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## Crossing the boundary between natural and social sciences

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## Is it important or necessary ?

Example 0: Geography

Example 1: 'Land Systems Science'

Example 2: The fusion process of University of Copenhagen leading towards the creation of a 'Sustainability Science Centre'



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## Vision for the 'Sustainability Science Centre' (draft version)

In order to meet this challenge (sustainable development), basic and applied research, as well as a wide variety of individual disciplines, need to join forces. While some of the global change processes involved, not the least climate change, requires that great efforts are invested in understanding the functioning of the natural and life science components of the Earth system, it is equally important that the human (economic, social, cultural and health) components of the problem are addressed as well. Most importantly, this must take place in a coherent framework, recognizing that human and bio-physical systems interact strongly, and do so in sometimes complex and non-linear ways.




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## Is it a problem ?

Questions:

1. Are there any commonly accepted definitions and standards for (good) science? If so, what are they?
2. If the objective of science is 'explaining' some 'reality', do scientists share an understanding of this 'reality'?
3. Do we share a 'scientific world view' and 'pre-analytic assumptions'?
4. Is there a shared language, allowing scientists from all relevant disciplines to communicate efficiently?




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## Question 1: The 'unity of science'

Ontological, epistemological and methodological unity (Faye)

- Ontological and epistemological unity: Dualism, reductionism, emergence
- Methodological unity: Empiricism, and the use of a 'generalized hypothetical-deductive method'



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## Question 2: Explanation in science

What is a good explanation ?

- Empirically falsifiable
- General (nomothetic versus ideographic science)
- Representation of 'process'

Types of explanation

1. Causal explanation: in *physics*, biology and social sciences
2. Functionalistic (or functional) explanation: in (physics), *biology* and social sciences
3. Intentional explanation: in social science



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### Linear and non-linear causation

Linear causality:

A → B → C → D → E

Circular causality, feedbacks:

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### Question 3: Differences in 'world views'

Pre-analytic assumptions

- Realism versus anti-realism
  - Social constructivism in the social sciences
- The 'ecological' versus the 'economics' world view
  - Are there 'limits to growth'? In what sense?
- Differences in time horizons
  - The use of discounting in economics

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### Question 4: Can we understand each other ?

Possible barriers:

- The use of mathematical representation and language
  - Associated with reductionism
  - Associated with deterministic cause-effect descriptions
  - Requires quantification
  - Exclusive
- Discipline-specific terminology/jargon
- Systems-analytical and modeling terminology/jargon

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### Explanation, systems and models

- 'Environmental' research themes are often formulated in 'systems terminology' (e.g. 'climate system', 'land systems', 'eco-systems')
- 'Systems' are characterized by circular causation and feedbacks
- 'Explanations' of systems are often partly functional
- Models (mathematical, numerical, graphical) are frequently used to represent systems

However

- Models tend to represent human actors as automata, and favor functionalistic rather than intentional explanations
- The terminology/jargon of systems analysis and modeling defers (some) social scientists (though not economists)

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### Land Systems Science

'Land systems science' focuses on complex relationships


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### A research agenda for the land-segment of the Earth System

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### The scientific justification for LUS research

- Global and regional land use strategies are poorly documented – and not fully understood
- Recent research underlines the significant importance of land use for 'global change'
- Results for recent, improved monitoring challenge 'received wisdom'
- Land use has an important human dimension – thus, truly interdisciplinary research needs to be developed
- There is a need for scenarios and prognoses – this requires models (soft and hard) which include change factors and processes, interaction between different land uses, human agents, institutional aspects, biophysical feedback processes, climate change, etc.**



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### Policy related justifications for 'land use insight'

**Human use of land is crucial for resilience and vulnerability** – and it is an explicit parameter in regional policies concerning natural resource management and development

There is a pressing need for a thorough insight in positive and negative implications of land use decisions

Land use choices have to do with provision of food, water quality, air quality, carbon-trading, flooding, ....


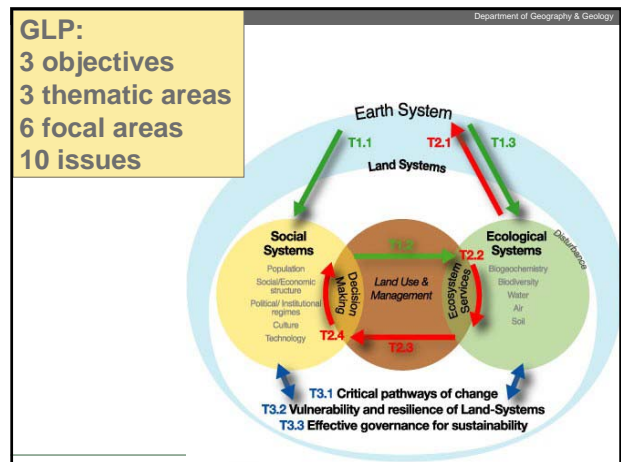
**Summing up:** reliable predictions of land use are needed as a basis for planning and management – on the local as well as the global level of scale



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### GLP – how do we meet the challenges?


- Insight from the past (retrospective studies)
- Understanding the contemporary situation (monitoring, mapping, understanding processes in coupled human-environment systems)
- Modelling the future** (prediction of land use changes)
- Understanding linkages and feedback mechanisms**
- Linking land use to other aspects of global change (collaboration with partners in IGBP/IHDP)

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### Objectives

- To identify the agents, structures, and nature of change in **coupled socio-environmental systems** on land and quantify their effects on the coupled system
- To assess how the provision of ecosystem services is affected by the changes above
- To identify the character and **dynamics of vulnerable and sustainable coupled socio-environmental land systems** to interacting perturbations, including climate change




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### Thematic areas

Theme 1:  
**Dynamics of land-systems**

Theme 2:  
Consequences of land-system changes

Theme 3:  
**Integrating analysis and modelling for land sustainability**

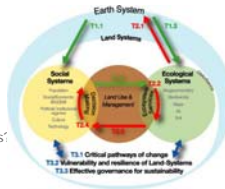


### Theme 3: Integrating Analysis and Modelling for Land Sustainability

What are the **critical pathways of change** in land-systems?

How do the **vulnerability and resilience** of land-systems to hazards and disturbances vary in response to changes in human and environment interactions?

Which **institutions** enhance decision making and governance for the **sustainability** of land-systems?



### Conclusion

The challenge is huge:

- Criteria for 'good science' vary widely
- No consensus on what constitutes a satisfactory scientific explanation
- Conflicting pre-analytic assumptions and world views
- Widely different time horizons
- Language, terminology and jargon barriers
- 'Science sociological' barriers: Bad for your career

But

- It is urgently needed
- Attempts are being made, within the framework of integrative constructs: 'Land systems science', 'ecological economics', 'sustainability science' etc.