Practical Assignment #2 - Fires in the Amazon

Objective: this activity aims to study the spatial and temporal variability of fires in the Amazon biome.

Activity

Fires have been used as a land-clearing tool in the Amazon, leading to significant emissions of greenhouse gases and to large deforested areas (Fig. 1). In this Practical assignment, you will work with real data from the historical time series of fires in the Amazon biome. In Brazil, the National Institute for Space Research (INPE) is a research institute that, among many other things, monitors biomass burning and deforestation throughout the national territory. This monitoring is done by remote sensing using several satellites. All data can be freely accessed at:

https://queimadas.dgi.inpe.br/queimadas/portal (1)

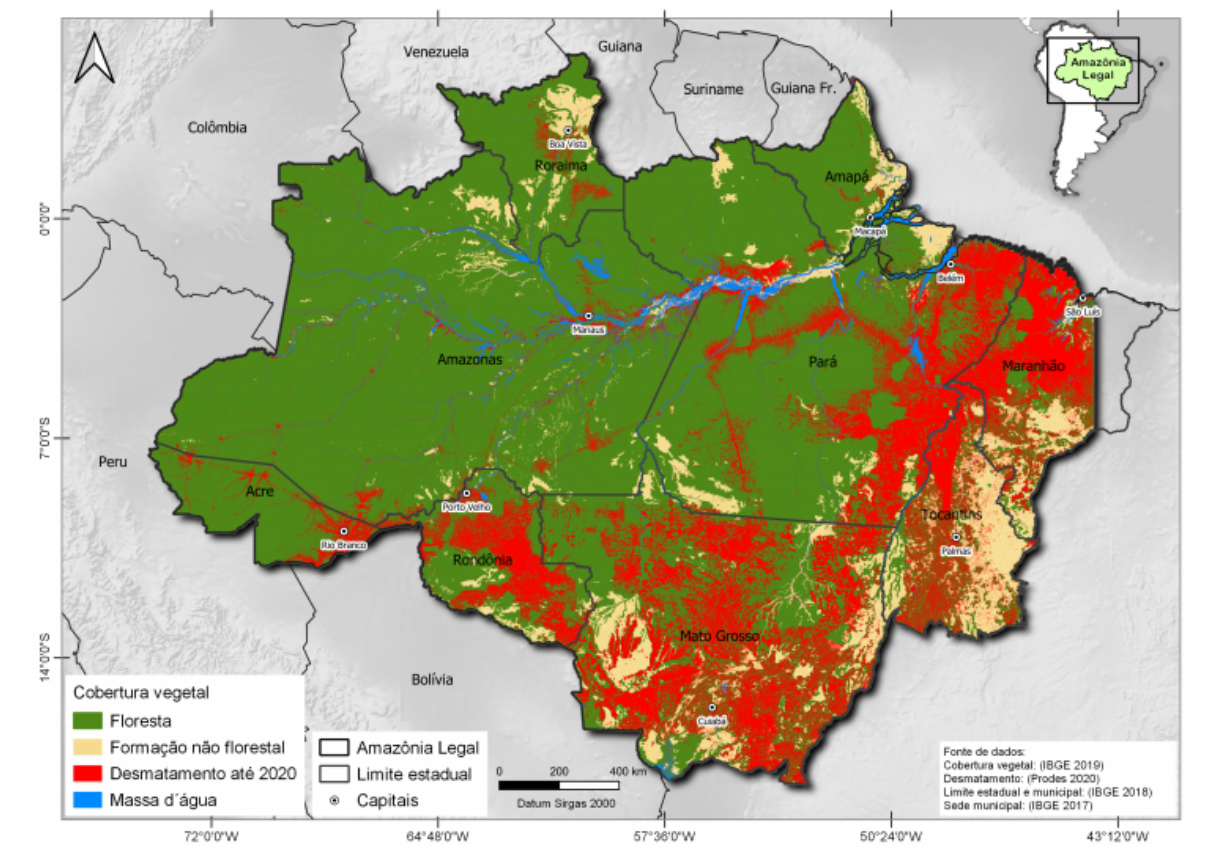

Figure 1. Brazilian legal Amazonia, showing deforested areas up to 2020.
Source: https://amazonia2030.org.br/fatos-da-amazonia-2021

Part 1. Access INPE's website (1) and navigate to the "Relatórios e Publicações - 11-Resumo histórico e animações" tab. Click on "Estatísticas/Gráficos Estados, Biomas e Regiões - BRA". Click on "Filtro por Bioma" and select "Amazônia". A table containing the time series of active fires in the Legal Amazonia from 1998 to June 2021 will be shown. This table can be downloaded in ".csv" format and opened in a spreadsheet such as Excel or Google Sheets. Below the table on INPE's website there is also a plot showing the historical evolution of total fires over the years ("time series graph", to be used below). Note that from 2018 to 2020 there is a clear growth trend in the number of detected fires. Assuming that elements controlling the occurrence of fires (e.g. environmental, political and economic factors) are constant between 2018 and 2021, estimate how many total fires should be observed by the end of 2021. To do this, use a simple linear fit using the 2018 to 2020 fire data, and extrapolate the model to find the expected number of fires for 2021. Next, find the year in the historical record when the number of fires was similar to your estimate for 2021. Finally, calculate the average number of fires over the last 10 years (2011-2020). How does your estimate for 2021 compare with the 10-year average?

Part 2. Plot the number of fires as a function of the month for 2020. What are the months of maximum and minimum intensity of fire outbreaks? Access INPE's website (1) again and click on "BDQueimadas" on the "Monitoring Systems" tab. This page will show satellite images of South America, overlaid with active fires detected during a given time period. In the upper left corner, look for the map icon and click on it. Select "Brasil" and in the Biomes tab, choose "Amazonia". For the two months you identified with the maximum and minimum number of fires in 2020, obtain the spatial distribution of fires in Amazonia. To do that, enter the first and last day of each of the two months in 2020 in the "Data inicio (UTC)" and "Data fim (UTC)" fields. You can zoom in or out, and pan the map around using your mouse to adjust the frame on the Amazon region. Take a screenshot when done to save the map to your local computer. Note that 2 maps are to be recorded, one for each month. Consider the distribution of precipitation for different sections of the Amazon region shown in Fig. 2. Can you explain the distribution of fires in the Amazon, for the two months you selected, using the data in Fig. 2?

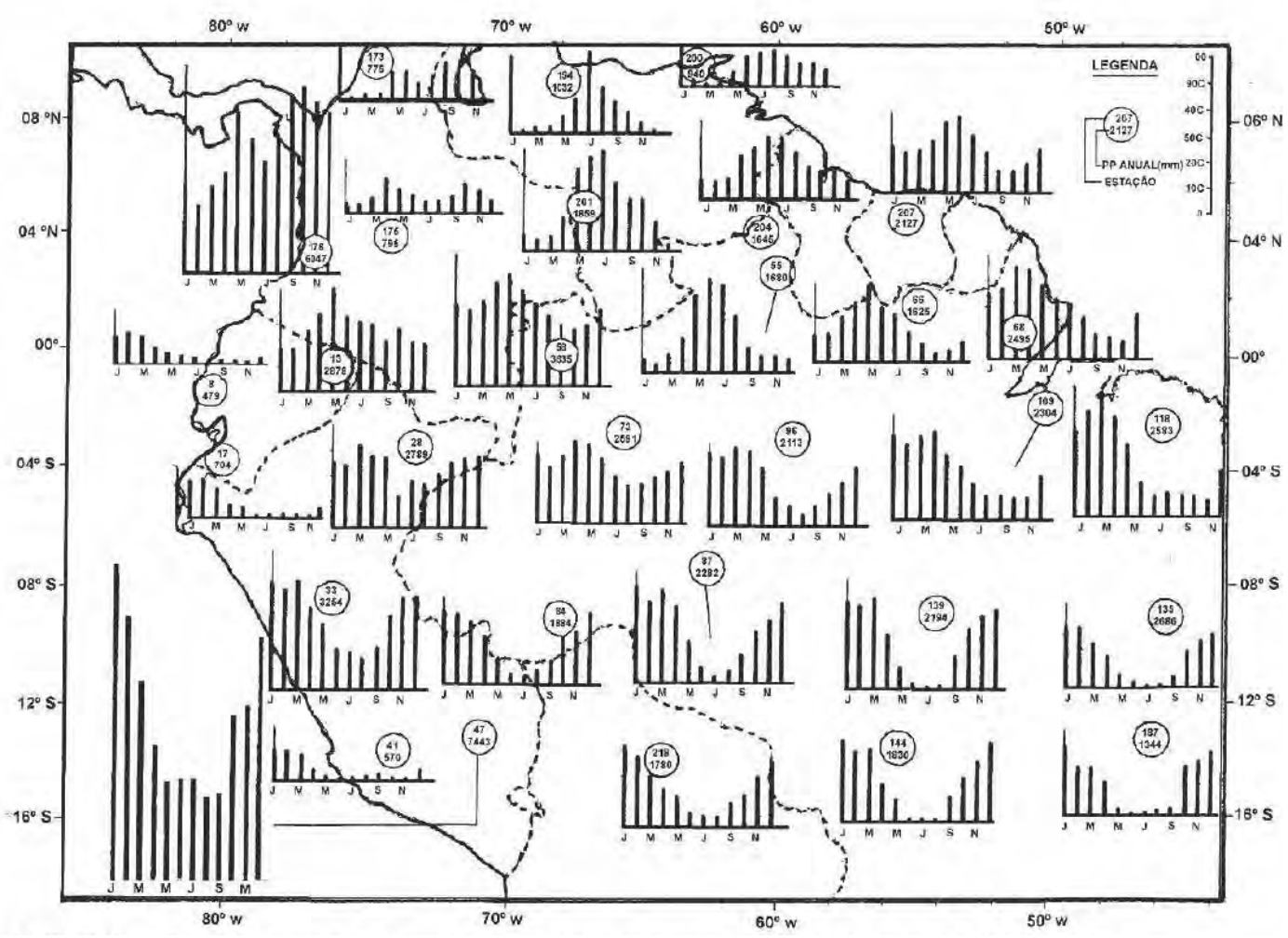

Figure 2. Spatial and temporal distribution of precipitation in the Amazon region. Vertical bars in the histograms indicate the amount of precipitation for each month of the year. "J M M J S N" corresponds to month labels, every 2 months: "January March May July September November" (Fisch et al., 1998).

[Extra]: Consider again the "time series graph" mentioned in Part 1. A strong decrease in the number of fires is evident from 2004 to 2009. In particular, Nepstad et al. (2009) predicted that by 2020 deforestation/biomass burning in the Amazon would end. What happened in the country that justifies this reduction in the number of fires to occur between 2004-2009?

References

Fisch et al. (1998) Uma revisão geral sobre o clima da Amazônia. Acta Amazonica 28, 101-126, DOI: 10.1590/1809-43921998282126.

Nepstad et al. (2009) The End of Deforestation in the Brazilian Amazon. Science 326, 1350-1351, DOI: 10.1126/science.1182108.