How validating future LUCC based on scenario-based modeling approach?

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How validating future LUCC under a scenario-based modeling approach?

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THE FUTUR IS UNPREDICTABLE… HOW CAN WE BE CONFIDENT IN THE SIMULATED LUCC?

A challenging issue

This poster presents an to propose a methodological approach to do so…
Model validation as a mean for improving users' confidence in the results of model outputs
The scenario is expected to be plausible… but are the simulated results consistent with the scenario in terms of :

- LUCC processes (transitions)
- LUCC allocation (landscape configuration)
- LUCC amount of change (landscape composition)

Statements

- Most of LUCC models a based on Markovian approaches and are path-dependent, hence mostly convenient for projecting trends LUCC (Brown, 2005)
- Most of existing validation tools are consistent to assess the predictive power of LUCC models whereas the exploration of the future does not aim at predict the future (Godet, 1986)
- Scenario's definition refers to the one given by Godet (1986), Amer *et al.* (2013)

INSPIRING FROM PROSPECTIVE APPROACH AND POSSIBLE CONTRIBUTIONS OF MODEL ASSESSMENT

Scenario are validated when respecting 5 criteria: creativity, relevance, transparency, plausibility and consistency (Durance and Godet 2010; Alcamo and Henrichs 2009)
Answering 4 key questions concerning model capabilities

1. Which model is the most convenient for the concerned LUCC? (depends on resolution and extent of the area)

3. How does the model function? (avoiding "black-box" model)

2. Is the model flexible?
- for simulating LUCC based on forecasting and/or backcasting assumptions)
- for simulating new LUCC transitions, patterns and demand, breaking LUCC trends.

4. How does the model perform?
Is the model able to simulate various landscape dynamics and patterns accordingly to the pre-defined scenario?

If validation techniques of LUCC models can contribute improving each criteria, hence it improves the confidence users (modelers, stakeholders, etc.**) can have in the simulated LUCC maps.**

The model is expected to simulated what the scenario defines in terms of future LUCC (new transition, patterns and demand; breaking LUCC trends)

As model validation is not made, it is not sure the simulated future LUCC are consistent with the scenarios.

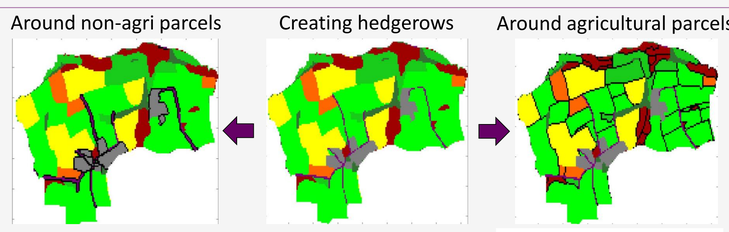
COMBINING SENSITIVITY TESTS AND ASSESSMENT OF MODEL OUTCOMES

Sensitivity tests and assessment of model outcomes are dedicated to demonstrate model capabilities to simulated scenario-based LUCC, contributing to the '*transparency*', '*plausibility*' and '*consistency*' criteria. Several techniques and tools can be used aiming at verifying the following questions:

Is the model able to simulate expected LUCC processes, allocation and demand?

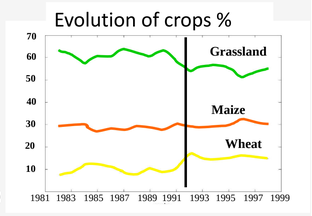
→ Verifying if the LUCC rules are conveniently simulated

EXAMPLE 1
Fine resolution agricultural LUCC



Annual crop proportions have to be:

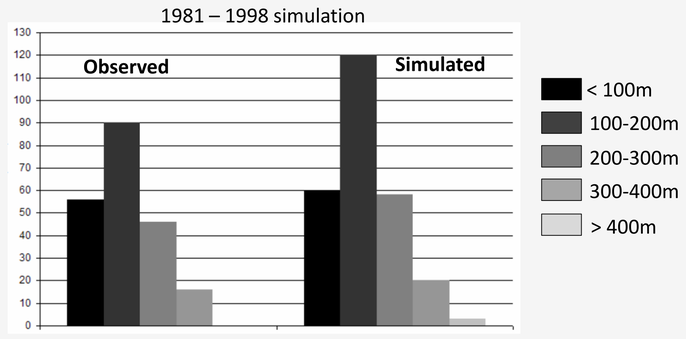
Before 1992:
[G: 63±5%, Maize: 25±5%, Wheat: 12±3%]
After 1992:
[G: 55±5%, Maize: 30±5%, Wheat: 15±3%]



Houet et al. (2007, 2014) and GLP poster 0459

Is the model able to simulate a past evolution?

→ Verifying if the simulated landscape is '*similar*' in terms of configuration and composition.



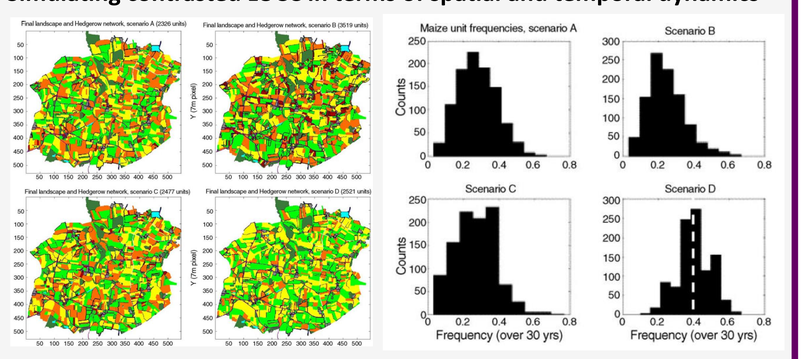
Distance to the hydrological network of cumulated maize (in ha)

Houet et al. (2007, 2014)

Is the model able to simulate breaking trends LUCC?

→ Verifying if the model can deal with breaking trends and if the combined LUCC rules does conveniently interact (avoiding unexpected effects).

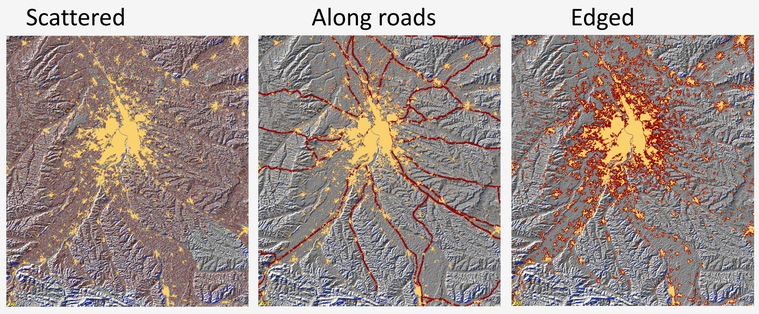
Simulating contrasted LUCC in terms of spatial and temporal dynamics

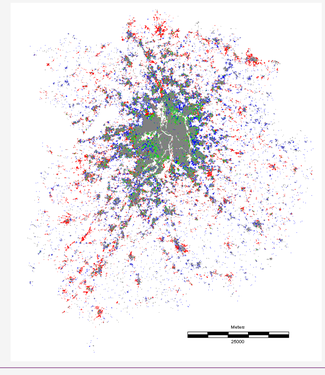


Gaucherel & al. (2006)

EXAMPLE 2
Urban sprawl

Controlling the patterns of urban growth

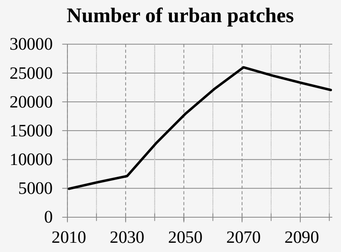




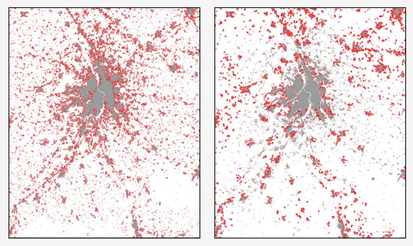
Similar patterns (in terms of urban patch size, mean distance, cohesion and clumpiness)
30.6% of predicted urban growth (fair results regarding the empirical parameters used)

Predicted urban growth
Under-estimated urban growth
Over estimated urban growth
Persistent urban area

Simulating contrasted dynamics



Simulating contrasted scenarios



See GLP Poster 0457 for more details

Answering these questions allow the modeller to assess model flexibility (Question 2)**. The choice of the model may be made *a priory* or adapted based on results** (Question 1)**. Presenting these results to stakeholders and decision makers improves the transparency criterion** (Question 3)**.**

CONCLUSION AND PERSPECTIVES

Using various and combined validation techniques

A **wide diversity of validation tools and techniques can be used** (few examples have been shown here)
Taken separately, they are suitable to assess the predictive power of the LUCC model.
Combined, they are **convenient for improving the confidence** users can have in simulating future LUCC.

Assessing model ability to simulate realistic (scenario defined) LUCC is crucial

All results have to be consistent (but not in perfect agreement) to improve the plausibility and the consistency of the model, hence the plausibility of the simulated LUCC (while scenario's assumptions remain plausible)
Toward the promotion of the development of new methods based on uncertainties, Monte carlo simulations, etc.

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GLP Poster 0459 - Houet T., Gaucherel C., Castets M., Schaller N. (2014), Combining process-based and optimization approaches for simulating fine scale agricultural LUCC. Global Land Project open science meeting

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