

GAME
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LATTS
LIENSS
LIEU
LISST
LRA



Ce travail a bénéficié d'une aide de l'Agence Nationale de la Recherche portant la référence ANR-13-VBDU-0004

FINANCE PAR
ANR

Building Local Climate Zones by using socio-economic and topographic vectorial databases

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**UMR 7266 LIENSS,
Littoral Environment and Society**

La Rochelle University - CNRS



icUC₉

20th-24th July 2015
Toulouse France

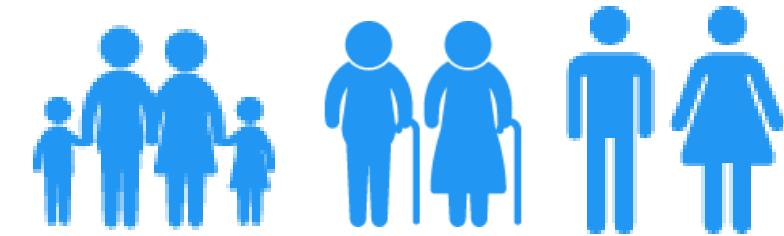


MAPuCE objectives

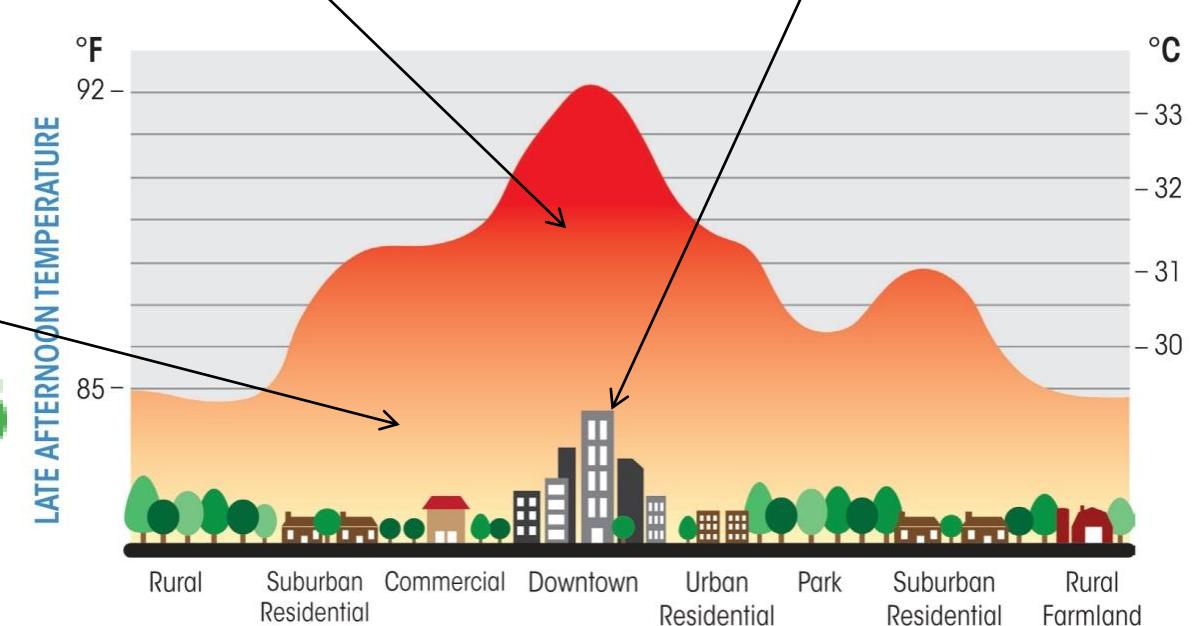
Morphology and characteristics of buildings



Land use & cover



Households behavior



Source : <http://www.c3headlines.com/global-warming-urban-heat-island-bias/>

LCZ as a tool for urban climat

LCZ

COMPACT MID-RISE

2

DEFINITION

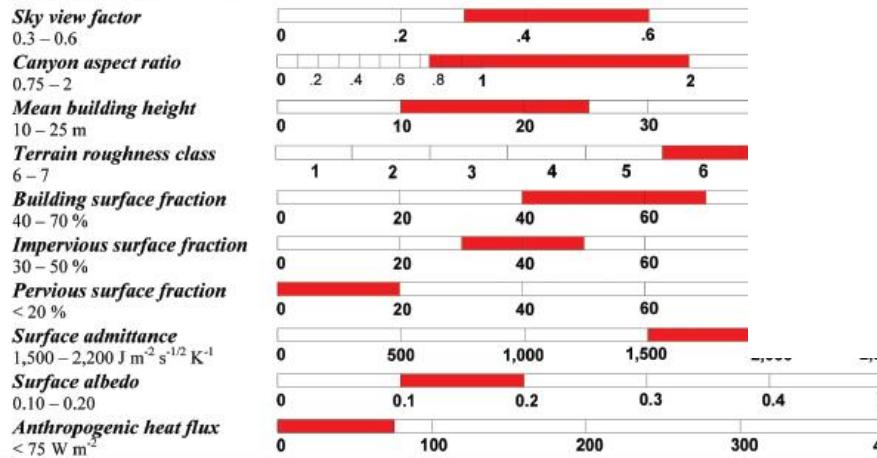
Form: Attached or closely spaced buildings 3–9 stories tall. Buildings separated by narrow streets and inner courtyards. Buildings uniform in height. Sky view from street level significantly limited by building height. Construction materials (stone, concrete, brick, tile); thick roofs and walls. Land cover hard-packed. Few or no trees. Moderate space heating/cooling demand. Moderate to high rainfall.

Function: Residential (multi-unit housing; multistorey tenements); commercial (office towers; retail shops); industrial (warehouses, factories). **Location:** Core (old city, old town; in business district); periphery (high-density sprawl). **Correspondence:** UCZ2 (Oke 2004); LCZ5 (Ellefsen 1990/91).

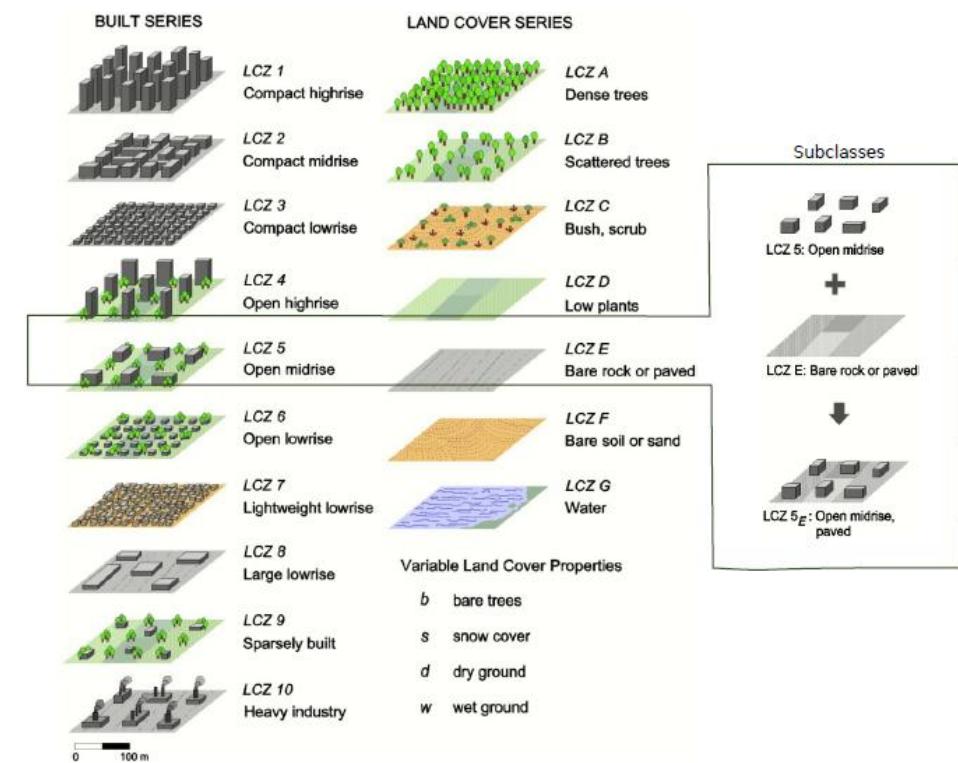
ILLUSTRATION



PROPERTIES

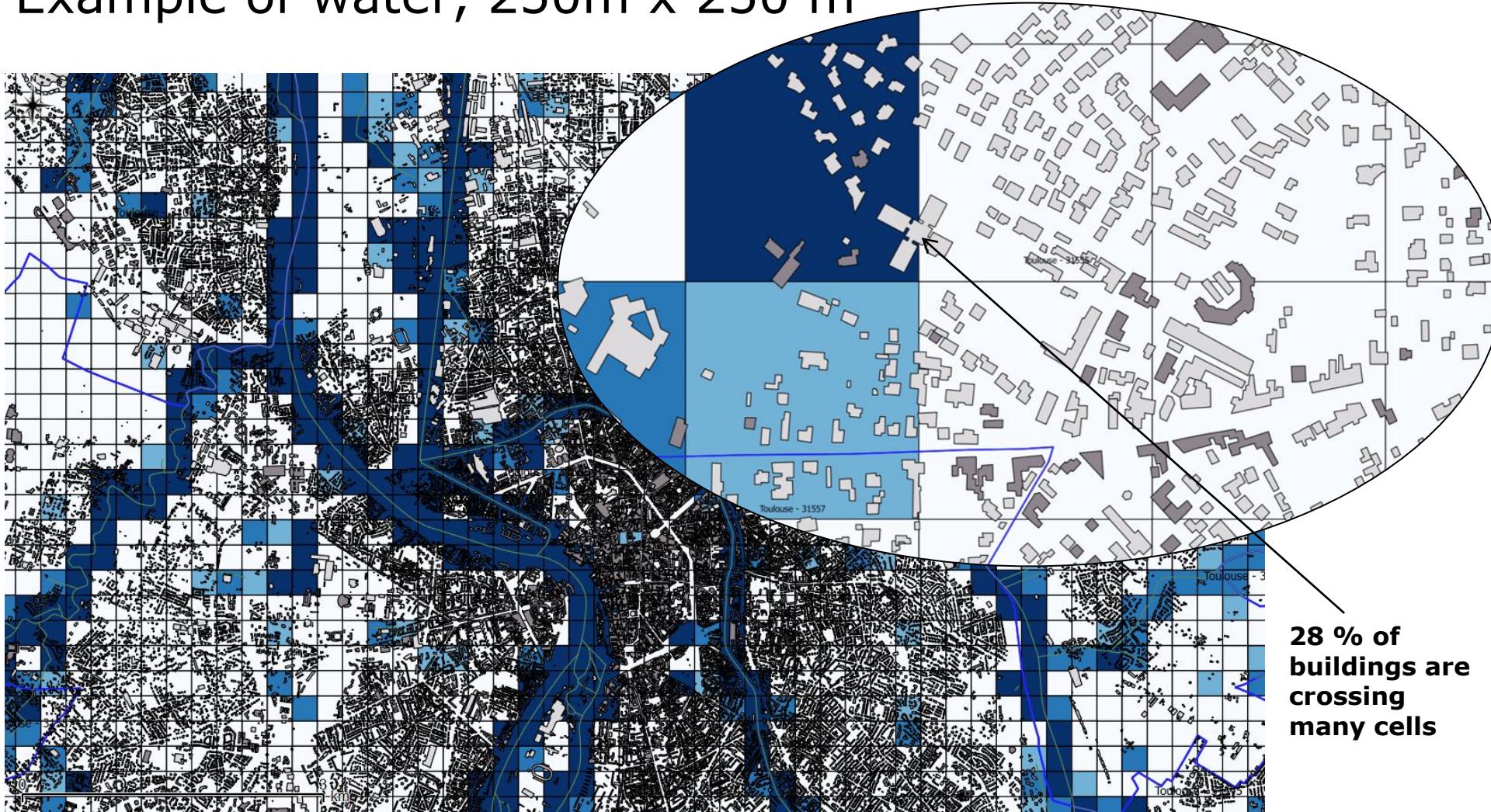


Local Climate Zones (LCZ)



Data available in vectorial databases : water, vegetation, roads, buildings, census, ...

Example of water, 250m x 250 m

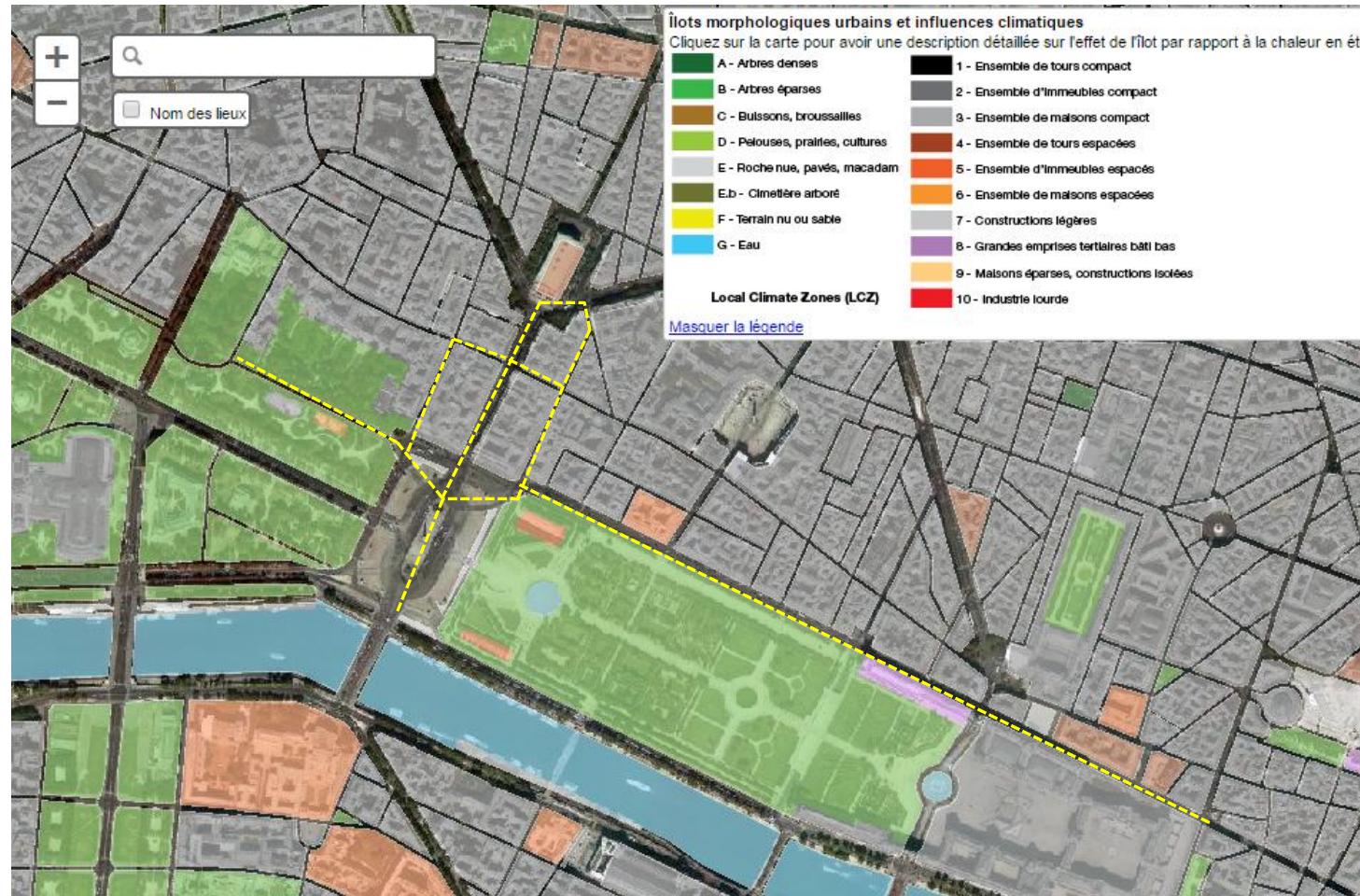


Building LCZ with topographic databases

LIENSs : C.Plumejeaud, C.Poitevin, C. Pignon, N.Long

Introducing a new zoning made of *islets*

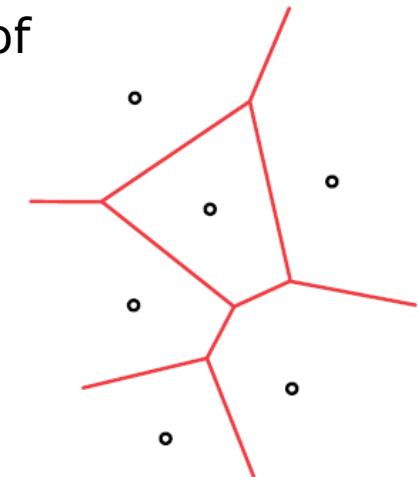
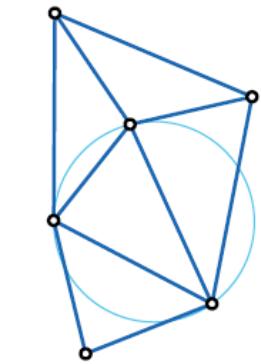
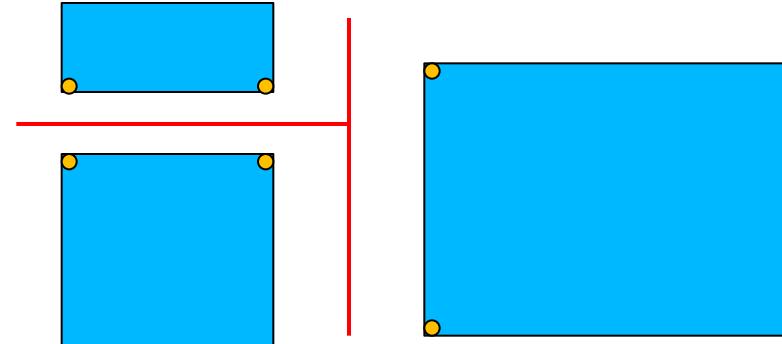
Expert map of urban agency (<http://carto.iau-idf.fr/webapps/imu/>)



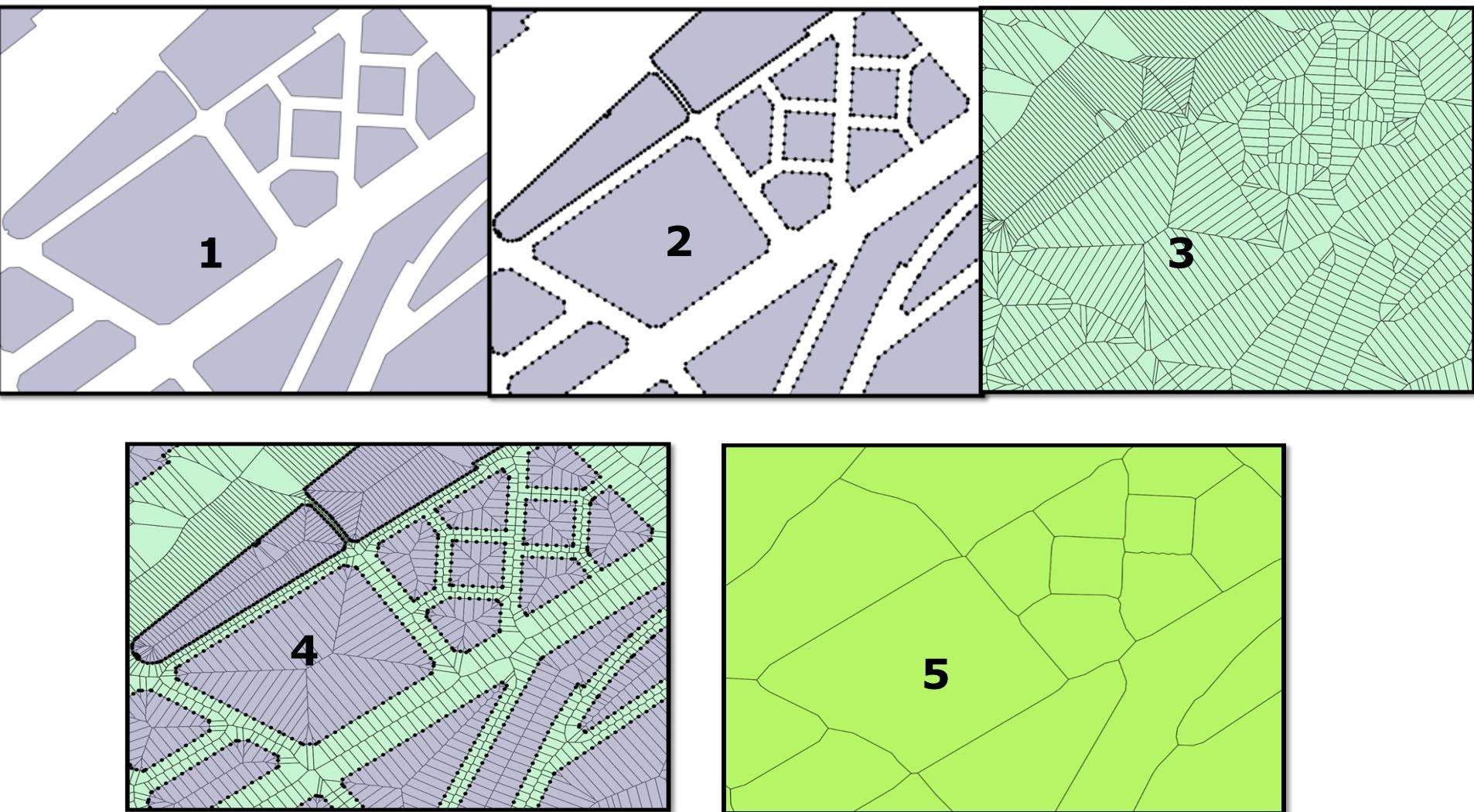
Draw the yellow limits
to build a
continuous
zoning
(complete
tessellation
of space)

Voronoi tessellation

- “In mathematics, a **Voronoi diagram** is a partitioning of a plane into regions based on distance to points in a specific subset of the plane. That set of points (called seeds, sites, or generators) is specified beforehand, and for each seed there is a corresponding region consisting of all points closer to that seed than to any other. These regions are called Voronoi cells. The Voronoi diagram of a set of points is dual to its Delaunay triangulation. Put simply, it's a diagram created by taking pairs of points that are close together and **drawing a line that is equidistant between them and perpendicular to the line connecting them**. That is, all points on the lines in the diagram are equidistant to the nearest two (or more) source points.” [\[wikipedia:
\[https://en.wikipedia.org/wiki/Voronoi_diagram\]\(https://en.wikipedia.org/wiki/Voronoi_diagram\)\]](https://en.wikipedia.org/wiki/Voronoi_diagram)
- Computation cost : **$n \log(n)$** , n being the number of points put along the street-blocks border

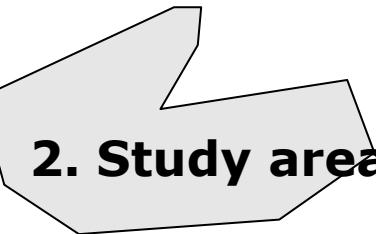


Steps of the islets computation



A generic and open-source workflow: SQL + R + postgis

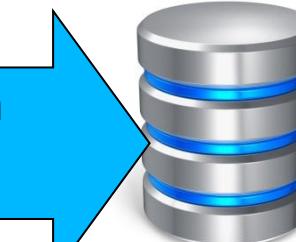
1. RAW_DATA



3. Clean data

4. Voronoï computation

**5. Export islets
6. Enrich data**



MAJGEO

Buildings

Islets

Buildings: we enrich their description

Height

→ **Fixed_height**

(13% of buildings)

→ **Nb_levels** =

f(fixed_height, rules)

team@LRA

Function : industrial | remarquable | unclassified

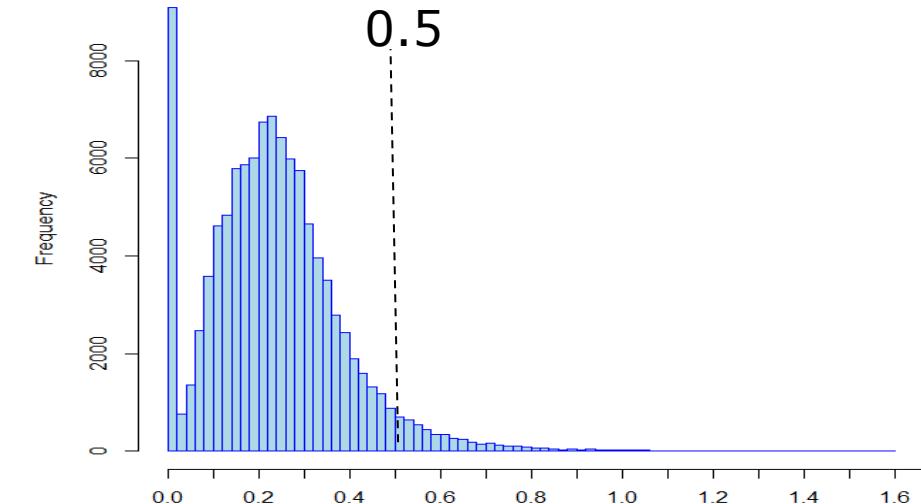
Non residential | residential

Socio-economic proxies:

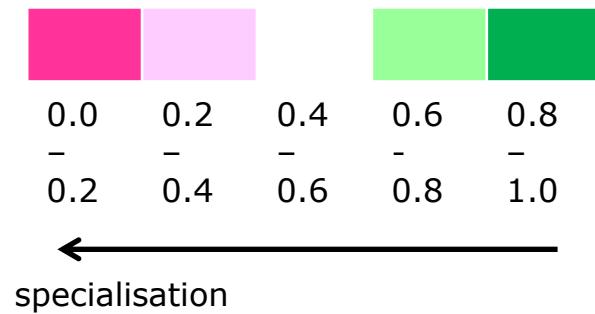
#Inhabitants,

#Households

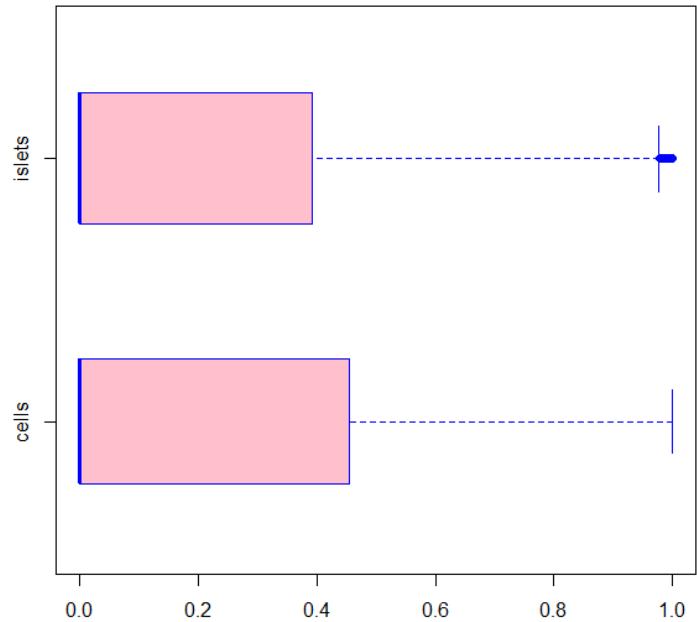
Dispersion of known height per islets



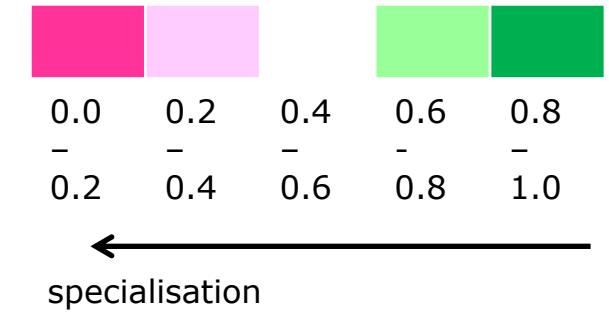
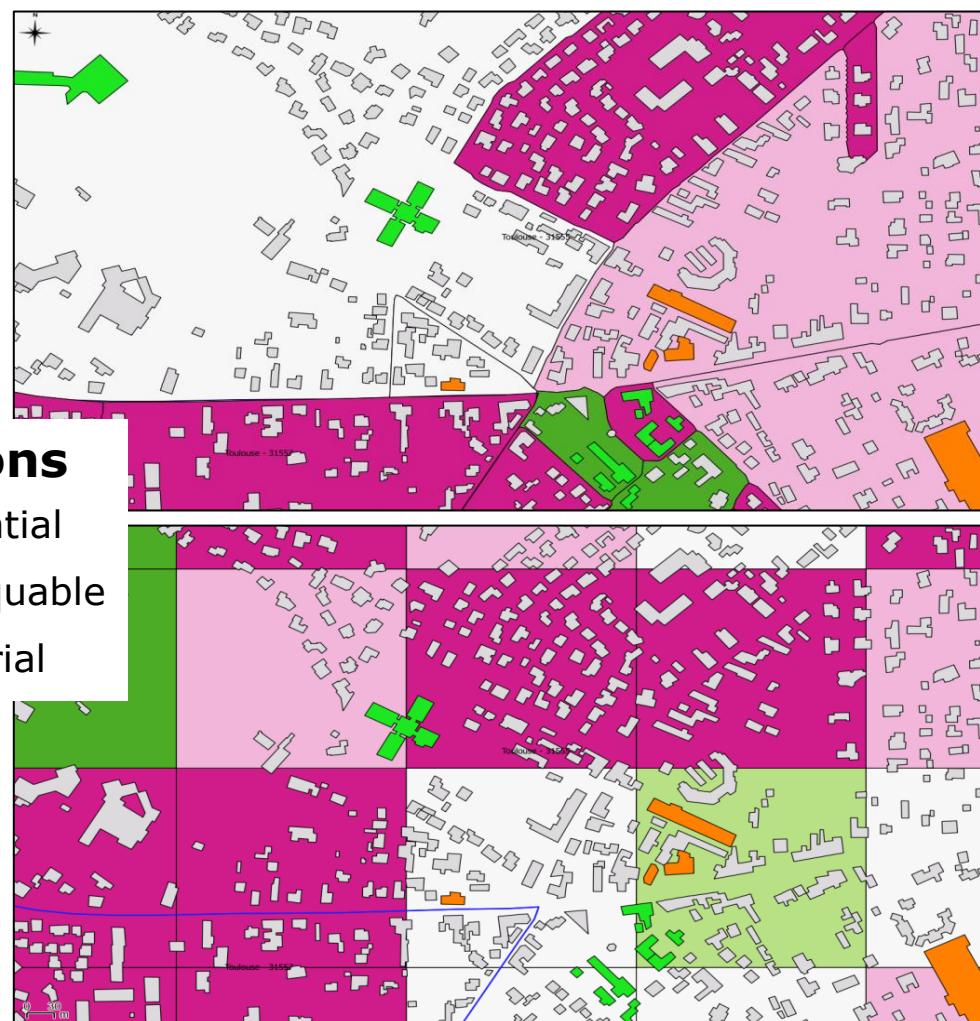
Analysis of building levels dispersion (above 2 or not)



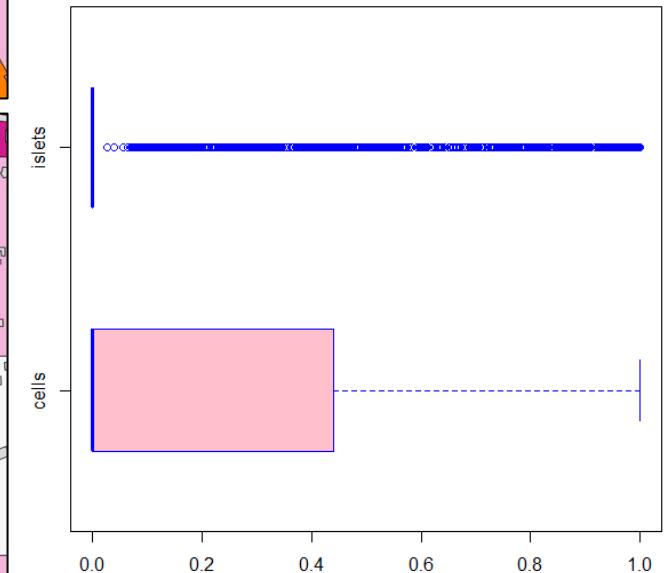
Distribution of shannon indexes for buildings levels



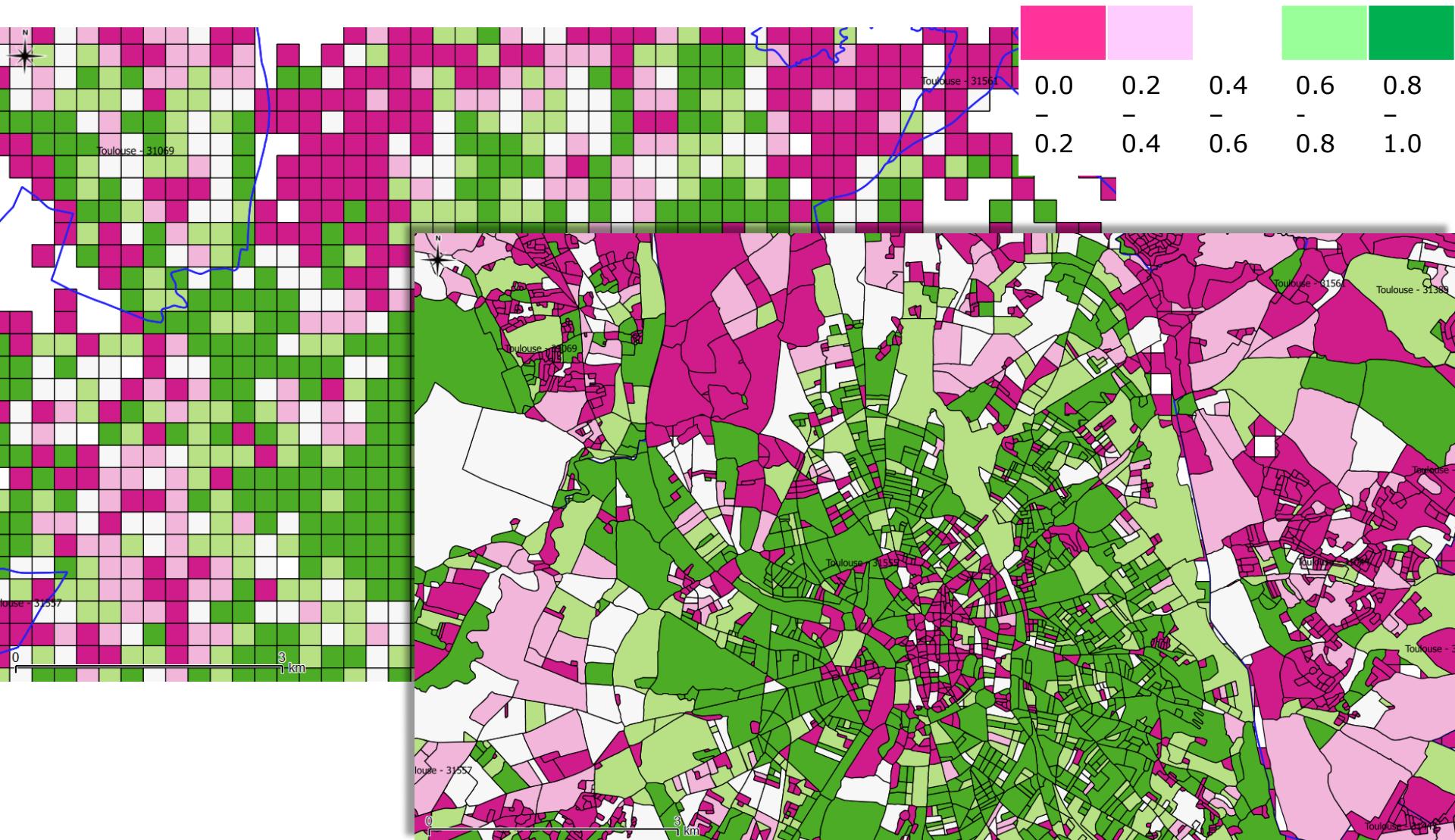
Analysis of buildings function (residential or not)



Distribution of shannon indexes for usage (residential or not)



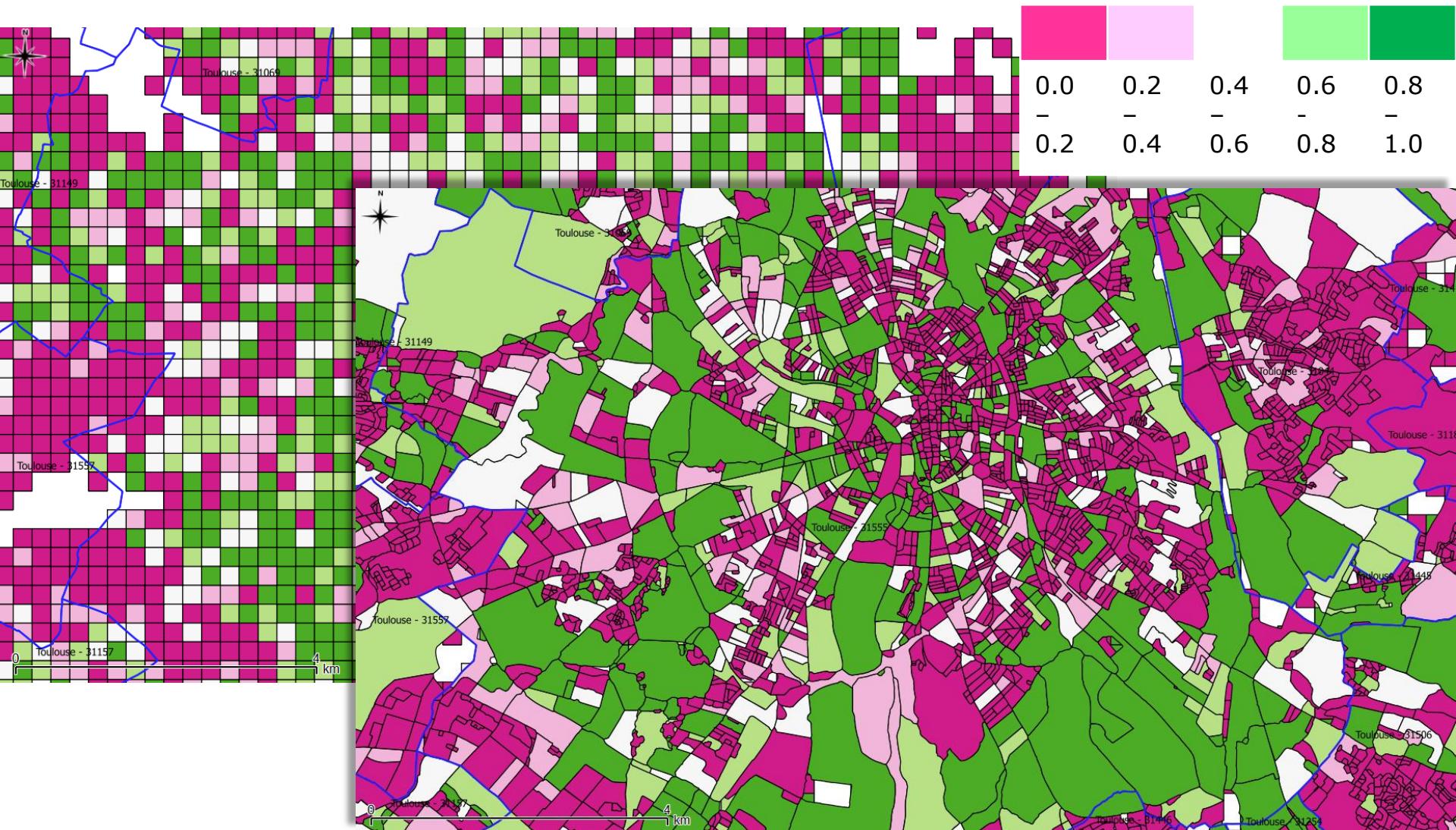
Toulouse (bati-levels)



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Toulouse (usage: residential or not)



Conclusion and perspectives

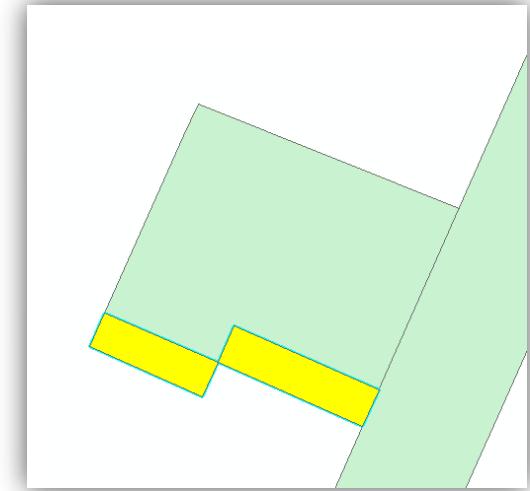
- The new zoning of islets allows for a fine estimation of households behavior
- The workflow is generic, automated for France, could be reused anywhere provided that cadastral databases exist.
- Islets can be used in further classifications to build LCZ, by union of contiguous islets having similar morphological and physical (land use/land cover) characteristics

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Data cleaning

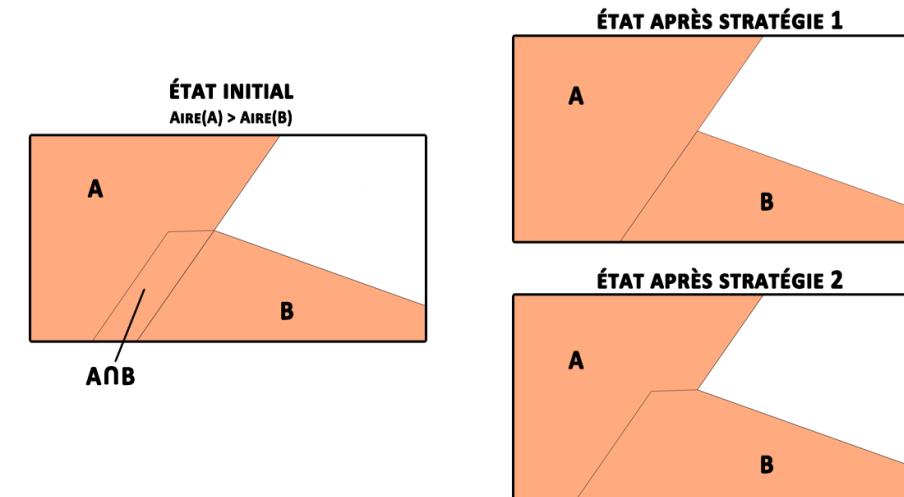
Cleaning strategies

- ❑ **Invalid** : `ST_MakeValid(a.the_geom)`
- ❑ **Doublons** : One is kept
- ❑ **Overlaps** : The smallest polygon is deleted



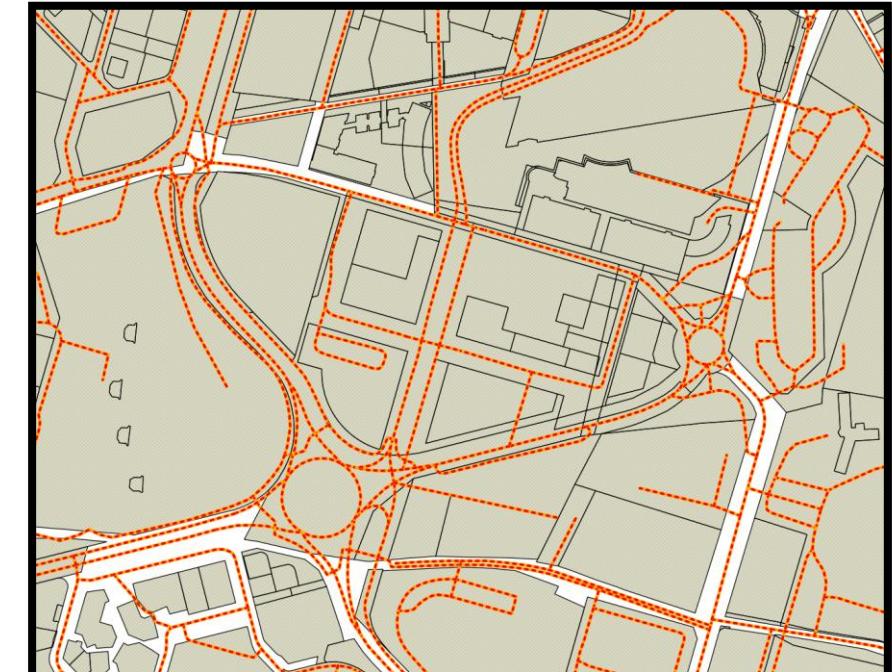
❑ **Intersects:**

- Strategy 1 : the biggest wins
- Strategy 2 : the smallest wins



Filtering parcels in public domain

- **Elongated parcels, without building and intersecting roads may be roads**



POI x parcel x building

- ***Identification of the functions of buildings by using Point Of Interest classes of BDTopo ©, with parcels.***

