CT9 FAIRMODE exercise:

Contribution to assessment of sensitivity of model responses to emissions changes: long term simulations for the Brussels Case
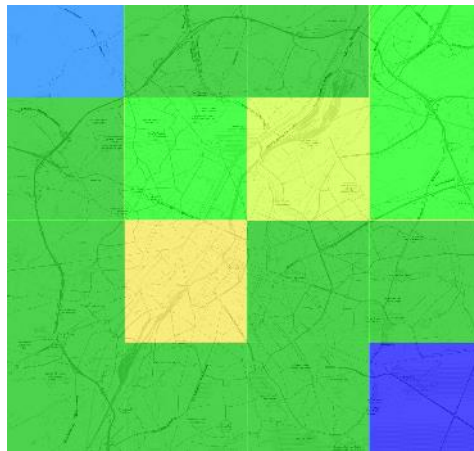
Belgian interregional environment agency

Fairmode - 07/10/2021

The methodology
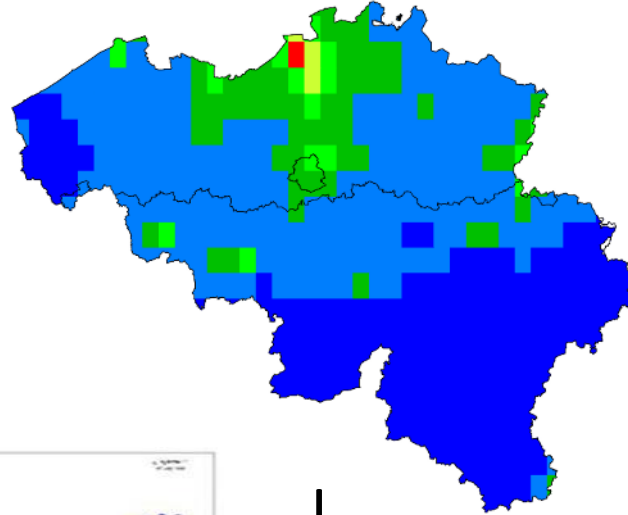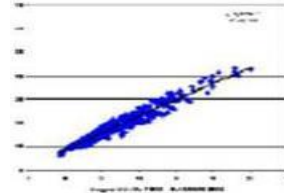
RIO

Ref 2015

SCENARIO x
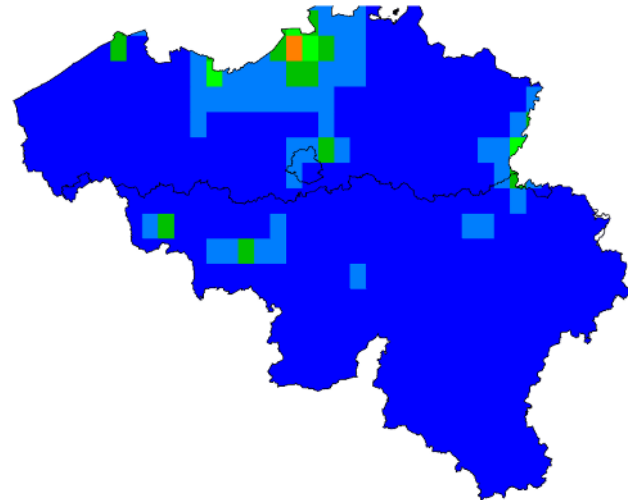
365 daily values

CHIMERE
Scenario x

365 daily values

RIO: interpolation method
based on measurements
at stations and land use.

Long-Term Scenario: a yearly
(exponential) trend is calculated
for each gridcell between Chimere
reference run and the scenario run
based on daily values.

The trend is then applied to each
RIO gridcell to reach the final
scenario concentrations.

Chimere long term runs

- Chimere v2017

- Meteo ECMWF 2015

- Local inventories in the North of BE + TOD emissions in the rest of EU. Surface and point emissions.

- Nesting (0.1°x 0.1°) within (0.5°x0.5°)

- 1 Ref scenario and 6 scenario calculations:
  - Reduction by 50 % of NOx, SOx, NH3, PPM, NMVOC and all pollutants
  - Reduction of surface and point emissions (0,1 x 0,1°) within the yellow square (Scenario -50%)
  - The emissions of the parent domain do not change
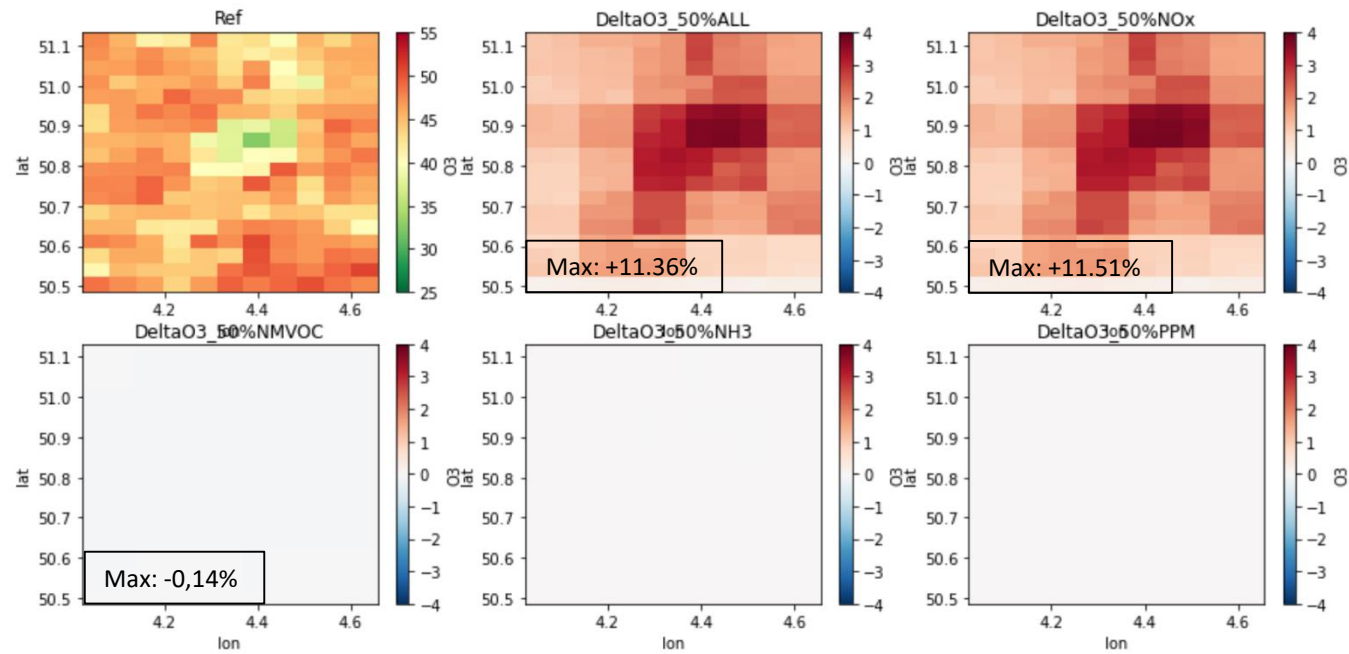
RIO calibration outputs for: NO, NO2, O3, PM2.5, PM10

O₃
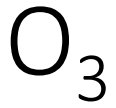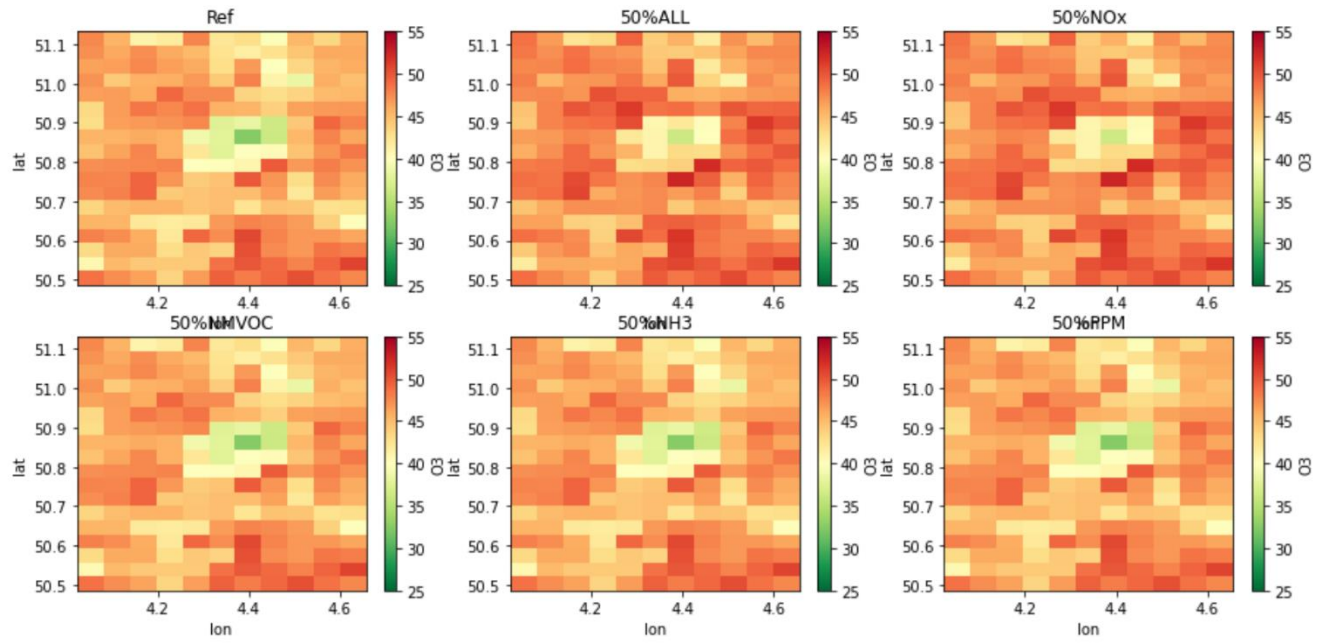
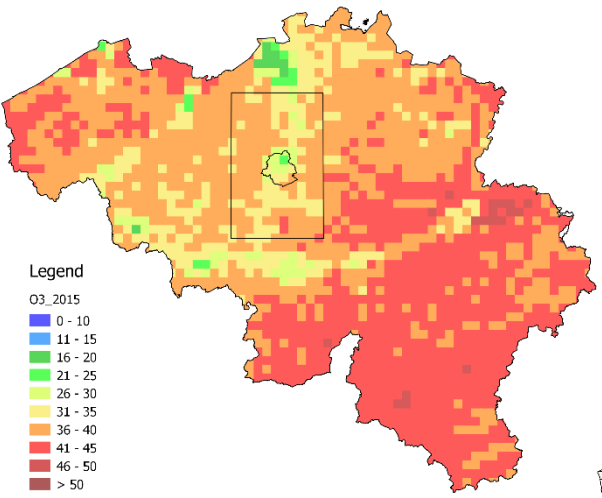Concentrations

Δ concentrations

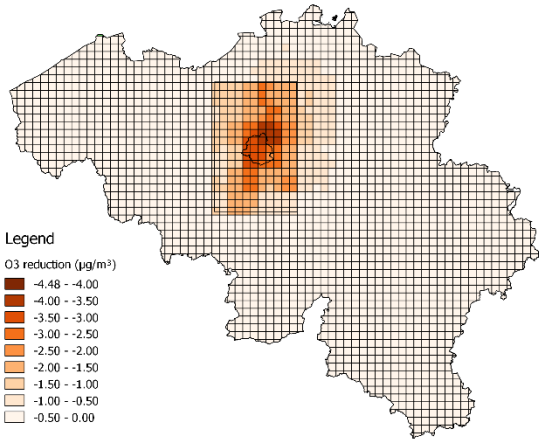NOx reduction increases significantly the Ozone concentrations (11%)

Very slight decrease of O3 concentrations due to NMVOC

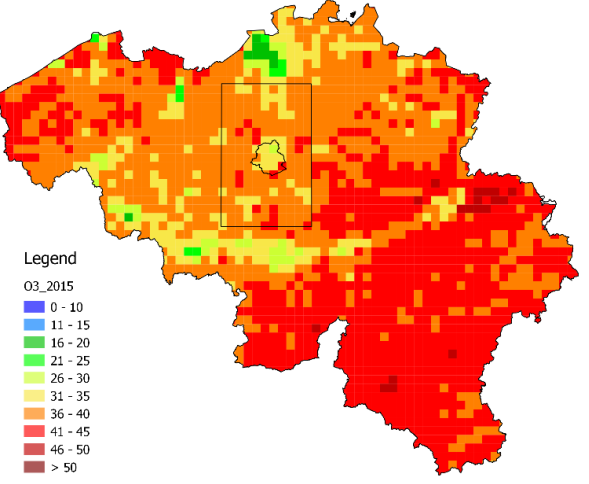# Impact of 50% reduction of NOx emissions on the ozone concentrations

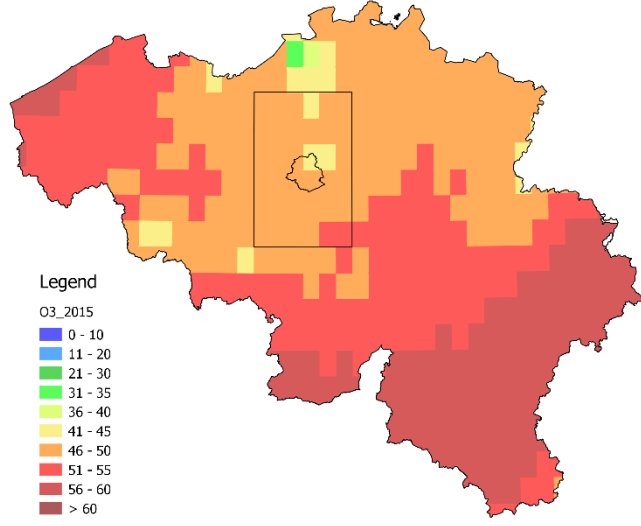**RIO O3: annual mean concentrations 2015**

Legend
O3_2015
- 0 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- > 50

RIO
Reducing the NOx emissions by -50 % raises the ozone concentrations with max 3,8 µg/m³

O3: annual mean concentrations 2015

Legend
O3_2015
- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60
- > 60

CHIMERE Runs
Reducing the NOx emissions by -50 % raises the ozone concentrations with max 4,5 µg/m³

Legend
O3 reduction (µg/m³)
- -4.48 - -4.00
- -4.00 - -3.50
- -3.50 - -3.00
- -3.00 - -2.50
- -2.50 - -2.00
- -2.00 - -1.50
- -1.50 - -1.00
- -1.00 - -0.50
- -0.50 - 0.00

RIO O3: annual mean concentrations 2015 with scenario -50% for NOx emissions

Legend
O3_2015
- 0 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- > 50
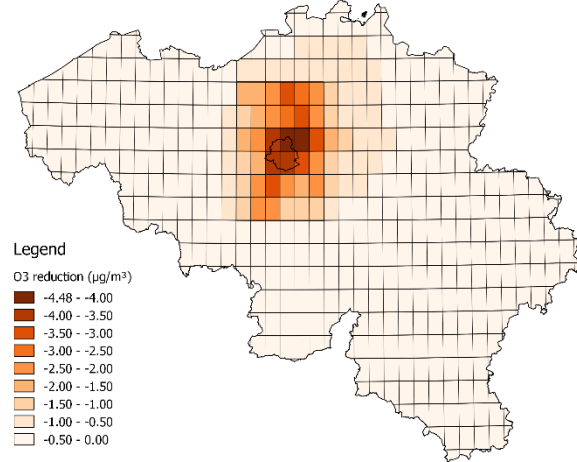
O3: annual mean concentrations 2015 with scenario -50% of NOx emissions

Legend
O3_2015
- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60
- > 60

Legend
O3 reduction (µg/m³)
- -4.48 - -4.00
- -4.00 - -3.50
- -3.50 - -3.00
- -3.00 - -2.50
- -2.50 - -2.00
- -2.00 - -1.50
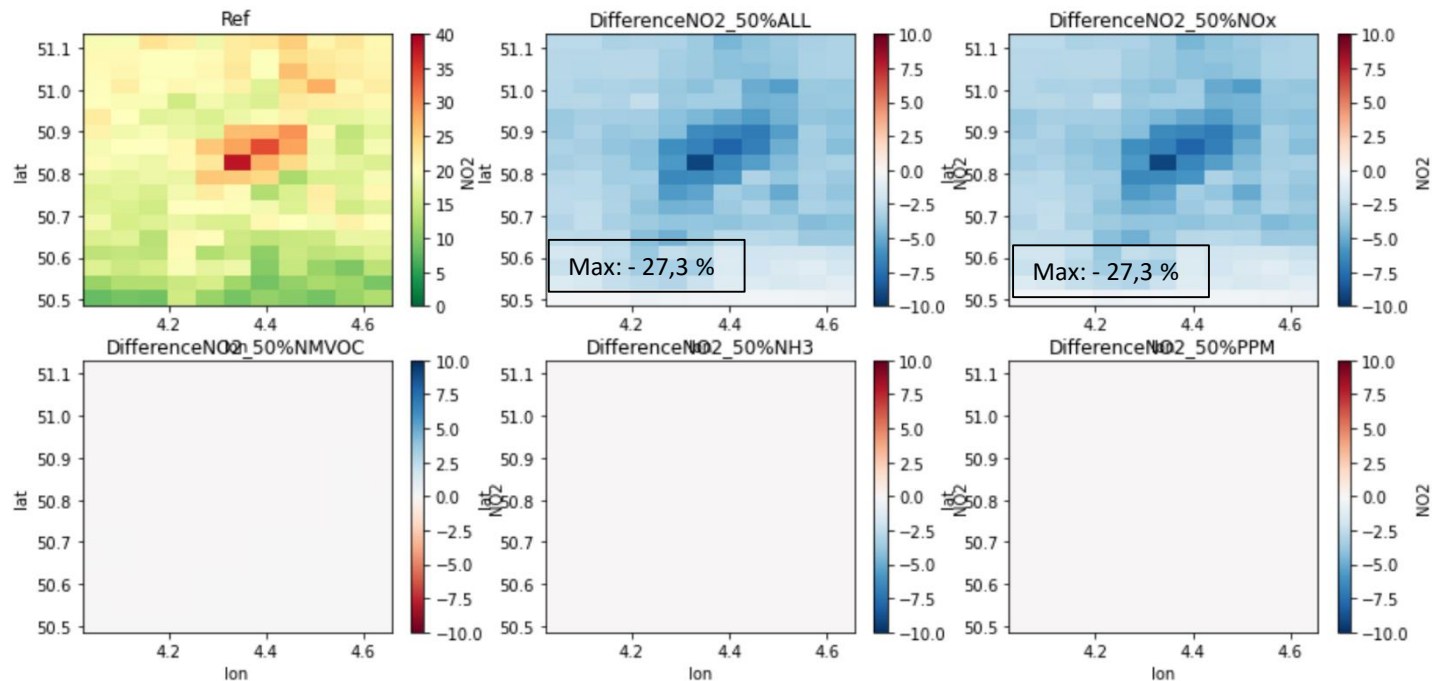- -1.50 - -1.00
- -1.00 - -0.50
- -0.50 - 0.00

NO$_2$
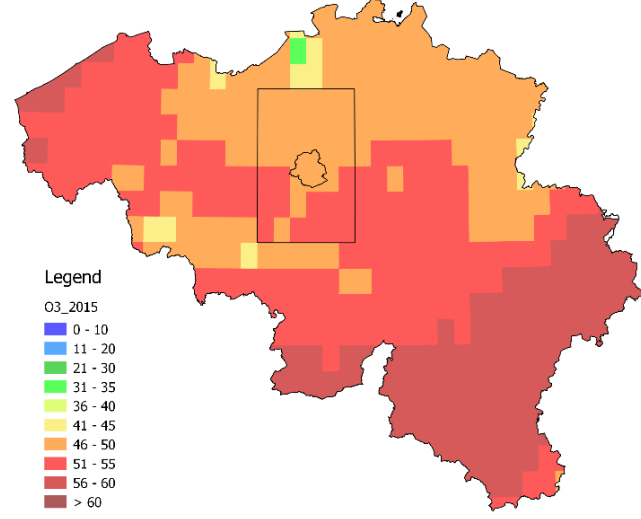
Concentrations
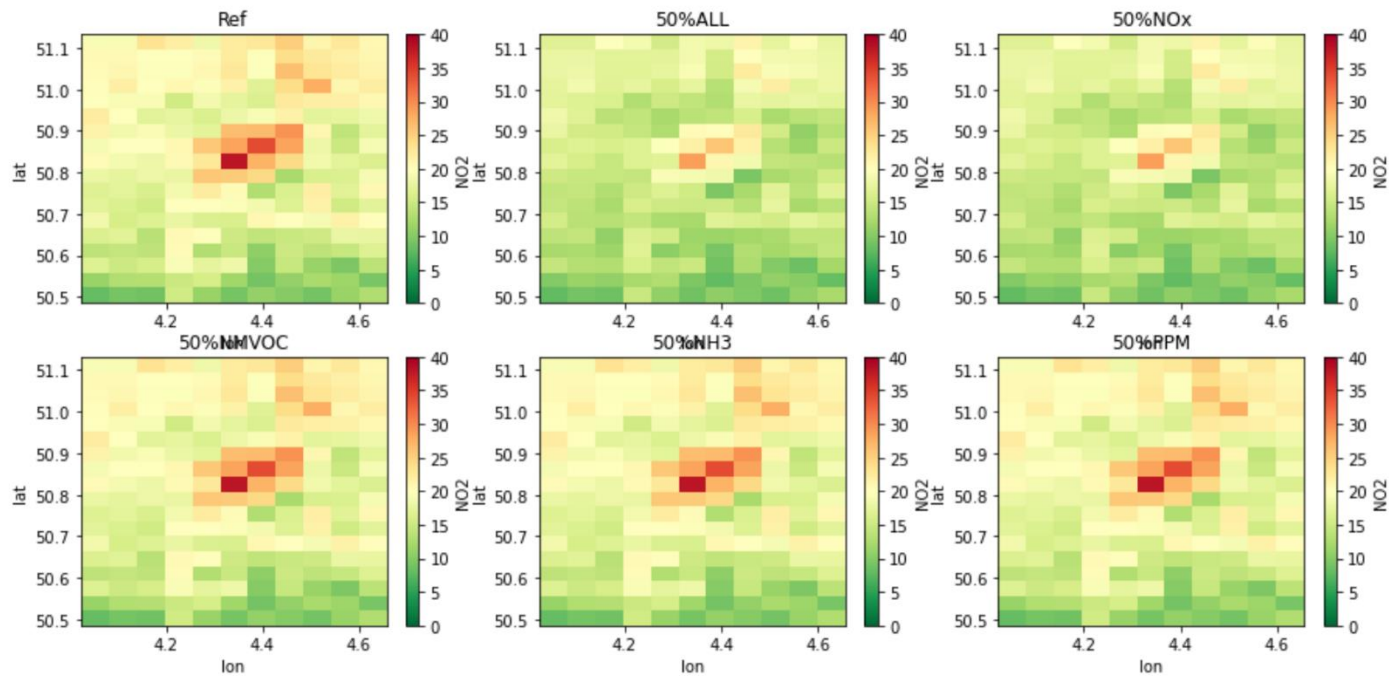
Δ concentrations
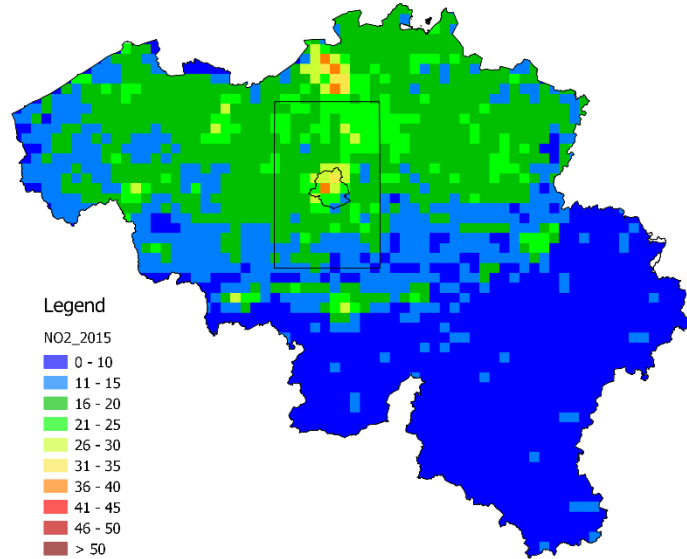

Only NOx reduction has a significant impact on the concentrations (max -27 % in the center of Brussels)

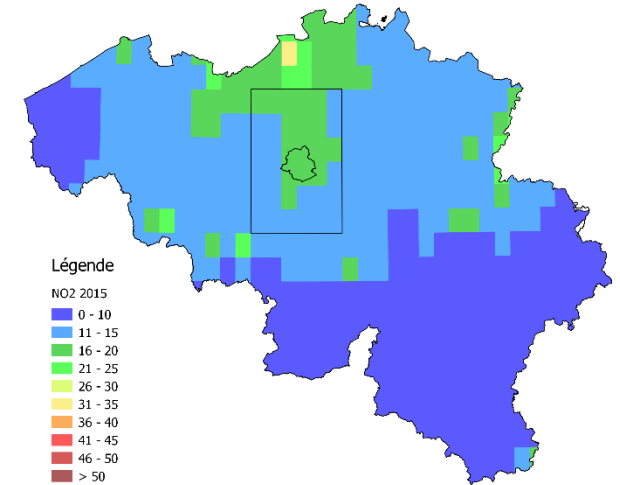RIO NO2: annual mean concentrations 2015

Legend
NO2_2015
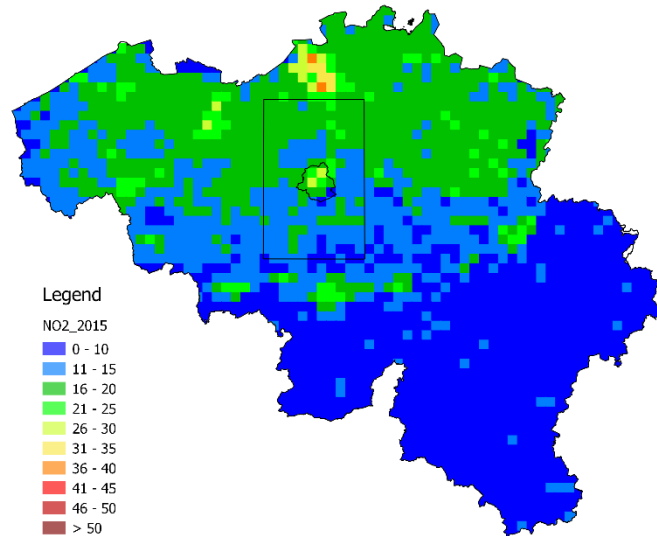- 0 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- > 50

Impact of 50% reduction of all emissions on the NO2 concentrations

CHIMERE Runs

NO2: annual mean concentrations 2015

Légende
NO2 2015
- 0 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- > 50

Max difference: 9,4 µg/m³

RIO NO2: annual mean concentrations 2015 with scenario -50% for all emissions

Legend
NO2_2015
- 0 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- > 50

RIO NO2 2015: gain in concentrations under the scenario -50% all pollutants

Legend
Test_CT9
- -0.04 - 0.88
- 0.88 - 1.79
- 1.79 - 2.71
- 2.71 - 3.63
- 3.63 - 4.55
- 4.55 - 5.47
- 5.47 - 6.39
- 6.39 - 7.31
- 7.31 - 8.22
- 8.22 - 9.14
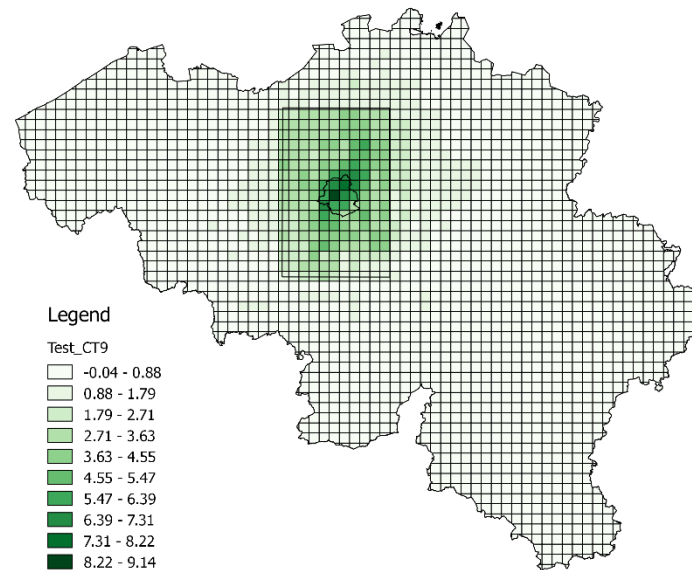
NO2: annual mean concentrations 2015 with scenario -50% of all pollutant emissions

Legend
NO2_2015
- 0 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- > 50
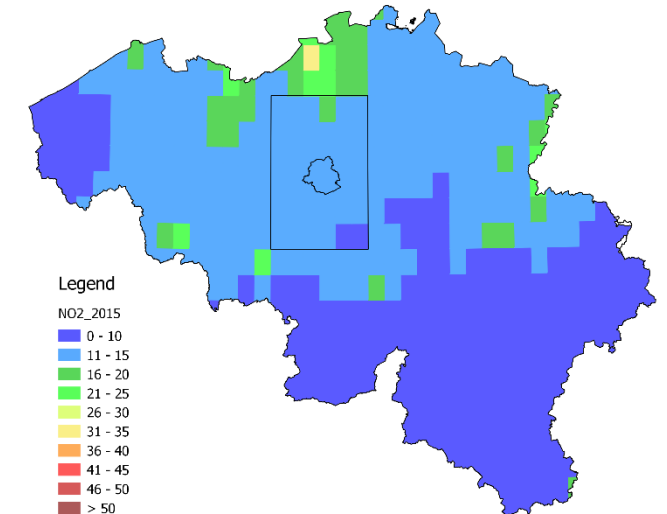
PM$_{2.5}$

Concentrations
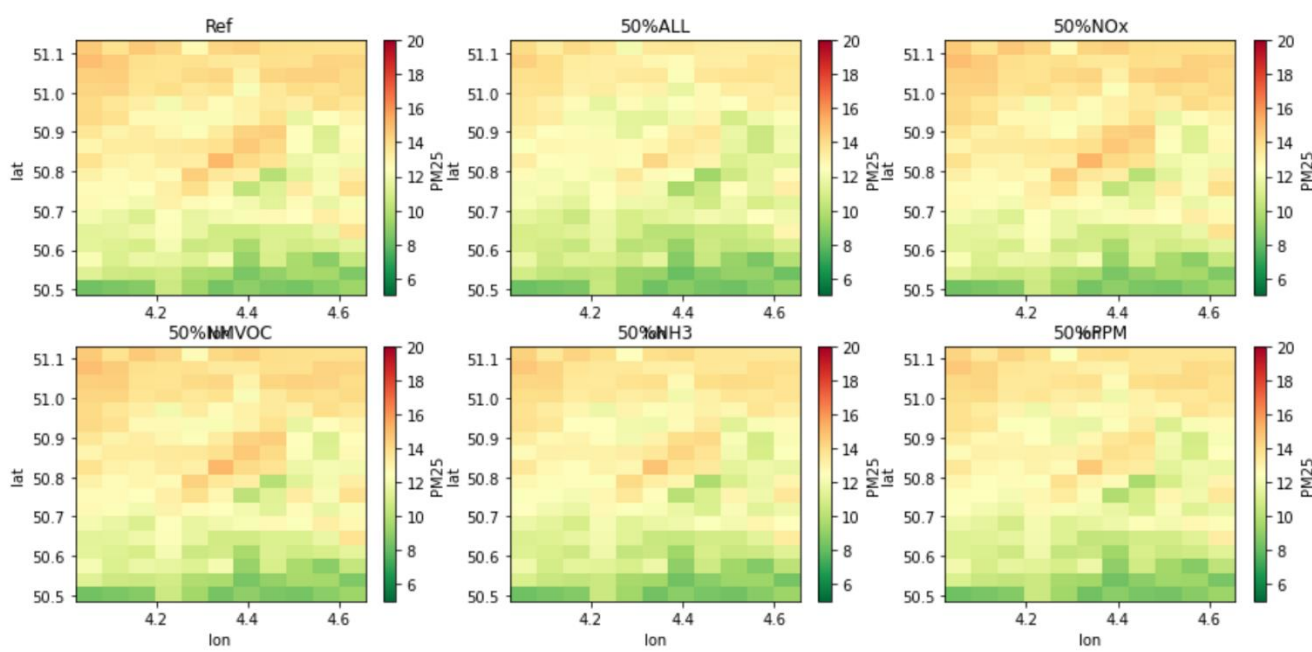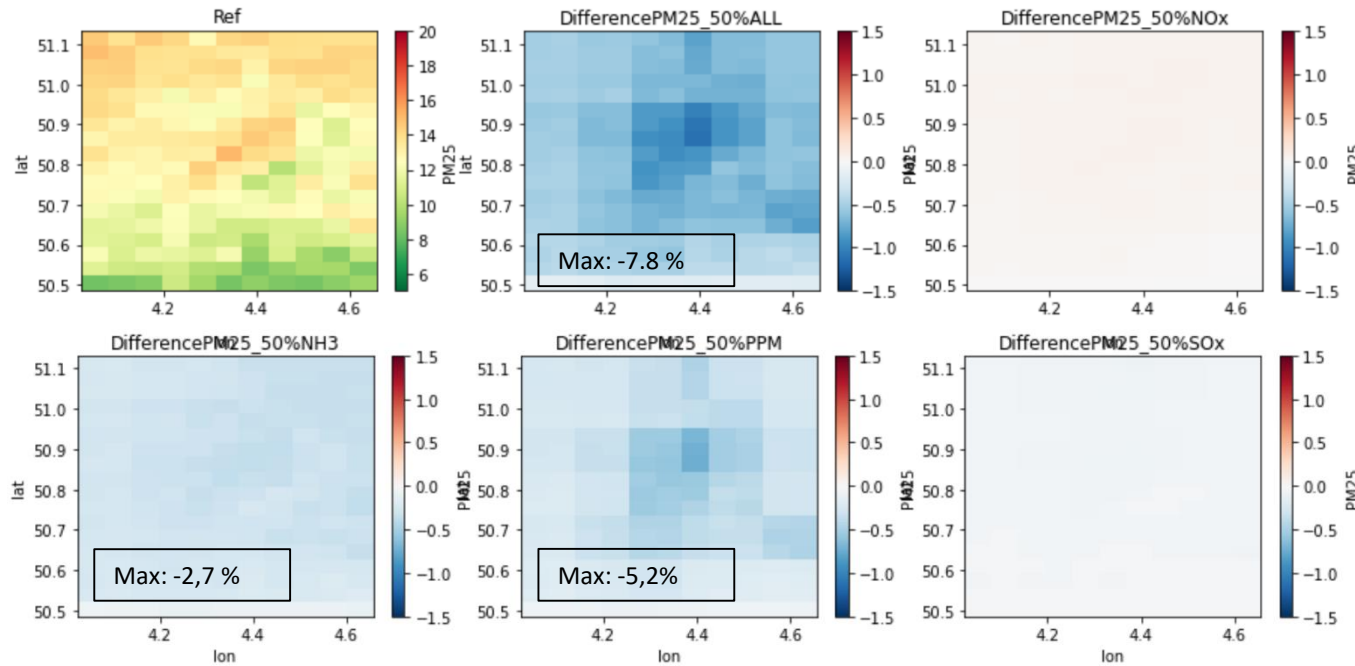

Δ concentrations

Both NH3 and PM emission reduction have an impact on PM2.5 concentrations

Conclusions

- Not only a CTM: calibration of the measurements using a CTM scenario model

- Results are as expected.

- In the future : Chimere grid at the same resolution than RIO.