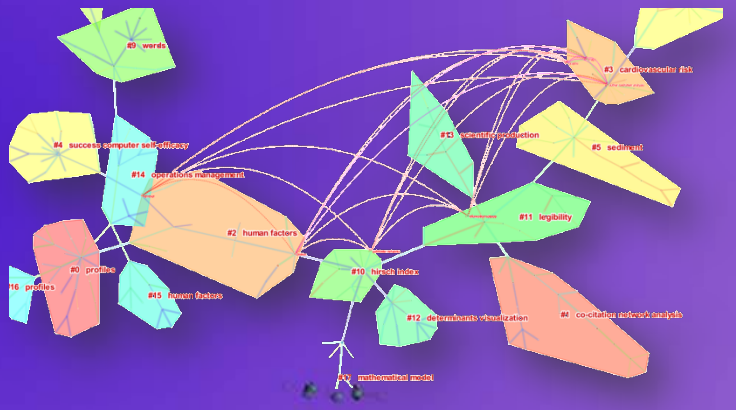
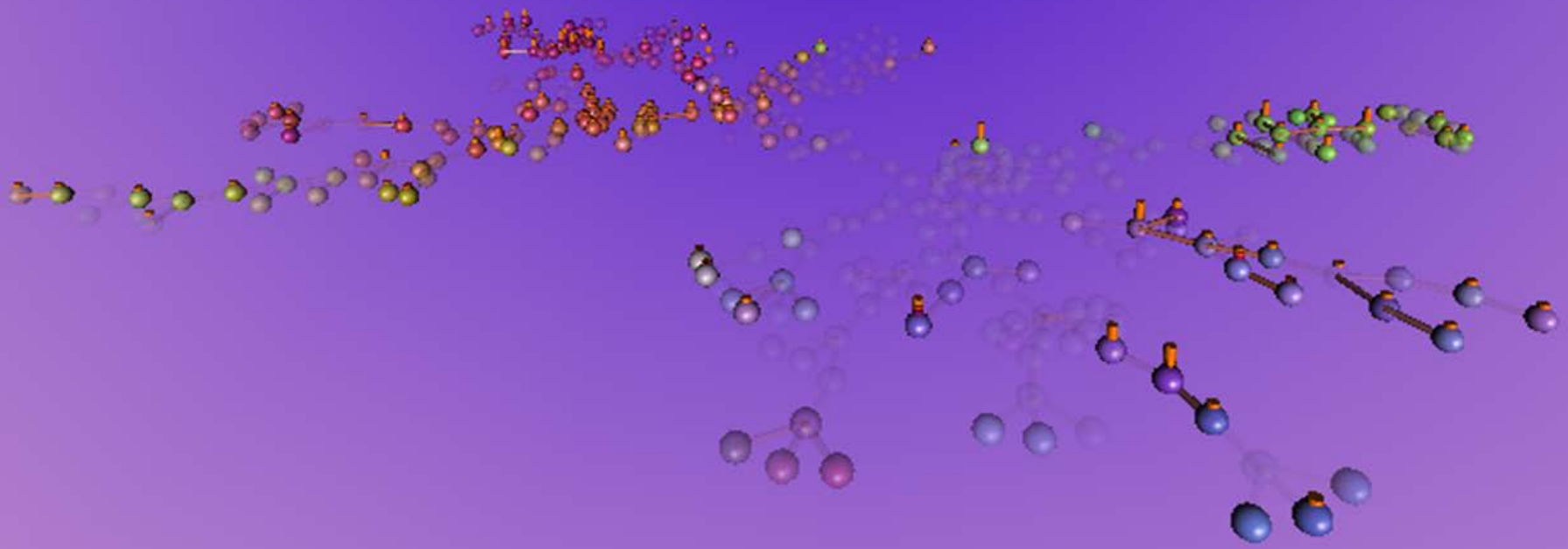
CiteSpace: Visualizing Trends and Patterns in Scientific Literature

Chaomei Chen
College of Computing and Informatics
Drexel University





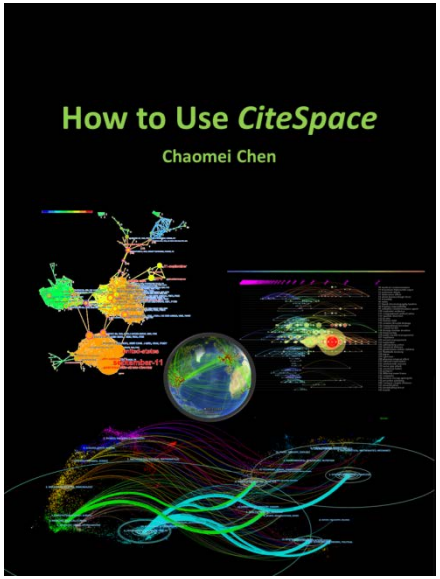
Outline

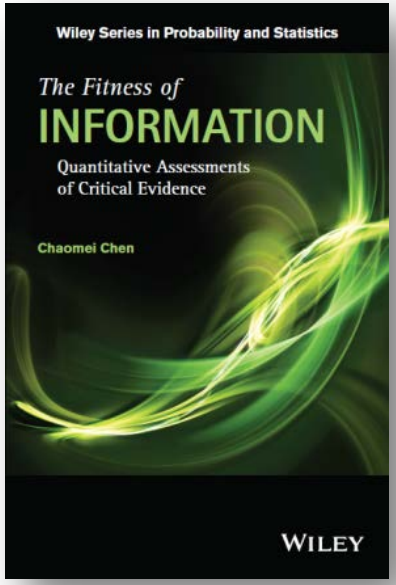
- What can we learn from scientific literature?
  - The structure and dynamics of scientific knowledge
  - Structural holes and turning points
  - Gestalt switch and paradigm shift
- What can we do with what we have learned?
  - Identifying emerging paradigms
  - Recognizing transformative discoveries
  - Predictive and proactive search and discovery

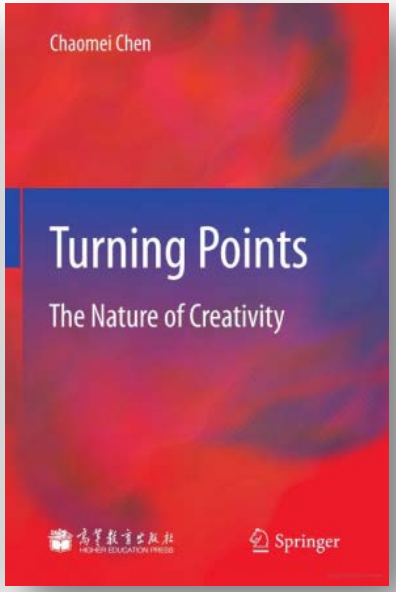
1. **Find a Turning Point**

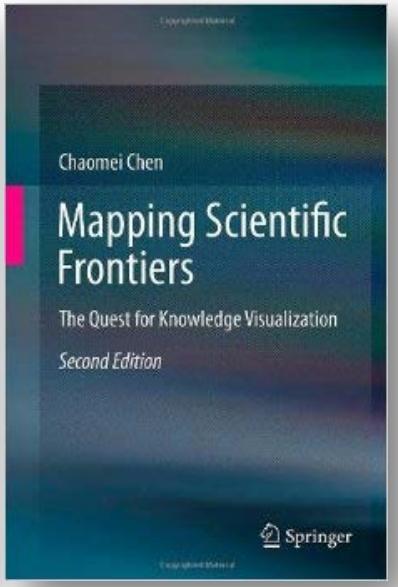
2. **Detect Early Signs of a Potential Turing Point**

Readings

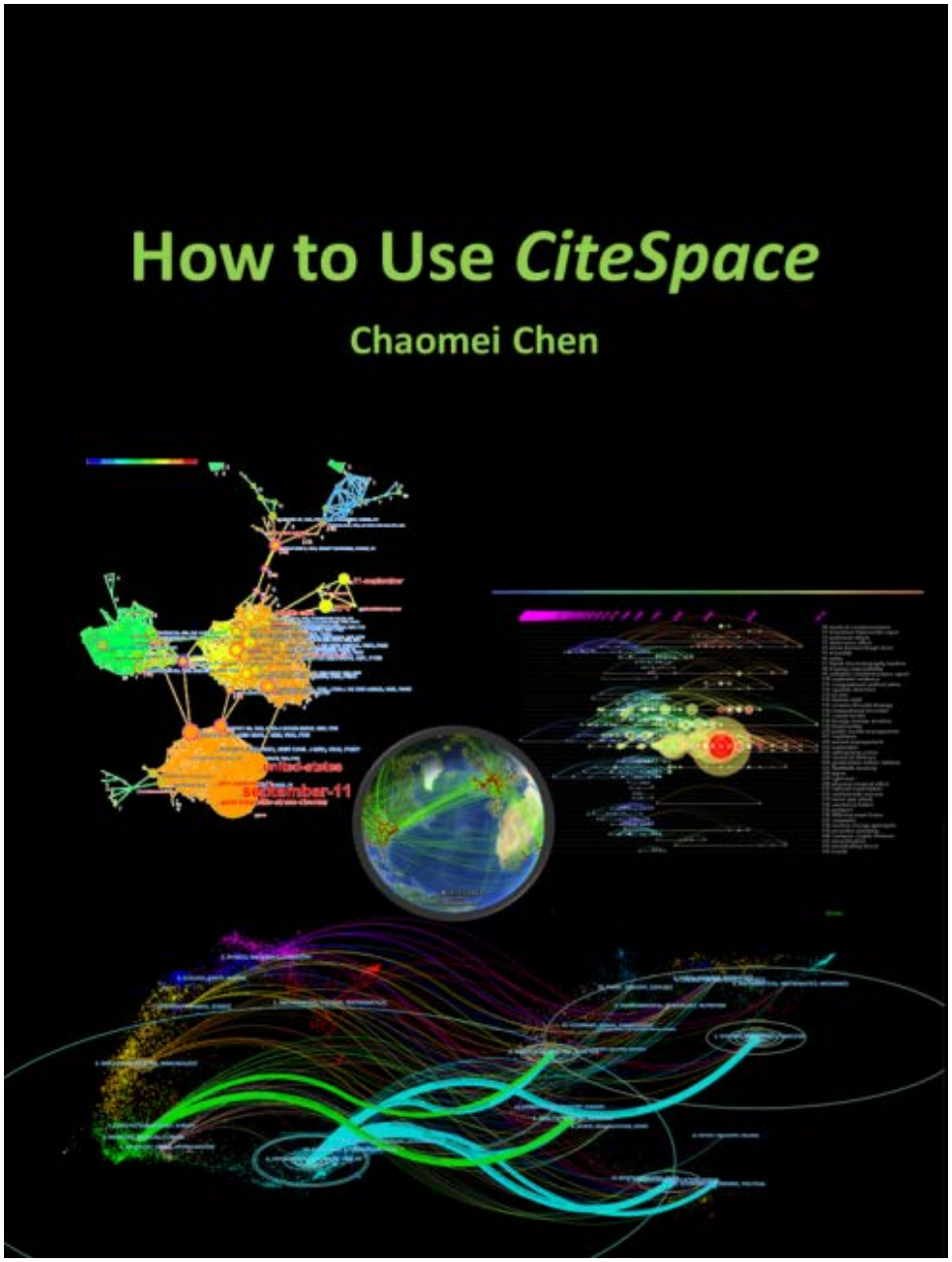




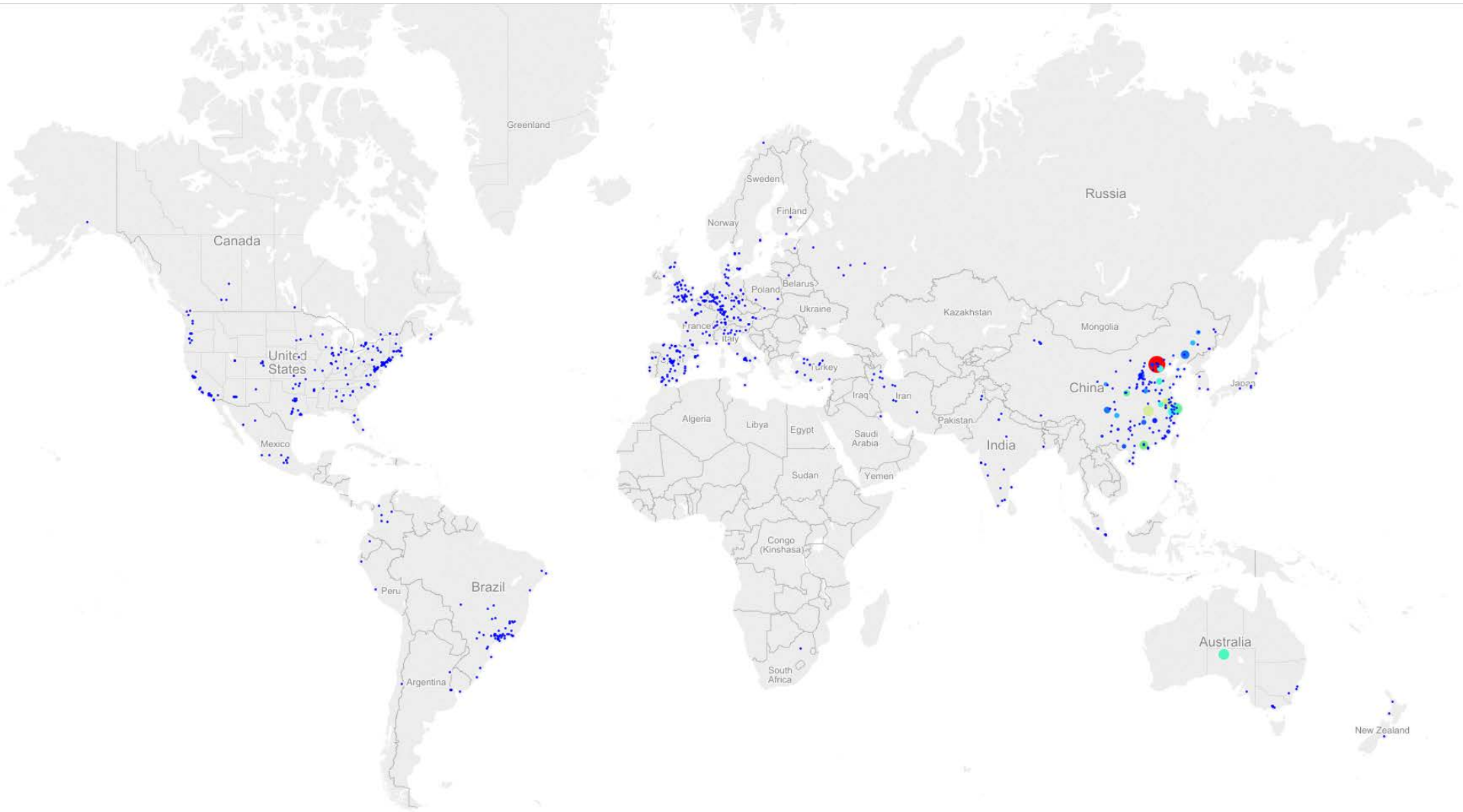




- Chen, C. (2015) *How to Use CiteSpace*. https://leanpub.com/howtousecitespace
- Chen, C., Leydesdorff, L. (2014) Patterns of connections and movements in dual-map overlays: A new method of publication portfolio analysis. *Journal of the American Society for Information Science and Technology,* **65**(2), 334-351. DOI: 10.1002/asi.22968
- Chen, C., Hu, Z., Milbank, J., Schultz, T. (2013) A visual analytic study of retracted articles in scientific literature. *Journal of the American Society for Information Science and Technology*, 64(2), 234-253. DOI: 10.1002/asi.22755
- Chen, C. (2012) Predictive effects of structural variation on citation counts. *Journal of the American Society for Information Science and Technology*, **63**(3), 431-449.
- Chen, C. (2006) CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. *Journal of the American Society for Information Science and Technology*, 57(3), 359-377.


How to Use CiteSpace
Chaomei Chen

Population of Users



The Usage of *CiteSpace*

Unique IPs	Version (*32-bit)	8.2013					1.2014											1.2015	2.2015
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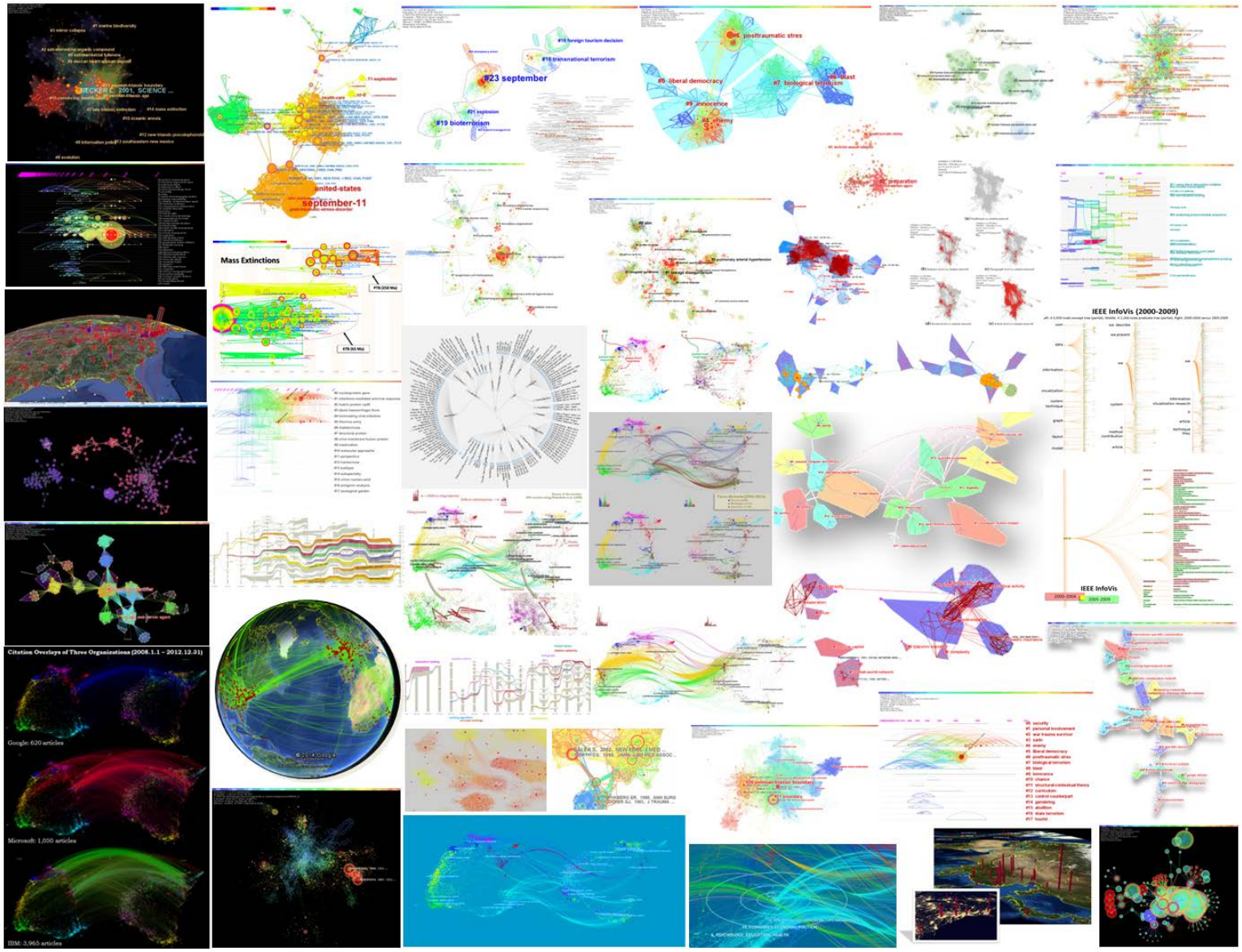
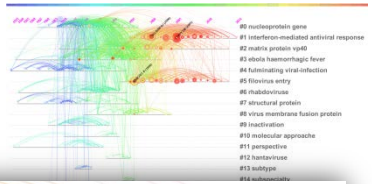
810	3.9.R5																		
597	3.9.R4																		
874	3.9.R3																		
320	3.9.R2																		
419	3.9.R1																		
460	3.8.R9																		
531	3.8.R8																		
1281	3.8.R7																		
773	3.8.R6																		
3057	3.8.R5																		
902	3.8.R4																		
801	3.8.R3																		
37	3.8.R2																		
8810	3.8.R1*																		
1943	3.8.R1																		
6546	3.7.R8																		
3360	3.7.R7*																		
824	3.7.R7																		
420	3.7.R6*																		
836	3.7.R5																		
44	3.7.R4																		
12	3.7.R3																		
223	3.7.R2																		
251	3.7.R1																		

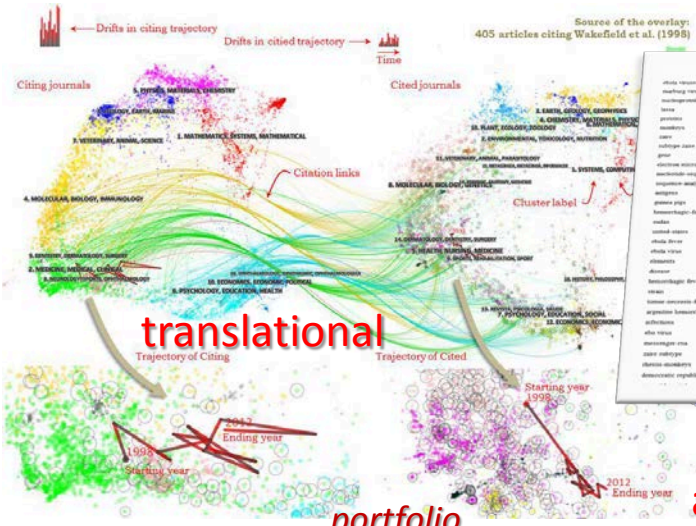
Visualizations Generated Using CiteSpace

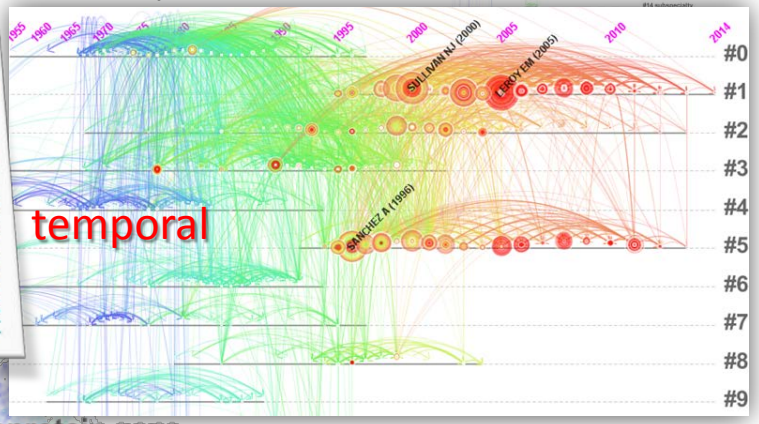


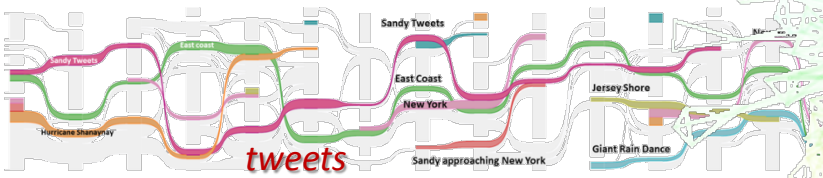
Tracking Emerging Trends and Evolving Patterns

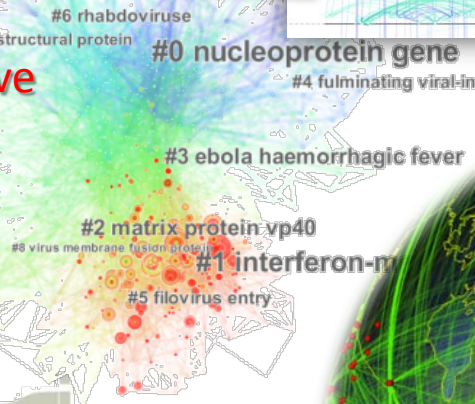


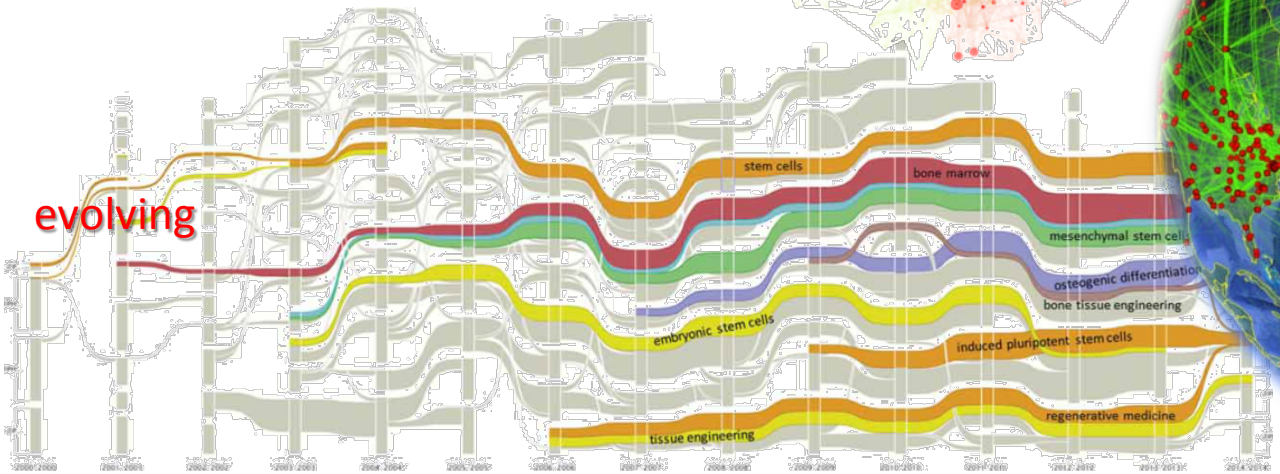
Ebola (1980-2014)

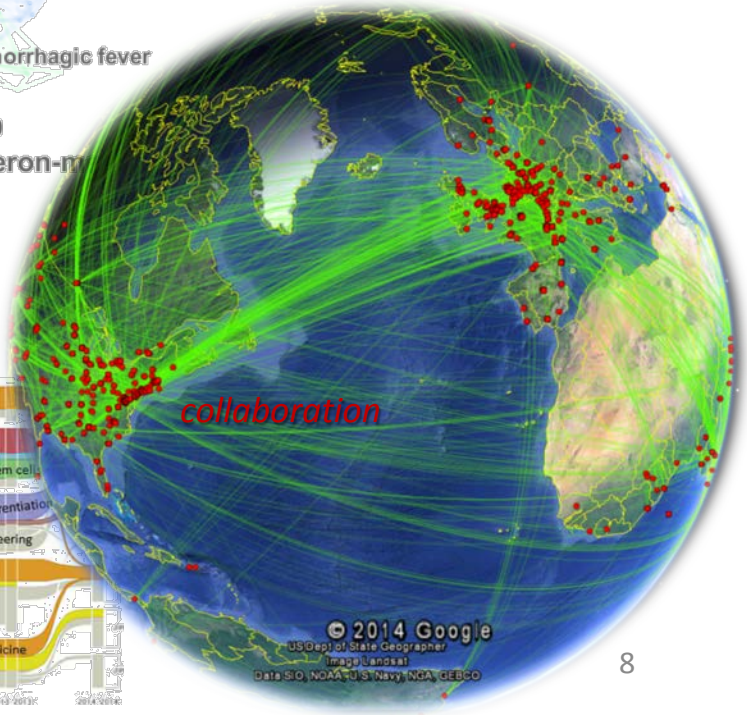






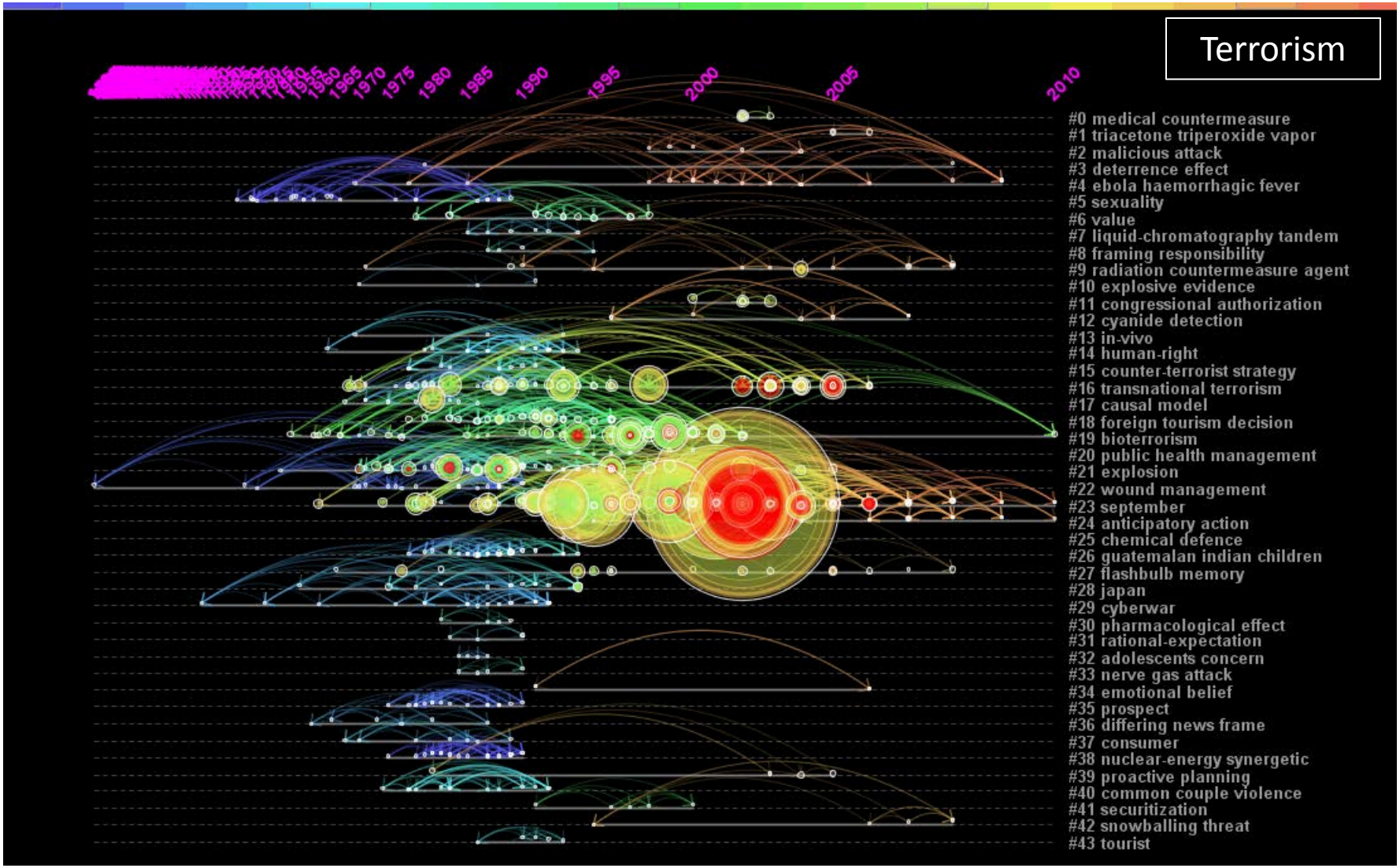







Ebola
© 2014 Google
US Dept of State Geographer
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Terrorism


1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
#0 medical countermeasure
#1 triacetone triperoxide vapor
#2 malicious attack
#3 deterrence effect
#4 ebola haemorrhagic fever
#5 sexuality
#6 value
#7 liquid-chromatography tandem
#8 framing responsibility
#9 radiation countermeasure agent
#10 explosive evidence
#11 congressional authorization
#12 cyanide detection
#13 in-vivo
#14 human-right
#15 counter-terrorist strategy
#16 transnational terrorism
#17 causal model
#18 foreign tourism decision
#19 bioterrorism
#20 public health management
#21 explosion
#22 wound management
#23 september
#24 anticipatory action
#25 chemical defence
#26 guatemalan indian children
#27 flashbulb memory
#28 japan
#29 cyberwar
#30 pharmacological effect
#31 rational-expectation
#32 adolescents concern
#33 nerve gas attack
#34 emotional belief
#35 prospect
#36 differing news frame
#37 consumer
#38 nuclear-energy synergetic
#39 proactive planning
#40 common couple violence
#41 securitization
#42 snowballing threat
#43 tourist

CiteSpace, v. 4.0.R4 (64-bit) beta
November 27, 2015 11:01:23 PM EST
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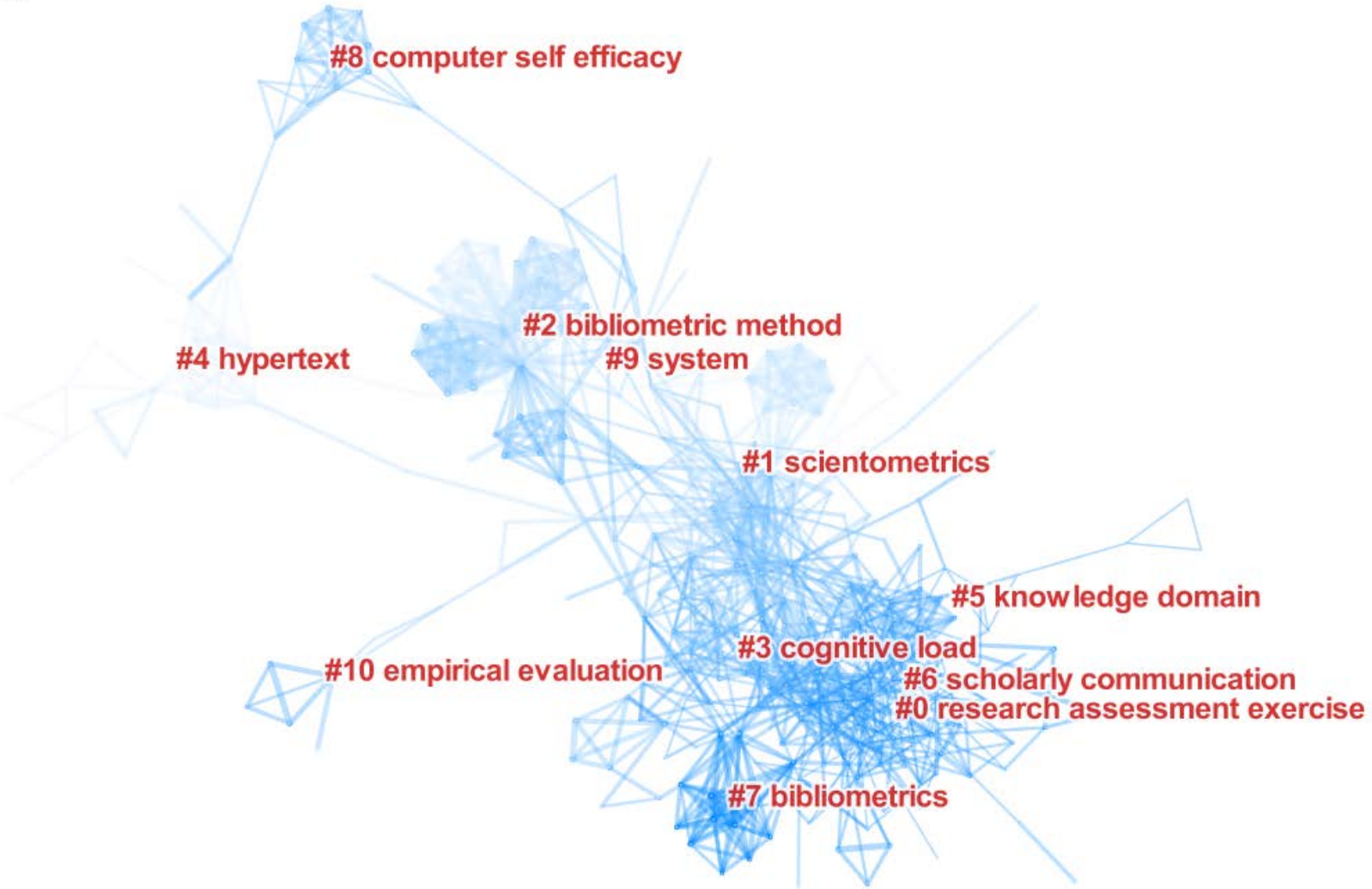
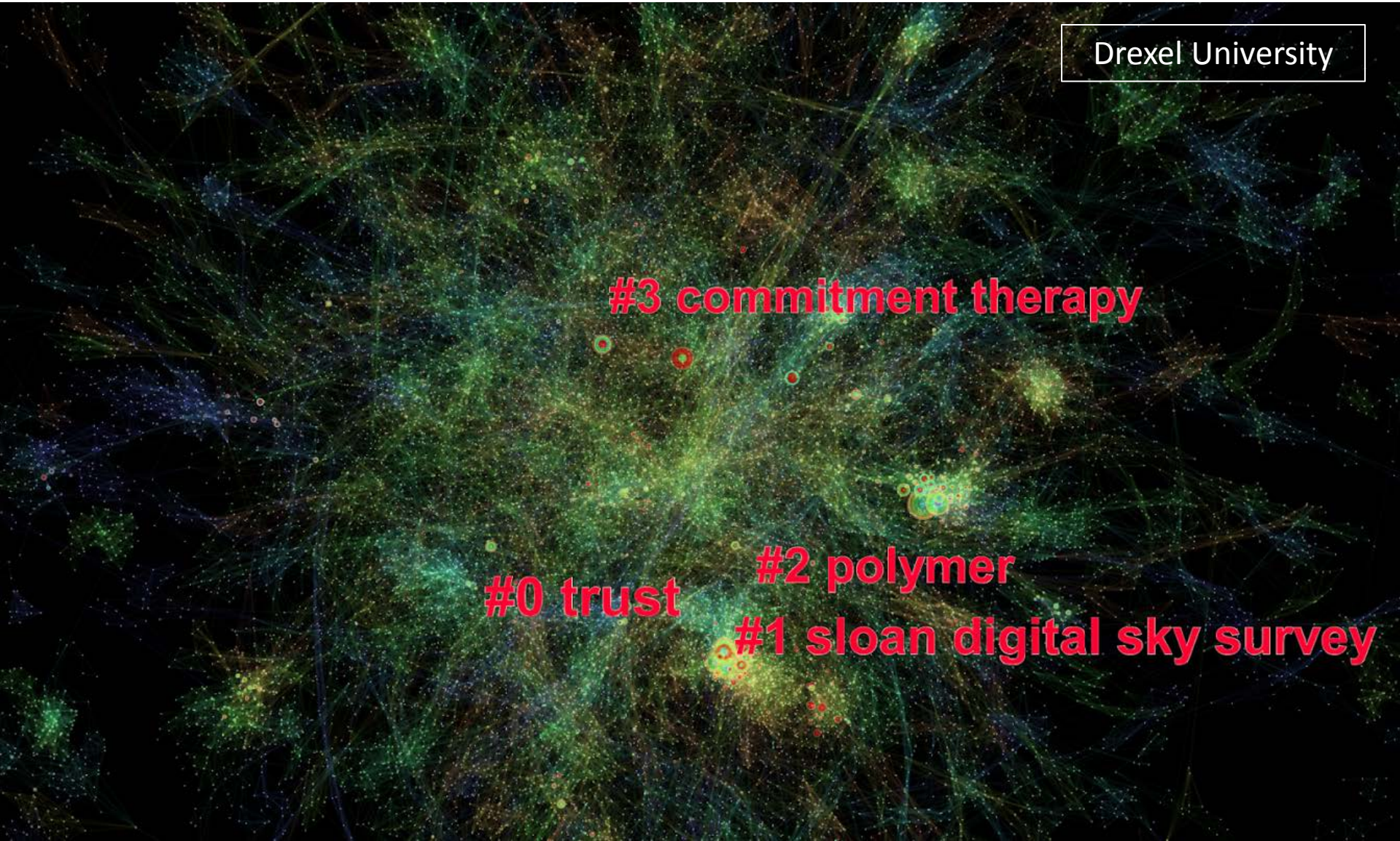
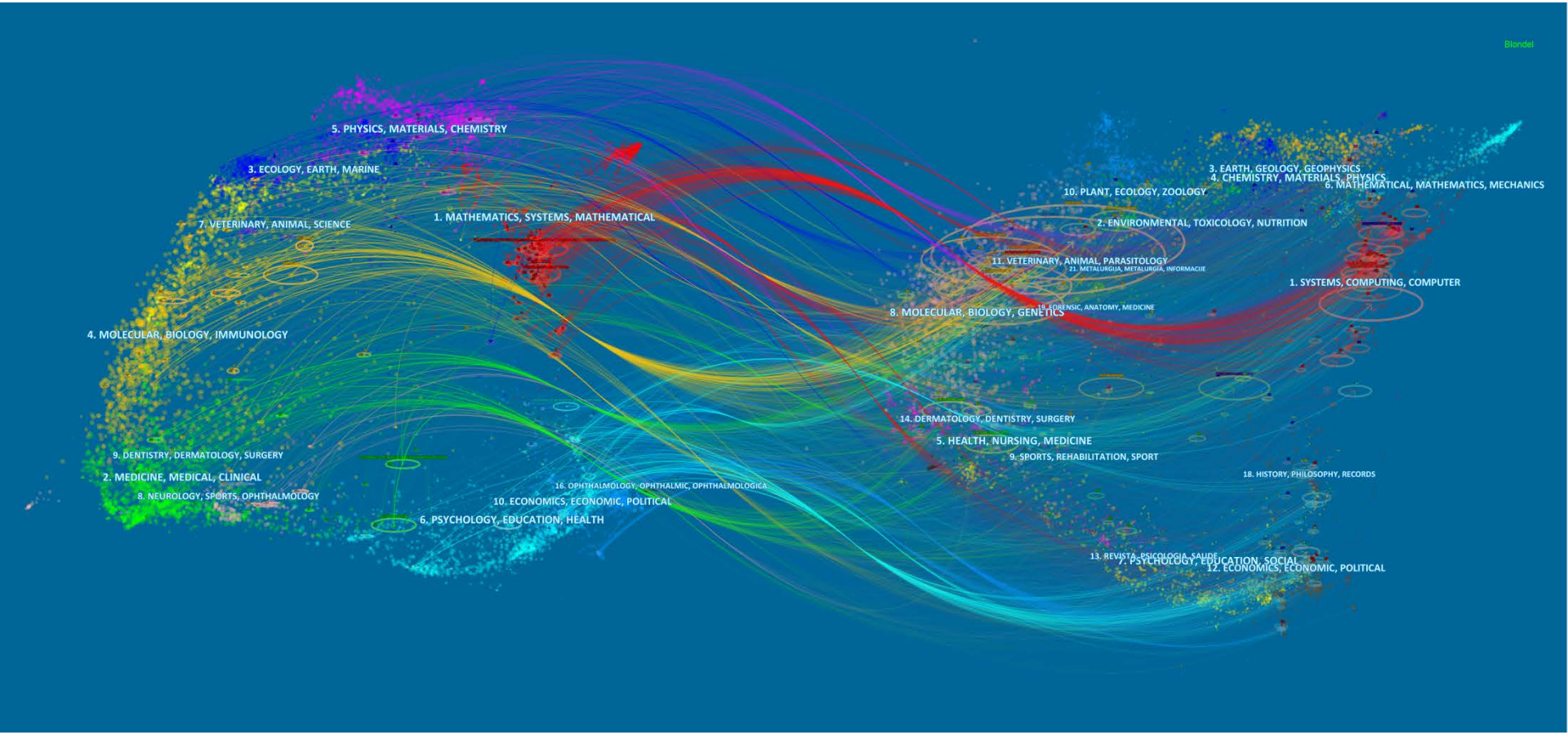
Mean Silhouette=0.3369



A network of 30,640 references with 133,975 co-citation instances in top 10% most cited publications of Drexel University each year (2000-2014)

Modularity Q=0.9756, Mean Silhouette=0.5702




Blondel
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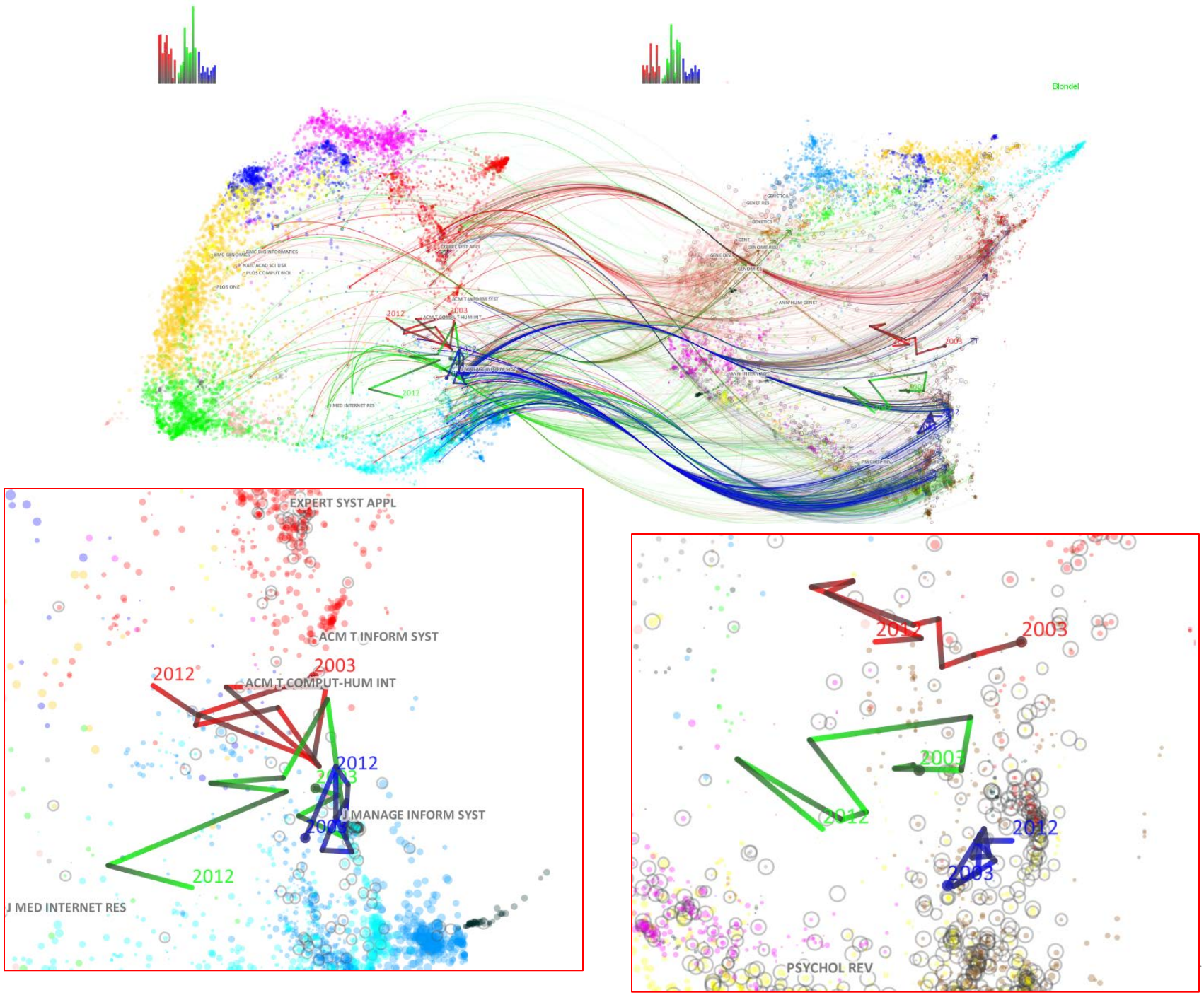
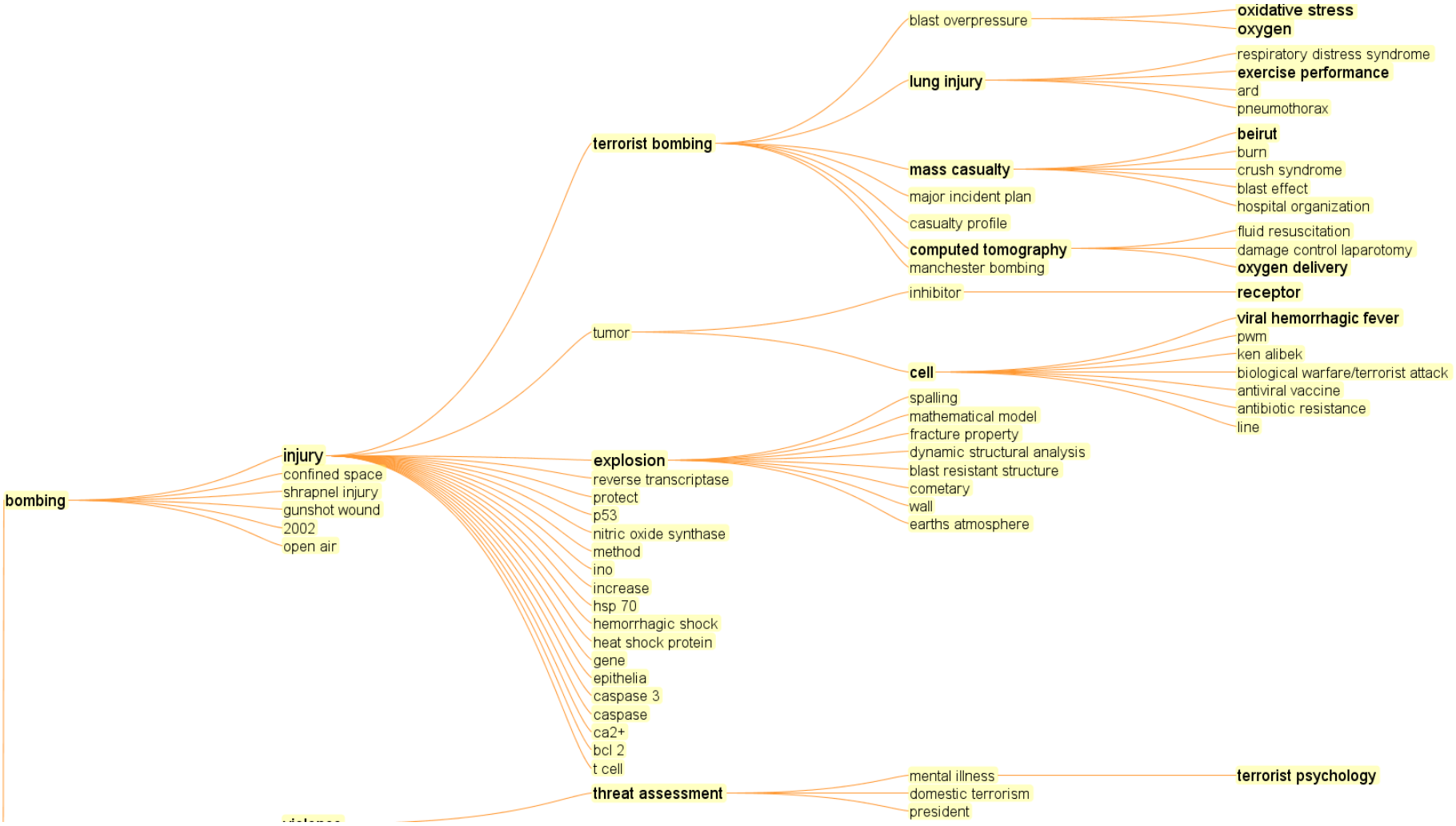
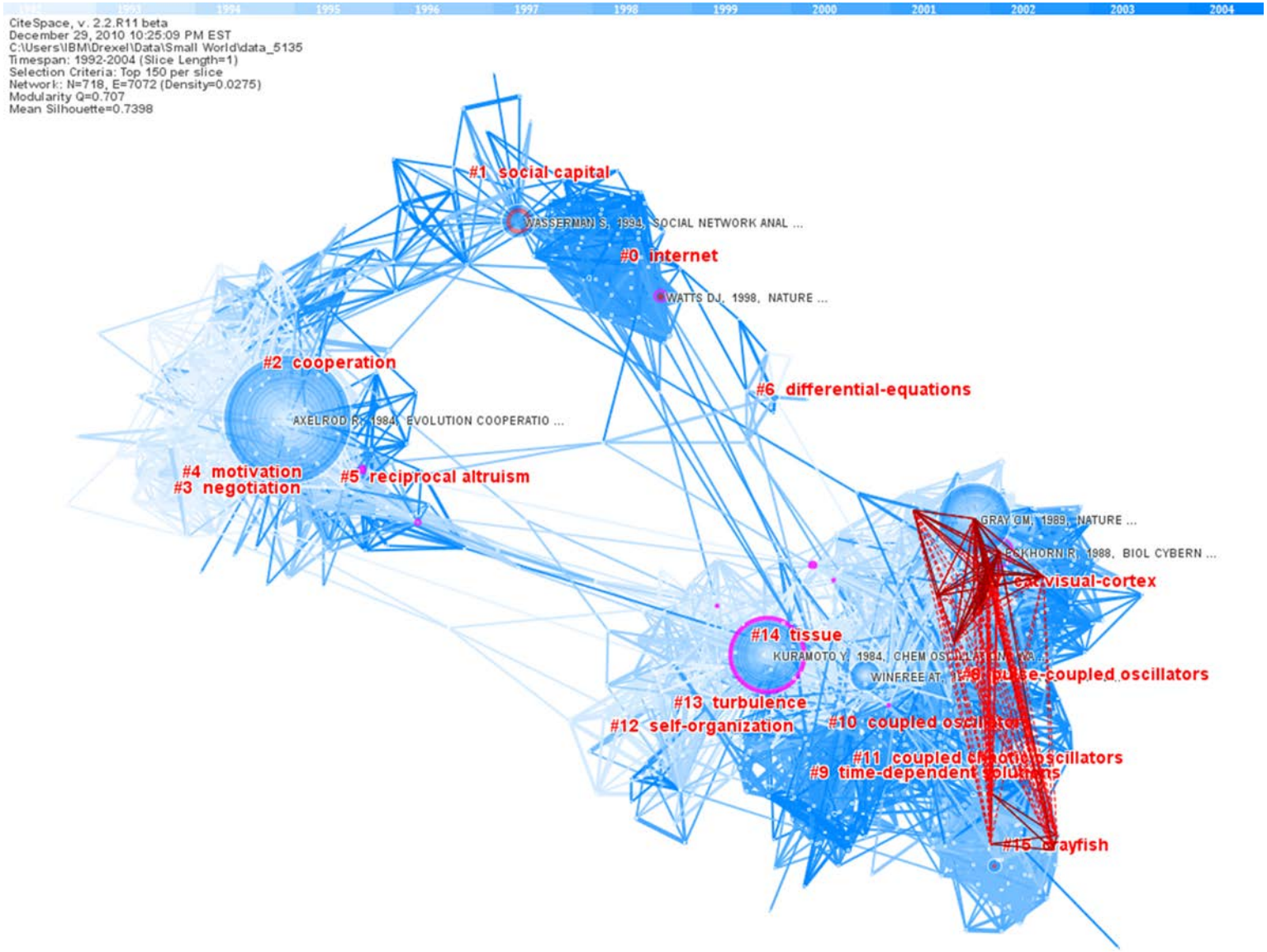
3. ECOLOGY, EARTH, MARINE
7. VETERINARY, ANIMAL, SCIENCE
1. MATHEMATICS, SYSTEMS, MATHEMATICAL
4. MOLECULAR, BIOLOGY, IMMUNOLOGY
9. DENTISTRY, DERMATOLOGY, SURGERY
2. MEDICINE, MEDICAL, CLINICAL
8. NEUROLOGY, SPORTS, OPHTHALMOLOGY
16. OPHTHALMOLOGY, OPHTHALMIC, OPHTHALMOLOGICA
10. ECONOMICS, ECONOMIC, POLITICAL
6. PSYCHOLOGY, EDUCATION, HEALTH
3. EARTH, GEOLOGY, GEOPHYSICS
4. CHEMISTRY, MATERIALS, PHYSICS
6. MATHEMATICAL, MATHEMATICS, MECHANICS
10. PLANT, ECOLOGY, ZOOLOGY
2. ENVIRONMENTAL, TOXICOLOGY, NUTRITION
11. VETERINARY, ANIMAL, PARASITOLOGY
21. METALURGIA, METALURGIA, INFORMACIE
1. SYSTEMS, COMPUTING, COMPUTER
8. MOLECULAR, BIOLOGY, GENETICS
14. DERMATOLOGY, DENTISTRY, SURGERY
5. HEALTH, NURSING, MEDICINE
9. SPORTS, REHABILITATION, SPORT
18. HISTORY, PHILOSOPHY, RECORDS
13. REVISTA PSICOLOGIA, SAUDE
7. PSYCHOLOGY, EDUCATION, SOCIAL
12. ECONOMICS, ECONOMIC, POLITICAL


Blondel
EXPERT SYST APPL
ACM T INFORM SYST
2012
2003
ACM T COMPUT-HUM INT
2012
2003
J MANAGE INFORM SYST
2003
2012
J MED INTERNET RES
2012
2003
2012
2003
2012
2003
PSYCHOL REV


Blondel
5. PHYSICS, MATERIALS, CHEMISTRY
3. ECOLOGY, EARTH, MARINE
7. VETERINARY, ANIMAL, SCIENCE
1. MATHEMATICS, SYSTEMS, MATHEMATICAL
4. MOLECULAR, BIOLOGY, IMMUNOLOGY
9. DENTISTRY, DERMATOLOGY, SURGERY
2. MEDICINE, MEDICAL, CLINICAL
8. NEUROLOGY, SPORTS, OPHTHALMOLOGY
16. OPHTHALMOLOGY, OPHTHALMIC, OPHTHALMOLOGICA
10. ECONOMICS, ECONOMIC, POLITICAL
6. PSYCHOLOGY, EDUCATION, HEALTH
3. EARTH, GEOLOGY, GEOPHYSICS
4. CHEMISTRY, MATERIALS, PHYSICS
5. MATHEMATICAL, MATHEMATICS, MECHANICS
10. PLANT, ECOLOGY, ZOOLOGY
2. ENVIRONMENTAL, TOXICOLOGY, NUTRITION
11. VETERINARY, ANIMAL, PARASITOLOGY
1. SYSTEMS, COMPUTING, COMPUTER
8. MOLECULAR, BIOLOGY, GENETICS
14. DERMATOLOGY, DENTISTRY, SURGERY
5. HEALTH, NURSING, MEDICINE
9. SPORTS, REHABILITATION, SPORT
18. HISTORY, PHILOSOPHY, RECORDS
13. REVISTA, PSICOLOGIA, SAUDE
7. PSYCHOLOGY, EDUCATION, SOCIAL
12. ECONOMICS, ECONOMIC, POLITICAL


bombing
injury
confined space
shrapnel injury
gunshot wound
2002
open air
terrorist bombing
blast overpressure
oxidative stress
oxygen
lung injury
respiratory distress syndrome
exercise performance
ard
pneumothorax
mass casualty
beirut
burn
crush syndrome
blast effect
hospital organization
major incident plan
casualty profile
computed tomography
fluid resuscitation
damage control laparotomy
oxygen delivery
manchester bombing
tumor
inhibitor
receptor
cell
viral hemorrhagic fever
pwm
ken alibek
biological warfare/terrorist attack
antiviral vaccine
antibiotic resistance
line
explosion
spalling
mathematical model
fracture property
dynamic structural analysis
blast resistant structure
cometary
wall
earths atmosphere
reverse transcriptase
protect
p53
nitric oxide synthase
method
ino
increase
hsp 70
hemorrhagic shock
heat shock protein
gene
epithelia
caspase 3
caspase
ca2+
bcl 2
t cell
threat assessment
mental illness
terrorist psychology
domestic terrorism
president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CiteSpace, v. 2.2.R11 beta
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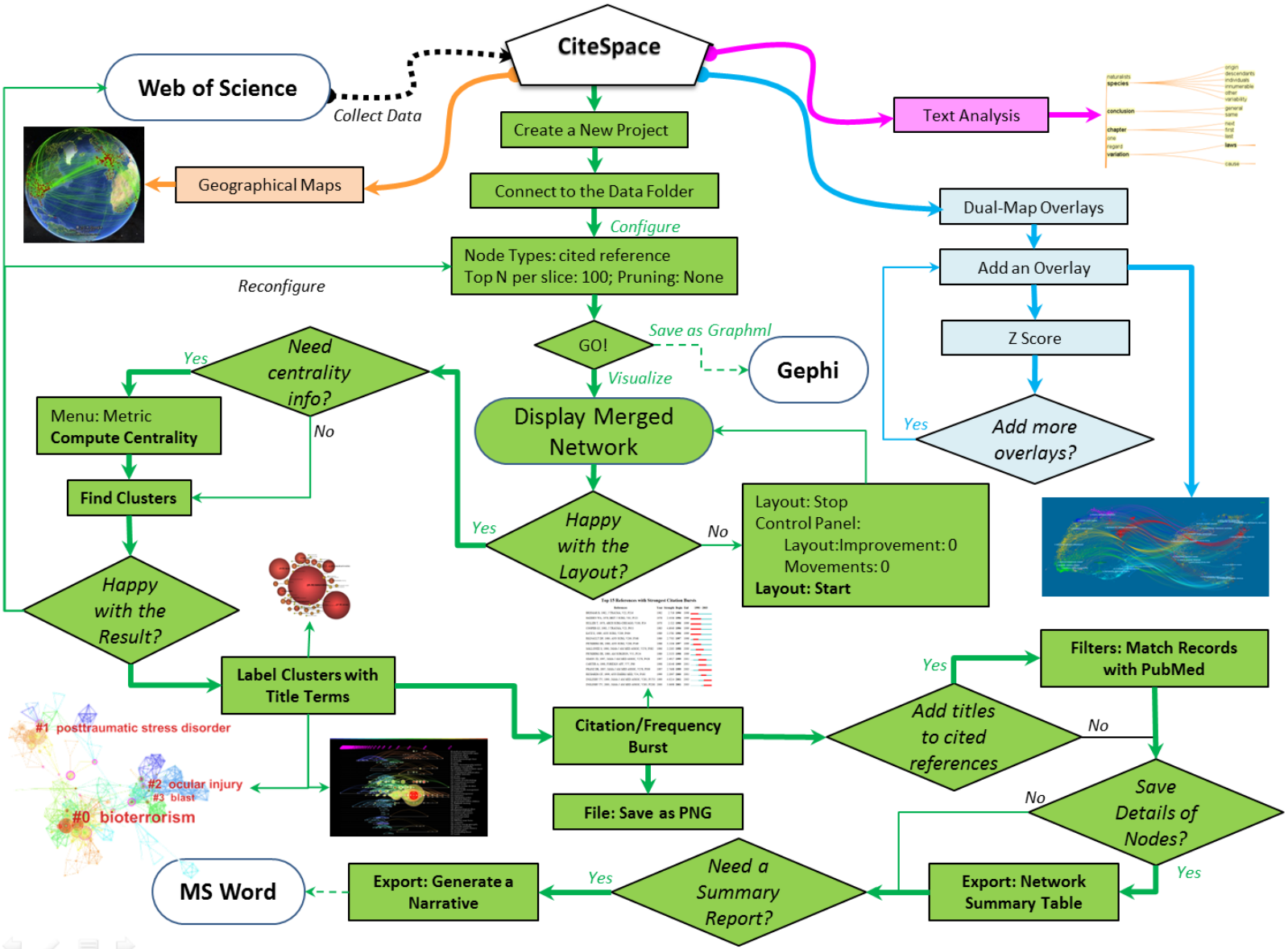
WASSERMAN S, 1994, SOCIAL NETWORK ANAL ...
#0 internet
WATTS DJ, 1998, NATURE ...
#2 cooperation
#6 differential-equations
AXELROD R, 1984, EVOLUTION COOPERATIO ...
#4 motivation
#3 negotiation
#5 reciprocal altruism
GRAY CM, 1989, NATURE ...
ECKHORN R, 1988, BIOL CYBERN ...
cat visual-cortex
#14 tissue
KURAMOTO Y, 1984, CHEM OSCILLATIONS ...
WINFREE AT, 1967, J THEOR BIOL
#13 turbulence
#12 self-organization
#10 coupled oscillators
#11 coupled chaotic oscillators
#9 time-dependent solutions
#15 crayfish

Procedures

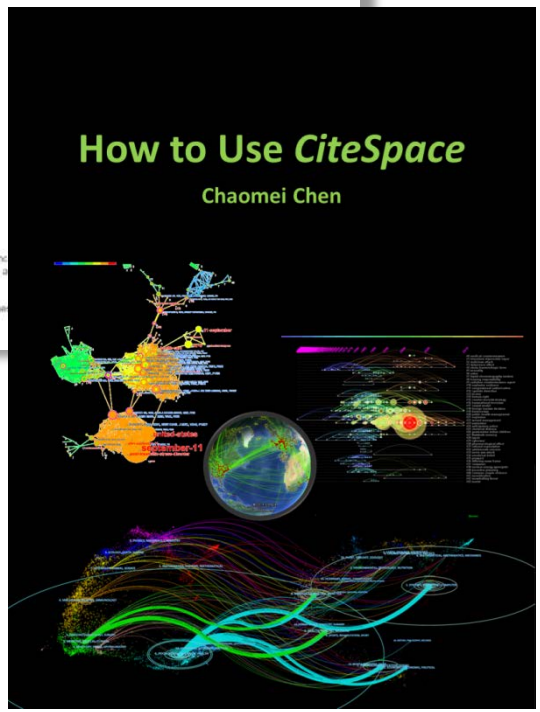

CiteSpace
Web of Science
Collect Data
Geographical Maps
Create a New Project
Connect to the Data Folder
Configure
Node Types: cited reference
Top N per slice: 100; Pruning: None
Reconfigure
GO!
Save as Graphml
Gephi
Visualize
Need centrality info?
Yes
No
Menu: Metric
Compute Centrality
Find Clusters
Display Merged Network
Happy with the Layout?
Yes
No
Layout: Stop
Control Panel:
Layout:Improvement: 0
Movements: 0
Layout: Start
Happy with the Result?
Label Clusters with Title Terms
#1 posttraumatic stress disorder
#2 ocular injury
#3 blast
#0 bioterrorism
Citation/Frequency Burst
File: Save as PNG
Text Analysis
Dual-Map Overlays
Add an Overlay
Z Score
Add more overlays?
Yes
Add titles to cited references
Yes
No
Filters: Match Records with PubMed
Save Details of Nodes?
No
Yes
Export: Network Summary Table
Need a Summary Report?
Yes
Export: Generate a Narrative
MS Word

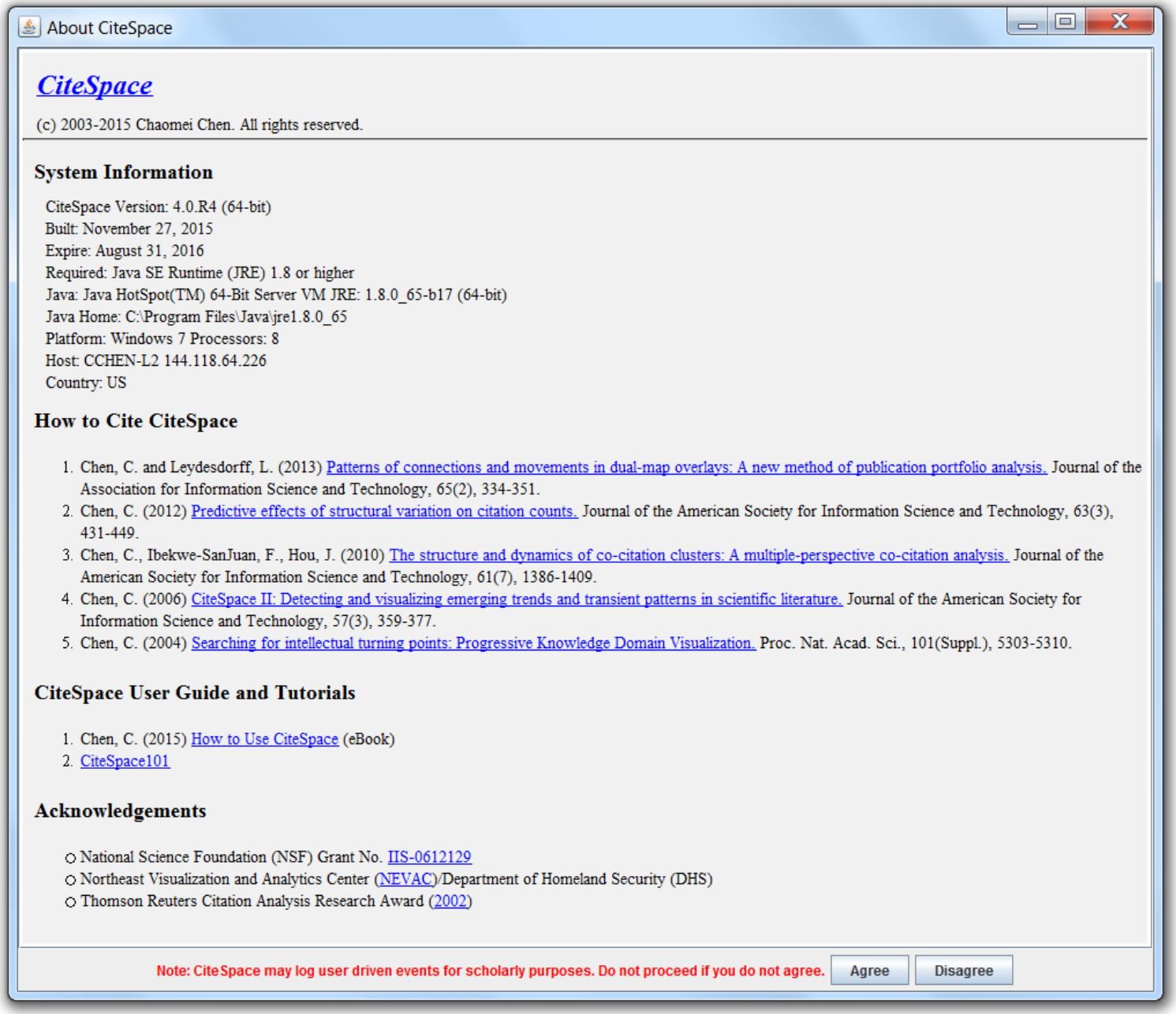
CiteSpace: Visualizing Patterns and Trends in Scientific Literature

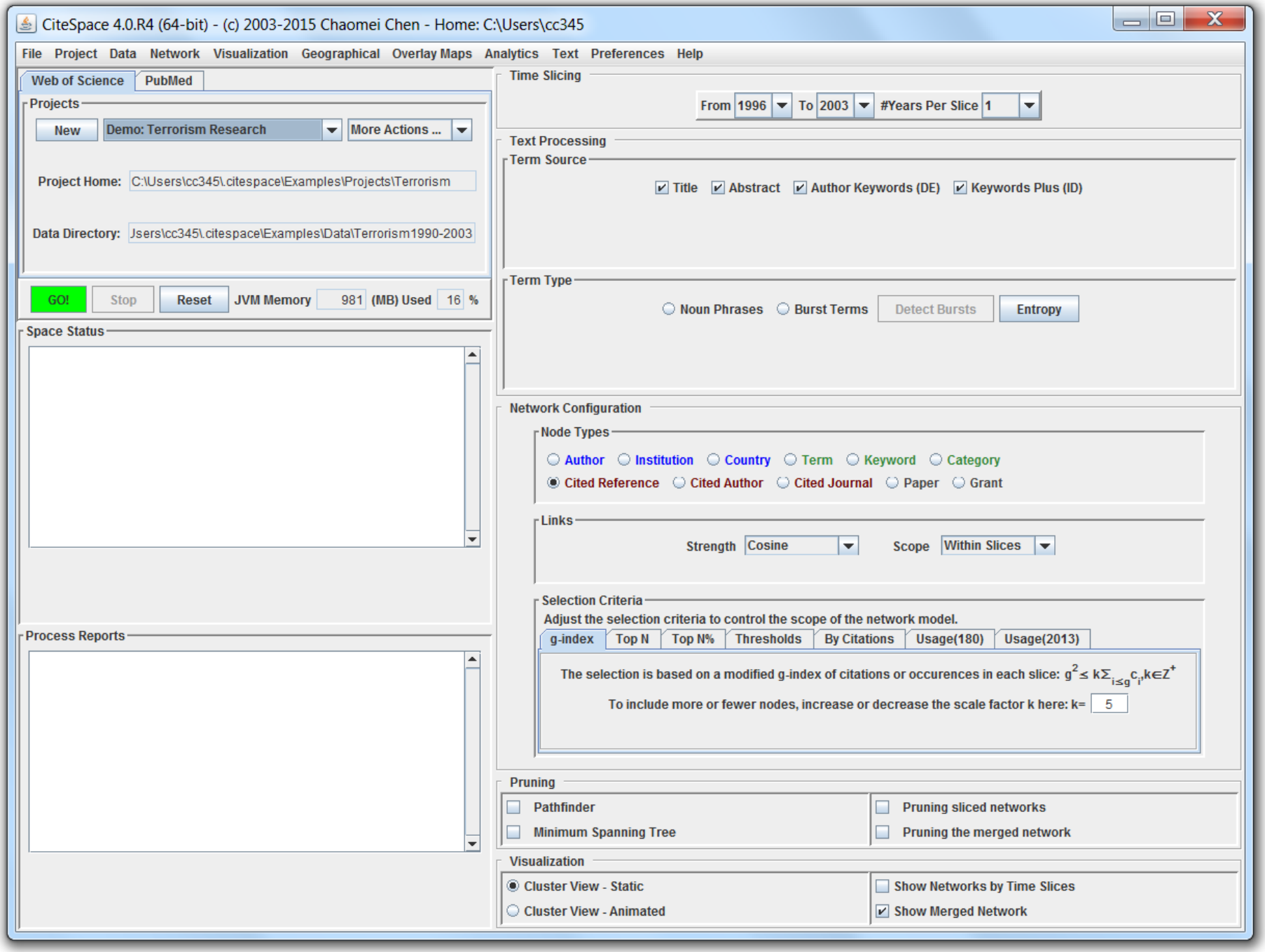
Chaomei Chen

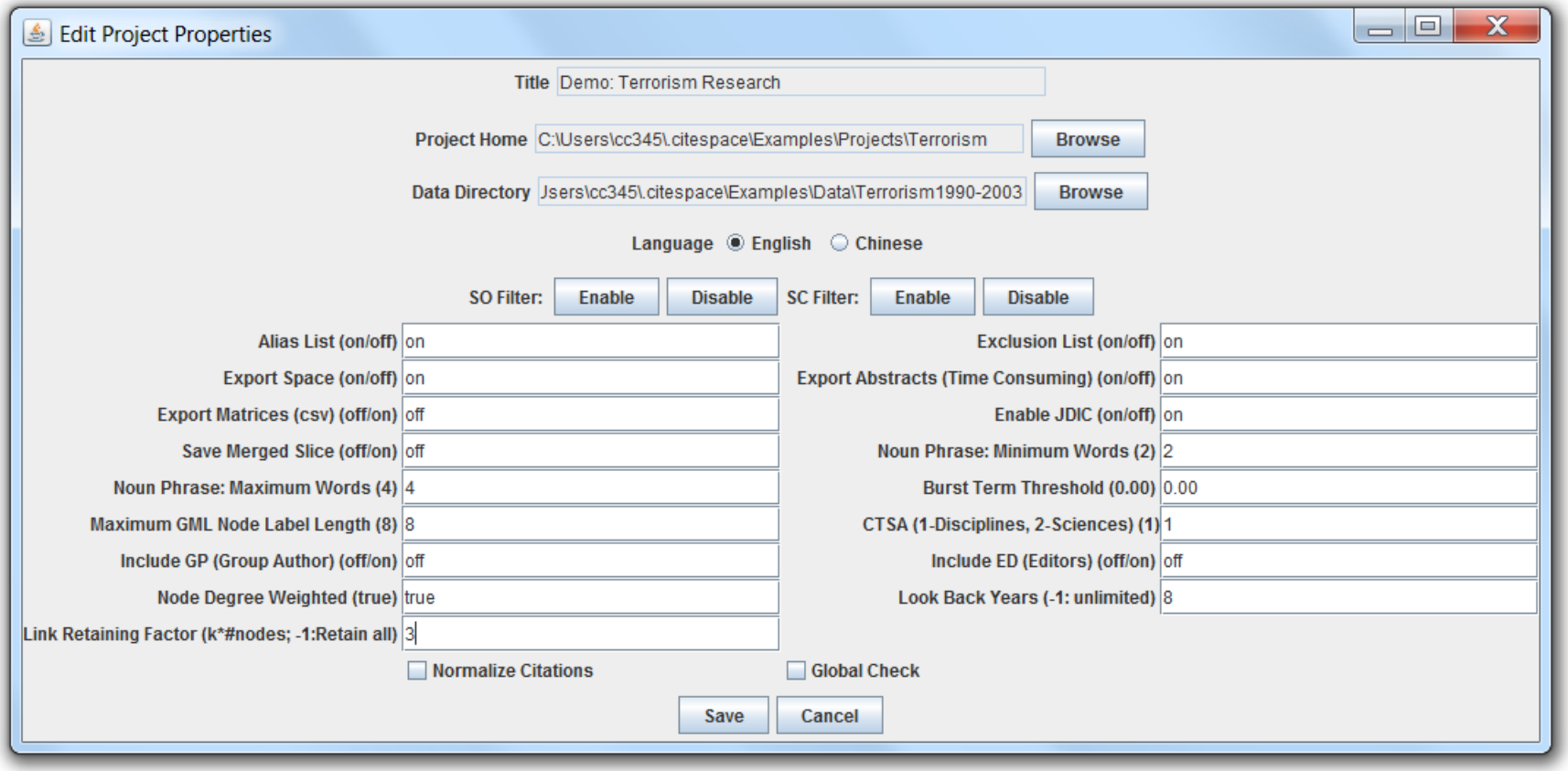
See CiteSpace101 for more!

Date	Version	Download *CiteSpace*	Download *Java JRE*	Notes
Nov 25, 2015	4.0.R4 (64-bit)	zip	64-bit / Windows x64	Require Java 8
Nov 14, 2015	4.0.R3 (64-bit)	zip	64-bit / Windows x64	Require Java 8
Oct 14, 2015	4.0.R2 (64-bit)	zip	64-bit / Windows x64	Require Java 8
Sept 17, 2015	4.0.R1 (64-bit)	zip	64-bit / Windows x64	Require Java 8
Sept 14, 2015	3.9.R13 (64-bit)	zip	64-bit / Windows x64	Require Java 8




About CiteSpace
CiteSpace
(c) 2003-2015 Chaomei Chen. All rights reserved.
System Information
CiteSpace Version: 4.0.R4 (64-bit)
Built: November 27, 2015
Expire: August 31, 2016
Required: Java SE Runtime (JRE) 1.8 or higher
Java: Java HotSpot(TM) 64-Bit Server VM JRE: 1.8.0_65-b17 (64-bit)
Java Home: C:\Program Files\Java\jre1.8.0_65
Platform: Windows 7 Processors: 8
Host: CCHEN-L2 144.118.64.226
Country: US
How to Cite CiteSpace
1. Chen, C. and Leydesdorff, L. (2013) Patterns of connections and movements in dual-map overlays: A new method of publication portfolio analysis. Journal of the Association for Information Science and Technology, 65(2), 334-351.
2. Chen, C. (2012) Predictive effects of structural variation on citation counts. Journal of the American Society for Information Science and Technology, 63(3), 431-449.
3. Chen, C., Ibekwe-SanJuan, F., Hou, J. (2010) The structure and dynamics of co-citation clusters: A multiple-perspective co-citation analysis. Journal of the American Society for Information Science and Technology, 61(7), 1386-1409.
4. Chen, C. (2006) CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. Journal of the American Society for Information Science and Technology, 57(3), 359-377.
5. Chen, C. (2004) Searching for intellectual turning points: Progressive Knowledge Domain Visualization. Proc. Nat. Acad. Sci., 101(Suppl.), 5303-5310.
CiteSpace User Guide and Tutorials
1. Chen, C. (2015) How to Use CiteSpace (eBook)
2. CiteSpace101
Acknowledgements
○ National Science Foundation (NSF) Grant No. IIS-0612129
○ Northeast Visualization and Analytics Center (NEVAC)/Department of Homeland Security (DHS)
○ Thomson Reuters Citation Analysis Research Award (2002)
Note: CiteSpace may log user driven events for scholarly purposes. Do not proceed if you do not agree.
Agree
Disagree


CiteSpace 4.0.R4 (64-bit) - (c) 2003-2015 Chaomei Chen - Home: C:\Users\cc345
File Project Data Network Visualization Geographical Overlay Maps Analytics Text Preferences Help
Web of Science PubMed
Projects
New Demo: Terrorism Research More Actions ...
Project Home: C:\Users\cc345\.citespace\Examples\Projects\Terrorism
Data Directory: Jsers\cc345\.citespace\Examples\Data\Terrorism1990-2003
GO! Stop Reset JVM Memory 981 (MB) Used 16 %
Space Status
Process Reports
Time Slicing
From 1996 To 2003 #Years Per Slice 1
Text Processing
Term Source
Title Abstract Author Keywords (DE) Keywords Plus (ID)
Term Type
Noun Phrases Burst Terms Detect Bursts Entropy
Network Configuration
Node Types
Author Institution Country Term Keyword Category
Cited Reference Cited Author Cited Journal Paper Grant
Links
Strength Cosine Scope Within Slices
Selection Criteria
Adjust the selection criteria to control the scope of the network model.
g-index Top N Top N% Thresholds By Citations Usage(180) Usage(2013)
The selection is based on a modified g-index of citations or occurences in each slice: $g^2 \leq k\Sigma_{i \leq g} c_i, k \in Z^+$
To include more or fewer nodes, increase or decrease the scale factor k here: k= 5
Pruning
Pathfinder
Minimum Spanning Tree
Pruning sliced networks
Pruning the merged network
Visualization
Cluster View - Static
Cluster View - Animated
Show Networks by Time Slices
Show Merged Network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Noun Phrase: Maximum Words (4)
4
Burst Term Threshold (0.00)
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Maximum GML Node Label Length (8)
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off
Node Degree Weighted (true)
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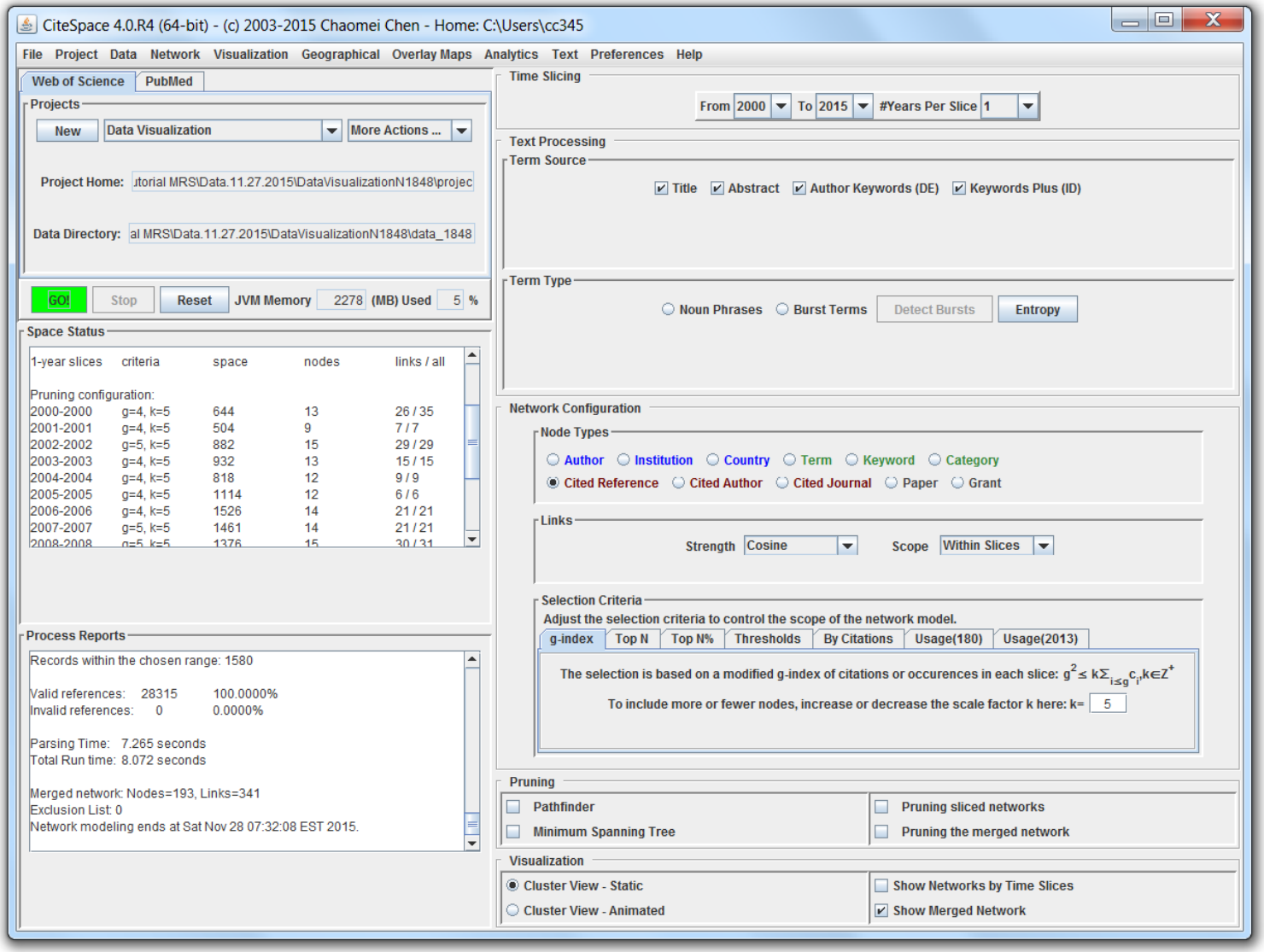

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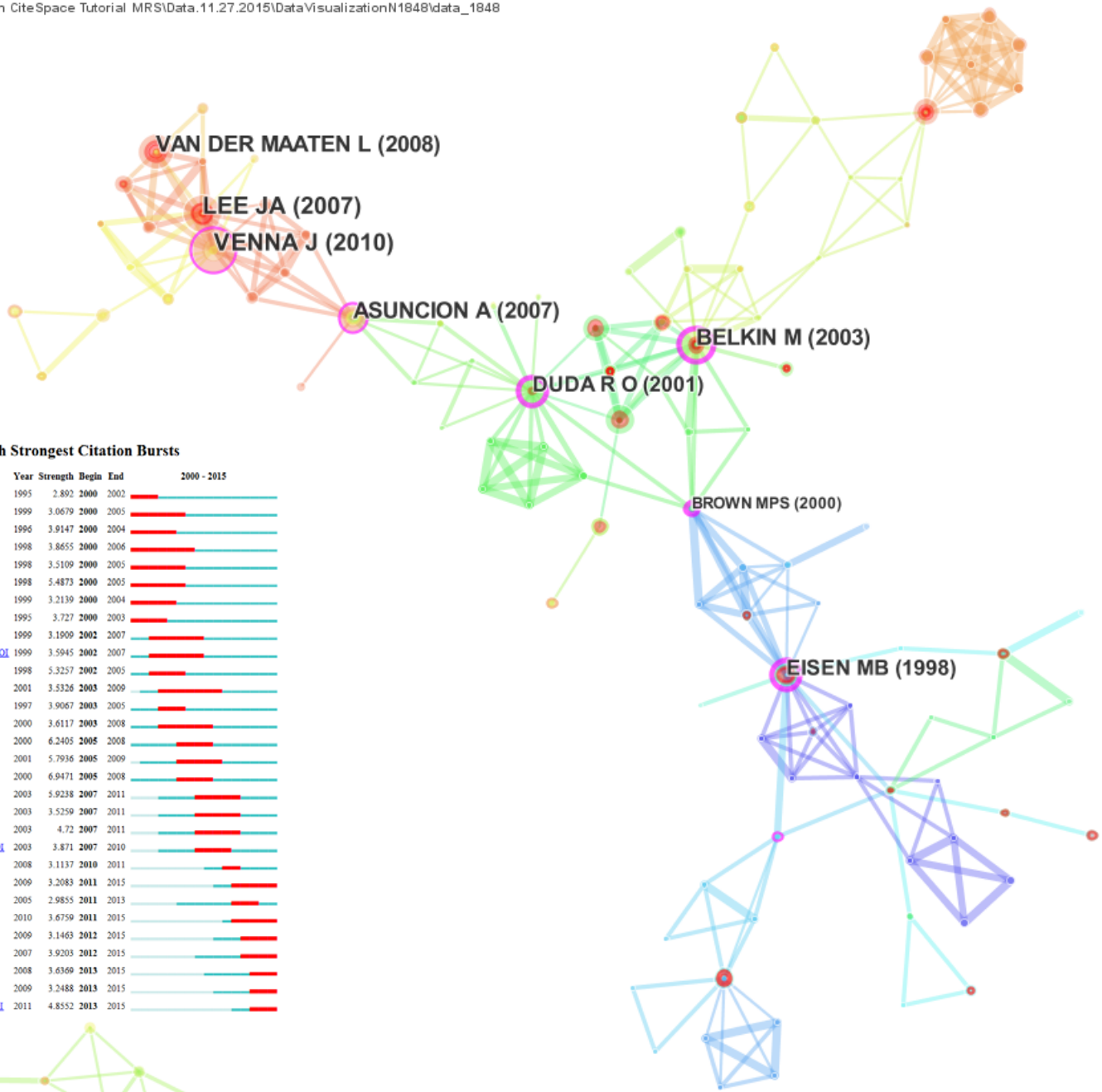

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RIPLEY B, 1996, PATTERN RECOGNITION, V, P	1996	3.9147	2000	2004	
BISHOP CM, 1998, NEURAL COMPUT, V10, P215, DOI	1998	3.8655	2000	2006	
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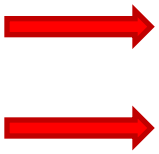

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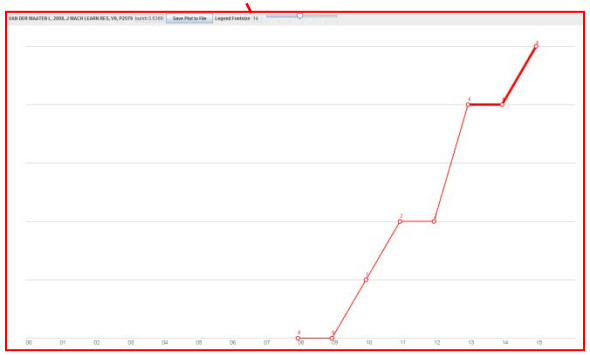

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#0 structure-activity modeling

#3 manifold

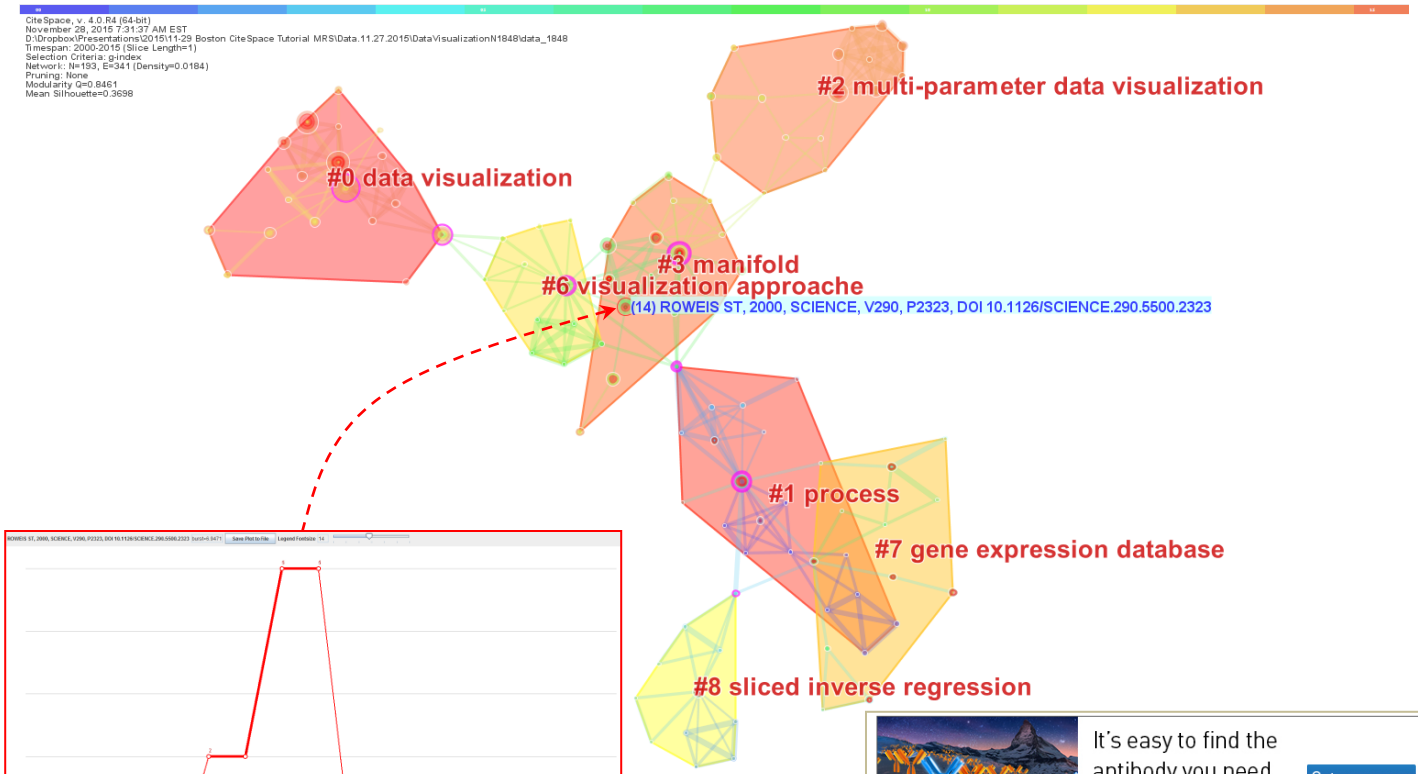
#6 visualization approache

#1 process

#7 gene expression data

#8 sliced inverse regression

#5 systems biology data



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REPORT

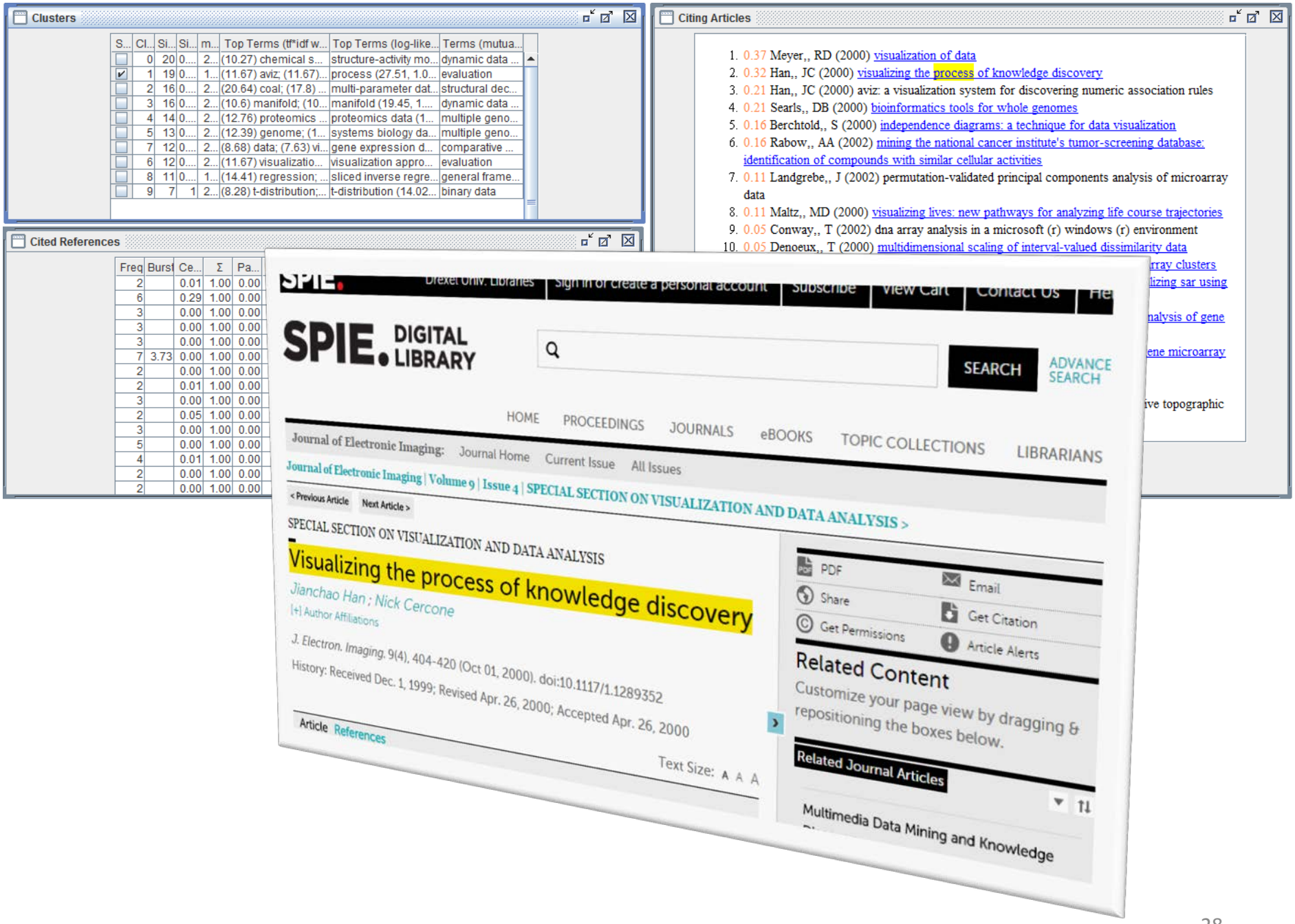
Nonlinear Dimensionality Reduction by Locally Linear Embedding

Sam T. Roweis[1], Lawrence K. Saul[2]

Author Affiliations

ABSTRACT

Many areas of science depend on exploratory data analysis and visualization. The need to analyze large amounts of multivariate data raises the fundamental problem of dimensionality reduction: how to discover compact representations of high-dimensional data. Here, we introduce locally linear embedding (LLE), an unsupervised learning algorithm that computes low-dimensional, neighborhood-preserving embeddings of high-dimensional inputs. Unlike clustering methods for local dimensionality reduction, LLE maps its inputs into a single global coordinate system of lower dimensionality, and its optimizations do not involve local minima. By exploiting the local symmetries of linear reconstructions, LLE is able to learn the global structure of nonlinear manifolds, such as those generated by images of faces or documents of text.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9. 0.05 Conway,, T (2002) dna array analysis in a microsoft (r) windows (r) environment
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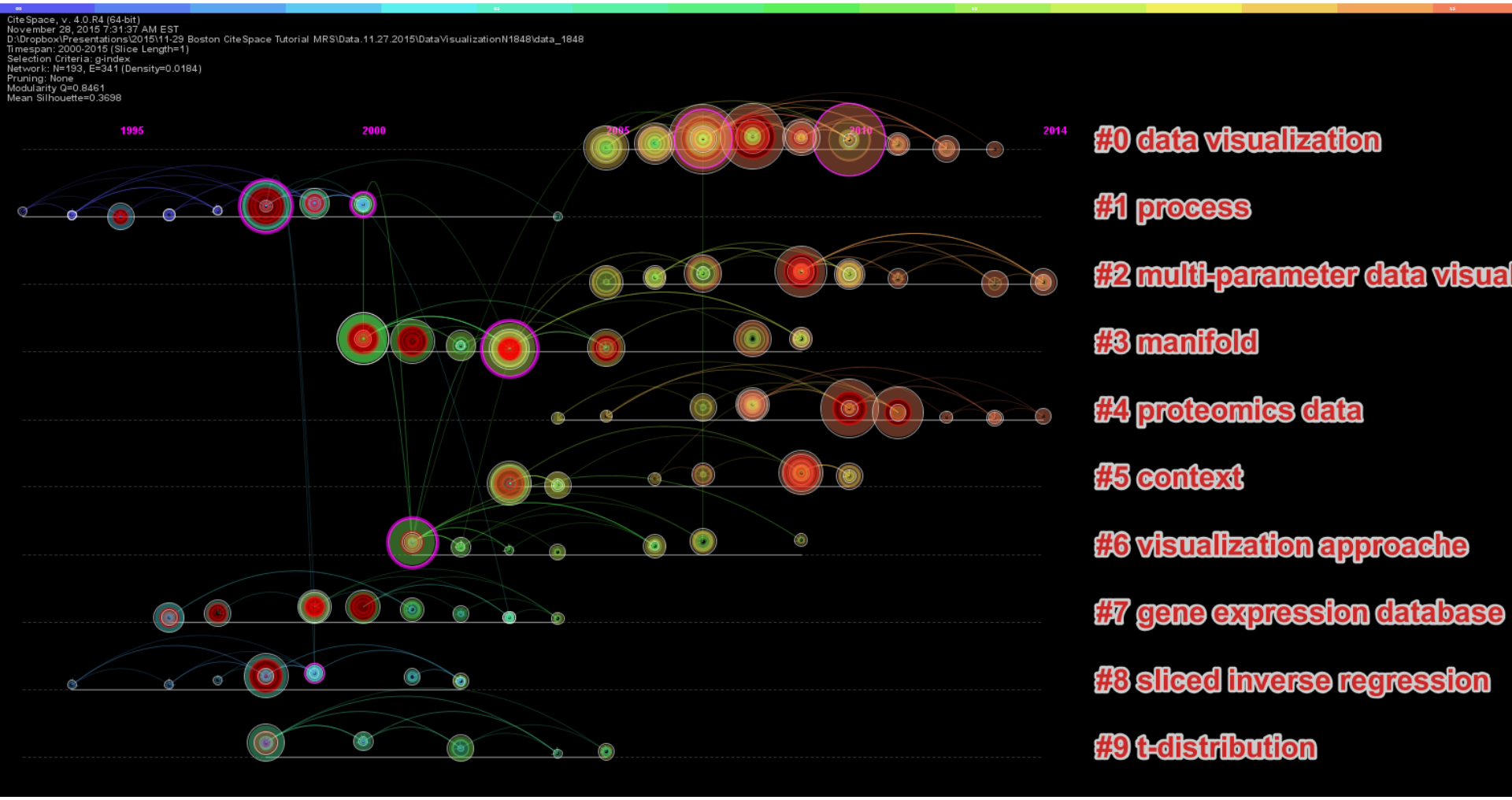
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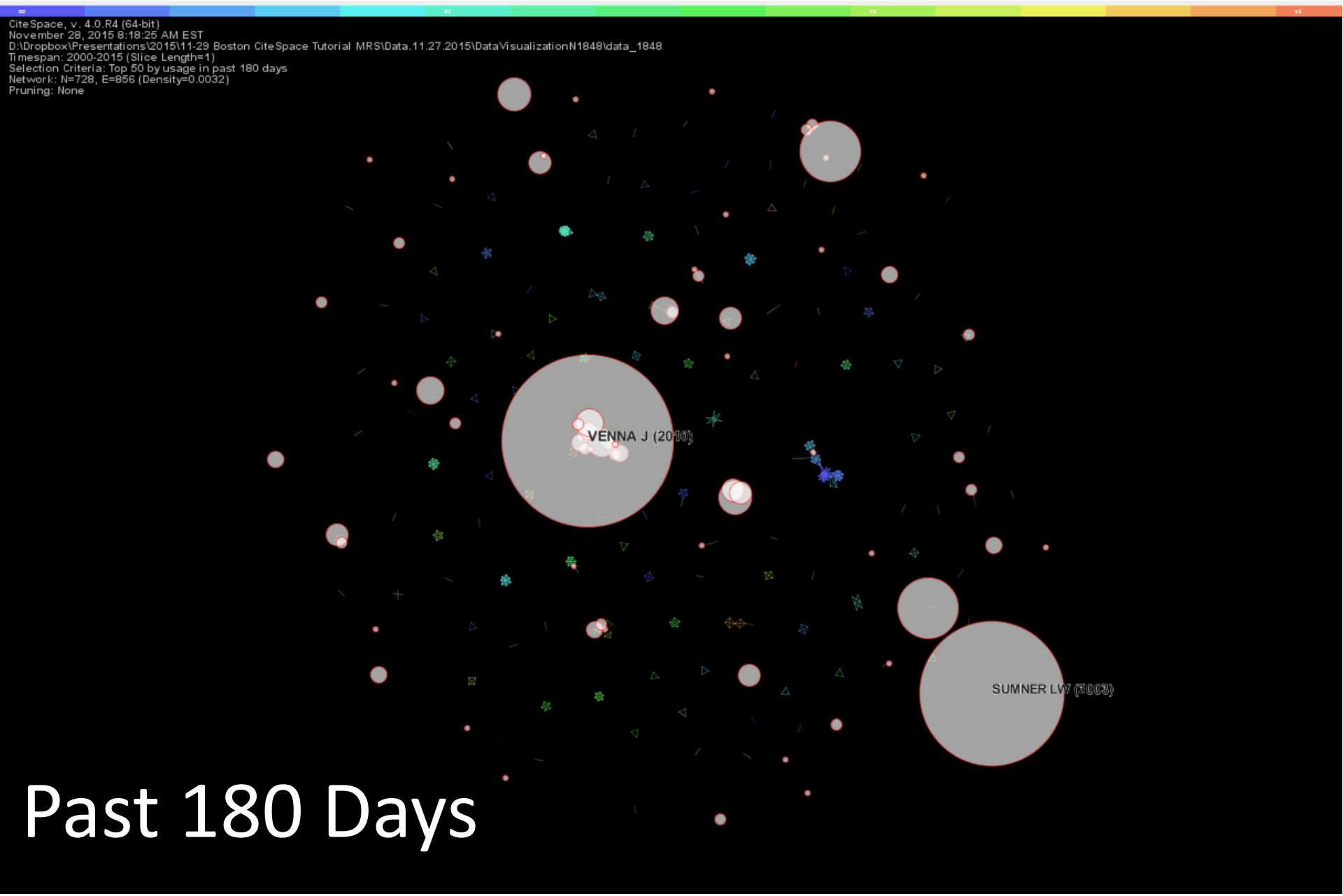

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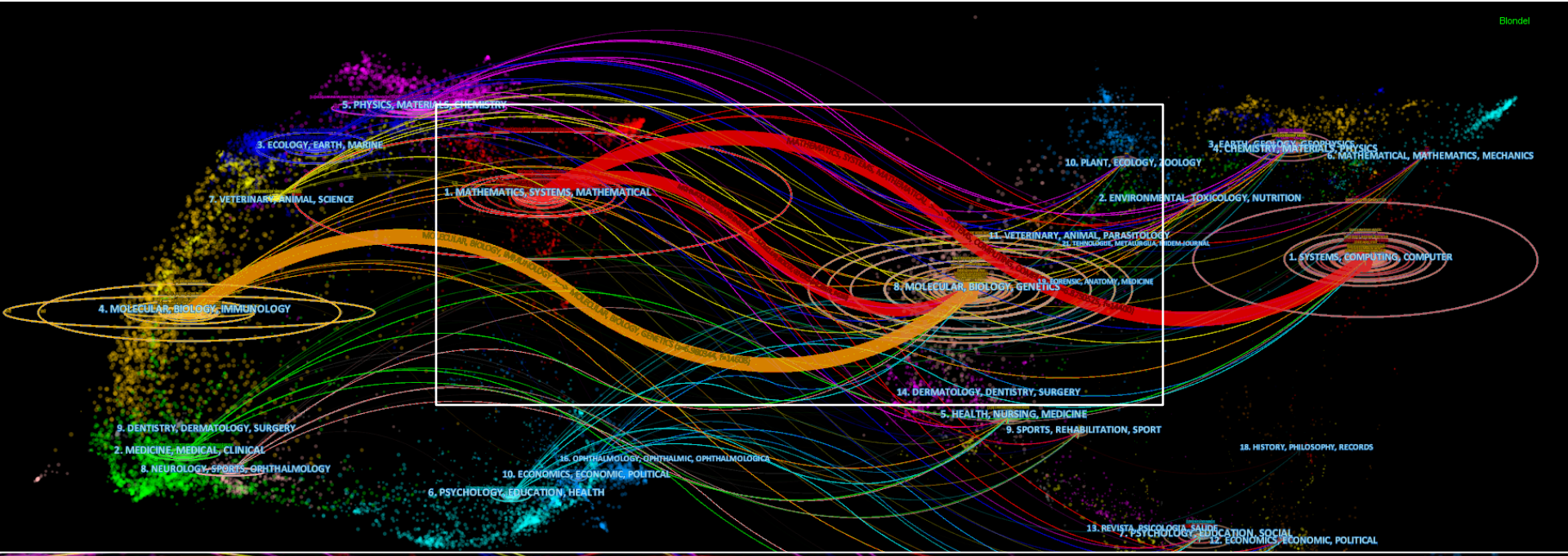
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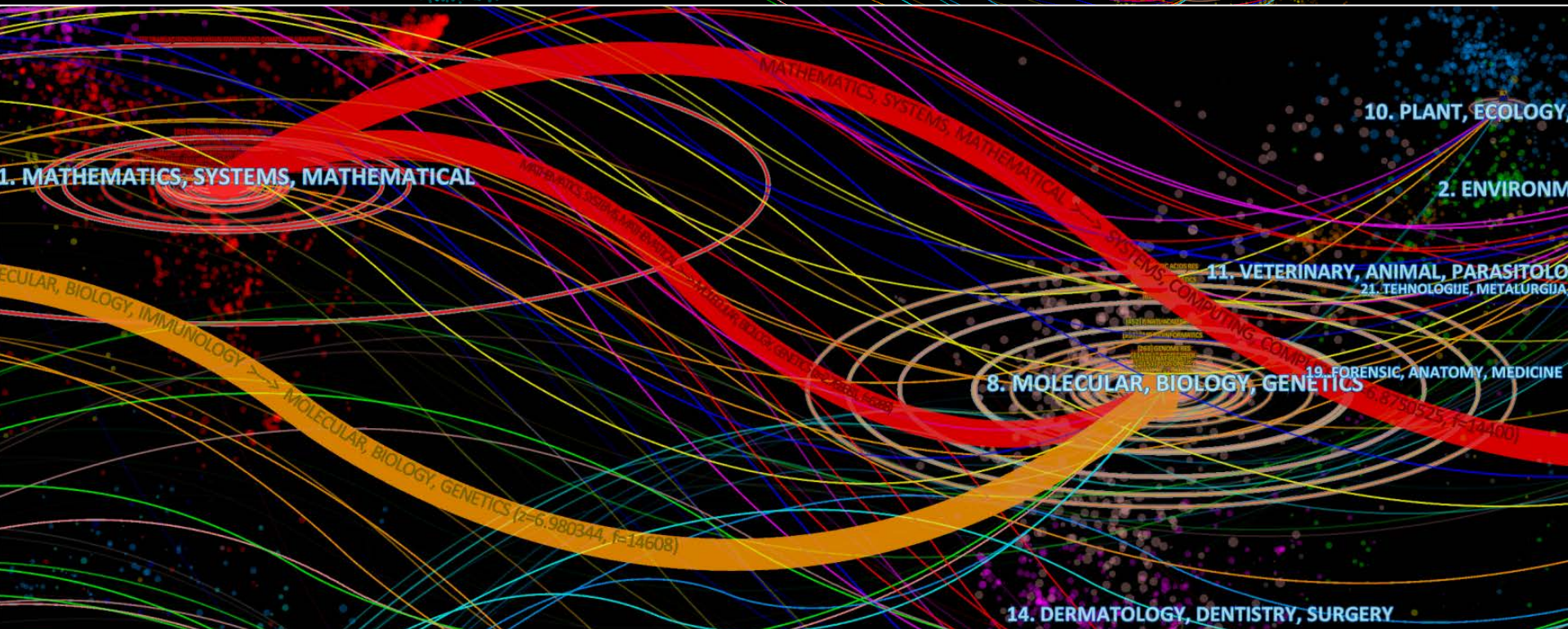
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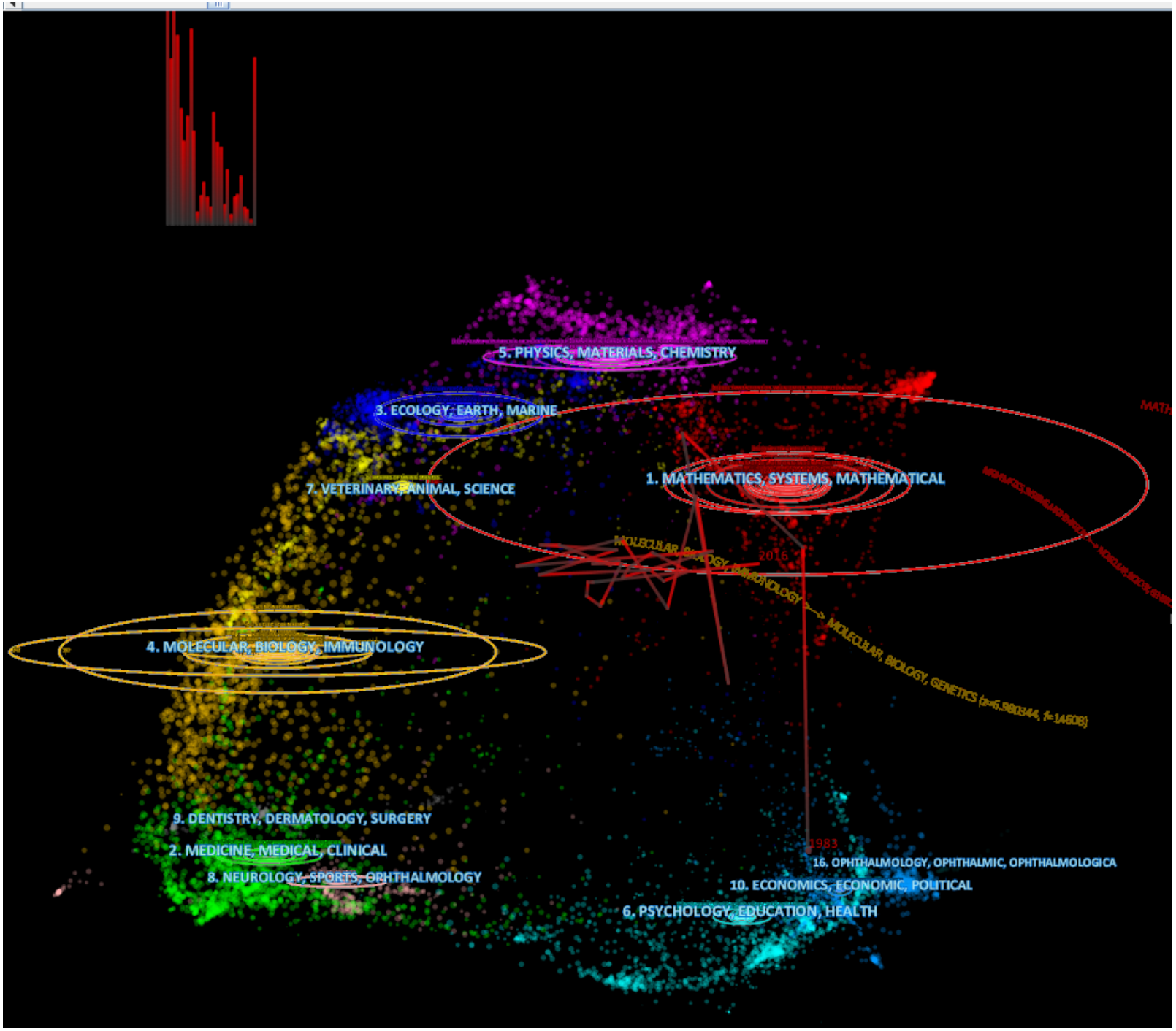
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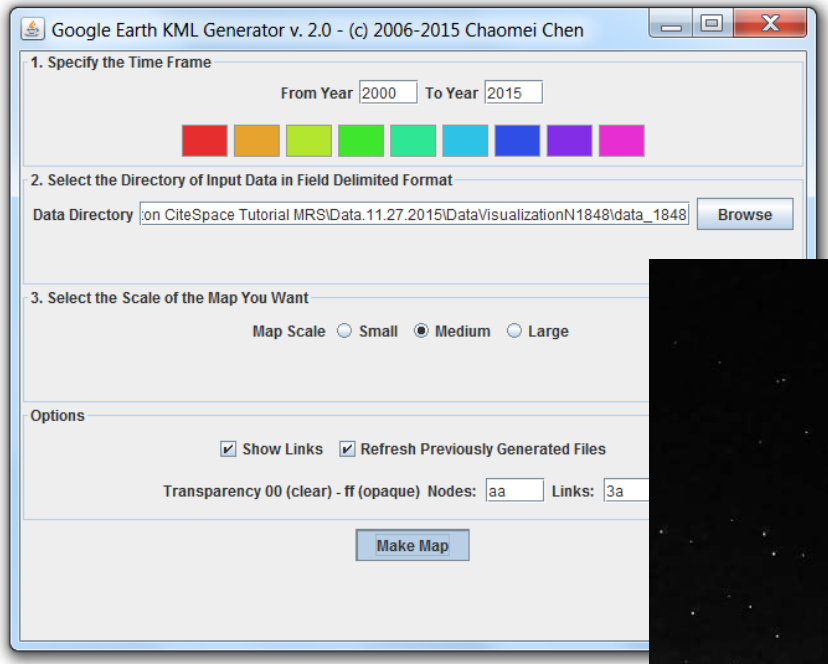

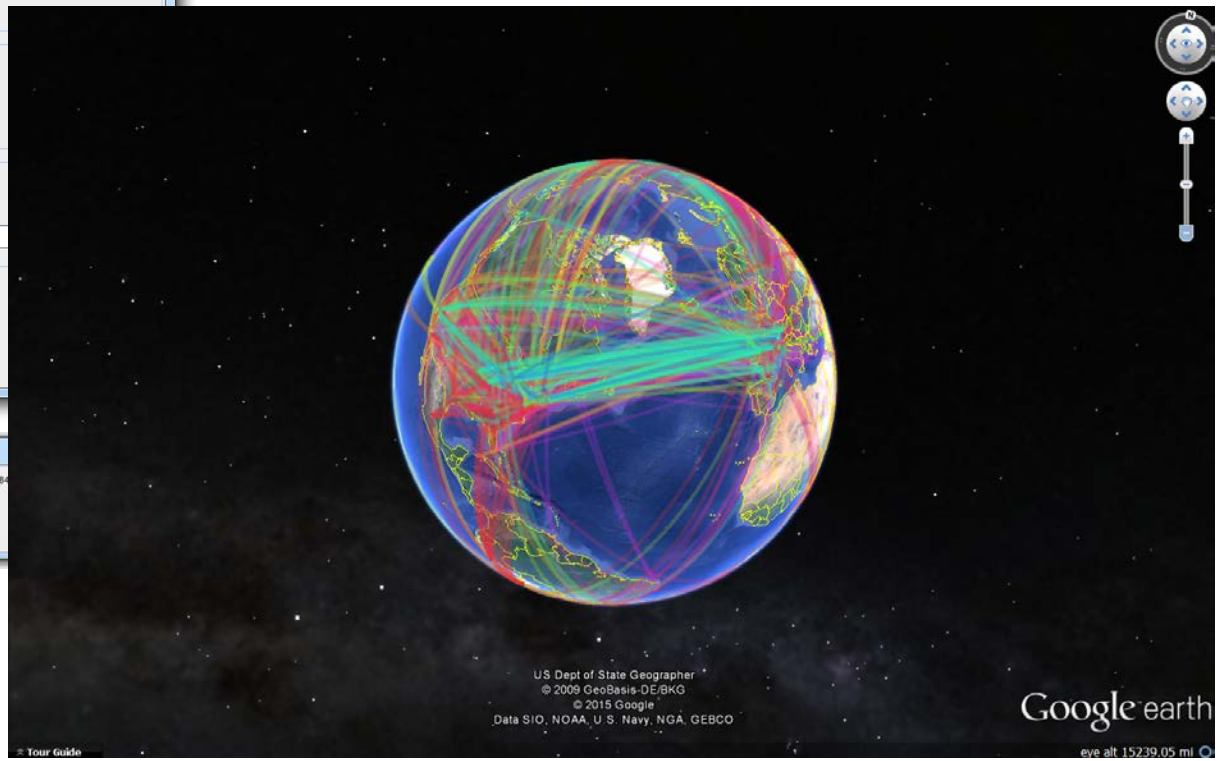

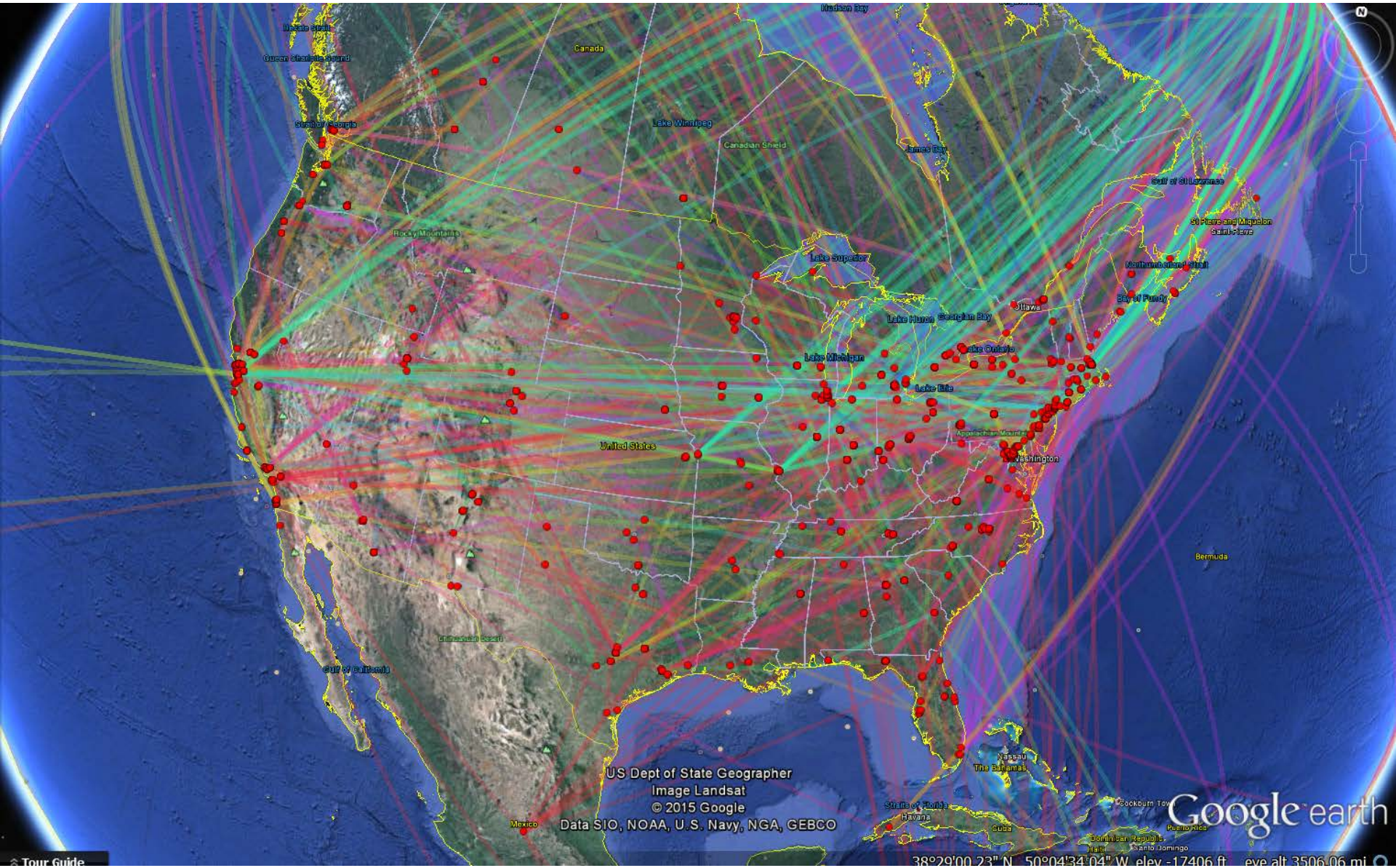
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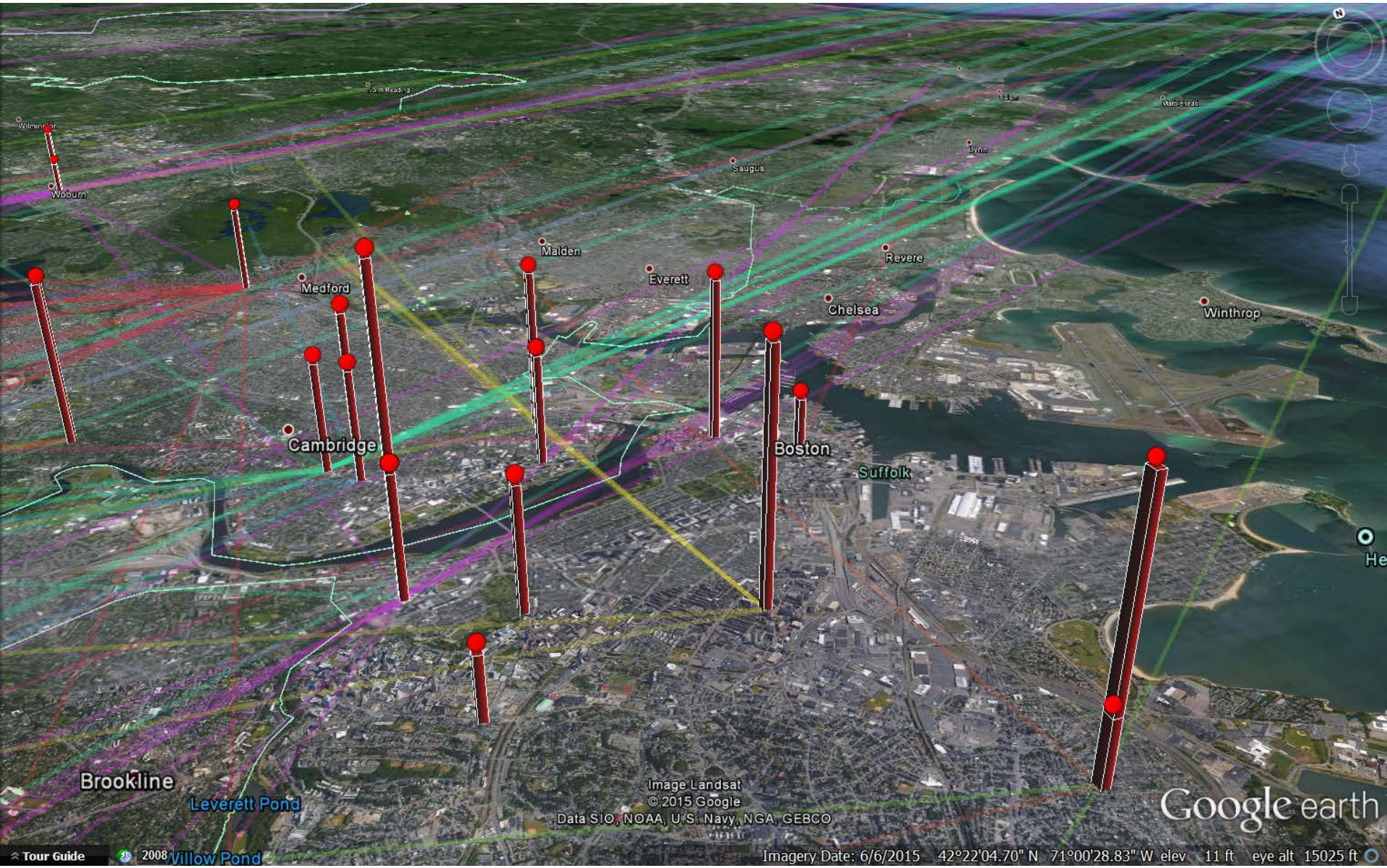
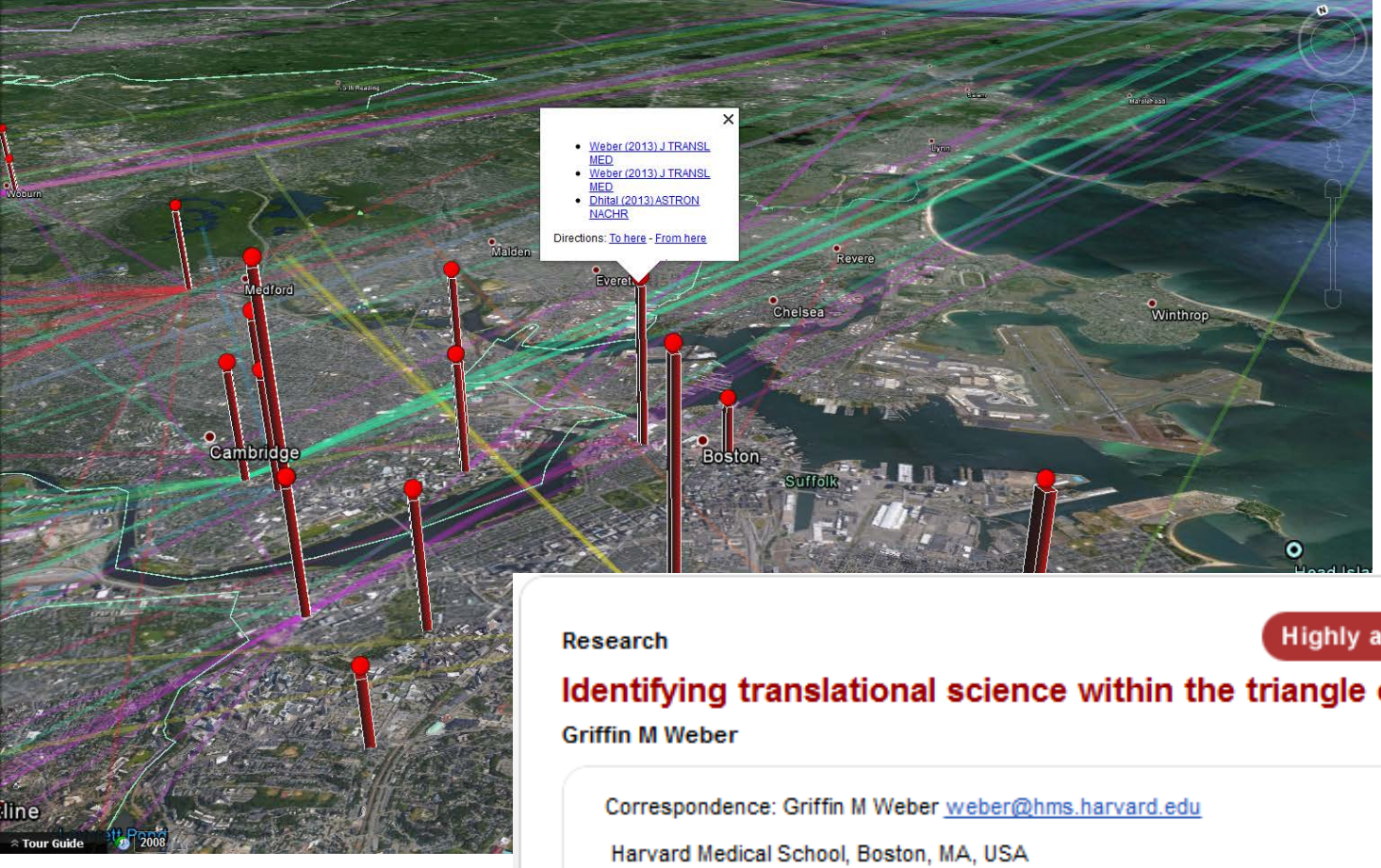

Woburn
Malden
Medford
Everett
Revere
Saugus
Lynn
Chelsea
Winthrop
Cambridge
Boston
Suffolk
Brookline
Leverett Pond
Image Landsat
© 2015 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google earth
Tour Guide
2008
Willow Pond
Imagery Date: 6/6/2015 42°22'04.70" N 71°00'28.83" W elev 11 ft eye alt 15025 ft



Research

Highly accessed | Open Access

Identifying translational science within the triangle of biomedicine

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Accepted: 15 May 2013
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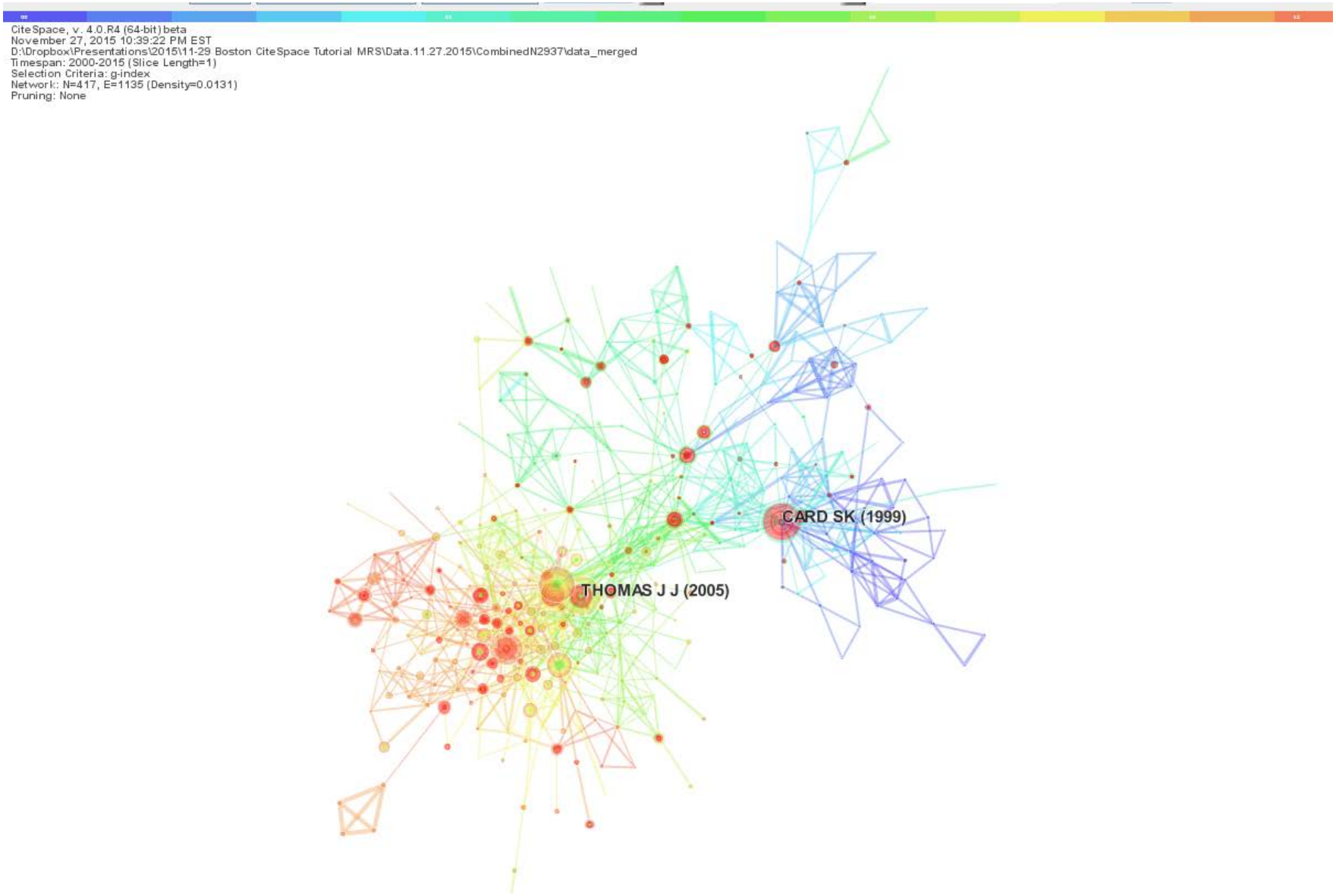
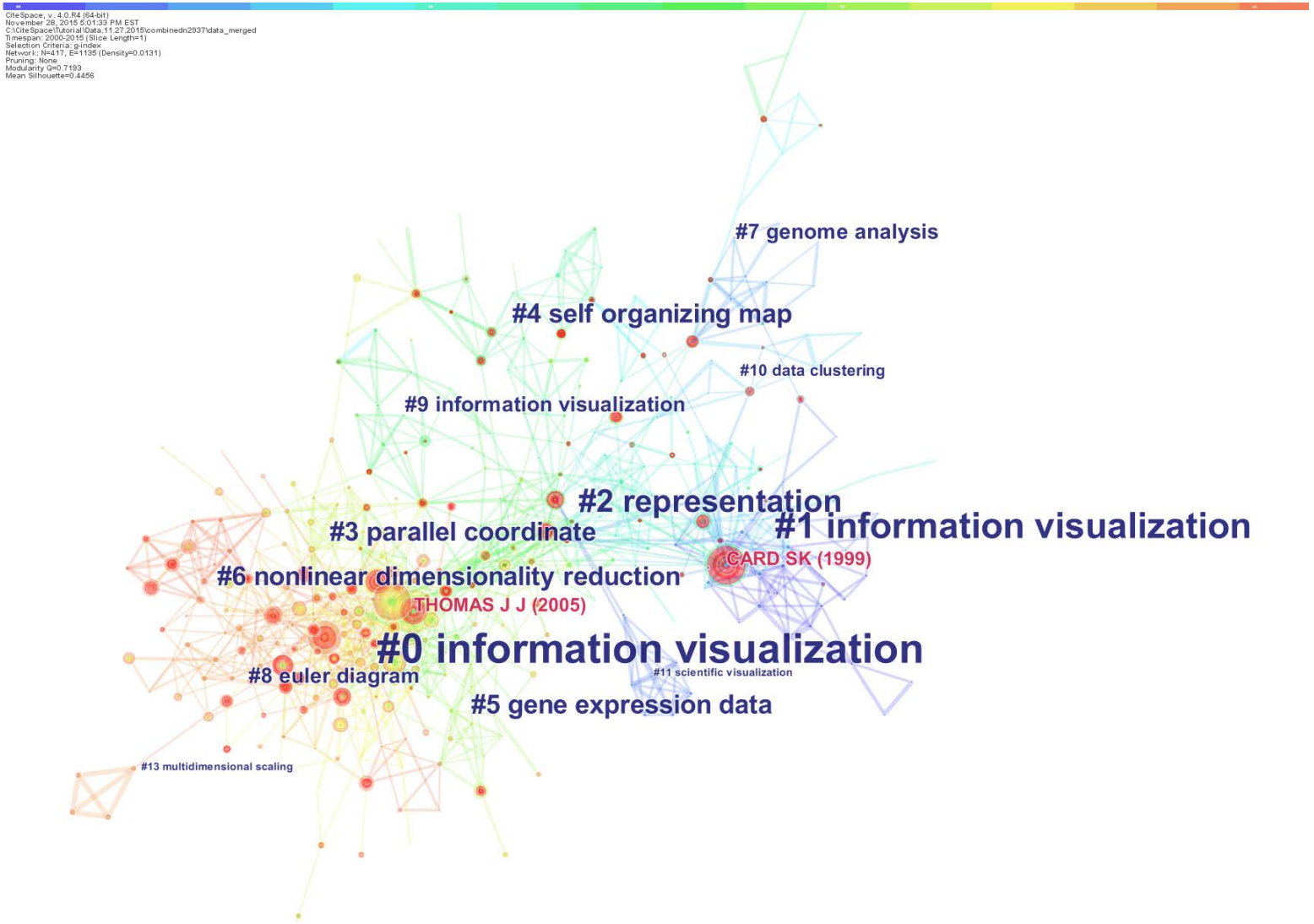
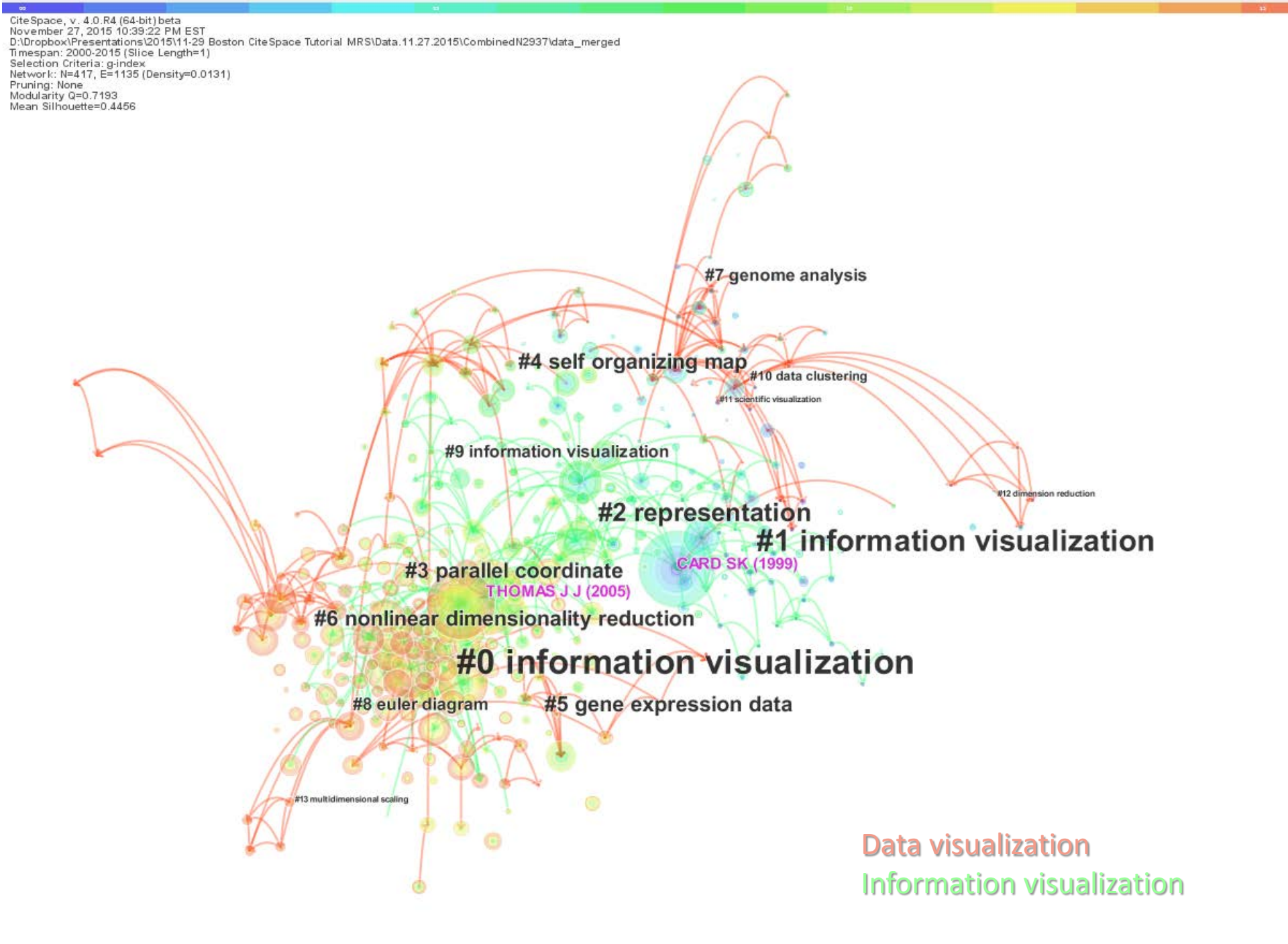
Data Visualization + Information Visualization



Data Visualization + Information Visualization

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November 27, 2015 10:39:22 PM EST
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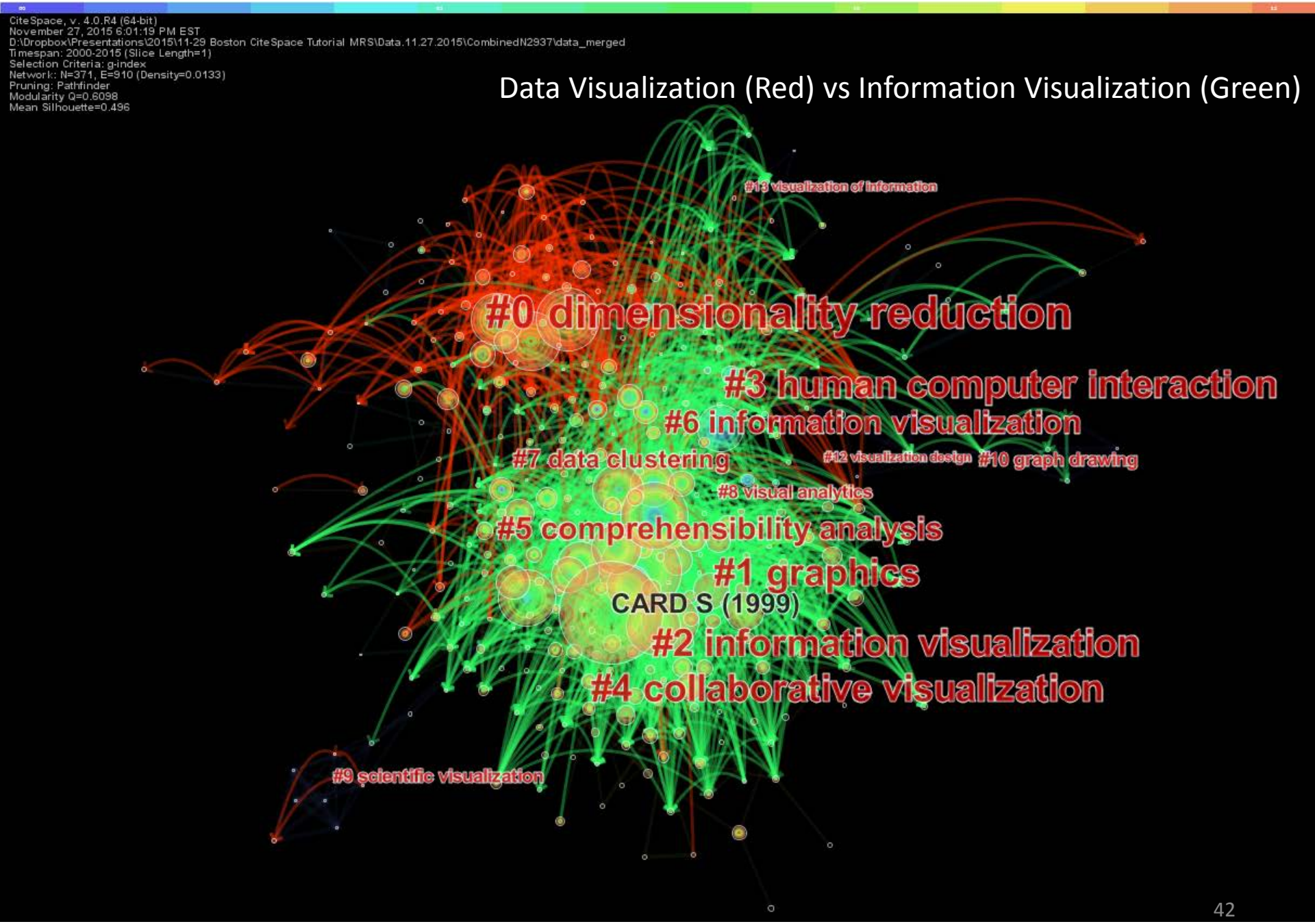
Selection Criteria: g-index
Network: N=417, E=1135 (Density=0.0131)
Pruning: None
Modularity Q=0.7193
Mean Silhouette=0.4456
#7 genome analysis
#4 self organizing map
#10 data clustering
#11 scientific visualization
#9 information visualization
#12 dimension reduction
#2 representation
#1 information visualization
CARD SK (1999)
#3 parallel coordinate
THOMAS J J (2005)
#6 nonlinear dimensionality reduction
#0 information visualization
#8 euler diagram
#5 gene expression data
#13 multidimensional scaling
Data visualization
Information visualization

Data Viz v. Info Viz

#0 information visualization
#1 information visualization
#2 representation
#3 parallel coordinate
#4 self organizing map
#5 gene expression data
#6 nonlinear dimensionality reduction
#7 genome analysis
#8 euler diagram
#9 information visualization
#10 data clustering
#11 scientific visualization
#12 dimension reduction
#13 multidimensional scaling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November 27, 2015 6:01:19 PM EST
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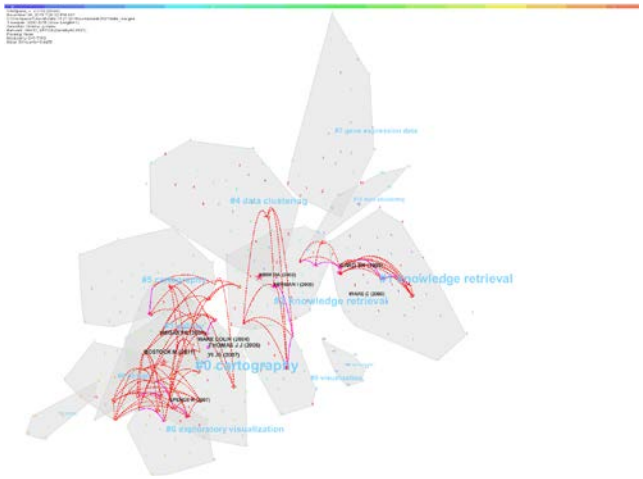
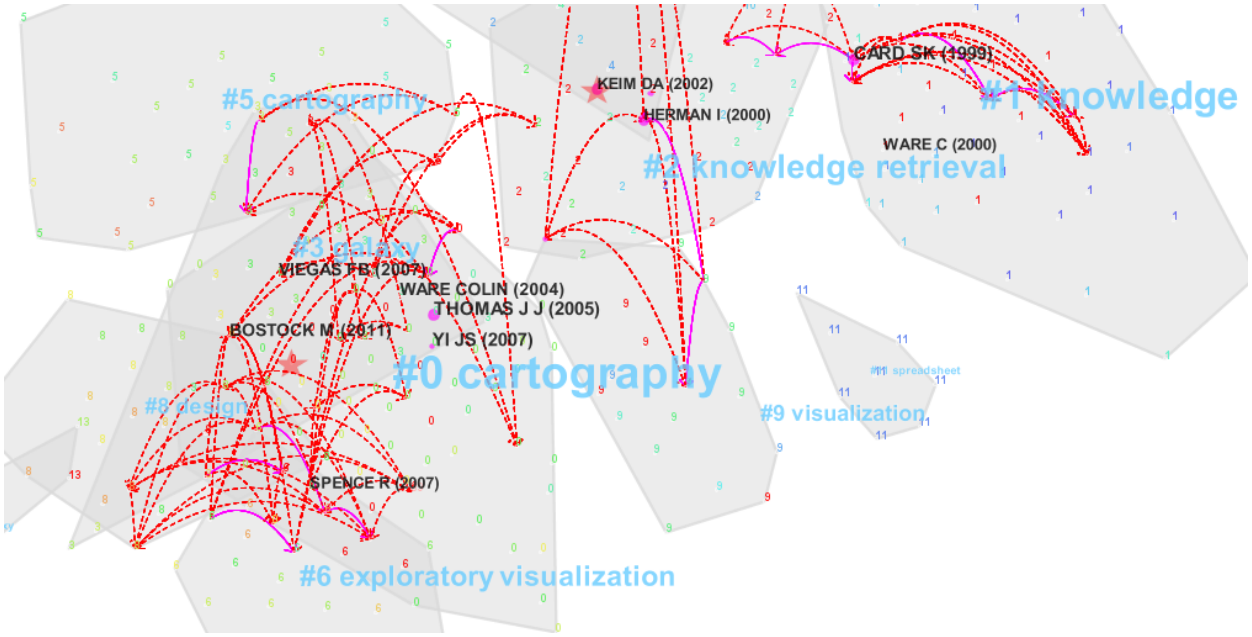
Selection Criteria: g-index
Network: N=371, E=910 (Density=0.0133)
Pruning: Pathfinder
Modularity Q=0.6098
Mean Silhouette=0.496
Data Visualization (Red) vs Information Visualization (Green)
#13 visualization of information
#0 dimensionality reduction
#3 human computer interaction
#6 information visualization
#7 data clustering
#12 visualization design
#10 graph drawing
#8 visual analytics
#5 comprehensibility analysis
#1 graphics
CARD S (1999)
#2 information visualization
#4 collaborative visualization
#9 scientific visualization

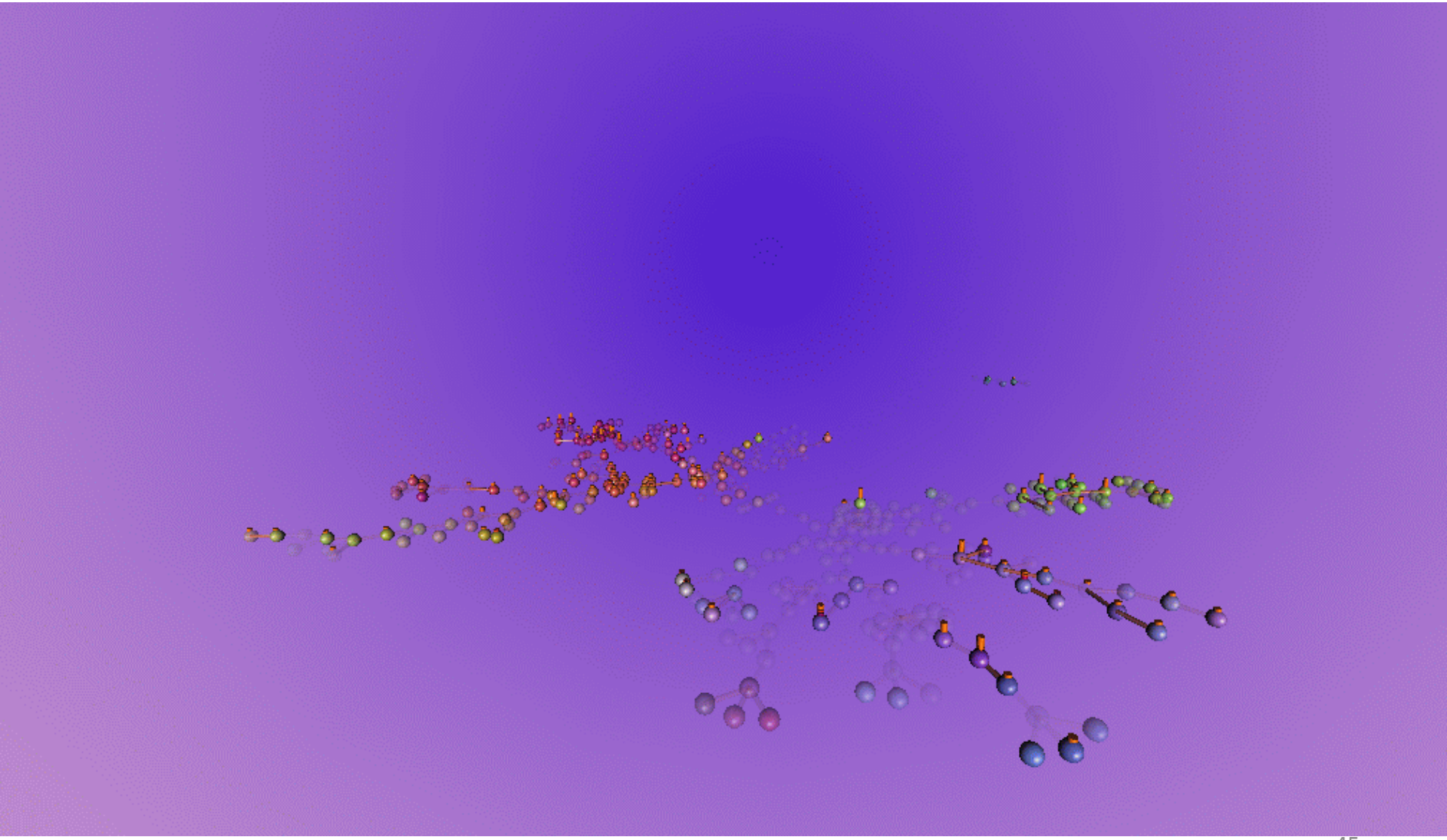
Top 10 papers that alter the modularity of the network the most





Sh...	Freq	ΔMod...	ΔC-...	ΔC...	Incr...	Tra...	Year	Citing Articles
☑	270	11.98	0.04	0.24	1.00	11.00	2002	KEIM DA, 2002, IEEE ...
☑	1	8.59	0.04	0.03	2.00	17.00	2015	MEYER M, 2015, INF...
☑	25	4.37	0.00	0.02	0.00	4.00	2006	SIIRTOLA H, 2006, IN...
☑	40	4.33	0.01	0.35	3.00	5.00	2008	COCKBURN A, 2008, ...
☑	0	3.68	0.02	0.03	2.00	6.00	2014	STOLPER CD, 2014, I...
☑	4	3.64	0.01	0.05	1.00	5.00	2010	REN L, 2010, J VISUA...
☑	3	3.47	0.00	0.02	0.00	5.00	2014	LIU SX, 2014, VISUAL...
☑	7	3.44	0.01	0.09	0.00	5.00	2012	DASGUPTA A, 2012, ...
☑	0	3.24	0.00	0.04	1.00	5.00	2014	PARSONS P, 2014, J ...
☑	30	3.21	0.00	0.03	2.00	4.00	2011	GLEICHER M, 2011, I...
☐	0	2.65	0.01	0.03	1.00	5.00	2015	SMELTZER K, 2015, ...
☐	19	2.63	0.02	0.13	0.00	3.00	2004	SOMORJAI RL, 2004, ...
☐	15	2.63	0.00	0.03	0.00	2.00	2006	KOSHMAN S, 2006, LI...
☐	3	2.62	0.01	0.02	1.00	4.00	2011	NORTH C, 2011, INF...
☐	19	2.42	0.00	0.02	1.00	2.00	2006	VAN WIJK JJ, 2006, IE...
☐	201	2.33	0.00	0.02	0.00	3.00	2010	GEHLENBORG N, 20...
☐	2	2.28	0.01	0.11	0.00	3.00	2012	SANFTMANN H, 2012...

Searching for an Intellectual Turning Point



Scientific Literature = Classic + Transient

2006

A research front represents the state-of-the-art thinking of a research field. Price (1965) noticed the interesting tendency that the most frequently cited articles tend to be the most recent ones in the citation network of scientific articles. The *immediacy* effect gives a good explanation of the well-known phenomenon of articles being considered obsolescent a few years after their publication. Price described an earlier conjecture made by Burton and Kebler (1960) that the periodical literature may be composed of two distinct types of literature with very different half-lives—the classic and the transient parts. The transient part essentially corre-

- Classic
- Transient

……

Burton, R.E., & Kebler, R.W. (1960). The “half-life” of some scientific and technical literatures. American Documentation, 11, 18–22.

……

Price, D.D. (1965). Networks of scientific papers. Science, 149, 510–515.

……

Theory: Thomas Kuhn: The Structure of Scientific Revolutions

before

after

Normal Science

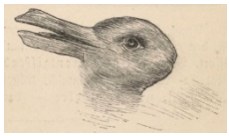
Crisis

Intellectual Turning Points

Gestalt Switch

Paradigm Shift

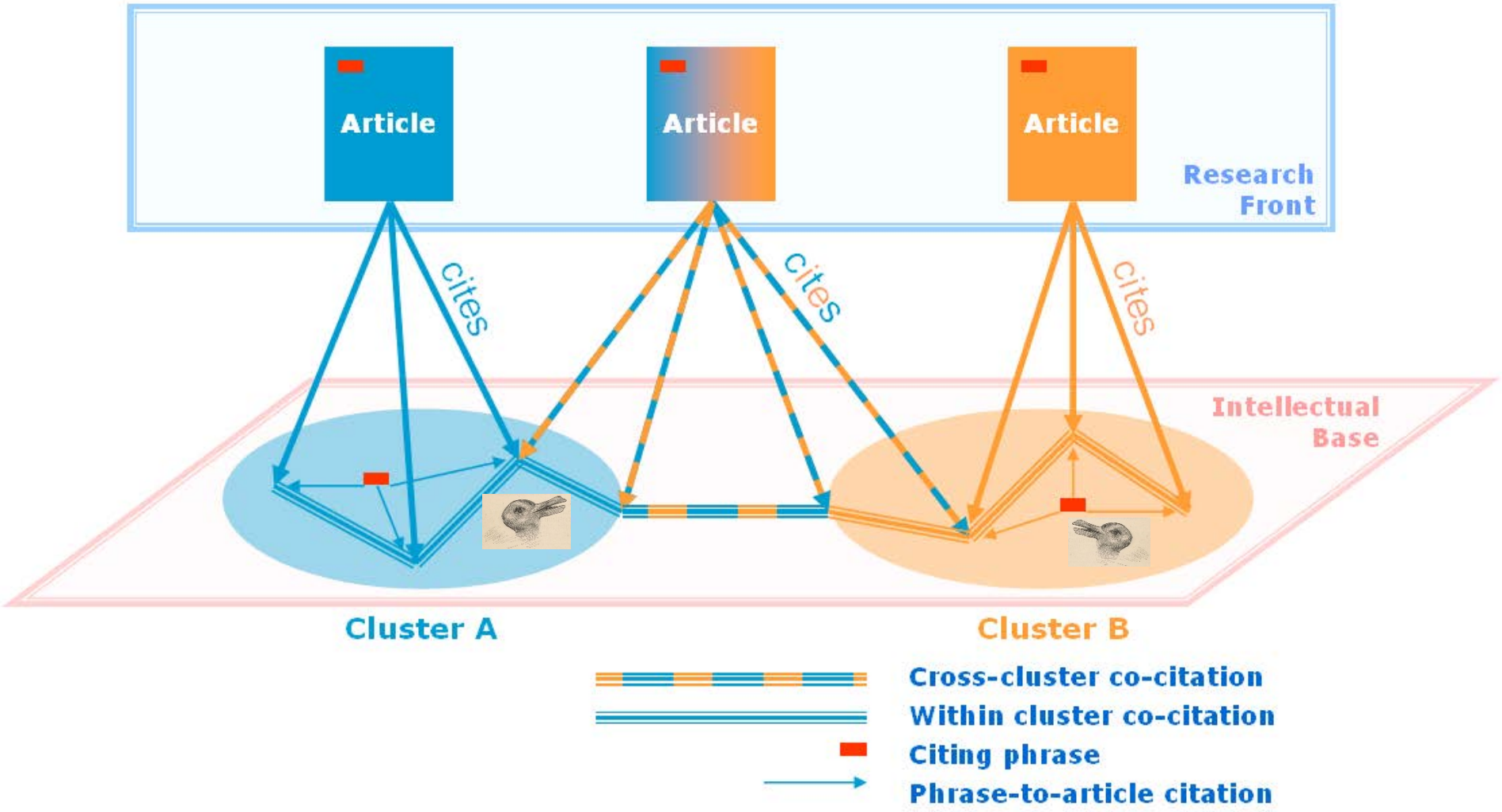
View Changing



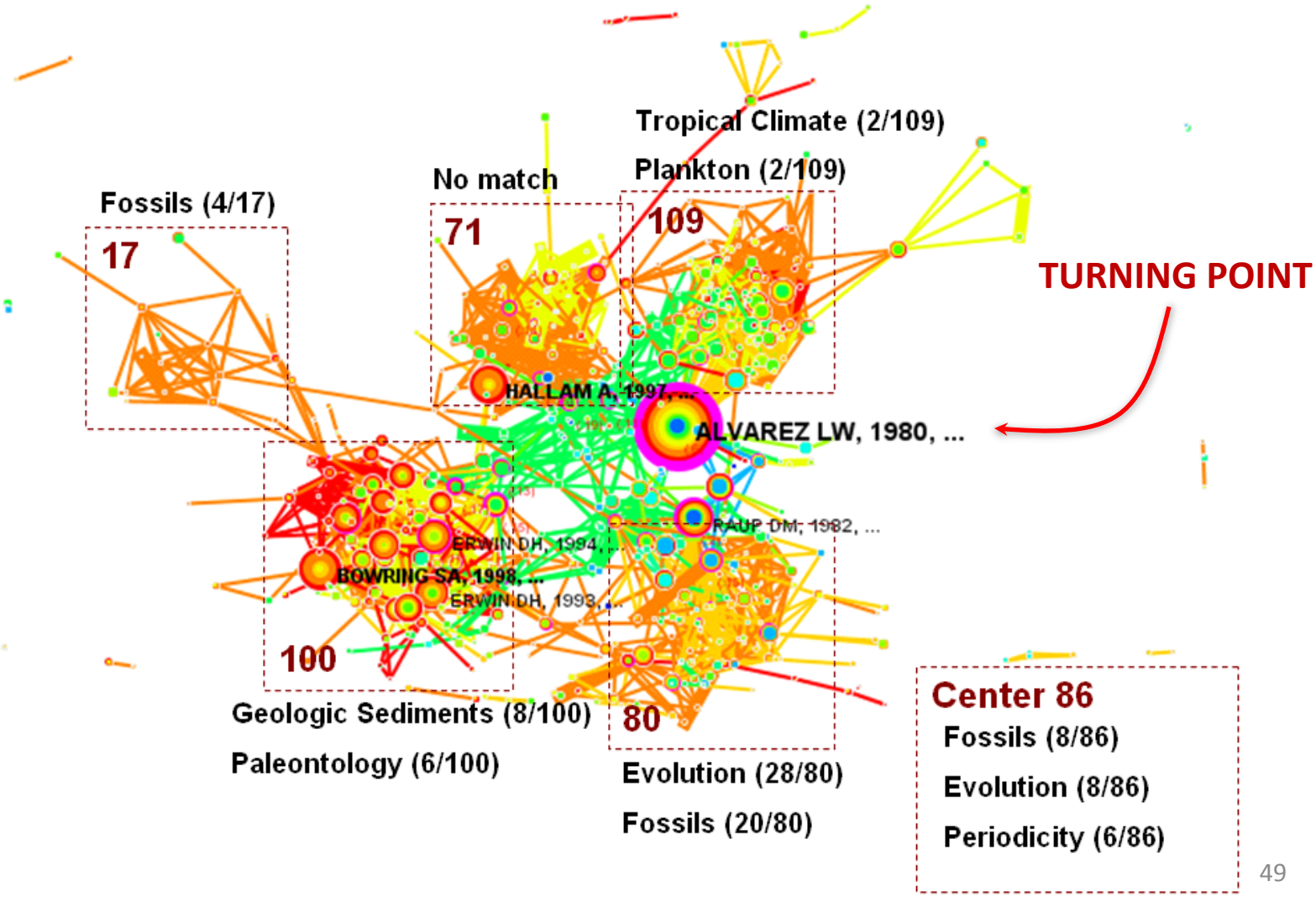
Paradigm Shift

Competing Paradigms

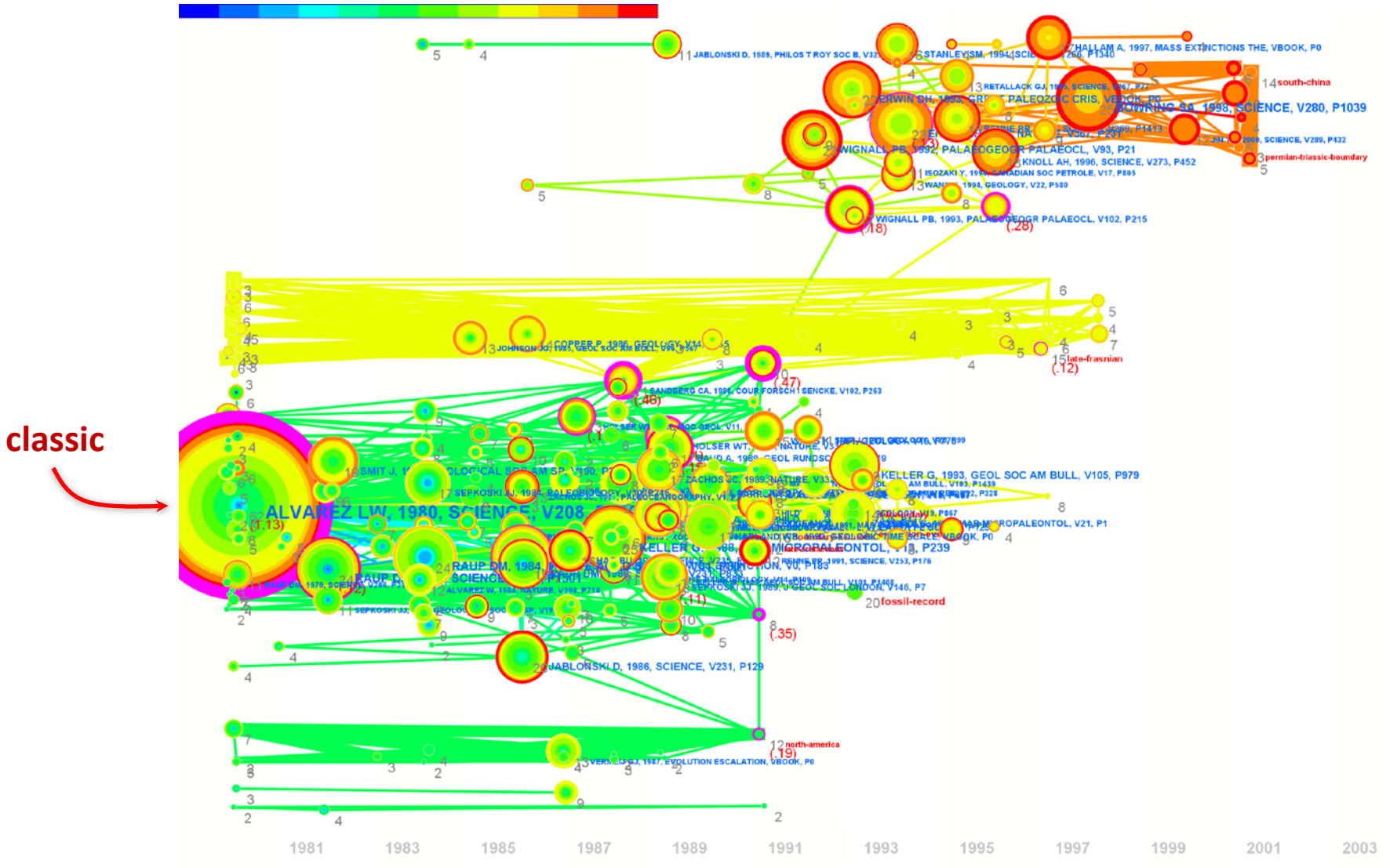
The Role of Citation in Scholarly Communication



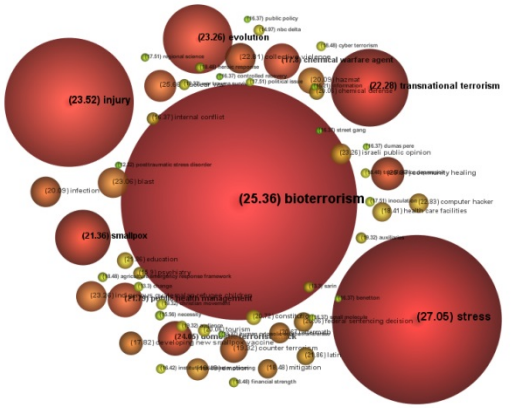
Mass Extinction

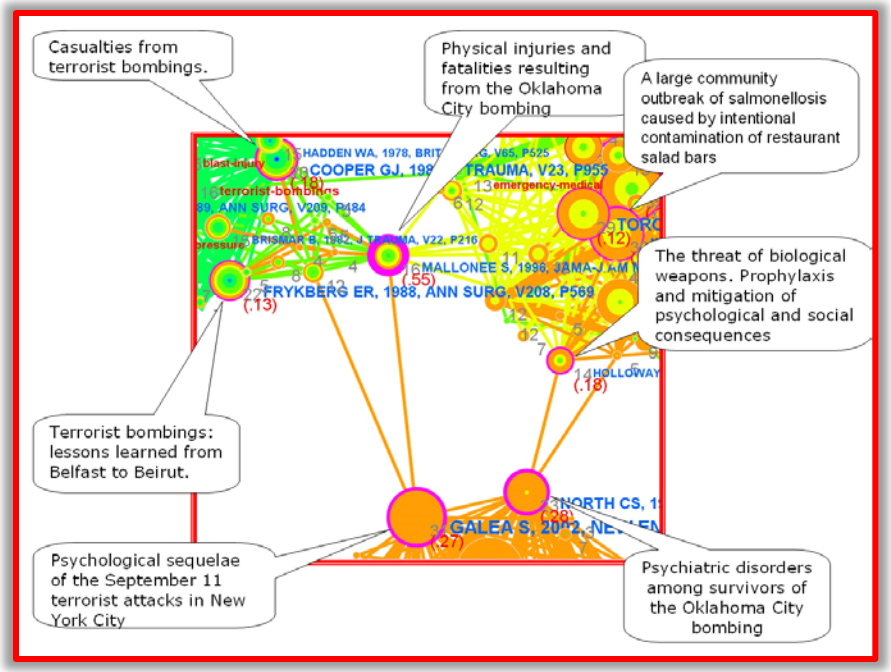


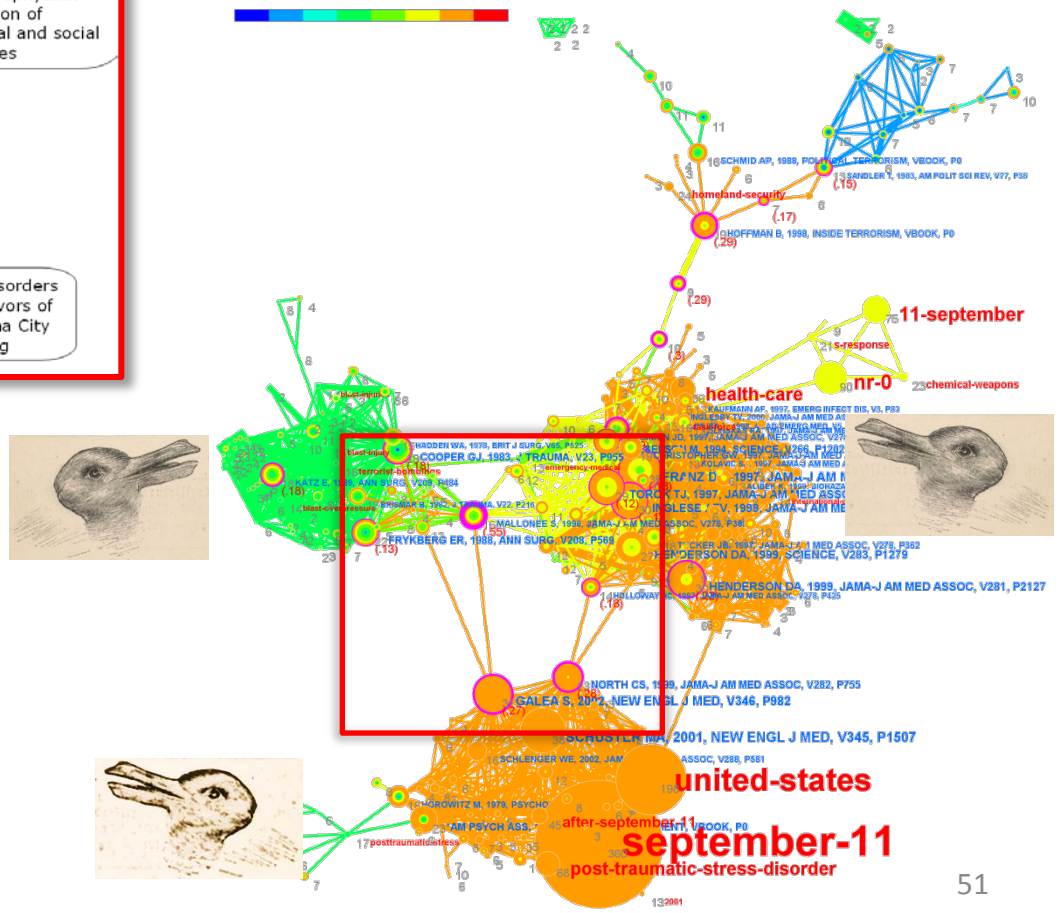
Mass Extinction



Terrorism

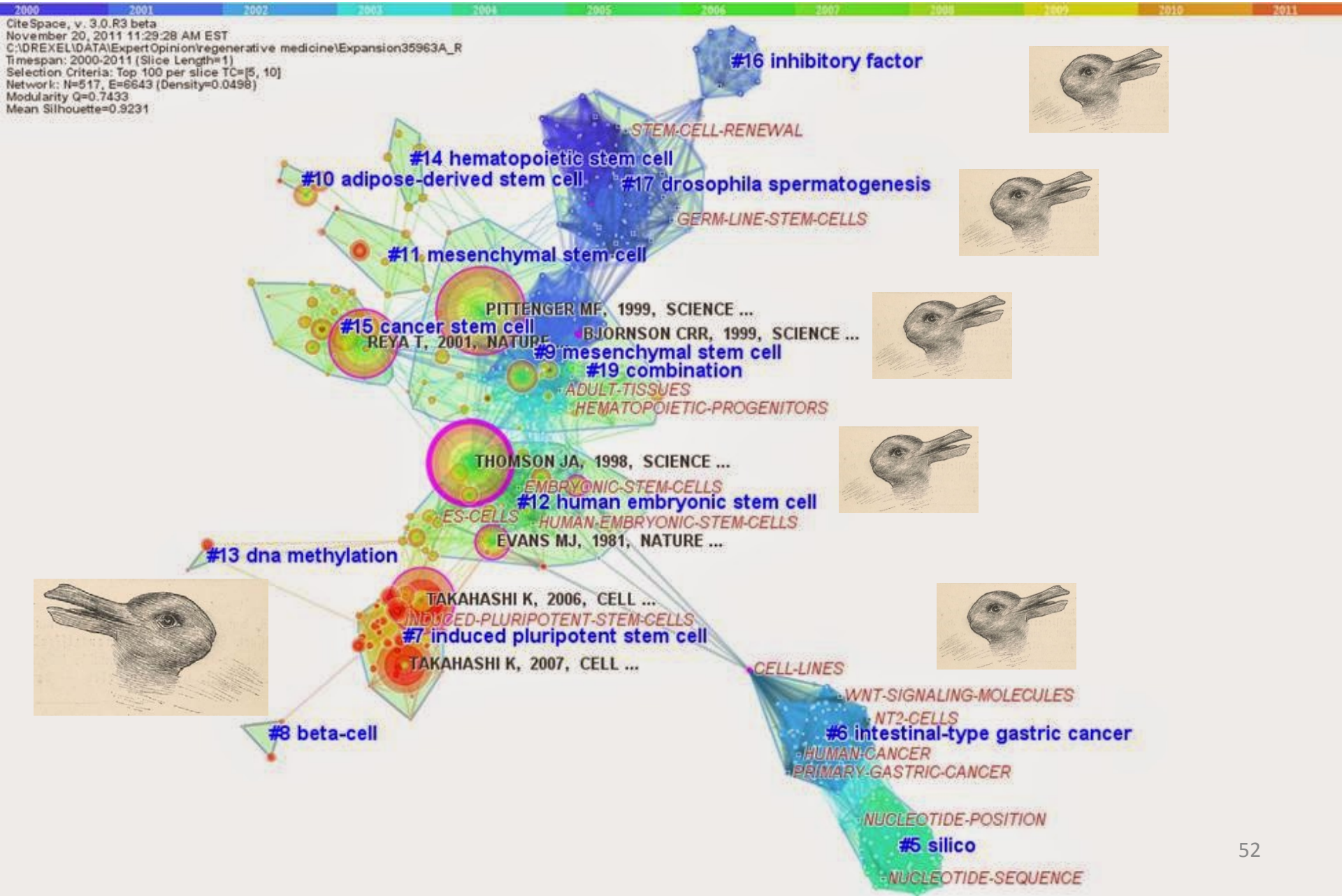






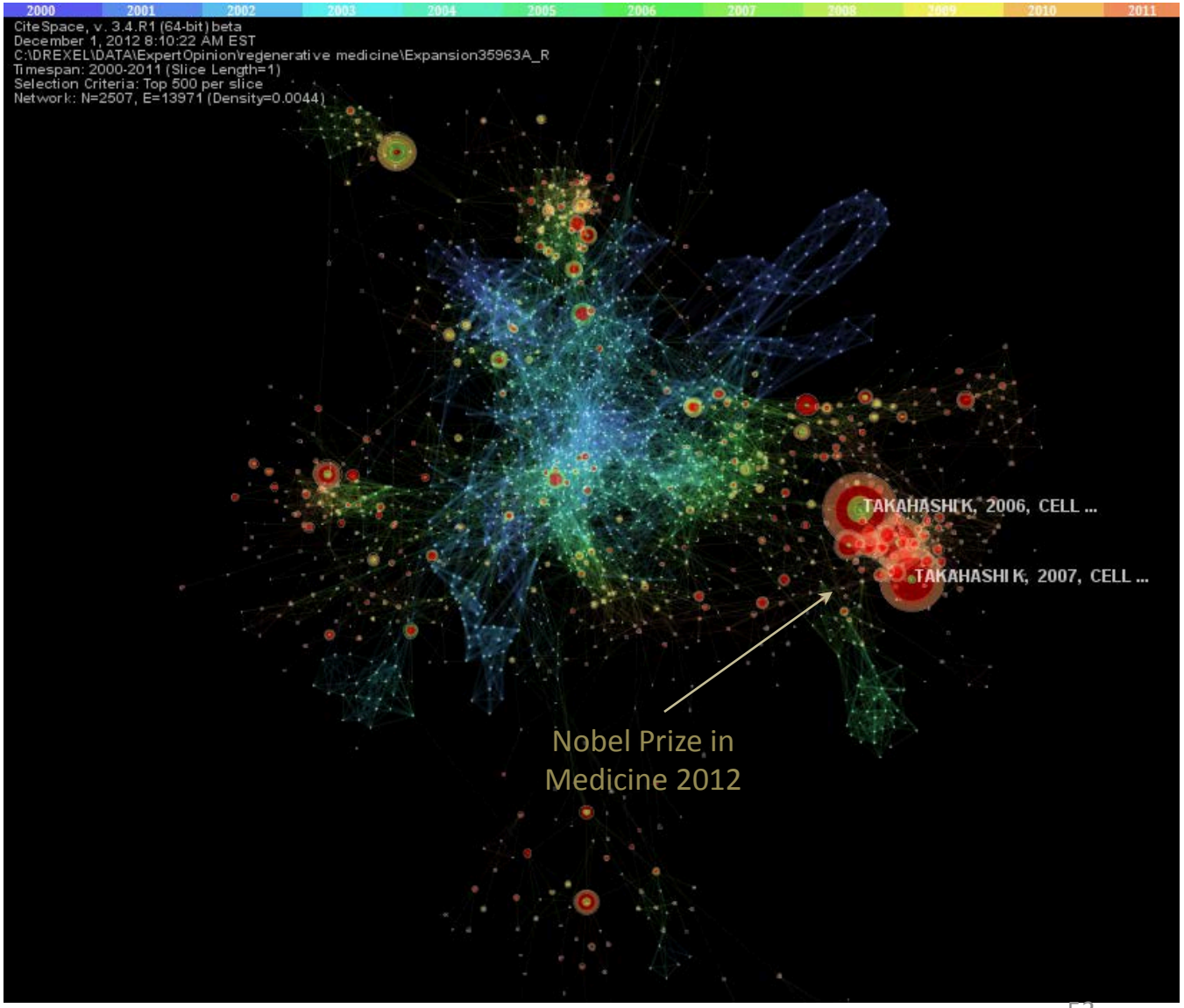
Structural hole

Regenerative Medicine



Regenerative Medicine

Regenerative Medicine (2000-2011). The two labeled articles represent the work that was awarded the 2012 Nobel Prize in Medicine. Red rings indicate the period of citation burst – hot spots.



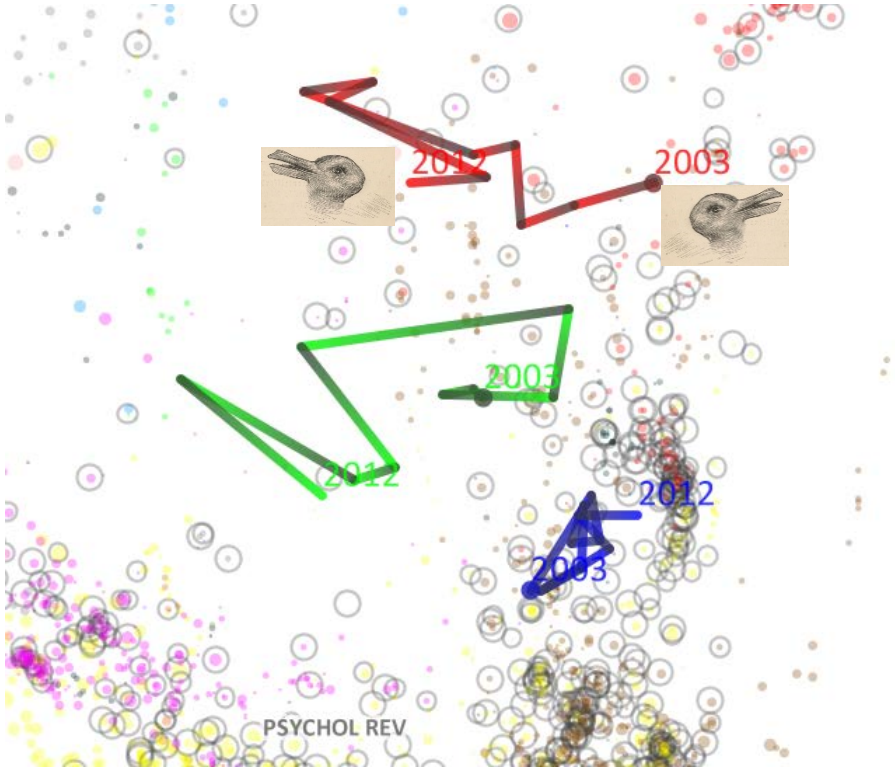
Dual-Map Overlays

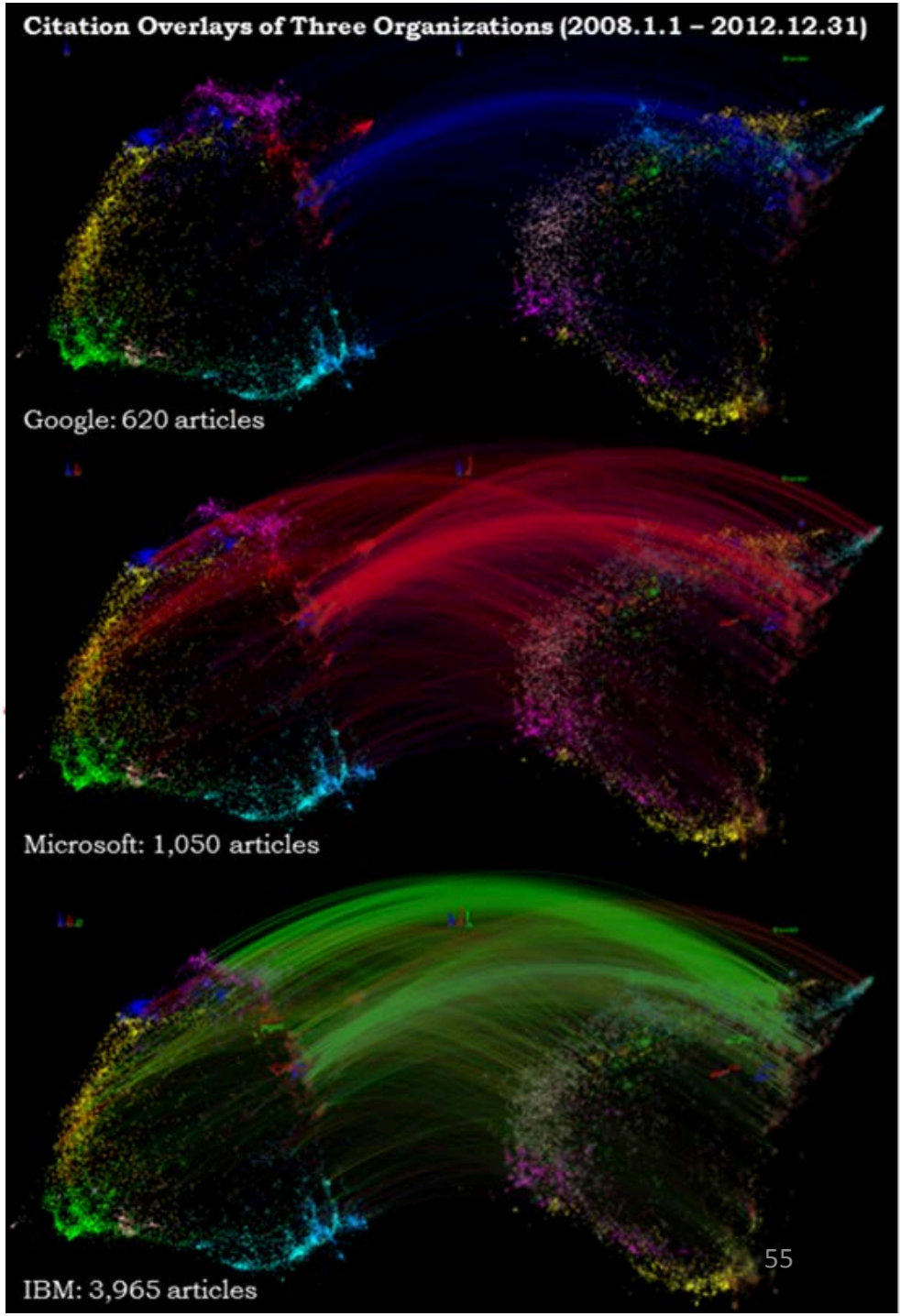
Chen, C., Leydesdorff, L. (2014) Patterns of connections and movements in dual-map overlays: A new method of publication portfolio analysis. *Journal of the American Society for Information Science and Technology*, **65**(2), 334-351. DOI: 10.1002/asi.22968

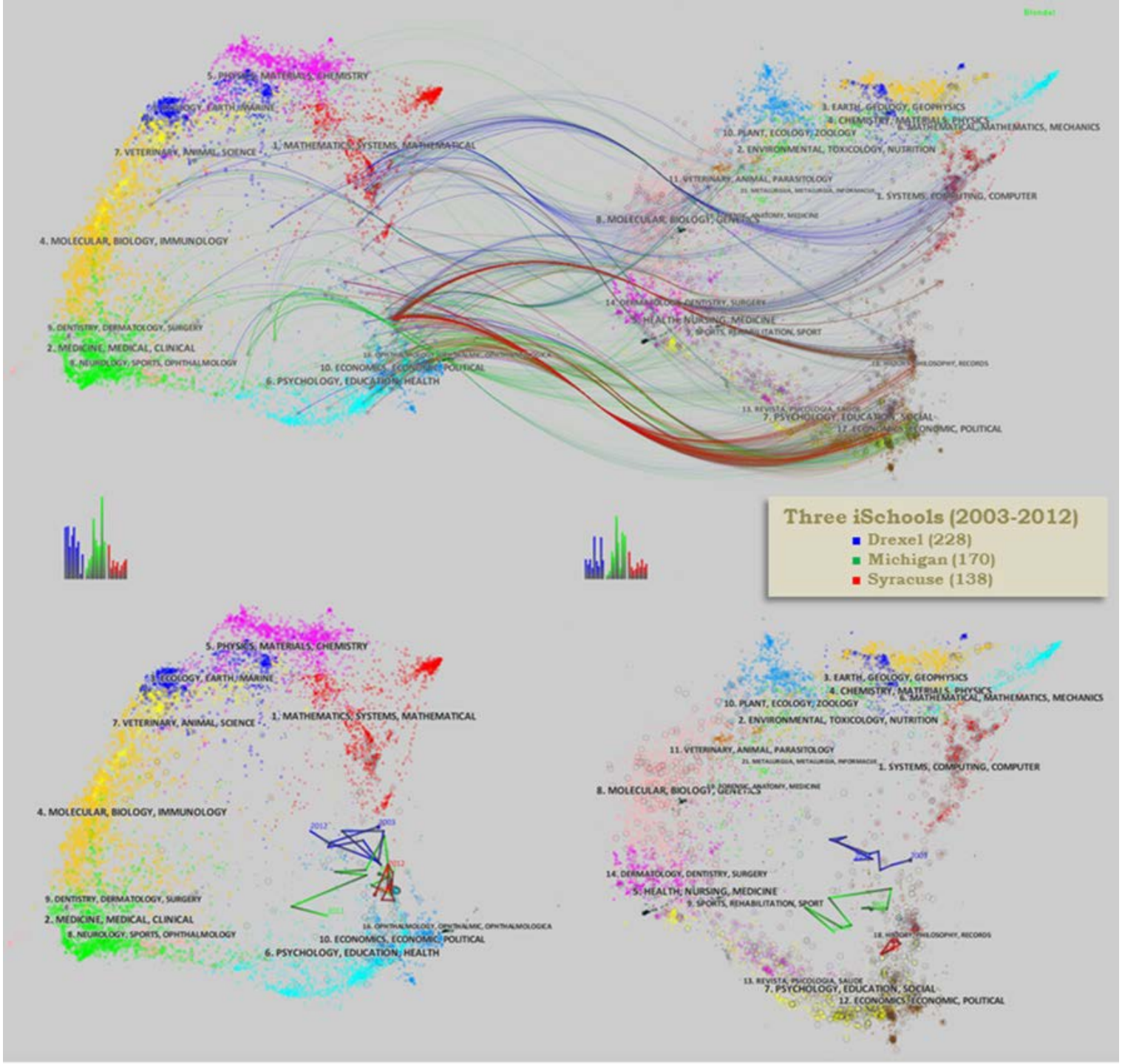
Trajectories of a Community

e.g. view changing = long distance shift

Chen, C., Leydesdorff, L. (2014) Patterns of connections and movements in dual-map overlays: A new method of publication portfolio analysis. *Journal of the American Society for Information Science and Technology*, **65**(2), 334-351. DOI: 10.1002/asi.22968

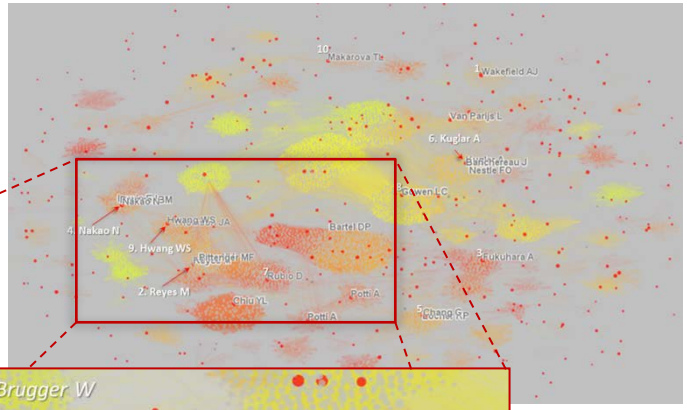


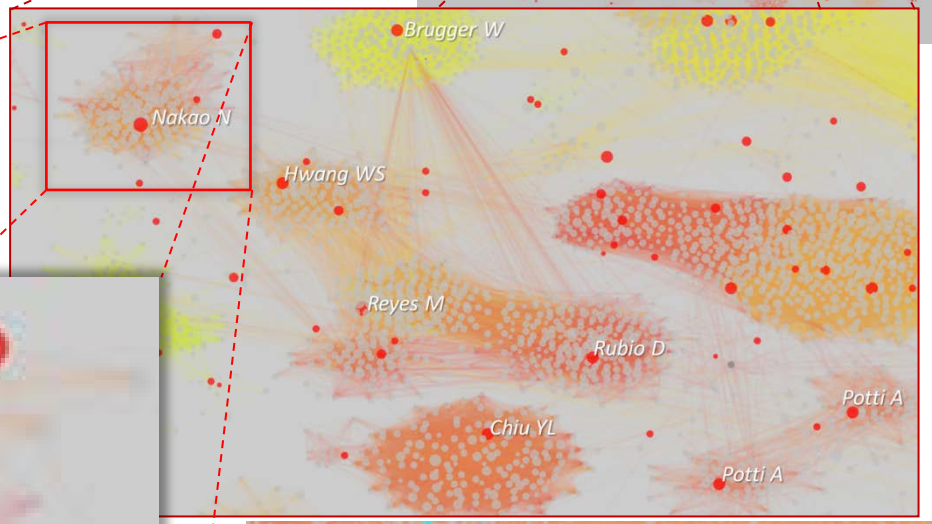


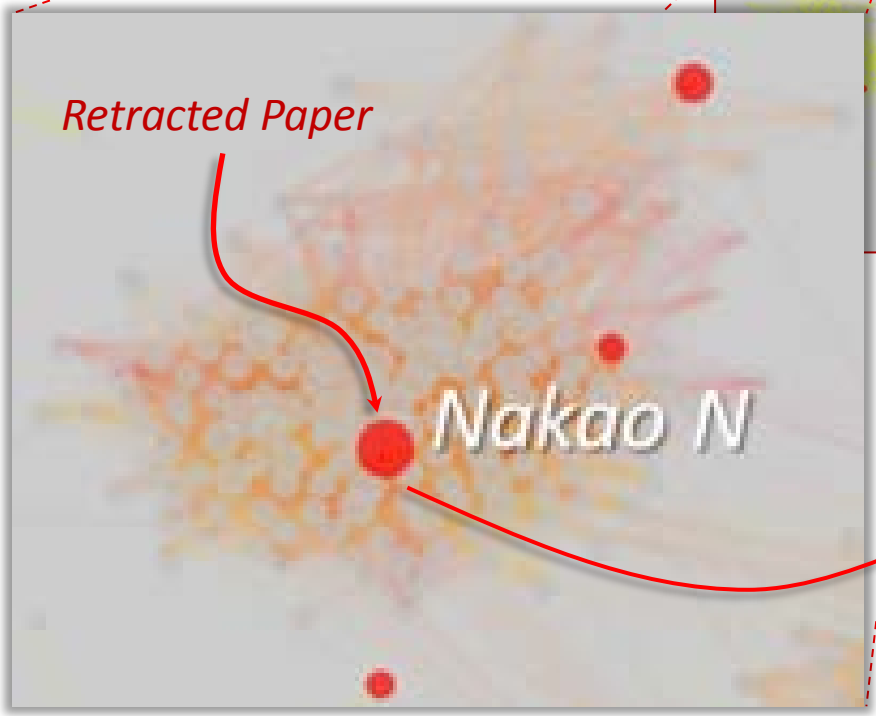

5. PHYSICS, MATERIALS, CHEMISTRY
3. EARTH, GEOLOGY, GEOPHYSICS
4. CHEMISTRY, MATERIALS, PHYSICS
6. MATHEMATICAL, MATHEMATICS, MECHANICS
10. PLANT, ECOLOGY, ZOOLOGY
2. ENVIRONMENTAL, TOXICOLOGY, NUTRITION
7. VETERINARY, ANIMAL, SCIENCE
1. MATHEMATICS, SYSTEMS, MATHEMATICAL
11. VETERINARY, ANIMAL, PARASITOLOGY
1. SYSTEMS, COMPUTING, COMPUTER
8. MOLECULAR, BIOLOGY, GENETICS
4. MOLECULAR, BIOLOGY, IMMUNOLOGY
14. DERMATOLOGY, DENTISTRY, SURGERY
5. HEALTH, NURSING, MEDICINE
9. SPORTS, REHABILITATION, SPORT
9. DENTISTRY, DERMATOLOGY, SURGERY
2. MEDICINE, MEDICAL, CLINICAL
8. NEUROLOGY, SPORTS, OPHTHALMOLOGY
10. ECONOMICS, ECONOMIC, POLITICAL
6. PSYCHOLOGY, EDUCATION, HEALTH
18. HISTORY, PHILOSOPHY, RECORDS
13. REVISTA, PSICOLOGIA, SAUDE
7. PSYCHOLOGY, EDUCATION, SOCIAL
12. ECONOMICS, ECONOMIC, POLITICAL
Three iSchools (2003-2012)
Drexel (228)
Michigan (170)
Syracuse (138)
2003
2012

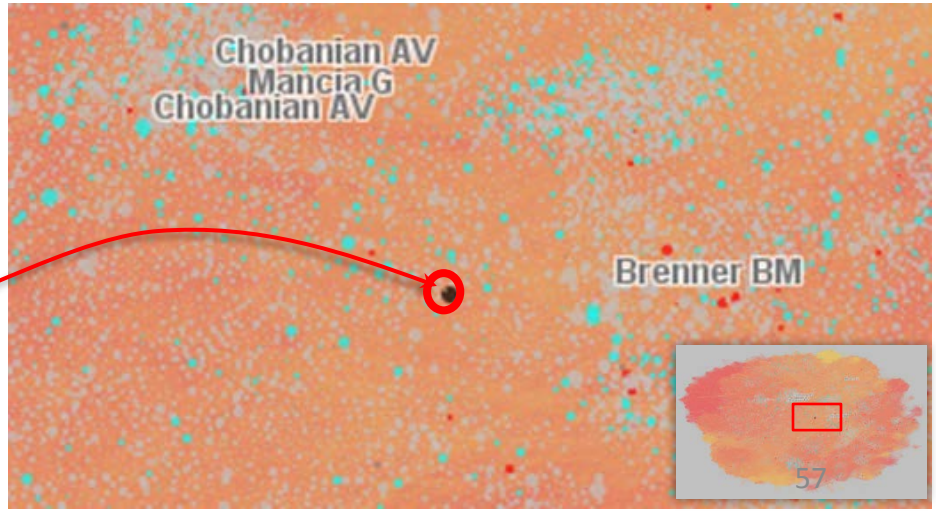
Retracted Articles in the Literature

Chen, C., Hu, Z., Milbank, J., Schultz, T. (2013) A visual analytic study of retracted articles in scientific literature. *Journal of the American Society for Information Science and Technology*, 64(2), 234-253.



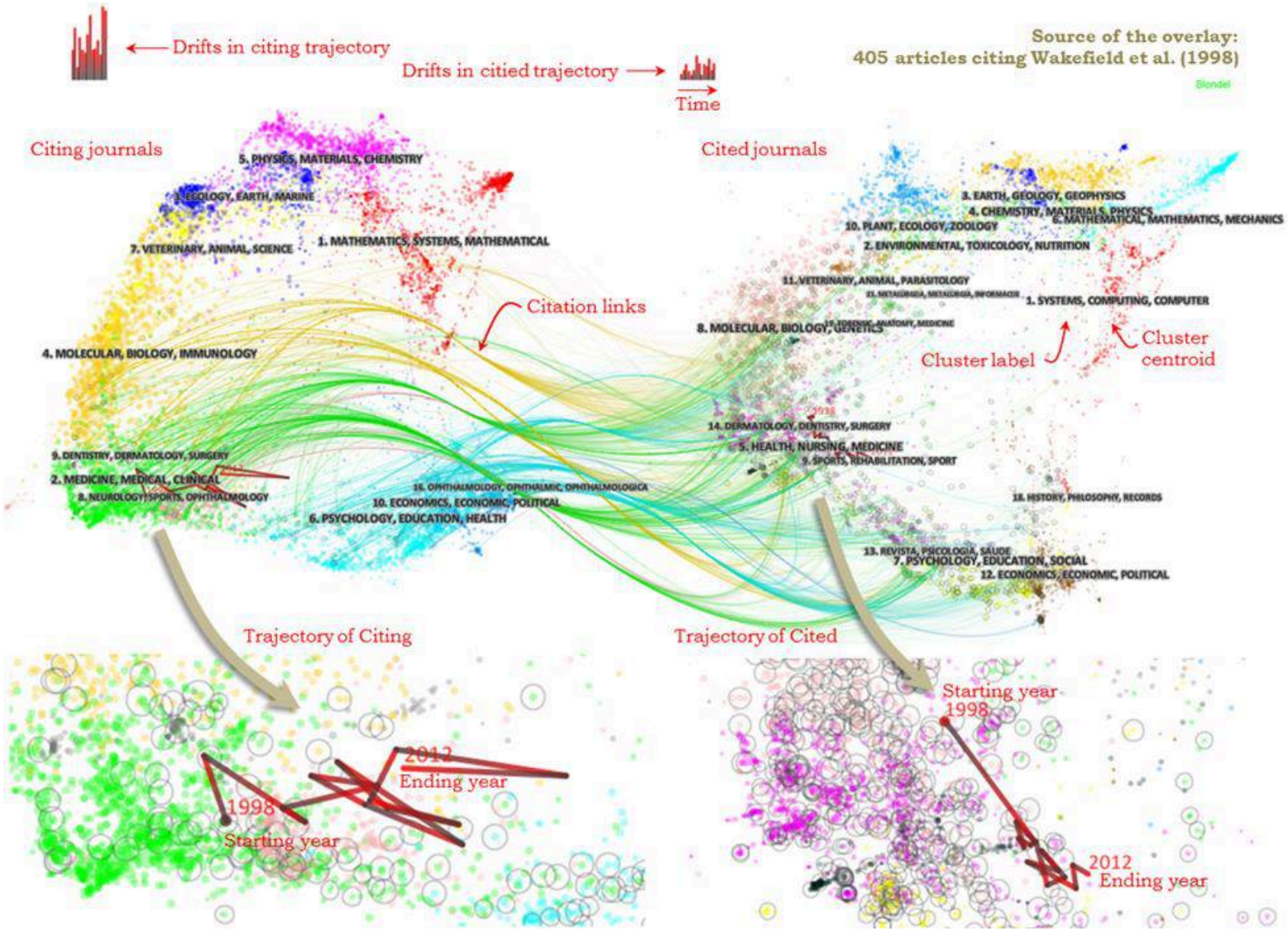


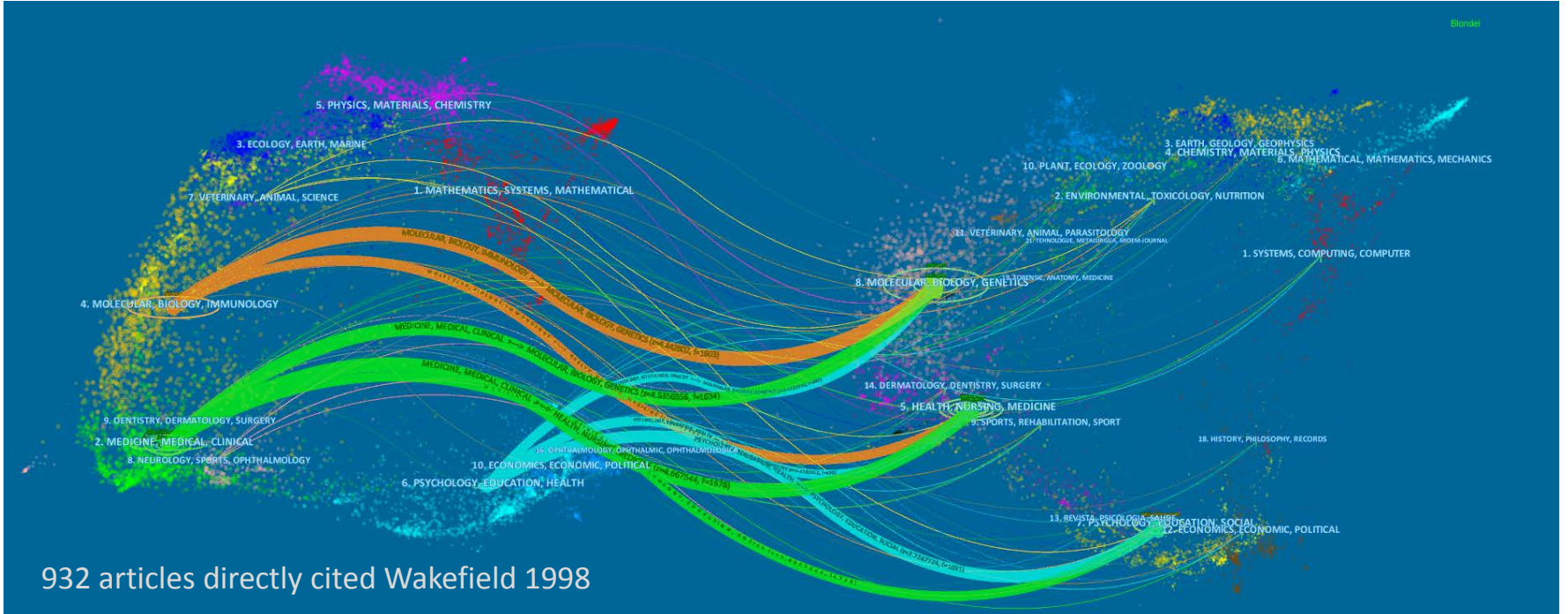




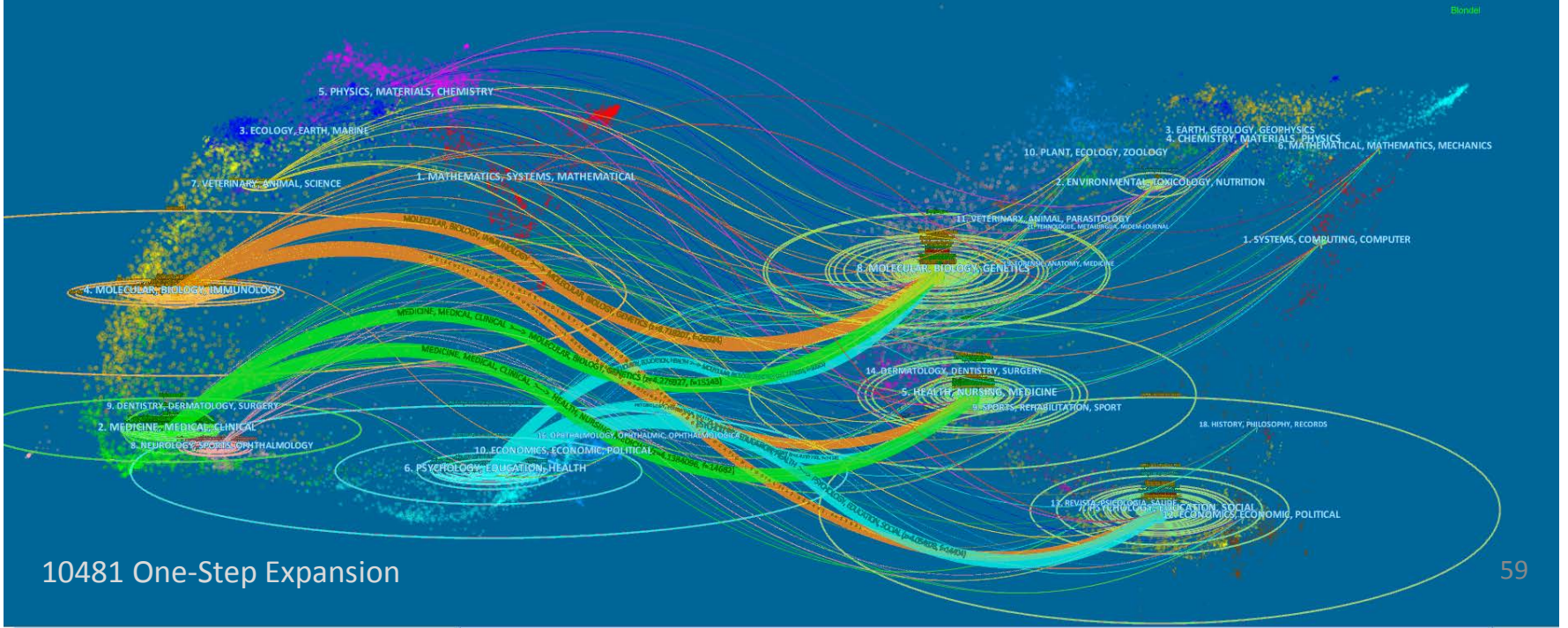
Uncertainty and Inaccuracy: Wakefield 1998

Chen, C., Leydesdorff, L. (2014) Patterns of connections and movements in dual-map overlays: A new method of publication portfolio analysis. *Journal of the American Society for Information Science and Technology*, **65**(2), 334-351. DOI: 10.1002/asi.22968





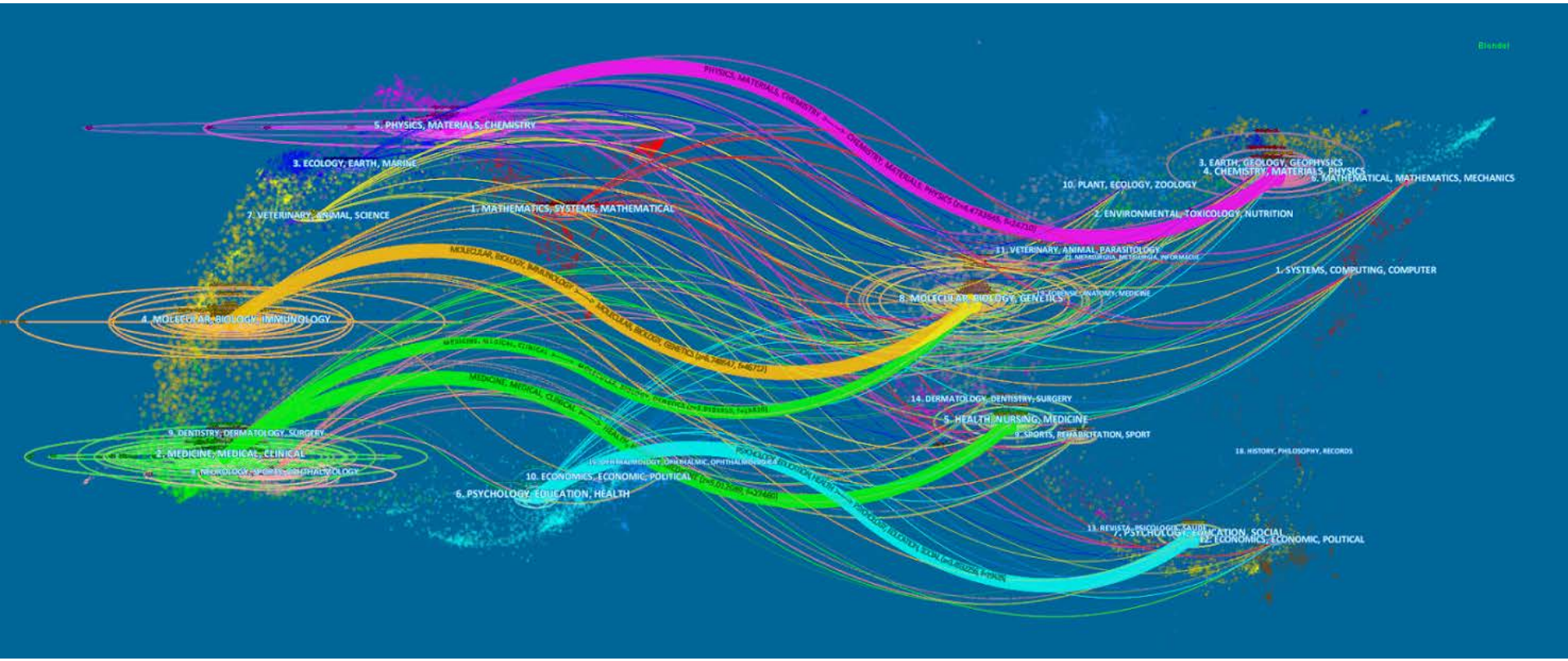
932 articles directly cited Wakefield 1998



10481 One-Step Expansion

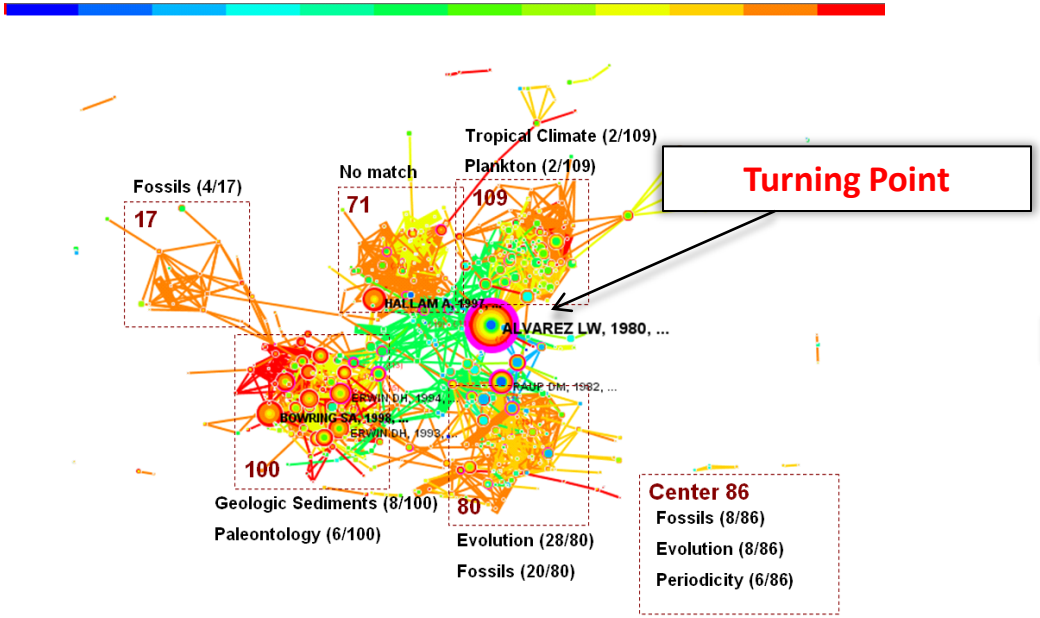
A z-score Enhanced Dual-Map Overlay

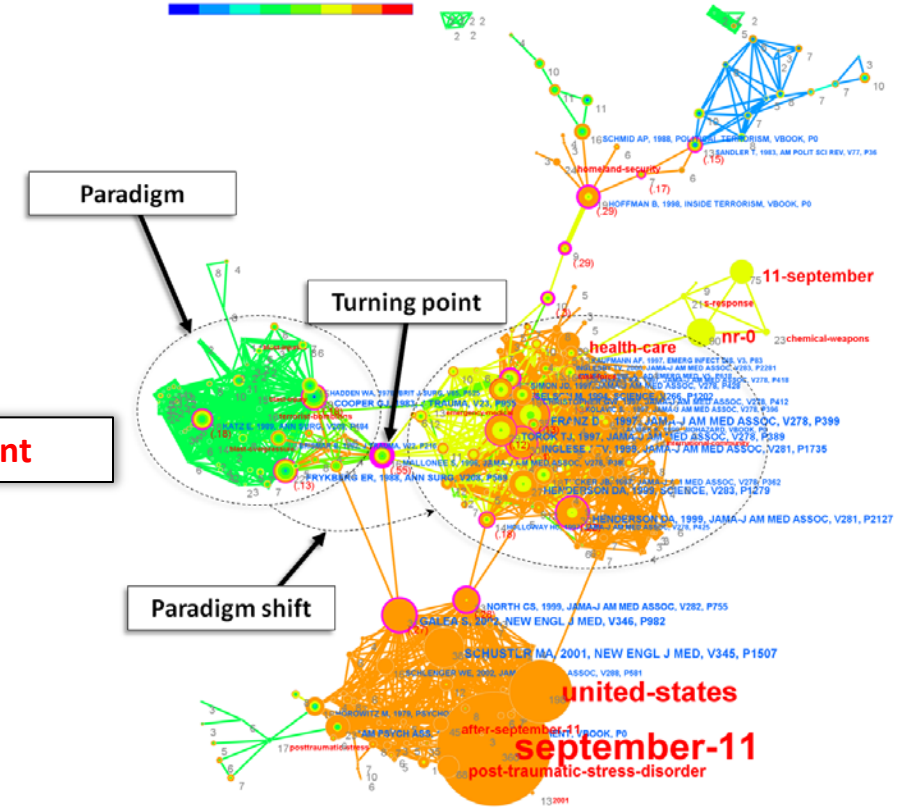
68,263 distinct references in 18,000+ publications by 3,790 authors at Drexel University



Detecting Early Signs of a Turning Point

?

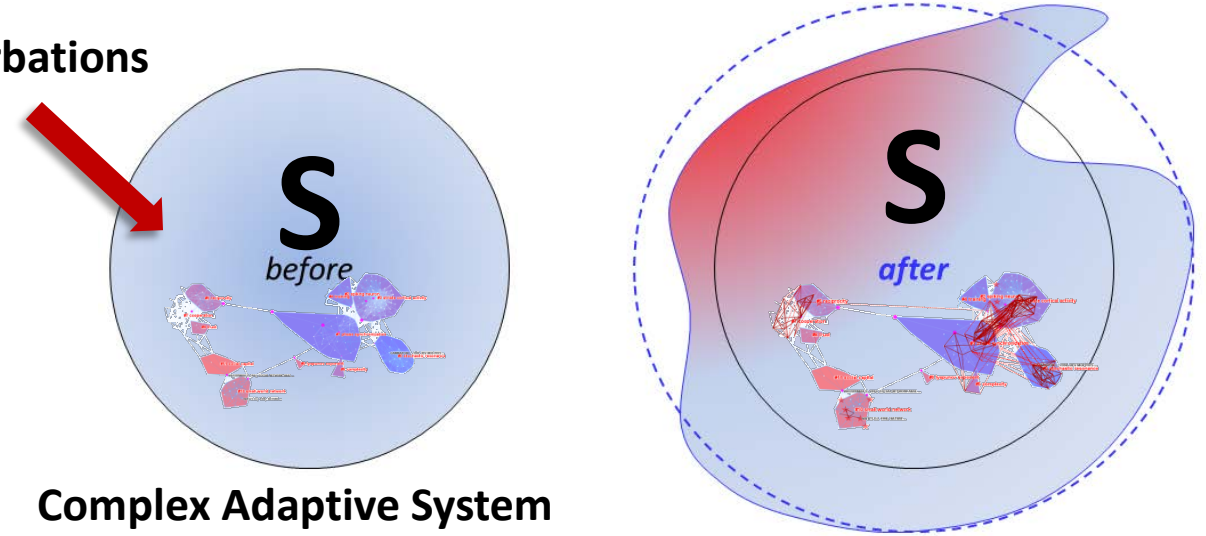




Chen, C. (2006) CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. *Journal of the American Society for Information Science and Technology*, 57(3), 359-377.

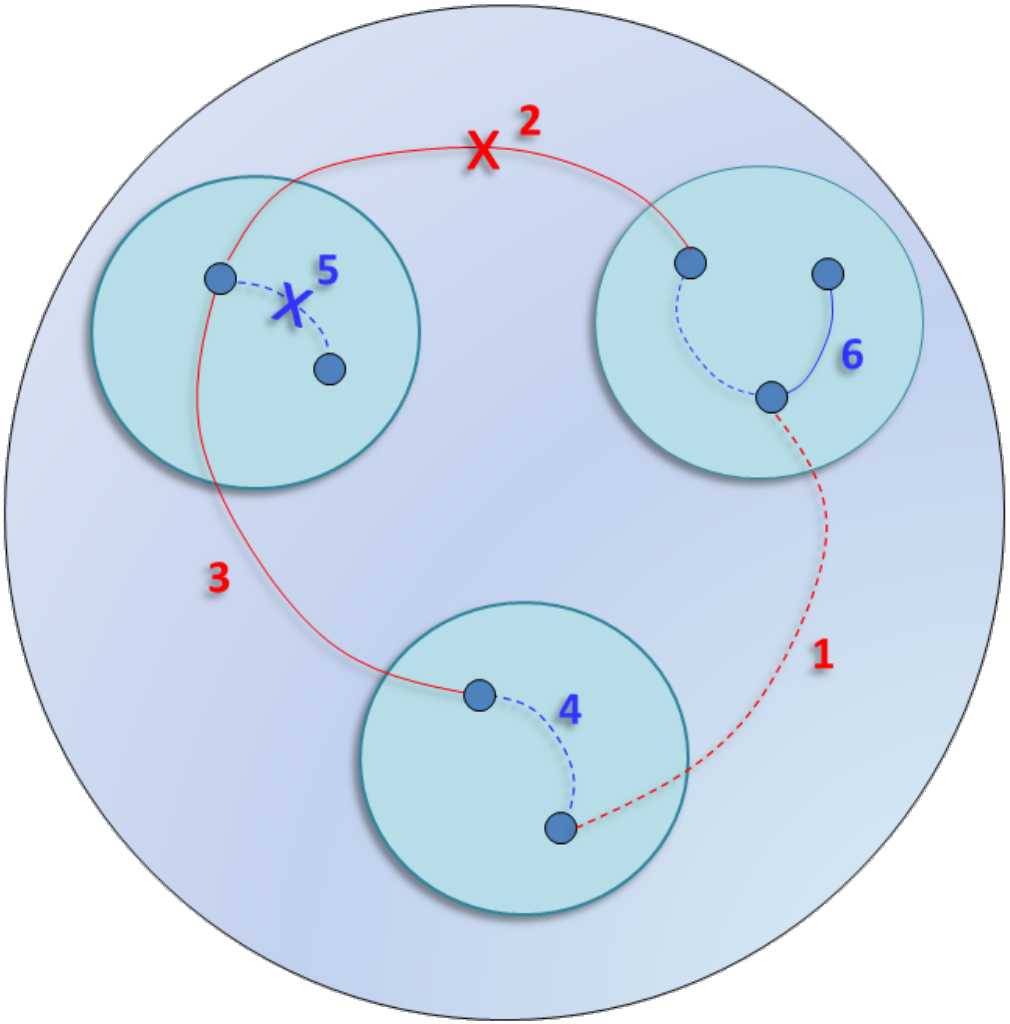
Scholarly Publications Impact on Scientific Knowledge

Perturbations



Complex Adaptive System

Transformative Potential and Future Turning Points



Structural Variation

Addition

Negation

Reinforcement

new information

transformative

1. add a long range link
2. remove a long range link
3. reinforce a long range link
4. add a short range link
5. remove a short range link
6. reinforce a short range link

incremental

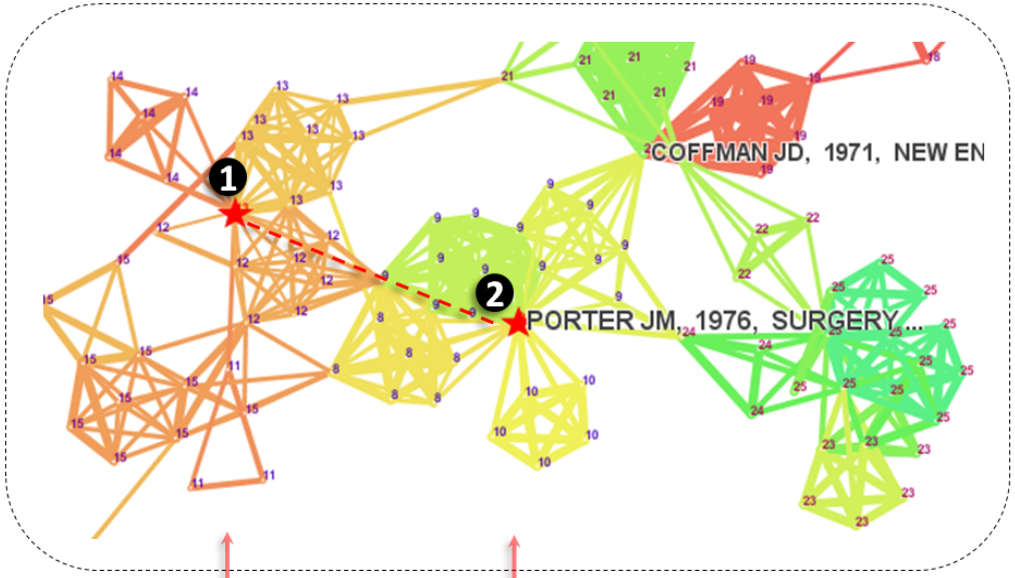
How Does It Change a Network of Citation?

1 HARPER FE, 1982, AM J MED, V72, P883

2 PORTER JM, 1976, SURGERY, V80, P756

co-cited by

3 MCLAFFERTY RB, 1995, J VASC SURG, V22, P361

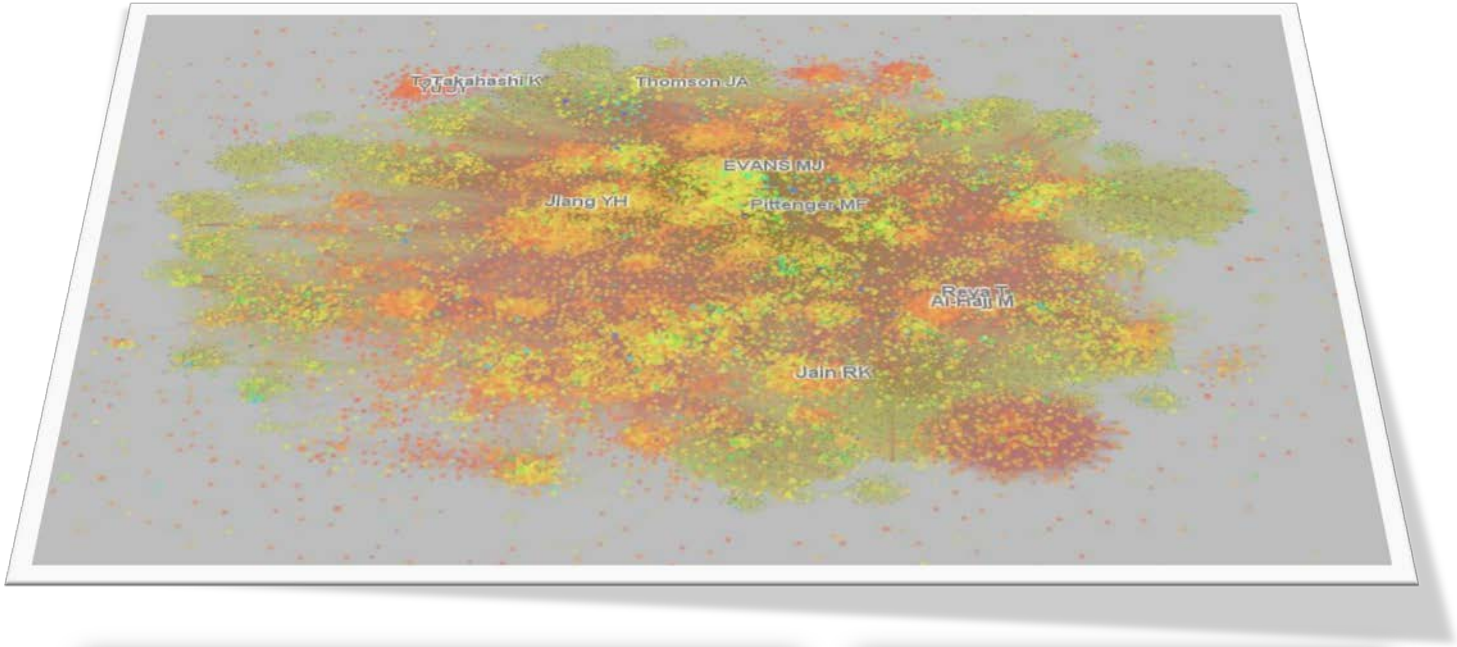


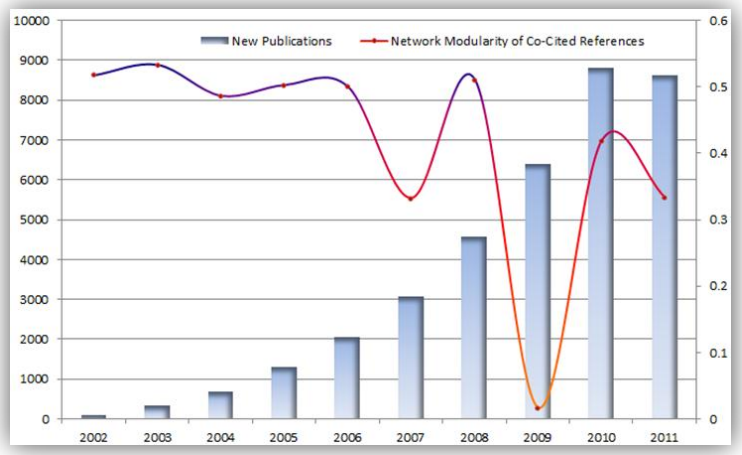
3 MCLAFFERTY RB, 1995, J VASC SURG, V22, P361 citations=14

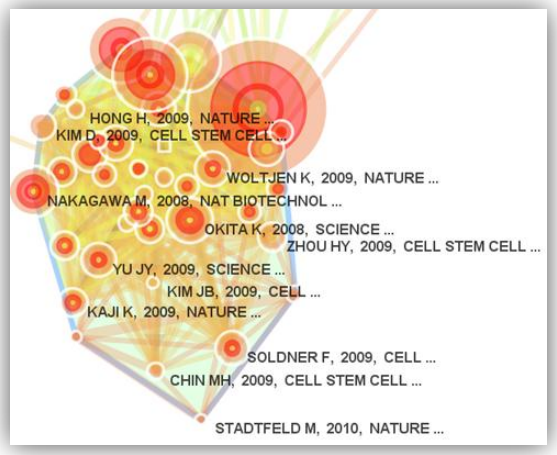
Modularity Reduced: **0.022048822** %
Centrality Changed: **0.016370589** %

Regenerative Medicine

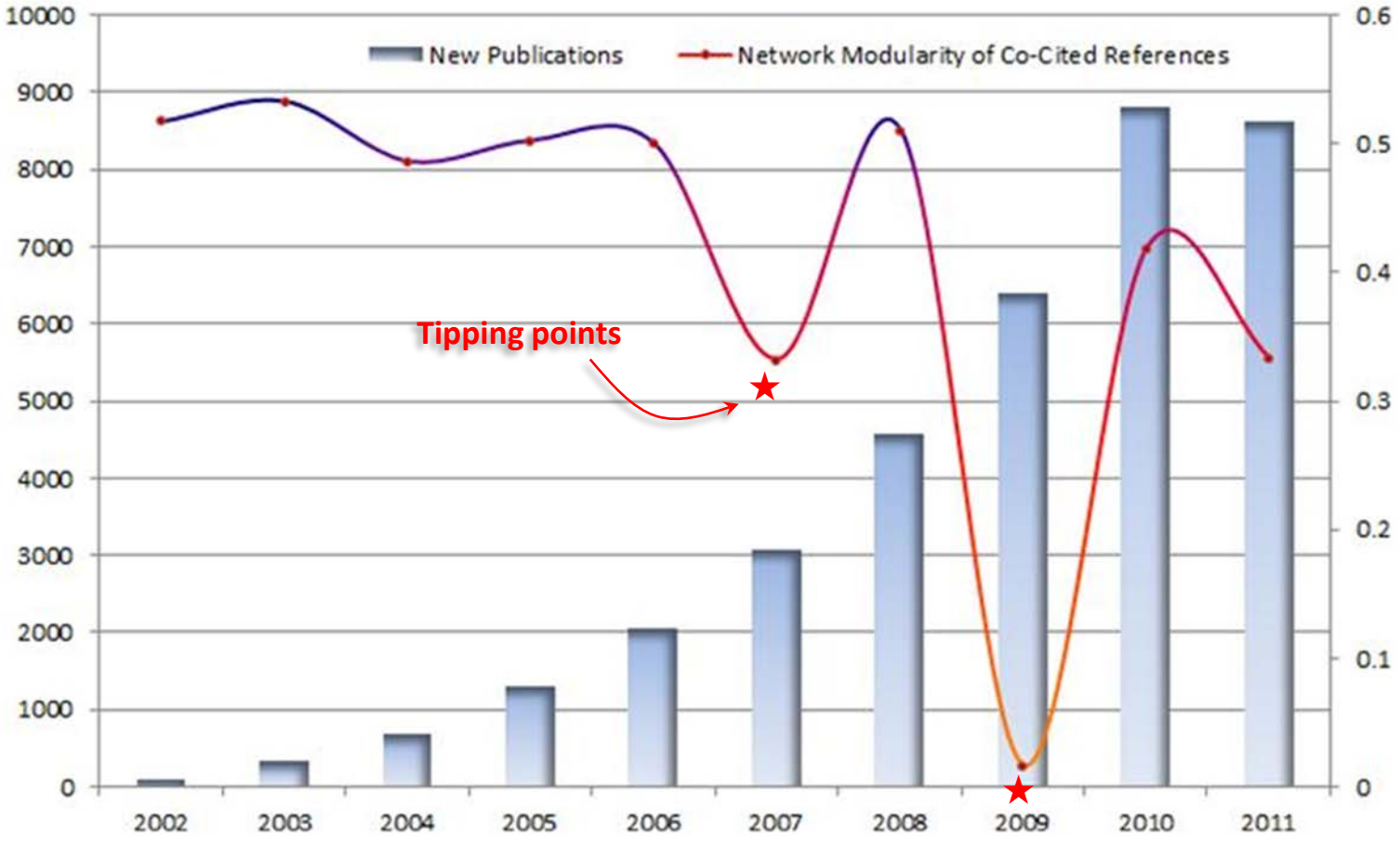
Chen, C., Hu, Z., Liu, S., Tseng, H. (2012) Emerging trends in regenerative medicine: A scientometric analysis in CiteSpace. *Expert Opinions on Biological Therapy*, 12(5), 593-608.

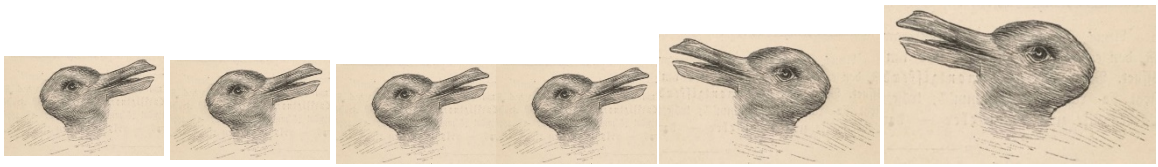






Detecting Transformative Discoveries

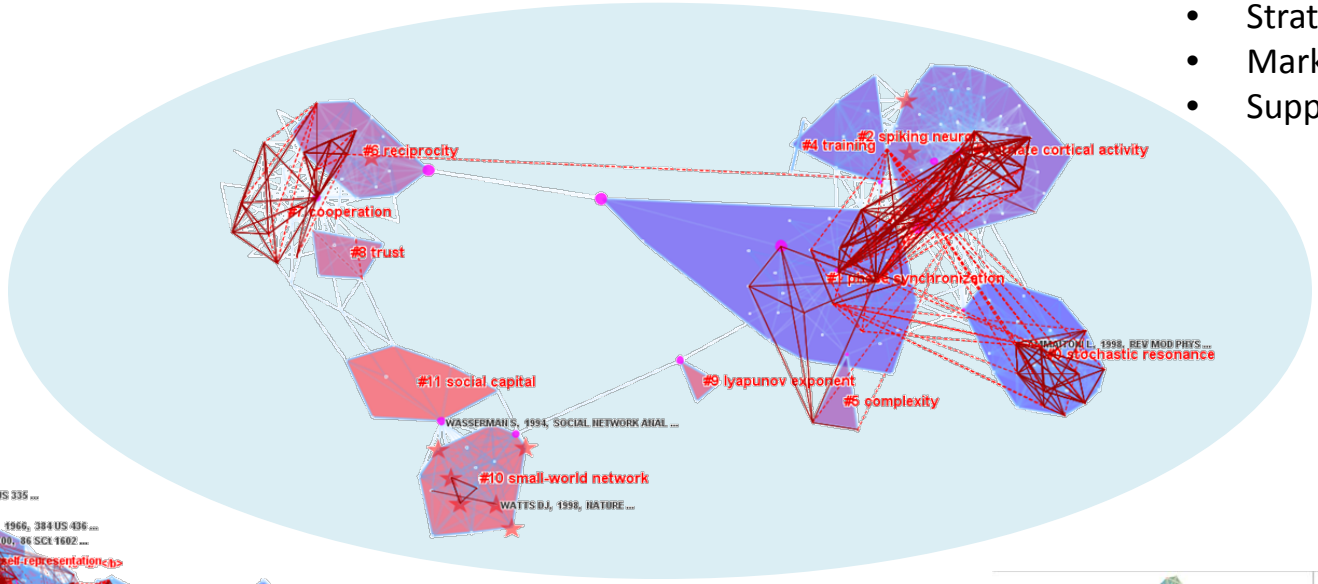


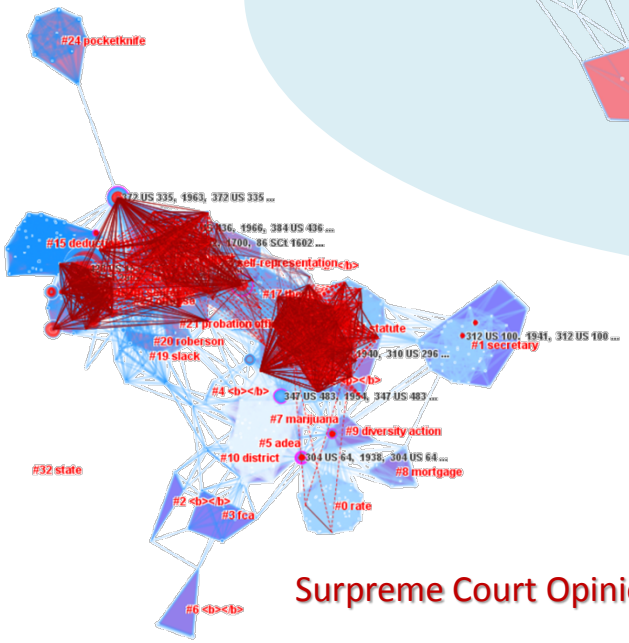


Predicting Structural Changes

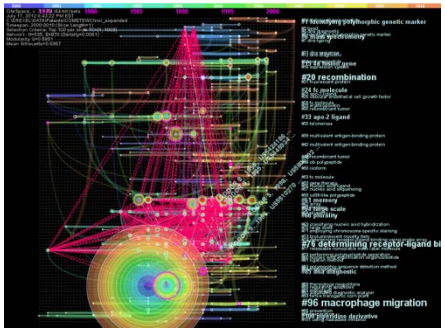
Detecting Early Signs of Fundamental Change
Monitoring Novel Patterns
Analyzing What-If Scenarios

- Competitive Intelligence
- Strategic Planning
- Market Analysis
- Supply Chain Evaluation

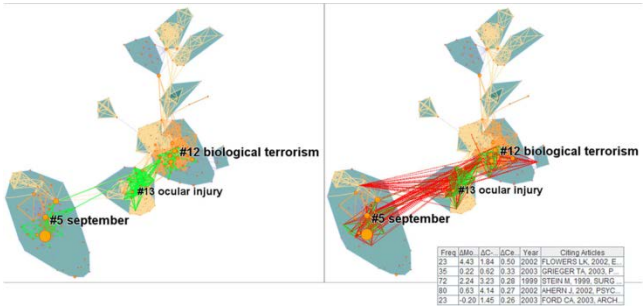




Surpreme Court Opinions

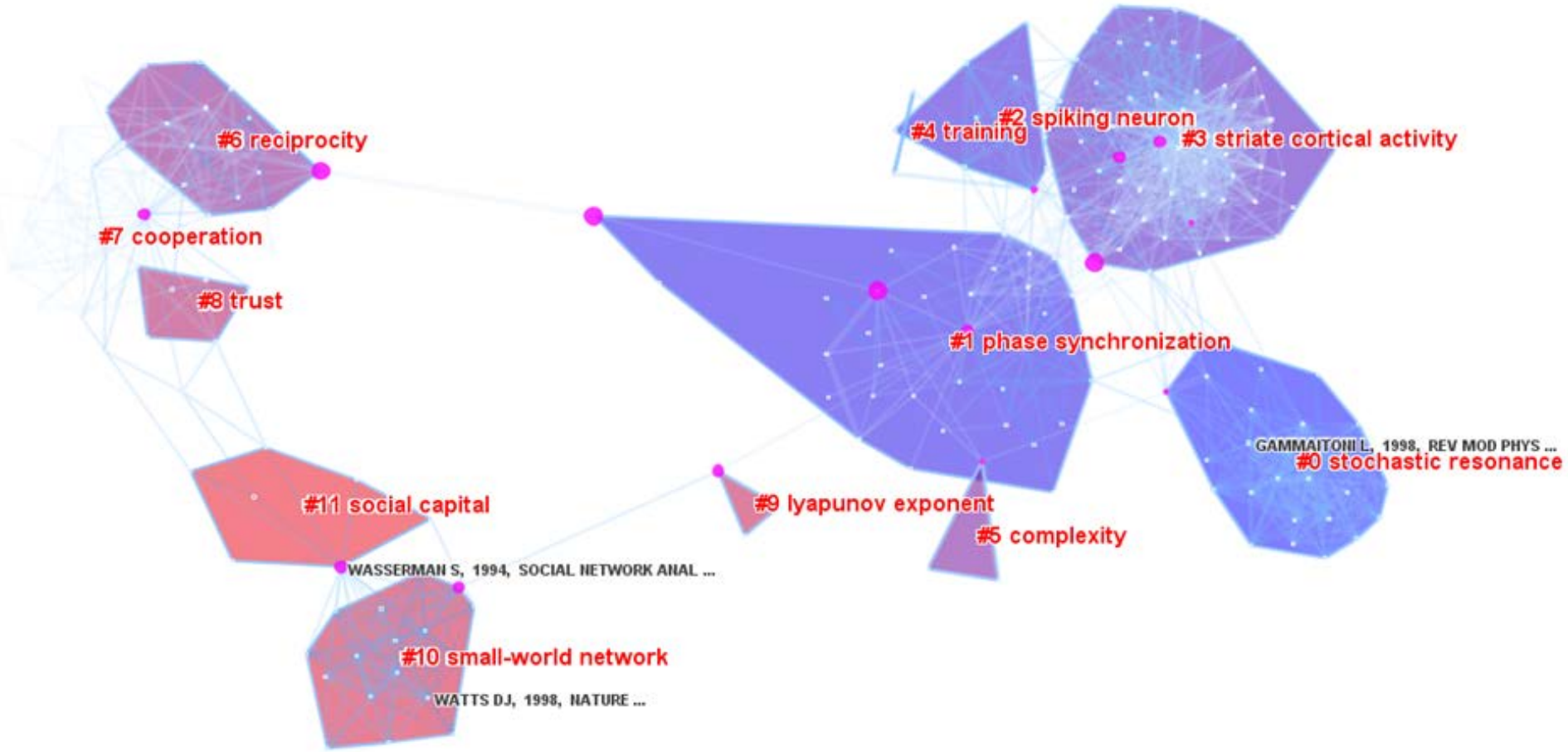


National Cancer Institute's Patents



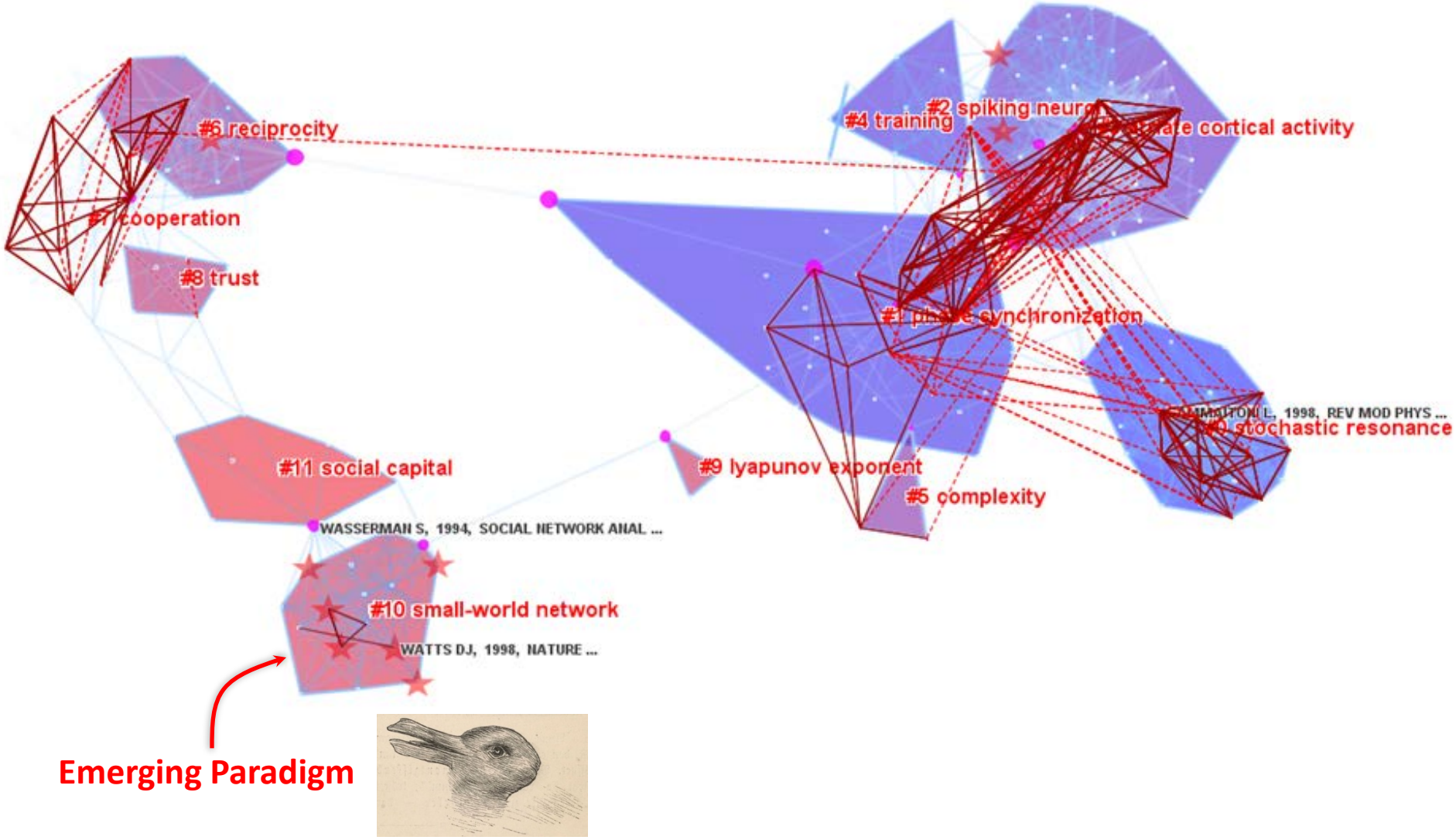
Scientific Publications

Small-World Networks (1990-2010): Before 1998



The synthesized network of classic work prior to the birth of the small-world network.

Small-World Networks (1990-2010): After 1998



Complex Network Analysis (1996-2004)

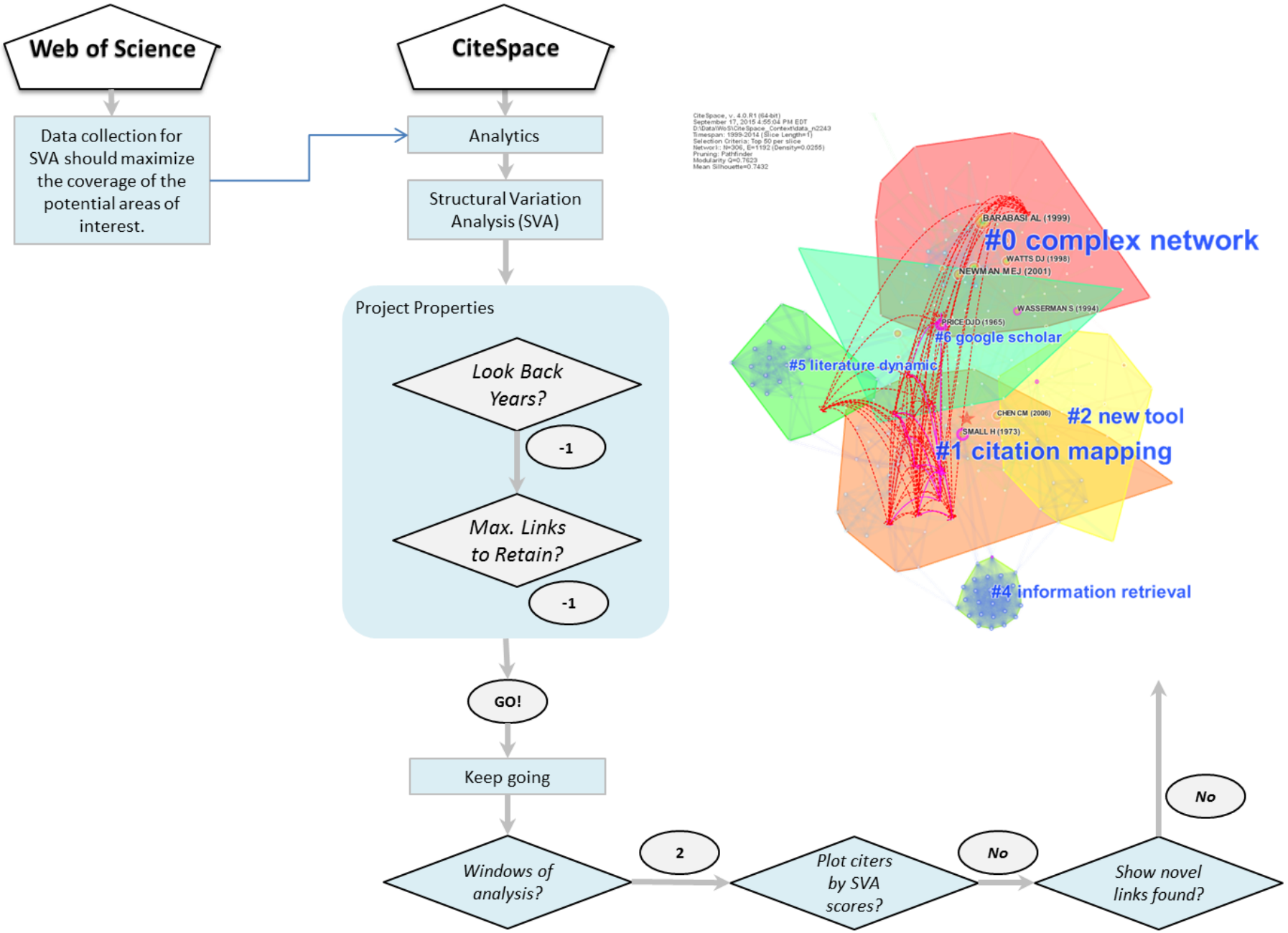
Zero-inflated negative binomial regression (ZINB) and negative binomial (NB) models of global citation counts of 3,515 citing articles on complex network analysis (1996-2004).

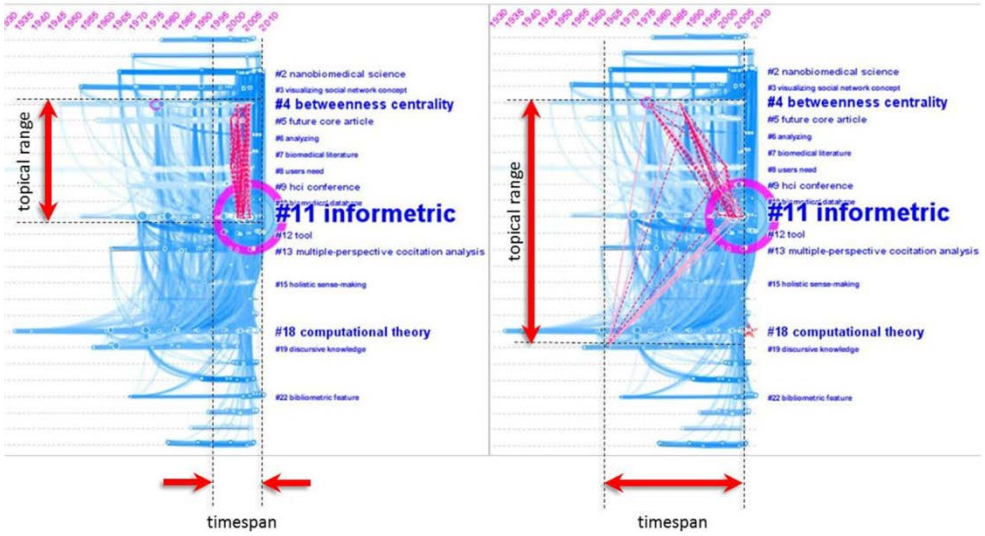
	ZINB					
Global cites	Count model Negbin with log link		Zero-inflation model Binomial with logit link		NB	
Coauthors	**1.293**	**0.000**	0.062	0.077	**1.306**	**0.000**
Modularity change rate	**1.080**	**0.014**	**0.012**	**0.044**	**1.083**	**0.025**
Weighted cluster linkage	**3.103**	**0.000**	1.304	0.906	**3.160**	**0.000**
Centrality Divergence	0.391	0.237	385363.6	0.102	0.343	0.184
No. of references	**1.013**	**0.000**	**0.489**	**0.027**	**1.013**	**0.000**
No. of pages	**0.970**	**0.000**	1.133	0.120	**0.970**	**0.000**
Dispersion parameter (θ)	0.536				0.528	
AIC			31,768		31,787	
Vuong test (ZINB > NB)			−2.7186, $p = \mathbf{0.0033}$			

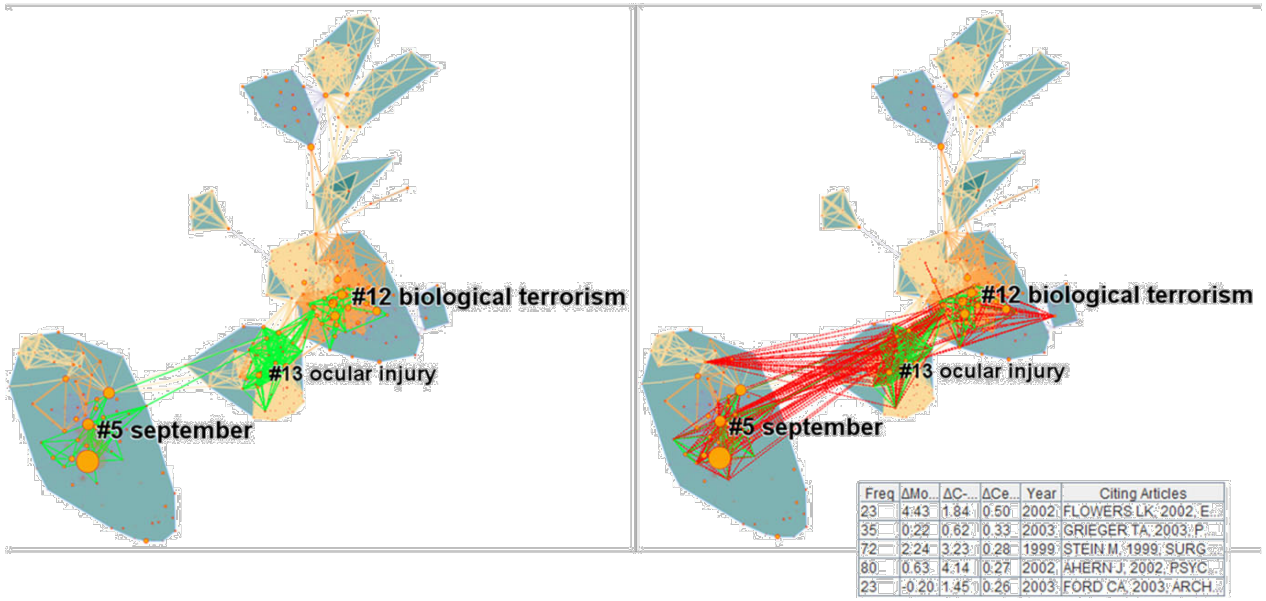
AIC = Akaike's Information Criterion.

[a]Coefficients are incidence rate ratios. Weighted cluster linkage is the strongest predictor of citation counts, followed by the number of coauthors, and the modularity change rate. In this case, with a lower AIC and a statistically significant Vuong test, the ZINB model is superior.

- The expected change in GlobalCites for a one-unit increase in Weighted Cluster Linkage is 3.103 (IRR – Incident Rate Ratio) holding other variables constant.
- The expected change in GlobalCites for a one-unit increase in NR is 1.103 (IRR) holding other variables constant.
- The log odds of being an excessive zero – The Number of Cited References (NR) is a good predictor of excessive zeros.


Web of Science
CiteSpace
Data collection for SVA should maximize the coverage of the potential areas of interest.
Analytics
Structural Variation Analysis (SVA)
Project Properties
Look Back Years?
-1
Max. Links to Retain?
-1
GO!
Keep going
Windows of analysis?
2
Plot citers by SVA scores?
No
Show novel links found?
No
BARABASI AL (1999)
WATTS DJ (1998)
NEWMAN MEJ (2001)
WASSERMAN S (1994)
PRICE DJD (1965)
CHEN CM (2006)
SMALL H (1973)
#0 complex network
#6 google scholar
#5 literature dynamic
#2 new tool
#1 citation mapping
#4 information retrieval

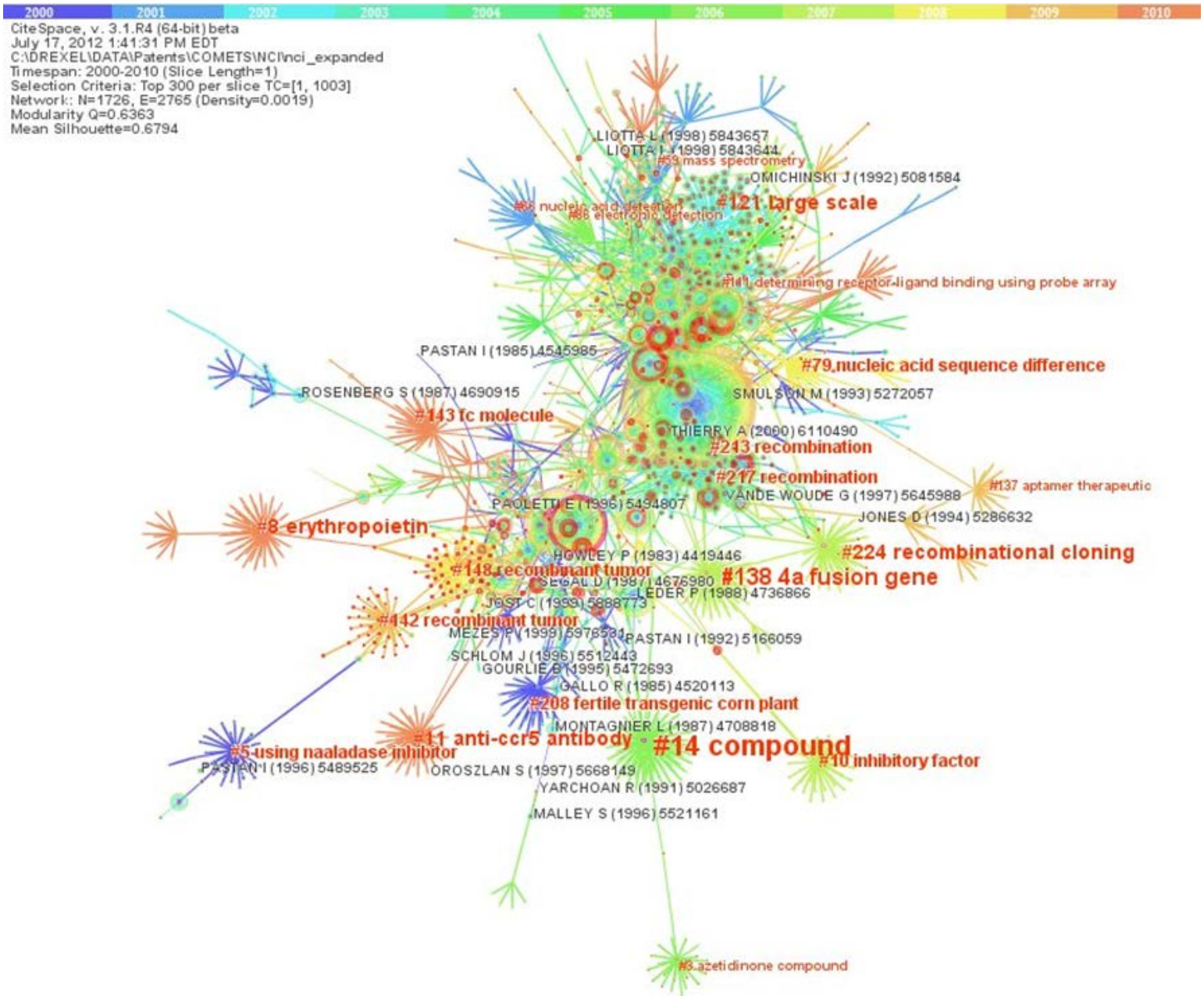




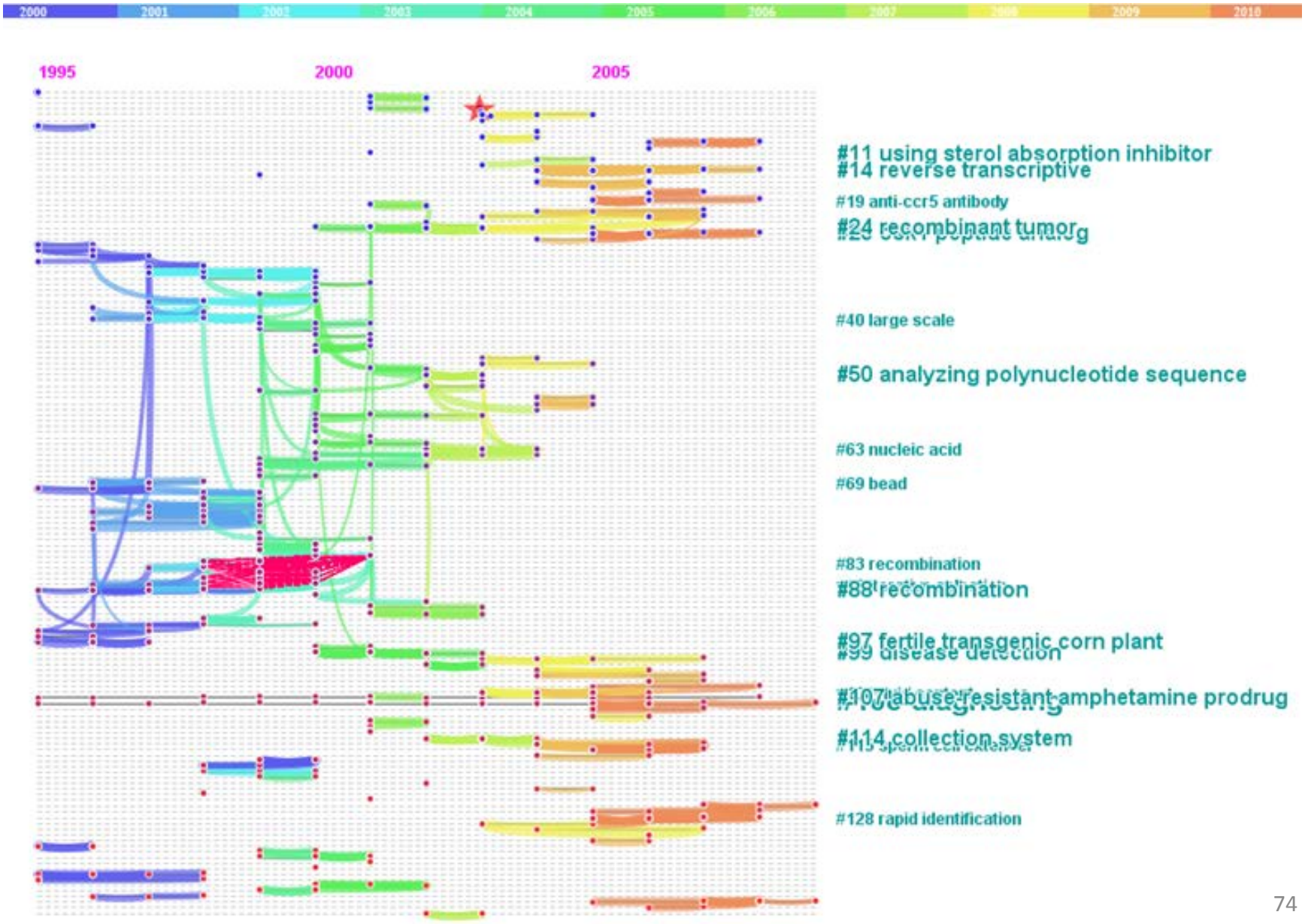
Chen, C. (2012) Predictive effects of structural variation on citation counts. *Journal of the American Society for Information Science and Technology*, **63**(3), 431-449.

Structural Variations in Networks of Patents

A minimum spanning tree of a network of 1,726 co-cited patents related to cancer research.



Recombinant Patents



NCI Patents Expanded

Negative Binomial

Input: 2,065 patents in the expanded NCI patents dataset

Theta=0.2788 AIC(NB)=8,176.7	Count model coefficients		
Variables	IRR	Z	p
Intercept	2.668	21.875	0.000
Local existing links	1.016	1.865	0.062
Local transformative links	0.963	-0.681	0.496
Local incremental links	**1.010**	2.941	0.003
Modularity	1.070	1.865	0.062
Cluster linkage	8.634	0.417	0.676
Centrality divergence	**4.411**	4.422	0.000

NCI Patents Expanded

Zero-Inflated Negative Binomial

ZINB model of 2,065 patents in the expanded NCI patents dataset

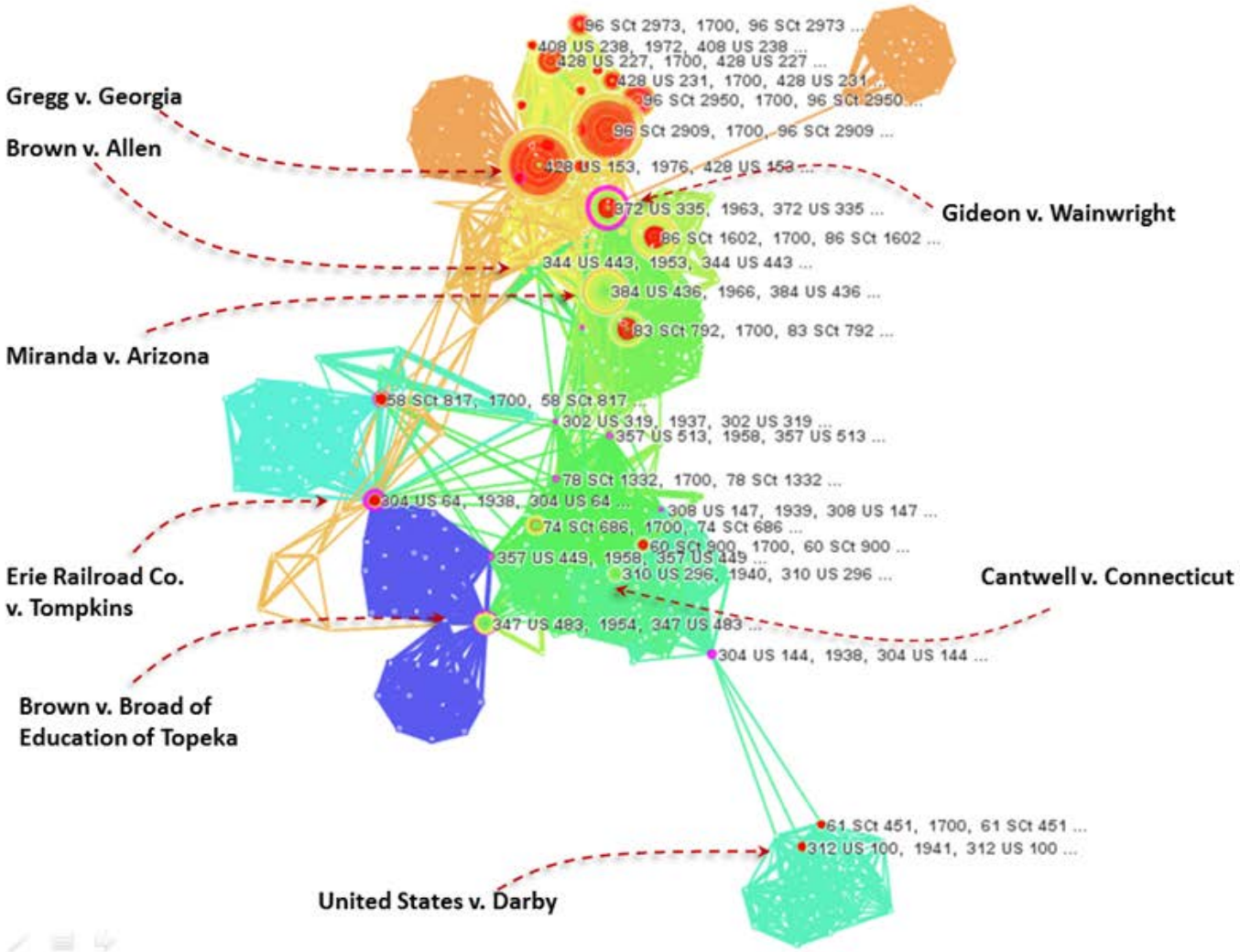
Theta=0.3457 AIC(ZINB)=8145.8	Count model coefficients			Zero-inflation model		
Variables	IRR	z	p	IRR	z	P
Intercept	0.000	-144.790	0.0000	0.1291	-4.141	0.0000
Local existing links	**1.021**	2.584	0.0098	**0.098**	-2.220	0.0264
Local transformative links	1.019	NA	NA	**14.083**	2.075	0.0380
Local incremental links	1.003	1.903	0.0570	0.545	-1.728	0.0840
Modularity	1.020	1.272	0.2034	0.0116	-1.773	0.0763
Cluster linkage	0.027	NA	NA	0.000	-1.797	0.0724
Centrality divergence	**51.481**	4.749	0.0000	629.302	1.892	0.0584

NCI Patents Expanded: ZINB Extended

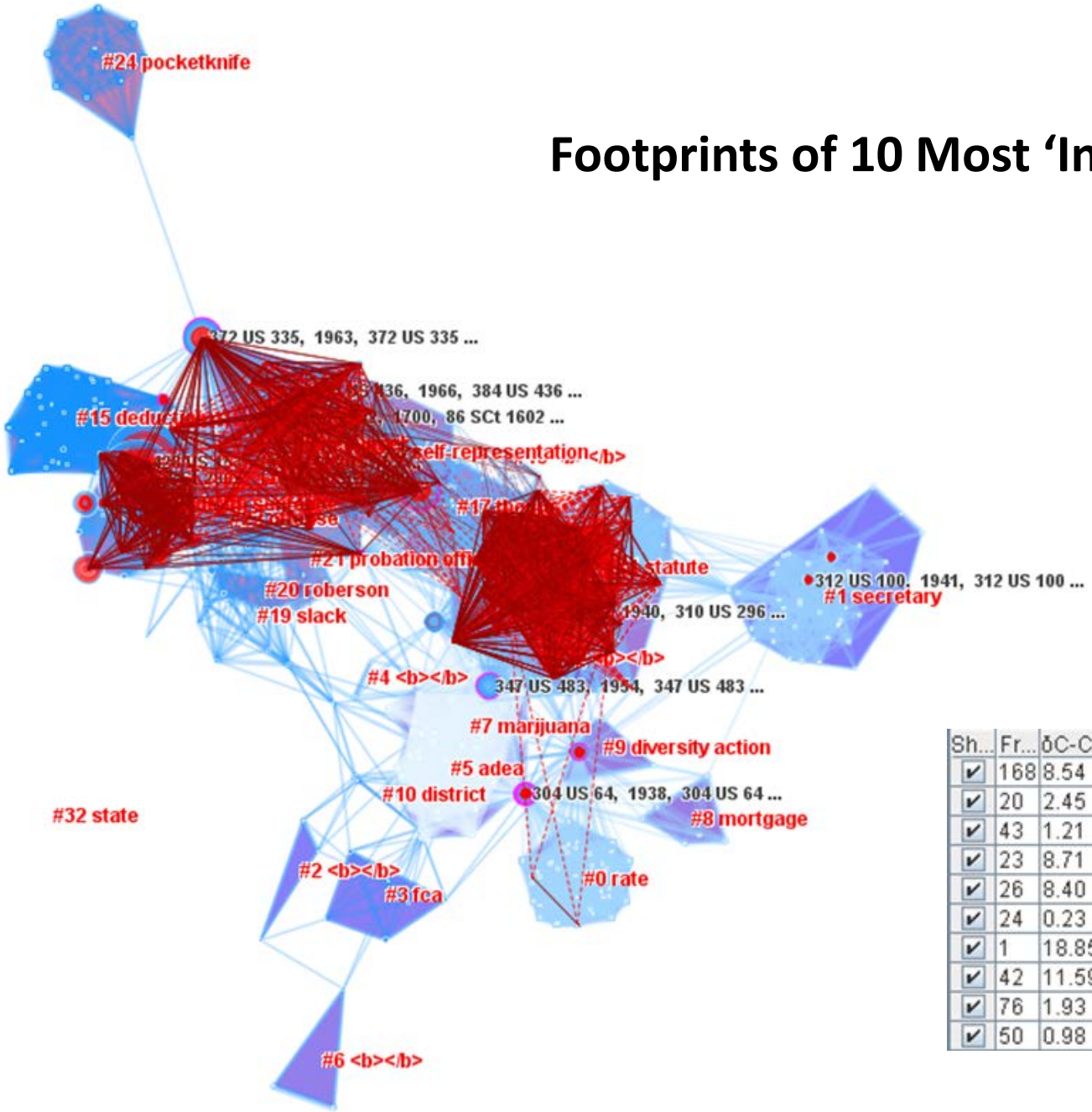
The ZINB model with more structural variation variables

Theta=0.3504 AIC(ZINB)=8146.052	Count model coefficients			Zero-inflation model		
Variables	IRR	z	p	IRR	z	P
Intercept	0.0001	-142.301	0.0000	0.1374	-4.146	0.0000
Local existing transformative links	1.1604	1.953	0.0508	0.6295	-0.290	0.7716
Local existing incremental links	1.0216	2.595	0.0095	0.0834	-2.371	0.0177
Local novel transformative links	0.9998	NA	NA	20.1540	2.103	0.0355
Local novel incremental links	1.0047	2.619	0.0088	0.4987	-1.771	0.0765
Modularity	1.0351	2.107	0.0351	0.0061	-1.818	0.0690
Cluster linkage	0.1379	NA	NA	0.0000	-1.938	0.0526
Centrality divergence	22.2186	3.399	0.0007	287.4846	2.189	0.0286

Landmark Cases



Footprints of 10 Most 'Influential' Cases

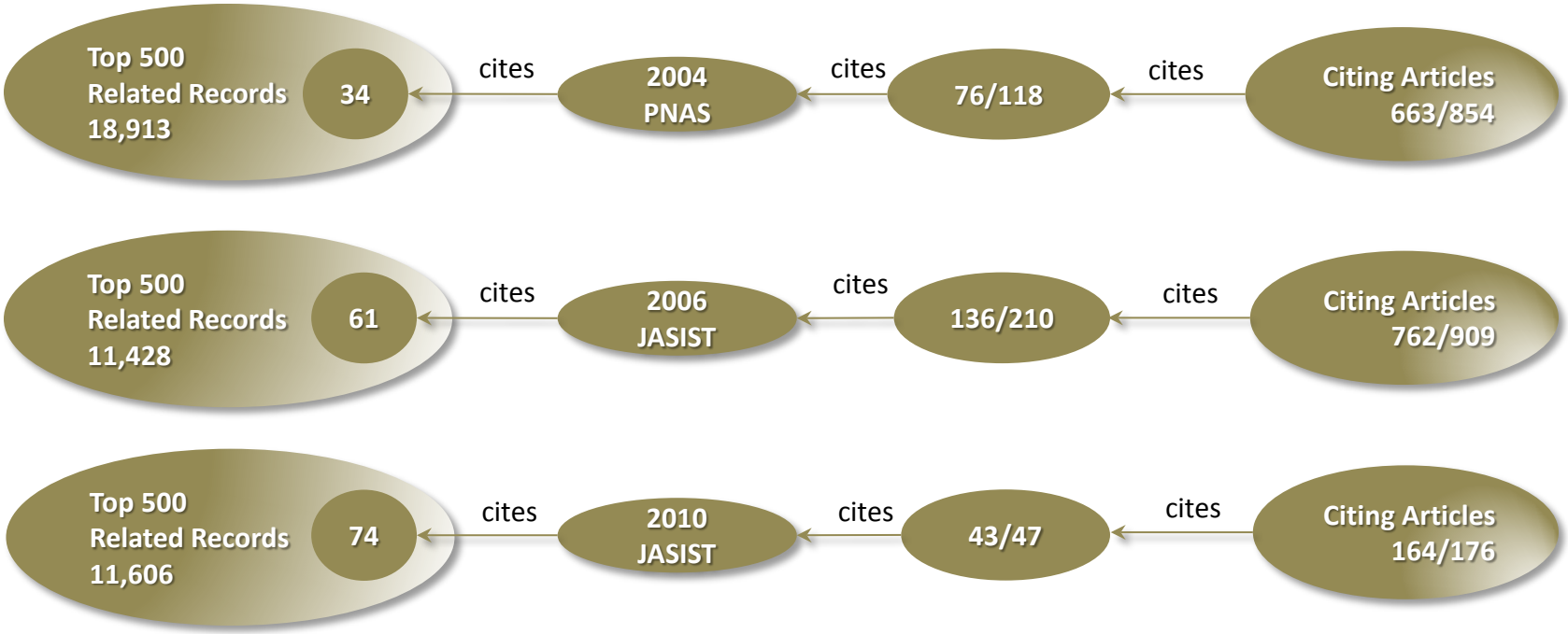


Sh...	Fr...	δC-C...	δC...	Year	Citing Articles
✔	168	8.54	0.05	1964	376 U.S. 254, 19...
✔	20	2.45	0.05	1984	467 U.S. 649, 19...
✔	43	1.21	0.05	1984	468 U.S. 447, 19...
✔	23	8.71	0.04	1984	465 U.S. 638, 19...
✔	26	8.40	0.04	1964	377 U.S. 288, 19...
✔	24	0.23	0.04	1944	322 U.S. 78, 194...
✔	1	18.85	0.03	1984	465 U.S. 1109, 1...
✔	42	11.59	0.03	1959	360 U.S. 109, 19...
✔	76	1.93	0.03	1969	395 U.S. 784, 19...
✔	50	0.98	0.03	1969	394 U.S. 576, 19...

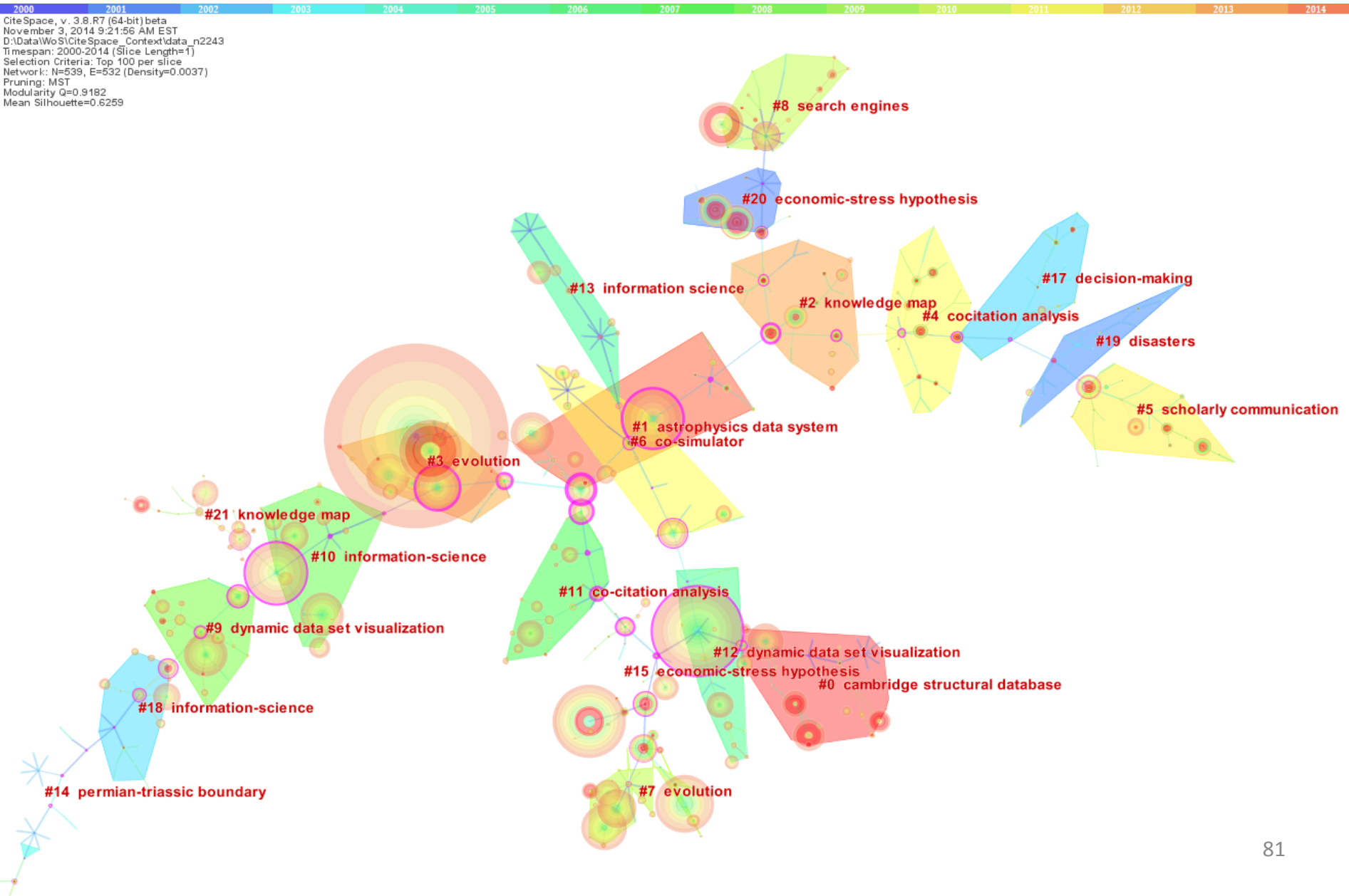
Structural Variations in the Context of CiteSpace

Data set: 2,243

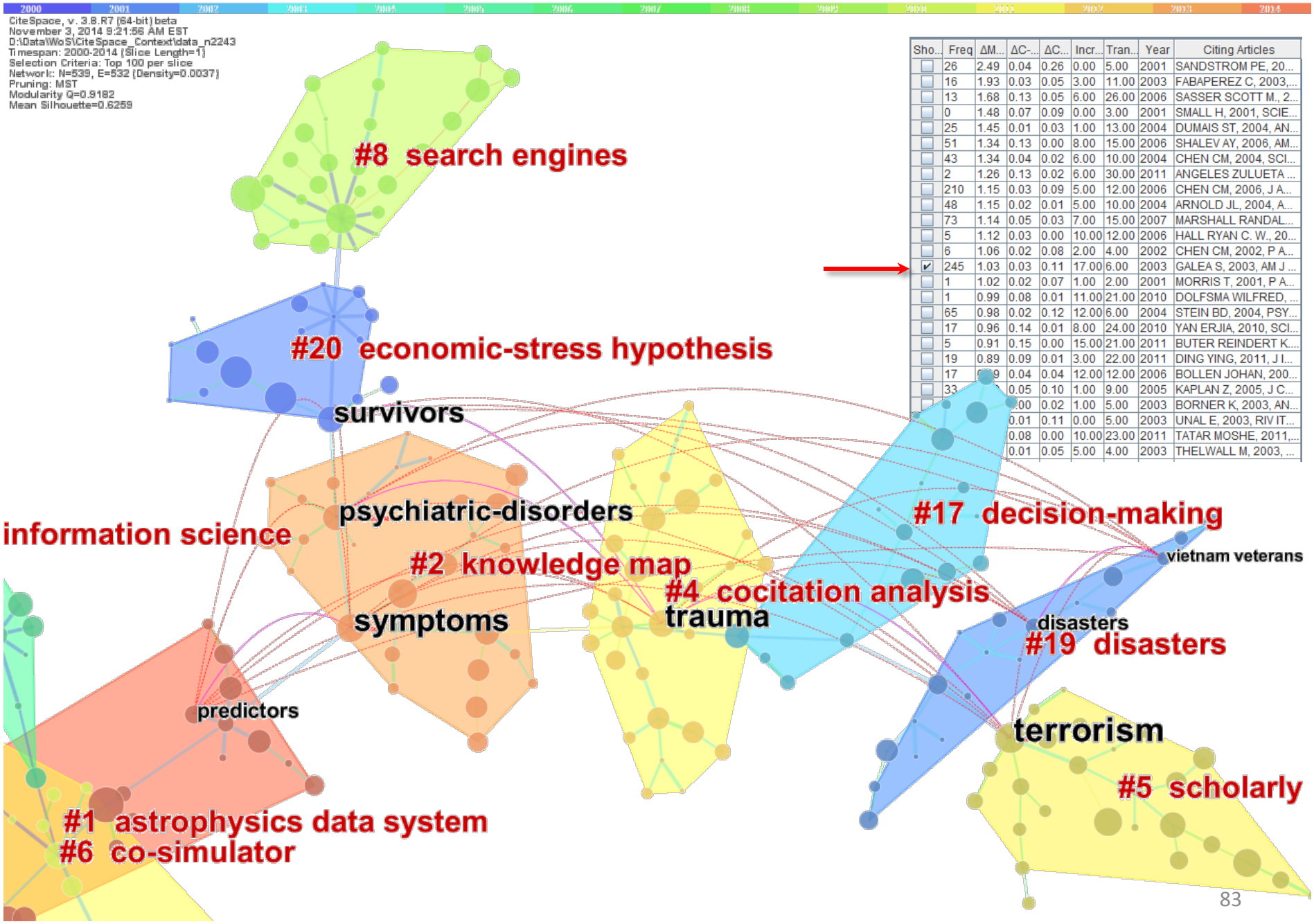
1. Keywords
2. Co-Cited References



A Network of Co-Occurring Keywords

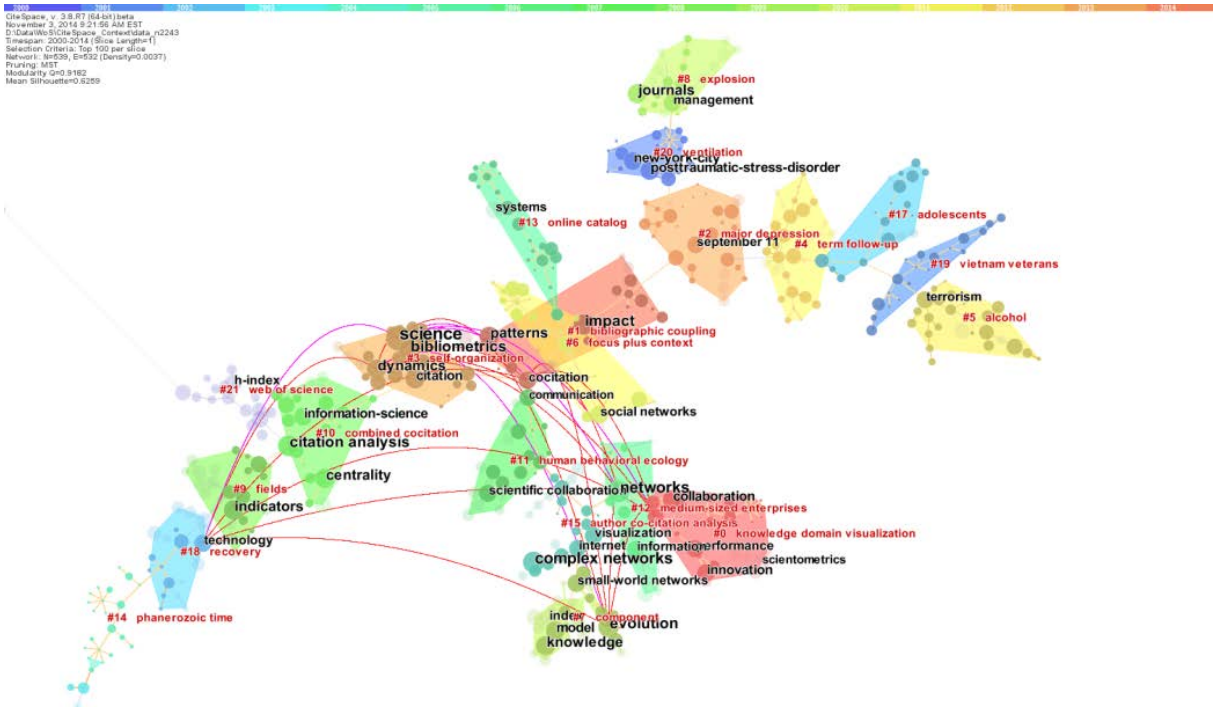


Cluster ID	Size	Silhouette	mean(Year)	Top Terms (tf*idf weighting)	Top Terms (log-likelihood ratio, p-level)	Terms (mutual information)
0	31	0.576	2002	(11.4) evolving network; (10.25) evolving scal...	kernel nonlinearity (26.25, 1.0E-4); heterogen...	quantifying structure
1	30	0.9	1995	(15.57) mass extinction; (15.44) large igneou...	mass extinction (200.02, 1.0E-4); large igneo...	haline
2	29	0.678	1997	(9.02) strength; (8.71) endorsement; (7.48) ci...	web search interface (23.59, 1.0E-4); utilizing...	text mining technique
3	28	0.757	1992	(14.19) using term co-occurrence analysis; (...	medical informatic (127.44, 1.0E-4); using ter...	negotiating authorship
4	27	0.63	2002	(9.02) commercialization gap; (9.02) solar cel...	tracking modularity (25.19, 1.0E-4); technolo...	new knowledge development
5	27	0.593	2005	(10.87) nanoscience; (9.98) network coheren...	interdisciplinarity (44.07, 1.0E-4); new tool (3...	text mining technique
6	26	0.627	1999	(7.59) interdisciplinarity; (7.45) nanoscience; ...	accounting focu (18.31, 1.0E-4); business et...	social processe
7	26	0.6	1997	(13.16) attack; (11.12) terrorist attack; (10.6) s...	terrorist attack (31.4, 1.0E-4); september (31....	metropolitan area
8	26	0.692	2000	(12.31) attack; (11.35) terrorist attack; (11.12) ...	terrorism (57.53, 1.0E-4); post-traumatic stre...	emergency department population
9	25	0.74	1999	(7.59) fundamental result; (7.59) network con...	scientific collaboration network (41.57, 1.0E-...	quantifying structure
10	24	0.58	1993	(10.25) book; (7.27) journal psychophysiolog...	three-level analysis (19.02, 1.0E-4); journal p...	emergent cognitive development
11	24	0.625	2004	(14.06) google scholar; (12.66) correlating cit...	google scholar (67.03, 1.0E-4); citation (61.7...	big bang theory
12	24	0.542	1997	(14.12) attack; (13.16) terrorist attack; (11.96) ...	terrorist attack (75.41, 1.0E-4); september (5...	metropolitan area
13	24	0.708	1999	(6.55) evolving hypernetwork model; (6.03) gr...	evolving hypernetwork model (12.99, 0.001); ...	link prediction
14	24	0.917	1995	(6.63) information retrieval; (3.58) web;	information retrieval (151.11, 1.0E-4); web (1...	web
15	22	0.715	1993	(8.58) three-level analysis; (6.55) citation stati...	three-level analysis (49.08, 1.0E-4); visualizat...	big bang theory
17	21	0.678	1986	(9.02) semantic network; (9.02) grammar-ba...	centrality measure (57.62, 1.0E-4); graph (44...	link prediction
16	21	0.731	1993	(15.63) navigation; (15.63) graph visualizatio...	navigation (113.22, 1.0E-4); graph visualizati...	co-citation context
19	21	0.658	1997	(1		
18	21	0.714	1995	(6		e policy context
21	20	0.688	1978	(9		ic surveillance
20	20	0.603	2002	(7		ape
22	19	0.579	1998	(7		ape
23	18	0.444	1997	(7		chnology co-author
24	16	0.875	1984	(1		on

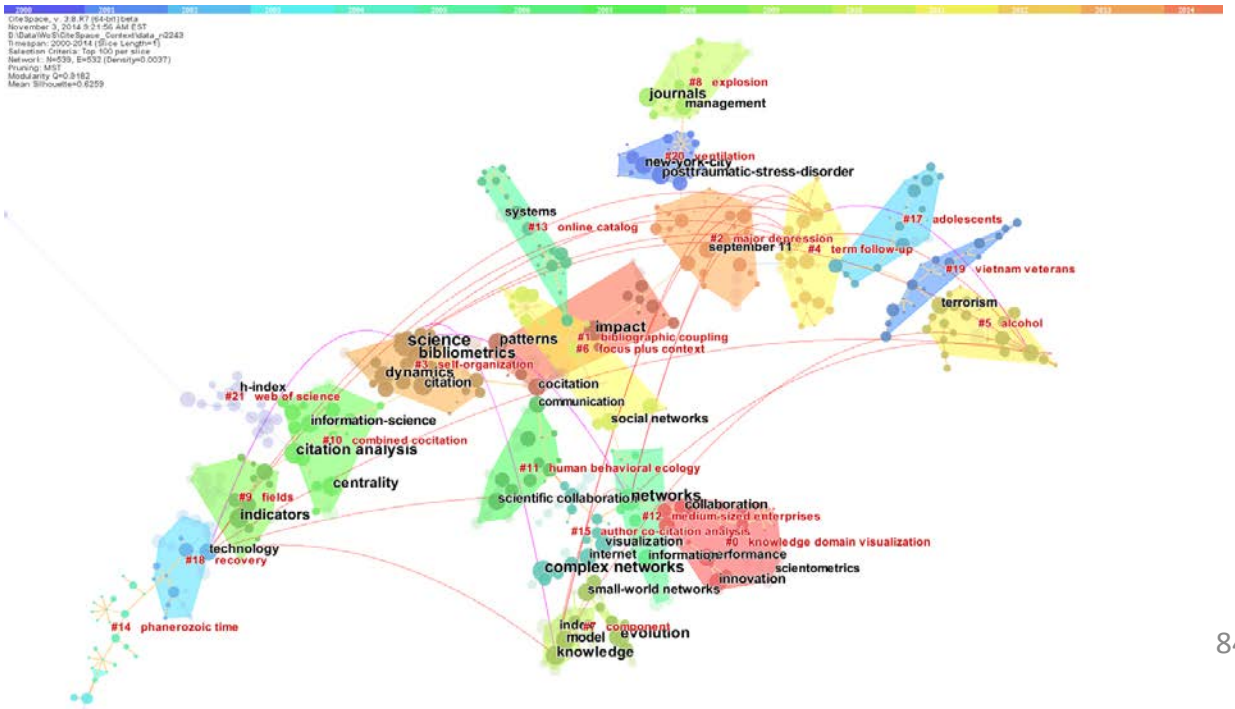


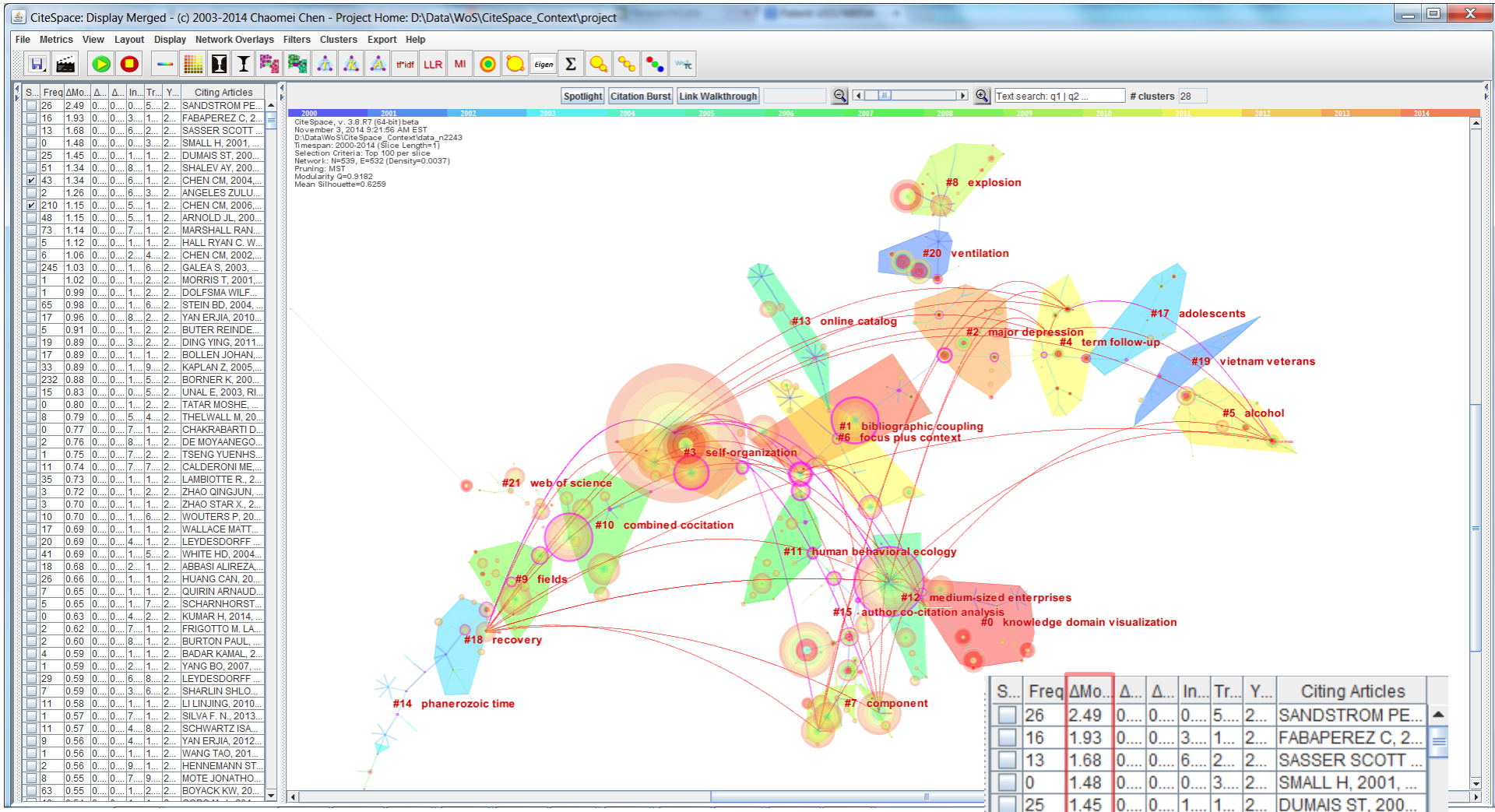
Sho...	Freq	ΔM...	ΔC-...	ΔC...	Incr...	Tran...	Year	Citing Articles
☐	26	2.49	0.04	0.26	0.00	5.00	2001	SANDSTROM PE, 20...
☐	16	1.93	0.03	0.05	3.00	11.00	2003	FABAPEREZ C, 2003,...
☐	13	1.68	0.13	0.05	6.00	26.00	2006	SASSER SCOTT M., 2...
☐	0	1.48	0.07	0.09	0.00	3.00	2001	SMALL H, 2001, SCIE...
☐	25	1.45	0.01	0.03	1.00	13.00	2004	DUMAIS ST, 2004, AN...
☐	51	1.34	0.13	0.00	8.00	15.00	2006	SHALEV AY, 2006, AM...
☐	43	1.34	0.04	0.02	6.00	10.00	2004	CHEN CM, 2004, SCI...
☐	2	1.26	0.13	0.02	6.00	30.00	2011	ANGELES ZULUETA ...
☐	210	1.15	0.03	0.09	5.00	12.00	2006	CHEN CM, 2006, J A...
☐	48	1.15	0.02	0.01	5.00	10.00	2004	ARNOLD JL, 2004, A...
☐	73	1.14	0.05	0.03	7.00	15.00	2007	MARSHALL RANDAL...
☐	5	1.12	0.03	0.00	10.00	12.00	2006	HALL RYAN C. W., 20...
☐	6	1.06	0.02	0.08	2.00	4.00	2002	CHEN CM, 2002, P A...
☑	245	1.03	0.03	0.11	17.00	6.00	2003	GALEA S, 2003, AM J ...
☐	1	1.02	0.02	0.07	1.00	2.00	2001	MORRIS T, 2001, P A...
☐	1	0.99	0.08	0.01	11.00	21.00	2010	DOLFSMA WILFRED, ...
☐	65	0.98	0.02	0.12	12.00	6.00	2004	STEIN BD, 2004, PSY...
☐	17	0.96	0.14	0.01	8.00	24.00	2010	YAN ERJIA, 2010, SCI...
☐	5	0.91	0.15	0.00	15.00	21.00	2011	BUTER REINDERT K....
☐	19	0.89	0.09	0.01	3.00	22.00	2011	DING YING, 2011, J I...
☐	17	[illegible]	0.04	0.04	12.00	12.00	2006	BOLLEN JOHAN, 200...
☐	33	[illegible]	0.05	0.10	1.00	9.00	2005	KAPLAN Z, 2005, J C...
☐	[illegible]	[illegible]	[illegible]	0.02	1.00	5.00	2003	BORNER K, 2003, AN...
☐	[illegible]	[illegible]	0.01	0.11	0.00	5.00	2003	UNAL E, 2003, RIV IT...
☐	[illegible]	[illegible]	0.08	0.00	10.00	23.00	2011	TATAR MOSHE, 2011,...
☐	[illegible]	[illegible]	0.01	0.05	5.00	4.00	2003	THELWALL M, 2003, ...

2004 PNAS



2006 JASIST

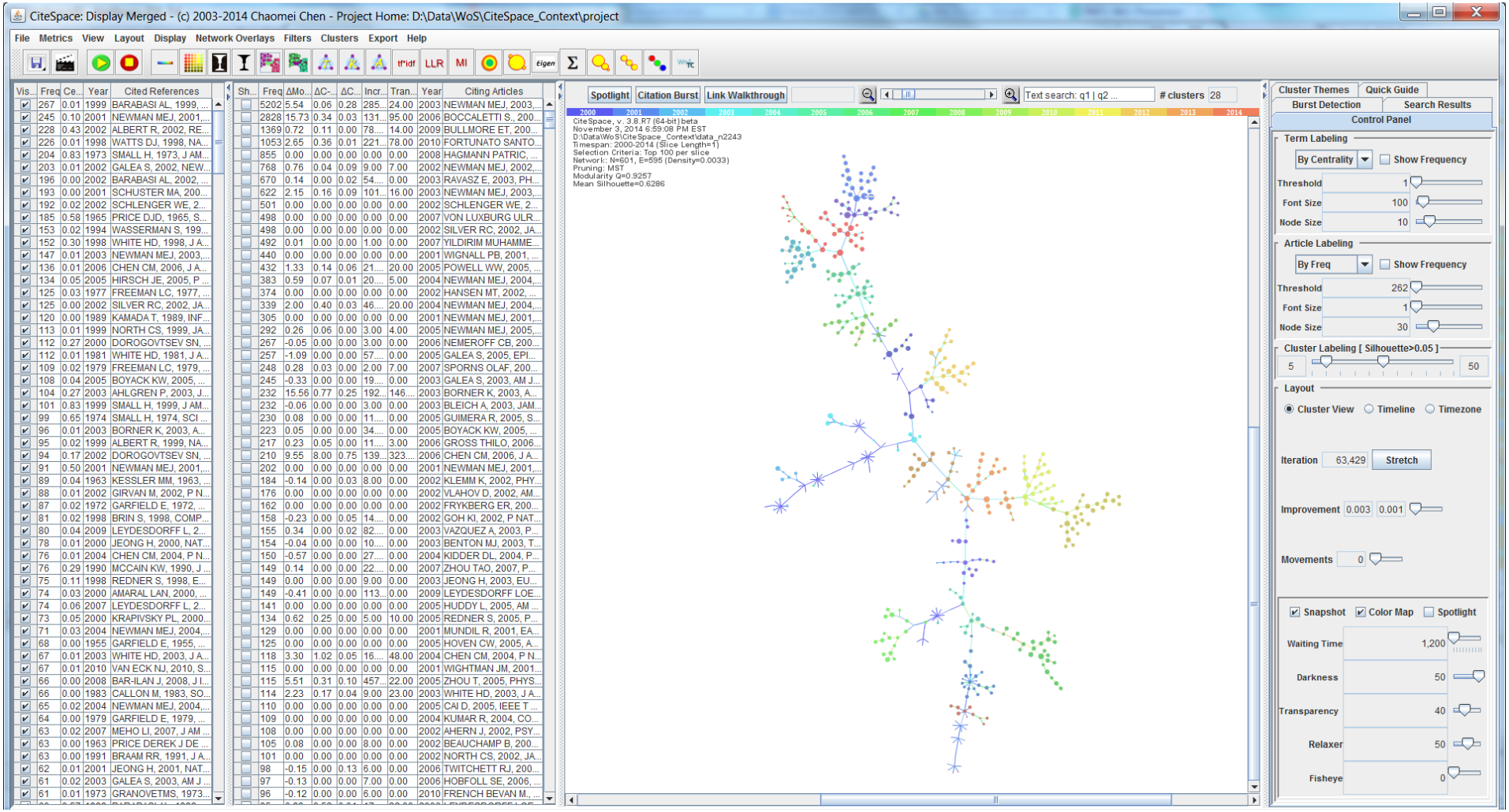


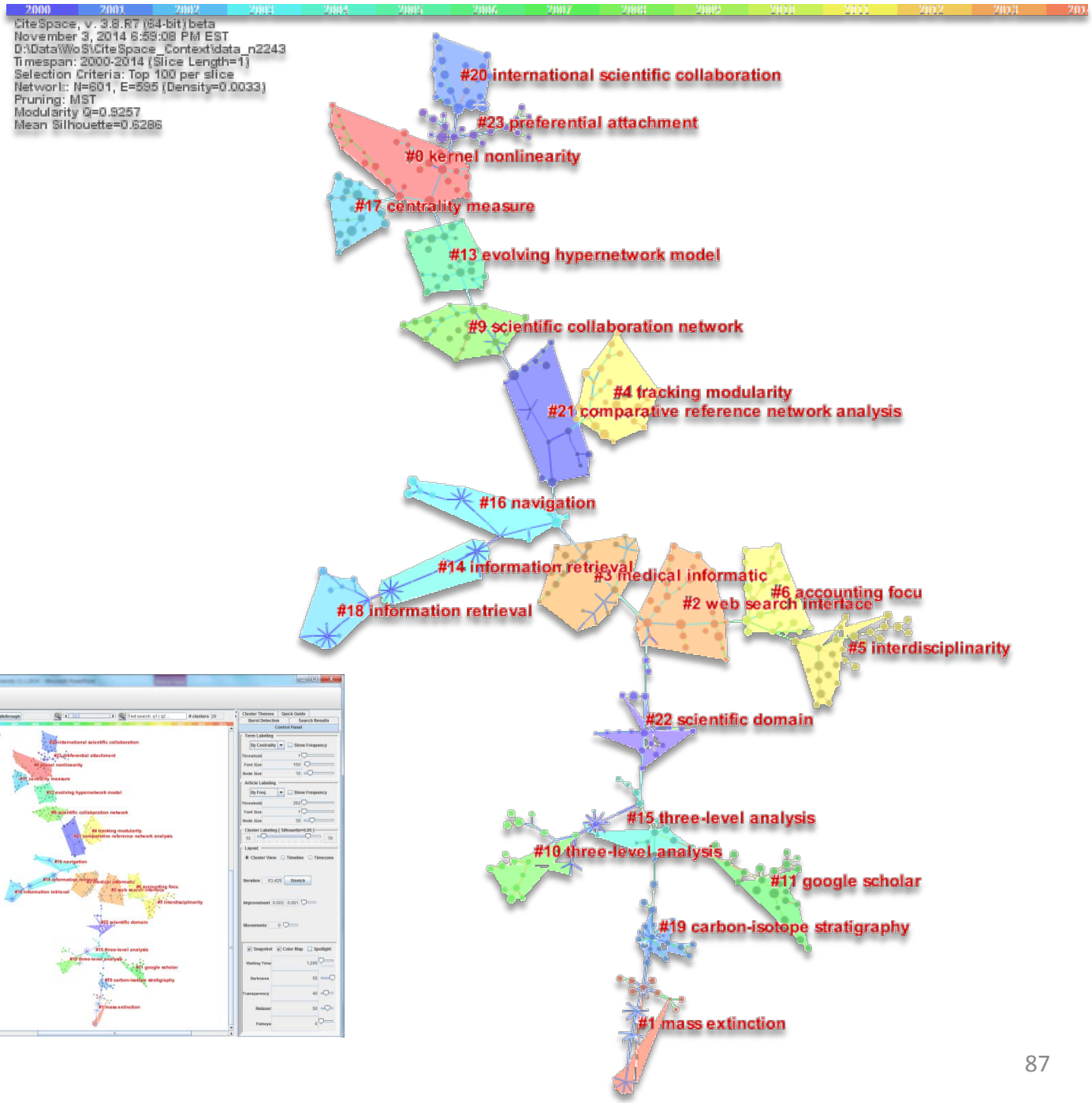


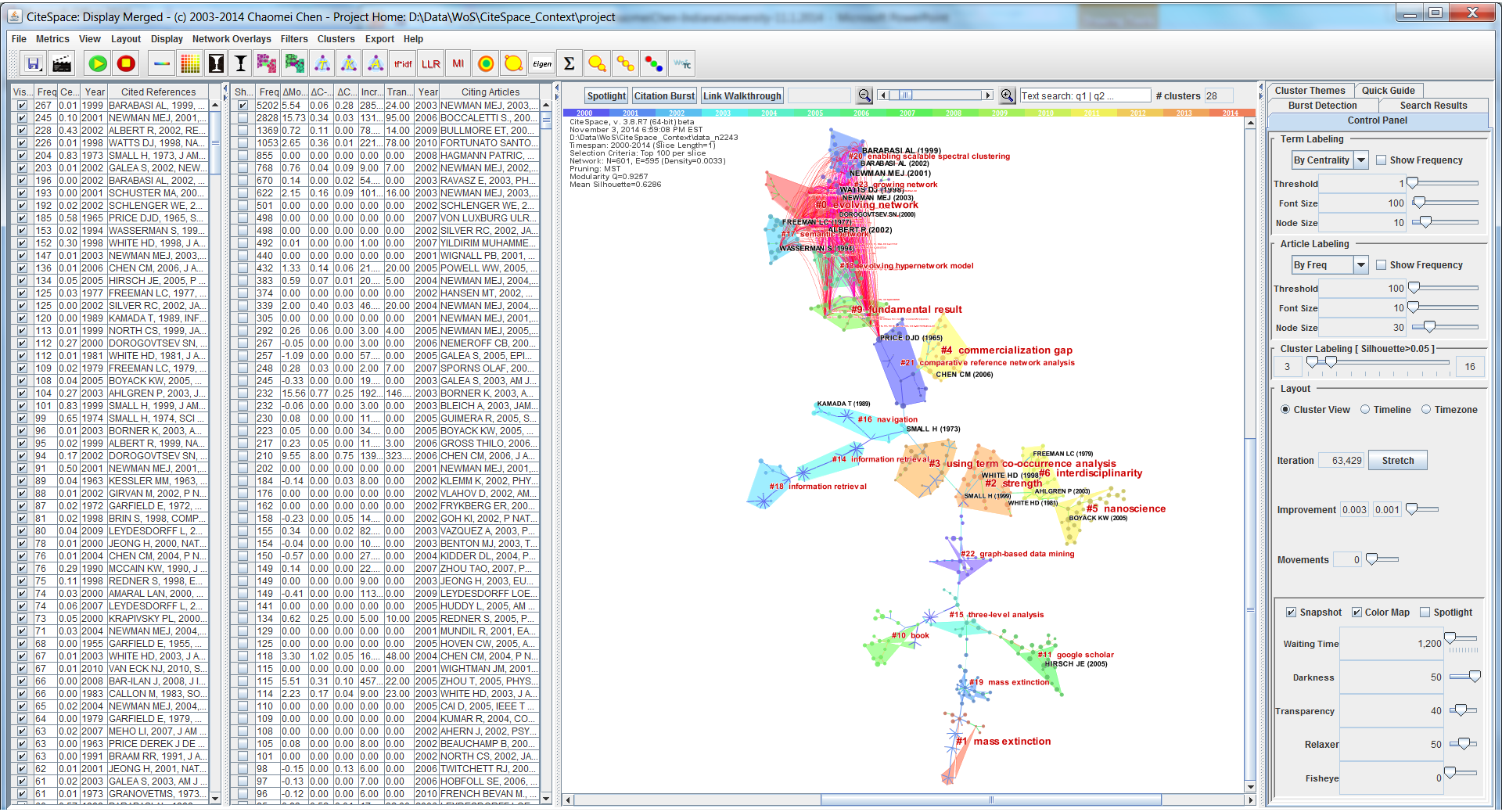
S...	Freq	ΔMo...	Δ...	Δ...	In...	Tr...	Y...	Citing Articles
☐	26	2.49	0....	0....	0....	5....	2...	SANDSTROM PE...
☐	16	1.93	0....	0....	3....	1...	2...	FABAPEREZ C, 2...
☐	13	1.68	0....	0....	6....	2...	2...	SASSER SCOTT ...
☐	0	1.48	0....	0....	0....	3....	2...	SMALL H, 2001, ...
☐	25	1.45	0....	0....	1....	1...	2...	DUMAIS ST, 200...
☐	51	1.34	0....	0....	8....	1...	2...	SHALEV AY, 200...
☑	43	1.34	0....	0....	6....	1...	2...	CHEN CM, 2004,...
☐	2	1.26	0....	0....	6....	3...	2...	ANGELES ZULU...
☑	210	1.15	0....	0....	5....	1...	2...	CHEN CM, 2006,...
☐	48	1.15	0....	0....	5....	1...	2...	ARNOLD JL, 200...
☐	73	1.14	0....	0....	7....	1...	2...	MARSHALL RAN...
☐	5	1.12	0....	0....	1....	1...	2...	HALL RYAN C. W...
☐	6	1.06	0....	0....	2....	4....	2...	CHEN CM, 2002,...
☐	245	1.03	0....	0....	1....	6....	2...	GALEA S, 2003,...
☐	1	1.02	0....	0....	1....	2....	2...	MORRIS T, 2001,...

2004 PNAS + 2006 JASIST

A Network of Co-Cited References




2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
CiteSpace, v. 3.8.R7 (64-bit) beta
November 3, 2014 8:59:08 PM EST
D:\Data\WoS\CiteSpace_Context\data_n2243
Timespan: 2000-2014 (Slice Length=1)
Selection Criteria: Top 100 per slice
Network: N=601, E=595 (Density=0.0033)
Pruning: MST
Modularity Q=0.9257
Mean Silhouette=0.6286
#20 international scientific collaboration
#23 preferential attachment
#0 kernel nonlinearity
#17 centrality measure
#13 evolving hypernetwork model
#9 scientific collaboration network
#4 tracking modularity
#21 comparative reference network analysis
#16 navigation
#14 information retrieval
#18 information retrieval
#3 medical informatic
#6 accounting focu
#2 web search interface
#5 interdisciplinarity
#22 scientific domain
#15 three-level analysis
#10 three-level analysis
#11 google scholar
#19 carbon-isotope stratigraphy
#1 mass extinction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File Metrics View Layout Display Network Overlays Filters Clusters Export Help
Spotlight
Citation Burst
Link Walkthrough
Text search: q1 | q2 ...
clusters 28
CiteSpace, v. 3.8.R7 (64-bit) beta
November 3, 2014 6:59:08 PM EST
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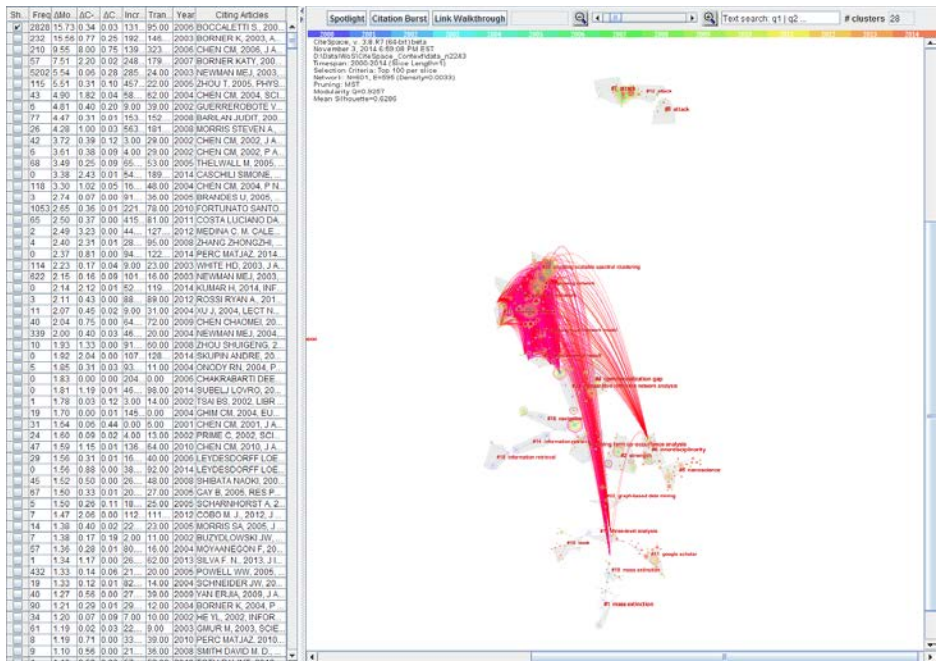
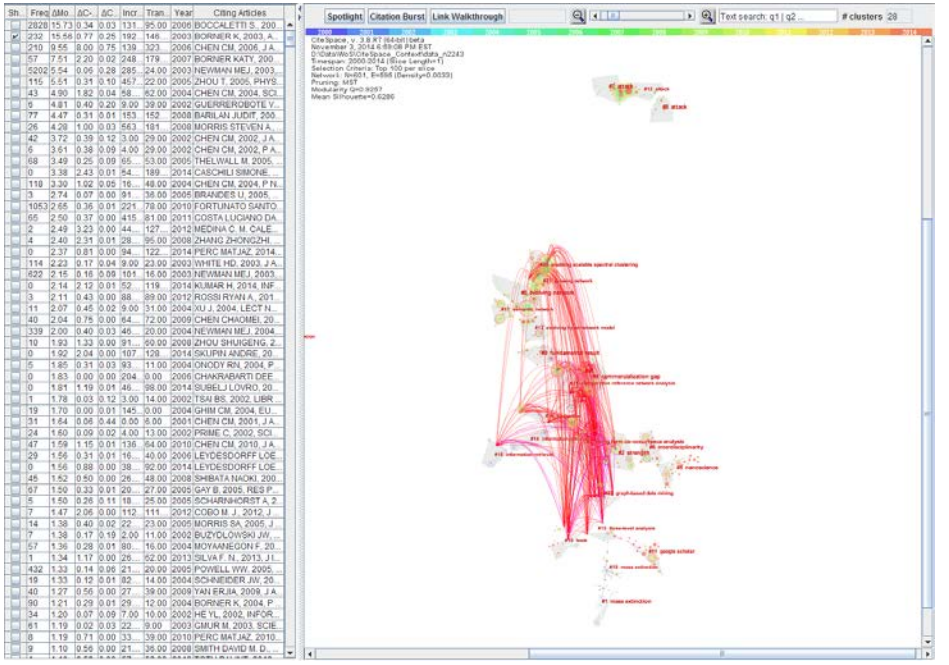
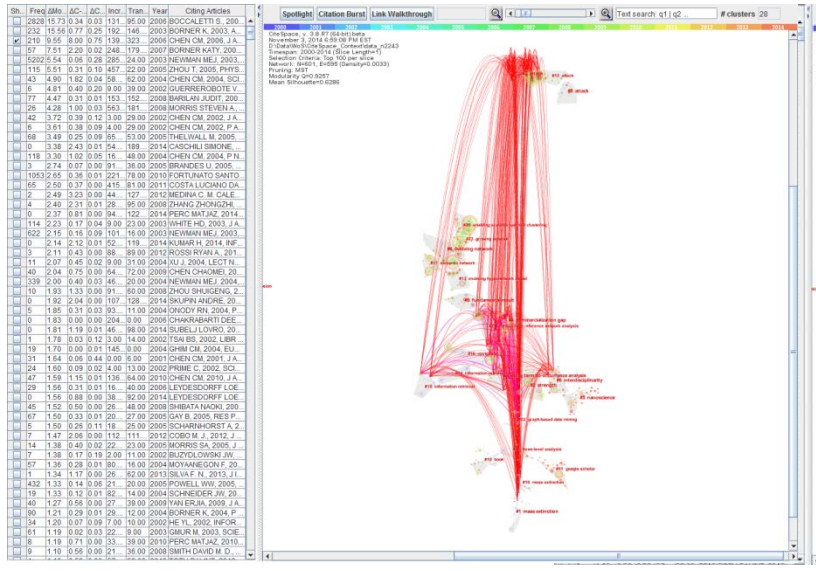
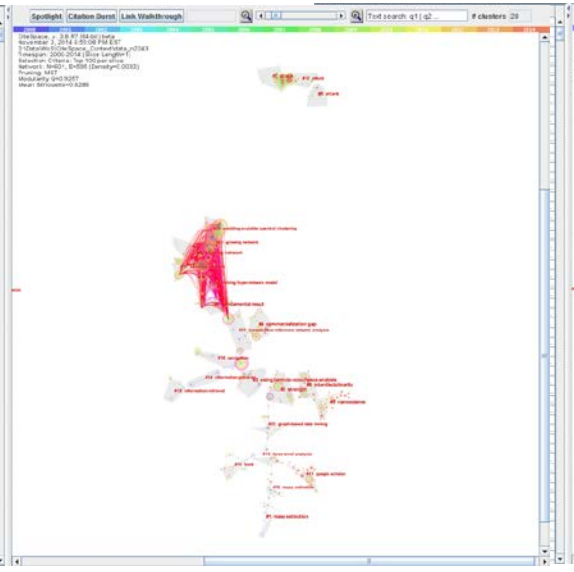
Timespan: 2000-2014 (Slice Length=1)
Selection Criteria: Top 100 per slice
Network: N=801, E=595 (Density=0.0033)
Pruning: MST
Modularity Q=0.9257
Mean Silhouette=0.6286
BARABASI AL (1999)
#20 enabling scalable spectral clustering
BARABASI AL (2002)
NEWMAN MEJ (2001)
#23 growing network
WATTS DJ (1998)
NEWMAN MEJ (2003)
#0 evolving network
DOROGOVTSEV SN (2000)
FREEMAN LC (1977)
ALBERT R (2002)
#17 semantic network
WASSERMAN S (1994)
#18 evolving hypernetwork model
#9 fundamental result
PRICE DJD (1965)
#4 commercialization gap
#21 comparative reference network analysis
CHEN CM (2006)
KAMADA T (1989)
#16 navigation
SMALL H (1973)
#14 information retrieval
#18 information retrieval
#3 using term co-occurrence analysis
FREEMAN LC (1979)
WHITE HD (1998)
#6 interdisciplinarity
#2 strength
AHLGREN P (2003)
SMALL H (1999)
WHITE HD (1981)
#5 nanoscience
BOYACK KW (2005)
#22 graph-based data mining
#15 three-level analysis
#10 book
#11 google scholar
HIRSCH JE (2005)
#19 mass extinction
#1 mass extinction
Cluster Themes
Quick Guide
Burst Detection
Search Results
Control Panel
Term Labeling
By Centrality
Show Frequency
Threshold 1
Font Size 100
Node Size 10
Article Labeling
By Freq
Show Frequency
Threshold 100
Font Size 10
Node Size 30
Cluster Labeling [Silhouette>0.05]
3
16
Layout
Cluster View
Timeline
Timezone
Iteration 63,429
Stretch
Improvement 0.003 0.001
Movements 0
Snapshot
Color Map
Spotlight
Waiting Time 1,200
Darkness 50
Transparency 40
Relaxer 50
Fisheye 0

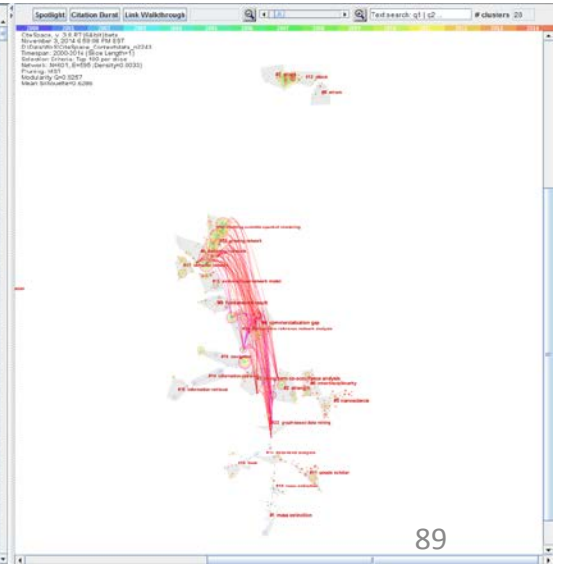
Modularity Change Rate











Sho...	Freq	ΔMod...	ΔC-...	ΔCe...	Increm...	Transf...	Year	Citing Articles
	5202	5.54	0.06	0.28	285.00	24.00	2003	NEWMAN MEJ, 2003, ...
	2828	15.73	0.34	0.03	1311.00	95.00	2006	BOCCALETTI S., 200...
	1369	0.72	0.11	0.00	78.00	14.00	2009	BULLMORE ET, 2009...
	1053	2.65	0.36	0.01	221.00	78.00	2010	FORTUNATO SANTO,...
	855	0.00	0.00	0.00	0.00	0.00	2008	HAGMANN PATRIC, 2...
	768	0.76	0.04	0.09	9.00	7.00	2002	NEWMAN MEJ, 2002, ...
	670	0.14	0.00	0.02	54.00	0.00	2003	RAVASZ E, 2003, PHY...
	622	2.15	0.16	0.09	101.00	16.00	2003	NEWMAN MEJ, 2003, ...
	501	0.00	0.00	0.00	0.00	0.00	2002	SCHLENGER WE, 20...
	498	0.00	0.00	0.00	0.00	0.00	2007	VON LUXBURG ULRI...
	498	0.00	0.00	0.00	0.00	0.00	2002	SILVER RC, 2002, JA...

Sh...	Freq	ΔMo...	ΔC-...	ΔC...	Incr...	Tran...	Year	Citing Articles
	210	9.55	8.00	0.75	139....	323....	2006	CHEN CM, 2006, J A...
	31	1.64	0.06	0.44	0.00	6.00	2001	CHEN CM, 2001, J A...
	0	0.89	0.03	0.34	0.00	3.00	2001	MORRIS TA, 2001, J ...
	1	0.89	0.02	0.34	0.00	3.00	2001	MORRIS T, 2001, P A...
	26	0.89	0.01	0.34	0.00	3.00	2001	SANDSTROM PE, 20...
	10	0.29	0.01	0.31	0.00	1.00	2001	JARNEVING B, 2001,...
	32	0.29	0.00	0.31	0.00	1.00	2001	NOYONS E, 2001, S...
	3	0.29	0.00	0.31	0.00	1.00	2001	MEGHABGHAB G, 20...
	11	0.13	0.00	0.30	0.00	2.00	2004	CHEN J, 2004, IOWA...
	5202	5.54	0.06	0.28	285....	24.00	2003	NEWMAN MEJ, 2003,...

Sh...	Freq	ΔMo...	ΔC-...	ΔC...	Incre...	Trans...	Year	Citing Articles
	2828	15.73	0.34	0.03	1311....	95.00	2006	BOCCALETTI S., ...
	232	15.56	0.77	0.25	192.00	146.00	2003	BORNER K, 200...
	210	9.55	8.00	0.75	139.00	323.00	2006	CHEN CM, 2006,...
	57	7.51	2.20	0.02	248.00	179.00	2007	BORNER KATY, ...
	5202	5.54	0.06	0.28	285.00	24.00	2003	NEWMAN MEJ, 2...
	115	5.51	0.31	0.10	457.00	22.00	2005	ZHOU T, 2005, P...
	43	4.90	1.82	0.04	58.00	62.00	2004	CHEN CM, 2004,...
	6	4.81	0.40	0.20	9.00	39.00	2002	GUERREROBOT...
	77	4.47	0.31	0.01	153.00	152.00	2008	BARILAN JUDIT, ...
	26	4.28	1.00	0.03	563.00	181.00	2008	MORRIS STEVE...

Sh...	Freq	ΔMo...	ΔC-...	ΔC...	Increm...	Tran...	Year	Citing Articles
	2828	15.73	0.34	0.03	1311.00	95.00	2006	BOCCALETTI S., ...
	26	4.28	1.00	0.03	563.00	181....	2008	MORRIS STEVEN...
	115	5.51	0.31	0.10	457.00	22.00	2005	ZHOU T, 2005, P...
	65	2.50	0.37	0.00	415.00	81.00	2011	COSTA LUCIANO ...
	5	-0.43	0.00	0.01	317.00	0.00	2010	VARGASQUESAD...
	5202	5.54	0.06	0.28	285.00	24.00	2003	NEWMAN MEJ, 20...
	57	7.51	2.20	0.02	248.00	179....	2007	BORNER KATY, 2...
	1053	2.65	0.36	0.01	221.00	78.00	2010	FORTUNATO SA...
	0	1.83	0.00	0.00	204.00	0.00	2006	CHAKRABARTI D...
	2	-0.54	0.00	0.01	201.00	0.00	2013	LEYDESDORFF L...

Sh...	Freq	ΔMo...	ΔC-...	ΔC...	Incr...	Tran...	Year	Citing Articles
	210	9.55	8.00	0.75	139....	323....	2006	CHEN CM, 2006, J A...
	2	2.49	3.23	0.00	44....	127....	2012	MEDINA C. M. CALE...
	0	3.38	2.43	0.01	54....	189....	2014	CASCHILI SIMONE, ...
	4	2.40	2.31	0.01	28....	95.00	2008	ZHANG ZHONGZHI, ...
	57	7.51	2.20	0.02	248....	179....	2007	BORNER KATY, 200...
	0	2.14	2.12	0.01	52....	119....	2014	KUMAR H, 2014, INF...
	7	1.47	2.06	0.00	112....	111....	2012	COBO M. J., 2012, J ...
	0	1.92	2.04	0.00	107....	128....	2014	SKUPIN ANDRE, 20...
	43	4.90	1.82	0.04	58....	62.00	2004	CHEN CM, 2004, SCI...
	10	1.93	1.33	0.00	91....	60.00	2008	ZHOU SHUIGENG, 2...

Sh...	Freq	ΔMo...	ΔC-...	ΔC...	Incre...	Trans...	Year	Citing Articles
	210	9.55	8.00	0.75	139.00	323.00	2006	CHEN CM, 2006,...
	0	3.38	2.43	0.01	54.00	189.00	2014	CASCHILI SIMO...
	26	4.28	1.00	0.03	563.00	181.00	2008	MORRIS STEVE...
	57	7.51	2.20	0.02	248.00	179.00	2007	BORNER KATY, ...
	77	4.47	0.31	0.01	153.00	152.00	2008	BARILAN JUDIT, ...
	232	15.56	0.77	0.25	192.00	146.00	2003	BORNER K, 200...
	0	1.92	2.04	0.00	107.00	128.00	2014	SKUPIN ANDRE,...
	2	2.49	3.23	0.00	44.00	127.00	2012	MEDINA C. M. CA...
	0	2.37	0.81	0.00	94.00	122.00	2014	PERC MATJAZ, 2...
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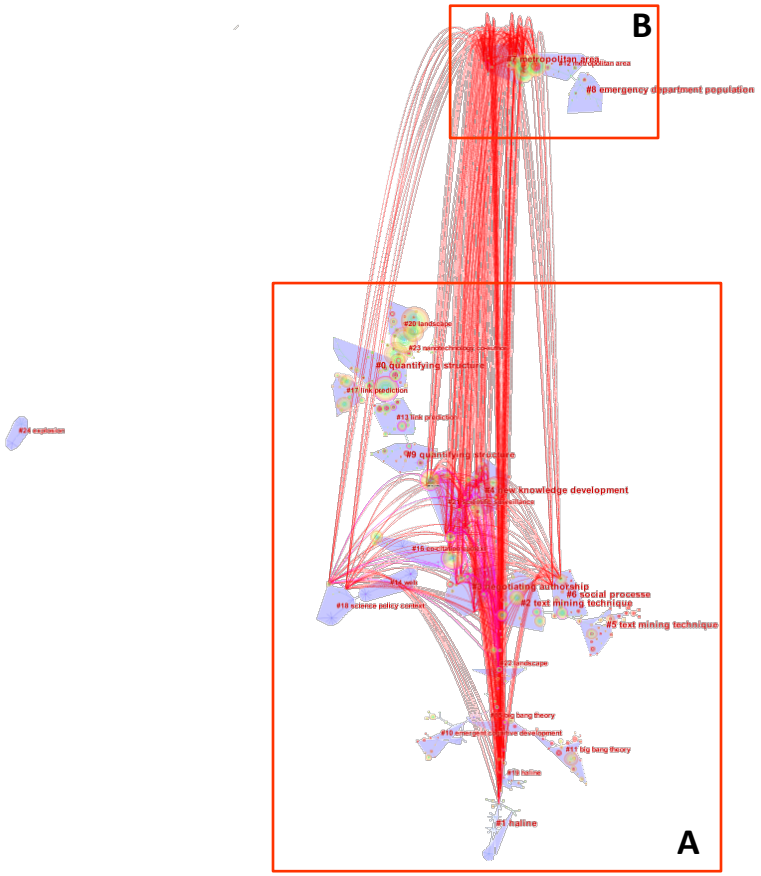
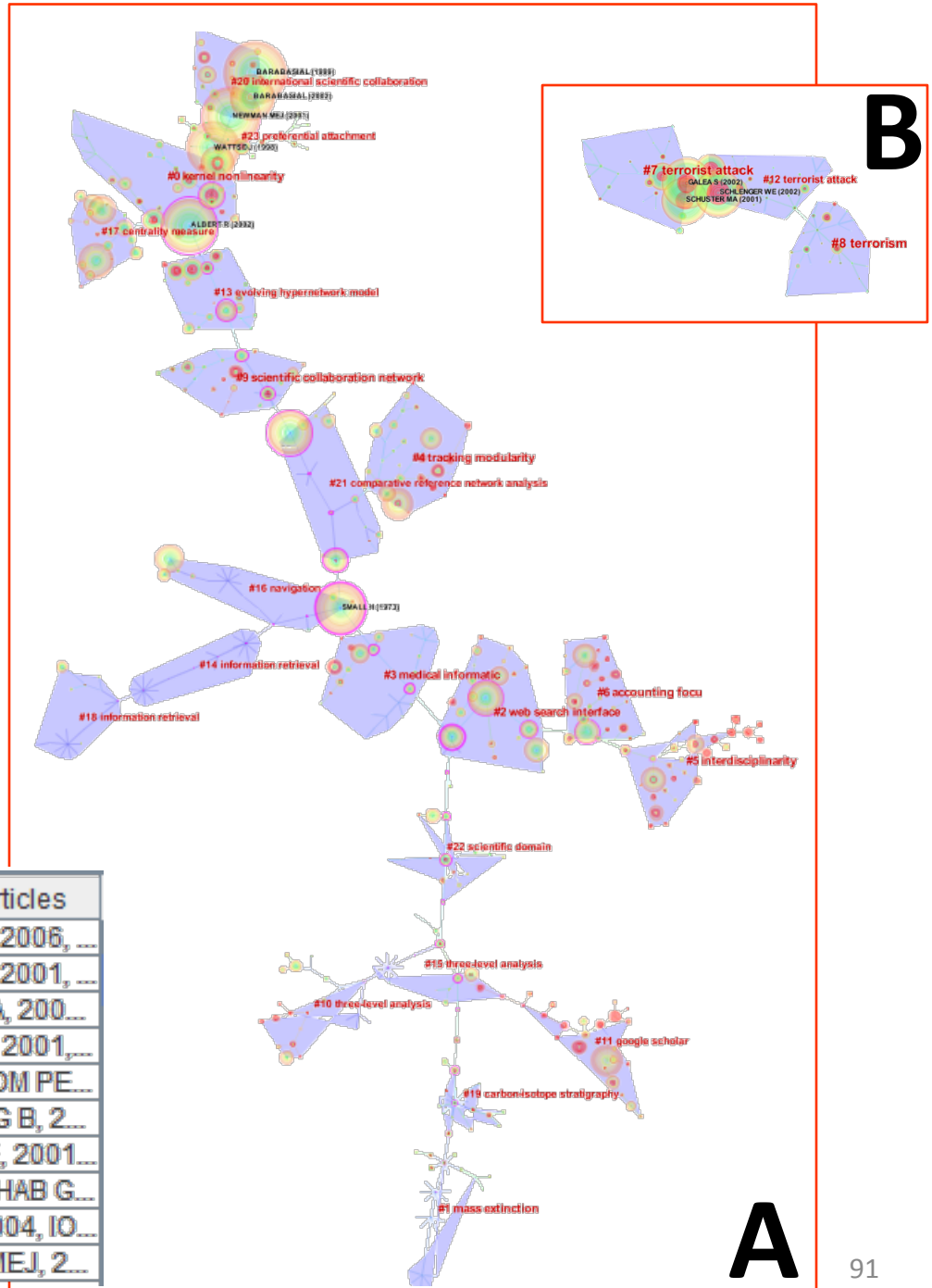
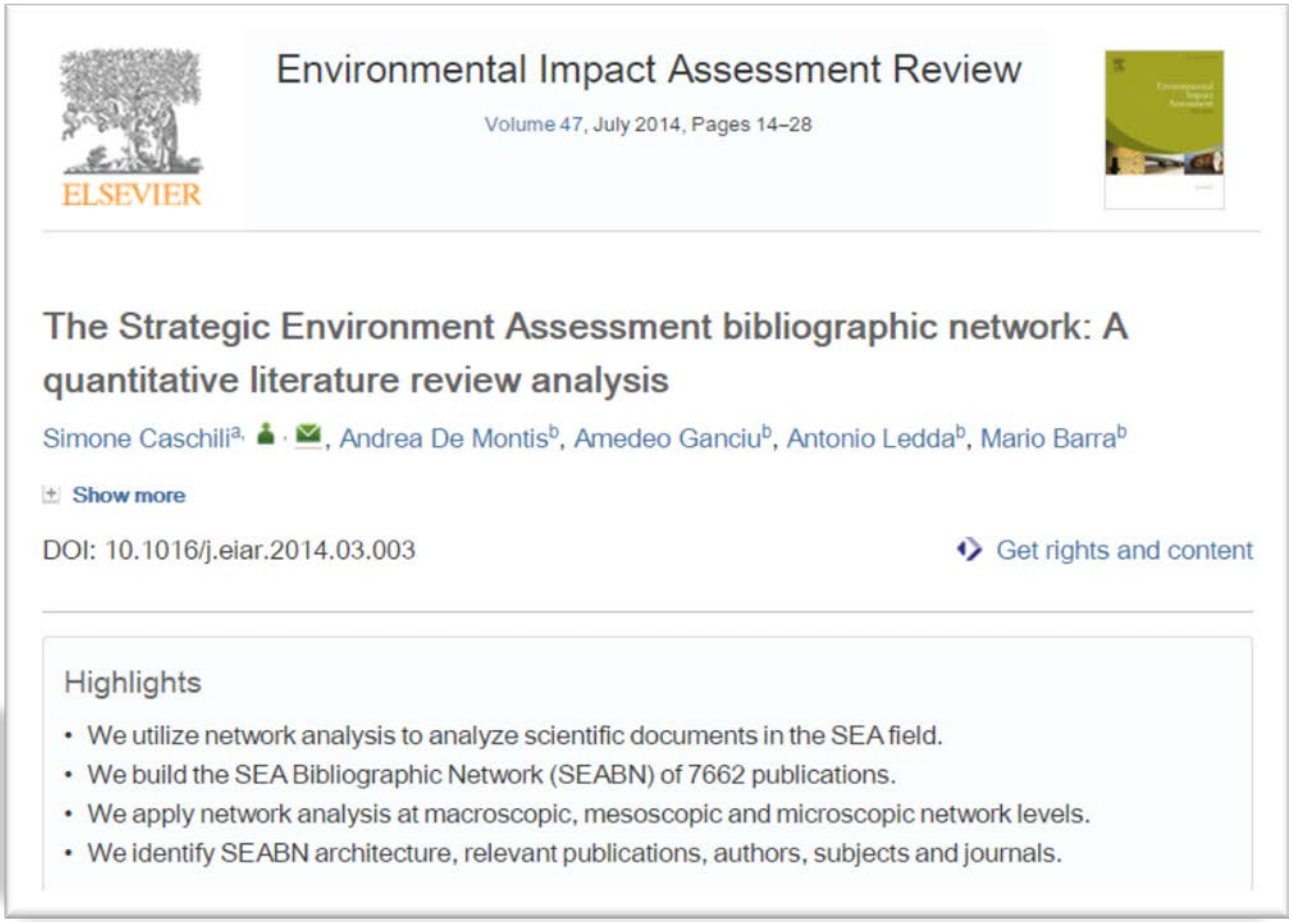




Sh...	Freq	ΔM...	ΔC...	ΔC...	Incre...	Tra...	Year	Citing Articles
✔	210	9.55	8.00	0.75	139....	323....	2006	CHEN CM, 2006, ...
	31	1.64	0.06	0.44	0.00	6.00	2001	CHEN CM, 2001, ...
	0	0.89	0.03	0.34	0.00	3.00	2001	MORRIS TA, 200...
	1	0.89	0.02	0.34	0.00	3.00	2001	MORRIS T, 2001,...
	26	0.89	0.01	0.34	0.00	3.00	2001	SANDSTROM PE...
	10	0.29	0.01	0.31	0.00	1.00	2001	JARNEVING B, 2...
	32	0.29	0.00	0.31	0.00	1.00	2001	NOYONS E, 2001...
	3	0.29	0.00	0.31	0.00	1.00	2001	MEGHABGHAB G...
	11	0.13	0.00	0.30	0.00	2.00	2004	CHEN J, 2004, IO...
	5202	5.54	0.06	0.28	285....	24....	2003	NEWMAN MEJ, 2...

Sh...	Freq	ΔMo...	ΔC-...	ΔC...	Incr...	Tran...	Year	Citing Articles
	210	9.55	8.00	0.75	139...	323....	2006	CHEN CM, 2006, J A...
	2	2.49	3.23	0.00	44....	127....	2012	MEDINA C. M. CALE...
	0	3.38	2.43	0.01	54....	189....	2014	CASCHILI SIMONE, ...
	4	2.40	2.31	0.01	28....	95.00	2008	ZHANG ZHONGZHI, ...
	57	7.51	2.20	0.02	248...	179....	2007	BORNER KATY, 200...
	0	2.14	2.12	0.01	52....	119....	2014	KUMAR H, 2014, INF...
	7	1.47	2.06	0.00	112...	111....	2012	COBO M. J., 2012, J ...
	0	1.92	2.04	0.00	107...	128....	2014	SKUPIN ANDRE, 20...
	43	4.90	1.82	0.04	58....	62.00	2004	CHEN CM, 2004, SCI...
	10	1.93	1.33	0.00	91....	60.00	2008	ZHOU SHUIGENG, 2...

Sh...	Freq	ΔMo...	ΔC-...	ΔC...	Incre...	Trans...	Year	Citing Articles
	210	9.55	8.00	0.75	139.00	323.00	2006	CHEN CM, 2006,...
	0	3.38	2.43	0.01	54.00	189.00	2014	CASCHILI SIMO...
	26	4.28	1.00	0.03	563.00	181.00	2008	MORRIS STEVE...
	57	7.51	2.20	0.02	248.00	179.00	2007	BORNER KATY, ...
	77	4.47	0.31	0.01	153.00	152.00	2008	BARILAN JUDIT, ...
	232	15.56	0.77	0.25	192.00	146.00	2003	BORNER K, 200...
	0	1.92	2.04	0.00	107.00	128.00	2014	SKUPIN ANDRE,...
	2	2.49	3.23	0.00	44.00	127.00	2012	MEDINA C. M. CA...
	0	2.37	0.81	0.00	94.00	122.00	2014	PERC MATJAZ, 2...
	0	2.14	2.12	0.01	52.00	119.00	2014	KUMAR H, 2014, ...



Environmental Impact Assessment Review

Volume 47, July 2014, Pages 14–28

ELSEVIER

The Strategic Environment Assessment bibliographic network: A quantitative literature review analysis

Simone Caschili[a], Andrea De Montis[b], Amedeo Ganciu[b], Antonio Ledda[b], Mario Barra[b]

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DOI: 10.1016/j.eiar.2014.03.003

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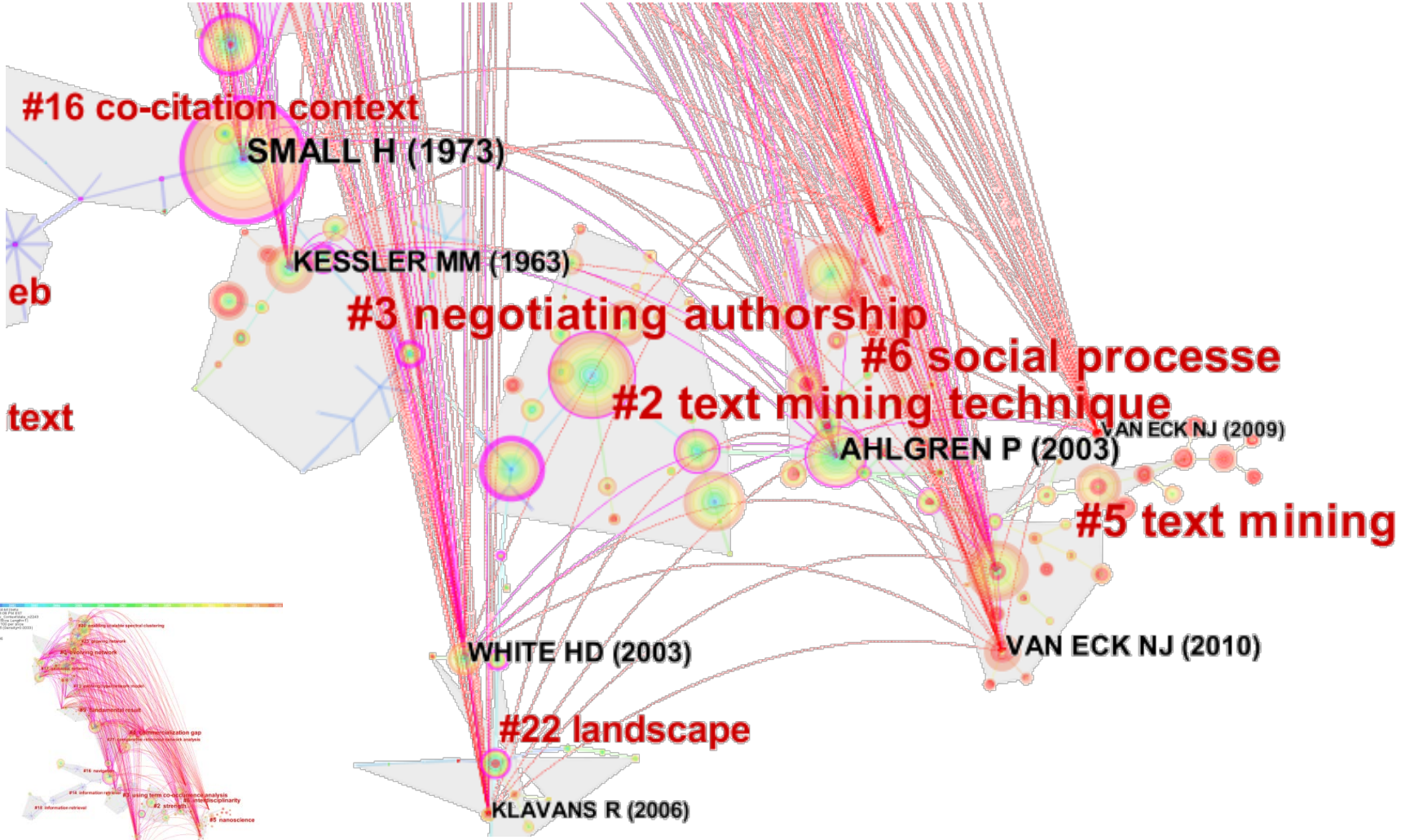
Highlights

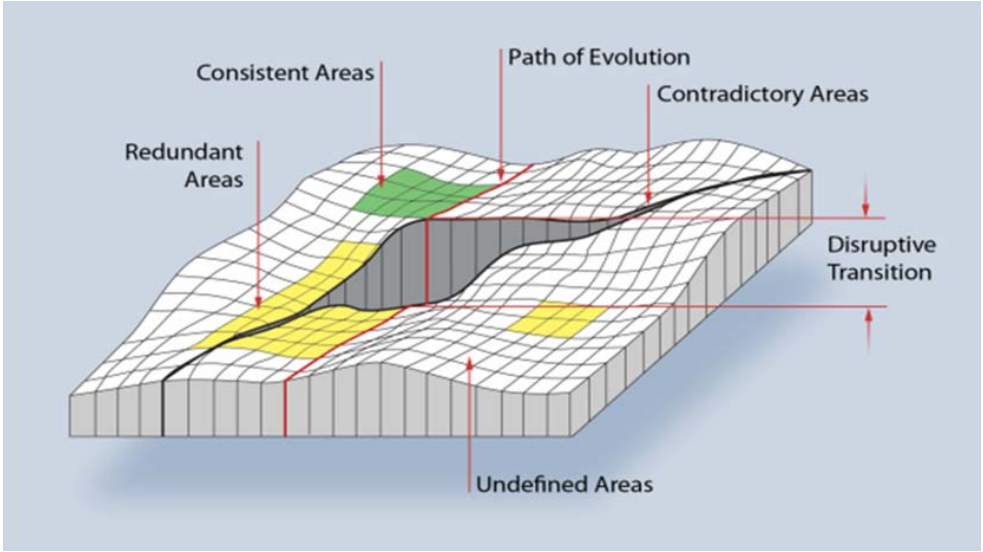
- We utilize network analysis to analyze scientific documents in the SEA field.
- We build the SEA Bibliographic Network (SEABN) of 7662 publications.
- We apply network analysis at macroscopic, mesoscopic and microscopic network levels.
- We identify SEABN architecture, relevant publications, authors, subjects and journals.

Sh...	Fr...	ΔM...	ΔC...	ΔC...	Incre...	Tra...	Year	Citing Articles
☐	210	9.55	8.00	0.75	139....	323...	2006	CHEN CM, 2006, J ...
☑	0	3.38	2.43	0.01	54.00	189...	2014	CASCHILI SIMONE,...
☐	26	4.28	1.00	0.03	563....	181...	2008	MORRIS STEVEN A...



Summary

- What is the most valuable information?
  - Information that has the potential to change the landscape of the current knowledge.
  - Information that has the potential to change the trajectories over such landscapes.
- How common is this phenomenon?
  - Scientific literature
  - Patents
  - Court opinions
  - Biochemical space of compounds



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  - Lockheed Martin
  - Pfizer