

Optimised Full Prototype of Generic City Climate Platform

DELIVERABLE 2.4

Key features and achievements of the Generic City Climate Platform as part of the CityCLIM ecosystem.



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Foreword

Welcome to the CityCLIM project. Europe's metropolitan areas are increasingly suffering from the effects of climate change. Prolonged heat waves pose a threat to the health of the population. To counter this threat, it is important to understand its causes and identify suitable countermeasures in good time. For this reason, the EU funded the project "Next Generation City Climate Services Using Advanced Weather Models and Emerging Data Sources", or CityCLIM for short (2021-2024), as part of its Horizon 2020 programme. The aim of the project was to develop a cloud-based platform which provide various weather and climate services specifically for metropolitan areas based on data from weather models, Earth observation and ground measurements.

Heat waves are a major problem for densely populated areas

As a result of climate change, heat waves are occurring with increasing frequency. Especially densely populated areas are strongly affected by high temperatures, as the heat usually lasts longer and temperatures hardly drop even at night. For this reason, the health burden caused by heat is significantly higher in cities than in surrounding areas. This is why the CityCLIM project aimed to develop a weather forecast model tailored to the needs of large cities. Unlike conventional forecast models, which resolution are usually in the range of several kilometres, the new weather model has a resolution of one hundred by one hundred meters. In addition, the model combines data from satellites with measurements from in-situ sensors and information provided by the population itself.

Weather and climate services for citizens and city administrations

The improved weather model and Earth observation data are the basis for deriving a suite of City Climate Services for combating some of the negative effects of climate change in cities, namely:

- Climate Information Services: Heat Wave Information and Warning, Pollution Information, historical Climate Information Service
- Citizen Weather Sensation Service
- Identification Services: Heat Island, City Air Flow and Pollution Area
- Simulation and Mitigation Strategies Services: Heat-Island, City Air flow and Pollution

These services are made available to the general public, specifically addressing citizens, city councils and other authorities. The services make it possible, among other things, to examine the effects of urban planning measures on urban heat or air flow.

Implementation by a European consortium

Several European companies were involved in implementing the CityCLIM project. OHB System AG was acting as the project coordinator and was responsible for processing and providing the satellite Earth observation data and services. OHB Digital Connect developed an airborne system to validate the calculated model predictions with thermal infrared measurement data. OHB Digital Services developed the cloud-based platform storing and processing the data and hosting the City Climate Services (CCS). OHB Digital Solutions from Austria was responsible for the integration of in-situ data from the pilot cities and the exchange with the pilot cities. Other industrial partners include the Institut für angewandte Systemtechnik Bremen GmbH (ATB), which was responsible for the technical coordination of the project together with OHB and was also supporting the development of the cloud-based data platform. At Meteogix AG, a subsidiary of Kachelmann GmbH, the high-resolution weather model providing the precise weather forecasts was developed. Scientific partners were the Global Change Unit of the University of Valencia, which contributed novel processing methods for thermal spaceborne data for the examination of urban heat islands. Finally, the Helmholtz Centre for Environmental Research from Leipzig developed methods to incorporate data collected by the population in the scope of citizen science.

Four European pilot cities as partners

To develop the City Climate Services as user oriented as possible, the CityCLIM project was carried out in close cooperation with four pilot cities which are spaced out across Europe to

represent its climatic diversity. These are Karlsruhe in Germany, the city of Luxembourg, Valencia in Spain and Thessaloniki in Greece. The cities were contributing to the project by defining their specific needs towards the City Climate Services and the data platform, by supporting the provision of data and by enabling the project results to be validated in a real environment.

Generic City Climate Platform

The Generic City Climate Platform manages the interaction of all components within the CityCLIM ecosystem, and moreover guarantees, among others, operational workflows between them. The design of the GCCP is open such that it supports the extension by new services within the urban domain and beyond. It also provides ready-to-use data sets that have the potential to spark both scientific research projects, as well as support efforts of administrations and businesses to develop data-based mitigation strategies to adapt to the effects of climate change.

Table of Contents

1	Introduction	4
2	Optimized Prototype of the GCCP.....	6
3	Conclusions.....	8

1 Introduction

Within the CityCLIM project was elaborated the Generic City Climate Platform (GCCCP) as part of the overall CityCLIM ecosystem (see Figure 1), which plays a central role in managing the interaction between key components, such as data processors, engines, City Climate Services (CCS), and third-party services like the weather model processor. The platform ensures seamless operational monitorable workflows between these components, external data sources, and integrated services, and guarantees a trusted and secure CityCLIM ecosystem through security mechanisms like API keys and OpenID. Overall, the GCCCP represents a cloud solution that manages the entire CityCLIM ecosystem in terms of orchestration and workflows while dealing additionally with general aspects such as e.g., identification, access rights, and data management.

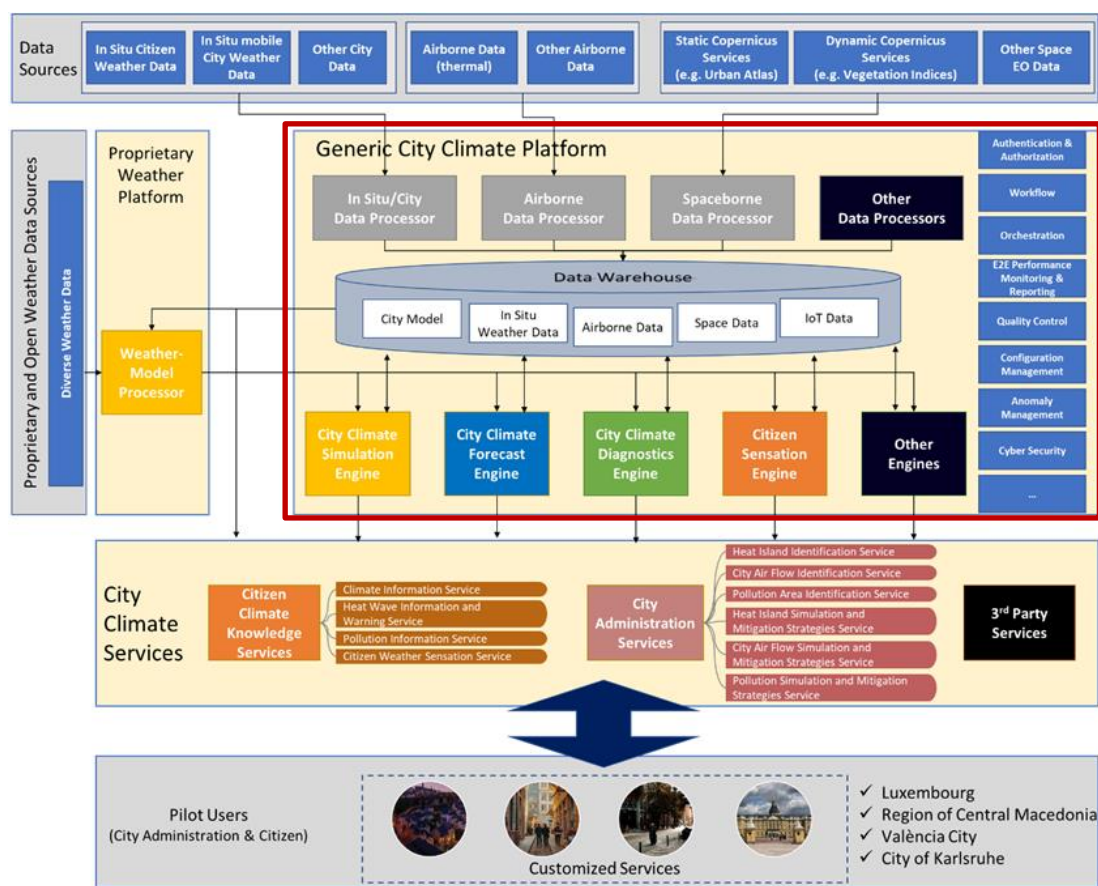


Figure 1: The “Generic City Climate Platform” and its components (red box) within the overall CityCLIM architecture.

The GCCCP is designed in such a way that it operates independent from integrated City Climate Services (CCS) and their required data processors, providers, GUIs and engines developed within the CityCLIM project. This extendable design allows a utilization by 3rd party services and component providers when implementing new services in the context of urban climate services.

Therefore, the GCCP extends the target groups of CityCLIM by potential service and components contributors, i.e.,

- developers, who are interested in using the storage capacities, access to already integrated workflows and data for the implementation of new software solutions.
- companies (or service providers), that are interested in extending the CityCLIM ecosystem by integration of further applications in the context of challenges induced by the climate change.

The development of the GCCP has followed a structured approach, gradually refining its features and capabilities through prototype development and user feedback. This public deliverable documents the final optimized version of the GCCP, summarising the key achievements made throughout the development process, and highlighting its ability to support efficient urban climate management.

2 Optimized Prototype of the GCCP

The GCCP forms the central management and orchestration part of the CityCLIM ecosystem, which is formed by different components ensuring ...

- ... **logging and telemetric** collection and analysis with adequate visualization (e.g., performance, service usage, data access, ...), see Figure 2.
- ... **managing external communication** as e.g., routing, rate limiting, load balancing for APIs and DDoS protection for web-site endpoints.
- ... a state-of-the-art **identity management** system to integrate authentication and authorization mechanisms (e.g., Single-Sign On, account and token management)
- ... storage management and **data operation workflows** allowing communication with the data warehouses using cloud-provider specific software development kits and APIs.
- ... **storage capacities** for various types of data.

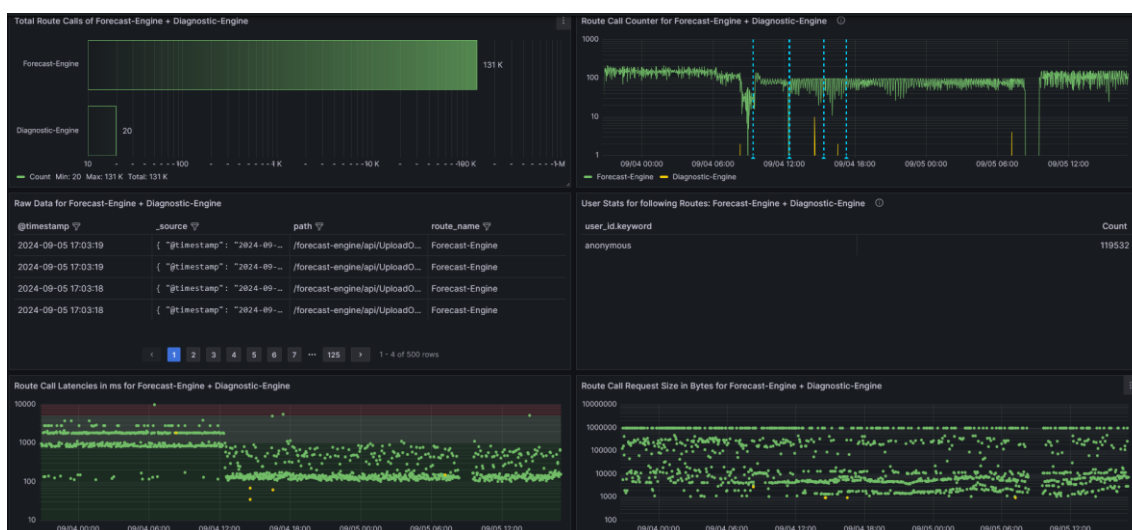


Figure 2: View on monitoring dashboard showing relevant information on processing tasks and communication within the platform.

Due to its open design, the GCCP can be extended and utilized by further development (e.g., by adding new storage capabilities, monitoring dashboards, and platform features).

Key features:

- Storage capacities and access together with dedicated APIs and SDKs for data management and operation actions.
- Identity Management system that handles authentication and authorization for integrated services.
- Visualization, collections and evaluation of different metrics for service-related telemetry.
- Data access to climate-related earth observation and model data.
- Technical access by APIs that allow interaction with services already operating in the CityCLIM ecosystem (see e.g. Figure 3).

tables		
POST	/table/write/entities	Write Multiple Structured Data
DELETE	/table/remove/query	Remove Structured Data Query
POST	/table/write/entity	Write Structured Data
POST	/table/remove/entities	Remove Multiple Structured Data
POST	/table/read/entities	Read Multiple Structured Data
POST	/table/remove/entity	Remove Structured Data
POST	/table/read/entity	Read Structured Data Entity
POST	/table/read/query	Read Structured Data Query
PATCH	/table/update/entity	Update Structured Data
PATCH	/table/update/entities	Patch Multiple Structured Data

Figure 3: Extract of APIs for managing structured data.

Methodology

The GCCP is a scalable multi-cloud solution that fulfils high-security and development standards, where its architecture is independent of the City Climate Services developed within the CityCLIM project, and so extension by new services is supported.

Application potential

- Accelerated implementation of new services in the context of urban climate services by utilizing storage management capabilities, identity management system and continuous metric monitoring.
- GCCP forms the foundation for eventually new services for the CityCLIM ecosystem.
- Ease integration and deployment of City Climate Services, where additional services can be added on the fly as the GCCP forms the backbone of all City Climate Services.
- Extension of the CityCLIM ecosystem by the integration of new services while establishing synergies with data from existing services.

Main achievements

Orchestration and management of workflows that process various types of data (e.g., weather stations, mobile sensors, earth-observation, airborne, models, ...) that lead to City Climate Services in an operational cloud environment.

3 Conclusions

The GCCP plays a dominant role in the CityCLIM ecosystem being responsible for all technical aspects required to establish all required operational workflows, that enable the City Climate Services. Nonetheless, its capacities allow to accelerate implementations of new services in the context of a new generation of climate services, and further ensures that the scope of the existing CityCLIM ecosystem can be extended. Hence, the GCCP can form a foundation for future climate services.

Technical interested reader finds in the developer guide Manual 4 “Development and Integration” at <https://www.cityclim.eu/info-material> further information about the GCCP, its functionality and benefits when utilizing it to own development projects.



About CityCLIM

The strategic objective of CityCLIM is to significantly contribute to delivering the next-generation of City Climate Services based on advanced weather forecast models enhanced with data both from existing, but insufficiently used, sources and emerging data sources, such as satellite data (e.g., Copernicus data) or data generated by Citizens Science approaches for Urban Climate Monitoring etc. For City Climate Services, data products of interest related to land surface properties, atmospheric properties (e.g., aerosol optical thickness), geometry etc. For all of those, information of interest concerns e.g., Copernicus data products and services that are already existing (e.g., based on Sentinel-3/OLCI, PROBA-V, SPOT, Sentinel-1, MetopASCAT data), will exist in the near future (based on already flying satellites such as Sentinel-2), or will exist in the mid-term (based on satellites currently under development) and long-term (based on satellites soon starting concept phase) future. The project will establish; (i) an open platform allowing for efficient building of services based on access to diverse data; (ii) enhanced weather models based on data from diverse existing and emerging sources; (iii) a set of City Climate Services customizable to specific needs of users in cities; and (iv) a generic Framework for building next generation of Urban Climate Services. CityCLIM will be driven by 4 Pilots addressing diverse climate regions in Europe (Luxembourg, Thessaloniki, Valencia, Karlsruhe) which will define requirements upon the tools to be developed, support specification and testing of the services and serve as demonstrators of the selected approaches and the developed technologies. The consortium will elaborate business plan to assure sustainability of the platform and services.

Every effort has been made to ensure that all statements and information contained herein are accurate, however the CityCLIM Project Partners accept no liability for any error or omission in the same.

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