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Climora: An Urban Heat Island Intelligence Platform

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Abstract: Urban Heat Island (UHI) effects occur when built-up urban areas become warmer than surrounding areas, with patterns influenced by surface materials, vegetation, urban form, and human activity. This paper presents CLIMORA, a web-based Urban Heat Island Intelligence Platform designed to combine climate information and geospatial context in an interactive decision-support dashboard. The current implementation uses NASA POWER climate data access, weather.gov/NOAA forecast integration, and OpenStreetMap-based geographic inputs. It provides heat-zone visualization, temperature trend charts, urban–rural comparison, interactive 2D/3D maps, and suggested cooling interventions with indicative cost and impact information. The application is implemented as a client-side Next.js and React system using TypeScript, Mapbox GL with a Leaflet fallback, Recharts, Zustand, and TanStack React Query. The available project materials document the platform's features but do not provide a controlled validation dataset, quantitative accuracy metrics, or measured post-intervention cooling results. Accordingly, the paper reports the architecture and qualitative functionality of the prototype rather than claiming validated street-level prediction or measured environmental improvement. CLIMORA is intended to support exploratory heat analysis and help identify locations for further assessment by urban planners and sustainability stakeholders.

Keywords: Urban Heat Island, climate intelligence, geospatial visualization, NASA POWER, heat mapping, urban sustainability, decision support.

I. INTRODUCTION

Urban Heat Island (UHI) describes the tendency for urban areas to be warmer than their less-developed surroundings [1], [2]. Urban form, impervious surfaces, building geometry, human activity, and reduced vegetation can influence how energy is absorbed, stored, and released. The resulting heat burden can affect outdoor comfort, energy demand, and public-health risk. Urban heat patterns are spatially variable, and their interpretation depends on local characteristics, weather conditions, observation times, and the sites selected for comparison.

City-wide averages may hide differences between neighbourhoods and individual locations. Urban planners therefore benefit from tools that allow temperature patterns to be explored alongside geographic information about roads, built infrastructure, land use, and green spaces [4]. Open climate and mapping resources provide a practical basis for such tools, although the spatial and temporal resolution of each dataset must be considered before drawing local conclusions [3], [4], [6].

CLIMORA, the Urban Heat Island Intelligence Platform, is a web-based prototype developed to make climate and geospatial information easier to explore [7]. It brings interactive heat maps, severity-zone displays, temperature trends, urban–rural comparison, and cooling suggestions into a single dashboard. The system is intended as a decision-support and visualization tool; it does not replace ground measurements or a validated urban-climate model.

II. LITERATURE SURVEY

Karagwal, Gupta, and Daiman [8] studied land-use and land-cover changes and their influence on Jaipur's thermal environment using Landsat imagery, Google Earth Engine, Random Forest classification, land-surface temperature, and vegetation indices. Their work shows how remote sensing can help examine links between urban growth, vegetation, and surface heat.

Brovelli et al. [9] explored urban air-quality and heat-island monitoring through multiple data sources, remote sensing, local climate-zone classification, and machine-learning methods. Their study highlights the value of combining environmental data with geographic context for urban monitoring.

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These studies inform CLIMORA's focus on presenting climate information through interactive maps, trends, and geographic context. Unlike the cited analytical studies, CLIMORA is currently a visualization and decision-support prototype; it does not claim to implement their satellite-processing or trained machine-learning workflows.
The project's contribution is to bring heat-related views, urban–rural comparison, and cooling suggestions together in one accessible dashboard [7]. Satellite-derived analysis and quantitative validation remain possible future extensions.

III. RESEARCH METHODOLOGY

A. System Architecture

The current project presentation describes CLIMORA as a client-side web application without an Express backend or database server [7]. The interface is built with Next.js App Router, React, and TypeScript. Tailwind CSS and Radix UI primitives support interface components; Recharts provides charts; Mapbox GL through react-map-gl provides interactive map views and 3D building visualization, with Leaflet/react-leaflet as a fallback. Zustand manages local interface state, while TanStack React Query manages remote data fetching and caching.

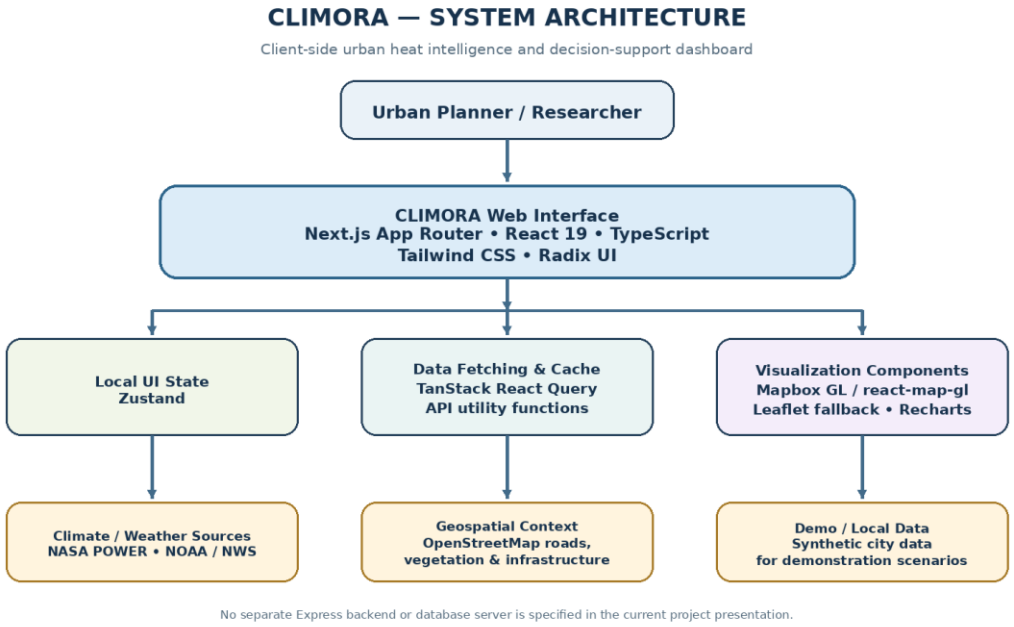


Fig. 1CLIMORA client-side system architecture

TABLE I SYSTEM ARCHITECTURE COMPONENTS

Component	Technology / Source	Function
Frontend	Next.js App Router, React, TypeScript	Dashboard interface and navigation
Styling and UI	Tailwind CSS, Radix UI	Responsive interface controls
Maps	Mapbox GL, react-map-gl; Leaflet fallback	Interactive map layers and 2D/3D views
Charts	Recharts	Temperature trends and comparison charts
State and fetching	Zustand, TanStack React Query	Local UI state, remote request caching
Climate data	NASA POWER; weather.gov/NOAA integration	Historical climate parameters and forecast context
Geospatial context	OpenStreetMap and urban geospatial inputs	Roads, vegetation, infrastructure, and land-use context
Demonstration data	Local generators in lib/data.ts	Demo cities, heat zones, statistics, and recommendations
Reporting	CSV, JSON, PNG export flows	Export of in-memory reports

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IV. RESULTS AND DISCUSSION

A. Implementation Overview

The project presentation documents a dashboard implementation with climate-data access, interactive map views, heat-severity zones, temperature trend charts, urban–rural comparison, recommendation panels, and report-export functions [7]. The qualitative functions described in the project materials are summarized in Table II. They represent documented application capabilities, not a controlled scientific benchmark.

TABLE II QUALITATIVE FUNCTIONAL SUMMARY

Feature	Documented Purpose	Evidence Status
Interactive heat maps	Explore geographic patterns and heat-zone overlays	Feature described in project presentation
Severity zones	Display low, moderate, high, and extreme categories	Classification feature described; thresholds not supplied
Temperature trends	Inspect temperature changes over time	Charting feature described
Urban–rural comparison	Compare temperature information for selected areas	Feature described; independent validation not supplied
Cooling recommendations	Suggest trees, green roofs, parks, and indicative costs/impacts	Local recommendation logic described; estimates not validated
Exports	Generate CSV, JSON, and PNG reports	Export functionality described

V. CONCLUSION

This paper presented CLIMORA, a web-based Urban Heat Island Intelligence Platform that integrates climate-data access, geospatial context, interactive heat maps, charts, severity-zone displays, urban–rural comparison, cooling suggestions, and report exports [7]. The current client-side architecture uses Next.js, React, TypeScript, Mapbox GL with a Leaflet fallback, Recharts, Zustand, and TanStack React Query. NASA POWER [3], weather.gov/NOAA integration [6], and OpenStreetMap [4] are identified as its principal external data sources, alongside local synthetic data for demonstrations.

The available evidence supports describing CLIMORA as a visualization and decision-support prototype, not as a quantitatively validated street-level heat predictor. Future work should formalize the analytical methods, make data provenance visible, validate outputs against independent observations, assess recommendation estimates [5], and conduct usability and performance testing. Such evaluation would help establish the reliability and practical value of CLIMORA for urban heat mitigation planning.

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