

Young Scientist Summer School 2011, Odessa, Ukraine

Modelling Influence of Urban Territories on
Meteorological Parameters that Affect Air
Pollution Dispersion Using ENVIRO-HIRLAM:
Vilnius Case Study

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2011-07-07

Vilnius

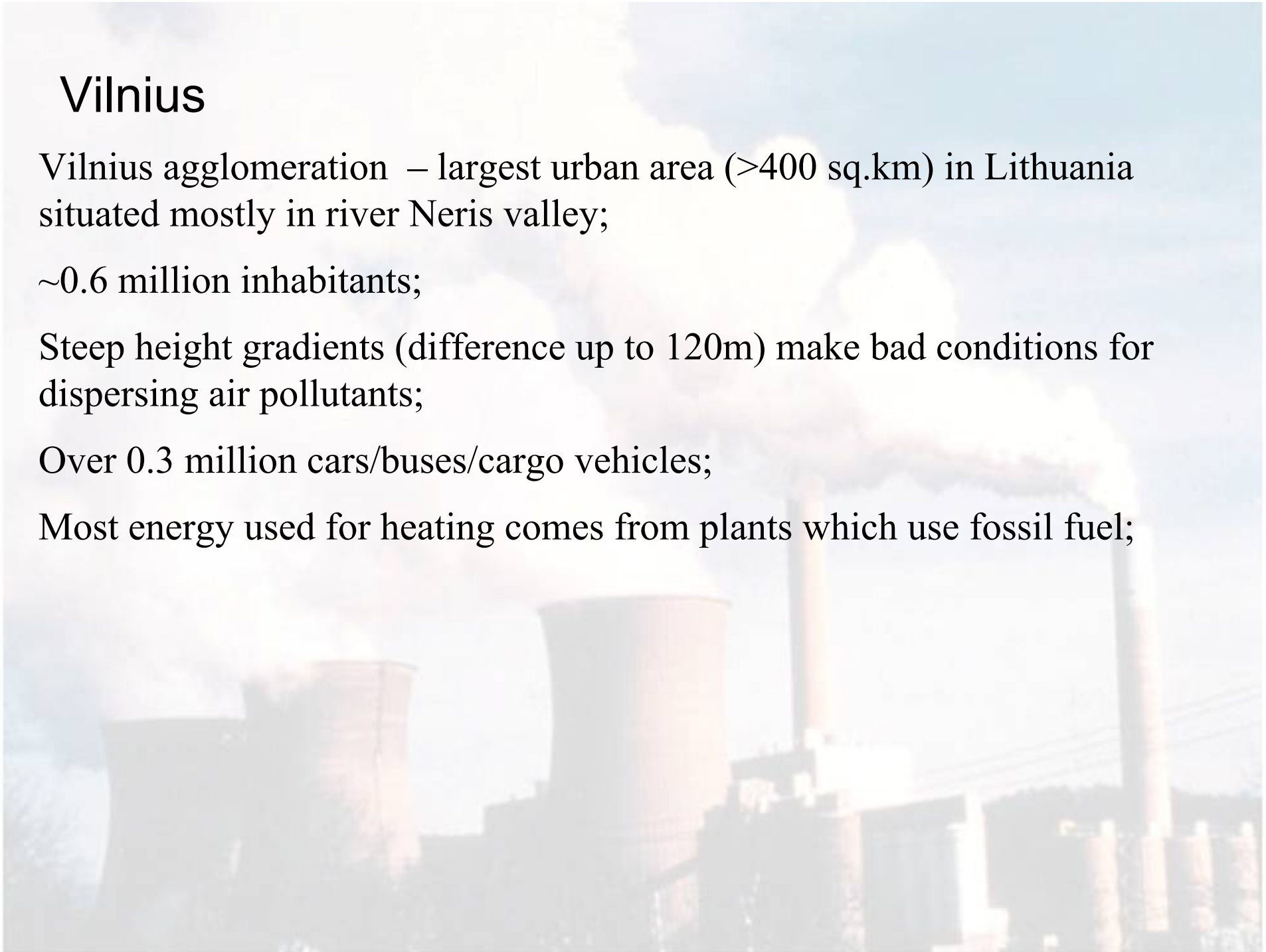
Vilnius agglomeration – largest urban area (>400 sq.km) in Lithuania situated mostly in river Neris valley;

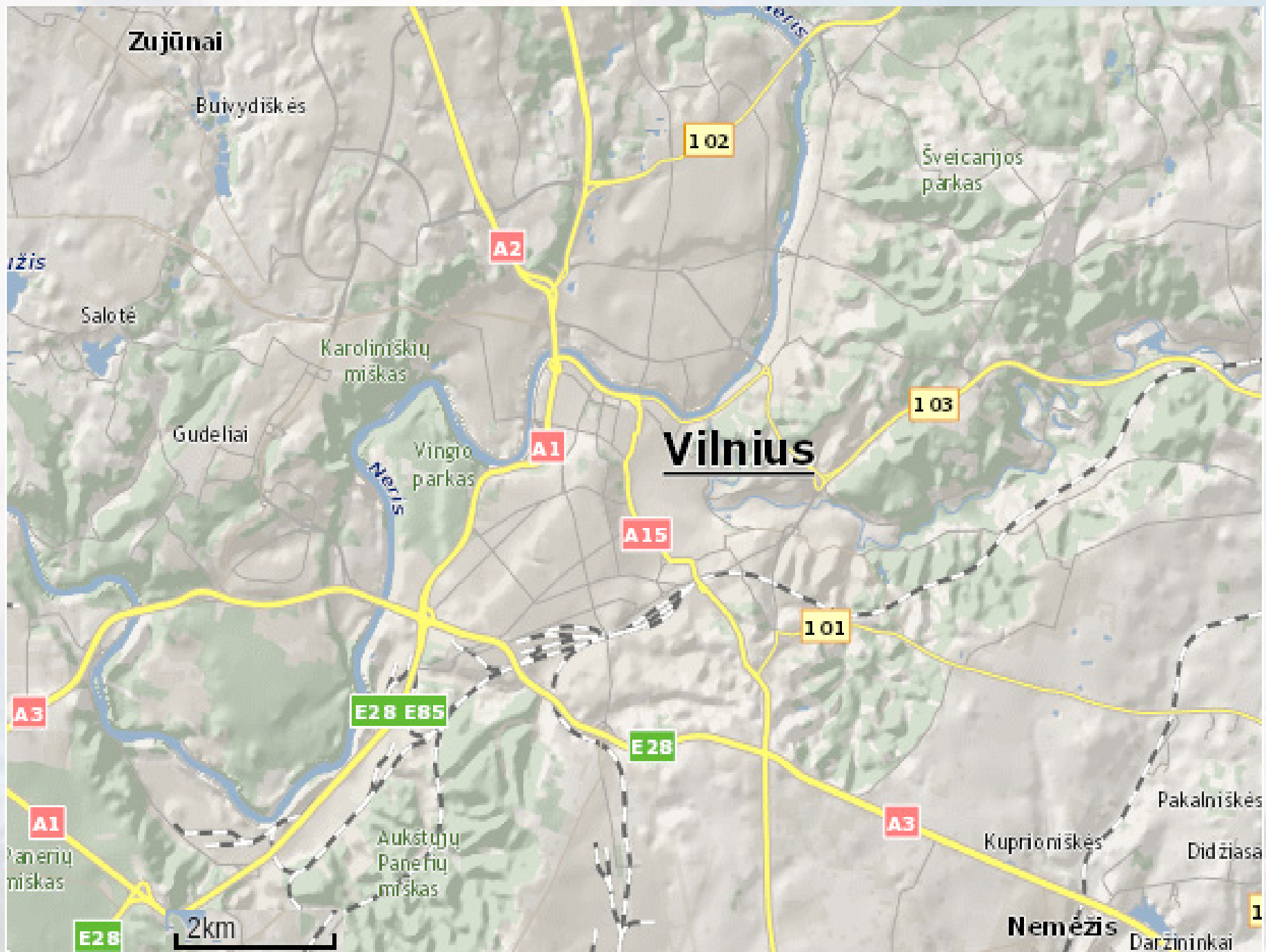
~0.6 million inhabitants;

Steep height gradients (difference up to 120m) make bad conditions for dispersing air pollutants;

Over 0.3 million cars/buses/cargo vehicles;

Most energy used for heating comes from plants which use fossil fuel;





Why is this important for Vilnius?

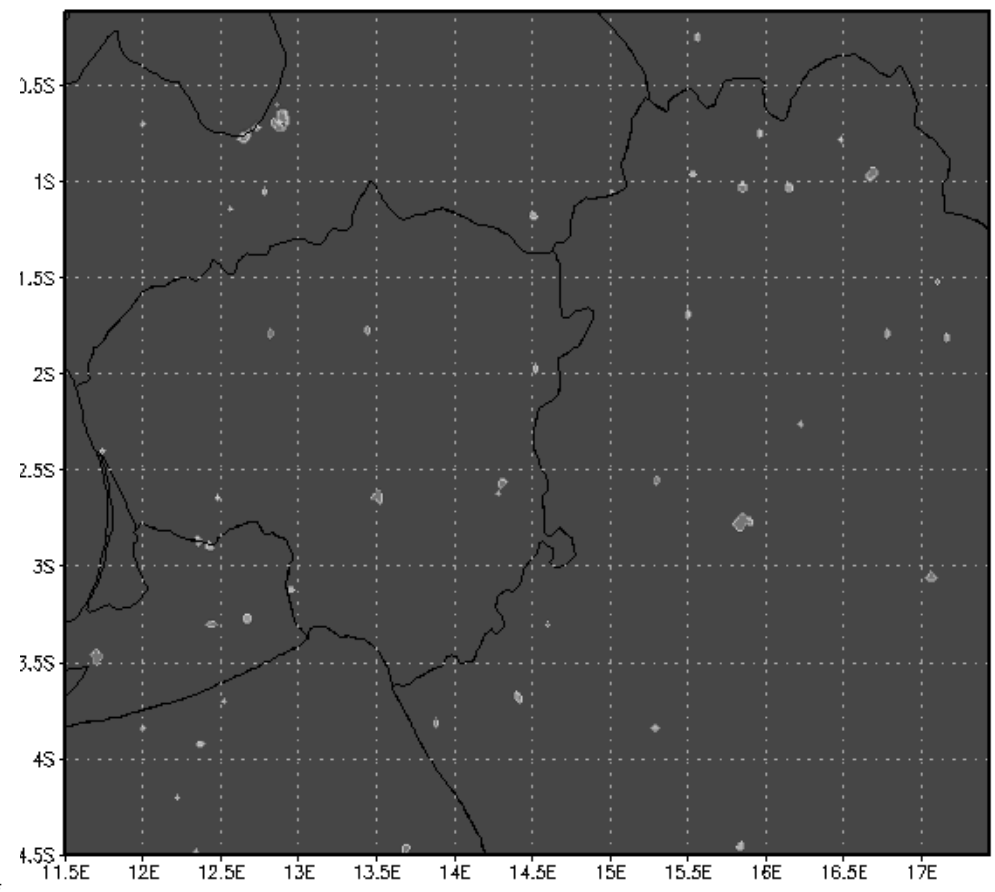
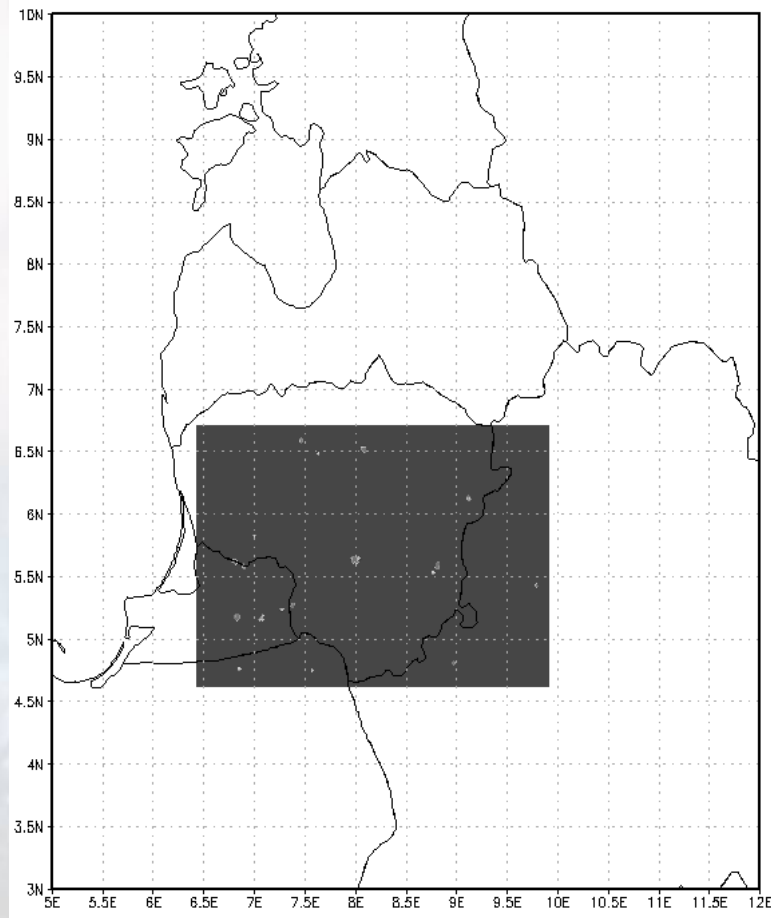
2 meter temperature can differ in more than 7 degrees Celsius in different city parts – current forecasts (7x7 and 4x4 km) cannot provide good results;

Better weather forecast -> better AQ forecast results;

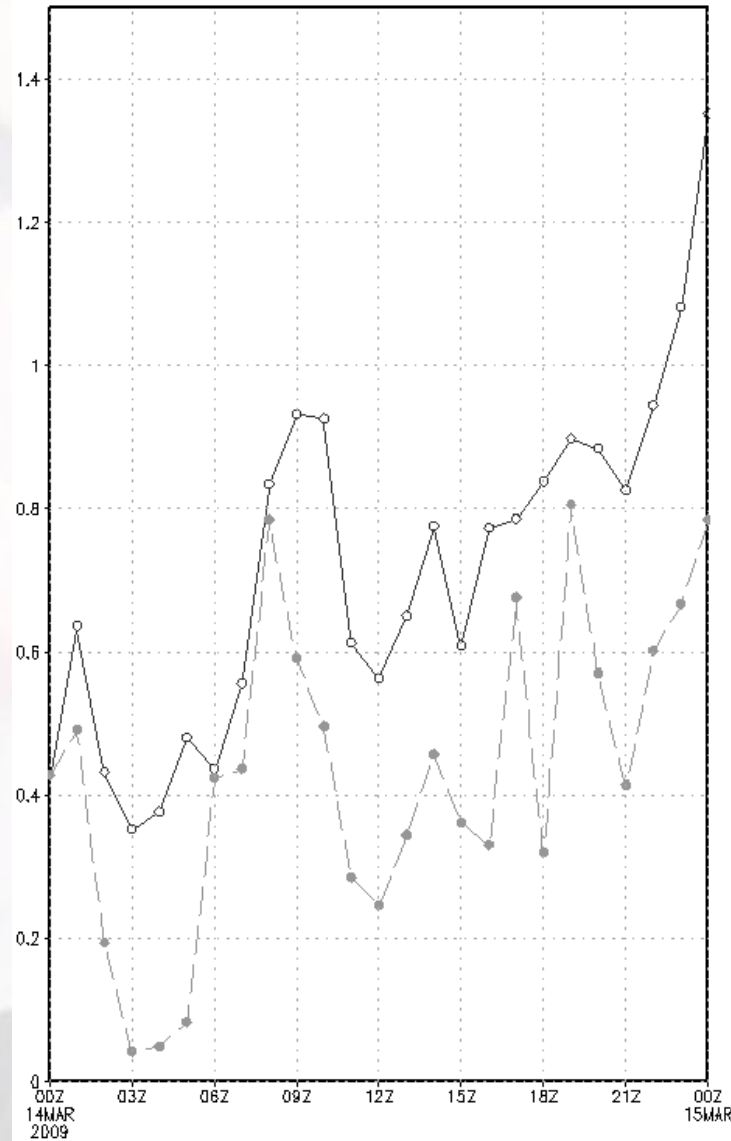
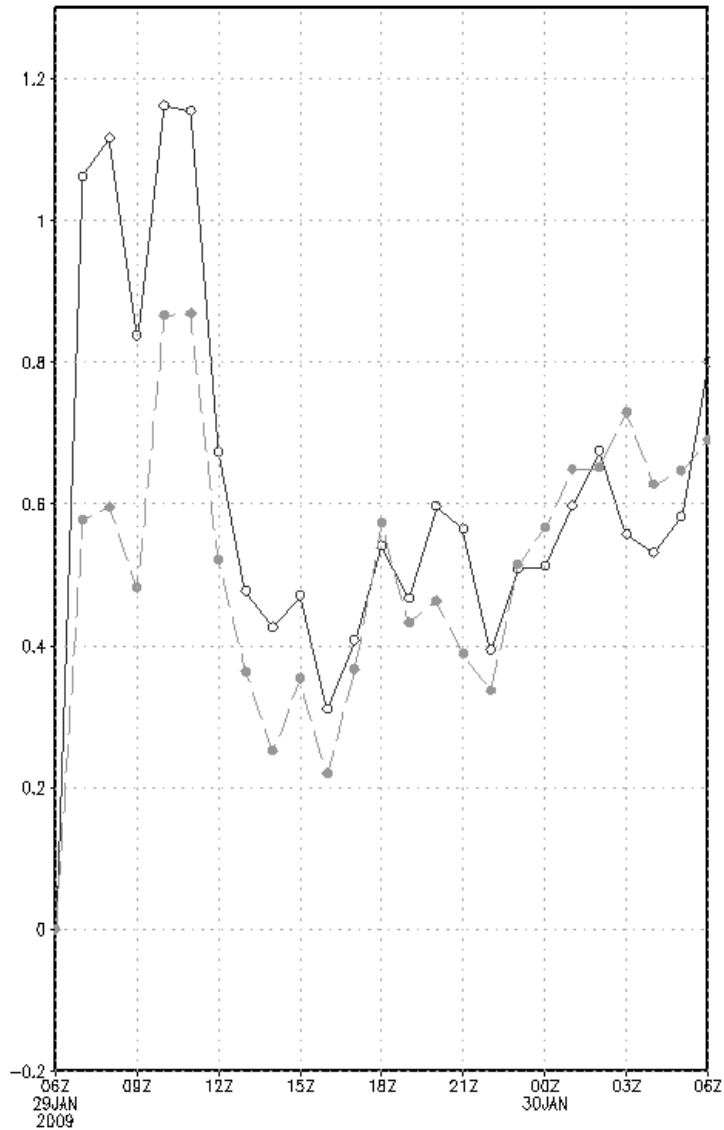


Experimental changes made

Two domains were tested with resolution of 1.4x1.4 km (LT1) and 2x2km (LT3);
All runs had modifications of roughness (2m) and albedo (0.15);
Anthropogenic heat flux was different for different runs: 100 and 200 W/sq.m



Experiment results (2m temperature)

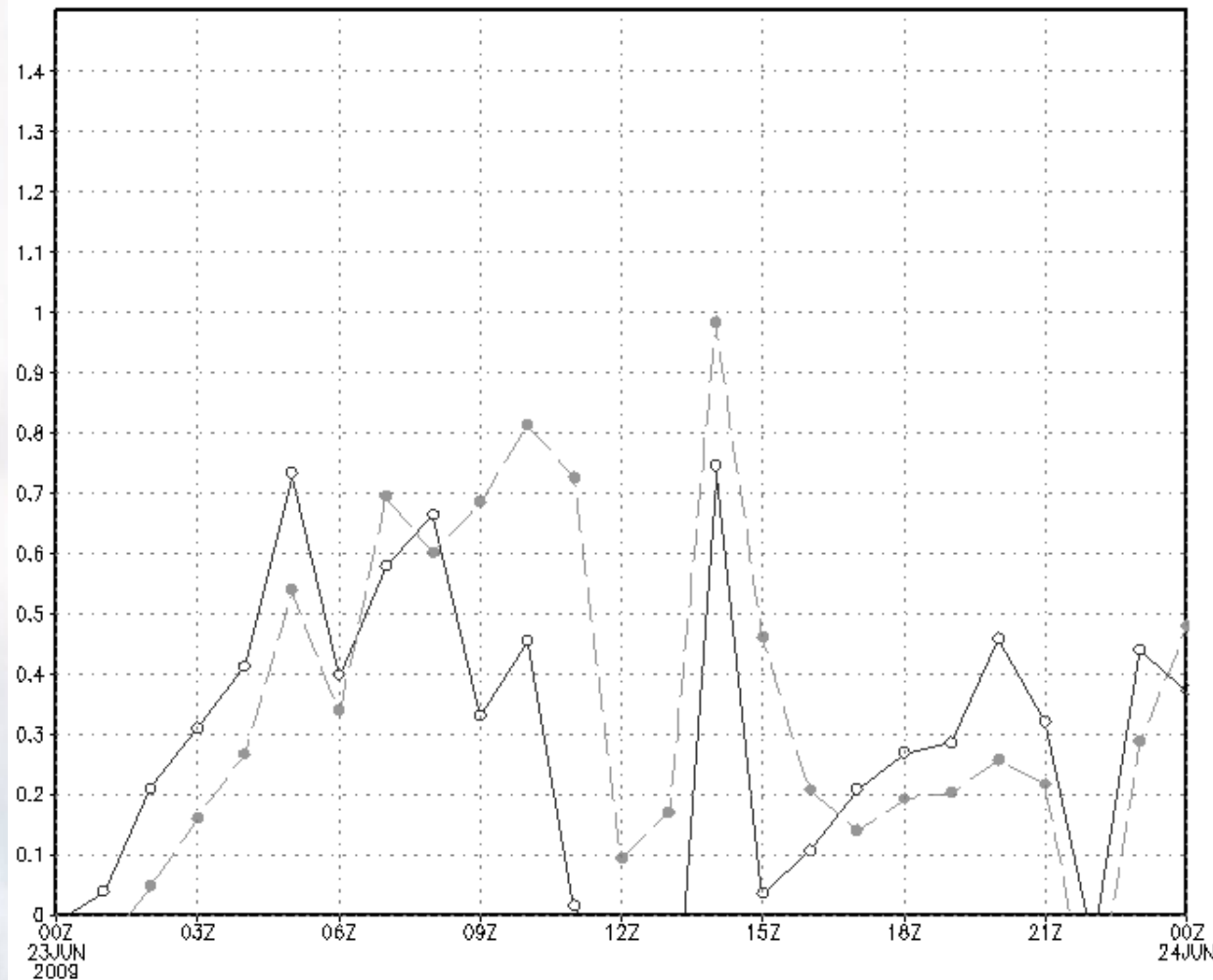


(vertical axis, °C) between control and modified runs.

LEFT: Solid line - LT10129II run and dashed line - LT10129I run.

RIGHT: Solid line - LT30314II run and dashed line - LT30314I run.

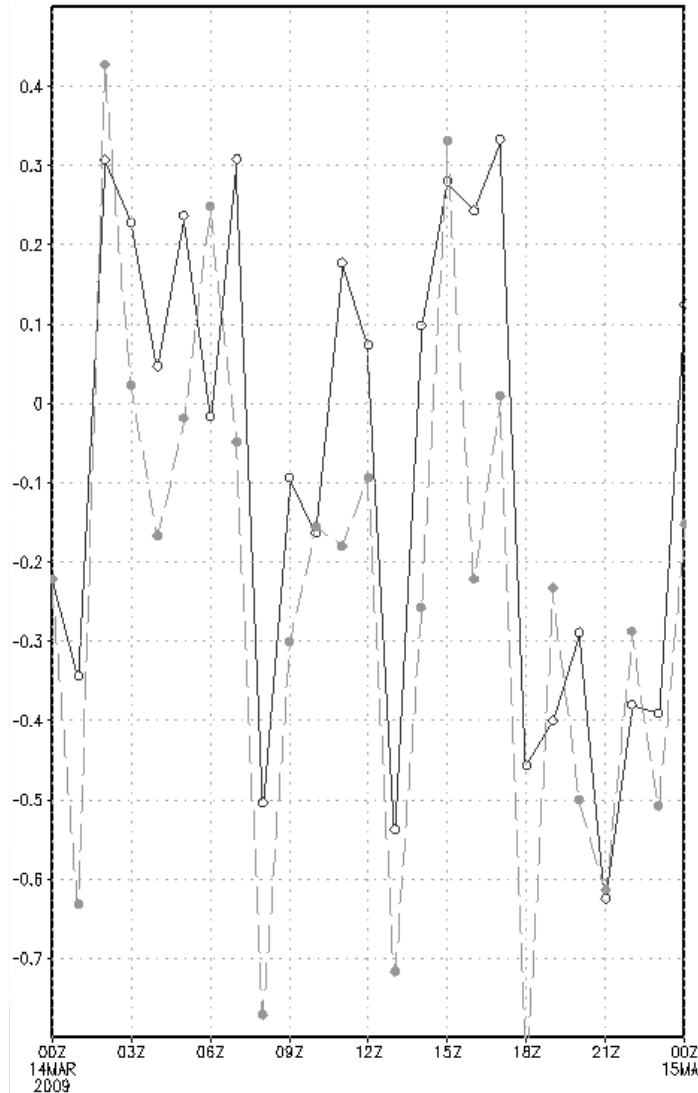
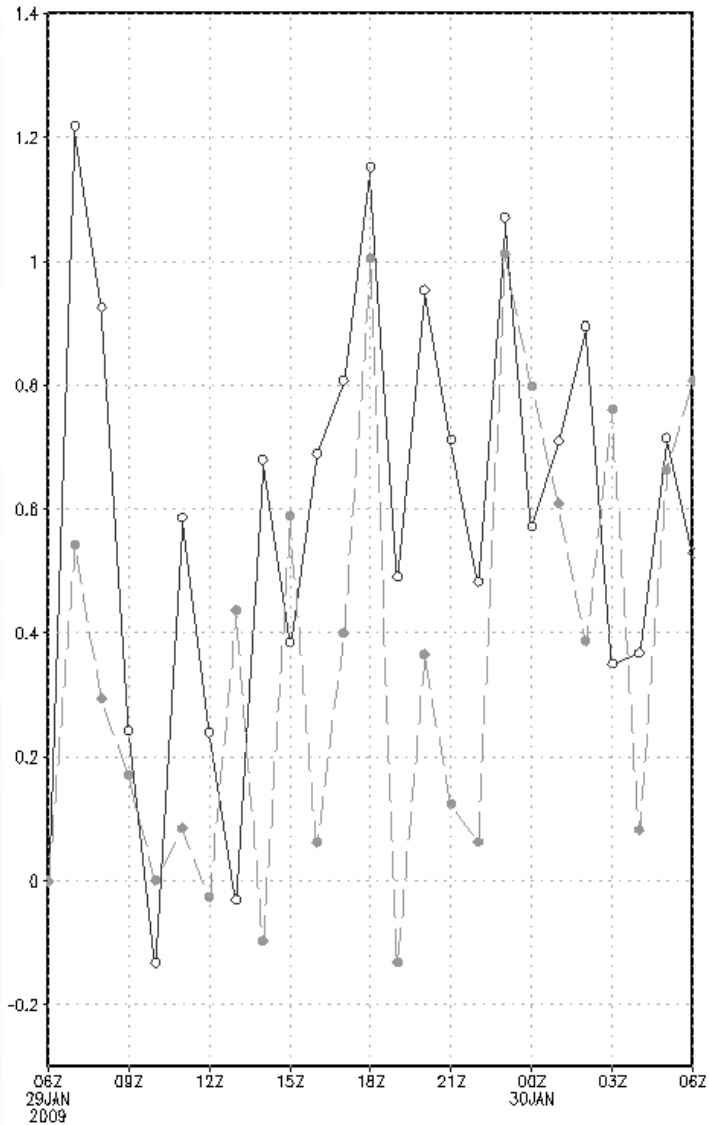
Experiment results (2m temperature)



(vertical axis, °C) between control and modified runs.

Solid line – LT30623II run and dashed line - LT30623I run.

Experiment results (10m wind speed)

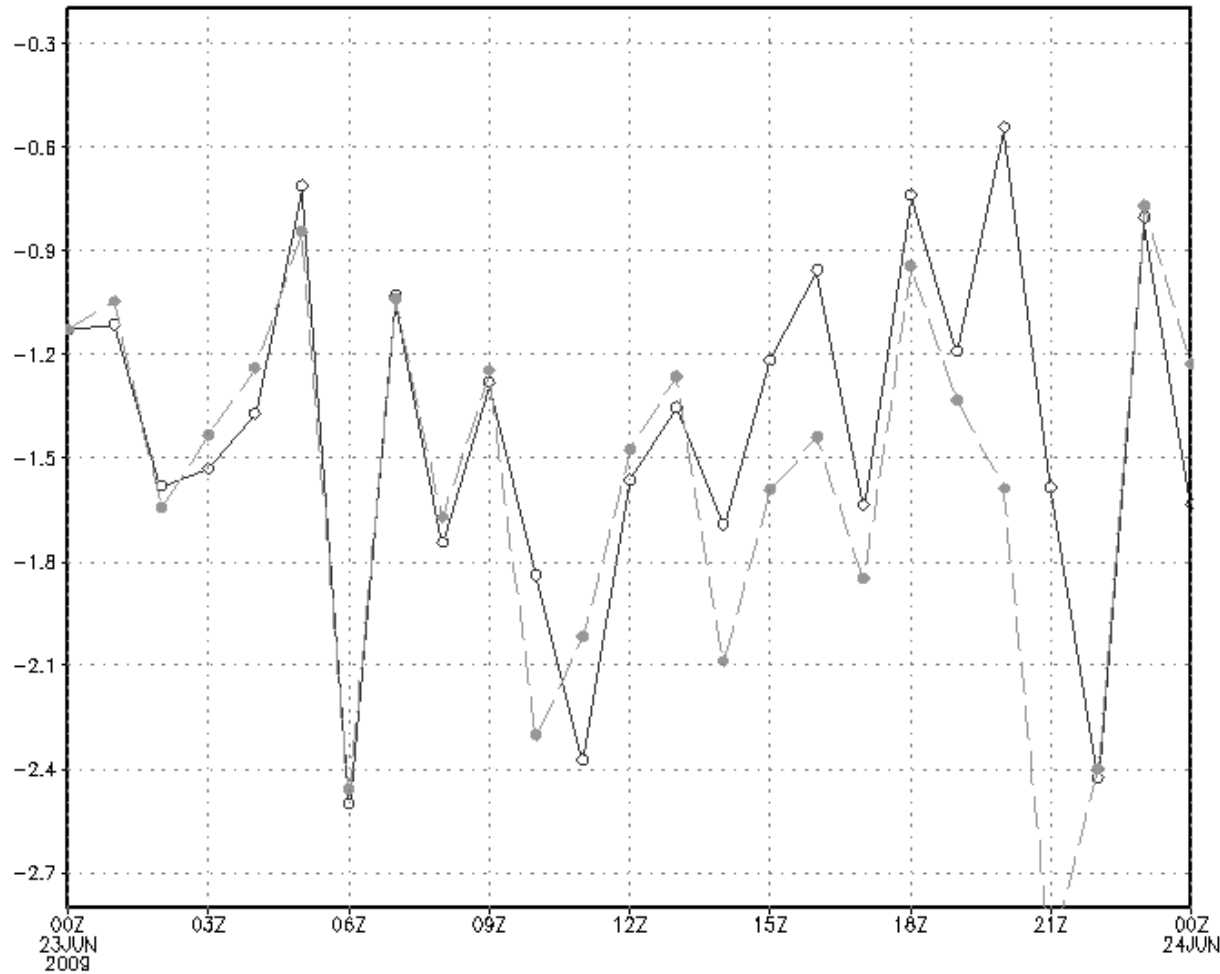


(vertical axis, m/s) between control and modified runs.

LEFT: Solid line - LT10129II run and dashed line - LT10129I run.

RIGHT: Solid line - LT30623II run and dashed line - LT30623I run.

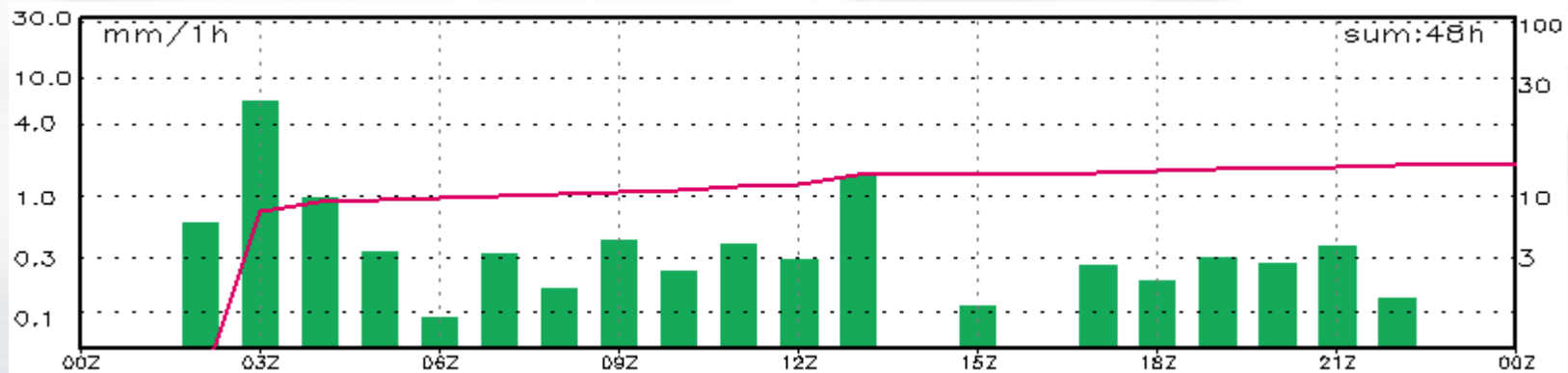
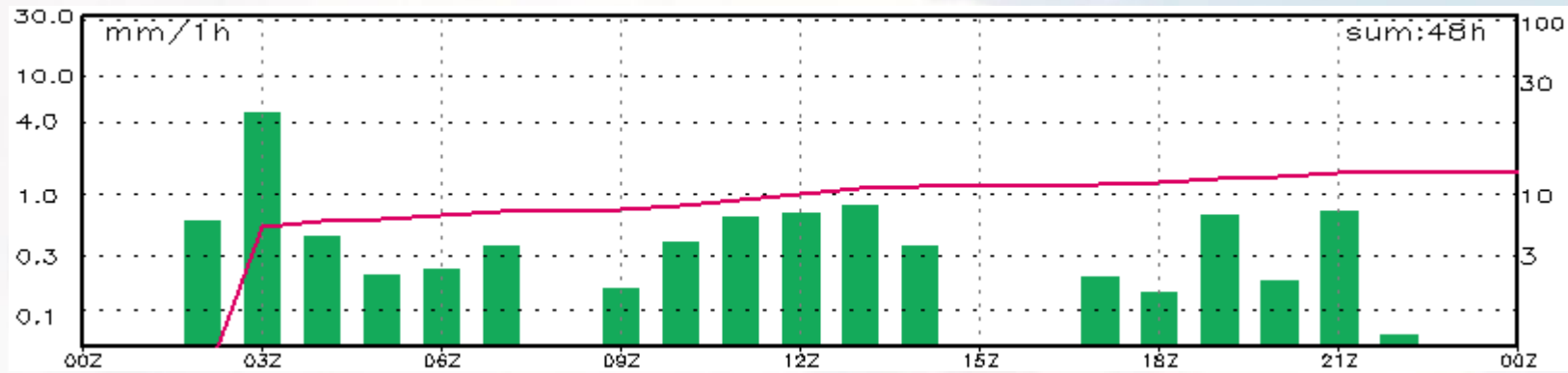
Experiment results (10m wind speed)



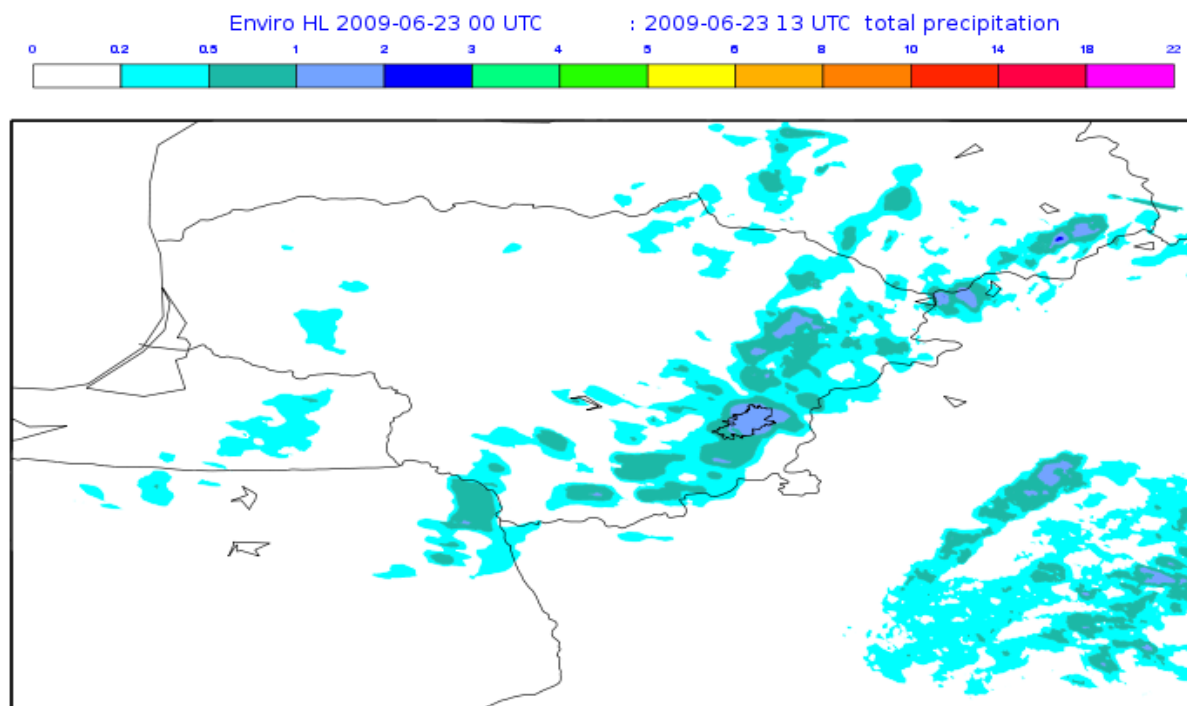
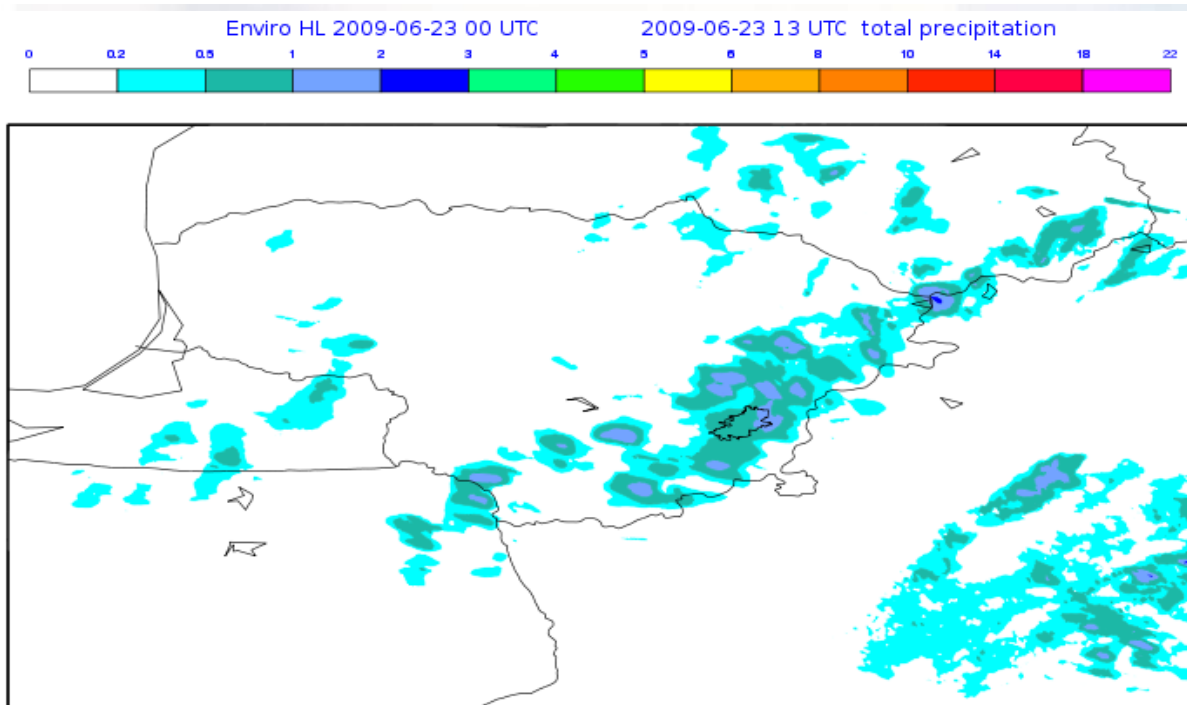
(vertical axis, m/s) between control and modified runs.

Solid line – LT30314II run and dashed line - LT30314I run.

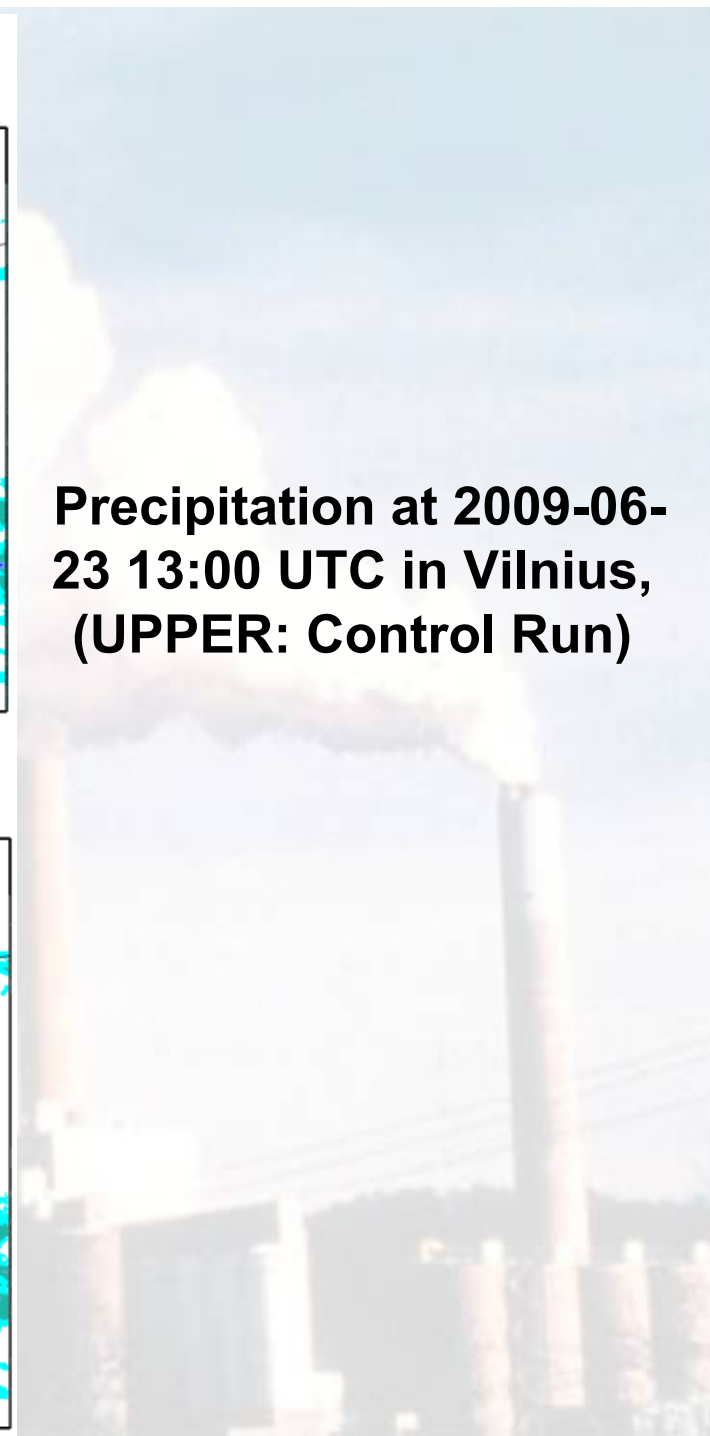
Experiment results (precipitation)



Precipitation at 2009-06-23 in Vilnius, (UPPER: Control Run)



Precipitation at 2009-06-23 13:00 UTC in Vilnius, (UPPER: Control Run)



Conclusions

The modifications of the surface parameters in urban territories have impact the meteorological fields that affect air pollution dispersion. However, the impact in different cases is different.

The temperature at 2m height is typically higher in modified simulation runs.

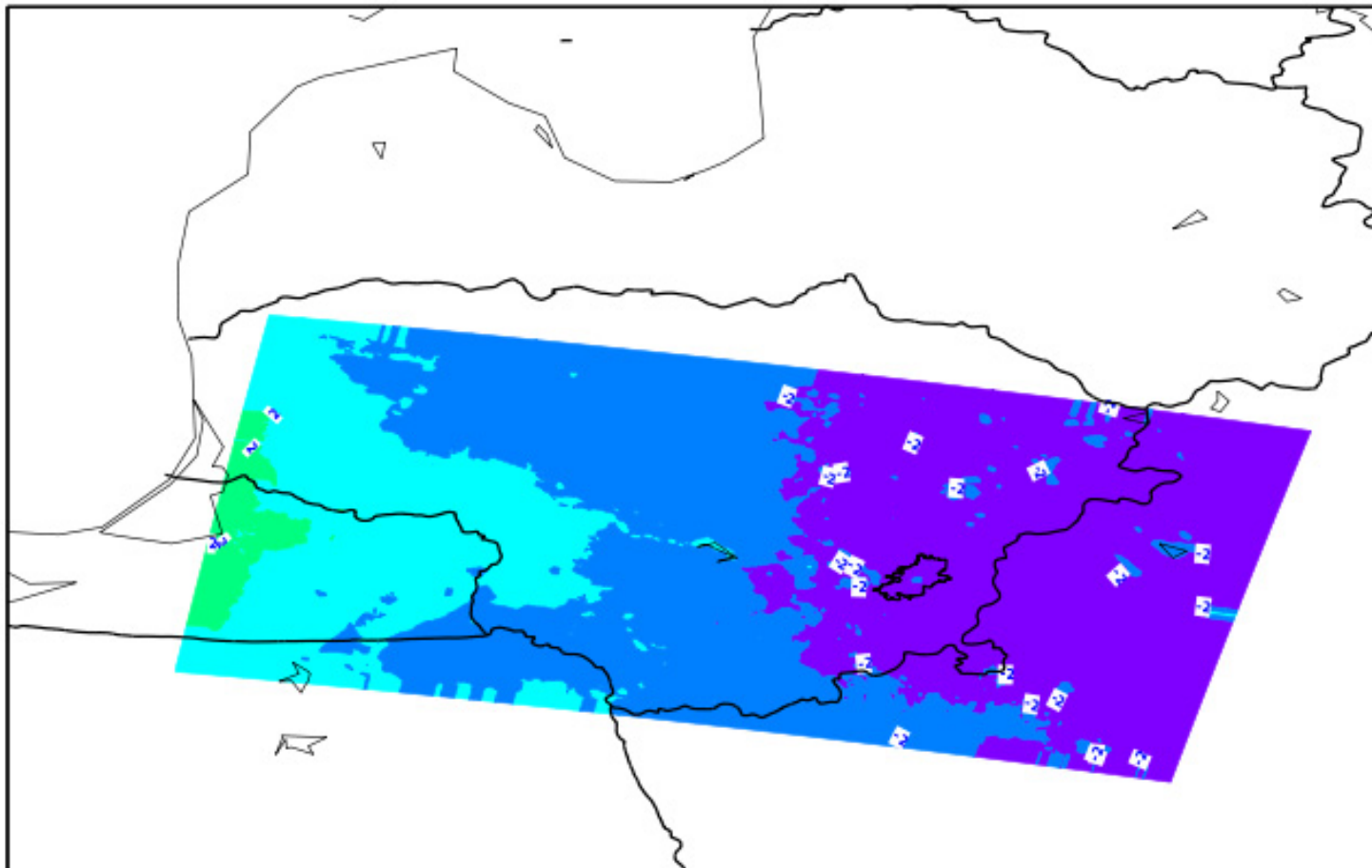
The wind conditions can be higher in some cases and in some cases significantly lower (up to 2.7 m/s).

The impact of urban territories in simulations is local (up to 2.8km and 30-40m height).

2m temperature, 2009-01-29

local definition = marsClass= marsStream= marsType=

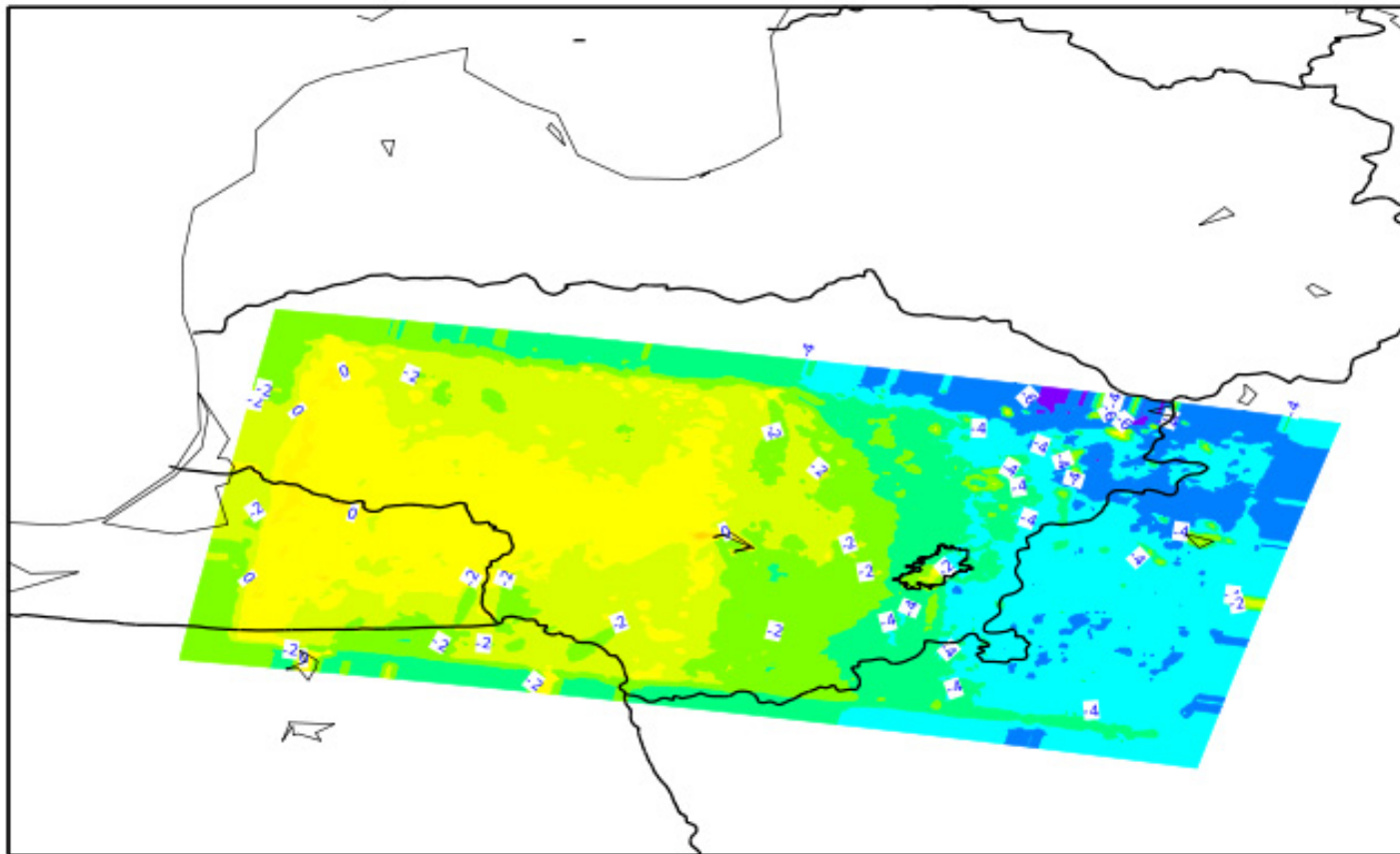
-10--8 -8--6 -6--4 -4--2 -2-0 0-2 2-4 4-6 6-8 8-10 10-12 12-14 14-16 16-18 18-20 20-22 22-24 24-26 26-28 28-30



2m temperature, 2009-01-29, 17:00 UTC

Enviro HL 2009-01-29 12 UTC Galioja : 2009-01-29 17 UTC 2 metre temperature

-10--5 -9--8 -8--7 -7--6 -6--5 -5--4 -4--3 -3--2 -2--1 -1-0 0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10



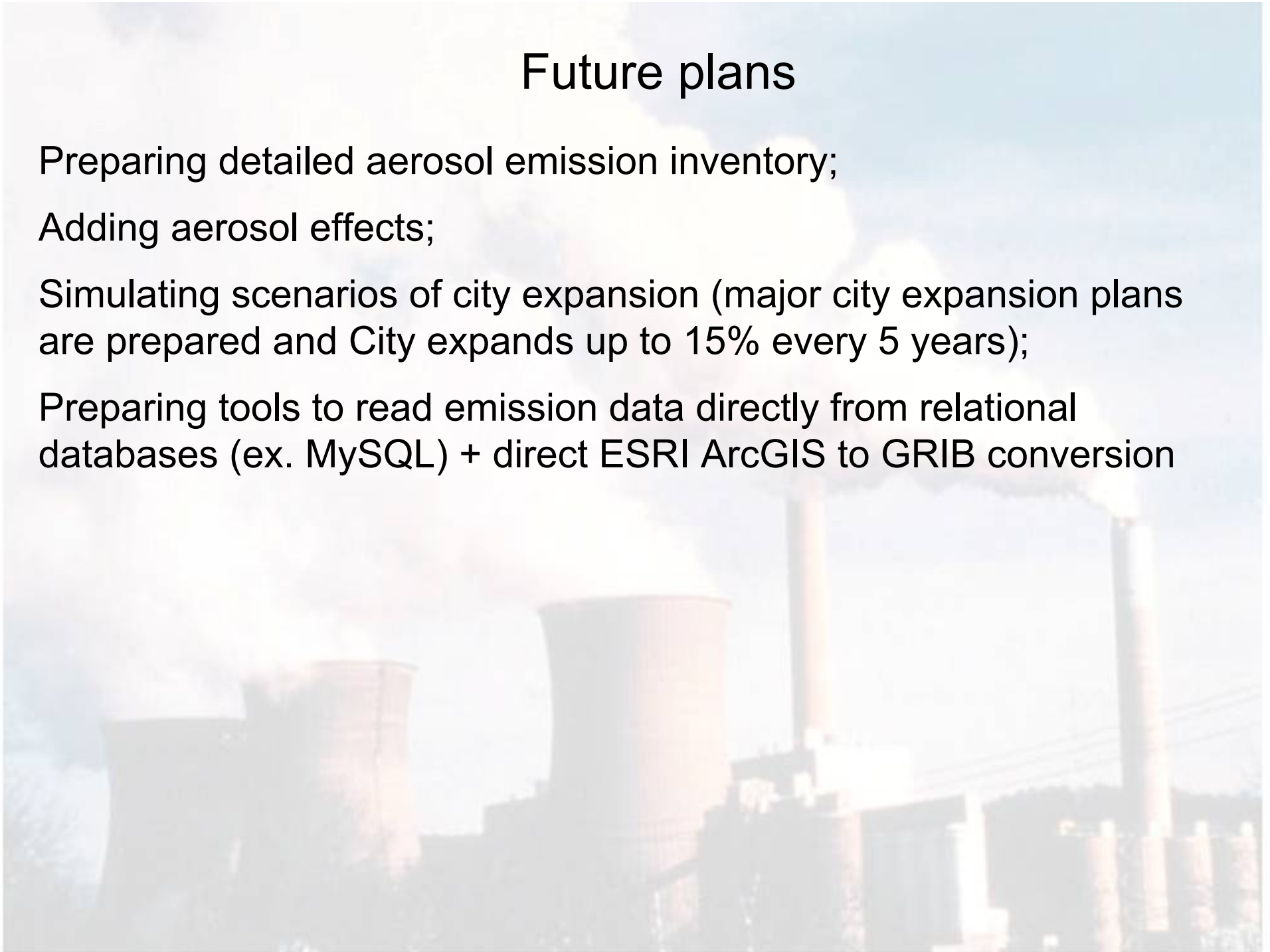
Future plans

Preparing detailed aerosol emission inventory;

Adding aerosol effects;

Simulating scenarios of city expansion (major city expansion plans are prepared and City expands up to 15% every 5 years);

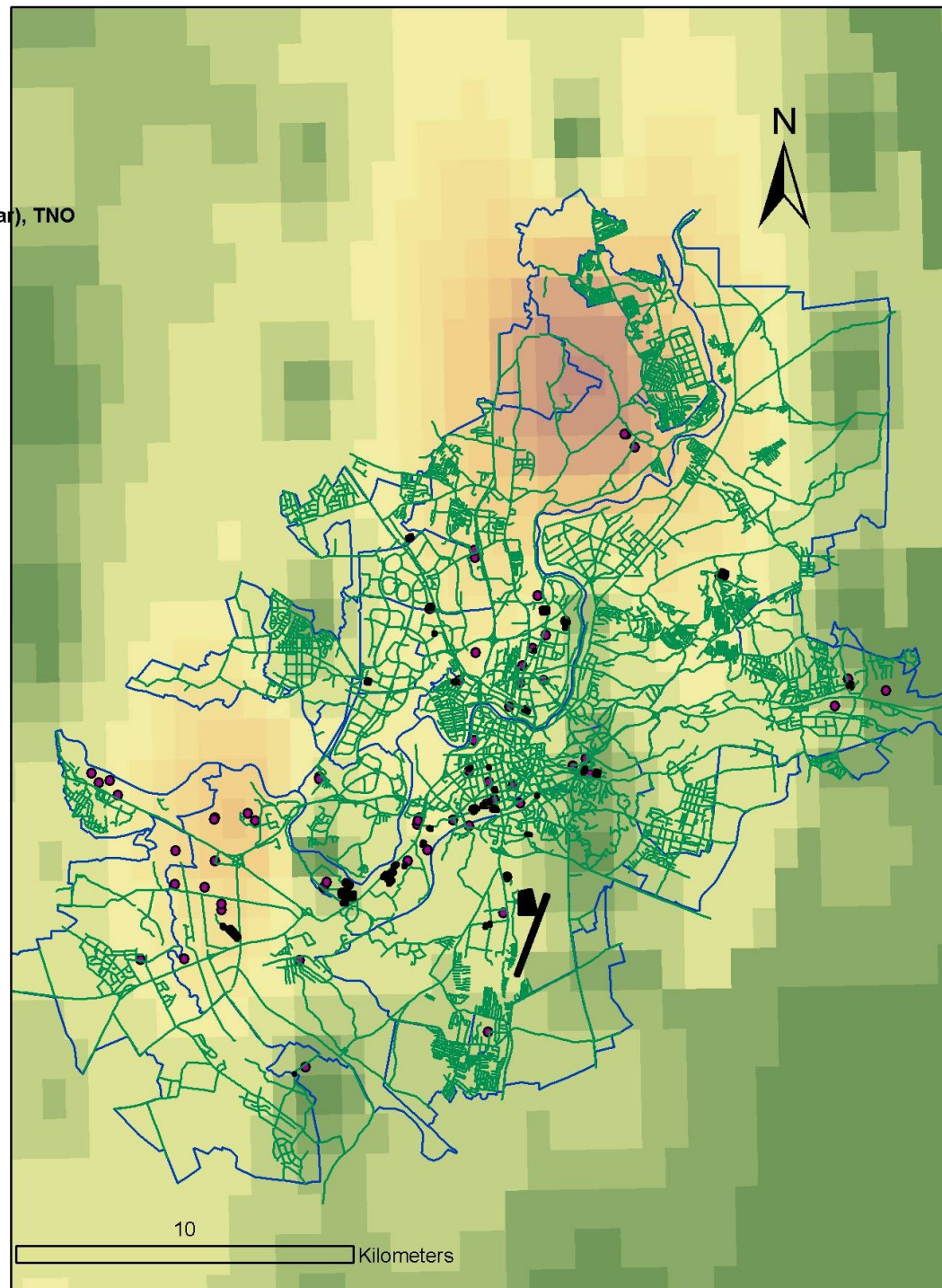
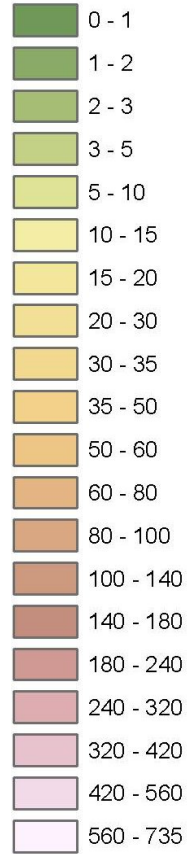
Preparing tools to read emission data directly from relational databases (ex. MySQL) + direct ESRI ArcGIS to GRIB conversion



Legend

- Area sources
- City streets
- Point sources
- Vilnius city

PM10 emission (t/year), TNO

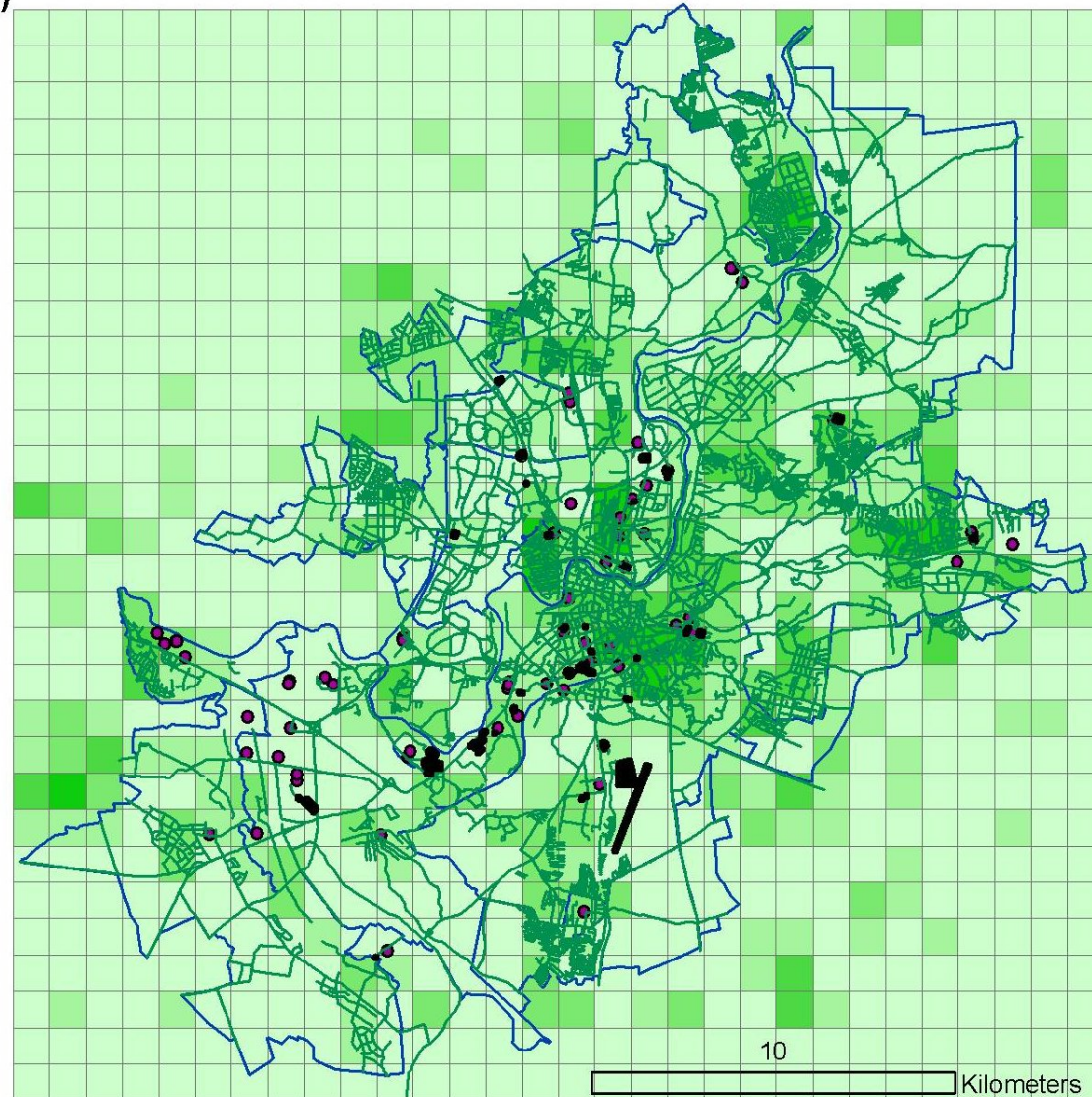


Legend

- Area sources
- City streets
- Point sources
- Vilnius city

Wood burnt (t/year)

- 0 - 250
- 250 - 720
- 720 - 1490
- 1490 - 2840
- 2840 - 6180





**Thank You for attention.
Questions?**