

Fine resolution modelling of meteorological and air quality conditions in urbanized areas.

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Goals of the project

Eulerian meteo and AQ modelling in urban scale for Prague

Tasks

- Meteorological model in very fine resolution with consideration of urban effects
- Fine scale emission and chemical transport model for Prague which utilize this meteorology
- Validation of the models
- Simulation of scenarios

Pilot project

Meteorological model

WRF model (NCAR, USA)

model configuration for urban scale

configuration for fine resolution

detailed input data for Prague and Czech Republic

Domains 27km, 9km, 3km, 1km, 333m

detailed orography, landuse and urban surface description

based on GIS data from City Development Authority of Prague

Urban surface model BEM (Building Energy Model)

urban surface layer model, NOT a street canyon model

parameters for Prague derived from sources supplied by City Development Authority of Prague (3D model of Prague, detailed maps, aerial photos)

Chemical Transport Model

CTM CMAQ v.5.0.1 (US EPA, regulatory model)

Gas phase chemical mechanism CB05TUCL

Aerosol mechanism AE6_AQ

Adjustments in model code and mechanism definition to work with urban landuse and with meteorological outputs from urbanized model WRF-BEM

Emission model

Europe - TNO inventories from MACC-II project for 2009

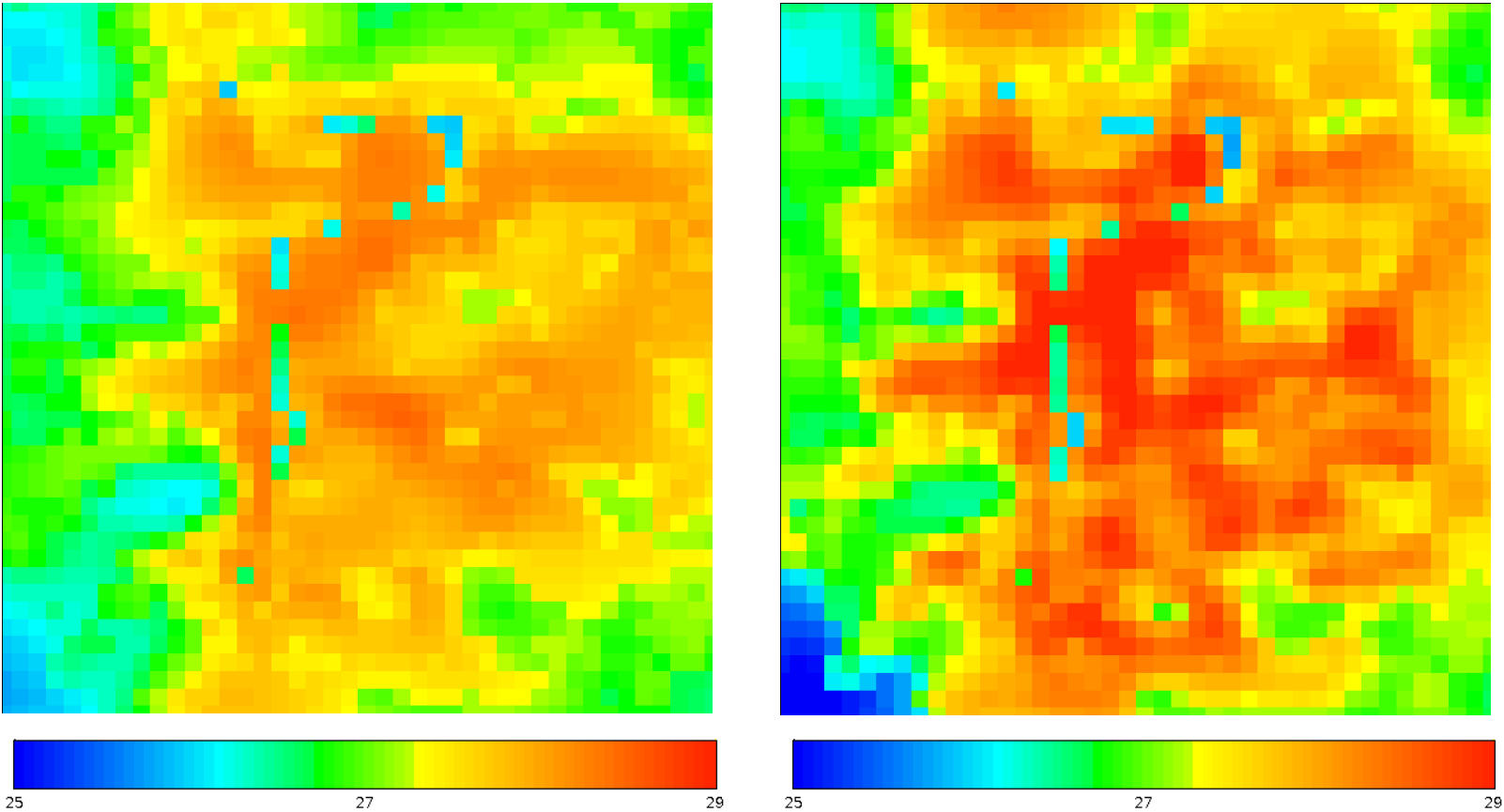
Czech Rep. and Prague – REZZO, MEFFA13, IPR sources,...

Biogenic emissions

Model BEIS3 with landcover

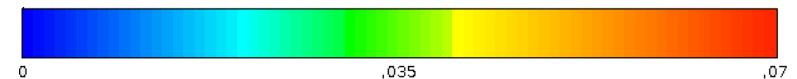
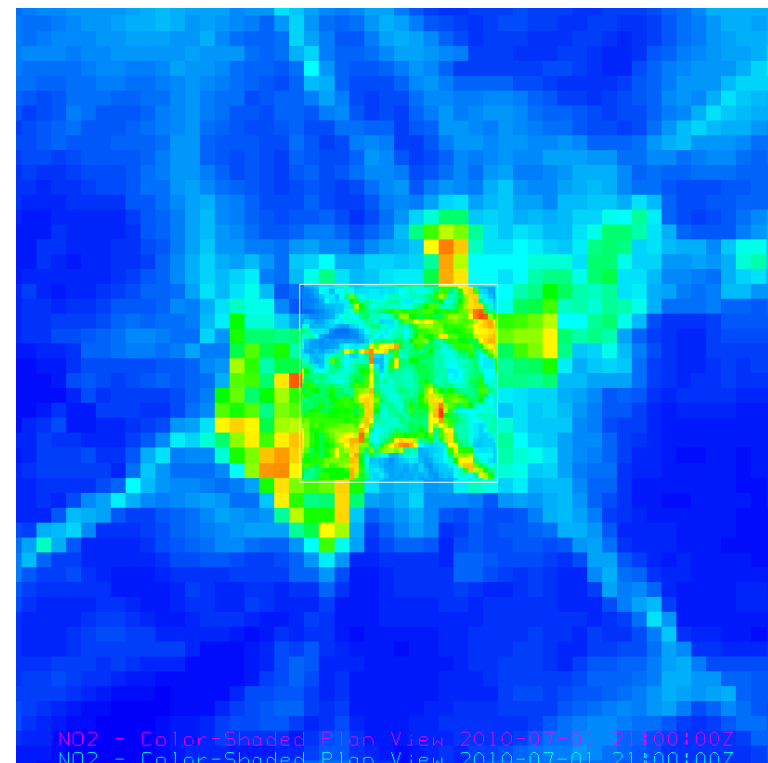
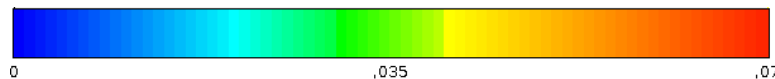
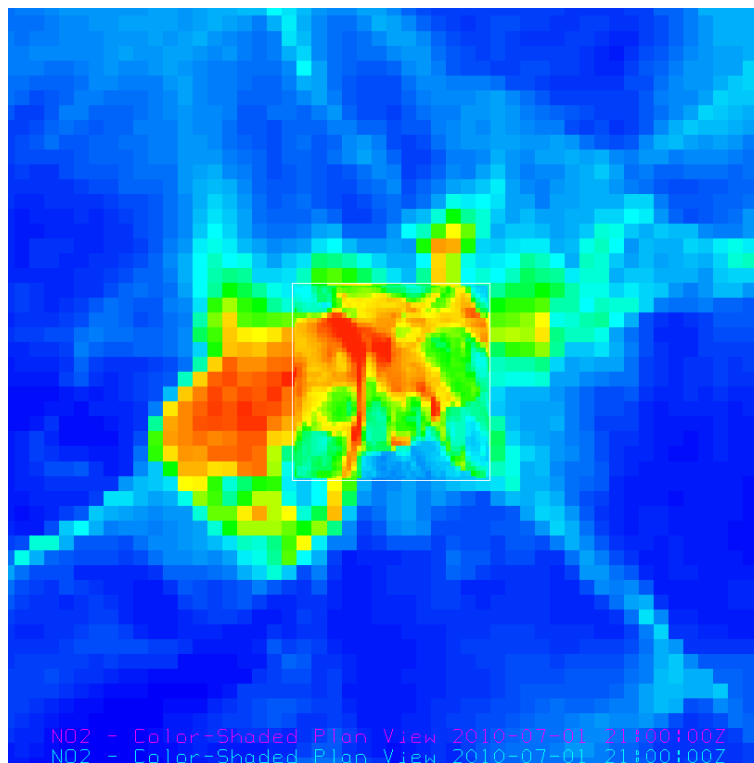
- *AFOLU (Agriculture, Forestry and Other Land Use)*
- *USGS Eurasia a USGS Africa*
- *CR and Prague based on detailed maps from IPR*

Urban surface – Temperature in 2m



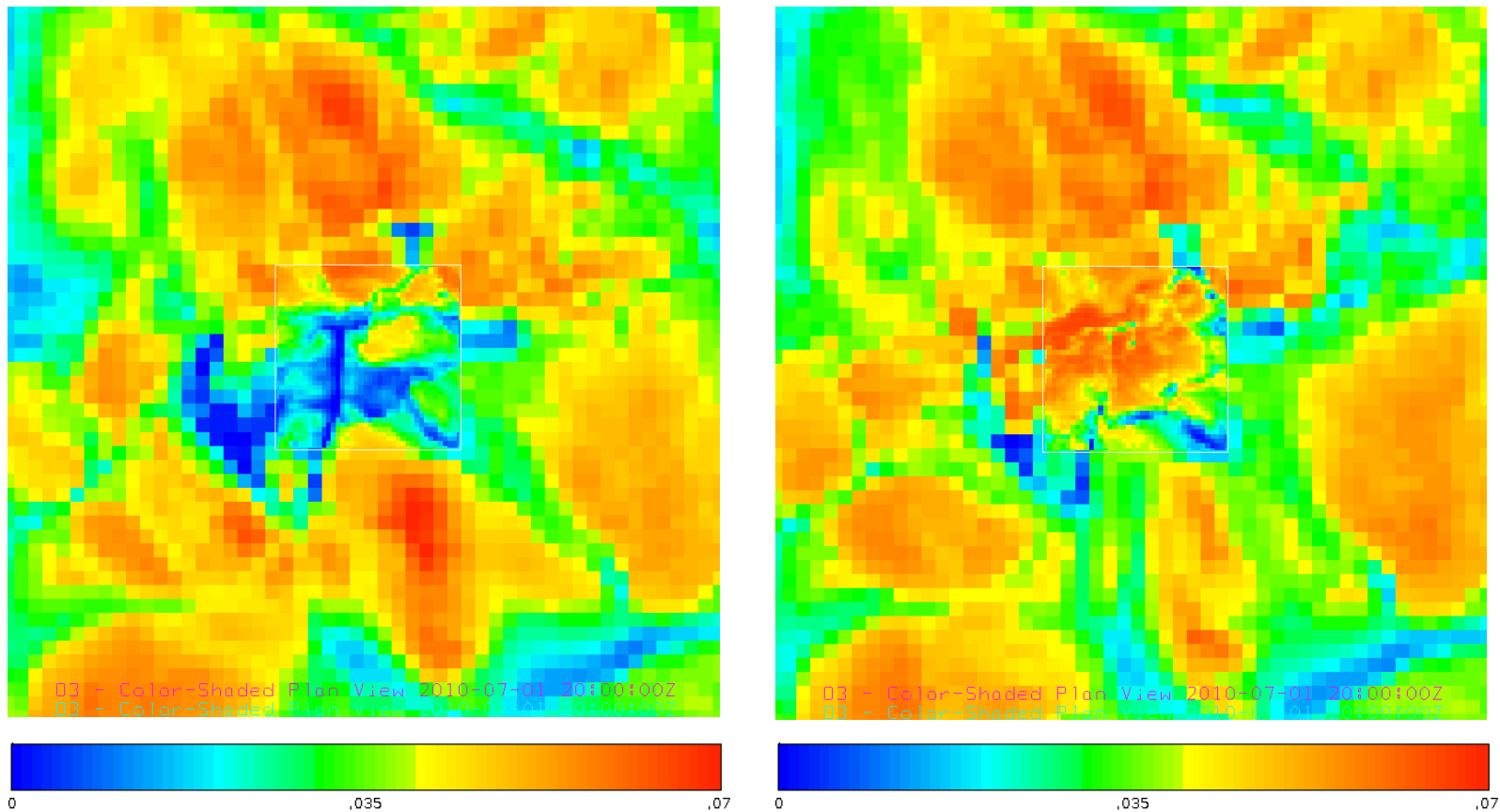
*Modelled temperature in 2m (°C)
without BEM (left) and with BEM (right)
on 333m domain, on June 26 at 15:00 CET*

Urban surface – concentrations of NO₂



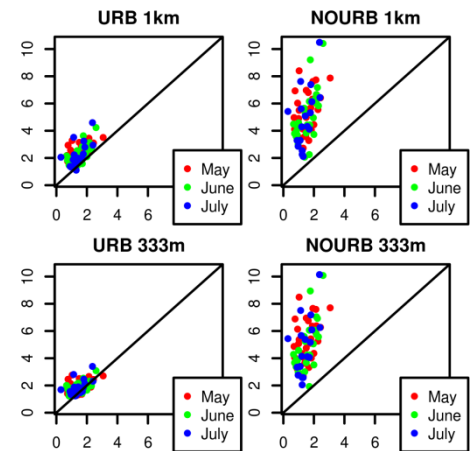
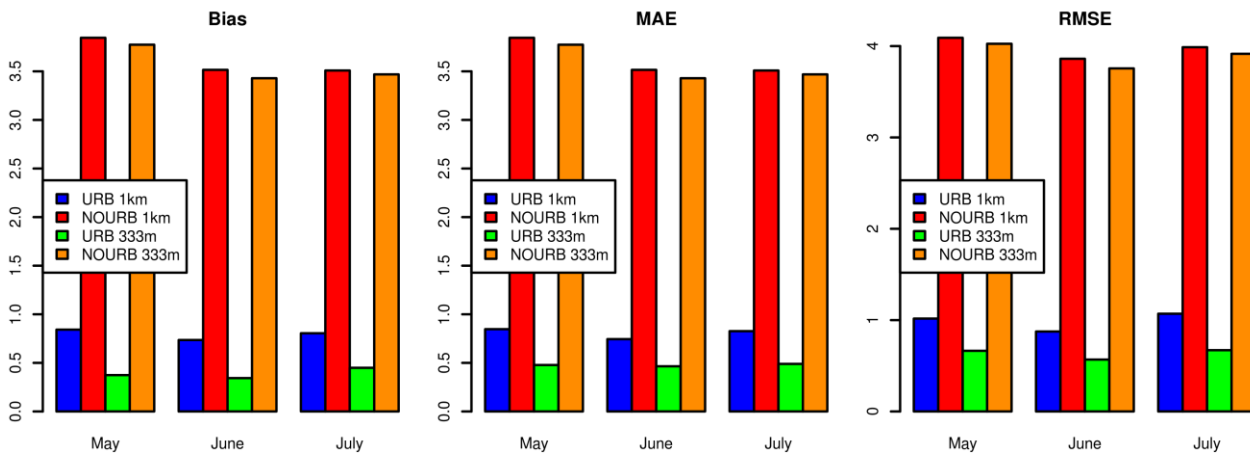
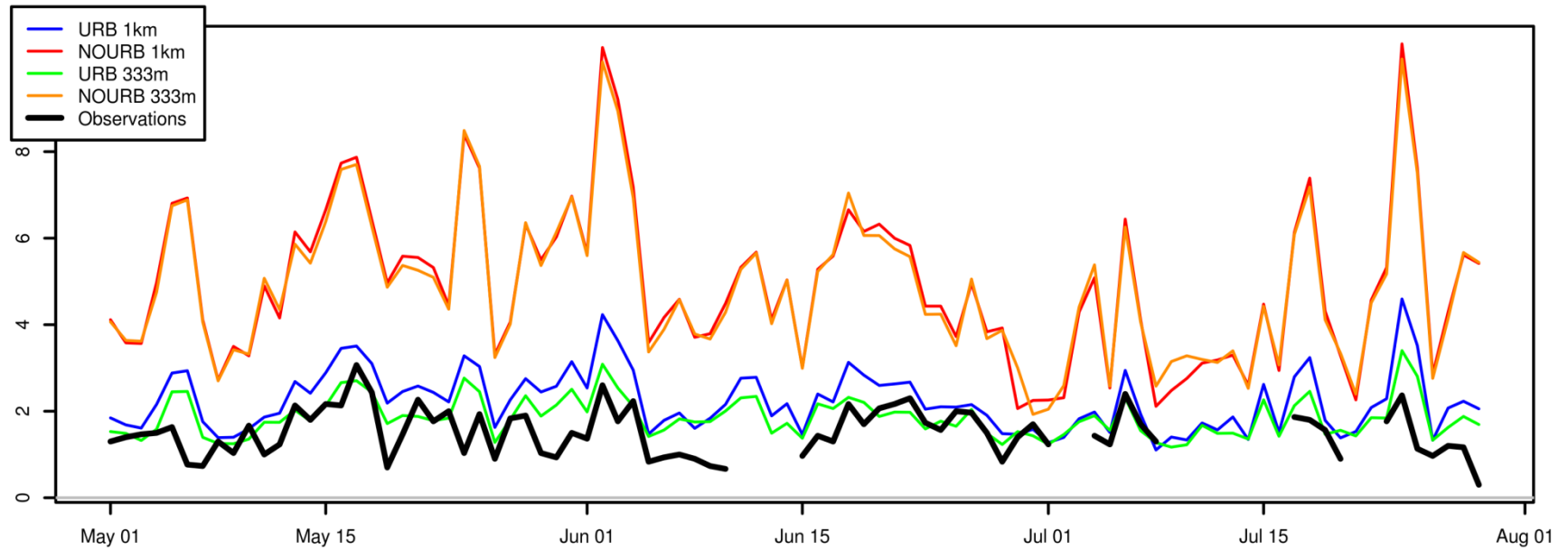
*Modelled concentrations of NO₂ (ppmV)
without BEM (left) and with BEM (right)
on 1km and 333m domain on July 1 at 20:00 CET*

Urban surface – concentrations of O₃



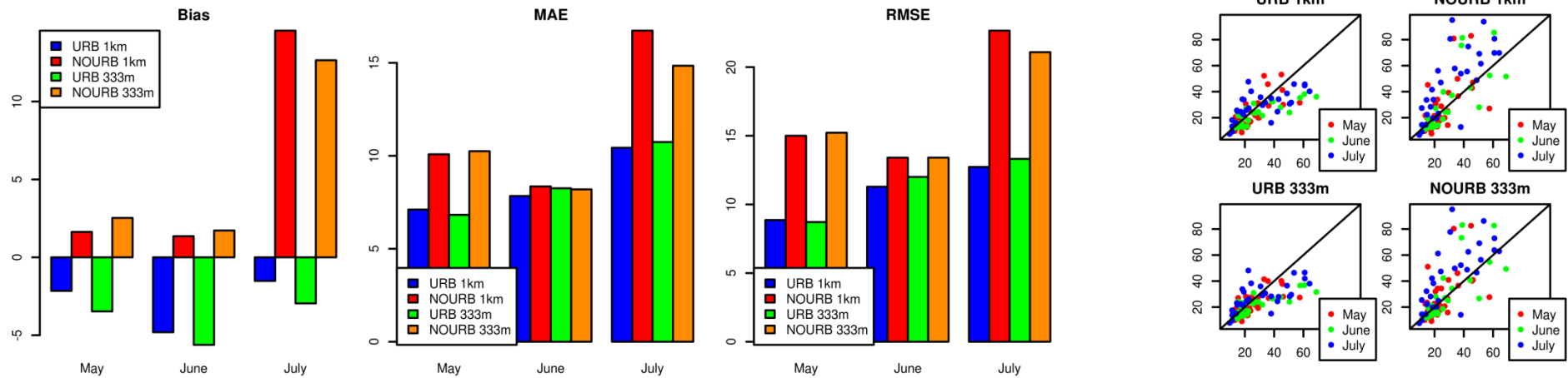
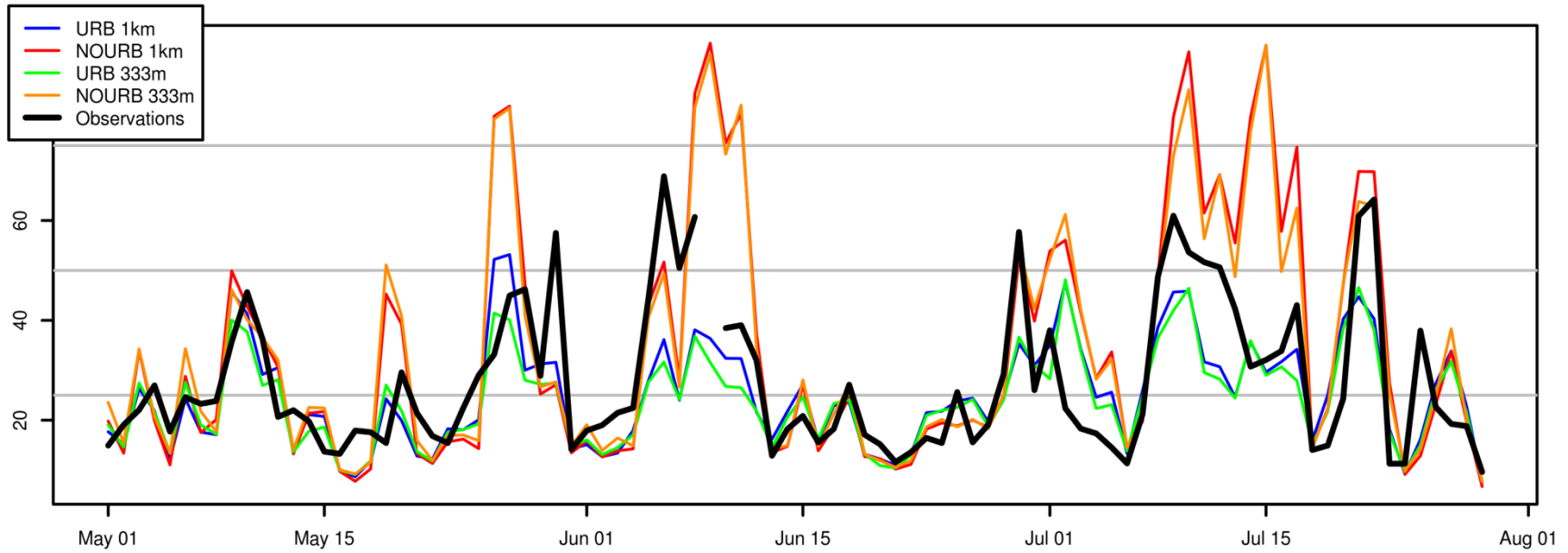
*Modelled concentrations of O₃ (ppmV)
without BEM (left) and with BEM (right)
on 1km and 333m domain on July 1 at 21:00 CET*

Results – wind speed



Modelled and observed wind speed in 10m on station namesti Republiky

Results – concentrations of NO₂



Modelled and observed concentrations of NO₂ on station Suchdol

Simulation of the scenarios

„2010” – reference year

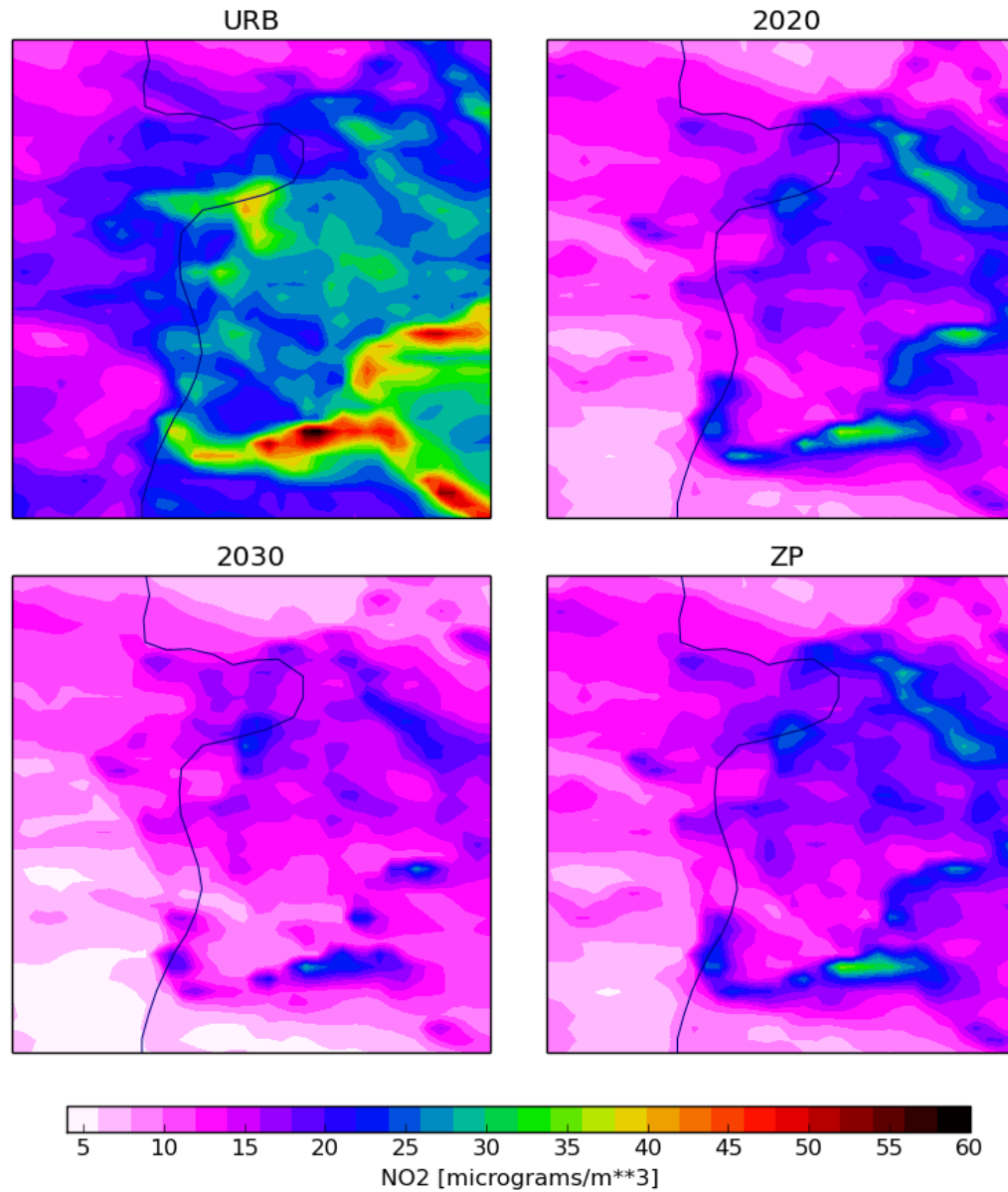
„2020” – planned situation of the year 2020 (changes in landuse, road constructions, changes in structure of the car park)

„2030” – scenario of the situation with low-emission zone in Prague

„ZP” – scenario with circle belt of parks in Prague

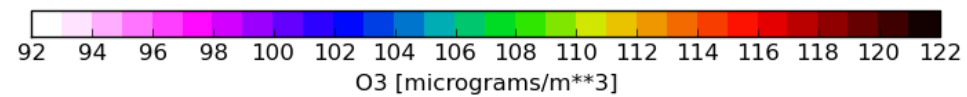
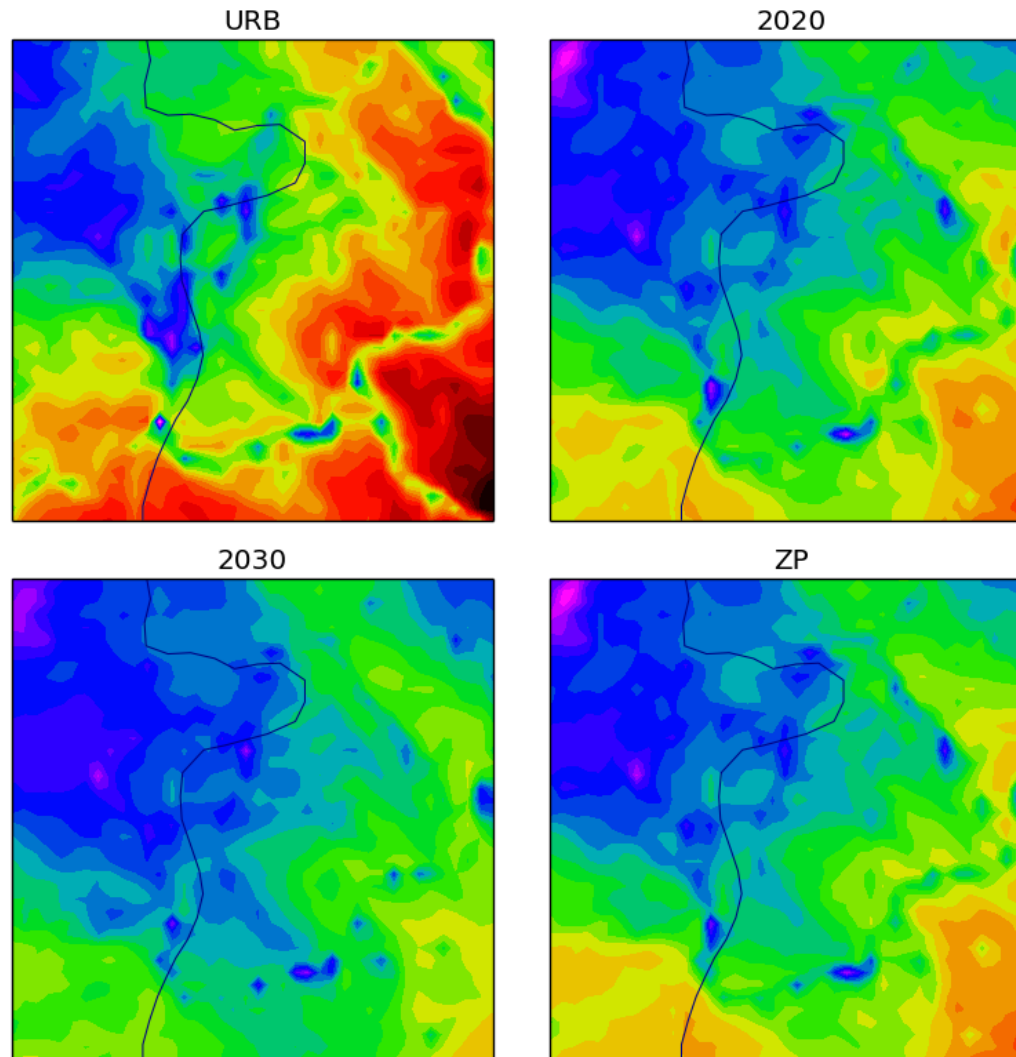
Comparison of the scenarios - NO2

26. 09. 2010, 18:00 CET



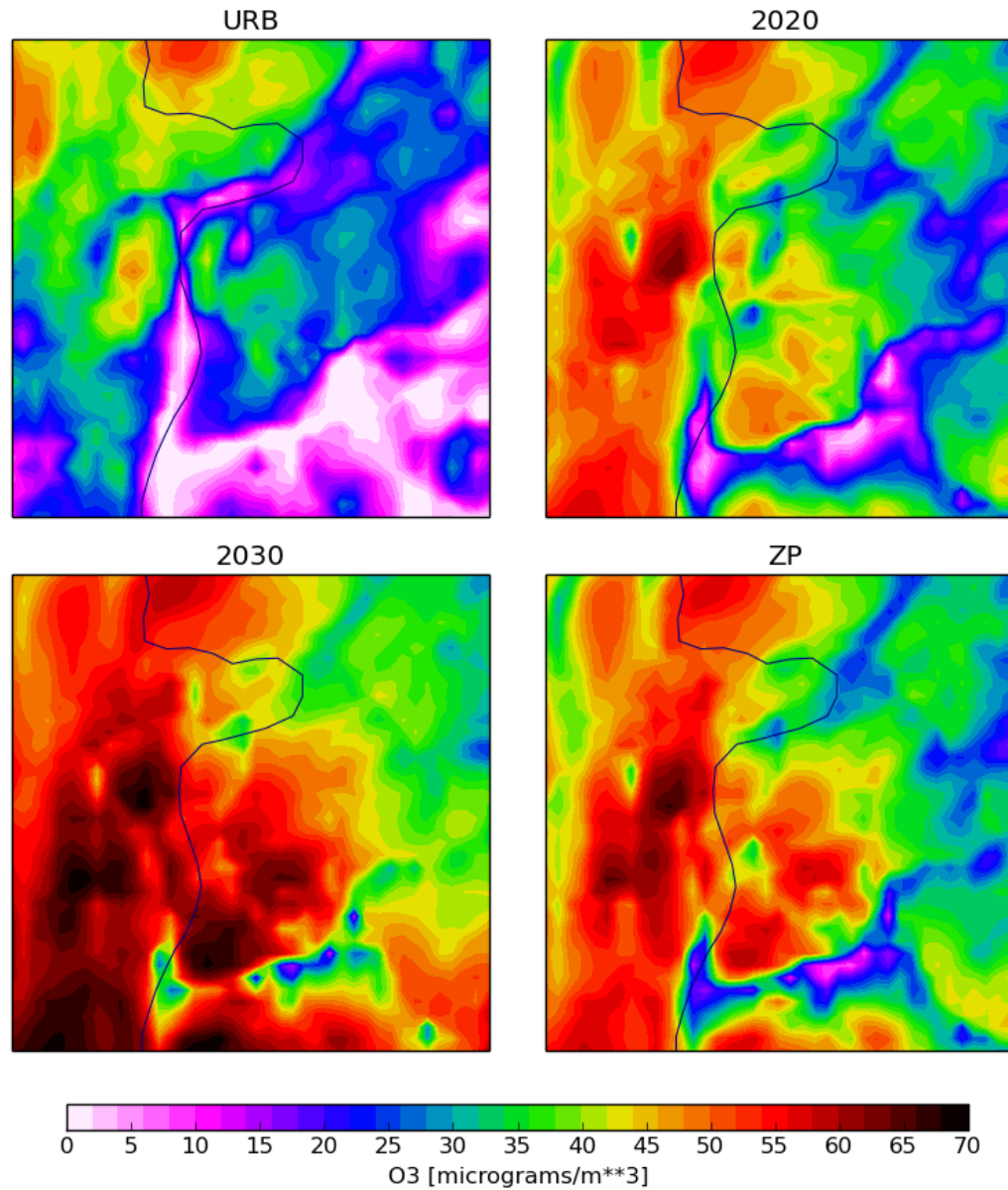
Comparison of the scenarios - O3

26. 07. 2010, 12:00 CET



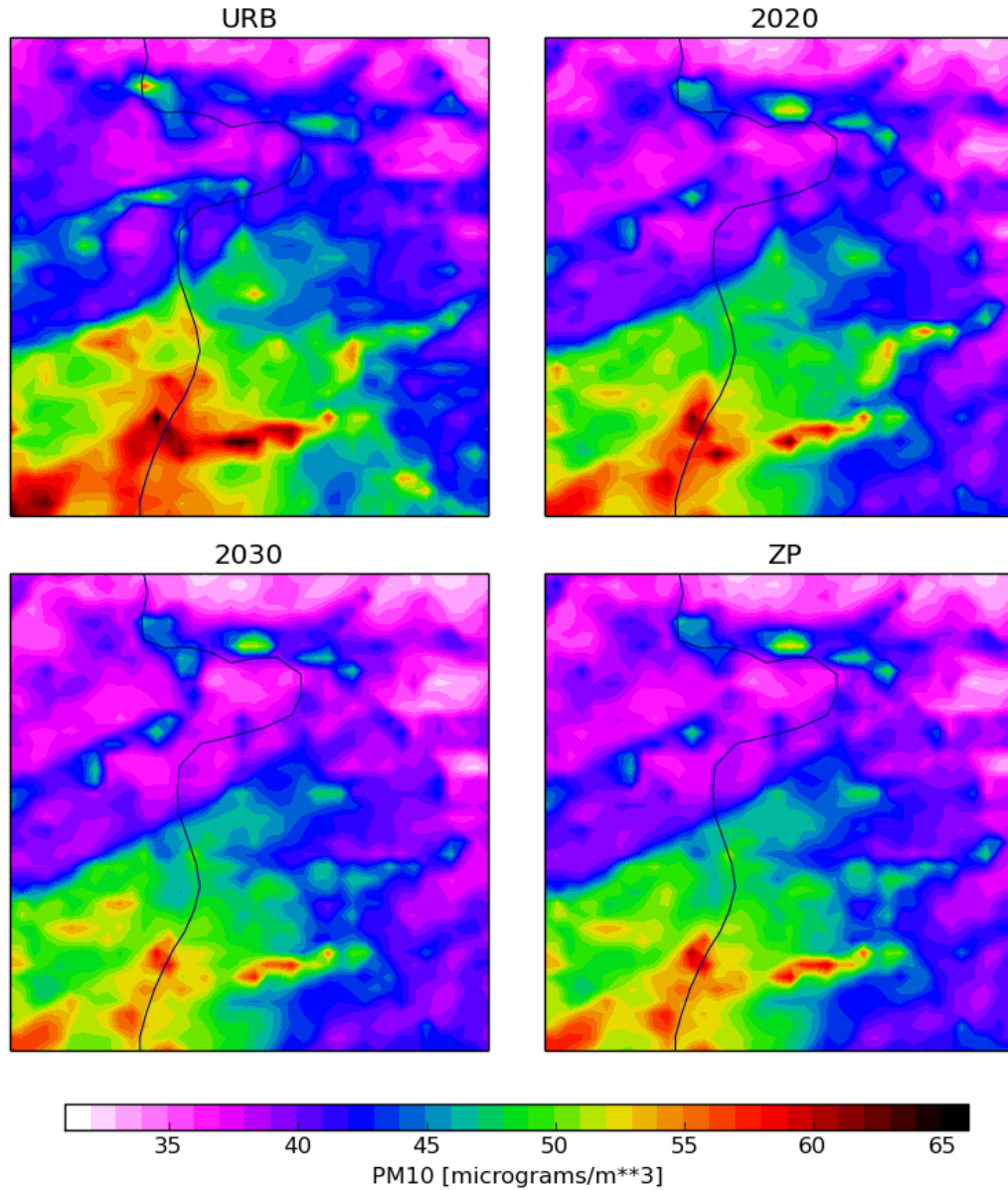
Comparison of the scenarios - O3

26. 07. 2010, 22:00 CET



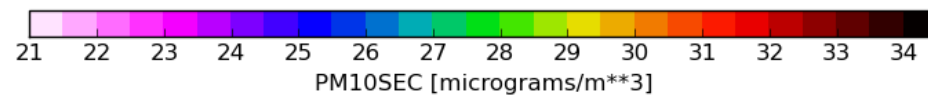
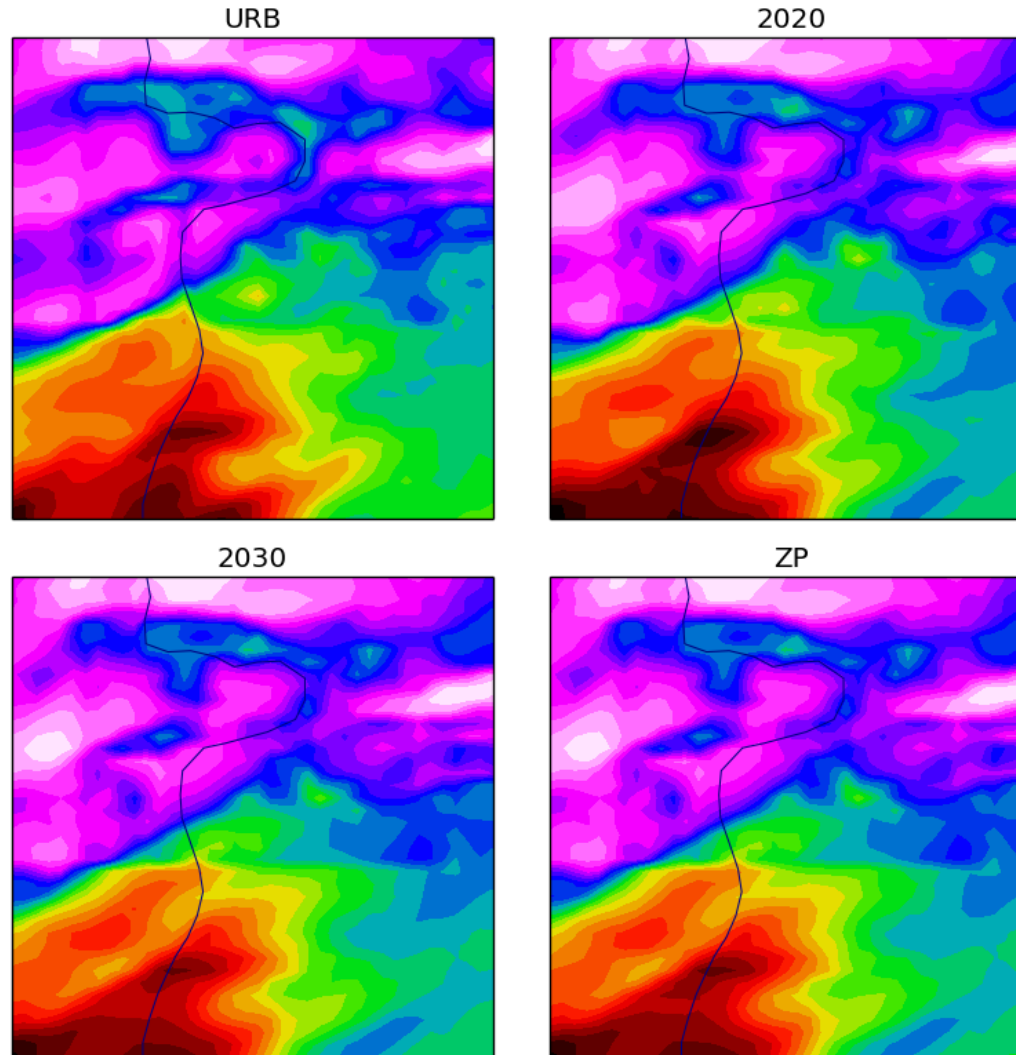
Comparison of the scenarios - PM10

22. 01. 2010, 17:00 CET



Comparison of the scenarios – PM10 SOA

22. 01. 2010, 17:00 CET



Conclusions

- The modelling system in resolution 1km and 333m for Prague have been developed, configured and successfully tested.
- The influence of the urban surface model and the very fine resolution is strongly positive for wind speed while it is less important for other meteorological and air quality quantities.
- The changes of the landuse and emission in the scenarios have the influence on the peak values of the temperature and concentrations as well as on diurnal cycle of the quantities.
- The model allows to asses secondary pollutants (e.g. O₃, SOA) which play a significant role.
- The results contain advanced data for short term air quality assessment (hourly and daily means, number of

Acknowledgement

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Thank you for your attention