Urban Morphology, Surface Characterisation and Anthropogenic Heat

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Introduction

The urban environment is one the most complex and diversified on the Earth's surface. By using Geographical Information Systems (GIS) and remote sensing the city can be characterised with respect to diversity and spatial variability:

How could one make use of morphological parameters within the concept of urban planning in order to **improve the urban environment**?

Can measuring the radiative properties of urban surfaces improve our understanding of city-wide phenomena, such as the **urban heat island**?

Urban Morphology

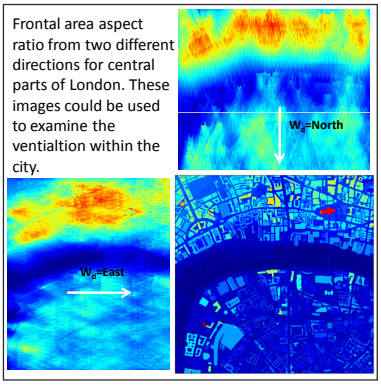
Analysis of the urban morphology at its different scales is used to improve urban parameterisation in numerical meteorological modelling. Knowledge of urban morphology parameters also helps the analysis of energy fluxes between the surface and the atmosphere in urban areas.

Examples of parameters derived:

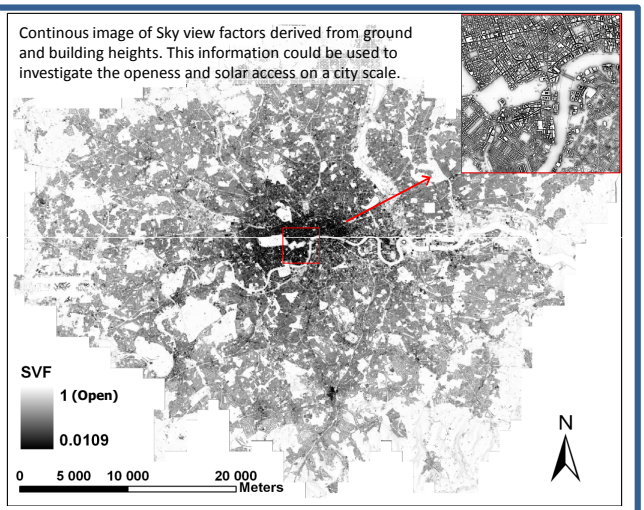
* Morphological characteristics
* Surface roughness lengths z_0
* Zero plane displacement height z_d
* Plan area aspect ratio λ_p
* Frontal area aspect ratio λ_f
* Sky view factor Ψ

We make use of the VIRTUAL LONDON dataset which is a 3D building structures vector dataset covering Greater London to derive the different morphological parameters.

Frontal area aspect ratio from two different directions for central parts of London. These images could be used to examine the ventialtion within the city.



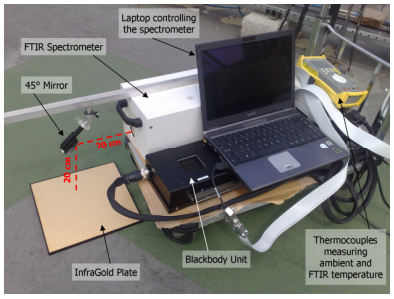
Continous image of Sky view factors derived from ground and building heights. This information could be used to investigate the openess and solar access on a city scale.



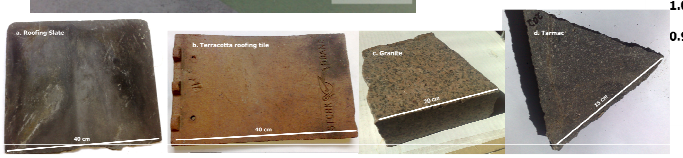
Measuring the emissivity of urban surfaces

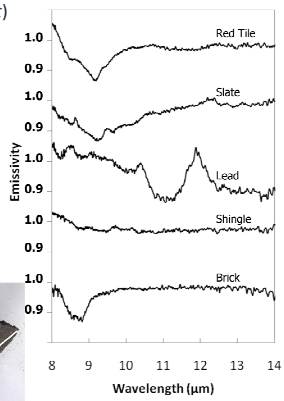
The amount of energy radiated by a surface at any given wavelength is a function of both its kinetic temperature and its spectral emissivity (ε). Measuring the emissivity of urban surfaces can improve the monitoring and modelling of urban landscapes, knowledge of surface emissivity can:

* Enable the accurate determination of surface temperatures by remote methods (i.e. airborne/satellite thermal remote sensing.
* Improve the parameterisation of urban energy balance models.
* Lead to the possibility of classifying different urban surfaces from remotely sensed hyper-spectral images.
* Help develop techniques to detect tarmac deterioration (Pascucci et al., 2008) and hazardous materials, such as asbestos-cement roofing (Bassani et al., 2007).



KCL's FTIR emissivity kit (*left*) can measure the thermal radiance of surfaces (*below*). By calibrating the spectrometer using target surfaces of known radiance (blackbodies) and eliminating background radiation (using a gold plate), emissivity spectra (*right*) can be computed.





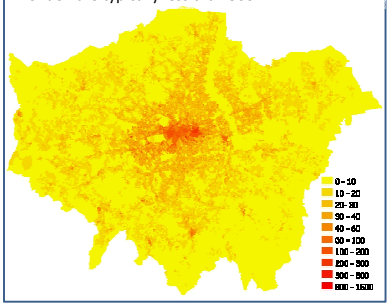
Anthropogenic Heat Flux (Inventory)

Estimation of the heat flux generated by anthropogenic activities in the Greater London area classified by source (buildings, transportation, human metabolism). Energy flux is allocated over the Greater London area according to a fine spatial mesh based on the NeSS Geography Hierarchy, as adopted by the Office for National Statistics, and taking into account temporal variations (seasonal, daily, hourly).

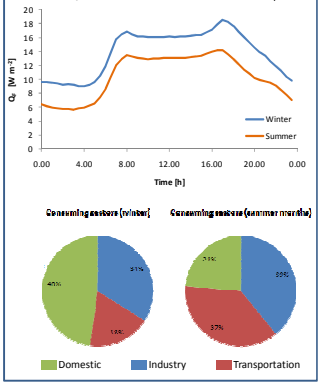
Results are correlated with residents and daytime density, consumer typology, temperature, etc., in order to obtain a predictive model for forecasting purposes.

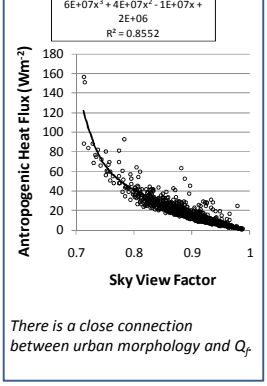
Data sources: DECC (Department of Energy & Climate Change), UK Office for National Statistics, Greater London Authority.

Q_f for Greater London, in 2004. The very large Q_f values (up to 1500 W m^{-2}) refer to some very small areas that cannot be easily individuated. The dark red areas you can see by eyes in central London are typically less than 300 W m^{-2}.



Daily and seasonal variation of Q_f





There is a close connection between urban morphology and Q_F

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