



forecAsting
System
for urban
heat Island
effect

Il modello previsionale LIFE ASTI

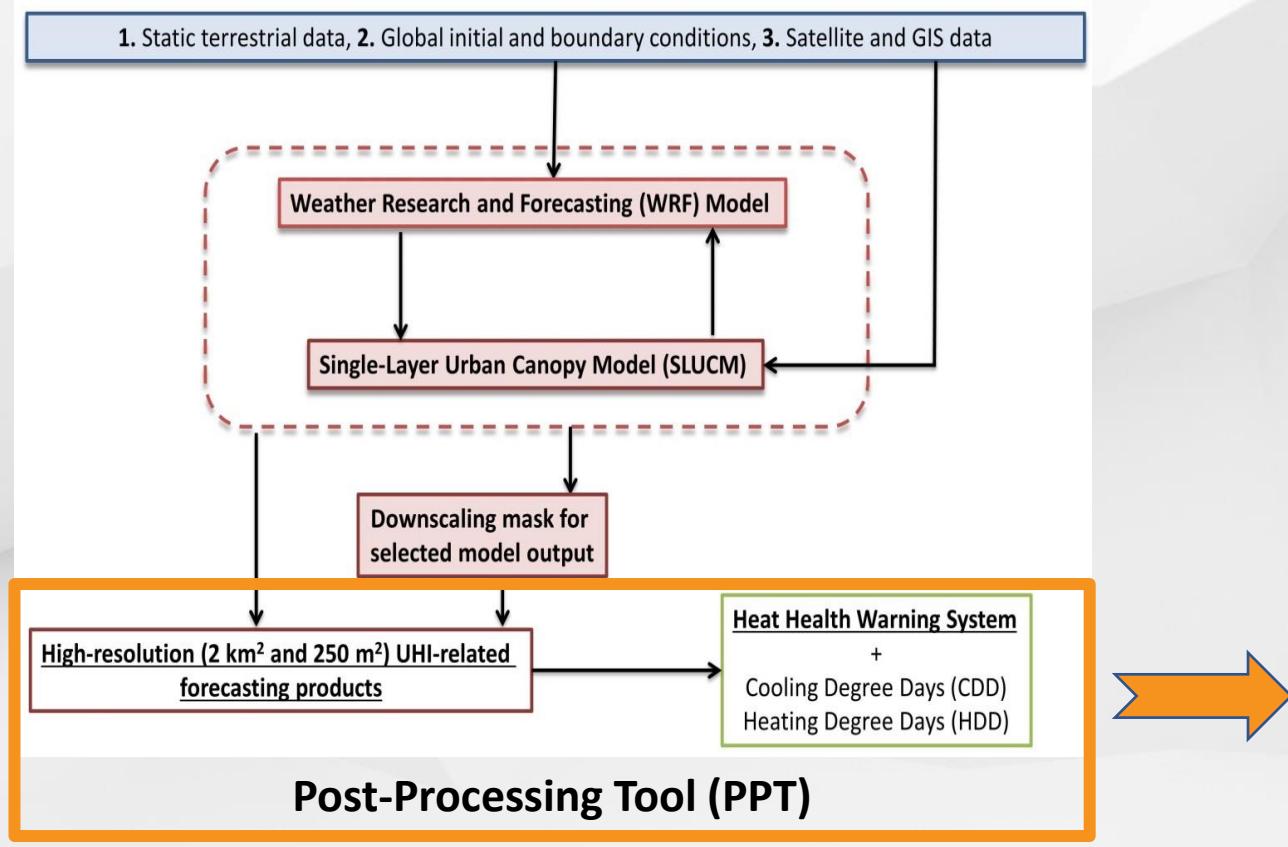
Giampietro Casasanta, CNR - ISAC



The project *Implementation of a forecAsting System for urban heat Island effect for the development of urban adaptation strategies - LIFE ASTI* has received funding from the LIFE Programme of the European Union.

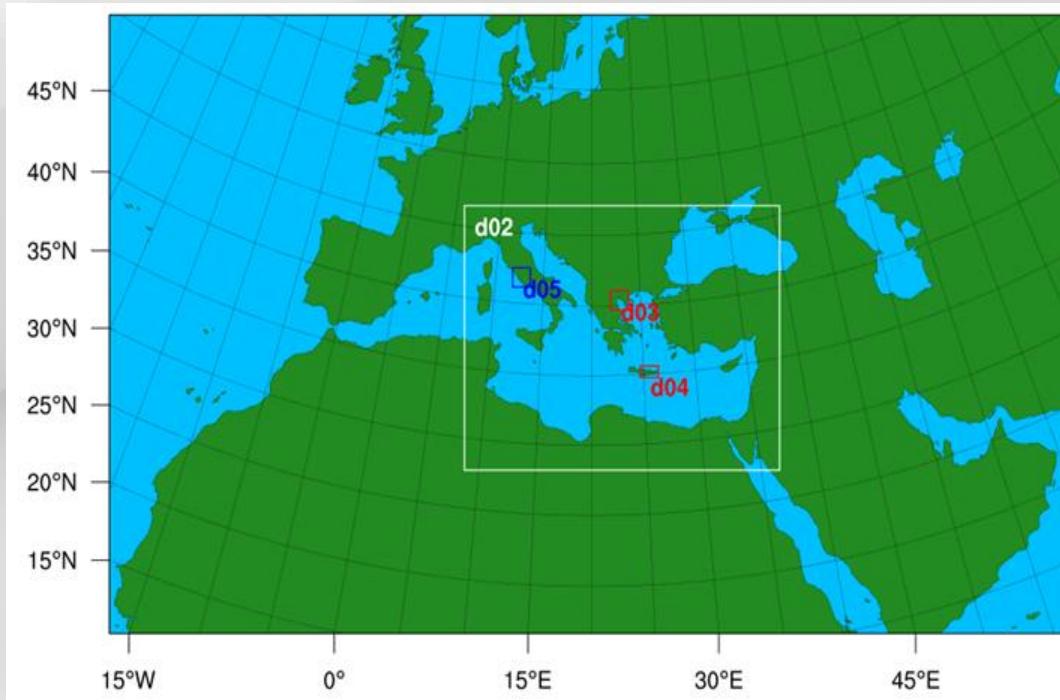
Struttura generale

Weather Research and Forecasting Model (WRF) accoppiato con il Single-Layer Canopy Model (SLUCM)



Configurazione

- Applicazione a 5 domini con risoluzione 18, 6 e 2 km, con 35 livelli
- Campi meteorologici forniti dal Global Forecast System (GFS)
- Schema della Yosei University per la parametrizzazione urbana
- Temperatura superficiale del mare ad alta risoluzione (NCEP/GFS)
- Categorie CORINE per l'utilizzo del suolo



Launch operational script-7 a.m. local time every day

Download data

Download GFS meteorological data-00 UTC forecasting hour

Download SST data-00 UTC of the previous day

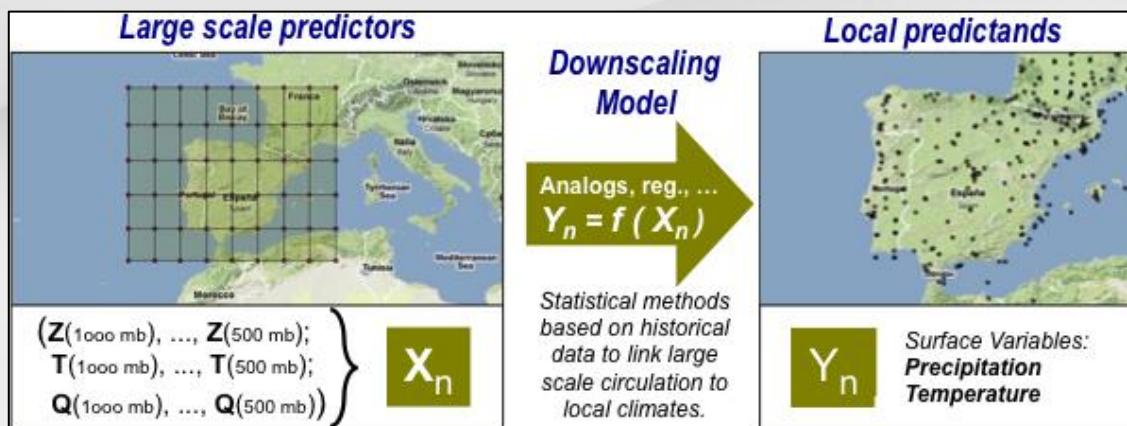
Run WRF+SLUCM system
(11 hours, 2 Intel Xeon Gold 6125)

Output temporary saved in netcdf Format

Post-processing

Downscaling statistico – catturare variazioni intra-urbane ad una scala rilevante per gli esseri umani

- Applicazione di metodi statistici non lineari: support vector regression con tecniche di machine learning
- **Dati di input:** simulazioni a 2 km, topografia, ora del giorno, utilizzo del suolo
- **Addestramento e test:** dati acquisiti sperimentalmente dalla rete di stazioni nelle tre città con risoluzione oraria
- **Prodotto finale:** temperatura e umidità relativa a 2 m dal suolo
- **Risoluzione finale:** 250 m



Prodotti



A che serve tutto questo?

A determinare, con risoluzione di 250 m

- Temperatura apparente
- Discomfort Index (DI)
- Urban Heat Island Intensity (UHII)
- Universal Thermal Climate Index (UTCI)

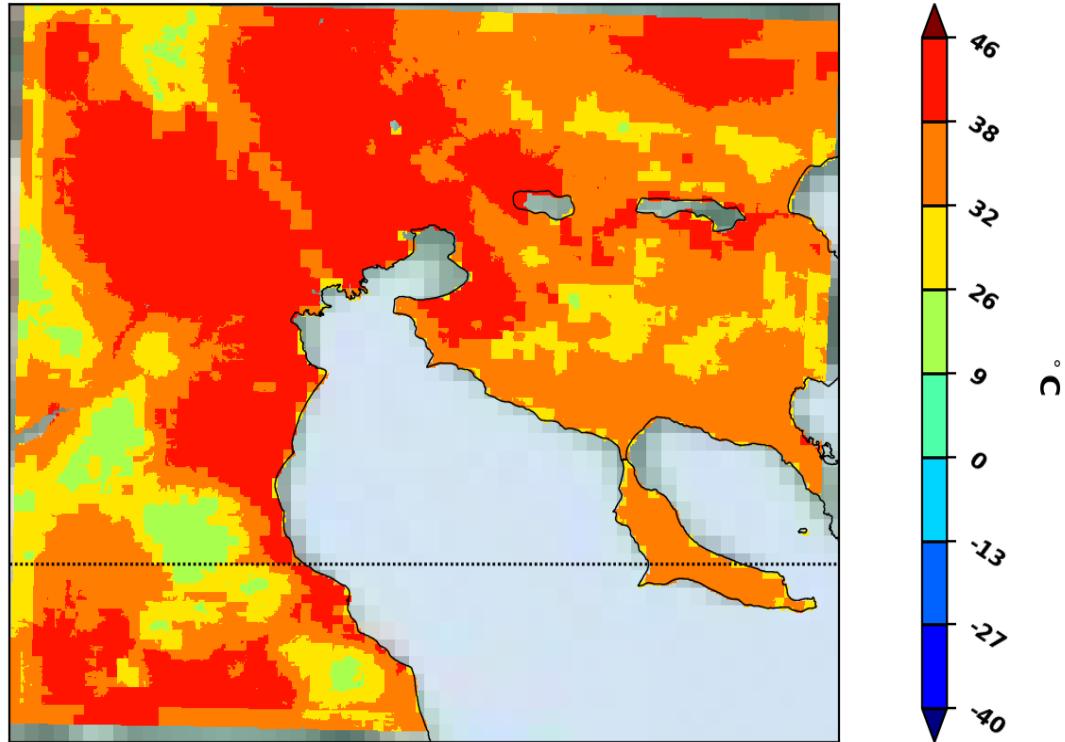
DI value	Discomfort conditions
$DI \leq 21^{\circ}\text{C}$	No discomfort
$21^{\circ}\text{C} < DI \leq 24^{\circ}\text{C}$	Under 50 % of the population feels discomfort
$24^{\circ}\text{C} < DI \leq 27^{\circ}\text{C}$	Above 50 % of the population feels discomfort
$27^{\circ}\text{C} < DI \leq 29^{\circ}\text{C}$	Most of the population feels discomfort
$29^{\circ}\text{C} < DI \leq 32^{\circ}\text{C}$	The entire population feels discomfort
$DI > 32^{\circ}\text{C}$	Sanitary emergency conditions

UTCI value	Thermal sensation
$UTCI \leq -40^{\circ}\text{C}$	Extreme cold stress
$-40^{\circ}\text{C} < UTCI \leq -27^{\circ}\text{C}$	Very strong cold stress
$-27^{\circ}\text{C} < UTCI \leq -13^{\circ}\text{C}$	Strong cold stress
$-13^{\circ}\text{C} < UTCI \leq 0^{\circ}\text{C}$	Moderate cold stress
$0^{\circ}\text{C} < UTCI \leq 9^{\circ}\text{C}$	Slight cold stress
$9^{\circ}\text{C} < UTCI \leq 26^{\circ}\text{C}$	No thermal stress (comfort)
$26^{\circ}\text{C} < UTCI \leq 32^{\circ}\text{C}$	Moderate heat stress
$32^{\circ}\text{C} < UTCI \leq 38^{\circ}\text{C}$	Strong heat stress
$38^{\circ}\text{C} < UTCI \leq 46^{\circ}\text{C}$	Very strong heat stress
$UTCI > 46^{\circ}\text{C}$	Extreme heat stress

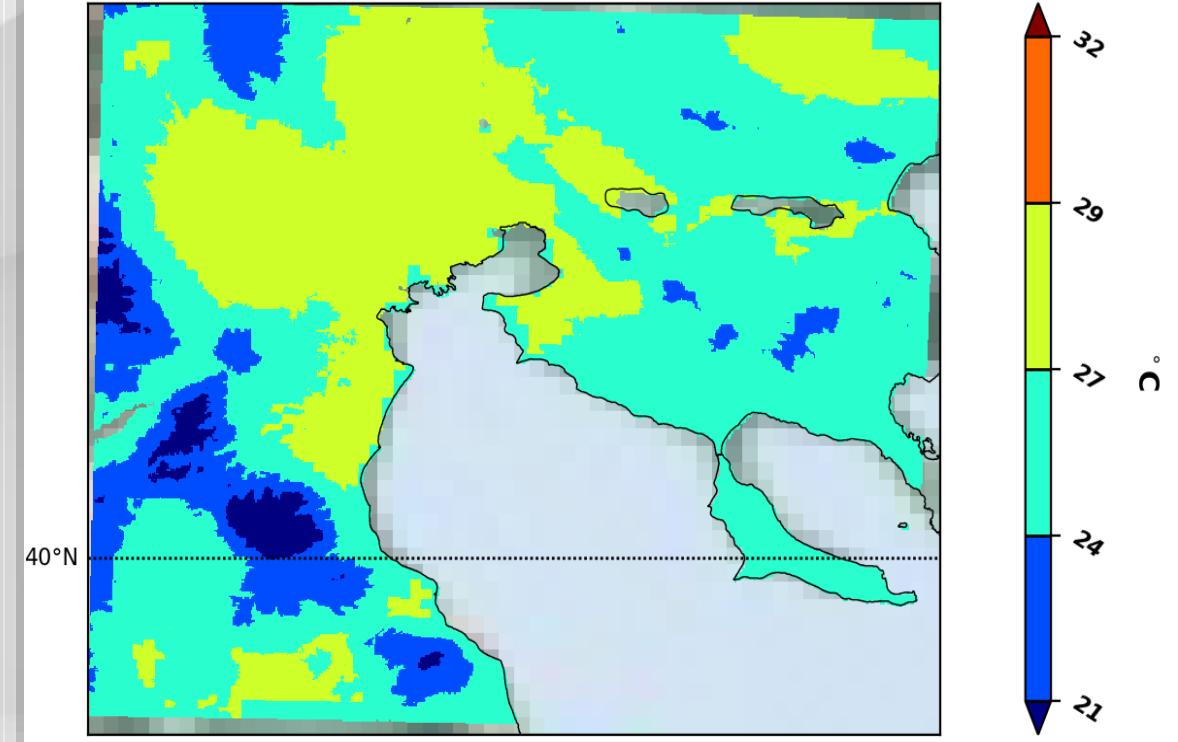
Risultati di esempio

1 Agosto 2019, 14:00 UTC (17 LST)

UTCI of Aug. 1st at 14:00 UTC



DI of Aug. 1st at 14:00 UTC



Validazione - Roma



Dataset di umidità e temperatura orari

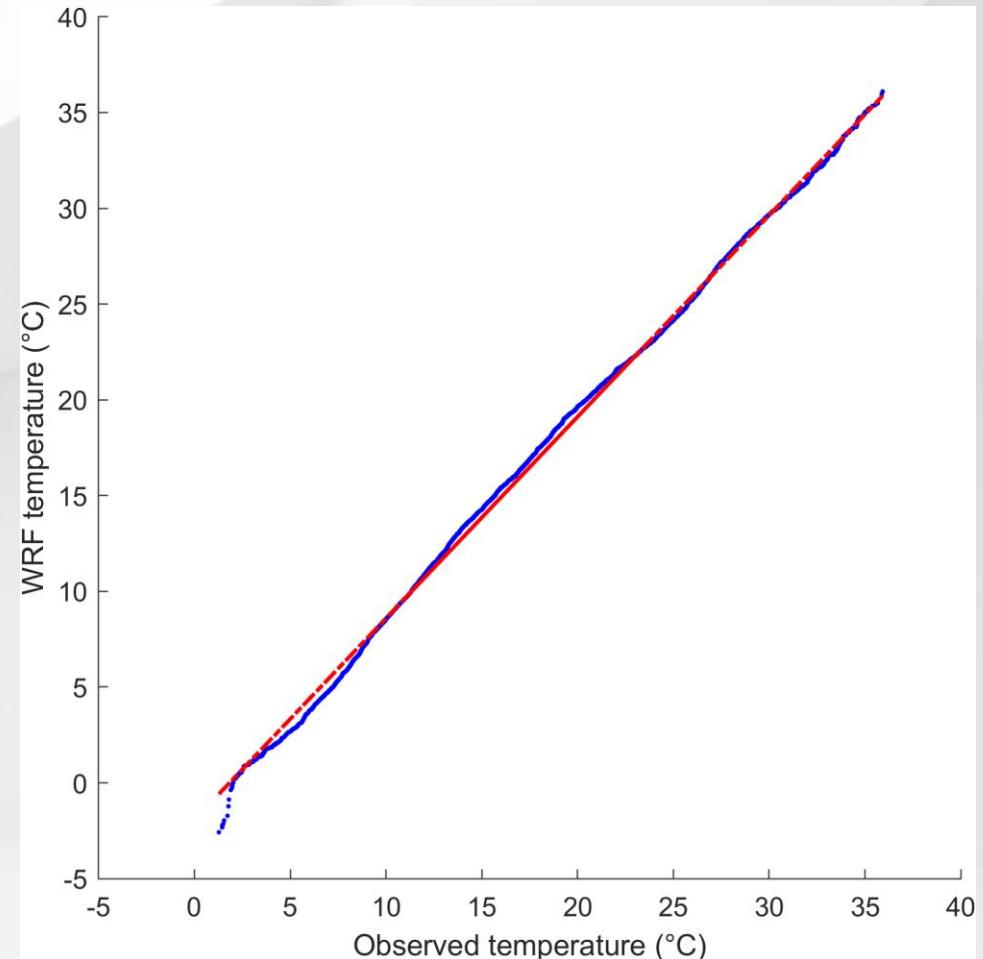
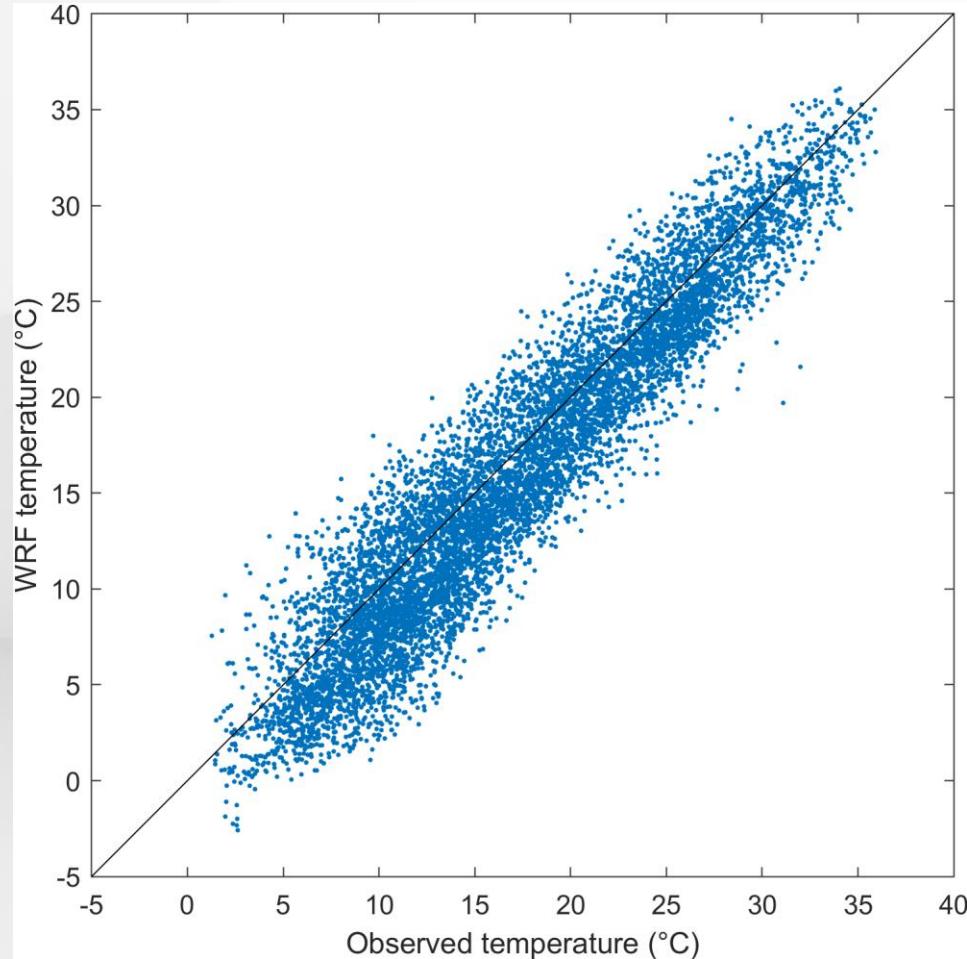
- Anno 2015
8 stazioni, intero anno
- Anno 2019
24 stazioni, estate (luglio-settembre)

Metodi

- Serie temporali orarie di umidità e temperatura
- Serie stagionali
- Scatter plots
- Q–Q (quantile-quantile) plot
- 13 indicatori statistici

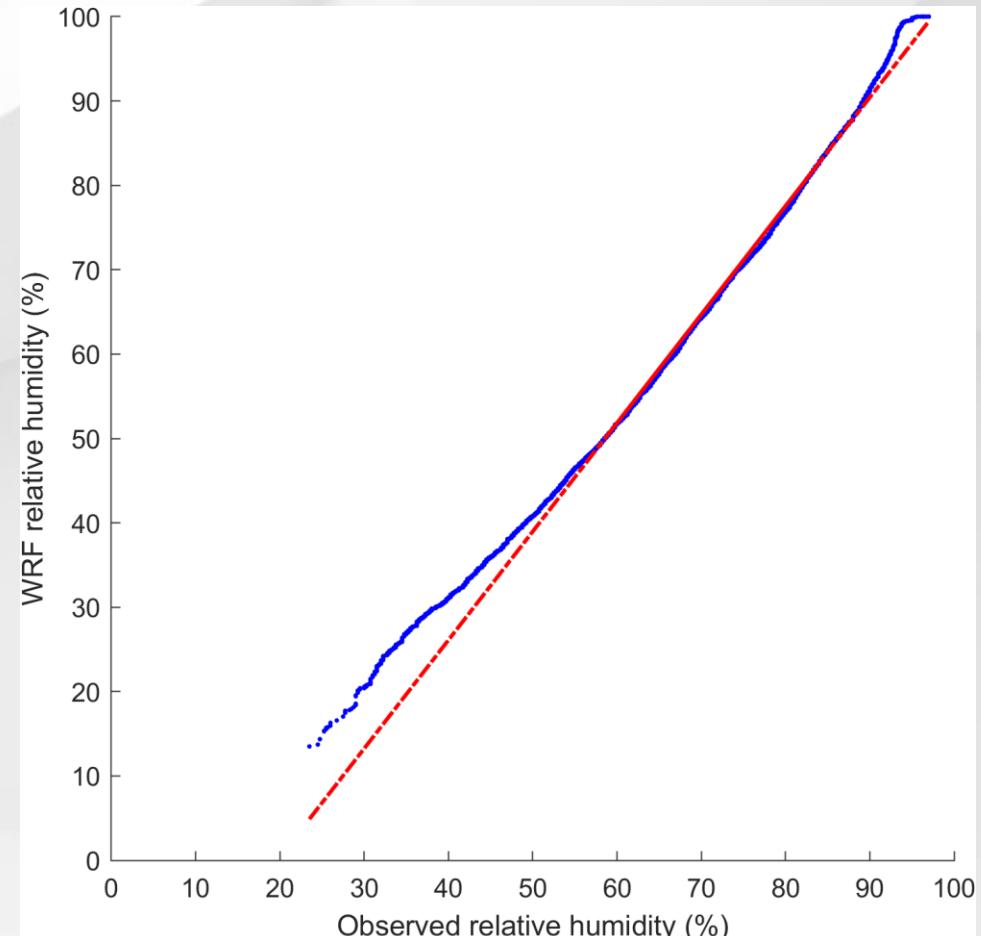
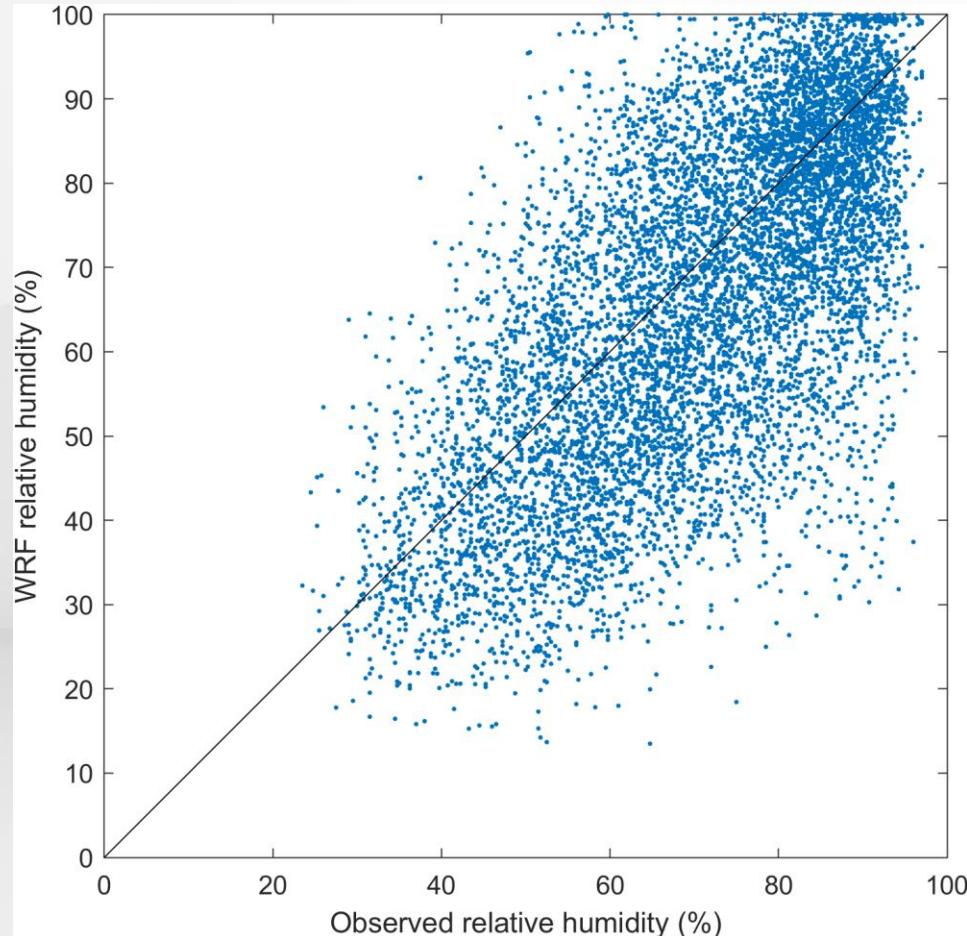
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Temperatura



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Umidità



Indicatori statistici

Temperatura

Station	N	R	IoA	RMSE	FB
AL001	7722	0.93	0.96	2.83	-0.06
AL003	8604	0.93	0.96	3.15	-0.03
AL004	8520	0.91	0.95	3.11	-0.02
AL007	8643	0.95	0.98	2.38	-0.02
ML-01	8370	0.95	0.97	2.87	-0.06
ML-04	8760	0.94	0.96	2.86	-0.05
ML-11	8158	0.93	0.96	2.86	-0.01
ML-13	8738	0.95	0.98	2.40	-0.02
AVG	-	0.94	0.96	2.81	-0.03

Umidità

Station	N	R	IoA	RMSE	FB
AL001	7722	0.60	0.76	16.53	-0.08
AL003	8521	0.63	0.79	16.72	-0.06
AL004	8390	0.60	0.77	15.64	-0.03
AL007	8643	0.67	0.81	15.07	-0.03
ML-01	8347	0.67	0.80	15.49	-0.06
ML-04	8759	0.63	0.75	16.77	-0.10
ML-11	8158	0.62	0.75	17.22	-0.11
ML-13	8738	0.68	0.78	17.36	-0.14
AVG	-	0.64	0.78	16.35	-0.08

Risorse



Sito ufficiale

- <https://lifeasti.eu/>

Siti dei partner

- <https://www.meteoregionelazio.it>
- <http://www.arpalazio.gov.it/ambiente/aria/>

A screenshot of the LIFE ASTI website homepage. The header features the "asti" logo with a yellow circular graphic, followed by navigation links for "HOME", "ROME ▾", "THESSALONIKI ▾", "HERAKLION ▾", "METADATA", "LOGIN", and language icons for English, Italian, and Greek. Below the header is a blurred background image of a city street. A large orange circle containing the "asti" logo is overlaid on the left side of the image. At the bottom, there is a horizontal bar with colored dots corresponding to a color scale from blue to red. The main content area has a heading "Urban Heat Island Forecasting System" and a descriptive paragraph about the project's focus on UHI effects in three Mediterranean cities using numerical models to produce short-term forecasts and future projections. There is also a brief description of the Heraklion model system's high-quality forecasting parameters. At the bottom right is the "asti" logo with the text "forecAsting System for urban heat Island effect".

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Thank you for your attention

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Slide title Calibri Bold 20pt

LOREM IPSUM DOLOR SIT AMET, CONSECTETUR ADIPISCING ELIT. NULLAM NON FELIS VEHICULA, VENENATIS ELIT EU, BLANDIT LACUS. IN CONDIMENTUM QUAM EGEST MAURIS IMPERDIET BIBENDUM. CURABITUR VIVERRA ENIM AC LUCTUS CONDIMENTUM. SUSPENDISSE CONSECTETUR NISI IPSUM, POSUERE FEUGIAT LIBERO PLACERAT EGEST.

Key factors:

- Curabitur luctus mi vitae lacus malesuada ultrices
- Pellentesque eu libero quis velit cursus euismod sit amet
- Donec dictum risus imperdiets justo viverra molestie
- Sed nec nibh in lectus venenatis posuere eget id ex
- Curabitur luctus mi vitae lacus malesuada ultrices



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