



# EARTH SYSTEM SCIENCE CENTER

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



# EARTH SYSTEM SCIENCE CENTER

## STRATEGIC GOALS

Development and improvement of earth system models, monitoring networks and socio-political analyzes, aiming at the construction and analysis of scenarios of environmental changes and climate projections.

# O CCST CONTRIBUITE:

- ✓ In drafting the Policy and the National Plan for Climate Change.
- ✓ In the executive coordination of the FAPESP Research Program on Global Climate Change.
- ✓ In the exercise of the Executive Secretariat of the Brazilian Network for Research on Climate Change.
- ✓ In the implementation of skills to generate scenarios of global environmental changes and their effects in the country and in Latin America.
- ✓ In the democratization and dissemination of the science of global climate change, through the diffusion of knowledge to the different public - educational area at all levels, media and public policy makers at the municipal, state and federal levels.
- ✓ In providing scientific and technological subsidies to the government to actively participate in the major forums of international environmental negotiation
- ✓ Sustainable development aims to reconcile the good functioning of the economic, social and environmental spheres. CCST encompasses skills in these areas and sustainable development is part of the Center's mission.



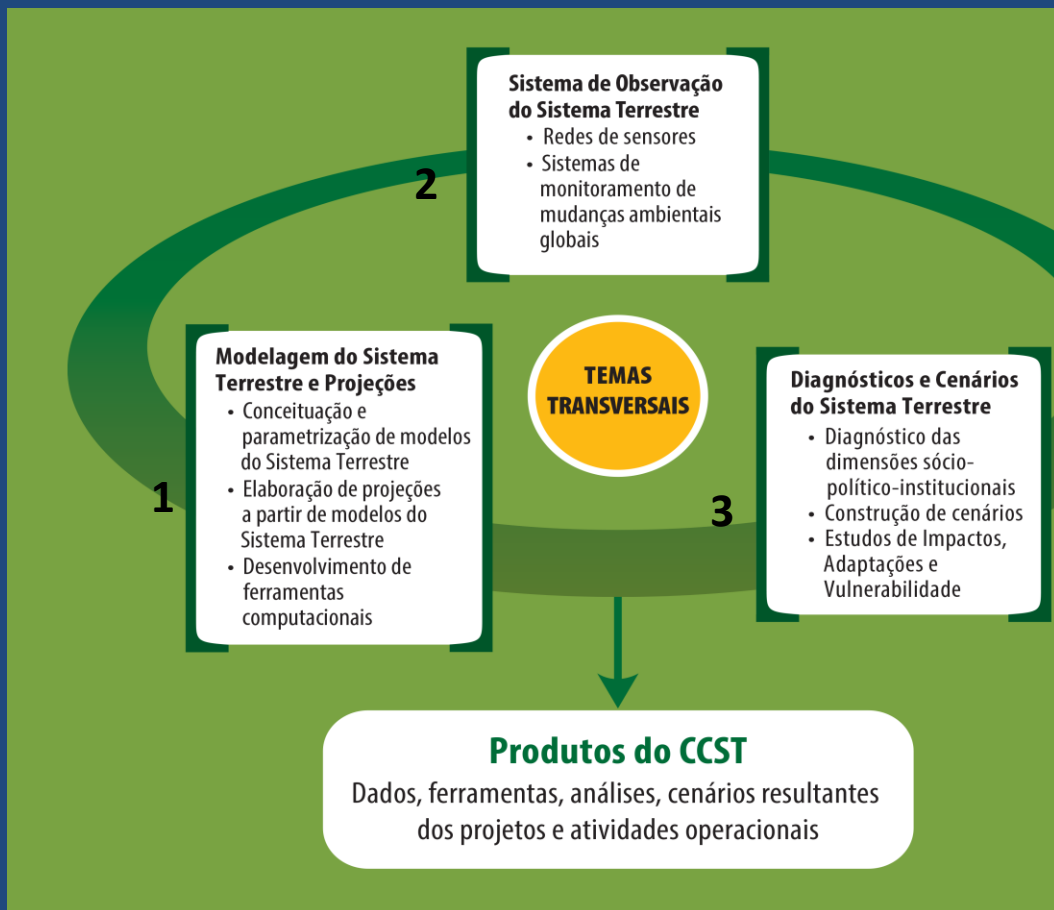
São José dos Campos



Cachoeira Paulista

# NEW CONCEPT

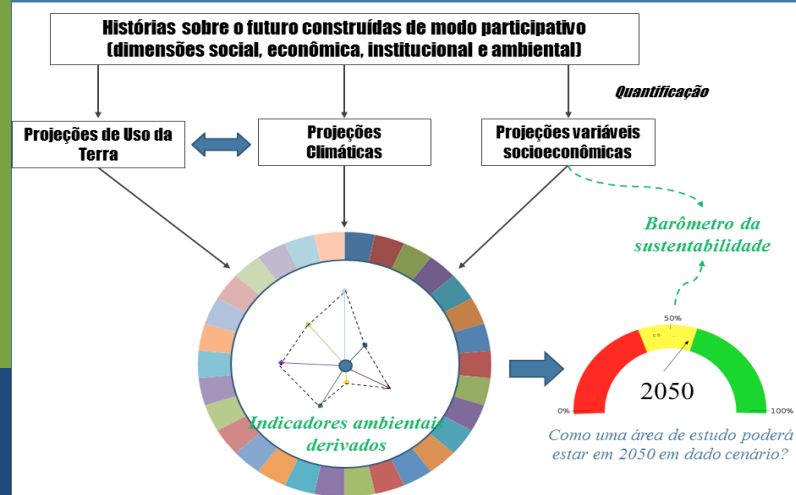
CCST organization in integrated components through cross-cutting projects, aiming at the construction of sustainability scenarios for Brazil.



## ÁREAS DE PESQUISAS



**Visão sobre cenários no CCST: integrando ciência e sociedade, combinando projeções climáticas e de uso da terra para gerar indicadores de sustentabilidade**



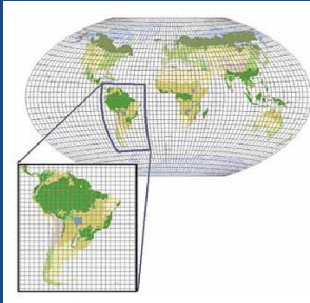
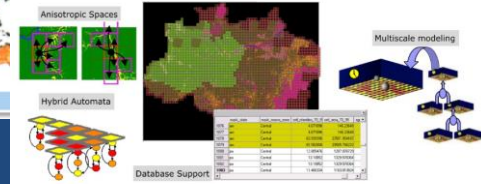
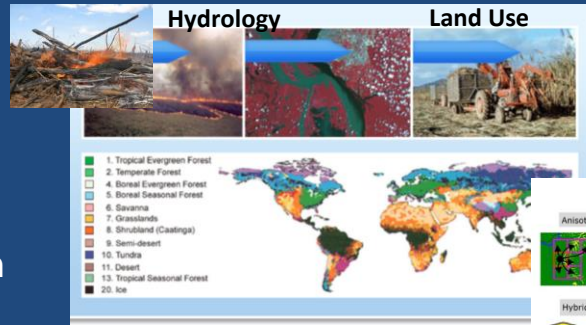
# 1 – EARTH SYSTEM MODELING

One of the greatest scientific challenges of the CCST/INPE is the ability to represent the Earth System (ST), covering not only the biological and physical dimensions, but also the human dimension. The challenge of studying in an integrated manner those dimensions is something globally, especially in countries embryonic in development.

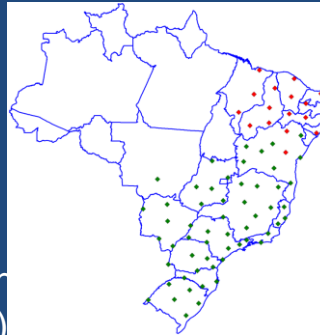
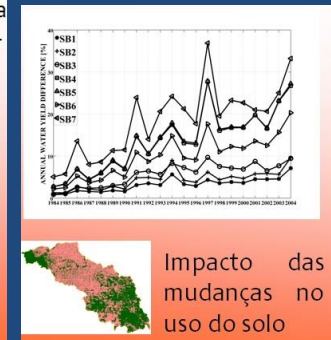
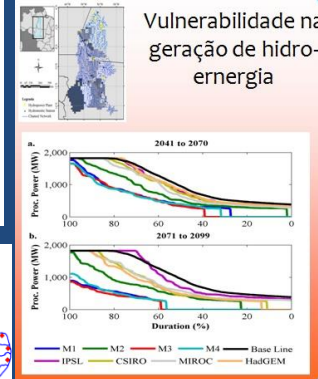
Among these initiatives are:

- ✓ the development of INLAND model;
- ✓ environmental modeling platform spatially explicit (EARTH);
- ✓ the development of models of land use changes (LUCC) and emissions of greenhouse gases (INPE-in);
- ✓ the development of models of electrical discharges in the atmosphere, atmospheric radiation and wind potential; hydrological models (MHD-INPE);
- ✓ Agricultural models, as well as regional climate modeling for construction of scenarios and impact of climate change at regional level

## INLAND (INPE/CCST)

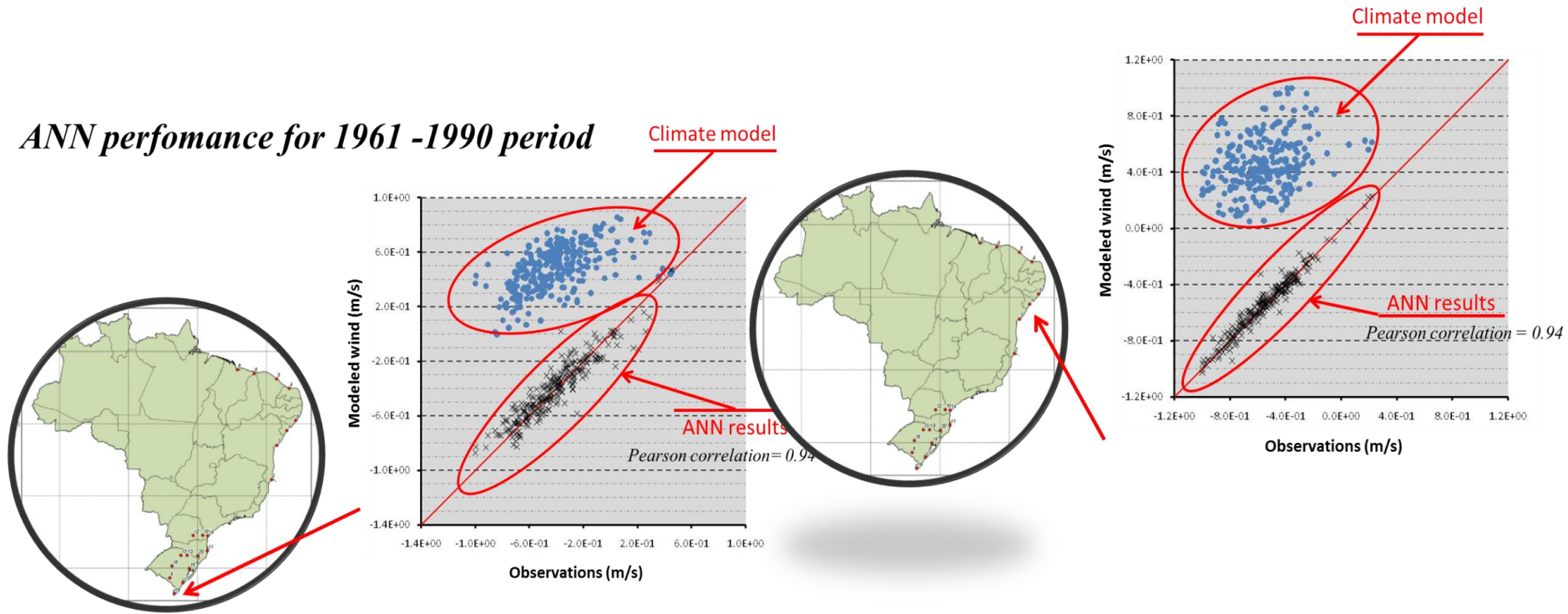


## MHD/CCST)



# Climate Projections

## ANN performance for 1961 -1990 period

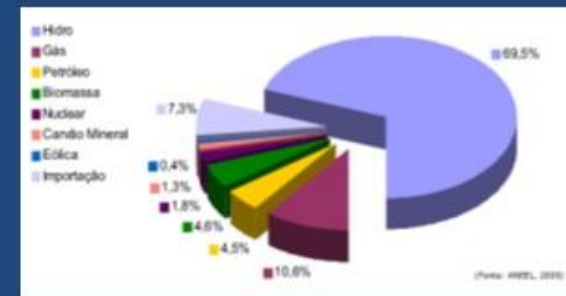


Slide: Rodrigo Costa

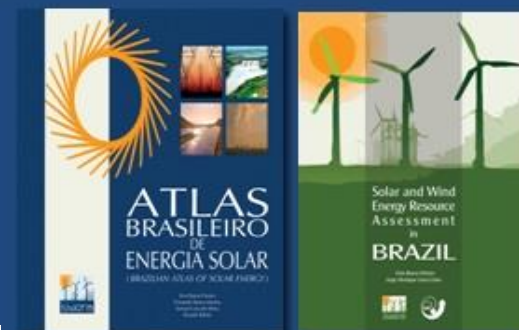
## 2 – OBSERVATION SYSTEM OF THE EARTH SYSTEM

✓The monitoring network coordinated by the CCST quest to build a reliable database, with a history and future perspective that allow to capture the effects of global environmental changes, bringing the information to the public domain to support decision-making.

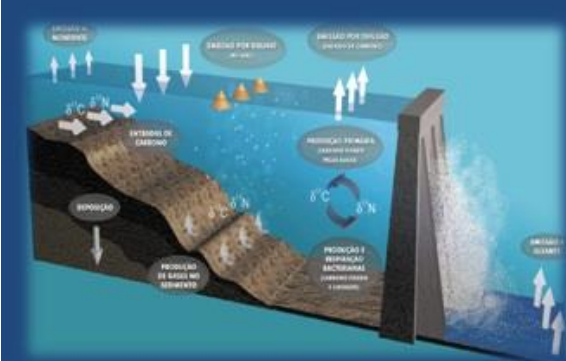
✓Currently, the information generated by the CCST subsidize not only the strategic objectives of the modeling Center, the construction of scenarios and diagnostics of human action in the Middle, as well as other areas of the INPE.



Generation of electric energy in Brazil (CEPEL)

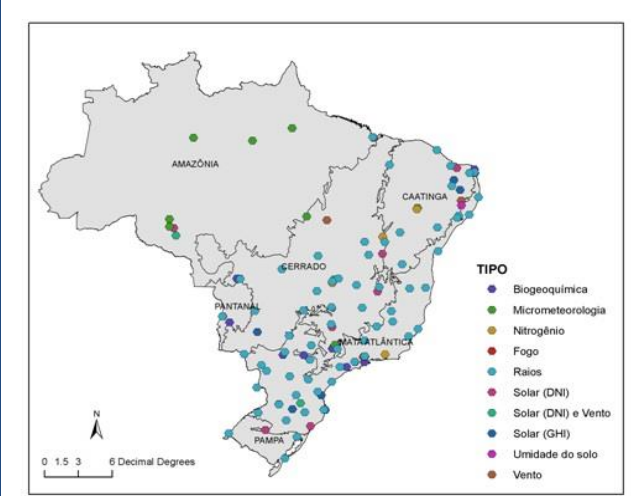


Atlas of Solar Energy and SWERA project (PNUMA-GEF)

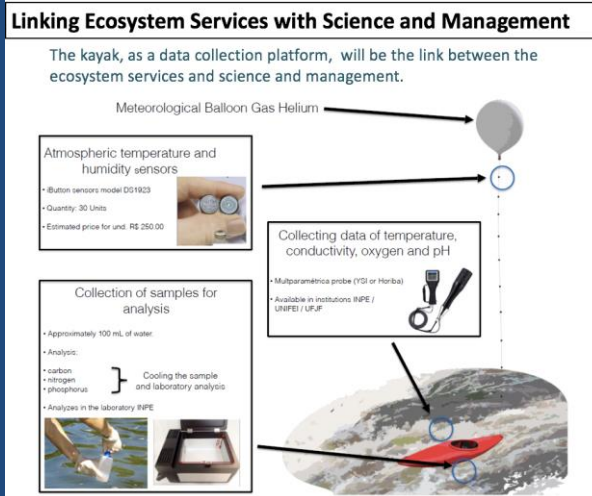


O balanço de carbono em barragens tropicais

CCST observation network between 2016-2019



Projeto Cachoeiras



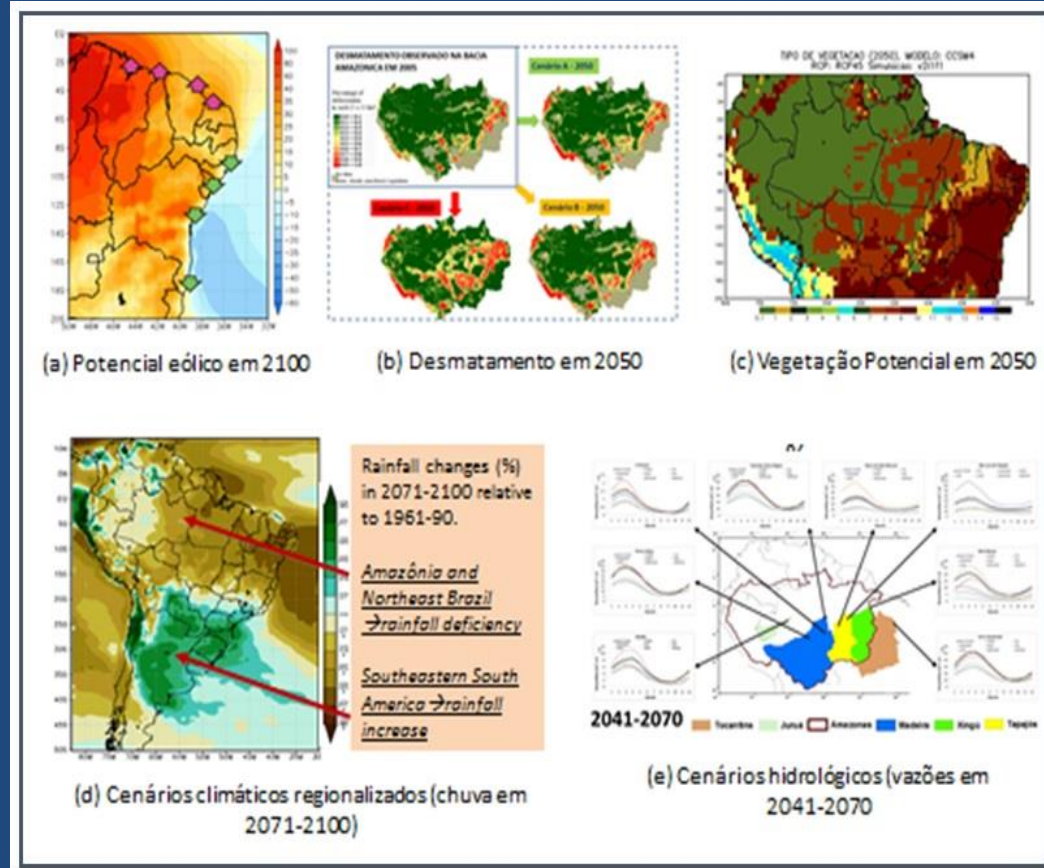
### 3 – DIAGNOSTIC AND SCENARIOS OF THE EARTH SYSTEM

✓ This nucleus aims at formulating scenarios for a sustainable national development, integrating results of observation and modeling activities.

✓ It is proposed here to transition from traditional search logic, focused on environmental impact studies, for the analysis of the trajectories, limits and spatio-temporal patterns under which the stability of natural systems can be sustained.

✓ This transition represents one of the greatest challenges to modern science and also a key element to support the formulation of public policies more consistent.

✓ The product of the work of the CCST in this scenario will be the component of dissemination of scientific knowledge related to global environmental changes and the transition to environmental sustainability



Examples of scenarios generated by the CCST currently, and that will be extended for the period 2016-2019.

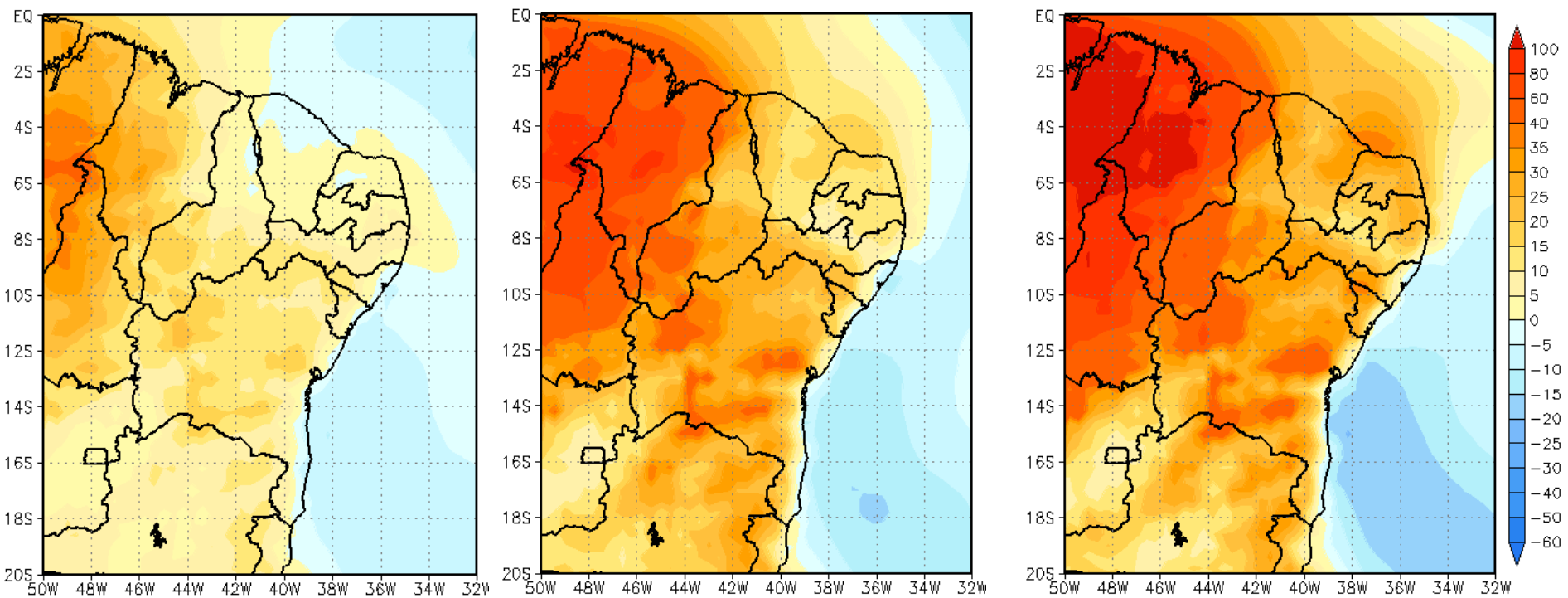


# Wind potential – study looking at energy production potential and scenarios

*2011–2040*

*2041–2070*

*2071–2100*

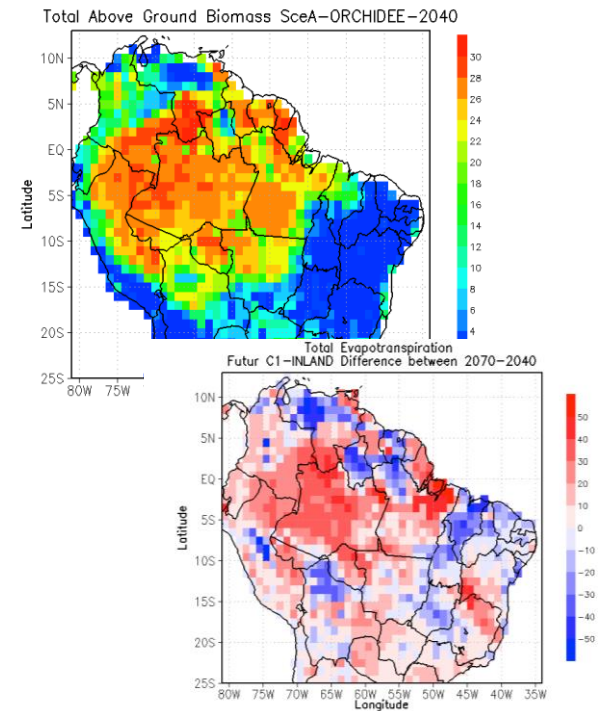
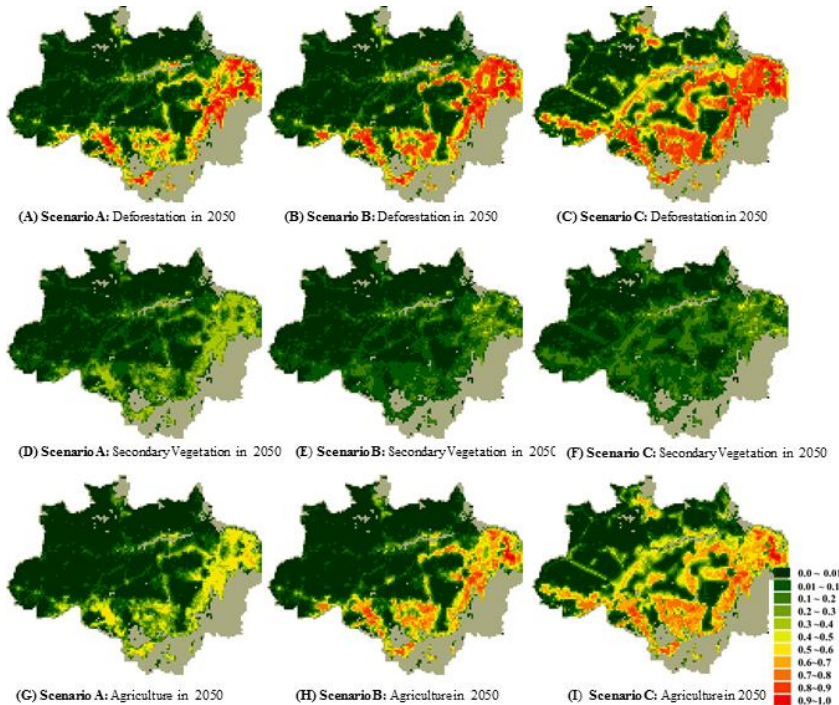


Slide: Rodrigo Costa

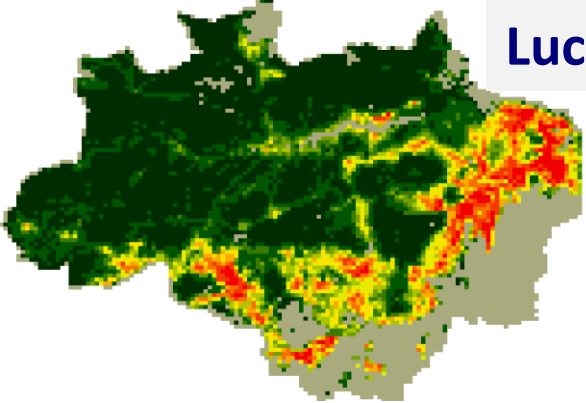
# Exemplo AMAZALERT

## Analysing impacts in provisioning of environmental services

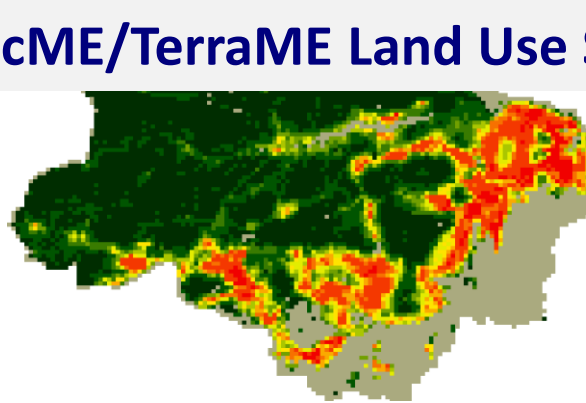
- Participative scenarios => Projections of LUCC => Hidrological and biosphere simulations => Impacts on hydrological cycle, biomass and state of the forest



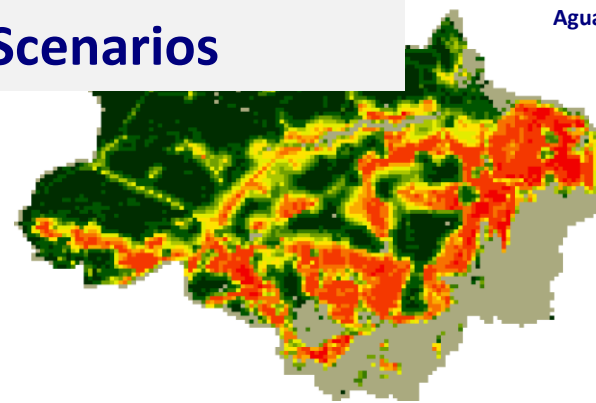
# LuccME/TerraME Land Use Scenarios



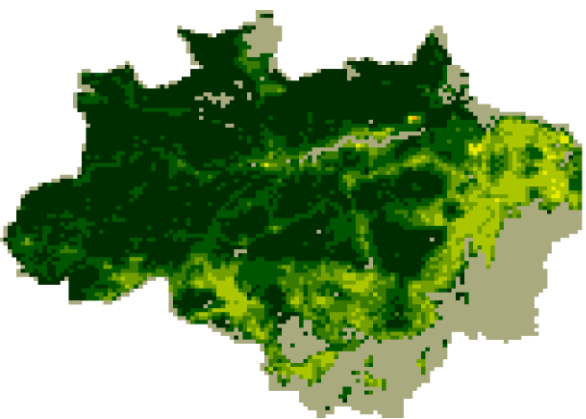
(A) Scenario A: Deforestation in 2050



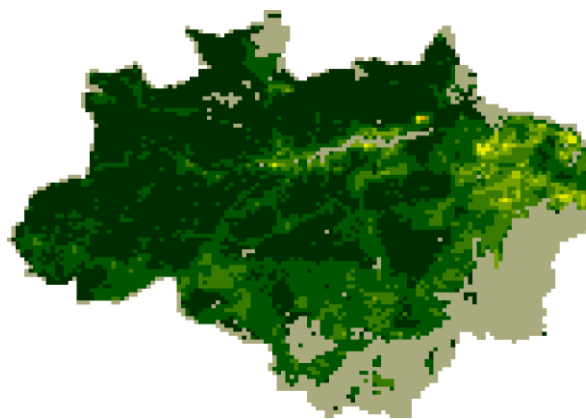
(B) Scenario B: Deforestation in 2050



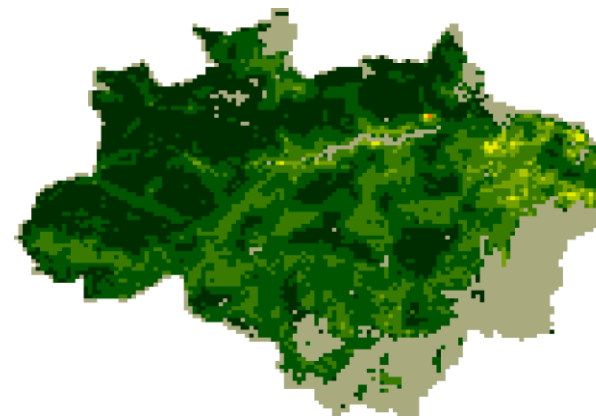
(C) Scenario C: Deforestation in 2050



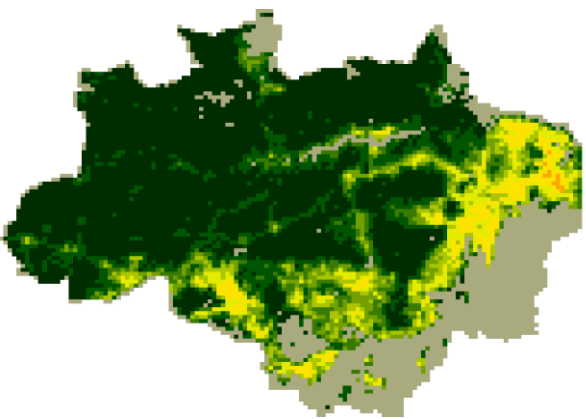
(D) Scenario A: Secondary Vegetation in 2050



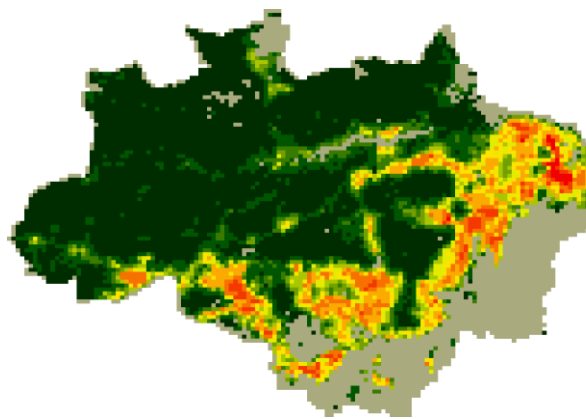
(E) Scenario B: Secondary Vegetation in 2050



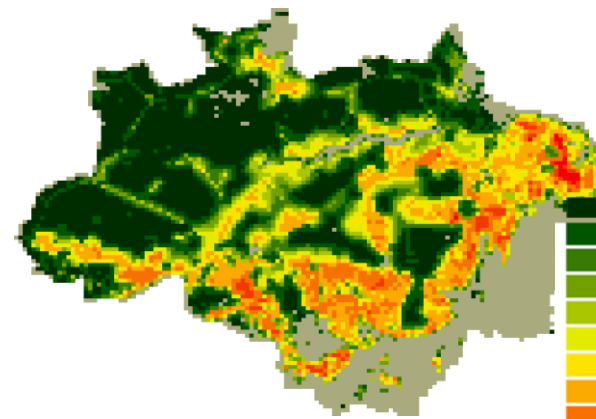
(F) Scenario C: Secondary Vegetation in 2050



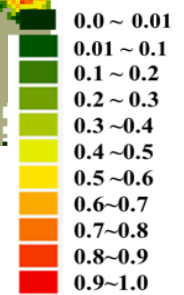
(G) Scenario A: Agriculture in 2050



(H) Scenario B: Agriculture in 2050

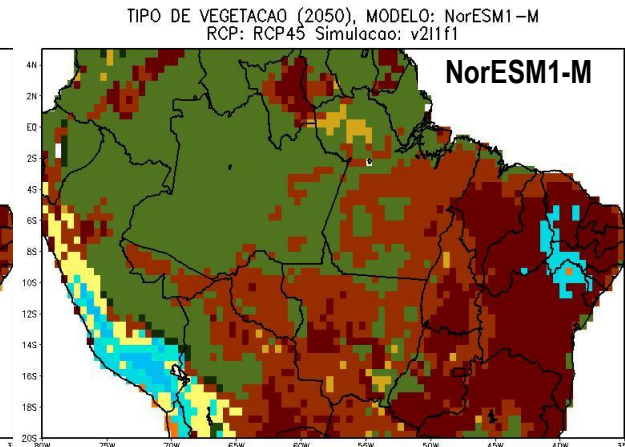
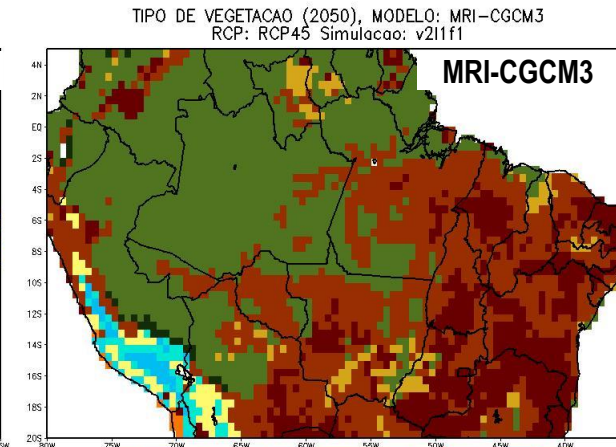
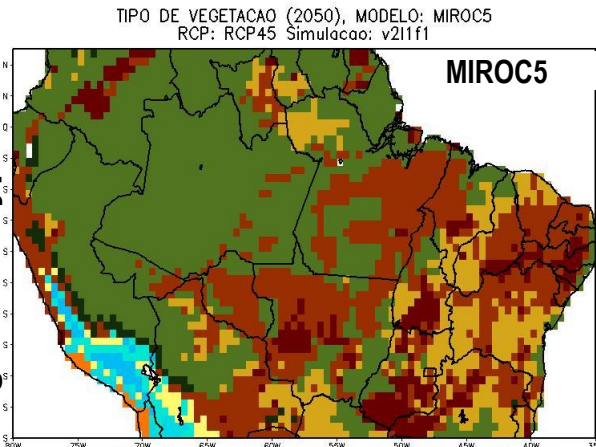
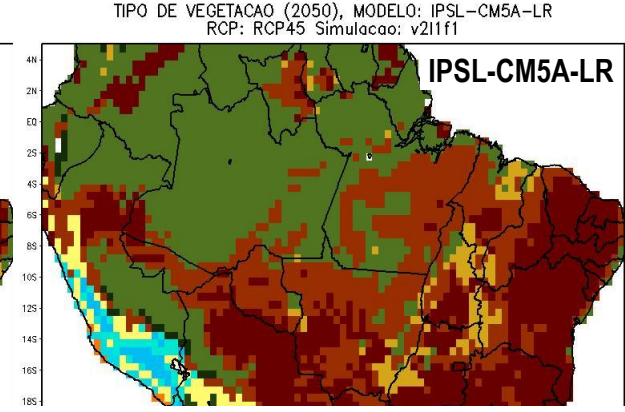
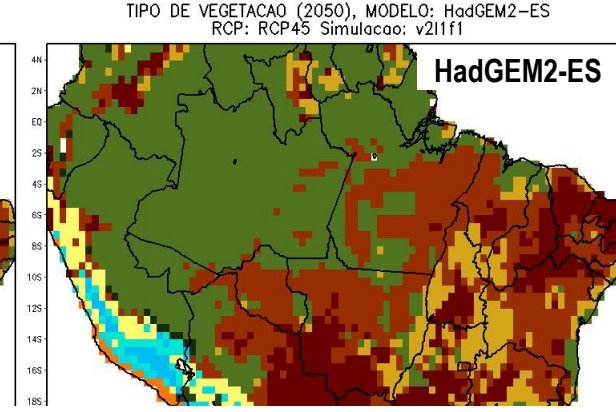
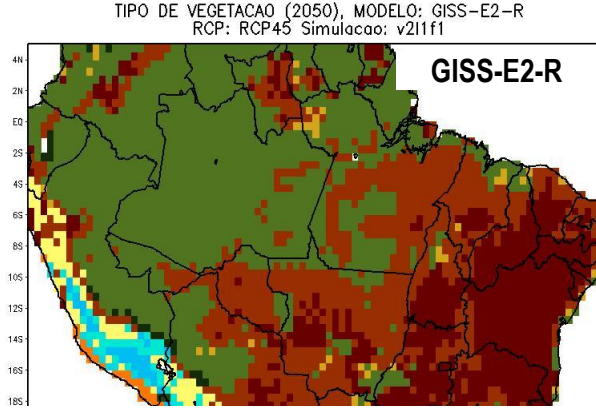
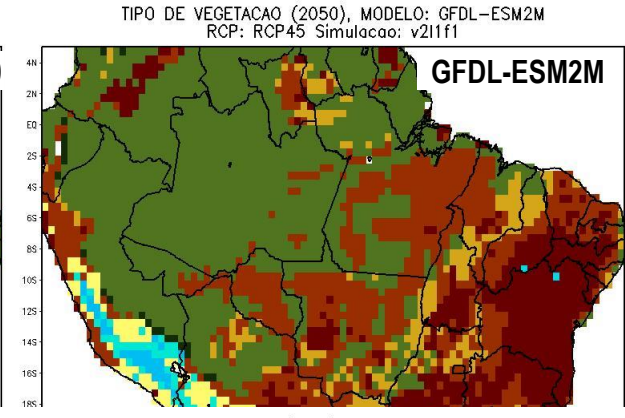
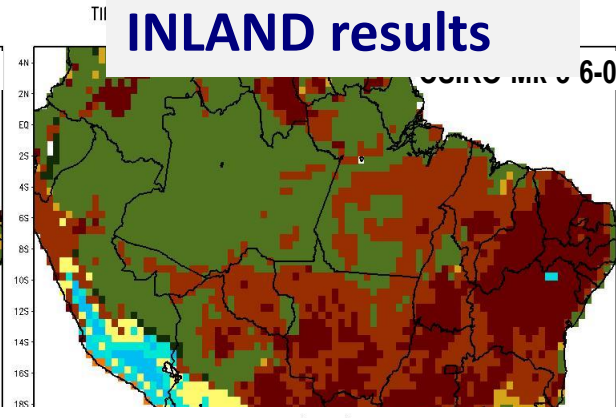
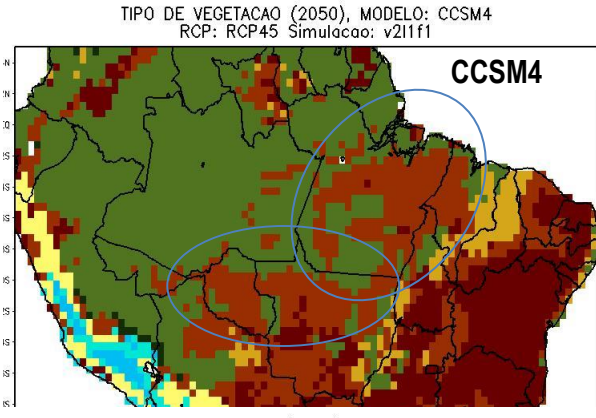


(I) Scenario C: Agriculture in 2050



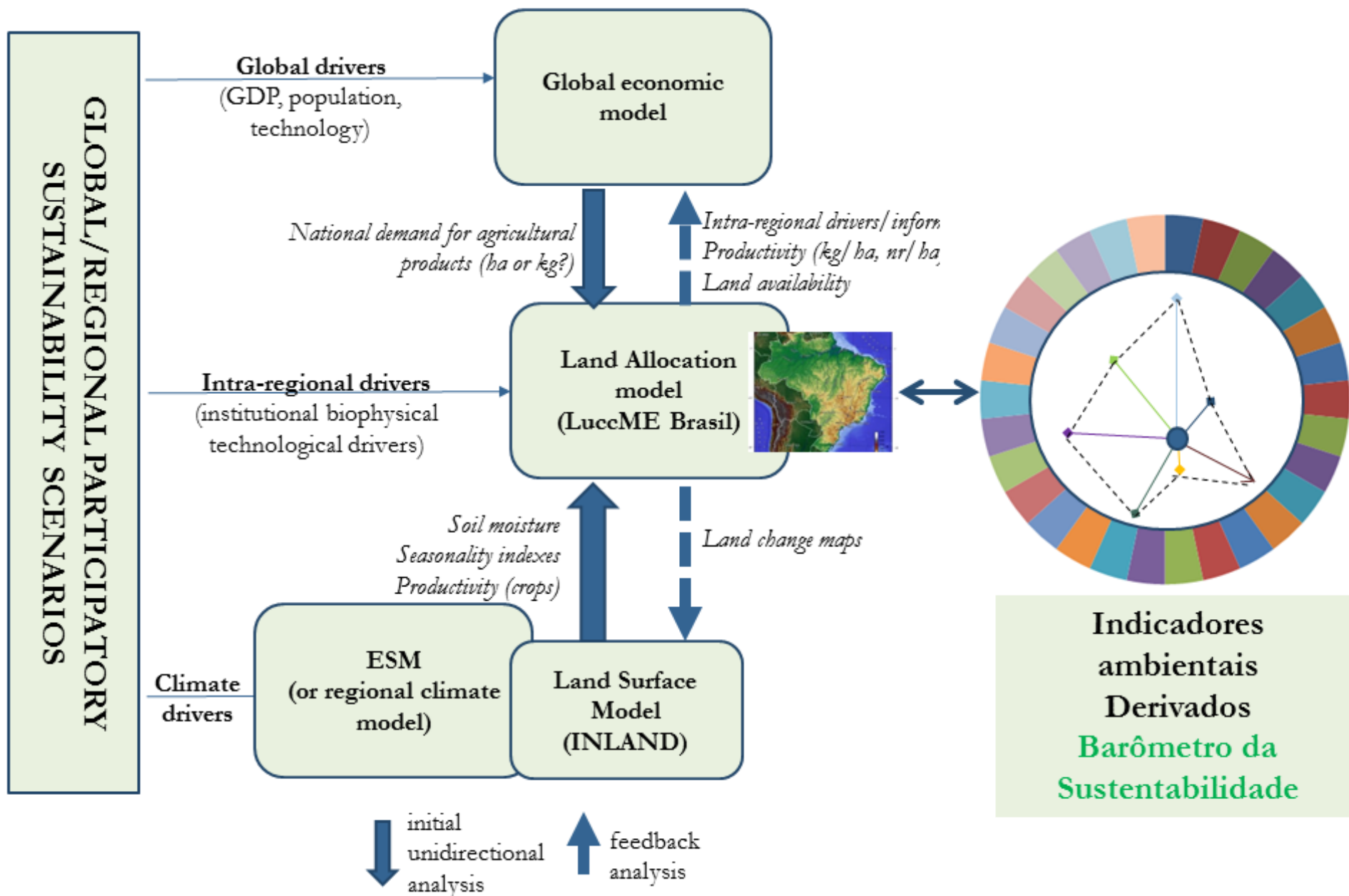
Vegetation Type - 2050: INLAND RCP4.5, LandUSE - ON, FIRE - ON

# INLAND results

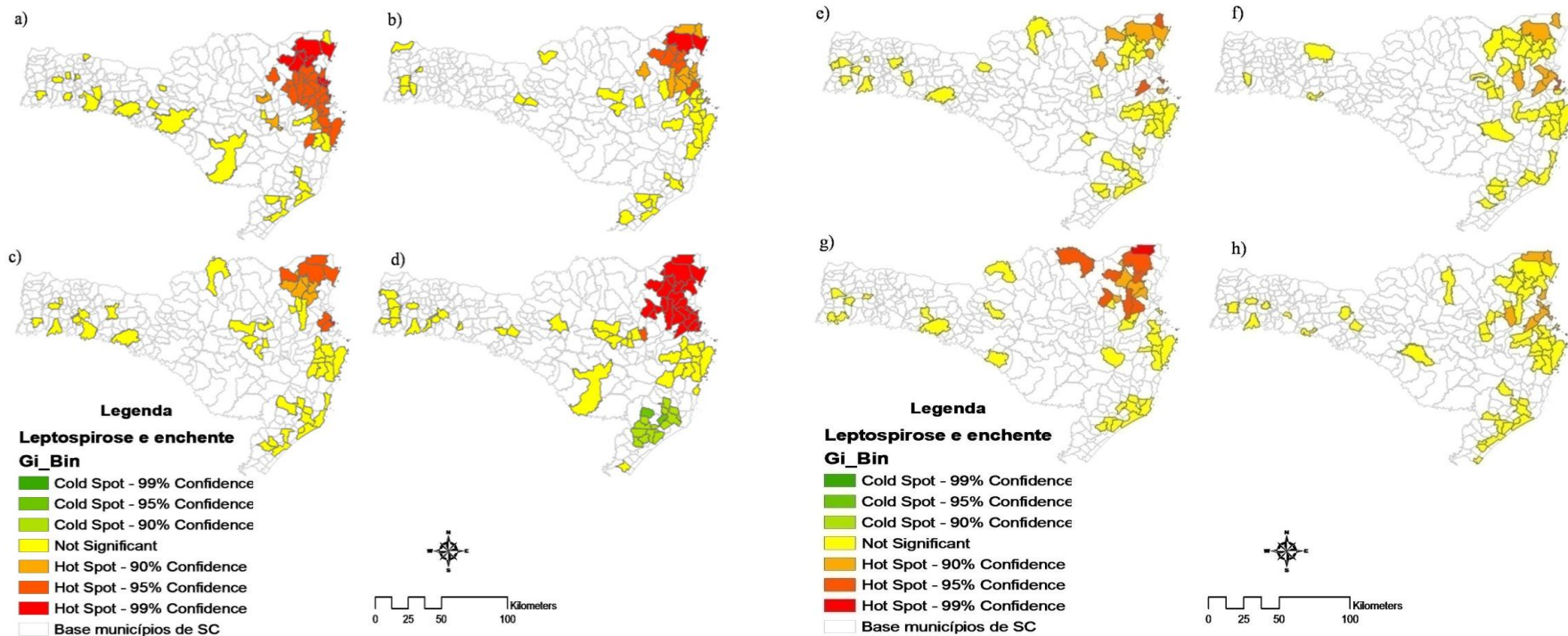


- 1-Tropical evergreen
- 2-Tropical deciduous
- 3-Temp. evergreen
- 4-Temp. evergreen conifer
- 5-Temp. deciduous
- 6-Boreal evergreen
- 7-Boreal deciduous
- 8-Mixed forest
- 9-Savanna
- 10-Grass. Steppe
- 11-Dense shrubland
- 12-Open shrubland
- 13-Tundra
- 14-Desert
- 15-Polar desert / rock /

# Integrating Projections and Scenarios to produce sustainable indicators



# Spatial evolution of leptospirosis and flooding in Santa Catarina (2008– 2015)



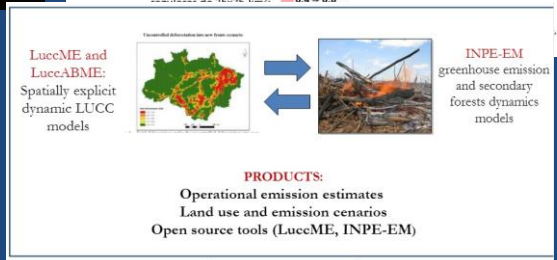
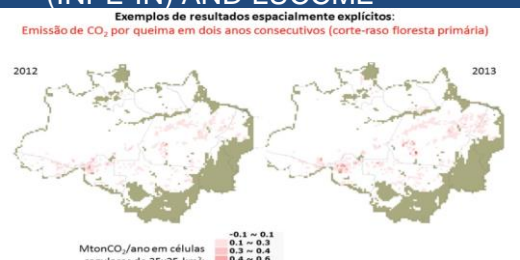
Análise Hot Spot (Getis-Ord  $G_i^*$ , ArcGis) das ocorrências de inundações e os casos de leptospirose em Santa Catarina - a) 2008; b) 2009; c) 2010; d) 2011; e) 2012; f) 2013; g) 2014; h) 2015.

# APPLICATION AND PRODUCTS

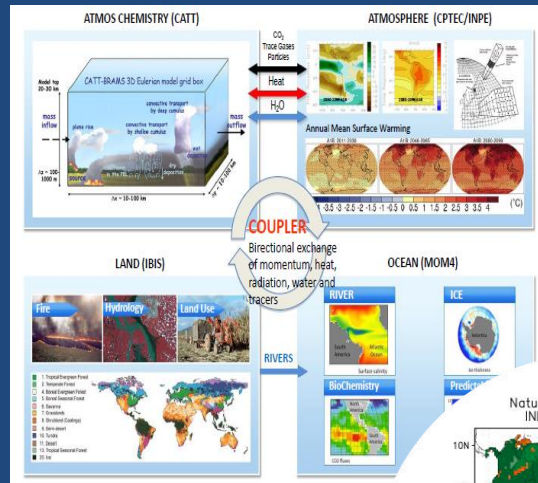
## NETWORK SONDA



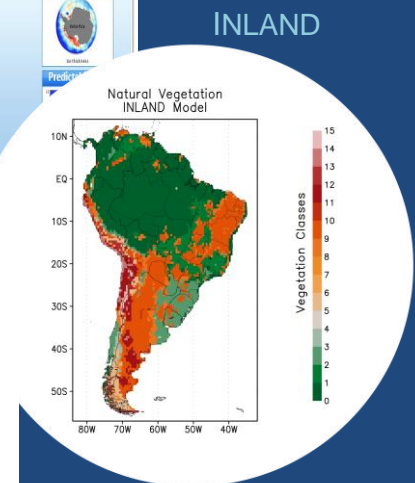
## EMISSION MODELS (INPE-IN) AND LUCCEME



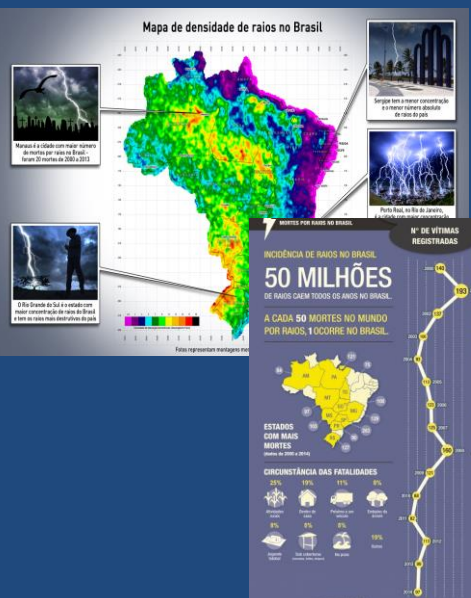
## BESM – BRAZILIAN MODEL OF THE EARTH SYSTEM



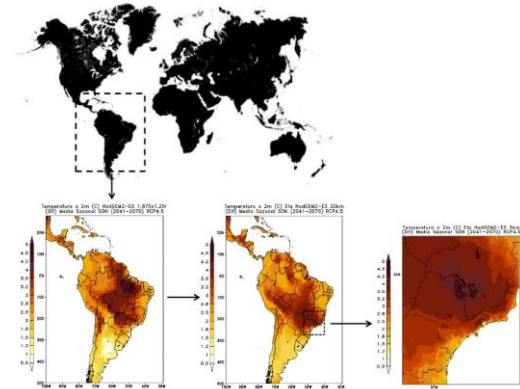
## CLIMATE PROJECTIONS



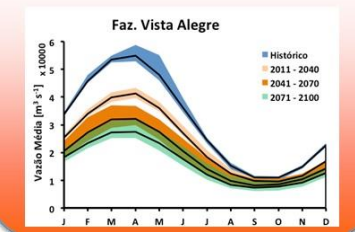
## MONITORING NETWORK LIGHTNING BRASILDAT



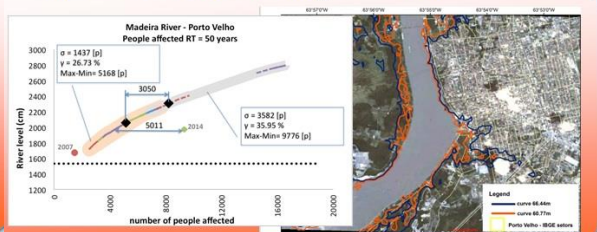
## OBSERVATÓRIO CCST



## Impactos das Mudanças Climáticas



## Impactos de eventos hidrológicos extremos

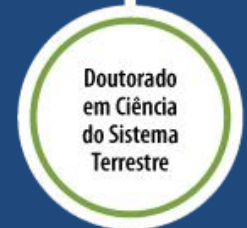


## Since February 2010

Objective: training human resources, doctoral level, to meet the institutional, national and scientific demands related to impacts, vulnerabilities, social and public policy processes related to regional and global environmental change.

## Lines of research

- 1-Integrated Earth System Modeling
- 2-studies of impacts, adaptation and vulnerability
- 3-technologies for mitigation and adaptation
- 4-political ecology of global changes and regional development
- 5-Biogequímicos Cycles
- 6-methods and techniques for socio-environmental system modeling





# PROJECTS AND PARTNERS

REDE CLIMA (REDE DE PESQUISAS EM MUDANÇAS CLIMÁTICAS DO MCT)

A Rede Clima foi criada pelo MCT em 2007. Seu objetivo principal é gerar e disseminar novos conhecimentos sobre as mudanças climáticas no Brasil. Assim o país poderá responder aos desafios impostos pela mudança climática e, também, se preparar para as negociações internacionais sobre o clima.

Novas subredes:

- Desastres Naturais
- Oceanos
- Serviços Ambientais dos Ecossistemas



INCT – MUDANÇAS CLIMÁTICAS

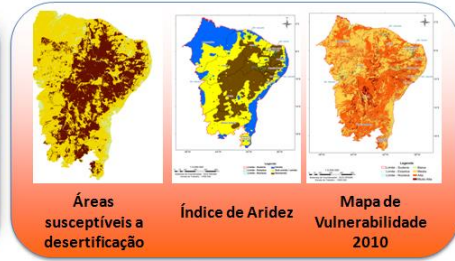
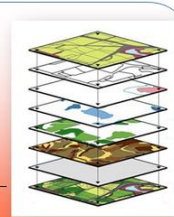
## Projetos de Pesquisa Científicos e Tecnológicos

A Base Científica	Estudos sobre Impactos, Adaptação e Vulnerabilidade	Mitigação	Produtos Tecnológicos (Modelos, Geo-Sensores, Riscos de Desastres Naturais)
1 3 5 7 2 4 6 8	9 11 13 15 17 10 12 14 16 18	19 20 21	22 23 24 25 26
<b>Projetos</b> <b>1</b> Detecção, Atribuição e Variabilidade Natural do Clima <b>2</b> Amazônia <b>3</b> Mudanças dos Usos da Terra <b>4</b> Ciclos Biogeoquímicos Globais <b>5</b> Oceanos <b>6</b> Gases de Efeito Estufa <b>7</b> Interações Biosfera-Atmosfera <b>8</b> Cenários Climáticos Futuros e Redução de Incertezas	<b>Projetos</b> <b>9</b> Cenários de Mudanças Climáticas para o Século XXI <b>10</b> Agricultura <b>11</b> Recursos Hídricos <b>12</b> Energias Renováveis <b>13</b> Biodiversidade <b>14</b> Saúde <b>15</b> Zonas Costeiras <b>16</b> Urbanização e Megacidades <b>17</b> A Economia das Mudanças Climáticas	<b>Projetos</b> <b>19</b> Emissões de Lagos e Reservatórios <b>20</b> Processos de Combustão <b>21</b> Redução de Emissões por Desmatamento e Degradação	<b>Projetos</b> <b>22</b> Modelo Brasileiro do Sistema Climático Global (MBSCG) <b>23</b> Modelo de Circulação Global da Atmosfera do CPTEC <b>24</b> Modelagem Multi-Escala: Desafios para o Futuro <b>25</b> Tecnologias Observacionais <b>26</b> Sistema de Informações para a Redução de Riscos de Desastres Naturais

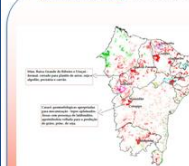
## Desastres Naturais

Sistema de Alerta Precoce Contra Desertificação - SAP

- ❖ Clima
- ❖ Vegetação
- ❖ Geomorfologia
- ❖ Geologia
- ❖ Solos
- ❖ Informações sócio-econômicas



Altimetria/Declividade



Varição da susceptibilidade entre 2000 e 2010

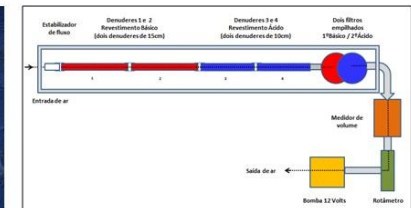


Página Web: <http://sap.ccst.inpe.br/>



## Nitrogen cycling in Latin America: drivers, impacts and vulnerabilities (Nnet)

Nnet network active sites: DELTA samplers



System mounting schema



System installed at INPE's main campus

This system allows the determination of atmospheric concentration of:  $\text{NH}_3$ ,  $\text{HNO}_3$ ,  $\text{SO}_2$  and  $\text{HCl}$  (gaseous form) and  $\text{NH}_4^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$  and  $\text{Cl}^-$  (particle form).  
Data will be used for modeling reactive nitrogen input/deposition  
Long term data on Reactive Nitrogen and other major ions atmospheric concentration → biogeochemical cycles changes: causes and effects

Financial support:  
FAPESP 12/06416-1 (from 2012 until 2015) Coord MC Fort  
IAI Project Number: CRN3005 Coord Jean PHB Ometto  
Counter part: INPE's staff, grants and infrastructure

# CCST IN NUMBERS



Science for Sustainability

www.ccst.inpe.br

http://pgcst.ccst.inpe.br /





THANK YOU

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**Cachoeira Paulista**  
**São Paulo, Brasil**  
**Telefone: (12) 3186 9249**

**CCST/INPE**  
**Av. dos Astronautas, 1758**  
**12227-010**  
**São José dos Campo**  
**São Paulo, Brasil**  
**Telefone: (12) 3208 7903**

## STAFF AT THE CCST-CACHOEIRA PAULISTA AND SÃO JOSÉ DOS CAMPOS

CCST	
Pesquisadores	<b>20</b>
Tecnologistas	<b>12</b>
Técnicos	<b>5</b>
Analistas C&T	<b>1</b>
Estagiários e bolsistas diversos	<b>19 – 10 PCI</b>
Pós Graduação (2010-2016)	78 alunos – 48 defesas <b>30</b> (alunos no CCST)
Outros serviços	<b>25</b>
<b>Total</b>	<b>112</b>

## SCIENTIFIC PRODUCTION of the CCST in 2016

Artigos em revista	52
Artigos em Congresso	30
Capítulo de livros	03
Relatórios	02
Notas técnicas	01
Manuais	02
Teses	11
<b>Total</b>	<b>101</b>

## ACCESS to the CCST's SITE DURING the LAST 12 MONTHS

### Total de seções/usuários

Brasil/Mundo - acessos externos (Interações)	INPE - acessos internos (Interações)	Total de usuários
24.334	2.483	23.579

### Tipo de usuários

Retorno (acessaram site mais de 1 vez )	Usuários Novos (acessaram pela primeira vez)	Taxa de rejeição (quando usuário abre a página e não clica em nada)	Visualizações de páginas
78.6%	20.4%	13,63	90.953

### Eventos

Relatórios	Lattes	Total de downloads
688	783	1.841

Seção de maior acesso
Projetos e Parceiros

Rede Social	Total
Facebook	905

Origem dos acessos	Total de seções
Direto (ccst.inpe.br)	14.626
google	10.580
yahoo	839
facebook	660
bing	261
greenpeace	200
Facebook mobile	159
Inpe (inpe.br)	89