



Modelling of aerosols during current and future climate, using the CTM CHIMERE, coupled to the high resolution ALARO NWP model

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Introduction

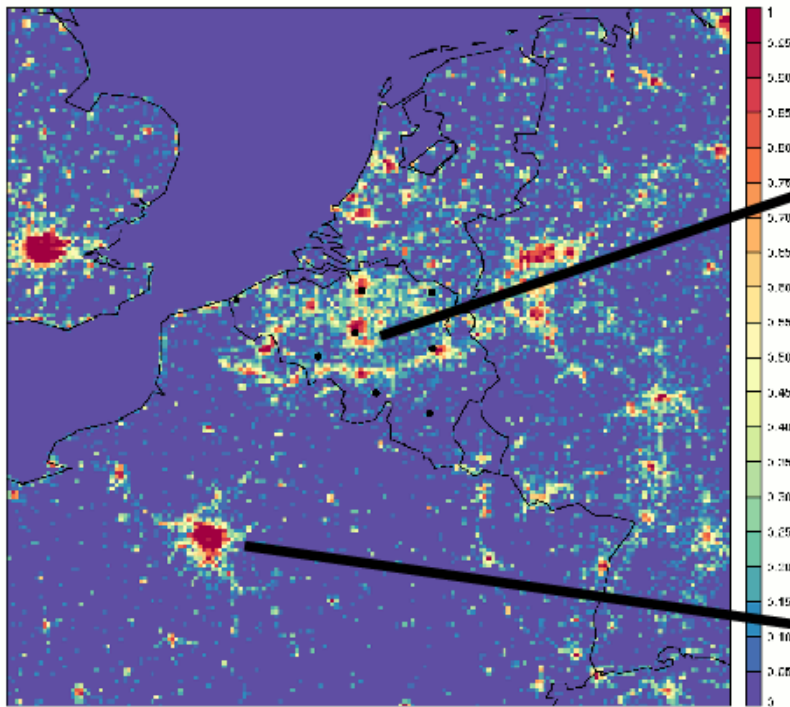
- Applying a high-resolution urban dynamical downscaling technique for the new version of the Arpège-IFS (SURFEX/TEB)
- Modelling PM10 on a 7 km x 7 km grid for climate studies
→ Brussels
- CTM CHIMERE → configuration
- Validation: Downscaling strategy first tested with ERA-INTERIM data
- First results for the climate scenario's HIS (1990-1999) and A1B (2046-2055)
- Conclusions
- Outlook

NWP models ALADIN/ALARO

- **ALARO** runs operationally 4 times a day (at 6-h intervals) based on analyses coming from the operational version of the ALADIN model running at Météo-France.
- **ALARO** → new version of hydrostatic LAM ALADIN with improved physical parameterization.
- For **non-urban** surfaces, the **SURFEX** scheme diagnoses the 2-m temperature, 2-m relative humidity, and 10-m wind by complex interpolation between the lowest ALARO level and the surface, making use of the Geleyn (1988) formulation.
- For **urban areas**, the standard 2-m temperature, 2-m humidity, and 10-m wind are obtained from the diagnosed **TEB** canyon temperature, humidity, and wind respectively.

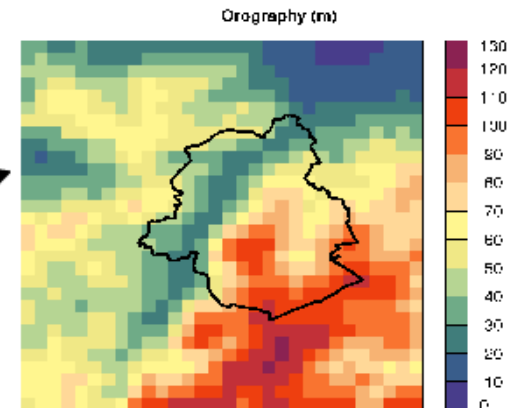
Urban climate simulations using SURFEX+TEB (Town Energy Balance)

ALARO+SURFEX INLINE 4 km

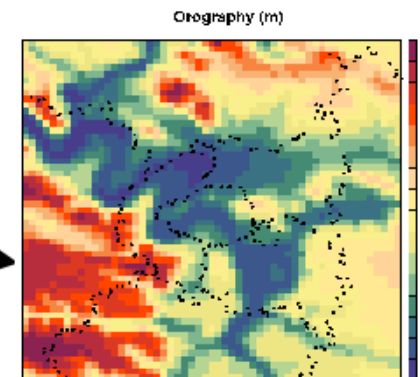


Percentage of impervious areas

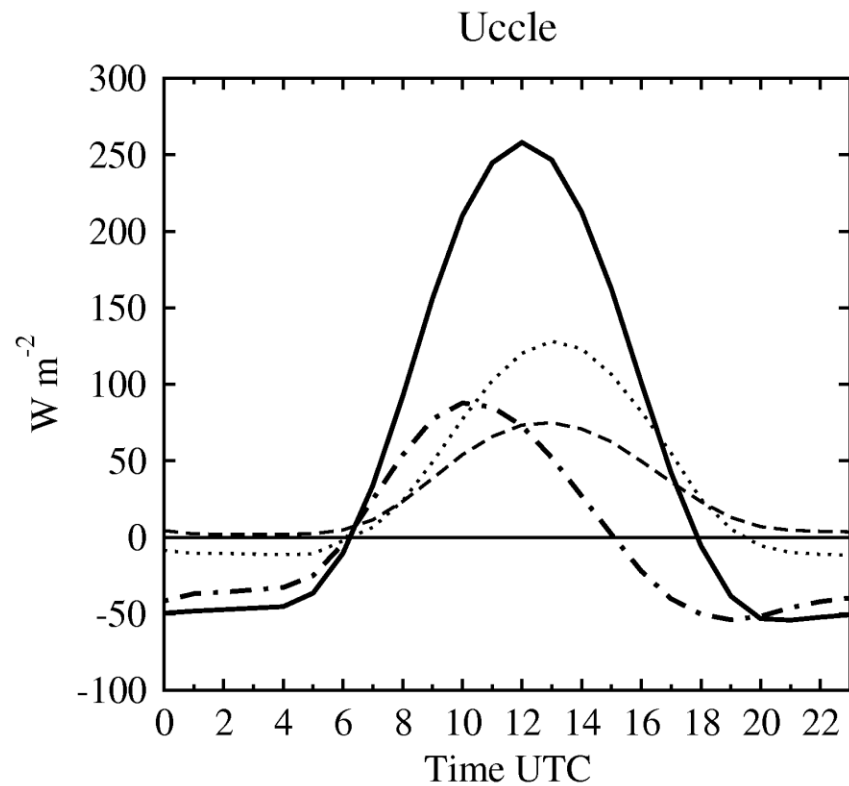
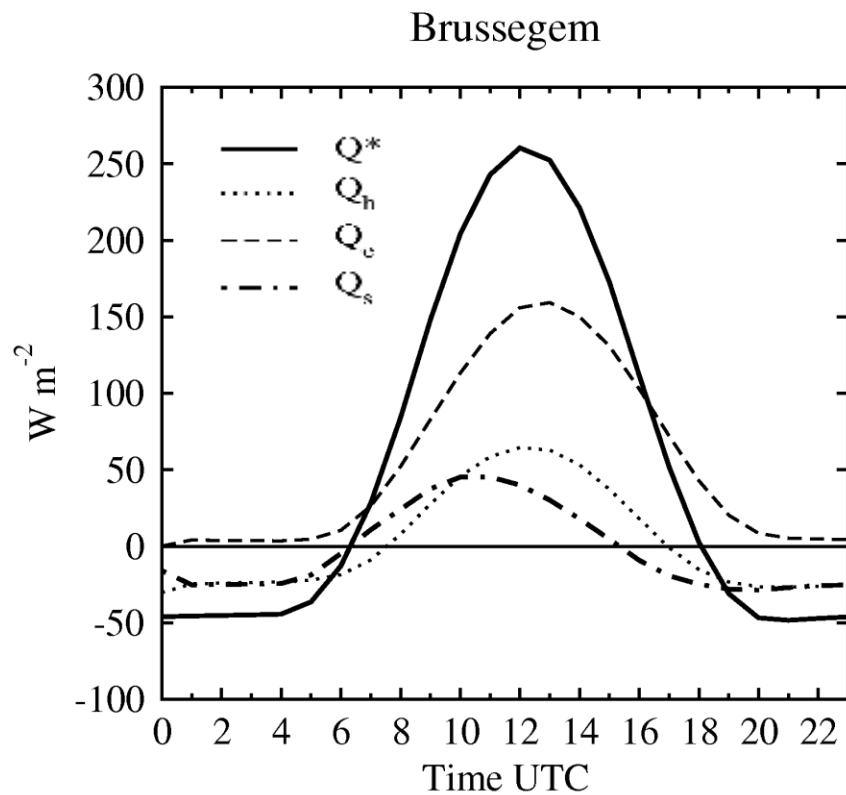
SURFEX OFFLINE 1 km, Brussels, 30x30



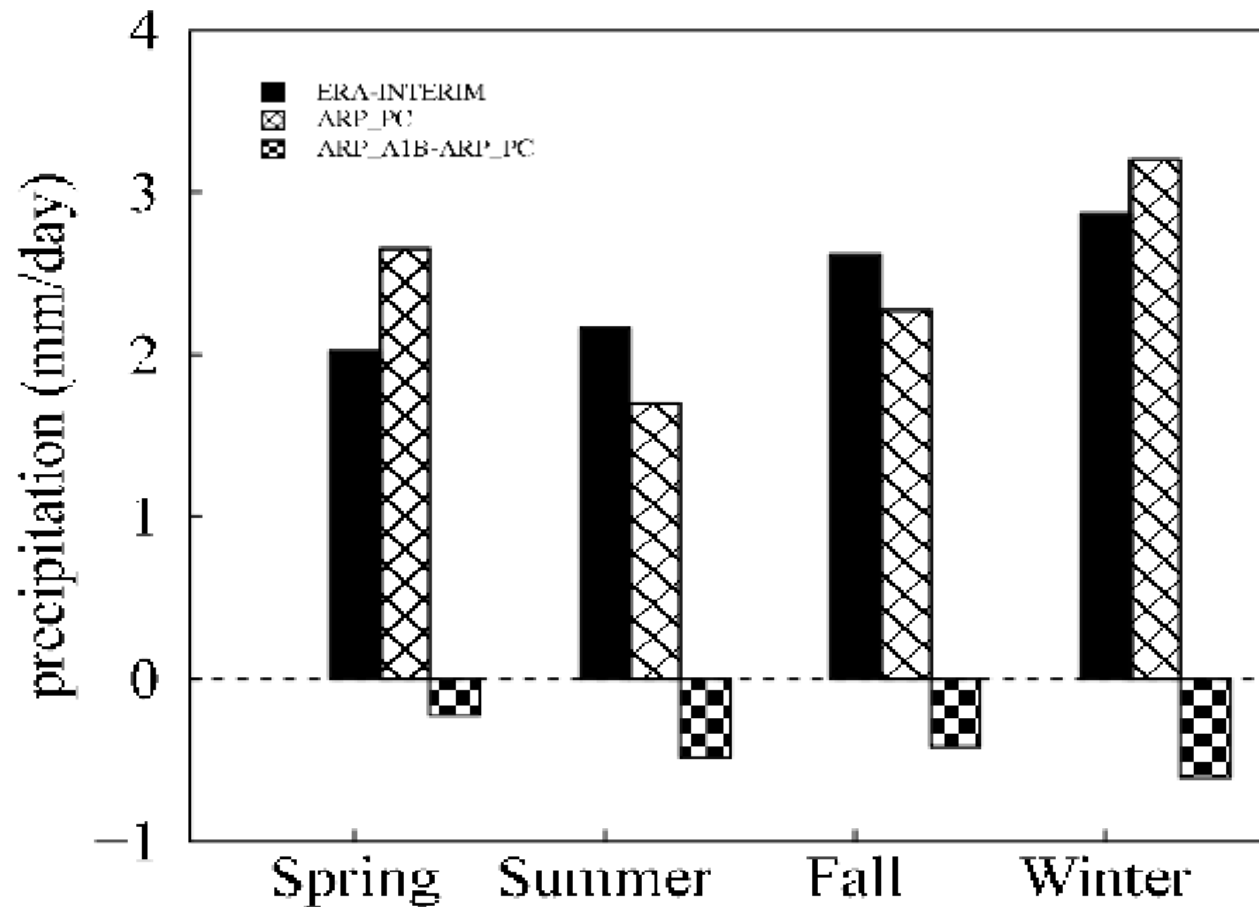
SURFEX OFFLINE 1 km, Paris, 55x55



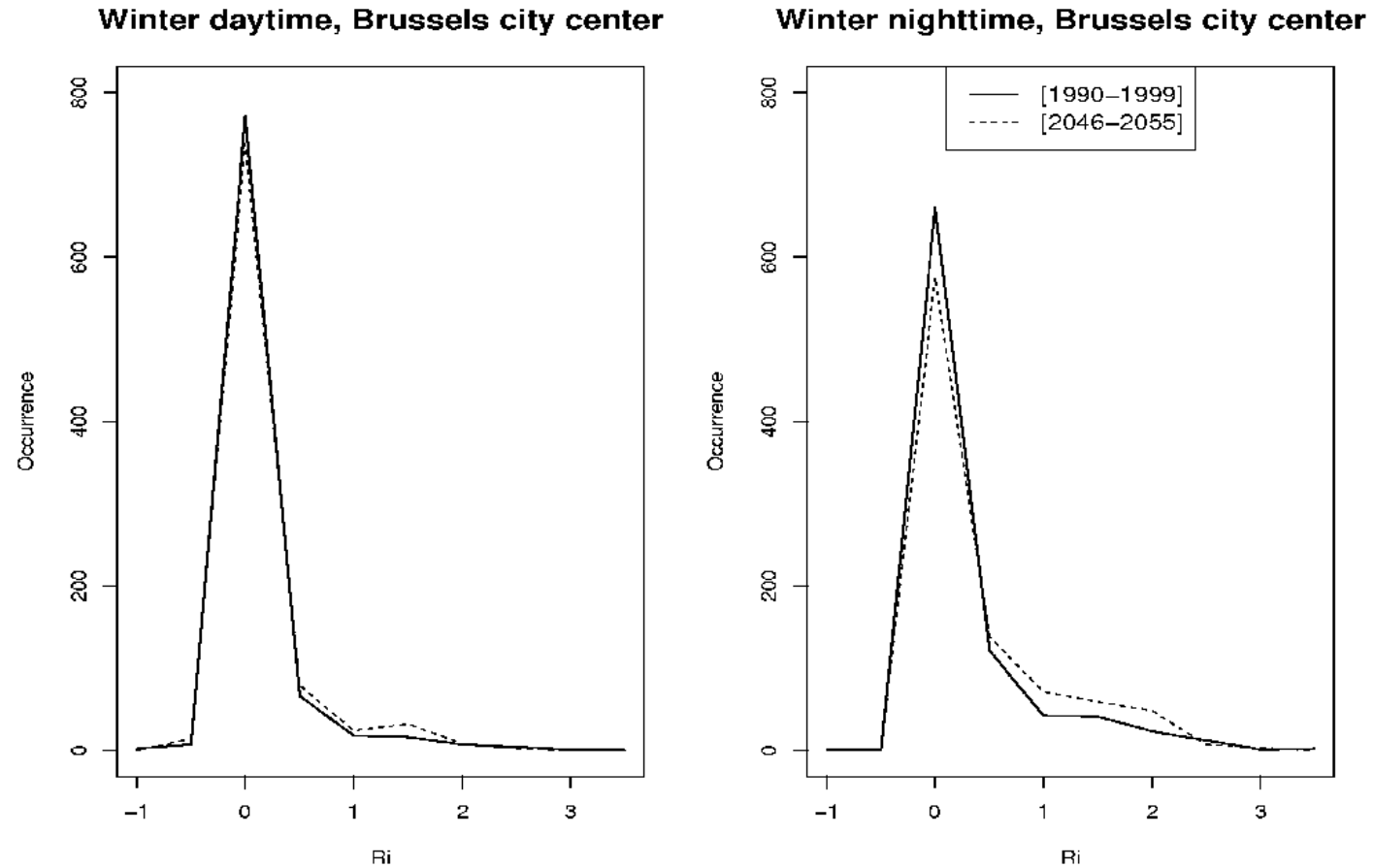
Fluxes in ALARO



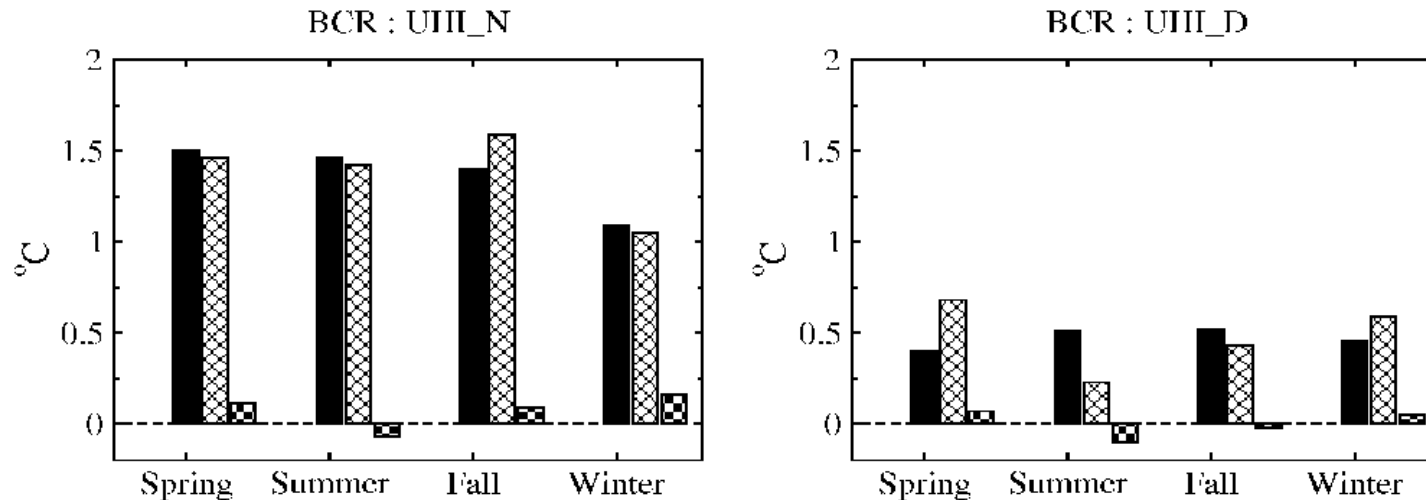
Averaged daily precipitation



Stability



Heat Island effect

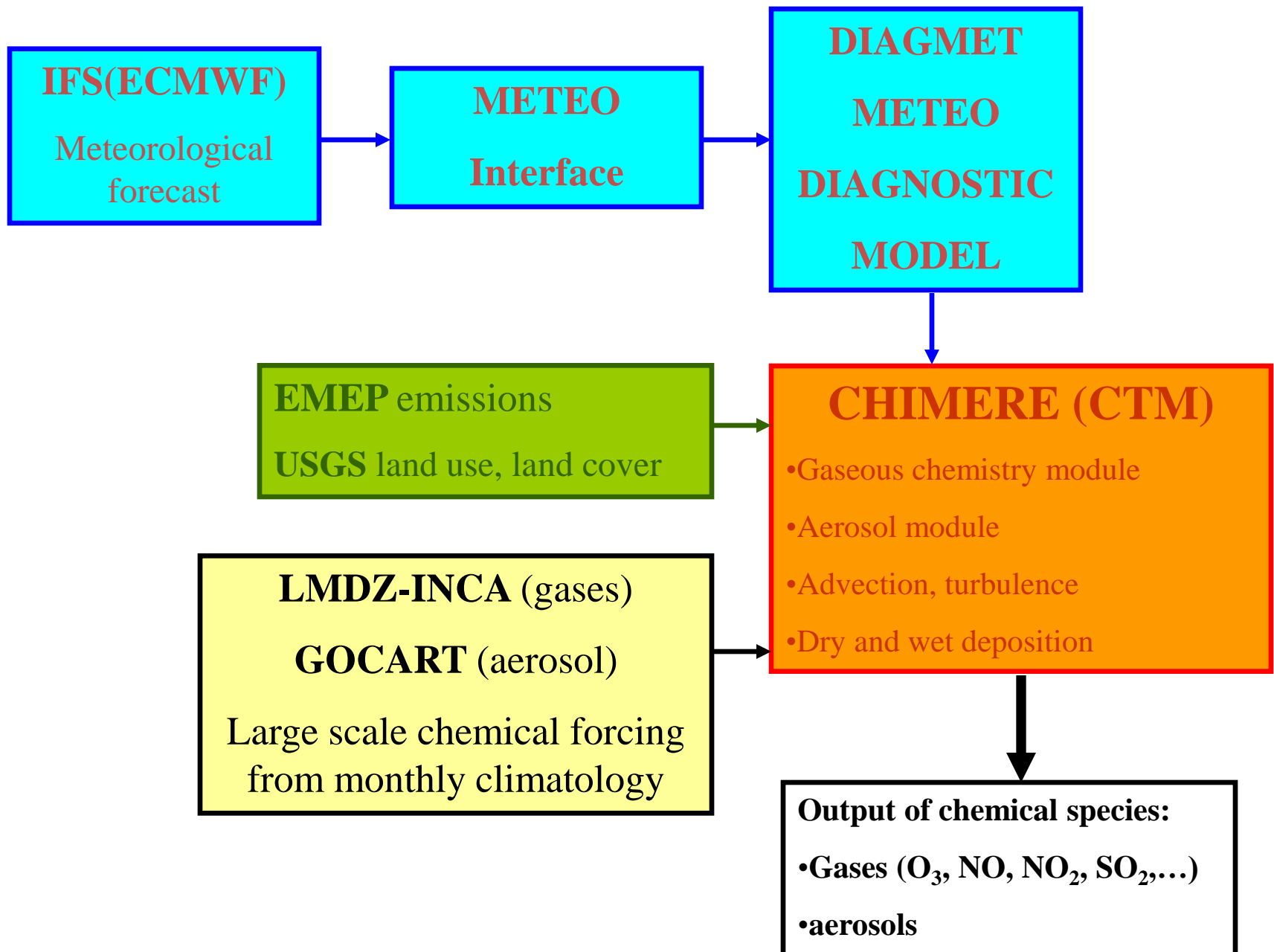


- Both urban and rural areas warm substantially for the 2050's horizon (1.5 °C)
- climate change will have a neutral impact on annual mean urban heat island (UHI) intensity

Configuration CHIMERE

- Resolution: 50 km² (0.5 °)
- Emissions: EMEP
- METEO: ECMWF (IFS)
- Domain: Europe (CONT 3)
- Levels (8, until 500 hPa (5.5 km))
- Parallel version (V200709C)
- Chemical scheme: Reduced Melchior scheme
- Site CHIMERE :

<http://euler.lmd.polytechnique.fr/chimere>



Coupling to ALARO

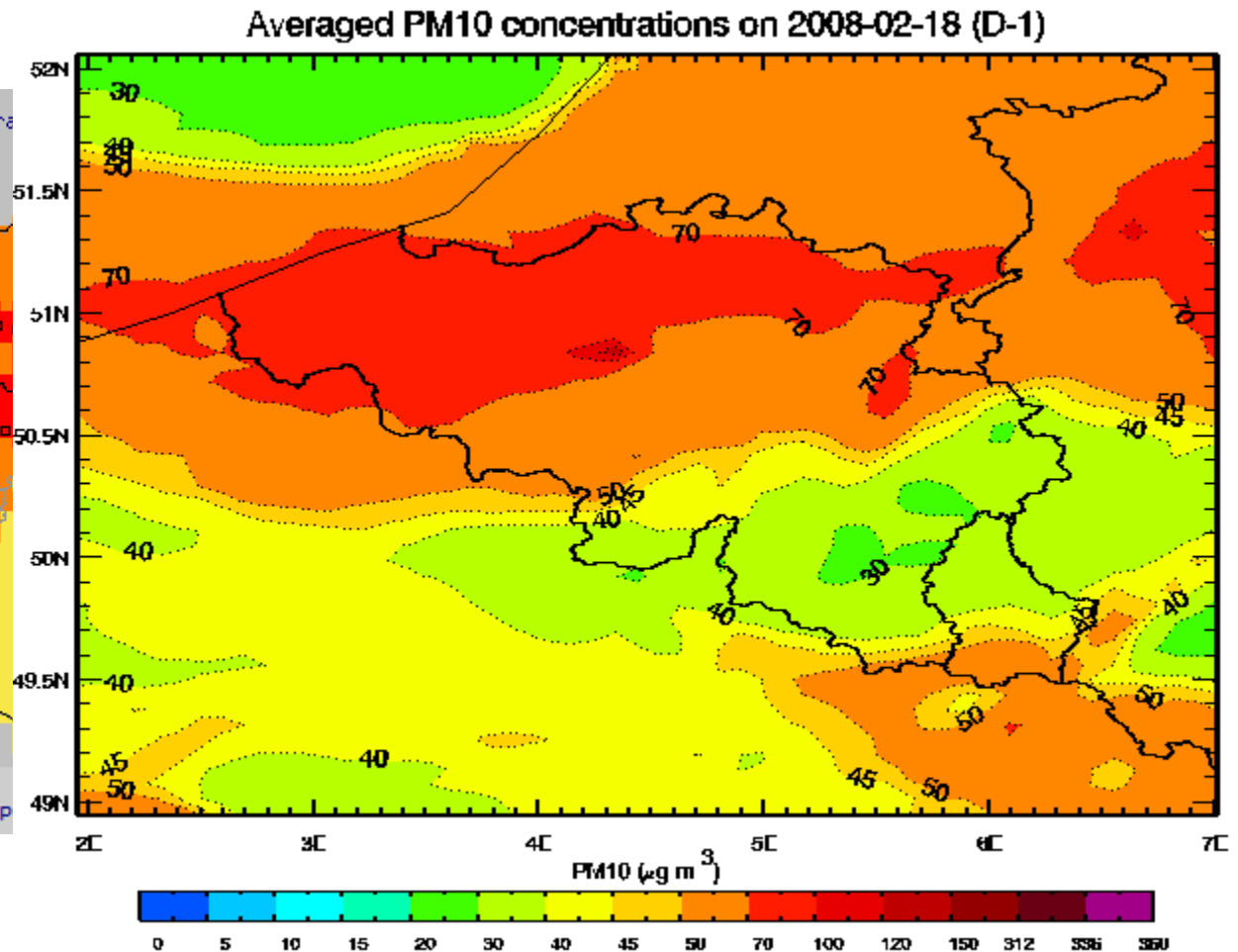
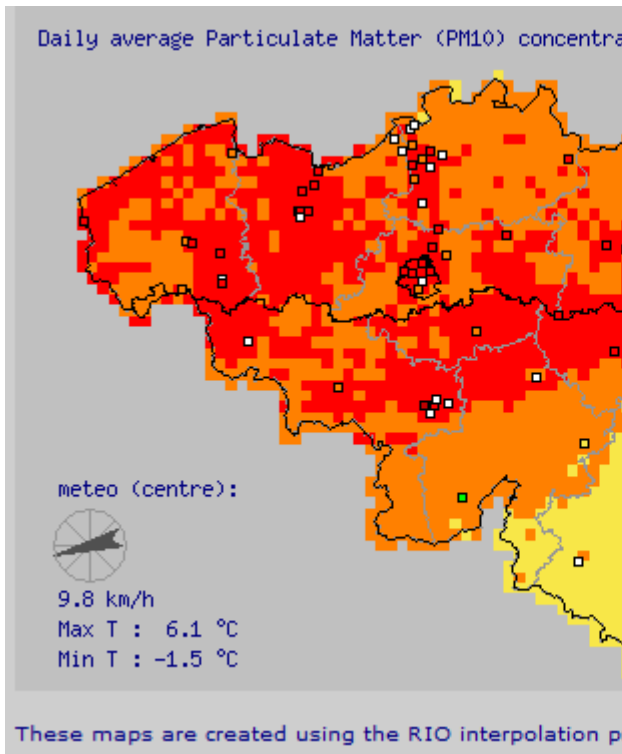
- One-way nesting
- TNO/GEMS emission database
- Domain: Belgium extended area
- METEO: ALARO (SURFEX-TEB)
 - Resolution: 7 km²
- Boundary conditions:
 - CHIMERE EUROPE



Different scenario's

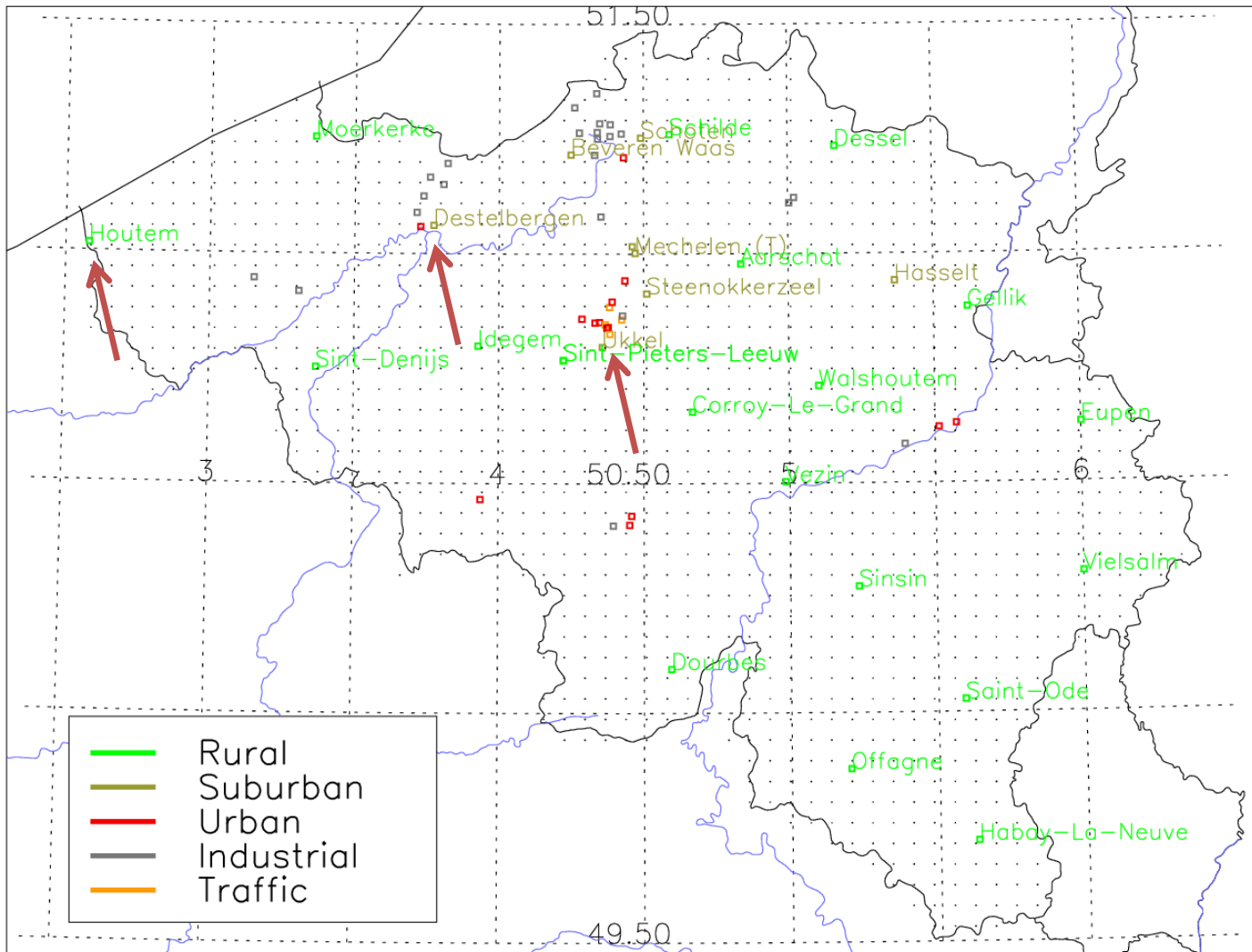
- 4 years with ERA-INTERIM (2005-2008)
- A1B scenario for 10 years (2046-2055)
- Current climate for 10 years (1990-1999)
 - Both scenario's will use the same emissions (TNO/GEMS)
 - >verify the effect of climate change on the modelled PM10 concentrations

Current climate runs (ERA-INTERIM)

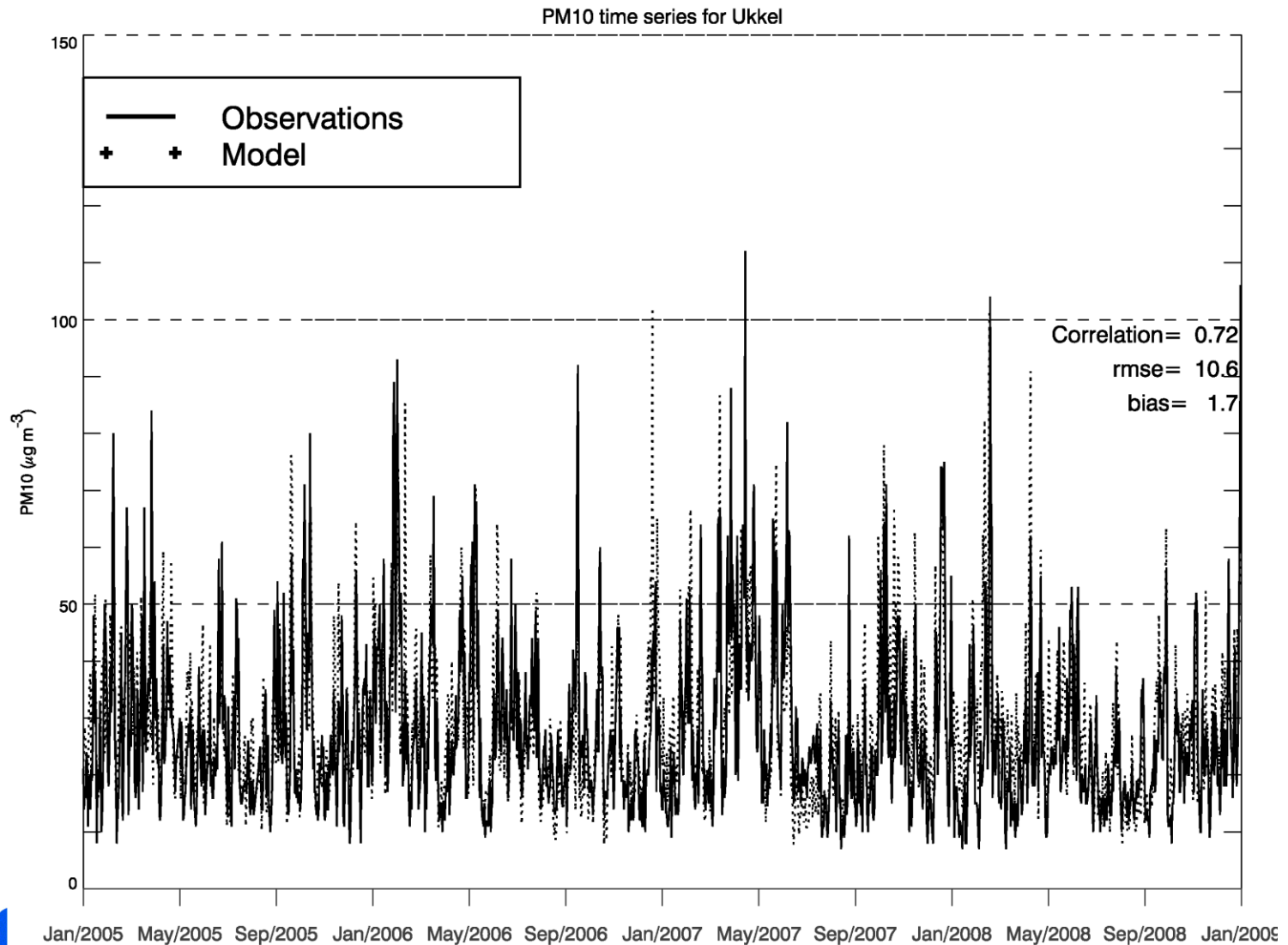


Credits: irceline
(<http://www.irceline.be>)

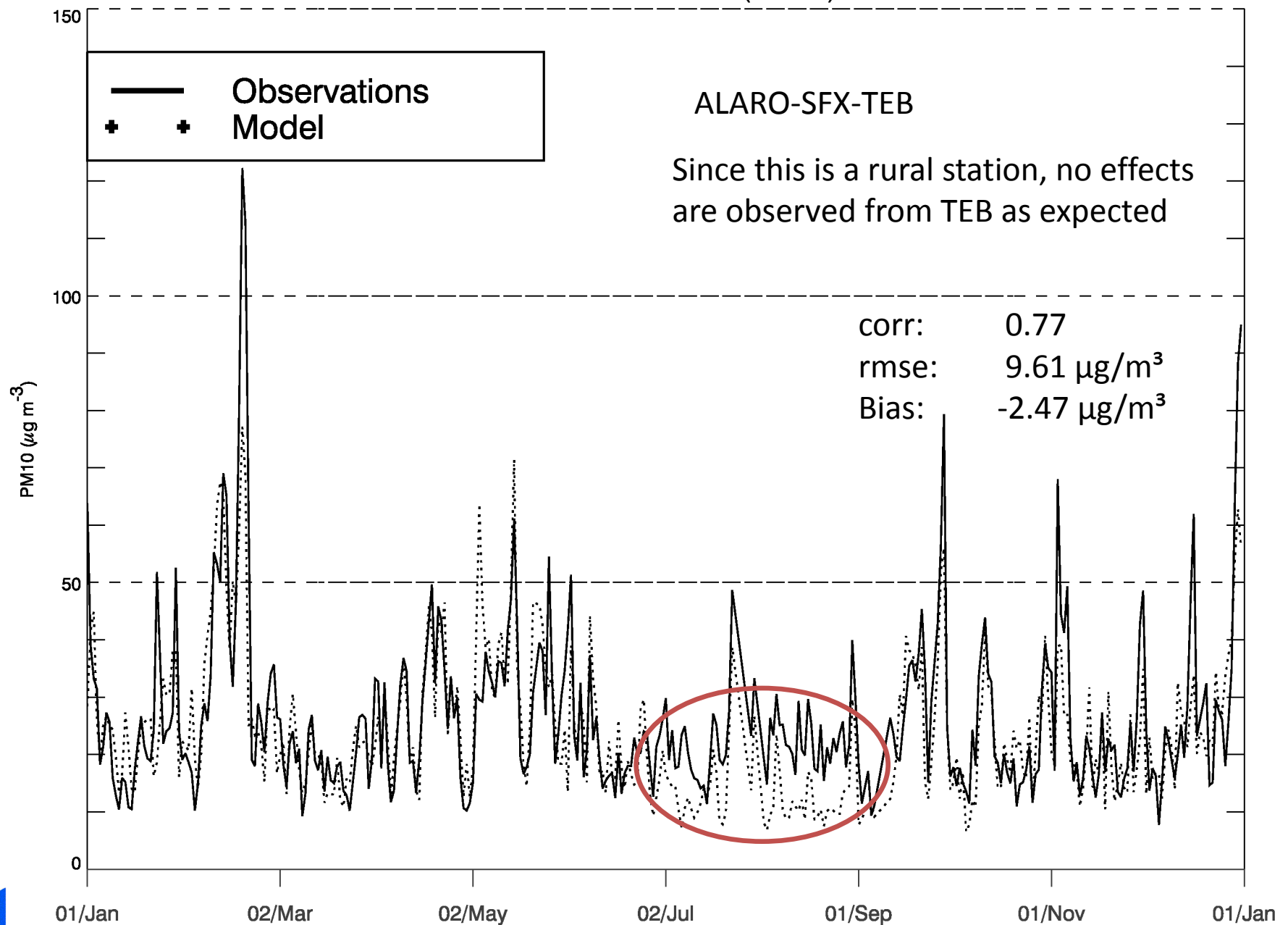
Observational network (<http://www.ircel.be>)



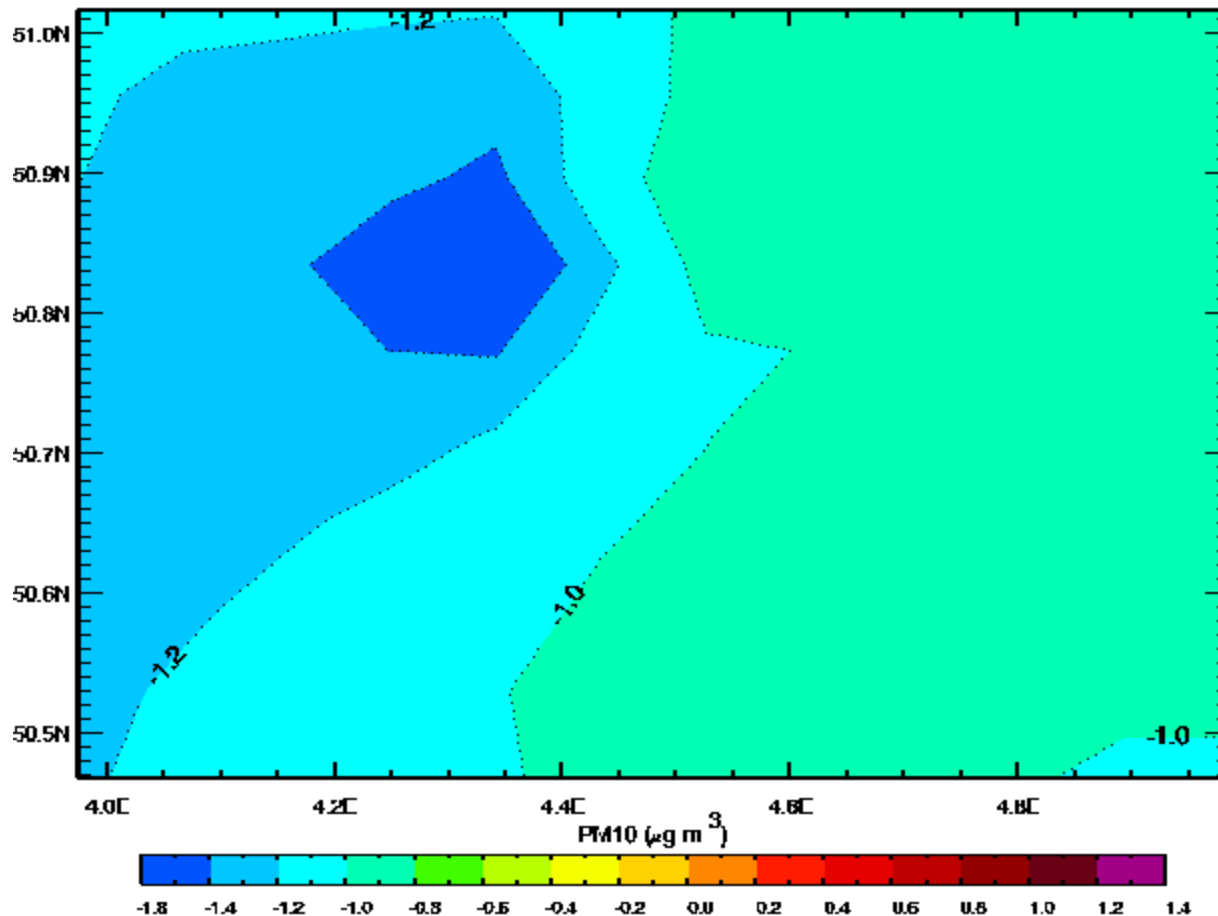
Time series for Ukkel (4 years)



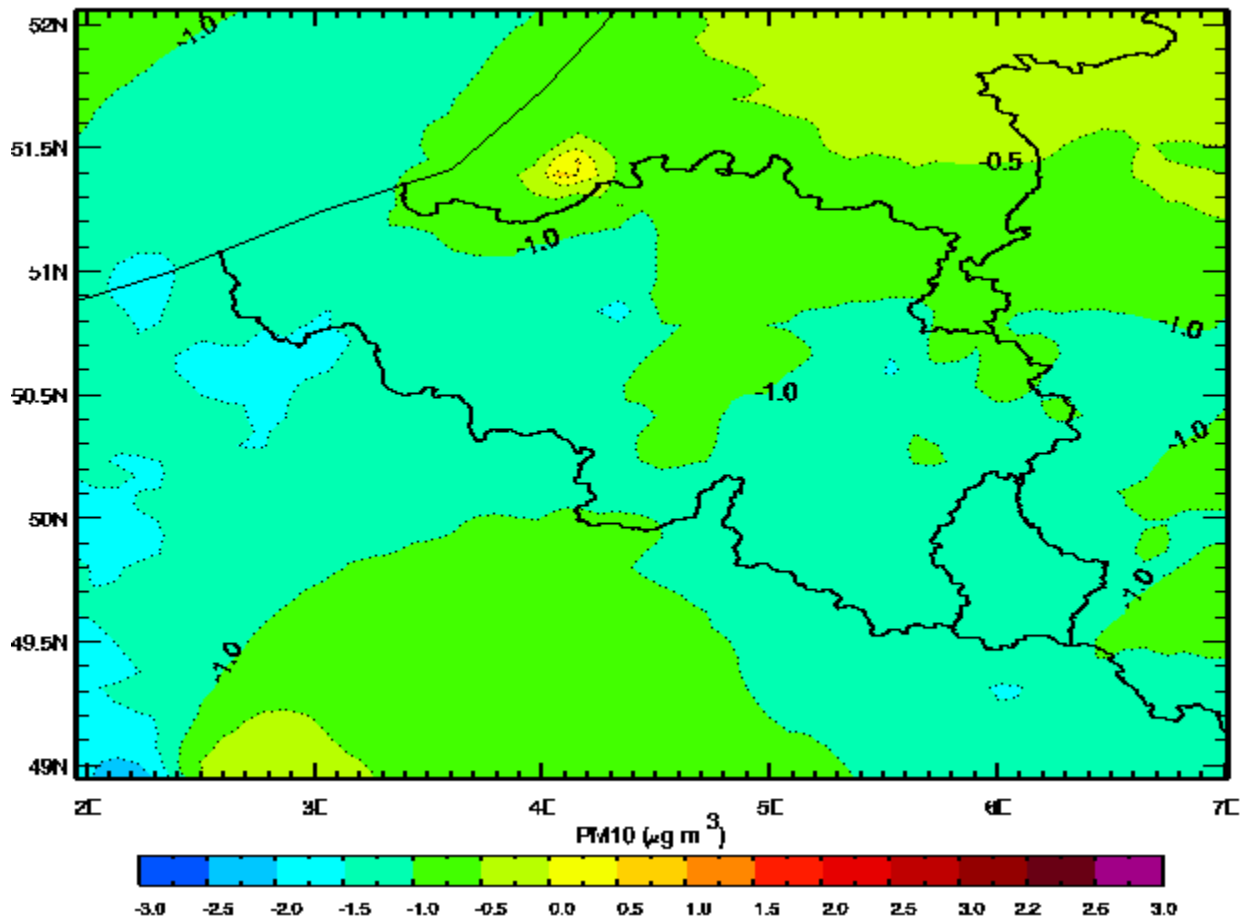
PM10 time series for D-1 (Houtem)



PM10 difference Brussels (HIS – A1B)



PM10 difference Belgium (HIS – A1B)



Number of exceedences PM10

- Including table with number of exceedences (%)
- Number of peaks is increasing

Stations	Future exceedences (%) (PM10 > 70 µg/m ³)	Future exceedences (%) (PM10 > 50 µg/m ³)
Uccle (sub-urban)	23.86	23.39
Houtem (rural)	22.86	33.33
Destelbergen (sub-urban)	14.81	22.19

Conclusions

- Current climate results, using ERA-INTERIM show that the configuration has skills.
- Future results for A1B scenario elucidates an increase in PM10 concentrations
- Evidence of the occurrence of more stable meteorological conditions during 2046-2055 scenario
- Also evidence of a reduction on averaged daily precipitation for the A1B scenario

Outlook

- Investigate the PM10 concentrations in function of different seasons
- Verify the correlation between PM10 concentrations and meteorological phenomena (e.g. inversion) by using a proxy
- Perform the analyses for ozone and NO2
- ACCEPTED project → health studies
- Questions ?