

Is OpenStreetMap suitable for Urban Climate Studies ?



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Context : urban climate studies

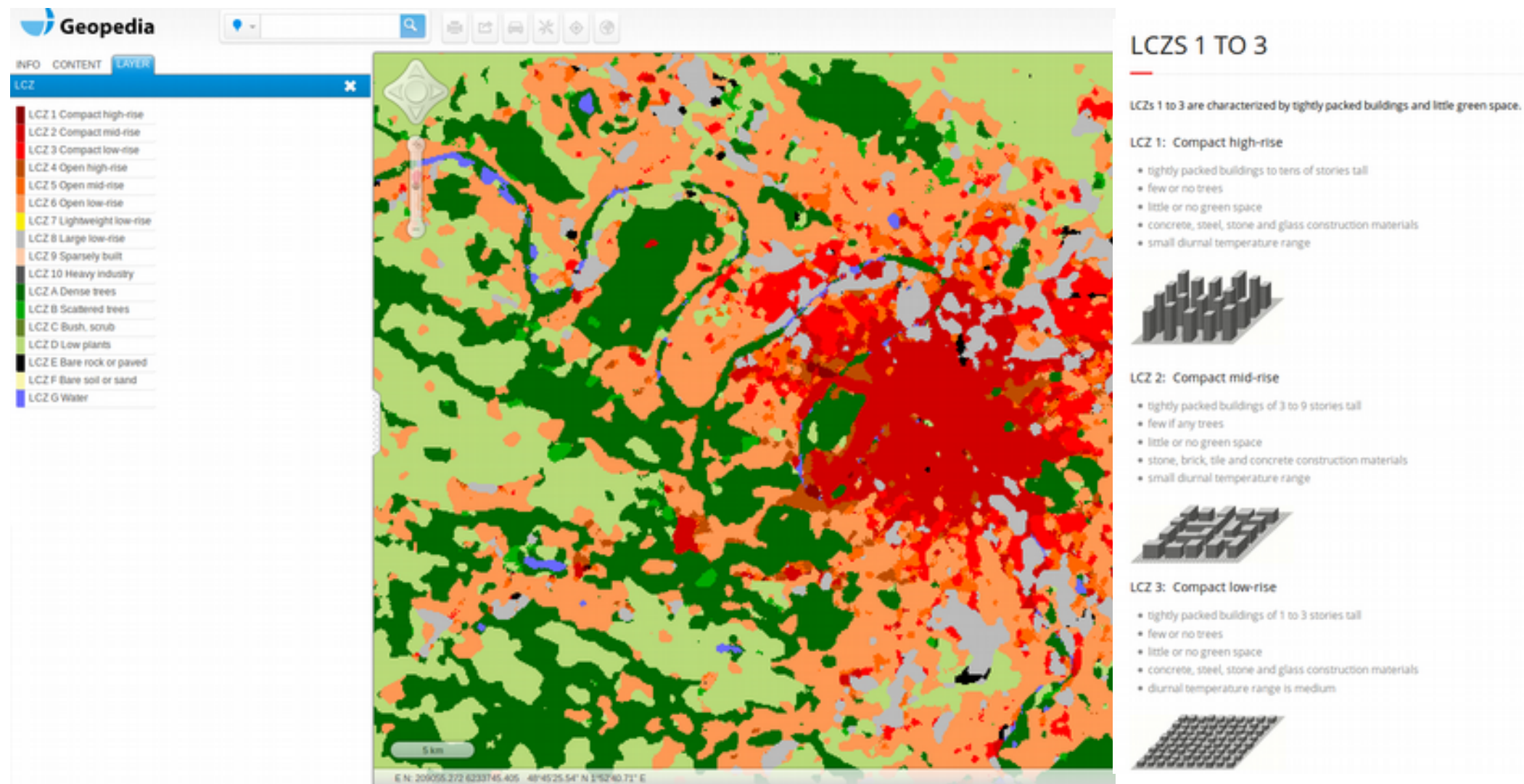
⇒ **How to assess the impact of cities on regional climate ?**

- Climate models were built to assess that, such as Town Energy Balance (TEB), but they need **data on urban areas**
- Existing methodologies providing urban geographical information such as World Urban Database and Access Portal Tools (WUDAPT), using Local Climate Zone (LCZ) classification framework

⇒ **Problems :**

- **Coarse resolution** (e.g. 100m * 100m for LCZ)
- **No morphological and architectural descriptions**

Context : urban climate studies



Source : <https://wudapt.org>

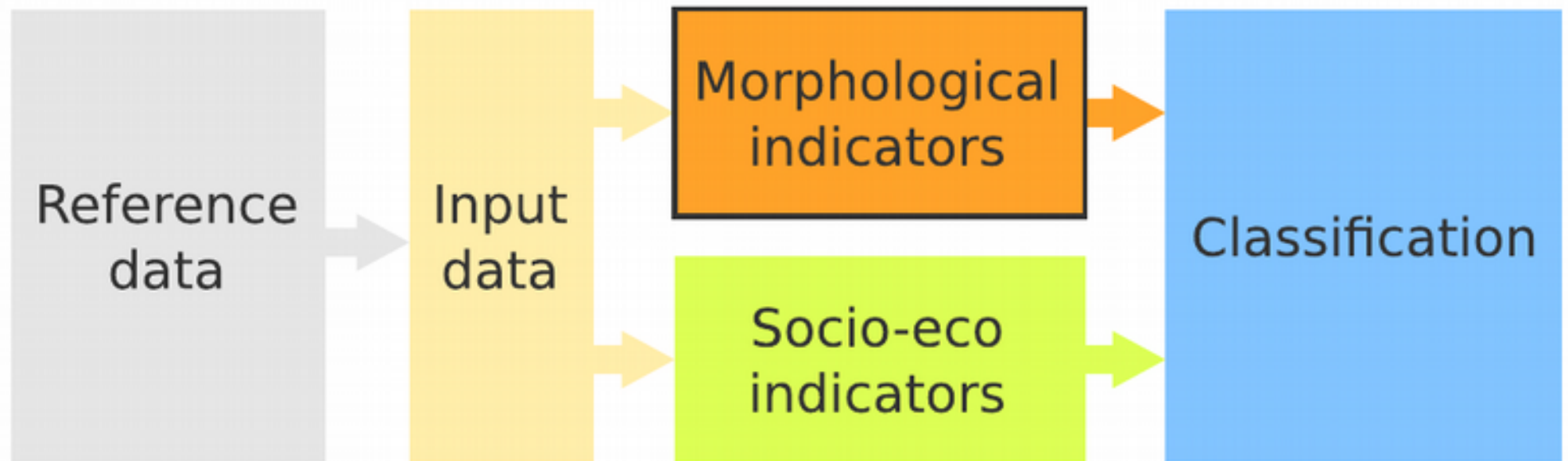
Context : urban climate studies

Research have been done to overcome these problems with MAPuCE program lead by CNRS & Meteo France :

- Open geoprocessing framework to calculate **standardized urban indicators at 3 geographic scales** : building, block and a Reference Spatial Unit (RSU).
- Based on a fine vector Data Base (DB) provided by the French National Geographical Institute (IGN).
 - ⇒ New opportunities to extend the WUDAPT DB at a finest scale with **morphological, architectural and socioeconomic indicators.**

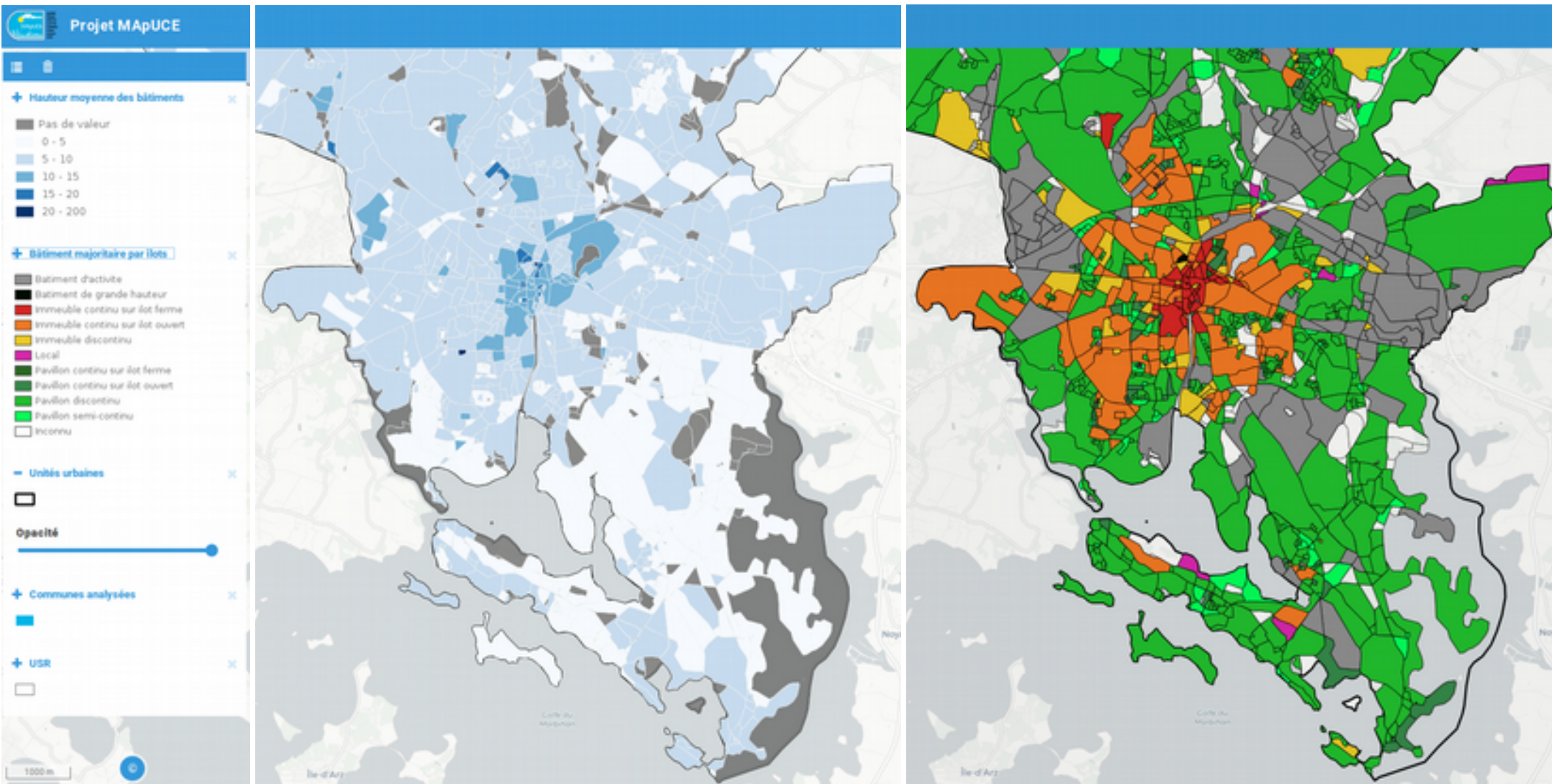
Context : urban climate studies

The main steps of the MAPuCE method



Source : <https://doi.org/10.1016%2Fj.uclim.2018.01.008>

Context : urban climate studies



Source : <https://mapuce.orbisgis.org>

Context : urban climate studies

WUDAPT intends to classify the urban fabric by climate properties from homogeneous and available data at world scale.

⇒ There is a **need to investigate other databases.**

OpenStreetMap project, an opportunity for urban climate studies ?

- It has a **world coverage**
- It has, *a priori*, **spatial attributes and metrics for morphological and architectural information** of cities
- The database is growing steadily so we are expecting **more and more valuable information**

Issues

- **Are OSM data suitable for these kind of urban climate studies ?**
- How to answer these question ?
 - ⇒ By building a **methodology** and a **set of tools** to check the availability of the OSM data to feed the MApUCE geoprocessing chain and thus urban climate studies

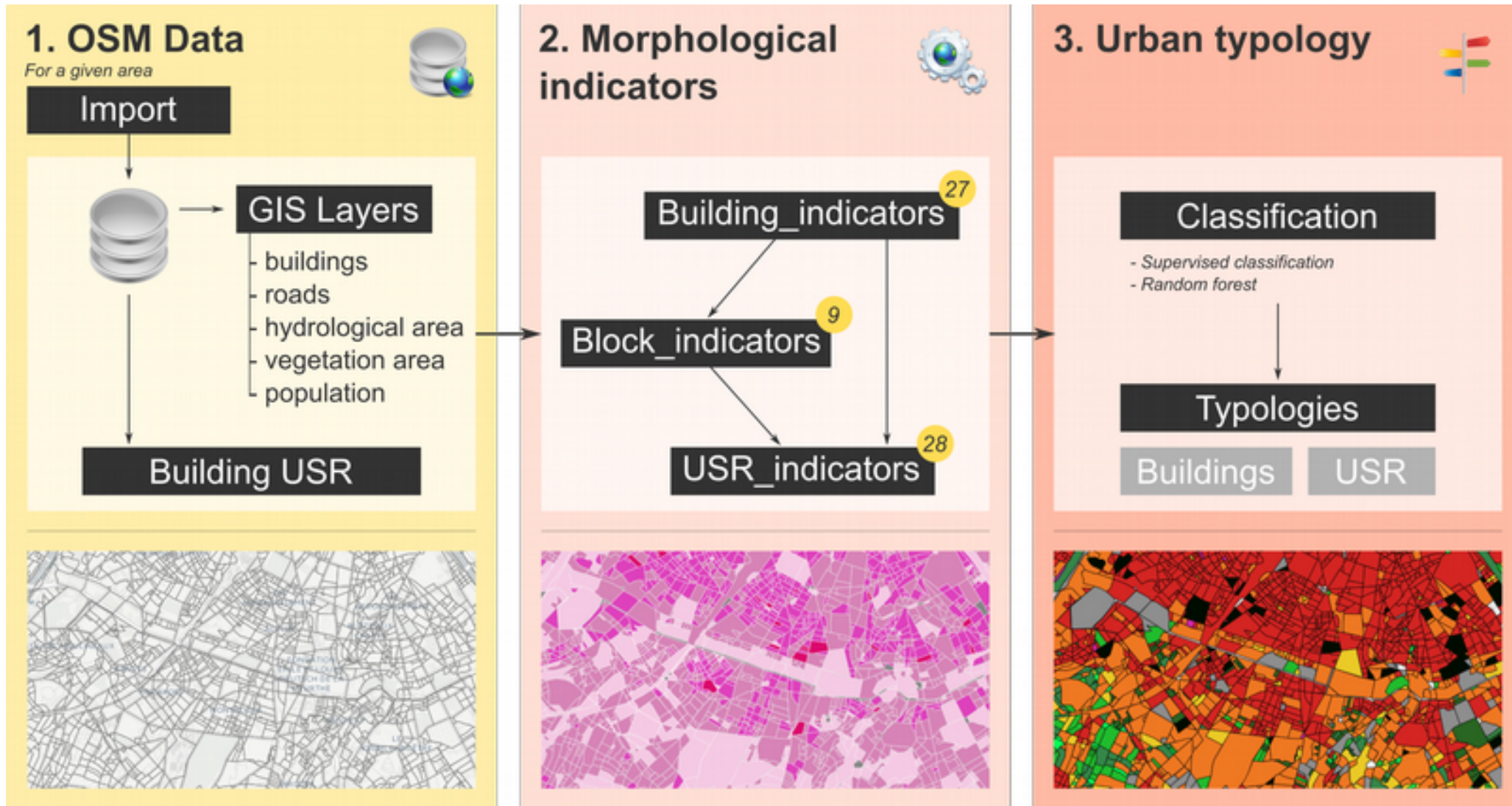
A lot of methods and tools to qualify OSM data

Some relevant examples ... :

- GeoFabric ⇒ Scale of the data
- OverpassTurbo ⇒ No geometric statistics calculation
- OSMnx ⇒ Roads analysis only
- Osm analytics ⇒ No customised statistics calculation, only online
- Etc.

... that do not meet enough criteria for urban climate studies

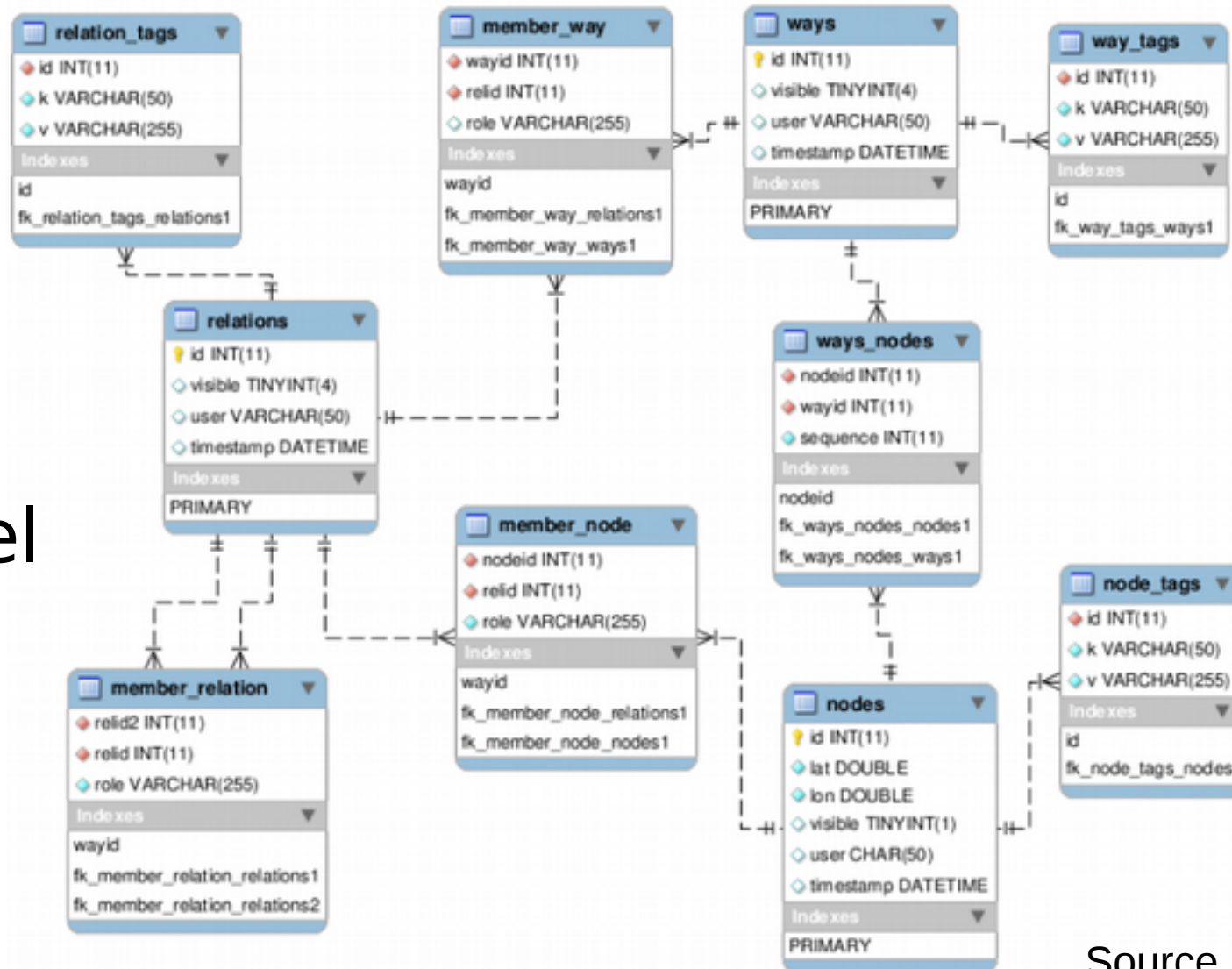
Needs on the data ?



Source : Bocher E., URCLIM project, 2018

Needs on the data ?

OSM
data
model



Source : Hombiat A., 2017

Needs on the data ?

That is able to match with an abstract data input model for urban climate study

Buildings		
Name	Type	Definition
id	SERIAL	Unique identifier
id_source	VARCHAR	Id of the source data
the_geom	POLYGON	Geometry
height_wall	FLOAT	The height of the wall
height_roof	FLOAT	The maximum is the height of a building is the distance between the top edge of the building and the lowest point at the bottom where the building meets the terrain
nb_lev	INTEGER	Number of levels (> 0)
area	FLOAT	Building's area
perimeter	FLOAT	Building's perimeter
category	VARCHAR	Attribut permettant de distinguer différents types de bâtiments selon leur usage
main_use	VARCHAR	Main use of the building
secondary_use	VARCHAR	Secondary use of the building
housing_nb	INTEGER	Number of housing in the building
wall_material	VARCHAR	Main material used for the wall
roof_material	VARCHAR	Main material used for the roof
id_city	VARCHAR	City's id where the building is (in France = CODE INSEE)

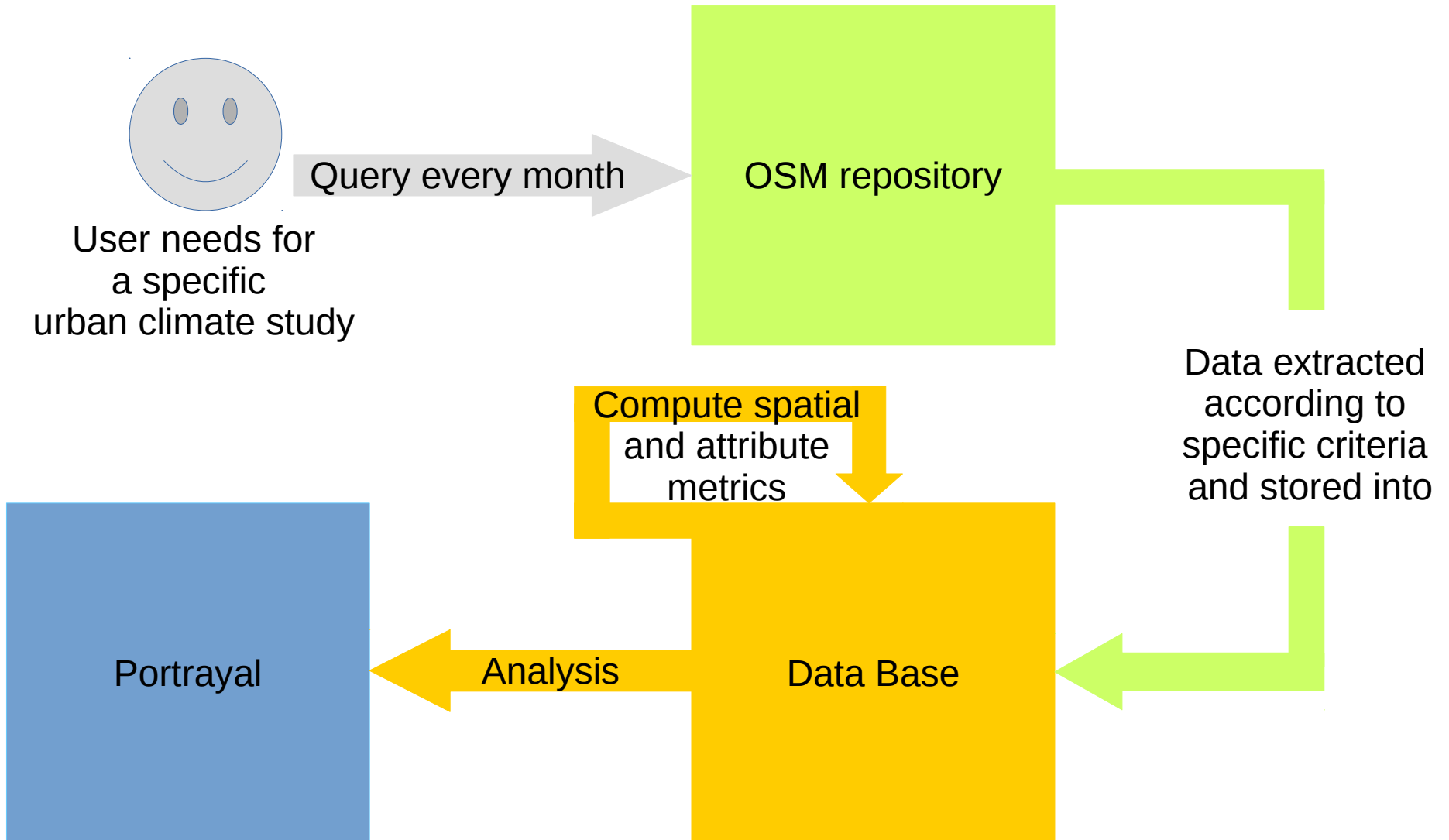
Hydrological		
Name	Type	Definition
id	SERIAL	Unique identifier
id_source	VARCHAR	Id of the source data
the_geom	POLYGON	Surface of the hydrological feature

Roads		
Name	Type	Definition
id	SERIAL	Unique identifier
id_source	VARCHAR	Id of the source data
the_geom	LINestringZ	Geometry
width	FLOAT	Width of the road
category	VARCHAR	Type of road
surface	VARCHAR	The surface value is used to provide additional information about the physical surface of roads/footpaths and some other features, particularly regarding material composition and/or structure.
sidewalk	VARCHAR	Specify if the road has two, one or no sidewalk(s) - values=[two, one, no]

Vegetation		
Name	Type	Definition
id	SERIAL	Unique identifier
id_source	VARCHAR	Id of the source data
the_geom	POLYGON	Surface of the vegetation feature
category	VARCHAR	Type of vegetation (High and low)

Source : Bocher E., URCLIM project, 2018

Method



Implementation

An Open source framework, in 4 main steps :

- Query on the fly the OSM database from a country code & store the data in a **Multi-Dimensional Data Base** (MDDDB),
- Compute **spatial and attribute metrics** on the city,
- **Store the results** in the MDDDB,
- **Visualise the results from Metabase dashboard service** that integrates chart and map representations at different scales : time, attributes, geography.

Geoprocessing chain : data acquisition

Query on the fly the OSM database from a country code :

- Through **OverPass API**
- With a **dedicated library** that reproducing the API in **JAVA/Groovy langage**
⇒ Aims to **improve the OverPass requests** in Groovy

(<https://github.com/orbisgis/OverPass4J>)

Geoprocessing chain : metrics computation

Compute spatial and attribute metrics on the country :

- Into the MBBD using **H2GIS** or **PostGre SQL/PostGIS**
- Computation are made with **SQL language functions**

Geoprocessing chain : Results storage

COMMUNES_REPORT		
insee_code	varchar(2147483647)	(PK)
process_date	timestamp	
message	varchar(2147483647)	

MEASURE		
id	bigserial(19)	(PK)
indicator_id	int4	(FK)
time_id	int4	(FK)
geo_id	int4	(FK)
value	float4	

INDICATOR_DIM		
id	serial(10)	(PK)
name	text(2147483647)	
layerid	int4	
layername	text(2147483647)	

GEO_DIM		
id	serial(10)	(PK)
level8	text(2147483647)	
level8_lib	text(2147483647)	
level7	text(2147483647)	
level7_lib	text(2147483647)	
level6	text(2147483647)	
level6_lib	text(2147483647)	
level5	text(2147483647)	
level5_lib	text(2147483647)	
level4	text(2147483647)	
level4_lib	text(2147483647)	
level3	text(2147483647)	
level3_lib	text(2147483647)	
country_code	text(2147483647)	
the_geom	geometry(2147483647)	
the_geom_old	geometry(2147483647)	

TIME_DIM		
id	serial(10)	(PK)
month	int2	
year	int4	
monthname	text(2147483647)	

Multi-Dimensional Database (MDDDB)

Results

Open Street Map dashboard

Indicateur

Région

This dashboard checks for each French communes the consistency of the Open Street Map database for environmental studies. It provides statistics on a set of GIS layers and their attributes. The GIS layers are reconstructed from the OpenStreetMap relational model. They are organized according to the simple features model. Currently statistics are only provided for the building layer and the attributes height, level and area.

16 350
Number of French communes processed

General informations for the buildings

Name	Number Of Buildings	Number With Height	Number With Level	Sum Area
NORD	1,625,299	54	1,585	17,808.28
PAS-DE-CALAIS	1,176,807	25	336	12,540.13
LOIRE-ATLANTIQUE	927,210	593	2,751	10,761.35
VAR	847,160	312	1,442	7,303.54
VENDÉE	826,552	79	292	9,512.73
FINISTÈRE	754,375	75	392	10,138.25
SEINE-ET-MARNE	752,219	35	1,285	8,375.67
MORBHAN	706,413	5	1,434	8,603.5
MAINE-ET-LOIRE	675,446	30	368	8,225.48
OISE	600,745	3	366	6,214.69
SACNE-ET-LOIRE	591,449	93	260	7,094.96

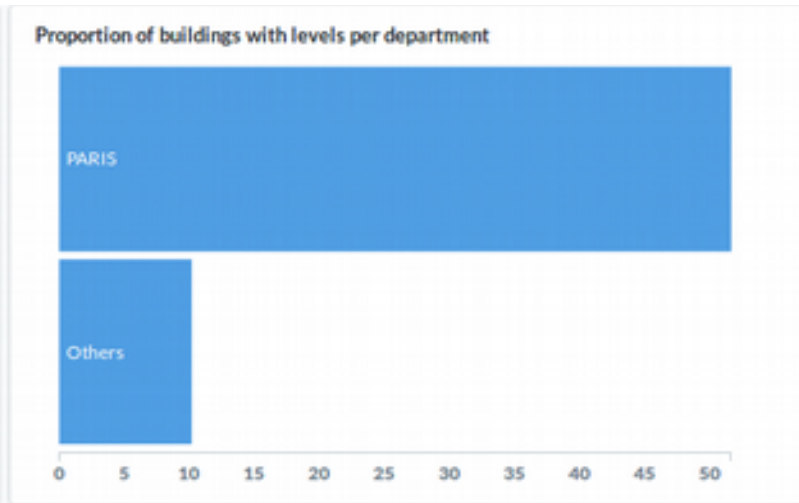
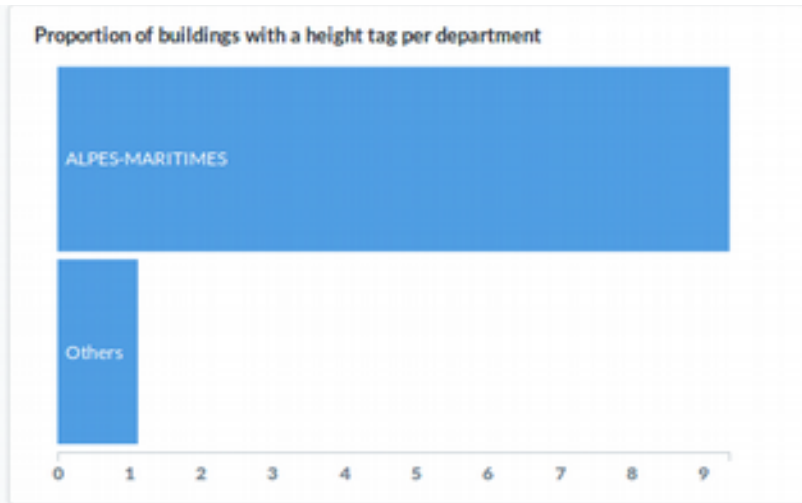
Number of communes without buildings per department

Name	Number Without Buildings
HAUTE-SACNE	113
AVEYRON	1
LORET	5
ARIEGE	1
MARNE	131
AUBE	54
HAUTE-VIENNE	3
ARDENNES	141
HAUTE-MARNE	214

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<https://dashboard.orbisgis.org/public/dashboard/1a6e66c2-1307-42d4-b344-dfbd56e08067>

Geoprocessing chain : Results



Test for dynamic table

Code Dpt	Dpt Name	Value
56	MORBIHAN	706,413
29	FINISTERE	754,375

<https://dashboard.orbisgis.org/public/dashboard/1a6e66c2-1307-42d4-b344-dfbd56e08067>

Conclusion

- Get **specific** and **detailed** informations on the **raw data** for a given territory, « **on-the-fly** »
- Know if a **spatial analysis** can be carried out on a territory with regard to the **necessary parameters for specific uses** (urban climate studies, land-planning project, environmental acoustic studies, ...)
- A possibility to **interract with the OSM community** to get the needed information for a given territory and **improve** the world community map

Thank you for your attention

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