COPERNICUS

of climate change at public transport stops in Prague

*** ----



INTAL AT

THE CITY OF PRAGUE WANTED TO VISUALISE HEAT VULNERABILITY NEARBY PUBLIC TRANSPORT STOPS.

DATA FROM SENTINEL-2A ALLOWED THE CITY TO REALISE THE URBAN HEAT VULNERABILITY MAP OF PRAGUE.

TRANSPORT STOPS MOST VULNERABLE TO HEAT WERE ADAPTED AND MADE MORE COMFORTABLE FOR CITIZENS AND TOURISTS.



COPERNICUS



COPERNICUS, EUROPE'S EYES ON EARTH

Copernicus is the Earth Observation Programme of the European Union, looking at our planet and its environment for the benefit of global citizens.

Five Copernicus missions are currently in orbit. The data they provide is coupled with groundbased, airborne, and seaborne measurements to make six information services focused on monitoring: Atmosphere, Marine environment, Land, Climate change, Security, and Emergency.

Such services are free and openly accessible and can be used by private, public and international organisations to improve life on Earth.

For more information about Copernicus, visit www.copernicus.eu

PRAGUE IS RECORDING INCREASING TEMPERATURES, OF UP TO 34°C IN SUMMER, WHICH HEAVILY IMPACT THE CITY'S INHABITANTS AND VISITORS.

As a consequence of climate change, temperatures in cities are increasingly elevated, causing a phenomenon widely known as "urban heat islands", places where temperature are particularly high as compared to the city's outskirts.

Cities are vulnerable to high temperatures because of their population density, extended built areas and the concentration of social and economic activities. The effects of climate change vary significantly among cities and within city areas.

THE PAVED SPACES AND BUILT AREAS IN PRAGUE, TOGETHER WITH THE INDUSTRIAL INFRASTRUCTURE IN ITS OUTSKIRTS, MAKE THE CITY PARTICULARLY VULNERABLE TO EXTREME HEAT EVENTS.

Nevertheless, Prague can also count on a good amount of green spaces and vegetation, that can help cooling the city.

In 2018, the City released a Climate change adaptation strategy aimed at "enhancing a longterm resilience and reducing vulnerability of the Capital City of Prague to climate change effects by step-by-step implementation of adaptive measures, preferably applying nature-based solutions combined with grey, i.e. technological and soft measures, to provide inhabitants with high well-being" [1].

The Prague Climate Plan 2030 "Prague on the road towards carbon neutrality", includes



measures to improve health and environment in Prague, to increase the city's resilience to environmental risks and extreme events, and to reach carbon-neutrality [2].

EURISY

PRA HA PRA GUE PRA GA PRA G

THE ENVIRONMENTAL PROTECTION DEPARTMENT OF THE CITY OF PRAGUE

Type of organisation: Public regional administration Country: Czech Republic Annual budget in 2020: More than € 100m Previous experience with Earth observation data: Yes

The Environmental Protection Department of the City of Prague approves and implements the Climate Change Adaptation Strategy and its Implementation Plans.

The Department designs, manages and finances adaptation projects and analyses of some selected data.

It can also count on the support of the Prague Institute for Planning and Development, which manages the Prague Geoportal, making available a number of maps of Prague, and which works with universities, scientific research institutions, and non-profit organisations, both nationally and internationally. BEING CONSCIOUS ABOUT THE THREATS POSED BY CLIMATE CHANGE ON THE CITY'S ENVIRONMENT AND ON PEOPLE'S HEALTH, THE ENVIRONMENTAL PROTECTION DEPARTMENT OF PRAGUE IS CONSTANTLY LOOKING FOR SOLUTIONS TO ADAPT SPATIAL PLANNING TO INCREASING TEMPERATURES.





The Department makes an extensive use of Geographic Information Systems (GIS) to understand how Prague is currently coping with climate change and to envisage scenarios to better adapt to rising temperatures in the future [3].

Indeed, GIS allow city planners to visualise and characterise the city and its assets both at the street level and as a totality from a bird's-eye perspective.

Different GIS layers allow to visualise on the same geographic map, information related to the physical space and human activities, such as infrastructure, buildings, materials, vegetation, demographics, and economics, and to see how these interact with raising temperatures. THE ENVIRONMENTAL PROTECTION DEPARTMENT WANTED TO VISUALISE HEAT VULNERABILITY IN THE CITY AND THE AREAS THAT ARE AFFECTED THE MOST, ESPECIALLY NEARBY PUBLIC TRANSPORT STOPS WHERE PEOPLE SPEND A CONSIDERABLE AMOUNT OF TIME.

Indeed, the City of Prague has one of the most efficient public transport systems in Europe and two-thirds of its 1.324.277 population use public transport to move around the city and its outskirts. To assess the effects of climate change on transport stops and identify the stops that are most vulnerable to extreme heat events, the Environmental Protection Department of the City of Prague asked for the support of ECOTEN Urban Comfort, a local start-up specialised in urban and environmental engineering.

As a first step, the company defined the indices to be taken into account for a heat assessment.

Thermal exposure, which indicates the distribution of heat over the city, was calculated by identifying the warmest areas of the city during the days in which temperatures exceeded 30 °C. These data were extracted from images acquired by the Landsat 8 satellite in the summers between 2015 and 2019.

Sensitivity, which represents the variable that drives the intensity of heat exposure (the longer you wait, the hotter you get), was measured through the average waiting time for passengers at each public transport stops, using information from Prague's OpenData.

Adaptive capacity, which is the ability of the urban ecosystem to be resilient to heat events, was assessed by mapping greeneries and water bodies around public transport stops.

The adaptive capacity was calculated by summing up the Advanced Vegetation Index and the Normalised Differential Water Index, both measured through data from the European Sentinel-2A satellite [4].

© Ecoten Urban Comfort

THE INDICES WERE COMBINED TO CREATE THE URBAN HEAT VULNERABILITY MAP OF THE CITY OF PRAGUE.

THE URBAN HEAT VULNERABILITY MAP SHOWS THE PUBLIC TRANSPORT STOPS THAT ARE MOST VULNERABLE TO EXTREME HEAT.

The map is meant to serve as a strategic tool for City administrators, urban planners and stakeholders, providing suggestions on measures to be taken to mitigate the effects of heat at the public transport stops in Prague. These include placing greeneries and systems to humidify the street pavement and the air, and using materials that retain less heat.

The Map classifies bus and tram stops in five categories, according to their degree of vulnerability to high temperatures.

- A category stops are highly vulnerable to heat and are typically located in the city centre within the pedestrian zone or in narrow streets with low traffic levels and no greeneries, but with the possibility of creating them in the nearby area;
- B category stops are located between the tram/bus and road lanes in wide streets, are not large enough to include greeneries, but could be widened to create space for plants (or plants could be placed in their proximity);
- C category stops are placed outside the city centre and along the tram/bus and road lanes in areas with few trees or greeneries;
- D category stops are located in the outskirts of the city, in developing or industrial neighbourhoods, along the tram/bus and road lanes in semi-open or open spaces, with few trees and greeneries;
- E category stops are in the outer city, typically on the side of wide roads with no tram lanes.



TOP Heat Vulnerable Stops

- Myslíkova
- Národní trída
- Masarykovo nádraží
- Námestí Republiky



Green solutions

Greenery provides shade to citizens and also cools down the urban environment through evapotranspiration.

Blue solutions

Misters and water fountains can help cool down the urban environment through humidification. Also, public drinking water stations can allow citizens to hydrate themselves during a heat wave event and hence better cope with extreme heat.

Source: Public Transport Stops Heat Vulnerability Assessment of Prague, Czechia, Urban Comfort



THE CITY AUTHORITIES USE THE MAP TO VISUALISE THE STOPS THAT NEED ATTENTION AND TAKE ACTION TO MAKE THEM MORE COMFORTABLE.

For example, the first green lawn on the roof of a tram stop was placed at the Hradčanská station, where the municipality planted grasses adapted to dry climates and rock gardens, which are to withstand drought and frost.

Solar panels were installed on some of the stops' roofs, supplying power for lighting and Wi-Fi signal.

Also, the Prague water supply company placed misting devices in the areas nearby some stops (Ládví, Palmovka, Karlínské náměstí, and Florenc). The droplets emitted from the misting devices absorb part of the heat in the immediate surroundings, thanks to the conversion of water into steam which cools the air.

MITIGATING THE EFFECTS OF CLIMATE CHANGE AT PUBLIC TRANSPORT STOPS IN PRAGUE Moreover, fountains were placed nearby stops for residents and visitors to refresh themselves during warm days.

THANKS TO THE COPERNICUS SATELLITES, THE CITY HAS RELIABLE, OBJECTIVE AND SHAREABLE DATA TO ACT AGAINST CLIMATE CHANGE.

The use of a virtual map allows the Environmental Protection Department to understand how climate change currently affects the city as a whole and at the street level, and to make predictions on how these effects will evolve over time.

Using a GIS, the Department can study the relationships between different data and overlay statistics on top of the environmental information derived from satellites, sensors and other observations. THE URBAN HEAT VULNERABILITY MAP PROVIDES AN EVIDENCE BASE TO PLAN FUTURE MEASURES TO MAKE THE CITY'S INFRASTRUCTURE MORE RESILIENT TO CLIMATE CHANGE.

The combination of different data sources on GIS allows the city to monitor the effects of climate change on vulnerable people, such as the elderly and the children.

Earth observation data, coupled with statistics and other survey data, can be a precious tool for city authorities to take evidence-based decisions to improve life in cities.

DATA DERIVED FROM SATELLITE REMOTE SENSING CAN BE USED BY CITY AUTHORITIES TO DECIDE ON WHERE AND HOW PLACE NEW INFRASTRUCTURE, HOUSEHOLDS AND PARKS, TO CHOOSE BUILDING MATERIALS THAT RETAIN LESS HEAT, OR TO INSTALL AND MONITOR GREEN ENERGY SYSTEMS, SUCH AS SOLAR AND WIND POWER PLANTS ON ROOF TOPS.



LINKS

Environmental Protection Department of the City of Prague: https://adaptacepraha.cz/en

Climate Plan Prague 2030: Prague on the road towards carbon neutrality: https://klima.praha.eu ECOTEN Urban Comfort: https://urban-comfort.eu Prague's OpenData: https://opendata.praha.eu/en Prague Institute of Planning and Development (IPR Prague): www.iprpraha.cz/en

IPR Prague's Geoportal: www.geoportalpraha.cz/en Public Transport Stops Heat Vulnerability Assessment of Prague, Czechia, Ecoten Urban Comfort, Portfolio: https://urban-comfort.eu/portfolio/city-of-prague SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable, United Nations Department of Economic and Social Affairs,

Sustainable Development:

https://sdgs.un.org/goals/goal11

Video. How we Assess and Mitigate Heat Vulnerability in Cities, Ecoten Urban Comfort.

https://www.youtube.com/watch?v=VfVgDtrqIEA&t=6s Video. Urban Heat Vulnerability Assessment, Ecoten Urban Comfort: https://www.youtube.com/watch? v=UTBEcfDYbPg

REFERENCES

[1] Capital City of Prague Climate Change Adaptation Strategy, Prague City Hall 2020. Consulted on 19 October 2021.

[2] Prague Climate Plan 2030 "Prague on the road towards carbon neutrality", Prague City Council 2022.
Consulted on 19 October 2021.
[3] Prague: Extreme-Heat Events Spur Climate Action, Using Geospatial Tech, ESRI Blog. 27 April 2021.
Consulted on 19 October 2021.
[4] Public Transport Stops Heat Vulnerability Assessment of Prague, Czechia, Urban Comfort s.r.o., February 2020 (in Czech). Consulted on 19 October 2021.

CREDITS AND CONTACTS

Tereza Líbová, Climate change adaptation specialist Prague City Hall, Department of Environmental Protection Prague, Czech Republic tereza.libova@praha.eu www.praha.eu www.adaptacepraha.cz

Manon Corneille, Business Developer ECOTEN Urban Comfort s.r.o. Prague, Czech Republic corneille@urban-comfort.eu https://urban-comfort.eu/

MITIGATING THE EFFECTS OF CLIMATE CHANGE AT PUBLIC TRANSPORT STOPS IN PRAGUE



COPERNICUS & ME

THIS ARTICLE HAS BEEN PRODUCED BY EURISY WITH THE SUPPORT OF THE FRENCH NATIONAL CENTRE FOR SPACE STUDIES WITHIN THE FRAMEWORK OF THE "COPERNICUS & ME" INITIATIVE.

THIS INITIATIVE IS IMPLEMENTED BY EURISY AND CNES WITH FUNDING FROM THE CAROLINE HERSCHEL FRAMEWORK PARTNERSHIP AGREEMENT **BETWEEN** THE **EUROPEAN** COMMISSION AND COPERNICUS PARTICIPATING STATES. THE INITIATIVE IS OVERSEEN BY CNES WITHIN THE CONTEXT OF THE INITIATIVE "CONNECT-BY-CNES.

