WG 3b, PT AEVUS 2 & PP CITTA

Activities and Updates CIRA - CMCC

F. Repola*, C. Apreda*, E. Bucchignani, A. Reder*, C and P. Mercogliano***

*** Centro euro-Mediterraneo sui Cambiamenti Climatici– Divisione REMHI**

****CIRA – Italian Aerospace Research Center**

COSMO GM 2020

4th September 2020

News

Germany	DWD	Deutscher Wetterdienst
Switzerland	MCH	MeteoSchweiz
Italy	ITAF ReMet	Aeronautica Militare-Reparto per la Meteorologia
Greece	HNMS	Hellenic National Meteorological Service
Poland	IMGW	Institute of Meteorology and Water Management
Romania	NMA	National Meteorological Administration
Russia	RHM	Federal Service for Hydrometeorology and Environmental Monitoring
Israel	IMS	Israel Meteorological Service

Other major members

Additionally, these regional and military services within the member states are also participating:

Germany	ZGeoBw	Zentrum für GeoInformationswesen der Bundeswehr
Italy	CIRA	Centro Italiano Ricerche Aerospaziali
Italy	ARPAE	Agenzia Regionale per la Prevenzione, l´Ambiente e l´Energia Emilia Romagna
Italy	ARPA Piemonte	Agenzia Regionale per la Protezione Ambientale Piemonte
Italy	CMCC	Centro euro-Mediterraneo sui Cambiamenti Climatici

- From March 2020, CMCC Foundation collaborates with the COSMO community.
- In the framework of PT_AEVUS2, CMCC collaborates by supporting CIRA for simulations over southern Italy and on analysis concerning external parameters.

Model version and simulation set-up

- Model versions:

  - int2lm_190524_2.06up

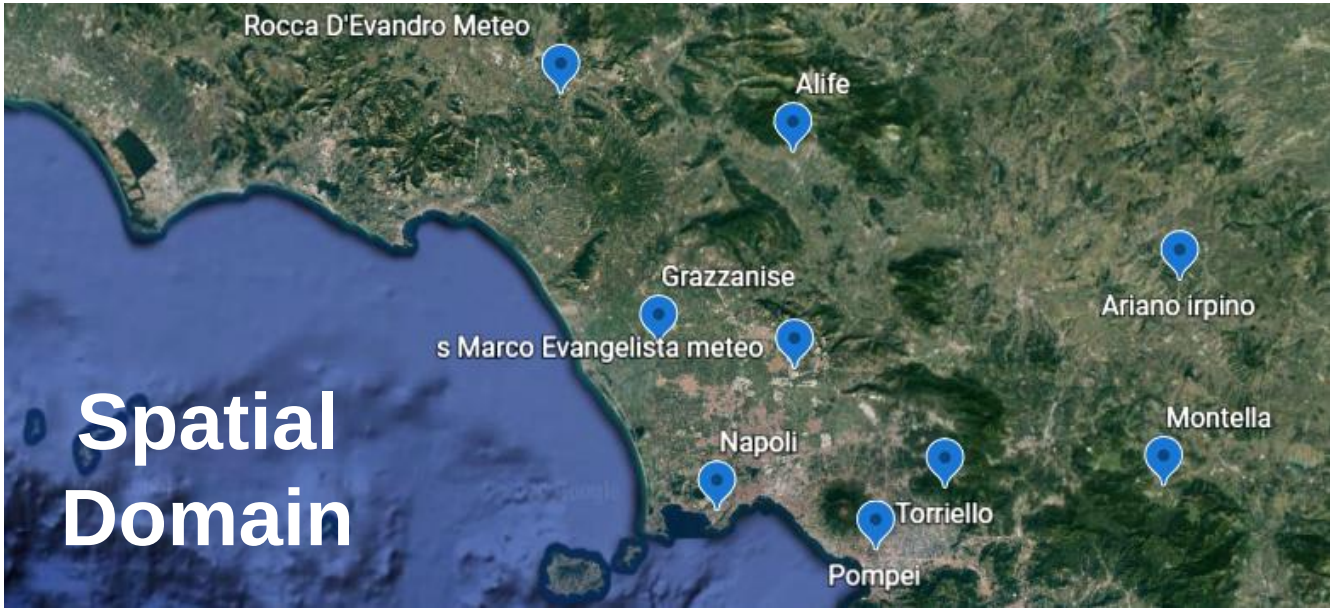
  - cosmo_181030_5.05_urb6up3

- COSMO-LM resolution: **0.009° (about 1 km)**
- Computational domain**: 260 x 138 points; 60 vertical levels, time step 10 s.**
- Domain:**12.22° – 14.55°E; 40.63° - 41.88° N (**Rotated North Pole**: -166°; 41°)**
- Forcing data: ECMWF IFS (resolution of 0.075°)
- Test cases considered: from August 8th to August 14th 2017
- Sensitivity analysis performed:

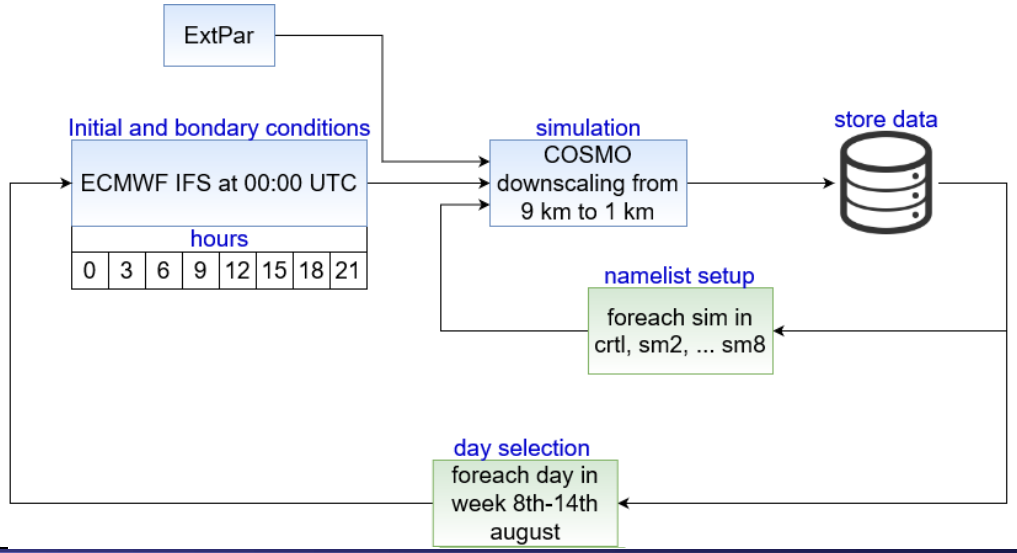
9 km -> 1 km								
	CTRL	sm2	sm3	sm4	sm5	sm6	sm7	sm8
terra_urb	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE
old_tur	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
itype_canopy	1	2	1	2	1	2	1	2

Model version and simulation set-up

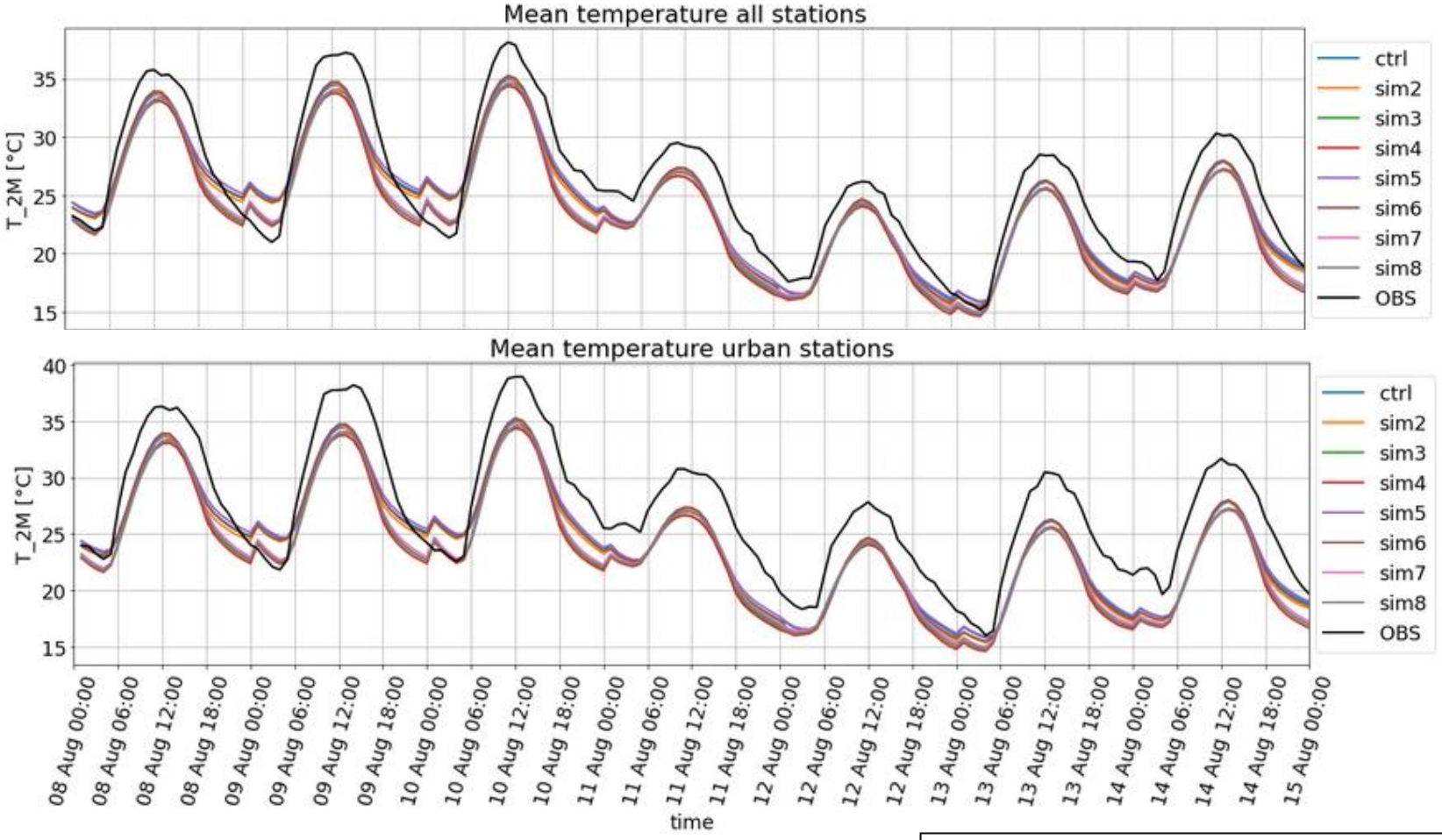
Observations: Hourly values by Civil protection of Campania (station locations are shown in blue)



Simulations workflow

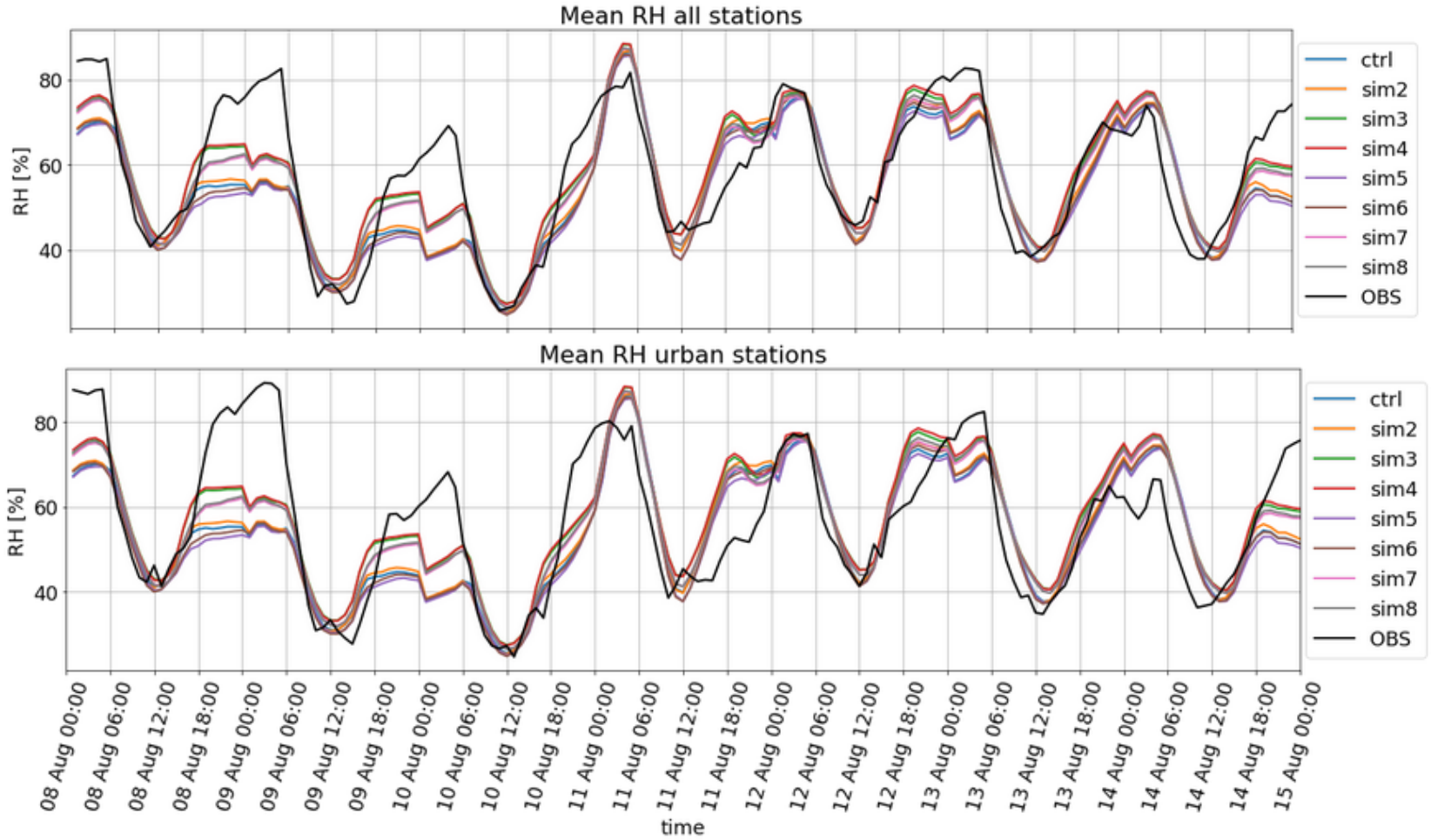


Mean temperature validation



9 km -> 1 km								
	CTRL	sm2	sm3	sm4	sm5	sm6	sm7	sm8
terra_urb	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE
old_tur	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
itype_canopy	1	2	1	2	1	2	1	2

Relative humidity validation



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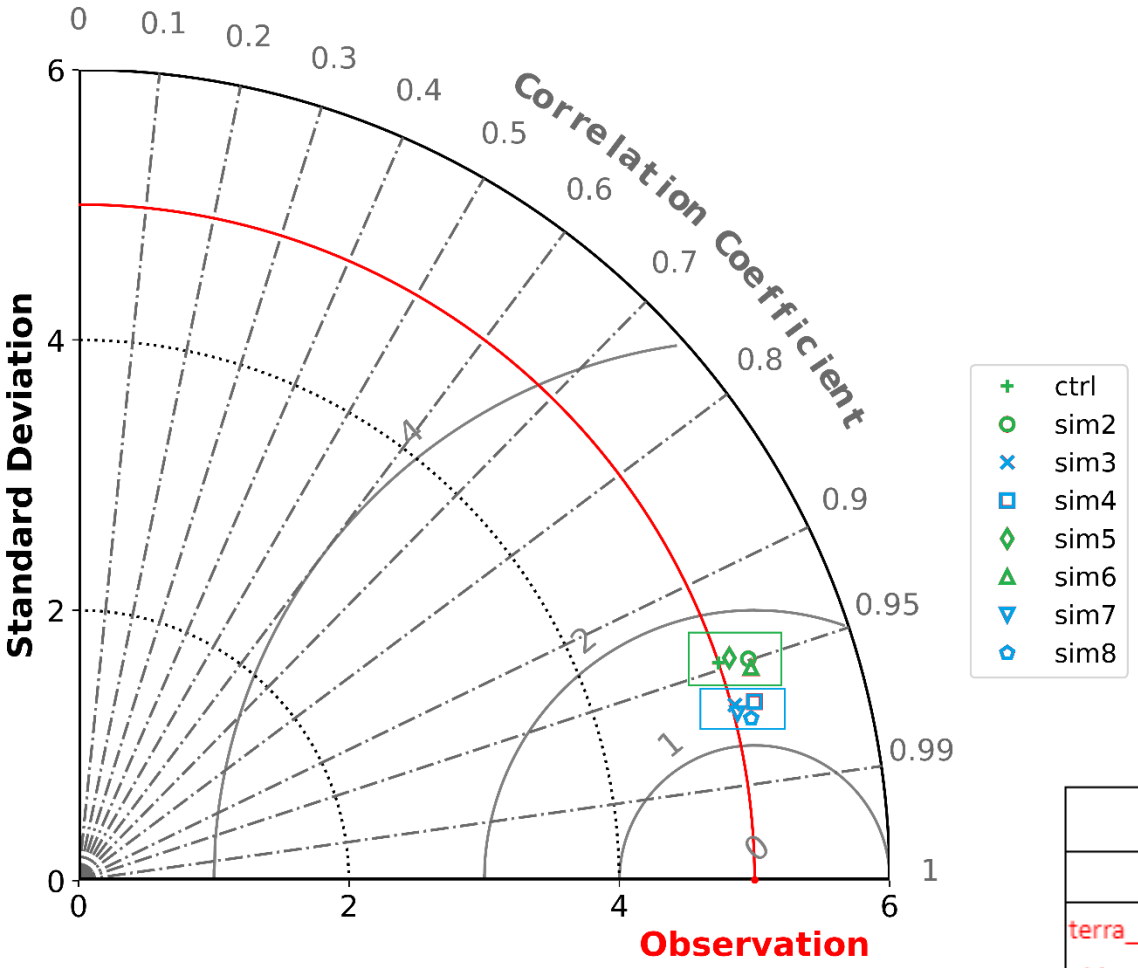
	CTRL	sm2	sm3	sm4	sm5	sm6	sm7	sm8
terra_urb	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE
old_tur	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
itype_canopy	1	2	1	2	1	2	1	2

Taylor Diagram for 2 meter temperature



- The new turbulence scheme improves the model performances in terms of RMSE and Correlation.
- Setting up itype_canopy=1 ensures better performances in terms of standard deviation
- Similar results including only urban stations

9 km -> 1 km								
	CTRL	sm2	sm3	sm4	sm5	sm6	sm7	sm8
terra_urb	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE
old_tur	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
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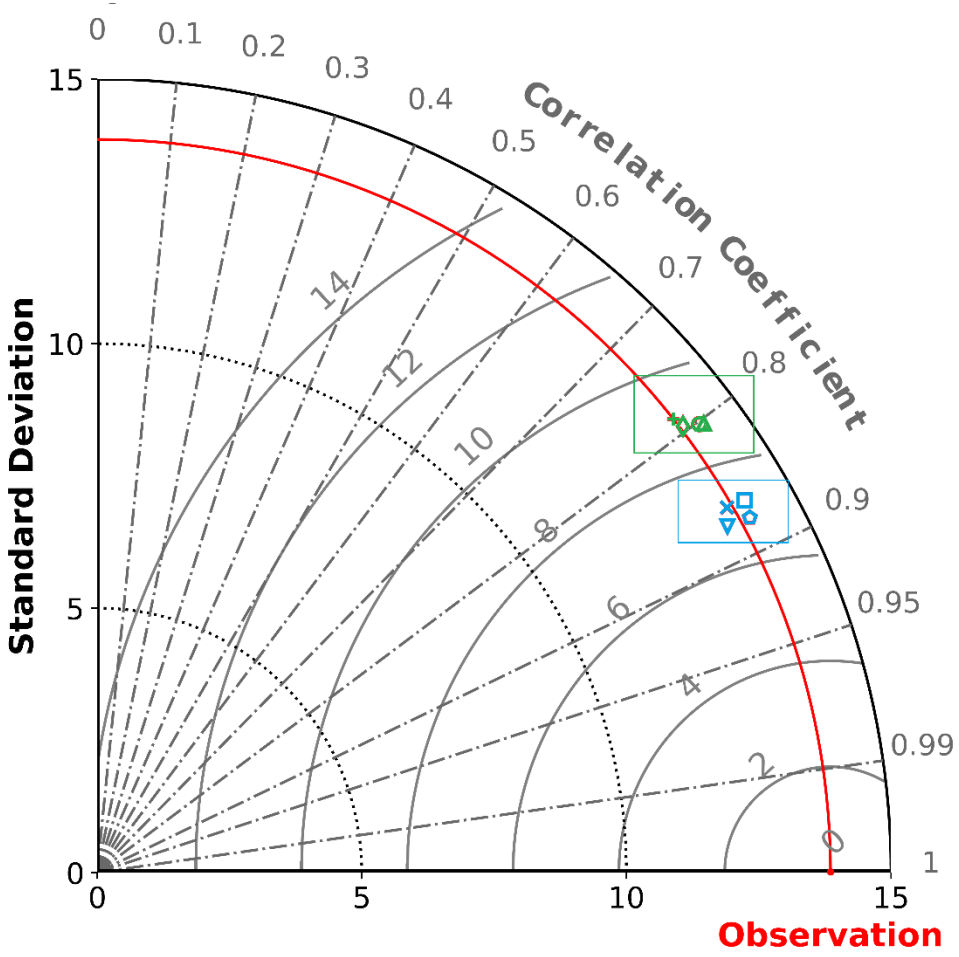
Taylor Diagram for Relative humidity



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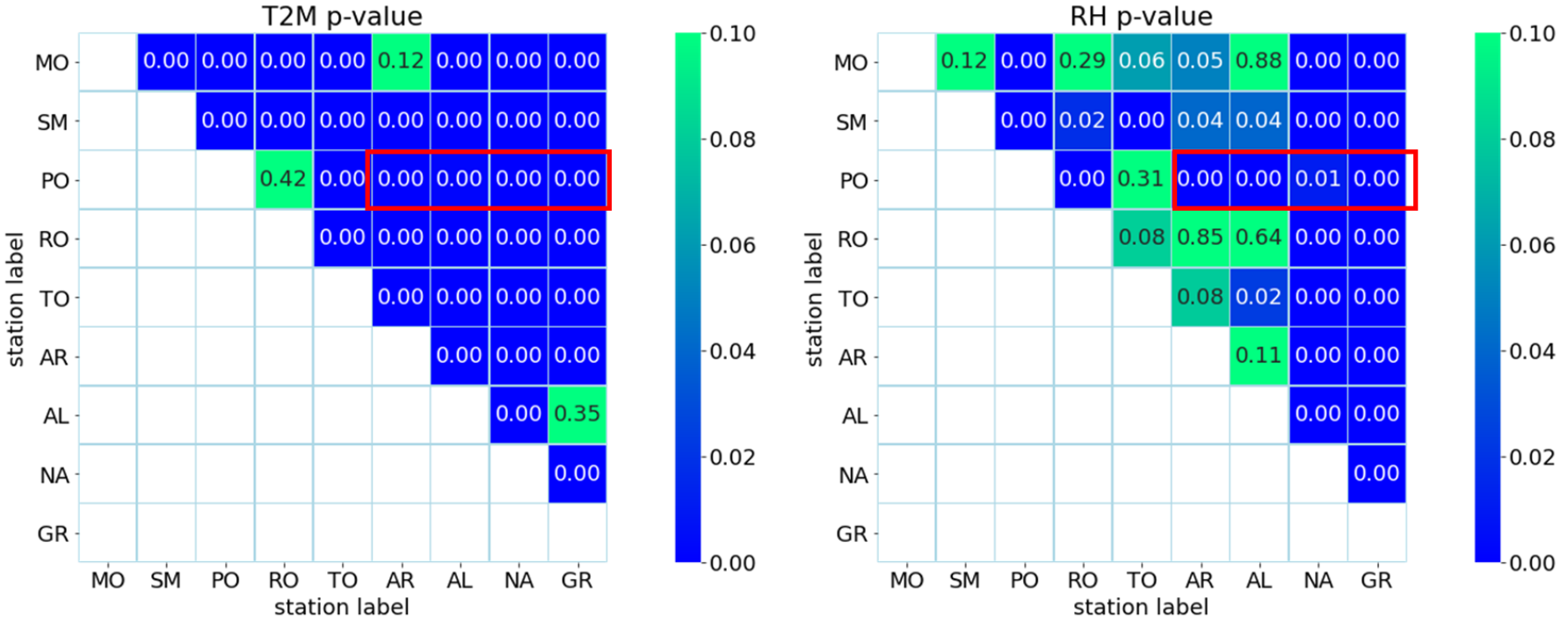
terra_urb	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE
old_tur	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE
itype_canopy	1	2	1	2	1	2	1	2

- The new turbulence scheme improves the model performances in terms of RMSE and Correlation.
- Similar results including only urban stations

Observations selection based on Wilcoxon test

(thanks to Massimo Milelli for the support)

P-value is computed for all pairs. A p-value lower than 0.05 imply that two time series do not belong to the same population.



*NOTE: values less than 0.01 are rounded to 0

Computing UHI intensity for selected stations

Selecting 5 stations:

- URBAN: Pompei (PO) – Napoli (NA)
- RURAL: Ariano Irpino (AI) - Alife (AL) – Grazzanise (GR)

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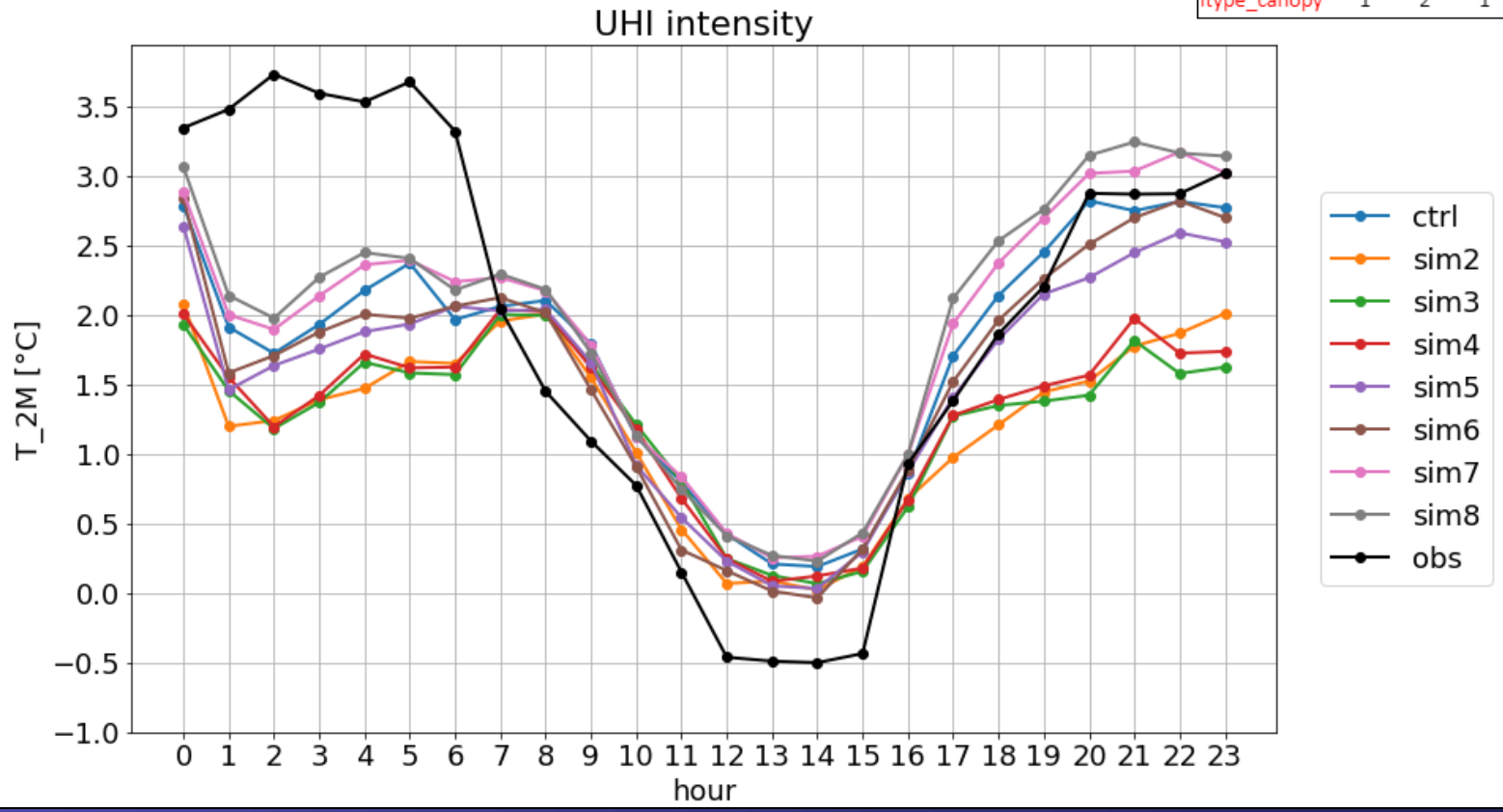


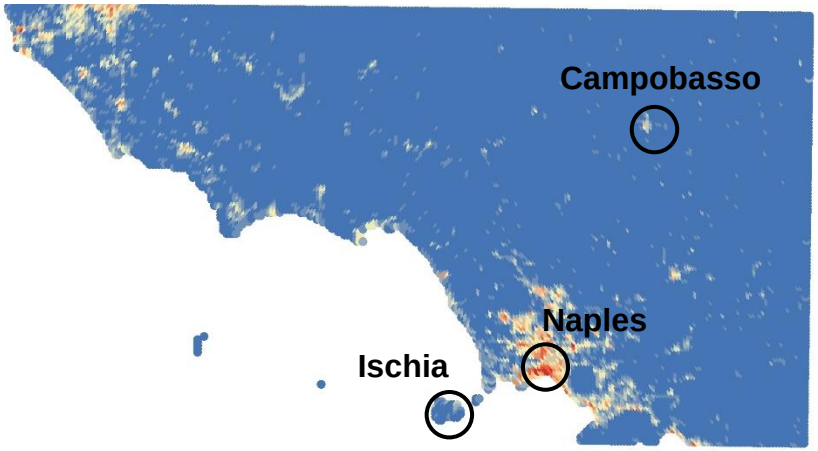
Updating the current EXTPAR field of ISA with new products

Italian Aerospace Research Centre

Centro Euro-Mediterraneo sui Cambiamenti Climatici

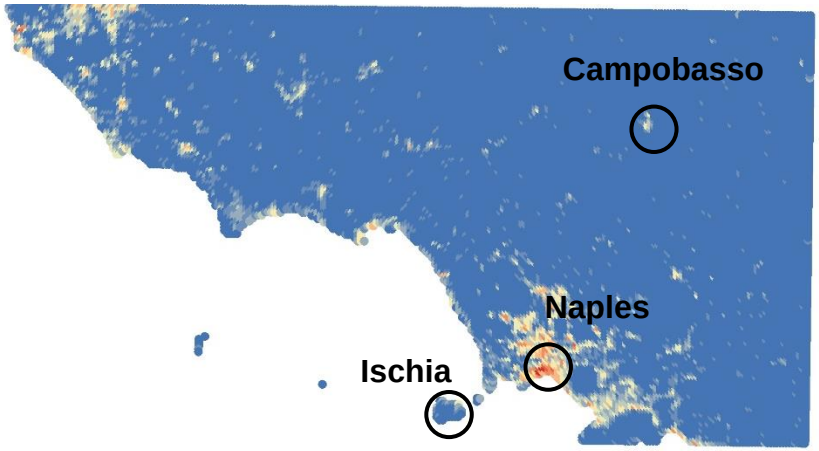
Original Ext_Par

Original spatial resolution: ~ 1 km



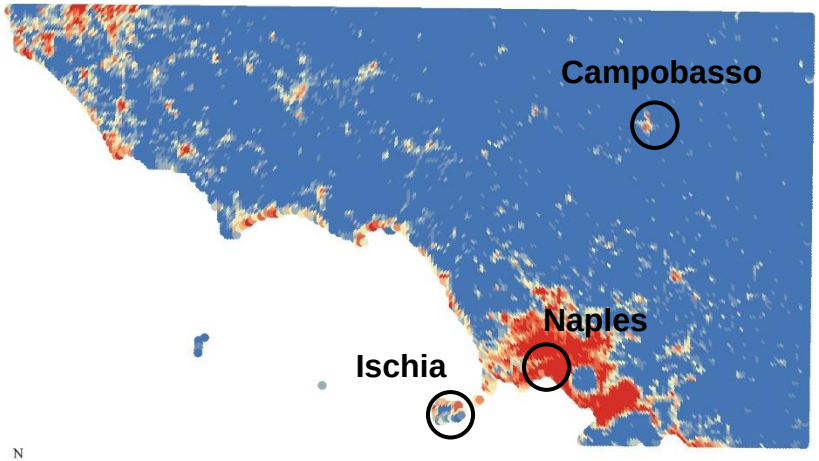
CLMS – Copernicus Land Monitoring Service (IMD)

Original spatial resolution: 20 m



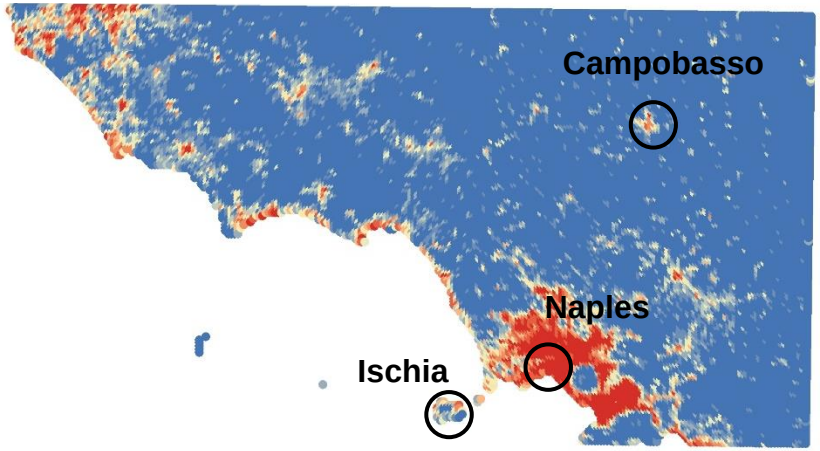
GAUD – Global Urban Change Dataset

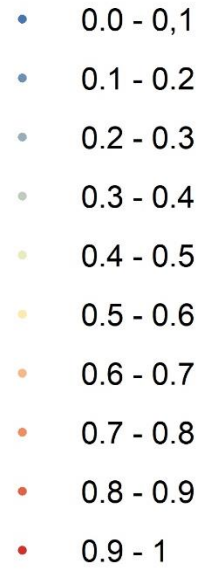
Original spatial resolution: 30 m

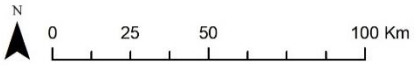


GAIA (Global Artificial Impervious Area)

Original spatial resolution: 30 m







All dataset are displayed at ~ 1 km resolution!

Double-Counting Effect

TERRA_URB switched off

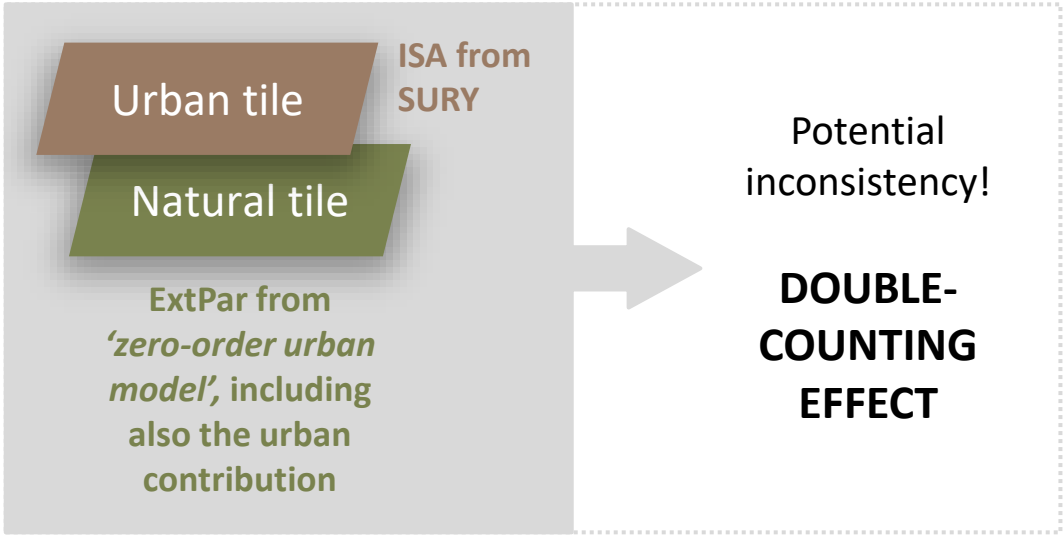
LU classes from Globcover

The parameters are calculated as weighted function of land classes, including the land use class 19 (**URBAN**). This *'zero-order urban model'* provides the model variables for each grid cells.

TERRA_URB activated

tile approach

If the urban scheme is activated (TERRA_URB=TRUE), a **tile approach** is implemented in which each cell is divided into two tiles, an urban tile and a natural tile.



Operational Workflow for avoiding double-counting effect (ArcGIS)

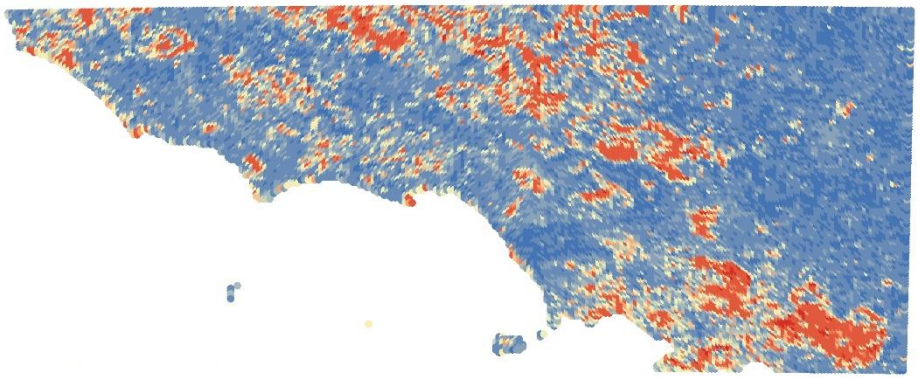
- **Preprocessing**
  - create shapefile (point) from NETCDF
  - create target grid (polygon) from points (centroids)

- **Calculating the percentage of land cover classes within each cells of the target grid**
  - convert the raster version of the land cover map to a polygon feature
  - union of land cover polygons with target grid
  - export each class of land cover
  - calculate the total area of each class within each cell
  - calculate the percentage of each class within each cell

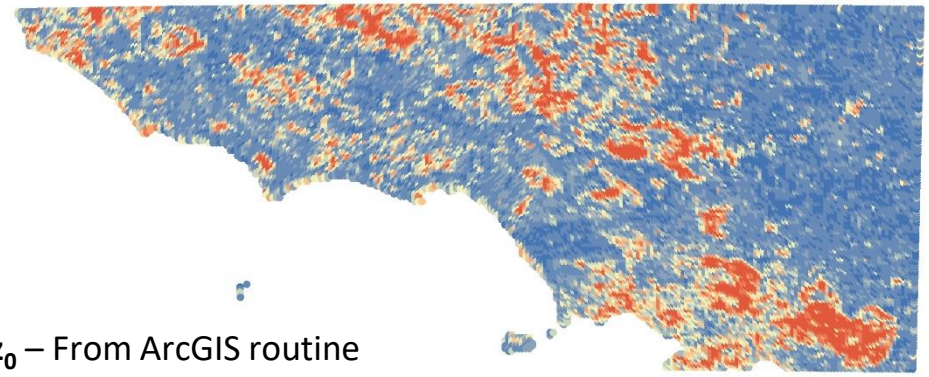
Ongoing activity

CONVERTING THE ArcGIS WORKFLOW INTO PYTHON SCRIPTS!

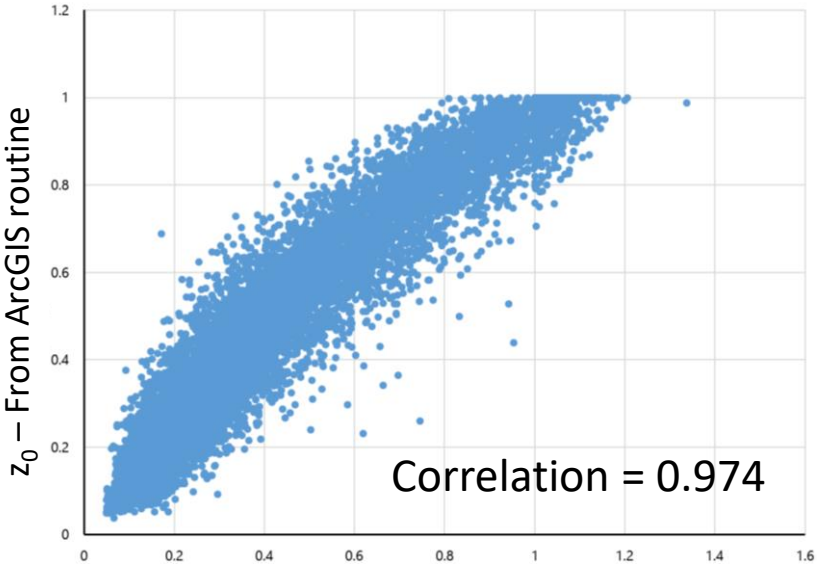
Original Ext_Par vs ArcGIS workflow Ext_Par

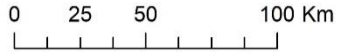


z_0 – Original Ext_Par (laf2017081000.nc)



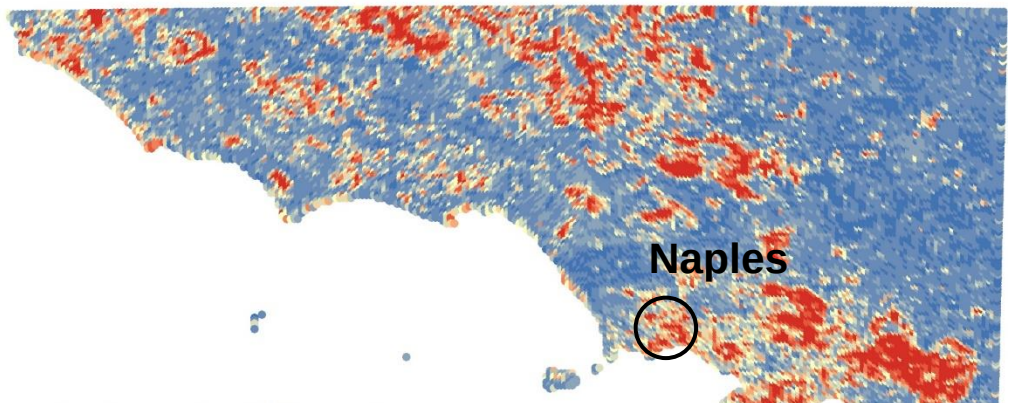
z_0 – From ArcGIS routine



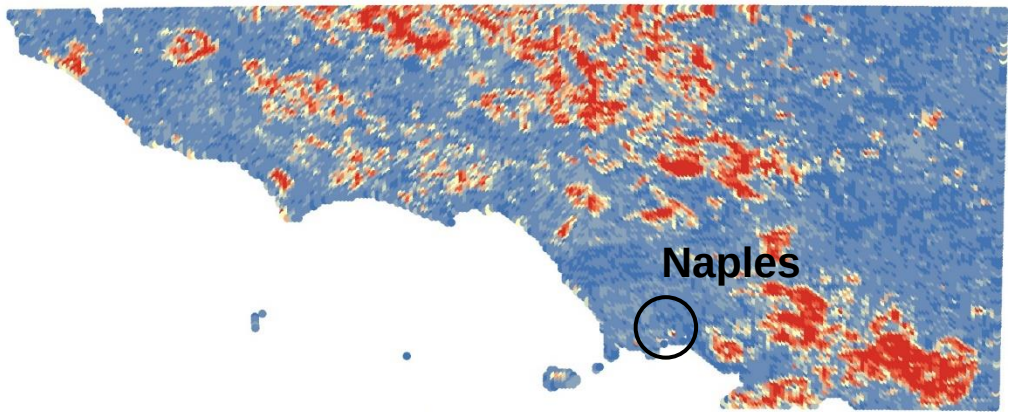


z_0 = Roughness length

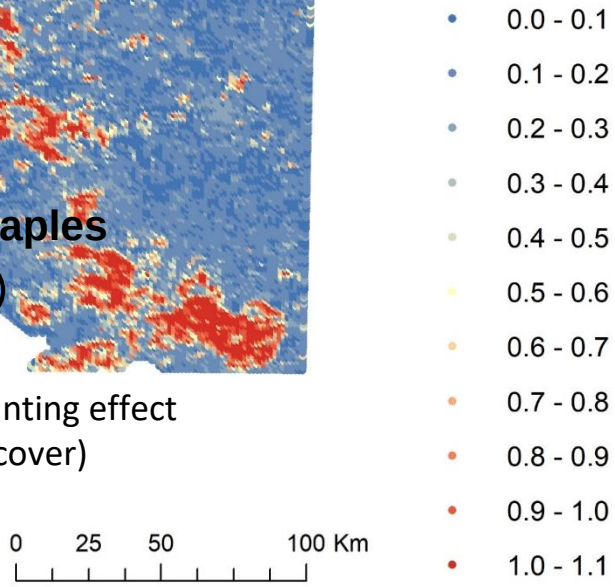
ArcGIS workflow Ext_Par (removing DC effect)



z0 – from ArcGIS routine (including artificial surfaces)



z0 – from ArcGIS routine removing double-counting effect (removing artificial surfaces, class 190 of Globcover)



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Thank you for your attention.
Any questions ?