concentration at 3136 AQ stations can be modelled
- Urban access regulations can be modelled for 947 European cities

Weaknesses

- Traffic intensities are not based on observations but on a proxy (road type and population) and calibrated with national totals ➔ deviations from actual traffic intensities
- No street canyon modelling (necessary data unavailable)
  - Significant underestimation in street canyons (-18.1 µg/m^3)
  - Mainly affects predictions at ~1000 traffic stations
  - “Solved” with a relative bias correction based on observations and modelling in 2018.

The Viewer: station compliance tab



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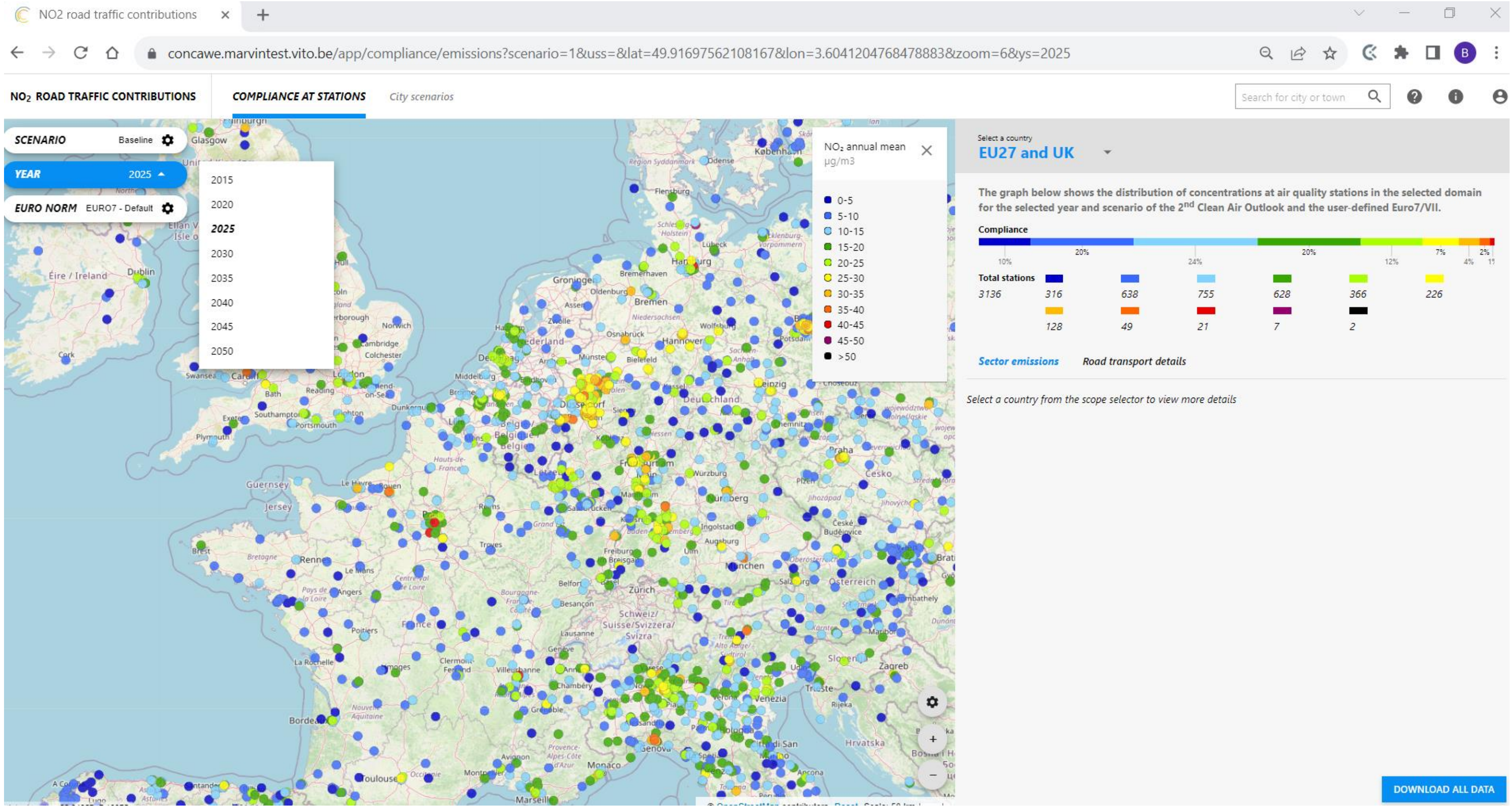
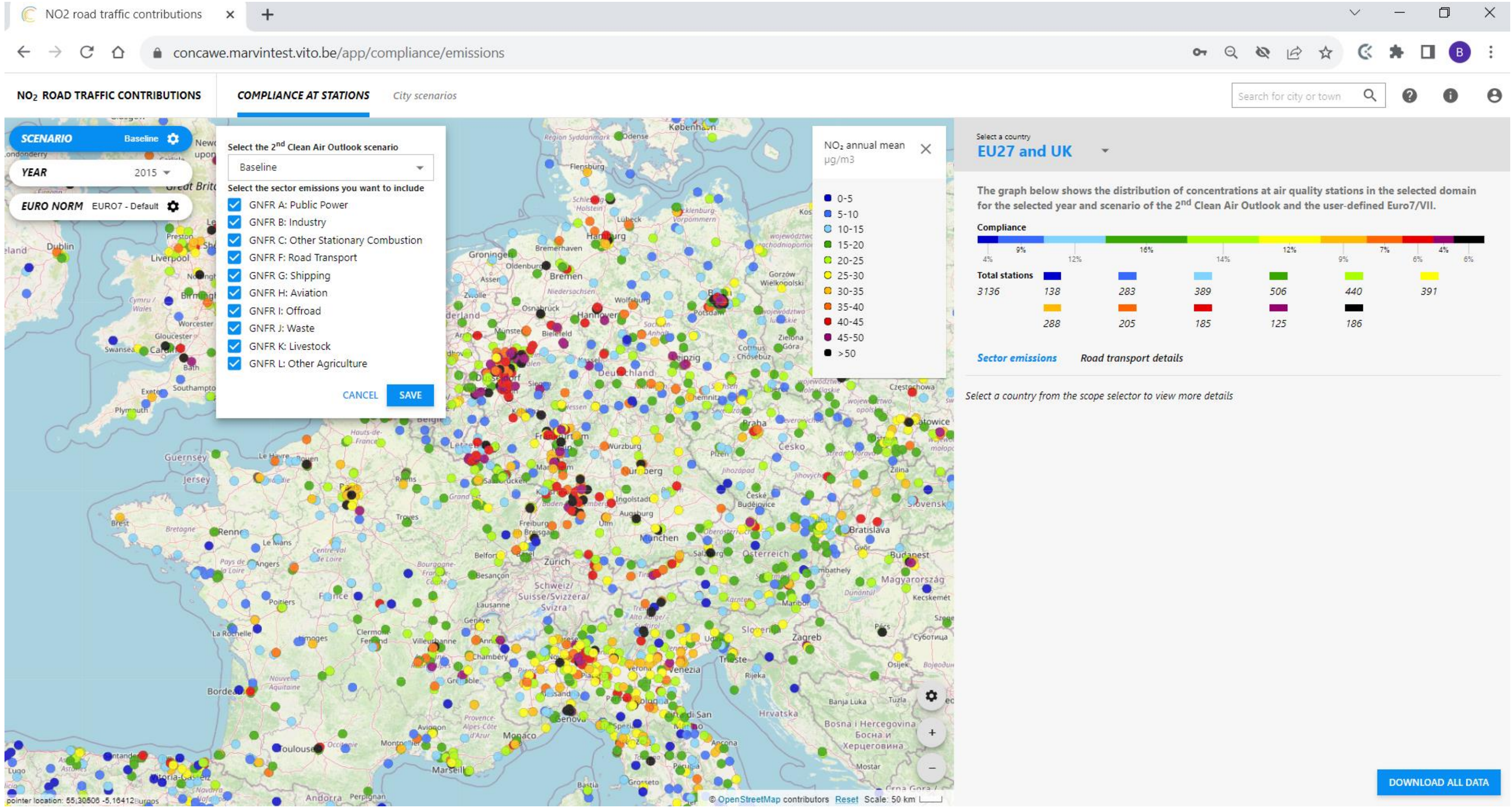
The Viewer: station compliance tab

- Compliance overview in selected year (2025)



The Viewer: station compliance tab

- Select a 2nd Clean Air Outlook scenario
- Switch on/off some sectors



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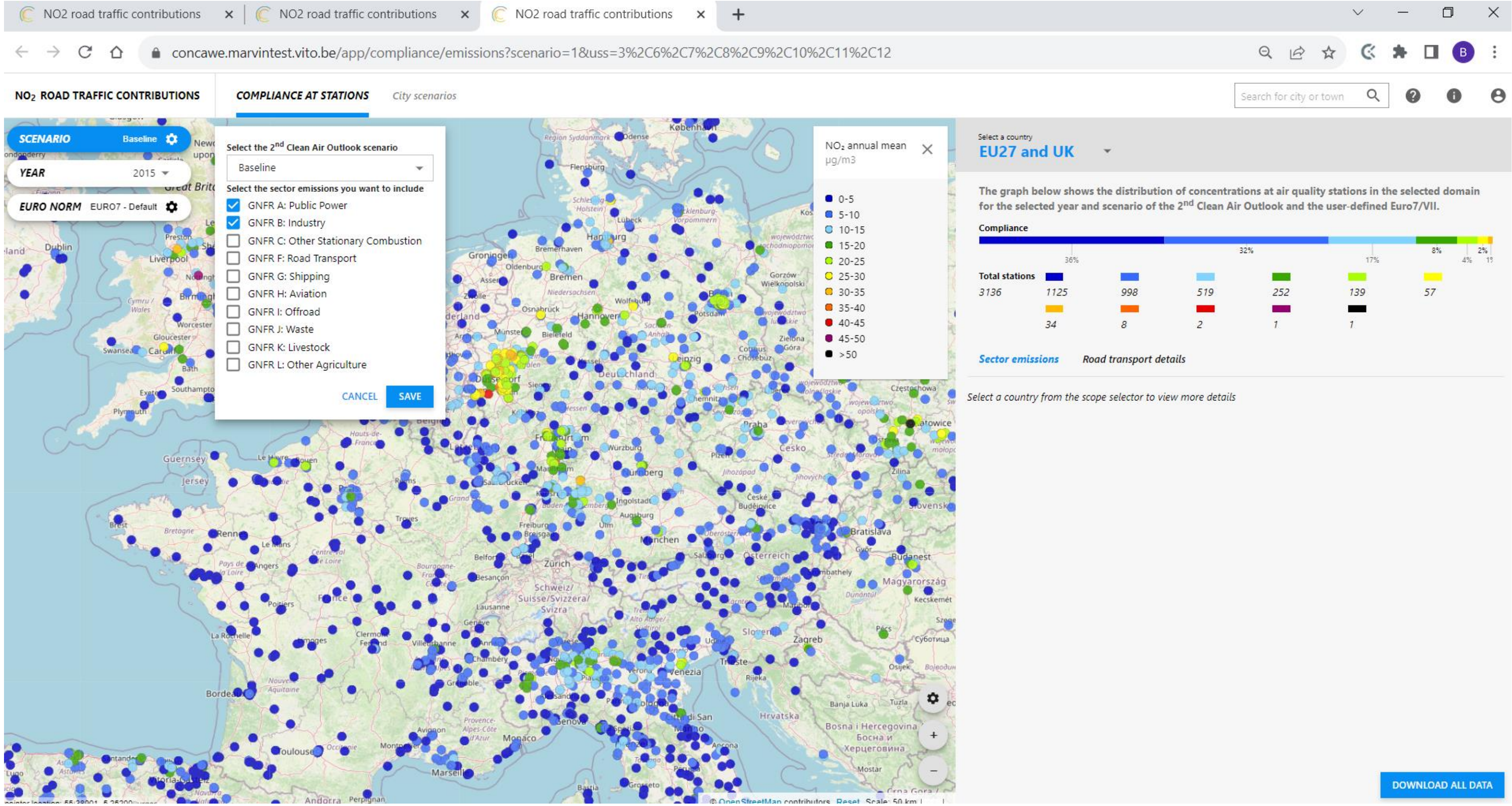
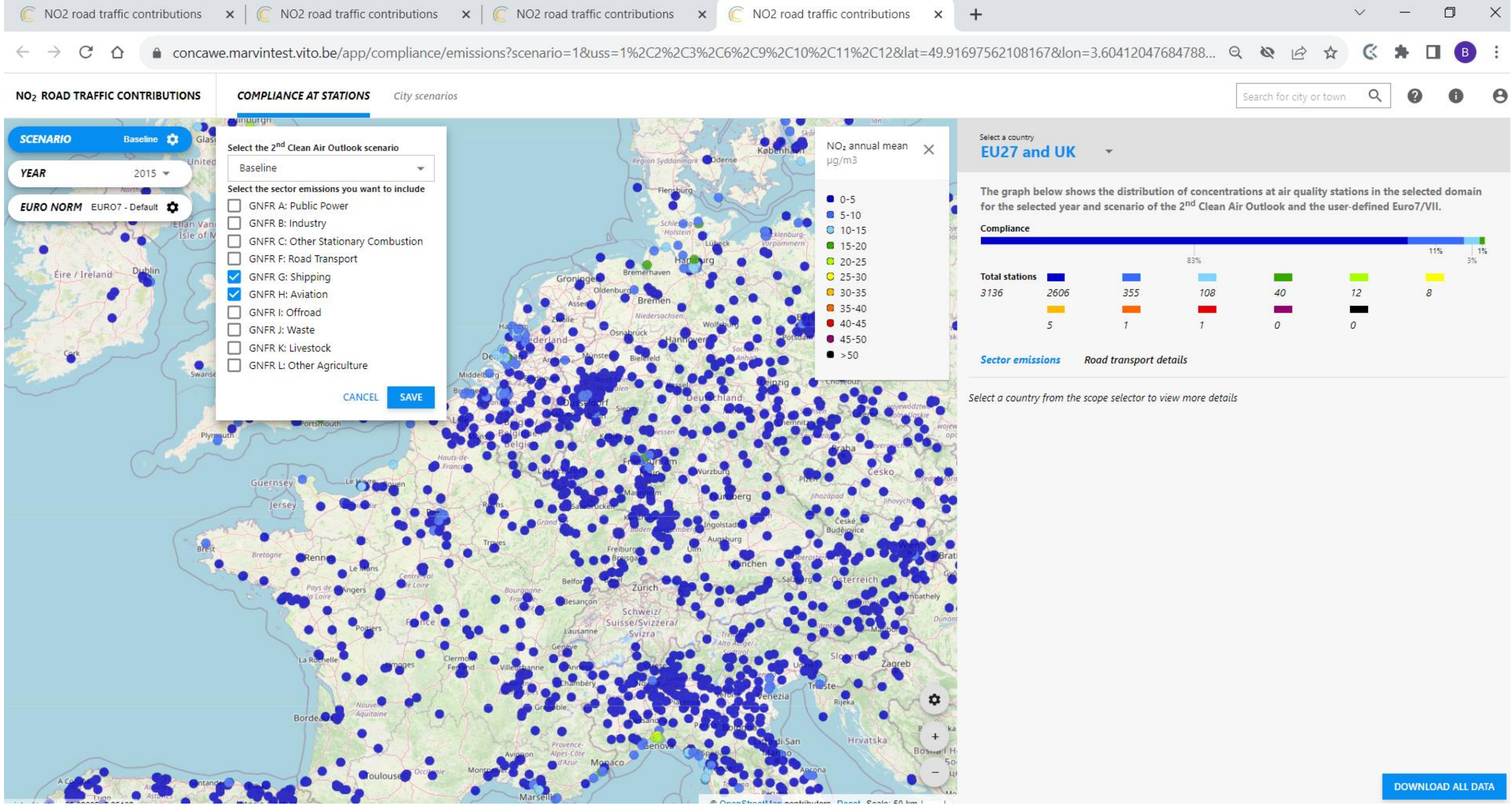
The Viewer: station compliance tab

- Impact of GNFR A (Public Power) and GNFR B (Industry)



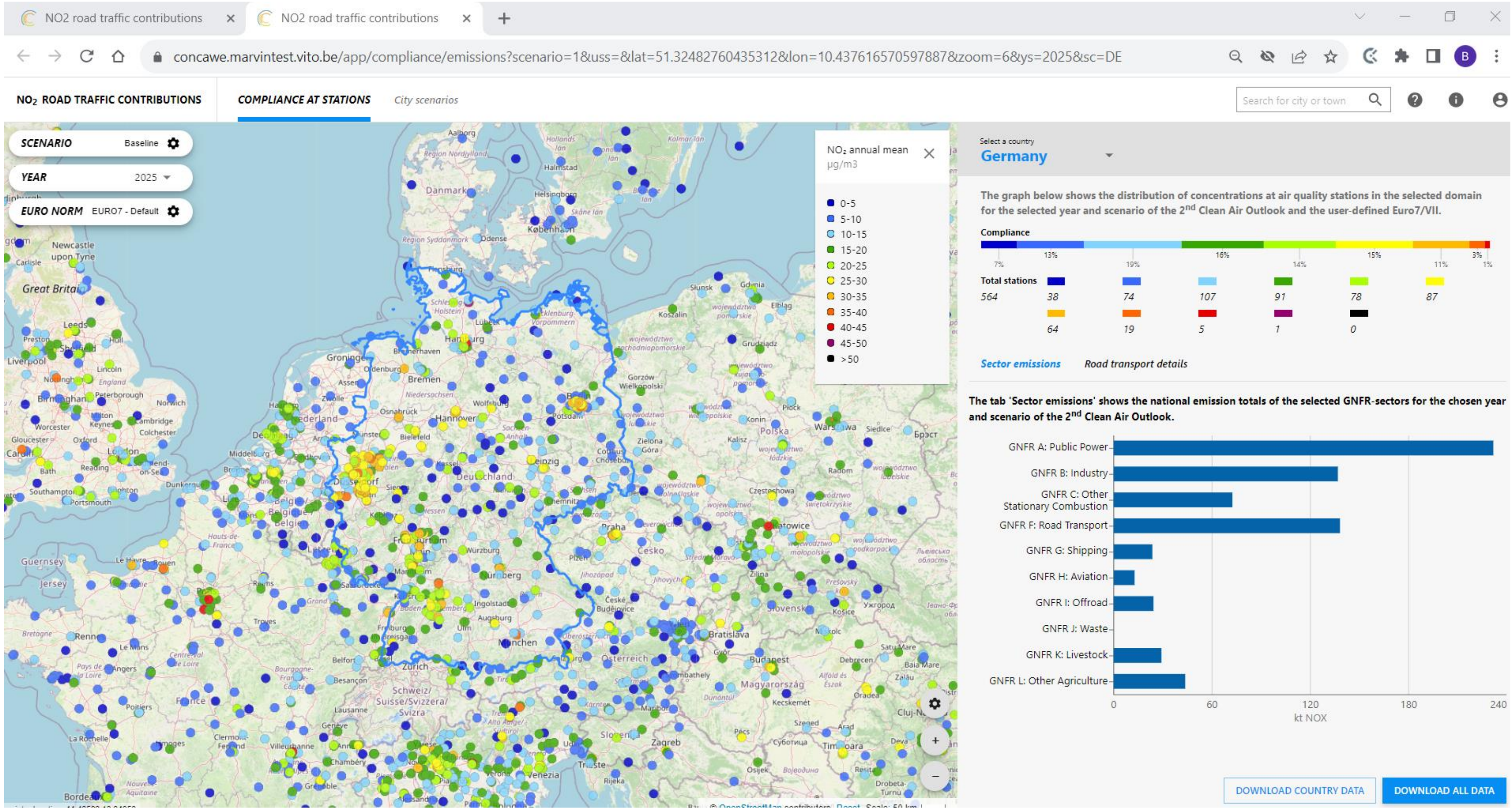
The Viewer: station compliance tab

- Impact of GNFR G (Shipping) and GNFR H (Aviation)



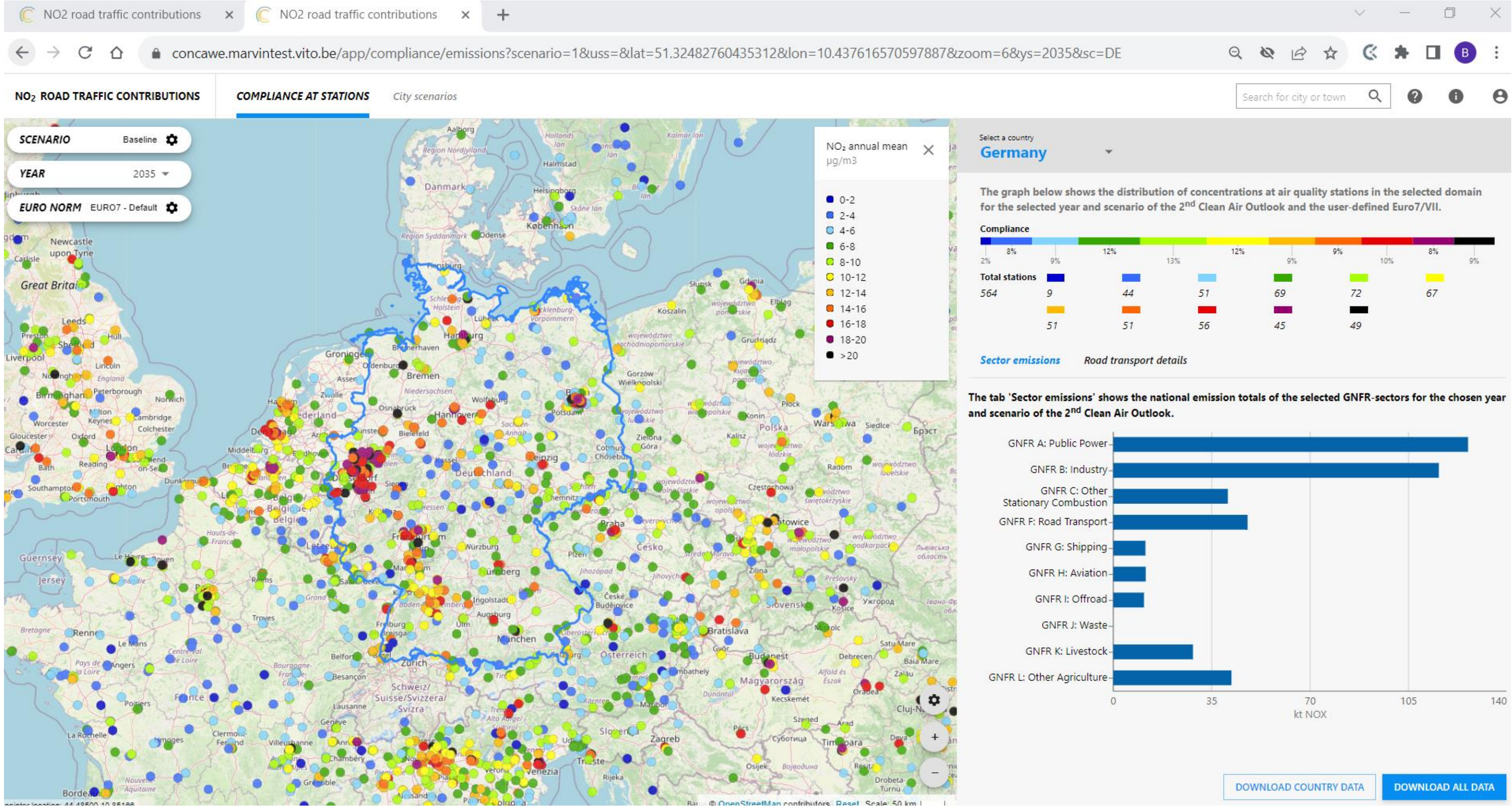
The Viewer: station compliance tab

- Zoom on a country (Germany in 2025) with CAO2 emissions overview and transport details



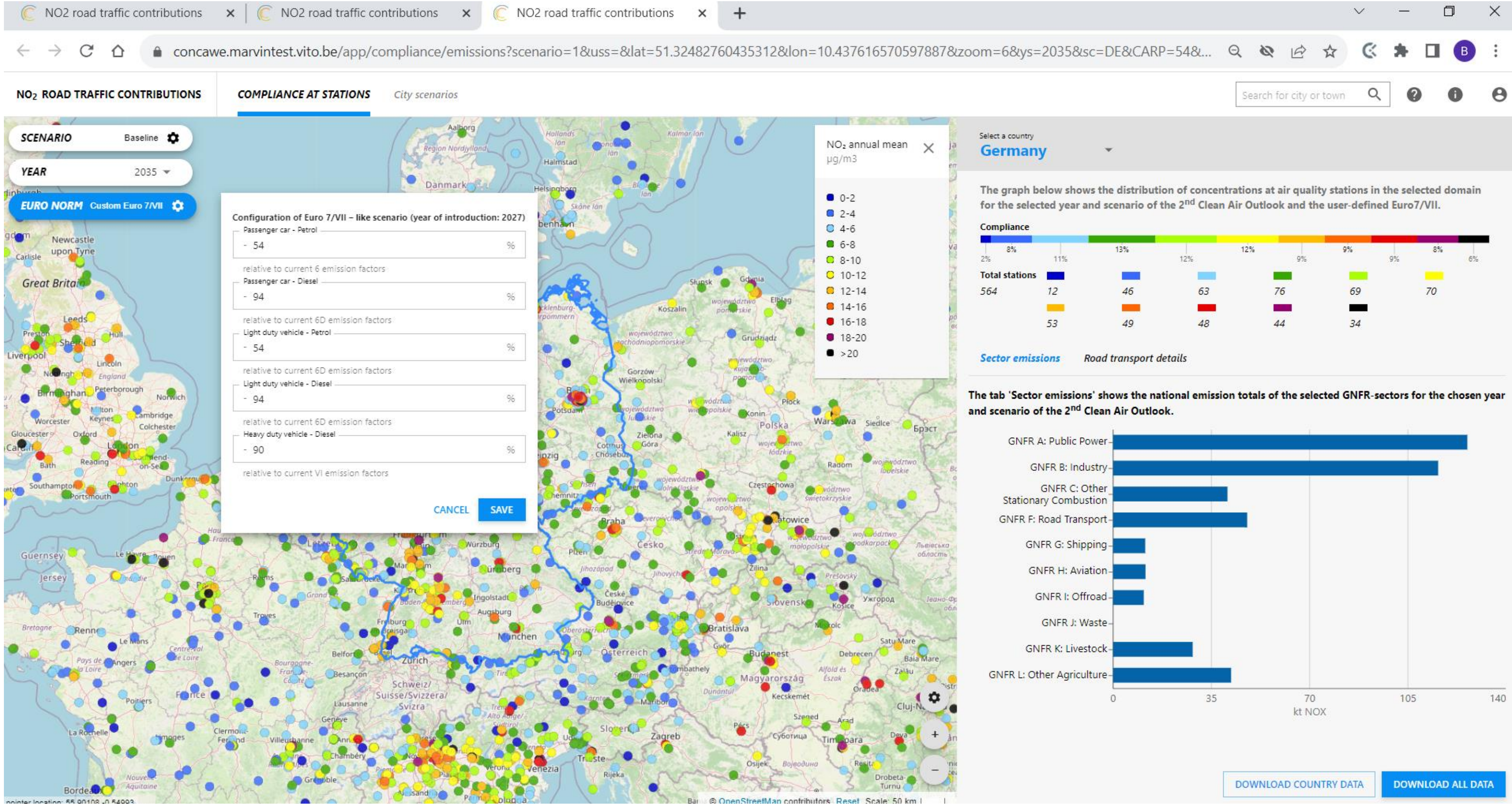
The Viewer: station compliance tab

- Zoom on a country (Germany in 2035) with CAO2 emissions overview and transport details



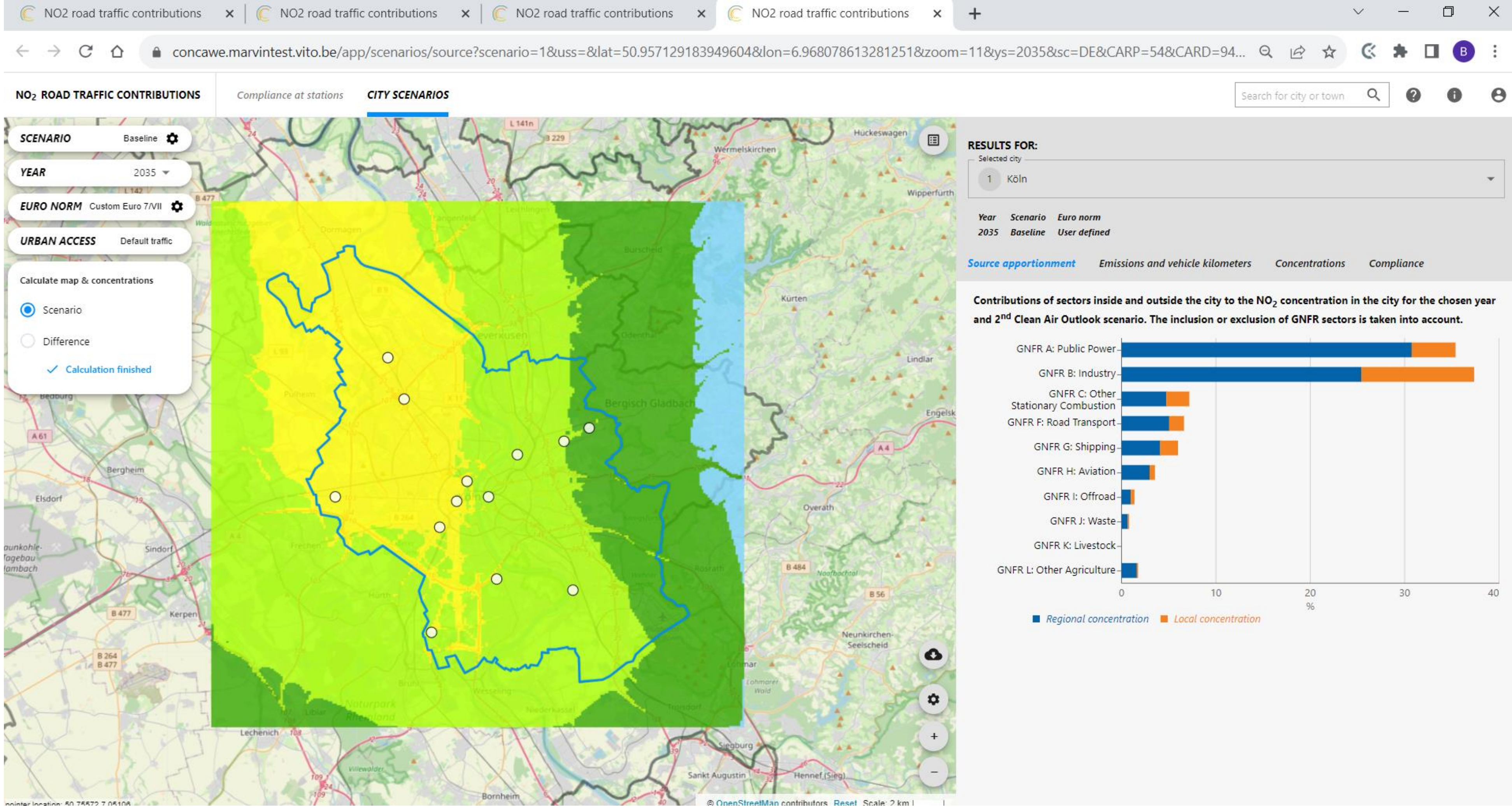
The Viewer: station compliance tab

- Impact of Euro 7 Impact Assessment Policy Option 3a



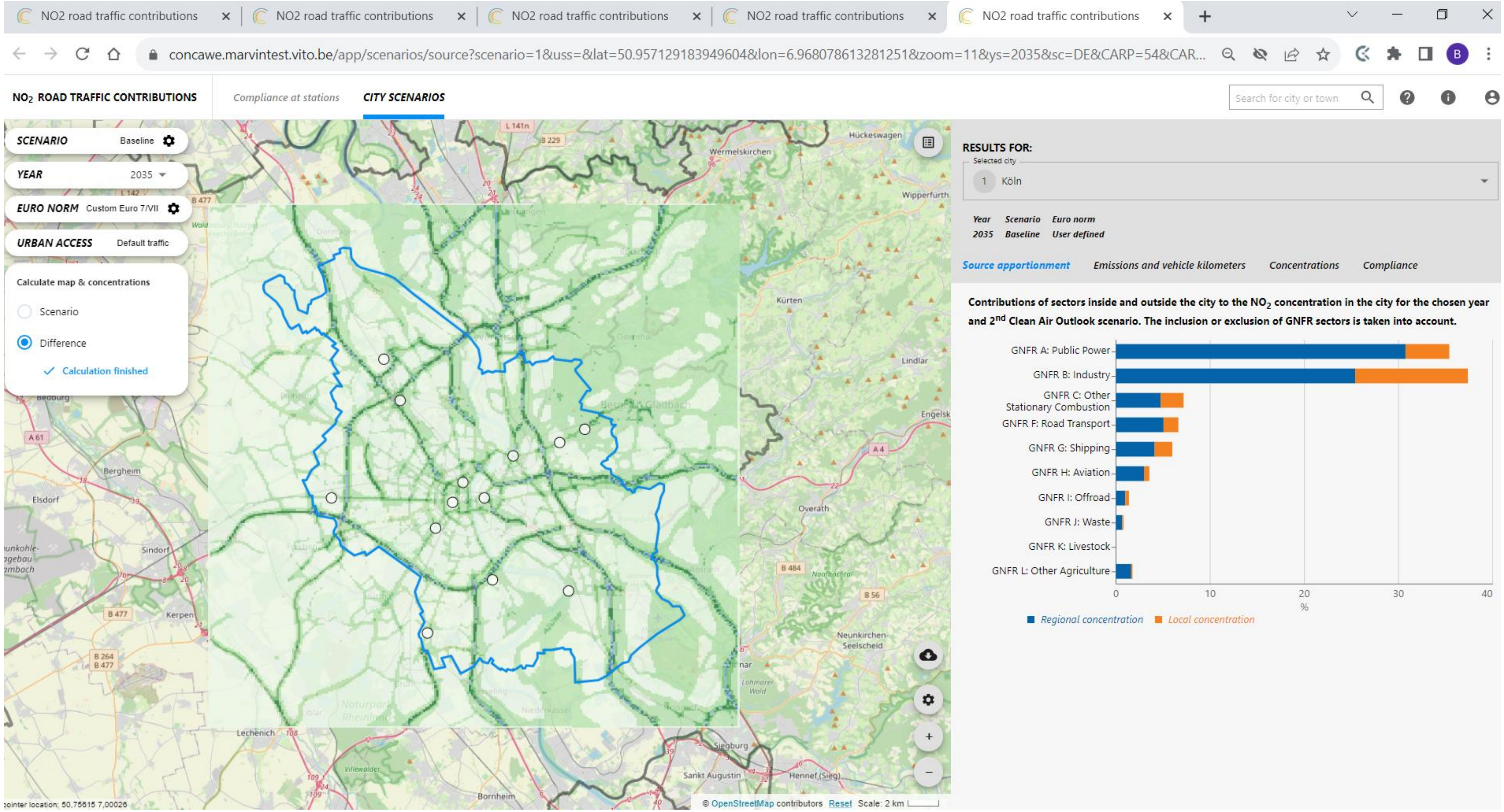
The Viewer: City scenarios tab

- Impact of Euro 7/VII PO3a in Köln



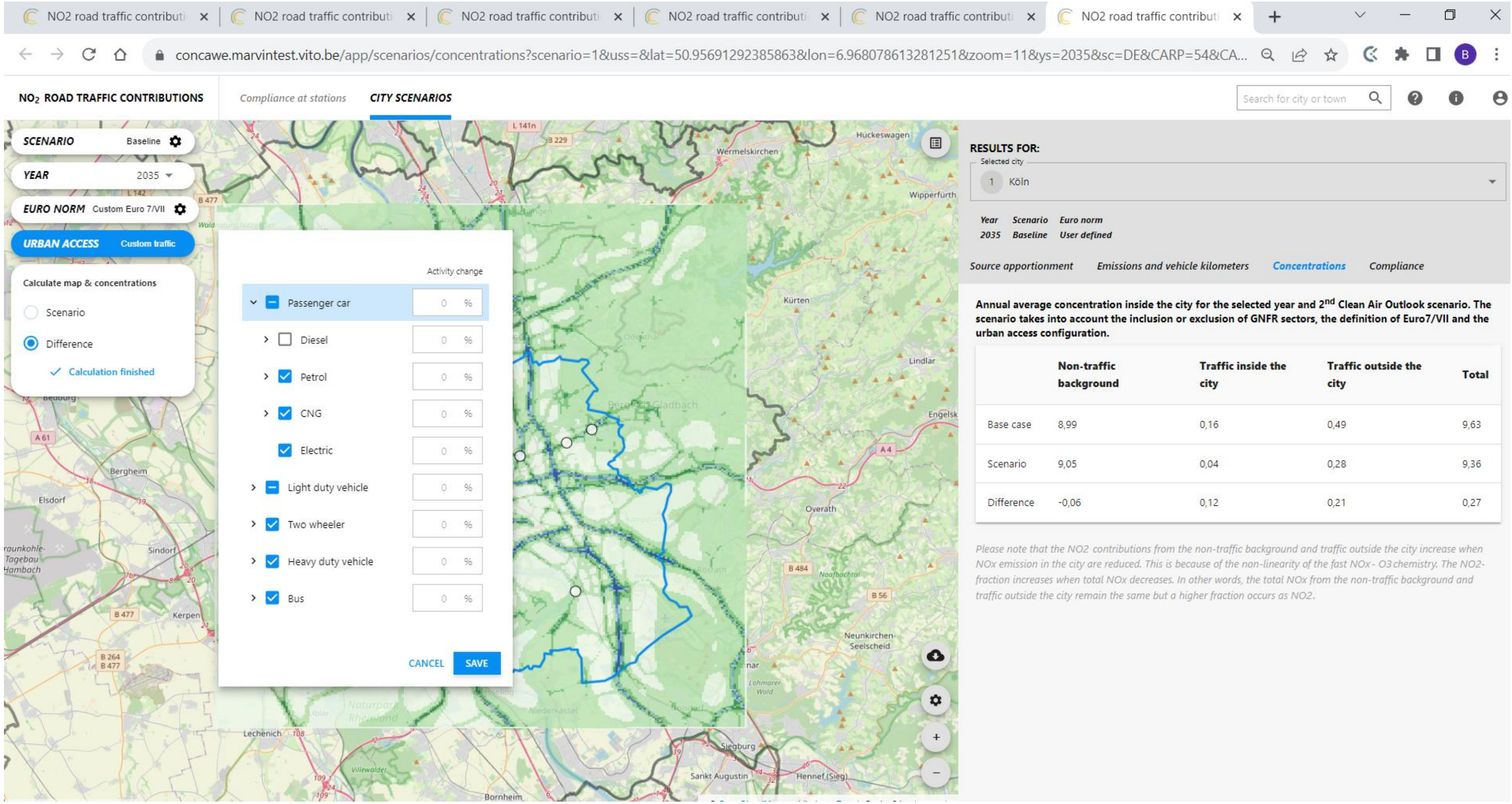
The Viewer: City scenarios tab

- Impact on a difference map



The Viewer: City scenarios tab

- Additional urban access regulations (no diesel cars and vans)



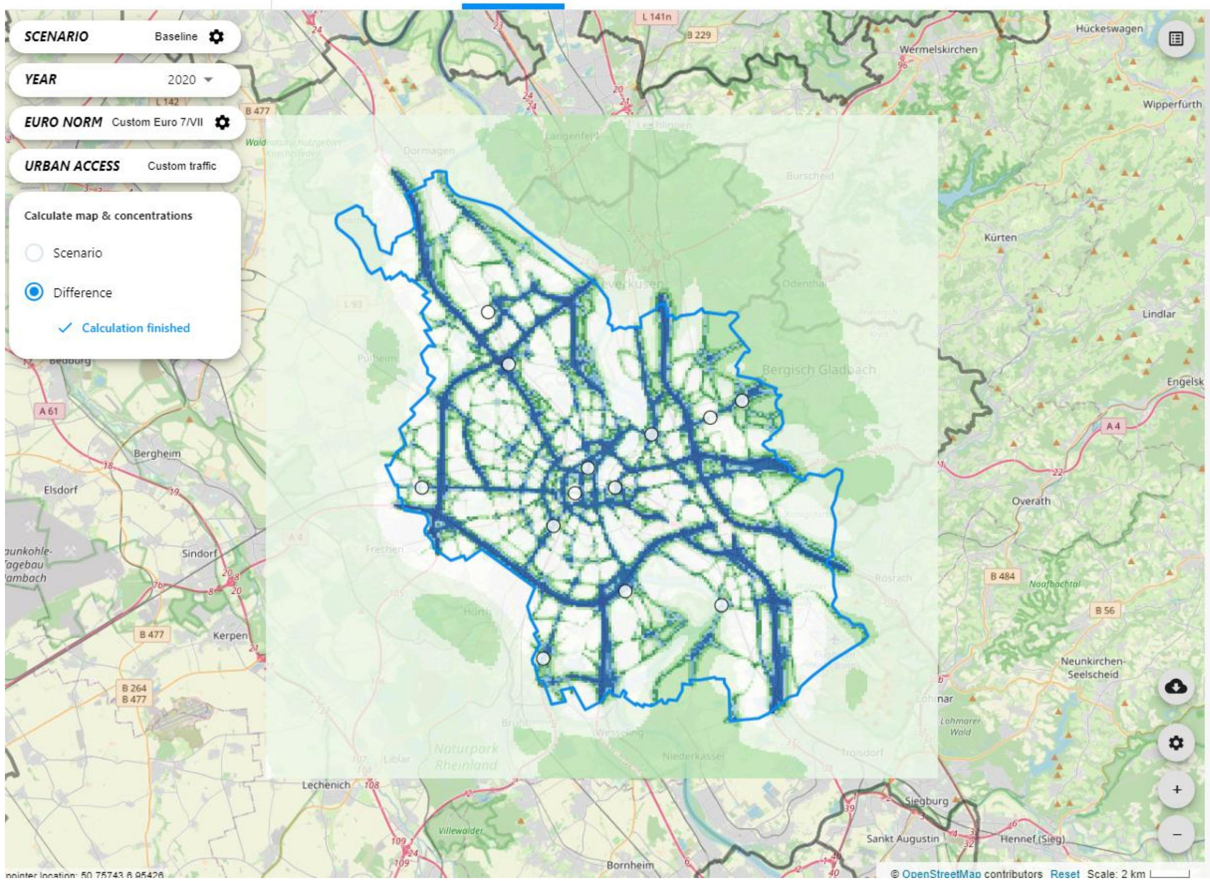
The Viewer: City scenarios tab

- The same scenario (no diesel cars and vans) in 2020

NO2 road traffic contributions

concawe.marvintest.vito.be/app/scenarios/concentrations?scenario=1&uss=&lat=50.95691292385863&lon=6.968078613281251&zoom=11&ys=2020&sc=DE&CARP=5...

NO_2 ROAD TRAFFIC CONTRIBUTIONS | *Compliance at stations* | *CITY SCENARIOS* | Search for city or town



RESULTS FOR:

Selected city: 1 Köln

Year	*Scenario*	*Euro norm*
2020	*Baseline*	*User defined*

Source apportionment | *Emissions and vehicle kilometers* | *Concentrations* | *Compliance*

Annual average concentration inside the city for the selected year and 2nd Clean Air Outlook scenario. The scenario takes into account the inclusion or exclusion of GNFR sectors, the definition of Euro7/VII and the urban access configuration.

	Non-traffic background	Traffic inside the city	Traffic outside the city	Total
Base case	14,80	1,00	2,96	18,75
Scenario	14,96	0,39	2,99	18,35
Difference	-0,17	0,60	-0,03	0,40

Please note that the NO2 contributions from the non-traffic background and traffic outside the city increase when NOx emission in the city are reduced. This is because of the non-linearity of the fast NOx - O3 chemistry. The NO2-fraction increases when total NOx decreases. In other words, the total NOx from the non-traffic background and traffic outside the city remain the same but a higher fraction occurs as NO2.

Thank you for your attentions!

Questions?