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Future land use change dynamics in Natural Protected Areas

Madrid region case study

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Introduction

- PAs Spain:
  - 1990-2013: x7 number, x3 surface
  - 27% terrestrial ecosystems
  - Largest contributor to Natura 2000 network.

- Threats:
  - Climate change
  - Deforestation
  - Habitat fragmentation
  - Loss of biodiversity
  - Propagation of invasive species…

Introduction

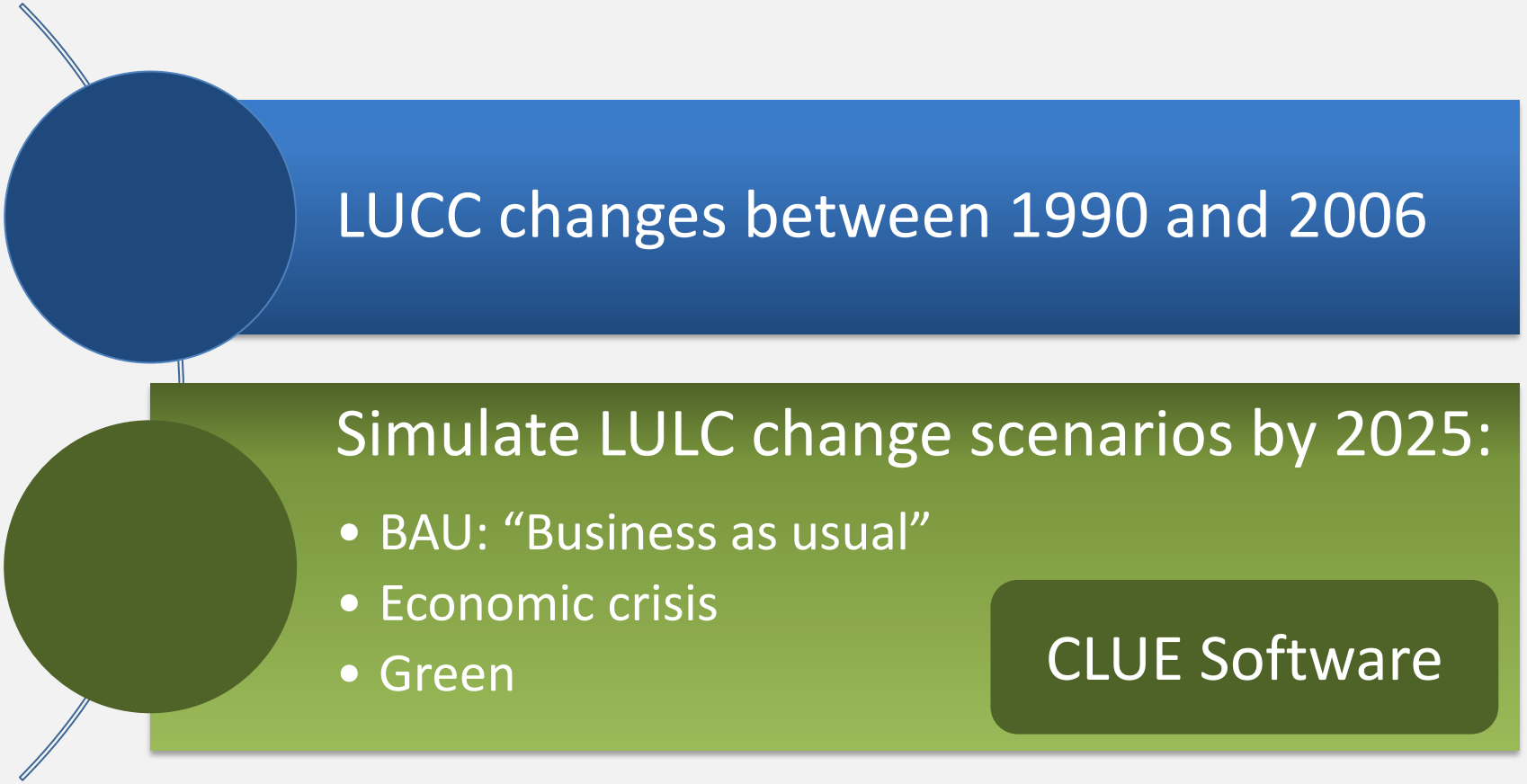
- LULC changes in PAs
  - Known little
  - Changes in PA and not PA around them

(Sastre et al. 2002; Romero-Calcerrada et al. 2004; Ruiz-Benito et al. 2010; Hewitt and Escobar 2011; Martínez-Fernández et al. 2015; Hewitt et al. 2016).

- LULC Scenarios
  - Preventive planning
  - Starting point for discussion and reaching agreements

Objectives

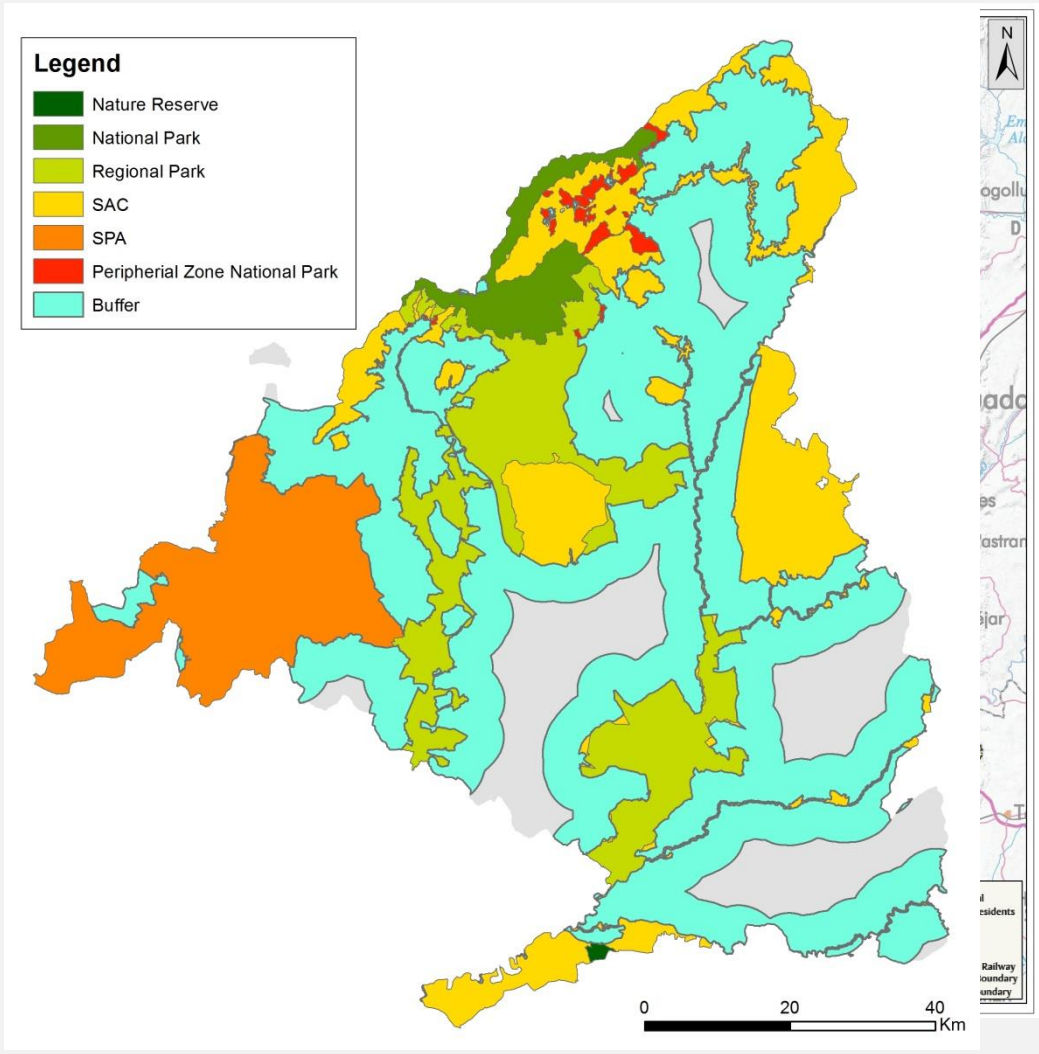
- Analyse LULC in PAs and their surrounding areas in the region of Madrid



Study site

- 8,027 km^2
- PA: 41%
- 800 inhab/km^2

SAC	15%
RP	12%
SPA	10%
NP	3%
PPZ & NR	1%



Data

Nationally Designated Protected areas
Natura 2000 Network areas

Ministry of Agriculture, Fisheries, Food and Environment

Dates for final approval of the SACs

Common Database on Designated Areas - European Environment Agency

CLC 1990, 2000 & 2006

CNIG - Spain

DEM: altitude / slope
Roads, railways, rivers
Lithological map
Public-utility forest areas
PA zoning
Legislation

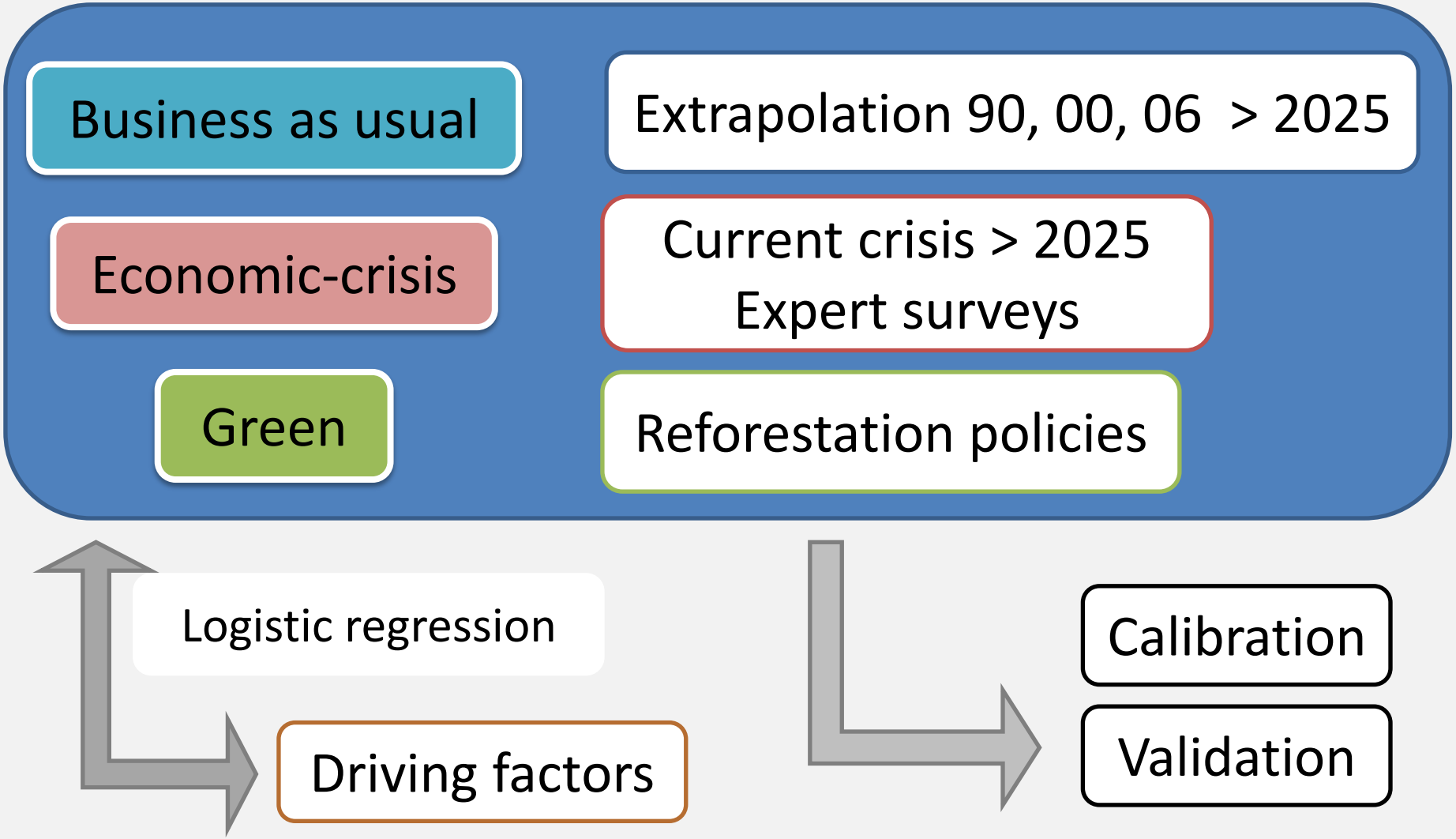
Methodology

- Simplification of CLC L3 Legend

(1)urban fabric
(2)industrial and commercial
(3)arable land and permanent crops
(4)heterogeneous agricultural areas
(5)forests
(6)shrubs and herbaceous vegetation
(7)other: open spaces with little vegetation, wetlands & water b.

- Past trends (1990, 2000 & 2006) to create scenarios

Methodology

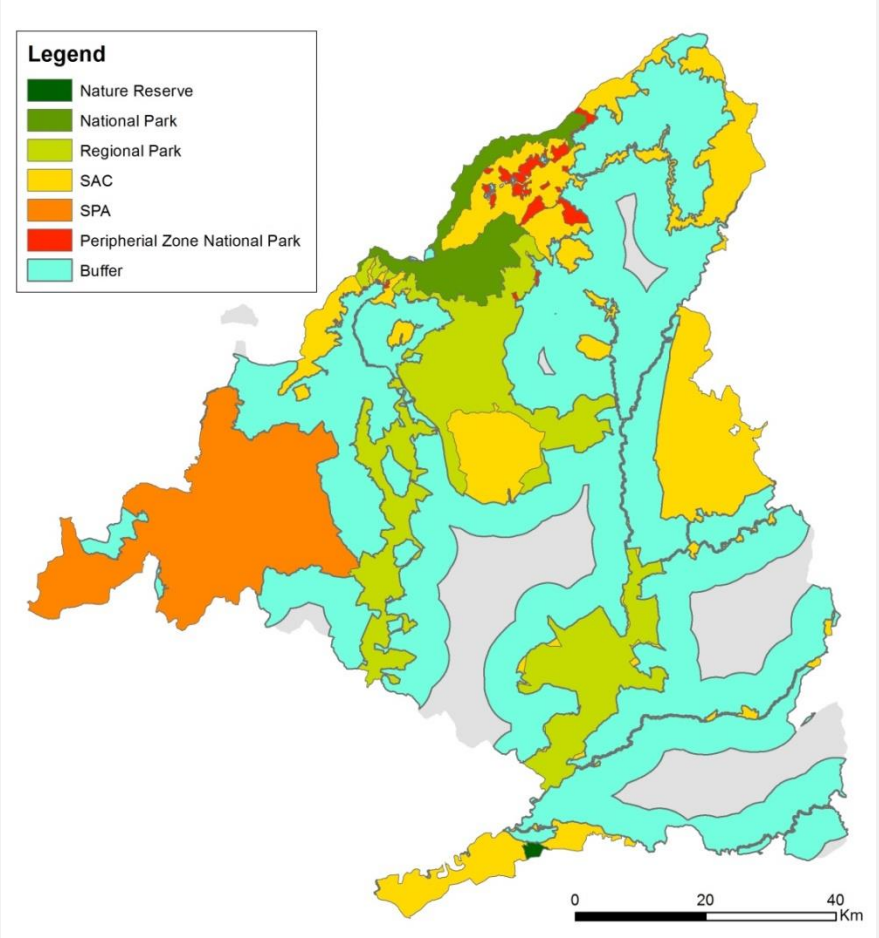


Methodology

- Level of priority in PAs (hierarchy) vs other approaches
  (Declaration year, Rodríguez-Rodríguez & Martínez-Vega, in press)

(1) Nature Reserve	(4) SAC
(2) National Park	(5) SPA
(3) Regional Park	(6) PPZ in Sierra de Guadarrama NP.

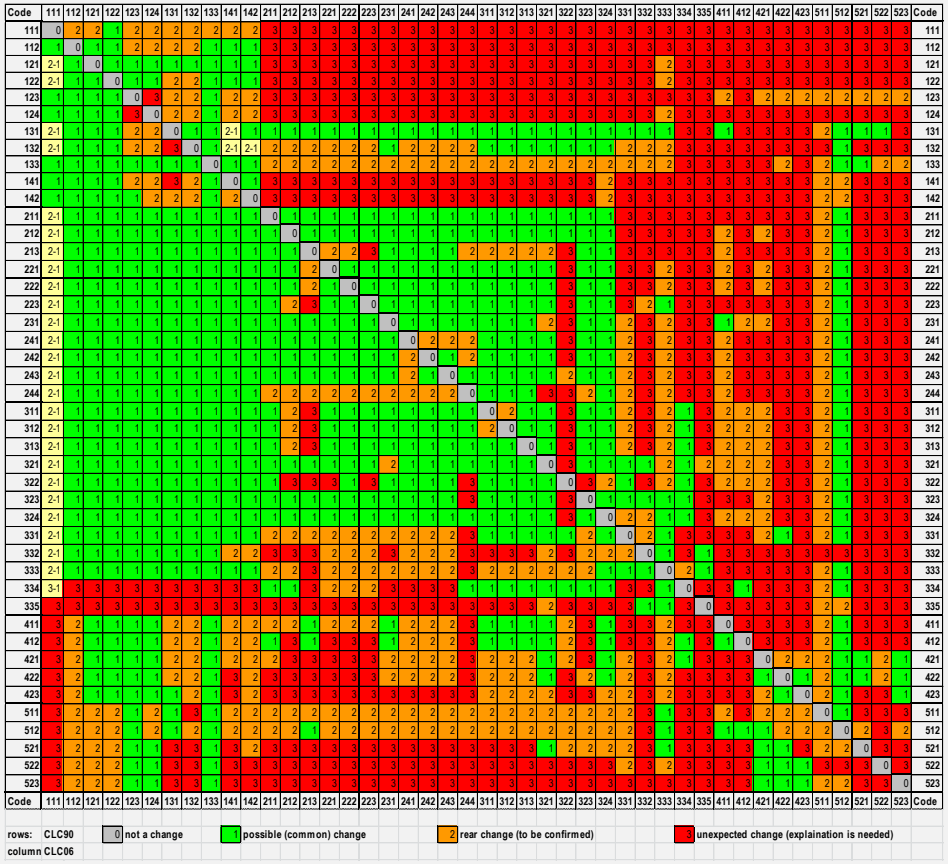
- 5-Km buffer around each PA
  - 46% of the region's area



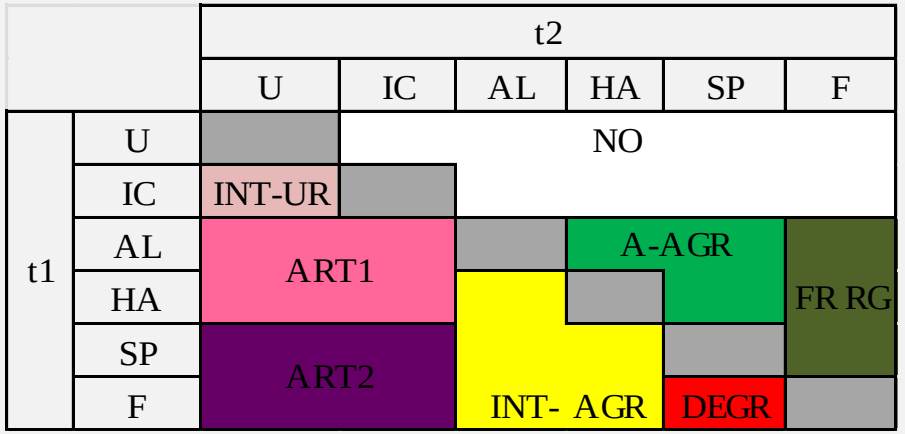
Methodology

Possible LULC changes

44 x 44 classes = 1,936



Main processes analyzed



ART: Artificialization

INT-AGR: Agricultural land intensification

A-AGR: Agricultural land abandonment

FRG: Forest regeneration

DEGR: Natural vegetation degradation

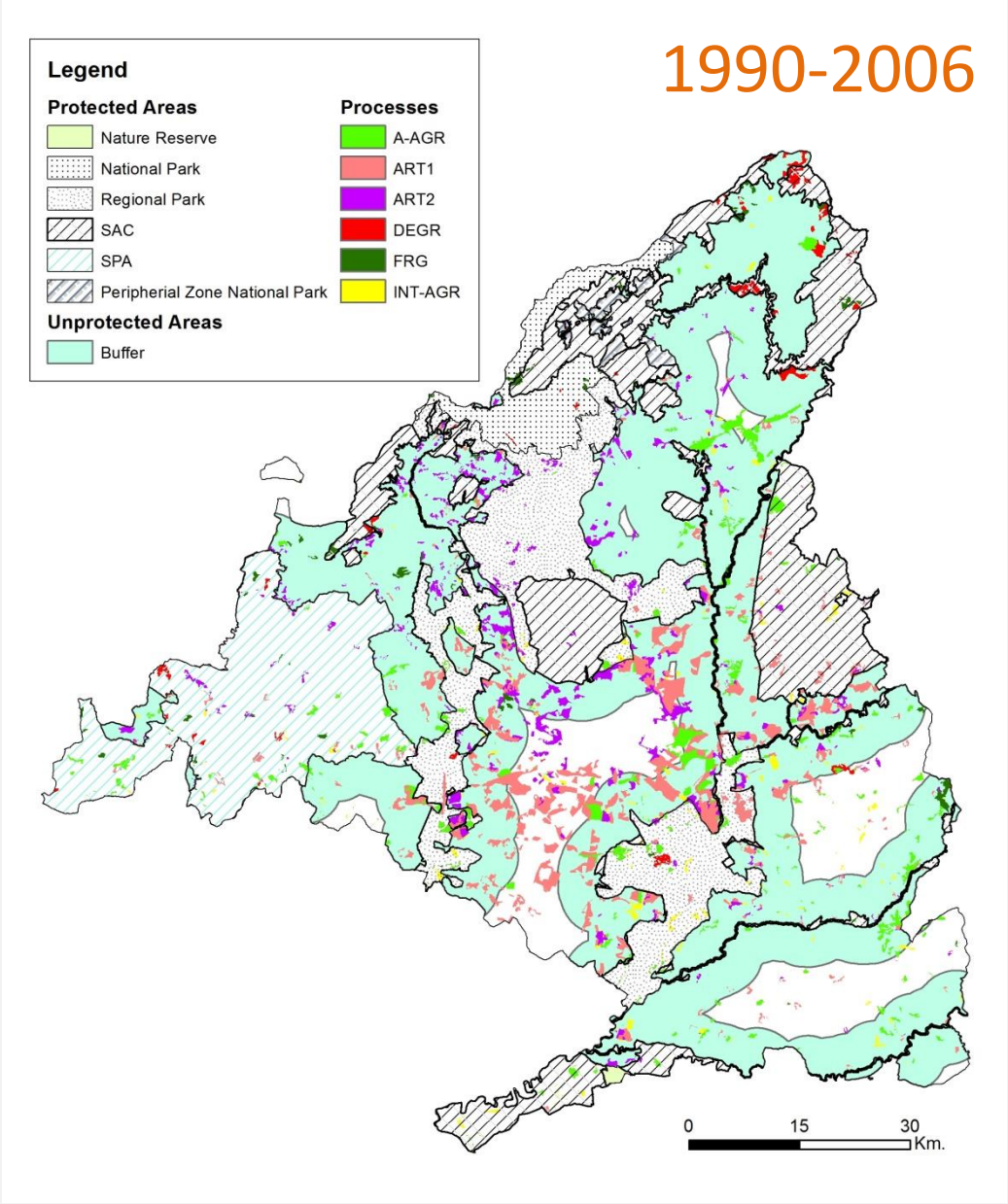
Results: 1990 – 2006

1990-2006	ART	INT-AGR	DEGR	A-AGR	FRG
NR	1,01	97,97	0,00	1,01	0,00
NP	0,00	0,00	28,24	0,00	71,76
RP	42,45	13,87	6,08	35,34	1,69
SAC	27,34	11,33	25,03	20,70	14,56
SPA	30,84	4,78	14,59	35,23	15,56
PPZ	40,60	0,00	0,00	0,00	59,40
BUFFER	68,90	4,56	3,32	18,71	3,78

Principal processes (1990-2006) in PA & surroundings, % of total change.

- PAs highest degree of protection: agriculture intensification (NR) and forest regeneration (National Park); management plans prioritize these processes.
- In the surrounding area, almost 69% of the change related with urban growth.
- 10% of urbanization developed inside PAs and 60% in their neighbourhood.

- NR: almost no change (strict regulation).
- NP: exchange between natural LU classes (forest fires and policy of promotion of forest ecosystems)
- RPs: 5.000 ha urbanized (forest losses in N & agrarian losses in S and E).



Results: 2006-2025. BAU Scenario

2006-2025	ART	INT-AGR	DEGR	A-AGR	FRG
NR	0,00	0,00	0,00	0,00	0,00
NP	0,00	0,00	0,00	0,00	0,00
RP	38,57	51,51	0,00	9,91	0,01
SAC	55,56	0,00	0,00	25,34	19,10
SPA	0,05	0,00	1,54	88,13	10,28
PPZ	0,00	0,00	0,00	0,00	0,00
BUFFER	99,44	0,00	0,00	0,55	0,00

Principal processes in PA & surroundings, % of total change.

- No change in NR and NP
- SAC and SPA: colonization of natural vegetation (land abandonment) and forest regeneration.
- Not the same as 1990-2006: restrictions in PA planning might be respected in the future.

Results: 2006-2025. Crisis Scenario

2006-2025	ART	INT-AGR	DEGR	A-AGR	FRG
NR	0,00	0,00	0,00	0,00	0,00
NP	0,00	0,00	0,00	0,00	0,00
RP	99,65	0,00	0,07	0,00	0,28
SAC	0,87	10,20	74,09	12,12	2,72
SPA	0,00	0,00	3,23	87,62	9,14
PPZ	0,00	0,00	0,00	0,00	100,00
BUFFER	98,58	0,03	0,02	1,37	0,01

Principal processes in PA & surroundings, % of total change.

- RP: Artificialization
- SAC: Degradation and natural colonization
- PPZ: forest regeneration

Results: 2006-2025. Green Scenario

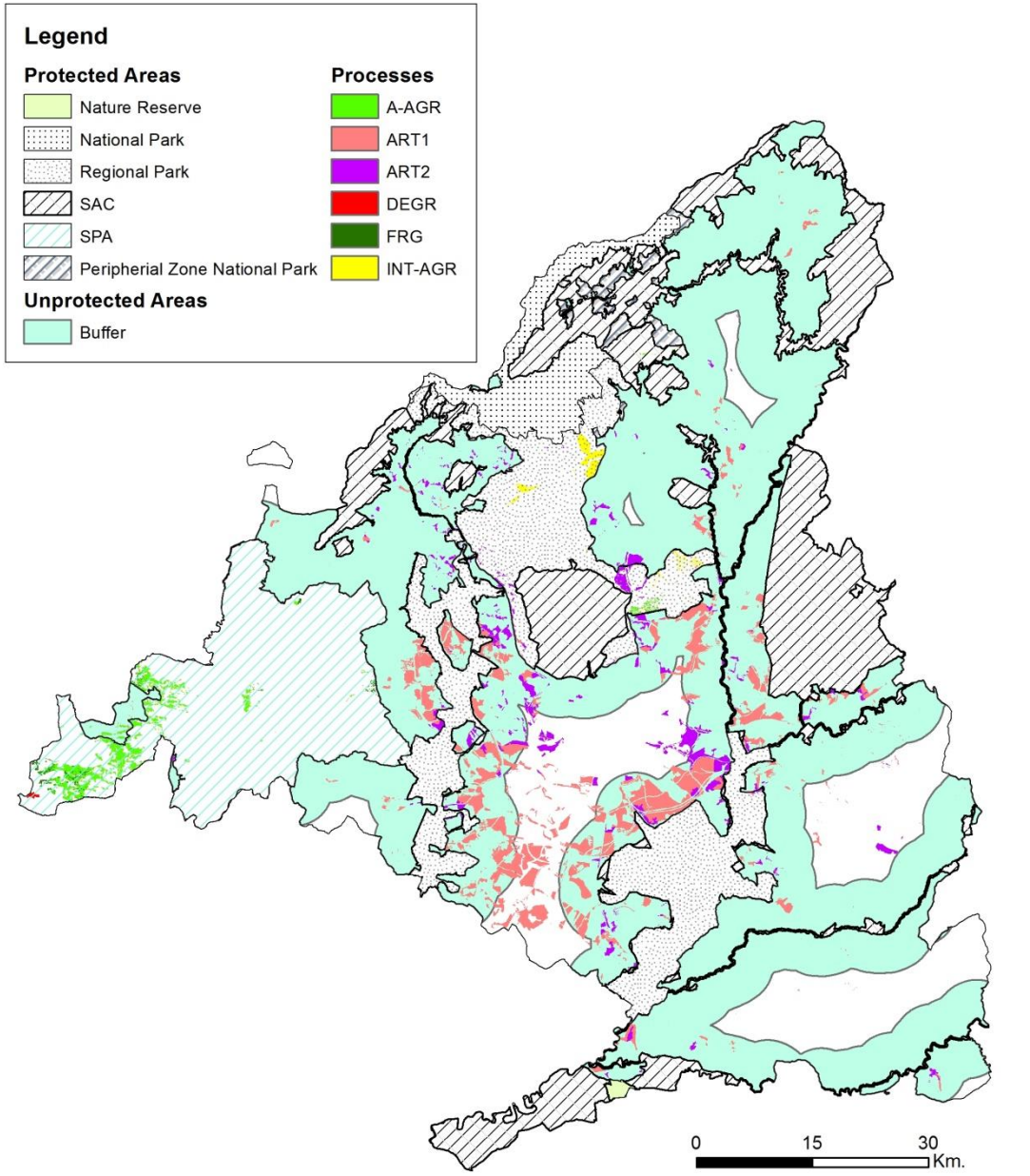
2006-2025	ART	INT-AGR	DEGR	A-AGR	FRG
NR	0,00	0,00	0,00	0,00	100,00
NP	0,00	0,00	0,00	0,00	0,00
RP	9,74	0,00	0,00	18,22	72,05
SAC	12,12	0,00	0,00	2,93	84,95
SPA	0,01	0,00	1,19	55,11	43,69
PPZ	0,00	0,00	0,00	0,00	100,00
BUFFER	67,64	0,00	0,00	7,56	24,79

Principal processes in PA & surroundings, % of total change.

- Abandonment of agriculture and regeneration of vegetation

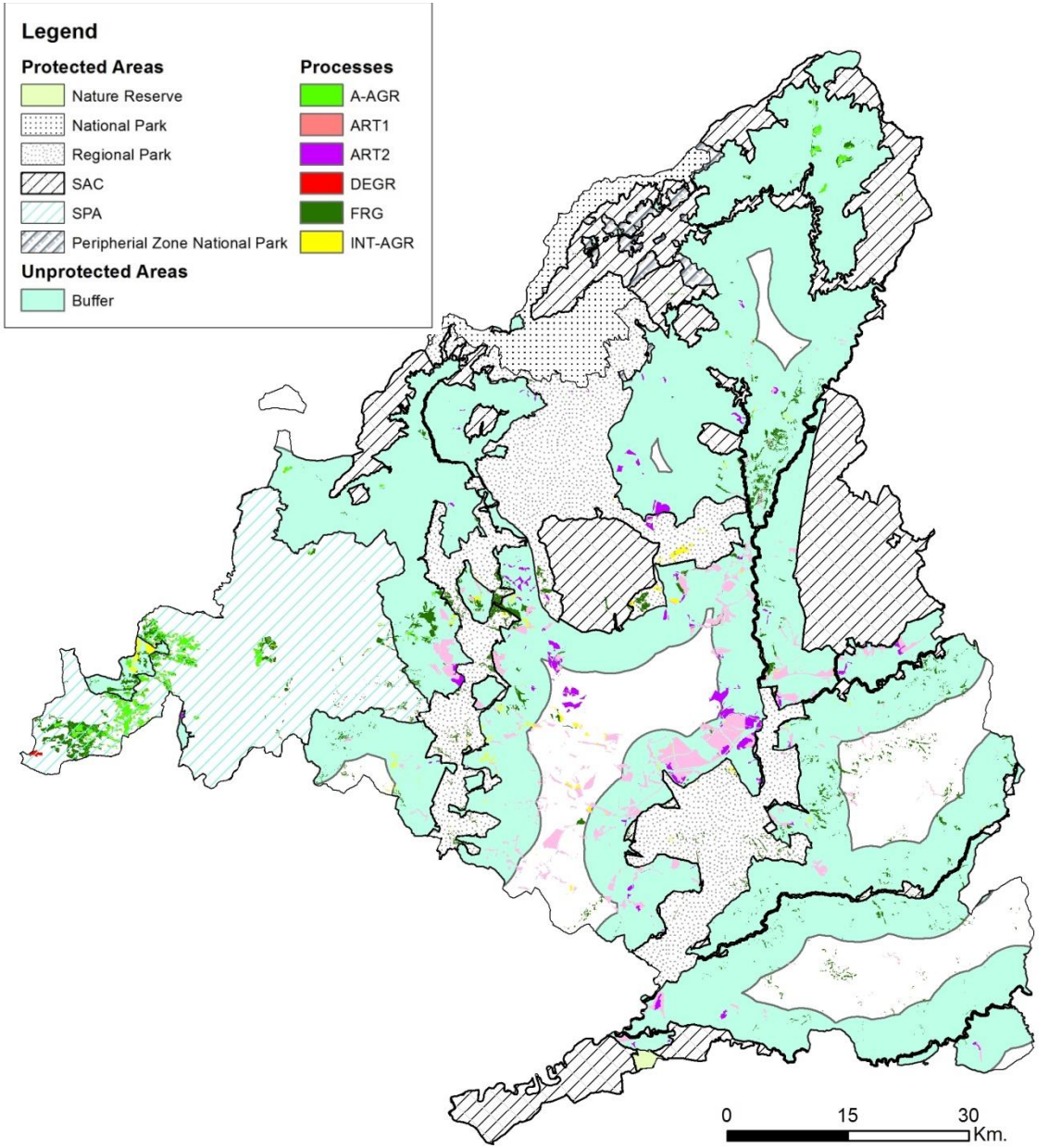
BAU Scenario

- Abandonment agriculture: progression of forest ecosystems
- PA neighbourhoods: urban and industrial increase: + 28,000 ha.



Green Scenario

- Forest regeneration especially SW and N.
- Less urban and industrial development



Discussion

- No LULC changes in the Nature Reserve, National Park and Peripheral Protection Zone,
- Green scenario: Just promotion of natural vegetation
- Results in the line with previous studies of LULC change and future scenarios in similar o nearby areas.

Conclusions

- Inside PA: relative persistence
- PA Neighborhood: increase built-up area: worrying process
- Naturalization of abandoned agricultural land
- Revegetation

- Transformation of habitats: irreversible effects on biodiversity
- Observe spill-over effect of protected areas

Thank you

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