



CEMADEN

Centro Nacional de Monitoramento e
Alertas de Desastres Naturais

Theme : Science for Policy in the EU
context: Advancing EU-Brazil
Cooperation on Amazon priorities

Climate extremes, disasters,
and their impacts on biodiversity
and populations in Brazil

Dr. Jose A. Marengo
(jose.marengo@cemaden.gov.br)

Amazon Week
Brussels, 2026



MOU – MCTI /JRC EU (as November 2025)

A Cooperation Arrangement under the existing bilateral Agreement was signed on 24 January 2013 in Brasilia between the Joint Research Centre (JRC) and the Brazilian Ministry of Science, Technology and Innovation (MCTI).

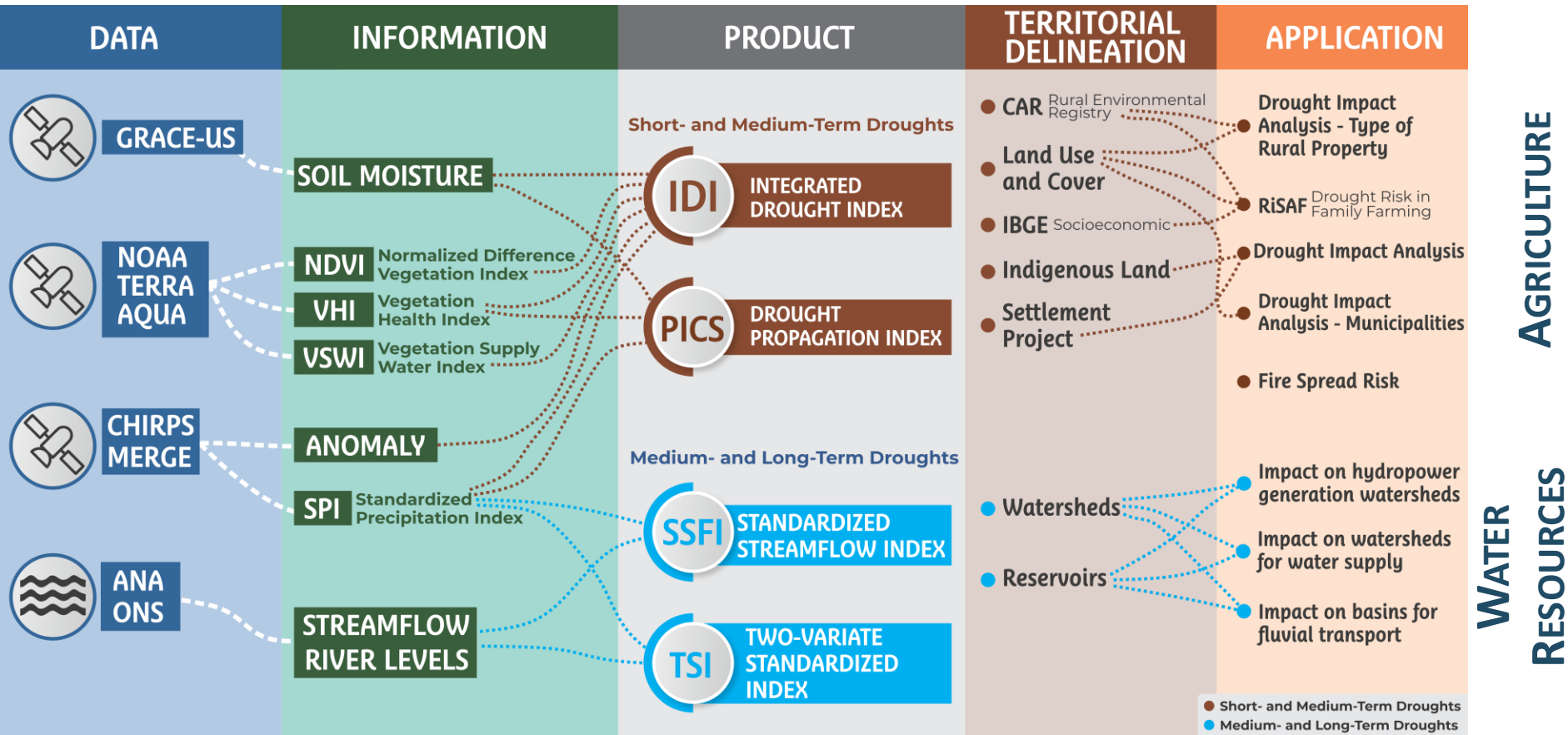
During the last decade Brazil progressed on several indicators related to scientific and technological performance. This is reflected in the increasing number of researchers, in the growth of R&D expenditure, and in the number of postgraduate scholarships, as well as in indicators of scientific publications and, more modestly, patents.

Theme:

Disaster Risk prevention and management/ natural disaster:

- Drought monitoring and resilience
- Impacts of droughts on strategic sectors
- Drought, aridification and desertification (UNCCCD agenda)

CEMADEN Drought risk monitoring



Drought monitoring at CEMADEN MCTI: past, present and future

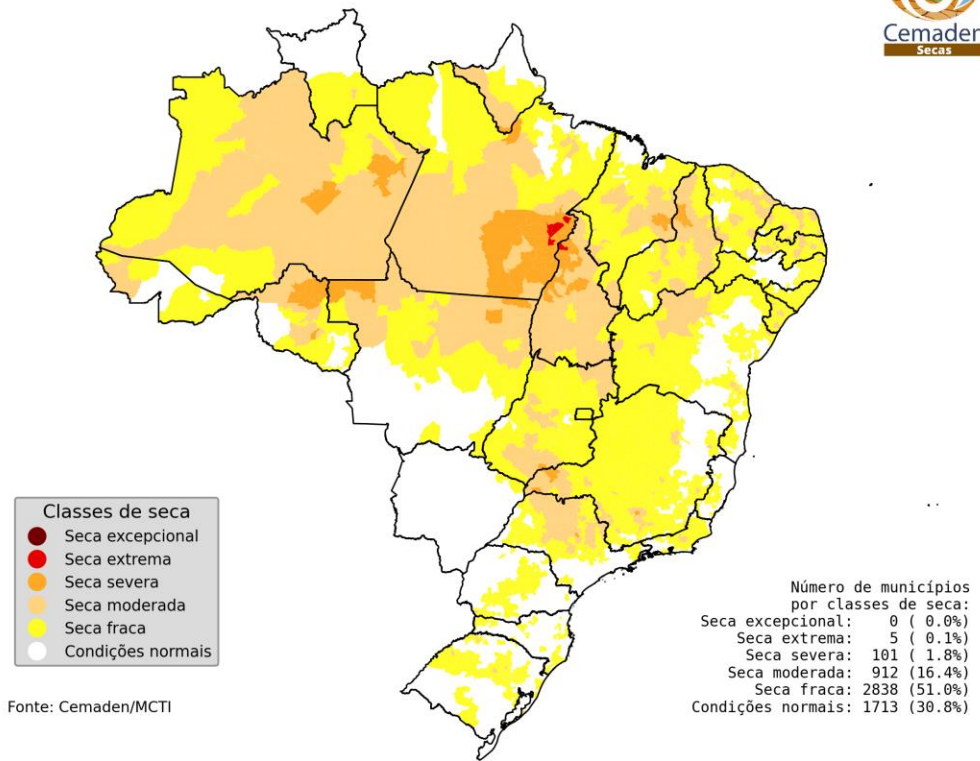
Monitoring since 2012

Attendance to the demands and actions of the federal government

Identification of municipalities affected by drought to support the Ministry of Agrarian Development's Crop Guarantee program

Support for National Water Agency (ANA) crisis rooms for southern, northern, northeastern regions, basins and biomes

Índice Integrado de Seca - 3 meses (IIS3)
June 2025



Fonte: Cemaden/MCTI

Integrated drought index (IDI)

Diagnostics of average drought conditions

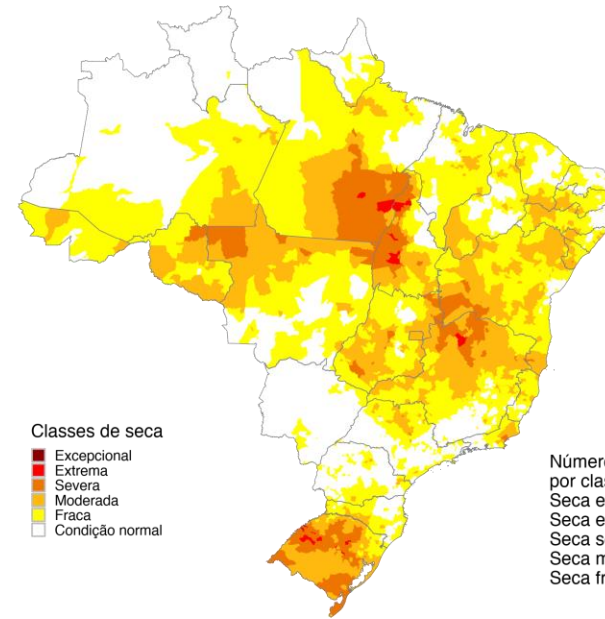
Rainfall, soil moisture and vegetation health with the same weight

Quantification of drought intensity

Updated monthly/biweekly

IIS processing steps:

- Spatial uniformization
- Conversion to drought classes
- Calculation by municipalities
- Preparation of maps and reports
- Updating online platforms

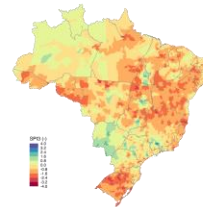


Classes de seca

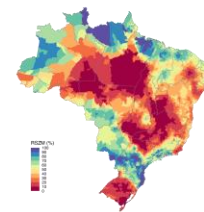
- Excepcional
- Extrema
- Severa
- Moderada
- Fraca
- Condição normal

Número de cidades por classes de seca

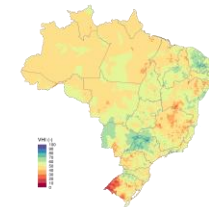
Seca excepcional	0
Seca extrema	34
Seca severa	352
Seca moderada	1250
Seca fraca	2418



Rainfall anomaly



Root Zone Soil moisture



Vegetation health index

Março 2023
Índice Integrado de Seca (SPI3, VHI, US)
Dados: CPTEC/INPE - NOAA - NASA / Preparação: Cemaden/MCTI

Drought in Brazil in 2025

In 2025, prolonged drought conditions were observed in several parts of Brazil, especially during the dry months and transition between seasons, affecting:

- **Northeast** – significant rainfall deficit during critical periods of the rainy season, with reduced reservoir levels and impacts on rural water supply.
- **Central-West** – agricultural areas and pastures under prolonged water stress.
- **Southeast** – moderate droughts in rural areas and reduced water levels in secondary rivers.
- **North** – some areas experienced lower rainfall than expected outside the rainy season.



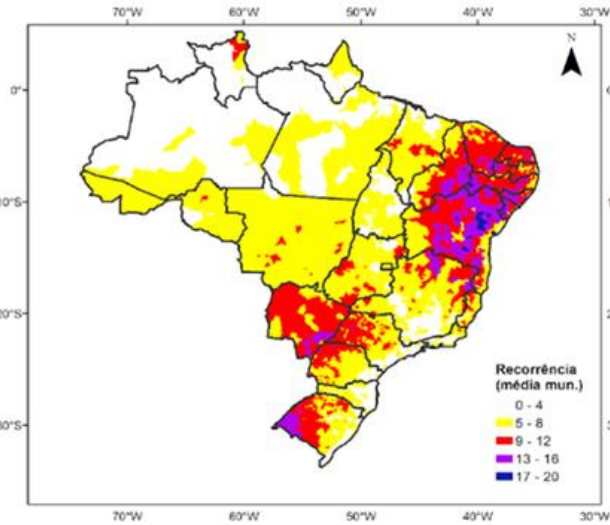
Rio Paraguai tem seca histórica e rompe padrão de cheias desde 2019

Bacia do Paraná também sofre com redução contínua de água por conta do baixo índice de chuva

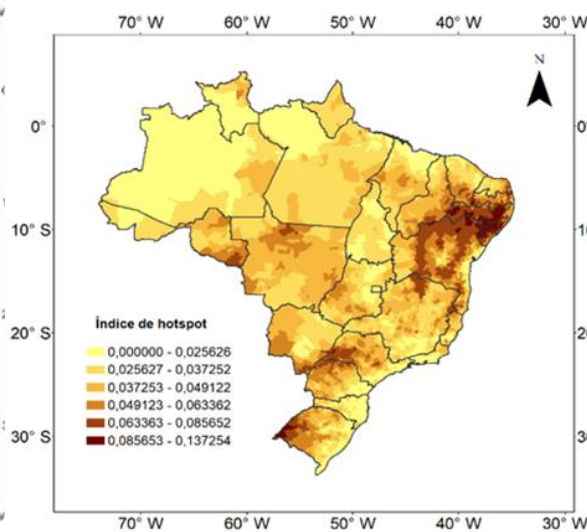
Por Inara Silva | 28/09/2025 07:32



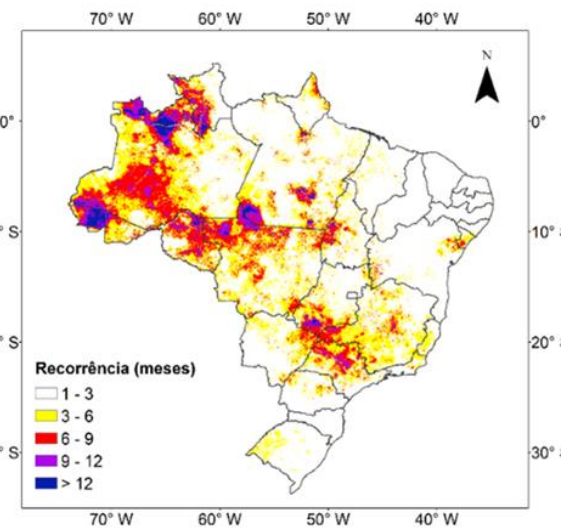
Drought in Brazil



Absolute frequency of severe droughts (or higher category) based on IIS-12 data, considering the average per municipality, for the period from 1982 to 2024.

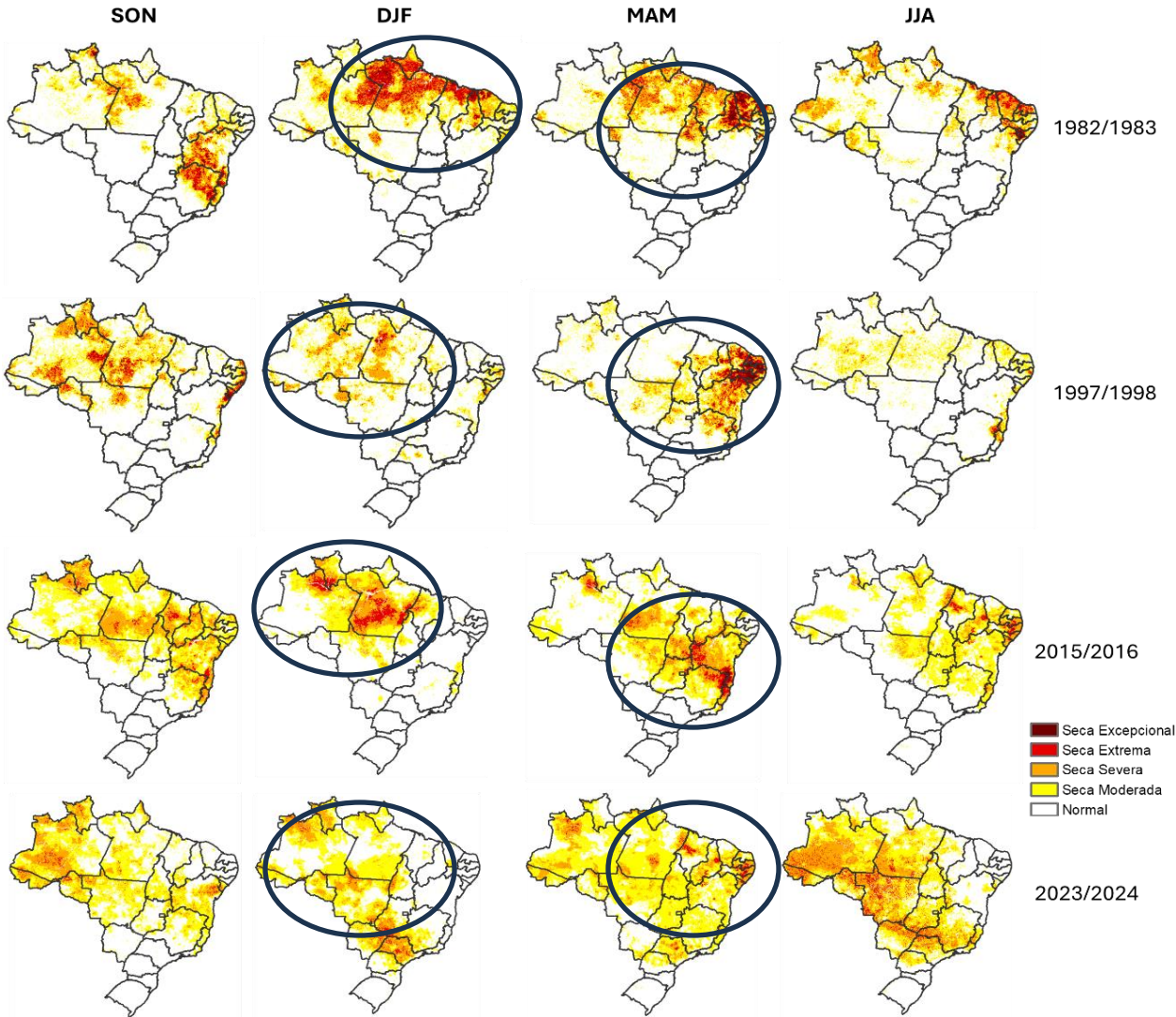


Hotspot index at the municipal level, representing the combined exposure to severe drought (IIS > severe) and extreme temperature (STI > 1) in the period from 1982 to 2024.



Frequency of droughts in the period from January 2023 to December 2024.

Drought in Brazil during some El Niño years

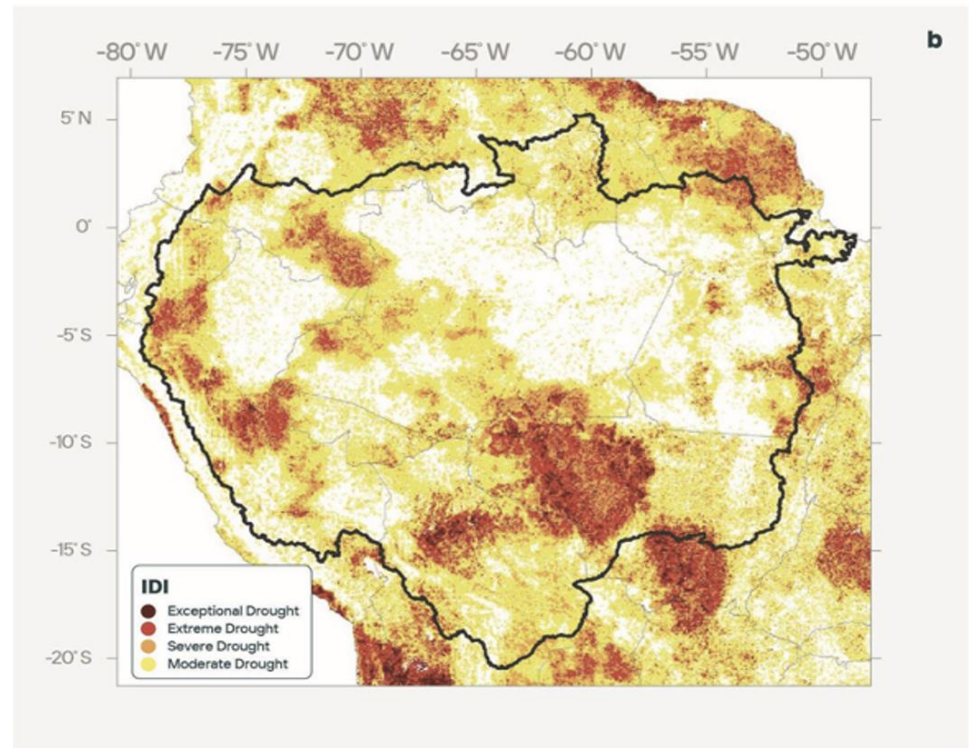


North and Northeast regions – reduced rainfall and increased temperatures. More severe and longer periods of drought, increasing the risk of water insecurity.

Importance of the outlook in the Tropical Atlantic. Southeast and Central-West regions – possible disruption of the rainy season (delayed start, premature end) affecting reservoir recovery and increasing hydrological risk.

Strong droughts in the Amazon have been increasing in frequency and intensity, from four in a century to four in less than 25 years, in concert with increasing deforestation and global warming. The synergy of droughts, deforestation, fire, and forest degradation have the potential to drive the Amazon to a tipping point where this globally important ecosystem may significantly reduce its capacity to provide critical services such as water recycling, carbon storage, and provision of goods for human well-being.

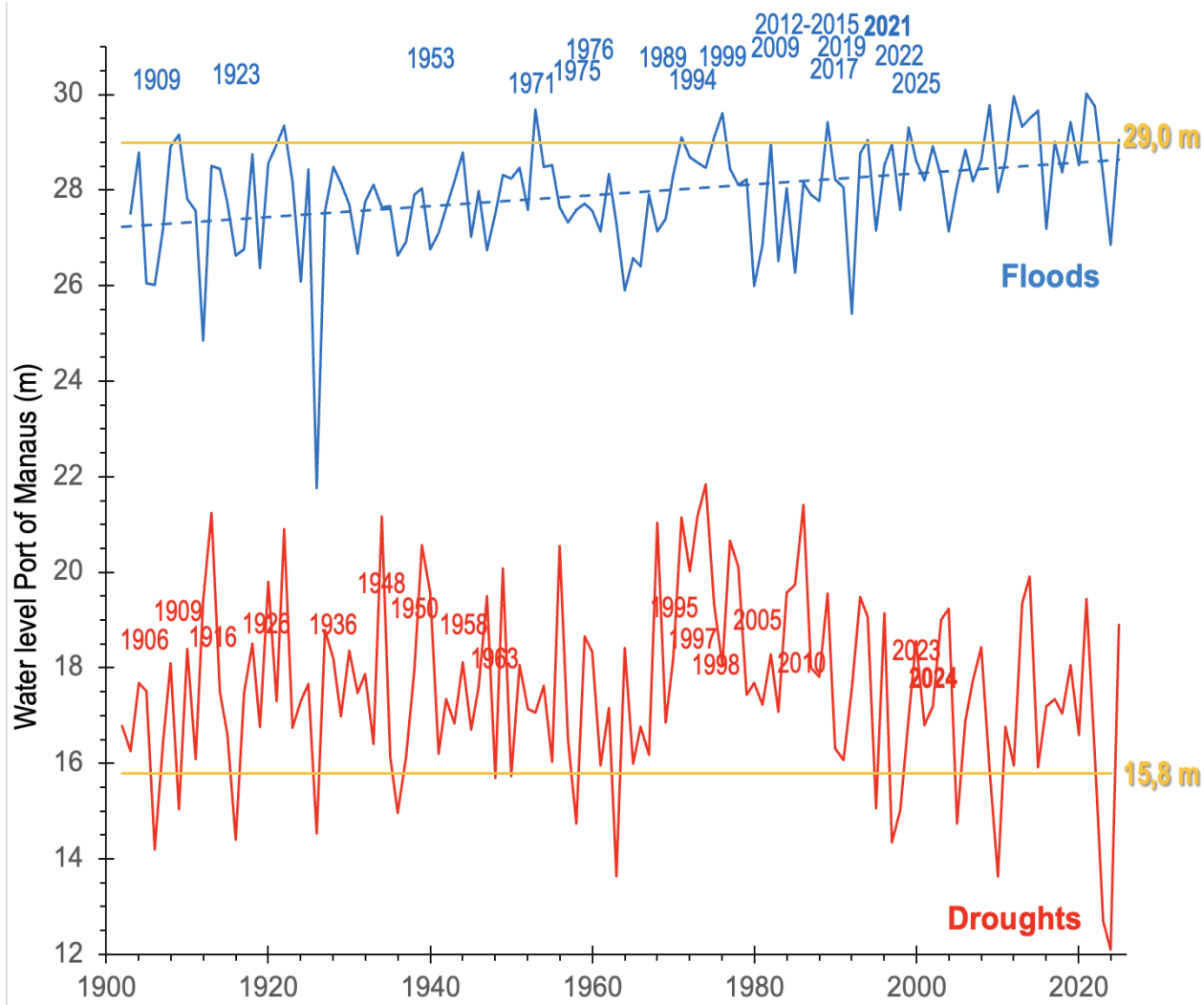
b. Integrated Drought Index (IDI) 2023



Impacts on river levels and air temperature. Over the last 120 years, 18 severe floods and 12 extreme hydrological droughts have been recorded at the port of Manaus. **Six extreme droughts occurred between 1995 and 2023, compared to seven in the whole period of 1903-1994.**

This scenario was changed by the 2023-24 drought. Most of the main rivers in the Amazon, including the Solimões, Purus, Acre, and Branco rivers all suffered from extreme drops in their levels, or just simply dried up. **In October 2023, the Rio Negro level in Manaus recorded its lowest level since measurements began in September 1902, 12.70m (the average annual minimum water level was 17.64 m for the 1902-2022 period).**

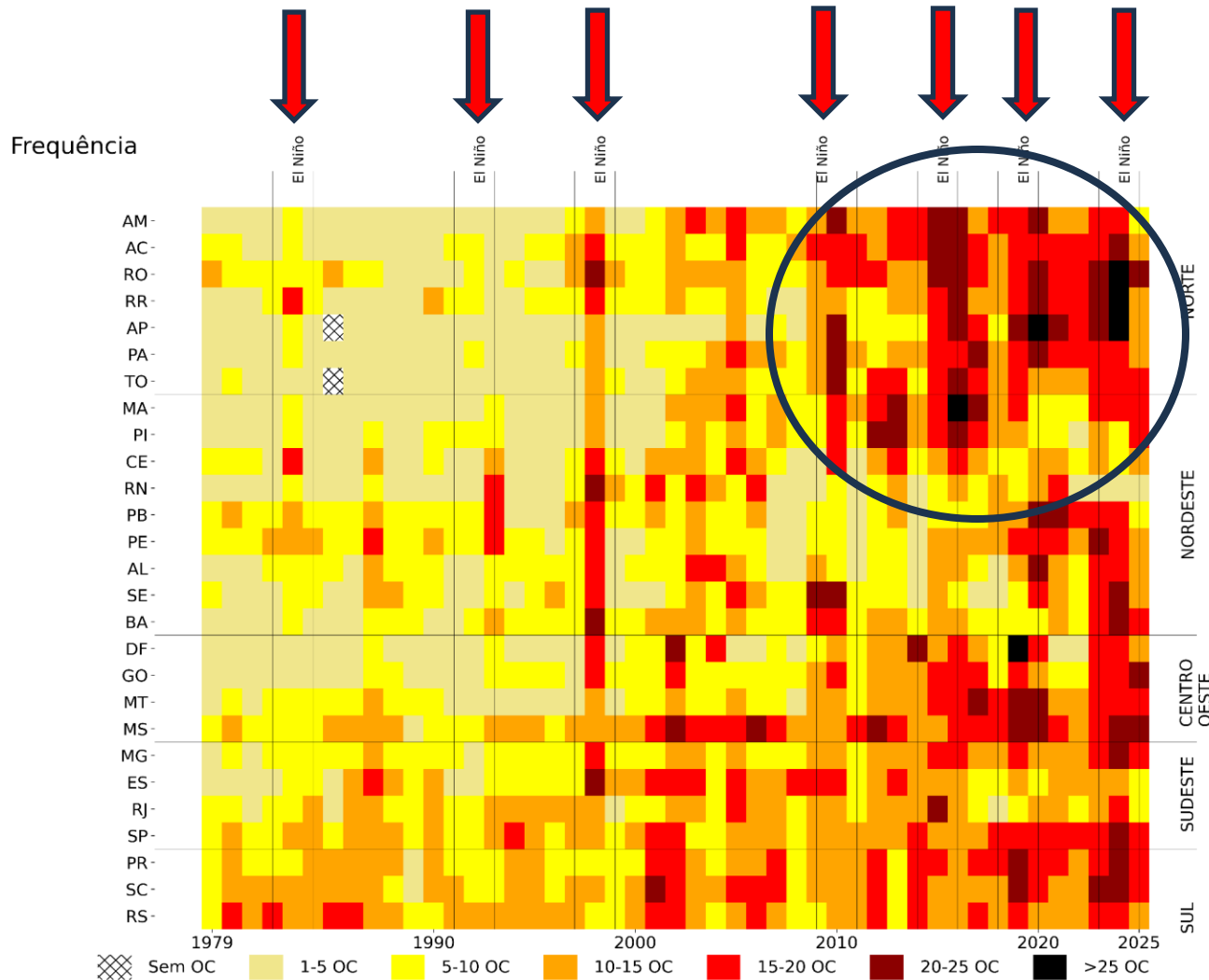
Drought in Amazonia



The Amazon rainforest has faced years of intense drought, **warm TNA or El Niño-induced drought (2005, 2010, 2015-16, 2023-24)** and the combined effects of deforestation and climate change put it at risk below 2°C of global warming (climate change).

During past El Niño Years, the Amazon region was affected by severe drought and intense heat waves, and in some regions, as in eastern Amazonia, the forest behaves as source of CO₂. During La Niña years the forest recovered its role as sink of CO₂ (climate variability)

Heatwaves in Brazil



In El Niño years—**1982-1983, 1997-1998, 2009-2010, 2014-2016, 2018-2020, 2023-2024**—the escalation of heat waves in all Brazilian states becomes clear.

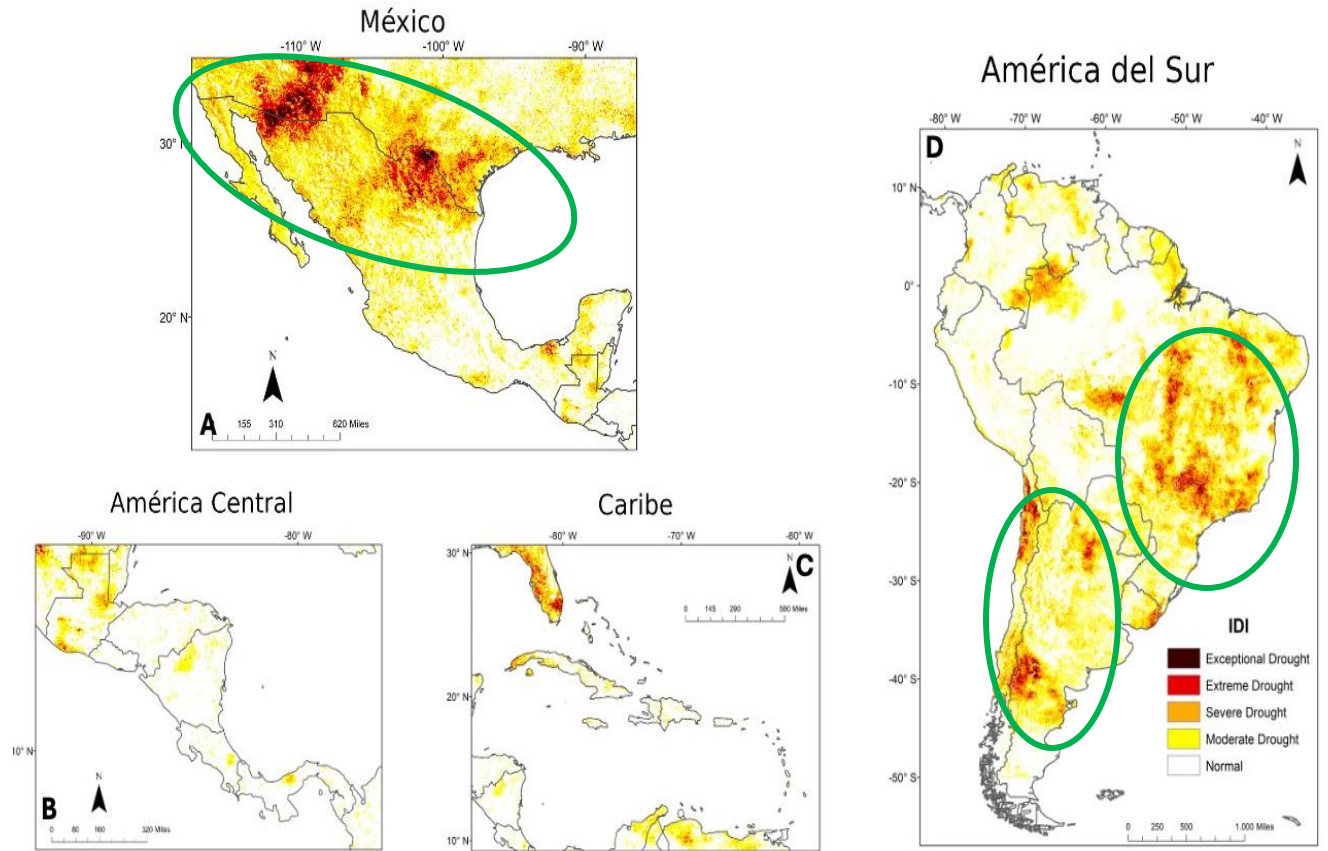
In El Niño years, after the year **2000**, the standard historical average of 8-14 heat waves per year easily rises, with values exceeding **25 heat waves in a single year**.

El Niño increases the chances of heat waves occurring, which increase the flammability of combustible materials and affect the health of the population.

Drought in Latin America and Caribbean in 2025

Severe drought in NW Mexico, Central America, and the Caribbean

Extreme to moderate drought in eastern Brazil, northern Argentina, and northern and central Chile



IDI for January–December 2025 in Mexico, Central America, the Caribbean and South America