MSc Research Skills

Topic: Finding & evaluating information

D G Rossiter

University of Twente.
Faculty of Geo-information Science & Earth Observation (ITC)

April 5, 2013

UT/ITC Enschede

Topics for this lecture

1. **Information and information overload**
2. **Literature review**
3. **Types of sources and their reliability**
4. **How to search**

Topic: Information and information overload

- Information
- Information overload
- Information literacy
- Information skills
- Personal information infrastructure

Information

> "Knowledge is power. The more one knows, the more one will be able to control events."
>
> – Francis Bacon, *Meditationes Sacrae* (1597)

Information has become a vital resource for world economies, and drives research. Information is highly **synergistic**: the more information one has, the more information one can generate.

It is certainly the basic component of any **research** project.

Information overload

Information is available from many sources and in many formats, such as:

- printed text (newspapers, magazines, journals, reports . . .);
- television (increasingly international);
- videos;
- library databases; and
- web sites.

Much of the printed material is also on the **Internet**.

- **Question**: How to avoid **information overload**?
- **Answer**: With a clear **information strategy**

Information skills

Information skills can be grouped in five categories:

1. **awareness** (that we need reliable information);
2. **access** (how to find it);
3. **evaluation** (how to decide what is most relevant and reliable);
4. **use** (how to use it in our work);
5. **generation** (how to produce new information).

Information skills for the MSc thesis proposal

- find **relevant** and **accurate** information on the research topic;
- relate these in a **literature review**

Personal information infrastructure

Slowly you can build up:

- A list of *your* favourite **reference materials** such as handbooks, user's guides and texts;
- A list of *your* favourite **journals** and book series;
- A list of the best **searchable databases** for *your* purpose;
- A set of *your* **saved searches** in the databases, also as e-mail or RSS **alerts**.

This is in fact an **infrastructure** for *your* research career.

Topic: Literature review in a research proposal

When proposing a research project:

1. to establish its **originality**
   - prove that the proposed work has not been done before;
2. to place the proposed research in **context** (related work);
   - how it fits in the “big picture”
   - related work done by others that influence the choices made for this research
3. to compare and justify the choice of **research methods**
   - methods used in similar studies
   - why some methods are preferred or appropriate in this research

Topic: Types of sources and their reliability

"Don't believe everything you read!"

Especially on the internet!

Not all sources are equally **reliable**, nor have they all had the same **quality control**.

Recommended: ITC library's **Information Literacy Course**[1] module 2 *"Selecting the right information sources"*

[1] http://www.itc.nl/Pub/Home/library/Library-Guides/LiteracyCourse

Journal Article

This is an **original contribution** that appears in a published **scientific journal**.

These contributions have been **peer-reviewed** to ensure quality control

Note: not all peer-review is equally effective.

In general, the more **influential** the journal (i.e. the more its work is cited and considered of top quality), the more likely that peer review has been rigorous.

Peer-review for quality control

1. The **authors** submit a **draft** of the article to a journal editor.

2. The **editor** checks the relevance for the journal and the format of the paper.

3. The **editor** sends the draft to several other scientists familiar with the subject matter; these are the **peer-reviewers**.

4. The reviewers read the draft and **advise the editor** to either:

   (a) **accept**;
   (b) **accept with minor revisions**;
   (c) **Reconsider** if major changes are made; or
   (d) **reject** outright.

Where is the quality control?

1. Recommendation to **revise** and possibly re-submit because:
   - **Incorrect analysis**, not suitable to the data
   - **Unjustified conclusions**, poor reasoning;
   - Work does not properly consider **related work**;
   - Poor **writing**.

2. Outright **rejection** because:
   - **Fraud**, e.g. plagiarism of others' work
   - Incorrect data collection or processing methods (therefore the **data are not reliable**);
   - Work **repeats** what has already been done, **nothing new is added** to the existing literature;
   - Work is **too narrow** ("light") to justify publishing, but could be incorporated into a bigger study.

Types of journal articles

Research Article Describes an **original** investigation, method, or procedure. Specific and limited

- Dobos, E.; Micheli, E.; Baumgardner, M. F.; Biehl, L.; & Helt, T. 2000. *Use of combined digital elevation model and satellite radiometric data for regional soil mapping*. *Geoderma* **97**(3-4):367–391

Review Article **Summarises** a set of research articles; surveying the state-of-art in a particular field. The title may include words like "review", "summary", or "overview".

- McBratney, A. B.; Odeh, I. O. A.; Bishop, T. F. A.; Dunbar, M. S.; & Shatar, T. M. 2000. *An **overview** of pedometric techniques for use in soil survey*. *Geoderma* **97**(3-4):293–327

Opinion A scientific **editorial**, either by the journal editor or an invited contributor.

- Basher, L. R. 1997. *Is pedology dead and buried?* *Australian Journal of Soil Research* **35**:979–94

Which journals are most reliable?

There are a great many journals, and all may have useful and reliable information.

However, certain journals have been identified as the most **important** and **prestigious** journals within a subject field.

The MSc researcher should prefer articles out of these journals; it would be very unusual not to refer to any of these.

These are called **ISI** journals.

- ISI: **Institute for Scientific Information** (Thompson Reuters)
- about 1/3 of all journals are ISI (about 3 700 in the sciences)

Criteria for selection as ISI journal

- the journal's **publishing standards**:
  - selectivity;
  - **peer-review** process.
- its editorial content (including **reputation of its editorial board**);
- the international diversity of its authorship;
- its **citation record** in other journals (**importance** of its papers).

Is a journal ISI?

Search the Journal Citation Reports (JCR).

Example, there are 15 ISI journals[2] in the "Remote Sensing" category (in alphabetic order):

1. Canadian Journal of Remote Sensing (Canadian Aeronautics & Space Institute)
2. GIScience & Remote Sensing (Bellwether Publishing, USA)
3. GPS Solutions (Springer)
4. IEEE Geoscience and Remote Sensing Letters (IEEE)
5. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing

(continued . . .)

[2] as of 12-April-2010

6. IEEE Transactions on Geoscience and Remote Sensing (IEEE)

7. International Journal of Applied Earth Observation and Geoinformation (Elsevier Science)

8. International Journal of Remote Sensing (Taylor & Francis)

9. ISPRS Journal of Photogrammetry and Remote Sensing (Elsevier Science for ISPRS)

10. Journal of Geodesy (Springer)

11. Photogrammetric Engineering and Remote Sensing (American Society of Photogrammetry and Remote Sensing)

12. Photogrammetric Record (Wiley-Blackwell)

(continued . . .)

13. Photonirvachak (Indian Society of Remote Sensing)

14. Radio Science (American Geophysical Union)

15. Remote Sensing of Environment (Elsevier Science)

16. Survey Review (Commonwealth Association of Surveying and Land Economy)

Relevance to MSc project

ISI journals have been **expertly evaluated** as:

- **reliable** (especially their quality control and editorial policies);
- **important** (i.e. their papers are cited by other researchers).

so the MSc student (beginning researcher) has an easier job of **evaluating** papers – these have been **screened** (filtered, pre-selected).

Open Access

Open Access (OA) publications are those made **freely available online** to libraries and readers, anywhere, with no charges imposed for access.

- The "Green" Road to OA: **repositories** of papers published commercially but then made available (often after a time lag);
  - Directory of Open Access Repositories (OpenDOAR): http://www.opendoar.org/
- The "Golden" Road to OA: **Open Access journals**: producer pays costs, papers are immediately OA
  - Directory of Open Access Journals (DAOJ); http://www.doaj.org/
  - Example: *Hydrology and Earth System Sciences*; http://www.hydrol-earth-syst-sci.net/

Conference Paper

- An original contribution that was presented at a scientific meeting;
- Usually **not** or minimally **peer-reviewed**, because . . .
- . . . conferences are mainly to discuss **work in progress**;
- Intensity of peer-review depends on quality of the conference;
- In most fields, papers presented at a conference should appear as **journal papers** theses within a few years of the conference;
- Some **high-prestige** conferences use **peer review**; the proceedings are **published** to the same standards as an edited book or a journal article

Conference papers in a journal

Conference papers may be collected for a **special issue** of a **peer-reviewed** journal; in that case they are peer-reviewed and cited as a journal paper, even though the work was first presented in a conference:

- Conference paper:
  - ▷ Rossiter, D. G. 2006. *Classification of urban and industrial soils in the World Reference Base for Soil Resources*. In *18th World Congress of Soil Science*. Philadelphia, PA (USA): IUSS
- Journal article:
  - ▷ Rossiter, D. G. 2007. *Classification of urban and industrial soils in the World Reference Base for Soil Resources*. *Journal of Soils and Sediments* **7**(2):96–100

There is no reason to cite the conference paper once the journal article is published.

Book chapter

This is an **original contribution** that is collected into an **edited book** on a specific topic.

These are typically invited by the book editor and may undergo some peer review; certainly they are edited. Often they are **review articles**.

▷ Skidmore, A. K. 1999. *Accuracy assessment of spatial information*. In Stein, A.; Meer, F. v. d.; & Gorte, B. G. F. (eds.), *Spatial statistics for remote sensing*, pp. 197–209. Dordrecht: Kluwer Academic.

Textbook

This is a published book meant to **introduce a subject** for classroom teaching or self-study.

It can treat a topic at any **level** (i.e. pre-requisites for understanding it), but given that level, it is intended as the **first contact** with the subject.

Not peer-reviewed as such, but are typically extensively **edited** and sent by the publisher to people who might use the text in teaching, to see if they find the book accurate and useful.

Example Textbooks

Some say “text”:

- Dupriez, H. & de Leener, P. 1998. *Trees and multistorey agriculture in Africa : a **textbook** for agro - forestry*. Nivelles; Wageningen: Terres et Vie; Technical Centre for Agricultural and Rural Cooperation (CTA)
- Kutilek, M. & Nielsen, D. 1994. *Soil hydrology : **textbook** for students of soil science, agriculture, forestry, geoecology, hydrology, geomorphology or other related disciplines*. Geoecology paperback. Reiskirchen (D): Catena Verlag

Others don’t:

- Lillesand, T. M. & Kiefer, R. W. 1994. *Remote sensing and image interpretation*. New York: John Wiley & Sons, 3rd edition
- Bishop, Y.; Fienberg, S.; & Holland, P. 1975. *Discrete multivariate analysis: theory and practice*. Cambridge, MA: MIT Press

Technical Report

These are publications from an institution or project, and often contain **primary data** and maps which do not appear elsewhere.

They are often difficult for others to obtain, but if they are the only source of information (e.g. of **primary data**), they should be cited.

They are not peer-reviewed; the **quality control was only as good as the project**.

- ▷ Center for Advanced Spatial Technologies (CAST). 1998. *AR-GAP final report: State-wide biodiversity mapping for Arkansas*. Report, Center For Advanced Spatial Technologies (CAST), Fayetteville, AR.
- ▷ Anonymous. 1985. *Soils and soil conditions, Kali Konto upper watershed, East Java*. Project Report ATA 206, Universitas Brawijaya (Malang), Agricultural University (Wageningen)

On-line access

More and more journals (also books and reports) are only available **on-line**, and have no printed equivalent.

Some of these are fully **peer-reviewed** and of good quality; they are used like printed journal articles.

Example:

▷ Bourne, P. 2005. *Ten simple rules for getting published*. *PLoS Computational Biology* **1**(5):e57. http://dx.doi.org/10.1371/journal.pcbi.0010057

Note the use of the **Digital Object Identifier (DOI)** system to help the reader locate the article on-line.

All peer-reviewed journal articles which are available on-lion have a permanent DOI.

Web access to printed sources

- e.g. on-line versions of printed journals, technical reports, books.
- the web source is a **copy** or a differently-formatted version of a **printed source**.
- The web alternative is **easier to access**
- The **printed source** is cited, optionally with the web address

▷ Center for Advanced Spatial Technologies (CAST). 1998. *AR-GAP final report: State-wide biodiversity mapping for Arkansas*. Report, Center For Advanced Spatial Technologies (CAST), Fayetteville, AR. URL: http://www.cast.uark.edu/gap/

▷ Dobos, E.; Micheli, E.; Baumgardner, M. F.; Biehl, L.; & Helt, T. 2000. *Use of combined digital elevation model and satellite radiometric data for regional soil mapping*. *Geoderma* **97**(3-4):367–391 DOI: http://dx.doi.org/10.1016/S0016-7061(00)00046-X

Web pages

Some information is only available via the web.

Tomorrow's version may be different from today's, it may move to another cyber-address, or it may even disappear.

- **not peer-reviewed**;
- **not permanent**;
- **not 'published'** in the traditional sense, or even the digital equivalent

Example of a web page

"In the USA, soil conservation is aggressively promoted through attractive web sites [e.g. 1]."

Entry in the list of references:

[1] USDA Natural Resources Conservation Service. No date. *North Carolina NRCS*. On-line document; URL: http://www.nc.nrcs.usda.gov/. Access date: 05-April-2013

The **access date** must be given, because digital sources may change, move or disappear.

Judging the reliability of web pages

- **Accuracy**:
  - As far as you can evaluate, is the factual information correct?
  - Are there grammatical, spelling and/or typographical errors?

- **Authority**:
  - Who sponsors the page?
  - Who wrote the material? What are the author's qualifications?
  - Who is the copyright holder?

  If you can't even tell who sponsors the page or who wrote the text, that is a bad sign: no **accountability** implies no authority.

  (continued . . .)

- **Objectivity**:
  - Is the text an advertisement?
  - Does the text seem to only present one side of a known controversy?
  - Is the sponsor known to be objective?
  - Is there a reason the sponsor would distort or exaggerate?

- **Currency**:
  - When was the page written?
  - Is the information kept current?
  - When is the information from any graphs and charts gathered?

- **Coverage**:
  - Is it completed or under construction?
  - Is there a print equivalent (or at least some printed sources to back it up)?
  - Is it an entire work or just a fragment?

Reliable web pages

- Technical pages of responsible organizations, e.g. NASA http://www.nasa.gov/
- Official pages of organizations, when presenting facts within their competence, e.g. FAO http://www.fao.org/
- **Collaborative** sites (many small contributors) with community peer-review, e.g. CC-CEDICT (Chinese-English dictionary) http://cc-cedict.org/wiki/

Wikipedia is a special case of a collaborative site: generally reliable because it requires a **neutral point of view** but this is difficult to enforce; there is no final authority.

Problematic web pages

- **Commercial** sites
  - obviously, promoting their product – but they can be reliable sources for technical information about the product
- **Special-interest** and **advocacy** groups, promoting a programme or viewpoint
  - May have valid information but often is one-sided ("slanted")
  - May have purposely misleading or exaggerated information to stimulate activism or financial support
- Lecture notes or tutorials: check the **credentials** of the author (their peer-reviewed journal articles)
- "Hobby" sites: an **amateur** with enthusiasm for a subject but not necessarily sufficient knowledge

FIND OUT MORE ABOUT...

- Biodiversity
- Climate Change
- Endangered Species
- Earth's most special places
- Reducing humanity's impact
- The health of our planet
- Volunteering & scholarship opportunities

WE NEED YOUR SUPPORT

We can only continue our work because of the amazing generosity of supporters like you. If you can, please **make a donation today** and help fund our vital projects around the world.

Donate now

GEOSTATSCAM.com

Geostatistics: From human error to scientific fraud

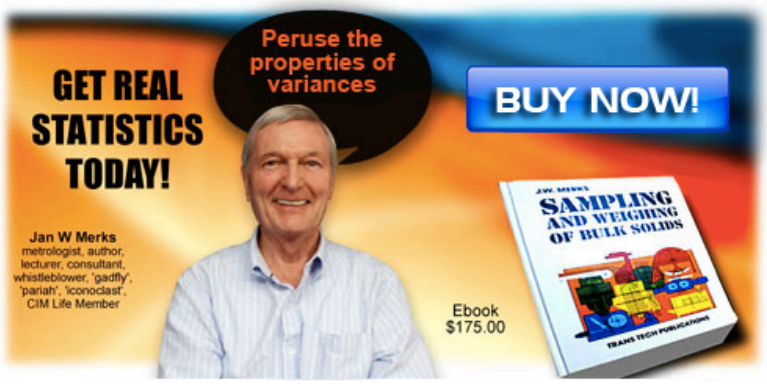
Home

What's wrong with geostatistics?

- Sampling paradox
- Kriging game
- Kriged estimate
- Missing variance
- Kriging Variance

Geostatistical factoids

- Spatial dependence



Topic: How to Search

Finding **relevant** material, and especially the **most important** for your purpose, is not easy.

It requires **patience**, **detective skills**, and continued **hard work**.

Fortunately, in the **digital age** it is possible to make much more rapid progress than previously. But, you should have a sound **search strategy**.

And, you have help from the information specialists in the **ITC library**.

Recommended: ITC library's **Information Literacy Course**[3] module 3 *"Searching the literature"*

[3] http://www.itc.nl/Pub/Home/library/Library-Guides/LiteracyCourse

ITC library search resources

Recommended: ITC library's **Information Literacy Course**[4] module 5 *"Databases"*

- Search and view **full-text** (if ITC has a subscription):
  1. Web of Science
  2. Science Direct / Elsevier
  3. SpringerLink
  4. JSTOR
- Search **abstracts**, some links to full-text
  1. Scopus
  2. Google Scholar
- **Subject-oriented** bibliographic databases
  1. Geobase
  2. CAB Abstracts

[4] http://www.itc.nl/Pub/Home/library/Library-Guides/LiteracyCourse

Starting points for search

- Keyword searches in **electronic resources** (e.g. ScienceDirect)
- Reference lists in **lecture notes**;
- Reference lists in earlier **theses**;
- Reference lists in **textbooks**;
- **Review papers**
  - Each reference is placed in **context**, with an indication of **importance**;
- Reference lists in **reseach papers** in recent issues of relevant **journals**.

Search strategy

- build **concept groups** from your research topic;
- develop a **set of terms** for each concept group;
- find **synonyms**;
- decide which **Boolean logic** is needed, place brackets and combine concepts;
- decide whether to use **truncation** or not;
- choose the **databases** and use proper search commands for each.

Example: Concept groups

From the ITC tutorial:

> "These concepts are the main topics which best describe the information you seek. Analyze the topic you need information about by writing out a few detailed sentences about this topic. Underline the main words in these sentences."

Example: "Kampala has a severe problem with flooding after heavy rains, which is caused by rapid runoff from imperemable areas (paved roads, compacted soils) and insufficient infiltration in vegetated areas. I want to assess this spatially with a distributed hydrological model, for urban flooding which needs a gridded map of soil parameters, especially infiltration rate, over a large area. Has anyone made a soil properties map of Kampala? Has anyone developed a methodology for rapidly identifying compacted soils from imagery? What methods have been used to interpolate from point samples of soil infiltration to a grid?"

Example: Terms from concept groups

1. Kampala (specific area), African urban/city/citites (similar areas)
2. distributed hydrological/runoff/infiltration model for urban flooding
3. soil properties/hydrology map
4. identify/map compacted/impermeable/impervious soil from imagery
5. interpolate point to grid/raster

These may have synonymns, to be joined with OR (see next)

Boolean (logical) operators

- **And** operator:
  - Retrieves records that include **both** terms
  - **narrows** your search
  - Used for terms or concepts that are **not related**
- **Or** operator:
  - Retrieves records that include **either** of the terms
  - **Widens** your search
  - Used for **related** terms or concept
- **Not** operator:
  - Retrieves records that include one term but **not** another term
  - Eliminates all the records containing the second term
  - **Narrows** your search
  - May eliminate relevant records

Truncation

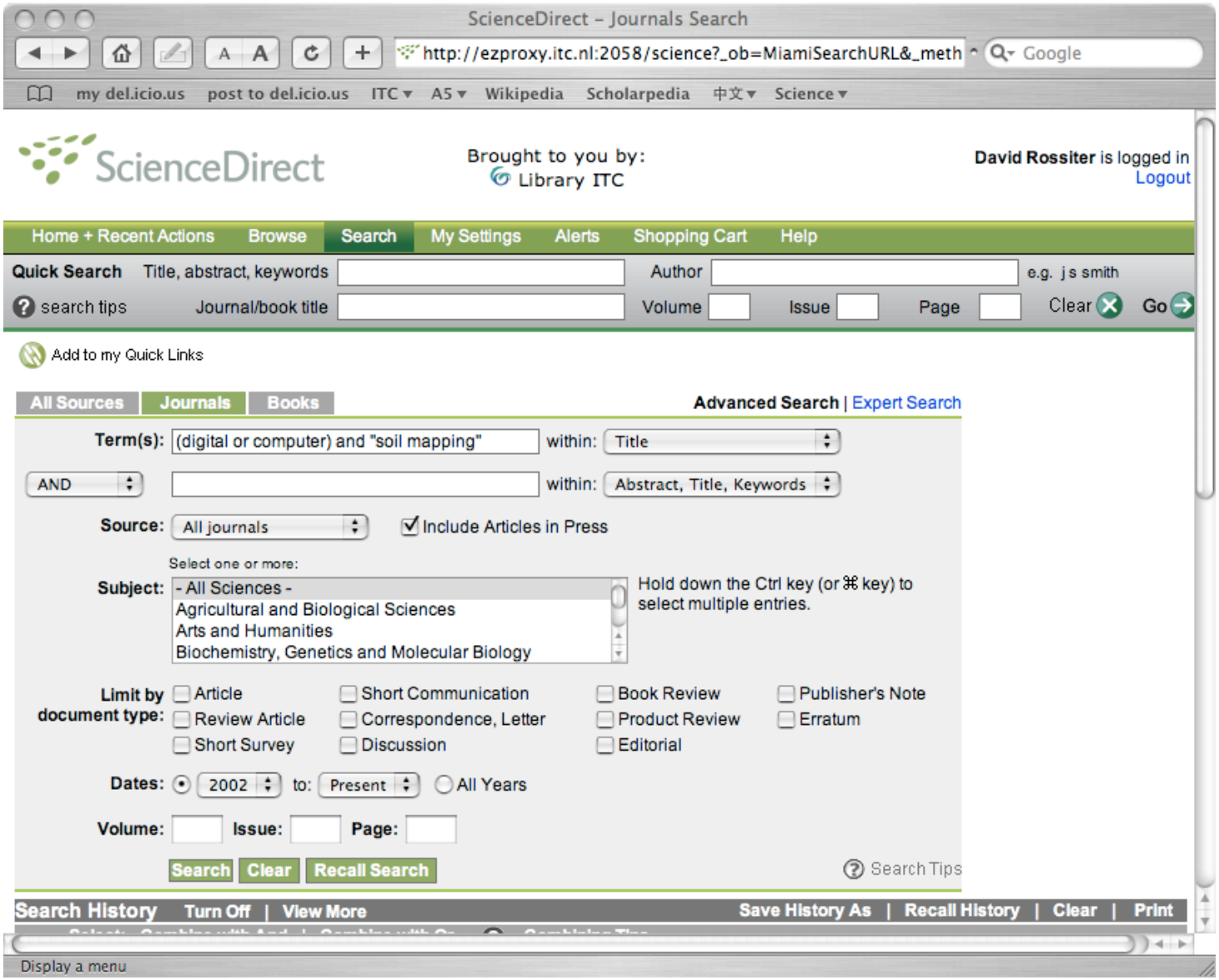
Replace part of a word with a symbol, the search engine will match anything for the missing part.

Truncation symbols can be used either **inside** the word or at the **end** of it.

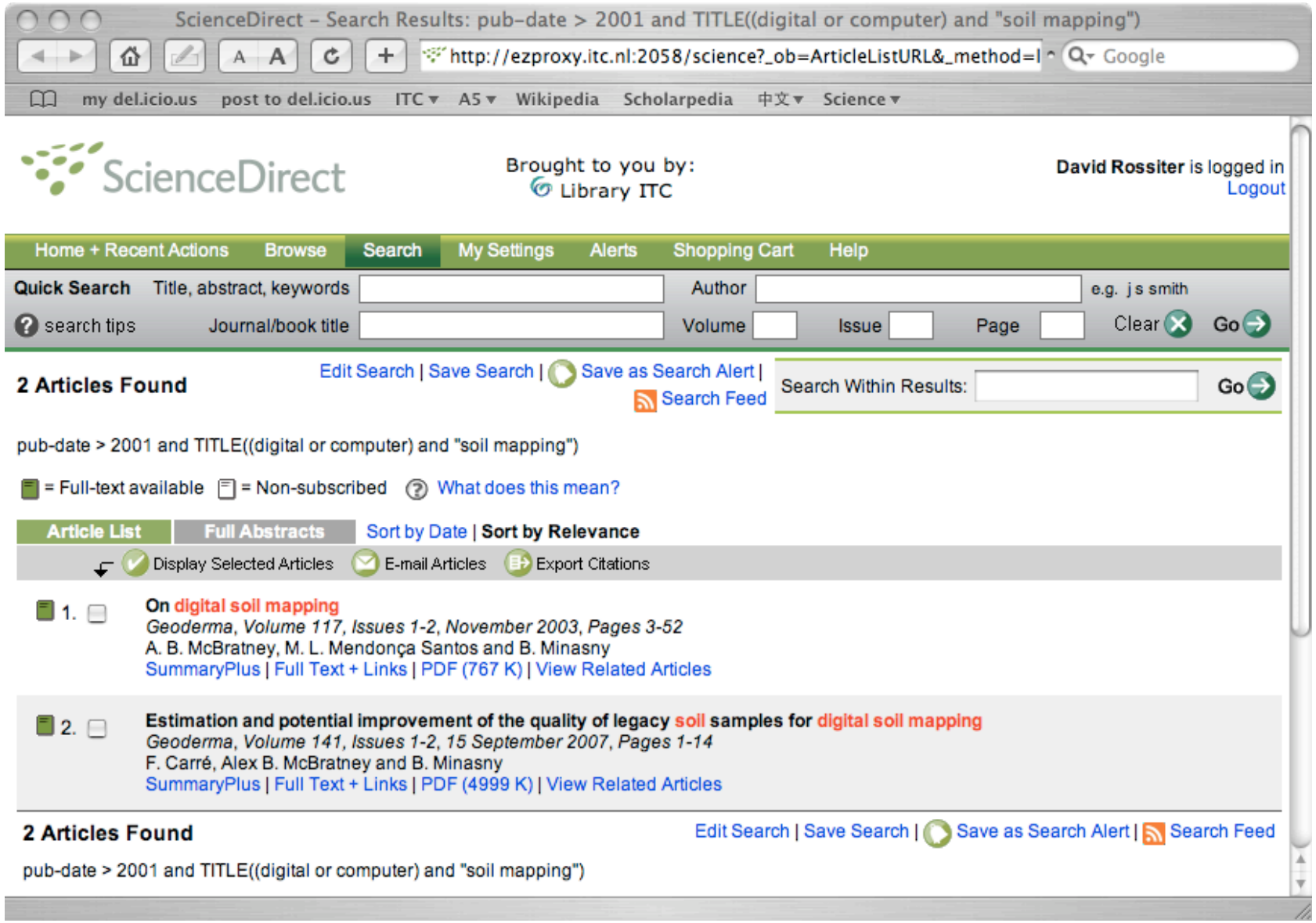
Each database uses its own truncation symbols; the **asterisk** * is most common.

- 'wom*n' - finds 'woman' or 'women'
- 'diet*' - finds 'diets', 'dietician', 'dieting', 'dietary', but also 'diethylstilbestrol' (a synthetic estrogen)
- 'cartograph*' - finds 'cartographic', 'cartography', 'cartographical'
- 'plan*' - finds 'plan', 'plans', 'planning' but also 'planet', 'planetary'
- 'system*' - finds 'system', 'systems'
- 'science*' - finds 'science', 'sciences'

Search in ScienceDirect



Search results

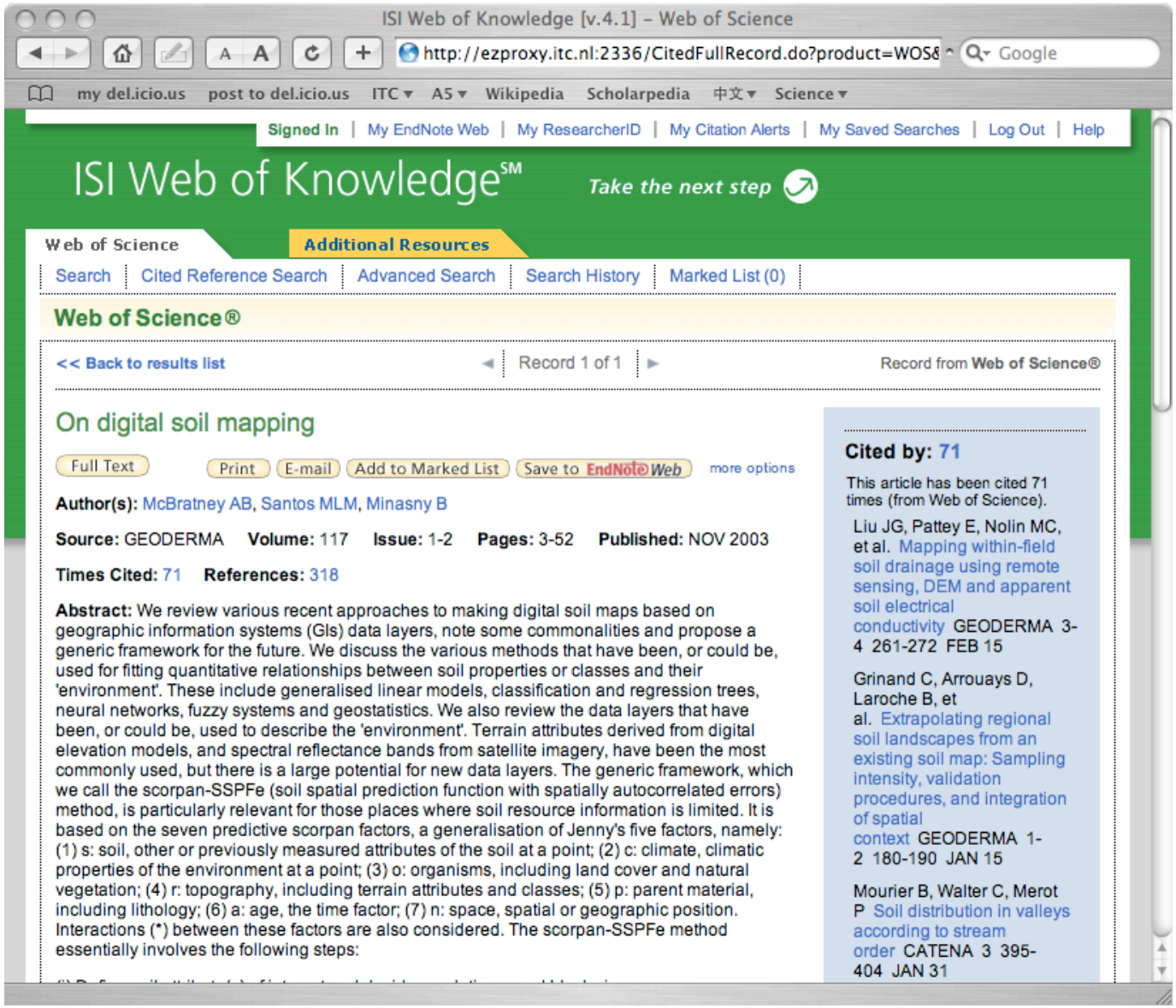


The “spider” approach

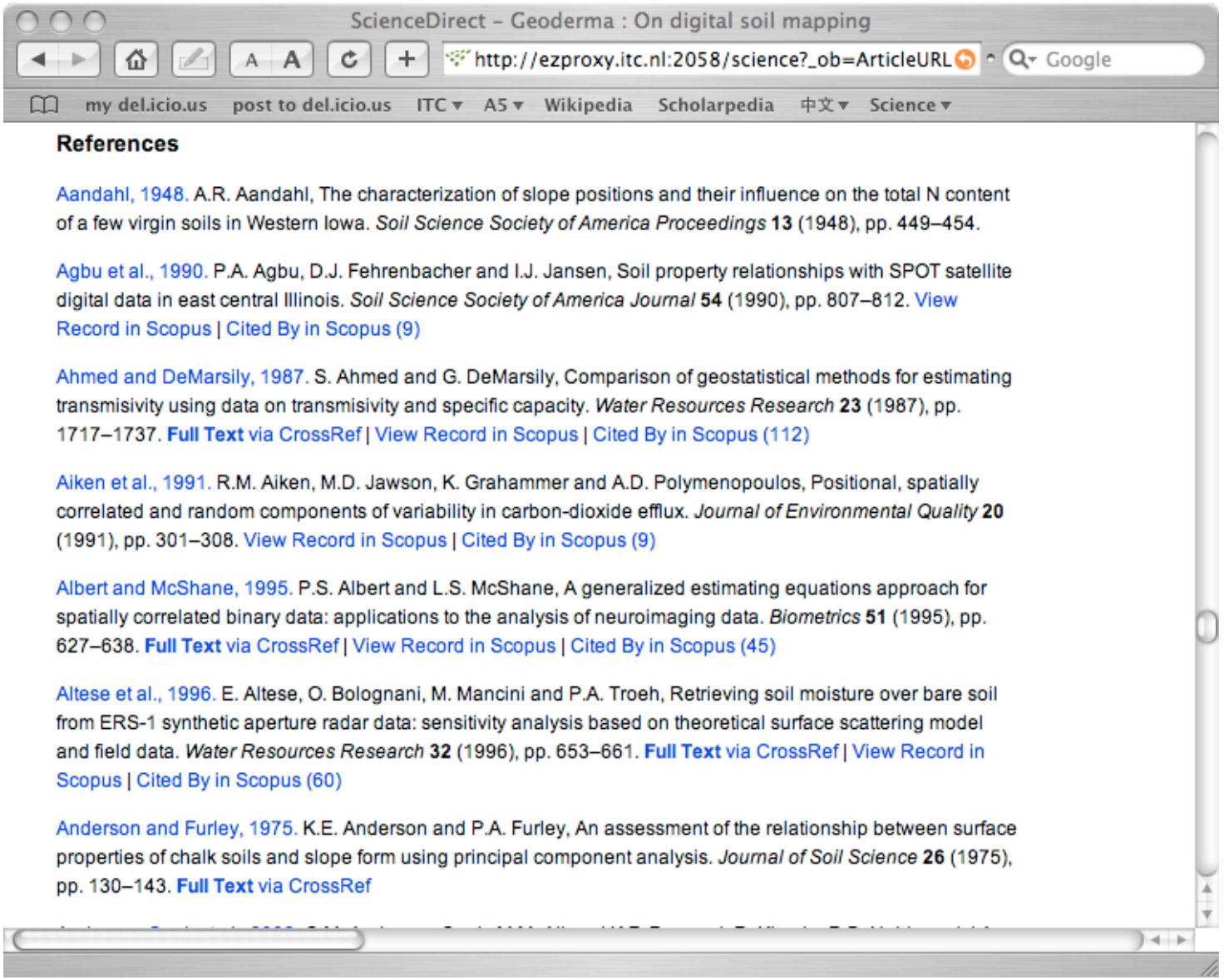
Once you have found some relevant literature, look for:

- Works that are cited in the papers you have found (**“backwards spider”**); note these have been put into **context** for you by the paper’s authors
- Works that cite the papers you have found (**“forwards spider”**)
  - use the **forward search** of an electronic resource such as **Web of Science**
- Works by the **same author(s)**
- **Related articles** links in the search results (**“sideways spider”**)
- Papers in the **same journal**

Web of Science record



References in the paper ("backwards spider")



References

Aandahl, 1948. A.R. Aandahl, The characterization of slope positions and their influence on the total N content of a few virgin soils in Western Iowa. *Soil Science Society of America Proceedings* **13** (1948), pp. 449–454.

Agbu et al., 1990. P.A. Agbu, D.J. Fehrenbacher and I.J. Jansen, Soil property relationships with SPOT satellite digital data in east central Illinois. *Soil Science Society of America Journal* **54** (1990), pp. 807–812. View Record in Scopus | Cited By in Scopus (9)

Ahmed and DeMarsily, 1987. S. Ahmed and G. DeMarsily, Comparison of geostatistical methods for estimating transmisivity using data on transmisivity and specific capacity. *Water Resources Research* **23** (1987), pp. 1717–1737. **Full Text** via CrossRef | View Record in Scopus | Cited By in Scopus (112)

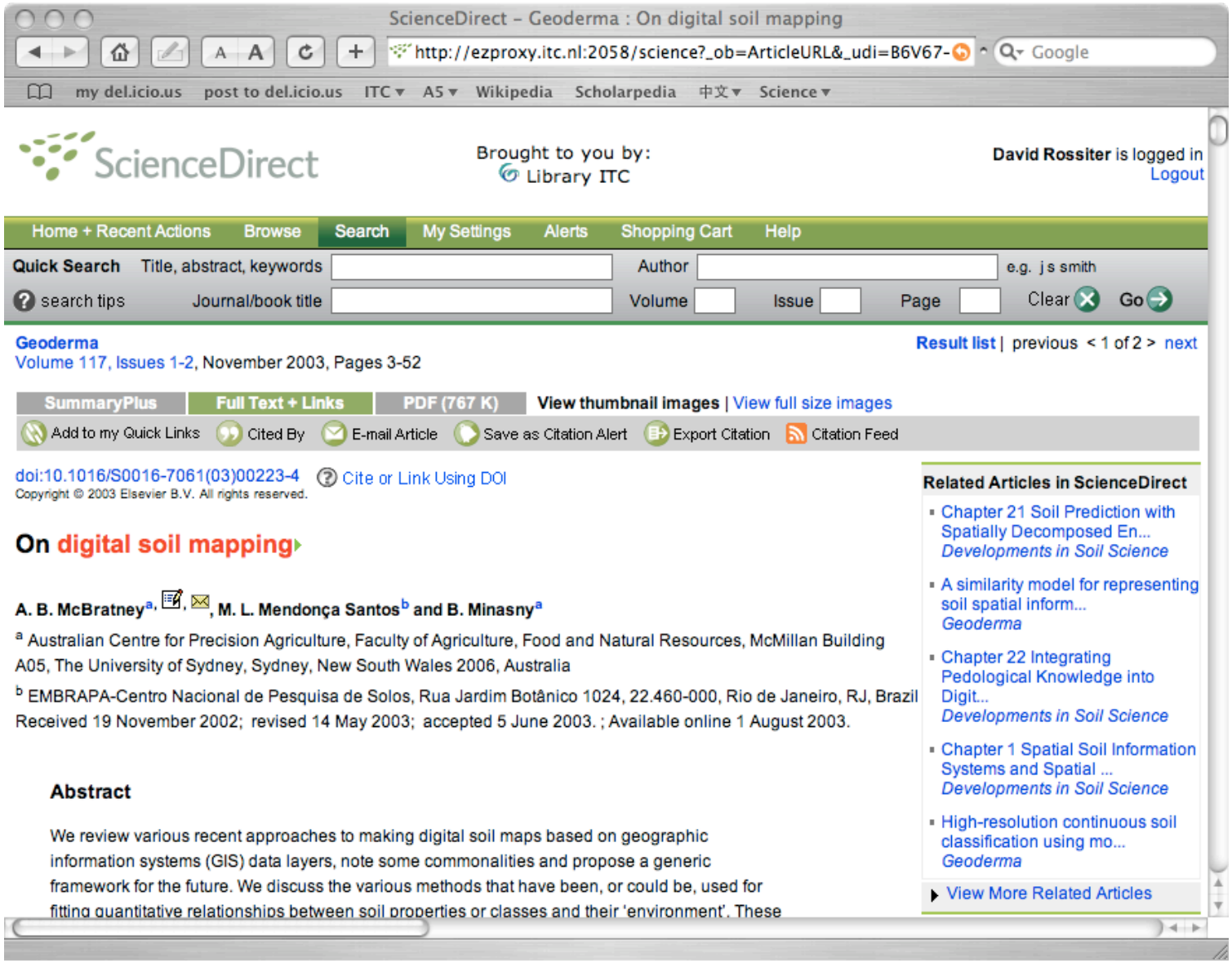
Aiken et al., 1991. R.M. Aiken, M.D. Jawson, K. Grahammer and A.D. Polymenopoulos, Positional, spatially correlated and random components of variability in carbon-dioxide efflux. *Journal of Environmental Quality* **20** (1991), pp. 301–308. View Record in Scopus | Cited By in Scopus (9)

Albert and McShane, 1995. P.S. Albert and L.S. McShane, A generalized estimating equations approach for spatially correlated binary data: applications to the analysis of neuroimaging data. *Biometrics* **51** (1995), pp. 627–638. **Full Text** via CrossRef | View Record in Scopus | Cited By in Scopus (45)

Altese et al., 1996. E. Altese, O. Bolognani, M. Mancini and P.A. Troeh, Retrieving soil moisture over bare soil from ERS-1 synthetic aperture radar data: sensitivity analysis based on theoretical surface scattering model and field data. *Water Resources Research* **32** (1996), pp. 653–661. **Full Text** via CrossRef | View Record in Scopus | Cited By in Scopus (60)

Anderson and Furley, 1975. K.E. Anderson and P.A. Furley, An assessment of the relationship between surface properties of chalk soils and slope form using principal component analysis. *Journal of Soil Science* **26** (1975), pp. 130–143. **Full Text** via CrossRef

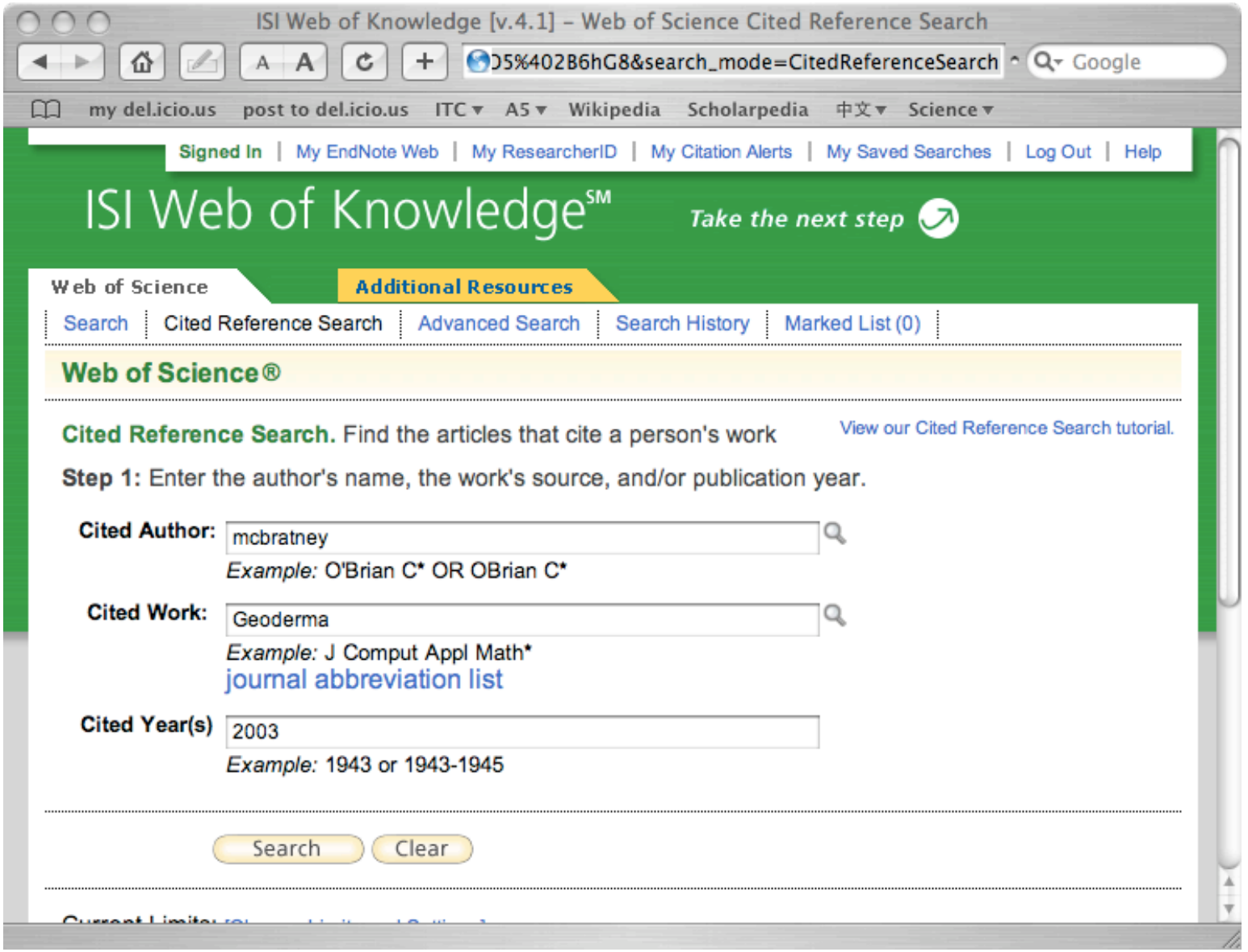
"Related articles" links ("sideways spider")



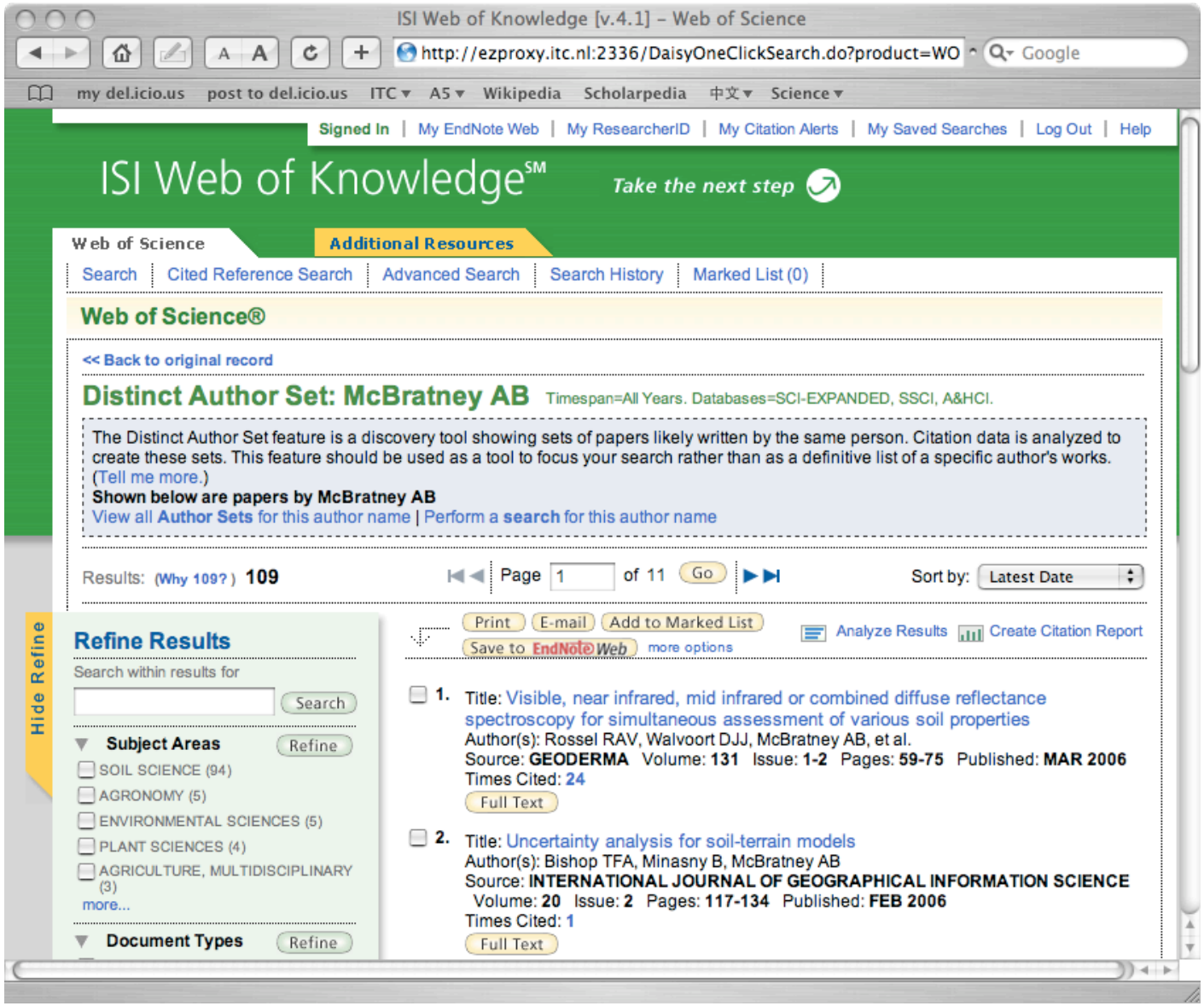
Web of Science “cited reference search”

- Purpose: discover how a known idea or innovation has been **confirmed, applied, improved, extended, or corrected**
- A feature of Web of Science (WoS)
- Search for articles that have cited a **previously published** work
- So, you don’t re-do something already known

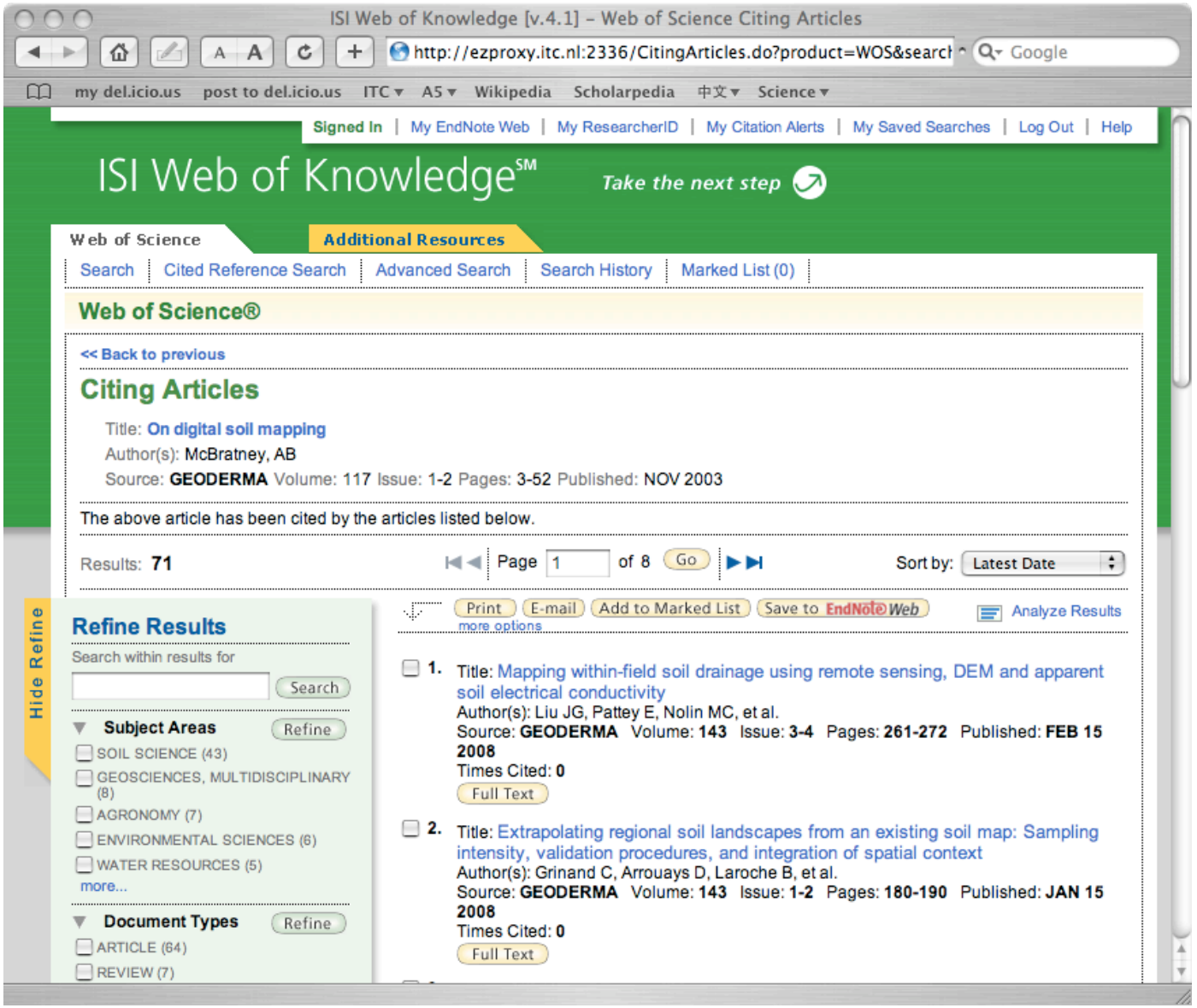
Finding works that cite a known reference



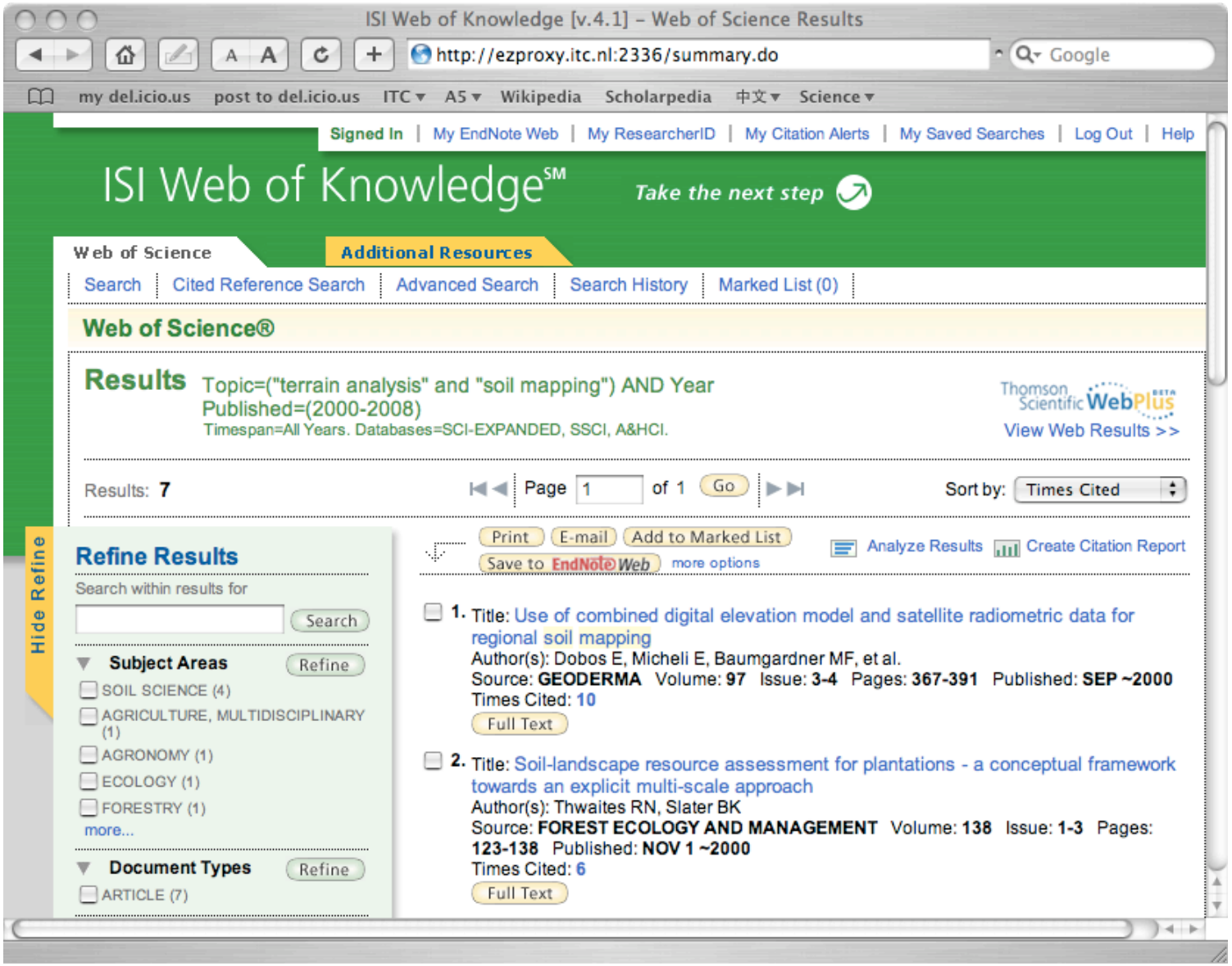
Web of Science: recent articles by the same author



Web of Science “Cited by” links (“forwards spider”)



Web of Science: sort results by number of times cited



Evaluating the search results

Recommended: ITC library's **Information Literacy Course**[5] module 6 *"Evaluating the search results"*

Don't just take the first search results you get! Ask: are there:

- Not **enough** references?: broaden the search, or use a spider approach to find more from the few good references you have
- Too **many** references?: narrow the search by adding search terms with 'and'
- Too **specific** references?: use some general terms, or use a spider approach to look for general references cited in these specific references
- Too **general** references?: use more specific terms, or look at the references cited in the general reference; these may be specific studies supporting the general ones.

[5] http://www.itc.nl/Pub/Home/library/Library-Guides/LiteracyCourse

Using Journal Citation Reports to evaluate journals

- At the level of MSc research, the student is advised to concentrate on the most **important** journals in the field.
- How to decide which are most important?
- Thomson Reuters (ISI) took the lead invented a journal **impact factor**: a **ratio** between the number of citations and recent citable items published in that journal.
  - There are also an "immediacy index" (measures how quickly articles are cited) and "half-life" (measures how long articles are cited)
- Used in an annual **Journal Citation Report**, available via Web of Science[6]

[6] http://www.itc.nl/Pub/Home/library/Search-for-information/Web_of_Science_link.html, tab "Additional Resources"

Journal Citation Report

Example: 2011, subject area “Remote sensing”, sorted by impact factor.

Rank	Abbreviated Journal Title	2011 Cites	**Impact Factor**	Immediacy Index	2011 Items	Cited Half-life
1	REMOTE SENS ENVIRON	**18449**	**4.574**	**0.654**	312	7.6
2	IEEE T GEOSCI REMOTE	16126	2.895	0.490	420	7.8
3	ISPRS J PHOTOGRAMM	1879	2.885	0.323	93	6.2
4	J GEODESY	1413	2.414	0.662	68	5.1
5	INT J APPL EARTH OBS	866	1.744	0.267	90	4.9
...						
10	INT J REMOTE SENS	10865	1.117	0.164	**535**	8.9
...						
14	PHOTOGRAMM ENG REM S	4056	1.048	0.098	82	**>10.0**

RSE many papers, very high impact and immediacy, medium duration

IJRS very many papers, long duration, but low impact and immediacy

PE&RS few papers, low impact and immediacy, but used for a long time

Using citation counts to evaluate papers

- What makes a given paper 'important'? One obvious answer: if the paper is **cited by many others**, it helped science progress.
  - For the MSc students, this indicates that the paper probably contains valuable information, and should be used by preference.
- A **newly-published paper** will not yet have any citations; the citation count isn't meaningful until about three years after a paper is published.
  - But this may be a very good paper, at the "cutting edge" of the field.
- **ScienceDirect**: citation count with the "Cited in" link; only finds citations to other Elsevier journal articles
- **ISI Web of Science**: citation count with each paper's record. **Search results** can be **sorted by citation count**.

Example Web of Science result

`TI=("remote sensing") AND TI=(soil) NOT TI=(moisture or hydrology or water)`; executed on 05-April-2013

1 Title: EXPLORING A V-I-S (VEGETATION-IMPERVIOUS SURFACE-SOIL) MODEL FOR URBAN ECOSYSTEM ANALYSIS THROUGH REMOTE-SENSING - COMPARATIVE ANATOMY FOR CITIES
Author(s): RIDD MK
Source: INTERNATIONAL JOURNAL OF REMOTE SENSING Volume: 16 Issue: 12 Pages: 2165-2185 Published: **AUG 1995**; **Times Cited: 273**

3 Title: Remote sensing of soil salinity: potentials and constraints
Author(s): Metternicht GI, Zinck JA
Source: REMOTE SENSING OF ENVIRONMENT Volume: 85 Issue: 1 Pages: 1-20
Published: **APR 25 2003**; **Times Cited: 110**

52 Title: Mapping within-field soil drainage using remote sensing, DEM and apparent soil electrical conductivity
Author(s): Liu JG, Pattey E, Nolin MC, et al.
Source: GEODERMA Volume: 143 Issue: 3-4 Pages: 261-272
Published: **FEB 15 2008**; **Times Cited: 12**

181 Title: Assessing land cover and soil quality by remote sensing and geographical information systems (GIS)
Author(s): Obade, Vincent de Paul; Lal, Rattan
Source: CATENA Volume: 104 Pages: 77-92 DOI: 10.1016/j.catena.2012.10.014
Published: **MAY 2013**; **Times Cited: 0**

308 Title: USING REMOTE-SENSING TECHNIQUE TO STUDY SOIL SEDIMENTATION FLOW
Author(s): KOLAWOLE MO
Source: ENVIRONMENTAL MANAGEMENT Volume: 17 Issue: 1 Pages: 73-81
Published: **JAN-FEB 1993**; **Times Cited: 0**

Evaluation of results by citations and publication date

1 classic paper (18 yr), highly cited → major contribution to science

3 newer paper (10 yr), relatively almost as highly cited

52 typical recent paper (5 yr) with few citations → modest contribution to science

181 new paper, no time to be cited

308 old paper (20 yr), never cited → has not further contributed to science

Next steps

1. Follow library tutorials

2. Try search strategy for your own research problem

3. Develop personal information infrastructure