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Assessing land cover changes in the French Pyrenees since the 1940s

A semi-automatic GEOBIA approach using aerial photographs

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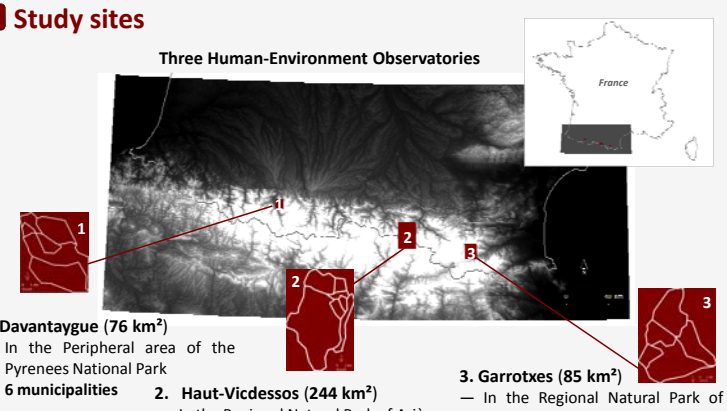
Introduction

As in many mountain areas in Europe, **agro-pastoral landscapes** of the Pyrenees **are subject to fast spontaneous reforestation**. Encroachment is mainly related to the abandonment of farmland in combination with rural depopulation and agriculture modernization.

Observed changes of land abandonment or land-use extensification can be similar at the regional scale but the **dynamics at the local scale do not occur homogeneously**, as it is determined by specific conditions (environmental, climatic, socio-economic, anthropogenic).

The **objective** of this work (part of the MODE-RESPYR project) is **to assess the spatial patterns of land cover changes** during the last 70 years in three study sites of the Pyrenees, and **to compare the local dynamics** in order **to observe and to explain similarities and disparities.**

Study sites



1. Davantaygue (76 km²)
— In the Peripheral area of the Pyrenees National Park
— **6 municipalities**

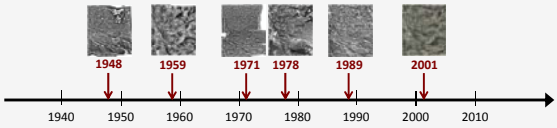
2. Haut-Vicdessos (244 km²)
— In the Regional Natural Park of Ariège
— **7 municipalities**

3. Garrotxes (85 km²)
— In the Regional Natural Park of the Catalan Pyrenees
— **5 municipalities**

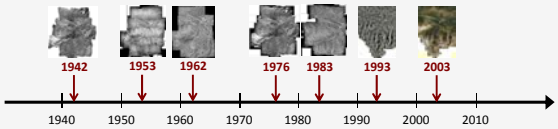
Material and Method

Data

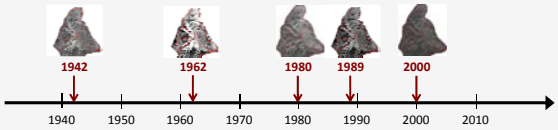
Historical panchromatic aerial photographs with recent true color digital images



1. Davantaygue
- Number of photographs: 67
- 6 dates: from 1948 to 2001
- Scale: 1:15000-1:30000
- Spatial resolution: 0.5m
- TIFF (8 or 24 bits)



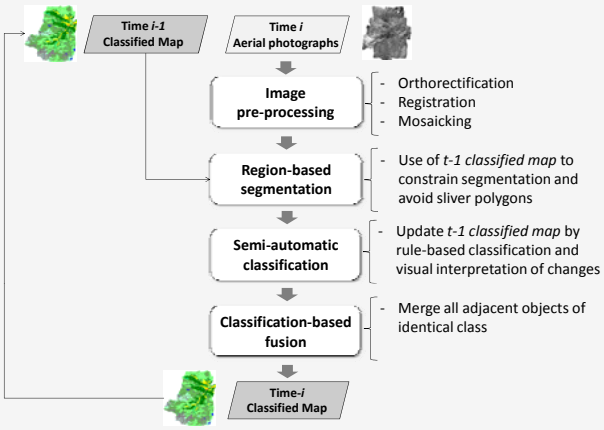
2. Haut-Vicdessos
- Number of photographs: 286
- 7 dates: from 1942 to 2003
- Scale: 1:25000-1:30000
- Spatial resolution: 0.5m
- TIFF (8 or 24 bits)



3. Garrotxes
- Number of photographs: 104
- 5 dates: from 1942 to 2000
- Scale: 1:25000-1:30000
- Spatial resolution: 0.5m
- TIFF (8 or 24 bits)

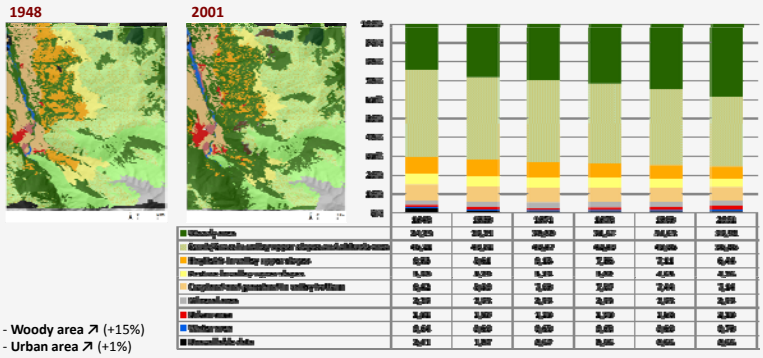
Methodological approach

Dependently-generated land cover maps from a GEOgraphic Object-Based Image Analysis



Results

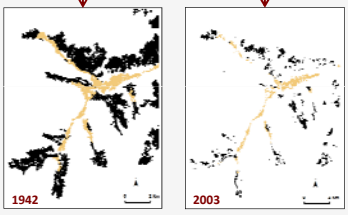
1. Davantaygue



- Woody area ↗ (+15%)
- Urban area ↗ (+1%)
- Scrub/Grass in valley upper slopes ↘ (-9.5%)
- Pasture and hayfields in valley upper slopes ↘ (-4%)
- Cropland and grassland in valley bottom ↘ (-1.5%)

2. Haut-Vicdessos

2003 \ 1942	Crop	Pasture / Hayfield	Scrub/ Grass	Urban	Forest	Water	Mineral	Total
Crop	157.9	1.1	0.0	0.4	1.5	0.0	0.2	161.1
Pasture/hayfield	2.3	268.4	0.7	1.3	1.3	0.0	0.1	274.1
Scrub/Grass	0.1	7.9	11807.1	0.0	14.9	1.8	47.6	11879.4
Urban	27.9	12.9	27.0	74.3	4.9	0.1	0.4	147.5
Forest	390.0	1494.9	1772.8	15.7	4436.9	0.9	244.2	8355.4
Water	0.0	0.0	61.0	0.0	0.1	285.7	3.5	350.3
Mineral	0.1	1.4	50.2	0.0	3.1	0.3	2875.6	2930.7
Total (in ha)	578.3	1786.6	13718.8	91.7	4462.7	288.8	3171.6	24098.5

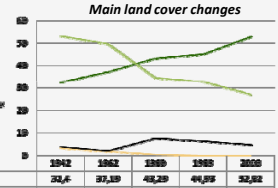


Woody area ↗ (+16%)
Urban area ↗ (+0.25%)
Scrub/Grass in valley upper slopes ↘ (-7.6%)
Pasture and hayfields in valley upper slopes ↘ (-6.3%)
Cropland and grassland in valley bottom ↘ (-1.7%)

3. Garrotxes

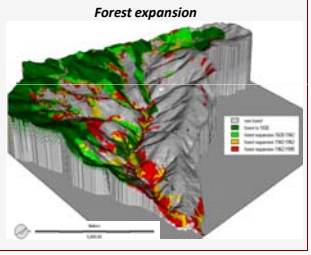
Woody area ↗ (+20.5%)
Urban area ↔ (0.2%)
Scrub/Grass ↘ (-26%)
Pasture and hayfields ↗ (+1%)
Cropland (valley bottom (-3.3%)

Main land cover changes



	1942	1962	1989	1998	2010
Woody area	32,4	37,19	43,29	44,95	52,62
Cropland and grassland in valley bottom	3,32	1,76	0,38	0,13	0,01
Pasture and Hayfields in valley upper slopes	3,76	1,81	2,62	6,32	4,73
Scrub/Grass in valley upper slopes and altitude zone	18,68	49,61	84,42	32,62	27

Forest expansion



Conclusions

- A **similar spatial pattern** of land cover changes for the 3 study sites (encroachment at low and medium altitudes) but with **different rates and extents**, and occuring at different periods.
- A spatial pattern highly related to pattern of **farmland abandonment** and depopulation.
- A **generic method** usable for various mountain areas
- Perspectives: developping an automatic classification procedure using very high resolution remotely sensed images for monitoring annual land use and cover changes.

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