Modeling land change using one or two time points based calibration
A comparison of factors

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Context

- Research Project **SIGEOMOD_2020** BIA2013-43462-P (2014-2017), funded by the Spanish Ministry of Economy and Competitiveness and by the Regional European Fund FEDER http://geofireg.ugr.es/sigeomod/

- Previous research and published papers based on:
  - The methodological comparison of pattern-based models
  - The accuracy assessment of land change models
  - **One or two time points based models**: suitability *versus* transition potential, their hard outputs assessment, etc.

Introduction

- Changes over time and space are considered differently in models
- A land change model can be calibrated with the state at **one time point** or with the difference **between two time points**
- These approaches involve modeling **LUC states** or **LUC transitions**
- In calibration stage, factors can be created with or without the LUC locations as **reference maps**

Objective

Comparing

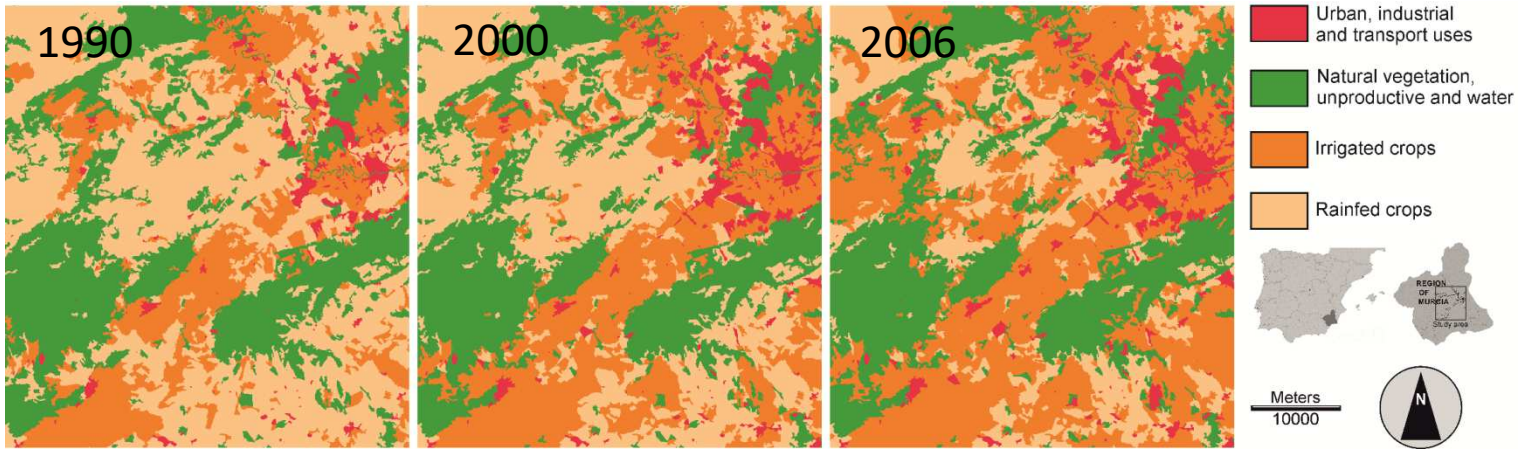
- **One / two time points based calibration**
- **Both for two consecutive calibration periods**

We obtained and compared factors in order to answer

- how the choice of LUC **reference maps** influences the factors?
- how these factors represent the change patterns in the **two calibration based models** and in the **two calibration periods?**
- how the behavior is specific to the different **LUC categories** or **variables**?

Study area and data sets

- 2,300 square kilometers in the province of Murcia (Southern Spain).
- **11 explanatory variables**: topographic variables, protected areas, territorial accessibility (roads diversity and quality), distance to roads and distance to hydrographic network
- 3 Corine Land Cover maps (CoORdination of INformation of the Environment, Instituto Geográfico Nacional, Spain) for dates 1990, 2000, 2006 and for **4 LUC categories**



Software

- TerrSet software (Clark Labs, 2016)

Methods

- Calibration based models and periods

  One / two time points based calibration
  Both for two consecutive calibration periods

  4 combinations

- Obtaining factors by evidence likelihood transformation

  Relative frequency of categories of **variables**

  ↓

  Reference maps (binary LUC category/transitions)

  ↓

  4 factors

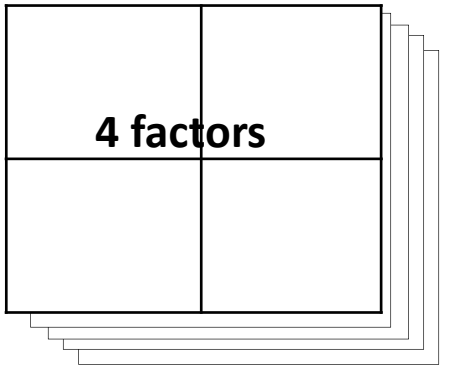
- Comparing factors by Pearson correlation index

Obtaining factors

4 combinations
4 LUC
up to 11 variables
= 96 factors

Reference maps (binary LUC category/transitions)	First calibration period	Second calibration period
One time point	2000 (t_1) LUC state	2006 (t_2) LUC state
Two time points	1990 (t_0) – 2000 (t_1) LUC transitions	2000 (t_1) – 2006 (t_2) LUC transitions

4 combinations



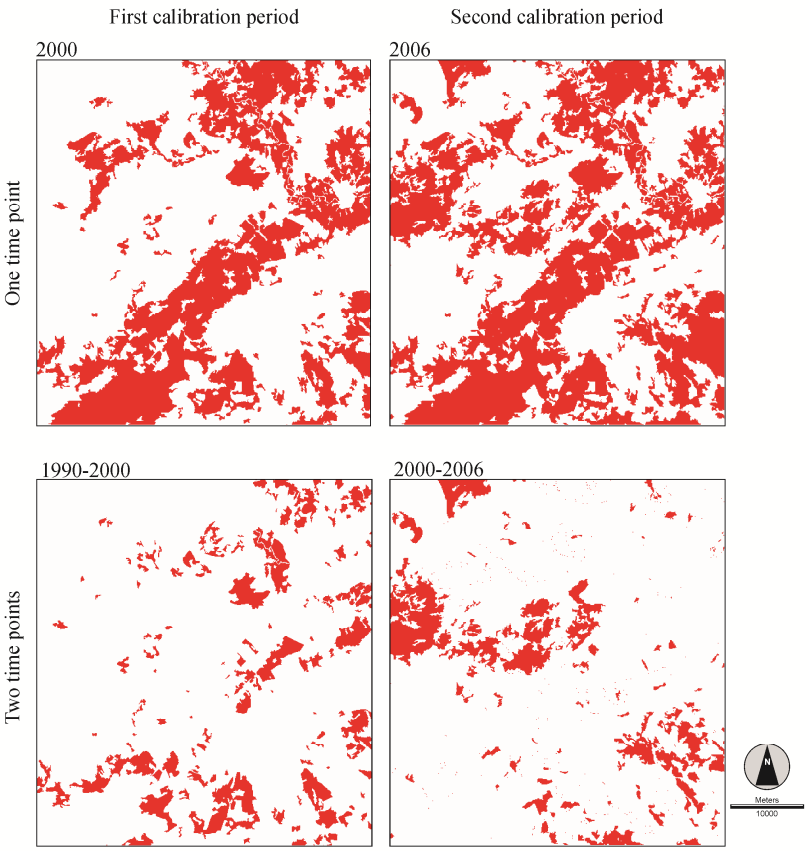
up to 11 variables

for 4 LUC categories/transitions

Obtaining factors

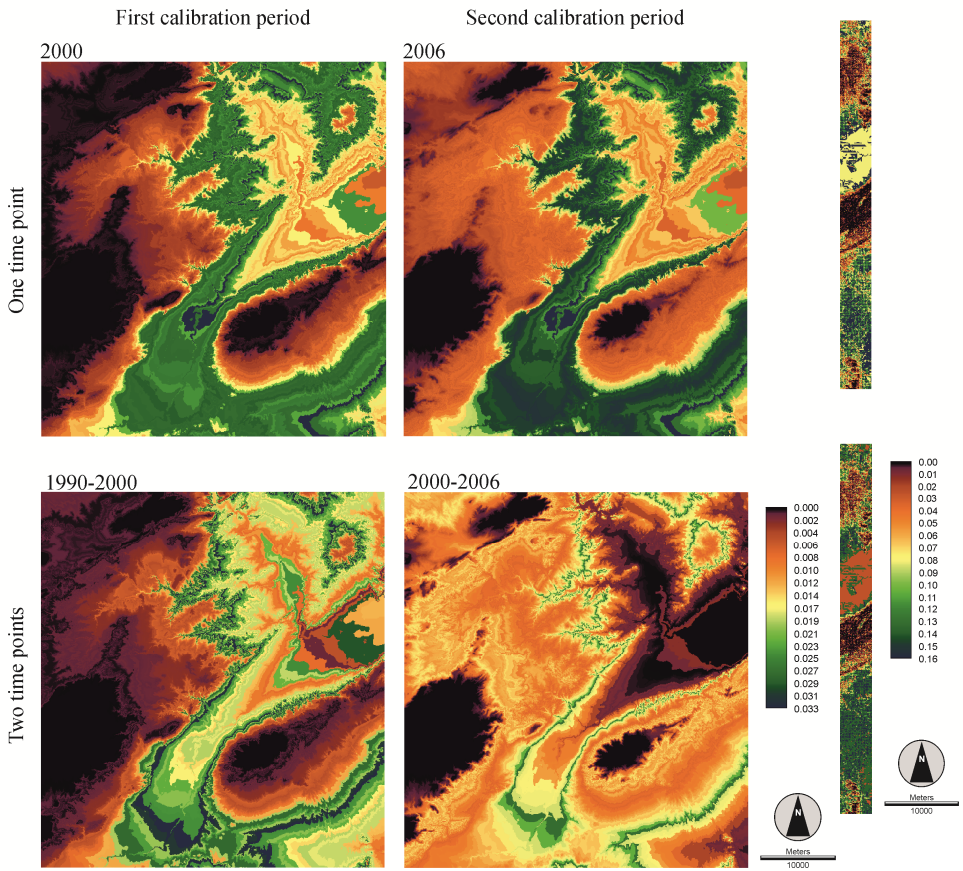
Example of irrigated crops LUC category / transitions

4 reference maps



4 factors for 9 variables

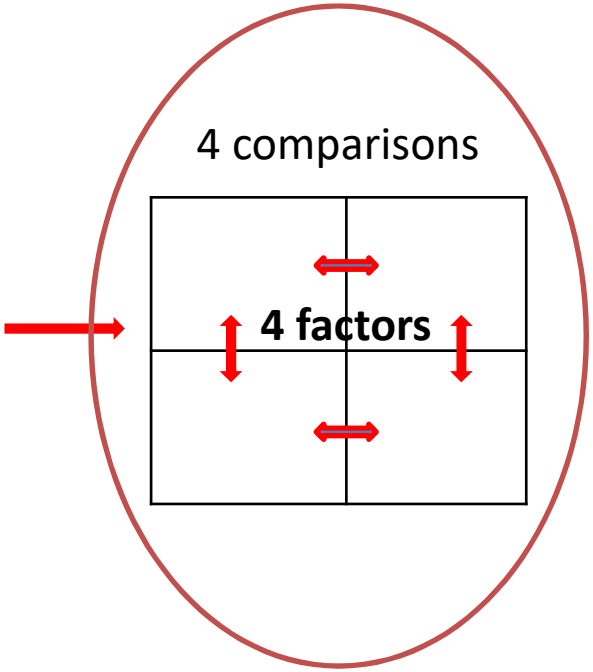
Example of elevation (front) and slope (behind)



Comparing factors Pearson correlation index

4 combinations

Reference maps (binary LUC category/transition)	First calibration period	Second calibration period
One time point	2000 ($_{t1}$) LUC state	2006 ($_{t2}$) LUC state
Two time points	1990 ($_{t0}$) – 2000 ($_{t1}$) LUC transitions	2000 ($_{t1}$) – 2006 ($_{t2}$) LUC transitions



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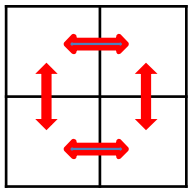
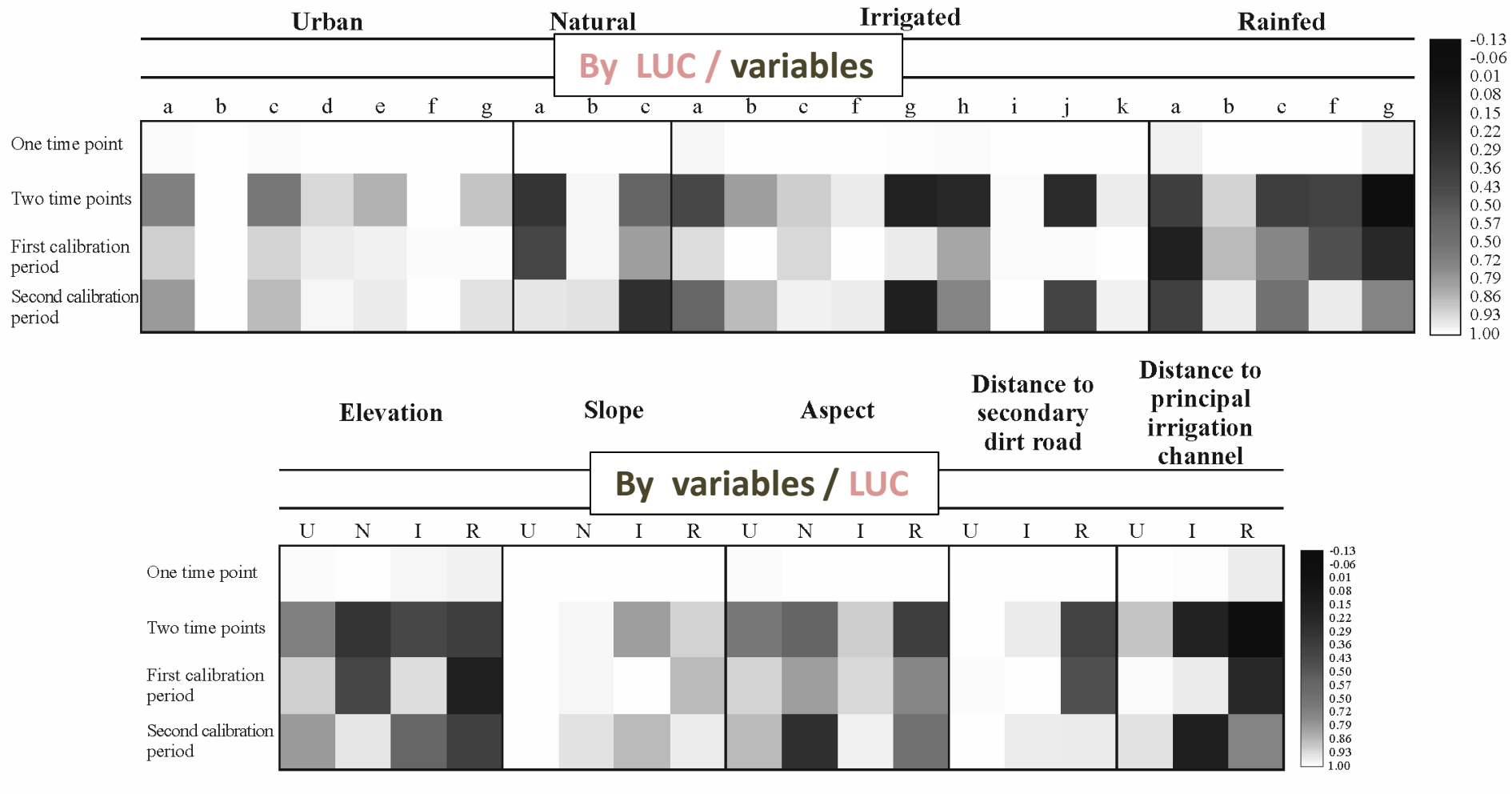
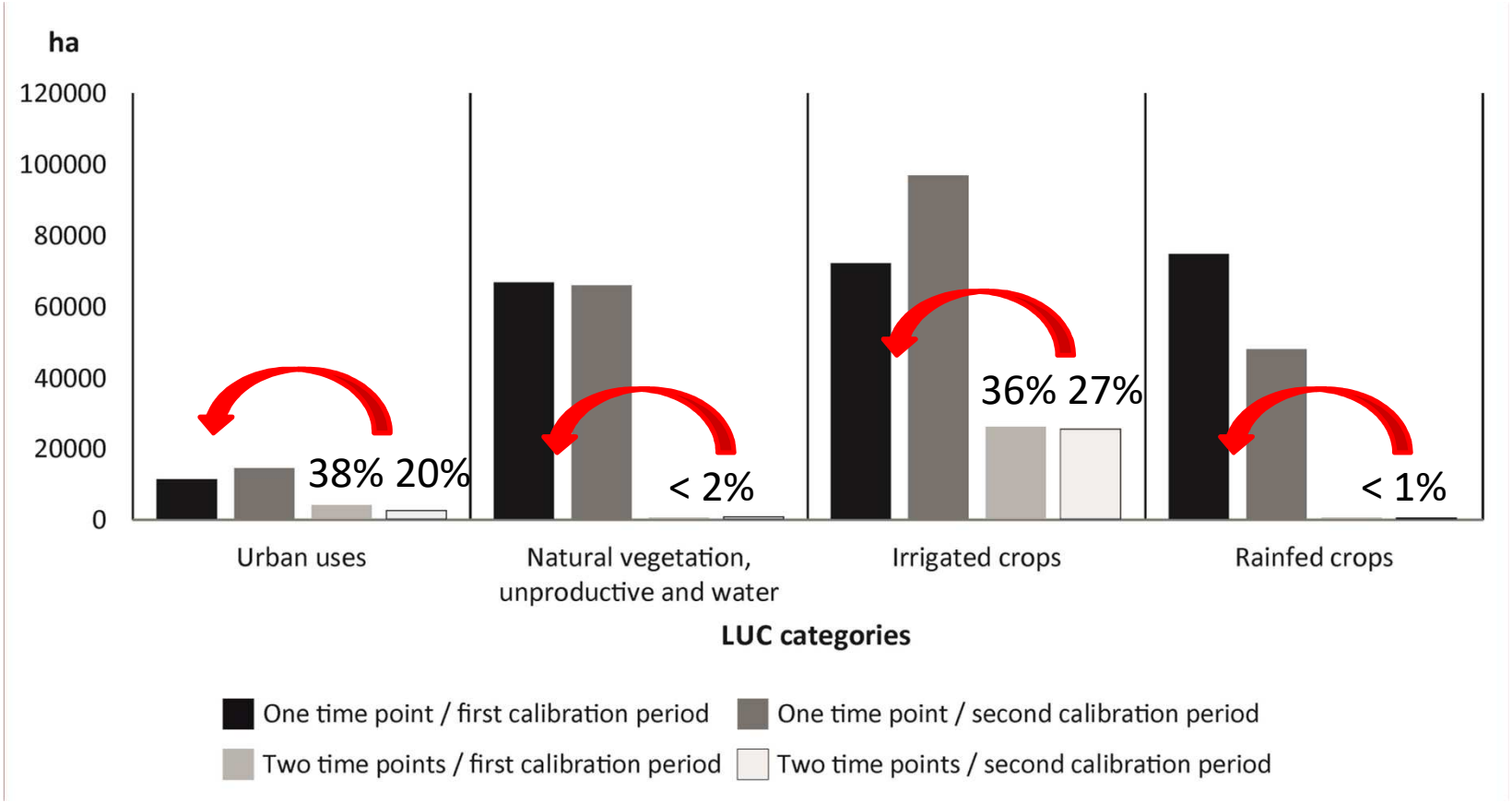


Comparing factors Pearson correlation



Comparing reference maps surfaces



Surface area (ha) of reference maps for the different LUC categories

Conclusions

- The **one time point based calibration,** "total past trend", involve modeling LUC states, that include all past changes. It is is more likely to capture historic patterns of change and simulations over longer time. It could be accurate at modeling categories in which transitions affect a proportionally small area.

- The **two time point based calibration,** "two past trend", involve modeling LUC transitions, that considers past changes that occurred during a recent period. It is more likely to capture these recent patterns of change and simulation over shorter periods. It could be statistically representative when they correspond to a proportionally larger area.

- Depending on multiple parameters, including form and intensity of dynamics, the two approaches may be complementary.

- A multi-temporal approach, integrating data about more than two training dates, could resolve potential errors resulting from only considering two past dates or by considering the total past.

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