PT AEVUS – Analysis and Evaluation of TERRA-URB scheme

Simulations over a domain located in southern Italy

E. Bucchignani and P. Mercogliano

CIRA – Italian Aerospace Research Center

COSMO GM 2019
Rome, 10th September 2019
h 16:30 - 18:00

The domain considered

The domain is centered over Campania and Lazio regions in southern Italy. This area includes three airports, i.e. Capua (military airport “O. Salomone”), Naples (Capodichino civil airport), and Pratica di Mare (military airport “de Bernardi”).

Pratica di Mare

Naples

Urban area

CIRA - Grazzanise

rural area

Domain: **12.22° – 14.55°E; 40.63° - 41.88° N**

Rotated North Pole: **-166°; 41°**

Italian Aerospace Research Centre

Model version and set-up

- Model versions:

  - int2lm_181109_2.05a

  - cosmo_181030_5.05_urb4

- COSMO-LM resolution: **0.009° (about 1 km)**

- Computational domain**: 260 x 138 points; 60 vertical levels, time step 10 s.**

- Forcing data: ECMWF IFS (resolution of 0.075°)

- Test cases considered:
  - **8-10 August 2017**, since the city of Naples experienced extreme temperature values and uncomfortable conditions for the population;
  - **6-8 June 2019**, since an exceptional temperature increase in a short time was recorded in Naples: +**6°C** increase between 6 June (h 15) and 7 June (h 15).

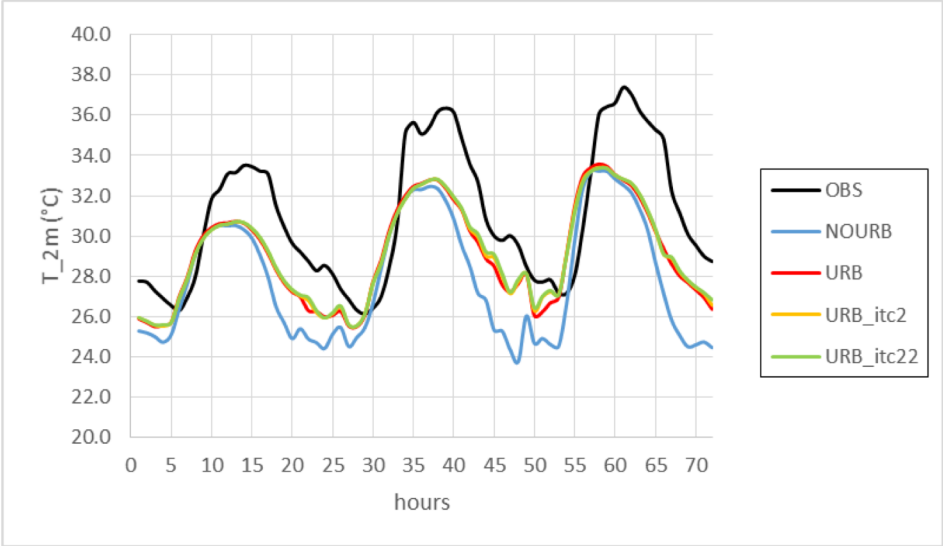
- Observational data: Hourly values provided by University of Naples (urban area) and daily values provided by Civil protection of Campania for a rural area.

Status of simulations

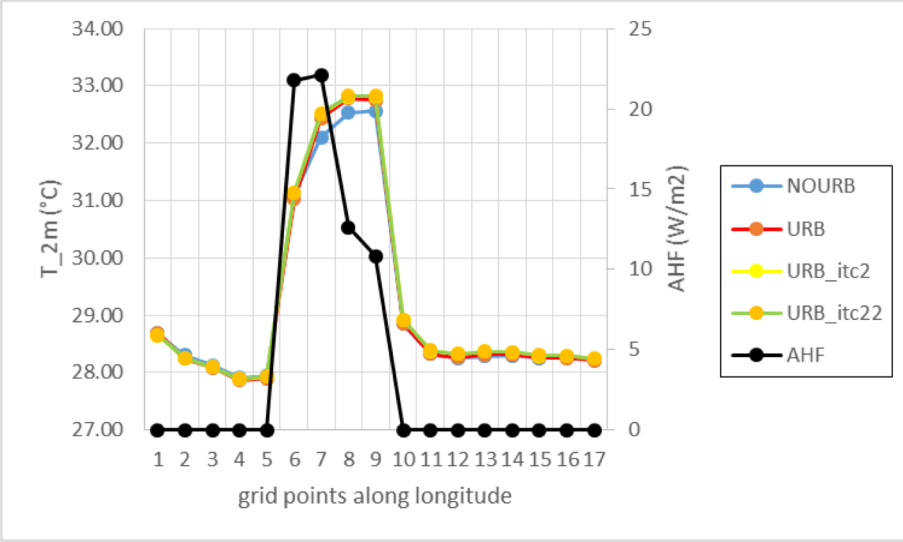
Date	Lterraurb	ntiles	Itype Canopy	cimpl	Status
08 -10 Aug 2017	False	0	1	20	OK
08 -10 Aug 2017	True	2	1	20	OK
08 -10 Aug 2017	True	2	2	120	OK
08 -10 Aug 2017	True	2	2	600	OK

Date	Lterraurb	ntiles	Itype Canopy	cimpl	Status
06 - 08 Jun 2019	False	0	1	20	OK
06 - 08 Jun 2019	True	2	1	20	OK

T_2m Naples (urban) for 8-10 Aug 2017



T_2m time series for the three days considered at Naples.

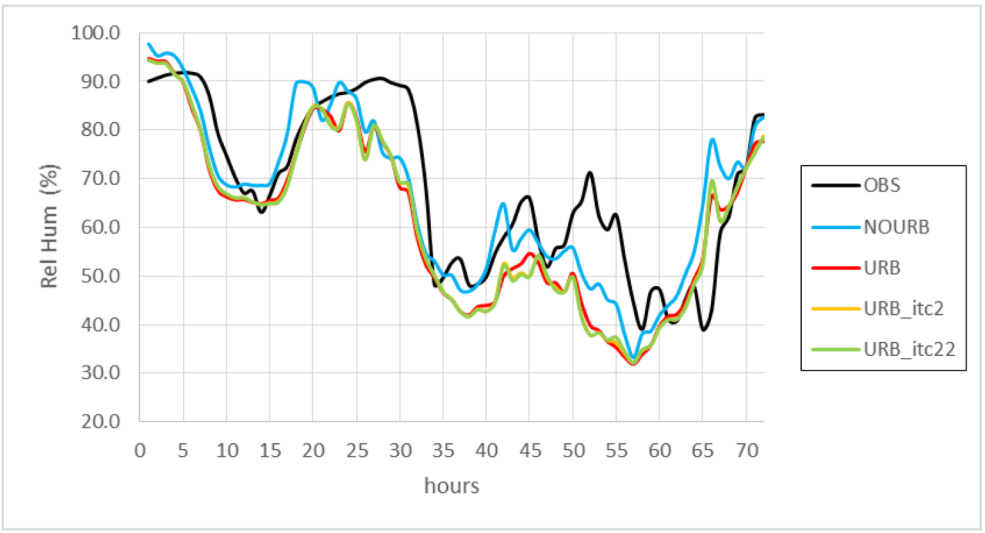


T_2m values as a function of longitude, in the neighborhood of the urban area of Naples, 10 Aug 2017. h 13:00. AHF: Anthropogenic Heat Flux

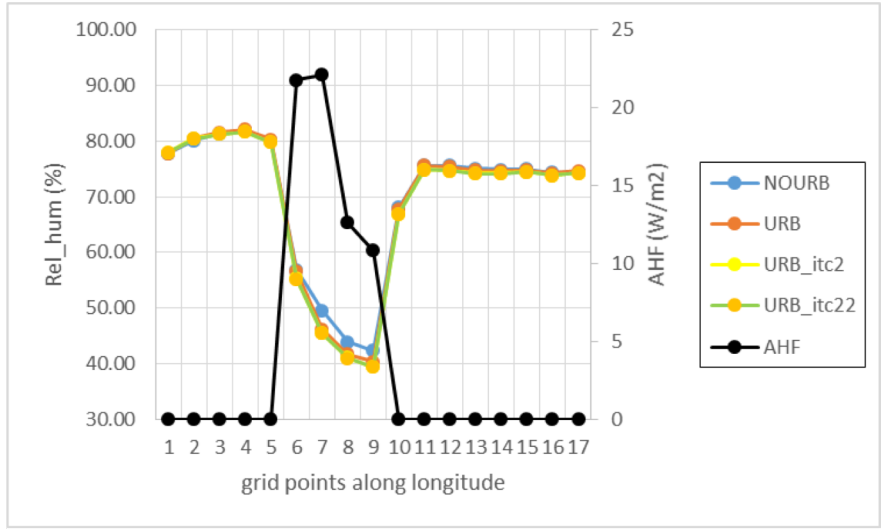
OBS: Observational values
NOURB: Terra_urb OFF
URB: Terra_urb ON, itype_canopy =1
URB_itc2: Terra_urb ON, itype_canopy =2, cimpl 120
URB_itc22: Terra_urb ON, itype_canopy =2, cimpl: 600

- Simulation with Terraurb ON generally provides higher values of temperature on validation point in urban area.
- In particular maximum daily value is increased of 0.7°C (on 9th) and 0.6°C (on 10th) while more evident differences are present on the minimum daily values (up to 2 °C).
- Usage of itype_canopy=2 (even with cimpl = 600) provides little modification.
- A general underestimation with respect to observational data is still evident.

Rel_hum at Naples (urban) 8-10 Aug 2017



Rel_hum_2m time series for the three days considered at Naples.

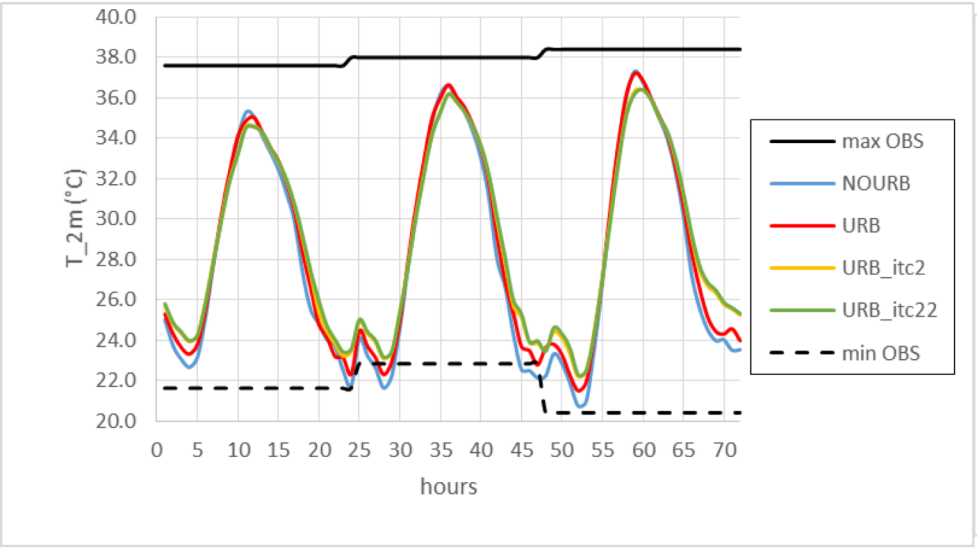


Rel_hum_2m values as a function of longitude, in the neighborhood of the urban area of Naples, 10 Aug 2017. h 13:00. AHF: Anthropogenic Heat Flux

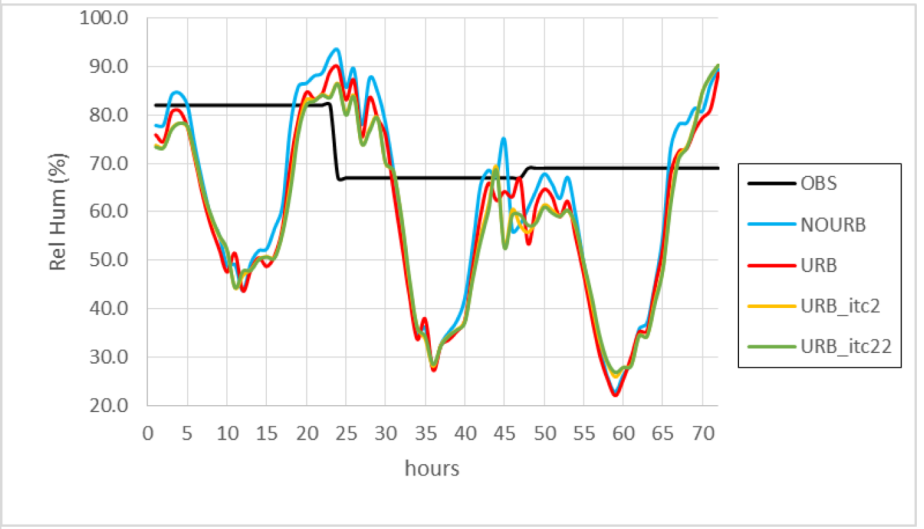
Simulation with Terraurb ON provides generally lower values of relative humidity.
General worsening of performances, with few exceptions.
No relevant differences between itype_canopy = 1 and 2

	OBS	NOURB	URB	URB_itc2	URB_itc22
Average value (%)	68.4	66.2	61.3	61.1	61.1

T_2m and Rel_hum2m at Grazzanise (rural), 8-10 Aug 2017



T_2m time series for the three days considered at Grazzanise.



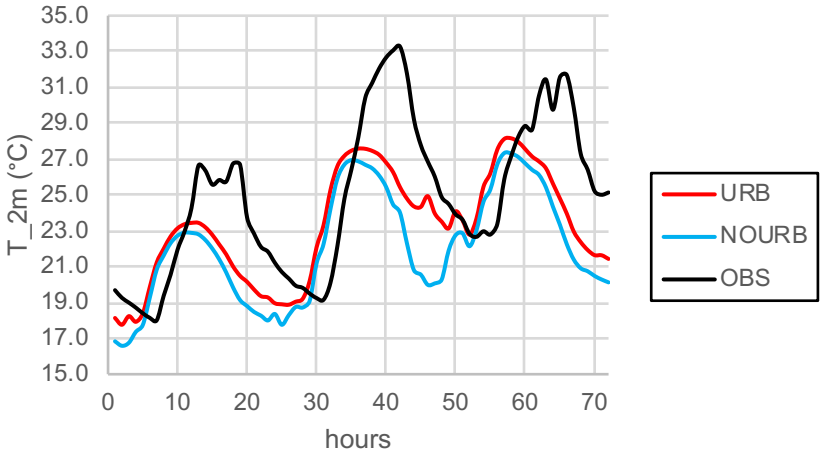
Rel_hum_2m time series for the three days considered at Grazzanise.

For this rural station, no hourly data are available, but only daily maximum and minimum values.

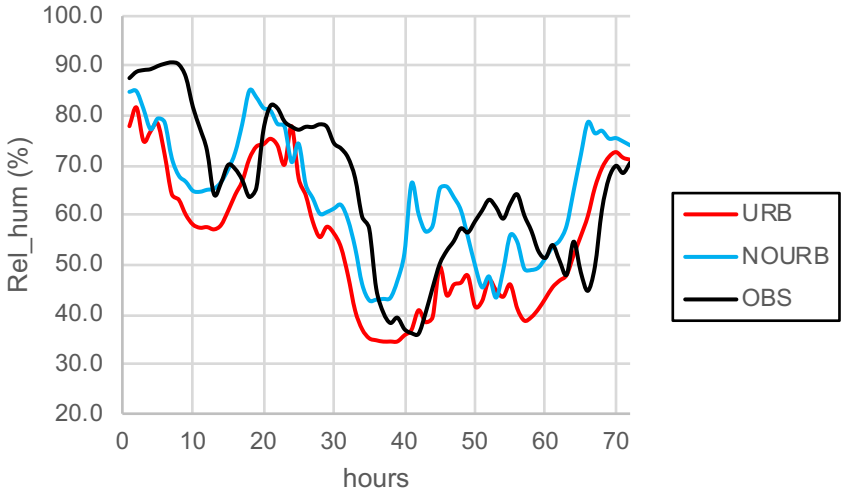
Simulation with Terraurb ON does not provide changes on the maximum temperature, but a slight increase on the minimum one. This has positive effects with respect to observations. Usage of itype_canopy=2 (even with cimpl = 600) provides small modifications (i.e. a small decrease of the diurnal cycle).

Simulation with Terraurb ON provides generally lower values of relative humidity.
General worsening of performances, with few exceptions.
No relevant differences between itype_canopy = 1 and 2

T_2m and Rel_hum_2m at Naples (urban), 6-8 Jun 2019 (itypecanopy=1)



T_2m time series for the three days considered at Naples.



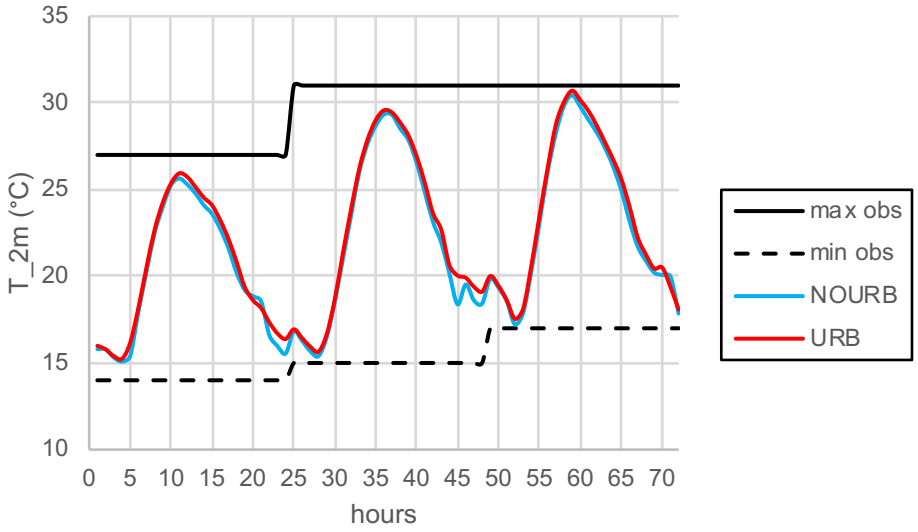
Rel_hum_2m time series for the three days considered at Naples.

Simulation with Terraurb ON provides higher values of temperature.
Maximum daily value is increased of 0.6° C(on 6th), 0.8°C (on 7th) and 0.6°C (on 8th).
For T_2m, a general underestimation with respect to observational data is still evident.

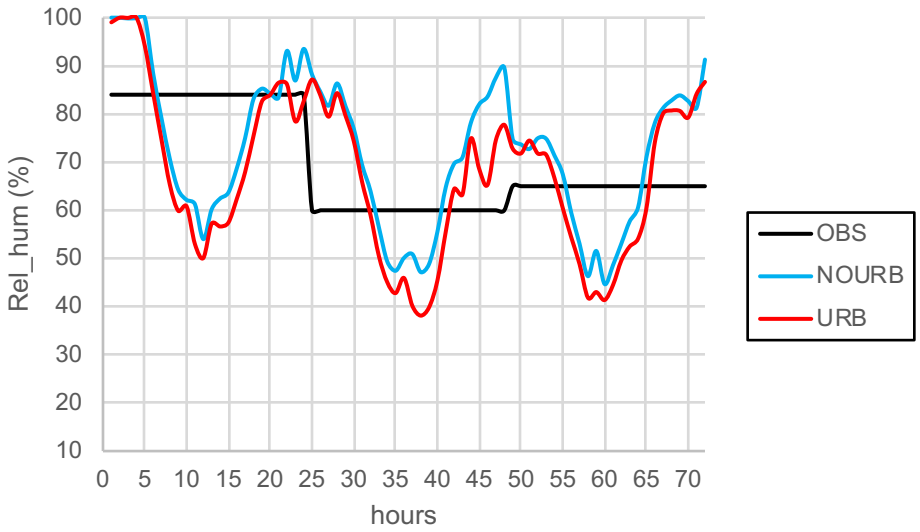
For Rel_hum_2m, usage of Terraurb ON produces a worsening of performances:

	OBS	NOURB	URB
Average value (%)	64.8	64.0	55.3

T_2m and Rel_hum_2m at Grazzanise (rural), 6-8 Jun 2019



T_2m time series for the three days considered at Grazzanise.



Rel_hum_2m time series for the three days considered at Grazzanise.

Simulation with Terraurb ON does not provide changes on the temperature, apart from a few nocturnal values.
Diurnal cycle amplitude is always underestimated with respect to observations.

Simulation with Terraurb ON provides general increase of performances for the relative humidity, considering average values.

Conclusions

- The usage of Terraurb ON produces a increase of temperature in urban areas (especially for minimum), reducing the model bias. In rural areas, it does not provide changes on the maximum temperature, but a slight increase on the minimum one. This has positive effects with respect to observations.

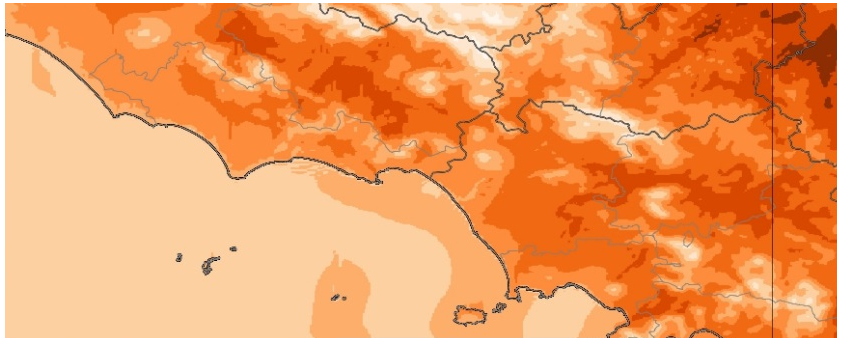
- The usage of Terraurb ON provides a general reduction of relative humidity in both urban and rural areas. This leads to a worsening of performances in the urban area. On the other side, in rural areas an improvement is observed in one test case.

- Simulation assuming itype_canopy = 2 does not provide relevant differences in urban areas, but it decreases the amplitude of the diurnal cycle in rural areas. Further investigation needs to be performed.

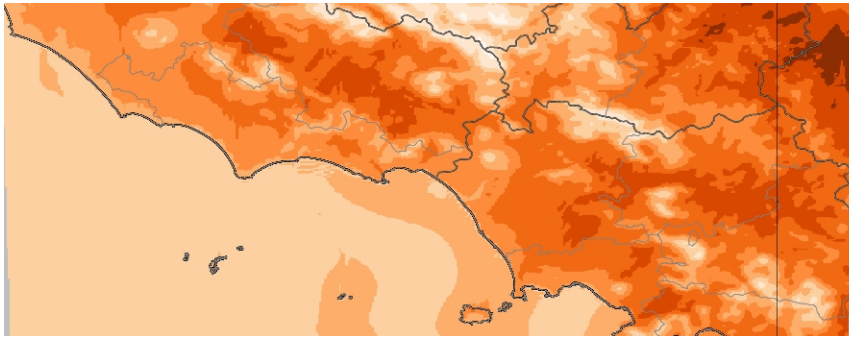
T_2m at 13.00 10/08/2018

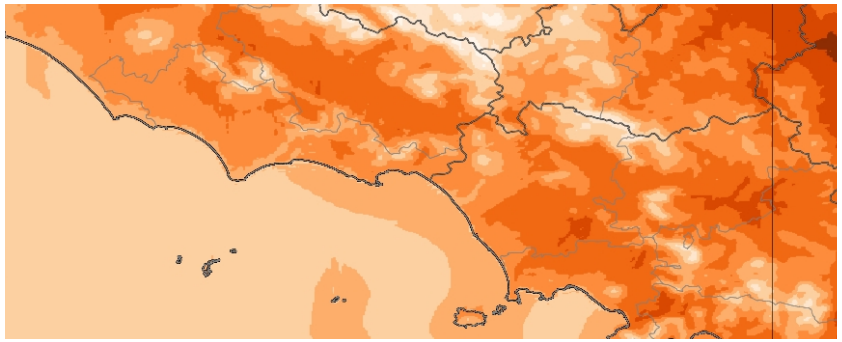
Distribution of daily maximum temperature

Nourb

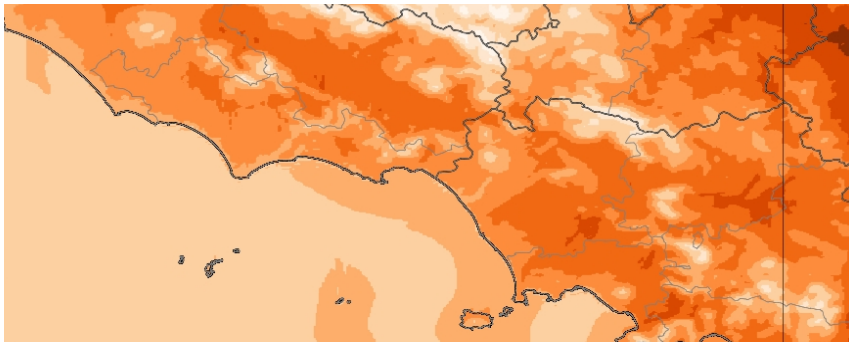


Urb itc = 1





Urb itc = 2, cimpl =120



Urb itc = 2, cimpl =600