



Ciclo de Debates 2010

“Repensando o desenvolvimento frente ao encontro de Copenhague”

Mudanças Climáticas e a tendência de aquecimento

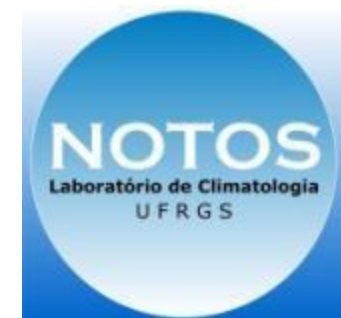
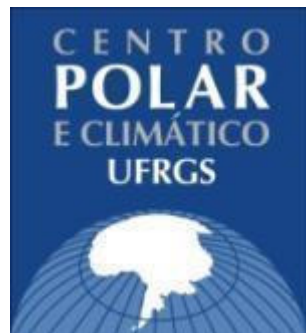
Prof. Francisco Eliseu Aquino

UFRGS

Departamento de Geografia

Instituto de Geociências

Email: francisco.aquino@ufrgs.br



www.ufrgs.br/antartica

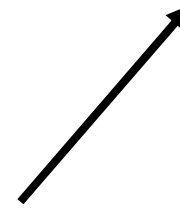
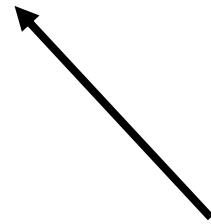


tempo cronológico

(série de 30 anos - OMM)

tempo meteorológico

ou atmosférico

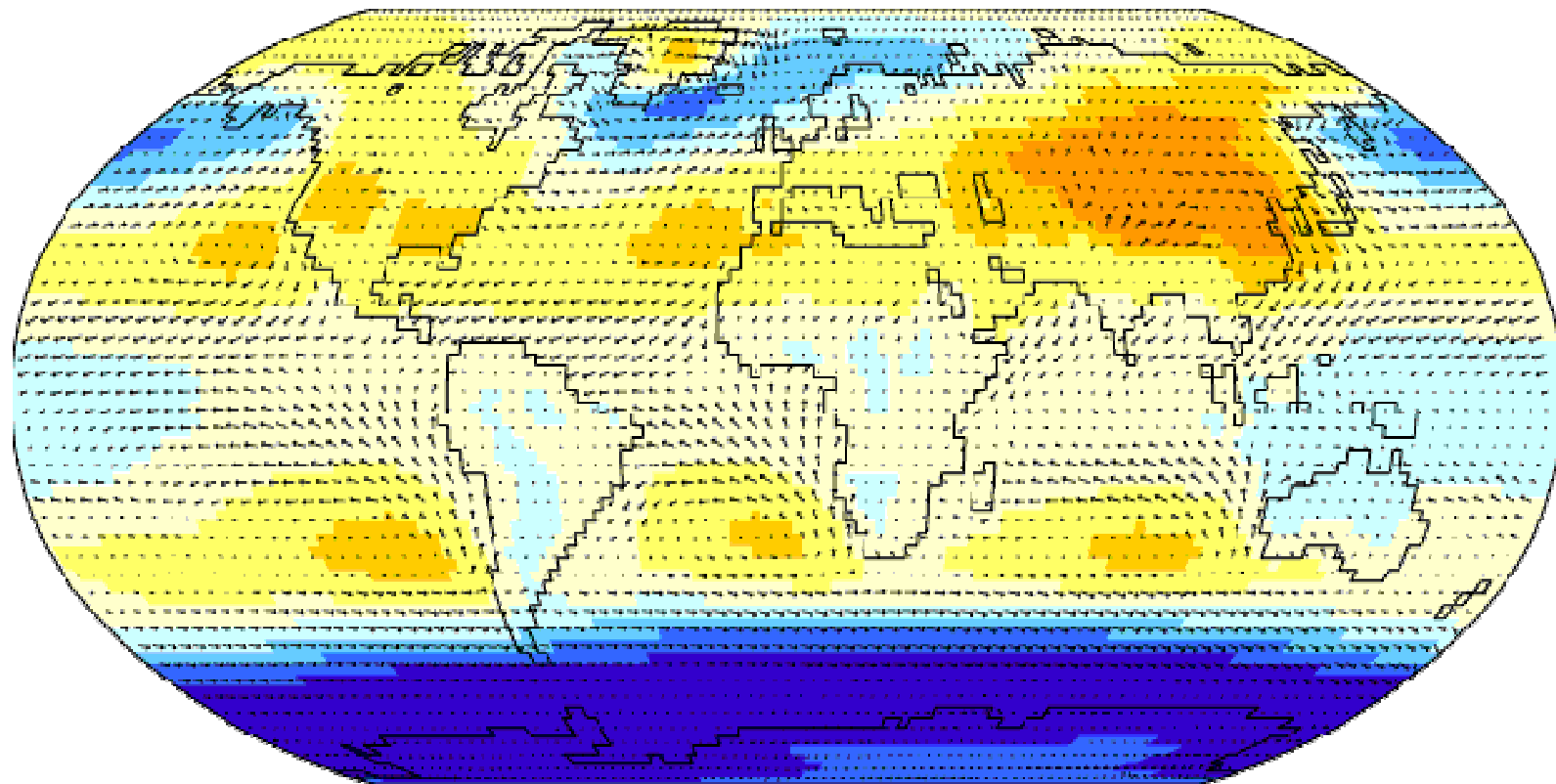


CLIMA ⇔ **TEMPO**

O clima pode ser definido como uma síntese do tempo meteorológico em um intervalo de tempo, que possibilite a sua descrição estatística de médio e longo prazo. Variações climáticas são também o resultado de interações não lineares muito complexas que ocorrem em diversos modos e escalas, fazendo com que o clima seja caracterizado por uma alta dimensionalidade (Barry e Carleton, 2001).

O ciclo mensal dos ventos (superfície)

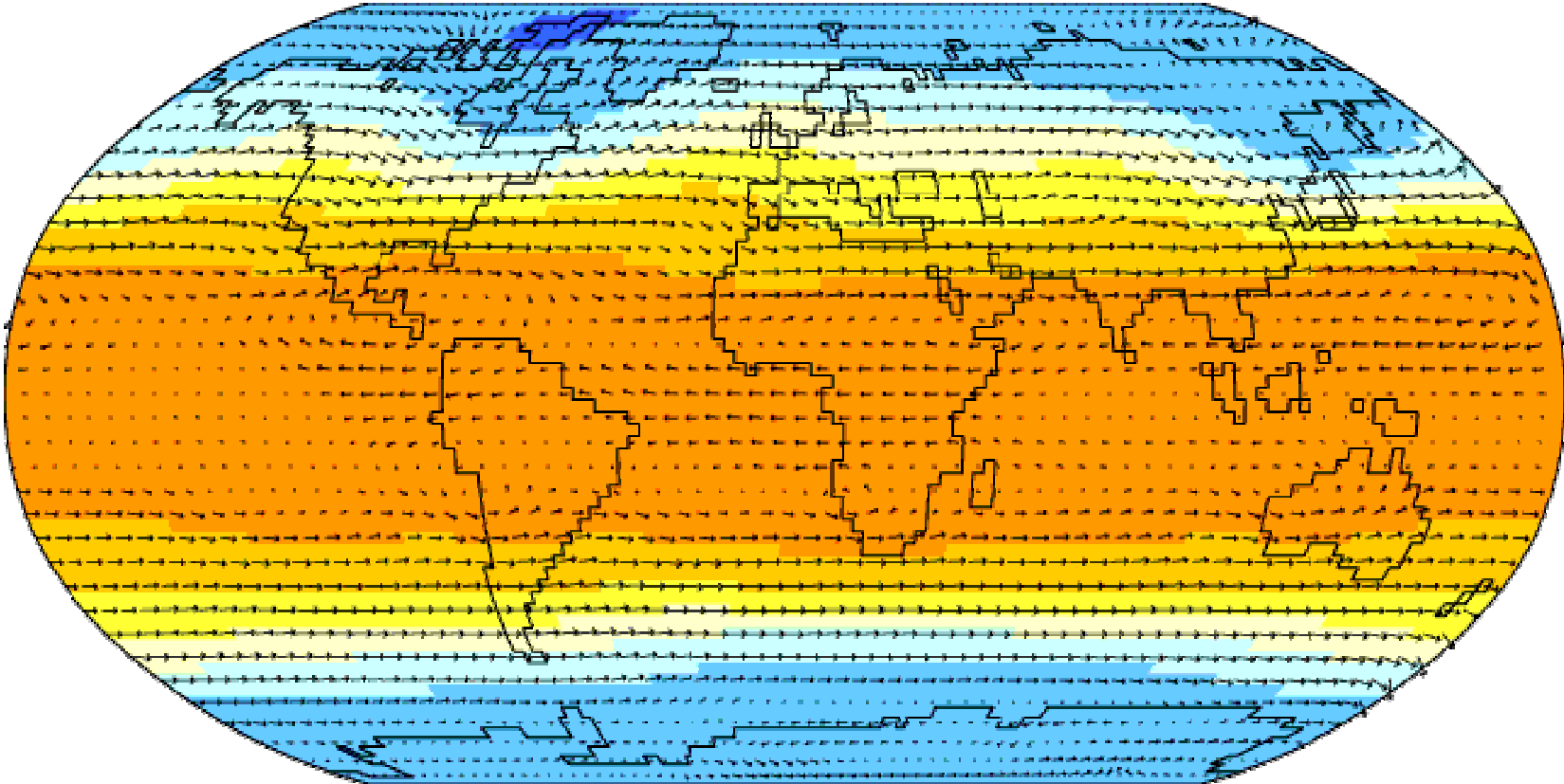
Dec



Data: NCEP/NCAR Reanalysis Project, 1959-1997 Climatologies
Animation: Department of Geography, University of Oregon, March 2000

O ciclo anual dos ventos (5000 m de altitude)

Dec



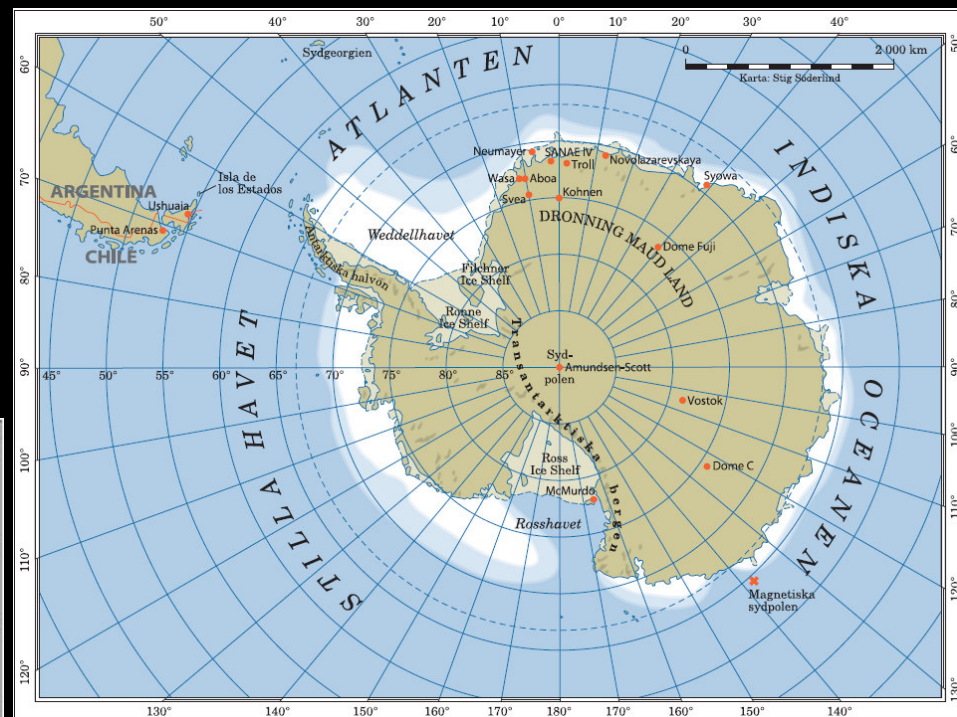
Data: NCEP/NCAR Reanalysis Project, 1959-1997 Climatologies
Animation: Department of Geography, University of Oregon, March 2000

Geografia das Regiões Polares

Ártico:
delimitado pela linha de árvore
(limite Tundra/Taiga)

- Mais de 12 etnias
(Inuits, Yakuts, Nenets, Lapões)

Ártico



Antártica

Continente = 13,6 milhões km²

Volume = 25,0 milhões km³

90% do gelo da Terra

68% água potável

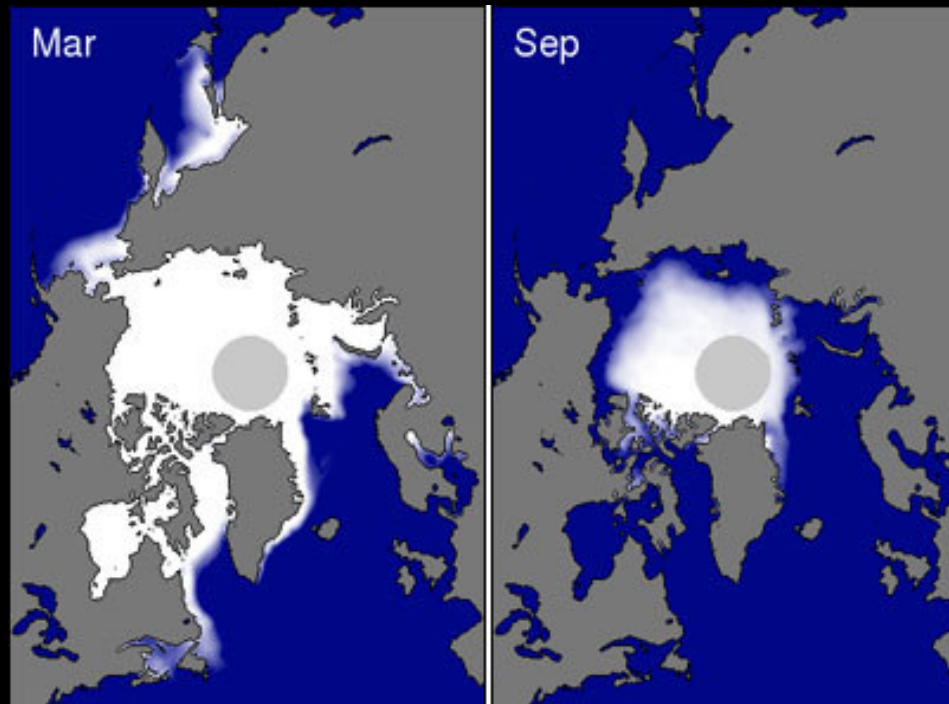
Espessura média de 2.040 m

Espessura máxima de 4.776 m

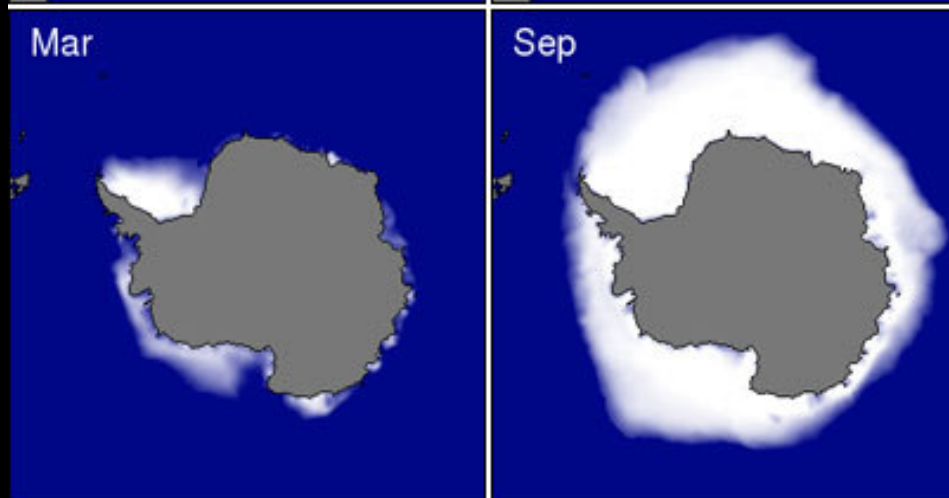
Geografia das Regiões Polares

Gelo marinho:

Ártico

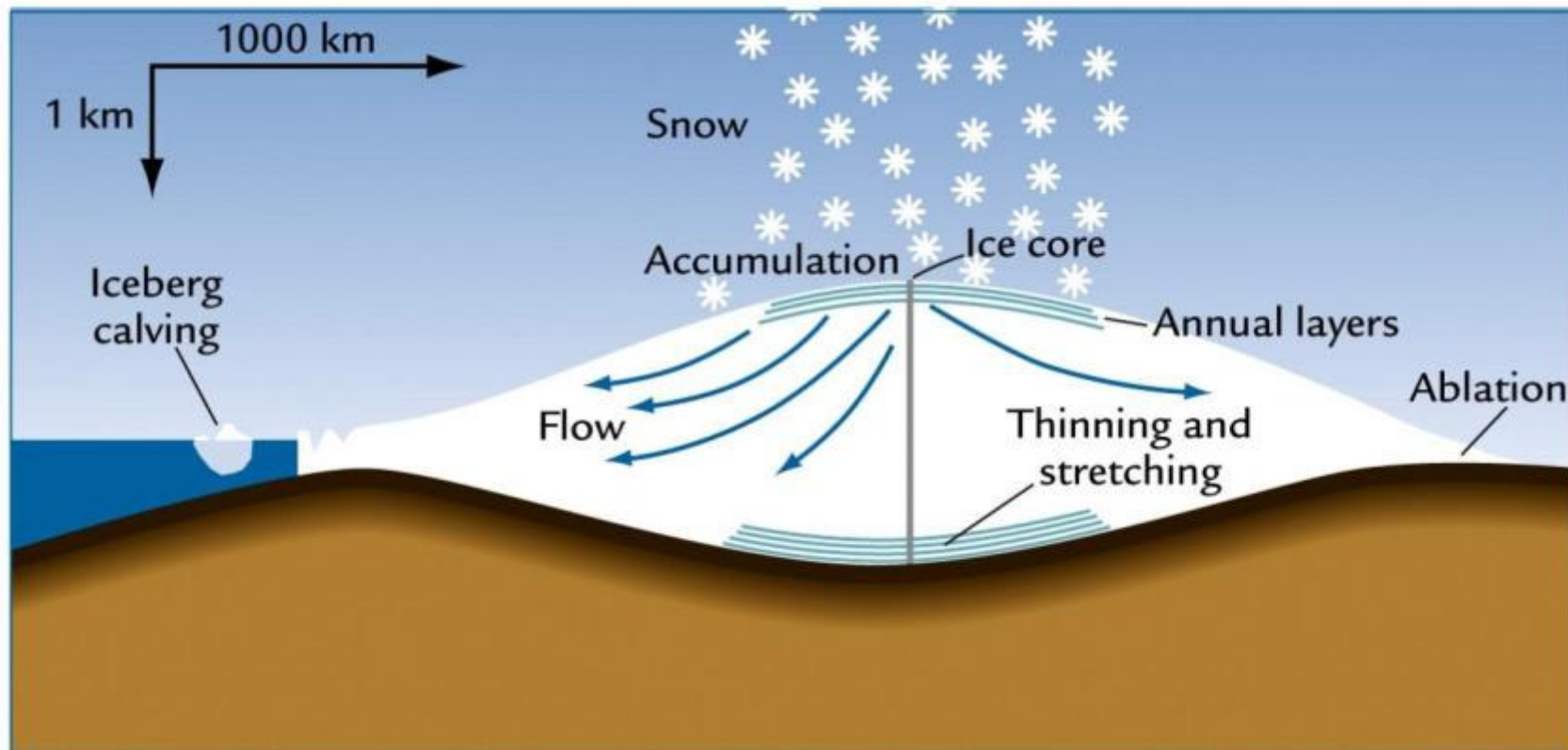


Antártica

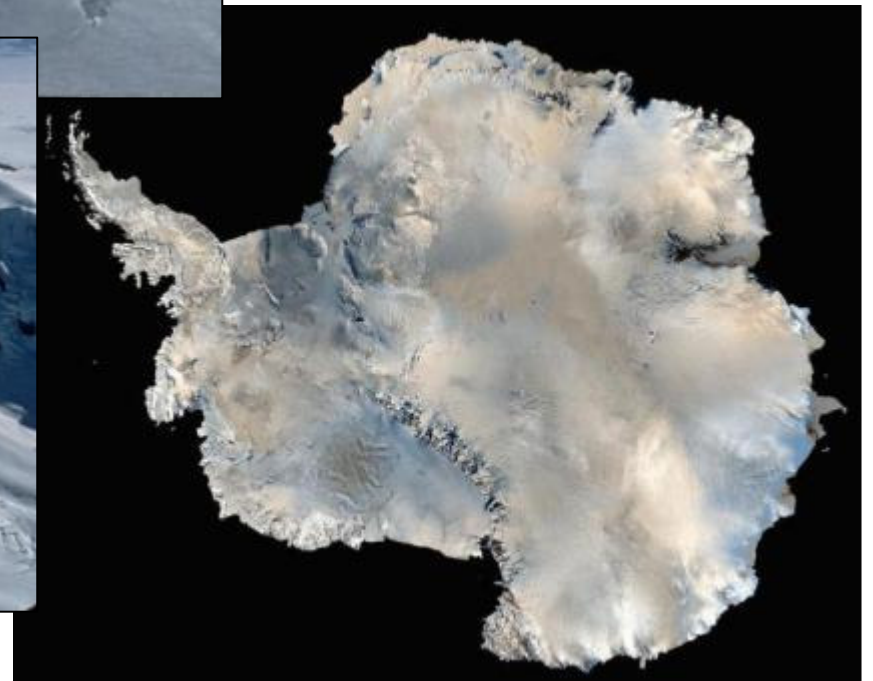


Fonte: NSIDC

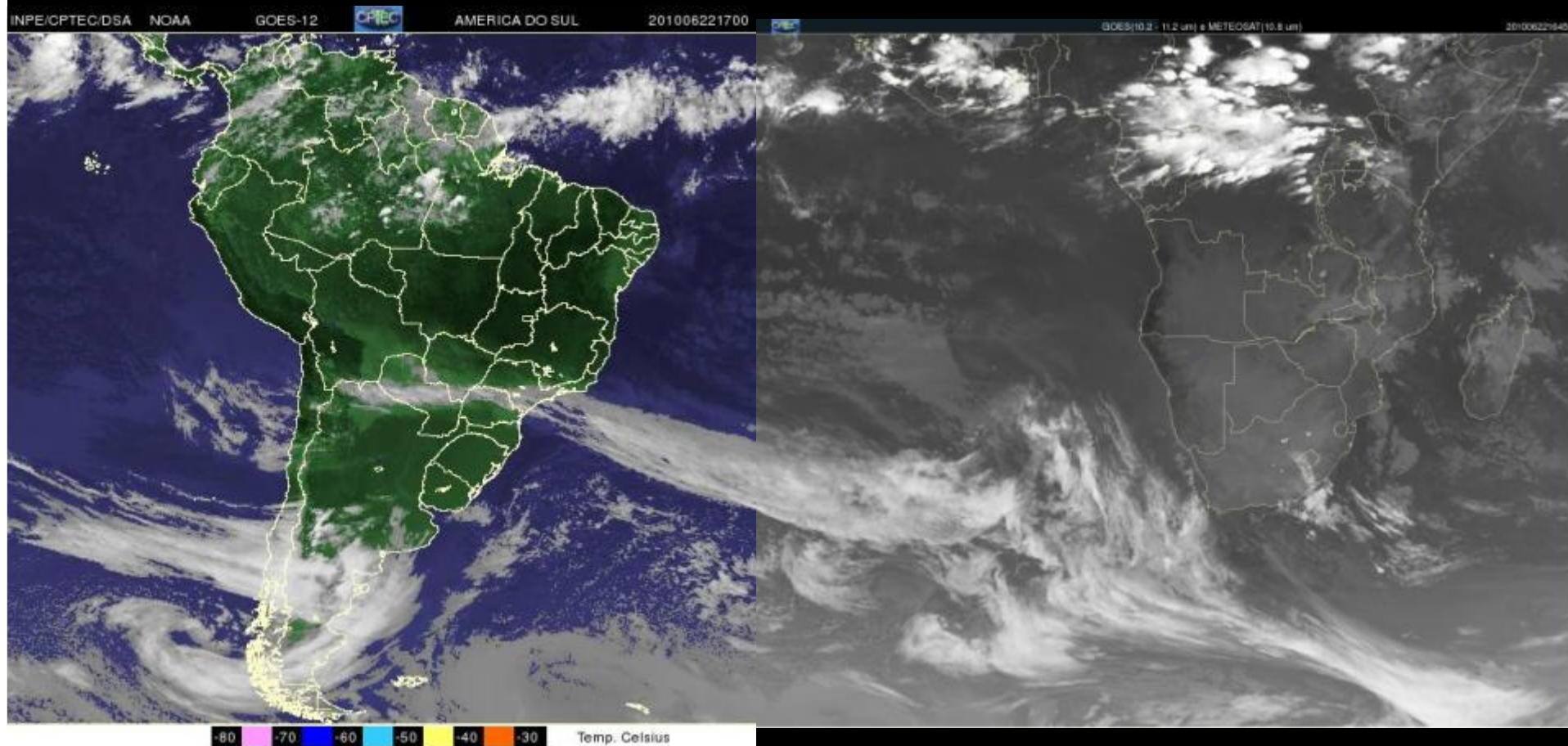
História do Clima é preservada nos mantos de gelo (ice caps)



Fonte: Anna Jones XXVI ATCM



Mosaico de Imagens do Satélite GOES + MSG em 22/06/2010.



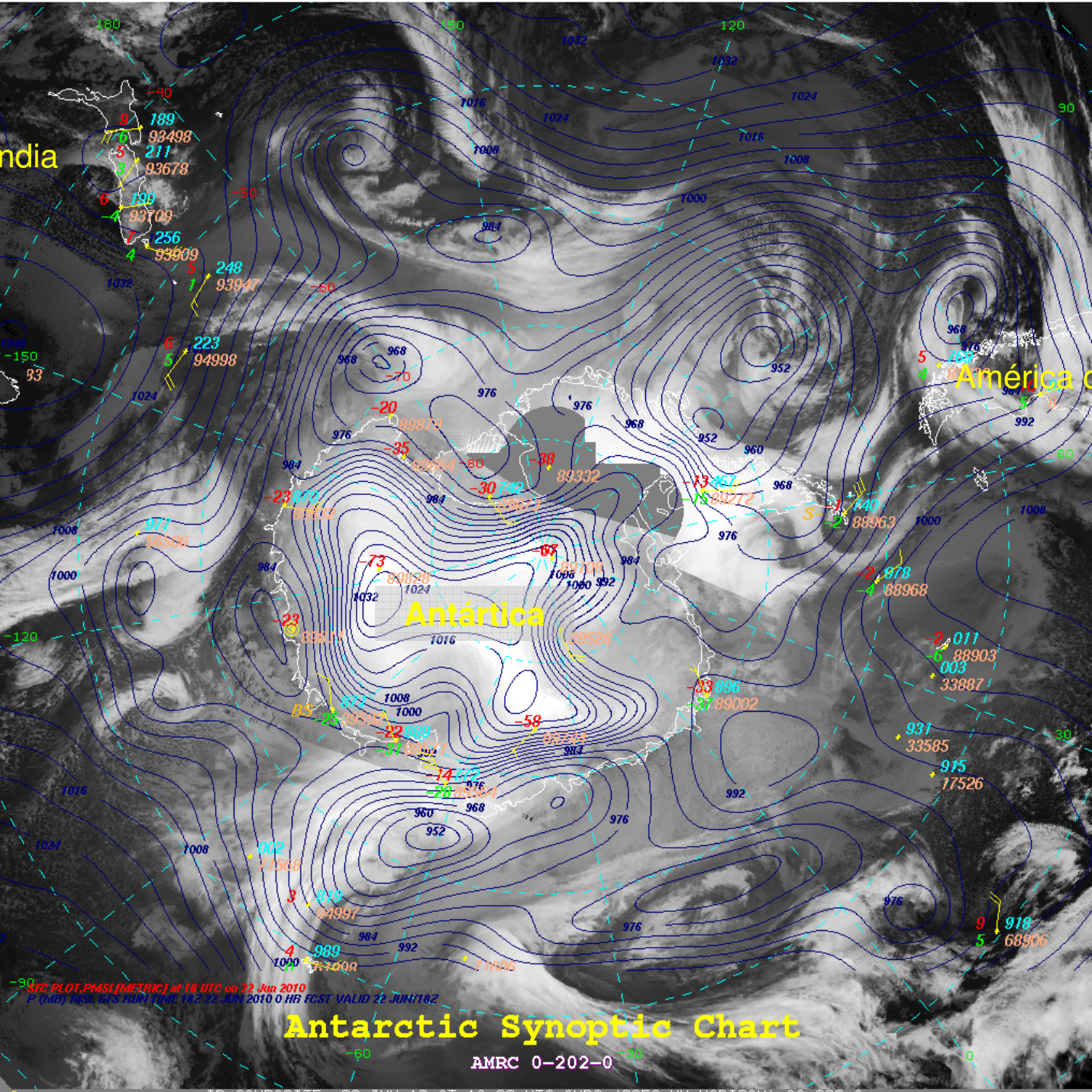
Nova Zelândia

América do Sul

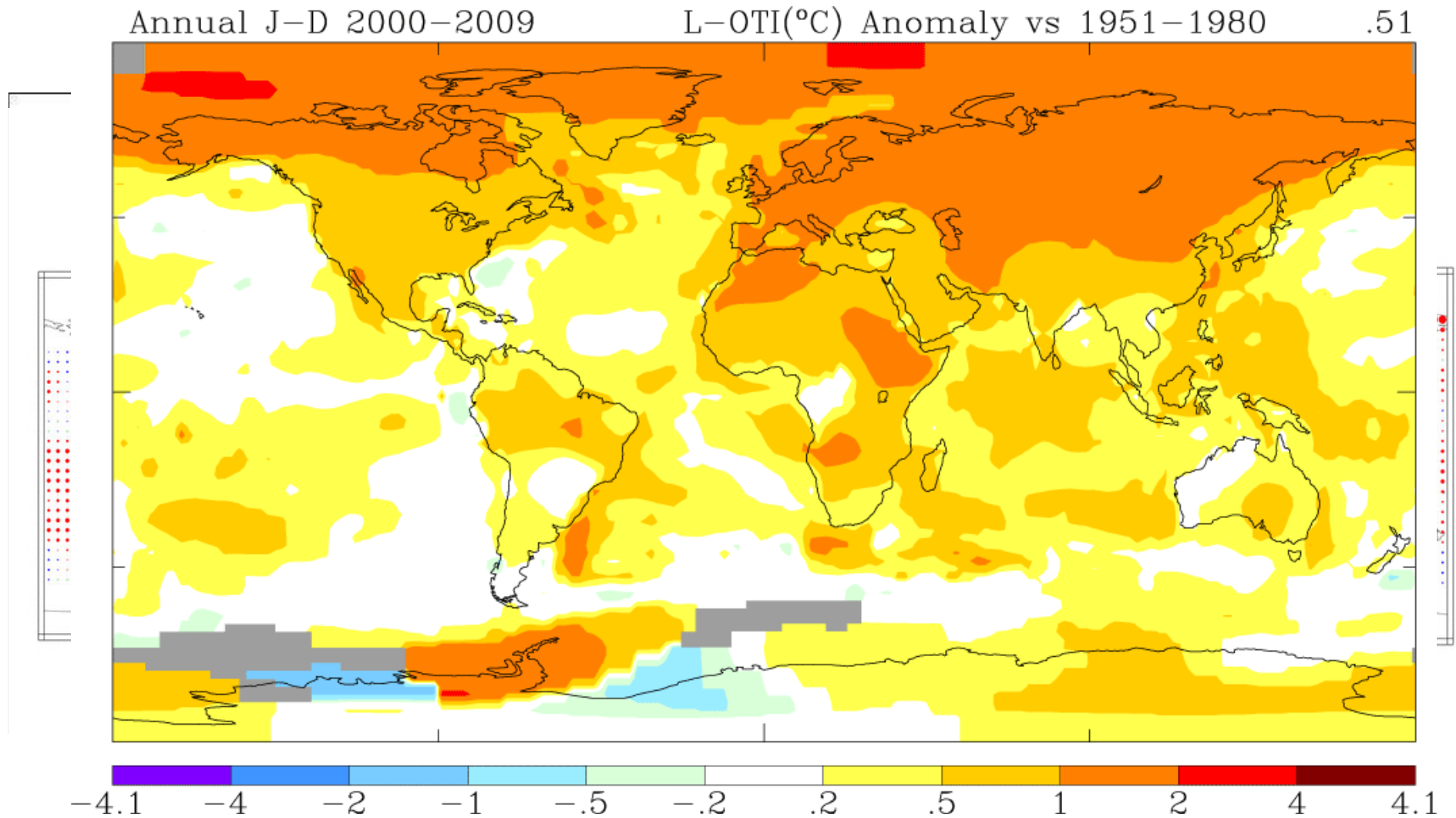
Antártica

Antarctic Synoptic Chart

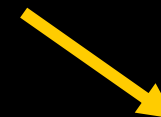
AMRC 0-202-0



Mapa das anomalias da Temperatura Média Mensal/Sazonal/Global



Estratigrafia e química da neve e do gelo



Amostragem superficial

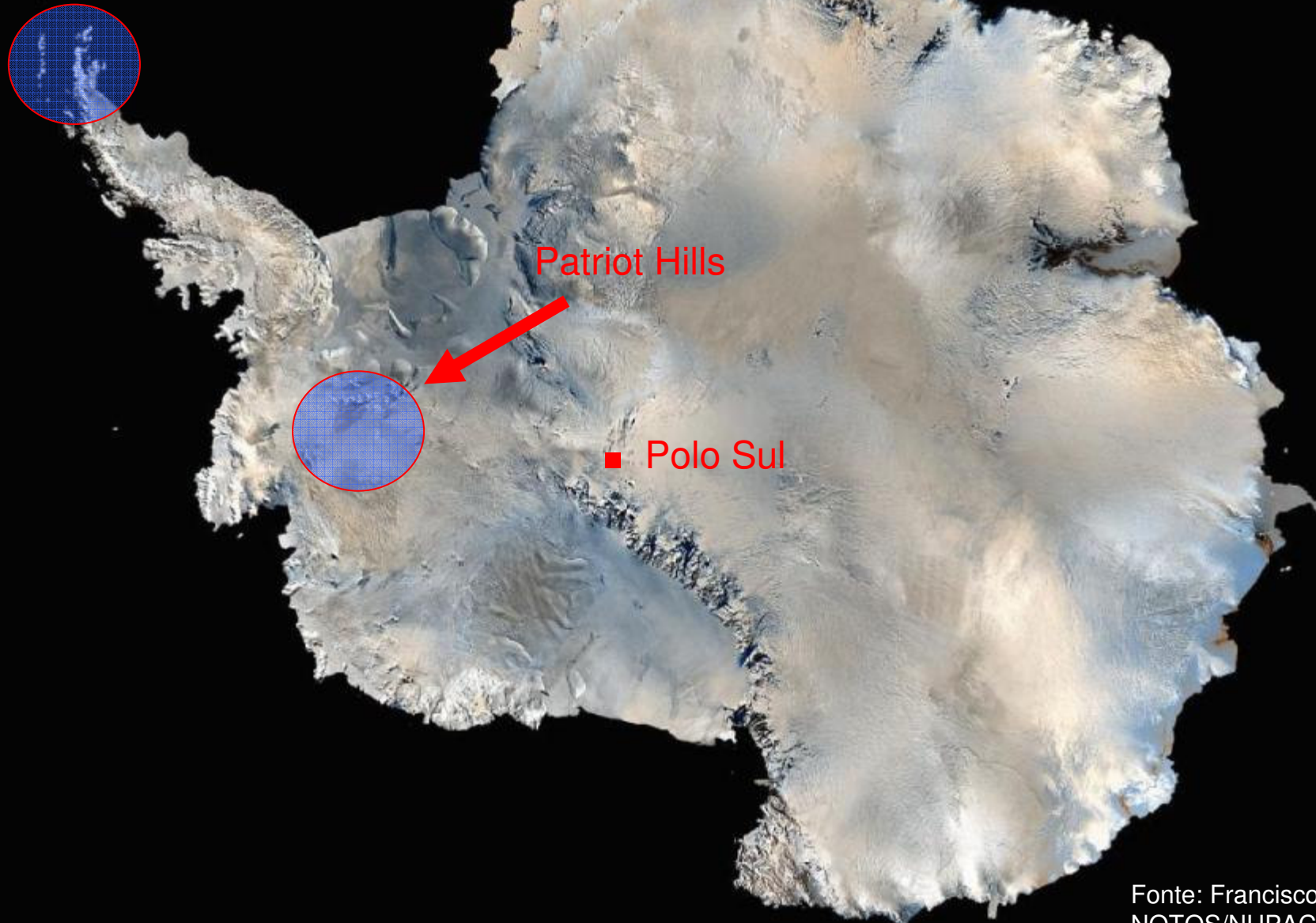


Testemunho



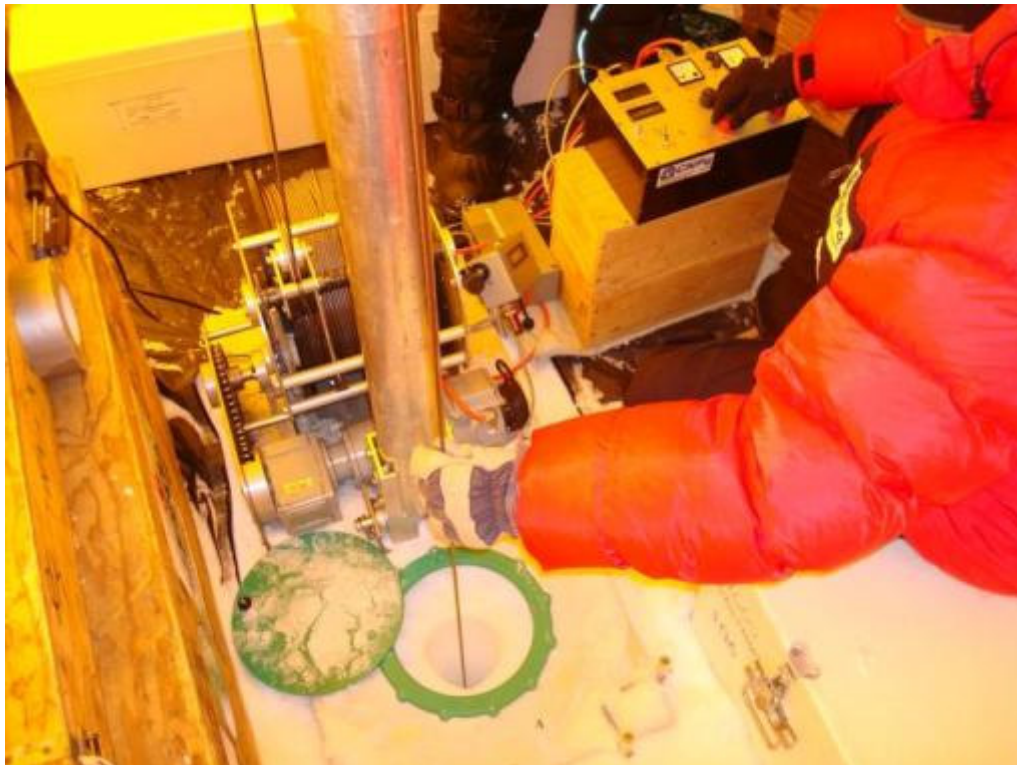
Perfuração

Qual a resposta dos mantos de gelo da Antártica e da Groenlândia ao aquecimento global?



Fonte: Francisco Aquino
NOTOS/NUPAC/UFRGS

Sondagem: obtenção dos testemunhos de gelo....



Testemunhos



Fonte: Jefferson Simões
NUPAC/UFRGS



Fonte: Jefferson Simões NUPAC/UFRGS



Fonte: Valérie Masson-Delmotte
XXIX ATCM, Edinburgh, June/2006 - SCAR



Fonte: Jefferson Simões NUPAC/UFRGS

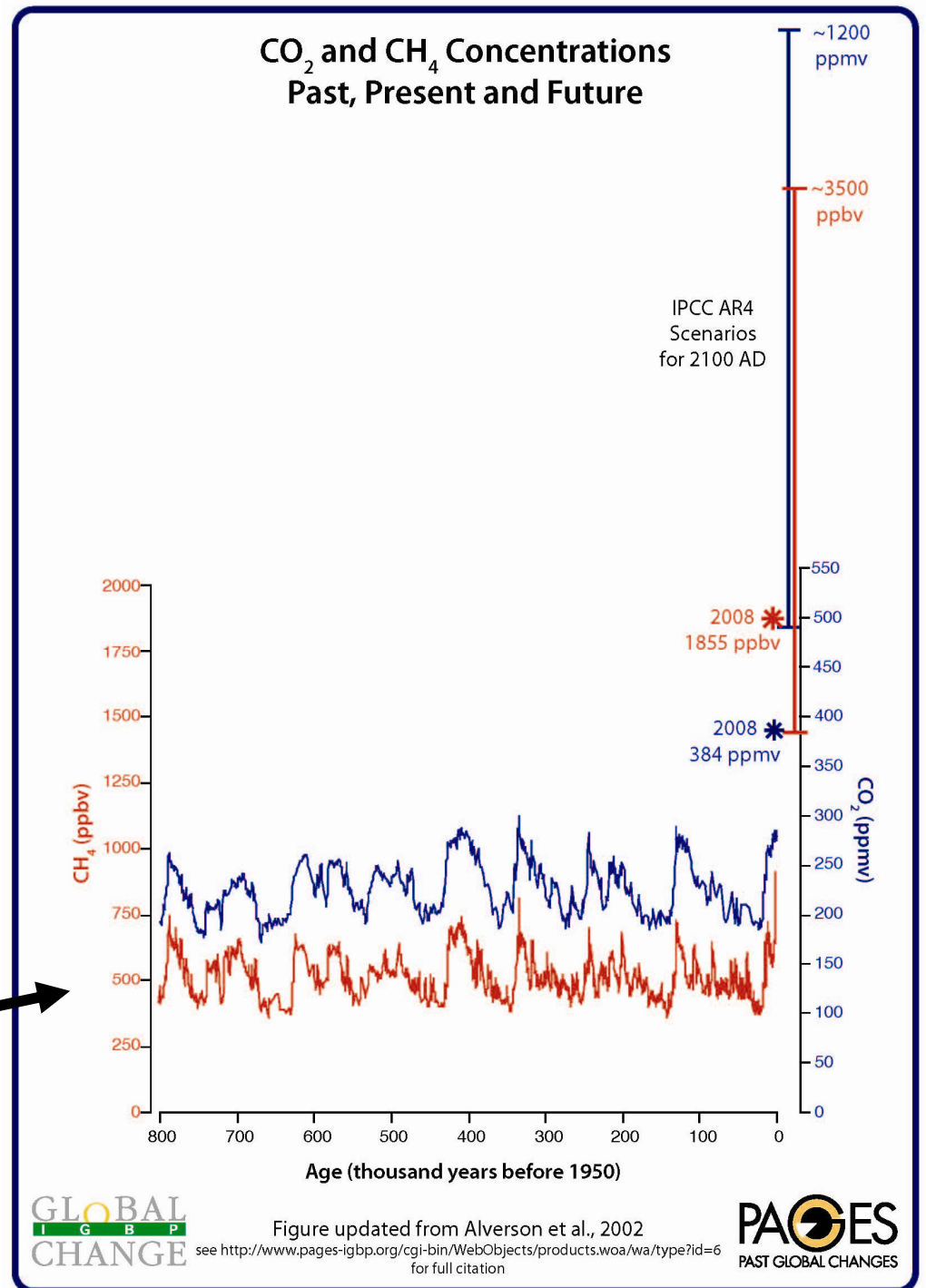
Gases (traço) do efeito estufa:

Concentração do CO₂ e do CH₄

Dióxido de Carbono aumentou 36%

Metano aumentou 130%

História dos ciclos
Glaciais-interglaciais



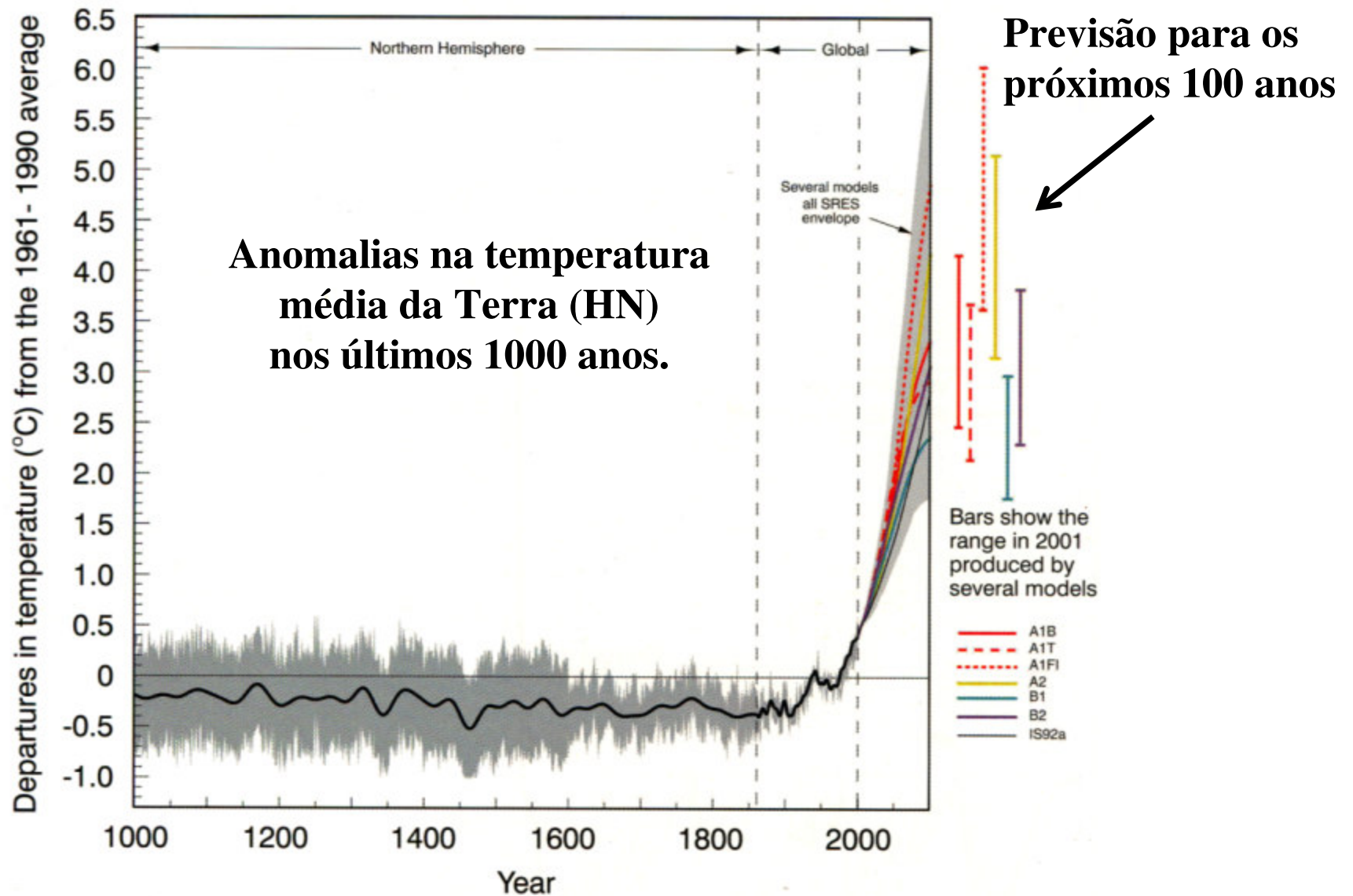
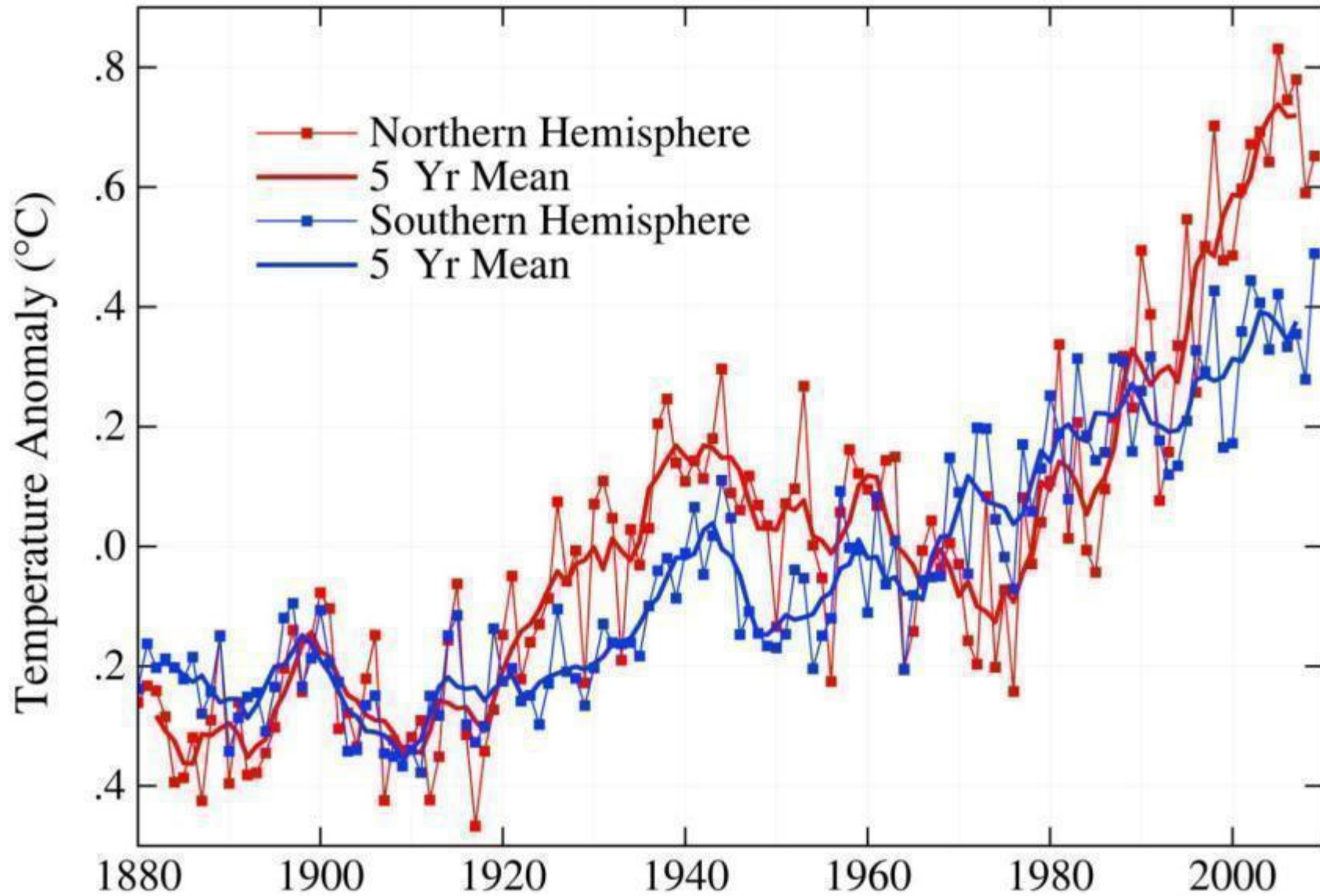


Figure 2. Variations of the Earth's surface temperature (1000 to 2100 AD). Data from IPCC Third Assessment Report (Prentice et al. 2001). Sources of data from 1000–1861 AD — northern hemisphere, proxy data (tree rings, sediment cores, etc.); 1861–2000 AD — global instrumental data; 2000–2100 AD — Special Report on Emissions Scenarios projections.

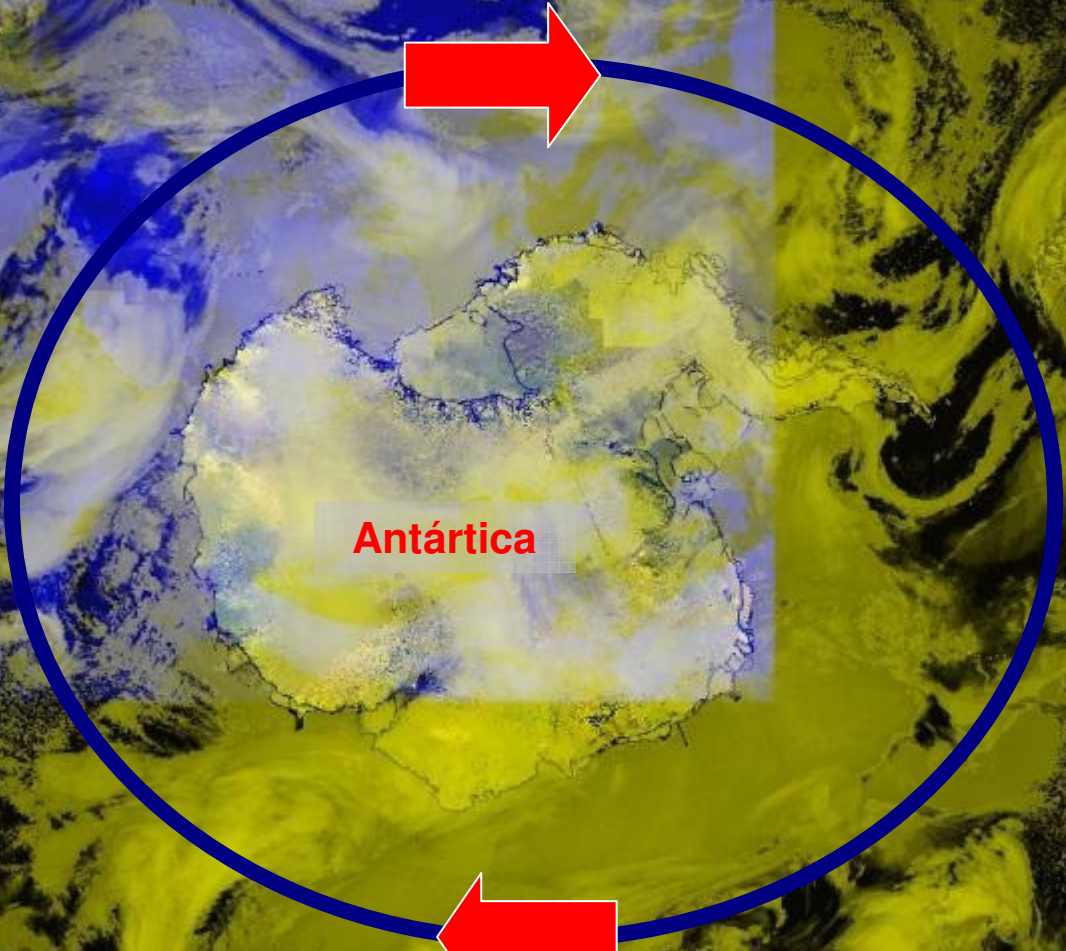
Hemispheric Temperature Change



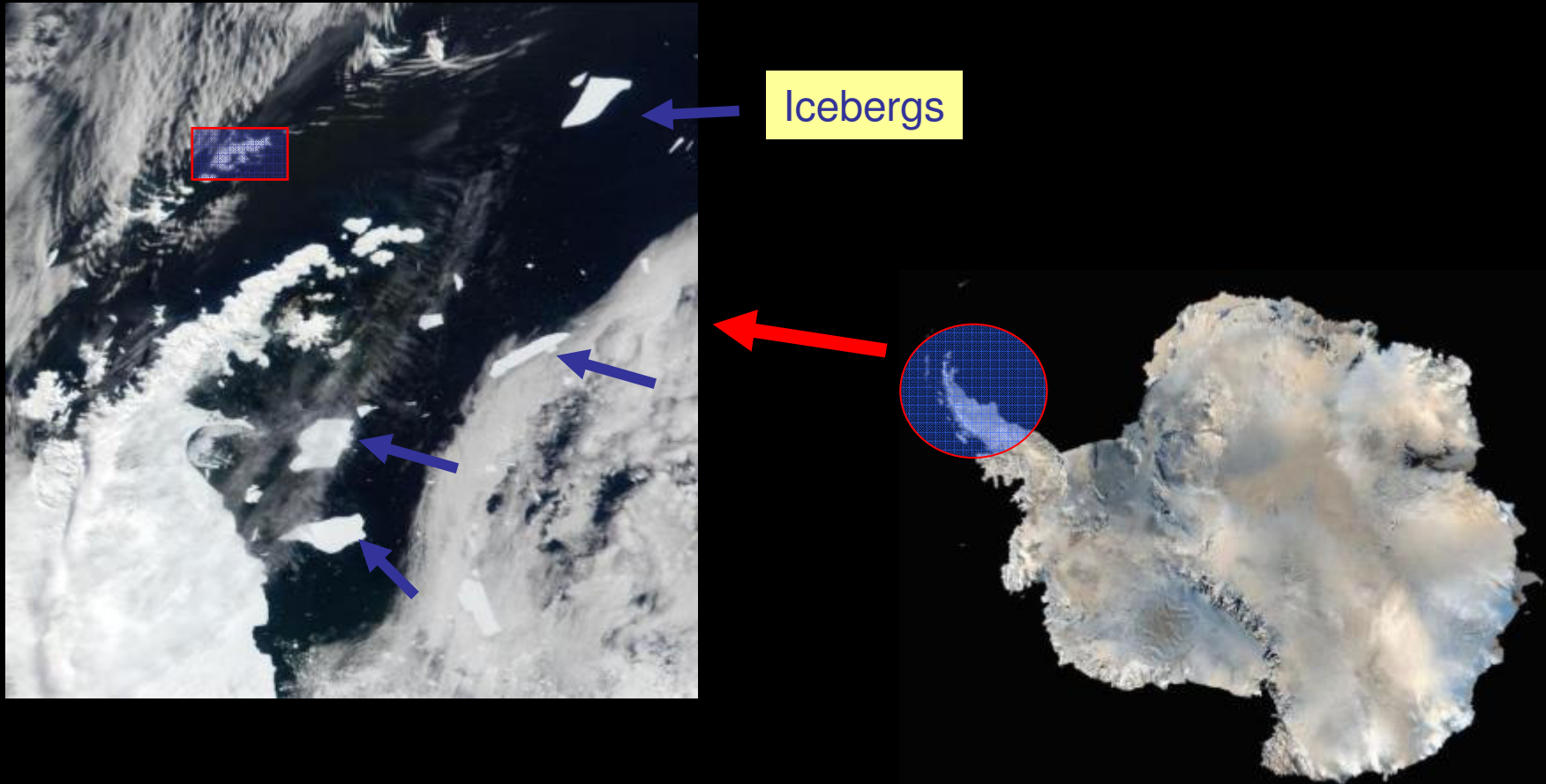
Nova Zelândia

América do Sul

Antártica



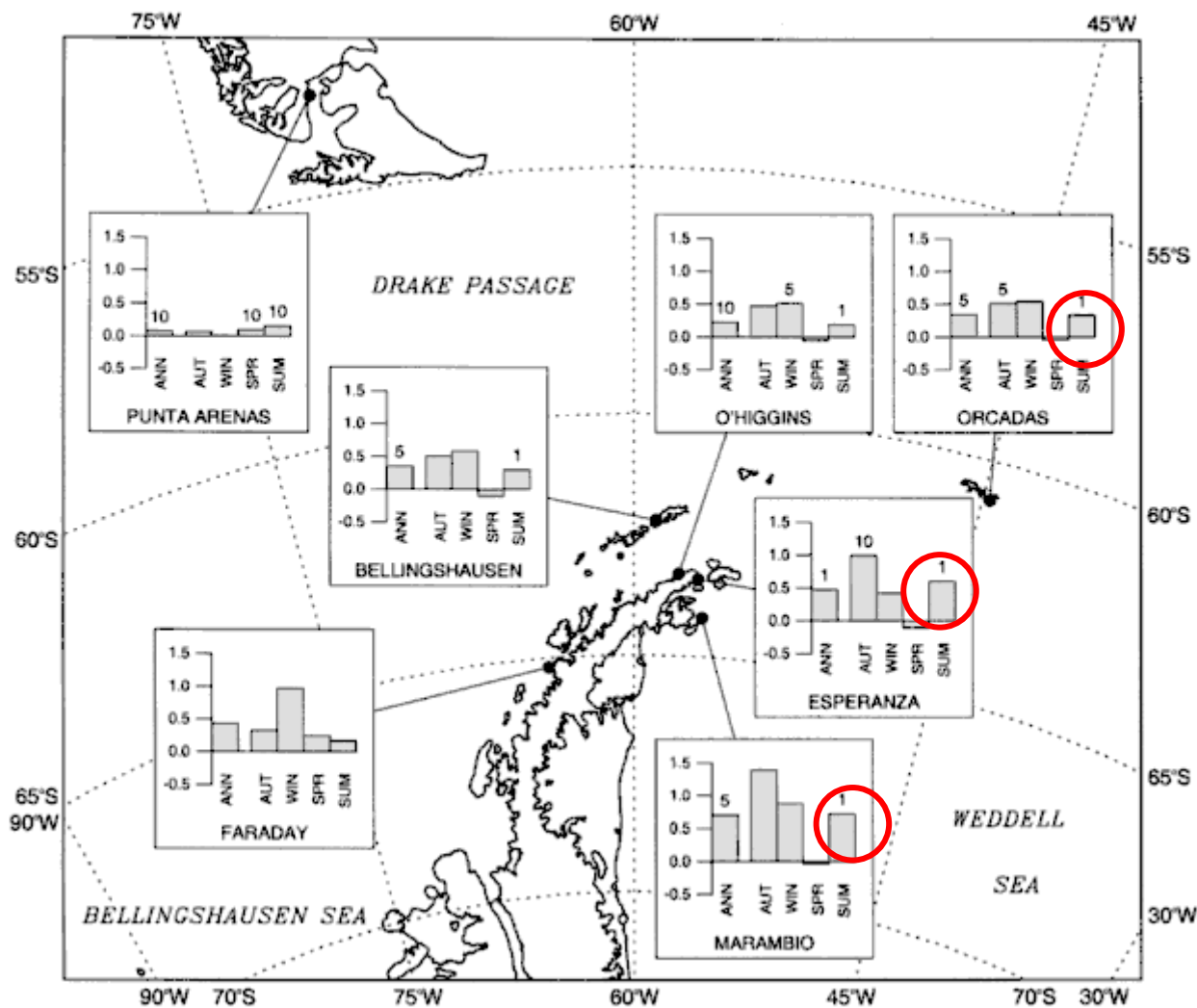
Qual a resposta dos mantos de gelo da Antártica e da Groenlândia ao aquecimento global?



A temperatura média do ar teve um aumento $\sim 3,0^{\circ}\text{C}$ no últimos 50 anos na região da Península Antártica.

E está associado a mudanças nos padrões dos ventos de oeste (SAM ou AAO)!

Tendências recentes na temperatura média do ar (superfície) na PA



Tendências anual e sazonal da temperatura média do ar à superfície calculada entre 1965-2000, exceto para Bellingshausen (1968-2000) e Marambio (1970-2000).

(°C por década)

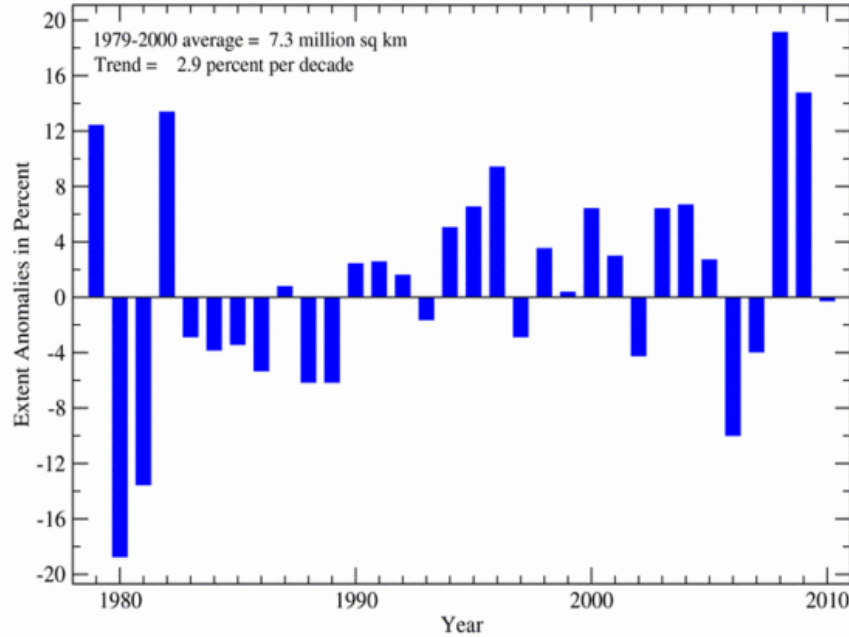
Significance values are shown if the trend is at the <1%, <5% or <10% level.

Fonte: G.J. Marshall, A. Orr, N.P.M. van Lipzig and J.C. King

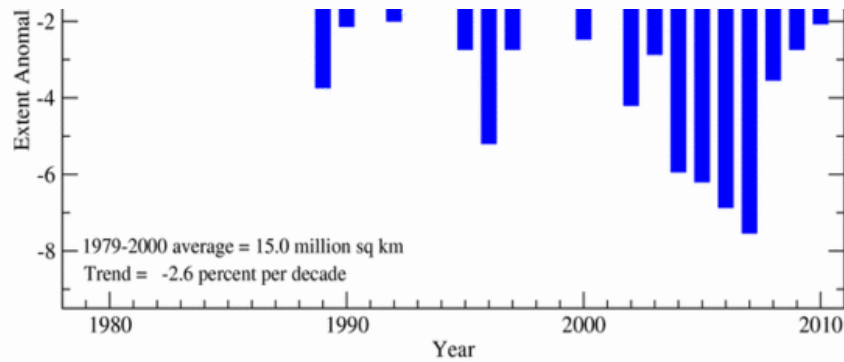
International Workshop on Antarctic Peninsula Climate Variability: observations, models and plans for IPY research, Boulder, USA, 14-16th May 2006.

Geografia das Regiões Polares

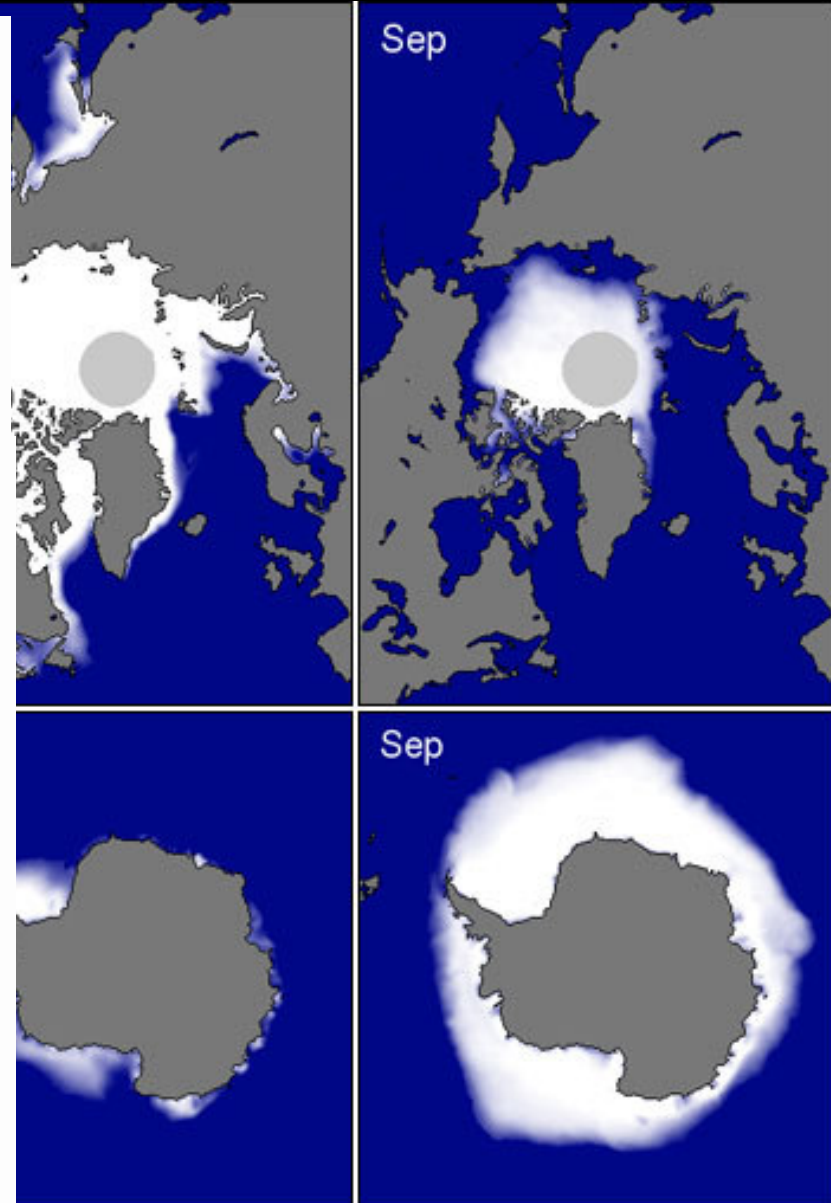
Southern Hemisphere Sea Ice Extent
April Anomalies, 1979-2010



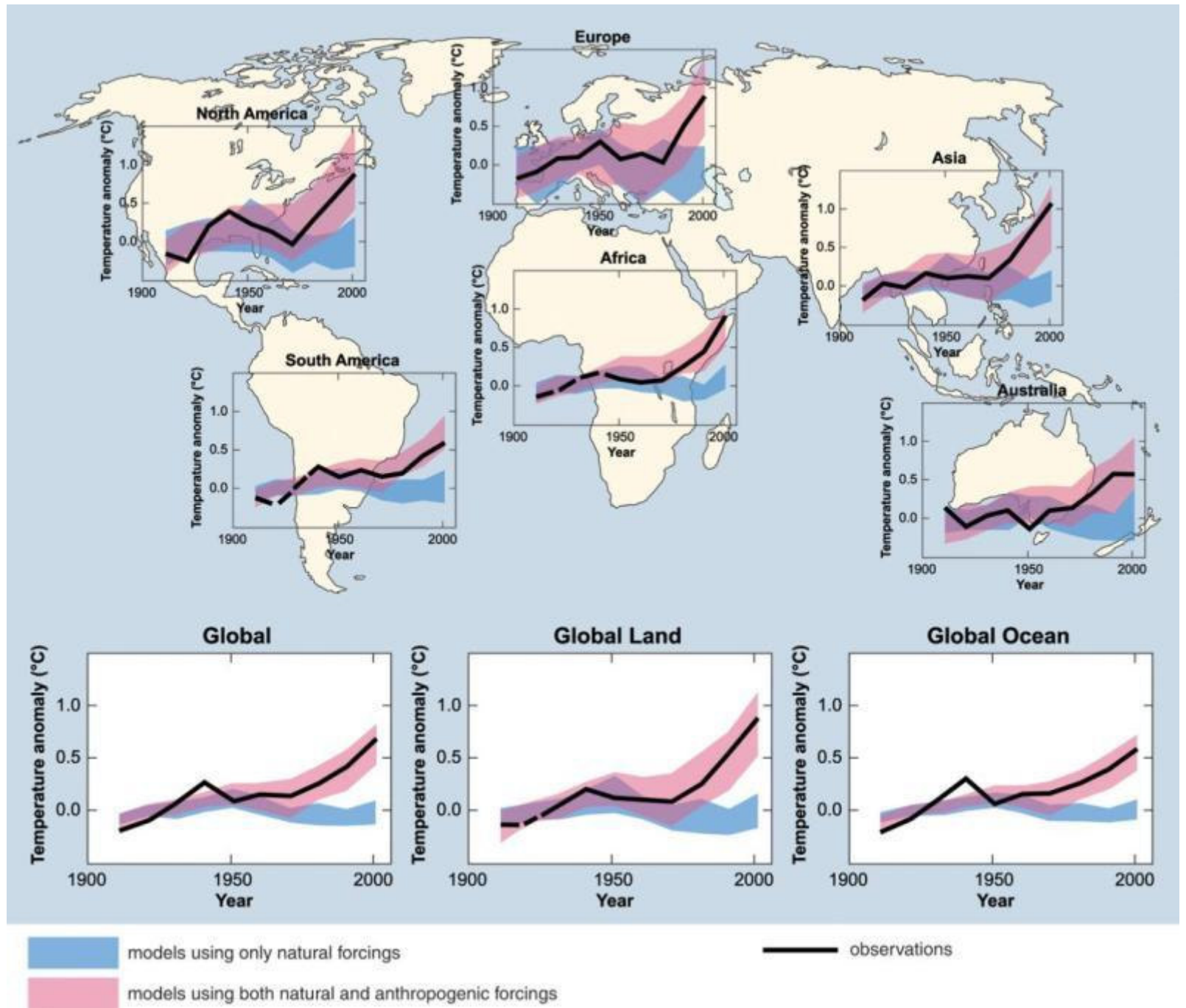
Data provided by the National Snow and Ice Data Center (NSIDC)



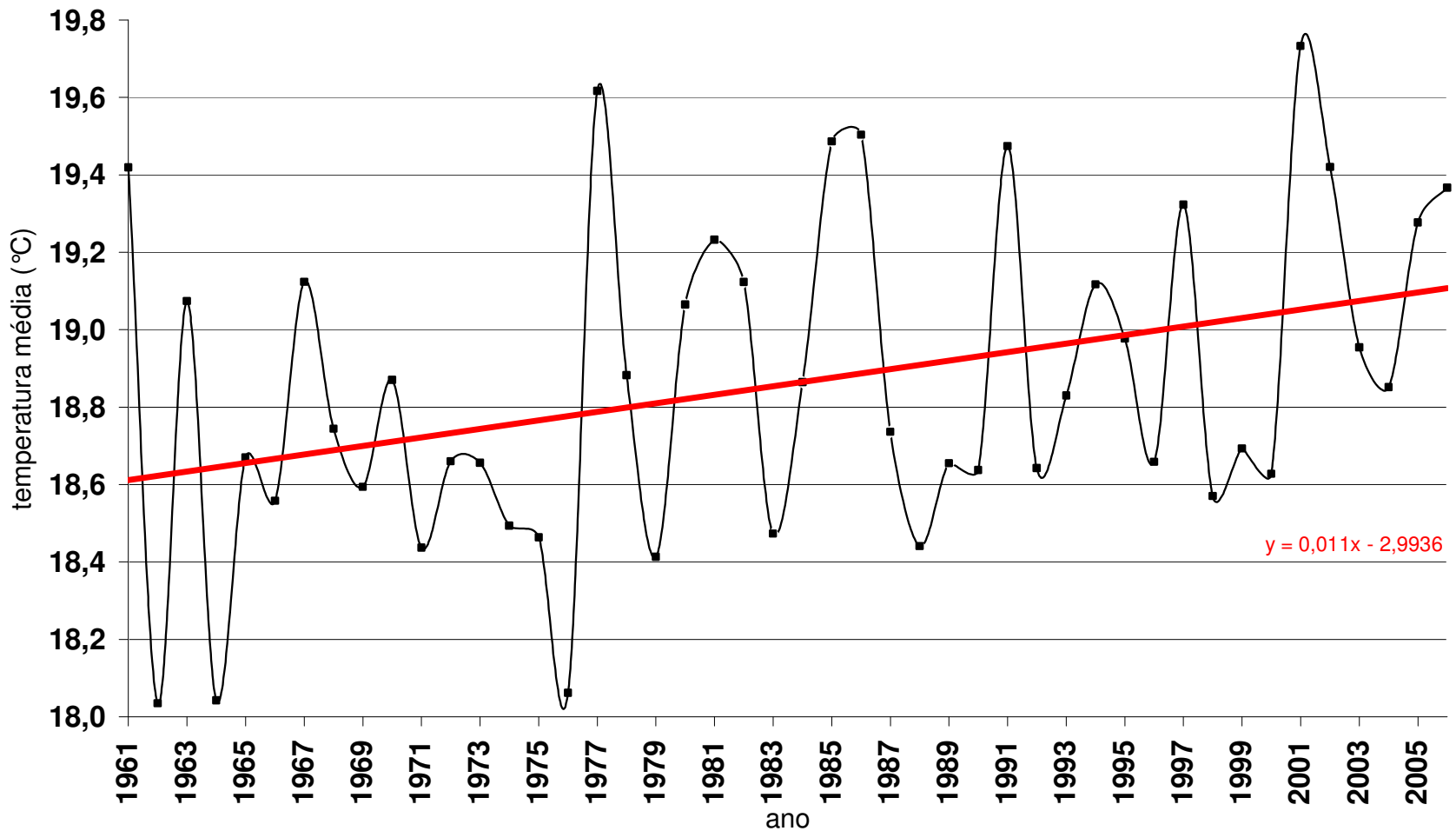
Data provided by the National Snow and Ice Data Center (NSIDC)



IPCC 2007



Tendência linear na temperatura média anual entre 1961 e 2006: **+0,5°C**.



Série1 — Temperatura média anual — Linear (Temperatura média anual)

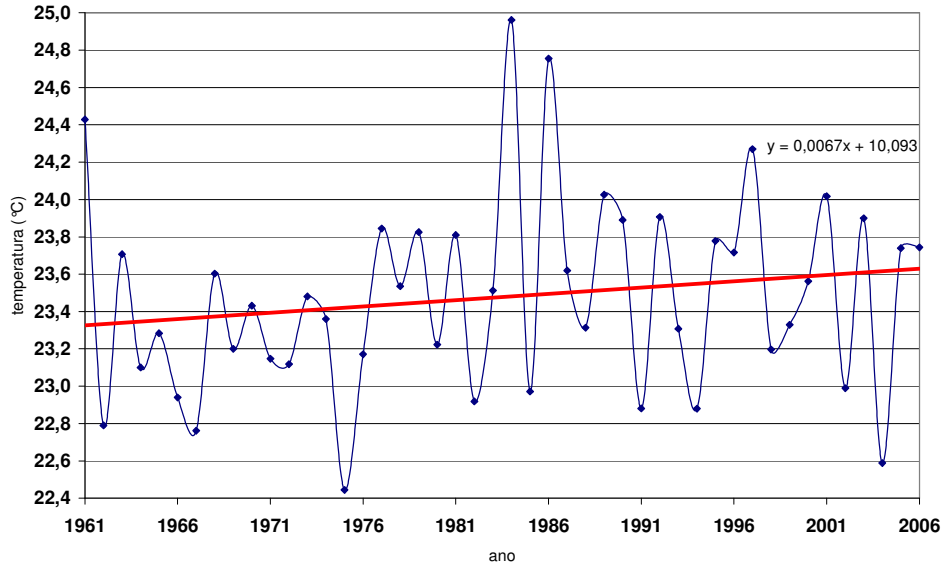


Carpeneo, C.B.; Aquino, F.E. ; Dewes, C.F. 2008.

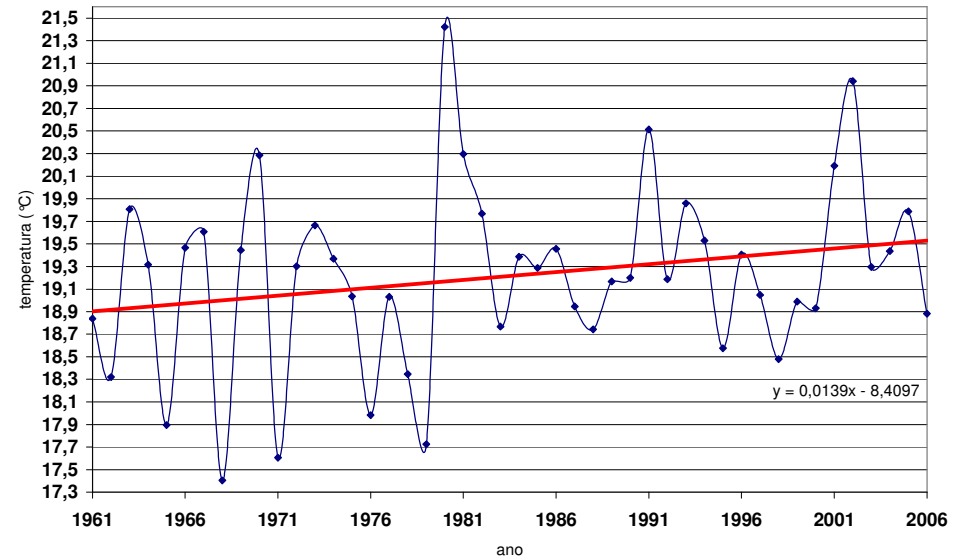


Tendência linear estacional: todas **positivas**

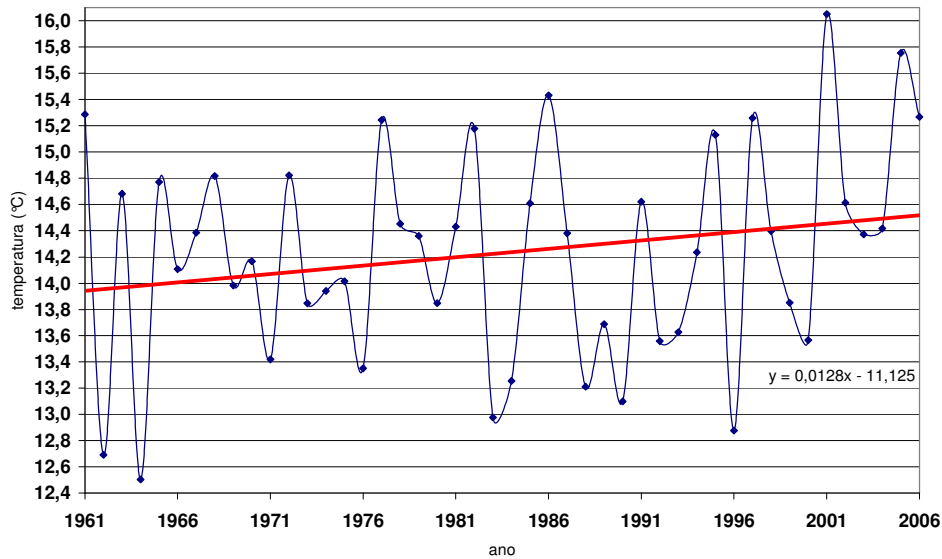
Verão: +0,3°C



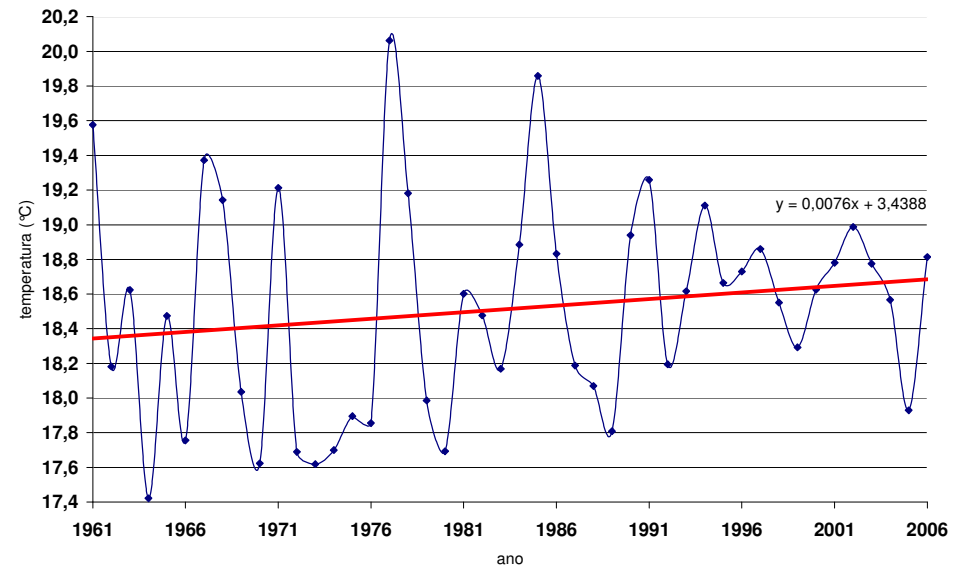
Outono: +0,6°C



Inverno: +0,6°C



Primavera: +0,3°C



Padrões projetados na mudança da precipitação Global

IPCC 2007

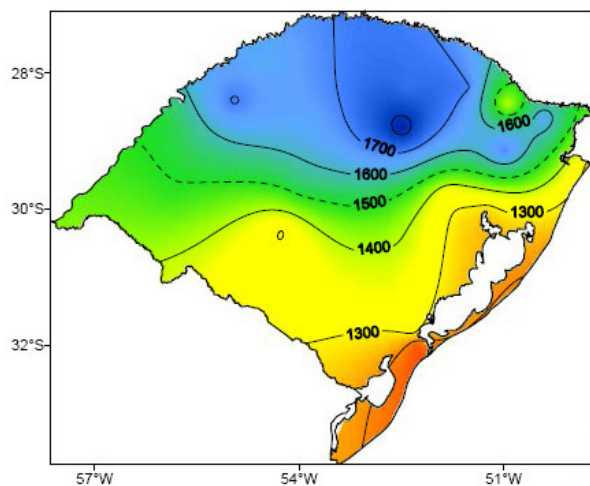
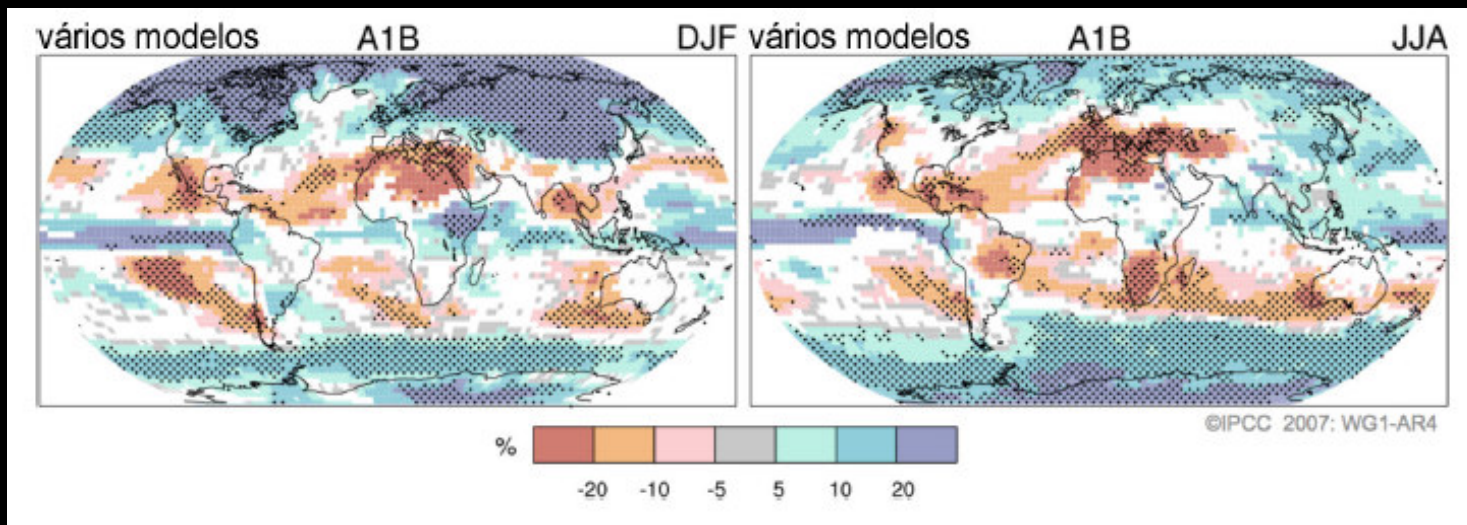


Figura 2a: Precipitação média anual 1945-1974.

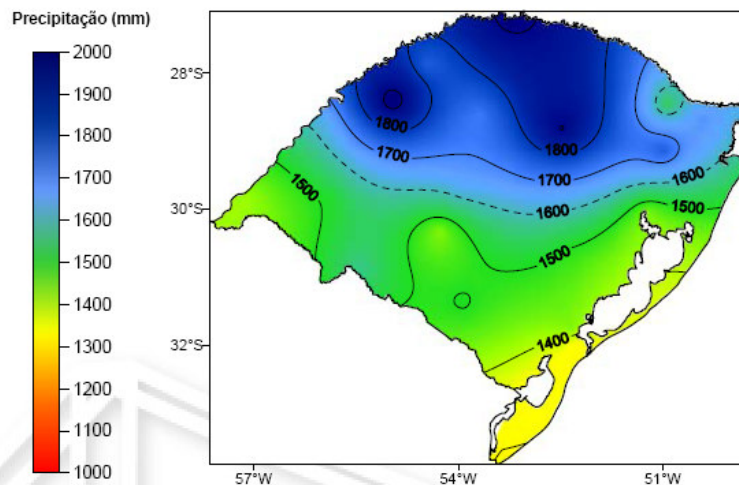
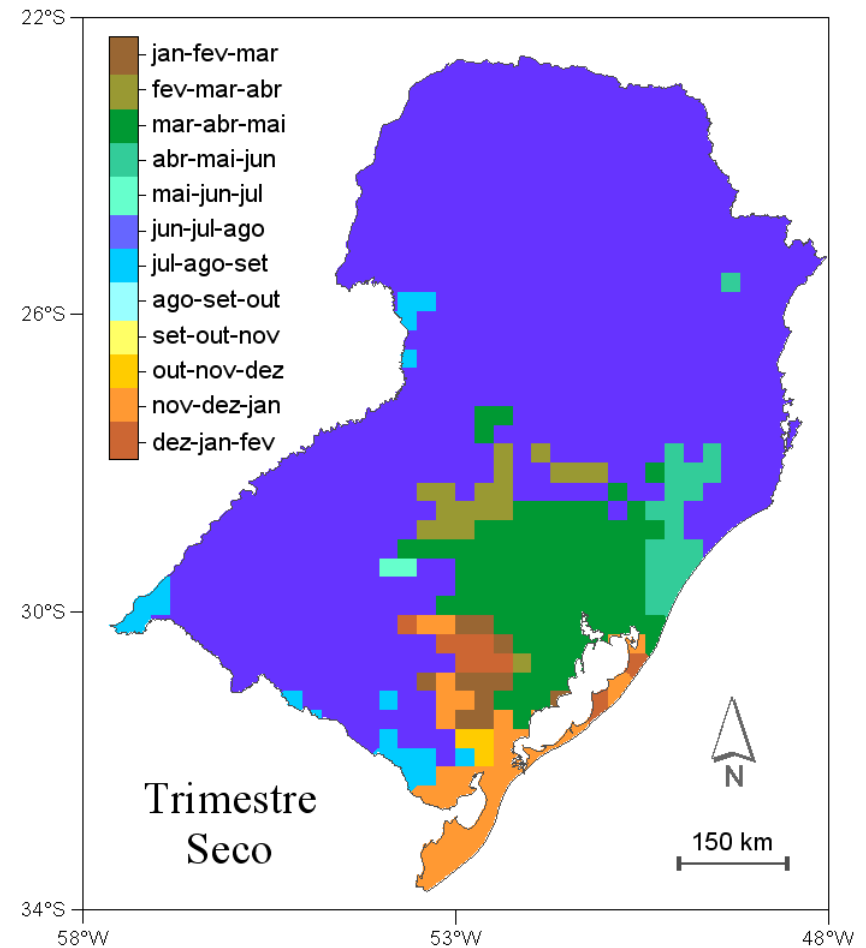
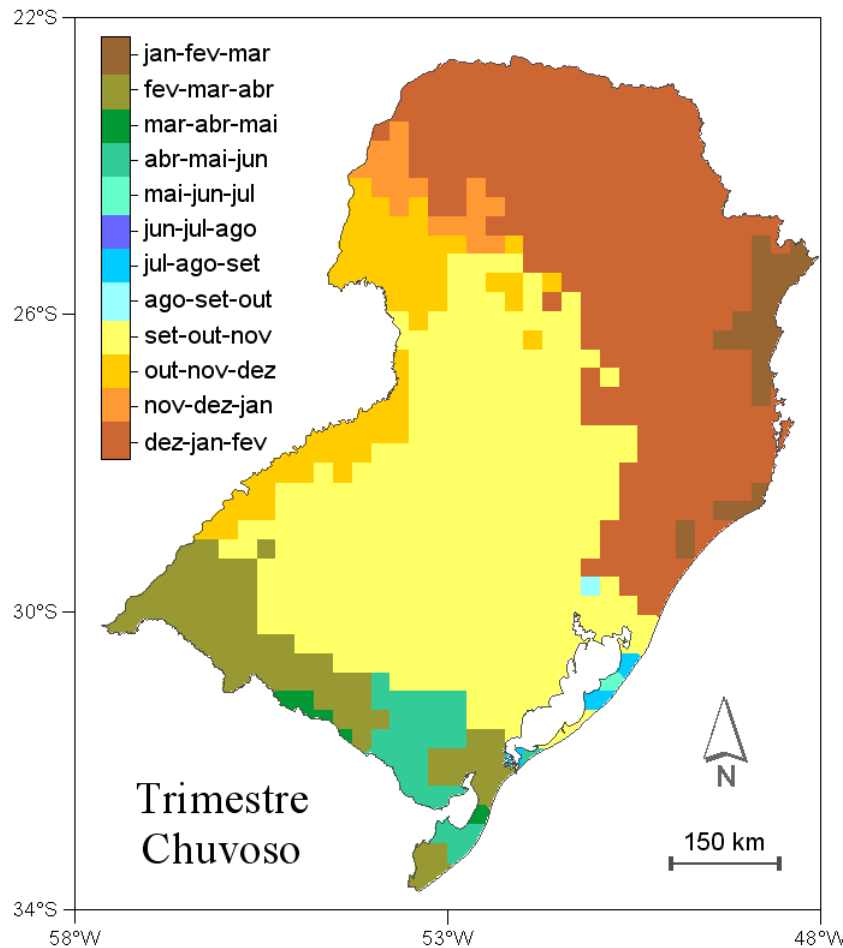


Figura 2b: Precipitação média anual 1975-2004.

Aumento de 8%
na precipitação no RS

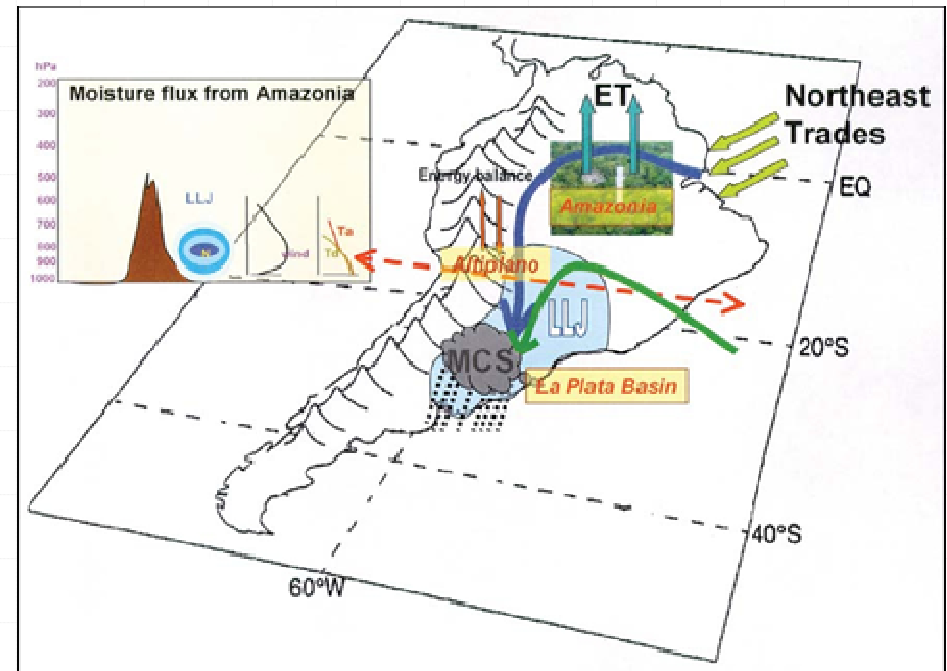
Estação	Desvio (%)
Primavera	9
Verão	7
Outono	17
Inverno	2

Climatologia e desvios



Alteração RS: out e inv. (Nimer, 1979); ASO (Grimm et al., 1998).

Caracterização CCM



Fonte: Marengo et al. (2004).

Avaliação da Precipitação e Desastres Naturais Associados a Complexos Convectivos de Mesoescala no Rio Grande do Sul entre Outubro e Dezembro de 2003

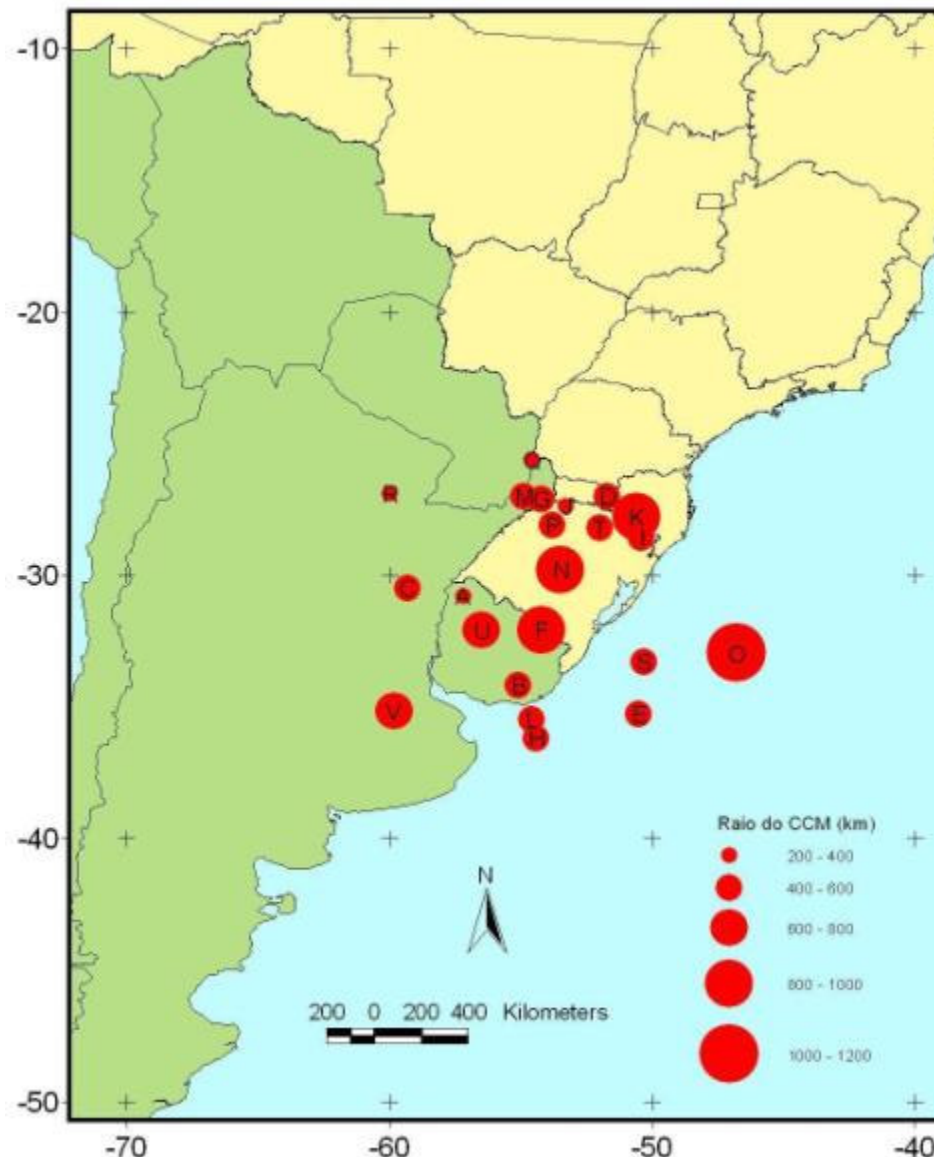
Denilson Ribeiro Viana, 2006

Identificação dos CCM

No período de estudo foram identificados 22 CCM que, em algum momento de seu ciclo de vida, aturam sobre o RS.

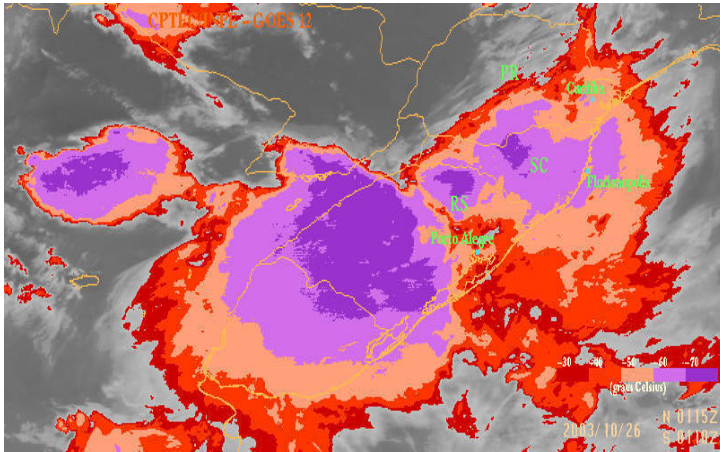
Desse total, 7 eventos ocorreram em outubro, 7 em novembro e 8 em dezembro.

O ciclo de vida médio dos eventos no trimestre foi de 18.6 h, sendo: 13 h no mês de outubro, 14.4 h em novembro, e 27.2 h em dezembro.



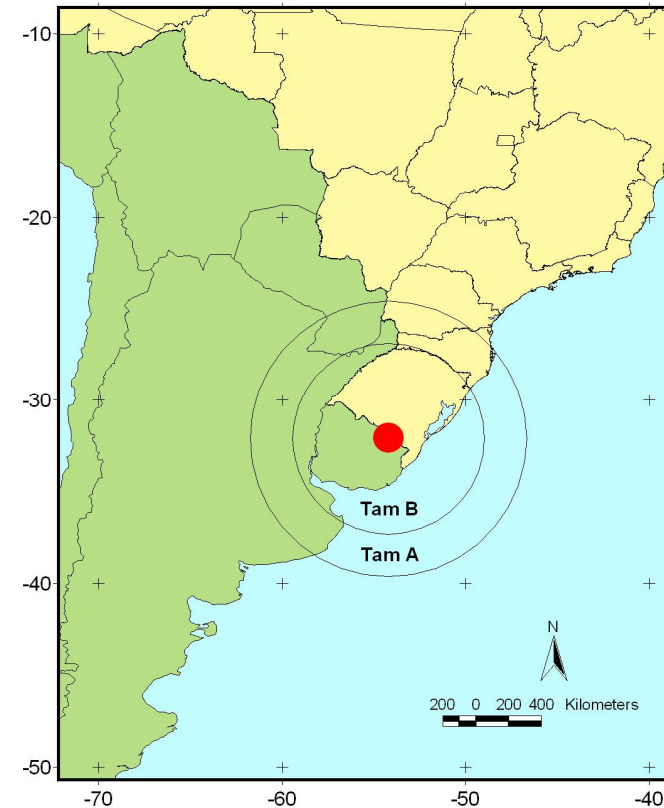
Avaliação da Precipitação e Desastres Naturais Associados a Complexos Convectivos de Mesoescala
no Rio Grande do Sul entre Outubro e Dezembro de 2003

Desastres Naturais associados aos eventos de CCM



CCM observado sobre o RS em 26/10/2003 01:15 UTC
(Imagem do Satélite GOES-12 realçada)

Fenômeno	Nº Municípios
Enchente	1
Enxurrada	2
Granizo	4
Inundação	1
Vendaval	26
Municípios Atingidos	34



Tamanhos A e B no instante de máxima extensão do
CCM observado sobre o RS em 26/10/2003 01:15 UTC

Revista Brasileira de Meteorologia, v.24, n.3, 276-291, 2009

45 **MESOSCALE CONVECTIVE COMPLEXES IN RIO GRANDE DO SUL BETWEEN OCTOBER AND DECEMBER OF 2003 AND ASSOCIATED PRECIPITATION**

ME 22

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Centro de Previsão do Tempo e Estudos Climáticos (CPTEC/ INPE)

²Universidade Federal do Rio Grande do Sul
Centro Polar e Climático (CPC/IGEO/UFRGS)
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Received December 2007 - Accepted May 2009

ABSTRACT

This study investigates the occurrences of Mesoscale Convective Complexes (MCC) and the associated precipitation in the southernmost Brazilian state, Rio Grande do Sul (RS), from October to December of 2003. The identification of MCC events was done using ForTraCC. The MCC precipitation was based on the daily data of 31 local weather stations. Twenty-two MCC events were identified over RS during the three month study period, and this total, seven events occurred in October, seven in November and eight in December. Results point to an MCC associated precipitation average of 119 mm in October, 90 mm in November and 152 mm in December. The percentages for MCC precipitation averages, for the period, were 64% in October, 65% in November and 61% in December. The average accumulated volume of MCC precipitation for the three months was 361 mm (63%). This confirms that MCC events contributed significantly to the precipitation totals in RS, and were responsible for almost two thirds of the precipitation in RS, for the period. **Keywords:** Mesoscale Convective Complexes, precipitation anomalies, Rio Grande do Sul

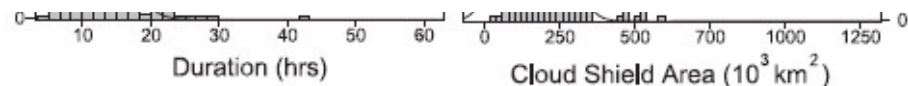
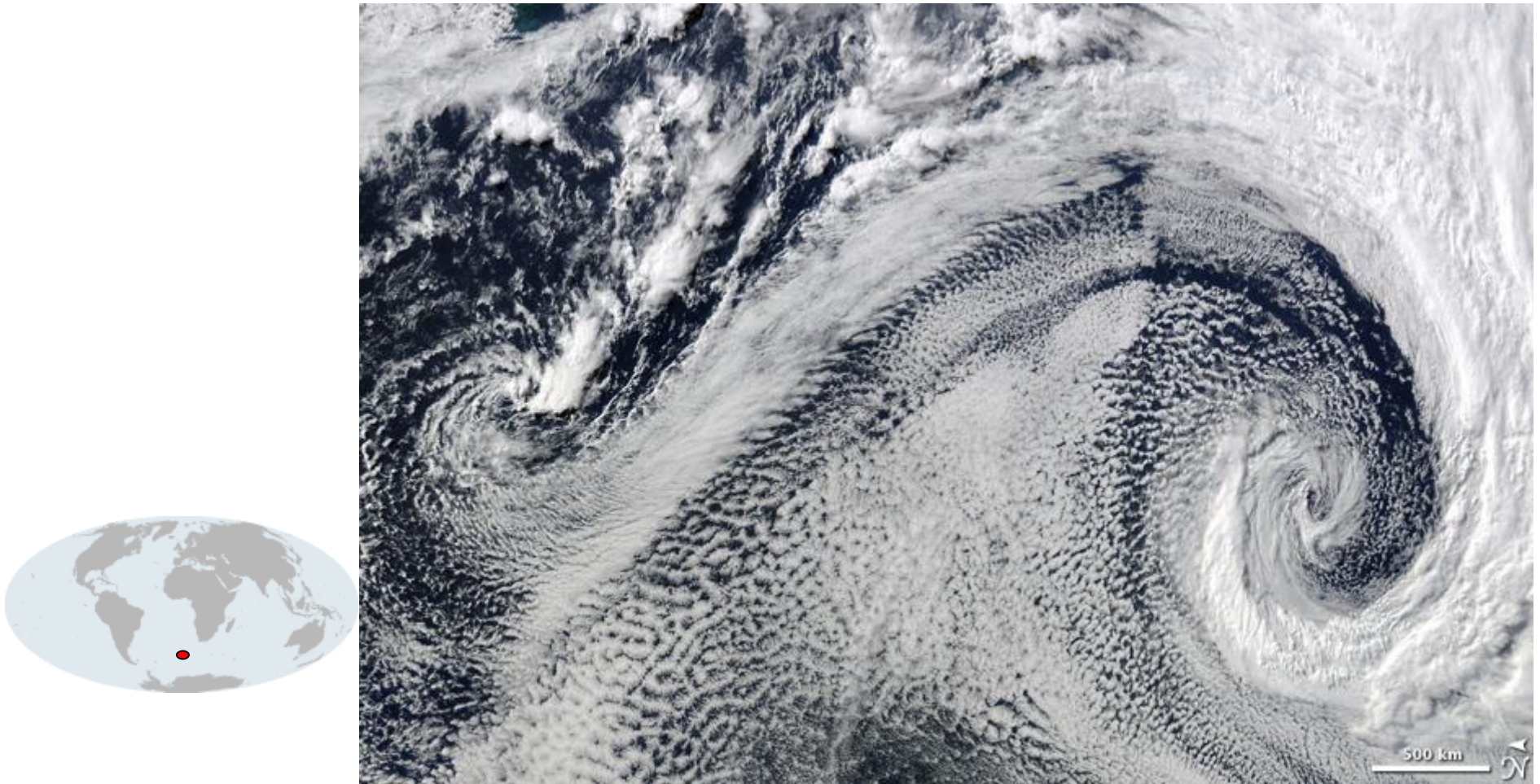


FIG. 2. Histograms of duration for MCCs in (a) SSA and (b) the United States, and histograms of MCC cloud shield areas in (c) SSA and (d) the United States.

Ciclones Extratropicais



It took the Moderate Resolution Imaging Spectroradiometer ([MODIS](#)) on NASA's [Terra](#) satellite a full five minutes to fly over this expansive cloud pattern on April 29, 2009. The sprawling "S"-shaped swirl is actually two cyclones that seem to be feeding on each other. Polar cyclones often form as a result of low-pressure systems over the ocean, and usually bring winds and heavy snow.

<http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=38388>



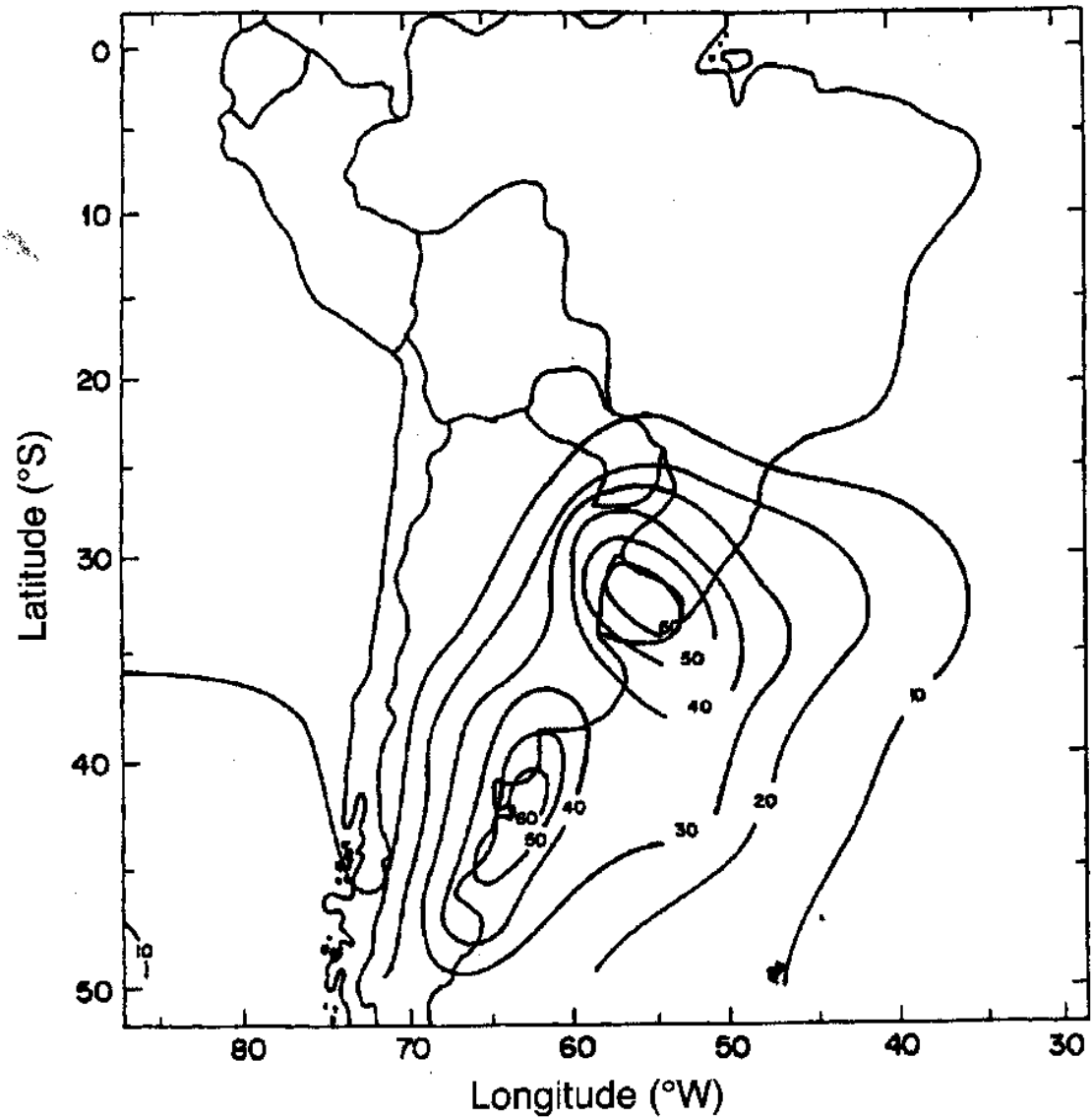
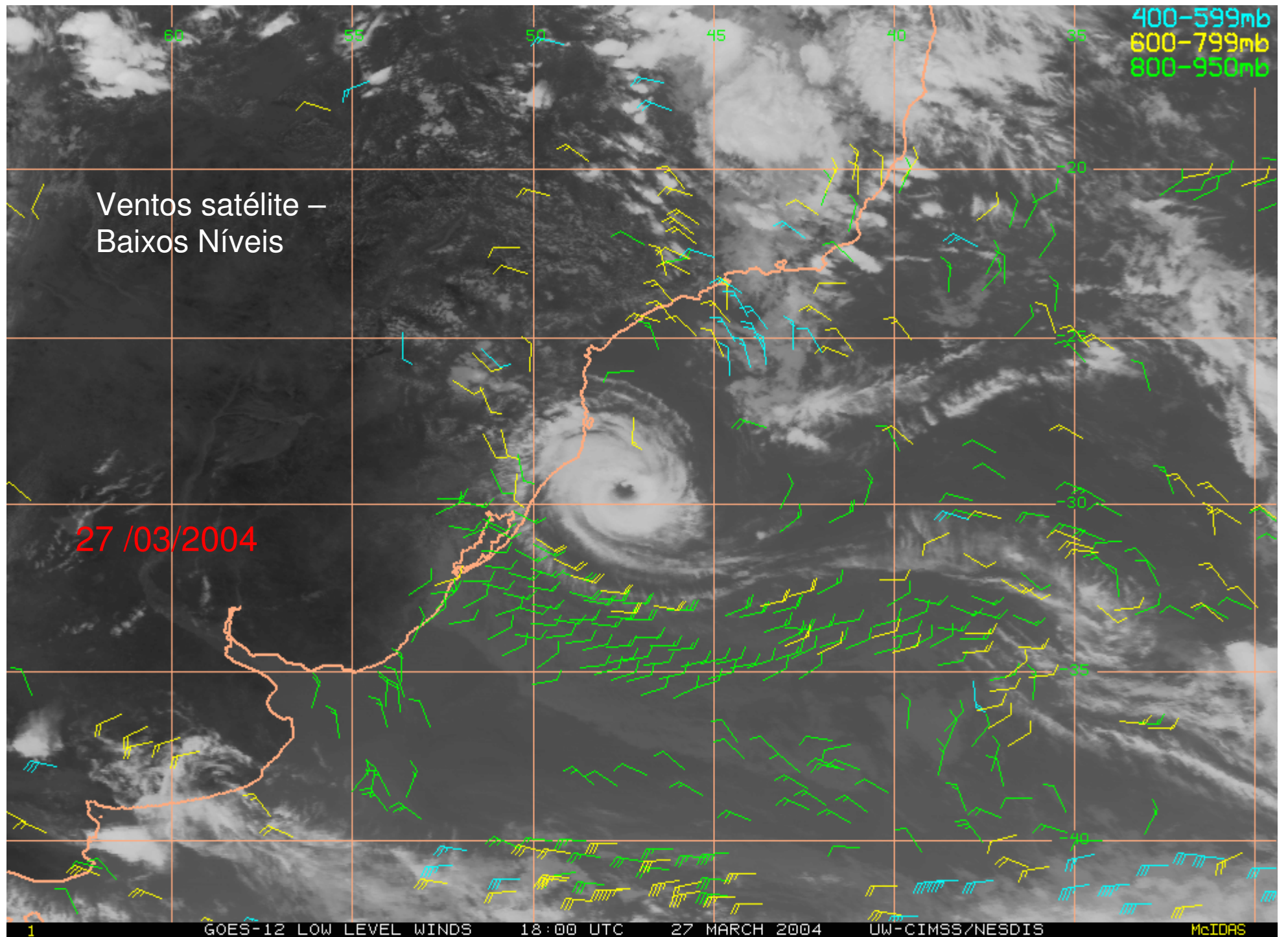


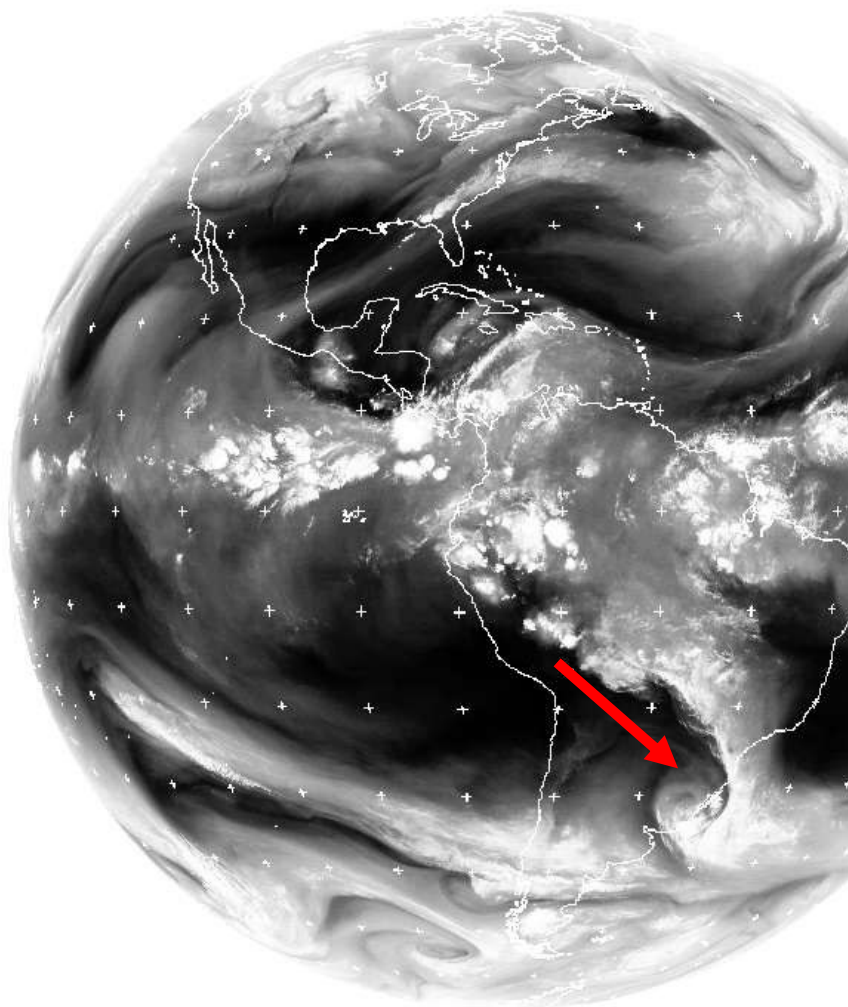
Figure 41.6 Surface cyclogenesis in South America, (From Gan and Rao 1991)



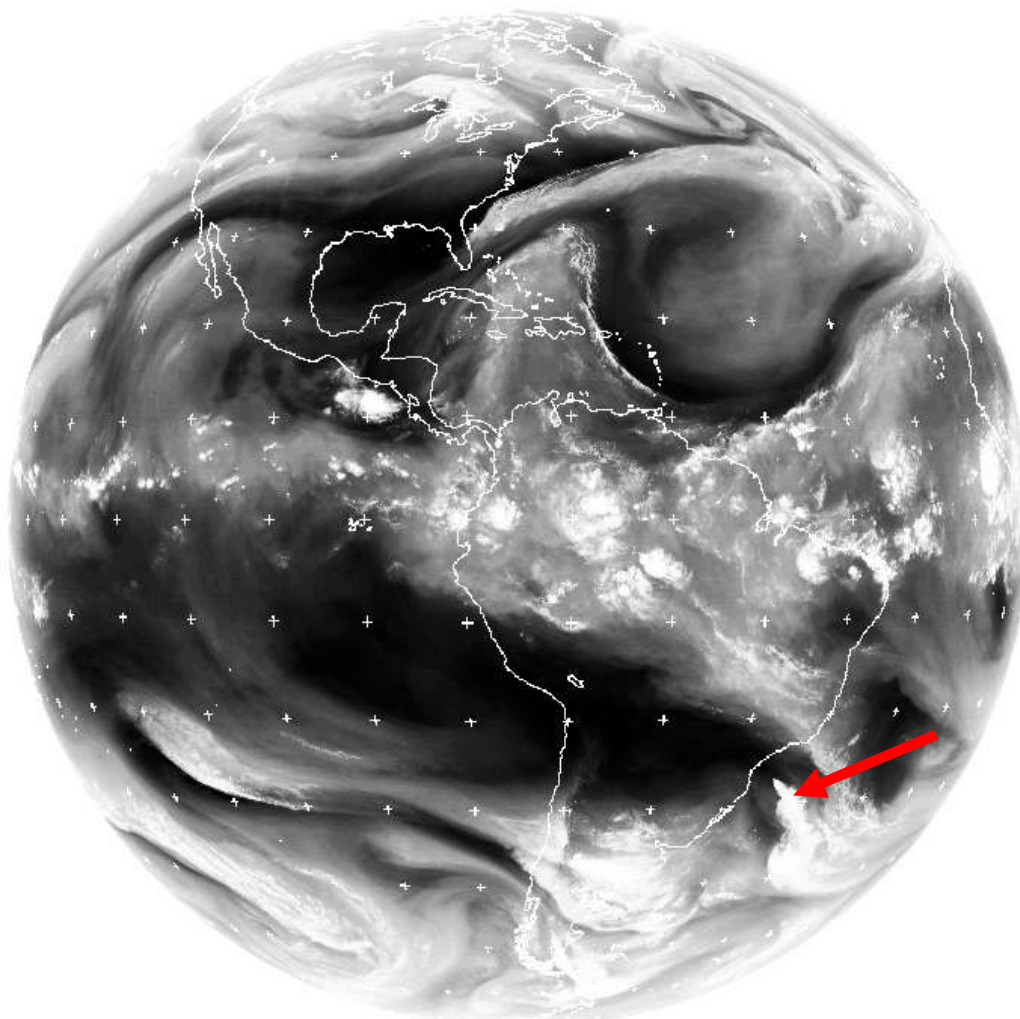
Imagens do Satélite GOES: 02/05/2010 – 05/05/2010.

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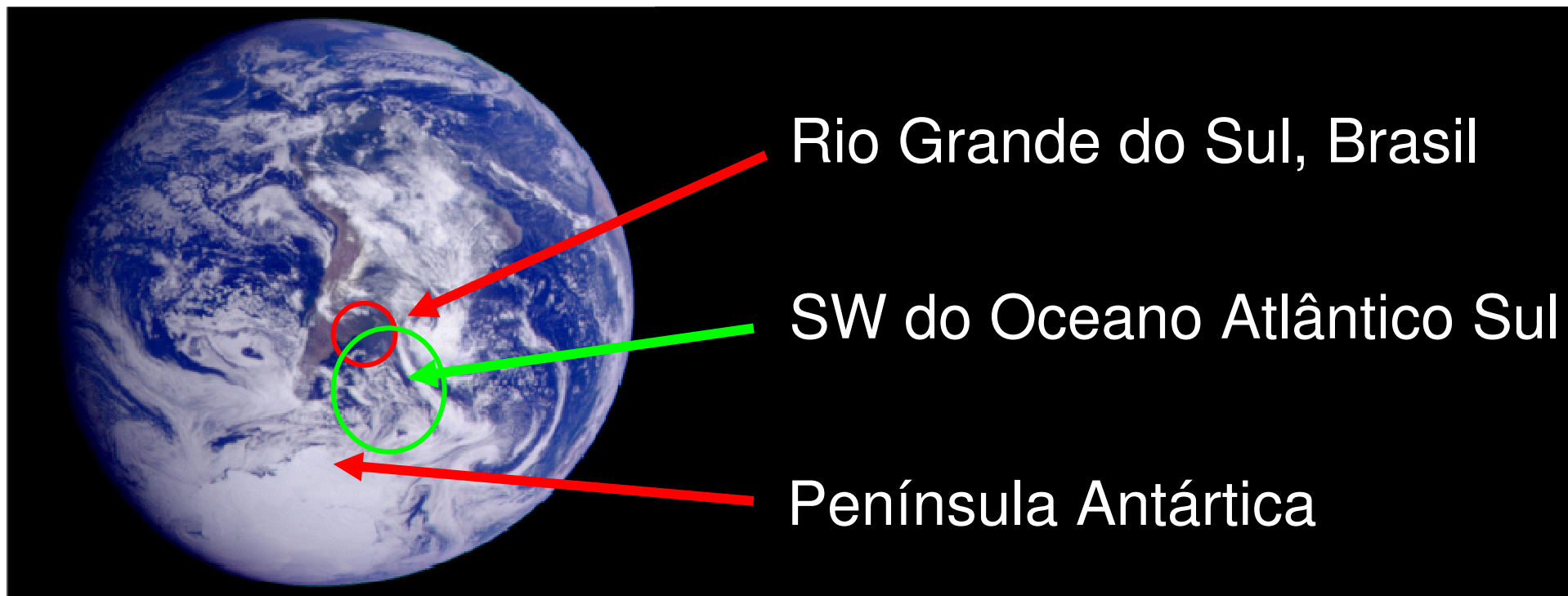
Channel 6 received on 4/5/2010 at 1200 from satellite GOES13



Channel 6 received on 5/5/2010 at 1200 from satellite GOES13

As conexões climáticas entre o Rio Grande do Sul e a região do mar de Weddell em 2004 e 2005 revelam o importante papel da Antártica no clima do Brasil

Francisco Eliseu Aquino, Alberto Setzer, Marcelo Romão, Denílson Ribeiro Viana, Jefferson Cardia Simões

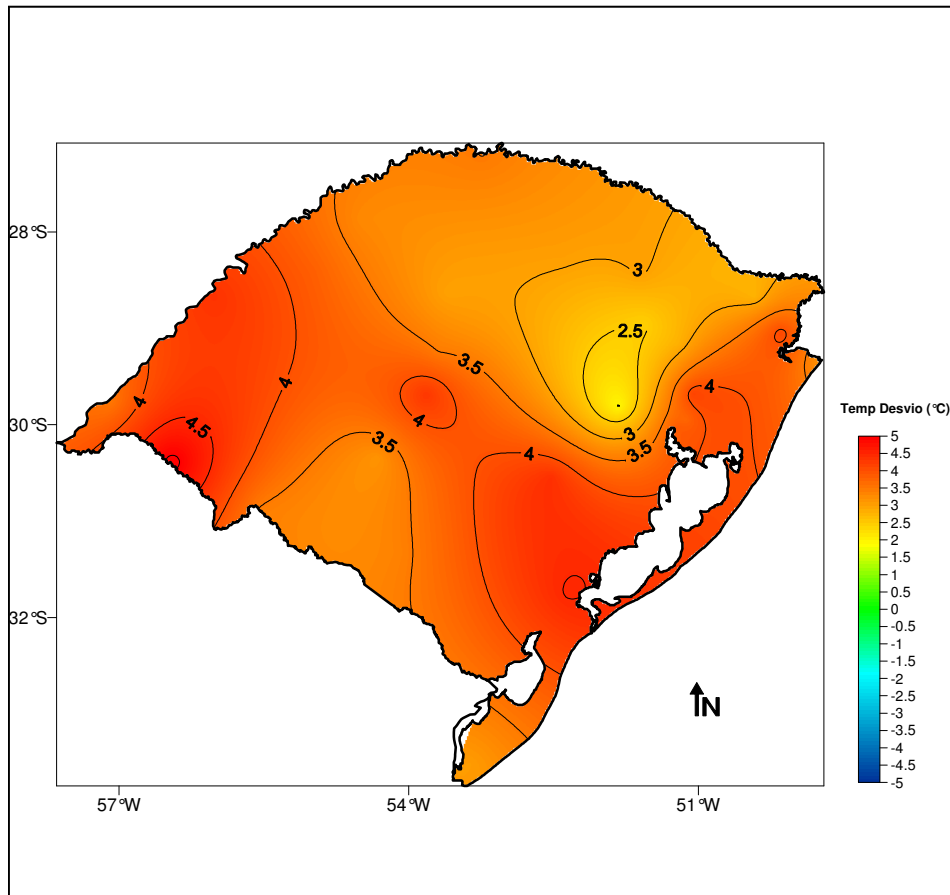


XIV Simpósio Brasileiro Sobre Pesquisa Antártica
Universidade de São Paulo - USP
Instituto de Geociências
Centro de Pesquisas Antárticas - CPA
São Paulo, 04 a 06 de Outubro de 2006

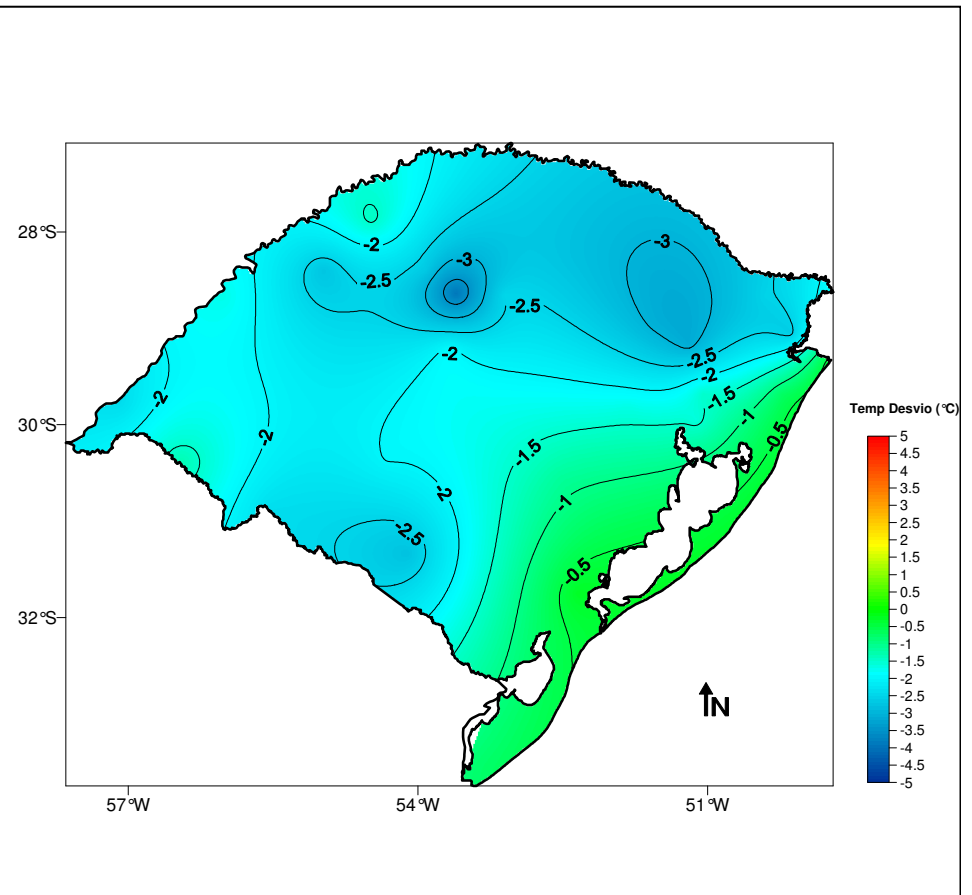


Anomalia da temperatura média do ar (°C) no RS em dois meses contrastantes de 2005

Desvio da média,
Junho/2005



Desvio da média,
Setembro/2005



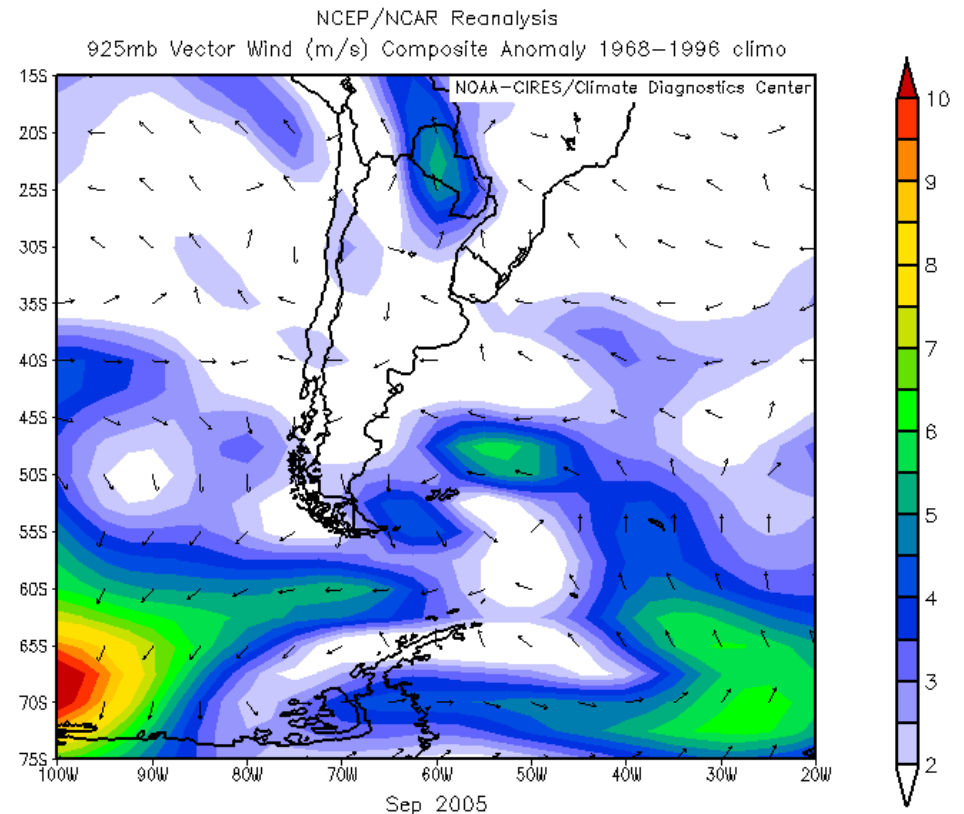
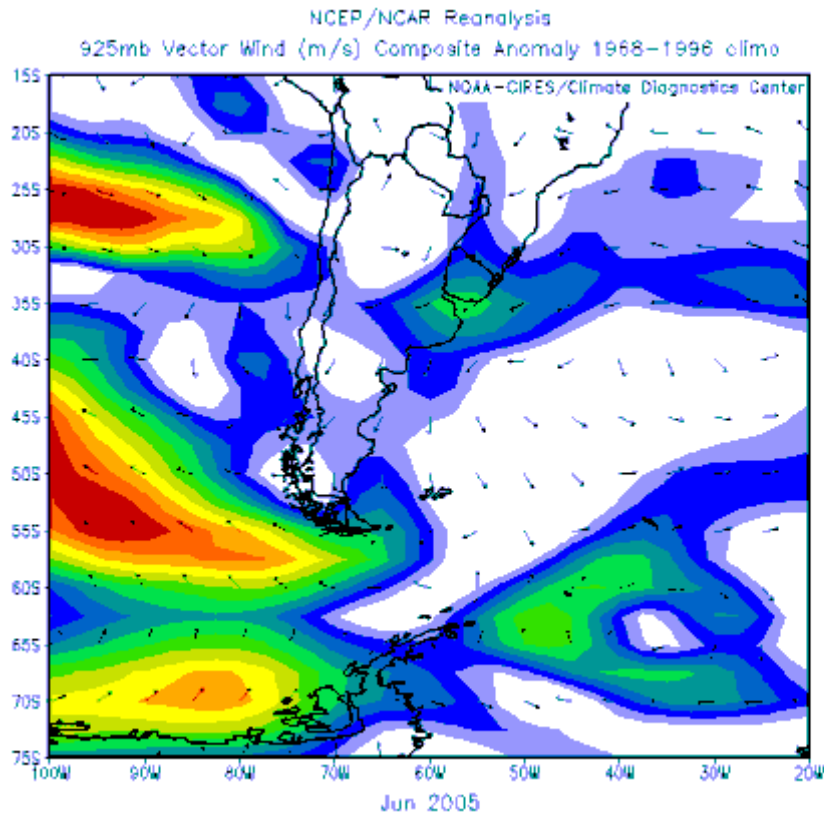
Anomalia mensal do vetor vento em 925 hPa (m/s) em dois meses contrastantes de 2005

Junho/2005

(evento quente – observar anomalia de norte para sul)

Setembro/2005

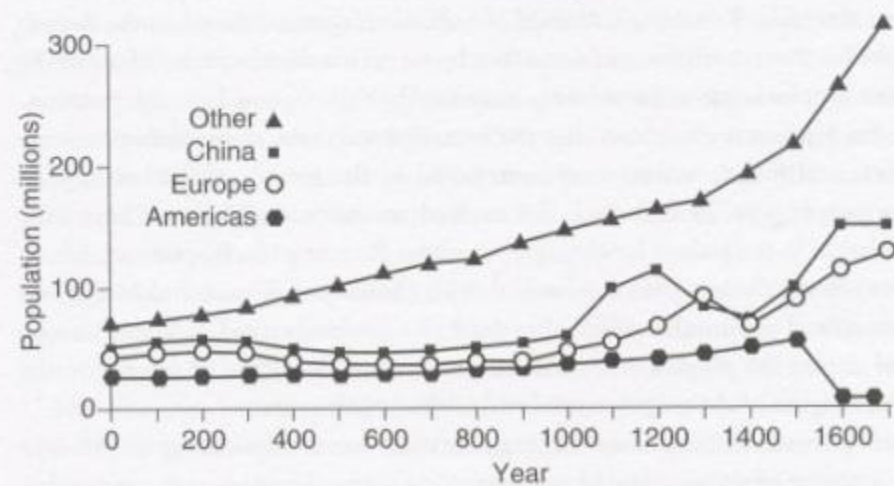
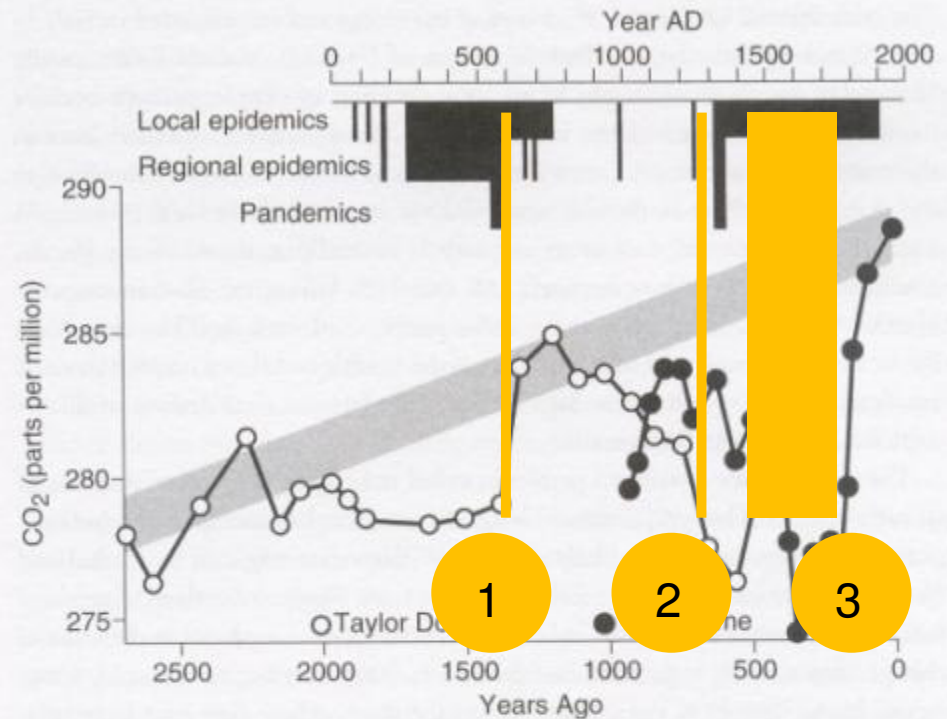
(evento frio – observar anomalia de sul para norte)



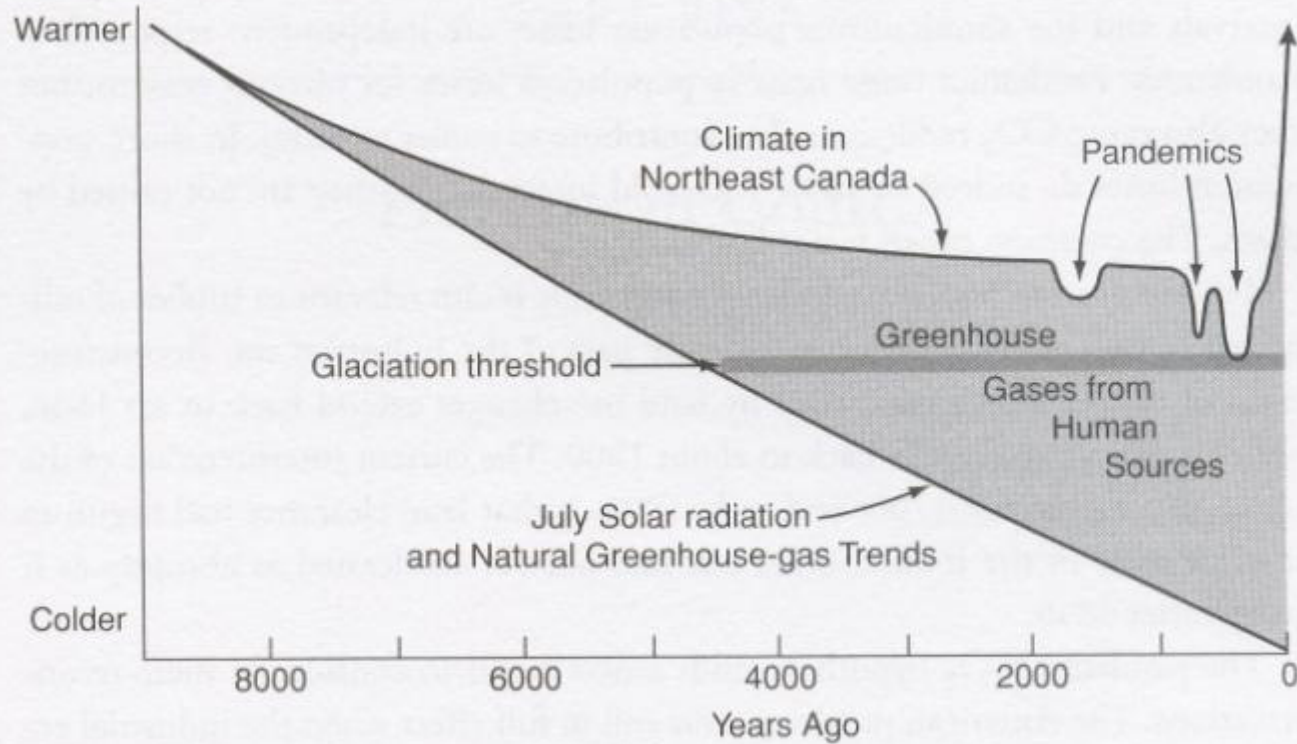
- 1 Era Romana (peste Bubônica)
- 2 Idade Média (peste Negra)
- 3 Varíola e outras (90% Pop. Américas)

Fonte: William F. Ruddiman, 2005.

PLOWS, PLAGUES & PETROLEUM, HOW HUMANS
TOOK CONTROL OF CLIMATE. 202p.



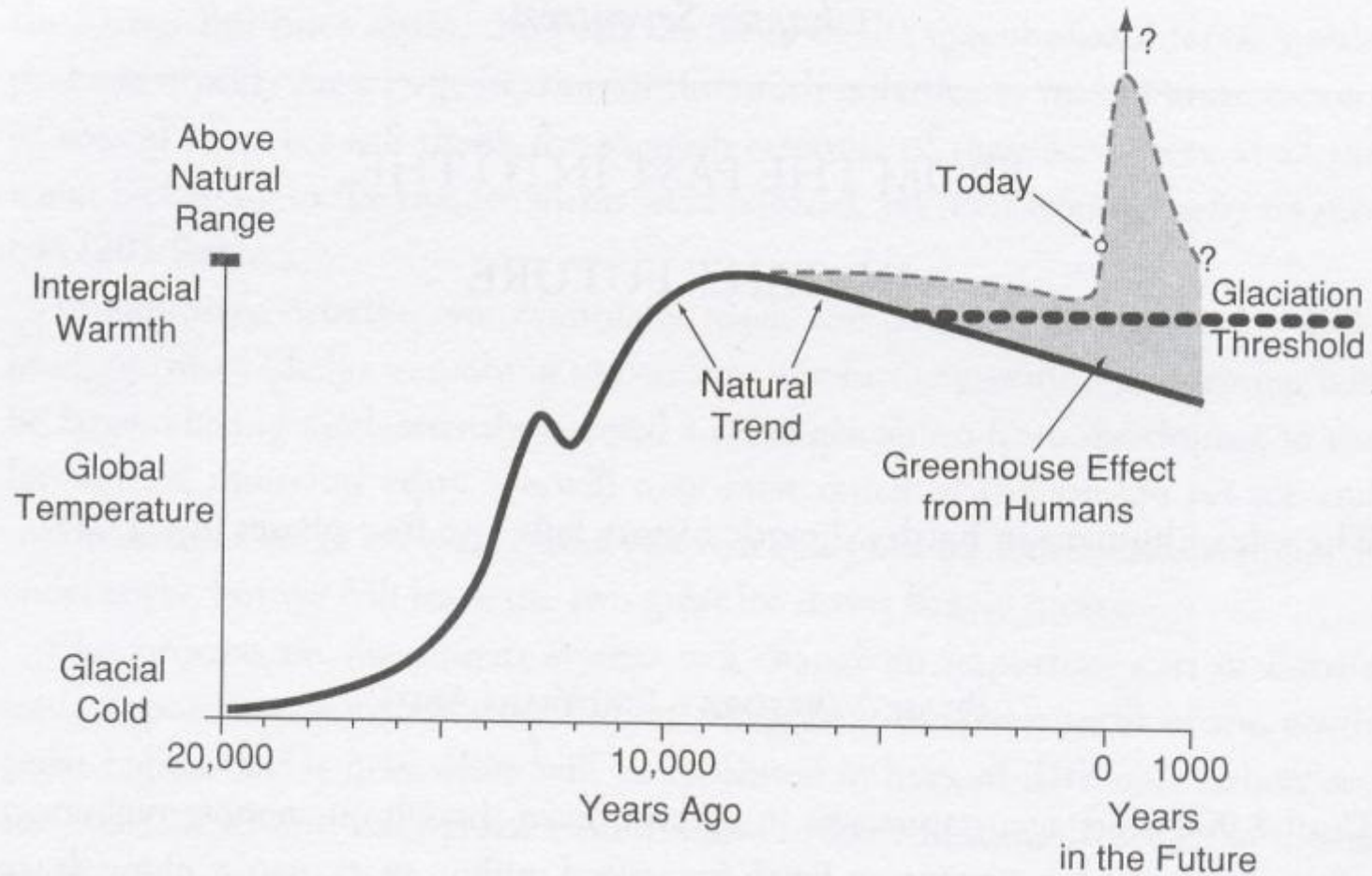
13.1. Intervals of low CO₂ concentrations in Antarctic ice cores correlate (within dating uncertainties) with major pandemics that decimated populations in Eurasia and the Americas.



14.2. CO₂ drops caused by major pandemics probably brought parts of northeastern Canada to the threshold required for renewed glaciation.

Fonte: William F. Ruddiman, 2005.

PLOWS, PLAGUES & PETROLEUM, HOW HUMANS
TOOK CONTROL OF CLIMATE. 202p.



Fonte: William F. Ruddiman, 2005.

PLOWS, PLAGUES & PETROLEUM, HOW HUMANS
TOOK CONTROL OF CLIMATE. 202p.

Pontos importantes !

- O Planeta está no período mais quente desde o início dos registros (1860), +0,7°C;
- O século XX é o mais quente dos últimos 2000 anos;
- Há um importante consenso científico internacional de que as atividades humanas têm contribuído no aquecimento Global, criando rupturas ou interferências na natureza tais como: ciclos dos nutrientes, ecossistemas, nível médio do mar, chuvas, ondas de calor/frio;
- O RS (Região Sul) pela sua localização geográfica possui um clima associado com a, mudanças/alterações, circulação atmosférica e oceânica no Hemisfério Sul;



Ciclo de Debates 2010

“Repensando o desenvolvimento frente ao encontro de Copenhague”

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- Geól. Juliana Young

OBRIGADO !



Porto Alegre, 23 de Junho de 2010.