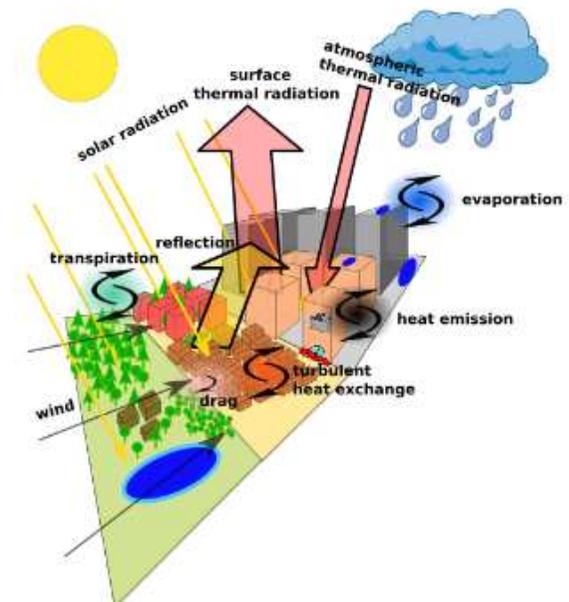# Evaluation of the urban parameterisation in COSMO-Model

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in collaboration with:
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J. P. Schulz and U. Schättler (DWD),
M. Varentsov (Roshydromet),
H. Wouters and M. Demuziere (UGhent),
J. M. Bettems (MeteoSwiss)

PROTEZIONE CIVILE
Presidenza del Consiglio dei Ministri
Dipartimento della Protezione Civile

2/10/2019 – EWGLAM and SRNWP meetings, Sofia 2019

- Bulk representation of the urban canopy
- Use of Anthropogenic heat emission (Flanner, 2009)
- Poor men's tile approach
- Application of the Semi-empirical Urban canopy parameterisation (SURY). It translates urban-canopy parameters (with 3D information) into bulk parameters
- Inclusion of the new bare-soil evaporation resistance formulation (Schulz and Vogel 2016) and the vegetation skin-temperature parameterisation (Schulz and Vogel 2017, Viterbo and Beljaars, 1995).

The simple bulk-model TERRA-URB parameterises the effects of buildings on the air flow without resolving the energy budgets of the buildings themselves, but using the externally calculated anthropogenic heat flux (Q_F). It accounts for country-specific data of energy consumption, based on the population density and the latitude dependent diurnal and seasonal distribution.

**Wouters et al., Geosci. Model Dev., 9, 3027-3054, 2016**

M. Milelli, COSMO Newsletter, 16, 3-12, 2016
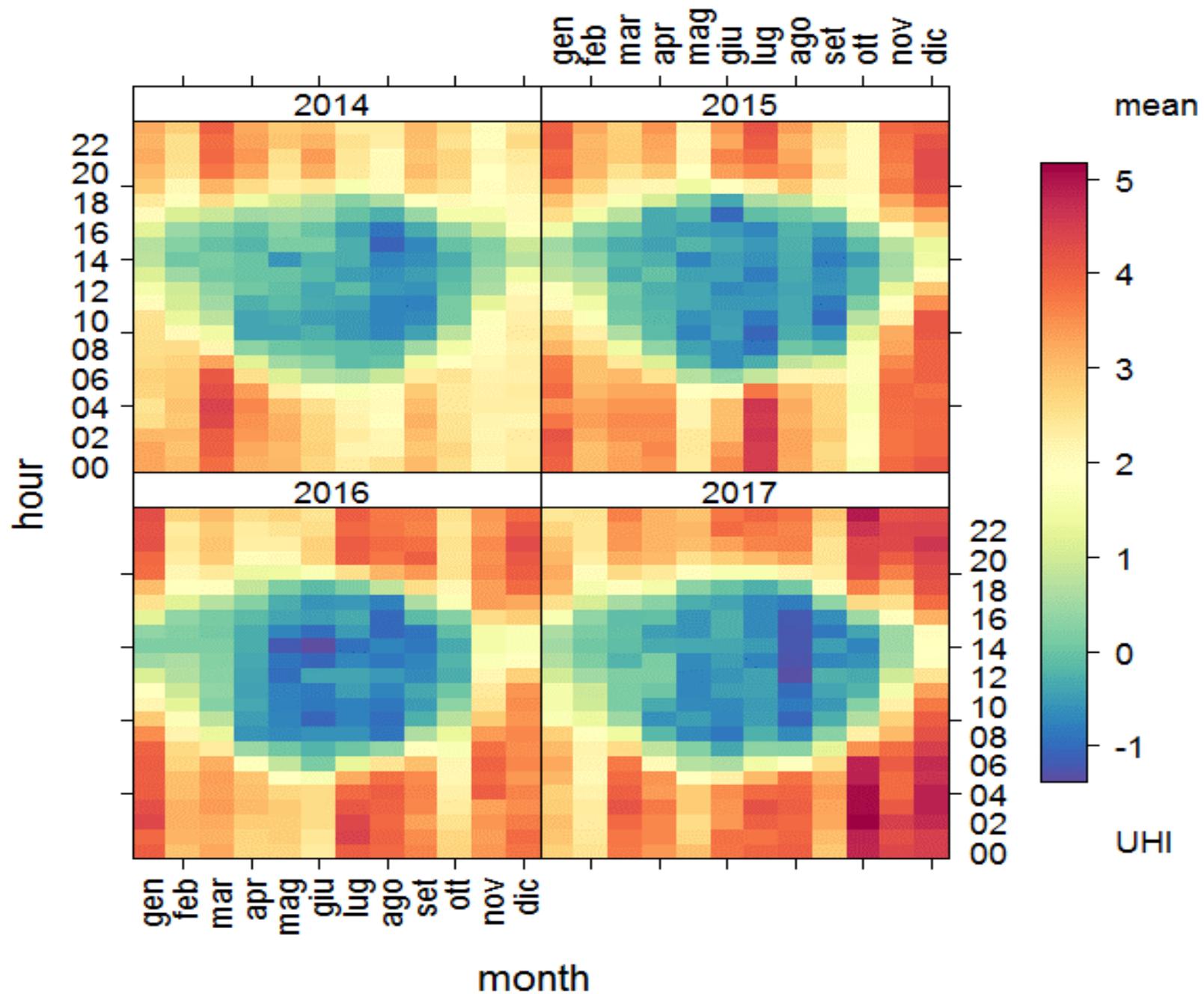
• COSMO run in analysis mode at 1 km resolution over a domain that includes Piemonte region

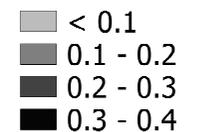• Boundary and initial conditions provided at 9 km resolution every 6 hours by IFS

• The goal is to test the urban parameterisation and the IFS skin temperature scheme (Viterbo and Beljaars 1995, Schulz and Vogel 2016)
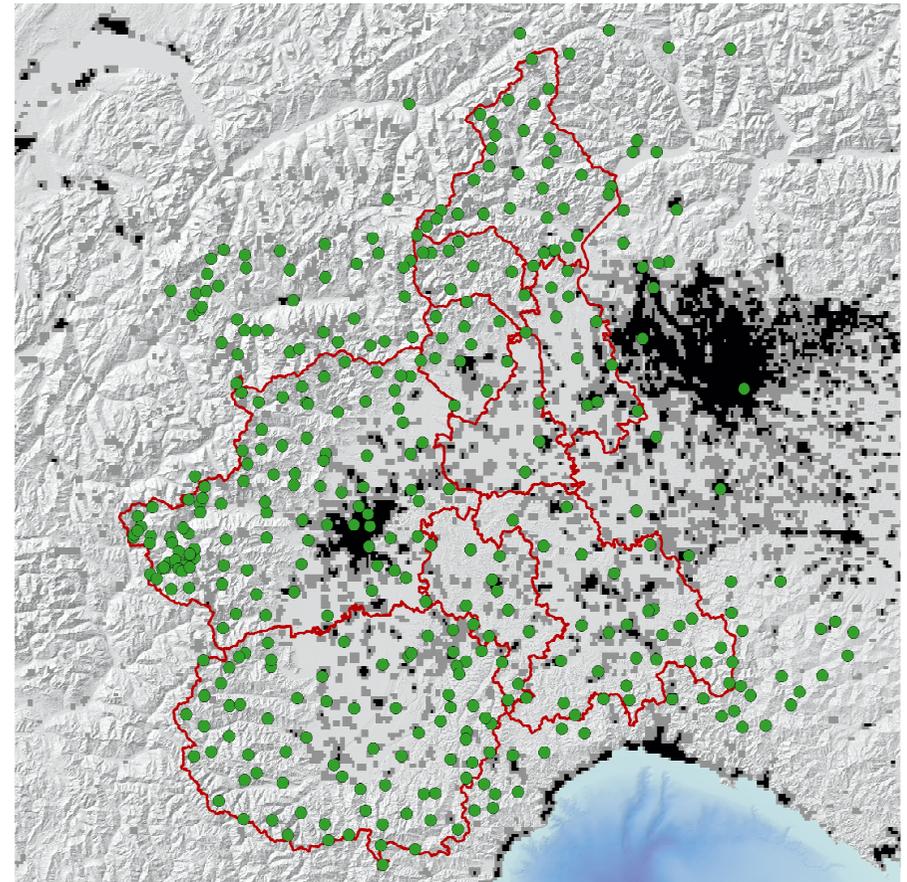

Orography (m)
- 0
- 1
- 150
- 300
- 500
- 750
- 1000
- 1250
- 1500
- 1750
- 2000
- 2500
- 3000
- 3500
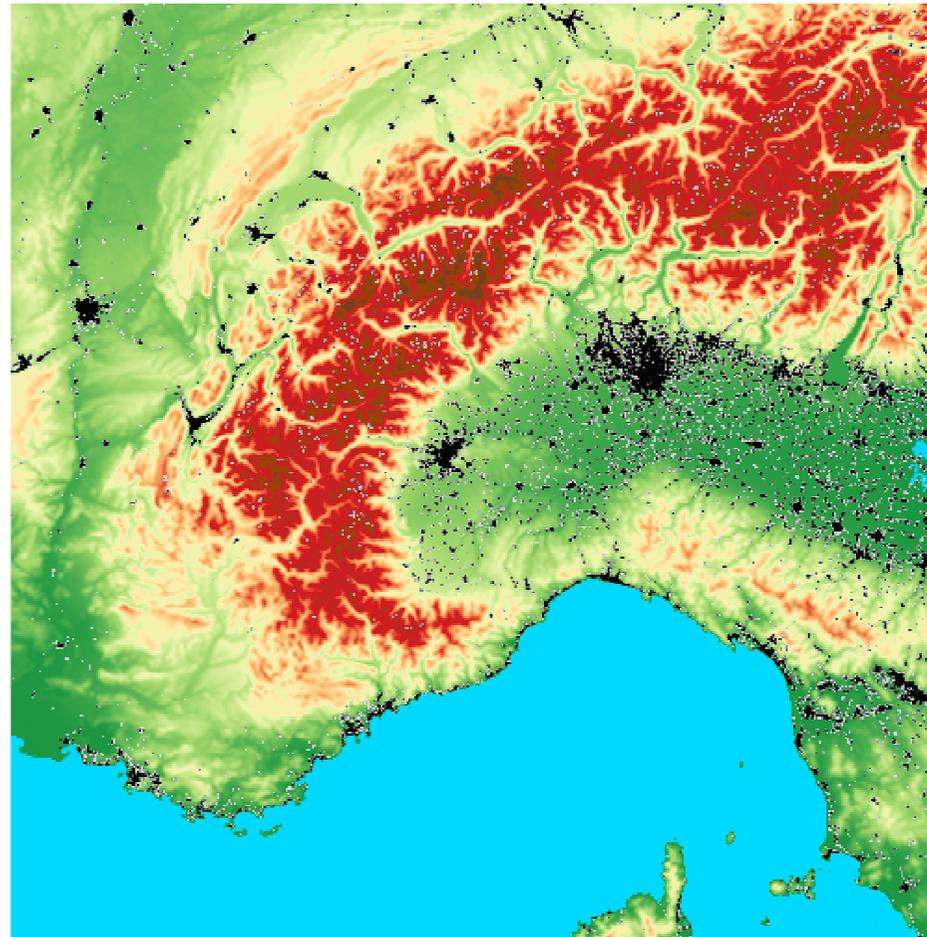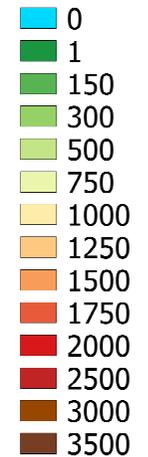
Urban fraction (%)
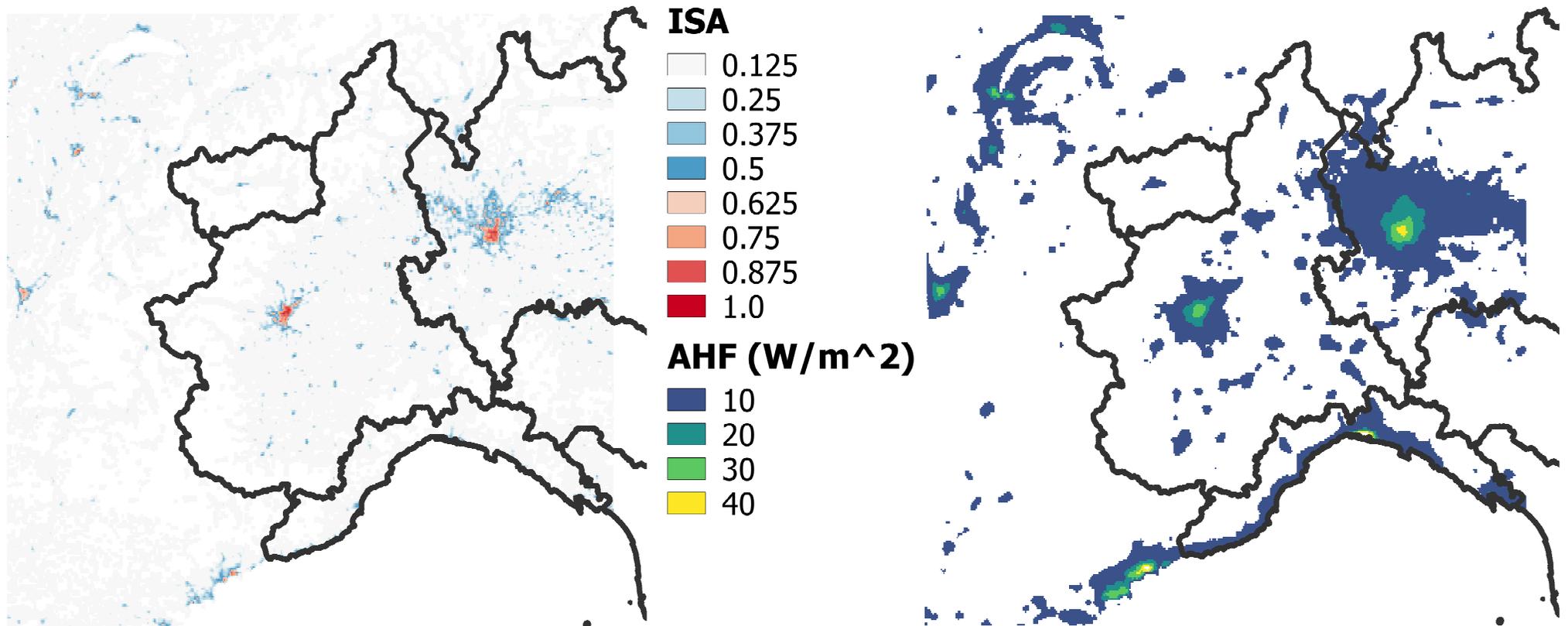- < 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4

4 different configurations have been tested on two test-cases - July 2015 and October 2017 - and evaluated using the Arpa Piemonte network (few urban stations, many non-urban stations)
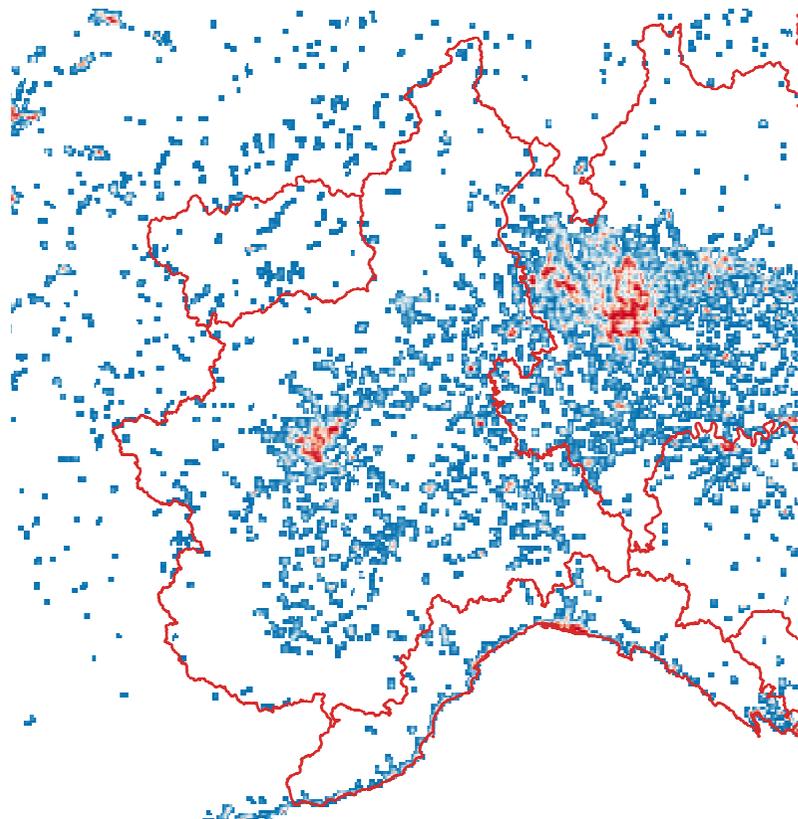
	Skin T scheme	
	OFF (CC1)	ON (CC2)
TERRA-URB scheme	ON (UC2)	OFF (UC2)

Urban canopy parameters provided by EXTPAR

ISA
- 0.125
- 0.25
- 0.375
- 0.5
- 0.625
- 0.75
- 0.875
- 1.0

AHF (W/m^2)
- 10
- 20
- 30
- 40

Urban canopy parameters provided by EXTPAR
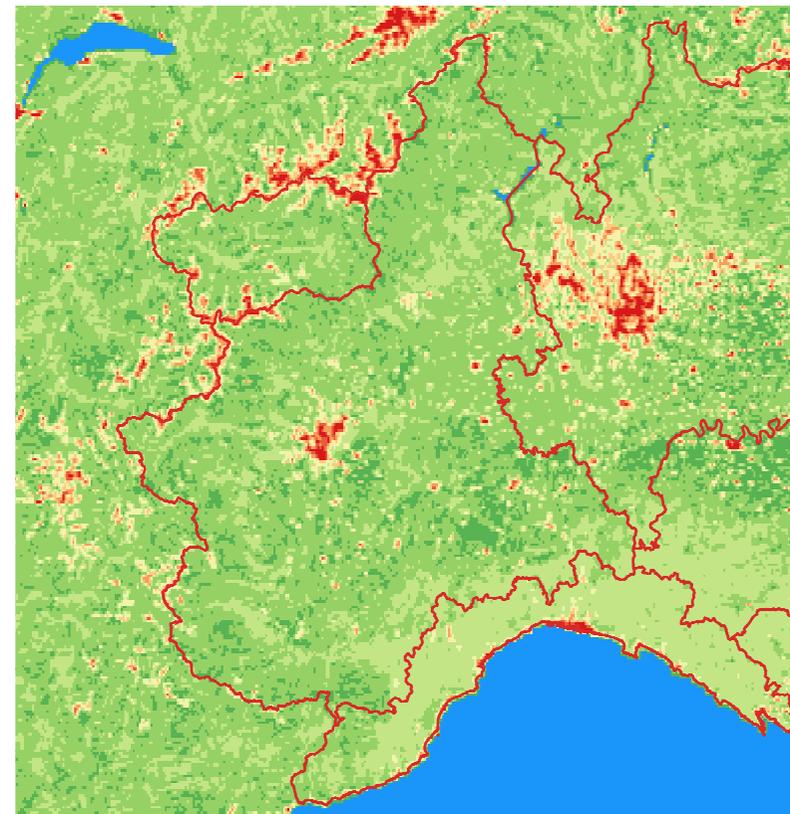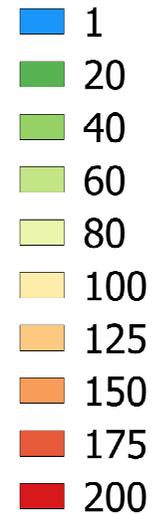
The different configurations have been
evaluated using <u>all the stations</u>

2m temperature in Turin
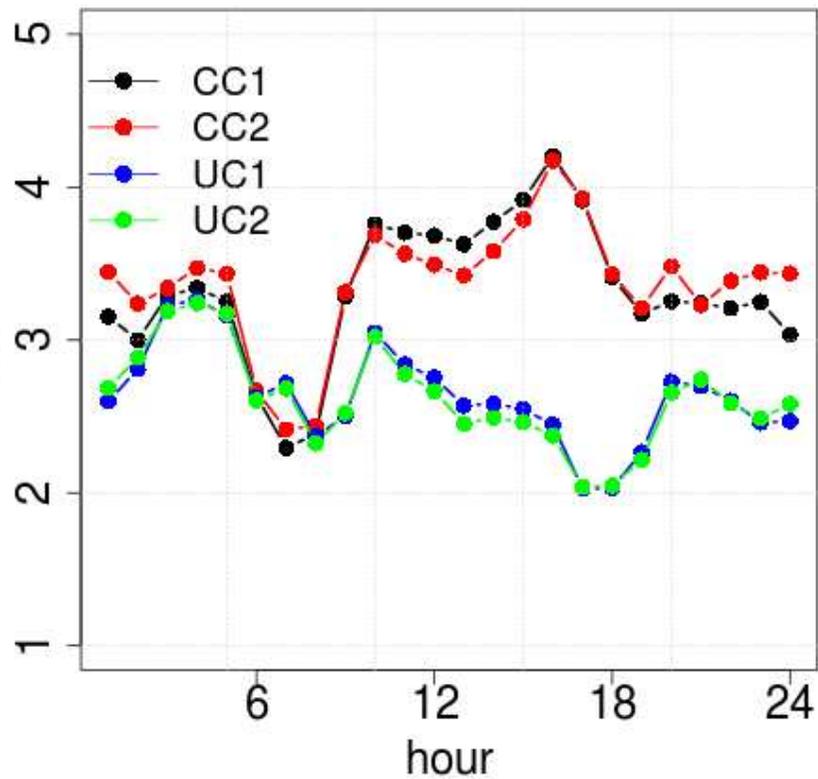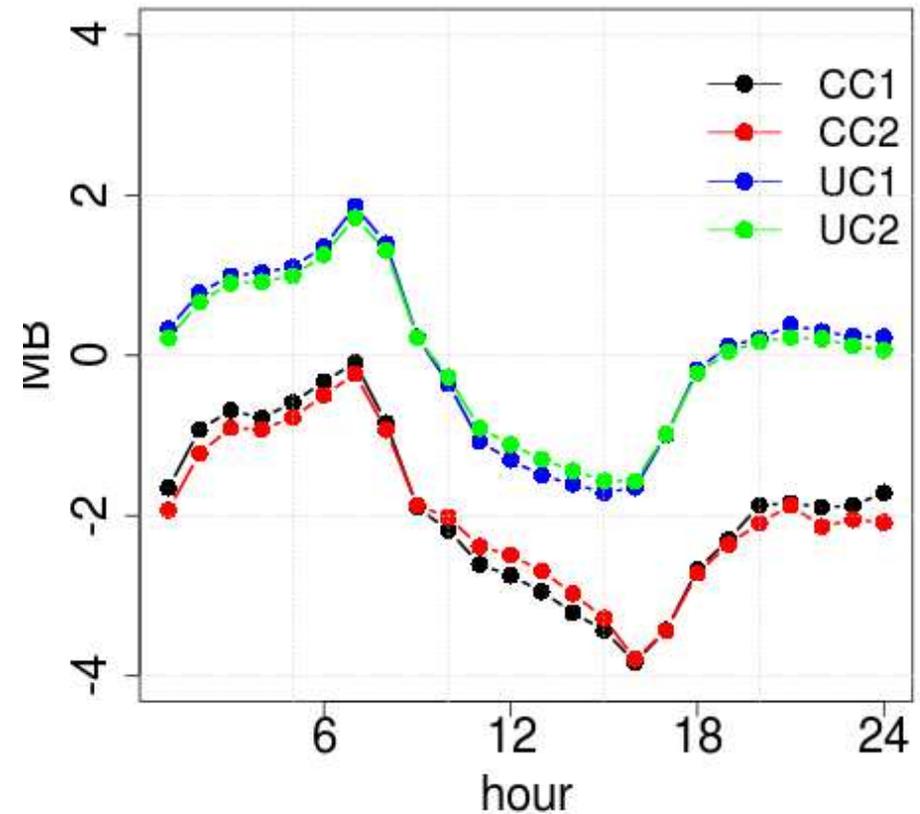
The different configurations have been evaluated using 4 urban stations in Turin
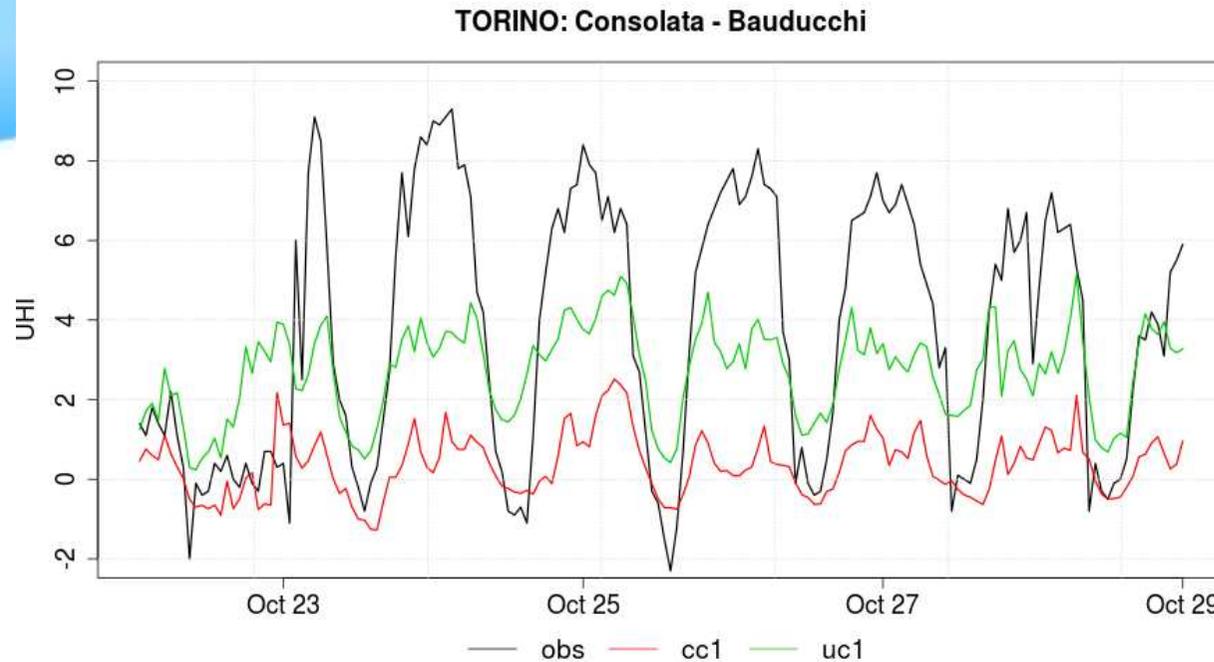

T (°C) - 2017/10/22-28

T (°C) - 2017/10/22-28

2m temperature in Turin

**Urban Heat Island index** (UHI) is measured as the temperature difference between urban area and its surroundings

URB configuration is able to represent the UHI effect, even if it overheats too much at night and too little during the day in urban area
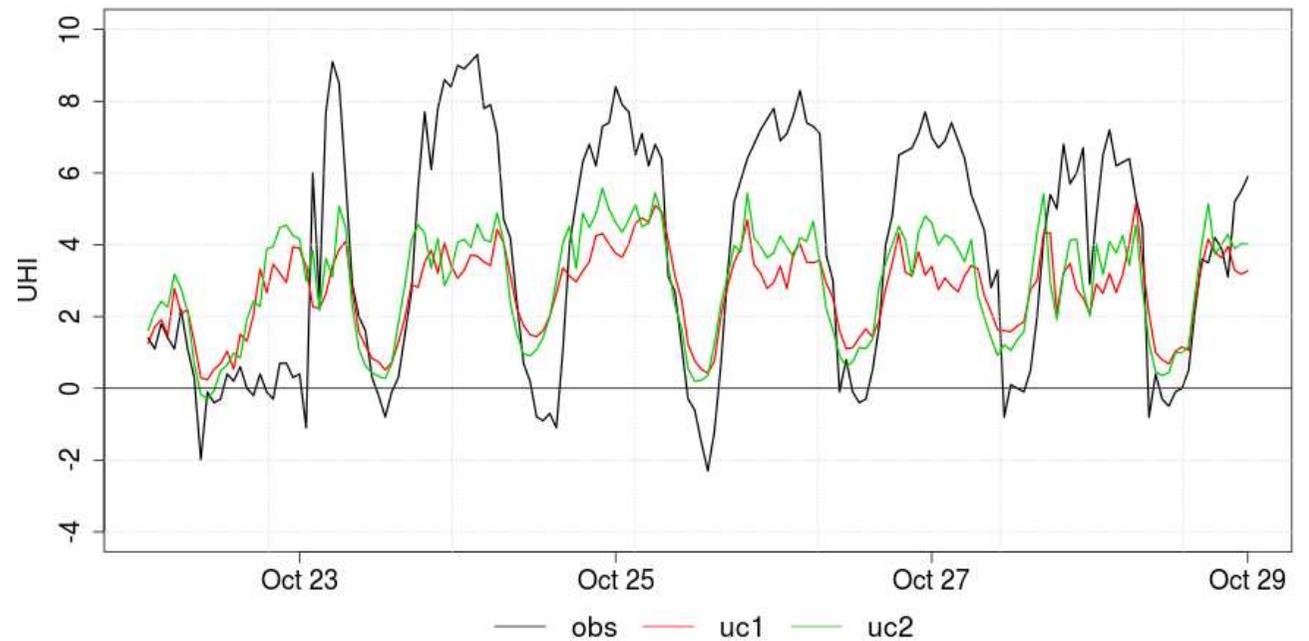

TORINO: Consolata - Bauducchi

obs   cc1   uc1

TORINO: Consolata - Bauducchi

obs   cc2   uc2
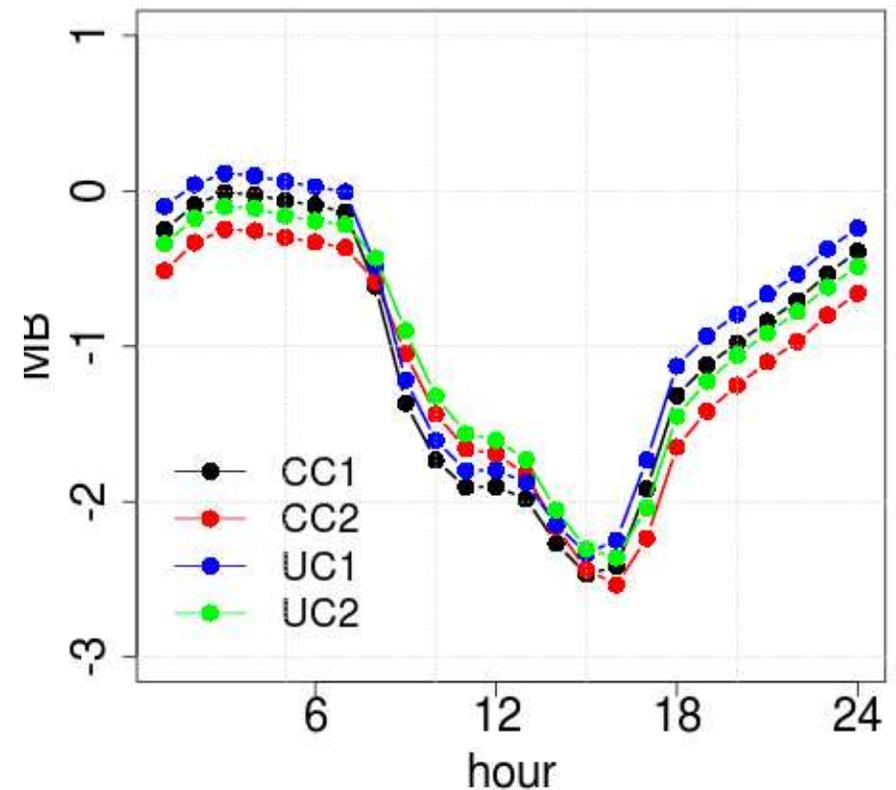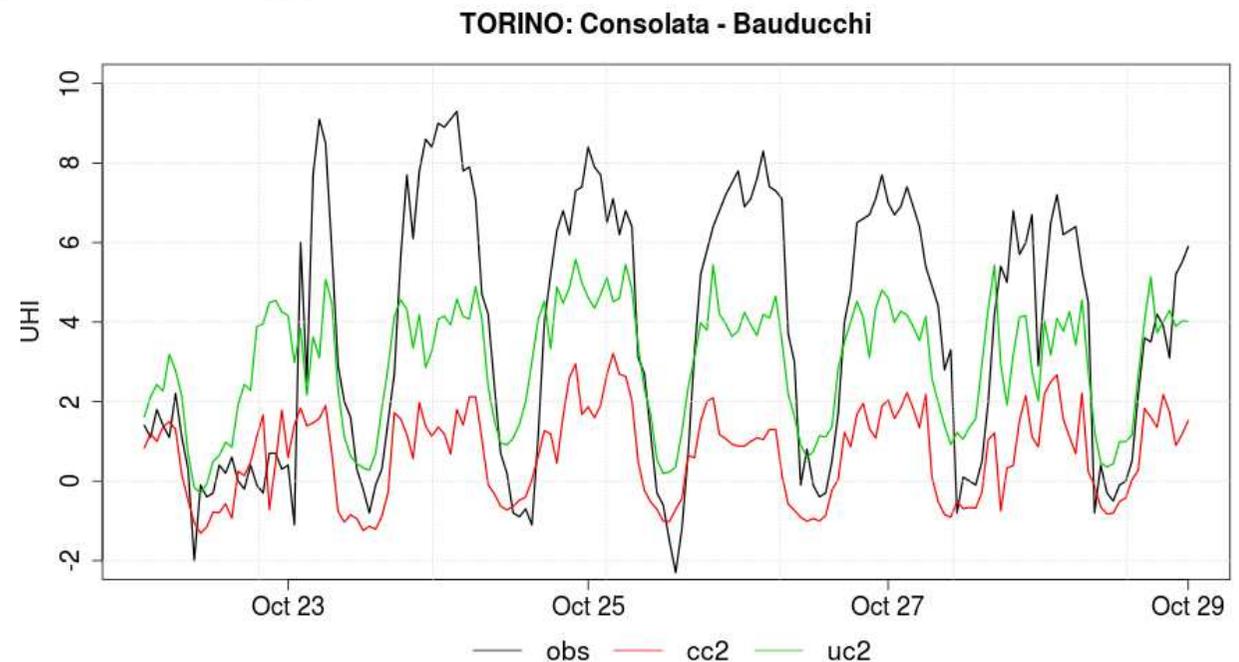
Results
2m temperature in Turin

TORINO: Consolata - Bauducchi

obs — cc1 — cc2

TORINO: Consolata - Bauducchi

obs — uc1 — uc2
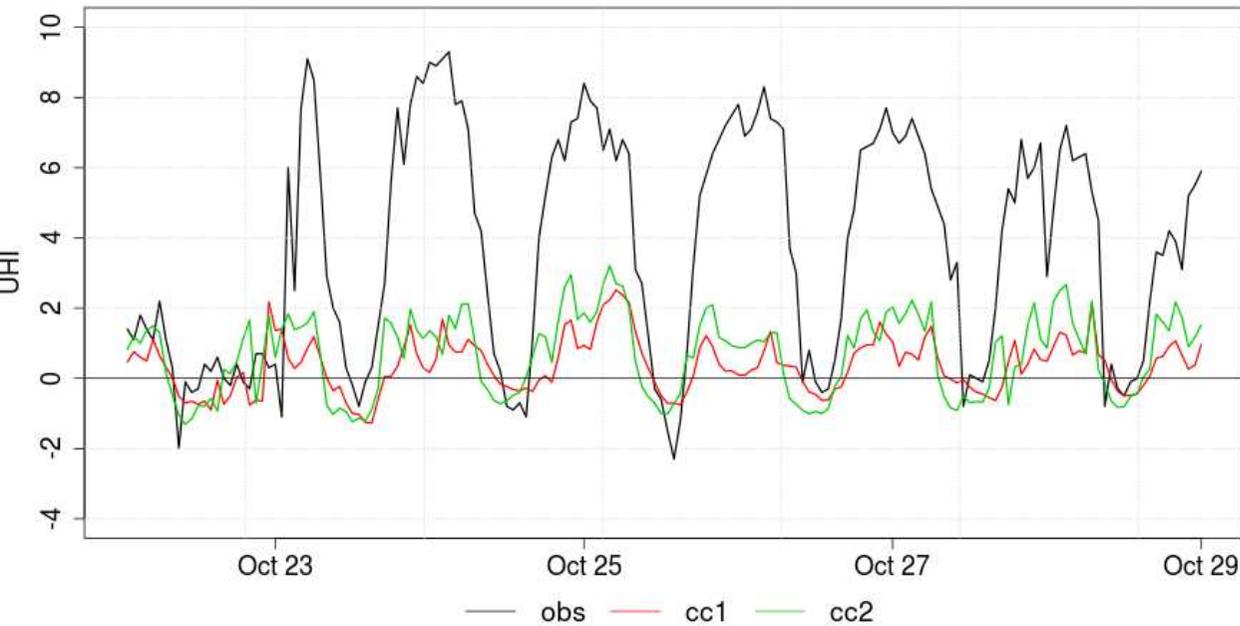
Future work

1) Calibration of the model by comparing not only simulated <u>2m air temperature</u> with the observations provided by meteorological stations but also:

- <u>surface temperature</u> with the Land Surface Temperature (LST) provided by the satellites

- vertical temperature profiles with the observations provided by 3 radiometers (1 in the city center, 1 in a suburban area, 1 in a rural area)

LST data are available:
- twice a day at 1 km resolution from MODIS or COPERNICUS and at 100 m resolution from LANSAT
- every 15 minutes at 3 km resolution from LSASAF EUMETSAT

2) More suitable and specific external parameters should be investigated and implemented

3) Porting to ICON

THANKS FOR YOUR ATTENTION