Vul'Clim – Climate change vulnerability studies in the region Auvergne (France)

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Abstract - The region Auvergne of France is a major livestock territory in Europe (beef and dairy cattle with permanent grasslands), with a place in climate change regional studies assisting policy makers and actors in identifying adaptation and mitigation measures. Vul'Clim is a research grant (*Bourse Recherche Filière*) of the region Auvergne and supported by the European Regional Development Fund (February 2014-September 2015), to develop model-based vulnerability analysis approaches for a detailed assessment of climate change impacts at regional scale. Its main goal is the creation of a computer-aided platform for vulnerability assessment of grasslands, in interaction with stakeholders from a cluster of eco-enterprises. A modelling engine provided by the mechanistic, biogeochemical model PaSim (Pasture Simulation model) is the core of the platform. An action studies the changes of scales by varying the granularity of the data available at a given scale (e.g. climate data supplied by global scenarios) to let them being exploited at another scale (e.g. high-resolution pixels). Another action is to develop an assessment framework linking modelling tools to entry data and outputs, including a variety of components: data-entry manager at different spatial resolutions; automatic computation of indicators; gap-filling and data quality check; simulation kernel with the model(s) used; device to represent results as maps and integrated indicators.

Index Terms - Climate change, grasslands, region Auvergne (France), vulnerability

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1 Introduction

Climate evolution projections are constructed with climate models on global emission pathways, in turn based on socio-economic scenarios that describe a variety of future worlds with particular social, demographic and economic, technological and environmental characteristics. Climate scenarios involve uncertainties, mostly related to the inability to simulate phenomena on scales of kilometers or fine time resolutions. To construct scenarios with high spatial resolution (down to a few kilometers), one must use dynamical or statistical methods for downscaling the global scenarios. Based on the most recent concepts about socio-economic and climate scenarios, the BRF Vul'Clim develops a framework for scenario regionalisation and vulnerability assessment on grassland ecosystems in the region Auvergne of France. It provides support to socio-economic actors for elaboration and implementation of regional strategies to reduce vulnerabilities to climate change.

2 Study region

The Auvergne region of France (Fig. 1) is centred around 45° 20' North and 03° 00' East, and extends over a surface area of 26013 km² (equivalent to 4.8% of metropolitan France's total surface area). The

average annual temperature is 12 °C, and the region receives 510-1020 mm of rainfall annually. Agriculture employs about 8.5% of the regional labour force, which is twice the national average. Cows are much in evidence in the mountainous areas of the region, used both for meat and milk.

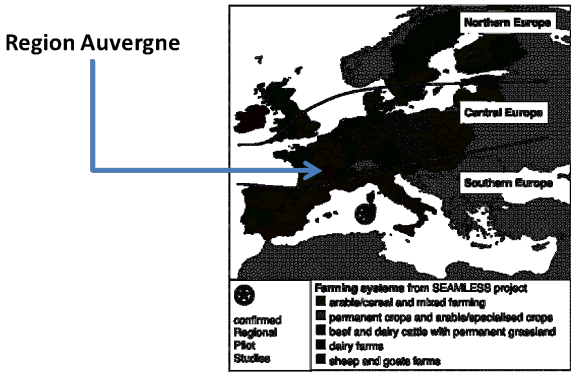

Fig. 1. Region Auvergne (France) and main category types of agricultural production regions in Europe, including MACSUR regional pilot studies (http://www.macsur.eu).

3 Vulnerability assessment concepts

The vulnerability of a system is determined by the potential impact (exposure plus sensitivity) and the coping (adaptive) capacity, which is the impact that may occur given projected changes and the degree to which adjustments in practices, processes or structures can moderate or offset the potential damages. Adaptation strategies aim at reducing the vulnerability of a system by reducing its exposure and/or its sensitivity to climate factors, as well as by improving the adaptive capacity through different types of levers depending on technological level and infrastructural supplies (ability), as well as information capabilities and equity dimension (awareness), and also due to economic wealth and human, institutional organization and social capital (action).

4 Framewok for vulnerability assessment of grasslands

To make concepts in vulnerability operational, a framework is developed (Fig. 2) to incorporate exposure, sensitivity and, partly, coping capacity via adaptation measures. The framework links outcomes from climate and impact models, represented as indicators of exposure and sensitivity, towards overall indicators of vulnerability. The advantages of the framework are the transparency of the indicators envelope and the linkage with simulation models. The Pasture Simulation model (PaSim, https://www1.clermont.inra.fr/urep/modeles/pasim.htm), a biophysical model of carbon and nitrogen fluxes of grassland ecosystems, provides the state-of-the-art knowledge of grasslands. The mechanistic

view of the model allows it estimating production and environmental performances of a variety of grasslands. Its ouputs, obtained under current and projected climate forcing scenarios, are exploited to calculate vulnerability indices (Lardy, 2013) at a variety of scales, thus facilitating the identification of vulnerable areas.

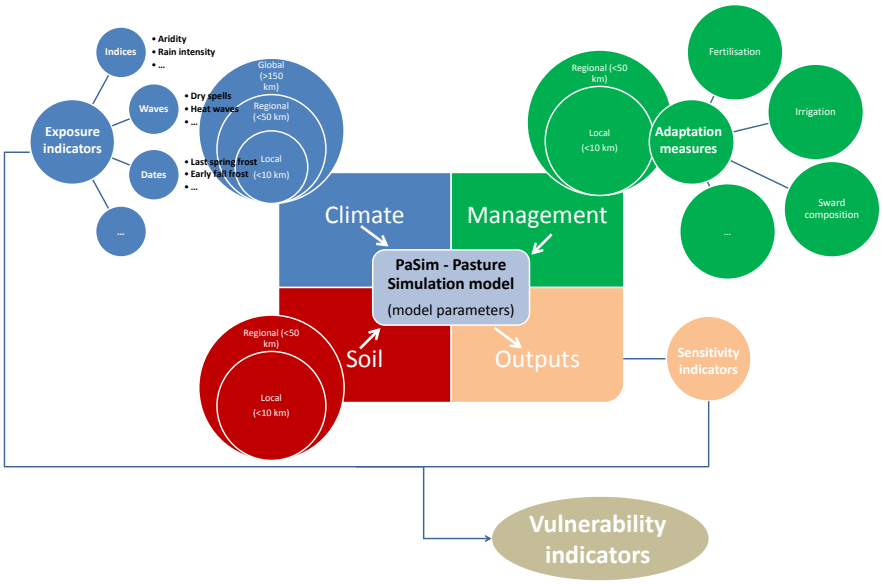

Fig. 2. Operational scheme of grassland vulnerability assessment at a variety of scales.

The methodology is applied on pixel-wise predictions (<10-km grid cells) of impact variables (gross and net primary productions, harvested biomass, etc.) in Auvergne. The association of local stakeholders (cluster of eco-entreprises, http://www.e2ia.fr/presentation-du-cluster) in the evaluation of grassland vulnerabilty allows putting it into the specific context of territory and its economic characteristics and living conditions, as well the social structure and institutional organization. The challenge is to incorporate aspirations and expectations of a spectrum of actors, and ensure continuity between model-based representation and experiential knowledge. Thanks to social dialogue, projected evolution of climate exposure is put in relation with impacts of interest for farmers and decision-makers. Using integrated indicators favours interpreting the reasons behind certain evolutions represtend by models. This kind of interpretation serves, on one hand, to legitimate the use of models in vulnerability assessment studies, and on the other hand to take decisions in terms of changing practices to reduce vulnerabilities.

5 References

Lardy, R., 2013. Calcul intensif pour l'évaluation approche d'Ingénierie Dirigée par les Modèles. Application à la vulnérabilité des prairies au changement climatique sous contraintes de plans d'expériences. PhD Thesis, Blaise Pascal University, Clermont-Ferrand, France.