urban climate • urban energy budget • anthropogenic heat flux • vehicular emissions • heating and cooling of buildings • industrial processing • metabolic heat release by people • heat storage • urban land cover • in-situ measurements • satellite remote sensing • Earth Observation data

URBANFLUXES

URBan ANthropogenic heat FLUX from Earth observation

urbanfluxes.eu

funded under HORIZON 2020

WHY URBANFLUXES

Cities are much warmer than their surroundings. Urban structures absorb and trap more solar and thermal radiation than soils or vegetation and that causes an increase in the urban temperature. Moreover, many human activities add heat to the urban system. The heating and the cooling of buildings, the traffic, various industrial activities and our own human metabolism release energy in the form of heat, called anthropogenic heat. Because of these effects the rate of warming in cities is higher than the average global warming, a phenomenon known as the Urban Heat Island (UHI). Especially during heat waves, which are expected to occur more often, the UHI plus the heat wave can create an increase in energy consumption, a decrease in human comfort and significant human mortality.

URBANFLUXES investigates the cities' warming by breaking down the urban energy budget and targeting the anthropogenic heat flux. For this research we use imagery from Earth Observation satellites combined with conventional meteorological measurements at street level. The resulted satellite-based approach is expected to be easily transferable to any city. With this knowledge, measures to reduce urban heat can be monitored and tested.

THE STUDY SITES

London

highly urbanized megacity | anthropogenic heat flux high throughout the year

Basel

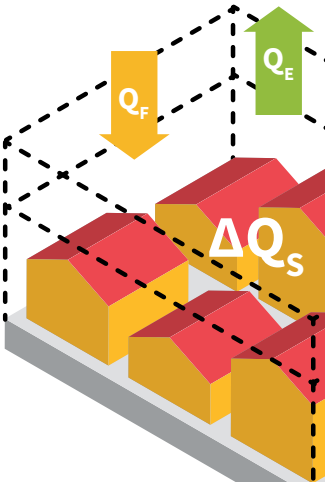
typical central European medium size city | anthropogenic heat flux high throughout the year

Heraklion

typical Mediterranean medium size city with dynamic urbanization process requires a substantial amount of energy for cooling

THE URBANFLUXES MODEL

To use data from Copernicus Sentinels satellite missions to break down the urban energy budget and quantify the anthropogenic heat flux patterns of day and night, week and weekend, and summer and winter times.



Urban surface energy budget: $Q^* + Q_F = Q_H + Q_E + \Delta Q_S + \Delta Q_A + S$

Q_F is the anthropogenic heat flux, Q^* is the net all-wave radiation flux, Q_H is the turbulent latent heat flux, Q_E is the latent heat flux, ΔQ_S is the heat storage, $\Delta Q_A = Q_{in} - Q_{out}$ and S represents all other sources and sinks.

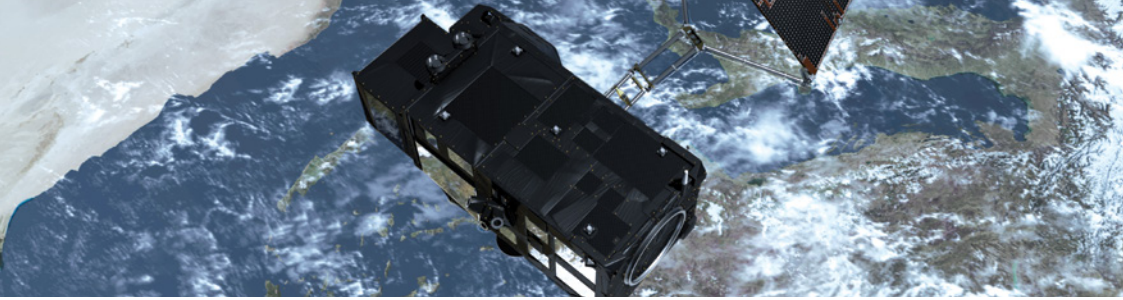


Photo: ESA/ATG medialab

SPECIFIC OBJECTIVES

- to improve the understanding of anthropogenic heat and its impact on the urban energy budget and urban climate and to communicate this understanding to the urban planning community;
- to employ energy budget closure to estimate the anthropogenic heat flux spatial patterns at city scale (1km x 1km) and local scale (100 m x 100 m), including associated uncertainties;
- to develop a highly automated method for estimation of urban energy budget components from Copernicus Sentinels data, enabling its integration into applications and operational services;
- to support sustainable urban planning strategies relevant to climate change mitigation and adaptation in cities, by taking into account the contribution of the anthropogenic heat.

Communities of Practice

In URBANFLUXES we want to develop a useful tool for improving urban structures. Communities of Practice are formed within URBANFLUXES, by bringing urban stakeholders and scientists together to talk and exchange knowledge and expertise. People involved in the communities meet on a regular basis to learn from each other and make clear what the important criteria are for developing useful URBANFLUXES end products.

EARTH OBSERVATION OF CITIES

Earth Observation satellites are widely used for monitoring the cities, for example, for urban expansion monitoring. Satellites can also assist in monitoring the urban climate. The Sentinels, a new family of satellites designed for the operational needs of the Copernicus programme, fulfil frequency, coverage, spatial and spectral requirements to allow quantitative estimations of the different urban energy budget components, including the anthropogenic heat flux.

URBANFLUXES

THE VISION

By using remote sensing data, anthropogenic heat can be measured in a less expensive and quick way. The project results can be easily transferred to other cities. Knowing what the anthropogenic heat flux patterns are in time and space can be an incentive for cooler urban design. It also creates more support for mitigation (e.g. insulation of houses) and adaptation (e.g. more trees). The results can lead to a reduced winter and/or summer peak of heat emissions, a reduction in CO_2 emissions and better human comfort in the urban areas.

URBANFLUXES is a 3-year (2015-2017) *Horizon2020* project coordinated by the Foundation for Research and Technology Hellas (Greece). The consortium consists of several other leading European organizations in Earth Observation and Urban Climatology:

- *Deutsches Zentrum für Luft - und Raumfahrt (Germany)*
- *Centre d'Etudes Spatiales de la Biosphère, Université Paul Sabatier (Toulouse III), CNRS, CNES, IRD (France)*
- *University of Basel (Switzerland)*
- *University of Reading (United Kingdom)*
- *Göteborgs Universitet (Sweden)*
- *Wageningen University and Research Centre-Alterra (The Netherlands)*
- *GEO-K s.r.l. (Italy)*

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