

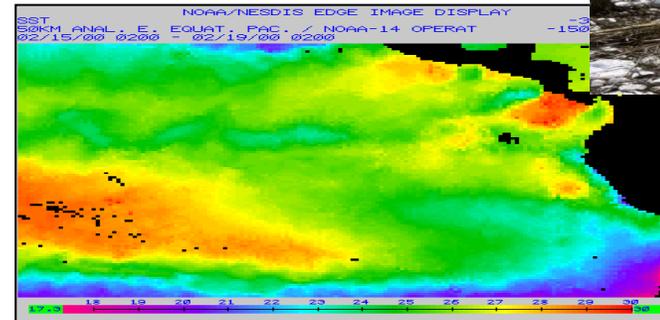
# Entendendo as mudanças climáticas e seus impactos

Ana Maria H de Avila

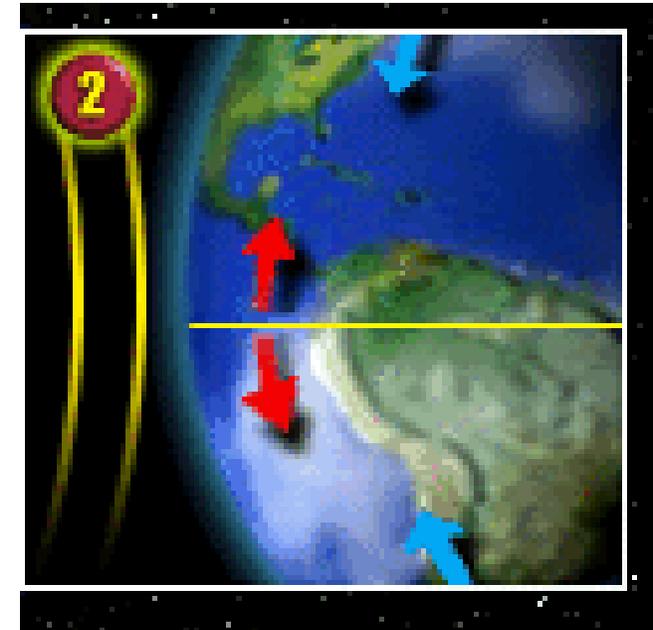
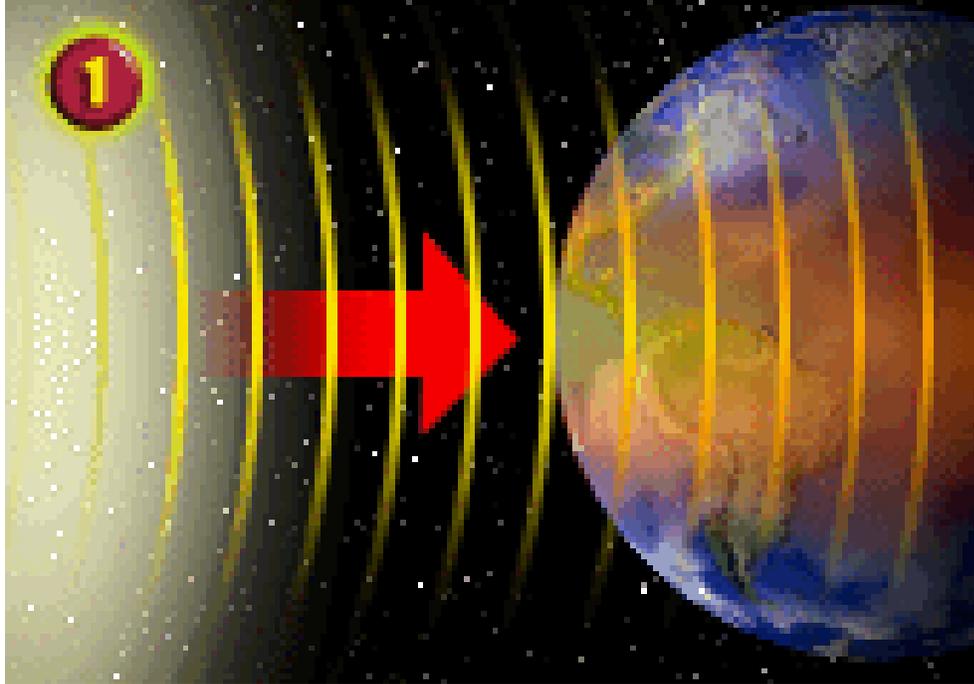
V Seminário de Áreas Protegidas das Bacias PCJ

# Mudança Climática Global

“Mudanças no meio ambiente global (incluindo modificações no clima, na produtividade do solo, nos oceanos ou outros recursos hídricos, na química da atmosfera e em sistemas ecológicos) que possam alterar a capacidade da Terra para sustentar a Vida”



# O Sol: a principal fonte de energia



# Atmosfera terrestre: frágil equilíbrio

A superfície da terra seria 33 graus Celsius mais fria se não existissem na sua atmosfera os gases do efeito estufa

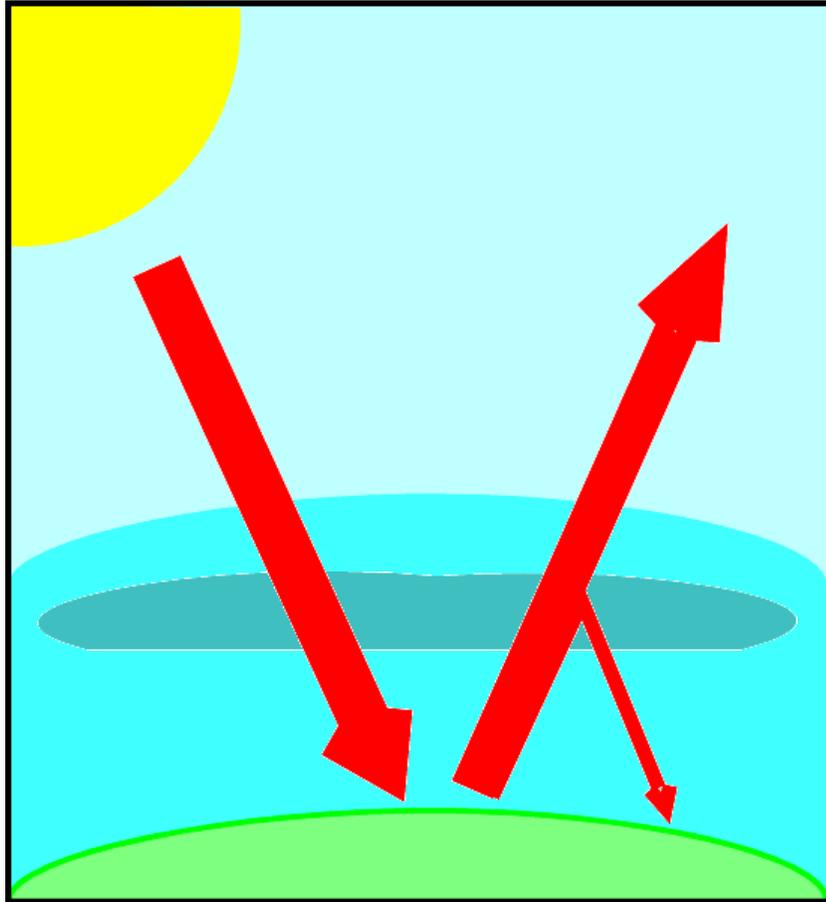


# Gases de Efeito Estufa

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- Dióxido de Carbono ( $\text{CO}_2$ )
- Metano ( $\text{CH}_4$ )
- Óxido Nitroso ( $\text{N}_2\text{O}$ )
- Hexafluoreto de Enxofre ( $\text{SF}_6$ )
- Perfluormetano ( $\text{CF}_4$ )
- Perfluoretano ( $\text{C}_2\text{F}_6$ )
- Hidrofluorcarbonos (HFC)
- Clorofluorcarbono (CFC)

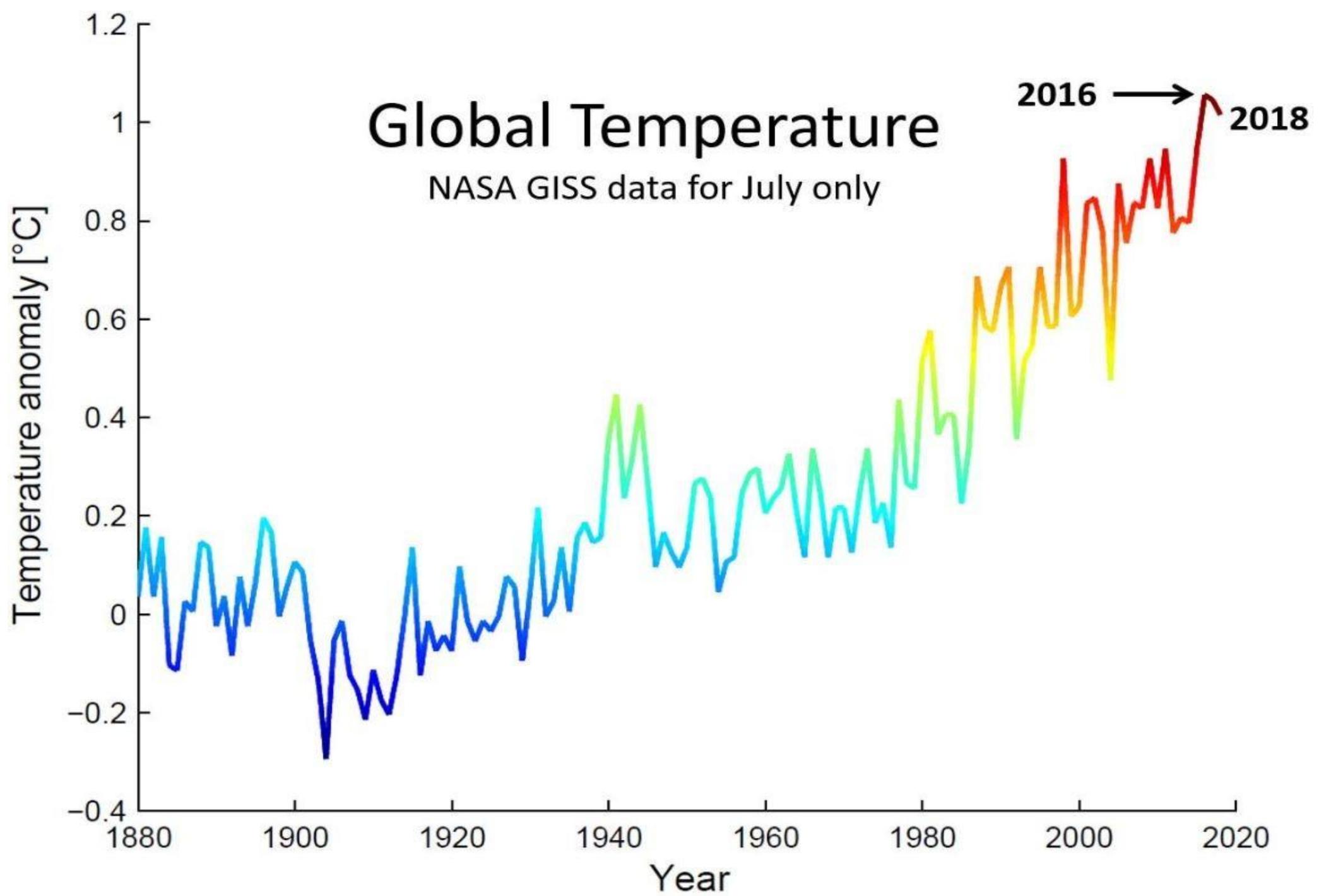
# O efeito estufa natural



$T_m = 15\text{ }^\circ\text{C}$



# MUDANÇAS CLIMÁTICAS OBSERVADAS



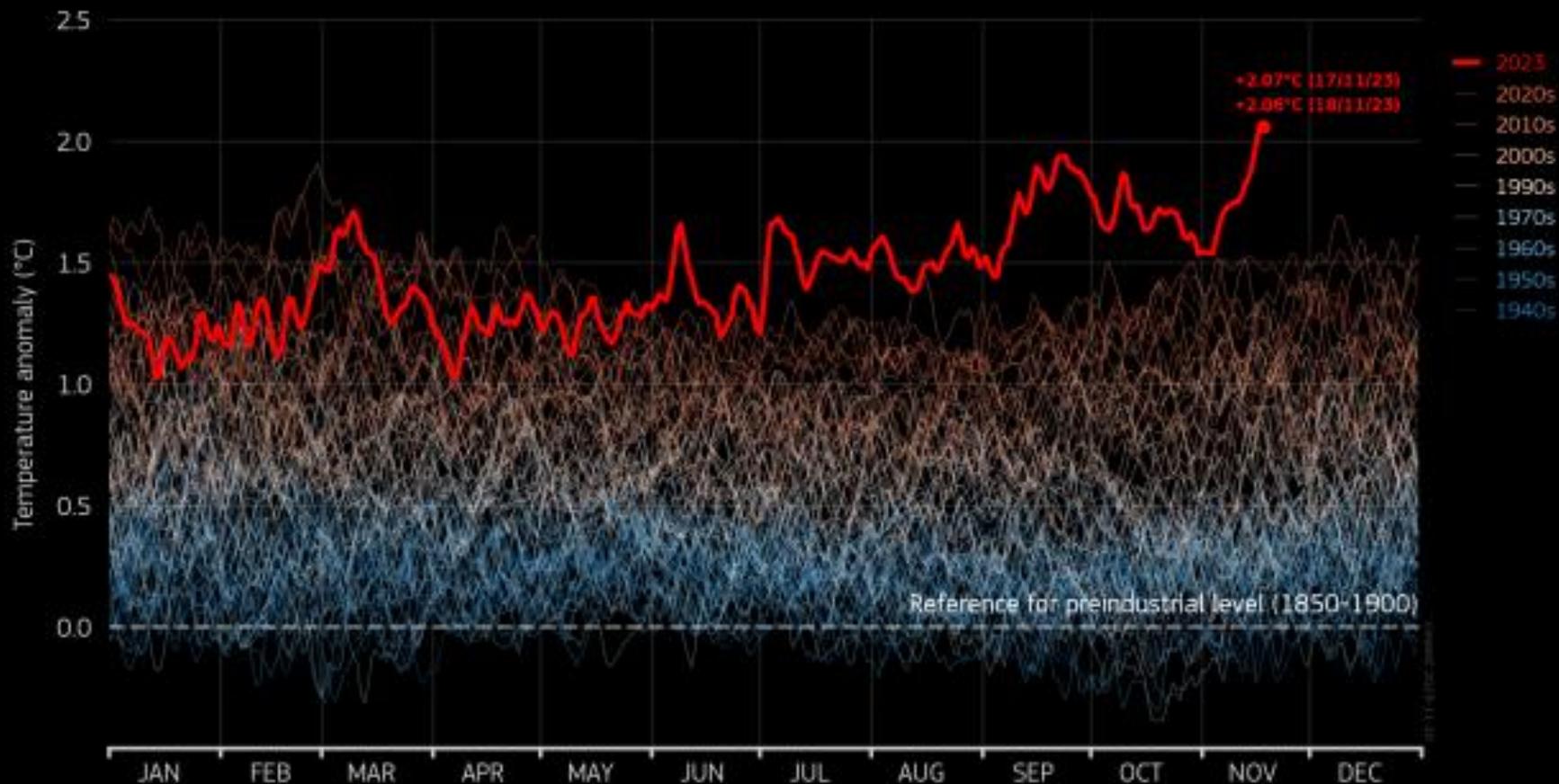
# DAILY GLOBAL SURFACE AIR TEMPERATURE ANOMALY

Data: ERA5 1940-2023 • Reference period: 1850-1900 • Credit: C3S/ECMWF



Climate  
Change Service

[climate.copernicus.eu](https://climate.copernicus.eu)



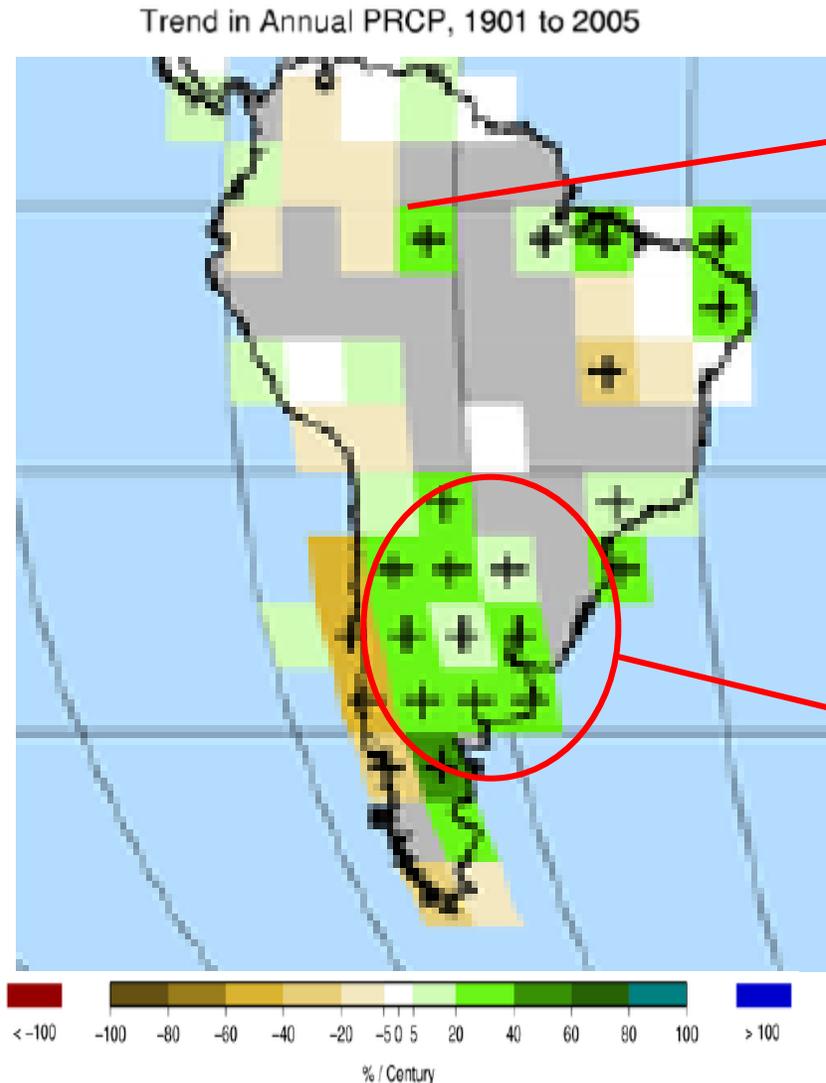
PROGRAMME OF  
THE EUROPEAN UNION



IMPLEMENTED BY



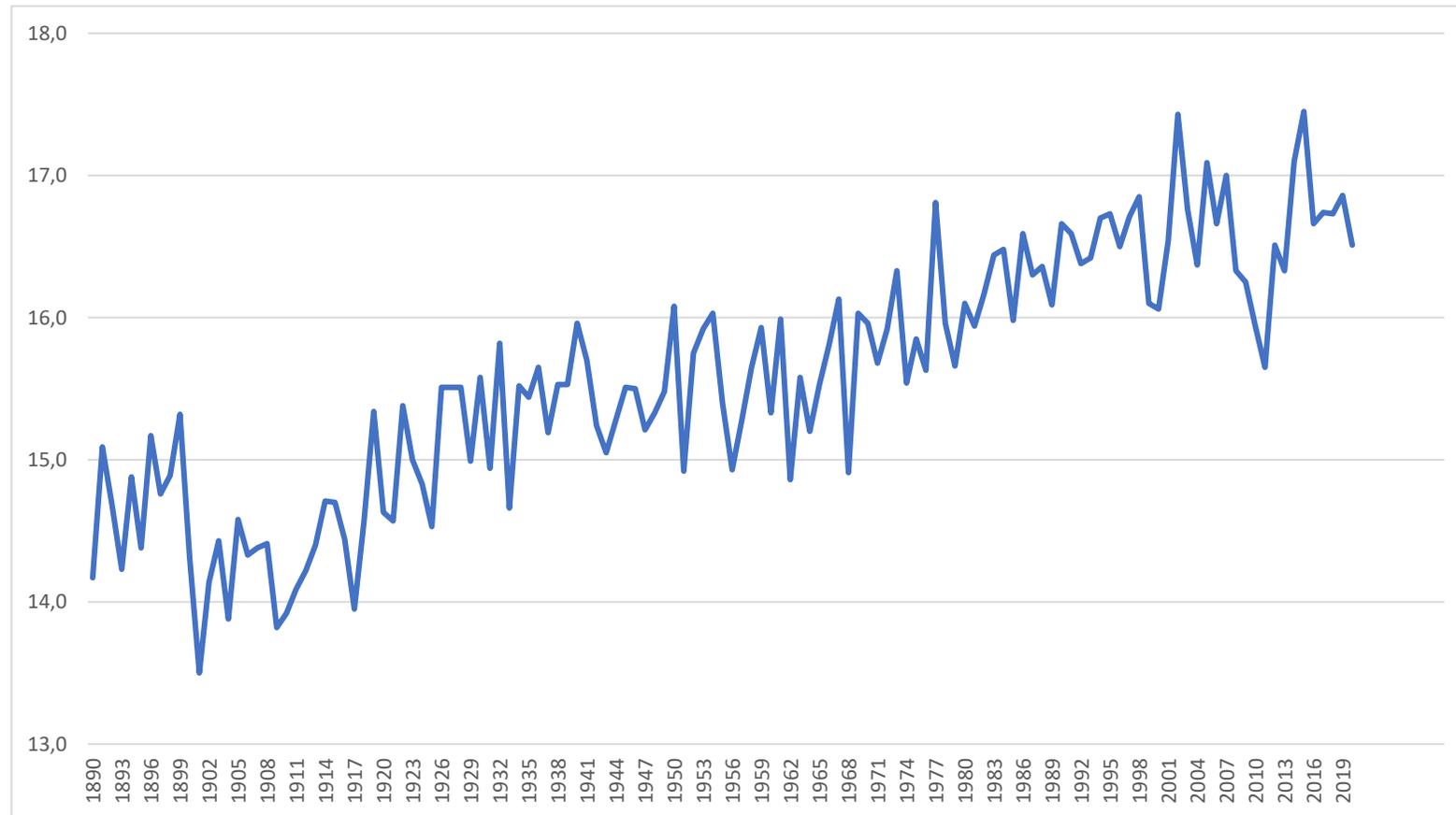
## Sul do Brasil tem tendência observada de aumento de chuvas : tendências da chuva de 1901-2005 (IPCC 2007)



Não tem sinais de redução de chuva na Amazônia devido ao desmatamento ou aumento na concentração de GEE. Secas associadas a variabilidade interanual de clima.

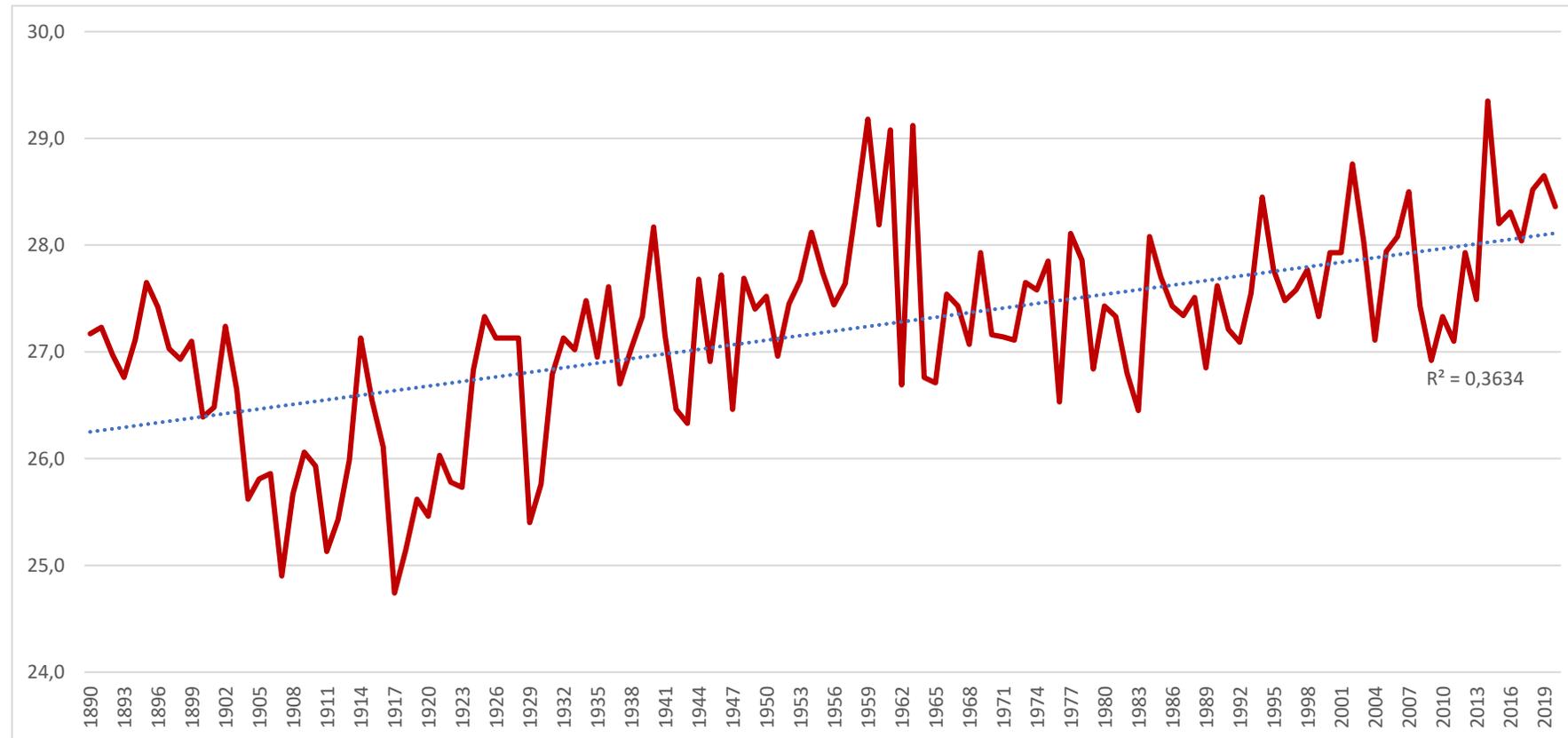
Causa do Aumento das Chuvas:  
Variabilidade Natural ou Aquecimento Global?

# Temperatura mínima média anual – Campinas/SP

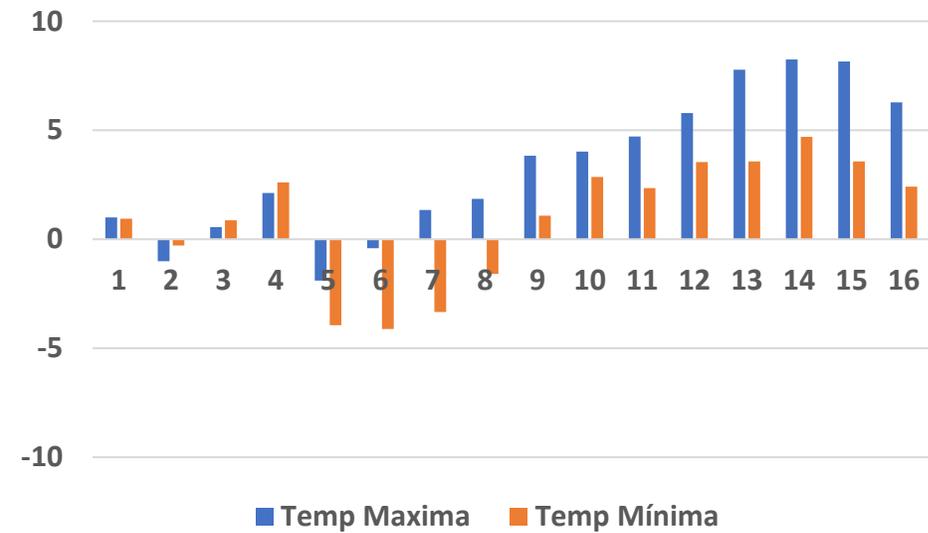
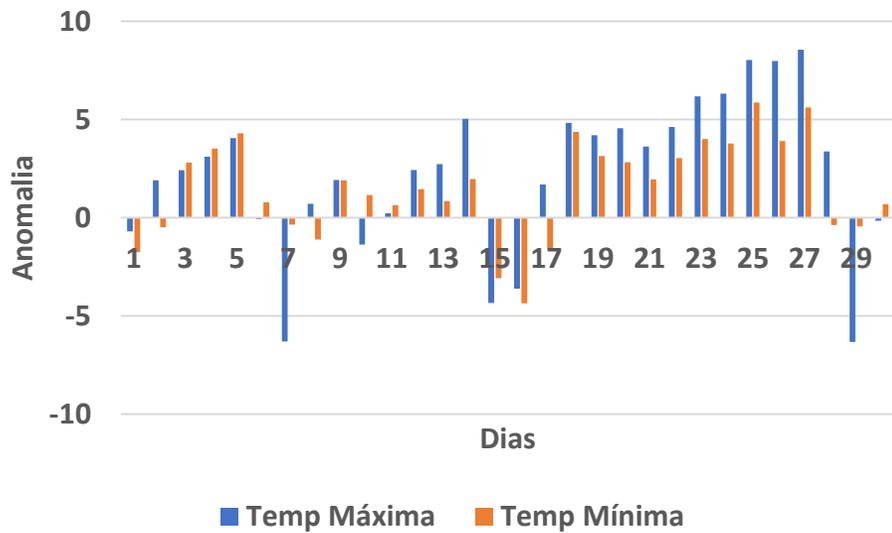


Fonte de dados IAC

# Temperatura máxima média anual – Campinas/SP



# Anomalia da Temperatura Máxima e Mínima – Campinas SP



Fonte: Cepagri/Unicamp

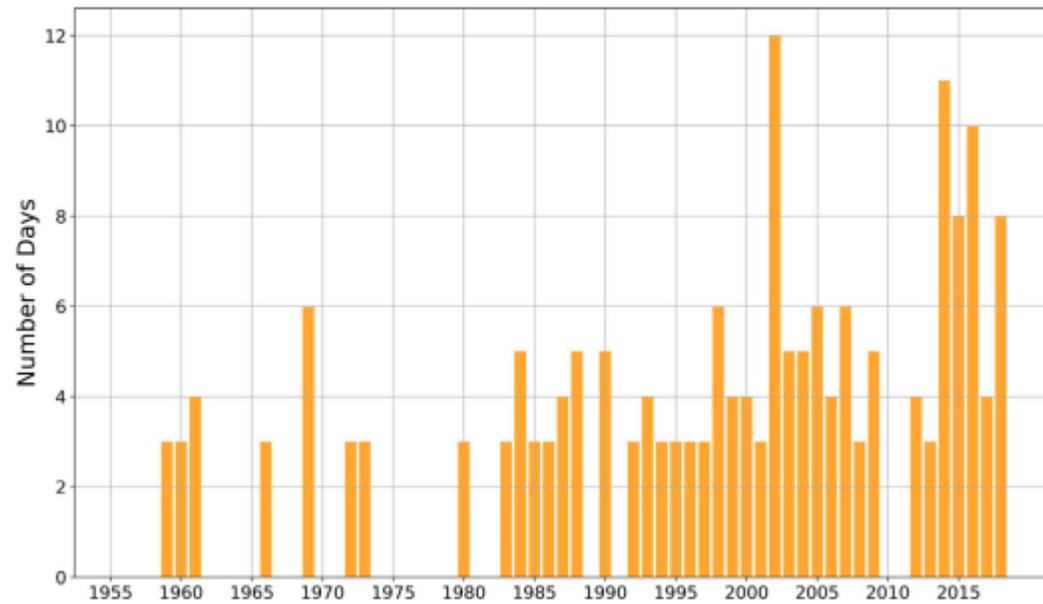


Figure 3 - Longest duration of heatwaves in days per year (HWD) for IAC weather station in the period of 1956-2018.

**\* 2002, 2014, 2015 e 2016 – El Niño  
Oscilação -Sul**

**Redução ou ausência de eventos em  
1999, 2000, 2010 e 2011 coincidem com  
La Niña**

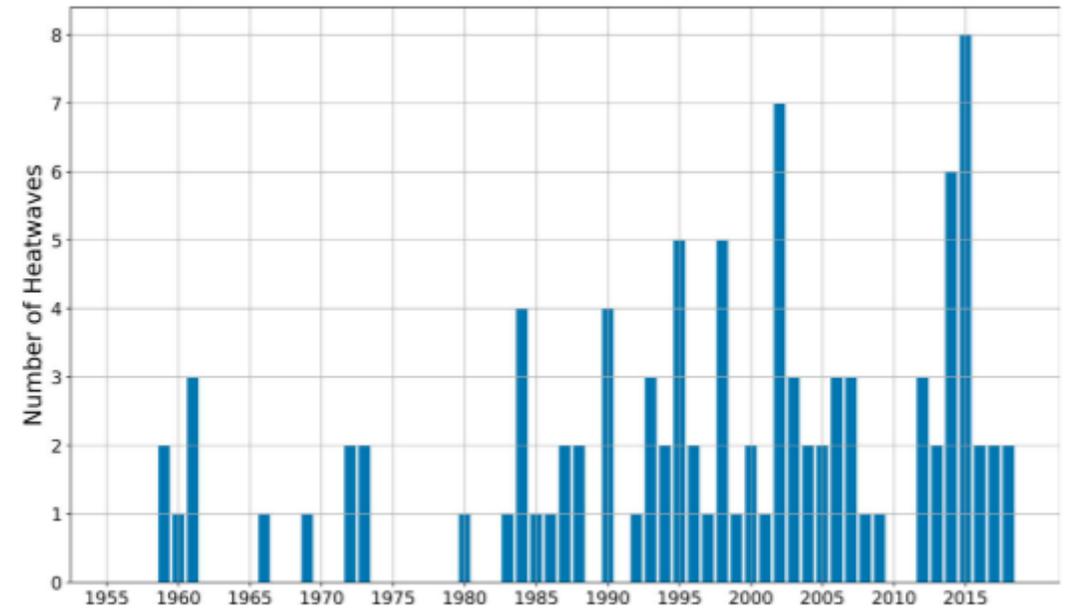
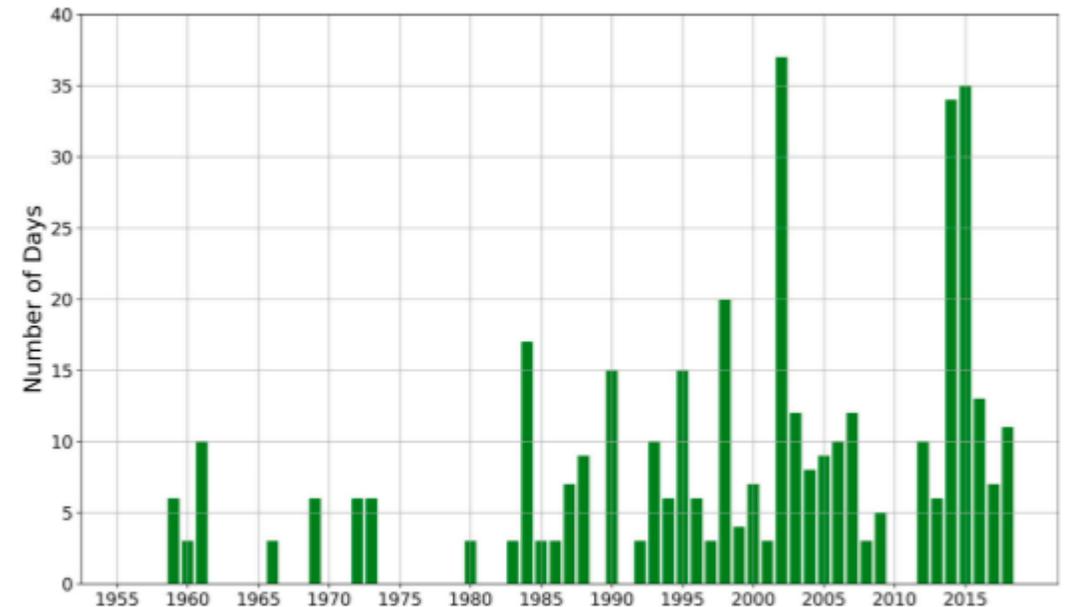


Figure 2 - Annual number of heatwaves (HWN) for IAC weather station in the period of 1956-2018.



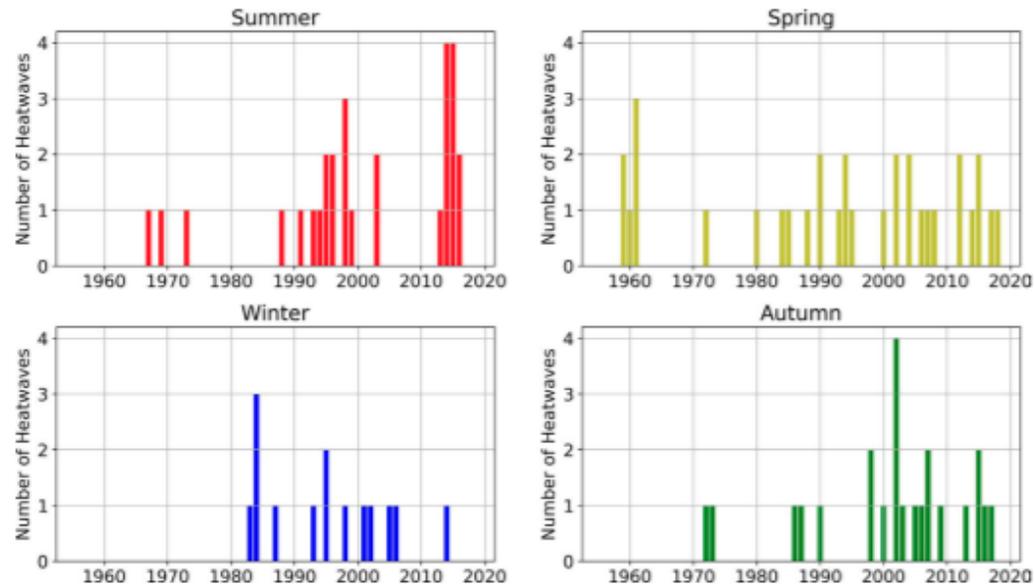


Figure 5 - Seasonal number of heatwaves (HWN) for IAC weather station in the period of 1956-2018.

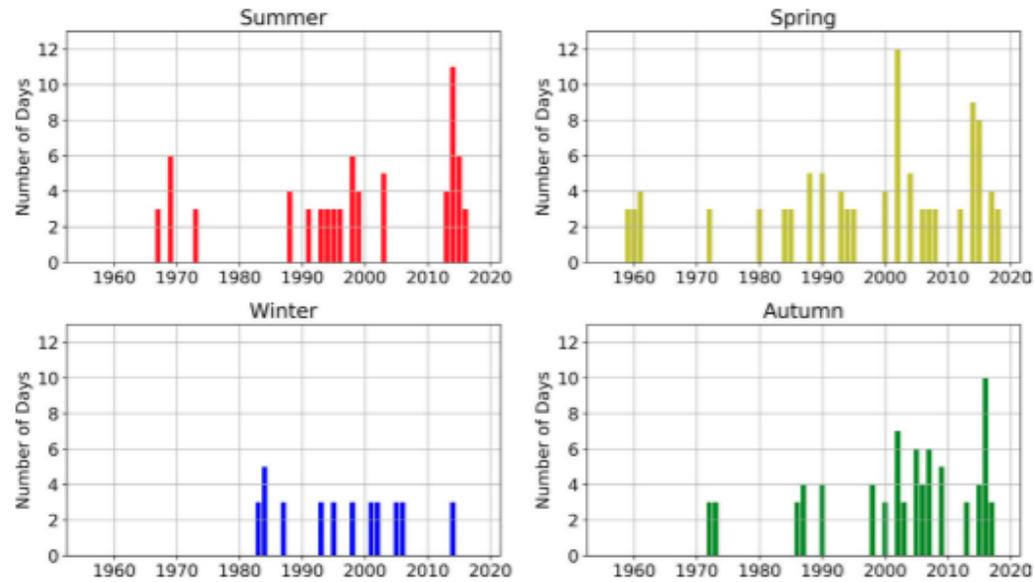
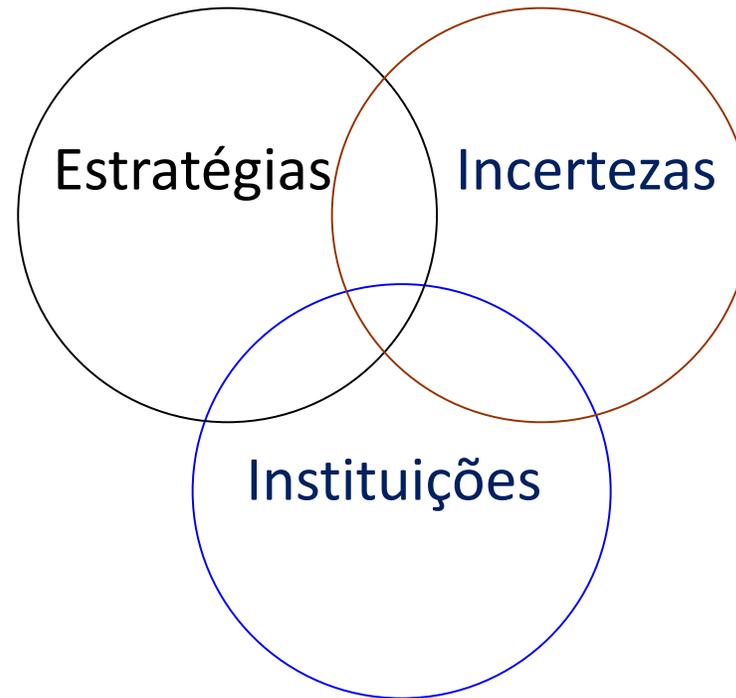


Figure 6 - Longest duration of heatwaves in days/season (HWD) for IAC weather station in the period of 1956-2018.

# O que fazer?

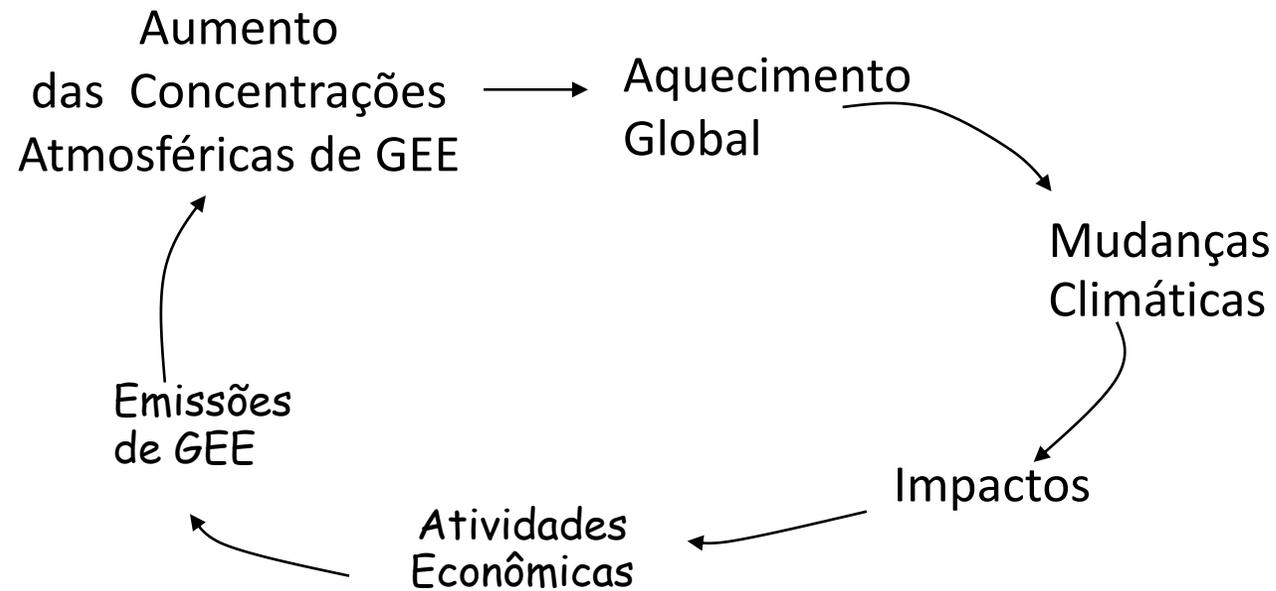
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Entrelaçadas!

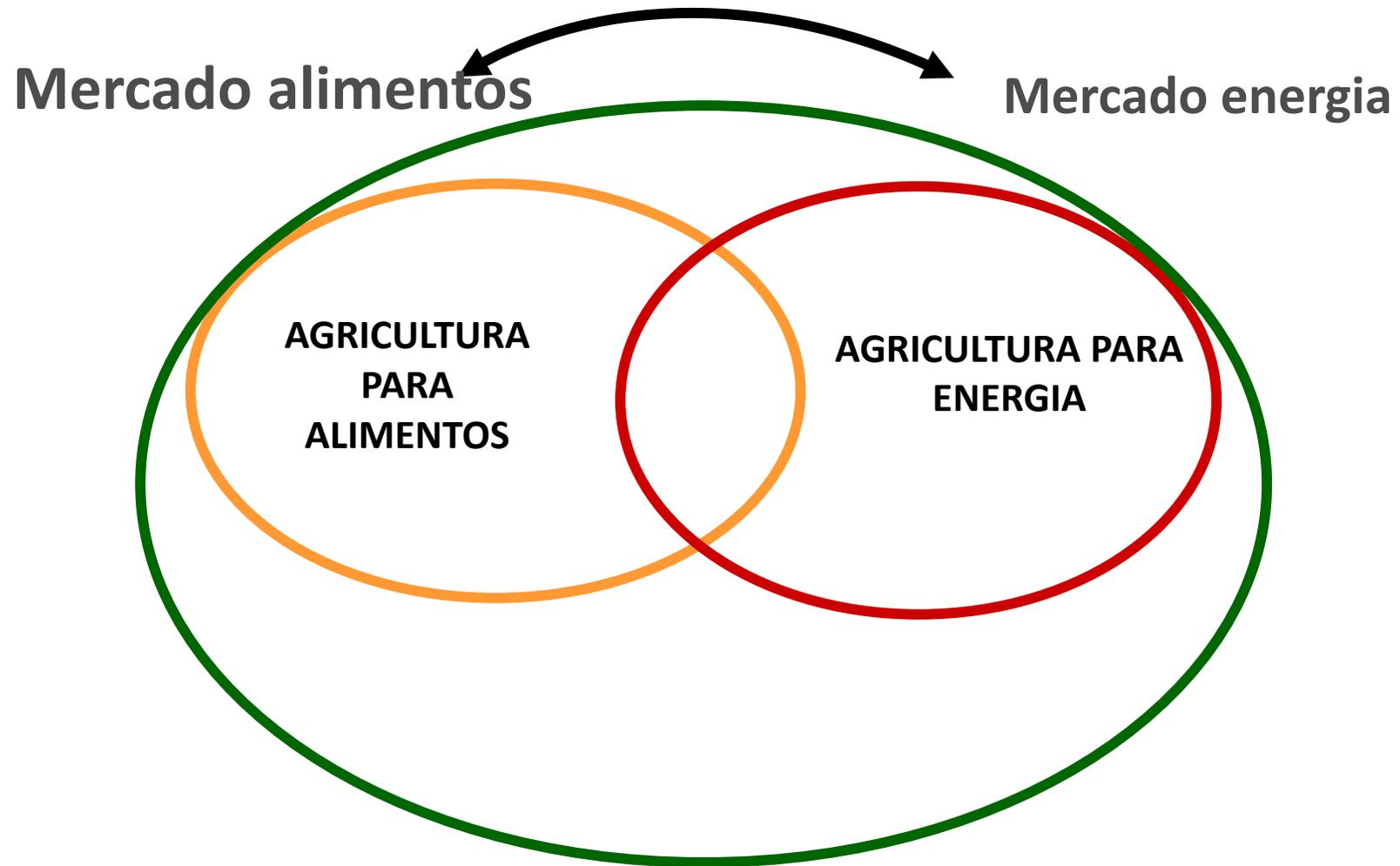
# Modelos Integrados Clima - Economia

## Cadeia de Causas e Efeitos



# Desafios globais

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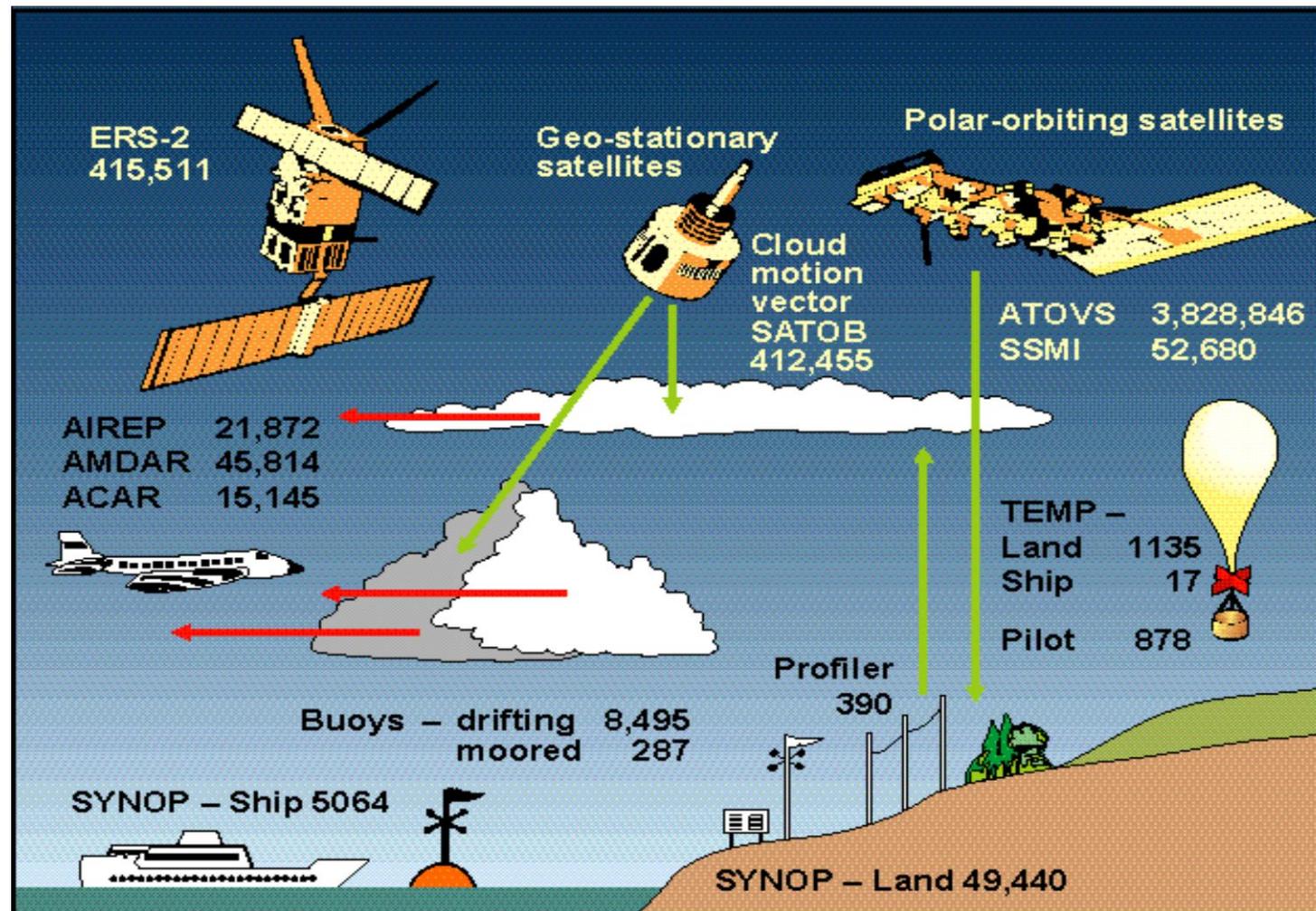
# Como são feitas as previsões?

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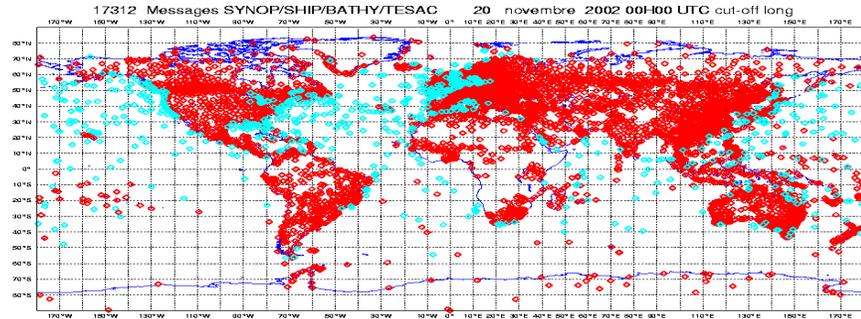


**QUE DADOS UTILIZA?**

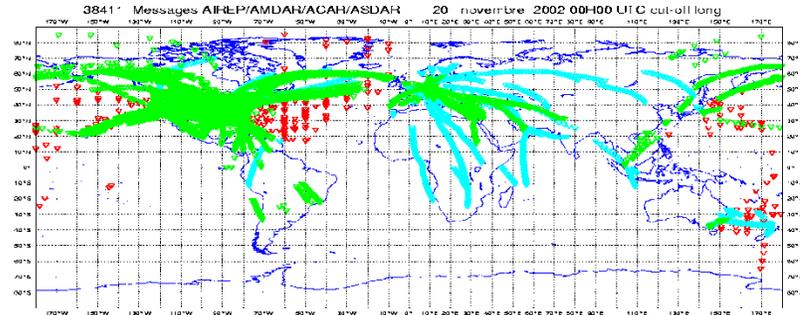
# Os números indicam observações recebidas - por dia em um centro de previsão de tempo



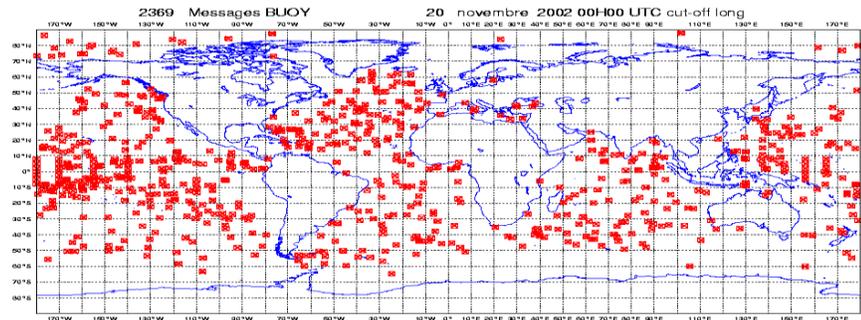
## SYNOP e SHIP surface P,T,UR,wind



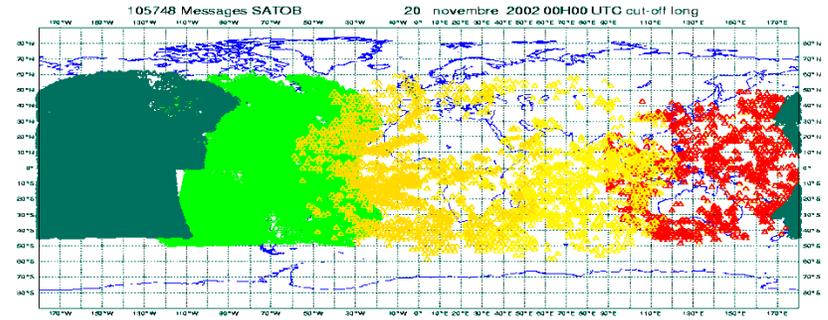
## aviões T,vento



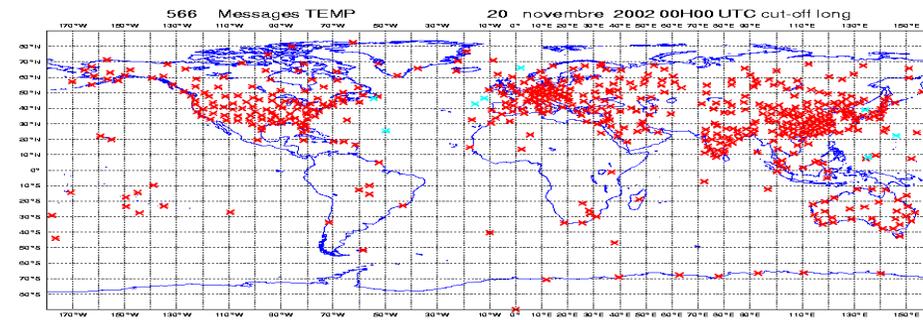
## bóias, superfície P,T,UR,wind



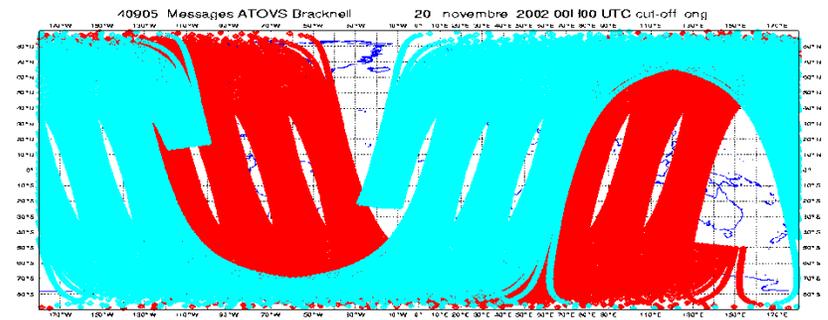
## Ventos de satélite geostacionário



## radiosondas P,T,UR,wind



## Radiâncias ATOVS NOAA

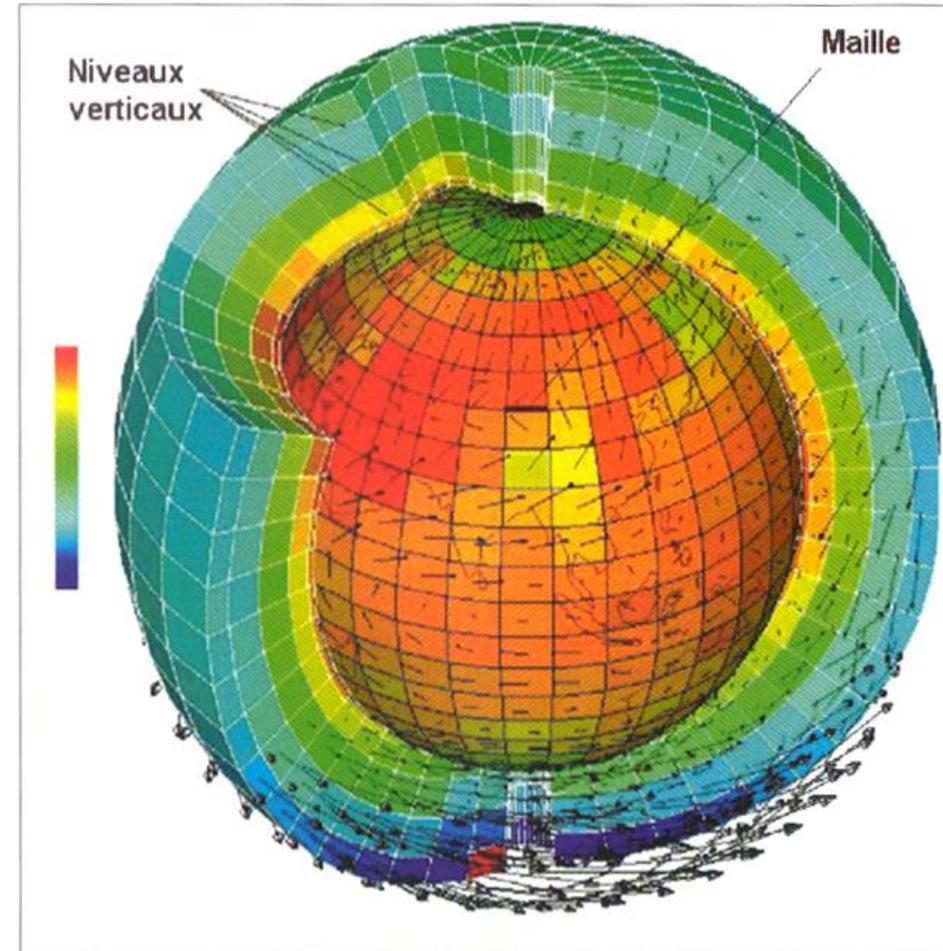


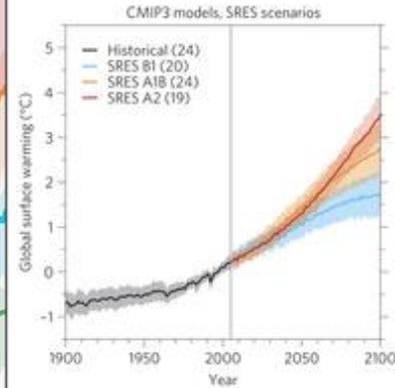
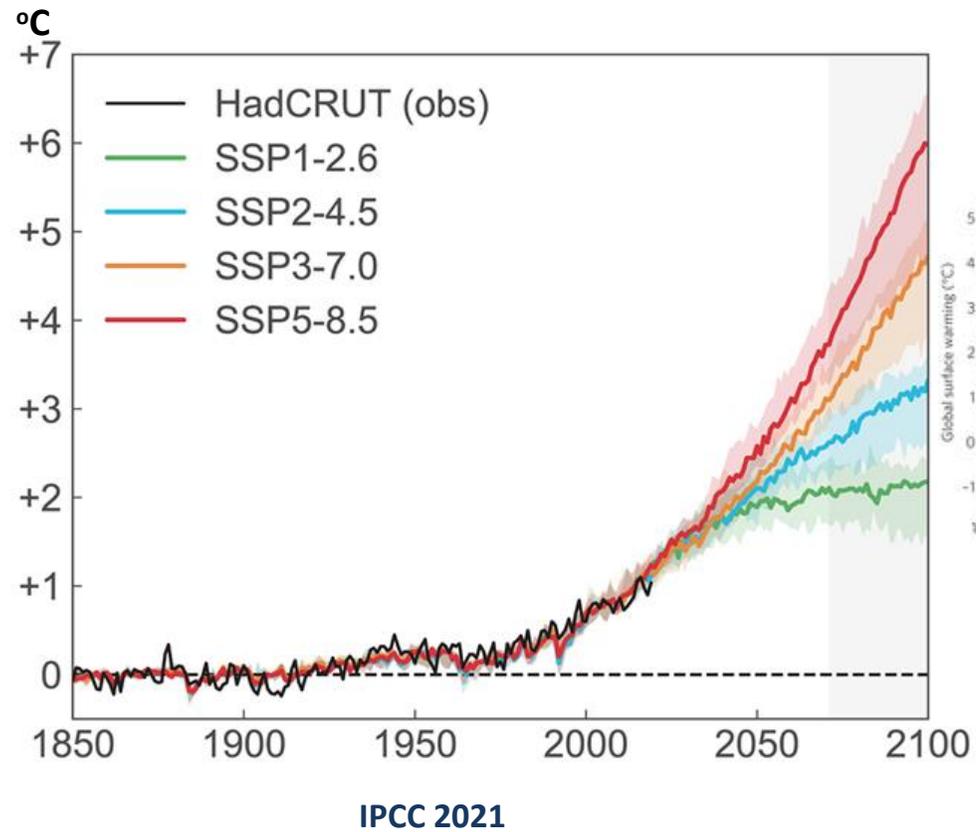
# CENÁRIOS FUTUROS IPCC

O espaço é dividido em caixas definidas por grades horizontais e níveis verticais.

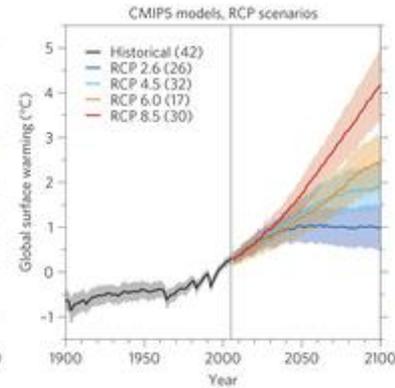
Em cada caixa a atmosfera é homogênea e é suficiente conhecer o valor em 1 ponto da caixa.

**Modelo em ponto de grade**

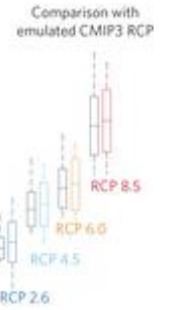




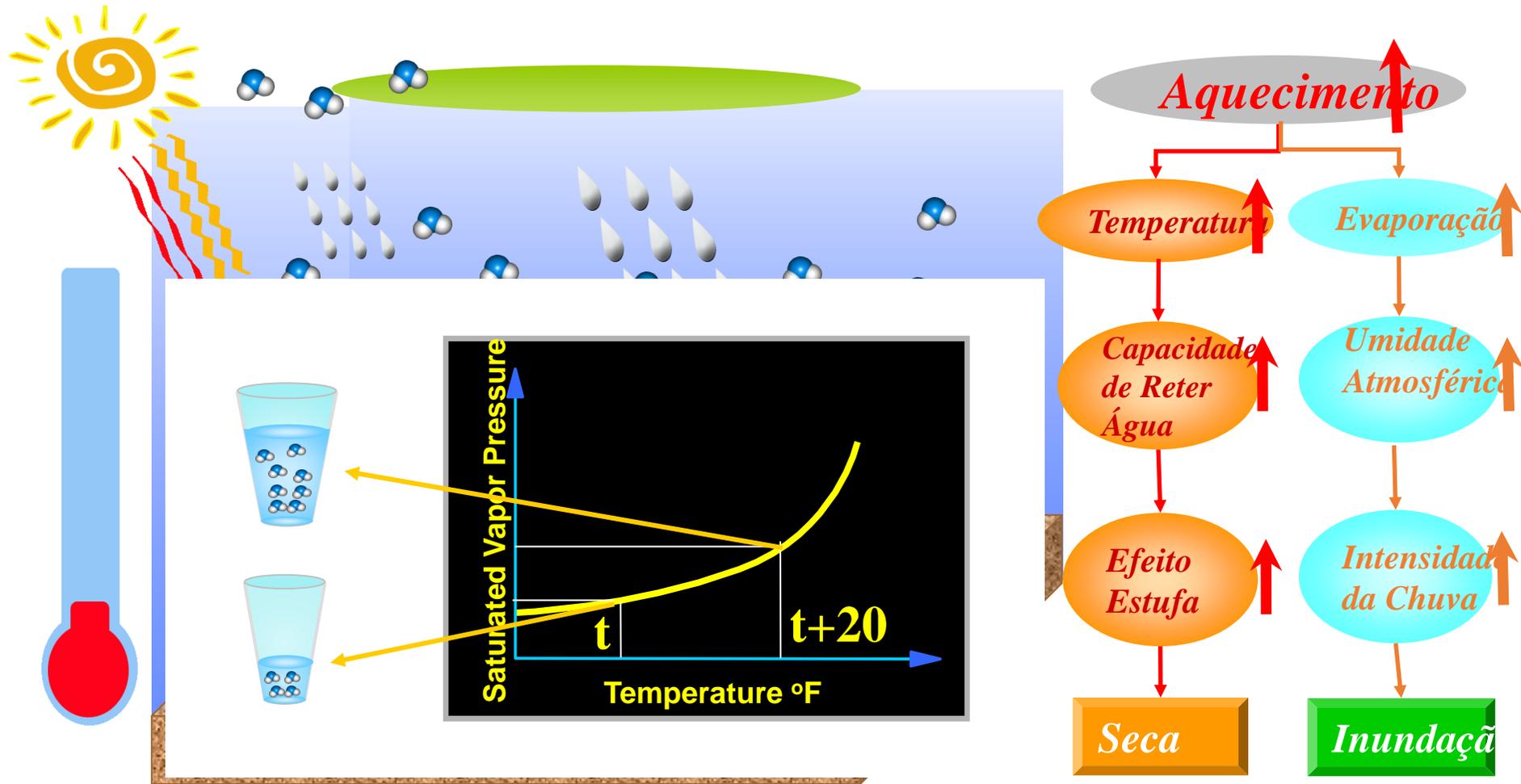
**IPCC 2007**



**IPCC 2013**

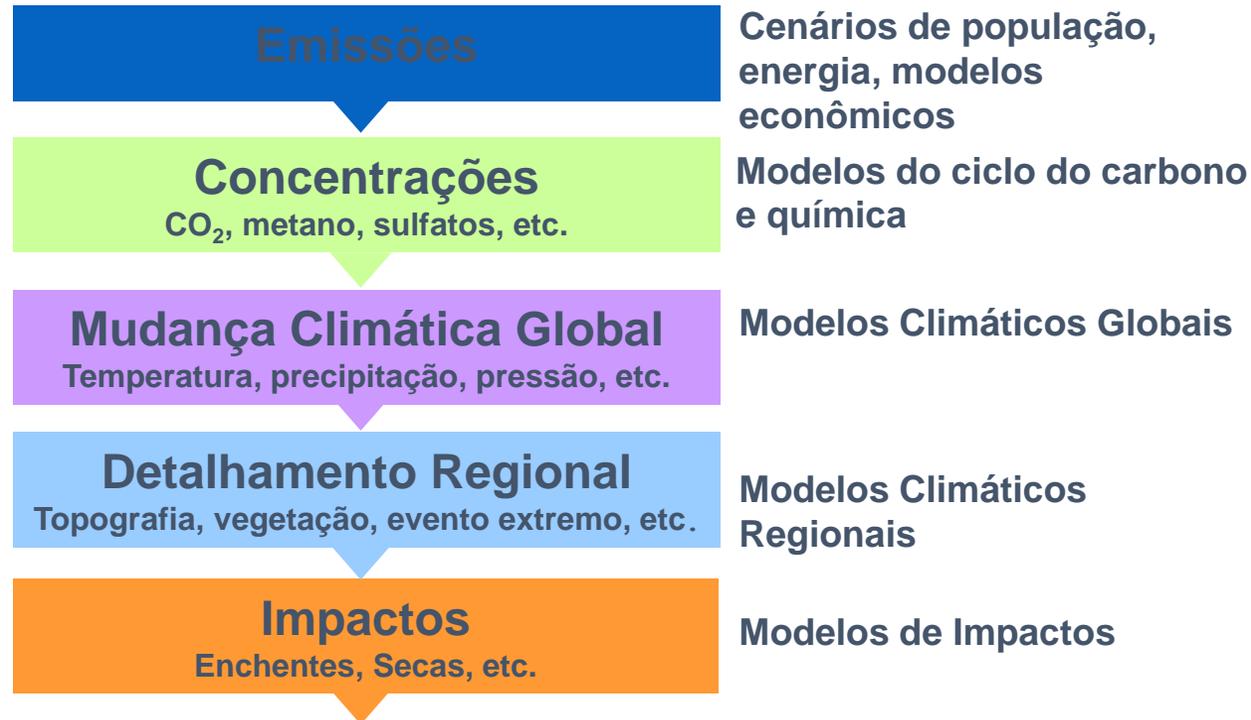


# Conexão entre Aquecimento Global e o Ciclo Hidrológico



# 'Cascata' de Incertezas

## Projetar os Impactos das Mudanças Climáticas



# Entendendo as mudanças climáticas e seus impactos

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