Extreme Weather and Climate in Latin America (LAC)

Jose A. Marengo
CEMADEN (National Center for Monitoring and Early Warning of Natural Disasters)
Sao Paulo, Brazil
jose.marengo@cemaden.gov.br

24 November 2021

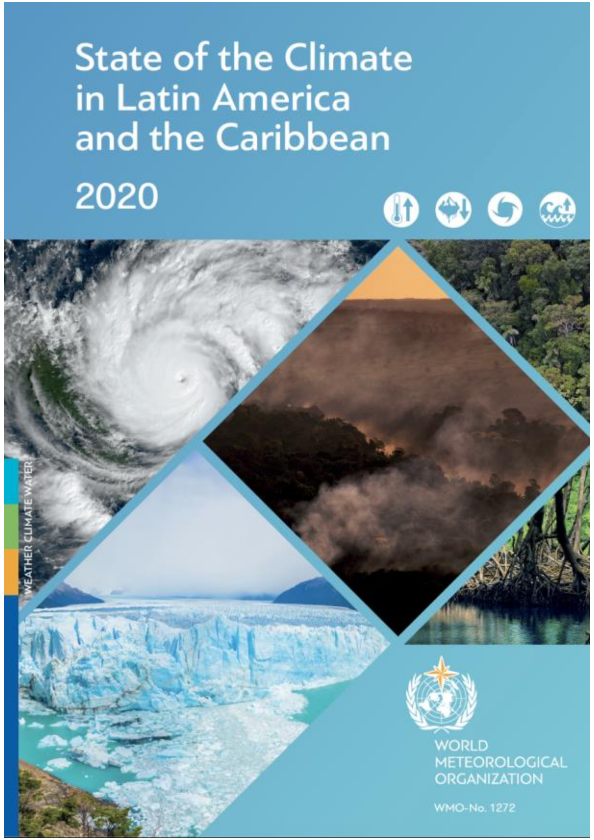
Overarching question:

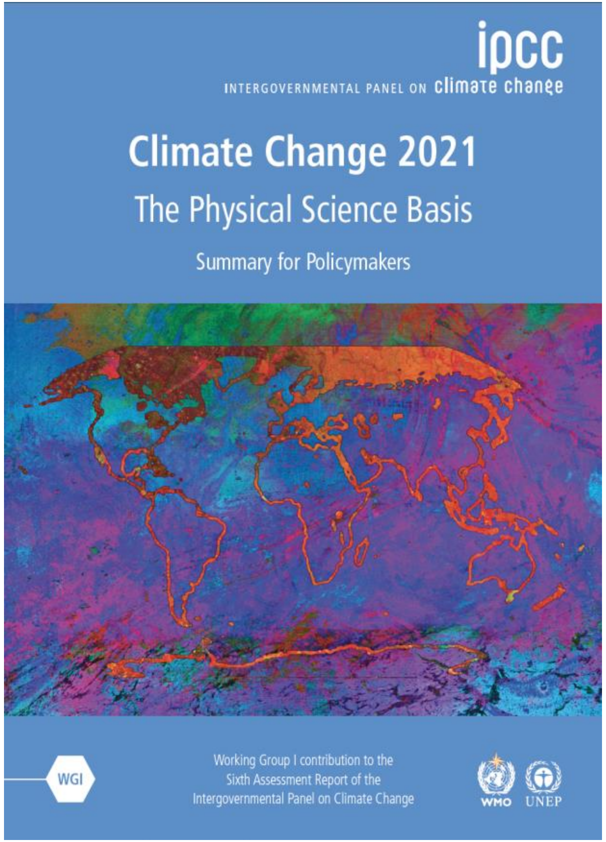
"***What are the status and trends of the state of climate indicators in LAC, associated impacts and key needs for adapting to climate variability and change?***"

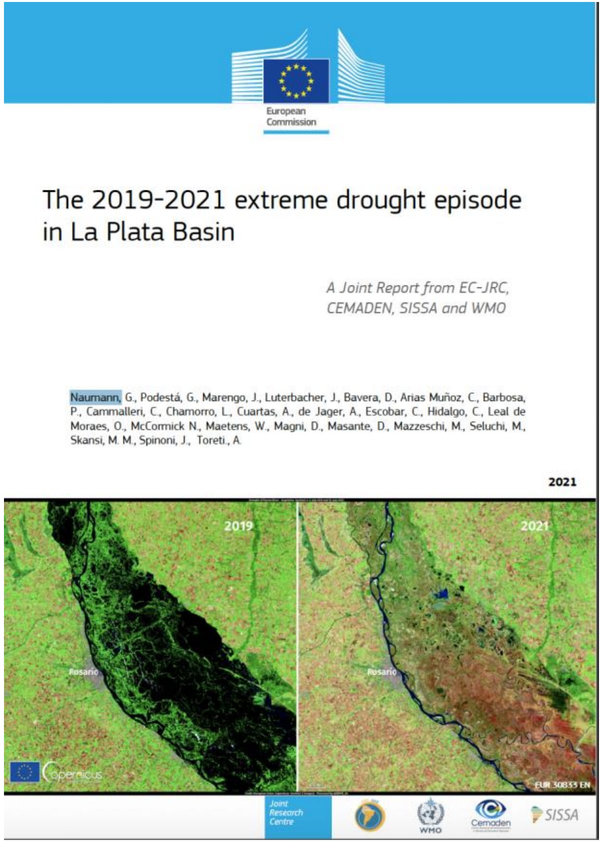
Latin America and the Caribbean is one of world regions where climate change effects and impacts such as heatwaves, decreases in crop yield, wildfires, coral reef depletion and extreme sea level events are projected to be more intense.

Thus, limiting global warming well below 2 °C, as prescribed in the Paris Agreement, is essential to reduce the risks in a region already facing economic and social asymmetries to its sustainable development.

Important references





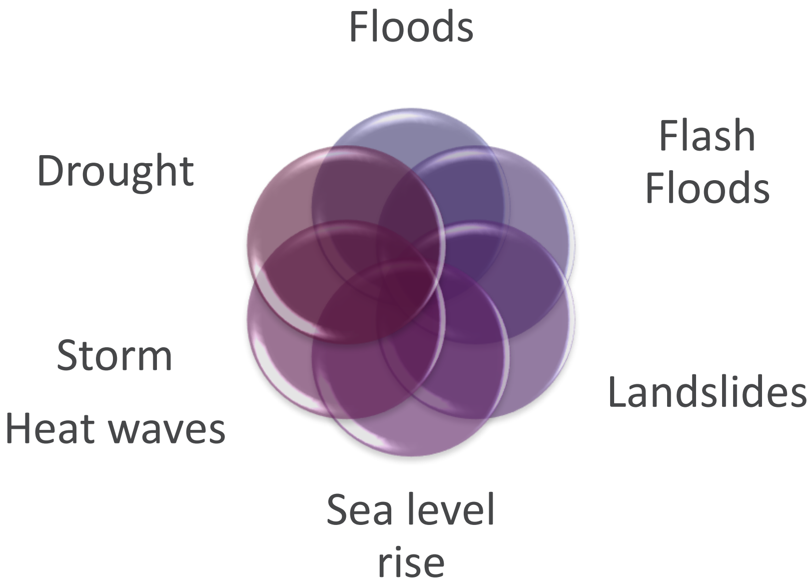


[Credit: Yoda Adaman | Unsplash]

"Já foi estabelecido que as atividades humanas estão afetando o clima, e isso faz com que eventos extremos, tais como ondas de calor, chuvas intensas e secas sejam mais frequentes e severas (IPCC AR6 WG1 SPM)

Isso aumenta o risco de crises hídricas, incêndios e desastres naturais e mais impactos setoriais e afetando segurança hídrica, alimentar, energia, saúde, social

Climate Change

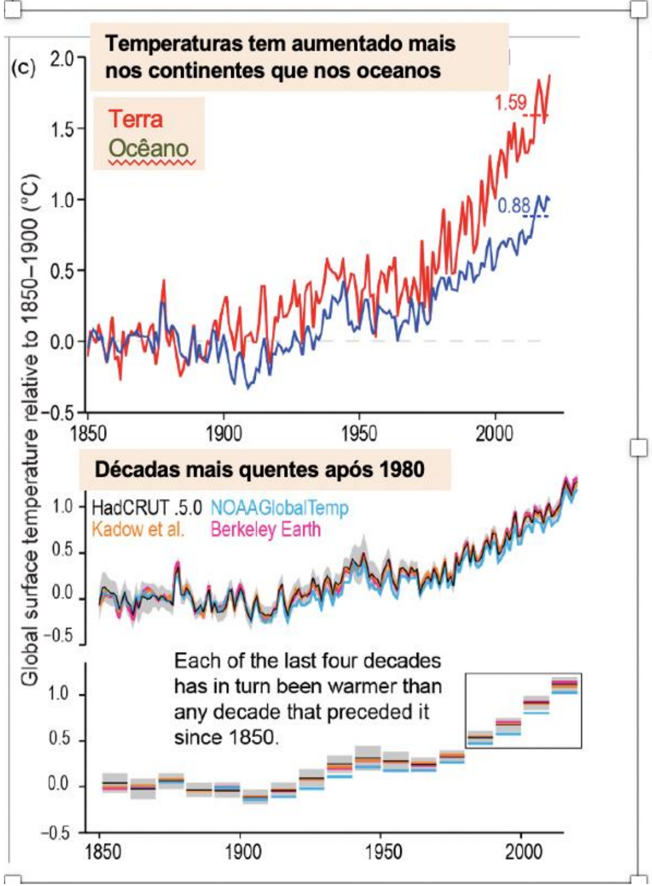


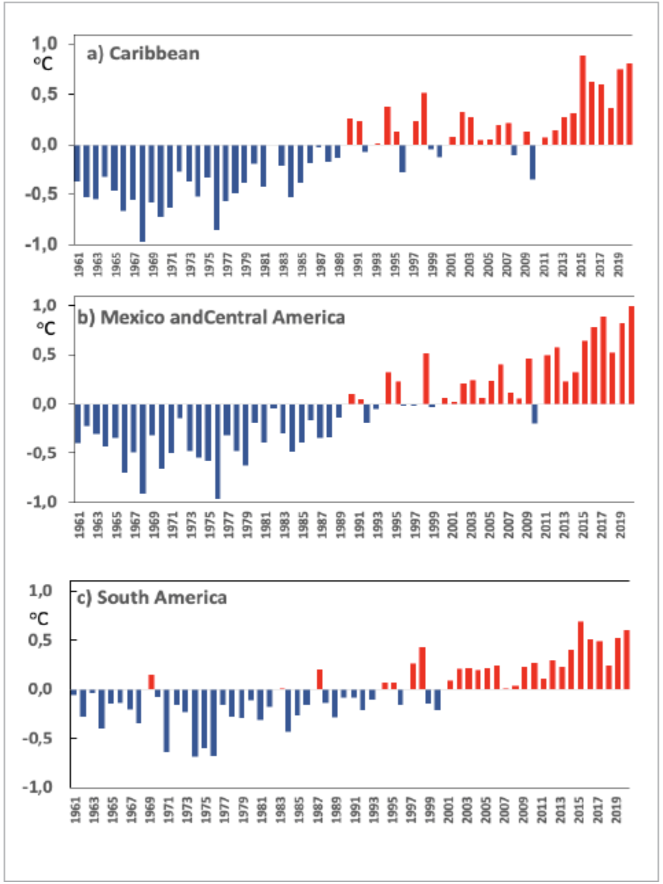



Main conclusions of IPCC AR6 WG1 (2021)

Aquecimento global e na America Latina e Caribe

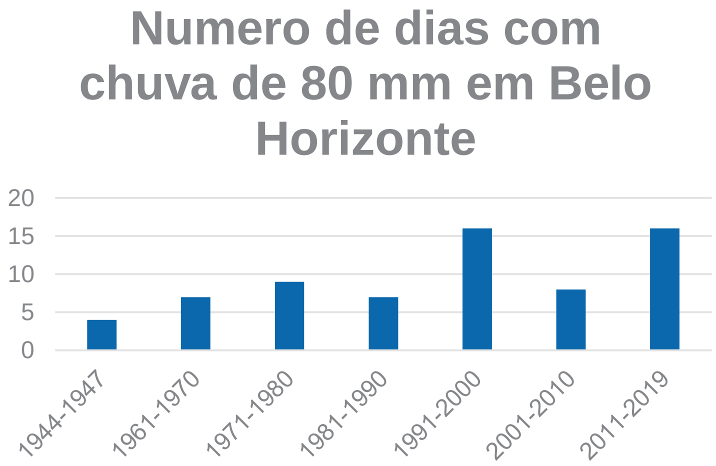
IPCC (2021)





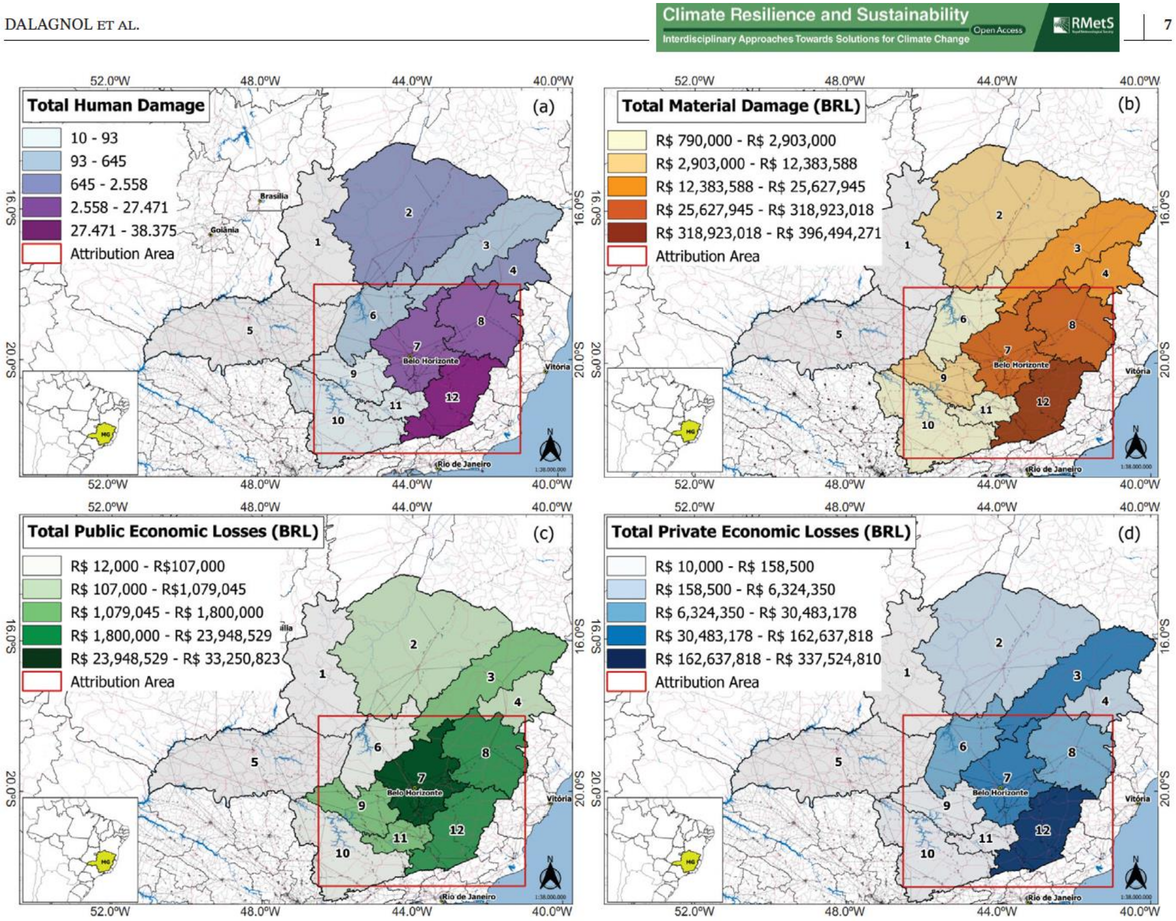
WMO (2021)

Extremos de chuva mais intensos e frequentes na decadas recentes nas cidades de Belo Horizonte, MG e Vitória, ES



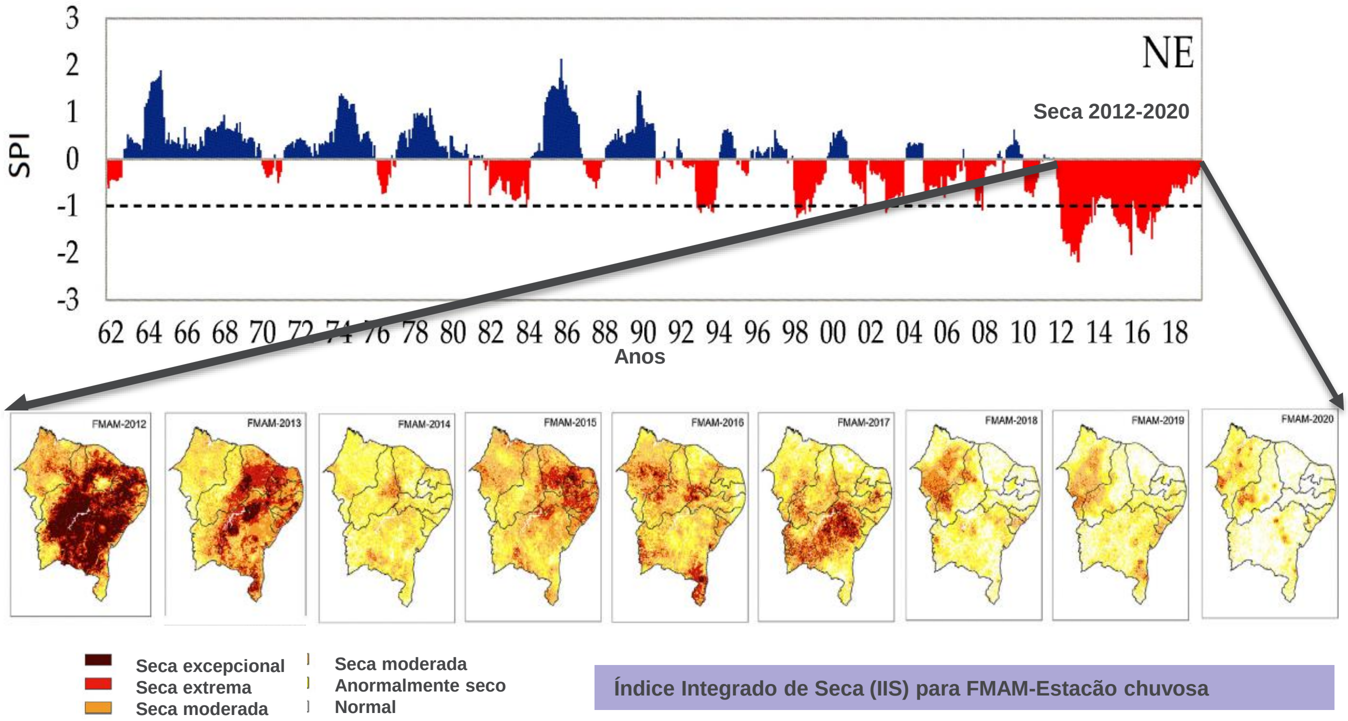
No período de 23-27 Janeiro 2020 choveu 320.9 mm/72 horas na cidade de Belo Horizonte. Isto corresponde a 97% da media climatólogica de Janeiro (329.1 mm) (INMET, 2021).

Impactos sócio econômicos das chuvas intensas de Janeiro 2020 em Minas Gerais



Drought in Northeast Brazil

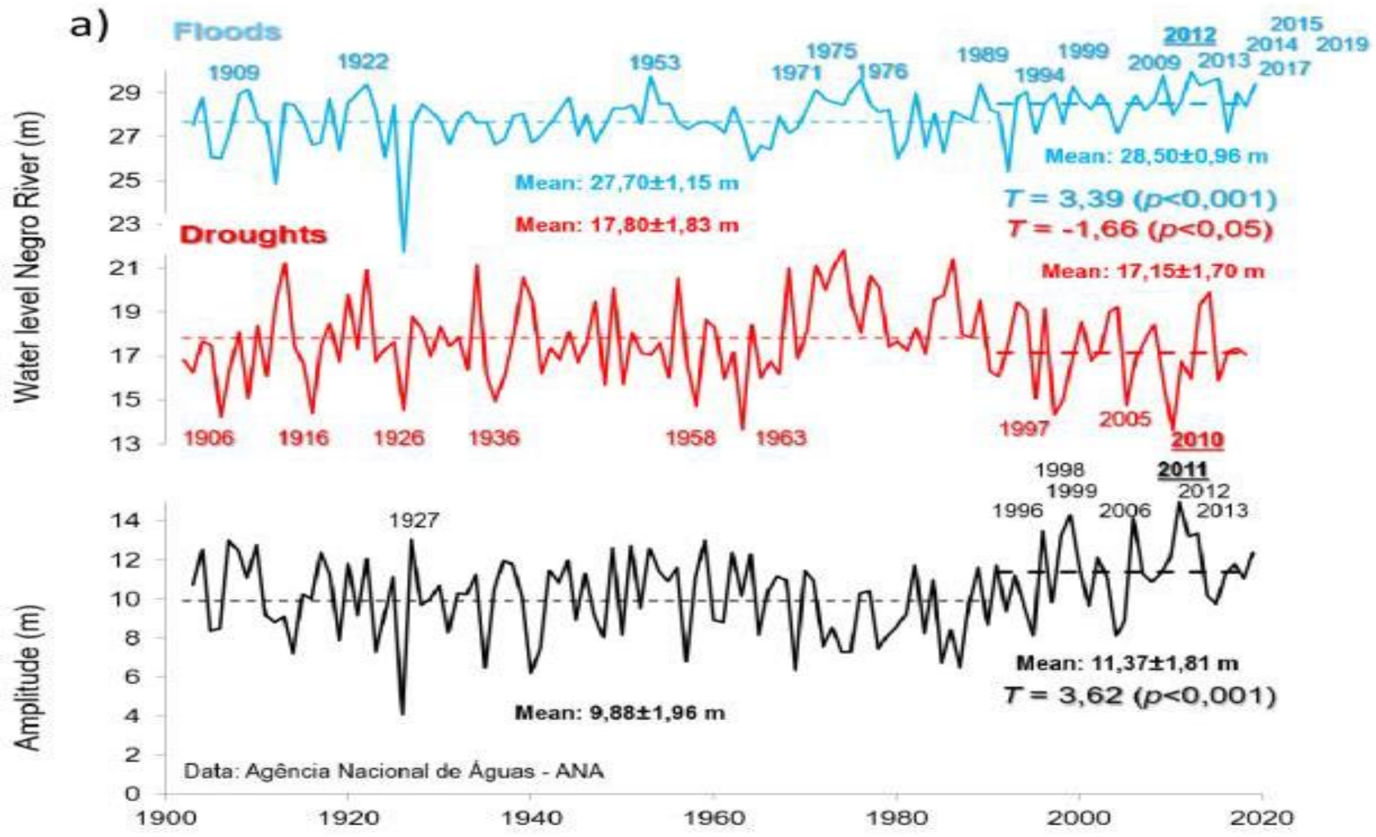
Índice SPI-12 (chuva) de 1962 até 2019 para o Nordeste do Brasil (NE)



Índice Integrado de Seca (IIS) para FMAM-Estacão chuvosa

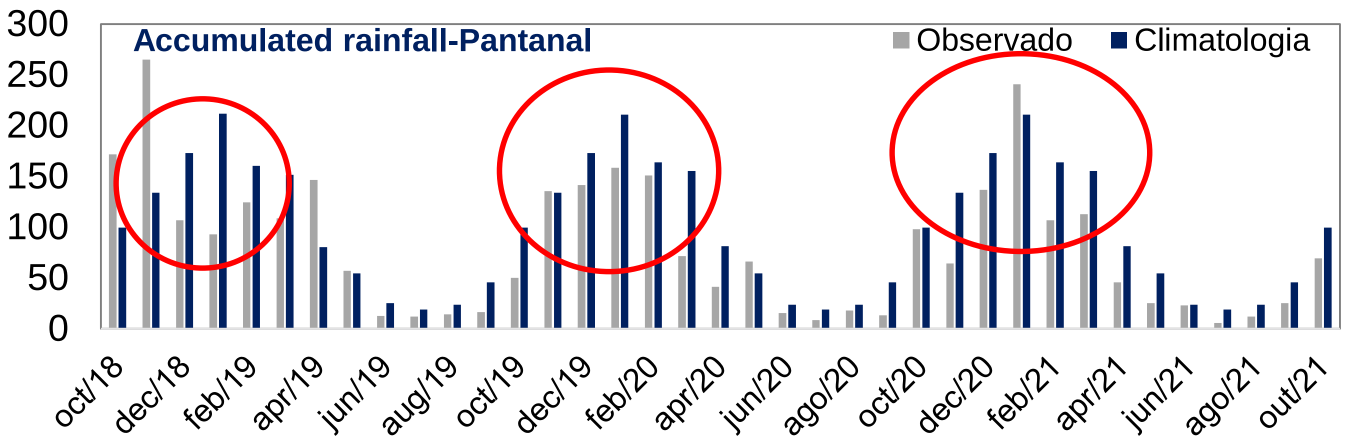
Níveis máximos (inundações, azul) e mínimos (secas, vermelho) do Rio Negro em Manaus (1903-2020). Anos que correspondem a extremos hidrológicos aparecem, indicados.

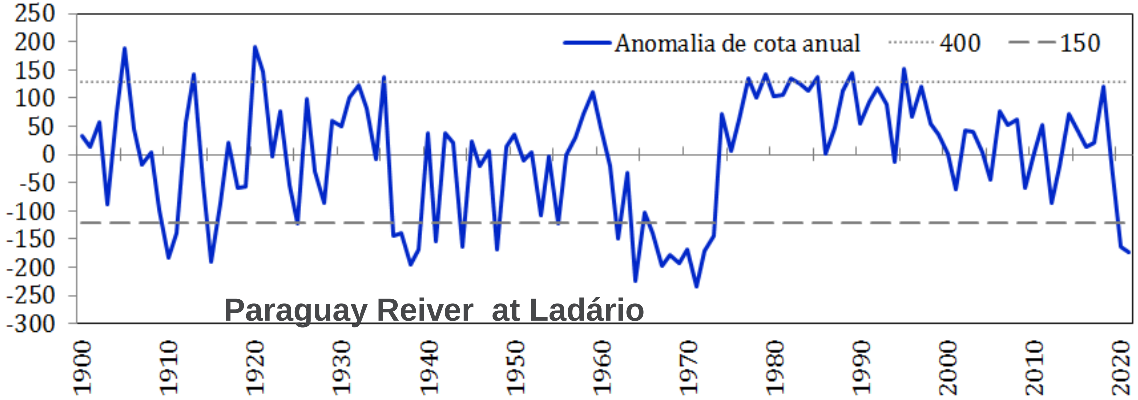
SPA (2021)



Desde 2000 aconteceram 3 secas e 3 inundações consideradas "de século" na Amazonia

Drought in Pantanal 2019-20: a drought-heat compound extreme event





Fonte dos dados: ANA Estimativa SSFI e Anomalias, e Gráfico: CEMADEN Período dos dados: Jan/1900-Out/2021

The heat wave of 2019-20 in Pantanal, part of a drought-heat compound extreme event

Marengo et al (2021)

BRAZIL			
Station	**TMax**	**Date**	**LTM**
1.São Paulo (highest in 77 years)	37.5 ºC	10/2	24.8 ºC
2.Lins (highest in history)	43.5 ºC	10/2	31.4 ºC
3.Curitiba (highest in 110 years)	35.5 ºC	10/2	22.6 ºC
4.Goiania	41.2 ºC	10/7	31.0 ºC
5.Campo Grande (highest in 100 years)	41.0 ºC	10/5	30.6 ºC
6.Aguas Claras	44.4 ºC	10/1	34.0 ºC
6.Aguas Claras (second highest in history)	44.6 ºC	10/5	34.0 ºC
7.Corumba	43.4 ºC	09/30	32.3 ºC
8.Nova Maringa	44.6 ºC	10/7	34.0 ºC
9.Paranaiba	44.7 ºC	10/7	32.8 ºC
10.Brasilia (highest in 110 years)	36.4 ºC	10/2	27.5 ºC
11.Cuiabá (highest since 1910)	44.0 ºC	09/30	34.0 ºC

PARAGUAY			
Station	**TMax**	**Date**	**LTM**
1.San Estanislao (highest in history)	41.2 ºC	10/1	28.4 ºC
2.Asunción	42.8 ºC	10/1	26.9 ºC
3.Paraguari (highest in history)	42.0 ºC	09/30	26.6 ºC
4.Pilar (highest in history)	43.5 ºC	10/1	28.4 ºC
5.Concepción (highest in history)	42.6 ºC	10/2	33.4 ºC
6.S. Juan Bautista Misiones (highest in history)	41.6 ºC	10/1	28.2 ºC
7.Luque (highest in history)	42.8 ºC	10/1	29.6 ºC
8.Gral Bruguez (highest in history)	43.6 ºC	10/1	30.7 ºC
9.Puerto Casado (highest in history)	42.4 ºC	10/1	32.6 ºC
10.Mariscal Estigarribia	44.0 ºC	10/1	34.4 ºC
11.Minga Guazú (highest in history)	42.4 ºC	09/30	26.9 ºC
12.Villarica (highest in history)	41.0 ºC	10/1	29.0 ºC

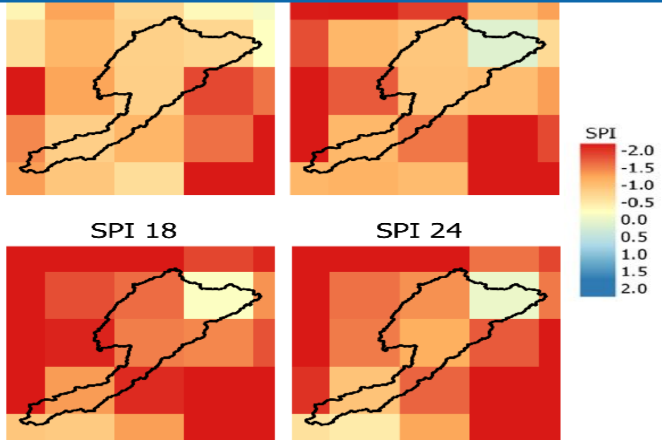
BOLIVIA			
Station	**Tmax**	**Date**	**LTM**
1.Ascensión de Guarayos	40.0 ºC	10/1, 2	32.7 ºC
2.Robore	41.6 ºC	10/8	34.0 ºC
3.San Ignacio de Velazco	40.6 ºC	10/8	32.7 ºC
4.San José de Chiquitos (highest ever)	43.4 ºC	10/8	33.9 ºC
5Cobija	38.3 ºC	10/11	32.6 ºC
6.San Joaquín	39.5 ºC	10/11	33.5 ºC
7.San Ramon	39.8 ºC	10/11	33.7 ºC
8.Riberalta	38.2 ºC	10/8	32.6 ºC

ARGENTINA			
Station	Tmax	Date	LTM
1.Formosa (highest in history)	43.3 ºC	10/1	29.0 ºC
2.Corrientes (highest in history)	43.5 ºC	10/1	27.9 ºC
3.Las Lomitas (highest in history)	43.6 ºC	10/1	32.2 ºC
4.Resistencia (highest in history)	43.6 ºC	10/1	28.1 ºC
5.Iguazú (highest in history)	40.1 ºC	10/1	28.3 ºC
6.Posadas (highest in history)	40.6 ºC	10/1	28.3 ºC
7.P. Roque S. Peña (highest in history)	43.5 ºC	09/30	26.5 ºC
8.Oberá (highest in history)	40.0 ºC	10/1	27.8 ºC

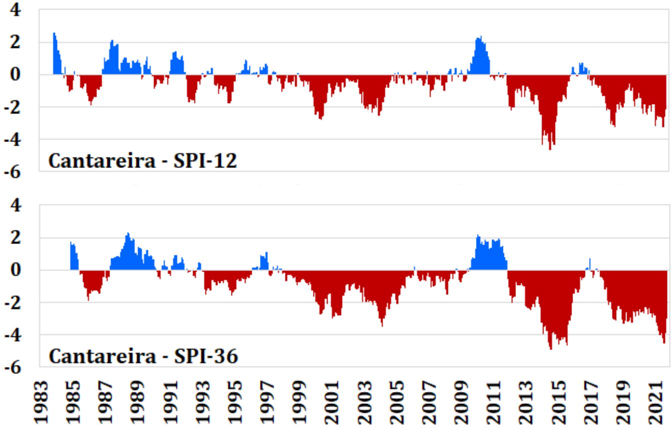
Maximum temperatures during heat wave of15 September-5 November 2020

Central South America Central region had record maximum temperatures from late September to mid-October 2020. Warming around 10ºC above normal, and some even have temperatures above 40ºC for several consecutive days. Over the Pantanal region, the heat wave defined by the WSDI>7 days, together with the severe drought (SPI <-2), constituted a a severe drought-heat compound extreme event that impacted natural and human systems and increased fire risk in October 2020 (fire season).

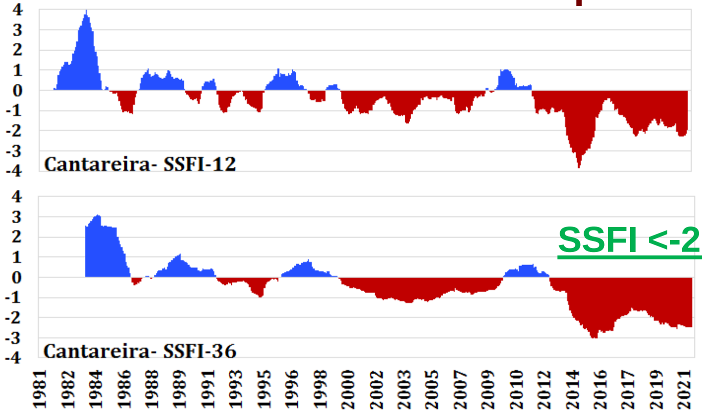
Drought over the Cantareira System in 2013-14 and 2020-21



Seca Excepcional



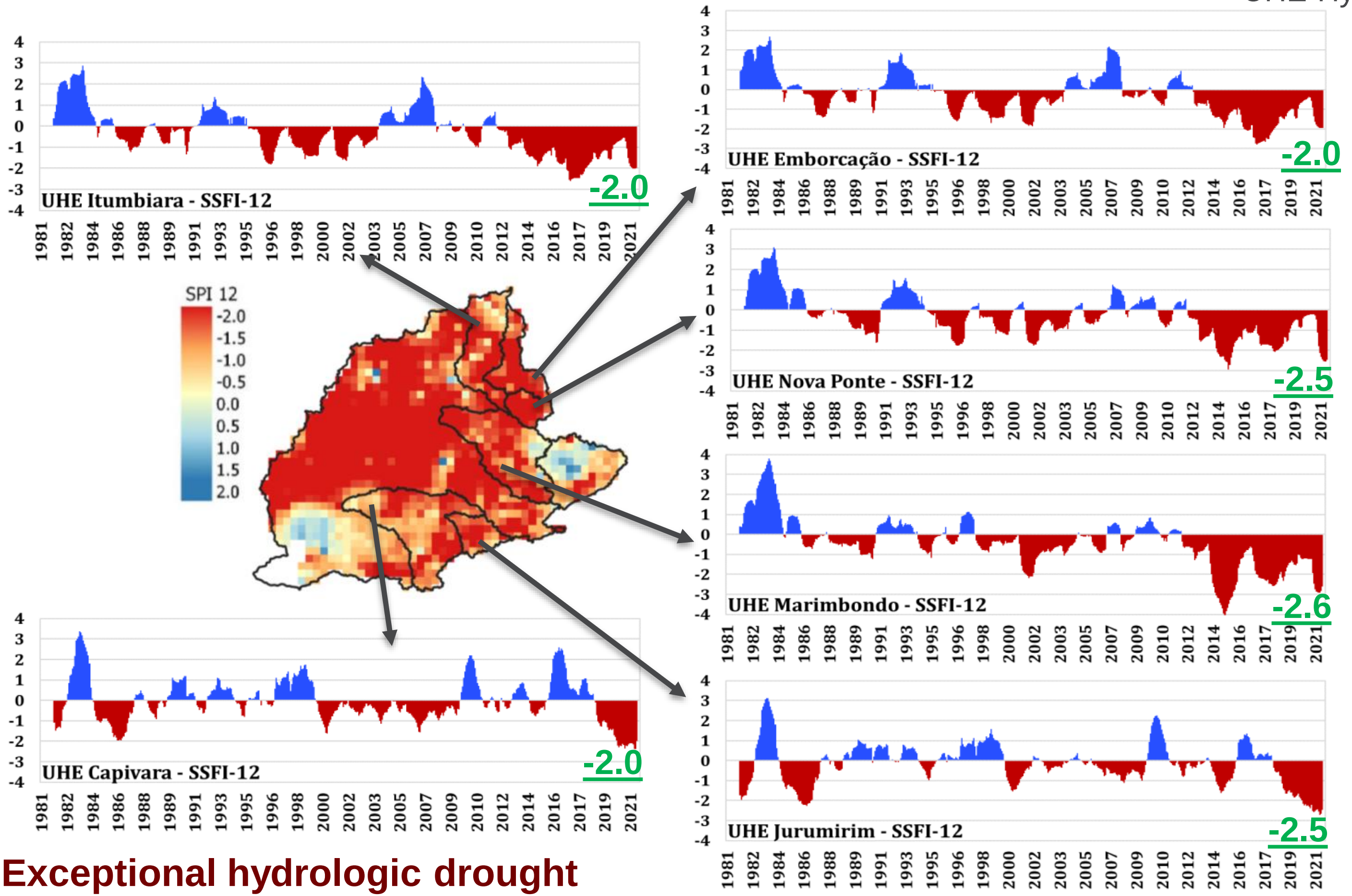
Índice Padronizado de Precipitação
(1983 - 2021)



Índice Padronizado de Vazão
(1981-2021)

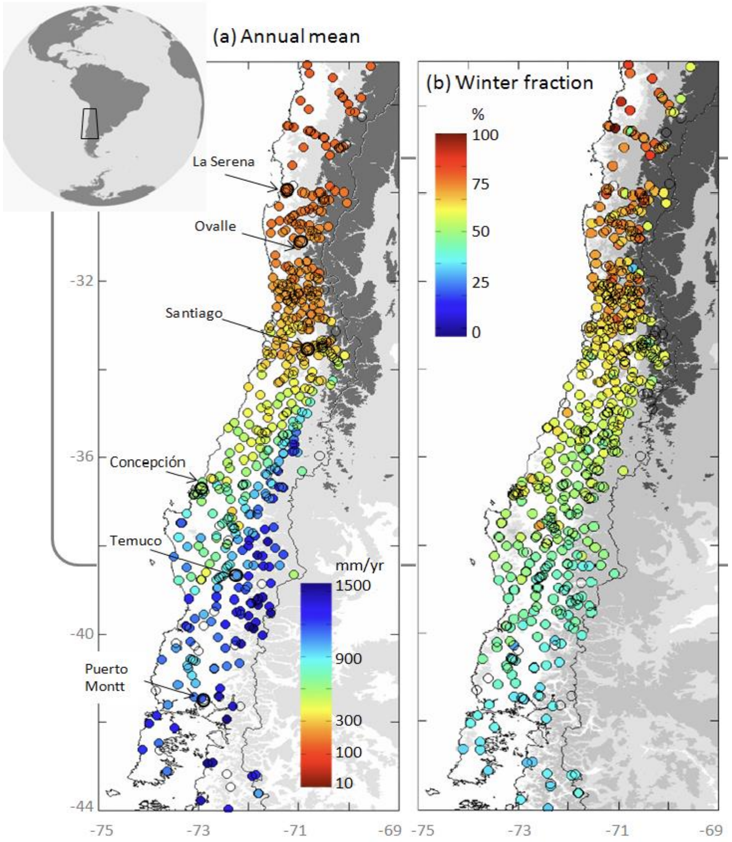
Drought in the Paraná River basin

UHE-Hydroeletric Plant



Exceptional hydrologic drought

Megadrought of Chile in 2010-20



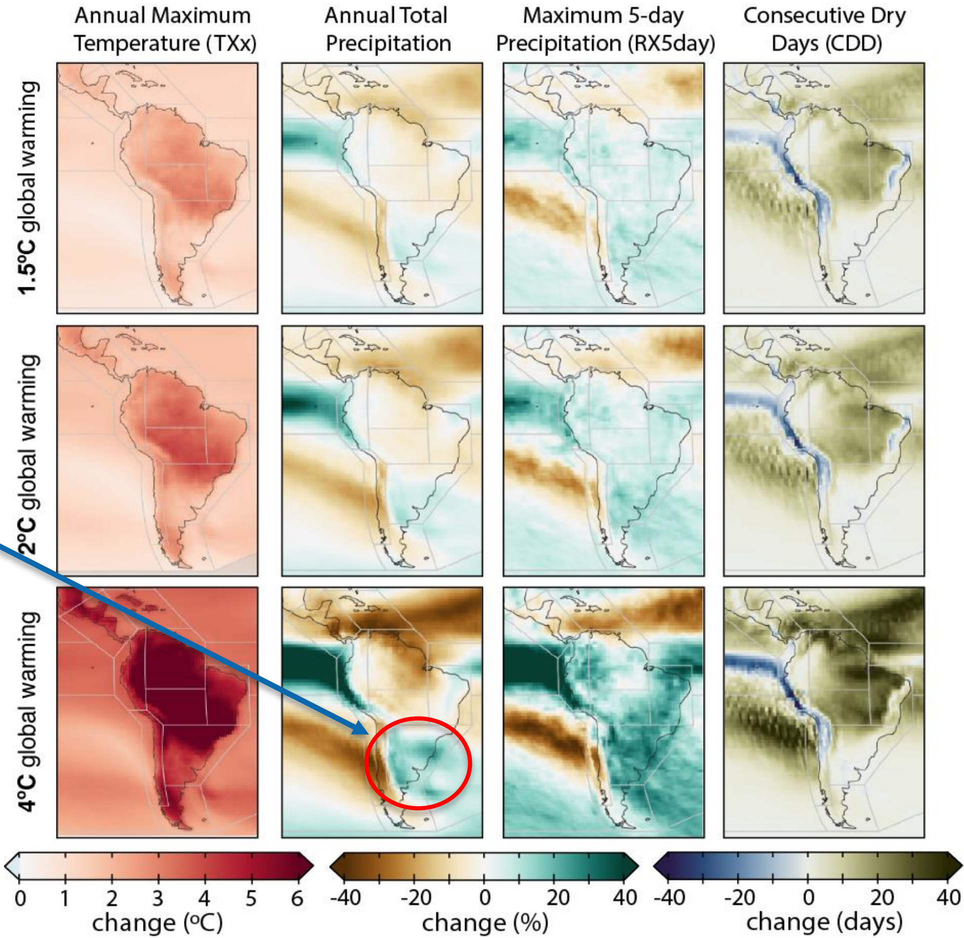
Central Chile, home to more than 10 million inhabitants, has experienced an uninterrupted sequence of dry years since 2010 with mean rainfall deficits of 20–40%. The so-called Mega Drought (MD) is the longest event on record and with few analogues in the last millennia. It encompasses a broad area, with detrimental effects on water availability, vegetation and forest fires that have scaled into social and economical impacts.

Long-term mean precipitation features along Central Chile. (a) Annual mean accumulation, 10 (b) winter (MJJAS)
fraction of the annual total, The variables are color-coded according
to their value in each precipitation station. The solid lines are the coastline and the political border. Grey and black
background areas indicate terrain elevation in excess of 1500 and 3000 m ASL, respectively

A blob of warm water in the southern Pacific east of New Zealand is driving hot and dry conditions in Chile fueling a decade-long megadrought, and climate change is at least partly to blame

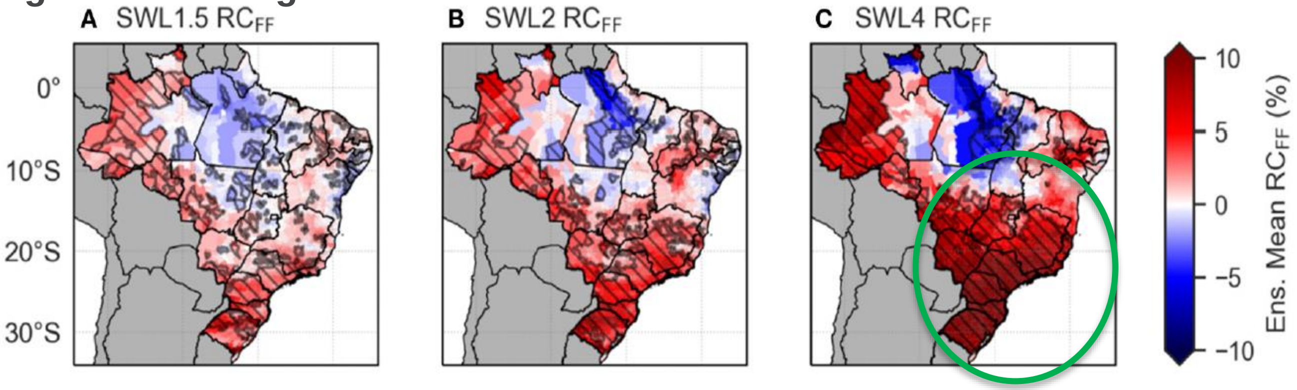
Projected changes in annual maximum temperature (TXx), annual total precipitation (Pr), maximum precipitation in 5 days (RX5day) and consecutive dry days (CDD) for global warming 1.5ºC, 2ºC and 4ºC compared to the pre-industrial period (1850-1900)

In SE South America the rains will be more intense and will occur in a few days, increasing the risk of natural disasters and with dry and hot periods between intense rains

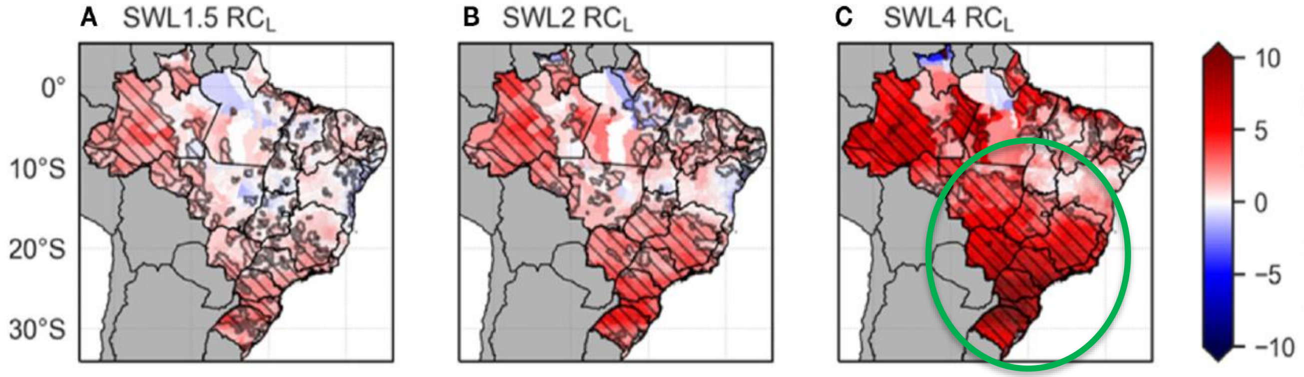


Projected changes in rainfall extremes increase the risk of natural disasters in Southeastern Brazil

Changes in the index of potential for flash floods at various levels of global warming



Changes in the index of potential for landslides at various levels of global warming



Extreme Rainfall and Hydro-Geo-Meteorological Disaster Risk in 1.5, 2.0, and 4.0°C Global Warming Scenarios: An Analysis for Brazil

Jose A. Marengo[1], Pedro I. Camarinha[1], Lincoln M. Alves[2], Fabio Diniz[1] and Richard A. Betts[3,4]*

Increasing warming enhances the risk of landslides and flash floods in the context of climate change. Comparisons of vulnerability and change in potential impacts of landslides and floods show that three regions, highly densely populated areas, are the most exposed to landslides and floods.

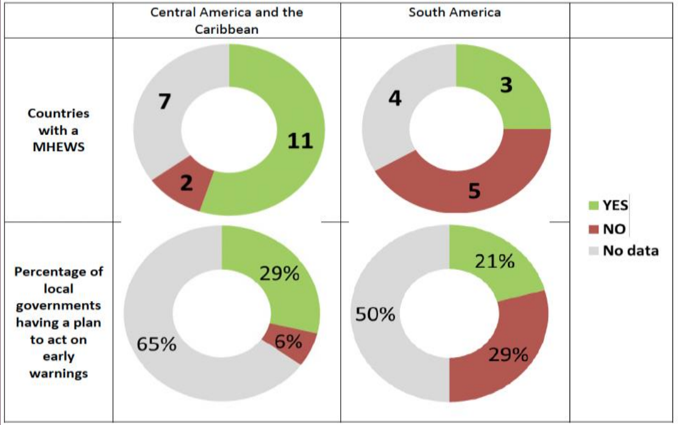
The Southern and Southeastern of Brazil stand out, including metropolitan regions with high economic development and densely populated, which may be those where disasters can intensify both in terms of frequency and magnitude. Projections of future climate allow for conclusive results regarding the intensification of extreme rainfall events in scenarios below 4◦C.

WMO (2021)

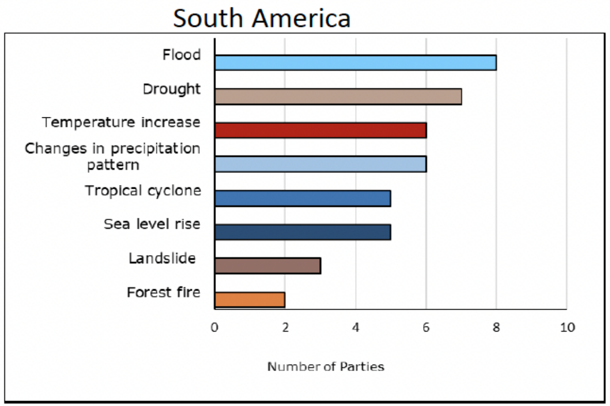
Improving Multi-hazard Early Warning Systems

Strong climate hazard monitoring linked to early warning systems can **inform anticipatory action** and contingency plans to **reduce disaster risk and disaster impacts on lives, livelihoods, and food security.**

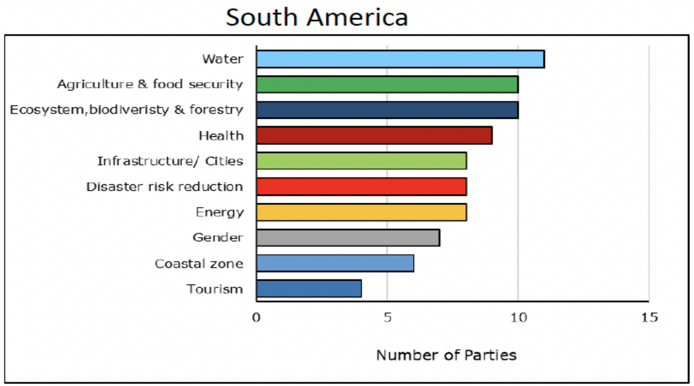
However, **early warning systems are underdeveloped in LAC region**, particularly in South America.



Hazard types of highest concern



Priority areas for adaptation



Considerations

- Research on extremes reveals much clearer signs of the effects of human-induced climate change on changes in climate extremes compared to AR5;

- Increases in observed extremes are already identified in all regions of the world; Changes in the frequency and intensity of extreme events increase with each increment in global warming;

- A world limiting global warming to about 1.5 °C would avoid numerous additional changes in extremes compared to 2 °C, but would be affected by additional changes and extreme events unprecedented compared to now.

- If we are not prepared for consequences nd impacts of extremes in the present, then, how can we cope with priohected changes in extremes in the future?, do we have an adaptation strategy as a public environmental policy?

- It is projected that many regions will experience an increase in the probability of simultaneous events with greater global warming (high confidence). In particular, simultaneous heat waves and droughts tend to become more frequent.

- Simultaneous extremes (compound extreme events-ex drought-heaty in Pantanal in 2020) in multiple locations become more frequent, including in agricultural production areas in a global warming of 2°C (high confidence).