Scientometric Mappings for Tentative Governance of Emerging Technologies

- Research Aim
- Theoretical background
- Methods
- Results
- Discussion and Conclusions

Website: http://www.interdisciplinaryscience.net/defactogov

SPRU Science and Technology Policy Research

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Research Aim

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Can **scientometric mapping and overlay techniques be used** as strategic intelligence tools for policy making of tentative governance of emerging science and technologies?

Research Aim

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Why is it important?

Emerging science and technologies have the potential to generate profound—both positive and negative—social changes such as creating new industries as well as dramatically reconfiguring or destroying existing ones

(e.g. Freeman and Soete, 1997)

Theoretical Background

- **Uncertainties** and **rapid** dynamics feature in the emergence process – directionality and **visions, goals, and expectations of the actors involved** (e.g. Geels, 2002; Stirling, 2009)

- ***De facto* governance** as the set of intentional and un-intentional influences (Rip, 2010)

- **Tentative forms of governance** to address the complexity, interdependencies, and contingencies of the emergence are needed (e.g. Kuhlmann, 2001; Wiek et al., 2007)

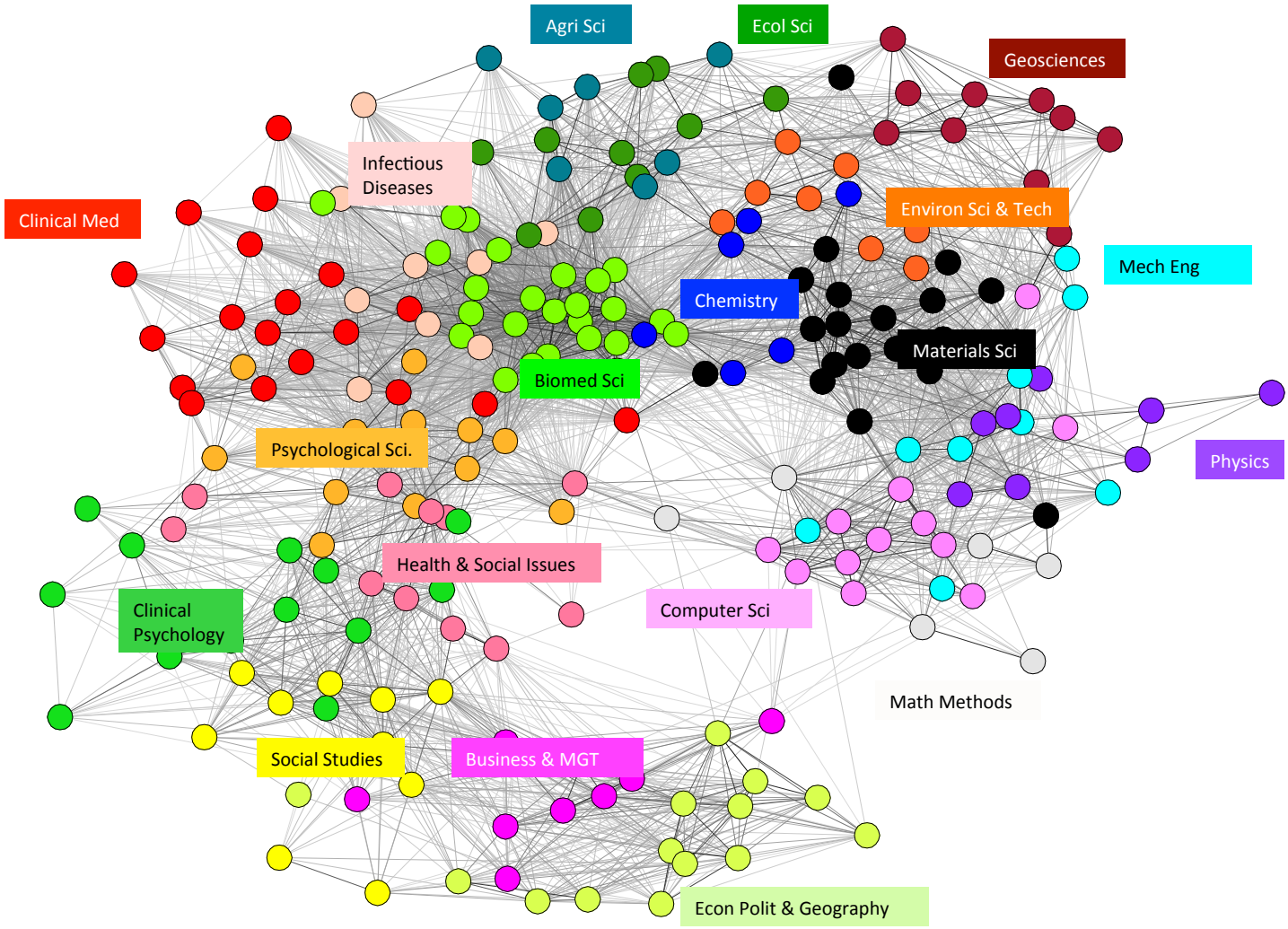
- Defining tentative governance requires 'strategic intelligence', i.e. 'intelligent inputs' that timely feed, especially at the very early stage of an EST, the policy making process (Kuhlmann et al., 1999)

- Mapping and overlay techniques may serve as strategic intelligence tools to specifically inform the analyst on the *de facto* arrangements: i) '**distributed**' strategic intelligence; ii) **flexibility,** and iii) **granularity**

Methods

Mapping and overlay techniques: The basic idea

An additional dimension to well established mapping approaches (e.g. co-citation analysis, bibliographic coupling, co-words analysis)



(based on Rafols et al., 2010)

Methods

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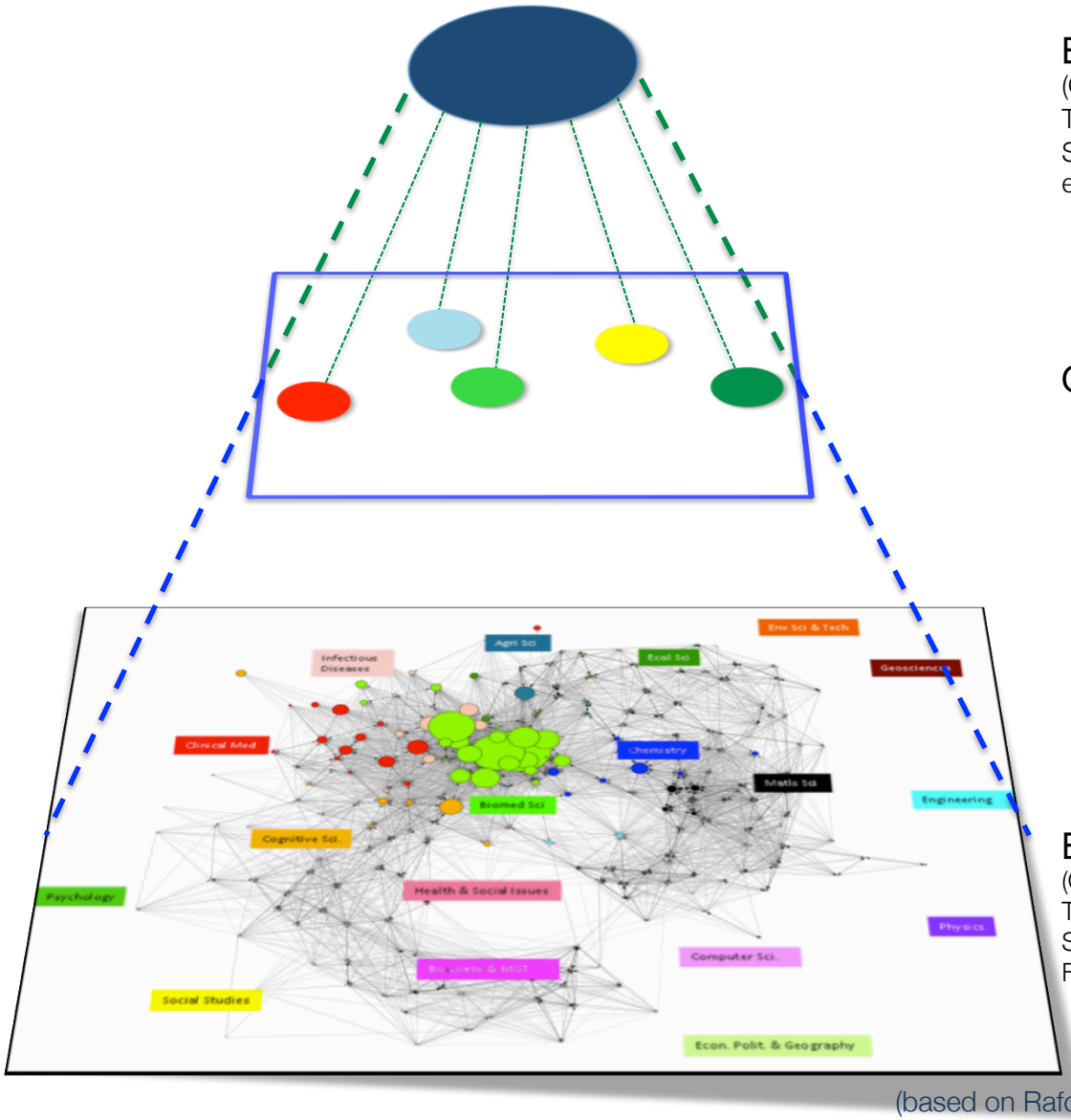


Entity (Organization, Technology, Scientific Field, etc.)

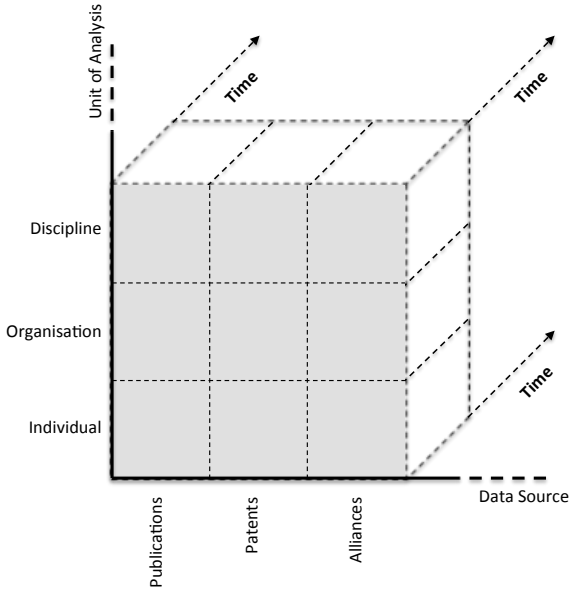
Overlay

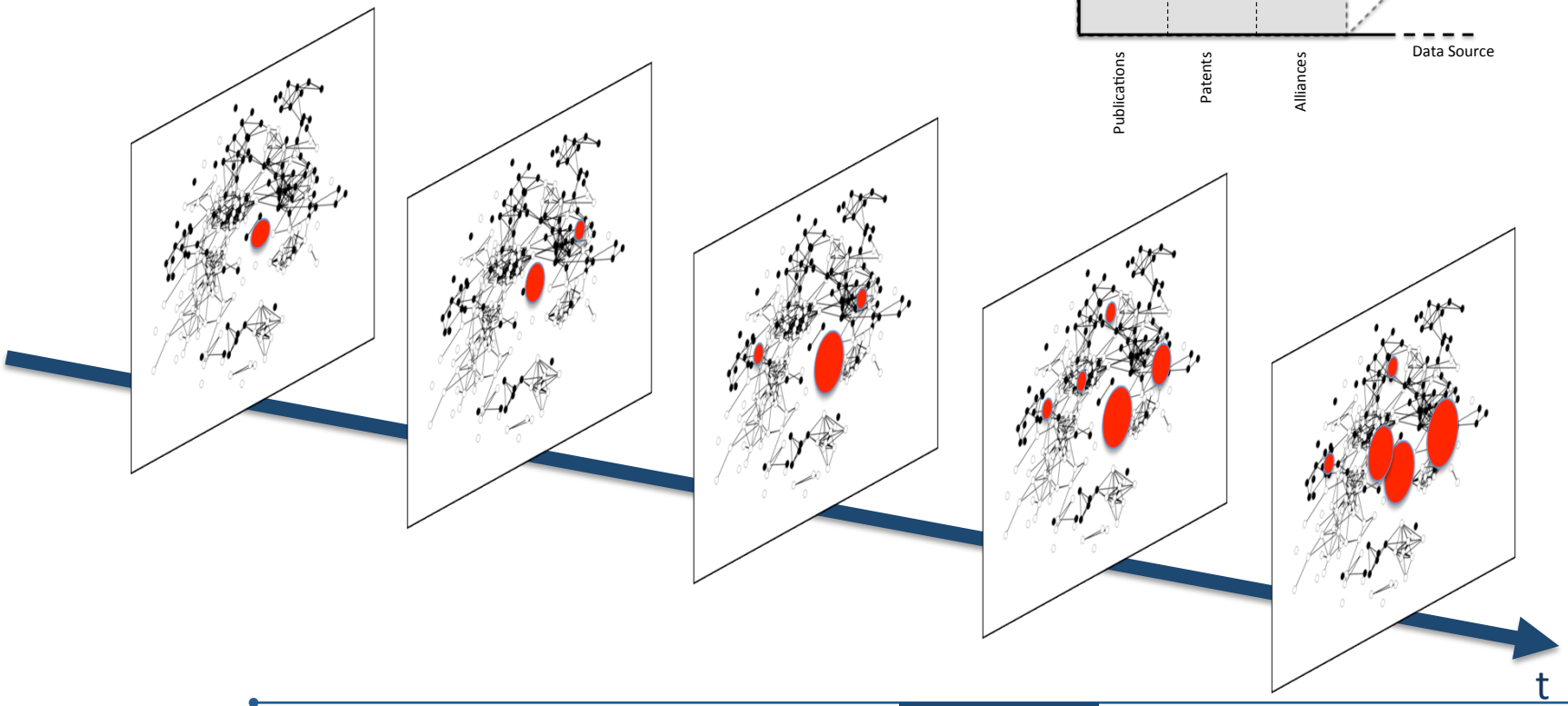
Basemap (Organizations, Technologies, Scientific Fields, etc.)

(based on Rafols et al., 2010)

Methods

Mapping and overlay techniques: Tracing dynamics

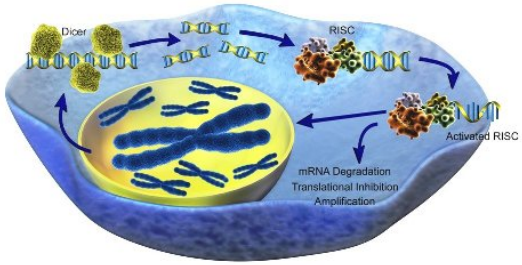




Methods

Case-studies

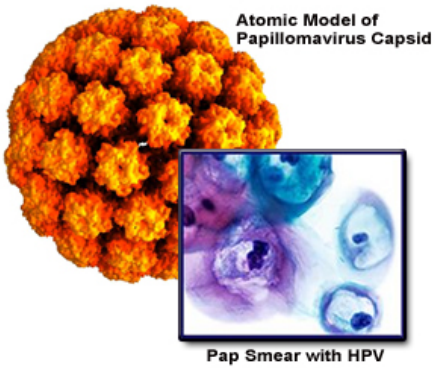
RNA interference (RNAi)



RNAi is a molecular process that can silence the expression of genes. By silencing specific genes one can stop the progression of a given disease. RNAi can be conceived therefore as a general purpose technology for research in labs

(Fire et al., 1998)

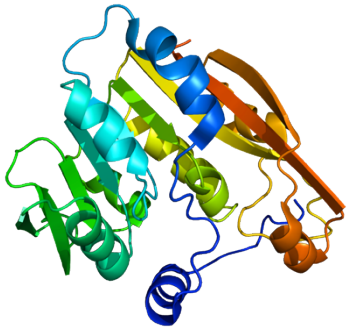
HPV testing



HPV testing is a diagnostic technology for the detection of Humana Papilloma Virus (HPV). HPV infections (especially types 16 and 18) are strongly associated with cervical cancer

(Casper and Clarke, 1998; Hogarth et al., 2012)

TPTM testing



TPMT testing technology is one of an emerging class of 'pharmacogenetic tests' which predict adverse events associated with pharmaceutical use. Its application for clinical utility is contested across medical fields

(Hopkins et al., 2006)

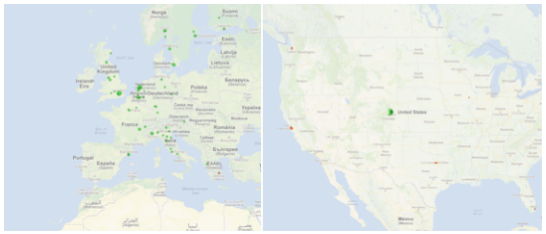
Diversity in terms of context, scale, and position in the innovation chain

Methods

Scientometric mappings can provide strategic intelligence across three space of emergences (as well as combinations of those):

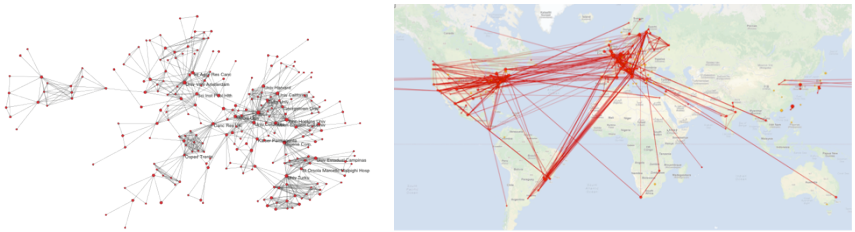
•Geographical

(e.g. Bornmann & Leydesdorff, 2011)



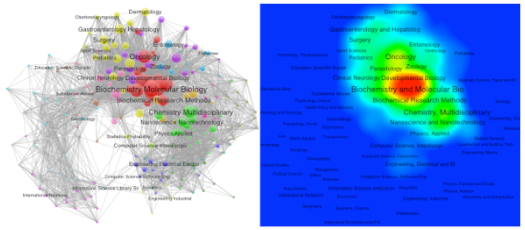
•Social

(e.g. Leydesdorff & Persson, 2010)



•Cognitive

(e.g. Leydesdorff et al., 2012; Rafols et al., 2010)



Methods

Data sources

Case Study	Data	Database	Search string
RNAi	Publications	ISI WoS	TI=siRNA or TI=RNAi or TI="RNA interference" or TI="interference RNA"
		MEDLINE/PubMed	siRNA[Title] or RNAi[Title] or "RNA interference"[Title] or "interference RNA" [Title]
	Patents	USPTO	ACLM/(siRNA or RNAi or "RNA interference" or "interference RNA")
HPV testing	Publications	ISI WoS	(TI=HPV* or TI="Human Papilloma Virus*" or TI="Human Papillomavirus*" or TI="Human Papilloma*virus*") and (TI=Cervical or TI=Cervix) and (TI=diagnos* or TI=test* or TI=assay or TI=detect* or TI=screen* or TI=predict*)
		MEDLINE/PubMed	(HPV*[Title] or "Human Papilloma Virus*"[Title] or "Human Papillomavirus*"[Title]) and (Cervical[Title] or Cervix[Title]) and (diagnos*[Title] or test*[Title] or assay[Title] or detect*[Title] or screen*[Title] or predict*[Title])
	Patents	USPTO	ACLM/((HPV or "Human Papilloma Virus$" or "Human Papillomavirus$") and (Cervical or Cervix) and (diagnos$ or test$ or assay or detect$ or screen$ or predict$))
TPMT testing	Publications	ISI WoS	TI=TPMT or TI= "Thiopurine Methyltransferase"
		MEDLINE/PubMed	TPMT[Title] or "Thiopurine Methyltransferase"[Title]
	Patents	USPTO	ACLM/(TPMT or "Thiopurine Methyltransferase")

Publication data

The mapping needs to be timely and provide relevant information with relatively low efforts – **search of the keywords in titles rather than abstracts**

Patent data

Search of keywords in fields where relevant information is provided – **patent's claims define "invention and are what aspects are legally enforceable"** (USPTO Glossary)

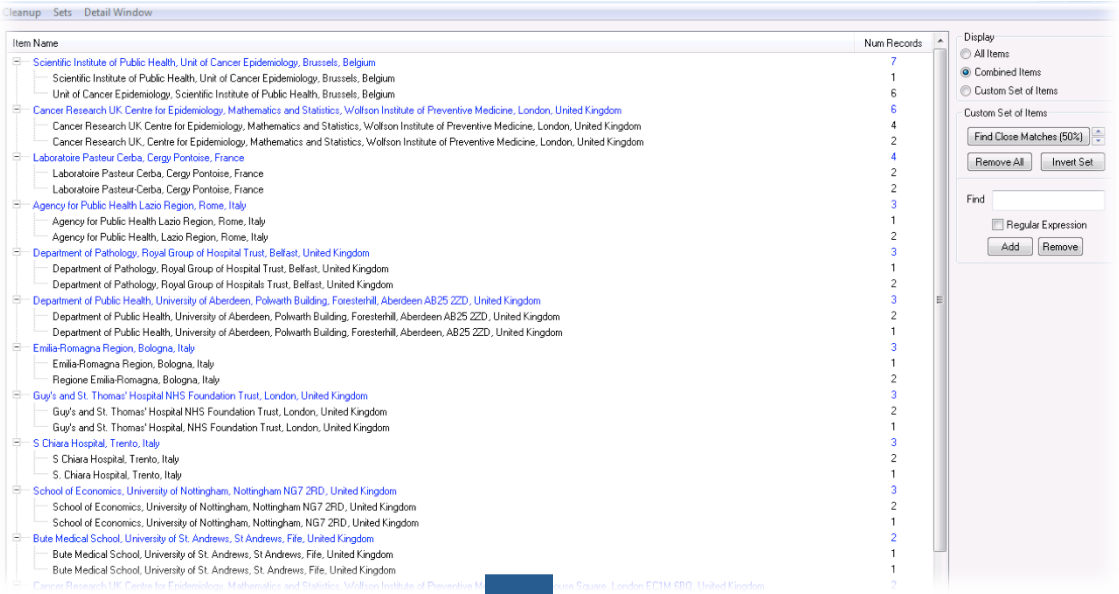
Methods

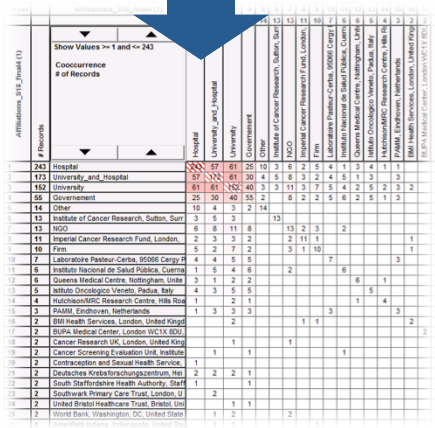
The Vantage Point and the organisational names harmonisation

Grouping organisations by country

	# Records	# Instances	Affiliations (Country)_S1	US	UK	France	Italy	Canada
1	1363	3477	United States	☑				
2	457	878	United Kingdom		☑			
3	202	412	France			☑		
4	196	511	Italy				☑	
5	179	398	Canada					☑
6	167	370	Japan					
7	160	295	Germany					
8	147	323	Netherlands					
9	136	295	India					
10	121	121	USA.					
11	112	191	Australia					
12	100	151	China					
13	86	280	Brazil					
14	71	182	Sweden					
15	61	152	South Korea					
16	59	147	Finland					
17	58	109	Belgium					
18	51	244	Taiwan					
19	48	69	South Africa					

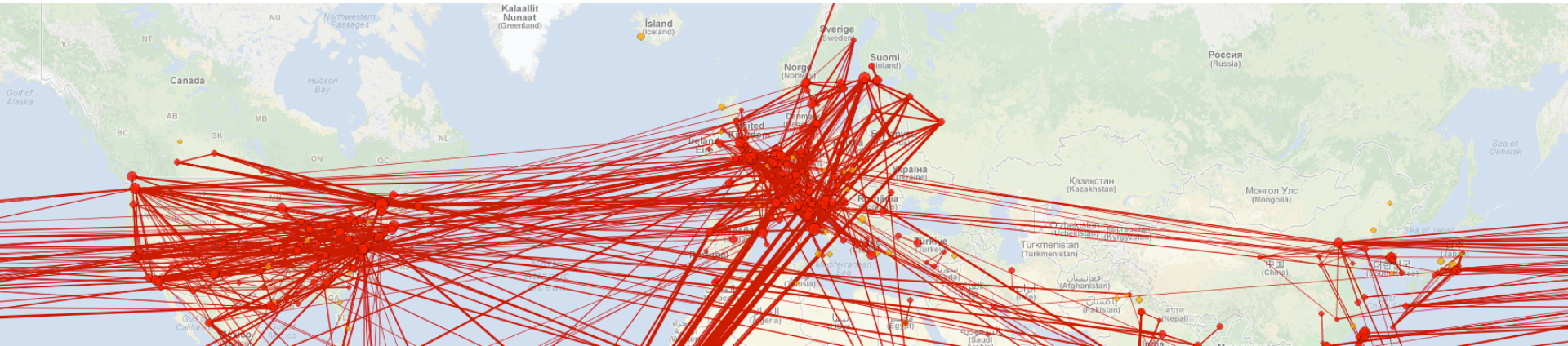
List Cleanup (country by country) → Thesauruses





Co-occurrence matrix to build network files

Mapping across the geographical and social spaces



Results

Mapping across the geographical and social spaces

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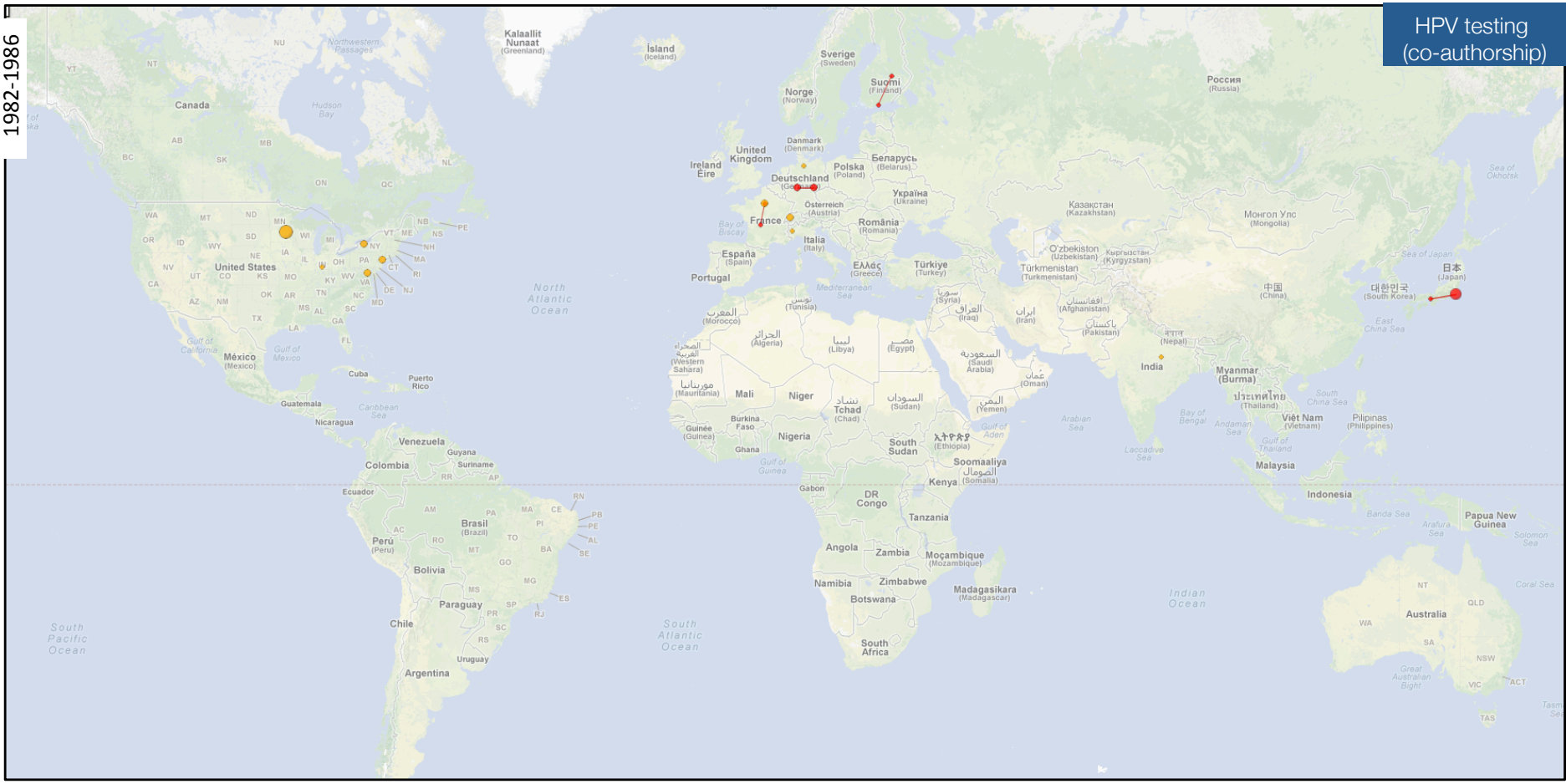
1982-1986



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Mapping across the geographical and social spaces

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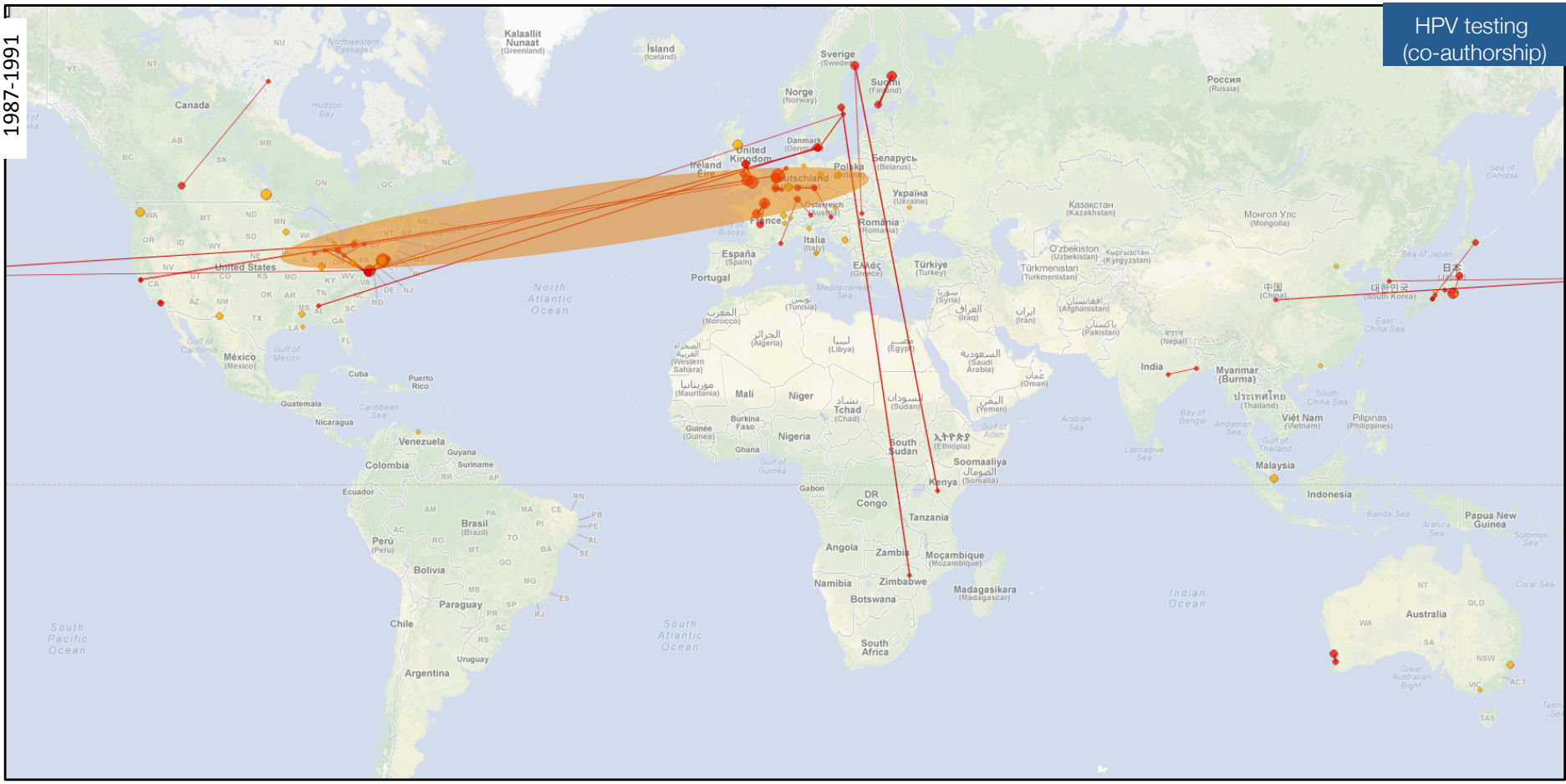

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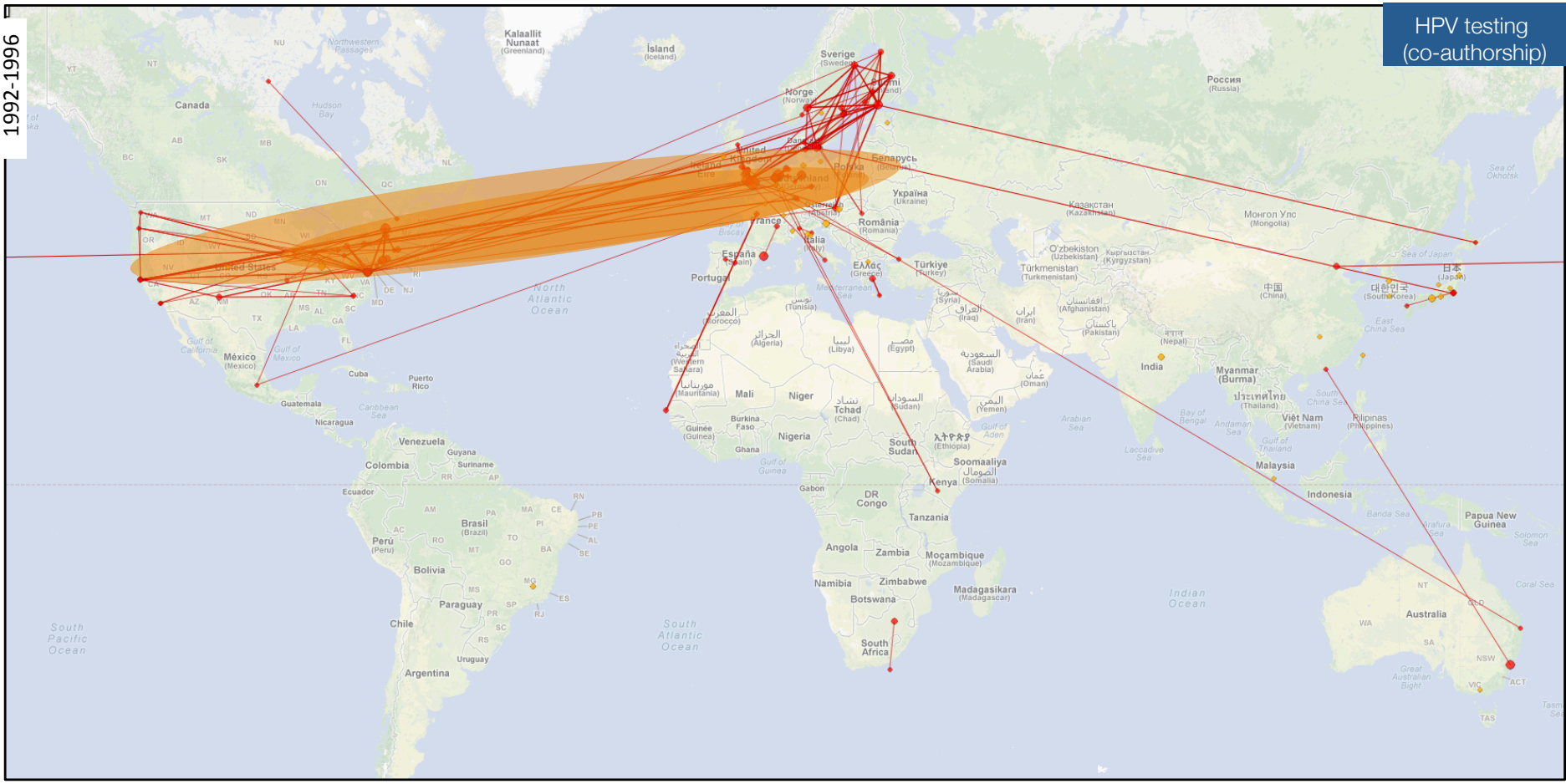

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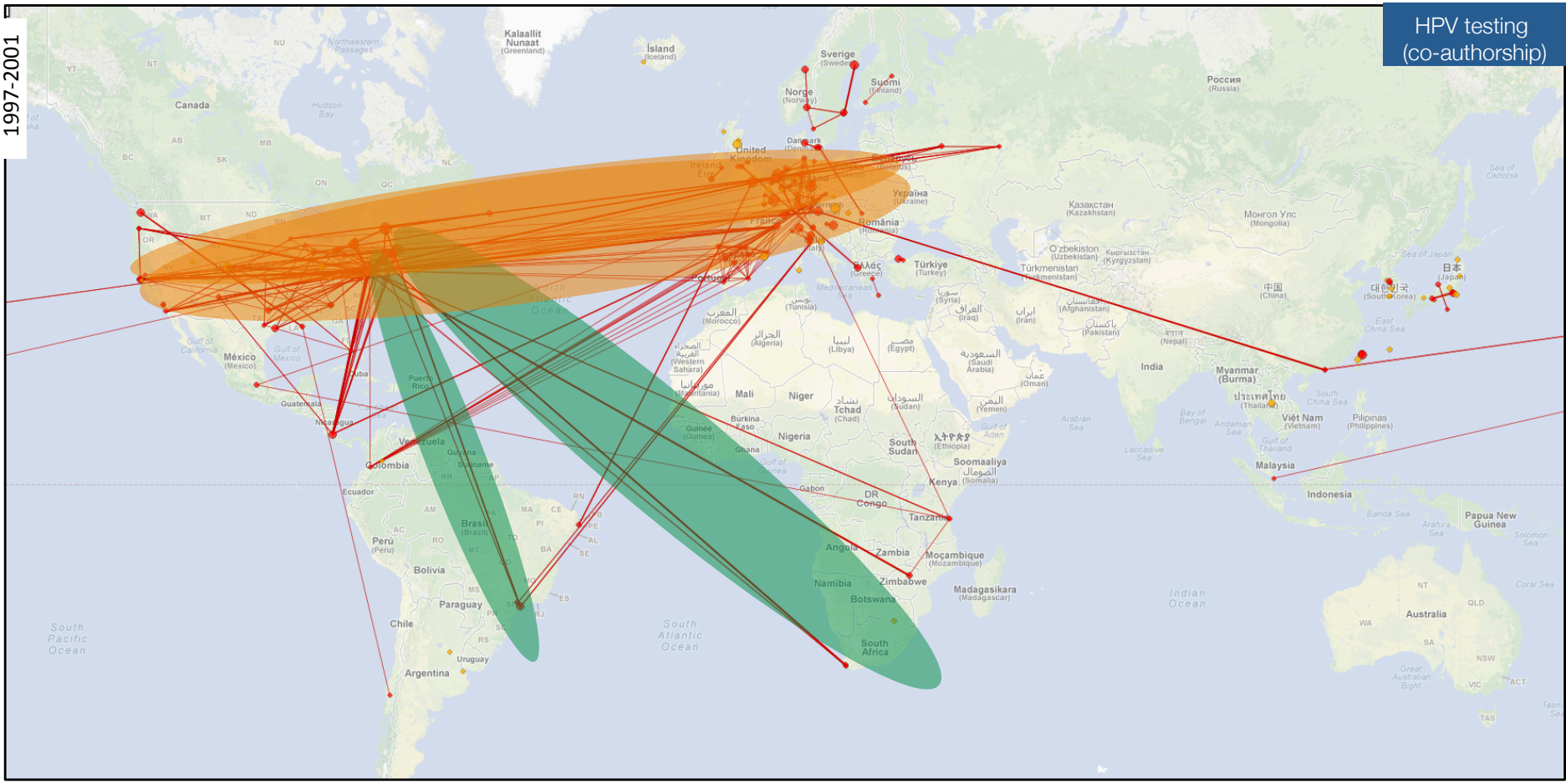

Results

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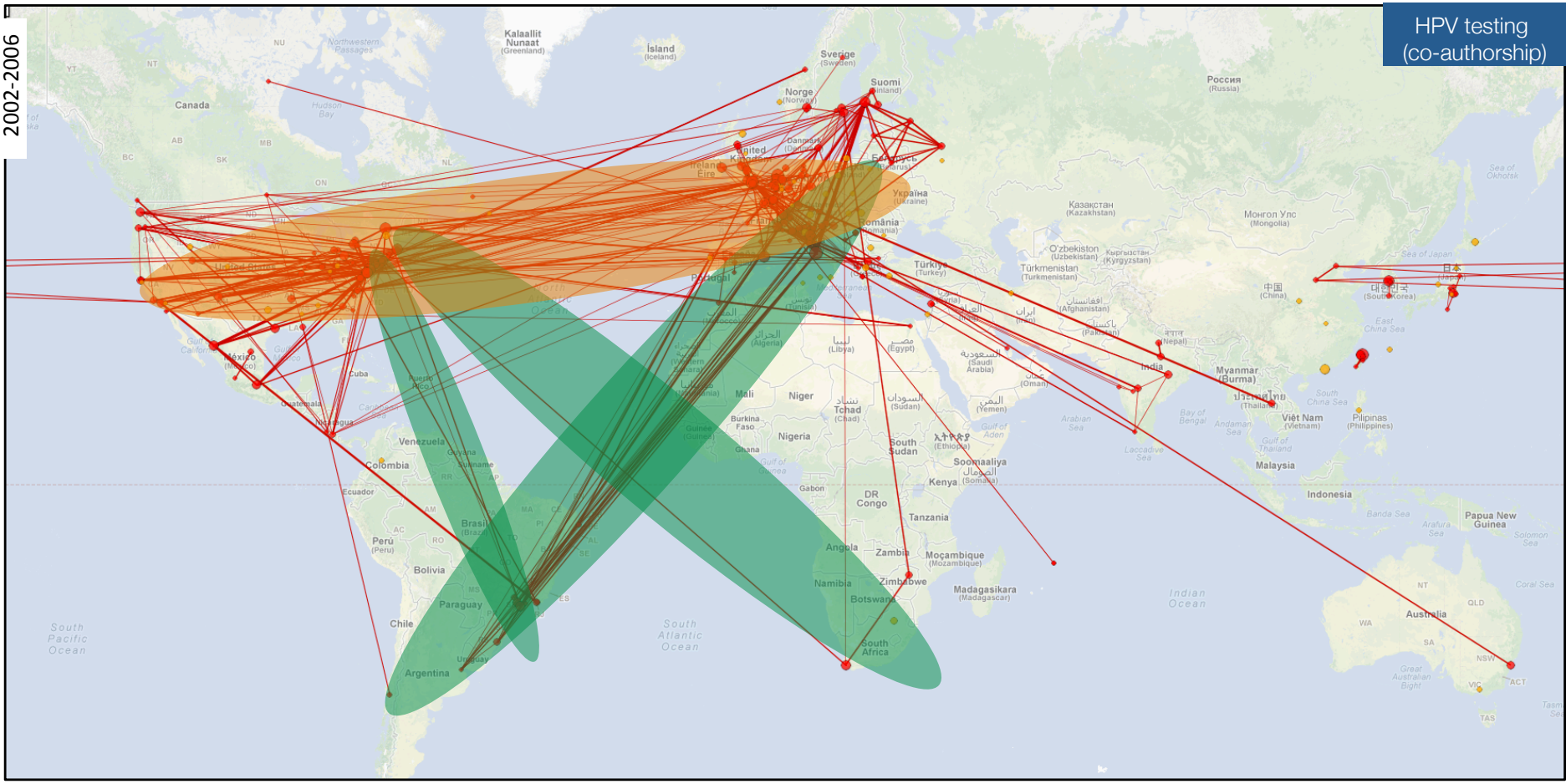
Mapping across the geographical and social spaces



Results

Mapping across the geographical and social spaces

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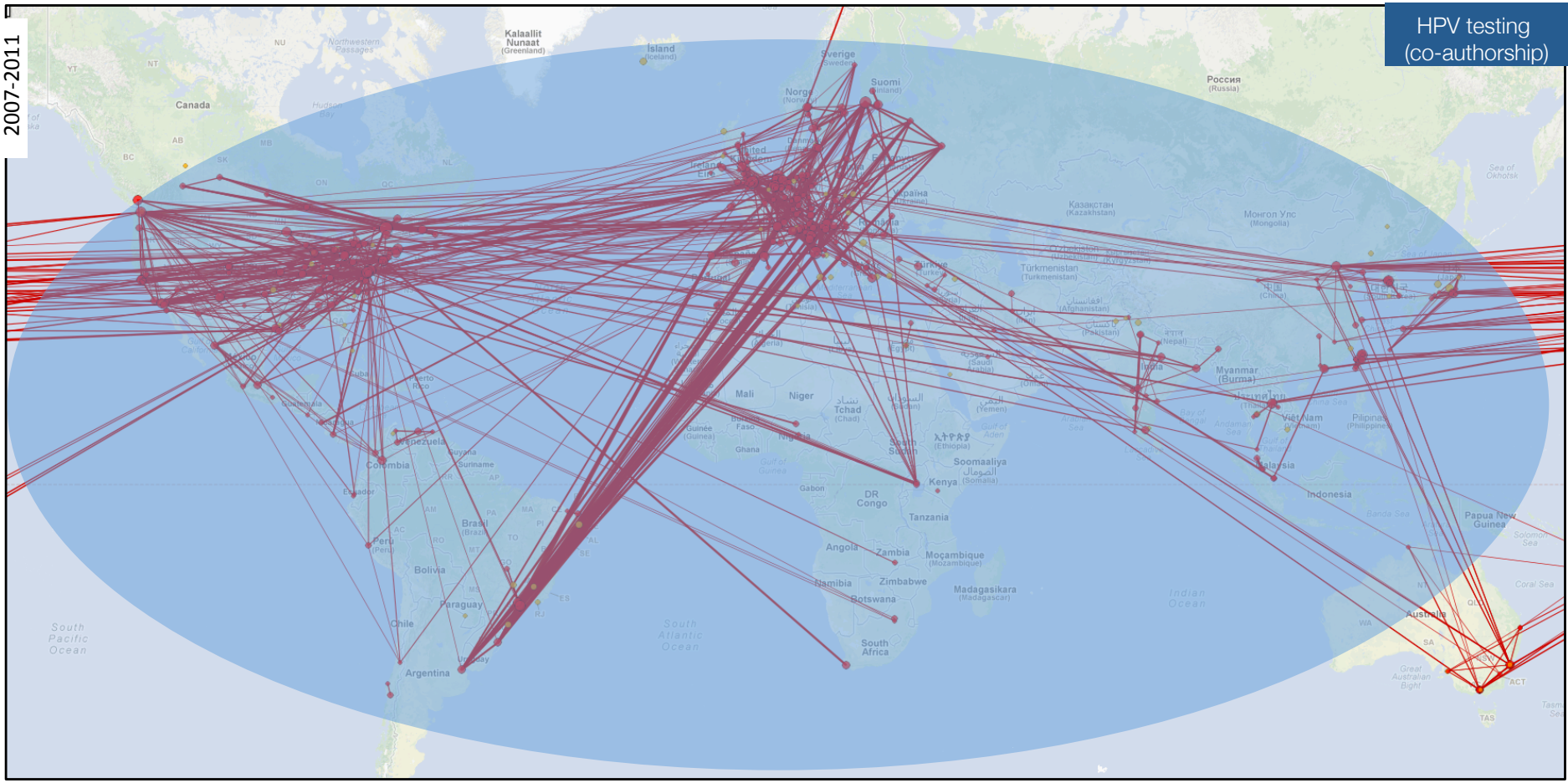
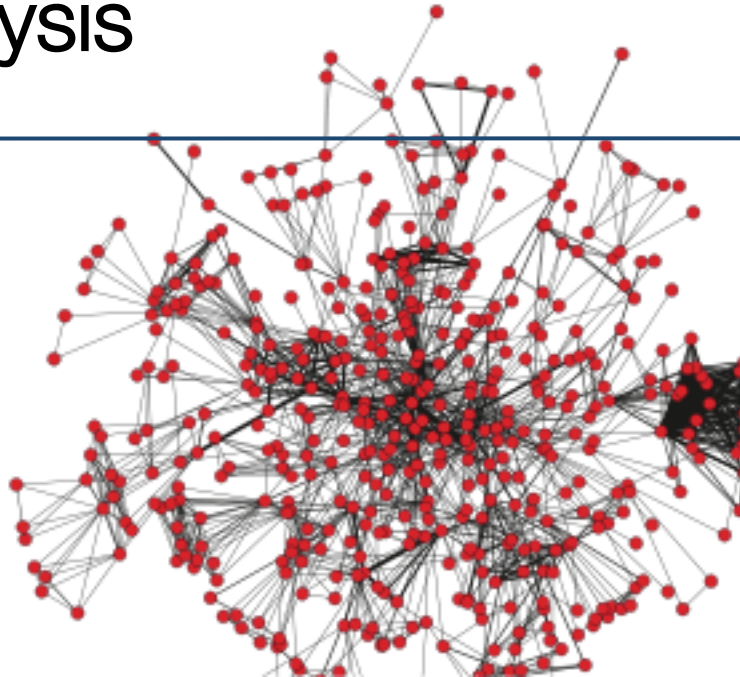
2007-2011



Social space:

Micro-level analysis

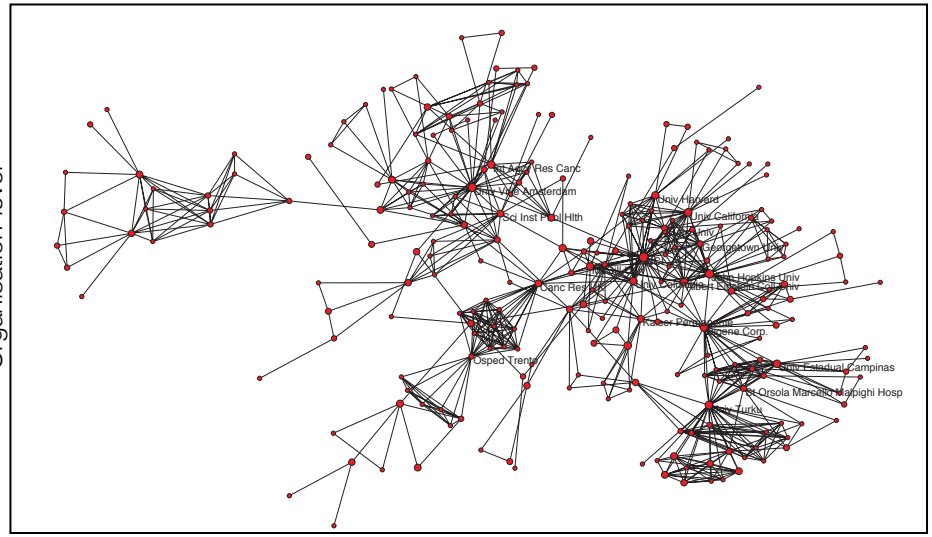


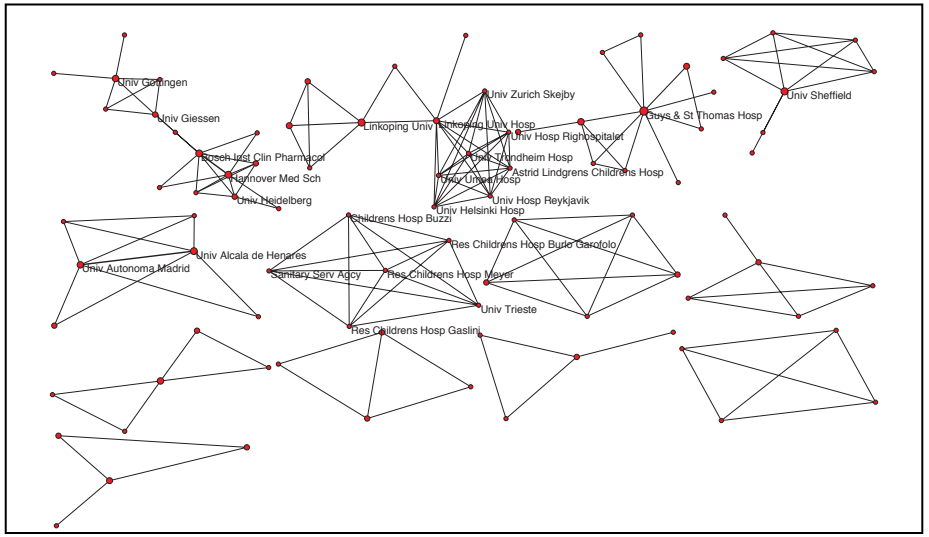
Results

Social space: Micro-level analysis

Urban area-level

Organisation-level

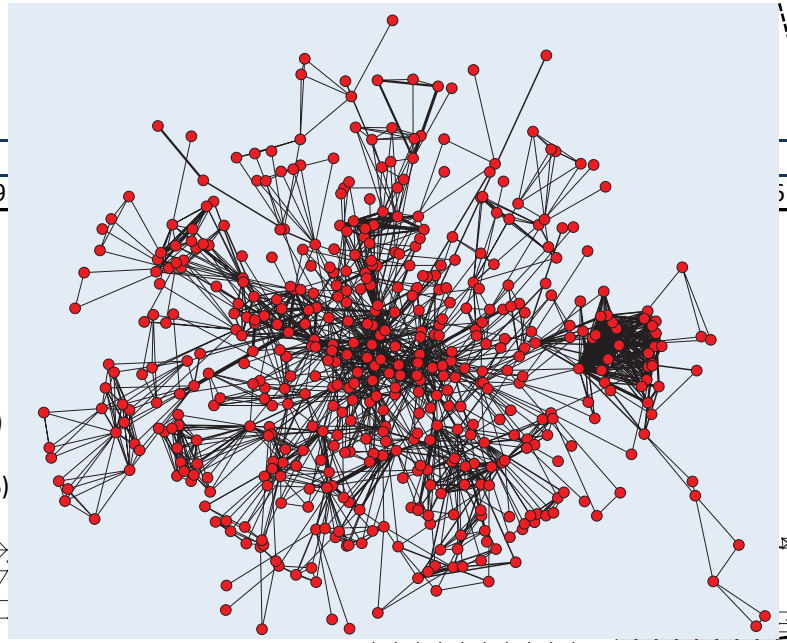


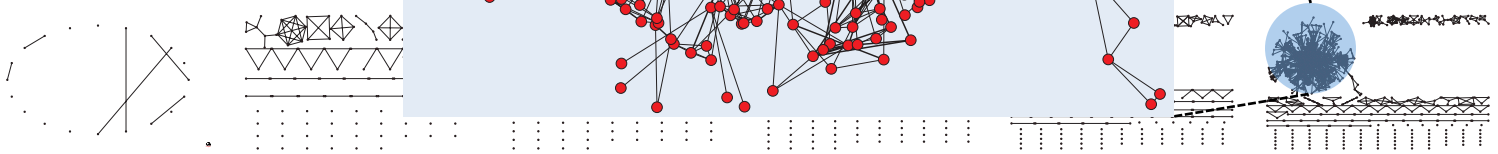


Results

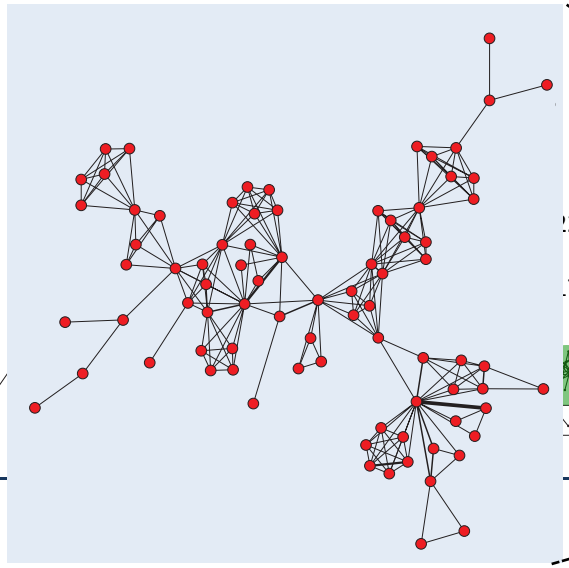
Social space: Micro-level analysis

	1982-1986	1987-199		2007-2011
HPV testing				
Scientific articles	18	137		673
Nodes	20	130		816
Ties	6	88		2075
Components	0	7		25
Nodes in the giant	0	7		504
component	(0.00%)	(5.38%)		(61.75%)
Isolated nodes	8	35		83
	(4.00%)	(26.92%)		(10.17%)



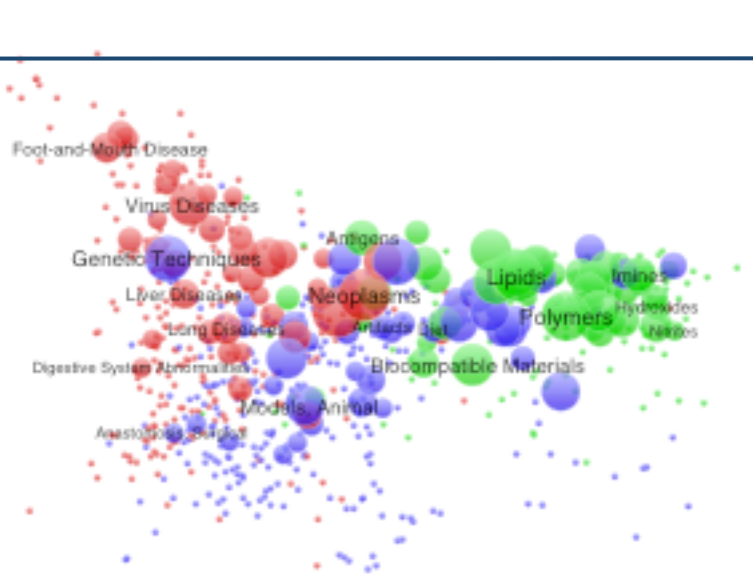


TPTM testing				
Scientific articles	13	108	200	151
Nodes	6	111	200	232
Ties	5	123	203	413
Components	1	6	13	12
Nodes in the giant	5	25	15	82
component	(83.33%)	(2.52%)	(7.50%)	(35.34%)
Isolated nodes	1	19	43	33
	(16.67%)	(7.12%)	(21.50%)	(14.22%)



Cognitive space:

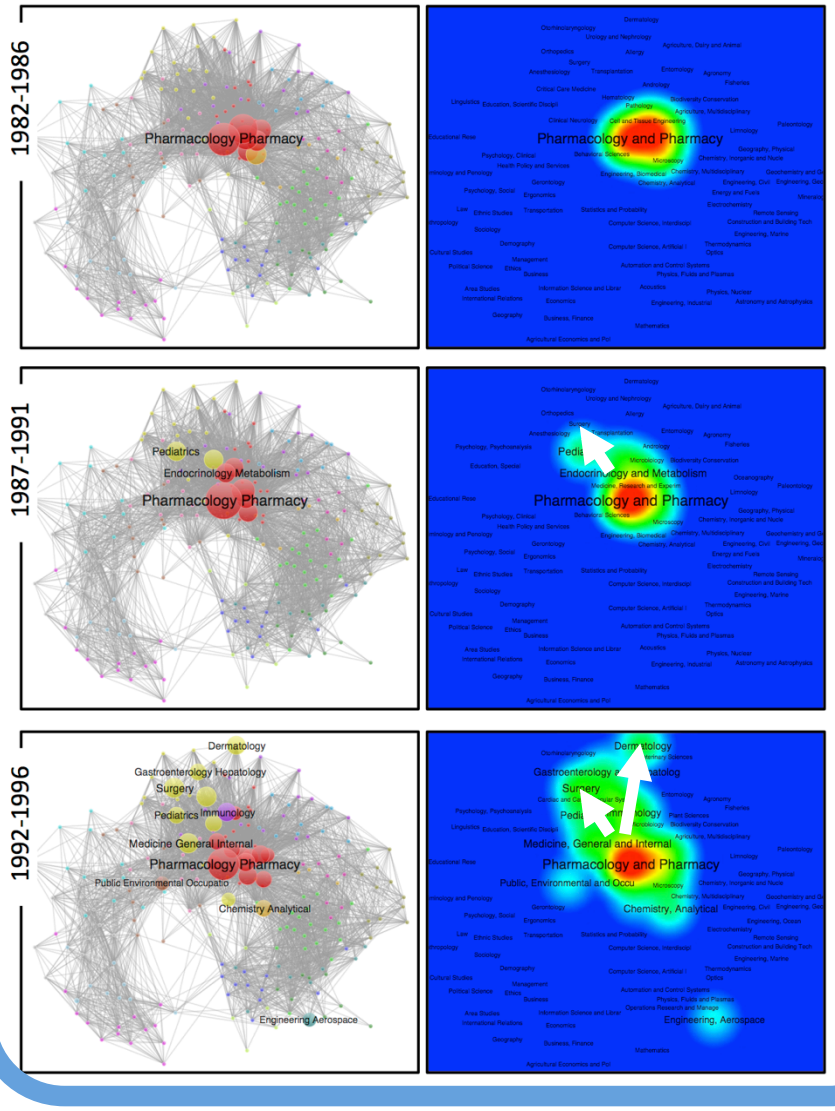
Mapping scientific disciplines

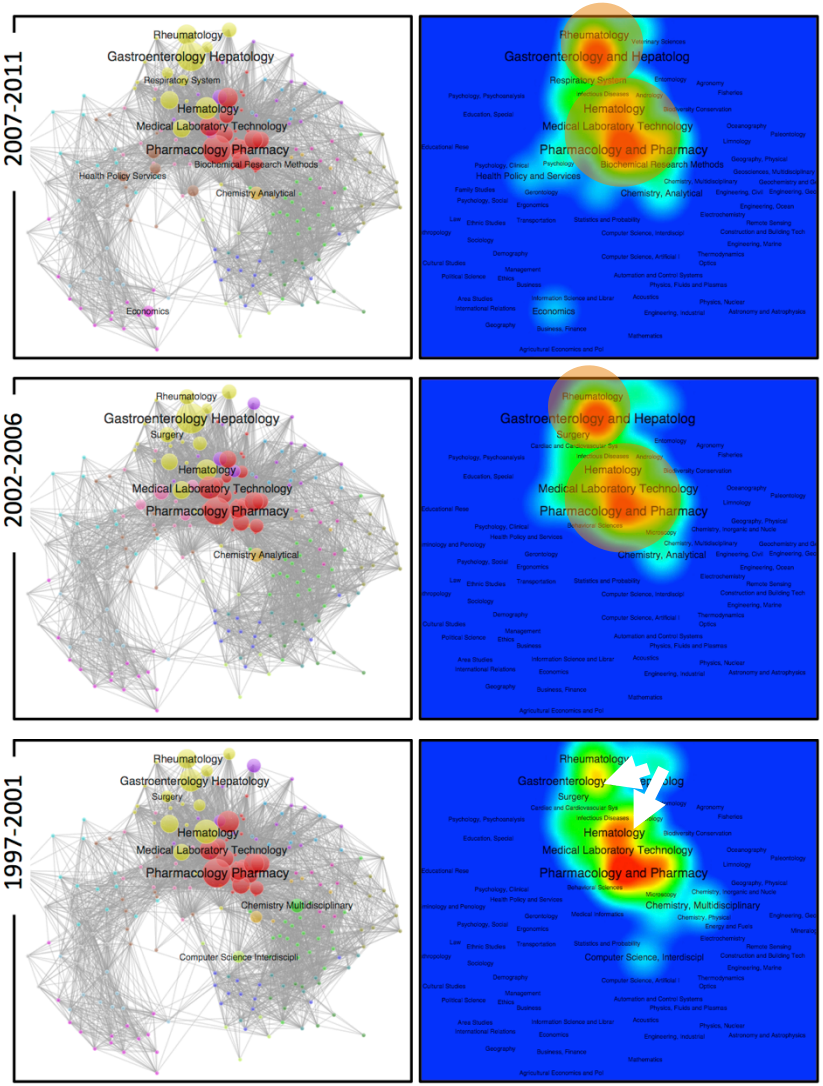


Results

Cognitive space: Mapping scientific disciplines

TPTM





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Cognitive space

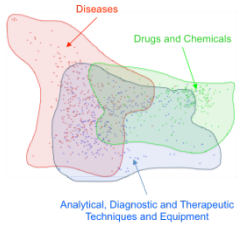
Similar mapping approaches can be built at different levels of analysis and using different data sources:

- Journals map

(e.g. Leydesdorff et al, in press)

- MeSH (Medical Subject Headings) map

(e.g. Leydesdorff et al, 2012)



- IPC technological classes map (for patent data)

(e.g. Leydesdorff et al., in press)

Discussion and Conclusions

- The uncertainty, ambiguity, and rapid dynamics featuring in the process of emergence of novel science and technologies requires an investigation from multiple perspectives (Stirling and Scoones, 2009)

- The mapping and overlay techniques can serve as strategic intelligence tool by providing informative perspectives on the *de facto* governance across spaces of emergence – flexibility, granularity and distributed strategic intelligence

- Degree of freedom in the mappings: i) delineation of the boundaries of ESTs, ii) database(s) selection, iii) elements to analyse and categories assigned

- It is worth noting that the informative and interpretative perspectives often do not provide answers, but they suggest additional questions that may drive the analyst in the investigation process

Full working paper available at

www.interdisciplinaryscience.net/defactogov

… thank you …

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