MET Norway contributions to CT9 intercomparison exercise

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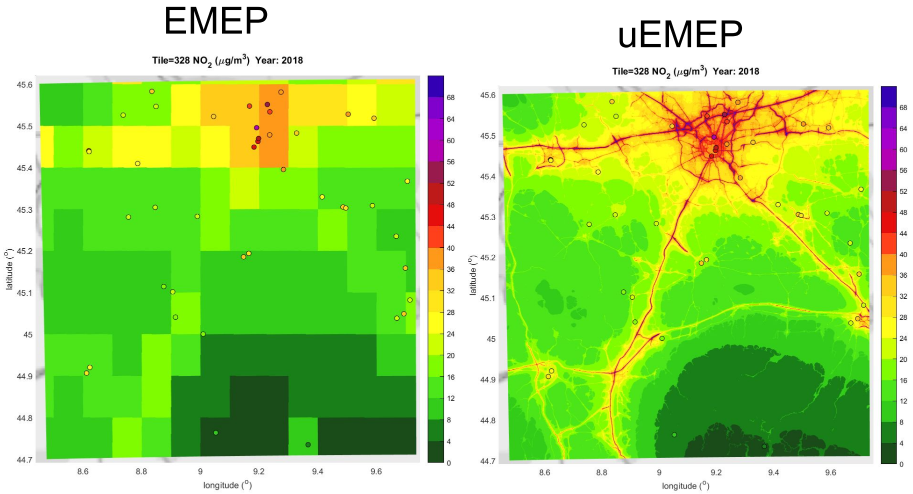
Background

Model setup:

1. EMEP MSC-W chemistry–transport model (EMEP model) –> 2.5–10 km resolution (0.1° for CT9)
2. Urban EMEP (uEMEP): Gaussian modelling of nearby sources –> 50–250 m resolution (250 m for CT9)
    - High-resolution emissions must be available

Applications

- Air pollution forecasts for all of Norway at high resolution, for PM, NO_2 and ozone
- Assessment of population exposure in Norway, for past years and future scenarios
- Assessment of exposure for all of Europe for future scenarios, used by European Commission for AAQD revision



Example from Europe runs (near Milan): Annual mean NO_2 (Mu et al., in review)

Contribution to the CT9 exercise

Contributions:

- All cities
- Only annual mean for full-year cases
- Only PPM and NO_x reduction scenarios

Timeplan:

- Already delivered: Annual means + 6 episodes
- We may deliver more episodes if requested

Model setup for CT9 runs

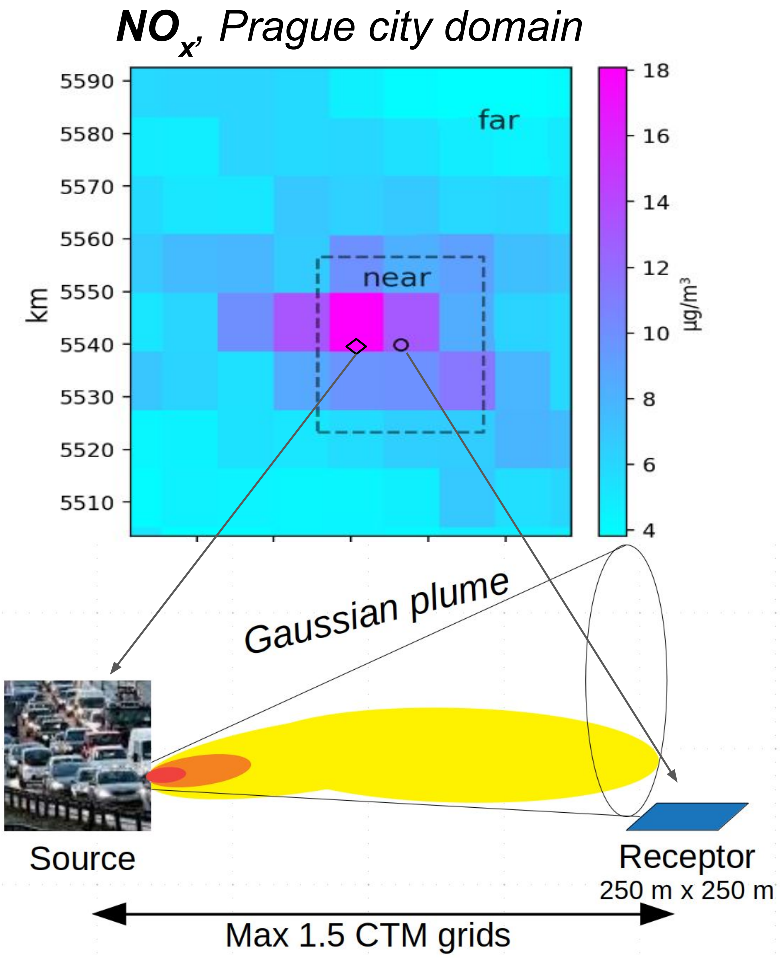
Step 1: Eulerian CTM (EMEP model)

- Run all of Europe at 0.1° resolution
- Use reported EMEP emissions (0.1° resolution)

Step 2: Gaussian plumes (urban EMEP)

- Receptor grid covering the city at 250 m resolution
- Proxy data to get emissions at 250 m resolution:
  - Traffic (GNFR 6): Open street maps
  - Residential combustion (GNFR 3): Building density & population
  - Shipping (GNFR 7): AIS data (ship positions)
- Sources closer than 1.5 grids (about 15 km) are downscaled
- Chemistry: Only simplified NO_2–O_3 interaction (Düring scheme[1])

Step 3: Use EMEP local fractions to avoid double-counting

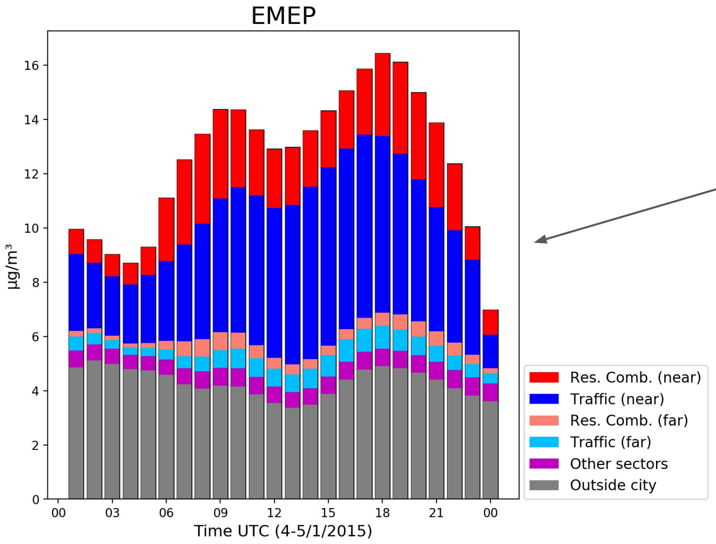


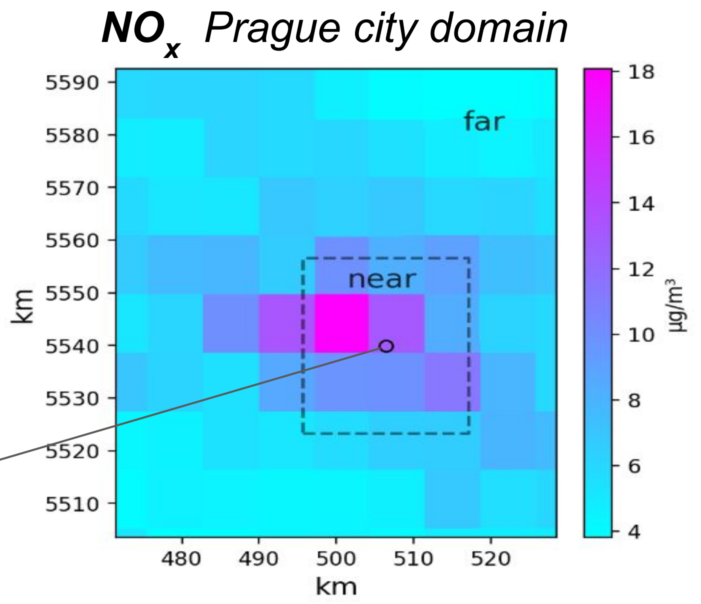
[1]https://ec.europa.eu/environment/air/pdf/NO2_Exposure_Final_Report.pdf, page 53

Avoiding double counting

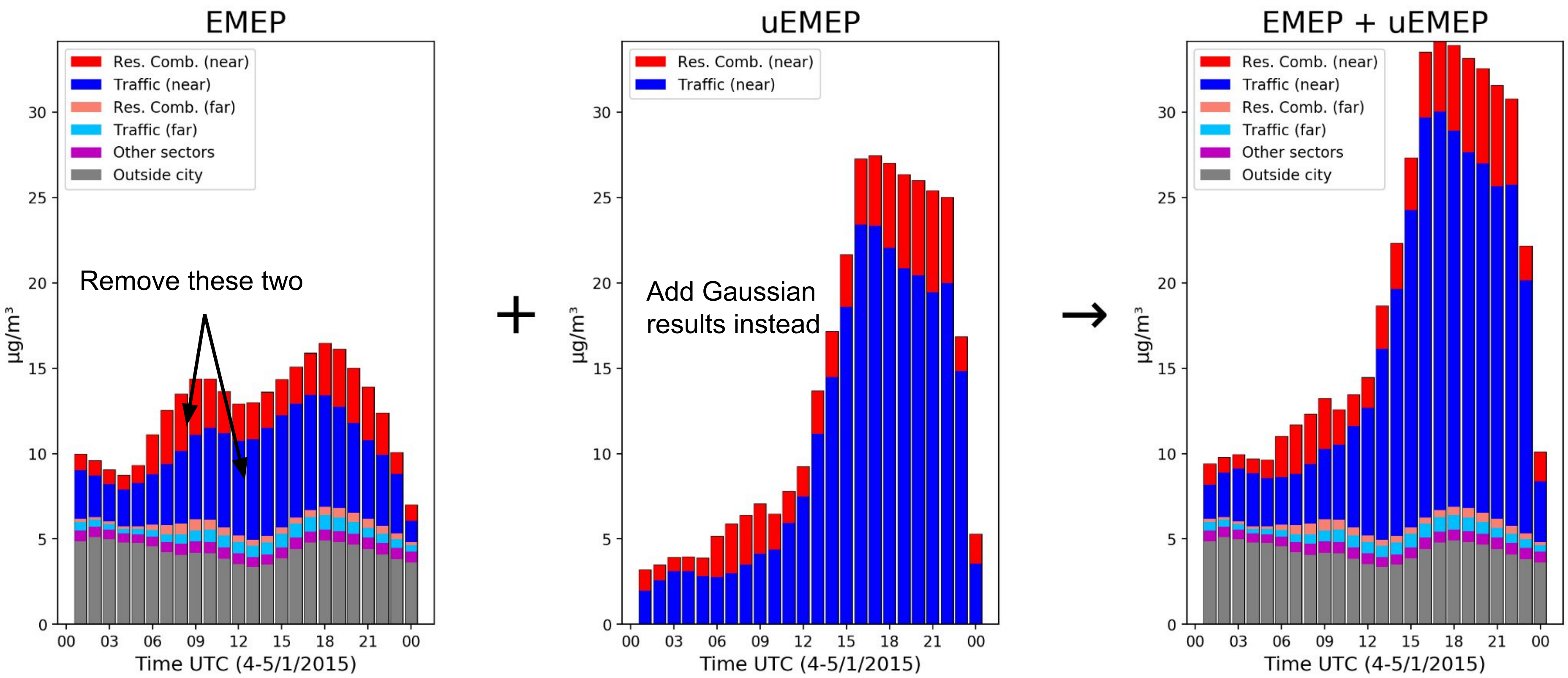
<u>EMEP local fractions</u>

- Each cell knows how much each nearby cell contributes
  - “tagging”: but primary pollutants only!
- Info given per GNFR sector
- Can distinguish what comes from “near”, “far” and “outside city”





Avoiding double counting



NO_x concentration, Prague, 4. January 2015, base case, location shown on previous slide

Fast scenario calculation using tagging

Method

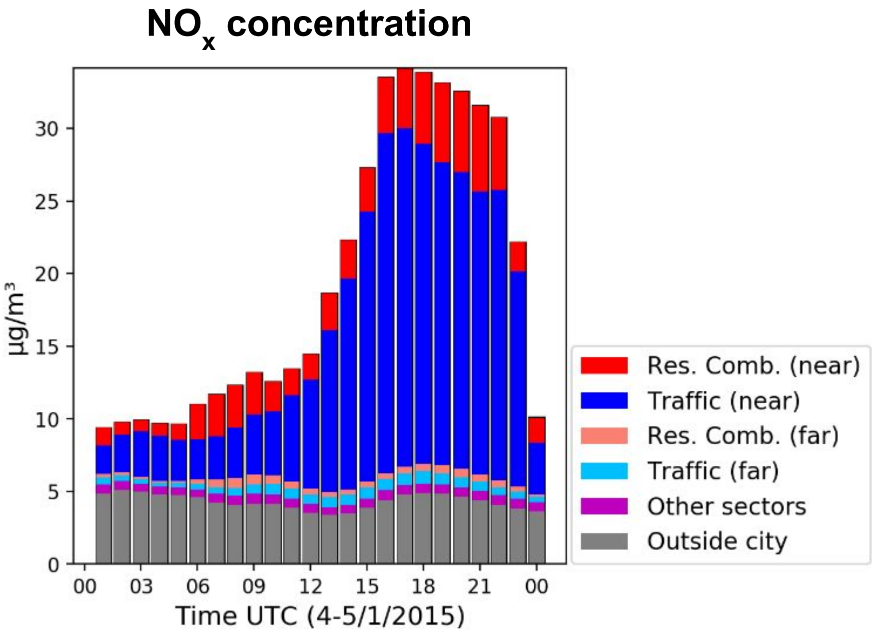
- At each cell, reduce contribution to PPM/NO_x from within city by the percentage reduction of the scenario
- Re-apply simple chemistry scheme to get NO_2, O_3 from NO_x

Pros and cons

+ No new model runs required for scenarios
+ Can be done separately for each sector
- Secondary pollutants not affected in scenarios, except NO_2–O_3 interaction
  - ➢ Can only study **NO_2,NO,O_3 in NO_x reduction scenario** and **PM10,PM2.5 in PPM reduction scenario**
  - ➢ No effect of PPM or NO_x reduction on secondary PM

Application

- Fast, self-service scenario calculator for Norwegian municipalities



Scenario results for CT9

EMEPNO (brute-force):

- EMEP without downscaling (0.1° x 0.1°)
- One rerun per scenario (-50% NOx, -50% PPM)

uEMEPTAG (tagging):

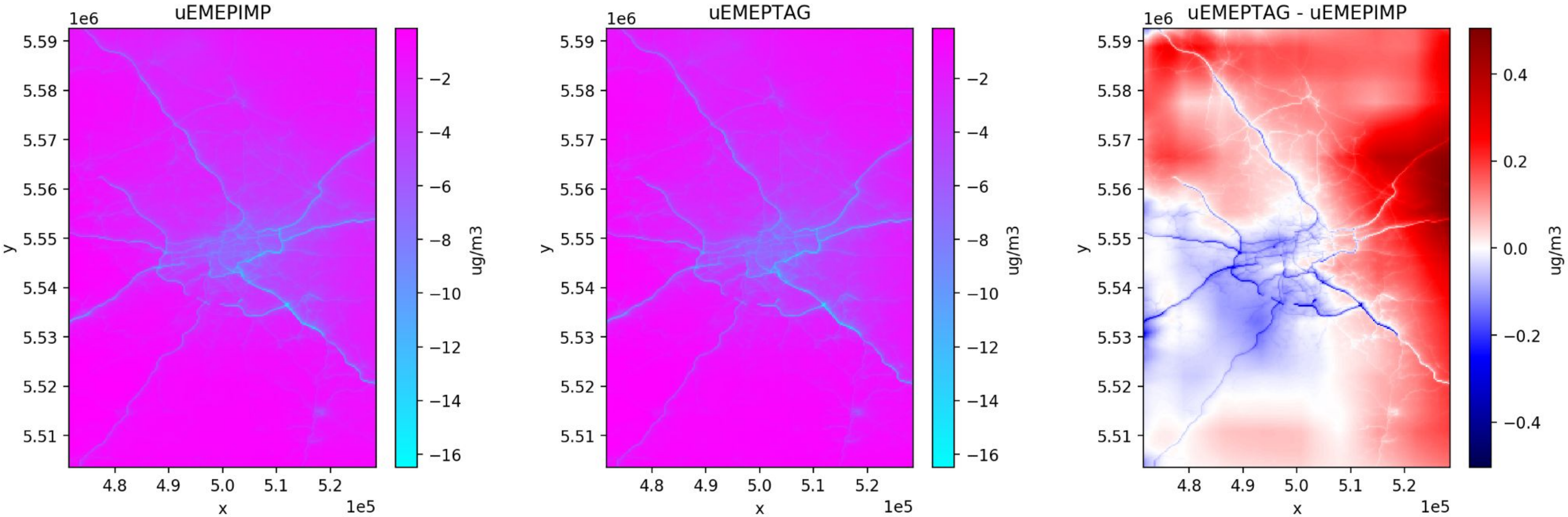
- Run only base case with uEMEP (250 x 250 m^2)
- Adjust city contributions to reflect reductions (all sectors)

uEMEPIMP (brute-force): Not currently delivered

- Downscaling to 250 x 250 m^2 of each EMEPNO rerun

Brute-force vs. tagging

Reductions in NO_2 concentration in -50 % NO_x scenario



Prague (mean 1.–9. January 2015)

- uEMEPIMP and uEMEPTAG differ by very little in this case
  - ➢ Simplified chemistry scheme for NO_2 seems to work well