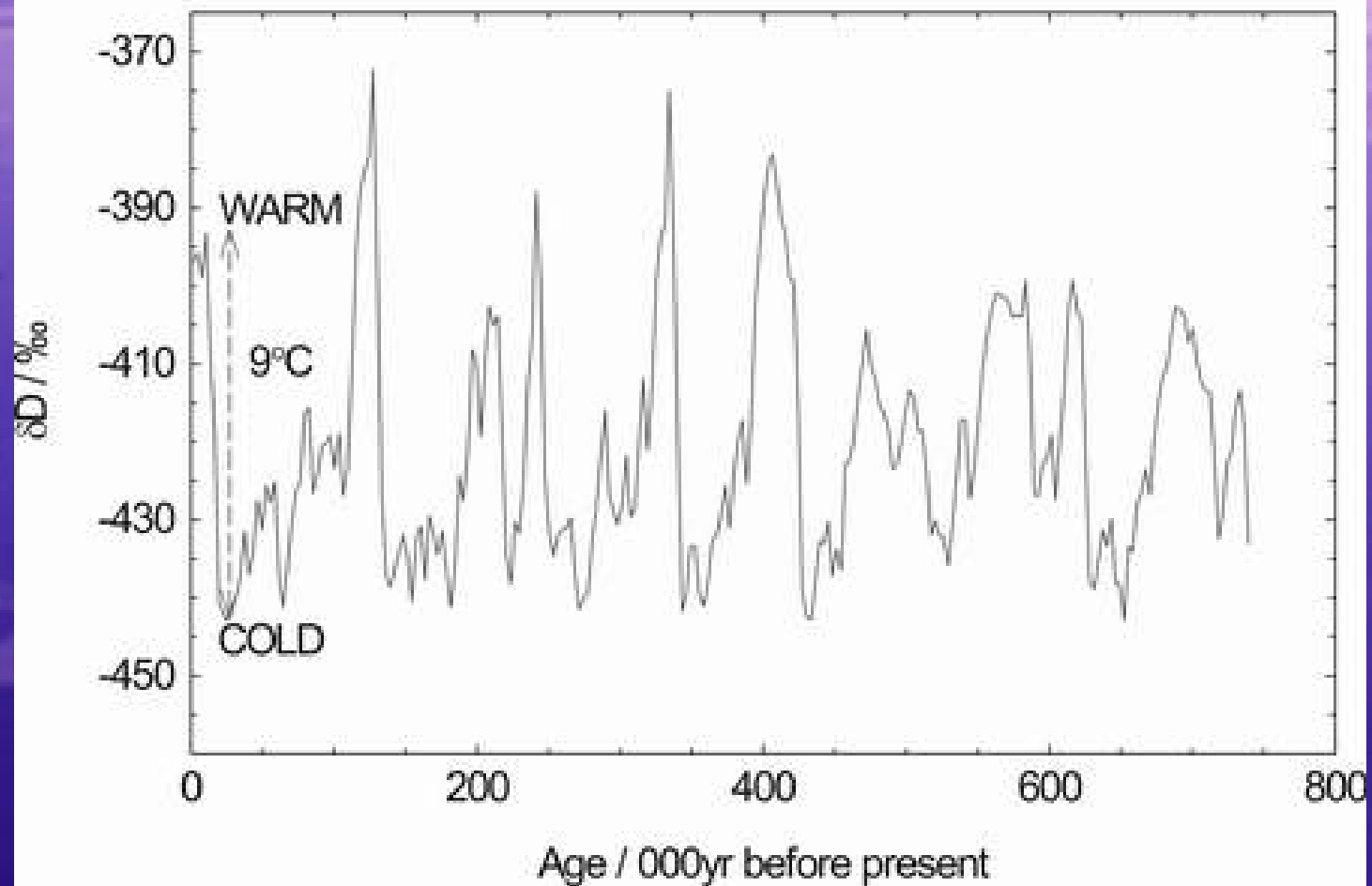


O que a paleoclimatologia nos mostra sobre a América do Sul?

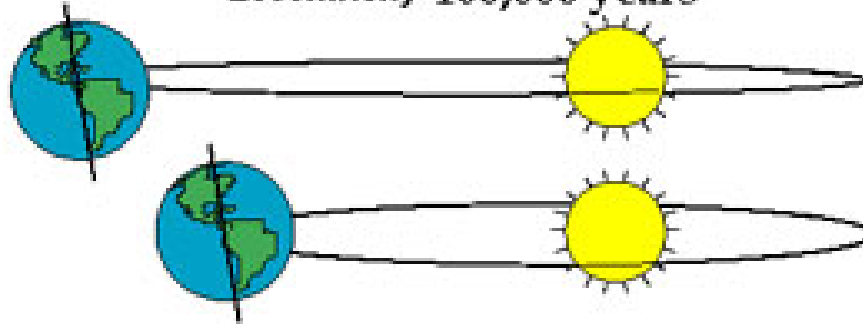
Variabilidade do clima da Amazonia durante o Holoceno

Bruno Turcq
IRD UR PALEOTROPIQUE
Laboratoire Mixte de Recherche sur l'Environnement
LAMIRE Universidade Federal Fluminense

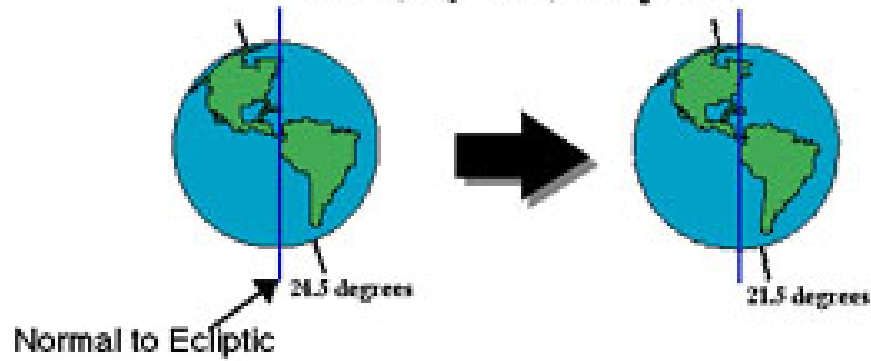
EPICA Dome C



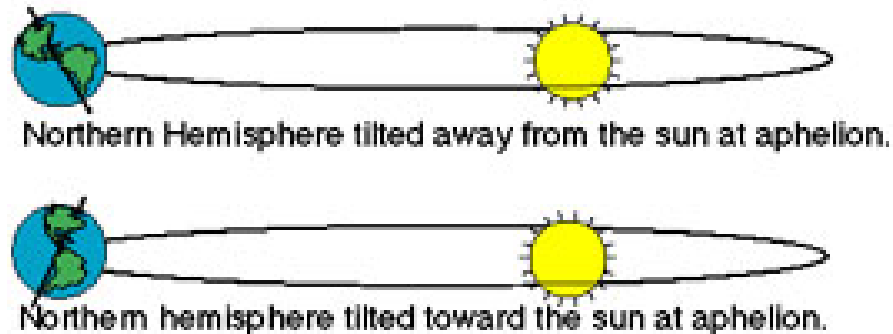
Eccentricity 100,000 years



Obliquity 41,000 years



Precession 23,000 years





Dinâmica da formações superficiais

Variações hidrológicas

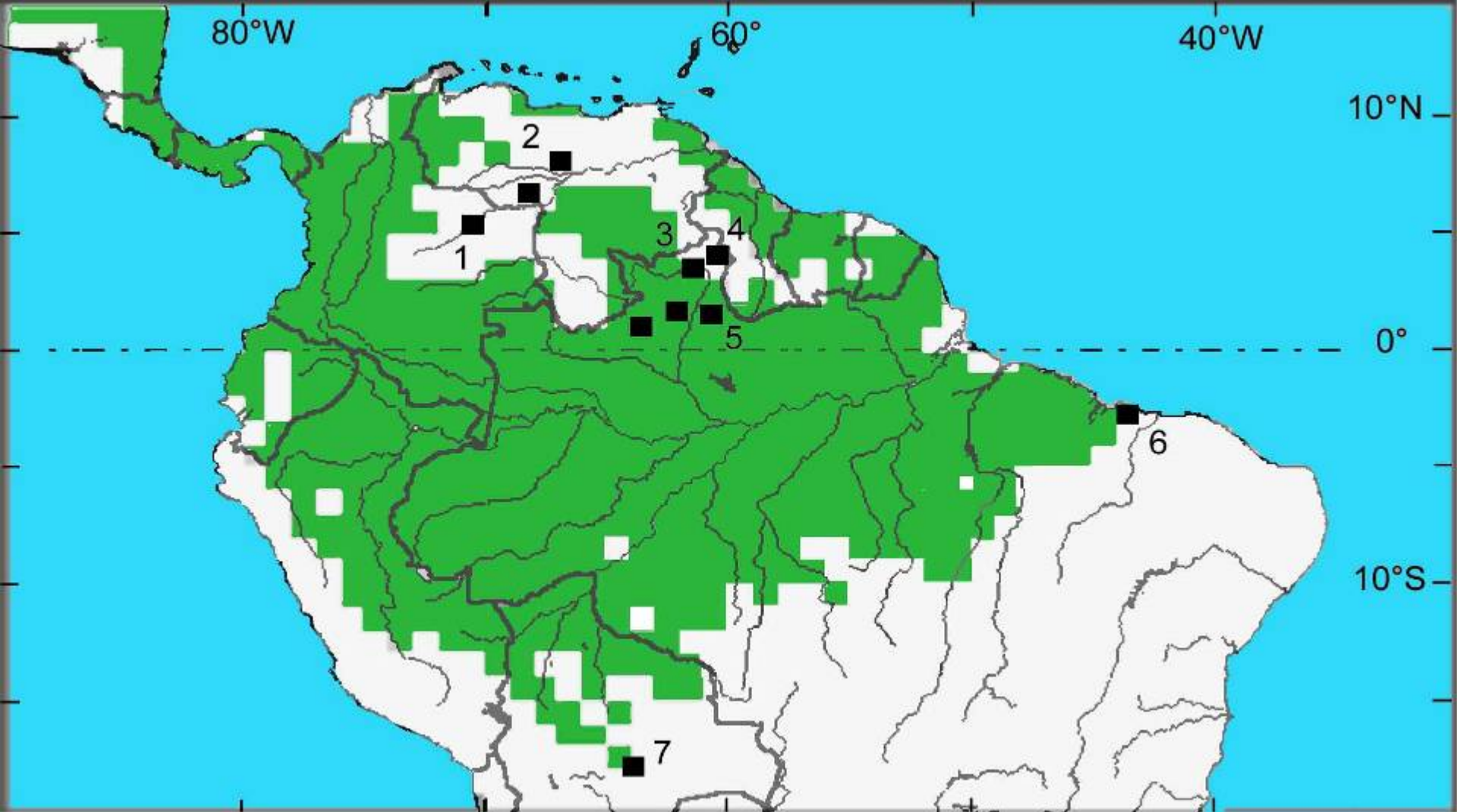
Mudanças de Vegetação

**Comparação com os modelos climáticos
globais**



Erosion scars





Occurrences of dune fields in Amazonia.

1: Orinoco Llanos (Tricard, 1974);

2: Cauamé Dune Field (Latrubesse and Nelson, 2001);

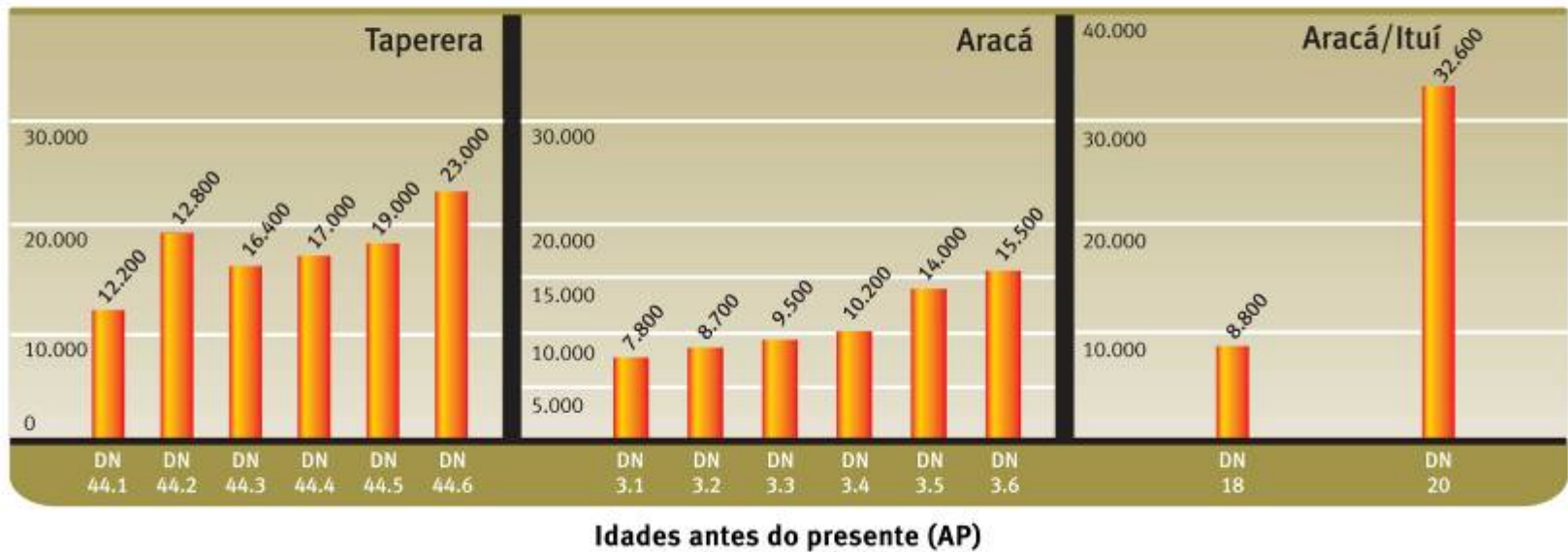
3: Tacutu dune field (Carneiro & Zink, 1994) 4: Dune fields between Negro and Branco rivers;

5: Lencois Maranhense dune field;

6: Santa Cruz dunes (Servant et al., 1981)

Datação das paleo-dunas por termo-luminescencia

Carneiro et al., 2003



Dunas eolicas



An aerial photograph showing a vast landscape. The left and bottom portions are covered in dense, dark green forest. The right and top portions are cleared, showing a brownish, textured ground surface, likely a field or pasture. The text 'REGISTROS LACUSTRES' is overlaid in yellow on the forested area.

REGISTROS LACUSTRES





80°W

60°

40°

0°

10°S

20°S

CARACARANA LAKE
RORAIMA

N3 LAKE CARAJAS
SERRA NORTE

FEIA LAKE BRASILIA

DOM HELVECIO LAKE
MINAS GERAIS

AGUA PR
BAIXO LA
MINAS GE







**CARACARANA LAKE
RORAIMA**

**N3 LAKE CARAJAS
SERRA NORTE**

FEIA

**DOM
M**



Lithology

¹⁴C Ages

RR 94-10

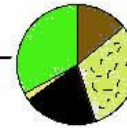
Depth

Organic Petrology

Black organic-rich clay with diatoms and sponge spicules

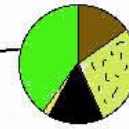
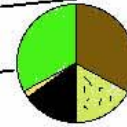
315±40

0



1440±50

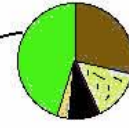
50



2560±50

Black sandy clay

4330±50



6040±50

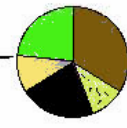
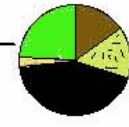
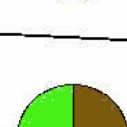
100

6955±55

7220±50

Dark grey sandy clay with diatoms

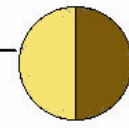
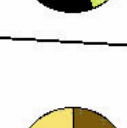
Bluish grey clay



8410±100

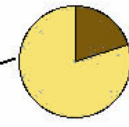
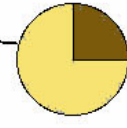
150

Light bluish grey clay with olive yellow horizontal laminations, color grading to reddish yellow toward the base



200

cm



10020±110

yr B.P.

translucent ligno-cellulosic debris

opaque ligno-cellulosic debris

charcoals fragments

greyish amorphous organic material

reddish amorphous organic material

Caracarana

Lithology

¹⁴C Ages

RR 94-10

Depth

Organic Petrology

Black organic-rich clay with diatoms and sponge spicules

Black sandy clay

Dark grey sandy clay with diatoms

Bluish grey clay

Light bluish grey clay with olive yellow horizontal laminations, color grading to reddish yellow toward the base

10020±110
yr B.P.

315±40

1440±50

2560±50

4330±50

6040±50

6955±55

7220±50

8410±100

0

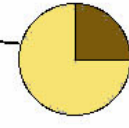
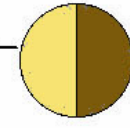
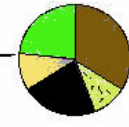
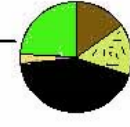
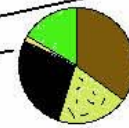
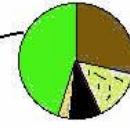
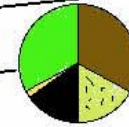
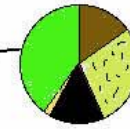
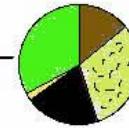
50






100

150

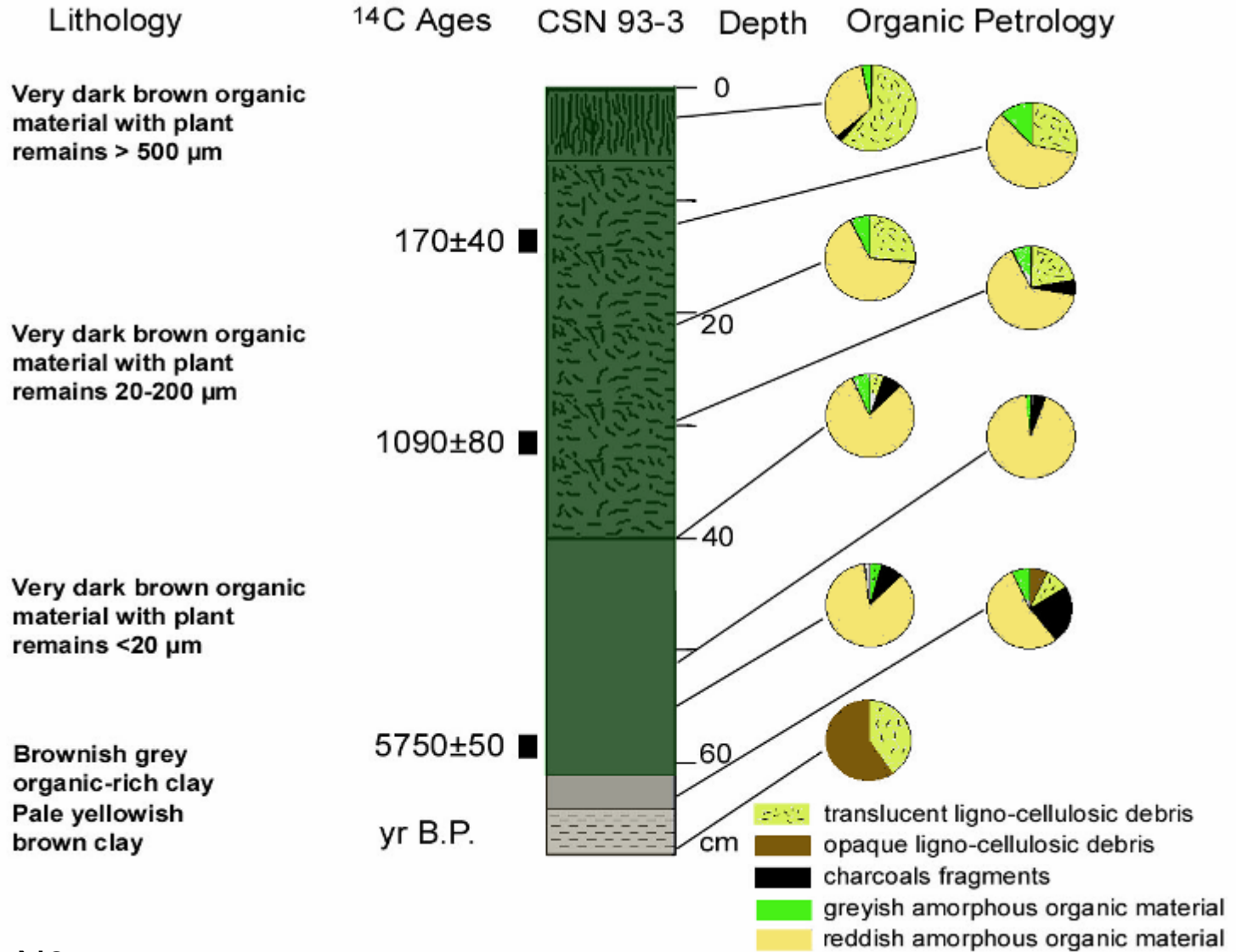
200

cm



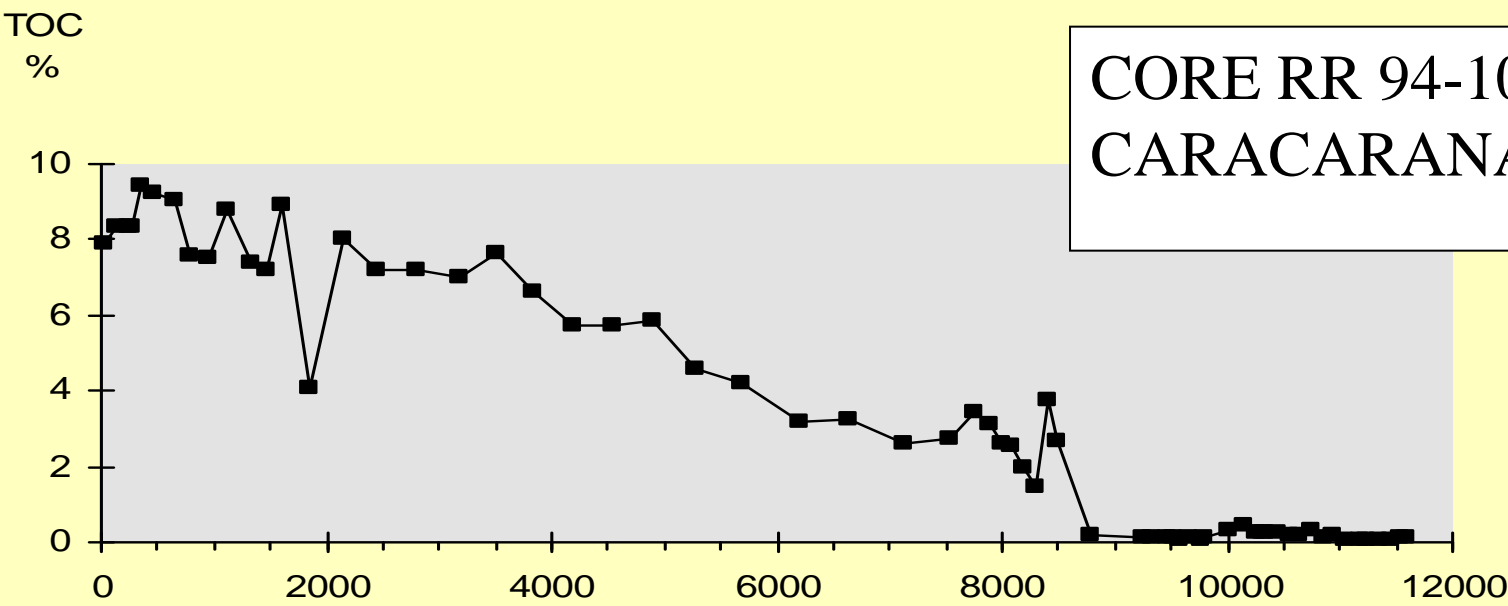
-  translucent ligno-cellulosic debris
-  opaque ligno-cellulosic debris
-  charcoals fragments
-  greyish amorphous organic material
-  reddish amorphous organic material

Caracarana

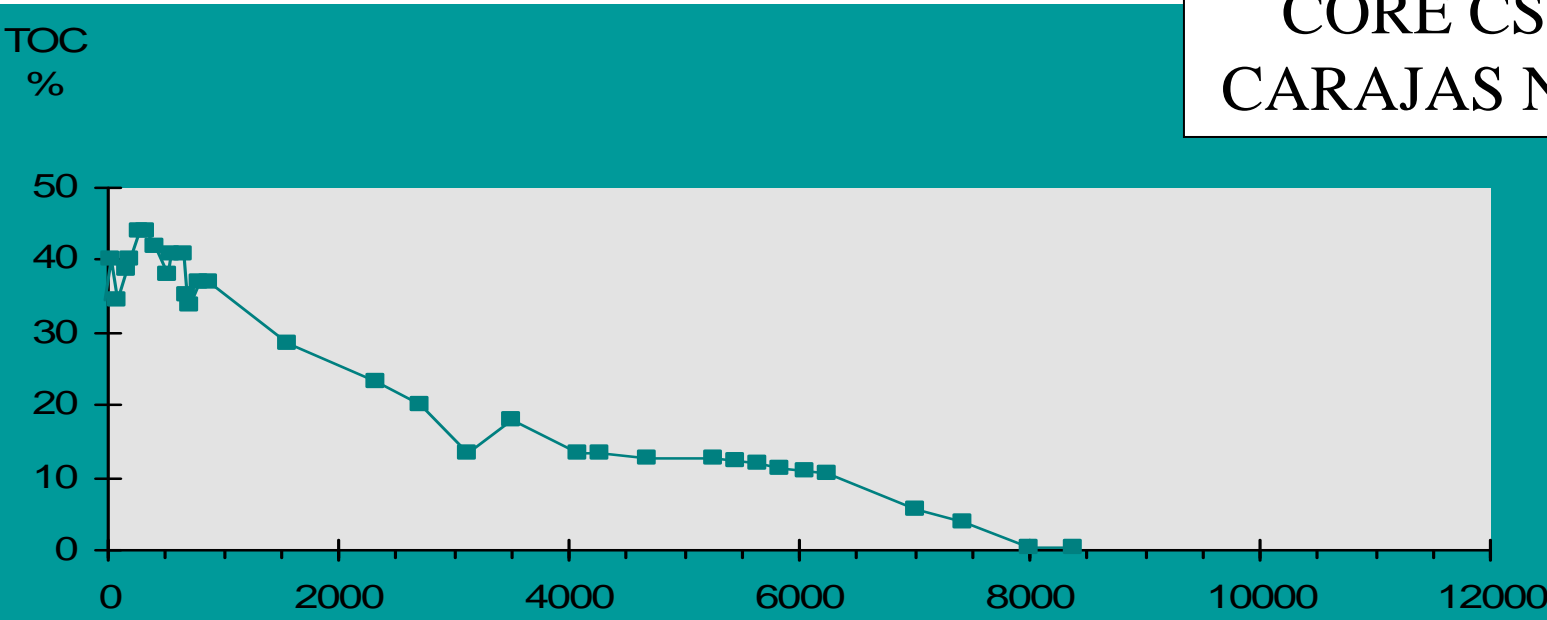


Carajas N3

CORE RR 94-10
CARACARANA LAKE



CORE CSN 93-3
CARAJAS N3 LAKE





VENEZUELA

COLOMBIA

PERU

BRAZIL

BOLIVIA

ARG.

Lago Caracaranã

Morro dos Seis Lagos

Lago Caçó

Carajás

Humaitá

Brasília

Crominia

Salitre

São Simão

Água Preta

Dom Helvécio

Jaçarei

Colônia











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COLOMBIA

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BRAZIL

Lago Caracaranã

Morro dos Seis Lagos

Lago Caçó

Humaitá

Carajás

Brasília

Crominia

Salitre

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Dom Helvécio

Jacareí

Colônia

Água Preta



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Carajás

Humaitá

Brasilia

Crominia

Salitre

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Dom Helvécio

Jacareí

Colônia



VENEZUELA

COLOMBIA

LAGO CALADO →

PERU

Humaitá

BOLIVIA

ARG.

BRAZIL

Lago Caracaranã

Morro dos Seis Lagos

Lago Caçó

Carajás

Brasilia

Crominia

Salitre

São Simão

Dom Helvécio

Jacareí

Colônia

Agua Preta



VENEZUELA

COLOMBIA

LAGO CALADO

PERU

Morro dos Seis Lagos

Lago Caracaranã

Lago Caçó

Carajás

Humaitá

BRAZIL

Brasilia

Crominia

Salitre

São Simão

Agua Preta

Dom Helvécio

Jacareí

Colônia

ARG.

BOLIVIA



VENEZUELA

COLOMBIA

LAGO CALADO

PERU

Humaitá

LAGO TAPAJOS

BRAZIL

BOLIVIA

ARG.

Lago Caracaranã

Morro dos Seis Lagos

Lago Caçó

Carajás

Brasilia

Crominia

Salitre

São Simão

Dom Helvécio

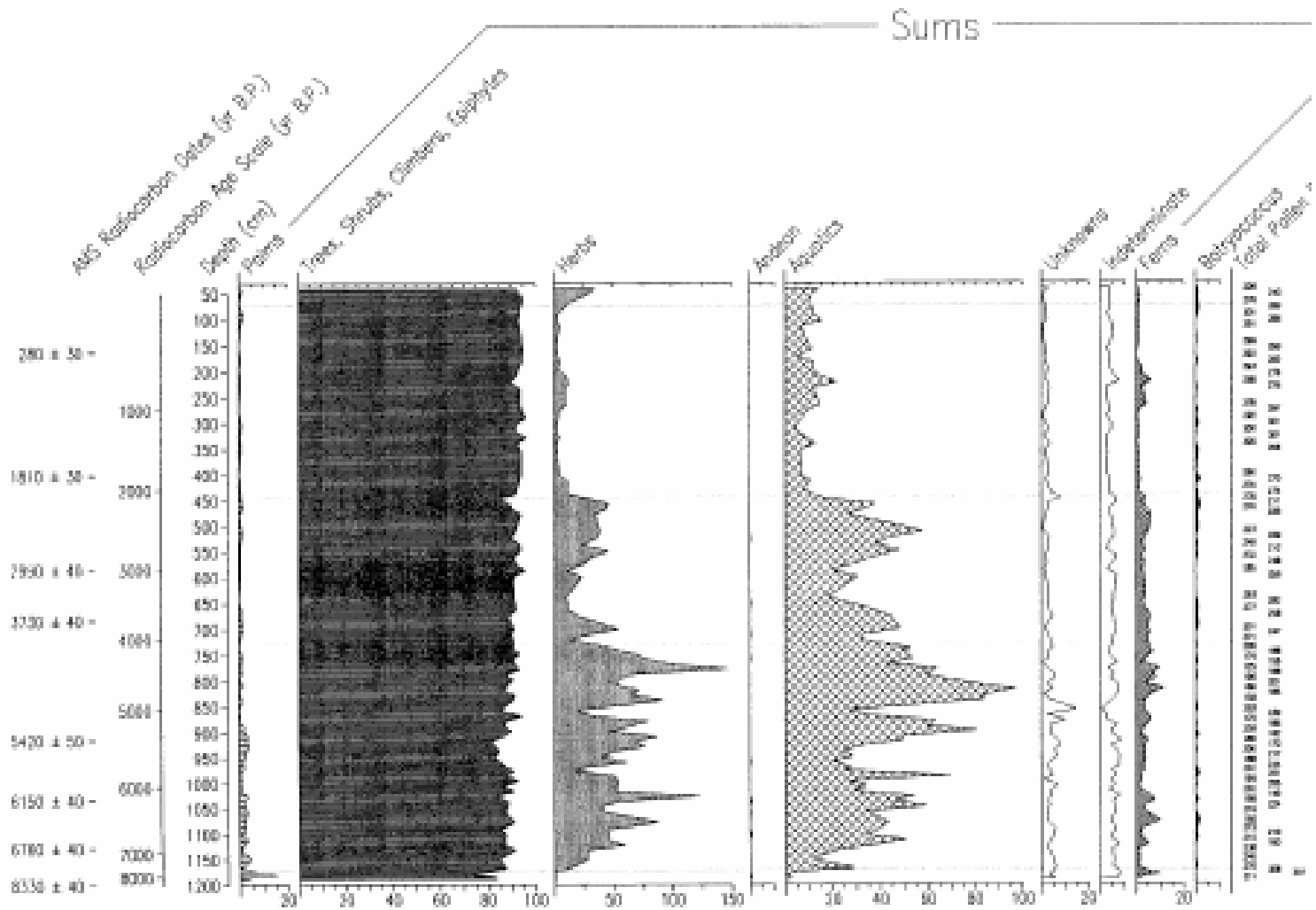
Jacareí

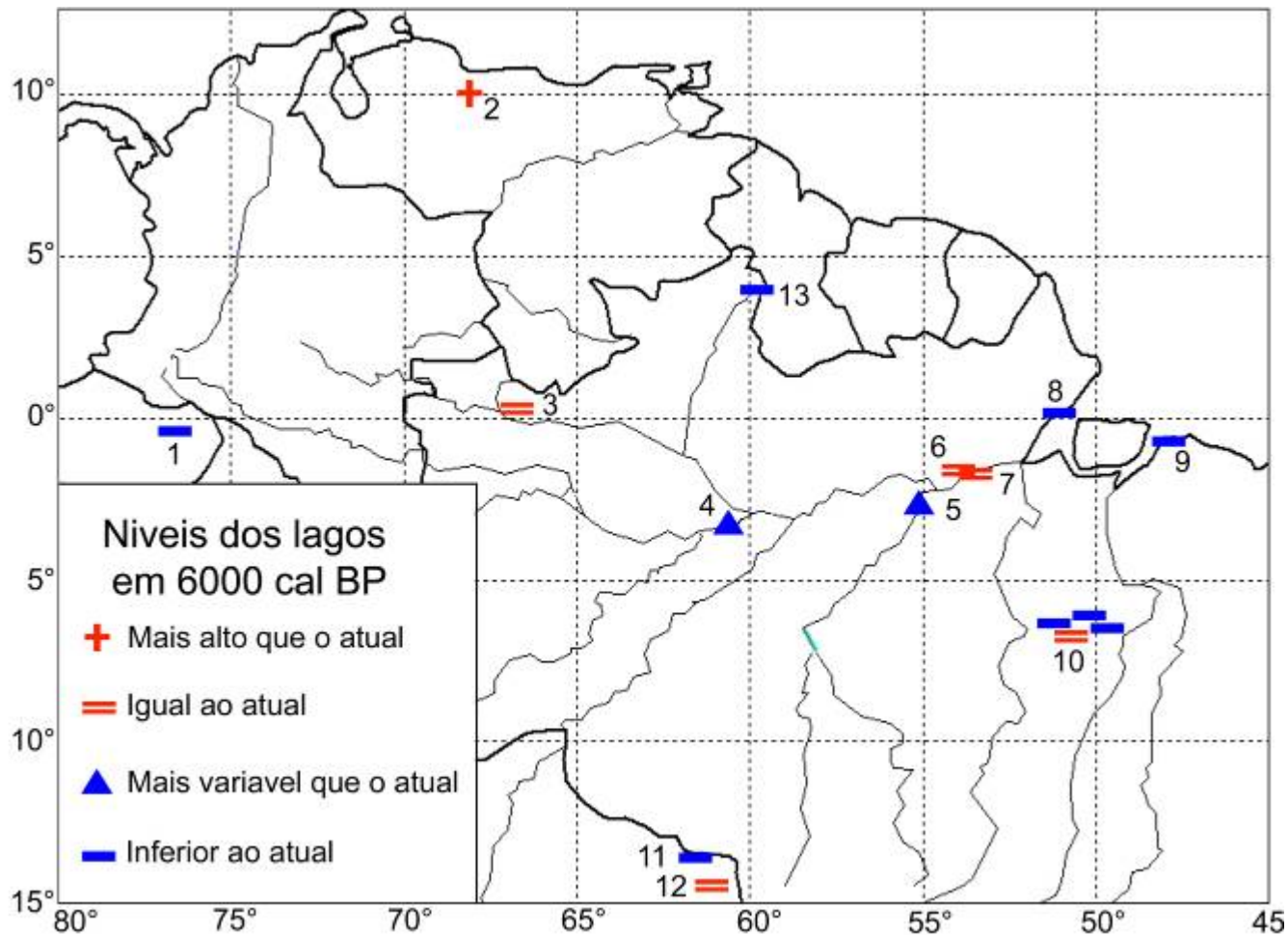
Colônia

Agua Preta

Lago Calado, Central Amazonia

Summary Pollen Diagram



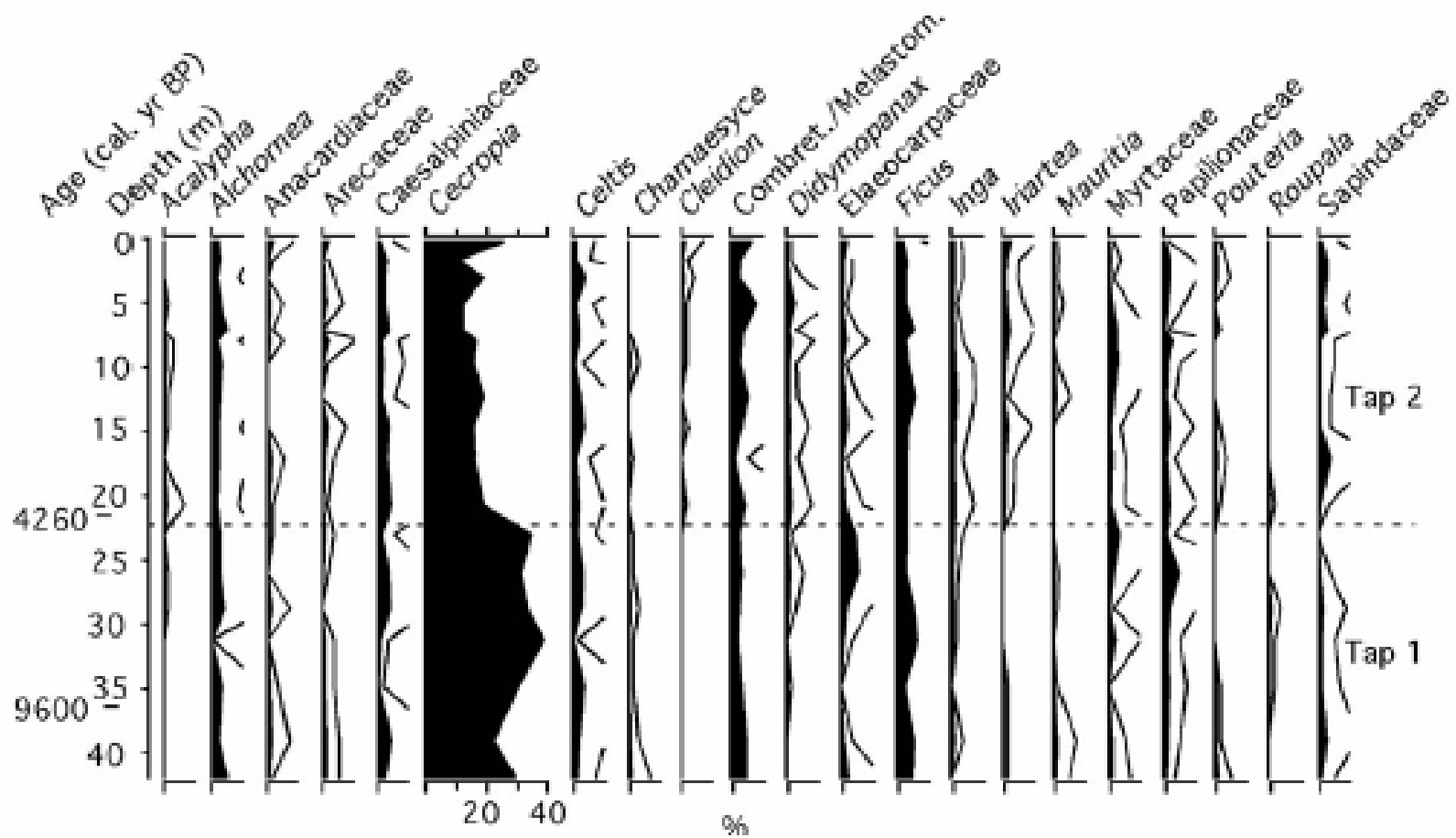


Níveis relativos dos lagos da Amazônia em 6000 cal BP comparados aos níveis atuais. 1: Maxus 4; 2: Valencia; 3: Pata; 4: Calado; 5: Lago Tapajós; 6: Comprida; 7: Geral; 8: Marcio e Tapera; 9: Curuçã; 10: Carajás Serra Sul e Serra Norte; 11: Bella Vista; 12: Chaplin; 13: Caracaranã.

An aerial photograph of a dense forest. The majority of the trees are a vibrant green, but there are several distinct patches and individual trees that appear brown or dark, indicating a change in vegetation. The text 'VEGETATION CHANGES' and 'MUDANÇAS DA VEGETAÇÃO' is overlaid in a small, dark font above the main title. The main title 'Mudanças de Vegetação' is written in a large, bold, yellow font.

VEGETATION CHANGES
MUDANÇAS DA VEGETAÇÃO

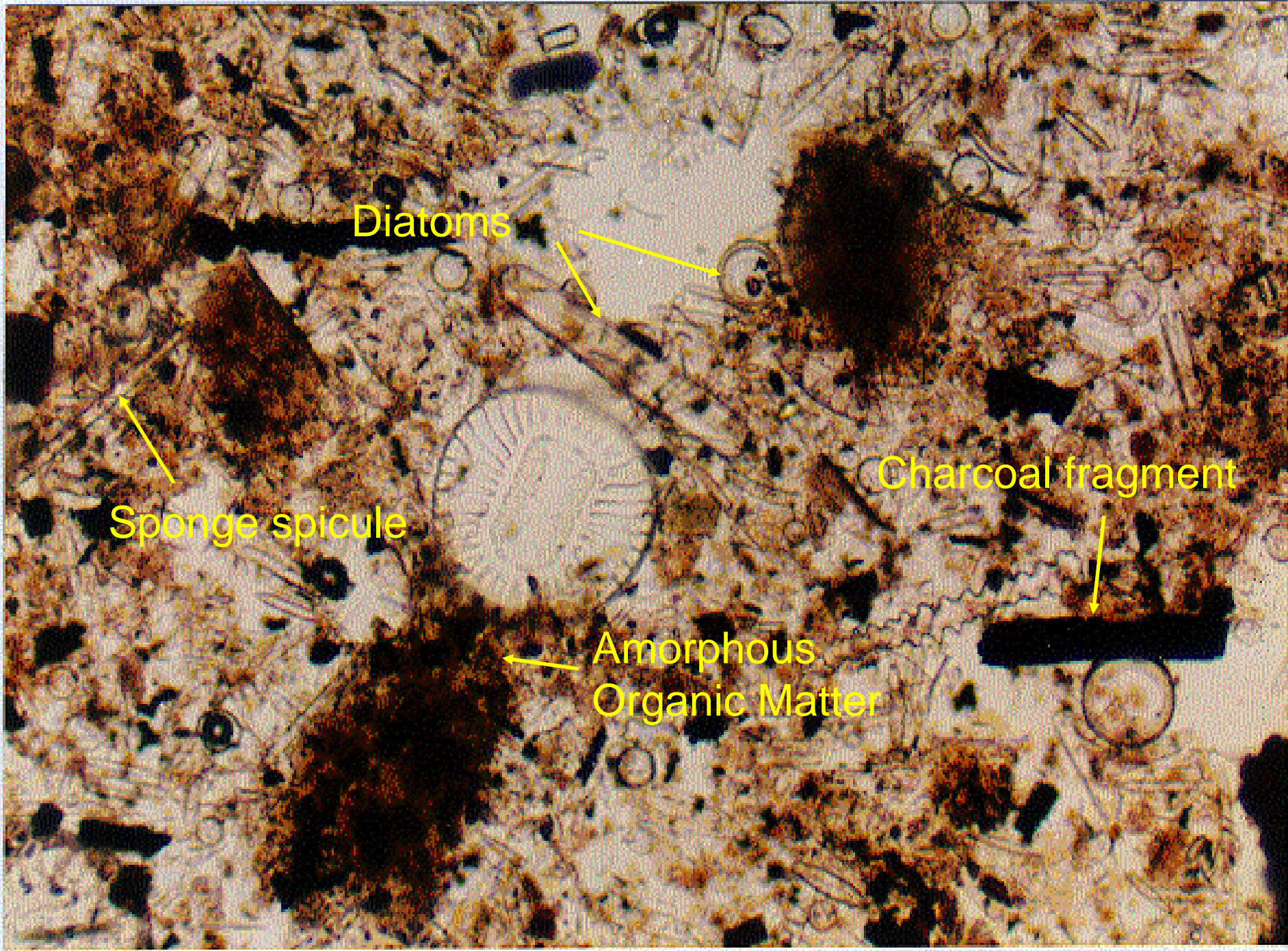
Mudanças de Vegetação



Lago Tapajos (Irion et al., 2006)

Incendios Holocênicos





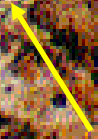
Diatoms



Charcoal fragment



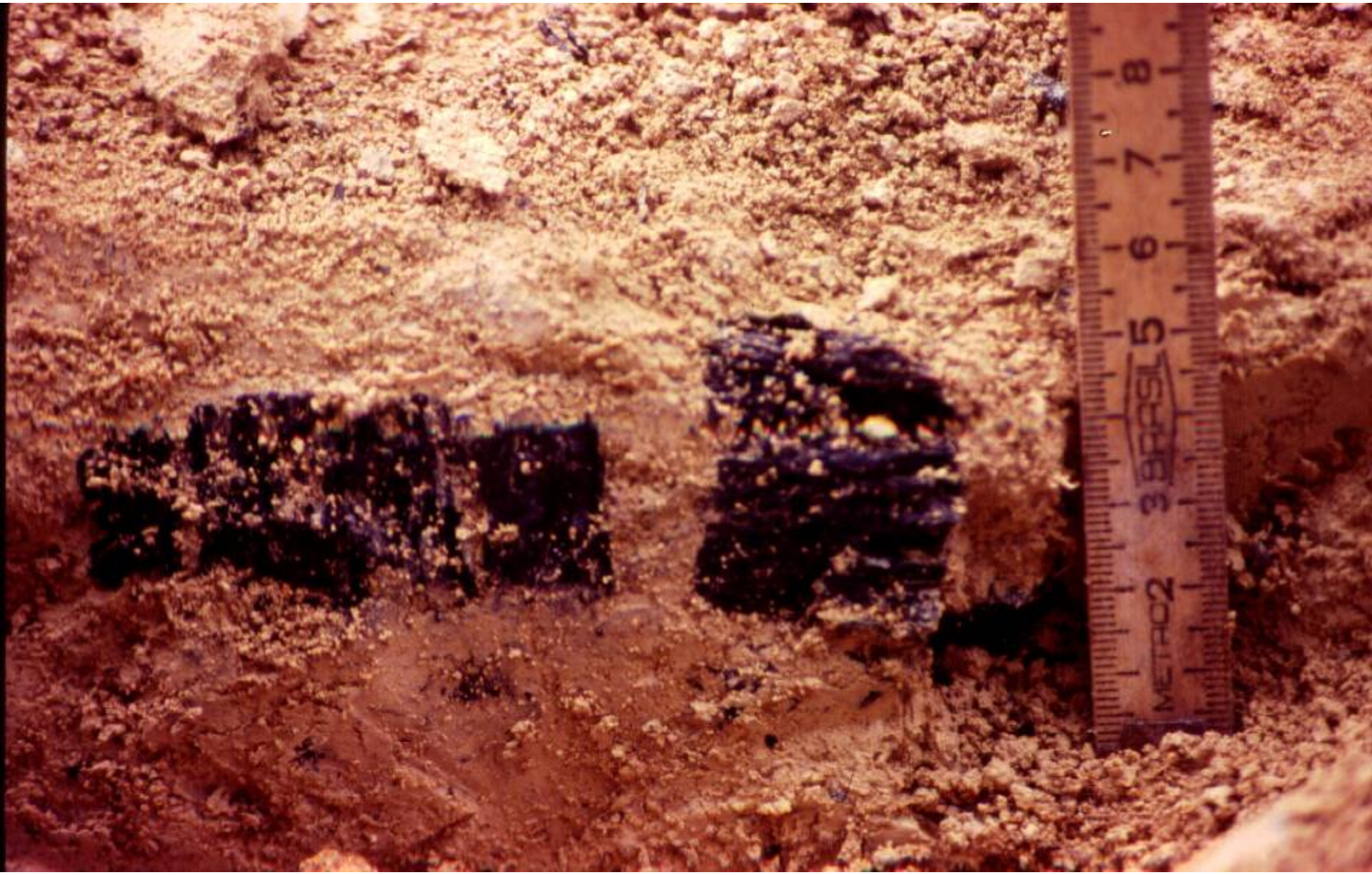
Sponge spicule

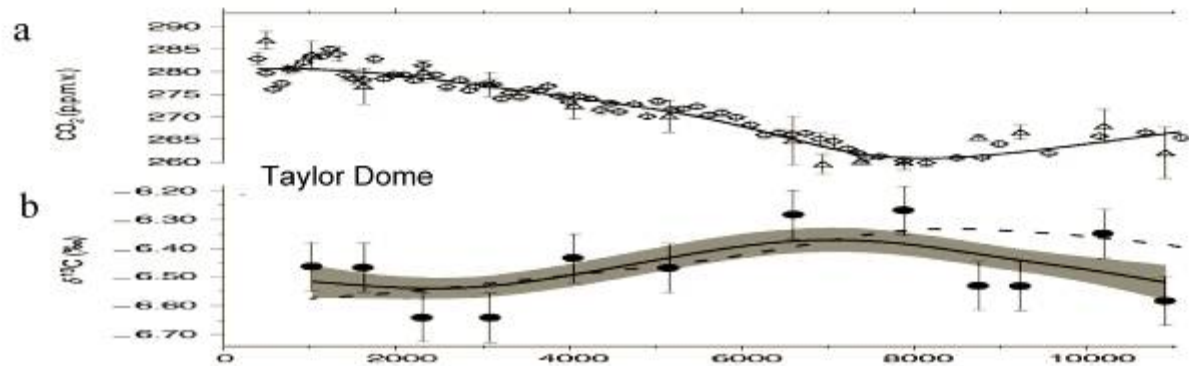
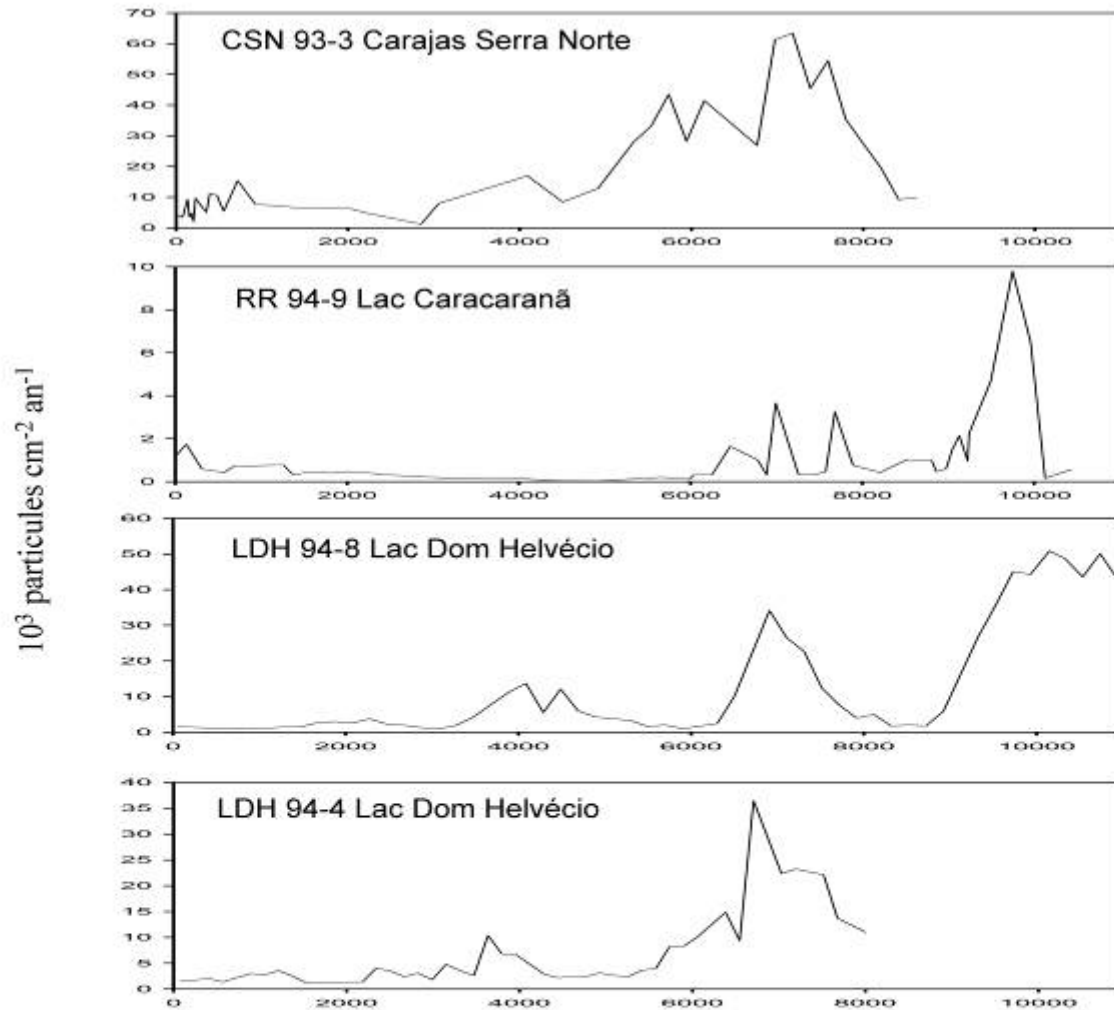


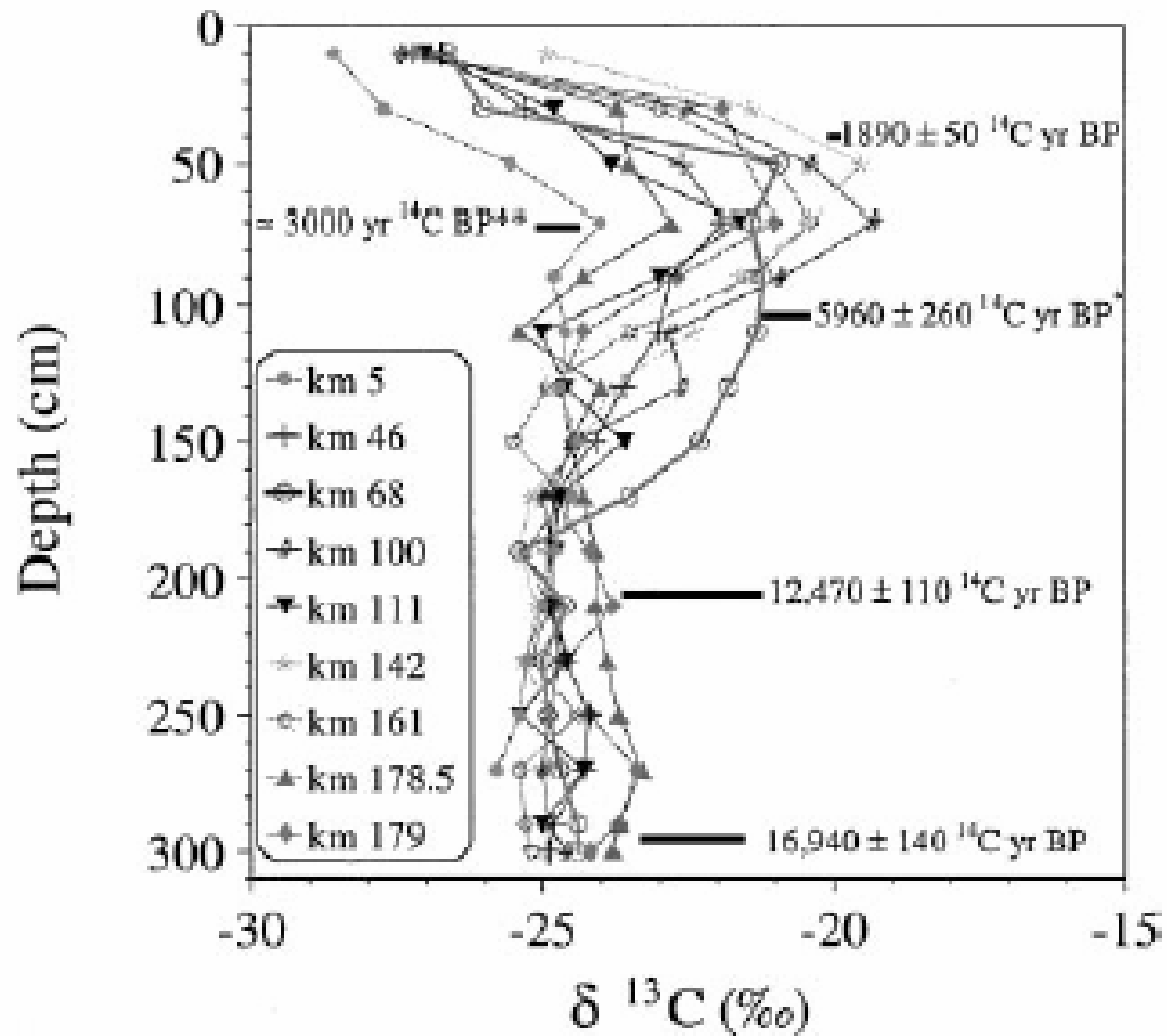
Amorphous Organic Matter



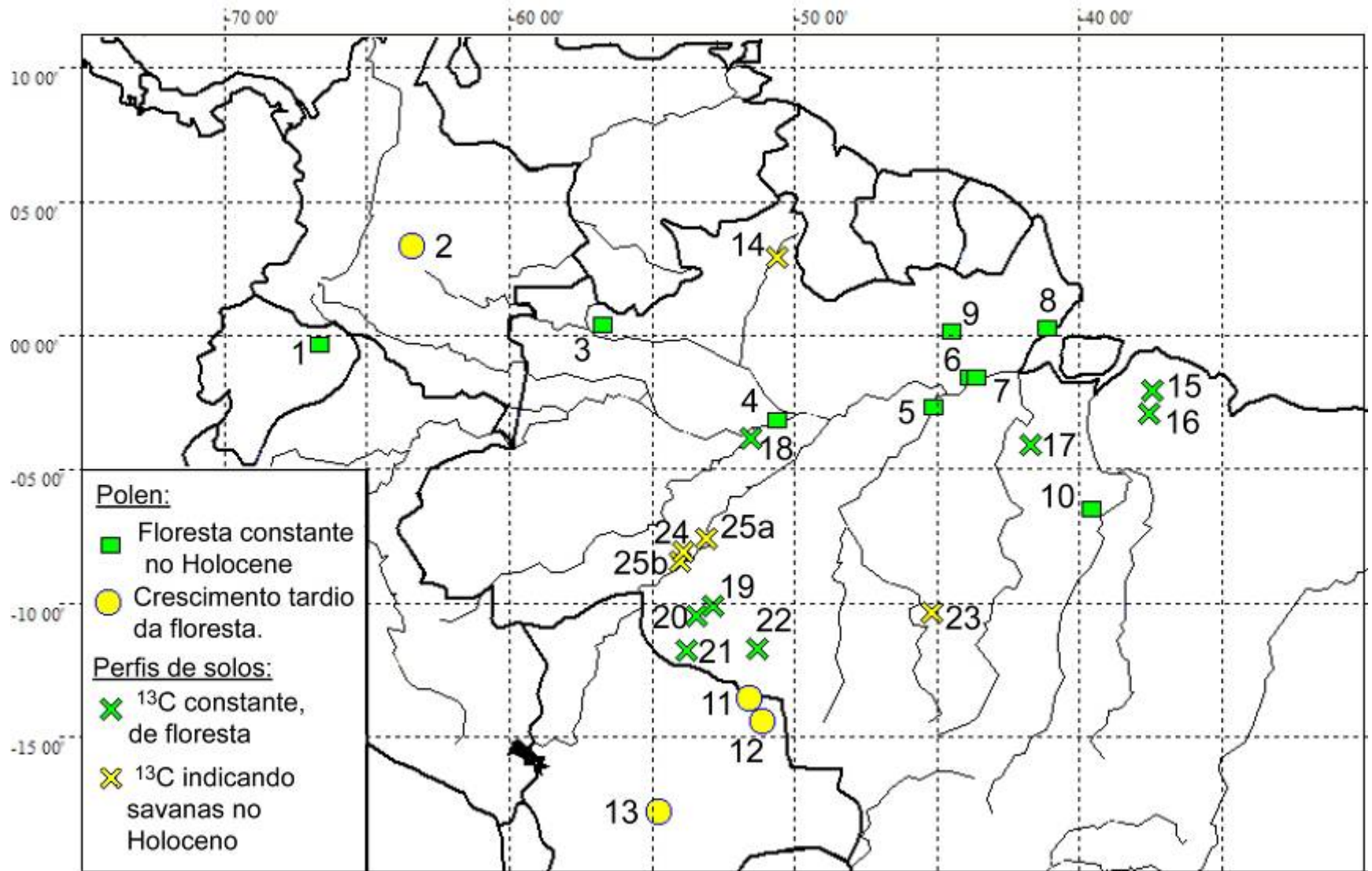








Freitas et al., 2001



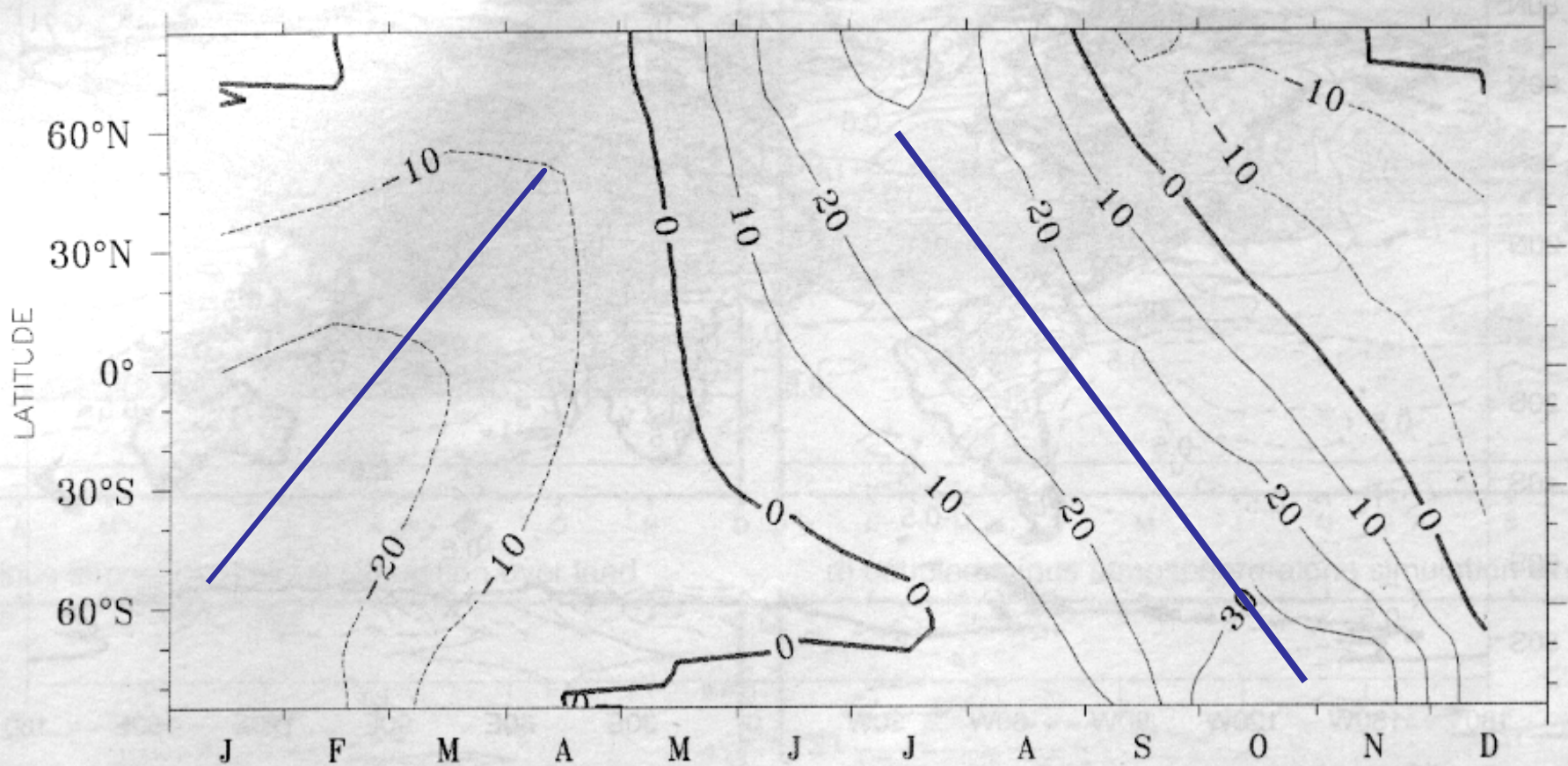
Turcq et al., 2007

- O Holoceno da Amazônia é caracterizado tanto pelos dados de pólen quanto pelos dados de $\delta^{13}\text{C}$ dos solos como um era de floresta e esta floresta ainda desenvolveu-se de 6800 até 700 cal BP nas regiões noroeste e sudoeste da Amazônia.
- Os estudos lacustres mostram uma subida dos níveis dos lagos durante o Holoceno, vários pequenos lagos tendo sido formados nesta época.
- Os dados paleohidrológicos são testemunhos de mudanças na variabilidade climática, mostrando que o Holoceno médio foi uma época de grande variabilidade das vazões dos grandes rios.
- Isto está de acordo com a observação de repetidas ocorrências de incêndios neste período e do aumento da proporção de elementos pioneiros na vegetação.
- A mudança para o clima atual, mais estável e mais úmido, ocorreu a partir de 5500 cal BP e o clima atual, em diversos sítios, parece ter sido, plenamente, estabelecido por volta de 1500 cal BP.

Comparação com os modelos climáticos globais

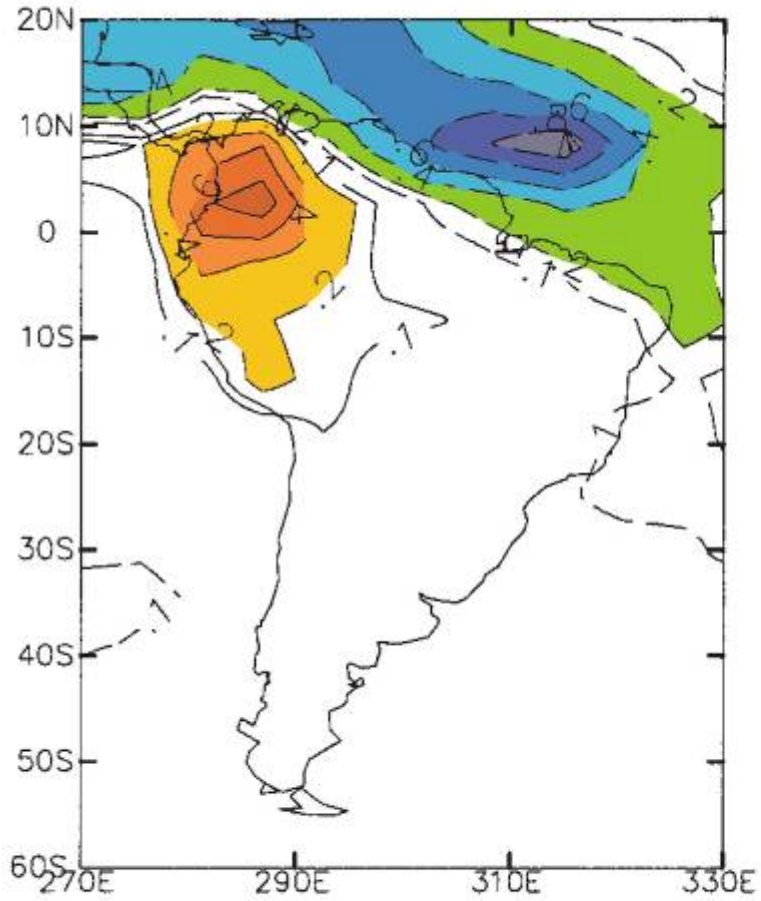
6k BP change with respect to present

a) Insolation at top of atmosphere Wm^{-2}

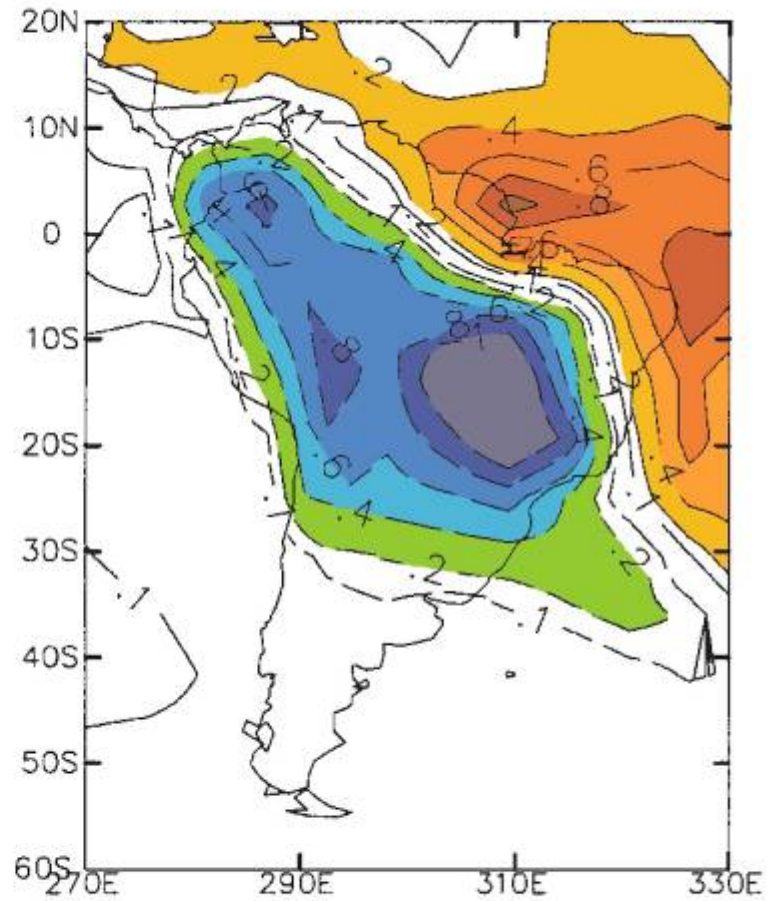


From Braconnot et al. 2000 – J. Climate

JJA



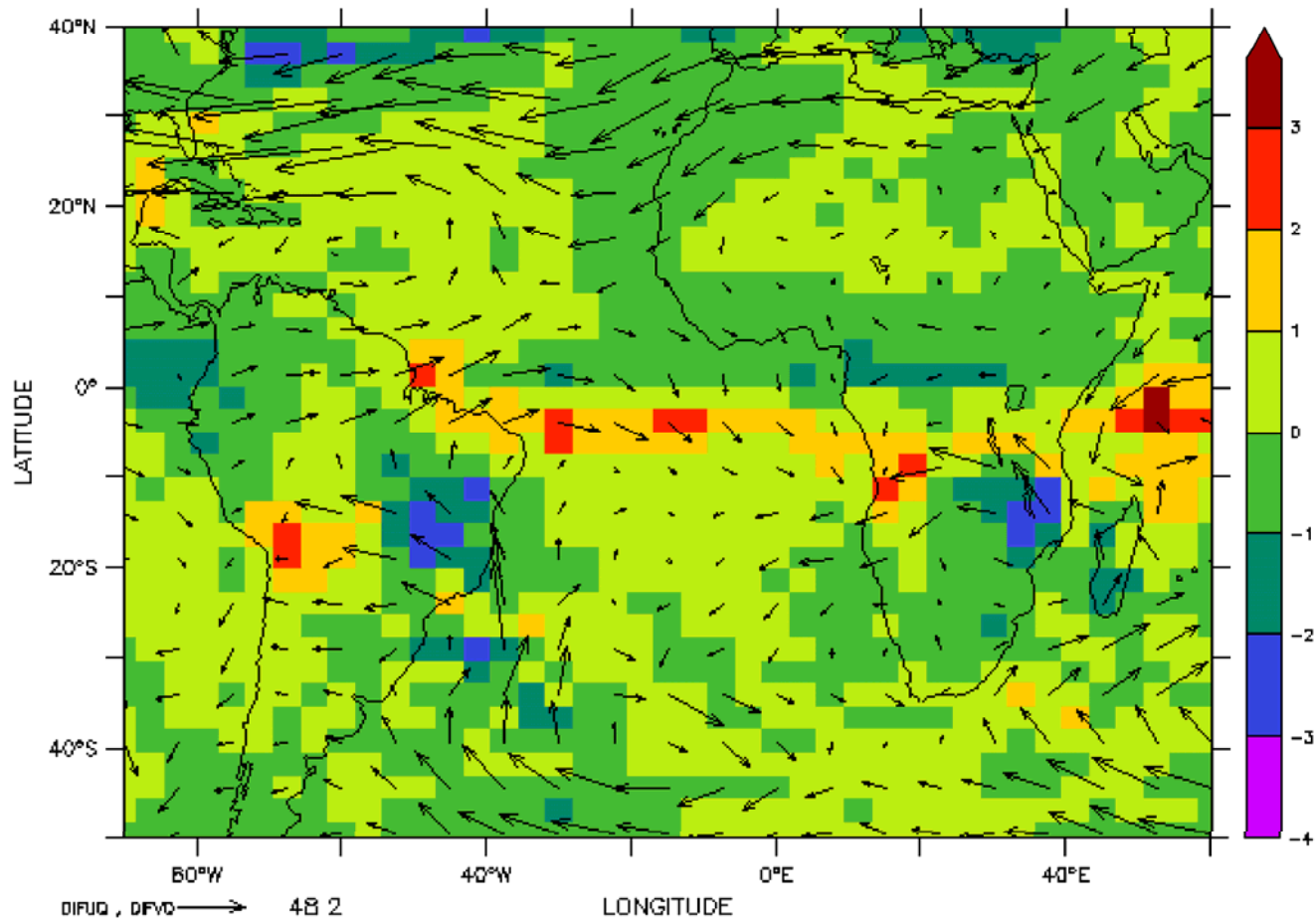
DJF



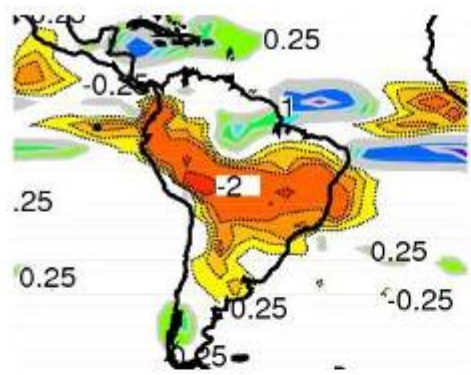
PMIP 6ka (Valdes, 2000)

PRECIPITATION AND WATER TRANSPORT DIFFERENCE

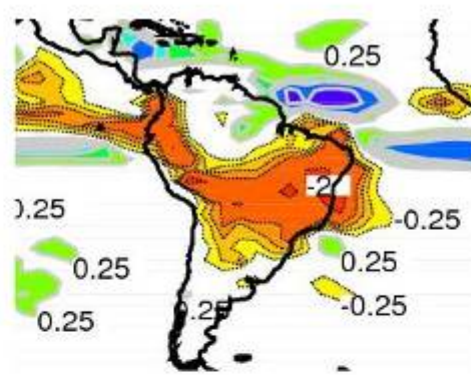
JANUARY 6K – PRESENT



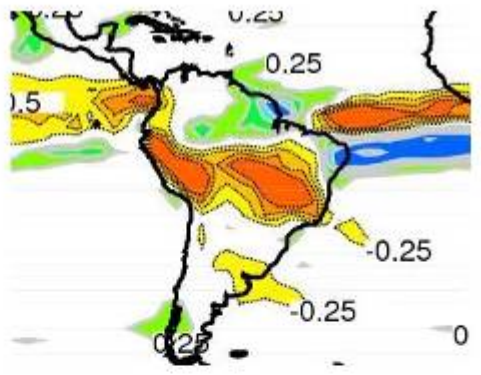
HAD CM3M2 OA



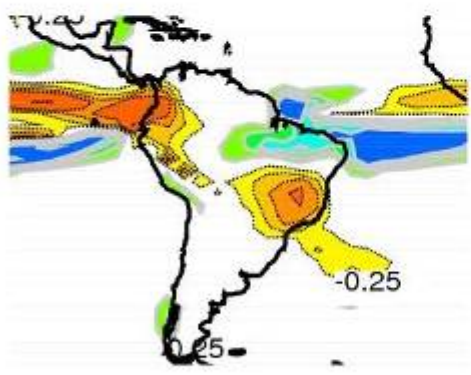
HAD CM3M2 OAV



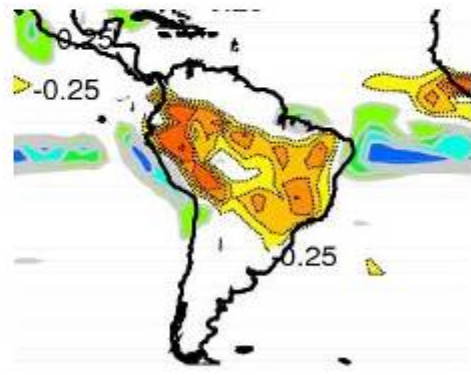
MIROC 3.2



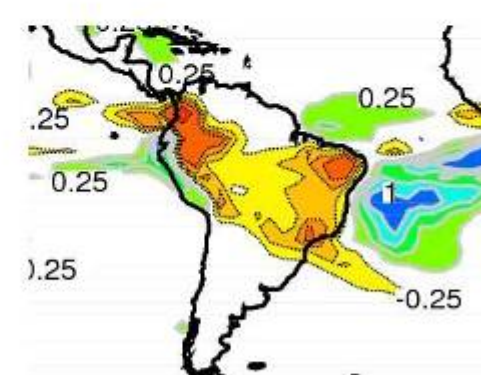
IPSL CM4



CCSM OA

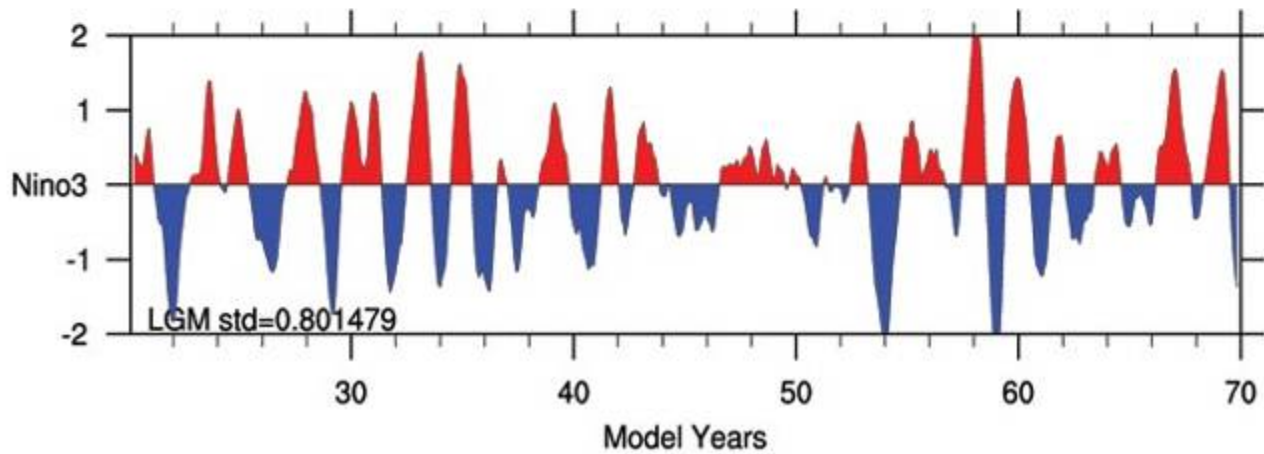
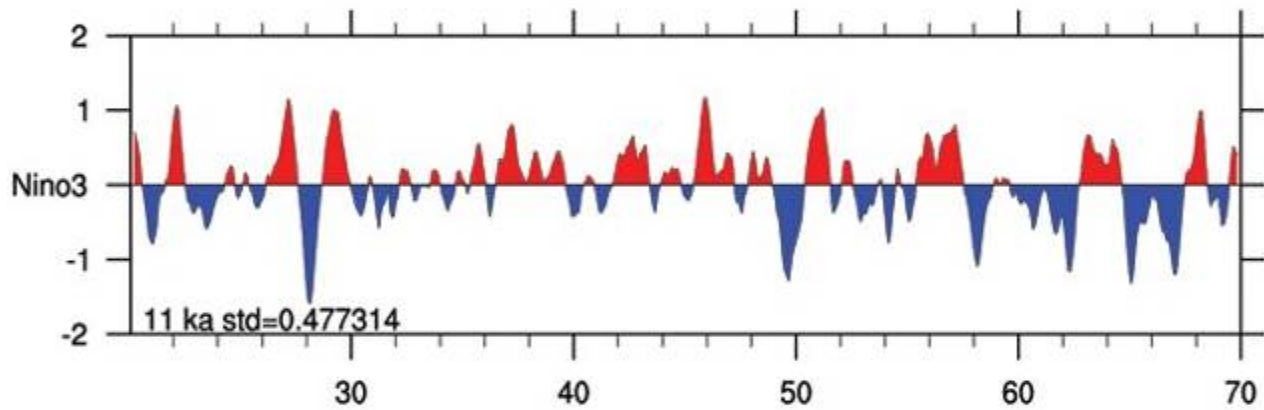
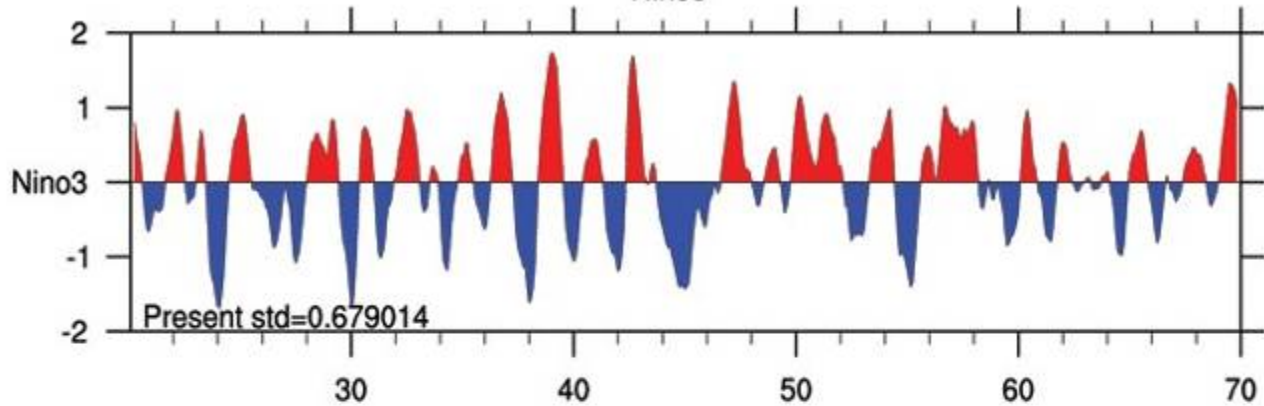


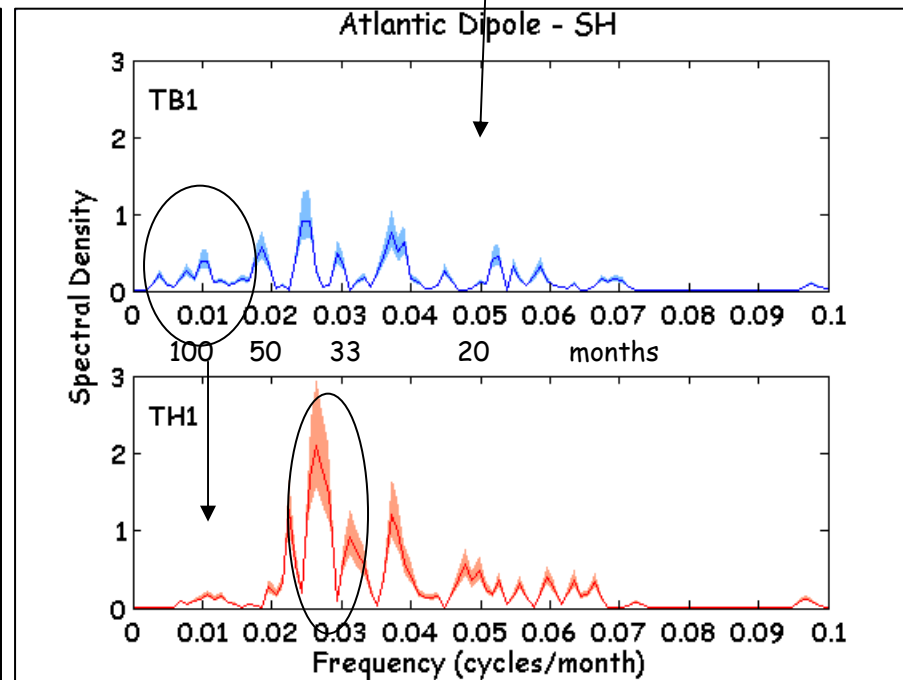
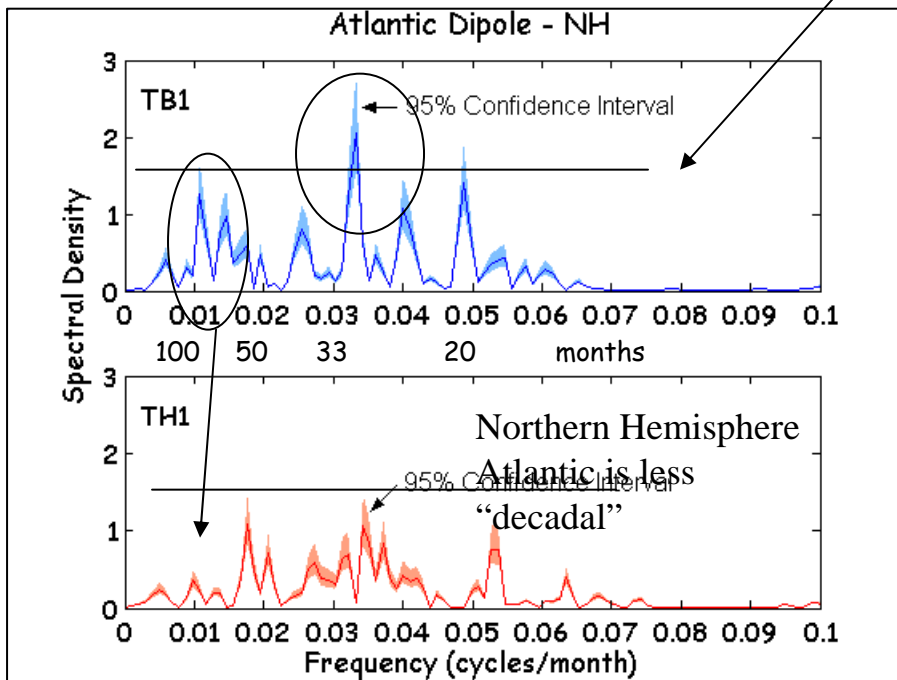
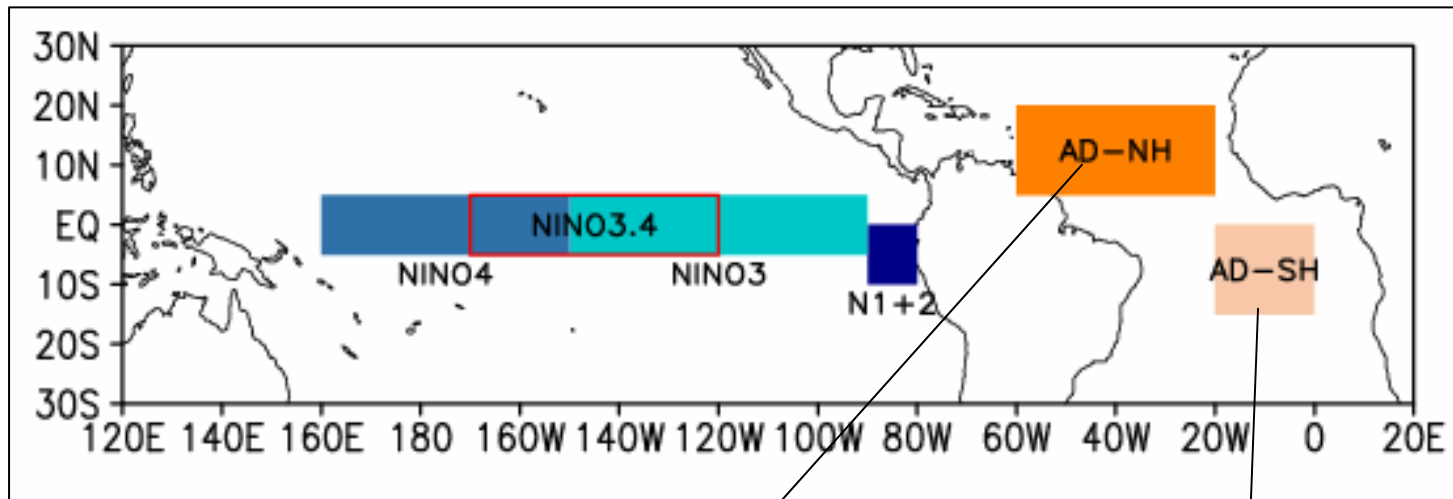
MRI CGM2.3



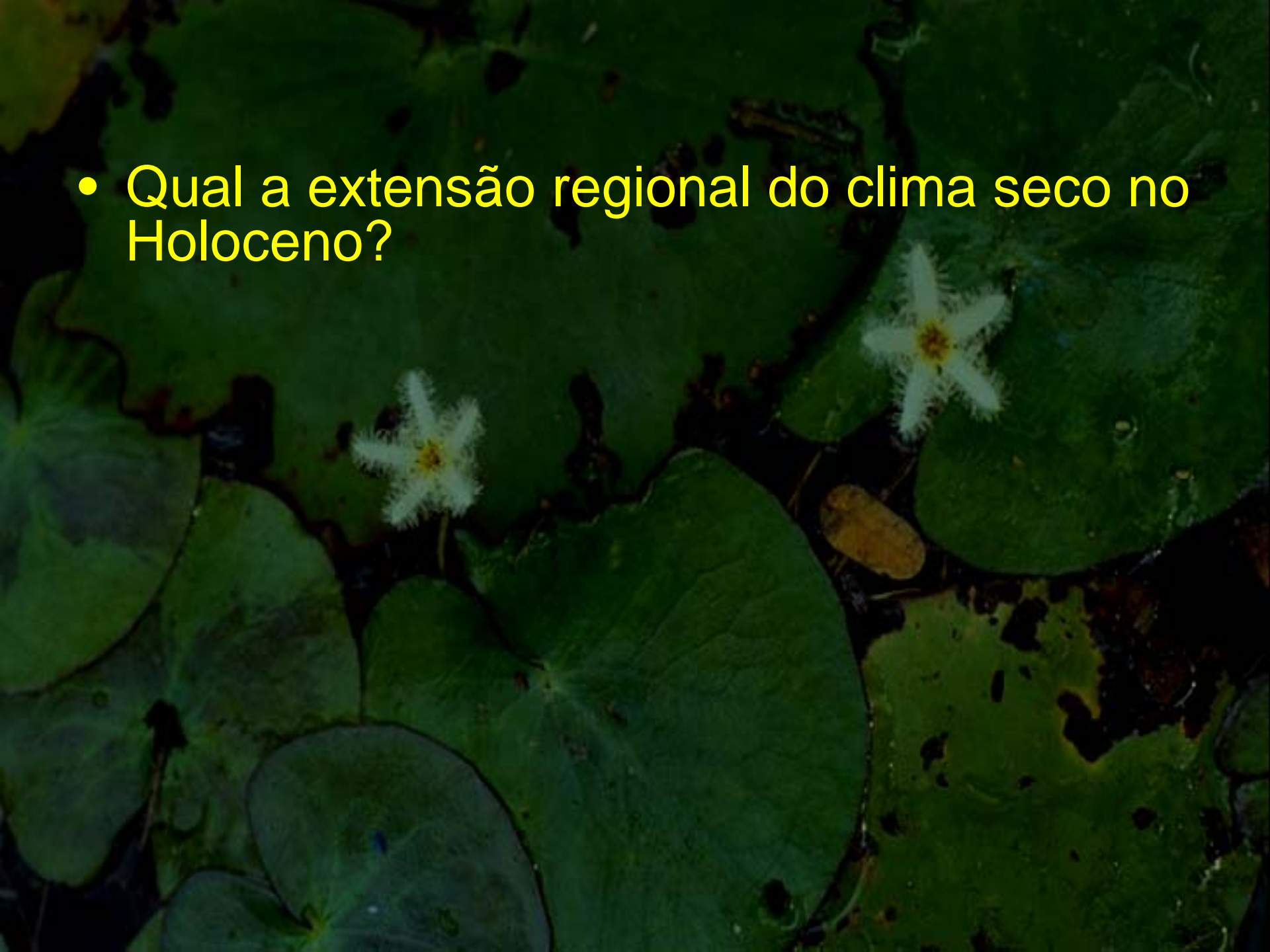
PRECIPITATION DIFFERENCE DJF 0-6K mm day⁻¹

Community Climate System Model
Nino3





- Qual a extensão regional do clima seco no Holoceno?



The background of the slide is a photograph of a pond. It features several large, round, green lily pads floating on the water. Two white flowers with yellow centers are in bloom, one in the upper right and one in the middle left. The water is dark, and there are some brown leaves or debris scattered among the lily pads.

- Qual a extensão regional do clima seco no Holoceno?

- Quais são as causas da maior variabilidade climática no Holoceno Médio?