



1996-2016 : 20 ans de cybergeo

1996-2016 : 20 years of cybergeo

Indirect Bibliometrics by Complex Network Analysis

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Cybergeo : 20 ans déjà !

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Context

"You are what you cite" : Which disciplines populate the scientific neighborhood of cybergeo ? Are they different from the ones obtained through article content (POC) and declared contents (HC) analysis ?

- Important for editorial policy : interdisciplinarity and Open Science
- Semi-qualitative approach, against purely quantitative bibliometrics harmful to humanities

Objective

Research question : *How does the combination of a citation network approach with a semantic analysis unveil disciplinary context of the journal ?*

- Hypernetwork methodology : superposition of a citation network with a semantic network, in the spirit of a transversal approach
- Data difficult to access : database to construct

Data collection

Cybergeo data : journal production base

→ Structuration and Consolidation

Citation data : cybergeo not indexed by “classical” bases (such as Web of Science[©], which are furthermore not open)

→ google scholar crawling by using “*cited by*” option [Noruzi, 2005]

Text data : need abstracts for all linked articles

→ use of Mendeley API [Mendeley, 2015] (free but not open)

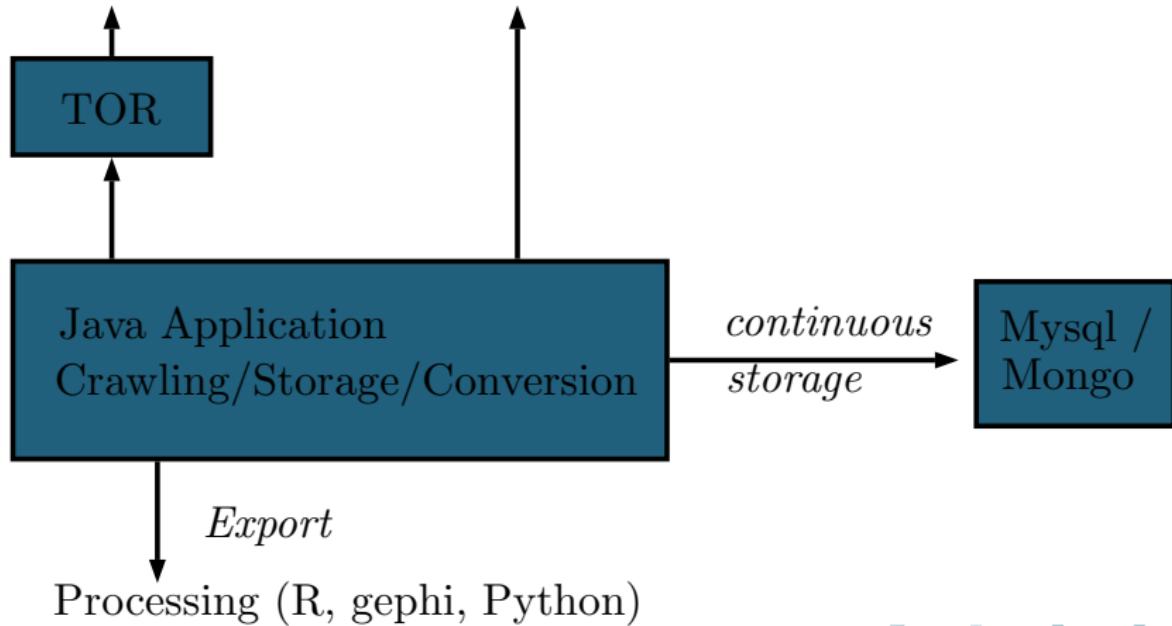
Data Collection Architecture

Google Scholar

Citations and ID

Mendeley

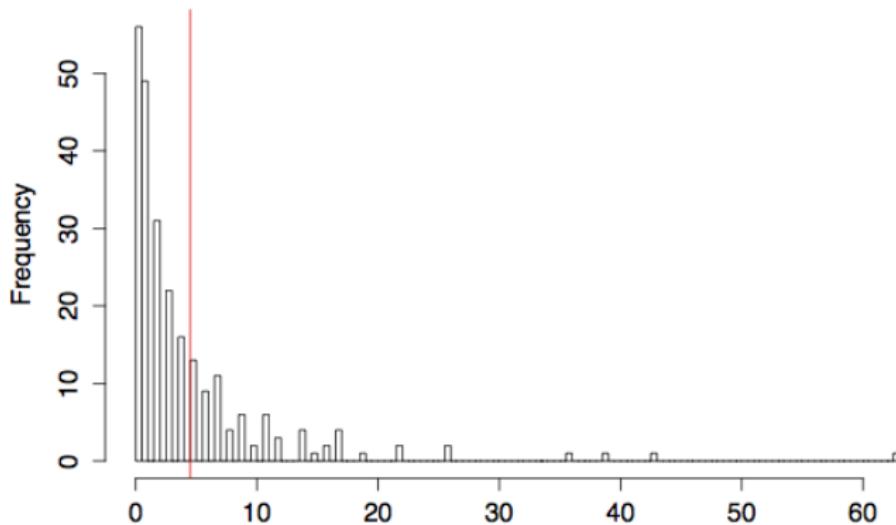
Abstracts



Network Properties

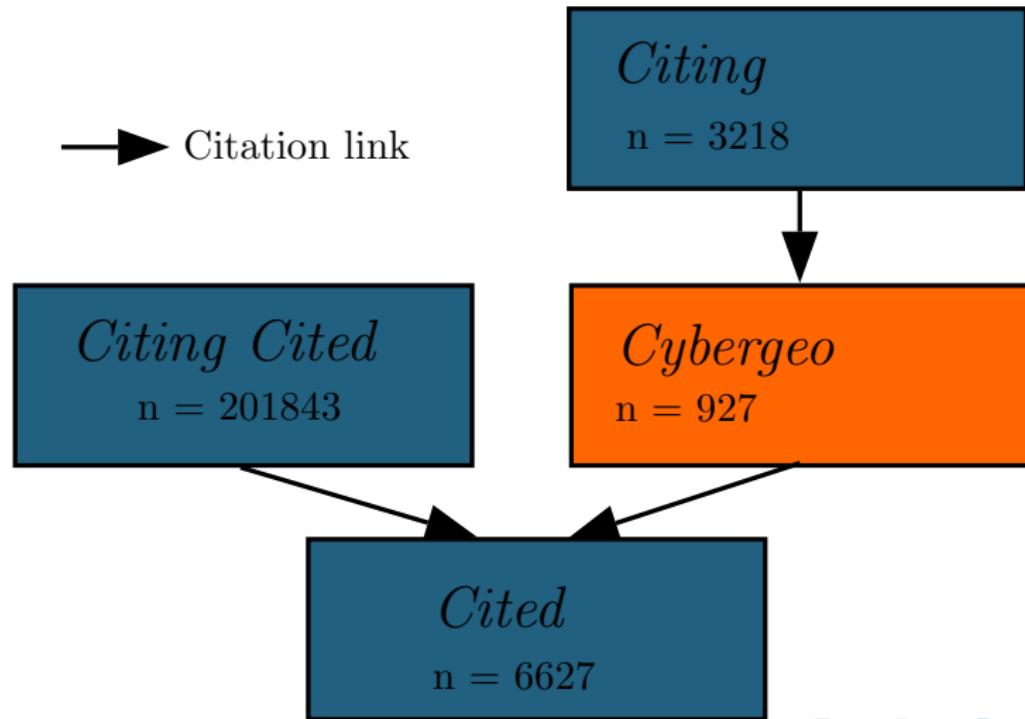
- $\simeq 947$ cybergeo articles can be studied, among $\simeq 1200$
- 418670 Nodes et 570352 Links ; Diameter : 9 ; Density : $3.25E-6$; average degree : 2.724284

Degree distribution, mean (impact factor) = 3.18

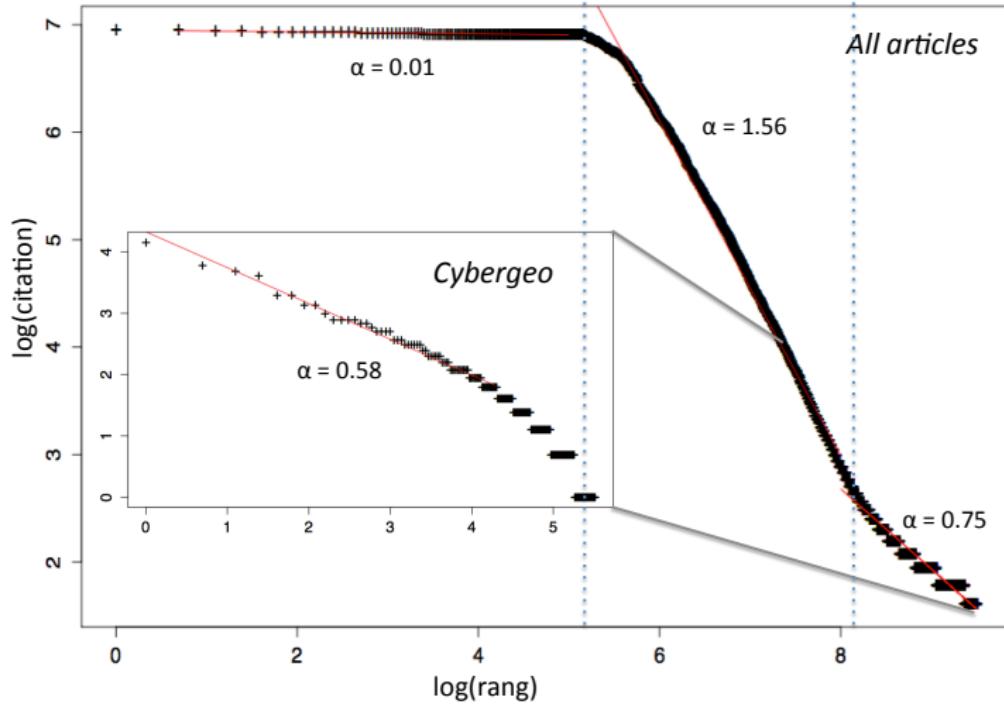


The stationary integrated impact factor, estimated as average citation count, means that a cybergeo paper gets at least 3 citations in its lifetime

Citation Network Structure



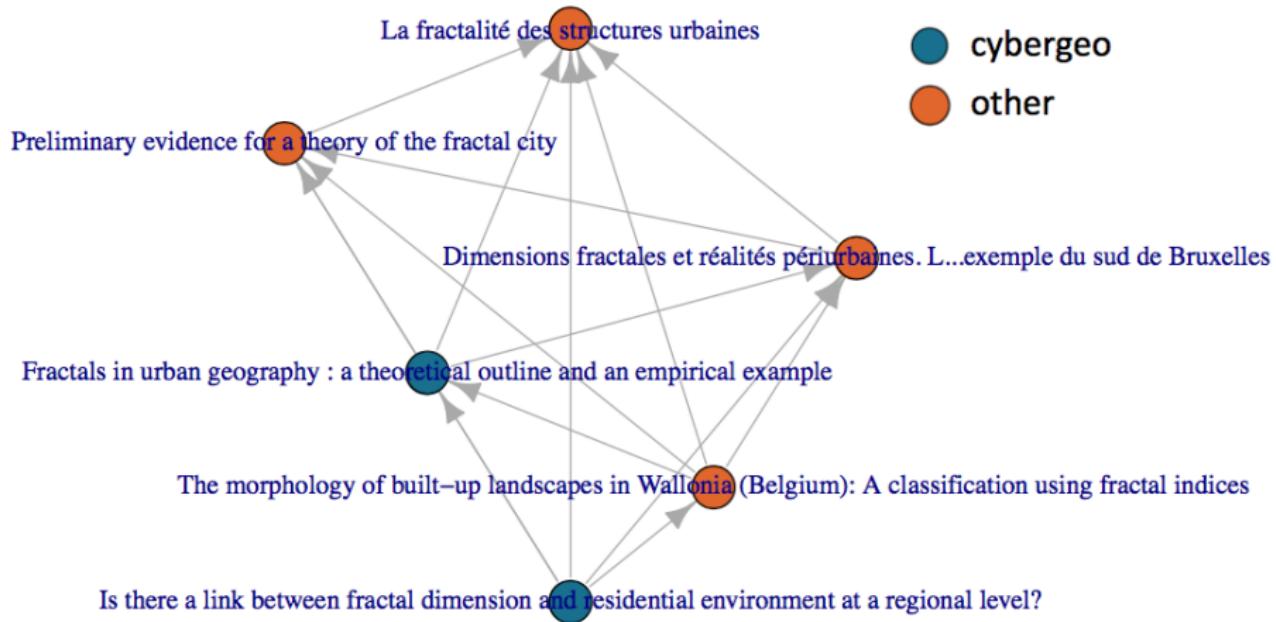
Hierarchy in citations



Superposition of different hierarchical citation regimes

Cliques

Complete subgraphs reveal strong affiliation patterns



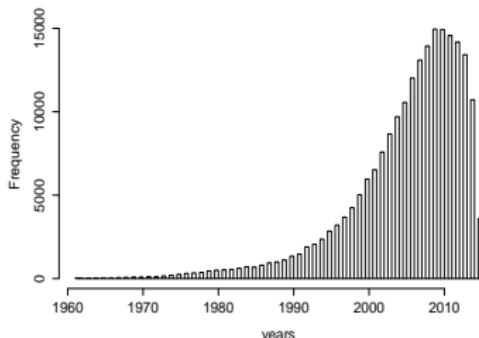
Semantic Network

Semantic Data : Collection of abstract/date/authors/keywords for the 400000 references via Mendeley API → ~ 215000 references with full data.

Summary Statistics

Language : English 206607, French 4109, Spanish 2029, German 892, Portuguese 891, Dutch 124, others 182

Yearly count



Keywords Extraction

Text-mining in python with nltk [Bird, 2006], method adapted from [Chavalarias and

- Language detection using *stop-words*
- Parsing and tokenizing / pos-tagging (word functions) / stemming done differently depending on language :
 - ▶ English : nltk built-in pos-tagger, combined to a PorterStemmer
 - ▶ French or other : use of TreeTagger [Schmid, 1994]
- Selection of potential *n-grams* (with $1 \leq n \leq 4$) : English
 $\bigcap\{NN \cup VBG \cup JJ\}$; French $\bigcap\{NOM \cup ADJ\}$
- Database insertion for instantaneous utilisation (10j → 2min)
- Estimation of *n-grams* relevance, following co-occurrences statistical distribution

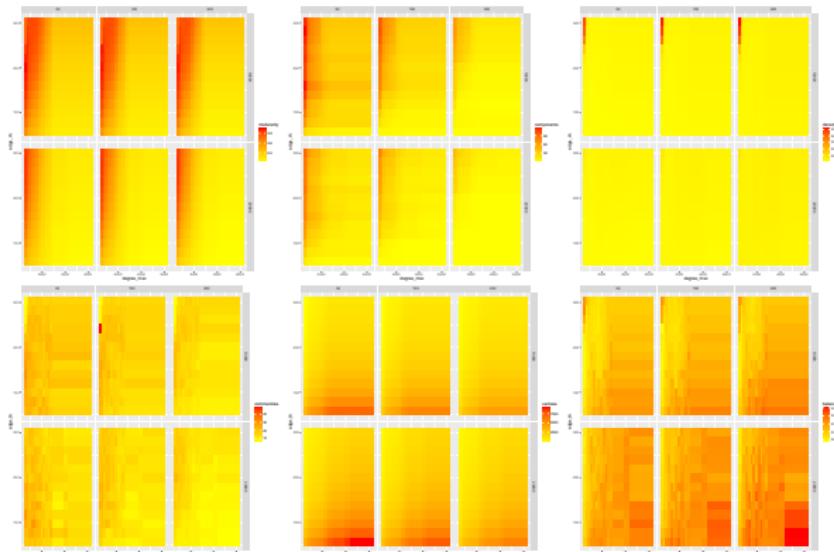
Construction of Semantic Network

- **Nodes** : Keywords with largest relevance
- **Links** : Weighted co-occurrences
- Manual suppression of parasite words (e.g. : copyright statements !)
- Low weight link filtering
- Suppression of *hubs* (ex. model, space, structure, process) that suppress community structure
- Community detection by greedy modularity maximization (Louvain method [Blondel et al., 2008])

Parameters influence

Importance of fine tuning :

- Sensitivity of models **and** data analysis to parameters. Systematic exploration mandatory, via OpenMole for example.
- Place of expert decision-making : no qualitative-quantitative dichotomy



Multi-criteria optimization (modularity, size, balance) on network construction parameters

Obtained disciplines

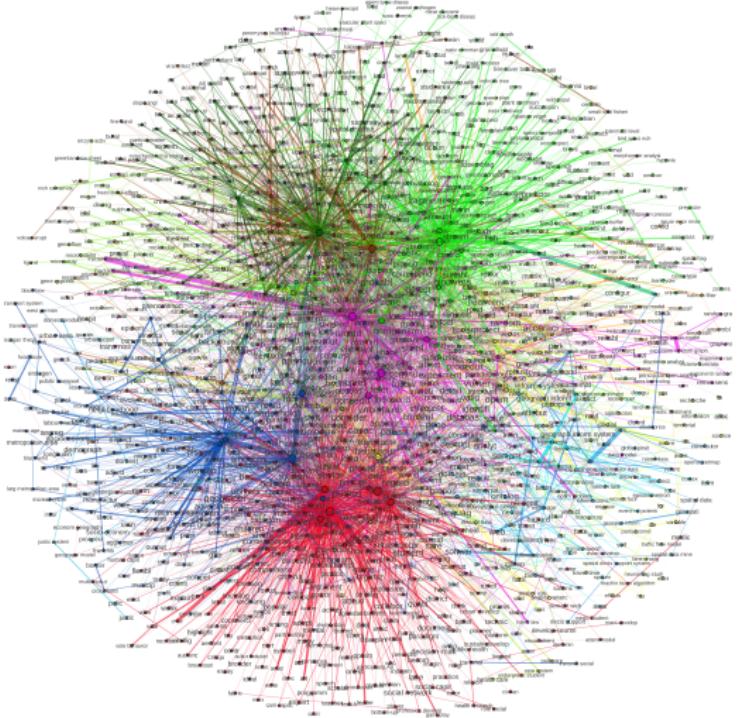
Communities obtained with $\theta_V = 1200, \theta_E = 50$

- Political sciences/critical geography (535) : decision-mak, polit ideolog, democraci, stakehold, neoliber
- Biogeography (394) : plant densiti, wood, wetland, riparian veget
- Economic geography (343) : popul growth, transact cost, socio-econom, household incom
- Environment/climate (309) : ice sheet, stratospher, air pollut, climat model
- Complex systems (283) : scale-fre, multifract, agent-bas model, self-organ
- Physical geography (203) : sedimentari, digit elev model, geolog, river delta
- Spatial analysis (175) : spatial analysi, princip compon analysi, heteroscedast, factor analysi

Obtained disciplines (continued)

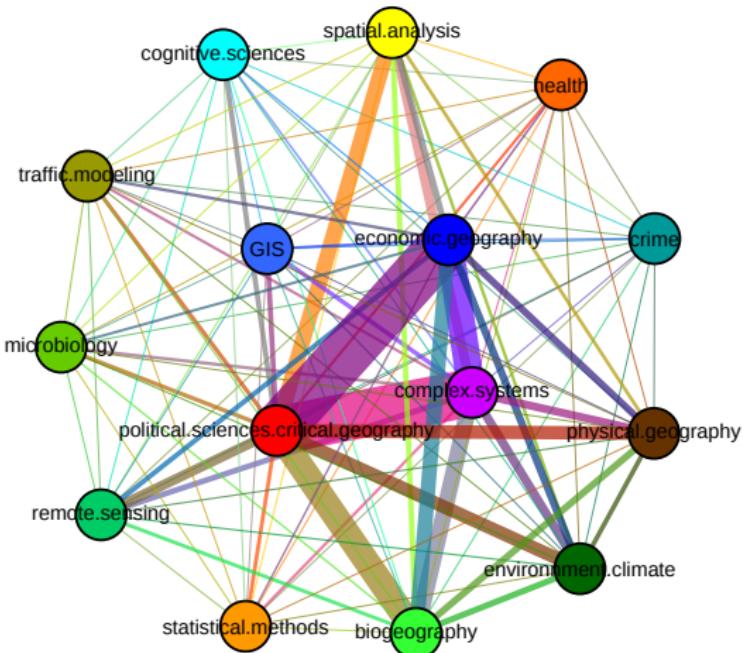
- Microbiology (118) : chromosom, phylogeneti, borrelia
- Statistical methods (88) : logist regress, classifi, kalman filter, sampl size
- Cognitive sciences (81) : semant memori, retrospect, neuroimag
- GIS (75) : geograph inform scienc, softwar design, volunt geograph inform, spatial decis support
- Traffic modeling (63) : simul model, lane chang, traffic flow, crowd behavior
- Health (52) : epidem, vaccin strategi, acut respiratori syndrom, hospit
- Remote sensing (48) : land-cov, landsat imag, lulc
- Crime (17) : crimin justic system, social disorgan, crime

Network



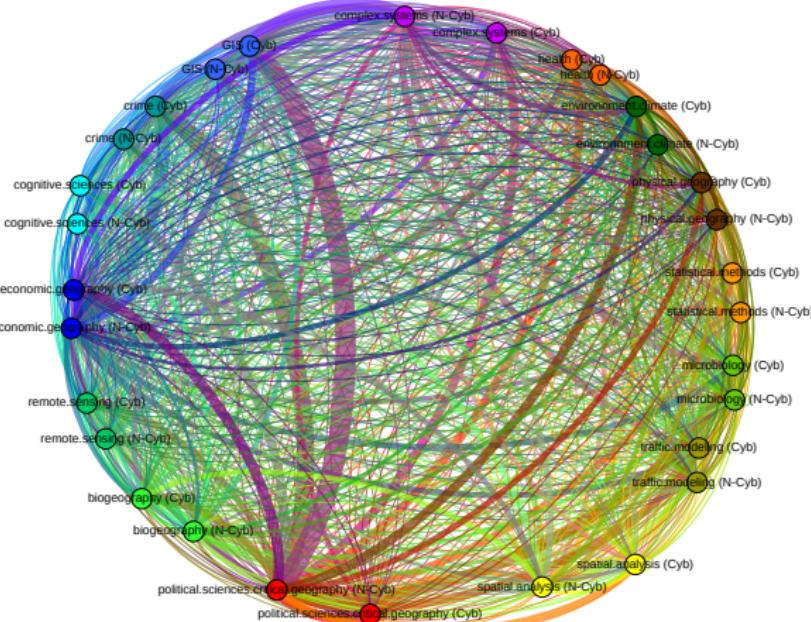
political sciences/critical geography	(19,92 %)
biogeography	(16,24 %)
economic geography	(13,31 %)
complex systems	(11,35 %)
environment/climate	(8,57 %)
physical geography	(7,82 %)
spatial analysis	(5,94 %)
microbiology	(3,83 %)
cognitive sciences	(2,93 %)
statistical methods	(2,86 %)
GIS	(2,48 %)
traffic modeling	(1,8 %)
remote sensing	(1,28 %)
health	(1,13 %)
crime	(0,53 %)

Interdisciplinarity



Synthetic representation of disciplines. Link strength gives the probability for two disciplines to appear

Citation interdisciplinarity

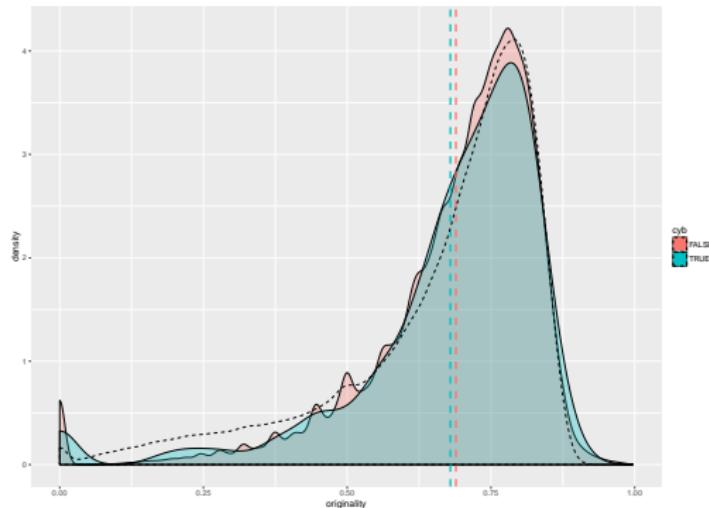


Citation flows between disciplines (directed links to be read in anti-trigonometric sense) reveal citation level interdisciplinarity

Article-level interdisciplinarity

An article has a proportion of keywords in each discipline, which can be understood as probabilities (p_i).
 Interdisciplinarity index defined as $i = 1 - \sum p_i^2$.

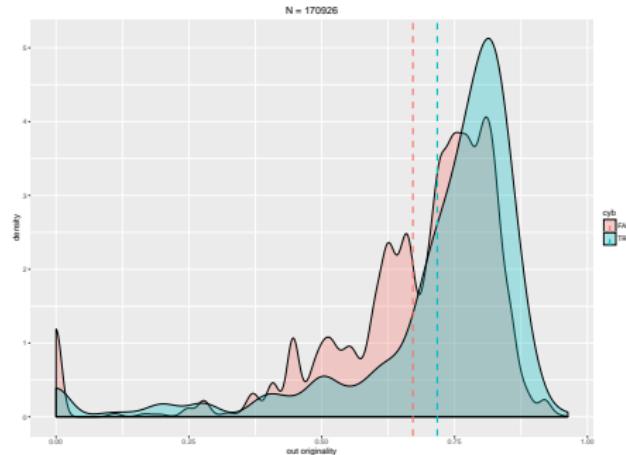
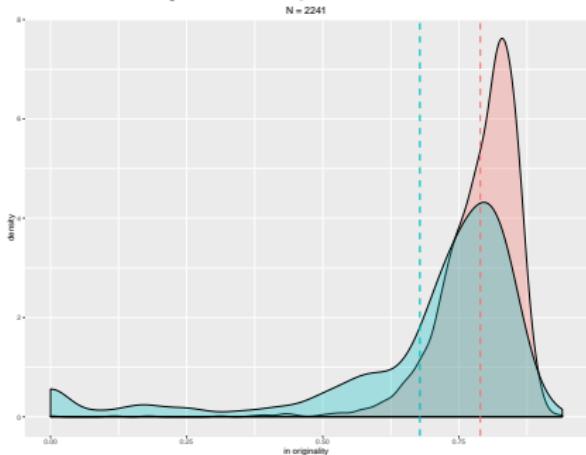
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Distribution of article interdisciplinaries (null model in dotted line).

Citation interdisciplinarity

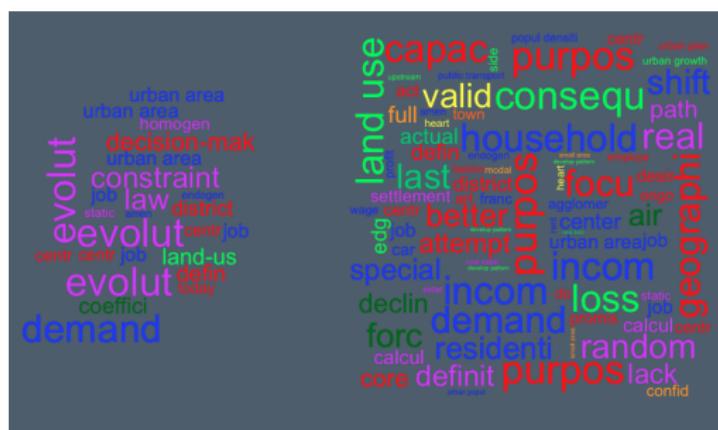
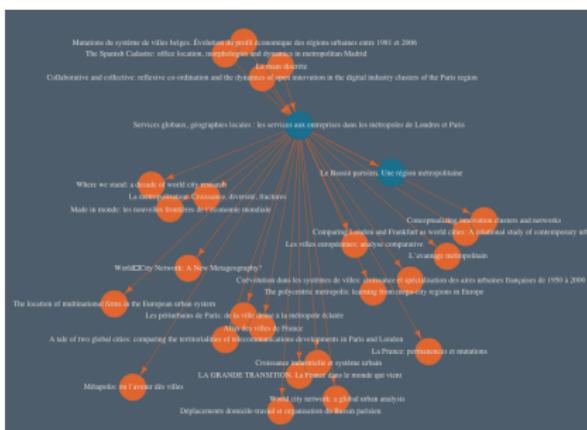
Citation interdisciplinarity defined the same way, based on probabilities to cite or be cited by a discipline.





Interactive exploration

On CybergeoNetworks : Article level citation and semantic exploration ; semantic network exploration



Conclusion

- A very rich scientific environment and a certain interdisciplinarity
- Approach to be combined with other classifications (thematic (POC), keywords (HC), geographical (CC)) to unveil patterns in geographical practices around the journal
- Generic method that can be applied to any network whose nodes have a textual description



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Reserve Slides

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Data Collection

Crawling of semi-open data : examples in geography

Mobility data : bike-sharing docking stations status (API)

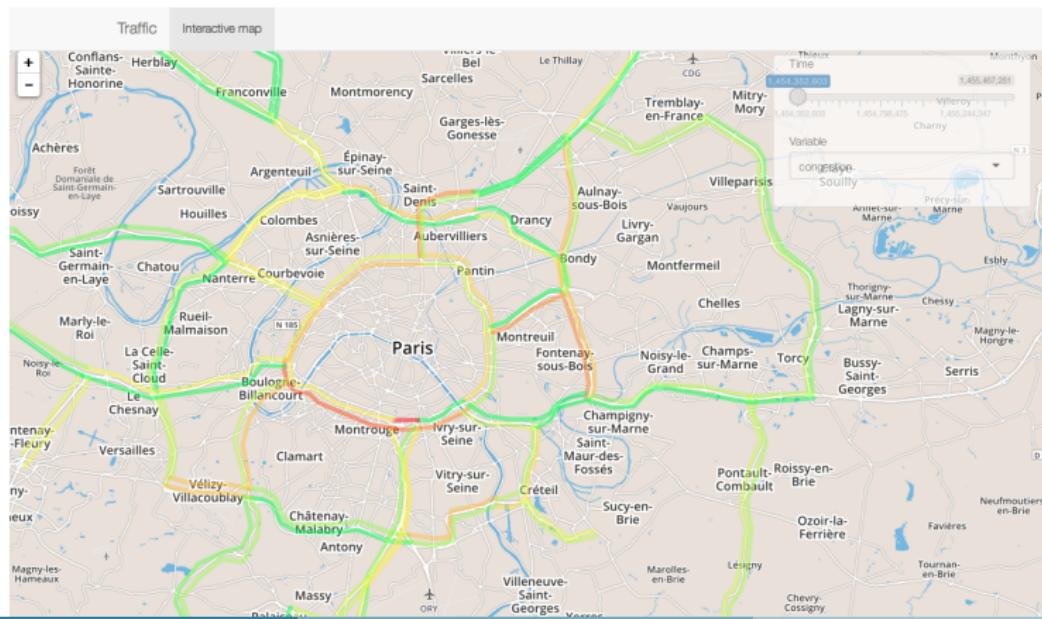
[?]



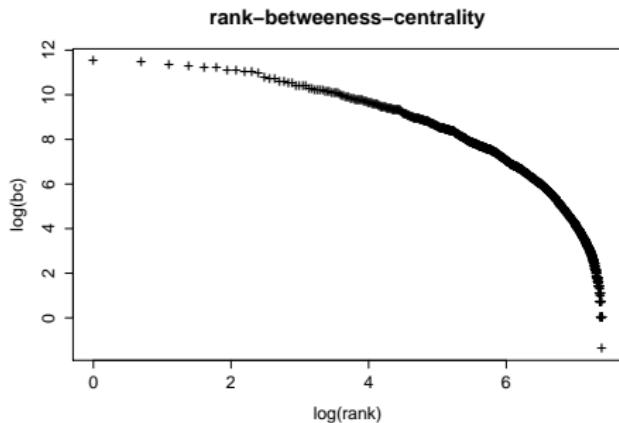
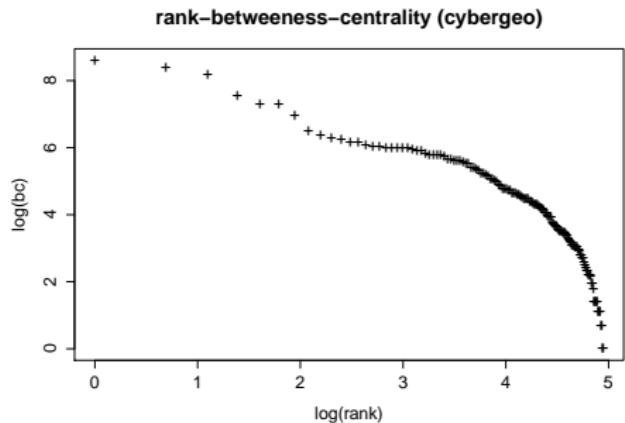
Data Collection

Exemples in geography (continued)

Road traffic : collect of *sytadin* data (no API : scrapping is necessary)



Centrality (citation)

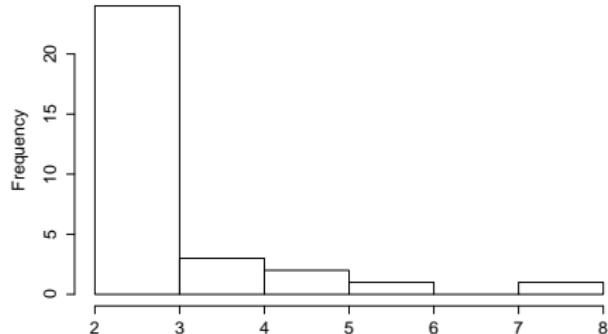


Weak centralities (rq : impossibility of having strong clusters because of temporal causality). Left : Cybergeo ; Right : Whole Network

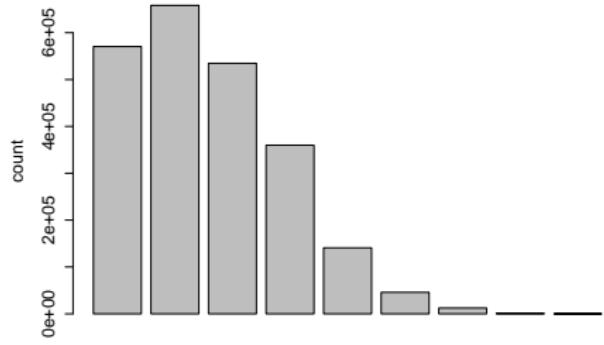
Clustering (citation)

Giant component : more than 99% of nodes.

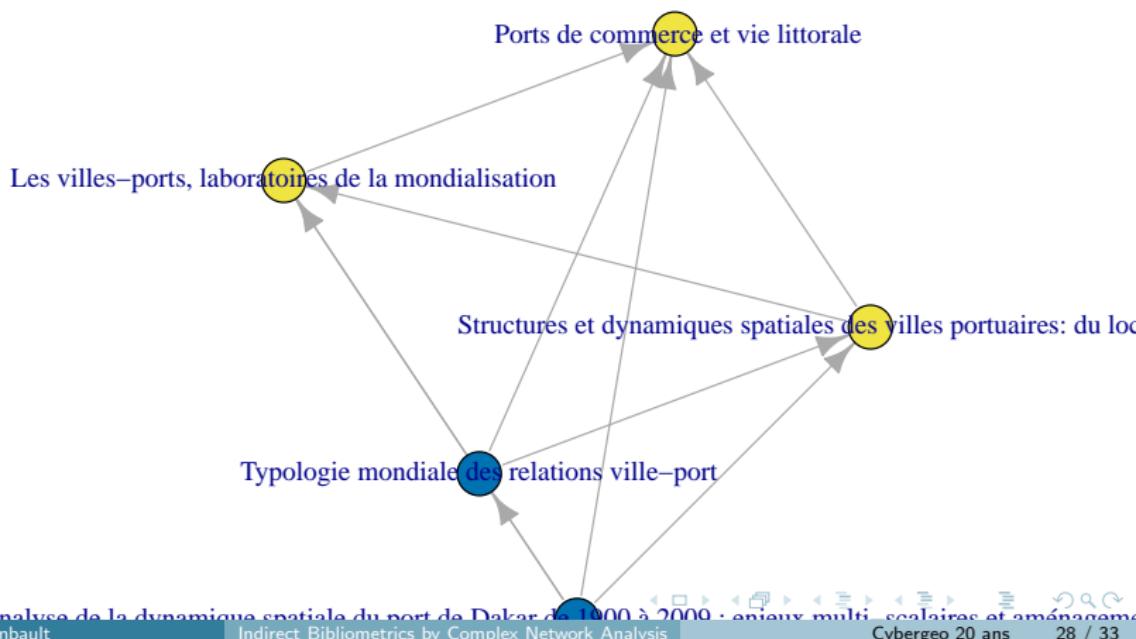
Weak clusters size without giant component



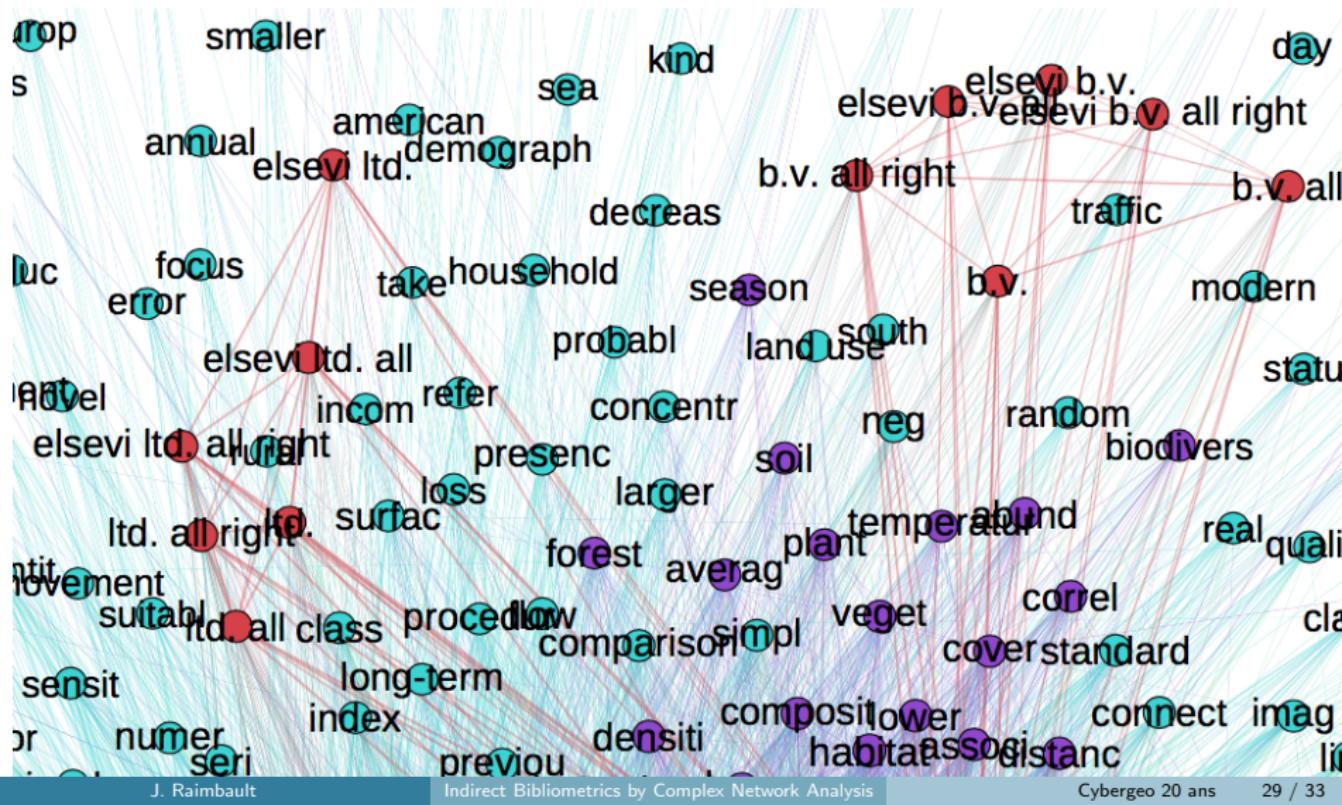
path length distribution



Cliques(citation)



Network Perturbation



Relevance estimation

Estimation exacte de la pertinence via la répartition statistique des co-occurrences (score de χ^2) : *termhood* définie, avec M_{ij} nombre d'articles où i et j apparaissent simultanément,

$$t_i = \sum_{j \neq i} \frac{(M_{ij} - \sum_k M_{ik} \sum_k M_{jk})^2}{\sum_k M_{ik} \sum_k M_{jk}}$$

en $\Theta(\sum_i N_i^2)$ (N_i taille des résumés) : difficile sur un corpus où $\sum_i N_i^2 \simeq N < N_i >^2 \simeq 8 \cdot 10^7$

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References III