Howden Re

Climate overview of Brazil and global climate impacts

4th edition
April/2025

In exclusive partnership with
MeteoIA

Disclaimer

These materials have been prepared by Howden Re to provide broad background information only and are based upon information from public and other sources which Howden Re believes to be reliable.

Howden Re does not perform and assumes no responsibility for the independent investigation or verification of such information and has relied on such information being complete and accurate in all material respects. To the extent such information includes estimates and forecasts of future financial performance, Howden Re has assumed that such estimates and forecasts have been reasonably prepared on the basis reflecting the best currently available estimates. No representation or warranty, express or implied, is made as to the accuracy or completeness of such information and nothing contained herein is, or shall be relied upon as, a representation, whether as to the past, the present or the future. The information contained herein is not intended to provide the sole basis for evaluating and should not be considered a recommendation with respect to, any transaction or other matter.

This communication has not been prepared with a view toward public disclosure under any securities laws and may not be reproduced, disseminated, quoted or referred to, in whole or in part, without the prior written consent of Howden Re.

About Howden Re & MeteoIA

Howden Re has partnered exclusively with MeteoIA, bridging the gap between weather data and meteorological intelligence. By combining scalable artificial intelligence (AI) with cutting-edge physics, MeteoIA 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 MeteoIA in this report, or to learn about our reinsurance brokerage solutions, please contact Howden Re's team at report.brasil@howdenre.com.

Summary

Recent climate events in Brazil

Drought conditions, increased volume in Amazonian rivers, heat waves, and the impacts of La Niña.

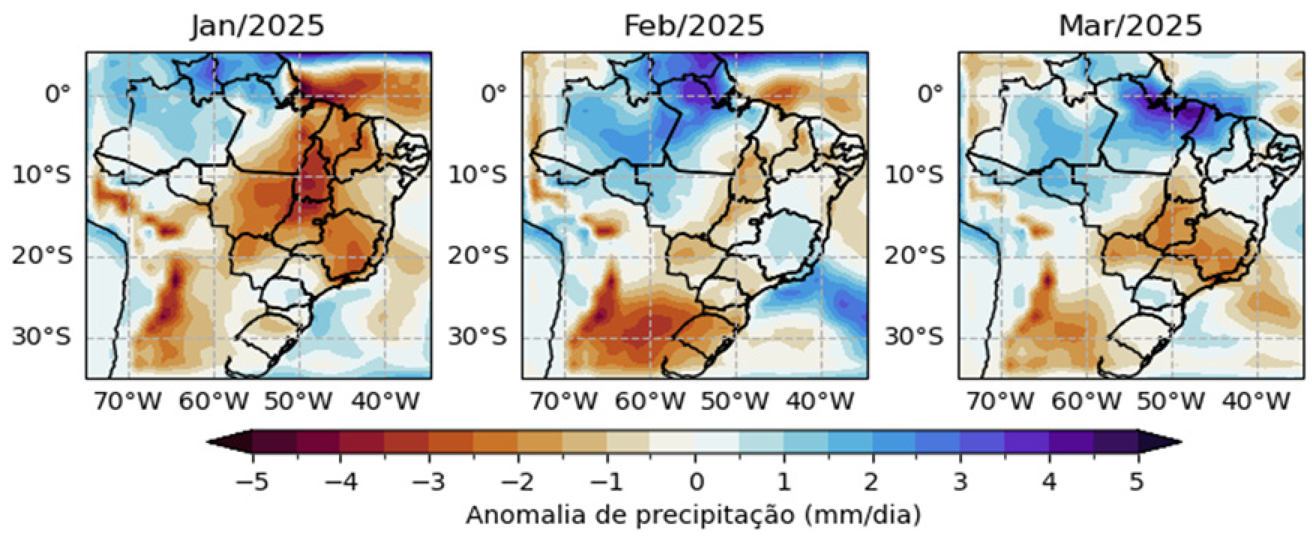
Overview of rainfall in Brazil: January – March 2025

In the previous edition of this report, published in January 2025, the forecast for the first quarter of 2025, the MIA Climate simulations were conducted between December and early January (figure 1).

For the Central-West and Northern Region of Brazil, the forecast proved to be accurate. Although the forecast captured the general trend of precipitation anomalies in other areas of the country, there were significant regional variations.

These differences are detailed in figures 3, 5, and 7, showing the observed data consolidated by INPE monitoring. Despite some local divergences, the model performed well in identifying the main patterns of precipitation anomalies throughout the quarter.

Figure 1 - Forecast for precipitation anomaly in January, February, and March 2025
(Source: MIA Climate)
Model run used in the report published in January 2025



We present below the comparison between the climate forecast generated by the MIA Climate model, based on the run conducted in January 2025, and the observation data consolidated by INPE monitoring.

This analysis aims to evaluate the degree of correspondence between the forecast and the patterns actually observed throughout the first quarter of 2025.

January 2025

Brazil experienced highly heterogeneous precipitation anomalies, with significant regional variations in January 2025.

The color scale in figures 2, 4, and 6 below represents negative and positive anomalies, corresponding to precipitation below and above the climatological average, respectively.

In the Southeast and Central-West regions, local instabilities generated by strong heating, along with the influence of the South Atlantic Convergence Zone (SACZ), caused accumulated rainfall, especially in Minas Gerais, Mato Grosso, and Goiás, accentuating the slightly above-average anomalies in these regions.

In the North and Northeast, the Intertropical Convergence Zone (ITCZ) was the main factor responsible for instabilities, favoring increased precipitation in Ceará, Piauí, Maranhão, and Pará.

The Northeast region and the northern and central portions of the North experienced positive anomalies and within the climatological average, except for western Amazonas and Acre, which had slightly below-average anomalies.

The MIA Climate model accurately predicted, in alignment with observations by the National Institute for Space Research (INPE), below-average rainfall in much of Brazil, especially in the central-western Amazonas, central-western and southwestern Rio Grande do Sul.

In the states of Pará and Amapá, the model's forecast was consistent with observations, although with some differences in the intensity and positioning of the maximum anomalies (peaks).

Additionally, the MIA Climate model correctly predicted rainfall between northern Minas Gerais, Espírito Santo, much of Bahia, and most of the Northeast.

Figure 2 - Precipitation forecast for January 2025 (Source: MIA Climate)

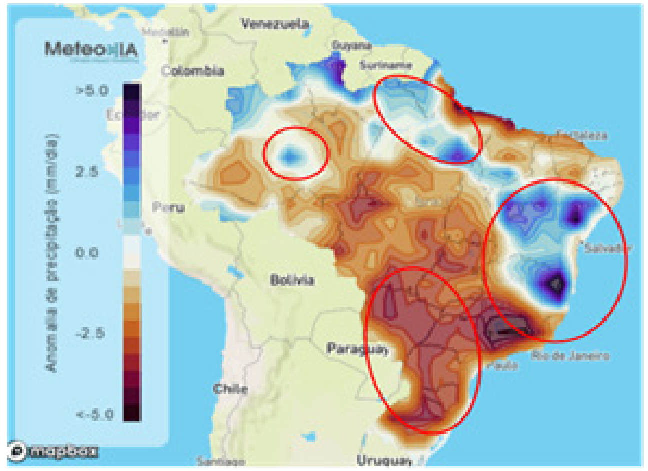
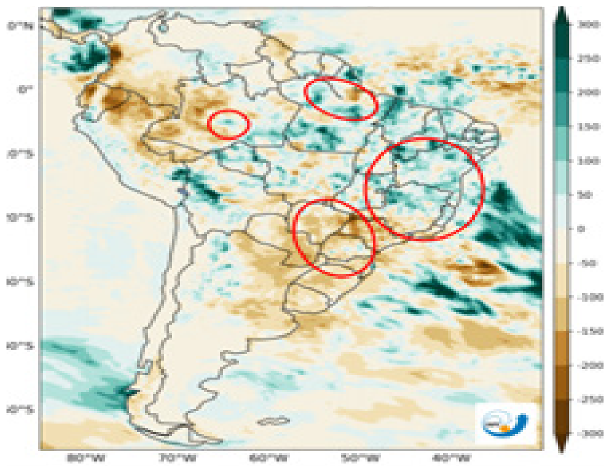


Figure 3 - Precipitation observed in January 2025 (Source: INPE, MERGE)



February 2025

During February 2025, precipitation was above average in the states of Amazonas, Pará, Roraima, Rondônia, Amapá, and parts of Mato Grosso and Maranhão.

Rio Grande do Sul experienced rainfall close to the average, with slight negative variations (with some correlation to the weak La Niña). In the rest of the country, rainfall was below average.

The MIA Climate model correctly predicted the general patterns of precipitation anomalies, especially in regions with negative anomalies, such as in the Southeast, between Minas Gerais and northern São Paulo, Rio de Janeiro, and Espírito Santo.

The model accurately forecasted rainfall within climatological norms and slightly above average in central-southern Goiás. The prediction of above-average rainfall in central Mato Grosso was also precise in relation to consolidated data.

Figure 4 - Precipitation forecast for February 2025 (Source: MIA Climate)

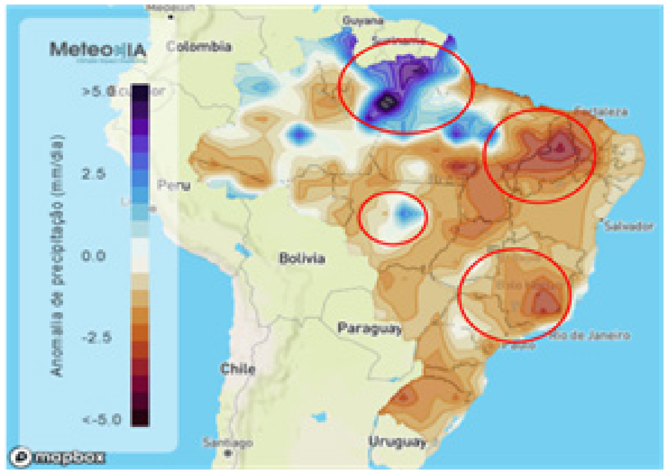
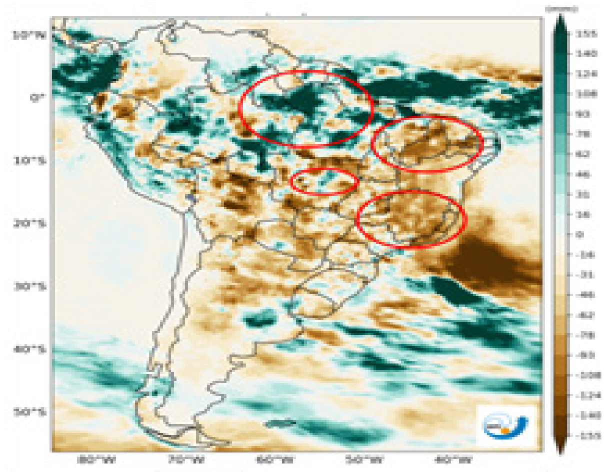


Figure 5 - Precipitation observed in February 2025 (Source: INPE, MERGE)



March 2025

In March 2025, most of Brazil recorded below-average rainfall, including the South and Southeast regions, as well as the states of Goiás, Tocantins, Bahia, and Piauí.

Conversely, Roraima, northern Maranhão, Ceará, and the coast of Rio Grande do Norte and Paraíba experienced above-average precipitation.

In the states of Pará, Amazonas, Rondônia, Acre, Mato Grosso, and Mato Grosso do Sul, rainfall totals were quite irregular, with some areas recording above-average climatological indices and others below the expected levels for the period.

The more southern influence of the ITCZ contributed to above-average rainfall in northern Maranhão and northeastern Pará.

The MIA Climate model performed well in predicting below-average rainfall in the South and Southeast regions, as well as in the states of Bahia, Tocantins, Goiás, and parts of Mato Grosso and Mato Grosso do Sul.

Regarding the forecast of above-average rainfall, the MIA model had good results in central-northern Roraima, northern Maranhão, parts of Rondônia, and Pará.

Figure 6 - Precipitation forecast for March 2025 (Source: MIA Climate)

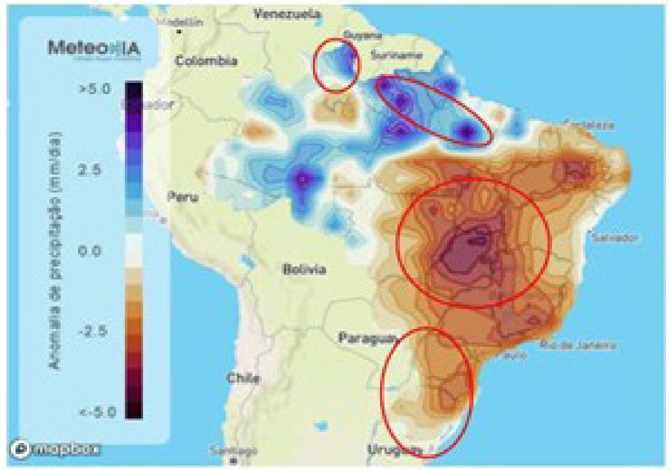
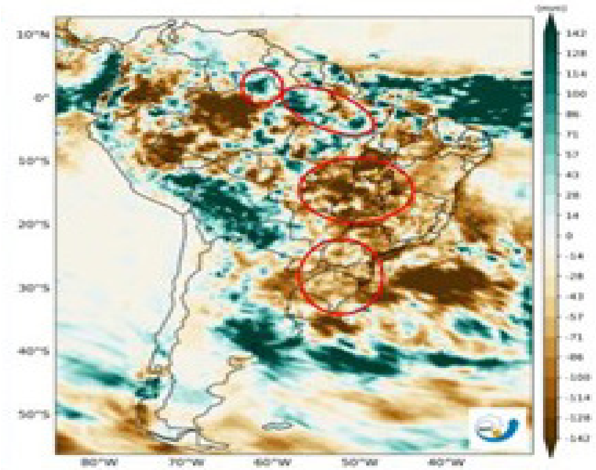


Figure 7 - Precipitation observed in March 2025 (Source: INPE, MERGE)



Update on drought conditions and Amazonian river levels

The latest drought assessments in Brazil, conducted by the National Center for Monitoring and Alerts of Natural Disasters (CEMADEN) and the National Water Agency (ANA) between December 2024 and February 2025, indicate an improvement in drought conditions in the North region and worsening in the South and Southeast regions compared to the last months of 2024 (figures 8, 9, and 10).

In December 2024, severe drought advanced in Maranhão, while negative rainfall anomalies intensified the drought from moderate to severe in the agreste of Pernambuco. In the North region, the phenomenon significantly receded, restricting itself to the western portion, except for Tocantins, where moderate drought began.

On the other hand, above-average rainfall in Rio de Janeiro, São Paulo, Minas Gerais, and the South and Central-West regions contributed to the reduction of drought from moderate to weak.

In January 2025, Rio Grande do Sul recorded a two-level intensification in drought severity, resulting from high temperatures and low rainfall during the period. Additionally, weak drought advanced in central-eastern Santa Catarina.

Despite the improvement in drought conditions in states like Acre, Amazonas, Pará, and Rondônia, driven by recent rains, the North region still holds the most critical drought scenario in the country.

The drought situation in the Central-West region also showed improvement, with the retreat of severe drought due to rainfall within or above average, although irregularly distributed.

Despite this, central-southern Mato Grosso do Sul and southeastern Mato Grosso still face severe drought. In the Southeast, there was a decrease in areas with moderate and severe drought in Minas Gerais, Espírito Santo, and the disappearance of the phenomenon in Rio de Janeiro. In São Paulo, drought went from moderate to weak on the southern coast of the state.

In February 2025, all states in the North region showed improvement in drought conditions, especially Amazonas, which no longer recorded severe and exceptional levels due to above-average rainfall in previous months.

The Northeast region also showed improvement in states like Maranhão, Sergipe, and Alagoas, while Piauí and Bahia experienced worsening drought conditions. Due to below-average rainfall, drought conditions worsened in the South and Southeast regions.

In Rio Grande do Sul, moderate drought spread to the center of the state, impacting agriculture. In the Central-West, severe drought increased its coverage in Mato Grosso do Sul, while there was improvement in Mato Grosso and stability in conditions in Goiás.

Figure 8 - Drought levels in December 2024 (Source: National Water and Basic Sanitation Agency)

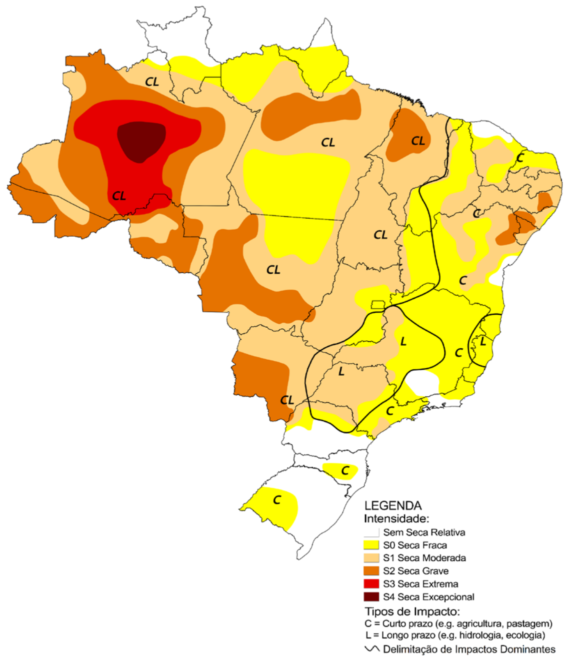


Figure 10 - Drought levels in February 2025 (Source: National Water and Basic Sanitation Agency)

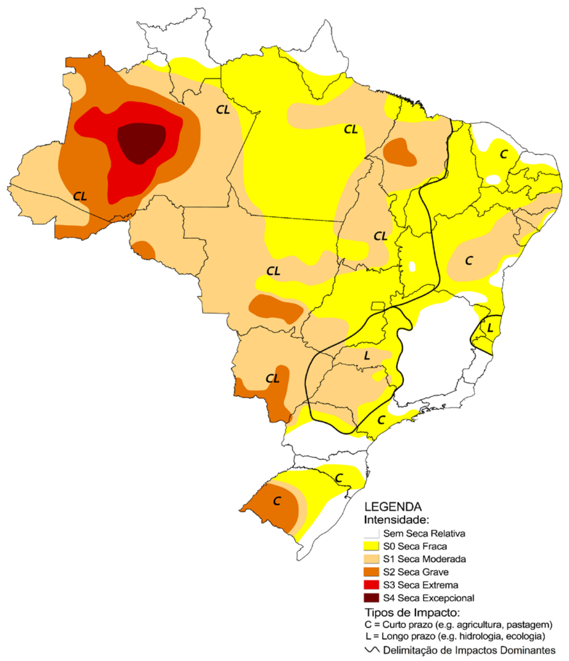
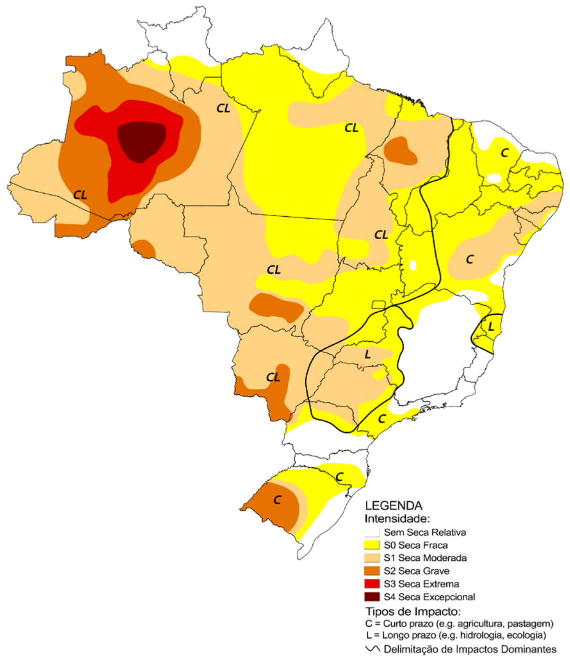


Figure 9 - Drought levels in January 2025 (Source: National Water and Basic Sanitation Agency)



After a period of extreme drought, the rivers of the Amazon began their flood cycle. In Manaus, the Rio Negro reached 21 meters in the second half of February, driven by increased rainfall. Last year, the same river marked 12.11 meters, the lowest level in 120 years of measurements (InfoAmazonia).

Despite the recovery, the Rio Negro is still below the average for this time of year. Marcus Suassuna Santos, a researcher at the Geological Survey of Brazil (SGB), highlights concerns about the water situation in the Brazilian Amazon, despite the gradual recovery (SANTOS, 2024).

The IV National Disaster Meeting emphasized the need for coordinated actions to mitigate the impacts of severe droughts and floods in the region, due to the vulnerability generated by extreme events over the past two years.

In March, the Rio Acre overflowed, reaching 14.13 meters, according to the Civil Defense of Rio Branco, affecting about 300 families and leaving three municipalities on alert.

Figure 11 illustrates the variation in the levels of Amazonian rivers between January and March 2025. There was a general increase in river levels in March, most notably in the Rio Negro (Manaus), Rio Acre (Rio Branco), and Rio Purus (Beruri), due to the rainy season. However, some rivers started the year with low levels, showing the residual effects of the previous drought.

Between January and February 2025, the basins of the **Coari**, **Tefé**, **Jutaí**, and **Javari** rivers (all belonging to the Solimões basin) had a precipitation deficit, while the basins of the **Branco** (Negro river basin), **Beni**, and **Mamoré** rivers (both in the Madeira basin) recorded above-average rainfall, with the **Beni basin** showing the highest positive rainfall anomalies.

This precipitation contributed to the faster recovery of these river levels in March. The basins of the **Madeira** (Madeira basin), **Purus** (Purus basin), **Guaporé** (Madeira basin), and **Napo** (Amazon basin, in the Peru/Ecuador border region) remained within normal levels.

It is also worth noting that global warming strengthens the inputs and outputs of the hydrological cycle in the Amazon, impacting not only the **Amazon Basin**, with reduced rainfall, but also the **Prata Basin** (Lemes et al., 2023).

A study conducted in 2008 by Dr. José Marengo from the National Center for Monitoring and Alerts of Natural Disasters (CEMADEN) analyzed the relationship between water resources and climate change.

The projections indicate that, in a scenario of high greenhouse gas emissions, such as carbon dioxide (CO_2), methane (CH_4), and nitrogen oxides (NO_x), regions like the Amazon and Northeast Brazil could face a reduction of up to 20% in rainfall by the end of the 21st century.

This scenario highlights the importance of climate policies aimed at mitigating emissions, given their direct influence on the region's hydrological regime.

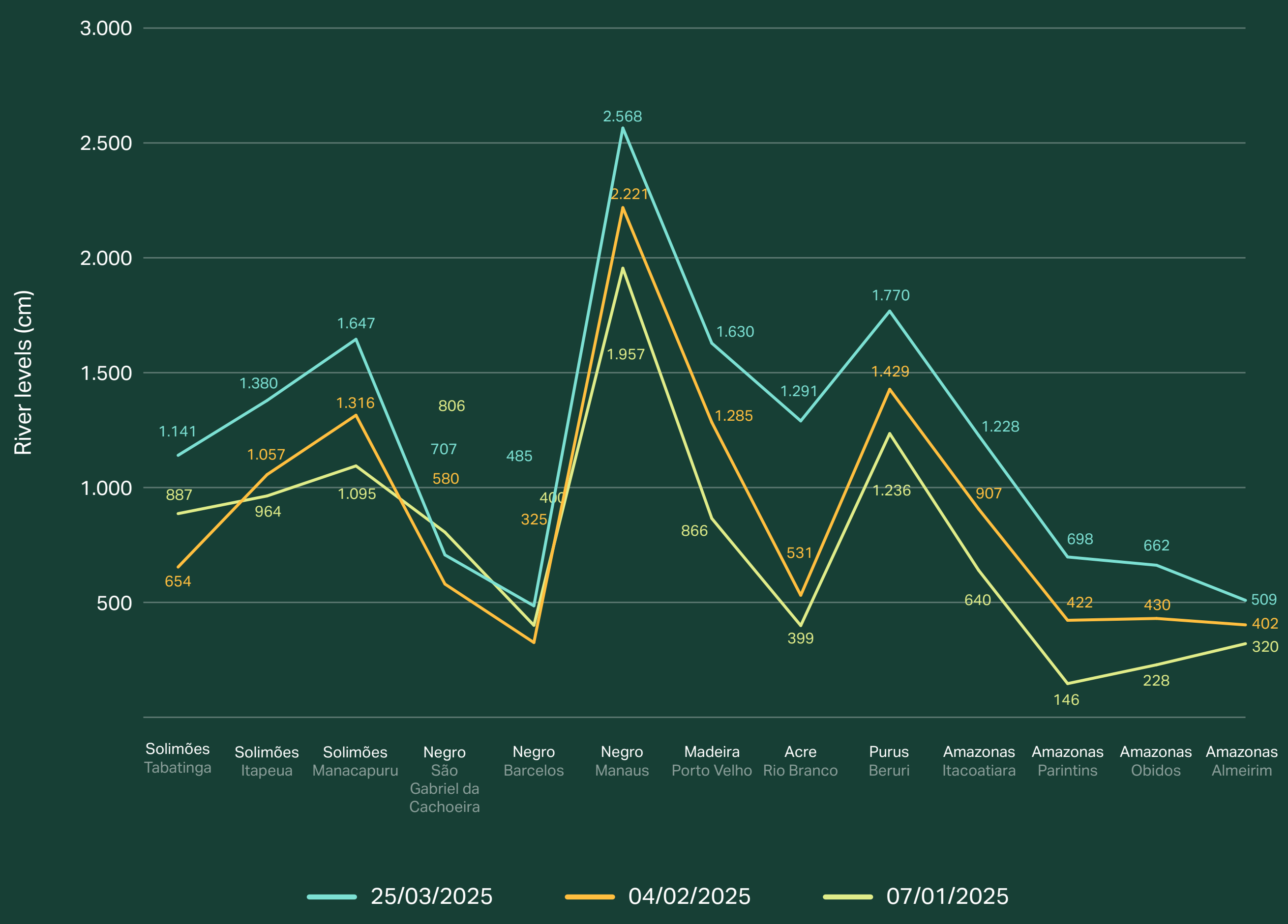
The consequences would include a possible loss of biodiversity in the Amazon and changes in the hydrological cycle, which could cause extreme rainfall events in Southern Brazil.

Years later, in 2011, another study led by Dr. José Marengo showed a prolonged dry season in the Amazon, which interfered with the Amazon Basin hydrology and river levels.

This study suggested that such changes were related to the increase in sea surface temperature in the tropical North Atlantic. In a more recent study conducted in 2024, Marengo and other authors show that the last 20 years have been the hottest in the Amazon.

The southern region of the Amazon was affected by decreased precipitation, while the northern region experienced increased rainfall. Additionally, the study reinforces that large-scale deforestation and global climate change prospects could intensify the risk of a drier and hotter Amazon.

Figure 11 - Amazonian river levels between January and March 2025, considering the geographical boundaries of the Western Amazon basins (Source: SGB)



Extreme events in Brazil and the world

Temperature

Similar to previous years, Brazil faced extreme heat in the first months of 2025. In Rio Grande do Sul, the city of Quaraí recorded record temperatures for January, reaching 42.4°C on the 23rd and later 43.8°C on February 4th.

In Rio de Janeiro, the intense heat was also notable. On February 17, the Guaratiba meteorological station recorded 43.8°C with humidity of only 35% at 12:15 PM, resulting in a heat index exceeding 52°C. This scenario led to the issuance of heat alerts and the implementation of preventive measures, such as hydration points.

In March, São Paulo also recorded record temperatures for the summer. On the 2nd, the Mirante de Santana station, from INMET, marked 34.7°C. This pattern of extreme temperatures is directly related to changes in the general circulation of the atmosphere, influenced by the higher incidence of solar radiation over the continent during the hot season.

According to Carvalho et al. (2004), during this period, the transport of warm and humid air from the tropical region to higher latitudes intensifies, driven especially by low-level jets (LLJs) that operate east of the Andes.

This mechanism favors increased precipitation, the occurrence of episodes of the South Atlantic Convergence Zone (SACZ), extreme events, and intense heat waves in South America.

Additionally, heat waves also affect various sectors, such as public health, agriculture, and urban infrastructure. The increase in temperatures intensifies the risk of dehydration and heatstroke, especially among vulnerable groups, such as the elderly (Kang et al., 2024).

In agriculture, extreme heat can compromise crop development, increasing evapotranspiration and reducing productivity (Santos et al., 2024).

In cities, thermal overload amplifies the effect of urban heat islands, impacting the well-being of the population, especially those in socio-environmental vulnerability (Jiang et al., 2024).

The increase in temperatures also influenced energy consumption. The National Electric System Operator (ONS) recorded a record average energy demand for the Southeast and Central-West subsystems, reaching 54,599 MWm on February 17. The direct relationship between the increase in temperature and the growth in energy demand is illustrated in figure 12.

Figure 12 - Variation in energy consumption (MWm) and average maximum temperature (°C) for the Southeast and Central-West regions (Source: CCEE e INPE)

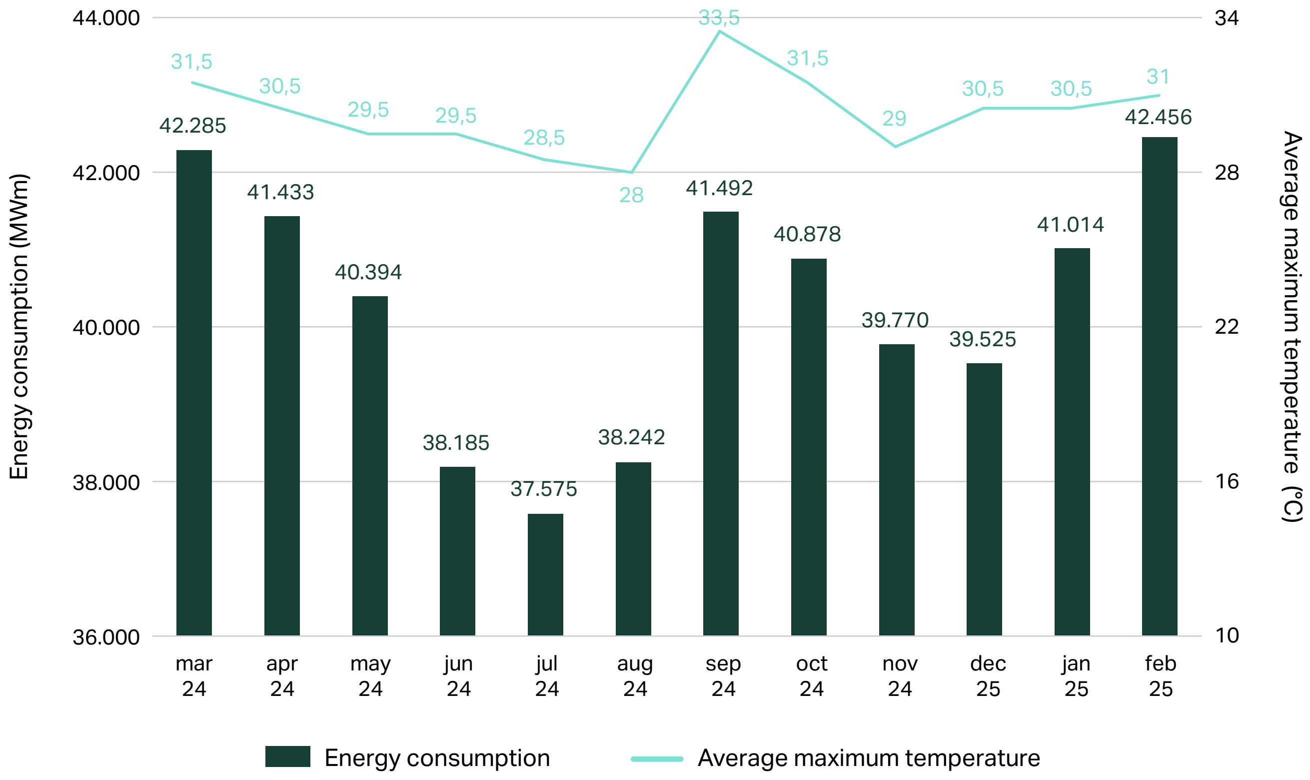
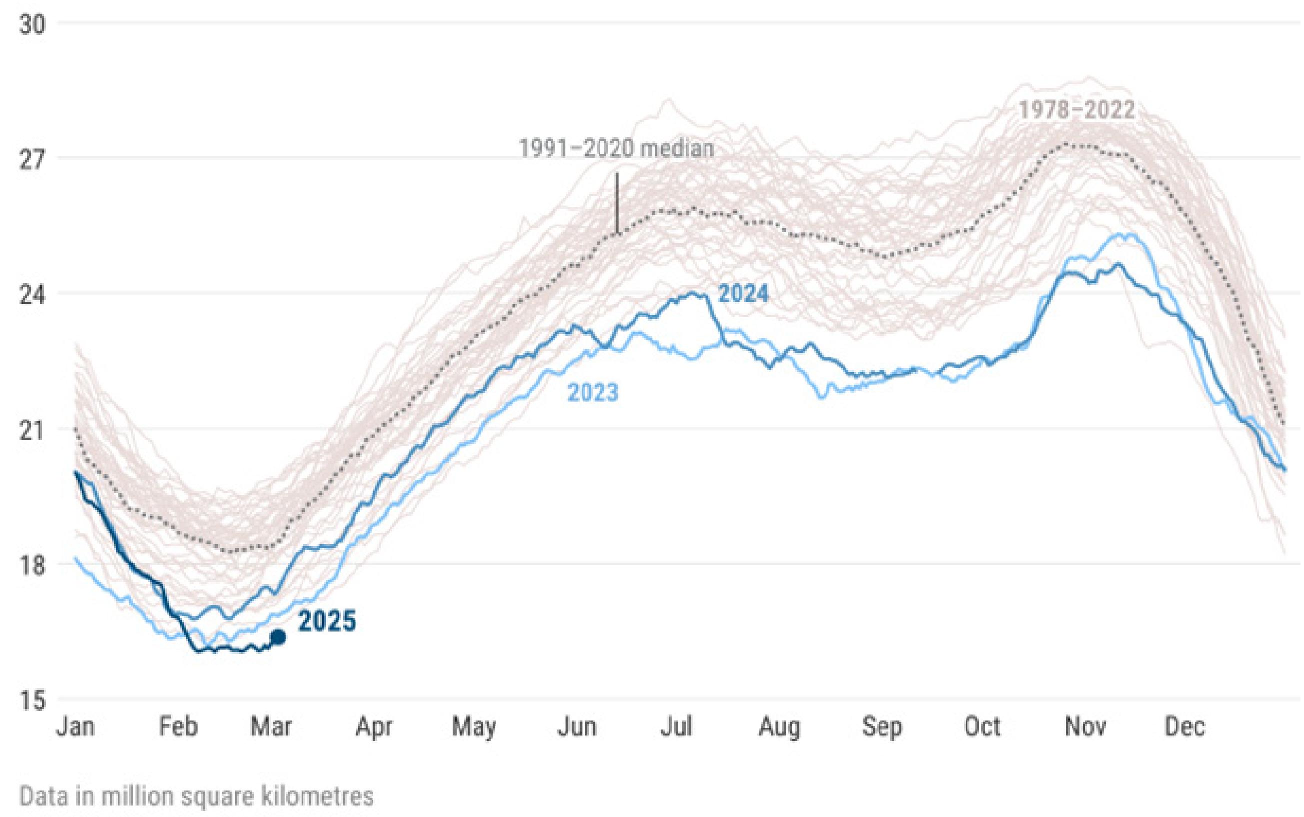


Figure 13 - Global sea ice extent from October 1978 to March 2025, EUMETSAT, OSI, SAF, Sea Ice Index v2.2 (Source: C3S/ECMWF/EUMETSAT)



This scenario of extreme temperatures is not limited to Brazil but reflects a global warming trend. January 2025 was the hottest month ever recorded, with a global average temperature of 13.23°C, according to the Copernicus Climate Change Service (C3S).

This value represents an increase of 0.79°C compared to the climatological average of 1991-2020 and 1.75°C above pre-industrial levels. February also showed significant anomalies, recording temperatures 1.59°C above pre-industrial levels. In addition to rising temperatures, the extent of sea ice in the Arctic and Antarctic reached record lows (figure 13).

In the Arctic, ice coverage was 8% below the historical average, while in the Antarctic, the reduction was even more significant, reaching 26% below average — the lowest extent ever recorded since 1978. At the end of January, Arctic sea ice experienced a drastic loss of approximately 0.3 million km² in less than a week, an area equivalent to the size of Italy.

In Europe, January was marked by an increase in average temperatures in much of Spain. According to the Agencia Estatal de Meteorología – Gobierno de España (AEMET), some areas of Galicia and Andalusia recorded extremely high temperatures.

In Gijón, the meteorological station recorded 16.3°C, the highest maximum temperature for the month since measurements began in 2002. In the United Kingdom, although January started with below-average temperatures, accompanied by widespread frost, snow, and freezing fog, there was an increase in average temperatures in mid-February.

England recorded temperatures about half a degree above average, while Ireland and Scotland also observed elevated values. According to the Met Office (the UK's national meteorological service), the Western Isles and Shetland set a new record, with the tenth highest temperature ever recorded since 1884.

Precipitation

Extreme precipitation events have become increasingly frequent and intense over the past few years. At the beginning of 2025, historical 24-hour rainfall records registered by INMET highlighted the intensification of extreme precipitation events in Brazil.

In Paraná, municipalities such as Japira, Ventania, and Morretes surpassed previous records, with accumulations of up to 121.8 mm in a single day. In the Southeast, Paraty (RJ) recorded 129.2 mm in a single day, equivalent to 60% of the monthly climatological average.

In the Northeast, cities like São Luís (MA) and Amargosa (BA) also broke their records, with daily volumes corresponding to more than half of the monthly average. In the North region, accumulations exceeding 150 mm were observed in various areas, reaching 300 mm in parts of Amazonas and Pará.

The data presented in figure 14, extracted from the Integrated Disaster Information System for the period from January 2025 to March 11, 2025, are continuously updated based on information sent by state Civil Defense agencies to the National Secretariat for Protection and Civil Defense (SEDEC).

It is noted that convective storms have the highest number of events in all regions except the Northeast, where drought predominates. Convective storms can be accompanied by strong winds and trigger floods, flash floods, and landslides, impacting the population in various ways.

In the South region, flash floods and floods are in second and third place, respectively. Among these events, the intense rain on January 16, 2025, stands out. In this episode, the eastern region of Santa Catarina was severely affected by rain, with the CEMADEN station in Balneário Camboriú recording a total of 197.8 mm.

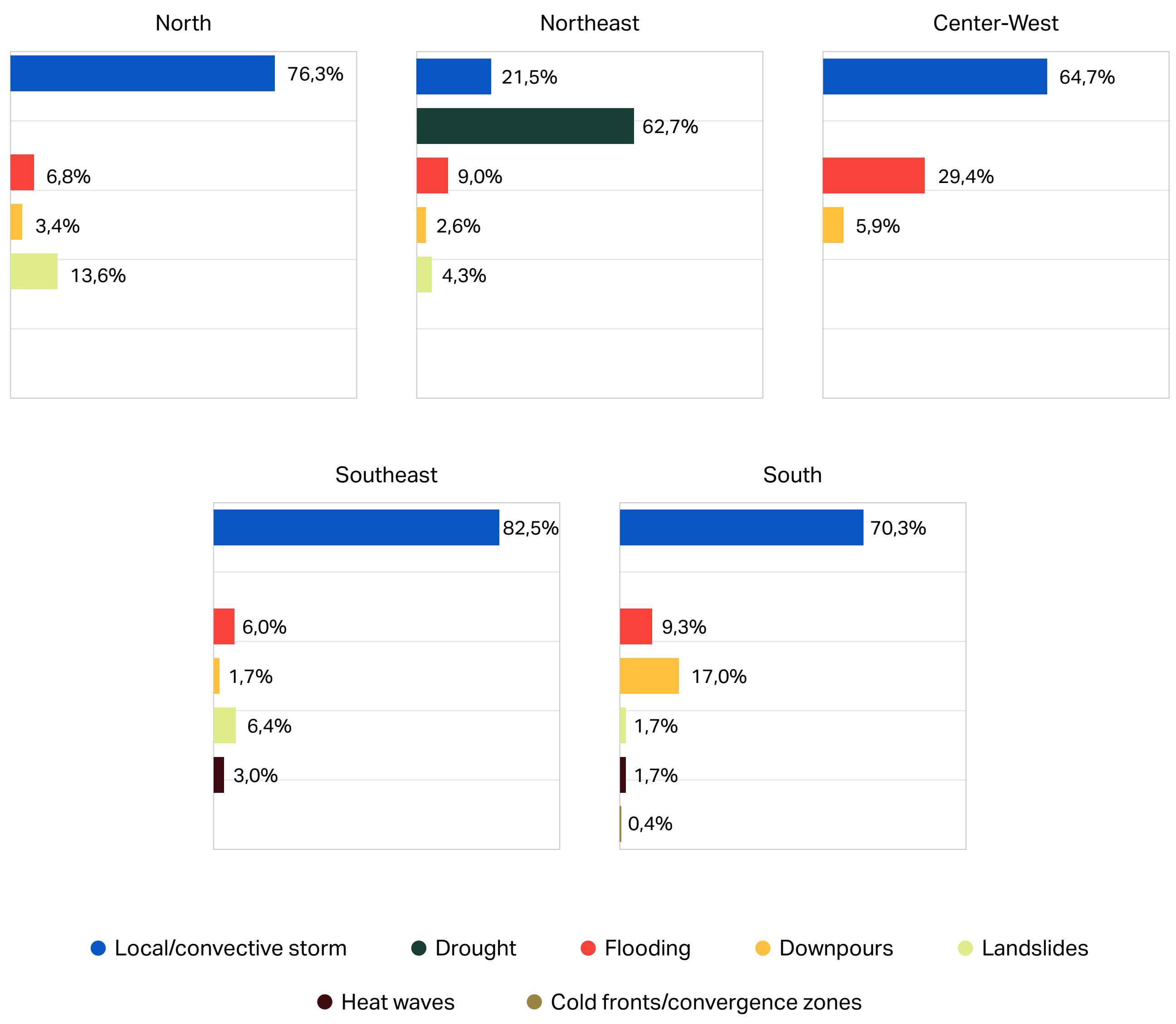
The high volume of precipitation caused widespread flooding and disruptions in several cities, such as Balneário Camboriú, Itapema, and Itajaí, with the latter recording 111.8 mm of rain on January 17.

Another notable case occurred in the city of São Paulo on January 24. The combination of factors such as strong daytime heating on the continent, cold air from an intensified anticyclone in the South and Southeast of Brazil, and the nearby oceanic cold front, favored the formation of rain clouds.

Local characteristics, such as proximity to the Serra do Mar, also contributed to the phenomenon. The Mirante de Santana station, located in the northern zone of the city, was the most affected, with a rainfall volume of 82 mm in just one hour and wind gusts of 64.8 km/h.

Meanwhile, the Interlagos station, in the southern zone, did not record any precipitation during the same period, demonstrating the intensity and localized nature of the rain. The storm resulted in 40 flood points, interruptions in metro lines, and 140,997 properties without electricity.

Figure 14 - Types of event by region (Source: Integrated Disaster Information System)



Other territories were also impacted by various extreme weather events at the beginning of this year. The fifth storm of the northern hemisphere winter season hit Ireland, the United Kingdom, and Norway in January 2025.

The explosive extratropical cyclone, named Éowyn by the Met Office Hadley Centre, the UK's national meteorological service, was the most intense system to hit Ireland since Hurricane Debbie in 1961.

In early March, the southern hemisphere also experienced significant storm extremes. The city of Bahía Blanca, in the province of Buenos Aires, Argentina, was struck by an extreme weather event associated with a cold front originating from an extratropical cyclone (figure 15).

This event was the worst ever recorded in the city, generating rainfall accumulations of more than 300 mm in less than a day, resulting in major damage and leaving over a hundred people missing and about a thousand homeless.

Almost simultaneously, Tropical Cyclone Alfred caused severe flooding in the states of Queensland and New South Wales, Australia, leading to strong coastal erosion due to wave impact.

These events caused severe flooding, turning streets into rivers, with numerous people stranded, mobilizing rescue teams to respond to emergency calls

Figure 15 - City of Bahía Blanca, Buenos Aires, Argentina (Source: Pablo Presti/AFP, O Globo)

The increasing frequency and intensity of extreme events, such as floods, inundations, and landslides, highlight the vulnerability of cities and the urgent need for mitigation and adaptation actions to climate change.

These events not only cause disruptions and damage to infrastructure but also generate significant socioeconomic losses, as well as social and environmental impacts.

Some studies point to the economic losses resulting from extreme events. For example, in the Metropolitan Region of Belo Horizonte, in 2020, the damages were estimated at around R$ 1.3 billion (Dalagnol et al., 2021).

In Petrópolis (RJ), the losses in 2022 reached R$ 200 million (Alcântara et al., 2023), while in 2024, in Rio Grande do Sul, the Inter-American Development Bank (IDB) calculated the flood damages at R$ 87 billion.

The fourth survey conducted by CNseg in September 2024 shows that insurance claims from customers exceeded R$ 6.0 billion, which corresponds to less than 10% of the economic loss estimated by the IDB.

These values reflect only the direct economic impacts, without considering the fatalities, the missing, and the homeless. The challenges posed by these increasingly frequent and intense phenomena make it even more urgent to strengthen and improve adaptation and mitigation strategies.

Climate forecast in Brazil

La Niña transition, anomalies in precipitation, and extreme temperature.

El Niño-Southern Oscillation (ENSO) Forecast

The National Oceanic and Atmospheric Administration (NOAA) confirmed the onset of a low-intensity La Niña on January 9, 2025, with the coldest anomalies recorded in the Equatorial Pacific.

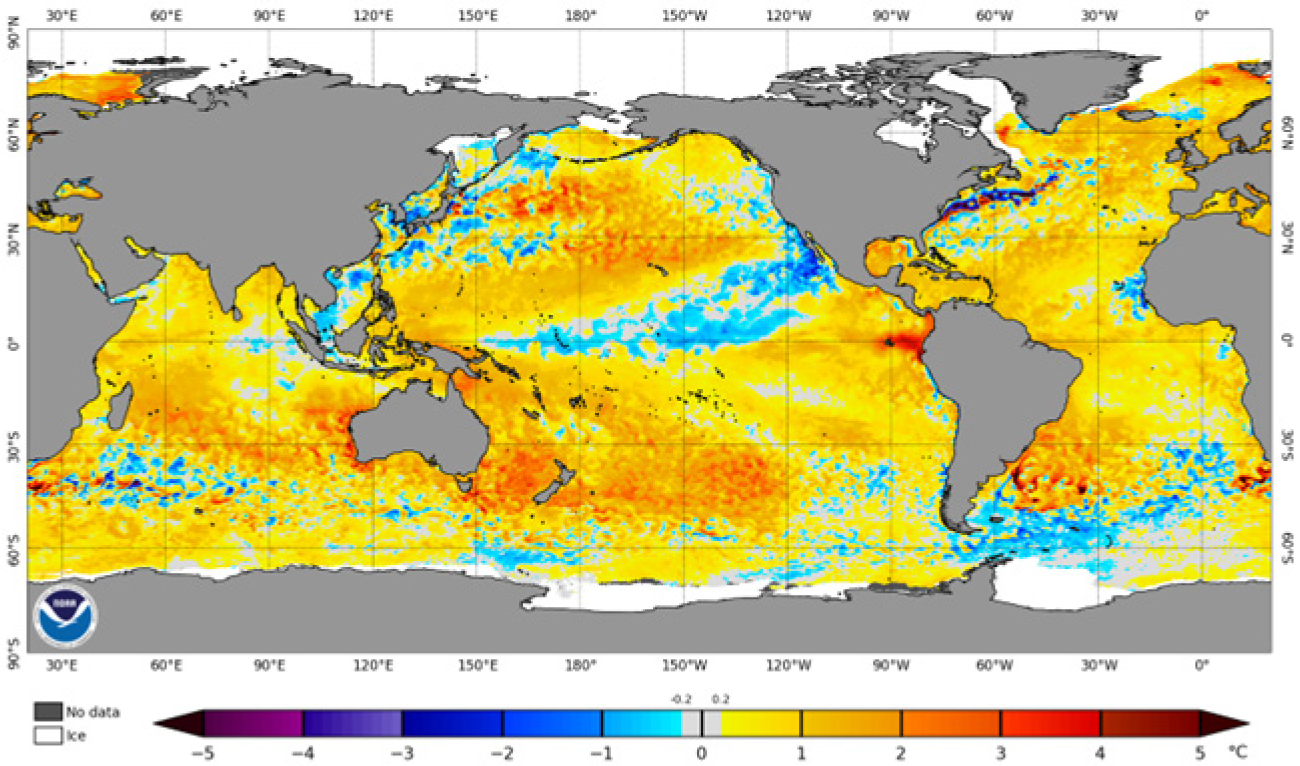
In February, warmer waters began to appear in the coastal region of South America, reducing the intensity of the negative anomalies. The latest record of above-average temperatures in this region was +1.6°C (figure 16).

La Niña is currently active. However, despite the return of rains in the Northeast and the reduction in the South, the impacts of La Niña in Brazil have been minimal.

NOAA's International Research Institute (IRI) multimodel projections indicate an increasing probability of transitioning from La Niña to a neutral phase between March and May 2025.

The probability that this neutrality will persist during the subsequent period, covering the months of June to August 2025, is estimated at 62%.

Figure 16 - Forecast of global ocean temperature anomalies - La Niña or El Niño
(Source: NOAA)



Retrospective of winters with similar ENSO (El Niño–Southern Oscillation) neutrality conditions in Brazil

Figure 19 maps illustrate the anomalies of minimum and maximum temperature (°C) and precipitation (mm/day) in Brazil during the winter (June, July, and August) of the years 2016, 2018, and 2021.

Despite all these periods being classified as neutral concerning the ENSO (El Niño–Southern Oscillation) phenomenon index, variations occurred in atmospheric patterns influenced by oceanic conditions preceding each winter.

In 2016, neutrality was preceded by an intense El Niño event at the beginning of the year, followed by a cooling of sea surface temperatures (SST) in the Pacific, resulting in a pattern of negative anomalies.

This year, maximum temperatures were above average in the North, Central-West, and Southeast, while the South Region showed contrasts.

In the autumn of 2016, Rio Grande do Sul recorded above-average precipitation, especially in March and April, but in winter, the situation reversed, with below-average rainfall in Rio Grande do Sul and western Santa Catarina, while Paraná, São Paulo, and Mato Grosso do Sul recorded above-average precipitation. Temperatures were predominantly warmer in the Central-North of the country.

In 2018, neutrality was characterized by higher sea surface temperatures, although still within the neutral ENSO state. This year showed a pattern similar to 2016, with above-average maximum temperatures prevailing in the North, Central-West, and Southeast. However, there was an exception in Rondônia, Acre, western Mato Grosso, and Mato Grosso do Sul, where negative temperature anomalies were recorded.

The winter of 2021, in turn, occurred in the transition from an intense La Niña episode to the neutral ENSO phase. This period was marked by above-average precipitation in northern Pará, Amazonas, Roraima, Amapá, and Ceará, while the South Region faced a drier pattern, with below-average rainfall in Rio Grande do Sul, Santa Catarina, and central-west Paraná.

Additionally, slightly dry conditions were observed in Mato Grosso do Sul, central-west Mato Grosso, São Paulo, central-south Minas Gerais, Rio de Janeiro, Espírito Santo, southern Goiás, Bahia, and the eastern strip of the Northeast. The period was marked by intense cold waves, including snow records in the mountain ranges of Rio Grande do Sul, Santa Catarina, and Paraná.

According to INMET, the city of São Paulo recorded low temperatures associated with the action of three intense cold air masses of subpolar origin, which caused widespread and consecutive frosts, even in the extreme north of São Paulo. On July 30, the minimum temperature in the capital reached 4.3°C, the lowest value recorded since June 2016, when the Mirante de Santana station recorded 3.5°C.

The winters of 2016, 2018, and 2021, all under ENSO neutrality conditions, illustrate how climate patterns can vary even without the influence of El Niño or La Niña. Each of these years presented distinct characteristics of temperature and precipitation in Brazil.

Above-average temperatures prevailed in the Central-North regions during the winters of 2016 and 2018. In contrast, the winter of 2021 was characterized by frequent cold air incursions, resulting in below-average temperatures in much of the country.

The graphs presented illustrate the impact of intense winters on the Brazilian agricultural market, based on data from IBGE and SUSEP. Figure 17 shows agricultural yield, calculated by the ratio between harvested area and planted area, while figure 18 highlights the loss ratio.

It is observed that the productivity of second-crop corn, for example, tends to decrease in all years of intense winter, which suffered an abrupt drop in 2016. During this year, severe drought resulted in a significant reduction in second-crop corn productivity.

Figure 17 - Yield (harvested area / planted area) of the agricultural market in years of severe winter (Source: IBGE)

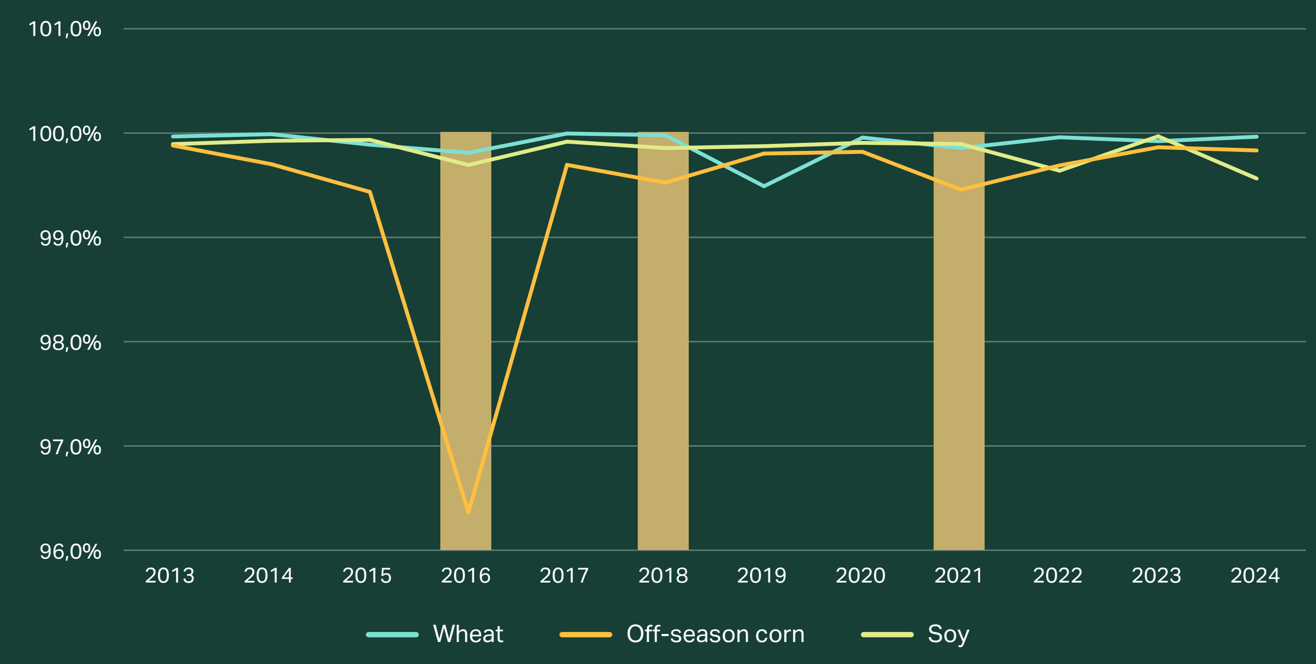


Figure 18 - Loss Ratio of the agricultural market in years of severe winter (Source: SUSEP)

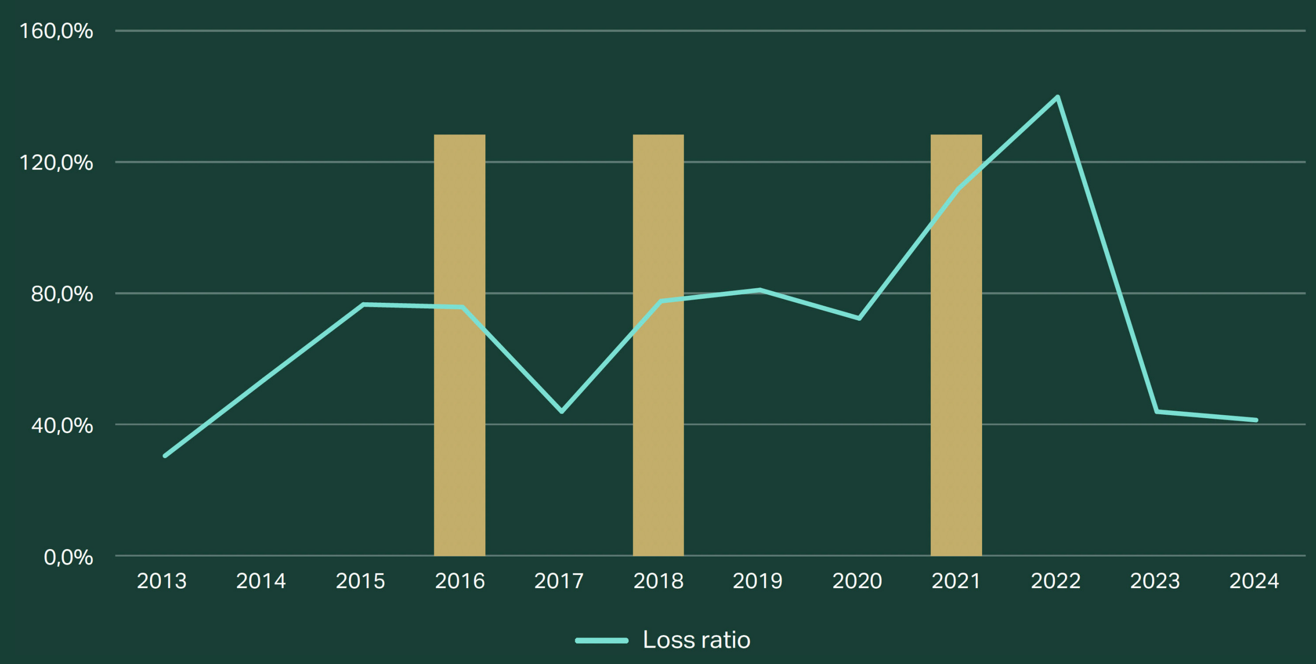
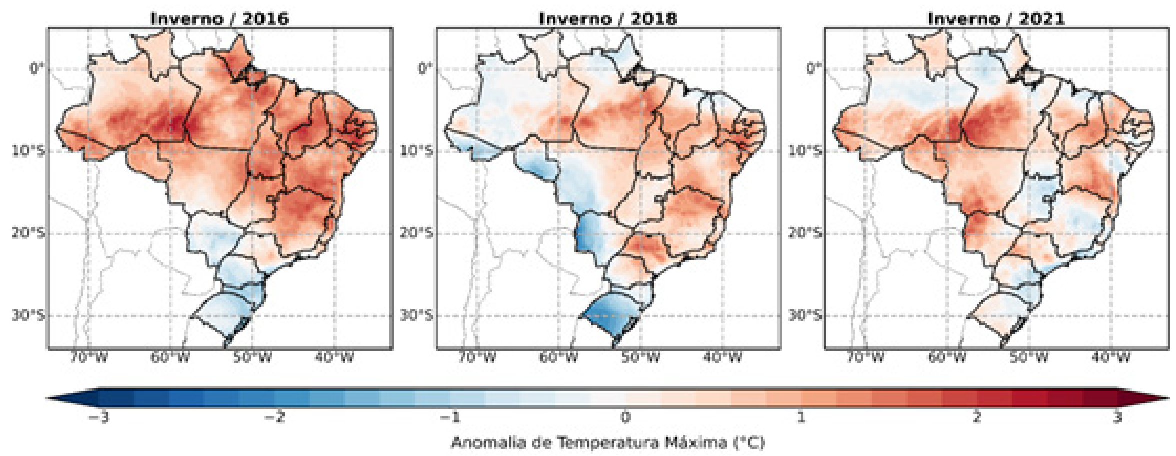
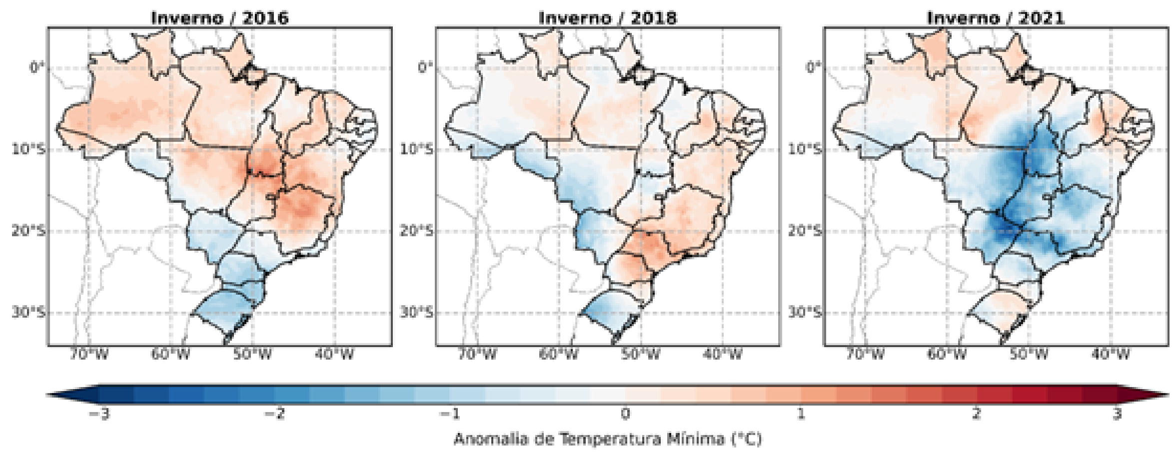


Figure 19 - Anomalies recorded in the winter of 2016, 2018, and 2021 - in relation to climatology between 1990 and 2020 (Source: ECMWF)

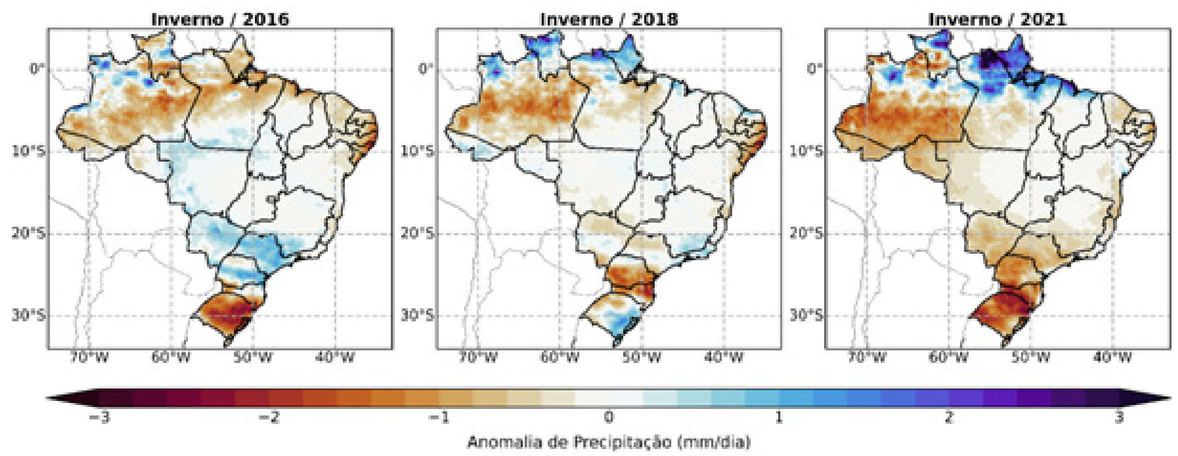
Maximum temperatures (°C)



Minimum temperatures (°C)



Precipitation (mm/day)



The precipitation anomalies forecasted by MIA Climate between April and June 2025 (figure 20) show alternating trends throughout the period, indicating that during the transition between autumn and winter, rainfall will increase between May and June, especially in the South and Northeast.

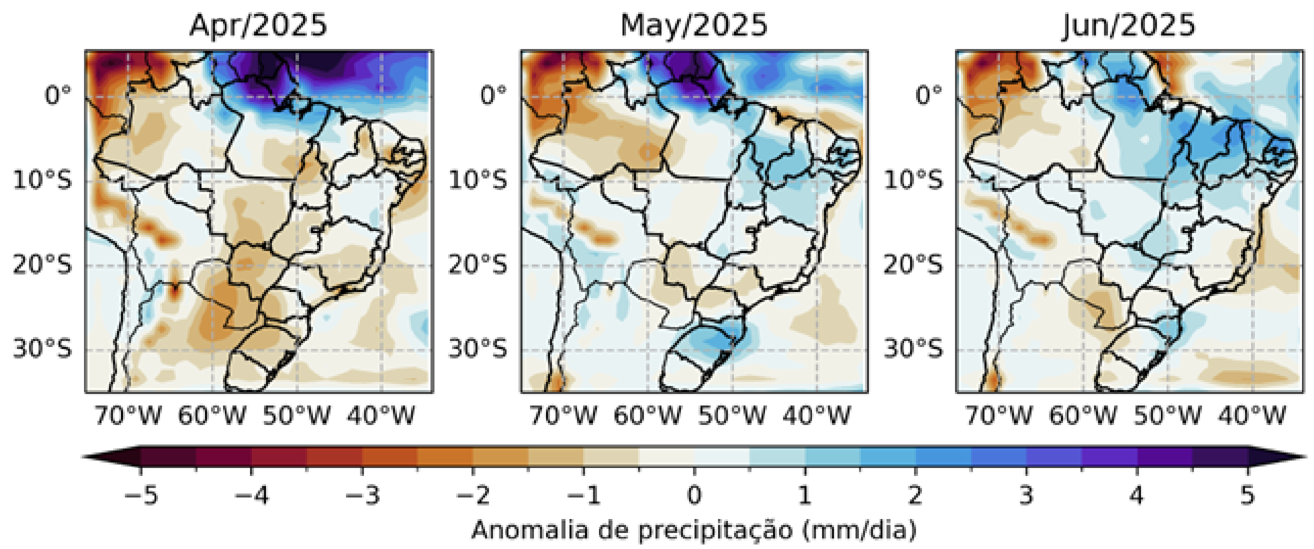
In April, the forecast is for below-average rainfall in the western part of the South region, Mato Grosso do Sul, and Mato Grosso. Goiás, southern Minas Gerais, and the eastern strip of São Paulo are also expected to record slightly below-average rainfall indices.

On the other hand, the North region will see an increase in precipitation, benefiting the water supply of the Amazon rivers and their tributaries, especially between Amapá and northern Pará.

In May, precipitation is expected to be above average in Rio Grande do Sul and Santa Catarina, with positive impacts, especially on water supply and soil stress reduction in western Rio Grande do Sul, an area severely affected by drought.

The Northeast is also expected to have above-average rainfall between May and June, while the Central-West will have precipitation within or slightly above the climatological average.

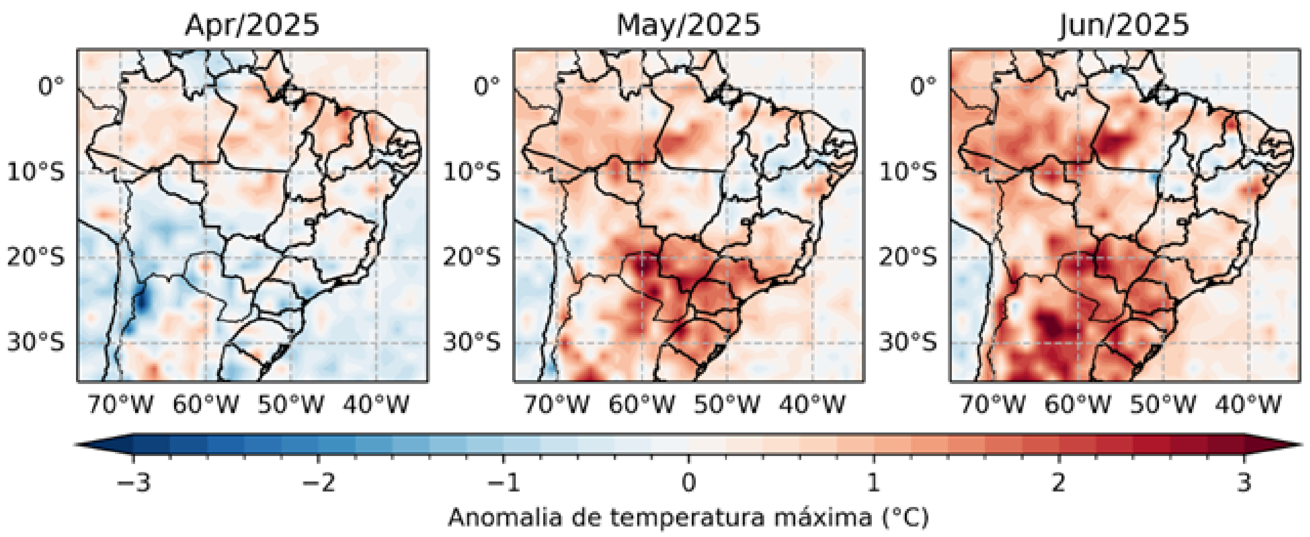
Figure 20 - Forecast for precipitation anomaly in Brazil, for the months of April to June 2025 (Source: MIA Climate)



Maximum temperatures in April will be slightly above average compared to climatology, especially in northern São Paulo, Minas Gerais, Mato Grosso, and the North region as a whole. This trend is more evident in Maranhão and Ceará (figure 21).

Between May and June, maximum temperature anomalies will intensify in much of the country, especially in western Mato Grosso do Sul and Rio Grande do Sul, with values that may range between 2.4°C and exceed 3°C compared to the climatological average for the period.

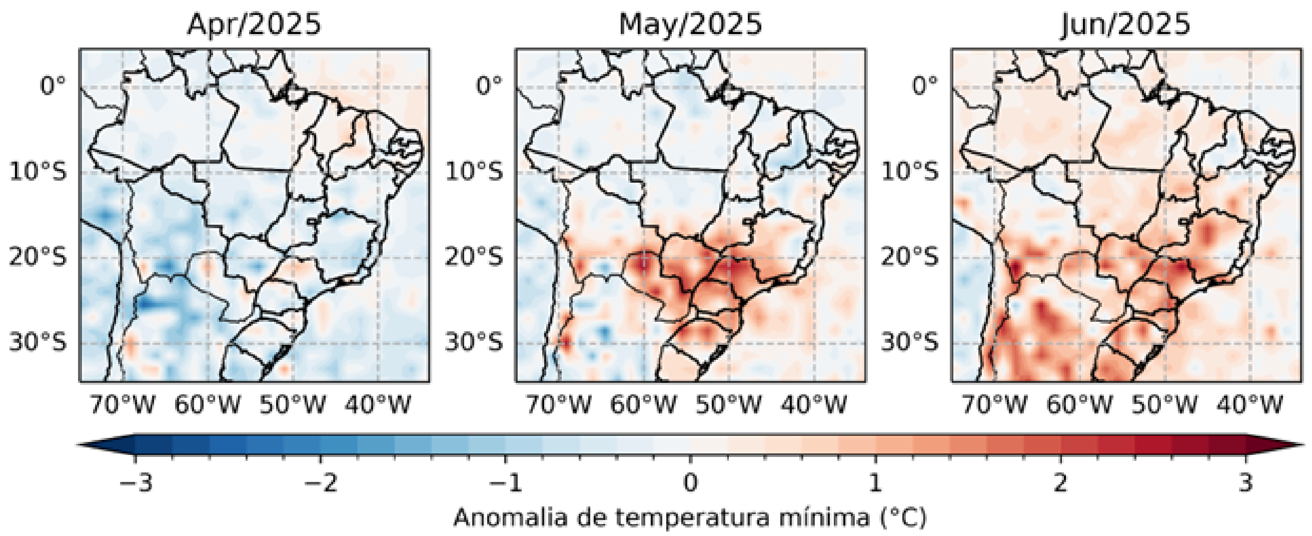
Figure 21- Forecast for maximum temperature anomalies in Brazil, for the months of April to June 2025 (Source: MIA Climate)



There is a greater signal of negative minimum temperature anomalies in April, in contrast to a greater tendency for above-average minimum temperatures between May and June (figure 22).

The scenario forecasted by MIA Climate indicates that between May and June, temperatures will be above average, especially in Mato Grosso do Sul, central-west São Paulo, and the western strip of southern Brazil. In the North region, minimum temperatures are expected to be slightly below average in May and above average in June.

Figure 22 - Forecast for minimum temperature anomalies in Brazil, for the months of April to June 2025 (Source: MIA Climate)



Projection of climate impacts for Brazil

Summary and highlights for the coming months: the autumn to winter transition and impacts on crops

The forecasts indicate a pattern similar to that observed in previous years when ENSO was neutral:

- Slightly below-average rainfall in the South and Central-West beginning in April/ within average between May and June;
- Above-average rainfall in the North, especially for Amapá and northern Pará;
- Above average rainfall in the Northeast between May and June.

Impact of climate on corn and soybean crops in Brazil

Climate conditions play an essential role in the development of agricultural crops in Brazil, especially for corn and soybeans, which are highly sensitive to variations in temperature and precipitation.

The patterns observed between January and March 2025 brought significant challenges for the maturation of the first crop in the South of the country, with more severe impacts in western Rio Grande do Sul.

Persistent heat waves resulted in thermal stress for the plants, impairing their growth and reducing productivity. Additionally, the lack of adequate rainfall compromised soil moisture, making nutrient absorption difficult and aggravating crop losses.

These adverse conditions also affected agricultural planning, making irrigation more complex and increasing the risk of crop failure. On the other hand, projections for the second corn crop (February to August 2025) point to distinct scenarios in different regions of the country

According to the risk analysis conducted by MeteoIA meteorologists, some areas present favorable conditions for cultivation, including southern Goiás, central and eastern Minas Gerais, northeastern Mato Grosso do Sul, and parts of Mato Grosso.

The evaluation considered various climatic factors, such as:

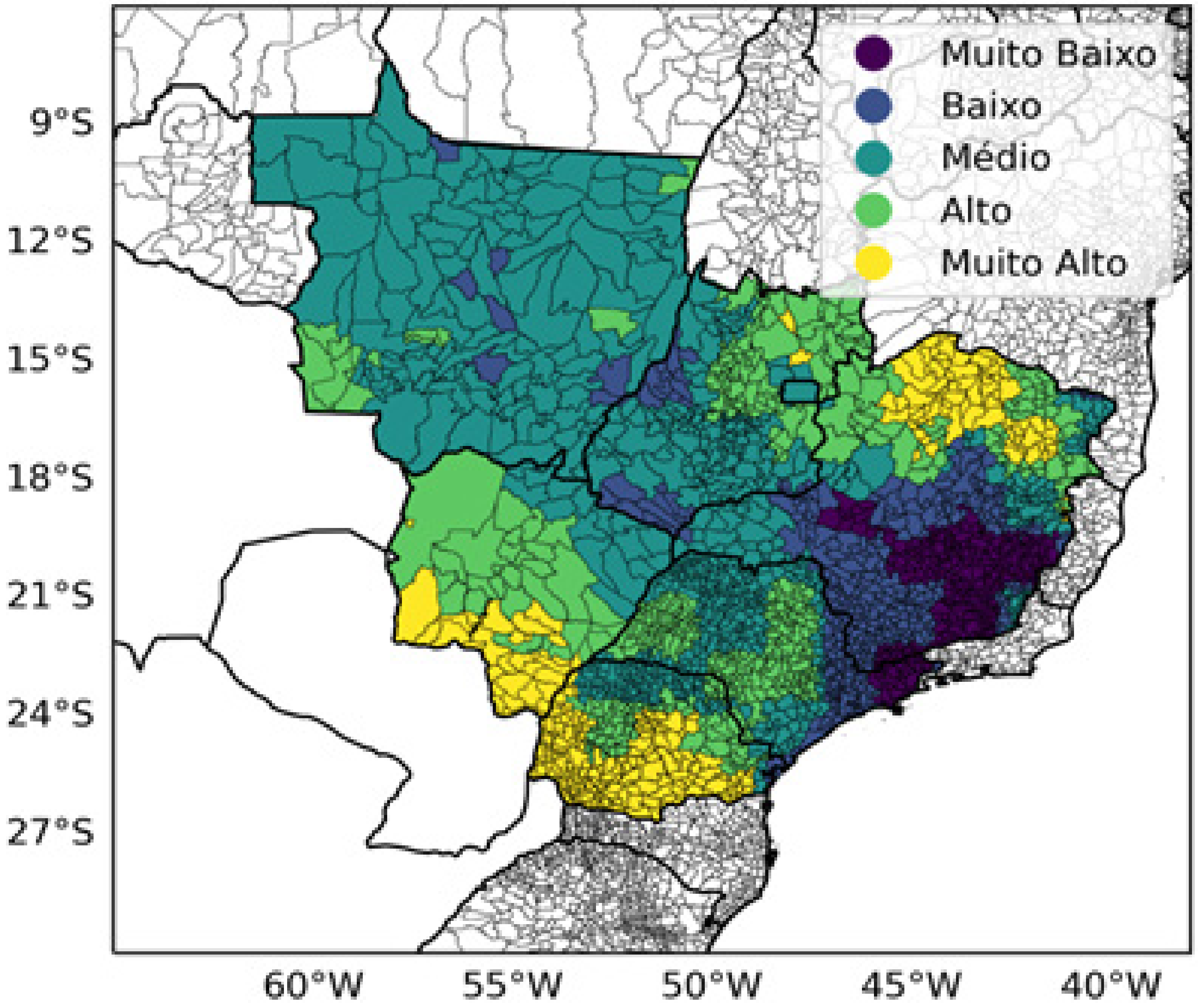
- Extreme rainfall (above 100 mm/day), which can negatively impact the crop;
- Water deficit (accumulated less than 600 mm during the crop period), hindering plant development;
- High temperatures (more than five days per month above 30°C), which can accelerate the crop cycle, reducing productivity;
- Low temperatures (more than five consecutive days below 10°C), which increase the risk of thermal stress;
- Strong winds (above 54 km/h), which can damage the crops.

The risk map (figure 23) highlights the areas most susceptible to second-crop corn failure in 2025 due to adverse climate conditions.

The regions at highest risk include central-south and western Paraná, southern and southwestern Mato Grosso do Sul, and northern Goiás and Minas Gerais.

This data shows that climate impacts can vary significantly by region. To mitigate risk and optimize adaptation, it is crucial for farmers to continuously monitor weather conditions.

Figure 23 - Spatial risk map for second-crop corn cultivation, between February and August 2025 (Source: MeteoAI, MIA Climate)



Climate impact and adaptation in Brazilian cities

The increase in thermal stress in urban areas is often linked to heat waves, characterized by temperatures above the climatic average for more than three consecutive days.

This phenomenon directly affects public health, productivity, and quality of life, impairing concentration, physical performance, and increasing the risk of dehydration and cardiovascular diseases.

In industrial environments, for example, excessive heat compromises worker safety and efficiency. To mitigate these impacts, measures such as expanding green areas, using reflective materials, and improving urban ventilation are essential.

Additionally, public policies focused on climate monitoring and city adaptation play a crucial role in reducing the effects of climate change.

The Universal Thermal Climate Index (UTCI) is calculated from meteorological data recorded at stations of the National Institute of Meteorology (INMET). This index considers environmental variables such as air temperature, relative humidity, wind speed, and solar radiation, allowing a precise estimate of the thermal stress to which individuals are subjected.

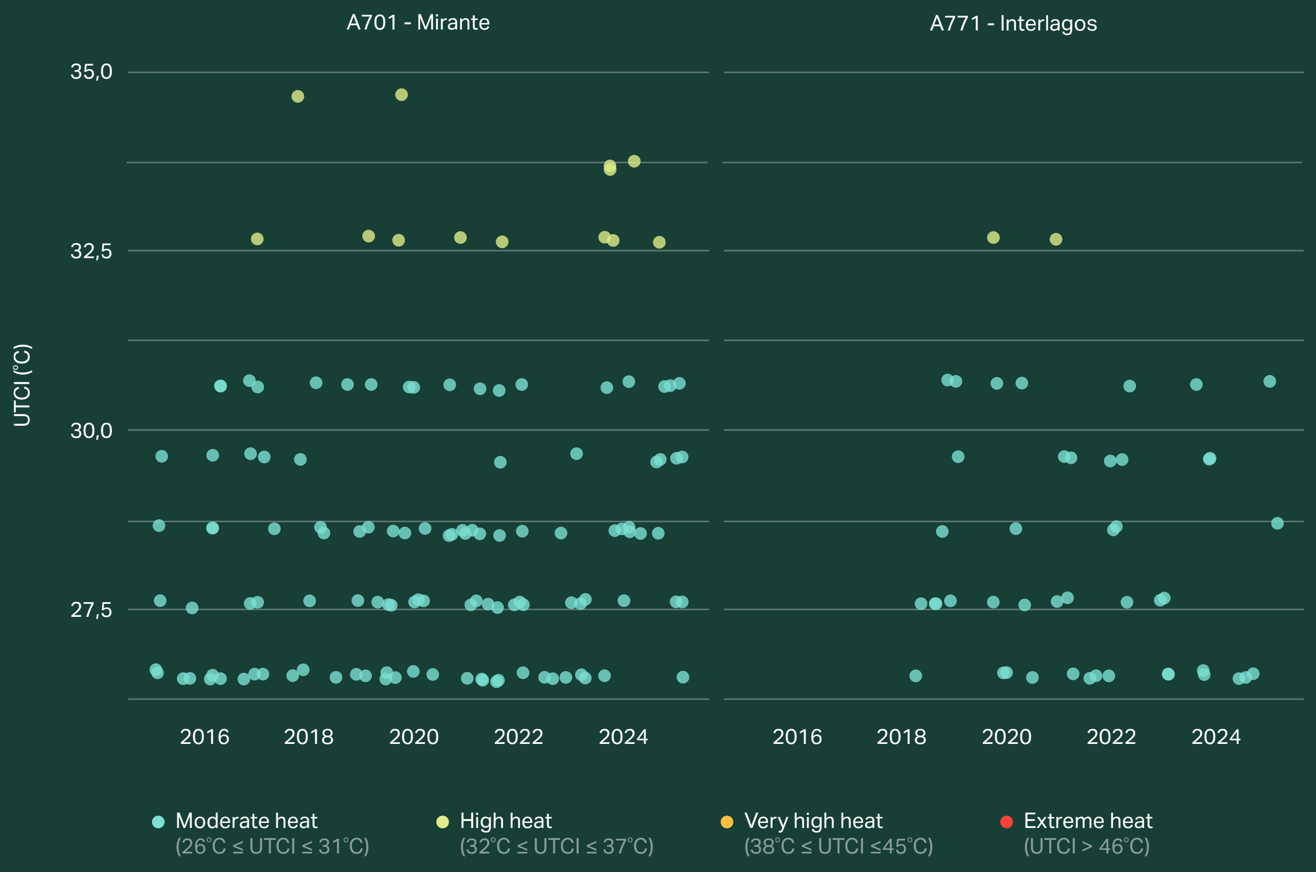
Figure 24 represents the distribution of thermal stress levels at two stations in São Paulo, in the south and north of the city respectively, “A771 - Interlagos” and “A701 - Mirante” from January 1, 2015, to February 28, 2025.

The results show a significant presence of periods of “Moderate Heat” (UTCI between 26 and 31°C) and “High Heat” (UTCI between 32 and 37°C), especially in recent years, indicating a progressive increase in thermal stress in São Paulo.

This phenomenon can be attributed to climate change and urban growth, which alter the microclimate due to the reduction of vegetation cover and the increase of impermeable surfaces, such as asphalt and concrete.

Although, so far, values above 38°C have not been recorded at these meteorological stations, the possibility of “Very High Heat” (UTCI between 38 and 45°C) and “Extreme Heat” (UTCI above 46°C) occurring in other locations, especially in areas with less vegetation and high building density, such as the city center, cannot be ruled out.

Figure 24- Thermal stress (UTCI) in São Paulo from January 1, 2015 to February 28, 2025 (Source: Howden, INMET)



The analysis of data from INMET stations demonstrates that thermal stress is a growing problem in the city of São Paulo, requiring effective urban adaptation measures. The implementation of nature-based solutions, combined with urban regulations that favor a more balanced microclimate, can mitigate the effects of high temperatures.

Continuing the calculations on UTCI in the city will allow a better understanding of the evolution of thermal stress experienced by the population in each neighborhood and will support measures to make urban centers more resilient to climate change. In the continuation of this study in upcoming reports, other major metropolises in Brazil (Rio de Janeiro, Brasília, Recife, Belo Horizonte, and Porto Alegre) will be addressed.

Definitions

Terms

Negative anomaly: when the analyzed variable is lower than the historical average for that period

Positive anomaly: when the analyzed variable is higher than the historical average for that period

Anticyclone: zone of high atmospheric pressure

Climatology: Historical average used for comparison (1990-2023)

ENSO: El Niño Southern Oscillation

LLJ: Low-Level Jets

SST: Sea Surface Temperature

SACZ: South Atlantic Convergence Zone

ITCZ: Intertropical Convergence Zone

Drought Criteria

Weak: entering drought - short-term dry spell reducing planting, crop growth, or pasture; exiting 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 water shortages developing or imminent; voluntary water use restrictions requested.

Severe: likely crop or pasture losses; common water shortages; imposed water restrictions.

Extreme: major crop/pasture losses; widespread water shortages or restrictions.

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

Heat Wave Criteria

A heat wave is considered when the temperature is 5°C above the monthly climatological average for at least 3 days.

Thermal Sensation

Involves the combination of radiation, air temperature, relative humidity, wind speed and direction, as well as the physical and metabolic characteristics of each individual; related to the sensation of higher temperatures than the environment when conditions are high temperatures, high relative humidity, and low wind, or the sensation of lower temperatures than the environment in low temperatures, high relative humidity, and low wind.

Thermal stress

Condition in which an organism suffers damage or dysfunction due to exposure to extreme temperatures.

References

Alcântara, E.; Marengo, J. A.; Mantovani, J.; Londe, L. R.; San, R. L. Y.; Park, E.; Lin, Y. N.; Wang, J.; Mendes, T.; Cunha, A. P.; Pampuch, L.; Seluchi, M.; Simões, S.; Cuartas, L. A.; Gonçalves, D.; Massi, K.; Alvalá, R.; Moraes, O.; Filho, C. S.; Mendes, R.; Nobre, C. (2023) Deadly disasters in southeastern South America: flash floods and landslides of February 2022 in Petrópolis, Rio de Janeiro. Natural Hazards and Earth System Sciences, v. 23.

Blazejczyk, K., Epstein, Y., Jendritzky, G., Staiger, H., & Tinz, B. (2012). Comparison of UTCI to selected thermal indices. International Journal of Biometeorology, 56(3), 515-535.

Carvalho, L. M. V. de, Jones, C., Liebmann, B. (2004). The South Atlantic convergence zone: Intensity, form, persistence, and relationships with intraseasonal to interannual activity and extreme rainfall. Journal of Climate, v. 17.

Dalagnol, R.; Gramcianinov, C. B. Crespo, N. M.; Luiz, R.; Chiquetto, J. B.; Marques, M. T. A.; Neto, G. D.; Abreu, R. C.; LI, S.; Lott, F. C.; Anderson, L. O.; Sparrow, S. (2021) Extreme rainfall and its impacts in the Brazilian Minas Gerais state in January 2020: Can we blame climate change?. Climate Resilience and Sustainability. v. 1.

Jiang, S., Lee, X., Wang, J., Wang, K. (2019) Amplified Urban Heat Islands during Heat Wave Periods. JGR Atmospheres, v. 124.

Kang, Y., Park, J., Jang, D. (2024) Compound impact of heatwaves on vulnerable groups considering age, income, and disability. Scientific Reports, v. 14.

Lemes, M. R., Sampaio, G., Garcia-Carreras, L., Fisch, G., Alves, L. M., Bassett, R., Betts, R., Maksic, J., Shimizu, M. H., Torres, R. R., Guatura, M., Basso L. S., Bispo, P. C. (2023) Impacts on South America moisture transport under Amazon deforestation and 2 °C global warming. Science of The Total Environment, v. 905.

Marengo, J. A. (2008) Água e mudanças climáticas. Estudos avançados, V. 22.

Marengo, J. A., Espinoza, J. C., Fu, R., Jimenez Muñoz, J. C., Alves, L. M., Da Rocha, H. R., & Schöngart, J. (2024). Long-term variability, extremes and changes in temperature and hydrometeorology in the Amazon region: A review. Acta Amazonica, 54(spe1), e54es22098.

Marengo, J. A., Tomasella, J., Alves, L. M., Soares, W. R., & Rodriguez, D. A. (2011) The drought of 2010 in the context of historical droughts in the Amazon region. Geophysical research letters, 38(12).

Santos, F. F., Gomes, H. B., da Silva, M. C. L., Silva, F. D. S., Morais, A. C. (2024). Tendências de ondas de calor e secas no Nordeste do Brasil e seus impactos na produção de cana-de-açúcar, milho e soja. Revista de Gestão Social e Ambiental, v. 18.

Serviço Geológico do Brasil (SGB). Monitoramento do Serviço Geológico do Brasil ajuda a antecipar e enfrentar eventos extremos. 11 de outubro de 2024. Disponível em: https://www.sgb.gov.br/w/monitoramento-do-servico-geologico-do-brasil-ajuda-a-antecipar-e-enfrentar-eventos-extremos-. Acesso em: março de 2025.

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

Let's start another great partnership.

Contact our team today to learn more about how we can help your business.

W howdenre.com
E report.brasil@howdenre.com