THE SPATIAL DYNAMICS OF SCIENCE

23/11/2017, IXXI, Lyon, « Understanding the dynamics of science »

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Post-doctoral fellowship CNRS, FR INCREASE (3707), Poitiers

Studying the dynamics of science

- A rather old question in philosophy, sociology and history of science
- A rather new question in geography :

S. Shapin, D. Livingstone → the *spatial turn* in STS and *history of science*

With three approaches:

- The« spatial scientometrics » trend (Frenken et al. 2009)
- The qualitative and historical trend mainly developed in the UK (Besse,2010)
- A third pathway combining social studies of science and spatial scientometrics (Grossetti, Milard et Maisonobe, 2015)

Multiscalar analysis

To follow the dynamics of science at the **world level**

Several level of spatial analysis are relevant :

- continental
- macro-regional
- national
- regional
- urban

Multiscalar analysis

To follow the dynamics of science at the **world level**

Several level of spatial analysis are relevant :

- continental
- **macro-regional (community detection)**
- **national**
- regional
- **urban (clusters of publishing localities)**

Research questions

1. How is the world system of science evolving (national contexts, regions of the world, interurban connections) ?
2. How does a speciality can emerge and develop at the world level with connections being activated between all the places that are involved in it ?

The world system of science expansion

- Continuous growth of research activities and publications
- A proliferation of sites of activity (Shofer & Meyer, 2005)
- An increase in the number of higher education personnel (UNESCO, 2010)

→**A re-balancing of the global scientific output over the last thirty years at the country and at the city level** (Grossetti et al., 2014)

- **What about the structure of the world network of collaboration ?**
- Is the globalization of scientific production activities accompanied by a blurring of national contexts to the benefit of global collaborative networks or on the contrary do national and macro-regional areas still have a structuring effect on the distribution of scientific cooperation ?

Data and method

- In 2013, more than 10 000 revues and about 2 millions of publications indexed in the Web of Science (SCI Exp, SSCI, AHCI)

1. **GEOCODING** : Almost 98% of all WoS publications (articles, reviews, letters) have been geocoded (1999-2014) = 19 millions publications
2. **CLUSTERING** : After the geocoding, the publication data are clustered by urban areas
3. **COUNTING** : Whole normalized counting (Gauffriau et al., 2008)

Ekert et al., 2013; Jégou, 2014; Grossetti et al., 2014; Maisonobe et al., 2016

Should I go by bus? The liberalization of the long-distance bus industry in France

By: Blayac, T (Blayac, Thierry)[1]; Bougette, P (Bougette, Patrice)[2]

TRANSPORT POLICY
Volume: 56 **Pages:** 50-62
DOI: 10.1016/j.tranpol.2017.03.004
Published: MAY 2017
View Journal Impact

Abstract

The opening up of the French long-distance bus industry is one of the outcomes of the Loi Macron. In this study, we build a unique data set of several representative bus routes and show that the effects of the liberalization have been encouraging in terms of fares, new entry, higher frequency, and higher quality. First, with regard to international routes that used to be under cabotage, we find that relaxing quantitative restrictions has led to the expected results on the Lyon-Torino and Paris-London routes. Second, with regard to domestic routes newly created from the Loi Macron, mostly all procompetitive expected variations in the variables have been observed, except for fares. Indeed, we show that bus operators used an initial aggressive pricing strategy to induce demand for the new services and then increased fares once customers became accustomed with the service.

Keywords

Author Keywords: Transportation services; Deregulation; Bus industry; Loi Macron; Intermodal competition; France
KeyWords Plus: DEREGULATION; MARKET

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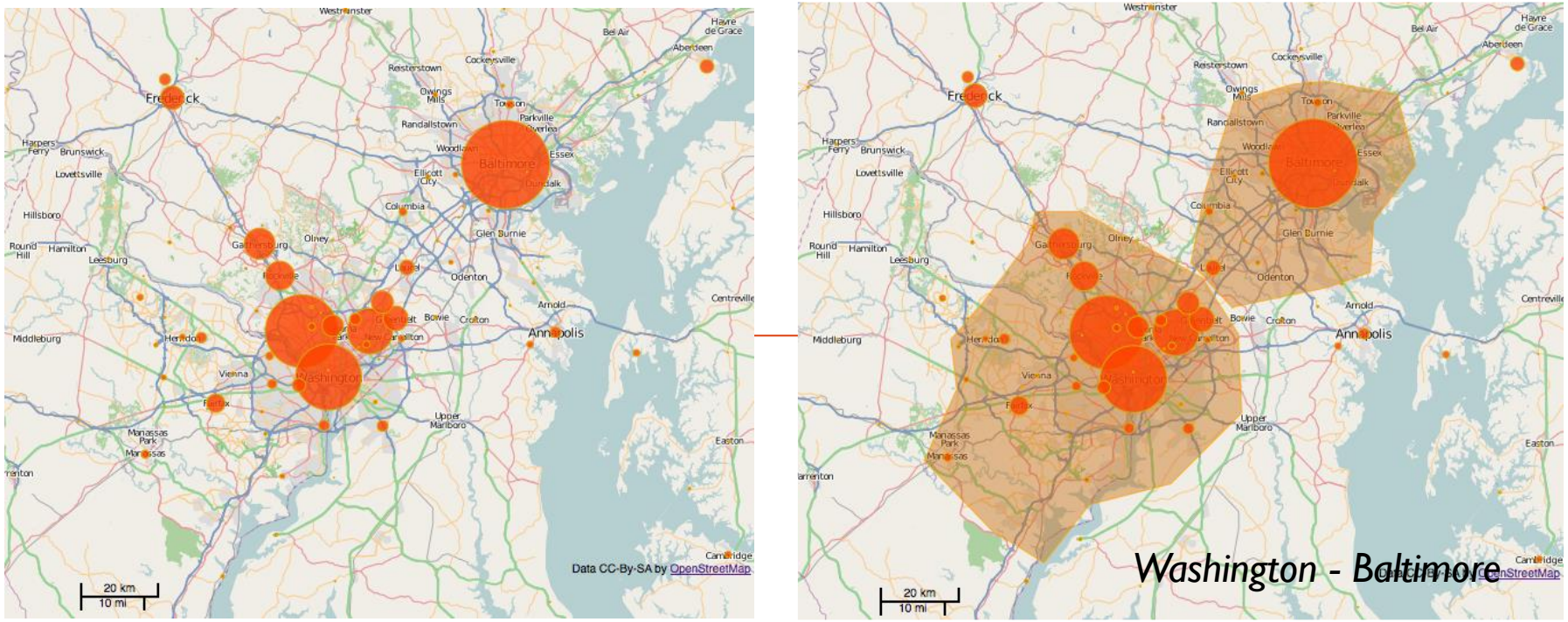
Publisher

ELSEVIER SCI LTD, THE BOULEVARD, LANGFORD LANE, KIDLINGTON, OXFORD OX5 1GB, OXON, ENGLAND

Localising the municipalities from which researchers are signing their publications

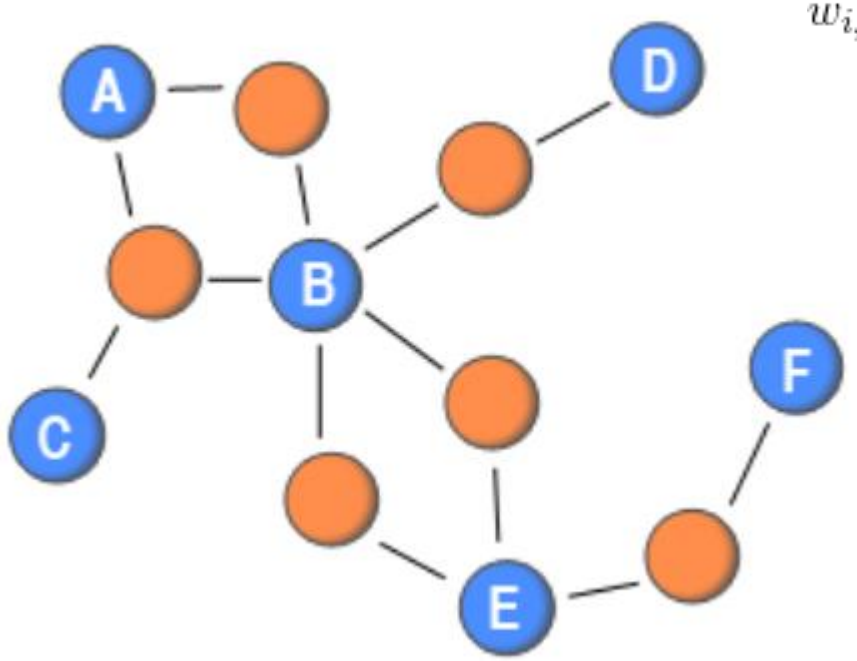
Building urban areas' perimeters using the distribution of population density



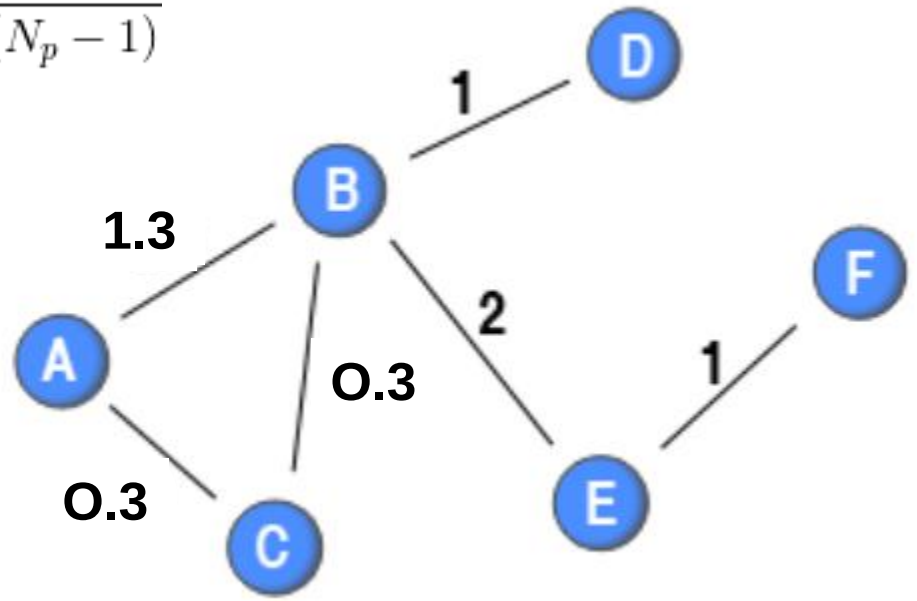
a spatial bibliometrics method to study science at the world scale and at the urban area resolution level

Normalizing the link values

The sum of the links equals the total nb of co-publications in the corpus

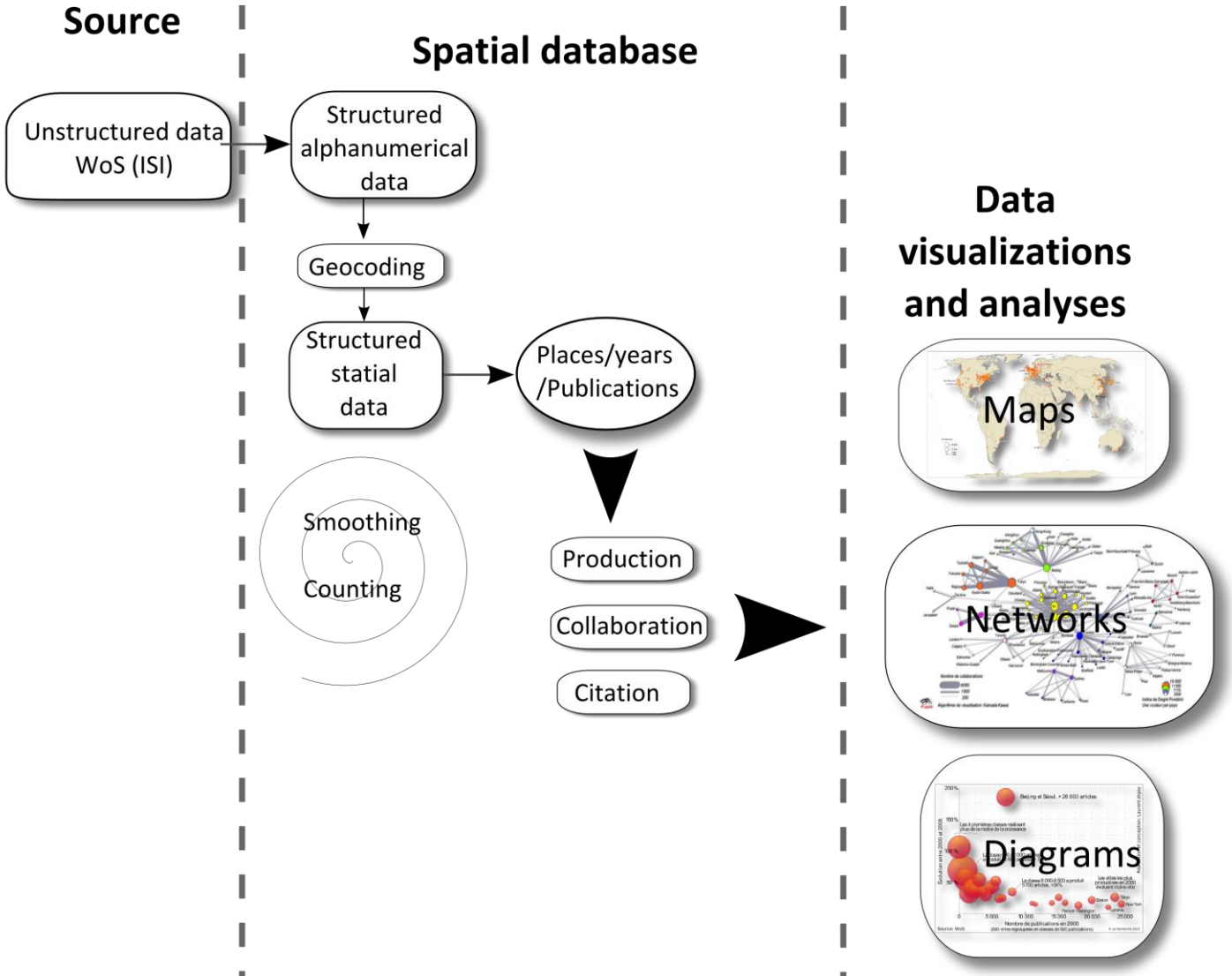


$$w_{i,j} = \sum_p \frac{2}{N_p(N_p-1)}$$



1.3+0.3+0.3+2+1+1 = 6

The process of treating spatialized bibliometric information



Designed by L.Jégou & M.Maisonobe. Geoscience and Netscience Projects.

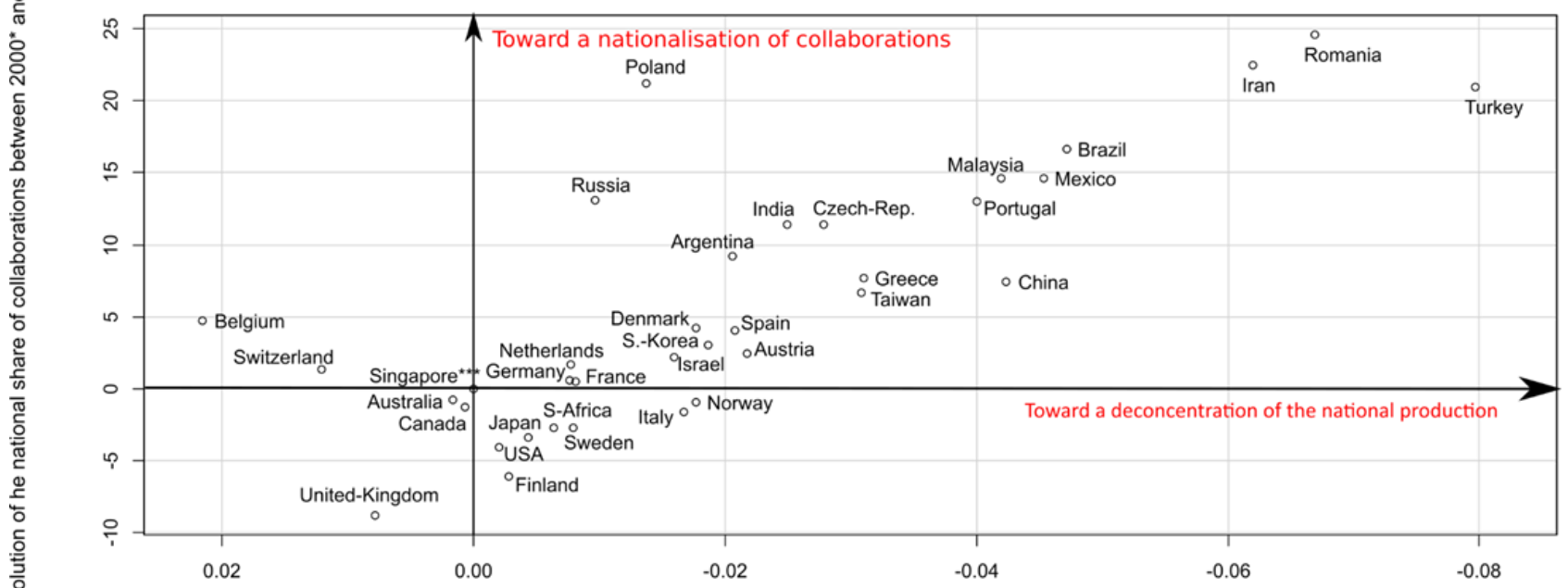
Geographic structure of world science production

Proportion of scientific publications (articles, reviews and reports) attributed to …	2000*	2007*	2013*
one agglomeration and one address	51.3	46.2	38.7
one agglomeration and several addresses	17.9	18.7	20.4
several agglomerations in the same country	15.5	17.7	20
several agglomérations, several countries	15.2	17.3	21
Total (%)	100	100	100
Total number of articles, reviews and reports	*753 377*	*1 098 161*	*1 467 464*

Source: WoS.

Note: * Full undivided counting, three-year moving average.

Correlation between the evolution of the Gini index** applied to the national production
and the national share of collaborations
(The 36 countries that published the most in 2013* in the SCI Expanded)



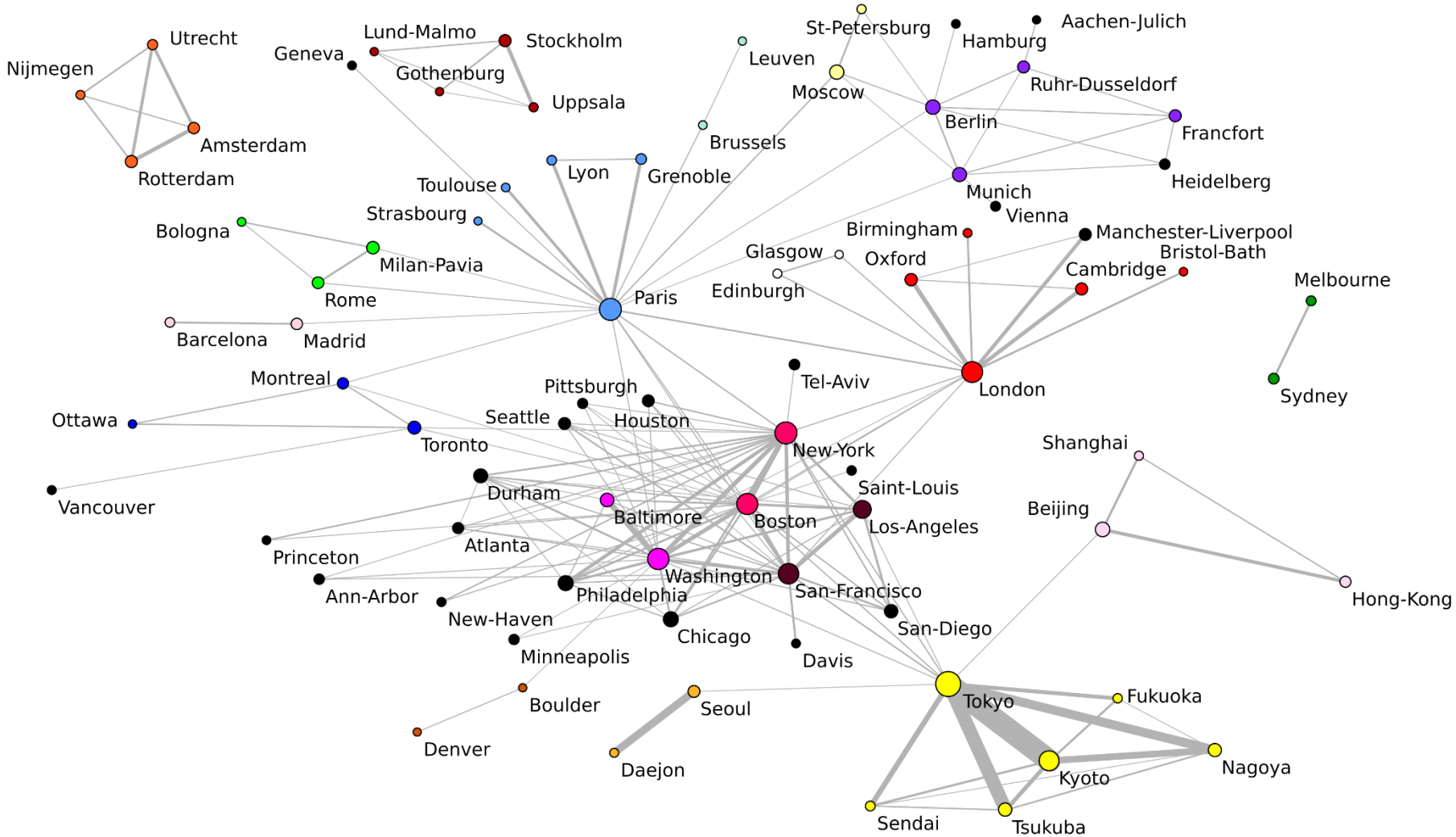
Evolution of the disparity index** applied to the national production by urban areas

*three-year moving average, whole normalized counting.
Source: SCI Expanded (articles, reviews and letters)
**The Gini index ranging from 0 to 1 measures discrepancy within a static distribution,
in other words here, the discrepancy between urban areas's national share of scientific production
***Singapour is a city state with only one urban area

1. Linear Regression: Multiple R-squared (r^2): 0,62
p-value: 1.05e-08
2. Pearson Correlation Coefficient: -0,79
p-value = 1.045e-08

MM

World network of interurban scientific collaborations in 2000*



Designed by: Marion Maisonobe

Co-authorship volume
Weighted degree
11 400
6000
1200

Lines values
2900
1300
550
155

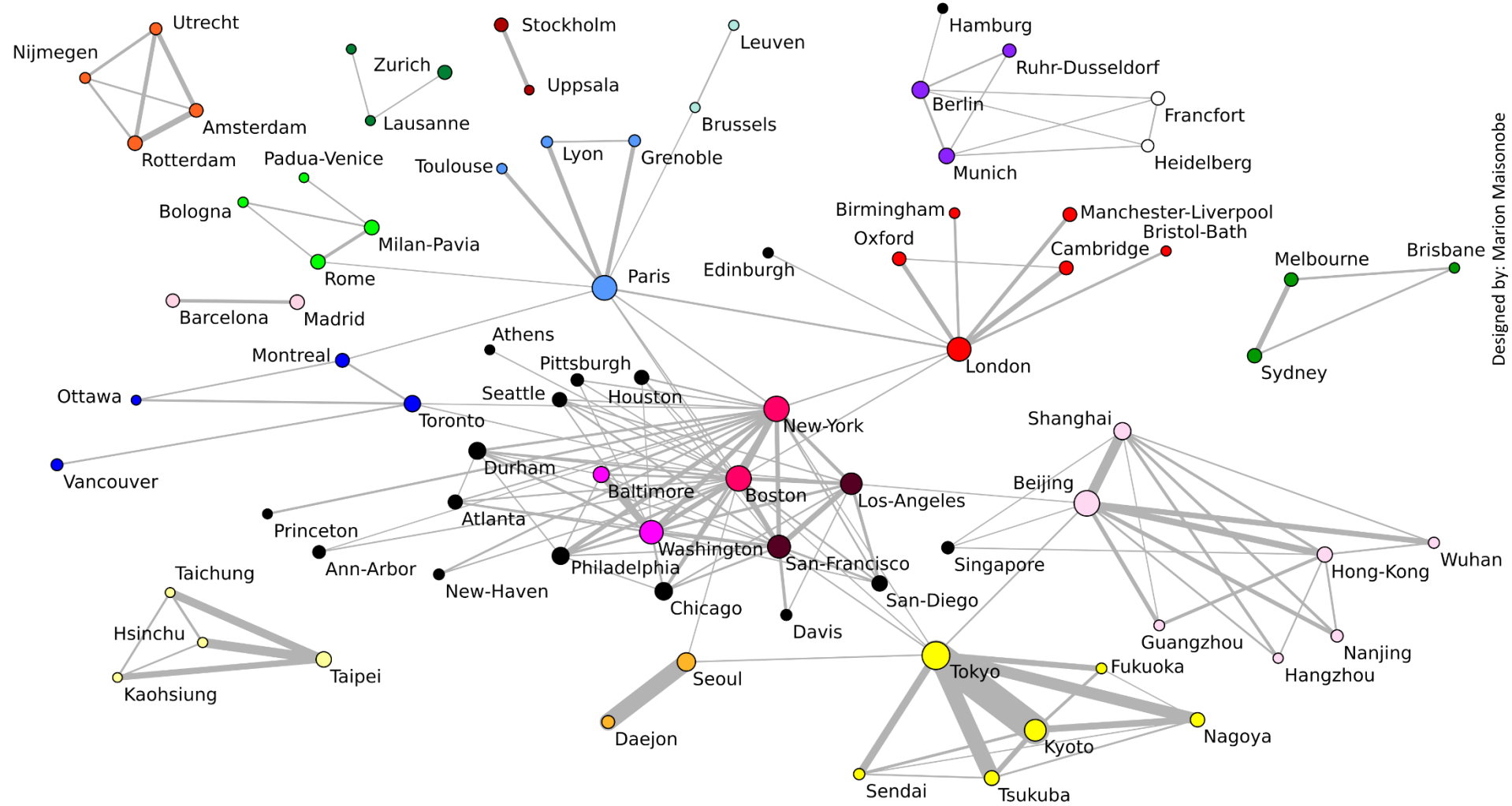
Pajek

Whole Normalized Counting, moving average (3 years)

Thresholds:
Scientific collaborations lines superior to 60 coauthorships in 2000*
Scientific agglomerations with a weighted degree value upper than 1000 in 2000*
Colored groups are islands (islands, taille min 2/max 45): islands are group of nodes more connected to each others than with neighboring nodes
Layout algorithm: Kamada Kawai applied on the network structure in 2013*

Source: SCIExp (articles, reviews, letters)

World network of interurban scientific collaborations in 2007*



Co-authorship volume

Weighted degree

11 400

6000

1200

Lines values

2900

1300

550

155

Pajek

Whole Normalized Counting, moving average (3 years)

Thresholds:

Scientific collaborations lines superior to 95 coauthorships in 2007*

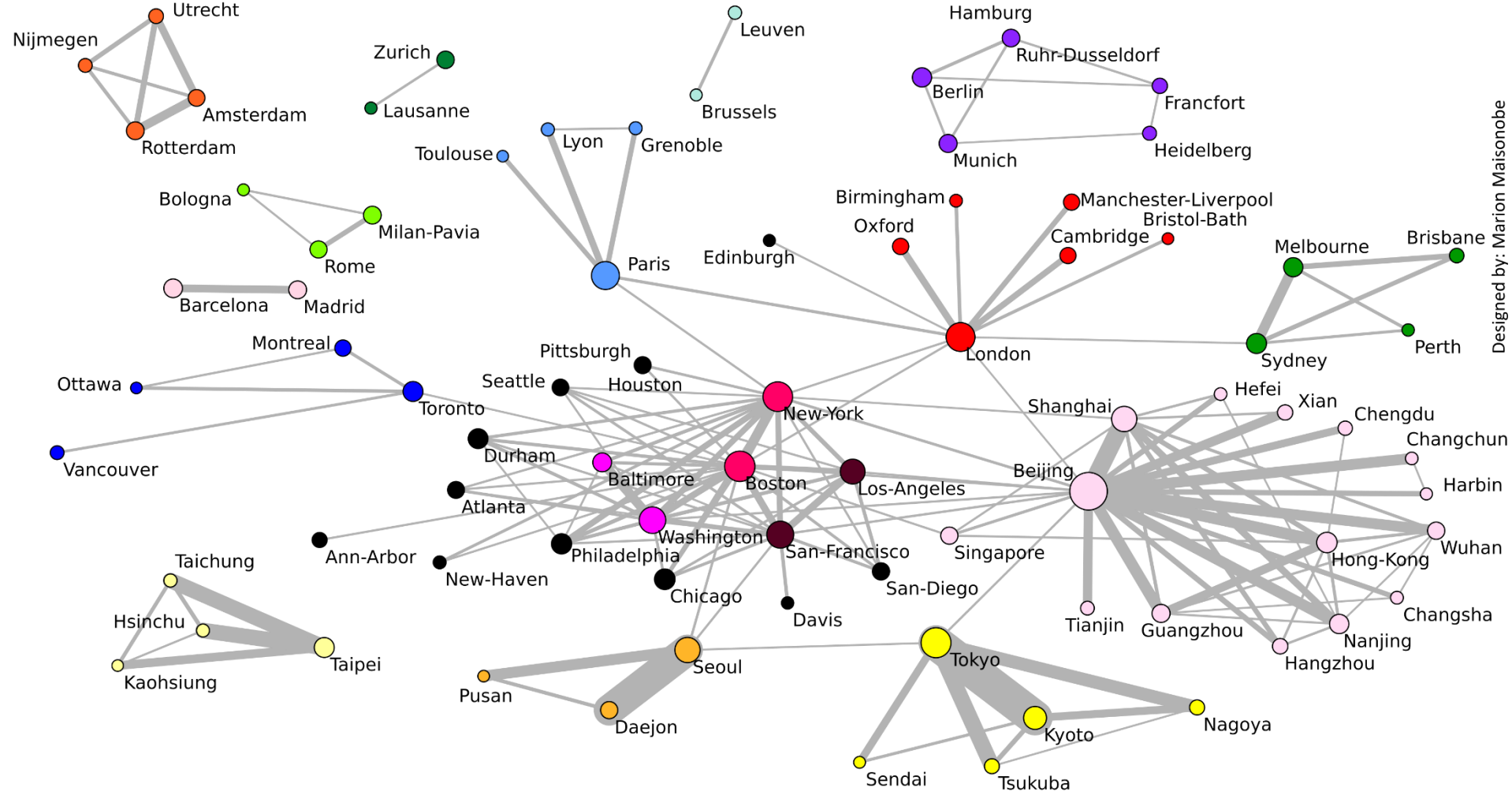
Scientific agglomerations with a weighted degree value upper than 1470 in 2007*

Colored groups are islands (islands, taille min 2/max 45): islands are group of nodes more connected to each others than with neighboring nodes

Layout algorithm: Kamada Kawai applied on the network structure in 2013*

Source: SCIExp (articles, reviews, letters)

World network of interurban scientific collaborations in 2013*



Co-authorship volume

Weighted degree

11 400

6000

1200

Lines values

2900

1300

550

155

Pajek

Whole Normalized Counting, moving average (3 years)

Thresholds:

Scientific collaborations lines superior to 154 coauthorships in 2013*

Scientific agglomerations with a weighted degree value upper than 1148 in 2013*

Colored groups are islands (islands, taille min 2/max 45): islands are group of nodes more connected to each others than with neighboring nodes

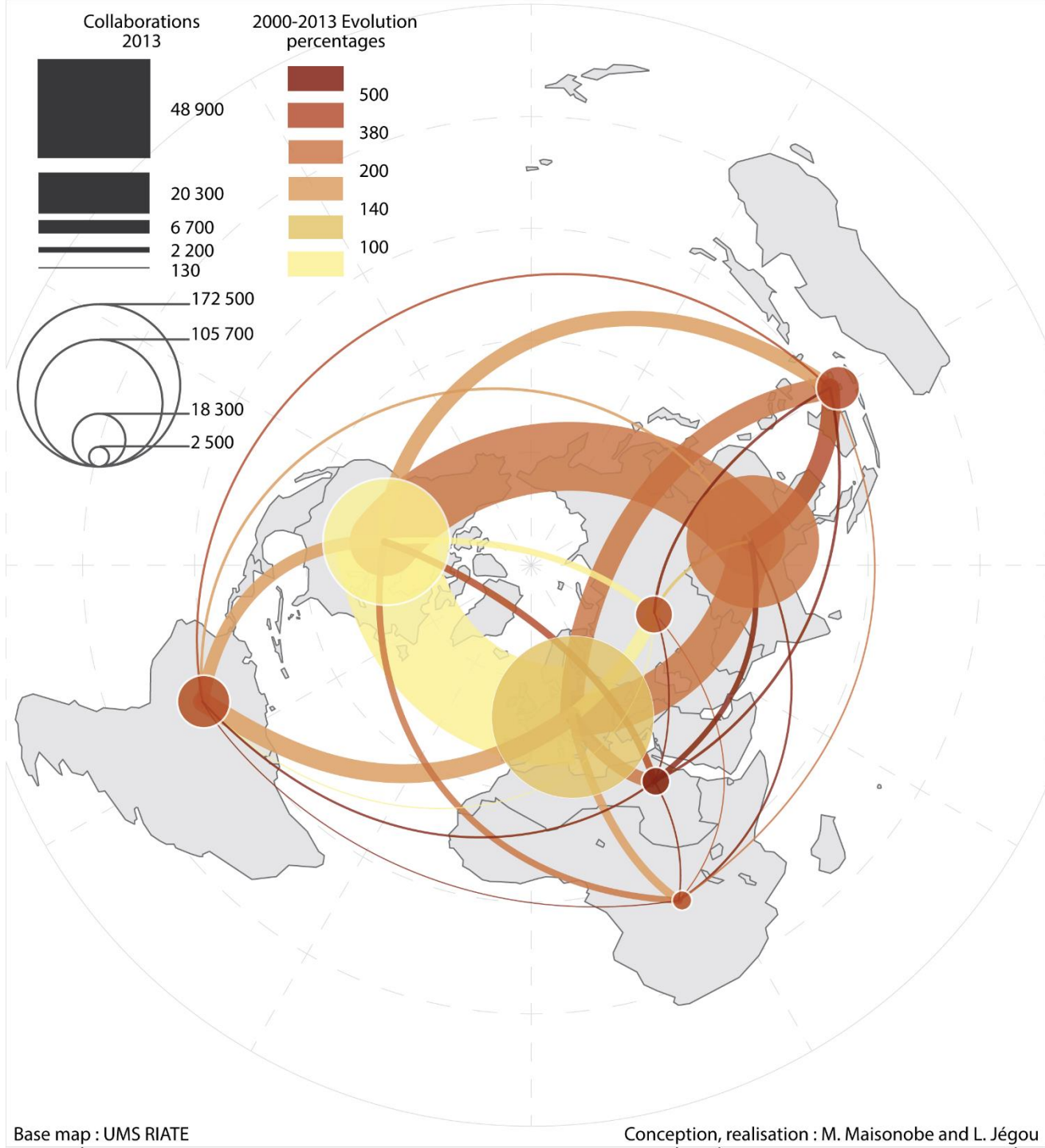
Layout algoriithm: Kamada Kawai applied on the network structure in 2013*

Source: SCIExp (articles, reviews, letters)

Trends in the development of collaborative structures according to major world regions

Europe	2000*	2007*	2013*		Russian world	2000*	2007*	2013*	
Intranational Links (%)	43.0	44.1	44.3	↗	Intranational Links (%)	29.0	41.6	56.5	↗
Intra-Europe Links (%)	33.0	32.3	31.5	↘	Intra-Russian world Links(%)	3.4	3.0	2.6	↘
Links with ROW** (%)	24.1	23.6	24.2		Links with RoW ** (%)	67.7	55.4	40.9	↘
	100	100	100			100	100	100	
Number of publications	*102614*	*156549*	*227732*		*Number of publications*	*5574*	*8249*	*15797*	
North America	2000*	2007*	2013*		Oceanic world	2000*	2007*	2013*	
Intranational Links (%)	66.1	64.9	61.9	↘	Intranational Links (%)	36.1	34.6	35.6	
Intra-N.-Am Links (%)	5.3	5.4	4.9		Intra-Oceanic Links (%)	7.5	8.0	8.6	↗
Links with RoW** (%)	28.6	29.7	33.2	↗	Links with RoW ** (%)	56.4	57.3	55.9	
	100	100	100			100	100	100	
Number of publications	*77738*	*116079*	*158381*		*Number of publications*	*7223*	*14120*	*28454*	
Asiatic world	2000*	2007*	2013*		Arab world	2000*	2007*	2013*	
Intranational Links (%)	70.1	71.3	71.0	↗	Intranational Links (%)	19.6	24.7	22.5	↗
Intra-Asian Links (%)	5.5	6.4	5.5		Intra-Arab world Links (%)	9.6	11.4	20.5	↗
Links with RoW ** (%)	24.4	22.3	23.5	↘	Links with RoW ** (%)	70.8	63.8	57.0	↘
	100	100	100			100	100	100	
Number of publications	*38224*	*80890*	*149438*		*Number of publications*	*1730*	*3903*	*12243*	
Latin America	2000*	2007*	2013*		Sub-saharan Africa	2000*	2007*	2013*	
Intranational Links (%)	43.3	56.0	60.8	↗	Intranational Links (%)	25.6	28.1	28.1	↗
Intra-Lat-Am Links (%)	8.5	7.1	6.3	↘	Intra-Sub-s Africa Links (%)	6.6	9.3	10.6	↗
Links with RoW ** (%)	48.2	36.9	32.9	↘	Links with RoW ** (%)	67.8	62.5	61.3	↘
	100	100	100			100	100	100	
Number of publications	*6866*	*15124*	*27364*		*Number of publications*	*1760*	*3546*	*6614*	

Source: SCI Expanded (articles, reviews, letters)
*Note : *Fractional whole number counting (WNC), three-year moving average. **ROW = Rest of World.*


Collaborations 2013
48 900
20 300
6 700
2 200
130
172 500
105 700
18 300
2 500
2000-2013 Evolution percentages
500
380
200
140
100
Base map : UMS RIATE
Conception, realisation : M. Maisonobe and L. Jégou

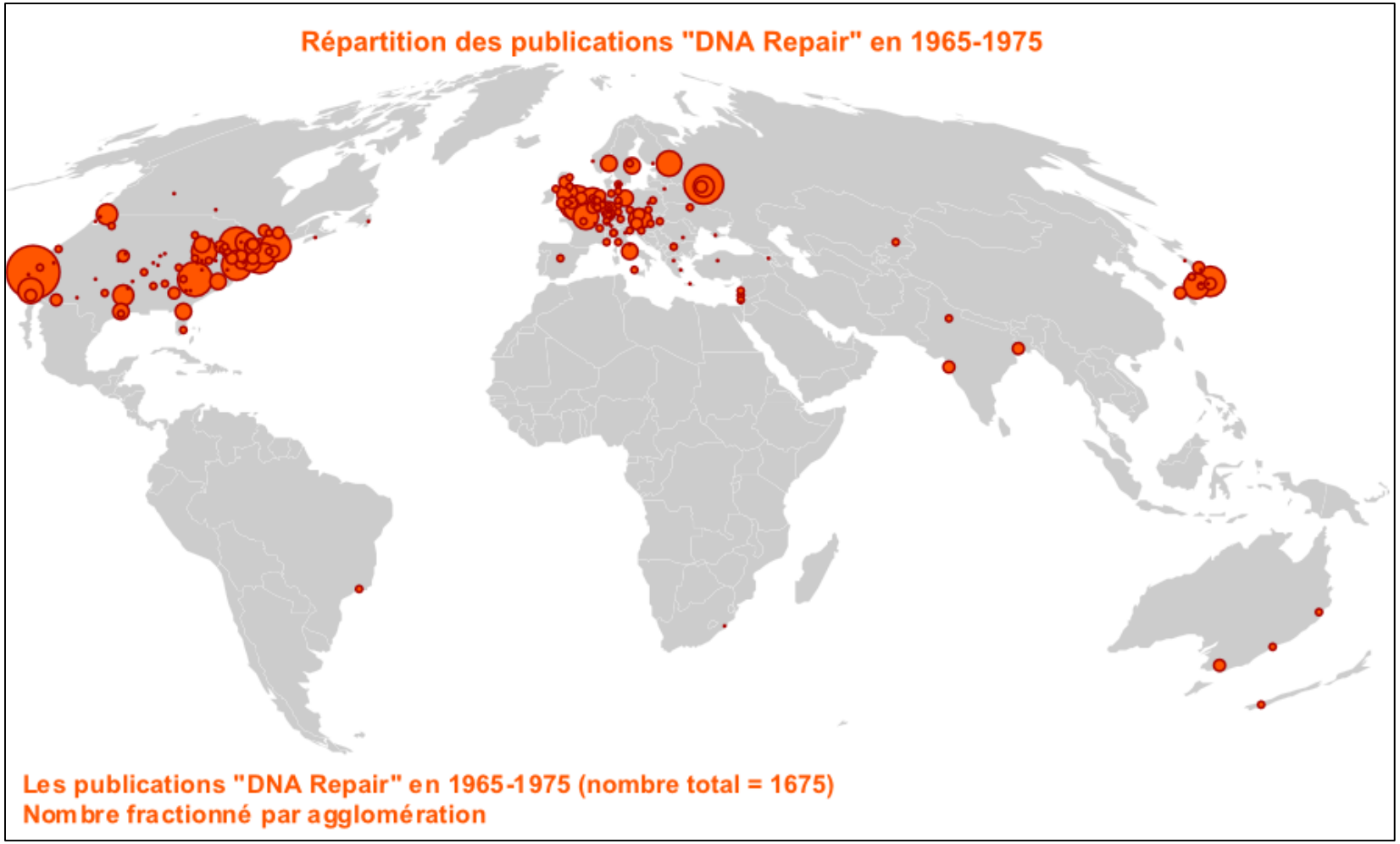
Main results

- An increasingly multi-centric structure of scientific collaboration (Glänzel et al, 2008; Henneman et al, 2012; Maisonobe et al, 2016)
- Overall growth of all types of collaborations to the detriment of single author articles
- An higher growth of intra-national collaborations in countries where the deconcentration process of the production have been the most intensive between 2000 and 2013
- The integration of China into the world network + the importance of intra-national links in the structuration and the growth of the world network
- Higher growth of macro-regional collaborations inside the Arab World and inside the Sub-saharian area
- Higher growth of collaborations between the macro-regional areas that are the most peripheric (South-South cooperation)

References

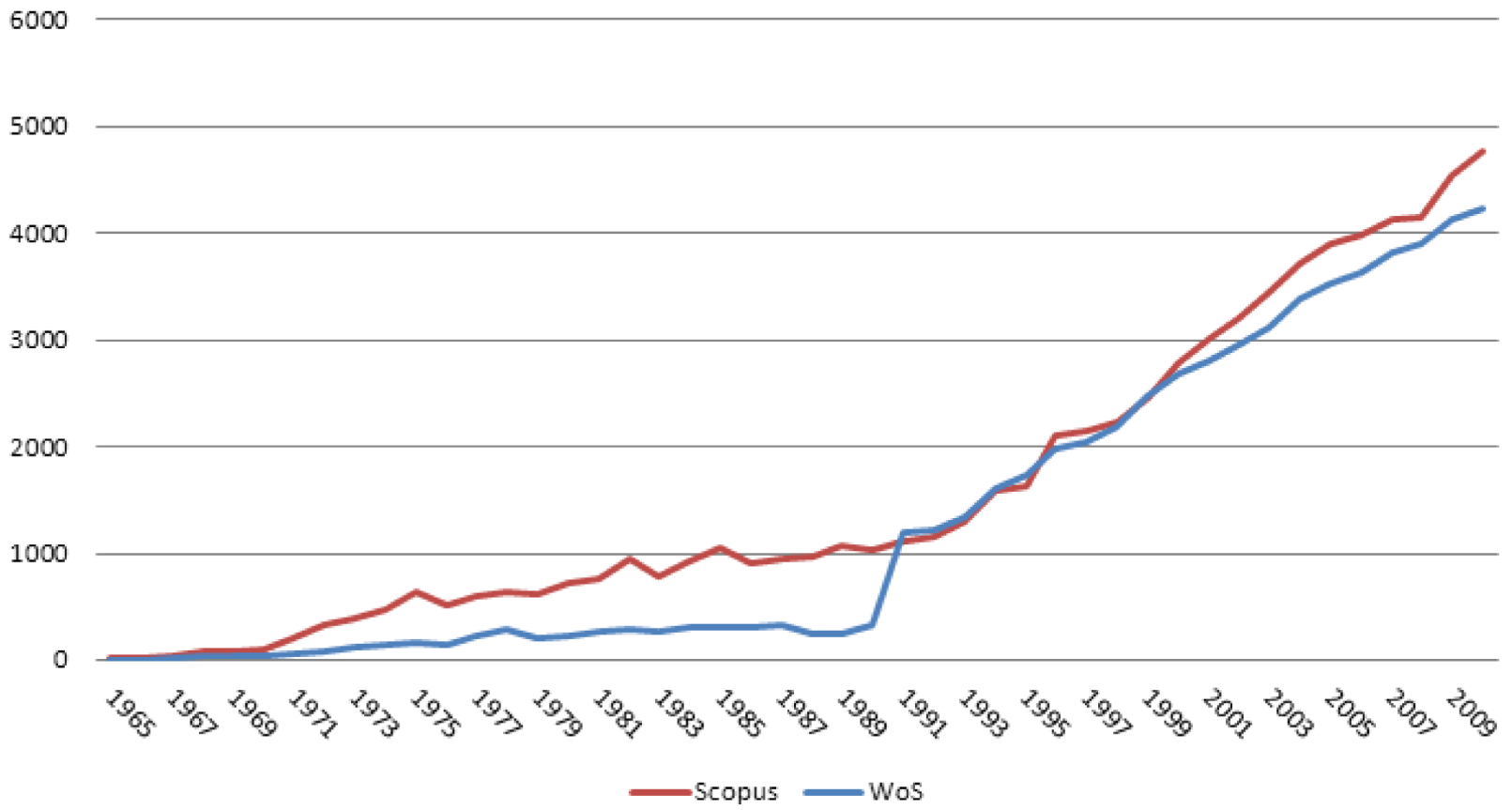
- Maisonobe Marion, Grossetti Michel, Eckert Denis, Jégou Laurent and Milard Béatrice. In press. « The Global Evolution of Scientific Collaboration Networks Between Cities (1999-2014): Multiple Scales ». Updated version. *Revue Française de Sociologie* 57(3).
- Maisonobe Marion, Grossetti Michel, Milard Béatrice, Jégou, Laurent, and Eckert Denis. 2017. « The global geography of scientific visibility: a deconcentration process (1999–2011). » *Scientometrics*, 1-15.
- Maisonobe Marion, Grossetti Michel, Eckert Denis, Jégou Laurent and Milard Béatrice. 2016. « L'évolution mondiale des réseaux de collaborations scientifiques entre villes : des échelles multiples ». *Revue Française de Sociologie* 57 (3) : 415-438.
- Maisonobe Marion, Eckert Denis, Grossetti Michel, Jégou Laurent and Milard Béatrice. 2016. « The world network of scientific collaborations between cities: domestic or international dynamics? ». *Informetrics* 10 (4): 1025-2036.

- **ANY QUESTIONS ?**



The spatial emergence of DNA Repair studies

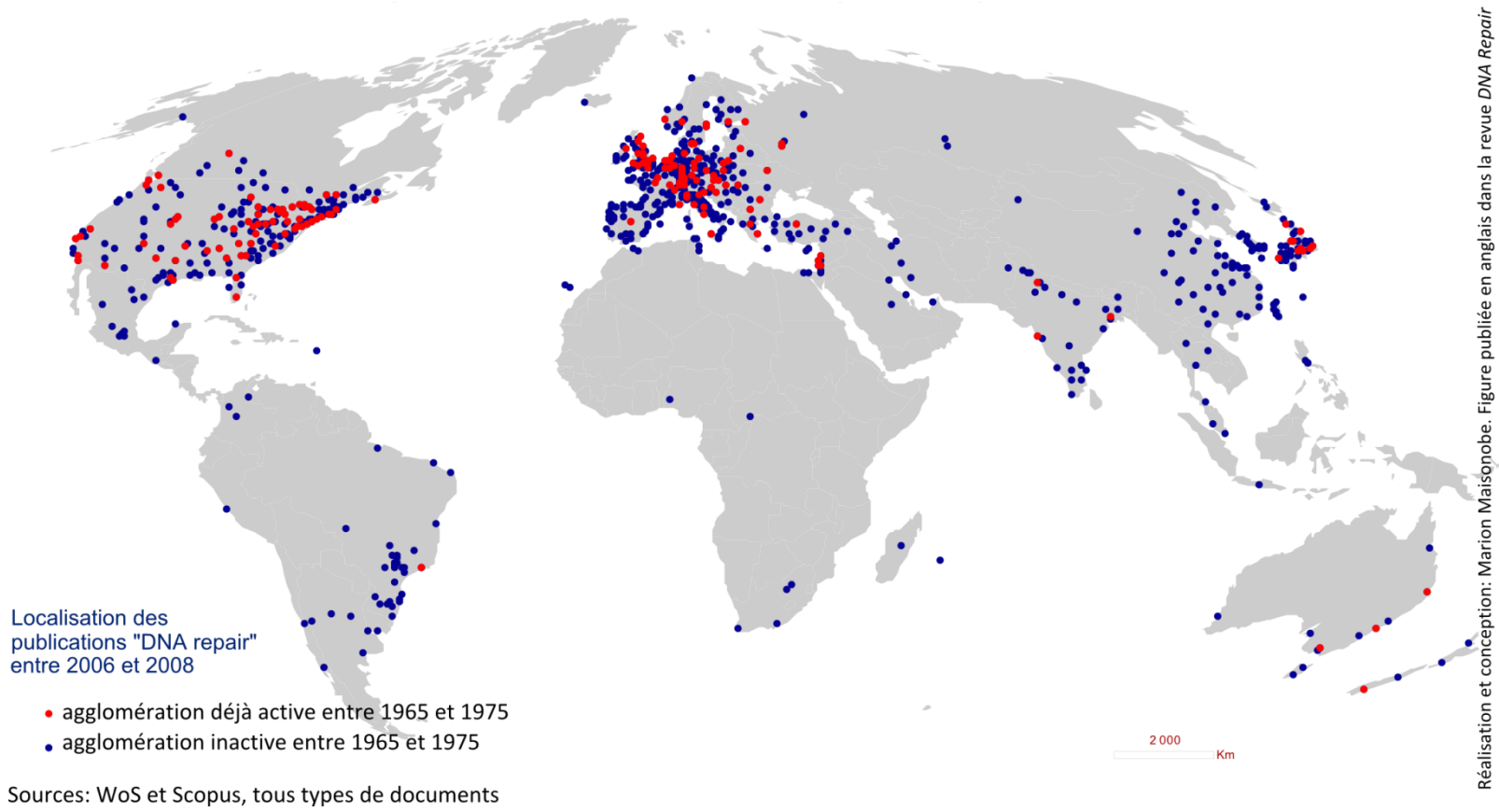
Number of DNA Repair publications per year



Two bibliographic databases:

the Web of Science (Thomson Reuters) and Scopus (Elsevier)

The spatial diffusion of the DNA Repair community



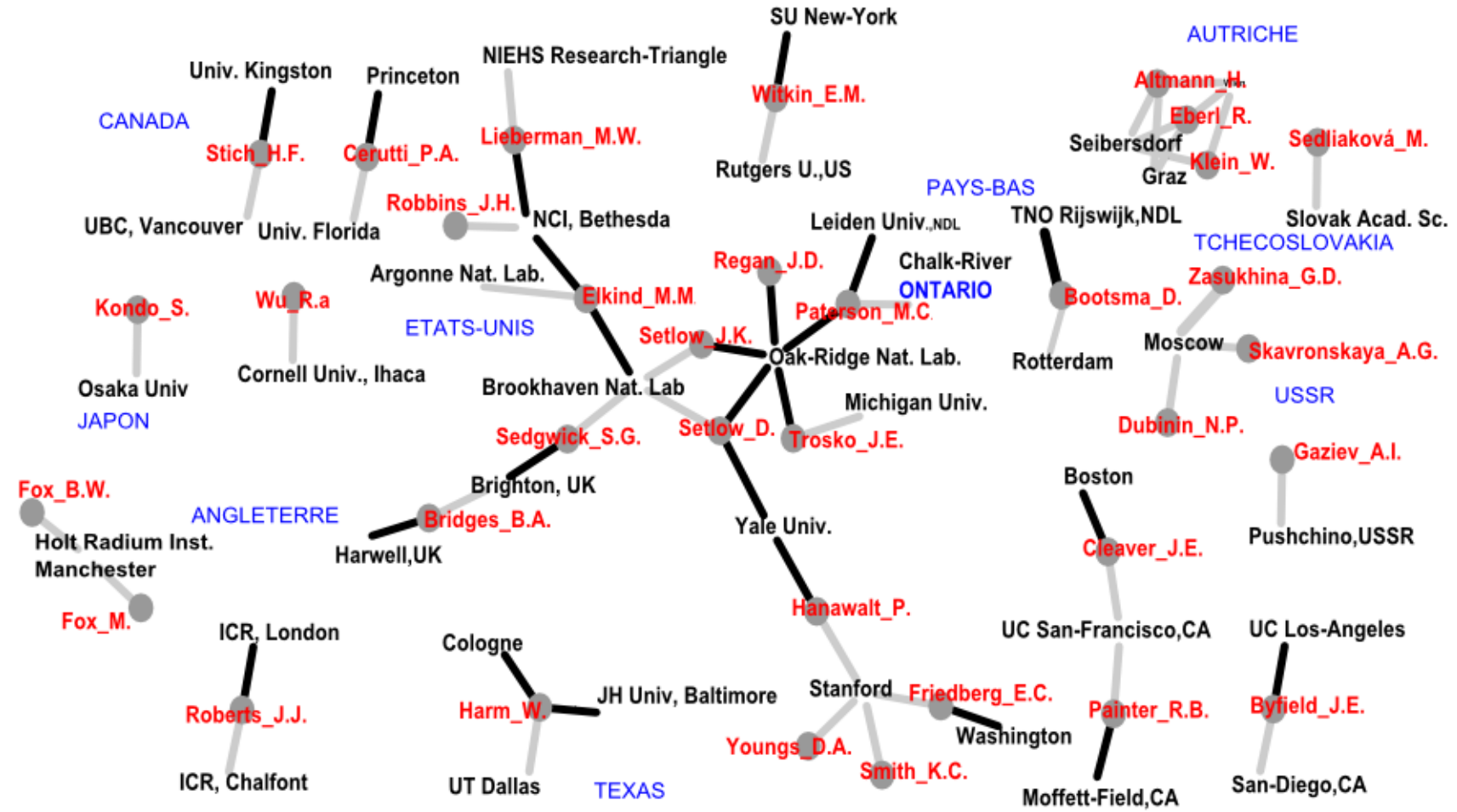
A geographic spread from three sources:

USA, Europe, Japan (the Triad)

Following pioneers trajectories

Authors having signed at least 10 « DNA Repair » publications between 1965-1975

Smith, K.C.
Cleaver, J.E.
Bridges, B.A.
Stich, H.F.
Setlow, R.B.
Painter, R.B.
Altmann, H.
Hanawalt, P.C.
Fox, M.
Lieberman, M.W.
Zasukhina, G.D.
Gaziev, A.I.
Skavronskaya, A.G.
Witkin, E.M.
Eberl, R.
Kondo, S.
Regan, J.D.
Roberts, J.J.
Setlow, J.K.
Trosko, J.E.
Wu, R.
Bootsma, D.
Cerutti, P.A.
Dubinin, N.P.
Elkind, M.M.
Harm, W.
Sedgwick, S.G.
Byfield, J.E.
Fox, B.W.
Friedberg, E.C.
Klein, W.
Robbins, J.H.
Sedliakova, M.
Youngs, D.A.
Paterson, M.C.



Trajectoires des premiers spécialistes de la réparation de l'ADN
(Ayant publié au moins 10 article avec le mot-clef "DNA Repair" avant 1975.)

Affiliation précédente
Affiliation suivante

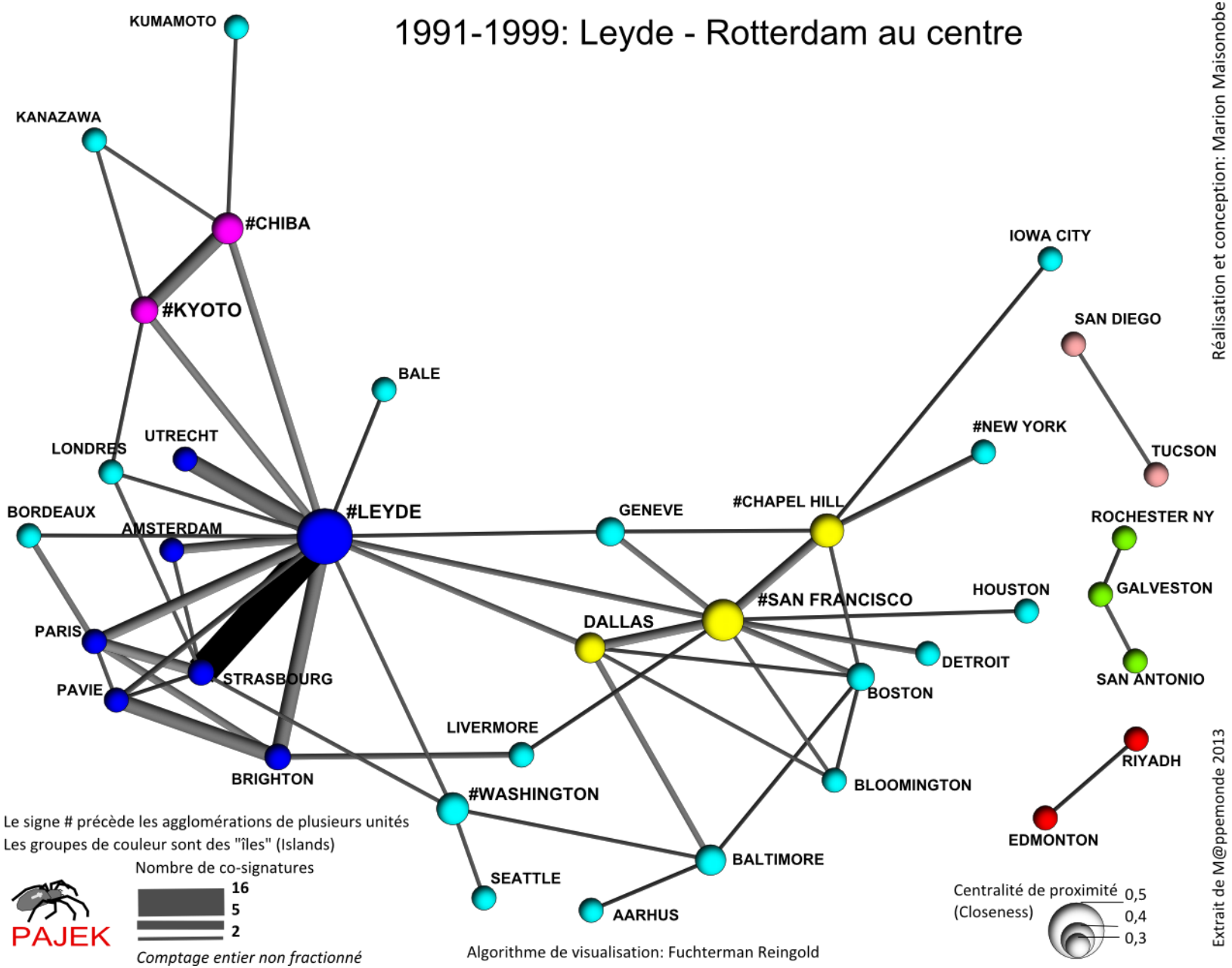
Réseau bipartite(auteurs-institutions) fait avec Cytoscape.

Pionniers

Institutions
ETATS

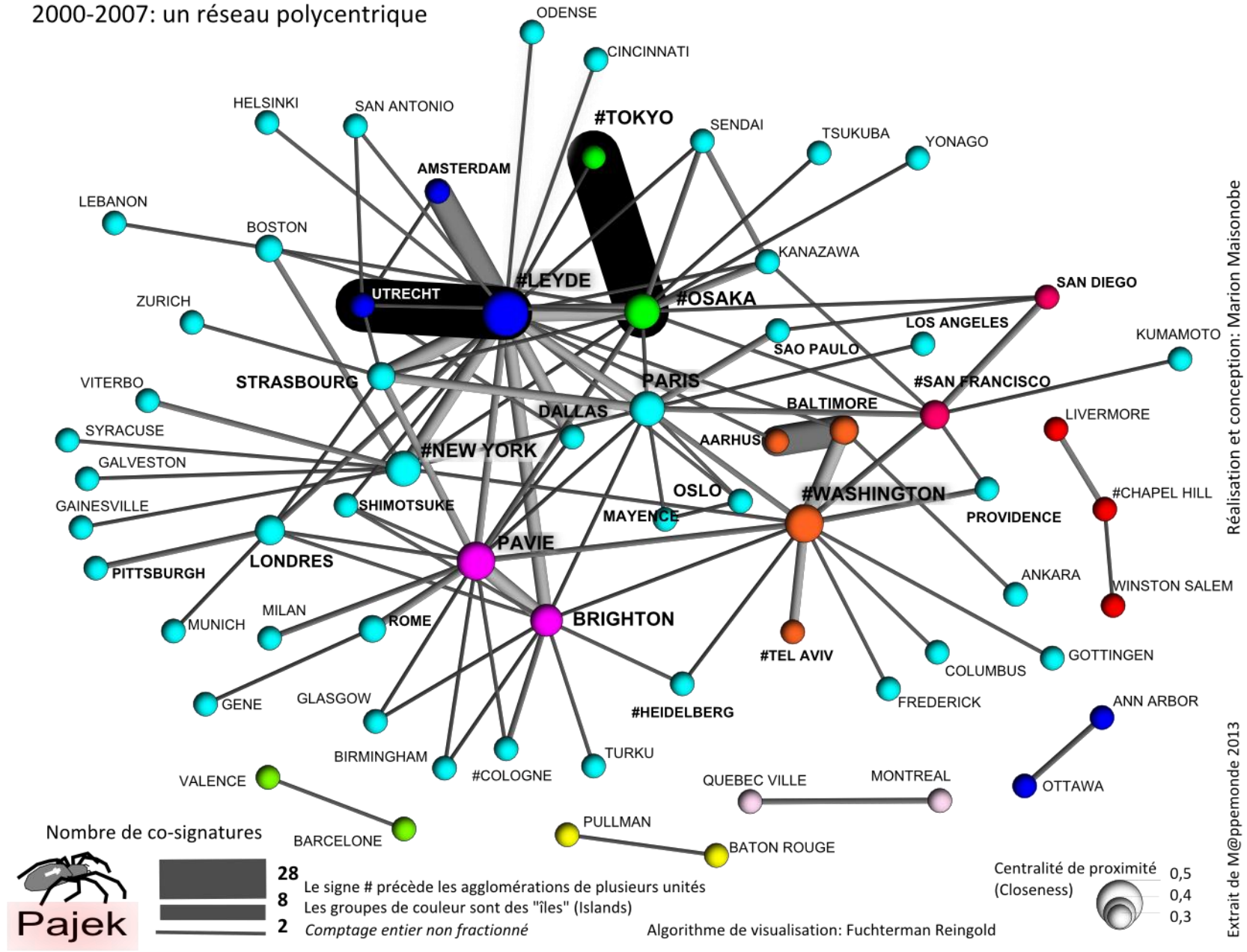
Conception et réalisation: Marion Maisonobe

1991-1999: Leyde - Rotterdam au centre



Réalisation et conception: Marion Maisonobe

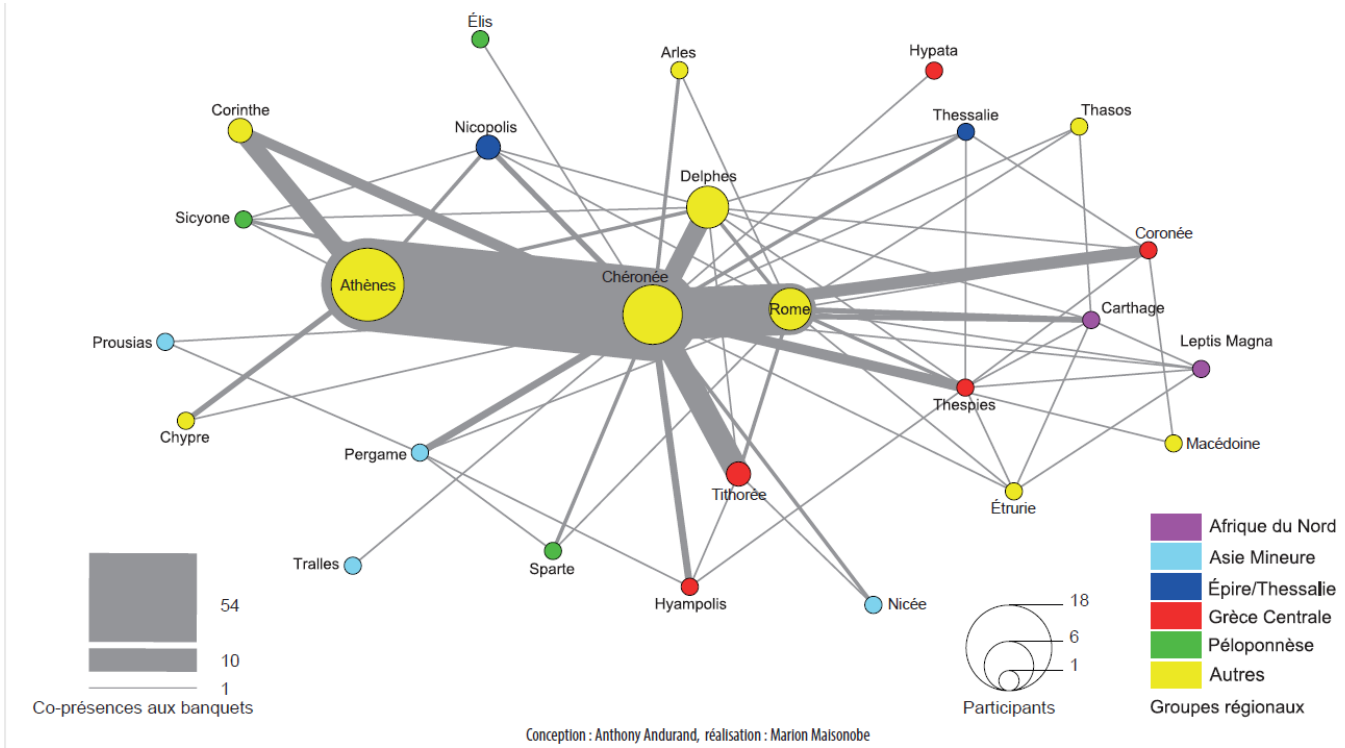
Extrait de M@ppemonde 2013

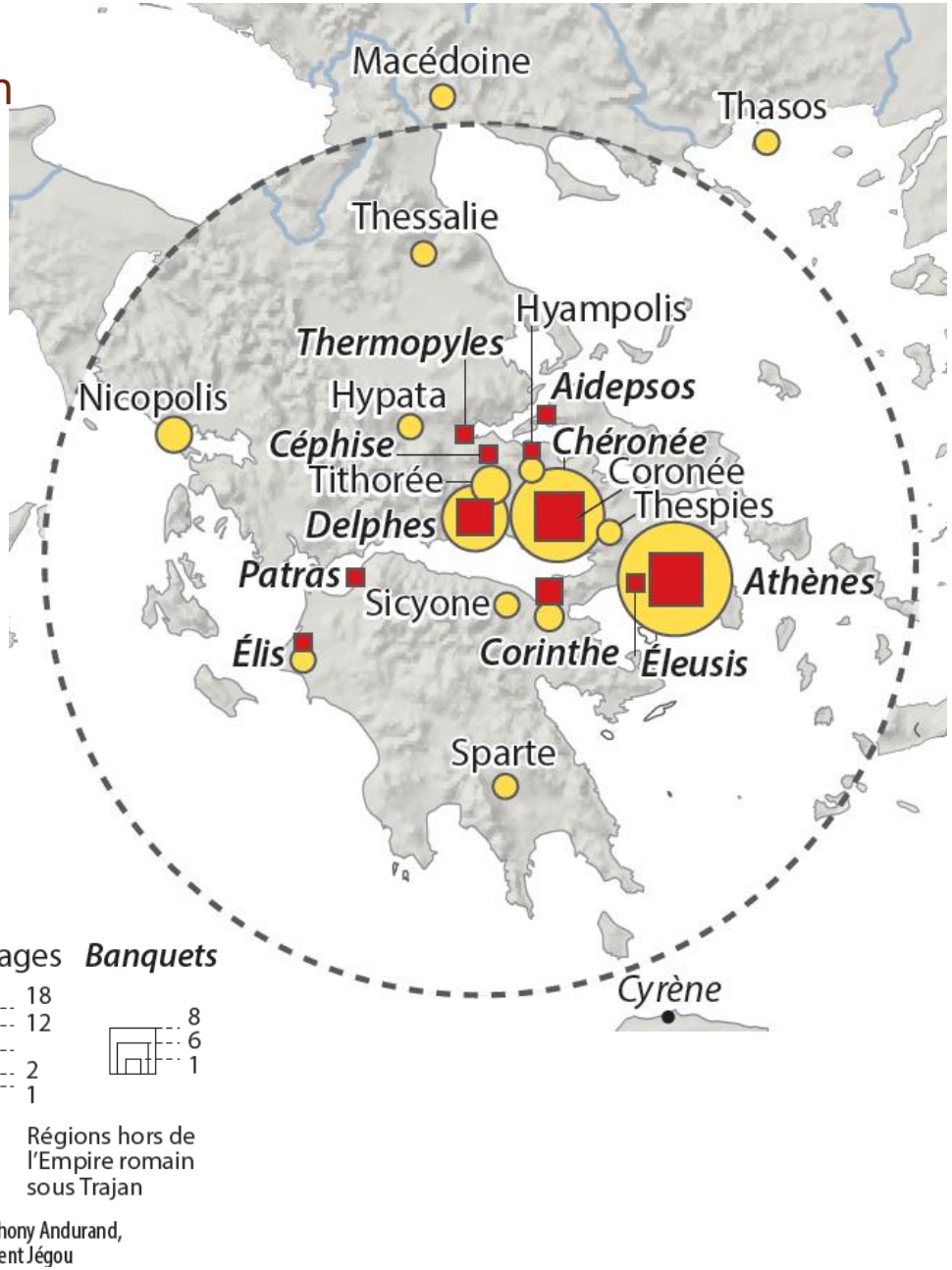

2000-2007: un réseau polycentrique
ODENSE
CINCINNATI
HELSINKI
SAN ANTONIO
#TOKYO
SENDAI
TSUKUBA
YONAGO
AMSTERDAM
LEBANON
BOSTON
KANAZAWA
#LEYDE
UTRECHT
#OSAKA
SAN DIEGO
ZURICH
LOS ANGELES
SAO PAULO
KUMAMOTO
VITERBO
STRASBOURG
PARIS
#SAN FRANCISCO
BALTIMORE
DALLAS
LIVERMORE
SYRACUSE
AARHUS
#NEW YORK
GALVESTON
OSLO
#WASHINGTON
#CHAPEL HILL
GAINESVILLE
SHIMOTSUKE
MAYENCE
PROVIDENCE
PAVIE
LONDRES
PITTSBURGH
ANKARA
WINSTON SALEM
MILAN
MUNICH
ROME
BRIGHTON
#TEL AVIV
COLUMBUS
GOTTINGEN
GENE
GLASGOW
FREDERICK
ANN ARBOR
#HEIDELBERG
BIRMINGHAM
TURKU
#COLOGNE
VALENCE
QUEBEC VILLE
MONTREAL
OTTAWA
PULLMAN
BARCELONE
BATON ROUGE
Nombre de co-signatures
28
8
2
Le signe # précède les agglomérations de plusieurs unités
Les groupes de couleur sont des "îles" (Islands)
Comptage entier non fractionné
Algorithme de visualisation: Fuchterman Reingold
Centralité de proximité
(Closeness)
0,5
0,4
0,3
Pajek
Réalisation et conception: Marion Maisonobe
Extrait de M@ppemonde 2013

Scholarly worlds and their visualization, from Antiquity to the present day

- Article written in collaboration with Antony Andurand, René Sigrist and Laurent Jégou, published in the journal *Histoire et Informatique* in 2015
- The evolution of material and documentary evidence available through time and the combination of two visualization tools: the map and the network which works for each period
- **See the example of Plutarch's *Table Talks***
- And the example of the contemporary scientific production indexed in the *Web of Science*

The localization of characters, banquets, and the copresence links to the banquets described by Plutarch





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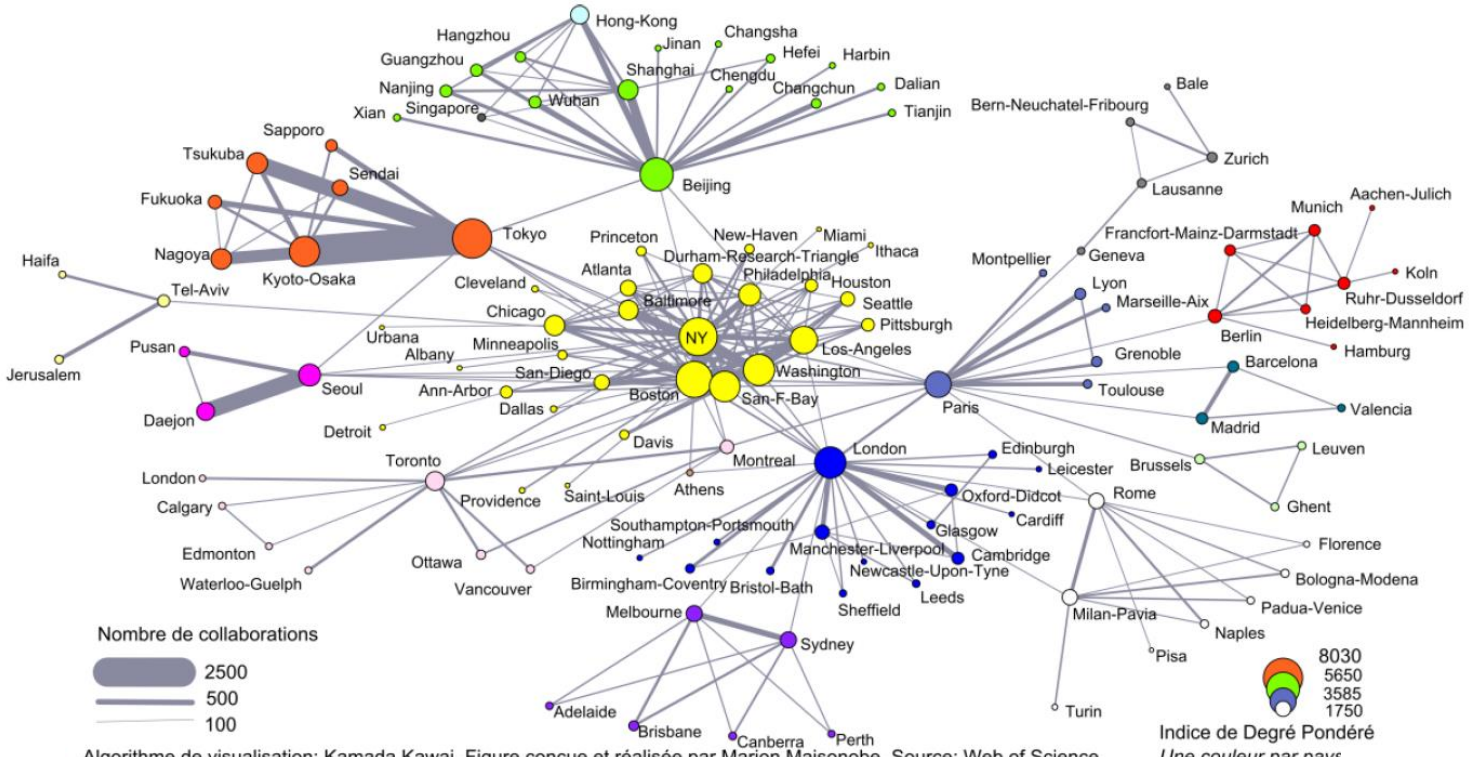
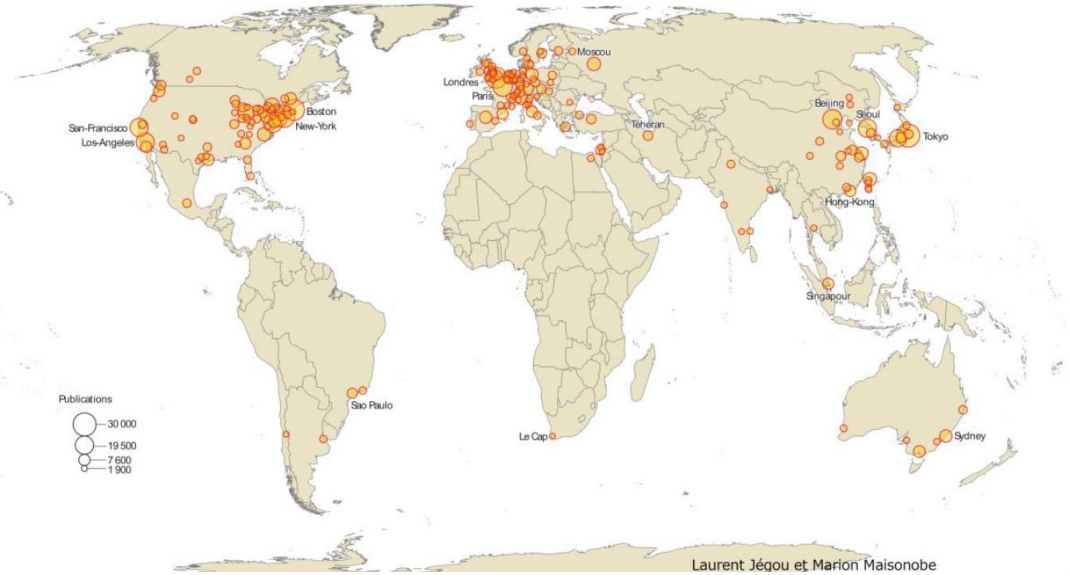
Main Component of the worldwide network of collaborations scientists between cities in 2007



Algorithme de visualisation: Kamada Kawai. Figure conçue et réalisée par Marion Maisonobe. Source: Web of Science.

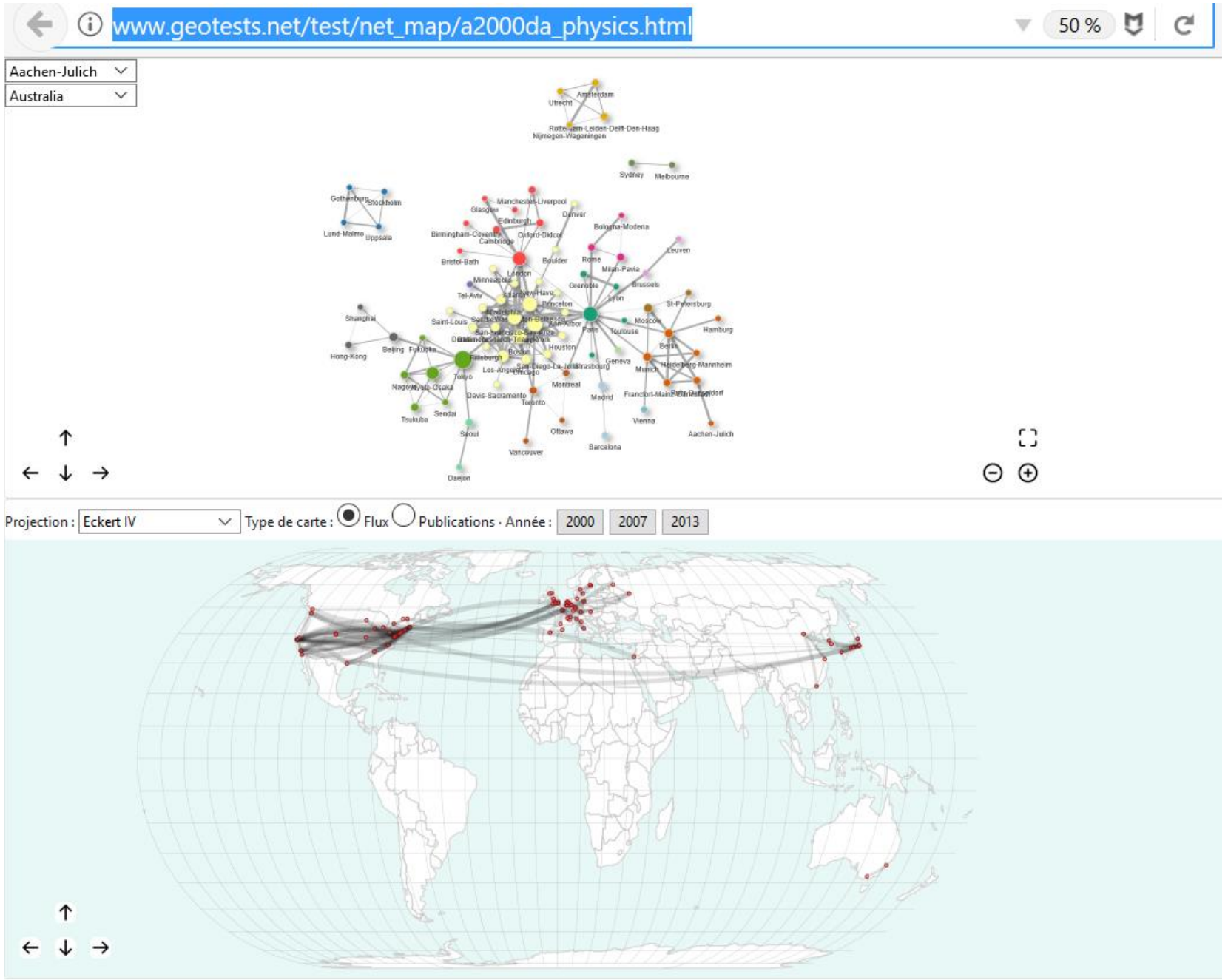
Localisation des villes de la composante principale et intensité de production



Laurent Jégou et Marion Maisonobe

Visualization of networks dynamics

- We propose a new web platform which combines the functions of two JavaScript librairies (Vis.Js + D3). The functions of Vis.Js are also available via the R package « VisNetwork ».
- We want to apply this methodology to scientific collaboration and citation networks between cities and countries through time
- We consider the option of creating an R packkage → allowing to integrate these two types of visual outputs on an interactive basis, for instance in a « flexdashboard »


www.geotests.net/test/net_map/a2000da_physics.html
50 %
Aachen-Julich
Australia
Projection : Eckert IV
Type de carte : Flux Publications
Année : 2000 2007 2013

Perspectives and conclusion

MACRO

- Comparing the evolution of cooperation network by disciplines
- Studying the evolution of citation networks between cities

MICRO

- Studying the inter-regional level: the case of an inter-regional network in green chemistry (INCREASE) in the West of France
- Studying the evolution of the field of urban modelling in the big data context and the entrance of new actors in the field (data scientists)

Any questions ?

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- Twitter: @GeoMaisonobe @ljegou