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Climate overview of Brazil and global climate impact

6th edition - October 2025

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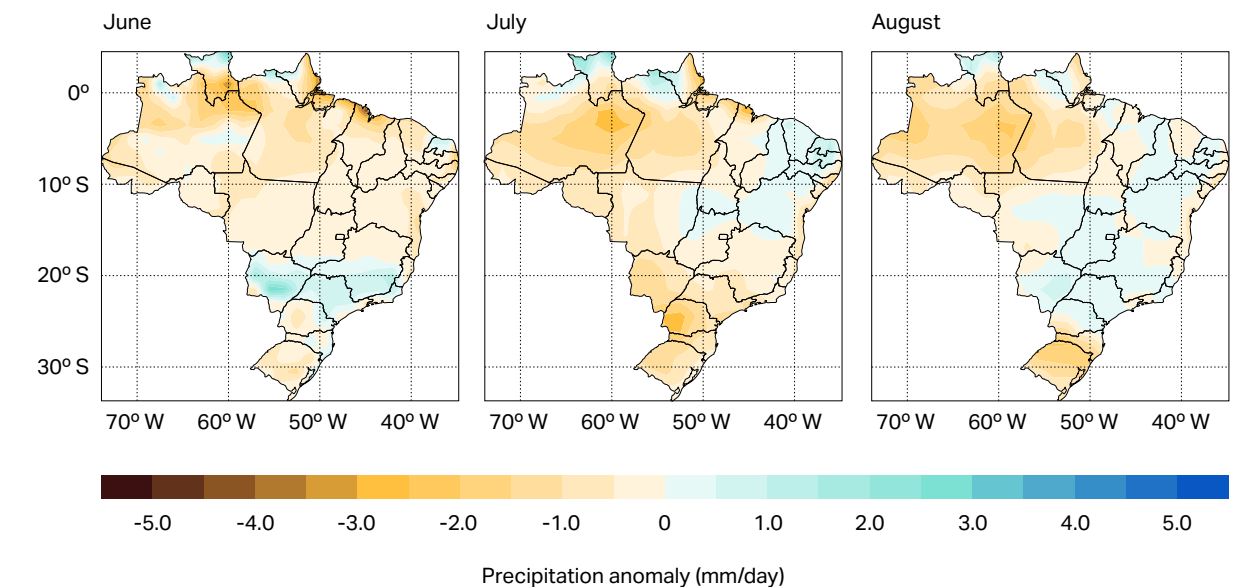
Rainfall conditions, drought evolution, the situation of Brazilian river basins and severe events in Brazil and worldwide

Rainfall in Brazil between June and August 2025

The previous edition of this report presented the MIA Climate model's forecasts for Brazil for the period from June to August 2025 (figure 1). The months leading up to winter (April and May) were under neutral El Niño-Southern Oscillation (ENSO) conditions. However, other atmospheric and oceanic patterns have negatively influenced the predictability of the rainfall regime in some regions of the country, especially in the South.

Despite these challenges, the MIA model correctly indicated signs of slightly above-average rainfall in specific areas, such as in the Southeast and the state of Mato Grosso do Sul, especially in June. In July, the model's performance was positive, consistently anticipating negative anomalies in much of the Centre-South. These patterns were confirmed by the ERA5 data from the European Centre for Medium-Range Weather Forecasts (ECMWF), which showed accumulations below the climatological average in Pará and southern Brazil, and values within the average in the central region of the country.

Figure 1 - MIA Climate model forecast for the precipitation anomaly for the months of June to August 2025, using the June 2025 run (Source: MIA Climate)



Figures 2 and 3 shows the precipitation anomalies predicted by the MIA Climate model for the months of June, July and August 2025, compared with the consolidated data from the ERA5-ECMWF reanalysis. The forecasts consider the updates of the rounds for each reference month, since the most recent rounds better incorporate the atmospheric and oceanic conditions in progress. The aim of this assessment is to check, on a regional scale, how close the forecast was to what actually happened.

June

Although the MIA Climate model performed well in predicting positive precipitation anomalies in May 2025, especially in the state of Rio Grande do Sul, the subsequent run for June revealed some limitations. The divergences observed between the forecast (figure 2) and the consolidated ERA5-ECMWF data (figure 3) may be related to dynamic and oceanic factors that reduced the predictability of rainfall during the transition period to winter.

ENSO's neutral conditions tend to increase uncertainties in forecasting models, both traditional and those based on artificial intelligence. Even so, the MIA model indicated slightly above-average rainfall in areas such as northern Roraima, part of Mato Grosso do Sul and São Paulo, in line with the observed data. In the case of Rio Grande do Sul, the pattern of above-average rainfall was associated with the intensification of frontal passages, favouring recurrent episodes of instability and the formation of extratropical cyclones in the South Atlantic.

July

The forecast indicated a rainfall scenario below the climatological average for much of Central Brazil and the southern region, with the most intense negative anomalies (between -2 and -3 mm/day) standing out. A comparison with the consolidated rainfall data from ERA5 shows that the predicted pattern was confirmed, especially in the South, Southeast and part of the Centre-West regions, where the accumulations were slightly below the historical average (between -1 and -3 mm/day).

In the far north of Brazil (northern Pará, Amapá and Roraima) the model was right to indicate above-average rainfall, albeit with slight regional variations. According to the National Meteorological Institute (INMET), the above-average accumulations in the North were associated with the persistent action of the Intertropical Convergence Zone (ITCZ) over the Equatorial Atlantic and the northern Amazon.

August

In August, rainfall remained close to average in most of Brazil. The MIA Climate model showed good correspondence with the consolidated data, especially in northern Pará and southern Amapá, where the observed values varied between +2 and +3 mm/day, which represents a monthly surplus of approximately 60 to 90 mm in relation to the climatology.

On the border between Pará and Amapá, accumulations reached +5 mm/day, totalling over 150 mm extra in the month. In the Centre-West and Southeast regions, the model's forecast was in line with the observed data. Rainfall was above average in the west of Mato Grosso do Sul and slightly above in the southwest of Mato Grosso, areas where excess moisture could favour soil preparation for the next summer crop. In the other areas of these regions, the accumulations were close to or slightly below the historical average.

The main divergences between forecast and observed occurred in the south and in the eastern part of the northeast. In the south, an intense cold front at the end of the month increased accumulations, resulting in positive rainfall anomalies, especially in Rio Grande do Sul and Santa Catarina. August marks the end of winter and the beginning of a seasonal transition phase, a period in which it is common for there to be greater variability and, consequently, differences between forecast models and observed data.

Figure 2 - Precipitation forecast made by artificial intelligence for the months of June, July and August (Source: MIA Climate)

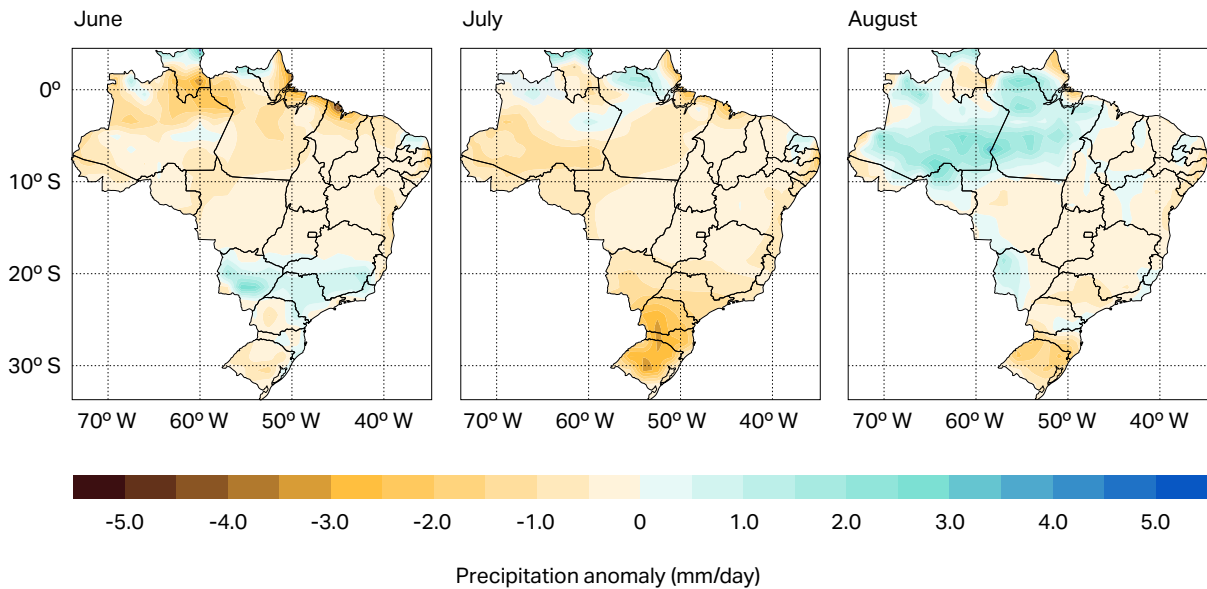
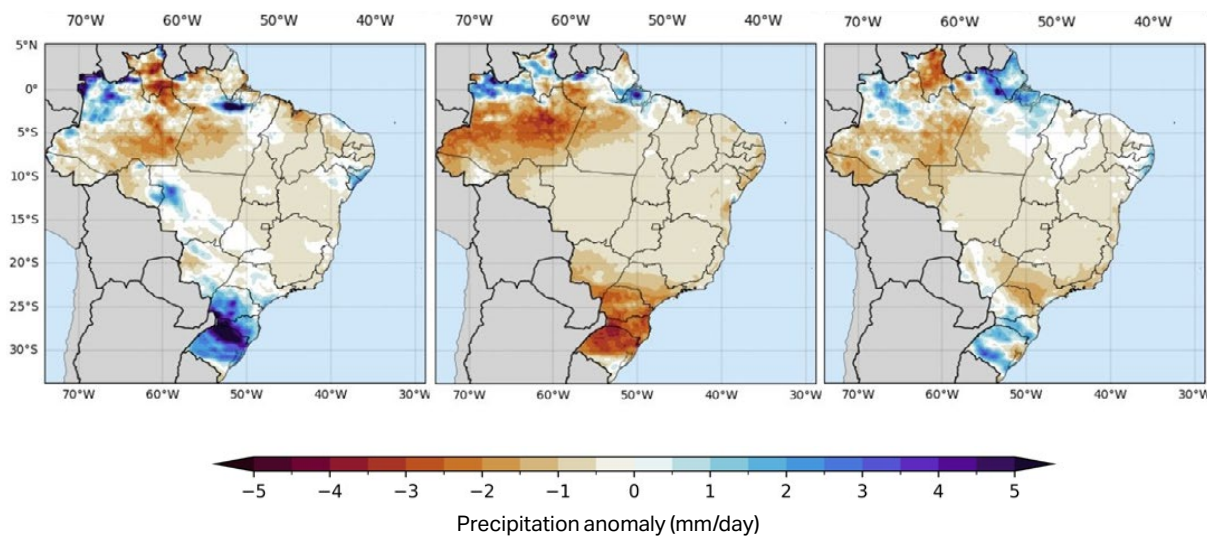


Figure 3 - Precipitation observed in the months of June, July, and August (Source: European Centre for Medium-Range Weather Forecasts - ECMWF)



In terms of temperature, the MIA Climate model predicted slightly above-average maximum temperatures for the winter of 2025 in most of Brazil, with notable successes in the North (southern Pará, Amazonas, Tocantins, Roraima and Amapá) and Northeast (Maranhão, Piauí and western Bahia). However, the model failed to anticipate the negative anomalies observed in the Centre-South, as indicated by the consolidated ERA5-ECMWF data.

The forecasts for minimum temperatures followed a similar pattern, although the values observed were significantly below average, especially in the Centre-South. This is due to the frequent presence of polar air masses, which caused sharp drops in temperature and episodes of frost, reinforcing the perception of a harsher winter compared to recent years.

Update on drought conditions and the status of river basins

According to the drought conditions maps, drawn up on the basis of data from the National Water Agency (ANA) (figures 4, 5 and 6), the above-average rainfall recorded in May contributed to the reduction of the weak drought in several regions, such as the northeastern coast (from Bahia to Rio Grande do Norte), Mato Grosso do Sul, the Pantanal in the state of Mato Grosso do Sul, northern Espírito Santo and areas of Minas Gerais. There was also a reduction in moderate drought in the north and south-west of Goiás and in the south of Mato Grosso do Sul, as well as a reduction in severe drought in Rio Grande do Sul.

On the other hand, below-average rainfall intensified severe drought conditions in Santa Catarina, Maranhão, Piauí and Pernambuco, and aggravated moderate drought in western Paraná. The weak drought also expanded to areas of central-eastern Minas Gerais, eastern Amazonas, southern Roraima, northern Rondônia and the state of Ceará.

In the city of São Paulo, for example, the Mirante de Santana weather station (INMET) recorded average maximum and minimum temperatures around 1°C below climatology (1961-2020) between the start of winter and 13 August. Despite this, the winter of 2025 will not be the coldest in the municipality's historical series. In years such as 1962, 1968, 1964, 1990 and 1994, the average minimum temperatures were between 1.7°C and 2.4°C below climatology, showing more intense cold episodes in the past.

In general, over the last three months there has been a change in the drought index categories in some regions. In Rio Grande do Sul, for example, the area is now classified as being out of drought. In the north of the country, especially in Amazonas, the intensity of the drought decreased from moderate to weak, due to the abundant rainfall recorded during the period. On the other hand, the lack of rainfall in the north-east and south-east resulted in a worsening of the indicators and an intensification of the drought. In the states of Bahia and Piauí, extreme drought was recorded, while in the west of São Paulo, moderate drought evolved into severe drought.

Figure 4 - Drought monitor in the month of May (Source: Brazilian National Water Agency - ANA)

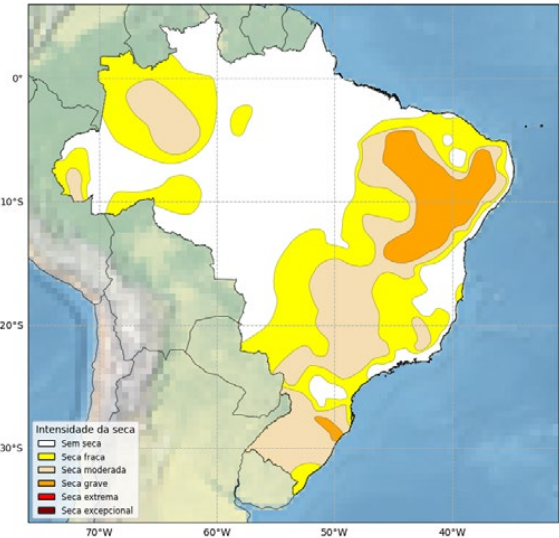


Figure 5 - Drought monitor in the month of June (Source: Brazilian National Water Agency - ANA)

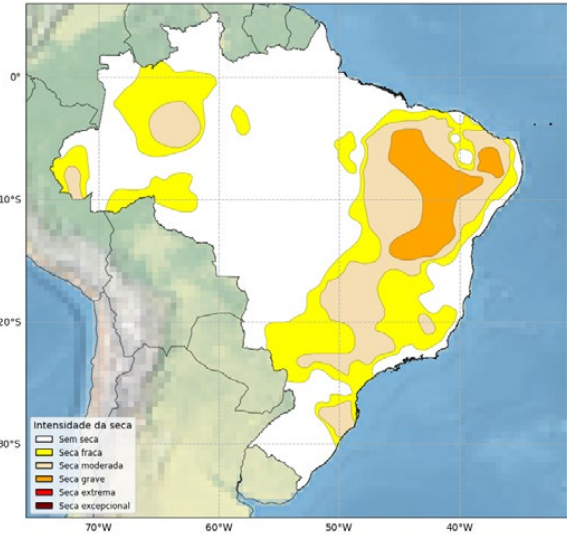
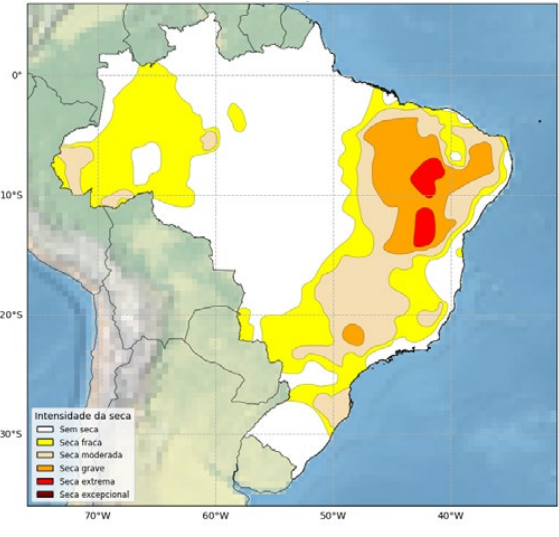


Figure 6 - Drought monitor in the month of July (Source: Brazilian National Water Agency - ANA)



At the beginning of September 2025, the storage levels of the main Brazilian reservoirs indicated a significant recovery in the southern subsystem, while the other subsystems showed stability or slight variations in their water volumes (figure 7).

The southern subsystem recorded a significant increase in stored volume, from 33.5 per cent in May to 89.7 per cent in August, an increase of more than 50 percentage points. This recovery is directly associated with the occurrence of episodes of intense and recurrent rain between the second half of May and June, in addition to the above-average rainfall observed in August.

This scenario helped to reduce the previously identified hydrological risk, expanding the regional hydroelectric generation capacity and reducing, albeit temporarily, the need for thermal power plants and the exchange of energy with other subsystems.

The northern subsystem maintained favourable conditions, with volumes above 87%, sustaining the stability seen since May (98%). Although it has a low representation in the formation of the Settlement Price of Differences (PLD), the region continues to play an important role in national water security.

In the Northeast, storage levels fell from 74.5 per cent in May to 59 per cent in August. The Southeast/Central-West subsystem, the country's main energy generation and consumption centre, recorded a storage volume of around 57%. This region concentrates large urban and industrial centres, which has a strong influence on the settlement price for differences (PLD) and the definition of tariff flags.

When reservoirs are at high levels, there is a greater supply of hydropower, which tends to reduce the cost of energy. However, the high regional demand puts significant pressure on the system. The state of São Paulo alone consumed around 17,163 MWm in July and 17,280 MWm in August 2025 (data from the Electricity Trading Chamber-CCEE), directly contributing to the pricing of energy in the country.

Maintaining adequate storage levels is essential for the balance of the National Interconnected System (SIN). Analysing the subsystems shows that water recovery does not occur evenly throughout the country. The red tariff flag level 2, the system's highest level, which was adopted in August, has been maintained for September.

17,163 MWm

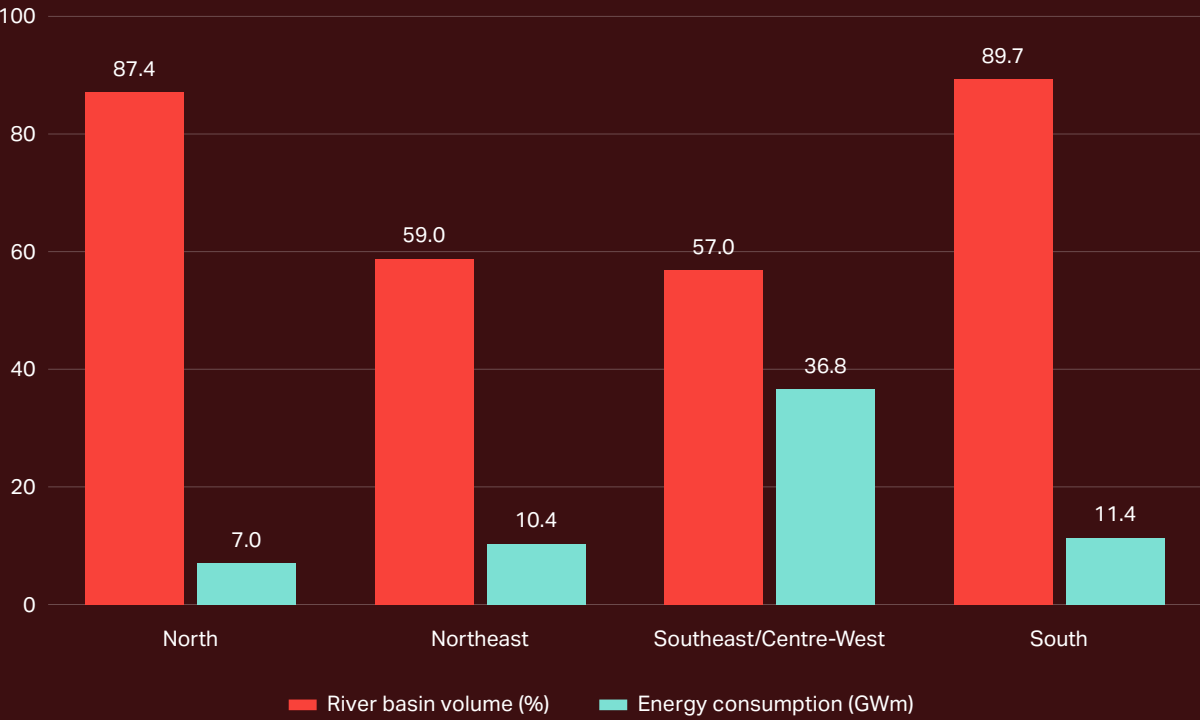
Energy consumption in the state of São Paulo in July 2025

17,280 MWm

Energy consumption in the state of São Paulo in August 2025



Figure 7 - Level of river basins and energy consumption by subsystem (Source: Electricity Trading Chamber - CCEE, National Electricity System Operator - ONS)



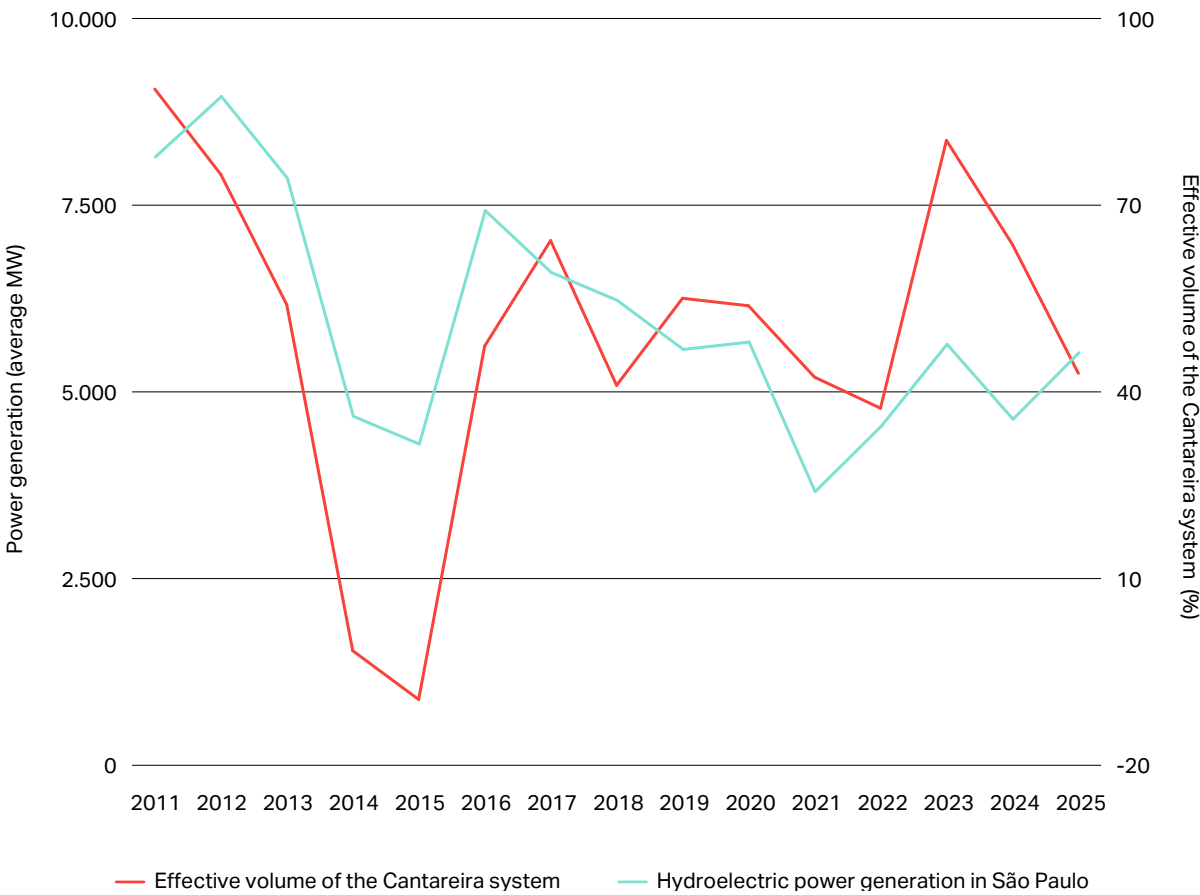
In the Southeast/Central-West subsystem, the country's main energy generation and consumption centre, the relationship between the volume of the Cantareira system and hydroelectric generation in São Paulo (July 2011 to 2025) reveals an interesting scenario. While the Cantareira is one of the largest water supply systems in the world, it is not home to large conventional hydroelectric power stations. Even so, it participates in energy generation through small hydroelectric plants (SHPs), which take advantage of unevenness and flows within the existing infrastructure.

The volume stored in the Cantareira reflects the hydrological conditions of the Southeast region and can be indirectly related to energy generation in the state, especially in basins such as the Tietê and Paraíba do Sul rivers. During the severe water crisis between 2013 and 2015, the system's levels reached negative values, between -1.66 per cent and -9.51 per cent, indicating operation at dead volume (below the catchment area). During that period, emergency measures were adopted, such as rationing and restrictions in public supply.

The crisis also had a strong impact on energy generation: in 2014 and 2015, the state's hydroelectric plants recorded averages of just 4,680 MWmed and 4,309 MWmed, respectively, figures significantly below the historical average. From 2016 onwards, with the gradual recovery of the reservoirs, both the useful volume of the Cantareira and hydroelectric generation began to grow again, albeit with oscillations influenced by climate variability and the management of water resources.

The year 2023 stood out as a period of recovery, with the highest useful volume in the series (80.46 per cent). In 2025, even with the current volume at around 57 per cent, the situation is not considered critical, but requires attention. The next rainy season will be decisive for maintaining the system's water security. This analysis reinforces the importance of integrated monitoring between the levels of strategic reservoirs and regional energy performance, especially in a context of growing demand and the need for resilience in the National Interconnected System – SIN (figure 8).

Figure 8 - Effective volume of the Cantareira system and hydroelectric power generation in São Paulo in July (Source: National Water Agency - ANA, National Electricity System Operator - ONS)



The interdependence between water, energy and food is essential to understanding the breadth and depth of water impacts on energy generation, especially in systems based on hydroelectric reservoirs. The study published by Chi Zhang (2018) in the Journal of Cleaner Production, entitled Water-energy-food nexus: Concepts, questions and methodologies, emphasises that the integrated assessment of these three sectors makes it possible to identify critical connections and systemic vulnerabilities.

In these interactions, water scarcity or variability not only affects energy production, but also jeopardises food security, environmental sustainability and socio-economic resilience. This integrated approach shows that fluctuations in reservoir levels have repercussions that go beyond the electricity sector, directly influencing public policies for managing natural resources and strategies for adapting to climate change.

Therefore, monitoring and analysing the water, energy and food systems in an integrated manner is fundamental to promoting efficient and sustainable governance in the face of climate challenges and the growing demand for resources.



Extreme weather events in Brazil and around the world

Temperature

Brazil

As highlighted in the last edition of this report, June was marked by several episodes of cold waves, the most intense of which occurred on 24 June. This wave caused sub-zero temperatures in several cities in the South, such as General Carneiro (PR), and triggered the phenomenon known as friagem, or cold snap, when a cold front advances to the North, causing a sharp drop in temperatures.

In the agricultural sector, these low temperatures have different effects: they are essential for inducing dormancy in crops such as grapes, apples and pears, but can be harmful to maize, especially during the fruiting and flowering phases. At the end of the month, a mass of polar air associated with a cold front passed over southern Brazil and neighbouring countries such as Argentina and Chile.

In the province of Chubut, in Argentinian Patagonia, temperatures reached -15°C on 30/06. In addition, 15 districts in the country were put on yellow alert due to the intense cold, making Argentina the coldest country on the planet at the time. In the province of Jujuy, on the border with Chile, around 200 lorries were stranded due to the accumulation of snow on the roads.

In Brazil, this same cold wave caused widespread frosts in Rio Grande do Sul. According to the Agroclimatic Alert Monitoring System (SIMAGRO), on July 2, 361 municipalities in the state were under a red alert for frost, showing the severe impact of weather conditions on regional agricultural production.

361

Municipalities in the state of Rio Grande do Sul declared a red alert for frost on July 2, 2025

World

Europe faced intense heatwaves in June, causing significant impact, especially in the southern and western regions of the continent. According to the meteorological service Copernicus, June was the hottest month ever recorded in Western Europe, with an average temperature of 20.49 °C, which is 2.81 °C above the historical average from 1991-2020. In the UK, the Met Office Hadley Centre recorded an average of 16.9 °C, while in El Granado, Spain, thermometers reached 46 °C on 28 June. In Sarajevo, the capital of Bosnia and Herzegovina, the temperature reached 38.8 °C.

The effects of these heatwaves were diverse and far-reaching:

- **Public health:** In Italy, there was a 10 per cent increase in heatstroke cases.
- **Infrastructure and transport:** The reduction in the Rhine's volume has jeopardised the cargo capacity of ships, increasing logistics costs.
- **Environment:** Forest fires hit the south of the Corbières mountain range, as well as areas in Spain, Turkey and Croatia.

Additionally, the Western Mediterranean Sea recorded its highest average daily temperature on 30 June, at 27 °C. In the Adriatic Sea, this warming has favoured the emergence of invasive species such as the lionfish, a predator that unbalances the marine biota. High sea surface temperatures not only cause thermal stress in ecosystems and reduce oxygen levels in the water (impacting fishing), but also limit night-time air cooling in coastal areas, increasing humidity and exacerbating the effects of heat on the population.

According to the article by Ondřej Lhotka, published in the journal Communications Earth & Environment in 2024, heatwaves in Europe are mainly associated with two factors: high latitude atmospheric blocking and subtropical high-pressure systems. In the case of the recent heatwave, the action of a high-pressure system was decisive, trapping the dry air coming from North Africa.

Rising temperatures, driven by climate change, have favoured the spread of diseases such as dengue, with more than 300 cases recorded in 2024 alone. According to Aleksandra Kazmierczak, climate change and human health expert at the European Environment Agency, several global infectious diseases have been intensified by climate risks.

A European Parliament document published in July 2025 revealed that the European Investment Bank estimates an average economic loss of 6% in agricultural and livestock production per year in EU countries, totalling €28.3 billion. South-eastern Europe is the region most affected, and in a high-emissions scenario, this figure could reach €40 billion by 2050. The impacts also extend to the storage and transport of crops, contributing to higher inflation and reduced access to food for the population.

Precipitation

Brazil

In June 2025, Brazil faced severe rainfall events, particularly in the North, Northeast and South. These extreme episodes have caused significant impacts on water logistics, public health and various social aspects, mainly affecting urban areas, riverside communities, agricultural areas and vulnerable populations.

According to data from the Integrated Disaster Information System (S2iD), compiled by the National Secretariat for Civil Protection and Defence (SEDEC), between June and mid-August approximately 12,003 people were left homeless, 52,429 displaced, 547 injured and 10 killed as a result of heavy rains, landslides, droughts, floods and flash floods. The most serious incidents were recorded in the states of Amazonas, Pará, Amapá, the eastern strip of Pernambuco, Paraná and Rio Grande do Sul.

Figure 9 shows the accumulated monthly rainfall in June 2025, compared with the climatological values in the three regions with the highest volumes, based on data from the National Institute of Meteorology (INMET) meteorological stations and the National Centre for Monitoring and Alerts of Natural Disasters (CEMADEN).

In the North, the highest accumulations of rain were concentrated in the north-west of the Amazon biome, especially in areas of Roraima, Amazonas and Amapá. Volumes exceeded 300 mm, with records exceeding 500 mm in parts of the far north-west of the state of Amazonas and in the central part of Roraima. This excess rainfall has raised the levels of Amazonian rivers, intensifying flooding in riverside and urban areas with limited drainage infrastructure. The scenario favoured the proliferation of diseases related to the contamination of water by sewage and waste washed away by the floods.

In the eastern part of the Northeast, cities like Natal (RN) recorded 509.2 mm of rain in June. In Matriz de Camaragibe (AL), the total was 536.2 mm, while Barreiros (PE) and Ipojuca (PE) recorded 515.1 mm and 507.9 mm, respectively. These volumes represent deviations of up to 257% above the monthly climatological average. The heavy rains caused urban flooding, soil erosion and logistical disruption, especially affecting family farming areas and urban peripheries.

509.2 mm

Accumulated precipitation recorded in Natal, in the state of Rio Grande do Norte, in June

257 %

Deviation above the monthly climatological average for precipitation in the Northeast's cities

In the southern region the persistent action of cold fronts resulted in rainfall accumulations that doubled the climatological values expected for June, normally between 180 and 220 mm. On 29 June, the level of the Taquari River exceeded 19 metres above flood level in the cities of Lajeado and Estrela, in the Vales region. In the Metropolitan Region of Porto Alegre, the Cai River also exceeded its flood level of 10.58 metres.

A year after the climatic tragedy that hit the state, the June rains left 1,388 people homeless in 38 shelters, as well as 9,600 displaced, 5 deaths and 1 disappearance. According to CONAB (06/2025), the impact extended to the agricultural sector, with seed losses, soil erosion and fertiliser leaching, causing delays in wheat planting in the state.

19 meters

The level of the Taquari River exceeded 19 metres above flood level in the Vales region

>9,600

Porto Alegre suffered with over 9,600 people displaced after heavy rains in June



Figure 9 - Comparison between accumulated precipitation in June 2025 and climatological normals in the north, northeast and south of Brazil (Source: INMET, Cemaden)

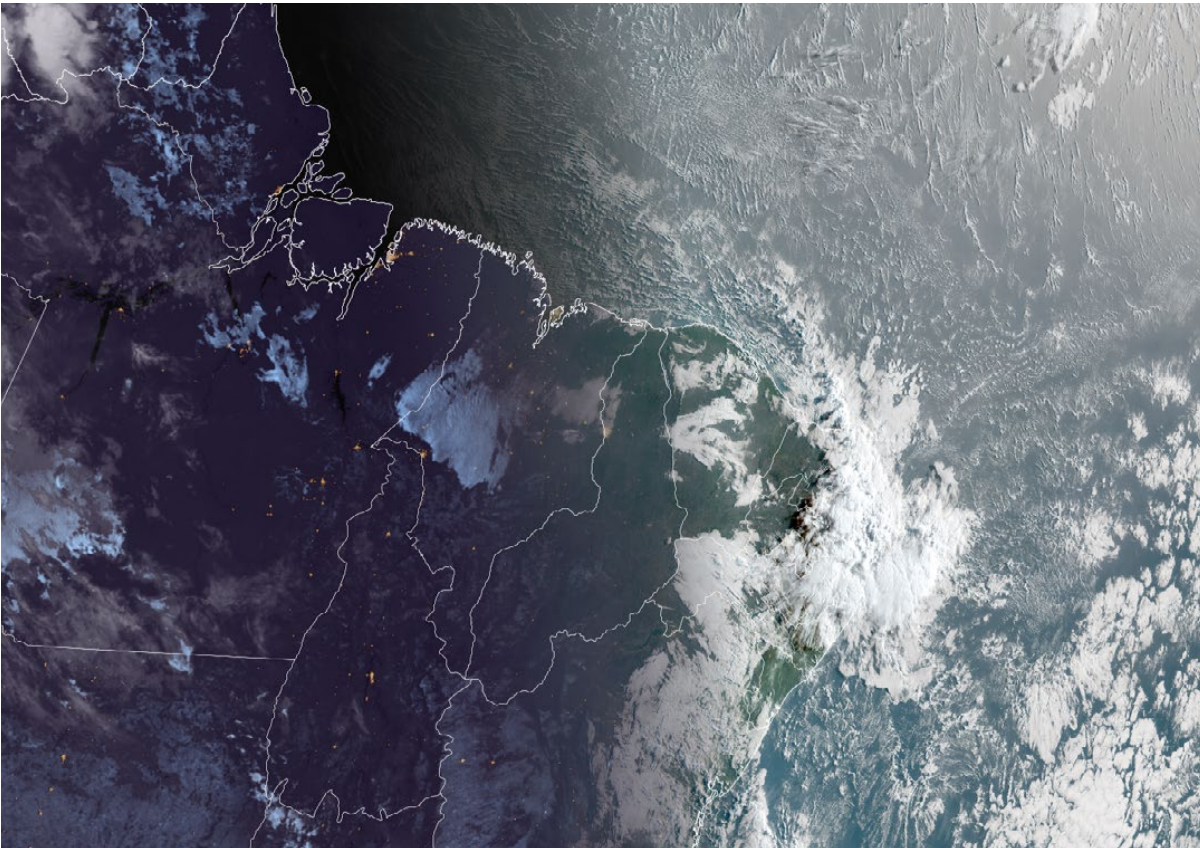
Region	Locality (UF-State)	Accumulated precipitation (June 2025, mm)	June climatological normal (1991-2020, mm)
North	Caracaraí (RR)	421	260-300
	Boa Vista (RR)	333	300
	Manaus (AM)	237	140
	Porto de Moz (PA)	290	140
	Belém (PA)	247	140
	Oiapoque (AP)	375	140
	Macapá (AP)	393	180
Northeast	Natal (RN)	509	180 - 220
	João Pessoa - Cuiá (PB)	367	180
	Recife - Nova Descoberta (PE)	436	180
	São Lourenço da Mata - Rua dos Milagres (PE)	459	140 - 180
	Ipojuca - Rurópolis (PE)	508	180
	Barreiros (PE)	515	180
	Matriz de Camaragibe (AL)	536	180 - 220
	Paripueira - Alto da Boa Vista (AL)	548	180 - 220
	Marechal Deodoro (AL)	533	180
South	Brejo Grande (SE)	440	140
	Passo Fundo - Integração (RS)	473	140 - 180
	Ijuí - Industrial (RS)	449	140
	Santa Maria (RS)	425	140
	Xaxim (SC)	434	140-180
	Lages (SC)	311	140-180
	Capitão Leônidas Marques - Bom Jesus do Sul (PR)	419	100 - 140
	Dois Vizinhos (PR)	398	140

The end of July 2025 was marked by the action of an extratropical cyclone that caused record sea storms on the coasts of the South and Southeast regions of Brazil. The effects were severe, with coastal flooding, damage to harbour structures and beach erosion. The cold front associated with the system also generated episodes of hail in several locations in Minas Gerais, with enough ice accumulating to cover streets, crops and cause damage to buildings.

One of the most significant cases took place in the municipality of Andradas (MG), where, according to the town hall, hail affected around 200 hectares of coffee plantations, damaging the current harvest and jeopardising the productive potential of future crops. According to a report in G1, other micro-regions affected included Poços de Caldas, Pouso Alegre, Santa Rita do Sapucaí, as well as isolated areas of Alfenas and Itajubá, with damage recorded in various sectors and direct impacts on the population.

Between 14 and 15 August, a new episode of an Eastern Wave (EW) favoured the formation and maintenance of persistent areas of instability over the eastern part of the Northeast. The phenomenon resulted in intense and concentrated rainfall in a short space of time, especially on the coast of Paraíba. The stations of the National Centre for Natural Disaster Monitoring and Alerts (CEMADEN) recorded volumes of more than 260 mm in just 24 hours in and around the João Pessoa region (figure 10).

Figure 10 - Extensive cloudiness and convective nuclei over the coast of the Northeast, with emphasis on Paraíba, Pernambuco and Rio Grande do Norte (Source: NOAA, CIRA-RAMMB)



GOES-19 satellite image (GeoColor channel) on August 15, 2025 at 09:30 UTC

Between 22 and 24 August, an intense cold front moved through southern Brazil, causing extreme weather conditions and widespread damage, especially in the states of Rio Grande do Sul and Santa Catarina. The system's intensity was boosted by a strong high-pressure centre over the continent, which accentuated the thermal contrast between the cold air mass coming from the south and the warmer air present over the country, favouring the occurrence of intense rainfall and severe storms. In the municipality of Camaquã (RS), the BR-116 motorway was temporarily closed due to overflowing watercourses.

In São Gabriel, the level of the Vacacaí River rose rapidly, flooding streets and causing inconvenience to the population. According to RS state Civil Defence, some locations recorded more than 200 mm of rain in less than 24 hours. In Porto Alegre, the INMET station recorded a total of more than 123 mm, associated with the advance of the frontal system. In addition, in the municipality of Lindolfo Collor (RS), a hailstorm damaged more than 30 properties, further aggravating the impacts of this severe event.

World

At the end of June 2025, heavy rains hit Colombia and Venezuela, causing widespread flooding, river overflows and landslides. At the same time, a severe cold front hit South Africa's Eastern Cape province with torrential rain, strong winds and even snow. The event left thousands of people homeless and resulted in 103 deaths. In the United States, the state of Texas faced one of the worst floods in recent years. Intense and persistent rains caused rivers to overflow, damage to urban infrastructure and more than 100 deaths.

The level of the Guadalupe River rose by around 9 metres in just two hours, directly affecting towns such as Hunt, Ingram and Kerrville, in the region known as the Texas Hill Country, an area of rugged terrain and low soil infiltration, highly prone to flooding. Rescue operations were hampered by the waterlogged ground. According to a study published in Nature Climate Change (2022), led by Oliver Wing, the United States faces average losses of \$32.1 billion a year due to flooding, which could reach \$40.6 billion by 2050 under the IPCC's RCP 4.5 scenario.

In early July, Sydney (Australia) was affected by a rapidly deepening low-pressure system, known as an explosive cyclogenesis event. In just six hours, the phenomenon generated rainfall equivalent to almost a month, with wind gusts of over 100 km/h, causing trees to fall, damage to transmission lines and interruptions to the power supply. In the same period, heavy rains in South Korea caused flooding and landslides, resulting in 19 deaths, 9 missing and the evacuation of more than 13,000 people. According to researchers Field and Wood (Journal of Climate, 2007), the intensity of extratropical cyclones is directly related to the transport of warm, humid air, which intensifies convection and increases precipitation rates.

In August, a flood in Uttarkashi, in northern India (Uttarakhand state), possibly caused by the rupture of a glacial lake, left at least five dead, more than fifty missing and caused severe damage to homes and hotels. A few days later, between 9 and 10 August, the city of Milwaukee (USA) was hit by a historic flood, with the cancellation of events, damage to vehicles and roads, and a power outage for around 47,000 people, with economic losses estimated at 23 million dollars.

Forecasted climate conditions for September, October and November

Regional climate trends in Brazil: temperature and precipitation in spring 2025

Spring represents a strategic period for the Brazilian agricultural sector, marking the start of planting essential crops such as soya, maize (first crop) and cotton. In this context, the current condition of neutrality of the El Niño-Southern Oscillation (ENSO) phenomenon, with around a 50 per cent probability of transition to a weak La Niña, combined with the persistent warming of the North Atlantic, could significantly influence the rainfall regime in the main producing regions.

September

Below-average rainfall is forecast for the Centre-West, Southeast, Pará and Paraná. In the northeast, volumes should remain close to average, while in Amazonas, Acre, Rondônia, Roraima and northern Rio Grande do Sul, rainfall is expected to be slightly above average.

October

The sign of above-average rainfall extends from Rio Grande do Sul to São Paulo and Mato Grosso do Sul. On the other hand, Tocantins, northeastern Mato Grosso, southeastern Pará and northern Goiás are expected to record below-average volumes.

November

The trend of below-average rainfall returns to the Centre-South, while the North, Northeast and northwest of Mato Grosso should see above-average or slightly above-average rainfall.

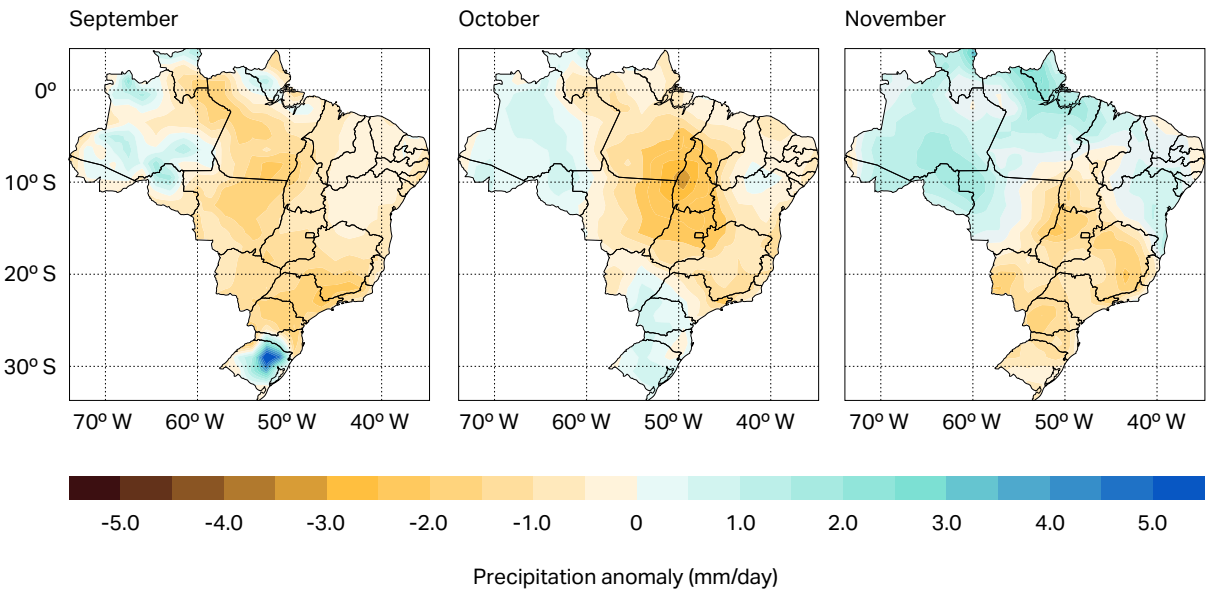
The oceanic and atmospheric conditions observed in 2025 are similar to the September 2024 scenario, when the start of the rainy season was marked by a precipitation deficit in the Southeast, Centre-West and parts of the North and South. The MIA Climate model projects similar behaviour for this year (figure 11).

According to a study by Márcia Marques et al. published in Weather and Climate Dynamics (2025), the drier pattern over the Centre-West and Southeast is associated with the generalised warming of the oceans, which acts as a dominant force. Projections indicate an increase in the frequency and intensity of seasonal droughts in the Centre-South of the country over the coming decades. With the predominance of a neutral ENSO phase, the MIA Climate model gives greater weight to global warming as a determining factor.

However, dynamic models such as C3S-ECMWF indicate the opposite scenario, with a higher probability of above-average rainfall in the Centre-South. This divergence between models reinforces the need for caution when interpreting forecasts, showing a context of low predictability for the start of the 2025 rainy season.

With that being said, the BAM model (CPTEC/INPE) points to below-average rainfall in the north of the region, Maranhão, Piauí and Bahia, while Minas Gerais, Goiás, Rio Grande do Sul and part of Mato Grosso are expected to record above-average volumes. In the other regions, rainfall tends to remain within the average expected for the period.

Figure 11 - Forecast for precipitation anomalies in Brazil between September and November 2025 (Source: MIA Climate)



September 1st, 2025 round.

The MIA Climate model projects maximum temperature anomalies (°C) for the coming months (figure 12), highlighting regional variations relevant to the agricultural and energy sectors.

September

Positive anomalies are expected in Rio Grande do Sul, north-western Mato Grosso, south-eastern Amazonas and south-western Pará. In contrast, Tocantins, northern Pará and northeastern Mato Grosso are expected to record intense negative anomalies, with most of the other regions showing below-average temperatures.

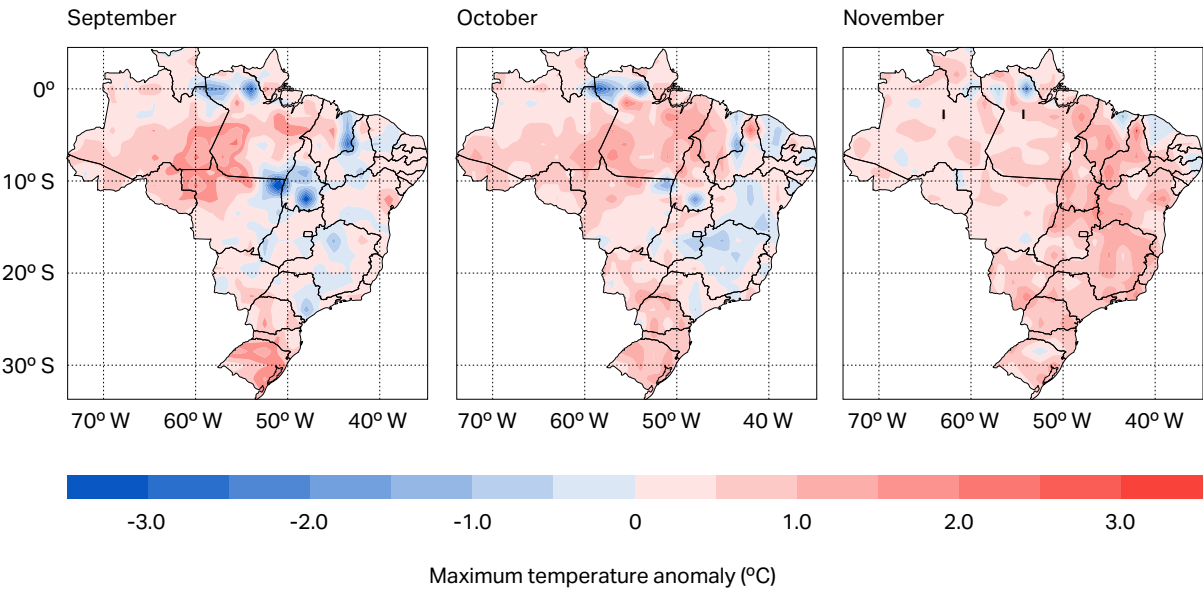
October

The forecast indicates slightly above-average maximum temperatures in the north and south. The north of Pará maintains the pattern of below-average temperatures, while Minas Gerais and Bahia should show slight negative anomalies.

November

The model projects positive anomalies in north-eastern Brazil and Minas Gerais, indicating a possible above-average warming for the period.

Figure 12 - Forecast for maximum temperature anomalies in Brazil for September, October and November 2025 (Source: MIA Climate)



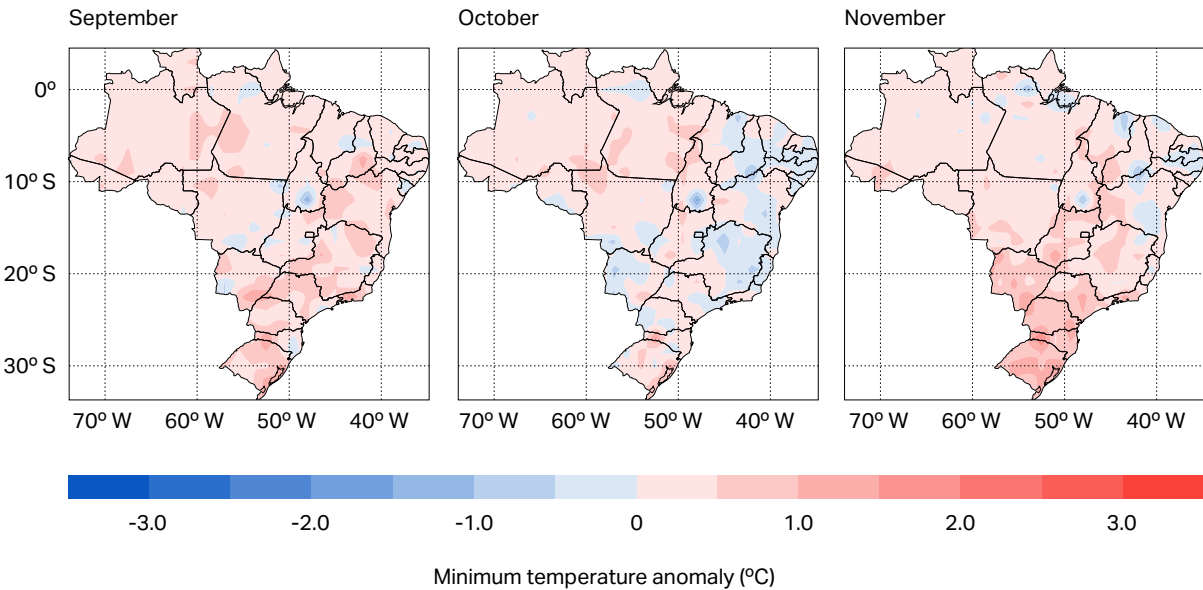
September 1st, 2025 round.

The MIA Climate model presents projections of minimum temperature anomalies (°C) for spring 2025 (figure 13), indicating a predominance of values slightly above the climatological average in much of the national territory.

The positive sign is more persistent in the South, particularly in Rio Grande do Sul and Santa Catarina, especially in September and November. In October, the pattern tends to be closer to the historical average, with slight negative anomalies in Minas Gerais, Mato Grosso do Sul and the Northeast, while the South and North should record slightly above-average temperatures.

In general, November shows an intensification of the positive anomalies over the South and parts of the Southeast, including the interior of São Paulo and Mato Grosso do Sul. This scenario suggests a warmer end to the quarter, with possible impacts on the population's thermal comfort and water stress in agricultural crops sensitive to the minimum temperature.

Figure 13 - forecast for minimum temperature anomalies in Brazil for September, October and November 2025 (Source: MIA Climate)



September 1st, 2025 round.

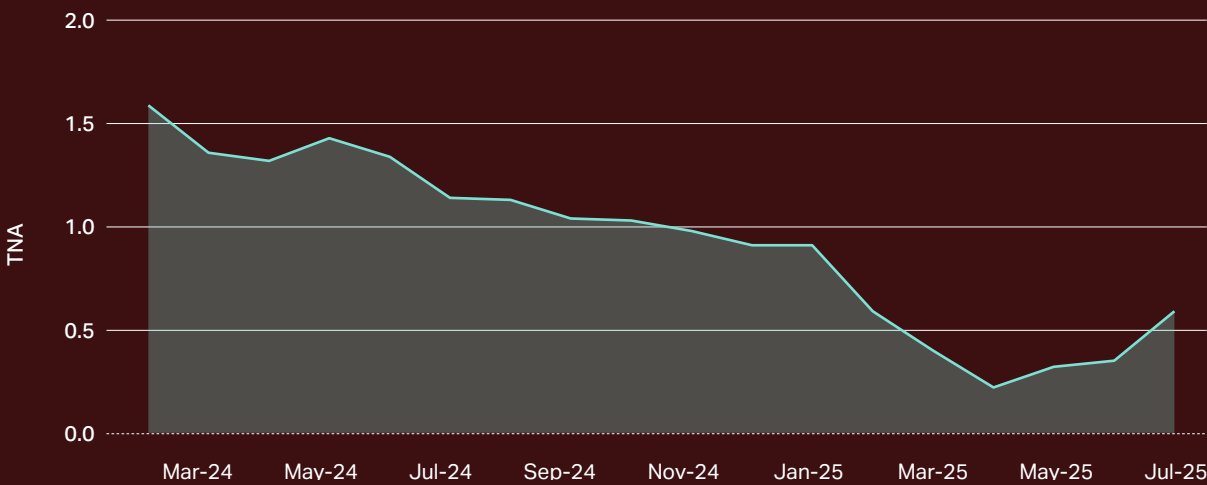
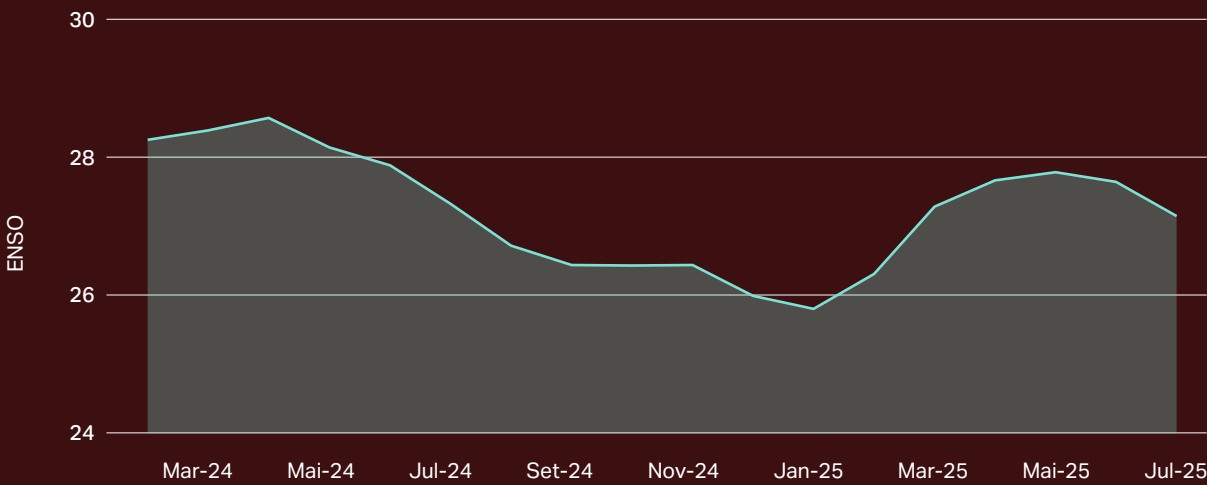
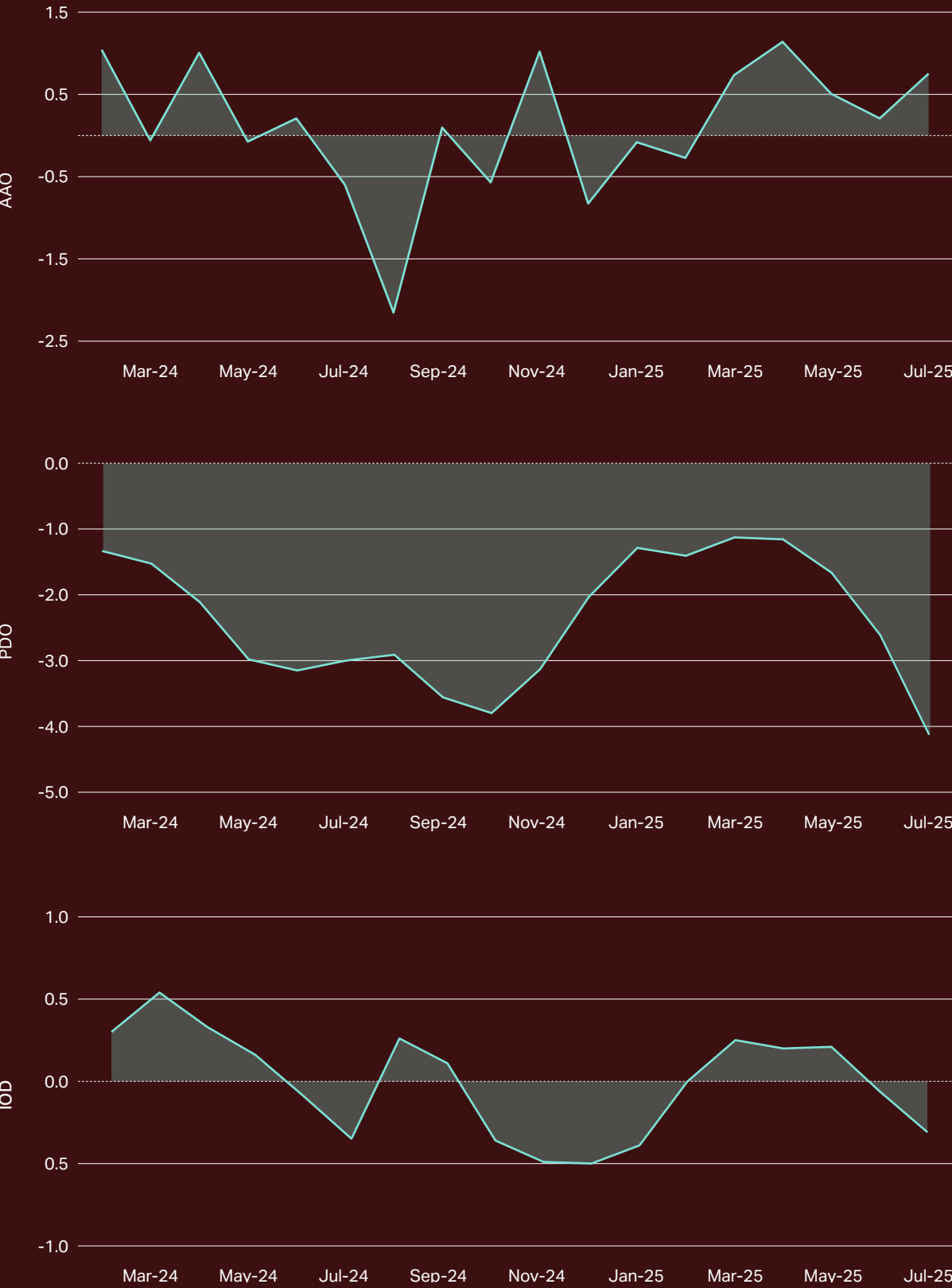
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The scenario suggests a warmer end to the quarter, with possible impacts on the population’s thermal comfort and water stress in agricultural crops sensitive to the minimum temperature.

Influence of climatic conditions on rainfall in Brazil

As explained in the previous report, climate teleconnections are large-scale oscillations in the atmospheric and oceanic systems that influence the general circulation of the atmosphere, and consequently, the rainfall regime in Brazil. These global patterns directly affect the frequency, intensity and spatial distribution of rainfall and are fundamental to understanding regional climate variability (figure 14). Current oscillations and their impact:

Antarctic Oscillation (AAO)	The AAO has remained in a positive phase since March 2025, influencing the entry of cold fronts and polar air masses into the continent. In June, cold fronts favoured Rio Grande do Sul, resulting in above-average rainfall. In July, atmospheric blocks associated with the AAO caused negative rainfall anomalies in a large part of the Centre-South. If this positive phase continues into spring, it could have a significant impact on the agricultural sector. Studies by Fernanda Vasconcellos and Iracema Cavalcanti (INPE), published in Atmospheric Science Letters (2010), indicate that the positive AAO can modulate the South Atlantic Convergence Zone (SACZ), favouring extreme rainfall events in the Southeast. The study by Camila Carpenedo and Tércio Ambrizzi (2020) published in Revista Brasileira de Meteorologia, points out that this phase can intensify south-westerly winds, strengthen atmospheric blockades and weaken cyclones, reducing the entry of cold fronts into the continent. In summer, it can favour the anomalous displacement of the Intertropical Convergence Zone (ITCZ) further south, increasing rainfall in the north.
Pacific Decadal Oscillation (PDO)	The PDO remained persistently negative, with a sharp drop in July, which may influence the reduction in temperatures in the central region of Niño 3.4.
Pacific Decadal Oscillation (PDO)	ENSO remains in a neutral condition in the Niño 3.4 region. According to NOAA , there is a possibility of a transition to a weak La Niña during the austral spring. This scenario tends to favour above-average rainfall in the north and part of the northeast, while the likelihood of drier periods in the south increases. However, the impacts vary depending on the interaction with other factors, such as the surface temperature of the Atlantic, and each El Niño or La Niña episode has its own characteristics.
Indian Ocean Dipole (IOD)	The IOD shifted from a positive to a negative phase between May and June 2025, which could alter atmospheric circulation and precipitation patterns in tropical regions. The negative phase of the IOD can favour increased rainfall in the North and parts of the Centre-West of Brazil, especially when there is a convergence of moisture from the Amazon. There is also potential for heavier rainfall in tropical areas, depending on the configuration of the Intertropical Convergence Zone (ITCZ). In the South and Southeast, the influence tends to be limited, although there may be interaction with other meteorological systems that modify local rainfall patterns.
Tropical Northern Atlantic Index (TNA)	The TNA remained positive, indicating high surface temperatures in the Tropical North Atlantic basin, although with less intensity than in 2024.

Figure 14 - Monthly evolution of the main teleconnection indices between August 2024 and June 2025 (Source: NOAA)



Neutrality has been maintained in the Equatorial Pacific (ONI: -0.1°C in May and June).

Prospects for Brazilian agriculture: soya beans and off-season maize in the spotlight

Maize production in Brazil is divided into two main crops:

01 First crop (summer crop)

Planted between October and December, usually in parallel with soya cultivation. It depends directly on the rainfall in spring and summer.

First crop performance of 2025

According to the National Supply Company (CONAB), by July 2025, the first corn crop had reached an average yield of 6,122 kg/ha, representing an increase of 11.6 per cent on the previous cycle. Total production was 131.97 million tonnes, an increase of 14.3%. Harvesting reached 97.2% of the area, favoured by low volumes of rain, except in Rio Grande do Sul, where high humidity hampered work in the field. Despite a 5% reduction in the area planted, the 8.5% gain in productivity reflects technological advances and better agricultural planning.

Performance of the second crop (safrinha) - 2025

In August, 83.7% of the off-season maize area had been harvested, slightly behind the historical average of 84.3%. This delay was attributed to rain and low temperatures, which made it difficult to dry the grains. Despite the late planting, weather conditions were generally favourable, and yields exceeded initial estimates in several states. With an estimated planted area of 17.3 million hectares and production of 109.57 million tonnes, this is shaping up to be the largest second corn crop in the country's history.

In Paraná, occasional frosts affected crops sown later but did not compromise the state's average yield. In Mato Grosso do Sul, production exceeded the initial projection of 10.1 million tonnes, reaching 14.2 million, an all-time record according to the State Secretariat for the Environment, Development, Science, Technology and Innovation. However, intense windstorms caused lodging over about 13,000 hectares, with losses estimated at between 20% and 40%, according to APROSOJA/MS.

131.9 millions

The first maize harvest of 2025 reached 131.9 million tonnes

02 Second crop (safrinha)

Sown just after the soya harvest, it is more exposed to the risks of autumn and winter weather, such as short dry spells (veranicos) and frosts.

109.6 millions

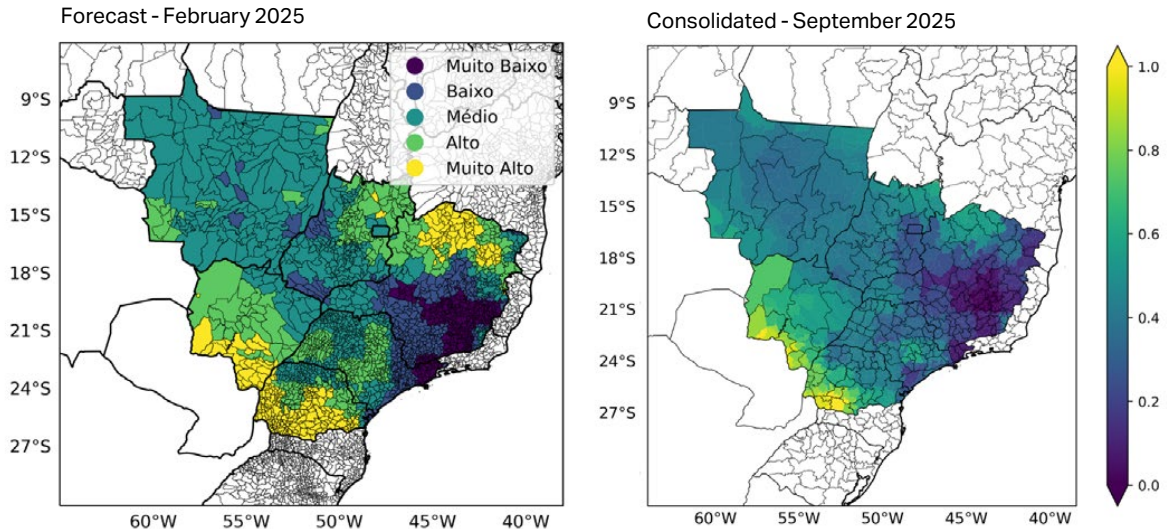
Production of the second corn crop of 2025, the largest ever recorded in the country

In April, MeteolA released its composite risk forecast for the off-season maize crop, considering critical variables such as:

- Daily rainfall of more than 100 mm
- Winds above 54 km/h
- Total rainfall less than 600 mm
- High temperatures (more than 5 days/month above 30°C)
- Low temperatures (more than 5 consecutive days below 10°C)

Figure 15 shows the forecast at the start of the harvest (left) and the consolidated data (right). The forecast showed good performance, even with overestimation in some areas, by correctly indicating the risks in southern Paraná, Mato Grosso do Sul and Mato Grosso. Since February, the composite risk maps had already signalled the possibility of losses associated with strong winds and temperature extremes, conditions that were confirmed and impacted productivity.

Figure 15 - Comparison between the forecast and the consolidated composite risk for second-crop maize (Source: MIA Climate)



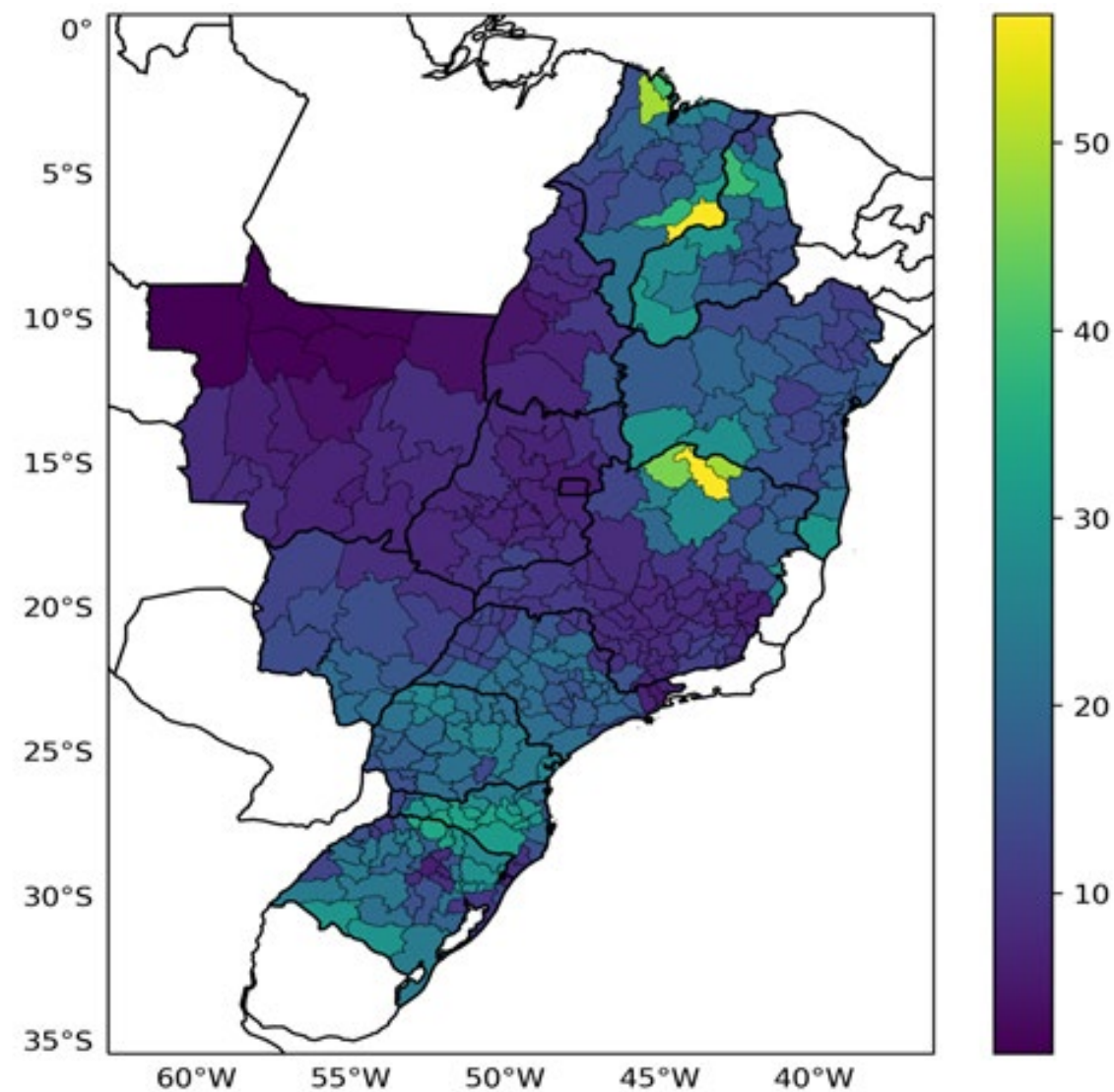
Considering wind above 54 km/h, insufficient rainfall, extreme rainfall, high temperatures and low temperatures throughout the harvest period (February and September 2025)

In October, the planting of the first corn and soya crop begins in Brazil's main producing regions. Soya, the country's main agribusiness crop, stands out not only for the volume it exports, but also for its importance in the production of animal protein and in various links in the food production chain.

Because of this, MeteolA has drawn up a composite climate risk map (figure 16) for soya planting in the producing states: Tocantins, Maranhão, Piauí, Bahia, Minas Gerais, Mato Grosso, Mato Grosso do Sul, Goiás, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul. The aim is to support agricultural planning in the face of forecast weather conditions.

To build the map, meteorological variables that directly influence the development of the soya crop were taken into account: rainfall, maximum temperature, minimum temperature and wind speed, for the period from September 2025 to February 2026. The result indicates a predominantly optimistic scenario for the next harvest. On the map, the higher the value assigned to a region, the greater the climate risk associated with planting. Areas such as the north of Minas Gerais and the east and north of Maranhão are receiving the most attention. On the other hand, states traditionally strong in soya production, such as Mato Grosso, Goiás and Mato Grosso do Sul, have favourable weather conditions, with low risk for cultivation.

Figure 16 - Spatial map of the composite risk for soya cultivation between September 2025 and February 2026 (Source: MIA Climate)



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The results of the study indicate a predominantly optimistic outlook for the next harvest.

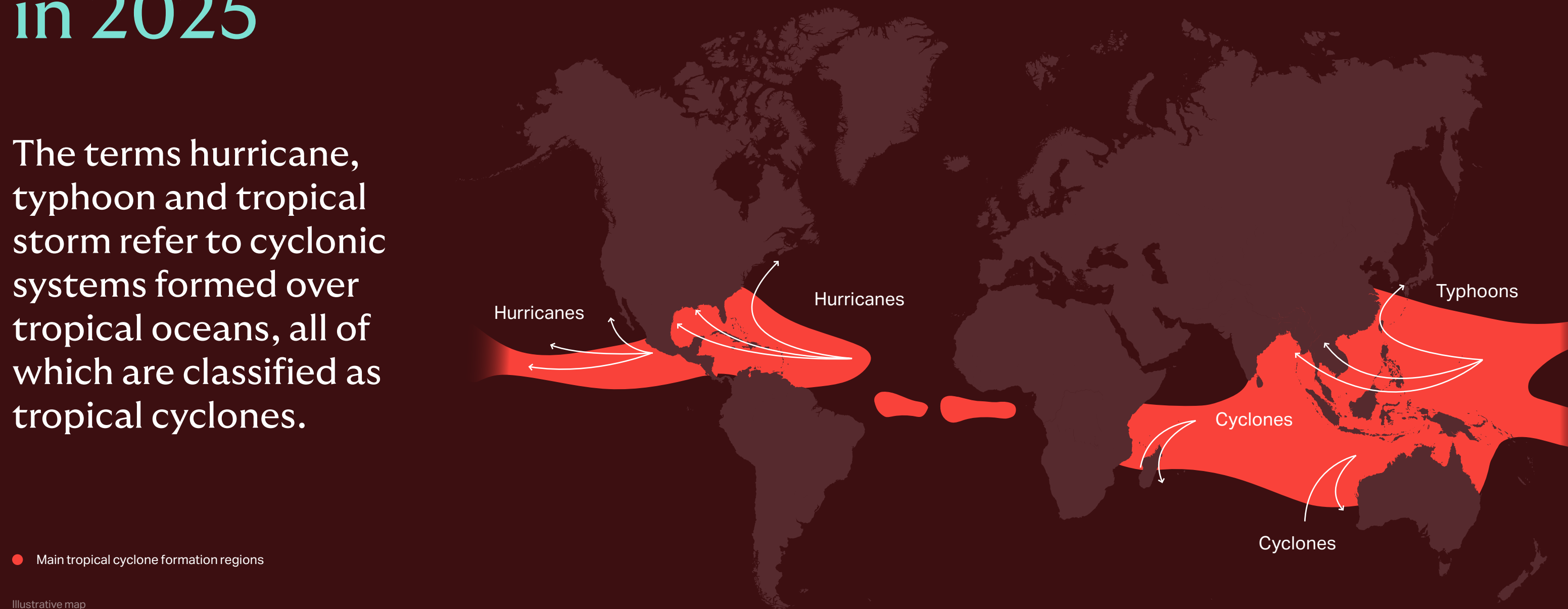
Hurricanes, typhoons and tropical storms in 2025

The terms hurricane, typhoon and tropical storm refer to cyclonic systems formed over tropical oceans, all of which are classified as tropical cyclones.

These systems share common characteristics, such as low-pressure centres, deep convection and winds organised around a well-defined core. The main difference between them lies in their geographical location and the intensity of the winds.

The term hurricane is used for tropical cyclones with winds of 119 km/h or more, formed in the North Atlantic or North-East Pacific, according to the Saffir-Simpson scale. A typhoon, on the other hand, refers to systems of the same intensity that occur in the north-west Pacific, especially between East Asia and the western Pacific Ocean.

Tropical storms, meanwhile, refer to tropical cyclones with winds between 63 and 118 kilometres per hour, regardless of the region in which they form. In other words, hurricanes and typhoons are more intense stages of a system that initially develops as a tropical storm and can evolve if atmospheric and oceanic conditions are favourable.



Illustrative map

2025 Atlantic Hurricane Season

The 2025 Atlantic hurricane season began on 24 June with the formation of Tropical Storm Andrea. So far, activity has been close to the climatological average, with the highlight being Hurricane Erin, which reached category 5 (figure 17). NOAA continues to forecast above-normal activity, influenced by factors such as the anomalous warming of the tropical Atlantic and a more active African monsoon.

- **Tropical Storm Andrea (24 June):** The first named system of the season, it was short-lived and dissipated in just 12 hours, without causing any significant impact.
- **Tropical Storm Barry (end of June):** Formed in the Bay of Campeche, it caused strong winds and heavy rains in southeastern Mexico, with economic losses and damage to infrastructure.
- **Tropical Storm Chantal (early July):** Formed near the southeast coast of the US, it caused flooding and disruption in the Carolinas, with gusts of up to 92.6 km/h.
- **Tropical Storm Dexter (towards August):** It developed to the north of the Caribbean and maintained tropical characteristics for a few days, with winds in excess of 83.3 km/h, before dissipating.
- **Hurricane Erin (11-21 August):** It quickly evolved from a tropical storm to category 5, with winds of up to 257 km/h and a central pressure of 915 hPa. It hit several regions of the Caribbean and the east coast of the USA, causing significant impacts.
- **Tropical Storm Fernand (23-28 August):** It had gusts of up to 92.6 km/h and stood out for having the longest trajectory of the season.

So far, there has been a delay in the formation of systems in the Gulf of Mexico and the Caribbean Sea, attributed to the presence of a drier middle troposphere. In contrast, the Tropical East Pacific had a more active season, with 12 tropical storms, 6 hurricanes and 3 major hurricanes recorded.

257 km/h

Winds recorded during Hurricane Erin, which was classified as a category 5 storm

Figure 17 - Hurricane Erin near the southeast coast of the United States (Source: NOAA, RAMMB, CIRA)



Image from the GOES-19 satellite (GeoColor channel) taken on 20 August 2025, at 12:30 UTC

2025 Pacific Typhoon Season

The 2025 tropical storm season in the Northwest Pacific occurs throughout the year, with the highest concentration of named systems between June and October, when oceanic and atmospheric conditions are most favourable. In June, Typhoon Wutip formed, followed in July by Typhoons Danas, Wipha and Co-may. At the beginning of August, Typhoon Podul also developed, adding to the other tropical storms active during the period.

- **Typhoon Danas (5-7 July):** It hit Taiwan with gusts of more than 222 km/h and rainfall accumulations of more than 500 mm, causing floods, landslides and damage to infrastructure. Around 300,000 homes were left without power, with two deaths and around 500 people injured. The system's unprecedented path, which directly hit Chiayi County, resulted in agricultural losses of more than NT\$ 1.6 billion (~US\$49.2 million), affecting more than 13,800 hectares and various production chains, such as fruit, livestock and fisheries.
- **Typhoon Wipha (formed on 18 July):** Originating in the Philippine Sea, it caused five deaths and seven people missing in the country. It then reached southern China, with high alert in Hong Kong and arrival in the city of Taishan (Guangdong), before heading north to Vietnam. The impacts included the cancellation of more than 200 flights, 30 injuries in China and three deaths in Vietnam, as well as agricultural losses of around 1,600 hectares of rice.
- **Typhoon Podul (Gorio):** It formed east of the Northern Mariana Islands and was classified as a tropical storm on 8 August. It hit southern Taiwan on 13 August, causing heavy rain, suspension of activities and 33 people injured. After crossing the Taiwan Strait, it reached the coast of mainland China, where around 15,000 people were evacuated as a precaution. The system caused transport disruption and maximum rainfall alerts in Hong Kong.

COP30 in Brazil

The 30th United Nations Climate Change Conference of the Parties (COP30), scheduled to take place between 10 and 21 November 2025 in Belém (PA), represents a strategic milestone for Brazil in the global scenario of tackling climate change.

The choice of the capital of Pará, located in the heart of the Amazon biome, reinforces Brazil's leading role in international climate discussions. The main themes of the conference include preserving the Amazon rainforest, promoting bioeconomy, advancing fair energy transition and strengthening climate resilience, with special attention to the most vulnerable populations.

By hosting the event, Belém symbolises a commitment to an agenda that combines sustainable development with environmental conservation. The Amazon region will be presented as an example of nature-based solutions, with an emphasis on the sustainable use of resources, the valuing of traditional knowledge and the integration of climate, biodiversity and social inclusion.

In an interview with the newspaper O Globo, scientist Carlos Nobre, who holds a doctorate in meteorology from the Massachusetts Institute of Technology (MIT), emphasised the importance of COP30 and the urgency of bringing greenhouse gas emissions to zero by 2040. He also warned of the Amazon's approaching point of no return, saying: "[...] the drought in the biome has already lasted 4 to 5 weeks and, if we carry on like this, it's likely to get worse over the next few decades, possibly reaching 6 months of dry season".

In this context, climate finance has emerged as one of the central pillars of the negotiations. As leader of COP30, Brazil seeks to push for more robust and accessible mechanisms to support developing countries in implementing their climate goals. One of the highlights will be the plan to mobilise US\$ 1.3 trillion a year by 2035, significantly more than the US\$ 300 billion a year defined at COP29.

Initiatives such as the Baku Belém Roadmap and the Tropical Forests Forever Facility (TFFF) fund, estimated at US\$125 billion, illustrate efforts to channel resources into the mitigation, adaptation and preservation of tropical forests, with greater participation by the private sector and innovation in financial instruments. COP30 also opens up a strategic window of opportunity for the Brazilian agricultural sector.

The event could strengthen public policies and practices aimed at low-carbon agriculture, integrating environmental conservation, technological innovation and food security. It is hoped to stimulate access to credit lines for sustainable practices, efficient irrigation and reducing deforestation, in synergy with national programmes such as the Climate Fund, the Amazon Fund and the Brazil Climate Investment Platform (BIP).

Despite the optimism, the event will also face political challenges and tensions. Concerns have been raised regarding the environmental effects of urban construction projects in Belém, as well as the importance of facilitating the involvement of indigenous peoples and traditional communities in decision-making processes.

The creation of an organising committee seeks precisely to ensure representation from different sectors of civil society, promoting transparency and engagement in climate action. COP30 has the potential to consolidate Brazil as a global leader in climate governance, connecting its natural wealth and social challenges to the demands of a planet in transition. The success of the conference will depend on the ability to turn commitments into concrete actions and to show the world that it is possible to grow while preserving.

About our team

Howden Re provides a differentiated and holistic approach to reinsurance, capital markets and strategic advisory.

Howden Re has partnered exclusively with MeteolA, bridging the gap between weather data and meteorological intelligence.

By combining scalable artificial intelligence (AI) with cuttingedge physics, MeteolA designs industry-specific weather solutions. Their technology transforms raw weather data into actionable insights for better decision-making. Combined with Howden Re’s expert re/insurance insights and analytical expertise, this unique partnership enables powerful risk assessment and strategic decision-making.

For more information on the datasets and methodologies used by MeteolA in this report, or to learn about our reinsurance brokerage solutions, please contact Howden Re’s team at report.brasil@howdenre.com.

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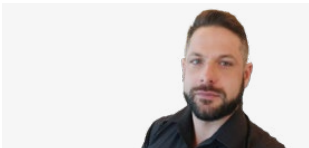
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Definitions used

Negative anomaly

When the variable analysed is lower than the historical average for that period.

Positive anomaly

When the variable analysed is higher than the historical average for that period

Anticyclone

High atmospheric pressure zone.

Wind shear

Variation of wind speed with height in the atmosphere

Climatology

Historical average used for comparison (1990-2023).

Easterly Wave Disturbance (DOL)

Are large-scale atmospheric systems that contribute significantly to the annual rainfall totals in north-eastern Brazil.

Drought criteria

Mild

Entering drought: short-term dry spell (veranico) reducing planting, crop growth or grazing. Coming out of drought: some prolonged water deficits, pastures or crops not fully recovered.

Moderate

Some damage to crops, pastures, streams, reservoirs or wells with low levels, some developing or imminent water shortages; voluntary water use restrictions requested.

Heat wave criteria

A heatwave is defined as a period when the temperature is 5o C above the monthly climatological average for at least 3 days.

ENSO

El Niño Southern Oscillation

Teleconnections

Planetary-scale climate variability patterns that manifest themselves through persistent anomalies in atmospheric circulation. These patterns connect distant regions of the Earth, influencing weather and climate systems on different time scales, from weeks to decades. They modulate the behaviour of phenomena such as cold fronts, convergence zones and precipitation regimes, covering vast areas and interfering in the distribution of heat and humidity around the globe.

SST

Sea surface temperature.

ITCZ

Intertropical Convergence Zone.

Severe

Crop or pasture losses likely; water shortages common; water restrictions imposed.

Extreme

Major crop / pasture losses; generalised water shortages or restrictions.

Exceptional

Exceptional and widespread crop / pasture losses; water shortages in reservoirs, streams and water wells, creating emergency situations.



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