



POLITECNICO
MILANO 1863



ASI I4DP_SCIENCE

Local Climate Zone & Open Data Cube (LCZ-ODC)

ASI | Politecnico di Milano – DICA | GEOlab

LCZ-ODC PROJECT



Goal: Identification of **Local Climate Zones (LCZ)** and study of their correlation with air temperature in the Milan Metropolitan City through the integration of geospatial data and Earth Observation technologies in the **Open Data Cube (LCZ-ODC)** environment.



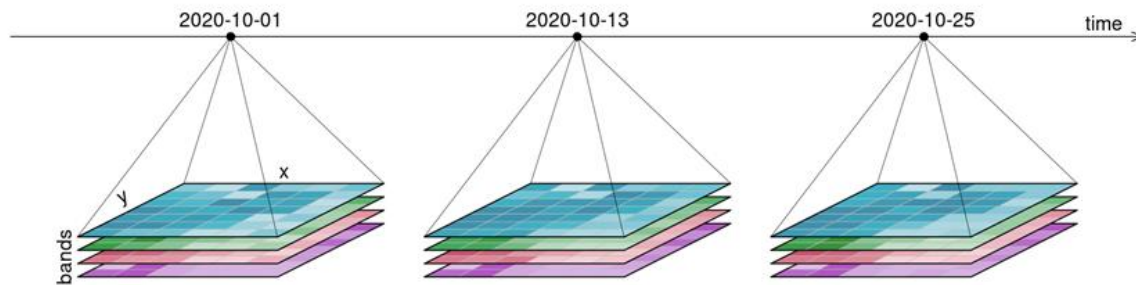
Open Data Cube (ODC) technology, a cloud-computing platform capable of integrating and managing multidimensional and multitemporal geospatial data with heterogeneous formats and resolutions in a single end-point.



First Call for ideas "**Sustainable Cities**" of the **ASI Innovation for Downstream Preparation for Science (I4DP_SCIENCE)** program.

Project Outcomes:

- **LCZs** identified by integrating high spectral and spatial resolution satellite images, and regional and local geospatial data.
- Hyperspectral images from the **PRISMA** mission will be merged with multispectral images from the **Sentinel-2 (S2)** constellation to obtain super-resolved images characterized by high spatial and spectral resolution.
- Information layers included in the **ODC** will also include land-cover maps, topographic databases and Digital Terrain Model.
- Study of the correlation between **LCZs** and heat island. Use and integration inside the **ODC** of meteorological data provided by regional monitoring networks (**ARPA** Lombardia) available for the Milan Metropolitan City.



Example of datacube with 4 dimensions: x, y, bands and time



The project also aims to:

- Demonstrate the developed applications with the users by organizing and holding events/workshops
- Consolidate the requirements for the applications
- Technical-scientific publications and dissemination at national and international conferences.

The expected outputs are:



1. **QGIS** Plugin for ARPA Weather data extraction - Source code available on GitHub



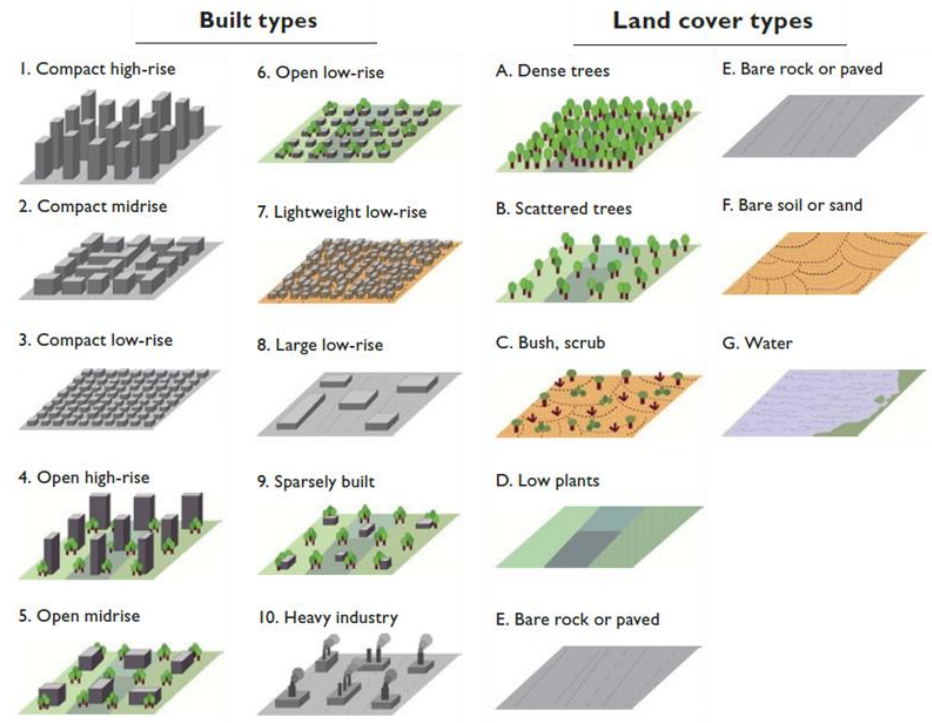
1. **Open Data Cube (ODC)** - Application containing images and analysis-ready data for further processing (Docker container with preconfigured ODC instance equipped with data and libraries needed for analysis).



1. **Python** applications for multi and hyperspectral image processing and integration - Notebook and source code available on GitHub

THE “LOCAL CLIMATE ZONE” CLASSIFICATION SYSTEM

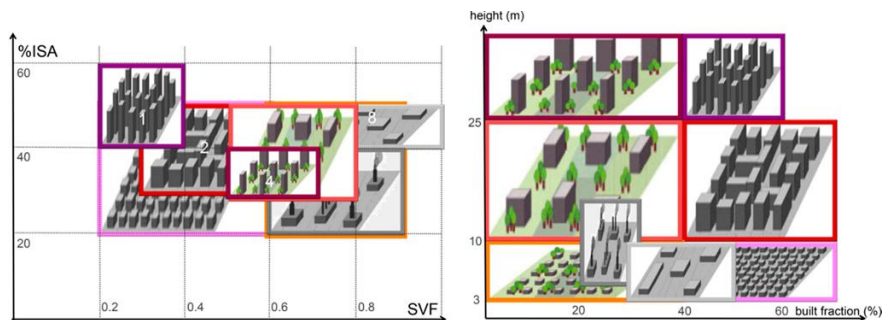
- The Local Climate Zone (LCZ) classification system provides a research framework for **urban heat island** and **climate-related studies**.
- The urban environment is divided according to properties that influence screen-height temperature: **surface structure** (height/spacing of buildings and trees) and **surface cover** (pervious and impervious).
- LCZs are regions of uniform surface cover, structure, material, and human activity that span **hundreds of meters to several kilometers**.



Stewart, I.D., and Oke, T.R. (2012) Local Climate Zones for Urban Temperature Studies. *Bulletin of the American Meteorological Society*, 93(12), 1879–1900. doi:10.1175/BAMS-D-11-00019.1

The physical properties of LCZ are **measurable and nonspecific as to place or time**:

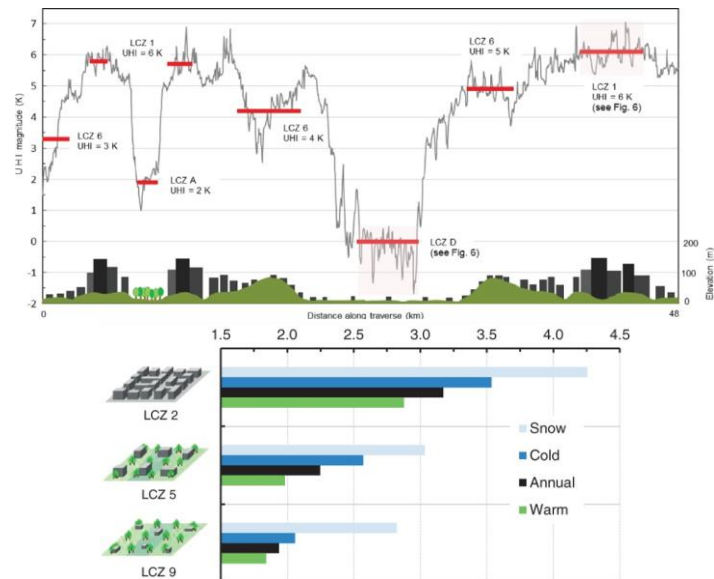
1. geometric and surface cover properties (*sky view factor, aspect ratio, building surface fraction, etc.*)
2. thermal, radiative, metabolic properties (*surface admittance, surface albedo, anthropogenic heat output*)



Bechtel B. et al. (2015) Mapping Local Climate Zones for a Worldwide Database of the Form and Function of Cities. *ISPRS International Journal of Geo-Information*, 4, 199-219. doi:10.3390/ijgi4010199

The logical structure of LCZ system is **supported by observational and numerical modeling data** (*air temperature at screen-height*).

Example below: UHI magnitude (i.e. temperature difference $\Delta T(\text{LCZ X-D})$) assessment



Stewart, I.D. et al. (2013) Evaluation of the 'local climate zone' scheme using temperature observations and model simulations. *International Journal of Climatology*, 34(4), 1062-1080. doi:10.1002/joc.3746

- Urban Heat Island assessment
- Micro-climate modeling
- Building energy
- Urban planning
- Human health

