Demonstration Report

Deliverable D7.8

The demonstration of the in-situ measurement infrastructure and the services developed within the CityCLIM project in 9 illustrative videos recorded in the four pilot cities.

September 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No *101036814*

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 Services
- 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 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 Meteologix 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

In order 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.

The Demonstration Report

This document presents the implementation of the services provided by CityCLIM, in the four pilot cities, according to their individual needs and the capabilities of the project. In order to demonstrate the services, their implementation and citizen involvement, 9 videos were made for the effective dissemination of the CityCLIM end products and their success in the pilot cities.

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1 Introduction

Many European cities are suffering from the effects of climate change and especially heat waves threaten public health. Citizens living in densely populated areas are particularly affected by high temperatures as heat is trapped by materials and hardly drops during the night. For this reason, a high-resolution weather model (UltraHD) was developed within the framework of the CityCLIM project with a spatial resolution of 100x100 m. The weather model was applied in three pilot cities, Valencia in Spain, Karlsruhe in Germany and the city of Luxembourg, while a MOS approach (Model output statistics) is applied in Thessaloniki, Greece.

To ensure a good performance of the weather model, new weather stations were installed in the pilot cities, providing local in-situ measurement data to enrich the existing network which in some cases was quite poor or not available at all. Additionally, amateur weather stations and mobile weather sensors (MeteoTrackers, to mount, e.g., on a bicycle or scooter), were given to citizens in so-called citizen science measurement campaigns. The aim is to raise awareness of the citizens about climate change and the microclimate in the urban environment. In each city, the campaign to collect in-situ data was applied in a different way, depending on its needs and interests.

Using the UltraHD high-resolution weather model, the in-situ weather measurements and the MOS-model, the CityCLIM project developed several services. These services are divided into two main categories: the **Citizen Climate Knowledge Services** and the **City Administration Services**.

The **Citizen Climate Knowledge Services** are publicly accessible services designed for interested citizens in and outside the pilot cities. The aim is to raise awareness for and gain insight into weather and climate related processes in the (urban) environment as well as to motivate citizens to get involved in potential adaptive strategies and knowledge gain around climate change and their consequences on urban environments. This group of services consists of the **Climate Information Services** which provide access to a huge database and processing engines with actual and historical measurement data as well as enriched data based on them. They allow access to an open database to analyse and visualise the data in different ways. The **Heat Wave Information and Warning Service** will help to monitor ongoing or upcoming heat waves and to identify strongly impacted areas. It may help to adjust personal activity plans and to reduce the experienced heat stress. The **Pollution Information Service** will provide information about the current pollution status in the city and the upcoming situation in the following days. This includes model analysis of in situ measurements and short-term pollution forecasts for the city of Valencia. The Citizen Weather Sensation Service in contrast takes into account the personal feeling of citizens facing the weather conditions.

The **City Administration Services** supply urban planners and city administrators with advanced tools and insights for city development and climate mitigation plans. Identification Services offer statistical maps that rely on aggregated results from past runs of the urban weather model, whereas, after the user has submitted simulated changes to urban areas, using the Simulation Editor tool, the Mitigation Services produce difference maps comparing the model results from simulated changes to prototypical days with respect to a predefined set of parameters.

For further details about Citizen Climate Knowledge Services and the City Administration Services, see D1.6 (Public CityCLIM Concept) which provides detailed manuals.

The aim of this deliverable is to present the CityCLIM-services and their implementation in the four pilot cities. For effective demonstration of the developed services, short video stories were created, each presenting a different content, emphasizing in the practical application of the services and the measurable benefits of urban resilience. Videos offer several advantages for effectively conveying information and demonstrating concepts. They combine both visual and auditory elements, making the content more immersive and memorable. Moreover, videos have a greater potential to reach many stakeholders and can be well used for many dissemination activities like in social media.

The demonstration videos were produced by RTL Luxembourg, the leading media brand in the Grand-Duchy of Luxembourg. RTL Luxembourg is the project partner for the pilot city of Luxembourg, with ex-tensive experience in radio and TV production. As each city has different needs, different scenarios were created for the videos in which their special characteristics are highlighted. Filmmakers from RTL Luxembourg visited the cities, where the videos were shot with the help of the local project leaders.

The demonstration report plays a critical role in helping stakeholders to assess the provided services and to guide potential next steps. This deliverable disseminates the innovated services and their successful implementation in pilot cities. It highlights the willingness of citizens to participate as citizen scientists and how their involvement raises their awareness to climate change. Finally, this project connects the needs of big cities with scientists regarding climate change mitigation, in order to develop effective sustainable urban strategies. By leveraging scientific expertise, cities can implement targeted and innovative solutions to address their specific climate challenges, like the urban heat island. In the next chapter, all promotional videos are explained and finally a conclusion is given.

2 Demonstration Videos

This chapter describes in a few words, the different videos in a way that is understandable and concise for the general public and stakeholders. The videos are currently in their finalization. They will be published on the public website of the CityCLIM project www.cityclim.eu/.

2.1 Video 1. Empowering Citizens with CityCLIM: Citizen Science in Karlsruhe

This video focusses on the citizen science measurement campaign of the CityCLIM project in Karlsruhe, as organized in the summer of 2023. The video showcases how citizens where enthusiastic to come in action and collected data using a mobile sensor (MeteoTracker). It is explained that the sensor measures temperature, humidity and the location of the sensor, and additionally it was shown how this works in practice and where the sensor was attached to a bicycle. An overview is given about details of the campaign itself and a participant volunteered to show the daily business of using a MeteoTracker. The participant starts at home, attaching the MeteoTracker at her bike, switches it on and cycles through the city towards her work where she switches off the sensor again. The data is analyzed by the Karlsruhe Institute of Technology and explained in the video. The MeteoTracker measurements complement to the local high-quality Barani weather sensors, installed within the CityCLIM project, in the sense that bicycle measurements are not stationary. This approach enhances the resolution of environmental data collection, especially in hard-to-reach areas, and aids in creating a more detailed climate map of the city.

2.2 Video 2. CityCLIM Simulations in Karlsruhe: Shaping Urban Environments for a Cooler Future

This video explores the simulation services provided by CityCLIM, specifically the Simulation Editor tool. This tool allows urban planners to model different scenarios, such as converting a park into a concrete area or vice versa, and to observe the potential impacts on the city's temperature development. These simulations can guide city planners in implementing structural changes that make the urban environment more liveable. The UltraHD model, which is the basis of the Editor tool, is mentioned and the sensor data and 3D city model of Karlsruhe that form input data for the weather model are explained in the video.

2.3 Video 3. Navigating Heat with Luxembourg's Heat Sensation Map

This video introduces Luxembourg’s Heat Sensation Map, a tool that allows users to set their preferred comfort temperature and receive a color-coded map indicating the most comfortable areas during hot days. This helps residents and visitors to identify cooler spots in the city. Additionally, the video plans to feature the installation of new weather stations in Luxembourg, further enhancing the city’s already dense network of environmental monitoring.

2.4 Video 4. Enduring the Heat: A Day in the Life of an Elderly Couple in Thessaloniki

This story highlights the severe impact of prolonged heat on vulnerable populations in Southern Europe, and the need for tools like the ones developed within CityCLIM. This video documents the daily struggles of an elderly couple in Thessaloniki as they cope with the extreme heat that dominates the city from April to late October. With temperatures regularly exceeding 35°C, the couple is forced to stay indoors for most of the day, only venturing out in the late evening when it cools down slightly. Due to their limited pension, they cannot afford to use air conditioning, forcing them to adjust their daily routine to avoid health risks. Therefore, a high-resolution heat map of the city would help their daily routines.

2.5 Video 5. Learning Through Climate Data: CityCLIM at 63rd Primary School of Thessaloniki

The aim of the citizen science campaign in Thessaloniki was to involve students in the project and to raise their awareness in climate change. In this video, we visit the 63rd Primary School of Thessaloniki, where students actively participate in projects that utilize data collected by the CityCLIM project. A weather station installed in the schoolyard monitors various environmental parameters, and the students are involved in overseeing its operation as part of their studies. The video highlights how challenging it can be for students to concentrate in the classroom during the spring when temperatures are already high. 63rd, is one of 13 schools in Thessaloniki participating in the CityCLIM project, where more than 1.000 students attended the presentation about the CityCLIM project, climate change and the urban heat island effect.

2.6 Video 6. CityCLIM's Impact on Thessaloniki: A Regional Perspective

This video provides an overview of the CityCLIM project in Thessaloniki and its significance for the entire region of Central Macedonia. We follow Chrisostomos Paranos, the local project leader, through his daily activities, including a visit to one of the sensor sites where he explains the various environmental parameters being measured. The video also features an interview with Gioutikas N. Konstantinos, Vice Governor of Thessaloniki, who highlights the importance of the project for the region's climate adaptation efforts.

2.7 Video 7. Optimizing School Outings with CityCLIM in Valencia

CityCLIM aids schools and teachers in planning safer excursions for students, ensuring they are not ex-posed to dangerous heat conditions. In this video, we visit the Public School "Ballester Fandos" in Valencia, where the principal demonstrates how teachers can use the CityCLIM services to choose the best day and location for school trips, minimizing the risks associated with extreme heat. The principal also explains to the students the necessary precautions to take during high temperatures.

2.8 Video 8. Valencia's Green Initiatives and Climate Planning with the CityCLIM services

This video highlights how the CityCLIM project supports Valencia in developing a comprehensive climate plan. We follow Ana Viciano Pastor, the project lead in Valencia, as she oversees the installation and operation of various sensors across the city. These sensors monitor temperature, humidity, air pressure, wind, rain, solar radiation, and even acoustic pollution, alongside air quality measurements like particulate matter. Valencia, already a green city with numerous parks, fountains, and green spaces, uses this data to further enhance the urban environment and adapt to its hot climate.

2.9 Video 9. Mapping Valencia's Heat Islands: The Overflight Campaign

In this demonstration video, we explore the overflight campaign in Valencia, designed to capture detailed data on ground temperatures and heat radiation across different urban areas. The campaign employs a single-engine aircraft equipped with specialized cameras, capable of producing high-resolution images, infrared footage, and precise temperature mapping. This method provides more accurate results than satellite data, helping to identify heat-retentive surfaces like large concrete areas and assisting in the city's climate planning efforts.

3 Conclusions

Climate change already has big impacts on big cities, especially due to rising temperatures and extreme weather events. The relationship between the Urban Heat Island effect and climate change highlights the need for integrated approaches to urban planning and environmental management. By implementing strategies to mitigate climate change, cities can improve their resilience to heat extremes, protect public health and create sustainable urban environments. Moreover, building public awareness about climate change is vital for fostering a well-informed society that can actively participate in climate action.

CityCLIM services are designed to meet the specific climate mitigation and adaptation needs of cities by providing localized climate data, advanced models and actionable solutions. The demonstration of City Administration Services and Citizen Climate Knowledge Services, showcases how these tools and technologies can be applied in real-world urban settings to help cities mitigate and adapt to climate change. This demonstration was provided by a series of videos that present the challenges of the pilot cities and the solutions that can be provided from CityCLIM. In that way, services can be spread through many different channels and reach even more stakeholders.

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.

Funded by the Horizon 2020 Framework Programme of the European Union