



Mapping the urban climate to reduce the heat island effect

Mannheim, Germany

IN A NUTSHELL

Mannheim has conducted an urban climate analysis to identify heat stress, in order to target planning measures reducing the urban heat island effect affecting more than 140,000 residents. One of these measures is an urban green corridor acting as a cold air guideway, mitigating the hot temperatures in adjacent neighbourhoods.

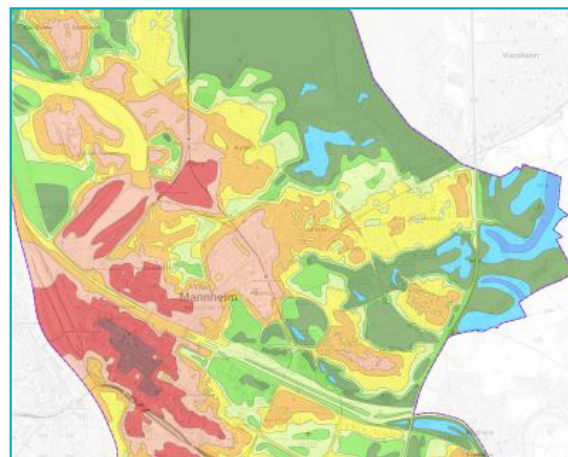
Assessing heat stress

With a 1.9° Celsius average temperature increase expected by 2050 and a likely increase in the rate of heat events in Mannheim, the city has carried out climate analyses (first in 2010, then in 2020) to identify the exposure of people and the urban environment to bioclimatic stresses. This exercise helps urban planners to identify solutions that mitigate the effects of heat on both citizens and critical infrastructure.

The 'Urban Climate Analysis Mannheim 2020' provides all city actors with sufficient and scientifically robust data on heat stress across the city. The analysis identifies the heat stress for each building and open space, allowing the city to draw a map of hotter and colder urban areas and their relation to each other, for instance, through green spaces acting as urban climate compensation areas.

How was the climate analysis developed?

For the Urban Climate Analysis Mannheim 2020, the city applied a computer-aided, model-based approach¹ in combination with air temperature measurements. Using a calculation model instead of an aerial survey like in 2010 – in which the surface temperature was derived from a static infrared thermal survey – allowed the city to model the impact of planned urban development projects on the local climate. For example, the transformation of the former military Spinelli Barracks area into a park and a new housing district was assessed in the model despite being under development at the time.



Isotherm map at 11 pm; © Department for Geoinformation and City Planning, Mannheim

MANNHEIM



Mannheim's Water Tower at dusk; © Philip Koschel

Population:

320,010 (2020)

Area

145 km²

Signatory to the Covenant of Mayors since:

2010

CO₂ emission reduction target:

40% (2030)



KEY FIGURES

8.5°C temperature differences within the city

140,000 city residents live within the urban heat island

11% more cold air transport expected thanks to **7 km** 'north-east green corridor'

1. FITNAH 3D – Flow over Irregular Terrain with Natural and Anthropogenic Heat sources

Using the heat maps for planning a green corridor

The climate analysis demonstrated how the urban heat island effect contributes to an 8.5 °C temperature difference between the city centre and outer areas in Mannheim. Notably, it has shown that almost half of all residents in Mannheim are directly affected by negative bioclimatic stresses. These results underscore the importance of securing green areas as cold air generation areas. Mannheim has seven existing green corridors including the 'north-east green corridor' consisting of agricultural fields and lakes in the city's outskirts. Thanks to the heat map analysis, Mannheim has decided to develop this corridor throughout the former 'Spinelli Barracks' into the city centre. By replacing barracks (acting as airflow barriers) with a new park, the German National Garden Show Mannheim 2023 and a new residential area, the city is creating a highly effective climate compensation area and a cold air guideway.

Using mobile measurements of temperature, wind speed, and wind direction, and smoke cartridge tests, the green corridor's potential for fresh air generation, already indicated by the climate analysis, was further confirmed. In total, this 7 km green corridor connecting 220 hectares of green spaces will reduce the inner-city heat island when channelling winds from the northeast. The green corridor can transport up to 11% more cold air, especially on cloudless summer nights. This increase in airflow will be thanks to the corridor's width of over 400 meters, which allows for a cold air volume flow of over 10,000 m³/s to develop in predominantly flat terrain.

In the new residential area 'Käfertal Süd (Spinelli)', Mannheim will also realise interventions to create a liveable district and reduce the heat island effect highlighted by the heat mapping, such as green roofs and facades, tree planting, and sufficient clearance between buildings for fresh air circulation. The transformation of the 'north-east green corridor' will be completed by 2023, coinciding with the German National Garden Show in Mannheim, a nationwide flower show dedicated to creating a sustainable city environment.

Lessons learned

Mannheim's experience with heat mapping has allowed the city to draw some key lessons. First, it became clear that the heat maps produced every ten years have to be combined with real-time small-scale temperature and precipitation measurements due to the increasing frequency of extreme weather events. As a result, the city is now building two weather stations in the inner-city heat island. They will provide planners and the public with real-time climate data, which can be used by the health department for targeted interventions during extreme heat events.

A second key lesson learned is the importance of carrying out urban climate analysis modelling for planned urban interventions. The computer-based model only requires calculating a city-wide climate model once (for 2020, 2050 or 2100, based on climate scenarios) and allows different variants of upcoming planning projects to be inserted, calculated, and compared with each other. This simplifies the selection of the best and most climate-adapted planning design and reduces modelling costs.

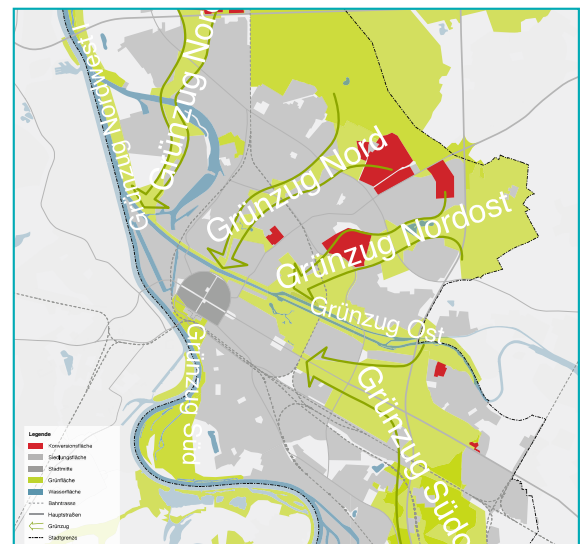
Citizens received the climate analysis with interest. In Mannheim, having robust and science-based heat mapping increased political and public acceptance of subsequent interventions. Part of the success lies in the simplicity of the isotherm maps, which are immediately understood by the wider public.



FINANCING THE PROJECT

- + **Financing sources for the Urban Climate Analysis Mannheim 2020:**
€50,990.59 self-financed by the City of Mannheim.
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- + **Total amount:**
€99,147.83



The North-east green corridor "Grünzug Nordost" with the Spinelli barracks area (in red) © Department for Geoinformation and City Planning, Mannheim

USEFUL LINKS

- [Urban climate analysis Mannheim 2020 website](#) (in German)
- [German National Garden Show Mannheim 2023 website](#)
- [Urban climate analysis Mannheim 2010 website](#) (in German)



CONTACT

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