



BESM

Brazilian Earth System Model



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World Meteorological Organization

The hydrology of tomorrow with the Brazilian Earth System Model

Paulo Nobre

MCTI/INPE/CPTEC

Workshop ANA/CAPES, Brasília, 19 de maio de 2016



Ministério da Ciência, Tecnologia,
Inovações e Comunicações - MCTI

Oficina de Trabalho

Edital ANA/CAPES Mudanças do Clima e Recursos Hídricos n° 19/2015

DESENVOLVIMENTO DO MODELO BRASILEIRO DO SISTEMA TERRESTRE –
BESM E GERAÇÃO DE CENÁRIOS DE MUDANÇAS CLIMÁTICAS, VISANDO
ESTUDOS DE IMPACTOS SOBRE OS RECURSOS HÍDRICOS

Paulo Nobre – INPE

Alfredo Ribeiro Neto – UFPE

Luiz Antonio Cândido – INPA

Brasília, 19 de maio de 2016

Objetivos

- Avaliar o impacto da inclusão dos módulos de aerossóis e química no Modelo Brasileiro do Sistema Terrestre (BESM) no ciclo hidrológico das principais bacias hidrográficas do país.
 - Implementar módulos de aerossóis (MAM) e química (MOZART) do NCAR no BESM;
 - Avaliar o impacto desses no balanço radiativo, ciclo hidrológico e umidade do solo do clima atual;
 - Avaliar impactos na disponibilidade hídrica futura nos cenários de Mudanças Climáticas RCP4.5 e RCP 8.5

Impactos da pesquisa para o avanço da ciência e sociedade

- Geração de cenários de mudanças climáticas mais realistas globais e seus impactos para o Brasil;
- Geração de suite de previsões contínuas de tempo, clima, e mudanças climáticas para a geração de políticas públicas;
- Formação de pesquisadores competentes para o desenvolvimento e utilização de modelo global do sistema terrestre.

Impactos para a gestão de Recursos Hídricos

- Gestão de alocação de águas para o uso compartilhado para abastecimento, geração hidrelétrica, indústria/agricultura:
 - variabilidade climática presente e
 - mudanças climática futuras;
- Planejamento de longo prazo para disponibilidade hídrica futura
 - E.g. diversificação da matriz energética nacional utilizando fontes/tecnologias complementares.

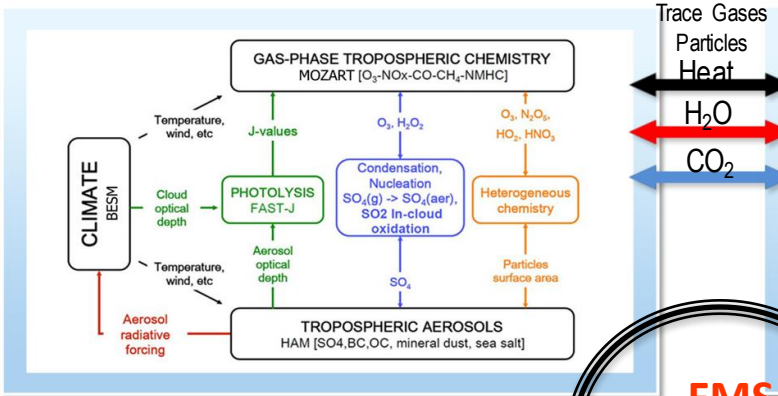
Cronograma de atividades

- Implementação dos componentes de aerossóis e química no BESM [1-12]
- Realização de integrações do BESM para o clima presente (1850-2010) [6-18]
- Geração de cenários climáticos RCP 4.5 e RCP 8.5 (2010-2100) [12-18]
- Estudos de impactos na variabilidade e mudança da disponibilidade hídrica [12-24]

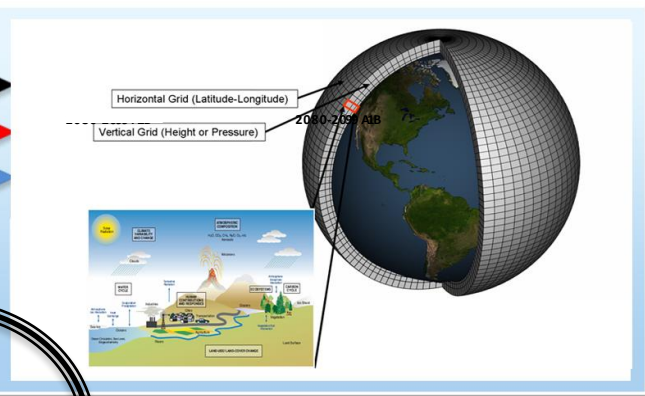


BESM Component Models

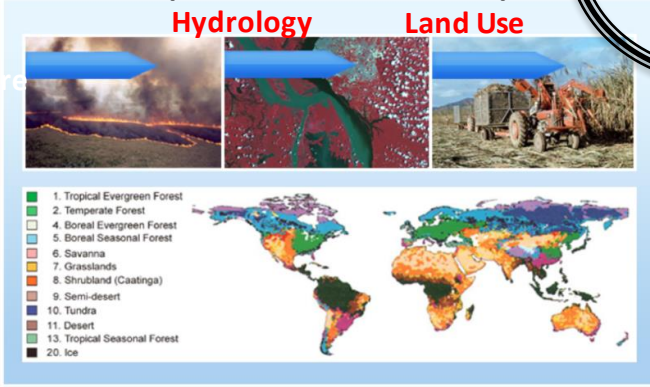
ATMOS CHEMISTRY (MOZART- NCAR)



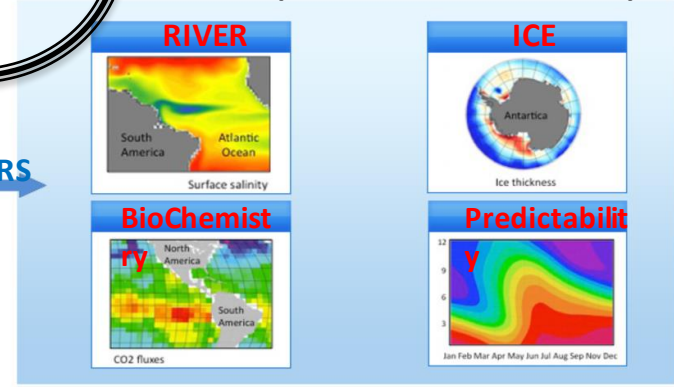
ATMOSPHERE (INPE/CPTEC)



LAND (INLAND – INPE/CCST)



OCEAN (MOM5 – NOAA/GFDL)



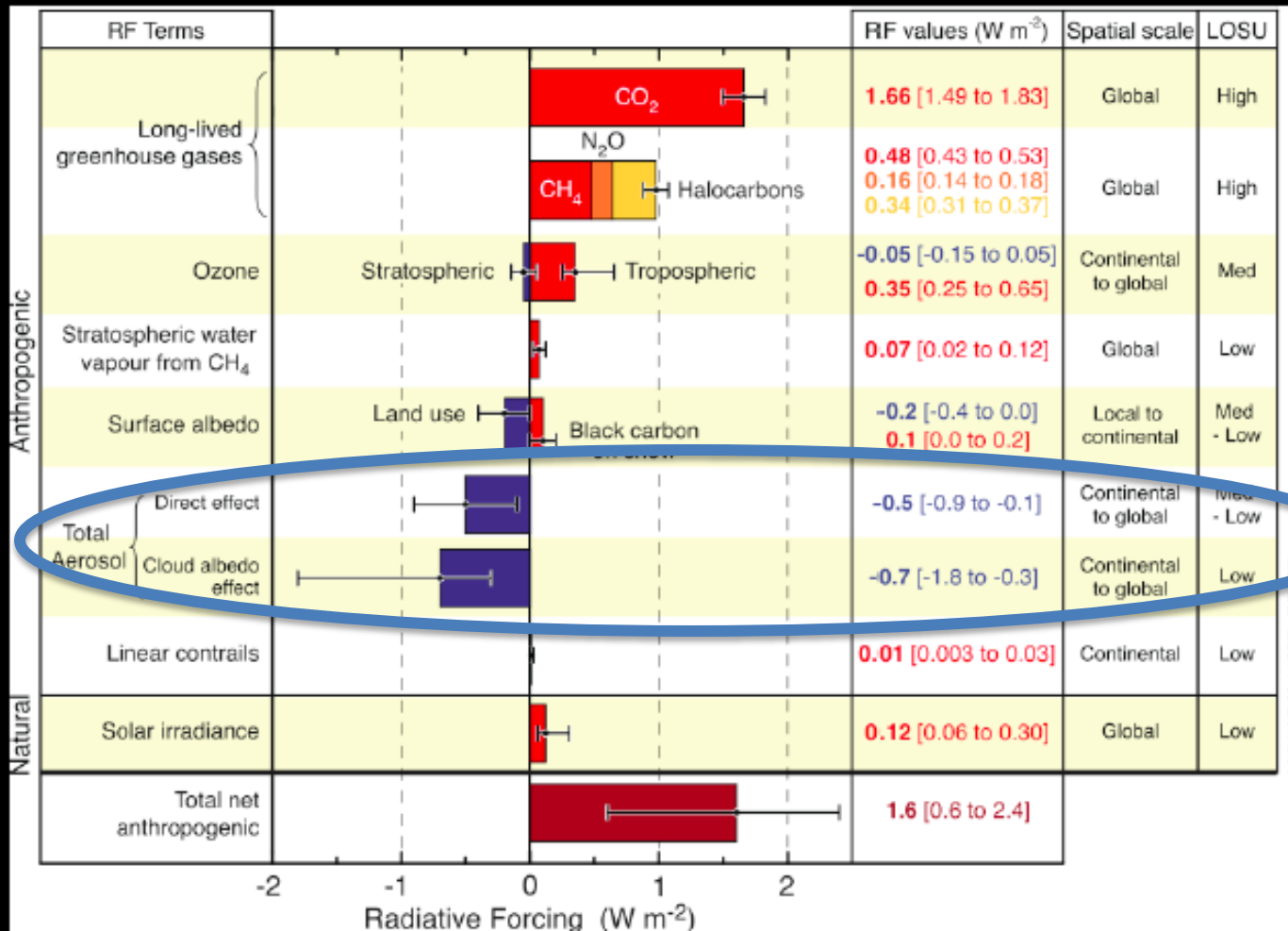
**FMS
COUPLER**

RIVERS





Radiative Forcing



Radiative forcings in 2005; from Ramaswamy et al. *Technology, Policy, and the Environment* - MCTI

BESM: SAME-MODEL From Weather Forecasting To Global Climate Change Scenarios

Extreme Events Hit Brazil



T126L64

T126L42

T666L96

30min 5 days

NWP

General Use

DERF

Agriculture
Planning
Water Resources
Energy

T213L64

1 Month

Seasonal Climate

Industry (clothing, beverages, ice creams)
Agriculture, Water Resources, Energy

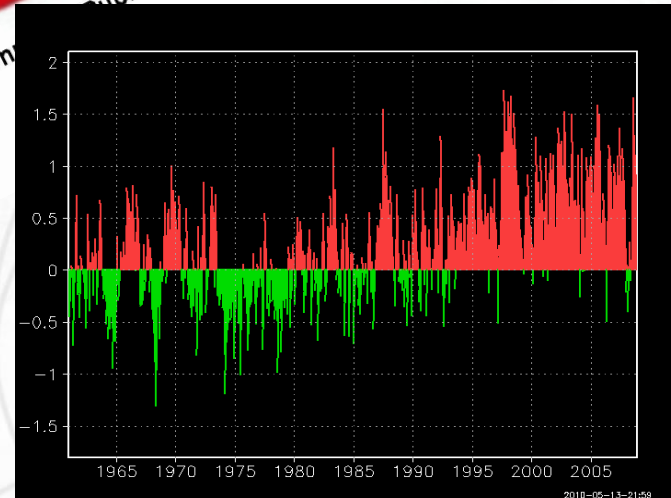
1 year

Government

Climate Change

1 century

Surface Temperature Trend in Brazil



Extremos Hidrológicos: Impacto na Saúde e Economia





ESTADÃO

POLÍTICA +

ECONOMIA +

INTERNACIONAL

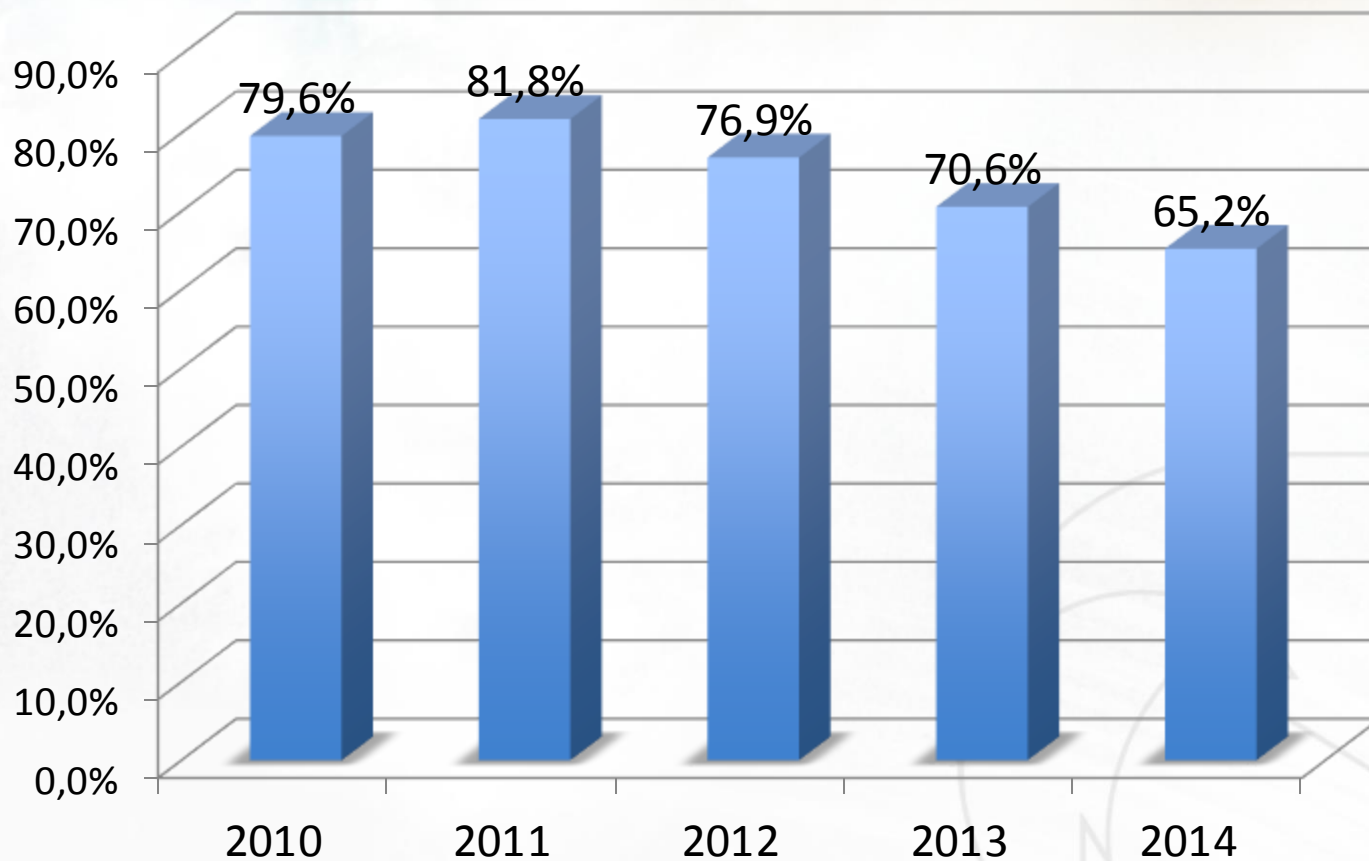
Maiores represas do Cantareira viram córrego

21 outubro 2014

Cantareira: **3,0 %**

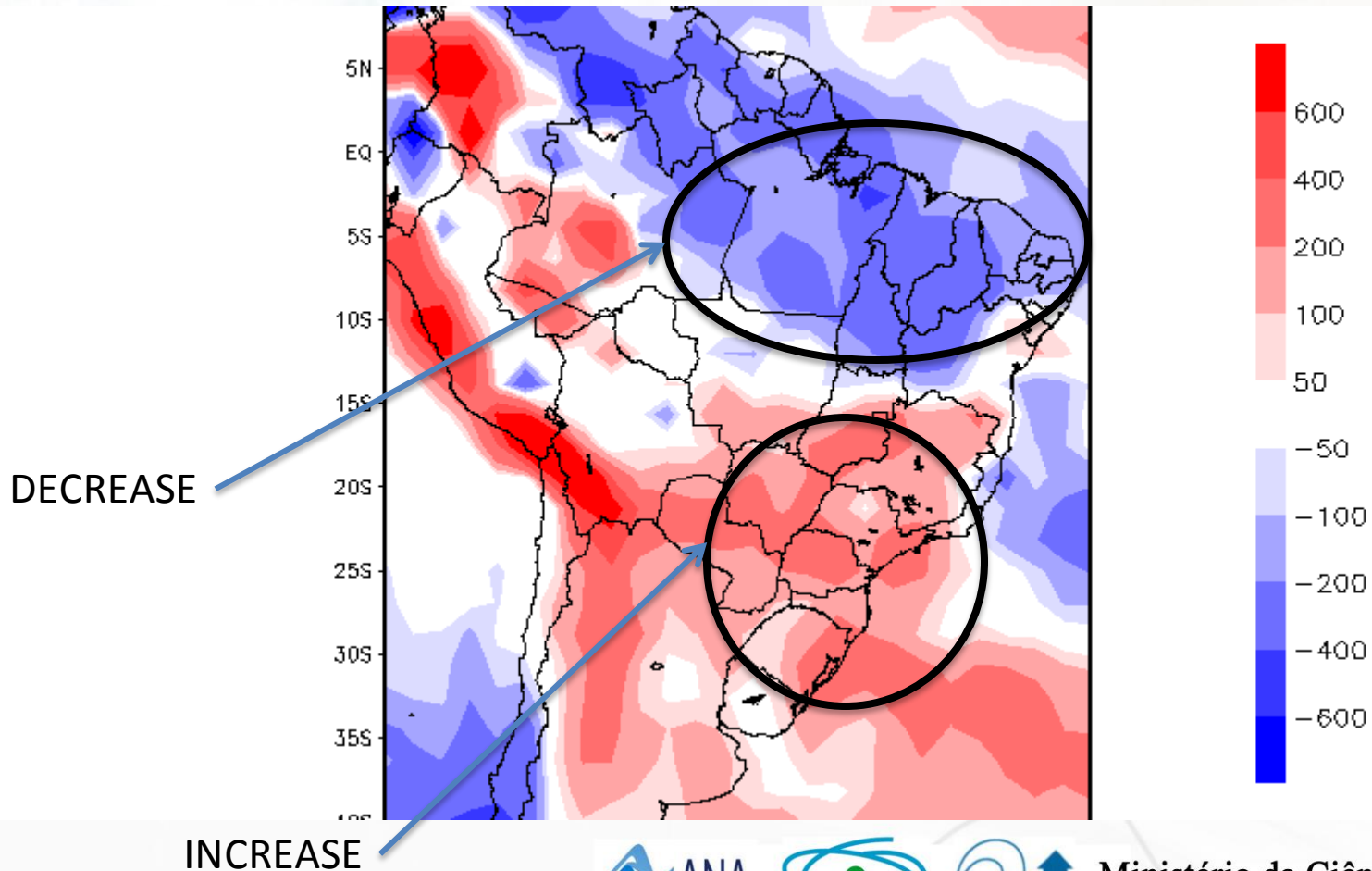


% Produção Hidrelétrica Energia Elétrica Nacional



BESM Extreme Events in a Changed Climate

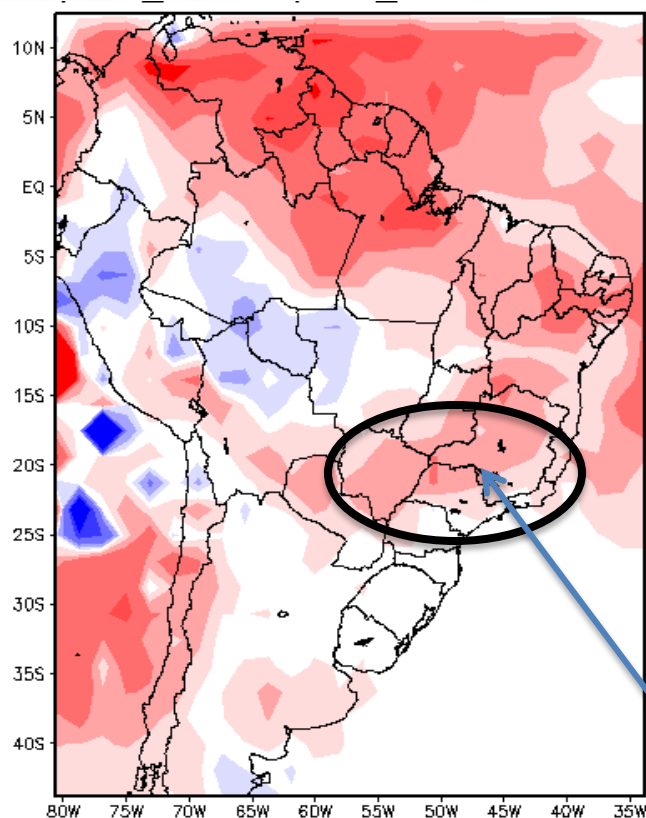
Annual Mean Precipitation Variation



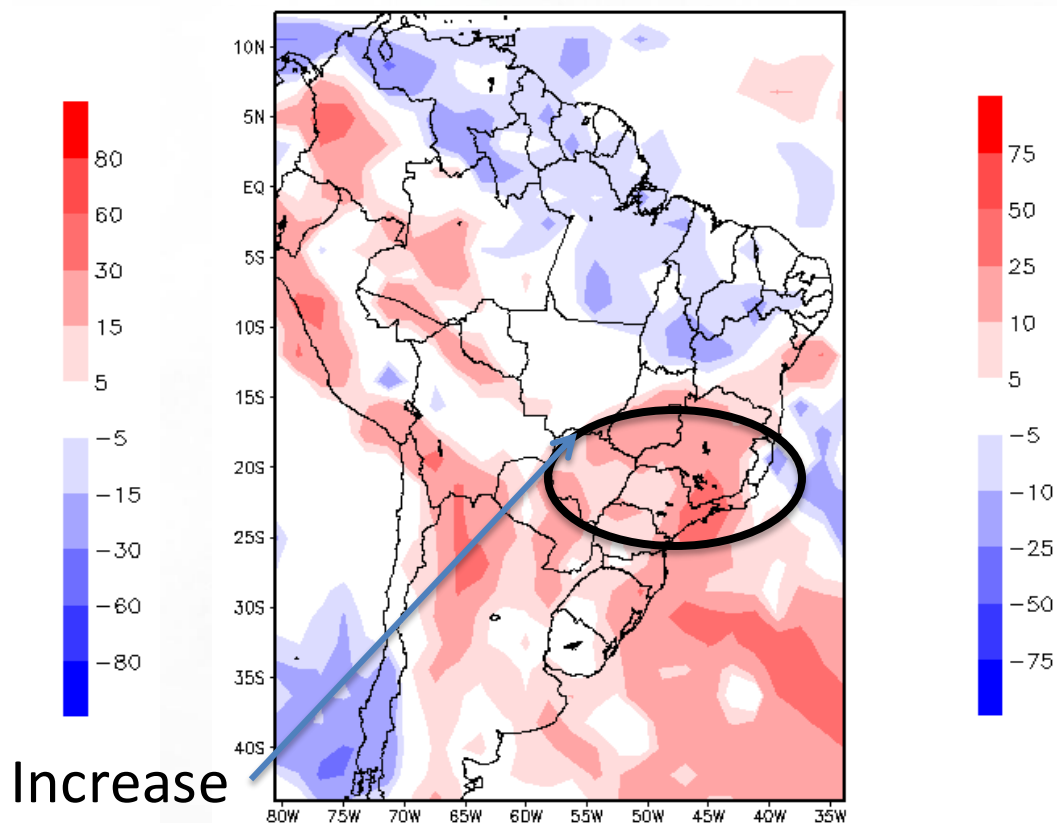
Source: Pesquero, Nobre et al (2016)

BESM Extreme Events in a Changed Climate

Consecutive Dry Days



Extreme Precipitation Days



Increase

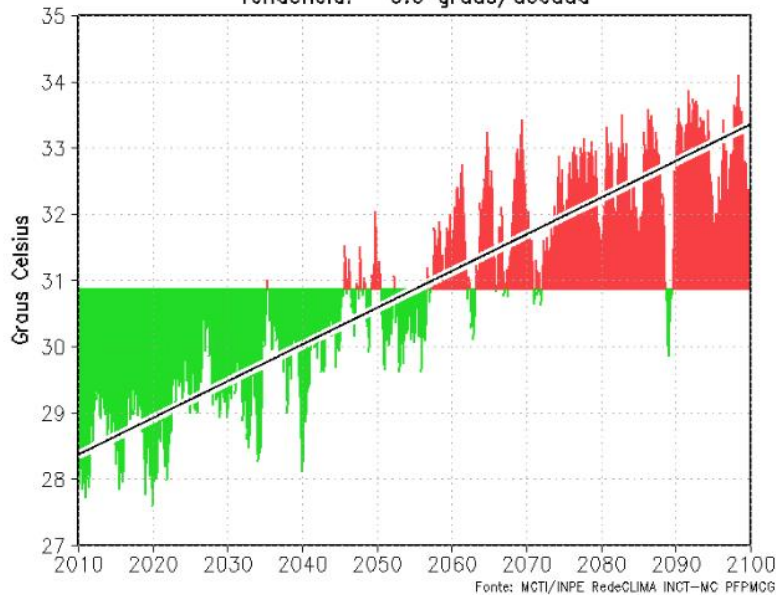
Source: Pesquero, Nobre et al (2016)



Produtos

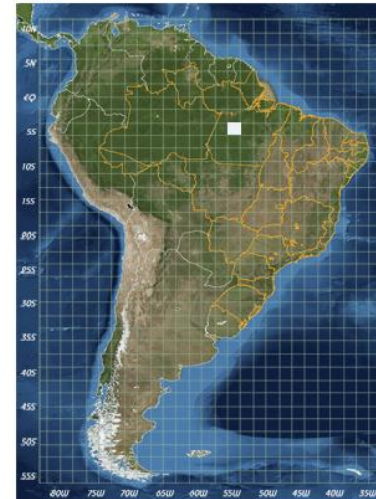
Valor médio para todo período de 2010 a 2100

TEMPERATURA RCP8.5 (54.4W 4.7S)
Tendência: 0.6 graus/decada



Selecione as opções:

Área:



Cenário: Variável:

Hosted by



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INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS



Powered by



The Earth System Grid Federation is currently in the process of redeployment. Although individual sites such as this one have been brought online you should consider the system at risk until integration testing between sites is completed. An update to this notice will be made once this is the case.

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esgf-inpe

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Welcome to the ESGF Node @ INPE/CPTEC

The Earth System Grid Federation (ESGF) maintains a global system of federated data centers that allow access to the largest archive of climate data world-wide. The ESGF Node at INPE/CPTEC is focused on supporting the access to the Brazilian Earth System Model (BESM) output. You can use this node as starting point for searching and downloading model output that are stored throughout the federation. You can also start from any of the other Nodes to download climate model output, reanalysis fields, as well as gridded and satellite data.



Search & Download Data ?

Simple Text Search

Search with options

Browse Projects

Parent projects (0)

Peer projects (0)

Child projects (1)

besm

Start typing, or use the 'Delete' key to show all available tags.

esgf-inpe Tags: None

Last Update: April 21, 2016, 11:58 a.m. by Admin User



No Comments

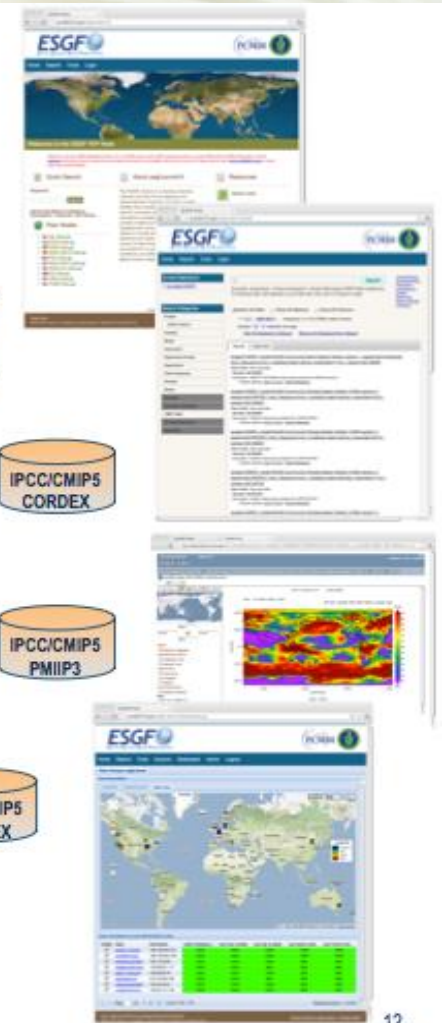


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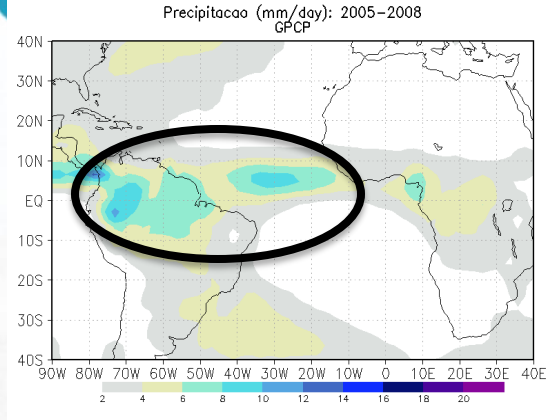
BESM
Brazilian Earth System Model

Brazil Participation on the Earth System Grid Federation - ESGF

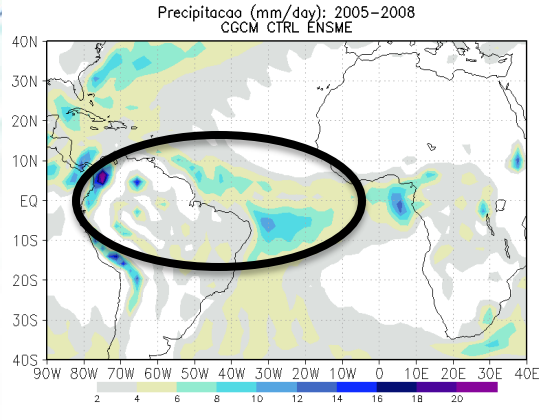


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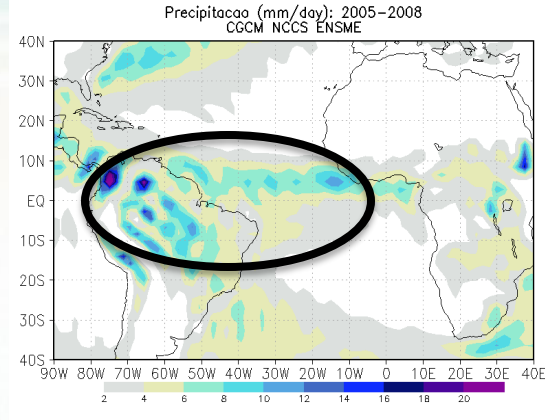
BESM AMAZON RAINFALL



BESM 2.3

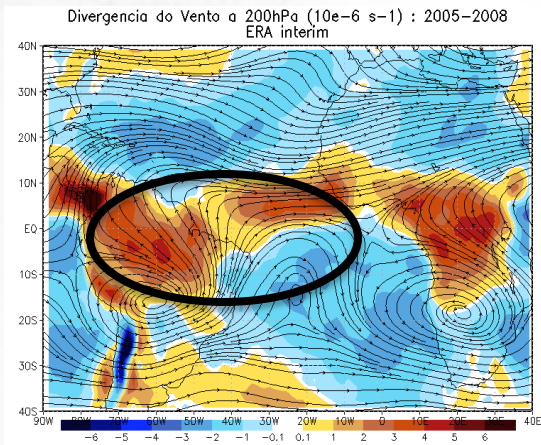


BESM 2.3.1

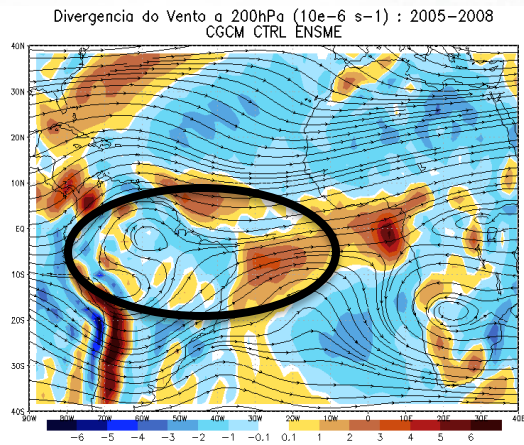


BESM UPPER LEVEL FLOW

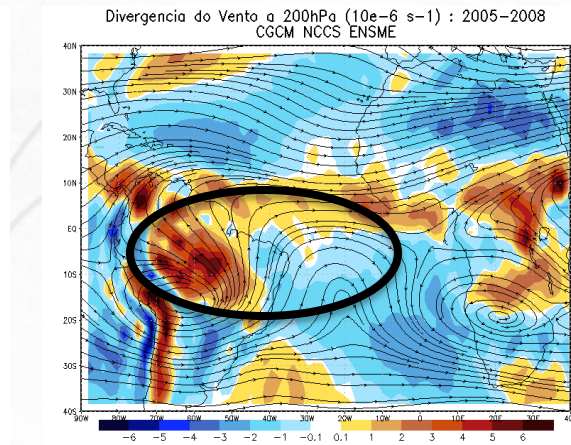
ERA interim REANALISYS



BESM 2.3

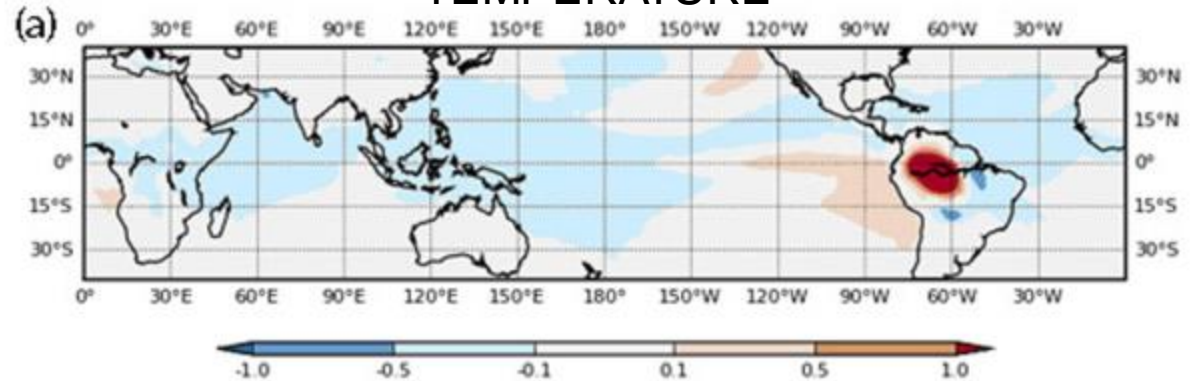


BESM 2.3.1

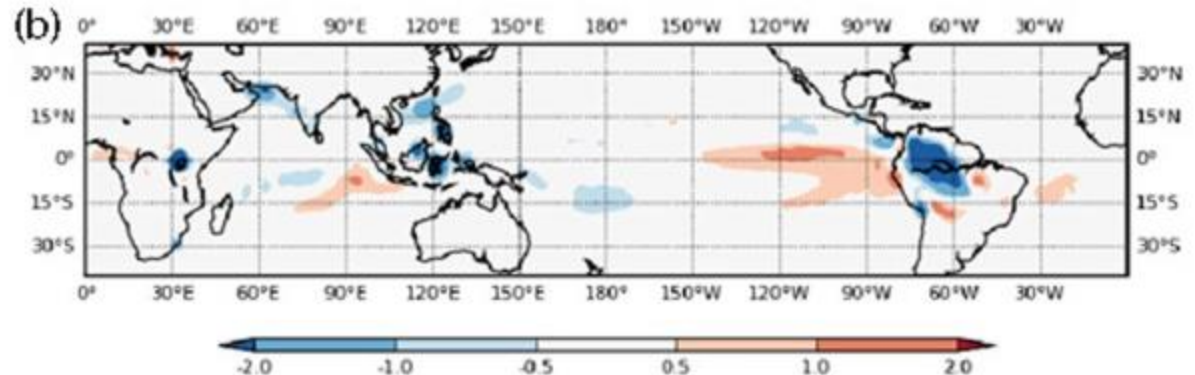


BESM Amazon Deforestation: Increased El Niño Conditions & Further Reduction of Amazon Rainfall

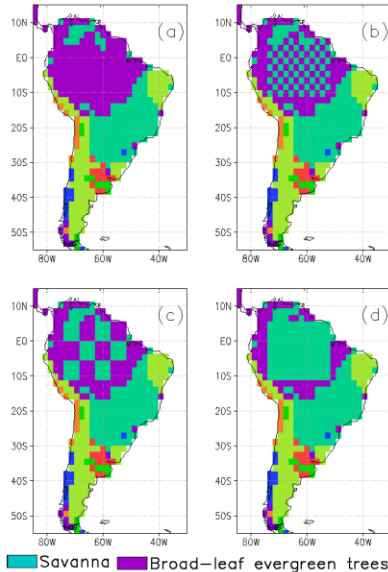
TEMPERATURE



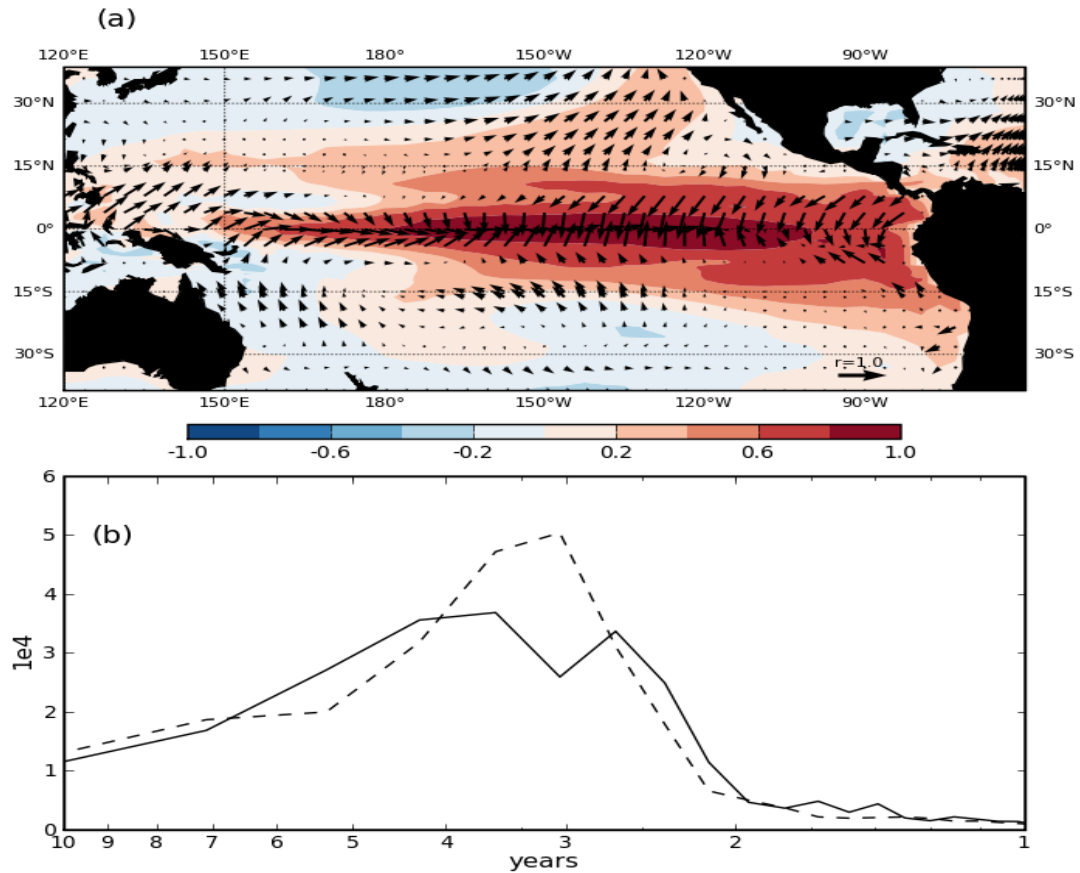
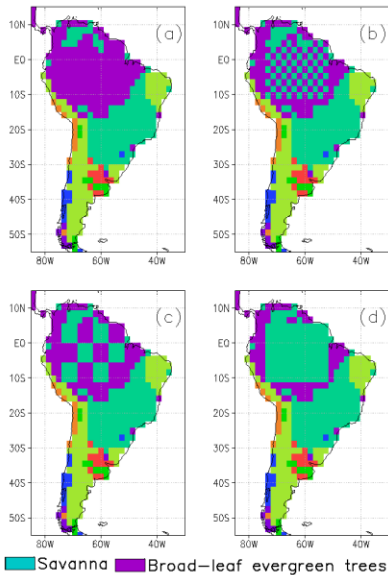
PRECIPITATION



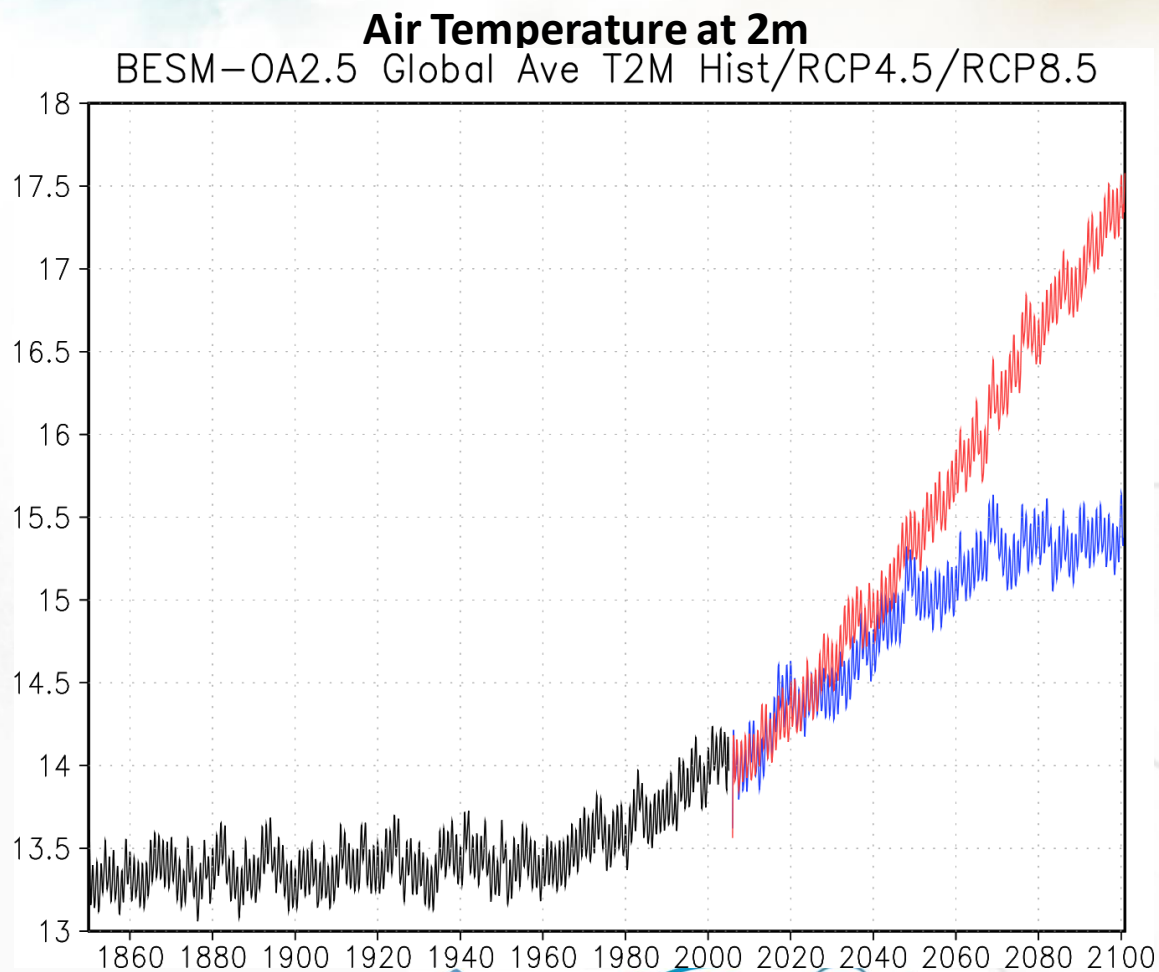
Statistically significant departures are shaded



BESM Amazon Deforestation: Increased El Niño Conditions & Further Reduction of Amazon Rainfall

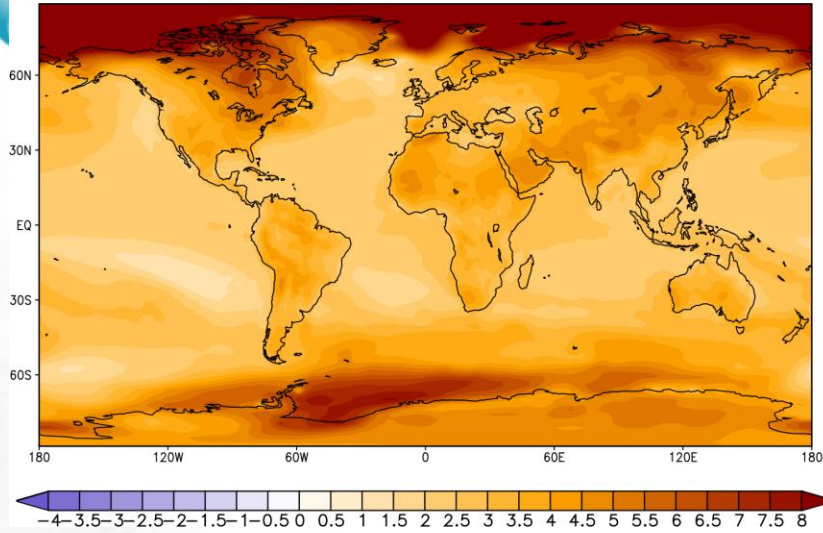


BESM2.5 CMIP5 Runs 1850-2100



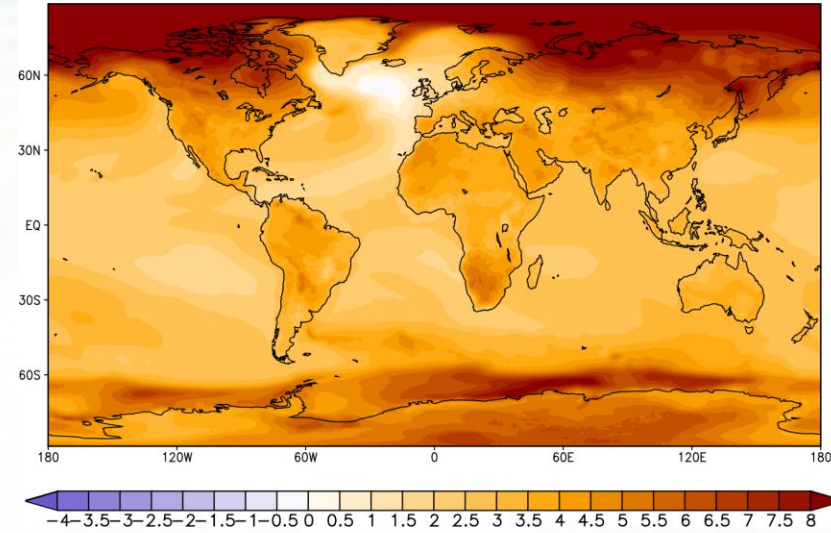
INPE/BESM 2.5

Annual near-surface air temperature (BESM2.5 RCP85 CMIP5)
(2096-2100)-(2006-2010)



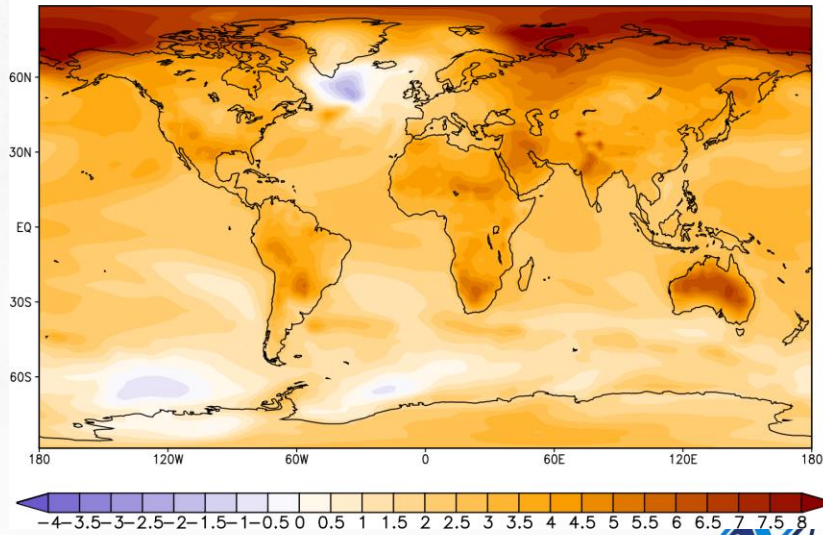
NCAR/CCSM 4

Annual near-surface air temperature (CCSM4 RCP85)
(2096-2100)-(2006-2010)



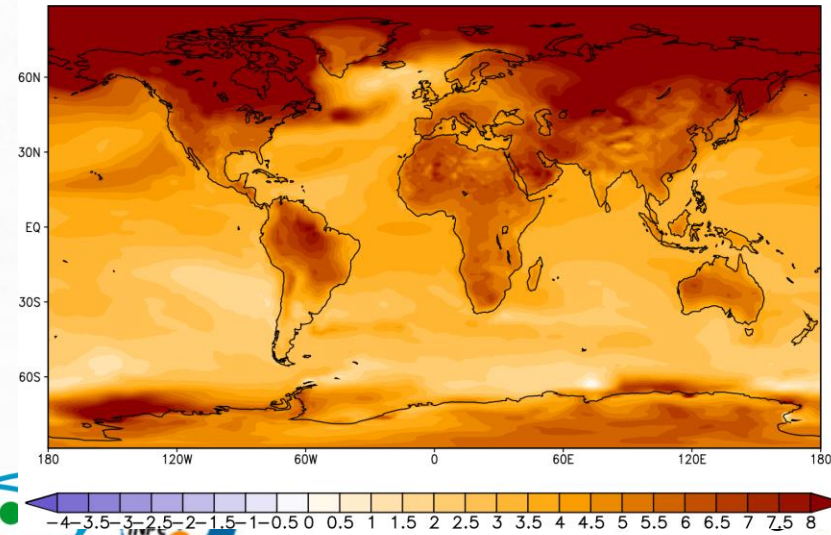
GFDL/CM 2.1

Annual near-surface air temperature (GFDL-ESM2M RCP85)
(2096-2100)-(2006-2010)



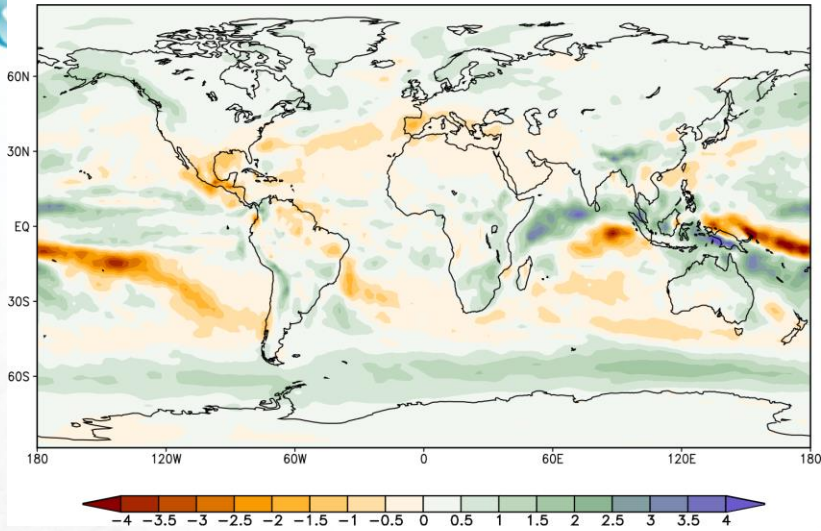
MOHC/HadGEM2-ES

Annual near-surface air temperature (HadGEM2-ES RCP85)
(2096-2100)-(2006-2010)



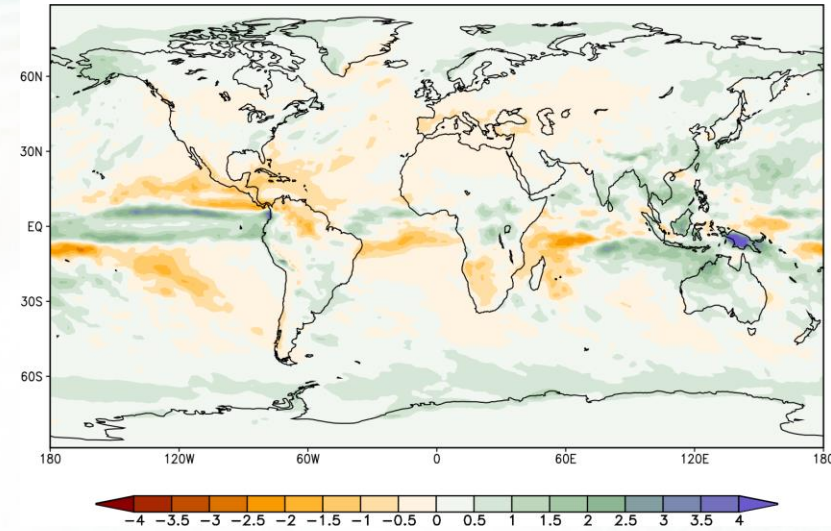
INPE/BESM 2.5

Annual precipitation in mm/day (BESM2.5 RCP85 CMIP5)
(2096-2100)-(2006-2010)



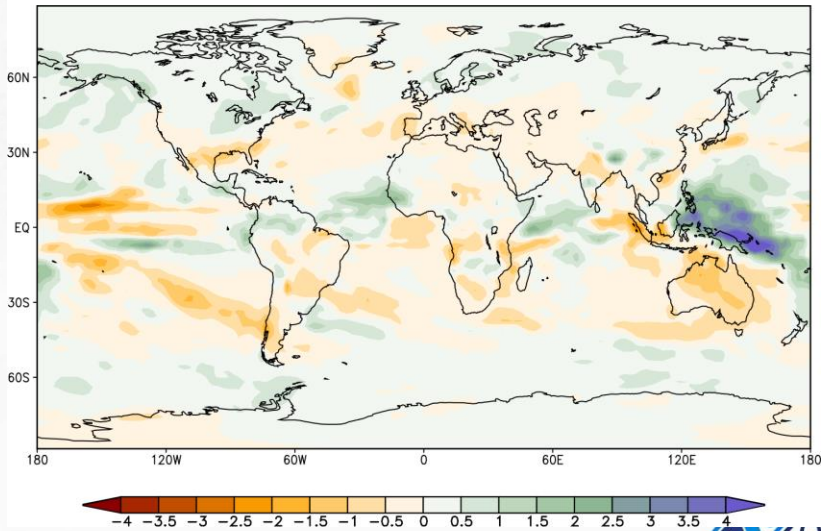
NCAR/CCSM 4

Annual precipitation in mm/day (CCSM4 RCP85)
(2096-2100)-(2006-2010)



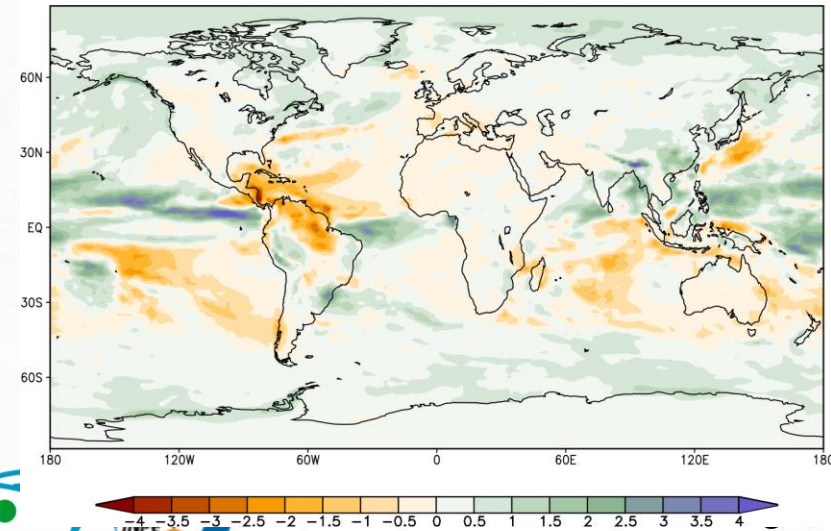
GFDL/CM 2.1

Annual precipitation in mm/day (GFDL-ESM2M RCP85)
(2096-2100)-(2006-2010)



MOHC/HadGEM2-ES

Annual precipitation in mm/day (HadGEM2-ES RCP85)
(2096-2100)-(2006-2010)

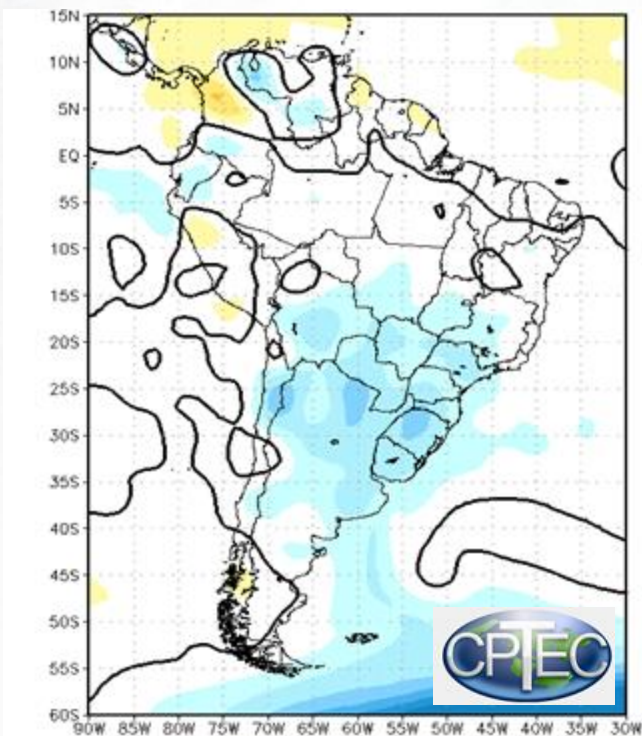


Previsão do BESM para 3a e 4a Semana

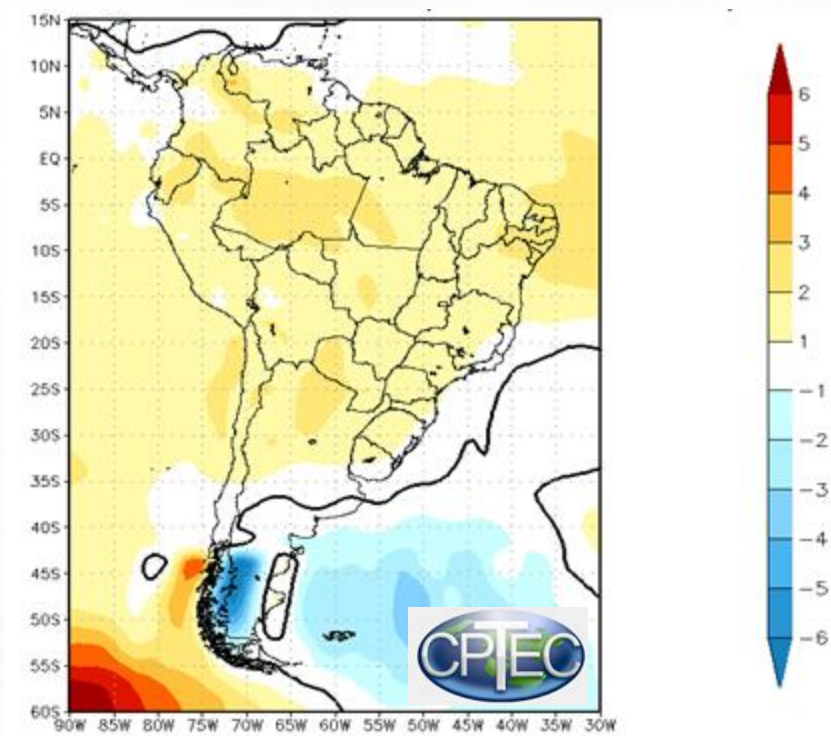
2016 05 31 – 2016 06 14

Condição Inicial: 2016 05 16 – 5 membros

Anomalia de Temperatura a 2 m



Anomalia de Pressão ao Nível Médio do Mar





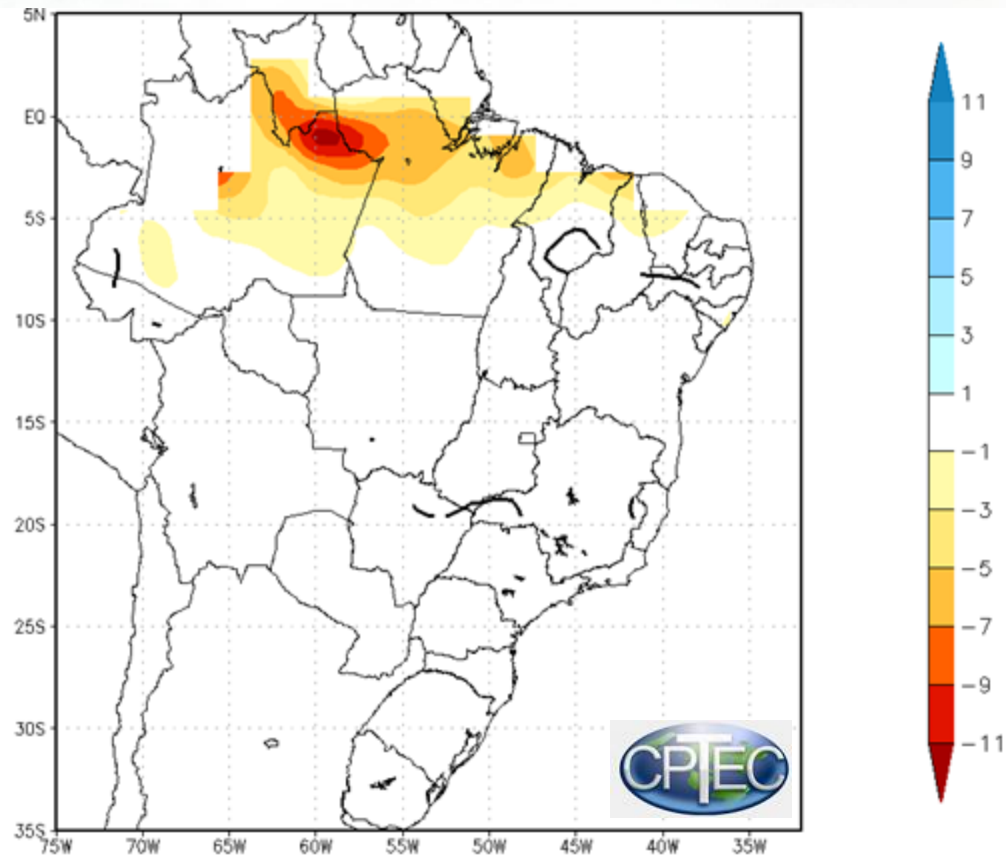
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Brazilian Earth System Model

Previsão do BESM para 3a e 4a Semana

2016 05 31 – 2016 06 14

Condição Inicial: 2016 05 16 – 5 membros

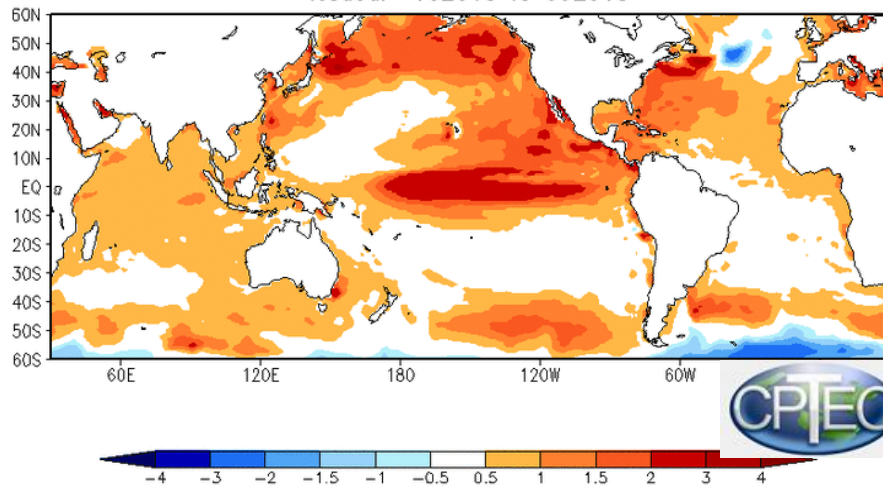
Anomalia de Precipitação (mm)



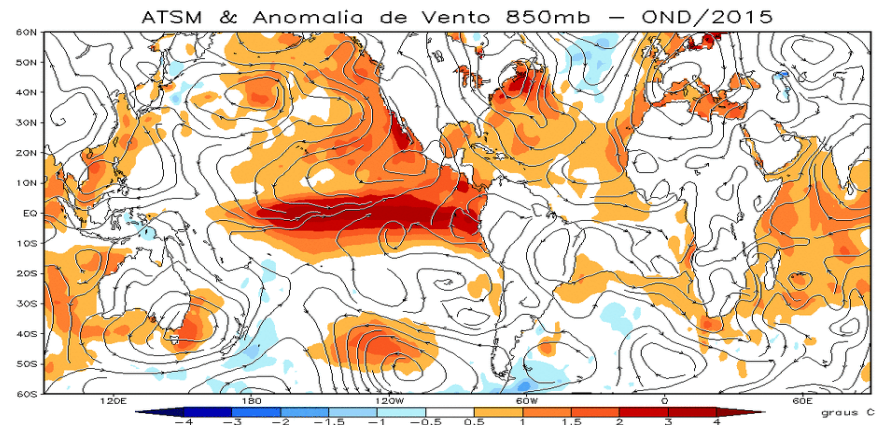
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OND 2015 SST FCST IC: Sept/2015

CGCM-CPTEC SST ANM. FCST (Valid for NDJ 2016)
Issued: 10/2015 IC 09/2015



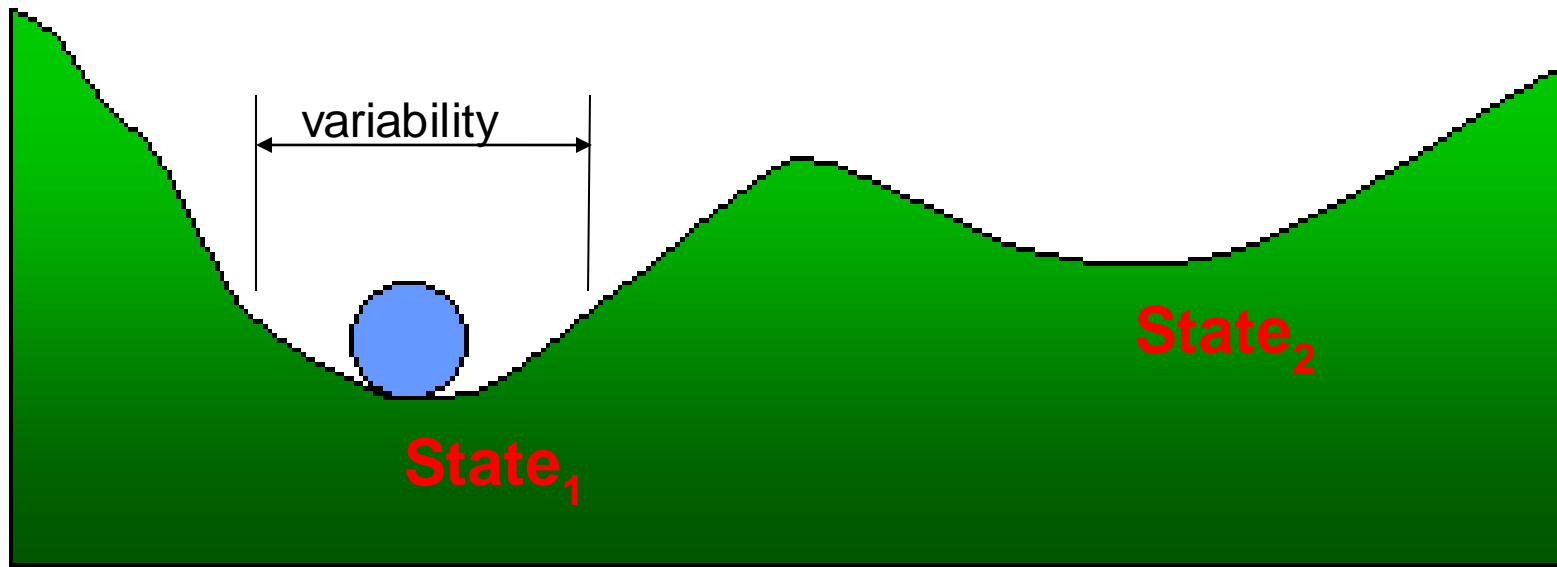
OND 2015 SST ersst





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Climate Variability x Change



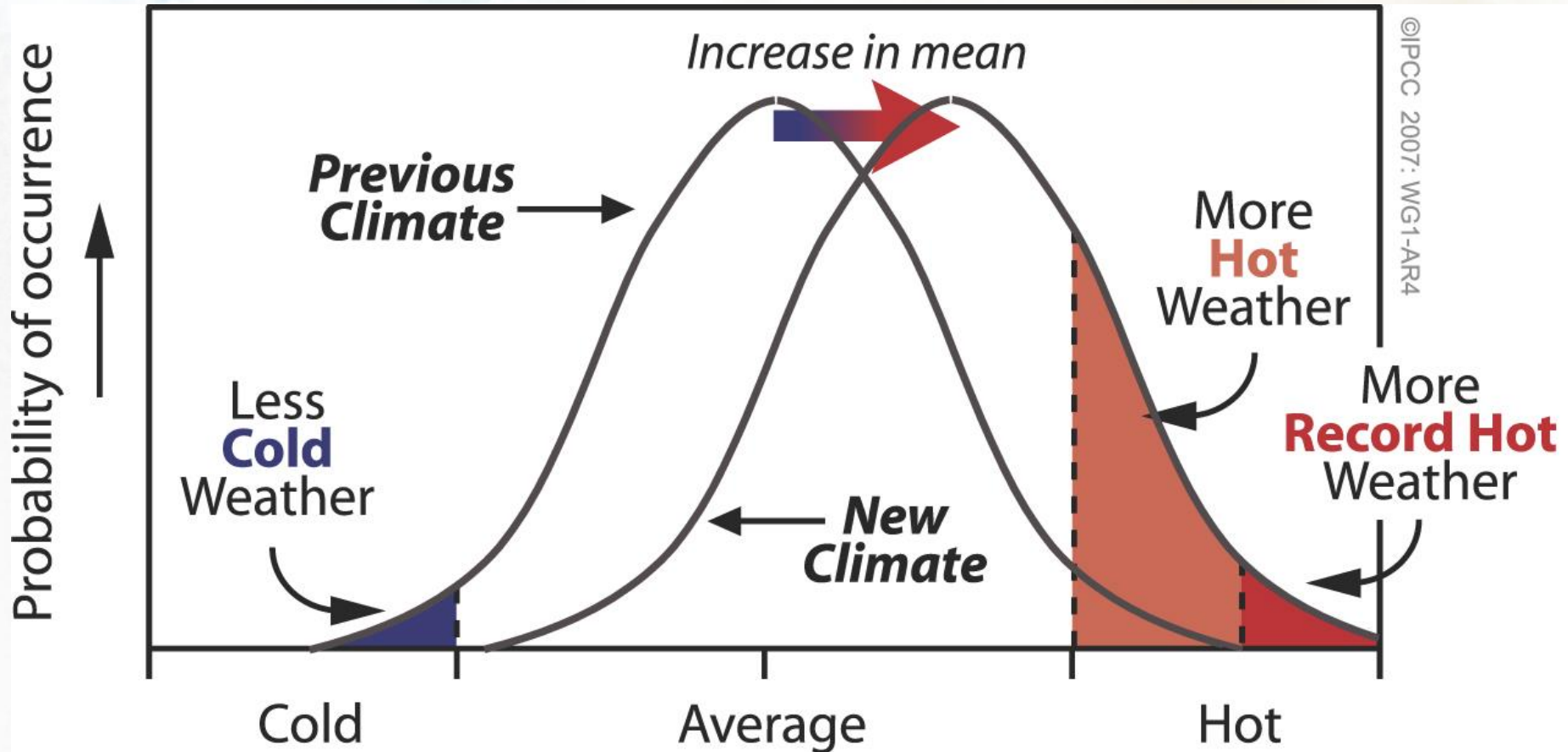
$$T_1 < T_2$$



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Change of Frequency of Extremes





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Cenários Cotas de Rios

Exemplo Rio Madeira



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