The Drought of Amazonia in 2005

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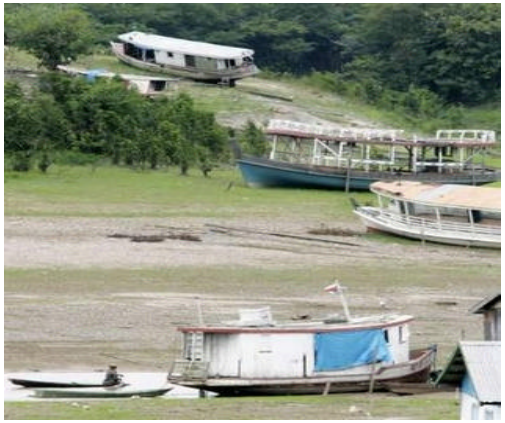
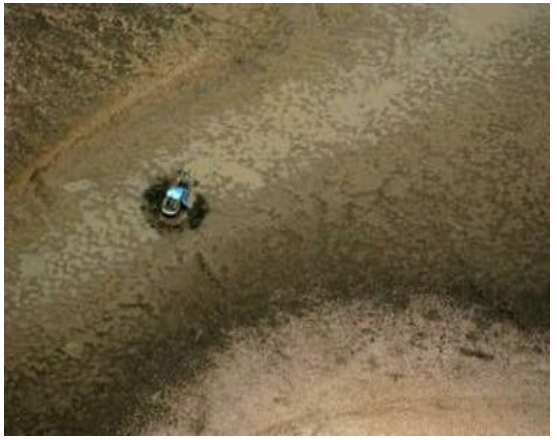
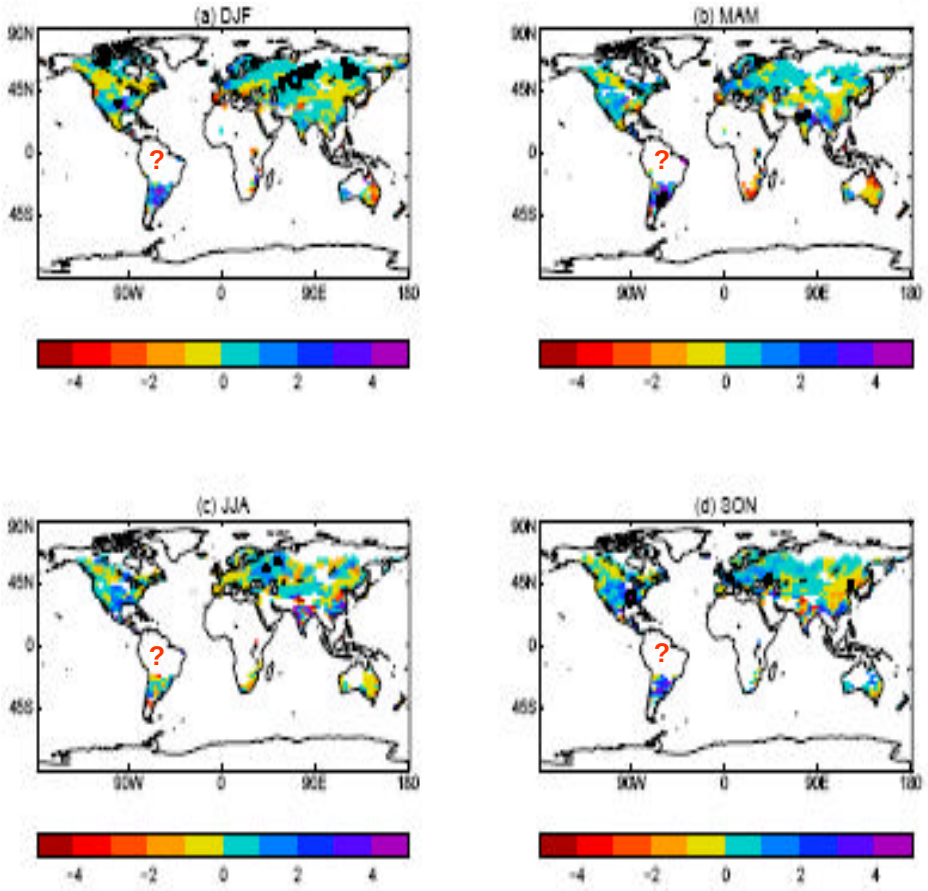
São Paulo, Brazil





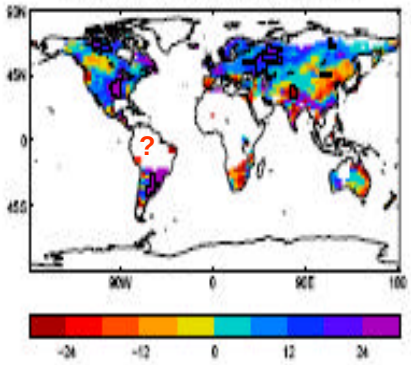
Decadal trends (mm) in 5-day precipitation



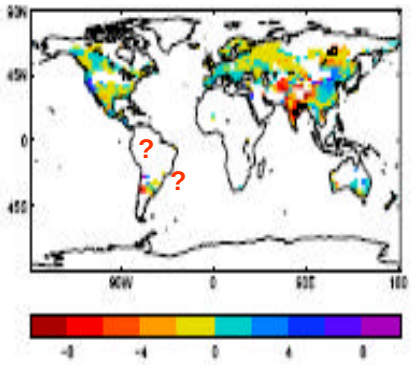
Alexander et al. (2005)

Period 1951-2003

Decadal trends (mm) in annual total rainfall



Decadal trends (days) in maximum consecutive dry days



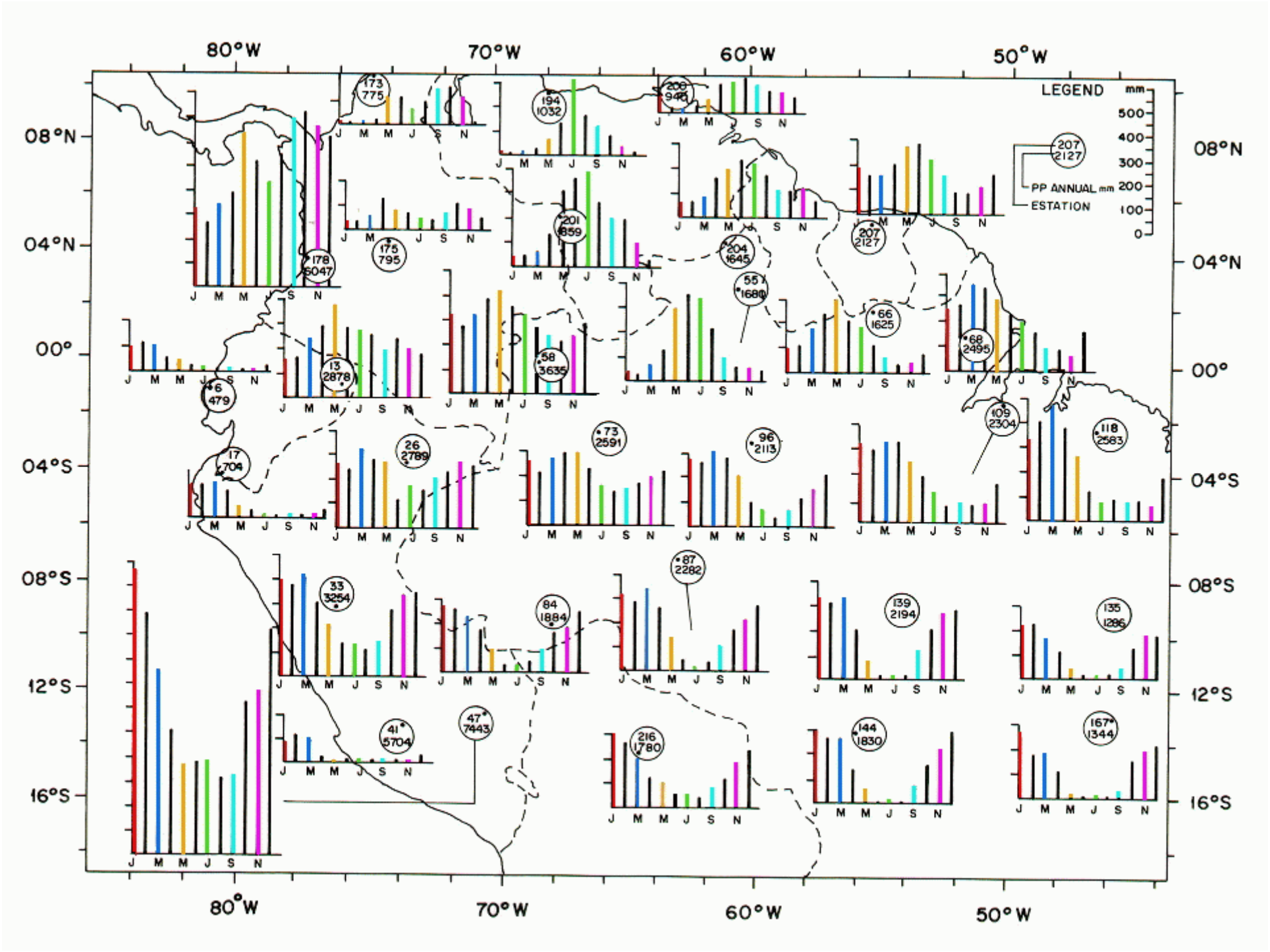
The drought of 2005 in Amazonia:

-In 2005, large sections of the western part of the Amazon Basin have been enduring the worst drought for 40 years and also one of the most intense during the entire XX century and beginning of the XXI century.

-The drought has evaporated whole lagoons, and kindled forest fires, killed off fish and crops, stranded boasts and the villagers who travel by them, brought disease and wreaked economic havoc

-The drought of 2005 in Amazonia has limited navigation in many tributaries leaving thousands of people short of food, caused problems to transportation, agriculture, generation of hydroelectricity and also affects directly and indirectly the populations living along the Amazon River streams.

-An estimated 30.000 people are suffering the lack of food and transport, and a fifth of the 1.3 million cattle herds in the State of Amazonas have died. The anomalously low levels of the rivers and lakes in Brazil, Peru and Bolivia affected the water supply for small towns along the rivers, and also affected transportation and commerce in the region along the Amazon Rivers, leaving thousands of people isolated.


80°W
70°W
60°W
50°W
08°N
04°N
00°
04°S
08°S
12°S
16°S
LEGEND
mm
500
400
300
200
100
0
207
2127
PP ANNUAL mm
ESTATION
J M M J S N
173
775
194
1032
200
948
178
5047
175
795
201
859
204
1645
207
2127
55
1680
66
1625
68
2495
13
2878
58
3635
6
479
109
2304
118
2583
17
704
26
2789
73
2591
96
2113
33
3254
84
1884
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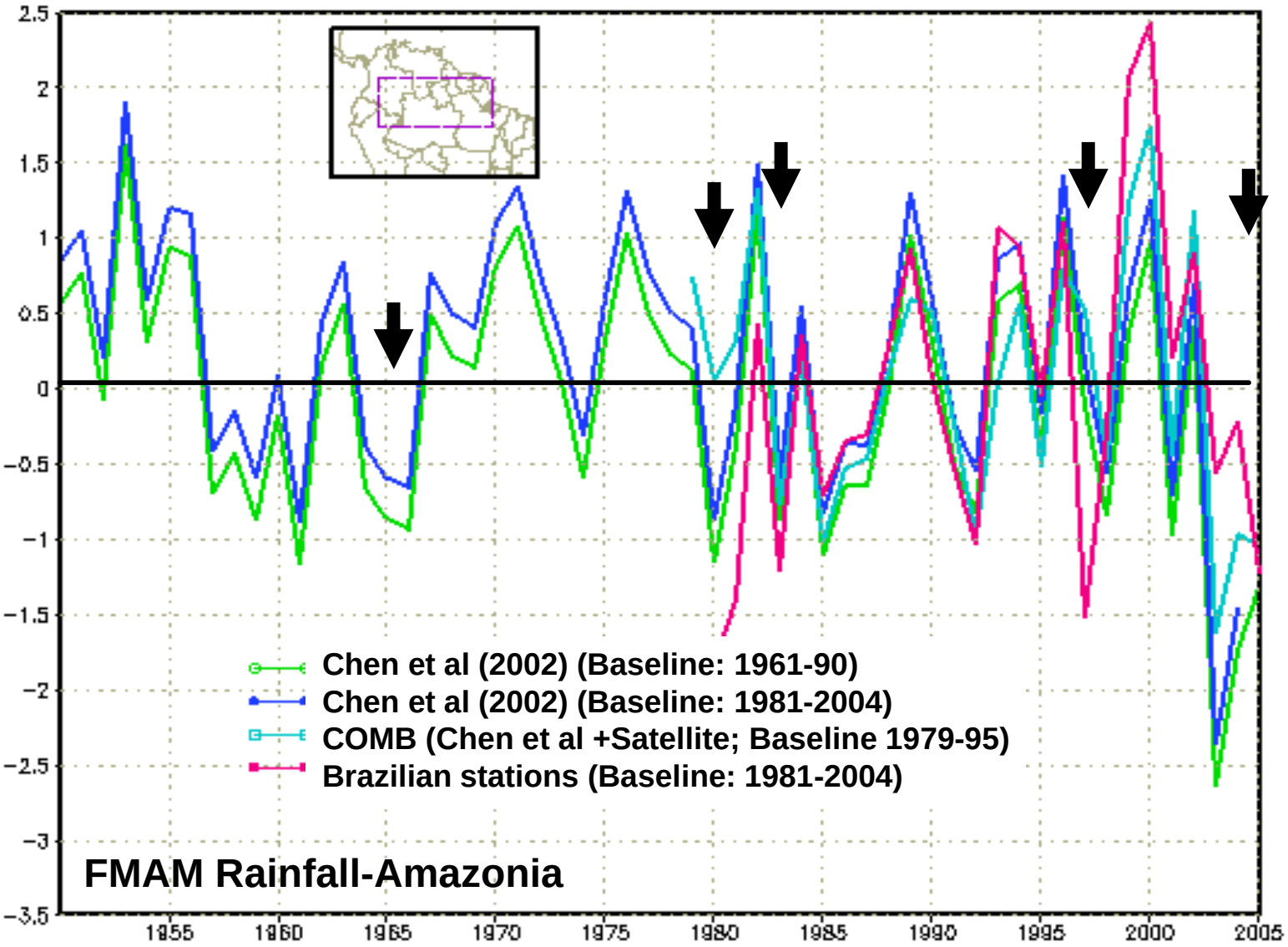
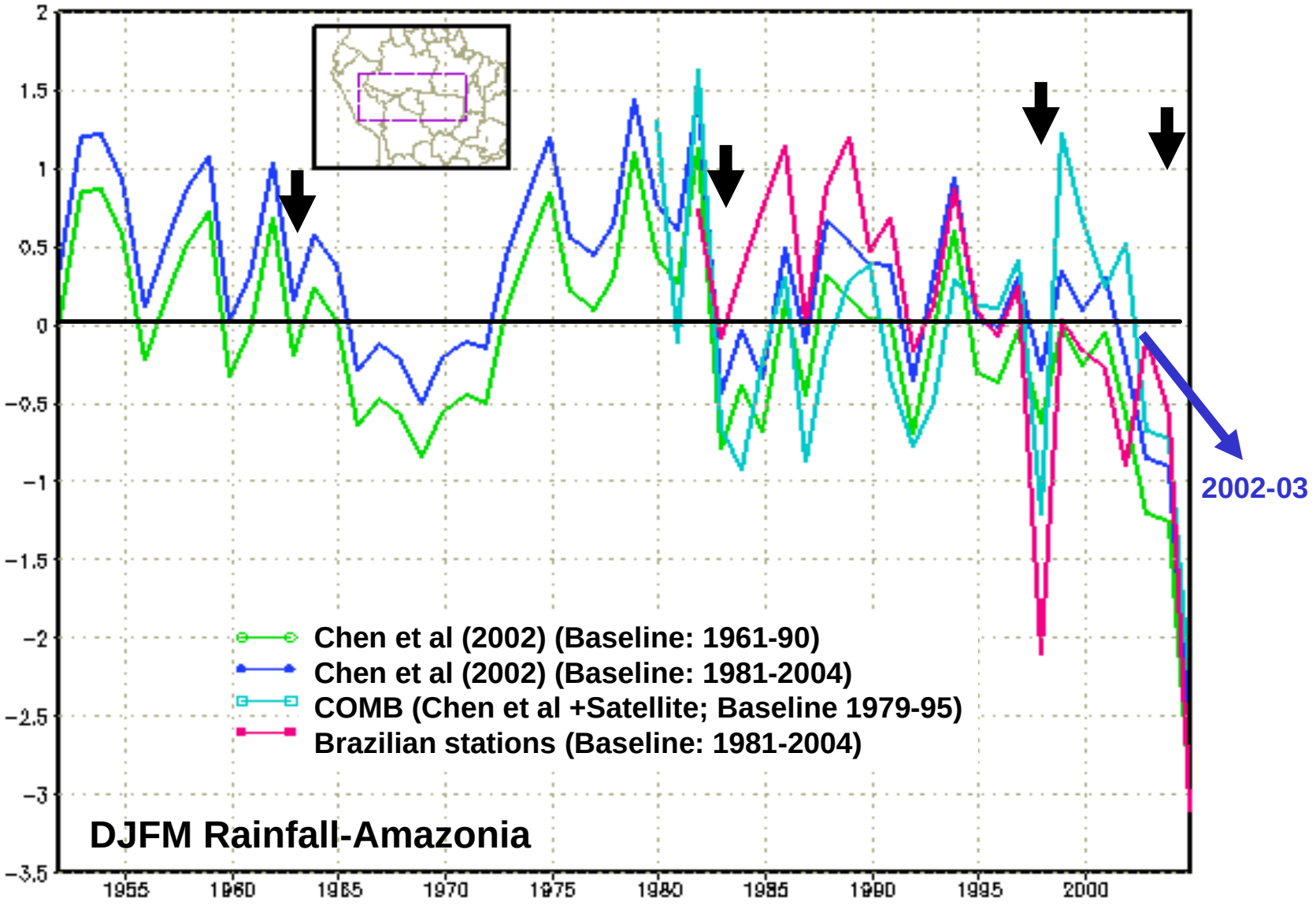
7443
216
1780
144
1830
167
1344


2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
−3
−3.5
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Chen et al (2002) (Baseline: 1961-90)
Chen et al (2002) (Baseline: 1981-2004)
COMB (Chen et al +Satellite; Baseline 1979-95)
Brazilian stations (Baseline: 1981-2004)
FMAM Rainfall-Amazonia


2
1.5
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−3
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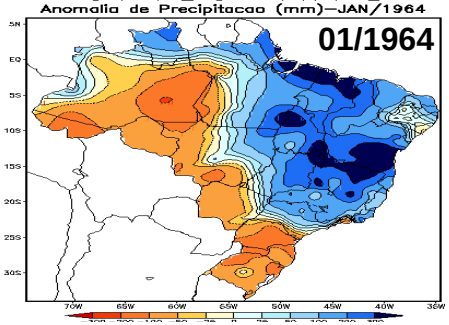
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2002-03
Chen et al (2002) (Baseline: 1961-90)
Chen et al (2002) (Baseline: 1981-2004)
COMB (Chen et al +Satellite; Baseline 1979-95)
Brazilian stations (Baseline: 1981-2004)
DJFM Rainfall-Amazonia

C P T E C — I N P E

Anomalia de Precipitacao (mm)—JAN/1964

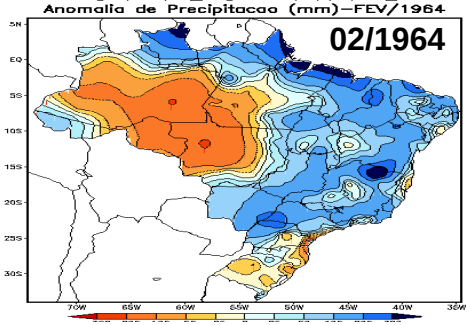
01/1964



C P T E C — I N P E

Anomalia de Precipitacao (mm)—FEV/1964

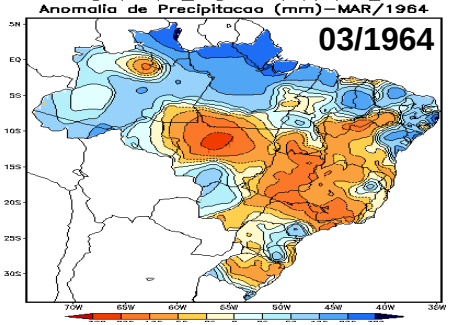
02/1964



C P T E C — I N P E

Anomalia de Precipitacao (mm)—MAR/1964

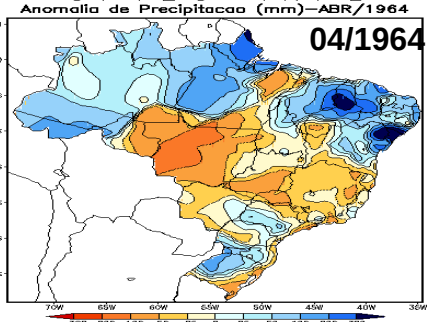
03/1964



C P T E C — I N P E

Anomalia de Precipitacao (mm)—ABR/1964

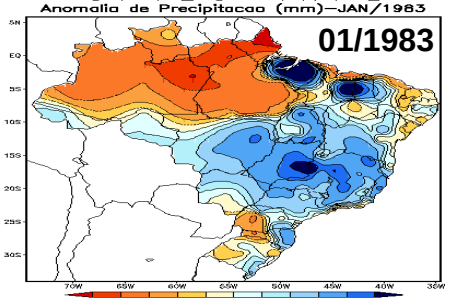
04/1964



C P T E C — I N P E

Anomalia de Precipitacao (mm)—JAN/1983

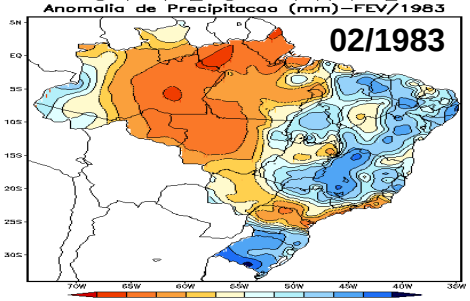
01/1983



C P T E C — I N P E

Anomalia de Precipitacao (mm)—FEV/1983

02/1983



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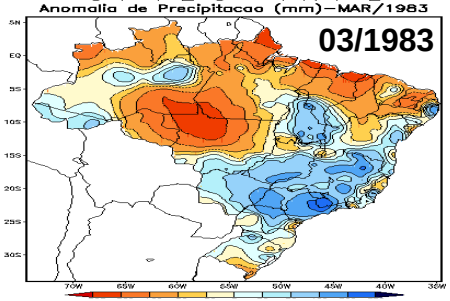
Anomalia de Precipitacao (mm)—MAR/1983

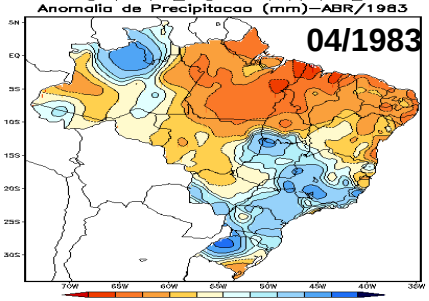
03/1983



C P T E C — I N P E

Anomalia de Precipitacao (mm)—ABR/1983

04/1983

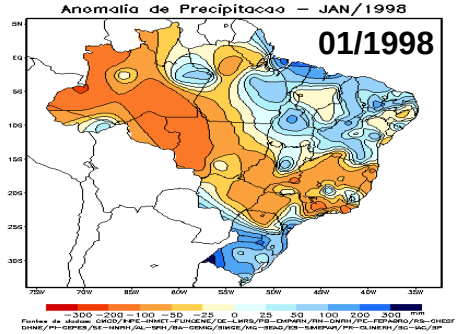


Data da ultima atualizacao: 18/10/2002

C P T E C — I N P E

Anomalia de Precipitacao — JAN/1998

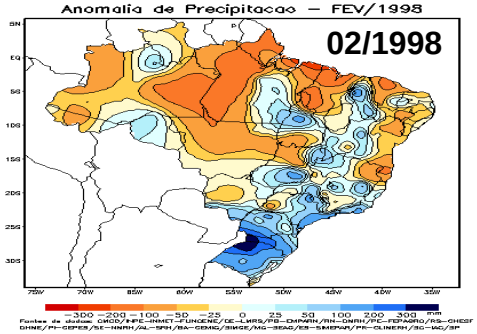
01/1998



C P T E C — I N P E

Anomalia de Precipitacao — FEV/1998

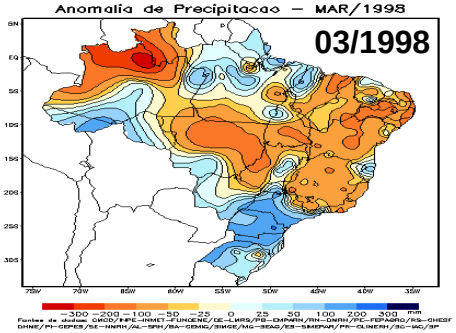
02/1998



C P T E C — I N P E

Anomalia de Precipitacao — MAR/1998

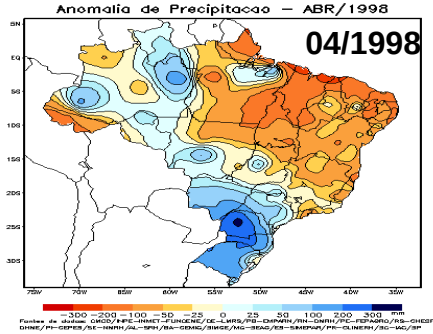
03/1998



C P T E C — I N P E

Anomalia de Precipitacao — ABR/1998

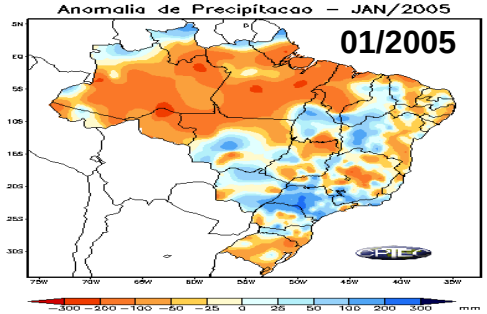
04/1998



Data da ultima atualizacao: 02/03/2005

Anomalia de Precipitacao — JAN/2005

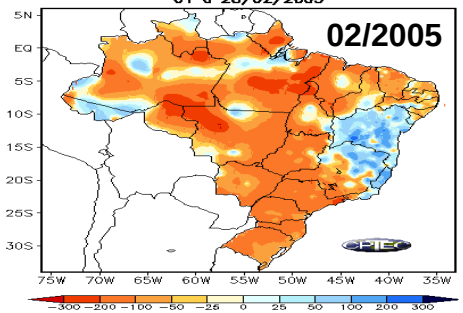
01/2005



Anomalia de Precipitacao em Fevereiro (mm)

01 a 28/02/2005

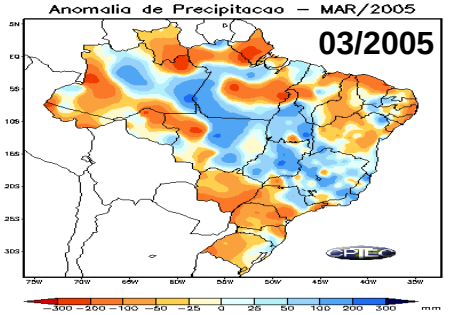
02/2005



Data da ultima atualizacao: 05/04/2005

Anomalia de Precipitacao — MAR/2005

03/2005



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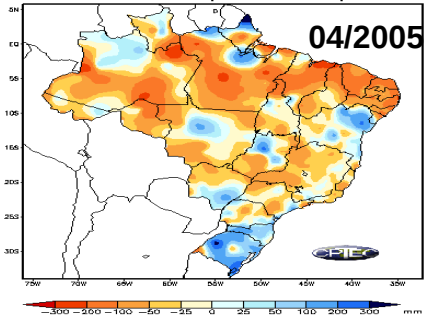
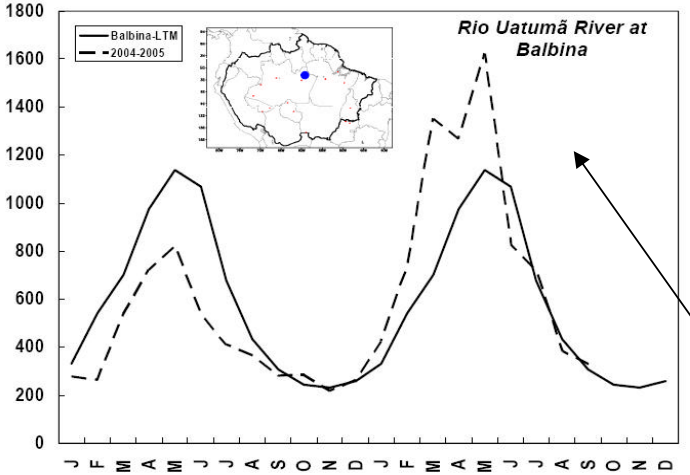
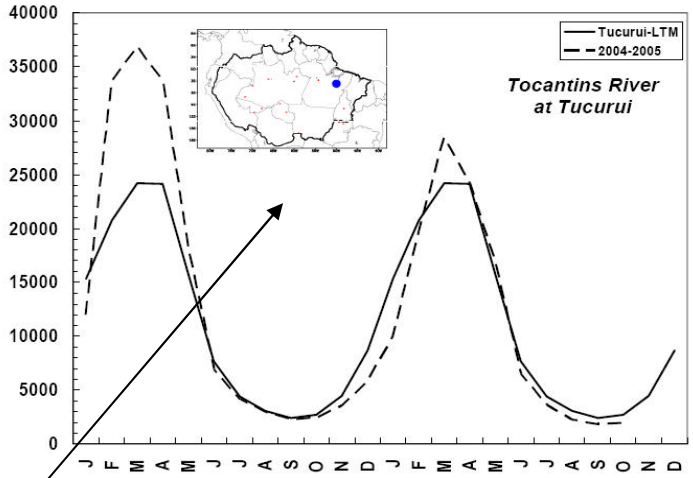
Anomalia de Precipitacao — ABR/2005

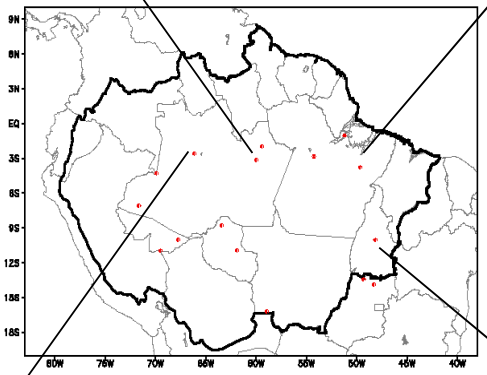
04/2005

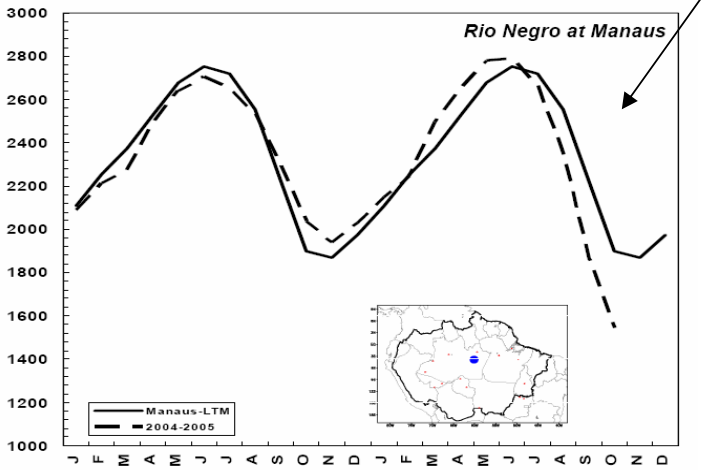


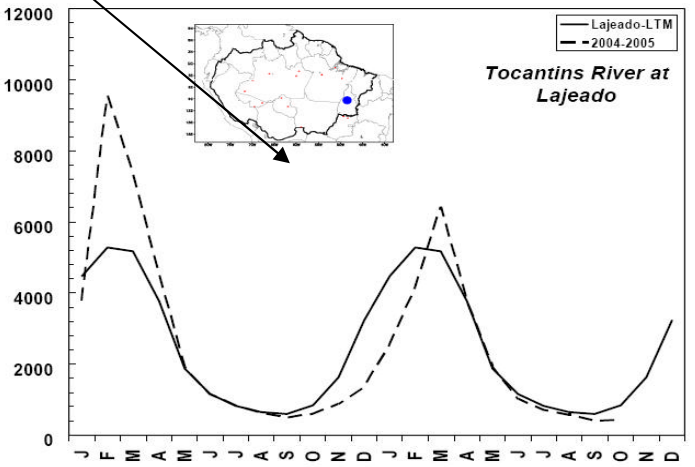
Northern-Eastern Amazonia



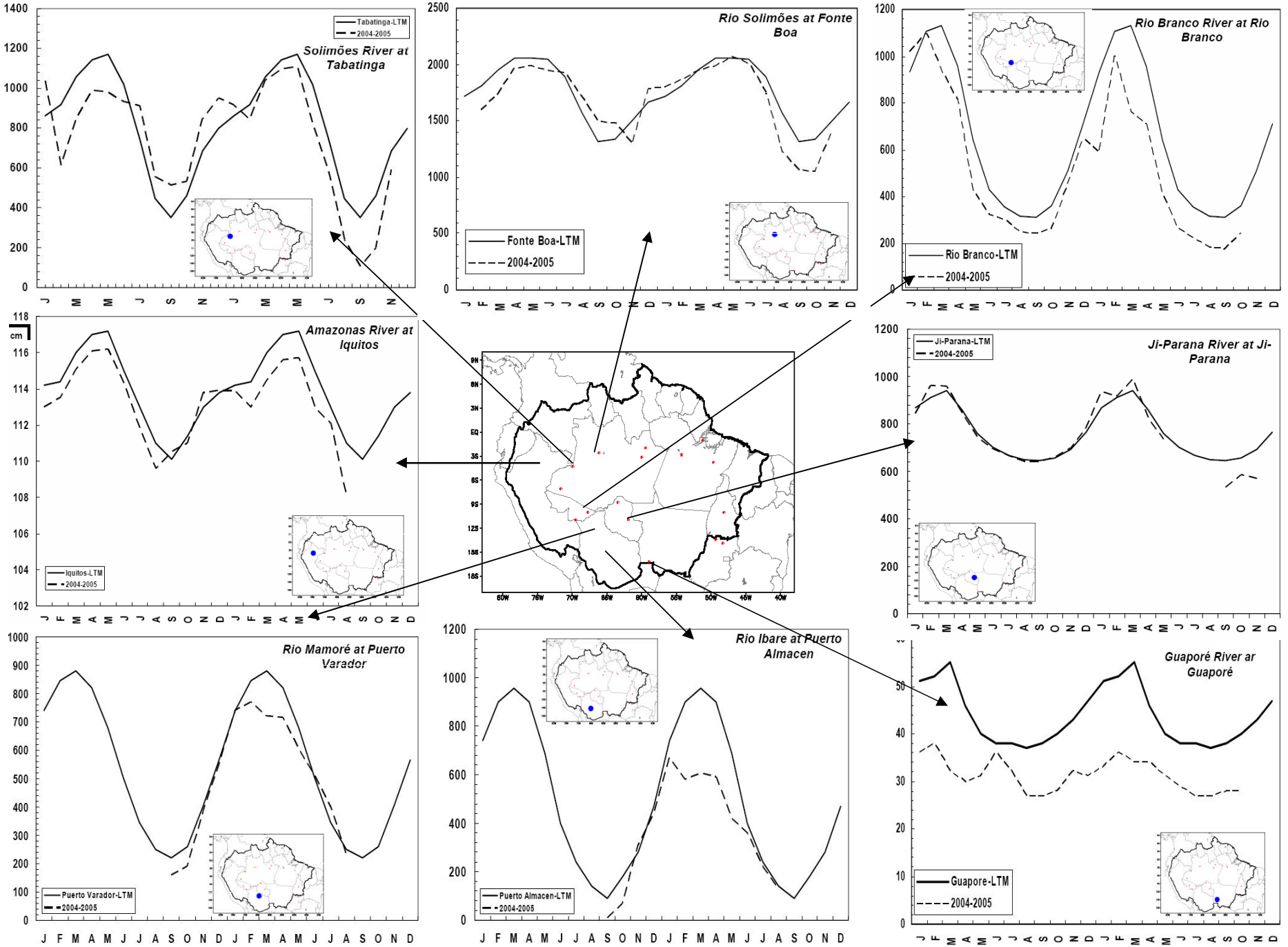




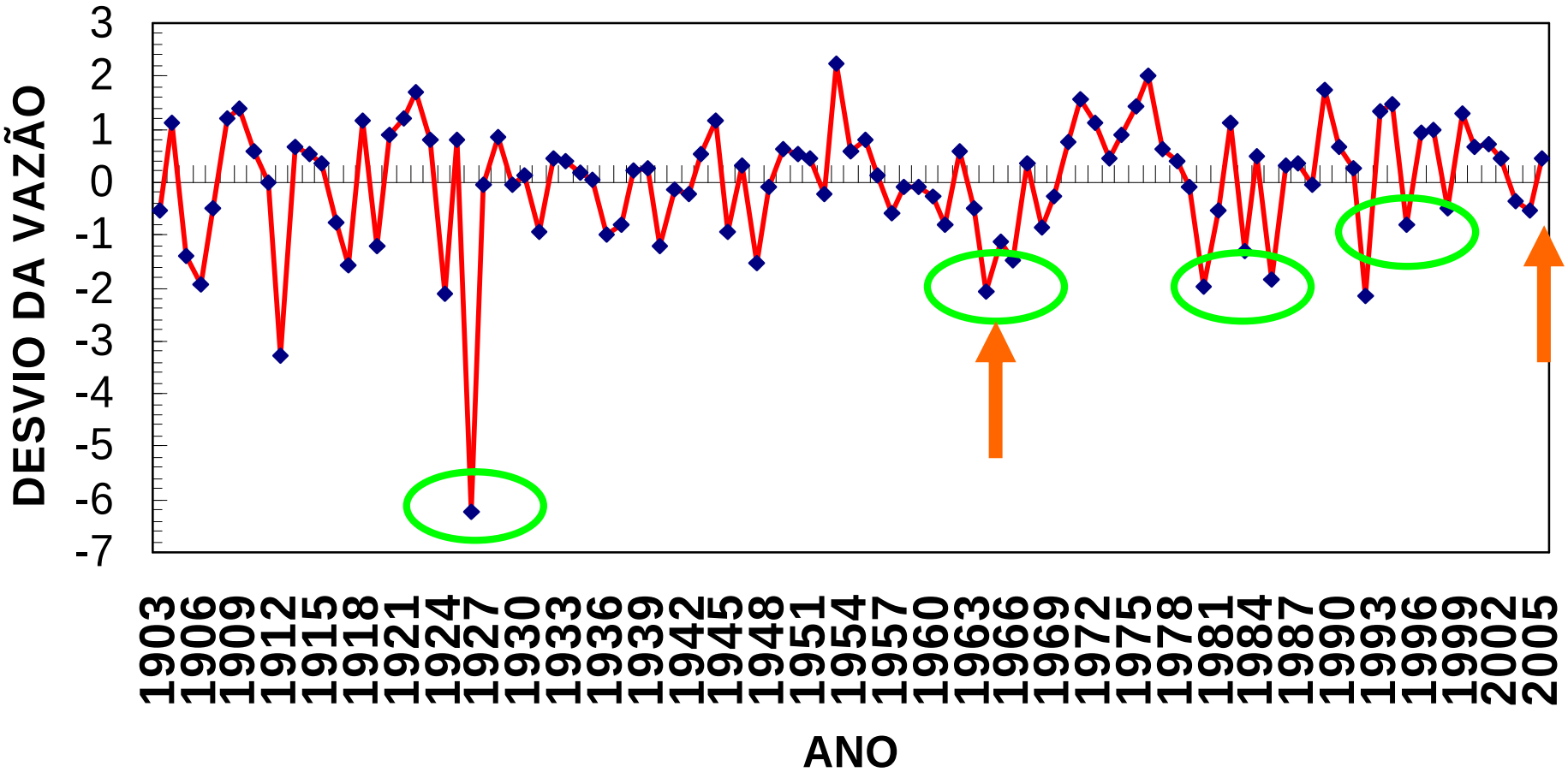


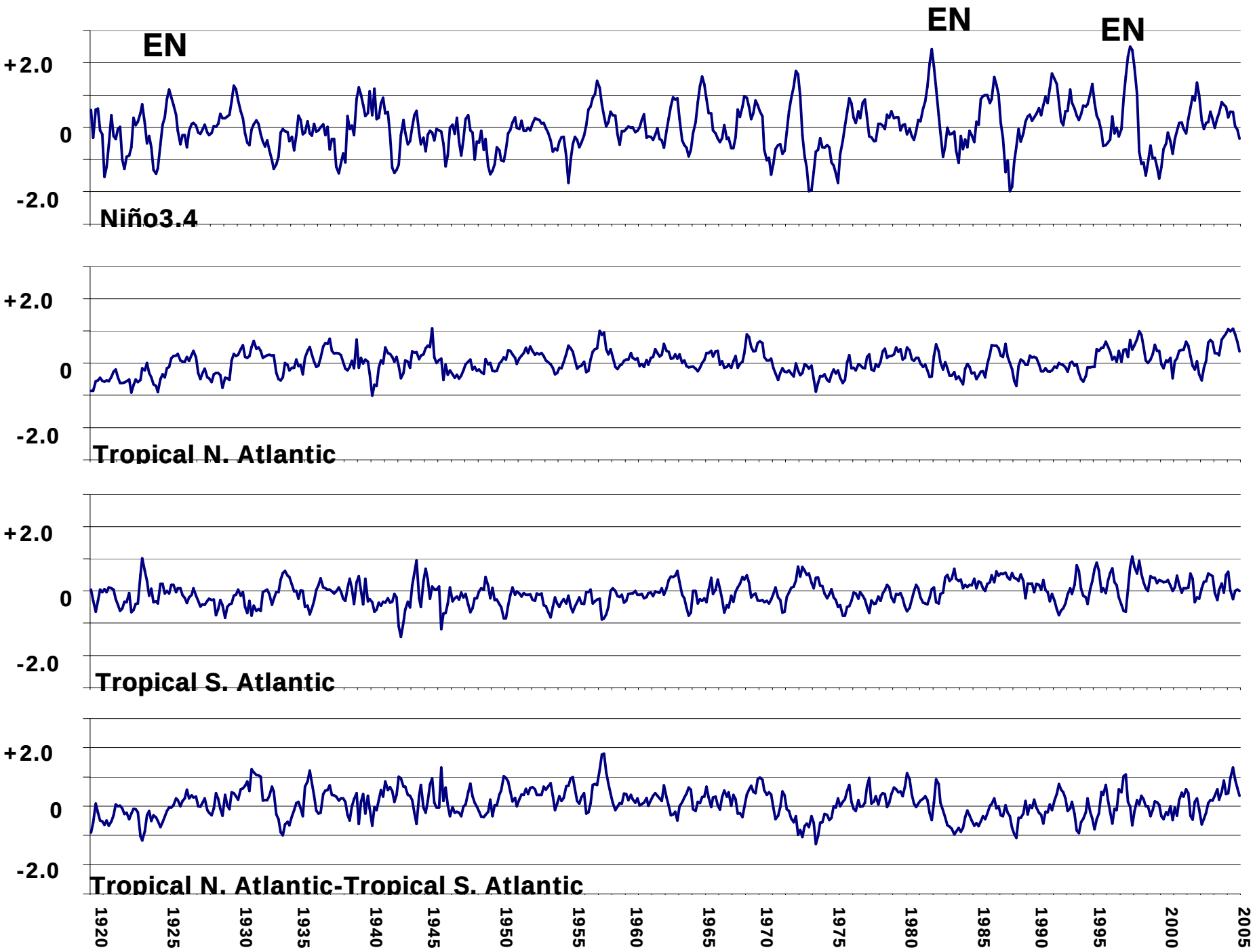


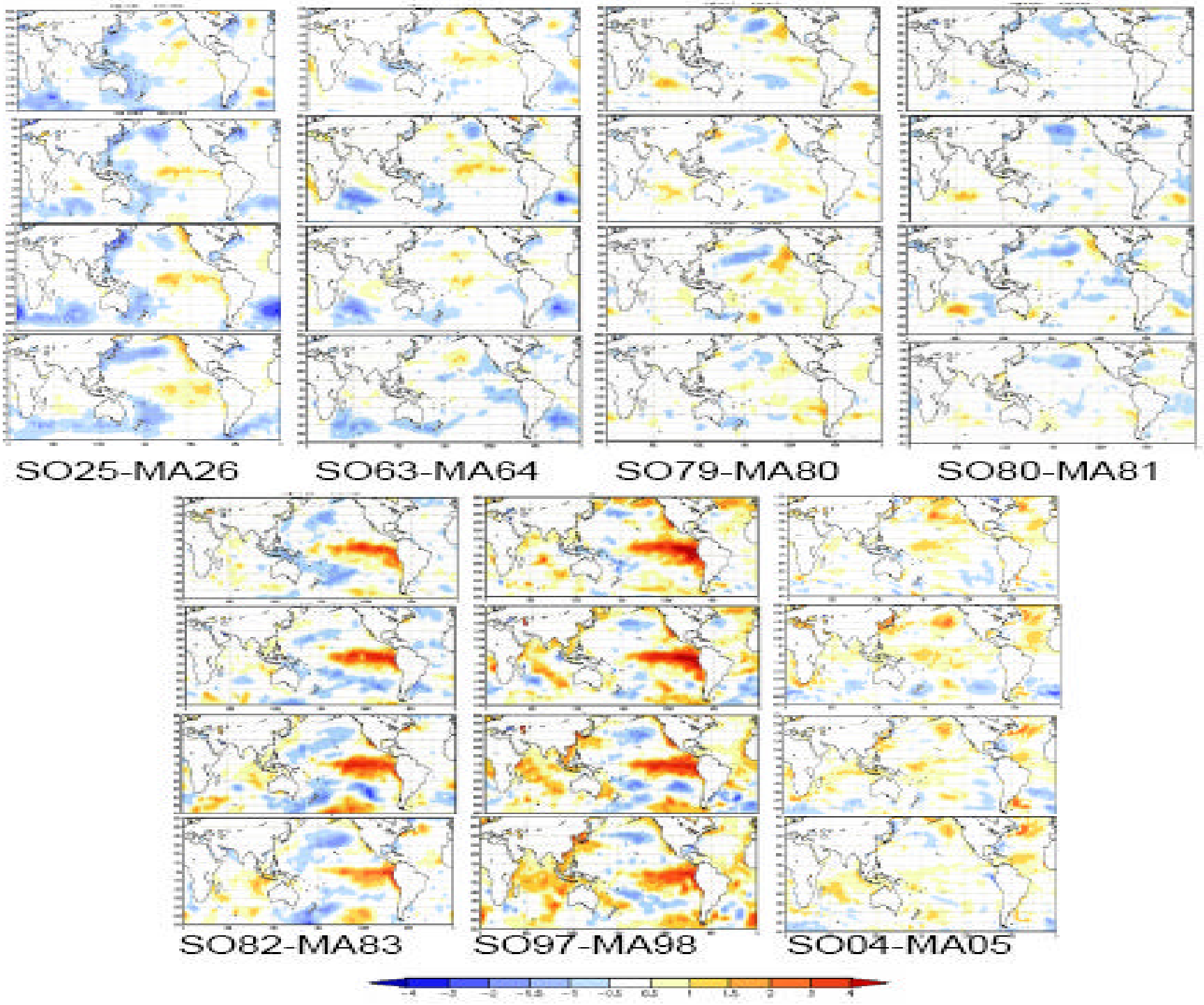
Southern-Western Amazonia

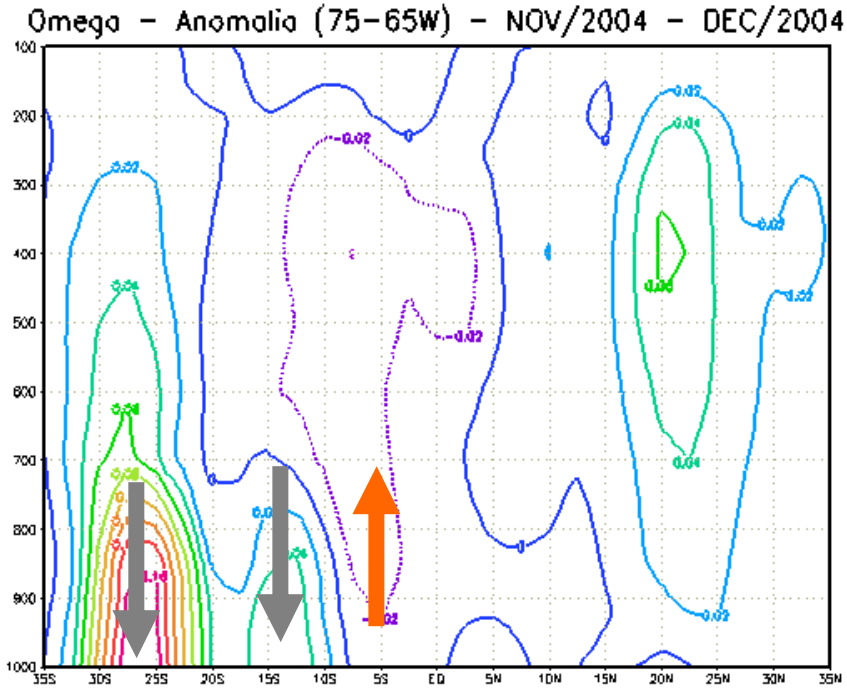


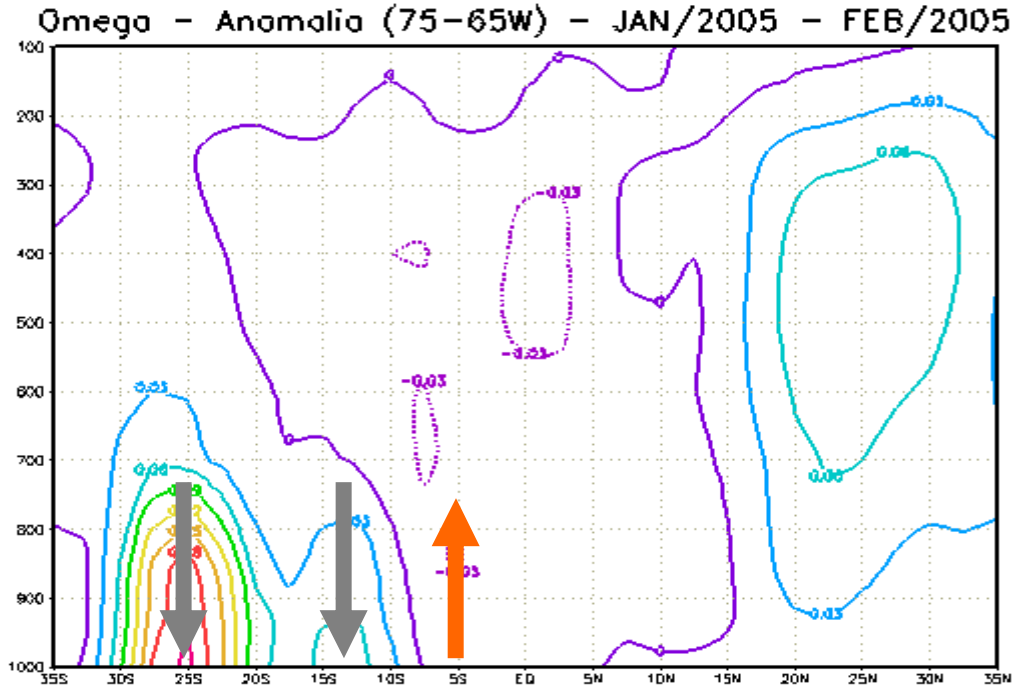
COTAS DO RIO NEGRO EM MANAUS AMJJ 1903 · 2005



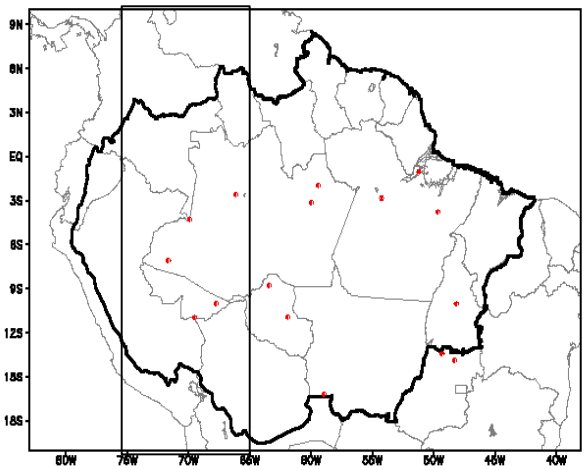

EN
EN
EN
+2.0
0
-2.0
Niño3.4
+2.0
0
-2.0
Tropical N. Atlantic
+2.0
0
-2.0
Tropical S. Atlantic
+2.0
0
-2.0
Tropical N. Atlantic-Tropical S. Atlantic
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

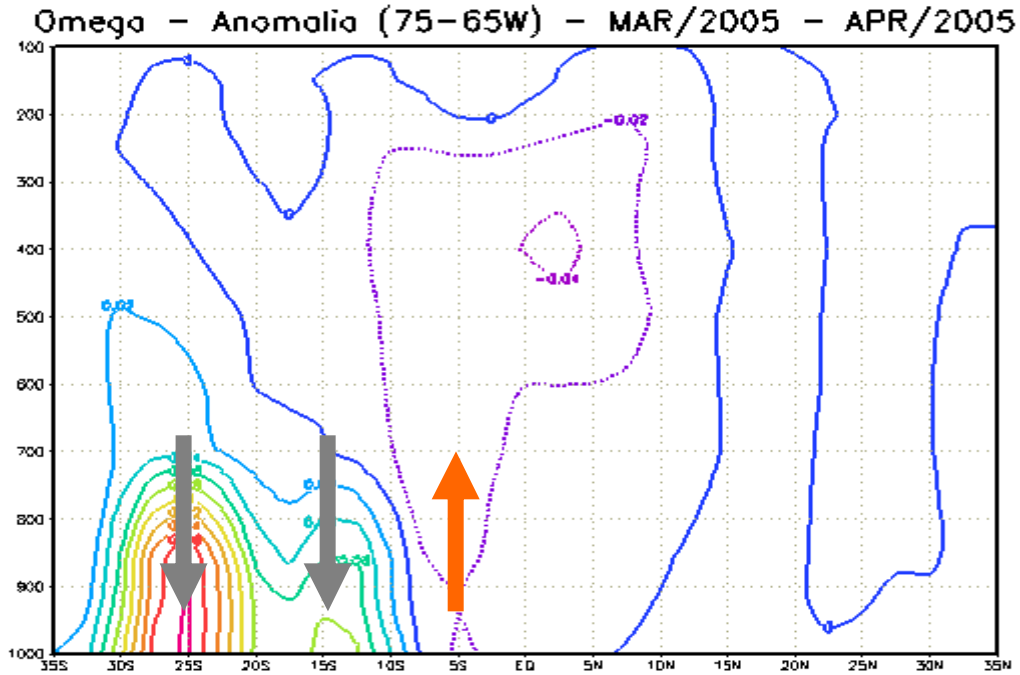

SO25-MA26
SO63-MA64
SO79-MA80
SO80-MA81
SO82-MA83
SO97-MA98
SO04-MA05

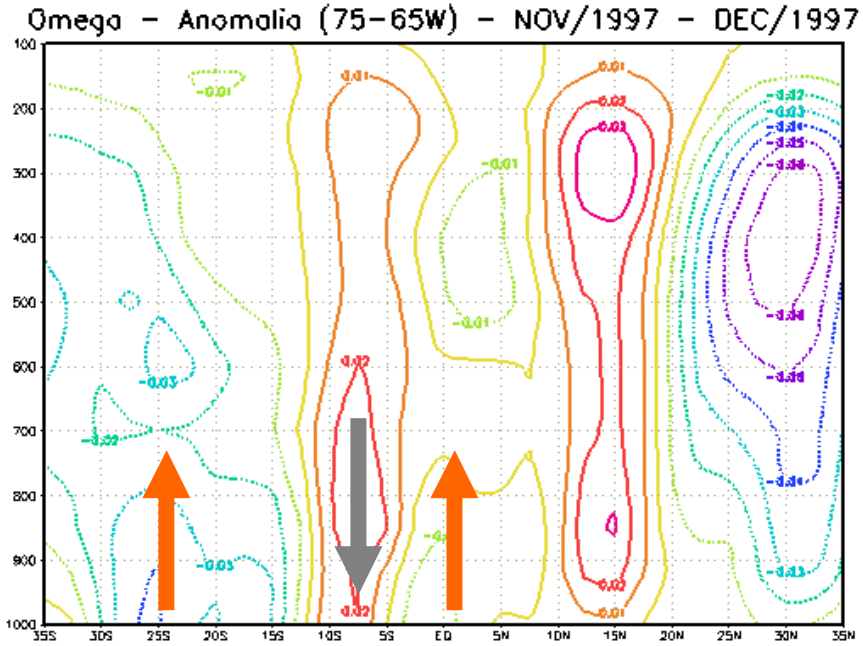


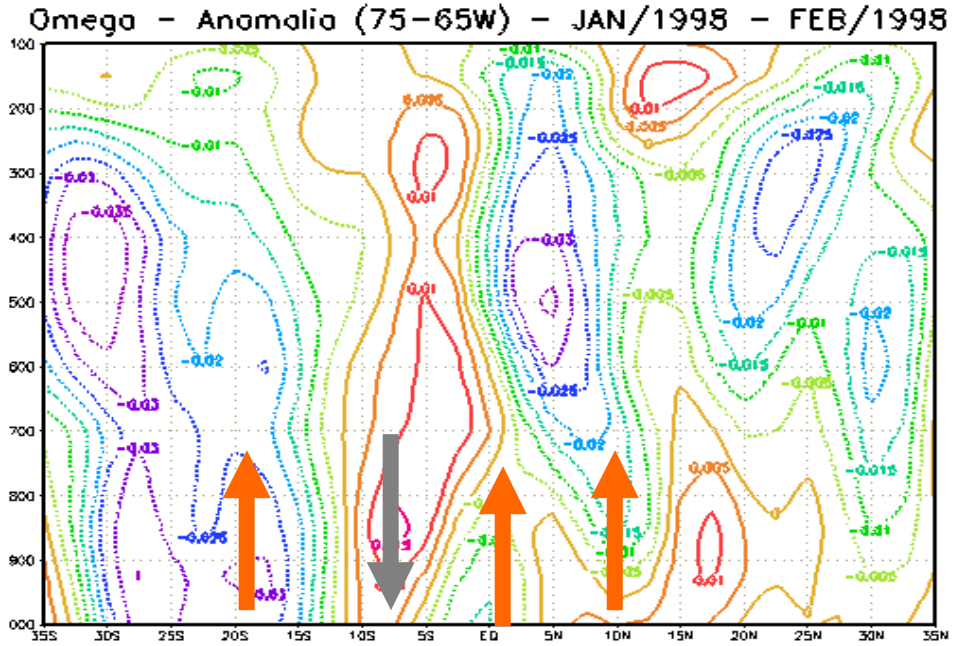


Drought of 2005

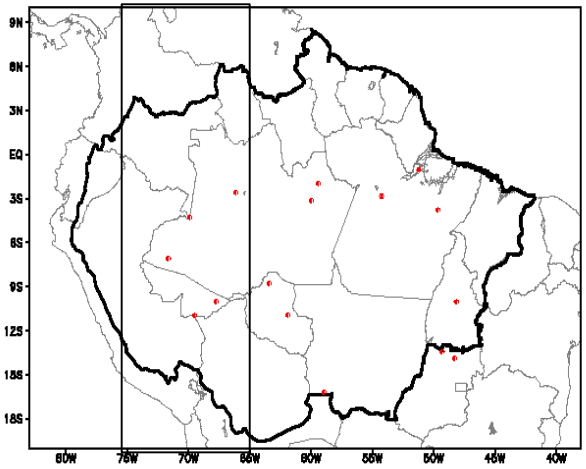


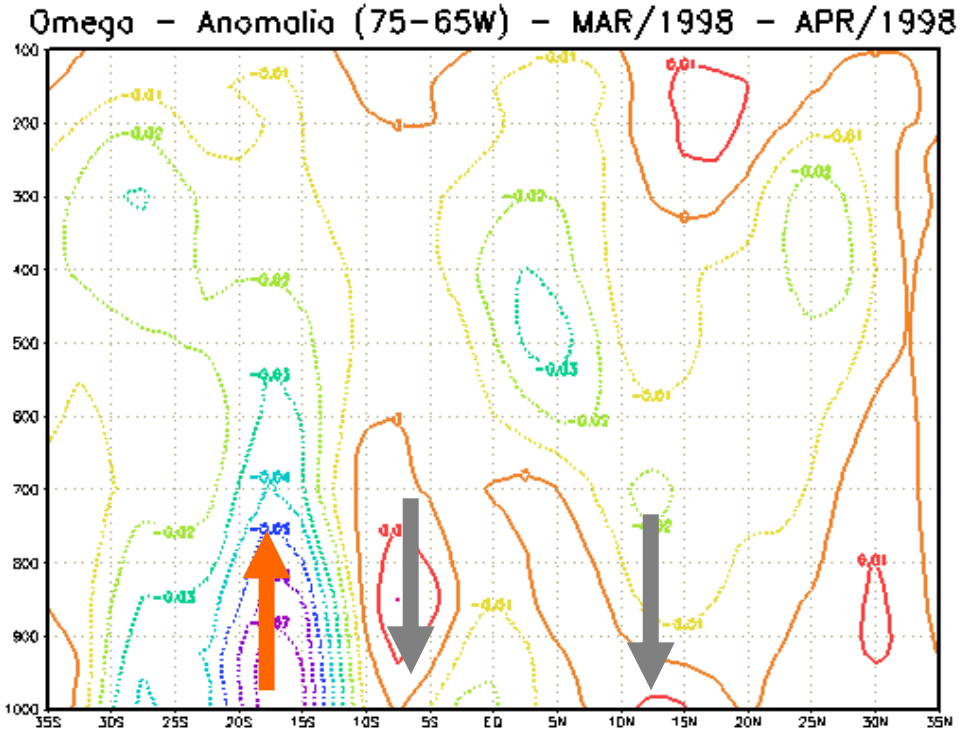






Drought of 1998

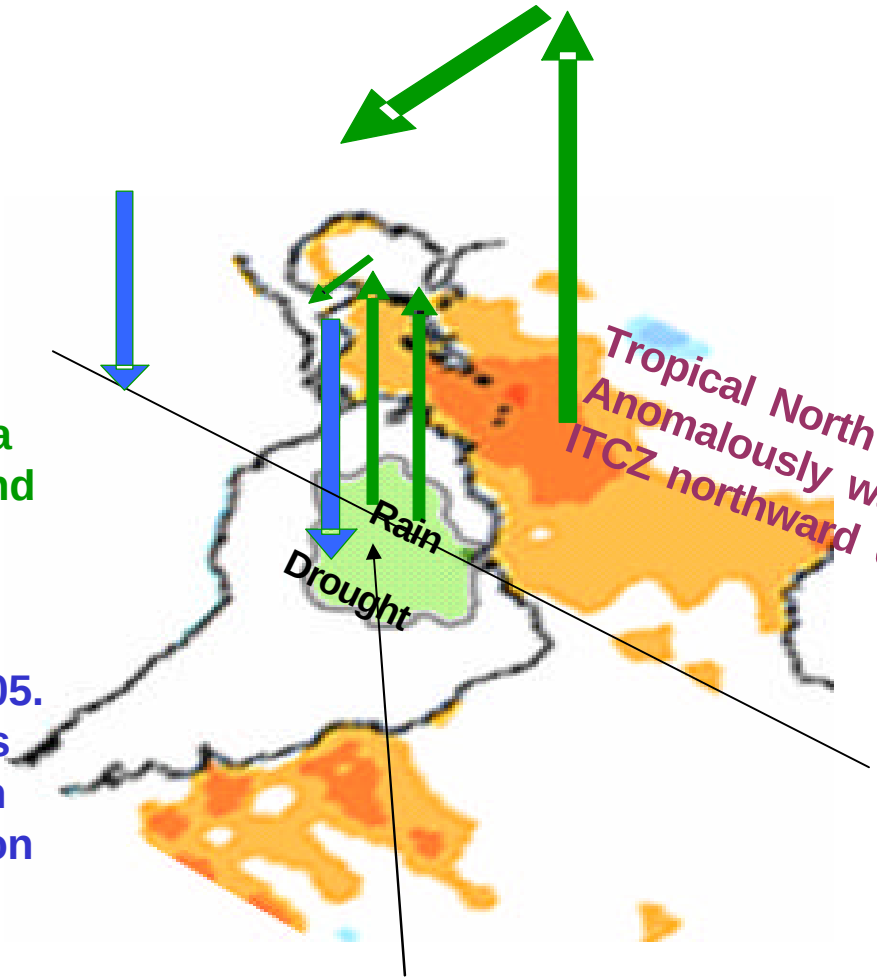




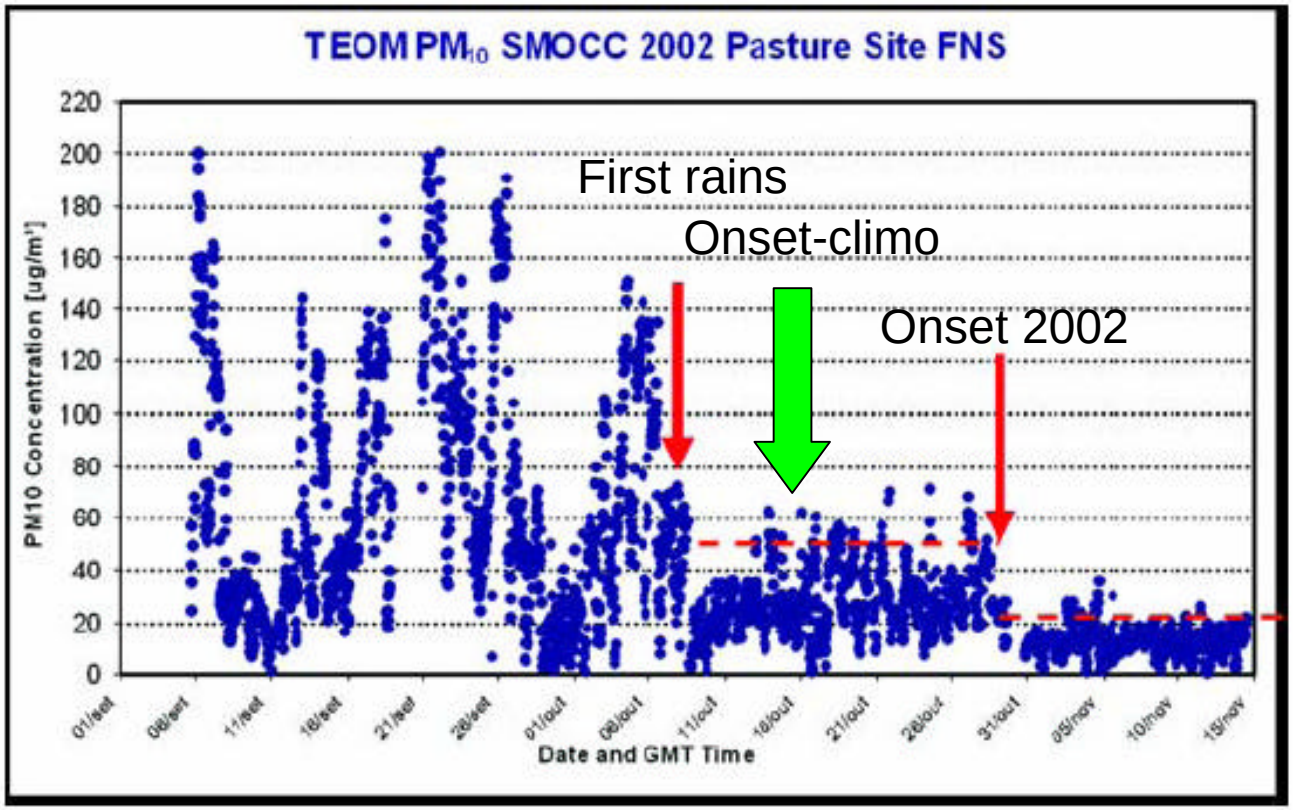
Circulation anomalies→Drought of 2005

Amazonia:
Downward motion in Southwestern Amazonia (less rainfall) over the Headwaters of major Amazonian Rivers :
Consequence: Low river levels in central Amazonia
Some rainfall in central and Eastern Amazonia

Not all Amazonia was affected by drought in 2005. (El Niño induced droughts affect central and eastern Amazonia also)→ 2005 Non El Niño year



Land surface processes?.
Role of smoke and aerosols in delaying onset of rainy season?



Evolution of the concentration of aerosols with a diameter less than 10 μm (PM10) measured in central Rondônia in a pasture site during September to November 2002. The ***arrows indicate the first significant rainfall on October 7 and the onset of regular rainfall in the beginning of November.*** *Data from LBA/Smoke, Aerosols, Clouds, Rainfall and Climate (SMOCC) [Silva Dias et al. 2004]*

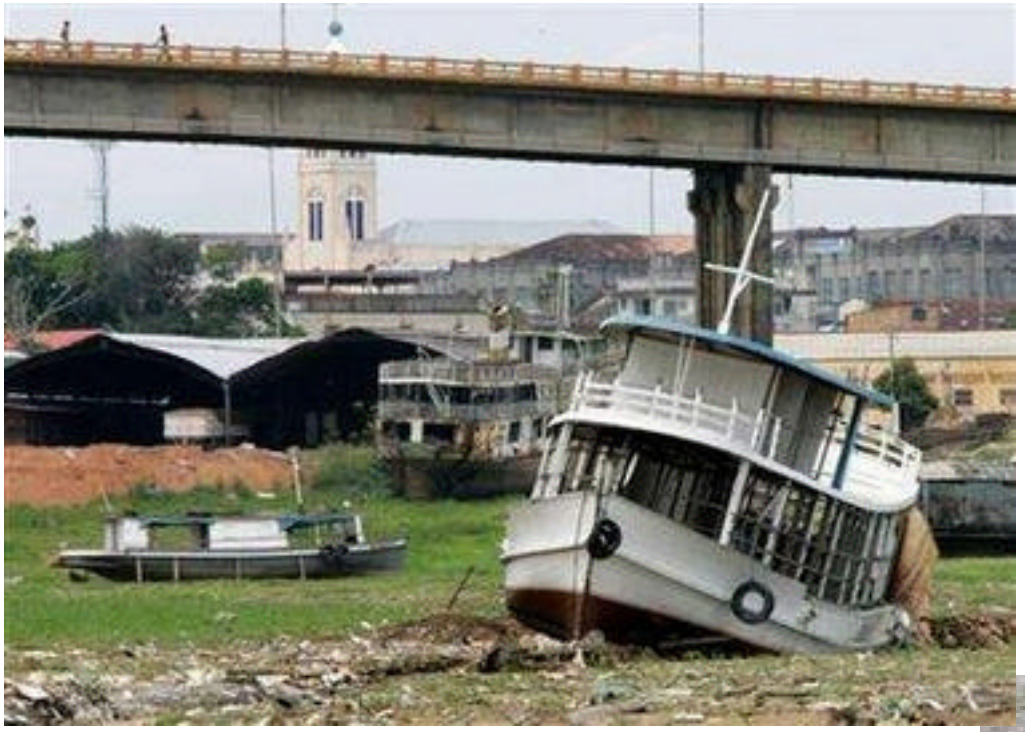
Regular onset of the rainy season in 2002 was ***delayed*** *as compared to climatology*

(pentads 56-57- Middle of October).

What was the situation in 2004-2005?

Facts:

-Drought in Amazonia in 2005 was characterized more based on the impacts in river streamflow/leves than on rainfall variability→different from El Niño induced droughts (1926, 1983, 1998)
-Ecological, economical impacts of drought in Amazonia ($$$)
-Forest become more vulnerable to drought
-Rainfall was lower than normal over the upper basins of the Amazon rivers in western Amazonia, and not over central and eastern Amazonia
-Causes of the drought were mostly related to abnormal warm surface waters in the tropical North Atlantic, generating strong subsidence over southwestern Amazonia. This may be due to decadal variabilty of the tropical Atlantic (similar to 1964?)→warming signal in the tropical Atlantic?
-Possible effects of changes in land use due to deforestation, fires, smoke and increase release in aerosols→effects of aerosol comncentration in onset and quality of the rainy season?.



Rio Branco, September 25 2005

Rio Branco, February 20 2006