

Urban Heat Island in London

The urban heat island

In general, temperatures are relatively higher in cities compared to surrounding rural areas, a phenomenon known as the “urban heat island” (UHI) effect. In the latest report of the International Panel on Climate Change, the effect is identified as one of the key risks for the coming decades.

UrbClim map

UrbClim is an urban climate model designed to model and study the urban heat island effect (UHI) at a spatial resolution of a few hundred meters. The model downscales large-scale weather conditions to agglomeration-scale and computes the impact of urban development on the most important weather parameters, such as temperature and humidity.

The map shows the results of an UrbClim simulation for the mean temperature at midnight during the summer of 2011 (period May - September) at a resolution of 250m. This summer has been selected as a typical summer for West-European city. On average, the nighttime temperature is approximately 4°C larger in the city centre. During some hot nights, even larger effects are observed.

Technical details:

Format: GeoTIFF

Coordinate system: EPSG 3035

Spatial extent: approx.. 90km x 90km (approx. 60 miles)

Resolution: 250m (approx. 273 yards)

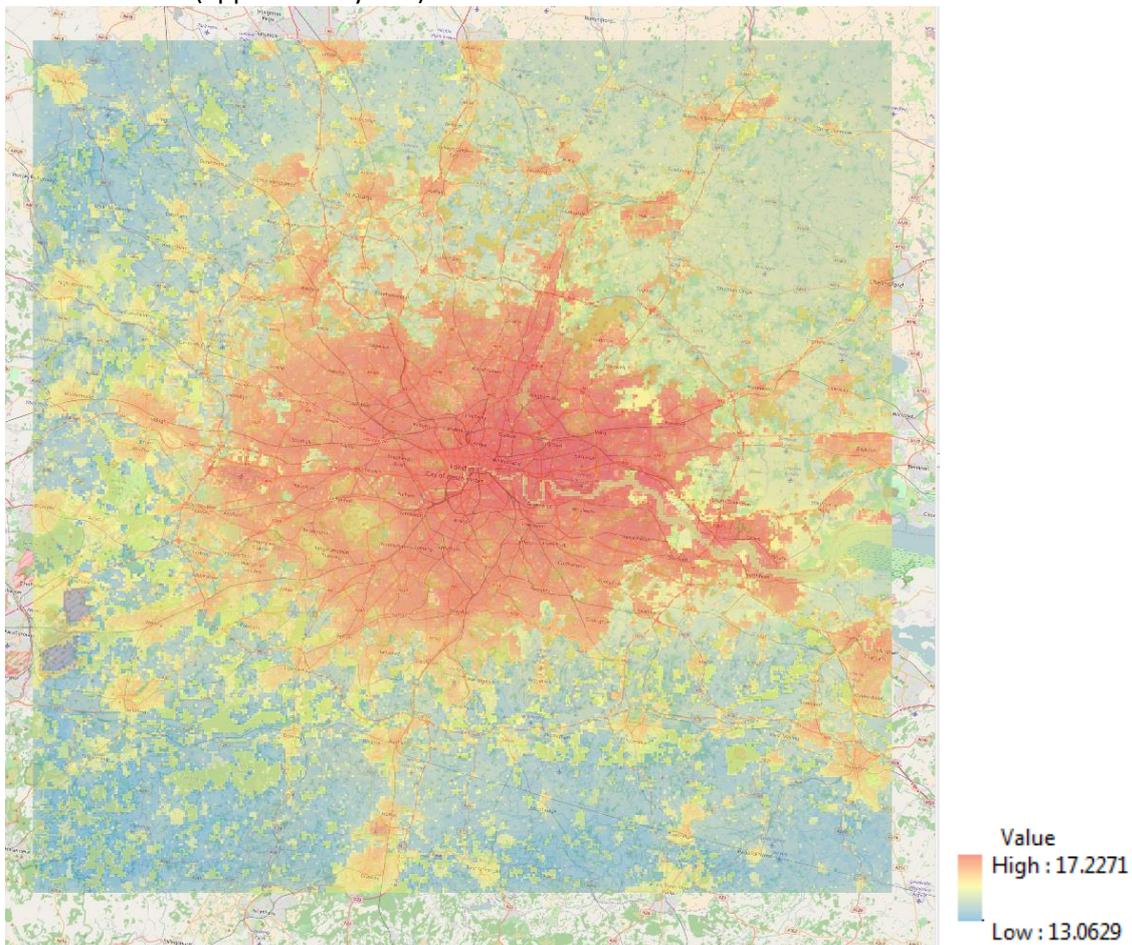


Figure 1: Mean temperature at midnight during the summer of 2011 (May – September). Unit: degrees Celsius (°C).

Technical details

UrbClim is composed of a land surface scheme describing the physics of energy and water exchange between the soil and the atmosphere in the city, coupled to a three-dimensional boundary layer module, which models the atmosphere above the urban agglomeration. The large-scale meteorological conditions are taken from global model output fields. Local terrain and surface data influence the heat fluxes and evaporation within the urban boundaries. The model has been subjected to exhaustive validation. Within the scope of the European RAMSES and NACLIM projects, model results have been compared with hourly temperature measurements for, amongst other, London (United Kingdom), Bilbao (Spain), Antwerp (Belgium), Berlin (Germany), Almada (Portugal) and Paris (France).

The meteorological input for this study was taken from the large-scale (70 km resolution) ERA-interim re-analysis data set of the European Centre for Medium-Range Weather Forecasts (ECMWF). The terrain input consisted of the spatial distribution of land use types, the degree of soil sealing, the vegetation cover fraction with a spatial resolution of 250m and detailed elevation data. These quantities were all taken from publicly available data sets, specifically, the 2006 CORINE land cover data for Europe, the European Environment Agency soil sealing data, the Normalized Difference Vegetation Index acquired by the MODIS instrument on the TERRA satellite, and the Global Multi-resolution Terrain Elevation Data (GMTED) of the U.S. Geological Survey (USGS), respectively.

Additional references

Technical papers:

- De Ridder, K; Lauwaet D. and Maiheu B., UrbClim - a fast urban boundary layer climate model., Urban Climate. 12 21-48, 2015.
Available from: <http://www.sciencedirect.com/science/article/pii/S2212095515000024>
- Lauwaet, D., H. Hooyberghs, B. Maiheu, W. Lefebvre, G. Driesen, S. Van Looy, and K. De Ridder, Detailed Urban Heat Island Projections for Cities Worldwide: Dynamical Downscaling CMIP5 Global Climate Models., Climate. 3 391-415, 2015. DOI: doi:10.3390/cli3020391
Available from: <http://www.mdpi.com/2225-1154/3/2/391>

Technical reports of the RAMSES-project:

- “Agglomeration-scale urban climate and air quality projections”. Deliverable 4.2.
Available from http://www.ramses-cities.eu/fileadmin/uploads/Deliverables_Uploaded/D4.2_Agglomeration-scale_urban_climate_and_air_quality_projections.pdf
- “Report on validation of agglomeration-scale climate simulations”. Deliverable 4.1.
Available from: http://www.ramses-cities.eu/fileadmin/uploads/Deliverables_Uploaded/ramses_deliverable4.1_final.pdf

Acknowledgements

The map has been composed within the top-down exercise of the EU-funded RAMSES-project (www.ramses-cities.eu). The result are top-down air temperature maps for 102 European cities (see https://www.urban-climate.be/services/eu_cities/ for a visualisation).