# EXPLOITING EARTH OBSERVATION DATA PRODUCTS FOR MAPPING LOCAL CLIMATE ZONES

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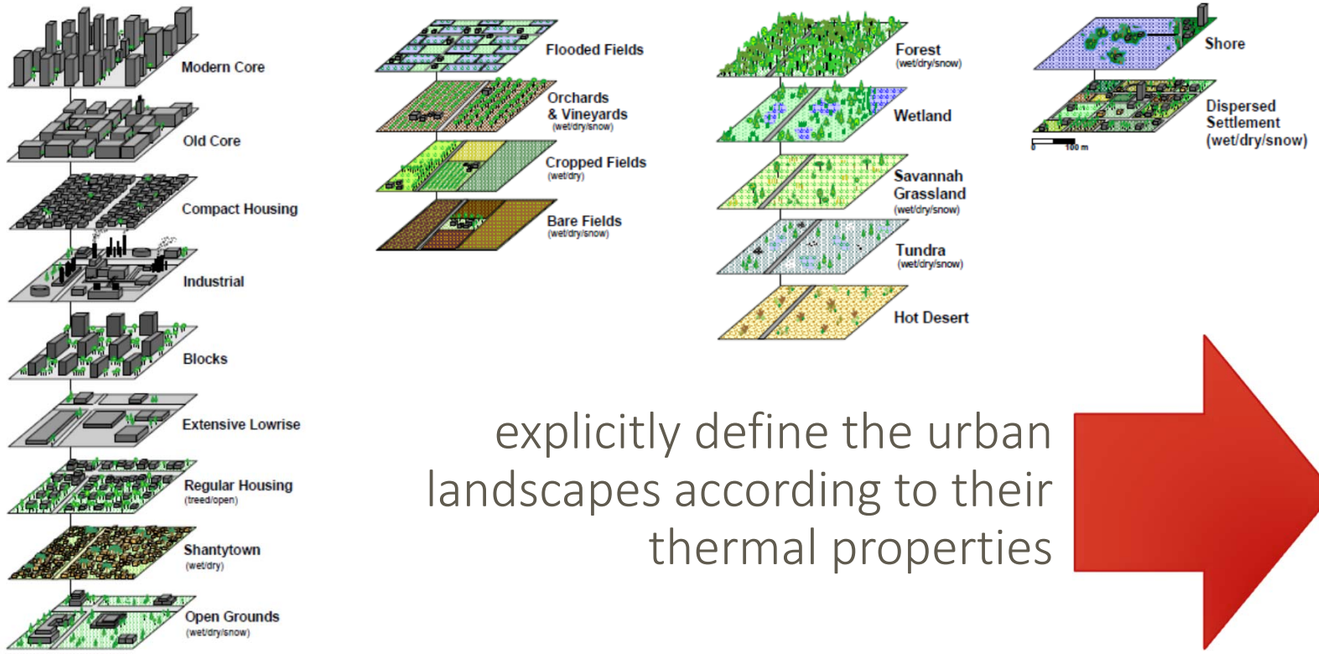
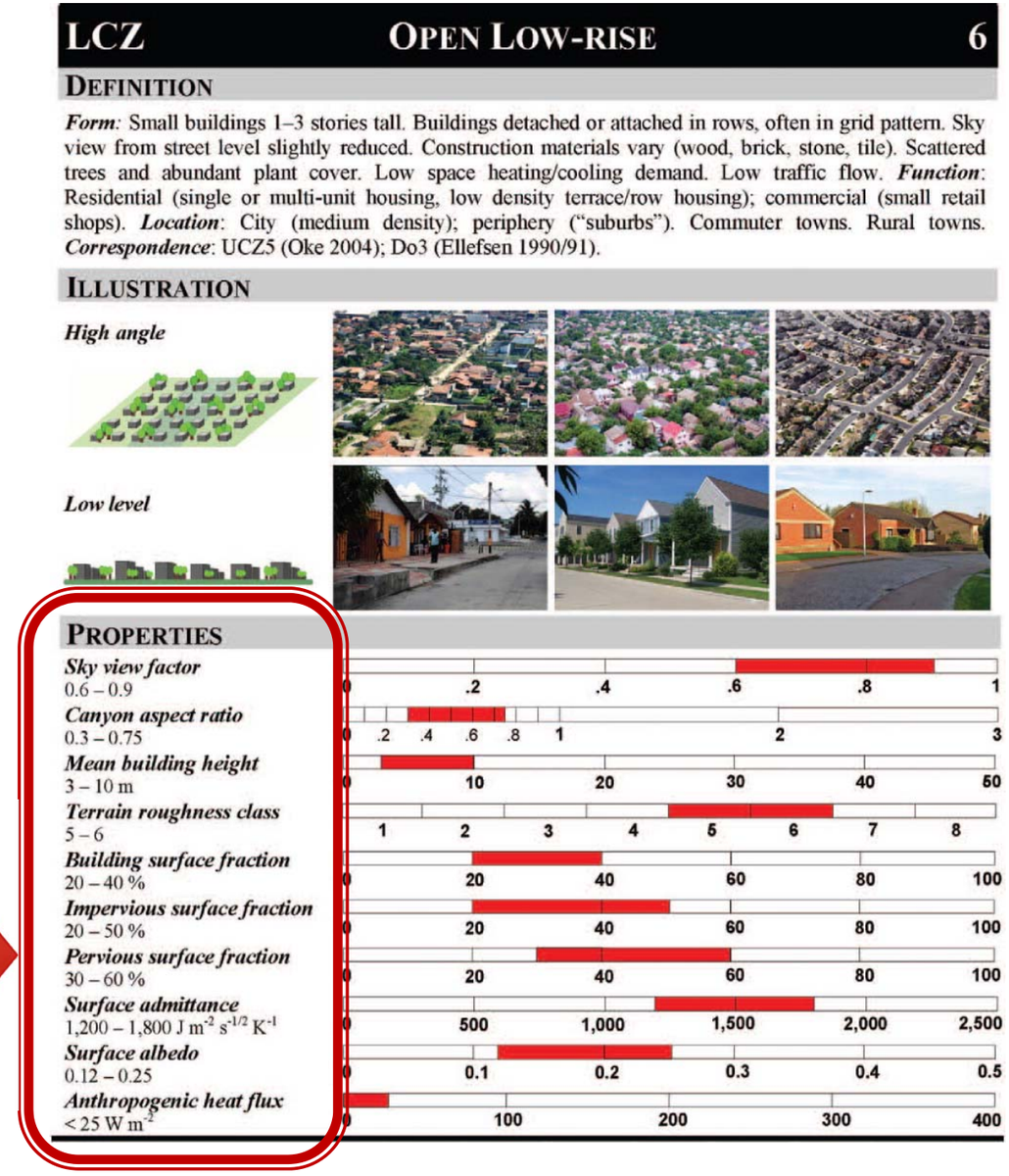
# LOCAL CLIMATE ZONES (LCZ)

Urban Landscape

City | Agricultural | Natural | Mixed




explicitly define the urban landscapes according to their thermal properties




Stewart, I. D., T. R. Oke, 2012: Local Climate Zones for Urban Temperature Studies. Bull. Amer. Meteor. Soc., 93, 1879–1900.

# THE EO4SEB PROJECT

Earth Observation for Surface Energy Balance

Objectives:

- to exploit EO to derive parameters related to LCZ;
- to investigate the potential of exploitation of recent (Landsat-8 and Sentinel-2) and upcoming (Sentinel 3) missions in SEB modelling;
- to use derived EO products to parameterize DARTEB model.

Landier, L. et al. *Modeling Parameters and remote sensing acquisition of urban canopies*

Thursday 15:00 - 16:00, Poster Session 25


http://www.eo4seb.gr

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Heraklion

# THE URBANFLUXES PROJECT

Urban Anthropogenic heat flux from Earth Observation Satellites

Objective:

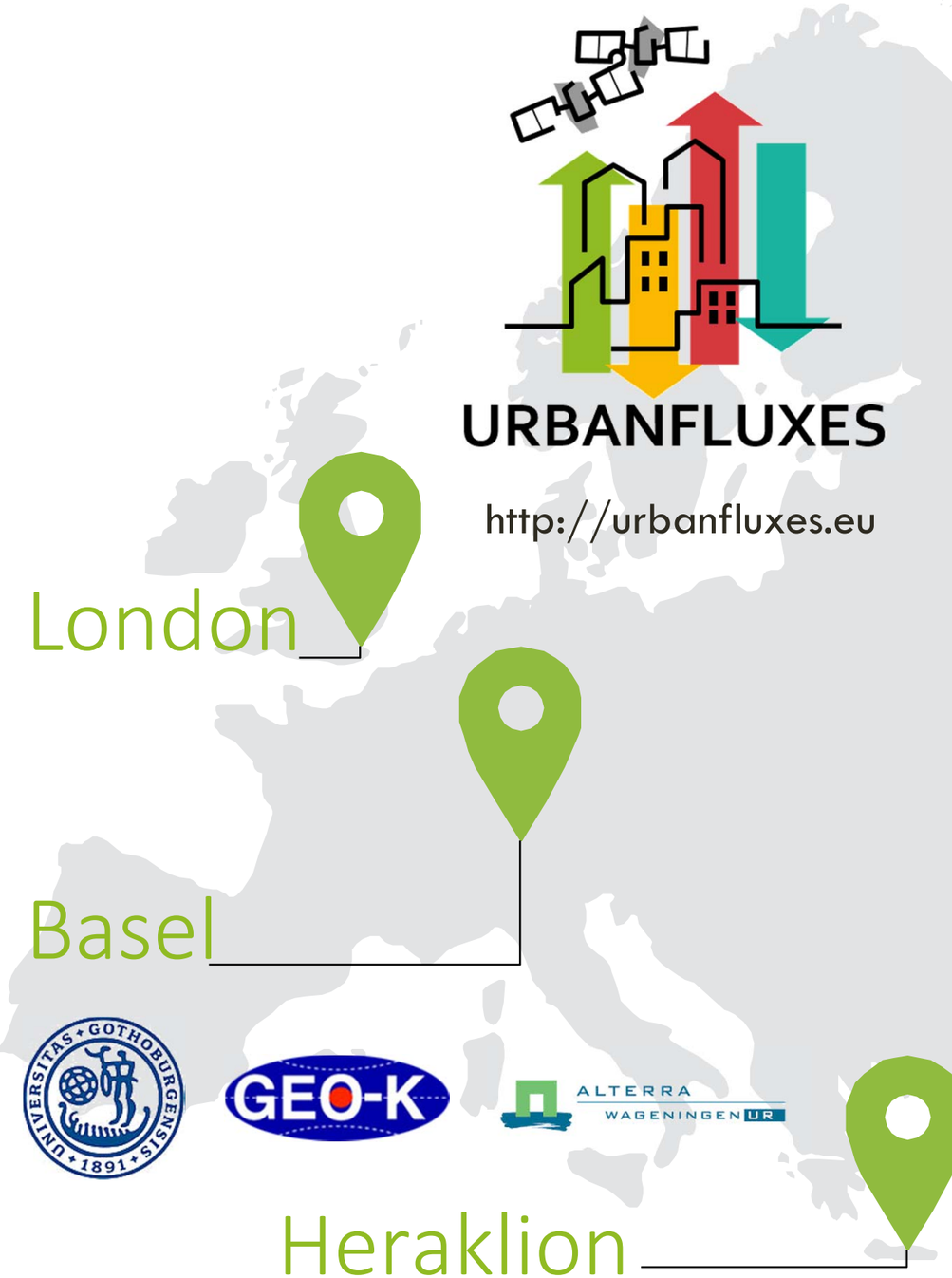
- to investigates the potential of EO to retrieve anthropogenic heat flux, as a key component in the Urban Energy Budget

Chrysoulakis, N. et al. *A novel approach for anthropogenic heat flux estimation from space*

Friday 11:00 - 12:30, St-Exupéry Amphitheater

URBANFLUXES

http://urbanfluxes.eu

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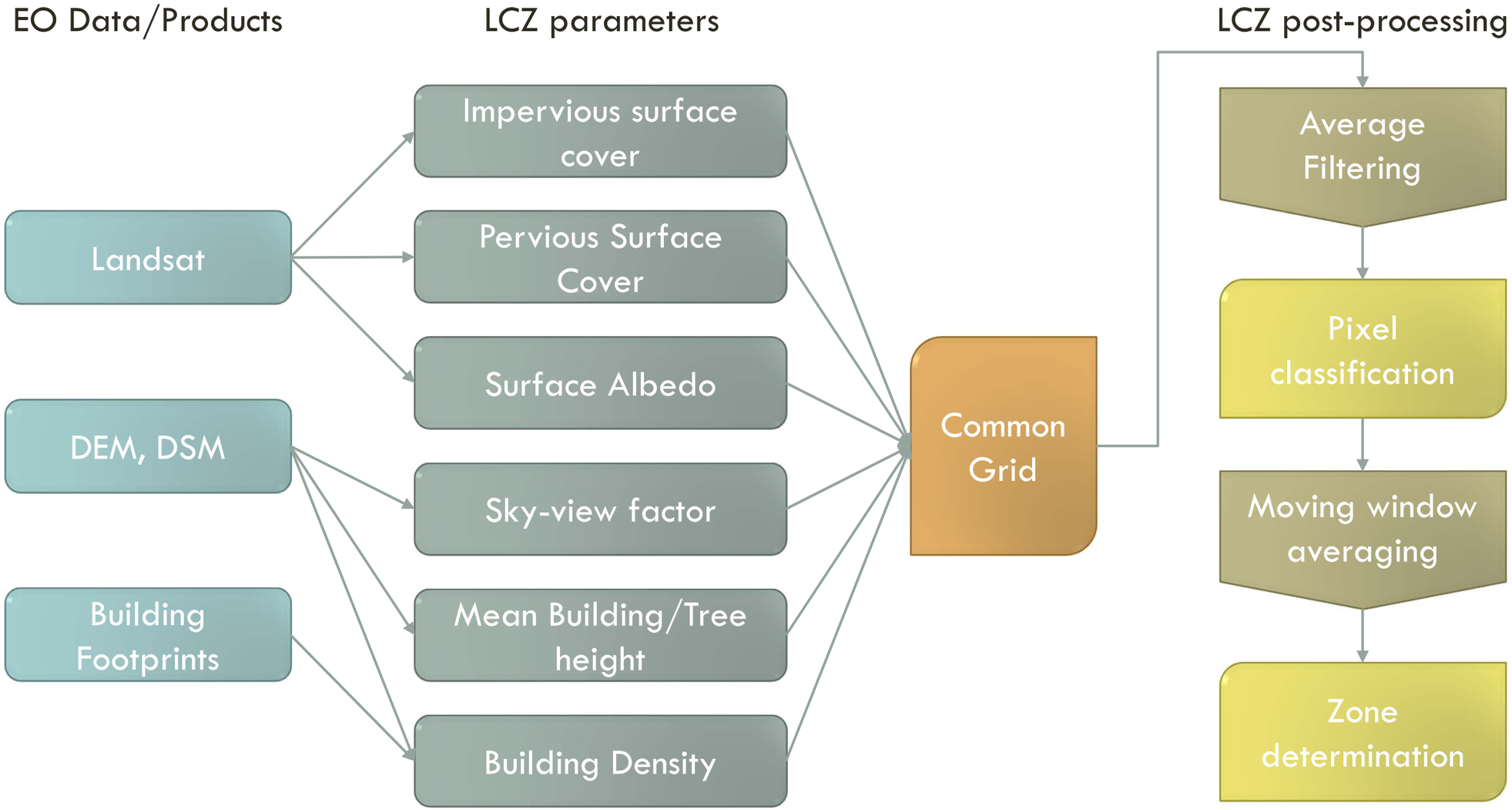
# METHODOLOGY

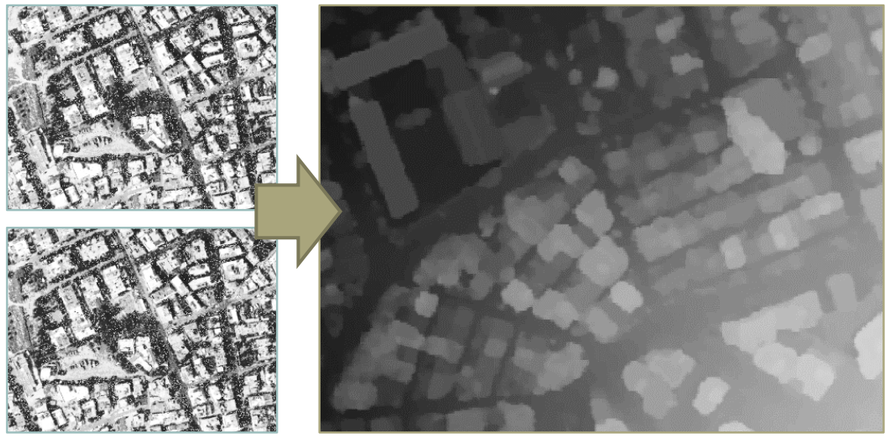


# SKY-VIEW FACTOR

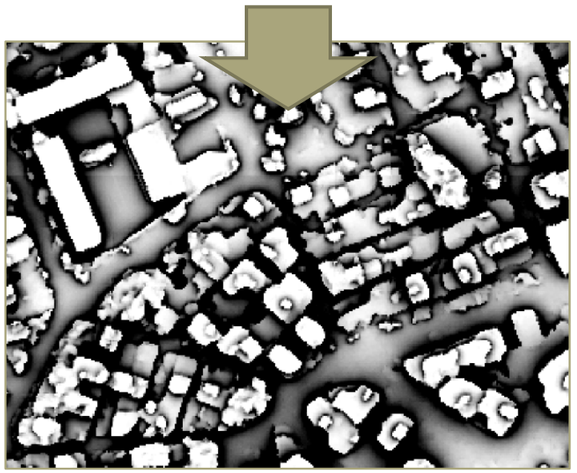
› Sky-view factor
the fraction of sky hemisphere visible from ground level

Remote Sensing data

high resolution stereo imagery or LiDAR data



Stereo imagery Digital Surface Model



Sky-view factor

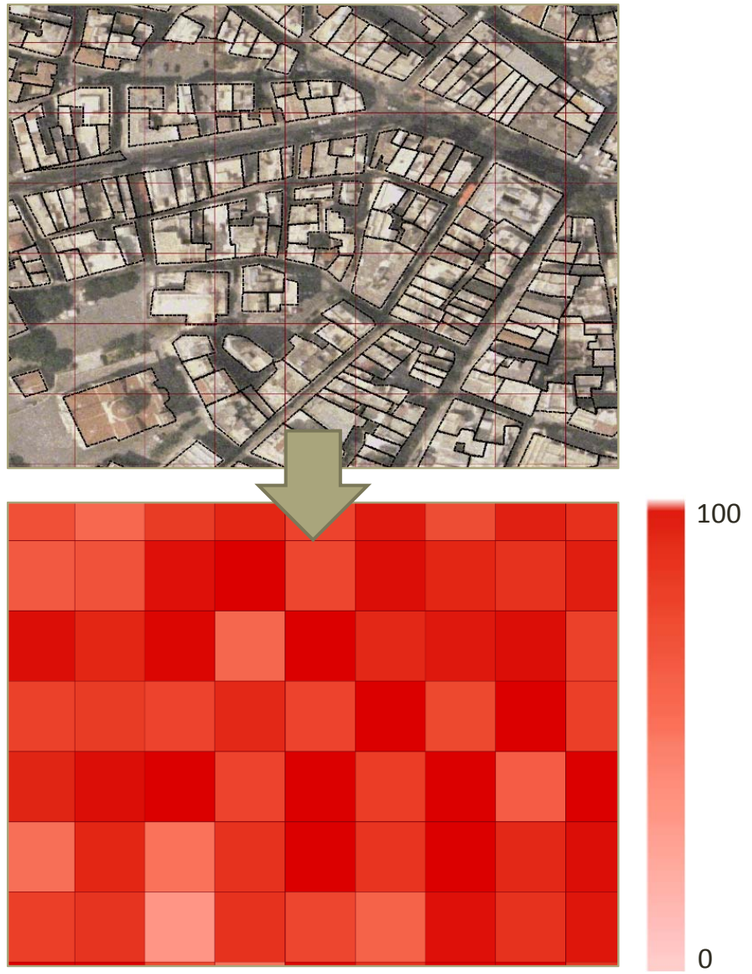
Lindberg, F. and Grimmond, C.S.B., 2010. Continuous sky view factor maps from high resolution urban digital elevation models. Climate Research, 42, 177 -183.

# BUILDING DENSITY

› Building Density
the proportion of ground surface with building cover

Remote Sensing data

high resolution optical imagery and/or LiDAR data and/or SAR data



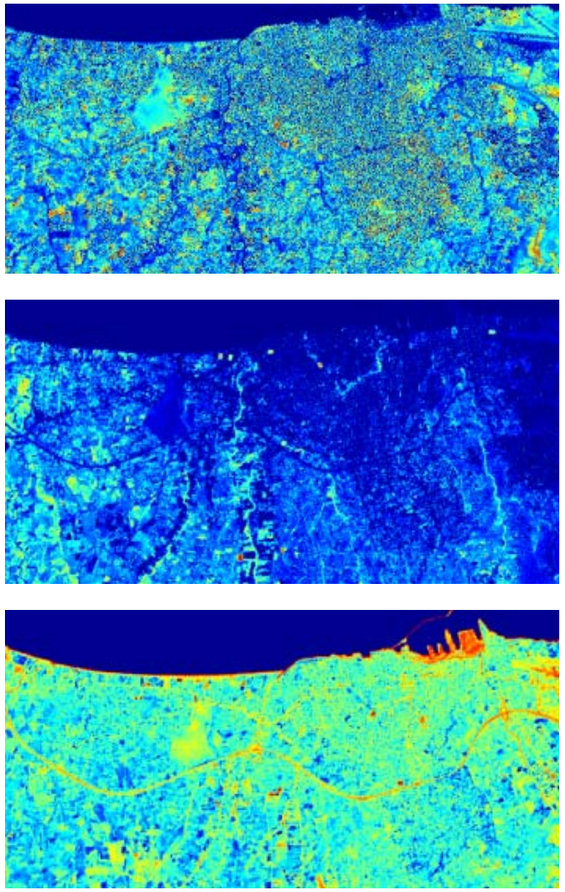

Esch, T., Thiel, M., Schenk, A., Roth, A., Müller, A. and Dech, S., 2010. Delineating of urban footprints from TerraSAR-X data by analyzing speckle characteristics and intensity information. IEEE Transactions on Geoscience and Remote Sensing, 48, 905 - 916.

# IMPERVIOUS, PERVIOUS SURFACE COVER

- Impervious and Pervious Surface Fraction
  the proportion of ground surface with impervious and pervious cover

Remote Sensing data

high resolution multispectral/hyperspectral imagery



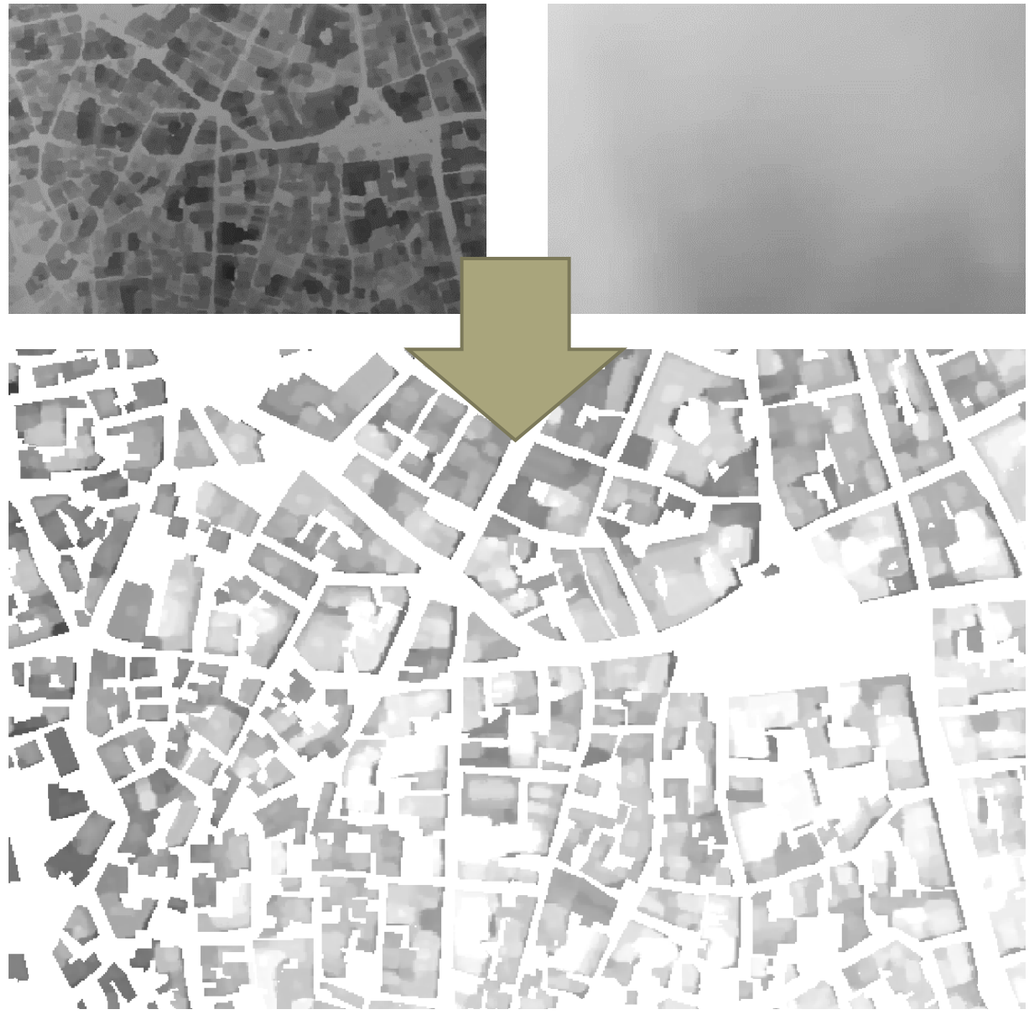
Mitraka, Z., Chrysoulakis, N., Kamarianakis, Y., Partsinevelos, P. and Tsouchlaraki, A., 2012. Improving the estimation of urban surface emissivity based on sub-pixel classification of high resolution satellite imagery. Remote Sensing of Environment, 117, 125 - 134.

# MEAN BUILDING, TREE HEIGHT

› Mean Building/Tree Height
the spatial average of building heights in an area of interest

Remote Sensing data

high resolution stereo imagery or LiDAR data or SAR data



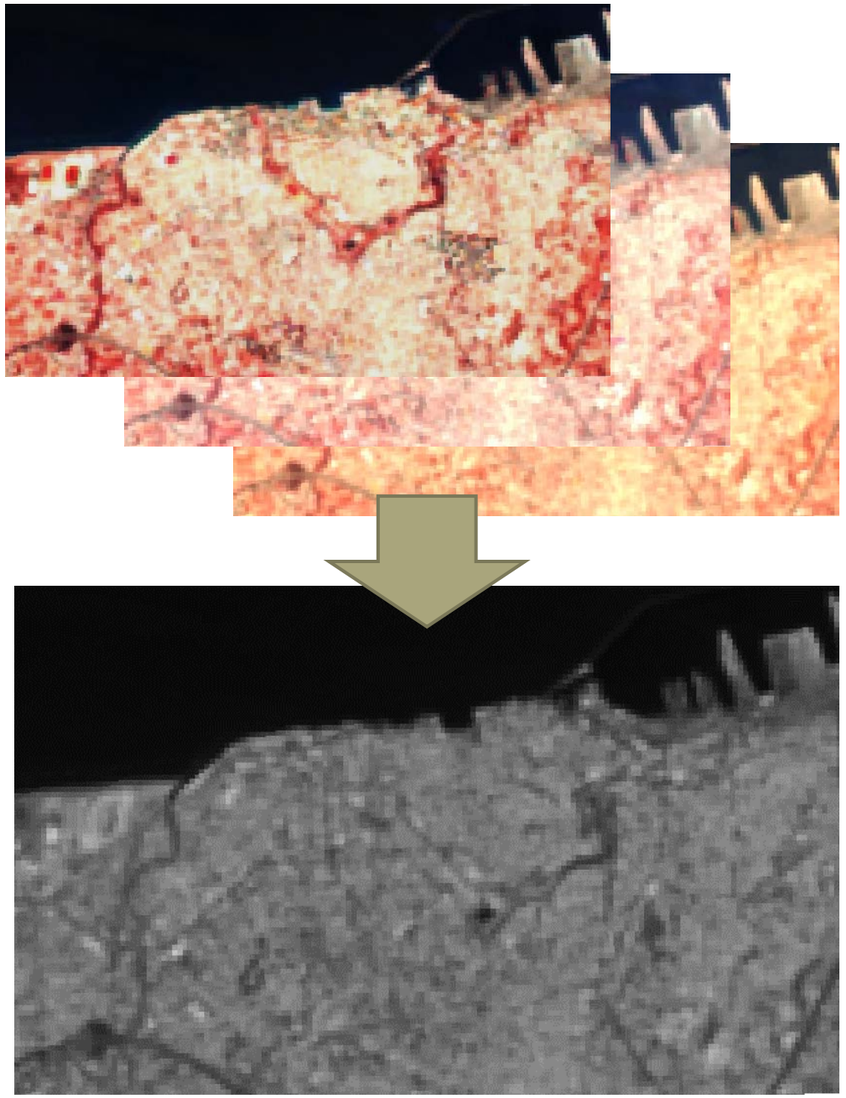
# SURFACE ALBEDO

- Surface Albedo

  the surface ability to reflect the incoming direct and diffused irradiance at all wavelengths and towards all possible angles

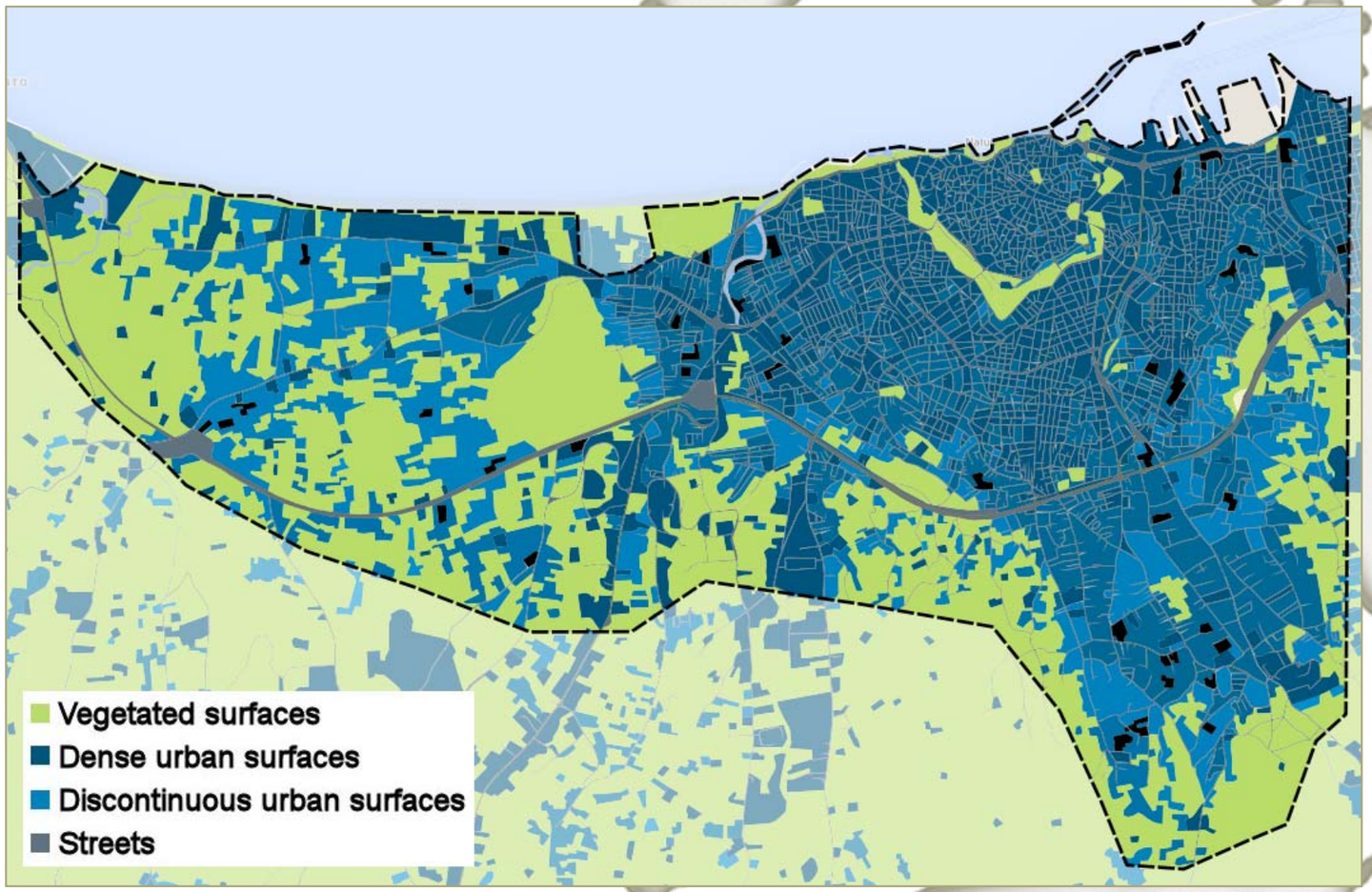
Remote Sensing data

high resolution optical imagery



Frey, C. M. and Parlow, E., 2009. Geometry effect on the estimation of band reflectance in an urban area. Theoretical and Applied Climatology, 96, 395 – 406.

# STUDY AREA

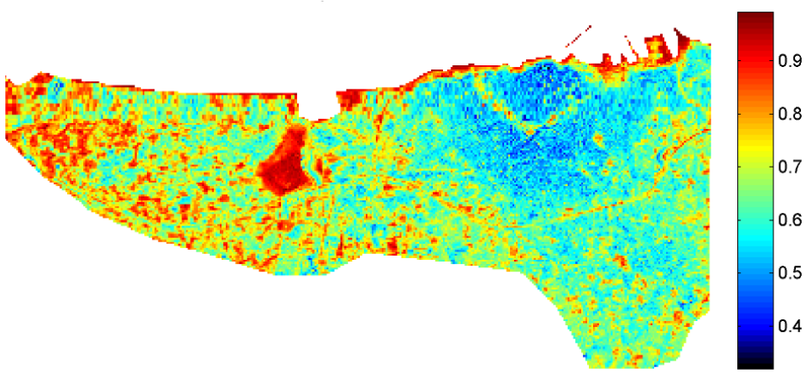



Urban Atlas Land Use polygons

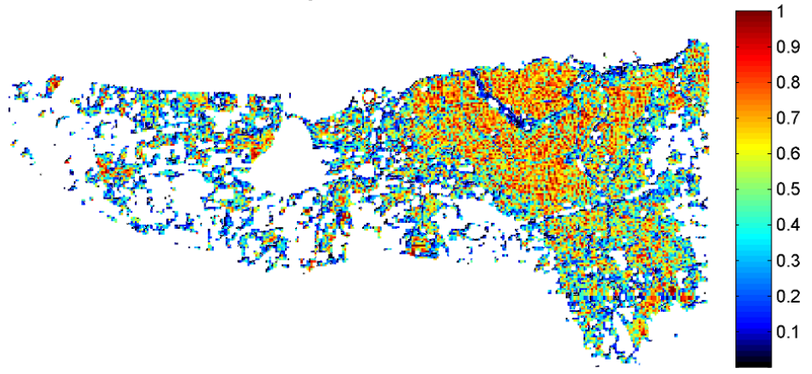
Heraklion, Greece

# LCZ PARAMETERS ESTIMATION USING EO DATA

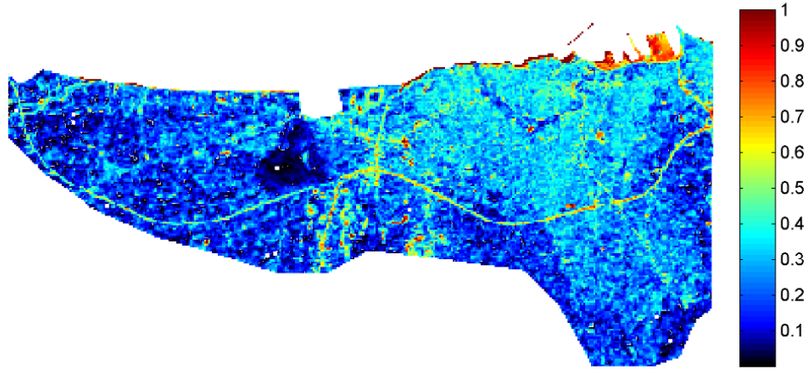
Sky view factor



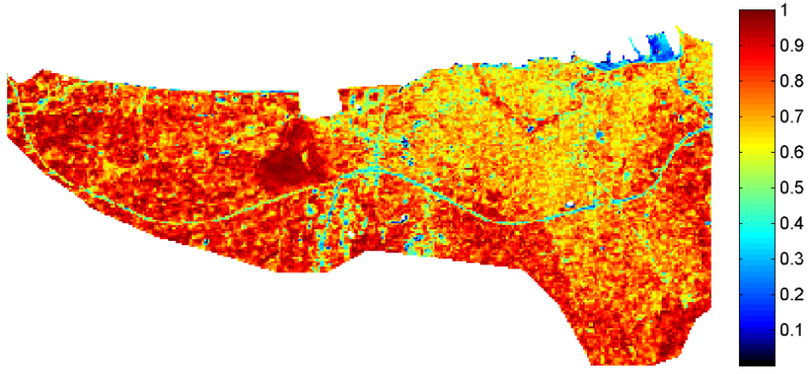

Building Surface Fraction



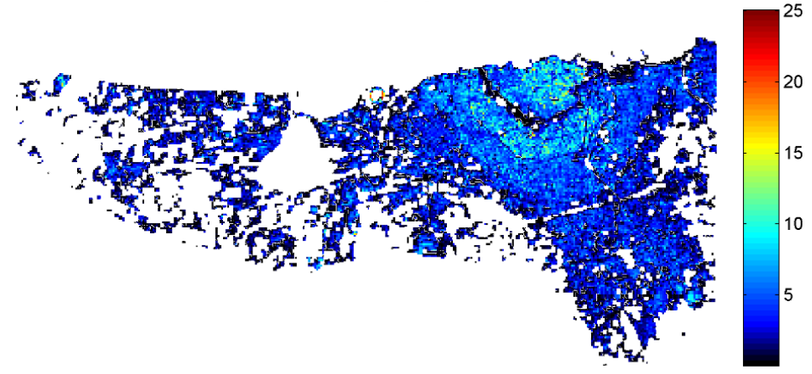

Impervious Surface Fraction



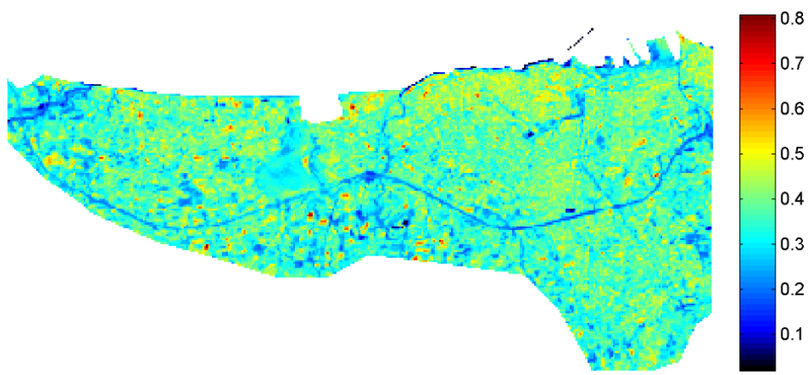

Pervious Surface Fraction



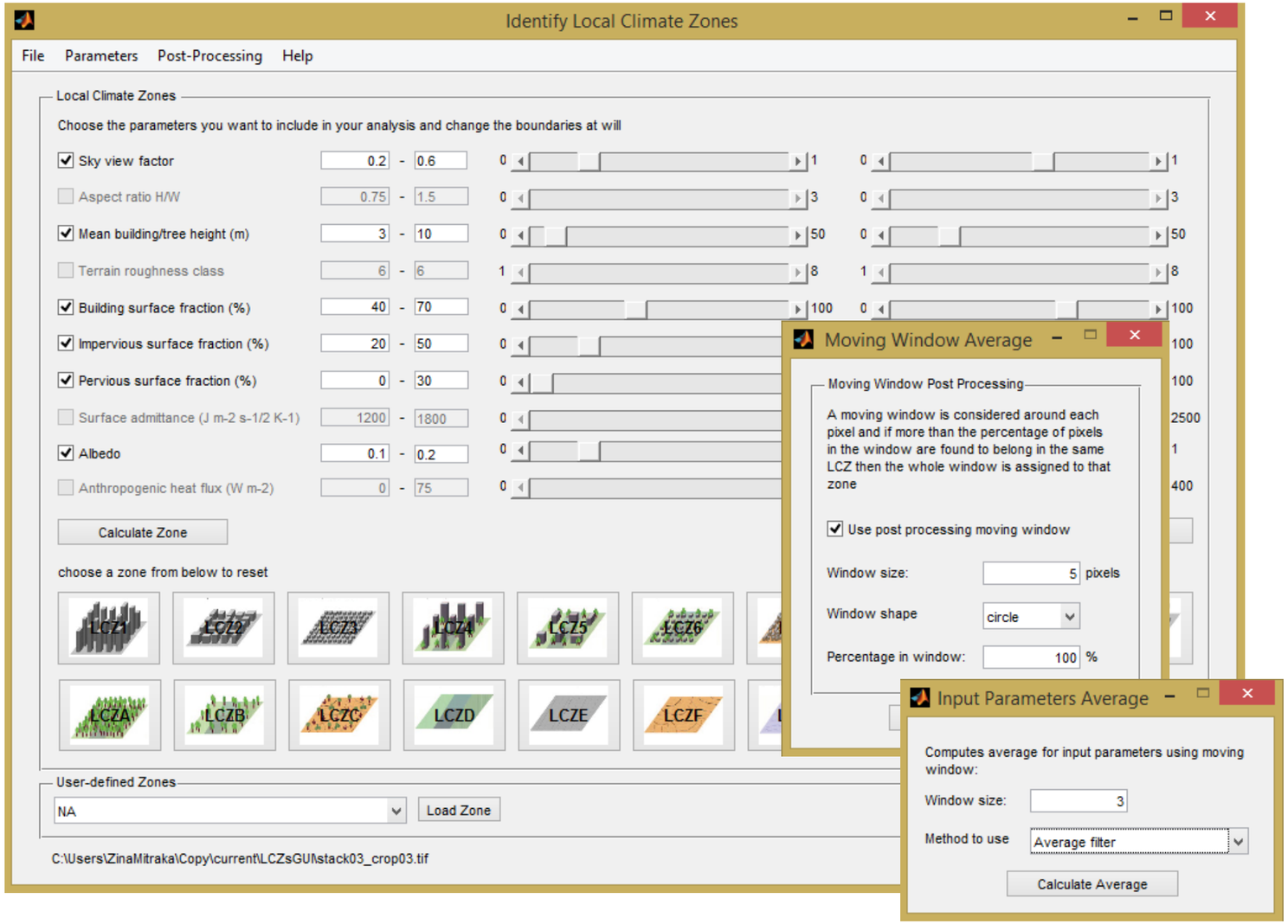

Mean Building /Tree Height (m)




Surface Albedo

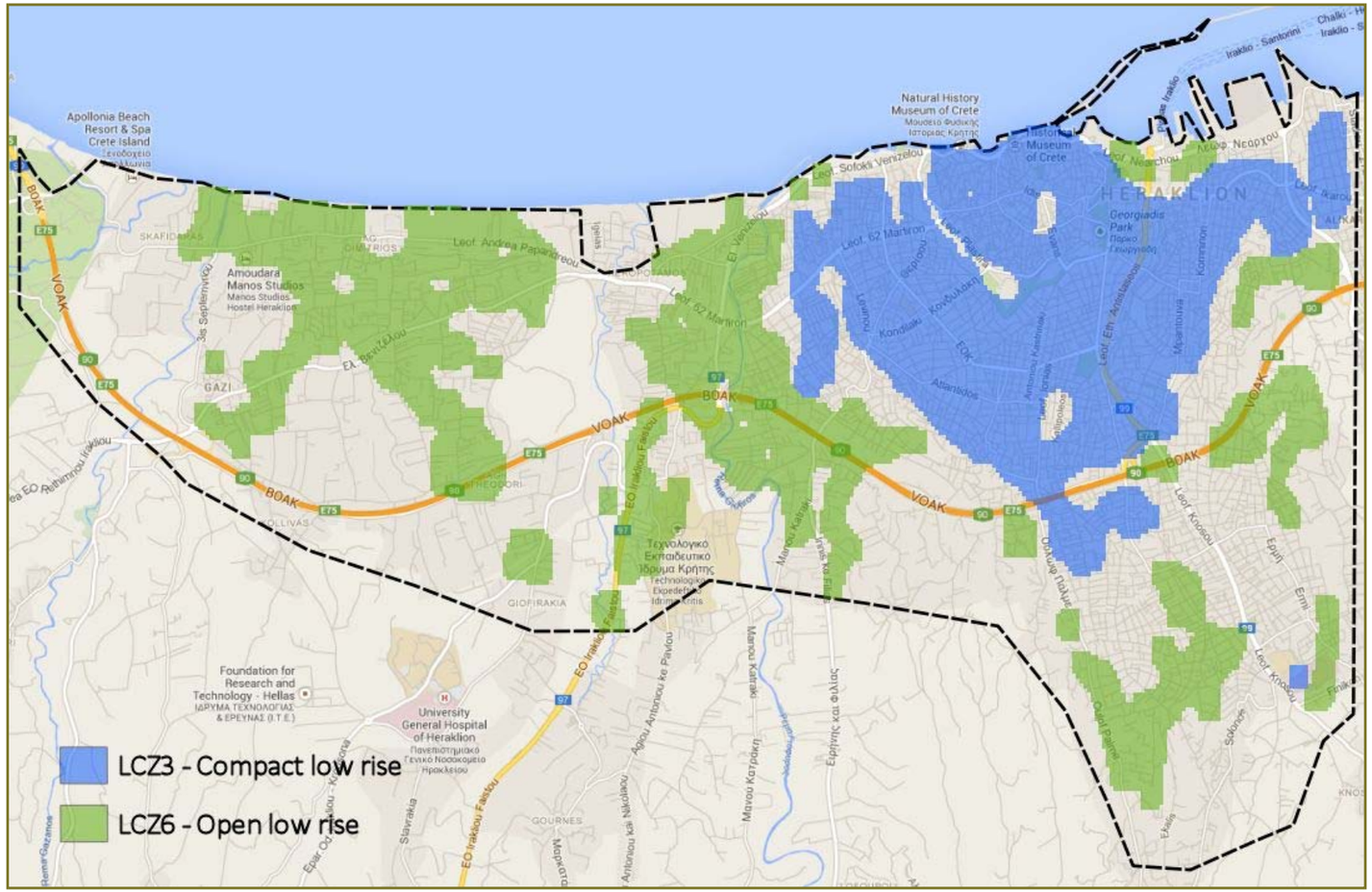


# IDENTIFYING THE LCZ




- *multiple sources* of information result in products of *different scales*
- *need for a common scale* to proceed with the identification of possible LCZ
- parameters were aggregated in a 90 m × 90 m cells grid and
- a 5 × 5 cells circular moving window was considered, since the minimum diameter of a LCZ is 400 – 1000 m

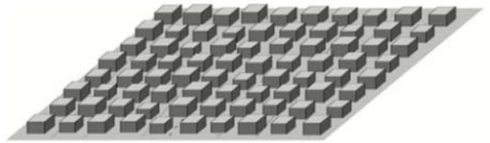
# LCZ CLASSIFICATION




Blue corresponds to LCZ3 – Compact low rise and green to LCZ6 – Open low rise.

*LCZ3 – Compact low rise*

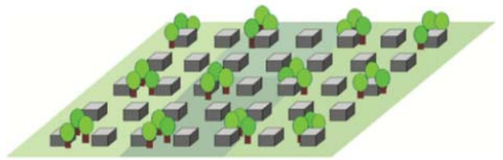
***High angle***



***Low level***

*LCZ6 – Open low rise*

***High angle***



***Low level***

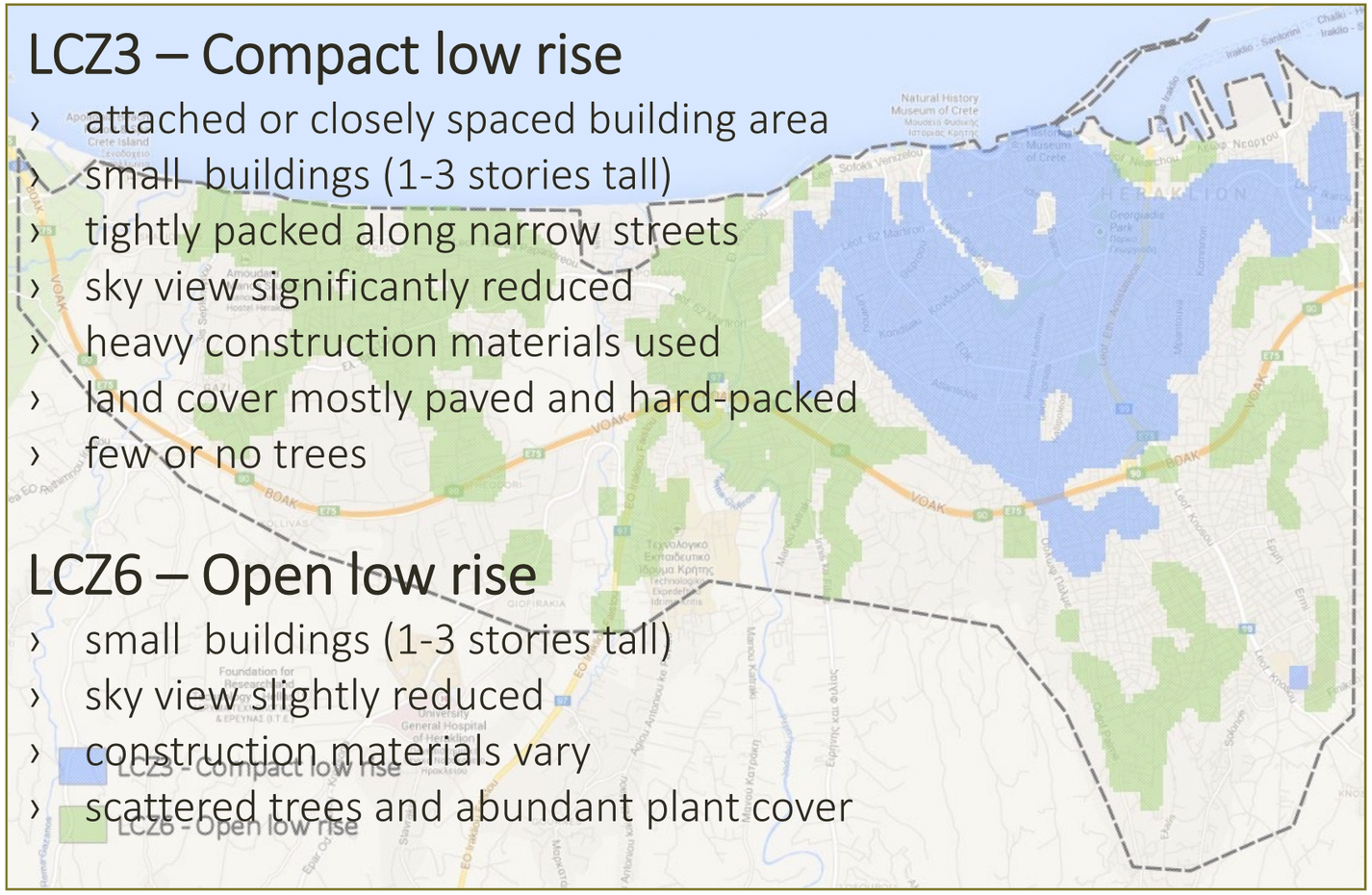
# LCZ CLASSIFICATION

## LCZ3 – Compact low rise

- attached or closely spaced building area
- small buildings (1-3 stories tall)
- tightly packed along narrow streets
- sky view significantly reduced
- heavy construction materials used
- land cover mostly paved and hard-packed
- few or no trees

## LCZ6 – Open low rise

- small buildings (1-3 stories tall)
- sky view slightly reduced
- construction materials vary
- scattered trees and abundant plant cover

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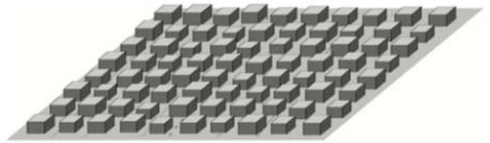
*LCZ3 – Compact low rise*

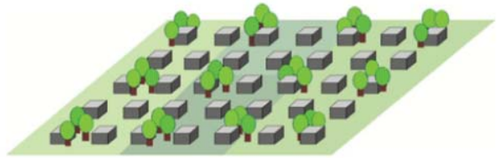
***High angle***



***Low level***

*LCZ6 – Open low rise*

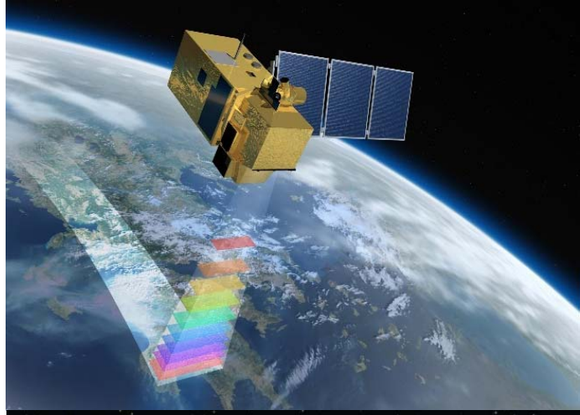
***High angle***



***Low level***

# CONCLUSIONS AND OUTLOOK

- *EO data* can be used *to quantify* the set of metadata necessary to *identify the LCZs of urban areas*
- Individual *EO products*, as well as the LCZ classification itself, can be used to urban climate modeling and studies with ultimate goal to *assist urban planning and decision making*
- Future research includes the *investigation of more urban parameters extraction using EO data*
- The ultimate goal is to develop *a methodology, adapted to the Copernicus Sentinels*, to standardize the LCZ mapping




Thank you for your attention...