

Indicators for disciplinary challenge  
and disciplinary change:  
the Dutch *coastal defence research* case

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Overall aim of this study:

- To develop a method to map the coastal defense research in the Netherlands
- With the purpose to evaluate on the national level whether the research agenda is well aligned with social and policy priorities

Focus

- Developing **indicators for disciplinary challenge and change**, changes in the disciplinary orientation of research, which are needed in order to address the varying knowledge needs that follow from changes in social and policy priorities

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Three types of  
disciplinary challenges:

- **Multidisciplinary research**
  - Post hoc synthesis of different disciplinary contributions
  - Change in multi disciplinary mix constitutes the challenge
- **Interdisciplinary research**
  - Integrated approach throughout the research process
- **Transdisciplinary research**
  - Emerges from a particular context of application (Gibbons et al. 2004), but not locatable on the prevailing disciplinary map
  - Transgresses the boundary between codified knowledge of researchers and tacit knowledge of practitioners (Pereira and Funtowicz 2005)
  - Is needed to solve badly structured problems (Hoppe and Huijs 2003).

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## Multi method approach

### 1. Mapping social and policy priorities

To map the need for disciplinary, interdisciplinary and transdisciplinary research as implicated in current social and policy priorities

### 2. Bird's eye view map

To map research groups and institutes in terms of main disciplinary orientation

### 3. Bibliometric analysis

To map the disciplinary constitution of the field (as based on the formal communication system)

to map the relative position of Dutch research; to map national patterns of collaboration.

### 4. Focus group meeting

To discuss barriers and drivers for one of the disciplinary challenges that were identified – transdisciplinary research

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## Social and policy priorities – disciplinary challenges

### 1) Dynamic preservation of the coast

→ Interdisciplinary biogeomorphology research

### 2) Integrated coastal zone management (ICZM)

→ Transdisciplinary research

→ change in multidisciplinary mix → social sciences and humanities research;

### 3) The paradigm shift from water defence to water accommodation

→ change in multidisciplinary mix → social sciences and humanities research;

### 4) Understanding mechanisms and impact of climate change

→ Interdisciplinary climate change research.

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## Bird's eye view

- 1<sup>st</sup> field demarcation criterion: relevancy for social priorities

→ Results in a too large field of research

- 2<sup>nd</sup> Demarcation criterion:

– Self acclaimed relevancy to coastal defence or integrated coastal zone management  
– Group/institutional focus on coastal issues

- As a result: climate change research is only partly covered

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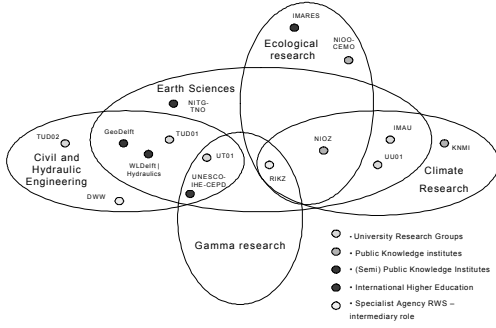
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### Bird's eye view map – some results




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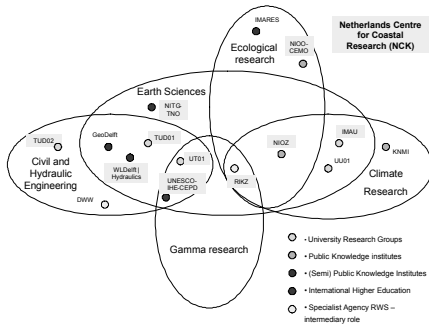
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### Bird's eye view map some results




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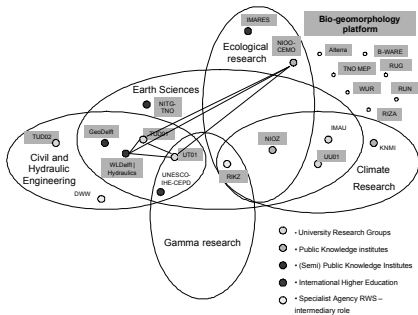
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### Bird's eye view map some results




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## Bibliometric analysis

1. Field characteristics in terms of disciplinary constitution
2. How do the Netherlands' research groups in this field publish compared to the international pattern?
3. Inter/multi/transdisciplinary research collaboration patterns (nationally)

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## 1) Field characteristics

What is the character of the field of coastal defence research in terms of disciplinary constitution? And how did this change through time?

Method used:

Journal-journal citation analysis

- The method can be used to determine the character (disciplinary, multidisciplinary, interdisciplinary or transdisciplinary) of a journal
- The *analysis of journal-journal citation relations* through time can be used to map the development of the field in terms of changes in the multi disciplinary mix of coastal defence research and in terms of the emergence and stabilization of new (inter)disciplinary specialties.
- Factor analysis of citation relations between journals

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Rotated Component Matrix (1)	Journal of Coastal Research (2004)									
	component									
	1	2	3	4	5	6	7	8	9	10
QUATERNARY SCI REV	.691				.168					
QUATERN INT	.885				.109		.180			-.122
GLOBAL PLANET CHANGE	.816		.463	.171	.172		.112			.122
NATURE	.790	-.105						.123	.284	.282
SCIENCE	.783				.168			.136	.254	.300
PALEOGINE	.767							-.127	-.170	-.220
PALAEODORPALAEODOL	.731				.478					
CLIMATIC CHANGE	.480		.381						.234	.234
MAR ECOL PROG SER		.010								-.103
ESTUAR COAST SHELF S	-.110	.691	.173				.120			
ESTUARIES	-.112	.895						.121		
J EXP MAR BIOL ECOL		.848					-.100			-.116
TRENDS OCEANOGR	-.134	.660							.618	
OCEAN MAR	-.147	.561	.187				-.112	.114		.310
OCEAN DYNAM			.885	.23	.8		.209			
J GEOPHYS RES	.173		.849	.26	.125					
CONT SHELF RES		.325	.725	.12	.3			.487		
J MARINE SYST		.568	.720	.14	.1					
NAT HAZARDS	.201	-.192	.482			.308				.228

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		Journal of Coastal Research (2004)									
		Component									
Rotated Matrix (2)	Component	1	2	3	4	5	6	7	8	9	10
COAST ENG J					862				143		
J WATERW PORT CANAL				170	863						
COAST ENG			247	840				160			-107
ENVRON BT			266	788						-281	317
J SEDIMENT RES			-127			879		253			
J GEOL	233		185			838	172				
SEDIMENTOLOGY			-135			778	134	269			
GEOL SOC AM BULL	274		428			717	226				
GEOLOGY	589		501	103		572	146				117
PROG PHYS GEOG	-120						959				
GEOMORPHOLOGY						232	934				
EARTH SURF PROC LAND						173	930				
GEO-MAR LETT	101		180			189		896			
MARGEOL	230		211			204		881			
J COASTAL RES		374						636	121		223
COAST MANAGE									870		
OCEAN COAST MANAGE			165						852	-138	
MAR CHEM	174	428	205							541	116
WETLANDS										432	
MAR POLLUT BULL		464					-137		110	-419	565
ENVRON GEOL		131	127					173		343	814

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## 1) Field characteristics - results

- A set of 10 journals was defined to demarcate the field
  - Multi demarcation criteria were used, field representatives opinion, publication behavior of main research groups, thematic linkage with social and policy priorities
- Some of the journals were strongly disciplinary and most of the journals only covered a particular subset of the entire multidisciplinary research field
- Best coverage of the entire research field: Journal of Coastal Research
  - 9 out of 10 journals appear in the citation environment of this journal
  - Journal of Coastal Research is of multi- or transdisciplinary nature
- Conclusion: Coastal defence research forms a multidisciplinary, but only weakly integrated field

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## Citations between the factors

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1 quaternary science / climate change	19509	1943	5045	14	1741	533	736	22	481	207
F2 marine ecology / estuarine research	311	12538	1457	23	45	31	561	32	809	670
F3 geophysics/oceanography	2044	1013	28730	247	968	199	703	0	265	113
F4 coastal engineering	4	29	244	568	9	10	87	2	0	13
F5 sedimentology	1875	116	1447	28	3440	836	750	0	36	42
F6 geomorphology	183	23	169	10	146	1337	117	0	8	35
F7 coastal research / marine geology	618	292	682	170	343	134	1705	15	77	76
F8 coastal management	0	18	9	0	0	2	46	168	0	13
F9 marine chemistry	56	514	233	0	10	8	49	0	799	116
F10 pollution research	16	376	92	15	0	23	72	14	46	1056

Columns: citing Rows: being cited

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## Conclusions

- It seems that the Journal of Coastal Research forms a linkage between the coastal engineering journals and fundamental subfields of coastal science

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## 2) Relative position of Dutch research

What is the position of Dutch researchers in the multidisciplinary field of coastal research?

Are there relative strengths and weaknesses compared to the international pattern?

Methods used:

1. Determining the absolute and relative share of Dutch publications in the subfields of the journal set
2. Determining the relative share of Dutch research on certain topics, as represented by title key word clusters
3. Comparison of citation environment of 'regionally based' journals

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## Dutch share of research in various subfields

National shares  
(1988-2005)

Country	nr of papers	percentage
USA	5479	31.66
UK	1620	9.36
France	965	5.58
Canada	923	5.33
Germany	859	4.96
Australia	827	4.78
Japan	708	4.09
Netherlands	500	2.89
Italy	474	2.74
Spain	450	2.60
China	393	2.27
Norway	355	2.05
Russia	272	1.57
Denmark	248	1.43
South Korea	238	1.38

Dutch share in this field is 50% higher than the share of all Netherlands academic publications in all fields in the ISI journal set

(2.9% and 2% respectively)

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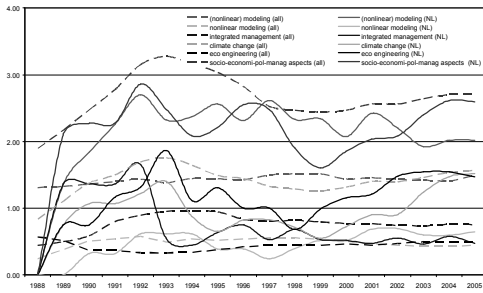
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## Key word cluster analysis



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## Regional differences

- There are 3 'regionally based' engineering journals.
- Do these journals differ in research perspective?
  - A factor analysis of journal-journal citation relations was used to answer that question:
  - How do the citation environments of these three journals differ?

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## Results

- **Coastal Engineering (EU)**
  - high share of NL publications
  - draws on factor representing physical geography and oceanography
- **Journal of Waterway, Port, Coastal, and Ocean Engineering - ASCE (US)**
  - average share of NL publications
  - draws on factor representing physical geography and oceanography
  - The journal set is larger and broader, including environmental journals, a management journal (environmental management), and a philosophy journal.
- **Coastal Engineering Journal (Japanese)**
  - Japanese
  - low share of NL publications
  - slightly more engineering oriented

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## Collaboration patterns

What interinstitutional interdisciplinary or transdisciplinary research collaboration exists?

Methods used:

- Co-authorship analysis as an indicator of a strong form of institutional collaboration.
- Complements the qualitative analysis of research collaboration networks.

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## Results

- Strongest collaboration was found between multidisciplinary constituted research institutes and organizations
  - not discriminative for either interdisciplinary or disciplinary collaboration
- No research collaboration was found between ecologists and geomorphologists

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## Collaboration patterns (results)

	1988-2000	2001-2005
Nr of research groups (nodes)	38	46
Nr of linkages (co-authorships)	40	172

- Collaboration has increased significantly over the last period

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### The main collaborations (2001-2005)

Between	And	Number
Delft Hydraul. WL, mar & coastal man	University Twente (general)	4
Delft Hydraul. WL, mar & coastal man	Utrecht University, IMAU	6
Delft Univ Technol, Dept Civil Engn & Geosci	Delft Hydraul. WL	20
Delft Univ Technol, Dept Civil Engn & Geosci	RIKZ	5
Delft Univ Technol, Dept Civil Engn & Geosci	University Twente (general)	4
NIOZ	Utrecht University, Inst Earth Sc	5
NIOZ	Free University, Fac Earth & Life Sci	4

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### Focus group meeting

- Mixed Group composition:  
Researchers, funding organizations, professionals, policy makers
- Issue discussed:  
Transdisciplinarity for integrated coastal zone management
- Method used:
  - Ranking exercise of barriers for transdisciplinary knowledge development
  - Ranking exercise of policy measures to stimulate transdisciplinary knowledge development

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### Some results

- The focus group meeting confirmed
  - the need for transdisciplinary research for integrated coastal zone management
  - the need for more involvement of social sciences and humanities researchers with the theme of integrated coastal zone management
- The focus group meeting identified
  - Disciplinary reputation mechanisms in academia as a main barrier to transdisciplinary research

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## Further research

### **To develop indicators for transdisciplinarity**

- A first indication for transdisciplinarity:
  - There is a large share of authors from non-research organizations (Engineering Consultancies, dredging industry, NGOs, public agencies)
- Further research to develop:
  - Indicators for transdisciplinary journals
    - Multi-disciplinary citation pattern combined with a relatively high number of contributions from non-research organizations
  - Indicators for transdisciplinary collaboration
    - Co-authorship analysis of research collaboration between research organizations and non-research organizations

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## Further research (2)

### **To make more reiterative steps between the different mapping approaches**

The bibliometric analysis that characterized the main journals of the field as disciplinary, inter-, multi-, or transdisciplinary can be fed back into the bird's eye view map of the field. The research groups that were identified can be characterized as disciplinary, multidisciplinary, interdisciplinary or transdisciplinary oriented on the basis of their publication behavior.

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## To conclude

- Indicators of disciplinary challenge and change can be developed using a multiple method approach
- Multiple methods inform each other:
  - Bird's eye view map informs the journal set of the bibliometric analysis
  - Journal-journal citation analysis can be used to characterise publication behavior of individual research groups
  - Bird's eye view map informs the interpretation of the co-authorship analysis

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- Multiple methods are useful to identify biases in single methods:

- Interdisciplinary collaboration of recent date is more visible in the qualitative analysis than in the co-authorship analysis (example of biogeomorphology)

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### Relation with positioning indicators concept

- The production of positioning indicators tends to be directed on individual strategic actors as the main users (e.g. universities)
- Positioning indicators can also be useful for the (supra)national governance level
- In that case the research field should be used as unit of assessment
- Embarking on the development of positioning indicators, the development of field level indicators seems a logical and complementary next step
- Indicators for disciplinary challenge and change are an example of how such field level indicators could look like

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