Cities Fingerprints

Andres PDLR

''' A city's physical structures, once established, may remain in place for more than 150 years '''

What

JOURNAL OF THE ROYAL SOCIETY INTERFACE

A typology of street patterns

Rémi Louf, Marc Barthelemy

Published 8 October 2014. DOI: 10.1098/rsif.2014.0924

Abstract

We propose a quantitative method to classify cities according to their street pattern. We use the conditional probability distribution of shape factor of blocks with a given area and define what could constitute the 'fingerprint' of a city. Using a simple hierarchical clustering method, these fingerprints can then serve as a basis for a typology of cities. We apply this method to a set of 131 cities in the world, and at an intermediate level of the dendrogram, we observe four large families of cities characterized by different abundances of blocks of a certain area and shape. At a lower level of the classification, we find that most European cities and American cities in our sample fall in their own sub-category, highlighting quantitatively the differences between the typical layouts of cities in both regions. We also show with the example of New York and its different boroughs, that the fingerprint of a city can be seen as the sum of the ones characterizing the different neighbourhoods inside a city. This method provides a quantitative comparison of urban street patterns, which could be helpful for a better understanding of the causes and mechanisms behind their distinct shapes.

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A typology of street patterns

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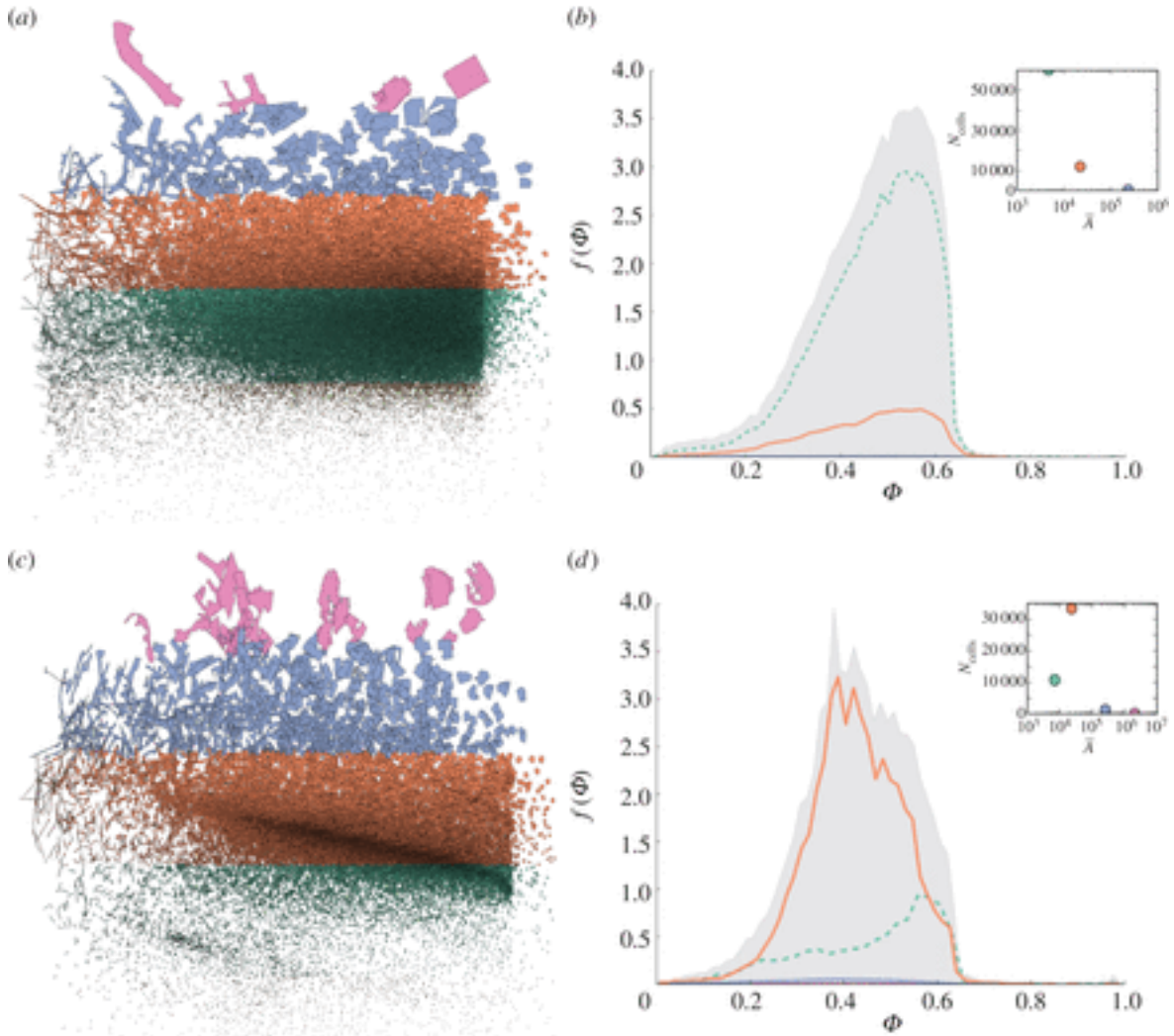


Why

- Science of cities
- Urban economics
- Rely in data provided from governments
  - Street patterns
  - Satellite slums detection

How

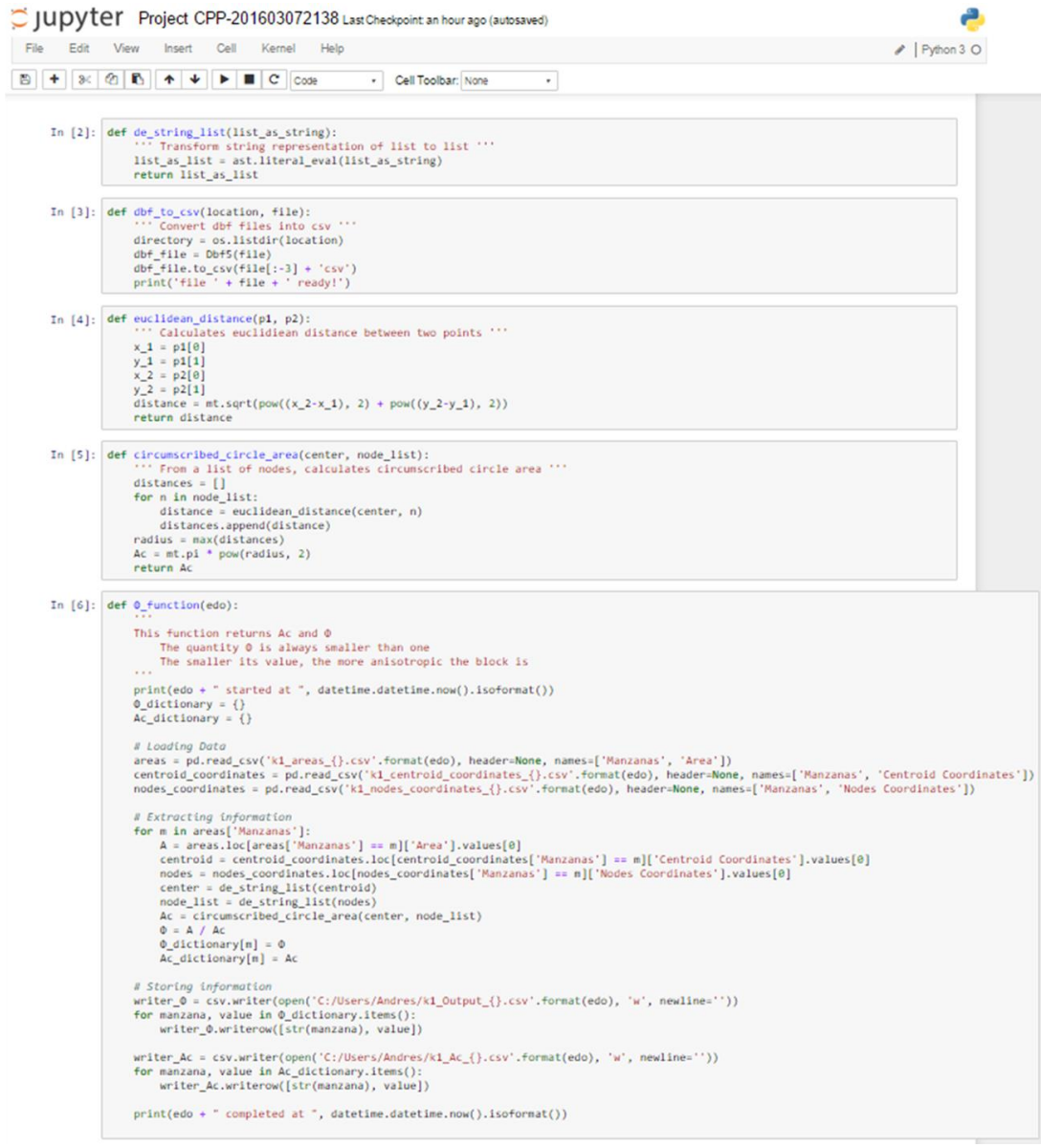
Python Console - QGis

Two modules:

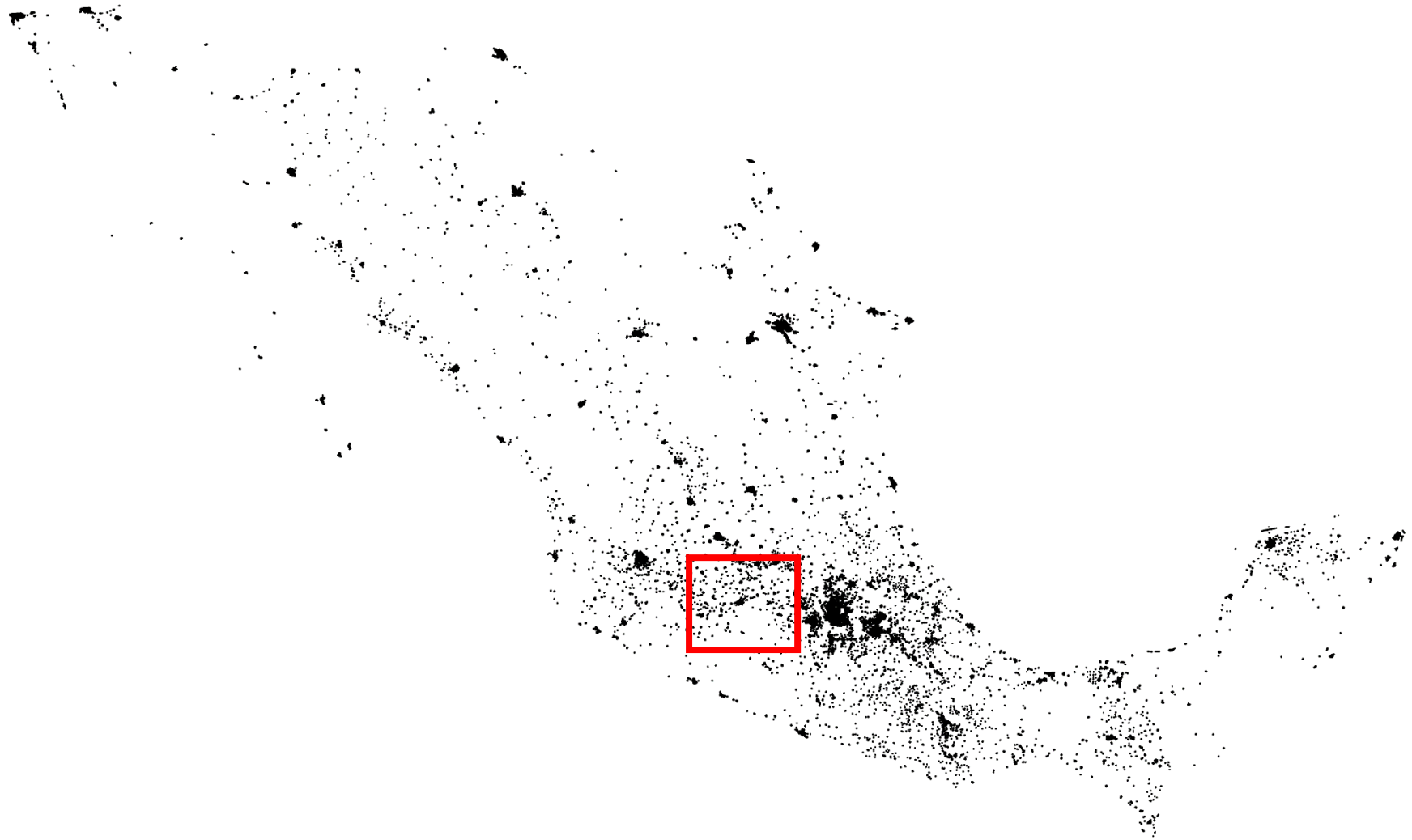
GIS Analysis

```
86
87  def extract_areas(edo):
88      ''' Extracs the area of a polygon '''
89      areas = {}
90      path = 'C:/Users/Andres/geo_mex_2015/{}/{}'.format(edo, edo) + "_manzanas_urbanas.shp"
91      manzanas_urbanas_layer = iface.addVectorLayer(path, edo + "_manzanas_urbanas", "ogr")
92      manzanas_urbanas_features = manzanas_urbanas_layer.getFeatures()
93      for feature in manzanas_urbanas_features:
94          manzana_ID = feature['CVEGEO']
95          geometry = feature.geometry()
96          m_area = geometry.area()
97          if manzana_ID in areas.keys():
98              areas[manzana_ID].append(m_area)
99          else:
100             areas[manzana_ID] = m_area
101     writer = csv.writer(open('C:/Users/Andres/k1_areas_{}.csv'.format(edo), 'wb'))
102     for key, value in areas.items():
103         writer.writerow([str(key), value])
104
105
106
107
108 def extract_centroid_coordinates(edo):
109     ''' Extracs centroids coordinates of a polygon layer '''
110     centroids_coordinates = {}
111     path = 'C:/Users/Andres/geo_mex_2015/{}/{}'.format(edo, edo) + "_manzanas_urbanas_centroids.shp"
112     centroids_layer = iface.addVectorLayer(path, "{}_centroids_layer".format(edo), "ogr")
113     centroid_features = centroids_layer.getFeatures()
114     for feature in centroid_features:
115         manzana_ID = feature['CVEGEO']
116         geometry = feature.geometry()
117         x = geometry.asPoint().x()
118         y = geometry.asPoint().y()
119         if manzana_ID in centroids_coordinates.keys():
120             centroids_coordinates[manzana_ID].append((x, y))
121         else:
122             centroids_coordinates[manzana_ID] = (x, y)
123     writer = csv.writer(open('C:/Users/Andres/k1_centroid_coordinates_{}.csv'.format(edo), 'wb'))
124     for key, value in centroids_coordinates.items():
125         writer.writerow([str(key), value])
126
```

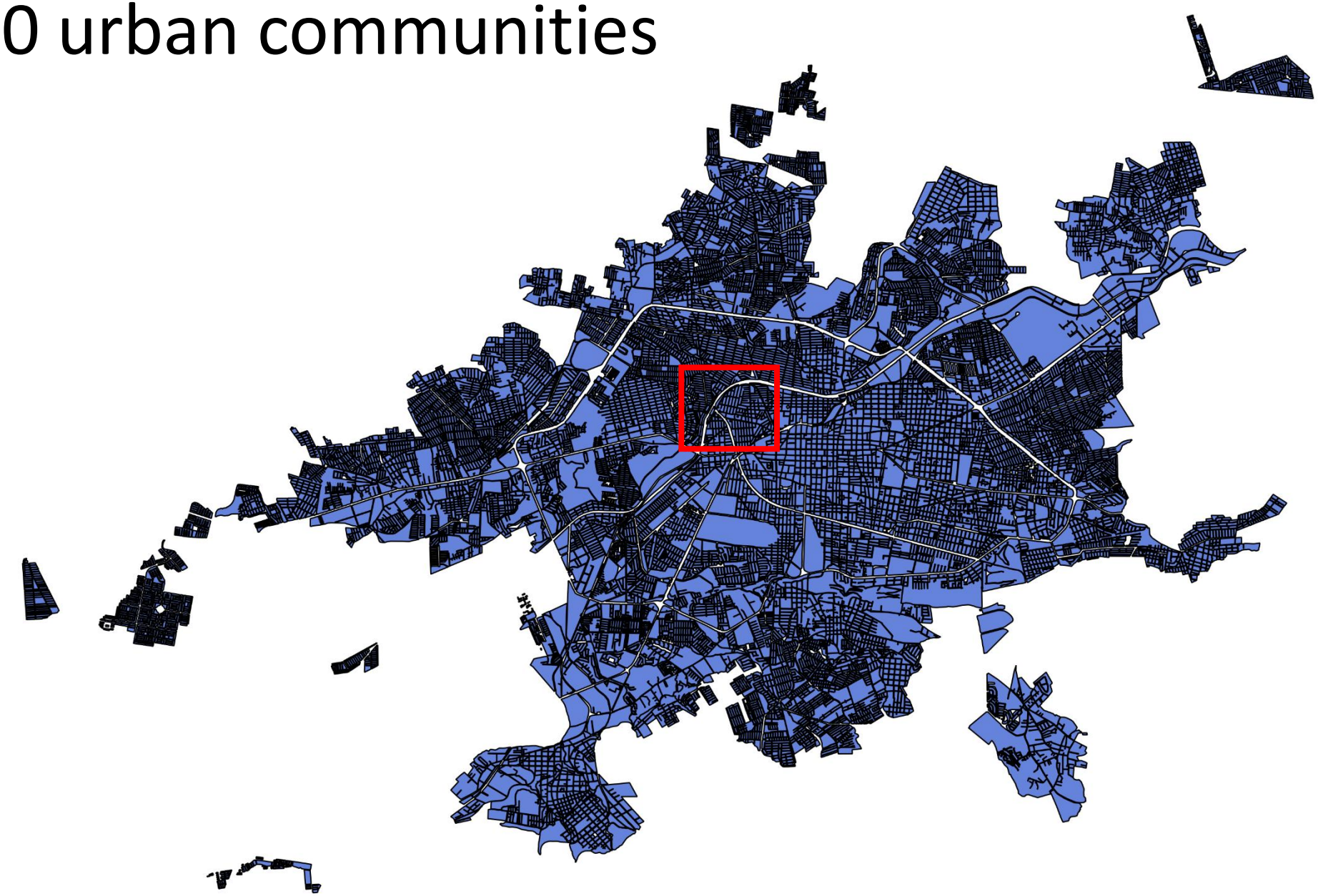
Data Analysis



1,456,596 urban blocks



+ 4,500 urban communities



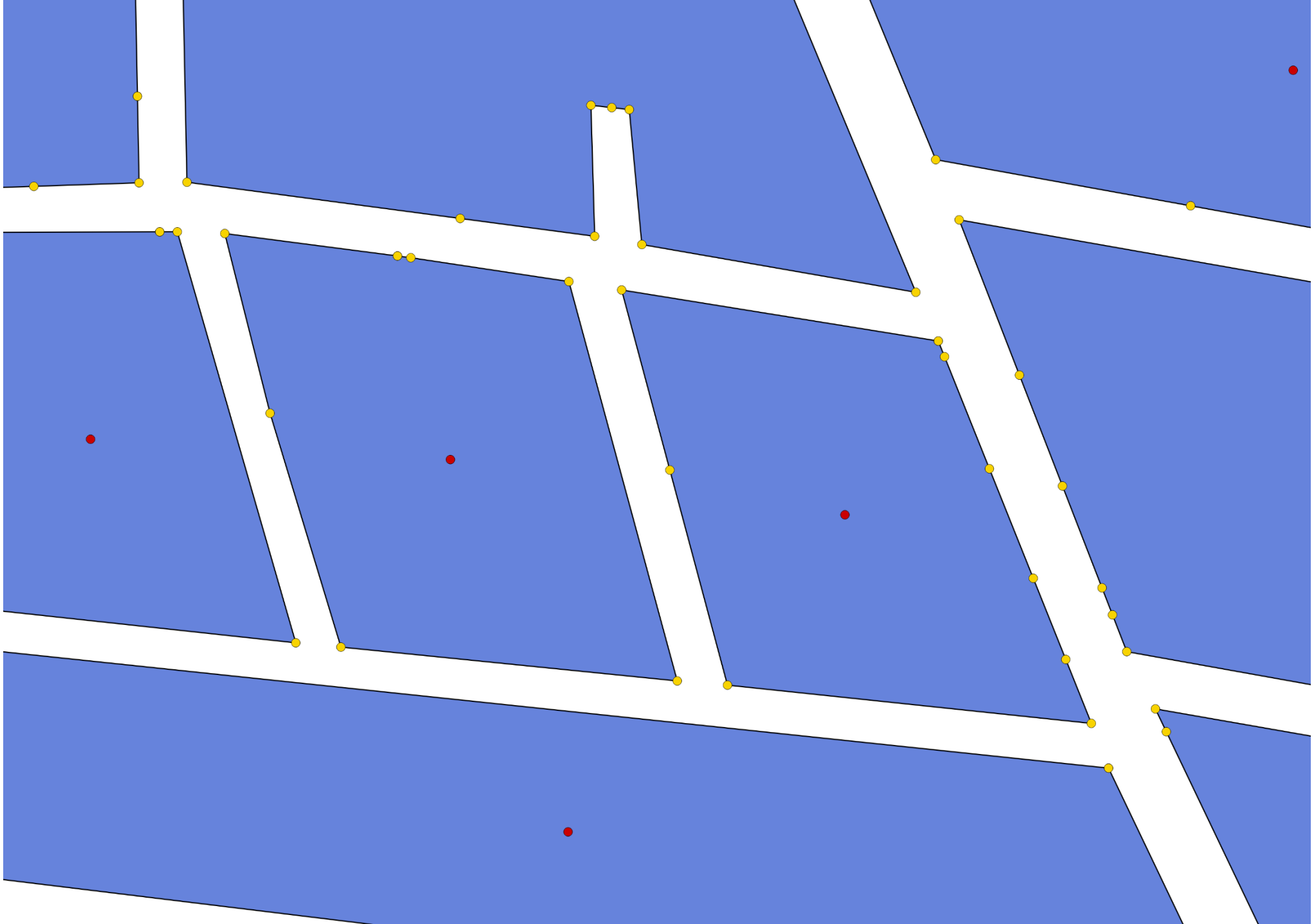
Output

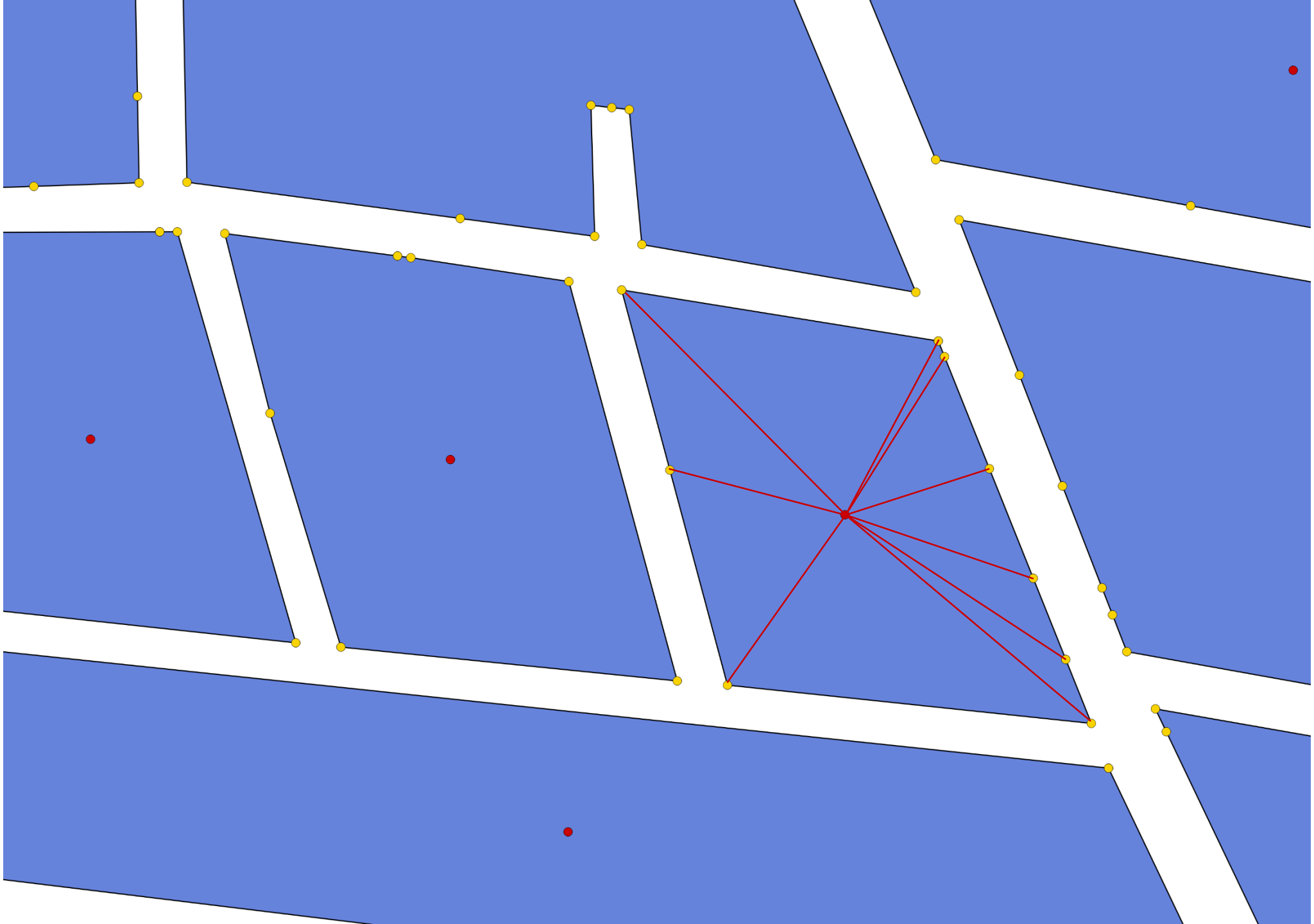
A = Area of the block

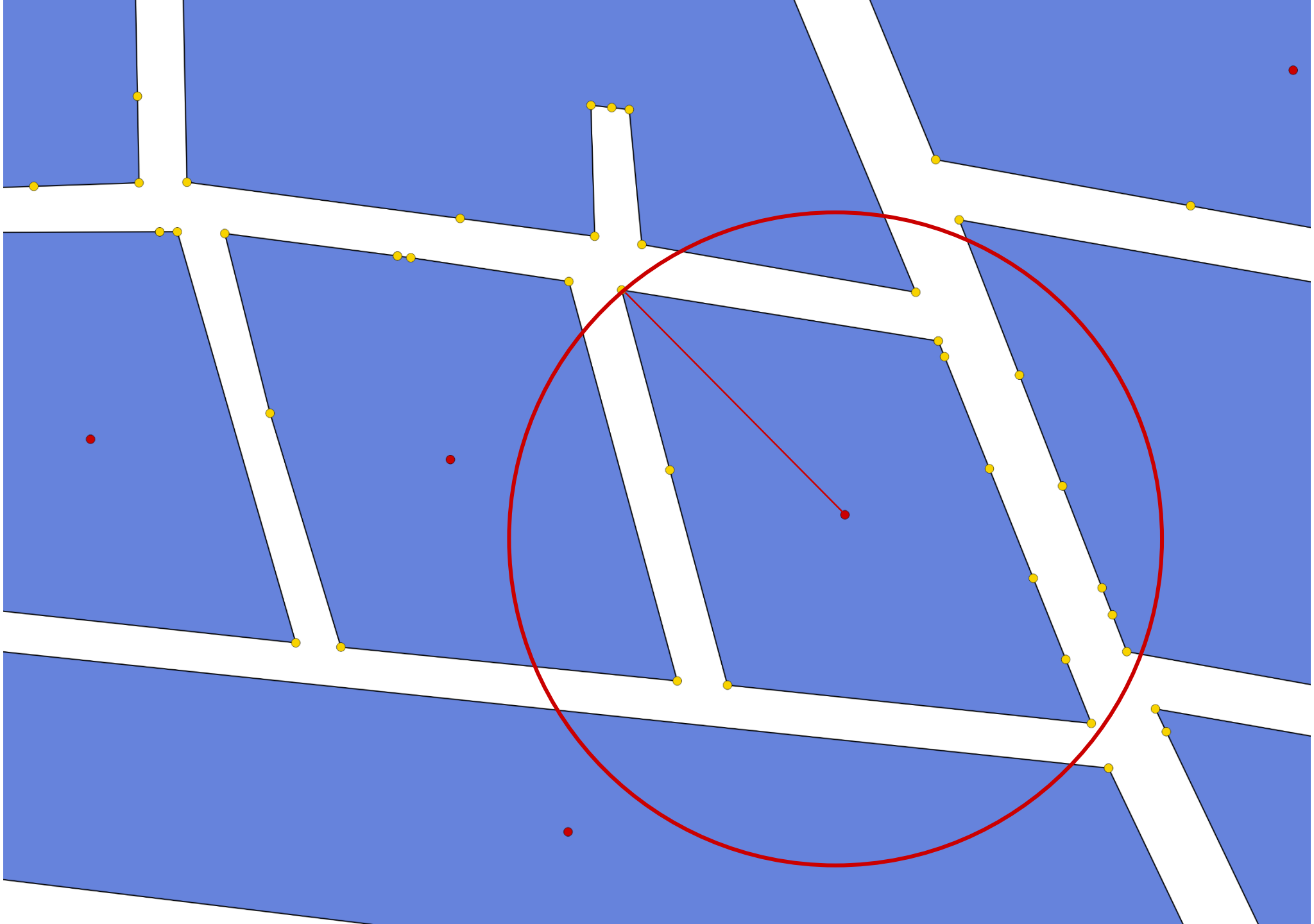
AC = Area of the circumscribed circle C

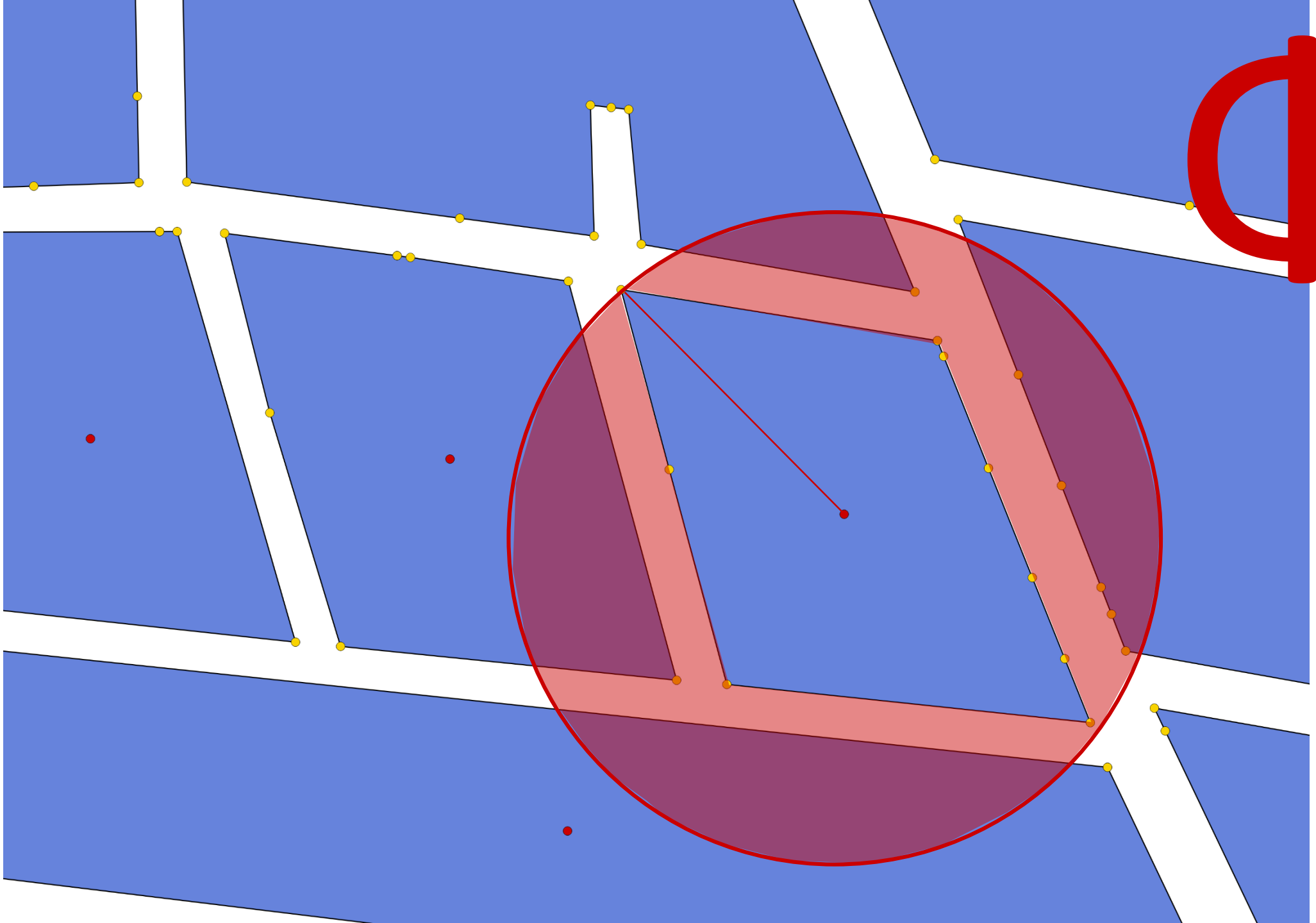
Φ = A/AC

P(Φ) = Distribution








Φ

In [62]:
```
dataframe_all.head()
```

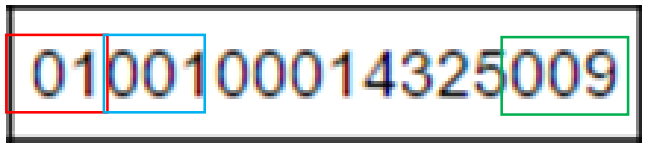
Out[62]:

	Manzanas	Area	Φ	Ac
0	0100100014325009	1.514624e-06	0.159168	9.515873e-06
1	0100100014325008	1.833420e-07	0.224965	8.149784e-07
2	0100100014325005	8.994317e-07	0.187952	4.785435e-06
3	0100100014325004	8.021103e-07	0.196058	4.091192e-06
4	0100100014325007	6.534422e-07	0.303527	2.152833e-06

In [48]:
```
# Number of blocks in Mexico
len(dataframe_all)
```

Out[48]: 1456596

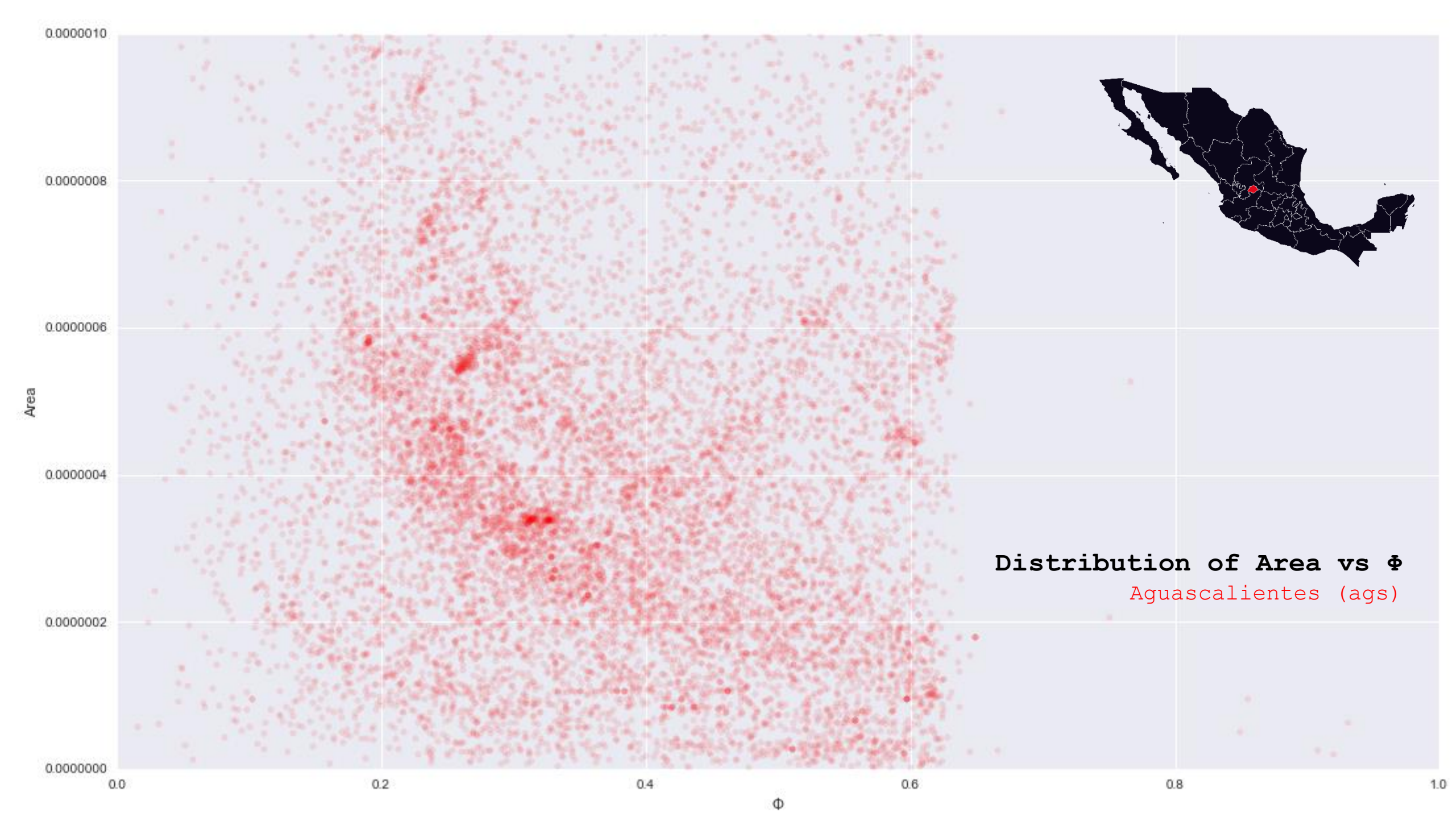
Municipio

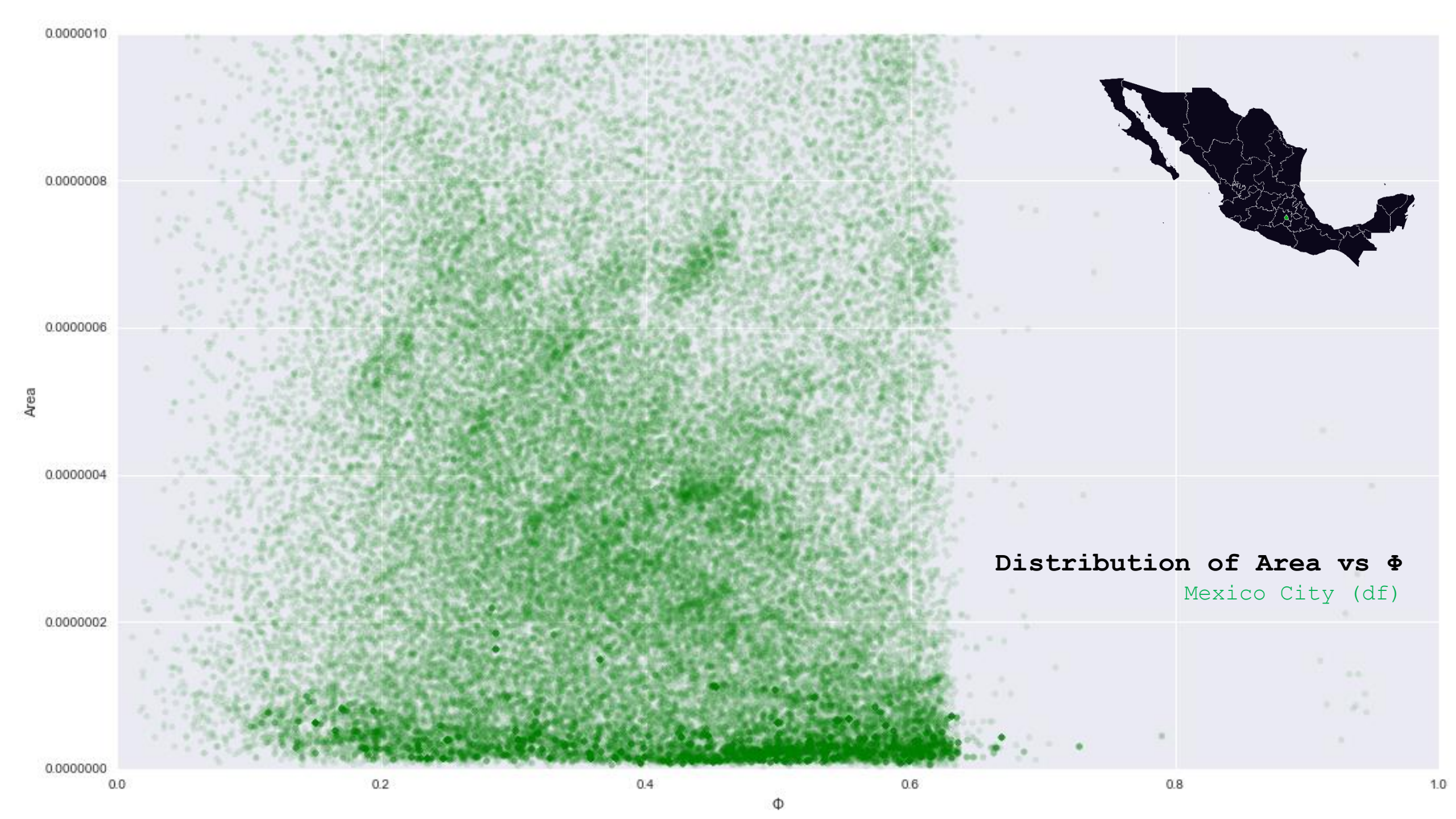


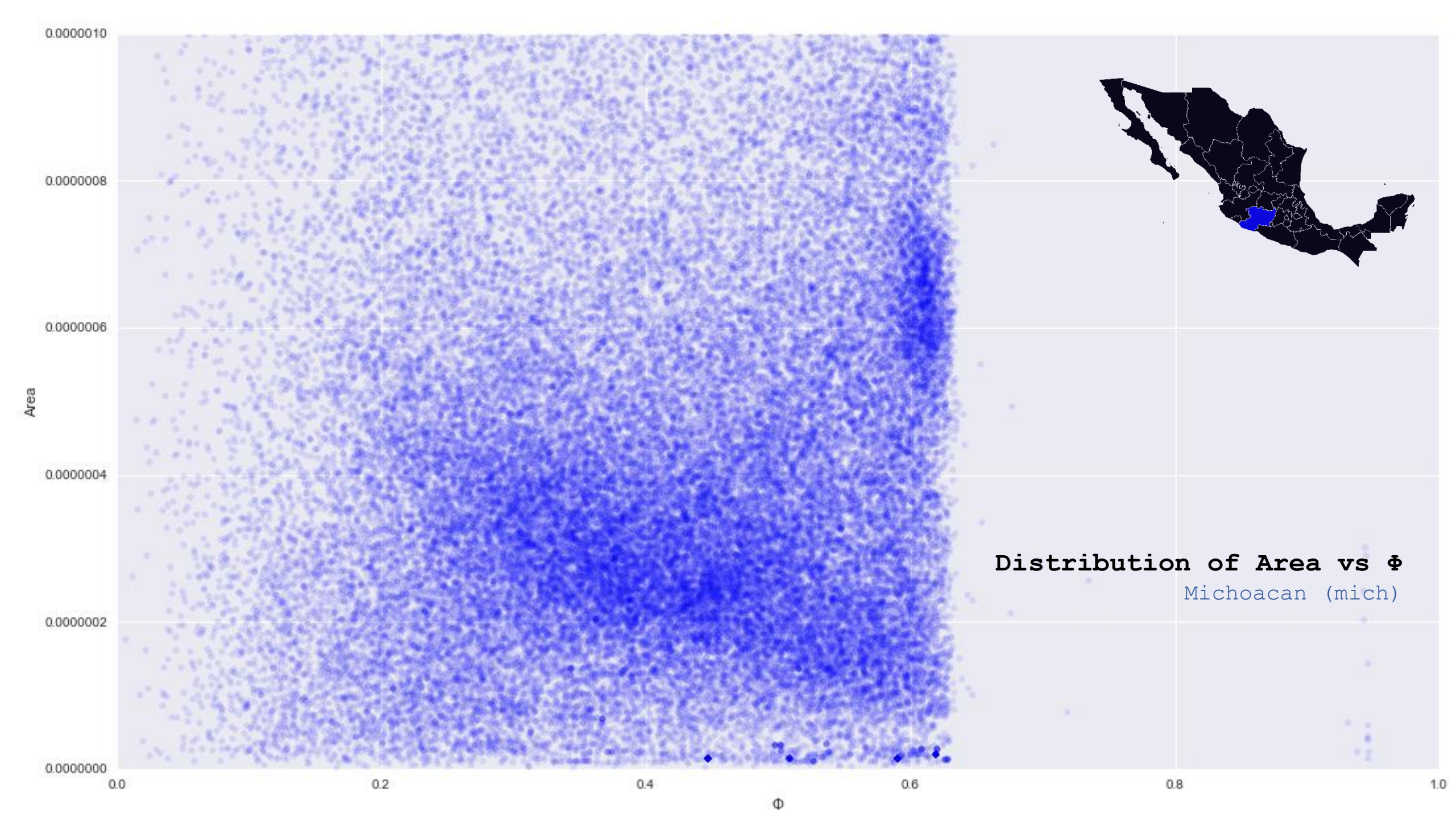
Hierarchical ID

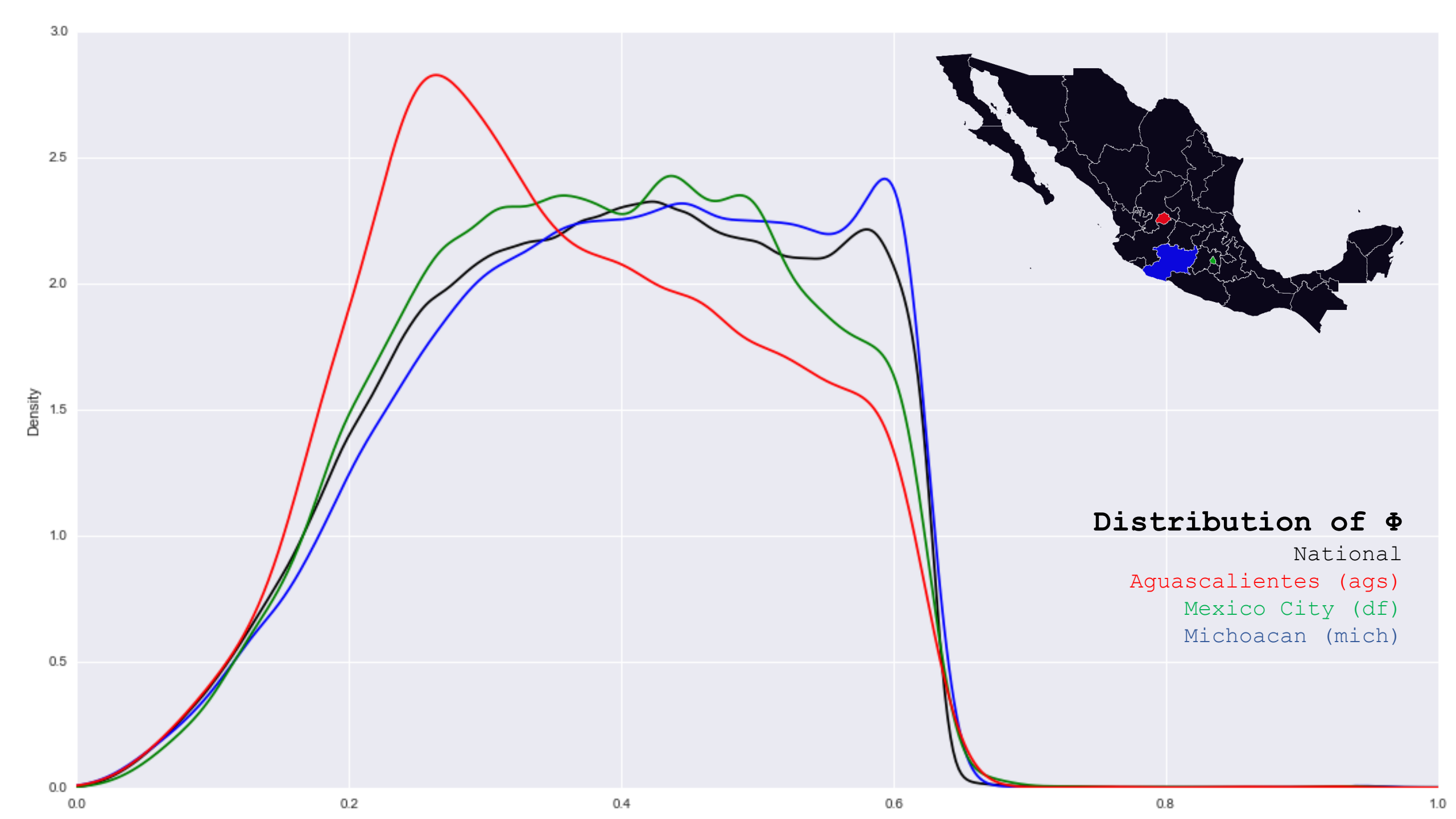
State

Manzana (*block*)

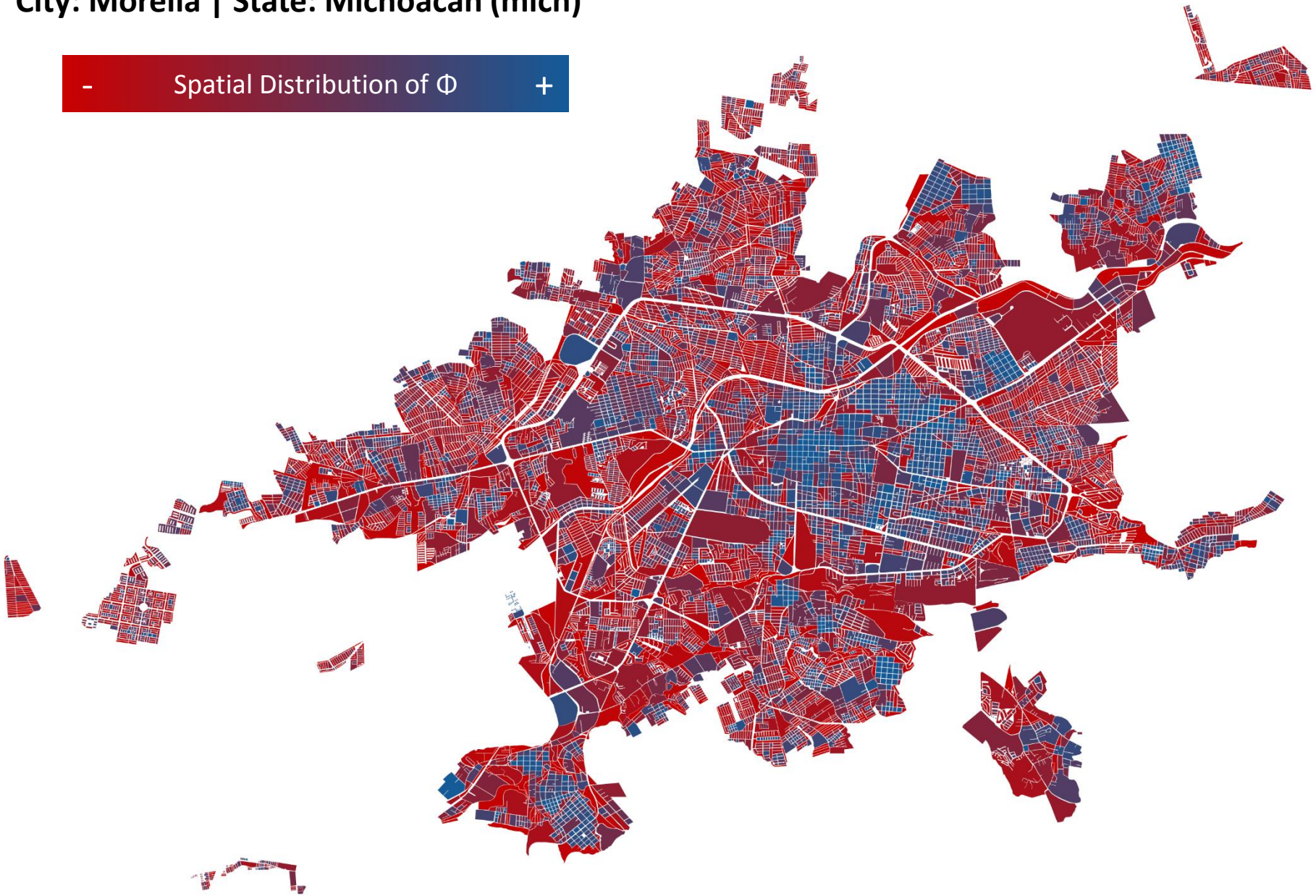

0.0000010
0.0000008
0.0000006
0.0000004
0.0000002
0.0000000
Area
0.0
0.2
0.4
0.6
0.8
1.0
Φ
Distribution of Area vs Φ
Aguascalientes (ags)


0.0000010
0.0000008
0.0000006
0.0000004
0.0000002
0.0000000
Area
0.0
0.2
0.4
0.6
0.8
1.0
Φ
Distribution of Area vs Φ
Mexico City (df)

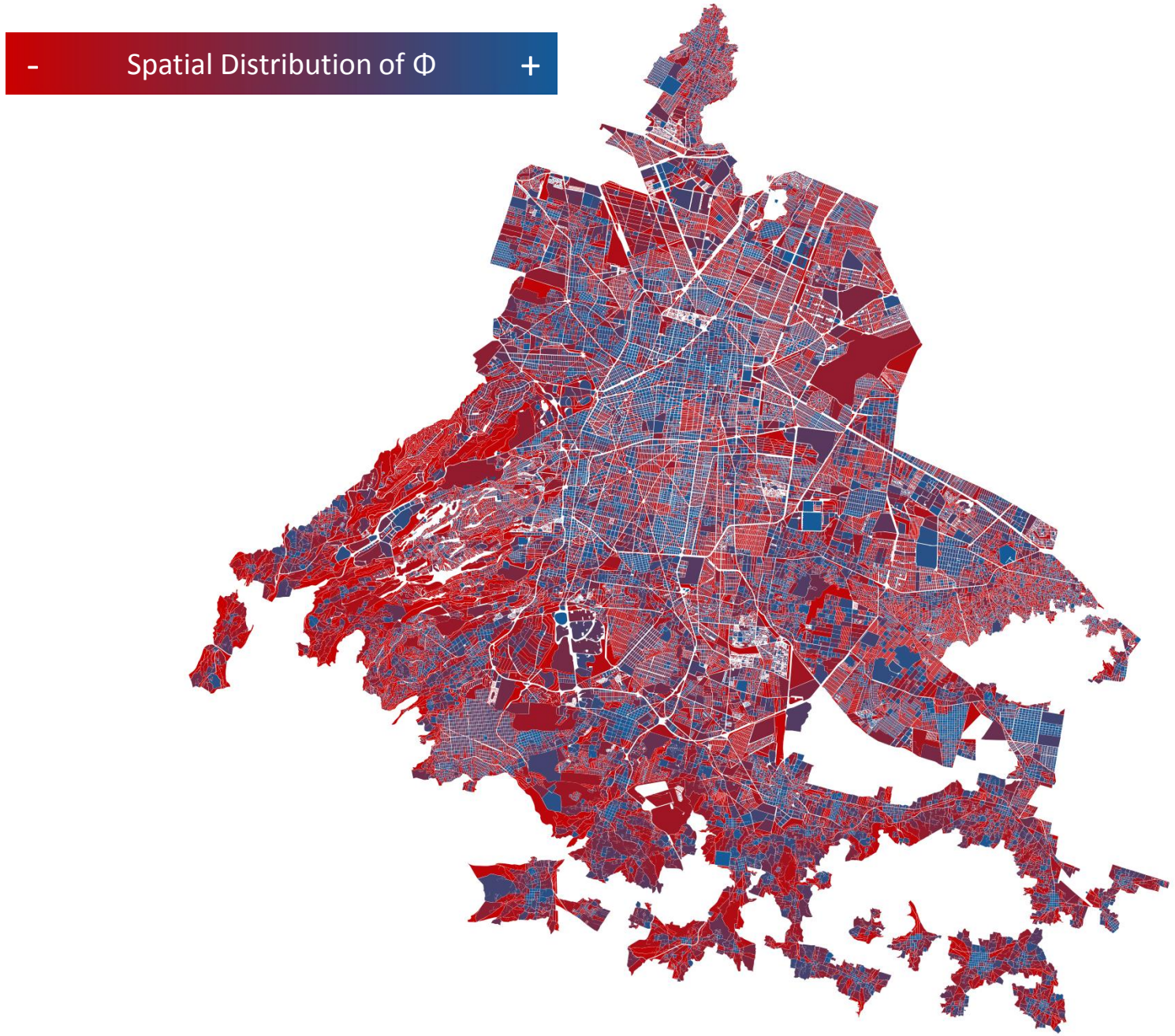

0.0000010
0.0000008
0.0000006
0.0000004
0.0000002
0.0000000
Area
0.0
0.2
0.4
0.6
0.8
1.0
Φ
Distribution of Area vs Φ
Michoacan (mich)


Distribution of Φ
National
Aguascalientes (ags)
Mexico City (df)
Michoacan (mich)
Density
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0

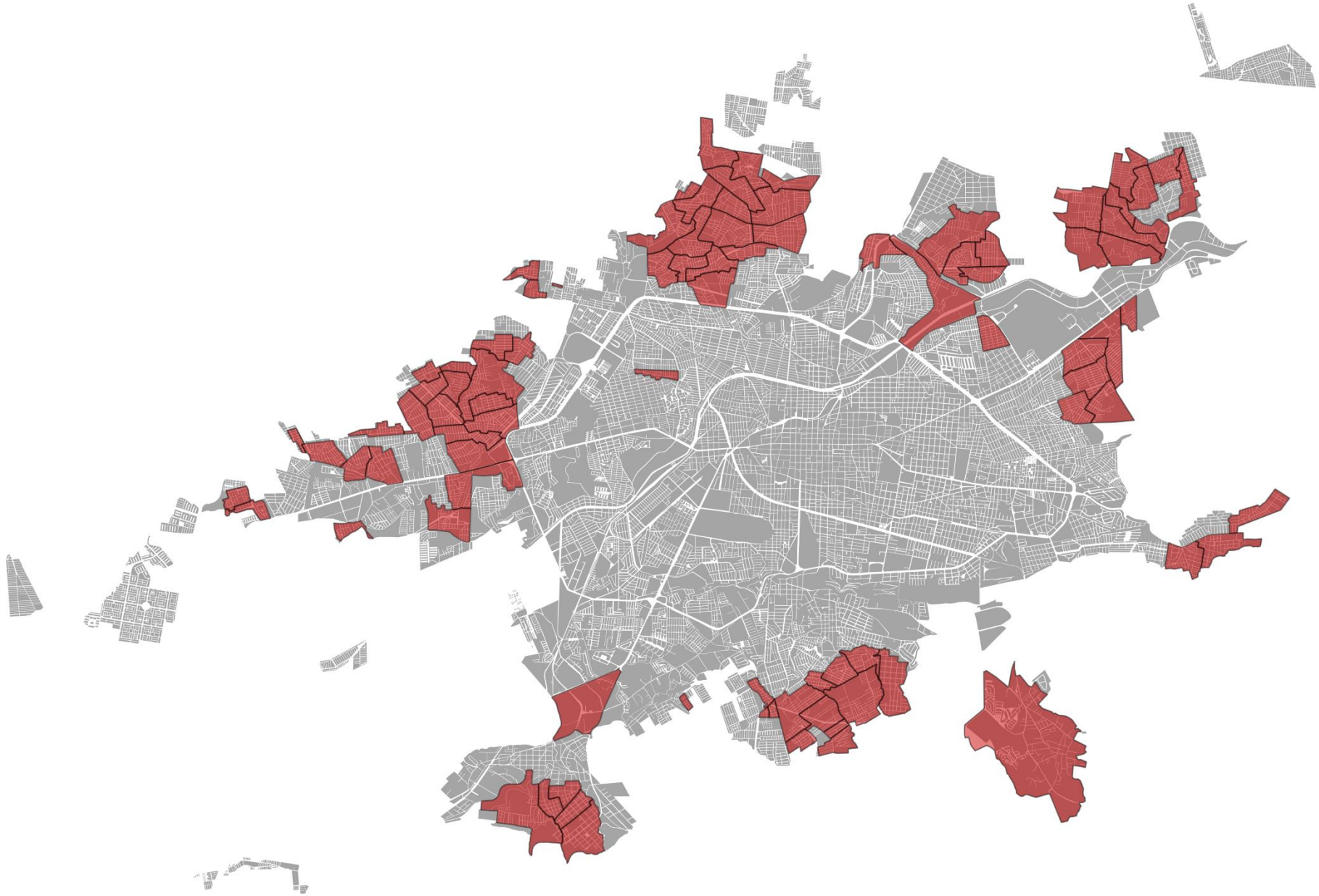
City: Morelia | State: Michoacan (mich)

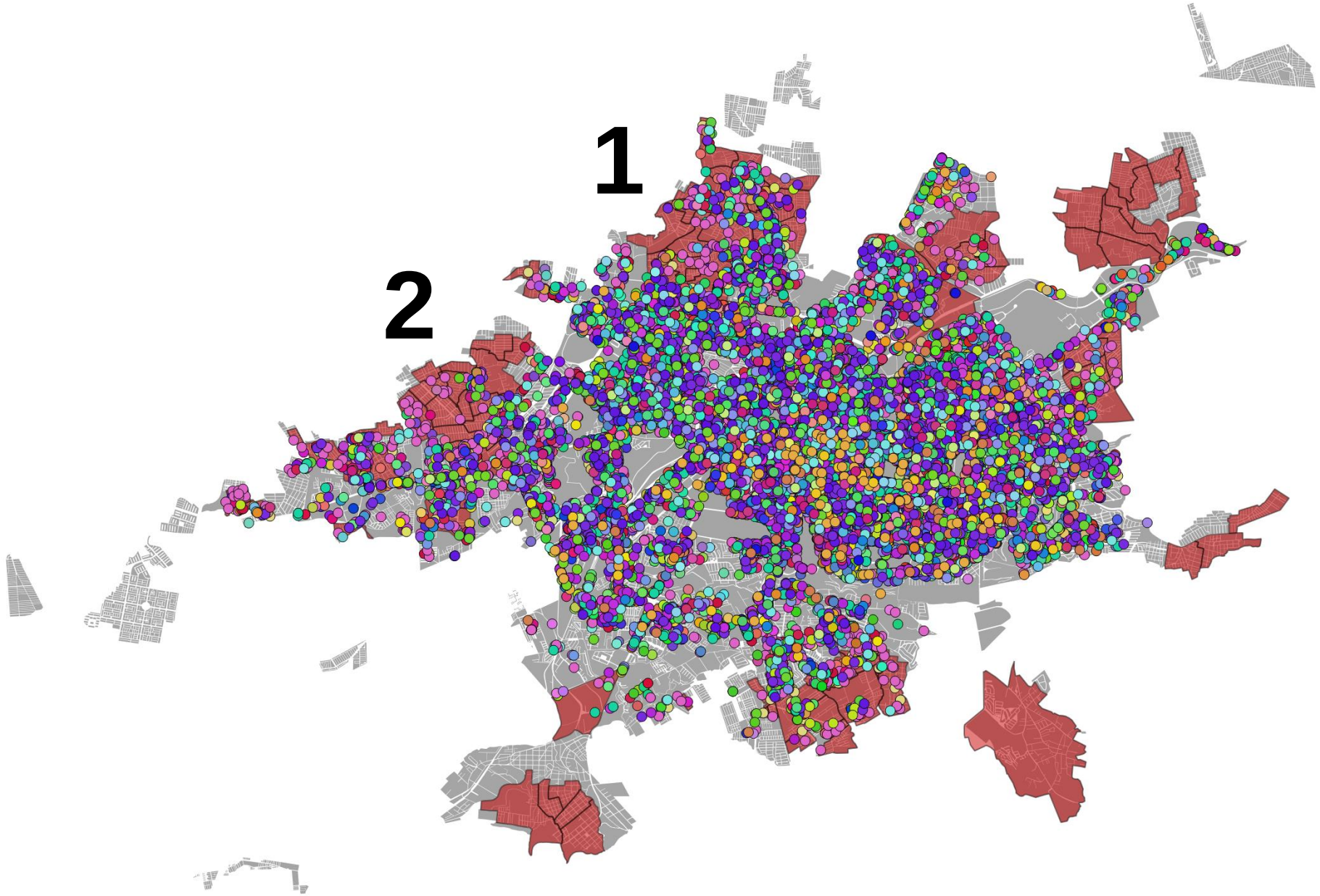


City: Mexico City | State: Distrito Federal (df)

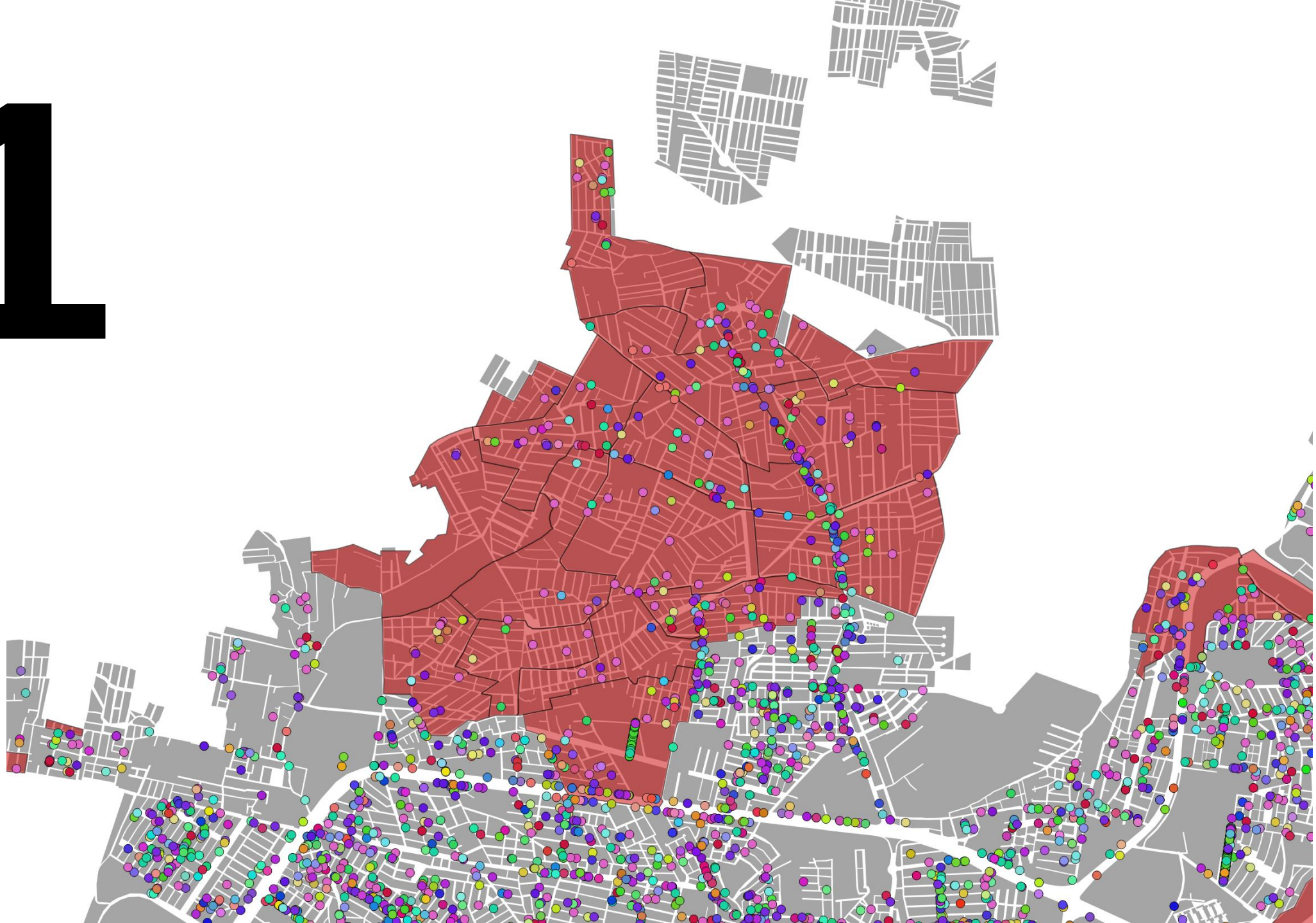


Next




1
2

1



2