SCITECH STRATEGIES

Better Maps • Better Solutions

Physics | Computer | Chemistry | Engineering | Earth | Biology | Disease | Medicine | Brain | Health | Social | Humanities

Mapping the Emergence and Convergence of Scientific Fields

GUIRR Roundtable
Washington DC
June 3, 2014

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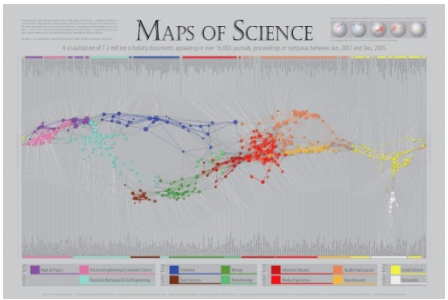
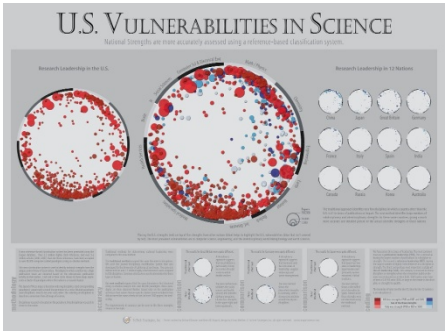
Agenda

- Creating Better Maps
- Identifying Emergence
- Evaluating Convergence

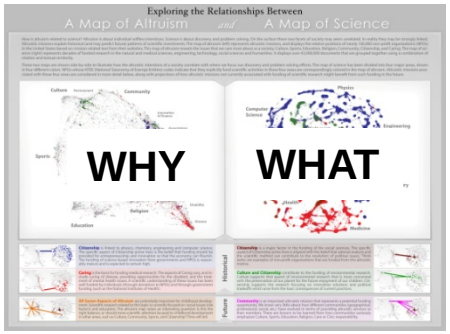
Improvements in Mapping Science



Increase Coverage
(by combining Multiple Databases)



Increase Accuracy
(by using document clusters)

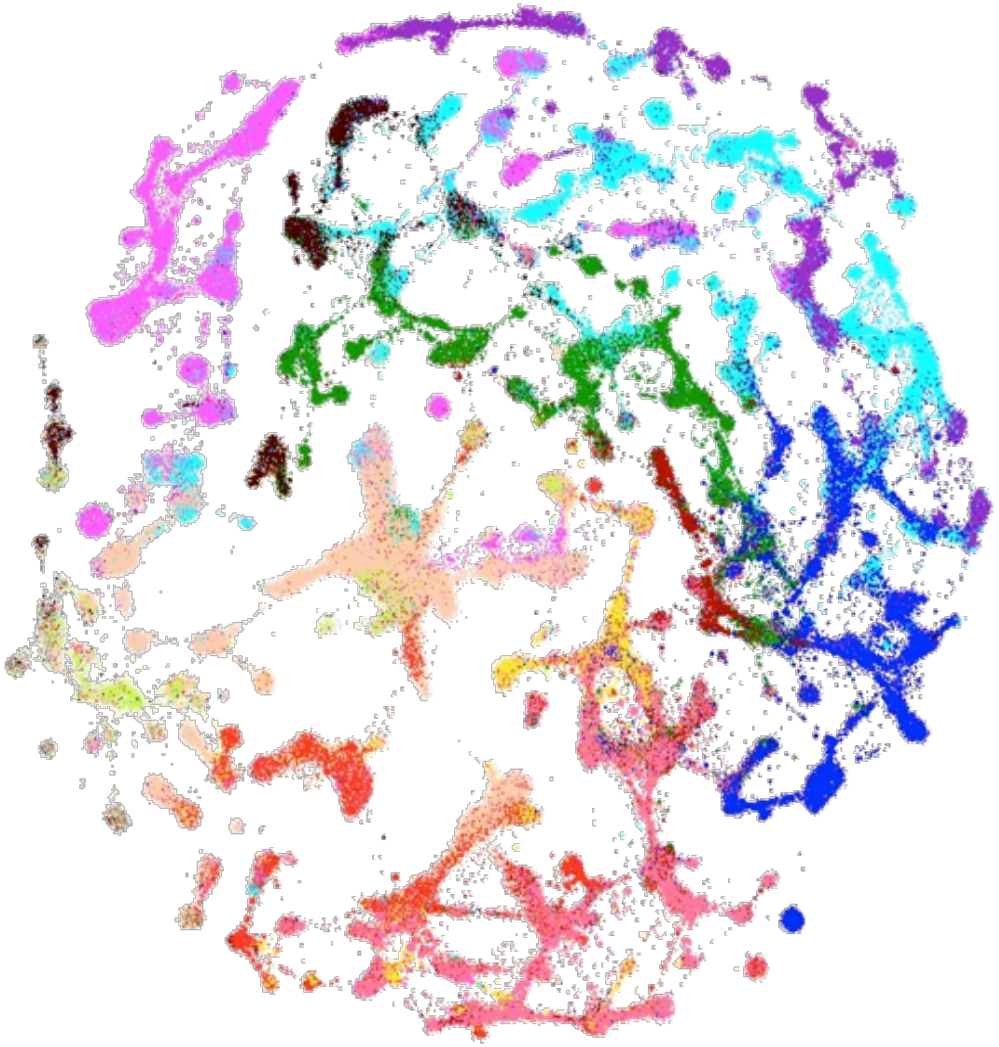


Increase Accuracy & Coverage
(new clustering algorithms, 43MM Documents)

What does this global map of science contain?

43 Million Documents

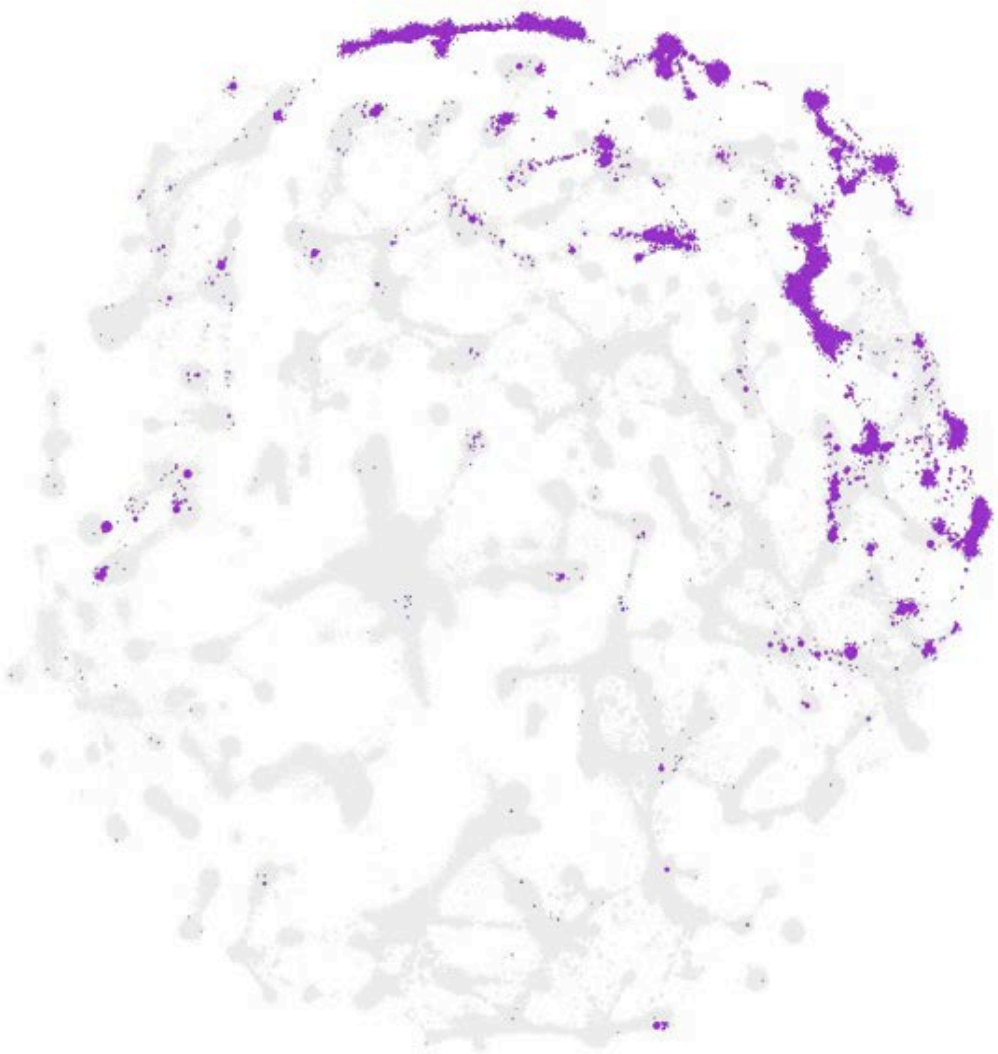
	# Documents (MM)
Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30
Infectious Disease	1.75
Medical Specialties	7.38
Brain Research	2.25
Health Sciences	2.97
Social Sciences	4.56
Humanities	0.35



Math / Physics:

4.20 Million Documents

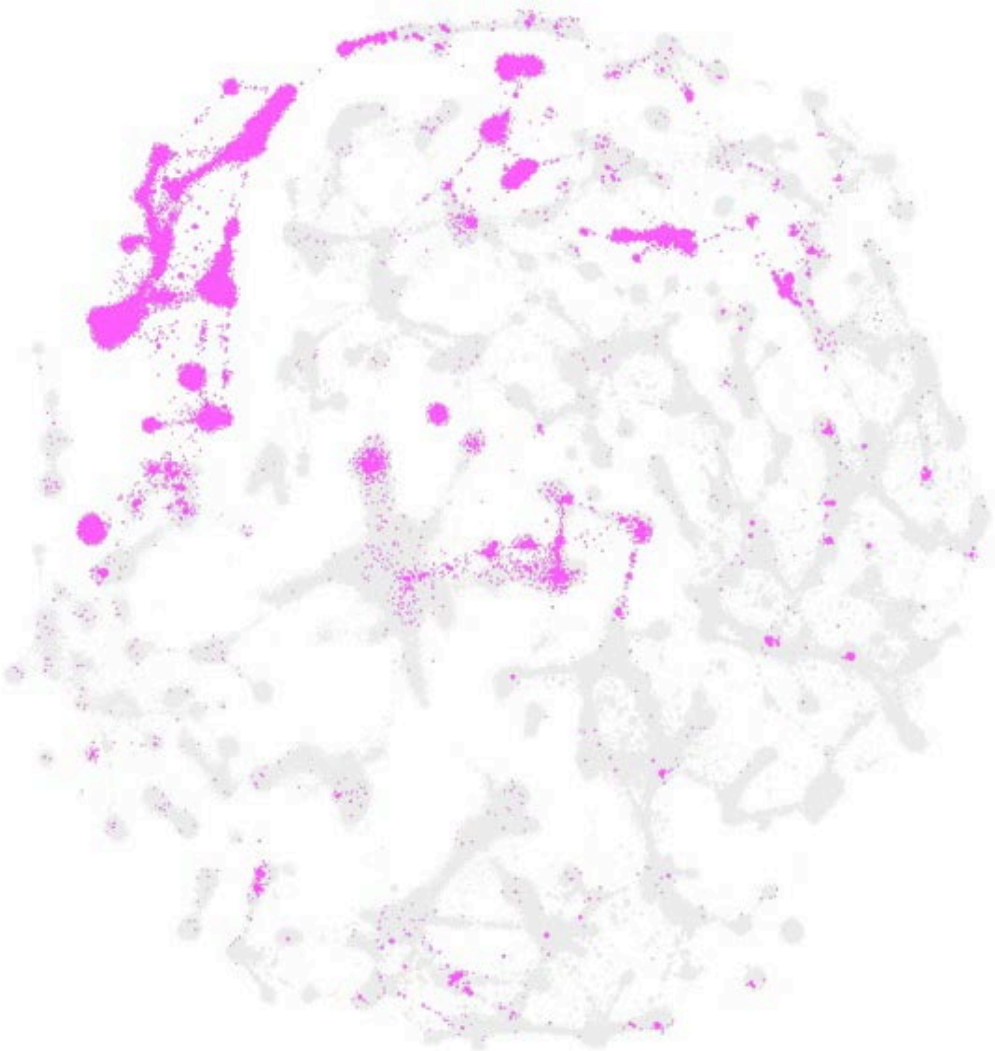
- Math / Physics 4.20



Computer Science:

4.57 Million Documents

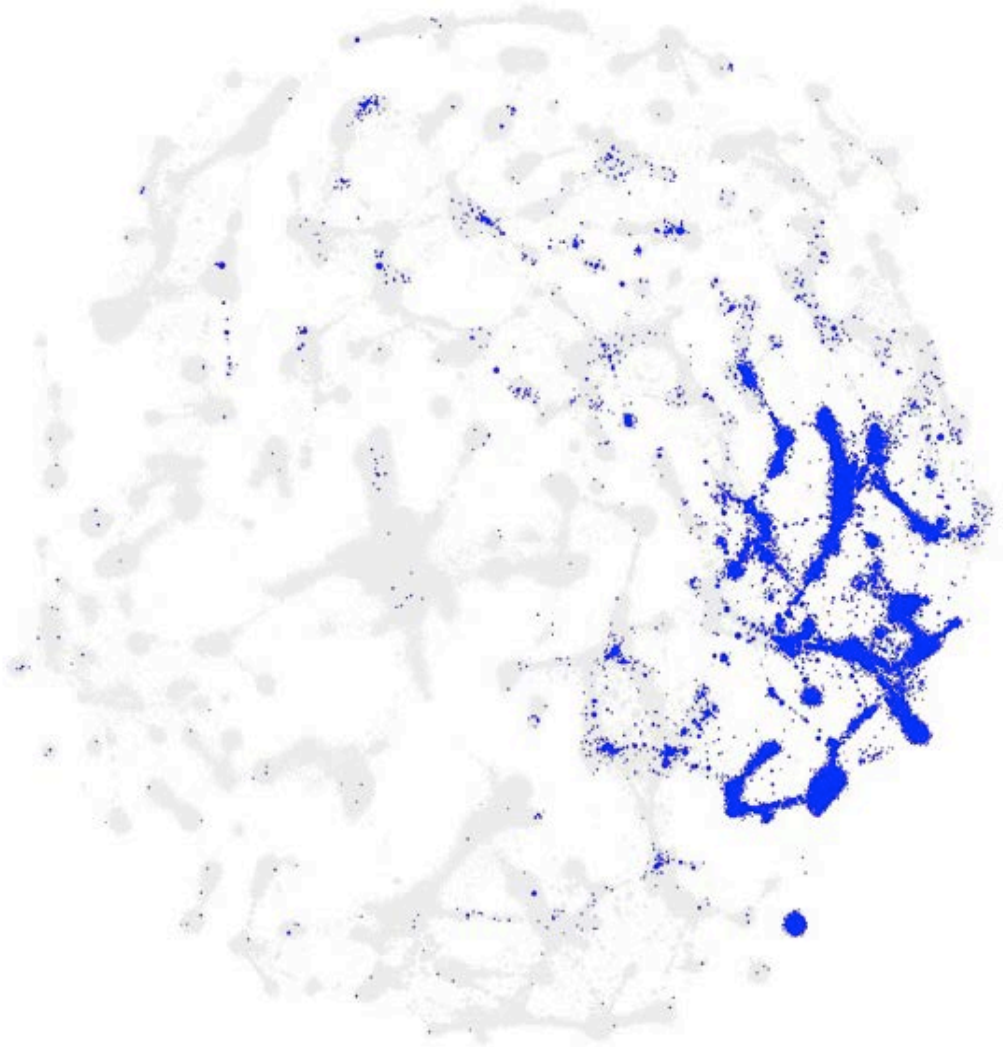
●	Math / Physics	4.20
●	Comp Sci / EE	4.57



Chemistry:

4.53 Million Documents

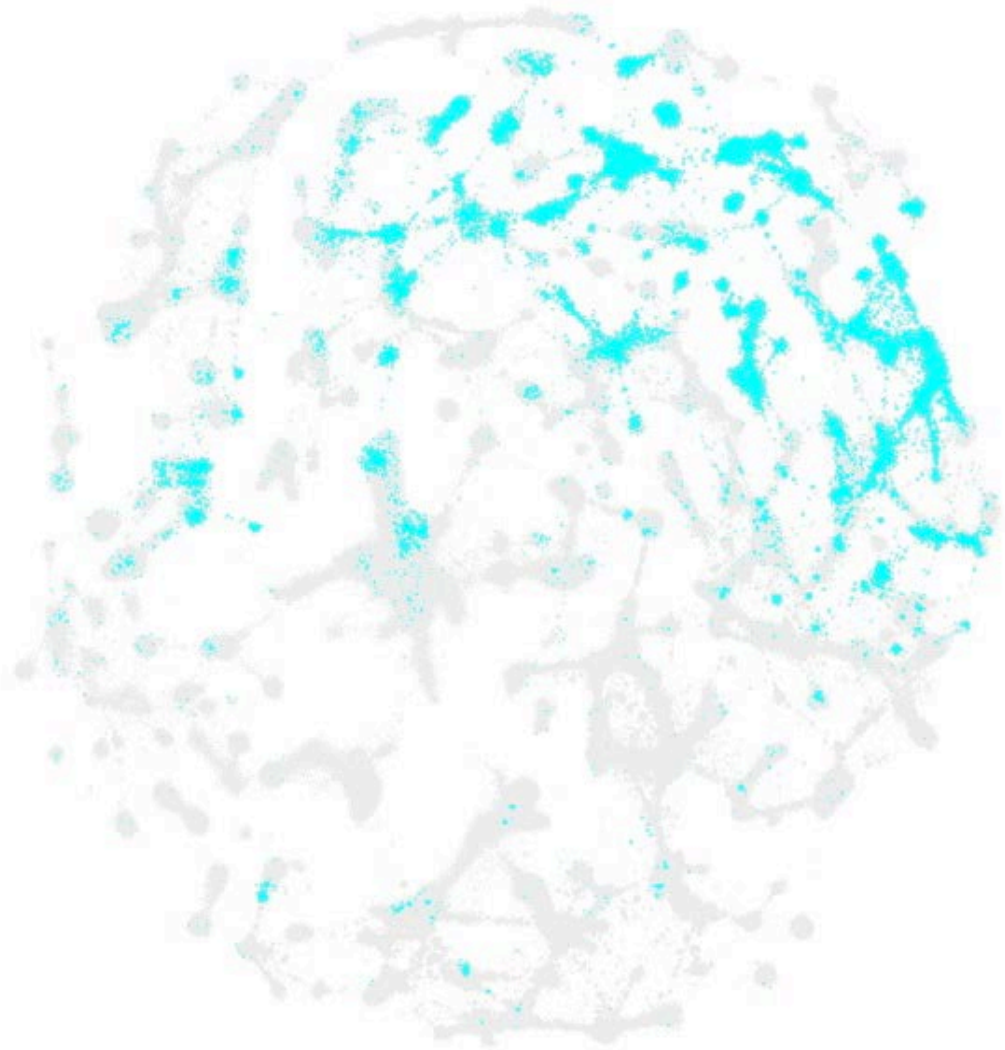
Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53



Engineering:

4.68 Million Documents

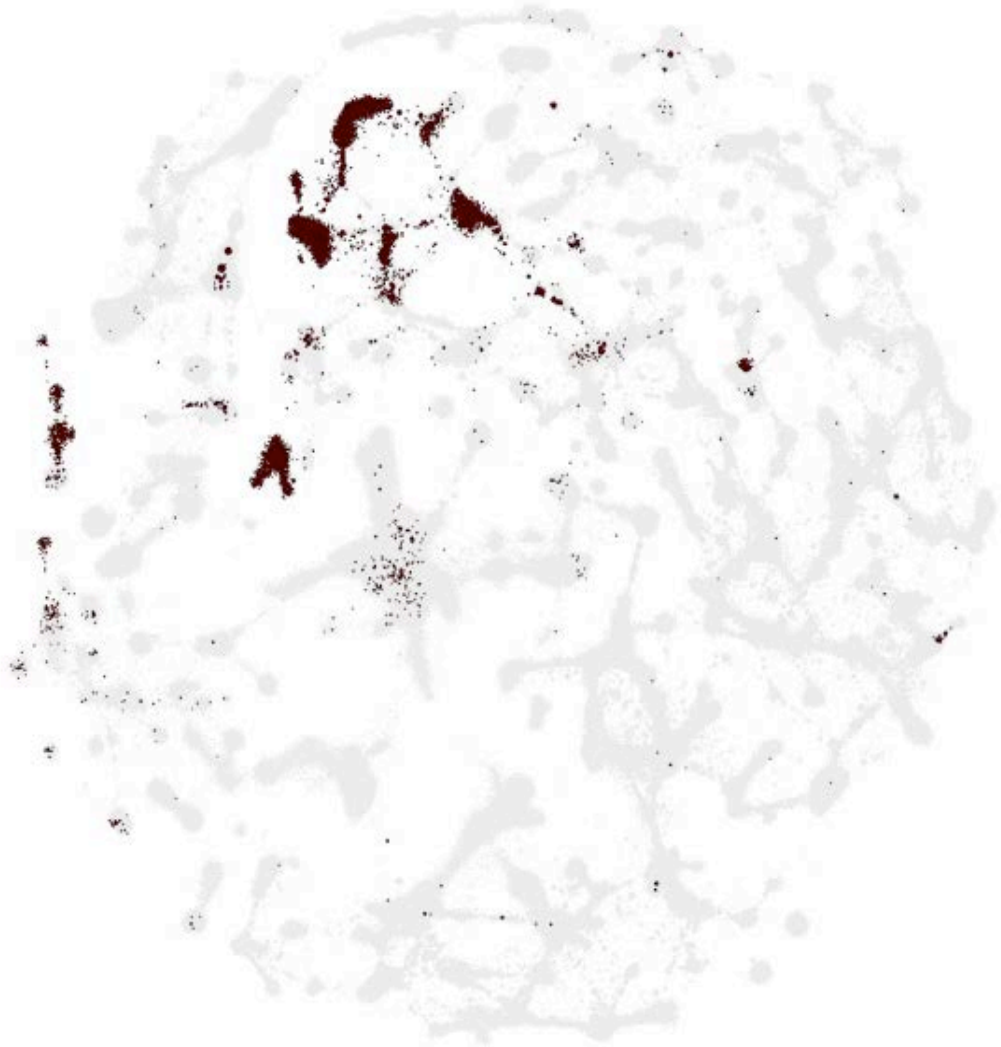
Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68



Earth Science:

1.80 Million Documents

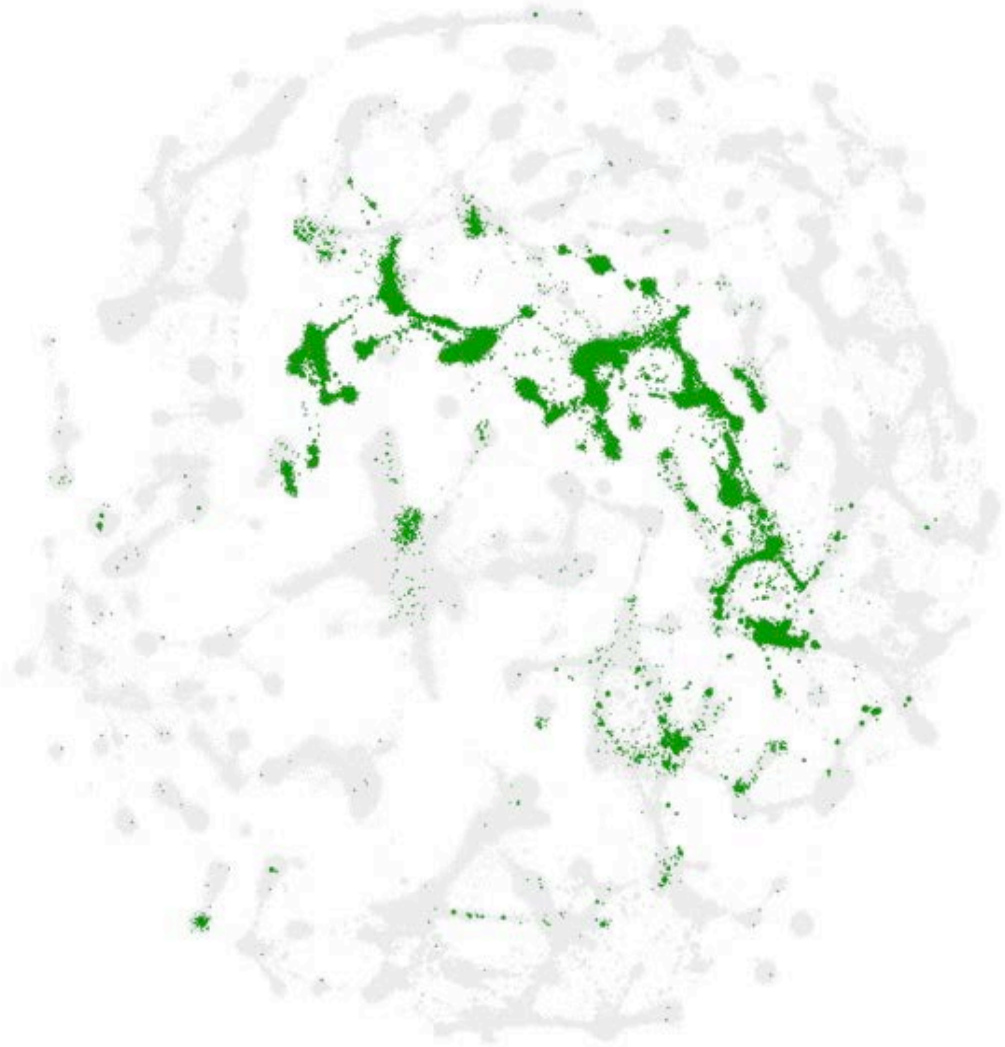
Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80



Biology / Biotech:

4.30 Million Documents

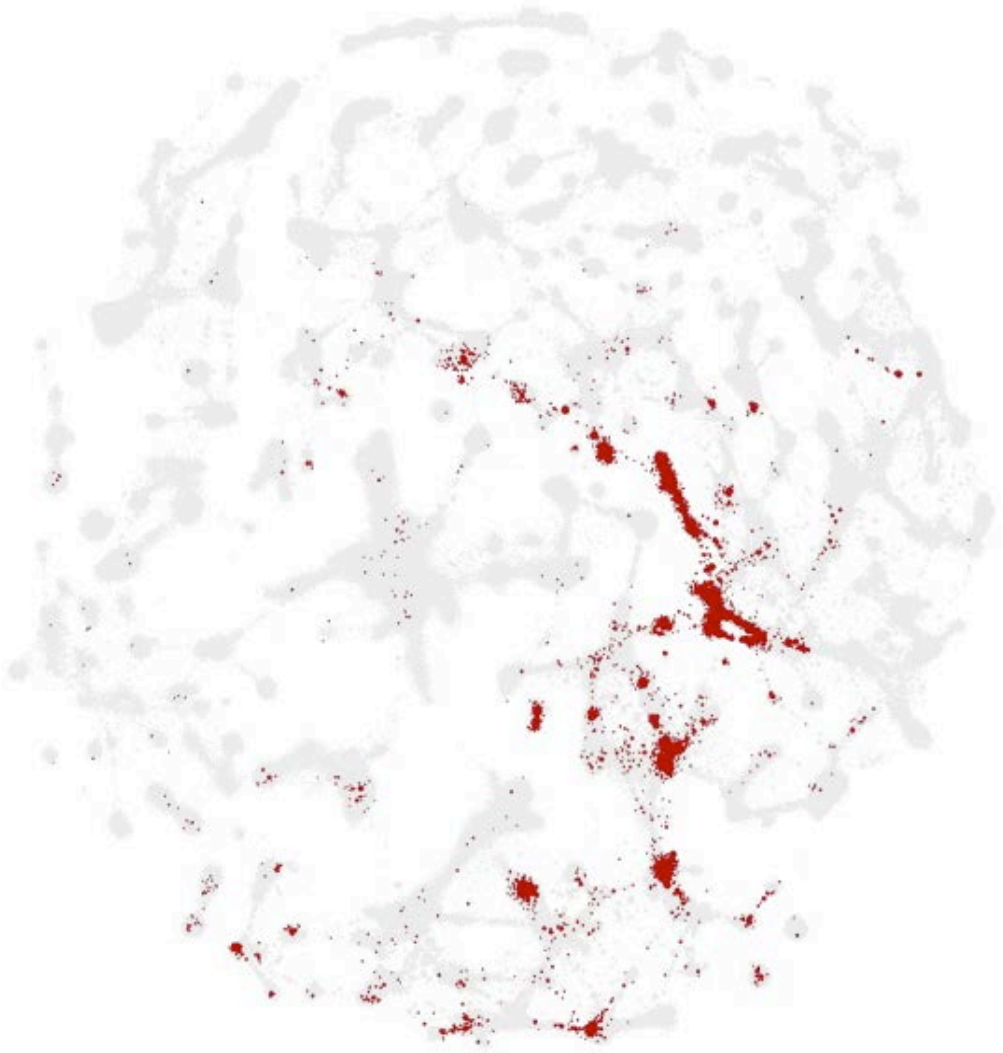
Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30



Infectious Disease:

1.75 Million Documents

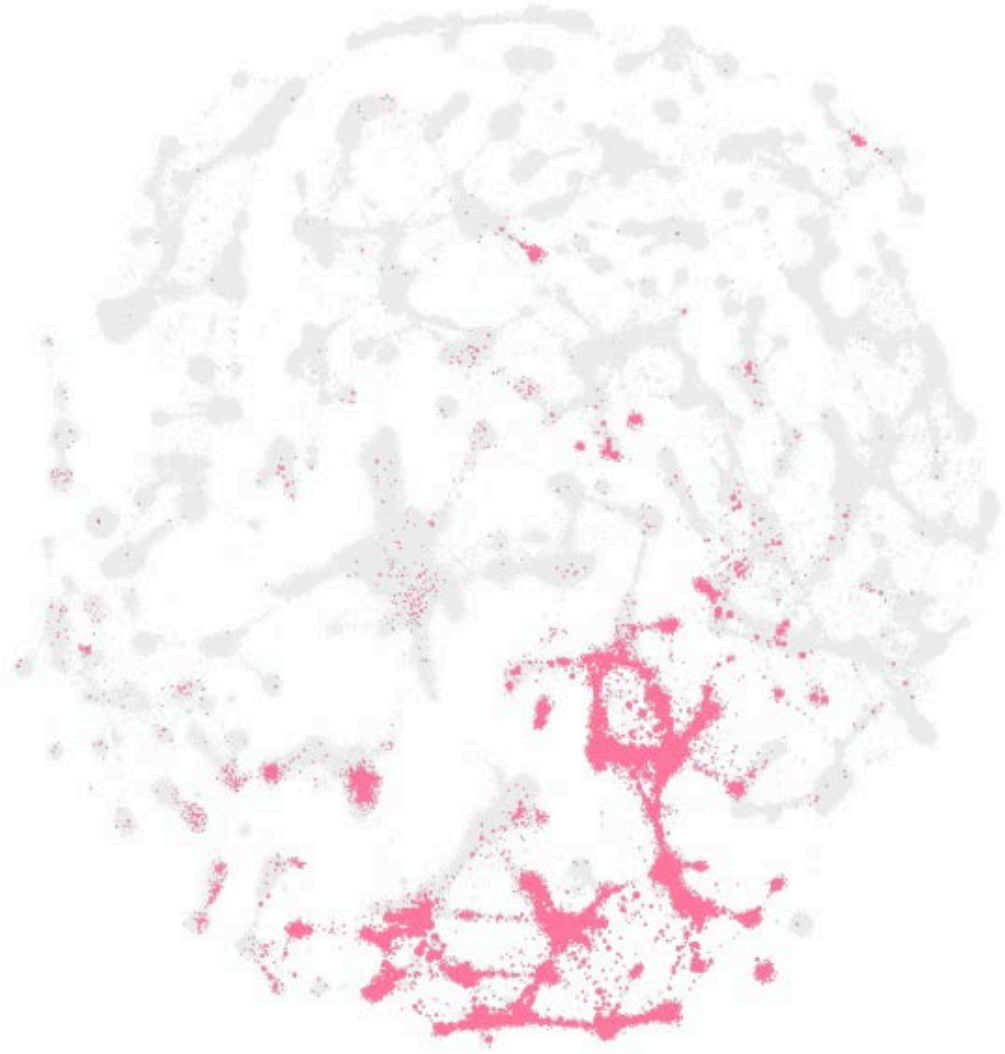
Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30
Infectious Disease	1.75



Medical Specialties:

7.38 Million Documents

Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30
Infectious Disease	1.75
Medical Specialties	7.38



Brain Research:

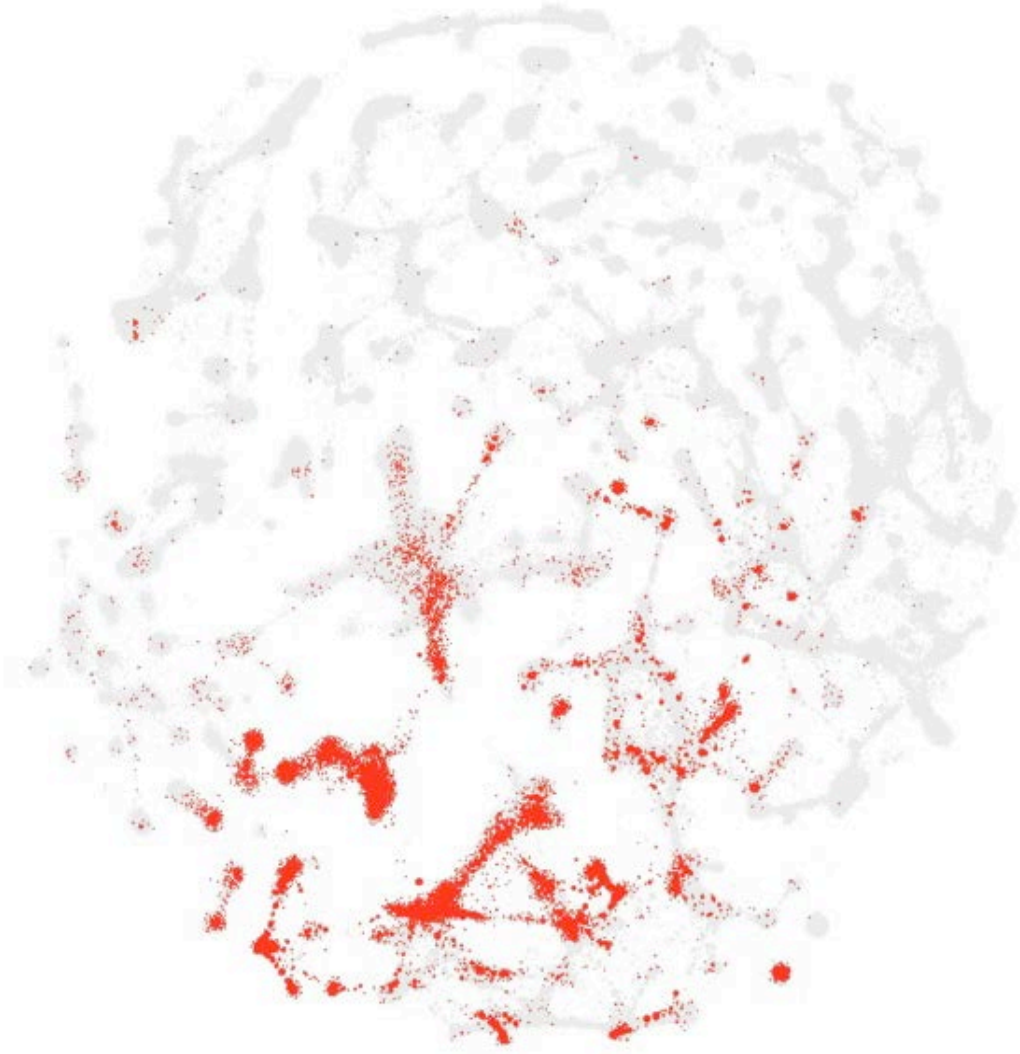
2.25 Million Documents

Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30
Infectious Disease	1.75
Medical Specialties	7.38
Brain Research	2.25

Health Sciences:

2.97 Million Documents

Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30
Infectious Disease	1.75
Medical Specialties	7.38
Brain Research	2.25
Health Sciences	2.97



Social Science:

4.56 Million Documents

Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30
Infectious Disease	1.75
Medical Specialties	7.38
Brain Research	2.25
Health Sciences	2.97
Social Sciences	4.56

Humanities:

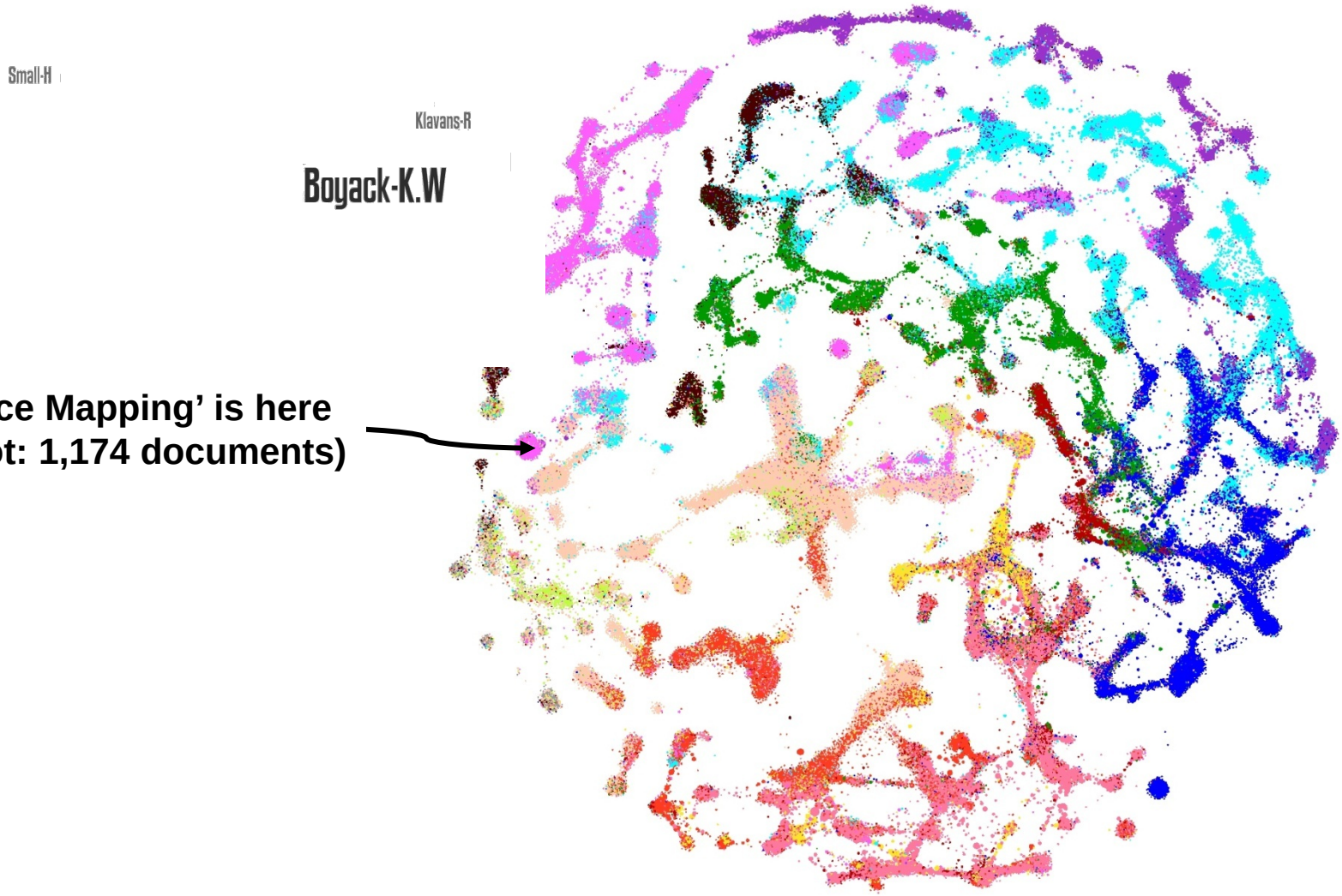
.35 Million Documents

Math / Physics	4.20
Comp Sci / EE	4.57
Chemistry	4.53
Engineering	4.68
Earth Sciences	1.80
Biology / Biotech	4.30
Infectious Disease	1.75
Medical Specialties	7.38
Brain Research	2.25
Health Sciences	2.97
Social Sciences	4.56
Humanities	0.35

What does this global map of science contain:

- Our most recent map classifies 43 million documents
  - Includes 21 million indexed records (including references) from 1996-2011
  - Includes 22 million non-indexed (non-source) items cited at least twice, such as papers from conferences and smaller journals, books, etc.
- These 43 million documents are grouped into 156,000 clusters, which are then “mapped” into a visual picture
- Each cluster represents the history of a single tightly-focused topic
- We know the CONTENT of each cluster and it’s CONTEXT
- The corresponding database is used for analyses

An Example



‘Science Mapping’ is here
(one dot: 1,174 documents)

Emergence

New areas of research that are expected to have exceptional growth

Cognitive radio

Graphene

High temp superconductivity

Social tagging

Flu pandemic

iPSC

64-slice tomography

Metal organics

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journal homepage: www.elsevier.com/locate/respol

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Identifying emerging topics in science and technology☆

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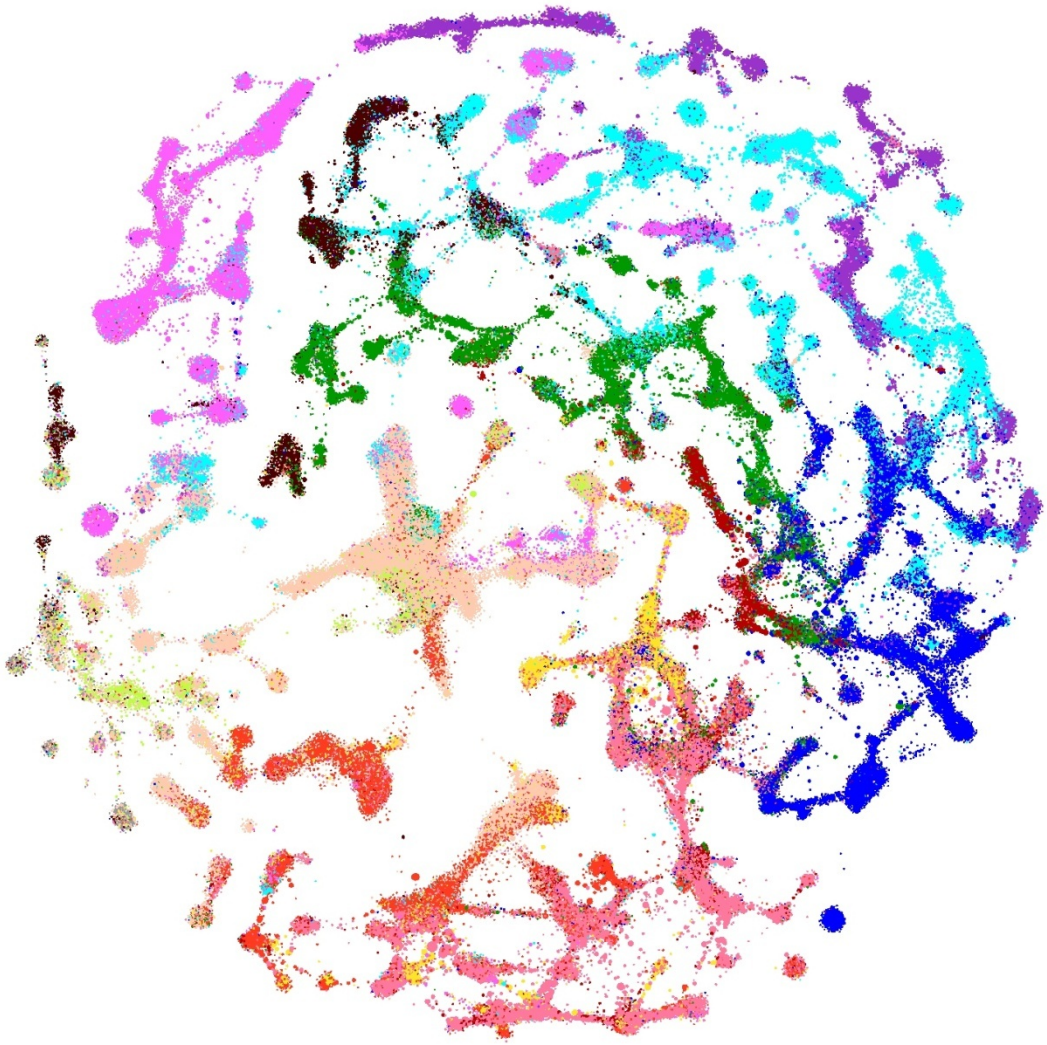
ABSTRACT

The identification of emerging topics is of current interest to decision makers in both government and industry. Although many case studies present retrospective analyses of emerging topics, few studies actually nominate emerging topics for consideration by decision makers. We present a novel approach to identifying emerging topics in science and technology. Two large scale models of the scientific literature, one based on direct citation, and the other based on co-citation, are combined to nominate emerging topics using a difference function that rewards clusters that are new and growing rapidly. The top 25 emergent topics are identified for each year 2007 through 2010. These topics are classified and characterized in various ways in order to understand the motive forces behind their emergence, whether scientific discovery, technological innovation, or exogenous events. Topics are evaluated by searching for recent major awards associated with the topic or its key researchers. The evidence presented suggests that the methodology nominates a viable list of emerging topics suitable for inspection by decision makers.

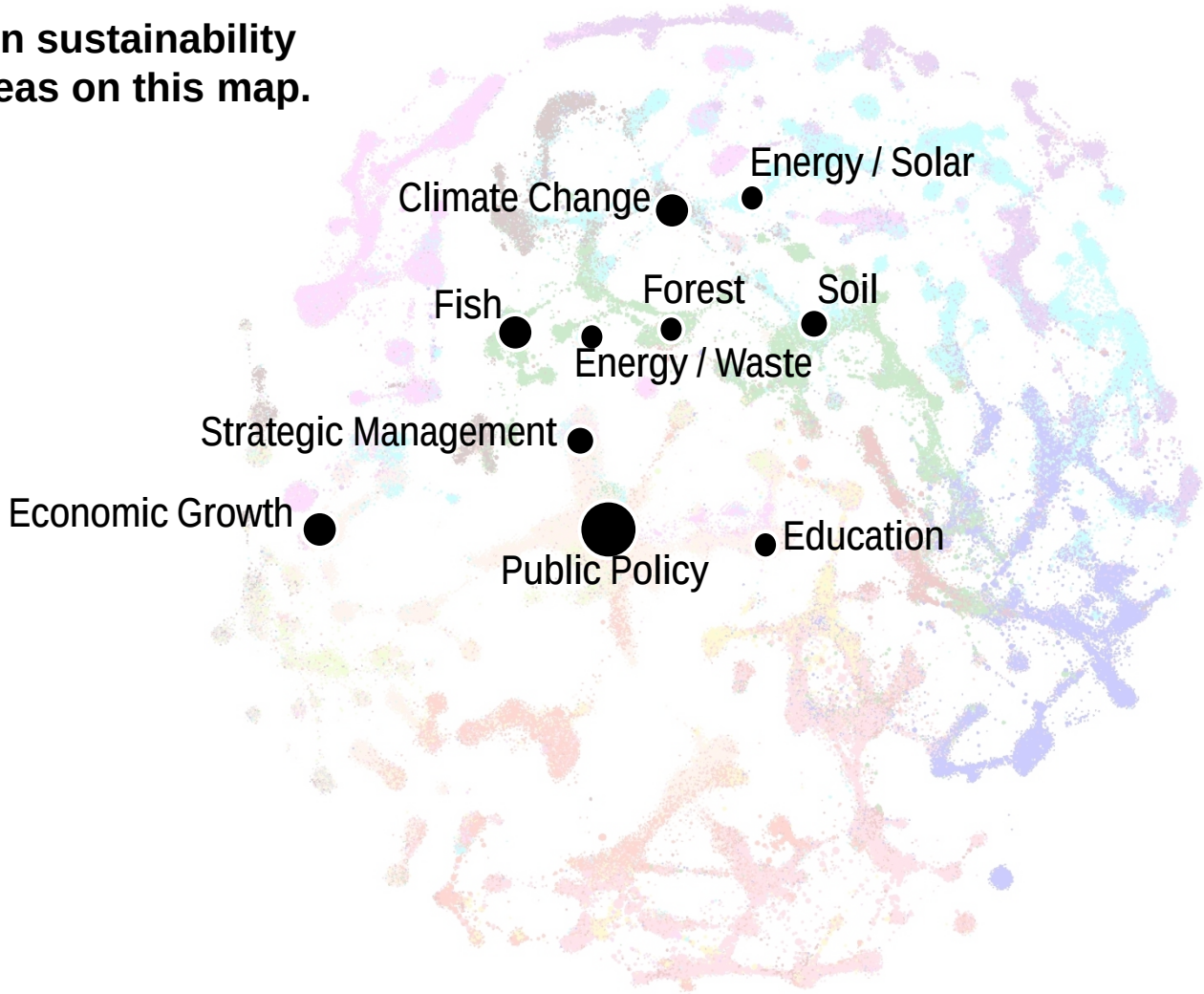
Convergence

Multiple disciplines working on a major research problem



Sustainability

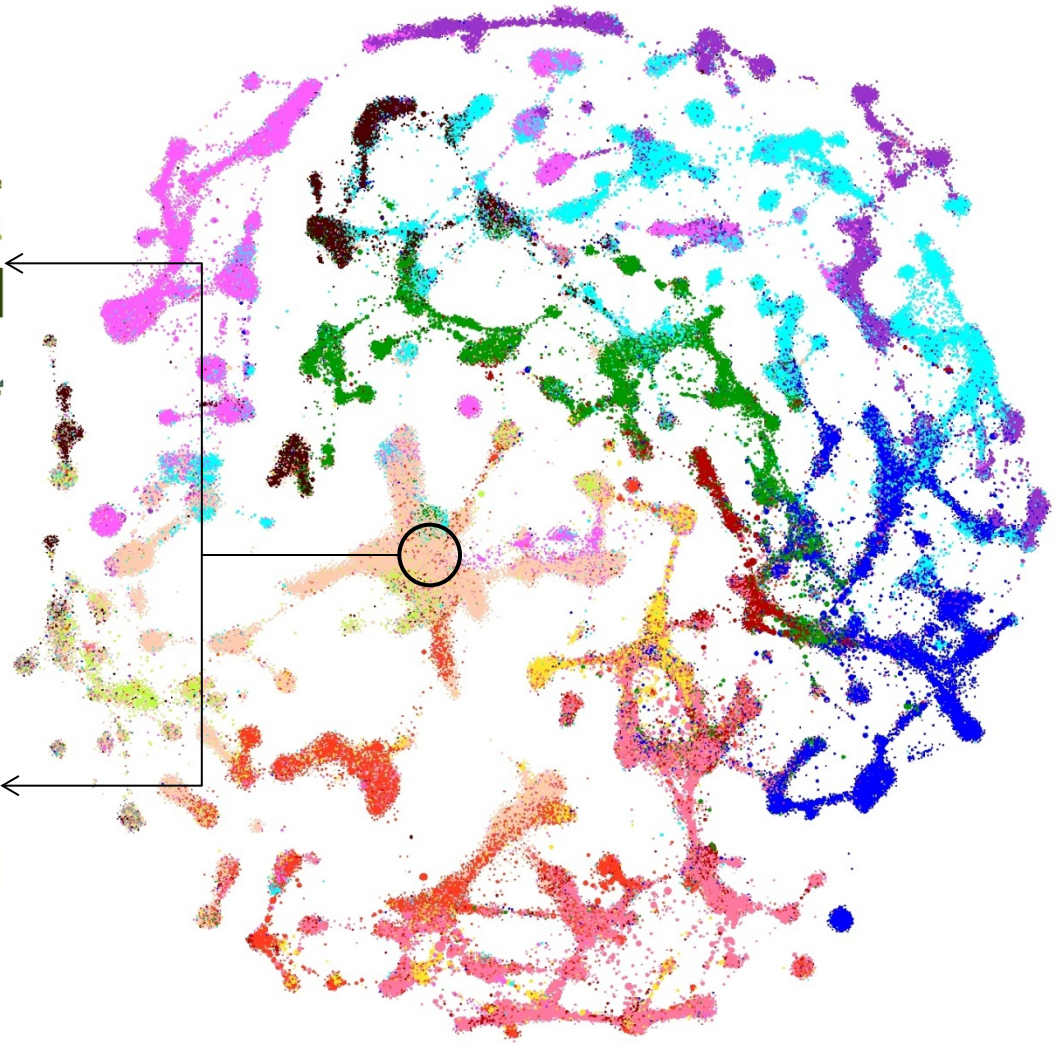
28,738 Documents on sustainability are located in ten areas on this map.



Sustainability: Public Policy (2027 topics)

Content: 10,569 Documents

Context: 253,311 Documents



Sustainability: Public Policy (2027 topics)

Number of Topics by Stage and Concentration

	<1%	1-5%	>5%	Total
Pre-paradigm	1	128	36	165
Emerging	8	22	12	42
Growing	185	618	205	1008
Mature	190	411	116	717
Declining	19	59	17	95
Total	403	1238	386	2027

Take-aways

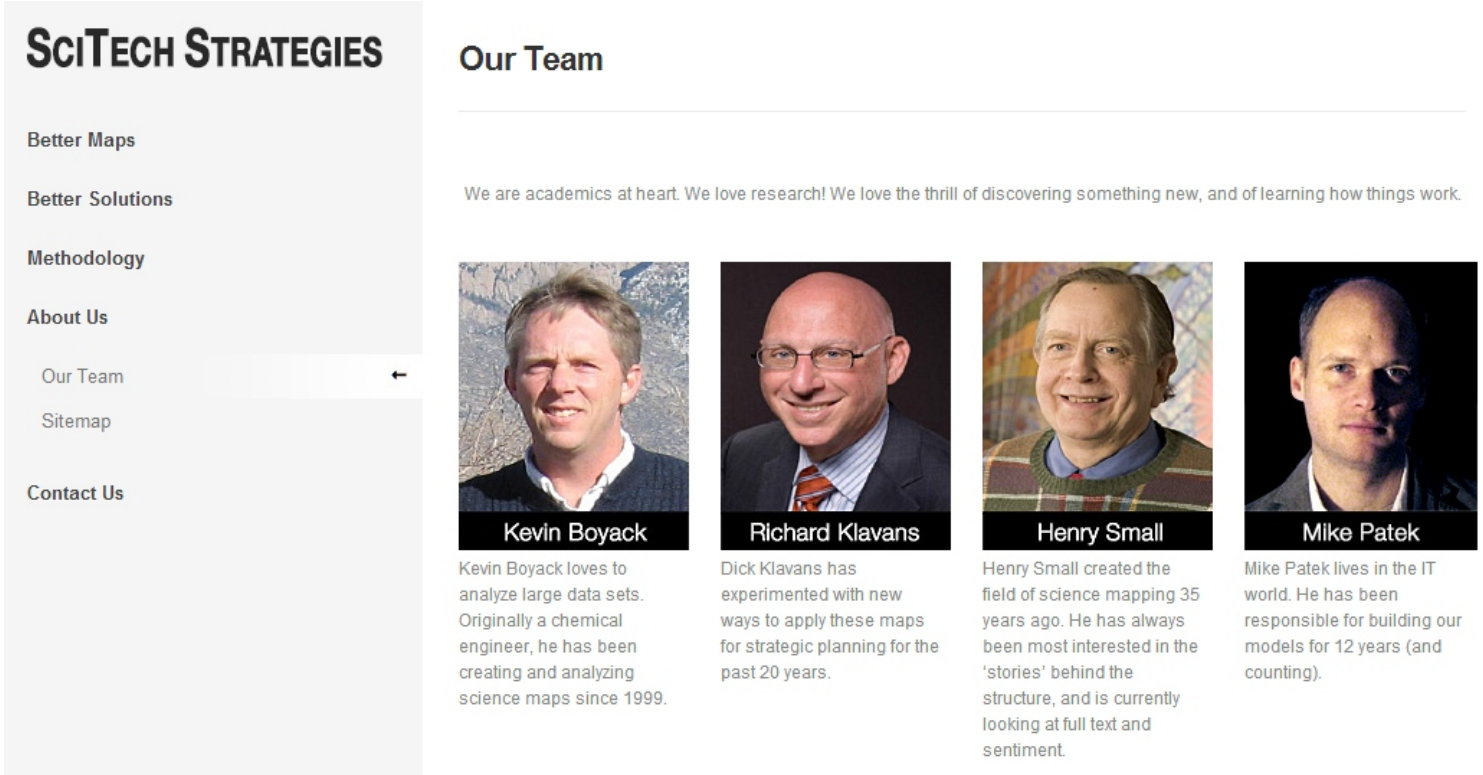
- Significant Improvements in Mapping Science over the past 20 years
- We can accurately identify emergent areas (less than .1% of the dots)
- We can quantitatively analyze a portfolio of research activities
- Mapping Science- understand what is being done
- Mapping Altruism- understand why we are doing what we are doing.

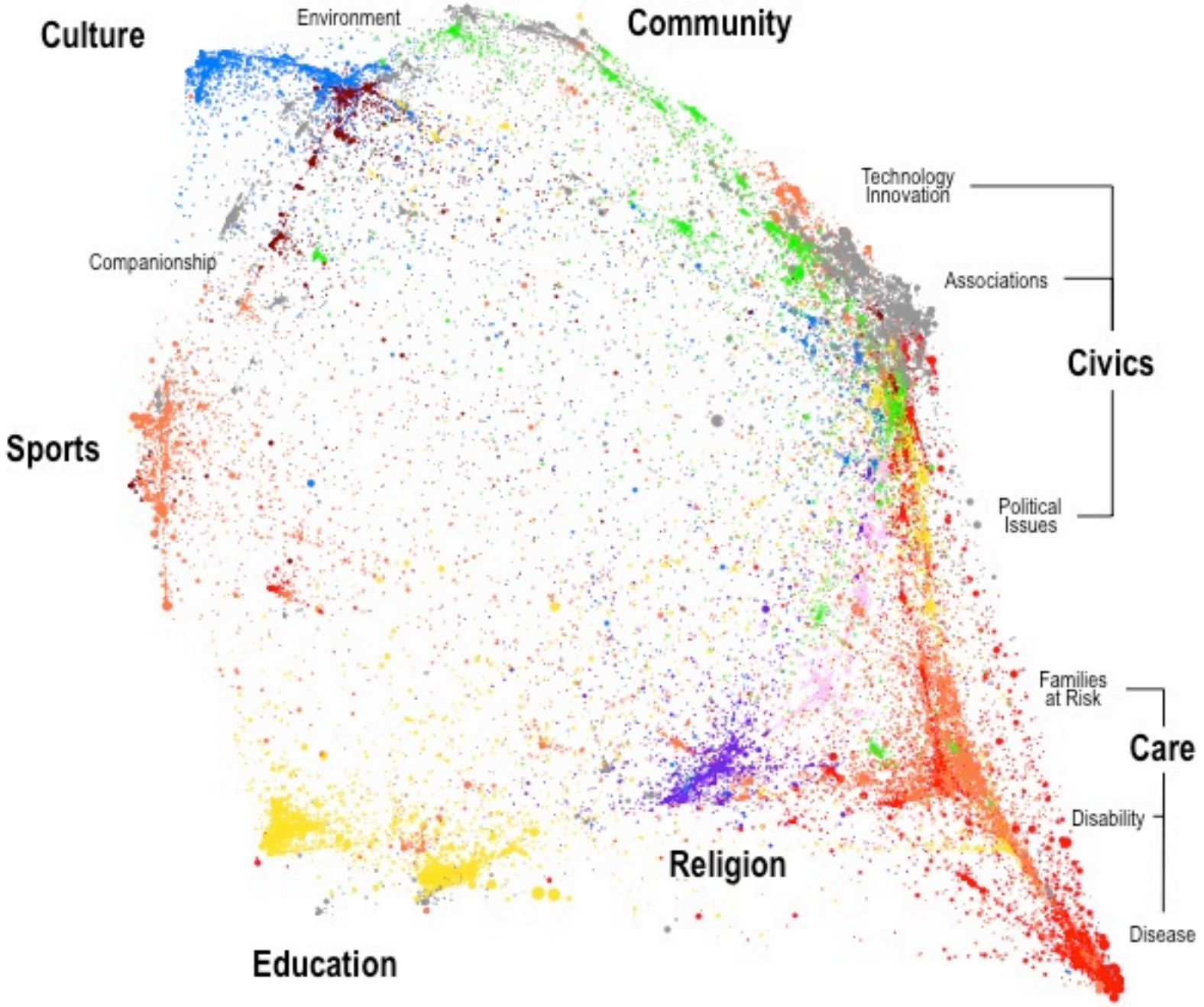
QUESTIONS

Thank-you for your attention !

SciTech Strategies, Inc.

- http://www.mapofscience.com/
  rklavans@mapofscience.com
- Decades of experience in
  - » Science mapping, Citation analysis, Advanced metrics




Culture
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Technology
Innovation
Companionship
Associations
Civics
Sports
Political
Issues
Families
at Risk
Care
Disability
Religion
Disease
Education