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Modelling past and future land cover changes. A multi-scale approach applied in the Pyrenees

T. Houet[1], D. Galop[1], F. Mazier[1], D. Sheeren[2], J.-F. Dejoux[3]

[1] GEODE UMR 5602
University of Toulouse,
5, al. Antonio Machado,
31058 Toulouse, France
thomas.houet@univ-tlse2.fr
didier.galop@univ-tlse2.fr
florence.mazier@univ-tlse2.fr

[2] INP-ENSAT Dynafor UMR 1201
University of Toulouse
BP 32607
31326 Castanet-Tolosan
david.sheeren@ensat.fr

[3] CESBIO UMR 5126
University of Toulouse
18 av. Edouard Belin,
31401 Toulouse cedex
jean-francois.dejoux@cesbio.cnes.fr

Abstract

MODE RESPYR project founded by the French Research Agency (ANR) is presented. Combining multi-temporal data as well as combining multi-scaled data is original to provide knowledge on past landscape changes in the Pyrenees. Multi-temporal data regroups palaeo-environmental data and land cover maps made from historical aerial photographs (from 1940's to 2000's). Multi-scale data are based on regional satellite images (from the 1990's) and aerial photographs on three local study sites. First results obtained provide a fine quantitative and spatial characterization of landscape's dynamics, i.e. the relations between land uses and land covers changes which are essential for modelling future changes based on combined scenarios and models. Finally this poster illustrates the interest of a multidisciplinary approach to improve the modelling of past and future land cover changes.
Keywords: Trends, Landscape, Remote sensing, modelling, mountains

1 Introduction

The MODE-RESPYR project (Modelling Past and future land cover changes in the Pyrenees - http://w3.mode-respyr.univ-tlse2.fr/index.php) aims to identify ancient and contemporary past land cover changes and project future possible changes at various spatial and temporal scales applied on the Pyrenees. Indeed, land cover changes have significant impacts on local and regional climate and on others environmental issues. Understanding the processes involved is essential for reducing uncertainties related to current changes and better anticipating future changes. Under climate change assumptions, Pyrenees Mountains are an attractive experimental site and show high environmental stakes: they facilitate the analysis of "society-environment" interactions; they face the disappearance of glaciers and snow cover reduction, show sensible landscape changes, etc.

The aims of this project are: (1) to provide knowledge on past and futures land cover changes in the Pyrenees; (2) to improve some methodological questions: What is the role of spatial approaches in prospective research? What spatial and temporal resolutions are required for short / long term projections?

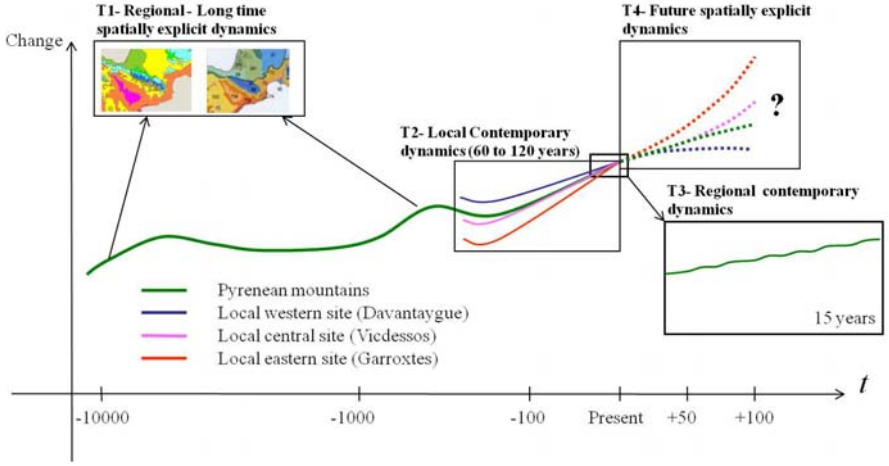
2 Methodology

The methodology is based on two modelling stages: retrospective and prospective phases (Fig 1.). The first step combines various spatial and temporal methods to identify land cover changes and their explanatory factors. The second, based on previous results, aims at building spatially explicit local / regional scenarios.

2.1 Retrospective modelling

Land cover changes are identified at three spatial and temporal scales: (1) at the regional scale over the last seven thousand years using palaeo-environmental data; (2) at the local scale, on three study sites, over the last 60-120 years using aerial photographs and historical maps; (3) at the regional scale over the last 15 years using high resolution satellite imageries. The use of models is necessary when using palaeo data to reconstruct land cover changes [1].

Figure 1: The methodological approach for modelling past and future land cover changes.



2.2 Prospective modelling

Futures scenarios will be defined based on scientific and/or land use planning issues. At regional scale, long term scenarios (duration to be defined) would assess the impact of climate change and humans land uses on land cover changes using land cover trends identified within tasks 1 and 3 of the retrospective approach. At the local scale, some scenarios would be defined accordingly with stakeholders, integrating local and regional trends identified in tasks 2 and 3.

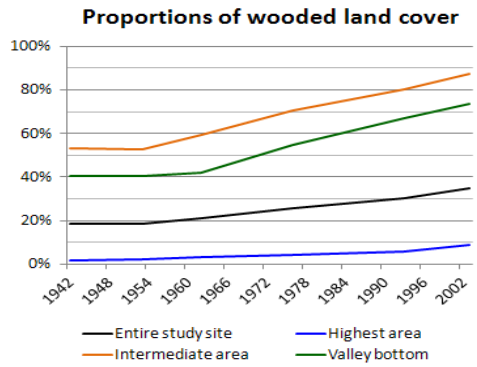
Land cover changes and projections would be made combining scenarios and land use and cover changes models [2, 3, 4, 5].

3 Results

3.1 Local land cover trends: rythm, rate and location of current changes

First results obtain on one of the three study sites illustrate different land cover dynamics considering various areas of the valley (valley bottom, intermediate and highest areas). First, the natural reforestation processes shows a temporal shift between these three areas (Fig. 2). Second, current rate of changes observed on highest areas are similar to the highest rates observed in the intermediate areas in the 70s and 80s [6].

Figure 2: Rates of wooded land cover changes in the Vicdessos valley from the 1940s.



3.2 Improving knowledge of contemporary land cover changes using multisource data

This multidisciplinary project helps to better understand land cover changes at a local scale using multisource data. Combining palaeo-environmental and aerial photographs is helpful to link human activities and land cover changes, i.e. to highlight how land uses influence landscape changes [7]. In mountain areas, high grazing pressure is essential to maintain open landscapes and floristic diversity. Inversely, pastoral abandonment leads to natural forest regeneration of deciduous forest and more recently of pine encroachment (Fig. 4).

Figure 3: Maps of land cover changes in the Vicdessos valley from the 1940s.

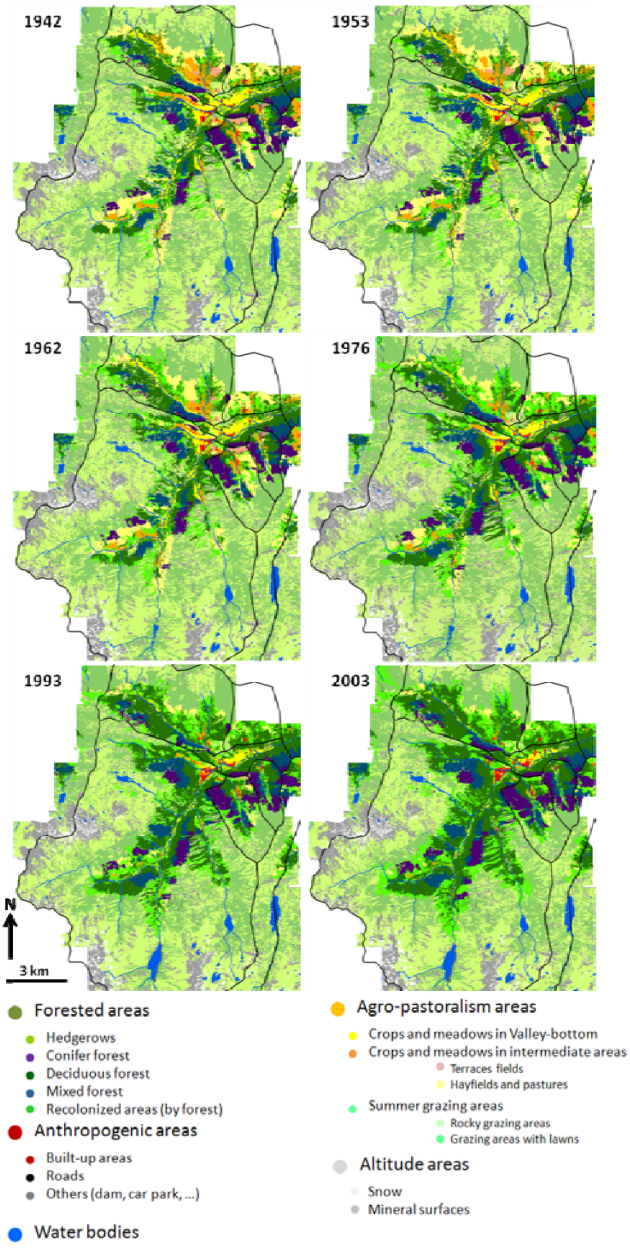


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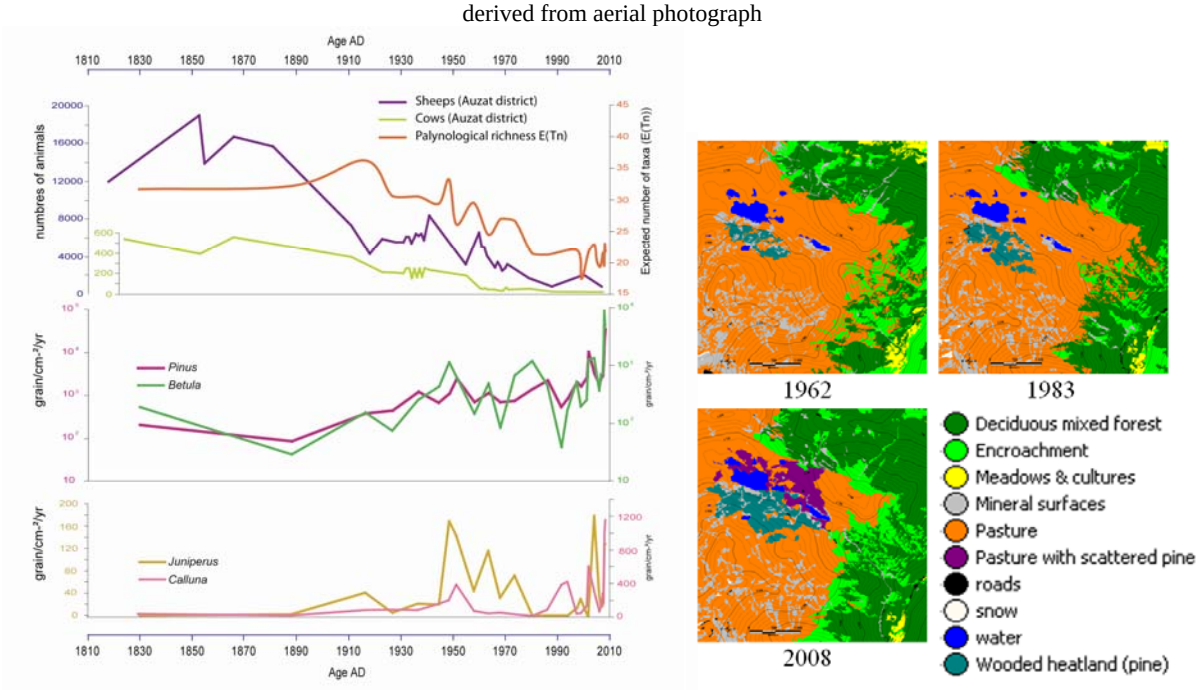
Figure 4: Linking grazing activities and land cover changes combining palaeo-environmental data and land cover maps derived from aerial photograph



4 Conclusion and perspectives

MODE RESPYR project (http://w3.mode-respyr.univ-tlse2.fr/index.php) aims at modelling past and futures land cover changes in the Pyrenees at various spatial and temporal scales. First results provide essential knowledge prior building scenarios of the future. Some work remains to combine local and regional land cover trends, but this paper illustrates as well the interest and importance of such multidisciplinary approach.

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