Land Change Modeling Handling with Various Training Dates

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Presentation plan

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- II. Objectives

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- I. Test area
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- III. Methods

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- I. Results
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Issues

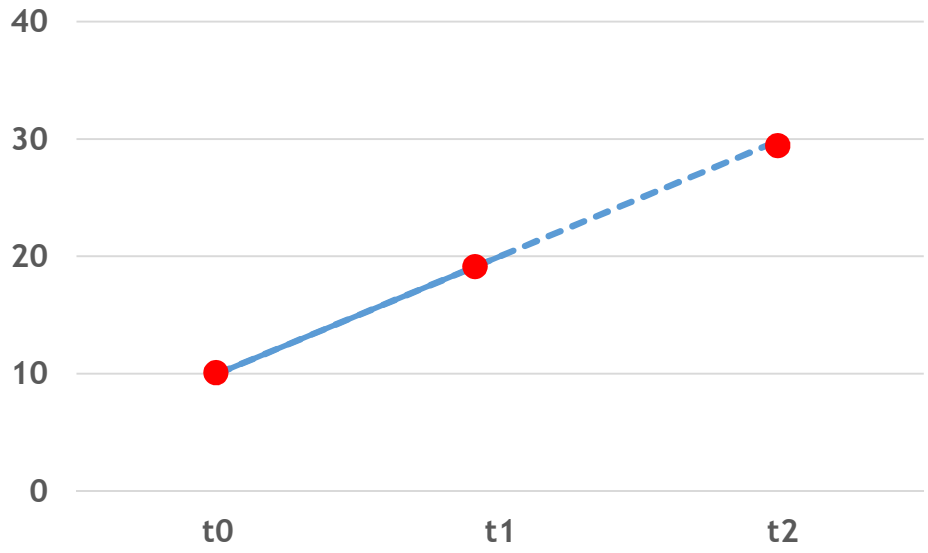
Path dependent land change modeling:

- Simulation of quantity
- Simulation of allocation

A lot of geomatic modeling programs use only 2 LUC maps as **training dates** (**TD**) for calibration and to simulate land change quantities by Markov Chain (MC).

Issues

Using only 2 TD is risk taking:



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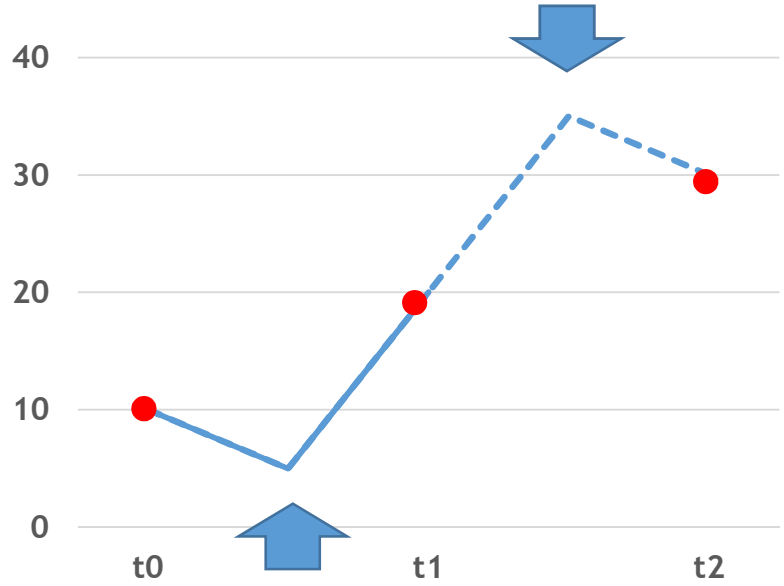

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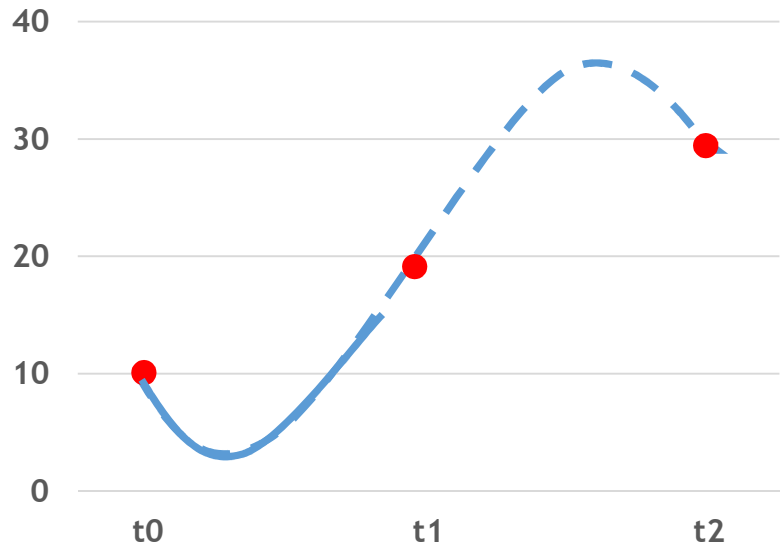

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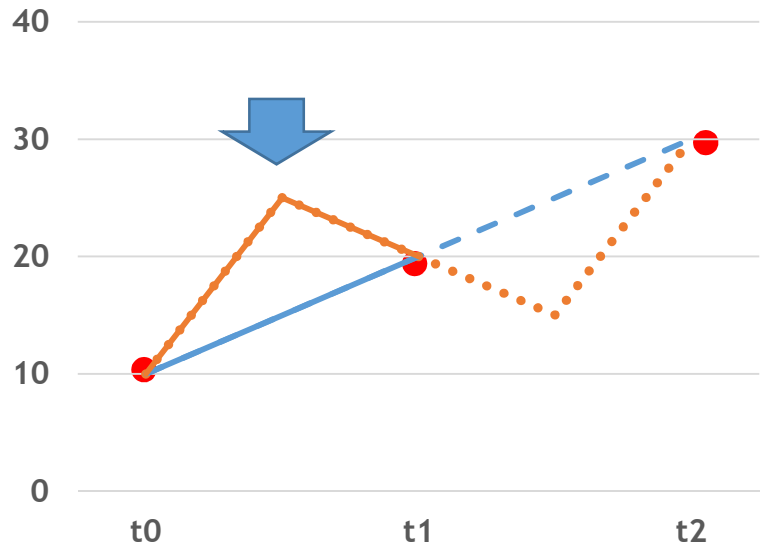
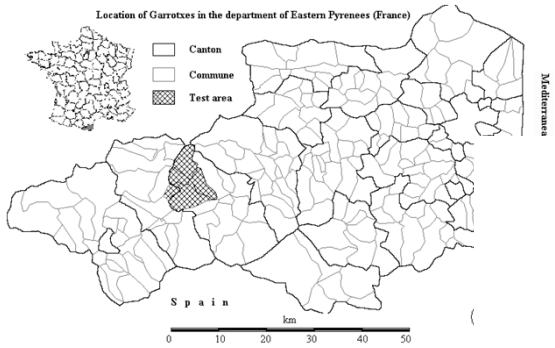


Objectives

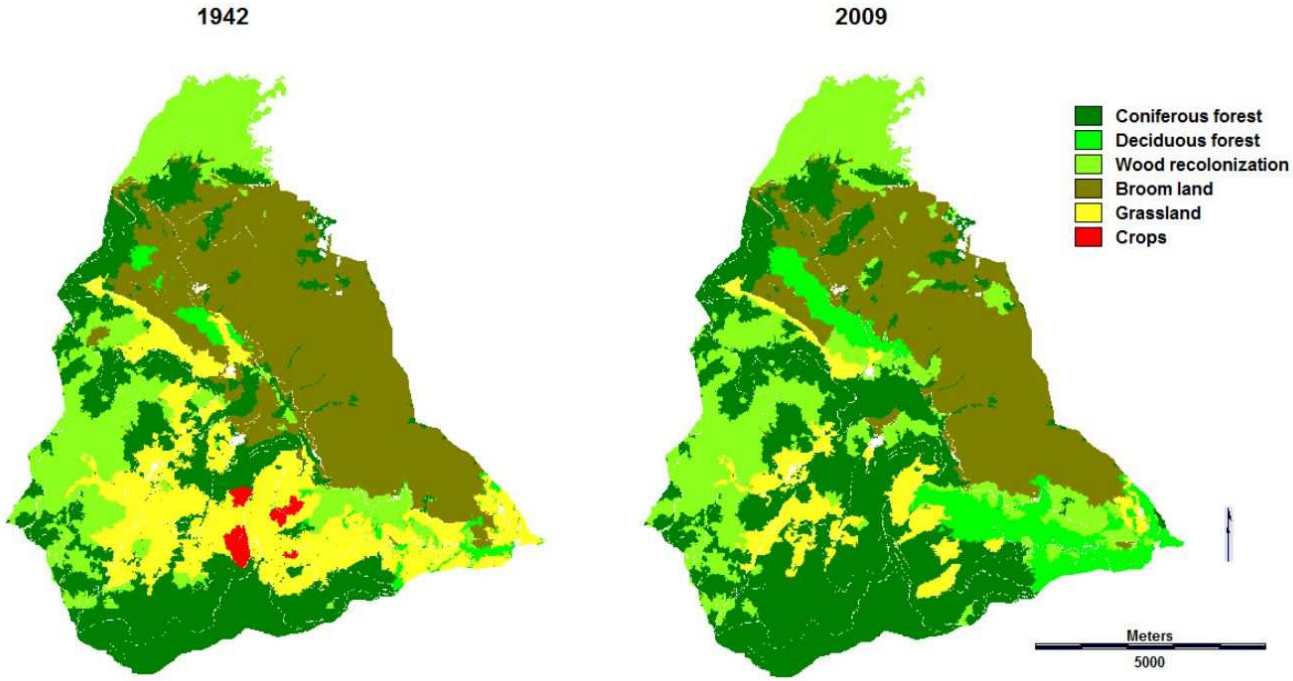
Using a simple data base, the purpose is to :

- Show the randomness of simulation when considering only 2 TD
- Present the range of MC predicted land change quantities using different TD by comparing them to observed land change
- Show the difference between predicted land change by:
  - MC using 2 TD
  - Very basic techniques considering all available TD

Test area

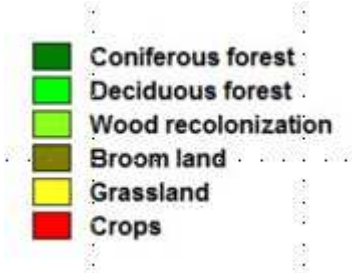


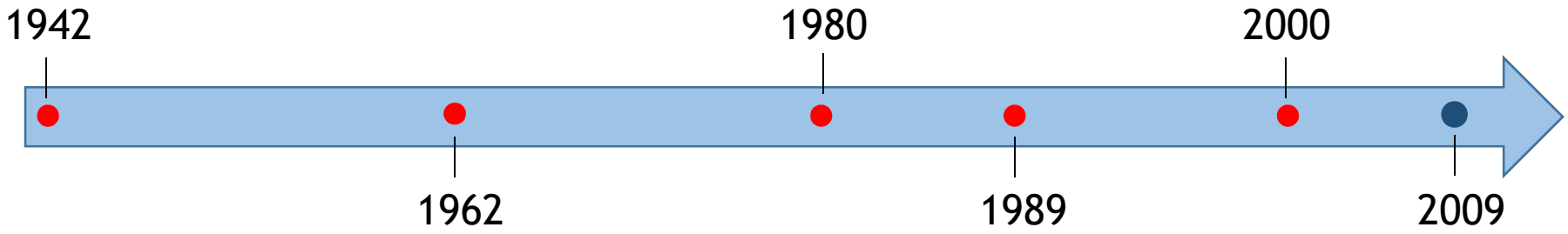
French Pyrenees – Garrotxes



Data set

- 6 LUC maps / irregular time points – the last one used for validation
- 6 land use / cover categories





Methodology

- Computing LUCC – budget and transforming it into annual rates

- Running Markov Chains (MC):
  - Considering all possible pairs of TD
  - Applying ≠ confidence levels (0.0; 0.1)

→ **2009**

Possible TD pairs for MC

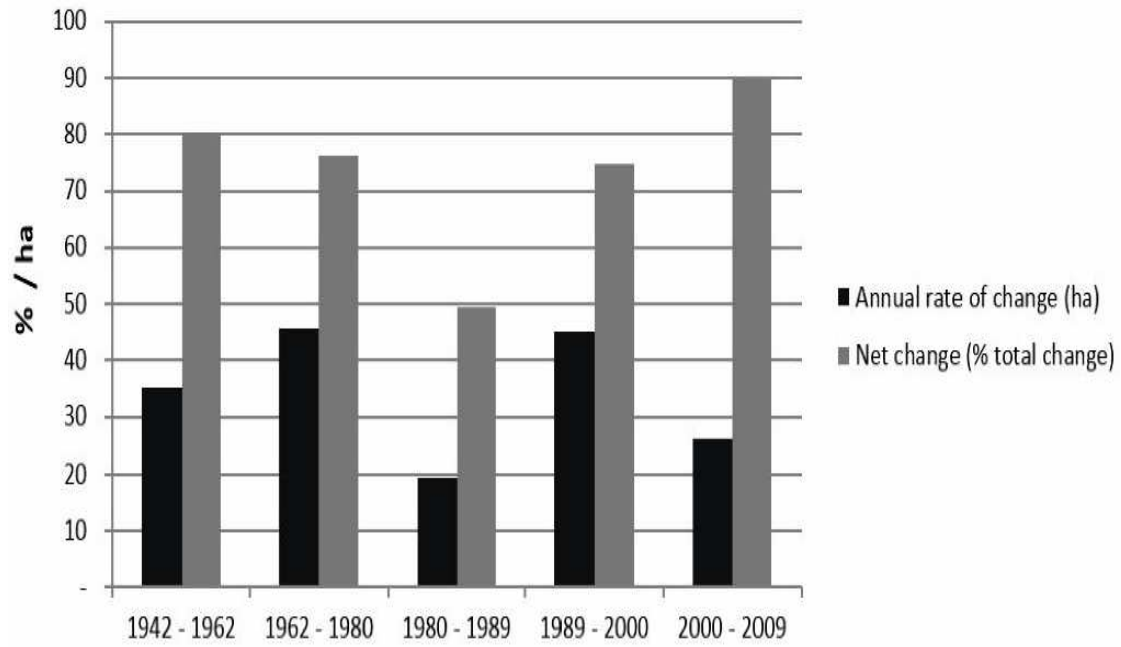
	1942	1962	1980	1989	2000
1942		1	5	8	10
1962			2	6	9
1980				3	7
1989					4
2000					

- Computing transition rates to 2020 using all TD and combining them with very simple techniques:
  - Average
  - Time distance weighted average
  - Linear trend
  - Exponential trend

→ **2020**

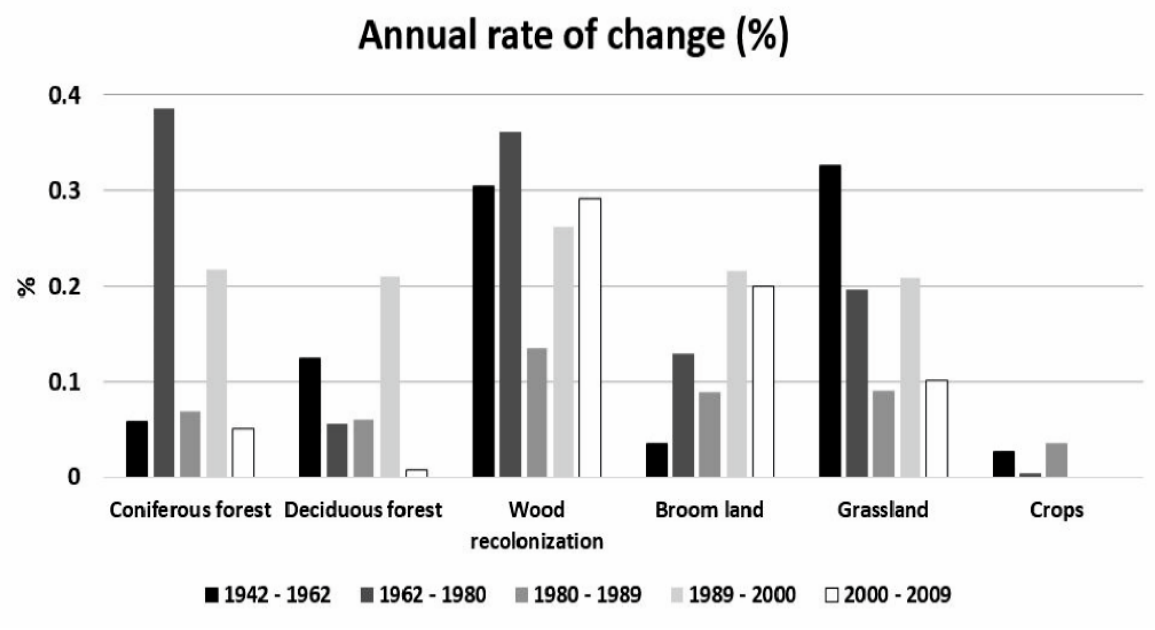
Results

LUCC budget indicators - mean annual rate of change (ha) and percentage of net change – for each of the five periods in the data set



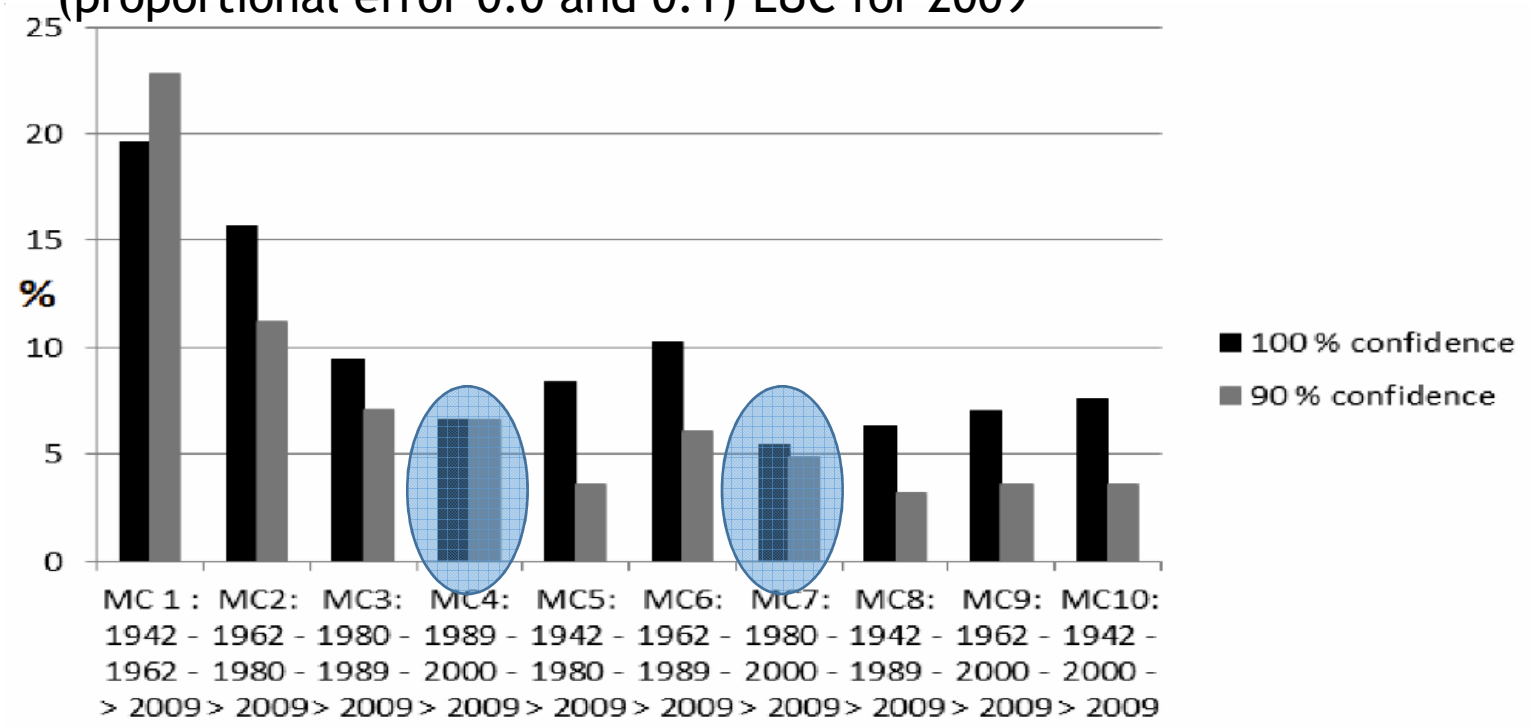
Results

Annual rates of change (%) for each LUC by period



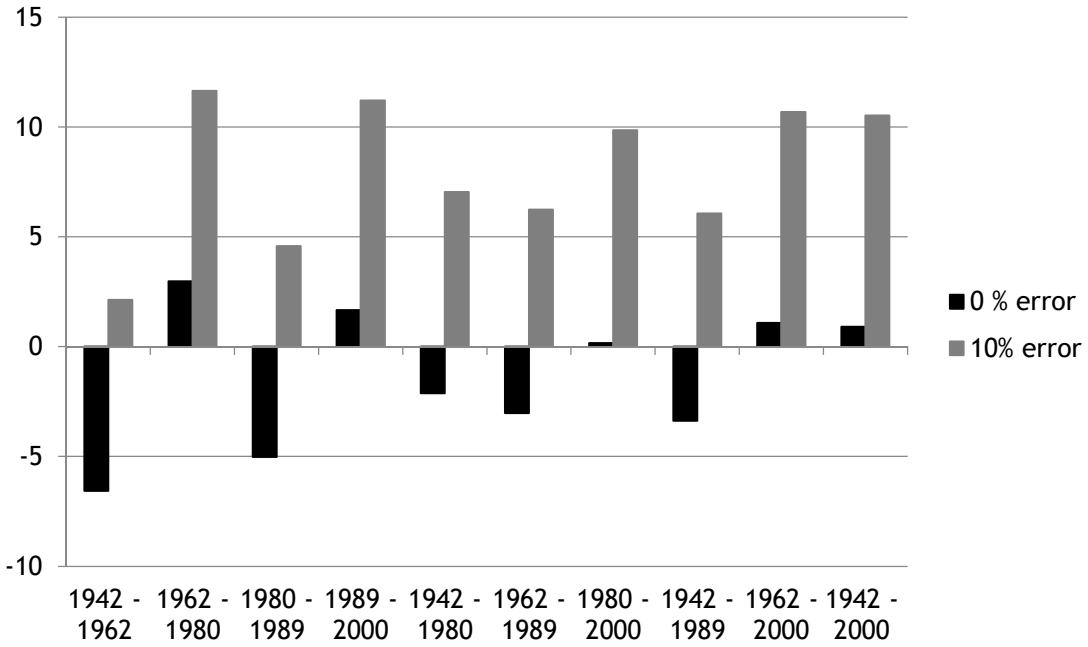
Results

Absolute differences between observed and MC predicted (proportional error 0.0 and 0.1) LUC for 2009



Results

Differences between observed and MC predicted (proportional error 0.0 and 0.1) LUC for 2009 – **persistence only**



Results

Absolute differences (%) between MC performed transition matrices and four alternative methods including the entire set of available TD for 2020. The left column shows the difference based on MC using 1989 and 2009 as TD while the right column indicates differences based on MC using 2000 and 2009 as TD.

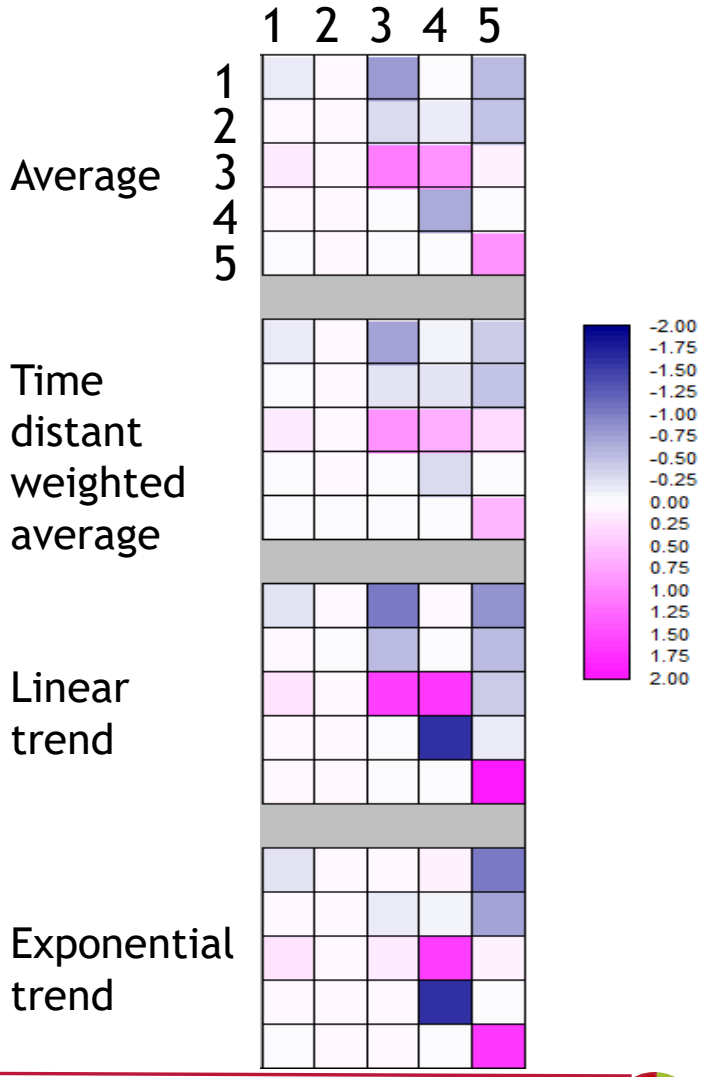
(next figure)

	MC (1989-2009)	MC (2000-2009)
Average	2.04	6.24
Time distance weighted	0.95	5.02
Linear trend	5.37	9.88
Exponential trend	3.36	7.36

Results

Differences between MC (TD: 2000 and 2009) predicted and alternatively calculated transition rates for 2020. Each square presents one comparison.
A positive number means that MC simulated transition is more voluminous. A negative result indicates that MC predicted transition affects less surface than alternatively calculated.

1 – Coniferous forest
2 – Deciduous forest
3 – Wood recolonization
4 – Broom land
5 - Grassland



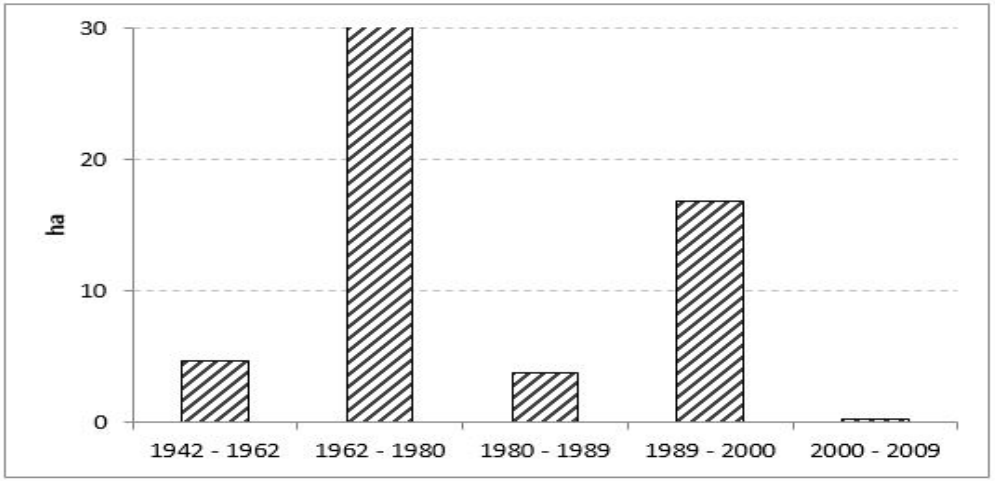
Discussion

LUCC budgets underline that land change is not linear.
We noted differences at the global, categorical and transitional level.

This figure shows the average annual net gain in ha of coniferous forest per period: what couple of TD would be closest to reality ?

Important differences :

- Time
- Categories
- Transitions



Discussion

Applied alternative techniques using all TD are rather simple and only aims to show that differences can be important between MC implemented in popular GIS software and knowledge about the whole data set.

Taking into account a memory in the simulation process by proposed alternatives is, theoretically, an improvement.
In contrast, using all available LUC maps makes necessary to supervise this process to avoid illogical transitions.

Nearby the frontier between path – dependent and contrasting scenarios

Conclusion & outlook

- Specific data dependent results

- What means path – dependent scenario when where is a lack of knowledge about the “path” ?

- How to use various TD when their number is limited ?

Thank you for your attention

Test area

French Pyrenees – Garrotxes :