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Simpósio Internacional de Ciências Virtual 2024

Clube de Ciências Minas Gerais
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"The strong El Niño tells the story of arbovirus epidemics in Brazil and in the carioca capital."

The objective of this study is to conduct a comprehensive review of data and literature regarding arboviruses in Brazil over the last decade, with a specific focus on epidemics of dengue, Zika, and chikungunya.

We aim to correlate these epidemics with strong El Niño events occurring in 2015/2016 and 2023/2024.

Arboviruses are diseases transmitted by the *Aedes aegypti* mosquito and have become a major public health problem worldwide, with dengue being the most significant in the Americas.

In Brazil, these urban diseases are part of a complex epidemiological scenario, with all four serotypes of the dengue virus circulating simultaneously, along with the Chikungunya virus (CHIKV) since 2014 and the Zika virus (ZIKV) since 2015.

QUESTION AND HYPOTHESYS

Figure 1.: Is the mosquito *Aedes Aegypti* our new pet?

QUESTION

" Does the occurrence of strong El Niño events in the last decade influence arbovirus epidemics in Brazil?"

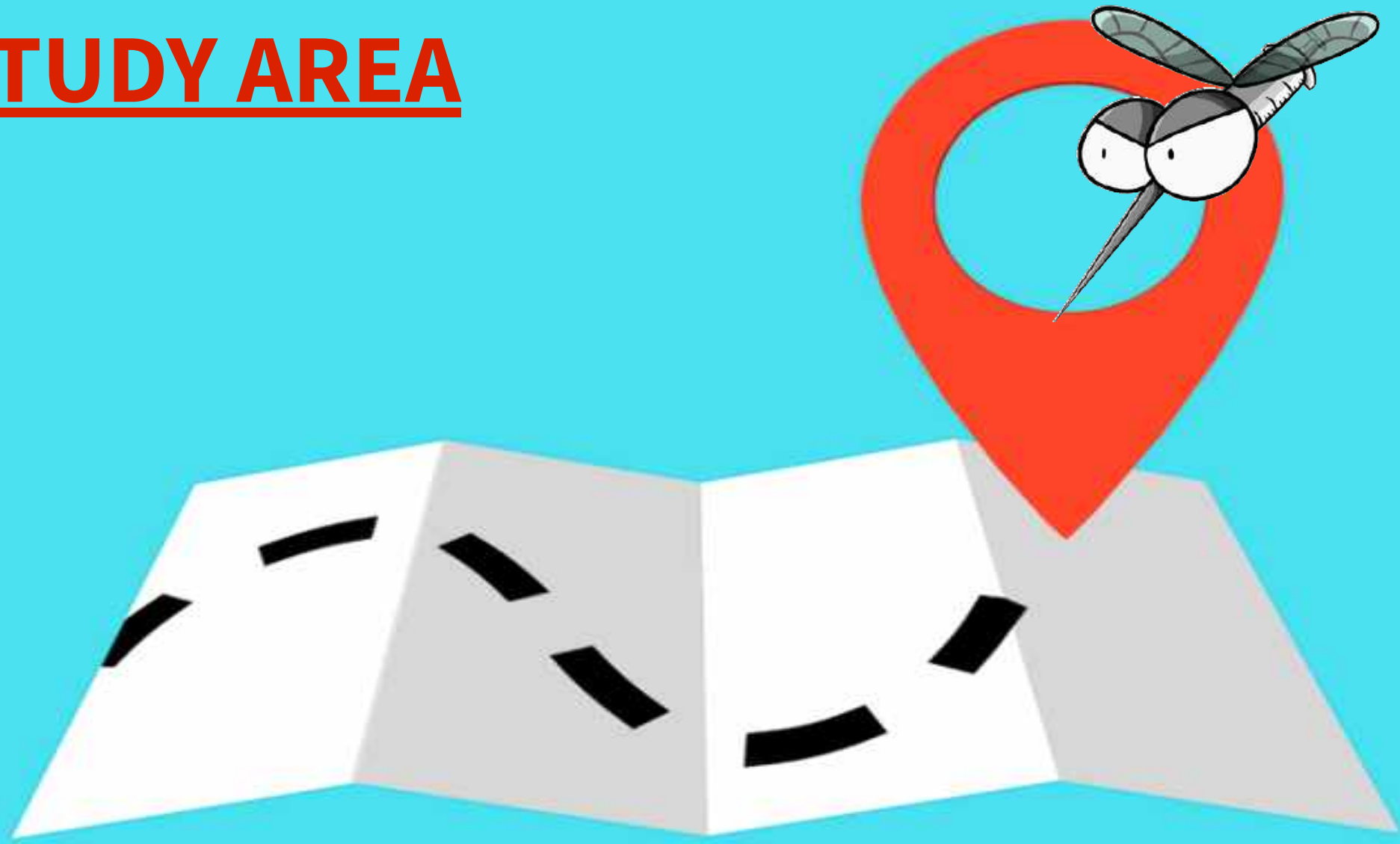
HYPOTHESIS

Because strong El Niño events in the last decade are associated with extreme weather events in regions of Brazil, leading to changes in temperature and precipitation patterns, they can create favorable conditions for increased mosquito proliferation, such as the *Aedes aegypti*, responsible for transmitting arboviruses and causes epidemic outbreaks.

The methodology applied in the research consisted of:

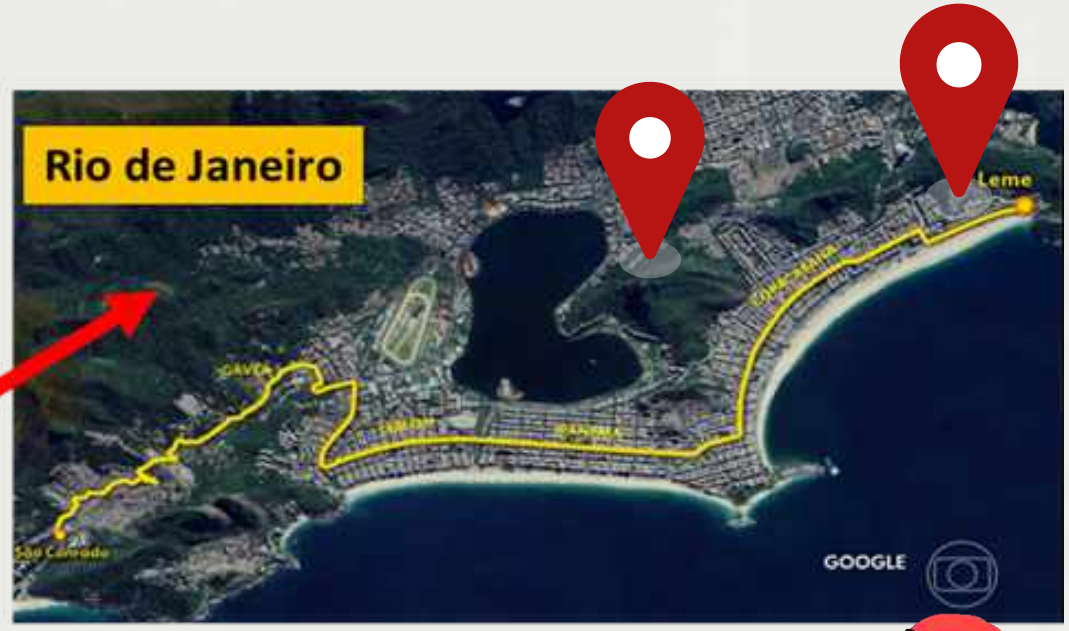
- **Literature review of arbovirus epidemics in Brazil, their durations, and the relationship with strong El Niño.**
- **Characterization of the study area in investigating breeding sites and the type of artificial breeding site - mosquito larval traps.**
- **Data analysis over a decade compiled from the GLOBE OBSERVER (MHM) application and visualization of data from the GLOBE platform (atmosphere and hydrology protocols).**

STUDY AREA



STUDY AREA


BRASIL
Image Landsat / Copernicus
© 2019 Google
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO


Rio de Janeiro
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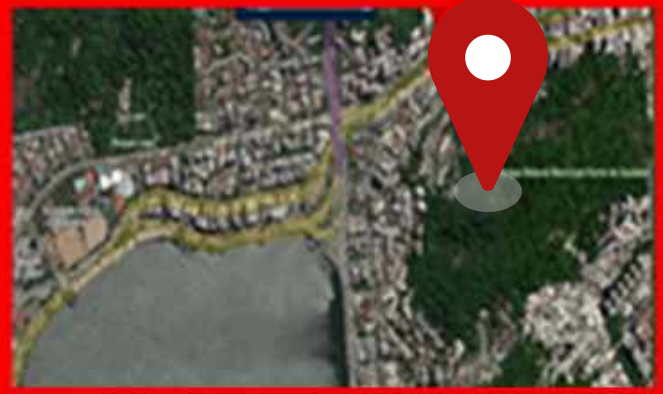
STUDY AREA

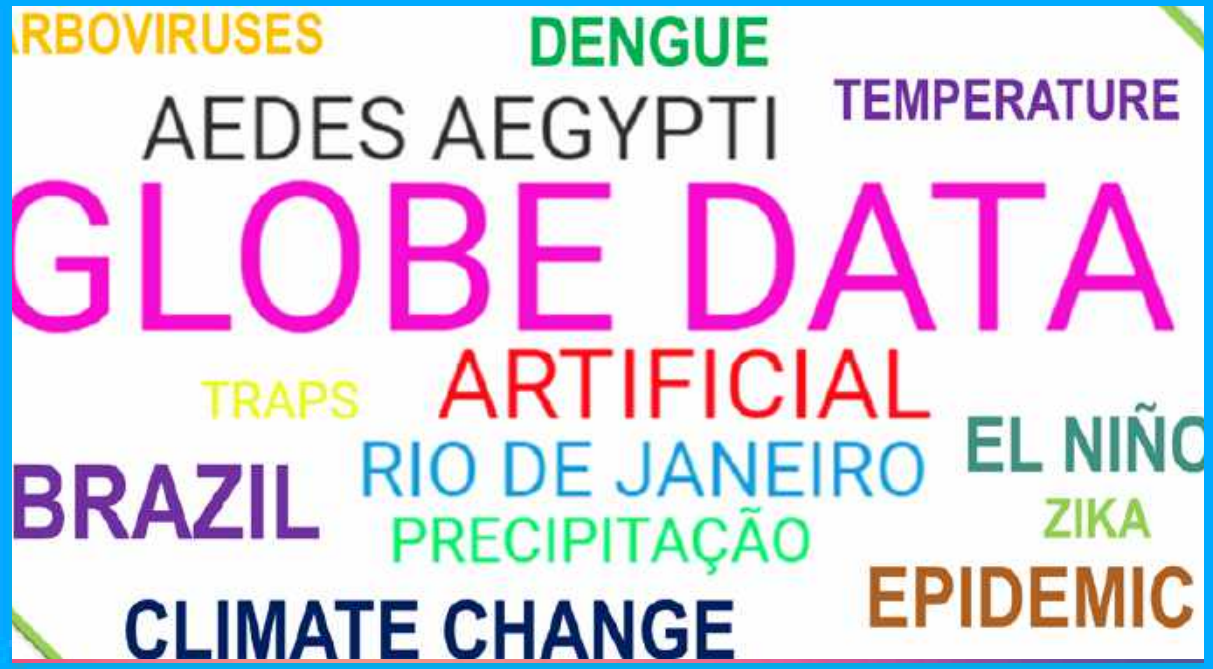
Study area, in Rio de Janeiro – Humaitá

Rio de Janeiro, the city where Minas Gerais Science Club is located has a latitude of 22°57'S, and a longitude of 43°11'W. The capital of the state has an estimated population of 6.748 million inhabitants, and is considered a megalopolis, a city primarily for housing, commerce and tourism, and is located between the mountains and the Atlantic Ocean.

Rio de Janeiro is part of the Southeast Region of Brazil, inserted in the Atlantic Forest biome, which is the most endangered forest in the country, with only 12.5% of its area preserved. The climate of the city is predominantly humid tropical, influenced by the moist air masses coming from the Atlantic Ocean. Its average temperatures and air humidity are high throughout the year and the rains are regular and well distributed.



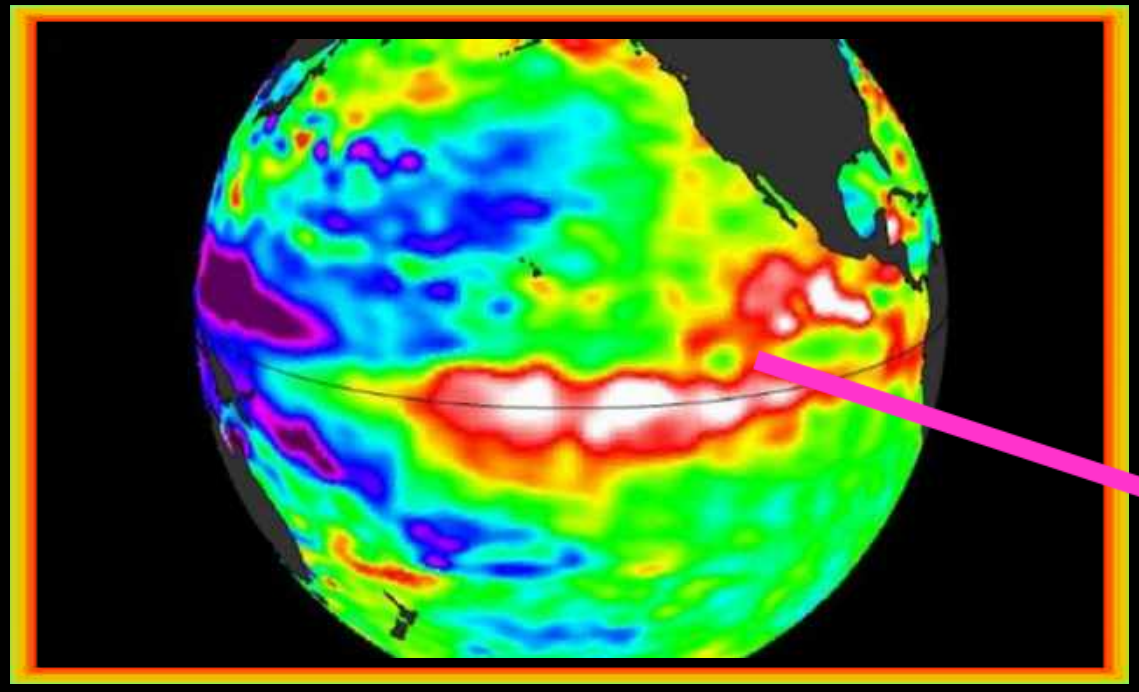
After the data collection phase, an analysis and interpretation of the results were carried out through comparative graphs, spreadsheets, and research on websites such as FIOCRUZ and NASA, as well as disease incidence reports from the Municipal Health Department.



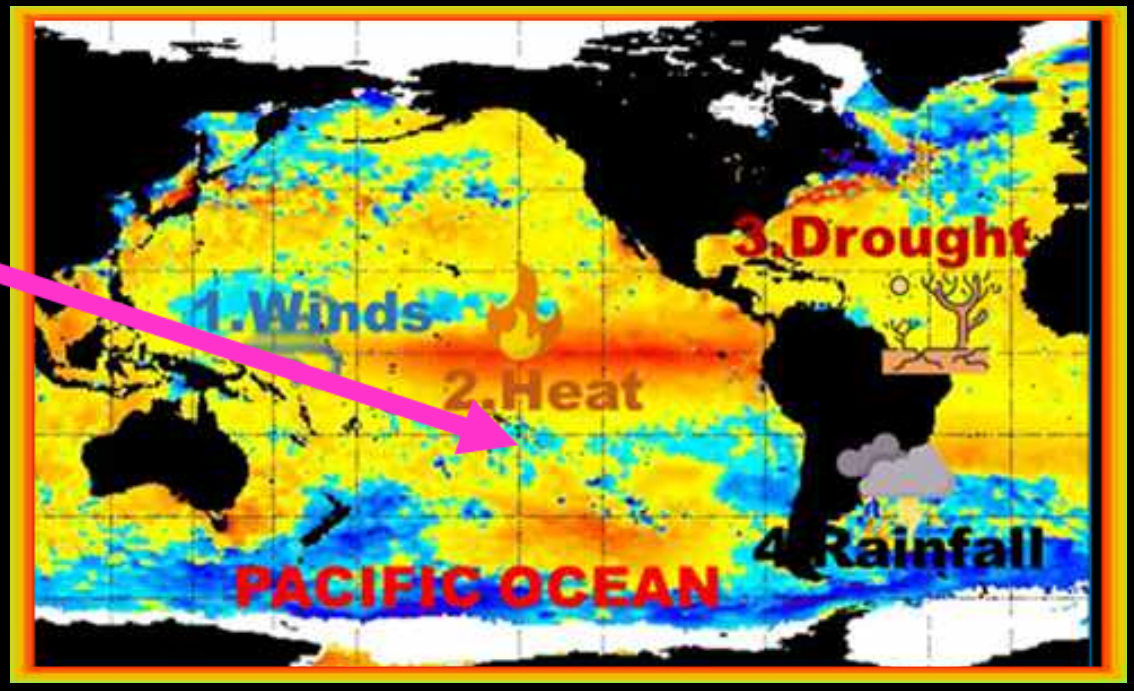
The research was conducted using data collected from December 2015 to February 2016 and from December 2023 to February 2024 (during the Strong El Niño cycle)


DATA
COLLECTION

EL NIÑO IN BRAZIL 2015/2016

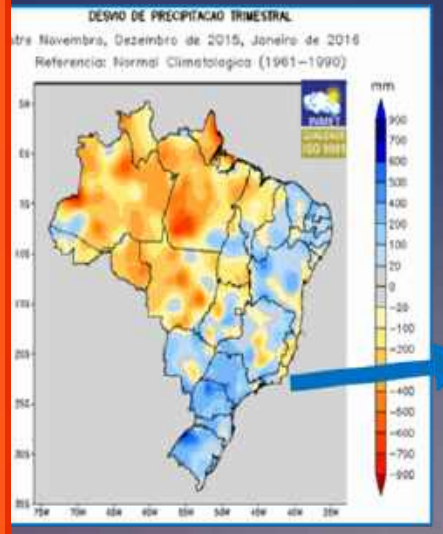


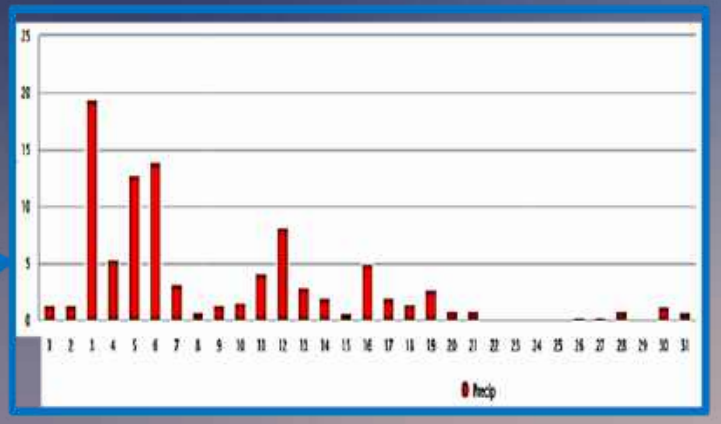
With the approach of summer and in a year marked by El Niño, attention to climate forecasts has intensified.

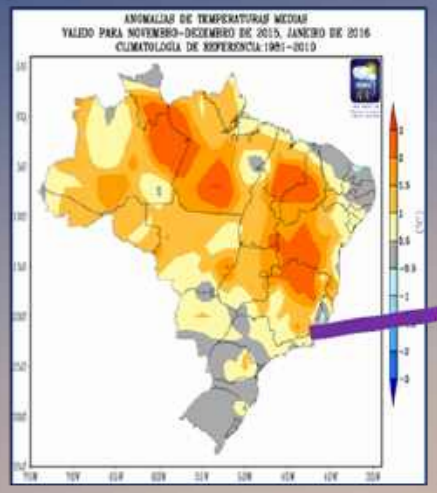


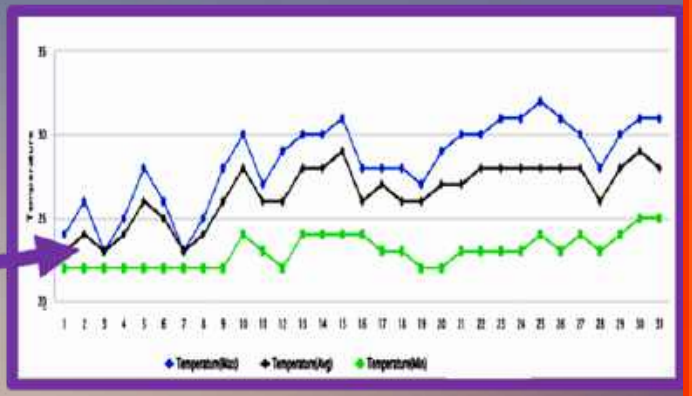
The 2015/2016 phenomenon, considered one of the strongest of all time, has been identified as the primary influencer of weather patterns in South America, potentially resulting in frequent rainfall and flooding in some parts of Brazil and droghts in others during this season.

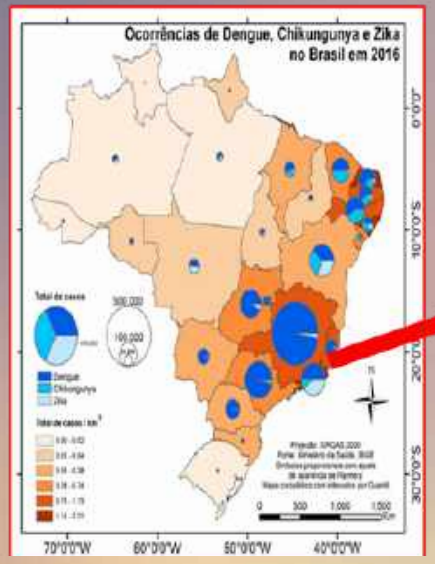
Precipitation, temperature, and arbovirus case index in the city of Rio de Janeiro in 2015/2016, during a period of strong El Niño.

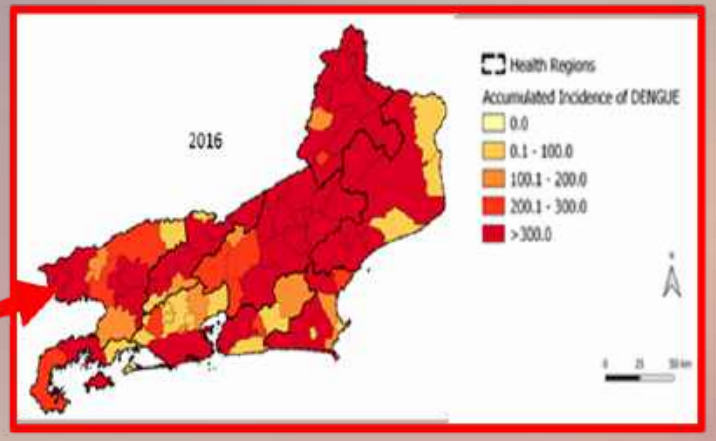






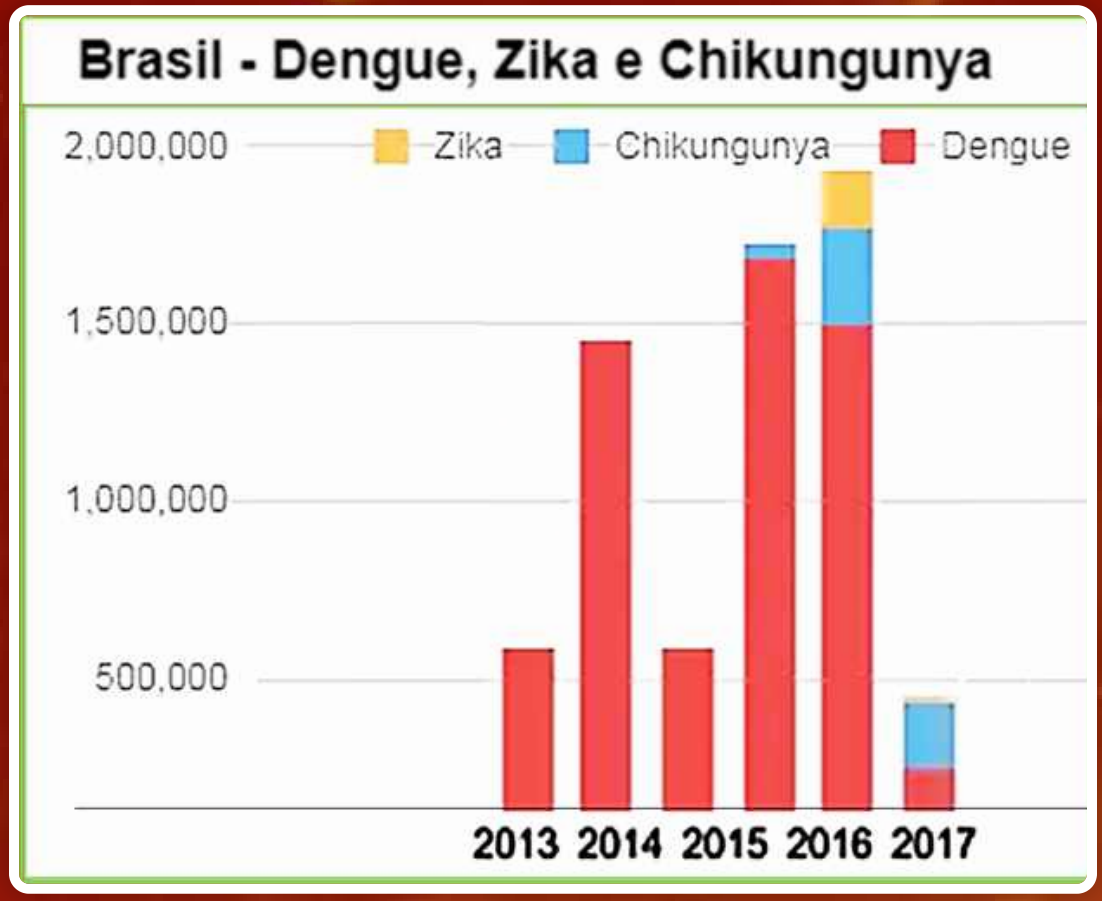


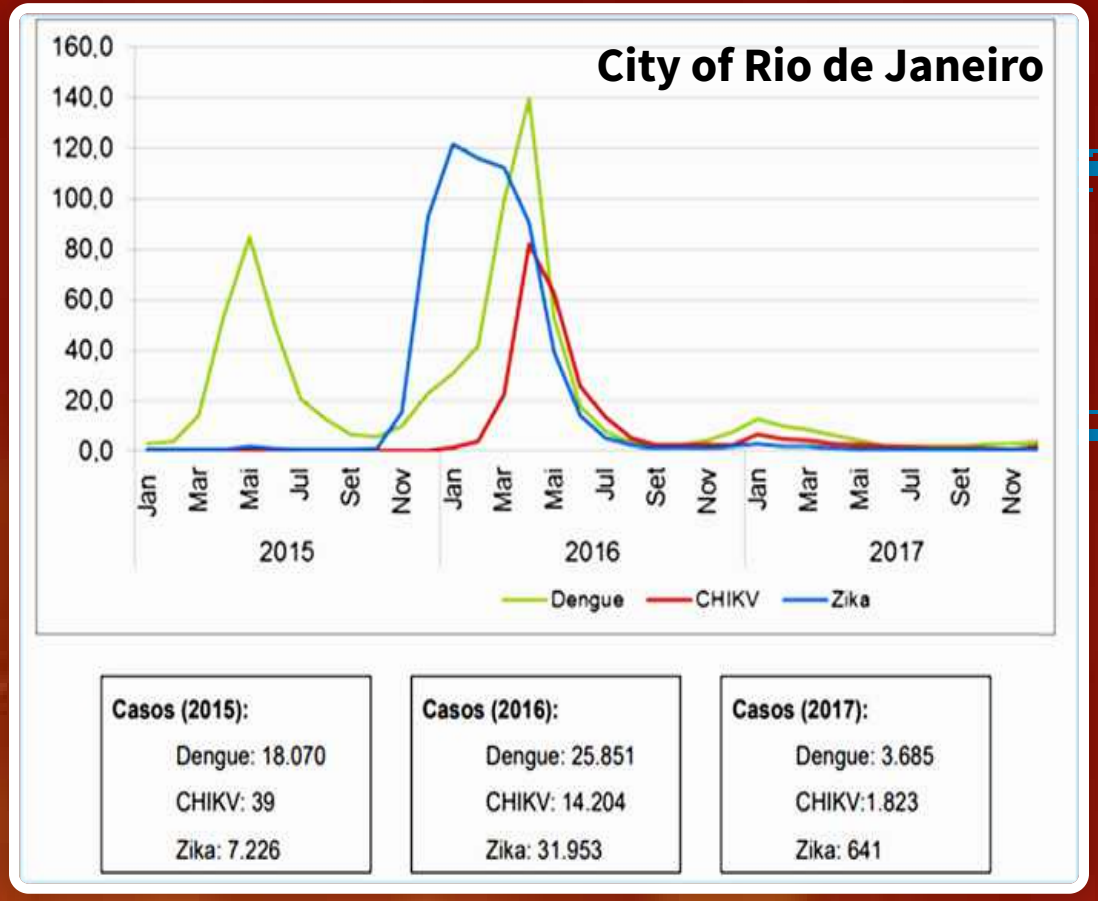




DATA SUMMARY AND ANALYSIS

The spread of Dengue, Zika, and Chikungunya in Brazil and Rio de Janeiro - 2015/2016 Arboviruses Epidemic





The figure at right size allows for examining the monthly incidence rates of the three arboviruses in the city of Rio de Janeiro, recalling the entry of the Chikungunya virus in 2014, followed by Zika in 2015.

The main symptoms of CHIKV, DENV and ZIKV

Chikungunya

Fever, headache, pruritus, pain, myalgia, arthralgia, maculopapular exanthema, conjunctivitis, retro-orbital, hepatomegaly, lymphadenopathy

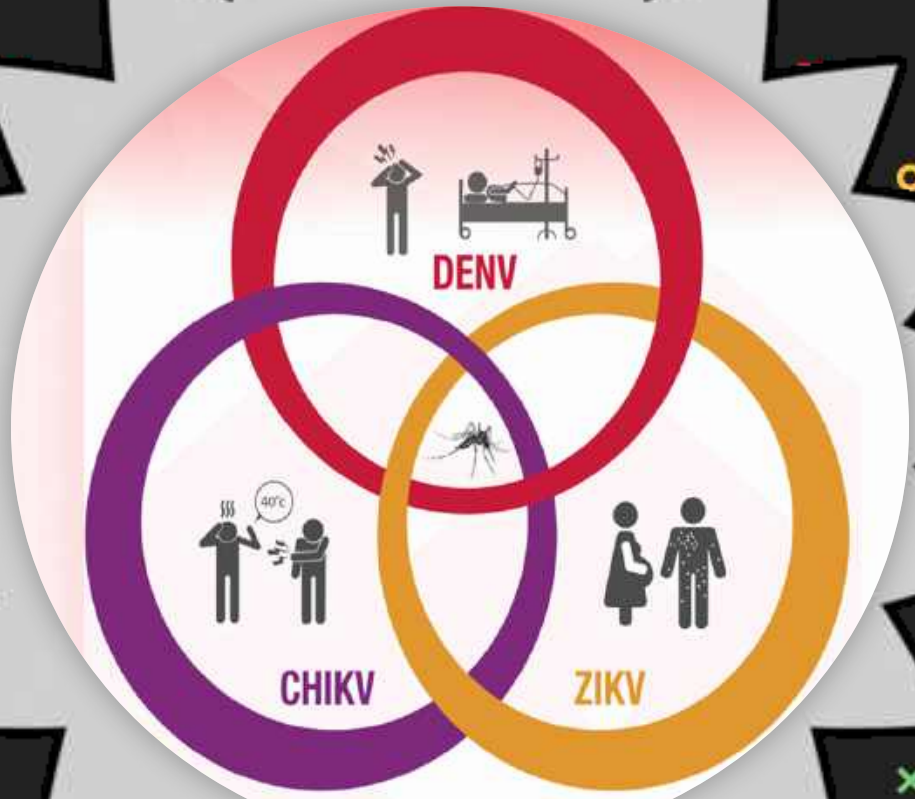
Zika

Fever, myalgia, arthralgia, oedema in limbs, retro-orbital pain, maculopapular exanthema, conjunctivitis, lymphadenopathy

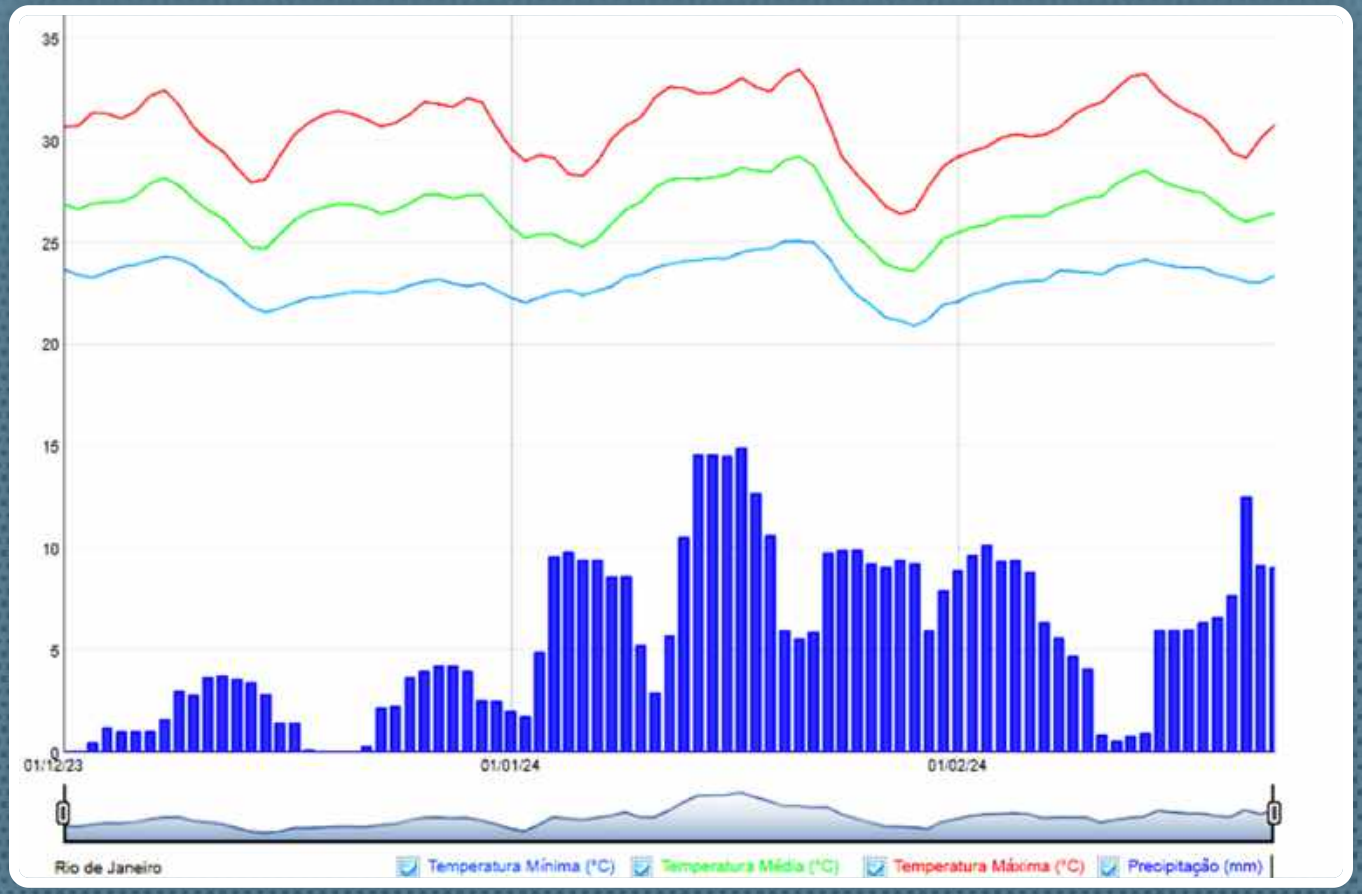
Arboviruses clinical signs and symptoms

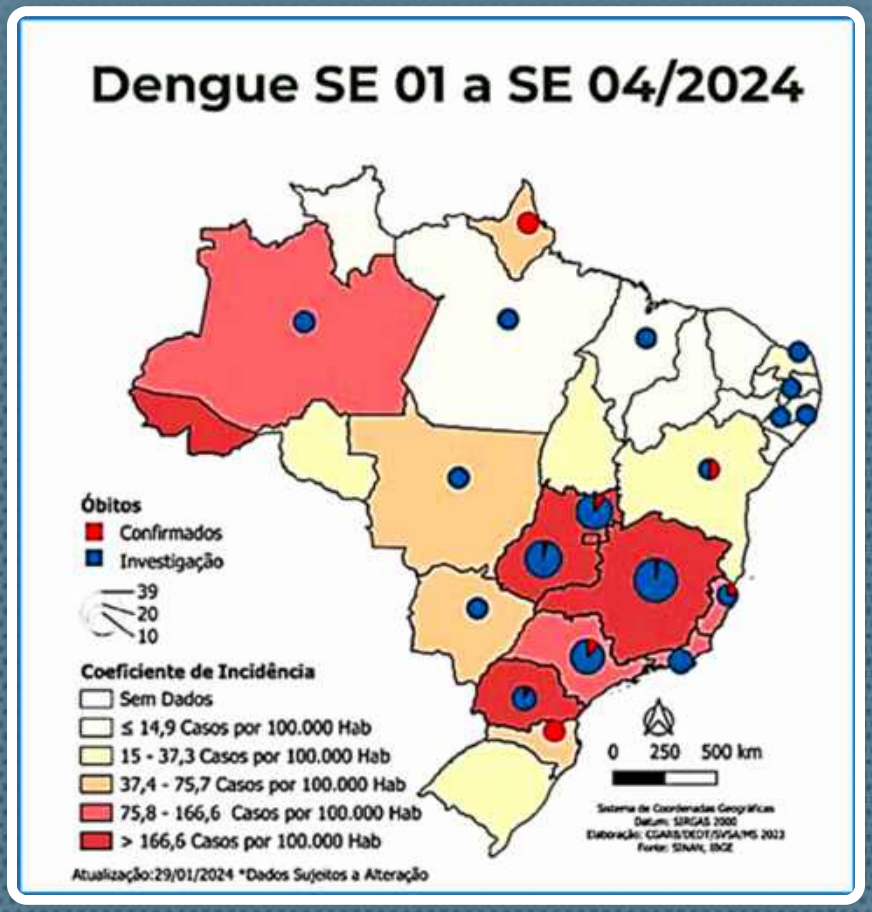
Fever, myalgia, headache, rash, fluid accumulation, low platelet count, abdominal pain, bleeding, high haematocrit, leukopenia, lymphocytosis,

Dengue

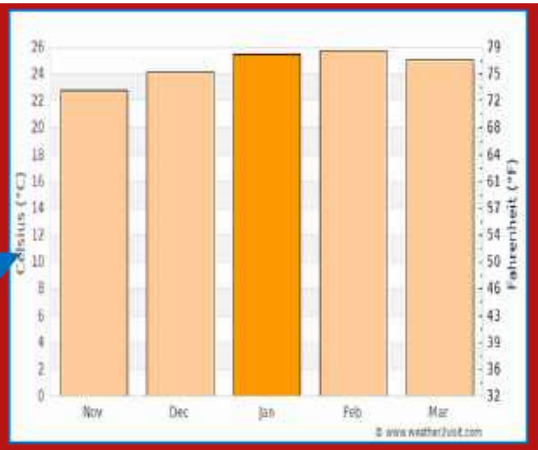


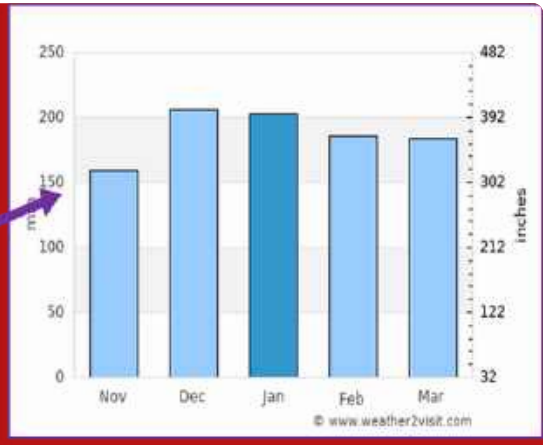
Precipitation, temperature, and arbovirus case index in Brazil in 2023/2024, during a period of strong El Niño

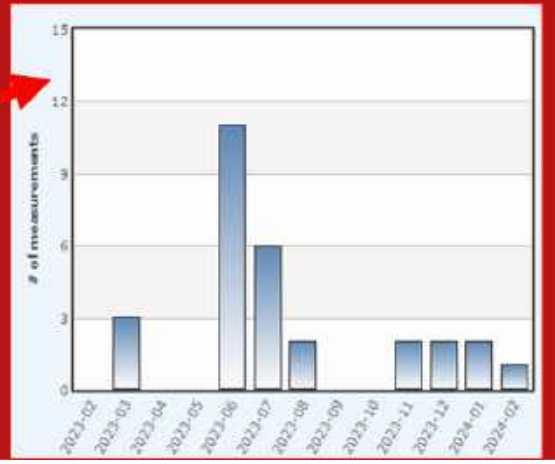




Precipitation, temperature, and arbovirus case index in the city of Rio de Janeiro in 2023/2024, during a period of strong El Niño.

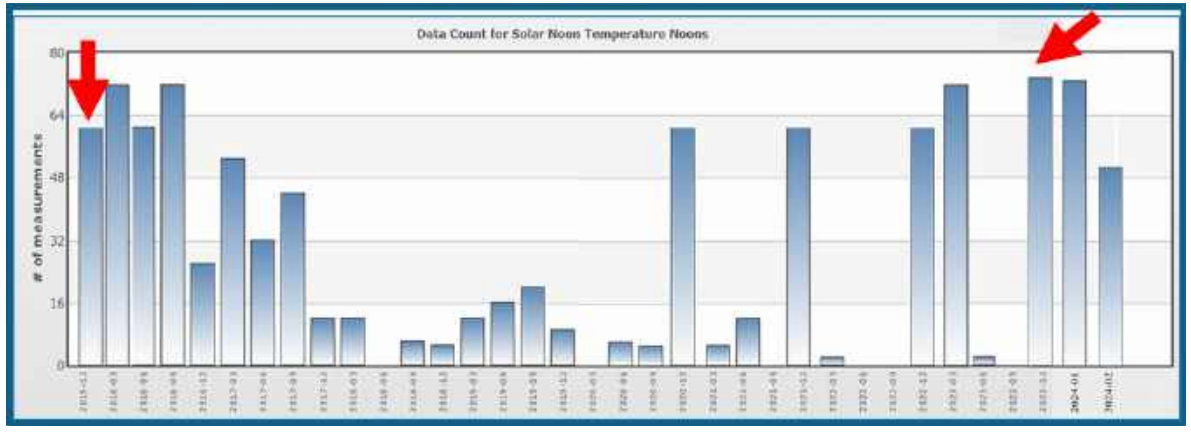


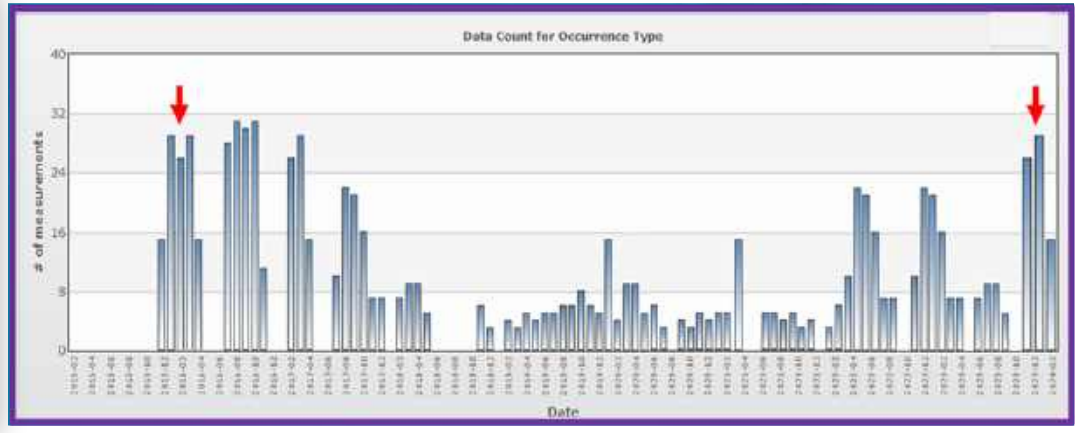


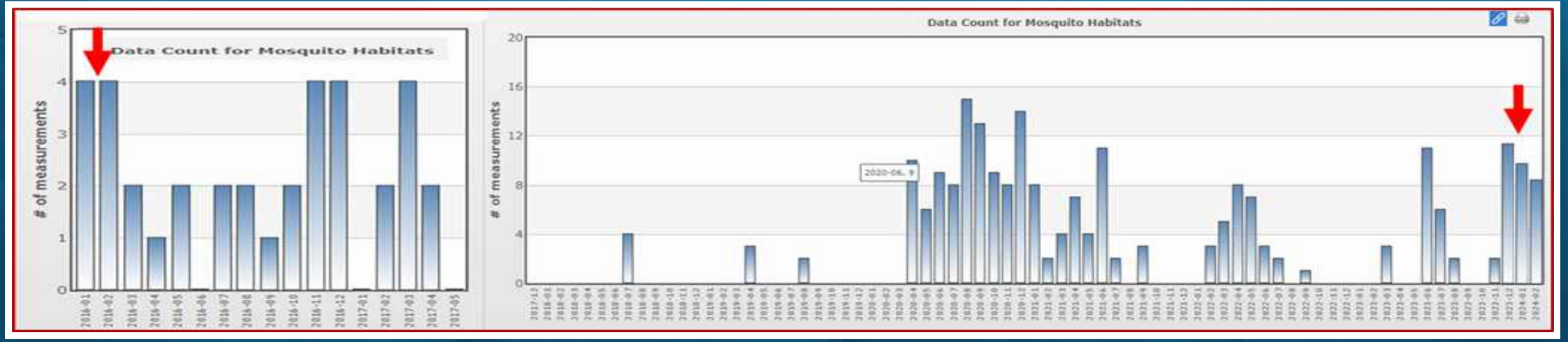


RESULTS

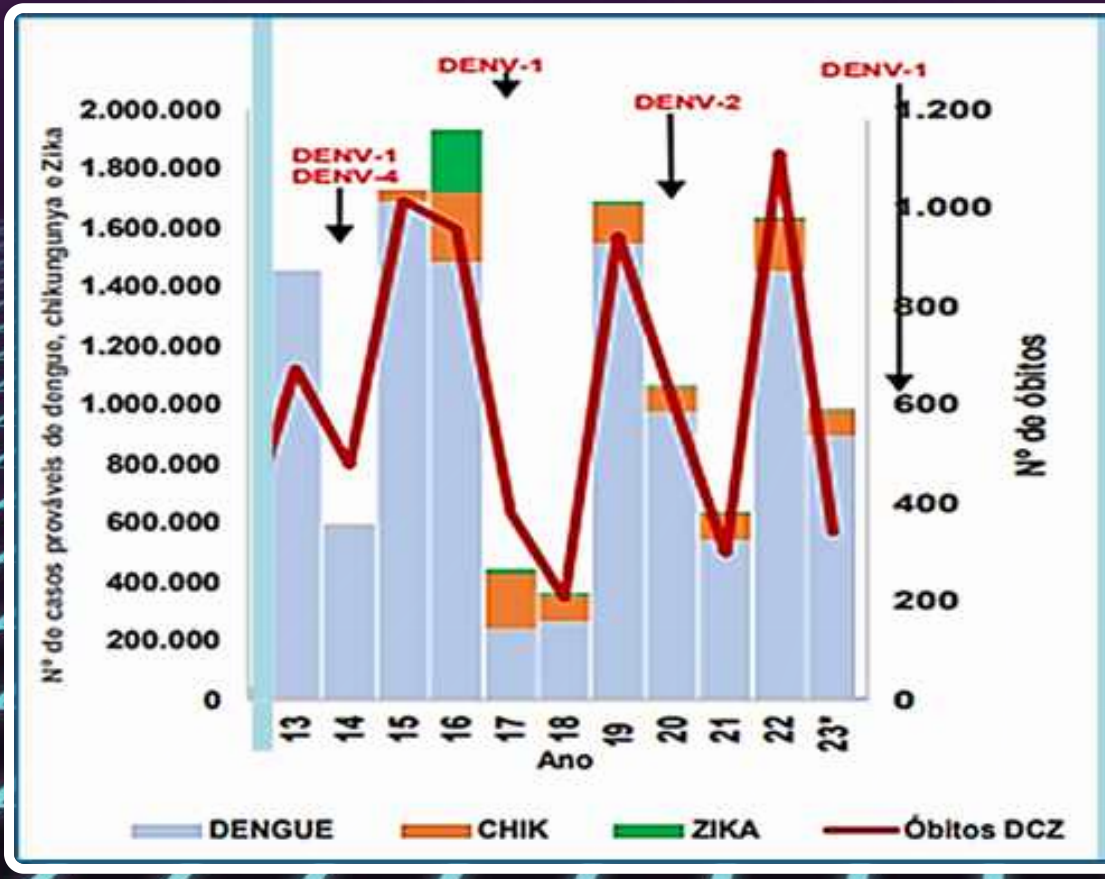
Data collected and studied by the Science Club of Minas Gerais on temperature, precipitation, mosquito larvae count, and habitats, from two strong El Niño events in the last decade: December 2015 to February 2016 and December 2023 to February 2024

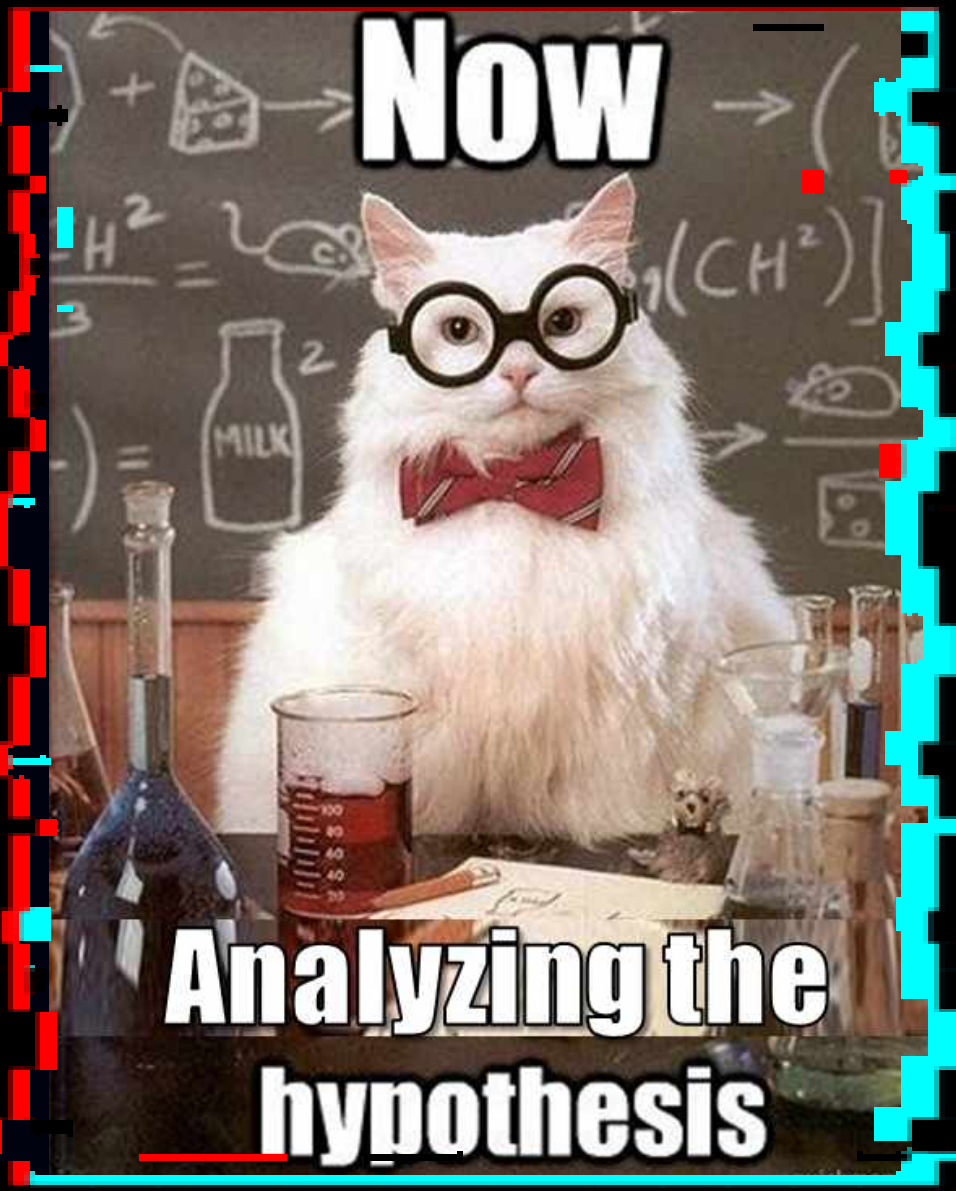






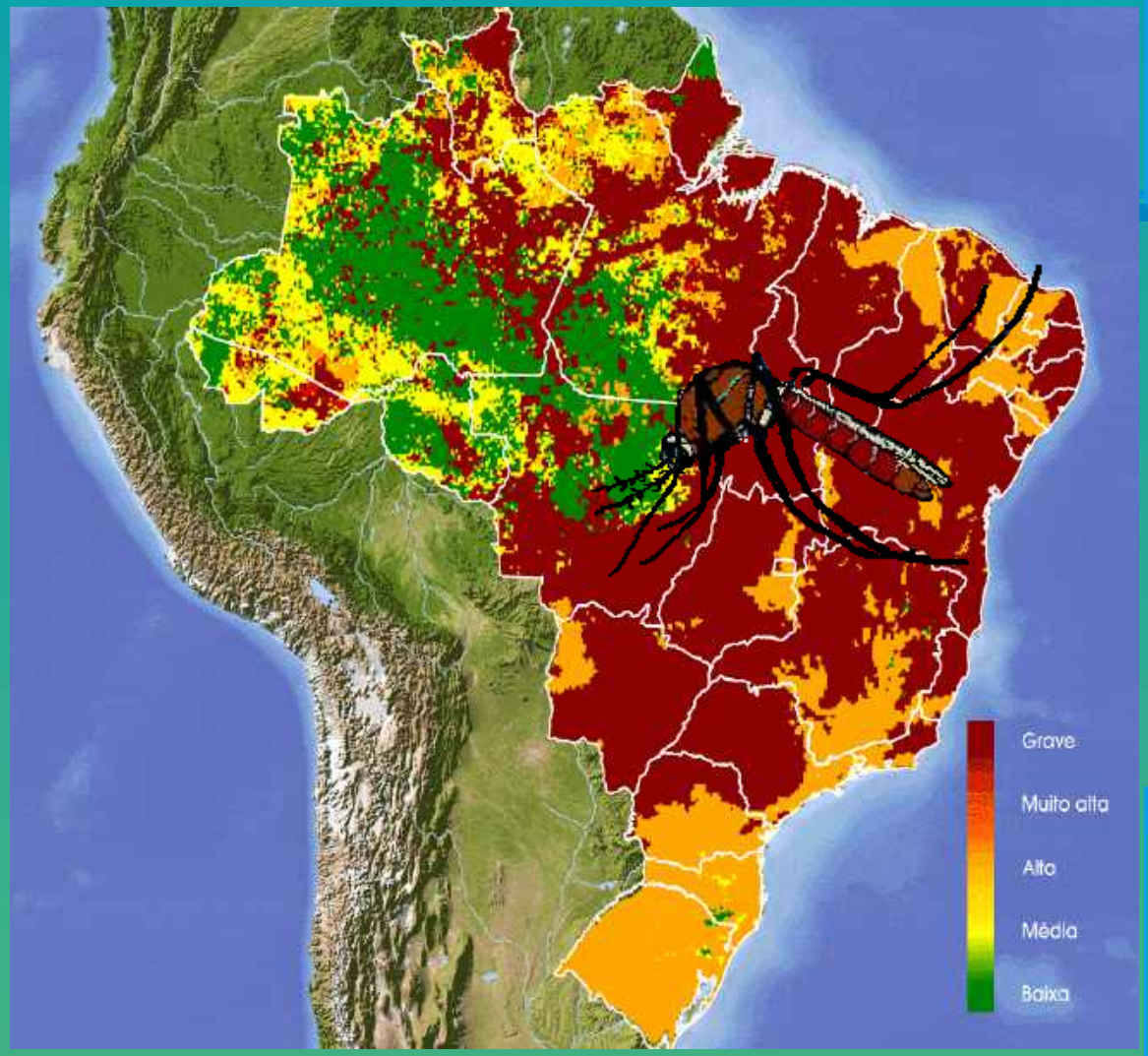
In the course of the study, a heightened prevalence of mosquito habitats was discerned in the data garnered from artificial capture breeding sites and from the reviewed literature during the intervals spanning December 2015 to February 2016 and December 2023 to February 2024.




Now
MILK
Analyzing the hypothesis

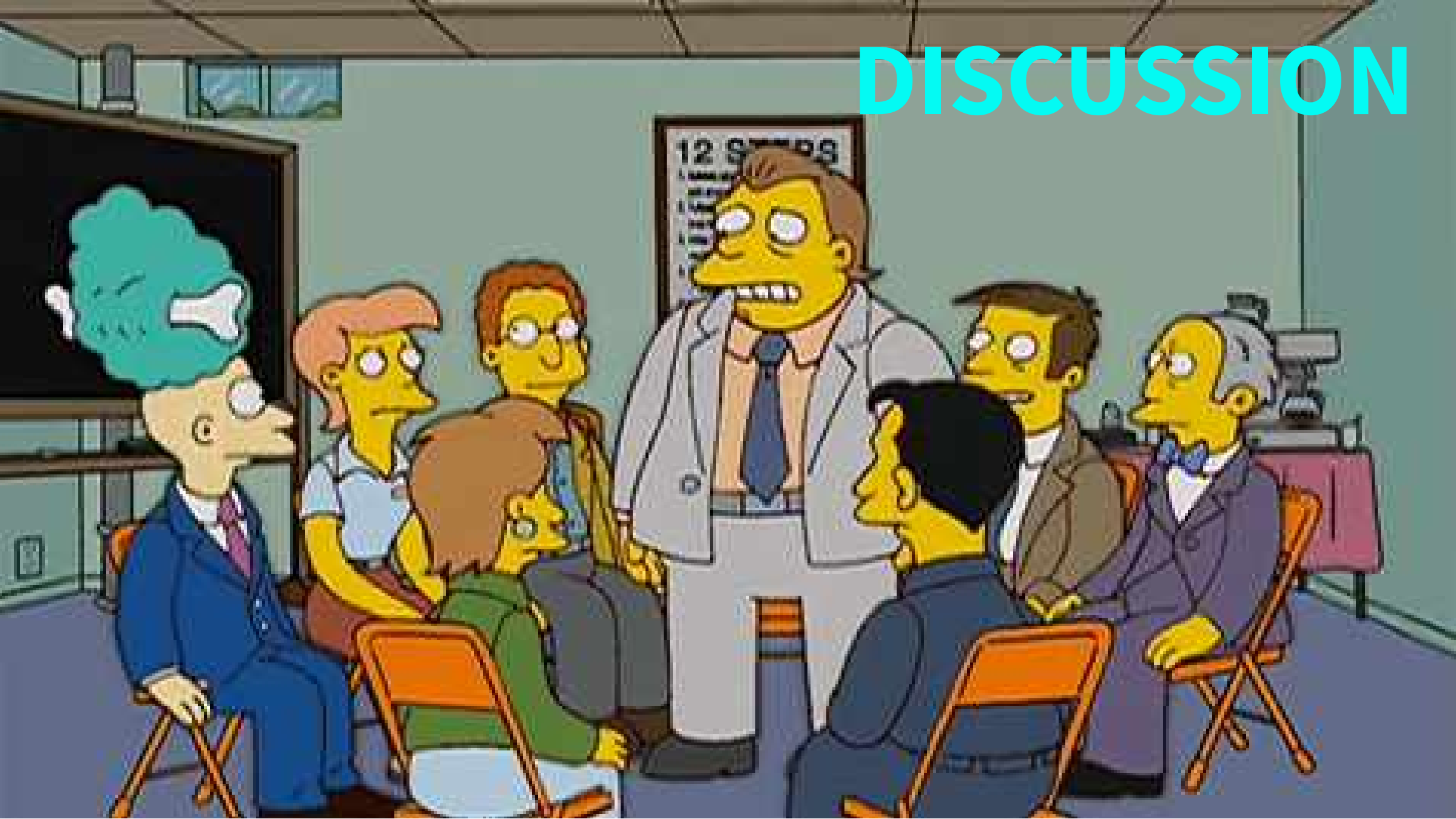
Aedes aegypti mosquito can be deadly. The mosquito begins its reproductive cycle during the warmer months when rainfall is more abundant, particularly proliferating in stagnant water. During the summer, there is a peak incidence ofarboviruses and in Strong El Niño season, this scenario worsens.

Our research results confirm that Strong El Niño brings about changes in climate patterns across all regions, resulting in serious consequences in Brazil, with a particular focus on Rio de Janeiro. This includes rising temperatures and more frequent and intense rainfall, negatively impacting the proliferation of the *Aedes aegypti* mosquito.



https://linhaoff.com.br/pt-br/previsao-de-mosquitos

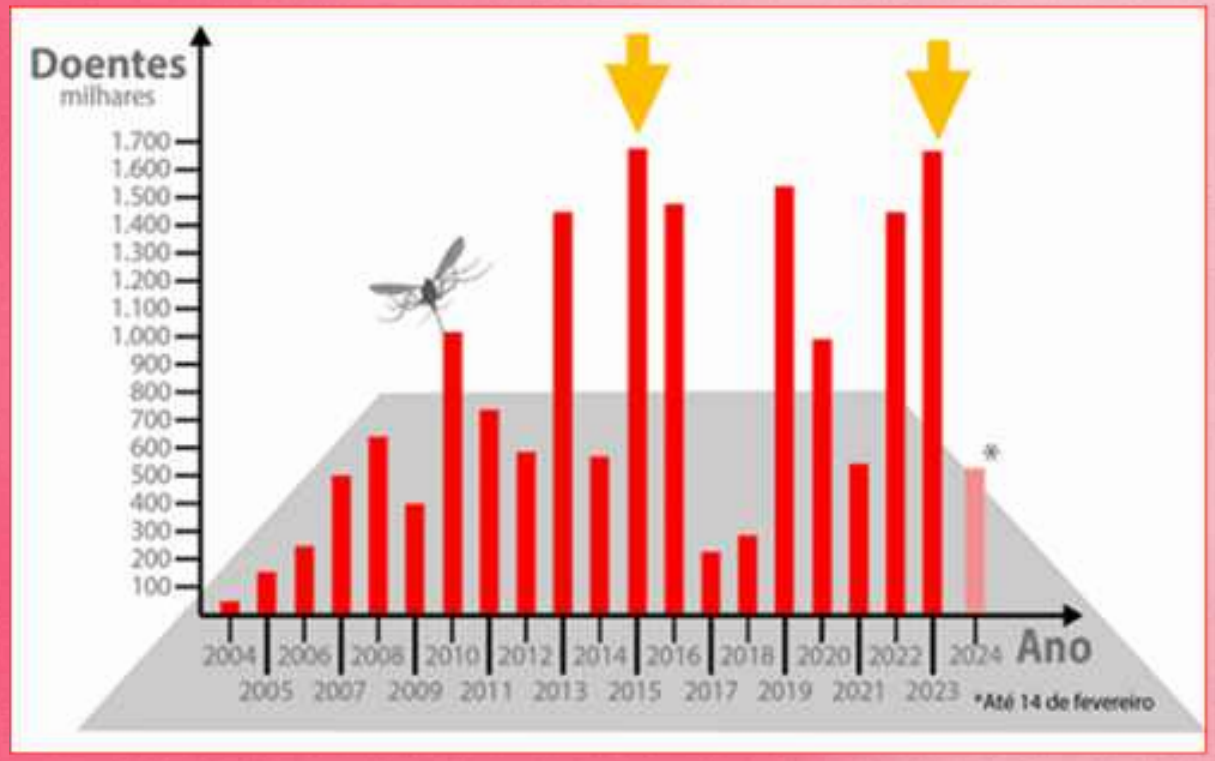
Understanding that changes in climate patterns, particularly the effects of strong El Niño events, is essential to implement effective measures for controlling and preventing dengue and other mosquito-borne diseases.

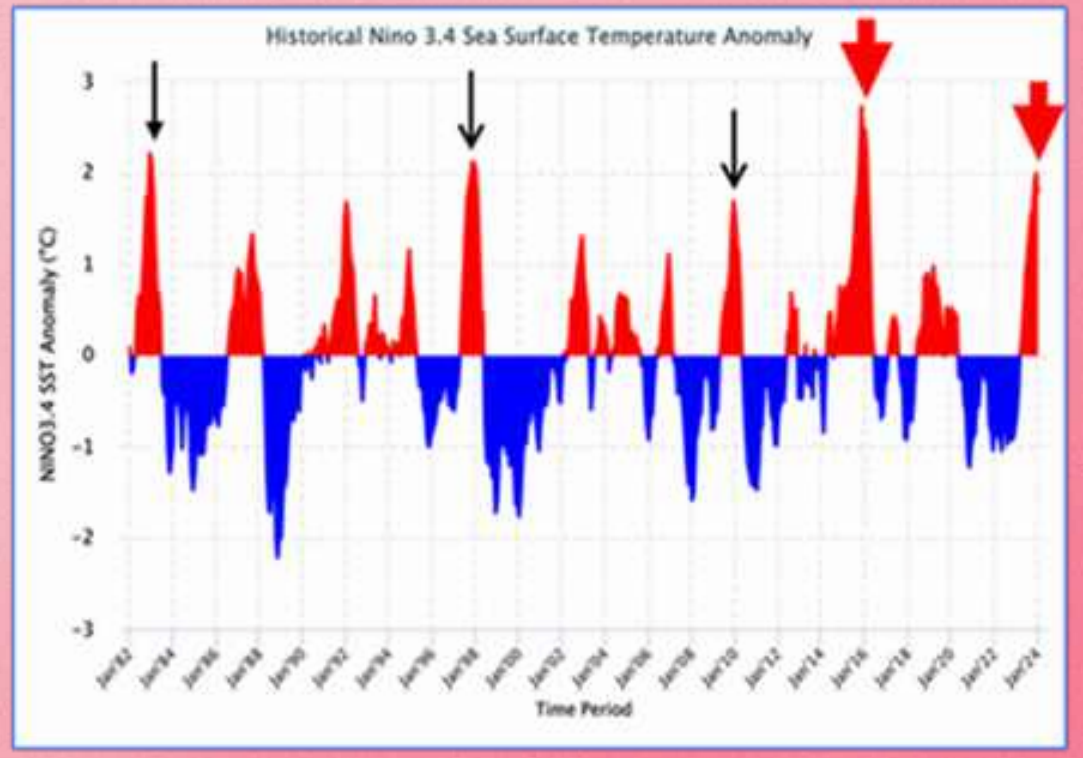

DISCUSSION

In the years 2023/2024, Rio de Janeiro city experienced epidemics of dengue fever as the number of cases surpassed 500 cases per 100,000 inhabitants. During strong El Niño season.

Is it a coincidence?

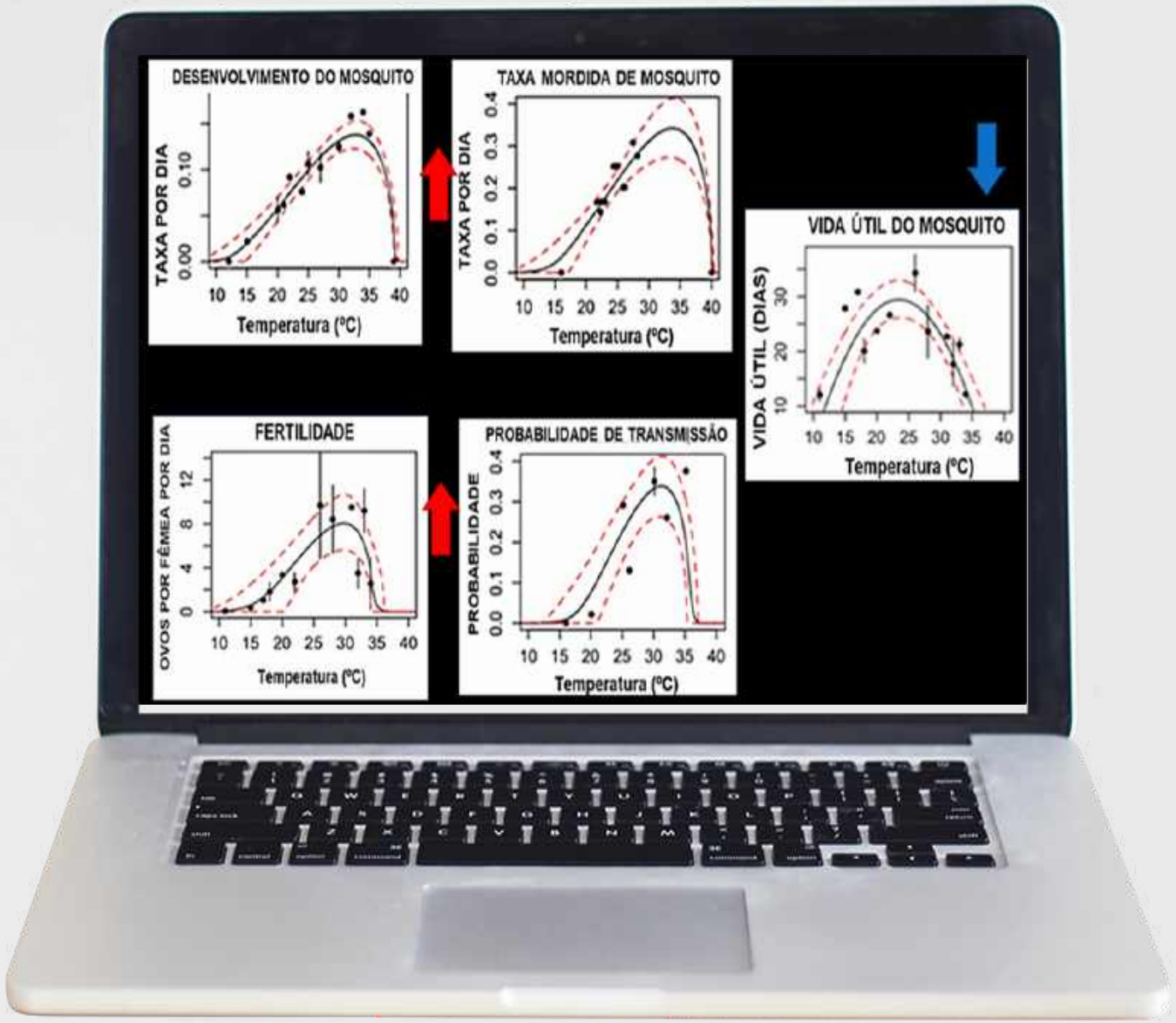
When we compare the collected data on mosquito proliferation with climatic factors, especially during strong El Niño summers in Rio de Janeiro, we observe a significant increase in the development of *Aedes aegypti*, responsible for transmitting diseases such as Dengue, Chikungunya, and Zika. The summers of 2015/2016 and especially 2023/2024 experienced very intense heatwaves, increasing the mosquito proliferation.





During periods of higher temperatures, the mosquito increases its search for human blood to produce eggs, resulting in a larger population of disease-transmitting mosquitoes.

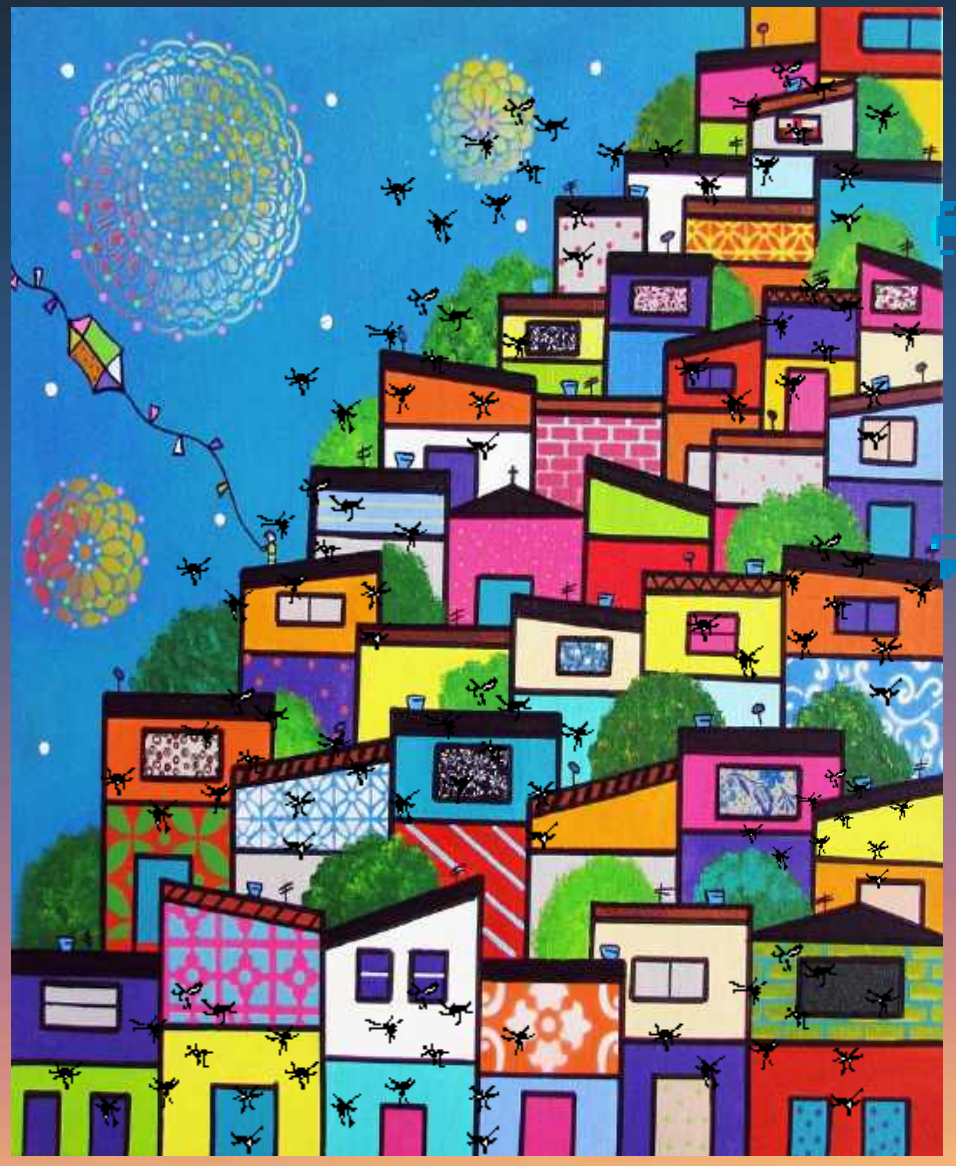
During the heat, the mosquito's reproductive cycle accelerates, it deposits eggs, which are hydrated by rain, allowing the larvae to develop. Thus, the larvae hatch, mature with the return of heat, and transform into another mosquito, continuing the cycle



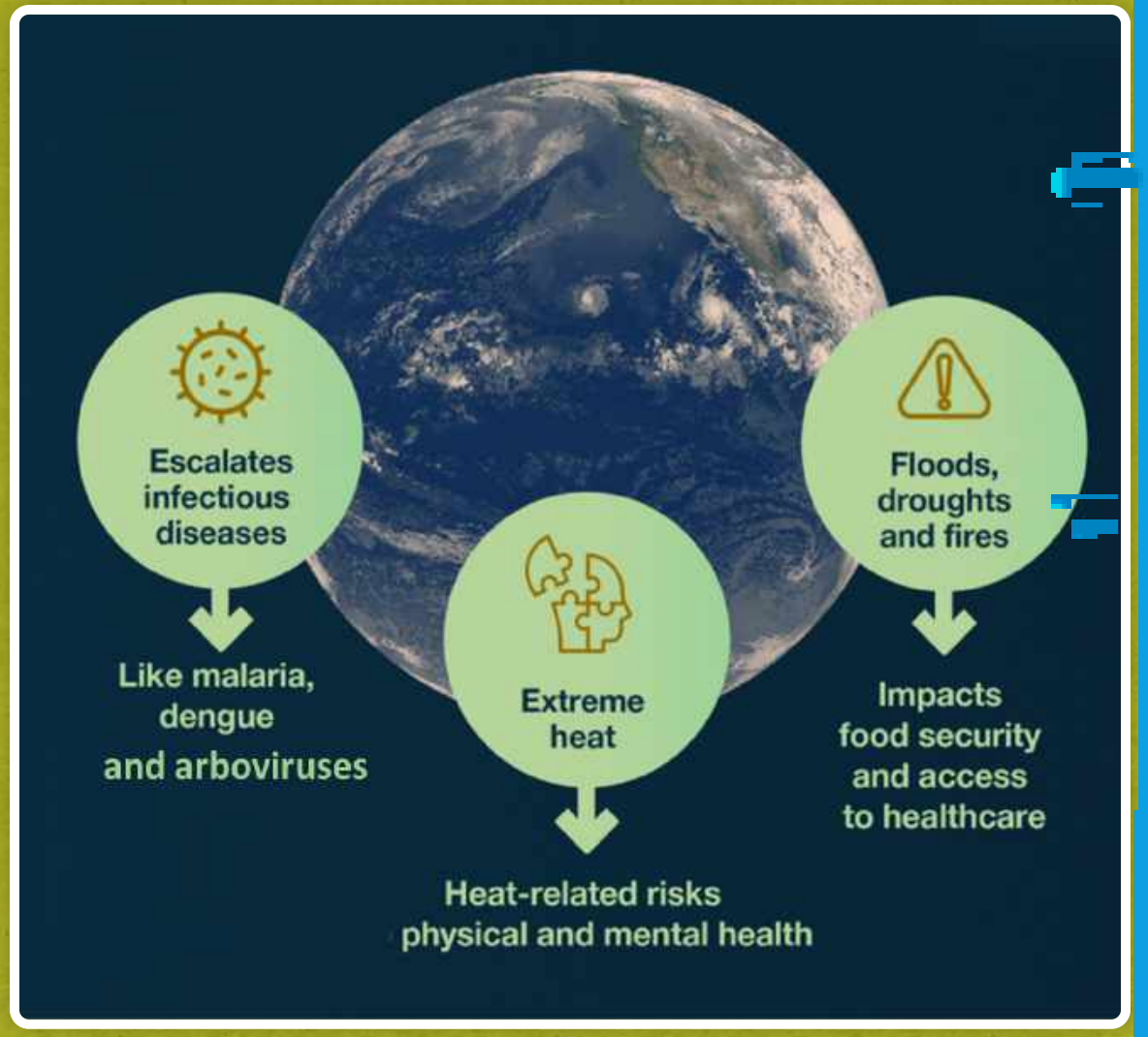
Dengue is considered by the Brazilian Ministry of Health as the most prevalent urban arbovirus in the Americas, mainly in Brazil.

In 2023, 74.8% of dengue mosquito breeding sites are found in households.

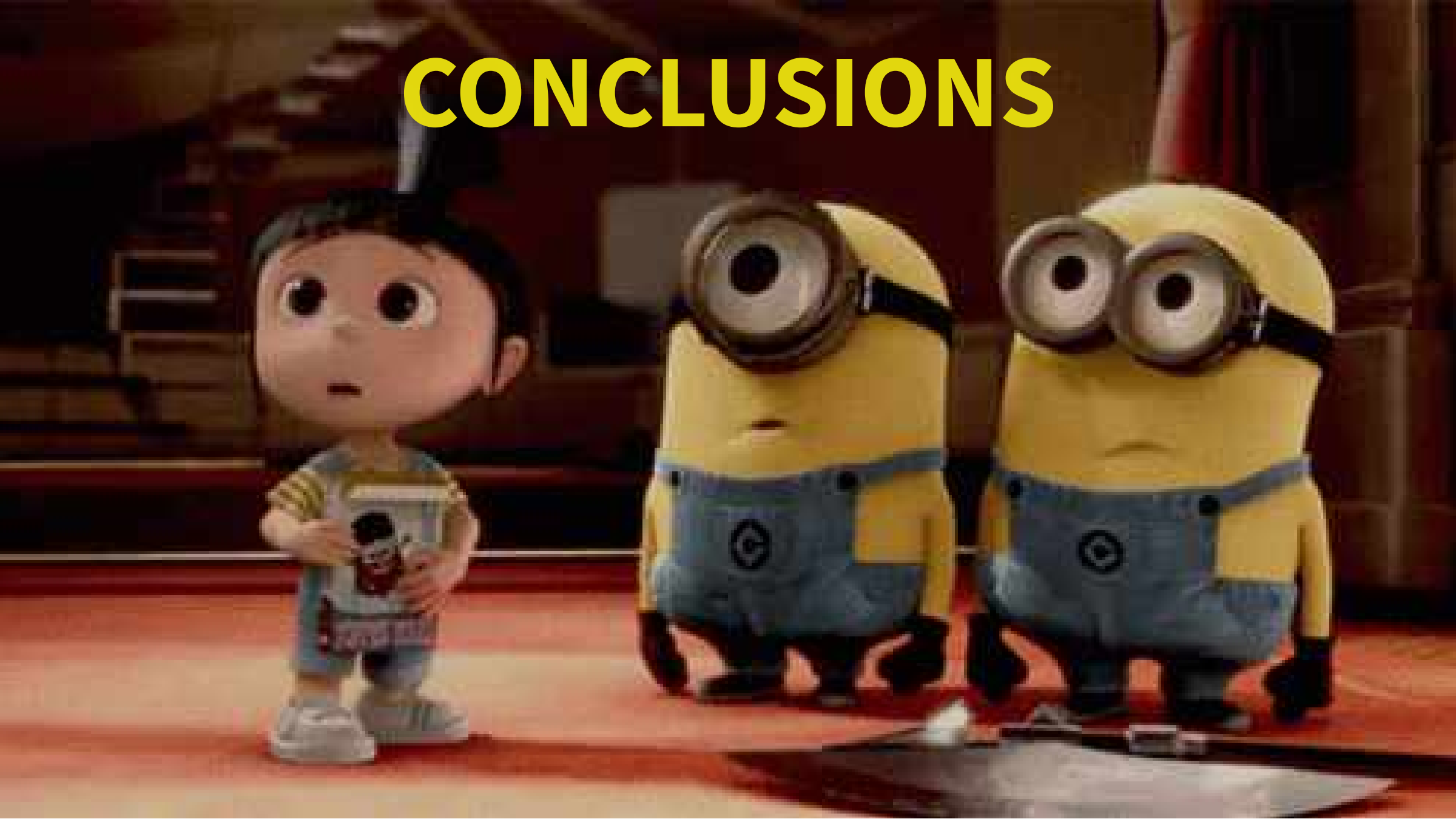
They are flowerpots and plant saucers, returnable bottles, drip trays, defrosting containers in refrigerators, water coolers, small ornamental fountains, and materials in construction sites (stocked toilets, pipes).



The relationship between El Niño and arbovirus epidemics is indeed complex and can vary depending on factors such as the specific arbovirus, geographical location, and local environmental conditions. While El Niño events may create conditions conducive to arbovirus transmission in some regions, the relationship may not be direct and can be influenced by other factors such as the type of dengue virus and its prevalence in specific regions.

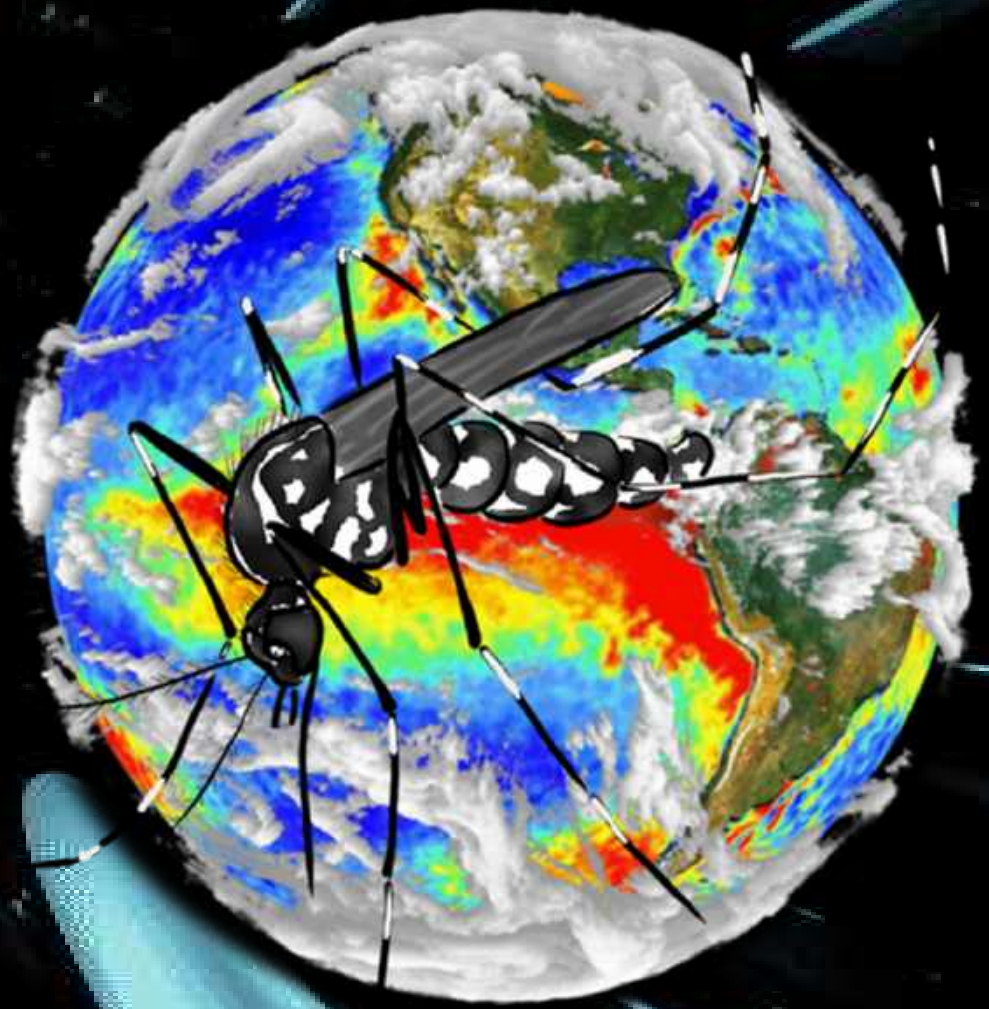


CONCLUSIONS

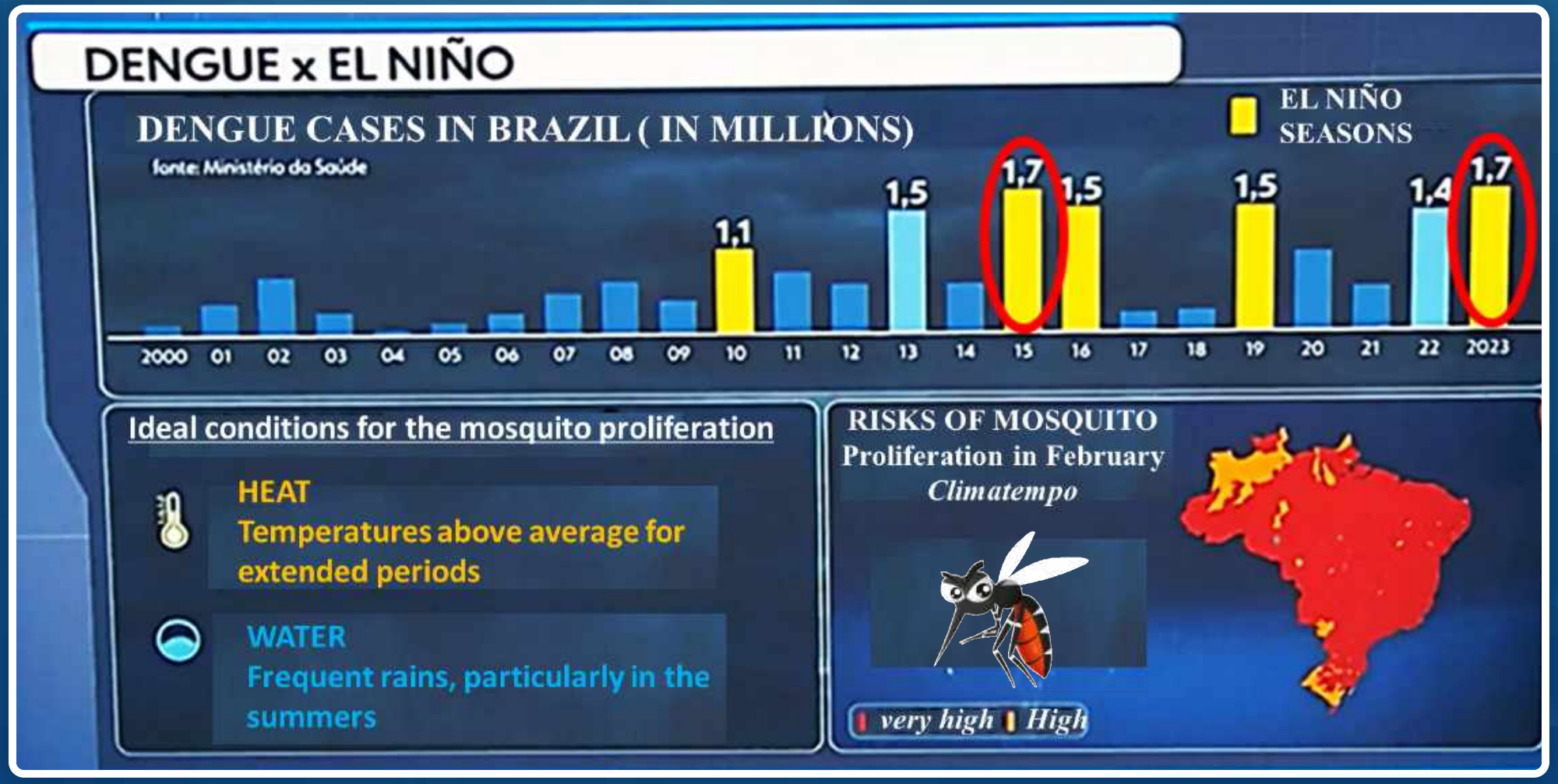


We can conclude that a complex association exists between strong El Niño events and arbovirus epidemics. The A*edes aegypti* mosquito reproduces more rapidly in regions with higher temperatures and during rainy periods.

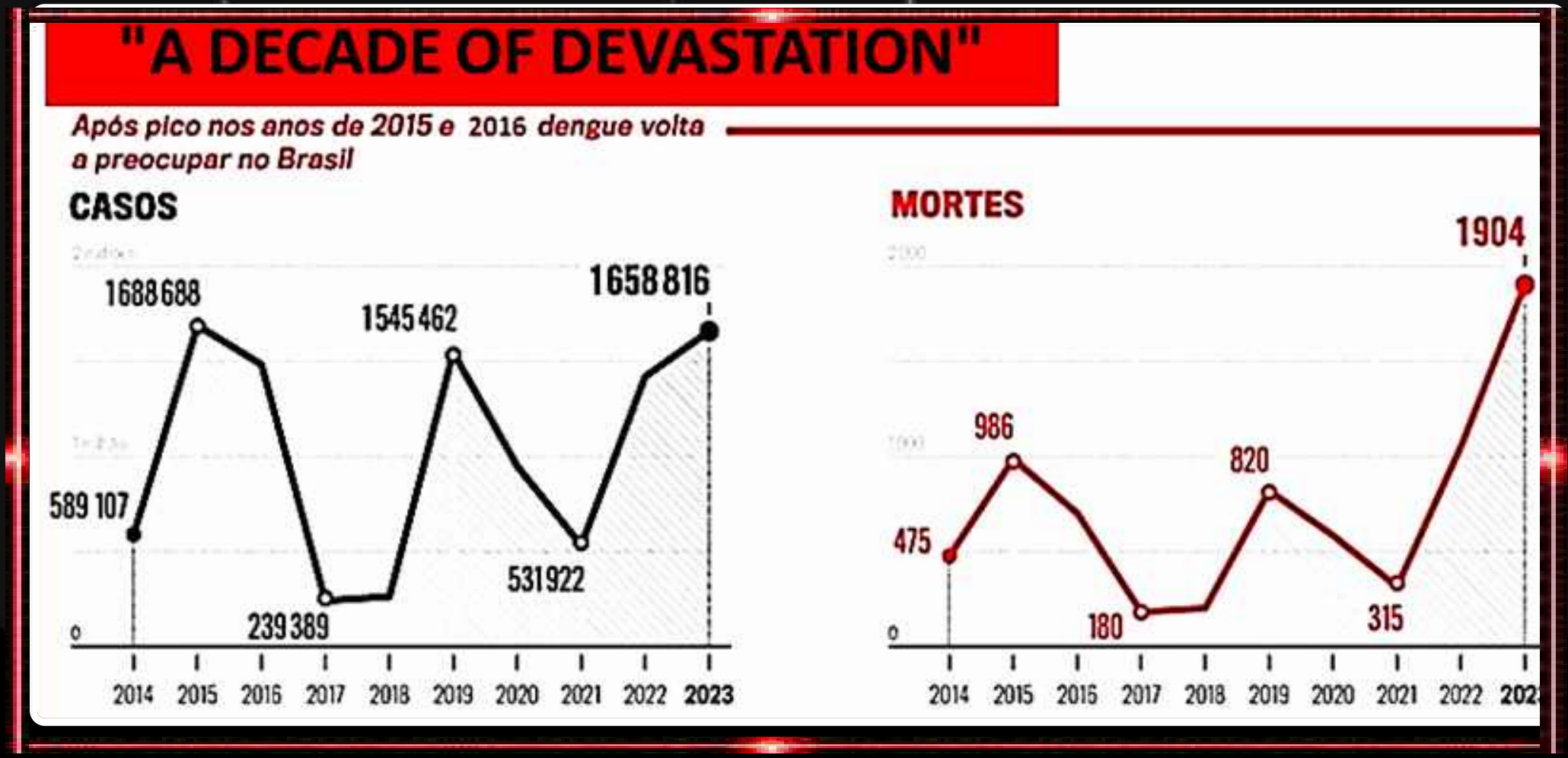
Additionally, these mosquitoes' eggs can remain dormant for up to 500 days waiting to rainfall and heat provide their breeding sites. Strong El Niño events can create environmental changes in Brazilian regions, making them more favorable for dengue and other arbovirus epidemics.



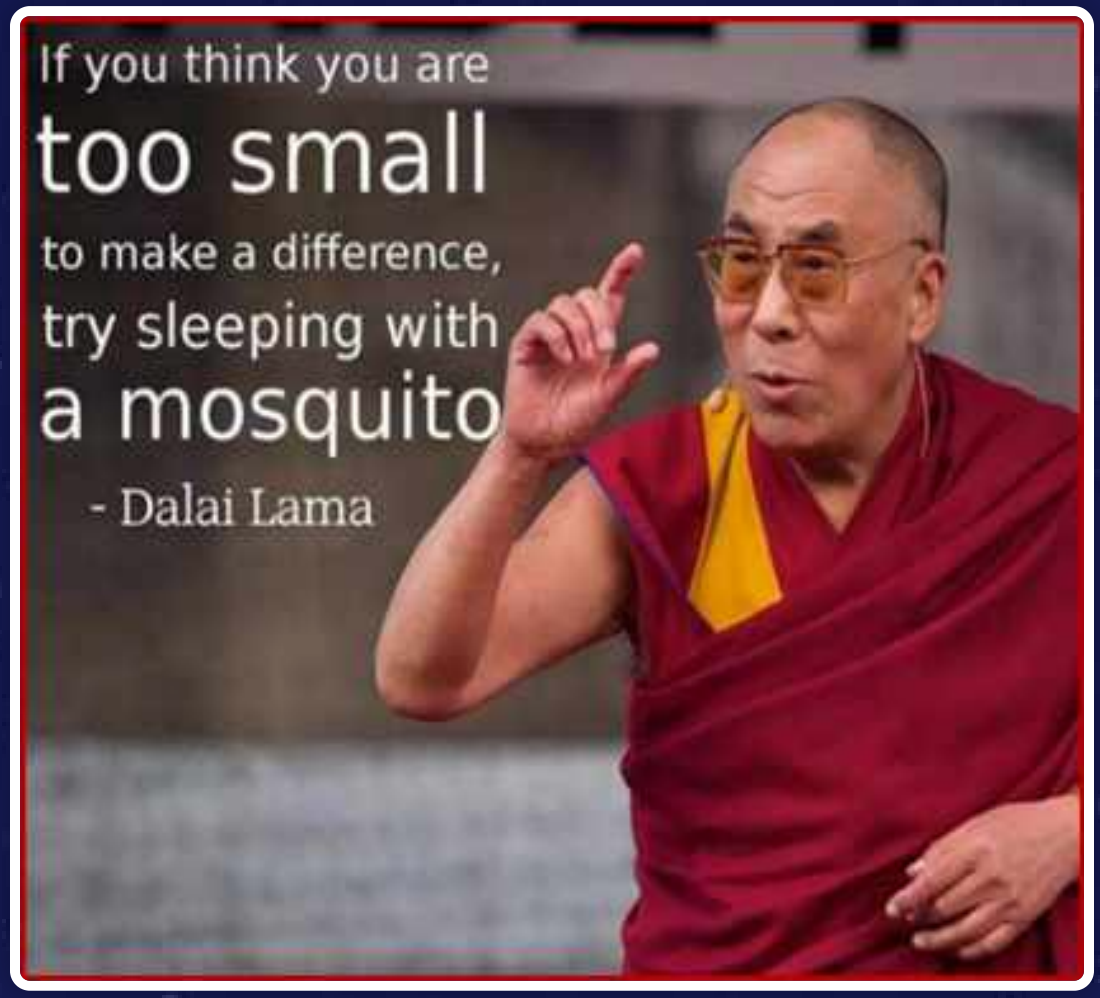
The data presented in the infographic indicate a decrease in cases of dengue (2023/2024) and other arboviruses (2015/2016) during the periods of analyzed El Niño, particularly the strong ones, showing changes in rainfall and temperature patterns.



A decade of devastation" - After the peak of devastation in 2015, arboviruses, particularly dengue fever, resurface as a concern for the Brazilian population in 2024.



PREVENTION AND SOLUTION



Several prevention and control measures have been implemented to tackle arbovirus epidemics, with a special focus on the Aedes aegypti mosquito.

Government programs prioritize the elimination of breeding sites through public awareness campaigns, supported by advances in diagnostic technologies, dengue vaccines, and genetically modified mosquitoes.

Additional measures include the use of repellents, mosquito traps, and window screens. In Brazil, efforts are comprehensive and involve the distribution of insecticides, health education, and community engagement.

Information campaigns aim to combat the transmitting mosquito, especially during climatic events like El Niño. Additionally, students are trained to promote preventive actions beyond school settings.

Agradecemos a todos que nos ajudaram no desenvolvimento do projeto:

Agência Espacial Brasileira – Aline Velloso e Erick Silva, FIOCRUZ - Elimina Dengue e Globe Mission Mosquito plataforma.


"That's all Folks!"