

# Effects of Climate Change in Brazilian Agriculture: Mitigation and Adaptation

**Cepagril/Unicamp**

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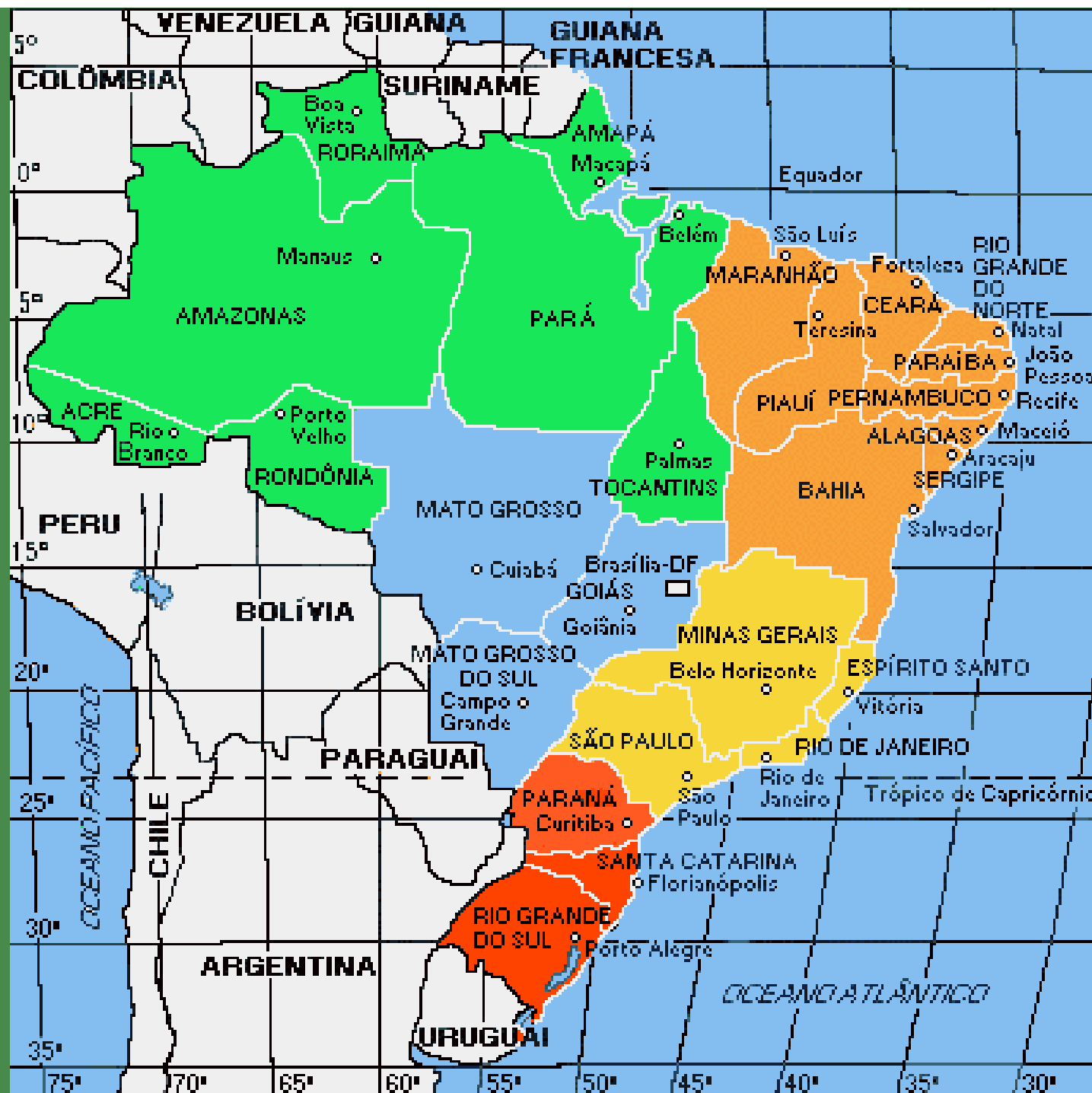
**WORKSHOP**

**CLIMATE CHANGE AND BIODIVERSITY FOR FOOD AND AGRICULTURE**

Food and Agriculture Organization of the United Nations

13-14/February/2007 - Rome, It





# **CLIMATIC RISK ZONING AGRICULTURE**

# Brazilian Economy

**Agribusiness. GDP in 2007: US\$ 333 billions (33% GDP)**

**Agribusiness Exportations: US\$ 35 billions**

**Grain production in 2007 :133,4 millions tons**

**Federal Farm Credit Policy**

**US\$ 8 billion (US\$ 2.5 billion for small farmers)**

**Small farmers agriculture insurance - 2006/07**

**602.000 families – 1,1 billion EUR**

# CLIMATIC RISC ZONING

1. 1991-1995 – PROAGRO (Brazilian Program for Agriculture).
  1. Governamental Lost of US\$150.000.000,00/year
2. 1996 – INTRODUCTION OF THE CLIMATIC RISK ZONING;
  1. RESPONSABILITY: EMBRAPA AND CEPAGRI/UNICAMP;
  2. WHAT, WHERE AND WHEN TO PLANT - 80% PROBABILITY OF SUCCESS;
  3. PUBLIC POLICY. EXECUTION – PUBLIC ENTERPRISE;
  4. ANNUAL REVIEW. 31 CULTURES IN 2009;
  5. RESPONSIBILITY FOR US\$8 BILLION/YEAR. AGRICULTURAL OPERATION.
3. GLOBAL WARMING AND AGRICULTURE SCENARIOS.
  1. FUNDS: GOF/BRITISH EMBASSY;

# **AGROMETEOROLOGICAL RISK ZONATION – PUBLIC POLICY US\$8 billion agriculture credit (what, where and when to plant)**

## **1. Probability of Climatic Local Conditions - Intervals of 5, 7 ou 10 days.**

- **Low and Hight Temperatures**
- **Water Excess**
- **WRSI – ETr/ETmax (Water Requirement Satisfaction Index)**
- **Dry Spell**

## **2. Climatic suitability for crops (Temperature and Water)**

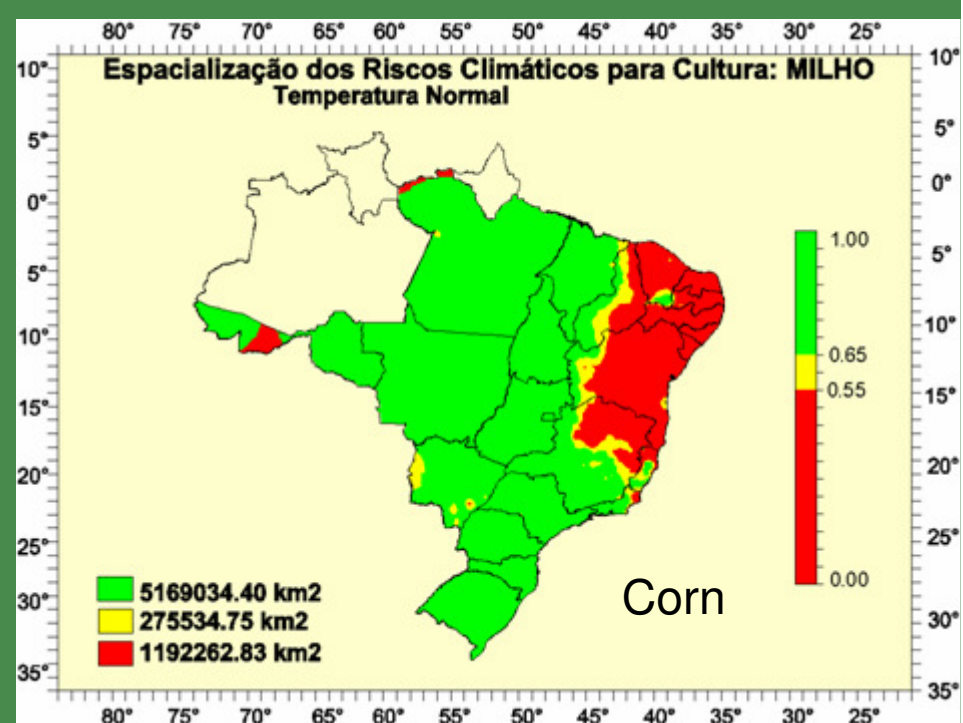
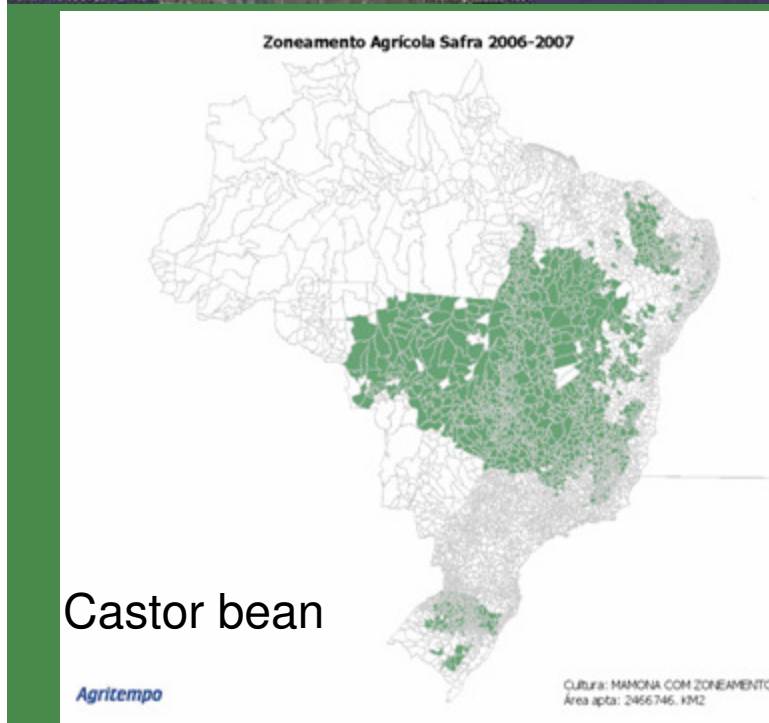
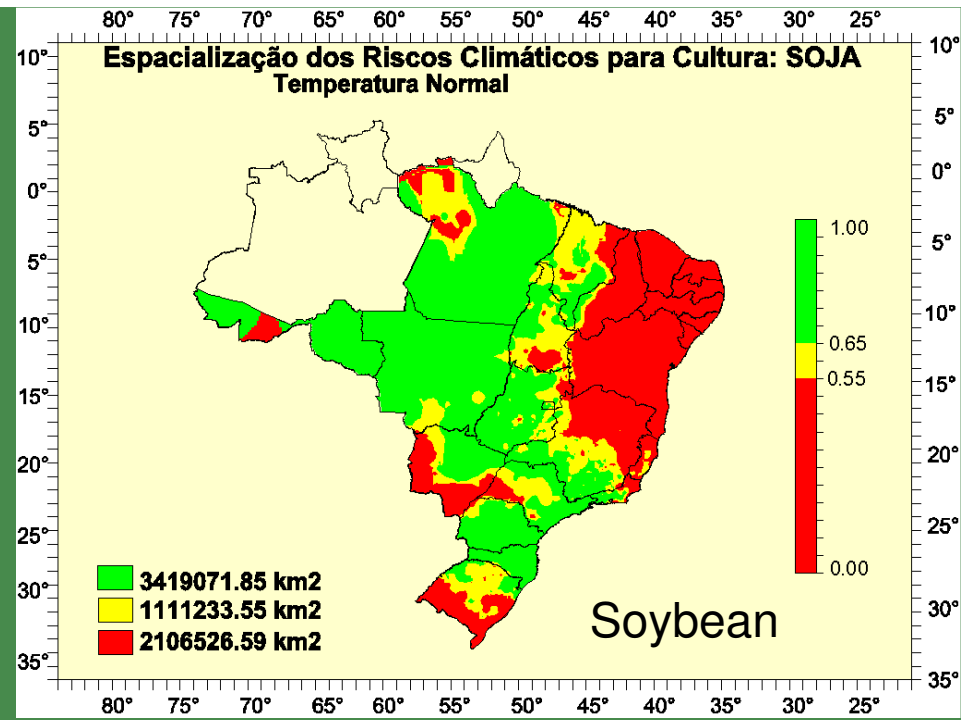
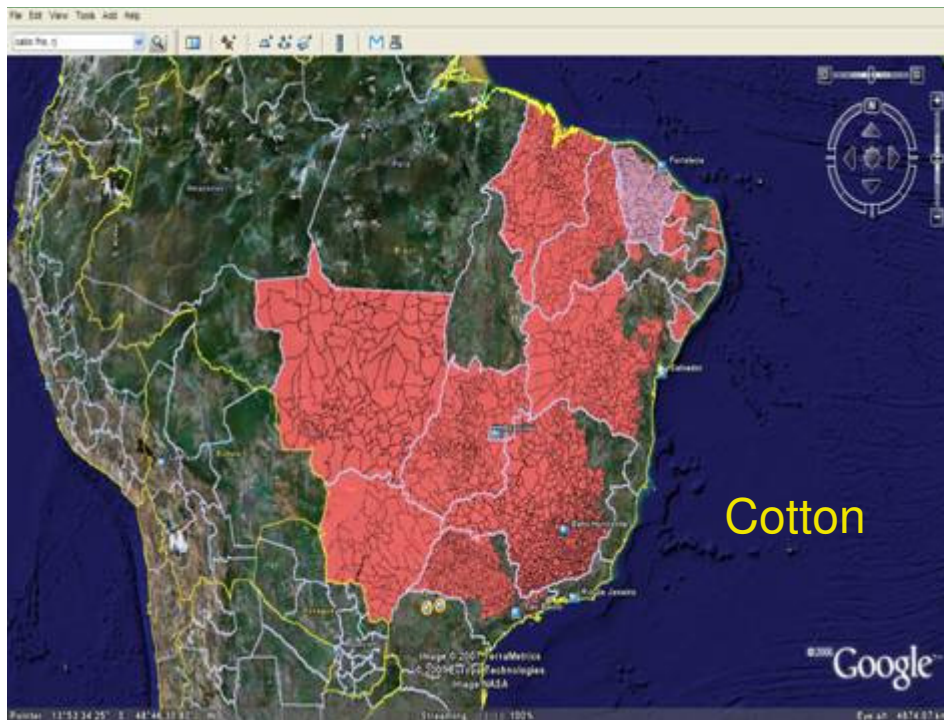
## **3. Phenological phases and susceptibility to meteorological extremes:**

- **Sowing**
- **Germination**
- **Flowering**
- **Fructification**
- **Ripening**
- **Harvesting**

## **4. Heat Unit (degree days) for simulation of the phenological cicle**

# Actual Zoning Crops

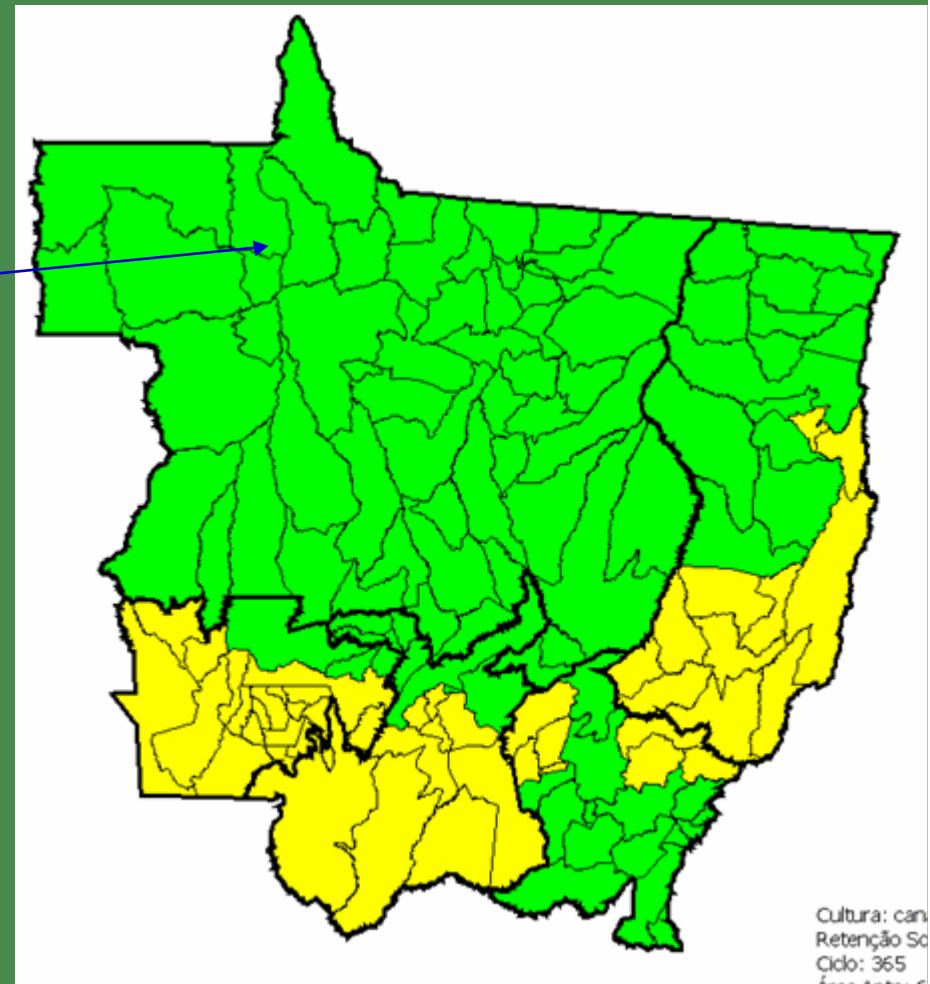
- Rice
- Beans
- Corn
- Wheat
- **Soybeans**
- Sorghum
- Coffee arabica
- Coffee robusta
- **Cotton**
- **Castor Bean**
- Apple
- Vigna beans
- Banana
- Cashew nuts
- Barley
- Maninhot
- **Palm Oil**
- **Sunflower**
- **Peanuts**
- **Rape seed**





# Sugar Cane: low risk production - Mato Grosso State

Low Risk  
Intermediate



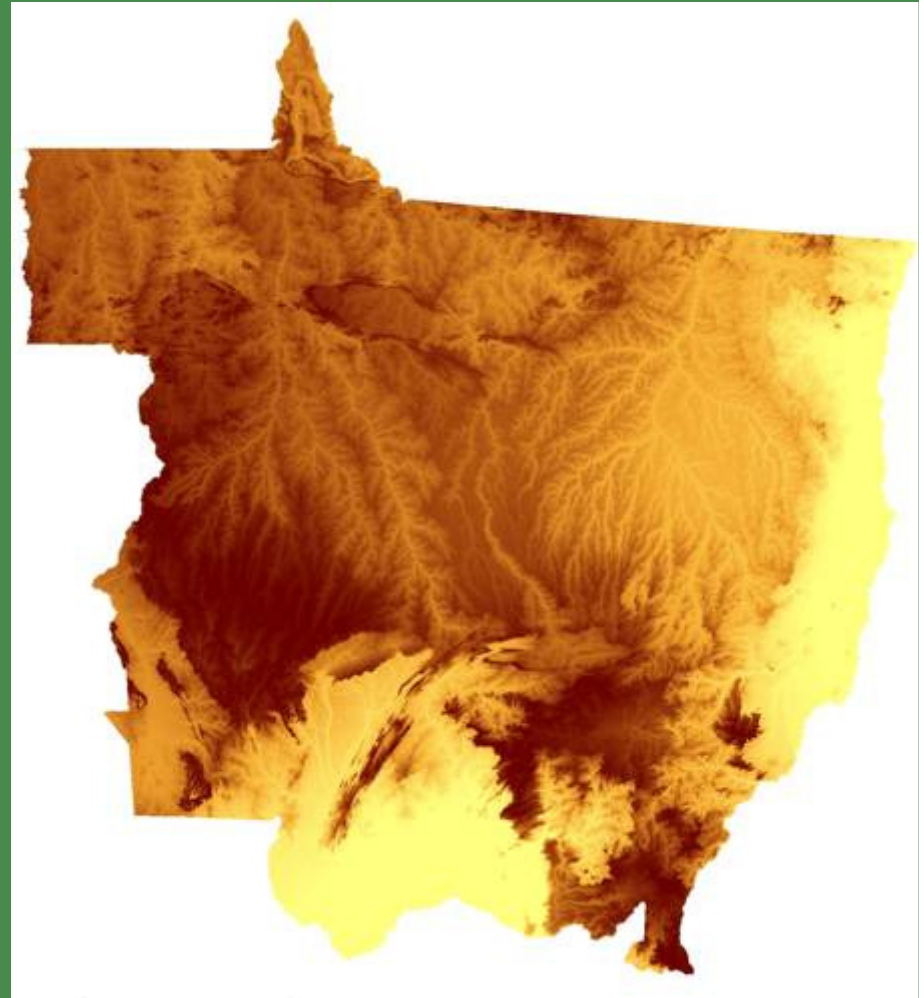
# Biomass Potential production

**Cana de Açúcar**

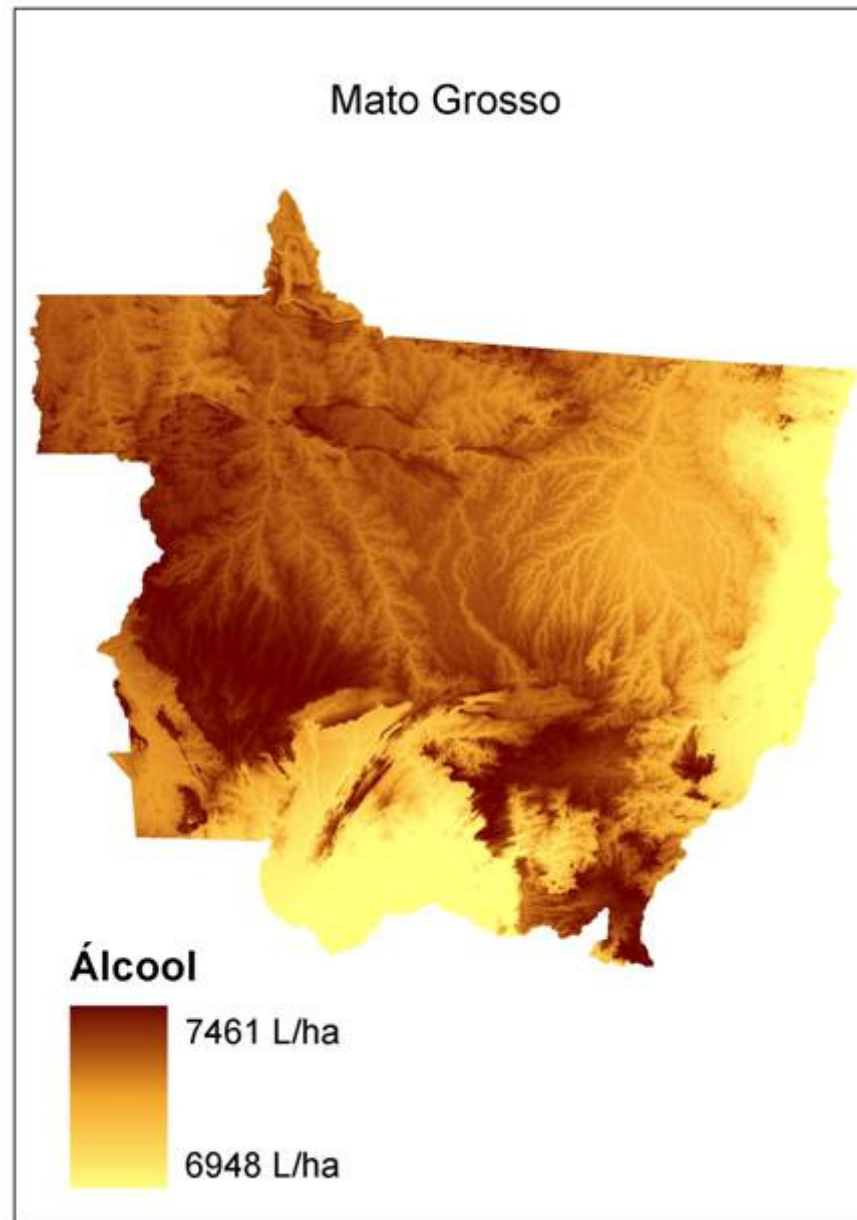


93 T/ha

86 T/ha



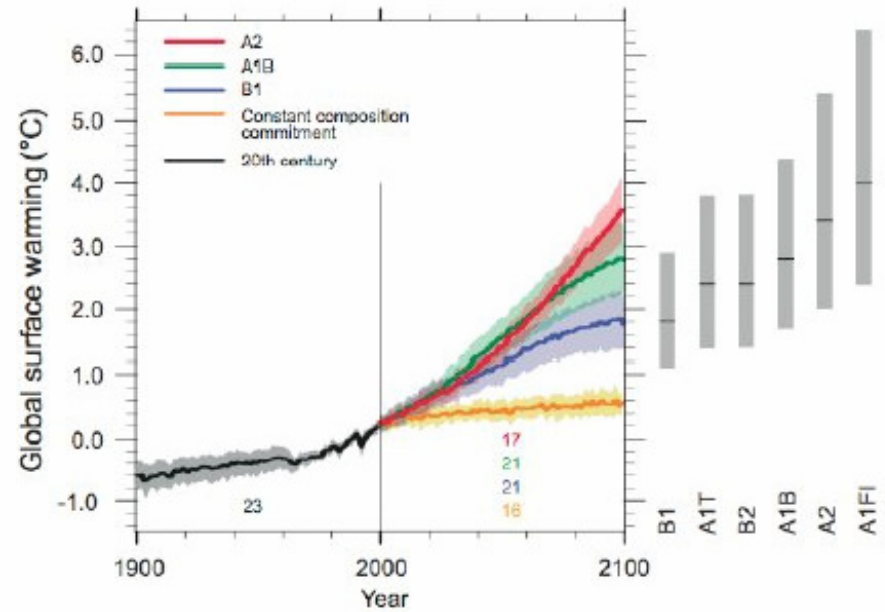
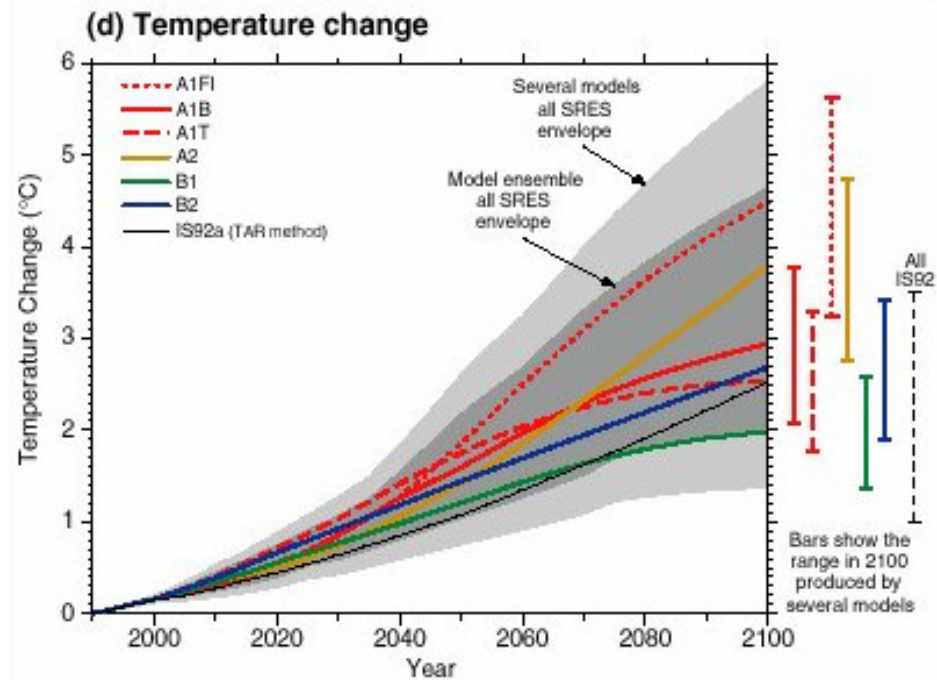
# Ethanol potential production



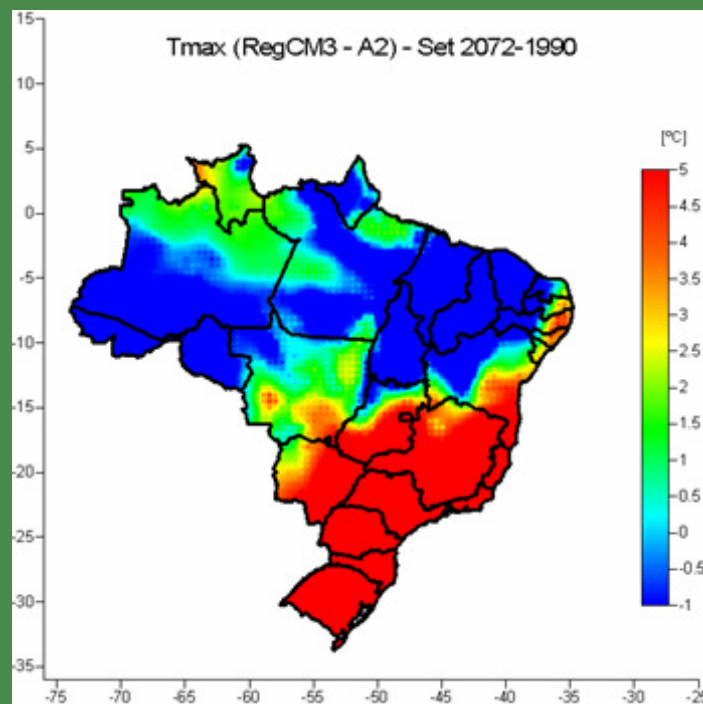
[illegible]



# **GLOBAL WARMING SCENARIOS**



IPCC 2001



IPCC 2007



**Coffee:**



Candle Buds

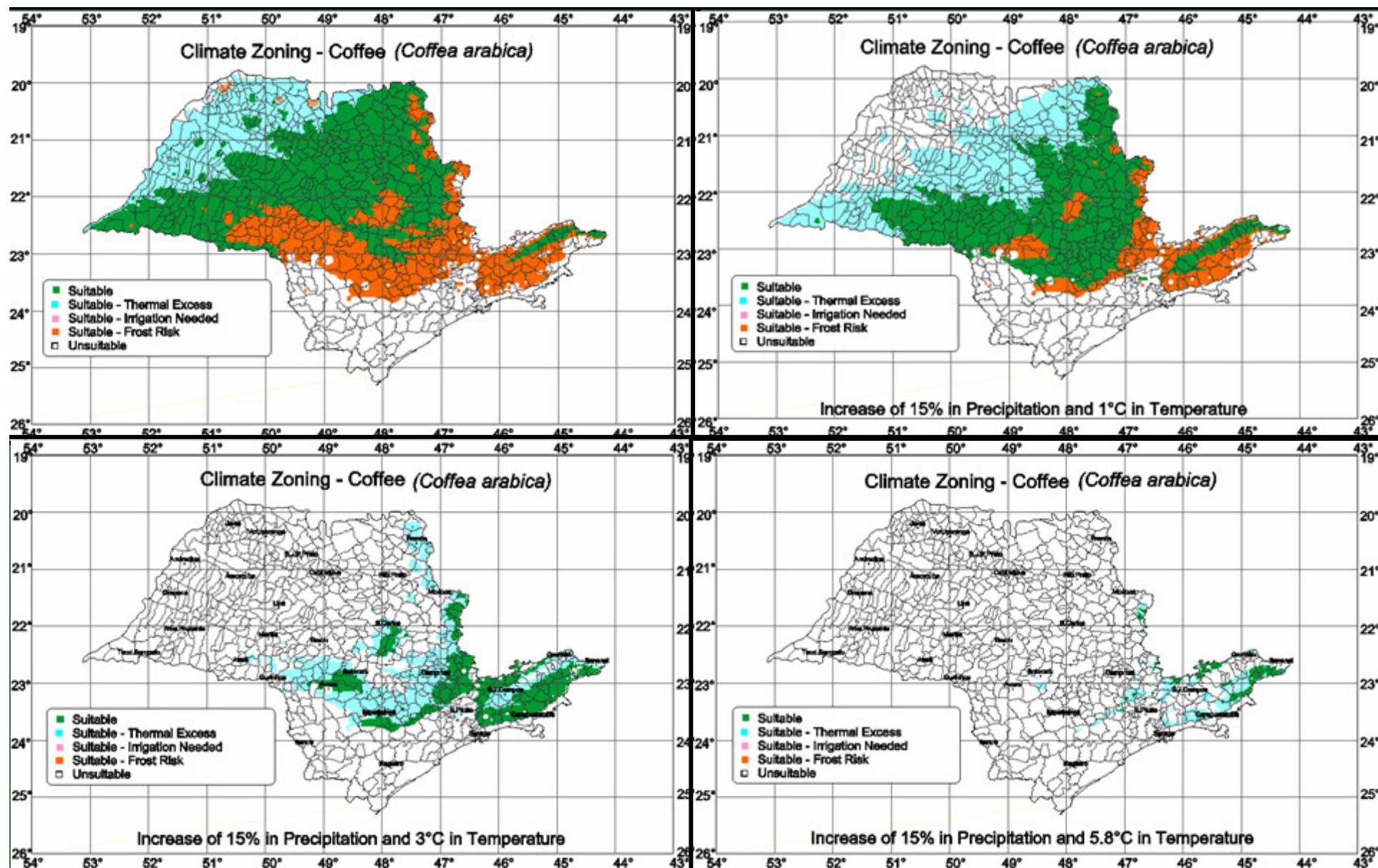
$T > 34^{\circ}\text{C}$

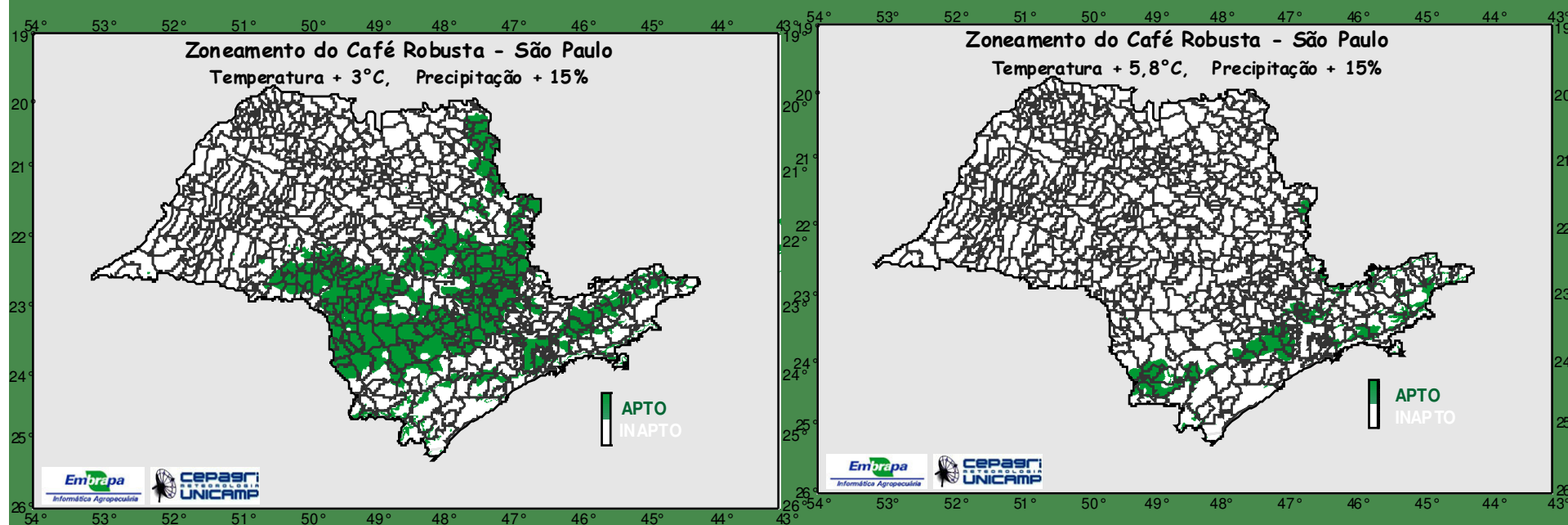
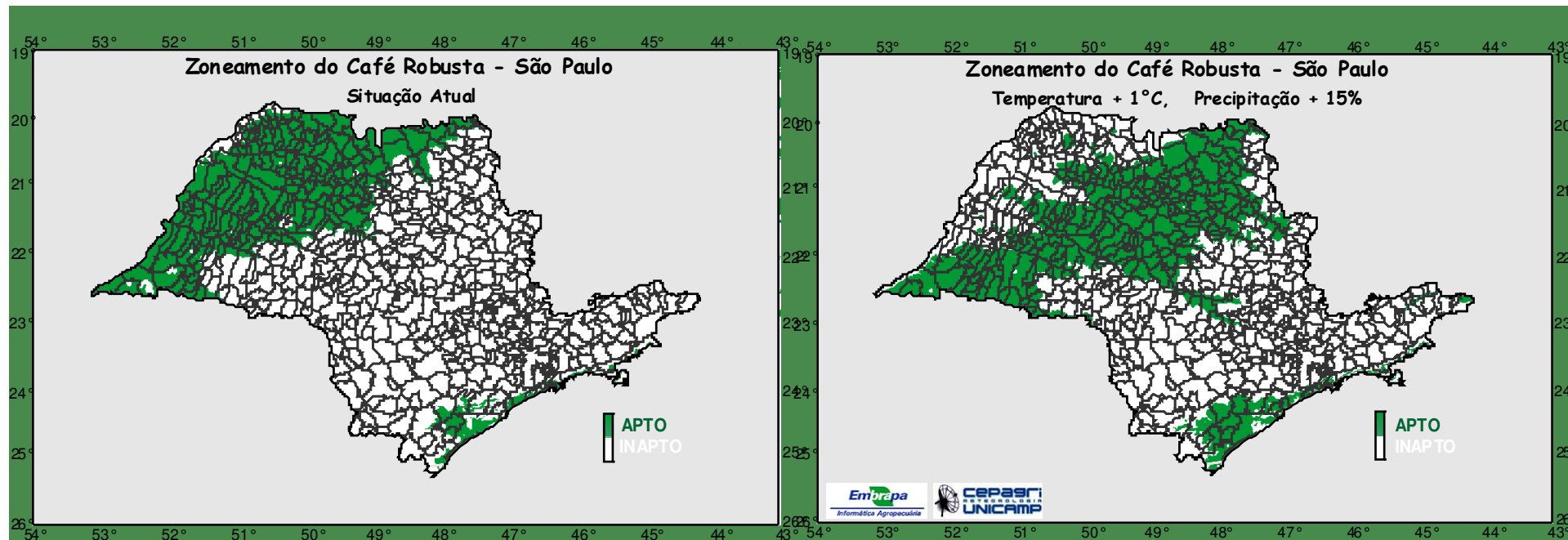


Star Flowers

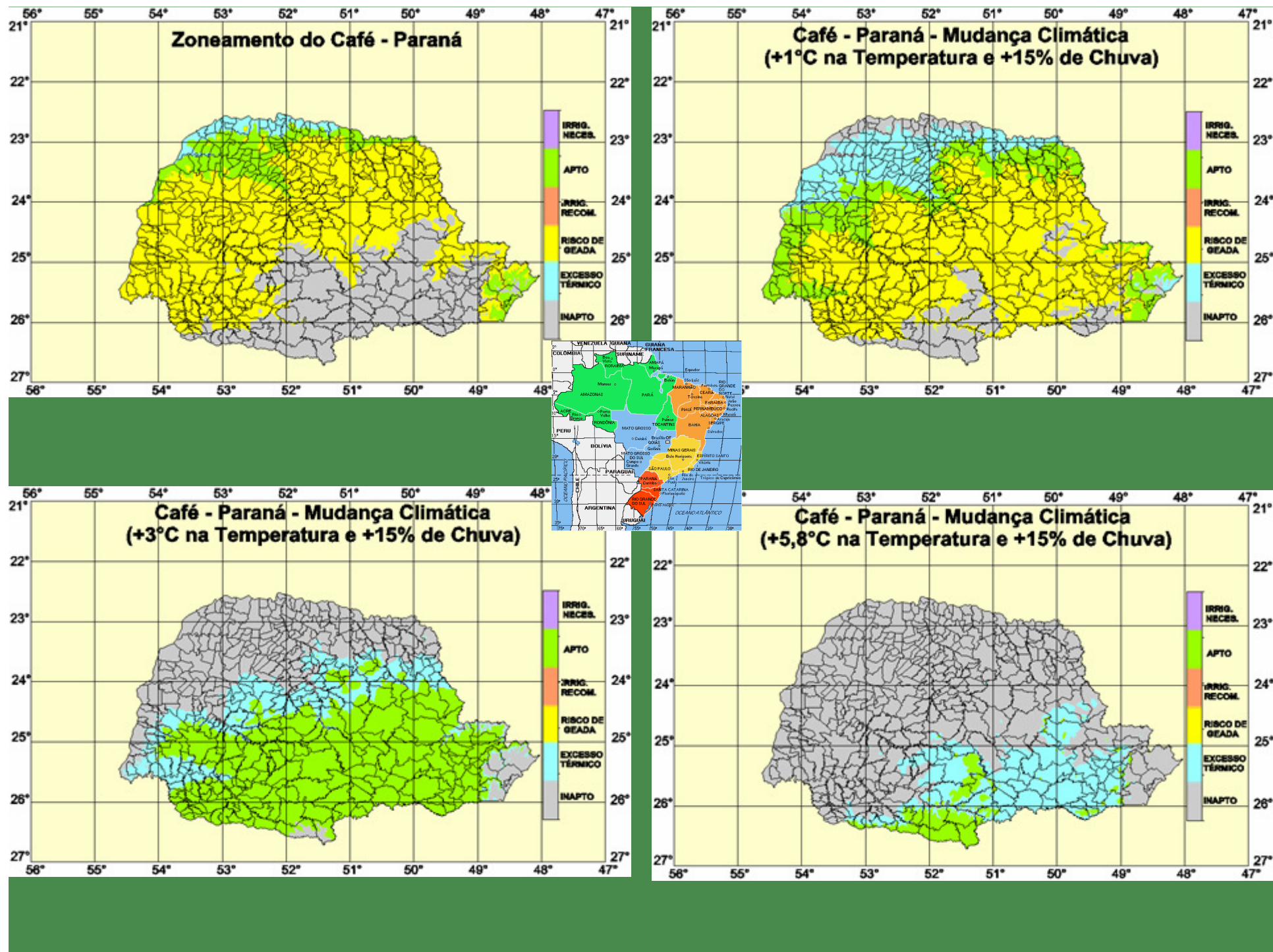












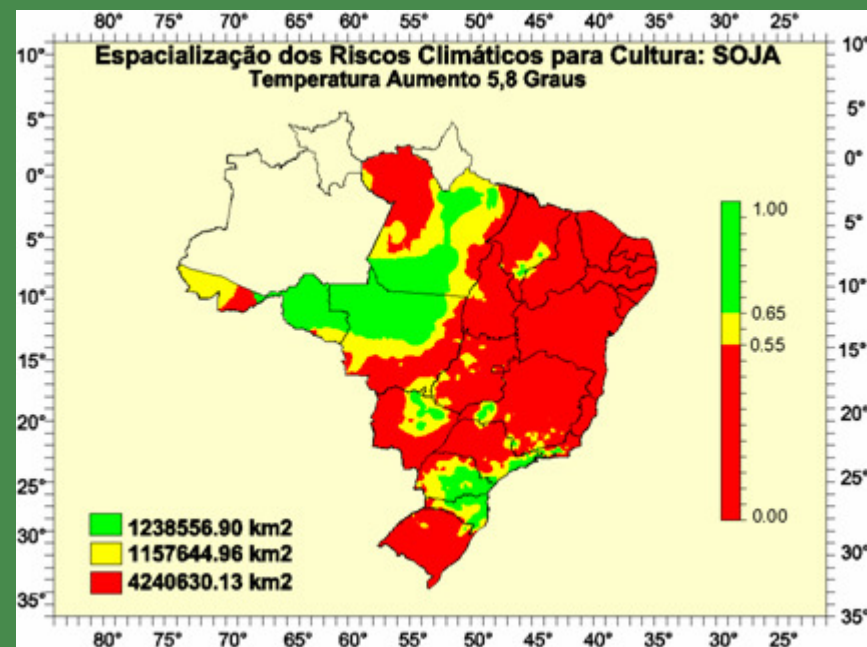
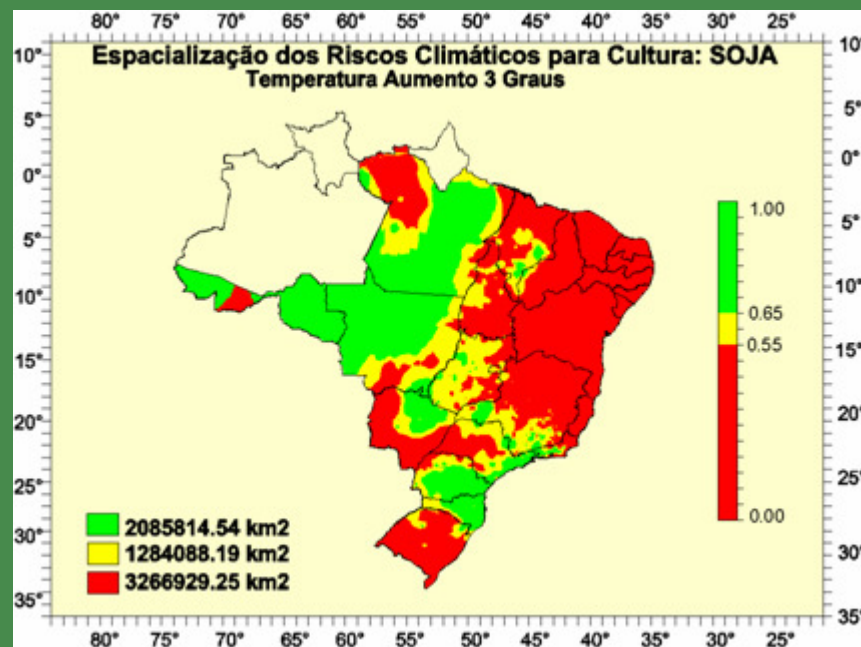
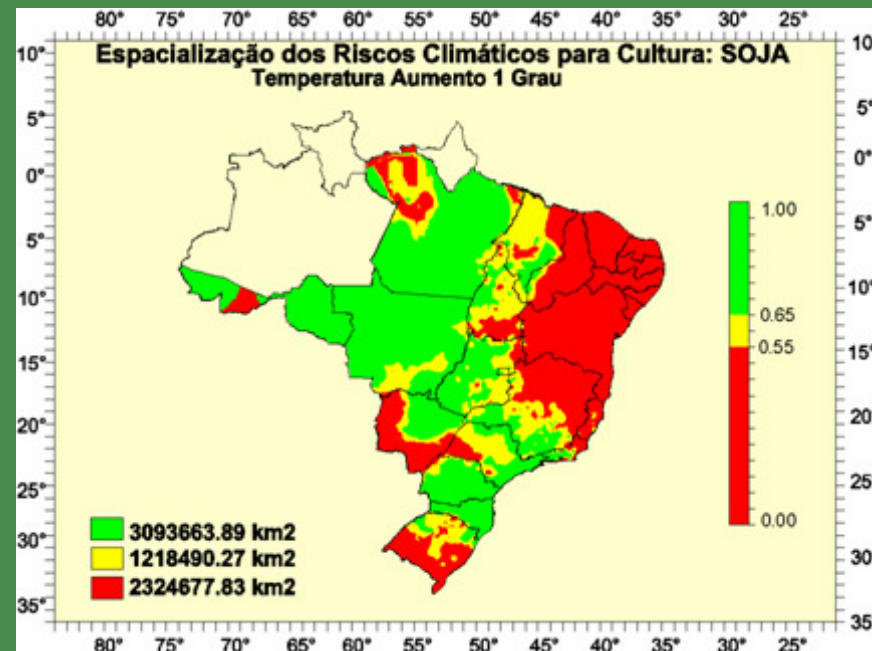
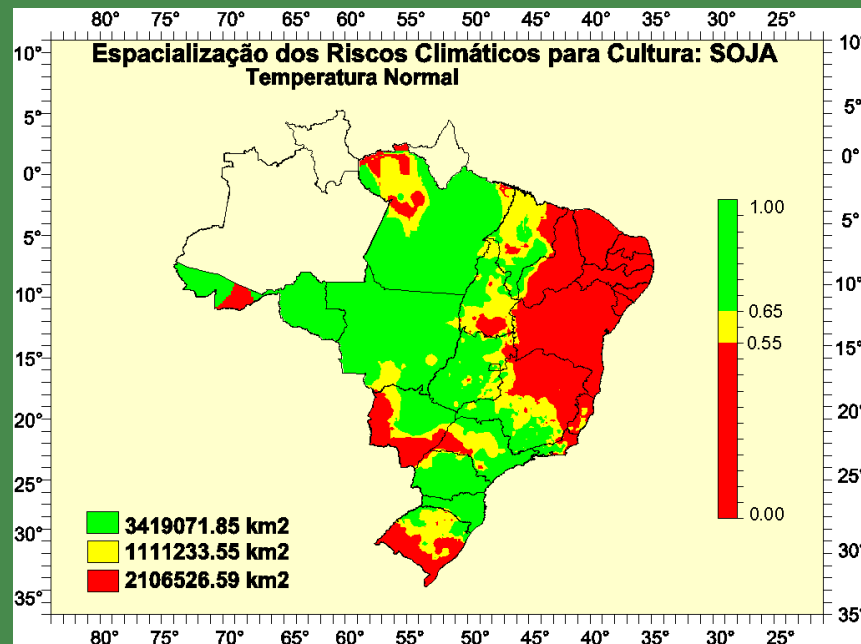




# Soybean



# Soil 50mm – 1 a 10 de November





A photograph of a sugarcane field. The image shows several stalks of sugarcane with green leaves and reddish-brown stems. The word "SUGARCANE" is overlaid in large, white, bold, sans-serif capital letters across the center of the image.

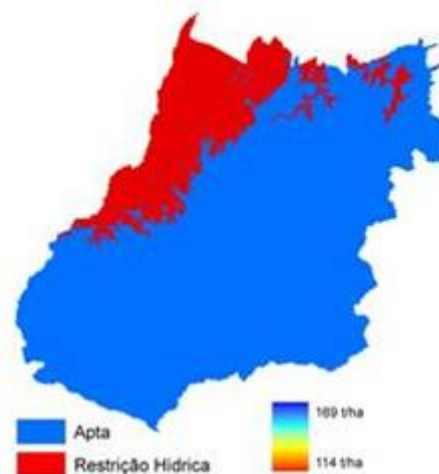
# SUGARCANE



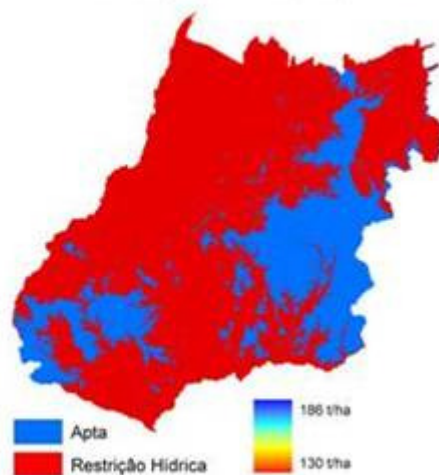
Zoneamento Agroclimática da Cana-de-Açúcar  
para o Estado de Goiás



Zoneamento Agroclimática da Cana-de-Açúcar  
para o Estado de Goiás  
Mudanças Climáticas (+1°C)



Zoneamento Agroclimática da Cana-de-Açúcar  
para o Estado de Goiás  
Mudanças Climáticas (+3°C)

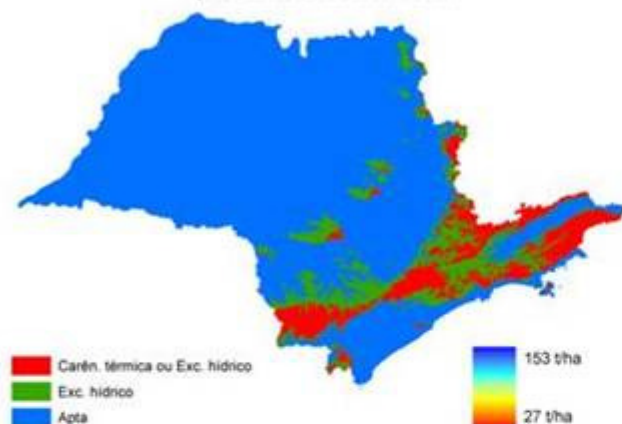


Zoneamento Agroclimática da Cana-de-Açúcar  
para o Estado de Goiás  
Mudanças Climáticas (+5°C)





Zoneamento Agroclimático da Cana-de-açúcar  
para o Estado de São Paulo



Zoneamento Agroclimático da Cana-de-açúcar  
para o Estado de São Paulo  
Mudanças Climáticas (+1°C)



Zoneamento Agroclimático da Cana-de-açúcar  
para o Estado de São Paulo  
Mudanças Climáticas (+3°C)



Zoneamento Agroclimático da Cana-de-açúcar  
para o Estado de São Paulo  
Mudanças Climáticas (+5°C)



Crop	Actual Production Million Ton	Production Million Ton T+1C	Production Million Ton T+3C	Production Million Ton T+5.8C
Rice	11,0	10,56 (-4.0%)	9,02 (-18,0%)	6,49 (-41,0%)
Bean	3,0	2,91 (-3.0%)	2,67 (-11.0%)	2,31 (-23.0%)
Soybean	55,0	49,50 (-10,0%)	33,55 (-39.0%)	19,80 (-64,0%)
Corn	43,0	42,14 (2,0%)	39,99 (-7.0%)	28,38 (-14,0%)
Arabica Coffee	2,0	1,54 (-23.0%)	0,84 (-58.0%)	0.16 (-92.0%)
Total	114.0	106,65 (-6,0%)	86,25 (-24.0%)	57,14 (-50.0%)

Actual and future grain production in Brazil according to the raise in the global temperature ( IPCC).

# HEAT WAVES AND EFFECTS ON ANIMALS



**Actual pasture area in Brazil = 220 million hectares.**

**About 100 million hectares correspond to degraded pasture and 70 million ha for expanding crop production.**

**Ethanol: actual sugar cane production area = 3,2 million ha or 20 billion of liters of alcohol.**

**Potential area for alcohol production = 24 million of hectares or = 150 billion of liters of alcohol.**



# HEAT WAVES

## Animal production

- Time interval with temperature above 32°C (2 days)

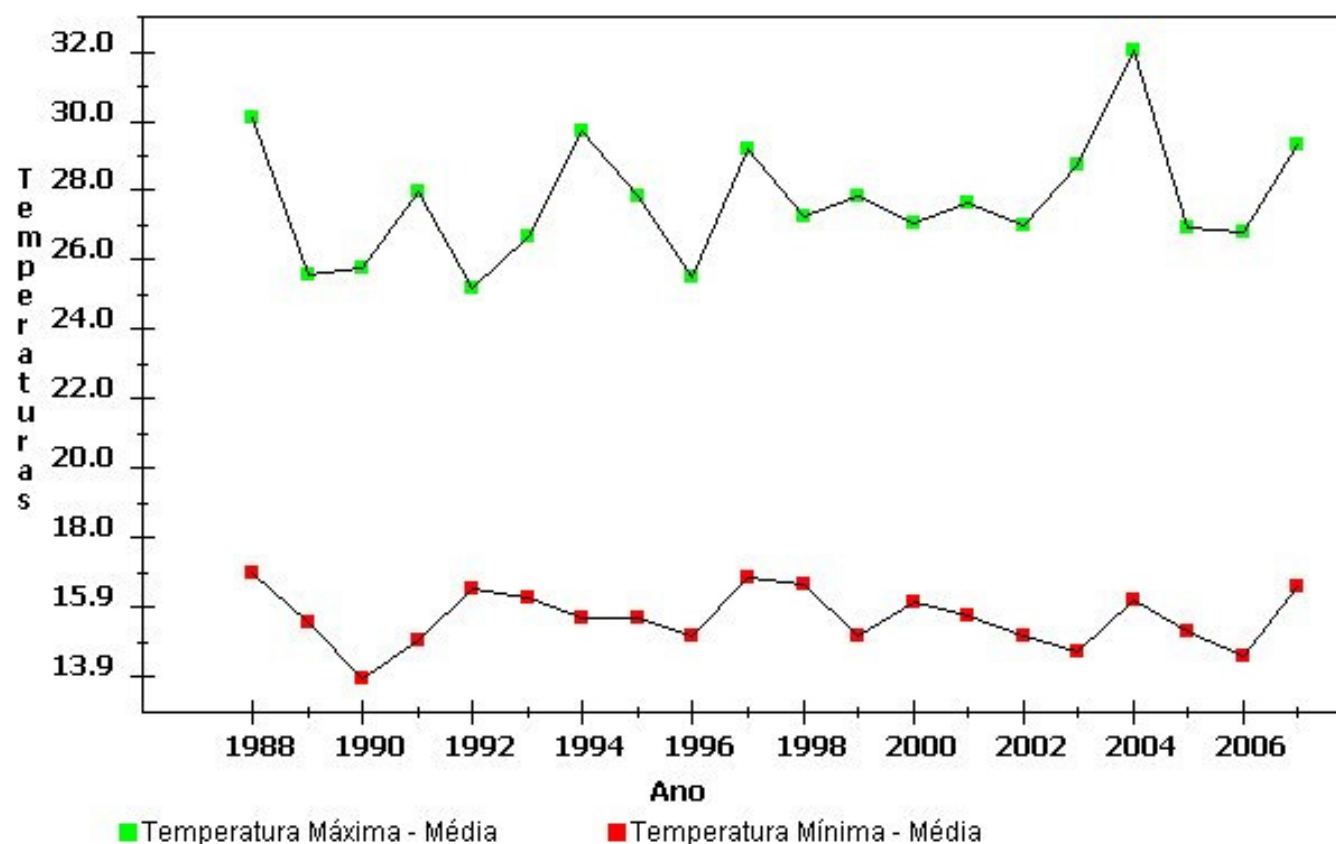
## PASTURE SCENARIOS FOR CENTER-WEST BRAZIL

If maintained the historical average rainfall index during the dry season (45.5 mm) and supposing a gradual increase in temperature of 5 °C (21.7°C to 26.7°C) the potential impact on pasture reduction tends to be 72%.

# Agritempo

Sistema de Monitoramento Agrometeorológico

Dados históricos para o mês 09 - Campinas (UNICAMP)



**SÃO PAULO STATE - BRAZIL**  
**SEPT/2004**  
**MEAN TEMP. 4C > NORMAL**

- **Decrease >50% of milk production**
  - **Increase of animal abortion**
    - **Eg without shell**
- **Increase of domestic fowl mortality**
- **Increase of new born animals mortality**

**Economic losses > \$50 million in one week**



# Mitigation and Adaptation

# **ENVIRONMENTAL SERVICES**

**Healthy development of the ecosystems**

**Reduction of deforestation**

**Atmospheric CO<sup>2</sup> absorption**

- Direct sowing**
- Agroforest systems**
- Forest-farming-pasture integration**

**Water conservation**

**Soil conservation**

**Biodiversity preservation**

**Fire risk reduction**

# Pasture



**Brazilian “Savana” – Estimated area of 40 million hectares  
of degraded pastures. 0,5 animal/ha/year**



## SISTEMA AGROSSILVIPASTORIL

Ótima opção para parte da fazenda



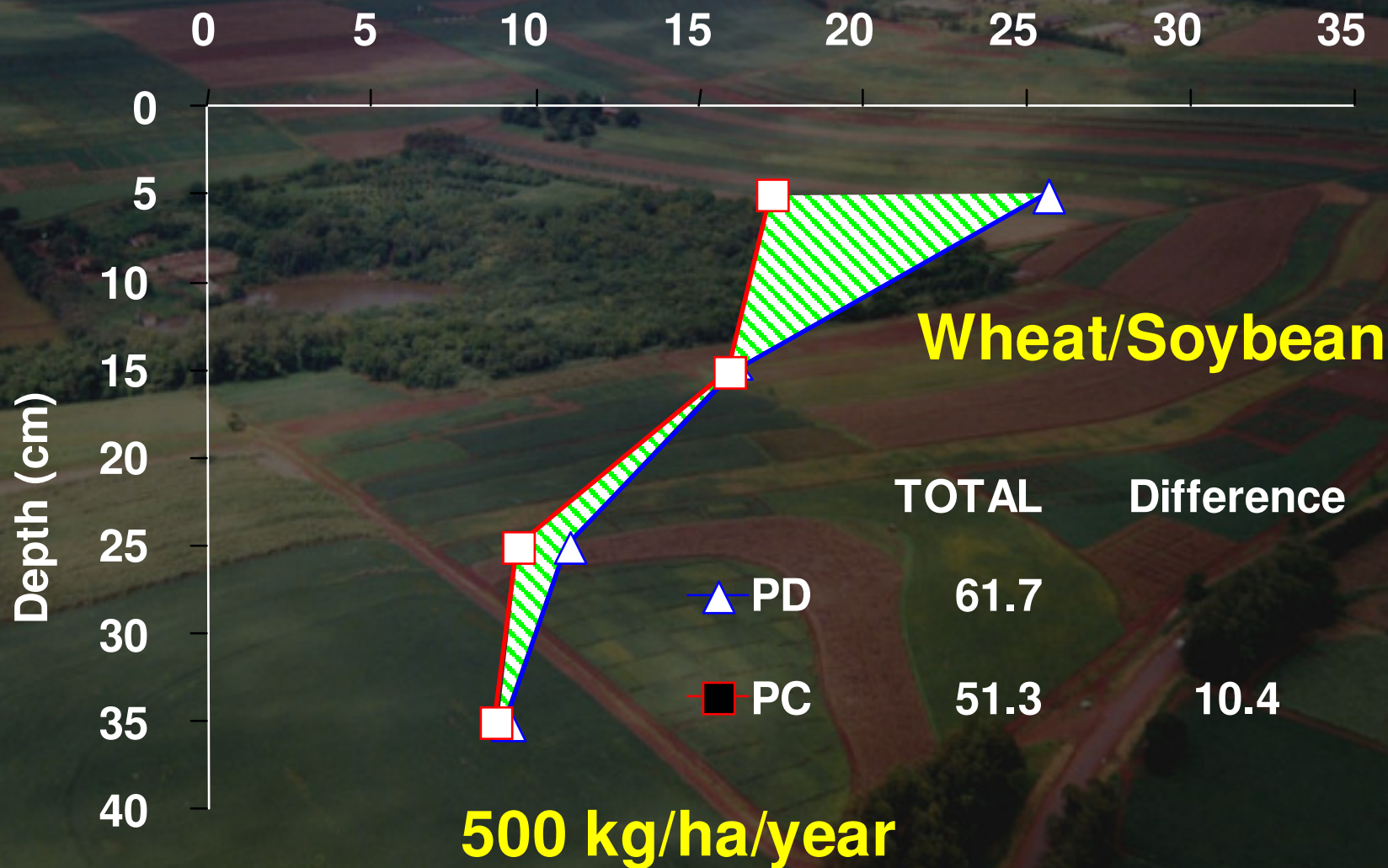
Cortesia: S. Crestana e F. Durães Embrapa Agroenergia



# Londrina

After 22 years

Carbon ( $\text{Mg ha}^{-1}$ )



# ARBORIZATION









### Estoque de Carbono em Sistemas Agroflorestais com Café - Rondônia

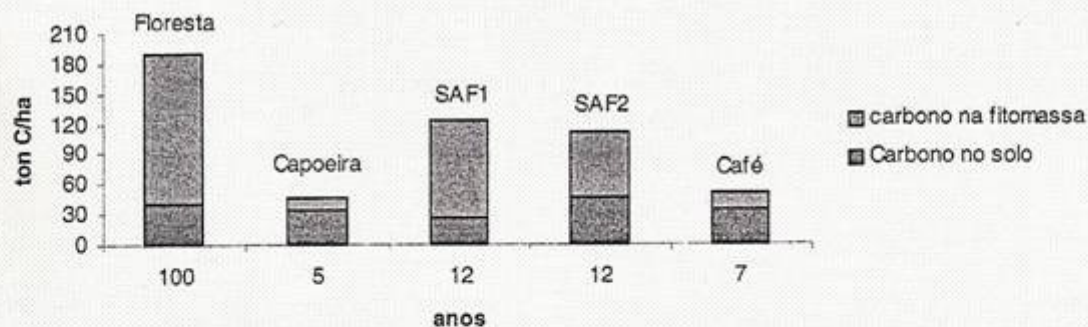


Figura 1. SAF<sub>1</sub>= café x seringueira (*Hevea brasiliensis*) SAF<sub>2</sub>=café x bandarra (*Schizolobium amazonicum*)

Sistema de uso da terra	Idade anos	C <sub>acima</sub> t/ha	I <sub>c</sub> t/ha/ano	T <sub>max</sub> anos	C <sub>max</sub> t/ha	C <sub>max</sub> /C <sub>floresta</sub>
Floresta Primária	∞	148,0	-	-	148,0	1
Capoeira Natural	5	11,2	2,2 b	5	11,0	0,07
SAF1-Café x Seringueira	12	97,2	8,1 a	15	121,5	0,82
SAF2- Café x Bandarra	12	64,5	5,4 a	15	80,6	0,54
Monocultivo de Café	7	16,6	2,4 b	12	28,4	0,19

CV=18%. Medias seguidas da mesma letra nas colunas não diferem entre si pelo teste de Tukey a nível de 5%.

TABELA 2. Valores médios do Carbono acima do solo (C<sub>acima</sub>), Taxa de acumulação de Carbono/ano (I<sub>c</sub>), tempo para máxima de acumulação de Carbono (T<sub>max</sub>), Carbono máximo acumulado em T<sub>max</sub> (C<sub>max</sub>) e relação do carbono nos sistemas de uso da terra com floresta primária. Rondônia. Brasil. 1997.

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 Porto Velho, RO. CEP 78900-970. vanda@cpafro.embrapa.br; Carlos CASTILLA, Eng. Agr. DSc.  
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 Agr. DSc. TSBF, PO Box 30677. Nairobi, Kenya.



# Expressão de gene tolerante à seca na Soja

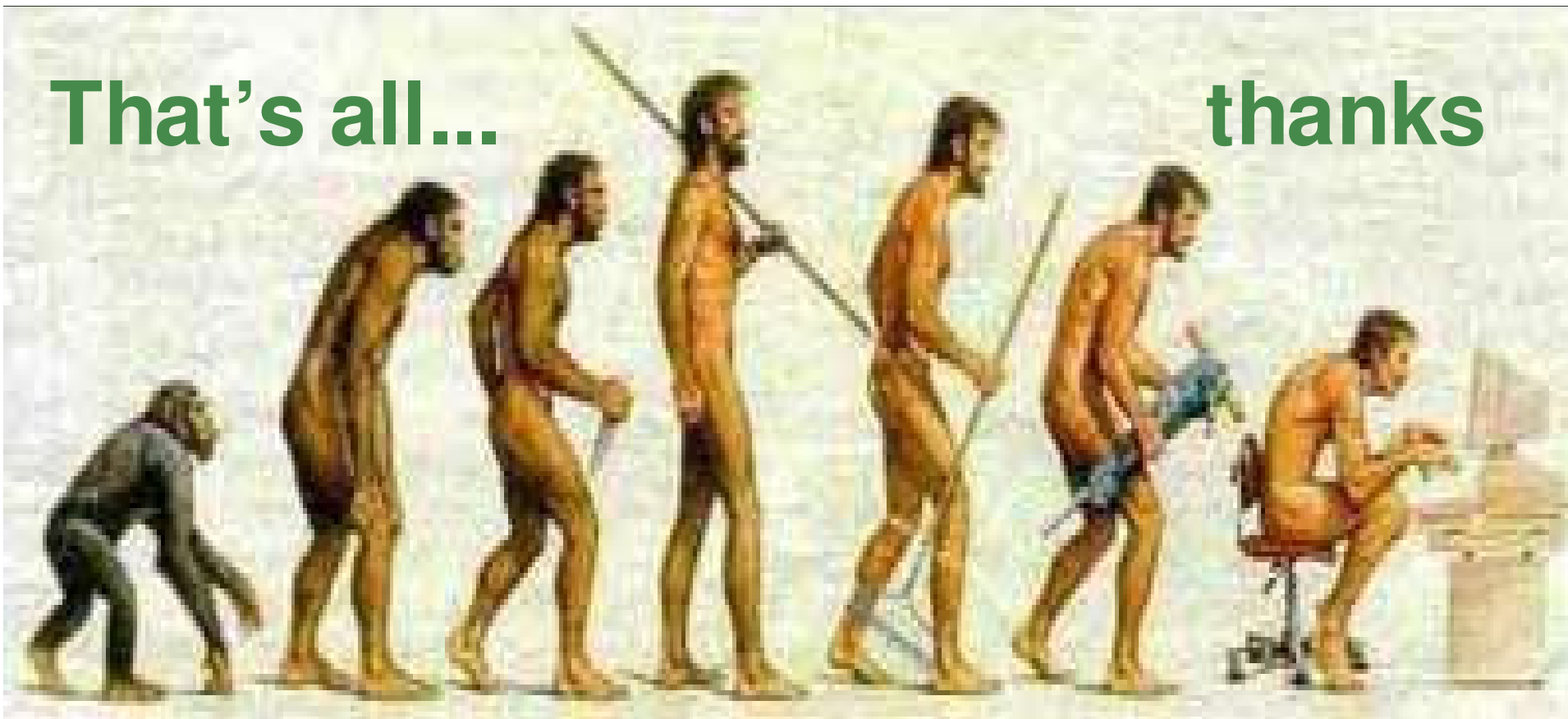


**P58 (BR-16 **com** gene)**  
**2.5% Umidade do solo**

**BR-16 **sem** gene**  
**2.5% Umidade do solo**

That's all...

thanks



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[www.agritempo.gov.br](http://www.agritempo.gov.br)

[assad@cnptia.embrapa.br](mailto:assad@cnptia.embrapa.br)

[www.cepagri.unicamp.br](http://www.cepagri.unicamp.br)

[jurandir@cpa.unicamp.br](mailto:jurandir@cpa.unicamp.br)

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

Onde procurar os Genes  
tolerantes?

# Número de Espécies

**12000**

Mendonça et al 2007

**6600**

Mata Seca

Cerradão

?

**1000  
Lenhosas**

Formações  
Florestais

Mata de  
Galeria

**1000  
Herbáceas**

**2000  
Florestas**

Formações  
Campestres

Campo  
Sujo

Campo  
Limp

Campo  
Rupestre

**4600  
Savanas e Campos**

Vereda

Palmeiral

Parque de  
Cerrado

Formações  
Savânicas

**3600  
herbáceas**

Cerrado

**1000  
Lenhosas  
(38 generalistas)**

Denso

Típico

Mendonça et al 1998



# Generalistas

*Qualea parviflora*



*Qualea grandiflora*



*Bowdichia virgilioides*



*Dimorphandra mollis*



*Lafoensia pacari*

