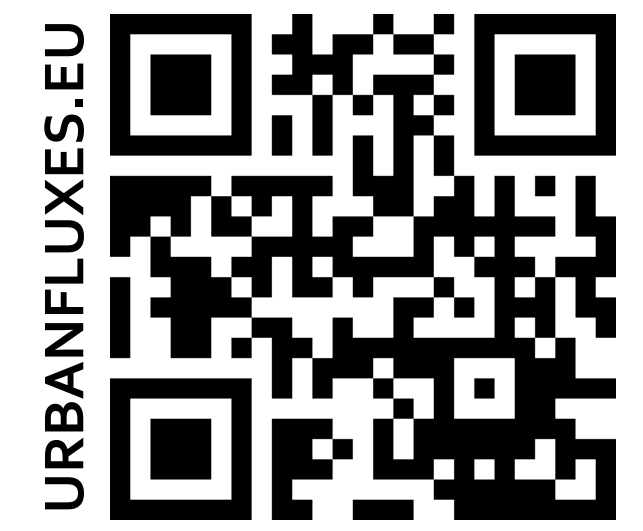


# Anthropogenic Heat Flux Estimation from Space: The URBANFLUXES Project



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## Abstract

The recently launched Horizon 2020 project URBANFLUXES investigates the potential of EO to retrieve urban energy budget components, focusing on the anthropogenic heat flux. The

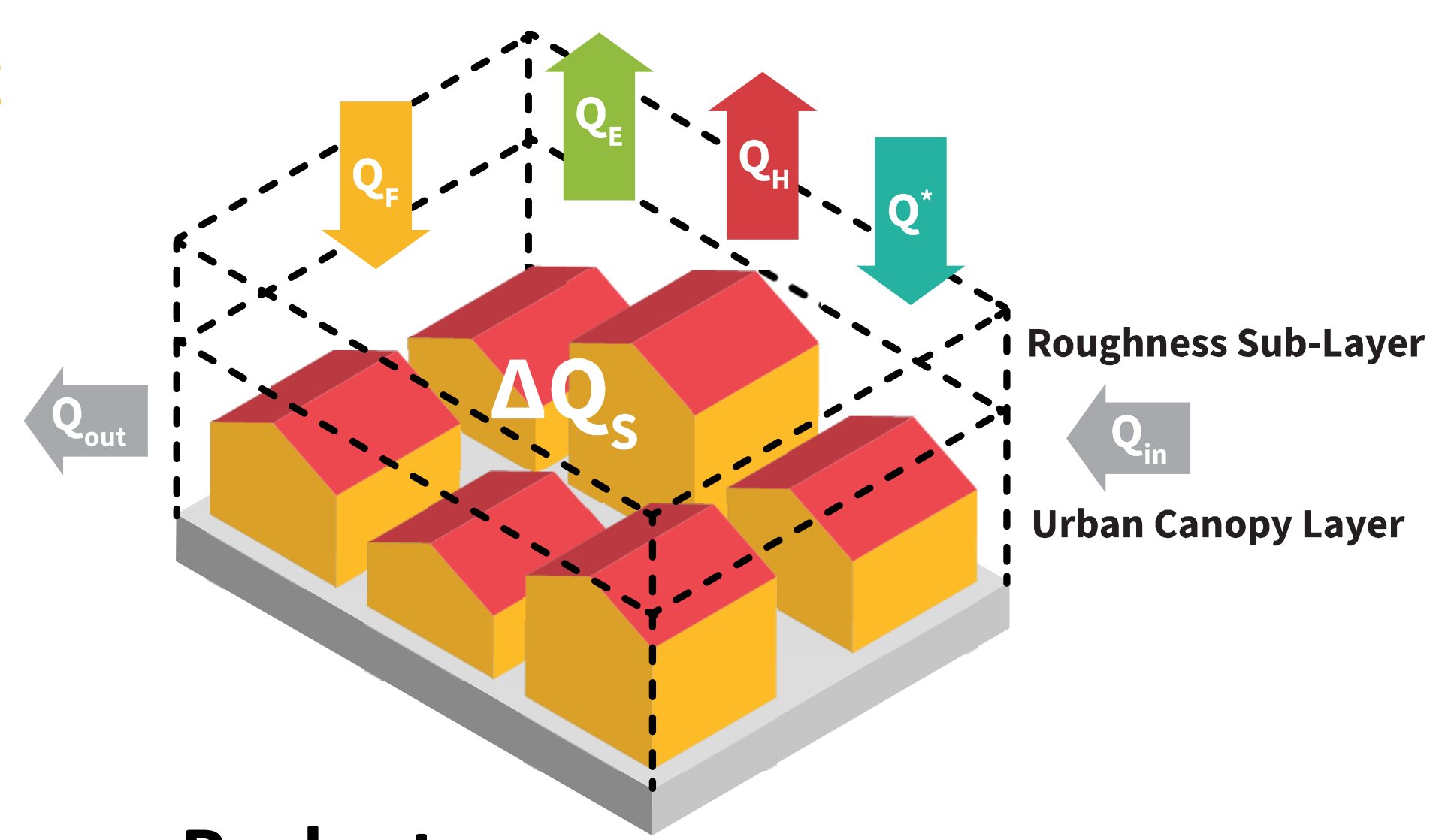
main challenge of this project is the innovative exploitation of the Copernicus Sentinels synergistic observations to estimate local scale spatiotemporal patterns of the anthropogenic

heat emission in cities. These EO-based spatially disaggregated estimations contain valuable information for both the urban planning and the Earth System Science community.

## The URBANFLUXES approach

### Anthropogenic Heat Flux ( $Q_F$ )

Energy balance residual approach



### Urban Surface Energy Budget

$$Q^* + Q_F = Q_H + Q_E + \Delta Q_S + \Delta Q_A + S$$

where  $\Delta Q_A = Q_{in} - Q_{out}$  and S represents all other sources and sinks

### Sensible Heat Flux ( $Q_H$ ) – Latent Heat Flux ( $Q_E$ )

Adjusted Aerodynamic Resistance Method for EO data

Xu, W., Wooster, M. J. & Grimmond, C. S. B. Modelling of urban sensible heat flux at multiple spatial scales: A demonstration using airborne hyperspectral imagery of Shanghai and a temperature–emissivity separation approach. *Remote Sens. Environ.* 112, 3493–3510 (2008).  
Kato, S., Yamaguchi, Y., Liu, C.-C. & Sun, C.-Y. Surface Heat Balance Analysis of Tainan City on March 6, 2001 Using ASTER and Formosat-2 Data. *Sensors* 8, 6026–6044 (2008).

### Net all-wave Radiation Flux ( $Q^*$ )

Discrete Anisotropic Radiative Transfer (DART) approach

Grau, E. & Gastellu-Etchegorry, J.-P. Radiative transfer modeling in the Earth–Atmosphere system with DART model. *Remote Sens. Environ.* 139, 149–170 (2013).

### Heat Storage Flux ( $\Delta Q_S$ )

Element Surface Temperature Method

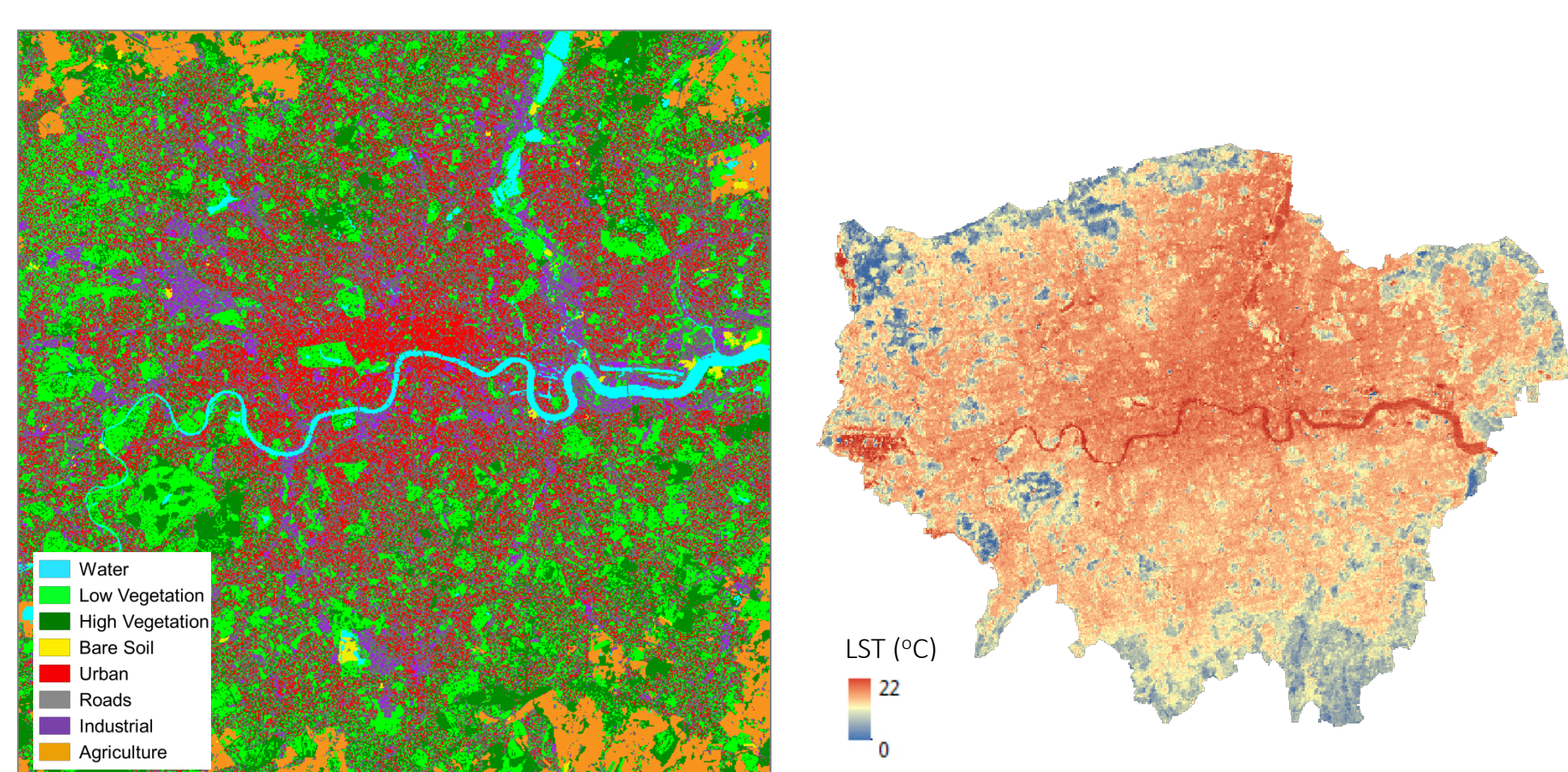
Offerle, B., Grimmond, C. S. B. & Fortuniak, K. Heat storage and anthropogenic heat flux in relation to the energy balance of a central European city centre. *Int. J. Climatol.* 25, 1405–1419 (2005).

## Preliminary Results

### Urban Surface Cover and Morphology

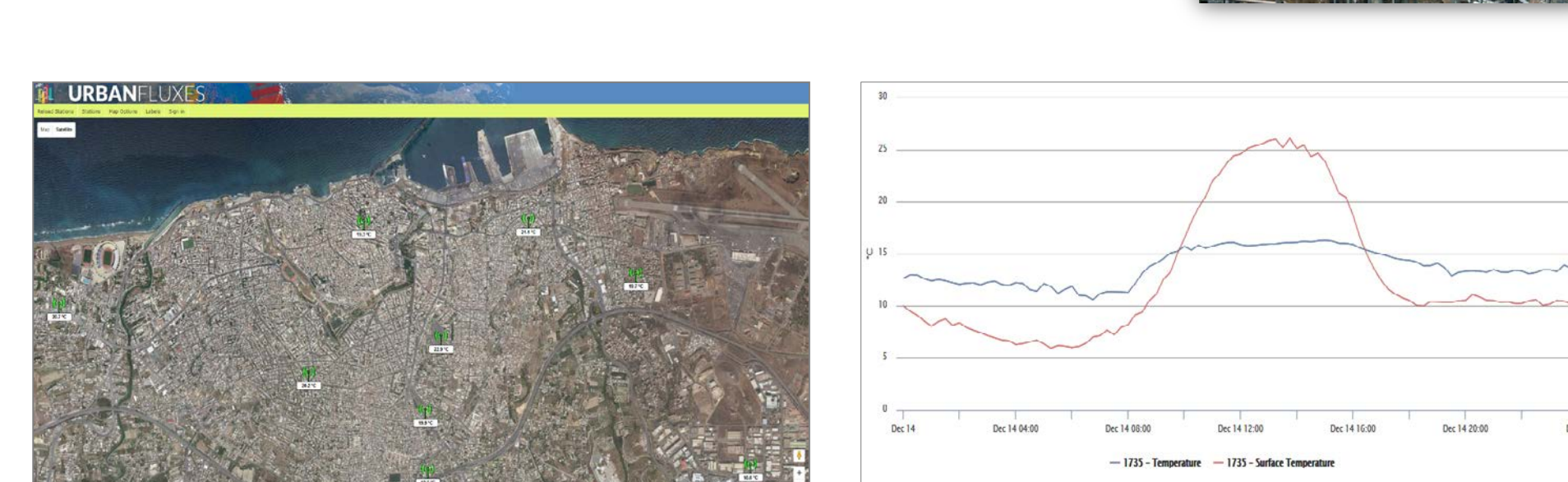


Example of buildings/trees height (left) and sky-view factor (right) for an area in Basel.



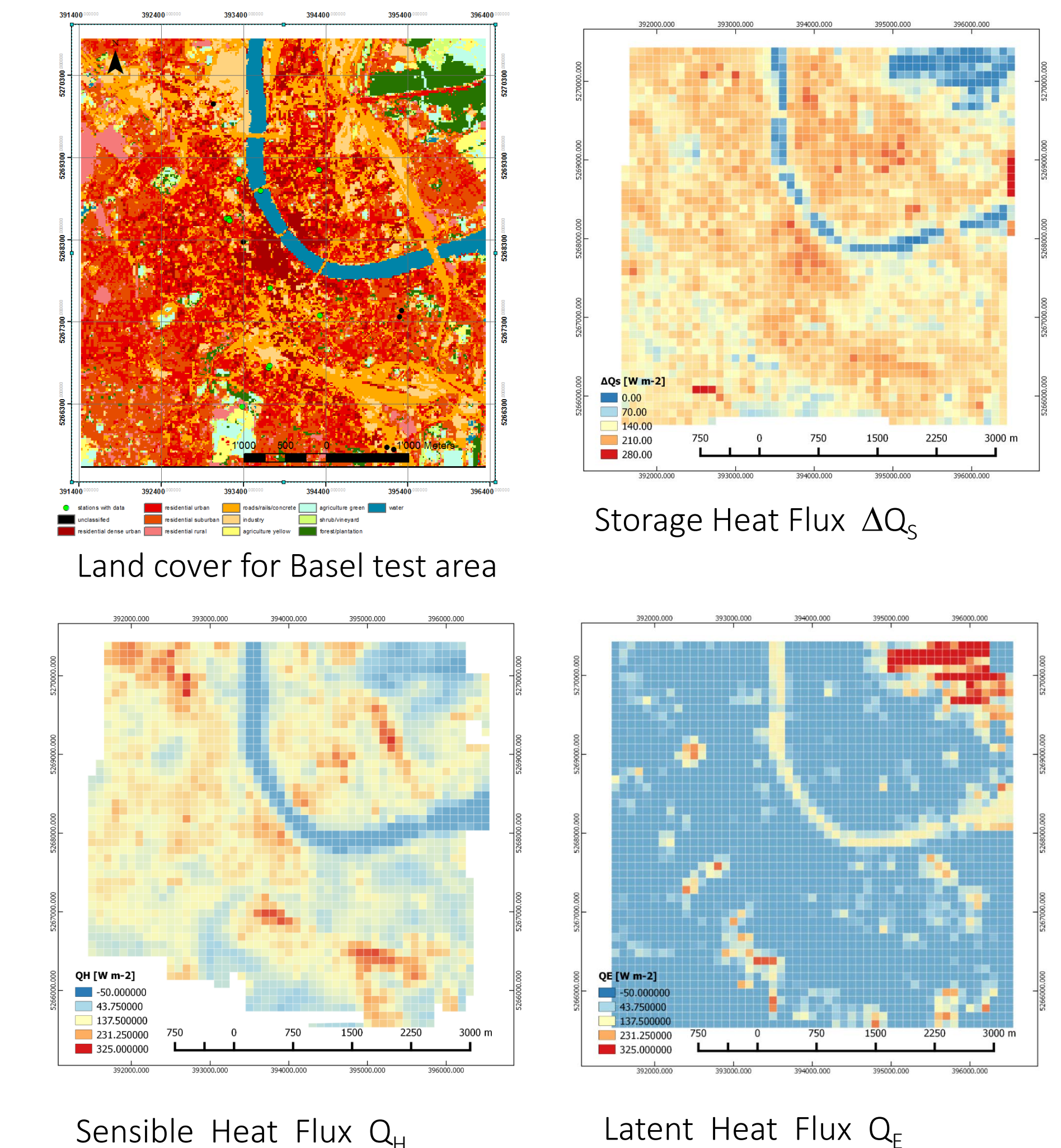
Land cover classification and Land Surface Temperature for London.

### Weather Sensor Networks



Heraklion stations and an example of surface and air temperature measurements.

### Heat Fluxes (Basel, 30 AUG 2015 1100 CET)



## The Vision

URBANFLUXES develops an automated EO-based method for estimating urban energy budget components, enabling its integration into operational services. Therefore, it prepares the

ground for innovative exploitation of space data in scientific activities (i.e. Earth system modelling) and future and emerging applications (i.e. sustainable urban planning). Its products is

expected to support both sustainable planning strategies to improve the quality of life in cities, as well as Earth System scientists to provide more robust climate simulations.

## The Consortium

