C.I.R.E.D.
CENTRE INTERNATIONAL DE RECHERCHE SUR L'ENVIRONNEMENT ET LE DÉVELOPPEMENT

Chaire Modélisation prospective au service du développement durable

A New Land Use Modelling Architecture: The Nexus Land Use

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Introduction

-Land Use is a crucial issue of climatic decisions in the framework of the REDD+ agreement

- New evaluations, based on integrated large-scale models, are needed to feed decisions-makers

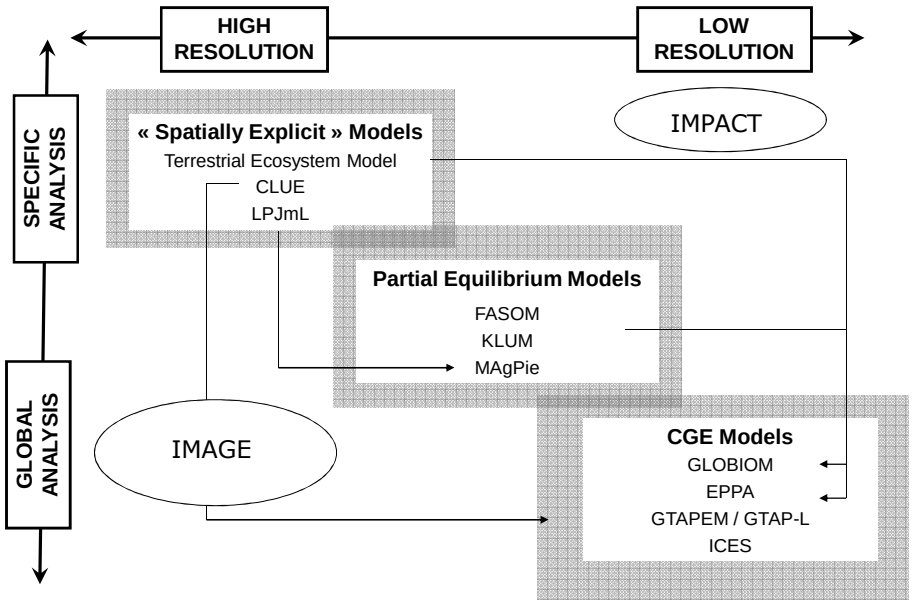
- I'll present here the methodology adopted to develop the Nexus Land Use

And…

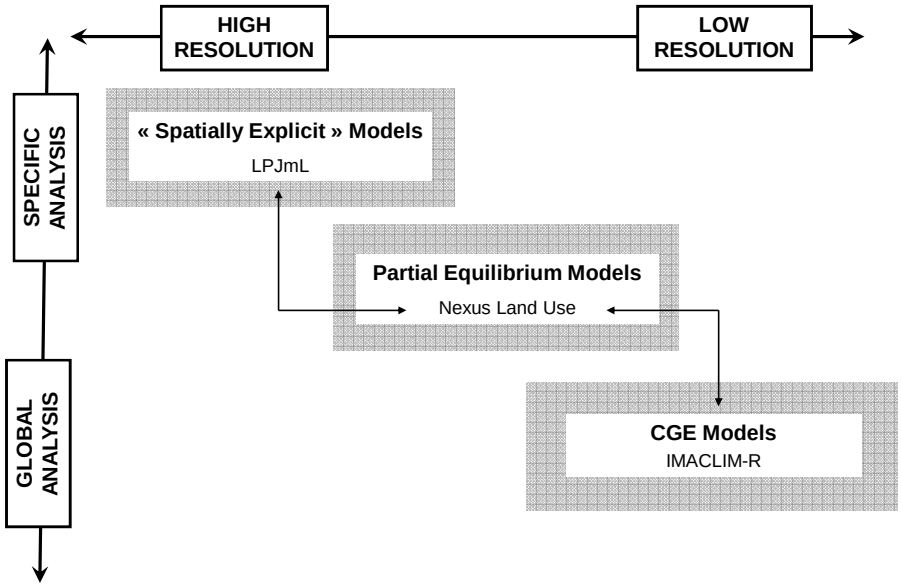
- An application to test the integration of food / energy and forest preservation objectives

I. Objectives and specificities of our model

Insights on land use modelling literature



Our Approach



Model specificities

- Feed back from the rest of the economy on the agricultural sector provided by the CGE framework ;

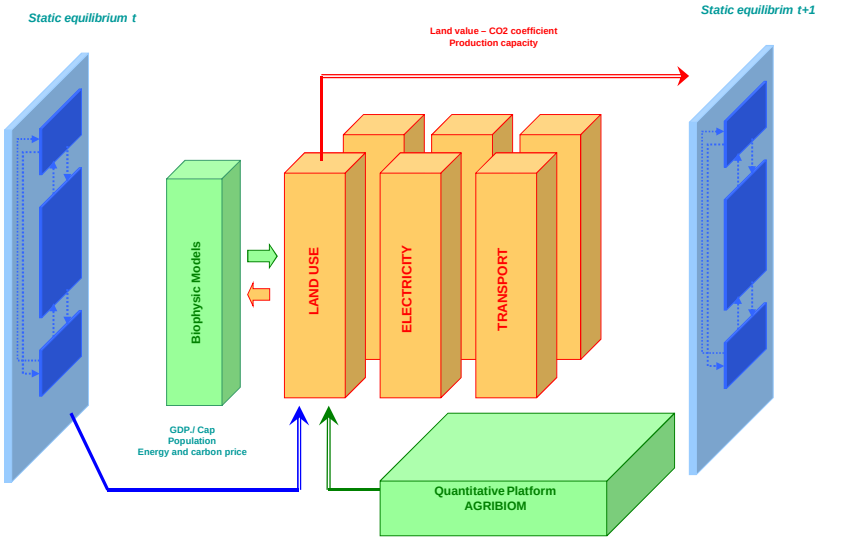
- Consistency between economic and physical realities ;

- Endogenous computation of yields ;

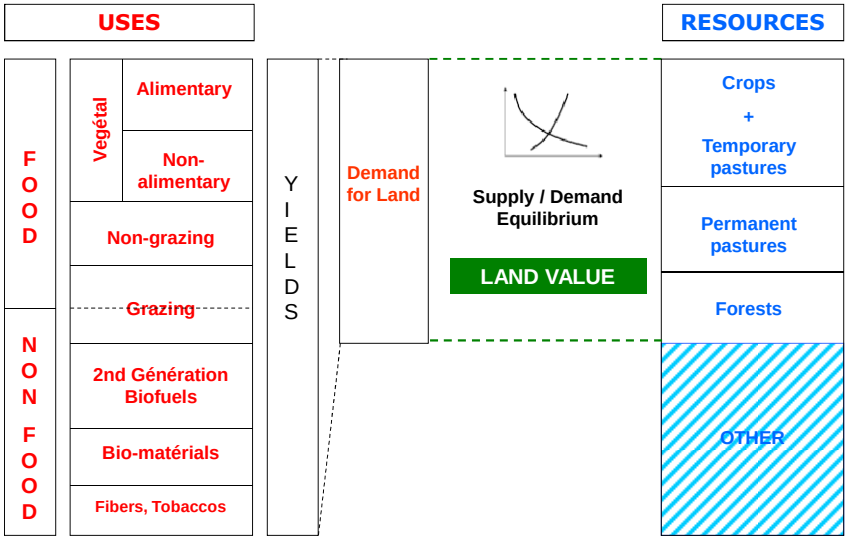
- Estimation of the evolution of land use modifications, as well as energetic consumptions of agricultural sector.

II. Methodology and Hypothesis

The Modelling Architecture



The Nexus Land Use Modelling Principle



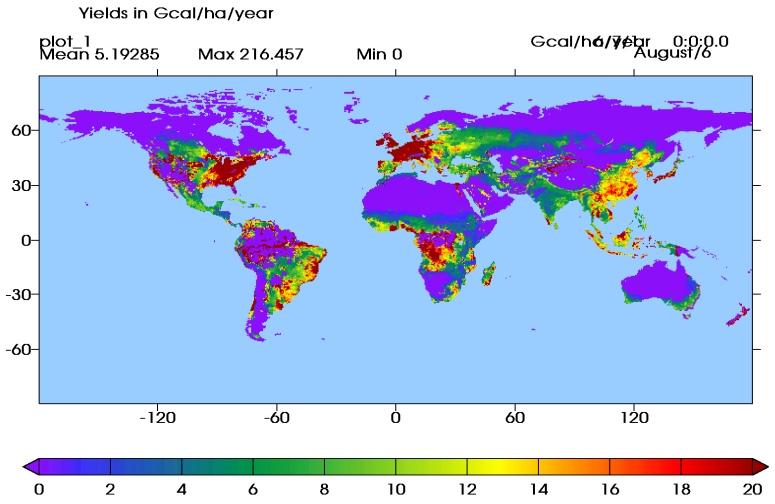
Hypothesis

1. Conventional agriculture ;
2. One representative crop which is an agregate of most crops (but not all !) ;

crop	in LPJmL	not in LPJmL
sugarbeet and sugar cane	sugarbeet	sugar cane
wheat	x	
oil seeds	x	
rice	x	
cereal grain nec	x	
vegetable		x
fruits		x
nuts		x
plant based fibers		x
crop nec		x

3. Arable land divided into classes based on their potential food yield for each of the 12 regions of the model ;

Potential Food Yield Map



Source : LPJmL

Hypothesis

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3. Arable land divided into classes based on their potential food yield for each of the 12 regions of the model ;
4. For each land classes, actual yields are computed according to :

- Potential yield level ;
- Profit maximisation :

$$\Pi_j(\rho) = p\rho - (p_\chi + wL_{CI} + p_E E_{CI})CI_j(\rho) - CF - \lambda$$

Production Value — Energy : fertiliser, machines… — Capital Labor — Land Rent

5. Optimal level of capital and labor production factors

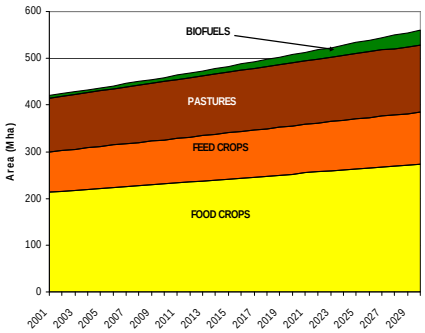
III. Results

A test for integrating food, energy and forest preservation objectives between 2001 – 2030 in the USA

Results : Scenarios 2001 – 2030 for the USA

STEP 1 :

- No modifcation of dietary habits until 2030 : 4286 kcal/day/pers ;
- Population growth : 0.6% / year ;
- Energy prices increases of 3.1% per year ;
- Biofuel production corresponding to the national objectives : 50 Mtep
- Deforestation at the historical level of appromaxitively 1% per year between 2001 and 2030 ;

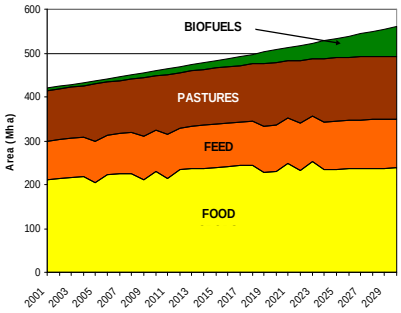


	Scenario 1
Cropland pastures surfaces	+ 33,45%
Pastures surfaces	+ 25,17%
Energetic Consumption	+ 31,43%
Food Price	+ 0.44%

Results : Scenarios 2001 – 2030 for the USA

STEP 2 :

- No modifcation of dietary habits until 2030 : 4286 kcal/day/pers ;
- Ambitious development of biofuel production: **100 Mtep in 2030 (TAR VI IIASA)**
- Deforestation at the historical level of appromaxitively 1% per year between 2001 and 2030 ;

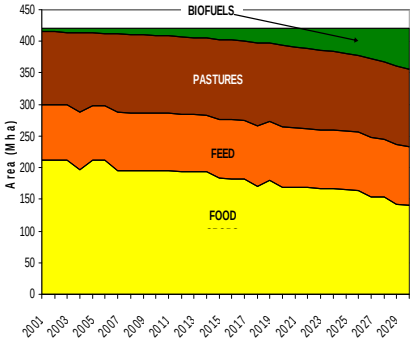


	Scenario 1	Scenario 2
Cropland + pastures surfaces	+ 33,45%	+ 33,45%
Pastures surfaces	+ 25,17%	+ 23,83%
Energetic Consumption	+ 31,43%	+ 55,52%
Food Price	+ 0.44%	+ 0.92%

Results : Scenarios 2001 – 2030 for the USA

Step 3 :

- No modifcation of dietary habits : 4286 kcal/day/pers.
- Ambitious development of biofuel production: 100 Mtep in 2030 (TAR VI IIASA)
- **No deforestation allowed**



	Scenario 1	Scenario 2	Scenario 3
Cropland + pastures surfaces	+ 33,45%	+ 33,45%	0%
Pastures surfaces	+ 25,17%	+ 23,83%	+ 6,17%
Energetic Consumption	+ 31,43%	+ 55,52%	+ 100.31%
Food Price	+ 0.44%	+ 0.92%	+ 12,95%

Solutions to bridge the conflict between multiple objectives

- **The « Searchinger Solution »: Stop biofuels production**
- **Reduce loss (or eat less)**

	Scenario 1	Scenario 2	Scenario 3	No biofuel	Less Food
Cropland + pastures surfaces	+ 33.45%	+ 33.45%	0%	0%	0%
Pastures surfaces	+ 25.17%	+ 23.83%	+ 6.17%	+ 6.18%	+ 24.1%
Energetic Consumption	+ 31.43%	+ 55.52%	+ 100.31%	+ 31.32%	+ 50.4%
Food Price	+ 0.44%	+ 0.92%	+ 12,95%	+ 6.08%	+ 0.6%

- **Break the relation between yield and energy : the ecologically intensive agriculture**
- **Find an optimal level of arable land expansion**
- **Promote trade to grow crops at the best suitable places**

Thanks for your attention