

Technical Background of CityCLIM

Thermal Sharpener

Technical Details

Thermal Sharpener



What is CityClim?

CityCLIM is a European Union-funded project designed to develop an open platform for climate information and mitigation services. It integrates data from Earth observation sources, ground measurements, and urban weather prediction models to provide detailed weather forecasts for various European cities. The project acknowledges the significant impact of climate change on urban life, particularly the Urban Heat Island (UHI) effect, and addresses these challenges through mitigation and adaptation strategies.

Generic City Climate Platform (GCCP)

The Generic City Climate Platform (GCCP) is a Software-as-a-Service (SaaS) solution developed as part of the CityCLIM project to provide climate adaptation and mitigation services for cities. It **integrates diverse climate data sources, including ground measurements, airborne and satellite data, to offer an advanced urban weather model.** The platform serves as a one-stop shop for City Climate Services, helping both city administrations and citizens understand, predict, and respond to climate-related challenges.

- Services**
- **Citizen Climate Knowledge Services (CCKS):** A public service that informs, warns, and engages citizens on climate change and extreme weather events, encouraging awareness and adaptation.
 - **City Administration Services:** A decision-support tool for city planners and policymakers to analyze, simulate, and implement sustainable urban climate strategies.

INFORM CITIZENS ON CLIMATE CHANGE

WARN CITIZENS ON ARISING HAZARDS

ONE-STOP SHOP FOR CITY CLIMATE SERVICES

SUPPORT MITIGATION & ADAPTATION STRATEGIES

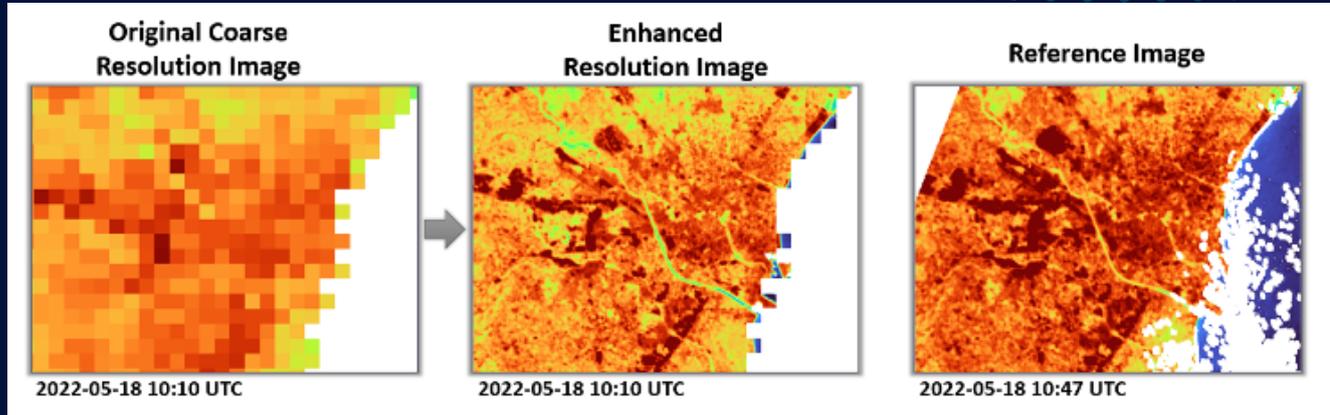
ADVANCED URBAN WEATHER MODEL

ADVANCED URBAN WEATHER MODEL



Thermal Sharpener

The Thermal Sharpener developed in CityCLIMs is responsible for fusing satellite data to produce enhanced Land Surface Temperature (LST) products. It fuses coarse but frequent LST data from Sentinel-3 (1 km) with finer but less frequent data from Landsat 8 and 9 (30 m), yielding bi-daily LST outputs at a 30-meter resolution for detailed urban heat analysis.



Thermal sharpener comparison of results.

Data Sources

- **Sentinel-3 LST:** Provides frequent data (2-4 images per day) at 1km resolution.
- **Landsat 8 and 9 LST:** Higher resolution (30 m), available every 16 days each satellite
- **Sentinel-2 Optical Data:** Used to calculate Normalized Difference Built-up Index and Normalized Difference Vegetation index, both of which contribute to the fusion process.

Applications & Achievements

- **CityCLIM Services:** Utilizes LST data for urban heat map visualization and analysis.
- **Beyond CityCLIM:** Supports climate research, environmental management, agriculture planning, disaster management, infrastructure development, public health, and policy-making
- **High-Resolution Data Generation:** Successfully combines frequent and fine-grained satellite data to produce accurate, high-resolution LST products
- **Validation Success:** Demonstrates significant improvements in temperature data enhancement, particularly in regions with low cloud coverage, proving its effectiveness as a scalable and reliable solution for urban heat analysis.

Key Features

- **Enhanced Spatial Resolution:** produce bi-daily 30 m LST data.
- **Daytime Fusion (ubESTARFM):** Uses high-resolution Landsat data to sharpen coarser Sentinel-3 data during the day, improving spatial and temporal resolution.
- **Nighttime Fusion (Area-to-Point Regression Kriging):** Enhances Sentinel-3 data at night using statistical techniques to approximate fine-resolution temperature data without Landsat data.

Validation & Key metrics

- **Performance Evaluation:** Assessed using Root Mean Square Error (RMSE), Bias, and R^2 .
- **Accuracy:** RMSE in Valencia and Thessaloniki around 1.83 K and 1.89 K with R^2 of 0.78 and 0.73; slightly higher RMSE in Luxembourg and Karlsruhe (~2.20 K) shows downscaling limitations.

Deliverable including the Thermal Sharpener:
<https://zenodo.org/records/13693256>