



MINISTÉRIO DA CIÊNCIA E TECNOLOGIA  
**INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS**

# *Ferramentas de modelagem de mudanças de uso da terra e emissões*

Celso von Randow, Francisco Gilney Bezerra, Talita Assis,  
Diego Melo,

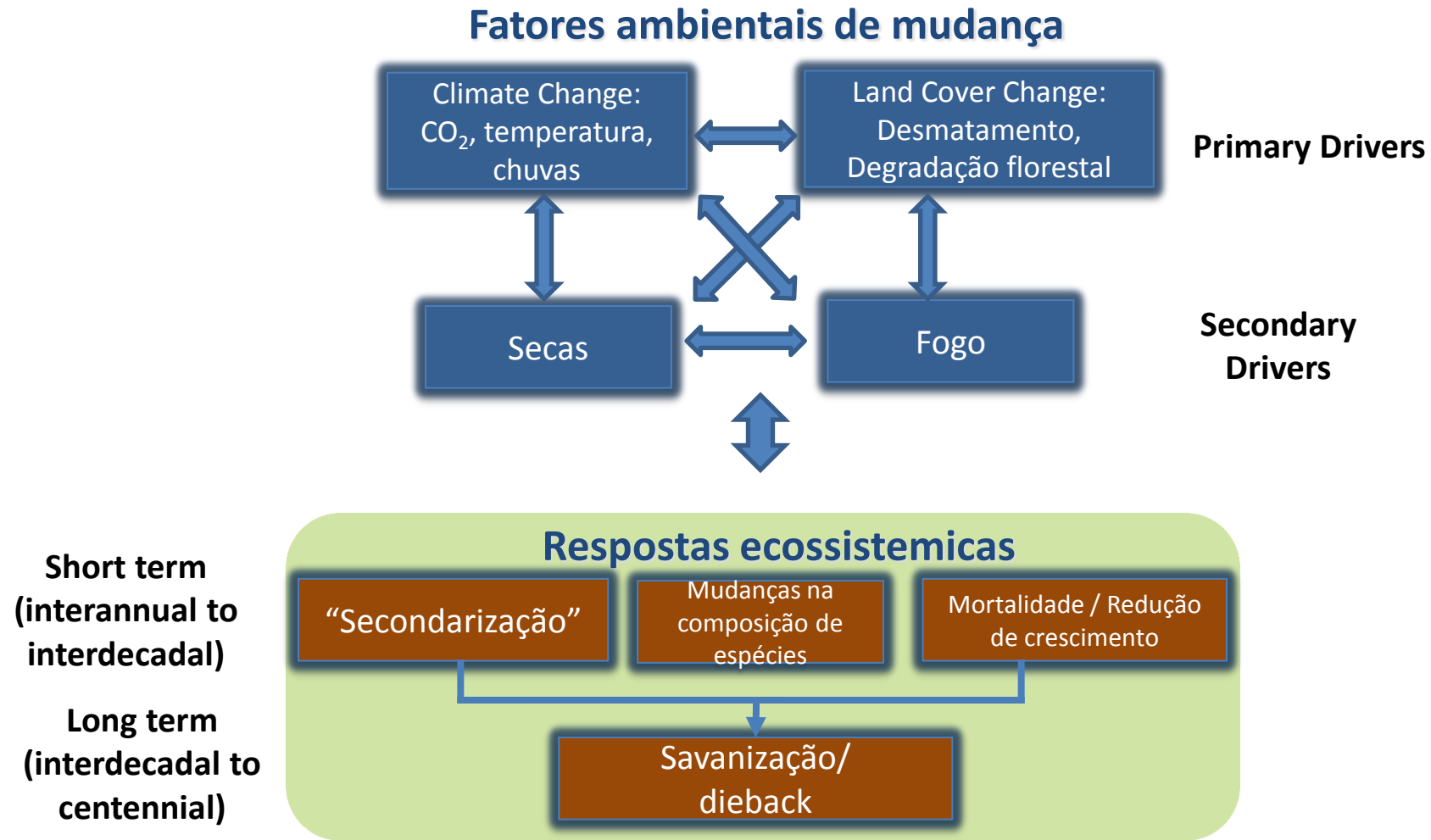
Rodrigo Avancini, Pedro Andrade, Ana Paula Dutra Aguiar



# Impactos do desmatamento no clima regional



# Possíveis impactos no bioma Amazônico relacionados a um conjunto de fatores ambientais de mudança



"Savanização" aqui refere-se mais ao contexto de mudança climática regional sem intenção de descrever os complexos processos ecológicos de substituição da vegetação.



# Efeitos Climáticos de um desmatamento de grande escala

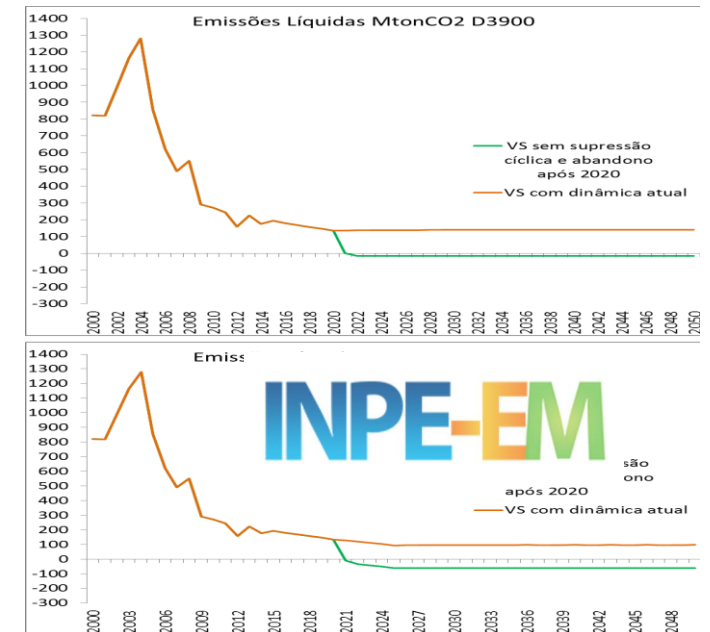
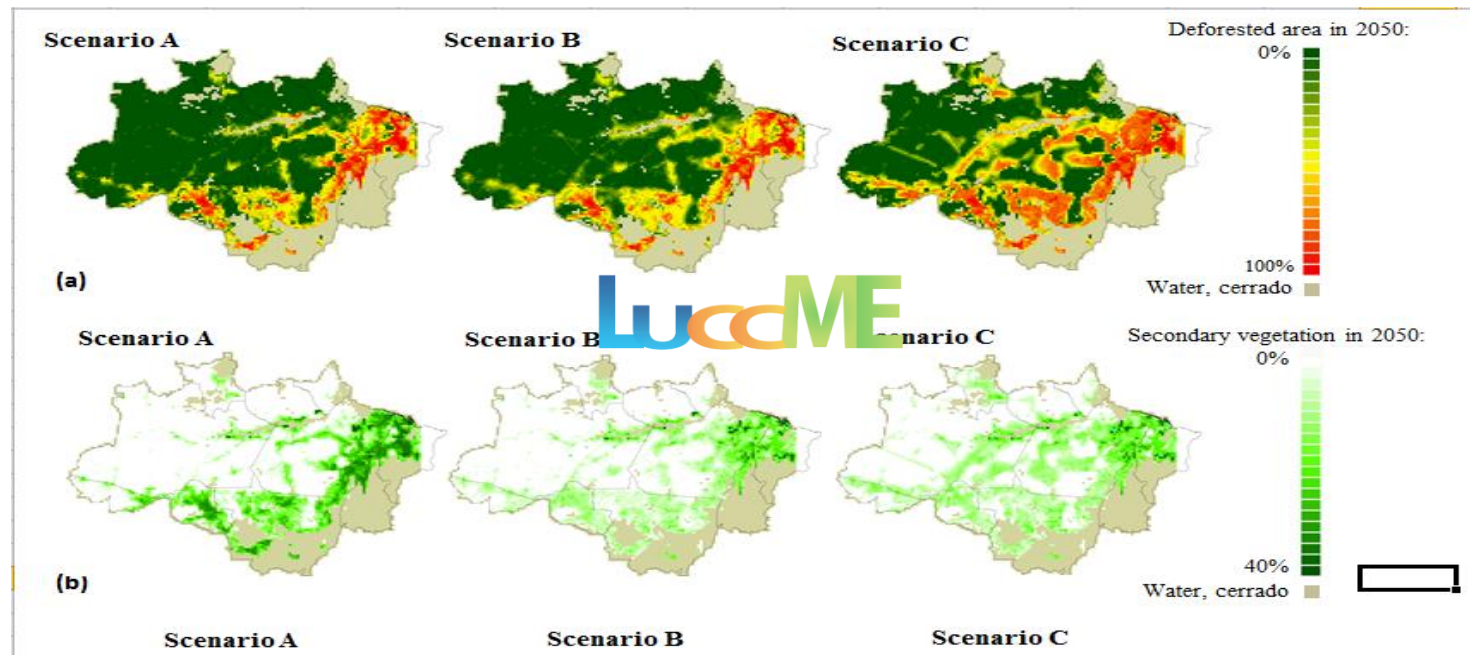
## Simulações Numéricas de desmatamento na Amazônia

- Aumento na temperatura da superfície: 0.3°C a 3.0°C
- Redução na evapotranspiração : 15% a 30%
- Redução na precipitação: 5% a 20%
- Aumento na duração da estação seca

Sources: Lean e Warrilow-1989; Nobre, et al.-1991; Henderson-Sellers et al.-1993; Lean et al.-1993, Sud et al.-1996, Lean et al.-1996, Manzi e Planton-1996, Rocha et al.-1996, Hahmann e Dickinson.-1997, Costa e Foley-2000, Rocha-2001, Werth e Avissar-2002, Voldoire e Royer-2004 e Correia-2005, Sampaio et al., 2007, Costa et al., 2007.

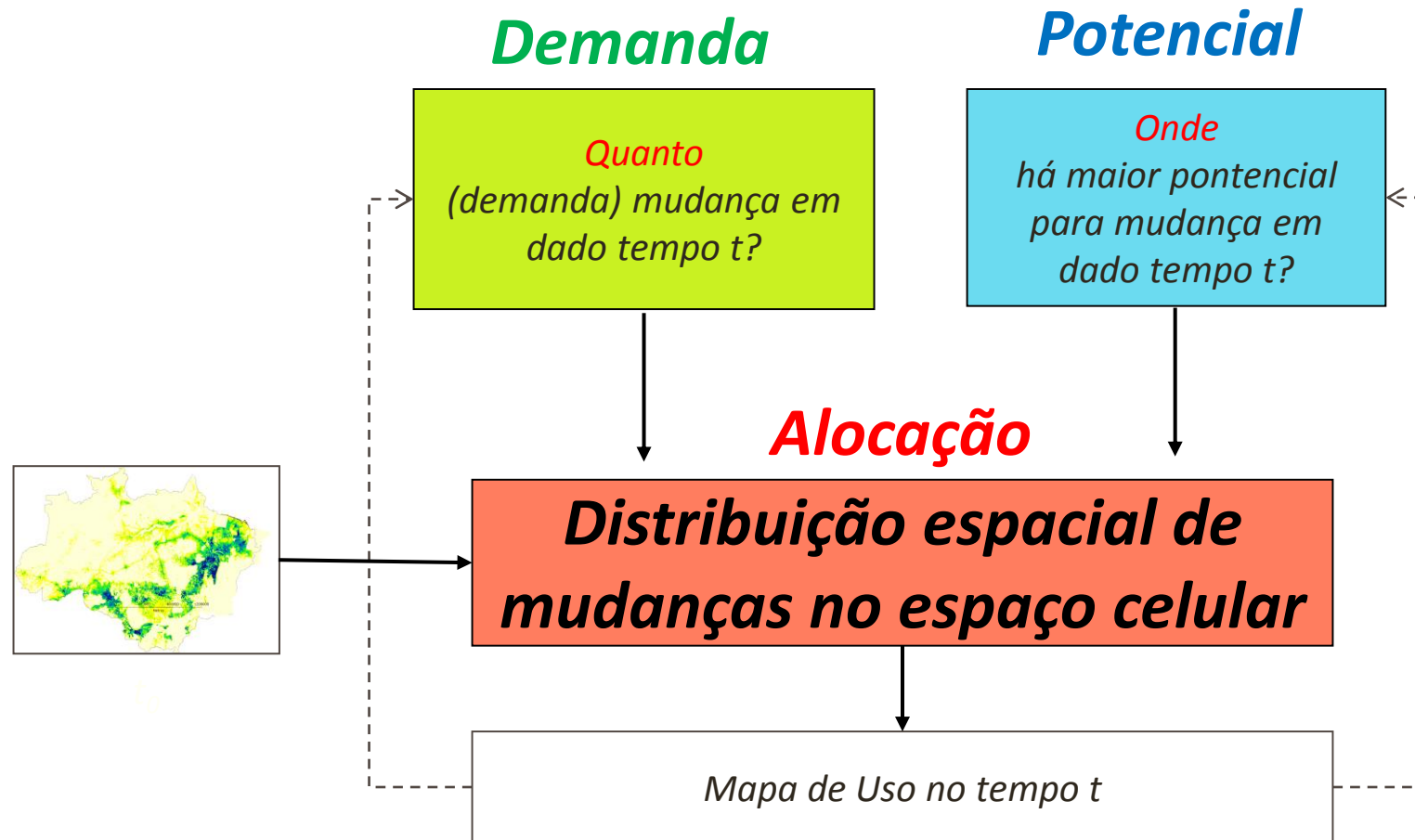
# Plataformas Open source

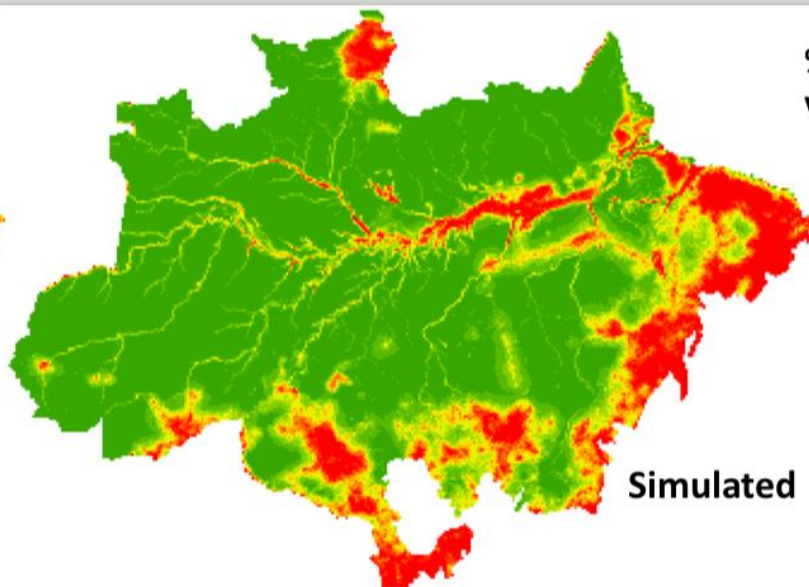
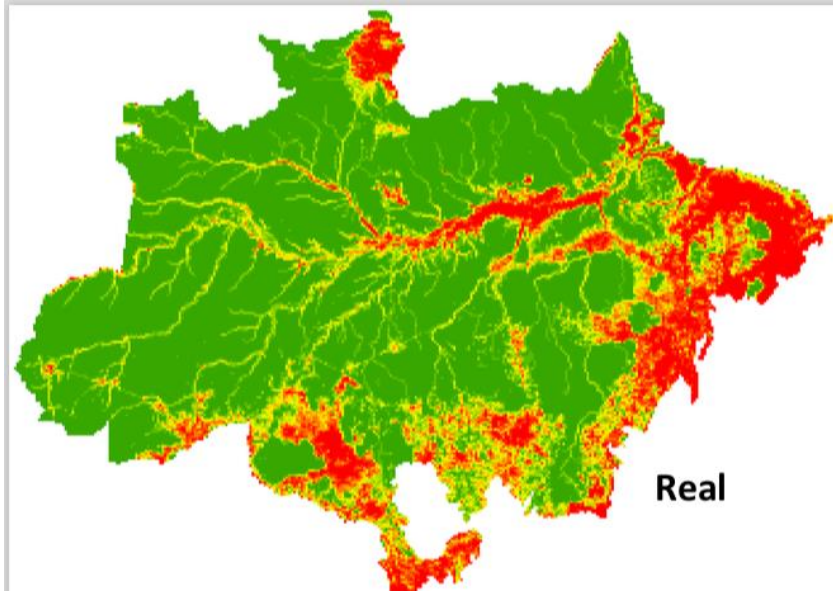
- **TerraME** - conjunto de ferramentas que apoiam todas as fases do processo de desenvolvimento de modelos ambientais
- **LuccME** - extensão do TerraME para construção de modelos de mudança de uso ou cobertura da terra
- **INPE-EM** – modelo tipo ‘book-keeping’, estima emissões por LUC e decomposição/queima da biomassa remanescente dos desmatamentos ocorridos nos anos anteriores



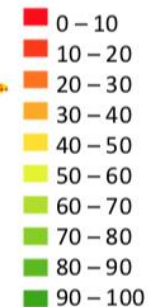
# *LuccME framework*

## *Estrutura geral de modelos de alocação em células*



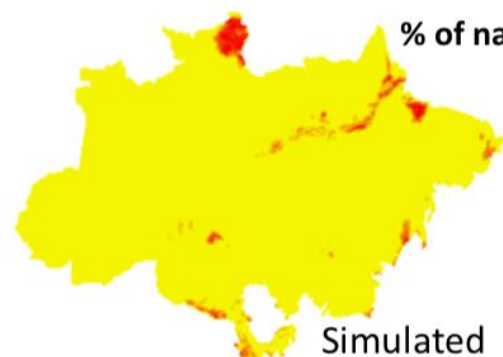


% of natural  
vegetation

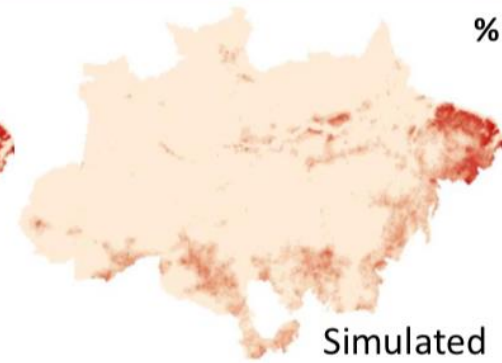
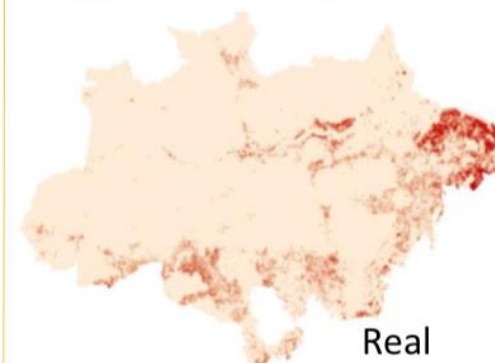
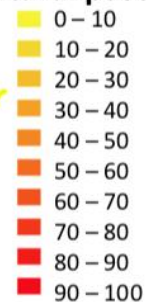


# Land use and cover change in 2010 for the Amazon Biome

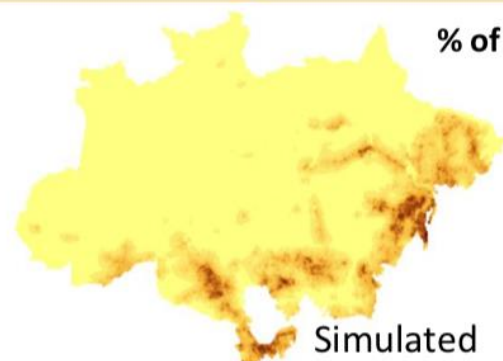
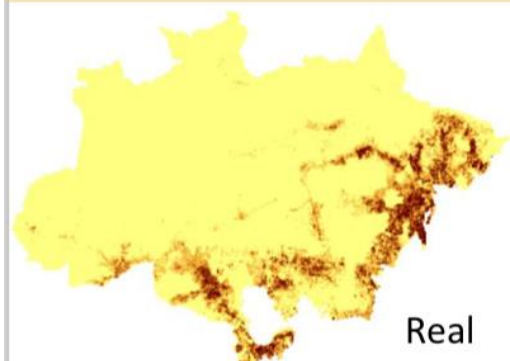
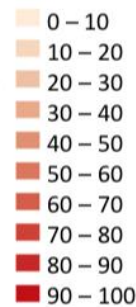
**LUCCME**



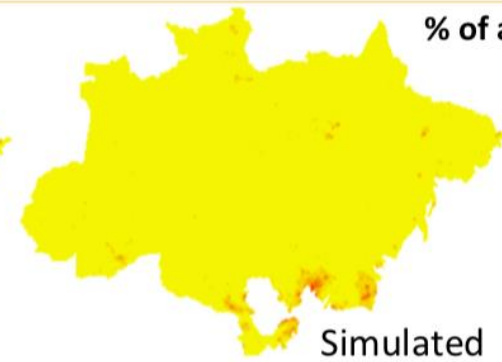
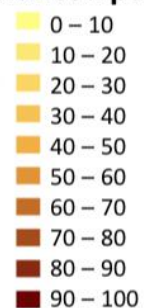
% of natural pasture



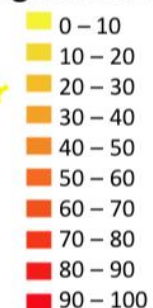
% of mosaic



% of planted pasture



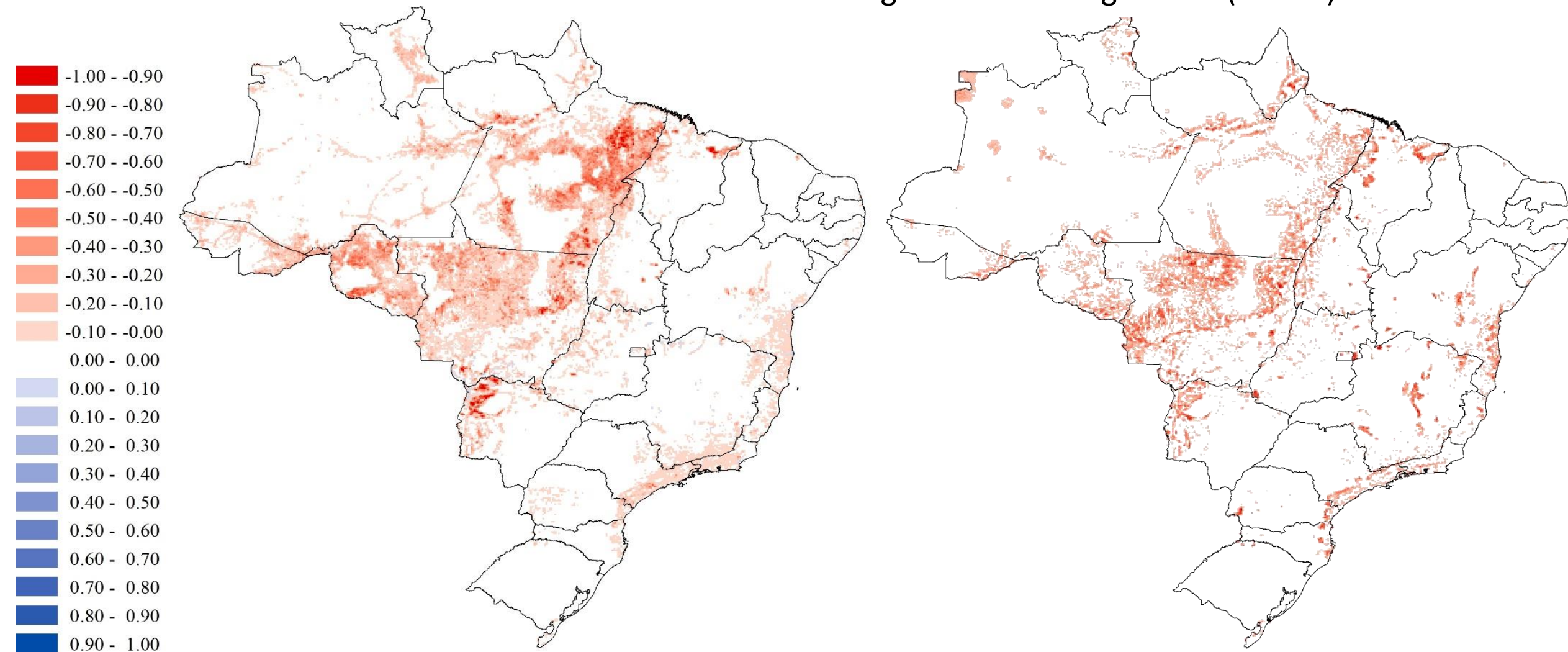
% of agriculture





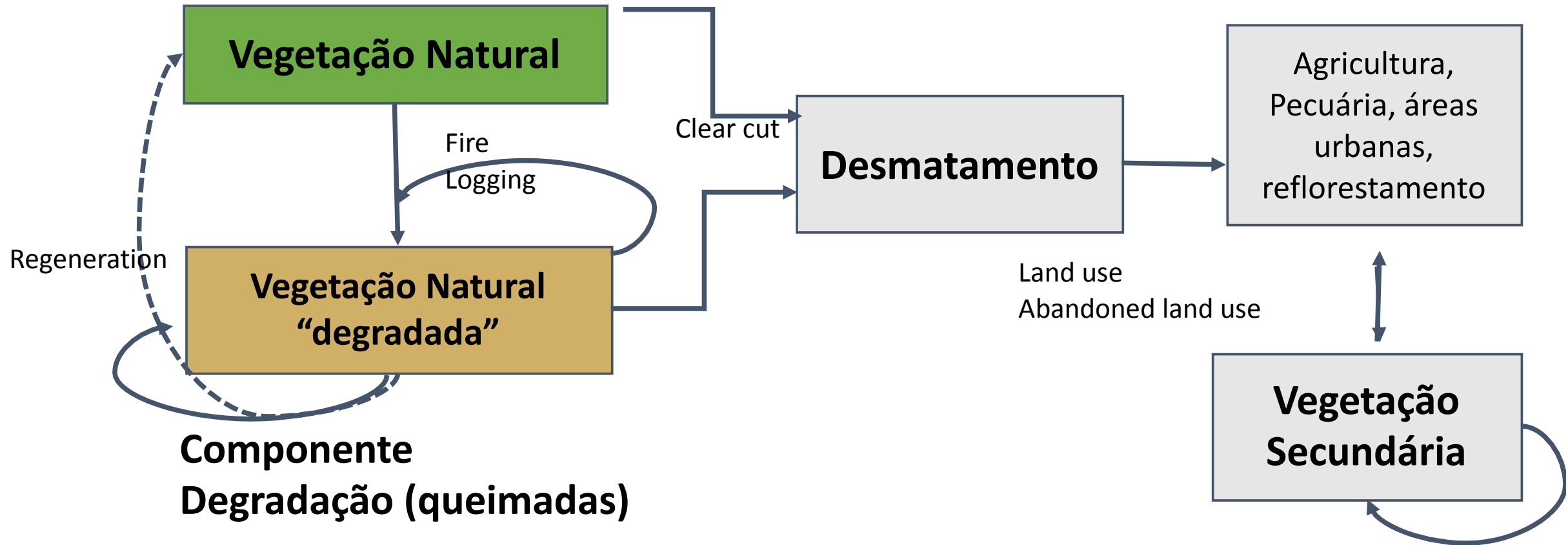
Change in Natural vegetation(obs) 2000-2010

Change in Natural vegetation (model) 2000-2010





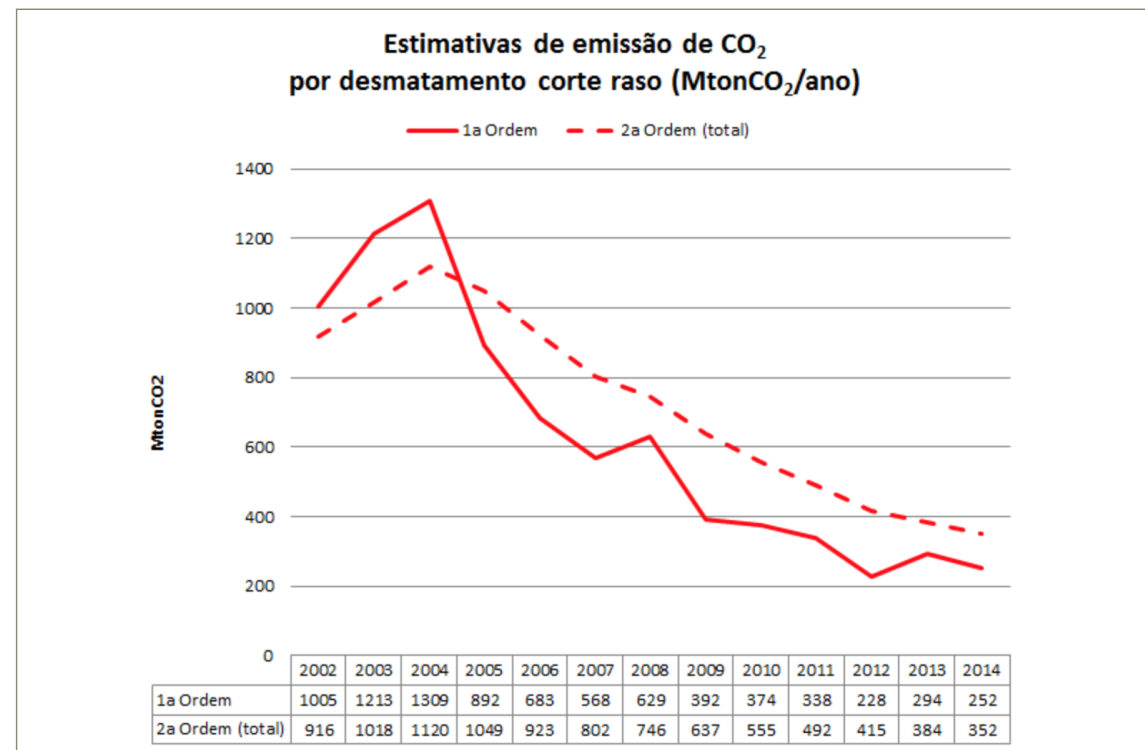
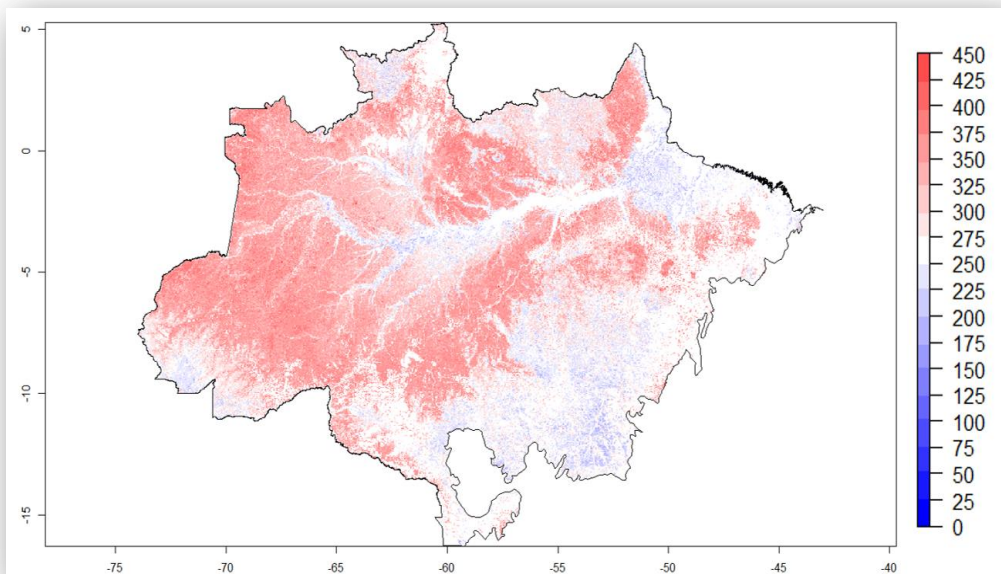
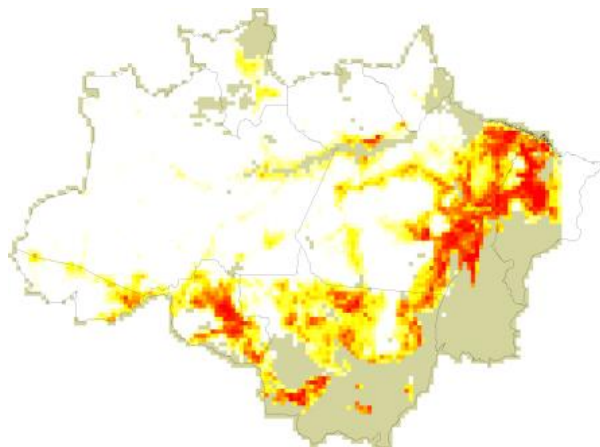
# INPE Emissions Model (INPE-EM)



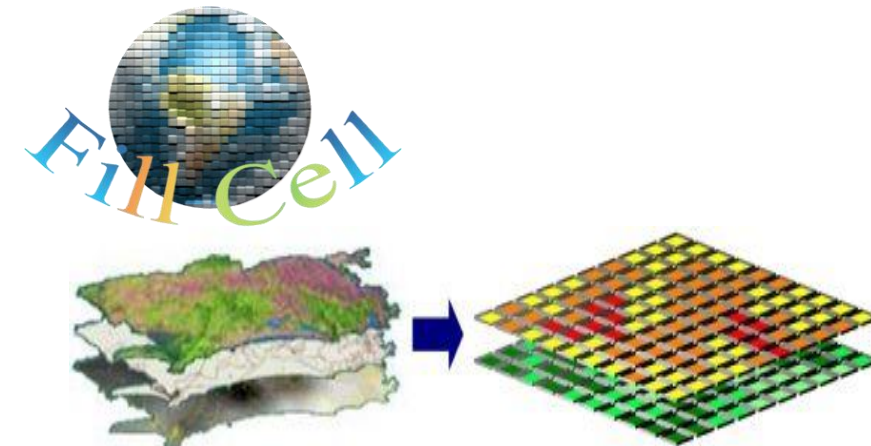
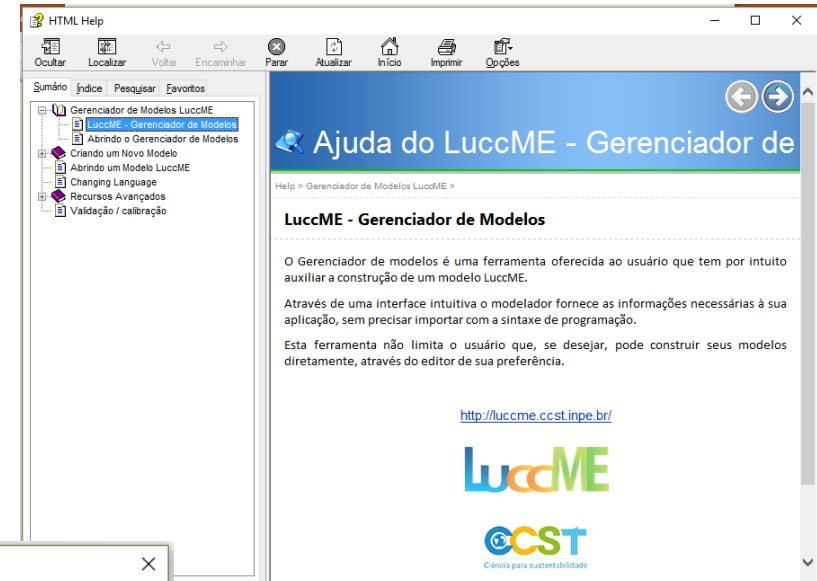
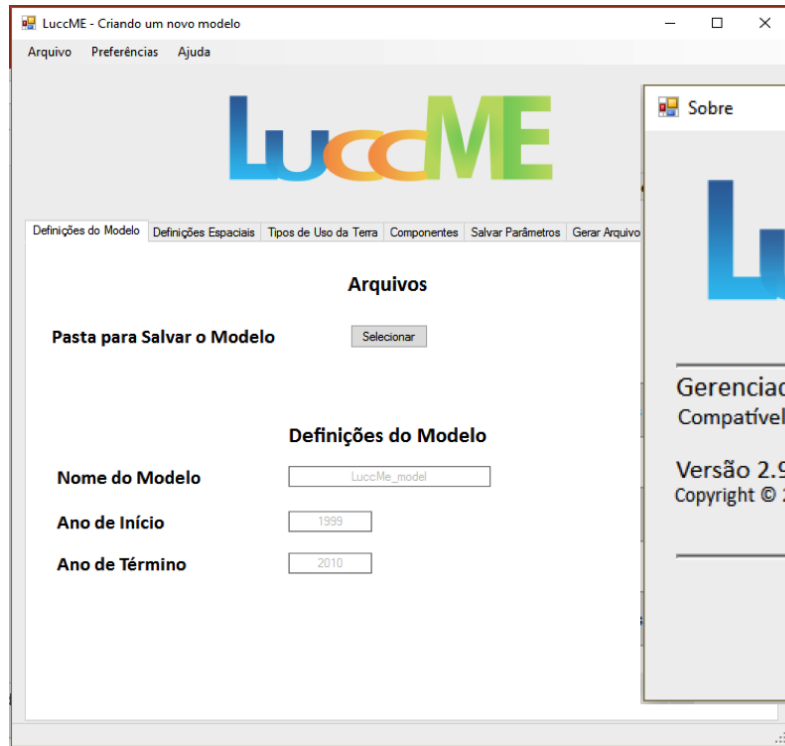
- emissões brutas/líquidas de diferentes gases GEE ( $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{N}_2\text{O}$ ,  $\text{NO}_x$ ,  $\text{CO}$ );
- estatísticas tabulares por bioma, estado e município; distribuição espacial



# INPE Emissions Model (INPE-EM)



# Interface gráfica, novas funcionalidades, documentação





# Disseminação

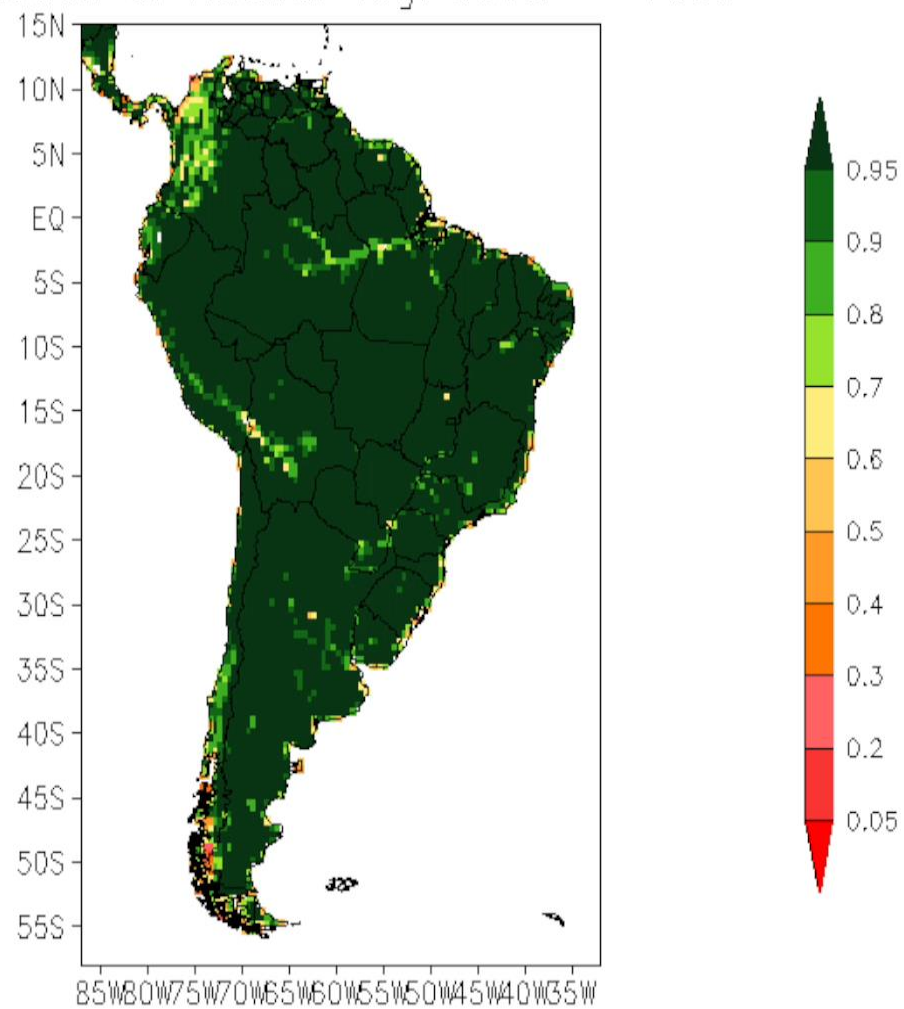
> 350 downloads do modelo

5 treinamentos presenciais

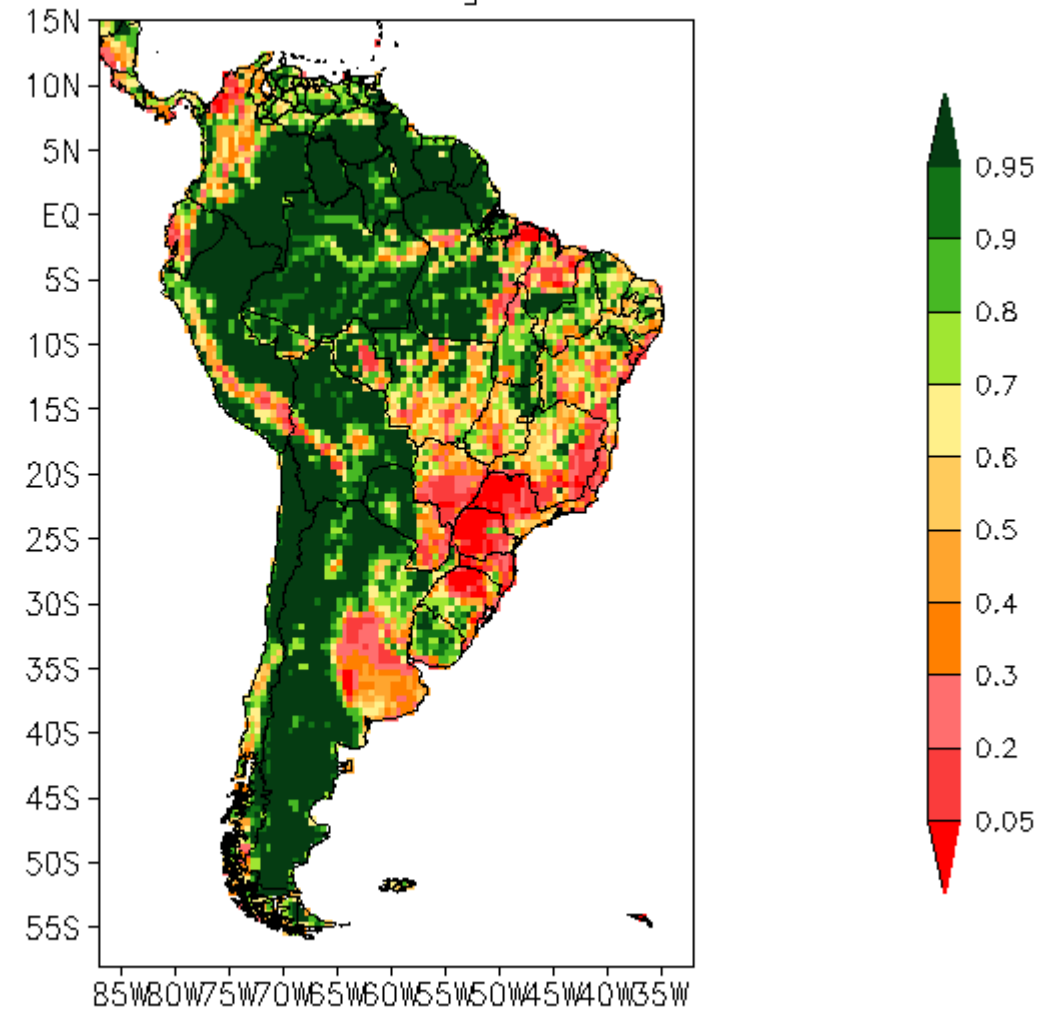
1º Workshop de Aplicações: 150 inscritos



Fraction of natural veg. cover – 1860

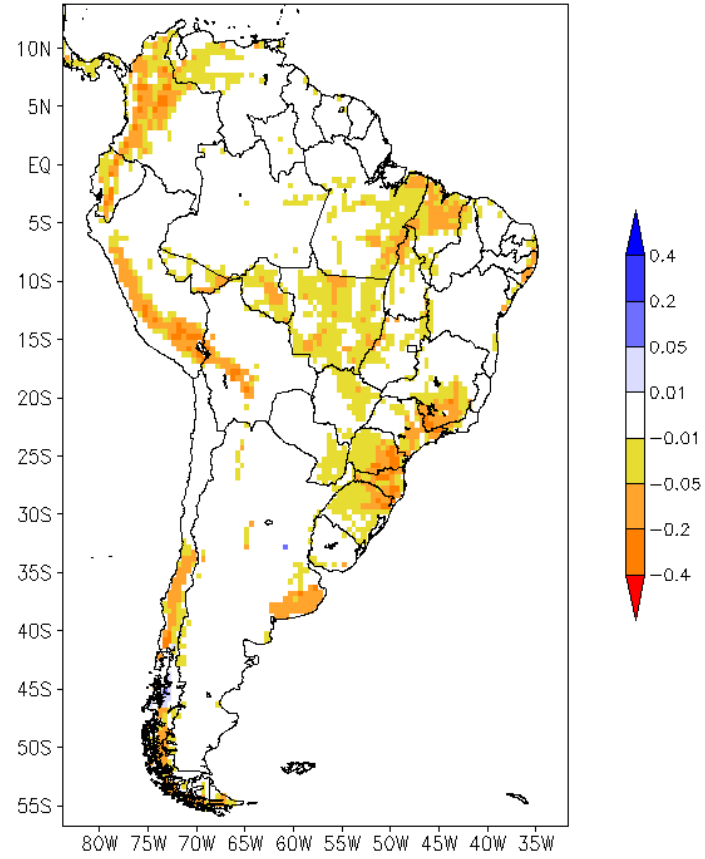


Fraction of natural veg. cover – 2010



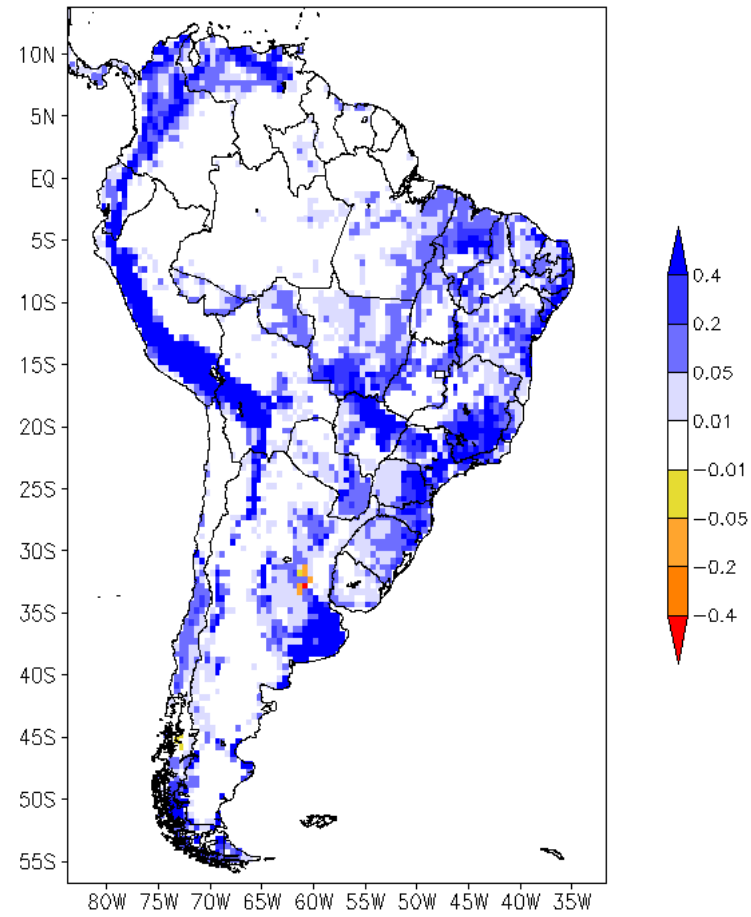


aet LUC-CTL (2001-2010)



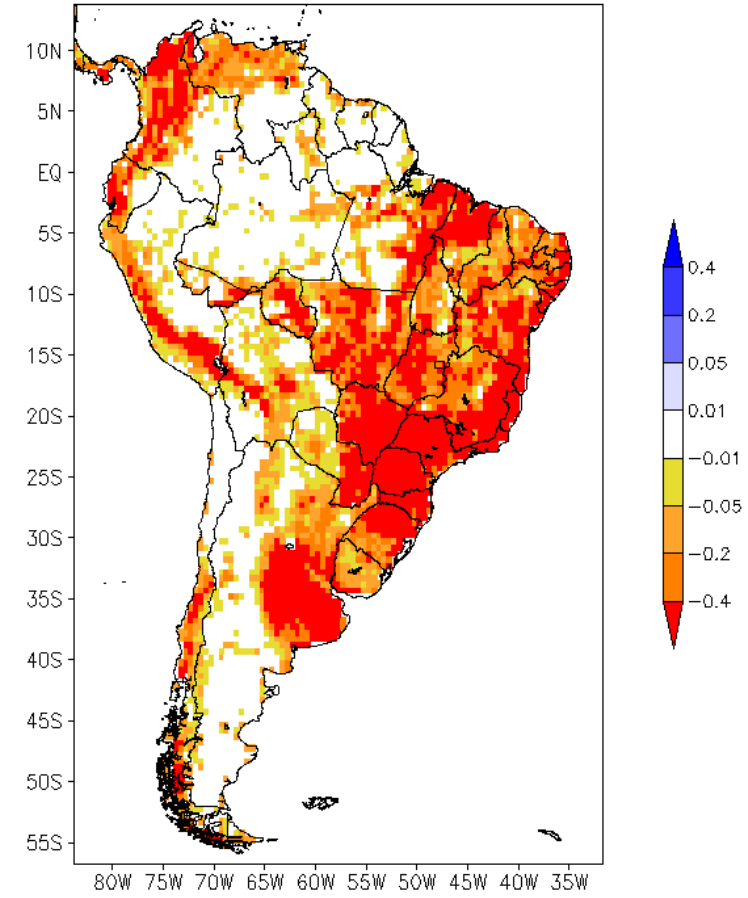
GRADS: COLA/IGES

trunoff LUC-CTL (2001-2010)



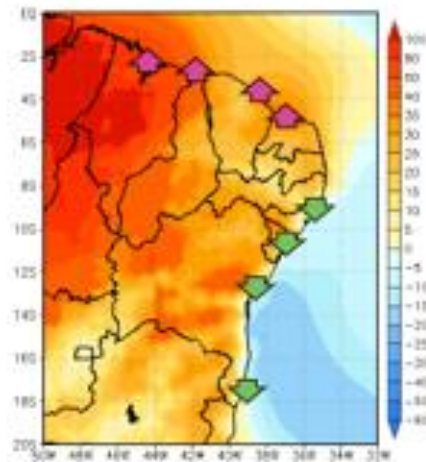
GRADS: COLA/IGES

woodbio LUC-CTL (2001-2010)

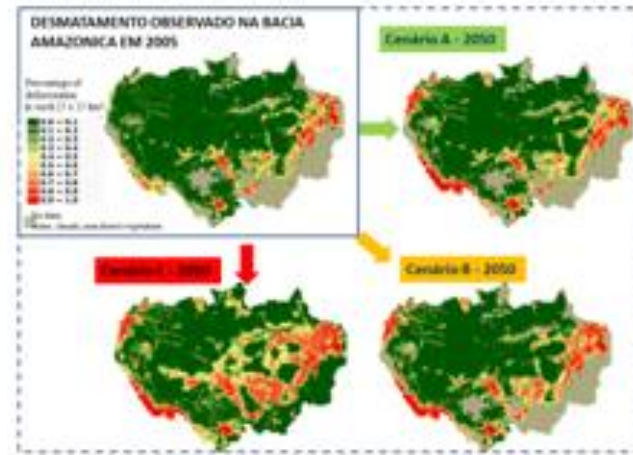


GRADS: COLA/IGES

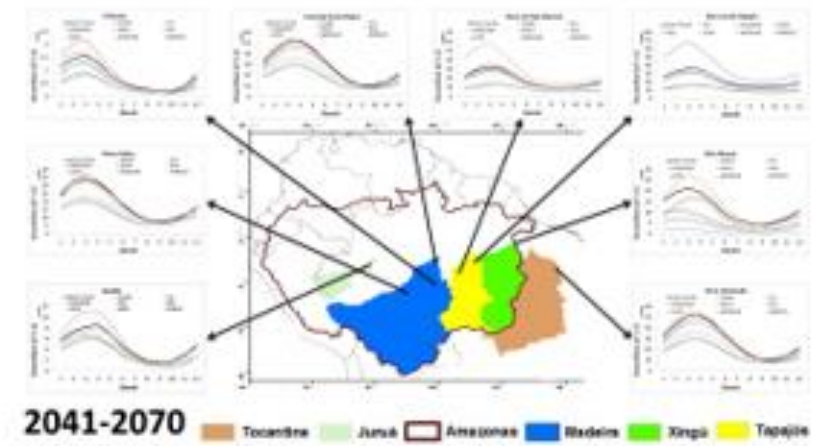
# Integração/aplicações de modelagem do sistema terrestre



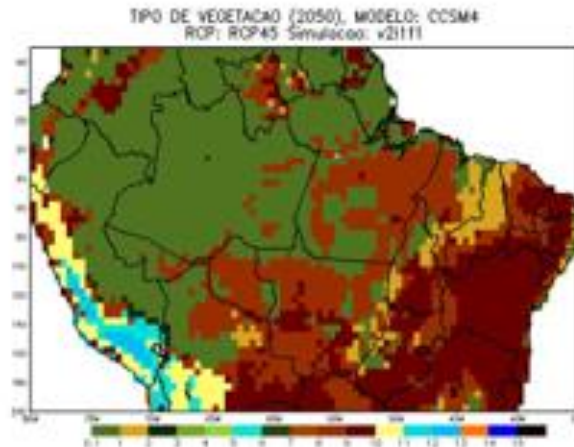
(a) Eolic potential 2100



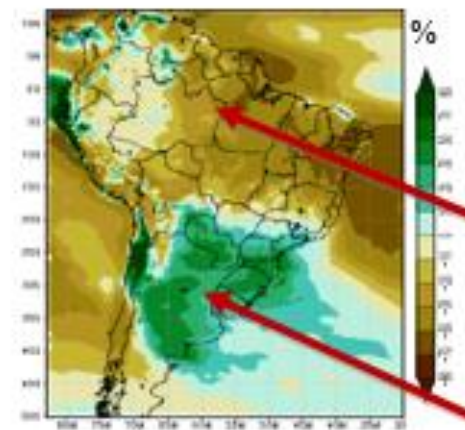
(a) Deforestation 2050



(a) River Discharge 2041-2070



(c) Vegetation types 2050



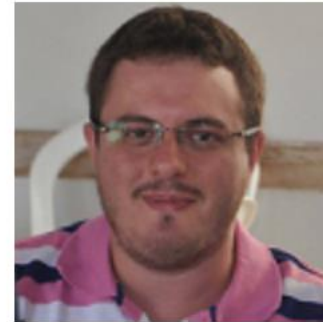
(d) Regionalize climatic model

Rainfall changes (%) in 2071-2100 relative to 1961-90.

Amazônia and Northeast Brazil → rainfall deficiency

Southeastern South America → rainfall increase

# Agradecimentos – Equipe de desenvolvimento



Francisco Gilney Silva Bezerra

Talita Oliveira Assis

Diego Melo de Paula Gomes

Ana Paula Dutra de Aguiar

## Interface com o TerraME

- Pedro Andrade
- Rodrigo Avancini

## Desenvolvimento de versões anteriores

- Sérgio Costa
- Paulo Pimenta
- Evaldinolia Moreira
- Tiago Carneiro
- Luciana Soler
- Eloi Dalla-Nora



# Mais informações

<http://luccme.ccst.inpe.br/>



[inpe-em.ccst.inpe.br/](http://inpe-em.ccst.inpe.br/)



[www.ccst.inpe.br/projetos/inland/](http://www.ccst.inpe.br/projetos/inland/)



<http://www.terrame.org/>



**TerraME**

