

# **“Improving potential biomes allocation by considering natural fires in savannas”**

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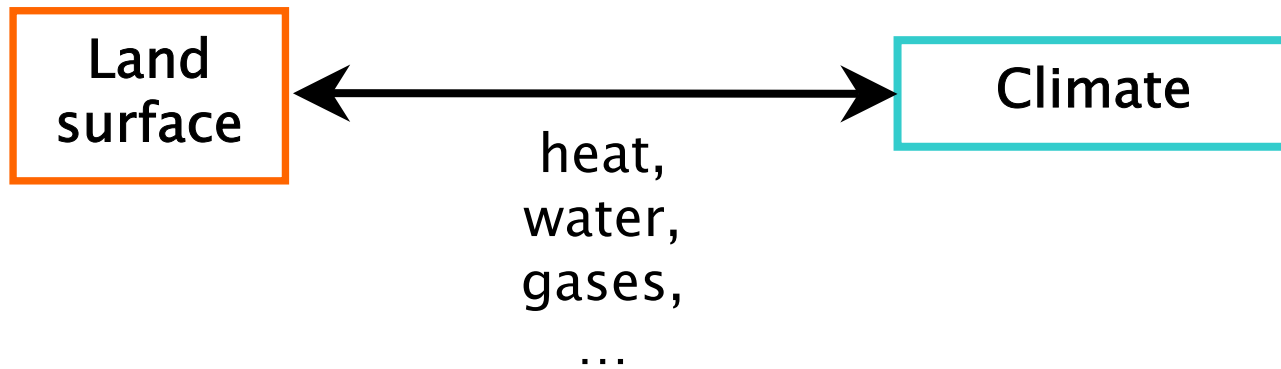


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**Brazil**

## ▫ Motivation



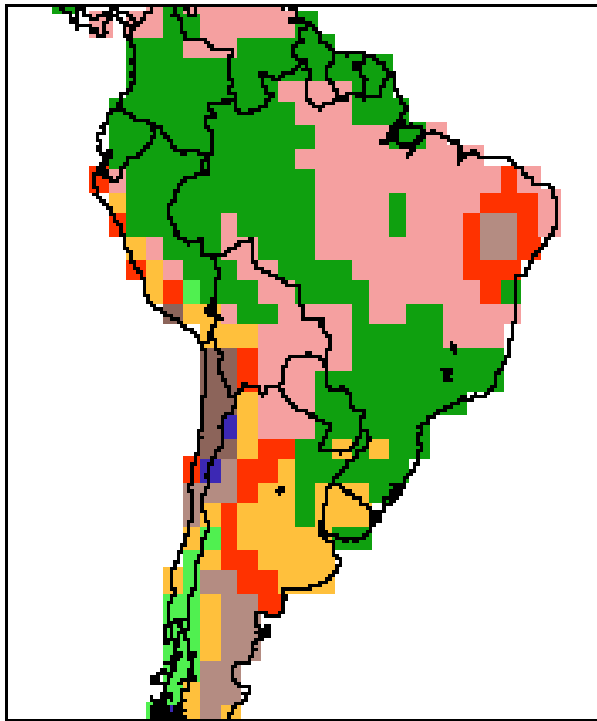
▫ It is important to have model able to represent atmosphere–biosphere interactions

▫ CPTEC–PBM

(Oyama and Nobre 2004; Brazilian Journal of Meteorology, 2004)

## □ Motivation

- “A new climate–vegetation equilibrium state for Tropical South America”



“ Eastern Amazonian forests are replaced by savannas and a semi-desert area appears in the driest portion of Northeast Brazil”

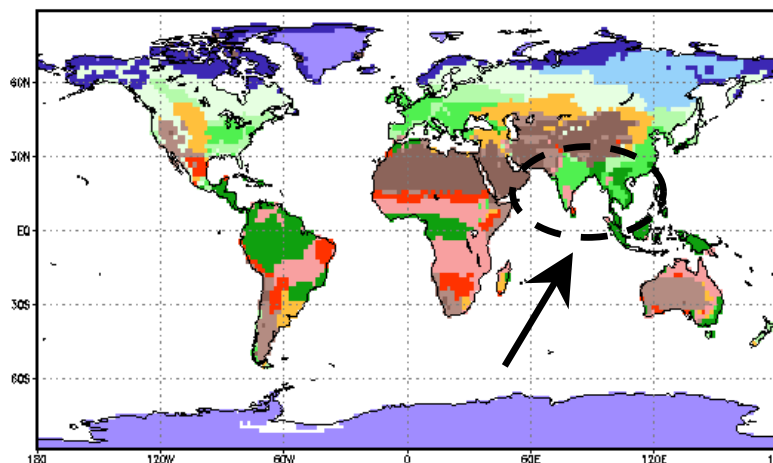
(Oyama and Nobre 2003;GRL)

## ▫ Motivation

- For similar climatic conditions, both savannas and dry forests may occur
- This is reflected in important differences between maps of natural vegetation and results from models of potential vegetation for large regions of savannas/dry forests.

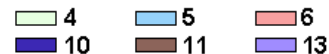
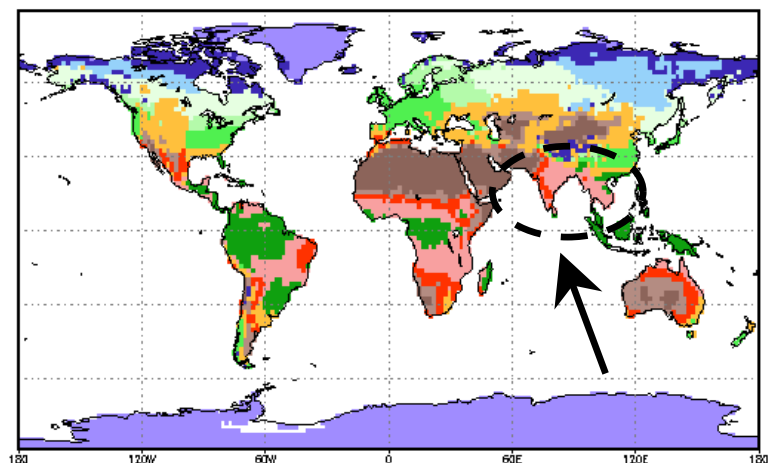
- For example, results from the CPTEC-PBM show that large areas in India and Southeast Asia have climatic potential for savannas but are covered by dry forests.

Natural vegetation



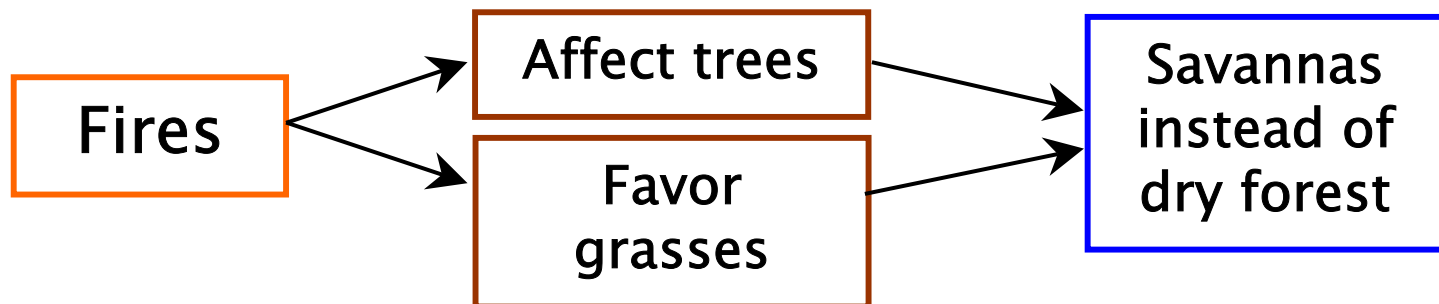
- 1 Broadleaf-evergreen trees (tropical forest)
- 2 Broadleaf-deciduous trees (temperate forest)
- 3 Broadleaf and needleleaf trees (mixed forest)
- 4 Needleleaf-evergreen trees (boreal forest)
- 5 Needleleaf-deciduous trees (larch)
- 6 Broadleaf trees with groundcover (savanna)

Potential vegetation

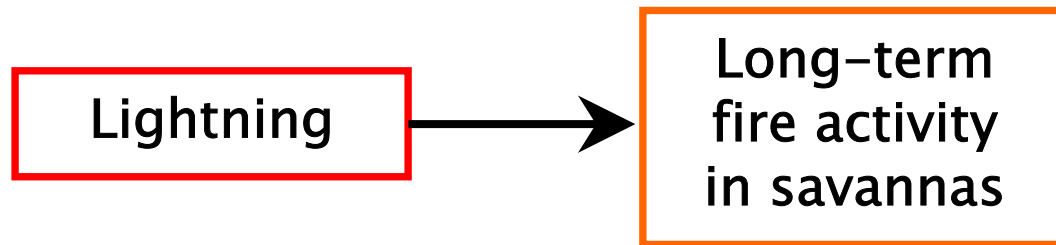


- 7 Groundcover only (grasslands)
- 8 Broadleaf shrubs with perennial groundcover (caatinga)
- 9 Broadleaf shrubs with bare soil (semi-desert)
- 10 Dwarf trees and shrubs with groundcover (tundra)
- 11 Bare soil (desert)
- 13 Perpetual ice

- One reason for these differences: long-term occurrence of fires
- Fires may interfere with the establishment of forests and favor savannas  
(Hoffman et al. (2000) Oecologia, Daly et al. (2000) and Bachelet et al. (2000) Ecological Modeling)
- Other reasons: soil properties, nutrient cycling, ...  
(Mistry (1998) Progress in Physical Geography, Coutinho (1990) FTB)



- How we could represent long-term natural fires in biome models ?



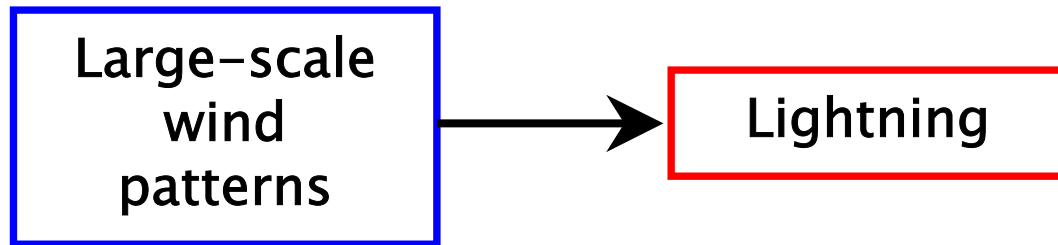
“Lightning is a major factor for natural fires”

(Bowman 2005, New Phytologist;  
Spessa et al. 2003, 3rd IWFC;  
Ramos-Neto e Pivelo 2000, Environ. Manag.)

“Lightning activity in the transition between dry and rain seasons is an important cause for fires in savannas in Brazil”

(Ramos-Neto e Pivelo 2000, Environ. Manag. )

- In a first approximation, large-scale lightning activity may be parameterized from patterns of wind direction



For example, based on previous studies for Amazonia:

“Petersen et al. (2002, J.Clim.) cite that low-level easterly wind flow is the most important factor modulating lightning activity over the Amazon Basin”

(Christian et al. 2003, JGR)

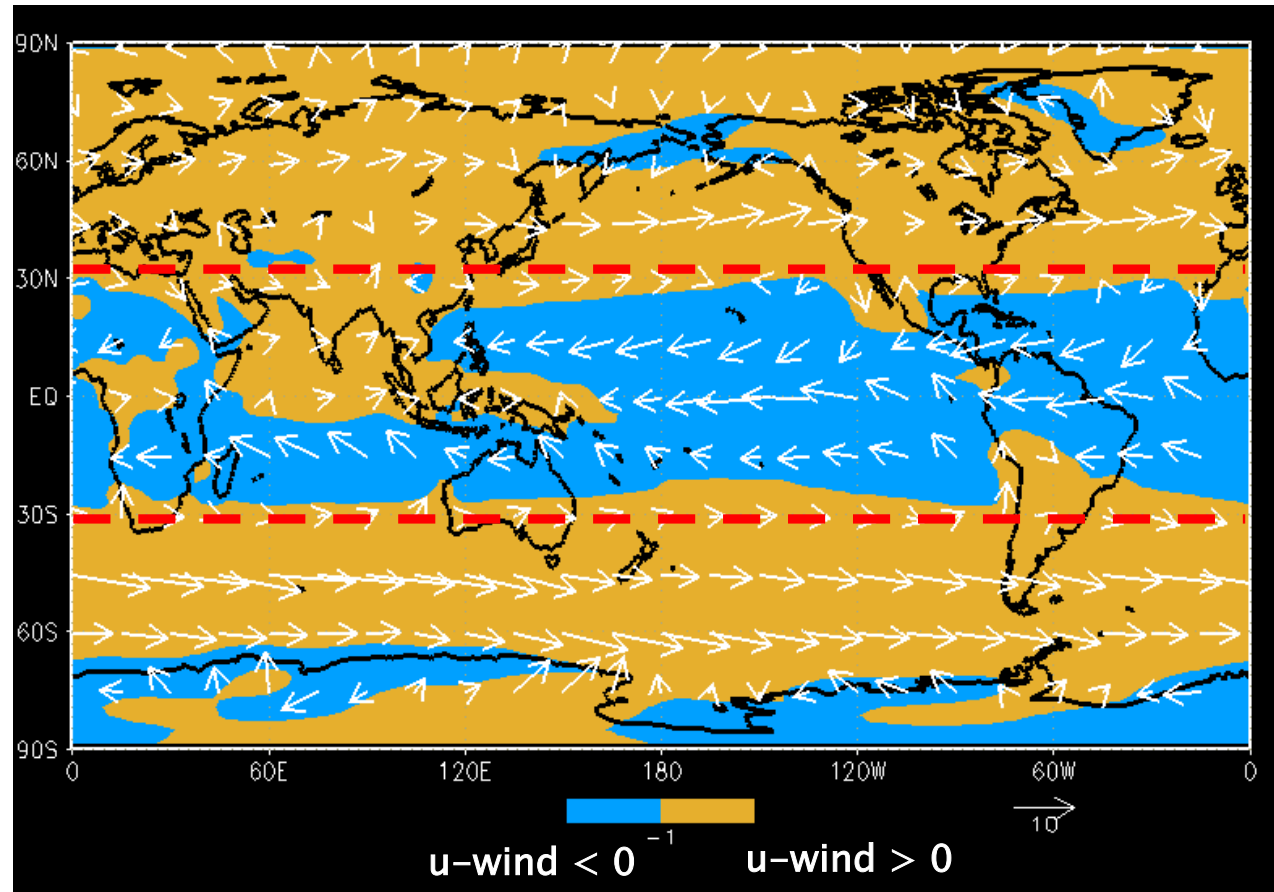
“During easterly regimes both relative increases in CAPE and convective forcing favor more lightning”

(Petersen et al. (2002, J.Clim.)



- Over continental areas in the tropics, lightning may potentially be related to the zonal flux of humidity

Wind  
Long-term  
average  
1948–  
present  
(NCEP)

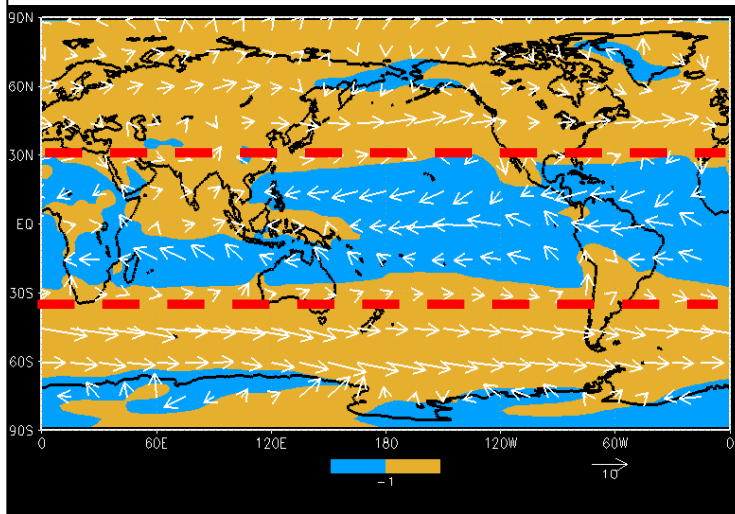


- Parameterization of long-term natural fire occurrence in savannas, based on two main hypotheses:

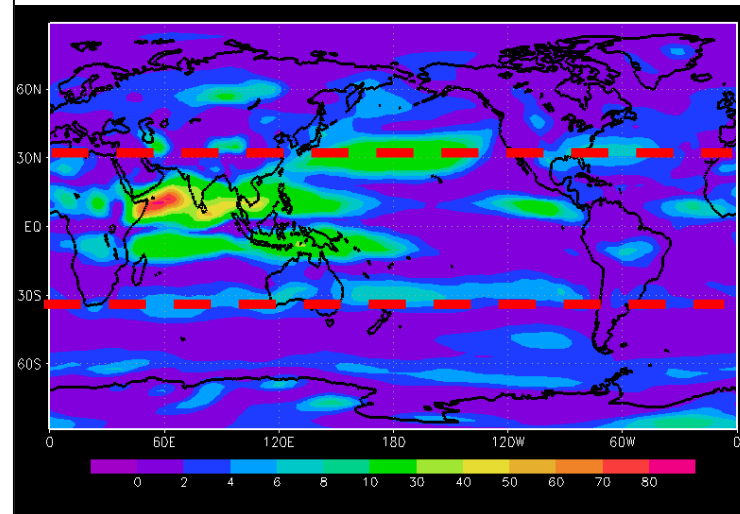
Lightning is the most important cause for natural fires

Over continental areas in the tropics, lightning can be related to the zonal flux of humidity

Long-term average  
of the zonal wind (m/s)



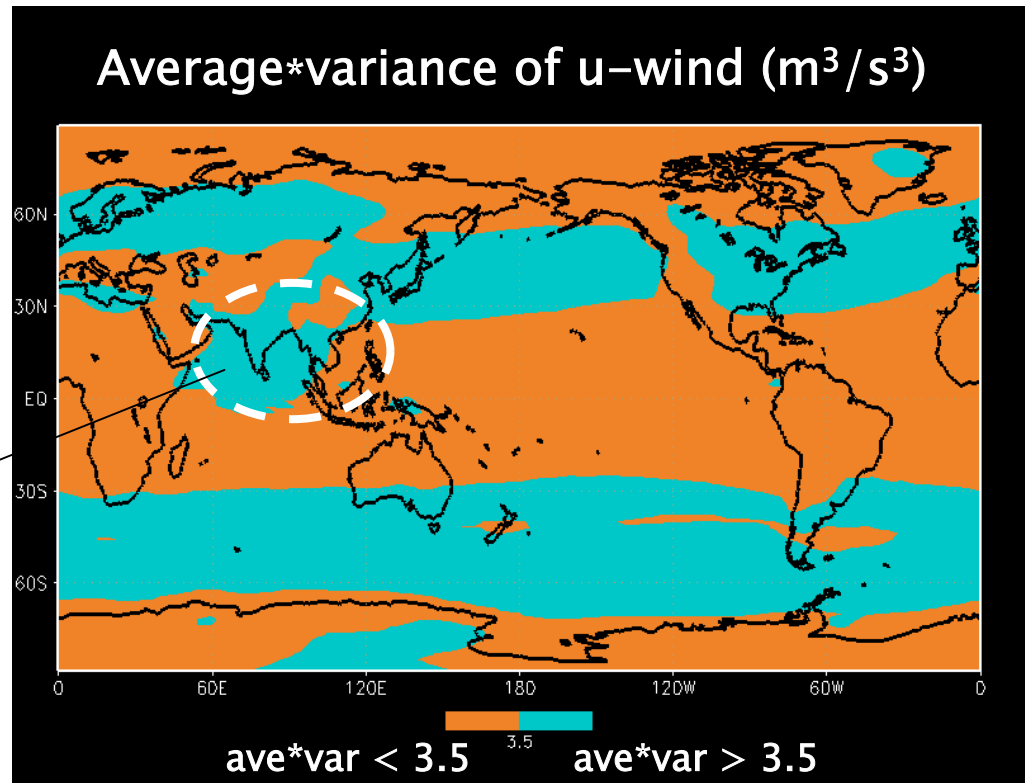
Long-term intra-annual variance  
of the zonal wind ( $\text{m}^2/\text{s}^2$ )



- The potential for lightning-fires was then parameterized using a simple rule, based on combined information on long-term average and intra-annual variance of the zonal wind:

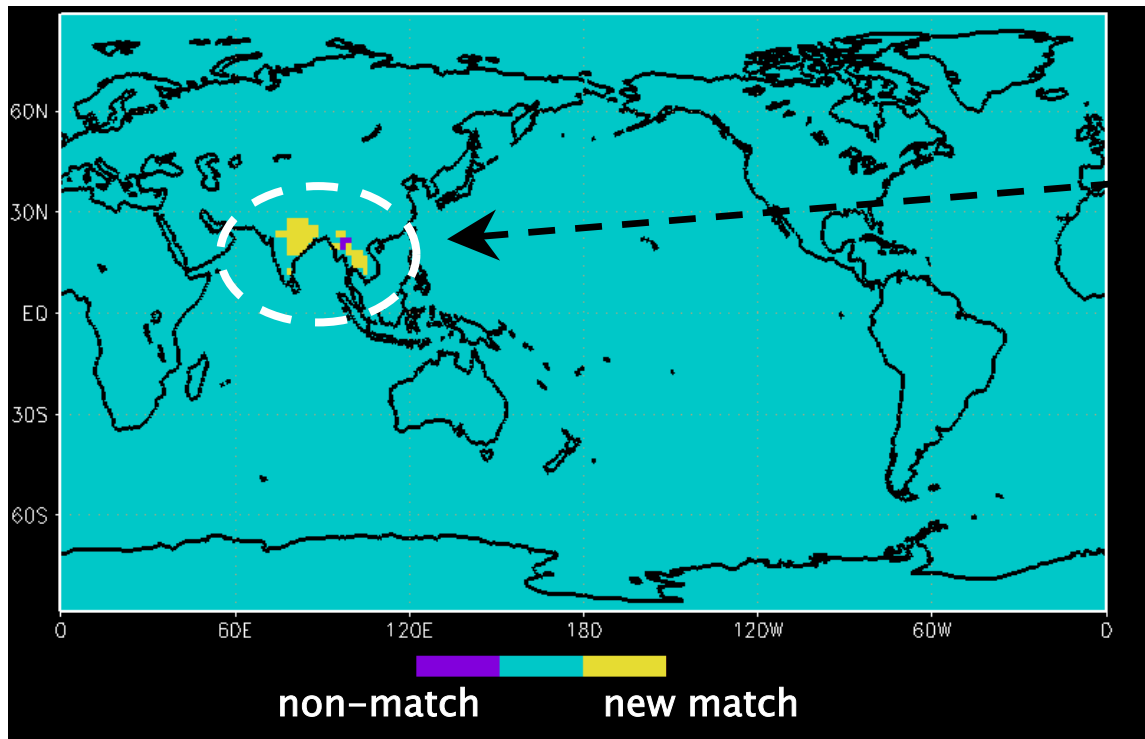
Long-term lightning activity is more likely in tropical regions where combined long-term average and intra-annual variance of the zonal wind is lower than  $3.5 \text{ m}^3/\text{s}^3$

According to this rule, this region will present relatively low long-term natural fire activity



- Impact of considering natural fires in savannas on the results of the CPTEC-PBM:

Difference between reference data and potential savannas information from the CPTEC-PBM



Regions were  
natural  
savannas are  
now correctly  
represented

Current total  
accuracy is:  
63.45%