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MISSIONE 4 ISTRUZIONE RICERCA

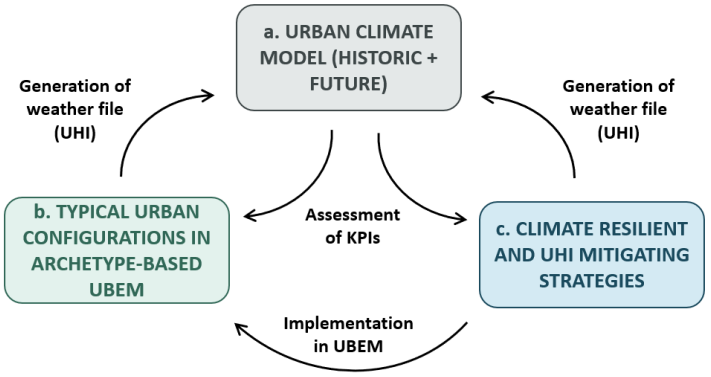
Climate Resilient Strategies by Archetype-based Urban Energy Modelling

Newsletter 2 – March 2025

ABOUT THE PROJECT

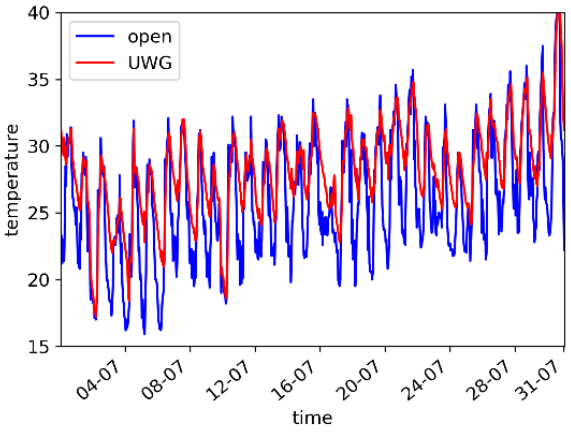
The CRiStAll project aims to tackle the challenges posed by rising temperatures and urban heat islands (UHIs) in Italian cities. By creating detailed climate datasets and using Urban Building Energy Modelling (UBEM) techniques, it seeks to enhance understanding of UHI impacts and inform the development of strategies to improve climate resilience. The main outcomes of the projects are the **Maps** of UHI intensity for typical districts in different periods of time and under the application of climate resilience strategies and the **Atlas** of typical urban configurations based on Italian archetypes.

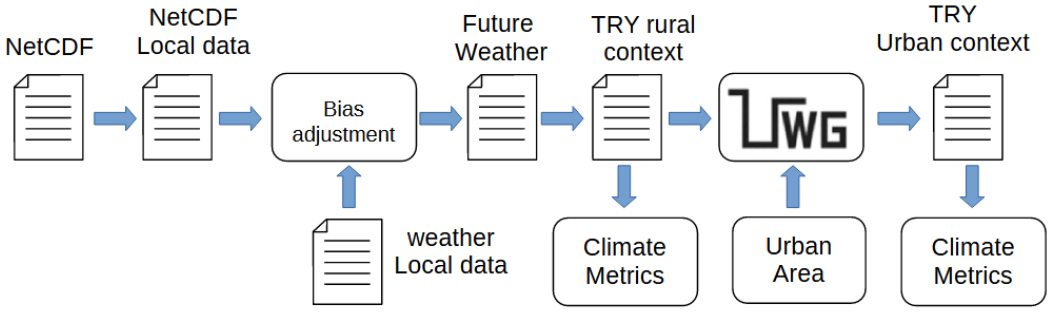
THE RESEARCH LINES



FUTURE URBAN CLIMATE FILES

Future GCM-RCM projections are first obtained from the CORDEX database to account for model variability. The first step involves extracting relevant data for the locations of interest, followed by bias correction using measured data from weather stations near the project cities (Turin, Bari, and Rome). Next, Test Reference Years (TRYs) are generated for rural areas. The Urban Weather Generator (UWG) tool is then used to incorporate Urban Heat Island (UHI) effects into the weather files. The UHI effect is evident when comparing temperature distributions between open and urban areas, as well as in climate metrics such as Heating Degree Days (HDD), Cooling Degree Days (CDD), and the number of tropical nights.





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cristall.polito.it

CRiStAll

This study was carried out within the «Climate Resilient Strategies by Archetype-based Urban Energy Modelling (CRiStAll)» project – funded by European Union – Next Generation EU within the PRIN 2022 PNRR program (D.D.1409 del 14/09/2022 Ministero dell'Università e della Ricerca), M4C2, I 1.1.

ARCHETYPES IN THE URBAN CONTEXT

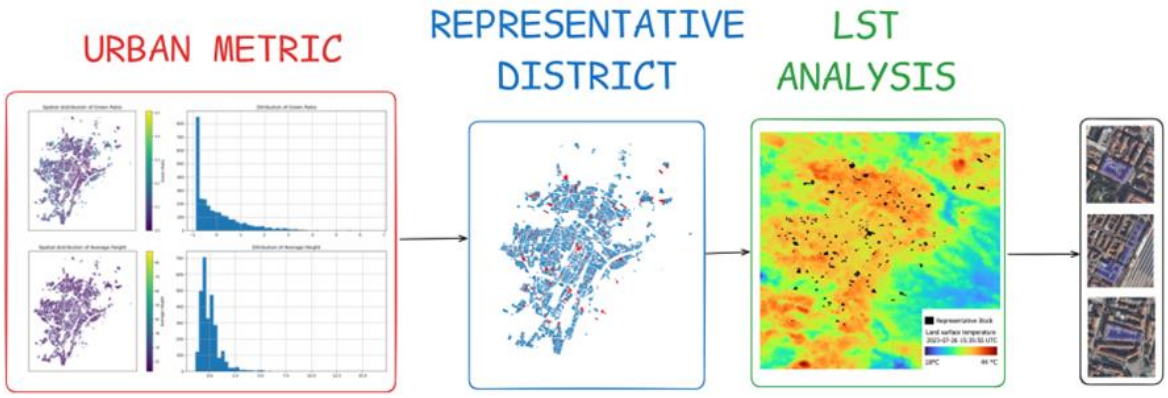
The methodology for defining district archetypes in the CRiStAll project involves two main parts.

1. Morphological Analysis

The first step in the morphological analysis is grouping buildings into urban blocks based on cadastral parcel areas. Blocks with fewer than four buildings, highly irregular shapes, or very large areas are excluded. Next, ten urban metrics, such as Average Building Distance (ABD), Average Building Height (ABH), and Green Ratio (GR), are calculated for each block. A statistical correlation analysis is then performed to define representative configurations based on these urban metrics.

2. Land Surface Temperature (LST) Analysis

In the LST analysis, satellite thermal images are used to study the LST of urban blocks during summer heat waves. These images are filtered for quality, and average LST values are calculated for each block. Blocks with the highest average LST values are identified as representative for further Urban Building Energy Modelling (UBEM) studies.



Application in Italian Cities

Turin: Comprehensive data allowed for detailed morphological and LST analysis. Initially, 171 representative blocks were identified, and this number was later refined to three blocks based on LST data.

Bari: Due to limited data, the focus was on LST analysis. Two building blocks were identified as representative.

Rome: Similar to Bari, four residential areas were identified for LST assessment.

This methodology ensures effective study and mitigation of Urban Heat Island (UHI) effects, contributing to more climate-resilient urban environments.

> *"We must act urgently on **climate change**, as its effects, combined with **urban heat islands**, are driving city temperatures up to **2°C higher**, threatening the well-being of current and future generations."*
>
> *- Intergovernmental Panel on Climate Change (IPCC), Sixth Assessment Report (AR6)*

NEXT STEPS

The next phase of the project will focus on completing the urban-scale simulations of typical configurations using the UBEM tool, based on weather files that incorporate UHI effects and account for their variation over different time periods due to climate change, as well as under the application of resilient and mitigating strategies.

Key Performance Indicators (KPIs) related to building energy performance and indoor and outdoor thermal comfort will be identified, calculated, and classified into thresholds and severity classes to assess the intensity of UHI impacts across different scenarios.

These results will contribute to finalising the Maps of UHI intensity and the Atlas of typical urban configurations enriched with the assessed KPIs.