Dynamic Modeling for Changes Simulations in the Forest Cover in Rio Grande do Sul State, Brazil

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Contents

Introduction

- Southern half of the of Rio Grande do Sul State is a region essentially agrarian with economy is consolidated in cattle raising and rice growing.

- In the year 2003, was released by the government of the Rio Grande do Sul State a Forestry Program.

- Implementation of 40.000 hectares of forests, which can generate up 2014, a gross revenues of U$ 100 million dolars to growers.

Introduction

- The expansion of forestry involves the environmental situation of a large area of the state territory, the Pampa Biome.
- In this approach, one of the issues lies in how to evaluate the dynamics of this landscape ?
- And yet, how to monitor the transition process between the original biome field and forest cover?
- In this case, the purpose of the dynamic modeling was to simulate changes in spatial and temporal attributes of the environment in a geographic territory.

Objective

- Application of a tool for modeling the vegetation dynamics, with a view to the forest cover in two micro regions of the southern half of Rio Grande do Sul State, in the period from 2000 to 2008, based on this model, making the projection of future scenarios to 2016.

Hypothesis

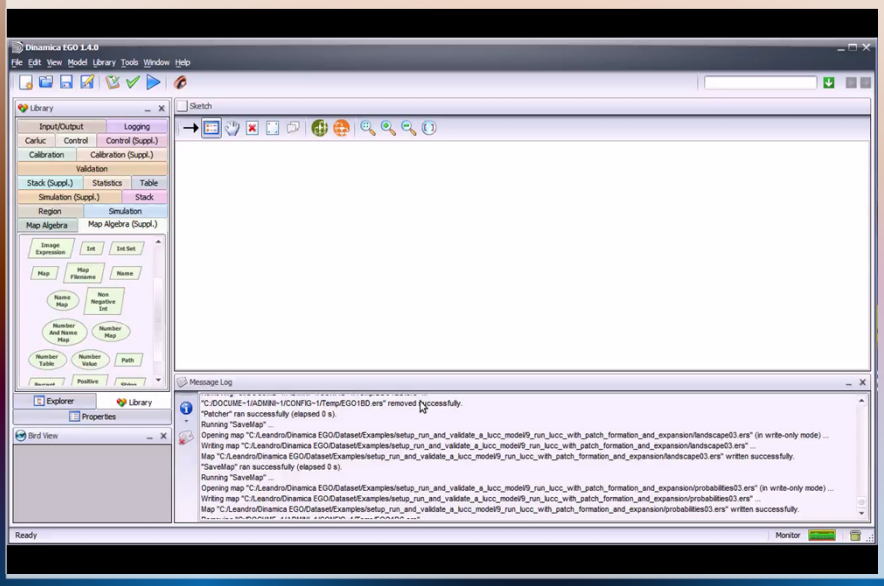
- Is it feasible to use images from low spatial resolution (250 meters) for the extraction of thematic information about the landscape, thus allowing the monitoring of their spatiotemporal dynamics ?
- Is it possible to establish a direct relationship between the themes of landscape and vegetation index provided by MOD13Q1 product ?
- Is it possible that you can feed a stochastic simulation model with the maps "vegetation index", for then obtain scenarios that describes the change process and rates transition observed in the vegetation during the period?

Background

- MODIS data satellite
  - Rudorff et al. (2007)
  - Matsumoto and Bittencourt (2001)
  - Huete et al. (2002)
- Spatial Dynamic Modeling
  - Soares-Filho (1998, 2002)
  - Gremonini and Vicentini (2008)
  - Haykin (2000)
  - Baca et al. (2007)

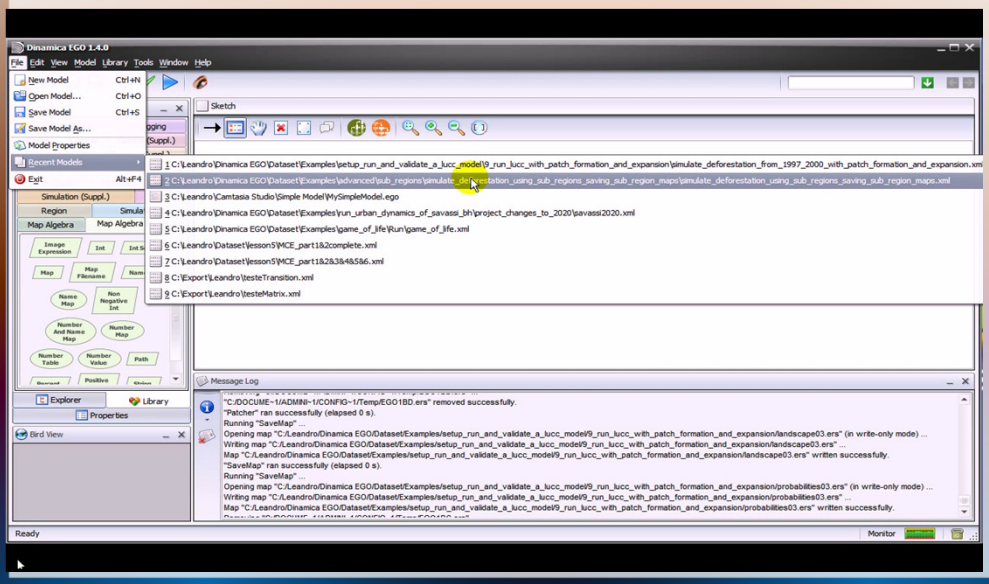
Dinamica Software to modeling

Graphic interface with areas of the work



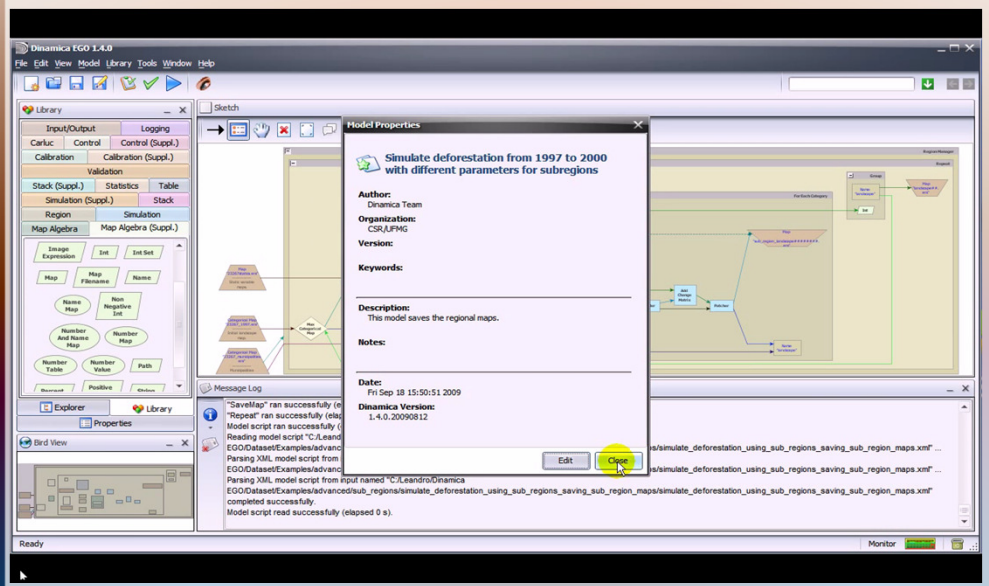
Dinamica Software to modeling

Loading model



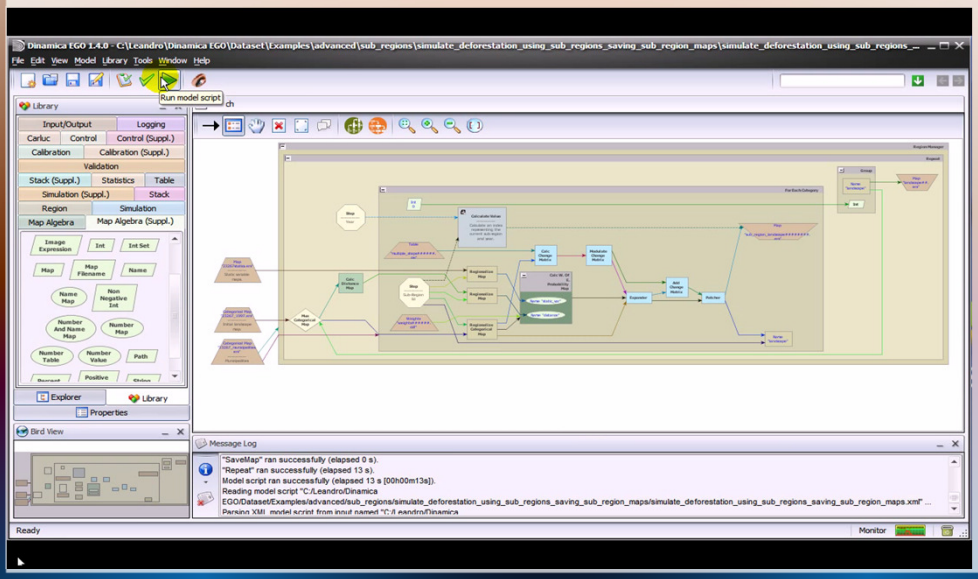
Dinamica Software to modeling

Loaded model



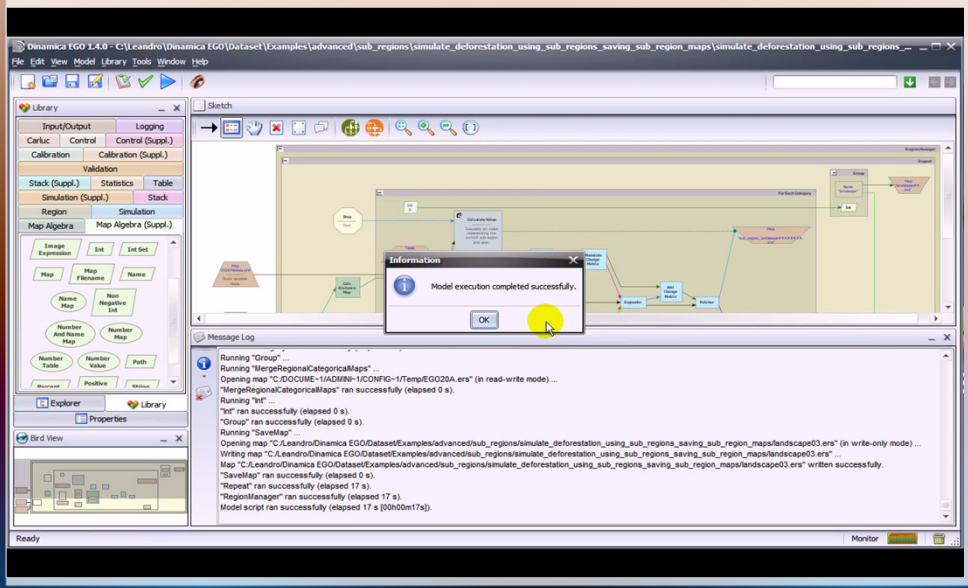
Dinamica Software to modeling

Model visualization and run script



Dinamica Software to modeling

Model execution completed



Results and Discussion

- Table 1 – Results of classification – Southeast Campaing

Land Use Class NDVI	Year 2000 Area (ha)	Difference Area(ha)	Year 2004 Area(ha)	Difference Area(ha)	Year 2008 Area(ha)	Difference Area(ha)
Soil without vegetation	276,643.75	-450.00	256,781.25	675.00	249,631.25	600.00
Field	**1,180,112.5**	-925.00	**1,083,706.30**	500.00	**991,193.75**	-825.00
Regeneration	**53,193.75**	725.00	**120,625.00**	-325.00	**174,593.75**	-550.00
Forest	142,331.25	650.00	191,168.75	-850.00	236,862.50	775.00
Total	1,652,281.25		1,652,281.25		1,652,281.25	

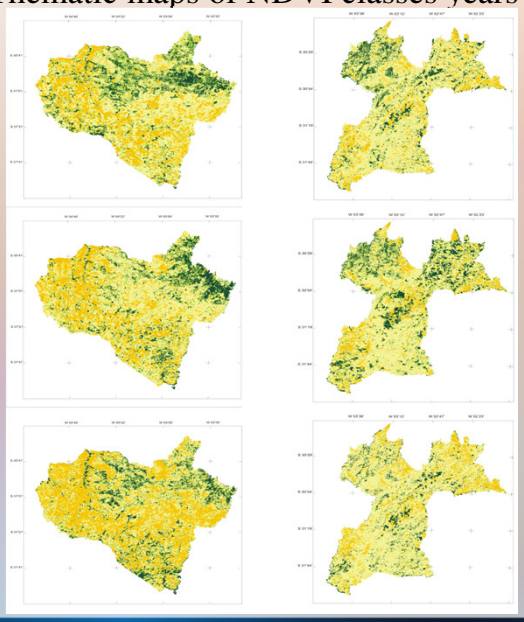
Results and Discussion

- Table 2 – Results of classification – Region of Southern Campaing

Land Use Class NDVI	Year 2000 Area (ha)	Difference Area(ha)	Year 2004 Area(ha)	Difference Area(ha)	Year 2008 Area(ha)	Difference Area(ha)
Soil without vegetation	550,875.00	775.00	377,150.00	475.00	349,237.50	-550.00
Field	**586,075.00**	-825.00	**724,906.25**	-625.00	**708,250.00**	725.00
Regeneration	**130,618.75**	675.00	**164,150.00**	-650.00	**203,962,50**	475.00
Forest	158,537.50	725.00	159,900,00	800.00	164,656.25	-650.00
Total	1,426,106.25		1,426,106.25		1,426,106.25	

Results and Discussion

- Thematic maps of NDVI classes years 2000, 2004 and 2008



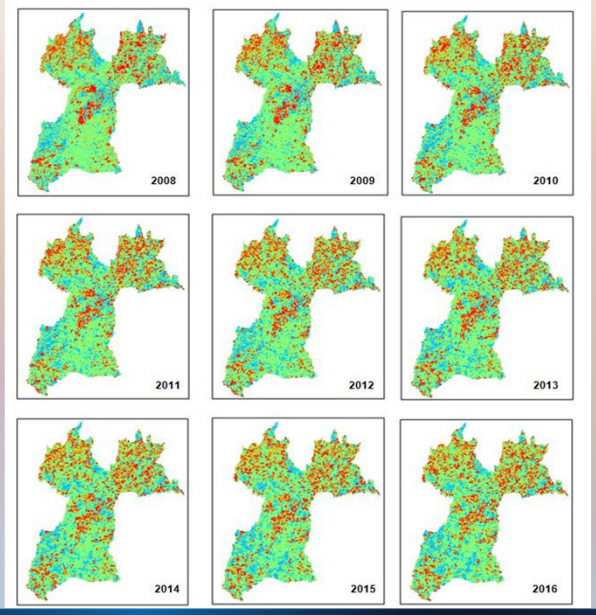
Results and Discussion

- Table 3 - Single step transition matrix to Southeast Campaing

Years 2000 - 2004				
From / To	Soil	Field	Regeneration	Forest
Soil	-	0.475	0.012	0.025
Field	0.099	-	0.175	0.069
Regeneration	0.026	0.481	-	0.311
Forest	0.028	0.243	0.131	-
Years 2004 - 2008				
From / To	Soil	Field	Regeneration	Forest
Soil	-	0.419	0.038	0.085
Field	0.112	-	0.085	0.095
Regeneration	0.032	0.539	-	0.193
Forest	0.031	0.275	0.231	-

Results and Discussion

- Maps of the Simulation Process, period 2008 to 2016, Southeast



2008 to 2010

2011 to 2013

2014 to 2016

Results and Discussion

- Table 4 - Conversion process between vegetation classes, Southeast Campaing, period 2008 to 2016

Class	Serras do Sudeste			
	Area (ha) 2012	Transition (ha) 2008-2012	Area(ha) 2016	Transition (ha) 2012-2016
Soil	245,018.75	-4,612.50	241,056.25	-3,962.50
Field	963,731.25	-27,462.50	953,956.25	-9,775.00
Regeneration	185,106.25	10,512.50	189,856.25	4,750.00
Forest	258,425.00	21,562.50	267,412.50	8,987.50
Total	1,652,281.25	-	1,652,281.25	-

Results and Discussion

- Table 5 - Conversion process between vegetation classes, Southern Campaing, period 2008 to 2016

Class	Camapanha Meridional			
	Area (ha) 2012	Transition (ha) 2008-2012	Area(ha) 2016	Transition (ha) 2012-2016
Soil	330,637.50	-18,600.00	322,025.00	-8,612.50
Field	708,950.00	700.00	709,587.50	637.50
Regeneration	212,950.00	8,987,50	216,487.50	3,537.50
Forest	173,568.75	8,912.50	178,006.30	4,437.50
Total	1,426,106.25	-	1,426,106.25	

Conclusions

- The thematic maps of vegetation, produced under the method NDVI, could be used as a bases for modeling spatial dynamics, since in them were properly allocated the transition processes (reduction and expansion) of the forest cover and the other classes adopted.
- The changes in forest cover, the maps produced indicated that the forest cover increased from 8.6% to 11.6% and 14.3% compared to the total area of the microregion Southeast Capaing, respectively in the years 2000, 2004 and 2008 .
- In the Southern Campaign, the rates of expansion of forest cover were quantified in 11.1%, 11.2% and 11.5% compared to the total area of micro in the years of 2000, 2004 and 2008.

Conclusions

- The methodology adopted to simulate possible scenarios predictions, explained the intensity and location of changes in forest cover by the year 2016, through outputs (maps) annually.
- The results expecteds indicate that the forest cover in the Southeast Campaing will from 15,6% in the year of 2012 to 16,8% of the total area of this micro region in the year of 2016.
- Southern Campaign in the micro region, the expansion is less pronounced, from 12.2% in 2012 to 12.5% in 2016.

Conclusions

- These values suggests, in the relation with the two micro-regions, the stability of the forest expansion.
- Is necessarie to consider that the model trends are good only if they are kept the same conditions regarding the variables investigated.
- In this sense, it is suggested, for further studies, the evaluation of not only physical variables but also socioeconomic and even policies inherent in the study region.

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Thank for your attention!