

Modelagem ambiental com Dinamica EGO



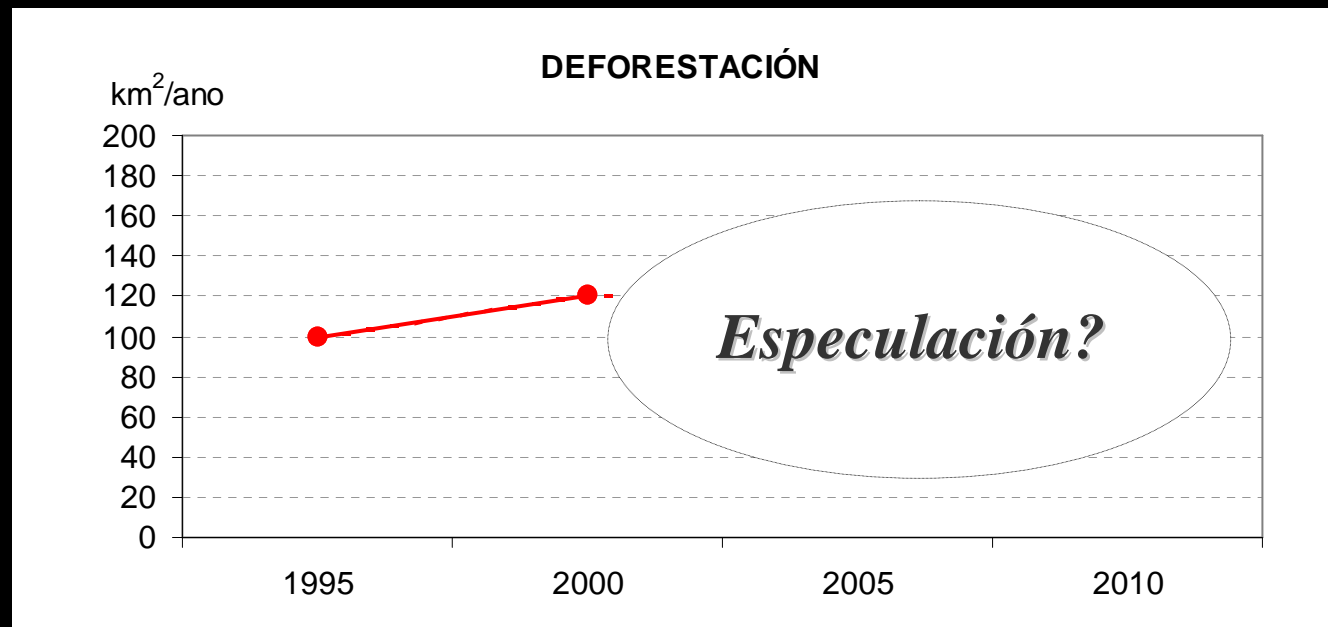
Britaldo Silveira Soares Filho



Para que servem modelos?



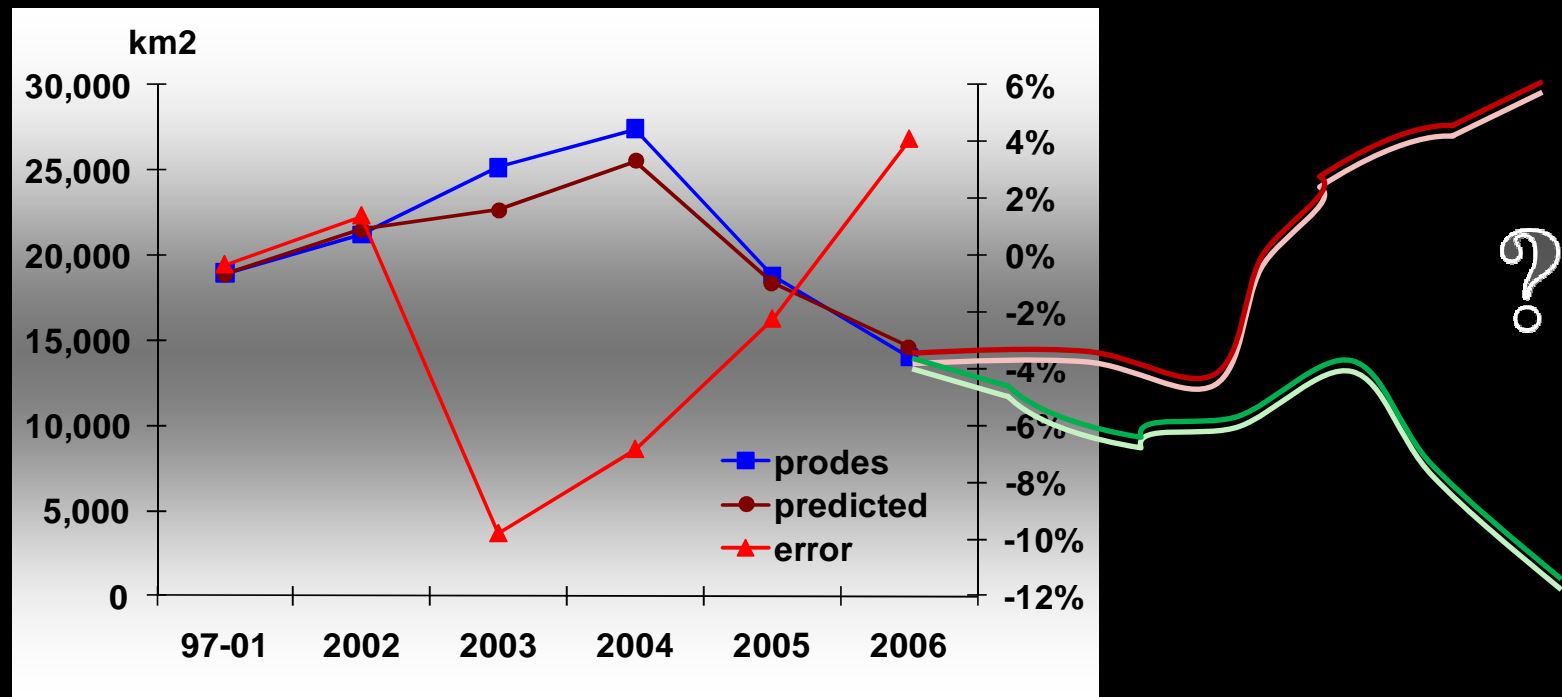
- n Se em 2006 predizíamos o fim da floresta Amazônica (Nature paper), em 2009 propusemos o fim do desmatamento (Science paper)



n

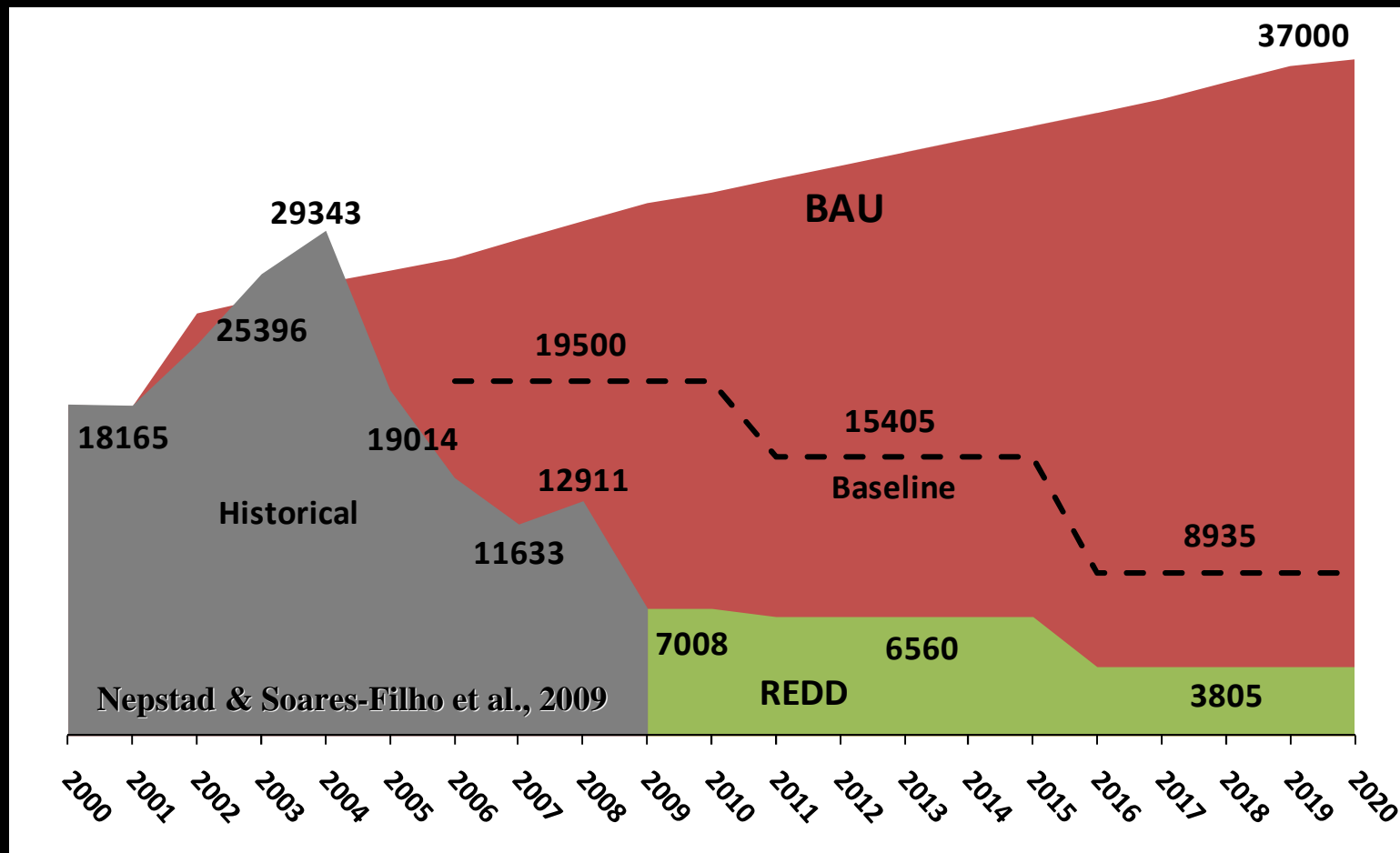
Estão os estudos equivocados?

Modelagem da trajetória do desmatamento



Soares-Filho et al. PNAS in press

O fim do desmatamento na Amazônia?



Expectativa do REDD!!!!

Dispositivo heurístico



Então para que servem os modelos de simulação

Dilema da modelagem

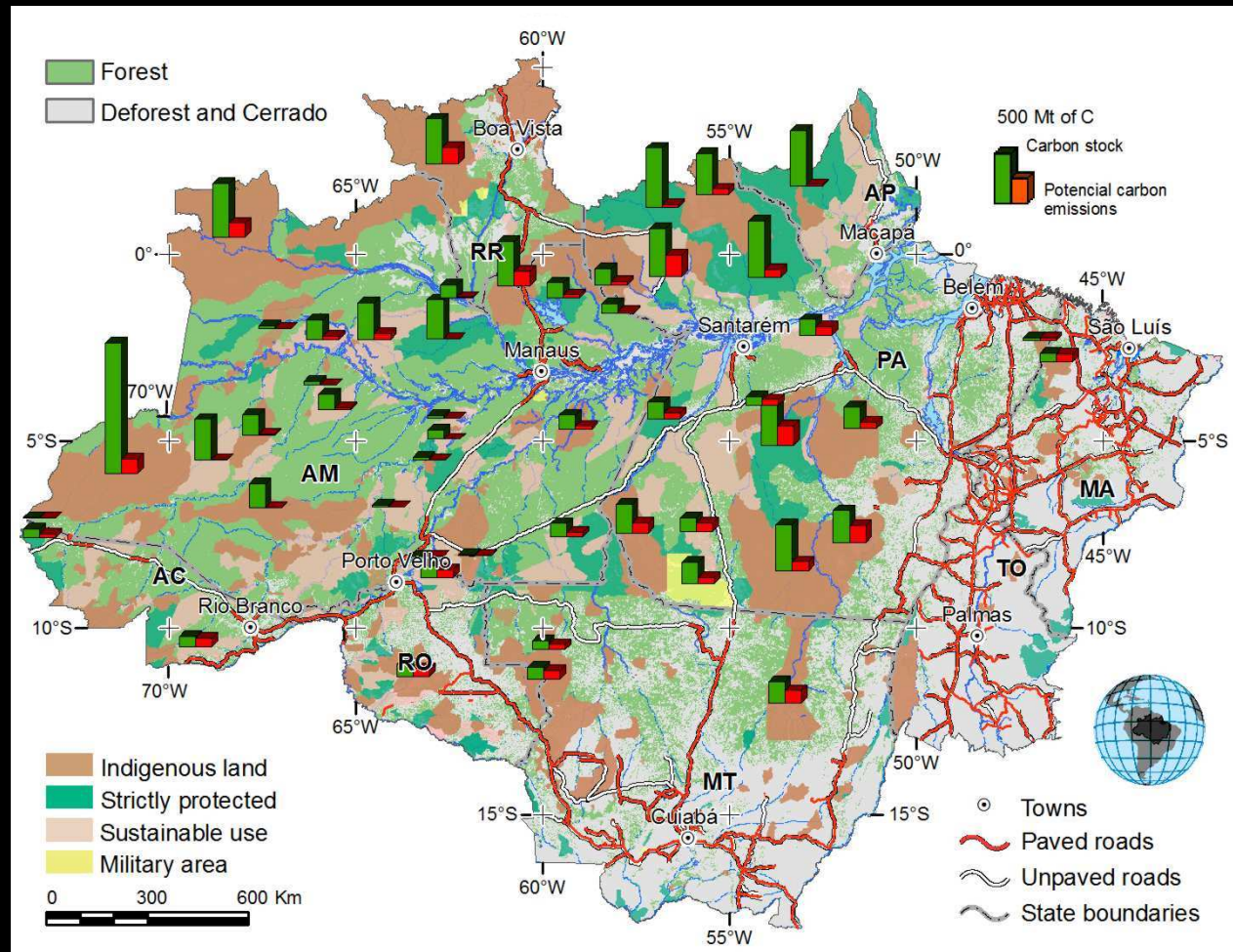


Solução Mágica (wizard)

Modelos hoje vendidos como solução
somente incorporam o efeito de
determinantes espaciais (causas proximais)

- n Modelos de simulação de dinâmica ambiental devem incorporar conhecimento local e serem construídos do chão.

Ferramenta de planejamento regional



Priorização de áreas protegidas

Soares-Filho et al. PNAS in press

Role of Brazilian Amazon protected areas in climate change mitigation

A scientific framework for basin wide conservation

urbanization



Socioeconomic and demographic dynamics

Science



Public policies

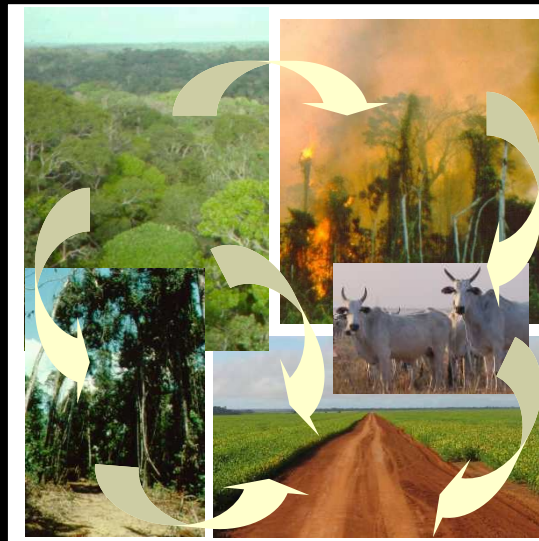
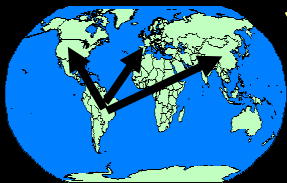


Land use and cover changes/logging forest disturbance (fire)



Atmosphere/Climate change

Local and global markets

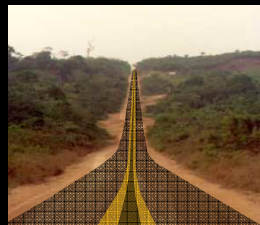


Aquatic resources
Watershed health



Terrestrial biodiversity

Infrastructure expansion and improvement



Ecosystem health

Analyze **interactions and feedbacks** between the various Amazon systems

SimAmazonia-2

Scenario Generating Models

Road Expansion and Improvement

Demographic Dynamics

Regional Economy and Policies



Land Cover Change Model

Logging Rent Model

Logged Forest

Fire Risk and Spreading Model

Burned Forest

Forest

Deforested

Mechanized Agriculture

Abandoned

Subsistence Agriculture

Pasture

CARLUC (Carbon Balance) Model

Secondary Forest

Regrowth



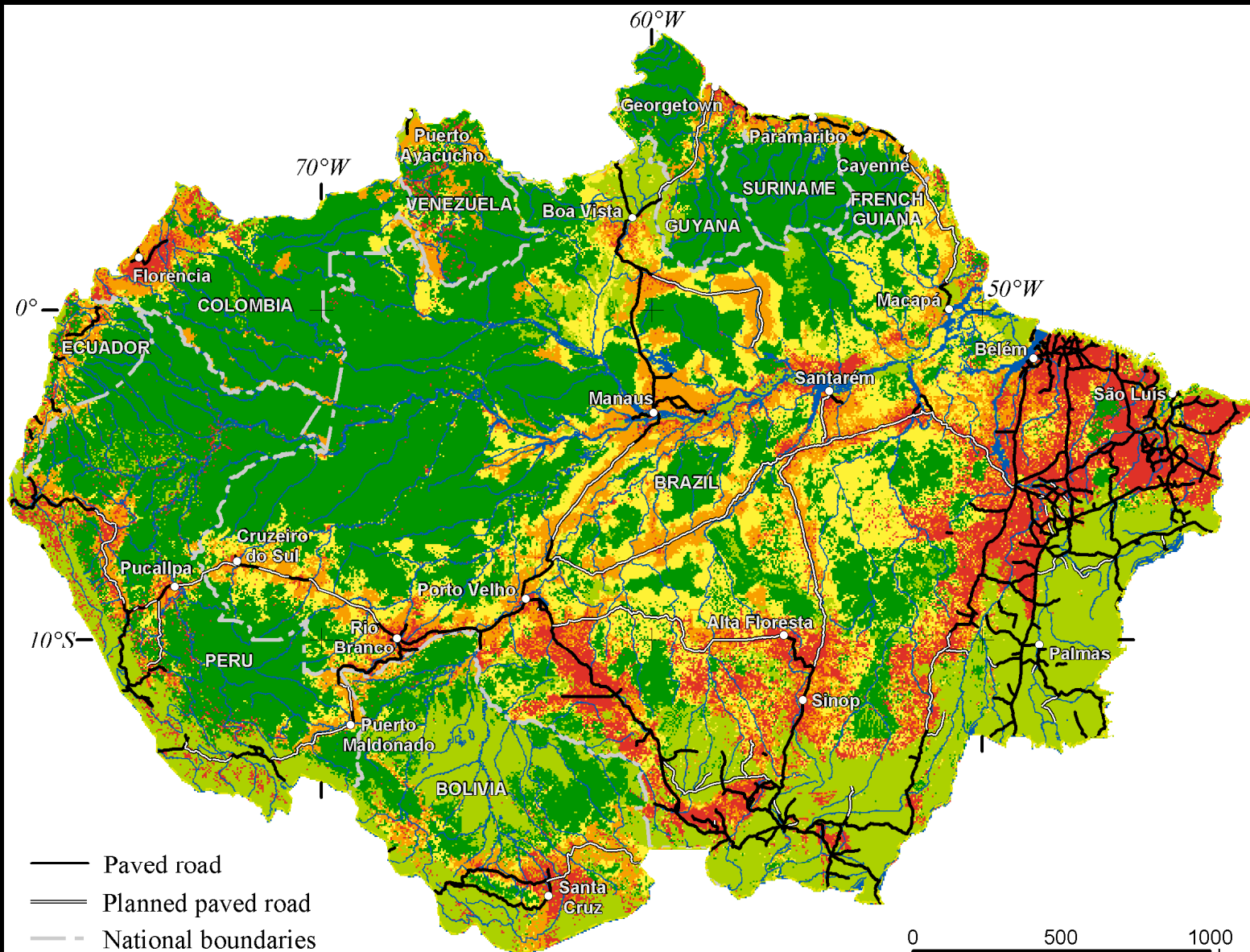
River Flow Regime

Climate Models

Biodiversity (Habitat Loss)

Offline Interaction

Rent Models

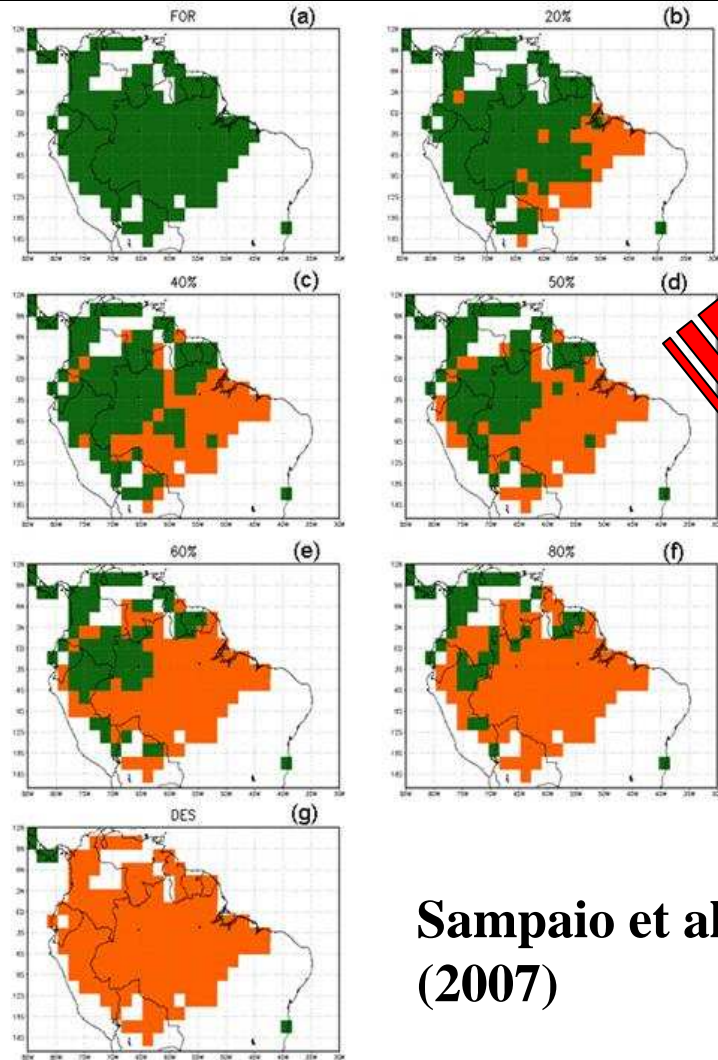


- Paved road
- == Planned paved road
- - National boundaries
- ~ Major river
- Forest
- Nonforest

- Deforested by 2003
- Deforested by 2050 in Governance scenario
- Deforested by 2050 in Business scenario

Soares-Filho et al., 2006

AMAZON SCENARIOS PROJECT



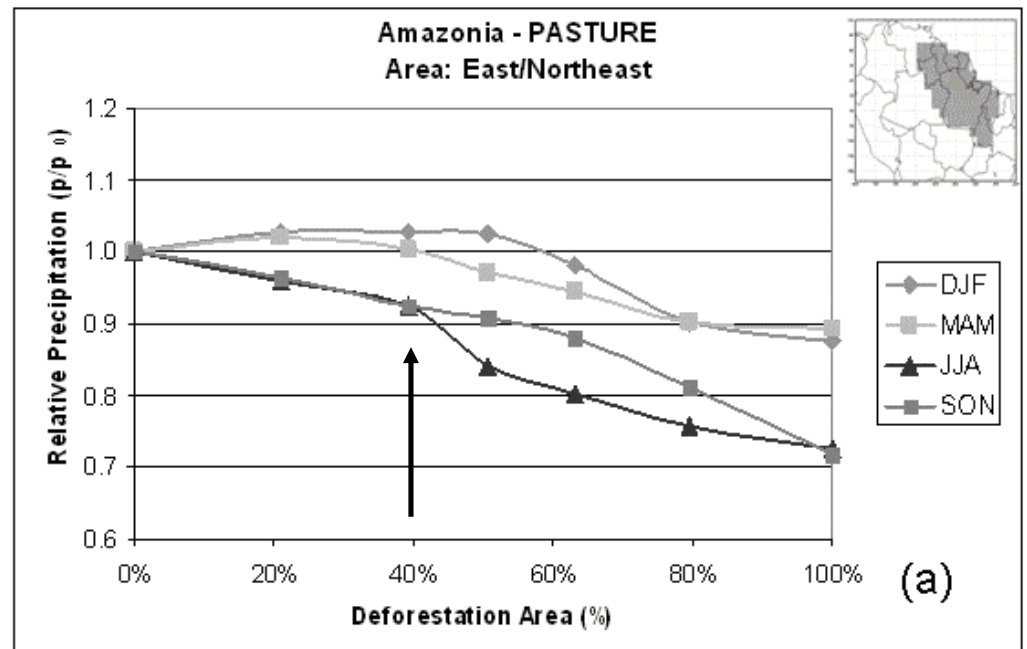
Sampaio et al.
(2007)

Figure 1

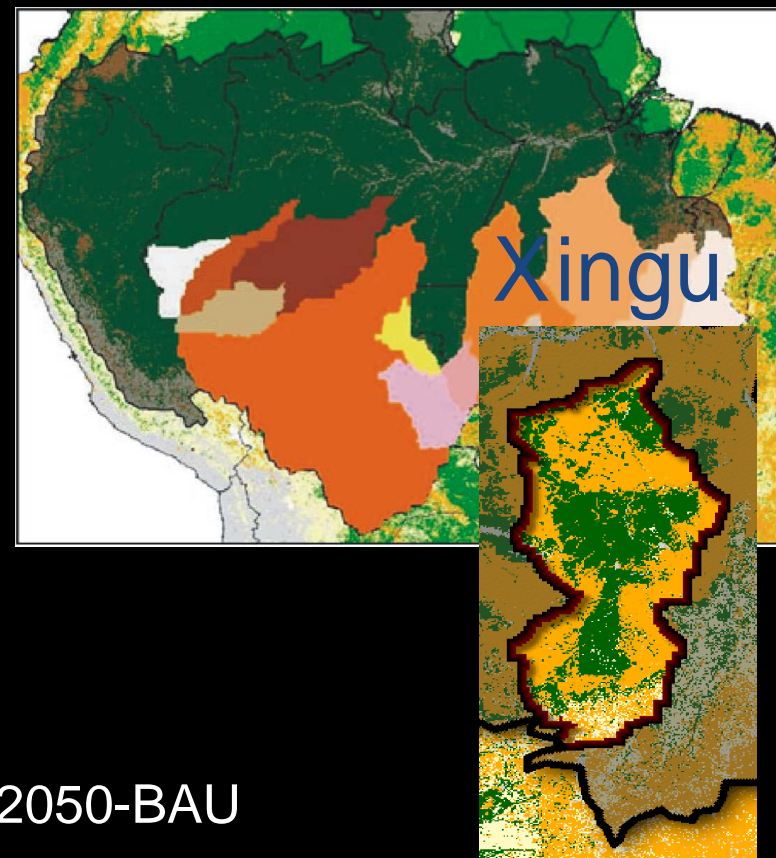
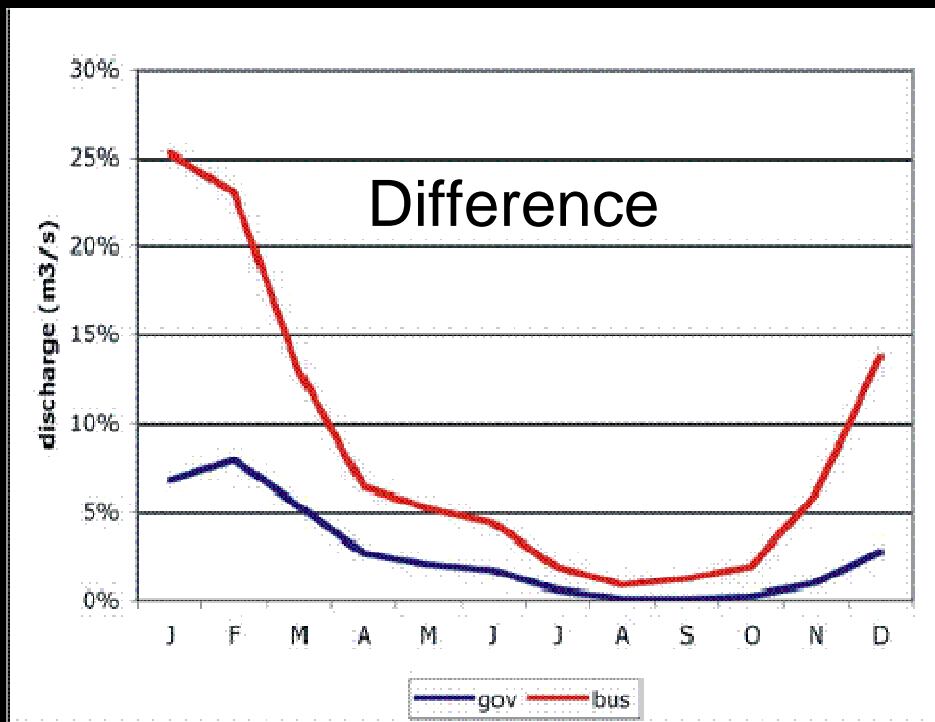
Precipitation decreases

CPTEC
GLOBAL MODEL

Results



Change in river regime

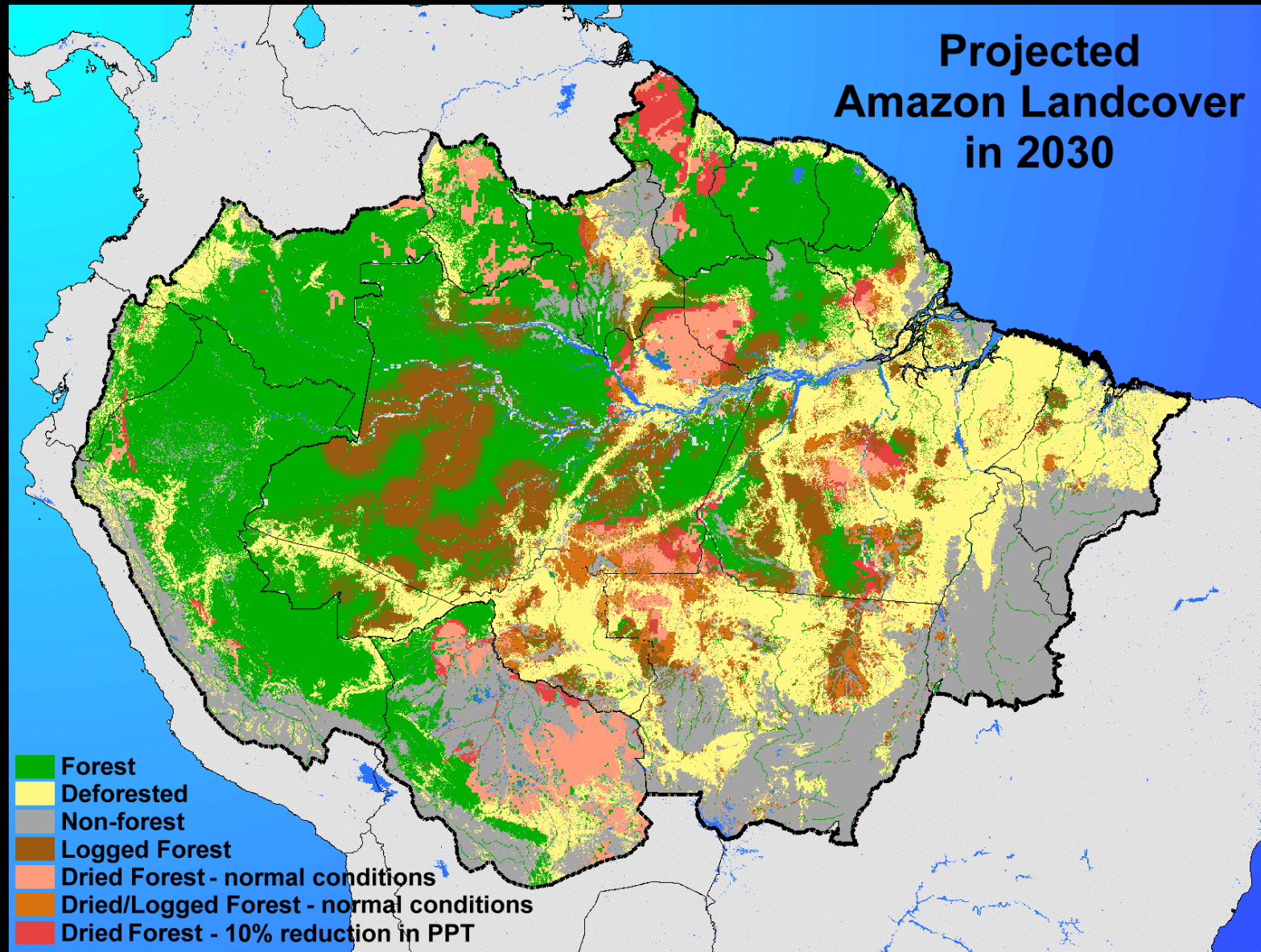


Xingu	2000	2050-GOV	2050-BAU
Area deforested	19%	35%	71%
Wet season change		+8%	+25%

Coe, Costa e Soares-Filho (2009)

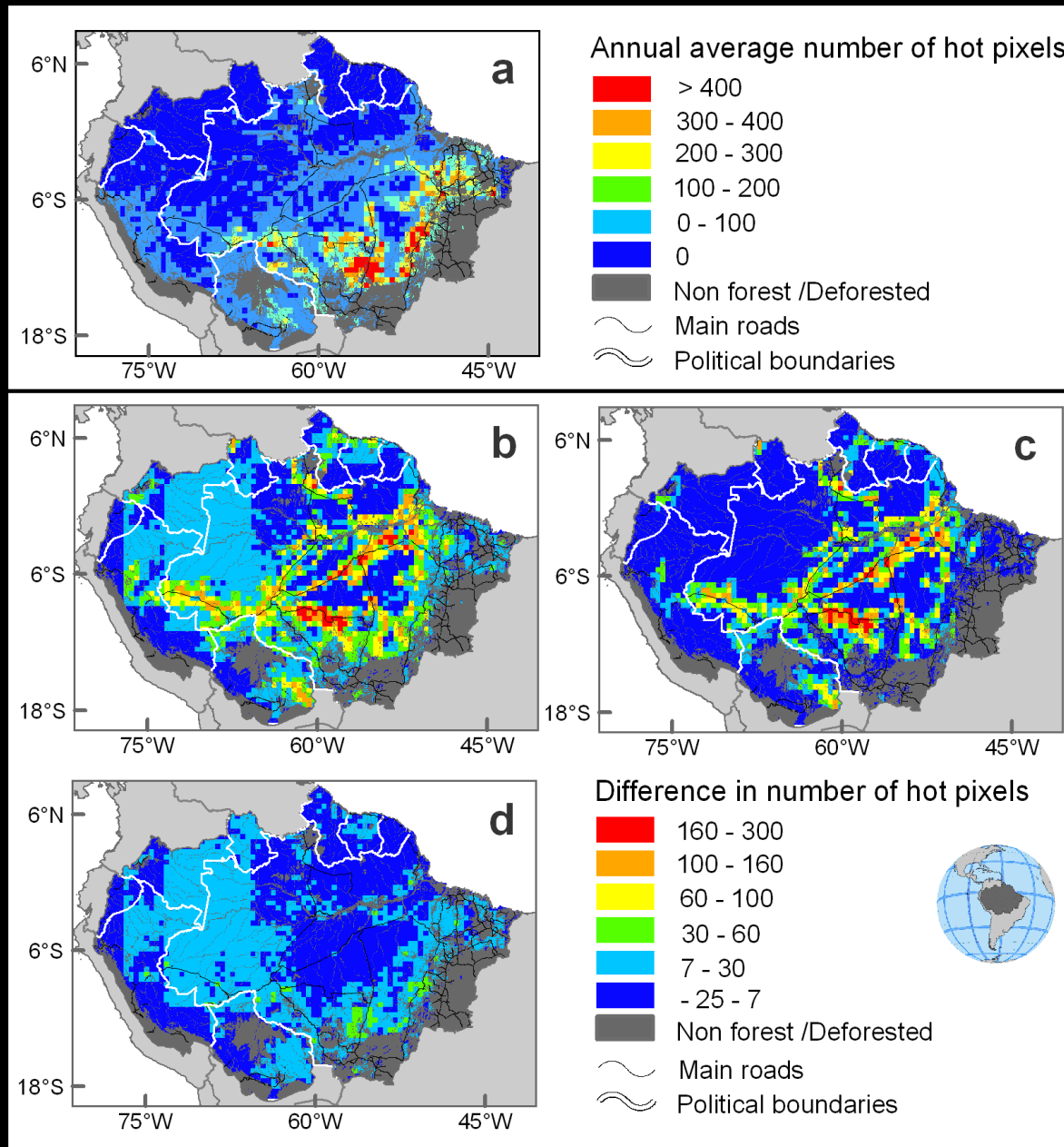
Impact on flooding and hydroelectric generation

Projected Amazon Landcover in 2030



A near-term tipping point in the Amazon? (Nepstad et al., 2008)

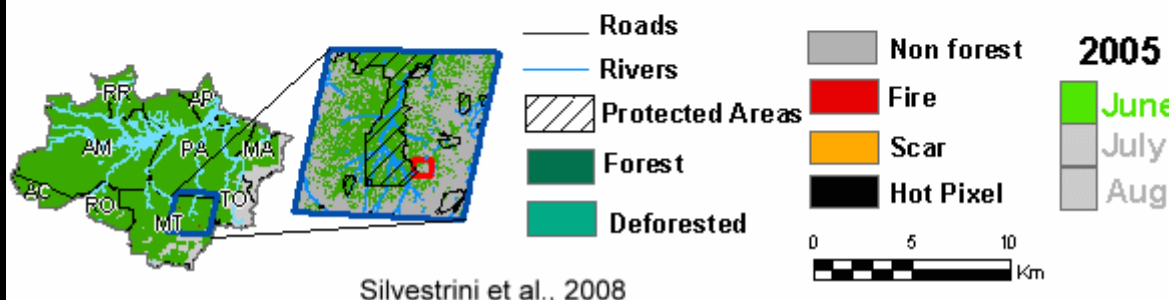
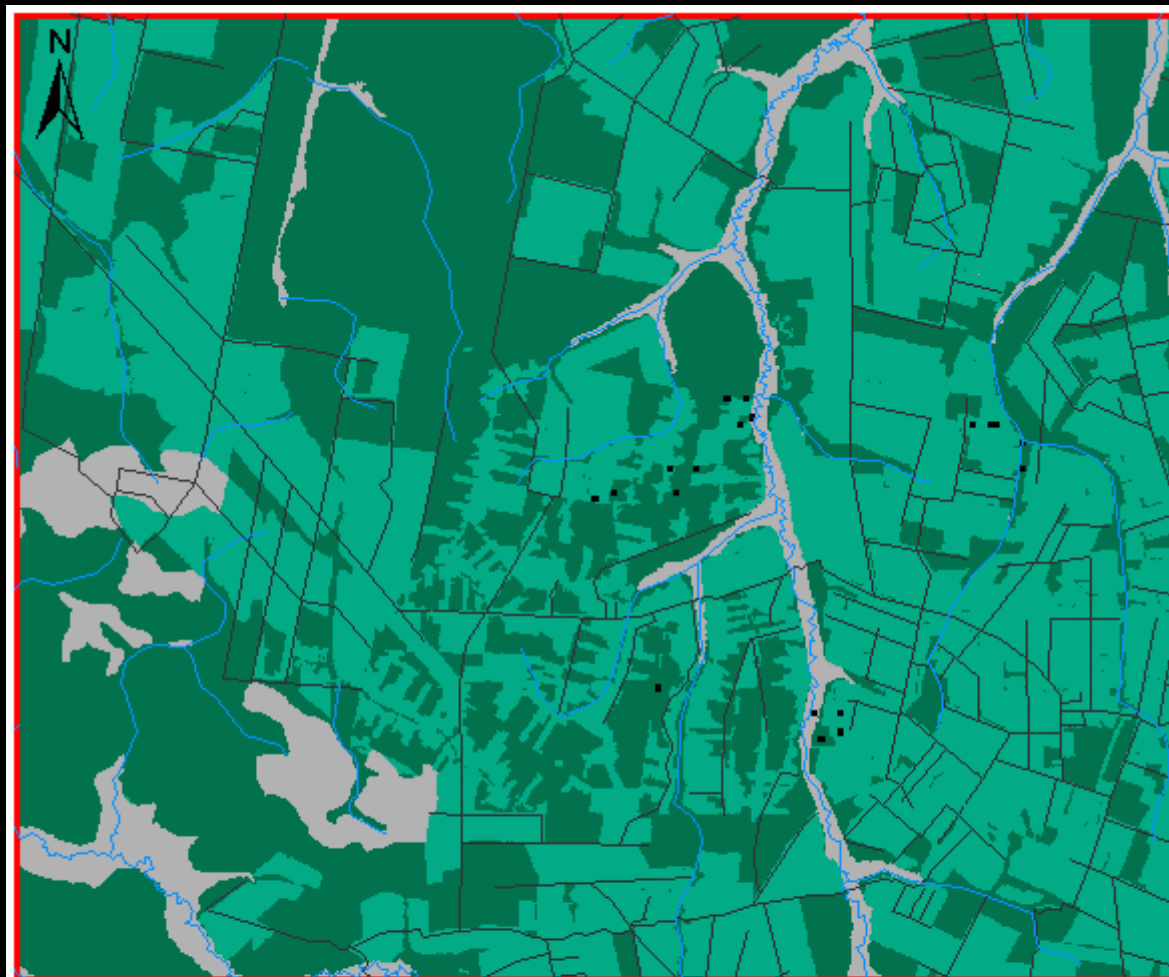
Fire regimes in response to climate change and deforestation



**Outro D do
REDD**

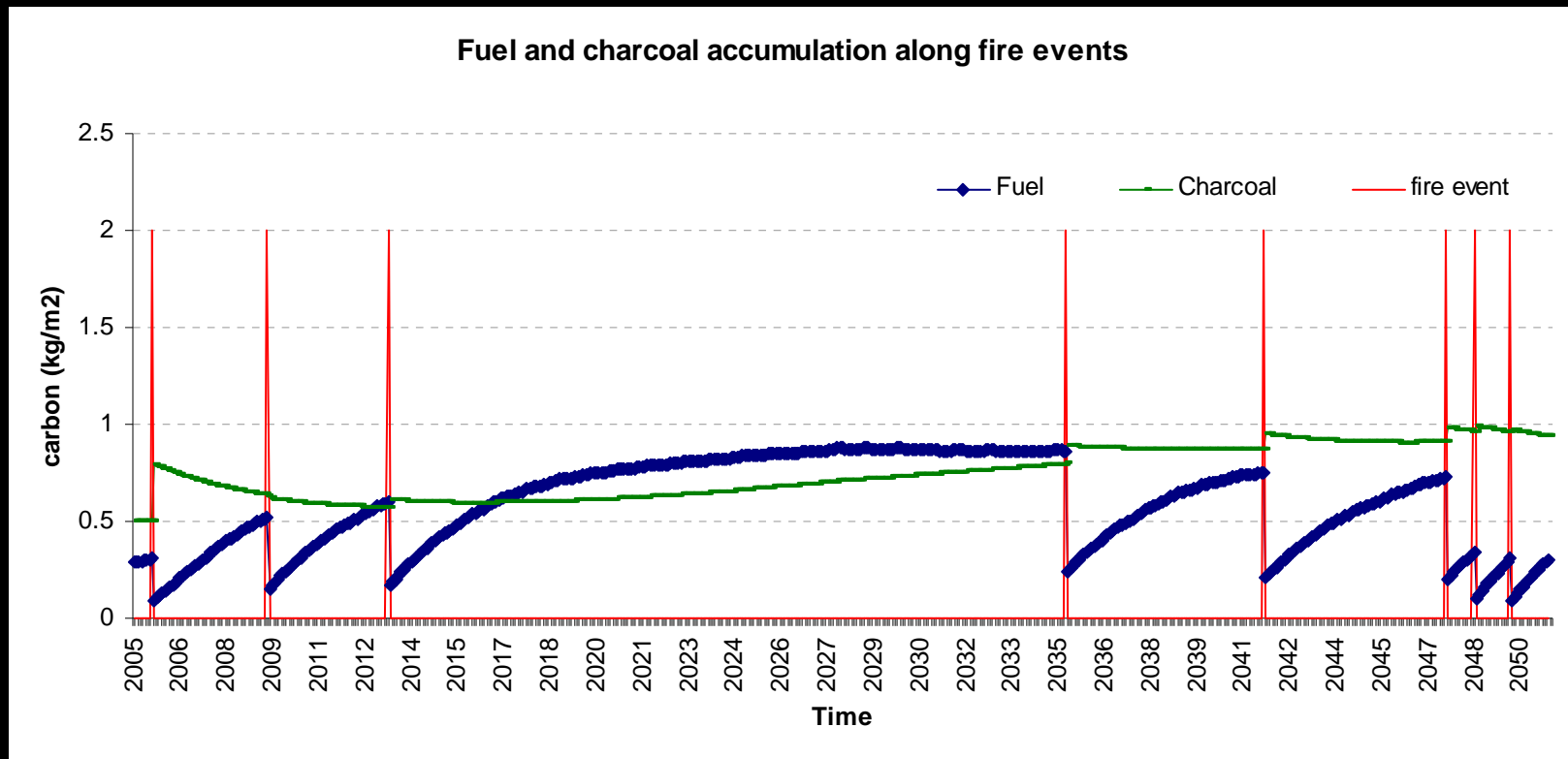
**Silveirine et al.
under review**

Fire spreading model



Silvestrini et al., 2008

Example of the interaction between fire and carbon stocks (CARLUC model)



Opportunity cost =



Rent from sustainable logging

Rent from other forestry products (Brazil nuts, rubber, etc)

X



Rent from agribusiness

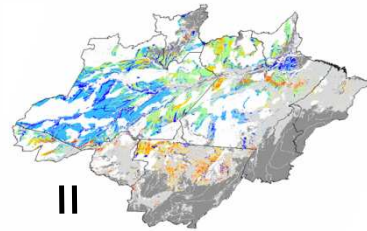


Rent from cattle raising

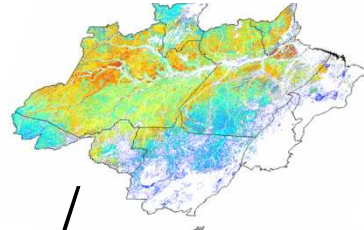


Rent from logging

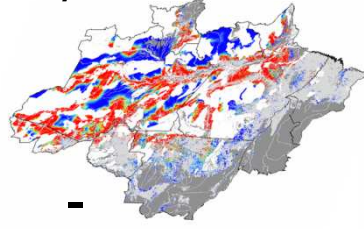
Opportunity Cost



Carbon stock

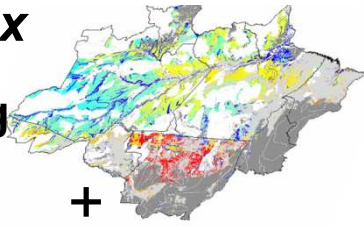


Rent from logging

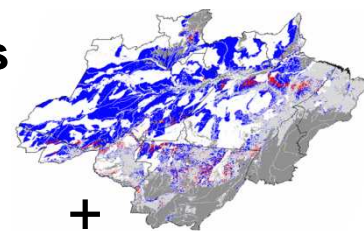


max

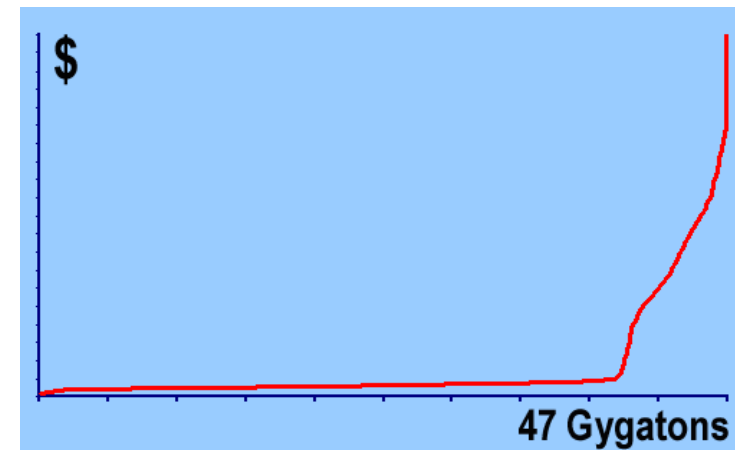
Rent from cattle raising



Rent from agribusiness



Supply curve



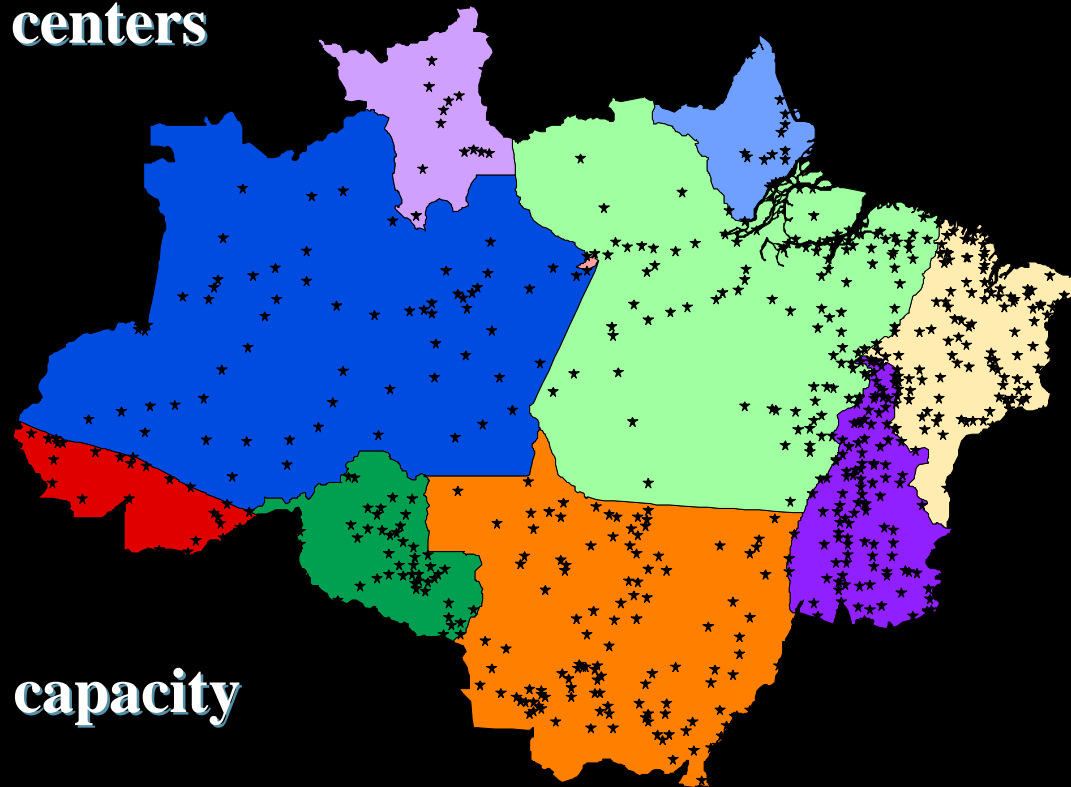
**Estudos de custo de
oportunidade e valoração da
floresta**

Logging rent model

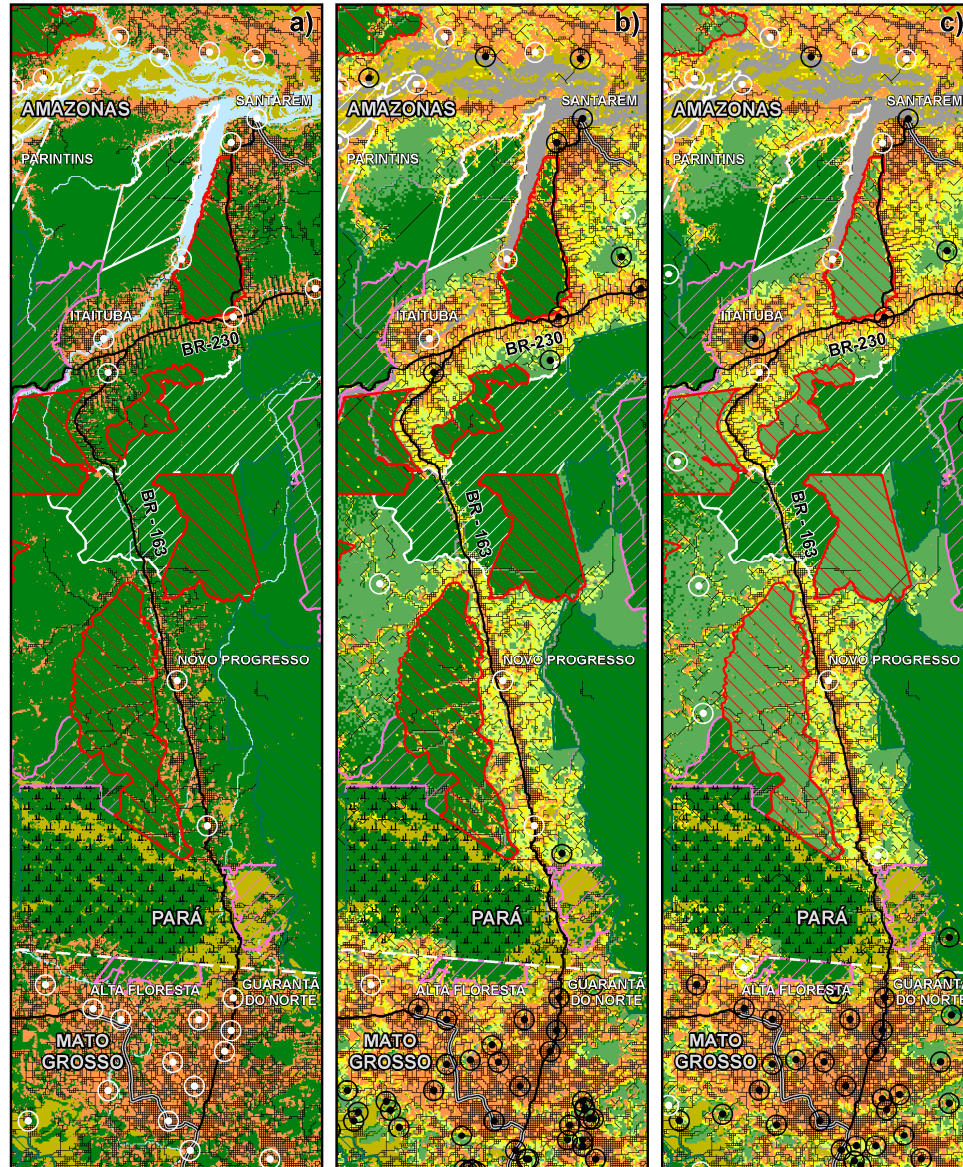
The model produces dynamic rent surfaces based on wood prices, harvest and milling costs collected for 588 milling centers located throughout the Amazon

$$\text{Rent} = \text{Wood_Price}_j * \text{tax_deduction} * \text{processing_loss} \\ - (\text{transportation_cost}_{xy} + \text{harvest_cost}_j + \text{milling_cost}_j) * \text{interest_rate}$$

milling centers



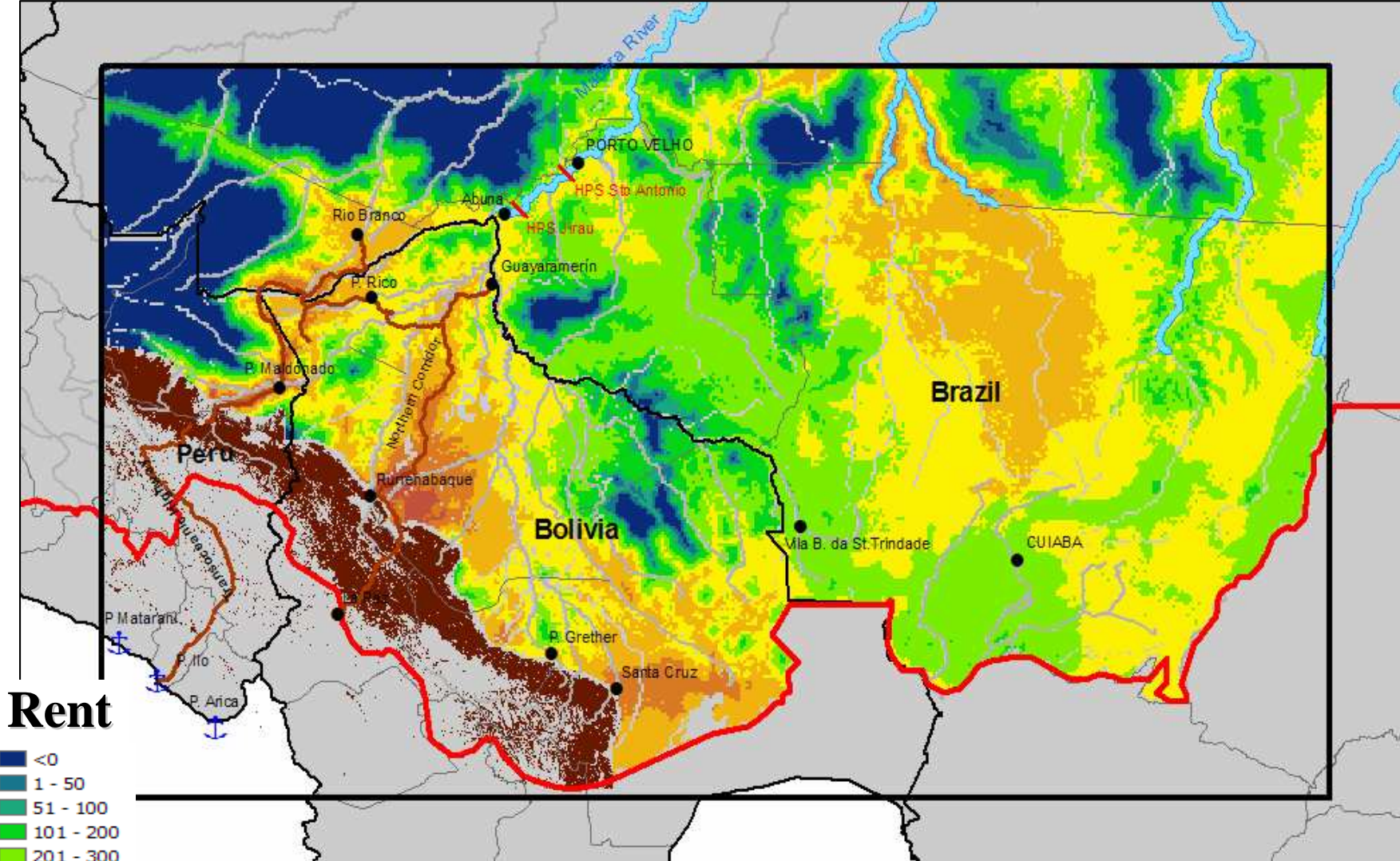
harvest capacity



Balancing Conservation and Economic Sustainability: The Future of the Amazon Timber Industry

Merry & Soares-Filho et al.
Environmental Management, 2009

Scenarios of Soy frontier expansion in response to Paving



Rent

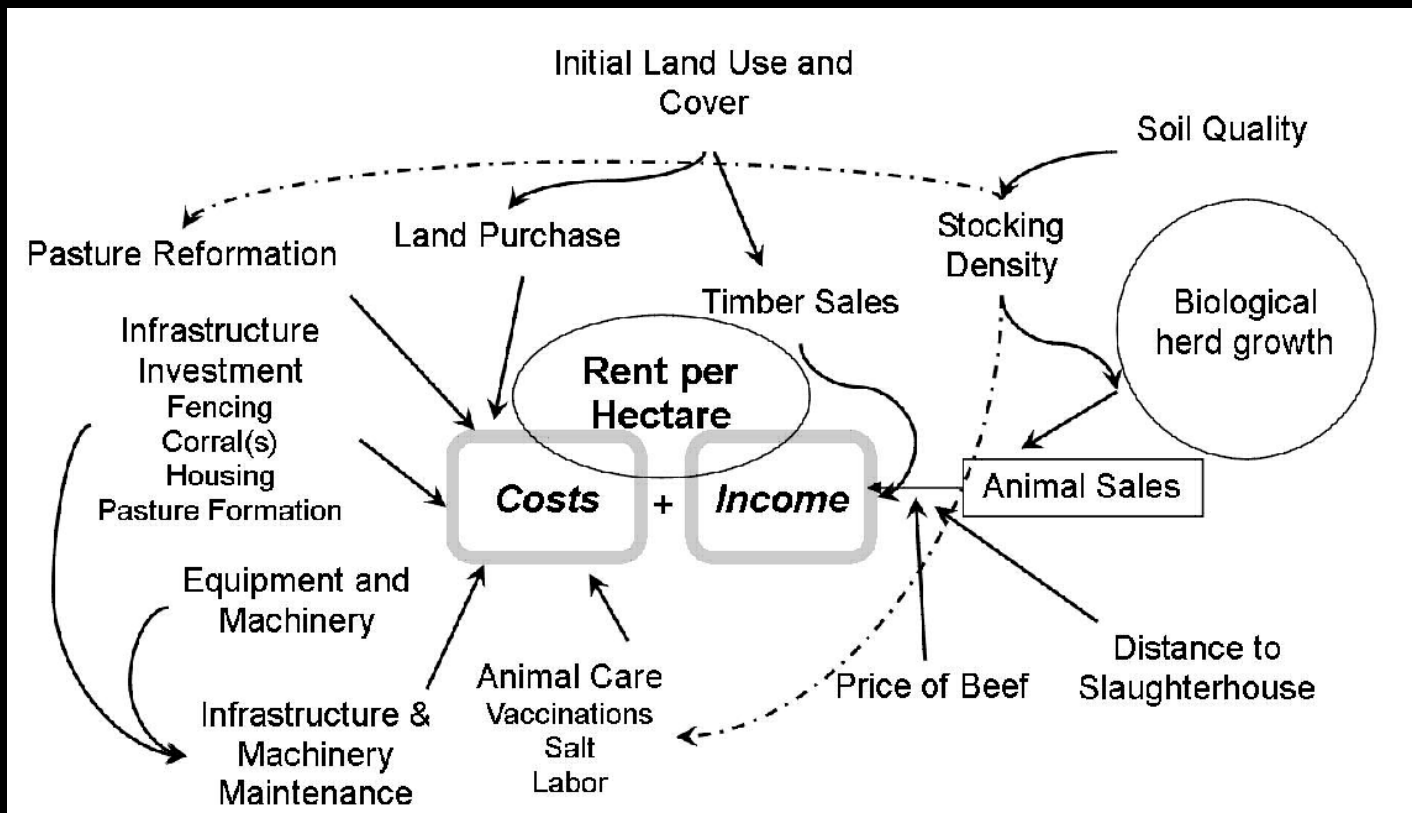
- <0
- 1 - 50
- 51 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 750

US\$/hec

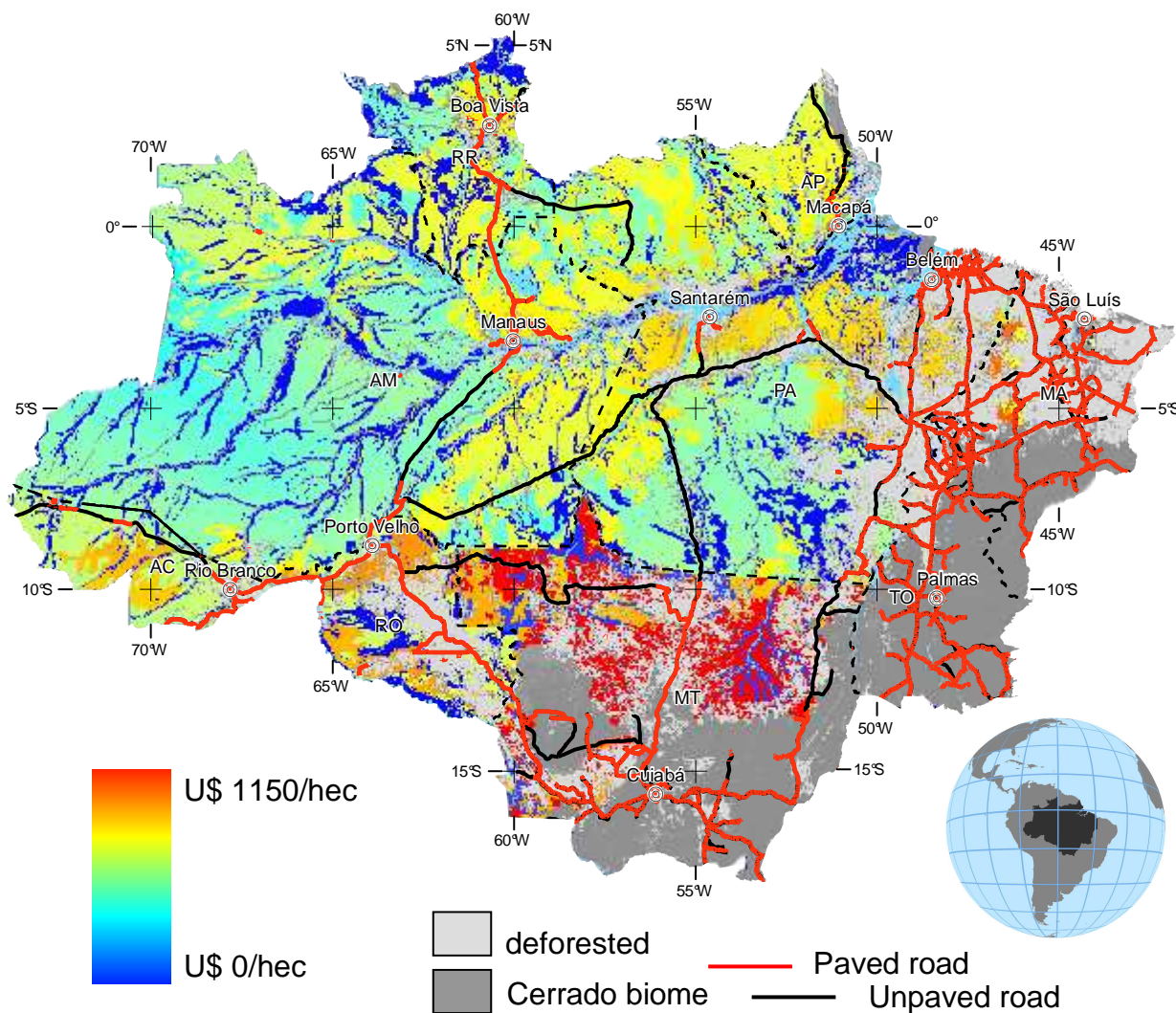
Hydro Powers: Jirau and Santo Antônio
Northern Corridor and Transoceanic Highway
Potential area with high rents = 976,000 km² or increase of 13%
Pando, El Beni, Acre, and Madre de Dios

Cattle model

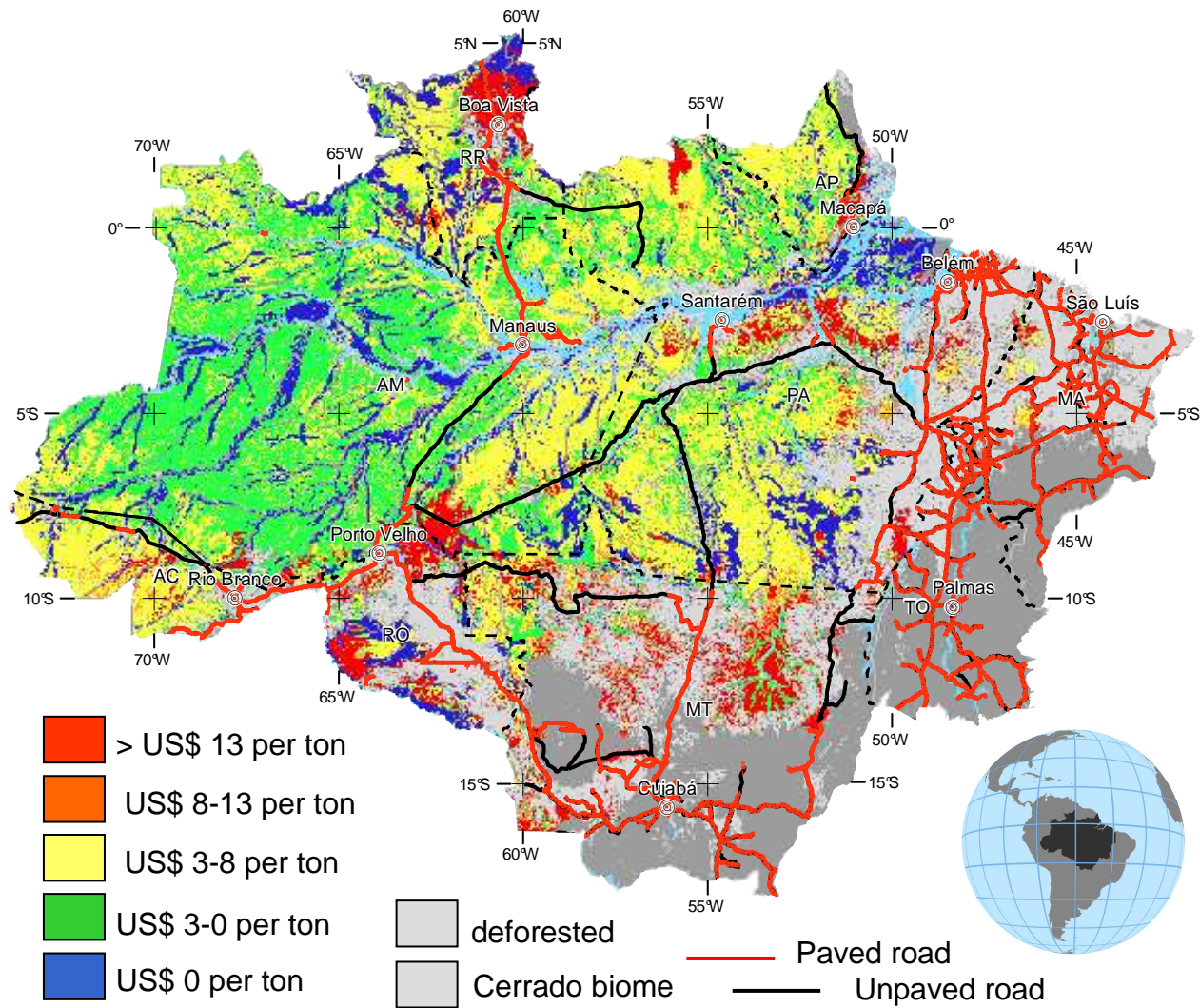
Spatial model at 1km²



(Bowman et al., in review)



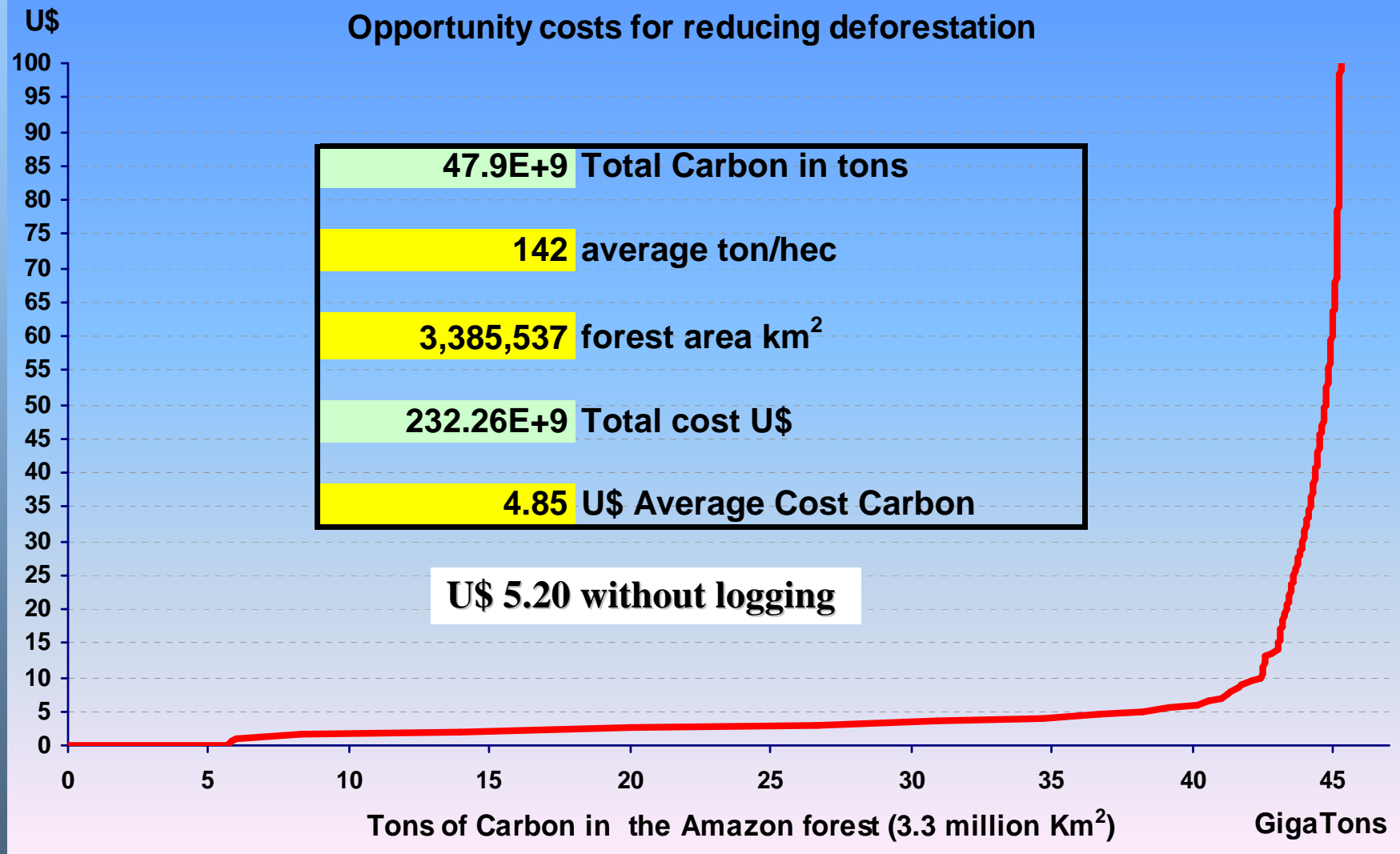
Cattle Net Present Value for 30 years
discount rate of 5%



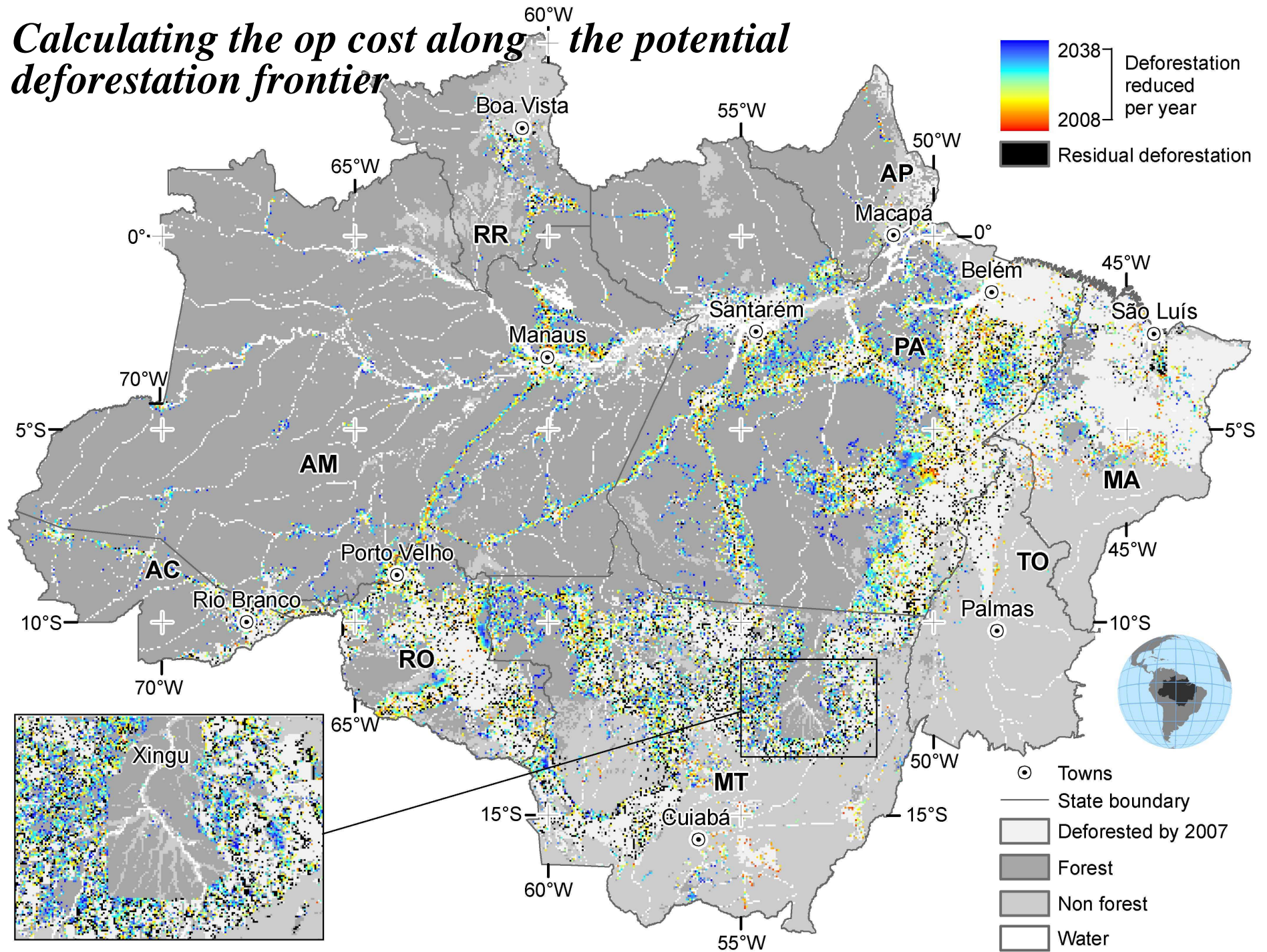
Opportunity costs



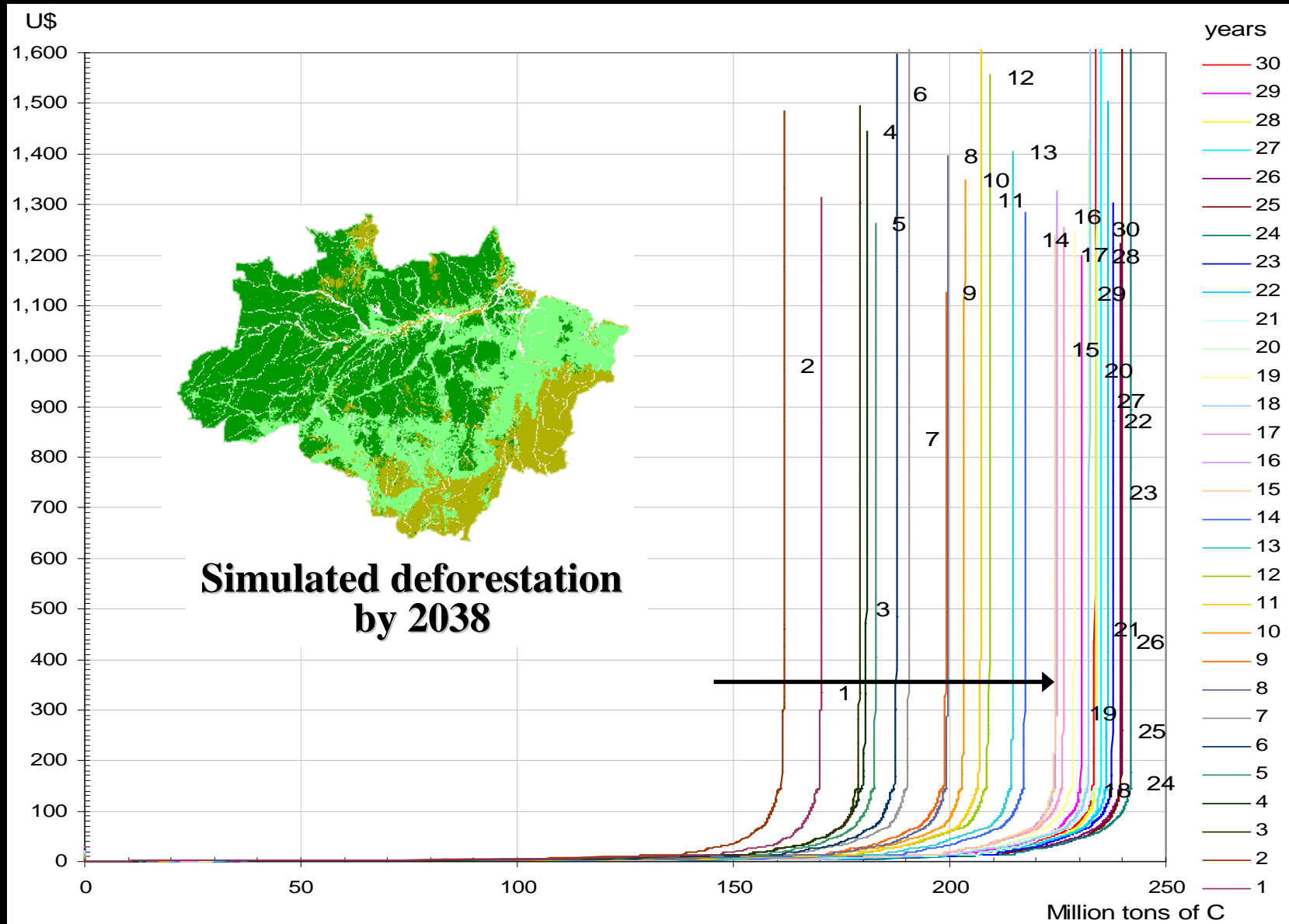
Opportunity costs for reducing deforestation



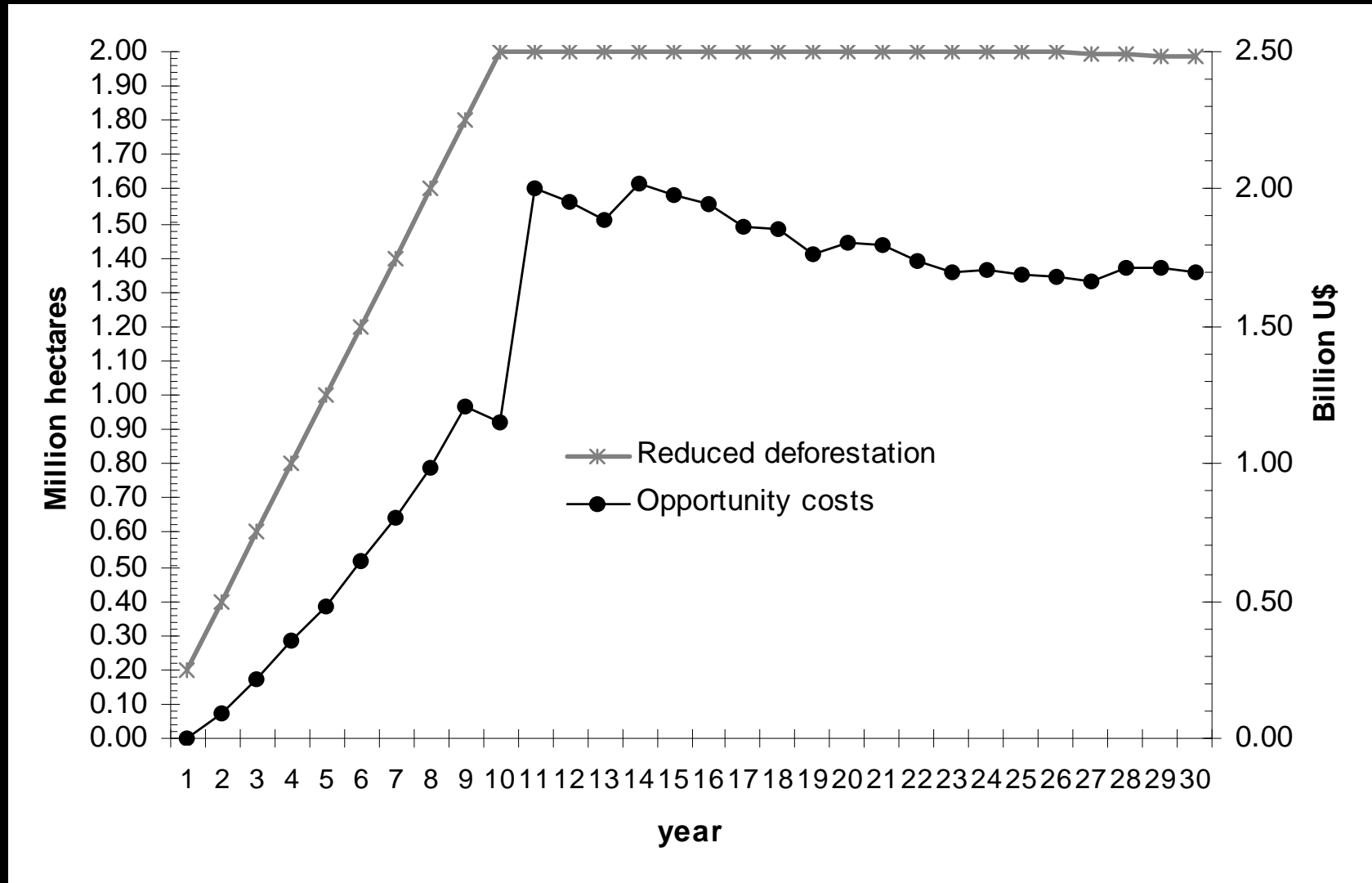
Calculating the op cost along the potential deforestation frontier



As the frontier advances opportunity costs fall



A scenario of deforestation reduced to 0 in 10 years



(Not all op cost should be compensated)

A proposal to end deforestation in the Brazilian Amazon

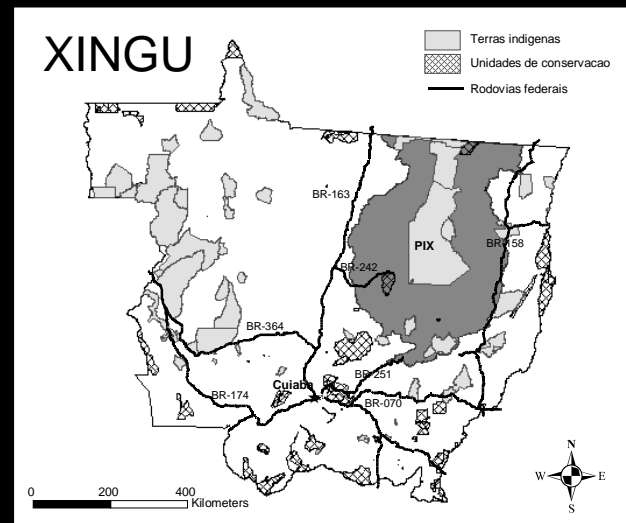
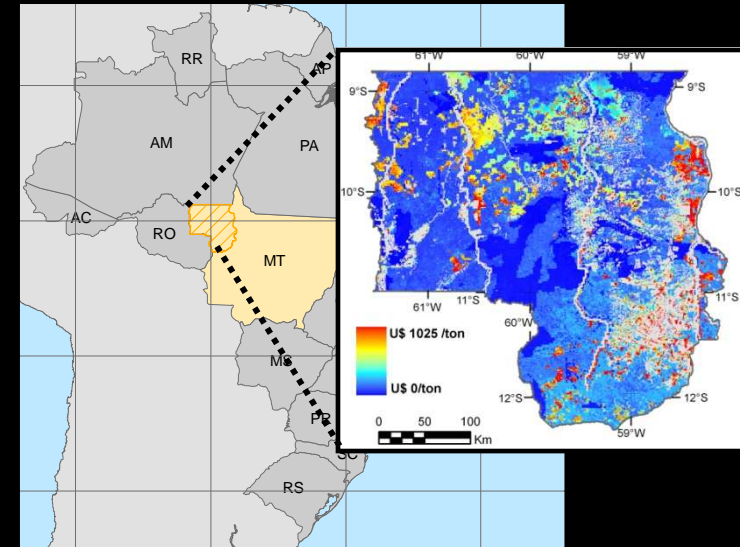
Estimated costs of a program to end deforestation in the Brazilian Amazon

Region or state	Forest peoples' fund (10 ⁶ U.S. \$)		Enforcement and landholder compensation (10 ⁶ U.S. \$)		Protected area management (10 ⁶ U.S. \$)		Total cost (10 ⁶ U.S. \$)	
	Low	High	Low	High	Low	High	Low	High
Brazilian Amazon	3,606	7,213	1,459	6,502	1,456	4,368	6,521	18,082
Acre	252	503	106	147	54	163	412	813
Amapá	68	135	13	12	56	168	136	315
Amazonas	565	1,129	229	116	546	1,639	1,340	2,884
Maranhão	189	377	13	248	10	31	212	656
Mato Grosso	335	669	693	4,135	80	240	1,107	5,044
Pará	1,357	2,715	280	639	488	1,464	2,125	4,818
Roraima	116	231	27	19	90	271	233	522
Tocantins	147	293	4	60	51	154	202	507

Ending deforestation in the Brazilian Amazon by 2020. These estimates for costs incurred from 2010 to 2020 assume that current budgetary outlays from the Brazilian government continue. (SOM § 9)

Nepstad & Soares et al., Science 2009

Scaling SimAmazonia to regional case studies



Noroeste MT

Redd report for SEMA

Dinamica EGO 1.4.1 - C:\users\britaldo\amazon_scenarios\simulation\ACRE_redd\originals\REDD_ACRE\analisa_linha_de_base_reducoes_e_observadas_com_ego

File Edit View Model Library Tools Window Help

Library

- Control Control (Suppl.)
- Calibration Calibration (Suppl.)
- Validation
- Stack (Suppl.) Statistics Table
- Simulation (Suppl.) Stack
- Region Simulation
- Map Algebra Map Algebra (Suppl.)
- Input/Output Logging
- Load Categorical Map Load Lookup Table
- Load Map Load Weights Save Lookup Table
- Save Map Save Weights

Sketch

Model Properties

Programa de Gestão REDD para o Estado do Acre

Author:
 Britaldo Soares-Filho, Elsa Mendoza, André Lima, Letícia Hissa, Aline Oliveira

Organization:
 UFMG/IPAM/WHRC

Version:
 1.0

Keywords:
 REDD, ACRE, Contabilidade

Description:
 Simula desmatamento de linha de base e meta e calcula reduções, identificando áreas críticas, como avalia priorização dessas áreas e compara com desmatamento observado

Notes:

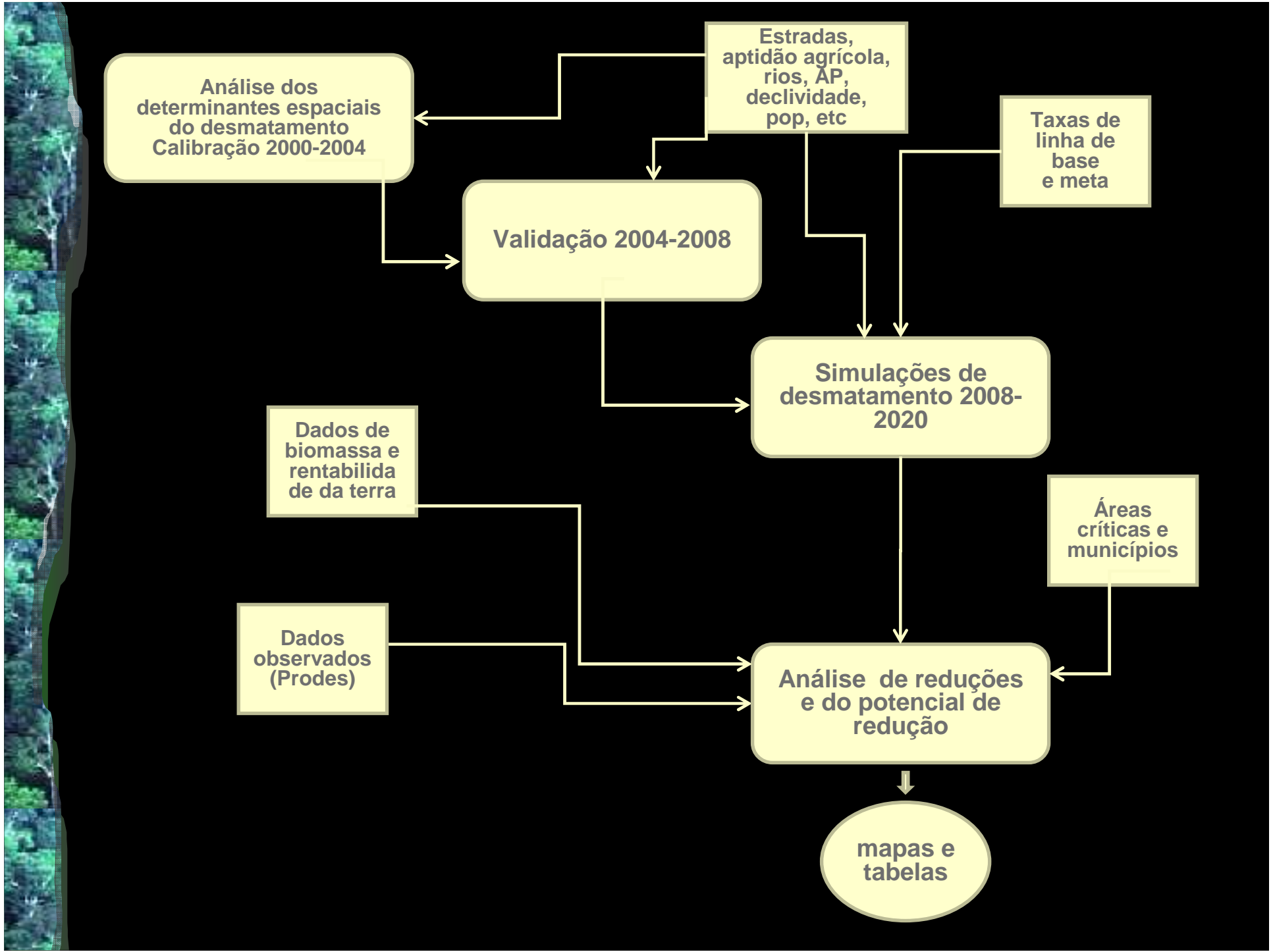
Date:
 Sat Feb 27 09:56:49 2010

Message Log

Reading model script "C:\users\britaldo\amazon_scenarios\simulation\ACRE_redd\originals\REDD_ACRE\analisa_linha_de_base_reducoes_e_observadas_com_ego" completed successfully.
 Parsing EGO model script from input named "C:\users\britaldo\amazon_scenarios\simulation\ACRE_redd\originals\REDD_ACRE\analisa_linha_de_base_reducoes_e_observadas_com_ego" completed successfully.
 Model script read successfully (elapsed 0 s).

Ready

Microsoft PowerPoi... g_ermapper Corel PHOTO-PAIN... originals Dinamica EGO 1.4... PT Pesquisar na Área de Trabalho 22:09



Análise dos determinantes espaciais do desmatamento
Calibração 2000-2004

Estradas, aptidão agrícola, rios, AP, declividade, pop, etc

Taxas de linha de base e meta

Validação 2004-2008

Simulações de desmatamento 2008-2020

Dados de biomassa e rentabilidade da terra

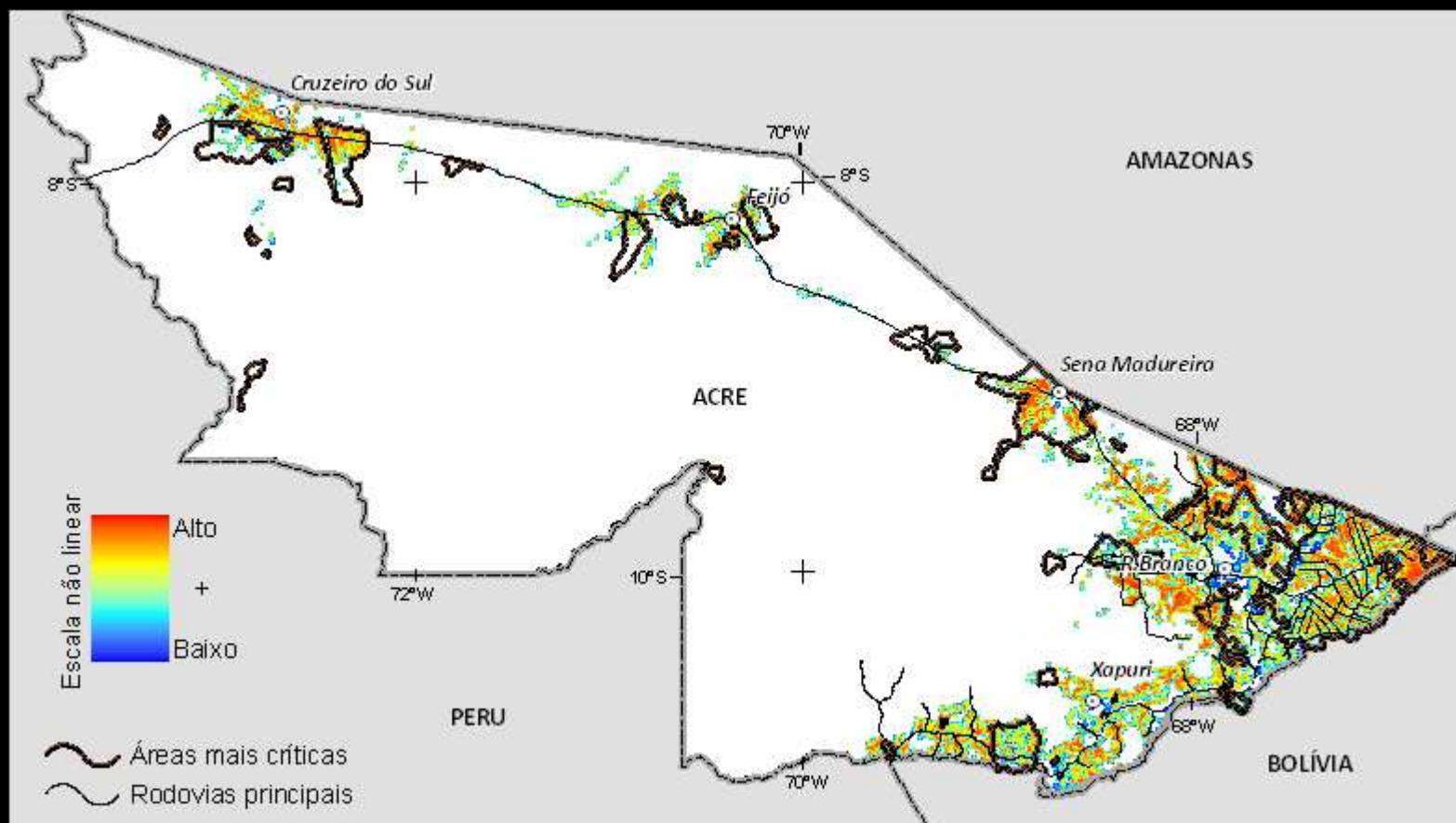
Áreas críticas e municípios

Dados observados (Prodes)

Análise de reduções e do potencial de redução

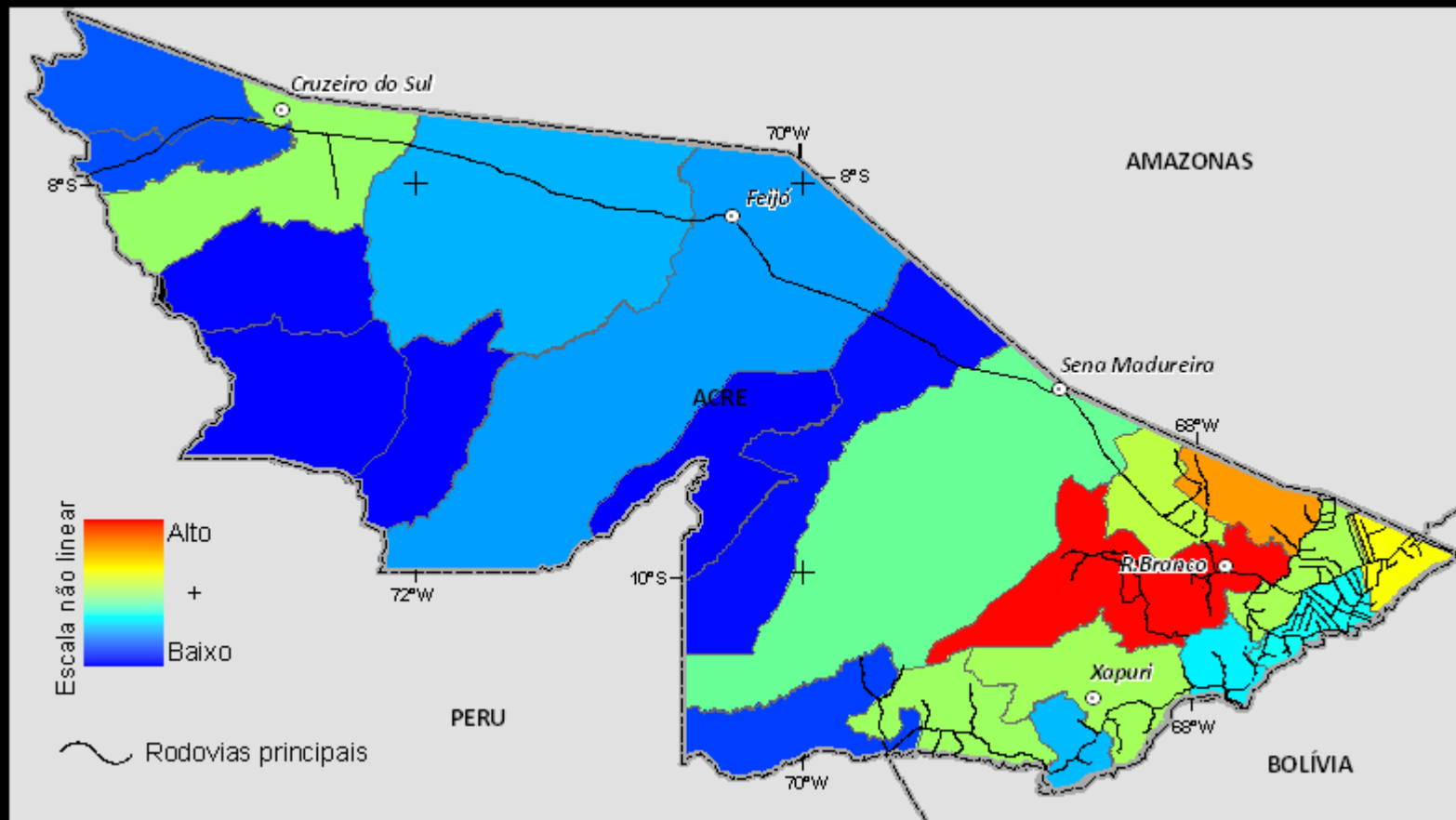
mapas e tabelas

Áreas com maior potencial de redução

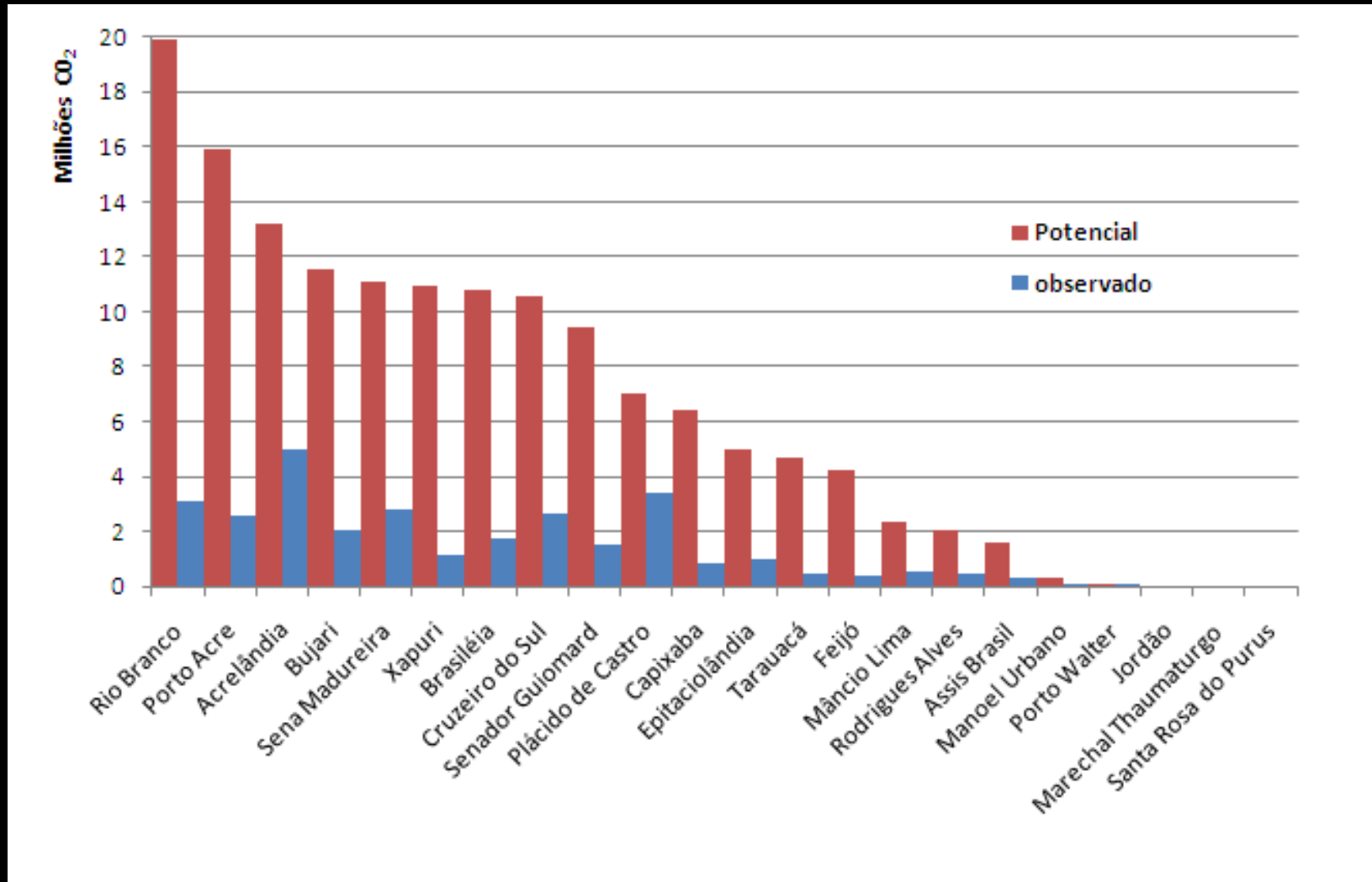


Aprox. 100% das reduções

Potencial de redução por município até 2020

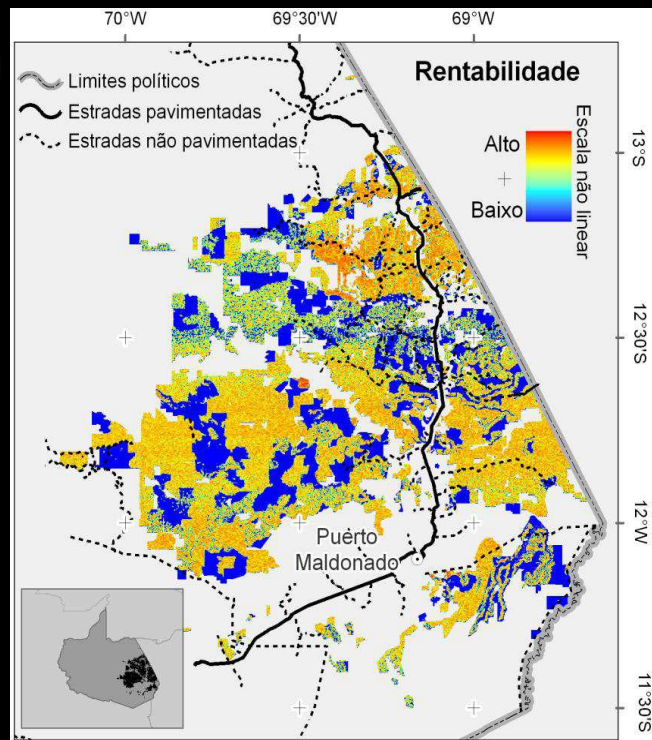


Análise municipal



Spatially explicit dynamic models of rents for forestry and agricultural uses and trade-off assessment of forestry and agricultural land uses

n Brazil nut economic model



castanha com casca, castanha sem casca (beneficiada) e castanha com certificação.			
	Cenário 1	Cenário 2	Cenário 3
Produtividade potencial anual*		16.311,73 toneladas	
Rentabilidade potencial anual	\$3.714.058,25	\$9.487.557,00	\$10.236.083,00
Rentabilidade por hectare	\$3,67	\$9,45	\$10,20

* castanha com casca

Santos et al, in prep.

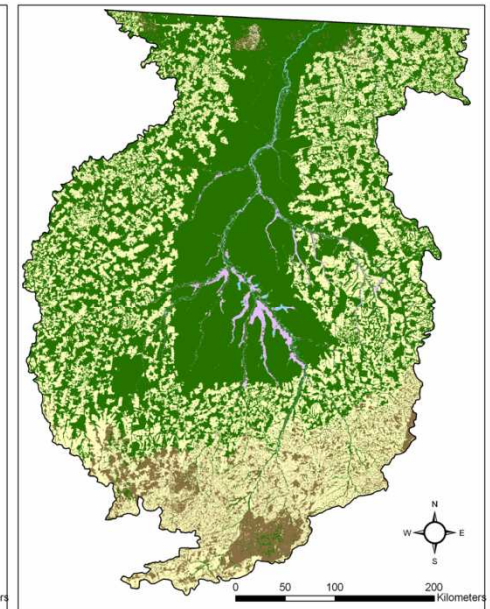
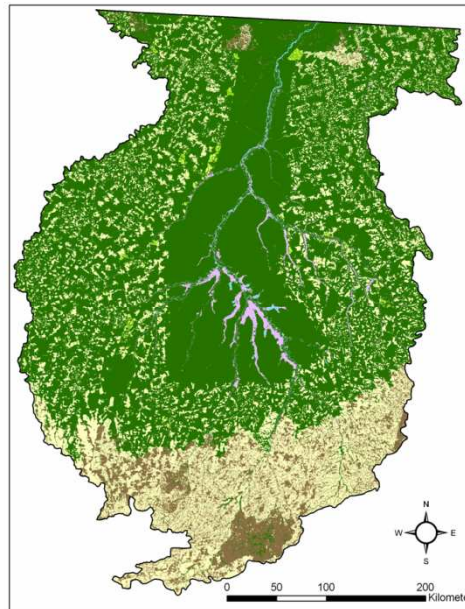
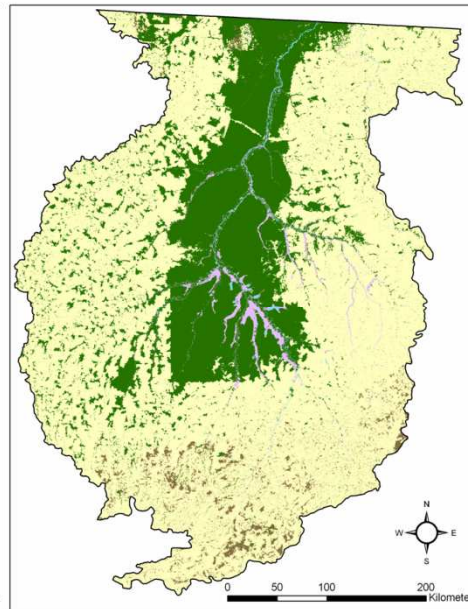
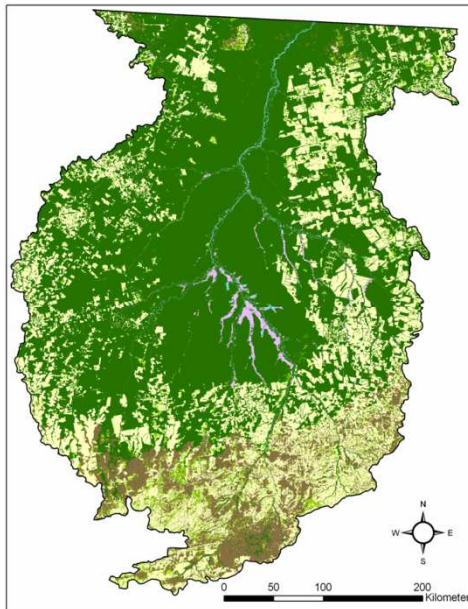
A policy scenarios model to support regional planning in an Amazonian agro-industrial region

Initial

Business as Usual

Current Forest Code

Reduce Legal Reserve



2005

2035

2035

2035

735 MtC

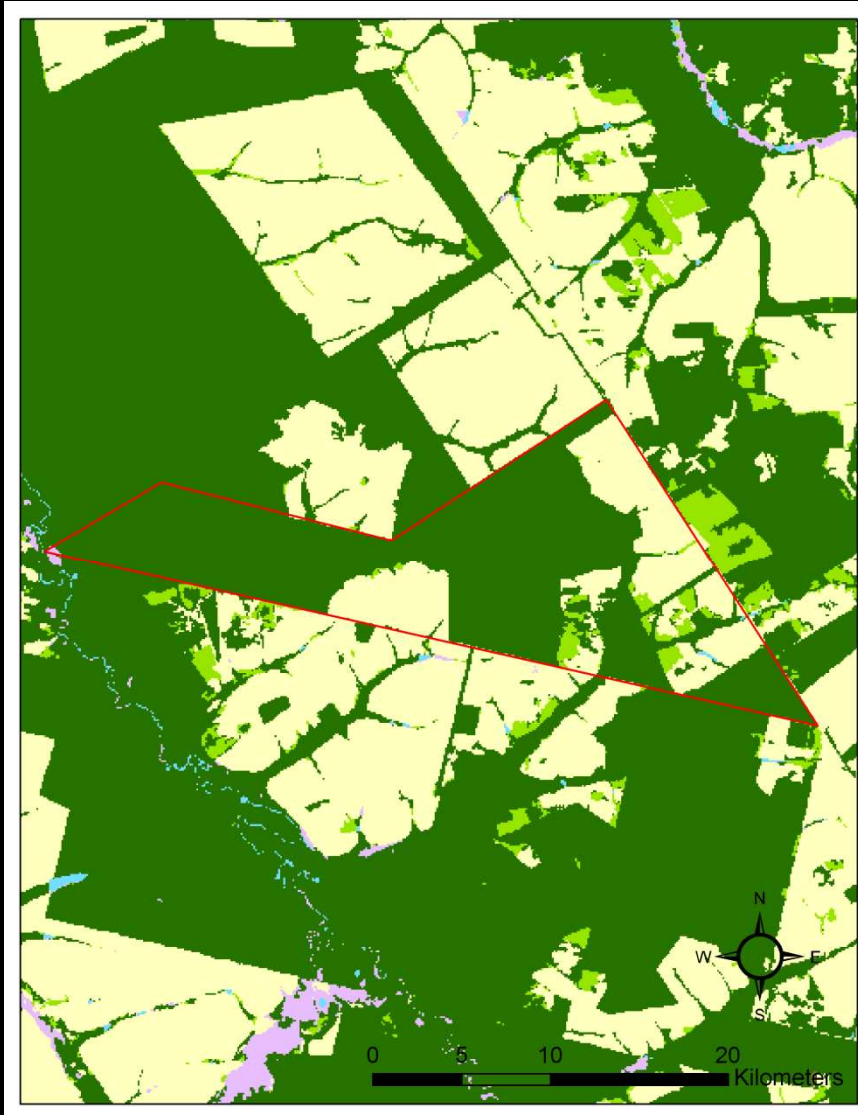
337 MtC

769 MtC

647 MtC

Stickler et al., Global Change Biology 2009

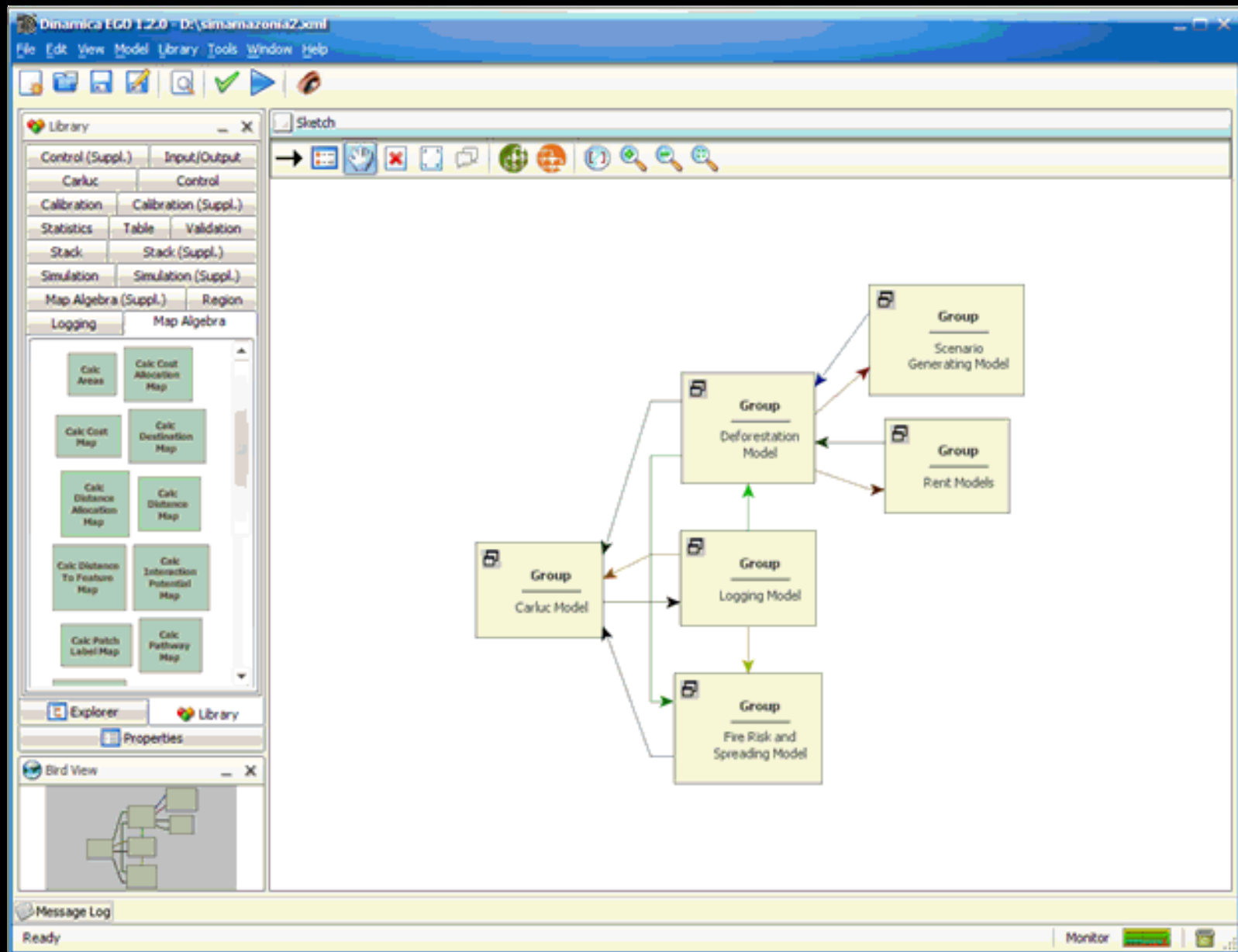
Simulating carbon stocks on individual properties



Initial 2005



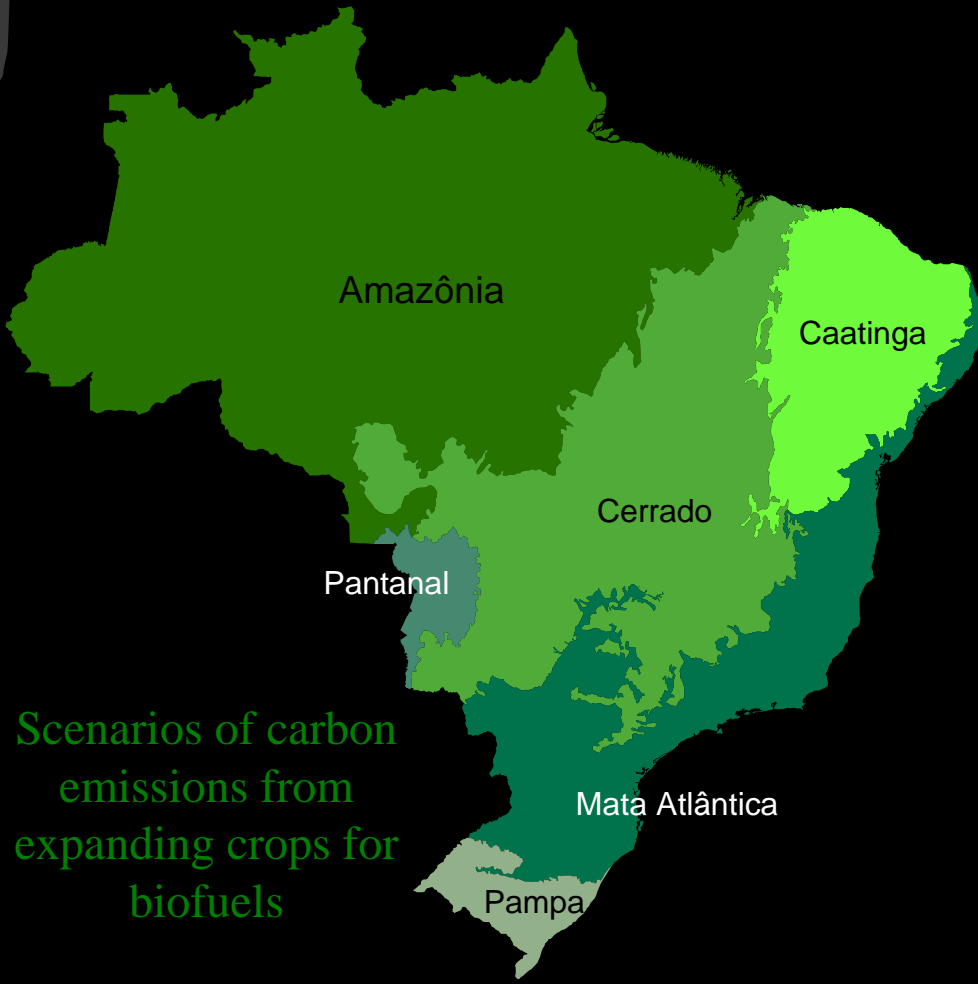
Current Forest Code 2035



All models are integrated on the same modeling platform

Expanding SimAmazonia to Brazil: SimBrasil

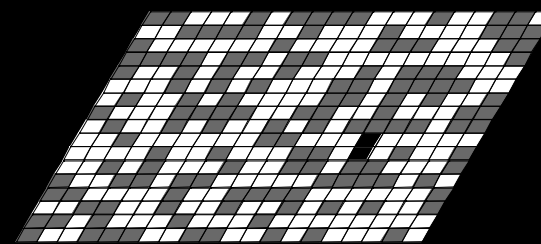
Brazil: Low Carbon Country Case Study



Scenarios of carbon emissions from expanding crops for biofuels

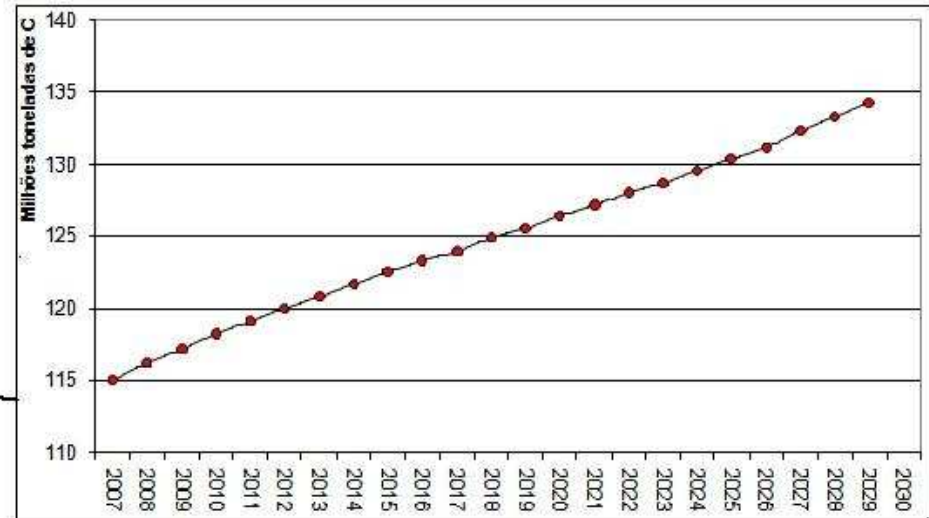
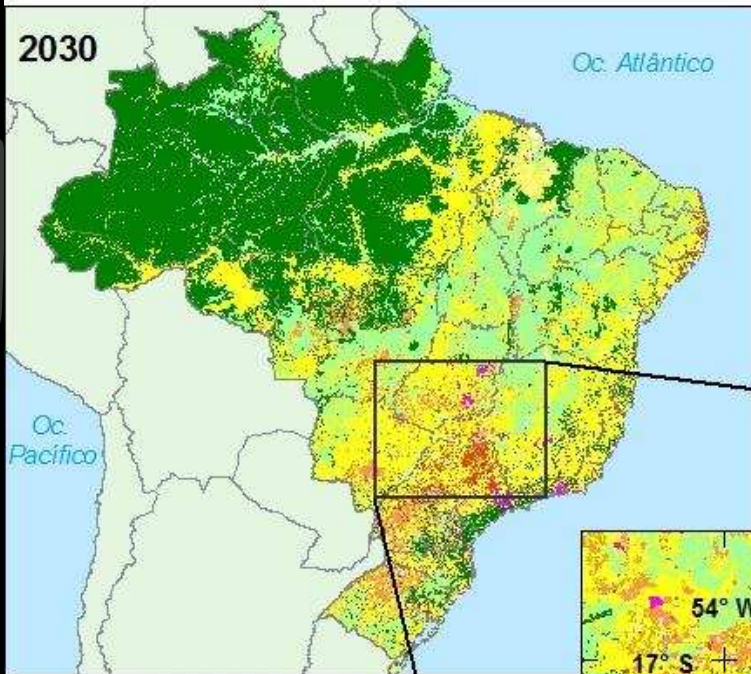


772



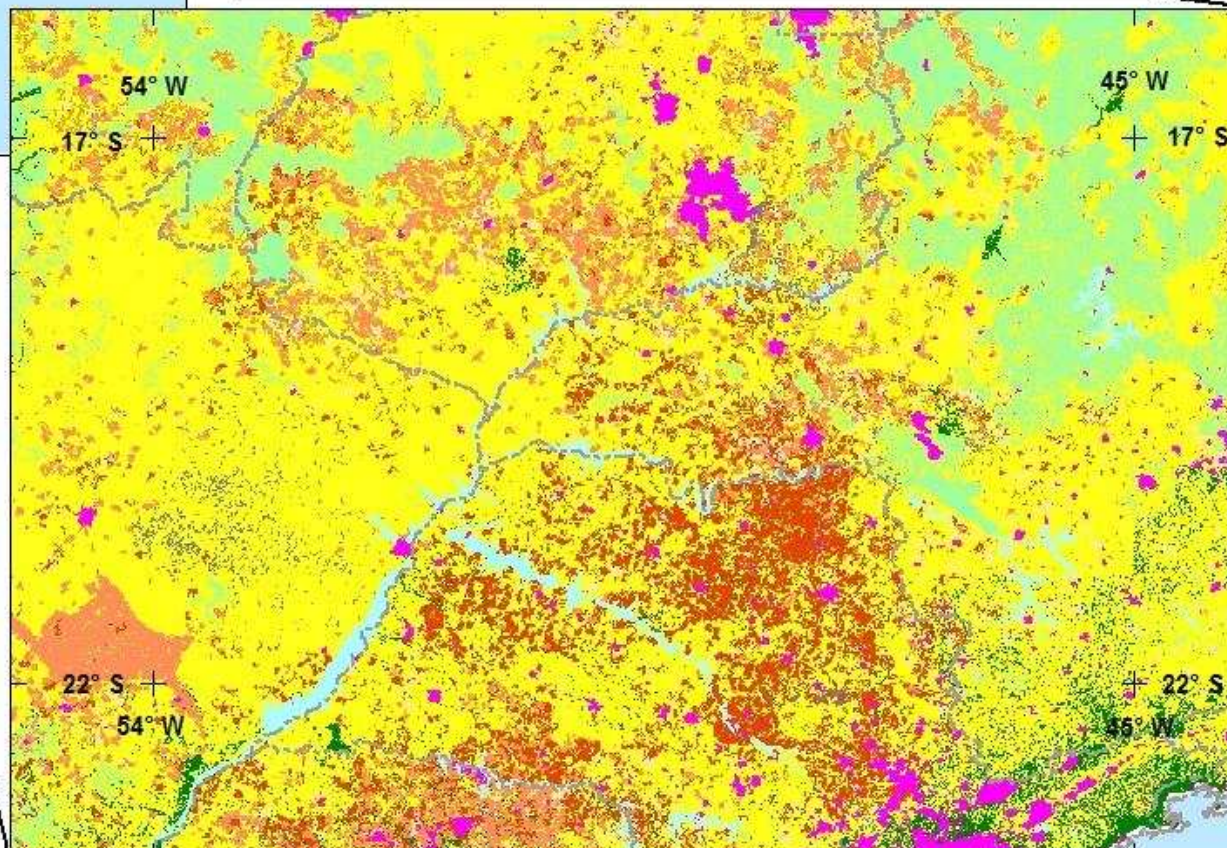
1x1 km = 4500x4500 = 20 M cells

World Bank report, in press



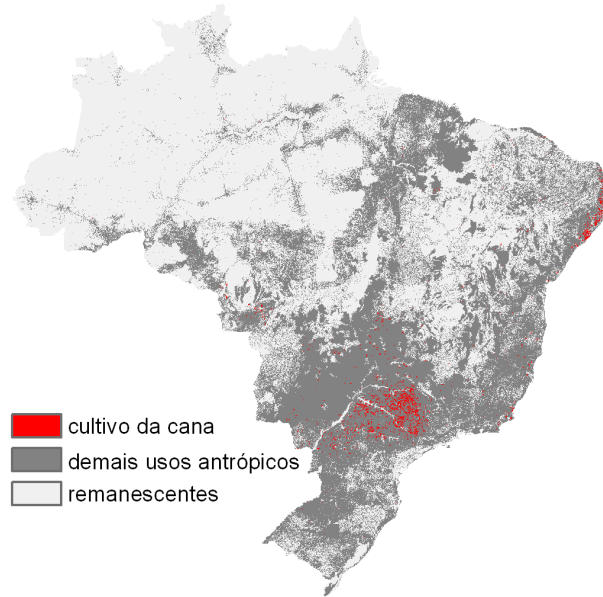
Uso e Cobertura da Terra (2006-2030)

- Limites Políticos
- Corpos d'água
- Pastagens
- Área urbana
- Capoeira
- Savana
- Floresta
- Floresta Plantada
- Cana
- Soja
- Milho
- Algodão
- Arroz
- Feijão

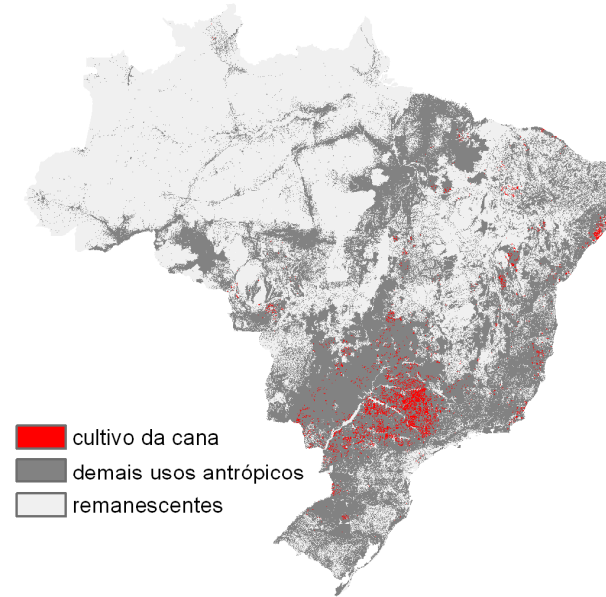




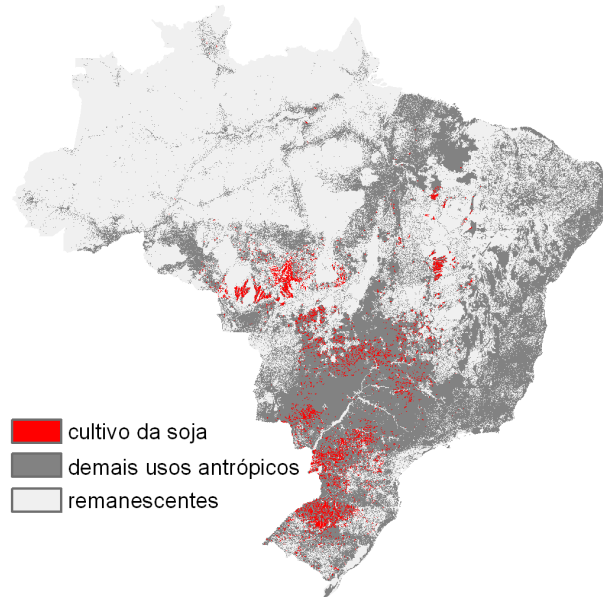
Cultivo da Cana em 2006



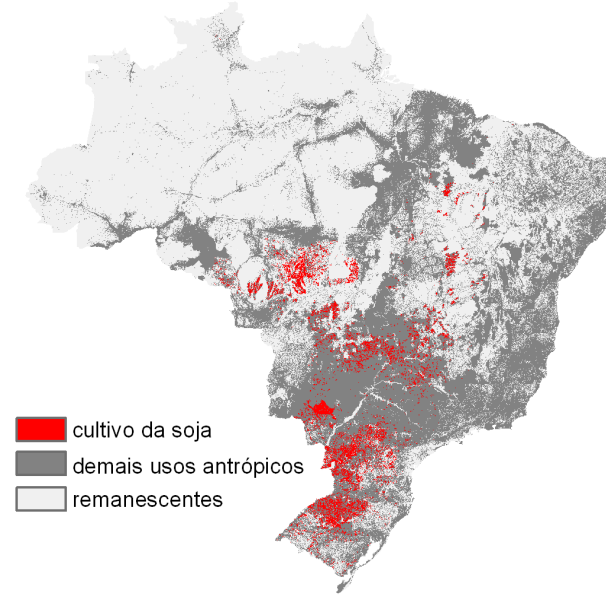
Cultivo da Cana em 2030



Cultivo da Soja em 2006



Cultivo da Soja em 2030



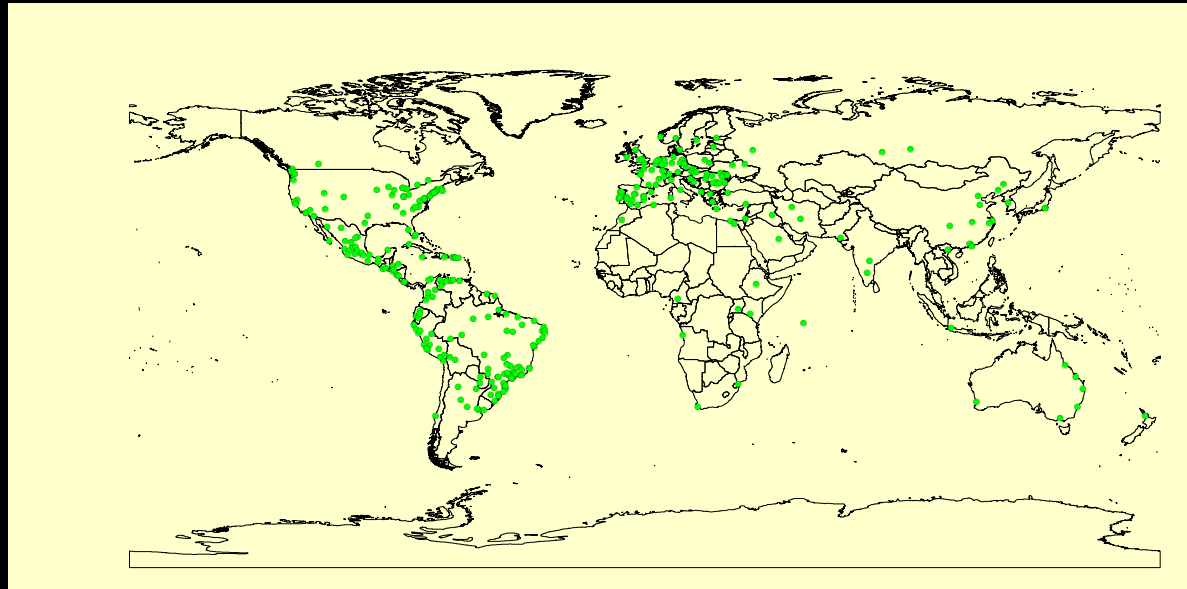
Capacity Building in the MAP region

- n Training workshops for the 3 countries on modeling using Dinamica software and SimAmazonia models.

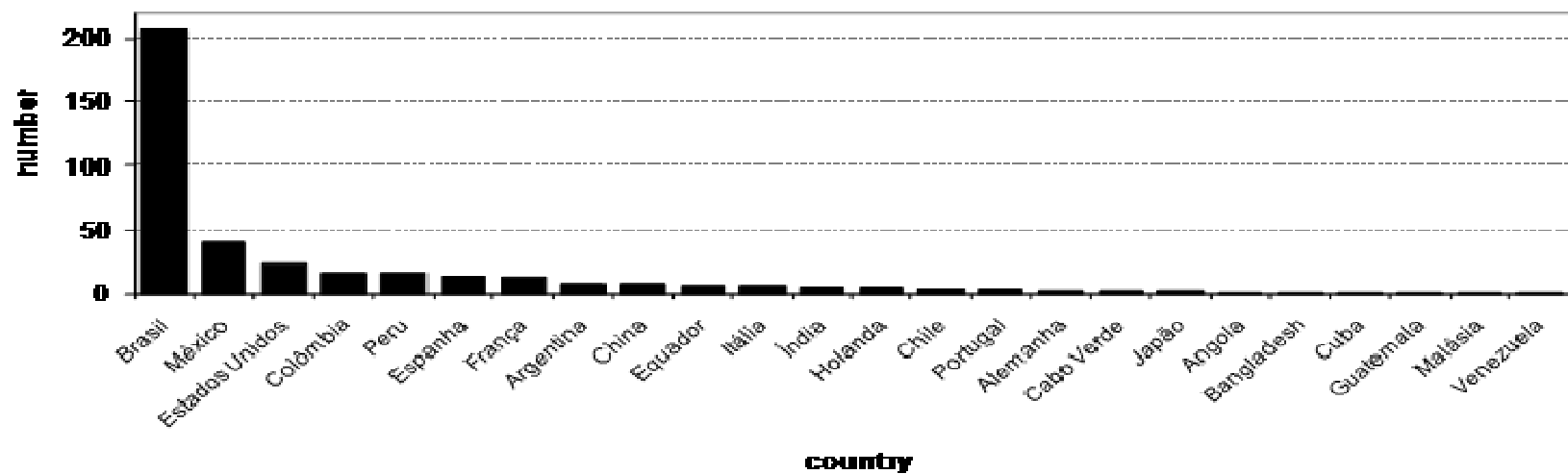
**Puerto Maldonado,
2009**



Dinamica EGO ao redor do Mundo



Users per country



Boas notícias

n Dinamica EGO 1.6 quebra a barreira dos 32 bits

Dinamica EGO 64 bits

XGis



Lmodel



Cchange



Dinamica guide book in three languages

Ciência
apoiando
política pública

Obrigado



Dinamica EGO freeware pode ser baixado de
www.csr.ufmg.br/dinamica