Deforestation, Climate Change and the Fate of the Amazon Forests

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Session II: "The Challenge of Environmental Preservation and Infrastructure Development: The Case for Brazil"
Infrastructure Integration and Environmental Preservation in the Amazon
Brazil Institute of the Woodrow Wilson Center
Washington, DC, 16 January 2008

Foto: David McGrath

Outline of Presentation

- Is there a ‘Tipping Point’ in the Amazon?.
- LUC Drivers and Infrastructure
- A new and sustainable model for the tropics

1
Is there a ‘Tipping Point’ in the Amazon?

Humanity has entered the Anthropocene without truly understanding its consequences.

- Growing understanding that the Earth system with its myriad of ecosystems present highly non-linear responses to human pressure, generating regime shifts and alternate stable states, with long periods of slow change followed by periods of abrupt change.

- The integrated nature of Planet Earth, where atmospheric, terrestrial and oceanic processes interact and reinforce each other, generating system feedbacks.

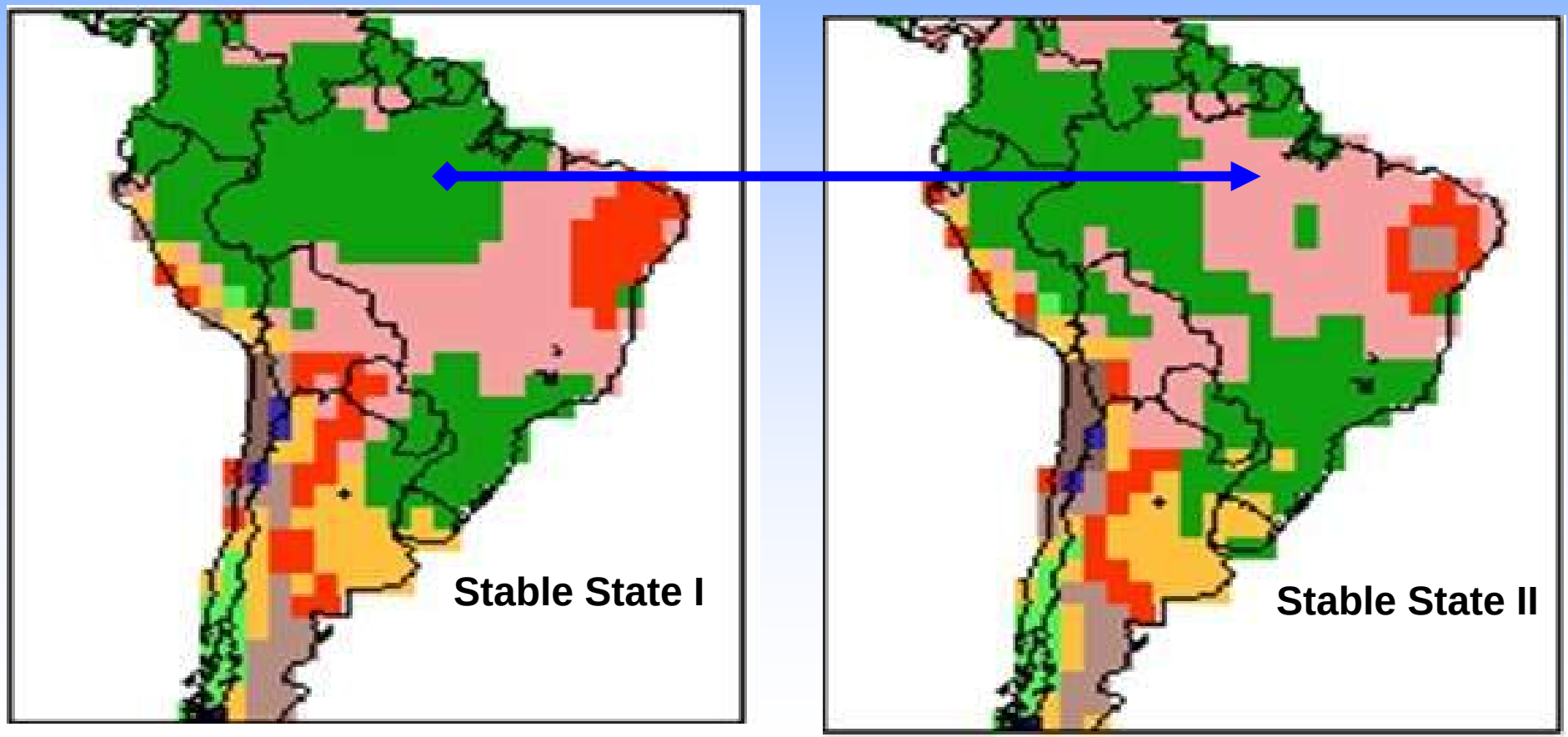
- Nature and humans are intrinsically coupled in social-ecological systems, generating self-reinforcing feedbacks between ecological regime shifts and social transformations.

Are there tipping points we must not cross in the Amazon? How much deforestation? Degree of global warming?

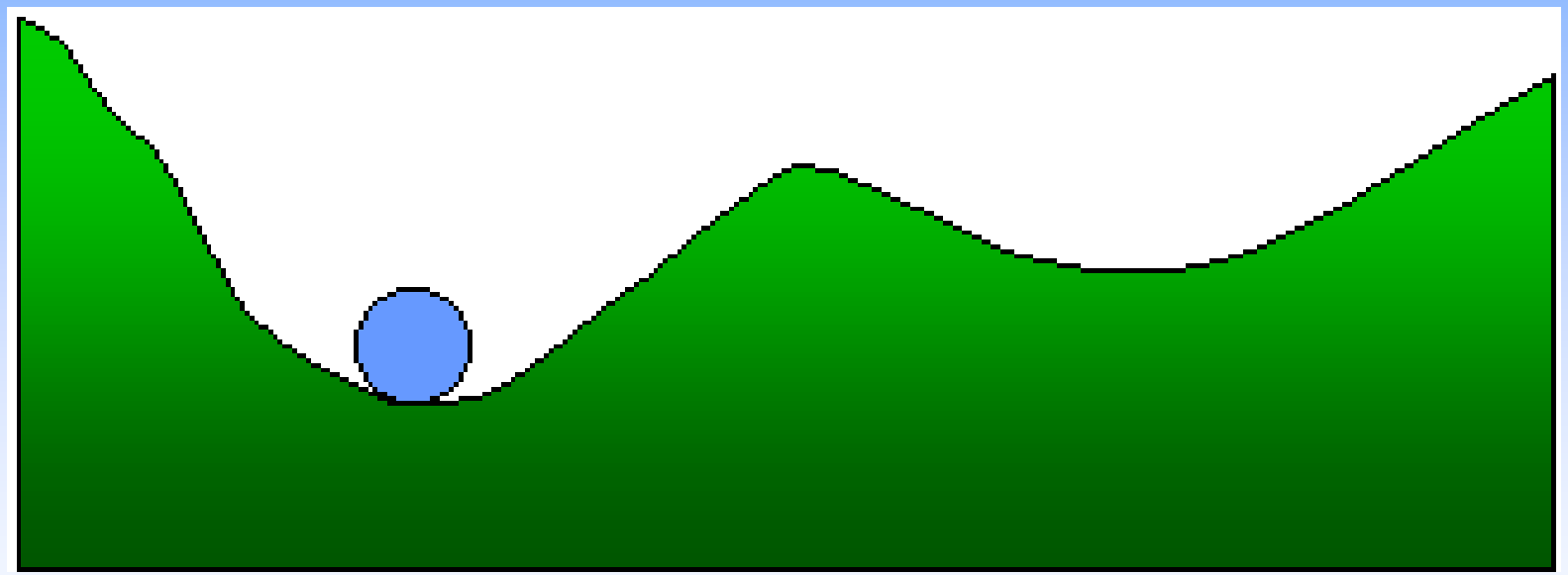
How to to establish a more solid knowledge base on the system-wide boundary conditions for Amazon and planetary sustainability?

Governance and management remain alien to complexities of human life on Planet Earth, and are still focused on optimization of welfare and development under assumptions of eternal linearity and ability to control "nature".

Question: are there “tipping points” of deforestation and/or climate change of other drivers of change to induce abrupt changes to the second biome-climate stable equilibrium?



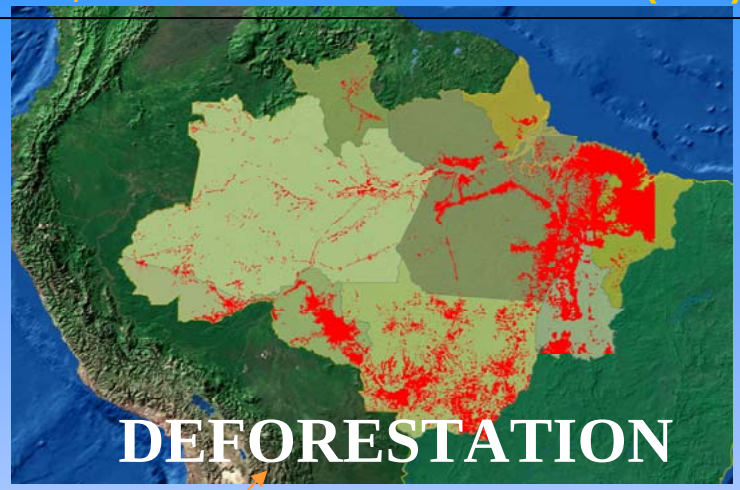
Externally driven equilibrium change



Need to advance our understanding of critical tipping-points and hot-spot systems at risk.

The picture remains relatively scanty, with limited system-wide mapping of thresholds, cross-scale interactions and how system components reinforce each other amplifying the risk of crossing thresholds.

In 2007, total deforested area (clear-cutting) is 700,000 km2 in Brazilian Amazonia (18%)



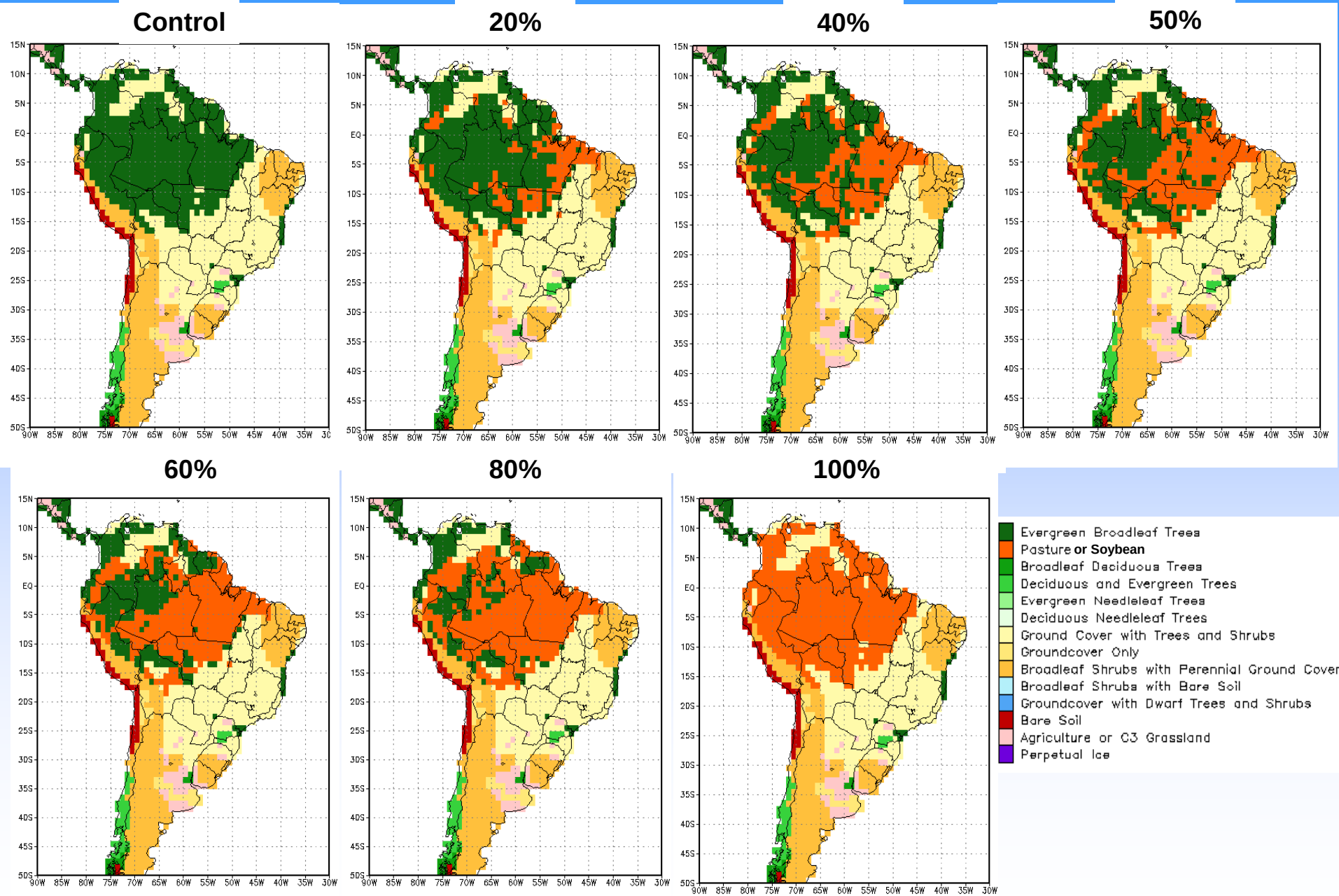
Anthropoenic and Natural Drivers of Environmental Change in Amazonia

Source: Greenpeace/Daniel Beltra

LAND USE AND COVER CHANGE

DEFORESTATION AND BURNING AROUND THE XINGU INDIGENOUS PARK, MATO GROSSO STATE, BRAZIL, 2004.
Source: Tropical deforestation and climate change / edited by Paulo Moutinho and Stephan Schwartzman. -- IPAM - Instituto de Pesquisa Ambiental da Amazônia, 2005.

PROJECTED LAND COVER CHANGE SCENARIOS

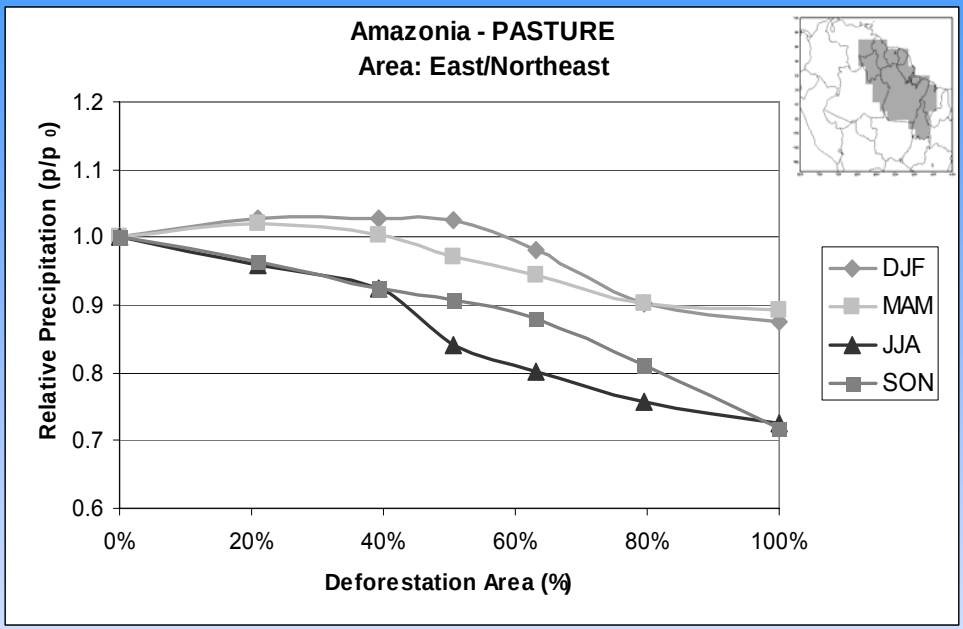


Source: Soares-Filho et al., 2006 - Amazon Scenarios Project, LBA

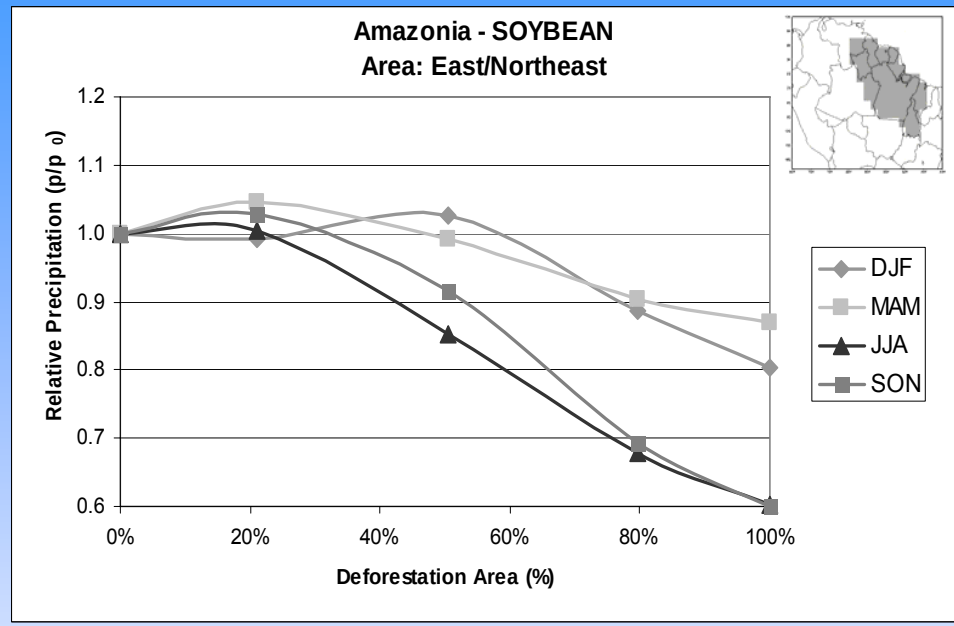
Sampaio et al., 2007

Precipitation

PASTURE



SOYBEAN

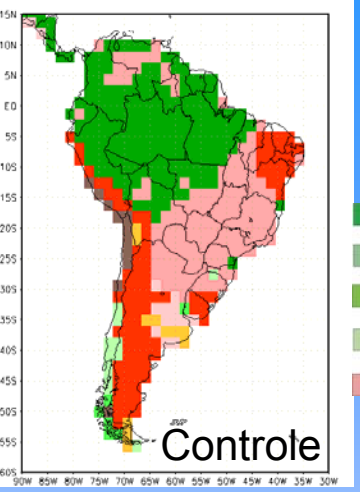


Precipitation Anomaly (%)

Season	All Pasture	All Soybean
JJA	**-27.5%**	**-39.8%**
SON	**-28.1%**	**-39.9%**

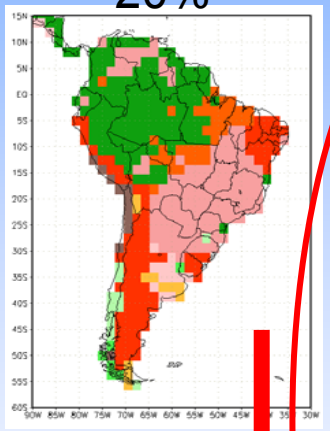
The reduction in precipitation is larger during the **dry season**, and is more evident when the deforested area is larger than 40% !

Sampaio et al., 2007

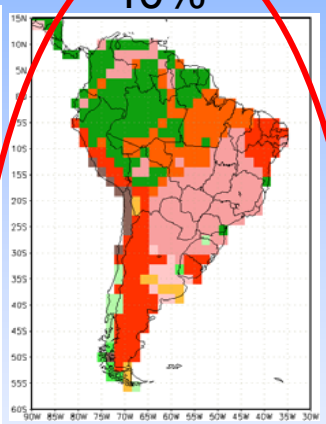


Threshold of Deforestation at 40%!

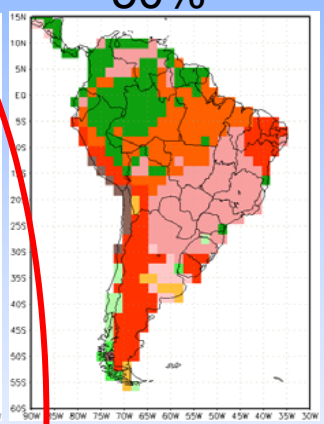
20%



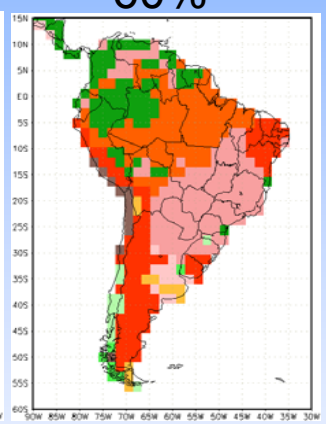
40%



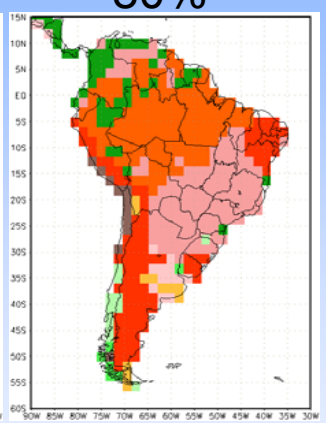
50%



60%



80%



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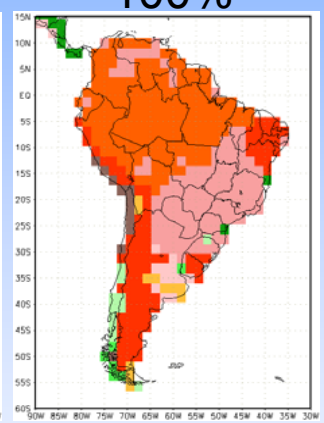
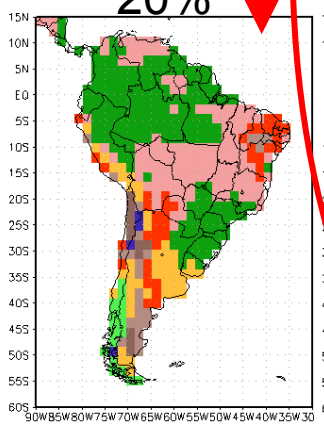
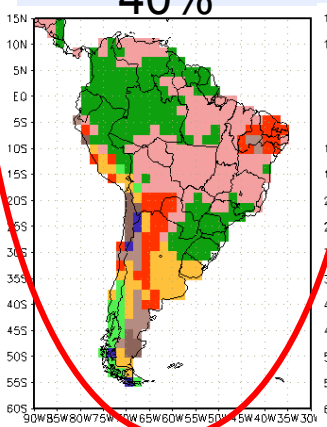


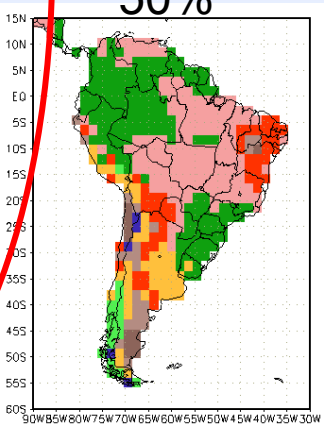
20%



40%



50%



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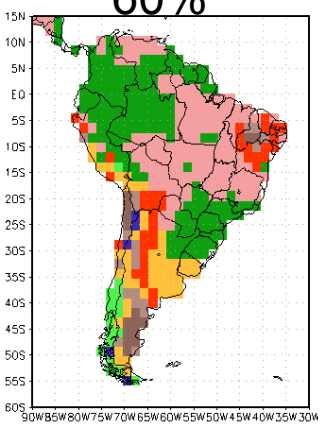

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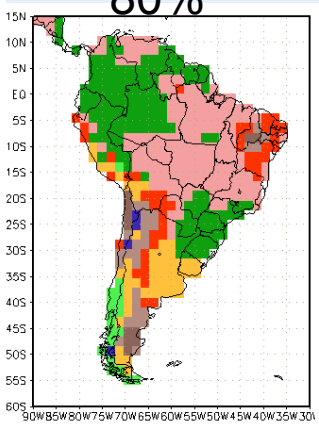

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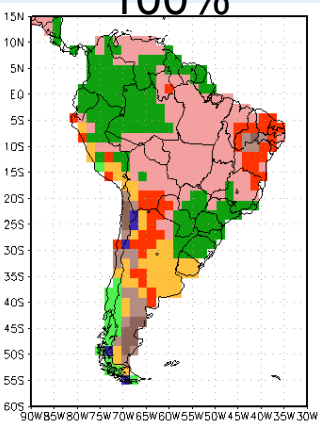
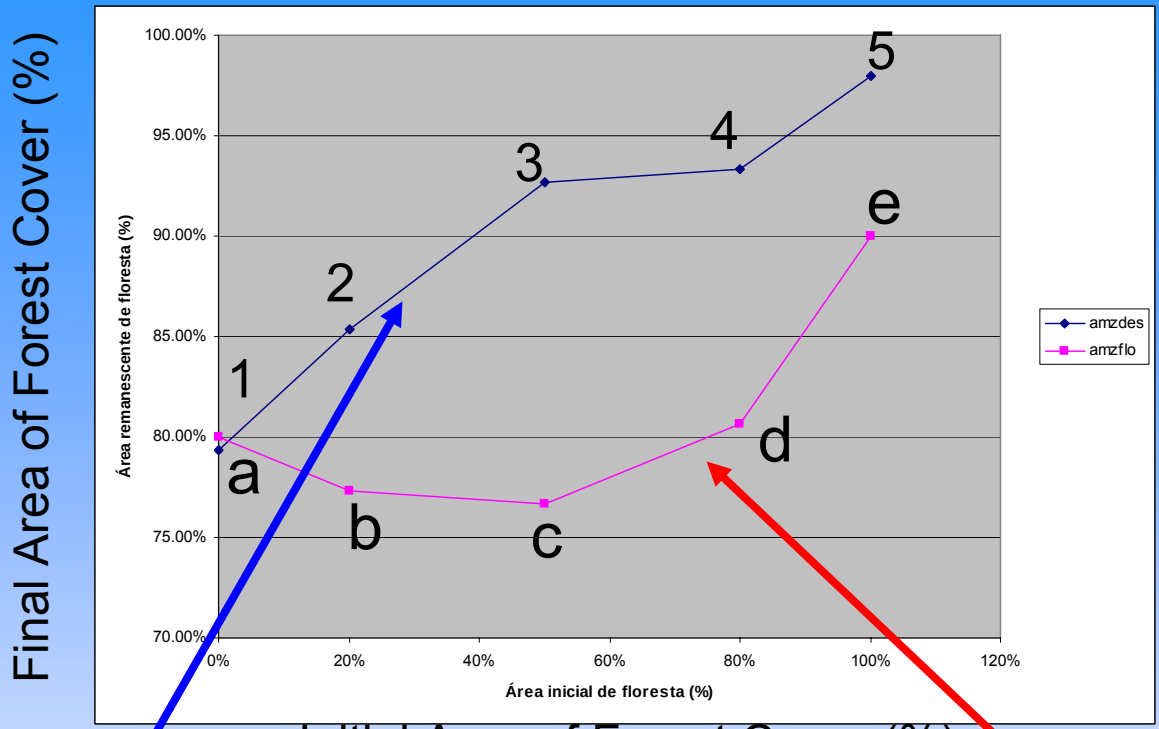
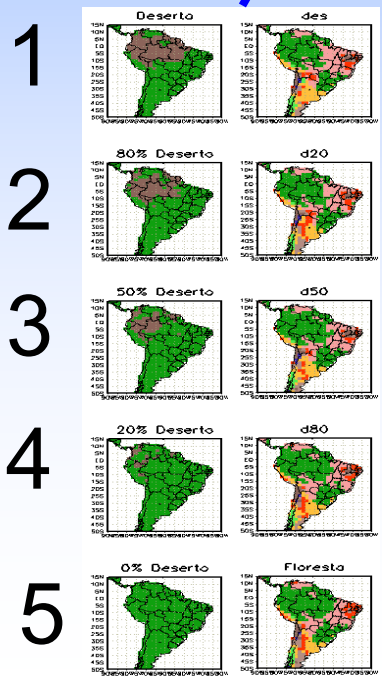
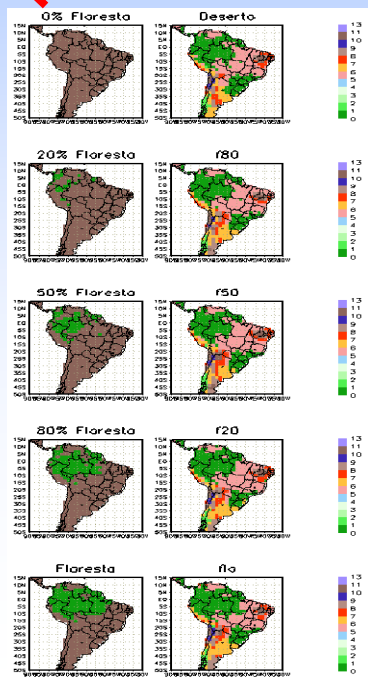




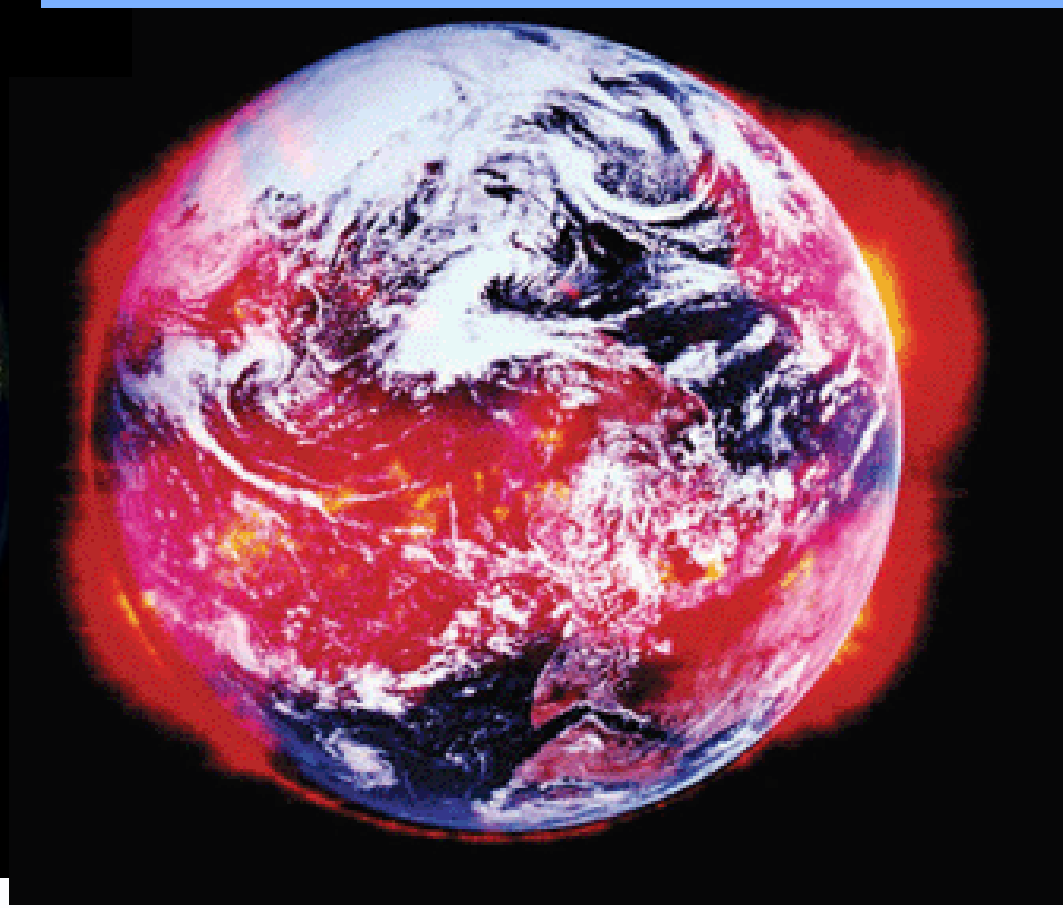
Initial Area of Forest Cover (%)



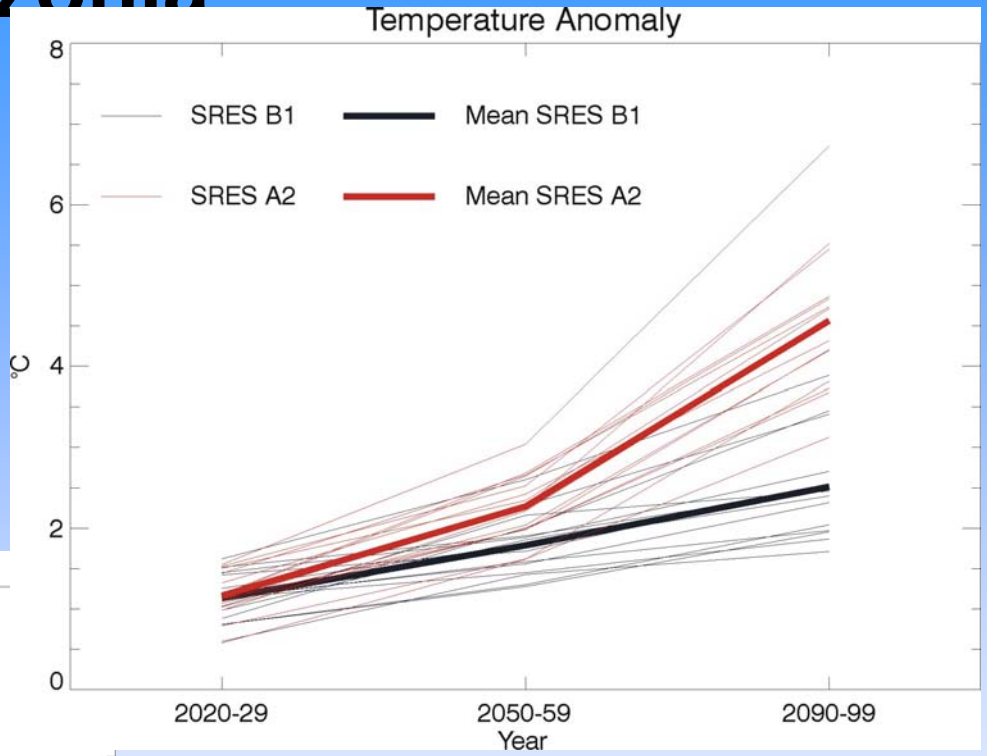


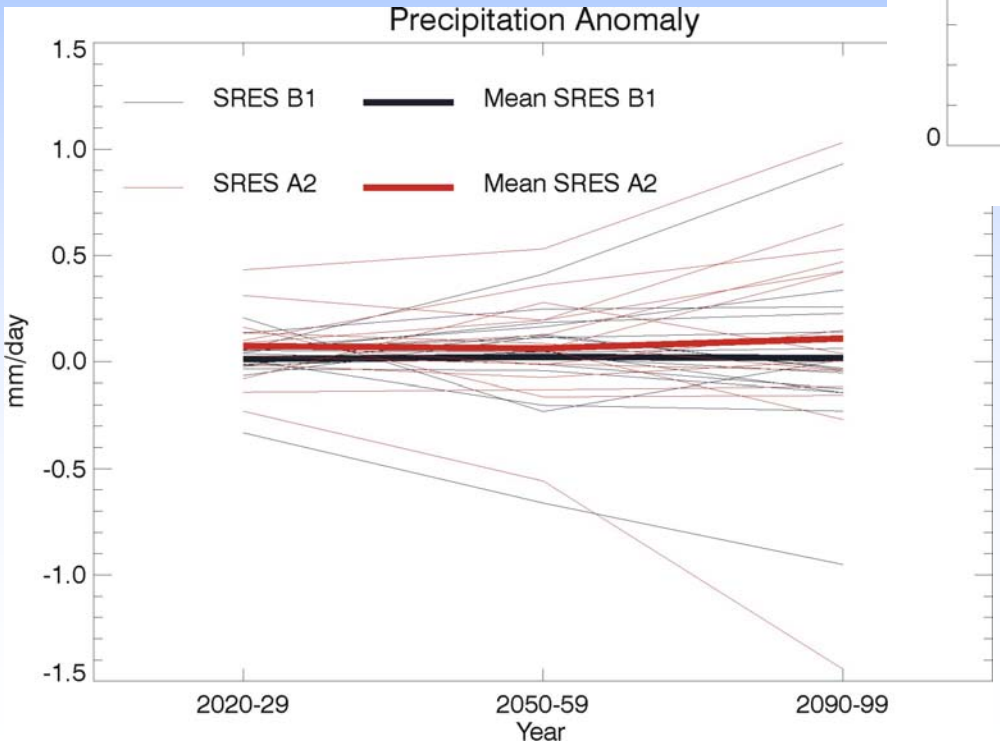
Sampaio 2008 PhD Thesis

GLOBAL WARMING



Climate Change Scenarios for Amazonia

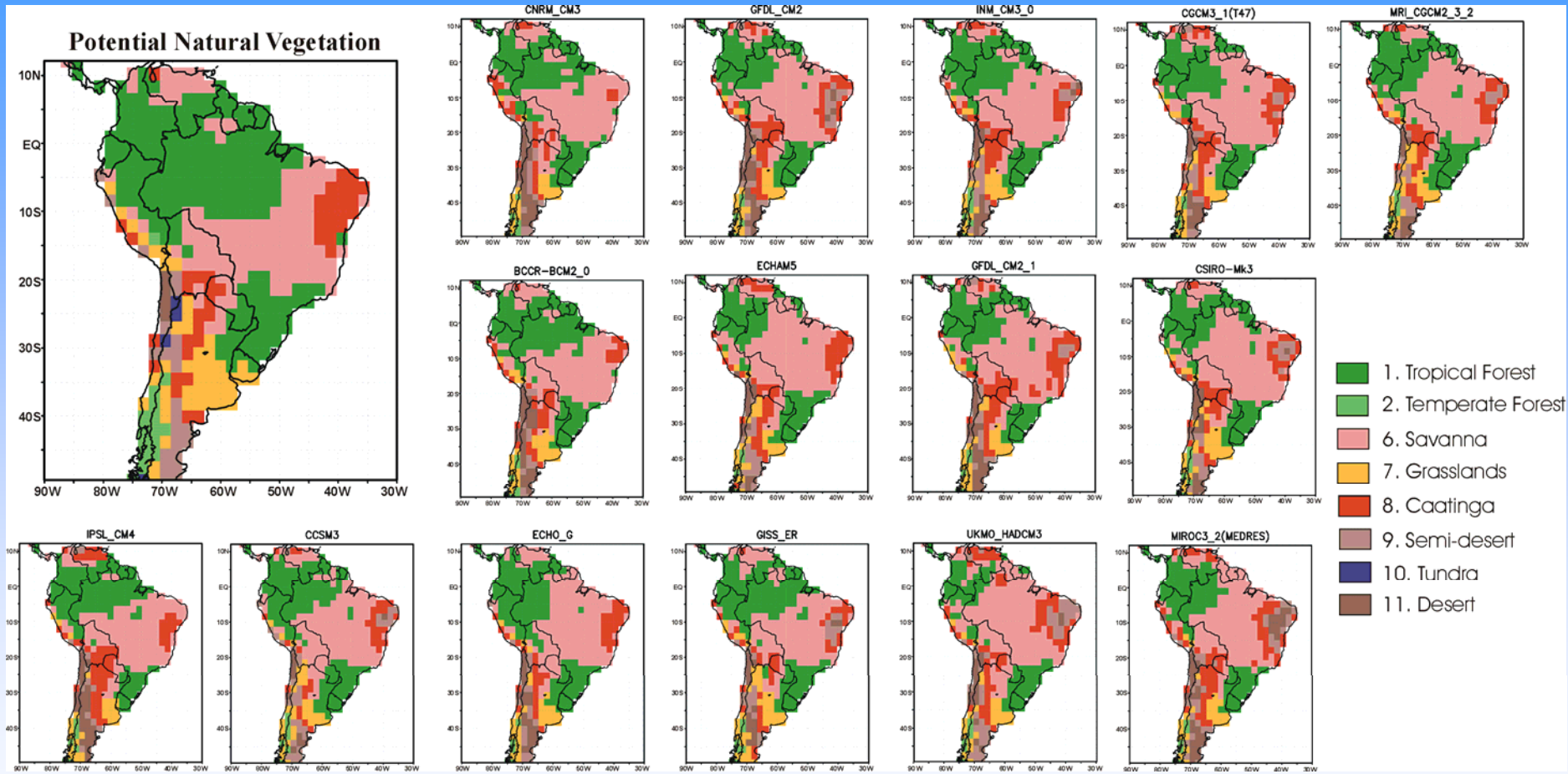




Results from 15 AOGCMs for the SRES A2 and B1 emissions scenarios, prepared for the IPCC/AR4.

Models: BCCR-BCM2.0, CCSM3, CGCM3.1(T47), CNRM-CM3, CSIRO-MK3, ECHAM5, GFDL-CM2, GFDL-CM2.1, GISS-ER, INM-CM3, IPSL-CM4, MIROC3.2 (MEDRES), MRI-CGCM2.3.2, UKMO-HADCM3, ECHO-G

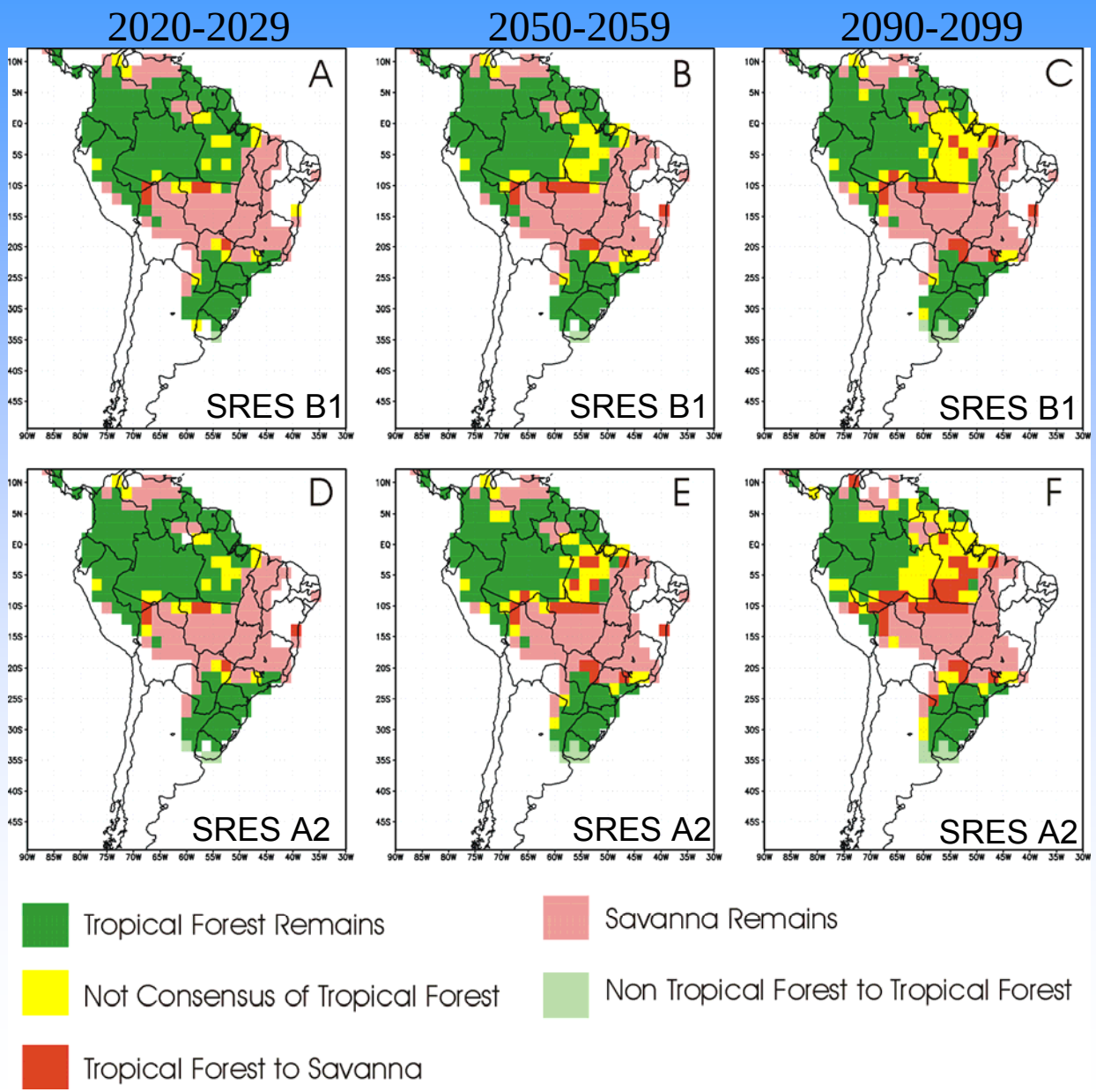
Climate Change Consequences on the Biome distribution in tropical South America



Projected distribution of natural biomes in South America for 2090-2099 from 15 AOGCMs for the A2 emissions scenarios, calculated by using CPTEC-INPE PVM.

Salazar et al., 2007

Climate Change Consequences on the Biome distribution in tropical South America



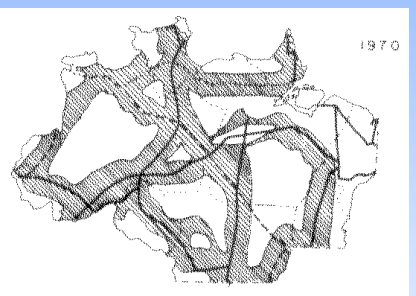
Grid points where more than 75% of the models used (> 11 models) coincide as projecting the future condition of the tropical forest and the savanna in relation with the current potential vegetation. The figure also shows the grid points where a consensus amongst the models of the future condition of the tropical forest was not found. for the periods (a) 2020-2029, (b) 2050-2059 and (c) 2090-2099 for B1 GHG emissions scenario and (d), (e) and (f) similarly for A2 GHG emissions scenario.

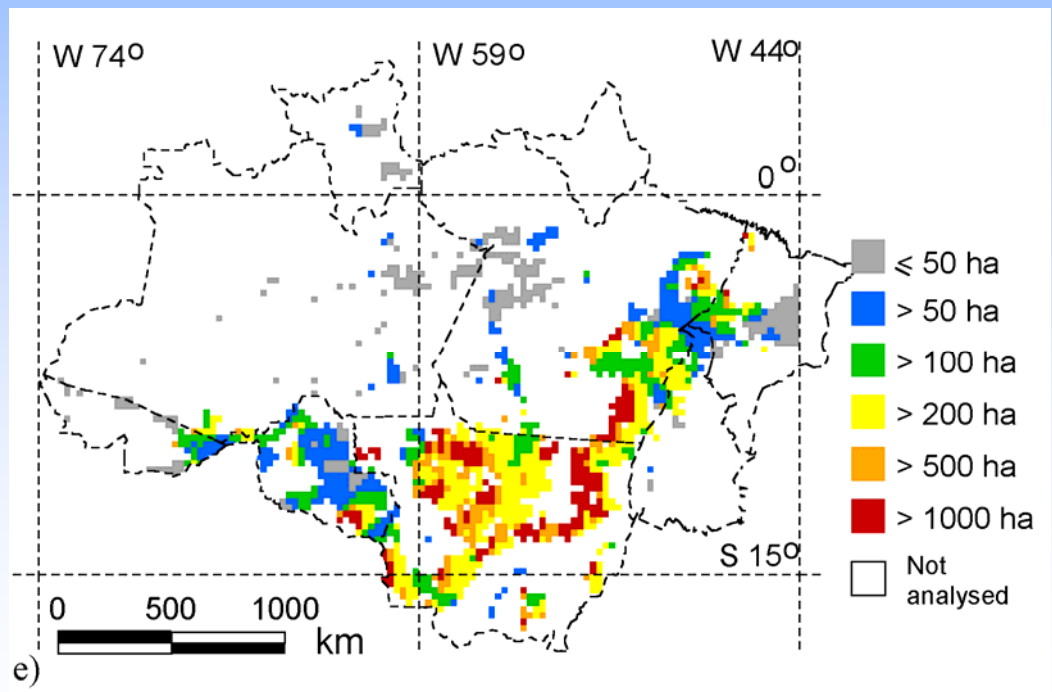
Salazar et al., 2007 GRL (accepted)

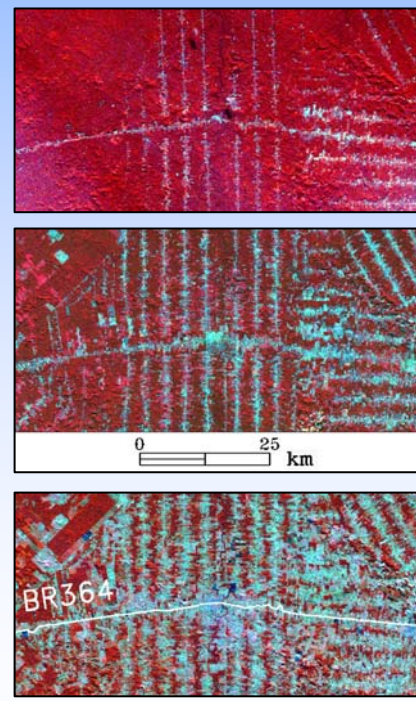
2

LUC Drivers and Infrastructure

- **desmatamento acompanhou *Eixos* (do PIN) e *Pólos* (dos PND)**
- **90% dentro de 100 km dos eixos rodoviários principais (1991-1997)**
- **86% dentro de 25 km das áreas de desmatamento "pioneiro" anos 70**
- **concentração - limites Cod Flor 1965 são excedidos frequentemente**
- **agregação de clareiras ⇒ "inversão" da matriz *(predomínio de pastos e culturas com poucos remanescentes florestais)***

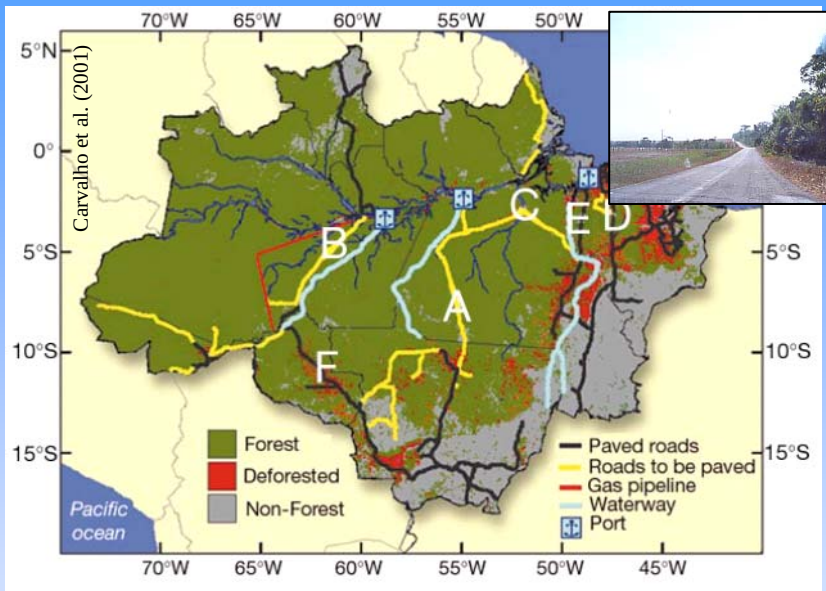






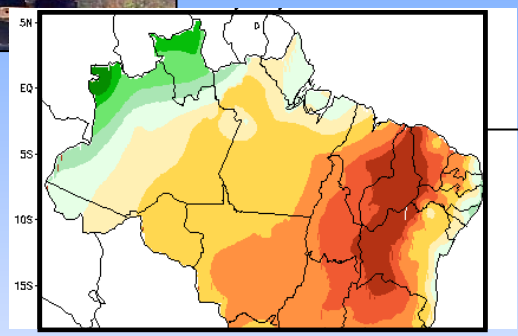
Anos: 1977, 1985, 1995 (floresta < 20%)

FIRES and ROADS



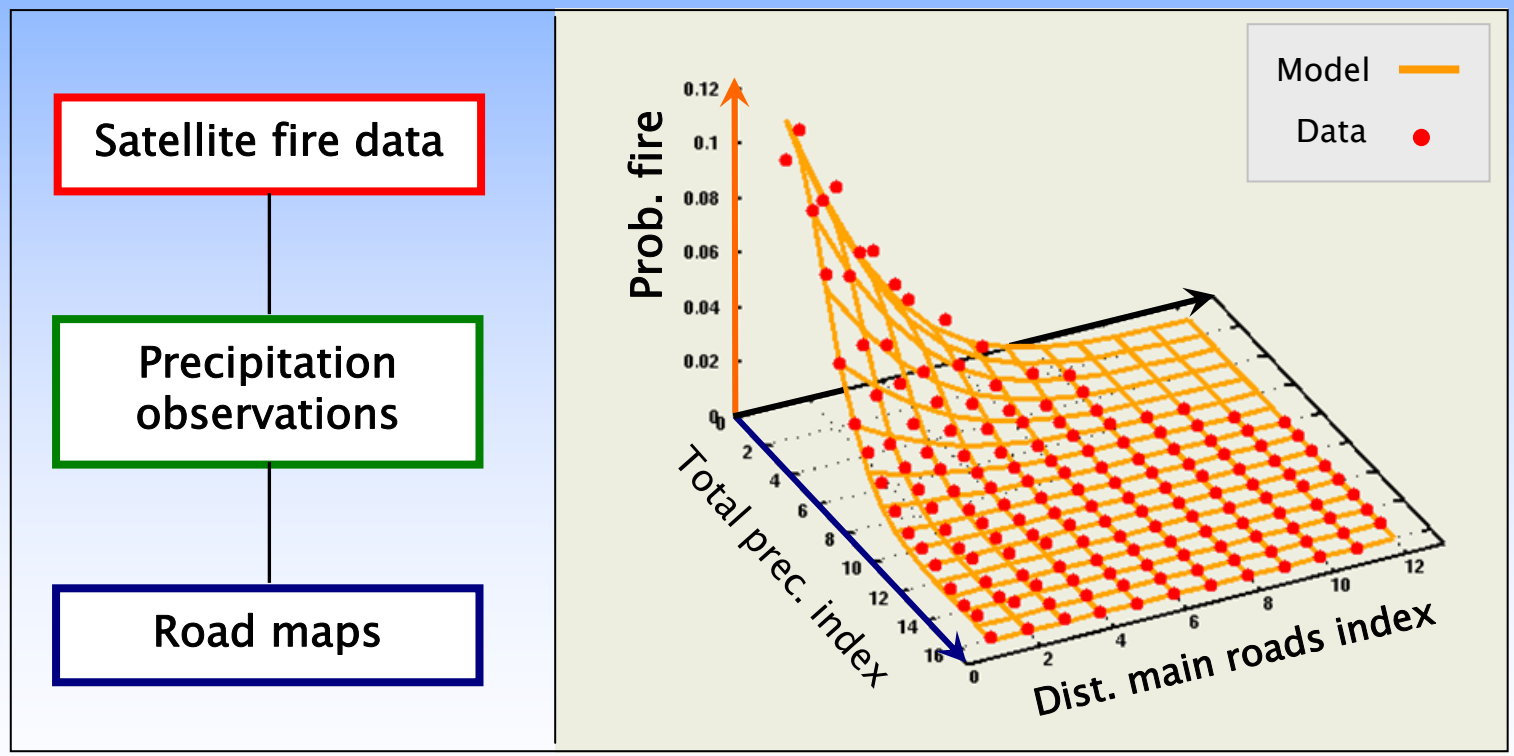
Land use

Dry season



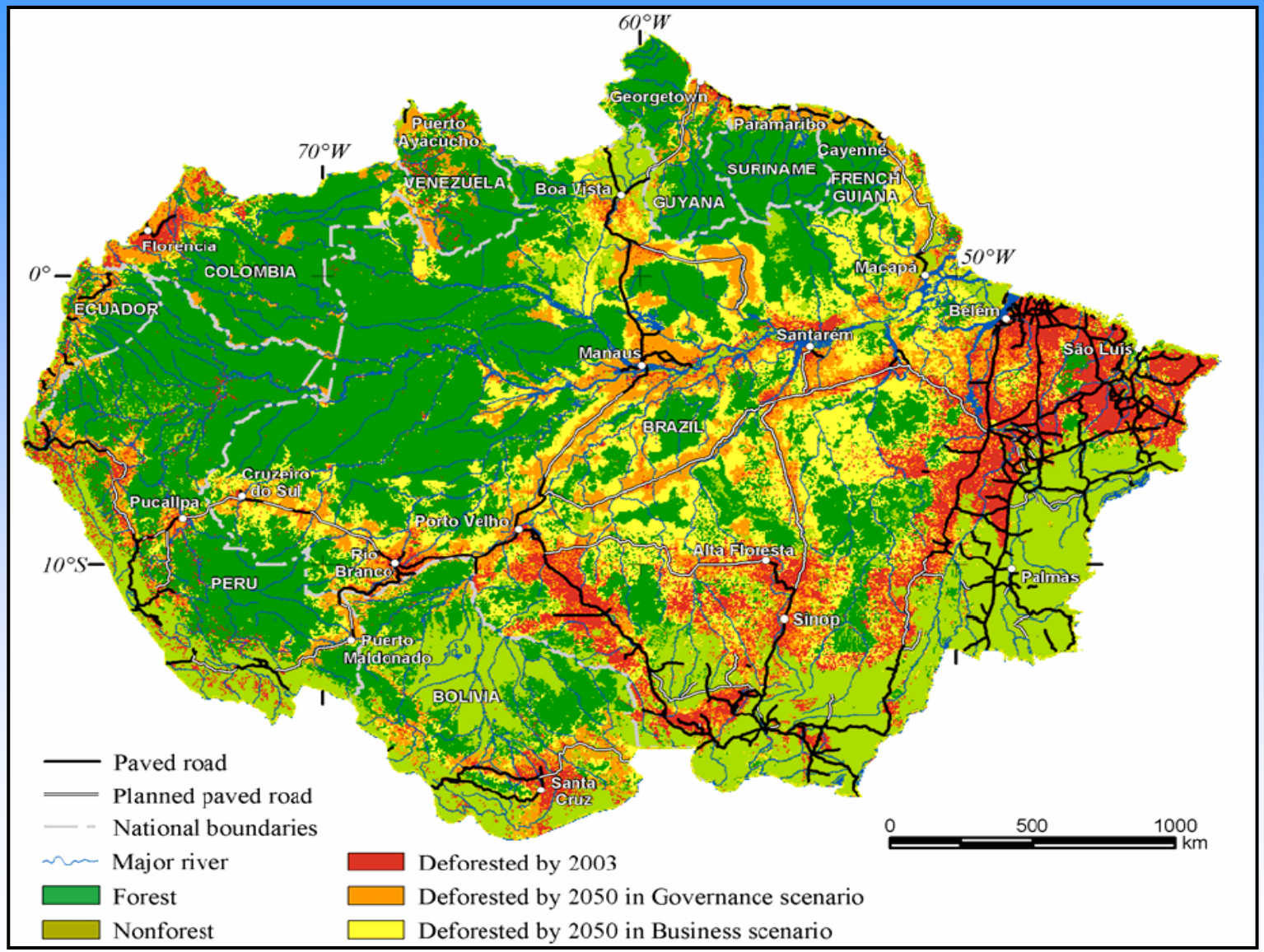
At year-decade time scales, the majority of fires in Amazonia occur during the dry season as a result of land use

Using remote-sensing fire data, we found new statistical relations between precipitation and distance to main roads, which are the major drivers for yearly-decade fire activity in the region:



Cardoso et al. (2003, 2007)

Roads and Deforestation, Deforestation and Roads …



Estimated deforestation in the Amazon by 2050

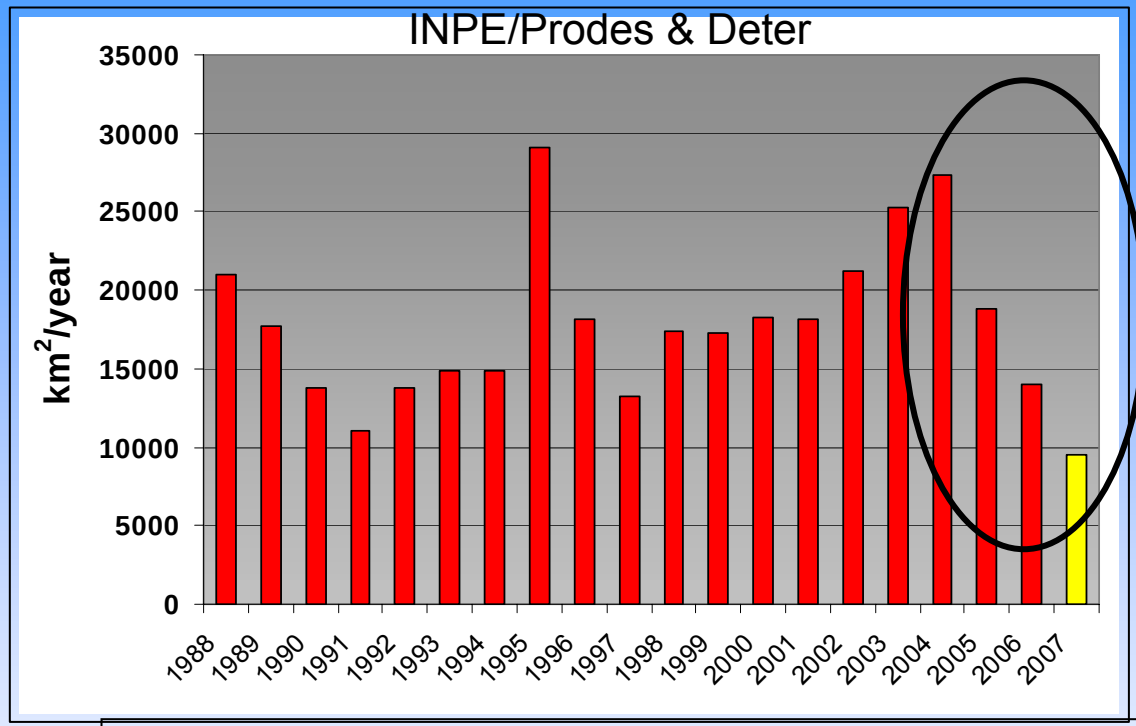
Amazon Scenarios Project; Soares-Filho et al., 2004

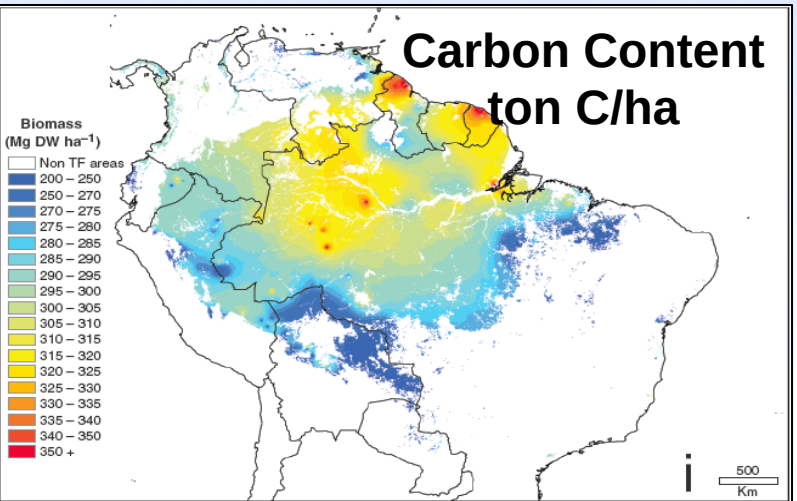
3

A new and sustainable model for the tropics

Avoided emissions from deforestation reductions make more sense

- 2004: 27.361 km² deforested in Brazilian Amazon
- 2005 – 2007: ~<u>60% reduction in deforestation</u>





≈17,000 km² avoided deforestation in 3 years (base line at 20,000 km²/year)

220 Mton C avoided emissions

~ US$ 2.2 bn value in carbon

Main services of Tropical Forests

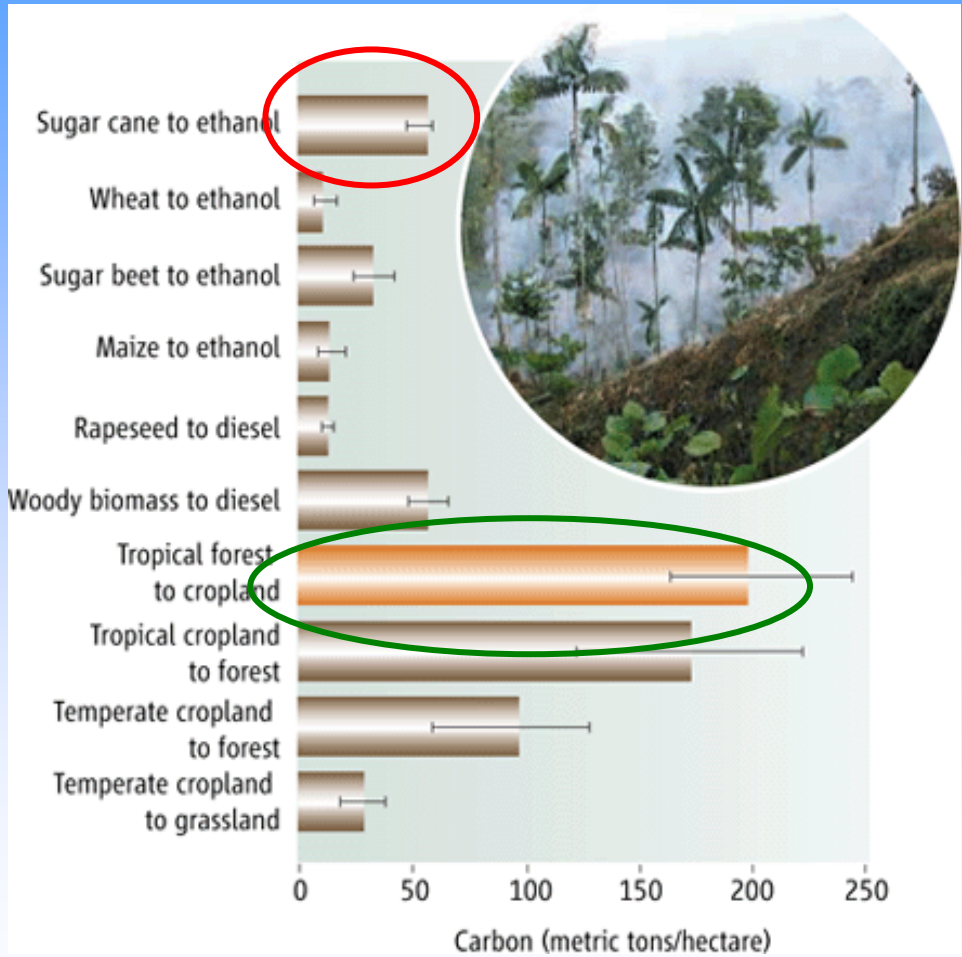
- Decreasing tropical deforestation rates by 50% up to 2050
- Up to 15% of avoided CO_2 emissions for stabilization at 550 ppm

Estimated cumulative reductions in carbon emissions achievable by 2100 through reducing tropical deforestation. Calculations assume (i), deforestation rates observed in the 1990s decline linearly from 2010–50 by either 20 or 50%, and (ii) that deforestation stops altogether when either 15 or 50% of the area remains in each country that was originally forested in 2000 (*1*).

Gullison et al., 2007 Science

Biofuels are no panacea …

- If the prime object of biofuels is mitigation of CO_2-driven global warming, in the short term (30 years or so) it is better to focus on increasing the efficiency of fossil fuel use
- Conversion of large areas of land to biofuel crops may place additional strains on the environment



Righelato and Spracklen, *Science* 17.Aug.2007

Need for a new model in the tropics

Can Brazil become an ‘environmental’ power?

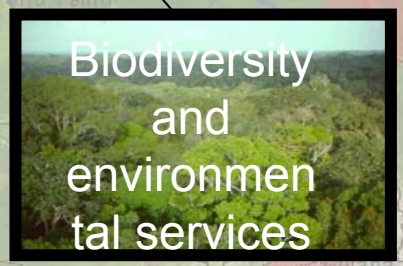
Can Brazil become an ‘environmental’ power?

Yes, but if and only if Brazil can create a completely new paradigm for the sustainable development of the Amazon …

Is there hope beyond the traditional model of development?

Challenge:
How to develop the Amazon sustainably?

Regional Plan



Main cities
Main rivers
Countries
Cuiabá-Santarém and Transoceanica Highways
Cuiabá-Santarem and

The concept of ITAs: "Institutes of Technology for Amazonia"

- Network of several Institutes of Technology focused on economic and environmental questions of regional importance
- Technological education, graduate programs and advanced research addressing specific areas (e.g., forest products, aquatic products, mineral resources, biodiversity, ecosystem services, etc.).
- Relatively small in size (200 to 500 faculty size; 1000 to 1500 undergraduate and graduate students)
- State-of-the-art research labs

The concept of ITAs: "Institutes of Technology for Amazonia"

- Two-tier approach for R&D
  - Development of capacity for 'globalization' of 50 to 100 products of biodiversity (science base, appropriate technologies, capacity of entrepreneurship, full productive chain approach)
  - High end technology: biotechnology, biomimicry and nanosciences

- International cooperation in all levels (education, fundamental and applied research) seen as essential

THANK YOU!