GEO717 – Time-Series Analysis Assignment: Forest Fire Trends in Bolivia

Results

The results in general show the annual burned area in Santa Cruz, Bolivia from 2000 to 2024. The Bar chart shows the burned area for each year of said time period in square kilometres [km^2] (Figure 1). The Scatterplot shows the proportion of burned area compared to the total area of the region (Santa Cruz) in percent [%]. An additional linear trendline shows the trend over those years, indicating a slight but steady increase of annual burned area (Figure 2). A GIF illustrates the change in annual burned area from 2000 to 2024 (Figure 3). Lastly, two static maps show display the burned area on top of a composite satellite image of the region. The first one only shows the year 2024 (Figure 4), the second one show all areas, that have been burned at least once in the time period (Figure 5).

The two plots indicate that the annual burned area has increased over the time (Figure 1, 2). But there is a significant dip around the years 2014 and 2015. After that, the following years definitely show a higher amount of annual burned area (Figure 2). When looking at the scatterplot, it can be seen that the percentage of burned area from the total area of the region ranges from over 5% to almost 30%, whit a trend starting a bit over 15% and going up to almost 20% in the last year, further supporting the observation of the increase in annual burned area (Figure 2). Besides that, a percentage of almost 30% in burned area for the "worst" year is pretty big, showing the importance of fires in that region. The GIF nicely illustrates change between consecutive years and the fluctuation in the amount of burned area. But despite that, it clearly shows a pattern where the fires occurred (Figure 3). This can be also seen in the two static maps, but the satellite image as a background adds a lot more context (Figure 4, 5).

Without any further analysis and additional research, we can only speculate what might cause the trend and patterns. But the most obvious reason might be the climate change, leading to not only warmer temperatures, but more importantly a more extreme situation. The burning season is getting longer, starting earlier and lasting longer. The area gets drier and weather events become more extreme. An additional factor might also be the anthropogenic activity in the region, for example harvesting trees, intensifying the agricultural use of the land and even man-made fires, often used for making the land usable (e.g. for agriculture). The variability over the years instead is rather natural, depending on various factors influencing the occurrence of fires, as well as the ability of the environment to deal/withstand them, like amount of vegetation, dryness of the region, weather changes between the years, etc.

In conclusion, a trend of increase in annual burned area can be observed.

Key processing steps

The basic structure mainly follows the one suggested by the task. First, the area AOI gets defined. Then, the MODIS data gets loaded and prepared by making a composite, applying cloud masking, and calculating the NBR. After that, the burned areas are detected and calculated, using a threshold of 0.05, which should be a good compromise between only detecting completely charred areas and detecting too much as burned, being "only" dark and dry but not actually burned. In a last step, the results are visualised. In addition to using what we already created, another cloud masked composite was generated to get a nice background for the static map. There, a time period before the main burning season was chosen, to get a nice and green image, as a best contrast for the highlighted areas. For the NBR, data from July to October was chosen, since this is the relevant fire season. That time frame is a compromise between the burning season a bunch of years back and the extended season nowadays, which might even last longer.

Link to GEE-Script: https://code.earthengine.google.com/c2f9d4038cbd9728be83614de652c188

Appendix

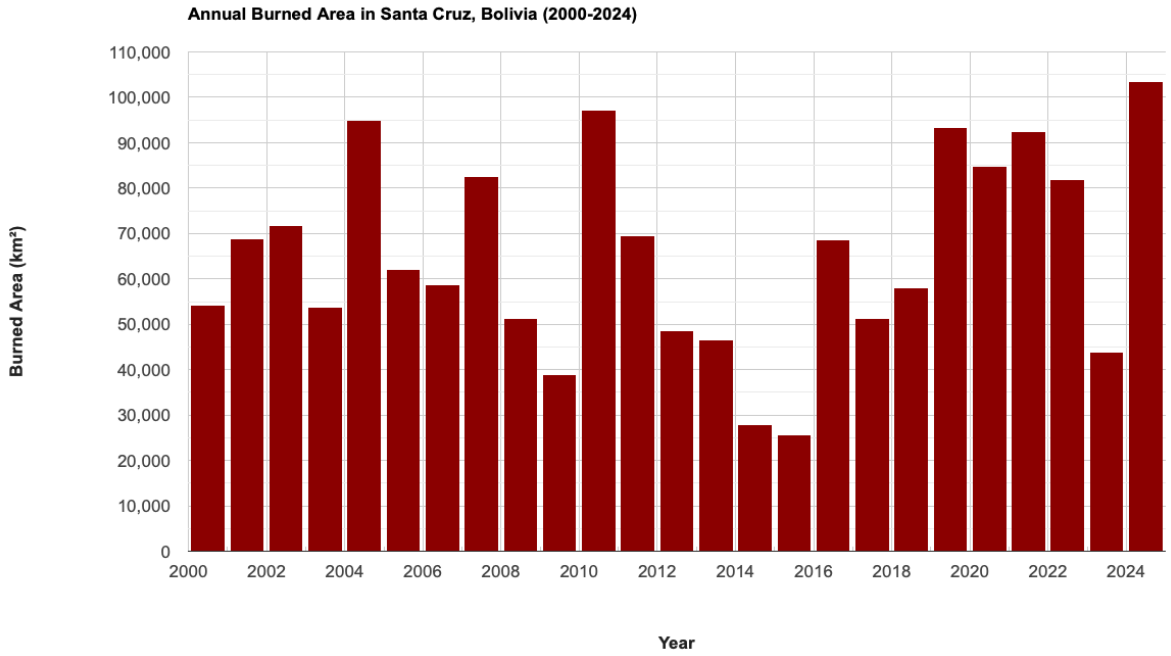

Figure 1. Bar chart, showing the detected annual burned area in Santa Cruz, Bolivia from 2000 to 2024.

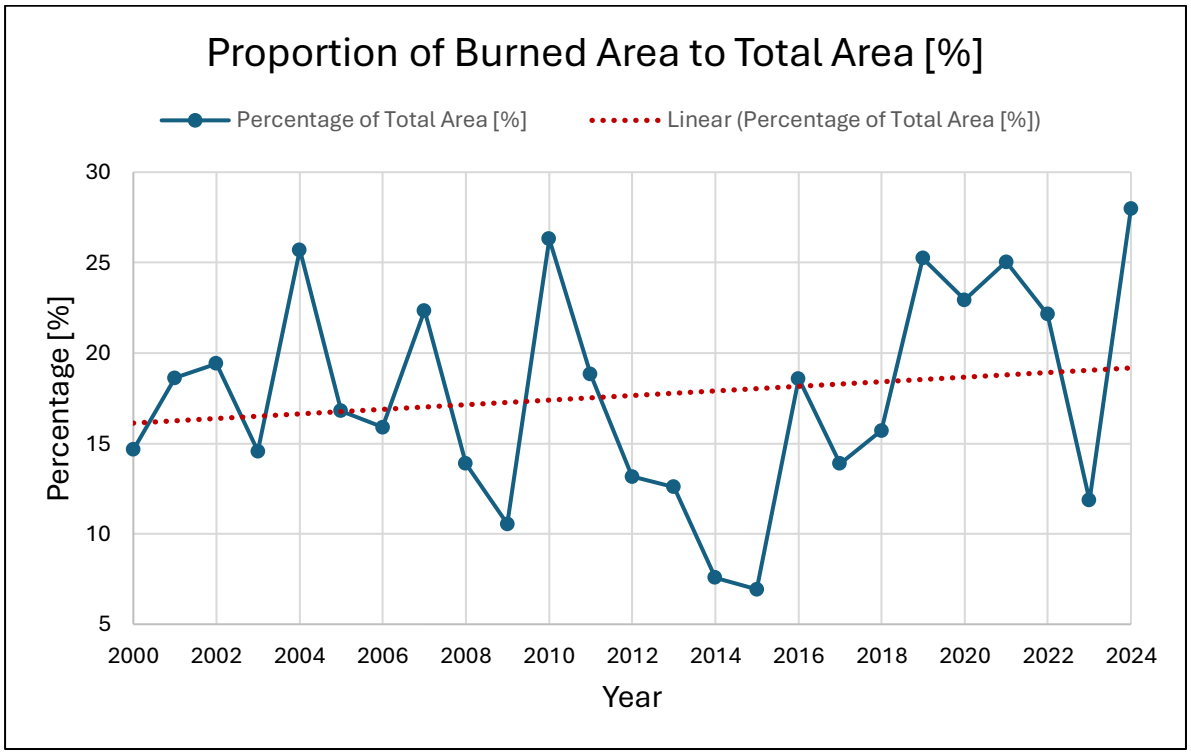

Figure 2. Scatterplot, showing the proportion of burned area compared to the total area of Santa Cruz from 2000 to 2024 in percent [%]. Additionally, a linear trendline shows the trend over that time period, indicating a slight increase in annual burned area.

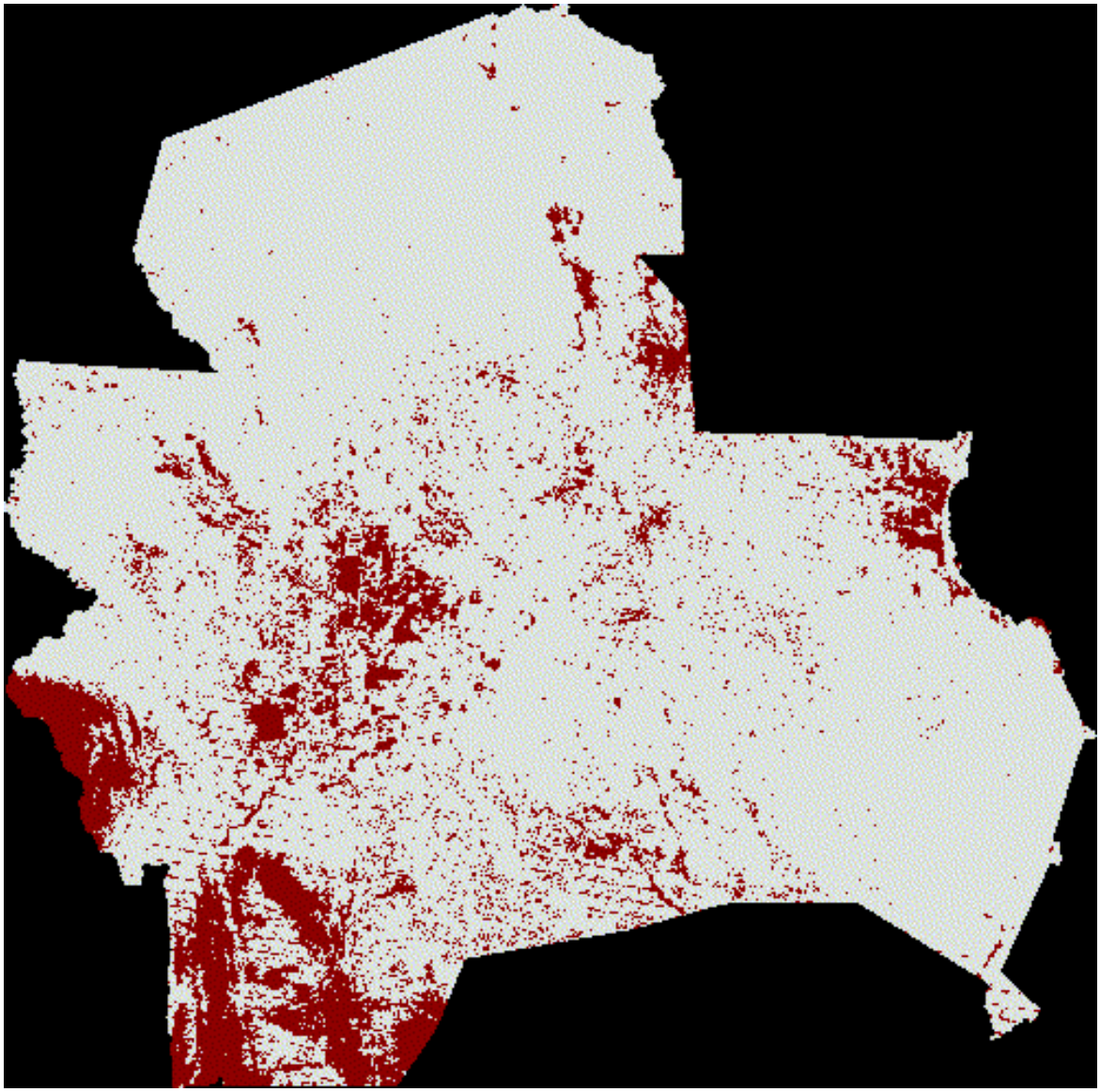

Figure 3. GIF showing the change in annual burned area from 2000 to 2024. The dark red area indicates the burned annual area.

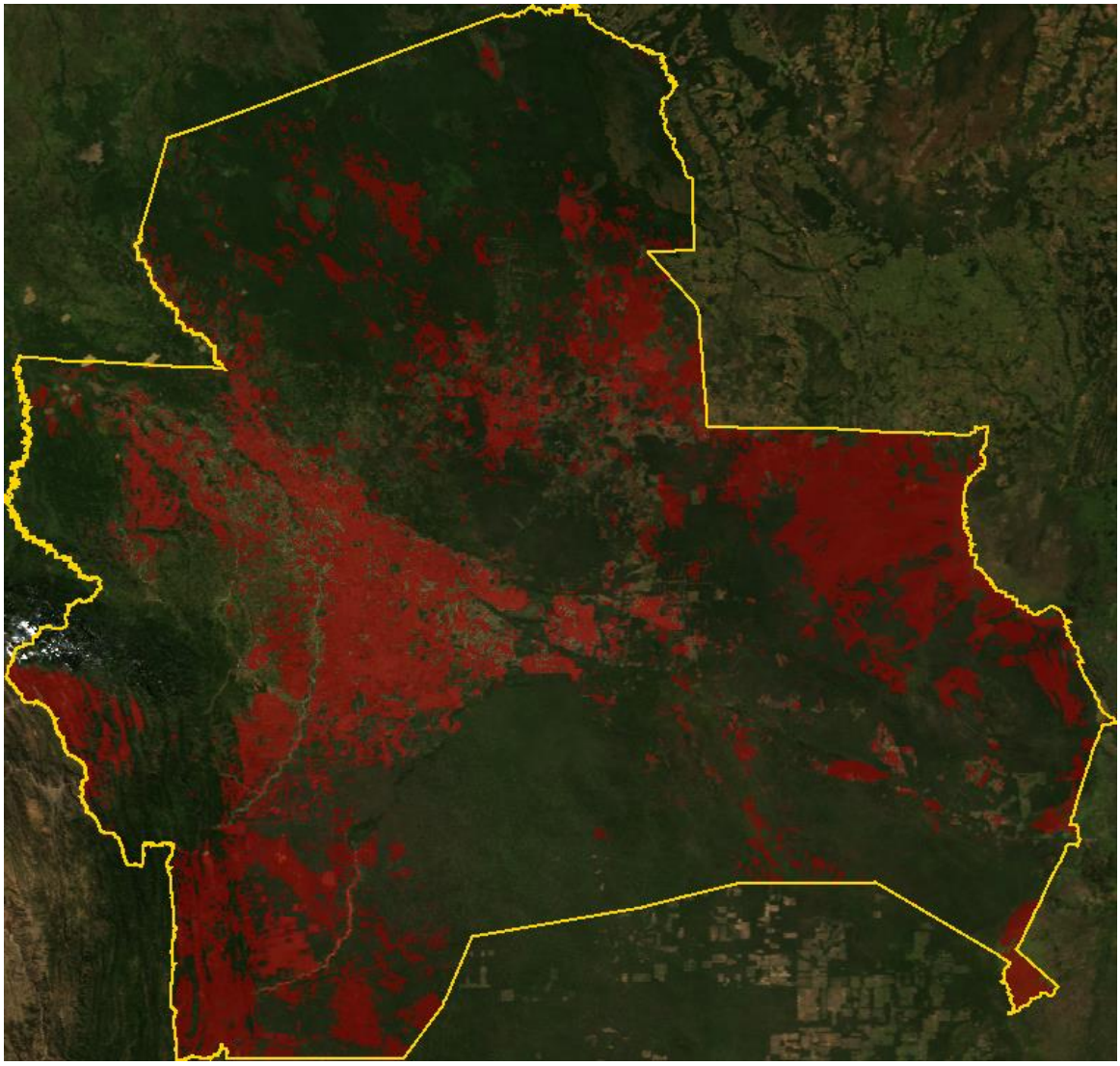

Figure 4. Static Map showing the burned area for 2024 in Santa Cruz, Bolivia. The Border is shown in yellow, the burned area is highlighted in dark red. The Basemap shows a cloudmasked, composite satelite image, made from MODIS data.

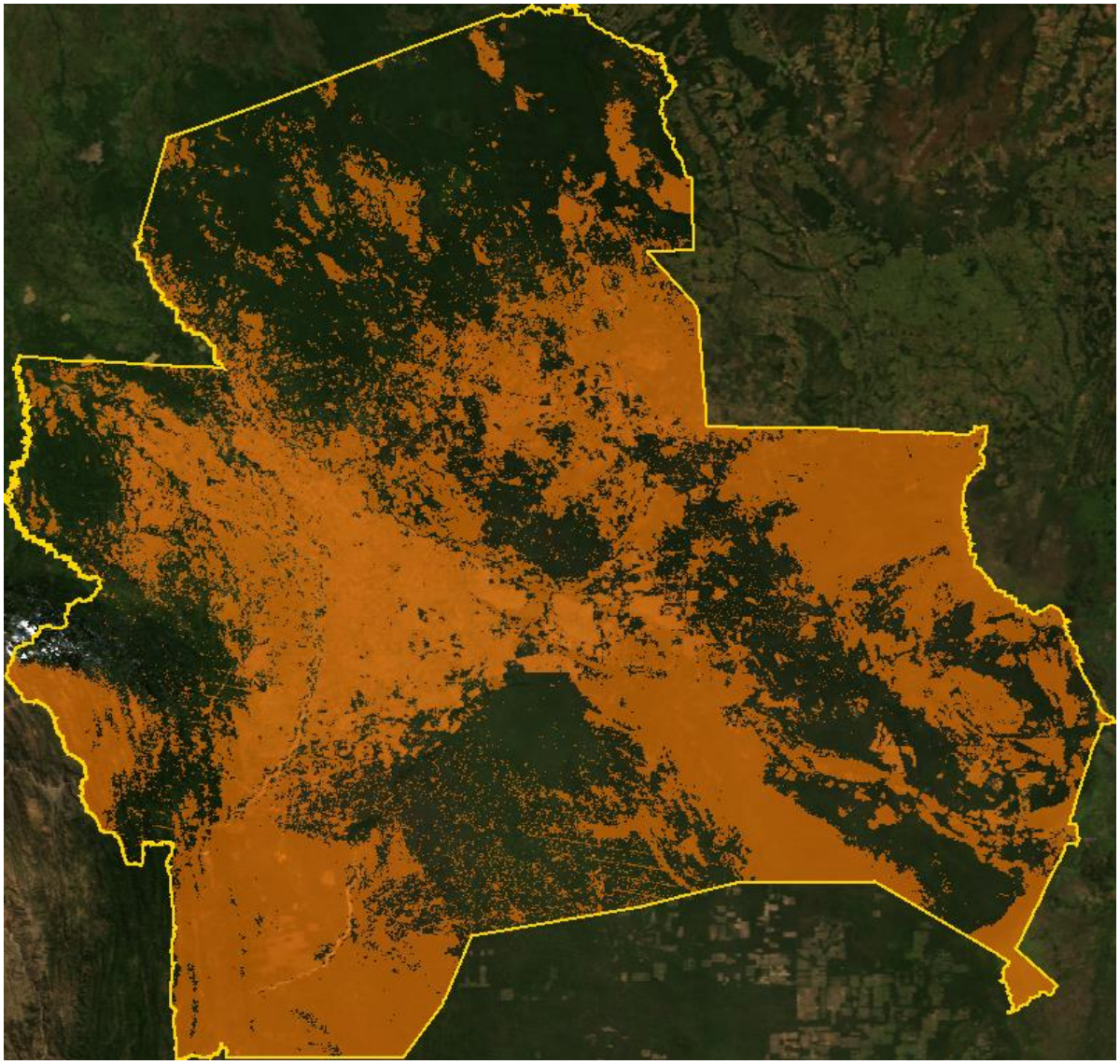

Figure 5. Static Map showing the annual burned area from 2000 to 2024 in Santa Cruz, Bolivia. The Border is shown in yellow, the burned area is highlighted in orange. The Basemap shows a cloudmasked, composite satelite image, made from MODIS data.