Evaluating and Comparing Publication Output Across Scientific Fields

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This lecture presents the state-of-the-art of an advanced bibliometric methodology, fine-tuned to the specific demands of the evaluation of academic research

Construction of Indicators

Acceptable, Valid, Robust, Reliable, Transparent Measures of Research Impact

Comprehensiveness Across the Science-Based Disciplines

Identifying High Quality Research

Distribution of impact within a department or institute: 'quality profile'

Basic Concept: How do we focus on ‘quality’?

Scientific performance relates to achieved quality in the contribution to the increase of our knowledge (‘scientific progress’)

(1) as perceived by others: peer review

(2) as measured by advanced bibliometric analysis

(1) and (2) correlate (very) well at group level

Citing Publications

From other disciplines

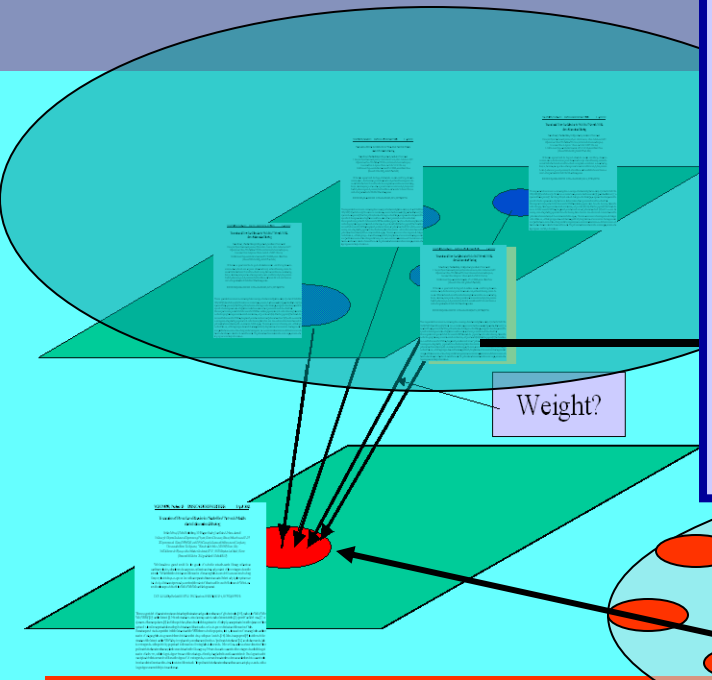
From emerging fields

From research devoted to societal, economical and technological problems

From industry

From international top-groups

These all f(t)!! > Sleeping Beauties



Cited Publications

Very Large Data Bases (Morgan Kaufmann Publishers, San Francisco, 1999); A. Broder *et al.*, Comput. Netw. **33**, 309 (2000); P. L. Krapivsky, S. Redner, and F. Leyvraz, Phys. Rev. Lett. **85**, 4629 (2000); S. N. Dorogovtsev, J. F. F. Mendes, and A. N. Samukhin, *ibid.* **85**, 4633 (2000); A. Vazquez, Europhys. Lett. **54**, 430 (2001).
[6] M. Faloutsos, P. Faloutsos, and C. Faloutsos, Comput. Commun. Rev. **29**, 251 (1999); G. Caldarelli, R. Marchetti, and L. Pietronero, Europhys. Lett. **52**, 386 (2000); A. Medina, I. Matta, and J. Byers, Comput. Commun. Rev. **30**, 18 (2000); R. Pastor-Satorras, A. Vazquez, and A. Vespignani, cond-mat/0105161; L. A. Adamic *et al.*, Phys. Rev. E **64**, 046135 (2001).
[7] F. B. Cohen, *A Short Course on Computer Viruses* (Wiley, New York, 1994); R. Pastor-Satorras and A. Vespignagni, Phys. Rev. Lett. **86**, 3200 (2001); Phys. Rev. E **63**, 066117 (2001).
[8] F. Liljeros, C. R. Edling, L. A. Nunes Amaral, H. E. Stanley, and Y. Aberg, Nature (London) **411**, 907 (2001).
[9] A.-L. Barabási and R. Albert, Science **286**, 509 (1999).
[10] Y. Ijiri and H. A. Simon, *Skew Distributions and the Sizes of Business Firms* (North-Holland, Amsterdam, 1977).
[11] G. Bianconi and A.-L. Barabási, Europhys. Lett. **54**, 436 (2001).
[12] A. F. J. Van Raan, Scientometrics **47**, 347 (2000).
[13] We consider a modification to the network growth rule described earlier in the paper: at each time step *t*, the new node establishes *m* new links, where *m* is drawn from a power law distribution with exponent gout.
[14] For n(I) = const, one recovers the scale-free model of Ref. [9].
[15] It is known [11] that, for an exponential or fat-tailed distribution of fitness, the structure of the network becomes much more complex; in particular, the in-degree distribution is no longer a power law. Hence, we do not consider in this manuscript other shapes of the fitness distribution.
[16] L. A. N. Amaral, A. Scala, M. Barthélémy, and H. E. Stanley, Proc. Natl. Acad. Sci. U.S.A. **97**, 11 149 (2000).
[17] H. A. Simon, *Models of Bounded Rationality: Empirically Grounded Economic Reason* (MIT Press, Cambridge, 1997).

No self-citations!

What do citations measure?

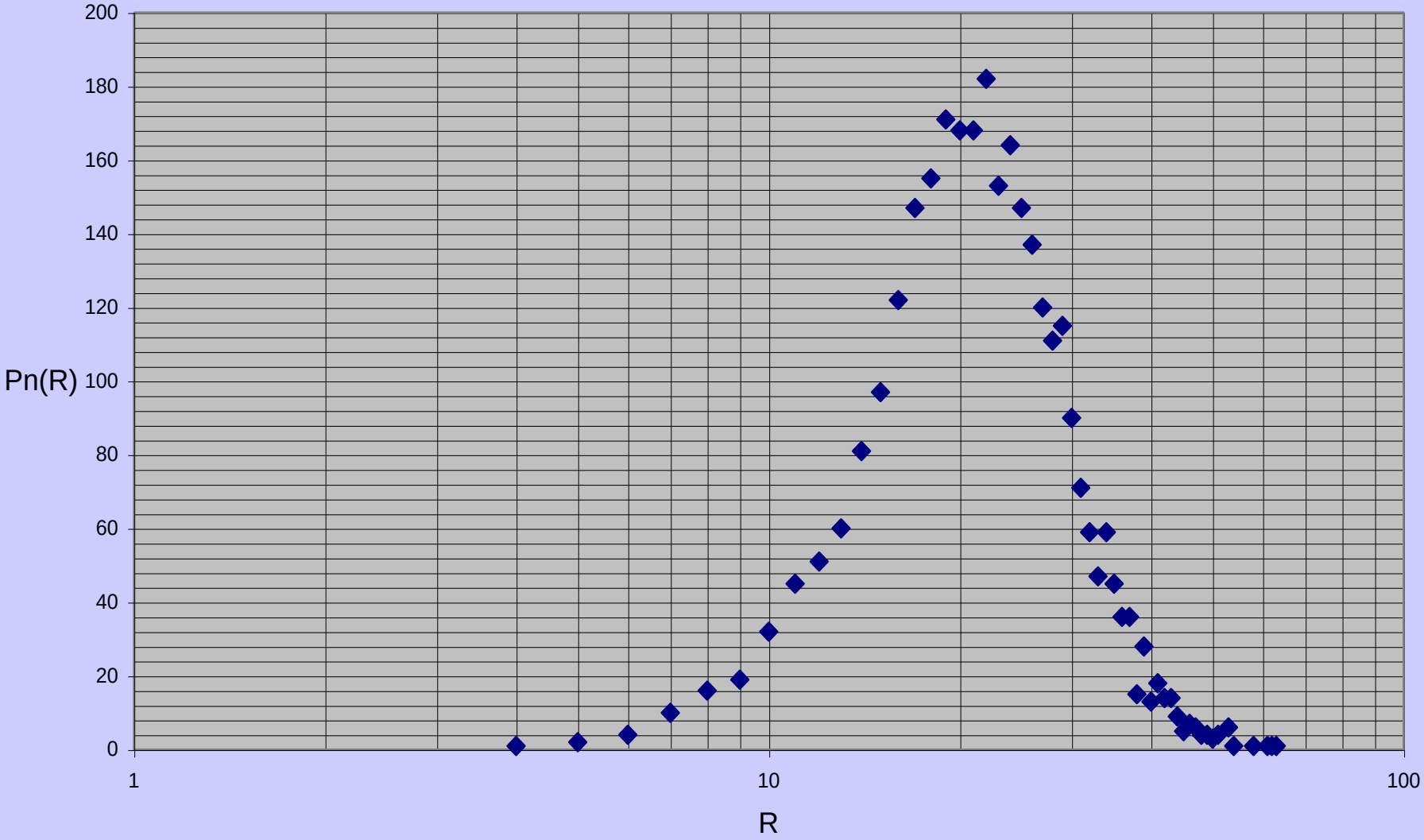
- Many studies show positive correlations between citations and qualitative judgments
- In principle it is valid to interpret citations in terms of intellectual influence which is an important aspect of scientific quality
- Thus, the concepts of citation impact and scientific quality do not coincide ‘automatically’

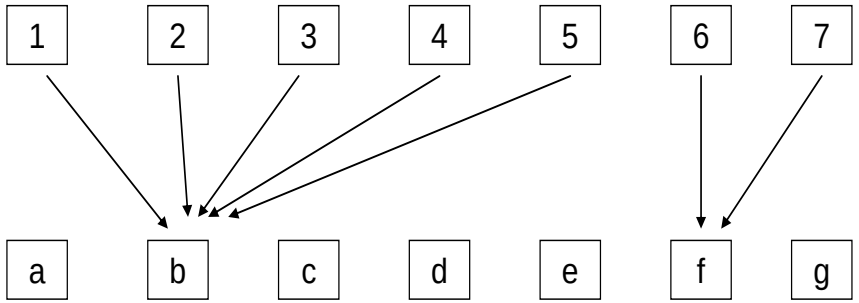
Qualitative versus quantitative assessment

peer review
reputation may have strong influence
includes 'tacit knowledge' (e.g., instrument building)
includes credits: expectations, we believe that…, ahead of time…
takes products other than journals papers into account
fashion and hypes perhaps less influential

bibliometric analysis
reputation much less influential
only 'codified knowledge'
no credits: only past performance, evidence-based
products other than journal papers less important
fashion and hypes perhaps more influential on the short term

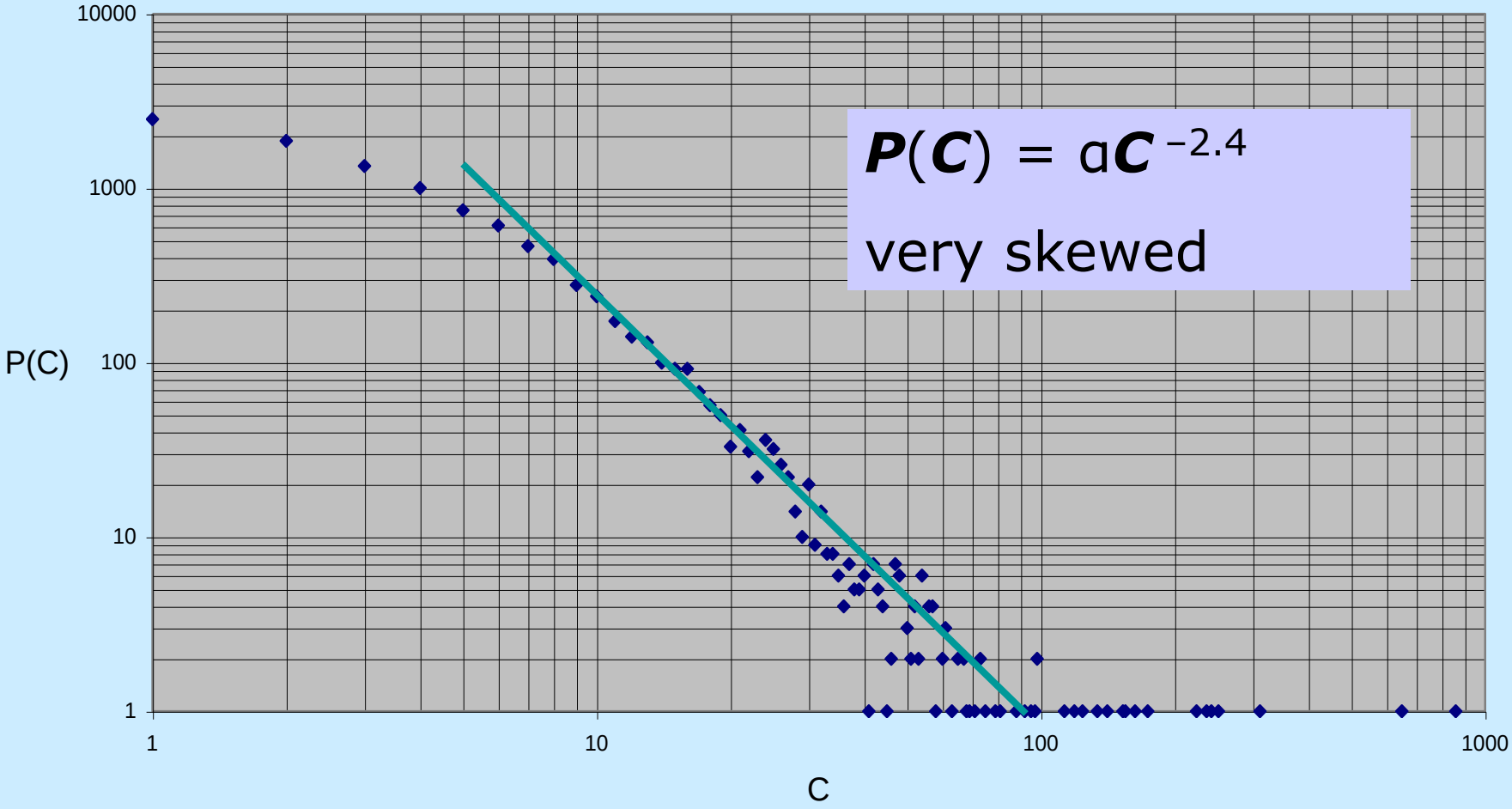
Number of publications with R refs
'normal' articles, total: 3,076, *Phys.Rev.Lett. 2003*





Citing and cited publications

Number of publications with C citations: $P(C)$



Network of publications (nodes)

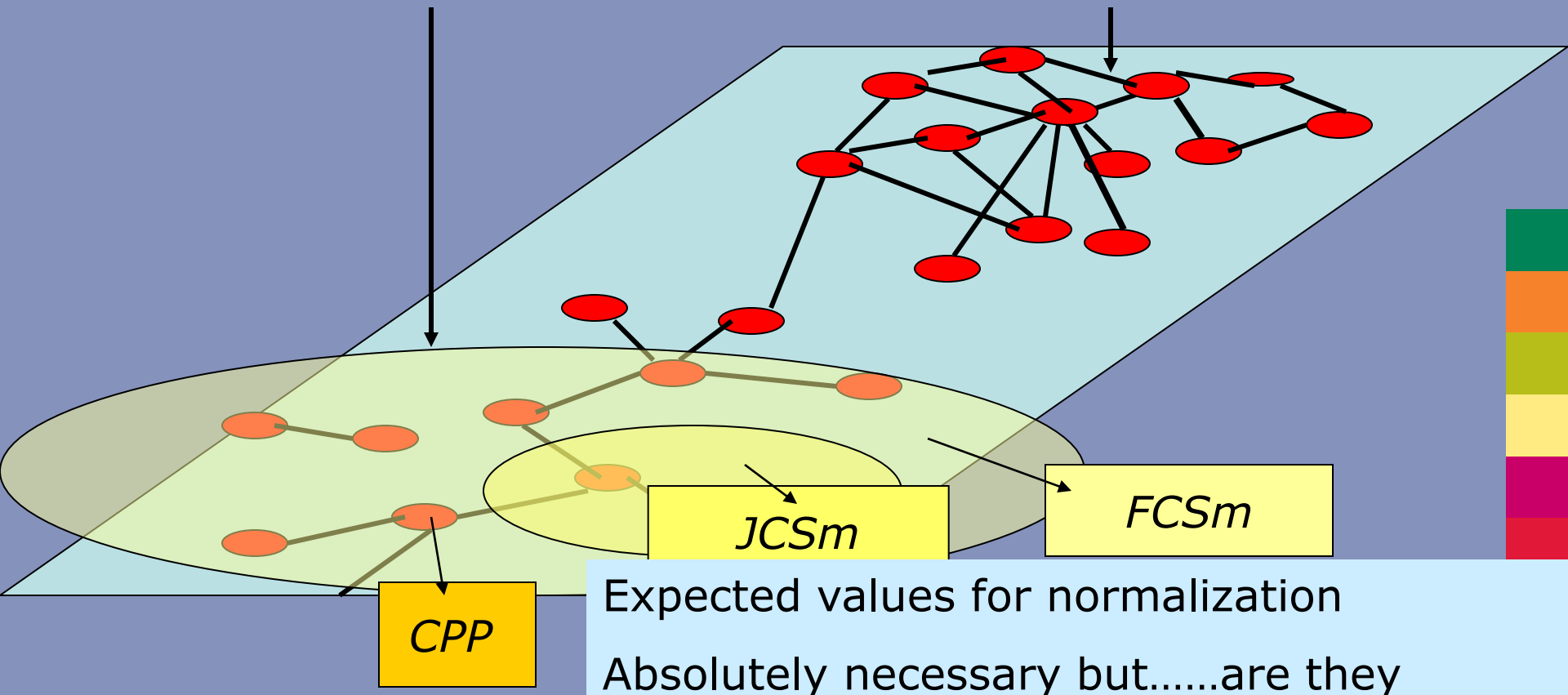
linked by citations (edges)

Lower citation-density

e.g., applied research, social sciences

Higher citation-density

e.g., basic natural medical research



Expected values for normalization

Absolutely necessary but……are they appropriate?

Total publ universe

on-WoS publ:

Books

Book chapters

proc.

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ar

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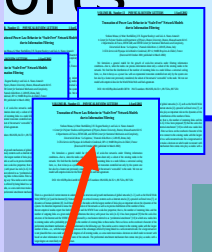
to

.....Google

Google Scholar, Google Book Search

within 5 years leading player?

/SIS

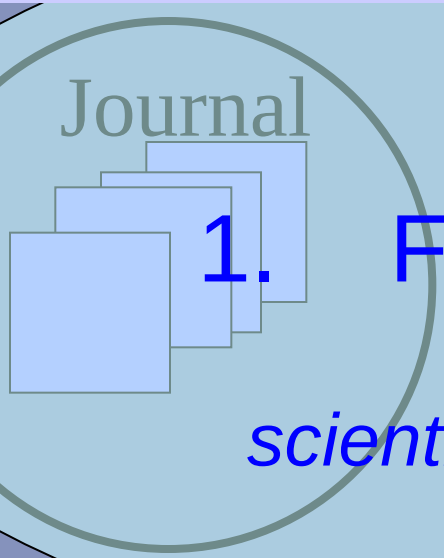


Example: Leiden University 2000-2005

INTERNAL COVERAGE OF THE CITATION INDEX BY MAIN FIELD

Main Field	*P 00-05*	*Avg Nr Refs*	*Refs <1980*	*%Refs <1980*	*Refs Non-CI*	*Refs CI*	*%Refs CI*
CLINICAL MEDICINE	3,893	33.3	6,950	5%	11,637	110,945	**91%**
BIOL SCI: HUMANS	2,421	39.0	4,449	5%	6,447	83,588	**93%**
BIOL SCI: ANIMALS & PLANTS	754	41.2	5,638	18%	6,611	18,805	**74%**
MOLECULAR BIOLOGY & BIOCHEM	1,257	40.5	2,930	6%	3,968	44,001	**92%**
PHYSICS AND ASTRONOMY	1,492	36.7	4,898	9%	7,555	42,320	**85%**
CHEMISTRY	871	34.5	3,608	12%	3,717	22,693	**86%**
MATHEMATICS	233	21.5	957	19%	1,680	2,375	**59%**
GEOSCIENCES	134	40.4	578	11%	2,169	2,673	**55%**
APPLIED PHYSICS AND CHEMISTRY	514	24.7	1,382	11%	2,081	9,256	**82%**
ENGINEERING	373	21.5	686	9%	3,151	4,185	**57%**
MULTIDISCIPLINARY	126	30.5	215	6%	339	3,291	**91%**
ECONOMICS	35	38.9	160	12%	593	608	**51%**
PSYCHOLOGY, PSYCHIATRY & BEHAV SC	633	40.3	2,789	11%	7,296	15,406	**68%**
SOCIAL SCIENCES RELATED TO MEDICINE	292	28.9	597	7%	2,153	5,698	**73%**
OTHER SOCIAL SCIENCES	291	34.9	1,469	14%	5,649	3,047	**35%**
HUMANITIES & ARTS	220	38.7	2,477	29%	5,063	973	**16%**

CWTS applies three types of field definitions:



1. Field = set of journals

‘established fields’

*scientific **medium-grained** structure*

+ reference-based re-definition (expansion) of fields

Main field: Medical & Life Sciences

Major field → **BIOMEDICAL SCIENCES**

fields

- ANATOMY & MORPHOLOGY
- IMMUNOLOGY
- INTEGRATIVE & COMPLEMENTARY MEDICINE
- MEDICAL LABORATORY TECHNOLOGY
- MEDICINE, RESEARCH & EXPERIMENTAL
- NEUROIMAGING
- NEUROSCIENCES
- PHARMACOLOGY & PHARMACY
- PHYSIOLOGY
- RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING
- TOXICOLOGY
- VIROLOGY

journals

ANNALES DE GENETIQUE
ANNALES DE GENETIQUE ET DE SELECTION ANIMALE
ANNALS OF HUMAN GENETICS
ATTI ASSOCIAZIONE GENETICA ITALIANA
BEHAVIOR GENETICS
BIOCHEMICAL GENETICS
CANADIAN JOURNAL OF GENETICS AND CYTOLOGY
CANCER GENETICS AND CYTOGENETICS
CARYOLOGIA
CHROMOSOMA
CLINICAL GENETICS
CURRENT GENETICS
CYTOGENETICS AND CELL GENETICS
CYTOLOGIA
DEVELOPMENTAL GENETICS
ENVIRONMENTAL MUTAGENESIS
EVOLUTION
GENE
GENETICA
GENETICA POLONICA
GENETICAL RESEARCH
GENETICS
GENETIKA
HEREDITAS
HEREDITY
HUMAN BIOLOGY
HUMAN GENETICS
HUMAN HEREDITY
IMMUNOGENETICS
INDIAN JOURNAL OF GENETICS AND PLANT BREEDING
JAPANESE JOURNAL OF GENETICS
JAPANESE JOURNAL OF HUMAN GENETICS
JOURNAL DE GENETIQUE HUMAINE
JOURNAL OF HEREDITY
JOURNAL OF IMMUNOGENETICS
JOURNAL OF MEDICAL GENETICS
JOURNAL OF MENTAL DEFICIENCY RESEARCH
JOURNAL OF MOLECULAR EVOLUTION
MOLECULAR & GENERAL GENETICS
MUTATION RESEARCH
PLASMID
SILVAE GENETICA
THEORETICAL AND APPLIED GENETICS
THEORETICAL POPULATION BIOLOGY
EGYPTIAN JOURNAL OF GENETICS AND CYTOLOGY
REVISTA BRASILEIRA DE GENETICA
ANNUAL REVIEW OF GENETICS
JOURNAL OF CRANIOFACIAL GENETICS AND DEVELOPMENTAL BIOLOGY
JOURNAL OF INHERITED METABOLIC DISEASE
PRENATAL DIAGNOSIS
ADVANCES IN GENETICS INCORPORATING MOLECULAR GENETIC MEDICINE
CHEMICAL MUTAGENS-PRINCIPLES AND METHODS FOR THEIR DETECTION
DNA-A JOURNAL OF MOLECULAR & CELLULAR BIOLOGY
EVOLUTIONARY BIOLOGY
TERATOGENESIS CARCINOGENESIS AND MUTAGENESIS
TSITOLOGIYA I GENETIKA
ADVANCES IN HUMAN GENETICS
PROGRESS IN MEDICAL GENETICS
GENETICS SELECTION EVOLUTION
MOLECULAR BIOLOGY AND EVOLUTION
SOMATIC CELL AND MOLECULAR GENETICS
BIOTECHNOLOGY & GENETIC ENGINEERING REVIEWS
EXPERIMENTAL AND CLINICAL IMMUNOGENETICS
GENE ANALYSIS TECHNIQUES
JOURNAL OF MOLECULAR AND APPLIED GENETICS
JOURNAL OF NEUROGENETICS
TRENDS IN GENETICS
DISEASE MARKERS
ANIMAL GENETICS
GENETIC EPIDEMIOLOGY
JOURNAL OF GENETICS

File Find VOS Options

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Open map...

Save similarities...

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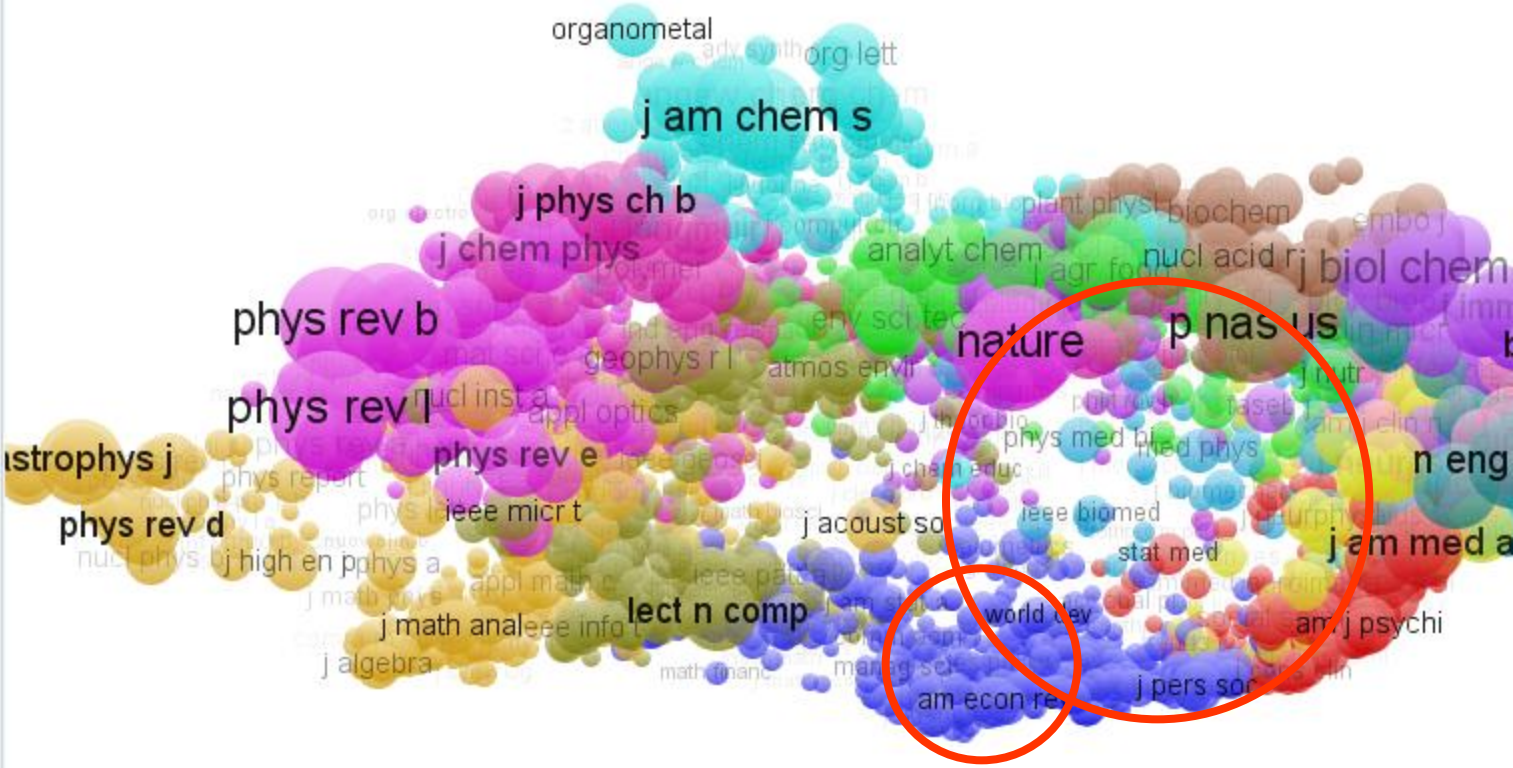
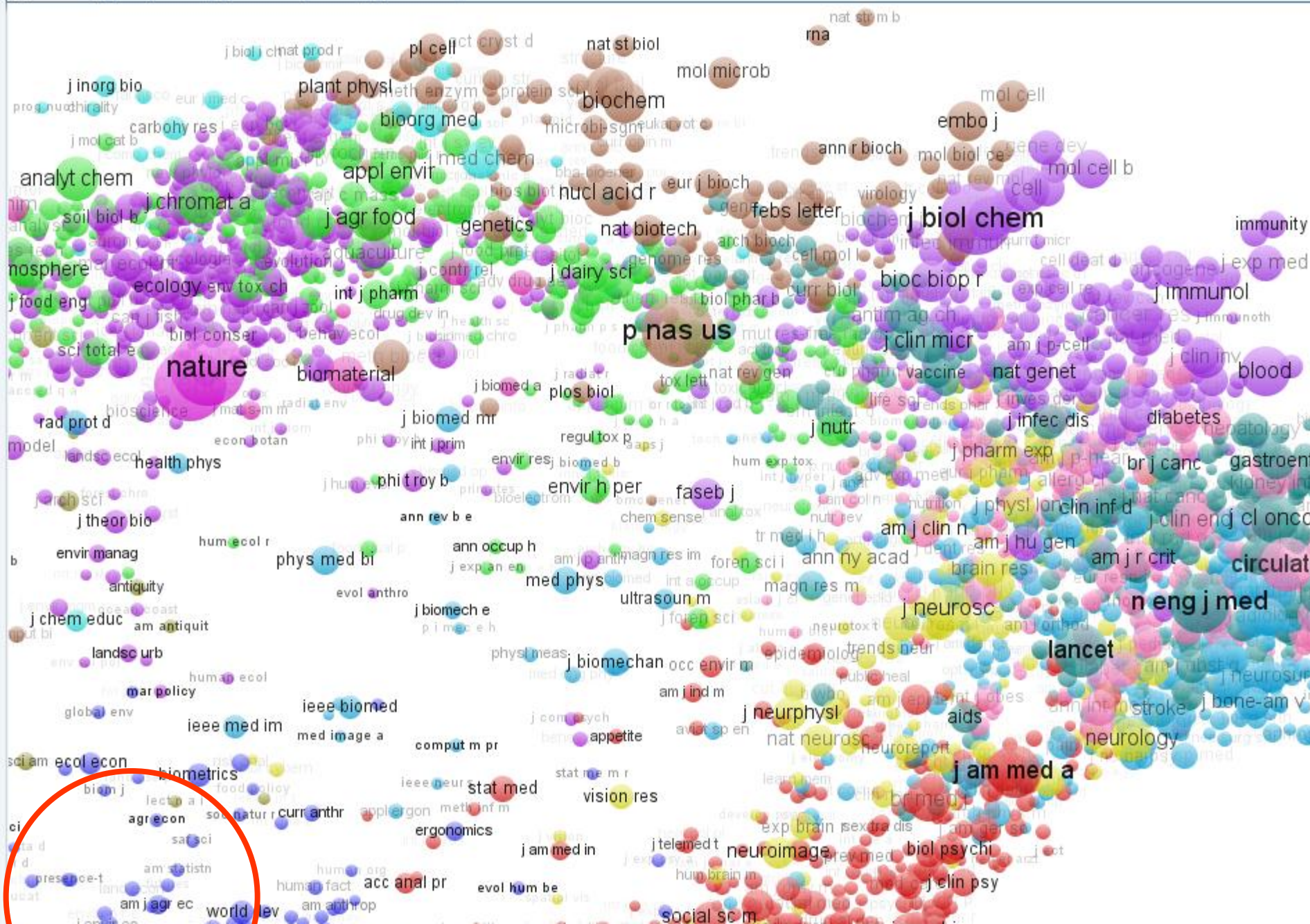
Save screenshot...

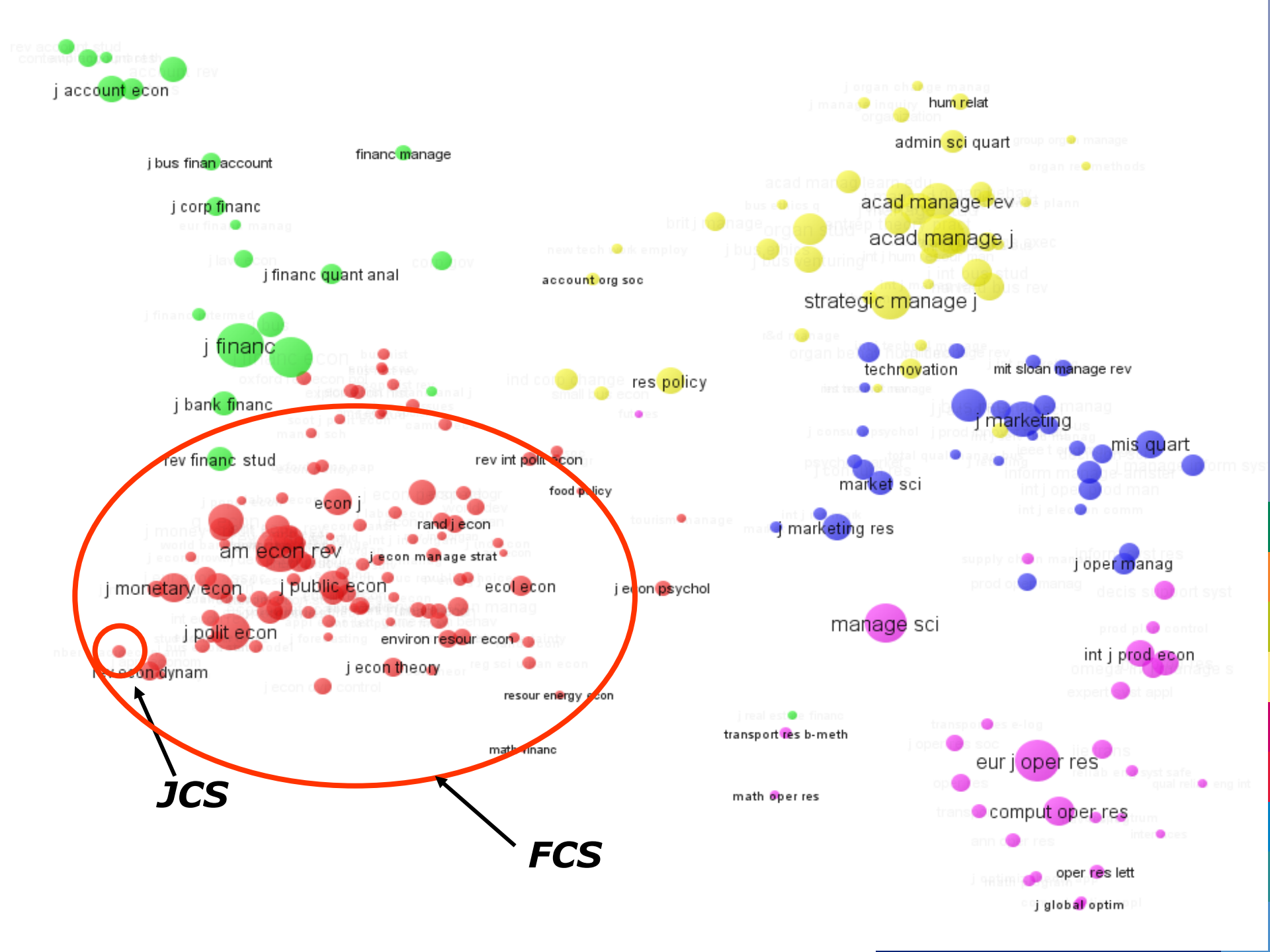
About VOSviewer

Exit



Label View | Density View | Cluster Density View | Scatter View

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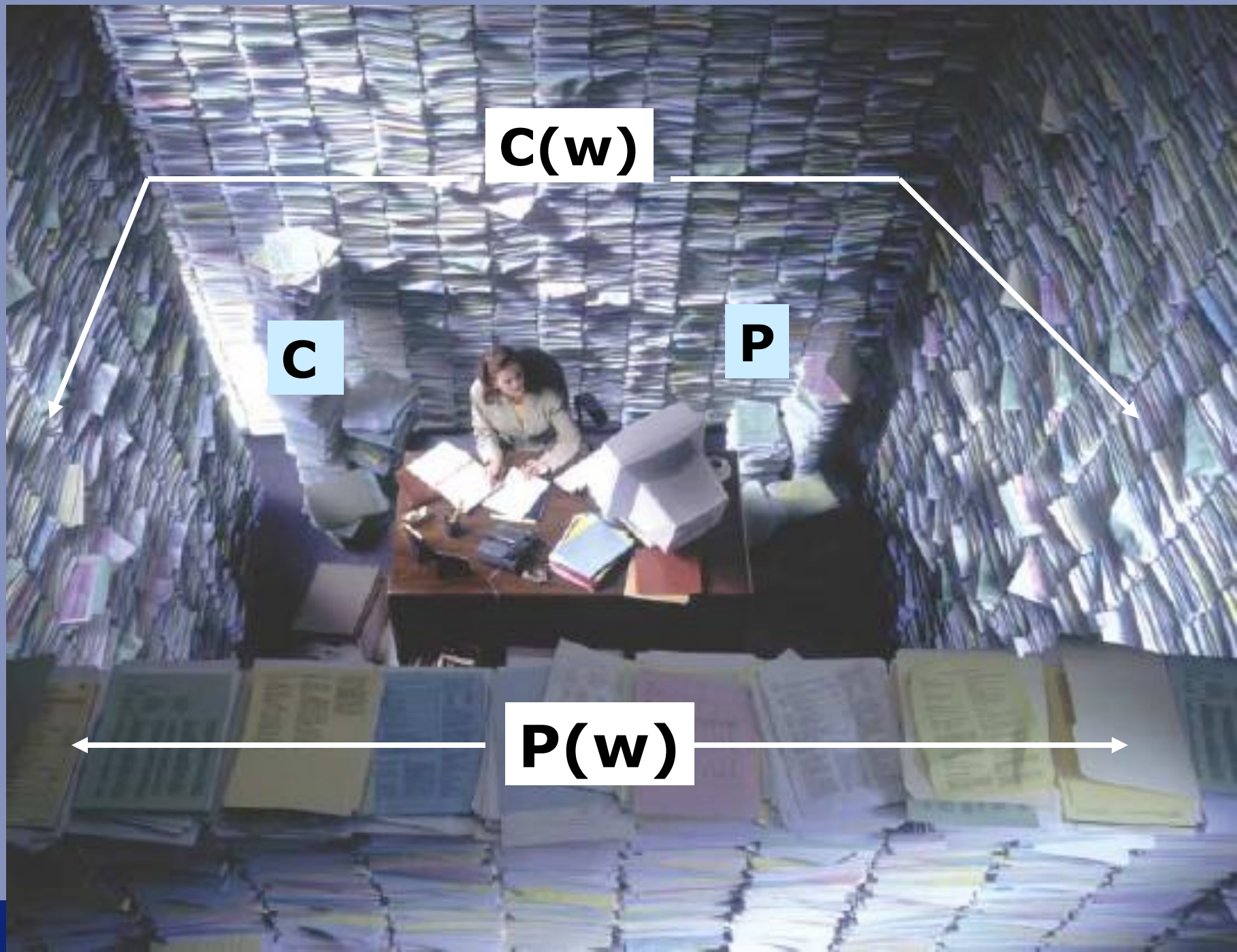

C(w)
C
P
P(w)

Citing publications

Field-specific normalization

$$\frac{C(A)/P(A)}{C(f)/P(f)} = CPP/FCSm$$

+ doc. type normalization
+ no self-citations, also not in C(f)!

Cited publications

FCS

Basic Performance Indicators

- ***P*** Ouput: Number of publications in internationally refereed CI-covered journals
- ***C*** Absolute Impact: Number of (self-ex) citations to these publications
- ***H*** Hirsch-index
- ***CPP*** Output-normalized Impact: Average number of cits/pub of the institute
- ***JCSm*** Average number of cits/pub of the journal set used by the institute
- ***FCSm*** Average number of cits/pub of all journals of a specific field in which the institute is active *(FCSm)*
- ***p0*** Percentage of not-cited publications

CWTS Key Research Performance Indicators:

- ***JCSm/FCSm*** Relative impact of the used journal set
- ***CPP/JCSm*** Internat. journal-normalized impact
- ***CPP/FCSm*** Internat. field & doc-normalized impact

- ***Pt/Πt*** Contribution to the top-5, 10, 20,..%
- ***P*CPP/FCSm*** Size & Impact Together: Brute Force

Application of Thomson-ISI Impact Factors for research performance evaluation is **irresponsible**

* Much too short 'Citation window'
* No Field-specific Normalization
* No distinction between document types
* Calculation errors/inconsistencies

  nominator/denominator
* Underlying citation distribution is very skew:

  IF-value heavily determined by a few very highly cited papers

Basic res

hig

High CPP

high FCSm, but
low JCSm

low FCSm, but
high JCSm

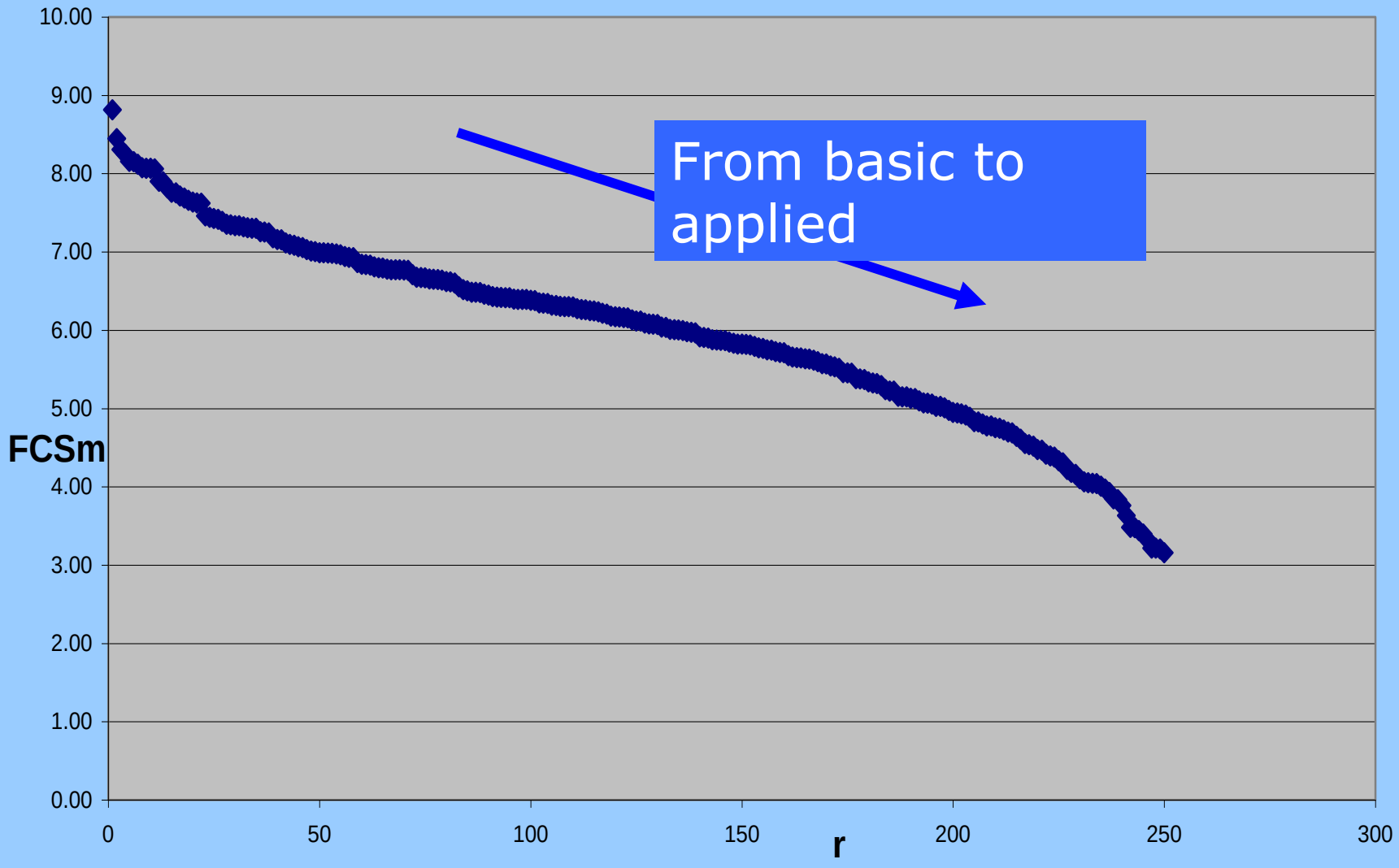
low CPP

low FCSm

Up to factor ~20

Applied research,
engineering

Ranking of the 250 largest European universities by FCSm



Field normalization

CPP >> *CPP/FCSm* is absolutely necessary

but

CPP: is as it is…..

FCSm: *do we apply the right field-specific normalization?*

Problems: size of the field, appropriateness of the WoS-category, role of underlying distribution function (>small non-linearity)?

..and on the basis of the 30,000,000 grammatically parsed publication abstracts (1980-2008):

2. Field = clusters of concept-related publications

new, emerging often interdisc. Fields

*scientific **fine-grained** structure*

Models

power law (w1), scale free networks (w2), growth (w3), universal scaling (w4),.....

	w1	w2	w3	.	.	wm
p1						
p2						
p3						
p4						
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pn						

	w1	w2	w3	.	.	wm
w1						
w2						
w3						
w4						
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wm						

ng information
the existing nodes in the
t the distribution of the [illegible] of incoming links to a node follows a universal scaling
ys as a [illegible] on controlled not only by the system size
not previ[illegible]work "accessible" to the node. We test our
data for [illegible]t.

sRevLet[illegible], 84.35.+i, 89.75.Da, 89.75.Hc

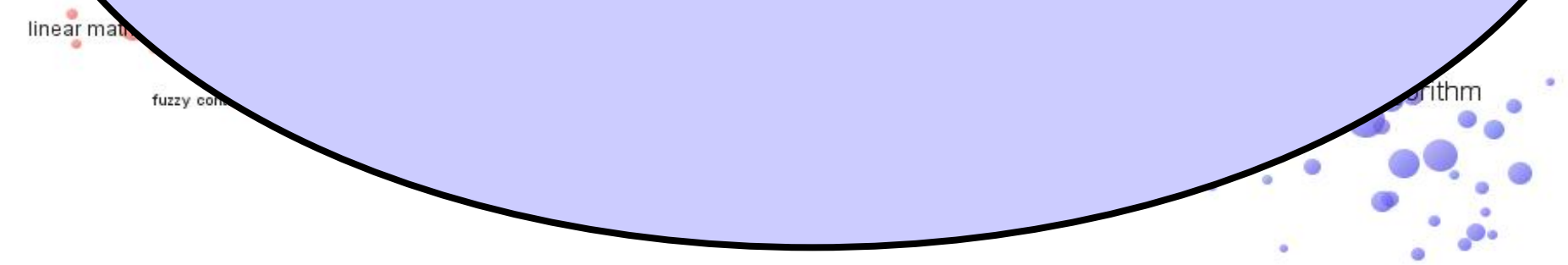
Th[illegible] in unde[illegible]hanisms of global networks [1–3], such as the World Wide
We[illegible]. Netwo[illegible]such as Internet attacks [2], spread of an Email virus [7], or
dy[illegible]ll these [illegible]mber of links play an important role on the dynamics of the
sys[illegible]w the gl[illegible]ts precise distribution of the number of links.
Re[illegible]oth the [illegible] properties; that is, the number of incoming links and the
nu[illegible]ode hav[illegible]w tails [4–6]. It has been proposed [9] that the scale-free
str[illegible] may be explained by a mechanism referred to as "preferential attachment" [10] in which new nodes link to
ex[illegible]ortional to the number of existing links to these nodes. Here we focus on the *stochastic* character of the
pre[illegible]hich we understand in the following way: New nodes want to connect to the existing nodes with the largest
nu[illegible]degree—because of the advantages offered by being linked to a well-connected node. For a large network it
is [illegible]now the degrees of all existing nodes, so a new node must make a decision on which node to connect with
ba[illegible]t the state of the network. The preferential attachment mechanism then comes into play as nodes with a
larger degree are more likely to become known.

CI2 label 1

Now specific sub-field CPP/FCSm values can be calculated, e.g., the normalized citation impact for research on **genetic algorithms**

instead of normalization based on much larger fields such as **Computer Science**

But, obviously, the finer grained, the more 'noisy'

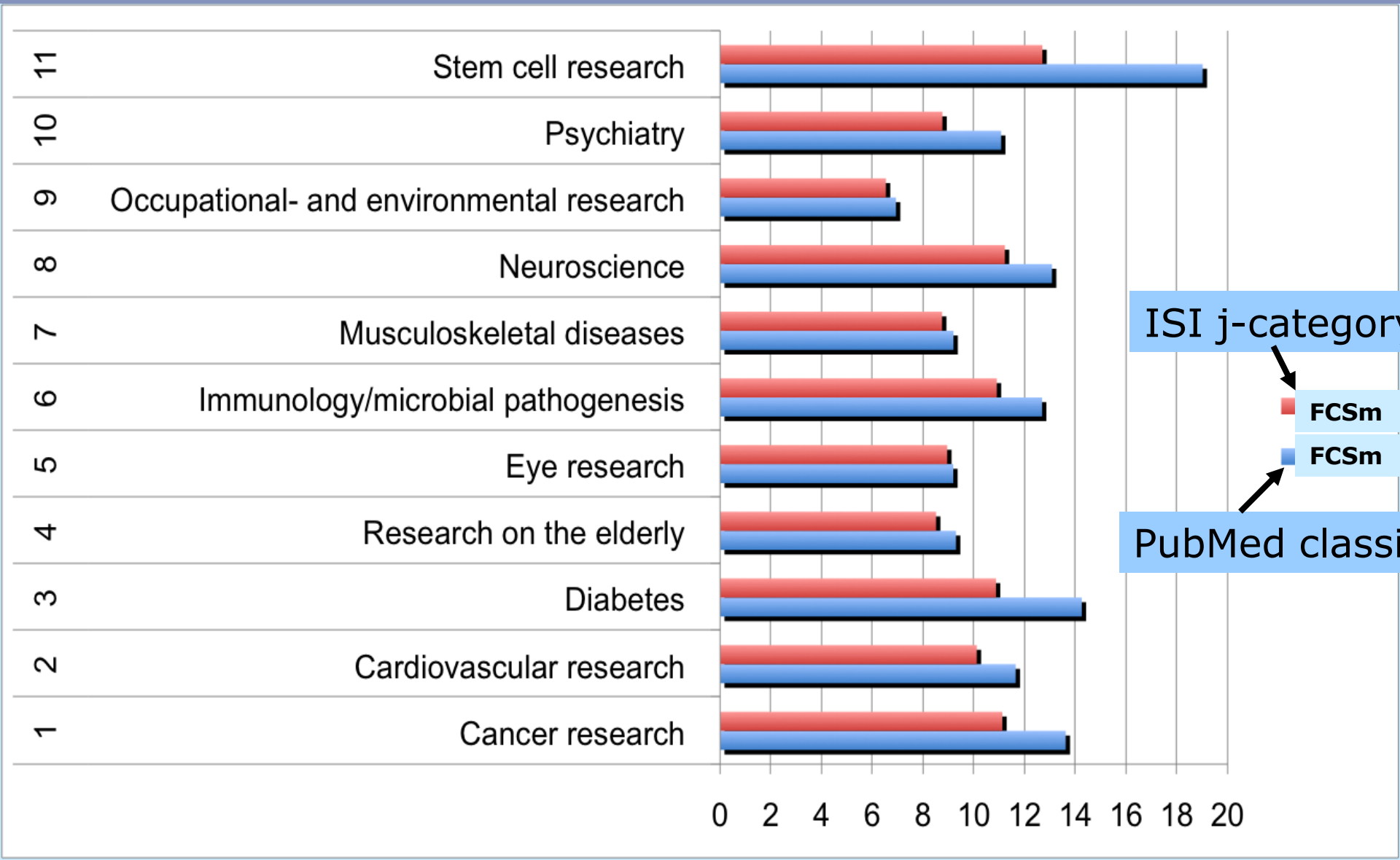


3.Field = set of publications with thematic/field-specific classification codes e.g., from PubMed

again for new, emerging often interdisc. fields

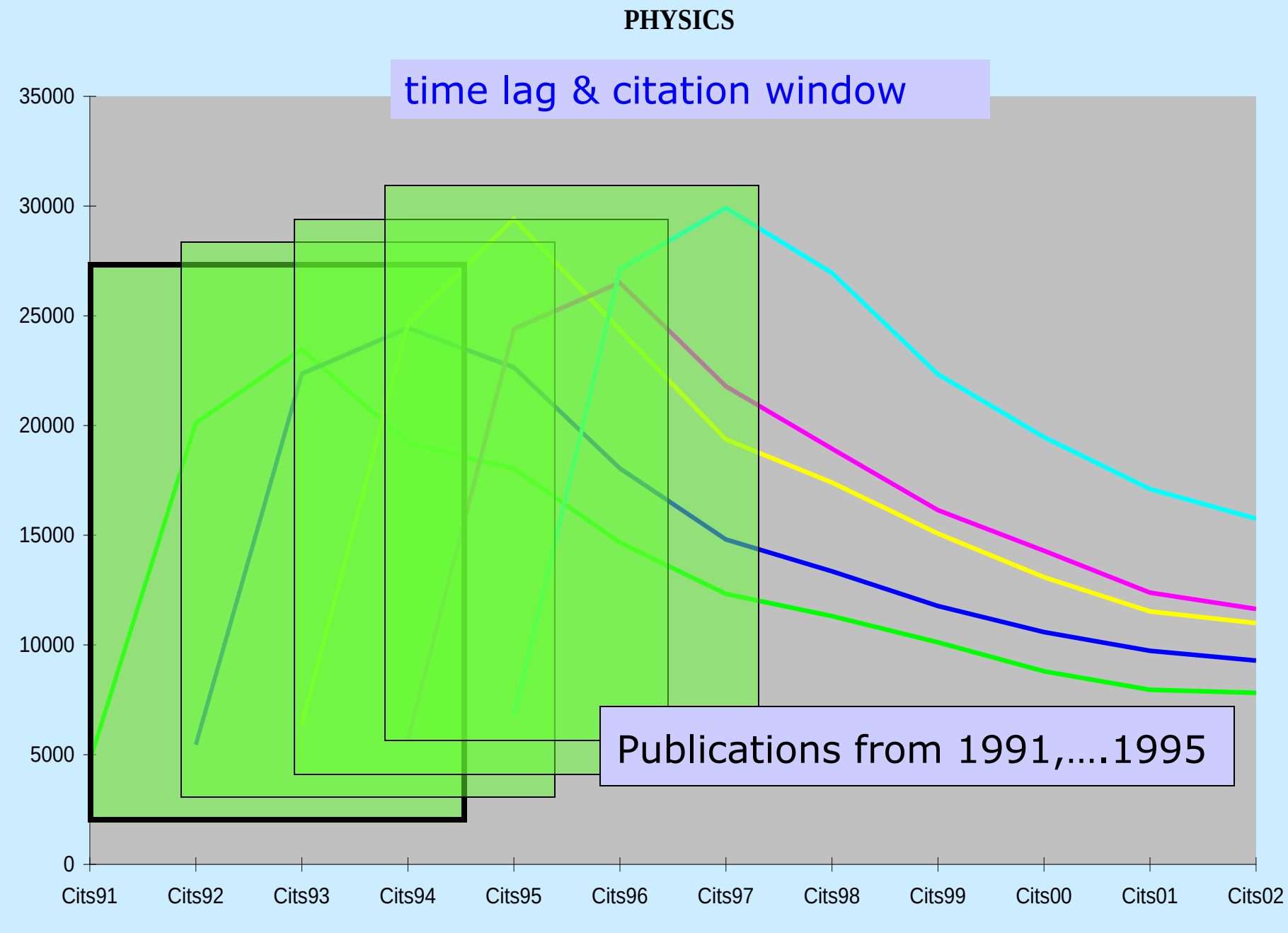
*scientific **fine-grained** structure*

Problem of the 'right' FCSm…..



Physics 1997-2006					
	P	CPP	CPP/ FCSm(RCUK)	CPP/ FCSm(WoS)	JCSm/ FCSm(WoS)
Canada	42,791	7.97	1.29	1.42	1.37
France	107,183	6.67	1.08	1.23	1.18
Germany	157,615	7.77	1.26	1.37	1.26
Japan	173,344	5.40	0.87	1.04	1.12
Netherlands	29,743	9.32	1.51	1.63	1.39
UK	103,885	8.09	1.31	1.39	1.25
USA	381,338	10.09	1.63	1.73	1.48

Physics papers in *Nature* & *Science* 1997-2006					
	P	CPP	CPP/ FCSm(RCUK)	CPP/ FCSm(WoS)	JCSm/ FCSm(WoS)
Canada	66	55.20	8.94	1.56	3.09
France	199	57.04	9.23	2.07	3.09
Germany	281	64.57	10.45	2.25	3.11
Japan	231	82.21	13.31	2.77	3.12
Netherlands	136	101.85	16.49	3.29	3.19
UK	233	76.63	12.41	2.59	3.22
USA	1,710	79.60	12.89	2.55	3.14


PHYSICS
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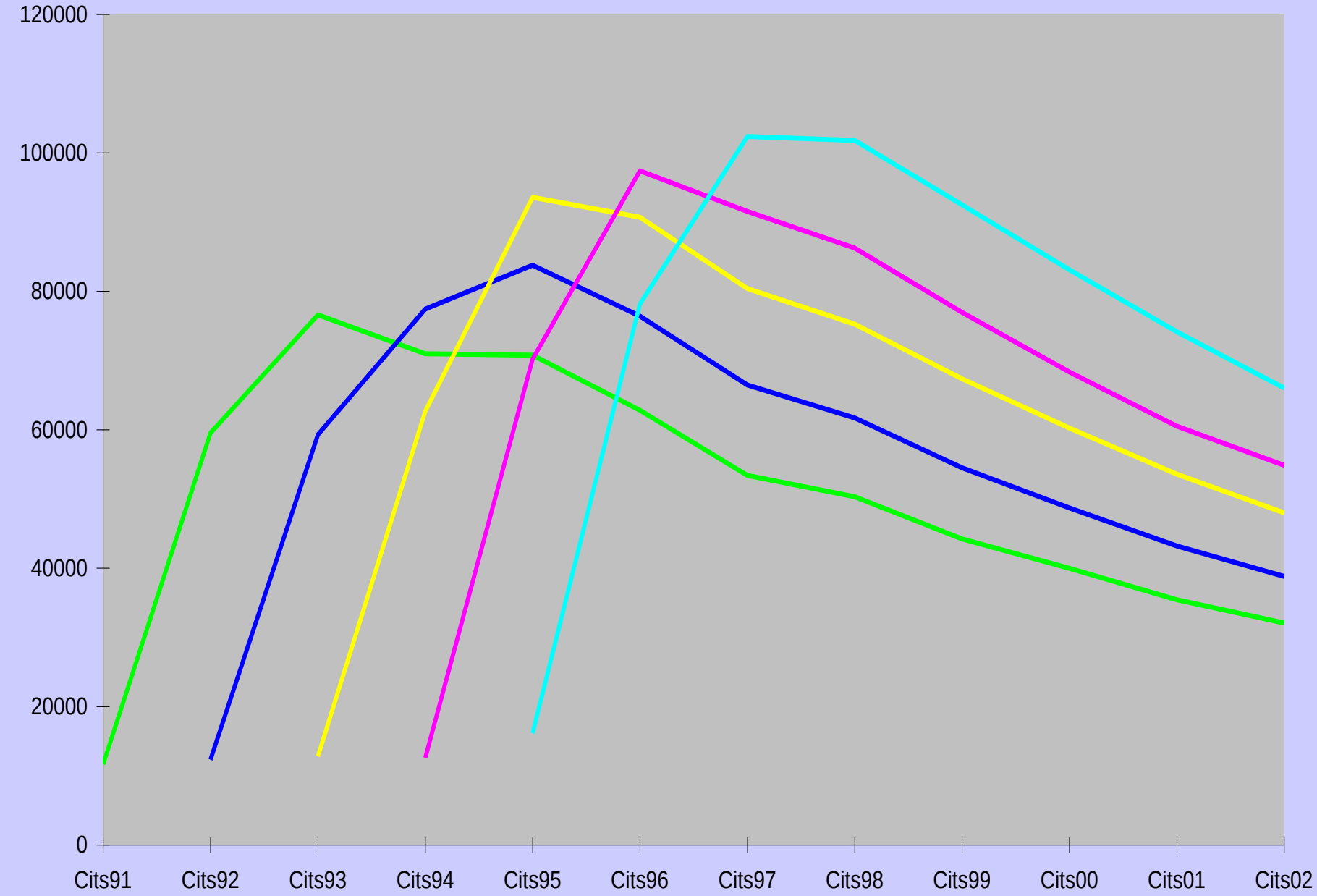
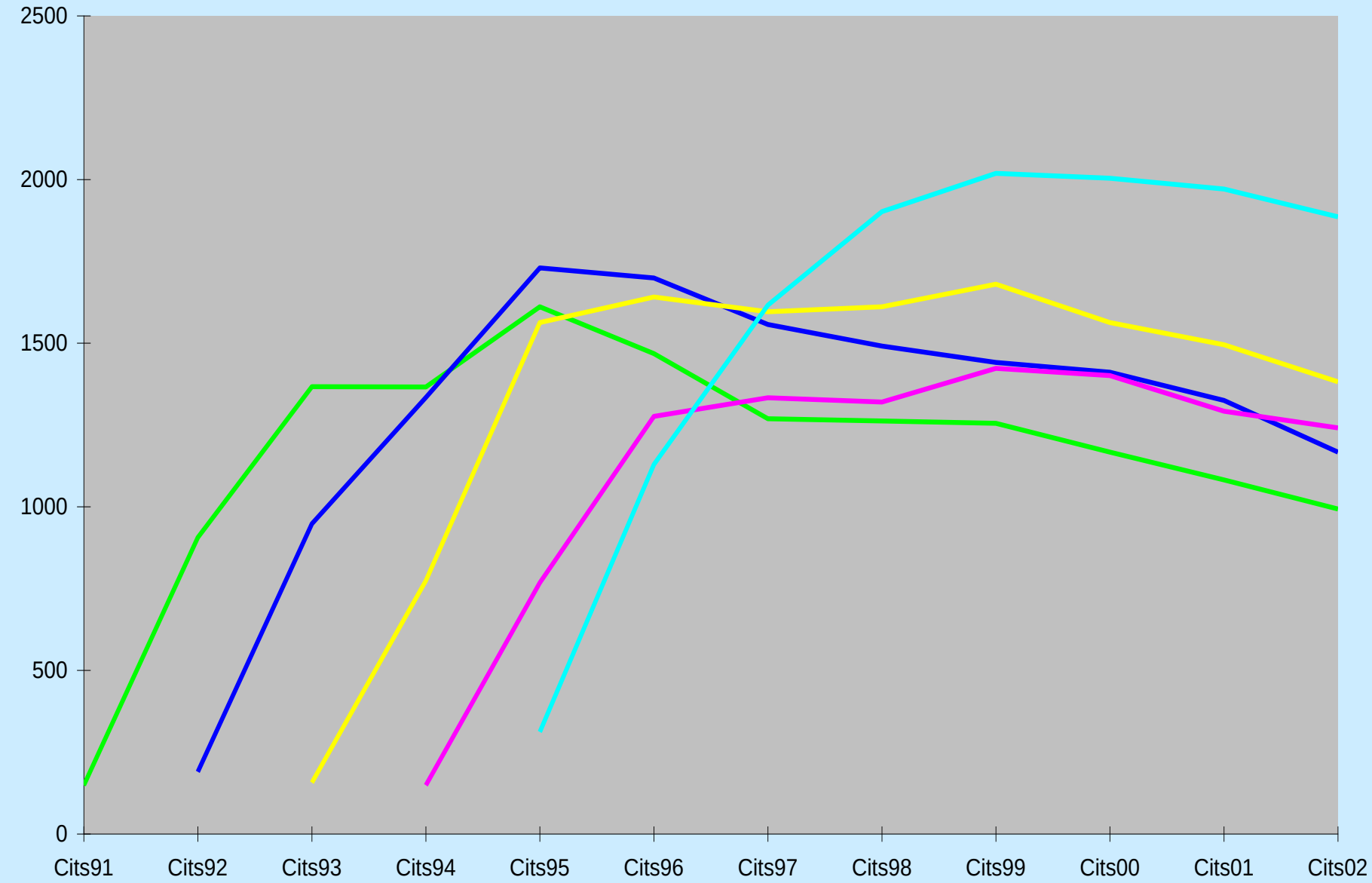
Publications from 1991,….1995

BIOCH & MOL BIOL



* SOCIOLOGY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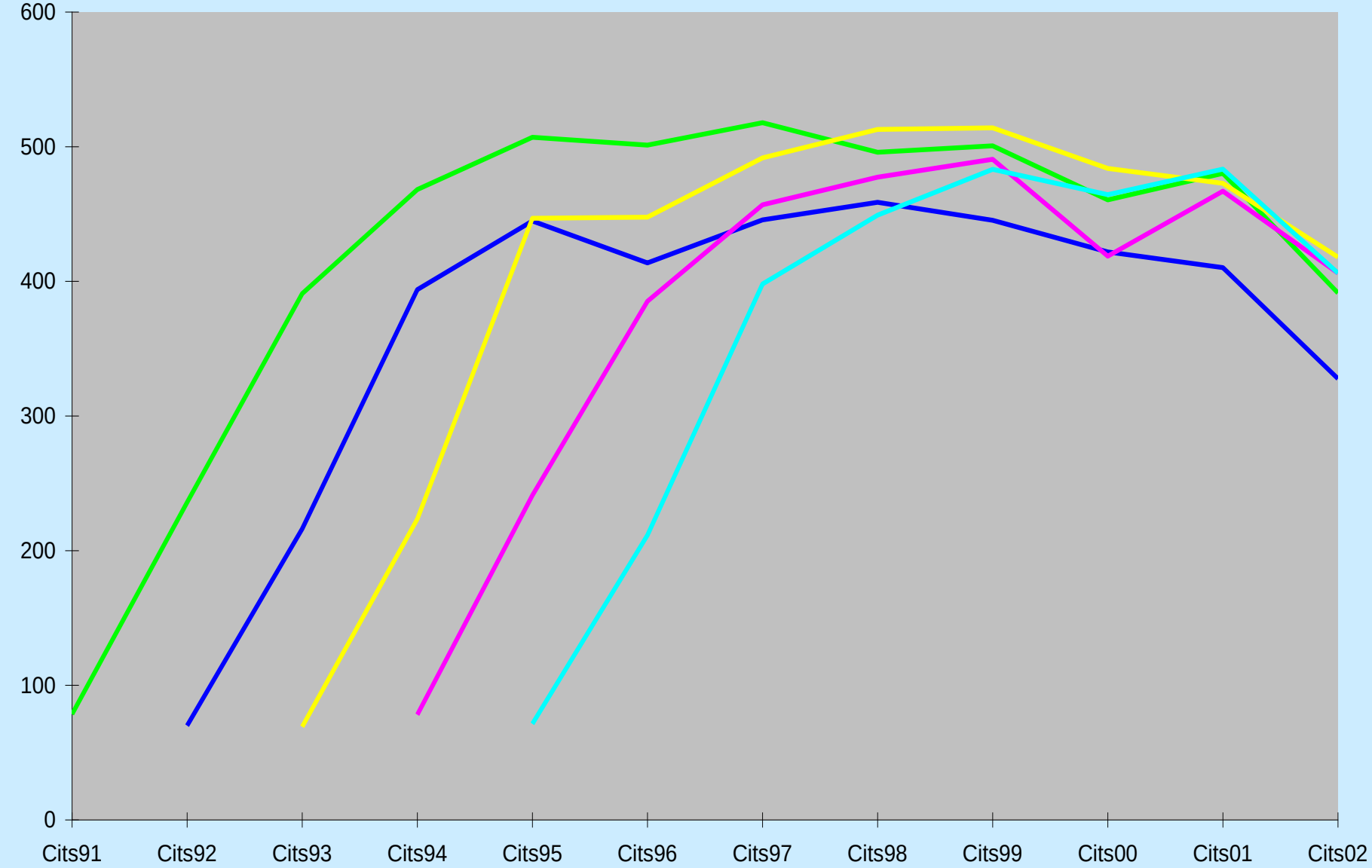
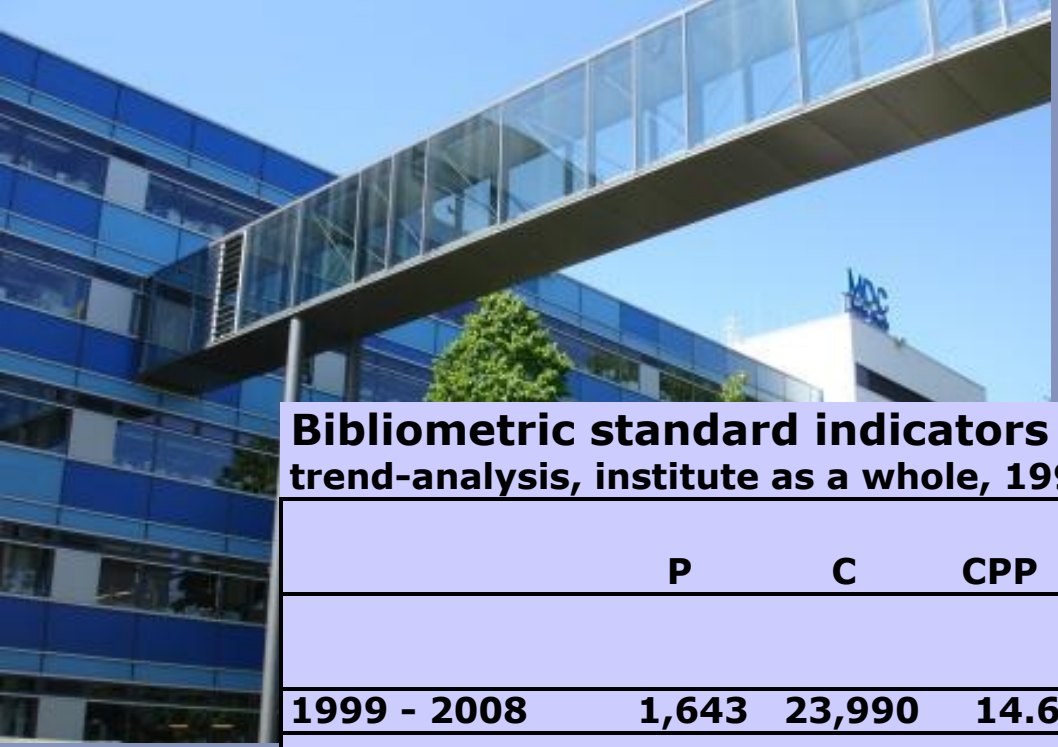
*** LANGUAGE&LING**

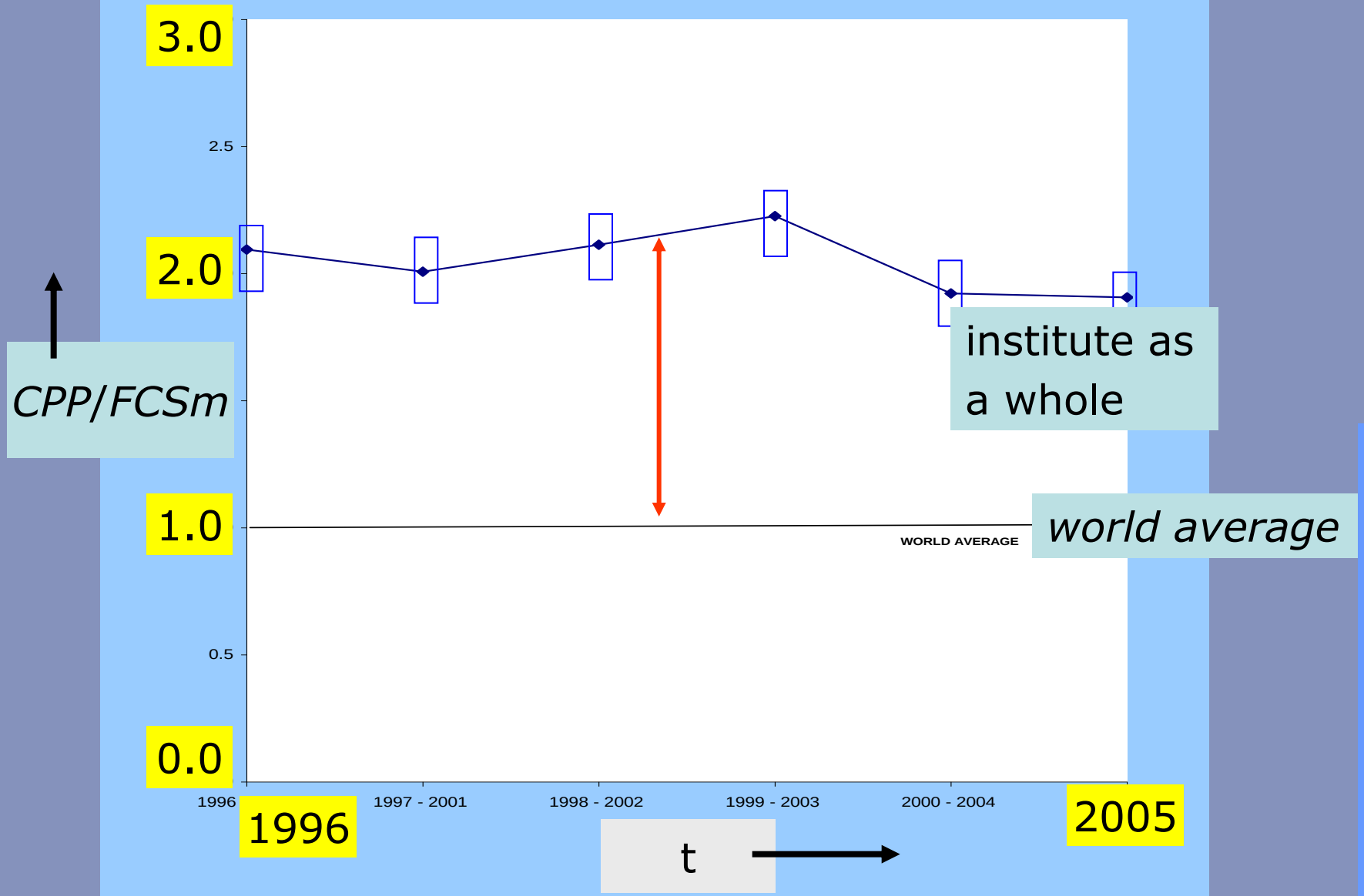




Bibliometric standard indicators
trend-analysis, institute as a whole, 1999-2008

	P	C	CPP	Pnc	CPP/ JCSm	CPP/ FCSm	JCSm/ FCSm	Self-Cit
1999 - 2008	**1,643**	**23,990**	**14.6**	**14%**	**1.08**	**1.34**	**1.24**	**20%**
1999 - 2002	625	2,882	4.61	34%	1.16	1.38	1.19	26%
2000 - 2003	610	2,971	4.87	34%	1.13	1.40	1.24	25%
2001 - 2004	615	3,038	4.94	35%	1.14	1.33	1.17	26%
2002 - 2005	632	3,010	4.76	33%	1.09	1.27	1.16	27%
2003 - 2006	646	3,220	4.98	30%	1.01	1.27	1.25	27%
2004 - 2007	677	3,397	5.02	31%	1.04	1.29	1.24	27%
2005 - 2008	718	4,134	5.76	27%	1.05	1.40	1.33	26%

FIGURE 1 :
TREND IN IMPACT PER PUBLICATION
COMPARED TO WORLD SUBFIELD AVERAGE



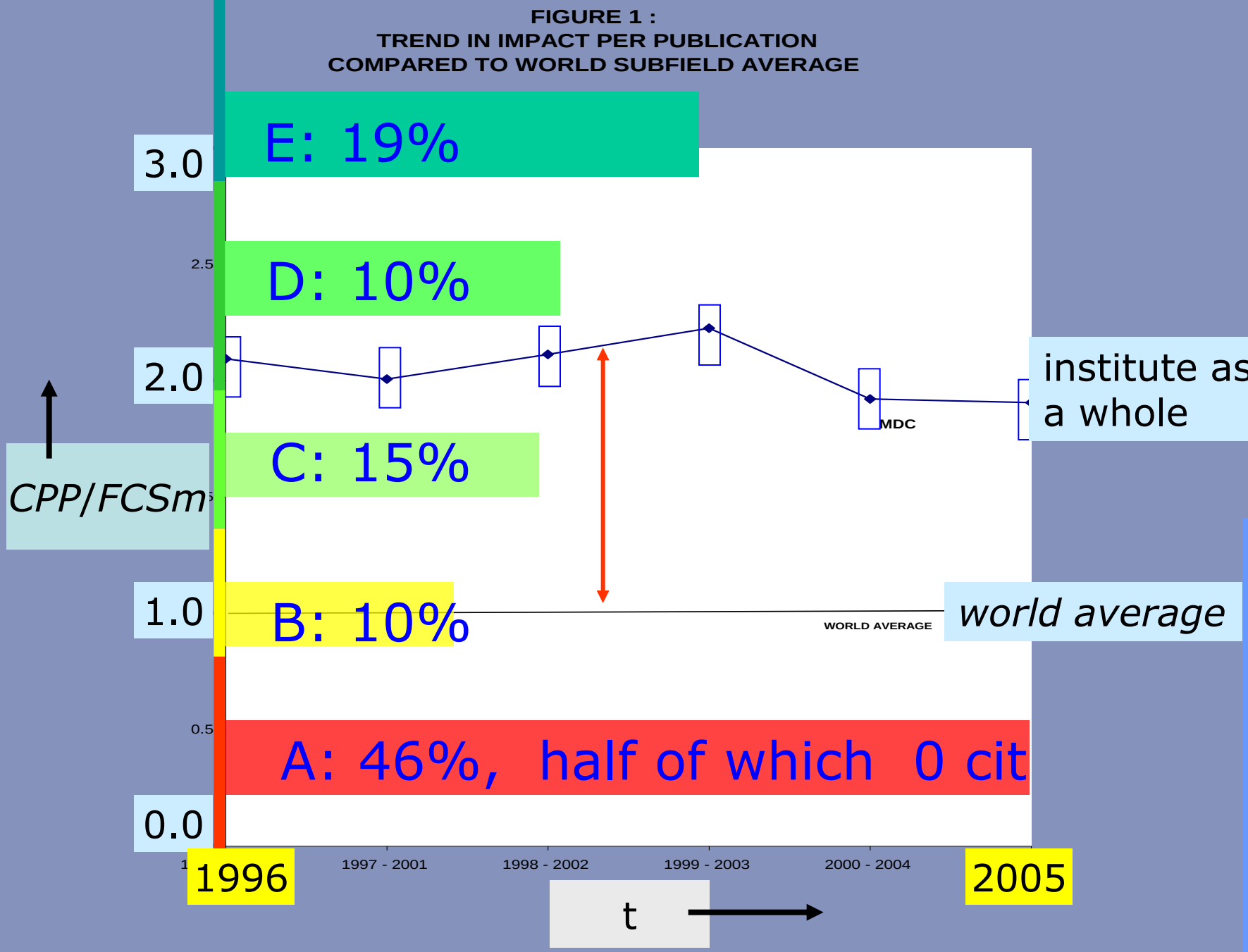
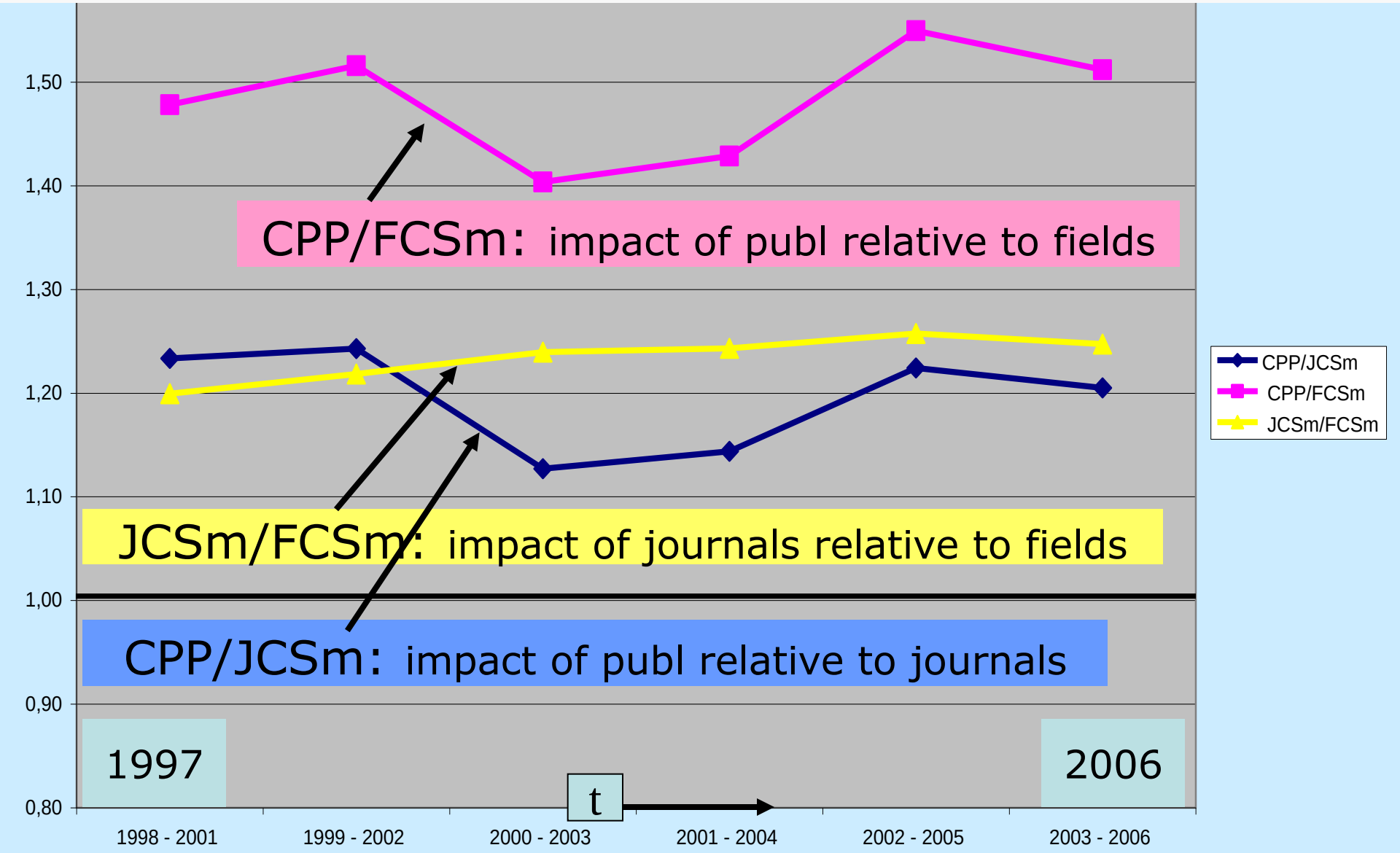
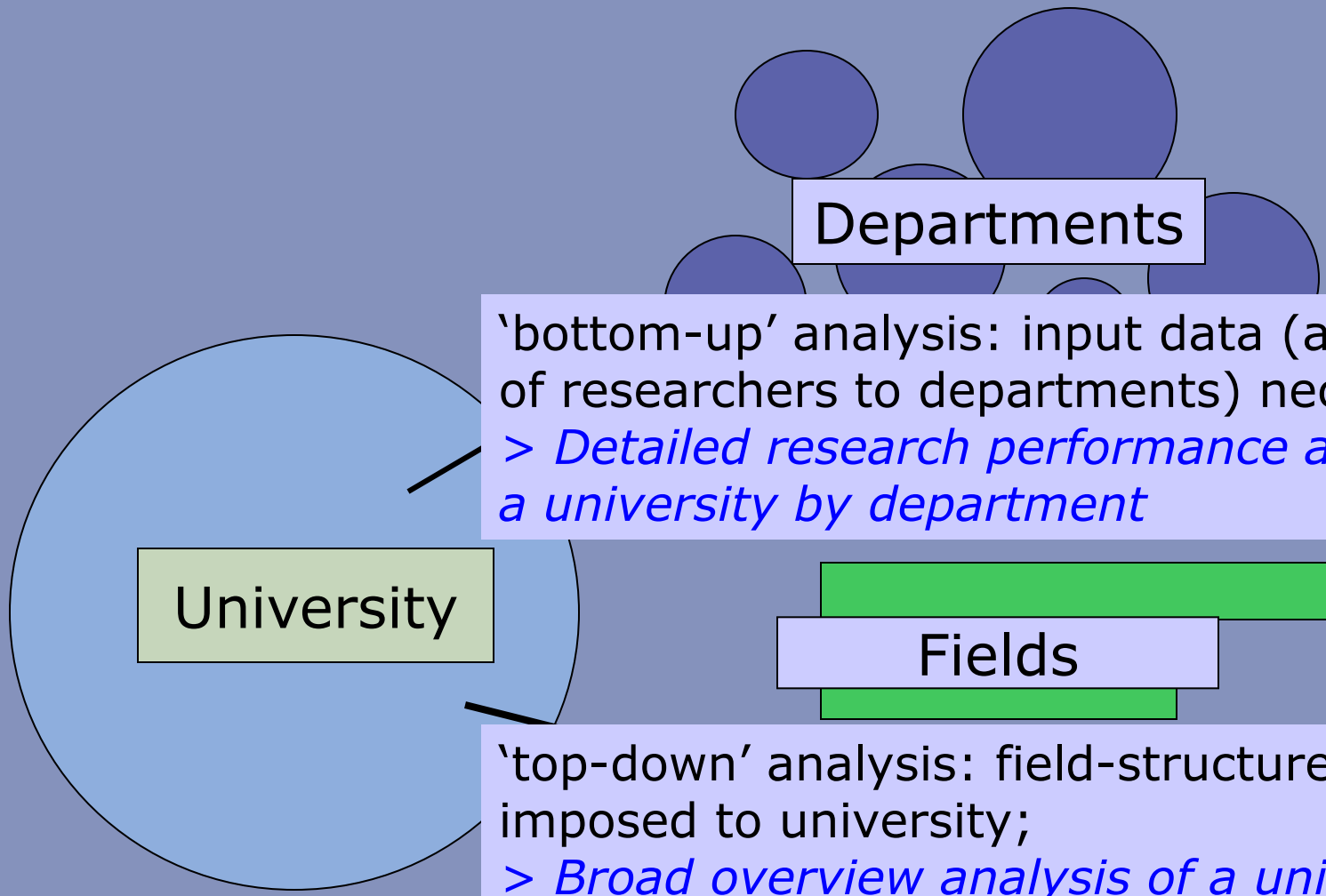


FIGURE 1 :
TREND IN IMPACT PER PUBLICATION
COMPARED TO WORLD SUBFIELD AVERAGE
E: 19%
D: 10%
C: 15%
B: 10%
A: 46%, half of which 0 cit
3.0
2.5
2.0
1.0
0.5
0.0
CPP/FCSm
MDC
WORLD AVERAGE
institute as a whole
world average
1996
1997 - 2001
1998 - 2002
1999 - 2003
2000 - 2004
2005
t

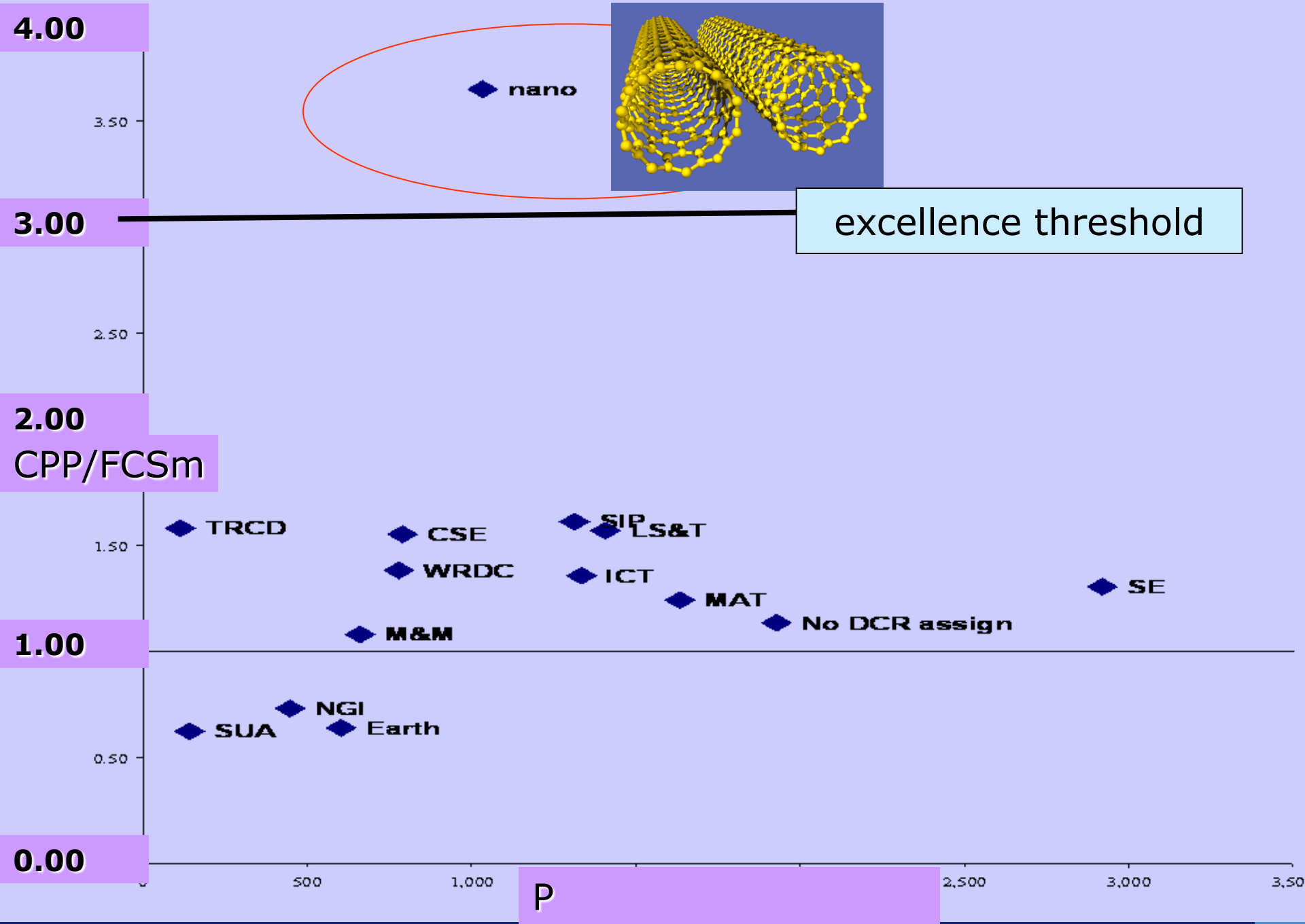
International impact of VUMC publications 1997-2006





'bottom-up' analysis: input data (assignment of researchers to departments) necessary;
> Detailed research performance analysis of a university by department

'top-down' analysis: field-structure is imposed to university;
> Broad overview analysis of a university by field


4.00
3.50
3.00
2.50
2.00
CPP/FCSm
1.50
1.00
0.50
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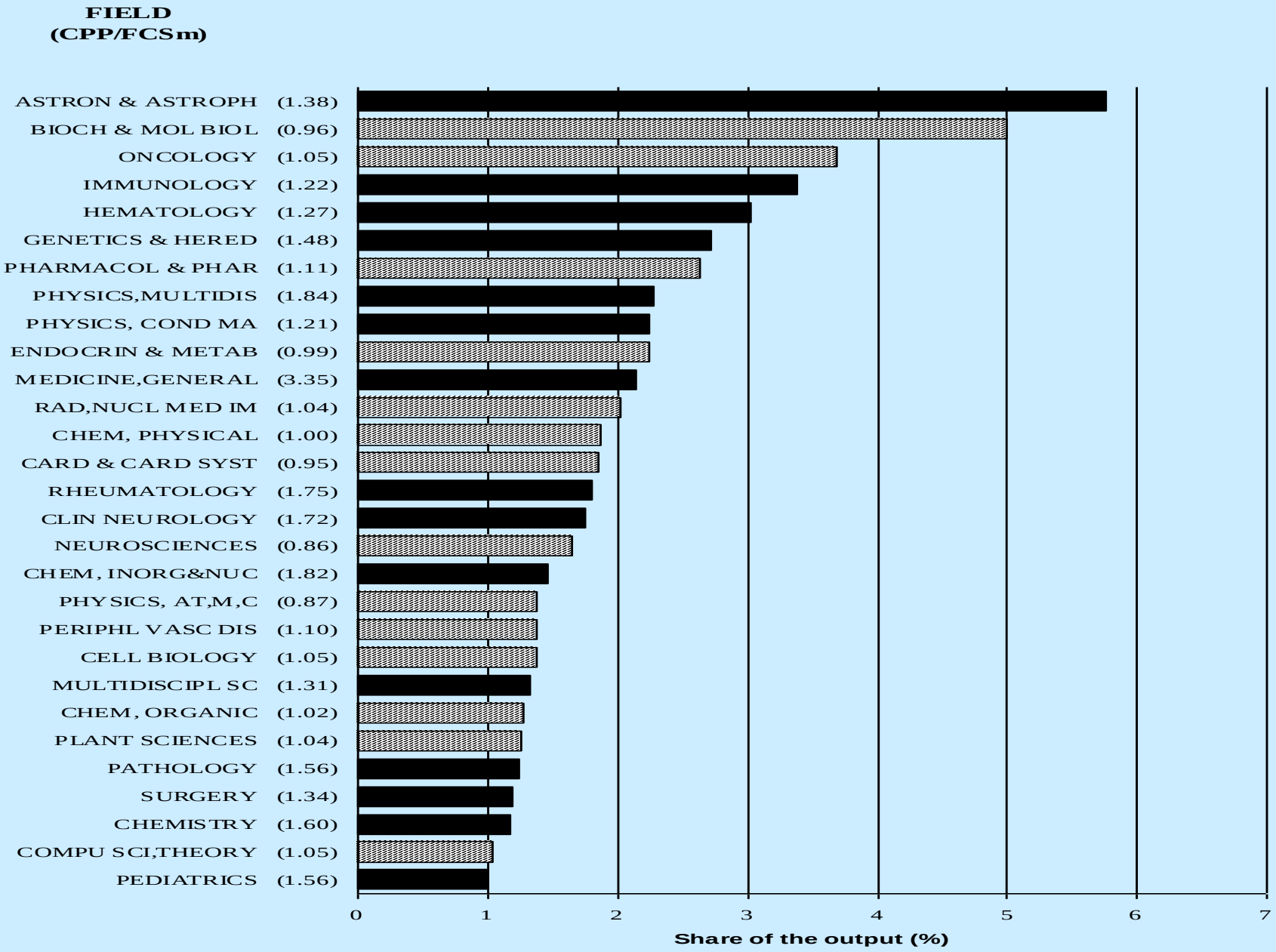
nano
excellence threshold
TRCD
CSE
SIP
LS&T
WRDC
ICT
MAT
SE
No DCR assign
M&M
NGI
SUA
Earth
500
1,000
2,500
3,000
3,50
P

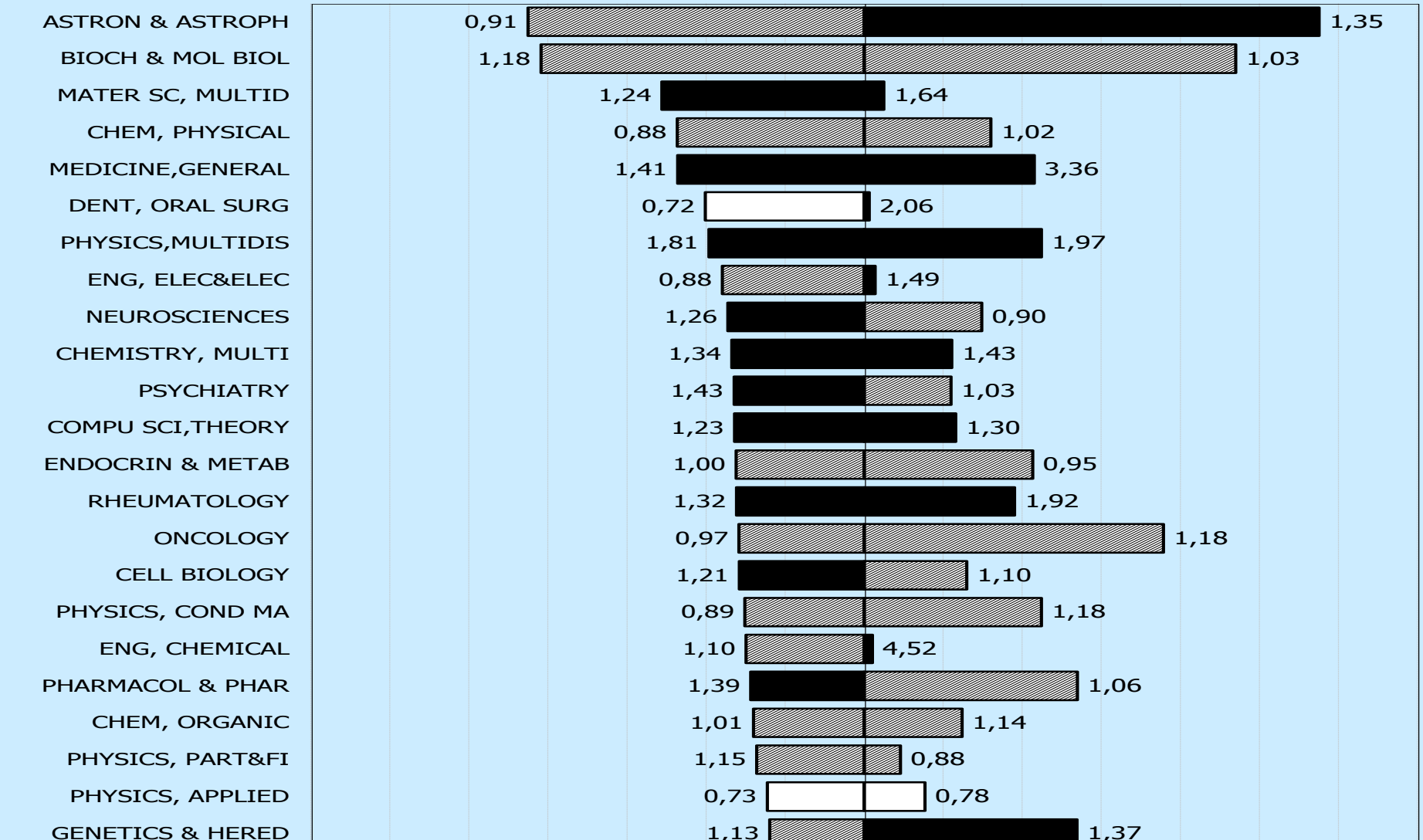
Output and impact per field
2000 - 2003

Leiden University



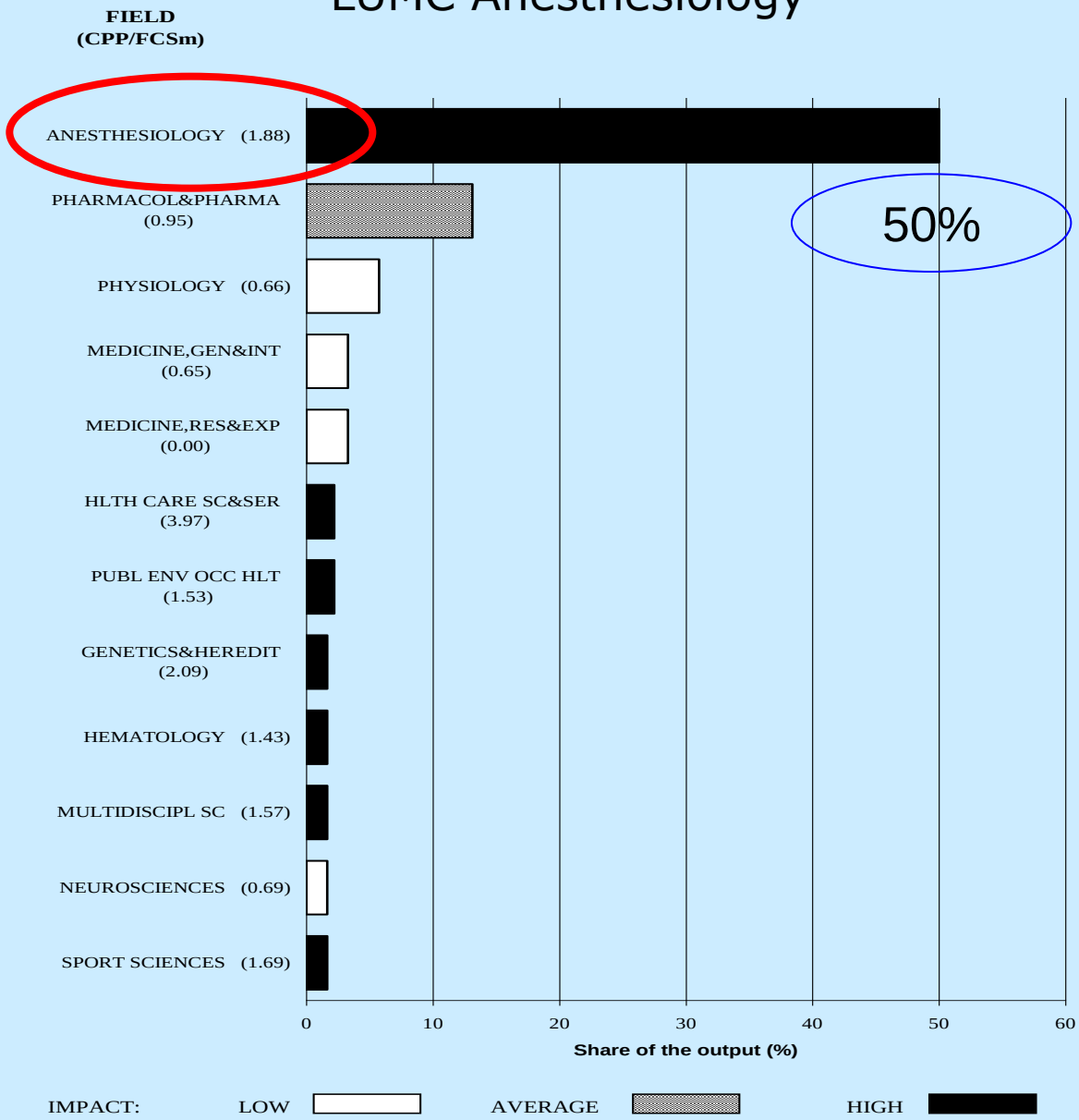
RESEARCH AND IMPACT PROFILE COMPARISON 2000 - 2005

Large UK University vs. Leiden University

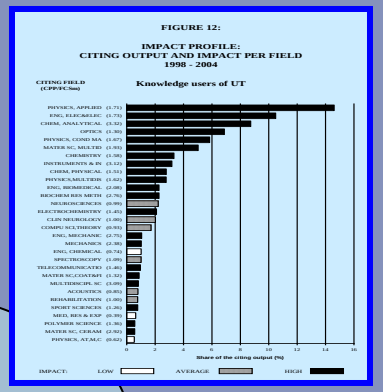


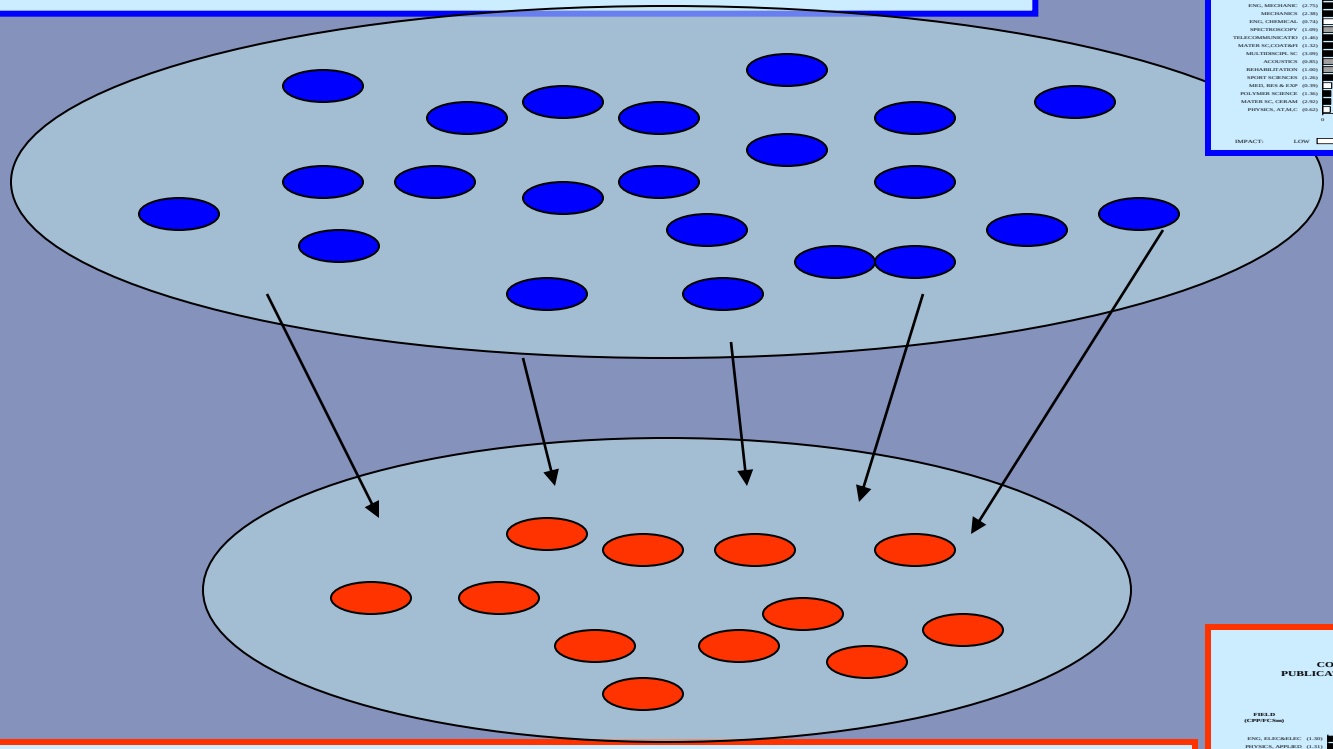
RESEARCH PROFILE
OUTPUT AND IMPACT PER FIELD
2003 - 2007

LUMC Anesthesiology

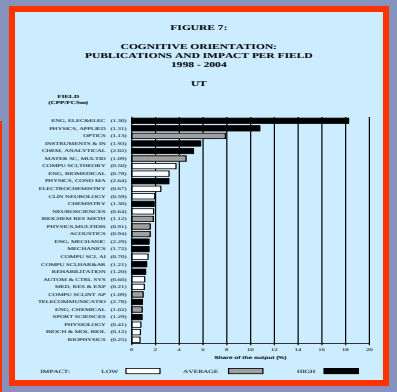


Citing Publications: Knowledge users with field-specific profile



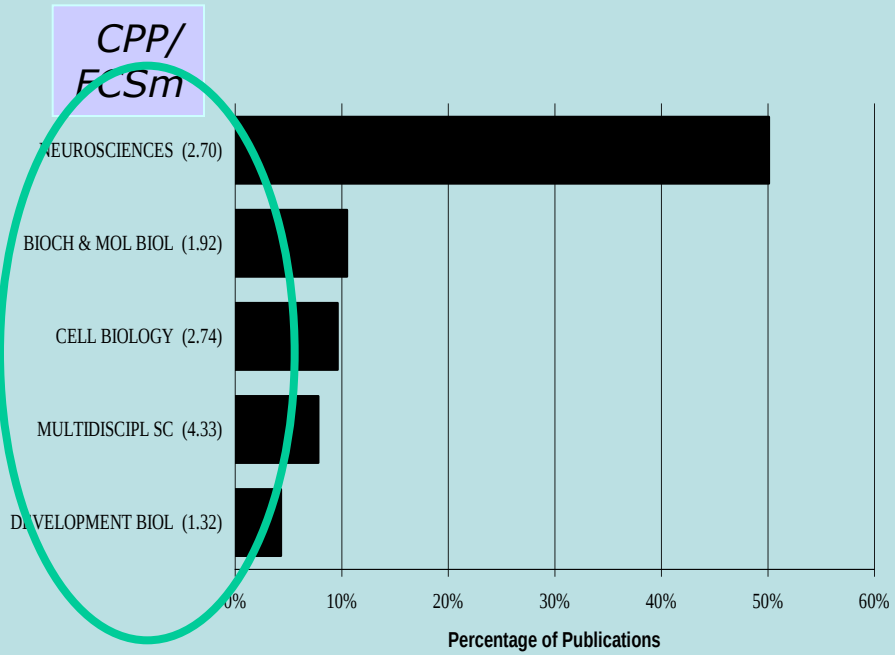


Cited Publications: Knowledge producers with field-specific profile



Diseases of the Neurosystem

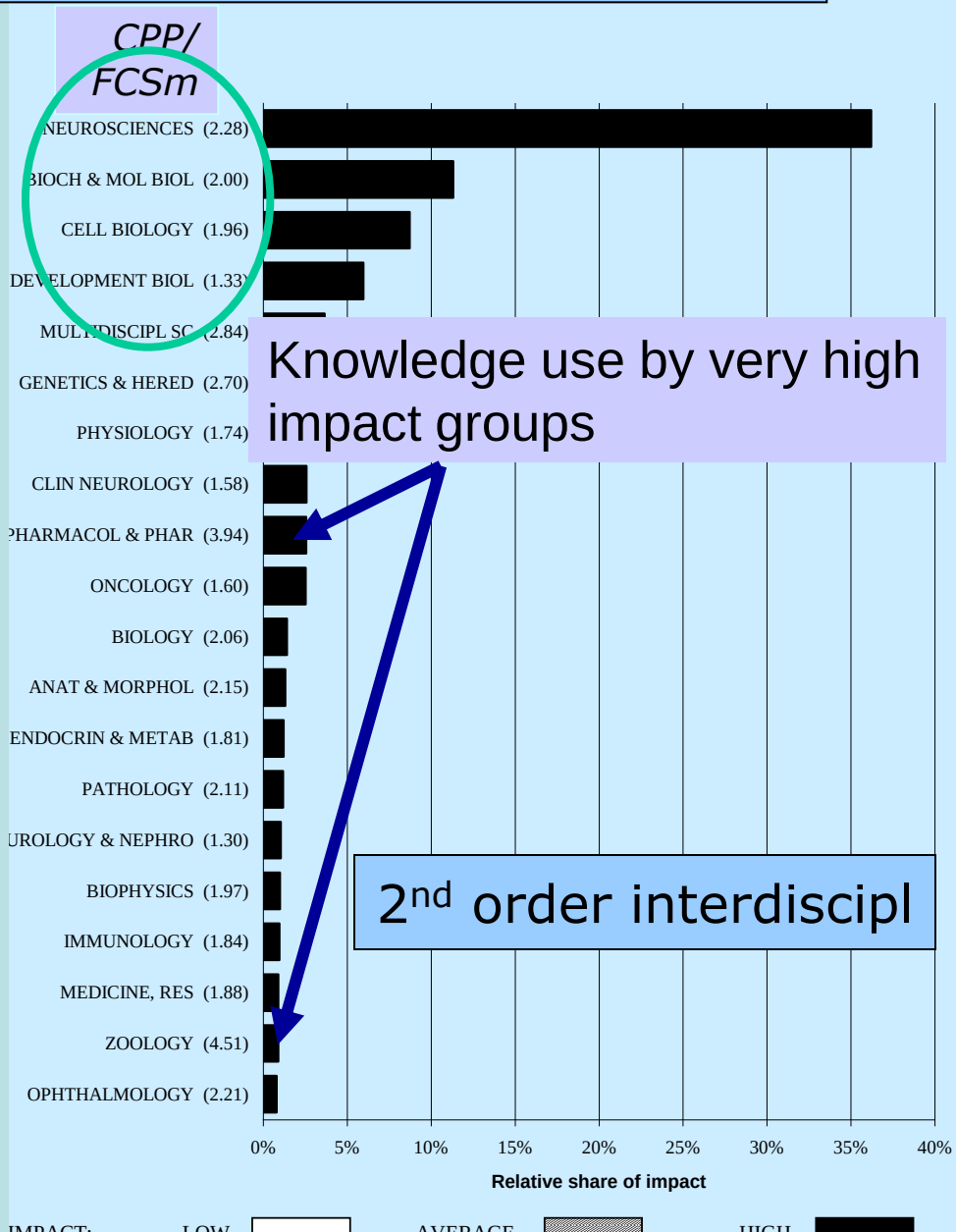
Dept Output in Fields



1st order interdiscipl

IMPACT: LOW AVERAGE HIGH

Dept Impact from Fields



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File

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Save similarities...

Save coordinates...

Save screenshot...

Info

VOSviewer manual

About VOSviewer

Label View | Density View | Cluster Density View | Scatter View

commercial mortgage
prepayment
real estate return
default risk
borrower
derivative
mortgage
pricing
price
credit
applicant
asset
externality
spatial heterogeneity
accuracy
gradient
slope
golf course
plant
habitat
landscape
productivity
land use pattern
manufacturing
bond
homeownership
wage
export
damage
urban landscape
voucher
housing policy
globalization
waste
governance
hispanics
whites
race
white
meaning
school district
learning
studio
school
administrator
design studio
student
teacher
classroom
student achievement

Find | VOS | Options

File

Open map...

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VOSviewer manual

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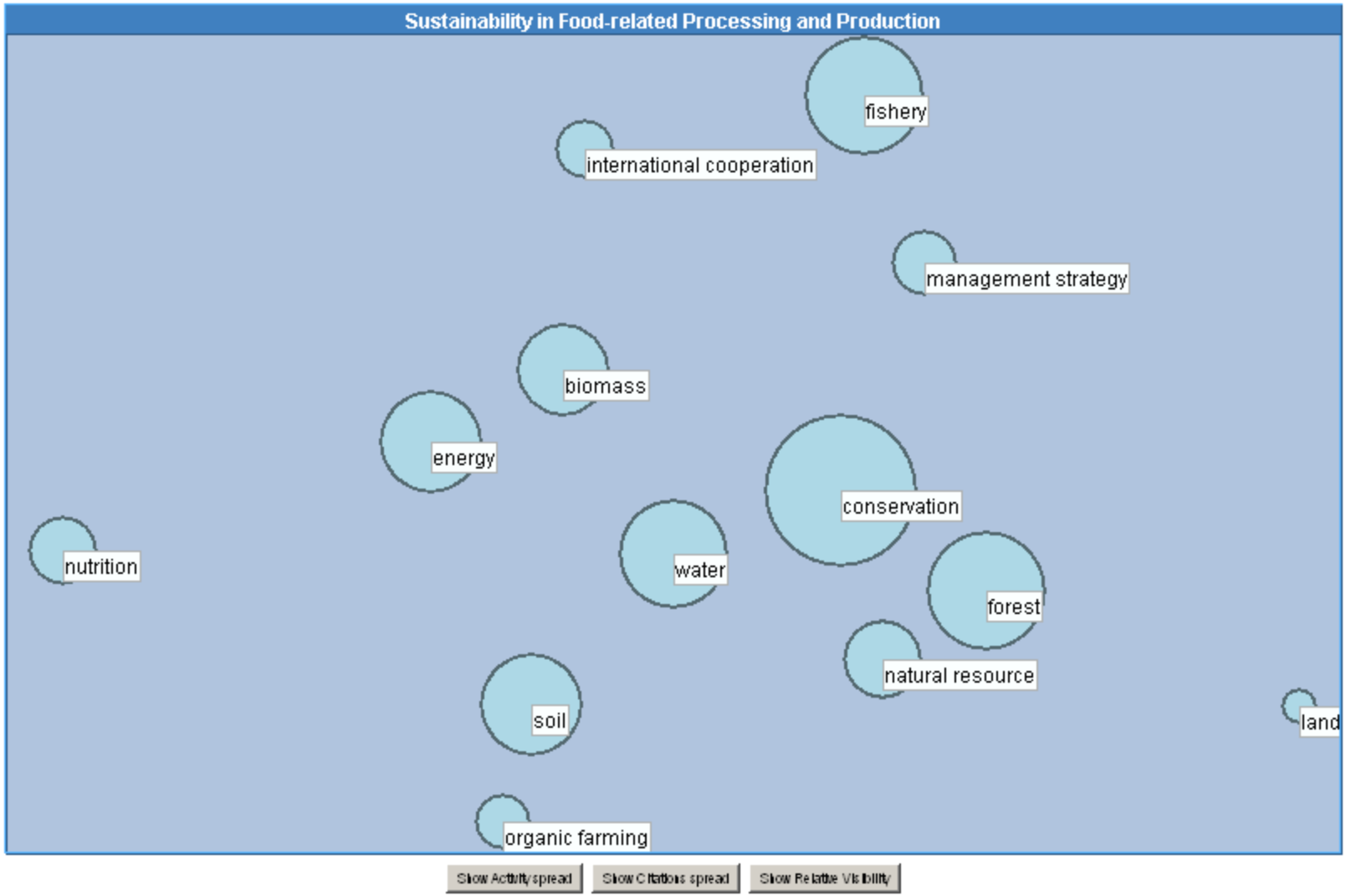
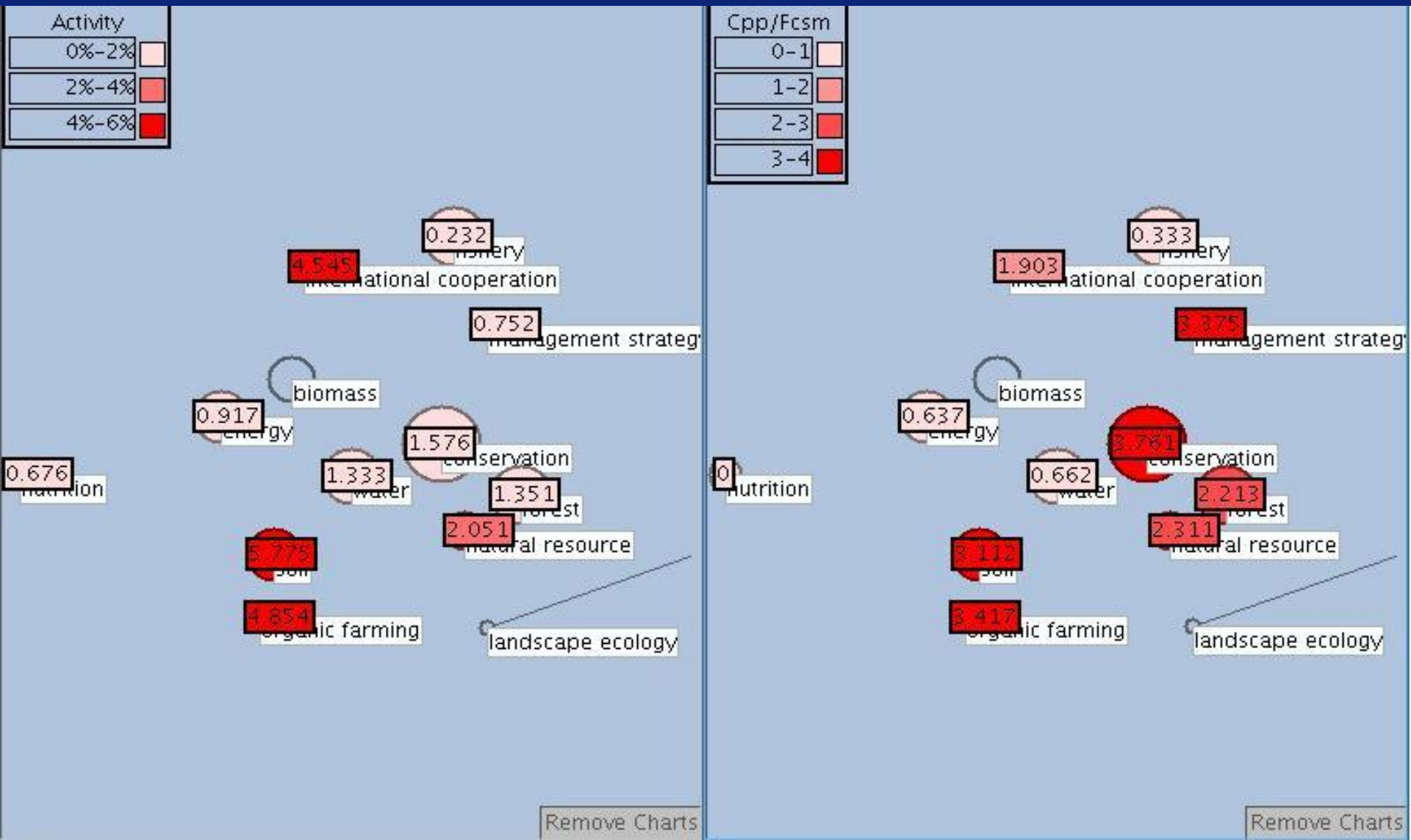
Label View | Density View | Cluster Density View | Scatter View

mortgage
payment
real estate return
risk
borrower
derivative
market value
mortgage market
portfolio
mortgage
pricing
seller
appraisal
mortgage lending
price
credit
applicant
asset
externality
congestion
accuracy
acre
spatial heterogeneity
green belt
golf course
slope
gradient
population density
urban fringe
productivity
land use pattern
plant
habitat
specie
bond
commute
manufacturing
urban expansion
landscape
homeownership
export
air pollution
wage
regional economy
damage
urban landscape
voucher
housing policy
globalization
waste
visualization
designer
shelter
prejudice
urban poverty
governance
landscape architecture
hispanics
whites
race
meaning
design process
white
career
accountability
school district
youth
learning
achievement
studio
school
administrator
design studio
public school
pedagogy
service learning
high school
student
teacher
curriculum
classroom
student achievement



Thematic Performance Wageningen University Sustainability-Food



Conclusion

Advanced bibliometric analysis is a powerful tool to make research assessment more objective, transparent and effective, particularly in the natural science and medical fields, and in several of the engineering and social science fields -but never use it as a stand-alone tool;

It is also an effective instrument for measuring interdisciplinarity, knowledge flows and knowledge diffusion, participation in solving societal/technological/economic problems

A scientist has index *h*
if *h* of his/her *N* papers have at least *h* citations each
and the other (*N*-*h*) papers have no more than *h* citations each

Search Results -- Summary

.U=(vanraan A*)
ocType=All document types; Language=All languages; Databases=SCI-EXPANDED, SSCI, A&HCI; Timespan=1945-2006

Search within results: En

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Subject Categories | Source Titles | Document Types | Authors | Publication Years

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1. MOED HF, BURGER WJM, FRANKFORT JG, et al.
THE USE OF BIBLIOMETRIC DATA FOR THE MEASUREMENT OF UNIVERSITY-RESEARCH PERFORMANCE
RESEARCH POLICY 14 (3): 131-149 1985
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2. **VANRAAN AFJ**, DEJONGH JP, VANECK J, et al.
ABSOLUTE CROSS SECTIONS FOR EXCITATION OF HELIUM BY ELECTRONS (20-2000EV) AND POLARIZATION OF EMITTED RADIATION
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Times Cited: 56
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3. **vanRaan AFJ**
Advanced bibliometric methods as quantitative core of peer review based evaluation and foresight exercises
SCIENTOMETRICS 36 (3): 397-420 JUL-AUG 1996
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4. BRAAM RR, MOED HF, **VANRAAN AFJ**
MAPPING OF SCIENCE BY COMBINED COCITATION AND WORD ANALYSIS .1. STRUCTURAL ASPECTS
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12. PETERS HPF, BRAAM RR, **VANRAAN AFJ**
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13. **VanRaan AFJ**
Scientometrics: State-of-the-art
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RESEARCH POLICY 23 (4): 443-457 JUL 1994
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15. TIJSSEN RJW, **VANRAAN AFJ**
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16. NEDERHOF AJ, **VANRAAN AFJ**
A BIBLIOMETRIC ANALYSIS OF
RESEARCH POLICY 22 (4): 353-
Times Cited: 19
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17. NEDERHOF AJ, MEIJER RF, MOE
RESEARCH PERFORMANCE INDIC
SCIENTOMETRICS 27 (2): 157-178 JUN 1993
Times Cited: 18
S·F·X

18. PETERS HPF, **VANRAAN AFJ**
CO-WORD-BASED SCIENCE MAPS OF CHEMICAL-ENGINEERING .2. REPRESENTATIONS BY COMBINED CLUSTERING AND MULTIDIMENSIONAL-SCALING
RESEARCH POLICY 22 (1): 47-71 FEB 1993
Times Cited: 18
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19. MOED HF, BURGER WJM, FRANKFORT JG, et al.
A COMPARATIVE-STUDY OF BIBLIOMETRIC PAST PERFORMANCE ANALYSIS AND PEER JUDGMENT
SCIENTOMETRICS 8 (3-4): 149-159 1985
Times Cited: 17

Hirsch (h-) index AFJ van Raan =

18

A has **6** publ: **5** are cited 5 times, 1 is not cited
H= **5**

B has **6** publ: 4 are cited 4 times**, 2 are cited 5 times**
H= **4**

r(B) **<** r(A)

This is unnatural and very difficult to justify.

We call this an inconsistent indicator.

Group **A**, 5 res, each res 5 publ, each publ 5 cit >> each res H=5, there are 25 publ with 5 cit (C=125)

Group **B**, 5 res, each res 2 publ with 10 cit and 3 publ uncited >> each res H=2, there are 10 publ with 10 cit (C=100)

Each res in group **A** outperforms **each** res in group **B**

Thus, clearly group **A** outperforms group **B**.

According to Hirsch this is NOT the case:
Group **A**: H=5, Group **B**: H=10

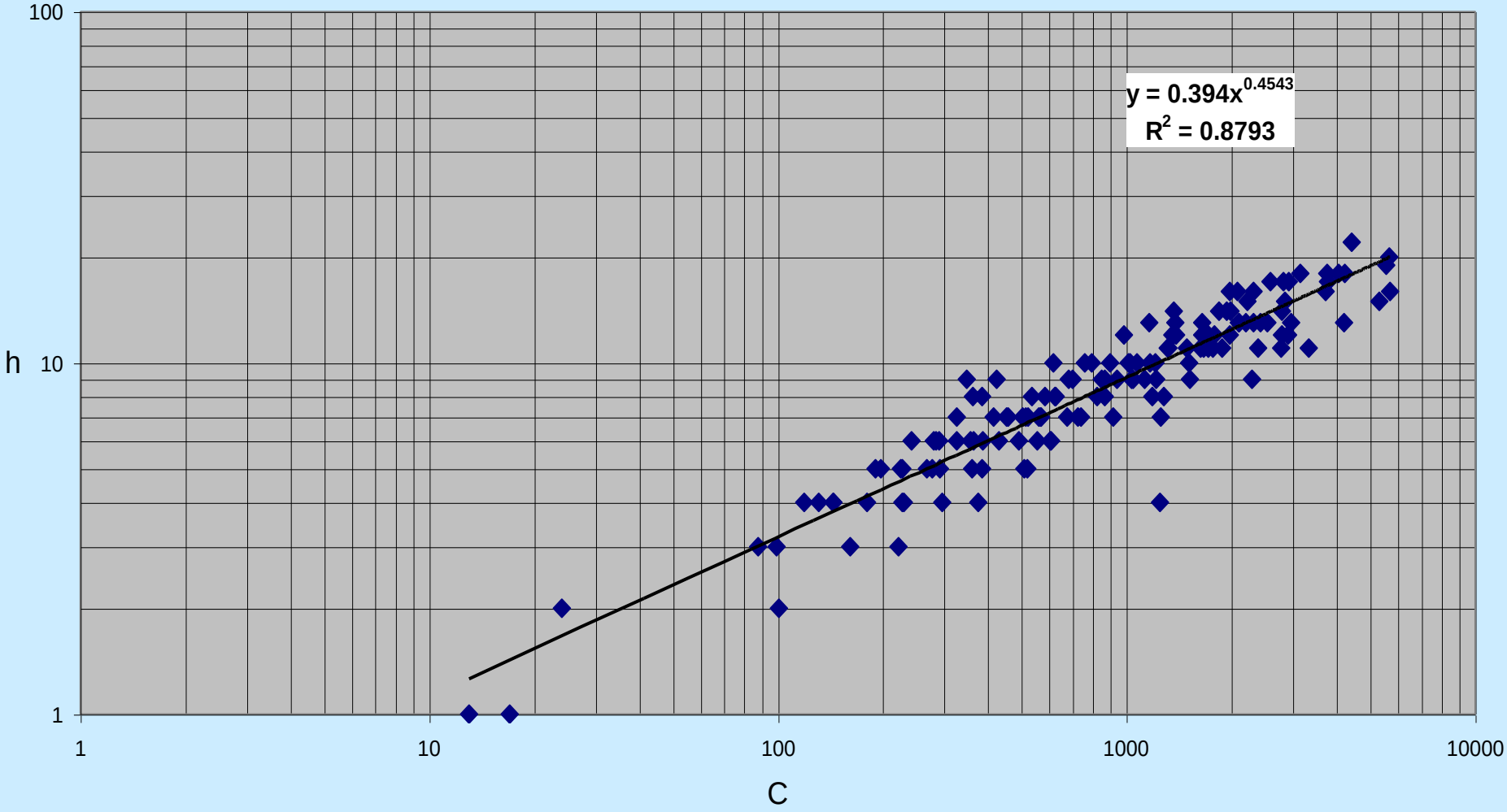
The H-index calculated at the level of research groups completely contradicts the *same* measure at the level of the individual researchers in the *same* groups

This is a rather odd result

Again: the H-index is inconsistent

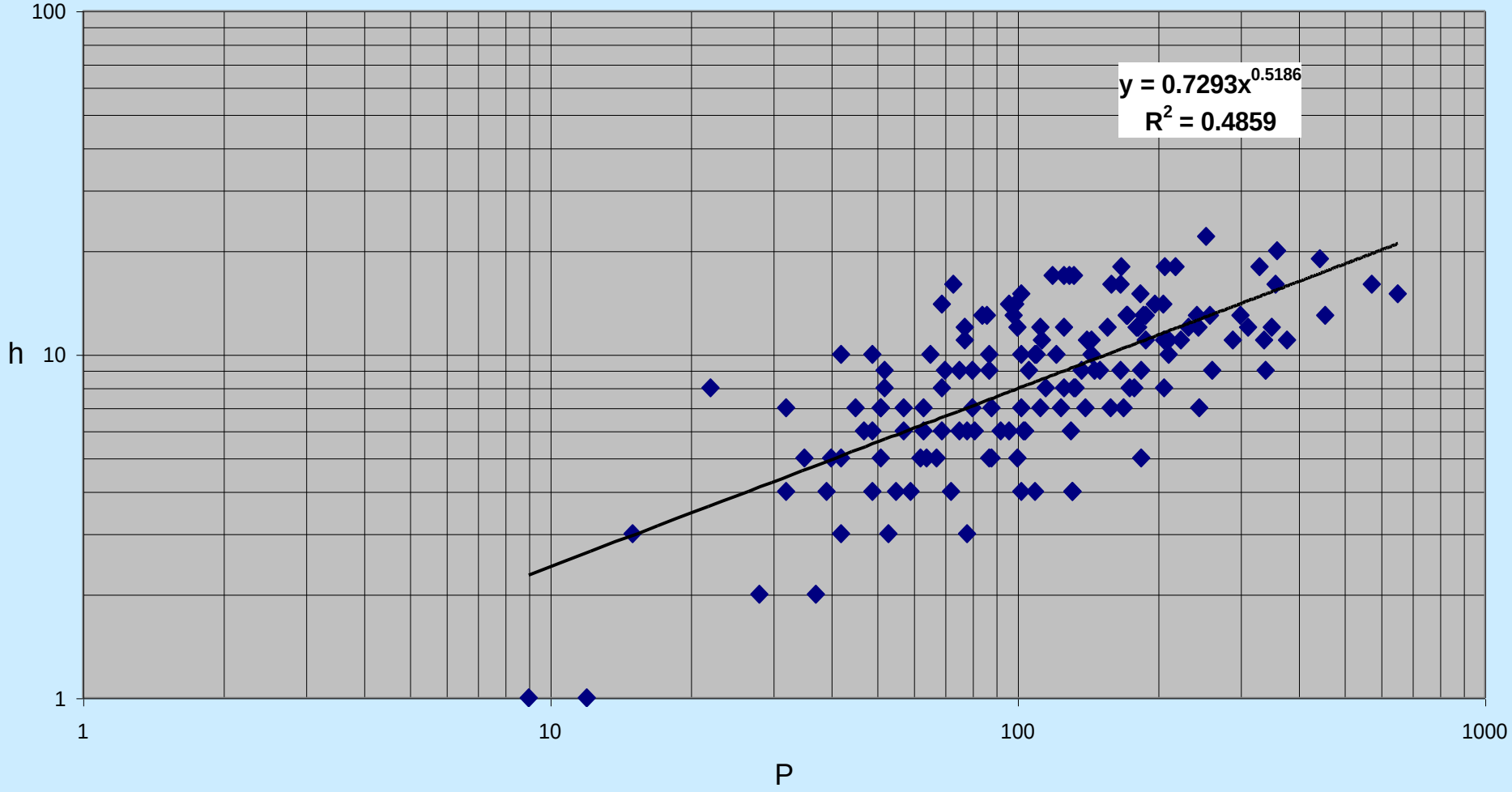
Correlation of h-index (h) with number of citations (C)

for all chemistry groups in the Netherlands



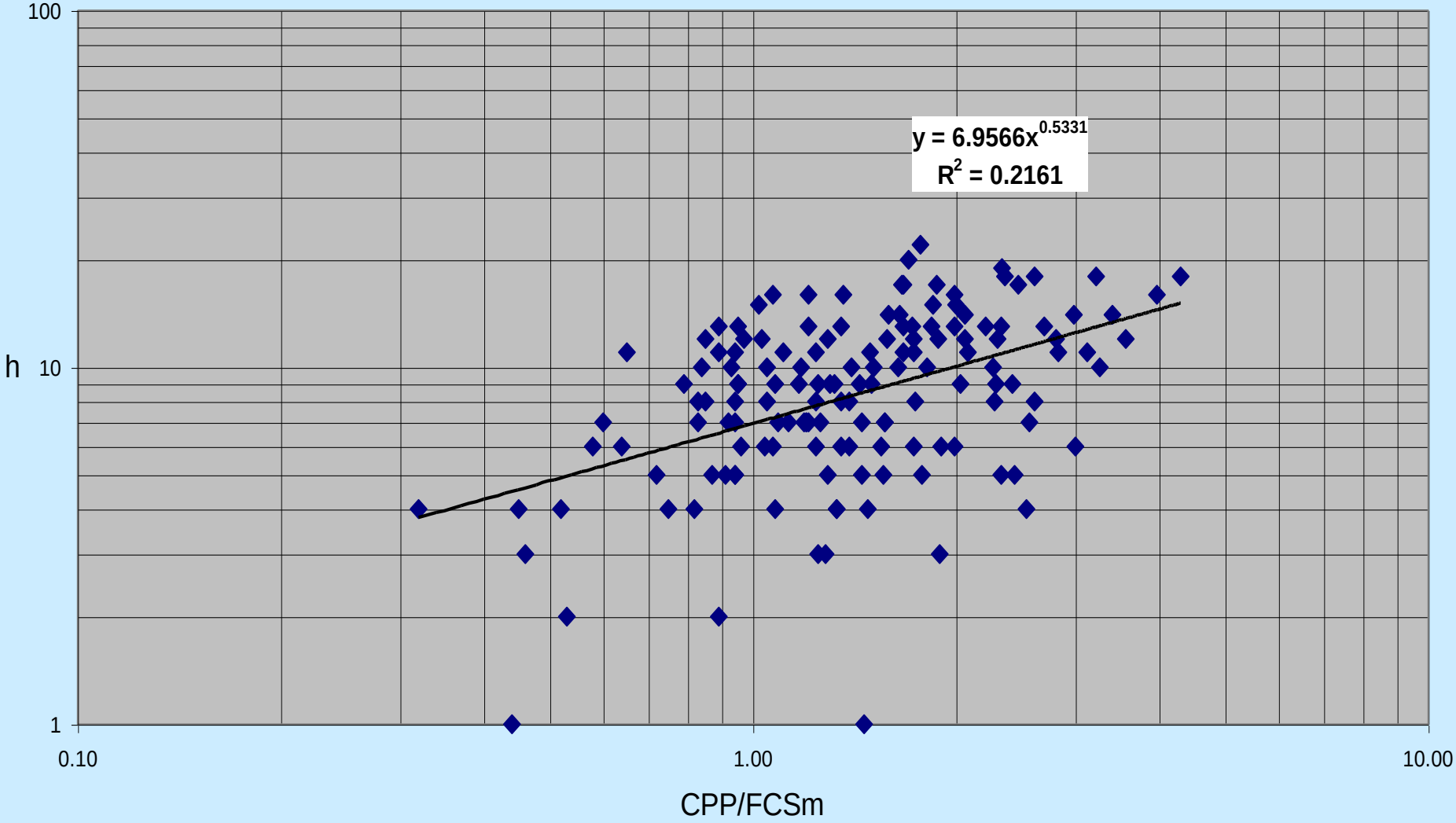
Correlation of h-index (h) with number of publications (P)

for all chemistry groups in the Netherlands



Correlation of h-index (h) with CPP/FCSm

for all chemistry groups in the Netherlands



Thank you for your attention