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Towards processing chains to estimate the urban heat island intensity using FOSS tools

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This contribution proposes an original and generic method to estimate the urban heat island (UHI) intensity both spatially and temporally. This method is based on two processing chains composed of :

- three data types :
  - air temperature data measure by some networks located in several French cities,
  - meteorological data (such as wind speed, solar radiation, etc.) provided by the French institute of meteorology,
  - geographical data (such as building shape, position and height or satellite images) provided by the French National Geographic Institute (IGN),
- two free open source softwares (OFSS) :
  - OrbisGIS, a GIS platform used for geographical calculation and mapping,
  - Python, a programming language used for meteorological data manipulation and calculation

A first processing chain is used to calibrate empirical models to estimate temporal and spatial variations of the UHI intensity. Temporal models are used to estimate the UHI intensity difference between two days. Air temperature measurement and meteorological data are combined using Python scripts to create multiple linear regressions explaining the temporal variations of the UHI. Spatial models are used to estimate the UHI intensity difference between two locations of the city. First, geographical indicators are calculated according to OrbisGIS scripts (SQL language) to characterize the morphological and the land type context of each of the air temperature network stations. Then air temperature measurement and geographical indicators are combined using Python scripts to create multiple linear regressions explaining the spatial variations of the UHI.

The second processing chain is used to verify the model performances. A new air temperature measurement network is used to compare estimated values to observed values. Temporal UHI variations are estimated using Python scripts, temporal model equations and meteorological data. Spatial UHI variations are estimated using Python scripts, spatial model equations and geographical indicators calculated according to OrbisGIS scripts from geographical data.

The same processing chain may then be applied to any French city to estimate the urban heat island intensity for any location and any day.

The scripts are run with free softwares and data available and homogeneous for any French city. It makes the method applicable by any research team (open science). This work allows several potential future developments regarding the data and the methods used. Internationally homogeneous open data may be used instead of the French one in order to apply the method to any city in the world. A user-friendly tool may be realized to connect all types of data and softwares in order to be easily applied by the operational world.