

**Bibliometric analysis of the
Netherlands Research School
for the Socio-Economic and
Natural Sciences of the
Environment**

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Introduction

The objective of this bibliometric analysis is to provide an overview of the publication output and the international impact of the Netherlands Research School for the Socio-Economic and Natural Sciences of the Environment (SENSE) from 1996 through 2005. This overview is based on a quantitative analysis of scientific articles published in journals and serials covered by the web version of the Science Citation Index (SCI), the Social Sciences Citation Index (SSCI) and the Arts & Humanities Citation Index (A&HCI) of Thomson Scientific, formerly the Institute of Scientific Information (ISI) in Philadelphia. The web versions of these indexes are known as ISI Web of Science (WoS).

Currently the number of peer reviewed scholarly journals is estimated to be somewhere between the 24.000 to 50.000 journals (Tenopir, 2004). WoS covers about 8.700 peer reviewed journals in all scientific disciplines. These journals are generally considered to be the most prestigious, or so-called core journals, of peer reviewed scientific journals. In addition to standard bibliographic details, WoS stores the article's cited reference list. The included references make the database unique and de facto the standard for bibliometric analyses.

Thomson Scientific also produces two analytical databases based on data from SCI, SSCI and A&HCI. These are the Journal Citation Reports, generating the journal Impact Factors (IF) and the database Essential Science Indicators (ESI) which provides the world average number of citations of publications for 22 different research areas. These world averages are the so-called baselines. The percentile thresholds for the top 10% and top 1% of most cited papers in each research field are also presented in ESI. This makes the Essential Science Indicators database a unique tool for benchmarking exercises.

Methods

In this analysis the citation impact of publications of the fellows of SENSE was investigated. In our approach the basic data are collected at the author level rather than the research groups or institutes. A list of permanent staff attached to the research groups part of SENSE was provided by mr. J. Feenstra. Publications of SENSE permanent staff were drawn from WoS. The results were sent to the authors to identify omissions or mistakes. Only articles, reviews, notes and letters were included in the analysis, because these publication types are most likely to report substantial research results that are peer reviewed.

From the lists of author publications the lists for the publications for chair groups were aggregated. For the period 2001-2005 it was indicated by the chair groups which authors belonged to the respective chair groups. For the period 1996-2000 this was determined on the basis of the author affiliations listed in WoS or the original articles. This method has a drawback that the coverage of the 1996-2000 period is not as complete as the coverage for the 2001-2005 period, since staff changes could have taken place that are not reflected in our list of publications. We are aware of the fact that in this method a few publications per research group could be missed. These missed publications will have a very small effect on the analysis results as such. From the publications lists of the chair groups the publication lists of the Institutes were aggregated and from those lists for the whole of SENSE.

The citation analysis involves two steps: retrieving the number of citations of an article (1) followed by a comparison with the world average number of citations (2). Following this method the field of science in which the article was published and the time since publication is accounted for. The number of citations of each publication was drawn from WoS. No corrections for self-citations have been made. There are three reasons for not correcting for self-citations. In the first place the baselines for world average citation rates provided by ISI were used. These world baselines are not corrected for self-citations. In the second place it

has been demonstrated that self-citations are an inevitable part of the research process (Glänzel, 2006), and moreover self-citation patterns are constant within disciplines (Snyder, 1998).

Since the coverage of ISI journals in the social and economic sciences is not up to the same standards as for the natural sciences, additional citation analyses were also carried out for the research groups belonging to review committee I. A second, so-called expanded citation analysis was performed (Moed, 2005). With an expanded citation analysis not only the source publications of ISI are searched for citations, but also all citations to original work of the first authors belonging to that group are included in the analysis. For the expanded citation analysis the authors were sent their individual list of publication results of an as good as possible cleaned cited analysis search in excel. Their feedback was subsequently incorporated. This type of analysis overestimates research performance to some extent since non-cited publications are not considered. The results of the expanded citation analysis are included in the discussion of the results for those research groups when this is applicable and presented in Table 4.

The number of citations of each publication is compared to the world average number of citations for the research area for each publication year (Gerritsma, 2006). The ratio of citations to the world average citations yields the relative impact (RI) for each publication. A relative impact smaller than 1 is below world average, and a relative impact larger than 1 is above world average. Closely related to the Relative Impact is the Σ citations / Σ World-average which is the sum of all citations divide by the sum of the world average citation rate. This last measure is in most cases slightly more conservative than the relative impact. Research from the Centre for Science and Technology Studies at Leiden (van Raan, 2004) has shown that differences in the order of variations between 0.8 and 1.2 are not significantly different from the world average. In this study a relative impact between 0.5 and 0.8 is rated below average, between 1.2 and 1.5 above average, or far above average >1.5 .

The h-index was determined in all analyses. A group or a researcher has an index of h , when they published h papers with at least h citations each (Hirsch 2005). The h-index is a new impact measure. Its strength lies in the combination of productivity and impact. In the calculation of the h-index we considered the publications for the period 1996-2005. The h-index has been tested to compare individual researchers, it has been applied for research groups in a few occasions only (van Raan, 2006). Research groups should have similar publication outputs, and active in the same field of research for the h-index to be a meaningful indicator. When comparing the h-factor presented in tables 1a and 2a between groups the publication output of the groups should be considered as well.

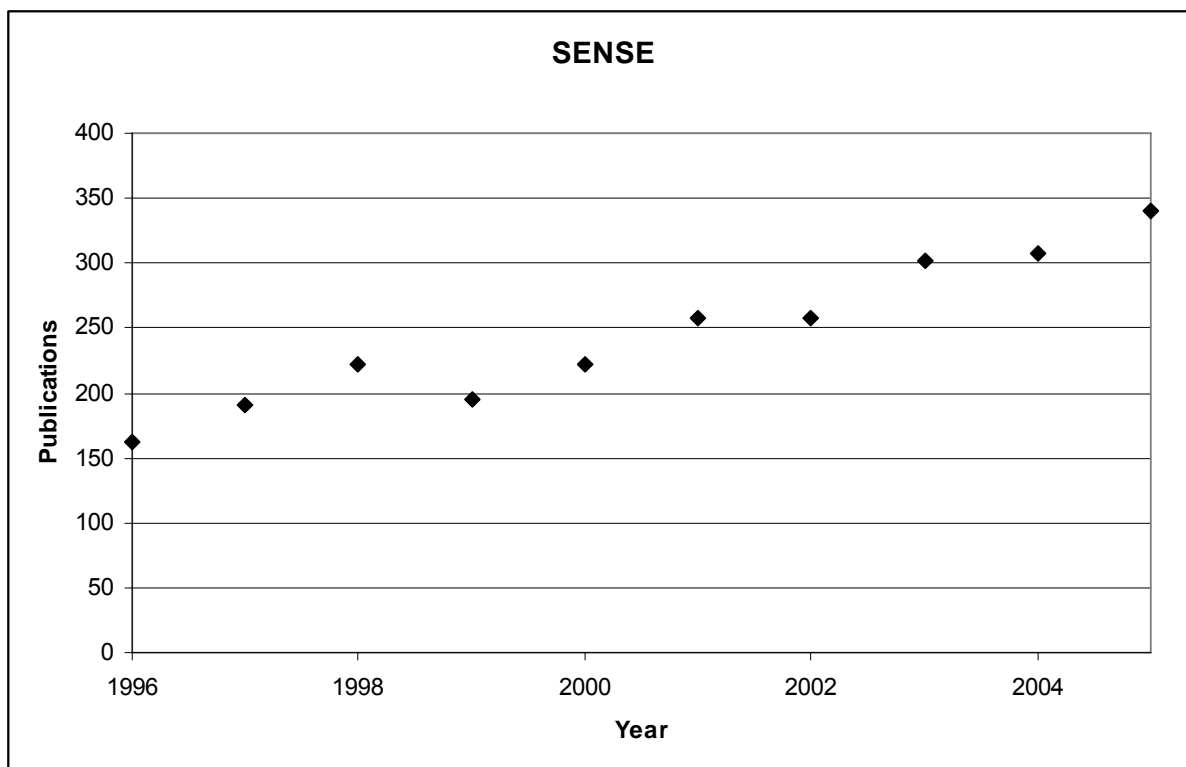
Citation analysis for SENSE as a whole

For the complete period we could retrieve 2476 publications overall for SENSE in our analysis. A steady increase in number of publications retrieved per year could be observed. For 1996, 162 publications were retrieved. In 2005 this has more than doubled to 340 publications. The relative impact of the publications over the whole period 1996-2005 was far above world average (1.69). It did not change very much between the years. It fluctuated between a minimum of 1.54 for publications from 2000 and the maximum of 1.79 for publications retrieved for 2005.

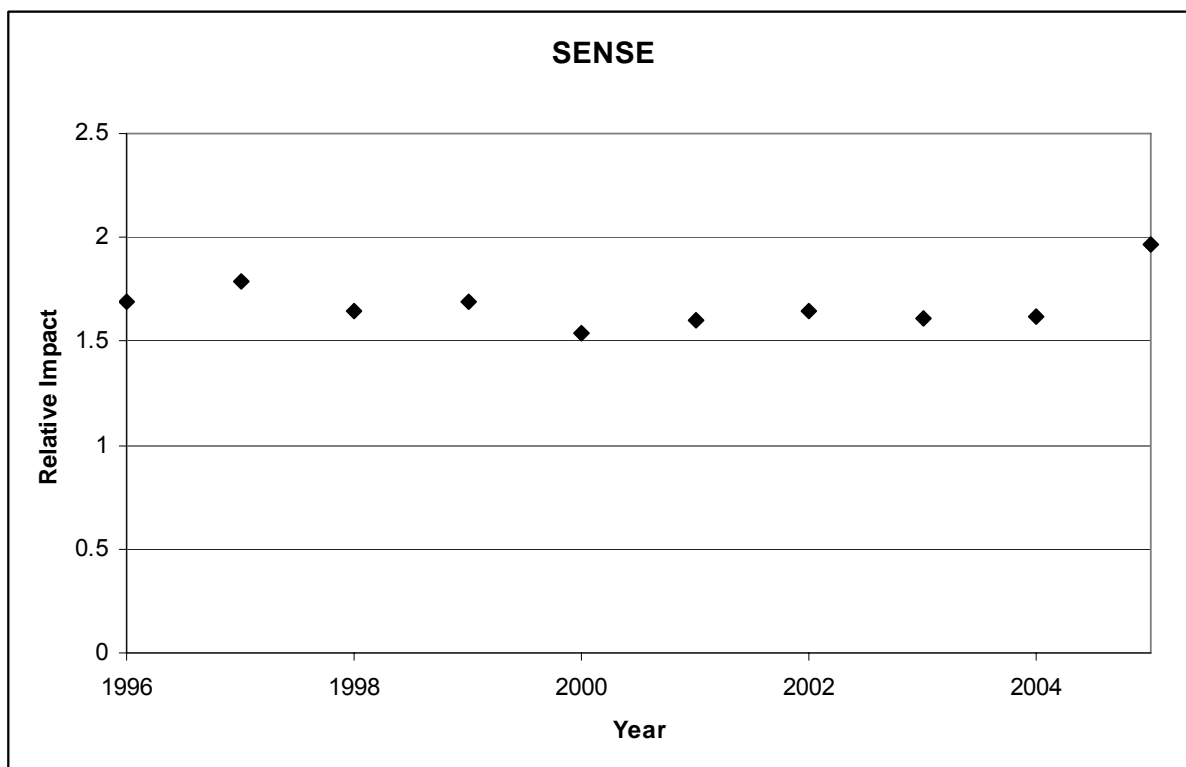
Some 474 publication belonged to the top 10 % most frequently cited publications in their field. This is about 19% of the total publication output. Of these publications 60 belonged to the group of the 1% most cited publications in their field. 215 publications were not cited yet, which is about 9% of the total publication output.

Most of the publications (1066) were categorized in the field of Environment/Ecology, these have a relative impact of 1.84. The second largest group of publications (232) was found in the group of Microbiology, these have a relative impact of 1.48. This was followed by Biology

& Biochemistry: 218 publications with a relative impact of 0.85 and Plant and Animal Sciences: 196 publications and with a relative impact of 1.91.



Yearly publication output that could be retrieved from WoS for SENSE over the period 1996-2005



The relative impact of the publications for SENSE over the period 1996-2005

Analysis for the Institutes and research groups

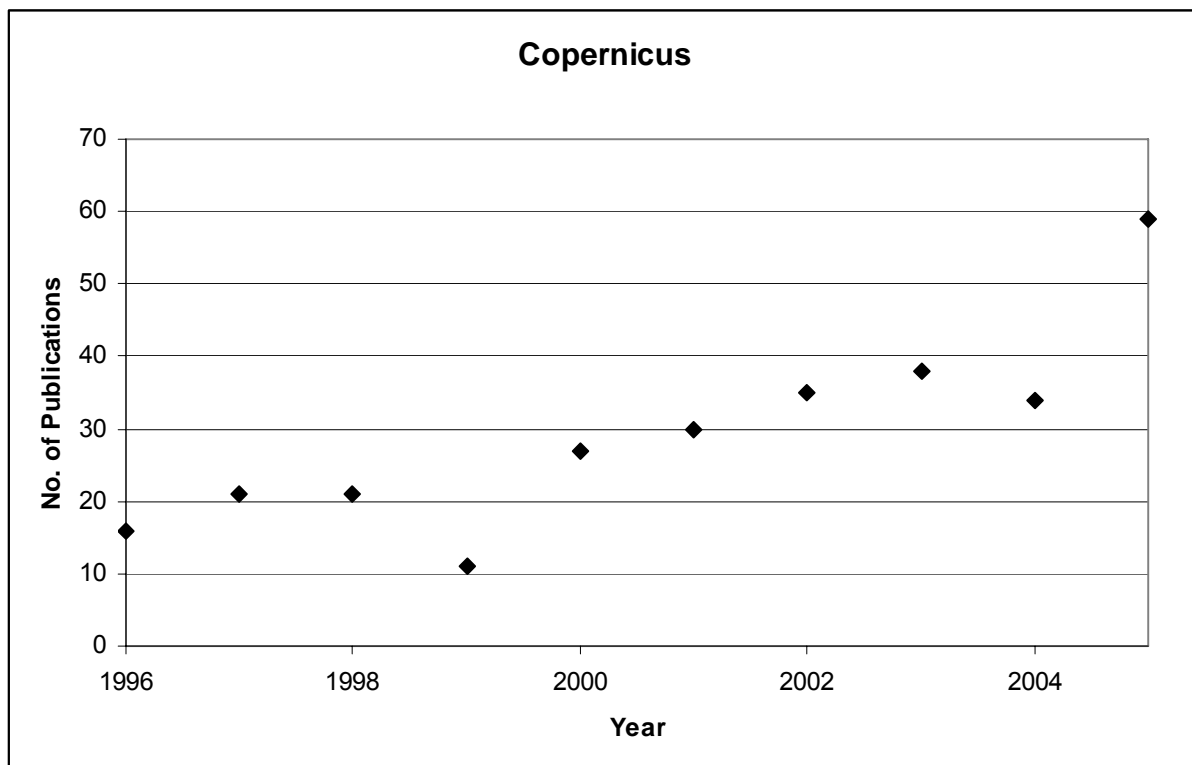
To assess the research impact of the Institutes and each research group, the bibliometric parameters were assessed for the whole period for each group and they were judged over two consecutive five year periods. Furthermore we looked for the complete period at the relative impact within each ESI research area and the number of publications in that research area. Tables 1a and 1b present the analysis for SENSE, and the three major institutes part of Sense for the whole period 1996-2005 and the two consecutive periods 1996-2000 and 2001-2005. In Table 2 a and 2 b the same analyses are presented for all research groups that are part of SENSE. In Table 3a, 3b and 3c the analyses for all groups per ESI research area for the period 1996-2005 are presented.

Copernicus Institute for Sustainable Development and Innovation (UU)

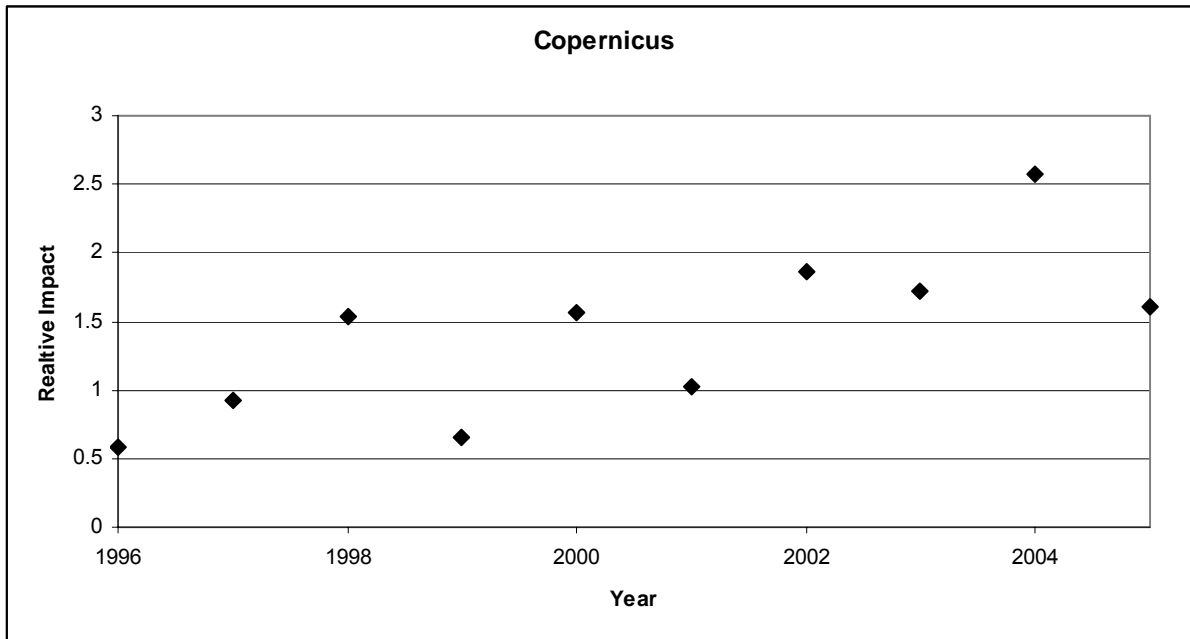
Copernicus is comprised of 4 groups. Altogether they produced 292 publications over the complete period that could be retrieved from WoS. There is a clear trend of increasing publications per year retrieved from the Web of Science. In 1999 and 2004 fewer publications were retrieved than the trend line suggested. The relative impact of these publications increased as well, from 1.15 for the period 1996-2000 to 1.75 for the period 2001-2005. Considering the whole period 1996-2005 the relative impact of the publications is far above world average (1.55). 57 publications belong to the top 10% best cited publications in their field, which represents nearly 20% of all Copernicus publications. The h-index for Copernicus is 22.

The main field in which the publications were categorized was the field of Environment/Ecology with 112 publications that have a relative impact of 1.63. Followed by the fields of Social Sciences general with 48 publications that have a relative impact of 1.80 and Engineering with 43 publications that have a relative impact of 1.31.

In the following two graphs the yearly number of publications retrieved from WoS and the relative impact are presented.



Yearly publication output that could be retrieved from WoS for Copernicus over the period 1996-2005



The relative impact of the publications for Copernicus over the period 1996-2005

Environmental Science Group (ESG)

81 publications in total were retrieved for ESG. The relative impact of this group is far above world average (2.30). 31% of the publications (25) are among the top 10% mostly cited publications in their field. The number of uncited publications 8 (10%) equals the average for SENSE as a whole. The h-index of this group is 20, which means that there are 20 publications that have at least 20 citations.

Over the two consecutive periods there is an increase in number of publications, from 27 to 54. This observed increase in number of publications is accompanied by an increase in relative impact, from 1.83 to 2.54 as well.

The large majority of publications (62) were categorized in the field of Environment/Ecology and have a far above world average impact (2.21). The numbers of publications in other research fields were considered too few for a meaningful analysis.

Environmental Studies and Policy Group (ESPG)

For this group 15 publications could be retrieved from the set of core journals covered by WoS. 5 publications were from the 1996-2000 period and 10 publications from the 2001-2005 period. For both periods the relative impact was below world average. None of the publications were among the top 10% mostly cited publications in their field. Three publications (20%) were not cited. The h-index for this group is 3.

The majority of the publications (8) were categorized in the field of Social Sciences, general. The average impact in this field was 0.45.

When using all the publications in an expanded analysis a total of 103 publications (books, book chapters, reports as well as journal articles) were retrieved for the period 1996-2005. These publications have a relative impact of 0.60 when compared with the baseline for social sciences general.

Science, Technology and Society Group (STS)

For the complete period of 1996-2005, 129 publications were retrieved. The relative impact of the publications is above average (1.33). 22 articles belong to the 10% highest cited publications; this is 17% of total publications which is about average for all SENSE groups. The number of uncited publications 20, or 16% of the total, is above the average for SENSE

as a whole. The h-index of this group is 15, which means that there are 15 publications that have at least 15 citations.

Considering the two consecutive periods, 1996-2000 and 2001-2005, we notice an increase in number of publications from 49 to 80, and an improvement in relative impact, from 0.90 to 1.60.

Most publications (47) were categorized in the field of Environment/Ecology and have an about average impact (0.98). The publications in the fields of Engineering (32) have a relative impact far above world average (1.52). This applies to the publications in the field of Social Sciences general as well. In this field we retrieved 23 publications which have an average impact of 2.31.

Innovation Studies Group (ISG)

For the whole period of 1996-2005, 79 publications were retrieved. The relative impact of the publications is above average (1.28). 11 articles belong to the 10% highest cited publications; this is 14% of total publications which is below the average for all SENSE groups. The number of uncited publications 13, or 16% of the total, is higher than the average for SENSE as a whole. The h-index of this group is 12, which means that there are 12 publications that have at least 12 citations.

Considering the two consecutive periods, we notice an increase in number of publications from 24 to 66, and an increase in relative impact, from 0.94 to 1.37.

Most publications were categorized in two fields, 18 both in Clinical Medicine and Social Sciences general. The publications in Social Sciences have a far above average relative impact of 2.07. Those in clinical medicine have an average relative impact (1.12).

Taking into consideration the results from the expanded analysis, a total of 158 publications were retrieved. This includes reports and book chapters as well. The relative impact of all these publications is 1.08 when we use the baseline for Social Sciences general.

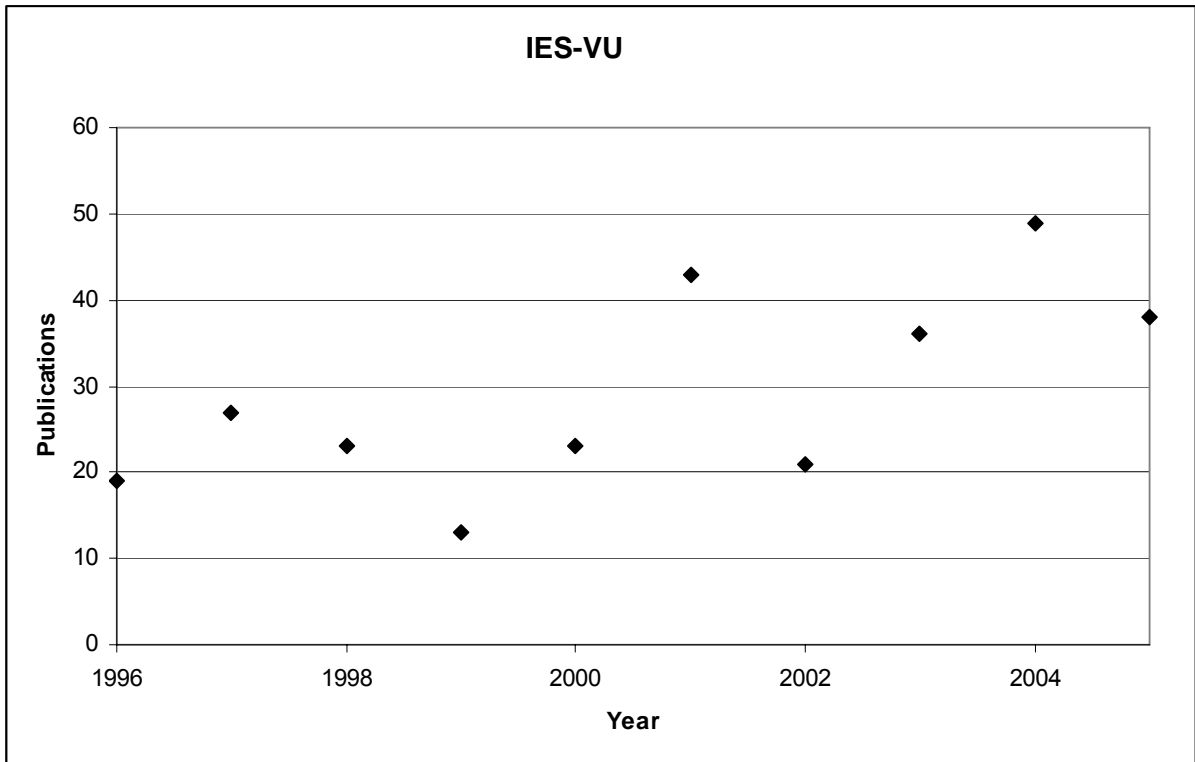
Institute of Ecological Sciences (IES-VU)

The Institute of Ecological Science is comprised of three research groups. Altogether they published 292 publications which have a relative impact of 1.81. A clear trend in publication output is less easy to distinguish, but in the period 1996-2000 105 publications were retrieved from WoS against 187 for the period 2001-2005.

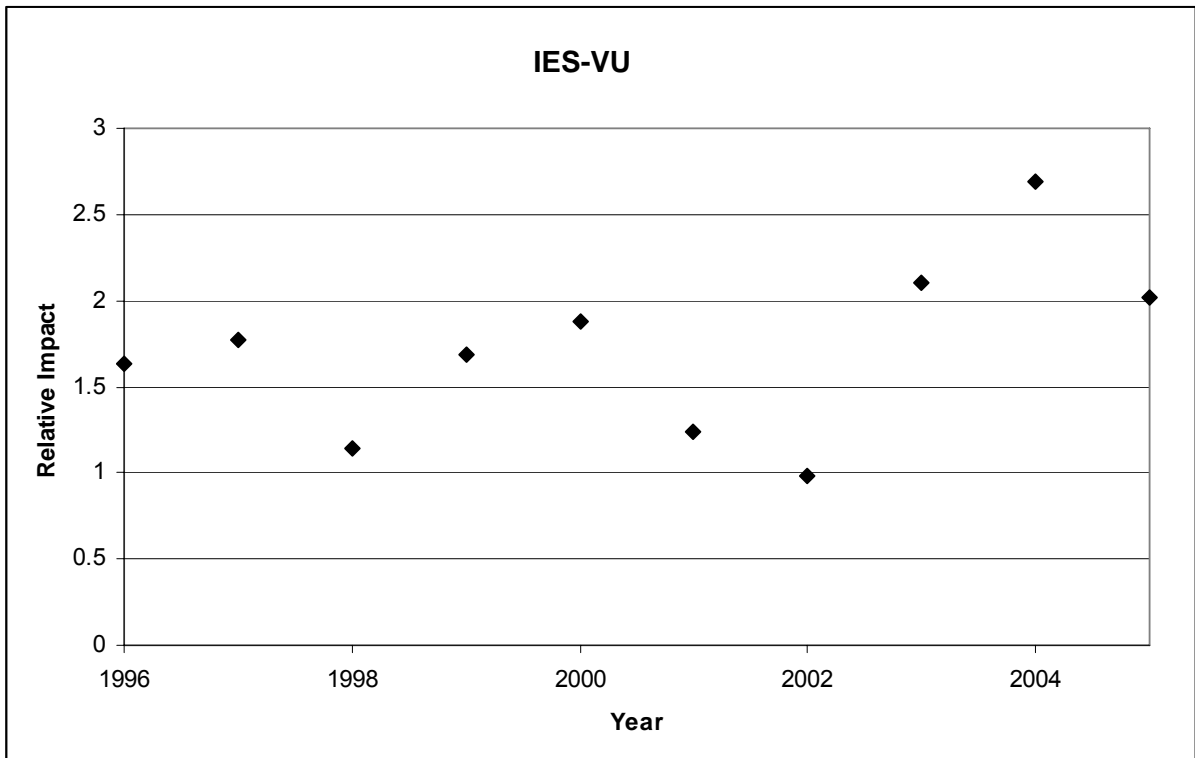
The relative impact for the publications was in most years far above world average. In the period 1996-2000 this was 1.62 and the subsequent period this improved to 1.91.

55 or 19% of the publications belong to the top 10% of the most cited publications in their field. The h-index for IES is 29.

Most of the publications, by far, 222 from the 292 from this institute belong to the field of Environment/Ecology, their relative impact was 1.79. The second largest field was Plant & Animal Sciences with 28 publications. The publications in that research area have a relative impact far above world average of 2.95.



Yearly publication output that could be retrieved from WoS for IES-VU over the period 1996-2005



The relative impact of the publications for IES-VU over the period 1996-2005

Animal Ecology Group 1 : Community and Evolutionary Ecology (VUIESAE1)

For the complete period of 1996-2005, 78 publications were retrieved. The relative impact of the publications is above average (1.37). 8 articles belong to the 10% highest cited

publications; this is 10% of total publications which is below the average for all SENSE groups. The number of uncited publications 3, or 4% of the total, is below the average for SENSE as a whole. The h-index of this group is 19.

Considering the two consecutive periods, we notice an increase in number of publications from 32 to 46, and an improvement in relative impact, from 1.02 to 1.61.

Most of the publications of VUIESAE1 fall in the group of Environment/Ecology, and have a relative impact above world average (1.38). The second largest group of publications is to be found in the field of Plant & Animal Science (13) and these have a far above world average impact (2.16).

Animal Ecology Group 2 : Ecotoxicology and Ecogenomics (VUIESAE2)

For the period 1996-2005 a total of 143 publications for this group could be retrieved. There was an increase from 60 publications for the period 1996-2000 to 83 publications for the period 2001-2005. The relative impact for all publications was above world average (1.29).

This was exactly the same for both periods. The number of publications that are among the top 10% most cited publications (27) or 19% of the total number of publications is on average for all SENSE groups. The number of uncited publications (4) is 3% of the total number of publications, which is below the average for SENSE. The h-index is 23.

Most (122) of the publications of this group were categorized in the field of Environment/Ecology, the relative impact of these publications was above world average in this field (1.22).

Systems Ecology Group (VUIESSE)

For the period 1996-2005 95 publications were retrieved. The relative impact of these publications is far above world average (2.81). 23 articles belong to the group of the top 10% most cited articles, of which 7 articles belong to the top 1% most cited articles in their field. The number of uncited publications is 8. The h-index for the group is 19.

For the two consecutive periods a considerably higher number of publications were retrieved for the period 2001-2005, 73 versus 22 for the period 1996-2000. The relative impact for both periods was far above world average.

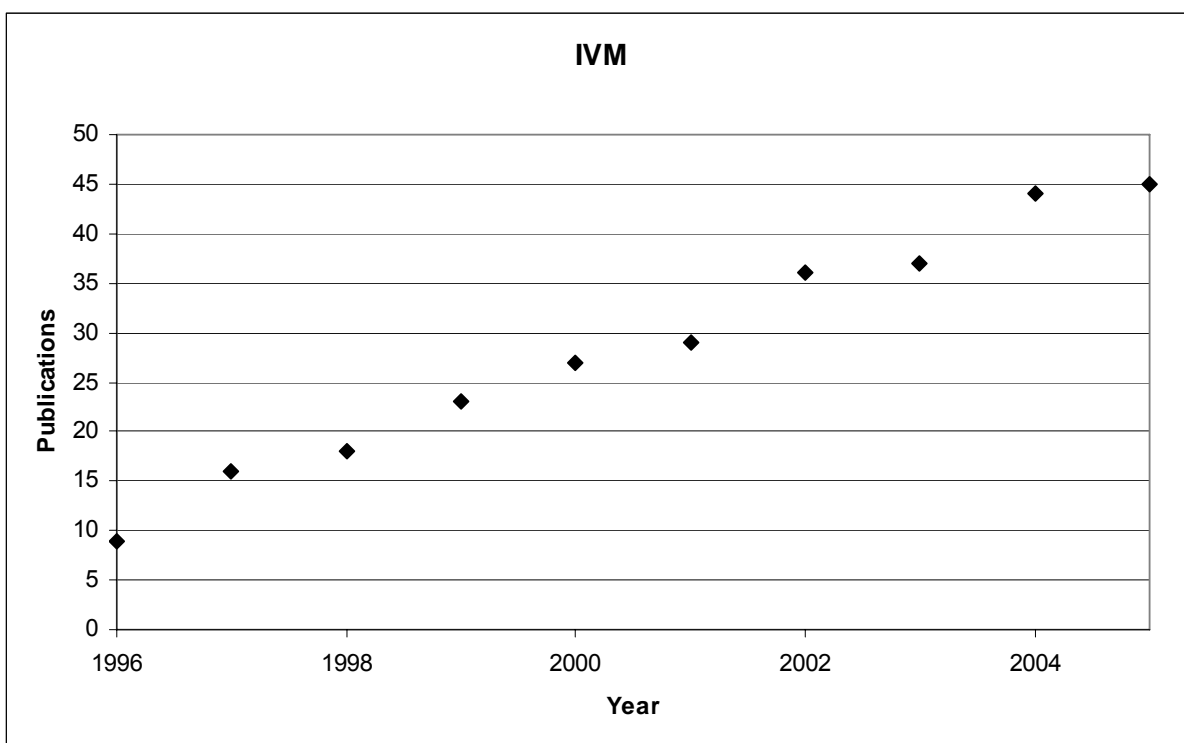
Most publications fall in the category Environment/Ecology (66) and have a relative impact far above world average (2.95). Another 12 publications were categorized in the field of Plant and Animal Science and the impact is far above world average as well (4.72)

Institute for Environmental Studies (IVM-VU)

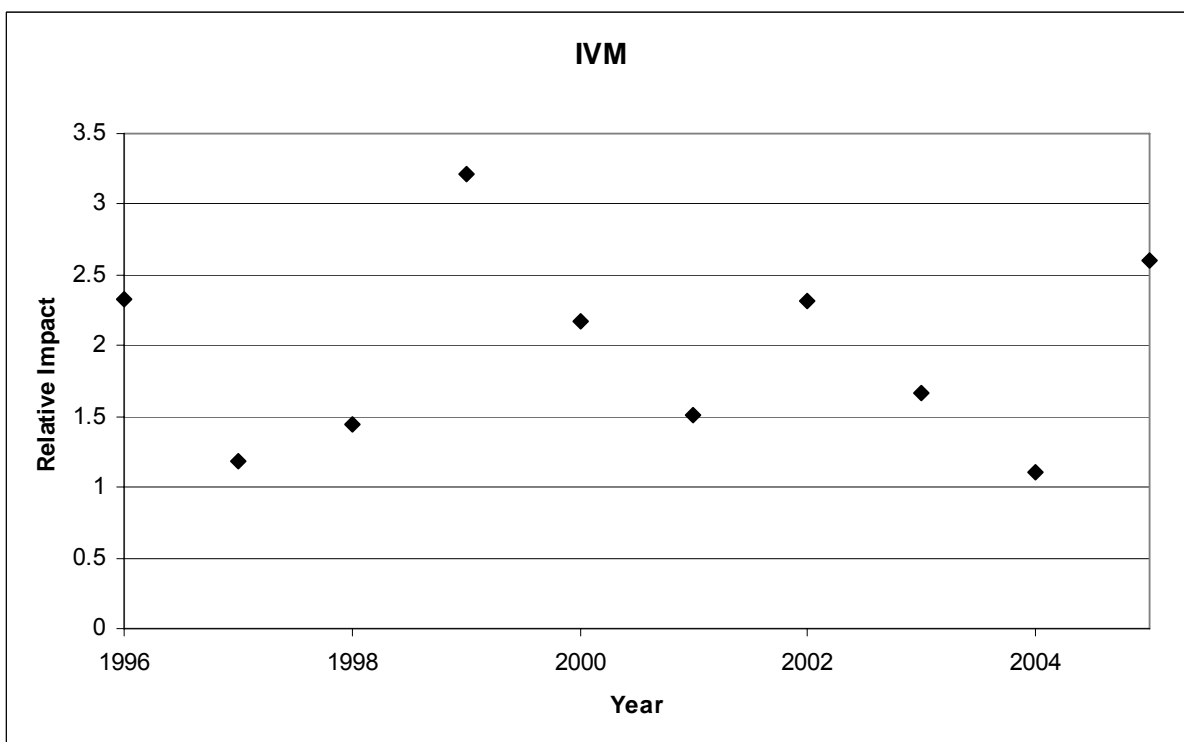
The Institute of Environmental Studies is comprised of four research groups. For this Institute we retrieved 284 publications for the period 1996-2005 which have a relative impact of 1.95. A clear trend in publication output retrieved each year from the WoS was easy to distinguish, showing an increase from around 10 publications per year in 1996 to about 45 publications in 2005. The relative impact for the publications was in most years far above world average. It was slightly higher for the period 1996-2000 (2.21) than the period 2001-2005 (1.85).

72 or 25% of the publications belong to the top 10% of the most cited publications in their field. 39 of the publications or 14% of the total number of publications have not been cited to date. The h-index for IVM is 31.

Most of the publications (97) from this institute belong to the field of Environment/Ecology, their relative impact was 2.13. The second largest field was Economics & Business with 78 publications that have a relative impact of 1.92. The third largest group of publications were found in Social Sciences general (35) and have a relative impact of 1.60.



Yearly publication output that could be retrieved from WoS for IVM over the period 1996-2005



The relative impact of the publications for IVM over the period 1996-2005

Department of Chemistry and Biology (Dept. C&B)

For the Department of Chemistry and Biology a total of 97 publications were retrieved. 39 articles belong to the group of the top 10% most cited article in their field, this represents 40% of the total articles published by the group. This is the highest percentage of top 10% articles of all observed groups belonging to SENSE. The number of uncited publications (5) is low. The h-index for this group is 26.

The relative impact of this group is far above world average (2.62) considering the whole period. Over the two consecutive periods, the relative impact is for both periods far above world average as well. 2.98 for 1996-2000 and 2.42 for the period 2001-2005.

Most of the publications of DCB fall in the group of Environment/Ecology, and have a relative impact far above world average (2.79). The second largest group of publications is to be found in the group of Pharmacology & Toxicology (19) and these have a far above world average impact (3.91) as well.

Department of Environmental Policy Analysis (Dept. EPA)

The Department of Environmental Policy Analysis has been established only in late 2001. For the entire evaluation period, 20 publications could be retrieved from the core set of Web of Science for researchers now affiliated with EPA, of which 12 publications since the department has been formally established. The relative impact of the publications for the period 2001-2005 is 1.46 and above world average. Considering the ESI fields in which most of the publications are categorized, it should be noted that none of the categories has a sufficient number of publications to do a meaningful analysis. The highest number of publications in a single category was 6 publications in Social Sciences, general. Taking into consideration the results from the expanded analysis, a total of 120 publications were retrieved. This includes reports and book chapters as well. The relative impact of all these publications is 0.72 when we use the baseline for Social Sciences general.

Department of Economics and Technology (Dept. E&T)

For the Department of Economics and Technology a total of 143 publications could be retrieved. There was an increase from 48 publications for the period 1996-2000 to 95 publications for the period 2001-2005. The relative impact for all publications was far above world average (1.68). The number of publications that are among the top 10% most cited publications (27) or 19% of the total number of publications is on average for all SENSE groups. The relative impact over the two consecutive periods dropped slightly, but is for both periods far above world average. For the period 1996-2000 it was 1.84, and for the period 2001-2005 it decreased to 1.60. The number of uncited publications (23) is 16% of the total number of publications, which is above the average for SENSE. The h-index is 23. Most of the publications (73) are categorized in the field of Economics and Business, these have a far above relative impact (2.01). The second largest group of publications fell in the field of Social Sciences general, the relative impact is far above world average (1.65) When all publications i.e. reports, books and book chapters are considered in an expanded analysis a total of 469 publications were retrieved which had an average relative impact of 1.10.

Department of Spatial Analysis and Decision Support (Dept. SADS)

The Department of Spatial Analysis and Decision Support was only recently established in 2002. For the period 2001-2005 a total of 27 publications for this group could be retrieved. The relative impact for all publications was far above world average (1.63). The number of publications that are among the top 10% most cited publications (5) or 19% of the total number of publications is on average for all SENSE groups. The number of uncited publications (7) is 26% of the total number of publications, which is above the average for SENSE. This is caused by the fact that we look here at relatively recent publications in comparison with other groups. The h-index for this group is 4. Most (8) of the publications of this group were categorized in the field of Environment/Ecology, the relative impact of these publications was not different from the world average in this field (0.92).

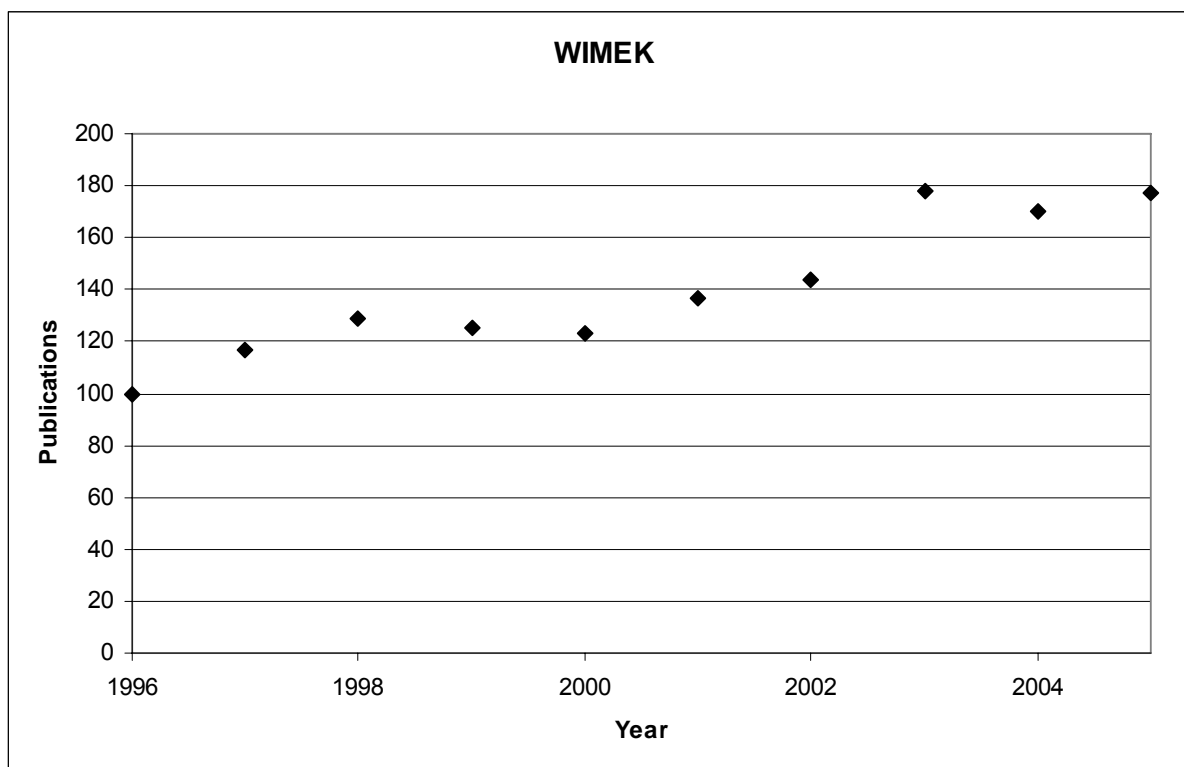
Wageningen Institute for Environment and Climate Research (WIMEK-WU)

The analysis of WIMEK included 11 research groups. The results for the recently created ESS group were not included in the institute results. A total of 1400 publications were retrieved for WIMEK, from the graph an increasing trend in the number of papers retrieved from WoS can be observed. For the period 1996-2001 594 publications were retrieved. In the subsequent period 2001-2005 806 publications were retrieved.

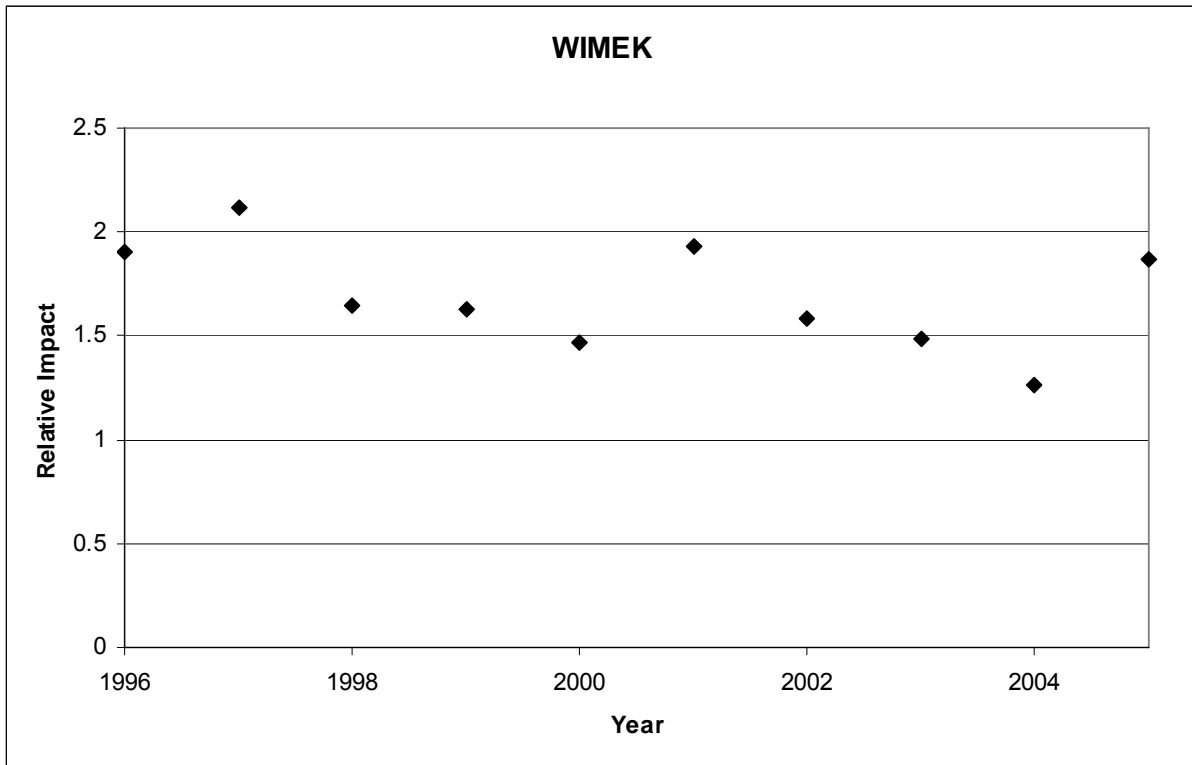
The relative impact showed a slightly decreasing trend over the whole period. The average relative impact for the whole period was 1.67. In the period 1996-2001 this was 1.74 and the subsequent five years this decreased to 1.62. Overall, and in both periods separately the relative impact of WIMEK publications is far above world average.

Some 254 publications, or 18 % of the total publications, belong to the top 10% highest cited publications in their field. Only 8% of the publications were uncited. The h-index for WIMEK is 60.

Most of the publications (528) are categorized in the field of Environment/Ecology, these have a far above world average impact of 1.93. The second largest group of publications (224) are categorized in the field of microbiology; these have a relative impact of 1.50. Followed by Biology & biochemistry (181 publications) with a relative impact of 0.83, Agricultural Sciences (106 publications) with a relative impact of 2.03 and Plant and Animal Sciences (103 publications) with a relative impact of 1.77.



Yearly publication output that could be retrieved from WoS for WIMEK over the period 1996-2005



The relative impact of the publications for WIMEK over the period 1996-2005

Aquatic Ecology and Water Quality Management Group (AEW)

A total of 133 publications were retrieved for the Aquatic Ecology and Water Quality Management Group for the period 1996-2005. There was an increase in number of publications that could be retrieved from WoS over the two consecutive periods. For 1996-2000 37 publications could be retrieved, for the period 2001-2005 96 publications were retrieved.

The relative impact of the group over the whole period is far above world average (2.43). There is an increase in relative impact from 1.65 for the 1996-2000 period to 2.74 for the 2001-2005 period. 37 publications, or 28% of the total publication output, are among the 10% most cited publications in their field. The monograph "Ecology of shallow lakes" with over 400 citations was not included in this overview.

6 publications, or 5% of the total, were uncited, which is below the average for SENSE. The h-index for the whole group is 22.

75 publications were categorized in the field of Environment/Ecology. These have a relative impact of 2.92. The second largest group of publications (54) is in the field of Plant & Animal science. These publications have a far above world average impact as well (1.85).

Environmental Policy Group (ENP)

For the Environmental Policy Group a total of 15 publications could be retrieved from WoS. These publications have a relative impact of 1.25, which is above world average. One publication was ranked among the top 10% most cited publications in their field, this is 7% of the total output. The h-index for the whole group is 4

Most publications (12) are categorized in the field Social Sciences general, these have an above average impact (1.38).

When all the publications are included, by means of an expanded analysis, 74 publications were found, using the baseline for social sciences general they have a relative impact of 1.93. Taking all these publications into account the h-index increases to 12.

Environmental Economic and Natural Resources Group (ENR)

For the Environmental Economic and Natural Resources Group a total of 32 publications were found. For the period 1996-2000 8 publications were retrieved from WoS, and 24 publications for the 2001-2005 period.

The relative impact over the whole period was 0.61, which is below world average. Taking the two consecutive periods in considerations we see the relative impact drop from 1.11 for 1996-2000 to 0.44 for the period 2001-2005.

One publication is ranked among the top 10% most cited publications in their field. This is 3% of the total publication output. There are 11 uncited publications, which is 34% of the total publication output. The h-index of this group is 4.

When all the publications are included, by means of an expanded analysis, 63 publications were found, which have a relative impact of 0.82. Taking into account all these publications the h-index is 4.

In the expanded analysis, which includes all reports, books and book chapters next to journal articles, a total of 63 publications were found for the this group. The relative impact, using the baseline for economics and business, is 0.83 which is about world average.

Environmental Systems Analysis Group (ESA)

For the Environmental Systems Analysis Group a total of 44 publications could be retrieved. There was an increase from 16 publications for the period 1996-2000 to 28 publications for the period 2001-2005. The relative impact for all publications was far above world average (4.54). The number of publications that are among the top 10% most cited publications (15) or 34% of the total number of publications is above average for all SENSE groups. The relative impact over the two consecutive periods dropped, but is for both periods far above world average. For the period 1996-2000 it was 7.07, and for the period 2001-2005 it decreased to 3.09. The number of uncited publications (6) is 14% of the total number of publications, which is above the average for SENSE. The h-index is 12.

Most of the publications (16) are categorized in the field of Environment/Ecology, these have a far above relative impact (6.66). The second and third largest groups of publications each with 9 publications fell in the field of Geosciences the relative impact is far above world average (3.50) and Economic & Business which publications also have a far above world average relative impact (2.35).

Environmental Technology Group (ETE)

For the Environmental Technology Group a total of 338 publications were retrieved. 25 articles belong to the group of the top 10% most cited article in their field, this represents 7% of the total articles published by this group. The number of uncited publications (27) is 8% of their total output. The h-index for this group is 30.

The relative impact of this group is about world average (0.98) considering the whole period. Over the two consecutive periods, the relative impact is for both periods about world average, 1.0 for 1996-2000 and 0.95 for the period 2001-2005.

Most of the publications of ETE (181) fall in the group of Environment/Ecology, and have a relative impact about world average (1.13). The second largest group of publications is to be found in the group of Biology & Biochemistry (100) and these have a below world average impact (0.59).

Hydrology and Quantitative Water Management Group (HWM)

For the period 1996-2005 a total of 77 publications for this group could be retrieved. There was an increase from 30 publications for the period 1996-2000 to 47 publications for the period 2001-2005. The relative impact for all publications was about world average (1.17). There is an increase in relative impact from 1.09 for the 1996-2000 to 1.22 for the 2001-2005 period.

The number of publications that are among the top 10% most cited publications (11) or 14% of the total number of publications is below average for all SENSE groups. The number of uncited publications (7) is 9% of the total number of publications, which is on average for SENSE. The h-index is 13.

Most (27) of the publications of this group were categorized in the field of Geosciences, the relative impact of these publications was not different from the world average in this field (1.05). The relative impact of the 25 publications in the field of Environment Ecology is about world average as well (1.17), the 14 publications in the field of Engineering have a far above world average impact (2.00).

Microbiology (MIB)

For the complete period of 1996-2005, 384 publications were retrieved. This is the largest number of publications for all SENSE groups. The relative impact of the publications is above average (1.51). 52 articles belong to the 10% highest cited publications; this is 14% of total publications which is below the average for all SENSE groups. The number of uncited publications 21, or 5% of the total, is about half the average for SENSE as a whole. The h-index of this group is 43.

Considering the two consecutive periods, we notice an increase in number of publications from 169 to 215, and a stable, above world average relative impact, of 1.5. Most publications (203) were categorized in the field of Microbiology and have an above average impact (1.54). The publications in the fields of Biology and Biochemistry (92) have an on average relative impact (1.05) the publications in the field of Environment/Ecology (45) have a far above world average impact (2.30).

Nature Conservation and Plant Ecology Group (NCP)

For the period 1996-2005 100 publications were retrieved. The relative impact of these publications is far above world average (2.43). 35 articles belong to the group of the top 10% most cited articles, of which 6 articles belong to the top 1% most cited articles in their field. The number of uncited publications is only 4. The h-index for the group is 21.

For the two consecutive periods a considerably higher number of publications were retrieved for the period 2001-2005, 75 versus 25 for the period 1996-2000. The relative impact for both periods was far above world average.

Most publications fall in the category Environment/Ecology (63) and have a relative impact far above world average (3.00). Another 29 publications were categorized in the field of Plant and Animal Science and the impact is far above world average as well (1.69)

Soil Physics, Ecohydrology and Groundwater Quality Group (SEG)

For the Soil Physics, Ecohydrology and Groundwater Quality Group a total of 108 publications were retrieved. 13 articles belong to the group of the top 10% most cited article in their field, this represents 12% of the total articles published by the group. This is below the average percentage of top 10% articles of all groups belonging to SENSE. The number of uncited publications (13) is about the average of 12% observed for all Sense groups. The h-index for this group is 14.

The relative impact of this group is about world average (1.24) considering the whole period. Over the two consecutive periods, the relative impact decreases from 1.59 for 1996-2000 to 1.01 for the period 2001-2005.

Most of the publications (33) fall in the group of Environment/Ecology, and have a relative impact about world average (0.95). The second largest group of publications is to be found in the group of Engineering (29) these have a far above world average impact (2.17). Another 28 publications are categorized in the field of Agricultural sciences and these have an about average relative impact (0.89).

Soil Formation and Ecopedology (SFI)

For the Soil Formation and Ecopedology Group a total of 131 publications were retrieved. 44 articles belong to the group of the top 10% most cited article in their field, this represents 34% of the total articles published by this group. The number of uncited publications (11) is 8% of their total output. The h-index for this group is 26.

The relative impact of this group is far above world average (1.99) considering the whole period. Over the two consecutive periods, the relative impact increases from 1.82 for 1996-2000 to 2.15 for the period 2001-2005.

Most of the publications of SFI (59) fall in the group of Environment/Ecology, and have a relative impact far above world average (1.89). The second largest group of publications is to be found in the group of Agricultural Sciences (49) and these have also a far above world average impact (2.41).

Soil Chemistry, and Chemical Soils Quality Group (SOQ)

For the complete period of 1996-2005, 139 publications were retrieved. There was a decrease from 76 publications for the period 1996-2000 to 63 publications for the period 2001-2005.

The relative impact of the publications is far above average (2.12). 40 publications belong to the 10% highest cited publications; this is 29% of total publications which is above the average observed for all SENSE groups. The number of uncited publications 6, or 4% of the total, is lower than the average for SENSE as a whole. The h-index of this group is 28. Over the two consecutive periods, the relative impact decreases from 2.42 for 1996-2000 to 1.77 for the period 2001-2005.

Most publications (72) were categorized in the field of Environment/Ecology and have a far above average impact (1.59). The publications in the fields of Chemistry (34) have a far above world average relative impact (3.69).

Not part of an Institute

Earth Systems Science group (ESS)

This is a newly formed WIMEK group for which the analysis is based on the recent past performance of the current members of this group.

For the period of 1996-2005, 108 publications were retrieved. There was an increase from 46 publications for the period 1996-2000 to 62 publications for the period 2001-2005.

The relative impact of the publications is far above world average (2.83). 39 publications belong to the 10% highest cited publications; this is 36% of total publications which is above the average observed for all SENSE groups. 9 publications are uncited, which is 8% of the total number of publications. This is lower than the average for SENSE as a whole. The h-index of this group is 22. Over the two consecutive periods, the relative impact increases from 2.07 for 1996-2000 to 3.40 for the period 2001-2005.

Most publications (35) were categorized in the field of Agricultural Sciences and have a far above average impact (2.89). The publications in the field of Environment/Ecology (31) have a far above world average relative impact (3.69). The third largest field of research output is in the field of Geosciences with 24 publications and a relative impact of 2.03.

International Centre for Integrated Assessment and Sustainable Development (ICIS-MU)

For the ICIS-MU group a total of 56 publications could be retrieved. There was a slight increase from 26 publications for the period 1996-2000 to 30 publications for the period 2001-2005. The relative impact for all publications was far above world average (2.80). The number of publications that are among the top 10% most cited publications (17) or 30% of the total number of publications is above average for all SENSE groups. The relative impact over the two consecutive periods decreased, but is for both periods far above world average. For the period 1996-2000 it was 3.98, and for the period 2001-2005 it decreased to 1.78. The number of uncited publications (5) is 9% of the total number of publications, which is average for SENSE. The h-index is 16.

Most of the publications (19) are categorized in the field of Environment/Ecology, these have a far above average relative impact (4.01). The second largest group of publications (16) fall in the field of Economics & Business, the relative impact is far above world average (3.49) as well.

Center for Energy and Environmental Studies (IVEM-RUG)

For the period 1996-2005 a total of 29 publications for this group could be retrieved. There was an increase from 9 publications for the period 1996-2000 to 20 publications for the

period 2001-2005. The relative impact for all publications was on world average (0.91). There is an increase in relative impact from 0.50 for the 1996-2000 to 1.10 for the 2001-2005 period.

The number of publications that are among the top 10% most cited publications (3) or 10% of the total number of publications is below average for all SENSE groups. The number of uncited publications (7) is 24% of the total number of publications, which is above average for SENSE. The h-index is 6.

The largest group of publications (10) of this group were categorized in the field of Environment/Ecology, the relative impact of these publications was above world average in this field (1.24).

RUN Environmental Biology Group (RUNENB)

A total of 81 publications were retrieved for the RUN Environmental Biology Group for the period 1996-2005. There was a slight increase in number of publications that could be retrieved from WoS over the two consecutive periods. For 1996-2000 38 publications could be retrieved, for the period 2001-2005 43 publications were retrieved.

The relative impact of the group over the whole period is far above world average (1.57).

There is a decrease in relative impact from 1.75 for the 1996-2000 period to 1.42 for the 2001-2005 period. 13 publications, or 16% of the total publication output, are among the 10% most cited publications in their field.

5 publications, or 6% of the total, were uncited, which is below the average for SENSE. The h-index for the whole group is 19.

42 publications were categorized in the field of Environment/Ecology. These have a far above average relative impact of 1.95. The second largest group of publications (35) is in the field of Plant & Animal science. These publications have an above world average impact (1.23).

RUN Environmental Sciences Group (RUNENS)

For the complete period of 1996-2005, 81 publications were retrieved. The relative impact of the publications is far above average (1.73). 21 articles belong to the 10% highest cited publications; this is 26% of total publications which is above the average for all SENSE groups. The number of uncited publications 10, or 12% of the total, is on average for SENSE as a whole. The h-index of this group is 14.

Considering the two consecutive periods, we notice an increase in number of publications from 18 to 63. There is a increase in relative impact from 0.90 for the 1996-2000 period to 1.97 for the 2001-2005 period.

39 publications were categorized in the field of Environment/Ecology. These have an above average relative impact of 1.50. The second largest group of publications (20) is in the field of Plant & Animal science. These publications have a far above world average impact (1.80).

VU Theoretical Biology Group (VUTB)

For the period 1996-2005 a total of 85 publications for this group could be retrieved. There was a slight decrease from 44 publications for the period 1996-2000 to 41 publications for the period 2001-2005. The relative impact for all publications was above world average (1.41). There is an increase in relative impact from 1.16 for the 1996-2000 period to 1.67 for the 2001-2005 period. The number of publications that are among the top 10% most cited publications (18) or 21% of the total number of publications is on average for all SENSE groups. The number of uncited publications (4) is 5% of the total number of publications, which is below the average for SENSE. The h-index is 16.

Most (37) of the publications of this group were categorized in the field of Environment/Ecology, the relative impact of these publications was above world average in this field (1.41), followed by 18 publications in the field of mathematics, which had a relative impact of 2.39.

In this analysis the book of Kooijman, S.A.L.M. (2000) Dynamic Energy and Mass Budgets in Biological Systems, which has been cited at least 173 times was left out the analysis.

Table 1a Publication analysis of SENSE (1996-2005).

Institute	Pubs	S cites	S Wavg	S Cits/S Wavg	RI	Pubs top 10%	As % of total pubs	Pubs top 1%	Uncited Pubs	As % of total pubs	h-index
IES-VU	292	3965	2525.22	1.57	1.81	55	19	8	14	5	29
Copernicus	292	2470	1906.09	1.30	1.55	57	20	6	41	14	22
IVM	284	3537	1763.53	2.01	1.95	72	25	10	39	14	31
WIMEK	1400	22872	14418.67	1.59	1.67	254	18	35	105	8	60
SENSE	2476	35178	22420.40	1.56	1.69	484	19	60	218	9	74

Explanation of the collums

- Pubs** Number of publications
- S Cits** Total number of citations
- S Wavg** Total of citations for the field and year corrected world average
- S Cits/S Wavg** Normalized Impact
- RI** Relative Impact
- Pubs top 10%** Number of publications in with the top 10% best cited papers
- As % of total pubs** Number of top 10% best cited papers as percentage of total papers
- Pubs top 1%** Number of publications in with the top 1% best cited papers
- Uncited pubs** Papers without citations
- As % of total pubs** Number uncited papers as percentage of total papers
- h-index** h-index over the period 1996-2005

Table 1b Publication analysis of SENSE for the two consecutive periods (1996-2000) and (2001-2005)

Institute	Pubs 1996- 2000	S Cits 1996- 2000	S Wavg 1996- 2000	S Cits /Swavg	RI 1996- 2000	Pubs 2001- 2005	S Cits 2001- 2005	S Wavg 2001- 2005	S Cits/ S Wavg	RI 2001- 2005
IES-VU	105	2238	1438	1.56	1.62	187	1727	1087.21	1.59	1.91
Copernicus	96	1033	1040	0.99	1.15	196	1437	866.44	1.66	1.75
IVM	93	2134	967	2.21	2.14	191	1403	796.21	1.76	1.85
WIMEK	594	15105	9332	1.62	1.74	806	7767	5086.36	1.53	1.62
SENSE	992	22231	14146	1.57	1.67	1484	12947	8346.72	1.55	1.71

Table 2.a Publication analysis of the SENSE research groups (1996-2005).

Institute	Group	S					Pubs top 10%	As % of total pubs	Pubs top 1%	Uncited Pubs	As % of total pubs	h-index
		Pubs	S cits	S Wavg	Cits/S Wavg	RI						
Copernicus	ESG	81	1288	638.14	2.02	2.30	25	31	6	8	10	20
Copernicus	ESPG	15	26	63.30	0.41	0.48	0	0	0	3	20	3
Copernicus	STS	129	693	752.16	0.92	1.33	22	17	0	20	16	15
Copernicus	ISG	79	513	560.94	0.91	1.28	11	14	0	13	16	12
IES-VU	VUIESSE	95	1835	725.02	2.53	2.81	23	24	7	8	8	19
IES-VU	VUIESAE1	78	868	743.25	1.17	1.37	8	10	1	3	4	19
IES-VU	VUIESAE2	143	1538	1283.17	1.20	1.29	27	19	0	4	3	23
IVM	DCB	97	2261	883.36	2.56	2.62	39	40	7	5	5	26
IVM	DEPA	20	69	98.13	0.70	1.12	2	10	0	4	20	5
IVM	DET	143	1122	669.16	1.68	1.68	27	19	3	23	16	18
IVM	DSADS*	27	91	99.22	0.92	1.63	5	19	0	7	26	4
Others	ESS	108	2175	774.54	2.81	2.83	39	36	7	9	8	22
Others	ICIS-MU	56	1568	448.62	3.50	2.80	17	30	2	5	9	16
Others	IVEM-RUG	29	115	156.32	0.74	0.91	3	10	0	7	24	6
Others	RUNENB	81	1199	718.69	1.67	1.57	13	16	1	5	6	19
Others	RUNENS	81	651	509.87	1.28	1.73	21	26	1	10	12	14
Others	VUTB	85	745	875.61	0.85	1.41	18	21	0	4	5	16
Wimek	AEW	133	2076	864.91	2.40	2.43	37	28	6	6	5	22
Wimek	ENP	15	61	52.66	1.16	1.25	1	7	0	1	7	4
Wimek	ENR	32	79	128.10	0.62	0.61	1	3	0	11	34	4
Wimek	ESA	44	1675	294.45	5.69	4.54	15	34	7	6	14	12
Wimek	ETE	338	3734	4074.18	0.92	0.98	25	7	0	27	8	30
Wimek	HWM	77	560	639.44	0.88	1.17	11	14	0	7	9	13
Wimek	MIB	384	8152	5531.55	1.47	1.51	52	14	8	21	5	43
Wimek	NCP	100	1887	701.52	2.69	2.43	35	35	6	4	4	21
Wimek	SEG	108	747	627.53	1.19	1.24	13	12	0	13	12	14
Wimek	SFI	131	2057	1076.84	1.91	1.99	44	34	5	11	8	26
Wimek	SOQ	139	3001	1293.40	2.32	2.12	40	29	5	6	4	28
Average		102	1459	905	1.7	1.8	21	20	3	9	11	17

* refers to the period 2001-2005

Table 2.b Publication analysis of SENSE for the two consecutive periods (1996-2000) and (2001-2005)

Institute	Group	Pubs 1996- 2000	S Cits 1996- 2000	S Wavg 1996- 2000	S Cit/ Swavg	RI 1996- 2000	Pubs 2001- 2005	S Cits 2001- 2005	S Wavg 2001- 2005	S Cits/ S Wavg	RI 2001- 2005
Copernicus	ESG	27	606	345.49	1.75	1.83	54	682	292.65	2.33	2.54
Copernicus	ESPG	5	12	41.74	0.29	0.39	10	14	21.56	0.65	0.52
Copernicus	STS	49	318	479.88	0.66	0.90	80	375	272.28	1.38	1.60
Copernicus	ISG	22	136	264	0.51	0.80	57	377	296.51	1.27	1.46
IES-VU	VUIESSE	22	913	286.83	3.18	3.26	73	922	438.19	2.10	2.67
IES-VU	VUIESAE1	32	471	465.05	1.01	1.02	46	397	278.20	1.43	1.61
IES-VU	VUIESAE2	60	1033	827.57	1.25	1.29	83	505	455.60	1.11	1.29
IVM	DCB	35	1376	466.97	2.95	2.98	62	885	416.39	2.13	2.42
IVM	DEPA	8	37	70.60	0.52	0.62	12	32	27.53	1.16	1.46
IVM	DET	48	710	402.36	1.76	1.84	95	412	266.80	1.54	1.60
IVM	DSADS						27	91	99.12	0.92	1.63
Others	ESS	46	1011	474.00	2.13	2.07	62	1164	300.54	3.87	3.40
Others	ICIS-MU	26	1357	295.30	4.60	3.98	30	211	153.32	1.38	1.78
Others	IVEM-RUG	9	34	68.29	0.50	0.50	20	81	88.03	0.92	1.10
Others	RUNENB	38	916	511.87	1.79	1.75	43	283	206.82	1.37	1.42
Others	RUNENS	18	192	215.83	0.89	0.90	63	459	294.04	1.56	1.97
Others	VUTB	44	493	644.32	0.77	1.16	41	252	231.29	1.09	1.67
Wimek	AEW	37	672	434.99	1.54	1.65	96	1404	429.92	3.27	2.74
Wimek	ENP	3	30	15.16	1.98	2.00	12	31	37.50	0.83	1.06
Wimek	ENR	8	55	64.76	0.85	1.11	24	24	63.34	0.38	0.44
Wimek	ESA	16	1454	181.92	7.99	7.07	28	221	112.53	1.96	3.09
Wimek	ETE	158	2672	2826.61	0.95	1.00	180	1062	1247.57	0.85	0.95
Wimek	HWM	30	366	369.58	0.99	1.09	47	194	269.86	0.72	1.22
Wimek	MIB	169	5224	3540.79	1.48	1.53	215	2928	1990.76	1.47	1.50
Wimek	NCP	25	1008	323.20	3.12	3.13	75	879	378.32	2.32	2.20
Wimek	SEG	42	502	377.36	1.33	1.59	66	245	250.17	0.98	1.01
Wimek	SFI	63	1278	721.06	1.77	1.82	68	779	355.78	2.19	2.15
Wimek	SOQ	76	2425	982.95	2.47	2.42	63	576	310.45	1.86	1.77
Average		1123	906	563.26	1.8	1.8	1732	553	342.32	1.5	1.7

Table 3a. Publication analysis per research field of Copernicus, IVM and IES for the 1996-2005 period.

Institute	Copernicus				IVM				IES-VU		
Group	ESG	ESPG	STS	ISG	DCB	DEPA	DET	DSADS*	VUIESAE1	VUIESAE2	VUIESSE
Agricultural Sciences	2.32(1)		1.06(7)		2.48(1)			6.93(1)		2.54(8)	0.66(3)
Biology&Biochemistry	2.19(3)		0.71(2)	0.68(2)	1.66(2)		0(1)		0.50(9)	1.08(5)	1.65(3)
Chemistry			1.55(2)		1.91(9)		0.22(1)				0.48(1)
Clinical Medicine			0.11(1)	1.12(18)	1.97(4)				0.24(3)		
Computer Science				3.92(1)				8.02(2)			
Economics & Business	3.97(2)		1.14(5)	1.24(12)		0.54(5)	2.01(73)	1.00(2)			
Engineering	0.64(4)	0.62(3)	1.52(32)	0.76(4)	2.83(1)	1.62(2)	0.99(6)	0(1)			
Environment/Ecology	2.21(62)	0.42(2)	0.98(47)	0.20(12)	2.79(59)	0.73(5)	1.3(24)	0.92(8)	1.38(52)	1.22(122)	2.95(66)
Geosciences		0.44(2)	0.61(5)			0.82(1)	1.14(10)	0.28(6)			0.57(4)
Immunology				0.52(4)							
Materials Science			0.99(2)								
Mathematics											
Microbiology				0.08(1)					0.84(2)		0.95(6)
Molecular Biology & Genetics					2.73(1)						
Neuroscience & Behavior				0.60(3)		0(1)					
Pharmacology & Toxicology				3.03(7)	3.91(19)				0.59(2)	1.23(3)	
Physics			0(2)					0.14(1)			
Plant & Animal Science	3.67(6)		1.21(1)	0.17(1)	2.62(1)		0.7(1)	1.82(3)	2.16(13)	1.22(5)	4.72(12)
Psychiatry/Psychology											
Social Sciences, general	2.73(3)	0.45(8)	2.31(23)	2.01(15)		2(6)	1.65(27)	1.49(3)			
Total	2.30(81)	0.48(15)	1.33(129)	1.27(79)	2.62(97)	1.12(20)	1.68(143)	1.63(27)	1.37(78)	1.29(143)	2.81(95)

Refers to the period 2001-2005

Table 3b. Publication analysis per research field of Wimek for the 1996-2005 period

Institute	Wimek										
Group	AEW	ESA	ENP	ENR	ETE	HWM	MIB	NCP	SEG	SFI	SOQ
Agricultural Sciences	2.48(1)	5.57(5)			0.94(6)		3.54(12)	1.13(2)	0.89(28)	2.41(49)	1.38(15)
Biology&Biochemistry					0.59(100)		1.05(92)	0.05(2)	0(1)		
Chemistry					0.98(17)	0.16(1)	0.36(8)			1.95(1)	3.69(34)
Clinical Medicine											0.44(1)
Computer Science						0.98(2)					0.09(2)
Economics & Business		2.35(9)		0.70(19)							
Engineering		0.68(1)		0.96(4)	5.70(2)	2.00(14)	3.35(1)		2.17(29)	0.43(5)	1.00(2)
Environment/Ecology	2.92(75)	6.66(16)	0.17(1)	0.24(6)	1.13(181)	1.17(25)	2.30(45)	3.00(63)	0.95(33)	1.89(59)	1.59(72)
Geosciences	0.31(1)	3.50(9)				1.05(27)		0.60(4)	0.76(13)	0.89(11)	2.52(12)
Immunology											
Materials Science											
Mathematics											
Microbiology					1.05(29)		1.54(203)				
Molecular Biology & Genetics						0.12(6)	0.88(12)				
Neuroscience & Behavior											
Pharmacology & Toxicology											
Physics					0(1)	0(1)					
Plant & Animal Science	1.85(54)	3.05(2)		0.54(1)	1.66(1)	1.62(1)	0.75(11)	1.69(29)	1.29(3)	2.95(6)	1.80(1)
Psychiatry/Psychology			0.99(2)								
Social Sciences, general	1.04(2)	2.80(2)	1.38(12)	0.20(2)	0(1)				0.79(1)		
Total	2.43(133)	4.54(44)	1.25(15)	0.61(32)	0.98(338)	1.17(77)	1.51(384)	2.43(100)	1.24(108)	1.99(131)	2.12(139)

Table 3c. Publication analysis per research field of the other groups for the 1996-2005 period

Institute	Others					
Group	ESS	ICIS-MU	IVEM-RUG	RUNENB	RUNENS	VUTB
Agricultural Sciences	2.89(35)		0.29(2)			
Biology&Biochemistry			1.38(2)	0.87(1)	0.55(4)	0.59(8)
Chemistry	0.87(3)				0.76(4)	1.87(1)
Clinical Medicine		1.22(7)				0.09(2)
Computer Science		0(1)				
Economics & Business		3.49(16)	1.14(5)			
Engineering	1.79(9)	0.22(1)	0.19(2)		6.23(5)	0.83(2)
Environment/Ecology	3.67(31)	4.01(19)	1.24(10)	1.95(42)	1.50(39)	1.41(37)
Geosciences	2.03(24)	2.17(5)		0.42(2)	0.51(3)	
Immunology						
Materials Science						
Mathematics						2.39(18)
Microbiology				1.00(1)	0.26(2)	0.12(2)
Molecular Biology & Genetics						0.23(8)
Neuroscience & Behavior			0(1)			
Pharmacology & Toxicology					0(1)	1.65(1)
Physics						
Plant & Animal Science	3.94(6)	1.46(1)		1.23(35)	1.80(20)	3.02(4)
Psychiatry/Psychology			0.20(1)			
Social Sciences, general		0.64(6)	0.73(6)		0.25(1)	0(2)
Total	2.83(108)	2.80(56)	0.91(29)	1.57(81)	1.73(81)	1.41(85)

Table 4. Analysis results for the expanded analysis for the research groups with the research emphasis in the Economic and Social sciences.

Institute	Group	Standard analysis		Expanded analysis		
		Pubs	RI	research field	Pubs	RI
Copernicus	ESPG	15	0.48	Social Sciences, general	103	0.60
Copernicus	ISG	79	1.28	Social Sciences, general	158	1.08
IVM	DEPA	20	1.12	Social Sciences, general	120	0.72
IVM	DET	143	1.68	Economics & Business	469	1.10
WIMEK	ENP	15	1.25	Social Sciences, general	74	1.93
WIMEK	ENR	32	0.61	Economics & Business	63	0.83

The groups which have a substantial output found by the standard analysis already, both show a decrease in relative impact when an expanded analysis was performed. Most of their important publication output takes place in the core journals covered by ISI. The groups which have a higher share of publication output as book chapters, reports etc show an increase in relative impact in the expanded citation analysis since most of their publication output takes place outside the journals covered by ISI.

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