Ponta Negra Beach in Manaus - 21st October 2023
Source: Jonas Gomes da Silva

Article on the Brazilian Amazon Region

Climate effects: floods, droughts, heat and smoke

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Manaus city faces once again the effects of climate change with another historic drought, hot and smoky days, with air quality at levels harmful to health. The article presents statistics on our droughts and floods, aggravating human actions and invites the reader to learn about possible locations of heat sources that are making the air unbreathable in the Amazon capital.

In recent years, the population living in Amazonas has witnessed severe climatic events, suffering from predatory human actions, as well as the effects of floods or droughts.

From a long-term historical perspective, if we analyze the values of each maximum level (flood) and minimum level (ebb) of the Rio Negro measured since 1902 until today by the Manaus Port team <https://tinyurl.com/3w4uwh3t\>, we will arrive at the following numbers:

a) The mean and median maximum levels are 27.93m (population standard deviation Sp = 1.16) and 28.11m (Sp = 1.88), respectively.

b) Regarding flood behaviour, the highest average level occurred in the most recent decades, 2010 and 2020, with 28.90 and 29.43 metres, respectively.

So far, 2021 registered the highest historical flood level of the Rio Negro (30.02m). After 2021, the ten biggest floods were in 2012 (29.97m), 2009 (29.77m), 2022 (29.75m), 1953 (29.69m), 2015 (29.66m), 1976 (29.61m), 2014 (29.5m) and 2019 (29.42m).

There was an overall increasing trend in the average level over the period, with some fluctuations. The average levels in the 2010s (2010 to 2019) are almost one metre (0.97m) above the overall average and are about 1.24 metres higher than at the beginning of the 20th century.

And apparently, we will have more severe floods ahead, as the average (29.43m) of the initial years of the 2020s (2020, 2021 and 2022) is 1.49m above the overall average, as well as 0.53 metres above the 2010s average and 1.76m above the 1900s. Thus, the higher levels in recent decades suggest that climate change impacts on our region may be occurring, with more rainfall in the Amazon basin leading to higher levels of the Rio Negro.

c) Regarding drought behaviour, the lowest minimum level occurred in the most recent decade, 2020, with an average of 16.23 metres, about 1.38 metres below the overall average (17.6m) and 0.27 metres below the 1900s (16.5m), whose period was the second lowest average over the decades.

So far, 2023 recorded the lowest historical ebb level of the river (12.7m) and after 2023, the ten biggest droughts were in 2010 (13.63m), 1963 (13.64m), 1906 (14.2m), 1997 (14.34m), 1916 (14.42m), 1926 (14.54), 1958 (14.74), 2005 (14.75m), 1936 (19.97m) and 1998 (15.03m).

The highest minimum level occurred in the 1970s, reaching 19.80 metres. After the peak in 1970, there was an overall downward trend in minimum levels in subsequent decades, culminating in the very low levels of 2020.

The difference between the 1970 peak and the 2020 minimum is more than 3 metres in the river's minimum level. This highlights how severe the recent droughts have been.

In the case of droughts, there is no clear long-term trend pattern in average minimum levels as there is for the case of average maximum flood levels. But the sharp decline since 1970 to 2020 suggests a worsening of droughts in the region.

c) in the years of the 2010s and 2020s, extreme floods of the Rio Negro have occurred more frequently, with 8 of the eleven biggest floods happening between 2009 and 2022. This reinforces the thesis that exceptional floods are becoming more common. In the same period, there were 3 of the eleven biggest droughts, two of which (2023 and 2010) were the worst ebbs throughout the records.

In the last 20 years there have been events of both extreme flooding and intense drought. This demonstrates a tendency towards more pronounced irregularity in the basin's water regime.

We know that floods and droughts are phenomena that have been happening for millennia, but we must stop blaming only El Niño, as there are factors related to human action that can worsen floods and droughts, such as:

F1) Irrational deforestation: deforestation reduces the absorption of rainwater by the soil, increasing surface runoff and river flow during rains, worsening floods. In addition, deforestation decreases soil moisture, generating high levels of thermal discomfort and air pollution, which end up exacerbating dry periods.

F2) Unplanned urbanization: our city and its surroundings are expanding in a disorderly way, without sustainable urban planning. From small to large enterprises, we see the cutting down of trees, being replaced by a lot of concrete and asphalt, generating impervious areas that prevent water infiltration into the soil, increasing surface runoff and flooding peaks.

F3) Incorrect waste disposal: pollution of streets and, consequently, rivers, poses risks in both floods and droughts.

F4) Dams and impoundments: can alter the water regime of rivers, sometimes worsening downstream flooding during rainy periods.

F5) Burning: the burning of vegetation, for the most diverse purposes (charcoal production, clearing land for livestock or agriculture, renewing pastures, timber extraction, land speculation, preparation of illicit crops, expelling animals or traditional populations, etc), licit or illicit, helps to unbalance the regional hydrological cycle, as well as increase air pollution.

F6) Mining: the removal of vegetation and topsoil during mineral exploration increases erosion. This results in increased silting of rivers during the rains, which can worsen floods. In addition, large volumes of water are used in some types of mining, which can reduce the flow of rivers in a basin, affecting drought.

In conclusion, there is a tendency for an increase in extreme flooding and worsening of historical droughts in the Manaus region in recent decades. In addition to natural climatic factors, the text points to various human actions that are contributing to intensifying these phenomena, such as deforestation, disorderly urbanization, pollution and burning. Given this alarming scenario, it is urgent that society, governments and economic sectors adopt long-term sustainable planning, based on green solutions, energy efficiency, recycling, and mitigation of climate change effects.

Finally, readers are invited to follow the upcoming articles, which will exclusively reveal the possible source locations of the smoke worsening air quality in Manaus during droughts.