

# Projeções de mudanças climáticas sobre São Paulo e a plataforma PROJETA



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# PROJEÇÕES x PREVISÕES

Nas previsões, a partir de uma dada condição inicial, os modelos numéricos são utilizados para prever as condições de tempo ou climáticas num horizonte de tempo futuro.

Nas projeções, são incluídas suposições no futuro e os modelos são utilizados para representar o clima nestes cenários supostos, por exemplo, de diferentes taxas de emissão dos gases de efeito estufa ou diferentes forçantes radiativas (ex. RCP4.5W/m<sup>2</sup>).

O termo "projeção" é usado em dois sentidos na literatura sobre mudanças climáticas:

1- No uso geral, uma projeção pode ser considerada qualquer descrição do futuro e o caminho que leva a ela.

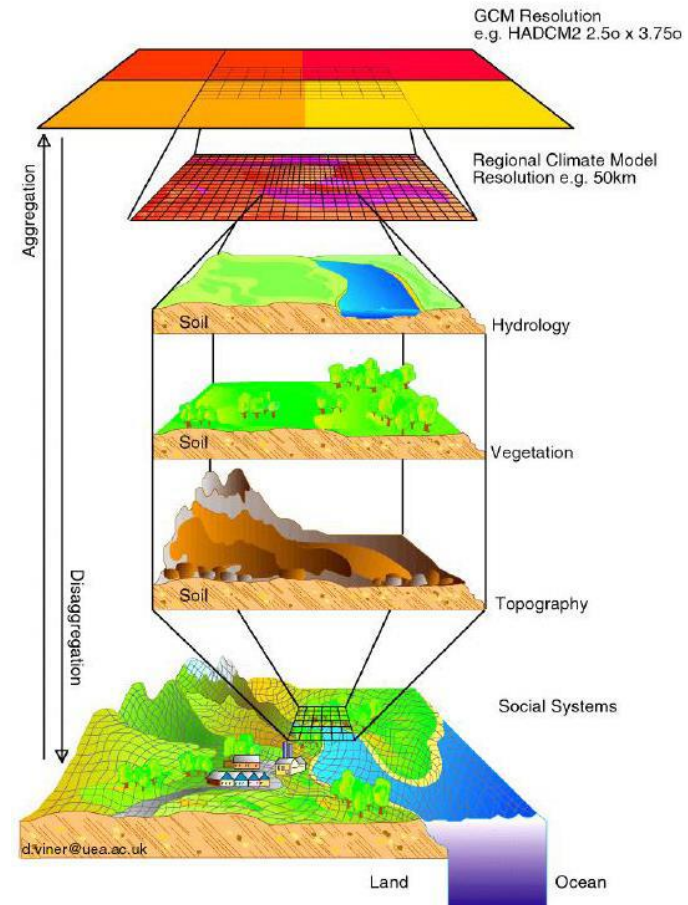
2- Uma interpretação mais específica foi anexada ao termo "projeção climática" pelo IPCC ao se referir a estimativas derivadas de modelos de clima futuro.

# Projeções climáticas regionalizadas ?

Topografia, vegetação, solo e linha de costa são melhores representados com a regionalização.

Tomadores de decisão estão exigindo cada vez mais informações sobre o clima em escala regional ou local, além de querer entender os impactos da mudança climática em setores específicos.

Crucial para os estudos dos impactos porque se adapta melhor a resolução espacial/temporal desses setores: agricultura, segurança alimentar, hidrologia, recursos energéticos, economia, doenças e vulnerabilidade da população.



# Experiência do INPE com Downscaling

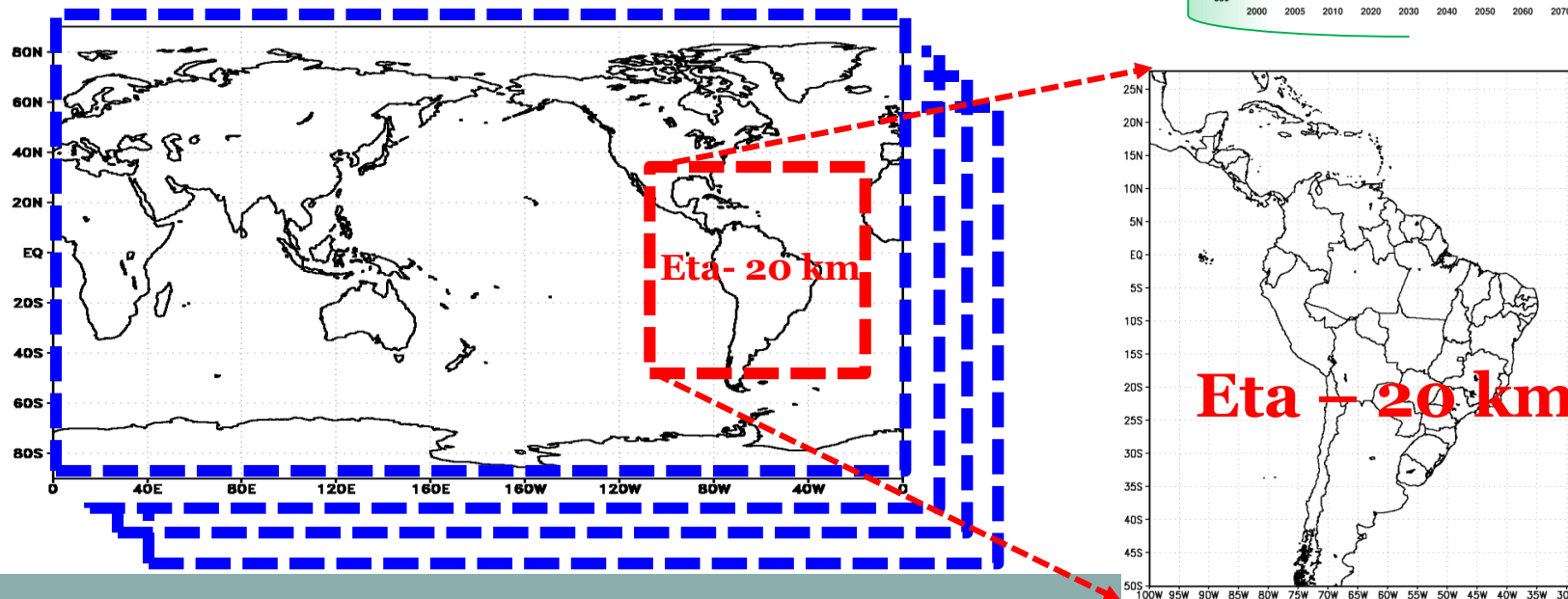
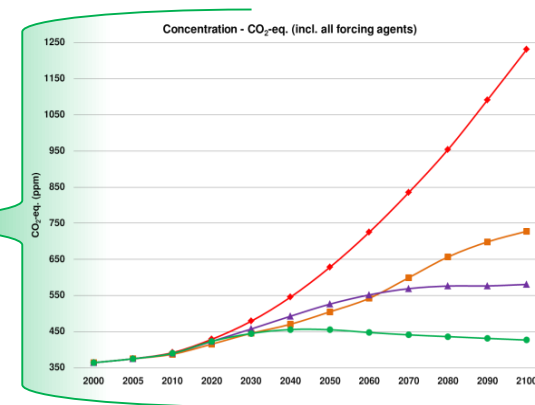
Apoio: da SAE, MMA e do MCTIC via PNUD

4 modelos globais como CC

1. HadGEM2-ES
2. MIROC5
3. BESM
4. CanESM2

2 cenários de emissão

1. RCP 4.5
2. RCP 8.5



# Modelo Eta: 20km

Precipitação média 1961-1990 (mm/dia)

CRU x Eta-HadGEM2-ES x Eta-MIROC5 x Eta-CanESM2 x Eta-BESM

**OBS**  
**(CRU)**

**Eta-HadGEM2-ES**

**Eta-MIROC5**

**Eta-CanESM2**

**Eta-BESM**

Precipitacao (mm/dia) CRU 0.5x0.5  
Media Sazonal DJF (1961-1990)

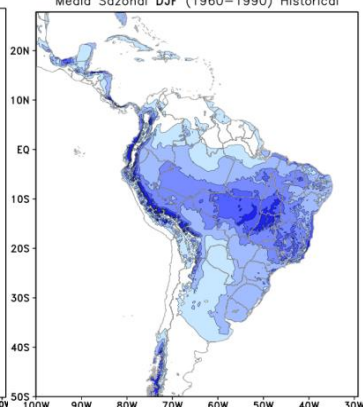
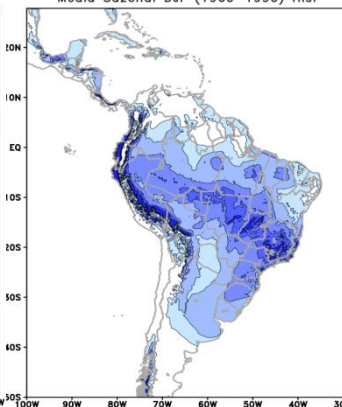
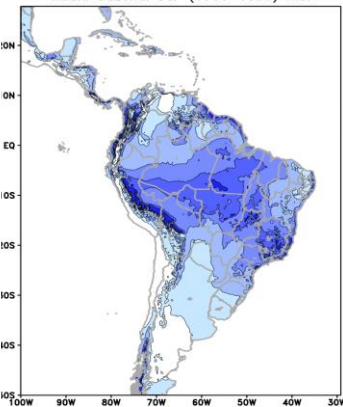
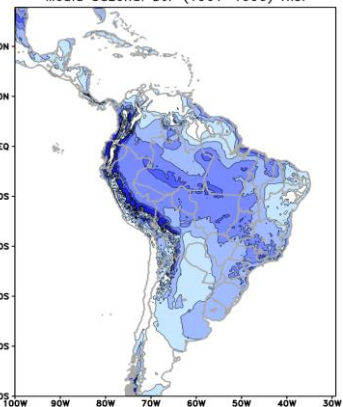
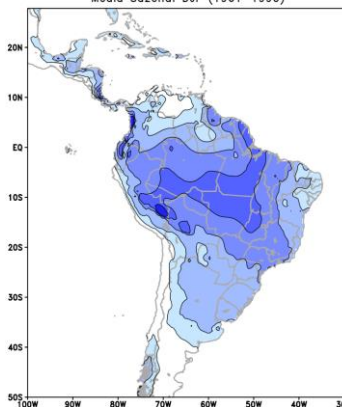
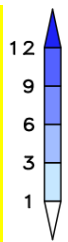
Precipitacao (mm/dia) Eta HadGEM2-ES 20km  
Media Sazonal DJF (1961-1990) Hist

Precipitacao (mm/dia) Eta MIROC5 20km  
Media Sazonal DJF (1961-1990) Hist

Precipitacao (mm/dia) Eta CanESM2 20km  
Media Sazonal DJF (1960-1990) Hist

Precipitacao (mm/dia) Eta BESM 20km  
Media Sazonal DJF (1960-1990) Historical

**D**  
**J**  
**F**



Precipitacao (mm/dia) CRU 0.5x0.5  
Media Sazonal JJA (1961-1990)

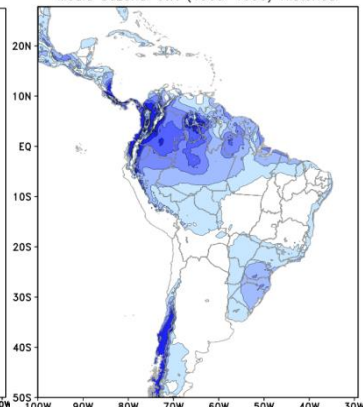
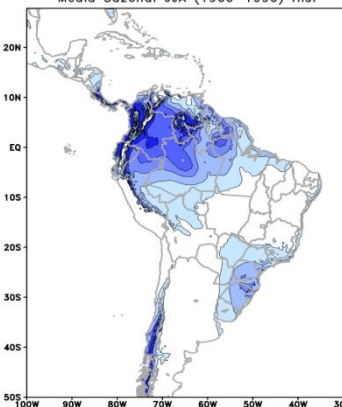
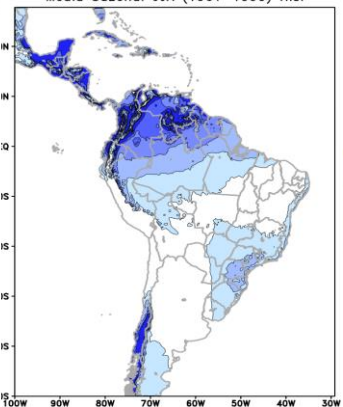
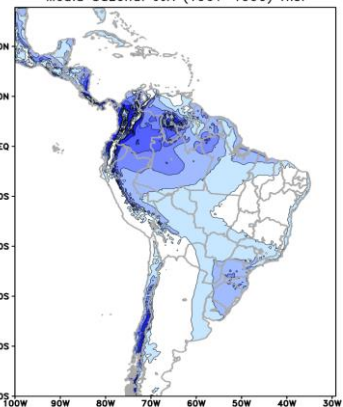
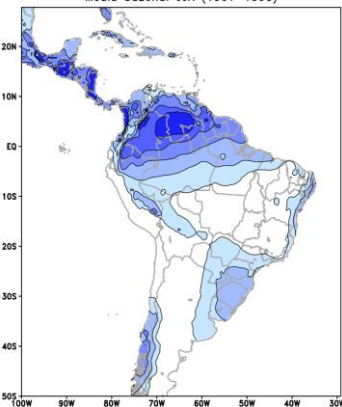
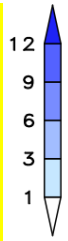
Precipitacao (mm/dia) Eta HadGEM2-ES 20km  
Media Sazonal JJA (1961-1990) Hist

Precipitacao (mm/dia) Eta MIROC5 20km  
Media Sazonal JJA (1961-1990) Hist

Precipitacao (mm/dia) Eta CanESM2 20km  
Media Sazonal JJA (1960-1990) Hist

Precipitacao (mm/dia) Eta BESM 20km  
Media Sazonal JJA (1960-1990) Historical

**J**  
**J**  
**A**





# Modelo Eta: 20km

Temperatura média 1961-1990 (°C)

CRU x Eta-HadGEM2-ES x Eta-MIROC5 x Eta-CanESM2 x Eta-BESM

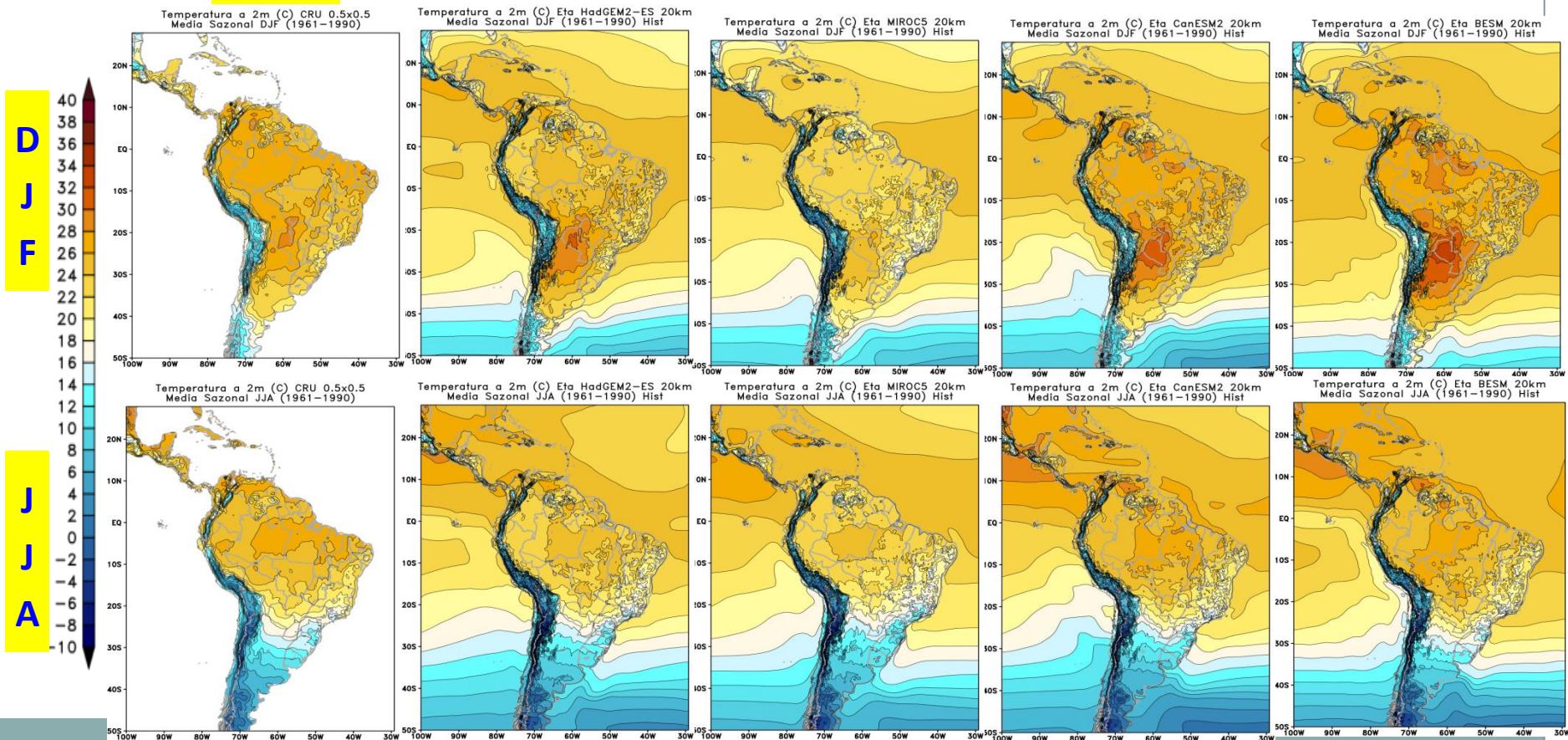
OBS  
(CRU)

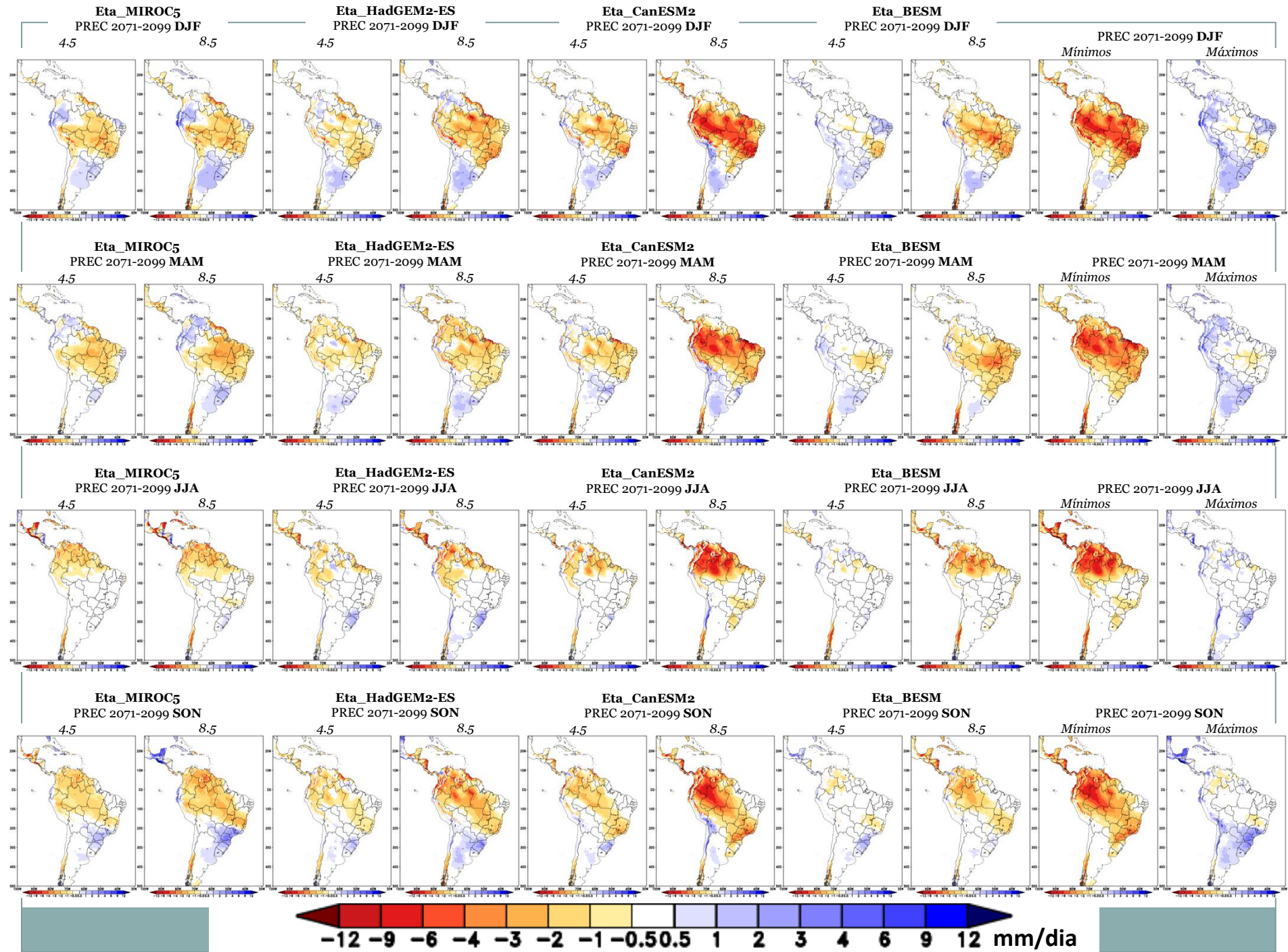
Eta-HadGEM2-ES

Eta-MIROC5

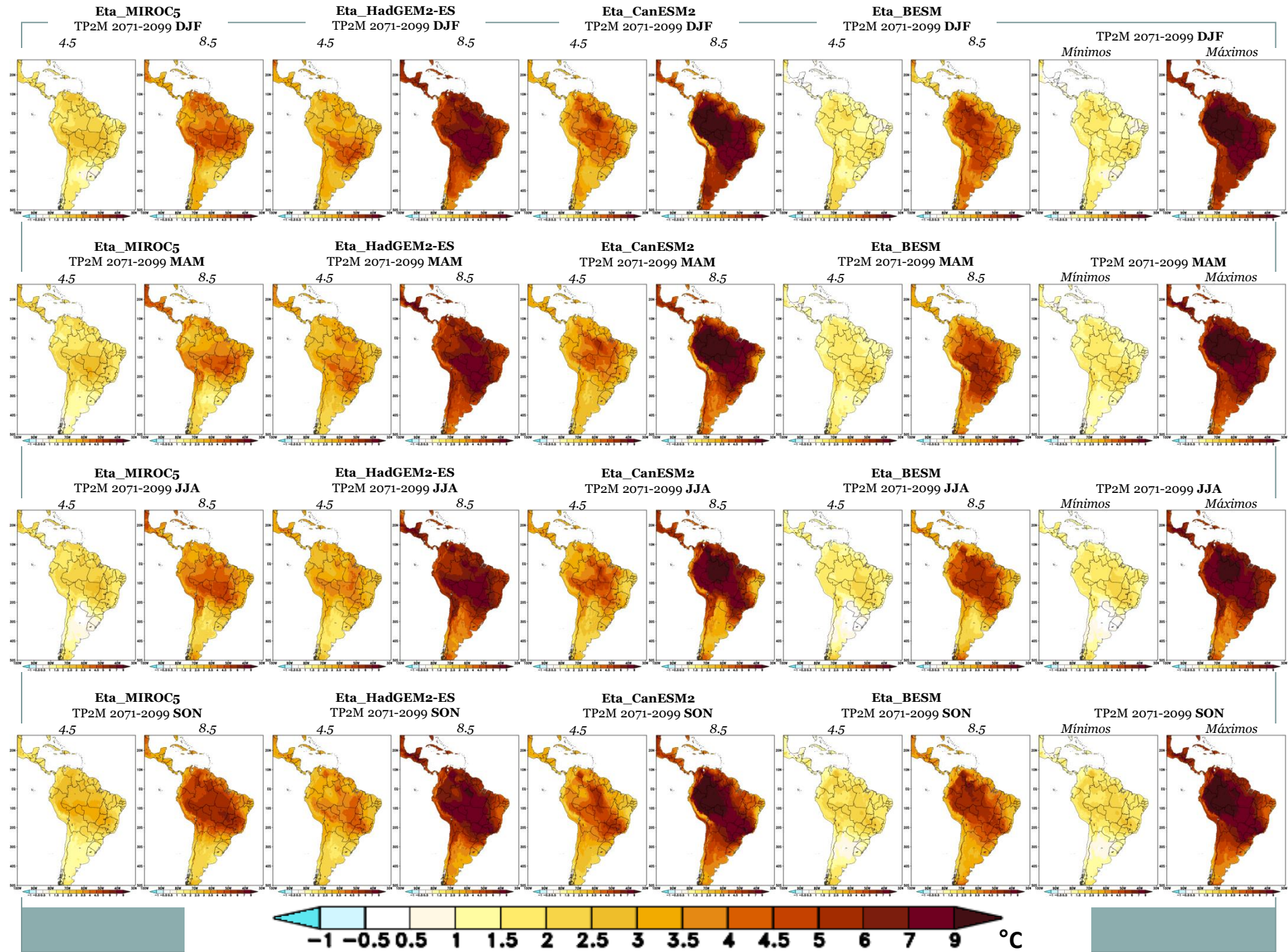
Eta-CanESM2

Eta-BESM



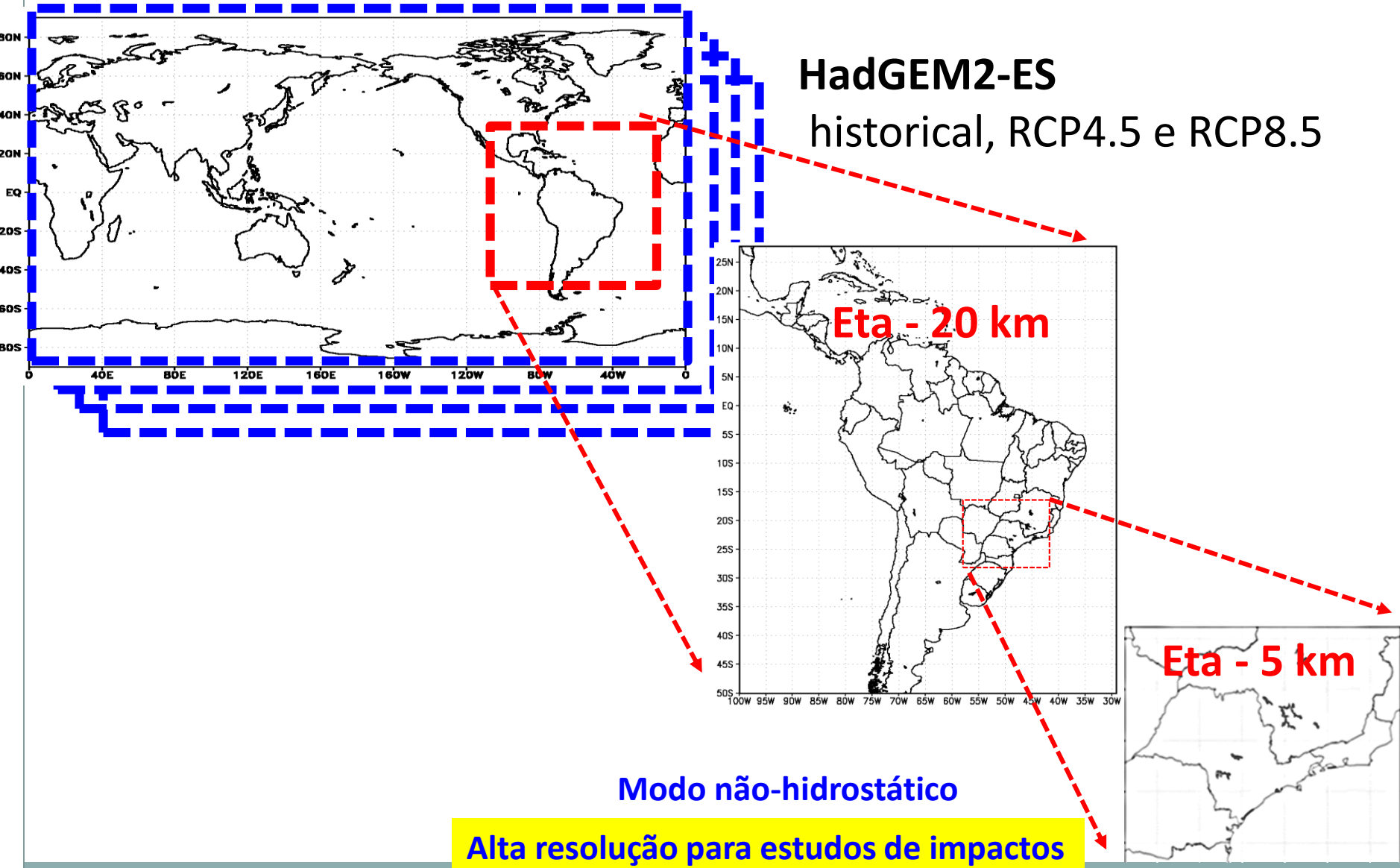








# Downscaling dinâmico com o modelo Eta em alta resolução (5 KM) : Second level nesting

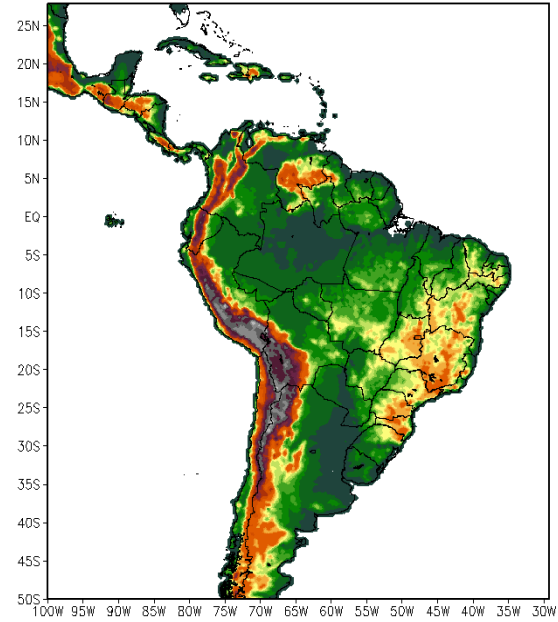
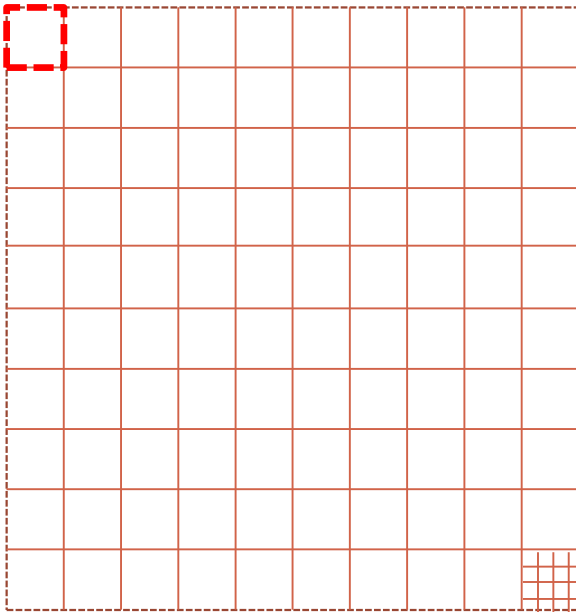


# Modelos Climáticos Globais

200 km

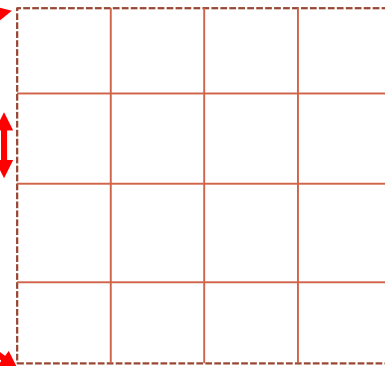
20 km

Modelo  
Climático  
Regional  
Eta-INPE



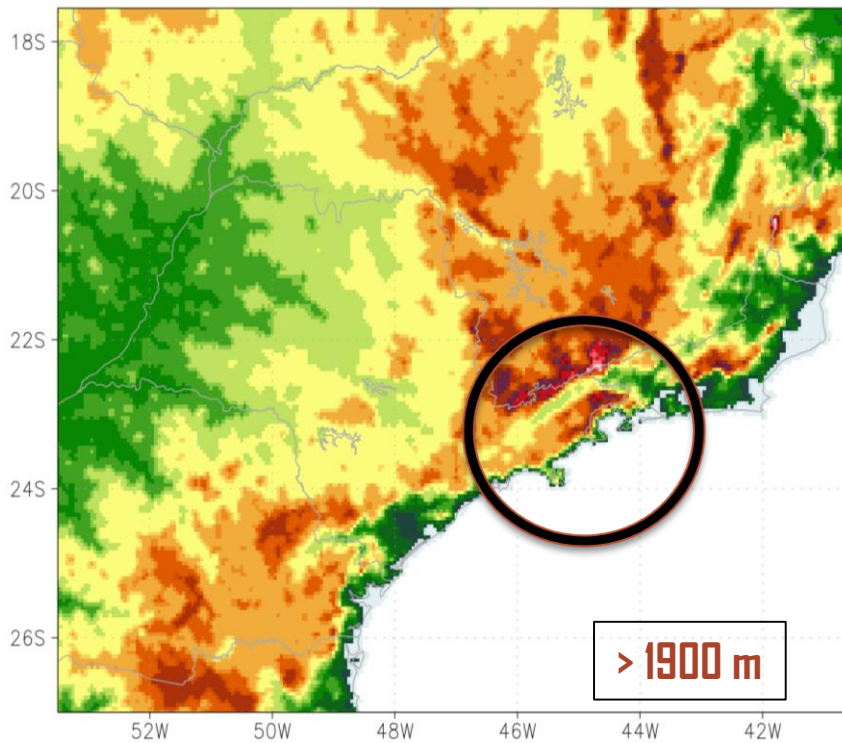
20 km

5 km

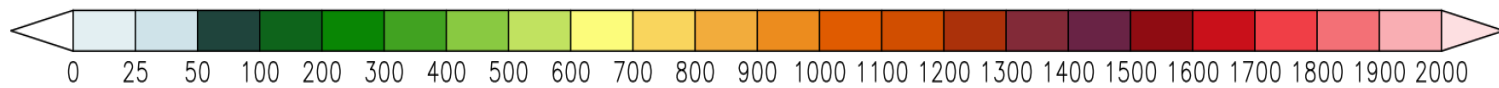
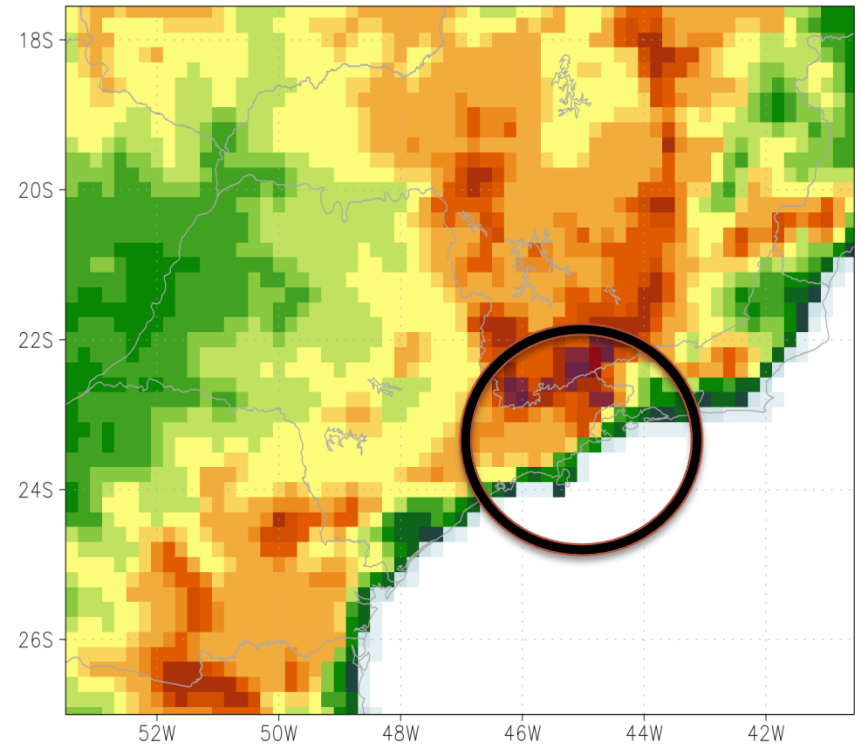


# Topografia (m)

5 km



20 km

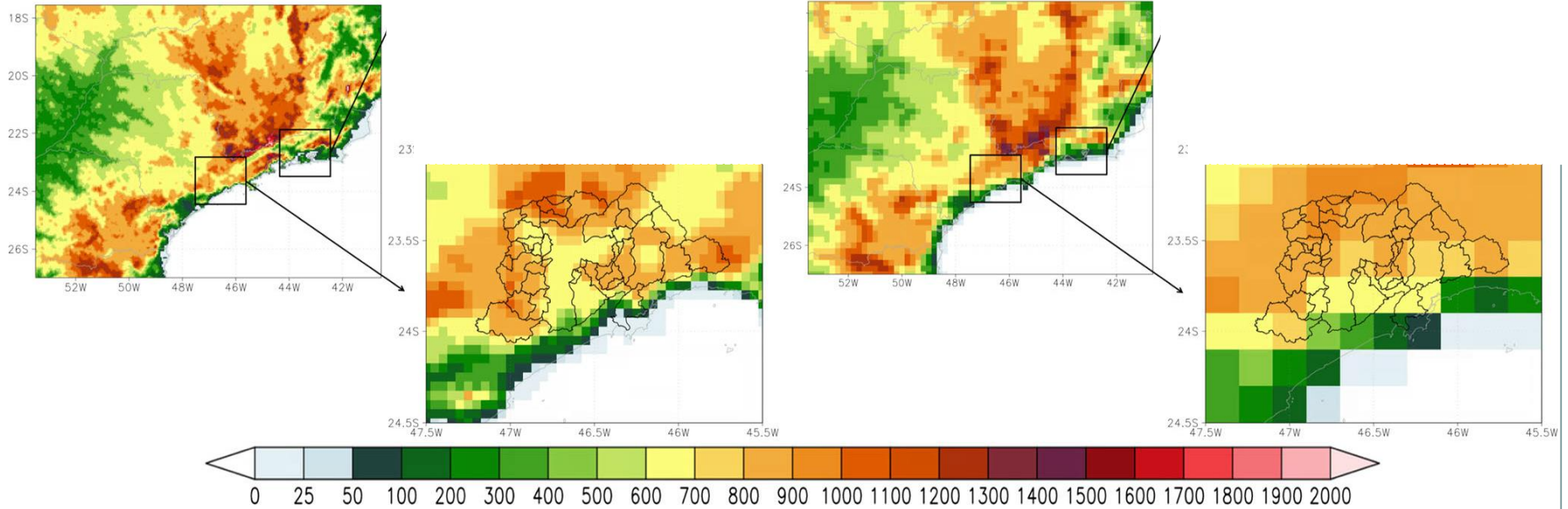




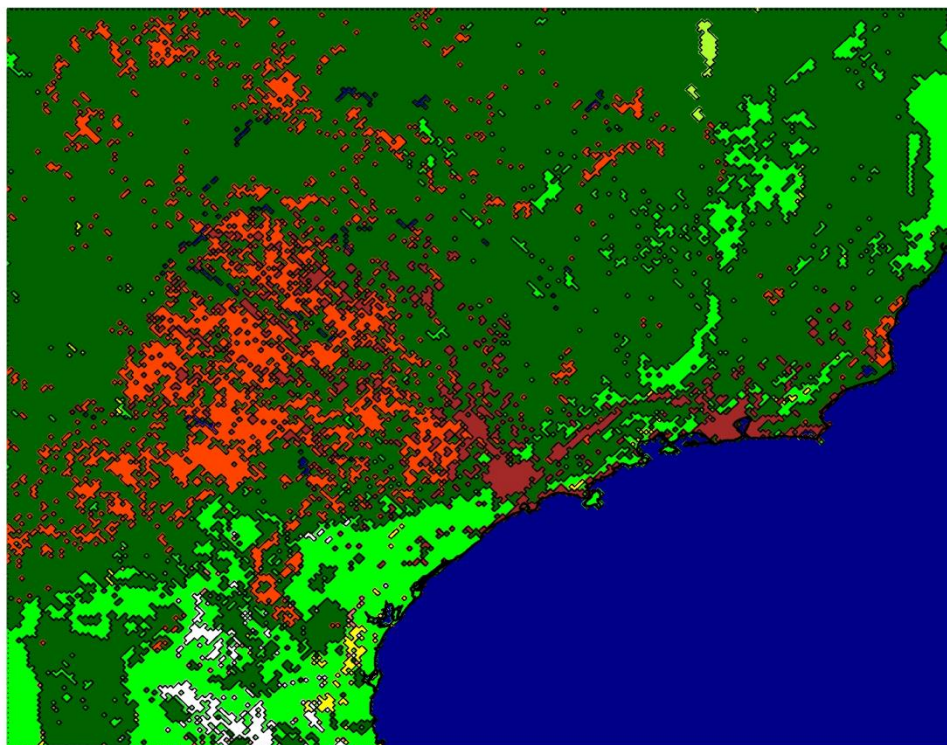
# Topografia (m)

5 km

20 km



# Vegetação



| Índice | Classes de vegetação – Noah<br>(DORMAN e SELLERS, 1989) |
|--------|---|
| 1      | Árvores latifoliadas perenes                            |
| 2      | Árvores latifoliadas decíduas                           |
| 3      | Árvores latifoliadas/aciculadas                         |
| 4      | Árvores aciculadas perenes                              |
| 5      | Árvores aciculadas decíduas                             |
| 6      | Savana  |
| 7      | Gramíneas e herbáceas, Cultivos                         |
| 8      | Arbustos latifoliados com cobertura herbácea perene     |
| 9      | Arbustos latifoliados com solo exposto                  |
| 10     | Tundra  |
| 11     | Solo exposto  |
| 12     | Cultivos  |
| 13     | Gelo  |
| 14     | Urbano  |



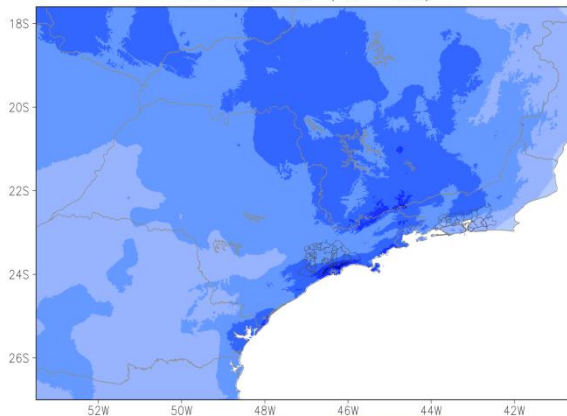
Mourão (2010) e Vieira et al. (2010)

# CLIMA PRESENTE: Eta-5km – HadGEM2-ES

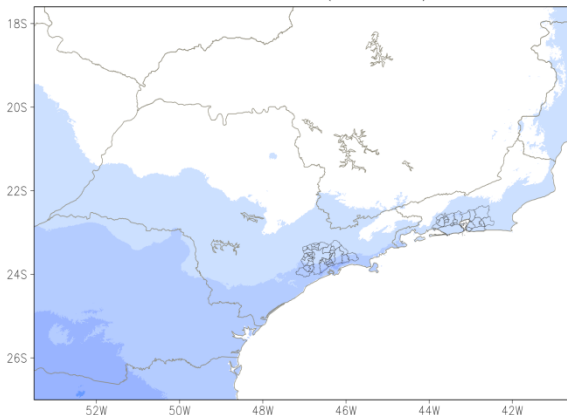
## Precipitação (mm/dia)

### Obs. WorldClim 1km

Precipitação (mm/dia) do WorldClimV1.4 30s  
Média Sazonal DJF (1961–1990)

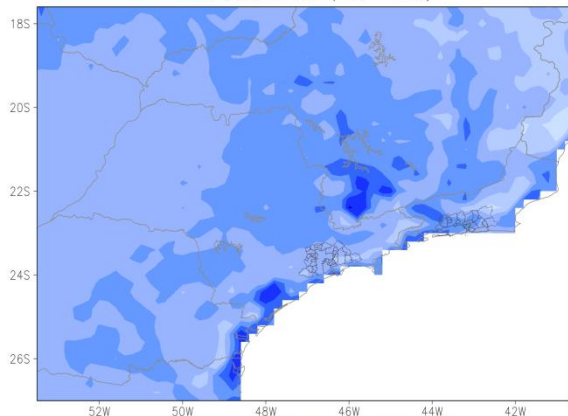


Precipitação (mm/dia) do WorldClimV1.4 30s  
Média Sazonal JJA (1961–1990)

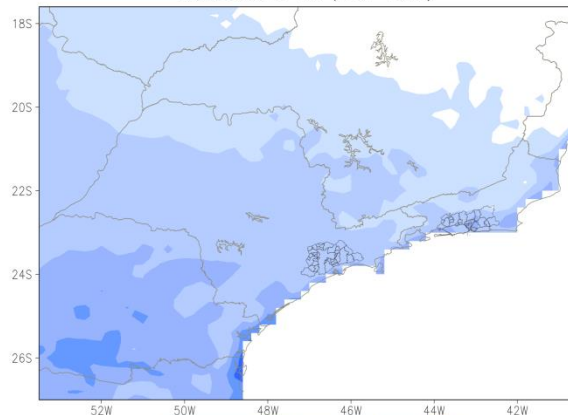


### Eta-HadGEM2ES 20km

Precipitação (mm/dia) do Modelo Eta HadGEM2ES 20km  
Média Sazonal DJF (1961–1990)

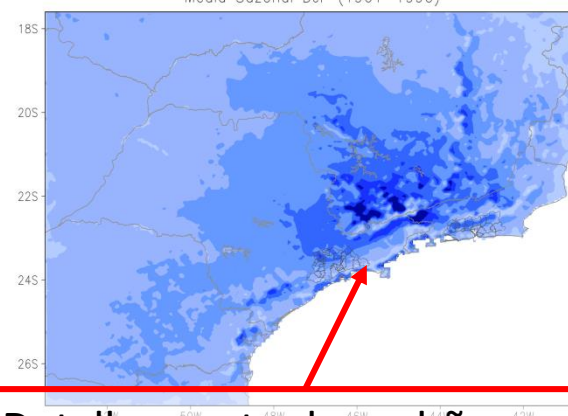


Precipitação (mm/dia) do Modelo Eta HadGEM2ES 20km  
Média Sazonal JJA (1961–1990)



### Eta-HadGEM2ES 5km

Precipitação (mm/dia) do Modelo Eta Eta-HadGEM2ES 5km  
Média Sazonal DJF (1961–1990)



Detalhamento do padrão espacial das chuvas





# CLIMA PRESENTE: Eta-5km – HadGEM2-ES

## Temperatura (°C)

### Obs. WorldClim 1km

### Eta-HadGEM2ES 20km

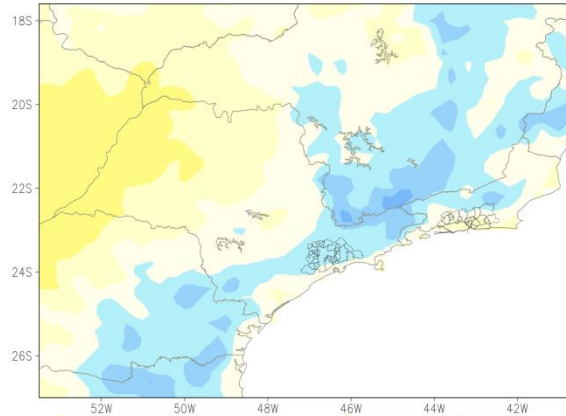
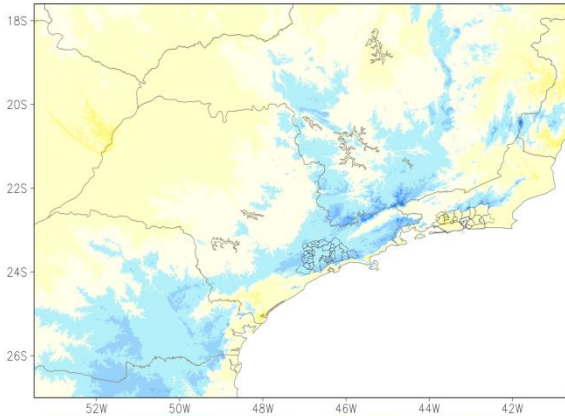
### Eta-HadGEM2ES 5km

Temperatura (C) do WorldClimV1.4 30s  
Media Sazonal DJF (1961-1990)

Temperatura (C) do Modelo Eta HadGEM2ES 20km  
Media Sazonal DJF (1961-1990)

Temperatura (C) do Modelo Eta Eta-HadGEM2ES 5km  
Media Sazonal DJF (1961-1990)

DJF



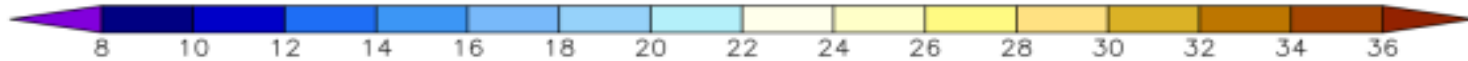
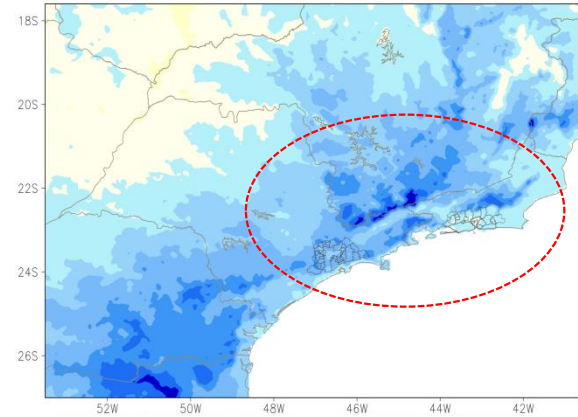
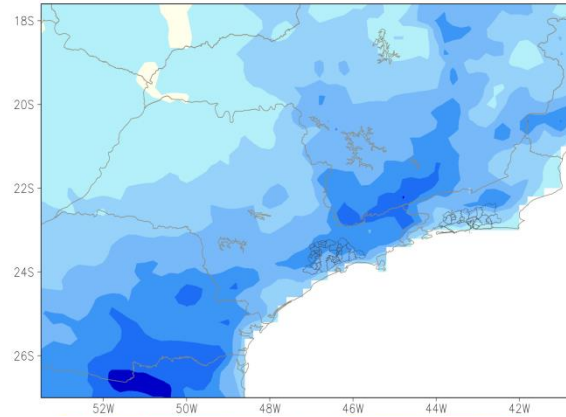
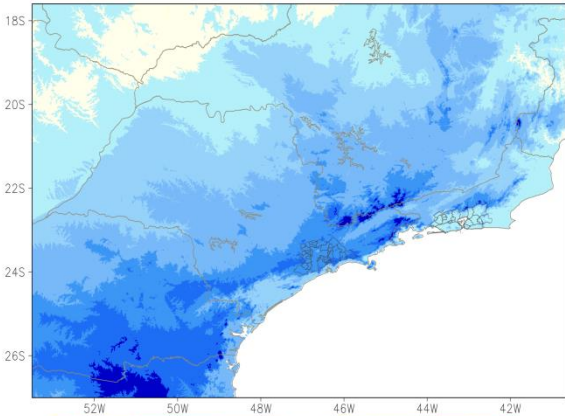
Mais detalhes,  
concorda melhor  
com observações

Temperatura (C) do WorldClimV1.4 30s  
Media Sazonal JJA (1961-1990)

Temperatura (C) do Modelo Eta HadGEM2ES 20km  
Media Sazonal JJA (1961-1990)

Temperatura (C) do Modelo Eta Eta-HadGEM2ES 5km  
Media Sazonal JJA (1961-1990)

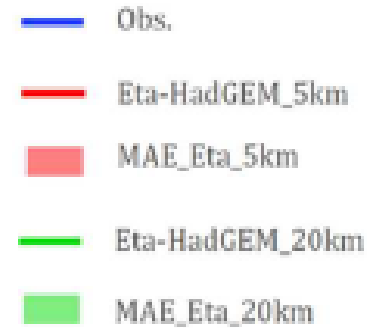
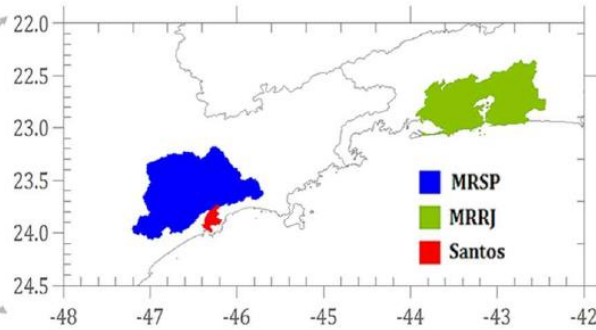
JJA



# Eta 5km

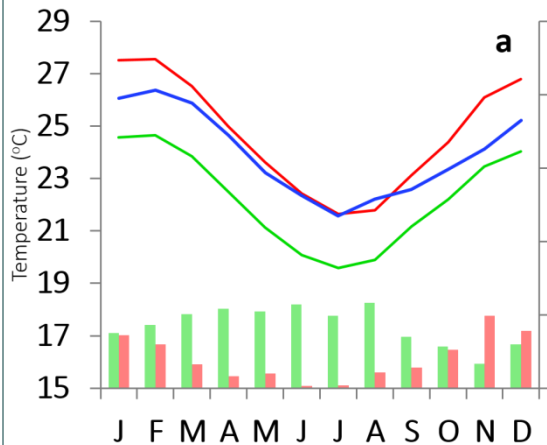


## Eta - 5 km Non-hydrostatic

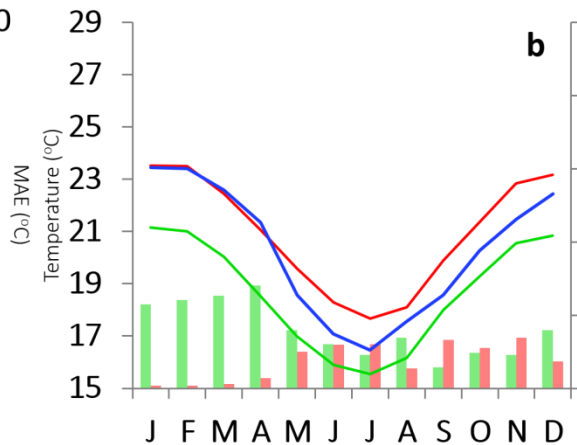


### CLIMA PRESENTE: Ciclo Anual - Temperatura a 2 metros (°C)

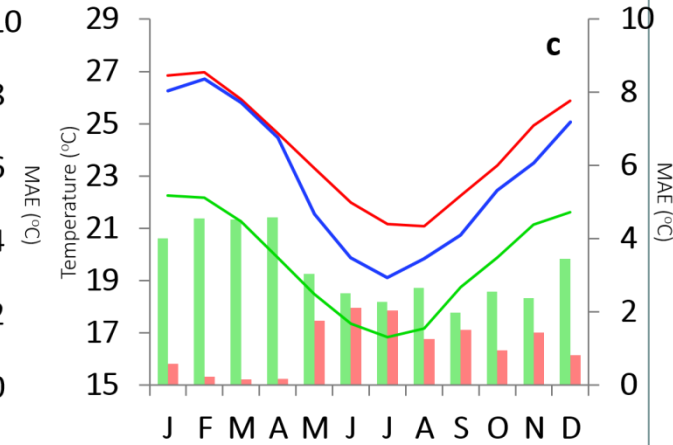
#### RMRJ



#### RMSP



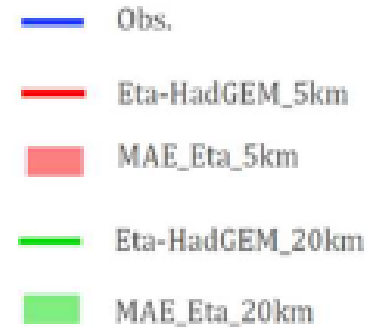
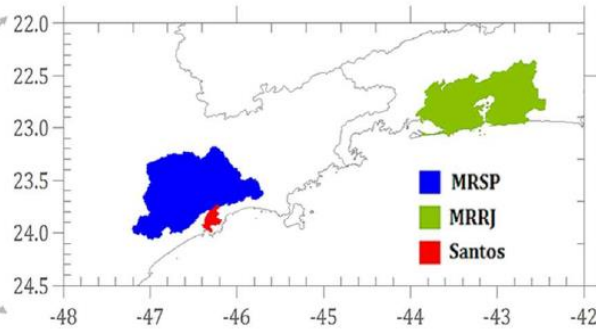
#### Santos



# Eta 5km



## Eta - 5 km Non-hydrostatic

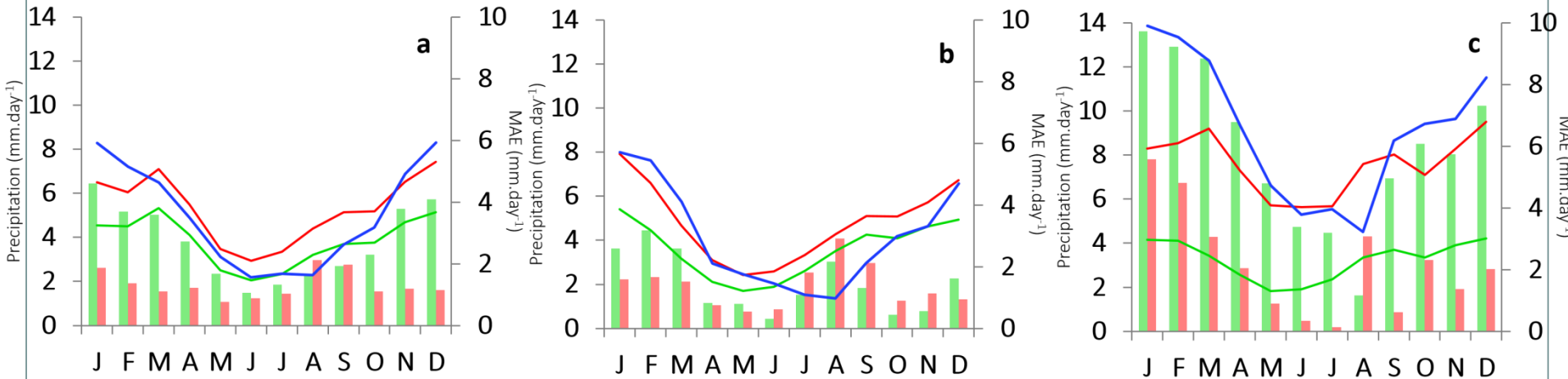


### CLIMA PRESENTE: Ciclo Anual - Precipitação (mm/dia)

#### RMRJ

#### RMSP

#### Santos





# Projeções climáticas – Eta 5km

DJF

Temperatura (°C)

JJA

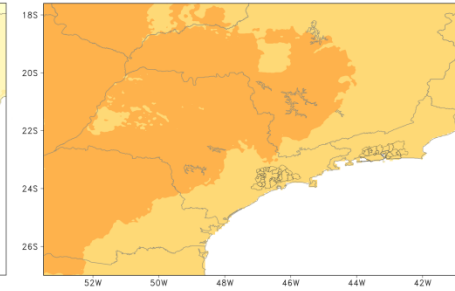
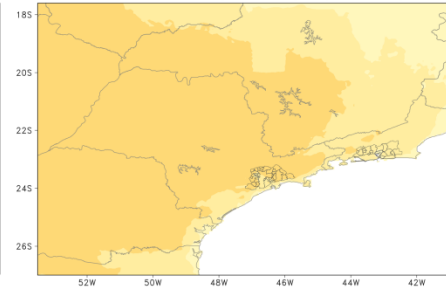
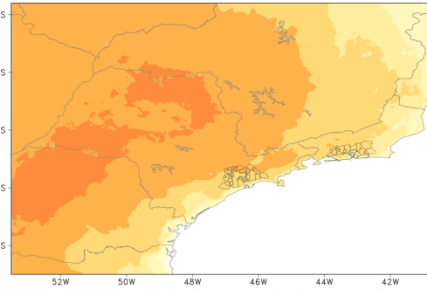
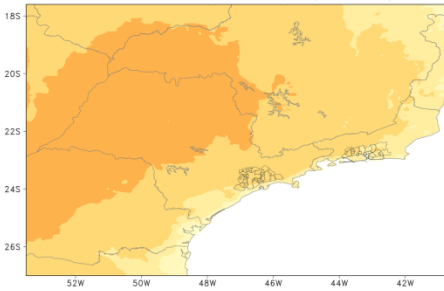
RCP4.5

RCP8.5

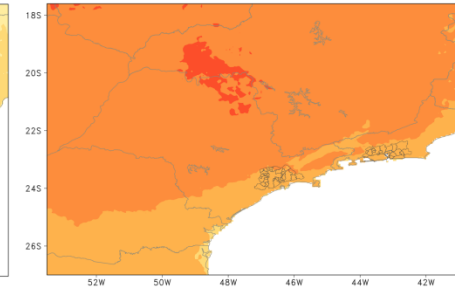
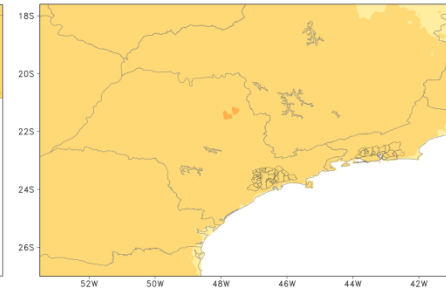
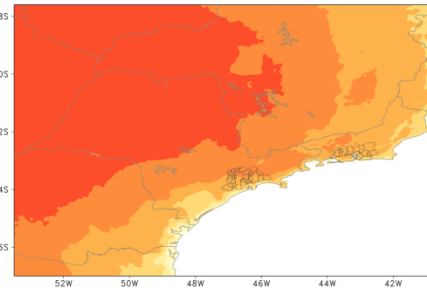
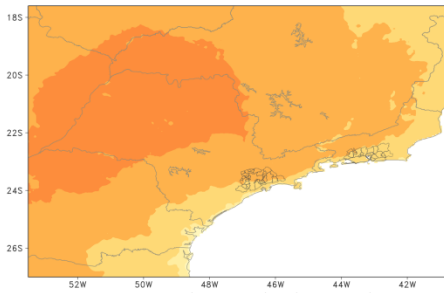
RCP4.5

RCP8.5

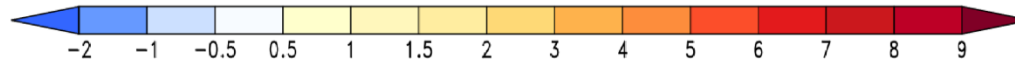
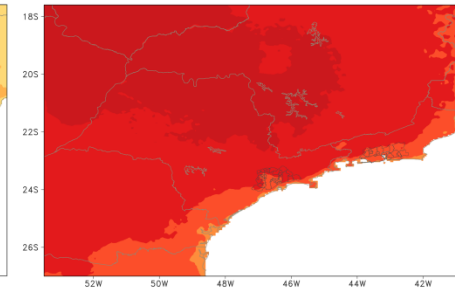
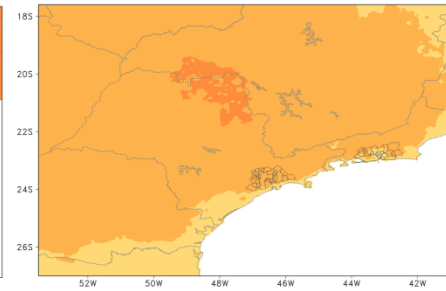
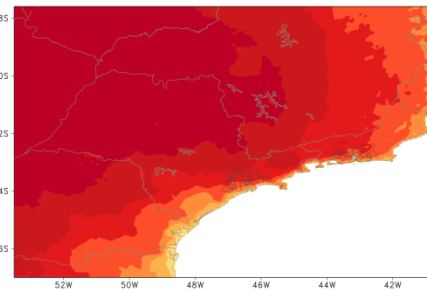
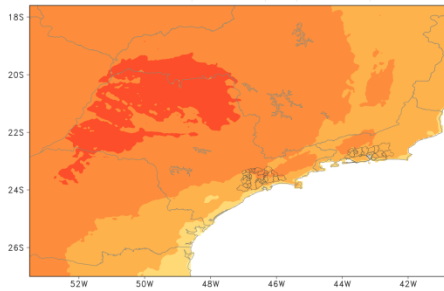
2011-2040



2041-2070



2071-2100



# Projeções climáticas – Eta 5km

DJF

Precipitação (mm/dia)

JJA

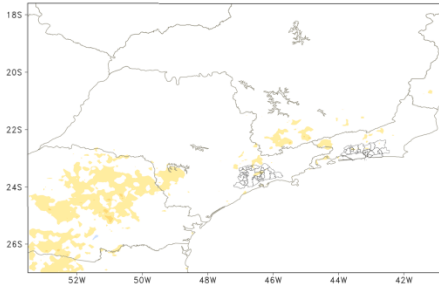
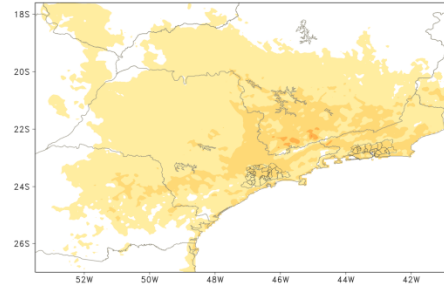
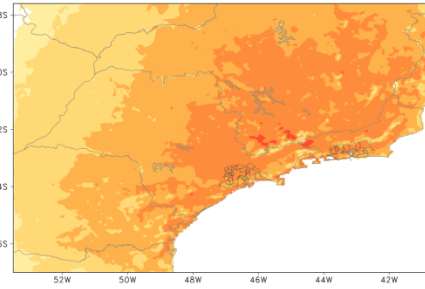
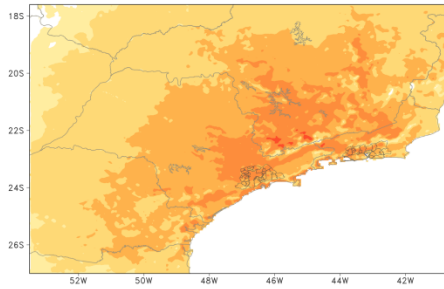
RCP4.5

RCP8.5

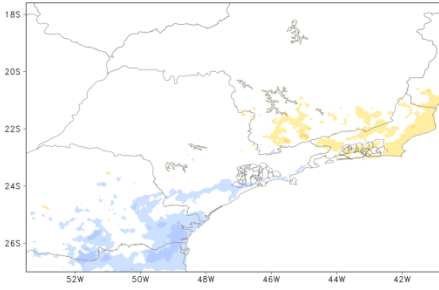
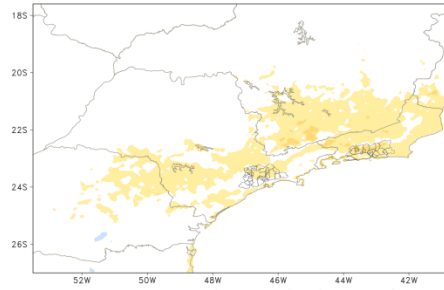
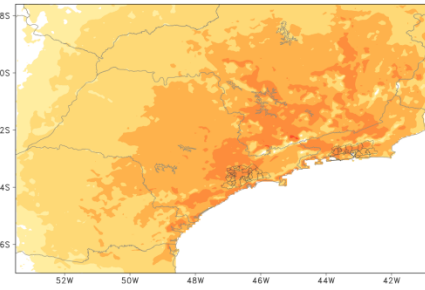
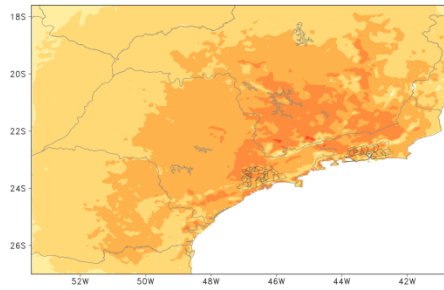
RCP4.5

RCP8.5

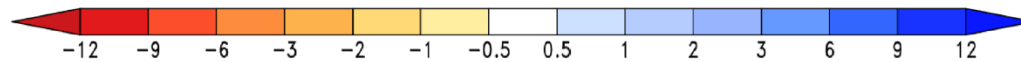
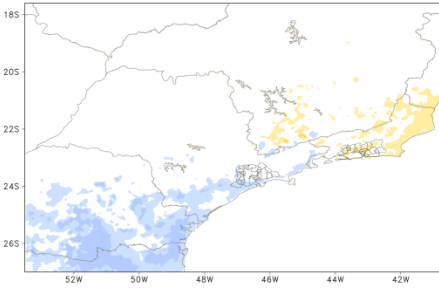
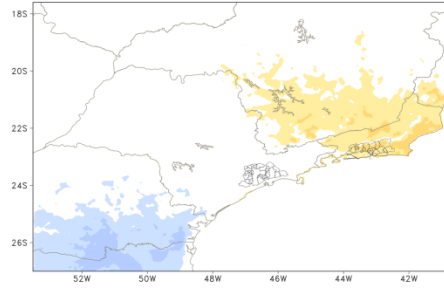
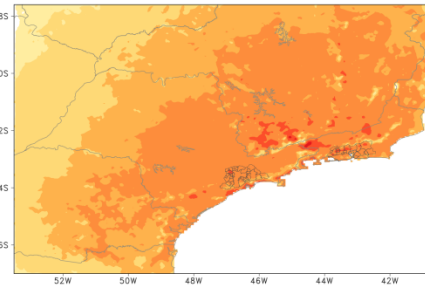
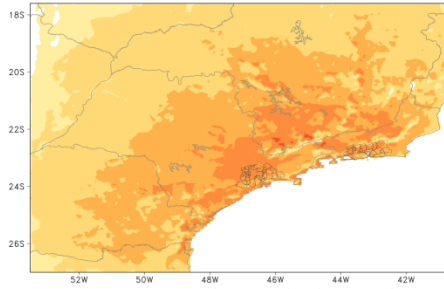
2011-2040



2041-2070



2071-2100



# Projeções climáticas – Eta 5km

DJF

Temperatura (°C)

JJA

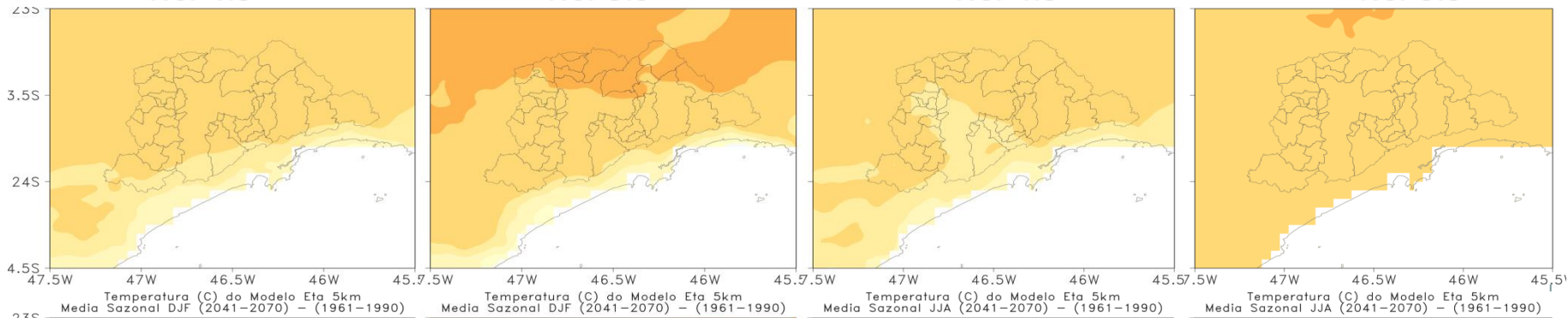
RCP4.5

RCP8.5

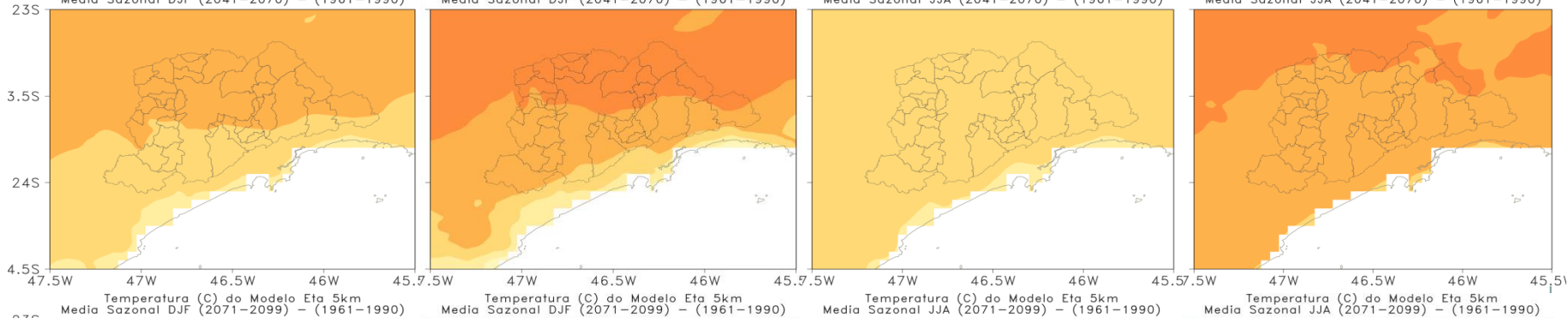
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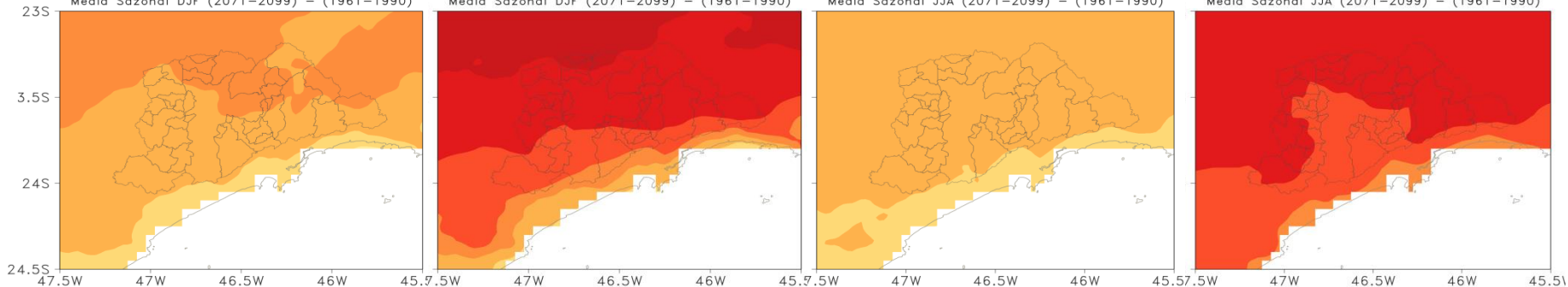
2011-2040



2041-2070



2071-2100





# Projeções climáticas – Eta 5km

DJF

Precipitação (mm/dia)

JJA

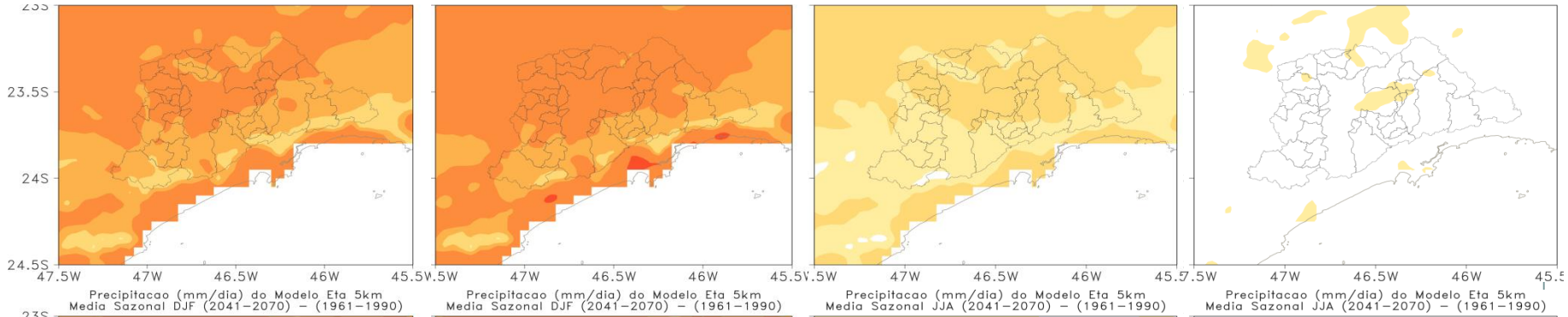
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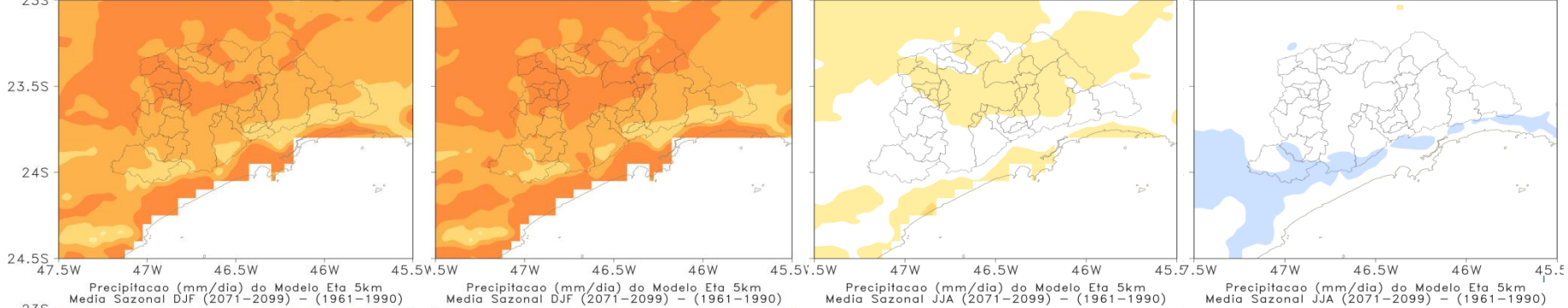
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RCP8.5

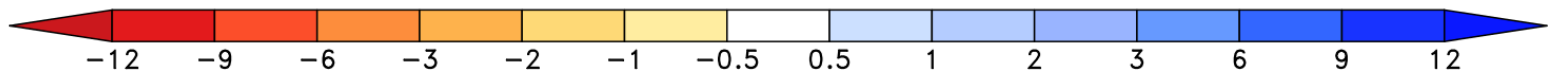
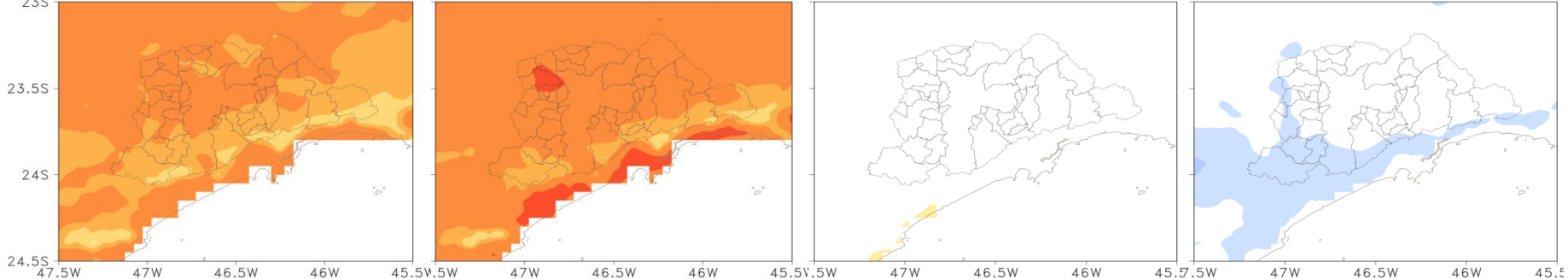
2011-2040



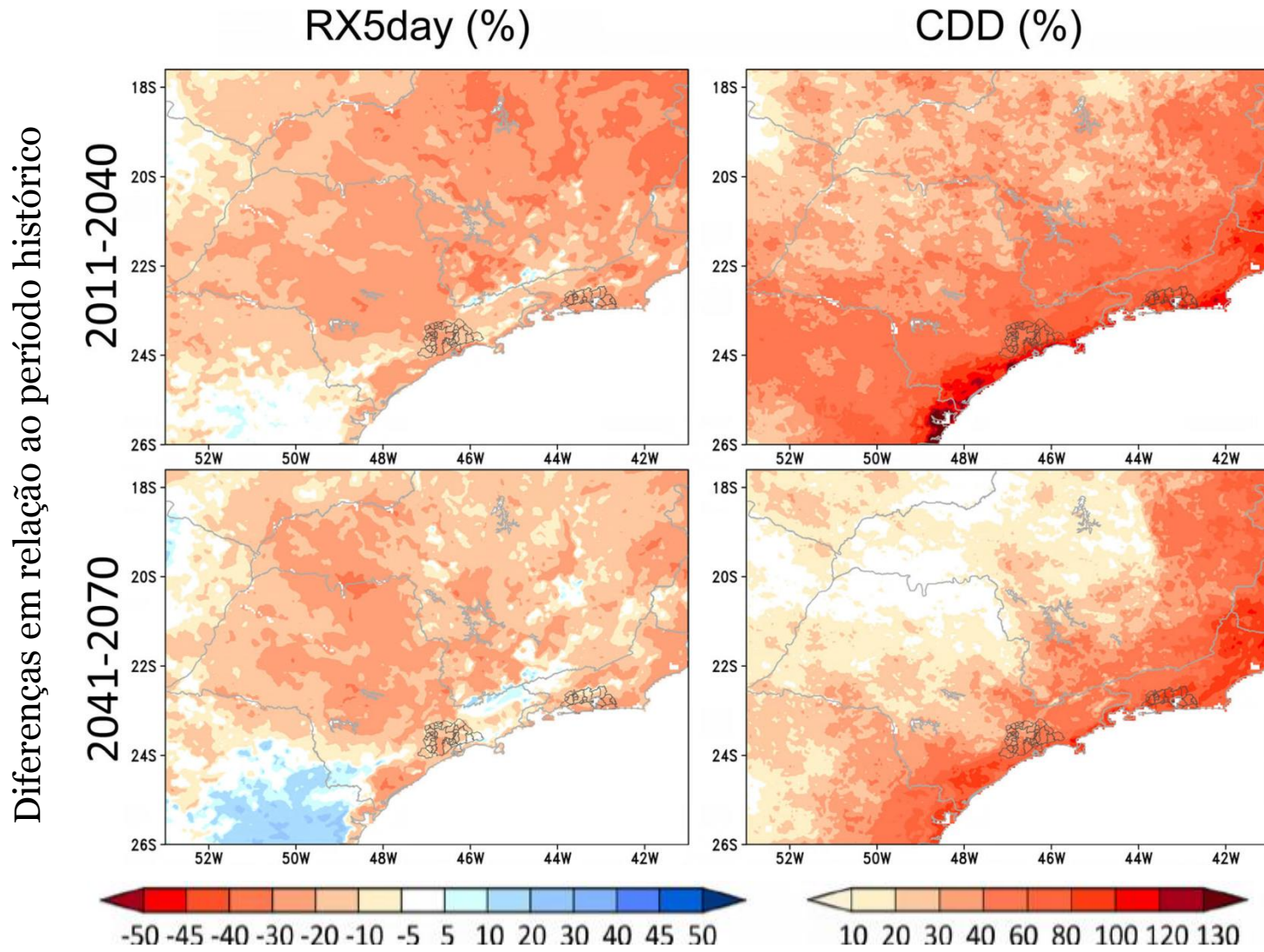
2041-2070



2071-2100



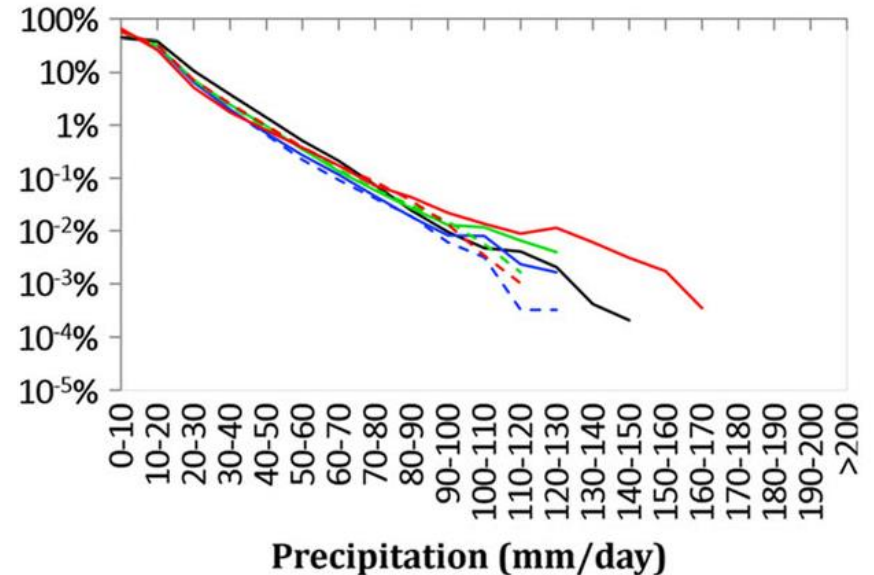
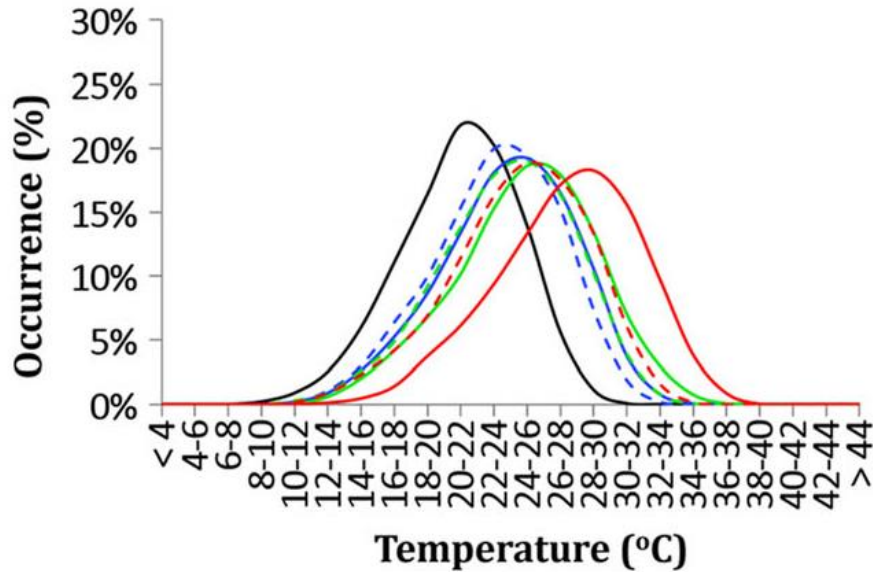
# Projeções climáticas – Eta 5km



# Projeções climáticas – Eta 5km

Distribuição de Frequência : 2011-2040, 2041-2070, 2071-2100

**RMSP**



— Eta-HadGEM\_Historical    - - Eta-HadGEM\_2011-2040\_RCP4.5    - - Eta-HadGEM\_2041-2070\_RCP4.5    - - Eta-HadGEM\_2071-2100\_RCP4.5  
— Eta-HadGEM\_2011-2040\_RCP8.5    - - Eta-HadGEM\_2041-2070\_RCP8.5    - - Eta-HadGEM\_2071-2100\_RCP8.5

# Disponibilidade dos dados

O conjunto de dados está sendo disponibilizado através da plataforma **PROJETA** do INPE.



<http://projeta.cptec.inpe.br>



Realização do Programa Políticas sobre Mudança do Clima – PoMuC, iniciativa do Ministério do Meio Ambiente (MMA) em parceria com o Ministério Federal do Meio Ambiente, Proteção da Natureza e Segurança Nuclear (BMU) da Alemanha, com o apoio técnico da Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Executado pelo grupo de computação da Universidade de Passo Fundo (UPF) e meteorologia do Instituto Nacional de Pesquisas Espaciais (INPE) através do Centro de Gestão de Pesquisa, Desenvolvimento e Inovação (CGPDI).

Iniciativa:



Apoio:



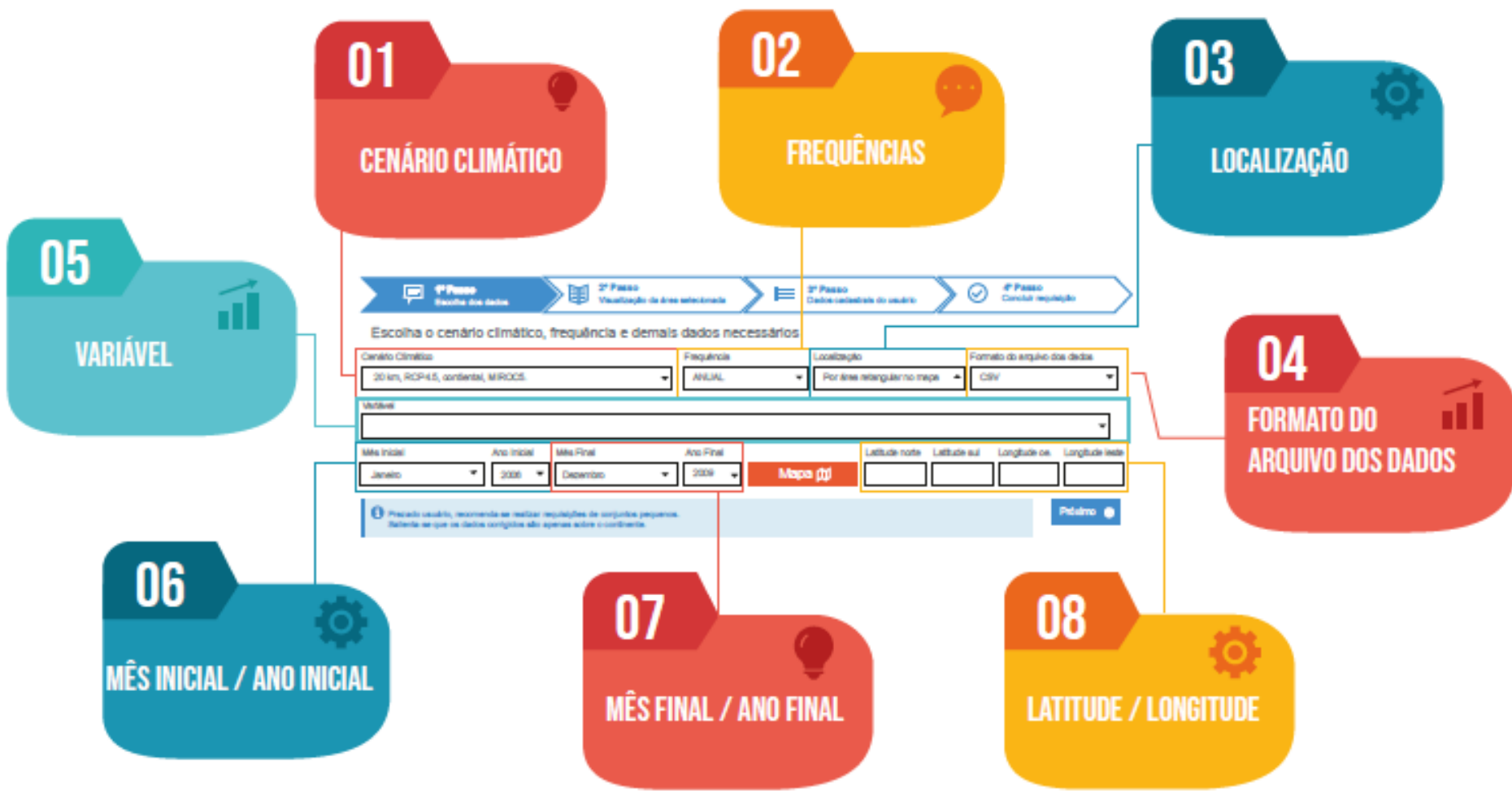




## PROJEÇÕES DE MUDANÇA DO CLIMA PARA A AMÉRICA DO SUL REGIONALIZADAS PELO MODELO ETA

### Objetivos:

- Automatização do processo de extração e disponibilização dos dados das projeções climáticas regionalizadas para Brasil, geradas pelo CPTEC/INPE.
- Permitir o acesso amplo e irrestrito a diversos parâmetros climáticos disponíveis.
- Atender as demandas dos usuários por acesso aos dados das projeções climáticas, tratados e compatíveis com programas e plataformas de análises setoriais.





## PROJEÇÕES DE MUDANÇA DO CLIMA PARA A AMÉRICA DO SUL REGIONALIZADAS PELO MODELO ETA

### REFERÊNCIAS:

"Dados gerados pelo CPTEC/INPE e disponibilizados na Plataforma PROJETA"

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4. Terceira Comunicação Nacional do Brasil à Convenção-Quadro das Nações Unidas sobre Mudança do Clima (2016).

Obrigado !



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