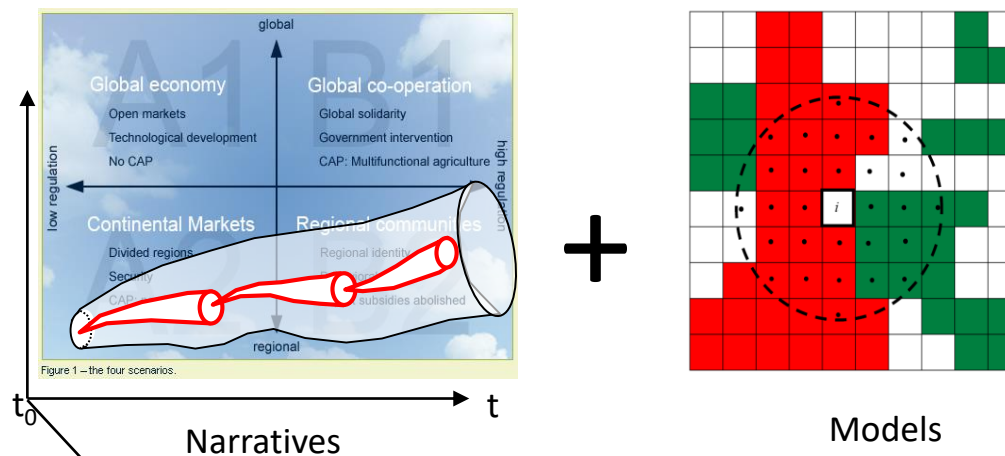


Combining scenarios and Land use and land cover change models: a short review



Thomas Houet

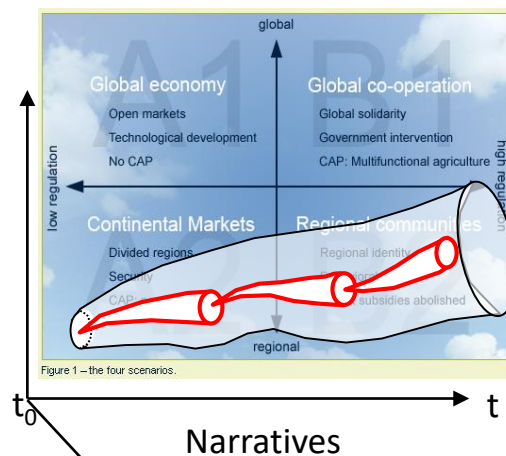
Director of Research CNRS

UMR LETG-Rennes CNRS / University of Rennes 2

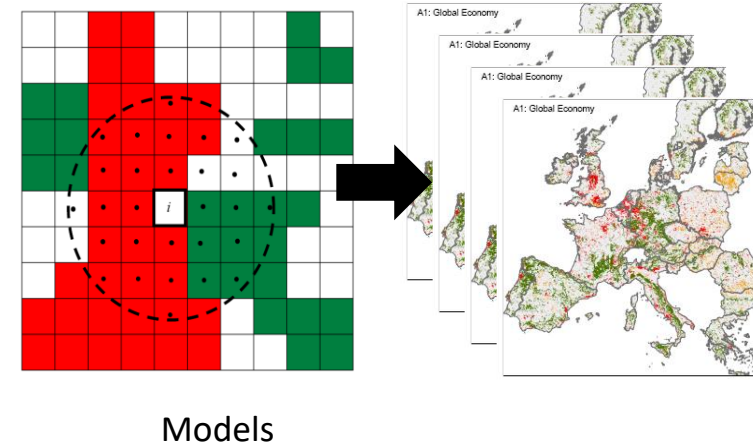
thomas.houet@univ-rennes2.fr

Why combining models and scenarios ?

- a. Understanding landscape dynamics and assessing possible impacts
- b. Helping participatory approaches
- c. Reducing future uncertainty by exploring a wide variety of future LUCS
- d. Helping the decision-making of sustainable policies



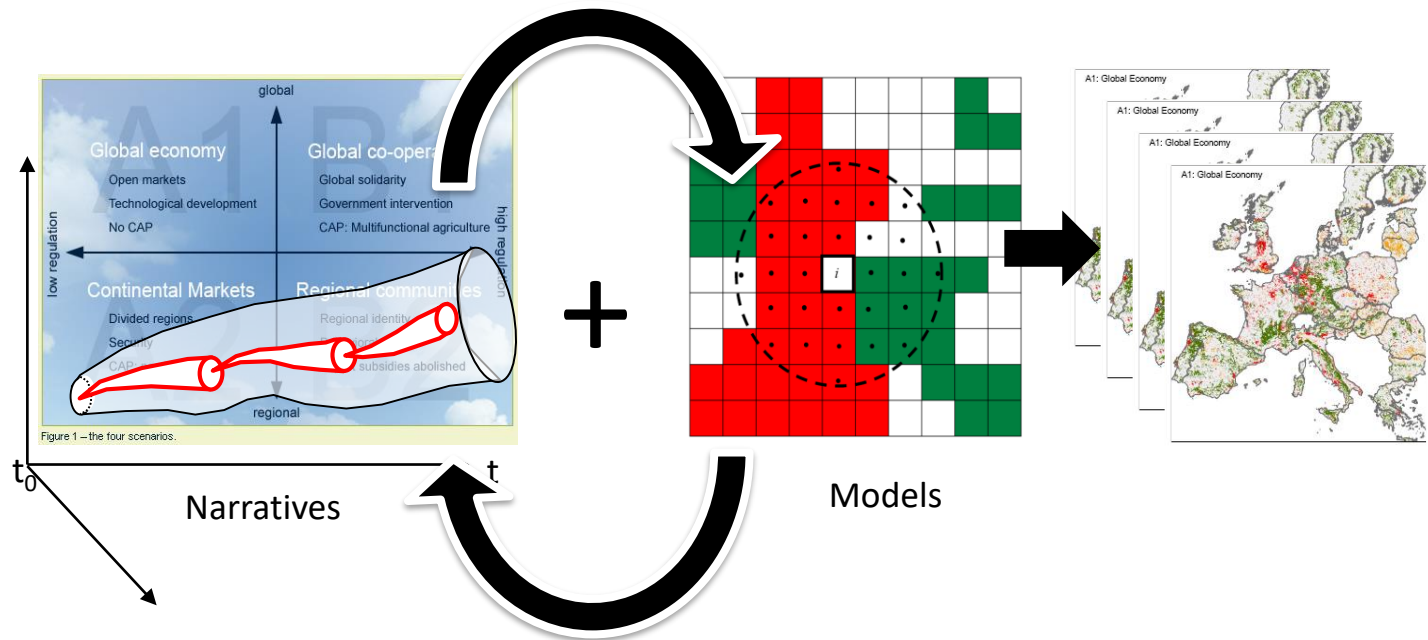
+



A decision is more sustainable thanks to the knowledge provided by future scenarios than without

From a simple representation...

Storyline and Simulation (SAS approach – Alcamo, 2008)

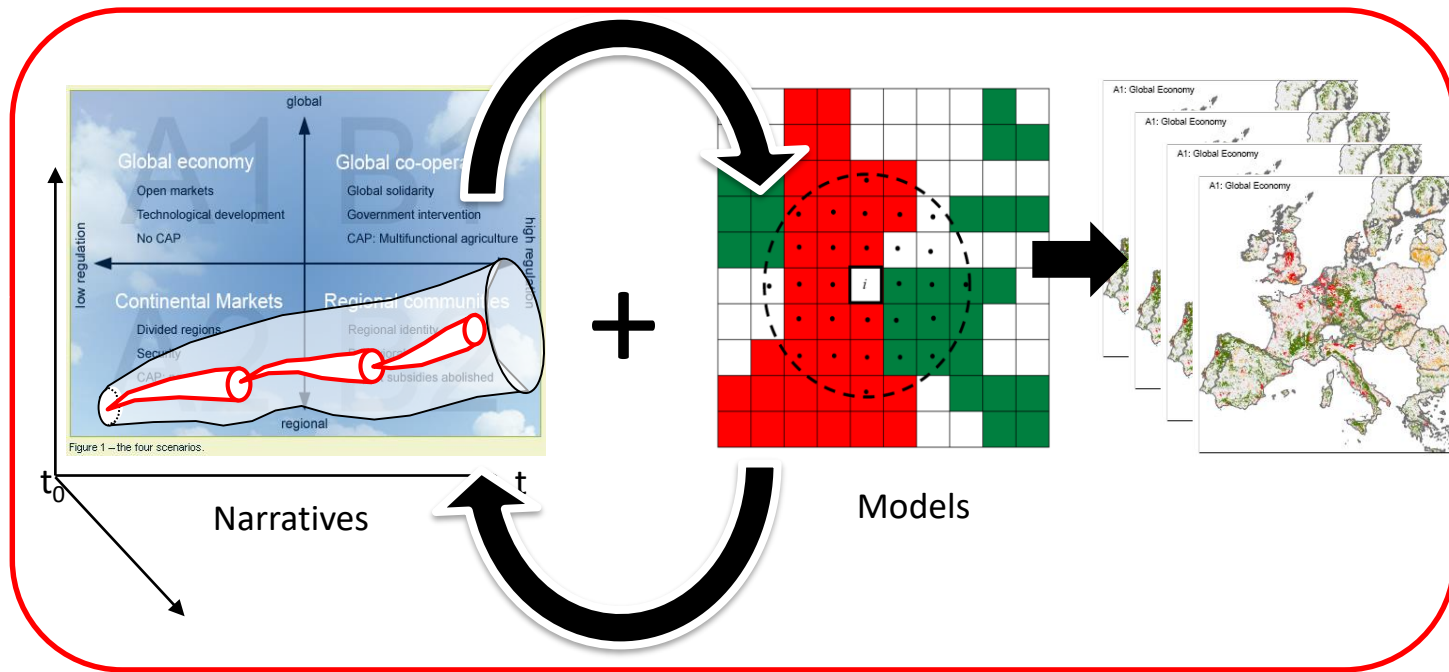


Path-dependence (Brown et al 2005, IJGIS)

i.e. when models are calibrated using past LULCC maps

From a simple representation

Storyline and Simulation (SAS approach – Alcamo, 2008)

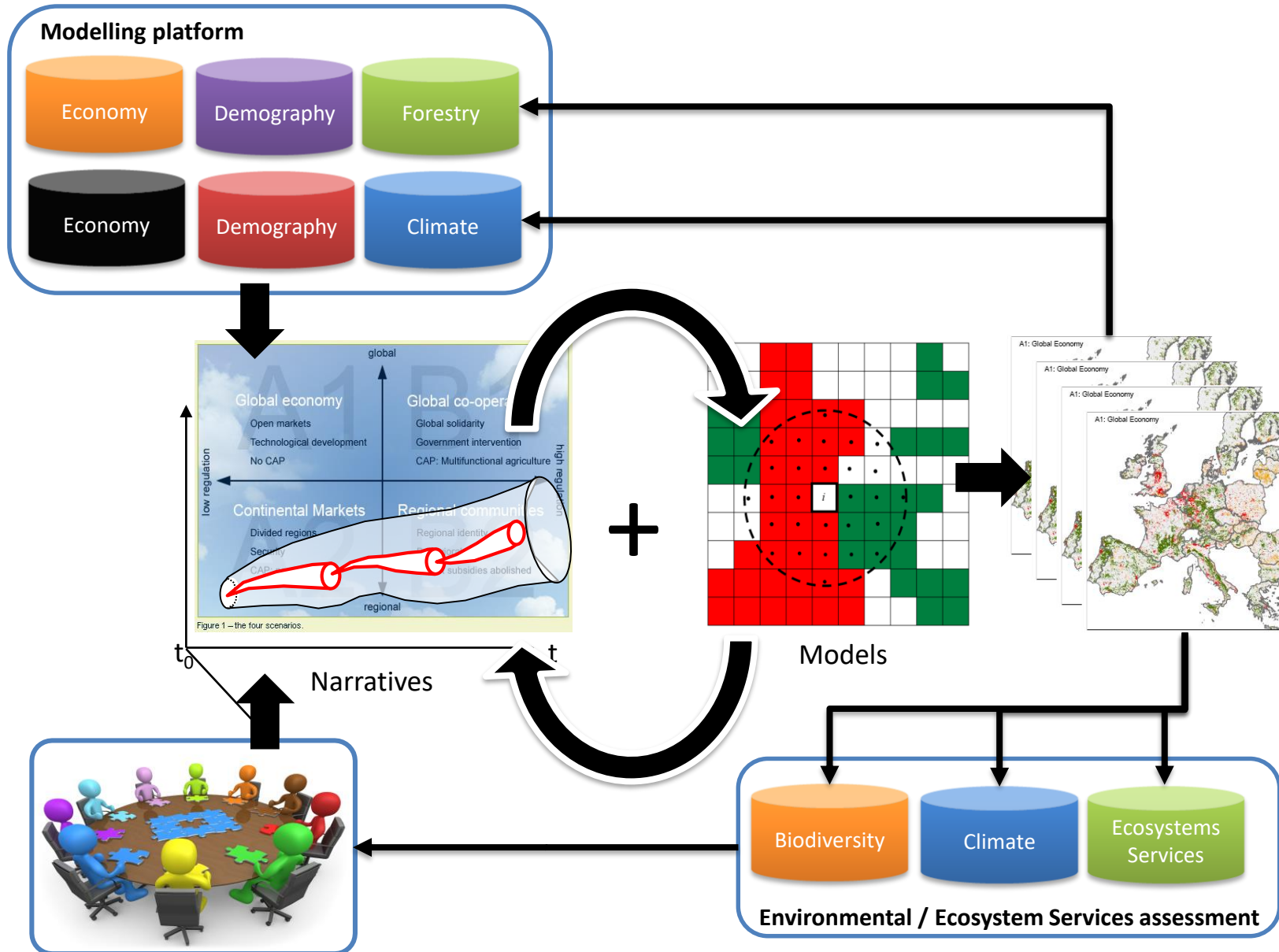


Spatially-explicit scenarios

Path-dependence (Brown et al 2005, IJGIS)

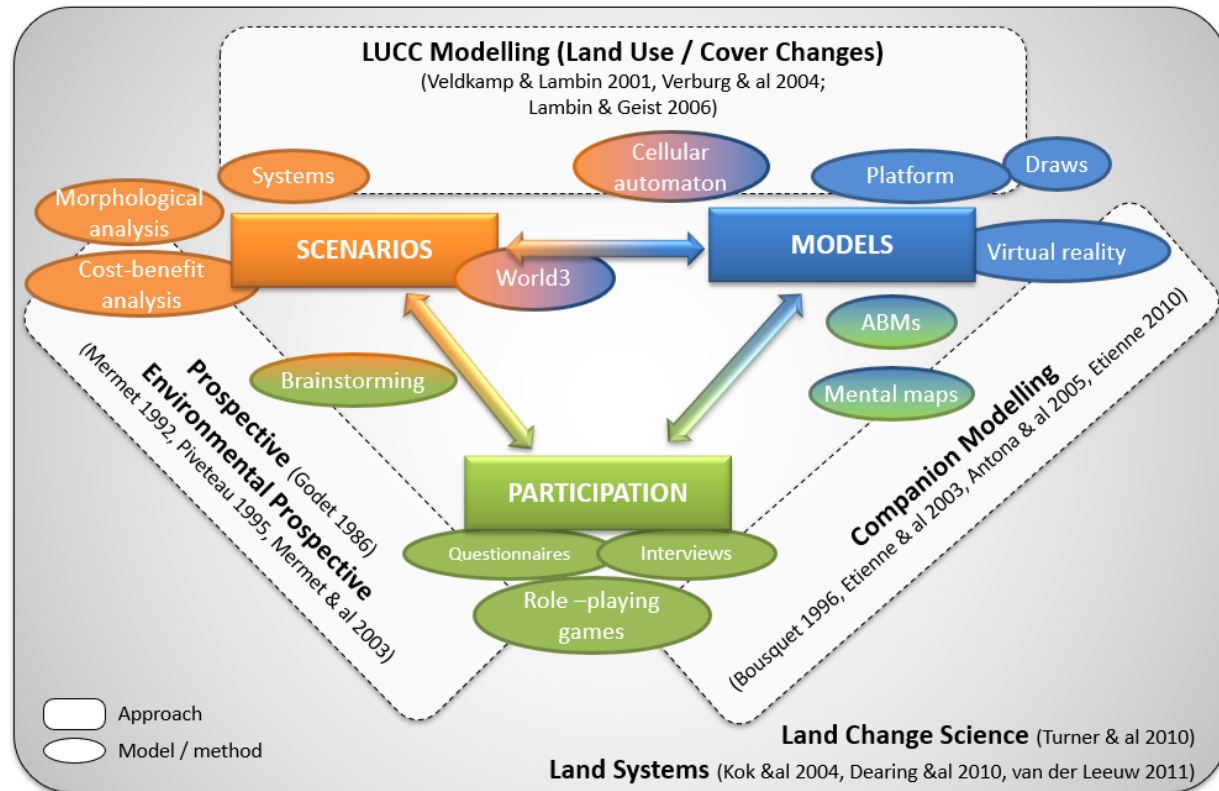
i.e. when models are calibrated using past LULCC maps

To more complicated applications



Multiples tools and methods... one common goal

Combining models and scenarios is definitely not straightforward



Houet T. et Gourmelon F. (2014) *Cybergeog*

For others methods see Mallampalli et al. (2016) *Environmental Modeling & Software*



A generic applied example

PARTICIPATORY SOCIAL SCIENCES

System analysis
(driving forces, seeds of change, projects...)

Co-construction
(narratives / participatory mapping)

Validation of spatially explicit scenarios
(Increasing stakeholders' engagement and confidence)

ENVIRONMENTAL MODELLING SCIENCES

LUCC Trends

Model development / Validation

Simulations

Assessment
(Water, Biodiversity, Ecosystems services...)

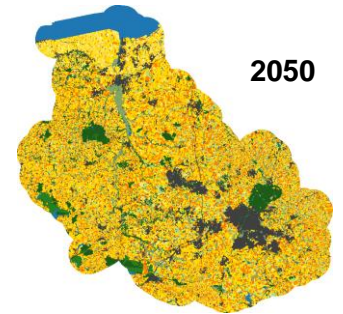
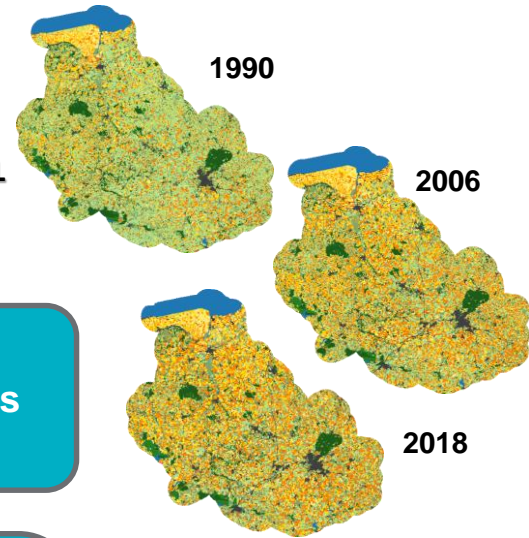
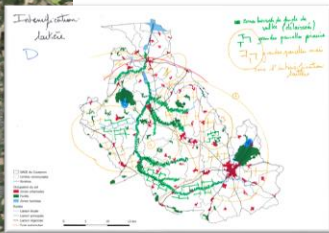
1990

2006

2018

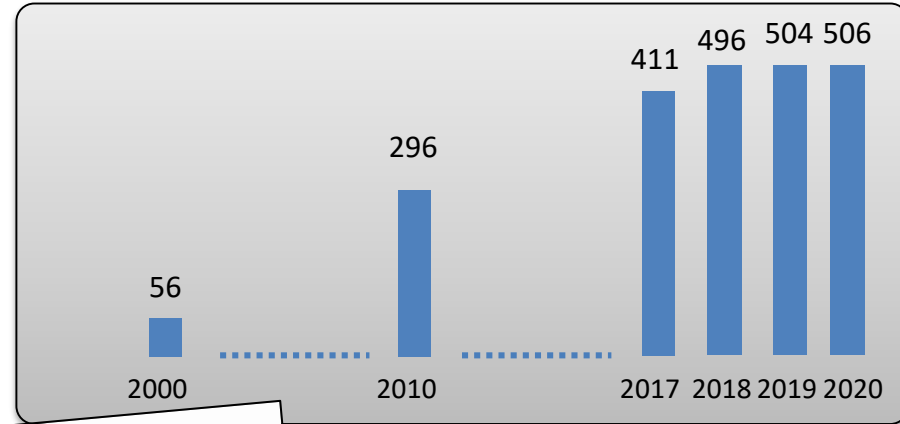
2050

NO3⁻



An inter/multidisciplinary and commonly used approach

"LUCC" & "Model" & "Scenarios"



Regional Environmental Change (2020) 20:106
<https://doi.org/10.1007/s10113-020-01675-w>

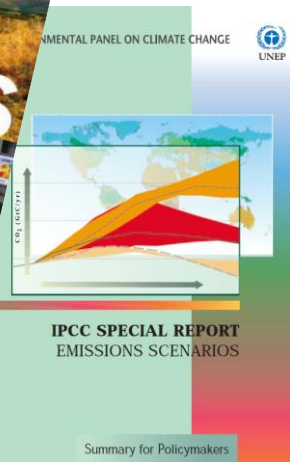
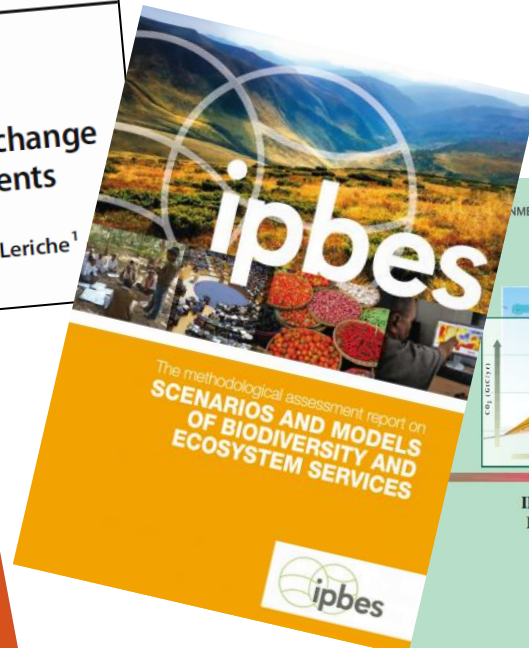
REVIEW

What ecologists should know before using land use/cover change projections for biodiversity and ecosystem service assessments

Cécile H. Albert¹ • Mathilde Hervé¹ • Mariana Fader^{1,2} • Alberte Bondeau¹ • Agathe Leriche¹
Anne-Christine Monnet¹ • Wolfgang Cramer¹

Social Scenario Modeling

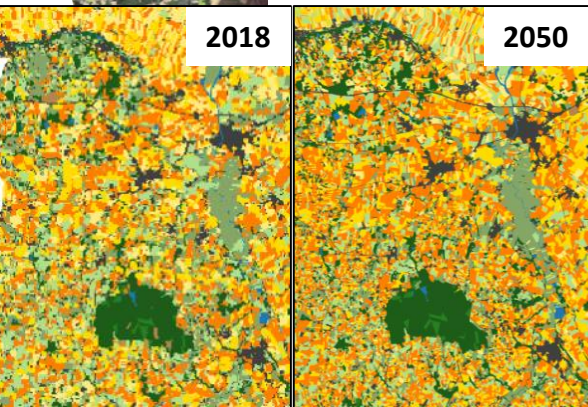
A Process For Uncovering and Managing Risk in Social Business



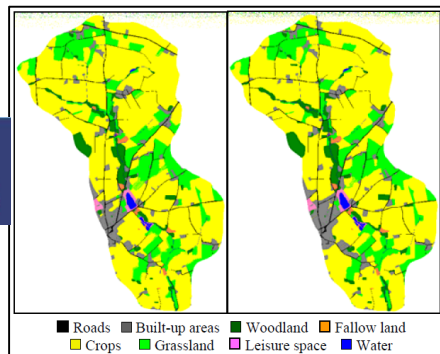
Applications at various scales



Zones Ateliers
 LTSE FRANCE ARMORIQUE

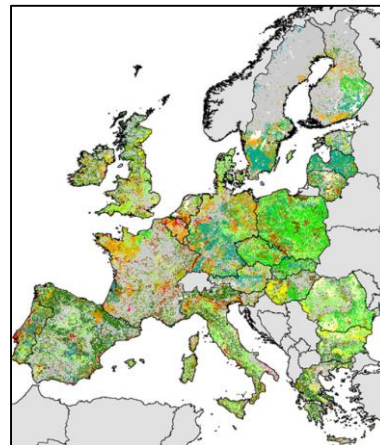


ORE
 AgrHyS

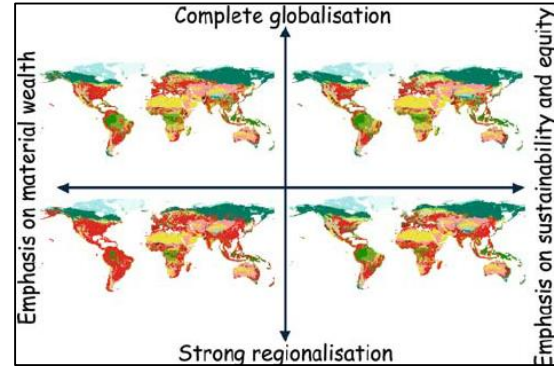


Houet et al 2006

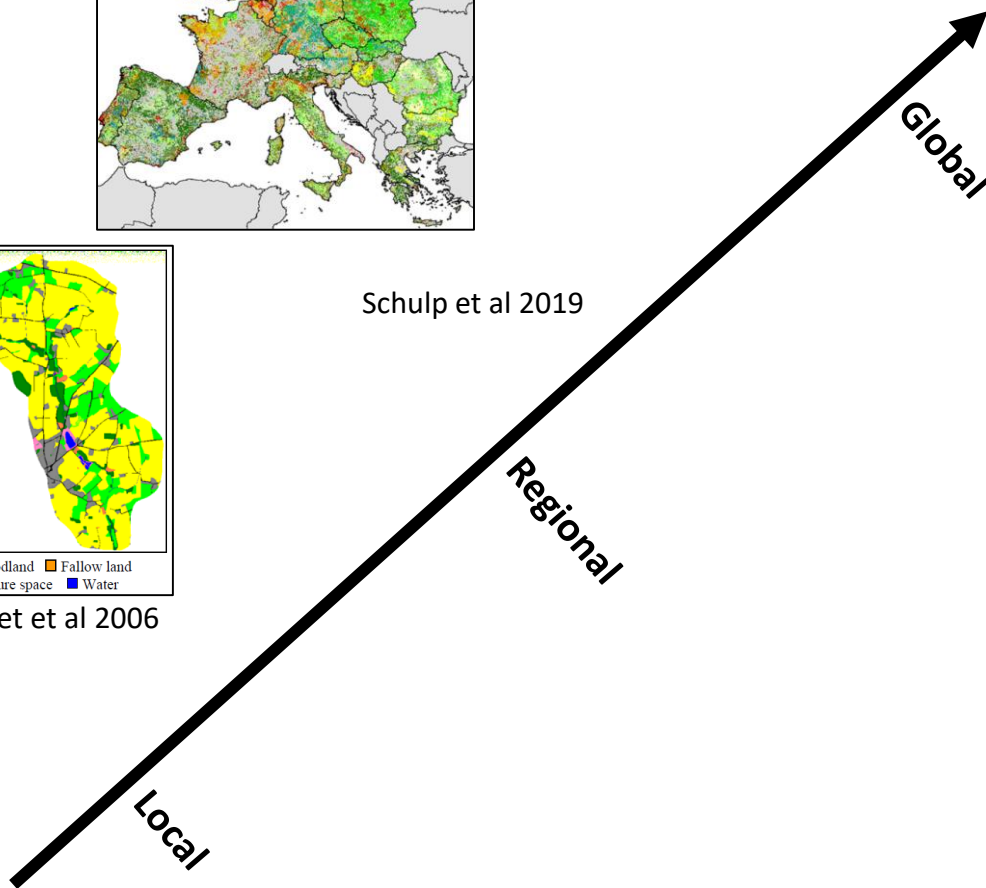
Houet et al (in prep)



Schulp et al 2019

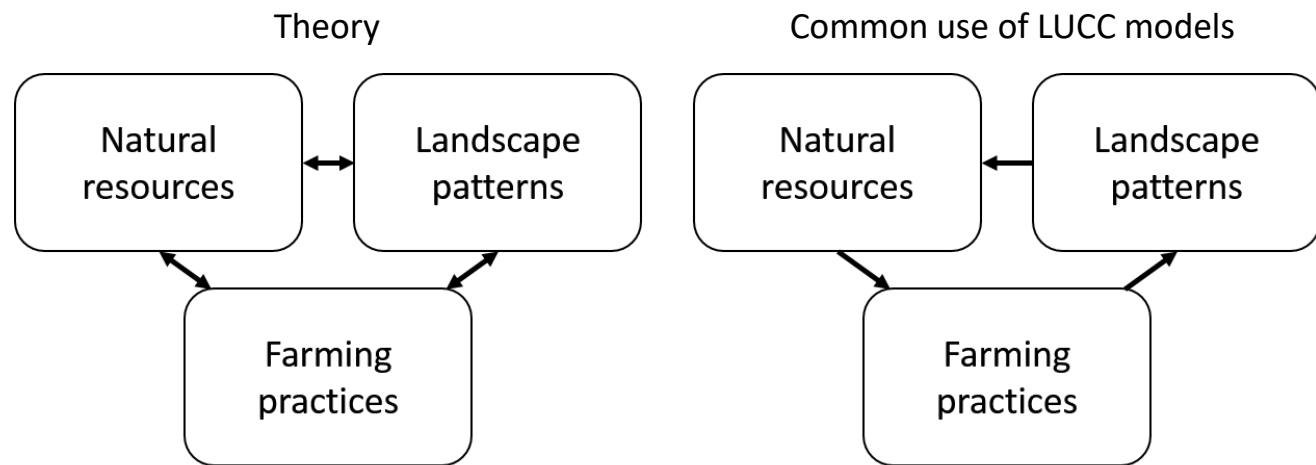


Leemans et al 2004



A focus on agricultural landscapes (Houet & Verburg, In press)

- Providing numerous Ecosystem Services
- Covering more than 40% of lands on Earth
- Facing controversial challenges:
 - expansion and intensification vs. sustainability and biodiversity
 - Abandonment vs. cultural heritage



Benoit et al. (2012) Landscape Ecology

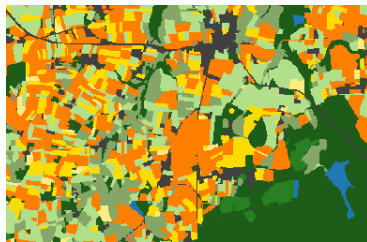
A focus on agricultural landscapes (Houet & Verburg, In press)

→ Choosing an appropriate model

A scale issue

Simulating LUCC processes or Patterns?

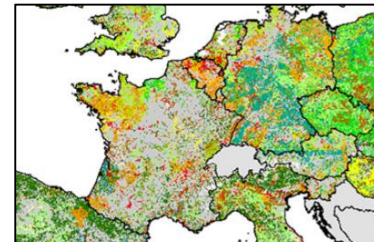
Fine scale models



Organization levels: plots, farms
LUCC: crops rotations, farms' evolution

Challenges: Refining LUCC practices, human decision, Accounting for global drivers (market, policies, etc.)

Large scale models



Organization levels: regions, countries
LUCC: patterns of land intensification, land abandonment, etc.

Challenges: Downscaling LU/LC changes, accounting for local specificities

Towards a combination of both fine / large scale modelling approaches

How validating the future ?

The future is uncertain and multiple pathways co-exists
Model validation = evaluating its predictive capacity

→ Two opposite paradigms

Although numerous tools exist, validation remains almost impossible when exploring future LUCC (Van Vliet et al, 2016)



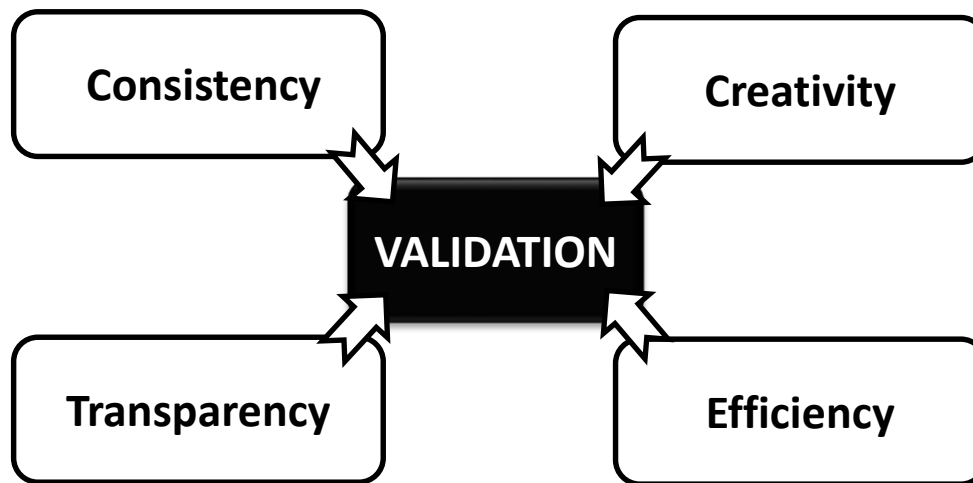
Observatoire
de Rennes

Terre, Écosystèmes et Sociétés

How validating the future ?

The future is uncertain and multiple pathways co-exists
Model validation = evaluating its predictive capacity

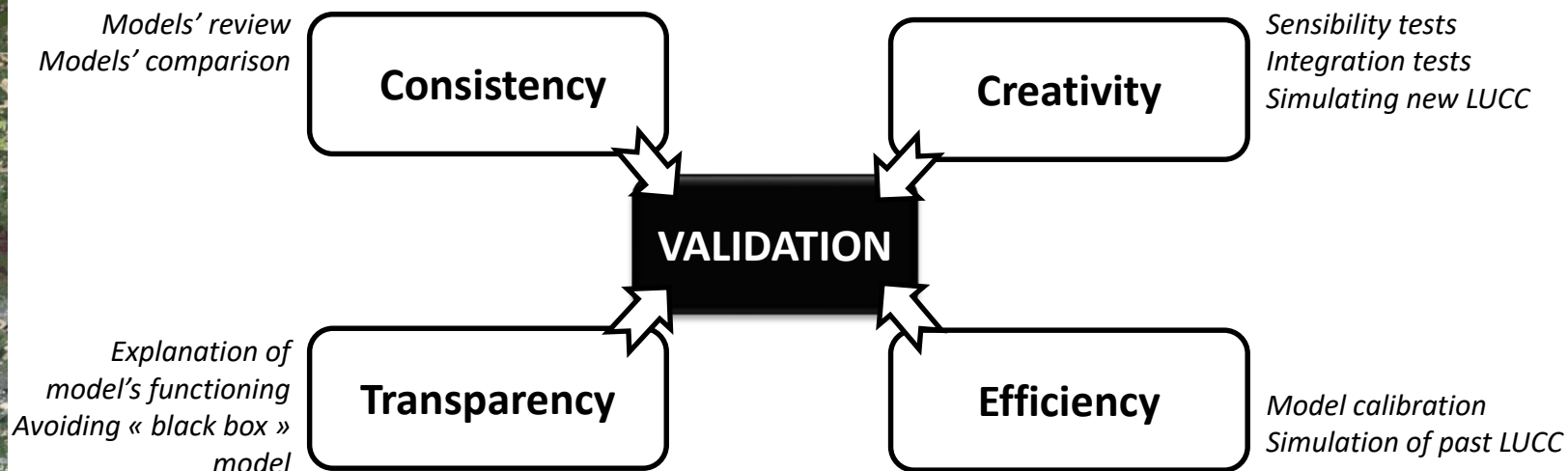
→ Two opposite paradigms



How validating the future ?

The future is uncertain and multiple pathways co-exists
Model validation = evaluating its predictive capacity

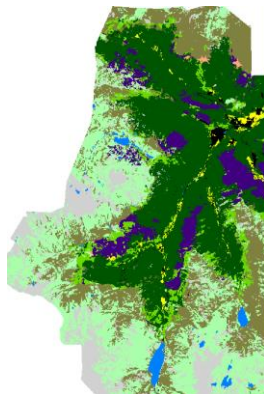
→ Two opposite paradigms



Reducing future uncertainty ?

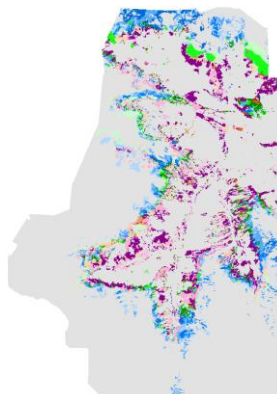
(1) Map accuracy uncertainty

Land cover

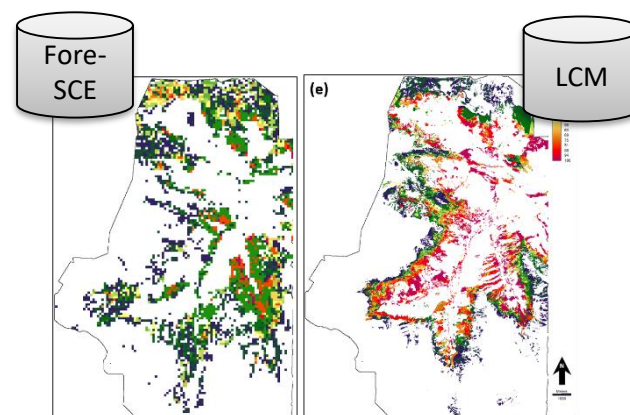


(2) Inherent model uncertainty

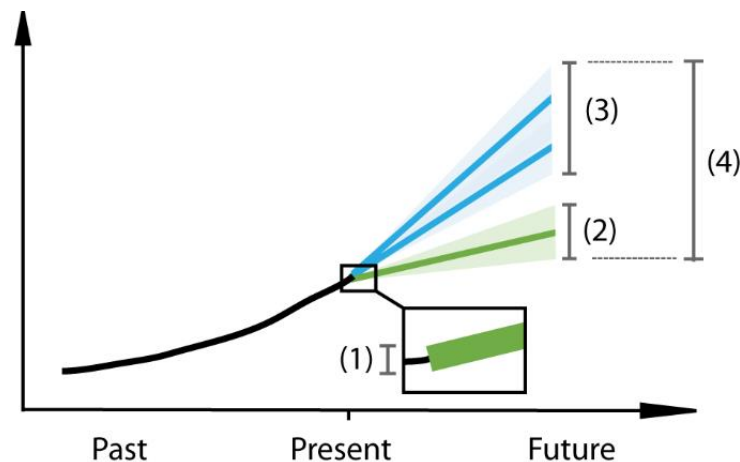
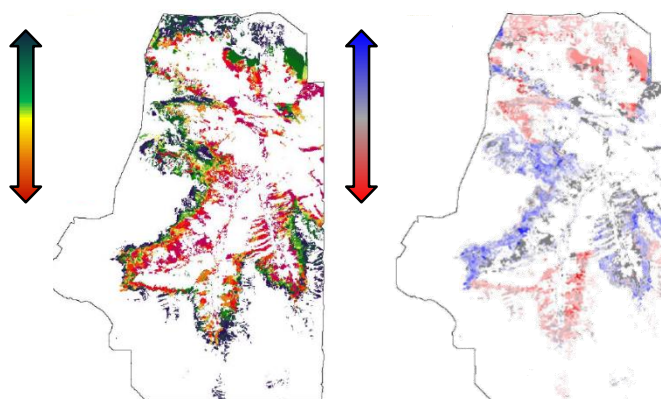
Standard deviation, randomness



(3) Ensemble multi-model uncertainty



(4) Future ensemble uncertainty



Futures challenges

Embracing complexity and diversity of human agency

Developping multiscale models

*Linking decisions of individuals, local to regional landscape legacies,
regional to national regulations and global market
Better unmixing « global LUCC pixel » & accounting for global trends
locally*

Demonstrating the usefulness of spatially explicit scenarios

No evidence from policy / and decision makers yet

Transforming science into actions / sustainable policies

Scientist activism or Improving transfer of knowledge?



Observatoire
de Rennes

Terre, Écosystèmes et Sociétés

(Verburg et al. 2019 – Current opinion in Env. Sustainability)