

# Social Dynamics in Urban Context

*Building open tools and datasets to explore the spatial and social history of Paris,  
1793-1950*

**Pierre-André Le Ny, Bertrand Duménieu**

with content from the SoDUCo and GeoHistoricalData teams



“One cannot understand social life without understanding the arrangements of particular social actors in particular social times and places...**Social facts are located.**”

~ Andrew Abbott, *Of Time and Space: The Contemporary Relevance of the Chicago School*, 1997

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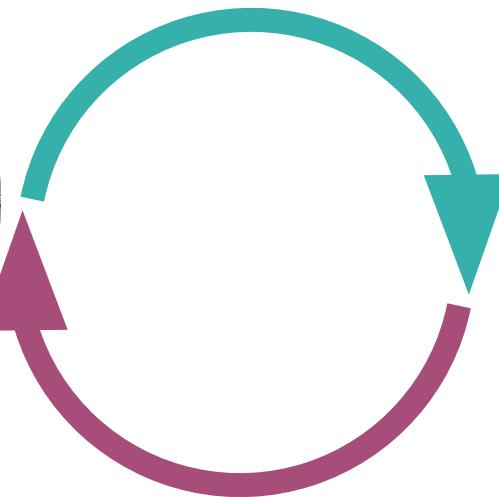
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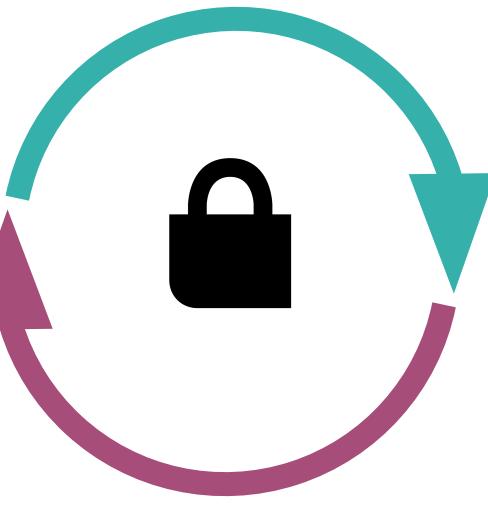
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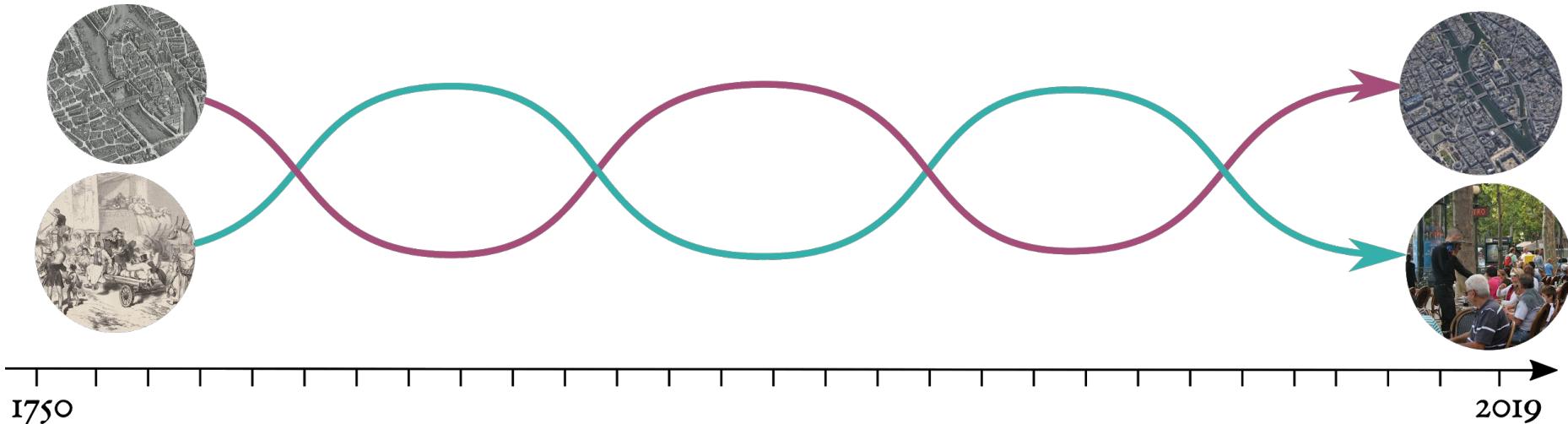
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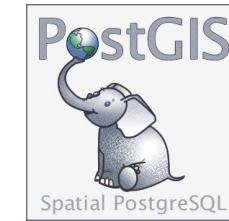
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# Motivational example : the regentrification of Paris, XIX<sup>th</sup> century

Study the evolution of wealth inequalities in the city of Paris in the 19th century, with an eye to the morphological changes in the city.

Common GIS tools to build geohistorical data



Multiple data sources covering the whole period

# Motivational example : the regentrification of Paris, XIX<sup>th</sup> century



Spatial source : 5 city maps, cadastres & atlases

NOMS, OU PROFESSIONS ET DEMEURES des PROPRIÉTAIRES.	ÉVALUATION du REVENU BRUT	MONTANT de l'IMPOSITION,	ANNÉES dans lesquelles l'évaluation échoue ou des échelons précédents.	NATURE des MUTATIONS	DATES des MUTATIONS	IN- TÉR- EST de la DÉCLARATION
CANON Marie Charlotte Baptiste à Venet rue 1 <sup>e</sup> Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1809	acquisition de financement de la vente 1810	15 Janv 1810	15 Janv 1810
Bathault 1 <sup>e</sup> 1810 Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1810	acquisition de financement de la vente 1810	15 Janv 1810	15 Janv 1810
Bathault 1 <sup>e</sup> 1810 Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1811	acquisition de financement de la vente 1811	27 Juillet 1811	27 Juillet 1811
Bathault 1 <sup>e</sup> 1810 Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1812	acquisition de financement de la vente 1812	27 Juillet 1812	27 Juillet 1812
Bathault 1 <sup>e</sup> 1810 Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1813	acquisition de financement de la vente 1813	27 Juillet 1813	27 Juillet 1813
Bathault 1 <sup>e</sup> 1810 Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1814	acquisition de financement de la vente 1814	27 Juillet 1814	27 Juillet 1814
Bathault 1 <sup>e</sup> 1810 Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1815	acquisition de financement de la vente 1815	27 Juillet 1815	27 Juillet 1815
Bathault 1 <sup>e</sup> 1810 Lyon le 15 Janv 1849. Vente par acte 27 Juillet 1810 à Eustache Bathault 1 <sup>e</sup> 45 Rue Neuve du Temple 2 <sup>e</sup> Bertrand 1 <sup>e</sup>	1000	1000	1816	acquisition de financement de la vente 1816	27 Juillet 1816	27 Juillet 1816

Social source : censal & inheritance registres

# Motivational example : the regentrification of Paris, XIX<sup>th</sup> century

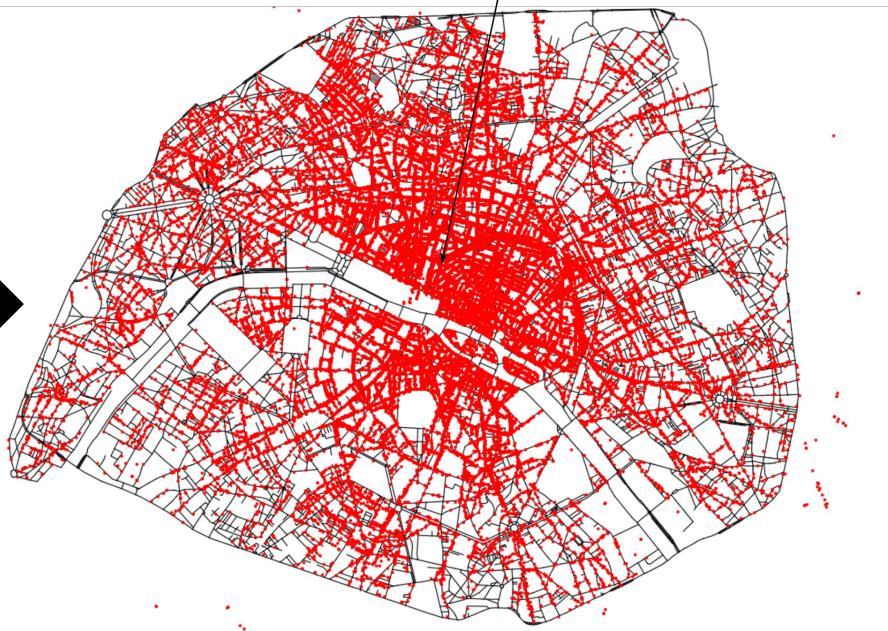


~30k address points, ~4.2k street sections

# Motivational example : the regentrification of Paris, XIX<sup>th</sup> century

A historical document from 1845, specifically a censal register from Paris. The document lists names, professions, evaluations, and other details for various individuals and households. The handwriting is in French and appears to be a ledger or tax record.

Last Name	First Name	Profession 1	Residence address	Birthdate	Total tax
ADAM	HENRY-EDMOND	Propriétaire	RUE NEUVE DES PETITS CHAMPS 6	09/03/1809	13200

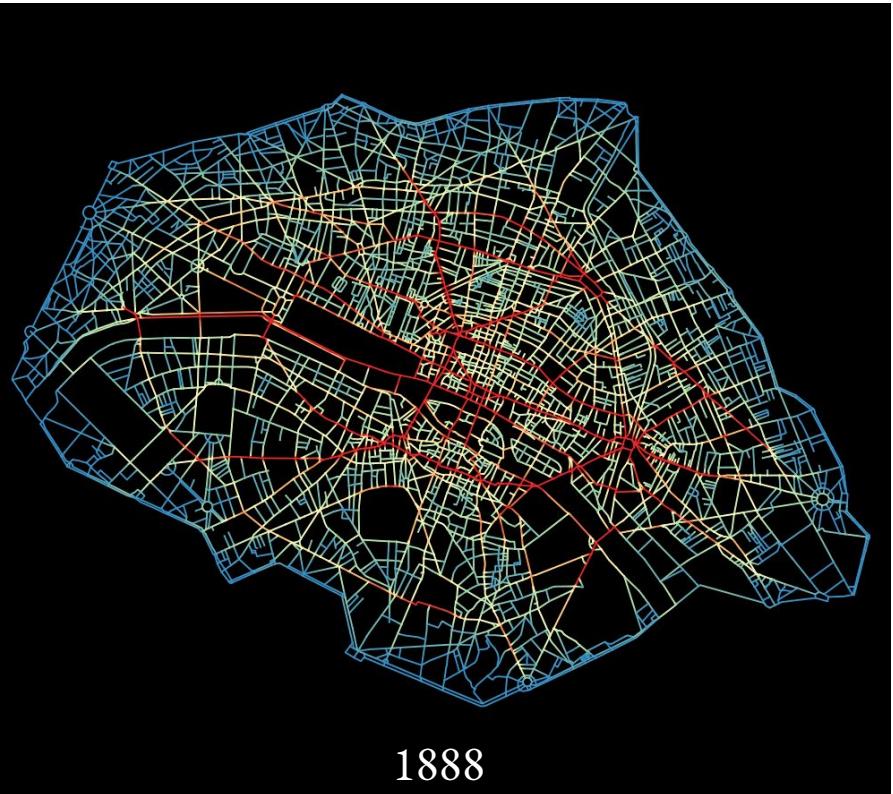


Censal registers 1845: ~20k entries, inheritance registers 1812-1907: ~130k entries

# Motivational example : the regentrification of Paris, XIX<sup>th</sup> century



1790



1888

Measuring the Haussmannian re-gentrification of the center Paris. Difference in betweenness centrality in center Paris, 1790-1888 [Costes 2017]

# Motivational example : the regentrification of Paris, XIX<sup>th</sup> century



Wealth concentration in Paris during the XIX<sup>th</sup> century according to the censal register for 1845 and the succession tables. Yellow areas indicate a concentration of the homes of the wealthiest 20% of Parisians.

\* censal registres

# Open (geo)data & historical sciences in 2019

GIS in historical sciences is finally a thing!



Massive amount of open archival documents are published by digital libraries on the Web.

Public policies to encourage or force the opening of research data.

A universe of small datasets with low redundancy and overlaying.



Building geohistorical data is a difficult task and results from an aggregative process.

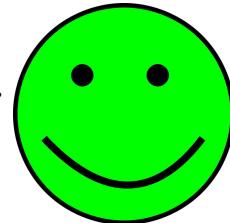
Ad hoc data production , lack of lineage metadata: hard to reuse, hard to understand.

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Building geohistorical data is a difficult task and results from an aggregative process.

Ad hoc data production, lack of lineage metadata: hard to reuse, hard to reproduce.

**We need specific tools to help people collaborate to build and share geohistorical data**

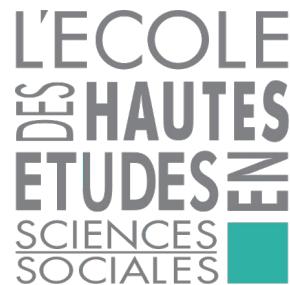
# The SoDUCo project

# Project overview

Project funded by the French National Research Agency

4 years: 2019-2023, 540k€

<https://anr.fr/Project-ANR-18-CE38-0013>



Le Ny Conseil

# Previous projects

**Cassini** (EHESS) <http://cassini.ehess.fr> - 2000-

History of French communes

**GeOpenSim** (IGN, LSIIT, LIVE) - ANR 2008-2011 <http://geopensim.ign.fr/>

Free and Open source simulation platform and building geo-historical data

**GéoPeuple** (IGN, EHESS, LIP6, IFSTTAR) - ANR 2010-2013 <http://geopeuple.ign.fr/>

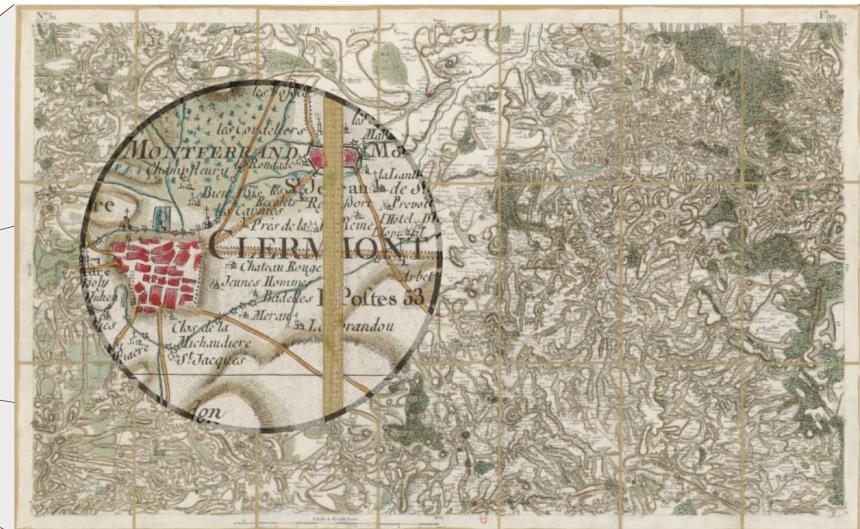
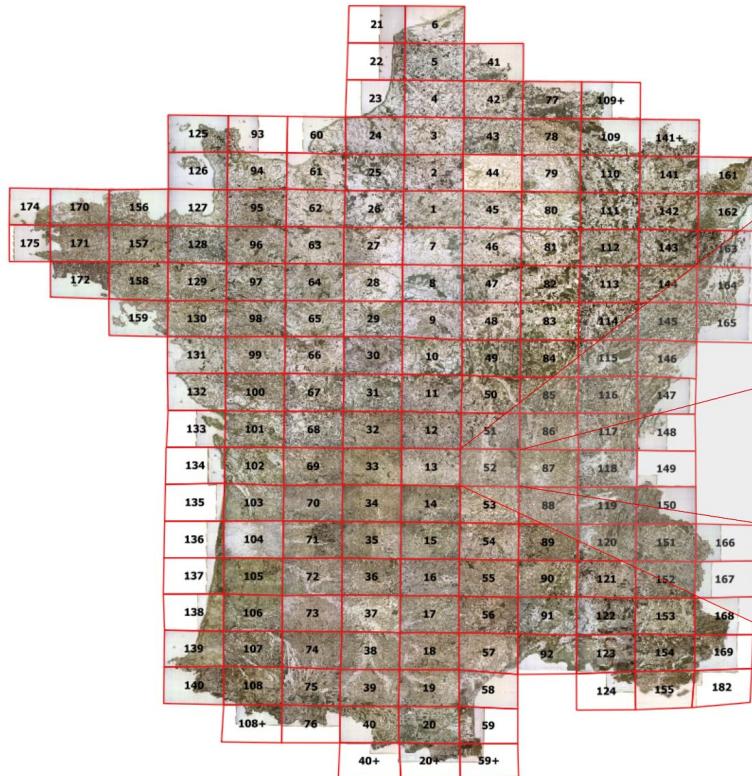
Building historical data in relation with population dynamics

**GeoHistoricalData** (IGN, EHESS, IFSTTAR, etc.) - 2013- <http://geohistoricaldata.org/>

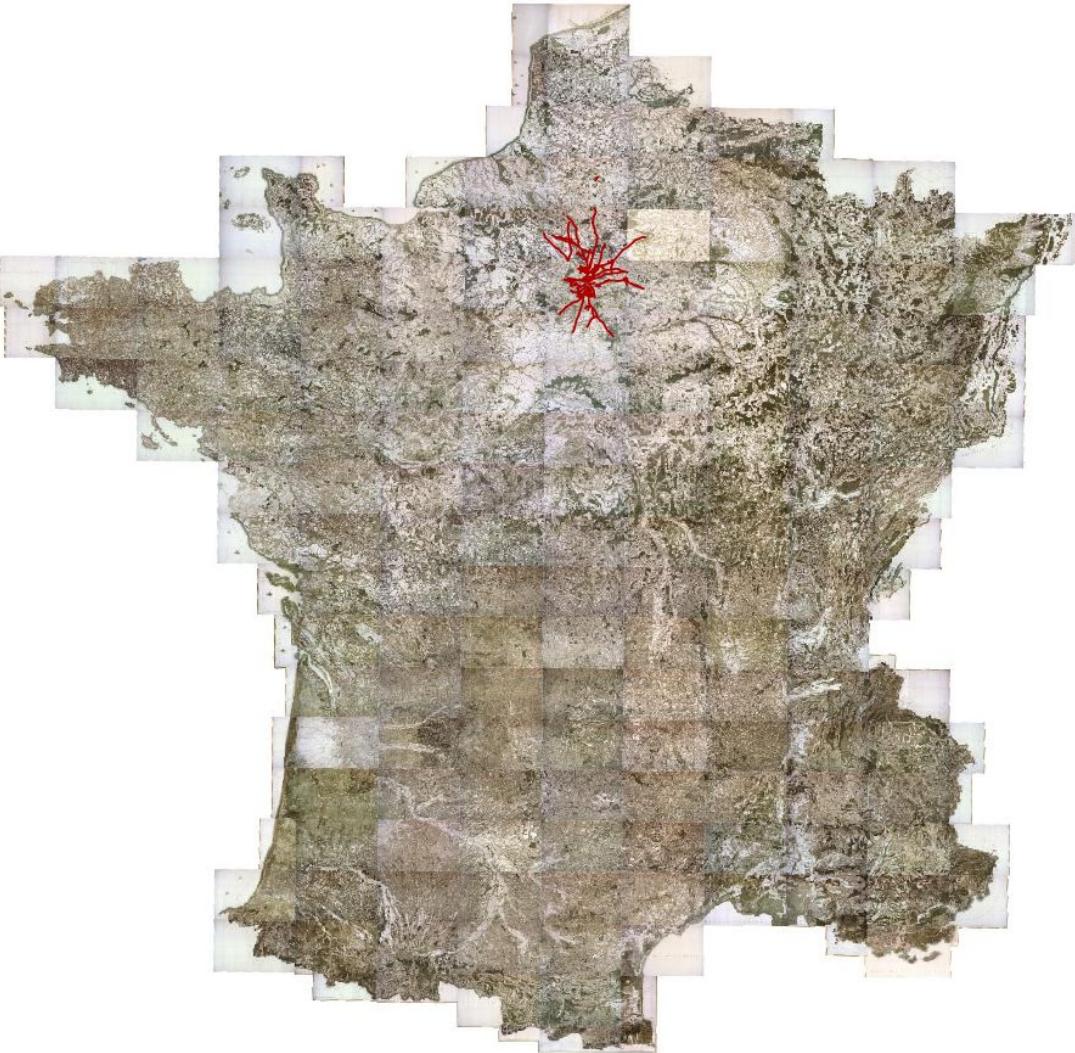
Building and analysing open geo-historical data

# A first collaborative experiment: digitising the Cassini *Map of France*, XVIII<sup>th</sup> century

Network data & related data paper available on the Harvard Dataverse, doi:10.7910/DVN/28674



Map of France, 1756-18..., georeferenced by Claude Motte & Marie-Christine Vouloir, available on the french GÉoportail

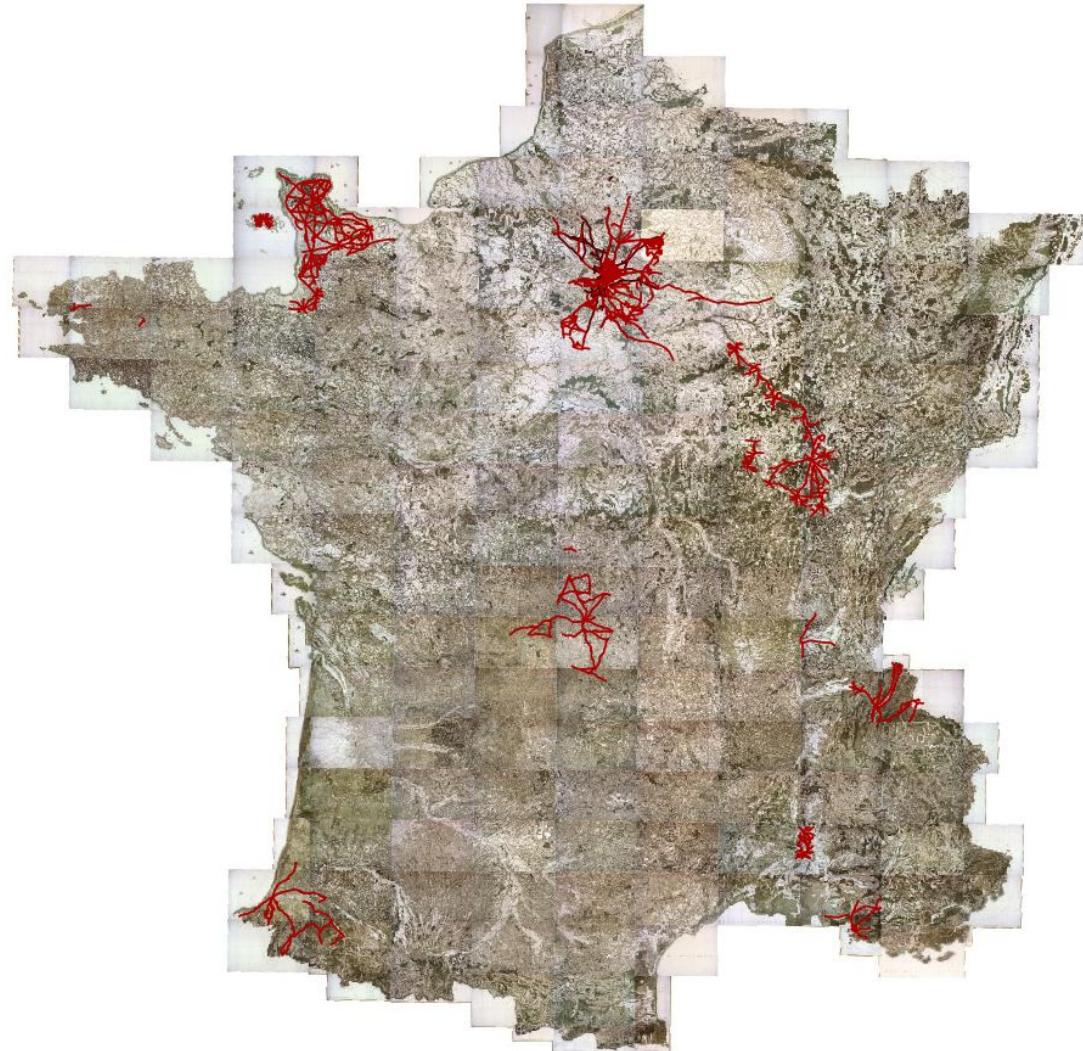


August 2013

*Network length: 1 070 km*

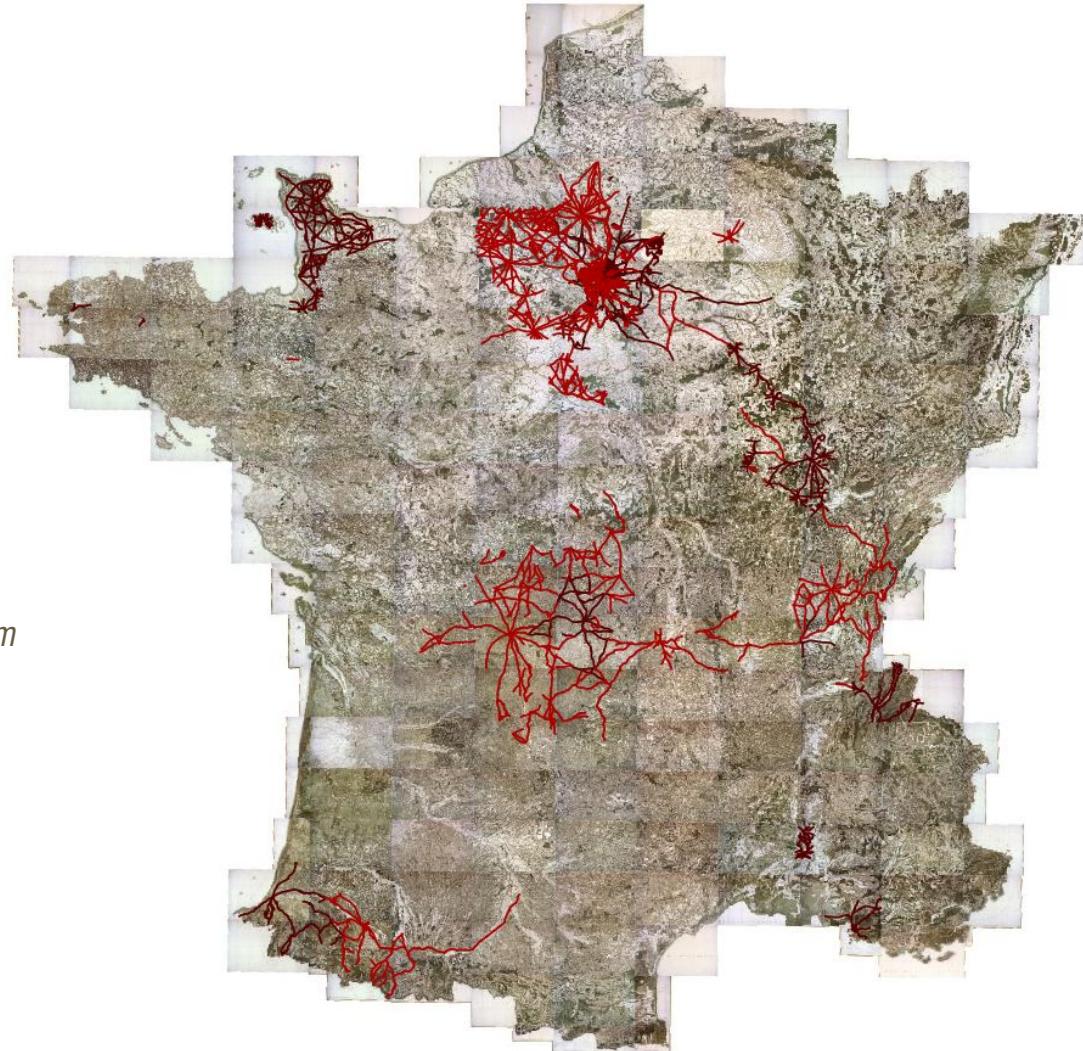
**September 2013**

*Network length: 8 297 km*



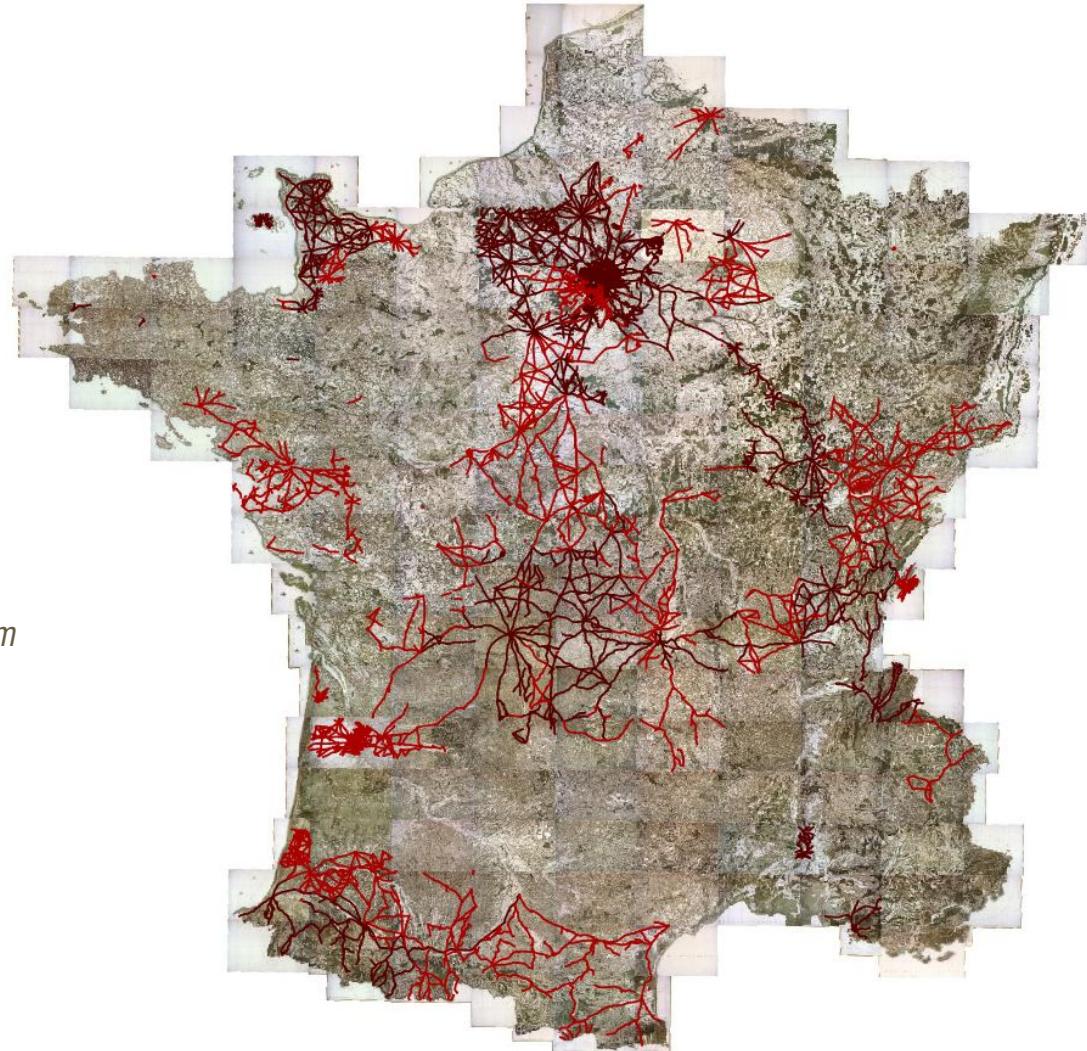
**October 2013**

*Network length: 19 333 km*



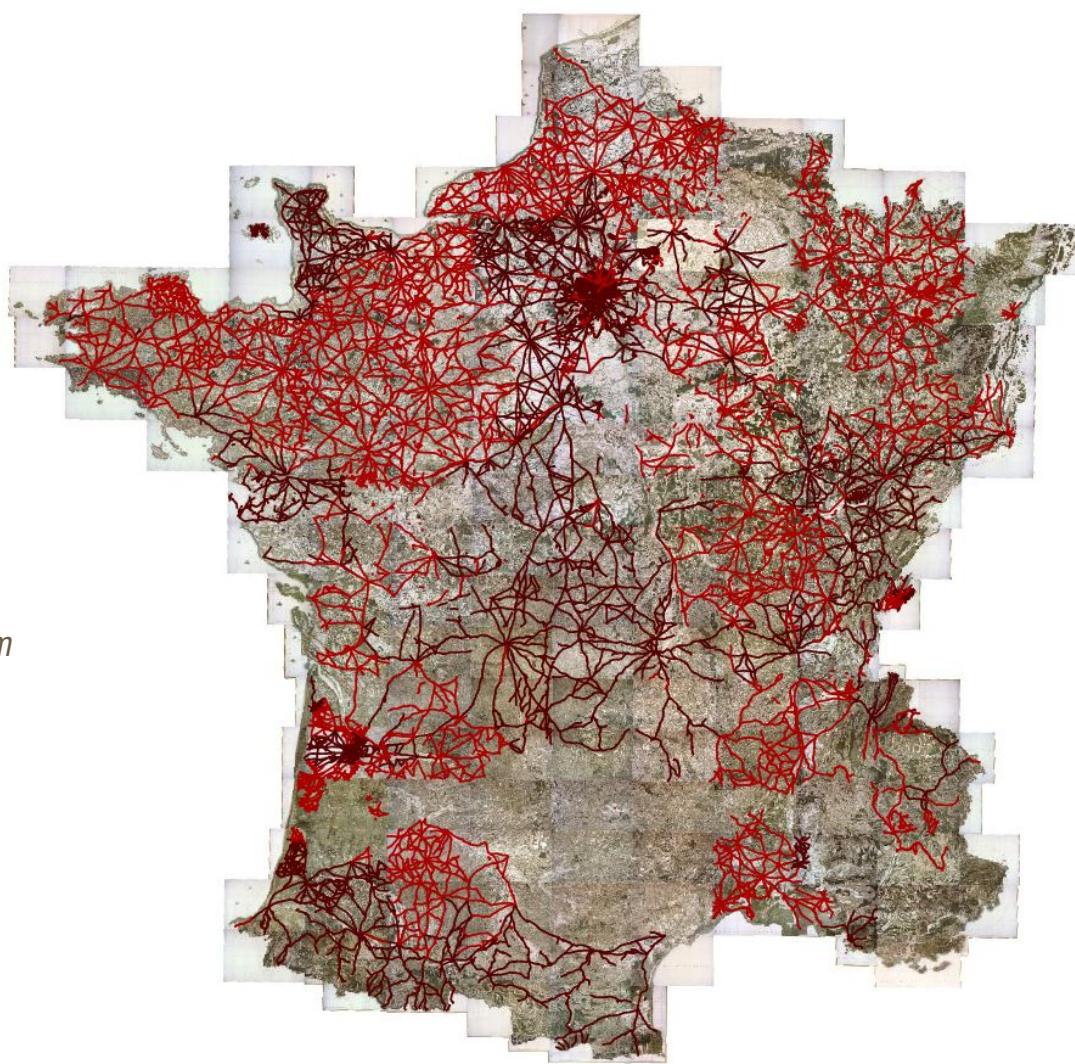
**November 2013**

*Network length: 38 109 km*



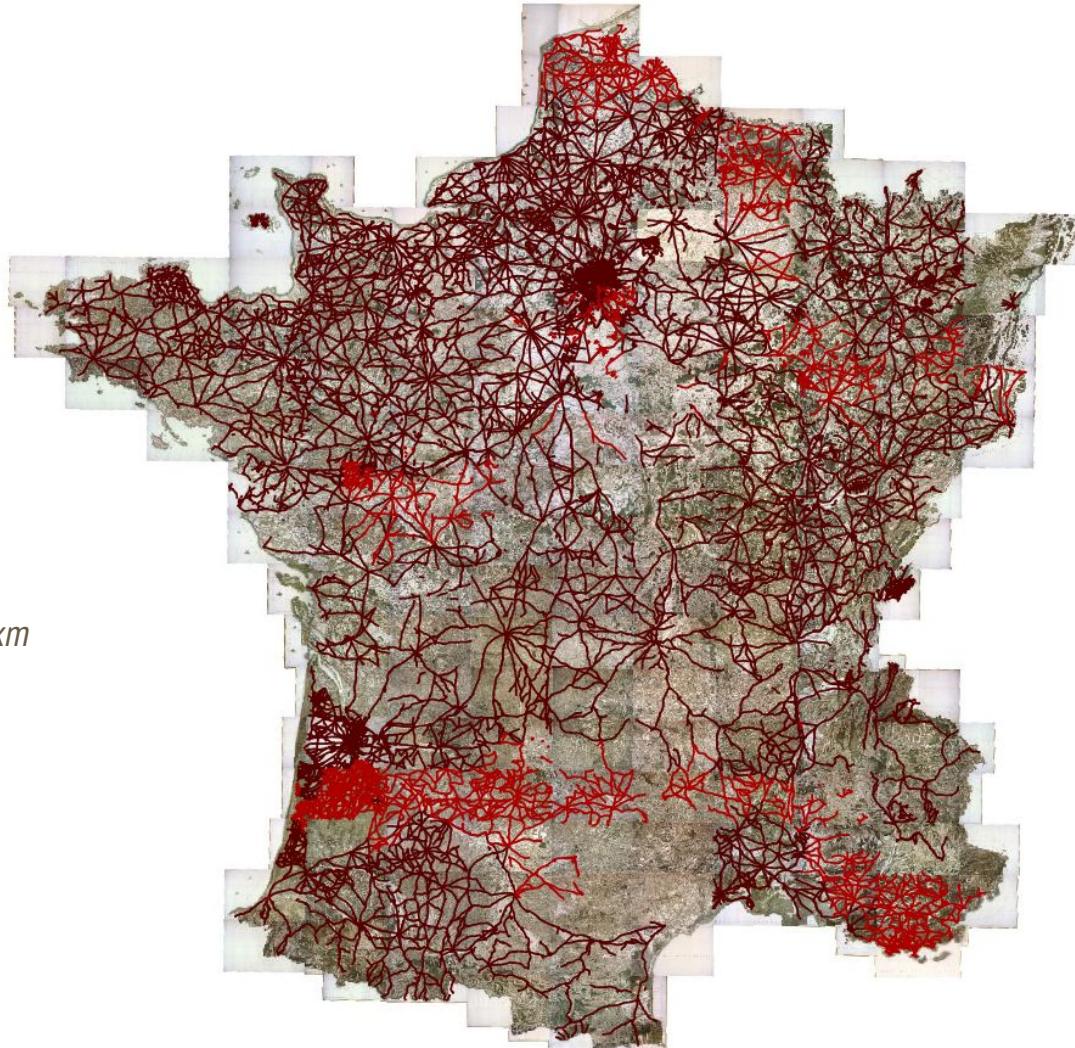
**December 2013**

*Network length: 83 179 km*



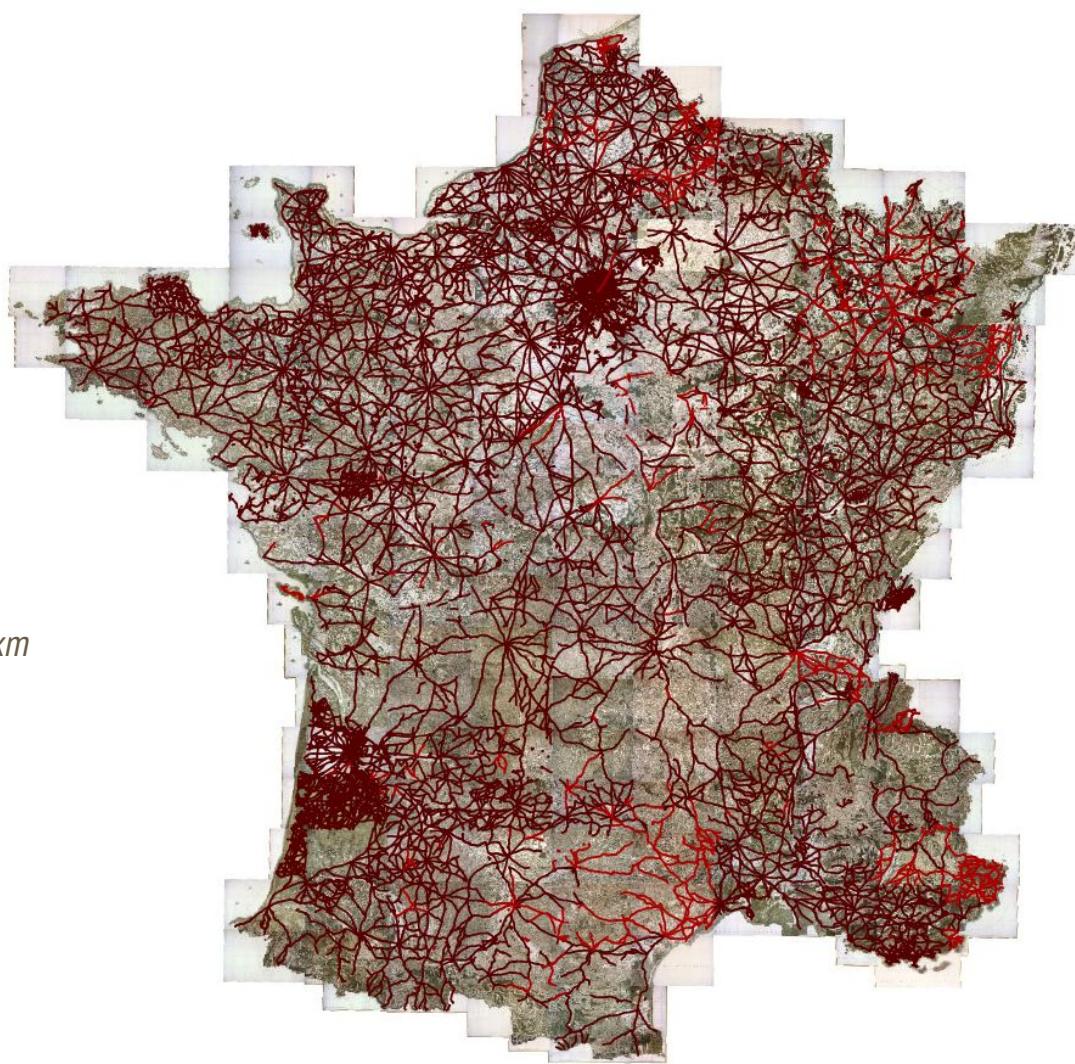
**January 2014**

*Network length: 102 801 km*



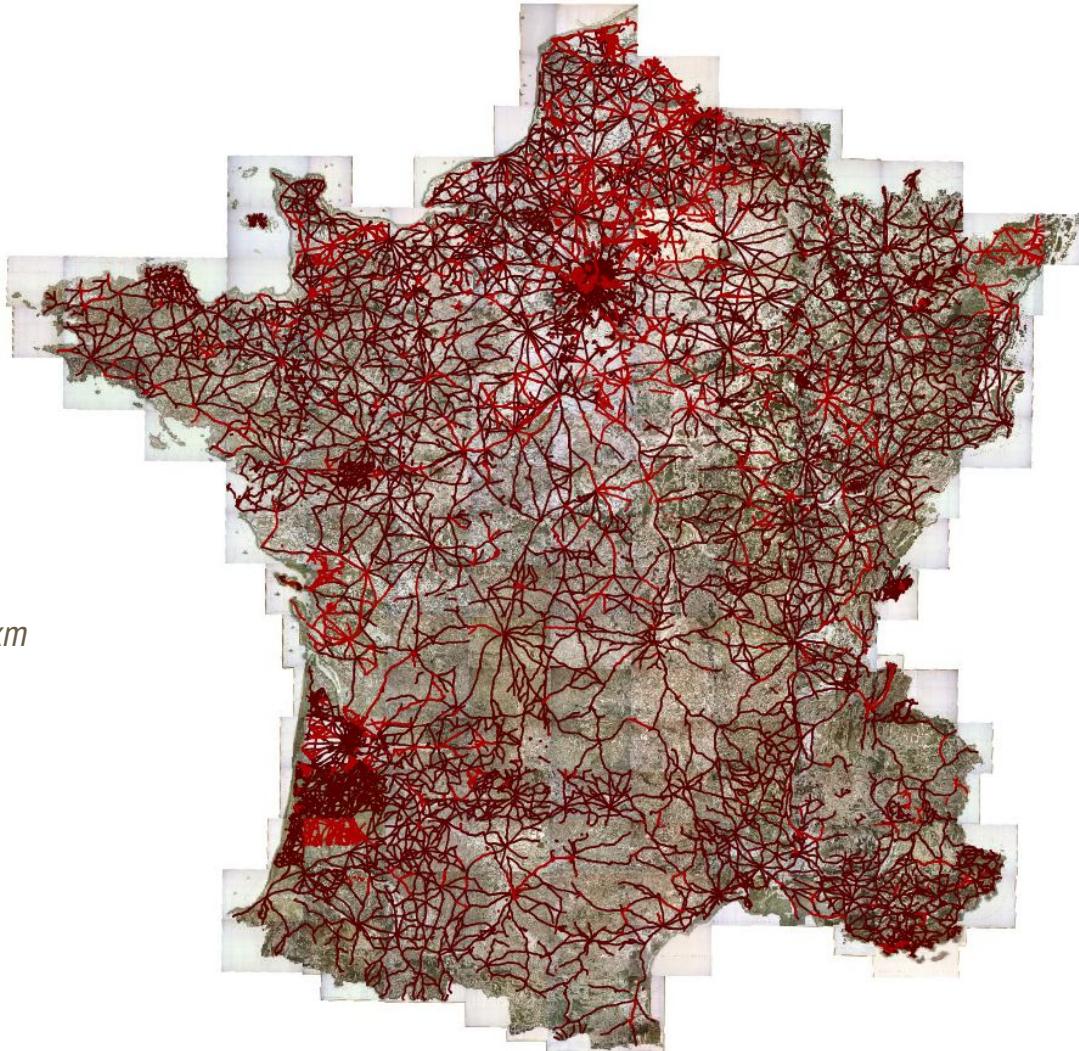
**February 2014**

*Network length: 111 872 km*



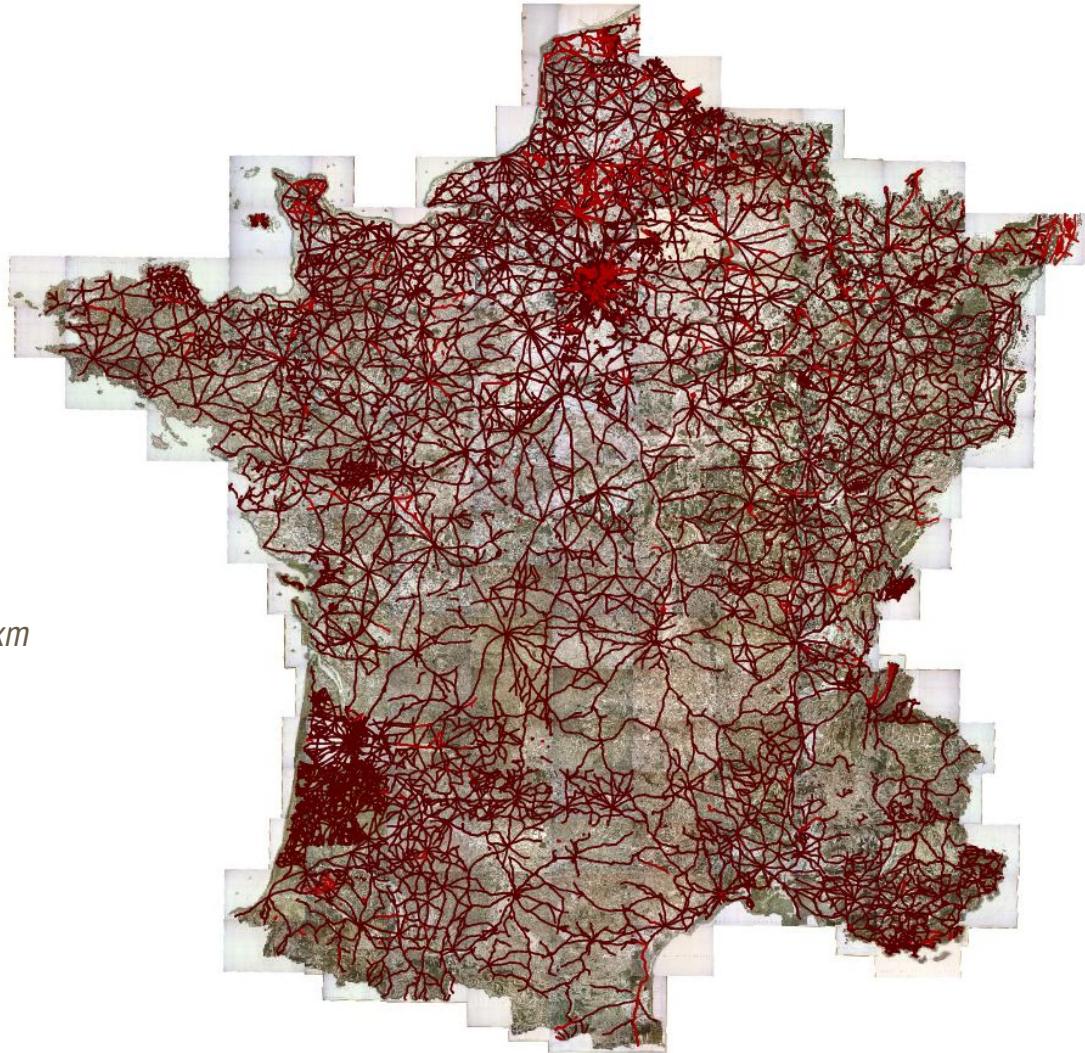
**March 2014**

*Network length: 132 564 km*



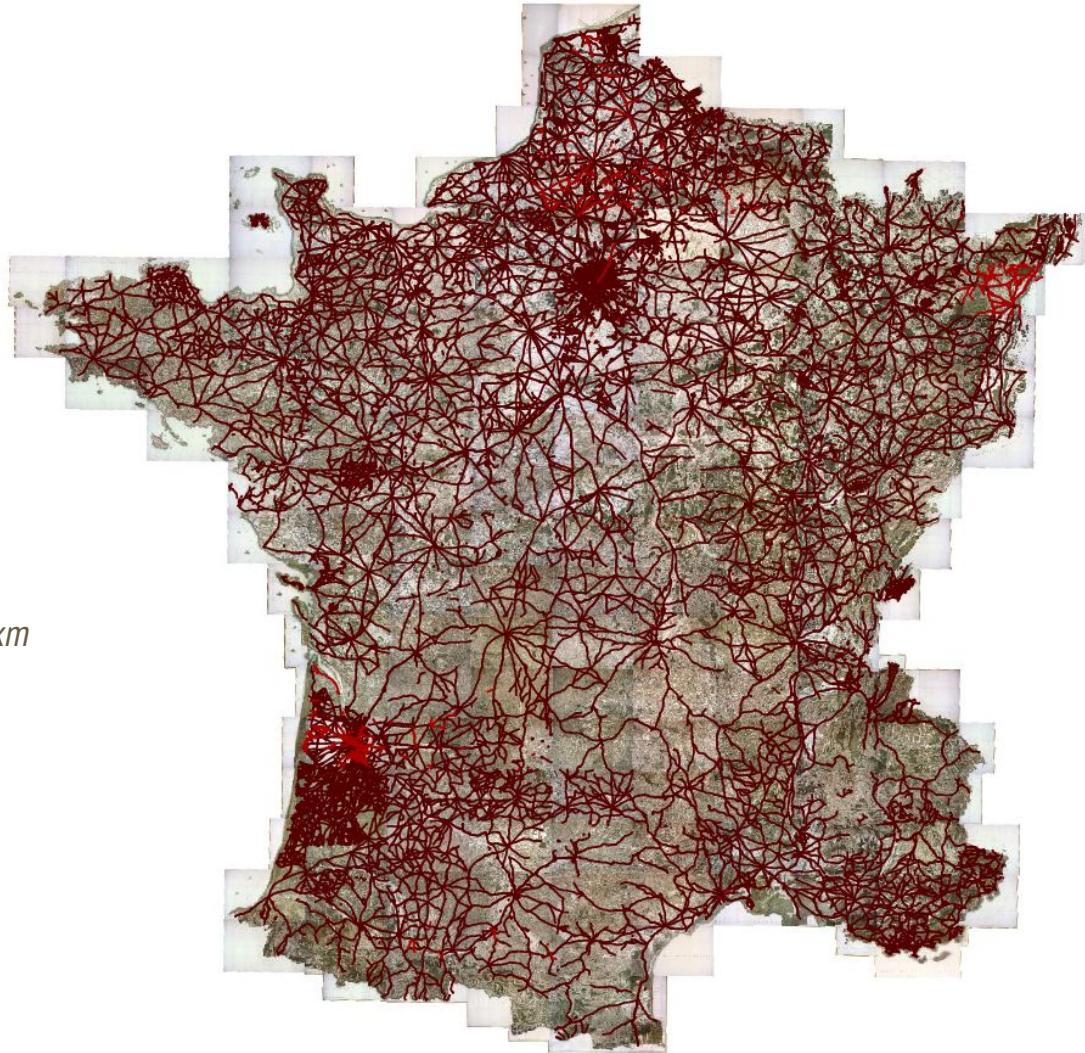
April 2014

*Network length: 138 309 km*



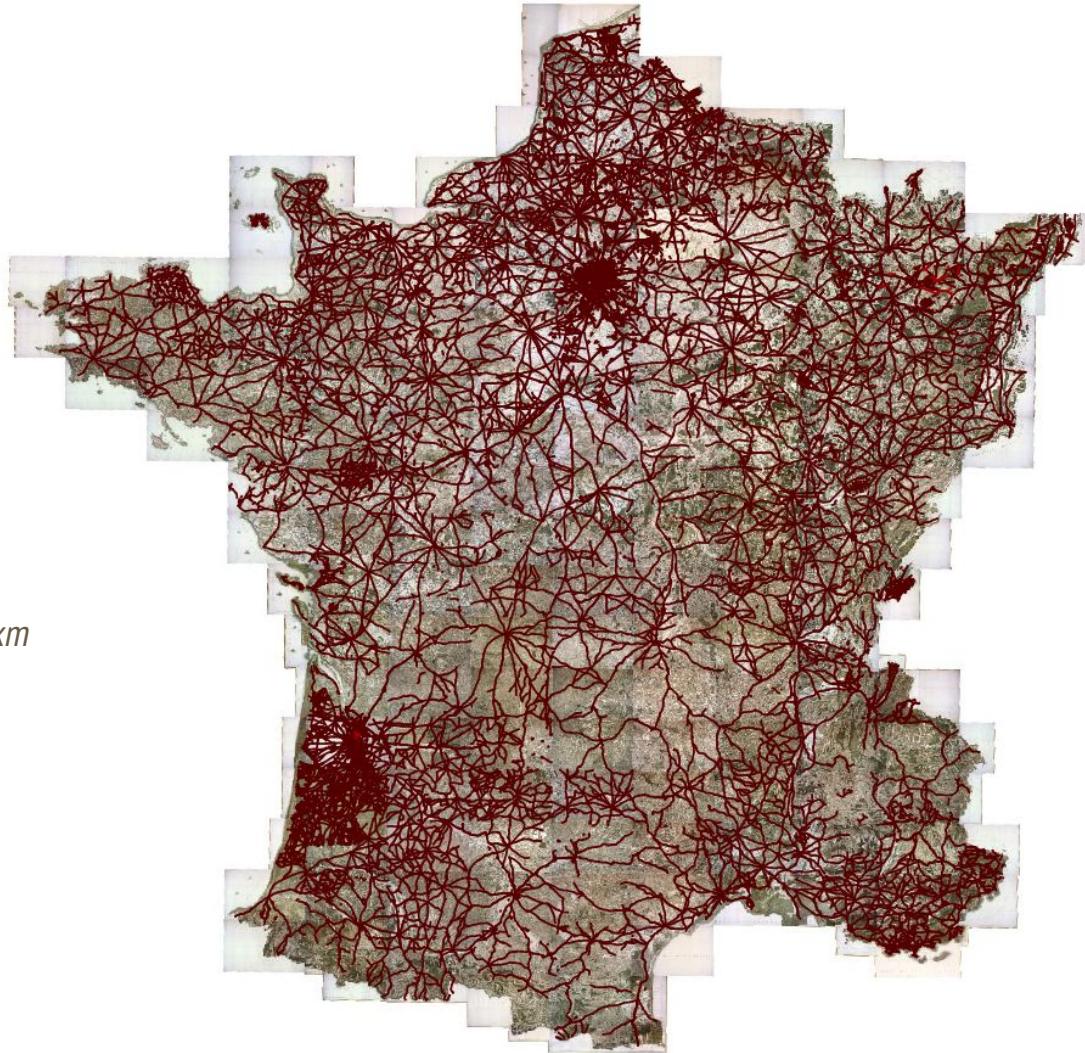
**May 2014**

*Network length: 140 601 km*



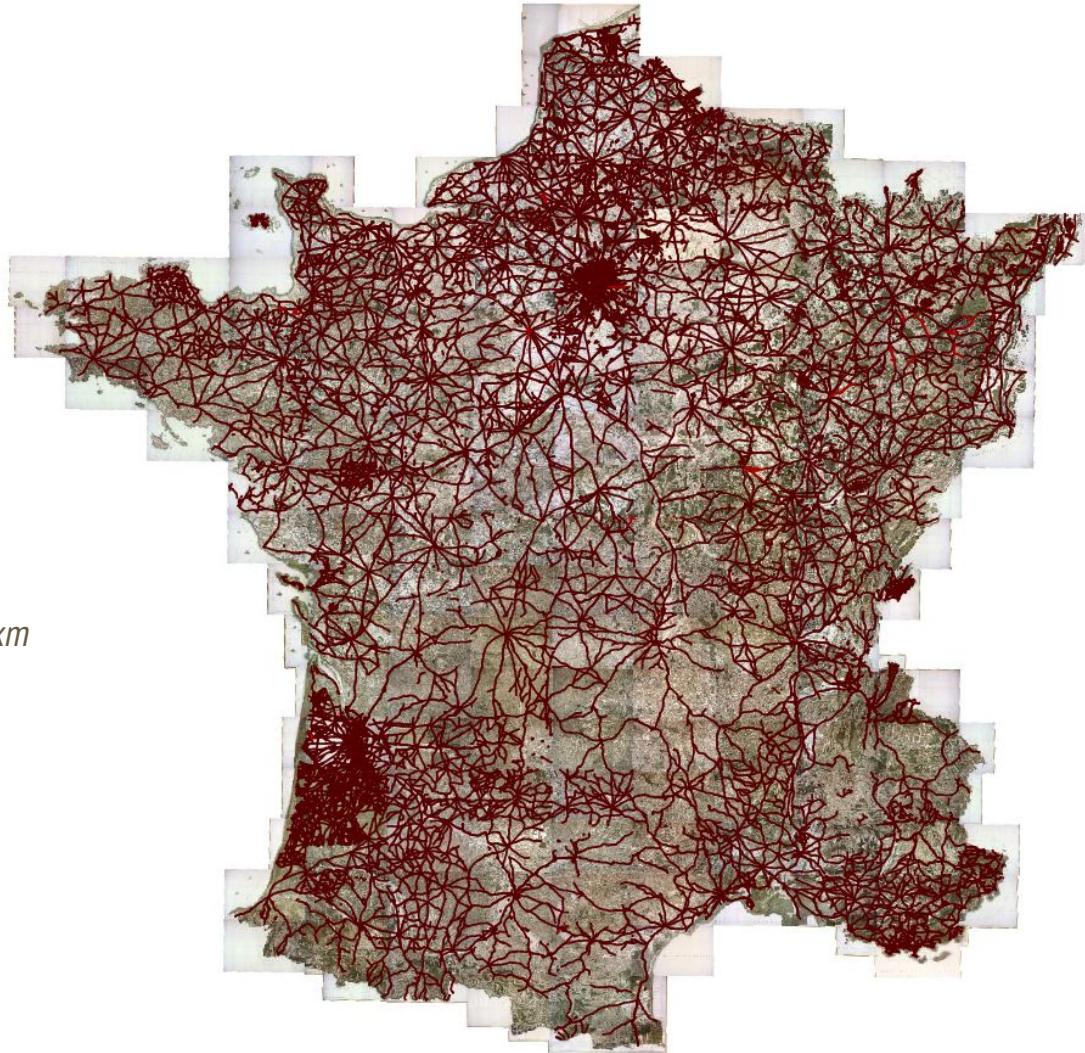
**June 2014**

*Network length: 140 703 km*



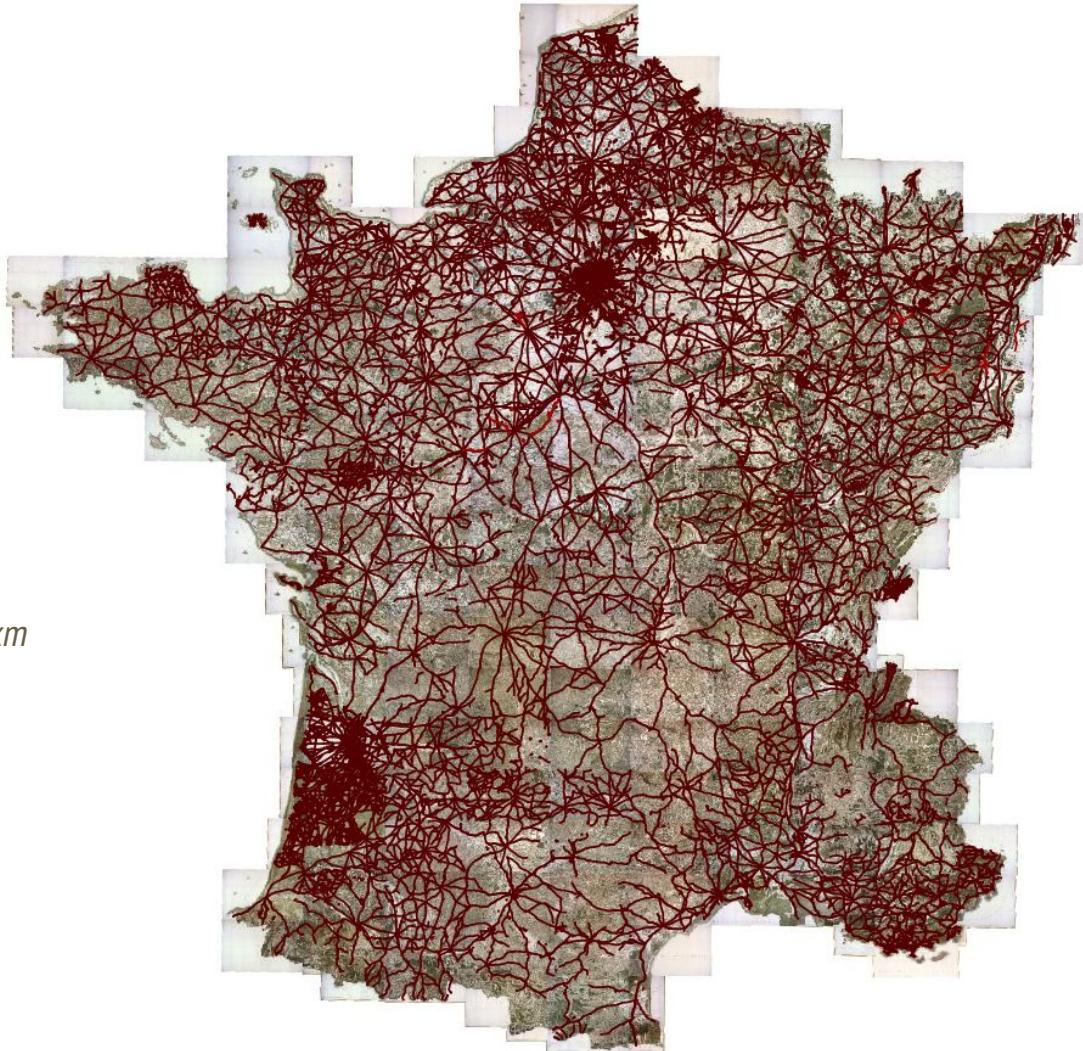
**July 2014**

*Network length: 141 093 km*



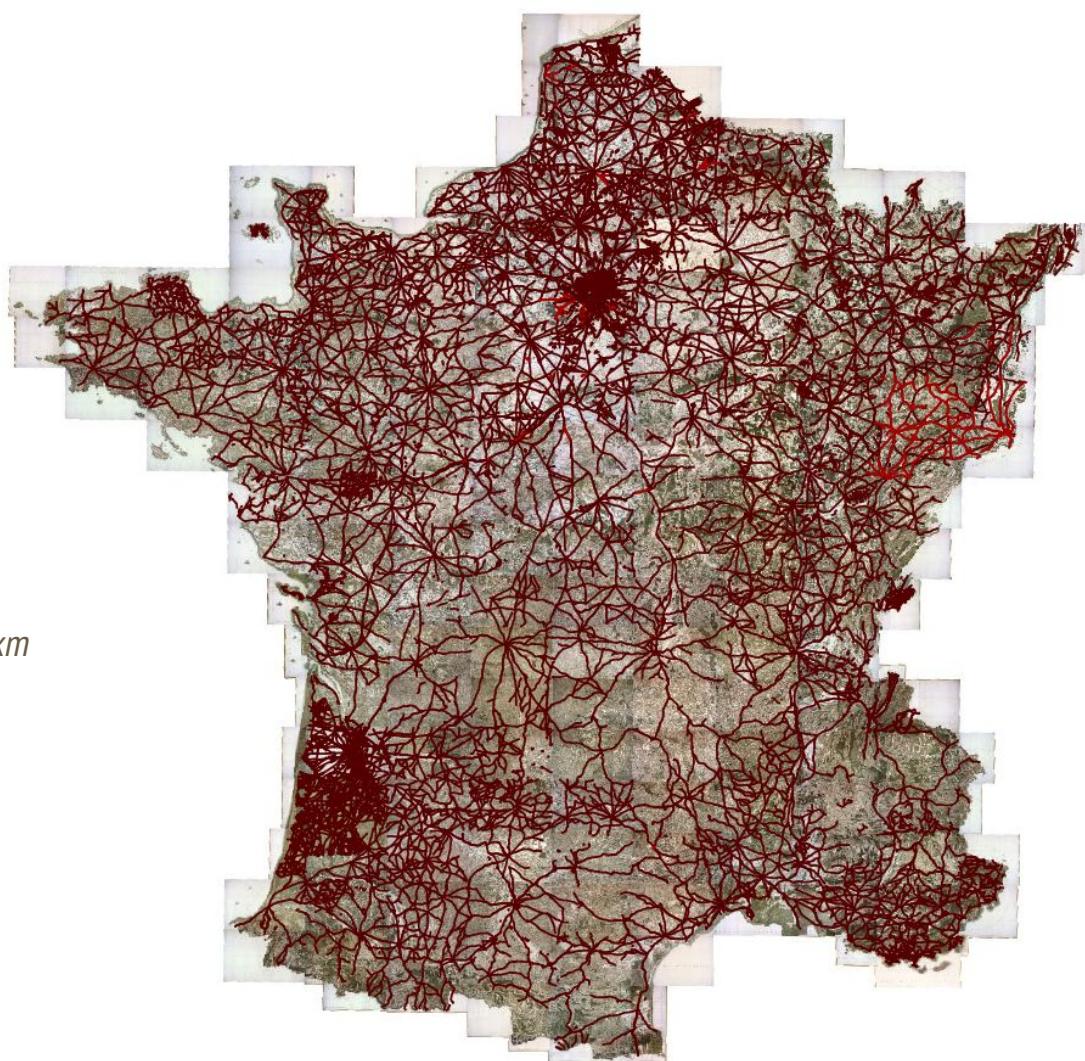
**August 2014**

*Network length: 141 398 km*



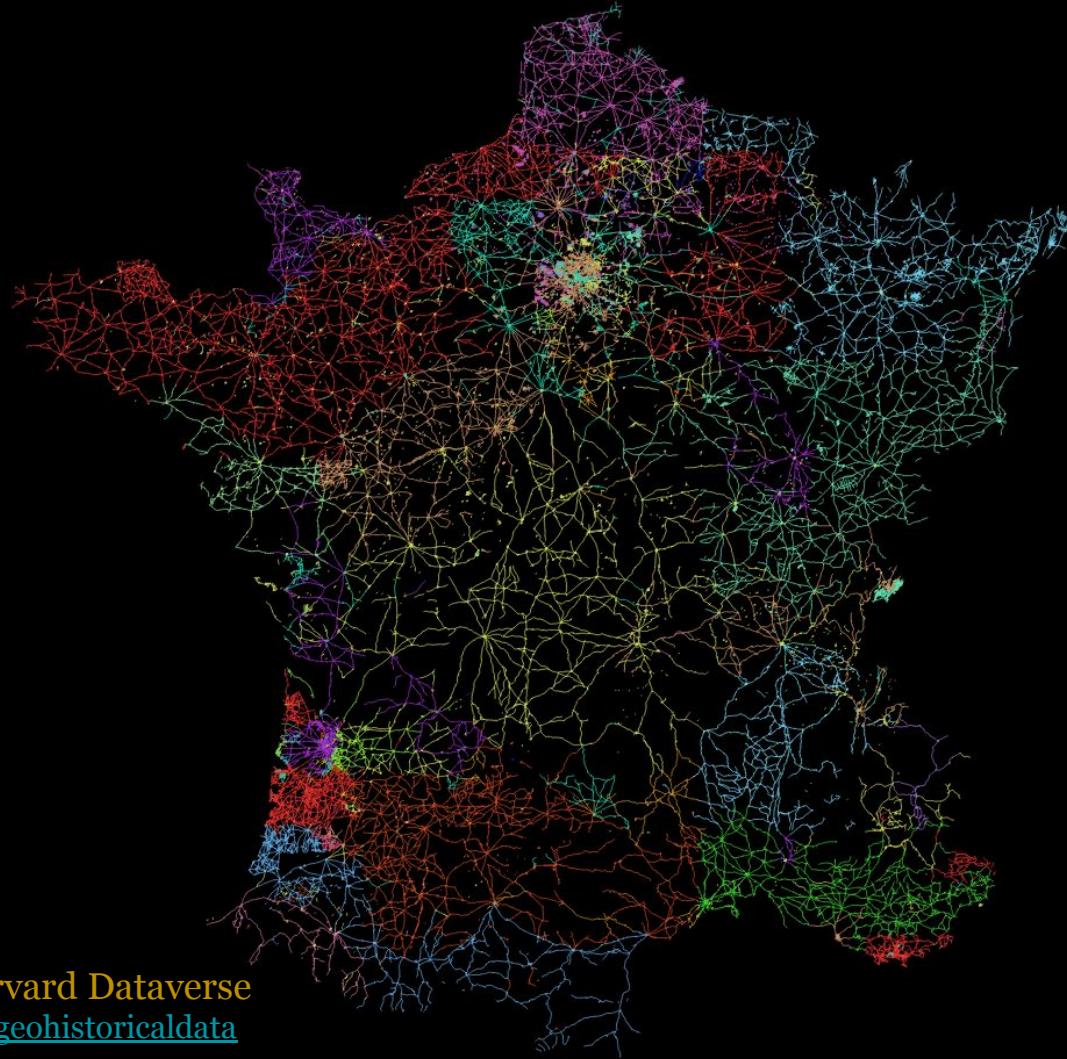
**September 2014**

*Network length: 143 343 km*



## Map of contributors

*27 main contributors*



Open Dataset and data paper on Harvard Dataverse  
<https://dataverse.harvard.edu/dataverse/geohistoricaldata>

# SoDUCo main goals & project outcomes

A reproducible approach to study the evolution of Paris over 150 years:

- analysing **social and spatial co-evolution**
- producing **critical analysis** of primary sources
- constructing **geo-historical data** in a semi-automatic collaborative way

Implement and make the approach available to others:

- developing **reusable, free and open sources tools** tailored for geohistorical data
- providing a **free and open Web platform to co-construct and share data**

# Sources

## Paris trade directories

MERCERIES, SOIERIES ET NOUVEAUTÉS (MARCHANDS DE).	
Achard, passage du Panorama, 61.	Belin, r. Saint-Martin, 125.
Alavoine, de soieries et nouveautés pour chaussure, rue de la Poterie - des Halles, 27.	Bellarde et Lhuillier (Méd.), nouveautés, r. de la Paix, 22.
Alexandre, de nouveautés et cachemires, Palais-Royal, galerie de pierre, 70.	Belleterm, menues merceris, rue de Seine-Saint-Germain, 49.
Alix r. du Commerce, 27.	Belly, en gros, r. des Bourdonnais, 19.

## Paris city maps and atlases



## Cadastres

### GRAVEURS EN GÉOGRAPHIE ET TOPOGRAPHIE.

- Arnoult, *Serpente* 16.  
Berthe, cit. 1827, *Noyers* 46.  
Chanois, *Harpé* 49.  
Chassant (P.-A.) *vieux-colomb*. 13.  
Collin (C.-E.) *\*MP Lond.*, q. conti 7.

Popincourt 150.  
Dehaeck, *Charenton* 166.

212 EBE

- Delaigle, p. *St-Germain-des-Prés* 6.  
Delangle, *Clotaire* 3.  
Delaporte, *Cassette* 12.  
Deschamps, *Boulangers* 22.  
Doublet et Sotin, *Val-de-Grâce* 16.  
Dumont, *Danphine* 17.  
Duverger frères, voitures publiques, Fossés-Saint-Germain-l'Auxerrois, 26.  
Duverger de Villeneuve, directeur-gérant des bains sur la Seine, quai Conti, 13.  
Duverger de Villeneuve, commissaire-priseur, Cadet, 8.  
Duverger de Villeneuve, propriétaire, Petits-Augustins, 21.  
Duvergier (J.-B.) \*, avocat à la cour royale, Jacob, 21.  
Duvergier, chef aux Assurances mutuelles, Neuve-St-Roch, 25.  
Duvergier de Hauranne, député, Tivoli, 5.  
Duverne, avocat à la cour royale, Guénégaud, 23.  
Duvernois, bureau de placement pour les eunisiers, Prouvaires, 8.  
Duvernoy ainé, fab. d'accordéons et orgues expressives, Orléans-Marais, 9.  
Duvernoy jeune, orgues expressives et accordéons, Montmorency, 4 [5].  
Duvernoy, horloger, Nve-Breda, 15.  
Duvernoy \*, prof. au coll. de France, Enfer, 31.  
Duvernoy (J.-B.), profess. de piano, Sentier, 21.  
Duvernoy (C.), profess. de clarinette, Faub. Poissonnière, 110.  
Duverrier, homme de lettres, Madeleine, 72.  
Duvart (Mme H.), couturière, Bleue, 19.  
Duyvert, homme de lettres, Tour-d'Auvergne, 27.

### ÉCRITURES (ENTREPRENEURS D').

Barhou et Palis, écrit. et autographes pour le bureau de Paris et des départem., r. de l'Évêque-St-Hou., 15.

Baudet et co., écritures et autographes; copie de manuscrits, notes et mémoires sur procès ou affaires administr. et commerciales, etc.: employés pour le dehors, soit temporairement, soit tout-à-fait à demeure, pass. des Panoramas, gal. St-Marc, 24. Une imprimerie fait partie de cet établissement.

Fournier, écrit. et autog., pl. Dauphine, 16.

Huolle et Nicea, r. N.-D.-des-Victoires, 23.

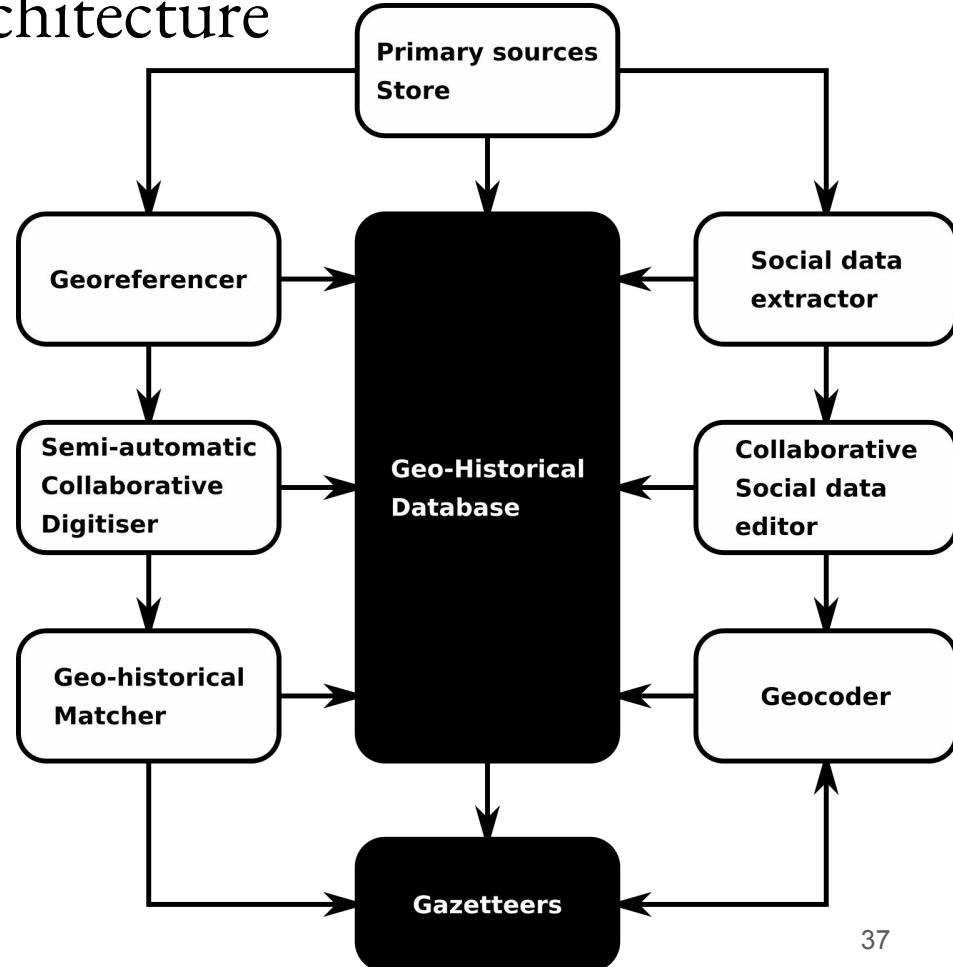
Ricard, r. de la Calandre, 59, et Croix des-Petits-Champs, 34.  
Targny (Mlle), adresses à la main, 25.000 peuvent être livrées par jour, r. J.-J. Rousseau, 2.

### ÉCRIVAINS PUBLICS.

Capriola (J.), rédacteur, traducteur en rep. d'écrit. et défenseur officieux, célérité, exactitude, discréption et loyat sincérité pour les personnes qui

# Components and platform architecture

- Main goal is to develop a platform
  - Unified
  - Distributed
  - Reusable
  - Interoperable
- Several independent components
- Building on existing FOSS tools
  - “Don’t reinvent the wheel”
- Develop generic tools
  - To permit reuse



# Technical aspects

- A central geohistorical DB using PostGIS
- FOSS4G/OSGeo stack (QGIS, PostGIS, Leaflet ..)
- OGC Compliant (WxS, WPS ...)
- Docker orchestration
- Hosted by Human-num : a very large research public structure for digital humanities (for our technical infrastructure, servers and computing capacity, technical support, SLA, backup...)

# Historical geocoder: PoC

- The first already developed component
- Inbase geocoder : postgreSQL/plpgsql + API stub  
(<http://api.geohistoricaldata.org/docs>)
- Proof of concept of a historical geocoder

<http://api.geohistoricaldata.org/geocoding?address=12%20rue%20du%20temple&date=1850&precision=true&maxresults=1>

# Historical geocoder: PoC

- Classic geocoders:
  - address -> coordinates
- Historical geocoder:
  - address + date (fuzzy) -> coordinates + data source

```
[  
  {  
    "rank": "1",  
    "input_adresse_query": "12 rue du temple, 1850",  
    "historical_name": "12 Rue du Temple",  
    "normalised_name": "12 Rue du Temple, Paris",  
    "fuzzy_date": "[1825-01-01,1837-01-01)",  
    "geometry": {  
      "type": "GeometryCollection",  
      "geometries": [  
        {  
          "type": "MultiPoint",  
          "coordinates": [  
            [  
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              6862655.34  
            ]  
          ]  
        }  
      ]  
    },  
    "geography": {  
      "type": "GeometryCollection",  
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        {  
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          "coordinates": [  
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              2.35726655782271,  
              48.8622039768356  
            ]  
          ]  
        }  
      ]  
    },  
    "historical_source": "jacoubet_paris",  
    "numerical_origin_process": "jacoubet_paris number",  
    "aggregated_distance": 28.848783,  
    "spatial_precision": 3.5,  
    "confidence_in_result": 1,  
    "semantic_distance": 0.261,  
    "temporal_distance": 23.5,  
    "number_distance": 0,  
    "scale_distance": 6.184,  
    "spatial_distance": 0  
  }  
]
```

# OS Model and Licenses

- Our goal is to increase OpenScience in historical sciences using FOSS
- Reproducible science needs FOSS!
- Not a unique license because of *contamination*
- Always aims for maximum openness
- Licenses used :
  - GNU Affero General Public License : well adapted to API context
  - MIT license

# Benefits for the FOSS4G community

- Open Tools
- Shared datasets
- Collaborative approach (crowd-sourcing)
- Open to contributions
  - Informal collaborations with : NYPL, Genealogists, World Historical Gazetteer

# Call for contributions

- Many ideas - small team
- Project 100% Free and Open Source code
- Open for contributions, mainly for development at this time :
  - Source-code repository: <https://github.com/GeoHistoricalData>
  - Project Website: <http://www.geohistoricaldata.org/>
- Possible replication for cities with similar sources (in a further step)

Contact us : [contact@geohistoricaldata.org](mailto:contact@geohistoricaldata.org)

# Conclusion

- SoDUCo is a project to build, share and analyse geo-historical data
- Multidisciplinary project (GIS, computer science, geography, history)
- Public funding with an opportunity of industrialisation
- Scientific and technical challenges

# Thank you for your attention!

<https://github.com/GeoHistoricalData>



# Backup Slides

# Primary sources store

Existing relevant open repositories

- Didomena  
<http://didomena.ehess.fr/>
- Dataverse  
<https://dataverse.harvard.edu/>
- Plenty of others...

Our goal

- Build on top of existing repositories
- Integrate specific metadata when necessary
- Store our data as linked open data from the start
- Catalog potential primary sources for further analysis (extraction, georeferencing, etc.)

# Georeferencer

## Existing online georeferencers

- Georeferencer (Proprietary)  
<http://www.georeferencer.com/>
- Map Warper (MIT license)  
<http://mapwarper.net/>

## Our goal

- A free and open source georeferencer
- Using image sources from external repositories (primary sources store)
- Semi-automatic collaborative capabilities
- Export georeferenced maps (WMS server, etc.)

# Semi-automatic collaborative digitiser

## Existing tools

- Online collaborative digitisers such as iD  
<https://github.com/openstreetmap/iD>
- Online collaborative validation/correction tools such as the building inspector  
<http://buildinginspector.nypl.org/>
- Plenty of image extraction tools...

## Our goal

- Integrate specific image extraction tools in a collaborative digitisation setting
- Make collaborative digitisation more time efficient by using map extraction
- Make map extraction tools more efficient by using collaborative validation and correction

# Geo-Historical Matcher

## Existing tools

- Many individual algorithms for specific data types
  - For networks <https://github.com/GeoHistoricalData/HMMSpatialNetworkMatcher>
  - For Surfaces, For points
- Few are actually free and open source

## Our goal

- Integrate state of the art algorithms into a free and open source library
- Be able to propose matching links during digitisation
- Propose a reference dataset for testing and comparing matching algorithms
- Build spatio-temporal graphs and geo-historical graphs from matched datasets
- Build the history of geographical objects

# Social data extractor

## Existing tools

- Pylene  
<http://olena.pages.lrdc.epita.fr/pylene/intro.html>

## Our goal

- Propose a free and open source tool to extract entries from structured documents such as trade directories

# Collaborative Social data editor

## Existing tools

- Semantic annotation  
<https://recogito.pelagios.org/>

## Our goal

- Edit the social data extracted from documents such as trade directories
- Validate/Correct/Enrich/Annotate them

# Geocoder

## Existing Free and Open Geocoders (not Historical)

- Nominatim and other OSM based Geocoders <https://nominatim.openstreetmap.org/>
- Pelias <https://github.com/pelias/>

## Existing Free and Open Historical Geocoder

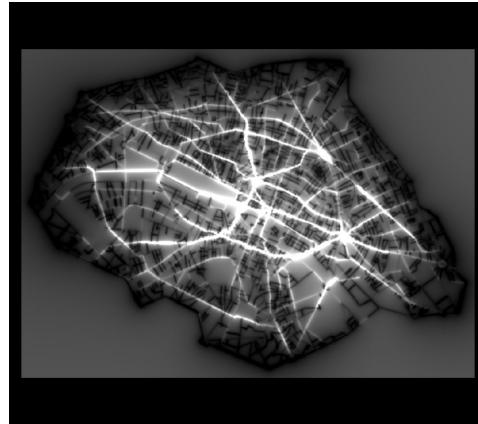
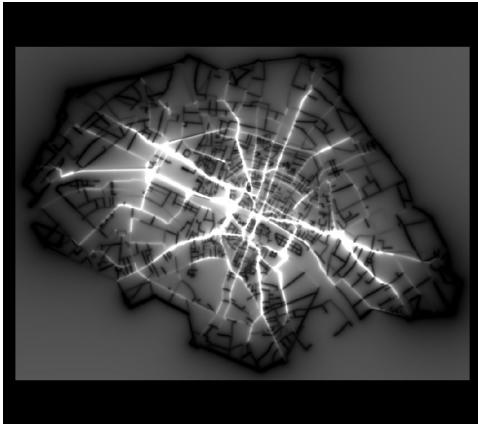
- PostgreSQL + PLPGSQL [https://github.com/GeoHistoricalData/historical\\_geocoding](https://github.com/GeoHistoricalData/historical_geocoding)
- Javascript REST API <https://github.com/GeoHistoricalData/geocoder-api>

## Our goal

- Integrate Pelias to provide it with historical capabilities
- Integrate existing (historical) datasets and gazetteers

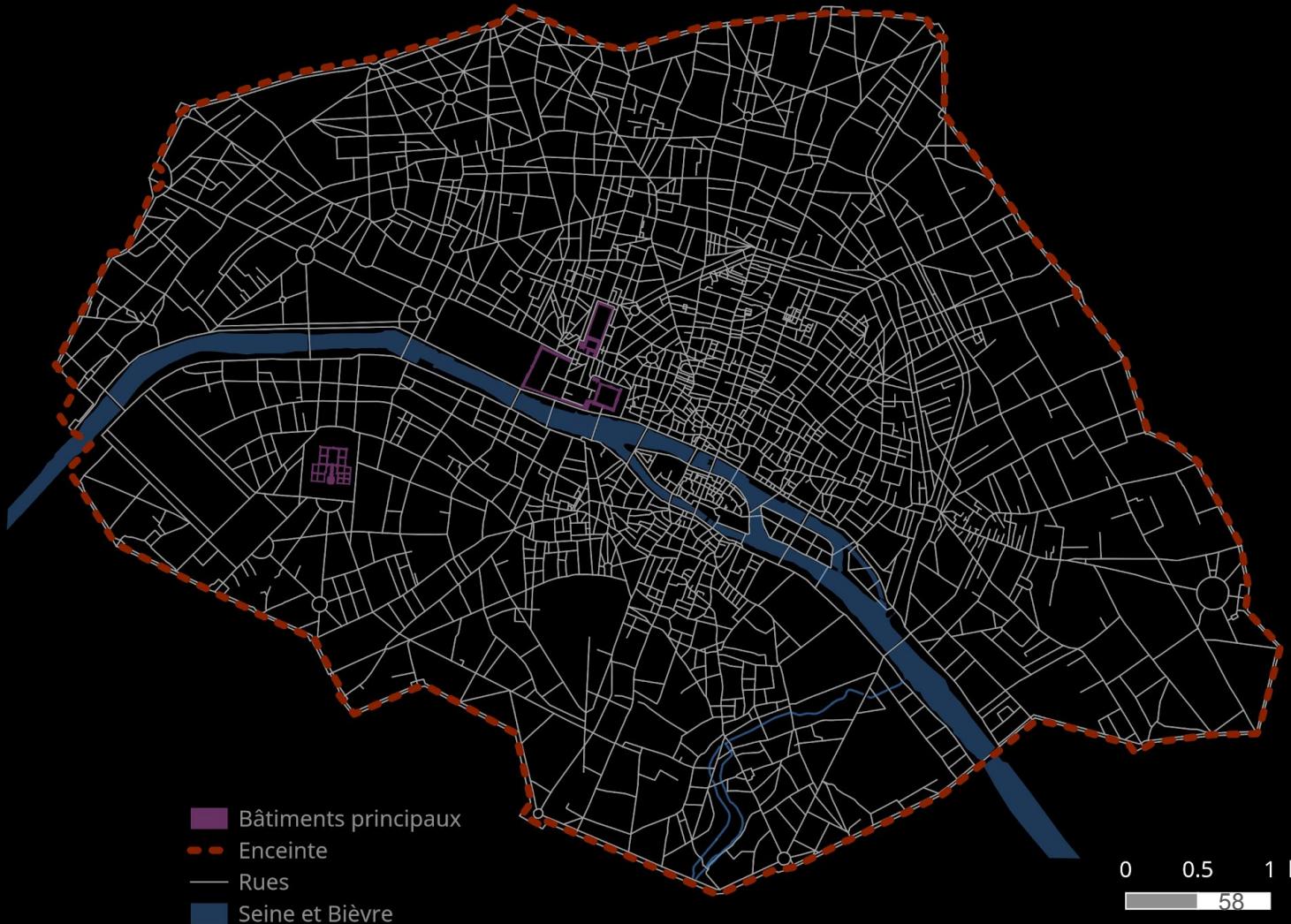
# Resources

- Journées de l'Archéologie des AN (2016,2017) :  
<https://docs.google.com/presentation/d/1IWXIDVVzziO6e0pmnfVQy002kPXO1fkUytAebKXR Pg/edit?usp=sharing>
- GeoHistoricaldata (EuroSDR 2014):  
[https://docs.google.com/presentation/d/1X\\_hRx6zzTOXmHw4pBA78FYHAq2Vs q4ODwfCSNWydZ3s/edit?usp=sharing](https://docs.google.com/presentation/d/1X_hRx6zzTOXmHw4pBA78FYHAq2Vs q4ODwfCSNWydZ3s/edit?usp=sharing)
- GeoHistoricaldata (Journées de la recherche IGN 2015) :  
[https://docs.google.com/presentation/d/1QoVZX\\_azzCH4La3FJ59bVfUo\\_sjnuCsHlhJRJQkFPc/edit?usp=sharing](https://docs.google.com/presentation/d/1QoVZX_azzCH4La3FJ59bVfUo_sjnuCsHlhJRJQkFPc/edit?usp=sharing)
- GeoHistoricaldata (Journées ArchiRes, 2018) :  
<https://docs.google.com/presentation/d/1ZB9ZwEJt5hEh-yInvilvrzKcfel6GgY38zVtgYhQNzw/edit?usp=sharing>
- GeoHistoricaldata :  
<https://docs.google.com/presentation/d/1gIGC6XUL1sQs8DupGUdyJEQQ-9w9bAVVisD4P8riQ7U/edit?usp=sharing>
- Stage IGN sur les paroisses :  
<https://docs.google.com/presentation/d/1ipNajBebMEIFS7X0HF20PwmOXqsnn2fpzGIMC6MAlig/edit?usp=sharing>
- Édition critique de la planche 52 de Cassini : [https://hackmd.iscpif.fr/tvHeUcY\\_QJuSha6yd-GdjA#](https://hackmd.iscpif.fr/tvHeUcY_QJuSha6yd-GdjA#)



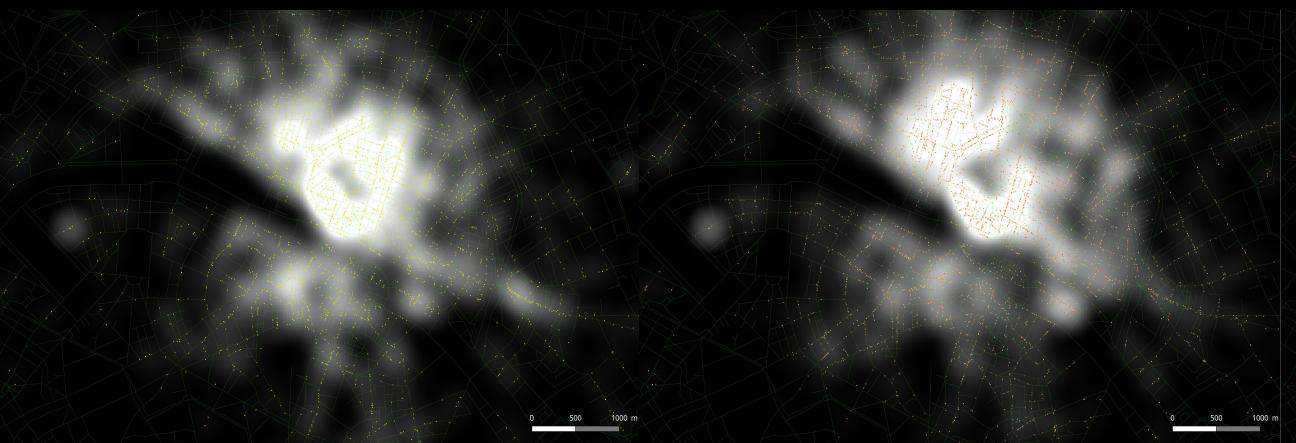












101 à 263 francs

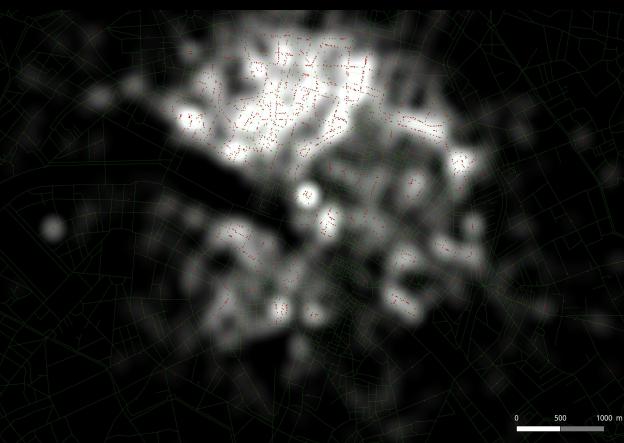
0 500 1000 m

264 à 691 francs

0 500 1000 m

691 à 14 600 francs

61



← → C ⌂ api.geohistoricaldata.org/geocoding?address=12 rue du temple&date=1850&precision=true&maxresults=1

JSON Données brutes En-têtes

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```
▼ 0:
  rank: "1"
  input_adresse_query: "12 rue du temple, 1850"
  historical_name: "12 Rue du Temple"
  normalised_name: "12 Rue du Temple, Paris"
  fuzzy_date: "[1825-01-01,1837-01-01)"
  ▼ geometry:
    type: "GeometryCollection"
    ▼ geometries:
      ▼ 0:
        type: "MultiPoint"
        ▼ coordinates:
          ▼ 0:
            0: 652845.83
            1: 6862655.34
  ▼ geography:
    type: "GeometryCollection"
    ▼ geometries:
      ▼ 0:
        type: "MultiPoint"
        ▼ coordinates:
          ▼ 0:
            0: 2.35726655782271
            1: 48.8622039768356
  historical_source: "jacoubet_paris"
  numerical_origin_process: "jacoubet_paris_number"
  aggregated_distance: 28.848783
  spatial_precision: 3.5
  confidence_in_result: 1
  semantic_distance: 0.261
  temporal_distance: 23.5
  number_distance: 0
  scale_distance: 6.184
  spatial_distance: 0
```

# Results & feedbacks

## PhD theses

Bertrand Duménieu. "Un système d'information géographique pour le suivi d'objets historiques urbains à travers l'espace et le temps". PhD thesis. EHESS, 2015.

Benoît Costes. "Vers la construction d'un référentiel géographique ancien. Un modèle de graphe agrégé pour intégrer, qualifier et analyser des réseaux géohistoriques". PhD thesis. Université Paris-Est, Nov. 2016.

## Scientific papers + reuses

Dumenieu, B., Chadeyron, J., Cristofoli, P., Perret, J., Jolivet, L., Baciocchi, S., ... & Vouloir, M. C. (2019). *Engraved footprints from the past. Retrieving cartographic geohistorical data from the Cassini Carte de France, 1750-1789*.

Costes, B., & Perret, J. (2019). A hidden markov model for matching spatial networks. *Journal of Spatial Information Science*.

Cura, R., Dumenieu, B., Abadie, N., Costes, B., Perret, J., & Gribaudi, M. (2018). Historical collaborative geocoding. *ISPRS International Journal of Geo-Information*, 7(7), 262.

Duménieu, B., Abadie, N., & Perret, J. (2018, April). Assessing the planimetric accuracy of Paris atlases from the late 18th and 19th centuries. In *Proceedings of the 33rd Annual ACM Symposium on Applied Computing* (pp. 876-883). ACM.

Perret, J., Gribaudi, M., & Barthelemy, M. (2015). Roads and cities of 18th century France. *Scientific data*, 2, 150048.

Costes, B., Perret, J., Bucher, B., & Gribaudi, M. (2015, May). An aggregated graph to qualify historical spatial networks using temporal patterns detection. In *18th AGILE International Conference on Geographic Information Science*.