Assess the OpenStreetMap data quality starting from contribution history

SAGEO2017 - Workshop Crowdsourcing and voluntary geographical information

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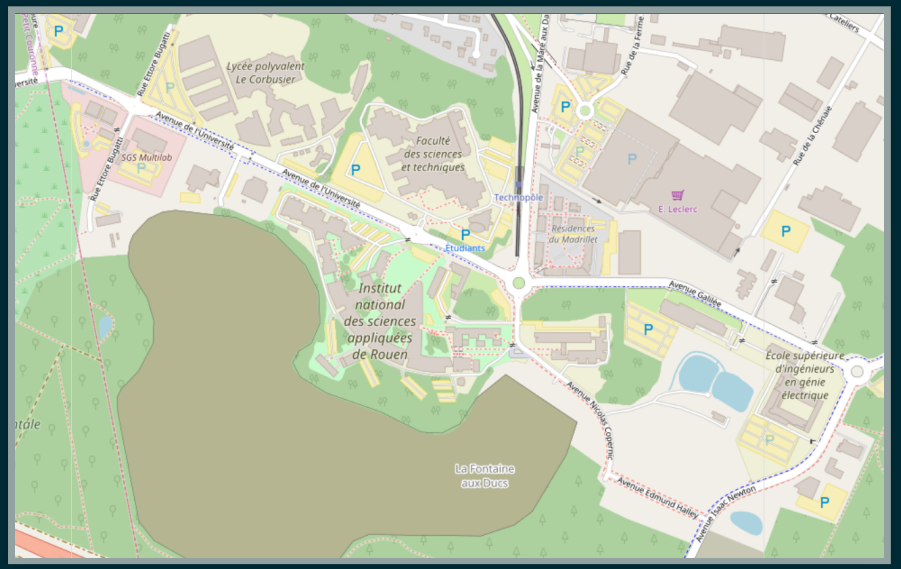
Introduction

OpenStreetMap (OSM)

View of Europe

Here we are!



OpenStreetMap (OSM)

OSM: Map the world collaboratively

OSM data quality

Research question: *can we assess the OSM data quality?*

- Sparsity of alternative data sources (what about reference data?)
- Everyone can contributes, but does everyone knows how to contribute?
- Evaluate the OSM objects with their metadata

Outline

(Part 1) Research framework: get and prepare the data

(Part 2) Unsupervised learning applied on OSM metadata

(Part 3) Insights about OSM data quality

Research framework

Where to get OSM data

- Direct exports on OpenStreetMap API (small areas)
- `osm.pbf` file dowloading from:
  - GeoFabrik (`osh.pbf` history files),
  - Mapzen (large cities all around the world),
  - download.openstreetmap.fr
- `osmium` extracting tool (a small area from a larger one)

Then, processing with various tools (imposm, pyosmium, osm2pgsql...)

Data gathering

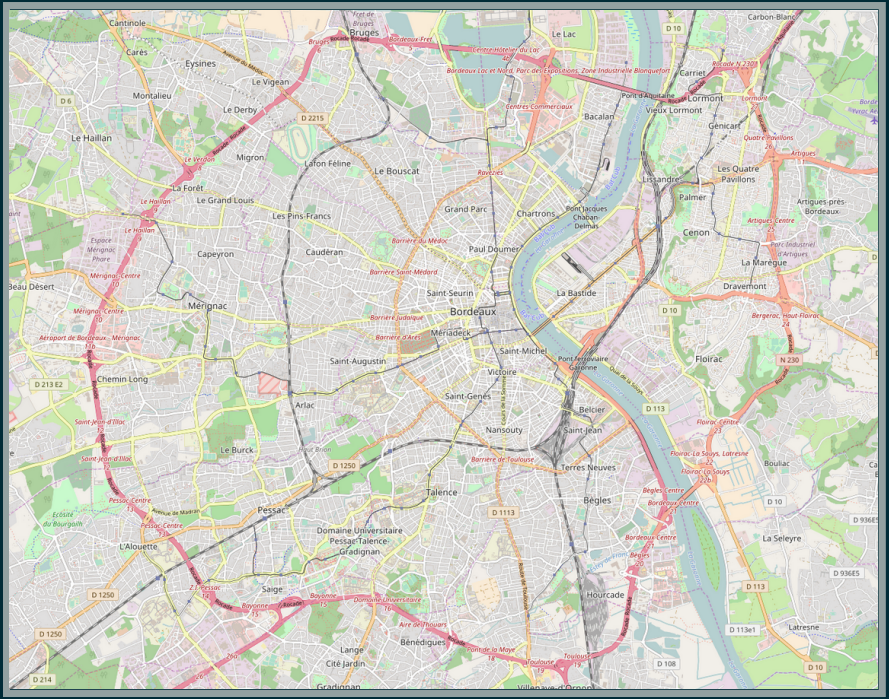
`Pyosmium`: a tool (among others) to parse OSM data

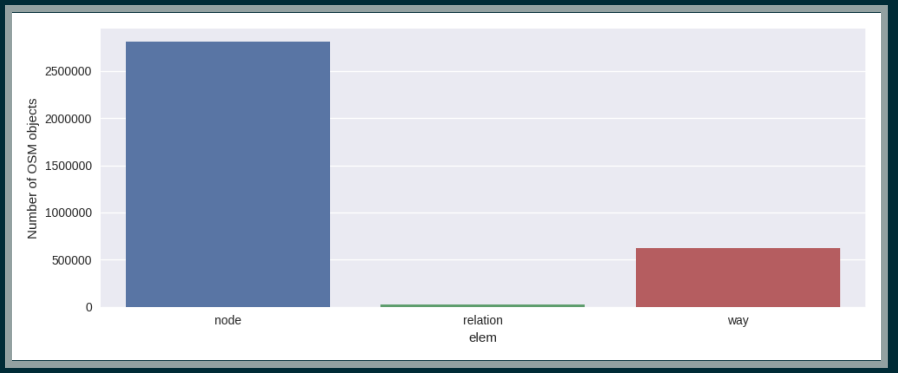
```
import osmium as osm

class TimelineHandler(osm.SimpleHandler):
    def __init__(self):
        osm.SimpleHandler.__init__(self)
        self.timeline = []
    def add_element(self, elem, elem_type):
        self.timeline.append([elem_type,
                              elem.id,
                              elem.version,
                              elem.whatever])
    def node(self, n):
        self.add_element(n, "node")
```

Recover the data in two lines:

```
timeline_handler = TimelineHandler()
timeline_handler.apply_file("osm_file.osh.pbf")
```

Data presentation





```
-<osm version="0.6" generator="CGImap 0.6.0 (6182 thorn-01.openstreetmap.org)"
copyright="OpenStreetMap and contributors" attribution="http://www.openstreetmap.org/copyright"
license="http://opendatacommons.org/licenses/odbl/1-0/">
   <node id="101439002" visible="true" version="6" changeset="25575532"
   timestamp="2014-09-21T09:49:32Z" user="Geofreund1" uid="179581" lat="44.5153863" lon="-
   0.8404732"/>
</osm>
```

Metadata extraction

From OSM data history, we get several versions per element, modified by different users.

-> How to exploit this information?

- Focus on change sets?
- Focus on contributors?
- Focus on elements themselves?

Metadata extraction

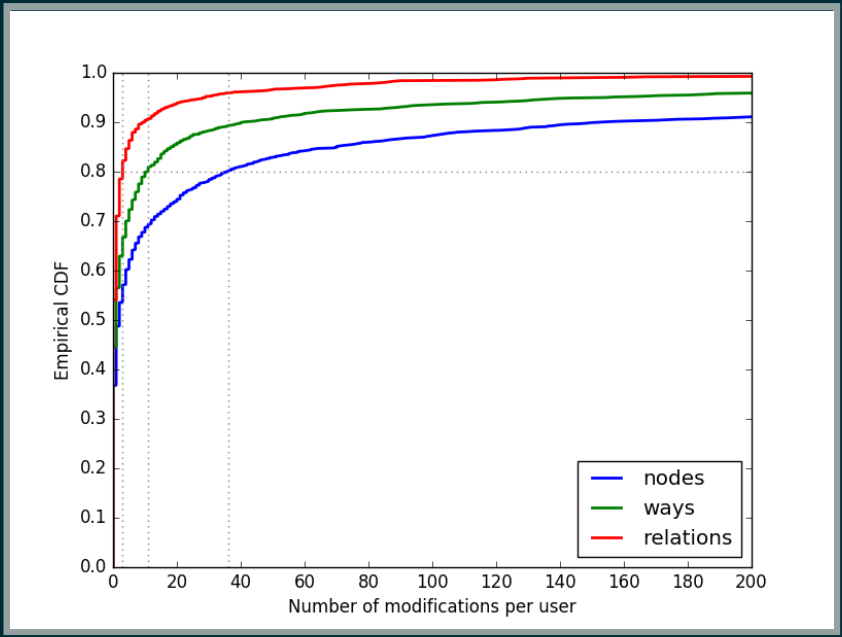
By focusing on OSM users (*ex:* Sylv1, id: 44978):

- temporal features
  - on OSM for 2136 days, 1 day of local activity
- change-set-related features
  - 19 change sets, among which 1 around Bordeaux
- modification-related features
  - 4 modifications, (3 node creations, 1 way improvement), corrected since
- editor-related features
  - 14 change sets done with Potlach, 3 with iD, 2 with JOSM

PCA and clustering on metadata

Metadata normalization

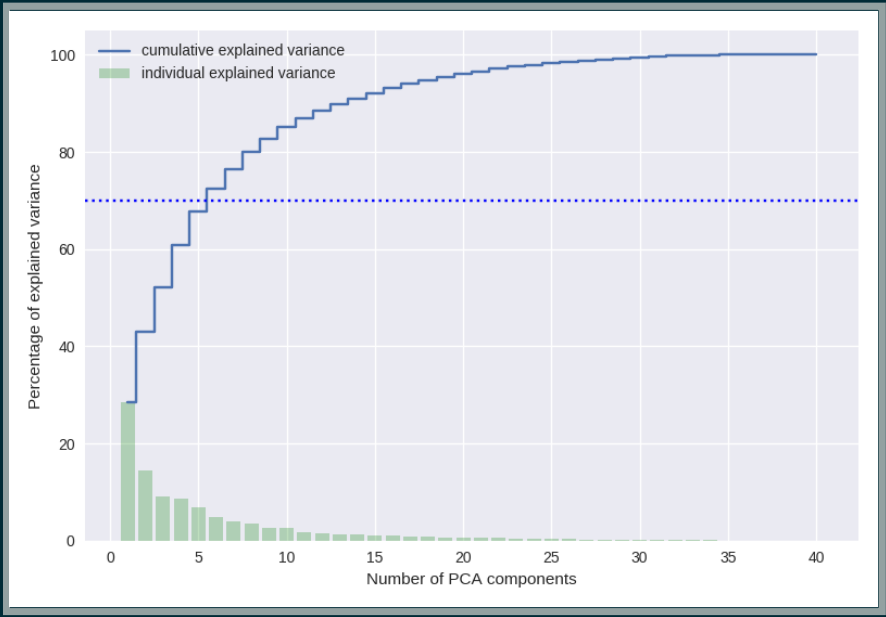
Some highly-skewed features...



- Modify feature definitions (%, empirical CDF)
- Min-Max scaler instead of standard scaler

Dimensionality reduction (Principle Component Analysis)

From 40 features to just a few ones: extract the most explainful components



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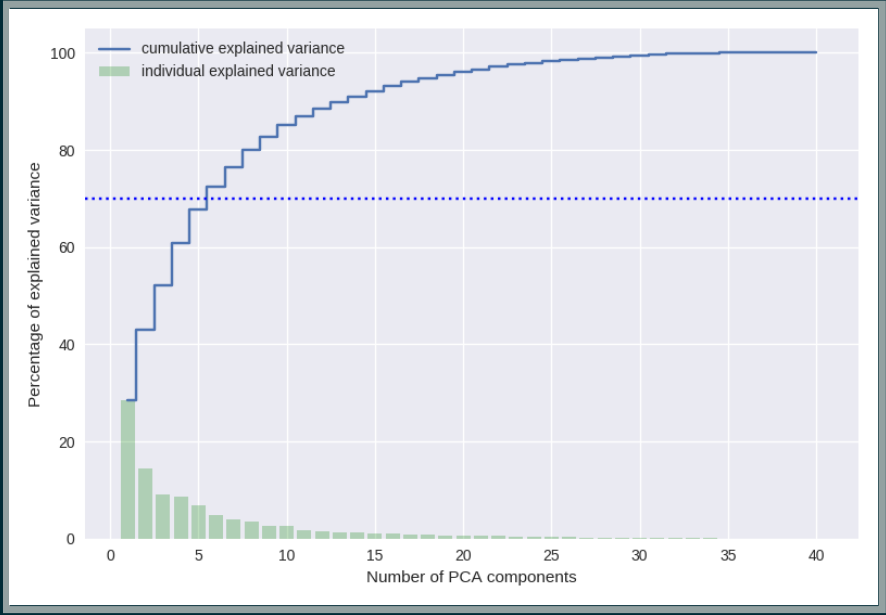
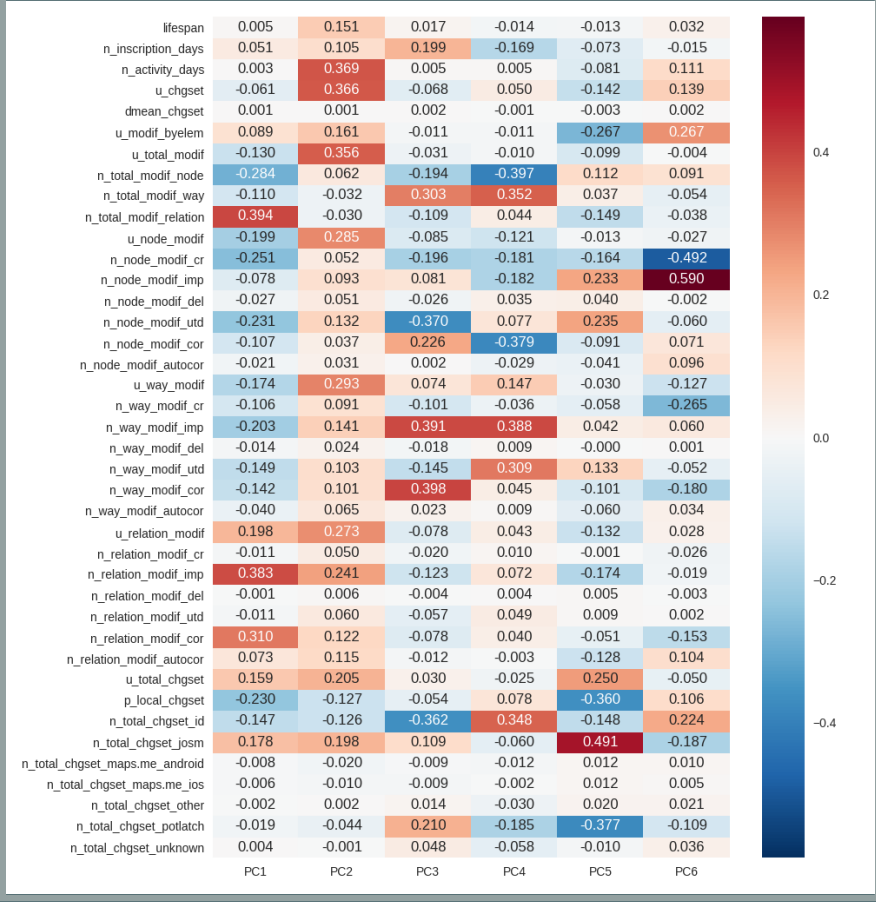




Principle Component Analysis interpretation

C1 (28.5%) Experience on OSM on relation improvement, a few local contributions

C2 (14.5%) Experience on OSM, local and global activity, various contributions

C3 (9.1%) Old out-of-date contribution, way-focused

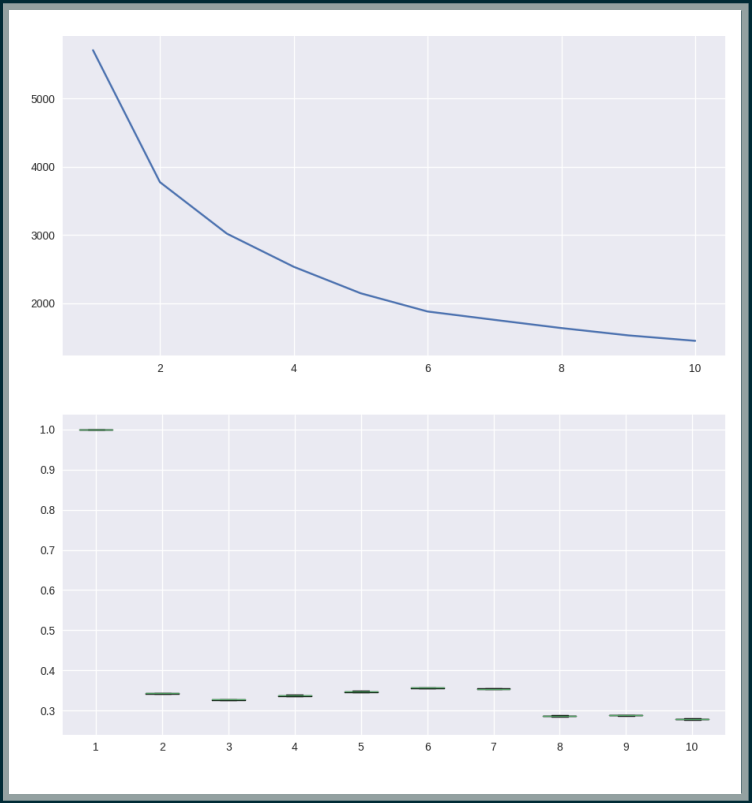
C4 (8.7%) Recent up-to-date contribution, mainly way improvement

C5 (6.9%) Experience on OSM, just a few local node-focused contributions

C6 (4.8%) Local specialization, node improvement (no creation), several contributions on the same OSM objects

Users classification through KMeans

How many user types?



Users classification through KMeans

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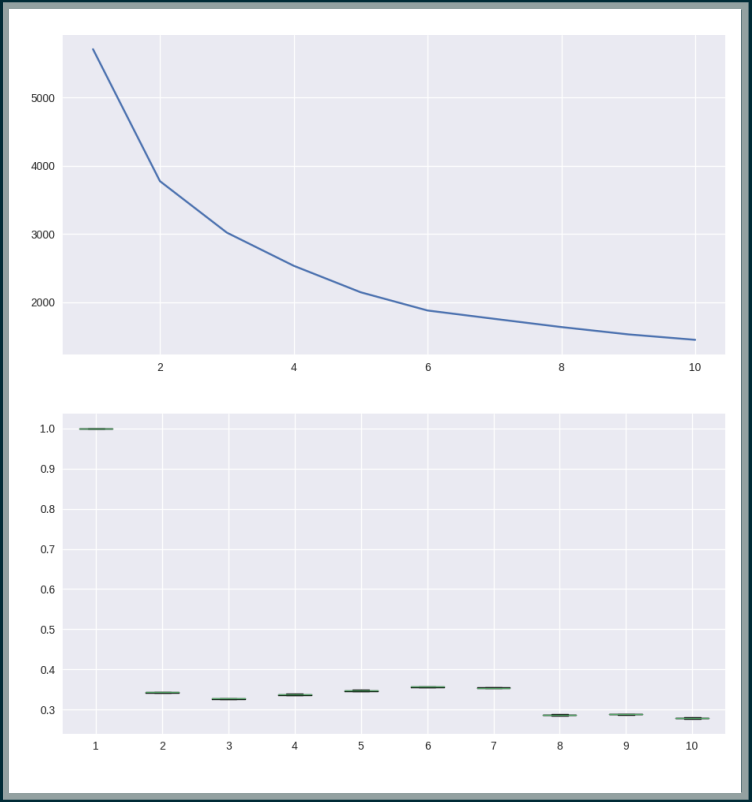
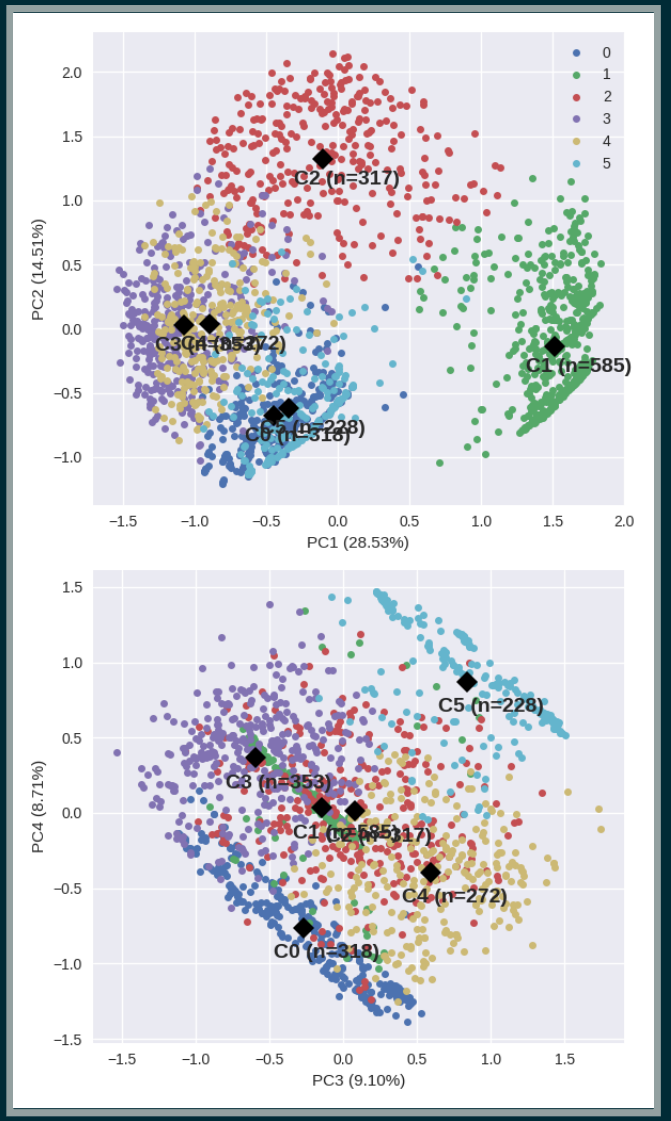


...6 clusters arise

User classification with KMeans



User classification with KMeans

G0 (n=318) Unexperienced node contributor

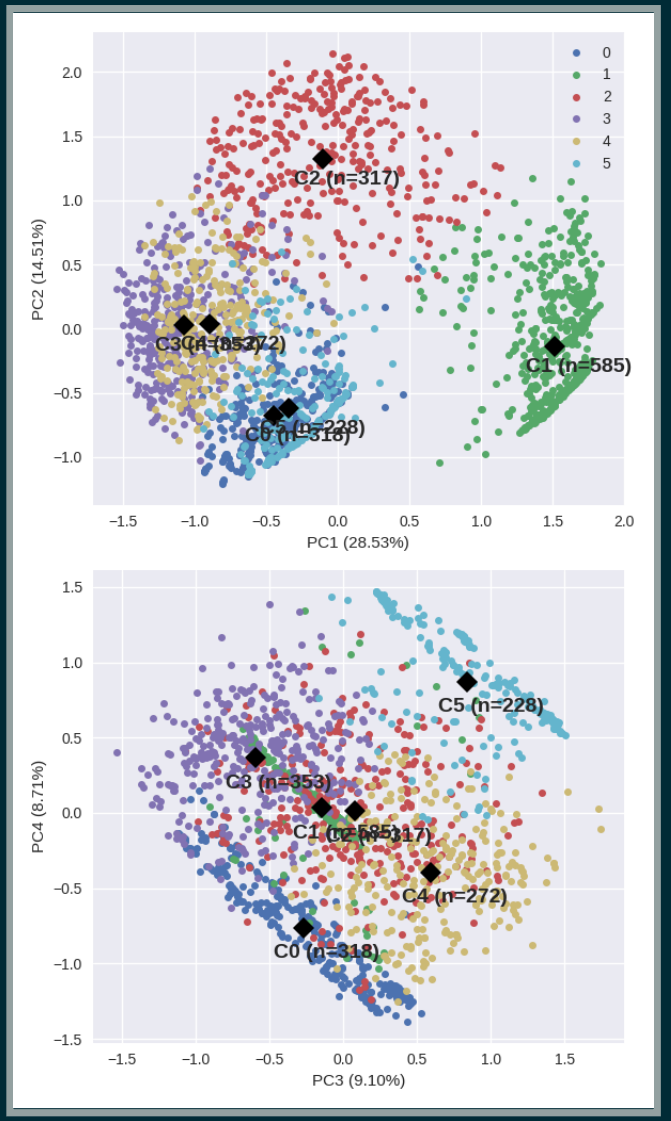
G1 (n=585) OSM experienced users, relation-focused on a unusual area

G2 (n=317) OSM experts, versatile users

G3 (n=353) New local way-focused contributors

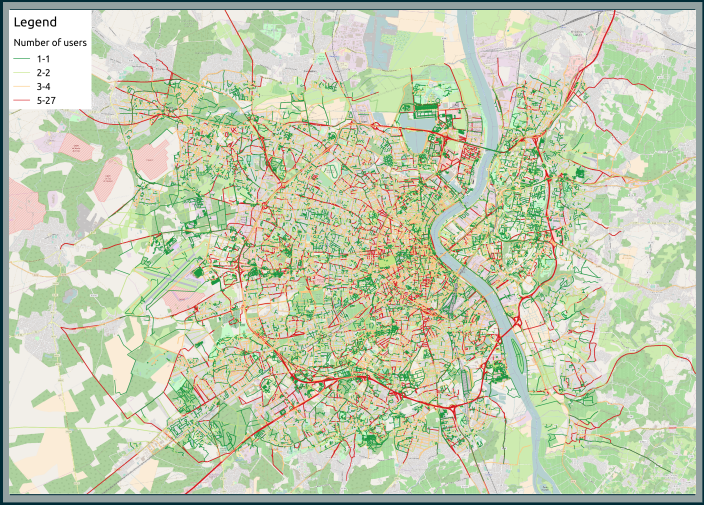
G4 (n=272) Old contributors, one-shotters

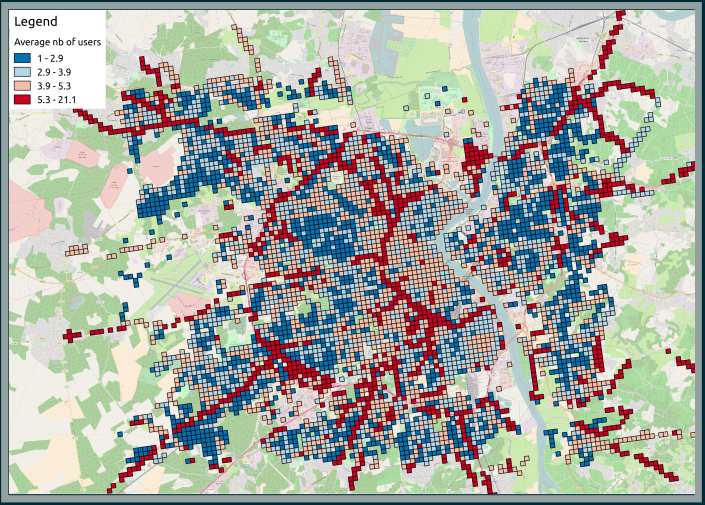
G5 (n=228) Way specialists, but little contributors

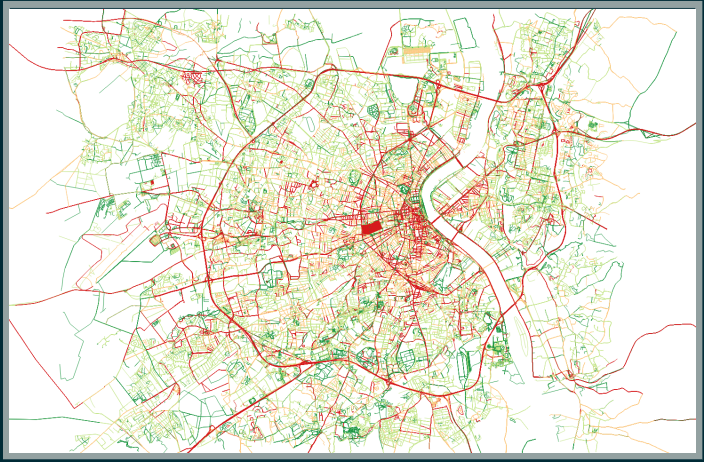


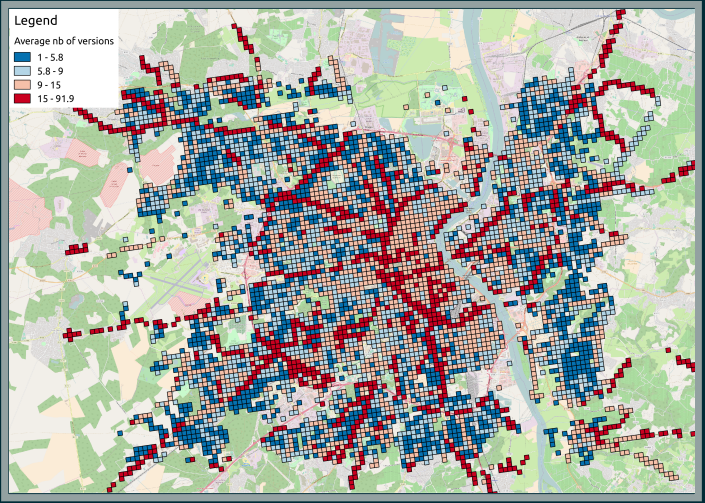
Address the OSM data quality issue

Mapping with metadata features







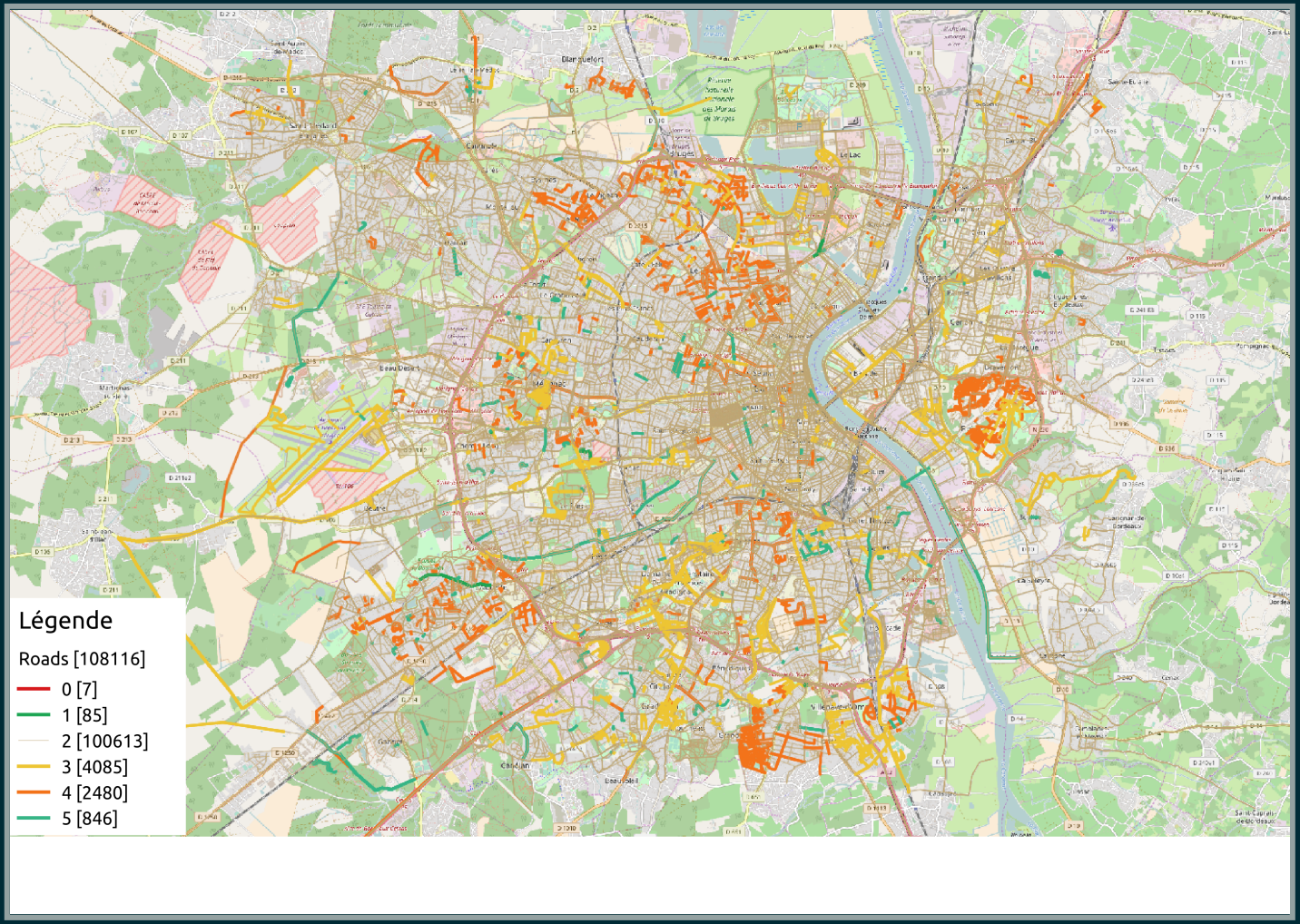


Integration of user classification

Example: OSM roads labelling -> experienced contributors produce good-quality elements

Users	Size	Last-modified objects
G0	318 (15.3%)	6690 (0.2%)
G1	585 (28.2%)	164 (0.0%)
G2	317 (15.3%)	2670391 (96.7%)
G3	353 (17.0%)	23287 (0.8%)
G4	272 (13.1%)	9993 (0.4%)
G5	228 (11.0%)	50474 (1.8%)

Map production



Conclusion

Conclusion about data quality

- Proposition of a methodology in order to characterize OSM metadata, after an unsupervised learning procedure

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- Proposition of a methodology in order to characterize OSM metadata, after an unsupervised learning procedure
- How to characterize OSM data in terms of quality: the example of roads in Bordeaux (France) area

Opening: how to go further?

- Metadata completeness
  - Consider every users, and every contributions for each users (not only local ones)

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- Metadata completeness
  - Consider every users, and every contributions for each users (not only local ones)
- Ground truth comparison
  - Compare the data with a ground truth -> IGN data, Bing orthophotos...?

Thanks for your attention!

Questions?

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See more on http://oslandia.com/en/blog/

Fun Facts

- more than 2000 contributors to design a medium-city like Bordeaux (over ~850k active OSM contributors)
- 50% of contributors around Bordeaux have produced less than 2 change sets, but the most "productive" contributor has produced 4428 change sets!
- Around Bordeaux, 73% of nodes, 44% of ways and 10% of relations have only one version!
- JOSM, iD and Potlach are the most used editors (75% of total number of change sets)