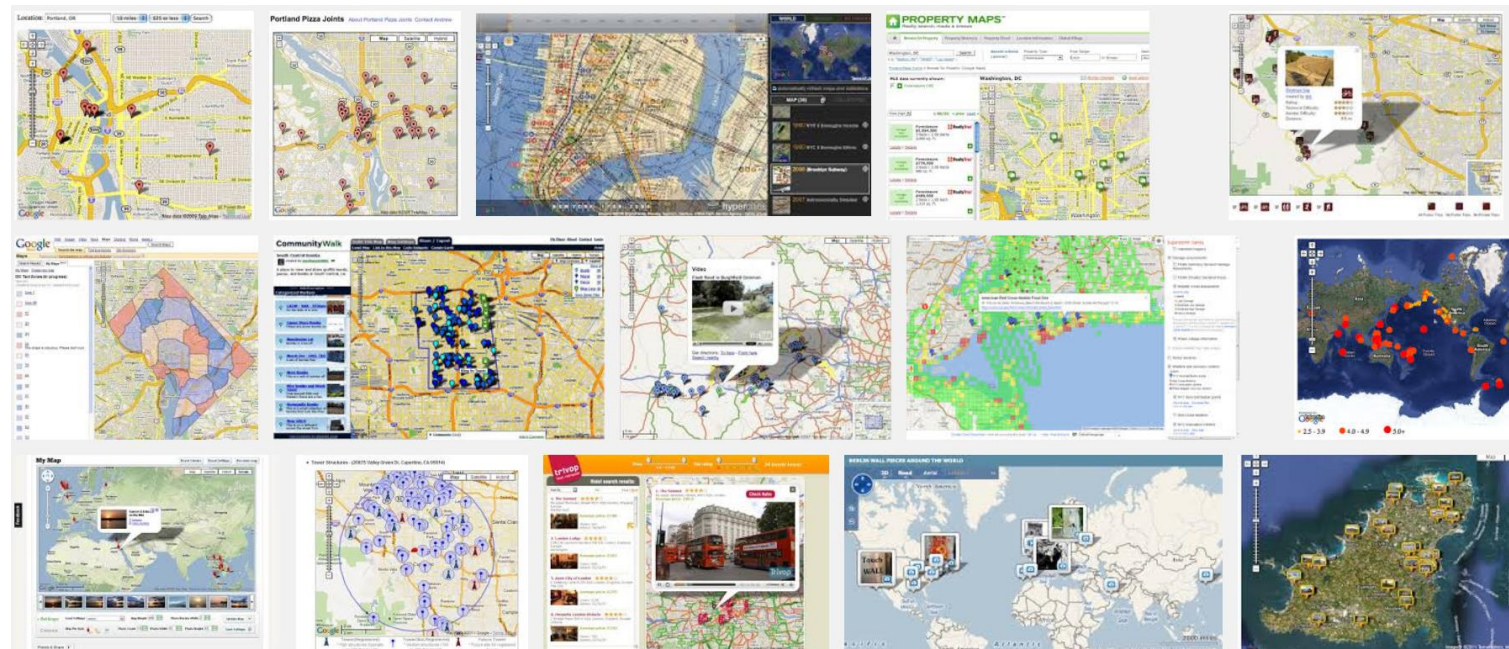


Visualisation dynamique de données spatiales

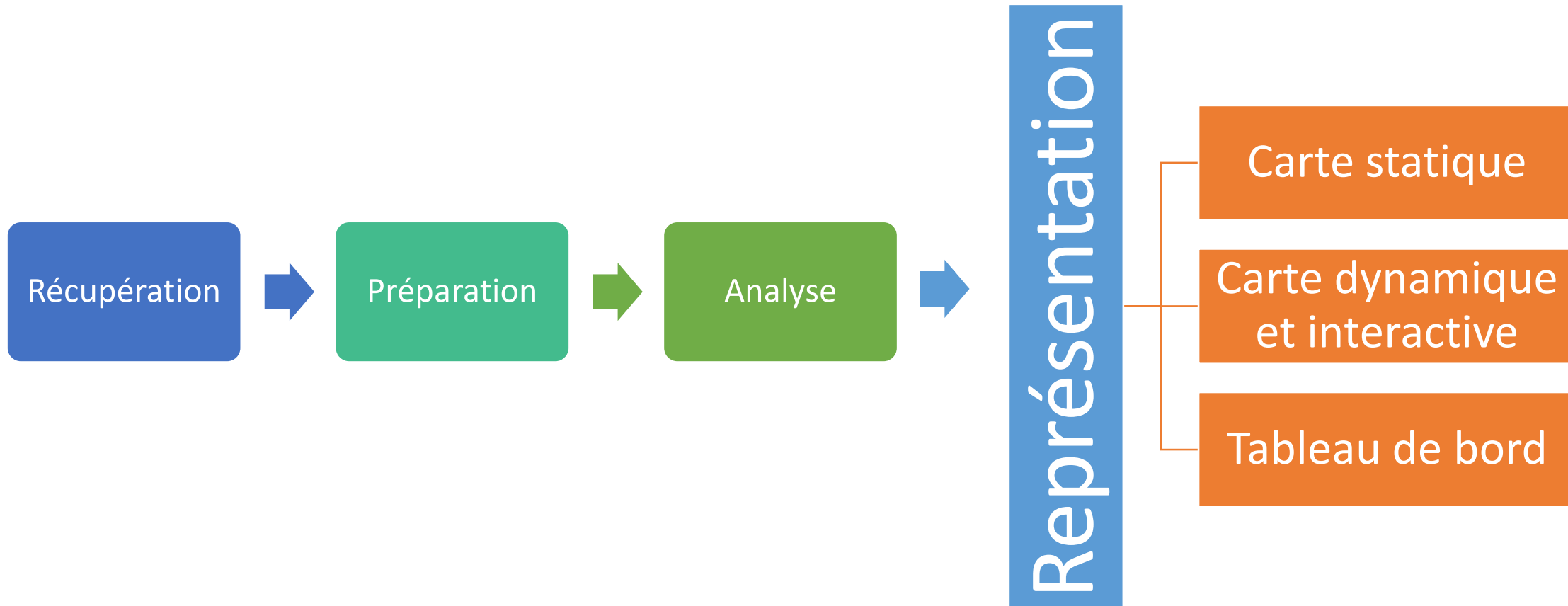


Les 60 prochaines minutes

- Faire un point le nouveau régime cartographique du GéoWeb
- Tour d'horizon des nouvelles modalités de représentation de données spatiales et de géovisualisation sur le Web

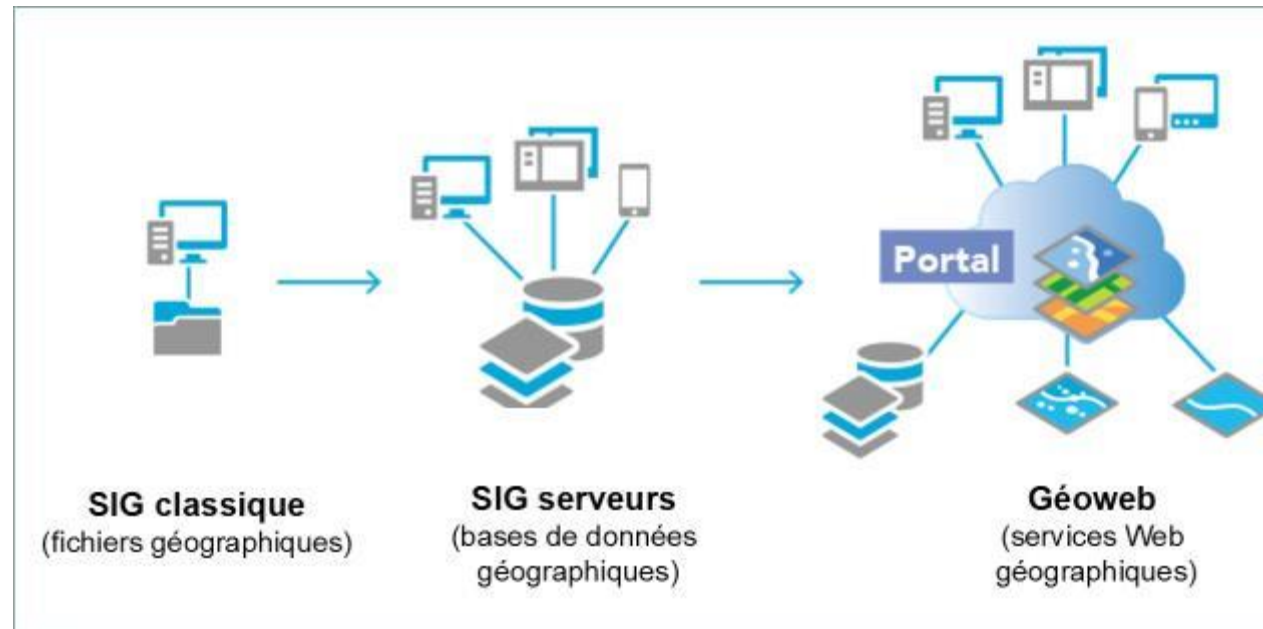


Géovisualisation de données en ligne



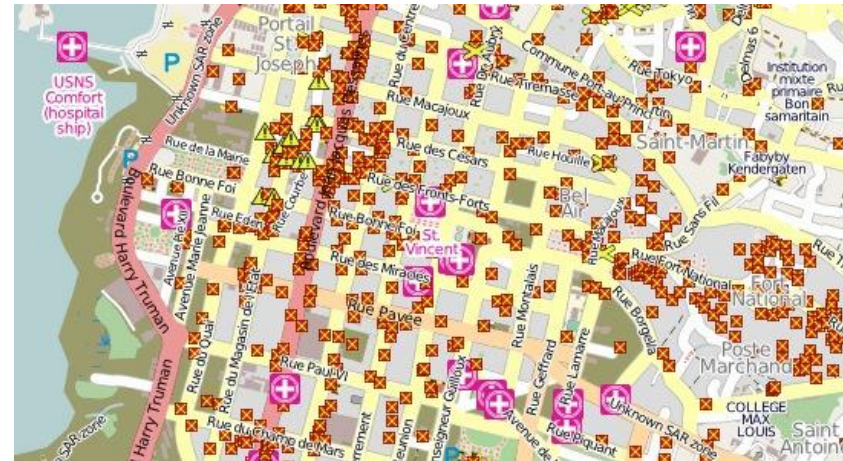
Ecosystème socio-technique du Géoweb

- La carte prend place au sein des réseaux, des flux
 - Mise en réseau des BD/utilisateurs/applications vient tout modifier
 - Une cartographie distribuée (services Web, API's)
 - Une cartographie grand public (écrans, tablettes, téléphones,...)



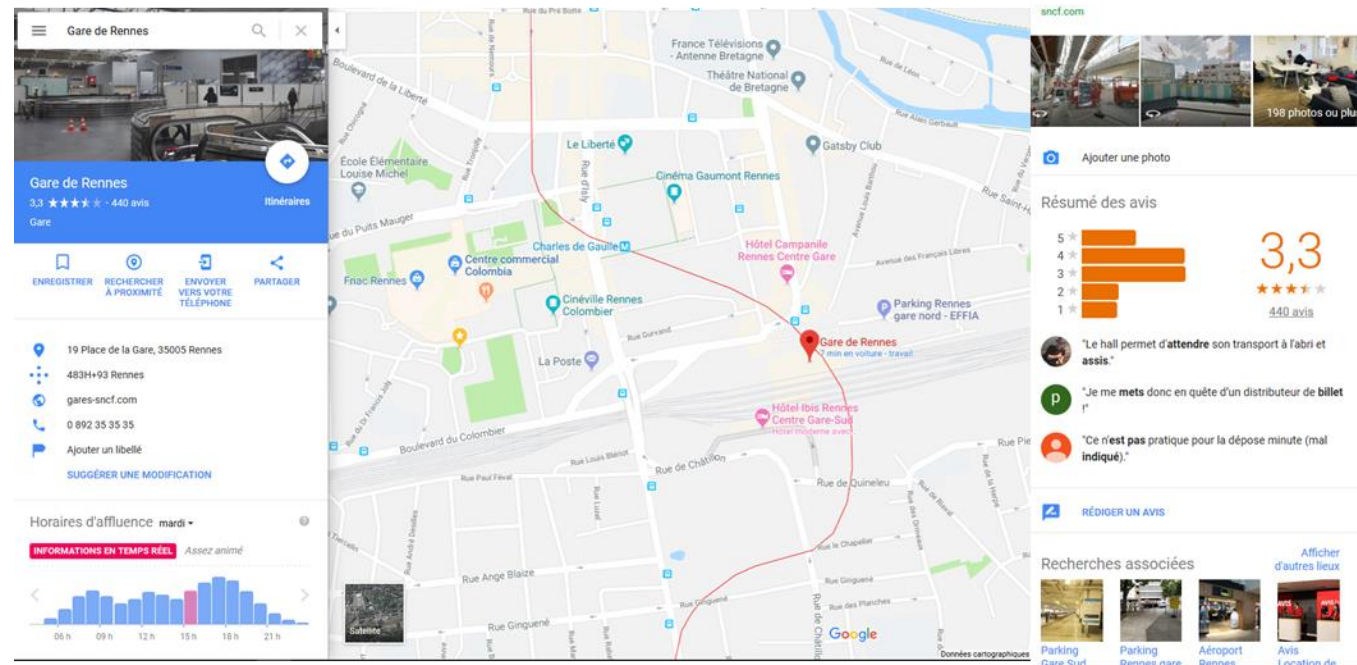
Ecosystème socio-technique du Géoweb

- Un nouveau paradigme informationnel
 - Prolifération des données, notamment spatiales (volume, vitesse, variété)
 - Diversification des producteurs
 - Ouverture et interopérabilité des données (spatiales)



Cartes dynamiques et interactives

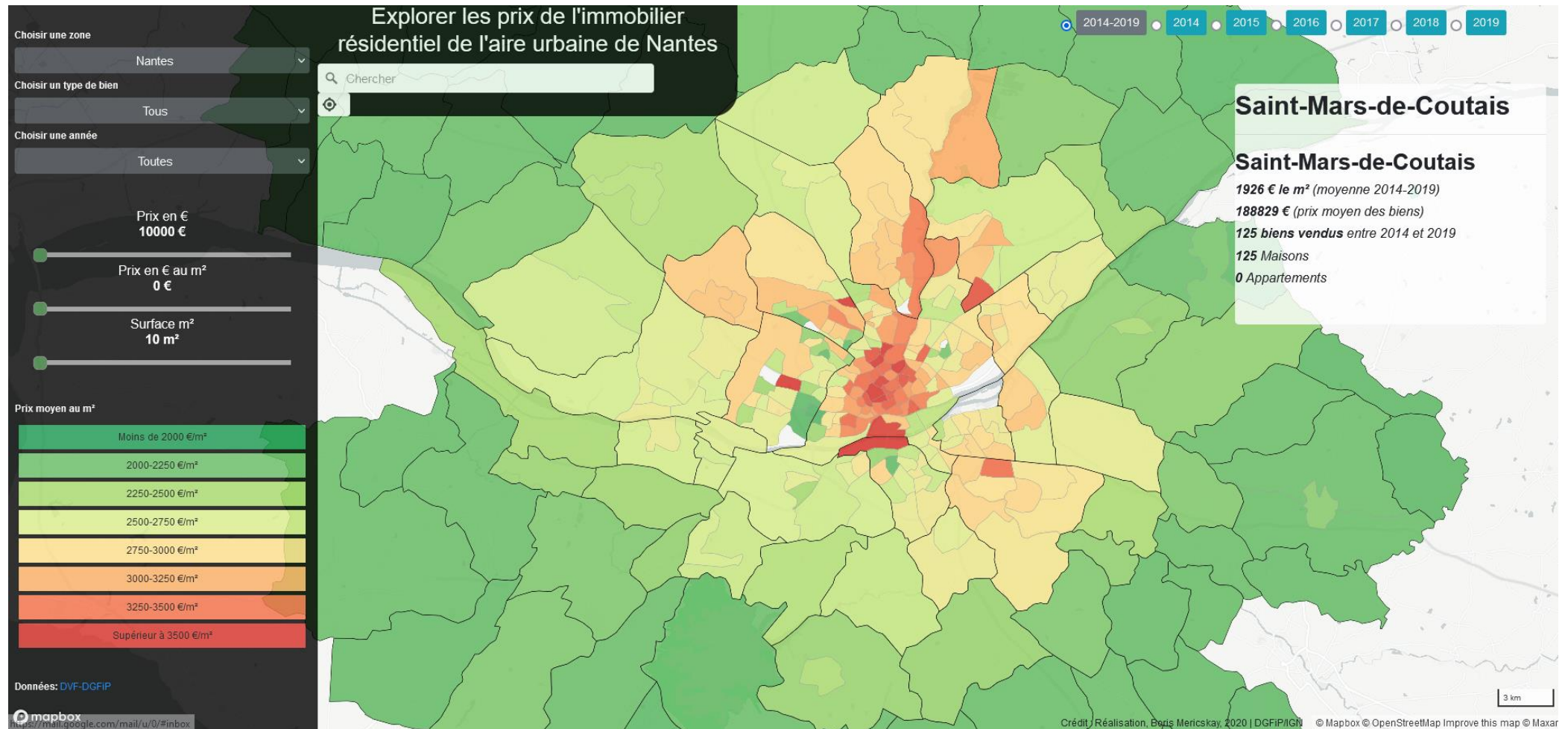
- Nouvelles interactions entre l'individu, la carte, les données
 - Déplacement (paning), changement d'échelle (zooming), superposition,...
 - Interrogation des objets sur la carte (fenêtres contextuelles)
 - Dimension agrégative de contenus divers (notion d'hypercarte)



Interactivité

Vue cartographique	Affichage et représentation
Déplacement	Affichage de couches (menu)
Zoom	Filtre et tri des données
Inclinaison	Barre de recherche
Rotation	Barre de temps
Fonds de carte	Intégration de données externes
Onglets géographiques	Annotation / Dessin
Géolocalisation	Calcul / Mesures / Analyses
Géocodeur	Brushing
Cartes glissantes	Informations contextuelles
Cartes synchronisées	Affichage adaptatif
Cartes d'aperçu	Symbologie adaptative

Démo

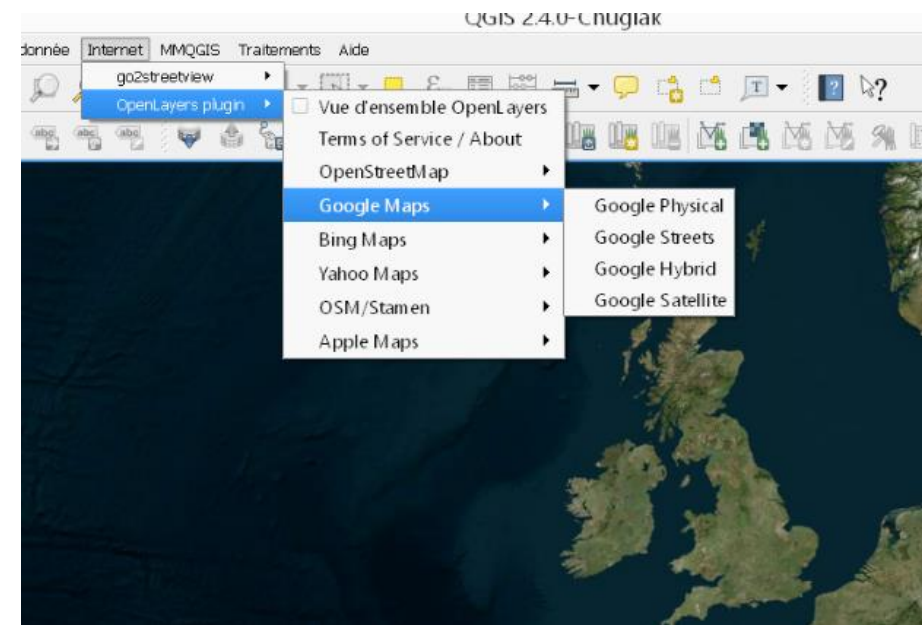
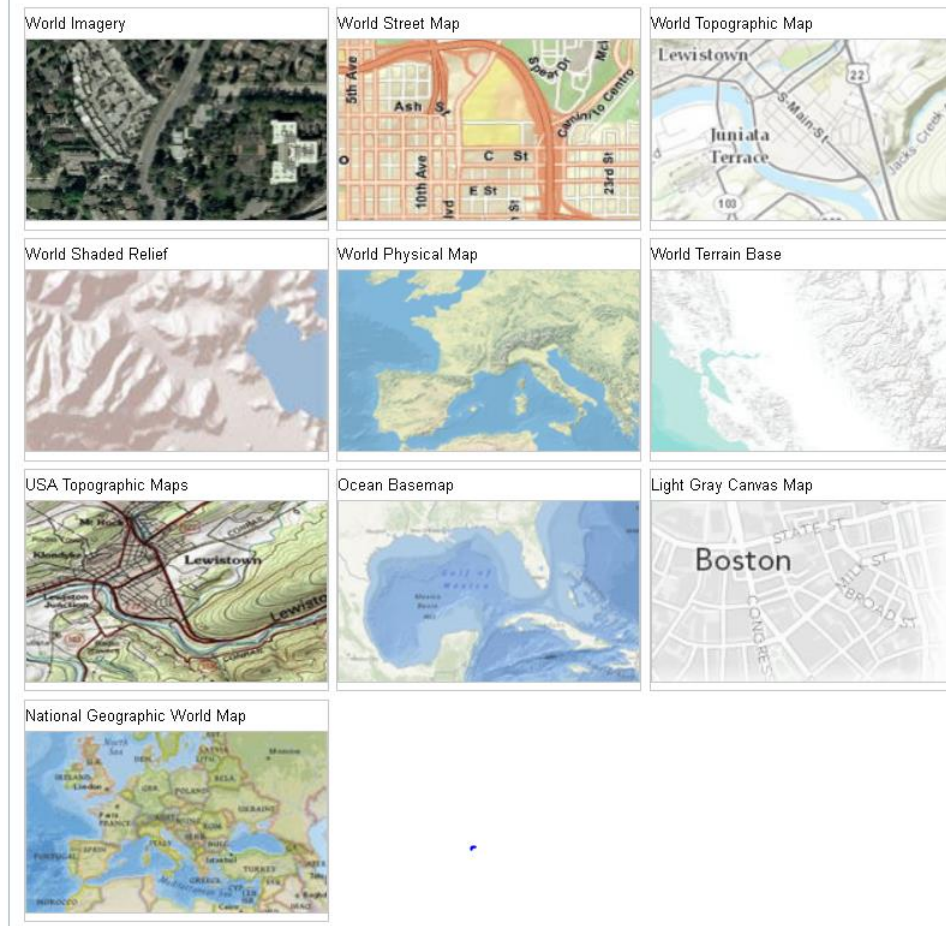


https://sites-formations.univ-rennes2.fr/mastersigat/WebMaps/Map_DVF_NantesV2.html

Les fonds de carte

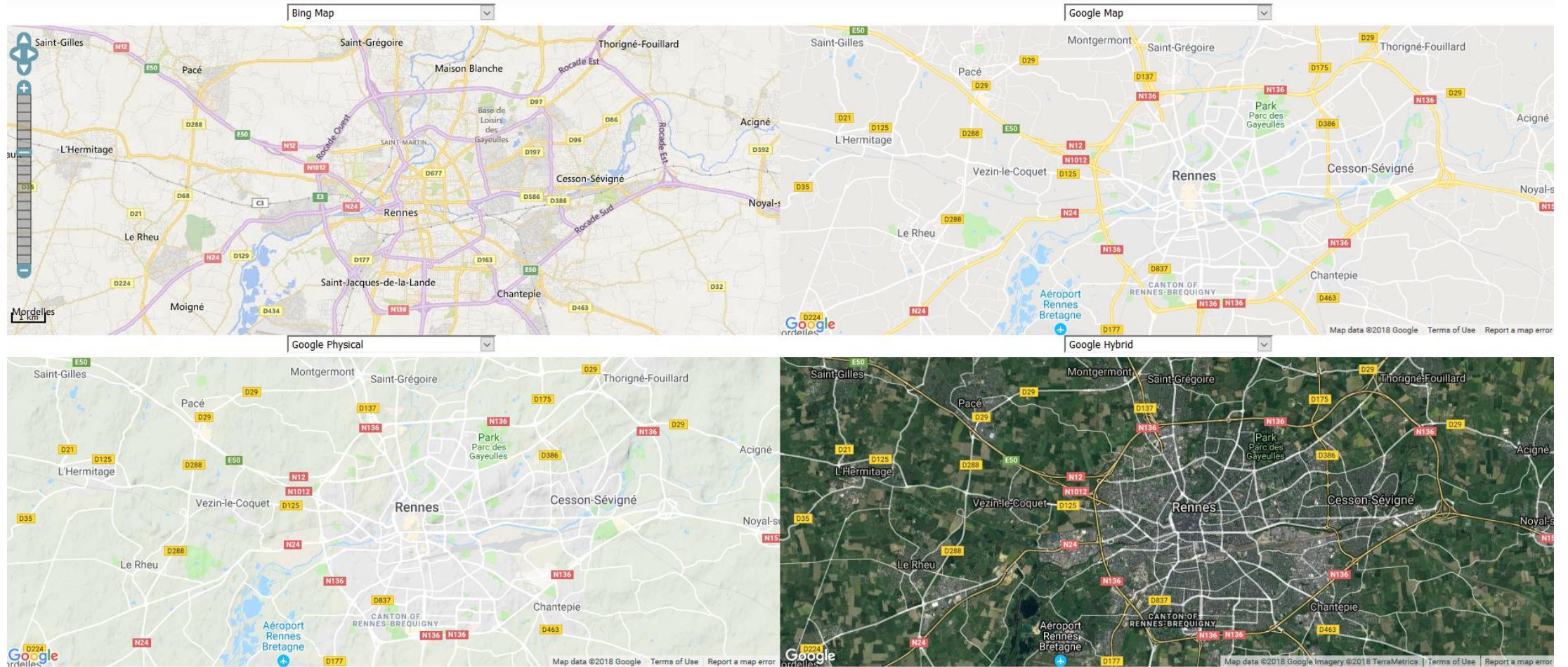
Un renouvellement des « référentiels » cartographiques pour
géovisualiser les données

Les fonds de carte



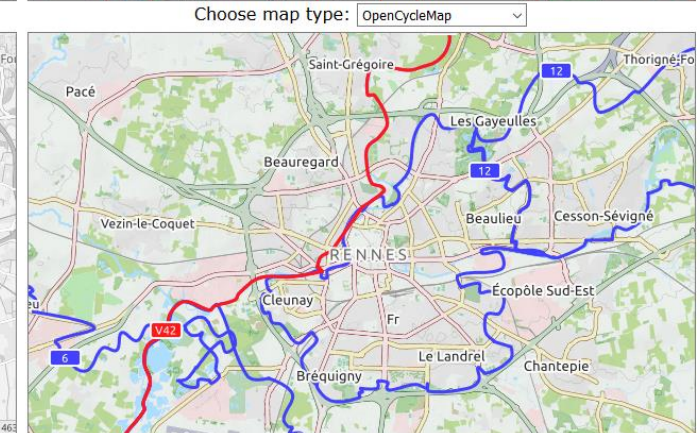
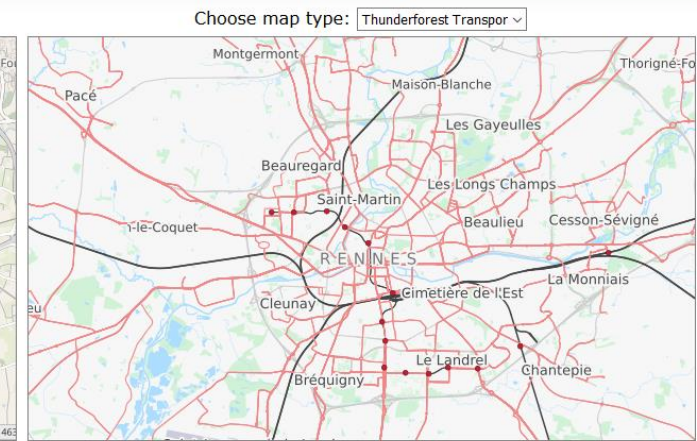
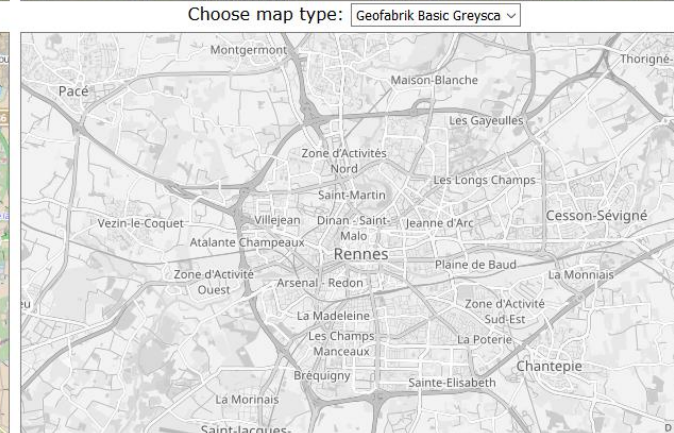
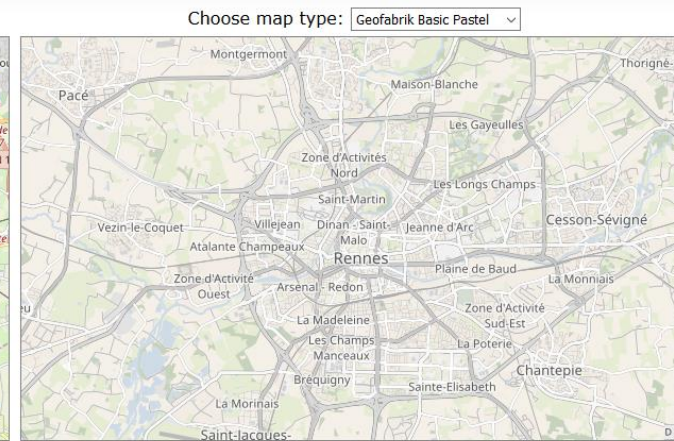
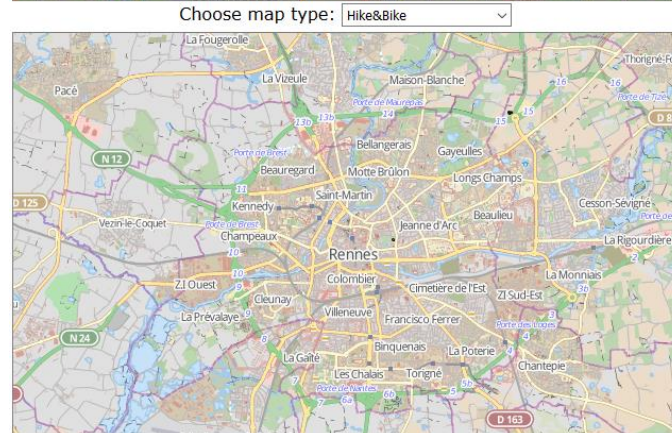
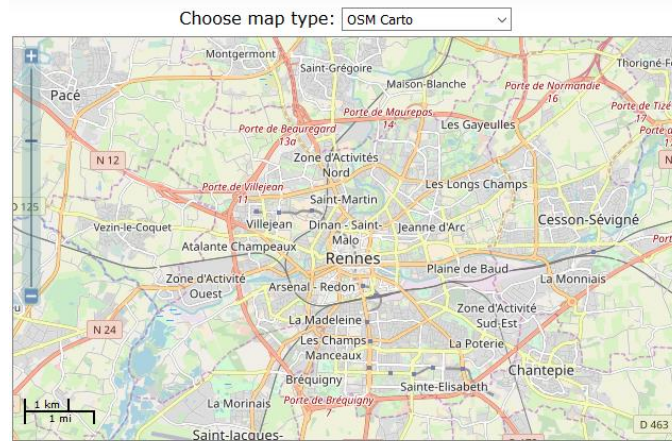
Fonds de carte

Map Compare

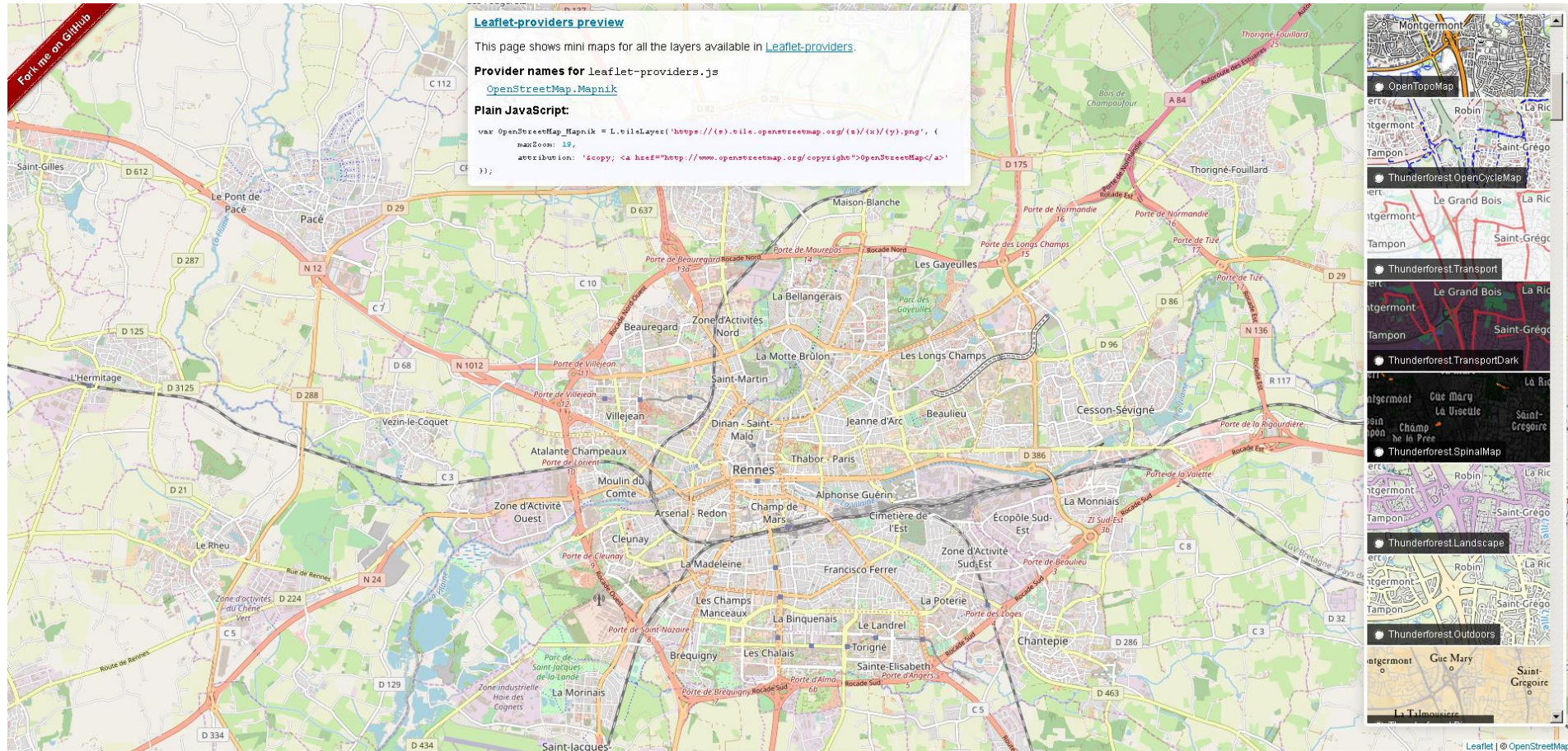


Fonds de carte

Map Compare



Fonds de carte



<http://leaflet-extras.github.io/leaflet-providers/preview/>

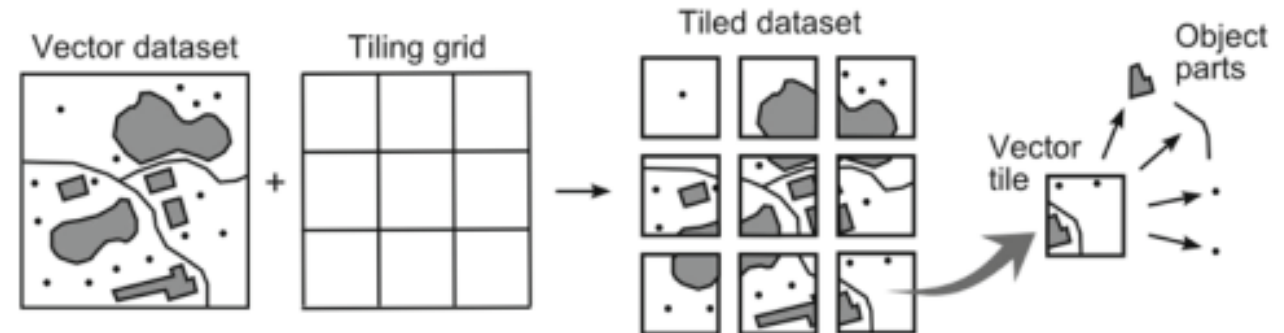
Tuiles vectorielles

- Passage des tuiles raster (images) aux tuiles vectorielles
 - Optimise la visualisation de données spatiales sur le Web
 - Travail de rendu déporté côté client (Mise à contribution des capacités de rendu des dispositifs)
 - Séparation des données et de la présentation (séparer le fond et la forme)
 - Symbologie plus poussée

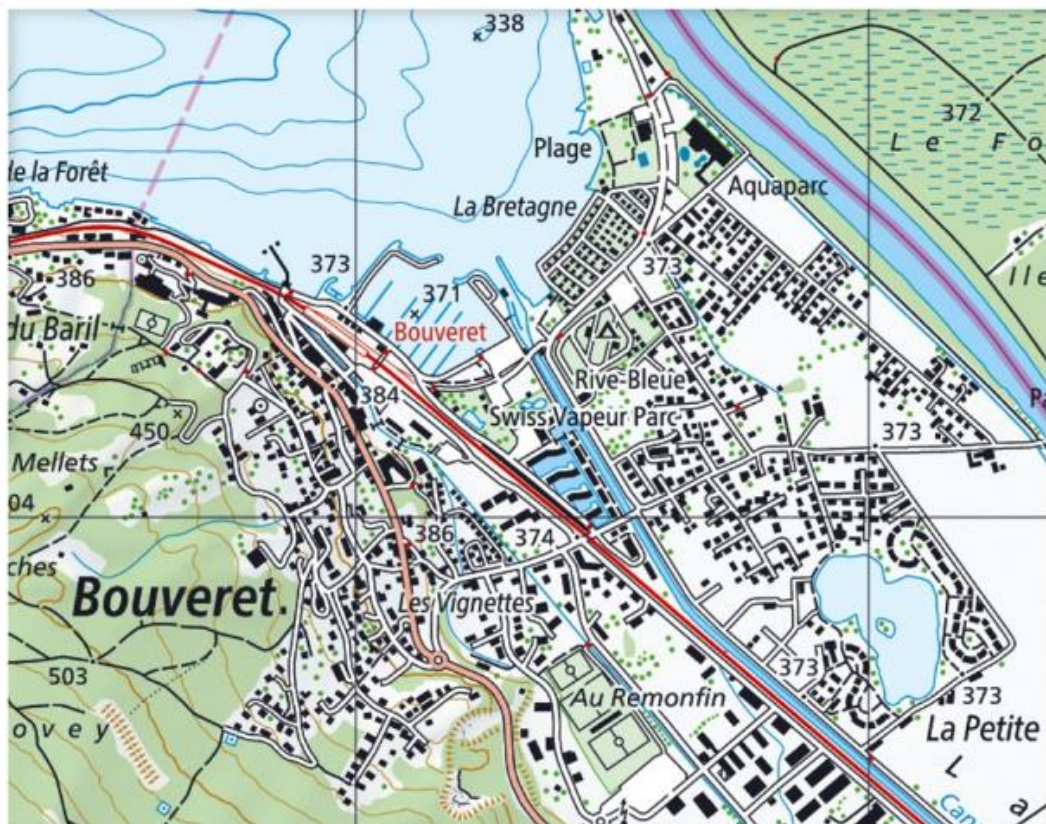
Tuiles rasters



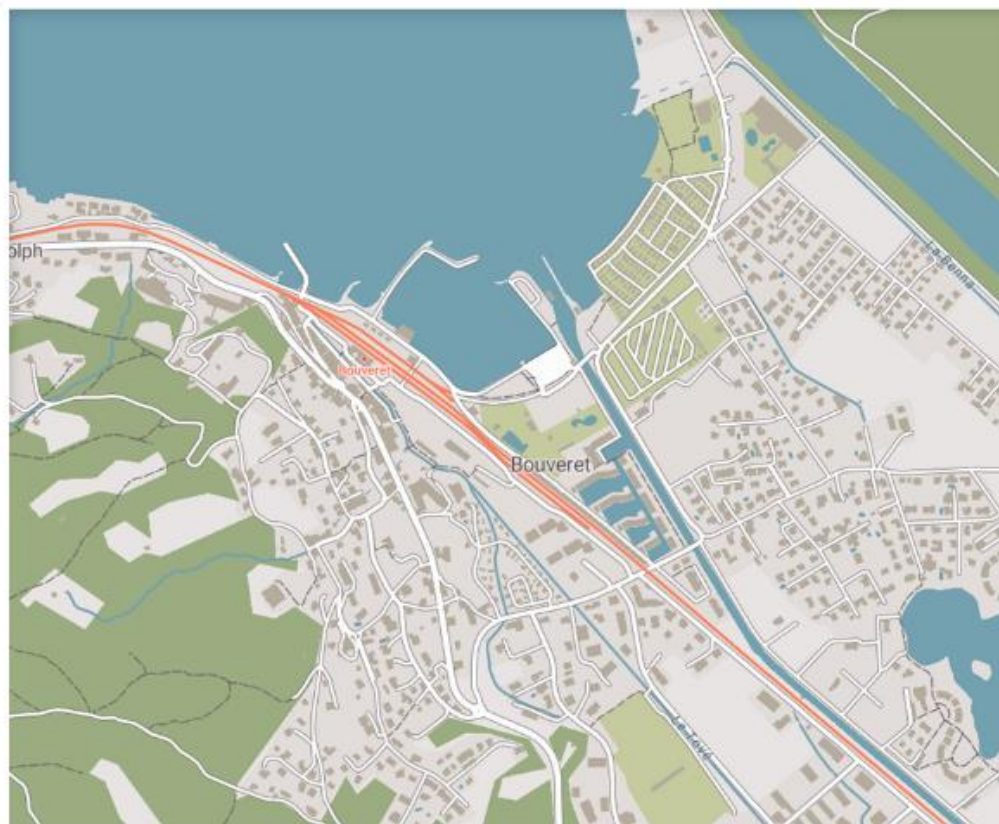
Tuiles vectorielles



Tuiles vectorielles

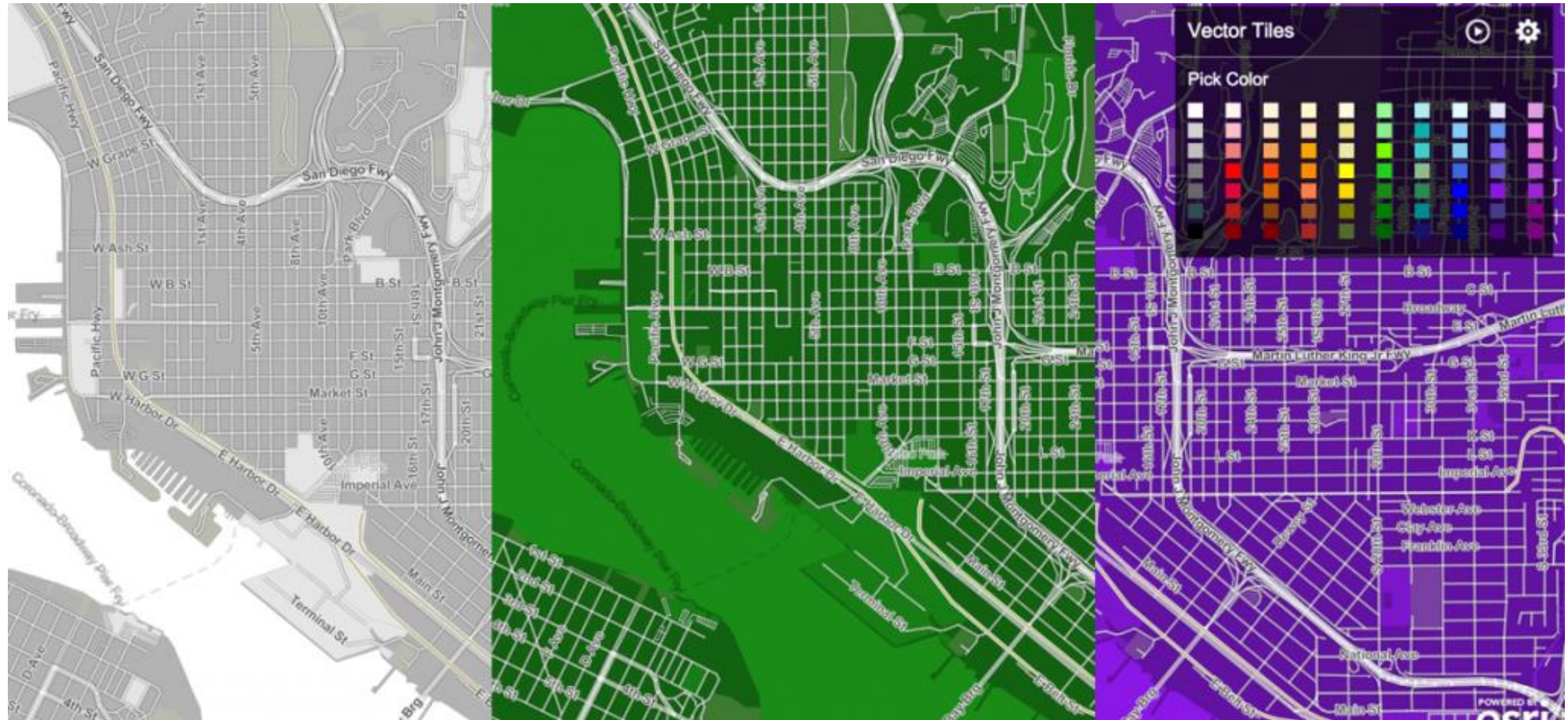


[Lien](#)

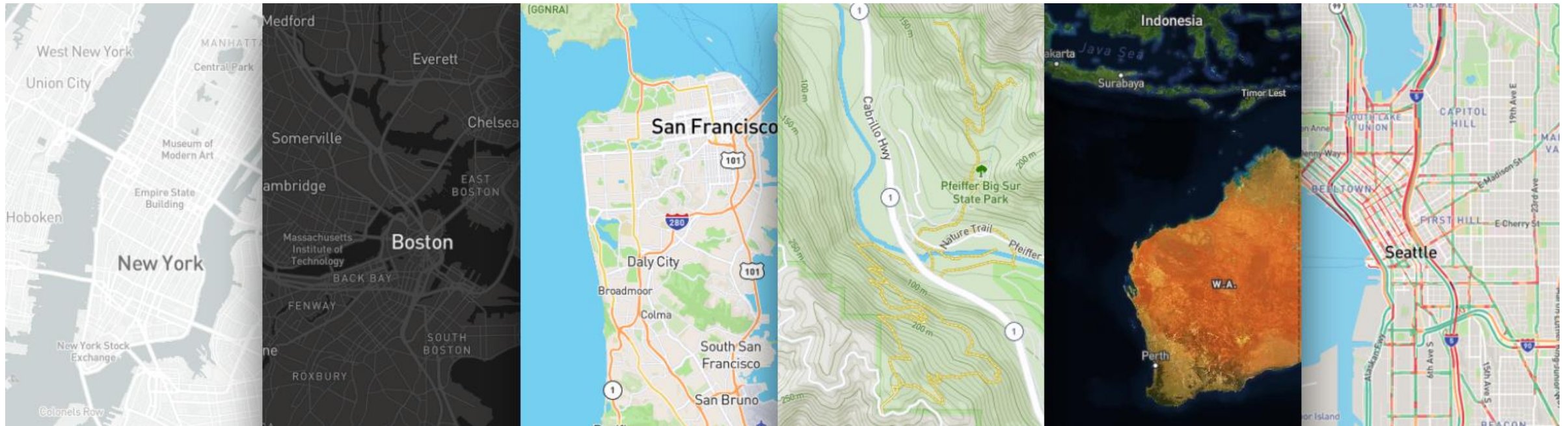
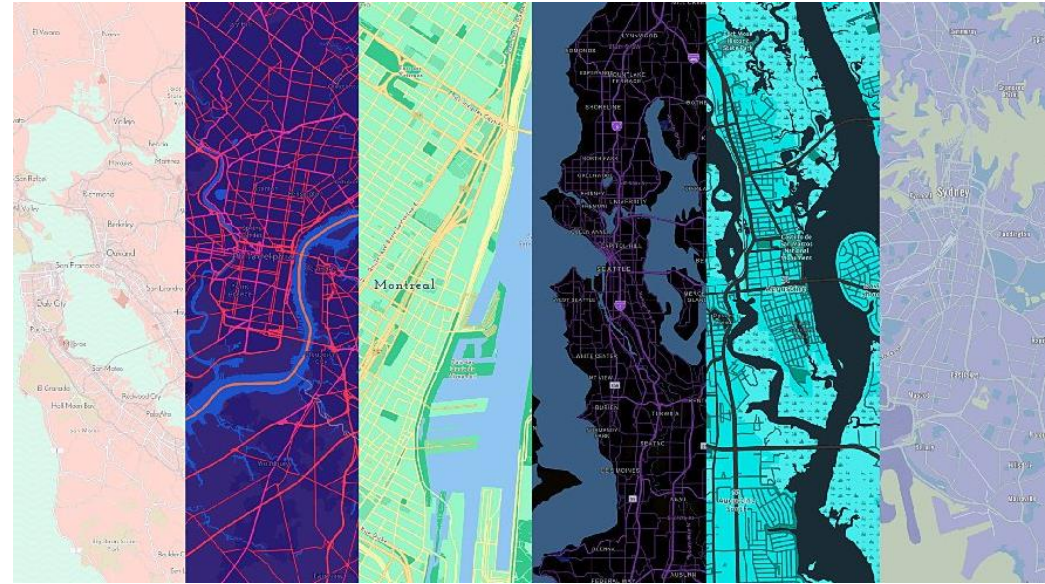


[Lien](#)

Tuiles vectorielles = Personnalisation

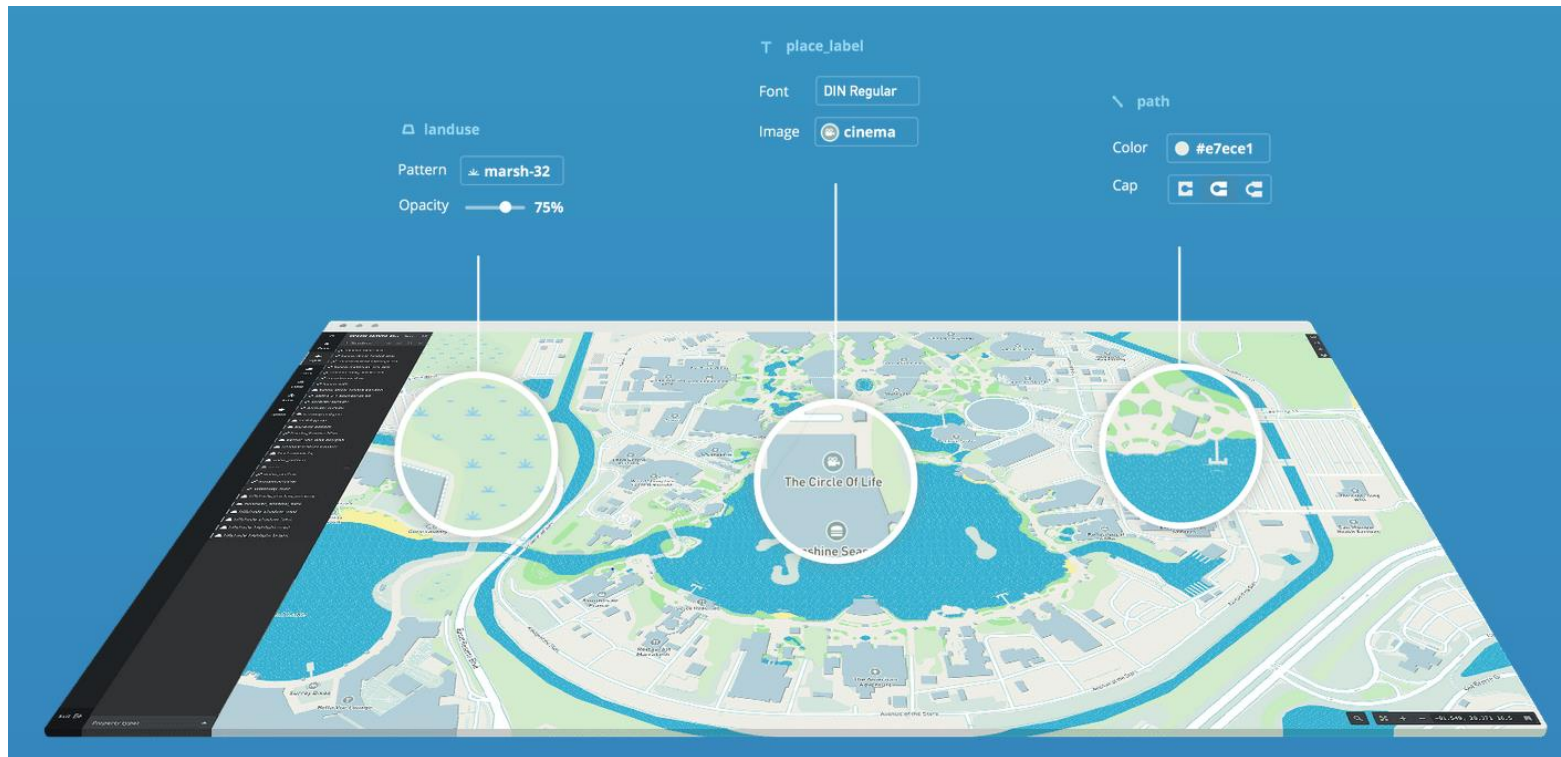


Fonds de carte



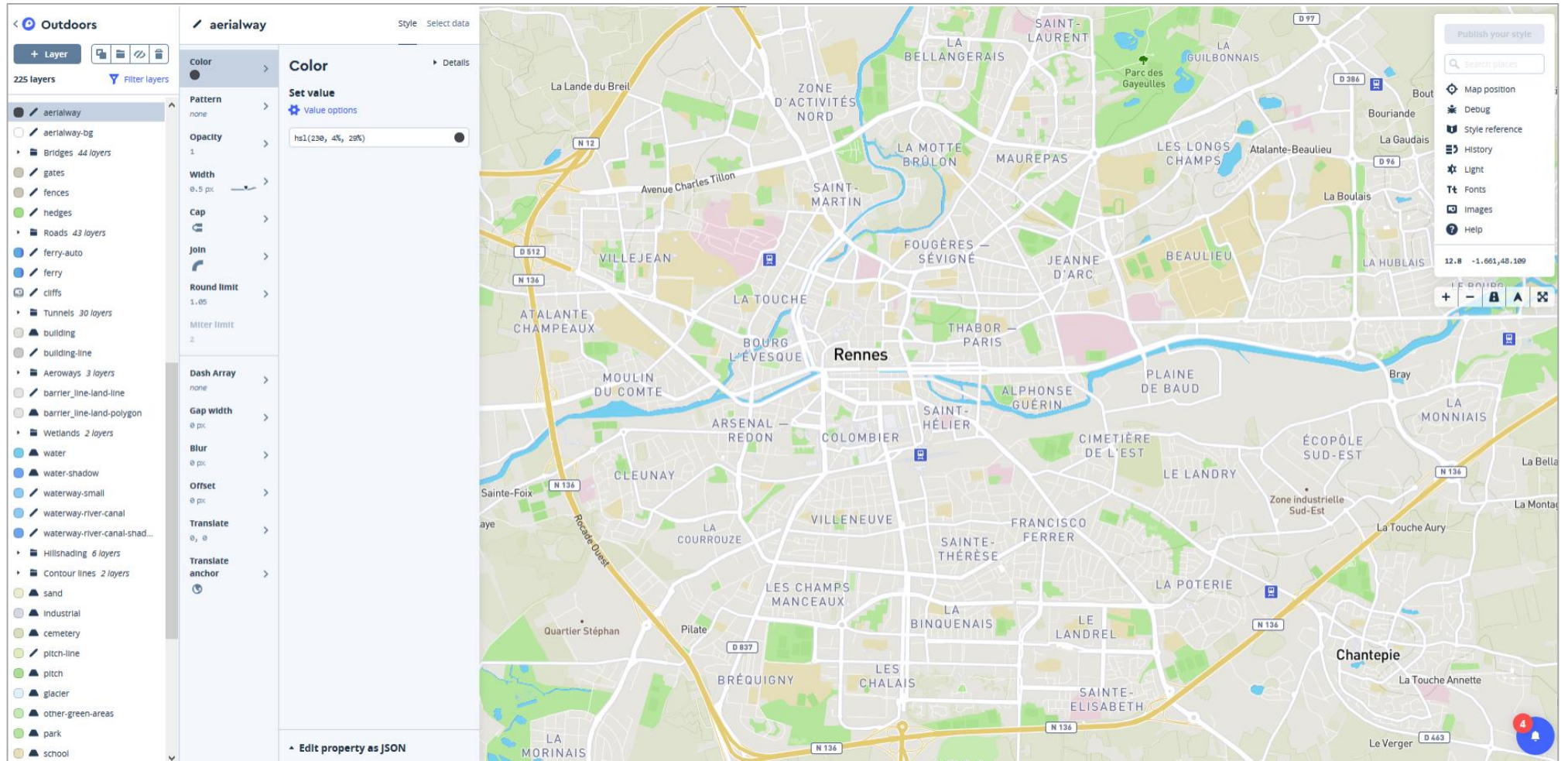
Fonds de carte personnalisables

- Possibilité de générer ses propres fonds de cartes
- Mobilisation des données de OpenStreetMap



Fonds de carte personnalisables

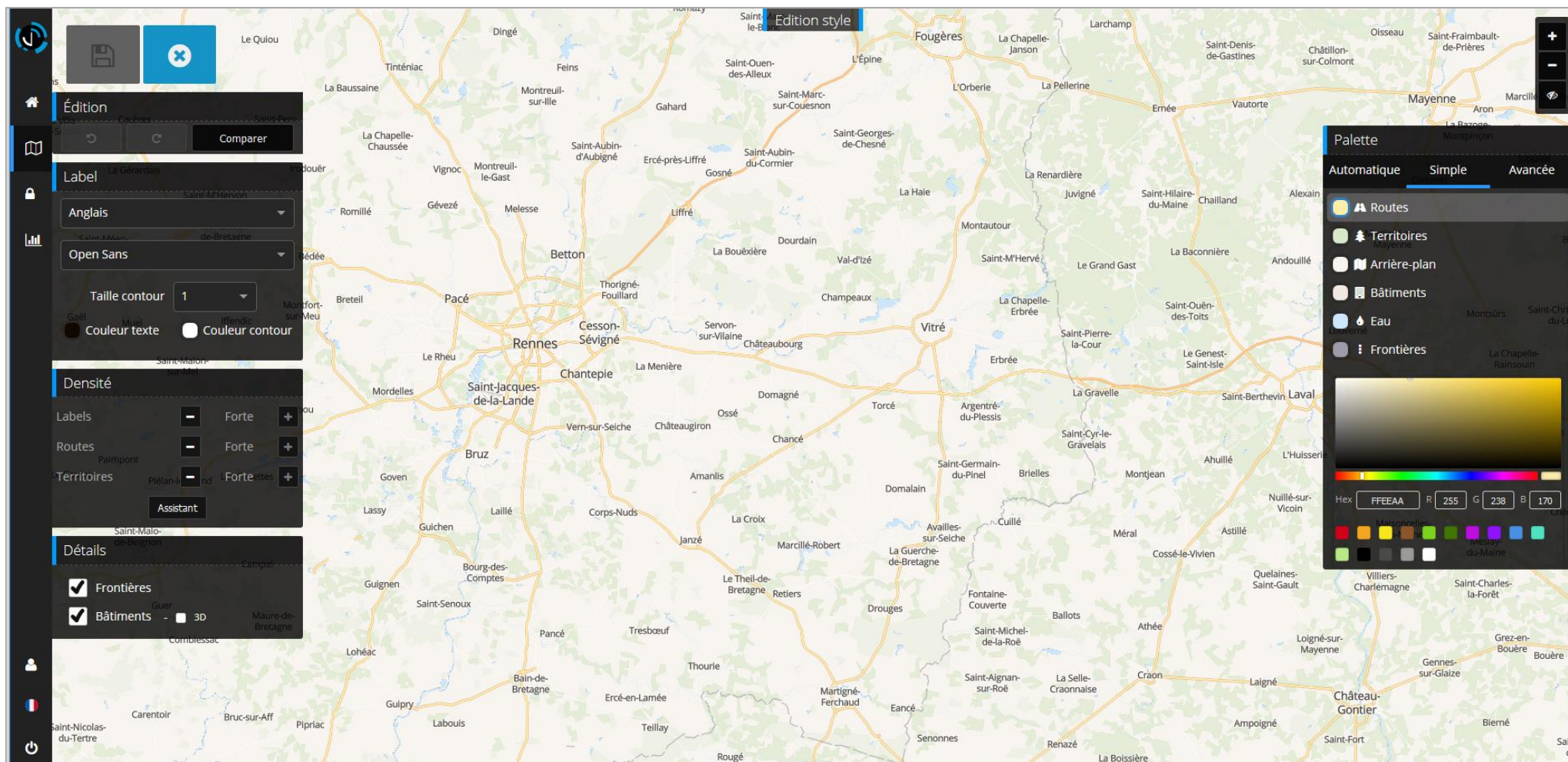
Mapbox Studio



<https://www.mapbox.com/mapbox-studio/>

Fonds de carte personnalisables

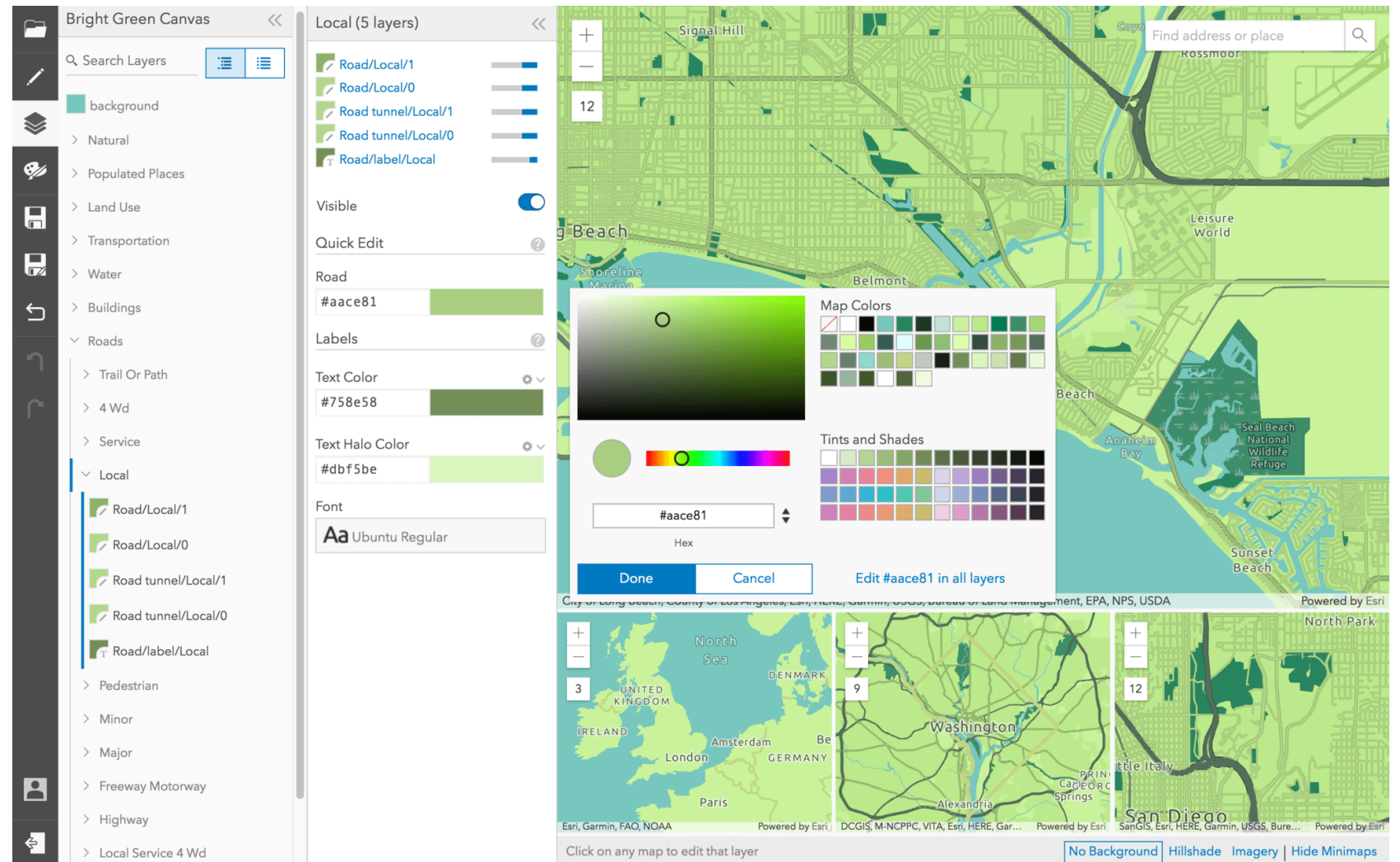
Jawg.io



<https://www.jawg.io/>

Fonds de carte personnalisables

ESRI Vector Style Editor

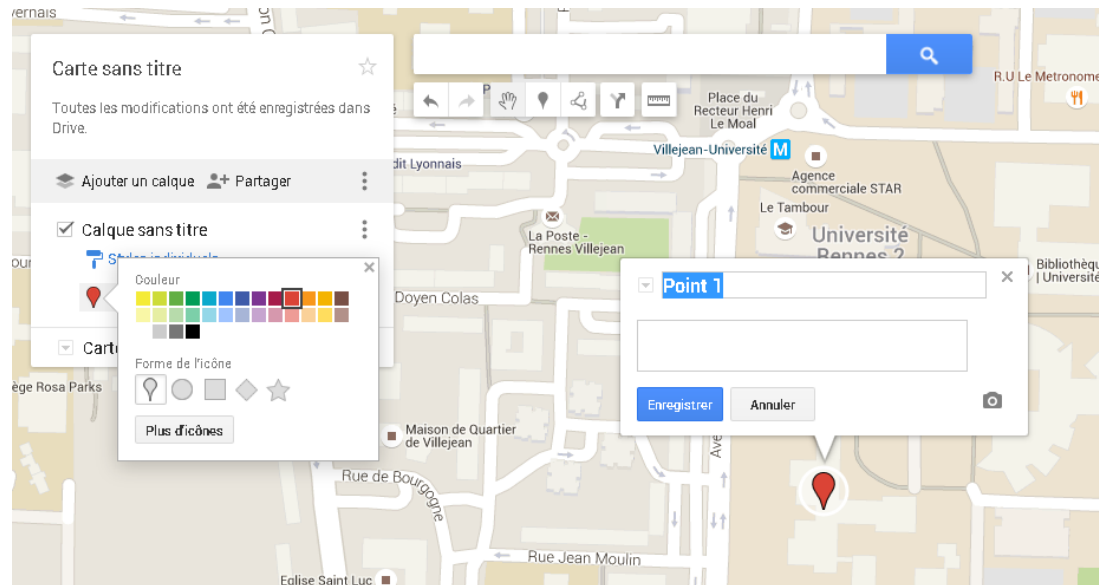


<https://developers.arcgis.com/vector-tile-style-editor/>

Un nouveau régime
cartographique

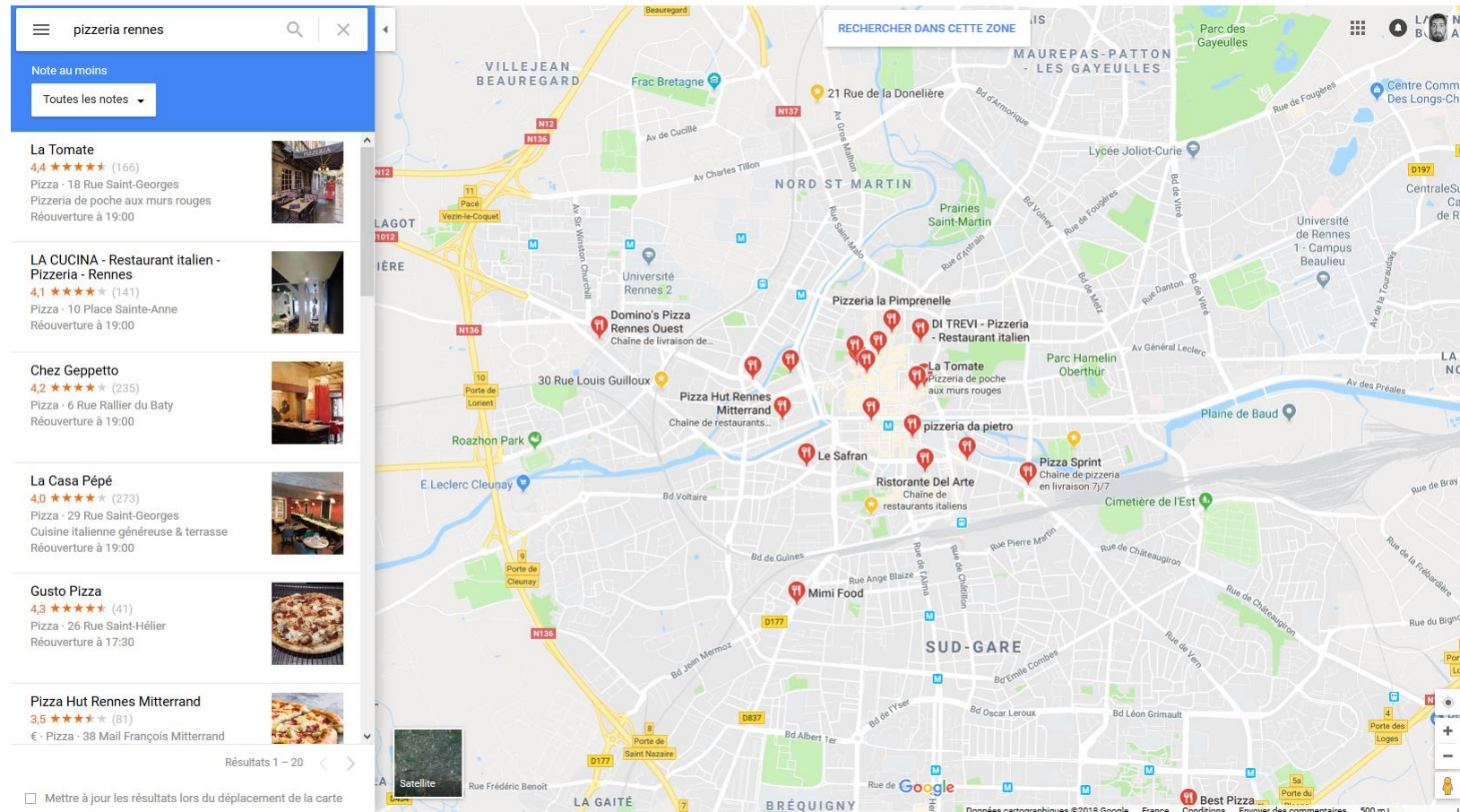
Nouveau régime cartographique

- La cartographie sur le Géoweb
 - La carte s'inscrit dans les technologies et les usages du Web
 - Tout le monde est cartographe
 - La carte en ligne : outil sémiotique (vocabulaire de signe) mais surtout procédural (design et programmation)

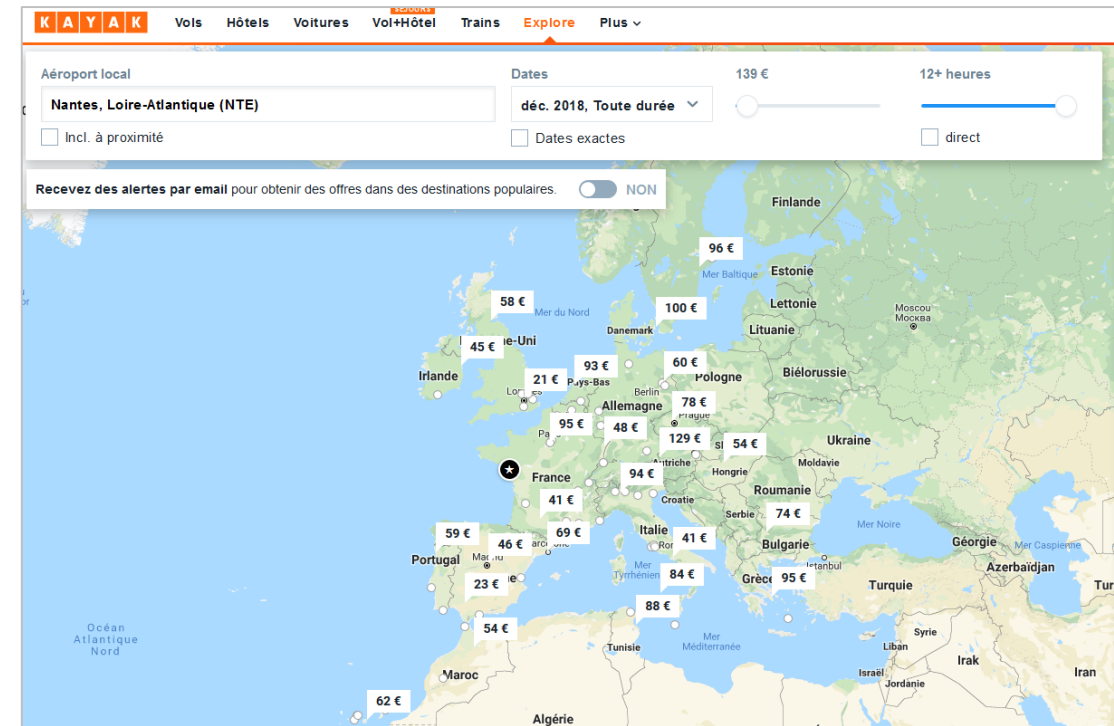
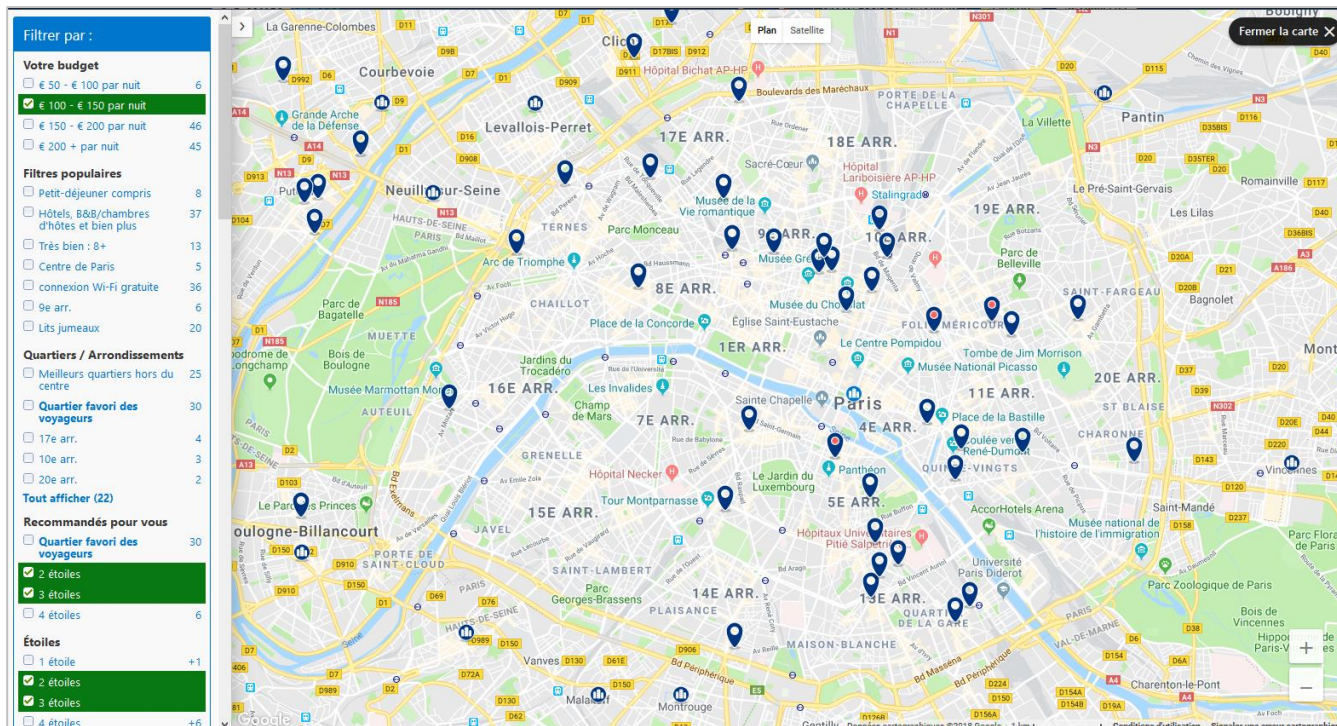


Cartographie transactionnelle

- Présenter les résultats d'une requête sur une carte

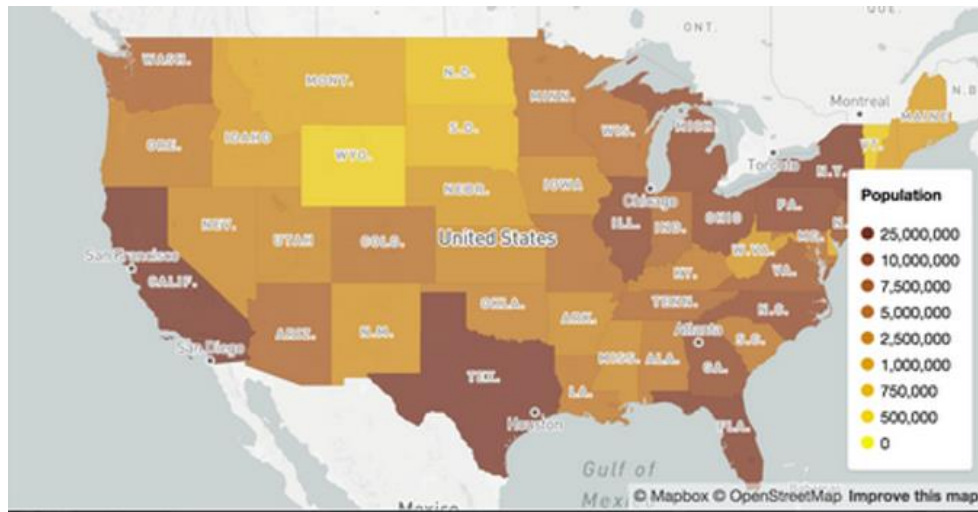


Mashup cartographique



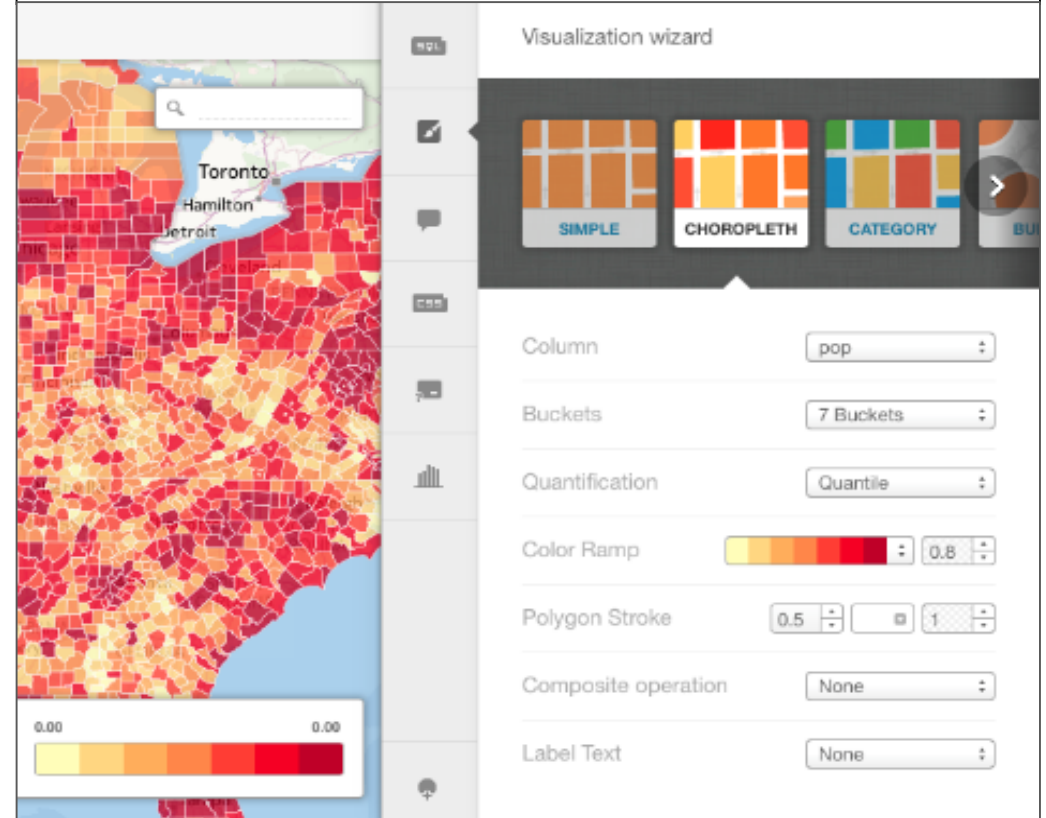
Nouveau régime, nouvelles règles

Choropleth map: In a choropleth map, a 'fill' layer changes color based on data properties. In [this example](#), the color of a state changes based on the population in the data.



Your First Choropleth Map

To make your first choropleth map, you will be using U.S. county population data. First, copy this link:



Nouveau régime, nouvelles règles



Products Solutions Documentation

Help Glossary ▾

Search

data-driven styling

Data-driven styling allows you to style your spatial data based on its properties. For example, with data-driven styling you can change the radius of a circle at an intersection based on the number of pedestrians crossing the intersection, change the color of a state polygon based on the population of each state, or use conditional logic to create bilingual labels. Data-driven styling is available in Mapbox Studio, Mapbox GL JS, the Mapbox Maps SDK for iOS, and the Mapbox Maps SDK for Android.

Data-driven styles

Data-driven styles allow you to change a layer's style based on properties in the layer's source. For example, you might create a data-driven style rule that sets the color of states in the US based on the population of each state.

Graduated circle map: In a graduated circle map, the radius of the circle layer is a representation of the magnitude of data values. In [this example](#), the color and radius of the circle layer changes based on the number of pedestrians at that intersection in the data.



Choropleth map: In a choropleth map, a 'fill' layer changes color based on data properties. In [this example](#), the color of a state changes based on the population in the data.



Colored line map: In a colored line map, a line layer changes color based on data properties. In this example, the color of a flight path changes based on the difference between local time at the flight's origin and destination.

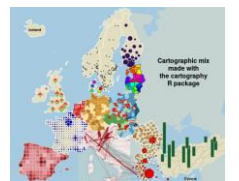
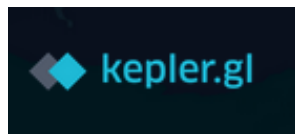


<https://www.mapbox.com/help/how-map-design-works/#data-driven-styles>

La boîte à outil de la
cartographie en ligne

La boîte à outils

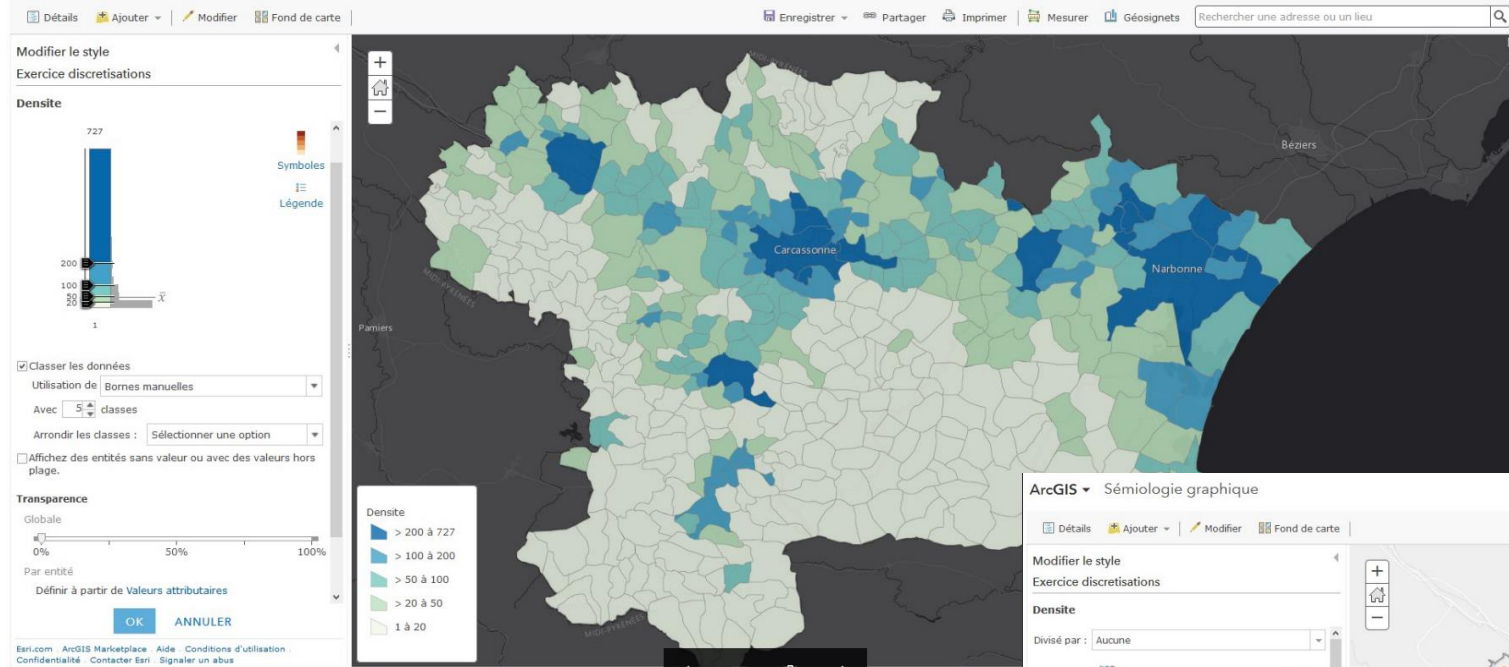
- Guider, accompagner l'utilisateur dans sa conception de géovisualisations en ligne
- Des outils qui contraignent l'utilisateur dans son choix de système de signes



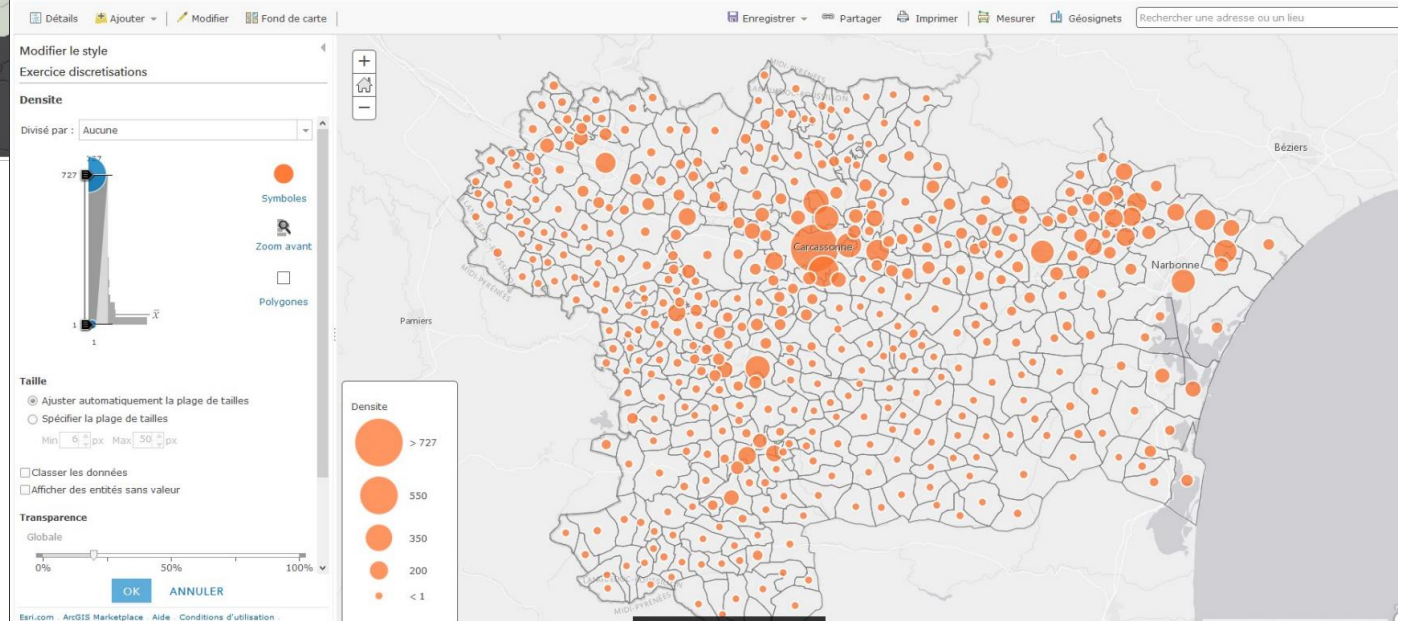


ArcGIS Online

ArcGIS ▾ Sémiologie graphique



ArcGIS ▾ Sémiologie graphique



Modifier le style

Data

1 Choisir un attribut à afficher

PNTCMT

Ajouter un attribut

2 Sélectionner un style de dessin

Totaux et montants (Taille)

OPTIONS

Totaux et montants (Couleur)

SÉLECTIONNER

Carte de densité

SÉLECTIONNER

Emplacement (un seul symbole)

SÉLECTIONNER

Types (symboles uniques)

SÉLECTIONNER

TERMINÉ ANNULER

Modifier le style

Data

1 Choisir un attribut à afficher

Pop

Ajouter un attribut

2 Sélectionner un style de dessin

Totaux et montants (Taille)

OPTIONS

Totaux et montants (Couleur)

SÉLECTIONNER

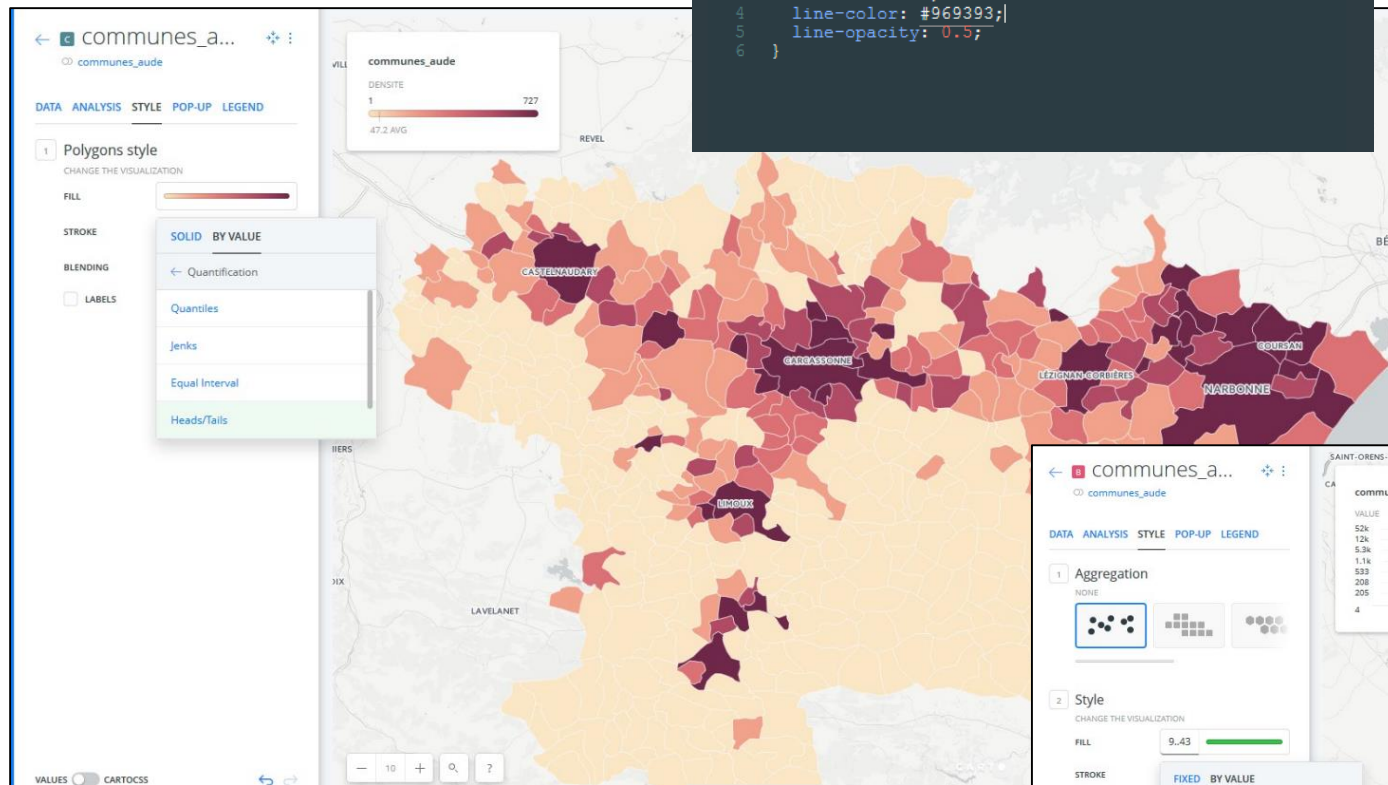
Emplacement (un seul symbole)

SÉLECTIONNER

Types (symboles uniques)

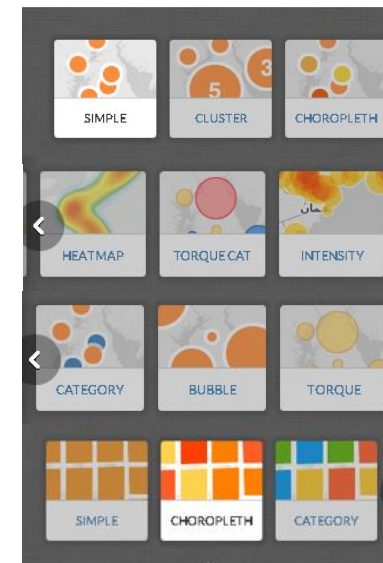
SÉLECTIONNER

TERMINÉ ANNULER



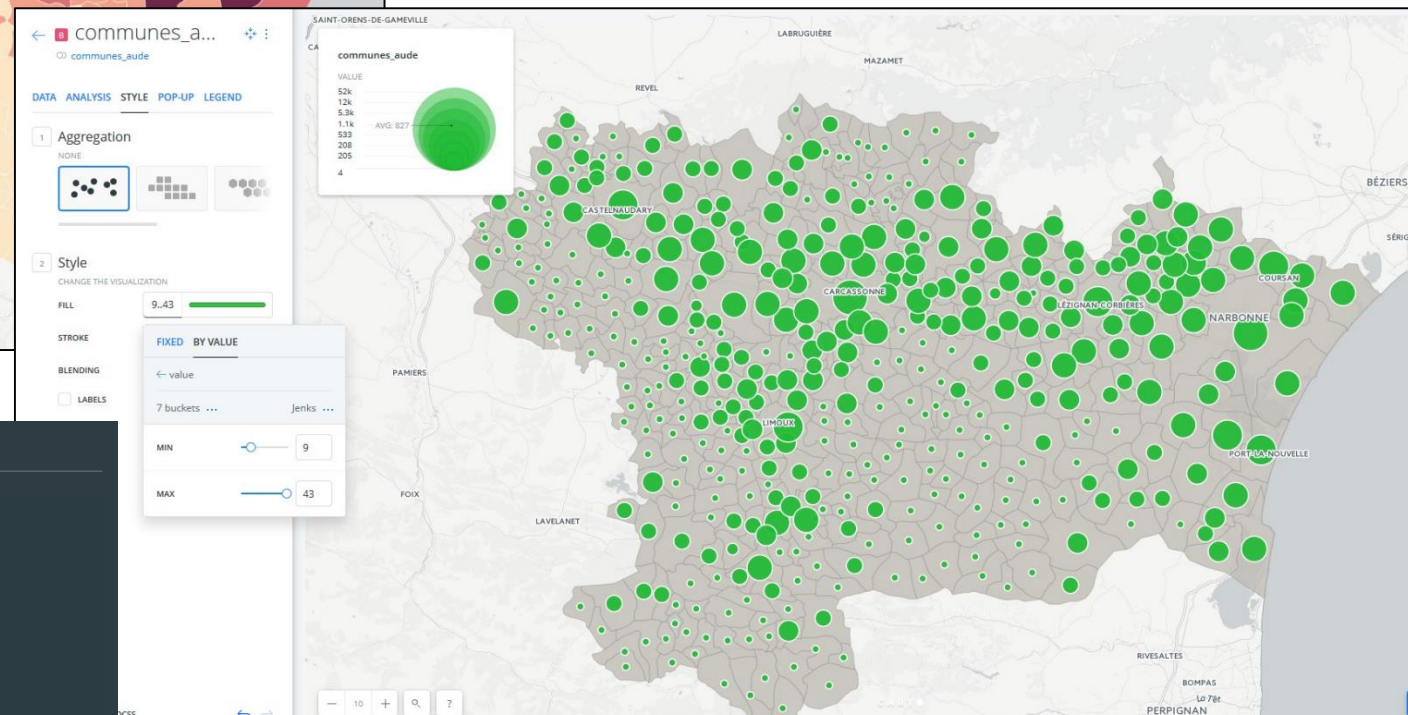
```
DATA ANALYSIS STYLE POP-UP LEGEND

1 #layer {
2   polygon-fill: ramp([densite], (#f6d2a9, #f3aa84,
3   #ea8171, #d55d6a, #b13f64), quantiles);
4   line-width: 1;
5   line-color: #969393;|
6   line-opacity: 0.5;
7 }
```

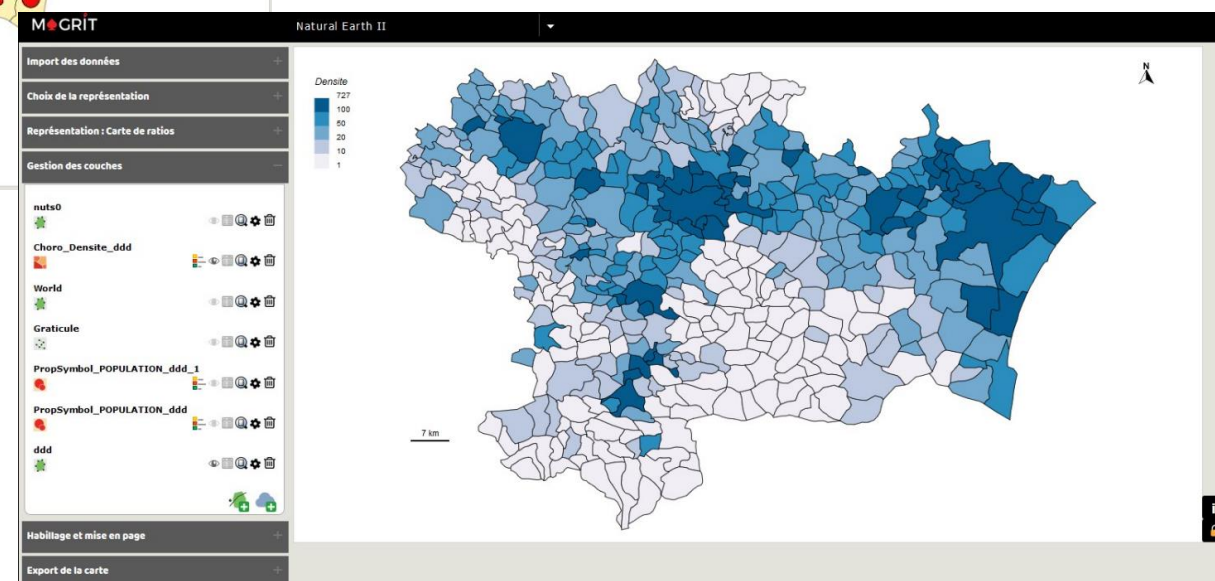
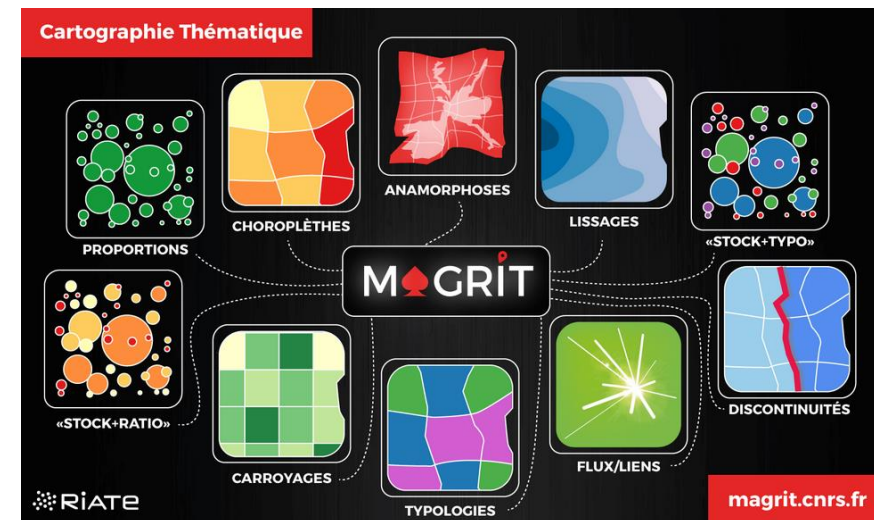
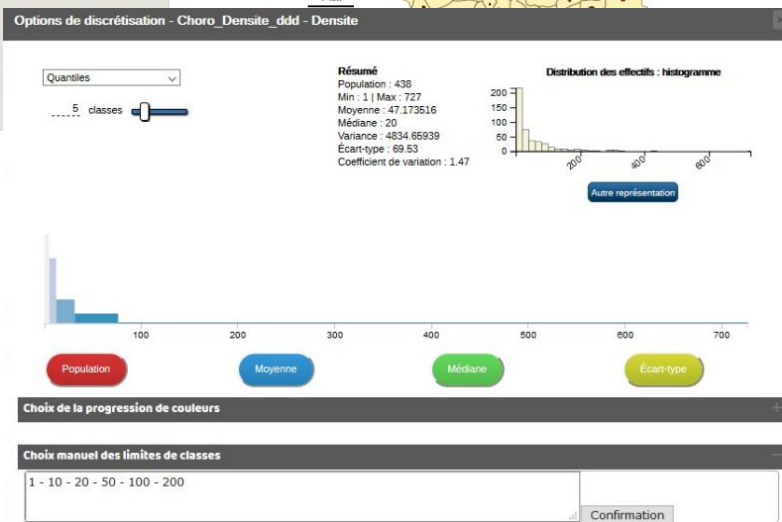
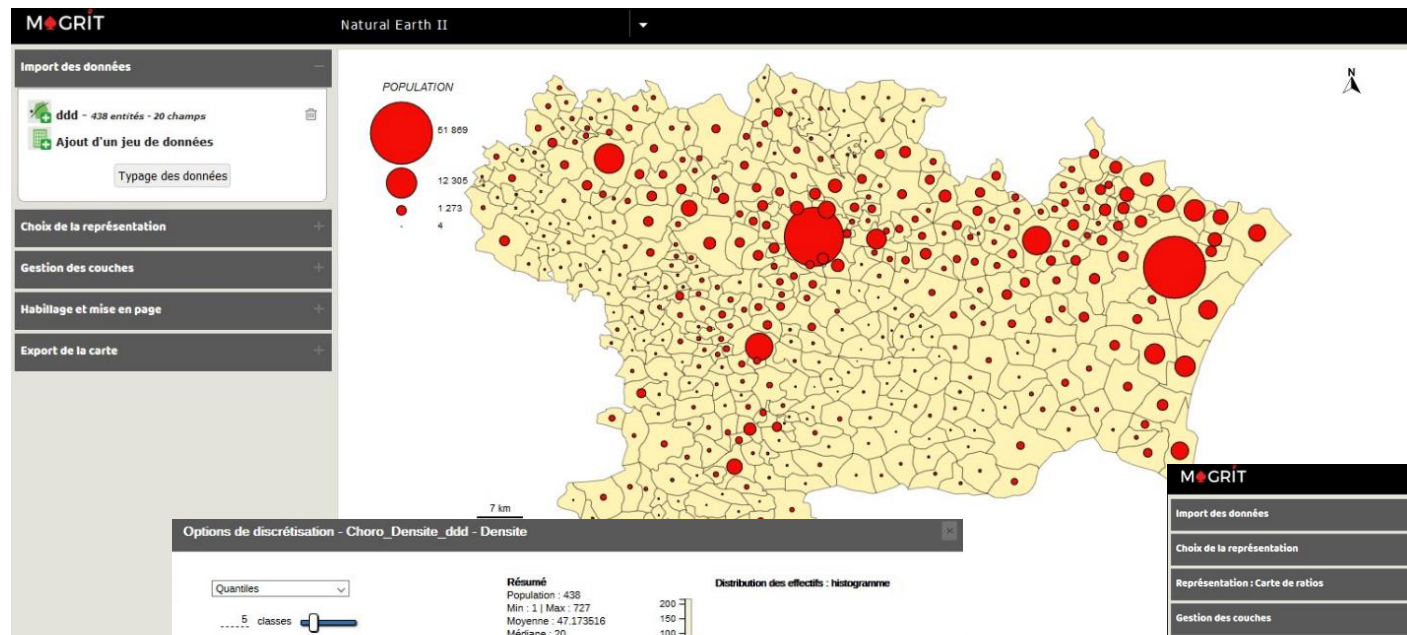


```
DATA ANALYSIS STYLE POP-UP LEGEND

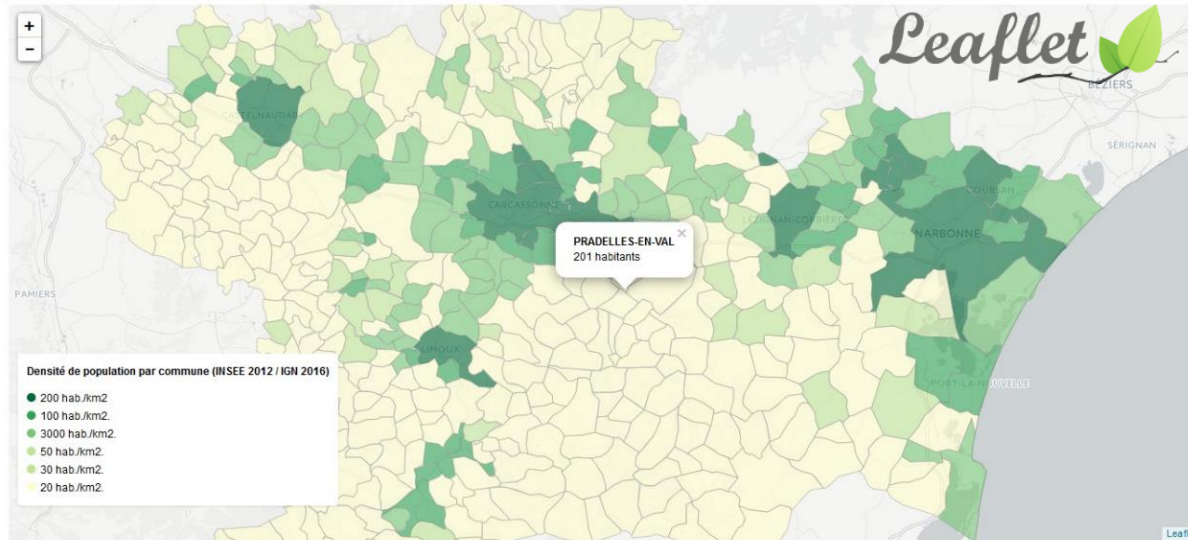
1 #layer {
2   marker-width: ramp([value], range(9, 43),
3   jenks(20));
4   marker-fill: #20bc35;
5   marker-fill-opacity: 0.9;
6   marker-allow-overlap: true;
7   marker-line-width: 1.5;
8   marker-line-color: #FFF;
9   marker-line-opacity: 1;
10 }
```



M♠GRIT

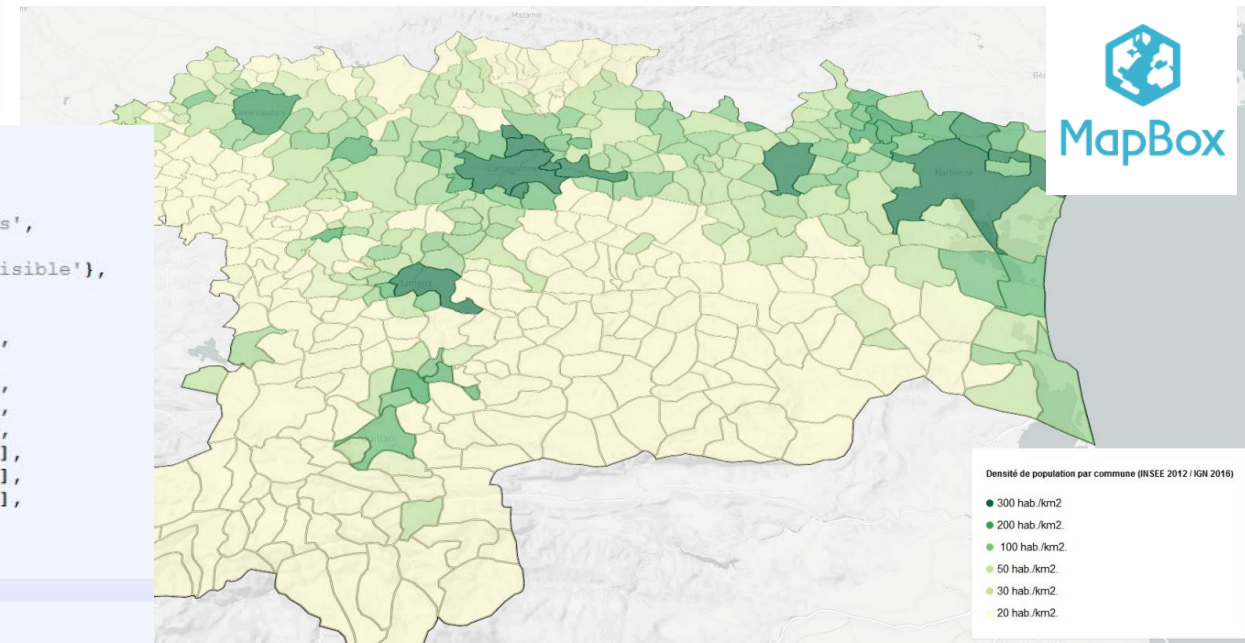


Bibliothèques Javascript



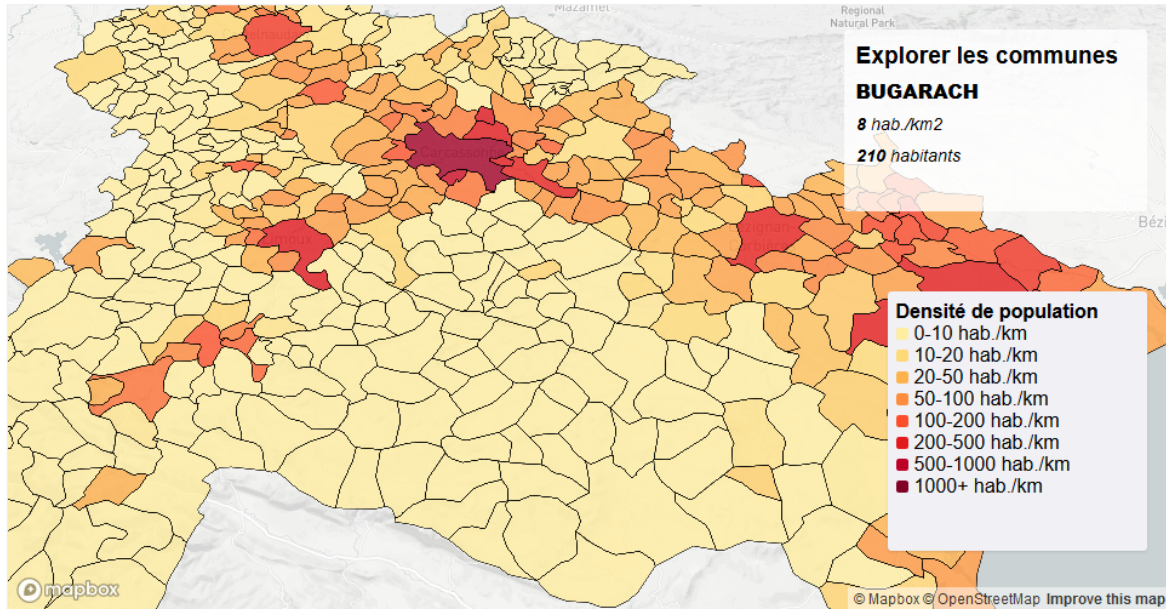
```
80
81 $.getJSON("dddd.geojson",function(hoodData) {
82   L.geoJson( hoodData, {
83     style: function(feature){
84       var fillColor,
85         Densite = feature.properties.Densite;
86       if ( Densite > 200 ) fillColor = "#006837";
87       else if ( Densite > 100 ) fillColor = "#31a354";
88       else if ( Densite > 50 ) fillColor = "#78c679";
89       else if ( Densite > 30 ) fillColor = "#ffffcc";
90       else if ( Densite > 20 ) fillColor = "#c2e699";
91       else if ( Densite > 0 ) fillColor = "#ffffcc";
92       else fillColor = "#f7f7f7"; // no data
93       return { color: "#999", weight: 1, fillColor: fillColor, fillOpacity: .6 };
94     },
95   }
```

```
115
116 map.addLayer({
117   'id': 'Population',
118   'source': 'IRIS',
119   'source-layer': 'dddd-cfu39s',
120   'type': 'fill',
121   'layout': {'visibility': 'visible'},
122   'paint': {
123     'fill-color': {
124       property: 'Densite',
125       stops: [
126         [20, '#ffffcc'],
127         [30, '#c2e699'],
128         [50, '#c2e699'],
129         [100, '#78c679'],
130         [200, '#31a354'],
131         [300, '#006837'],
132       ]
133     },
134     'fill-opacity': 0.6
135   }
136 });
137
```



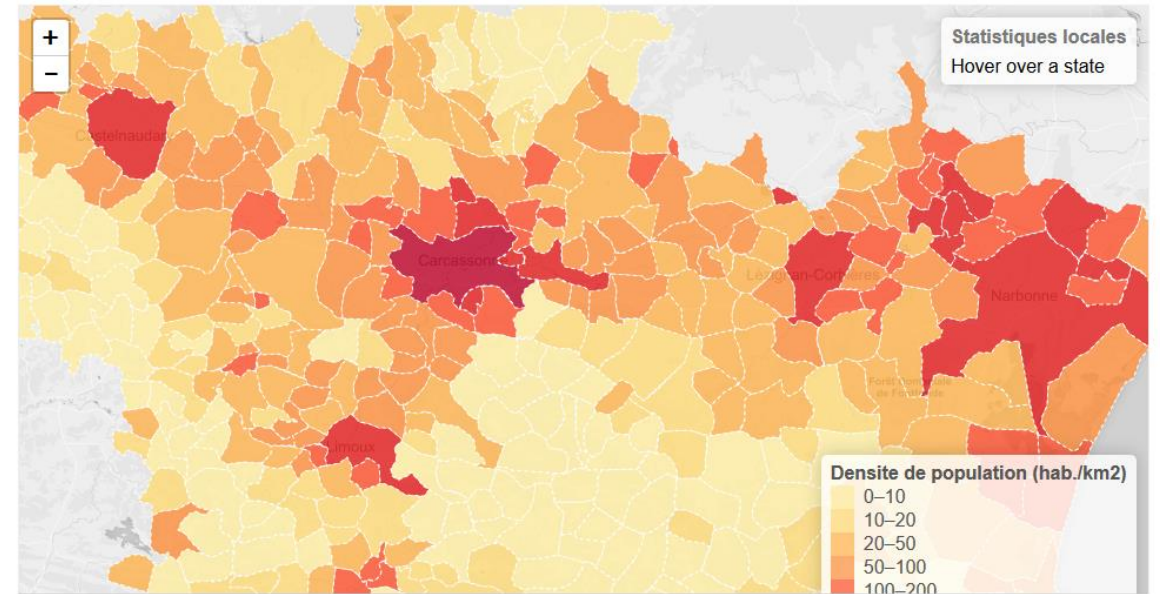
Bibliothèques Javascript

#MapboxGL / Carte choroplèthe interactive



<https://bl.ocks.org/mastersigat/02576120fff70307c85ebb7eeef3d05e>

#Leaflet / Carte choroplèthe interactive

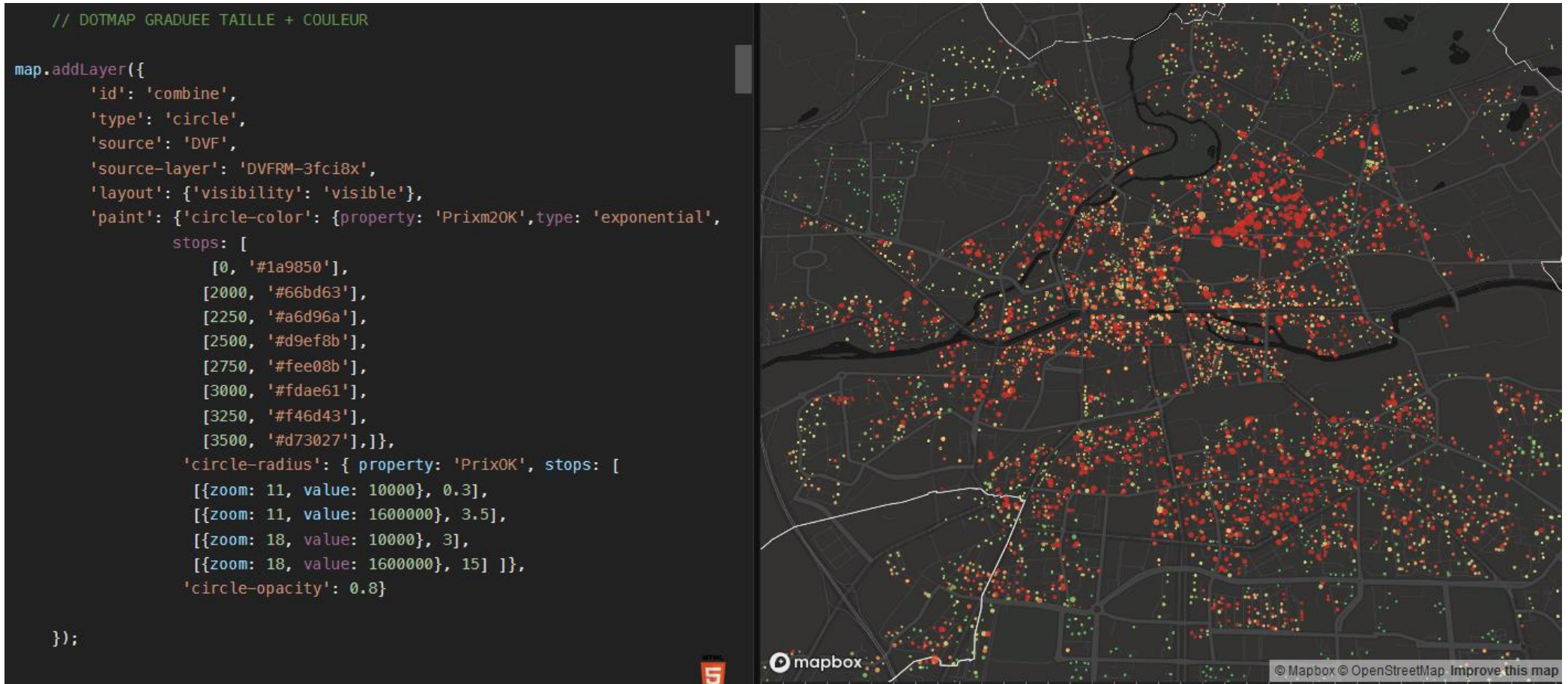


Carte choroplète interactive avec leaflet

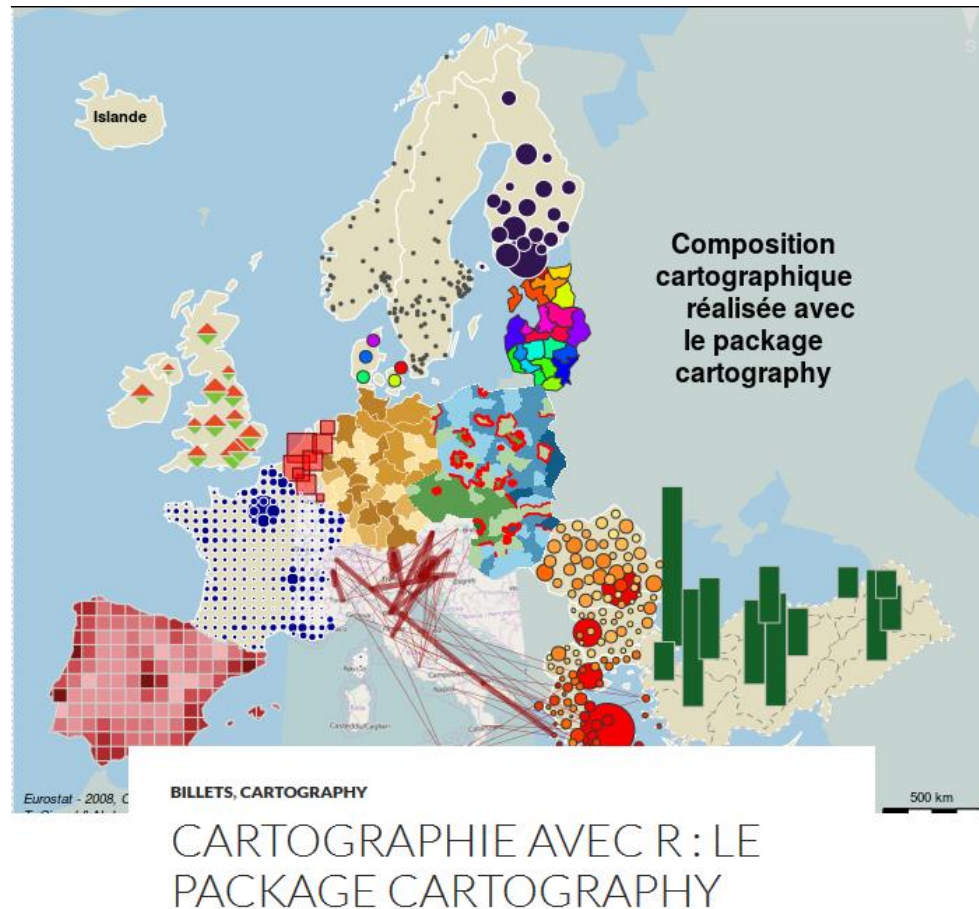
Open [↗](#)

<https://bl.ocks.org/mastersigat/b6272eb75a2bf1b57ffb6dd58cb74b36>

Bibliothèques Javascript



Faire des cartes avec R



<https://rgeomatic.hypotheses.org/659>

Leaflet for R

Introduction

The Map Widget

Basemaps

Markers

Popups and Labels

Lines and Shapes

GeoJSON and TopoJSON

Raster Images

Shiny Integration

Colors

Legends

Show/Hide Layers

Choropleths

Projections

Additional Features

Introduction

Leaflet is one of the most popular open-source JavaScript libraries for interactive maps. It's used by websites ranging from [The New York Times](#) and [The Washington Post](#) to [GitHub](#) and [Flickr](#), as well as GIS specialists like [OpenStreetMap](#), [Mapbox](#), and [CartoDB](#).

This R package makes it easy to integrate and control Leaflet maps in R.

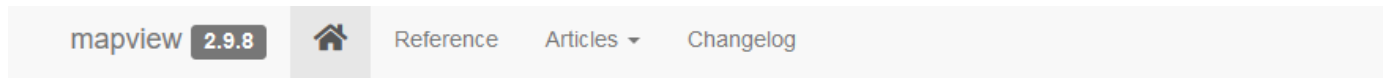
Features

- Interactive panning/zooming
- Compose maps using arbitrary combinations of:
 - Map tiles
 - Markers
 - Polygons
 - Lines
 - Popups
 - GeoJSON
- Create maps right from the R console or RStudio
- Embed maps in [knitr/R Markdown](#) documents and [Shiny](#) apps
- Easily render spatial objects from the `sp` or `sfc` packages, or data frames with latitude/longitude columns
- Use map bounds and mouse events to drive Shiny logic
- Display maps in non spherical mercator projections
- Augment map features using chosen plugins from [leaflet plugins repository](#)

Installation

To install this R package, run this command at your R prompt:

Faire des cartes en ligne avec R



Interactive viewing of spatial data in R

mapview provides functions to very quickly and conveniently create interactive visualisations of spatial data. It's main goal is to fill the gap of quick (not presentation grade) interactive plotting to examine and visually investigate both aspects of spatial data, the geometries and their attributes. It can also be considered a data-driven API for the **leaflet** package as it will automatically render correct map types, depending on the type of the data (points, lines, polygons, raster). In addition, it makes use of some advanced rendering functionality that will enable viewing of much larger data than is possible with **leaflet**. Furthermore, if you're a fan of **mapdeck** (which you should!), you can choose to use it as the rendering platform instead of **leaflet** by setting `mapviewOptions(platform = "mapdeck")`.

The main user relevant functions are:

- `mapview` - view (multiple) spatial objects on a set of background maps
- `viewExtent` - view extent / bounding box of spatial objects
- `viewRGB` - view RGB true- or false-color images of raster objects
- `mapshot` - easily save maps (including leaflet maps) as `html` and/or `png` (or other image formats)



<https://r-spatial.github.io/mapview/>

Leaflet for R

Introduction

The Map Widget

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Raster Images

Shiny Integration

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- Embed maps in [knitr/R Markdown](#) documents and [Shiny](#) apps
- Easily render spatial objects from the `sp` or `sfc` packages, or data frames with latitude/longitude columns
- Use map bounds and mouse events to drive Shiny logic
- Display maps in non spherical mercator projections
- Augment map features using chosen plugins from [leaflet plugins repository](#)

Installation

To install this R package, run this command at your R prompt:

```
install.packages("leaflet")  
# to install the development version from Github, run  
# devtools::install_github("rstudio/leaflet")
```

<https://rstudio.github.io/leaflet/>

Faire des cartes en ligne avec python

Folium 0.12.1 documentation » Quickstart

Quickstart

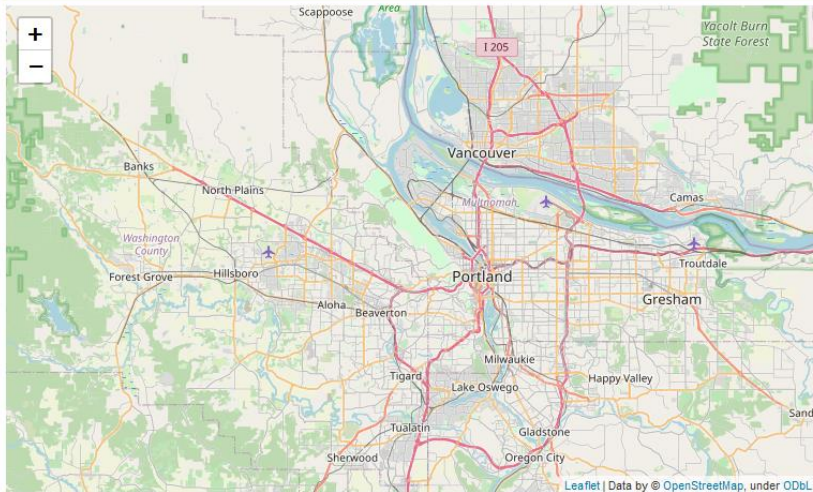
Getting Started

To create a base map, simply pass your starting coordinates to Folium:

```
[1]: import folium  
  
m = folium.Map(location=[45.5236, -122.6750])
```

To display it in a Jupyter notebook, simply ask for the object representation:

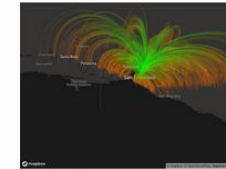
```
[2]: m  
[2]:
```



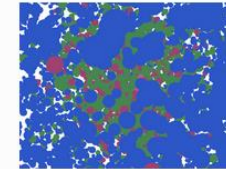
High-scale spatial rendering in Python, powered by deck.gl.

Get started by [installing pydeck](#).

Gallery



ArcLayer



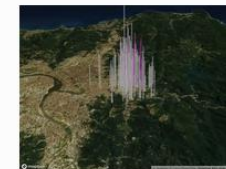
Binary Transport



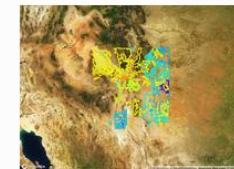
BitmapLayer



CartoSqlLayer



ColumnLayer



ContourLayer



<https://python-visualization.github.io/folium/quickstart.html>

<https://deckgl.readthedocs.io/en/latest/>

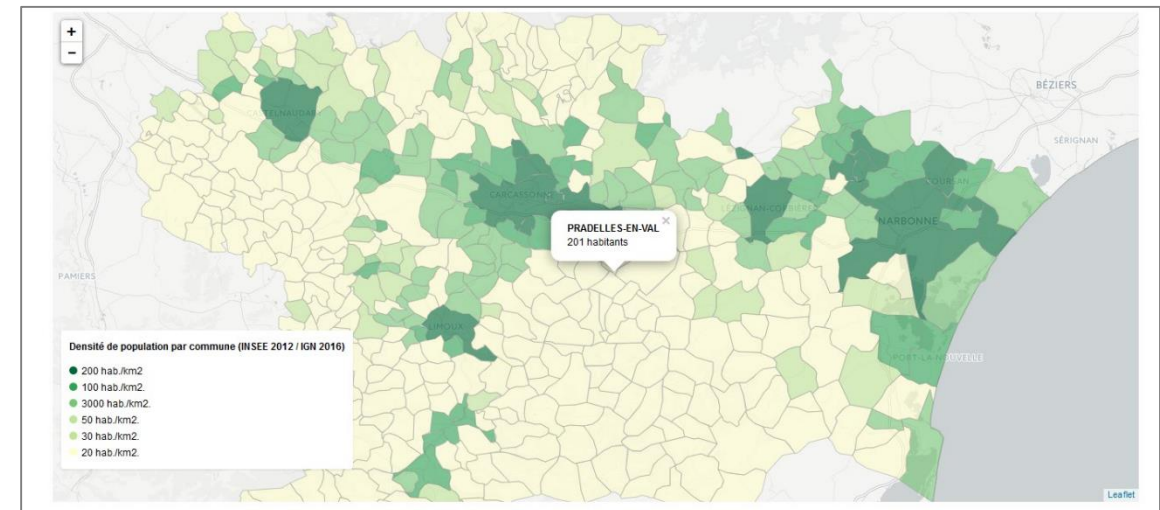
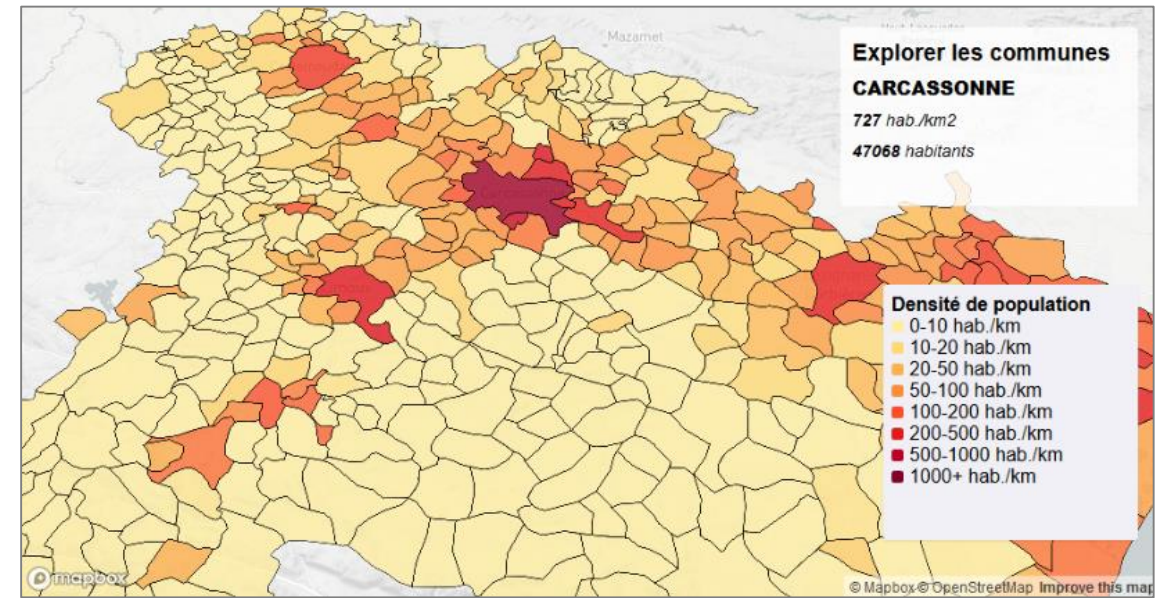
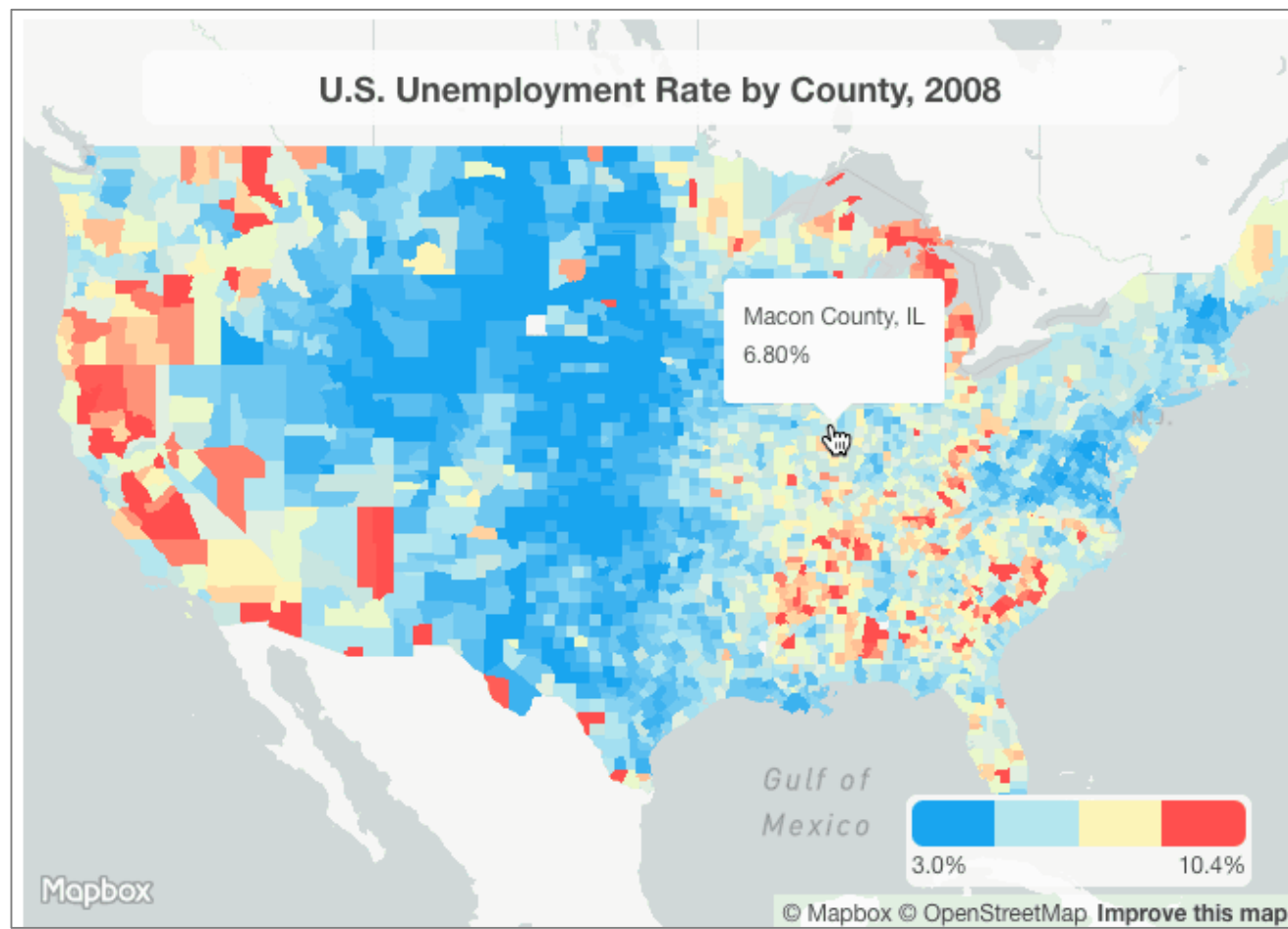
Quels types de « cartes » sur le Géoweb

Sous-culture cartographique ?

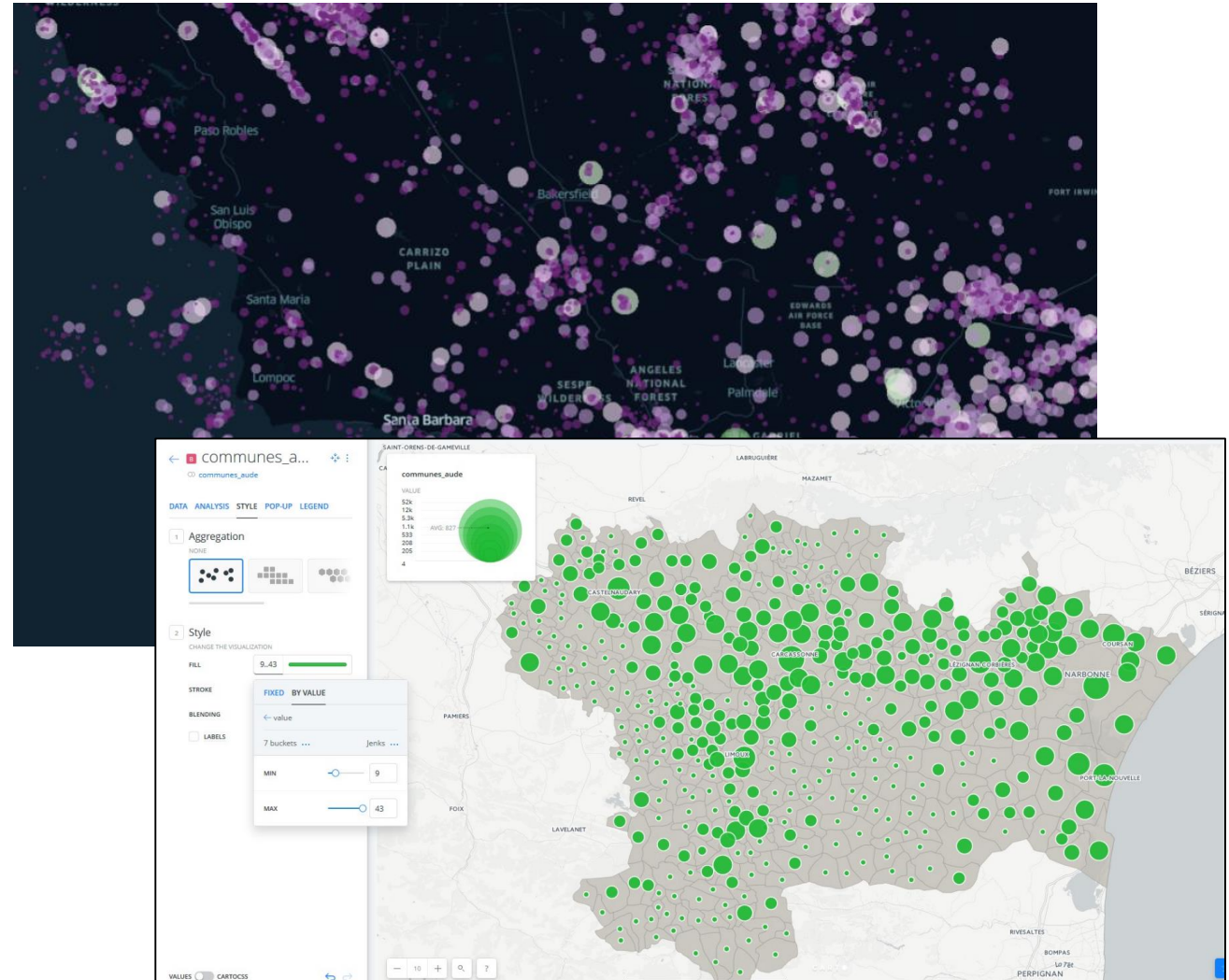
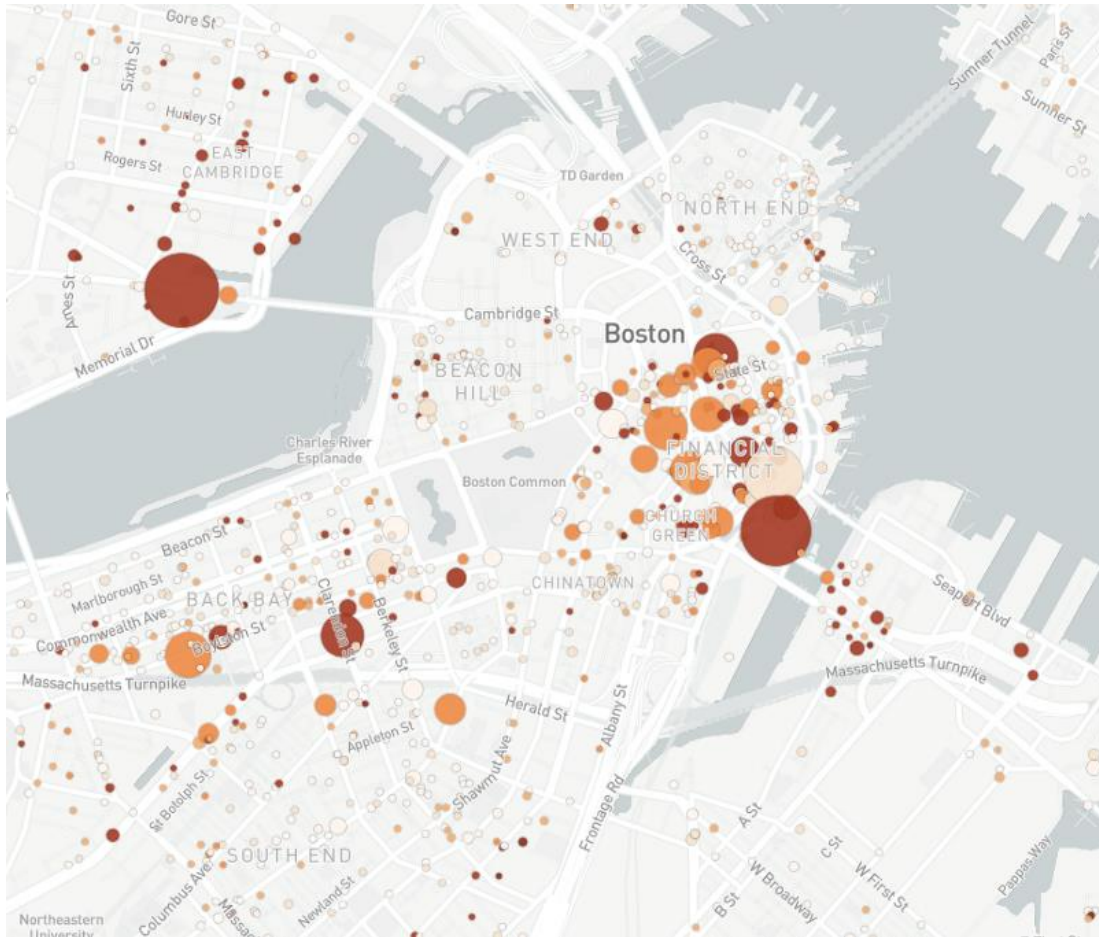
Transposition de la cartographie « classique » ?

Renouvellement de la cartographie ?

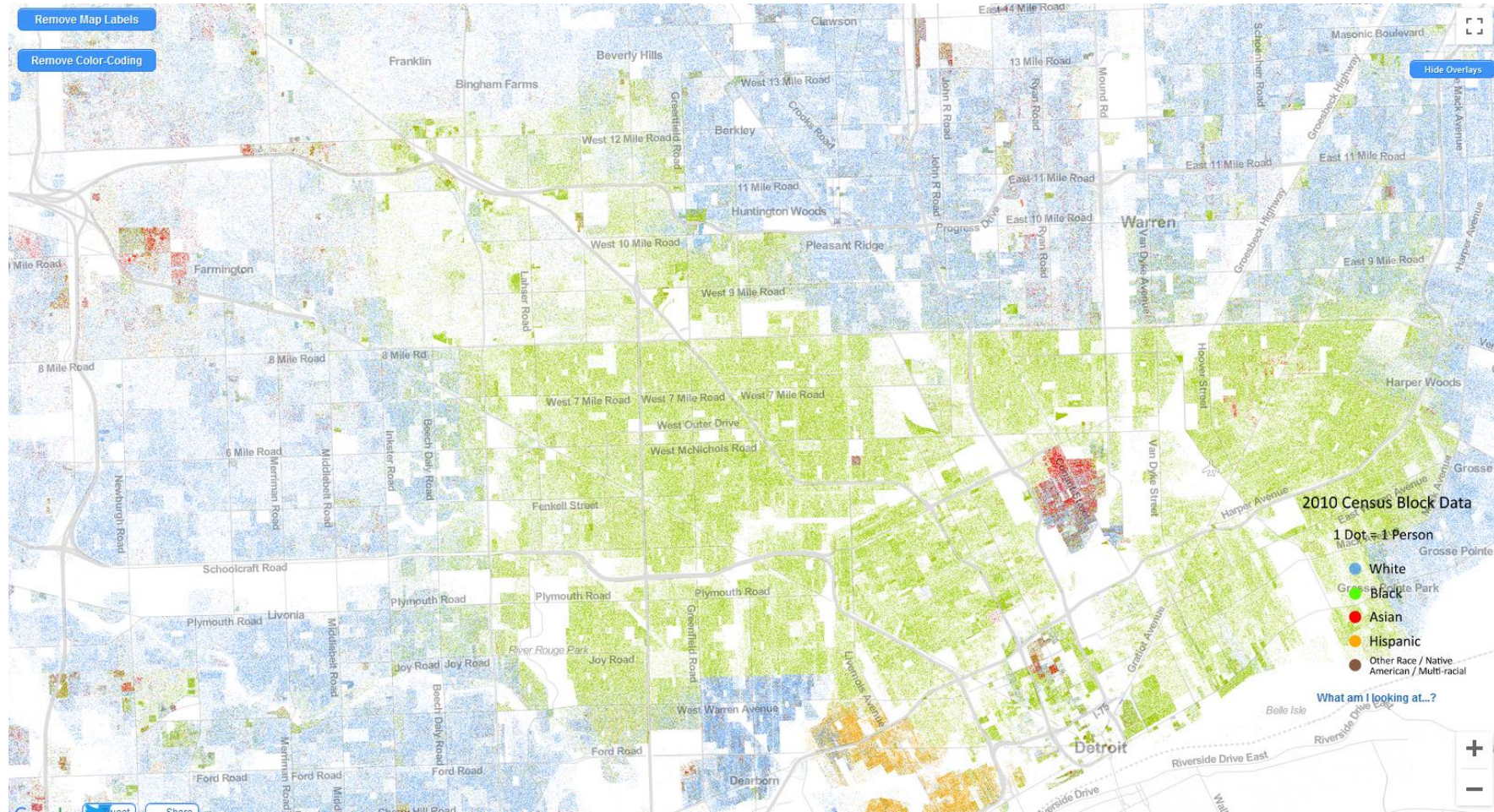
Cartes choroplèthes



Cartes en symboles gradués/proportionnels

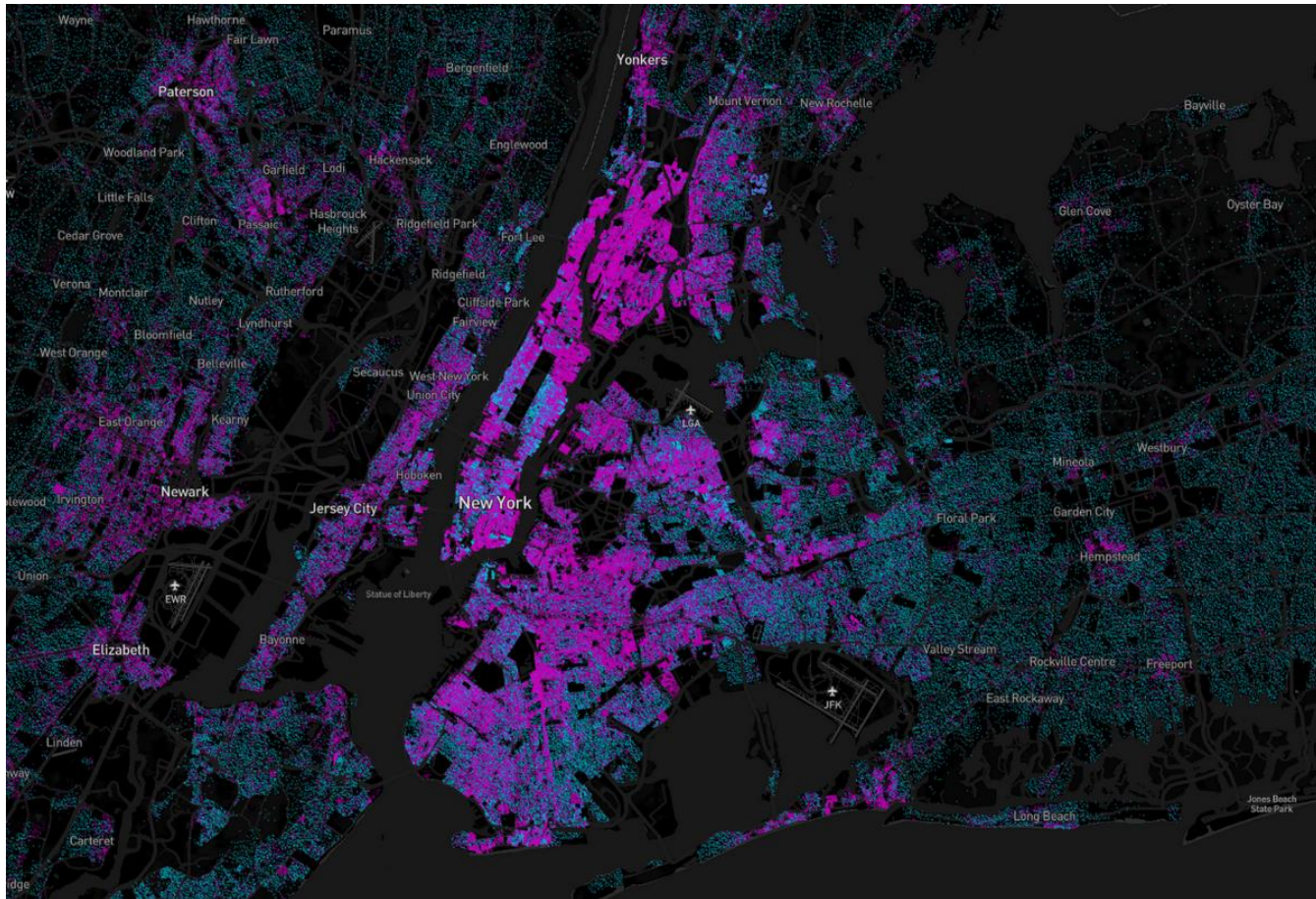


Carte de points

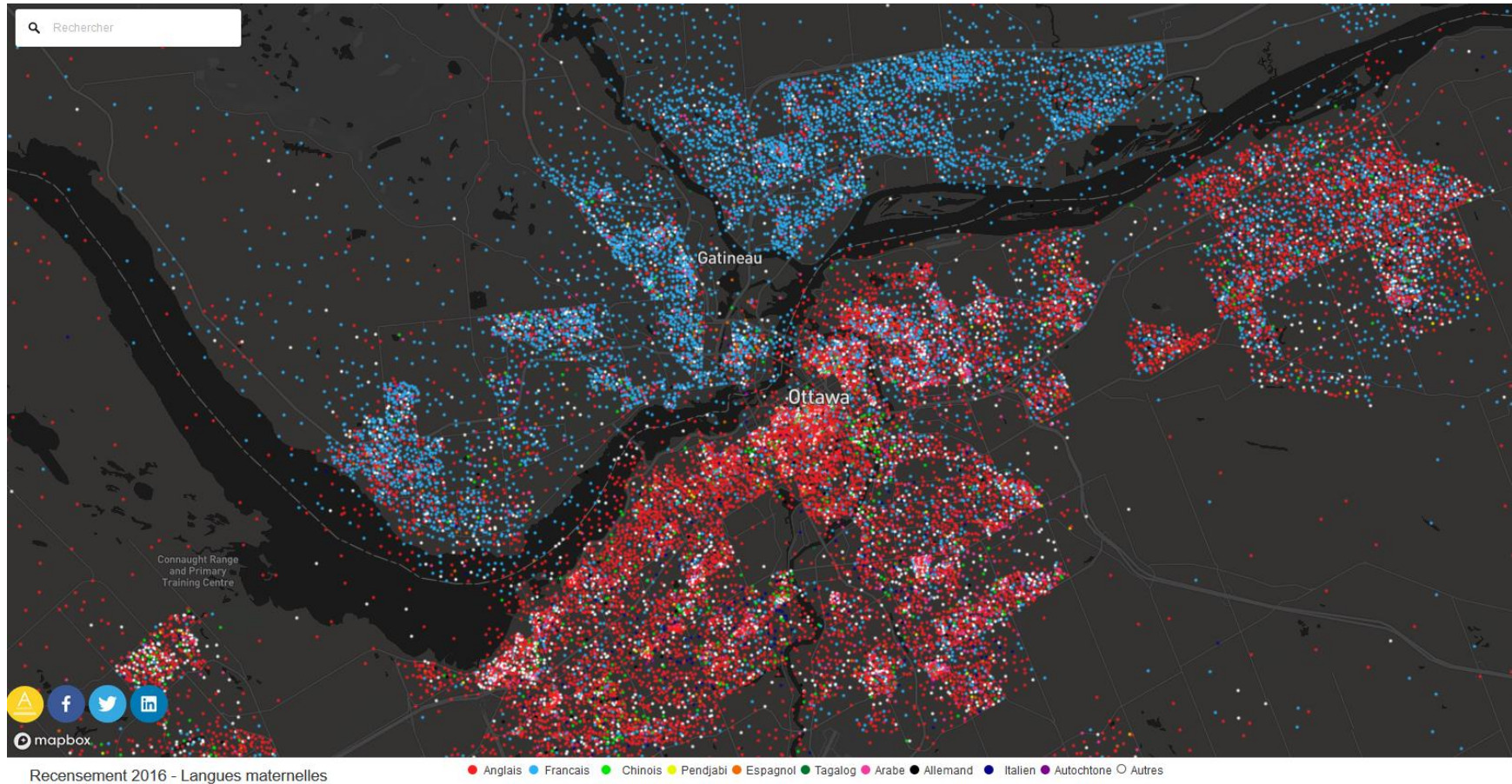


<https://demographics.virginia.edu/DotMap/>

Carte de points



Carte de points



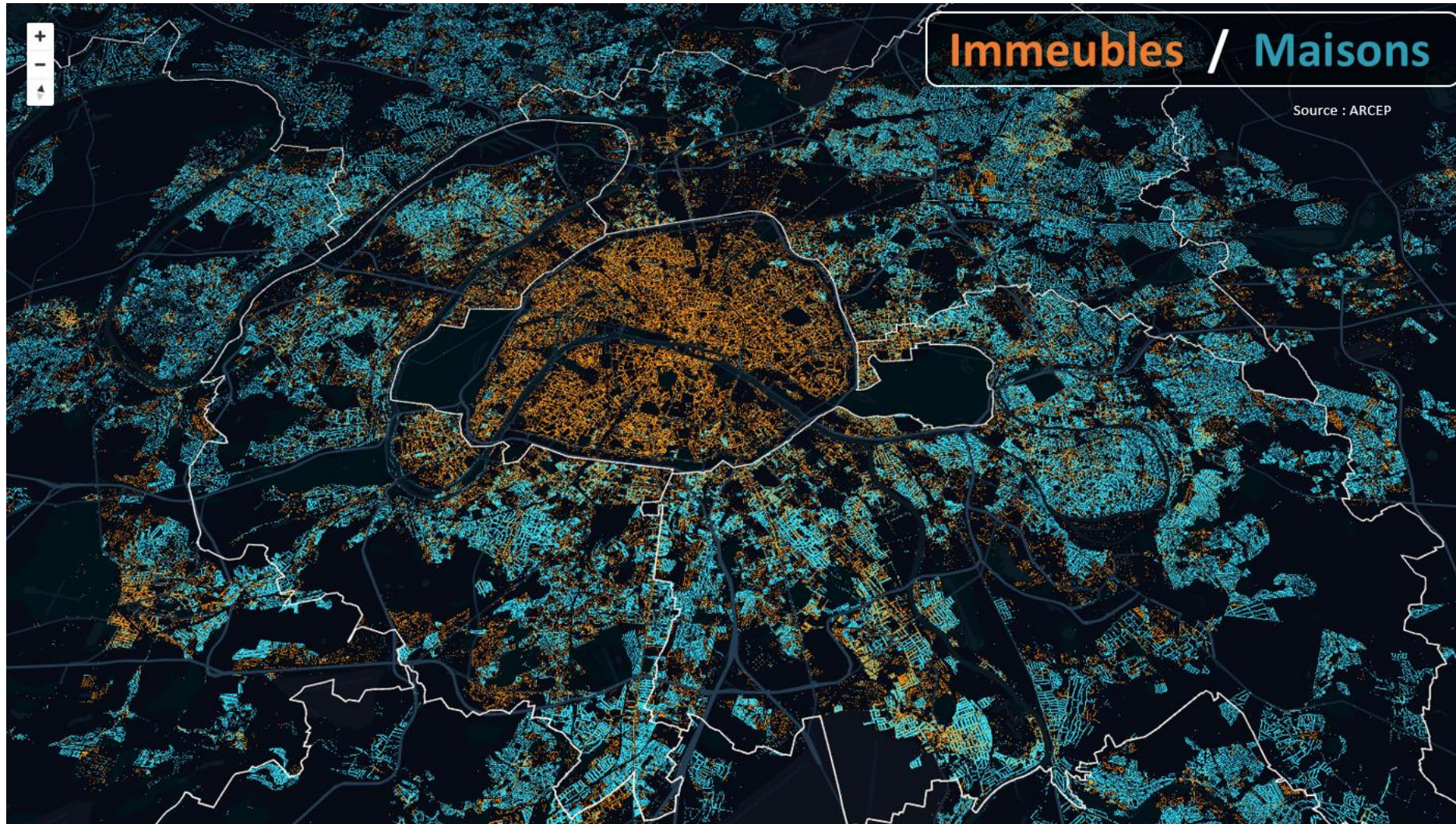
<http://vt.anagraph.io/recensement/languesmaternelles/>

Carte de points

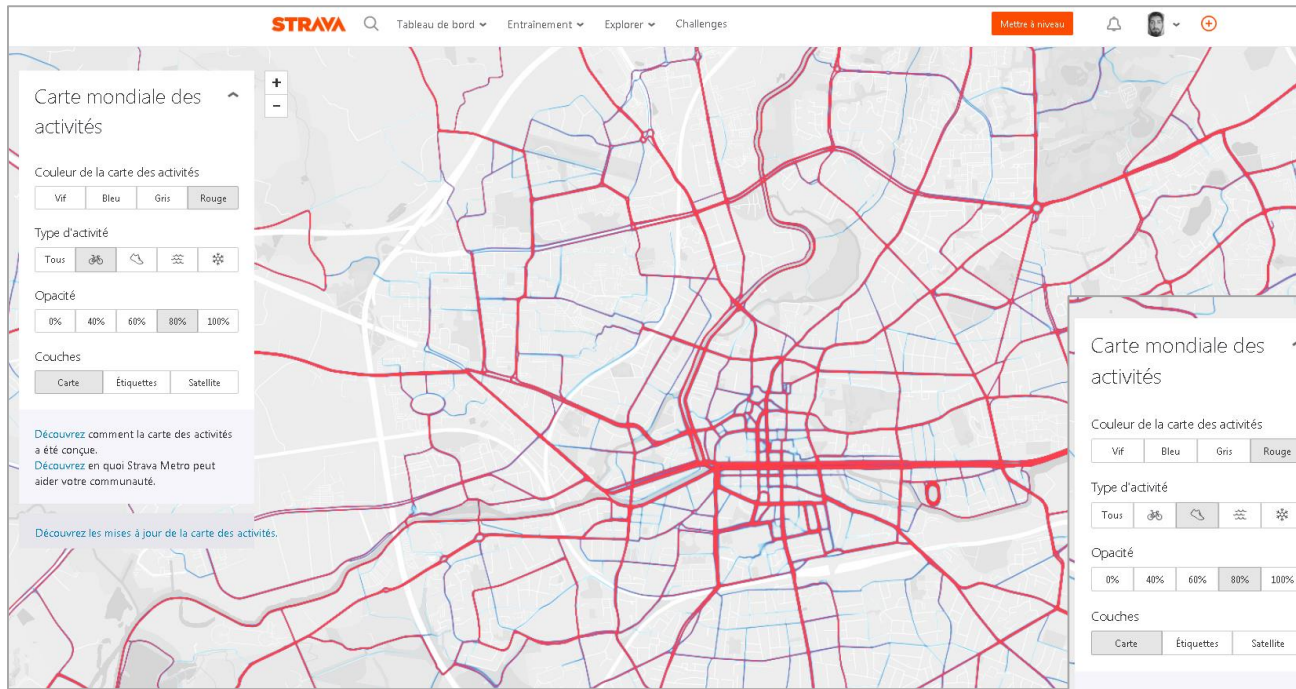


<https://www.mapbox.com/labs/twitter-gnip/brands/#5/38.000/-95.000>

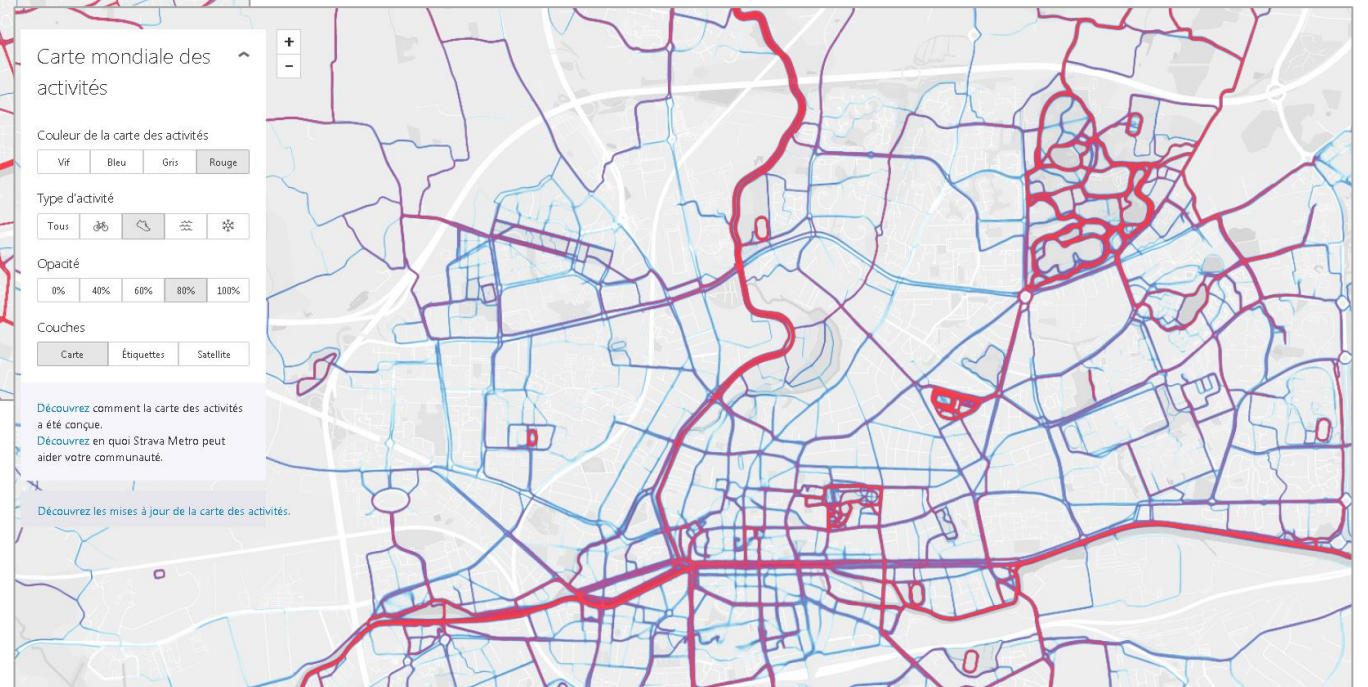
Carte de points



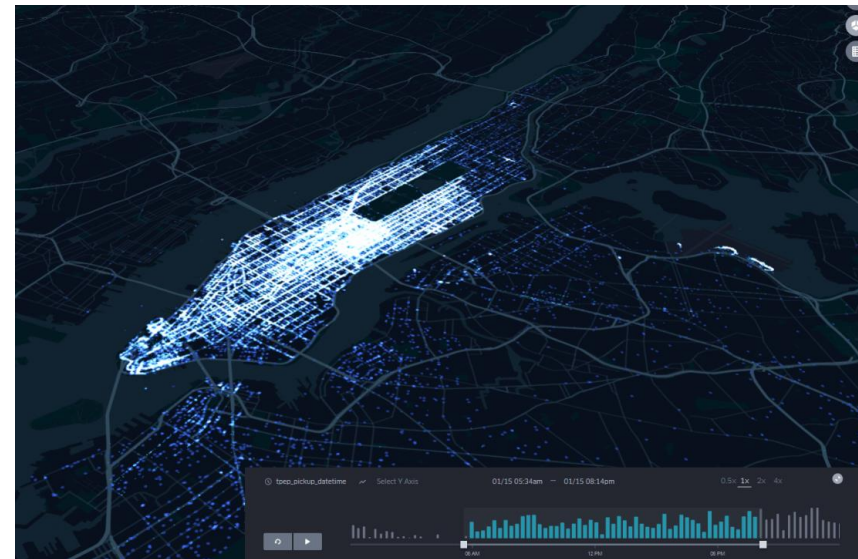
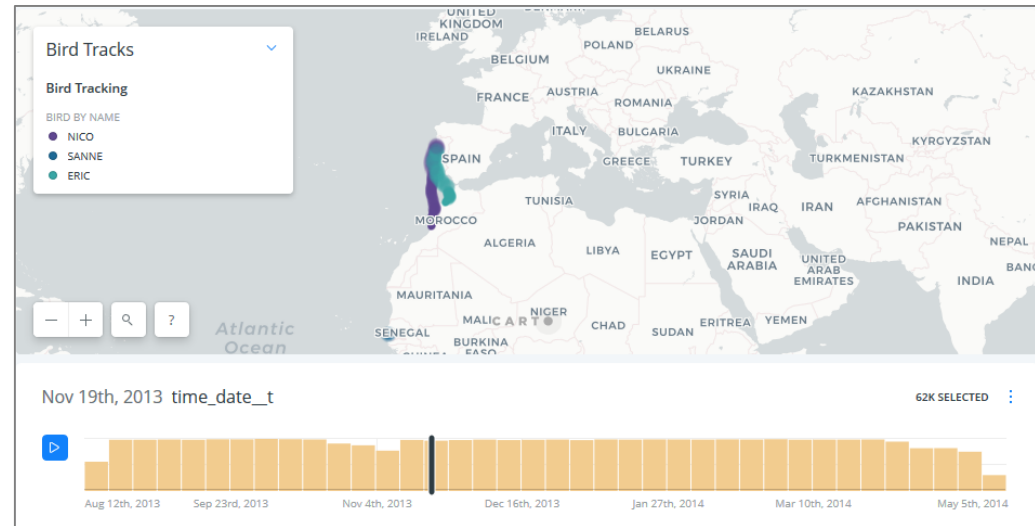
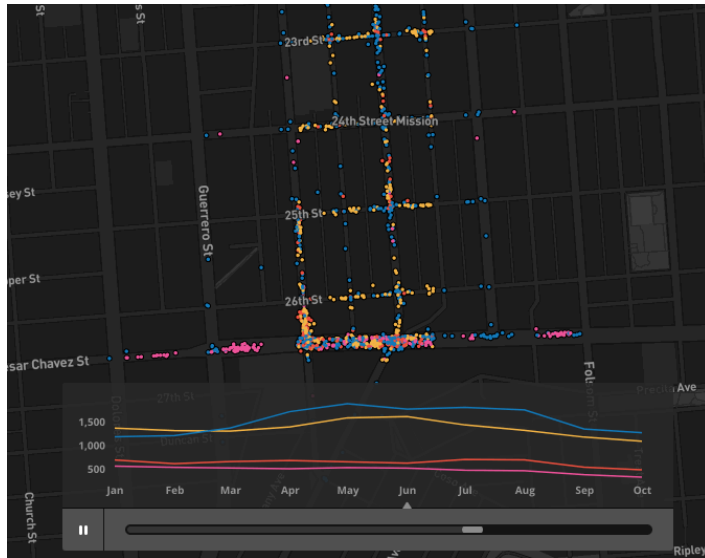
Géovisualiser des traces



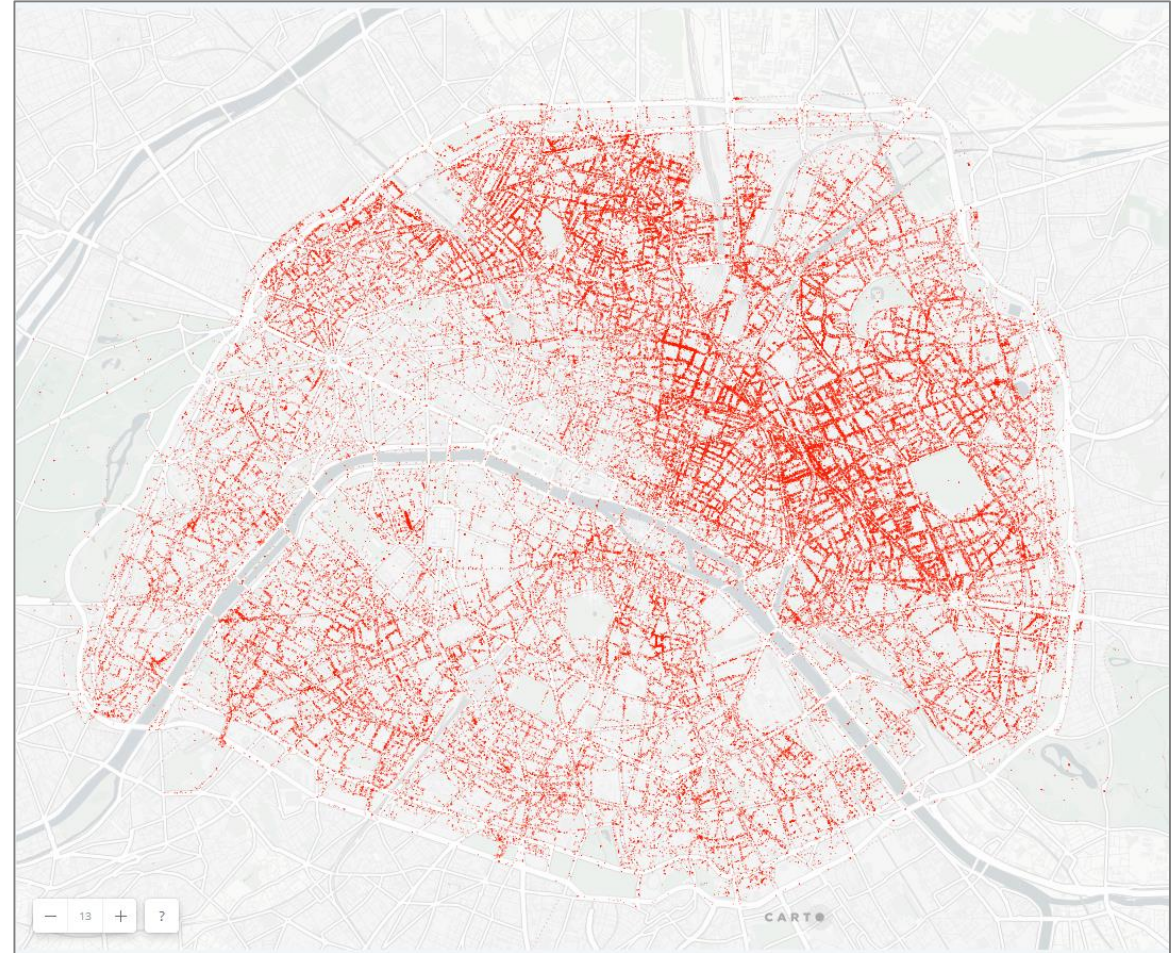
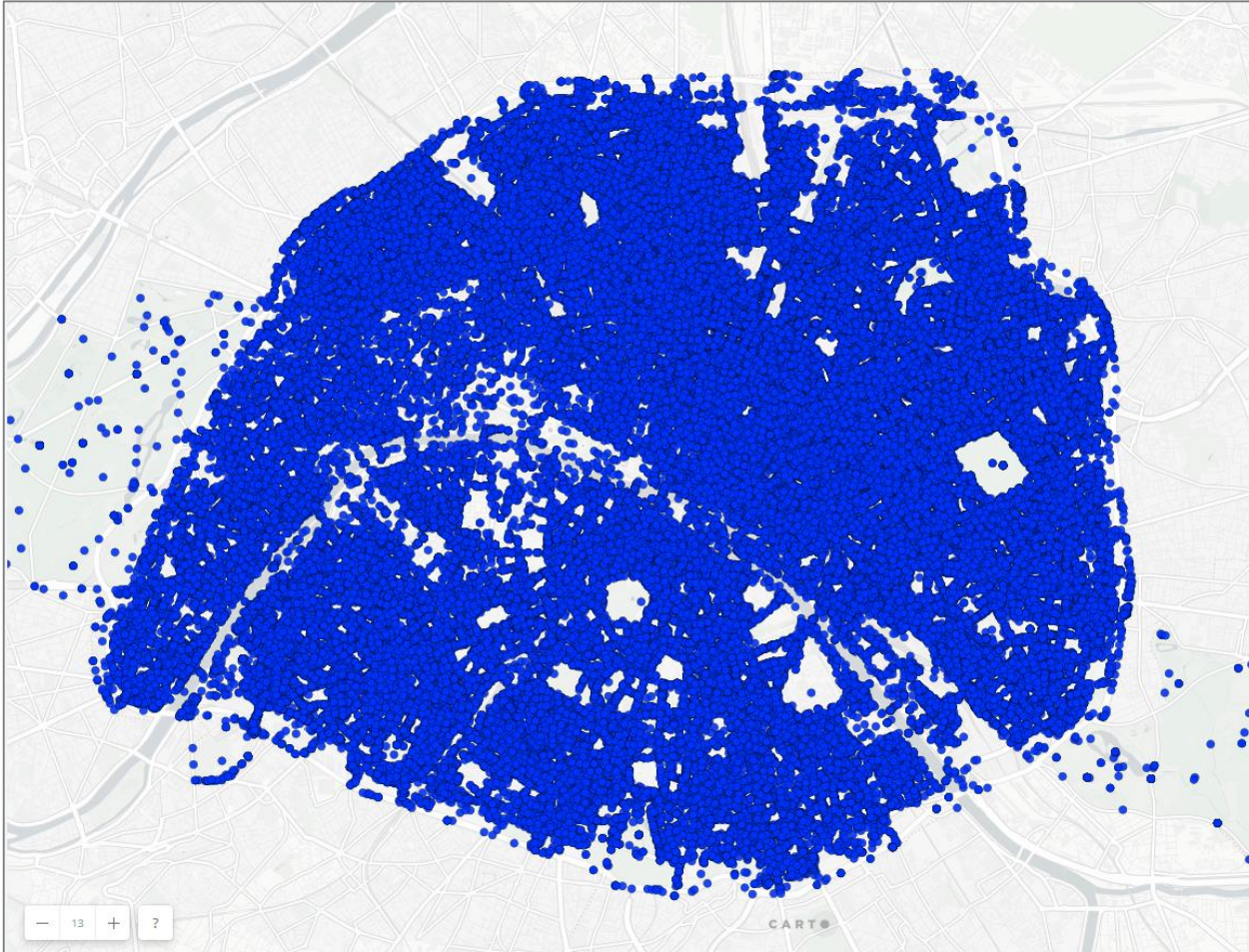
<https://www.strava.com/heatmap>



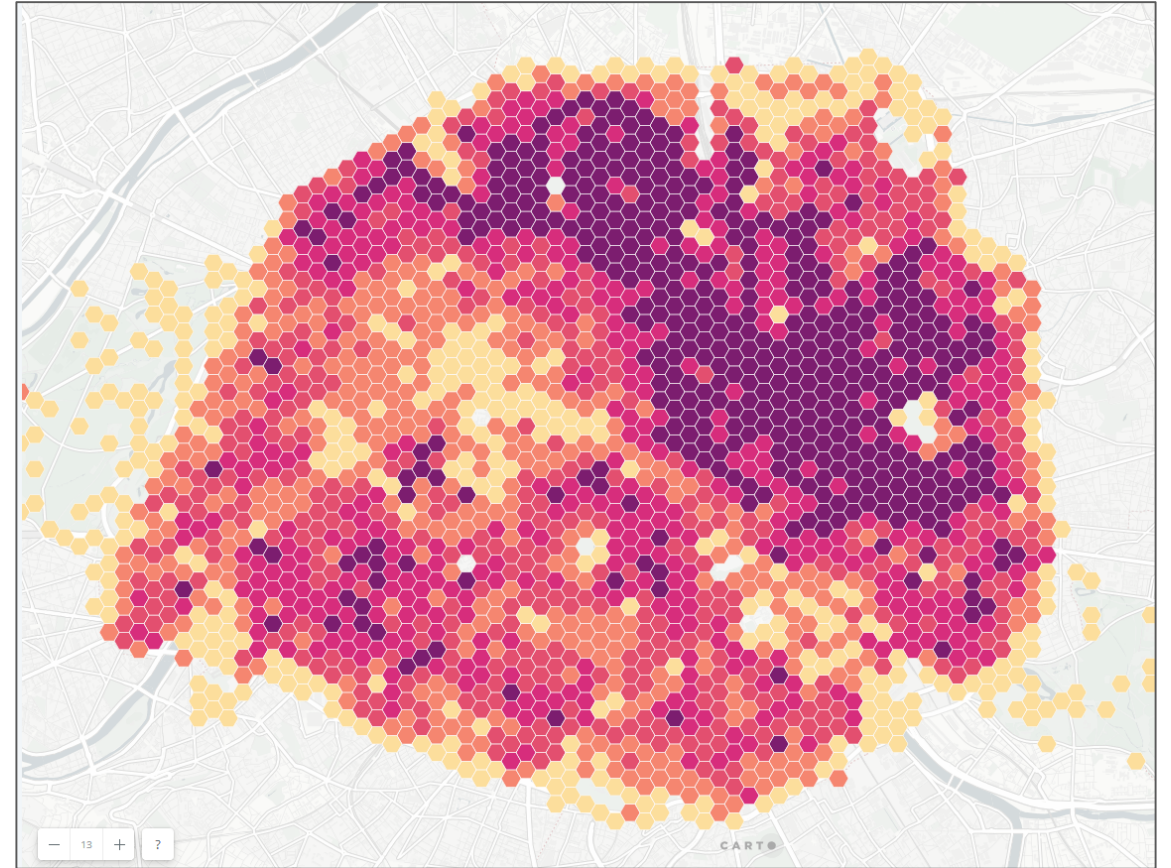
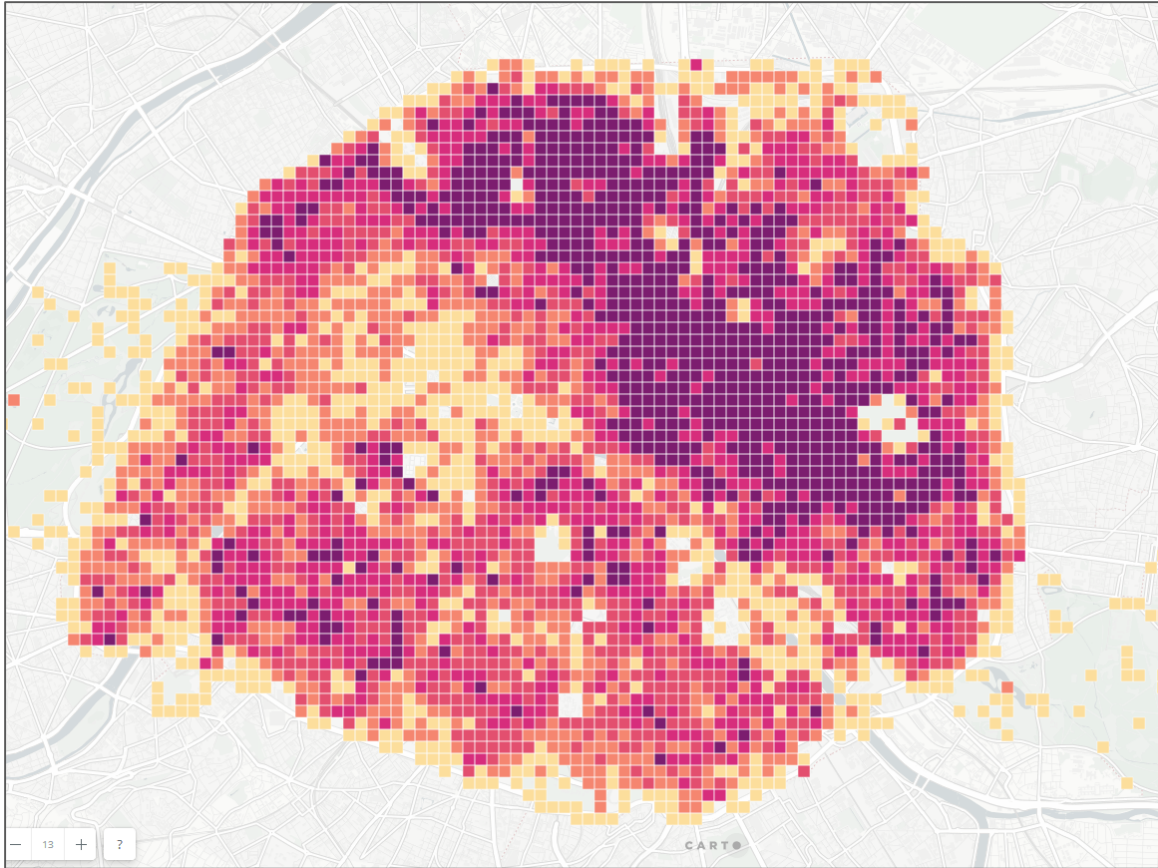
Géovisualiser des données spatio-temporelles

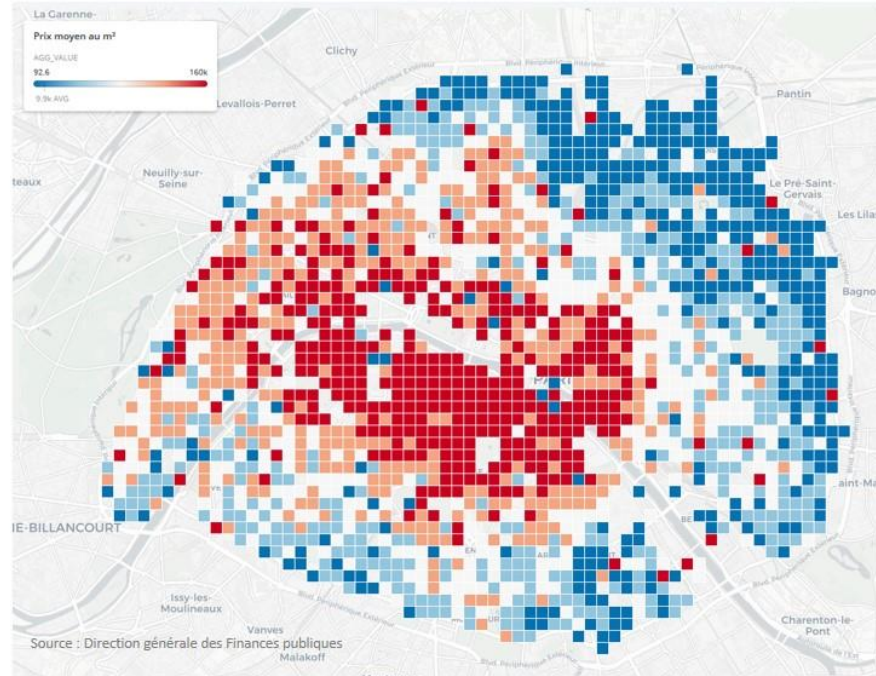
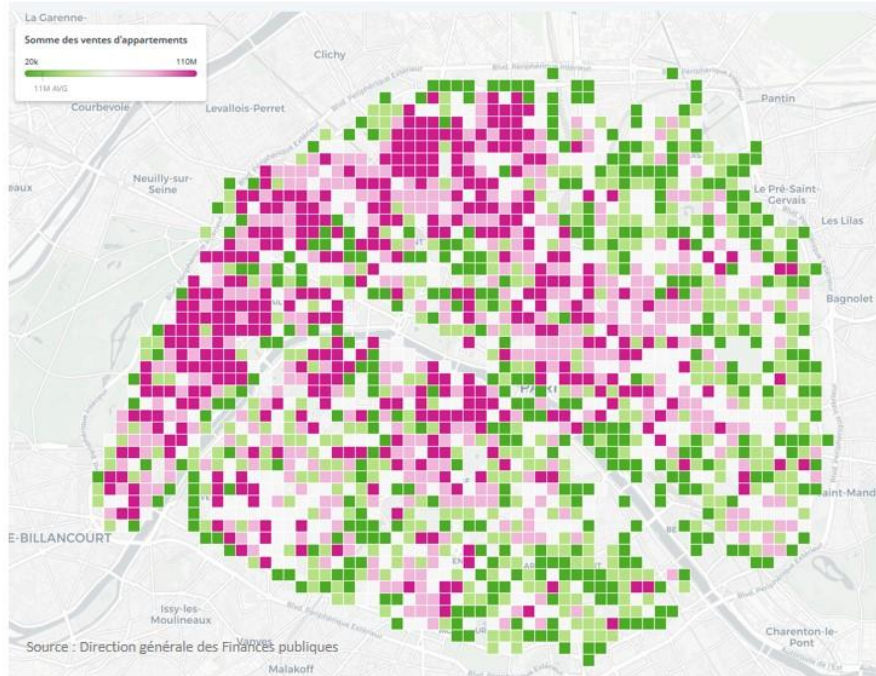
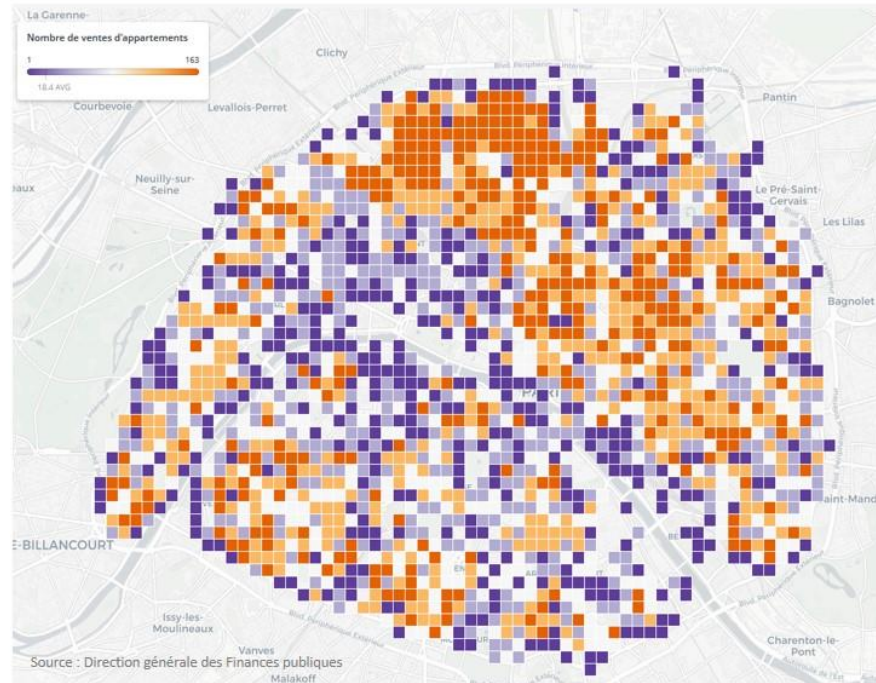
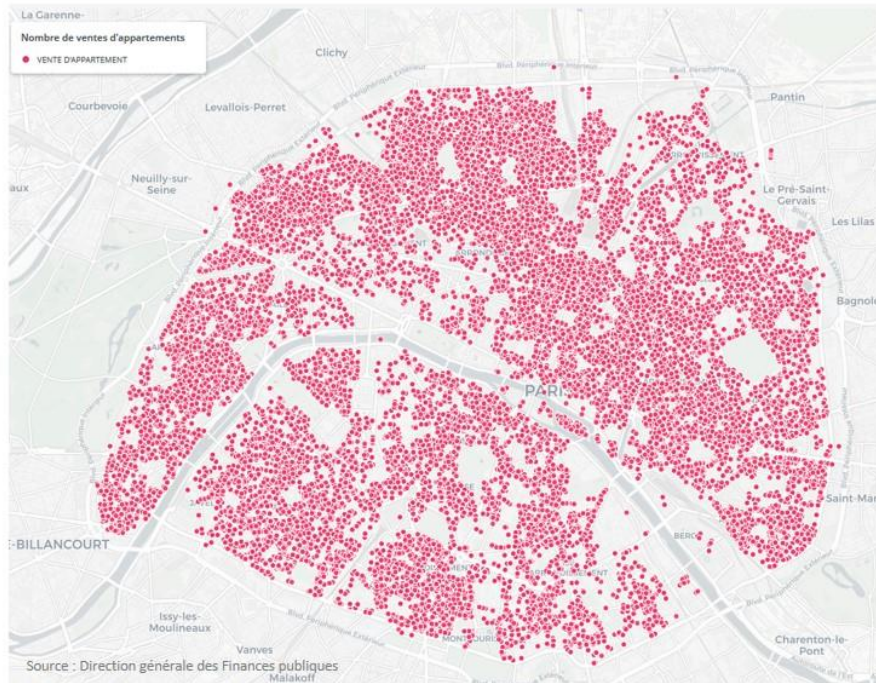


Géovisualiser des données nombreuses

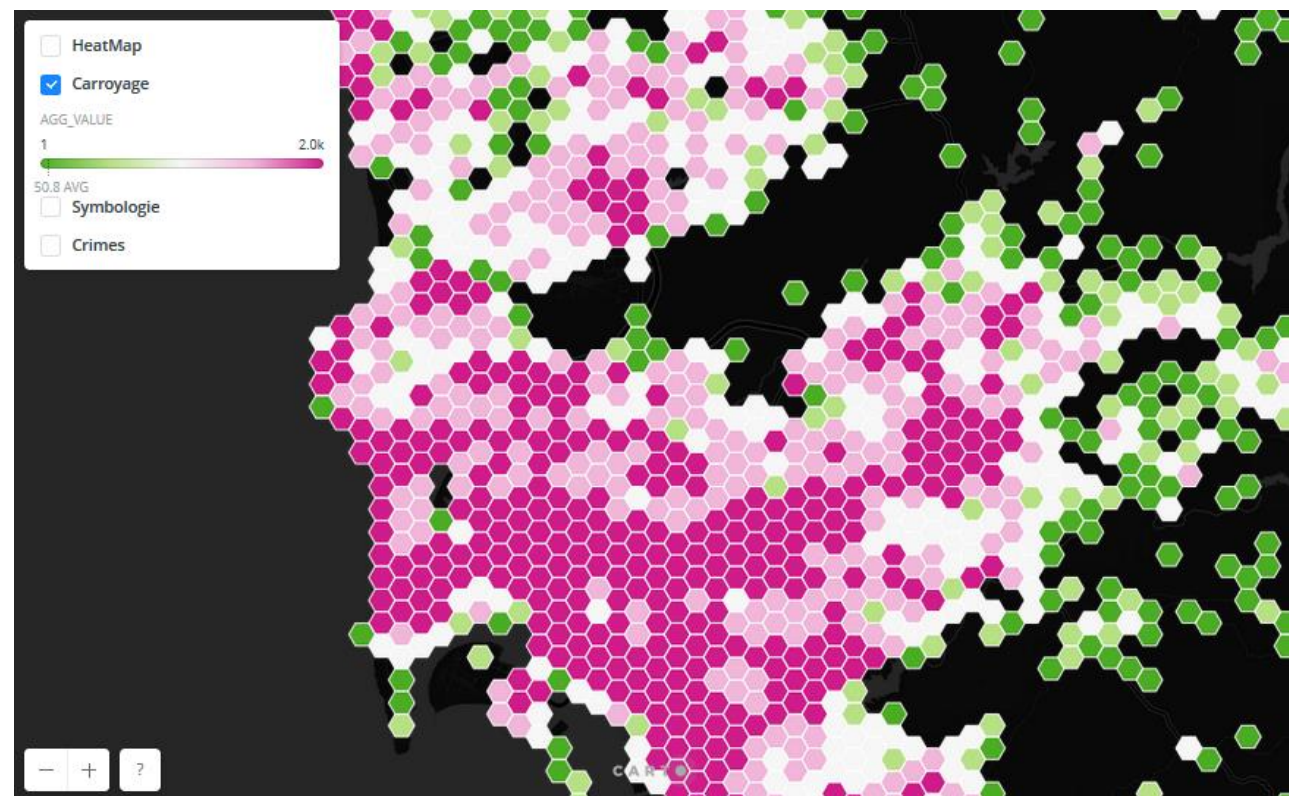
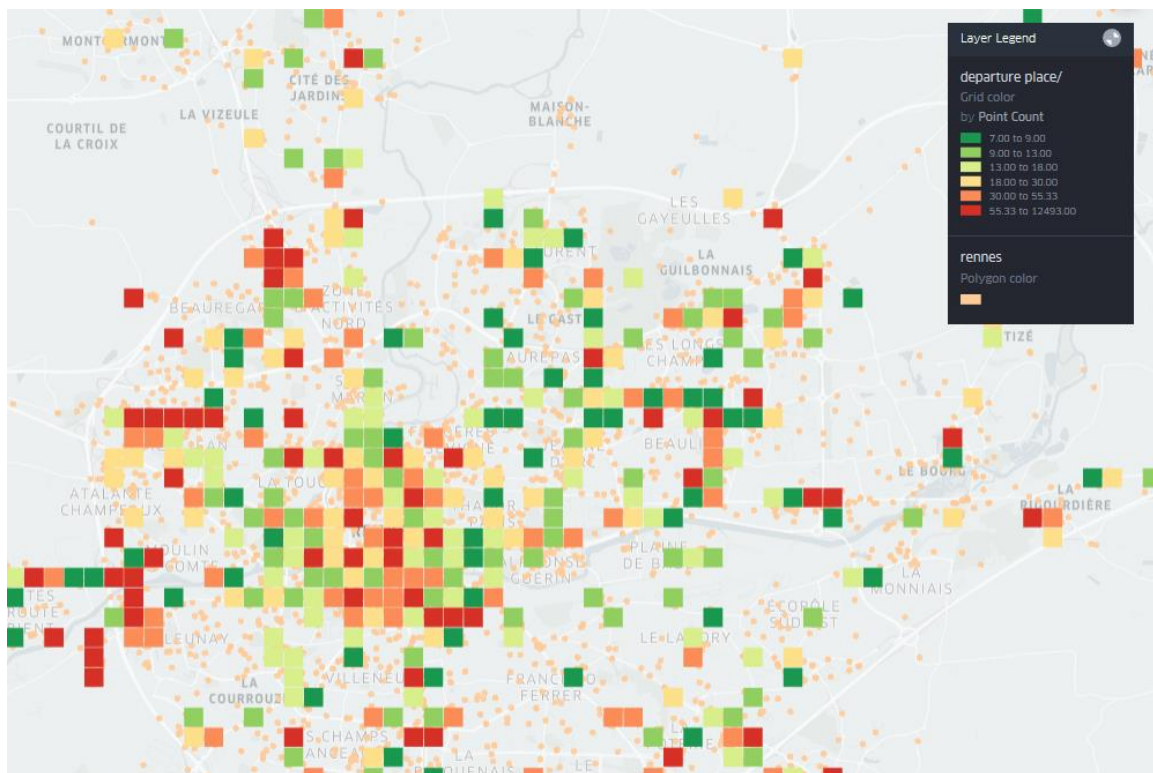


Les cartes agrégatives

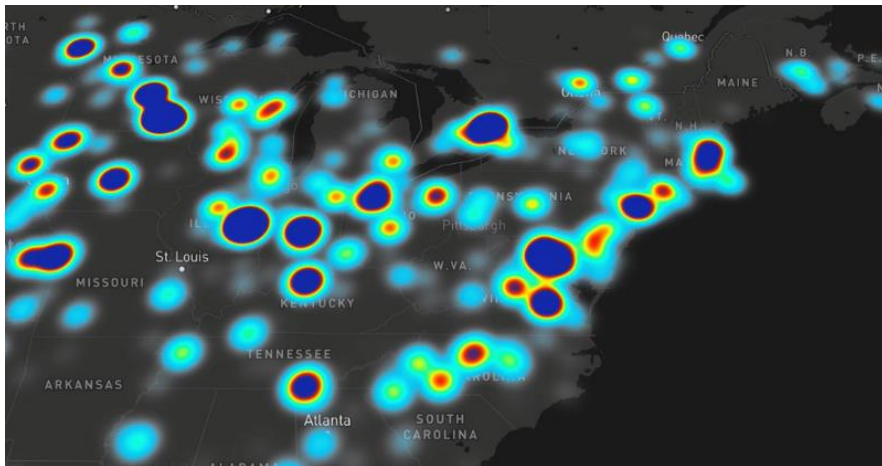
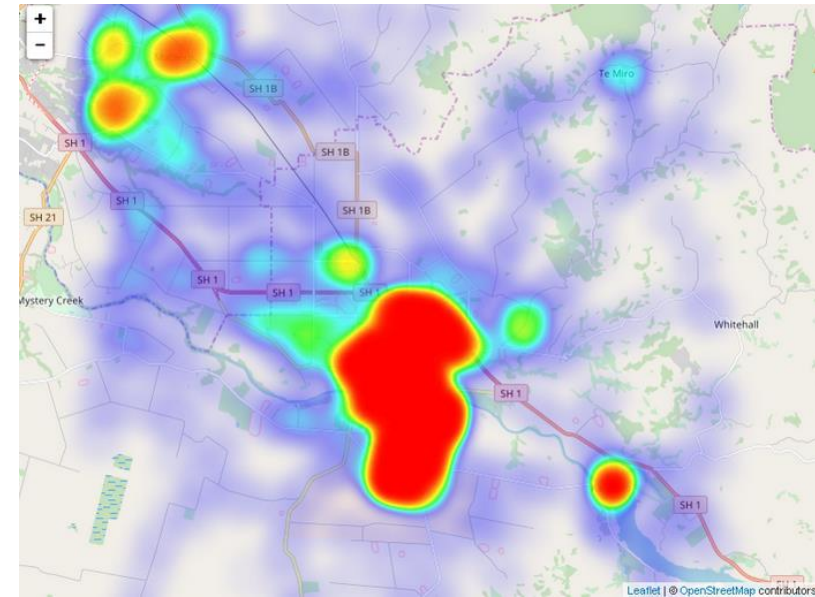
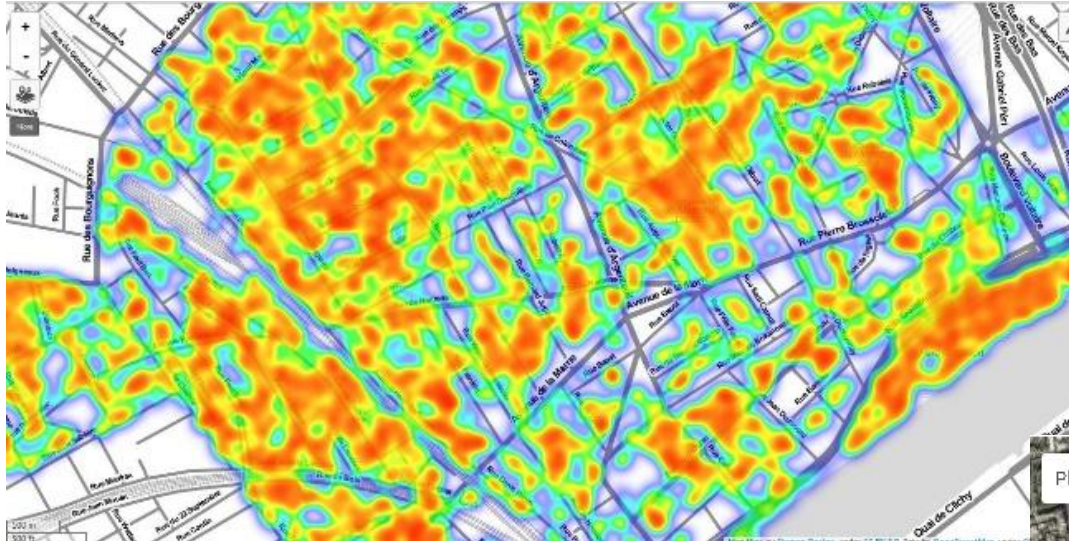




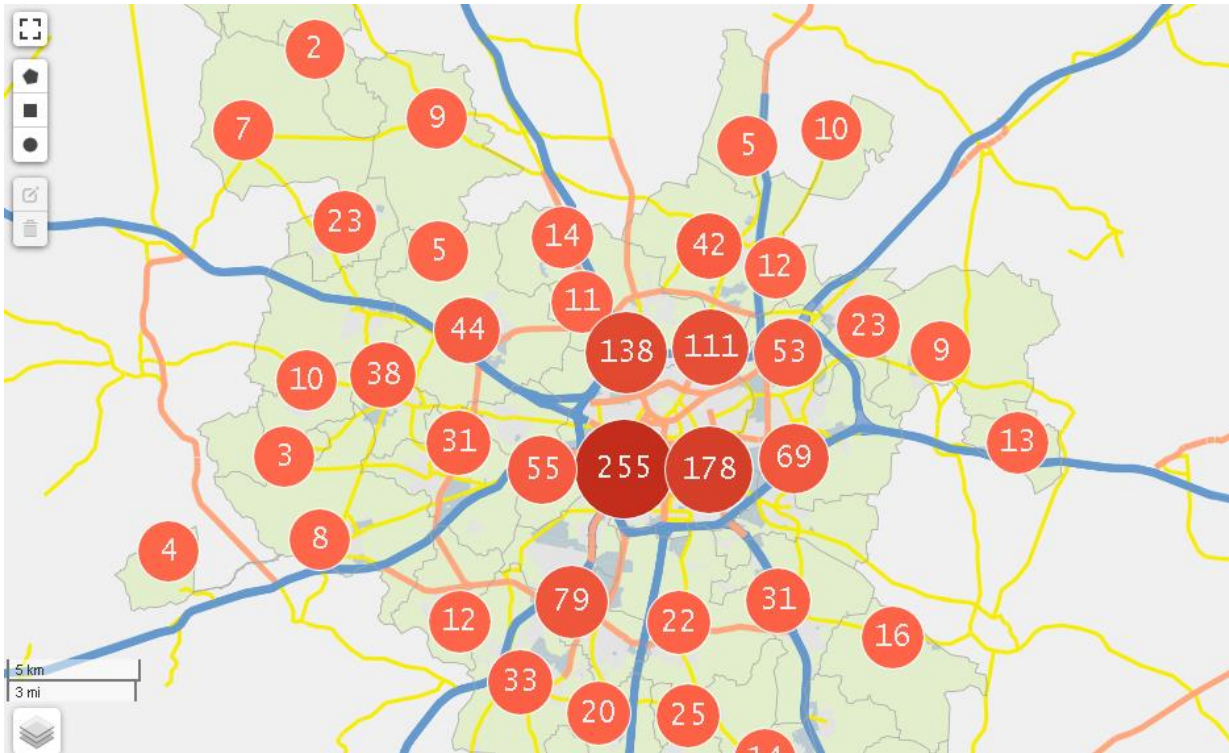
Les cartes agrégatives



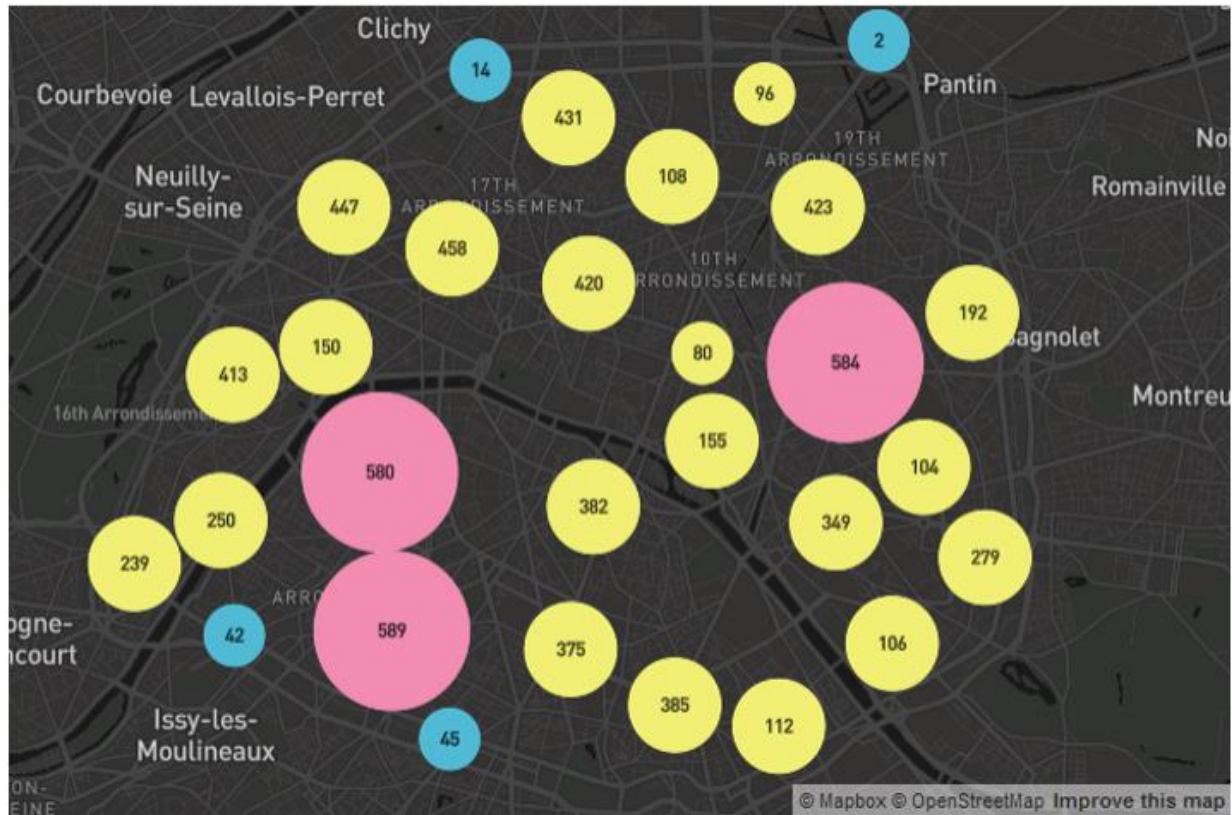
Les cartes de chaleur



Les cartes en clusters



Les cartes en clusters



Animer des données spatiales

Animate a point along a route

Use [Turf](#) to smoothly animate a point along the distance of a line.



<https://www.mapbox.com/mapbox-gl-js/example/animate-a-line/>

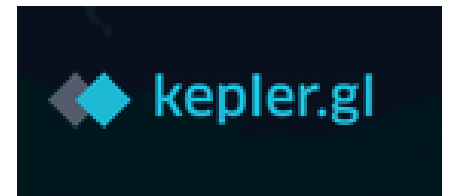
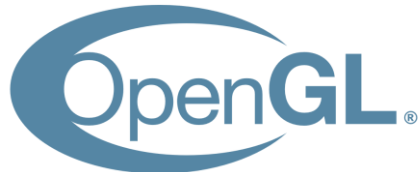
<https://www.mapbox.com/mapbox-gl-js/example/animate-point-along-line/>

<https://www.mapbox.com/mapbox-gl-js/example/animate-point-along-route/>

<https://www.mapbox.com/mapbox-gl-js/example/dancing-buildings/>

Nouvelles formes de géovisualisation

- Du WebGL dans les cartes en ligne
 - Le WebGL permet de tirer partie de la puissance graphique de la machine cliente afin de pouvoir afficher de façon fluide des éléments complexes
 - Déléguer des rendus complexes au client et non plus au serveur ce qui allège donc considérablement sa charge et offre d'autres avantages
 - Afficher des scènes tridimensionnelles complexes à partir de simples primitives géométriques
 - Rotation et inclinaison des cartes



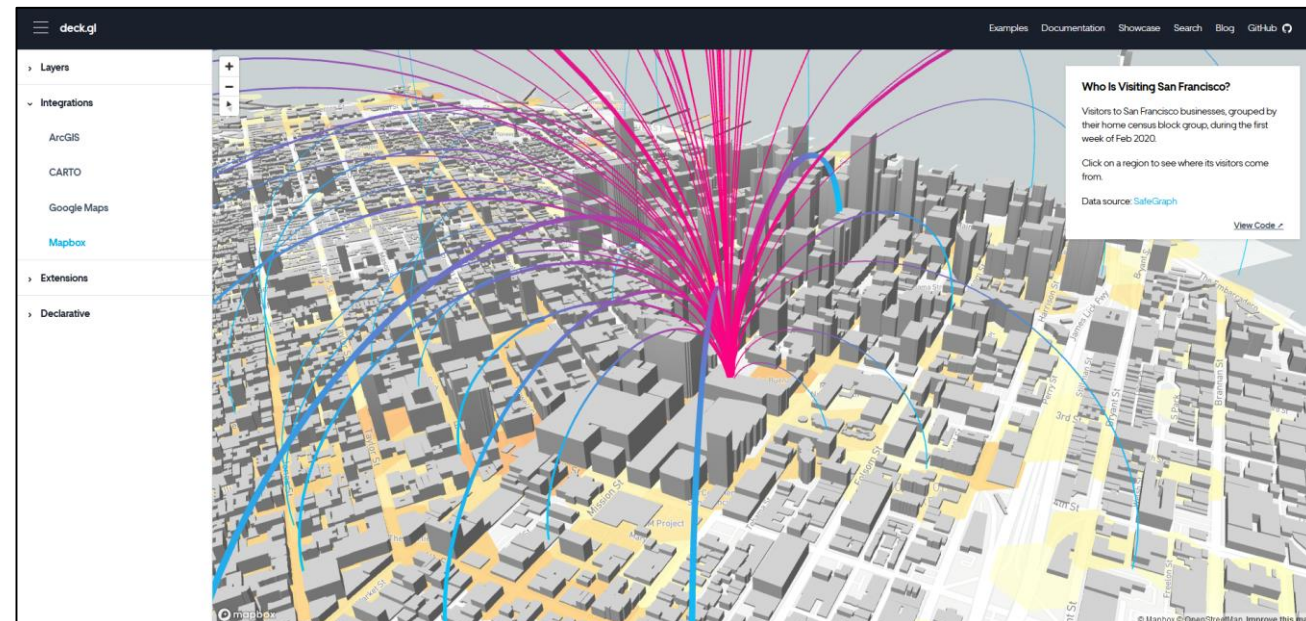
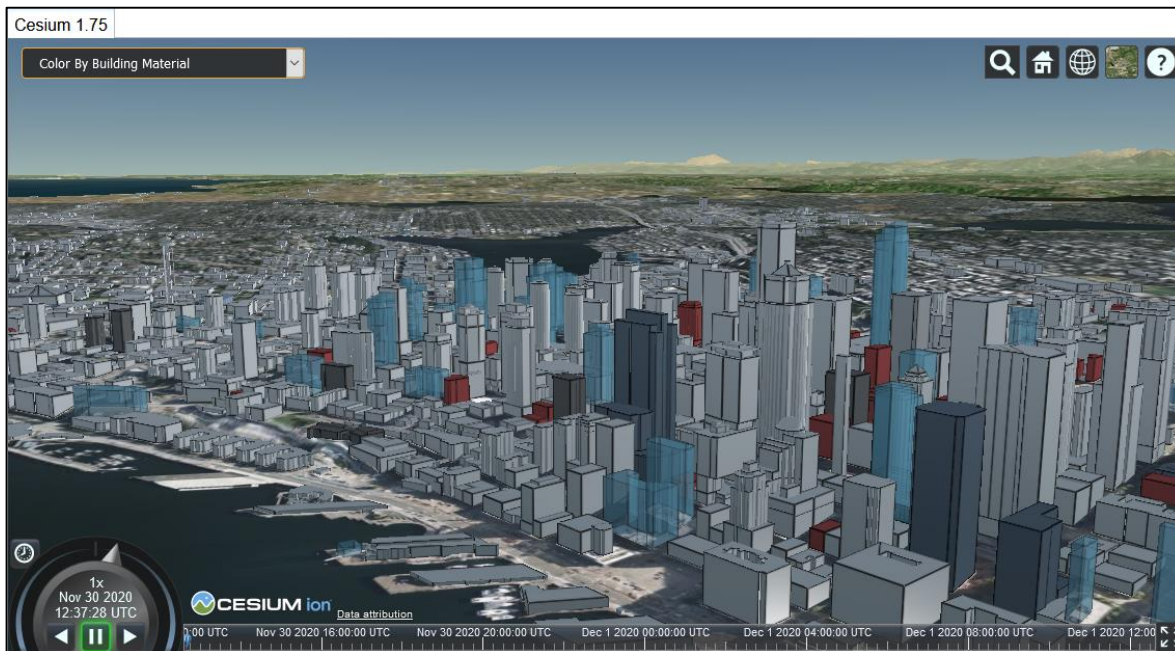
Google Maps comme précurseur

- Google a été l'un des premiers à se saisir des potentialités de cette innovation technique pour la cartographie en ligne
 - Dès 2010, le service Google Maps a intégré ces nouvelles spécifications pour de meilleures performances d'affichage, des graphismes en 3D plus précis, des transitions plus fluides et la possibilité d'incliner et de changer d'orientation



Les outils du WebGL carto

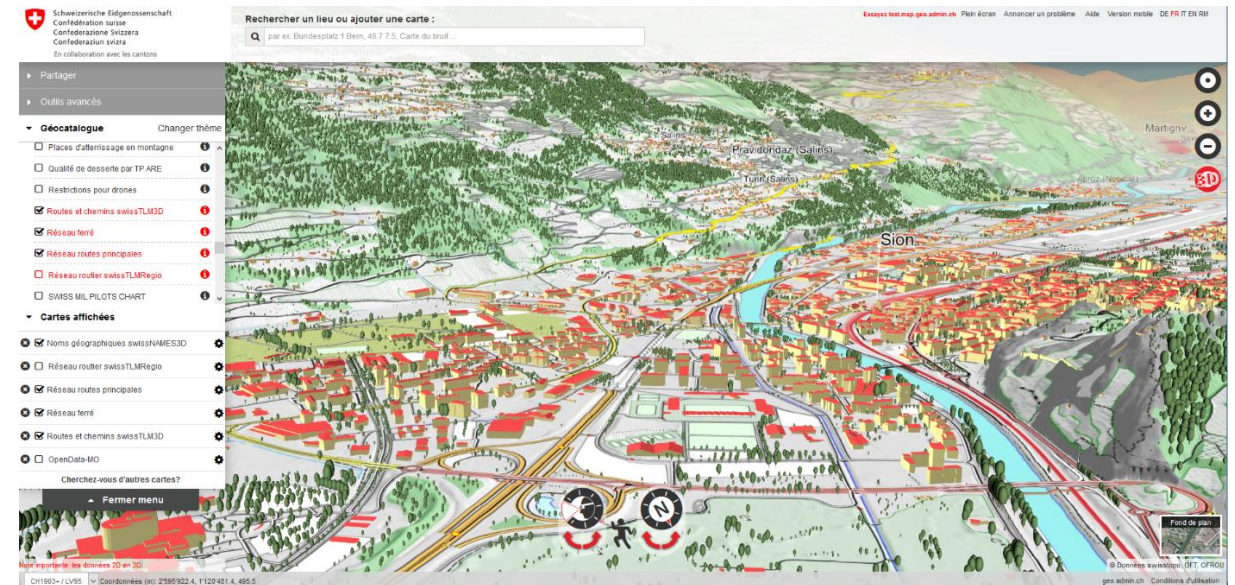
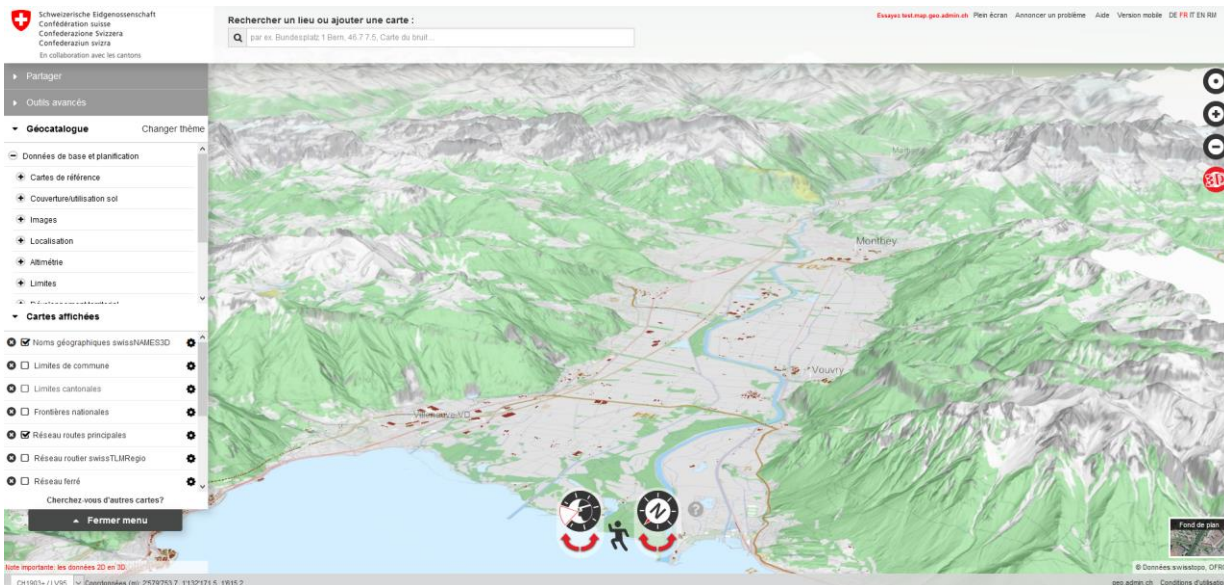
- Bibliothèques JavaScript dédiées à la cartographie en WebGL
 - « Vraie 3D » > [Cesium](#), [iTowns](#) (IGN)
 - « 2.5 D » > [ArcGIS API for JavaScript](#) (ESRI), [MapboxGL](#) (Mapbox), [DeckGL](#) (Uber), [harp.gl](#) (HERE)



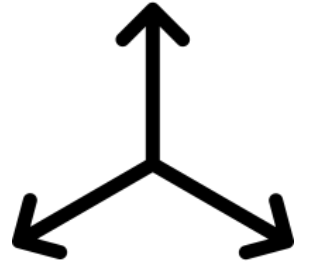
Le géoportail suisse comme démonstrateur

<https://map.geo.admin.ch/?lang=fr>

- Géoportail basé sur les tuiles vectorielles et le Web pour le rendu 3D
 - Plus de 80 millions d'objets vectoriels en 3D (bâtiments, arbres, ponts, POI,...)
 - Géoservices 3D basés sur différentes standards (OGC, Cesium3DTiles, ESRI)
 - Un visualiseur carto 3D unique, impressionnant mais lent...



Quels impacts sur la cartographie ?



- De nouvelles formes de représentation des données spatiales, qui font appel à des capacités d'interprétation différentes de celles des cartes en deux dimensions
 - Orientation, inclinaison, animation, extrusion,...
 - Possibilités d'extrusion 3D de données diversifiées (bâtiments, statistiques, flux) qui autorisent de nouvelles formes de géovisualisation pour l'exploration de données territoriales et l'analyse de phénomènes socio-spatiaux
- Appliquer des modes de représentation en 3D à des données en 2D
- Repenser la cartographie thématique en ligne en intégrant de la 3D !

Représenter les bâtiments

<https://demo.f4map.com/#lat=48.1197132&lon=-1.7040502&zoom=18&camera.theta=60.756&camera.phi=36.956>



<https://sites-formation.univ-rennes2.fr/mastersigat/WebMaps/Parisbati.html>



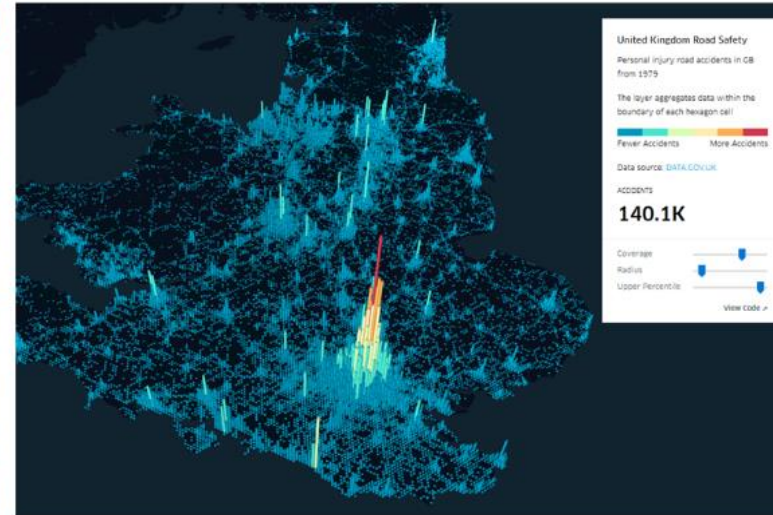
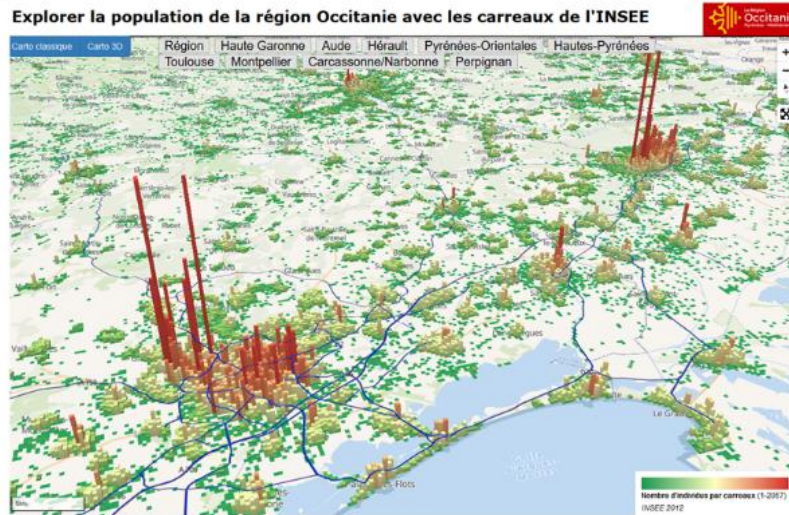
<http://www-personal.umich.edu/~yonghah/rooms3d/>



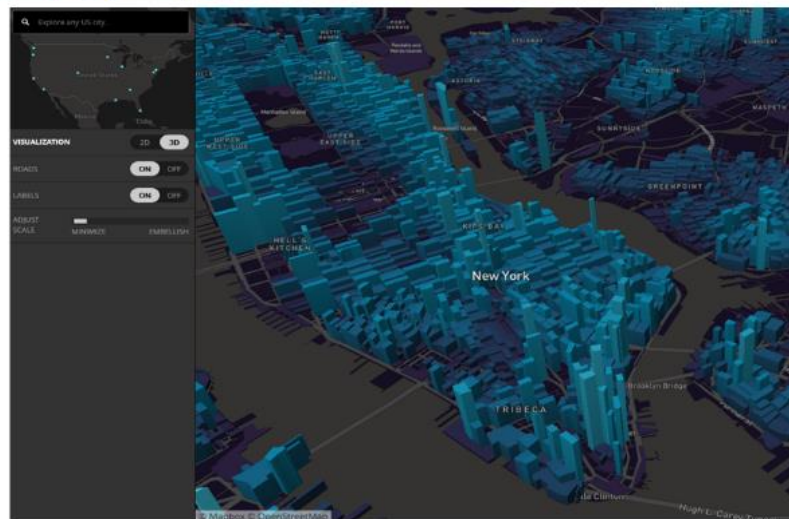
<http://maps.nicholsonroad.com/zones/>

Cartographie thématique

https://sites-formations.univ-rennes2.fr/mastersigat/WebMaps/Extrusion_Occitanie.html



<https://deck.gl/examples/hexagon-layer/>



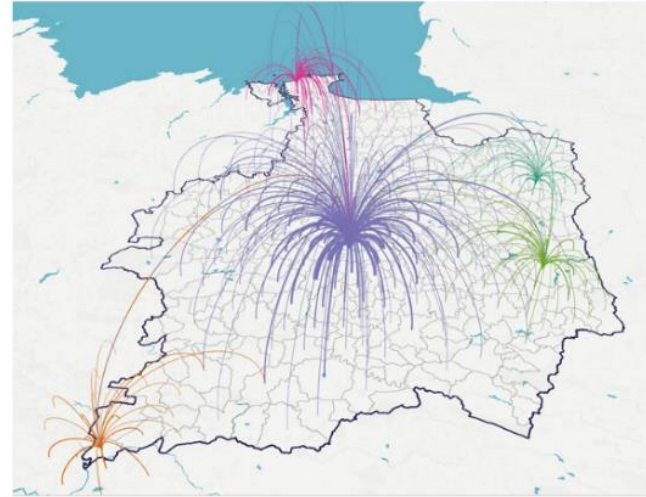
<https://labs.mapbox.com/bites/00273/>



<https://ovrdc.github.io/gis-tutorials/mapbox/05-2-choropleth/#4/39.94/-95.52>

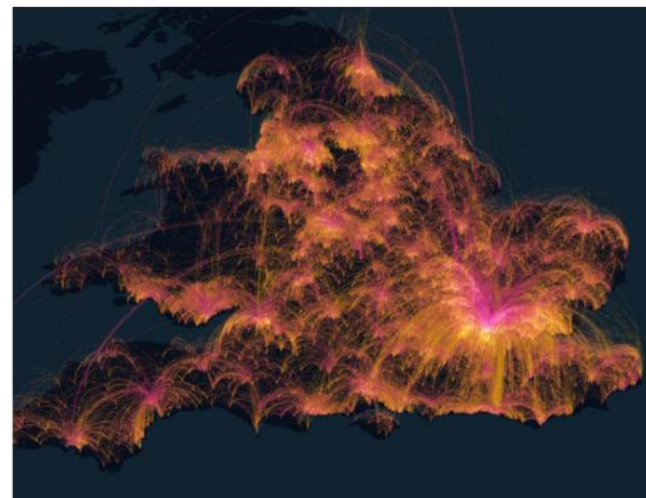
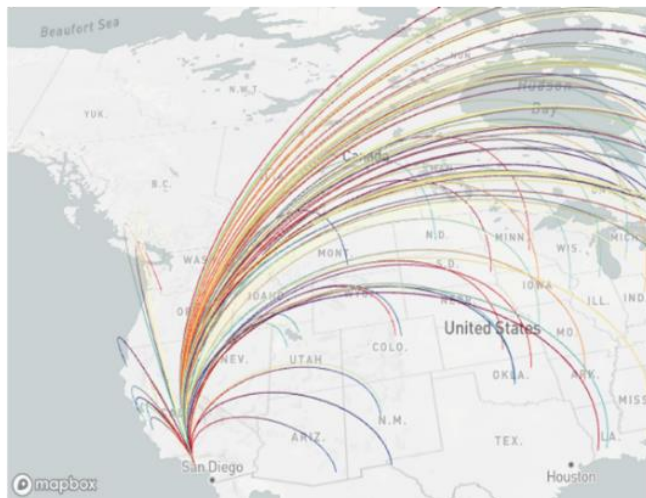
Représenter les flux autrement

<https://flourish.studio/2018/11/16/a-rc-map-webgl/>



https://sites-formations.univ-rennes2.fr/mastersigat/WebMaps/Mobilites_Quotidiennes_35_GL.html

<https://deck.gl/examples/arc-layer/>




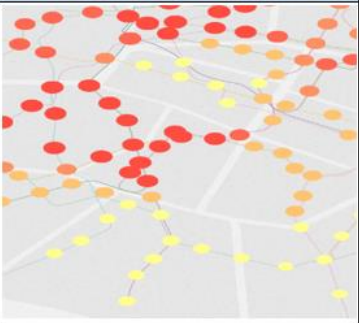
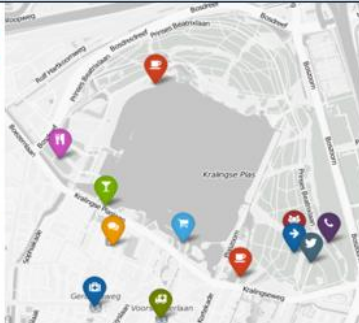
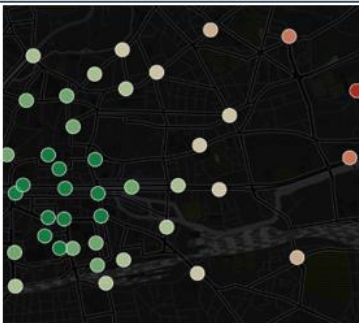




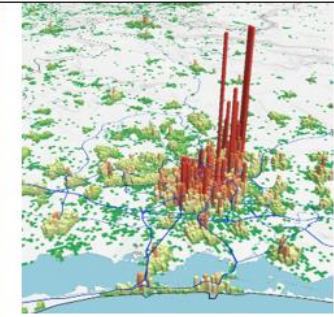
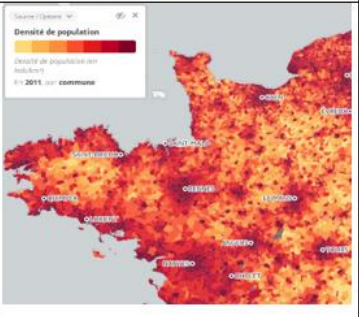
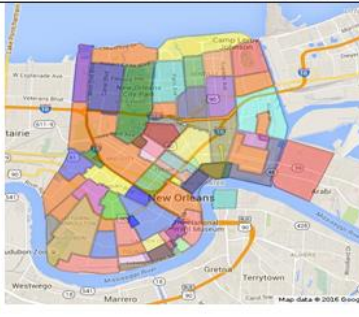

<https://deck.gl/examples/brushing-extension/>

Extruder des lignes



<https://www.mapbox.com/bites/00372/>

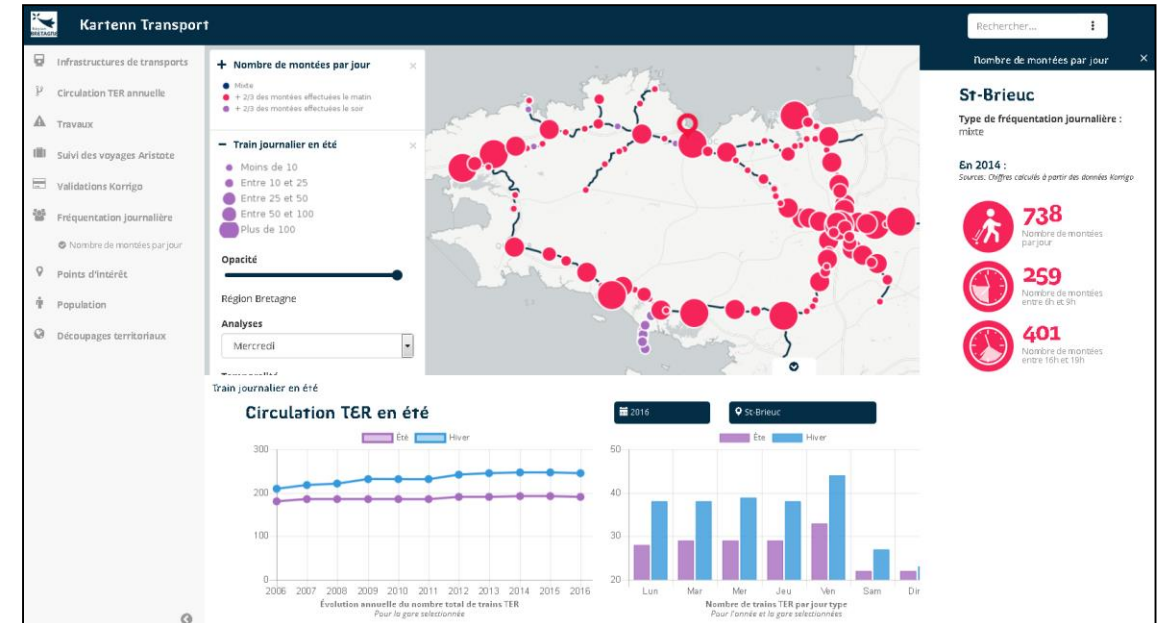
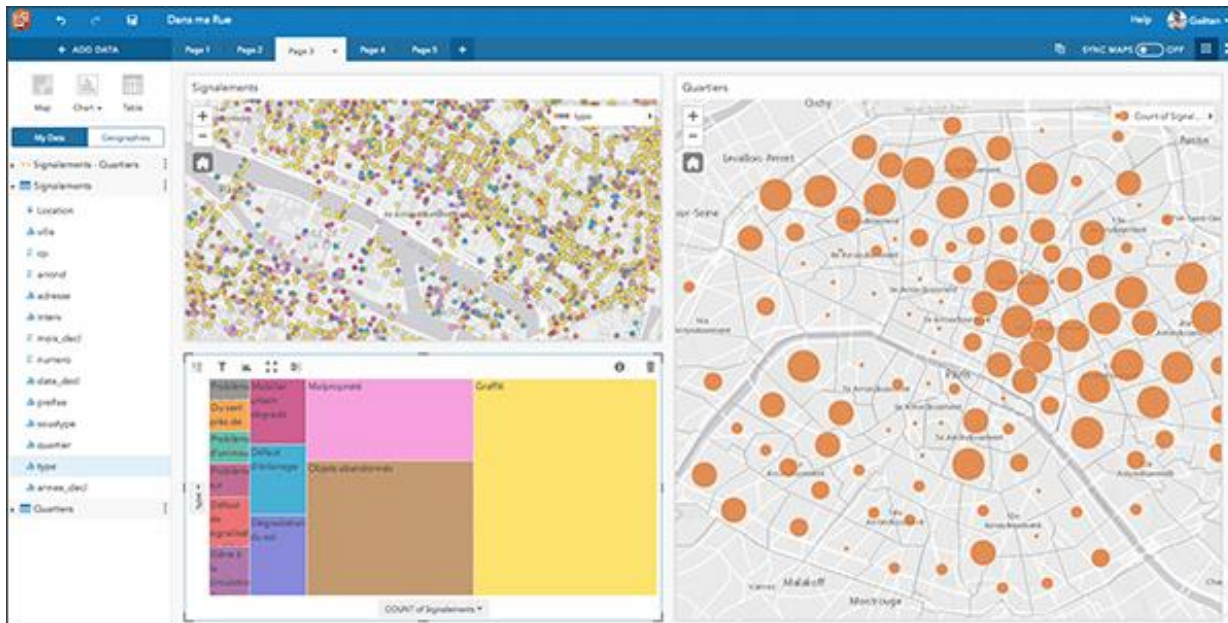
Nouveau régime cartographique ?

	Quantitatives		Qualitatives	
	Absolues	Relatives	Nominales	Ordinales
Ponctuelle				
Linéaire				
Zonale				

Les tableaux de bord

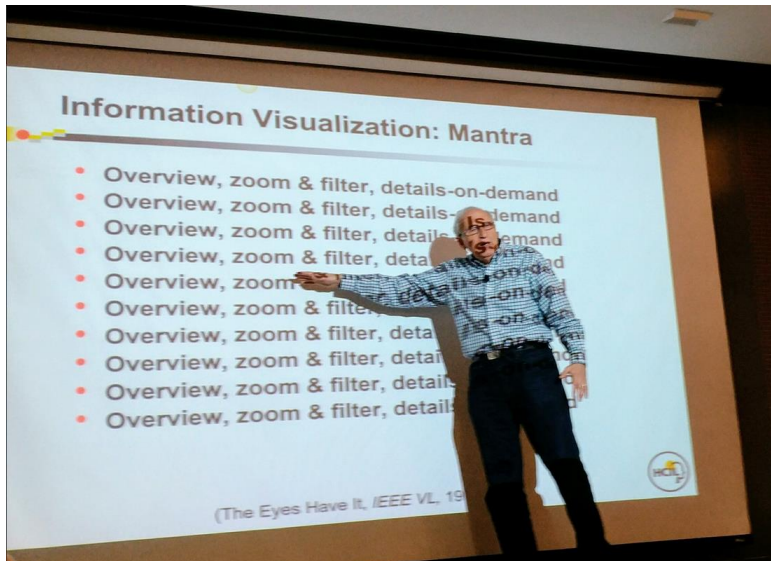
Tableaux de bord

- Interfaces décisionnelles pour « comprendre » en un coup d'œil
 - Combiner cartes, graphiques, indicateurs pour faire parler les données
 - Dimension interactive (interrogation des données, informations supplémentaires)



Tableaux de bord

- Le mantra de Ben Shneidermann
 - Principes et cadre de développement d'applications de visualisation d'informations
- Dépasser la simple perception des données, mobiliser d'autres approches avec **l'interactivité entre l'utilisateur, les données et les visualisations**



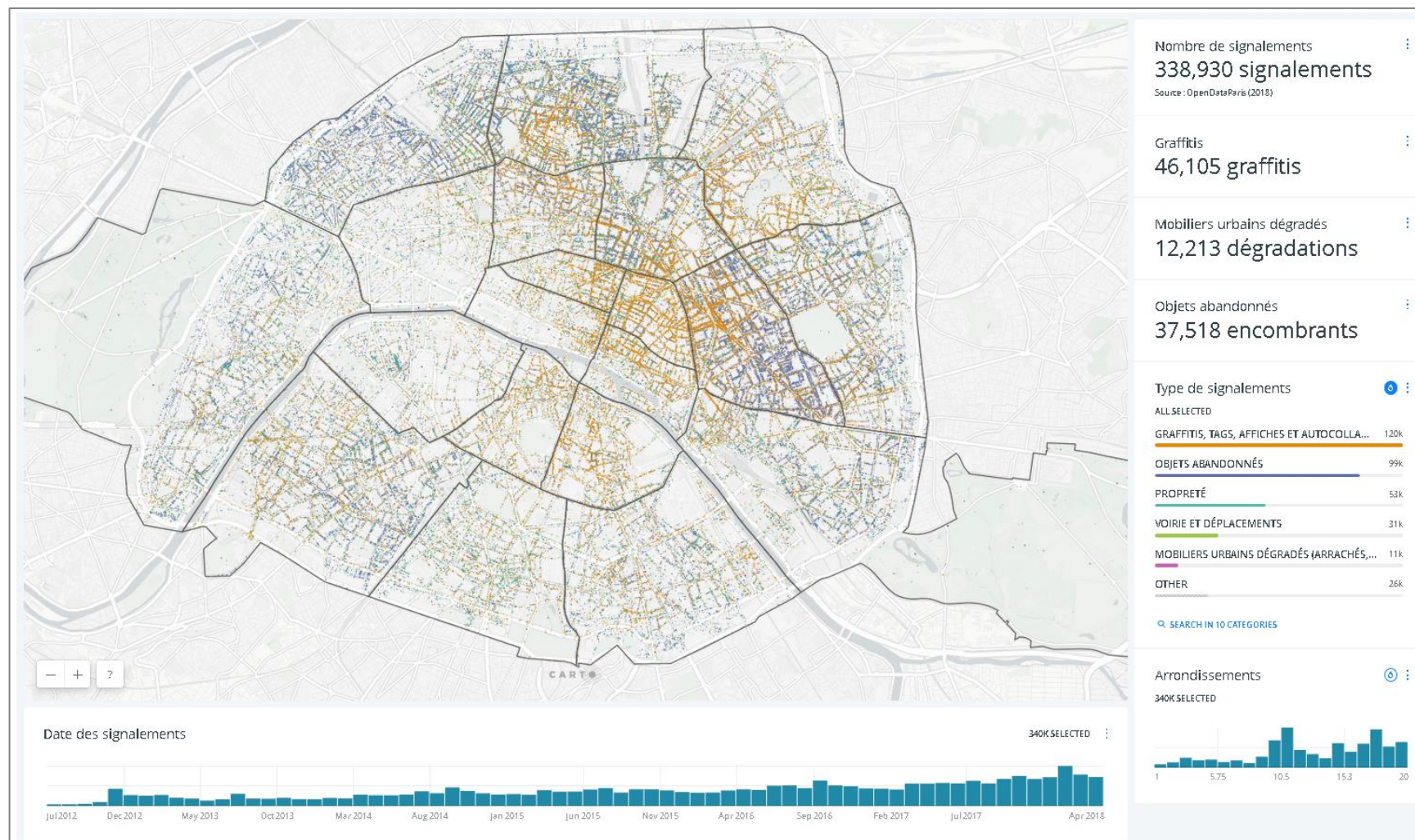
Overview : Vue d'ensemble des données

Zoom & filter : changer d'échelle, filtrer les données

Details on demand : Fenêtre d'information contextuelle

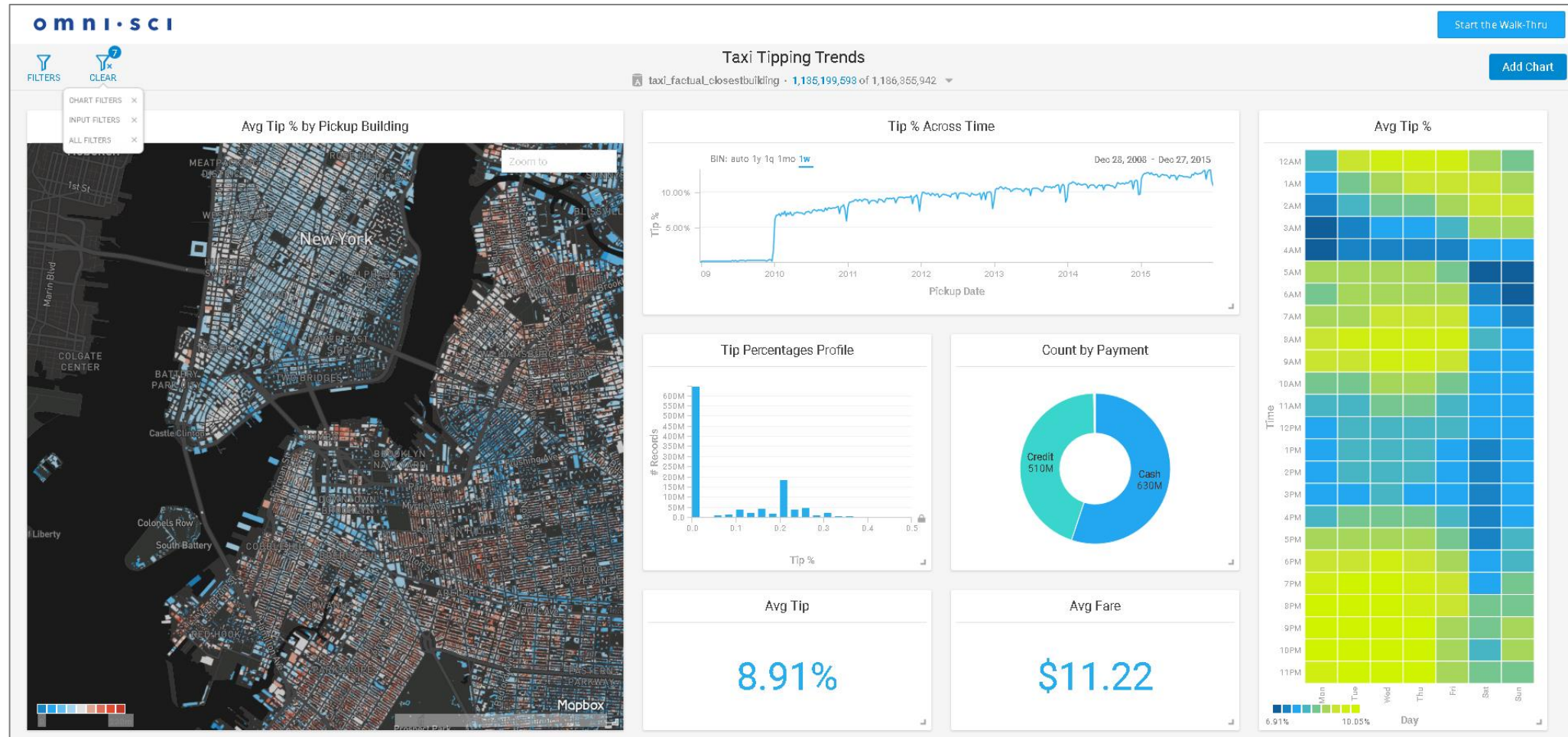
*The purpose of visualization is **insight**, not pictures*
Perspicacité, vision, connaissance, trouver la solution,...

Tableaux de bord



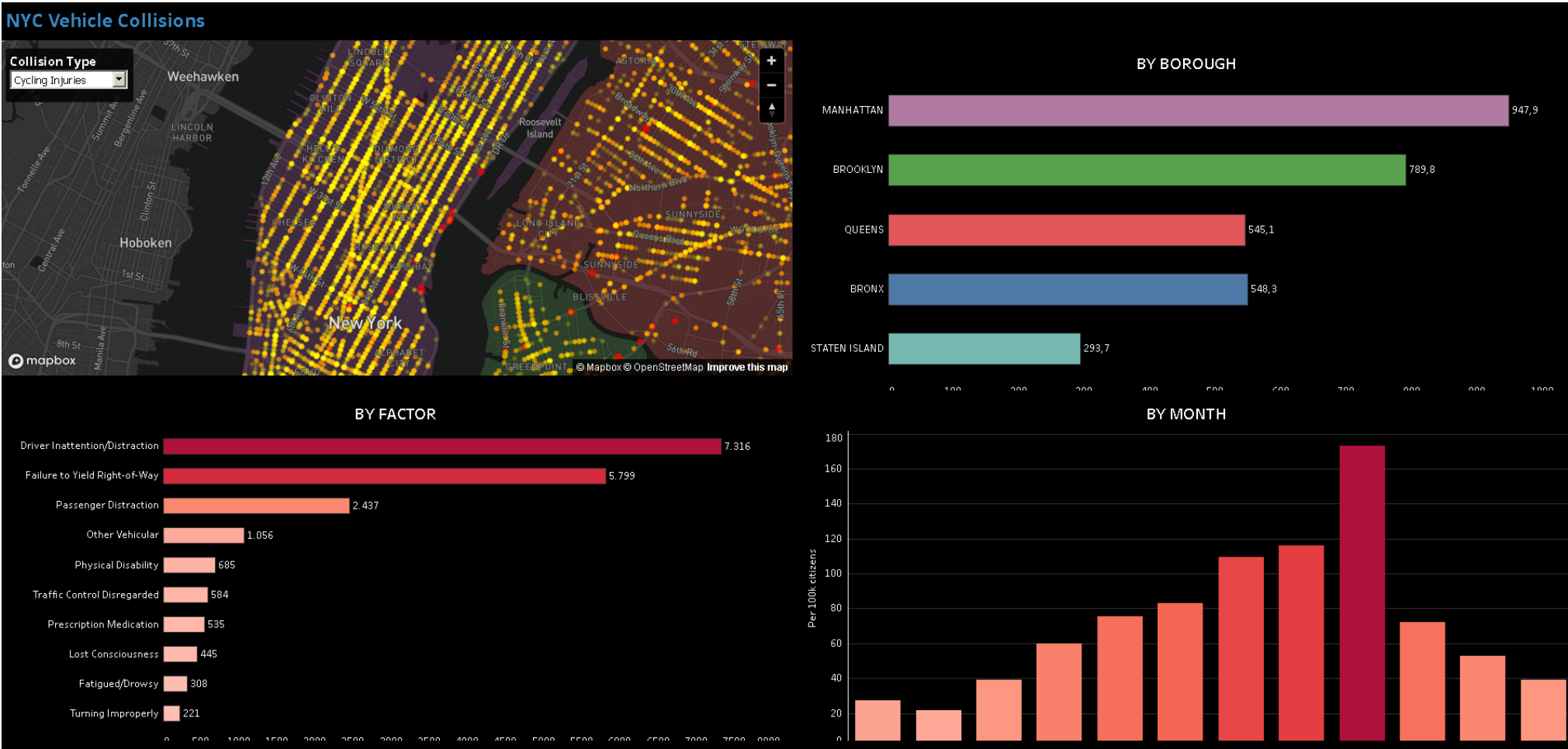
<https://www.sites.univ-rennes2.fr/mastersigat/Webmapping/Dashboard/index.html>

Tableaux de bord



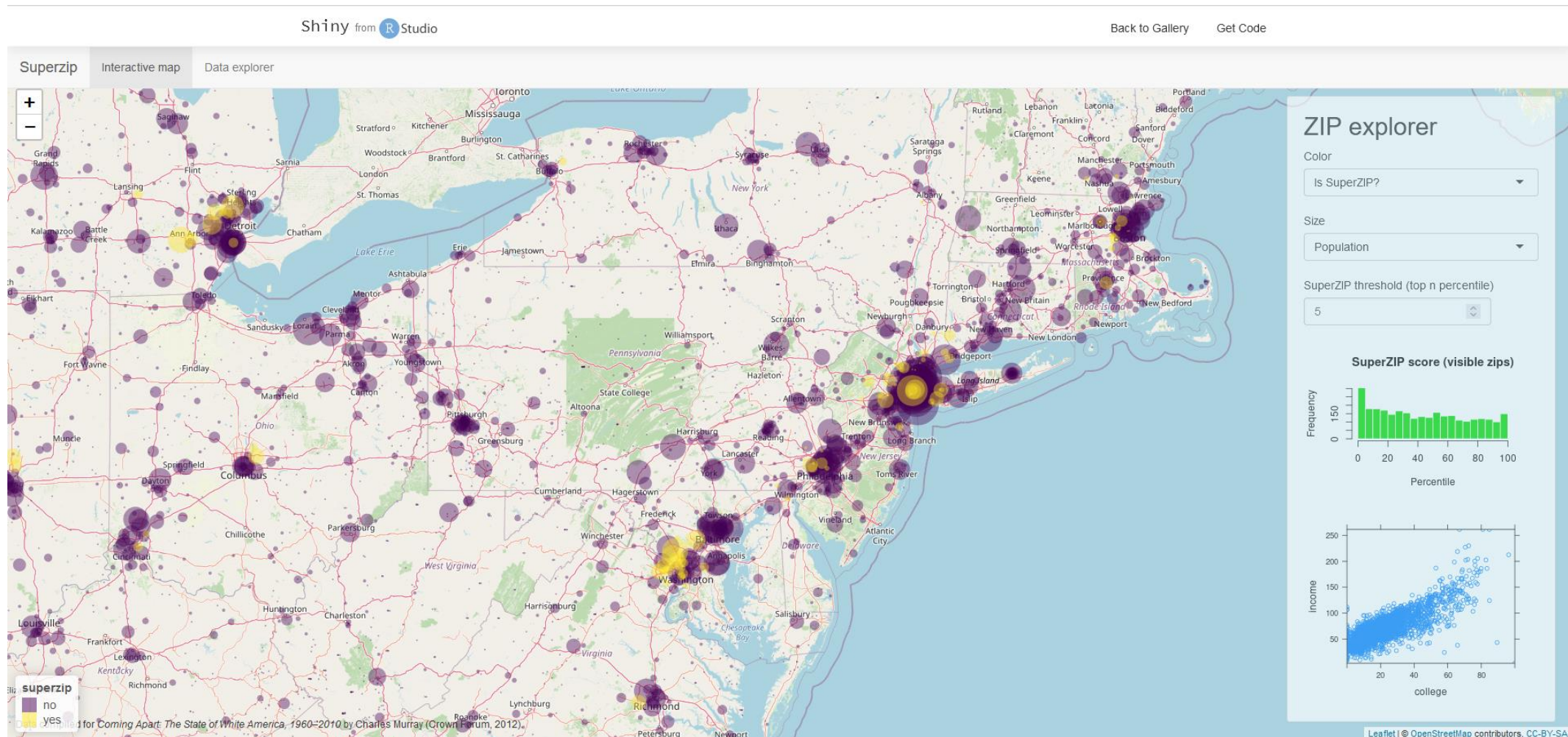
https://www.omnisci.com/demos/taxis/#/dashboard/10?_k=jpboqr

Tableaux de bord



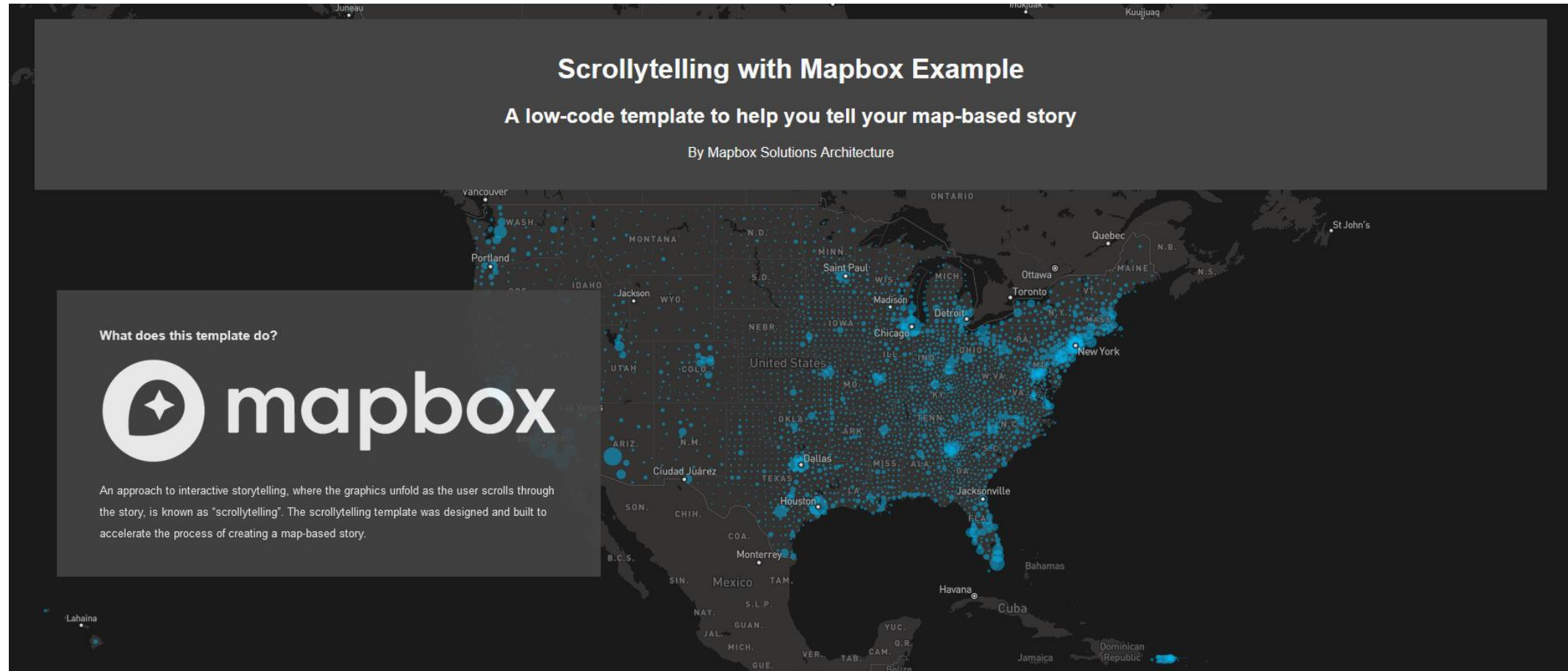
<https://www.mapbox.com/bites/00309/>

Tableaux de bord



<https://shiny.rstudio.com/gallery/superzip-example.html>

Scrollytelling



<https://demos.mapbox.com/scrollytelling/>

Perspectives et défis

- De la carte aux géovisualisations de données => repenser la cartographie thématique
 - Son rôle, son statut, ses usages, ses producteurs, ses lecteurs,...
- La question des fond de cartes
- L'interactivité comme clef
- De nouveaux modes de représentation cartographique
- L'importance du design
- Evolution perpetuelle des outils

KeplerGL : la nouvelle génération

