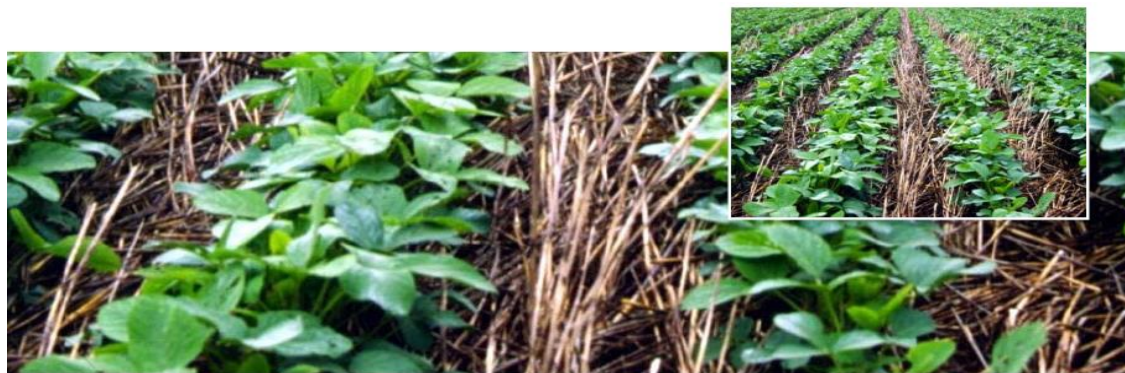




Mudanças Climáticas, Tecnologia e Agricultura

Prof. Dr. Flavio Justino



Sumário

◆ **Motivação**

- **Crise de alimentos e segurança alimentar**
- **Elevação dos preços**
- **Aumento na demanda**

◆ **Relação clima-agricultura**

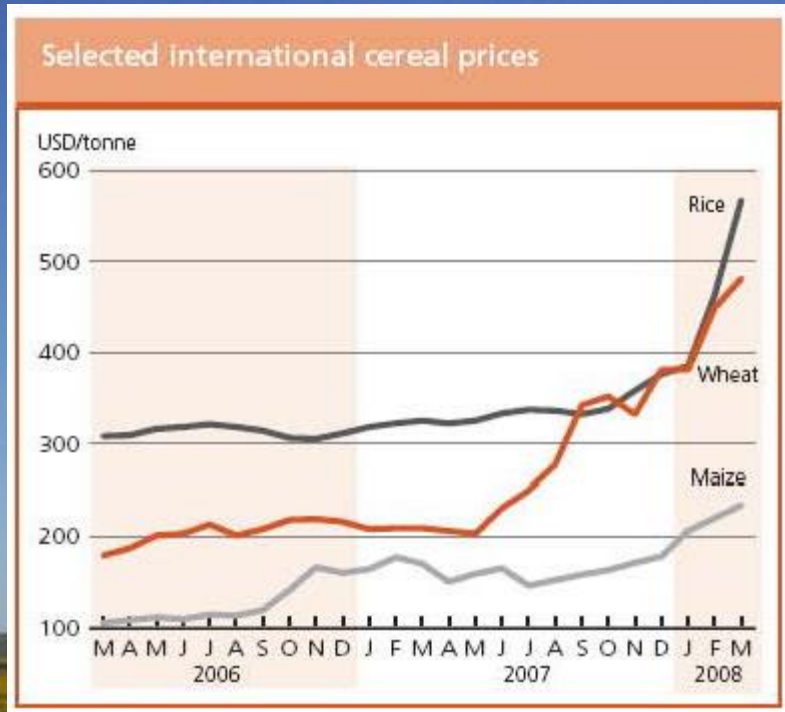
Efeito Estufa

Simulações Numéricas de Produtividade Agrícola

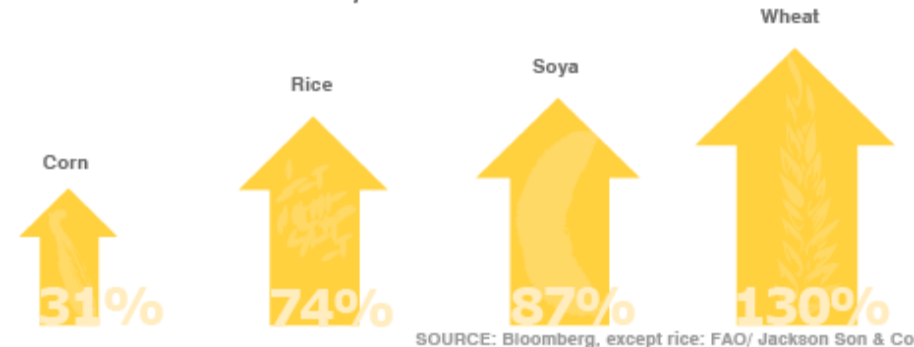
◆ **Estudo de caso**

Minas Gerais, São Paulo e Amazônia

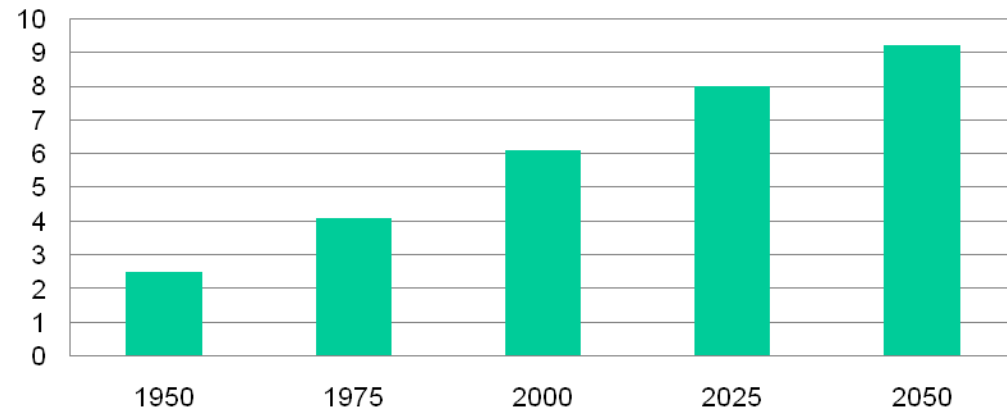
PREÇOS



PRICE RISES IN A SINGLE YEAR, MARCH 2007-MARCH 2008



Crescimento da População Mundial (Bilhões)



CHANGING EATING HABITS

Meat consumption in China per capita:

1980

20kg

2007

50kg

PRESSURE ON RESOURCES

1,000-2,000 litres of water is needed to produce 1kg of wheat



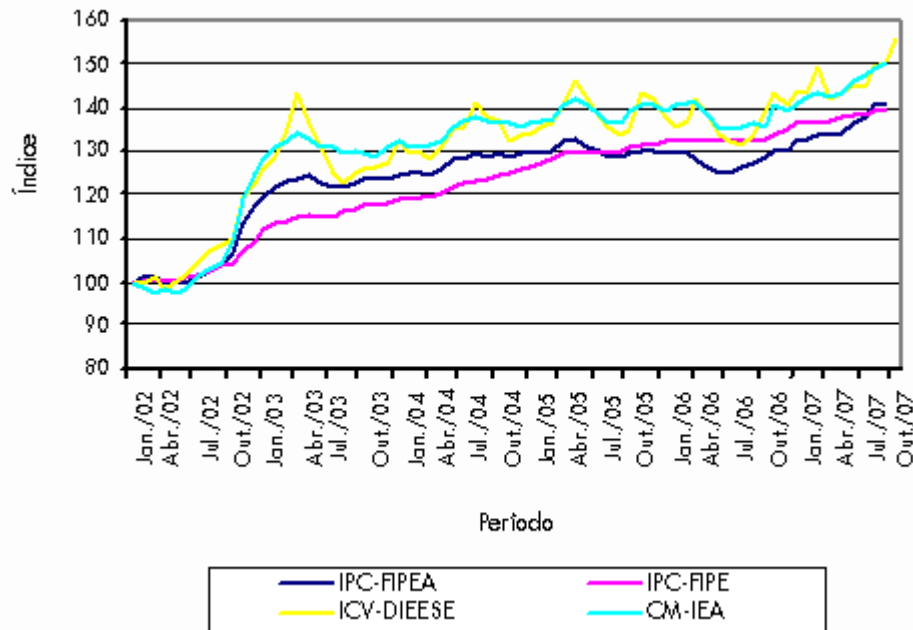
10,000-13,000 litres of water is needed to produce 1kg of beef



SOURCE: FAO

Preço x Oferta x Demanda <> CLIMA

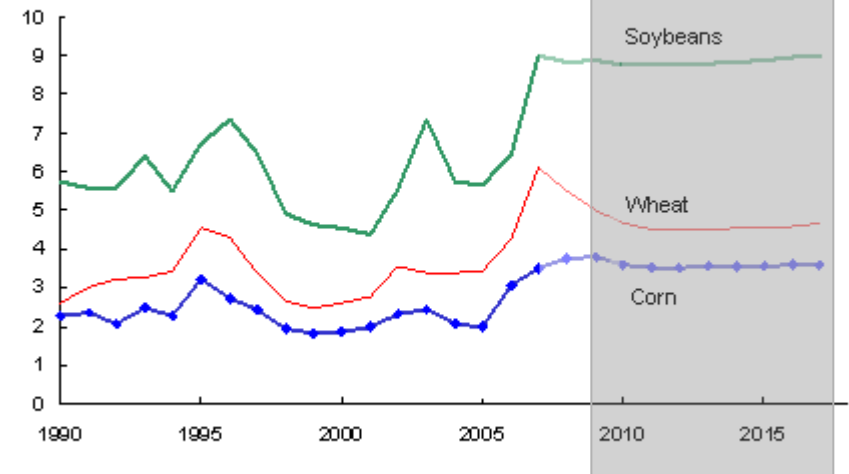
Brasil



Estados Unidos

U.S. farm-level prices: Corn, wheat, and soybeans

Dollars per bushel



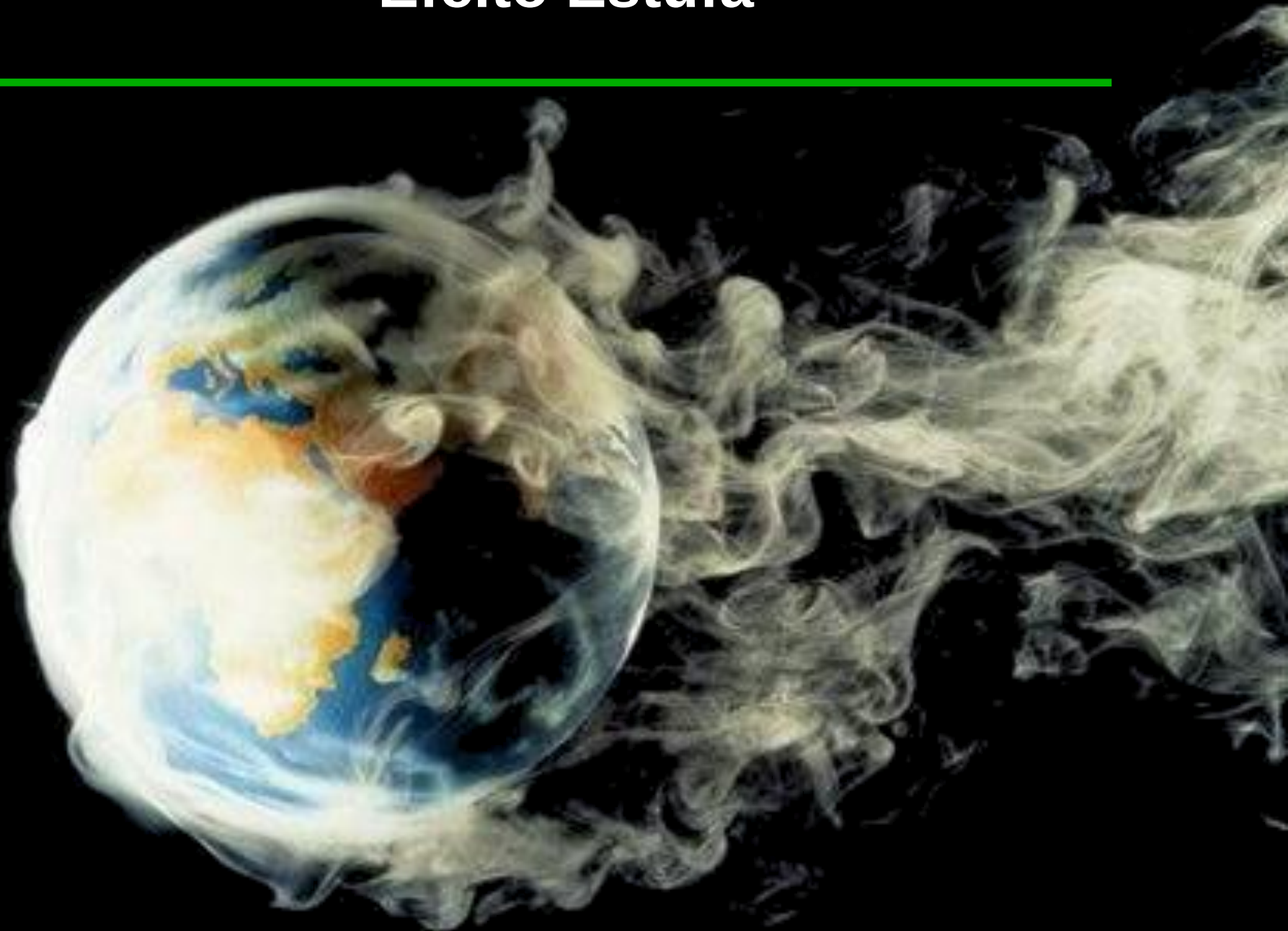
Source: *USDA Agricultural Projections to 2017*, February 2008.
USDA, Economic Research Service.

**Forçante
Climática?**

Um pouco de FÍSICA

$$\Delta F = 5.35 \times \ln C/Co$$

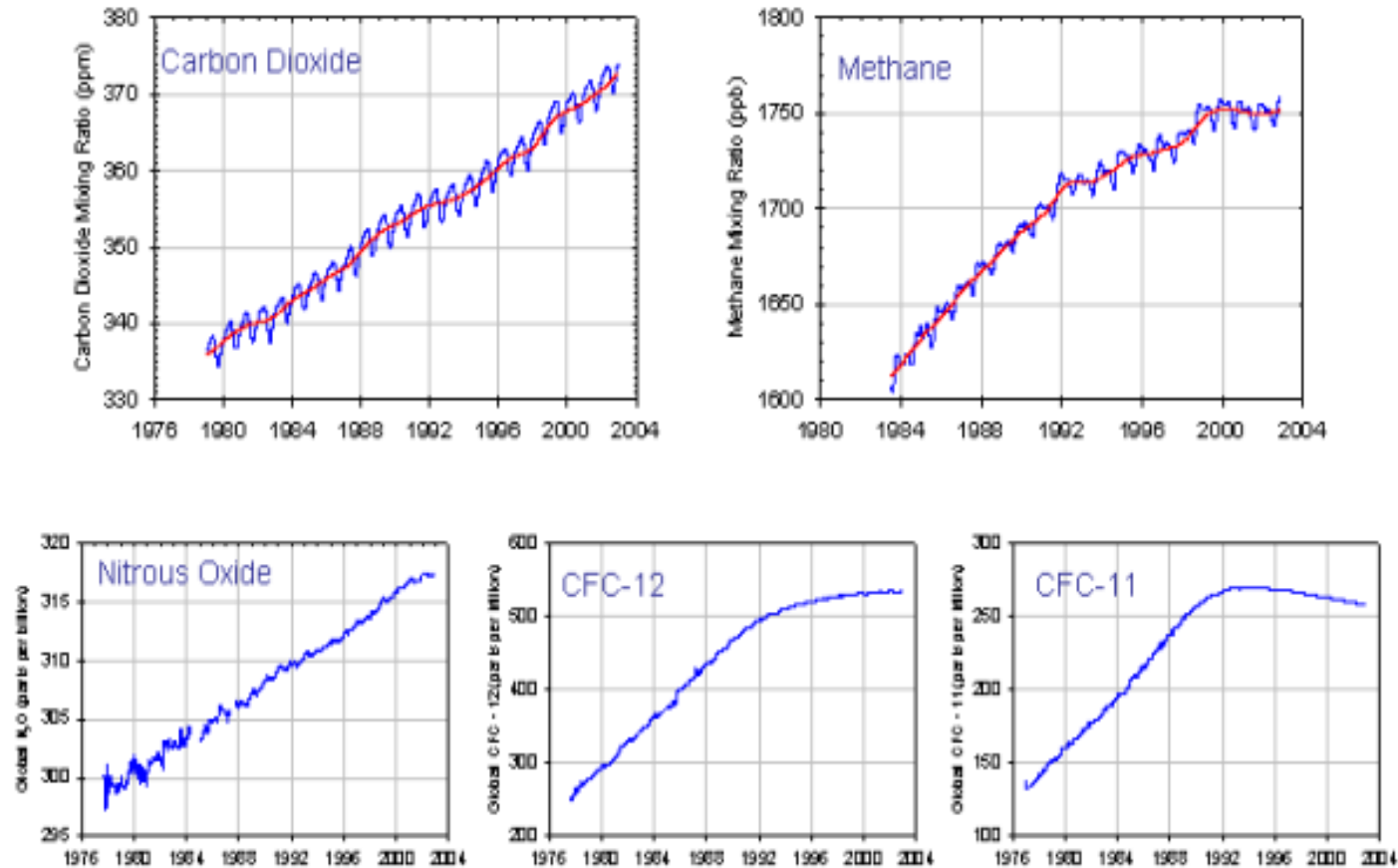
Efeito Estufa



Gases de efeito estufa (GEE)

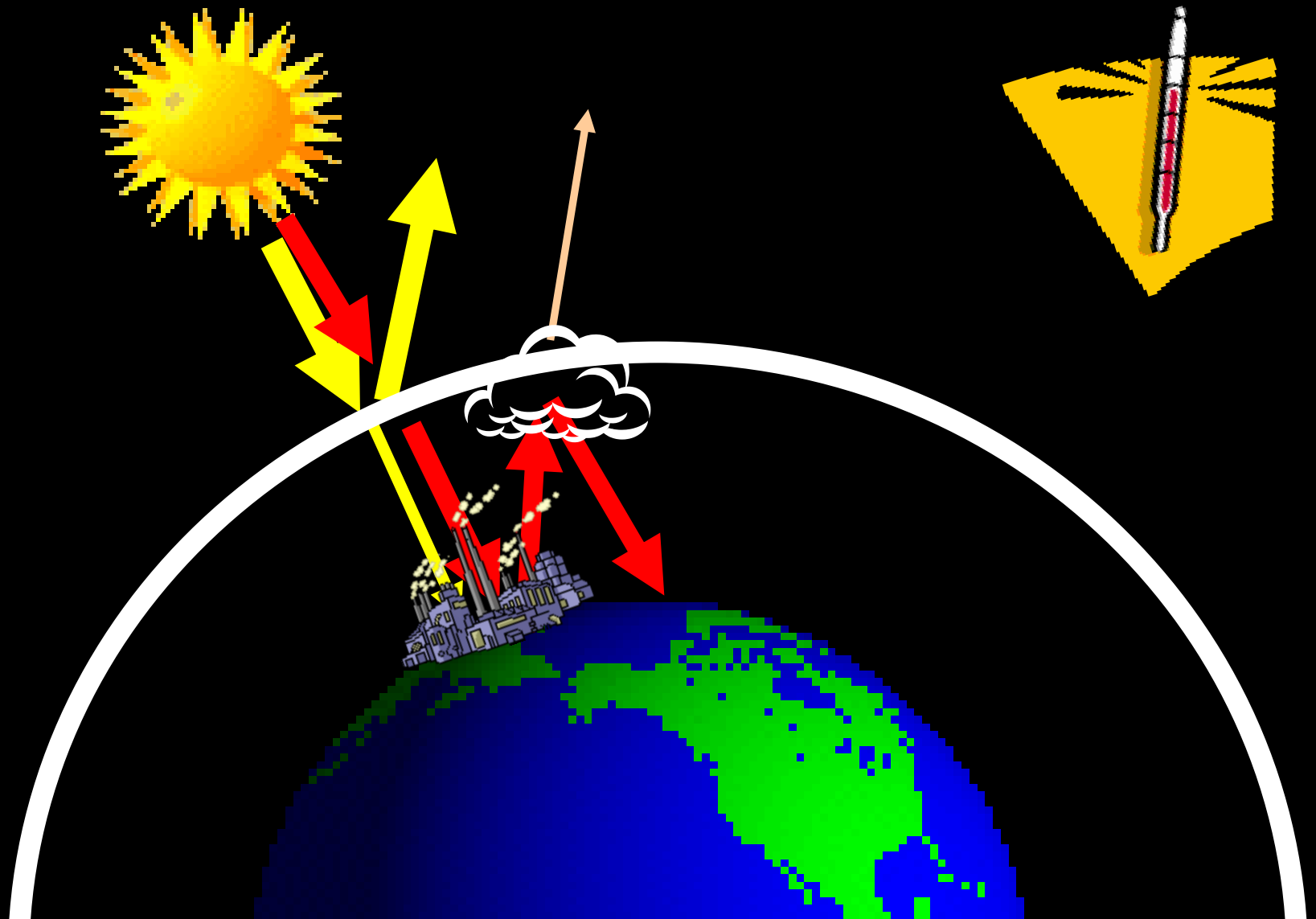
Gases de Efeito Estufa(GEE)	% em volume
Dióxido de Carbono	49%
Metano	18%
CFC´s	14%
Óxido Nitroso	6%
Outros	13%

Variação nos principais gases de efeito estufa



Global trends in major long-lived greenhouse gases through the year 2002. These five gases account for about 97% of the direct climate forcing by long-lived greenhouse gas increases since 1750. The remaining 3% is contributed by an assortment of 10 minor halogen gases, mainly HCFC-22, CFC-113 and CCl_4 .

EFEITO ESTUFA



“A Seca da Amazônia em 2005 considerada uma das mais severas em 100 anos”



11 dos últimos 12 anos (1995 -2006) estão entre os 12 mais quentes já registrados (desde 1850).



1928

Geleira Upsala, na Argentina



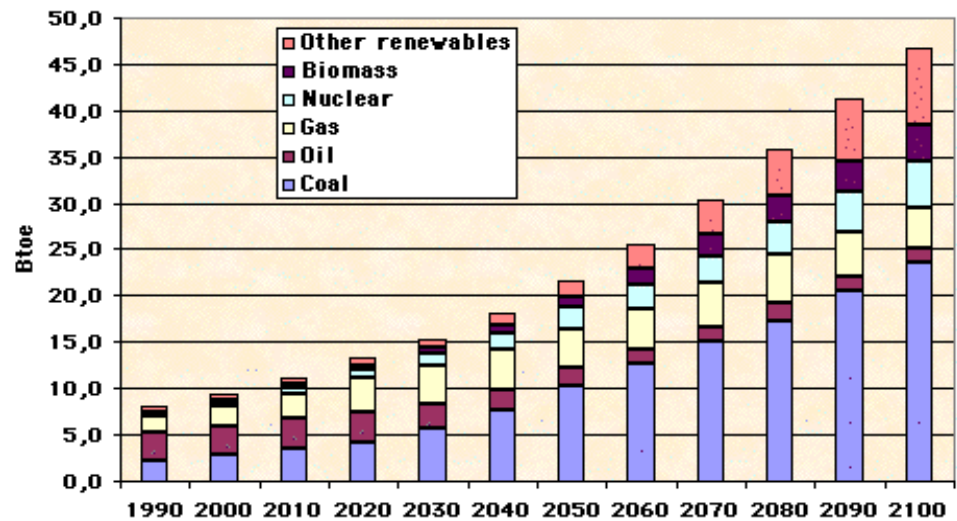
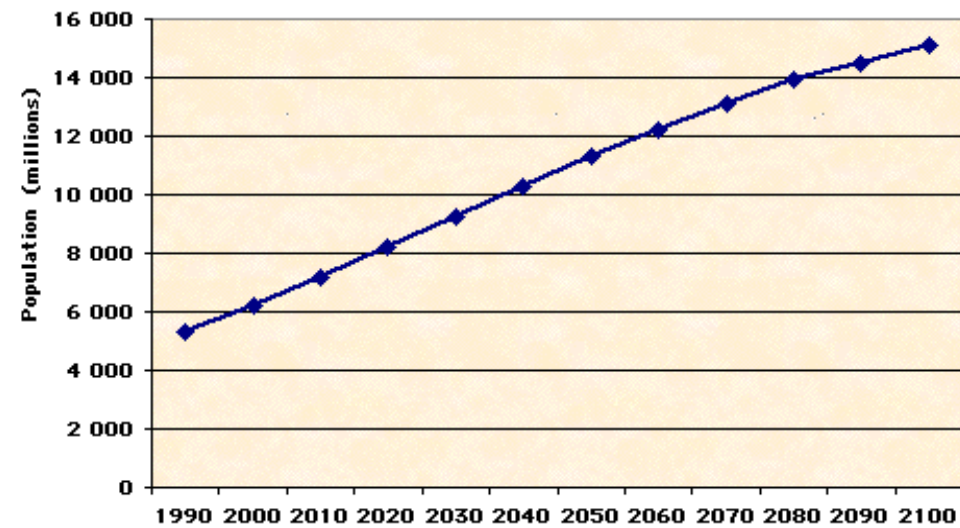
2004

CENÁRIOS DO IPCC

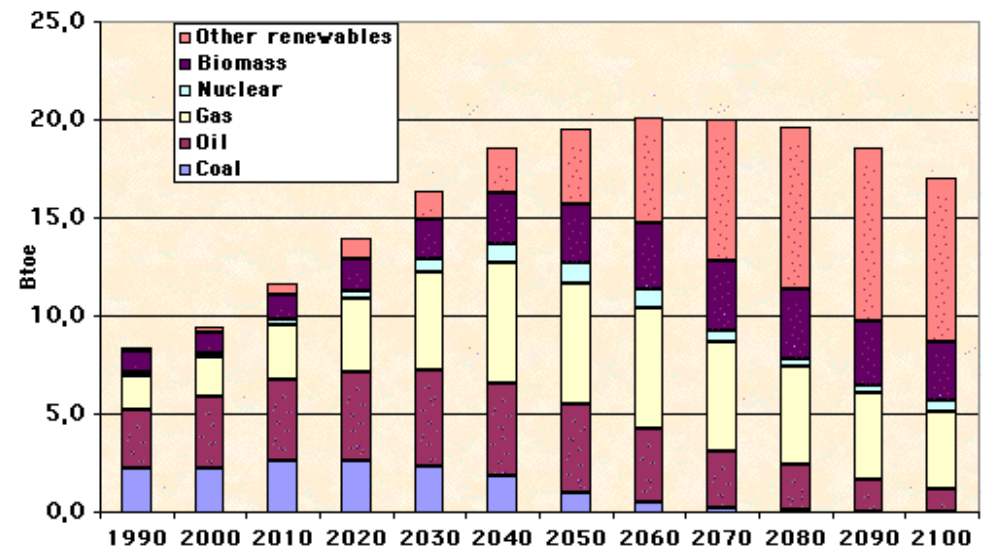
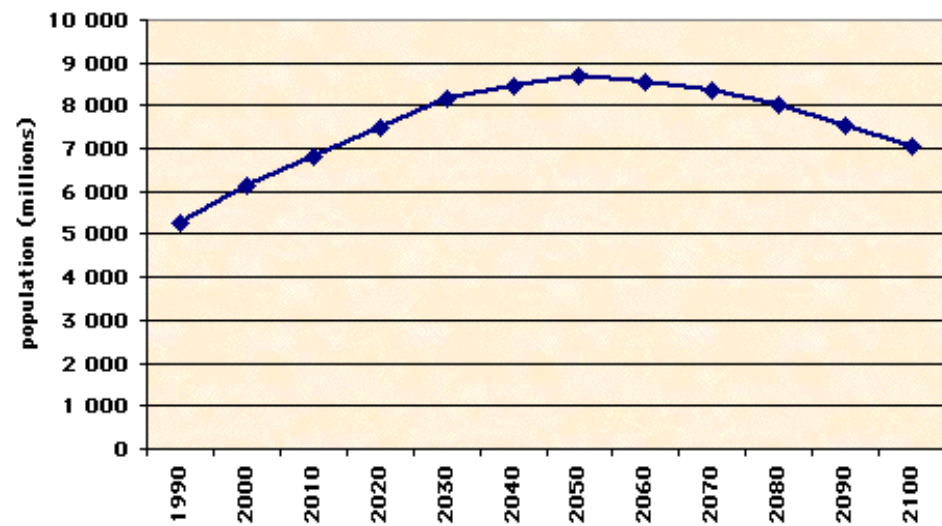
Familia A2

Familia B2

CENÁRIO A2

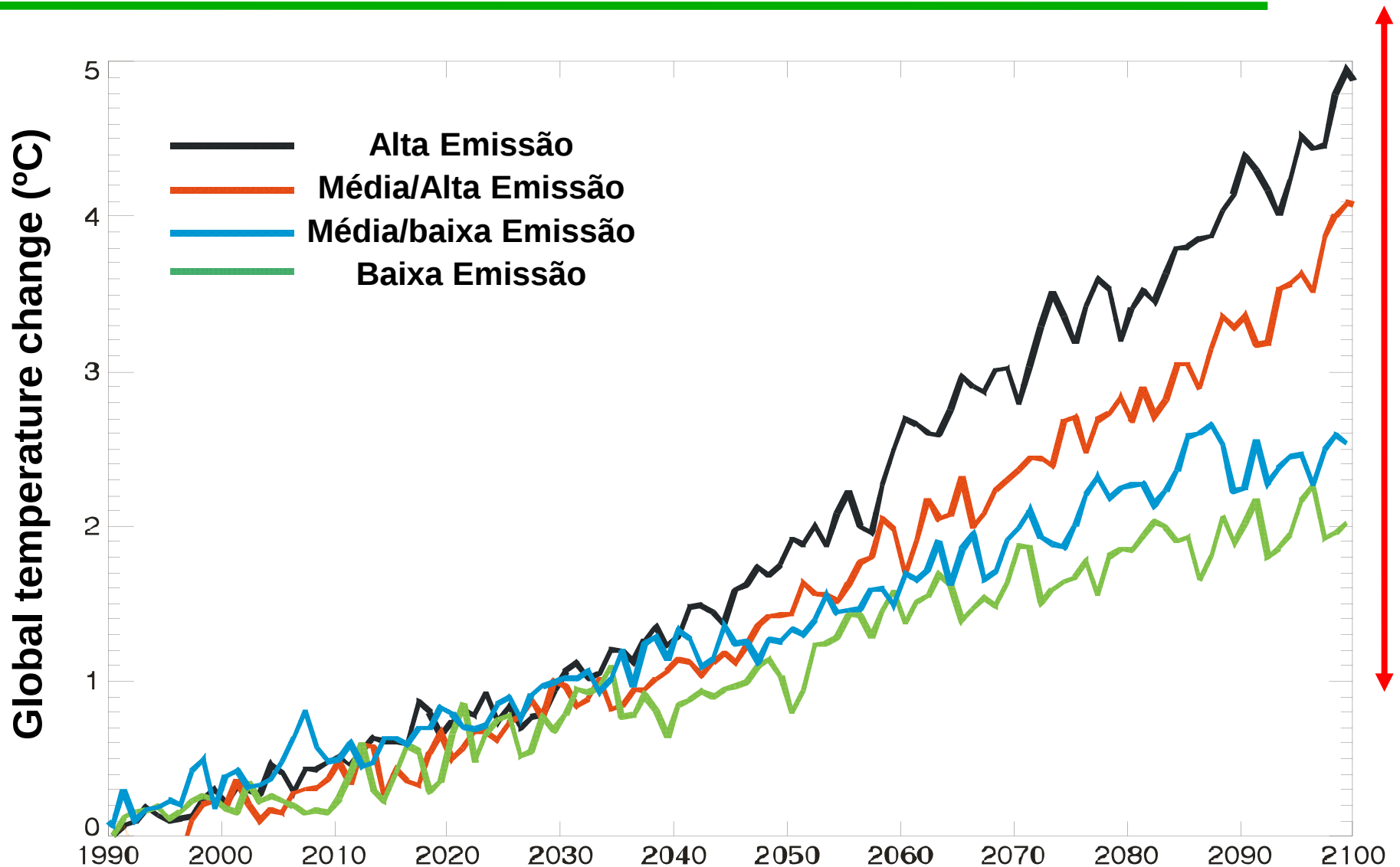


CENÁRIO B2



CONSECUENCIAS

Aumento da Temperatura Global



Projeções Futuras

Desafios

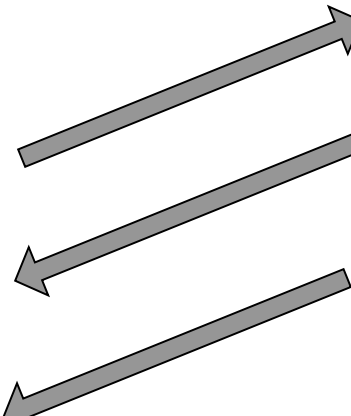
Escala



Complexidade

Disponibilidade de dados

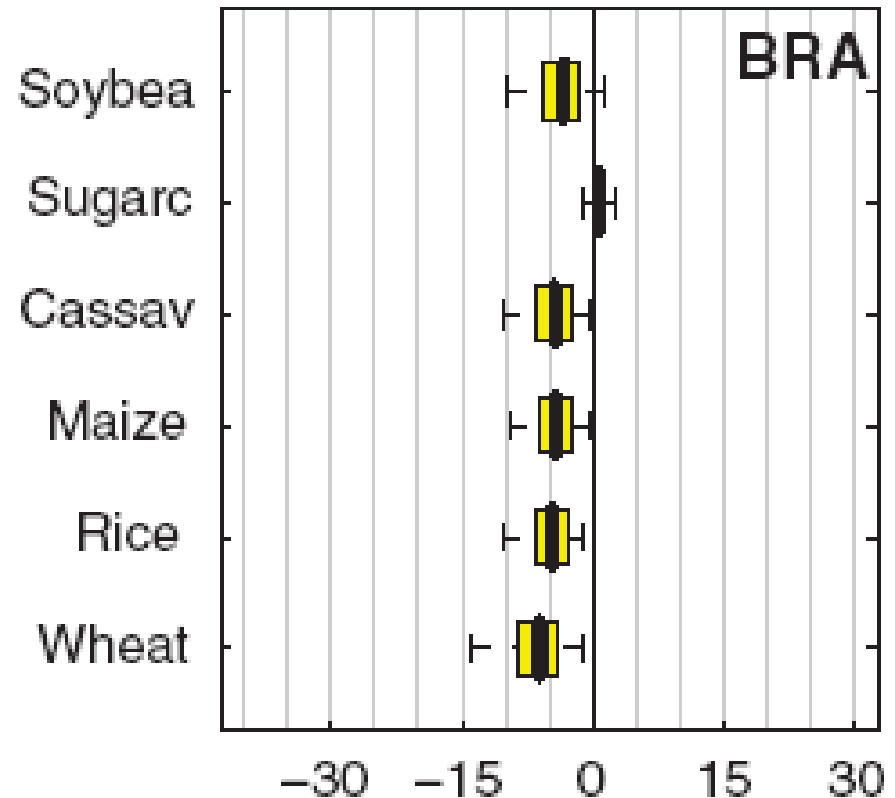
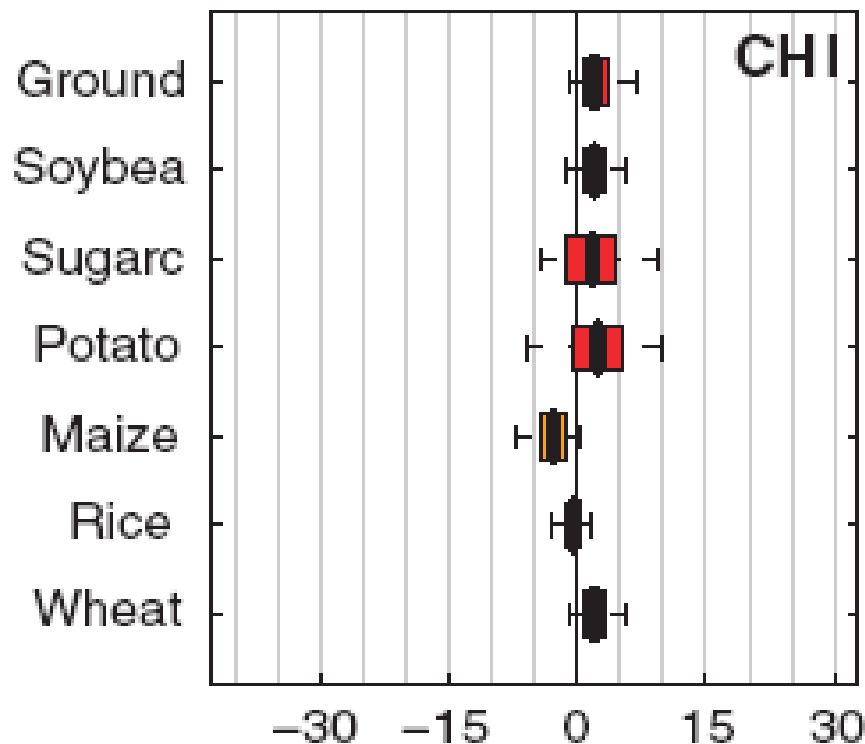
Experimentos



Interação entre Clima e Cultura

Prioritizing Climate Change Adaptation Needs for Food Security in 2030

David B. Lobell,^{1,2*} Marshall B. Burke,¹ Claudia Tebaldi,³ Michael D. Mastrandrea,⁴
Walter P. Falcon,¹ Rosamond L. Naylor¹

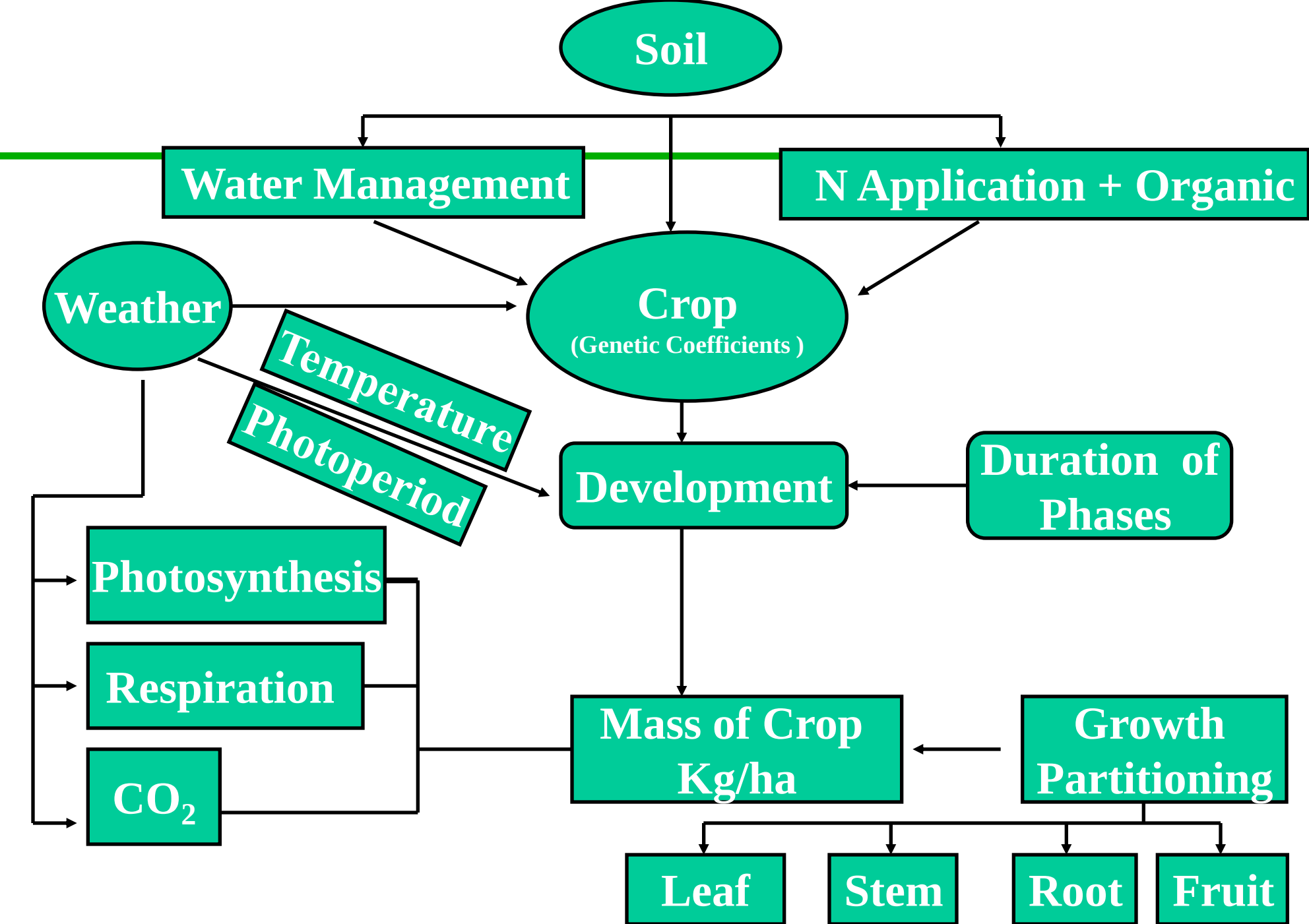


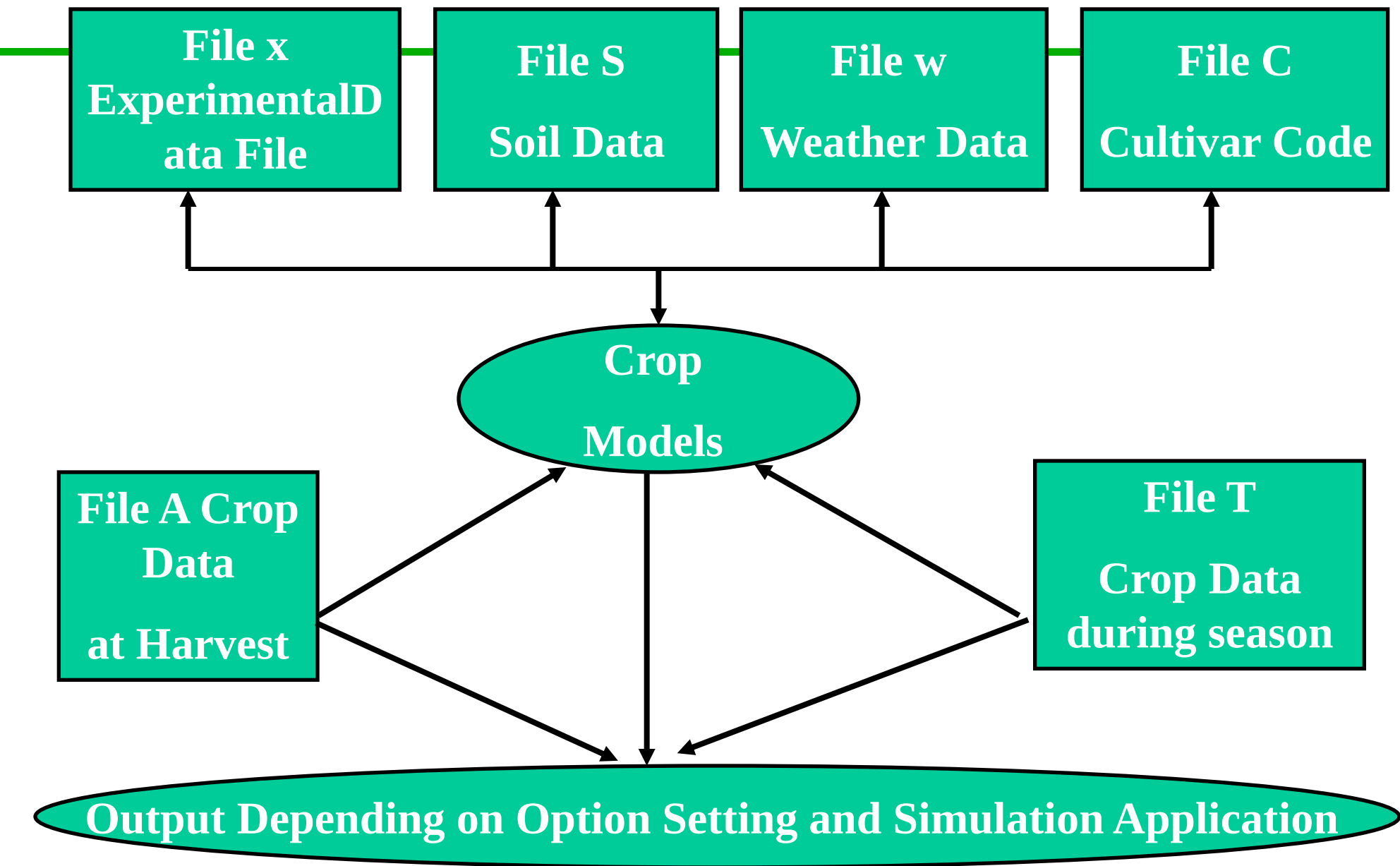
Avaliação das Projeções Futuras na Agricultura de MG

Efeitos Isolados da Tecnologia, CO₂ e Clima

Minas Gerais é responsável por 14.5% (11%) do feijão (milho) produzido no Brasil o que representa 2% (0.5%) da produção mundial.

(www.mg.gov.br)



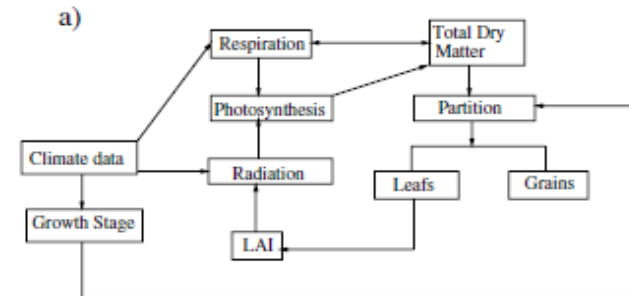


Potential forcing of CO₂, technology and climate changes in maize (*Zea mays*) and bean (*Phaseolus vulgaris*) yield in southeast Brazil

L C Costa¹, F Justino¹, L J C Oliveira¹, G C Sedyama¹,
W P M Ferreira² and C F Lemos¹

¹ Department of Agricultural Engineering, Federal University of Vicosa, PH Rolfs S/N.

Model development



This can be computed by the equation below:

$$P_{CO_2} = \frac{f_{CO_2} \Delta CO_2}{100} + 1. \quad (6)$$

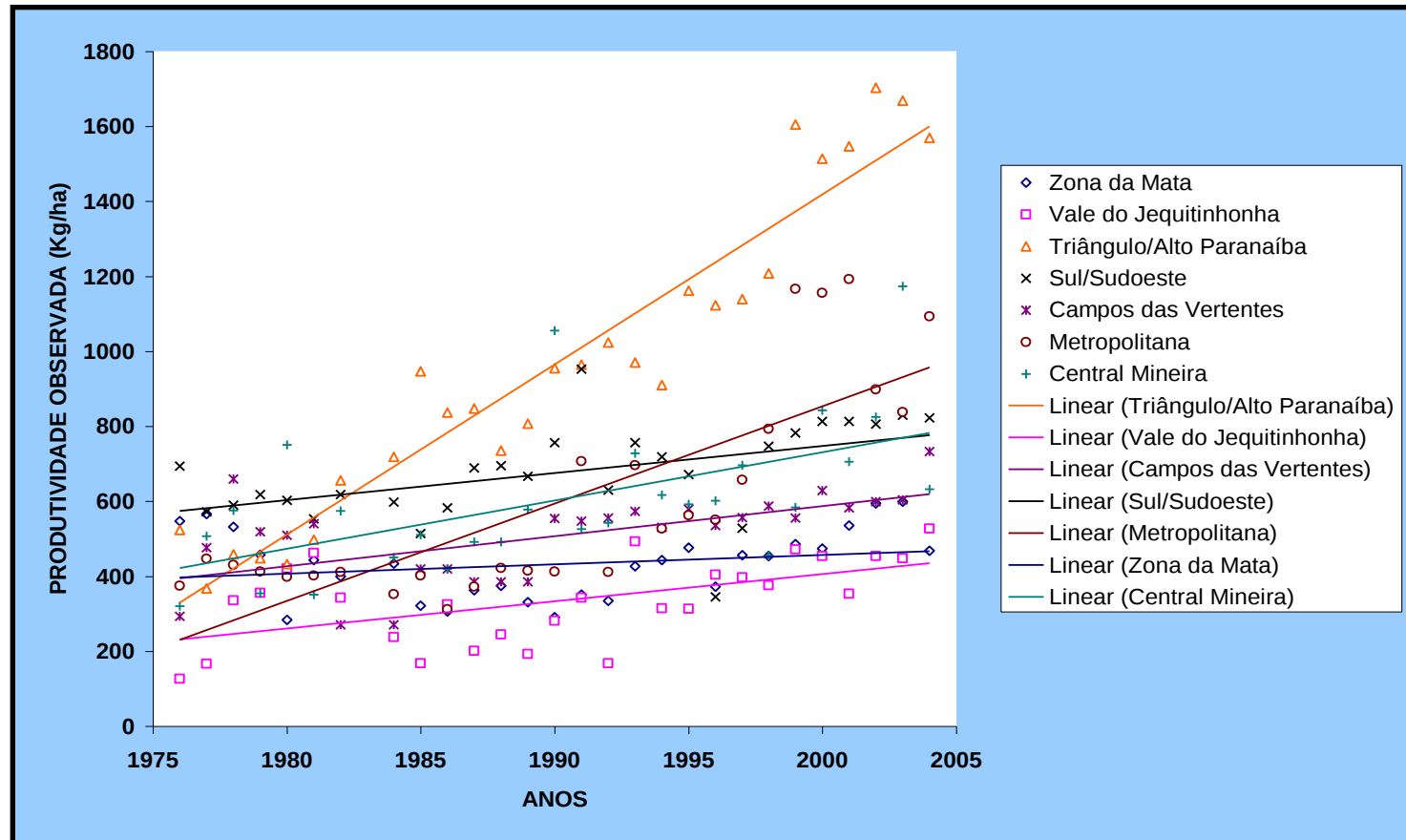
Here P_{CO_2} stands for the effect of increased atmospheric CO_2 on the crop productivity; f_{CO_2} is the rate of productivity for unit CO_2 increase (%/ppm); and ΔCO_2 is the difference between the future CO_2 level and the amount of CO_2 in the year 2000.

$$PP_T = P_g + \int_{t_0}^t P_g f_{T,PP_T}$$

rate. For instance, in 2020 the technological effect on potential productivity of common beans would be responsible for a 27.2% increase in the potential productivity (i.e. $PP_T(\%) = 1.6 + (1.6 \times 0.8)(2020-2000) = 27.2$).

Avaliação das Projeções Climáticas na Agricultura de MG

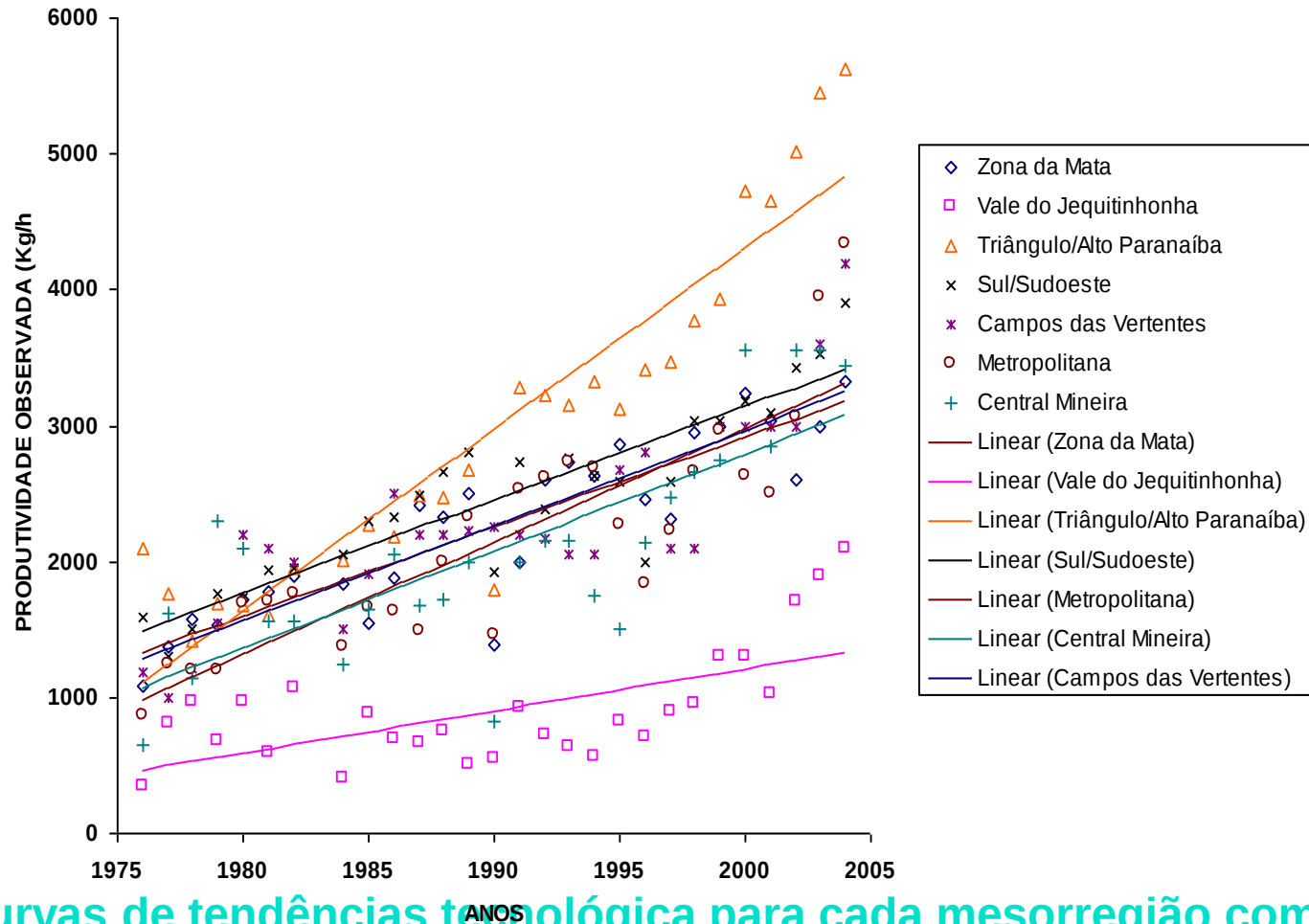
Tendência Tecnológica - Feijão



Curvas de tendências tecnológica para cada mesorregião com base na série histórica de produtividade do feijão do IBGE

METODOLOGIA

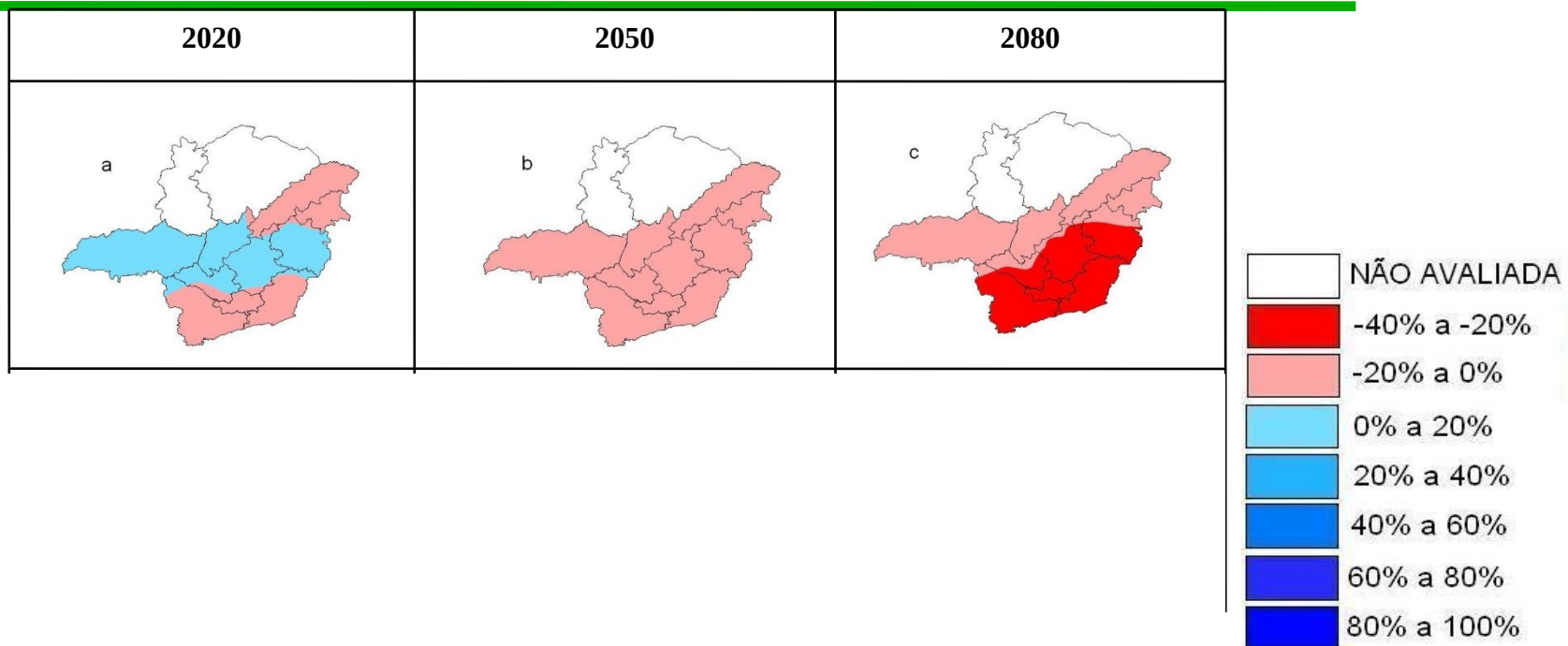
Tendência Tecnológica - Milho



Curvas de tendências tecnológicas para cada mesorregião com base na série histórica de produtividade do milho do IBGE.

Feijão

Clima



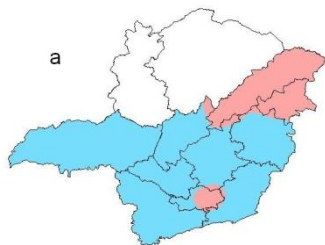
Clima + CO₂

Clima+CO₂+
Tecnologia

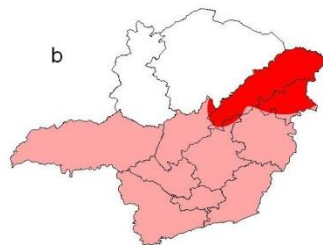
Milho

Clima

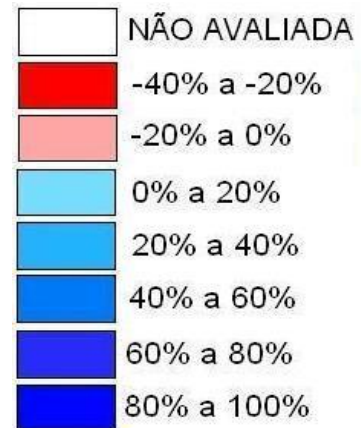
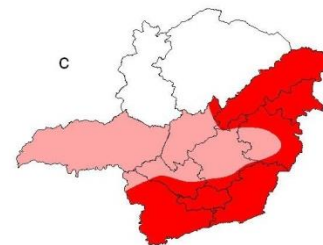
2020



2050



2080



Clima + CO₂

Clima+CO₂+
Tecnologia

**E a Amazonia é viável para as
atividades agrícolas?**

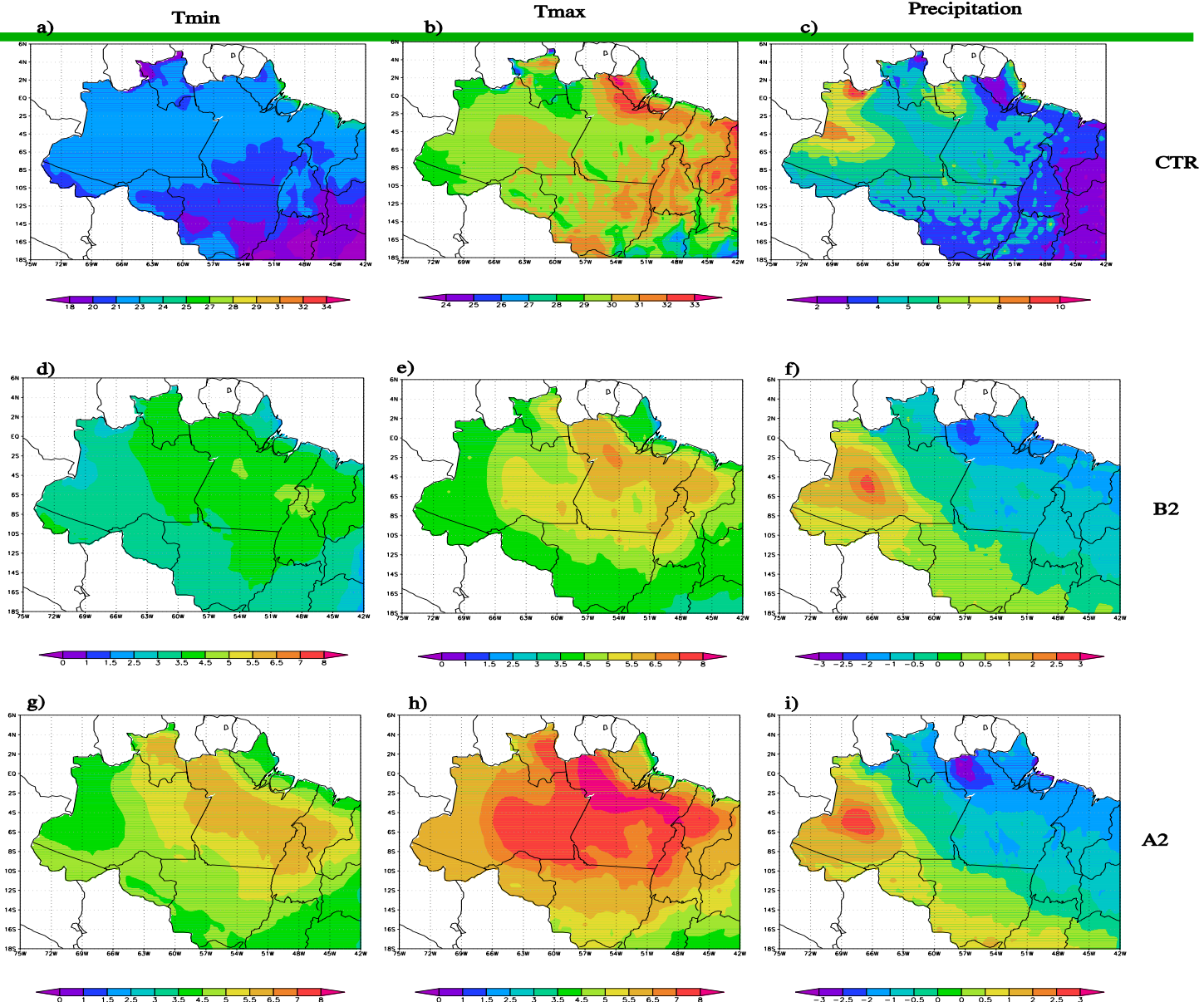
DSSAT (Crop Model)

- **DSSAT: Decision Support System for Agrotechnology Transfer**
- **DSSAT: a microcomputer software program combining crop soil and weather data bases and programs to manage them, with crop models and application programs, to simulate multi-year outcomes of crop management strategies.**
- **DSSAT allows users to ask "what if" questions and simulate results by conducting, in minutes on a desktop computer, experiments which would consume a significant part of an agronomist's career.**

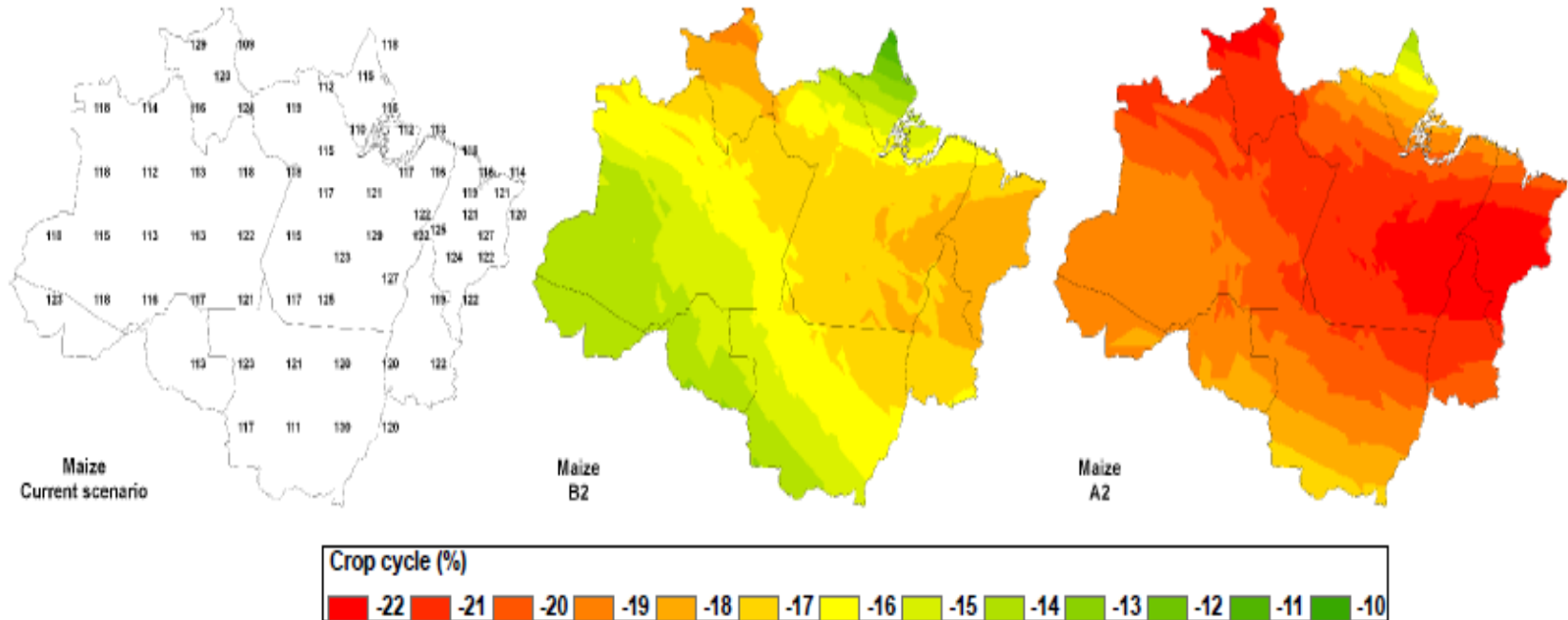
Amazon Basin

- ◆ High Pressure to Crop Area Enlargement
- ◆ Soybeans and Maize
- ◆ Modeling Input
 - Climate data (Hadley Centre Regional Model)
 - *T_x, T_m, R_g, Wind and Prec*
 - Optimum soil managements
 - CO₂ fertilization effect
 - Thermal and water stress

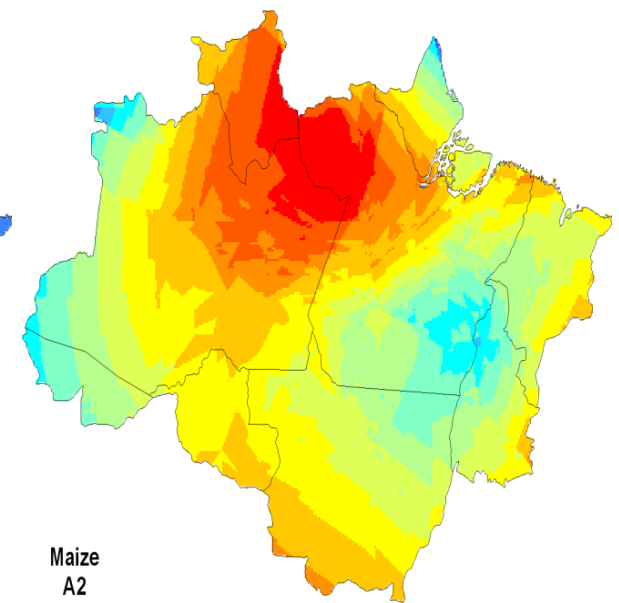
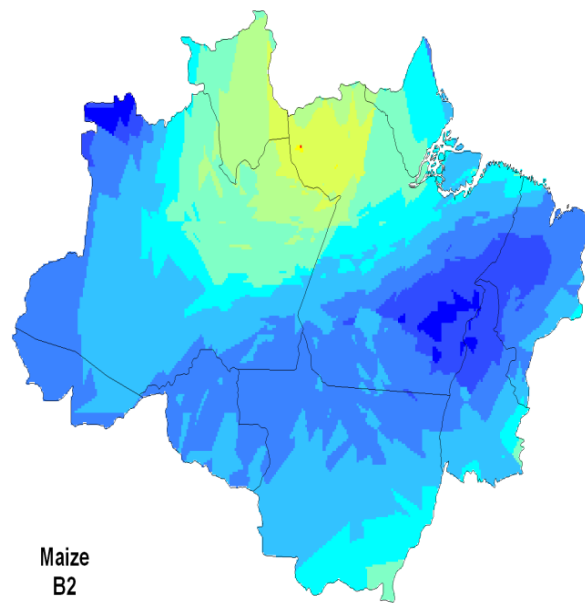
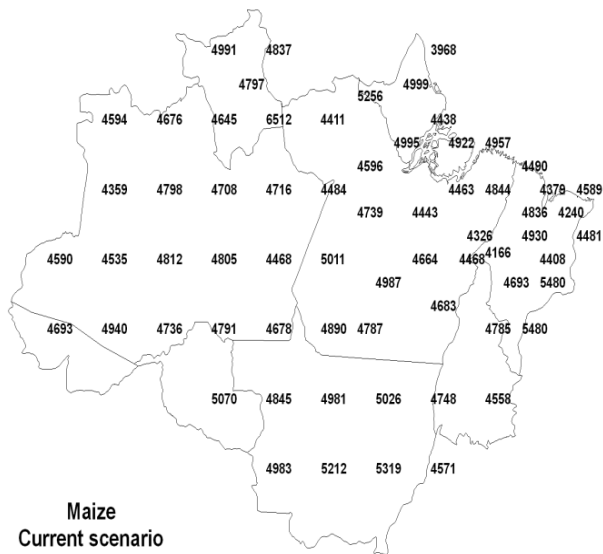
Climate Projections



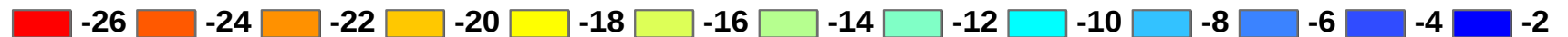
Maize Phenological Cycle



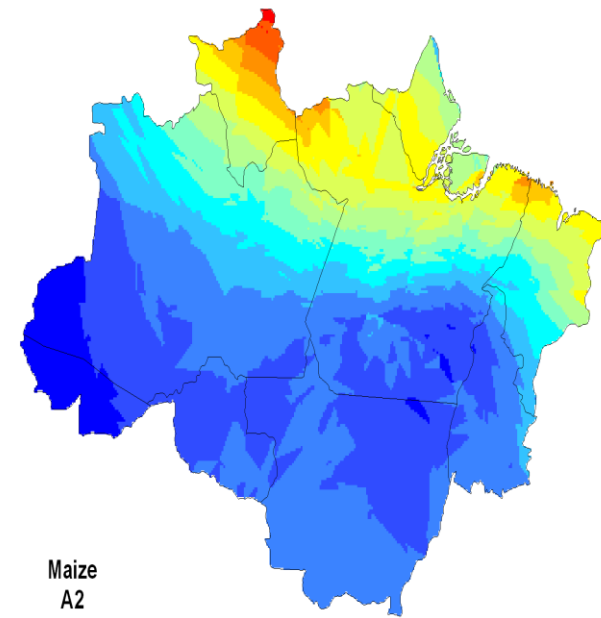
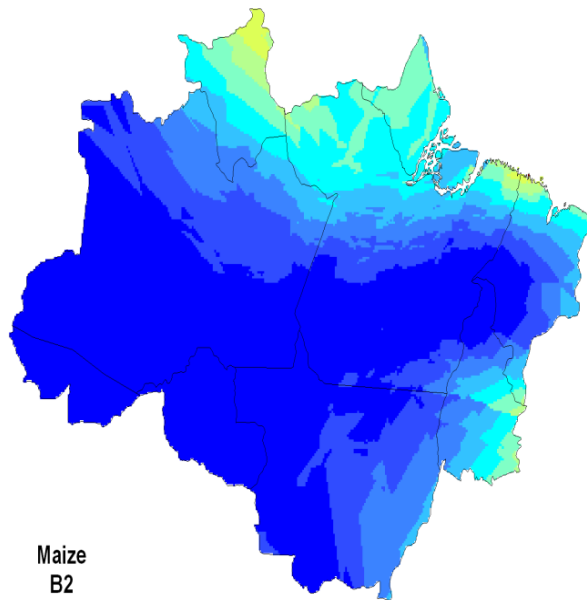
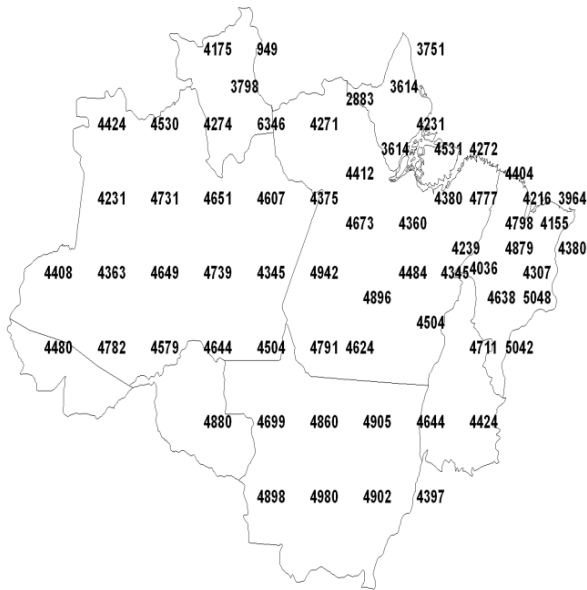
Productivity Potential



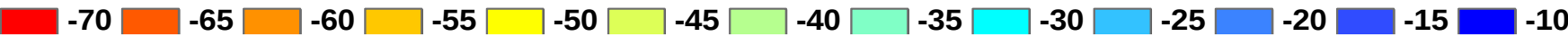
Grain yield (%)



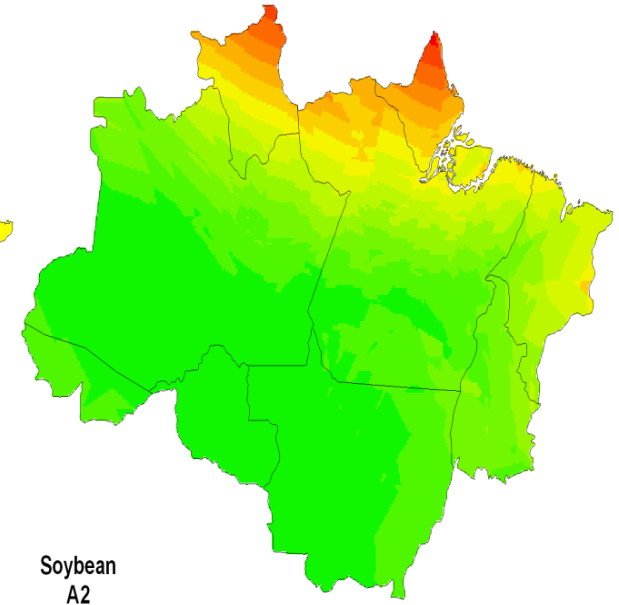
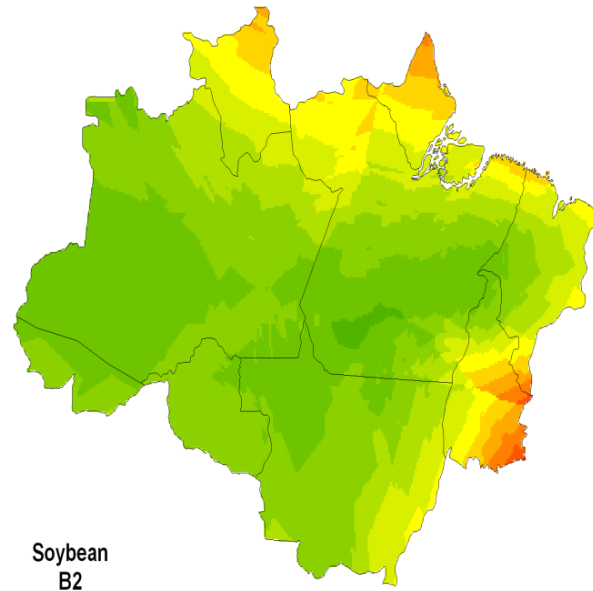
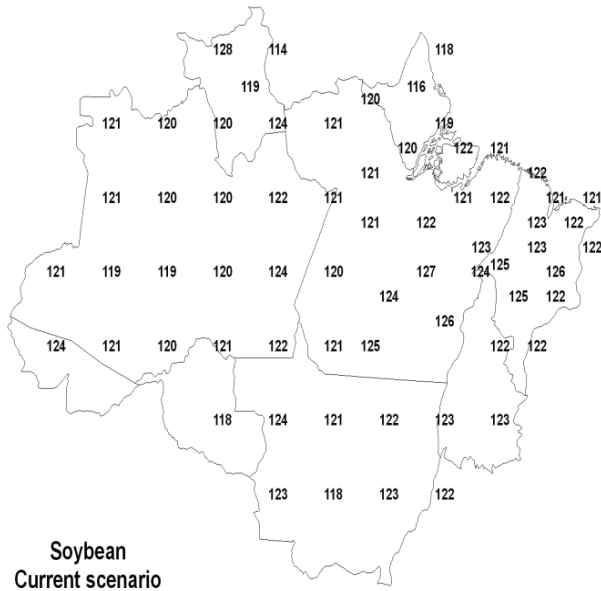
Actual Productivity A2 B2 (Kg/ha)



Grain yield (%)



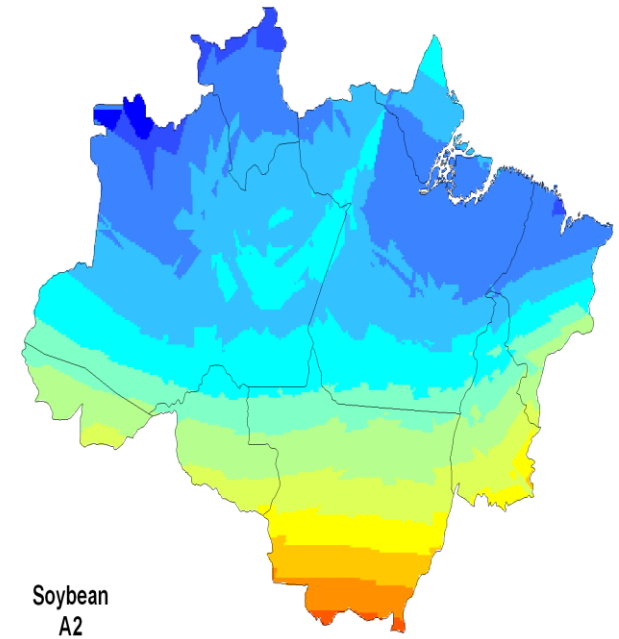
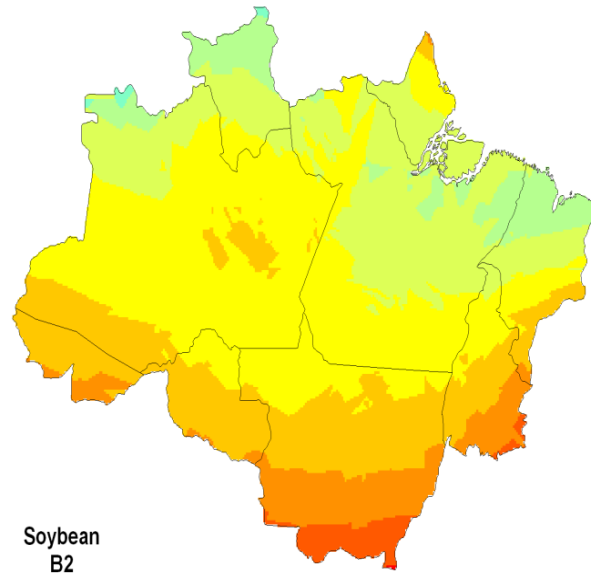
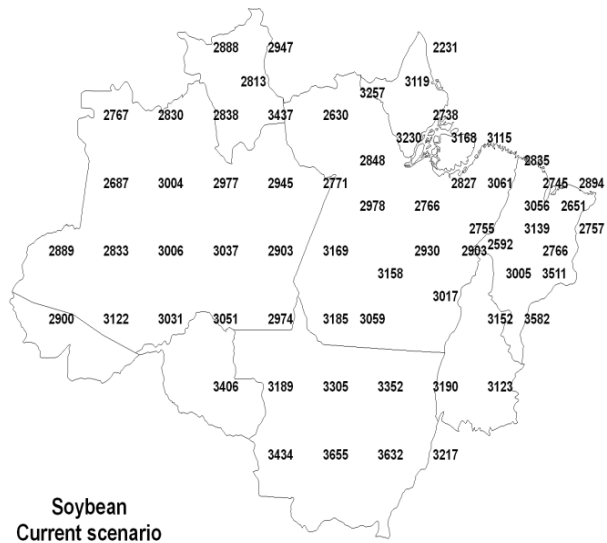
Soybeans – Phenological Cycle



Crop cycle (%)



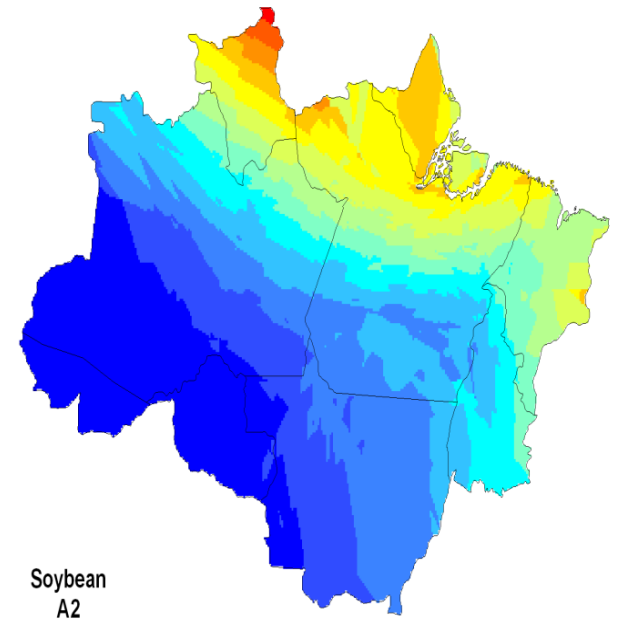
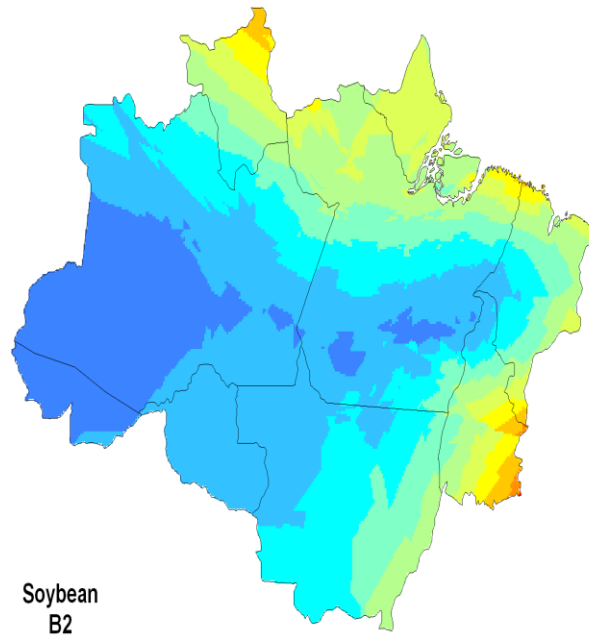
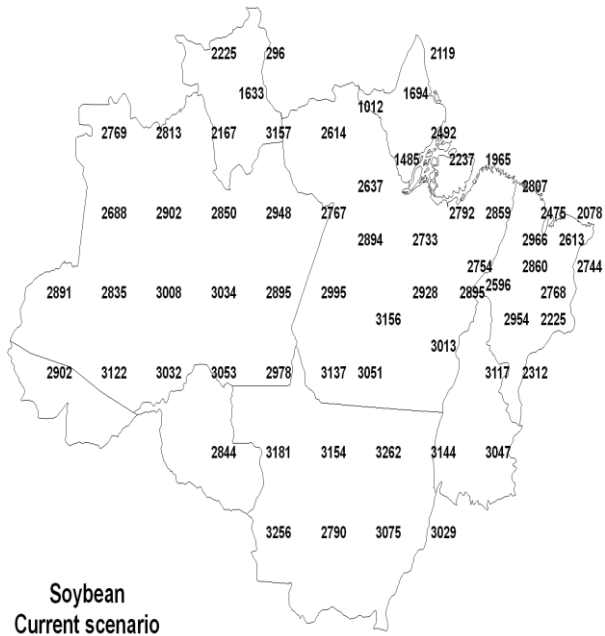
Potential Productivity



Grain yield (%)



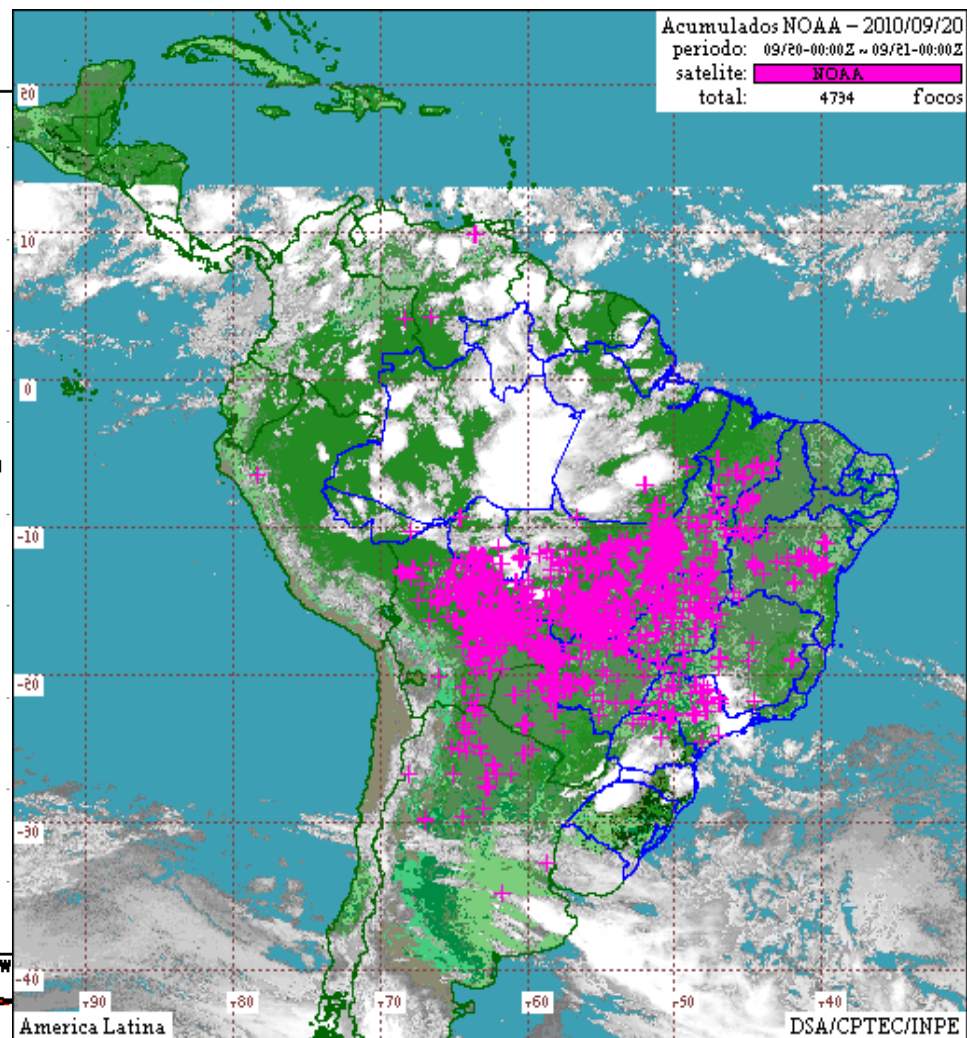
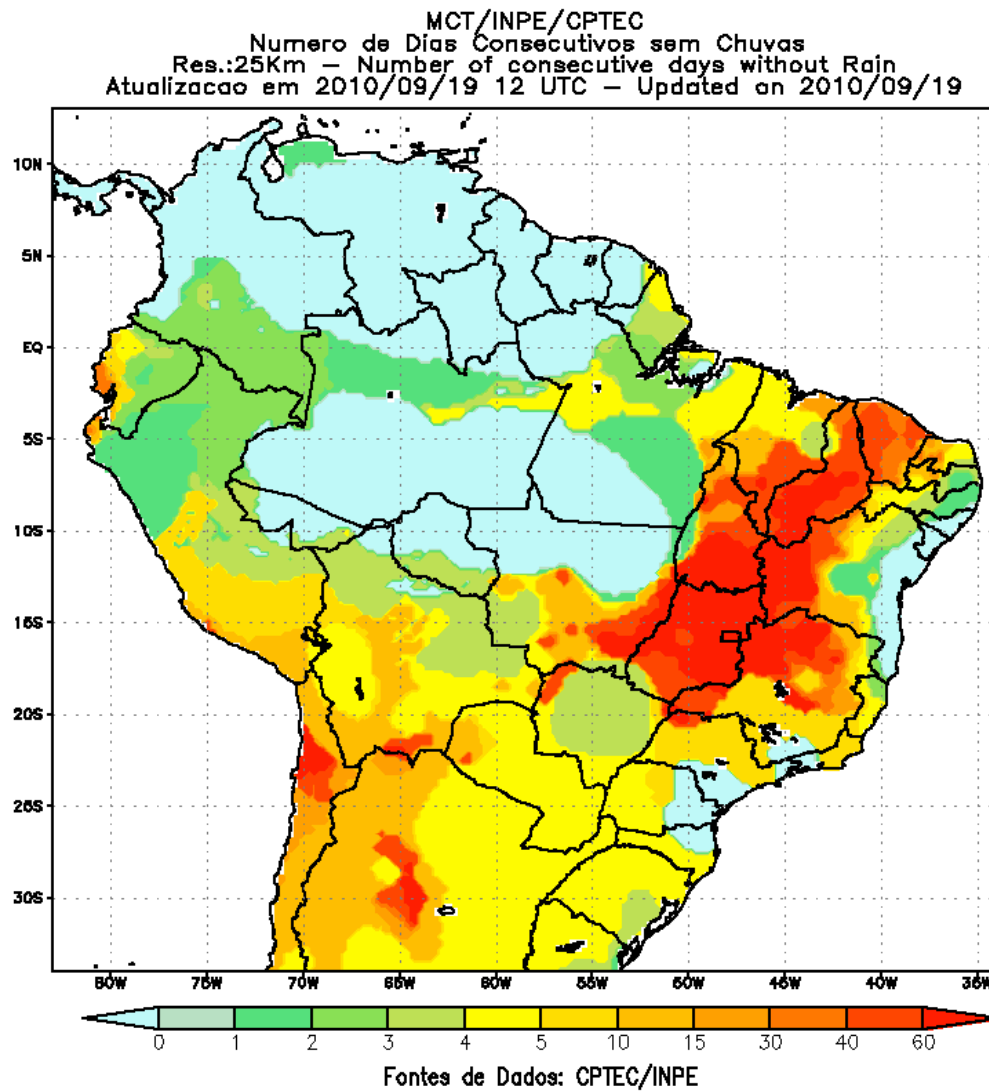
Actual Productivity



Grain yield (%)

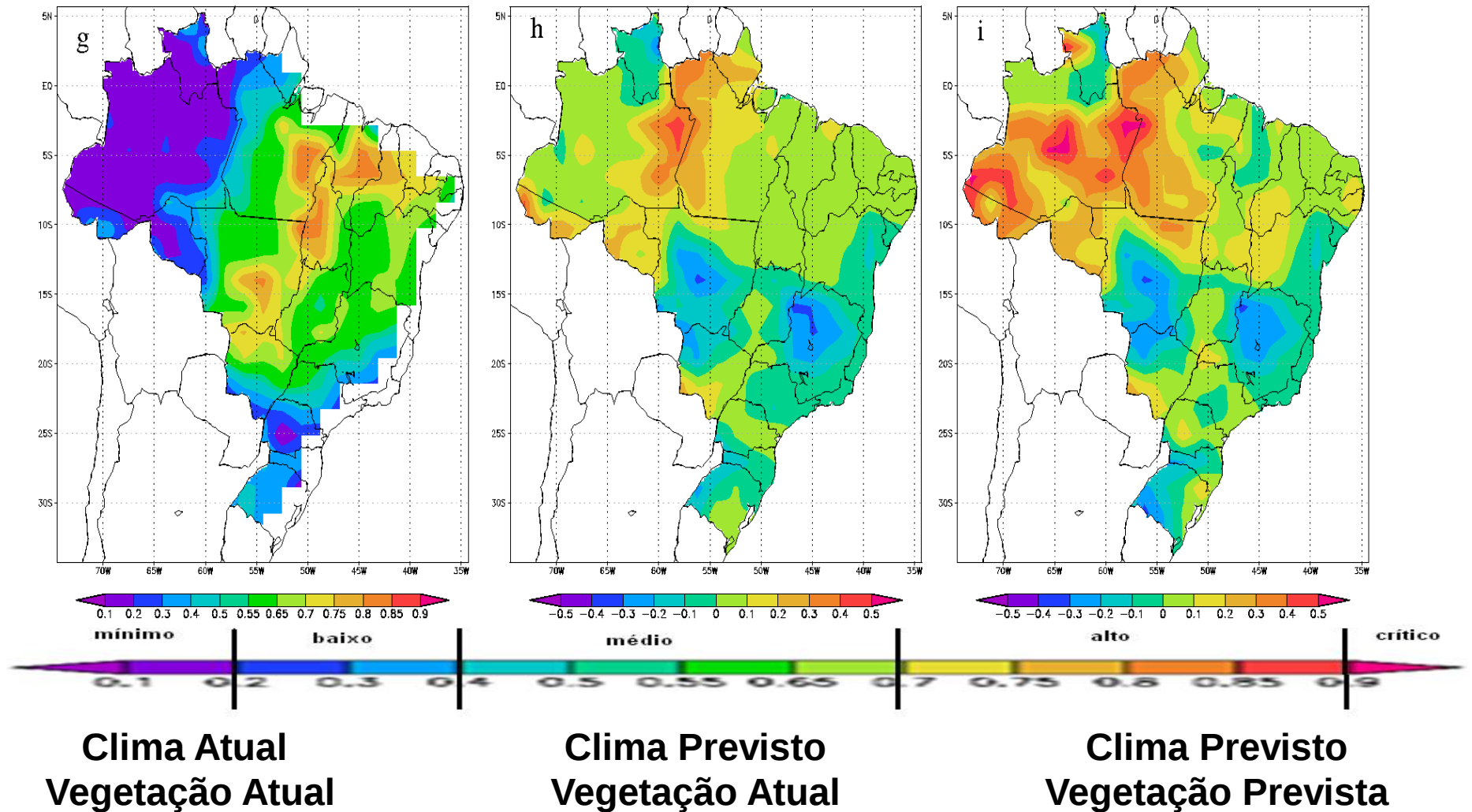


Risco de Queimadas



Índice Potencial de Fogo

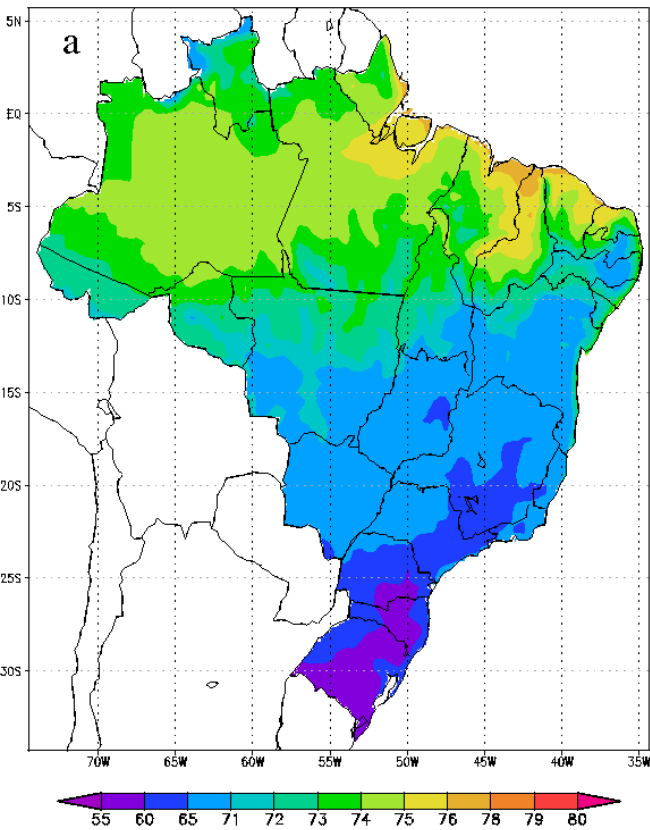
(Setembro)



E as atividades agropecuárias?

Tendência do ITU Futuro

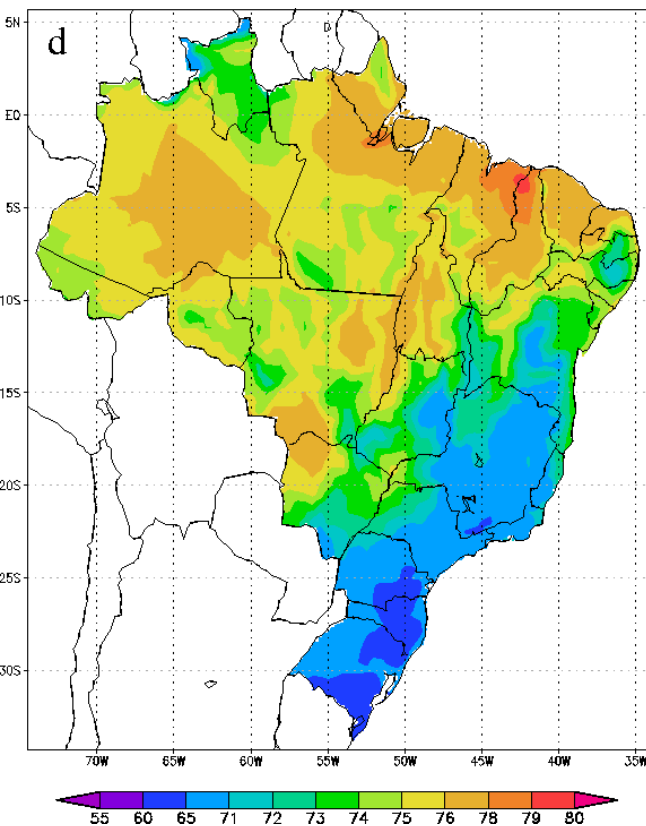
Junho-Julho-Agosto



Atual

Tendência do ITU Futuro

Setembro-Outubro-Novembro



Atual

O que está sendo feito para validar?

EXPERIMENTOS

Enriquecimento de CO₂ , feijão e milho



Experiments



Experiments



An aerial photograph of a vast, green landscape. A dirt road winds through the middle of the frame, curving from the upper right towards the lower left. The terrain is covered in dense green vegetation, possibly a field or a forest. The sky is visible at the top, showing some light clouds. The overall scene is bright and natural.

**Departamento de Engenharia
Agrícola**

www.ufv.br/dea

Obrigado