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Wildfires in the Amazon region 2019

Artes, T., Oom, D., San-Miguel-Ayanz, J

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Contact information
Name: Global Wildfire Information System
Address: https://gwis.jrc.ec.europa.eu
Email: jrc-effis@ec.europa.eu
Tel.: +39 0332 786138

EU Science Hub
https://ec.europa.eu/jrc

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Contents

Executive summary

In 2019, the Amazon region and neighbor countries were affected by an intensive fire activity, above the norm in that region. Given the magnitude of the fire episodes in 2019, wildfires became a concern for society as well as for policy makers in Europe and elsewhere.

This report describes the trends of wildfires in the Amazon in 2019 through the comparison with the fire activity in the region in the period 2001-2019. The report has been produced by the European Commission's Joint Research Centre (JRC) within its activities on the development of a Global Wildfire Information System (GWIS)[1].

- About 47 Million ha of land burnt in 2019 in the Amazon region, within Brazil, Bolivia, Paraguay and Peru, an area larger than Sweden.
- Nearly 33.6 Million ha burnt in Brazil in 2019, which is approximately four times more than the total burnt area in the country in 2018 (8.8 Mha). The number of fires in 2019 is within the average of the period 2001-2018, while the burnt area so far is above the average.
- The area burnt in the Brazilian Legal Amazon[2] region is about 21.7 Million ha, the highest total annual values of burnt areas since 2010, which was a critical year of fire activity.
- The burnt areas in Brazil and within the Brazilian Legal Amazon region are above the average, as compared to the trends in the period 2001-2018. In 2019, there were periods of intense fire activity; e.g. nearly 3 Mha were burnt in Brazil in a 10 day period, August 20th-30th, 2019.
- Bolivia experienced large and severe fire episodes in 2019, with a total yearly burnt area higher than the annual burnt area in all the precedent years, since 2011.
- As in the case of Bolivia, large fires occurred in Paraguay in 2019. A total of 3.5 Mha has burnt in Paraguay in 2019, above the average from 2001 to 2018 but with lower number of fires.
- Peru almost doubled the burnt area of 2018 during 2019 with a relatively small average fire size. There was an increase of fire activity in Peru in 2019, as compared to the trends in the period 2001-2018.

1 Introduction

This report provides an insight of the fires which took place in Amazon region and neighbor countries during 2019 and analyzes the fire seasonality based on remote sensing data acquired from 2001 to 2018.

In the first section of this report, we present trends on the number of fires and the burnt areas in the Brazilian Legal Amazon[2] (BLA), Brazil, Bolivia, Peru and Paraguay. The Brazilian Legal Amazon is a geopolitical region established by the Brazilian Federal Law 1806/1953 and includes 9 Brazilian states. It comprises approximately five million square kilometers (61% of the country's total area). Overall, the Amazon biome covers around 65% of the Brazilian Legal Amazon and expands in the areas of Peru and Bolivia, which are analyzed in this report. In addition to the analysis of fires in the Brazilian Legal Amazon, individual analyses are performed at country level for Brazil, Bolivia, Paraguay and Peru.

Wildfires are often used as a tool for clearing forested areas which are then used for non-forestry purposes, such as crops or cattle rising. Often, the variability in the rate of deforestation is related to the number of fires and the area they burn in many regions of the world. In 2019, critical fires have taken place in very diverse regions of the world, including the Artic, Siberia and currently the Amazon.

The fire data described in this report are derived from satellite imagery from the NASA MODIS and VIIRS sensors, within the JRC's work on the development of the Global Wildfire Information System (GWIS). GWIS aims at establishing a platform to provide harmonized information on wildfires at the global level, supporting wildfire management at national, regional and global scales. This initiative is actively supported at the global scale by

1 https://gwis.jrc.ec.europa.eu
2 https://en.wikipedia.org/wiki/Amazônia_Legal

scientists[3] and managers[4]. GWIS[5], led by JRC, is an activity under the umbrella of the Group on Earth Observations (GEO) and the EU Copernicus program, actively supported by NASA[6].

2 Data and methods for wildfire analysis

Active fires may cover a significant area as they spread, being detected by the satellite sensors at multiple locations. The proximity or contiguity of active fire detection (hot spots) is used in GWIS to identify **single fire events** that are represented by simultaneous multiple active fire detections by the satellite sensors. Often, data presented in the media refer to active fire hot spots, which are often part of a single fire event. **GWIS presents trends in number of single fire events**, while active fire hot spots represent fire activity and are not necessarily correlated the number of single fire events. We consider the methodology used in GWIS, which is consistent with the methodology used in the European Forest Fire Information System (EFFIS) under the EU Copernicus Emergency Management Services, as the most robust method to estimate the number of fire events in a region or a country.

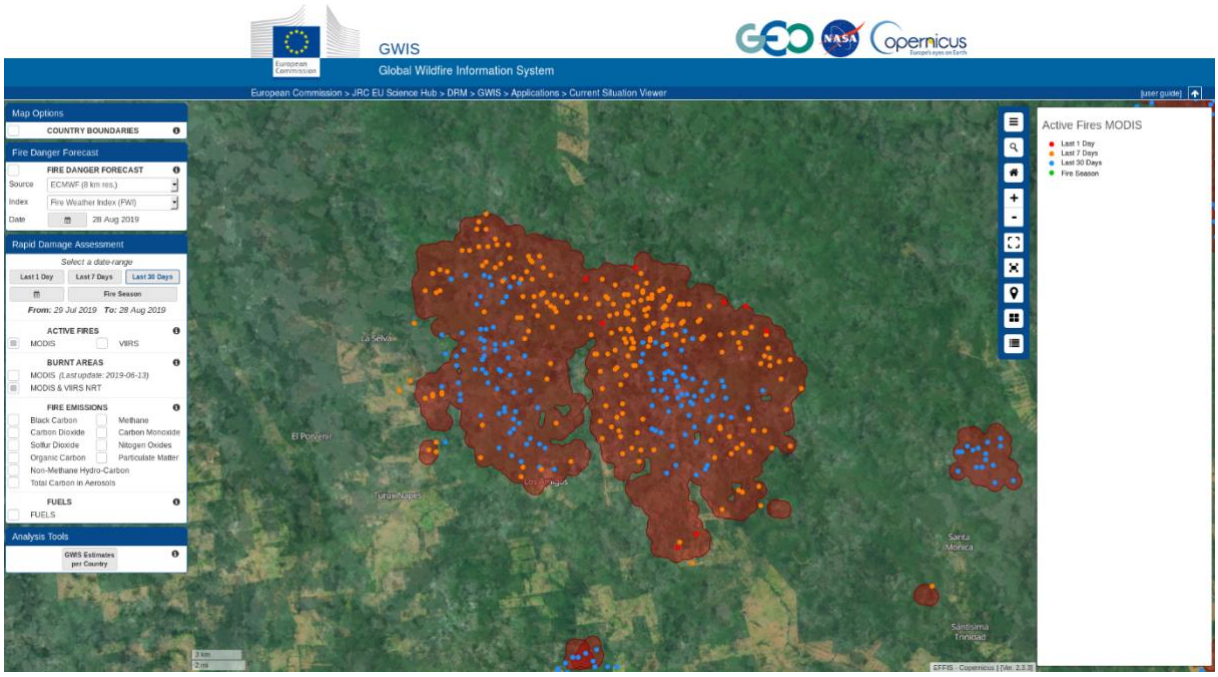


Figure 1 shows a screenshot from the GWIS Current Viewer. Active fires from MODIS are visualized with points in different colors. The polygons on the background are the fires counted by GWIS in near-real time.

The data presented in this report are produced by GWIS on the basis of satellite imagery. Currently, the near-real time mapping of single fire events in GWIS is based on data from the NASA MODIS and VIIRS satellite sensors, which allow a frequent coverage of fire activity around the world, with up to 6 daily updates. Near-Real time burnt area data are routinely derived in GWIS from the same sensors, i.e. MODIS and VIIRS, once a day. This method for near-real time mapping of active fires and burnt areas is referred to as GWIS NRT. The GWIS NRT methodology is able to detect fires with a minimum size between 14ha to 100ha approximately. The accuracy of the mapping of wildfires decreases as the fire size gets close to the minimum detectable size.

In addition to the GWIS NRT method used for near-real time mapping of active fires and burnt areas, GWIS uses a historical database[7] of active fire hot spots and burnt areas derived by NASA FIRMS from the MODIS sensor. The methodology to derive wildfires and burnt area trends from these data is referred to as GWIS MODIS. These data, which allow for the analysis of time series back to the year 2001, are produced and published by NASA with

3 BOWMAN, David. Wildfire science is at a loss for comprehensive data. Nature, 2018, vol. 560, no 7716, p. 7-8.
4 ROBINNE, F.-N., et al. Global fire challenges in a warming world.
5 GWIS draft Work Program 2020-2022
6 NASA GEO-GWIS portfolio
7 ARTÉS, Tomàs, et al. A global wildfire dataset for the analysis of fire regimes and fire behaviour. Scientific data, 2019, vol. 6, no 1, p. 1-11.

a nearly 3-month delay. Therefore, these data are not used to produce near-real time information, but to compare this with historical fire trends. The ground spatial resolution of the above data is approximately 500 m, which allow for the analysis of wildfire trends at national and global levels, although it is not suitable for the analysis of wildfire trends and burnt areas in countries in which the average wildfire size is around 100 ha or below.

In the chapters that follow, the GWIS MODIS methodology was used to derive trends of wildfires and burnt areas for the period 2001-2018. For the year 2019, the GWIS NRT method was used for all countries except for Peru, as the data were derived in near-real time during the 2019 wildfire season.

When comparing the GWIS MODIS used for the mapping of fires in the time series 2001-2018 with GWIS NRT it becomes evident that the latter is able to detect many more small fires than the GWIS MODIS method. When the average fire size is a country is well above 100 ha, the difference in the estimation of number of fires and burnt areas is negligible. However, in countries like Peru, in which the average fires size is 103 ha, both datasets could provide different results when monitoring small fires for large areas during long time periods. For this reason, data derived by the GWIS MODIS method were used for the analysis of wildfires in Peru in the whole time series 2001-2019 (see section 8).

3 Wildfires in the Amazon Region

Just for display purposes, Figure 2 shows the active fires from MODIS for the years 2017, 2018 and 2019. The fire activity is noticeable higher in 2019, as compared to the two previous years, especially in the center and southern part of the region.

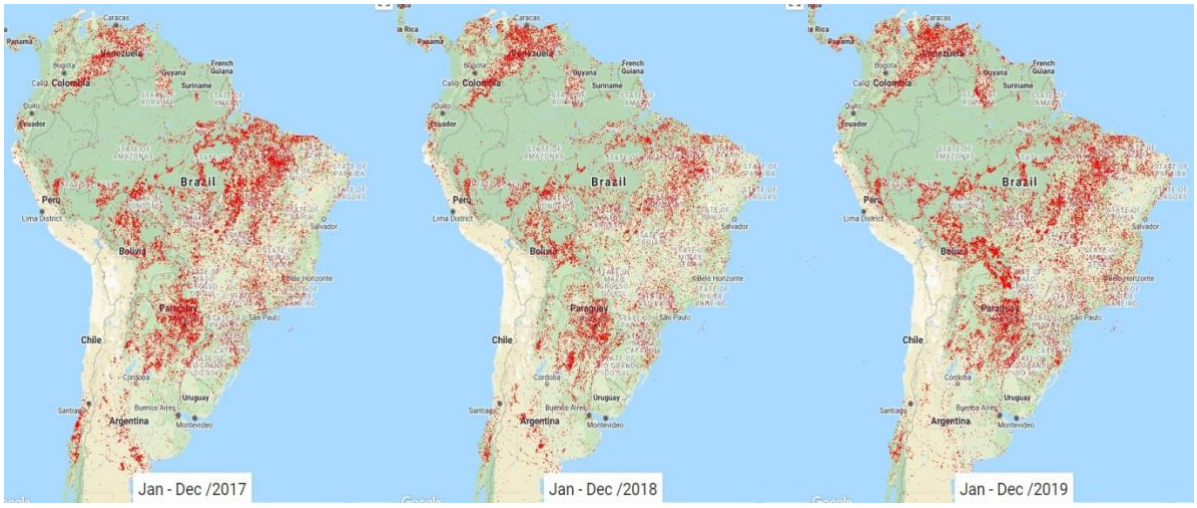


Figure 2 on the spatial distribution of fires in the whole region for the years 2017, 2018 and 2019

As mentioned in the Introduction, this report presents trends on the number of fires and the burnt areas in the Brazilian Legal Amazon, Brazil, Bolivia, Peru and Paraguay. Figure 3 shows the geographical extent of these areas. The Brazilian Legal Amazon is a region within Brazil, shown in the Figure 3 by a polygon filled with a pattern. The color display matches with the colors used in the graphs for each region/country in the next sections, except for the Brazilian Legal Amazon, for which graphs in blue are presented.

Figure 3. Areas analyzed in this document: Brazil, Bolivia, Peru, Paraguay and the Brazilian Legal Amazon within Brazil

3.1 Seasonality of fires, burnt areas and fire size

Figure 4 and 5 shows the monthly distribution of the number of fires and burnt areas respectively in the BLA and the countries. In most countries, the peak of the fire season, as regards the number of fires, spreads between July and October; however, fire activity is still relevant in Brazil and in the Brazilian Legal Amazon region during November and December. However, there is internal variability within these large countries, which is not reflected in the country statistics. For instance, in some regions of Brazil, such as the Roraima state, the core of the fire season is between January and March.

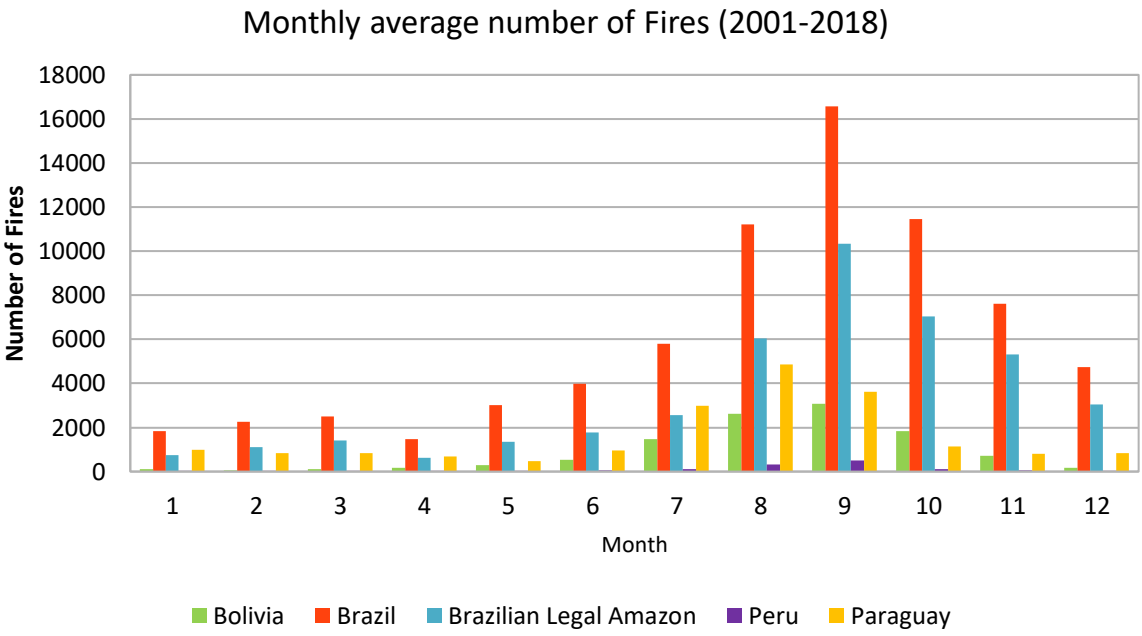


Figure 4 Average number of fires per month

In the BLA and in all the countries fires burn throughout the whole year, but most of the burnt areas occur between July and October. Although often a high number of fires in Brazil occur in the last two months of the year, the amount of area burnt by these fires is not as significant as that of the fires in the period July-October.

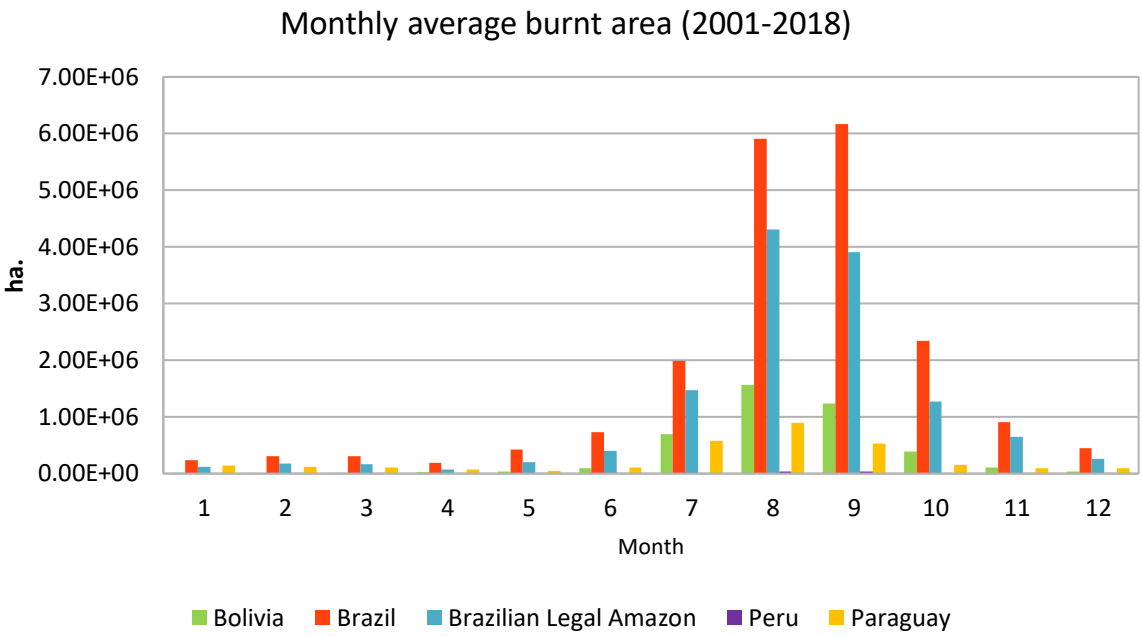


Figure 5 Average burnt areas per month

The largest fires, as shown in Figure 6, occur in August, although large fires also take place in July and September. These fires are the result of most of the burnt area in the countries, which, as presented above, occurs between July and October. As in many other regions of the world, most of the burnt area in the countries is caused by a small percentage of large fires; for instance, in Europe, on average, about 3% of the fires are responsible for 85% of the total yearly burnt area.

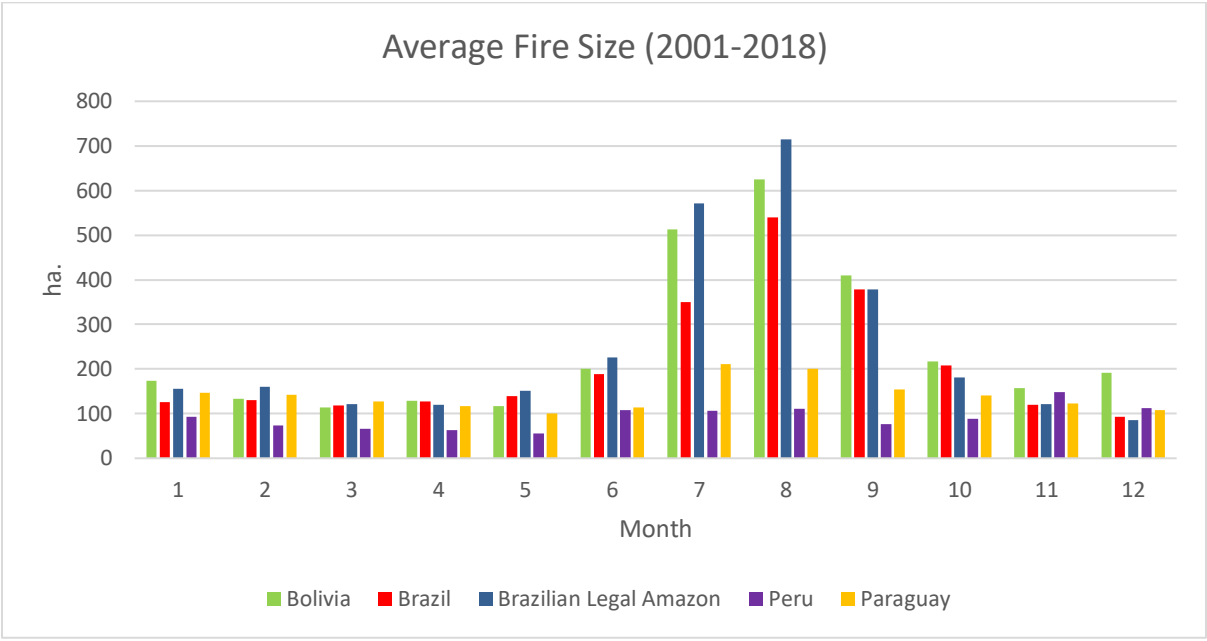


Figure 6 Average fire size per country in the period 2001-2018

Trends in the number of fires and burnt areas

The number of fires in 2019 was compared to the historical data for the years 2001 to 2018 in all the countries and in the Brazilian Legal Amazon Region. The resulting graph is presented in Figure 7. For instance, in Brazil the number of fires was the highest in the last decade, although larger values were reached in 2004, 2005 and 2007.

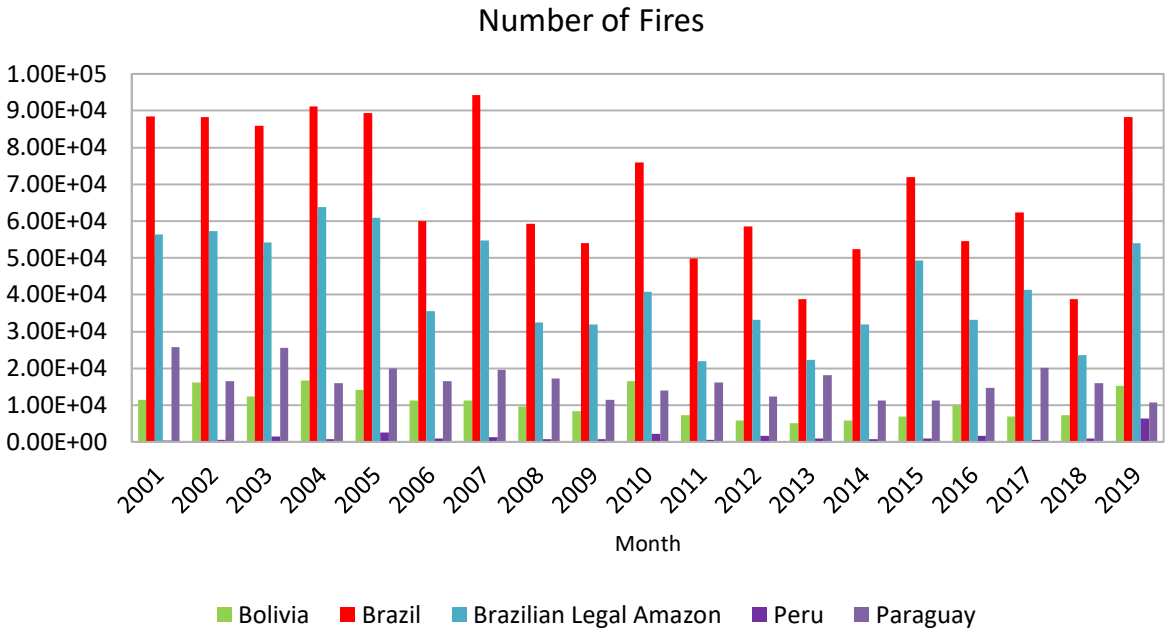


Figure 7 Trends of number of fires per country in the period 2001-2019.

In 2019, the numbers of fires in all the countries, except for Paraguay, are higher than the values of the last decade, and this is the case also for the number of fires in the Brazilian Legal Amazon Region.

Regarding burnt areas, the results presented in Figure 8 show that burnt areas in the countries and those in the Brazilian Legal Amazon Region reached high values in 2019, as compared to those in the last years. Within the last decade, the burnt areas were only larger in some countries in 2010, which was an exceptional year in the Amazon region. The spatial distribution of the fire frequency and seasonality is shown in Figure 9. This shows, for instance, that most of the big fires in Bolivia took place in areas that rarely burnt in previous years. The analysis per country/region is done in the next sections.

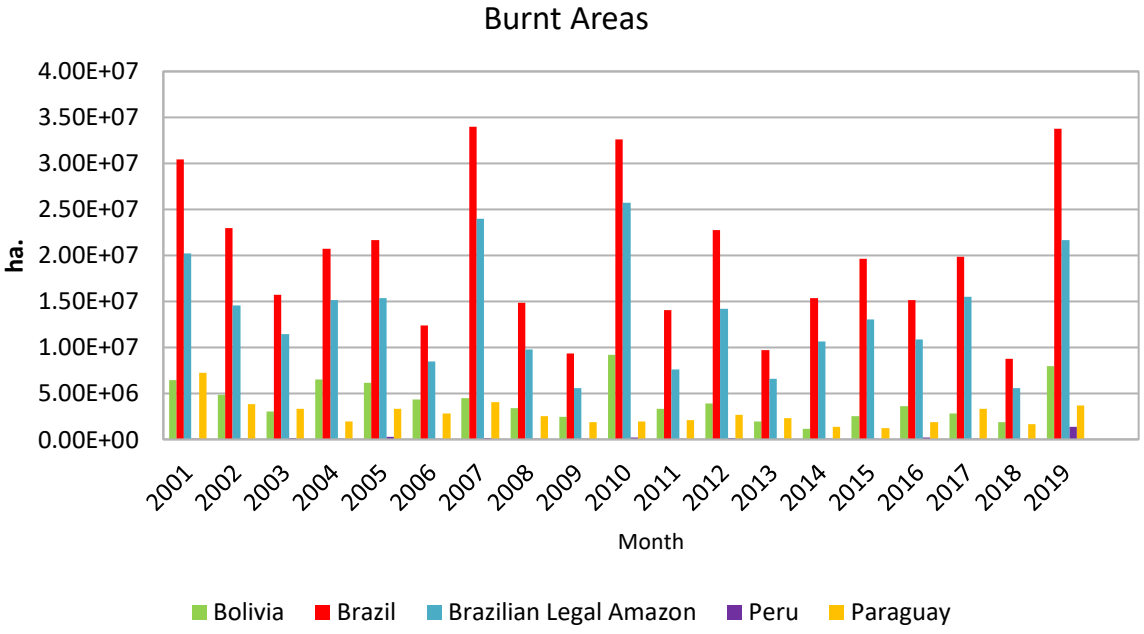


Figure 8 Trends of burnt areas per country in the period 2001-2019

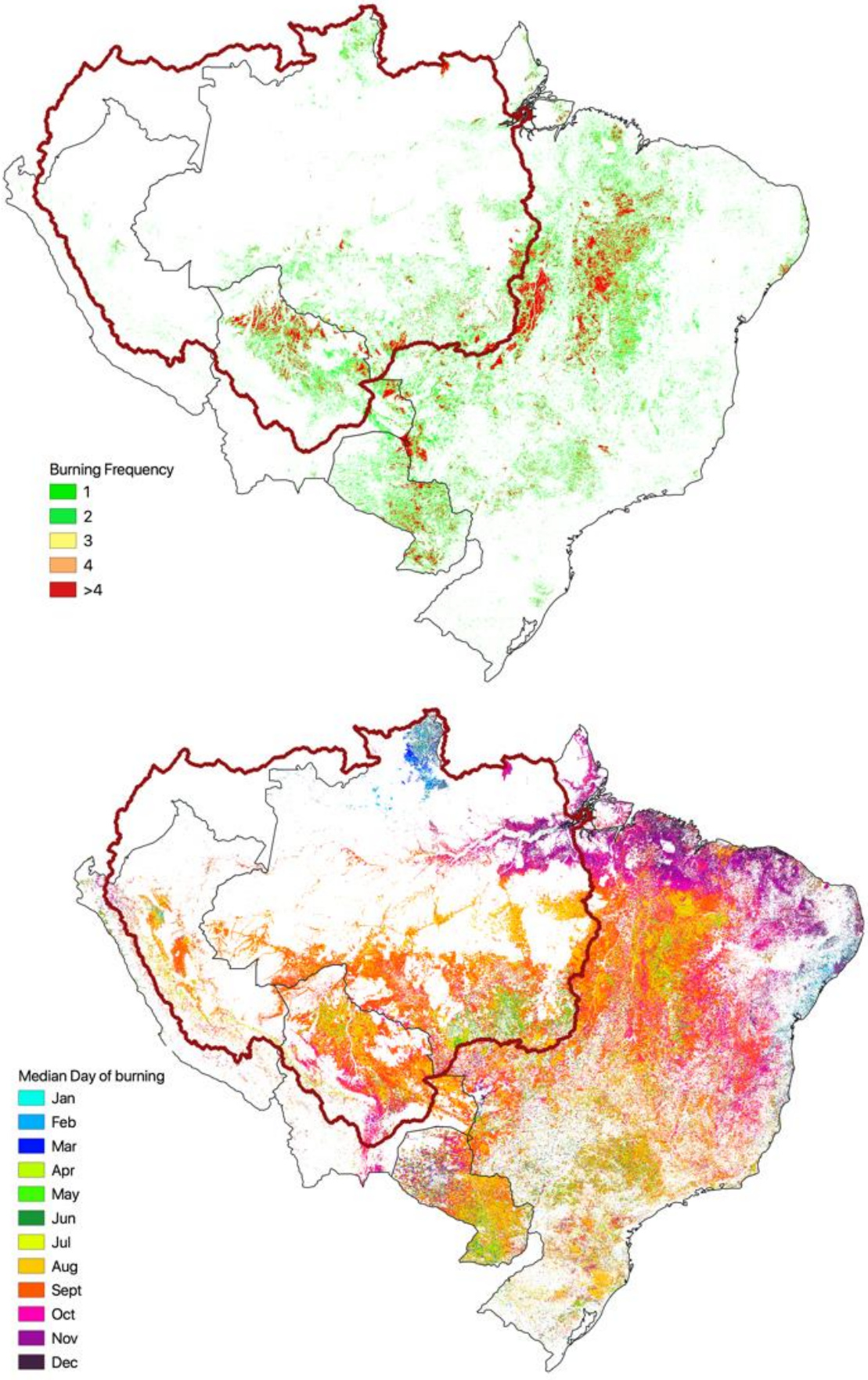


Figure 9 Burning frequency and Median day of burning in the Amazon region

4 Wildfires in the Brazilian Legal Amazon Region

4.1 Trends in the number of fires and burnt areas

Figure 10 shows the spatial distribution of burnt areas for 2019 produced by the Near-Real Time process in GWIS, and Figure 11 shows the trends of number of fires and burnt areas from 2001 until 2019.

The year 2019 was one of the worst years in the BLA region as regards both the number of fires and the burnt areas. As shown in Figure 8, in the BLA, critical years in terms of burnt areas were 2001, 2007 and 2010. The total burnt area in 2019 was higher than the total burnt area in the previous years, since 2011, and only smaller than the burnt area of critical years such as 2007 and 2010, since 2001.

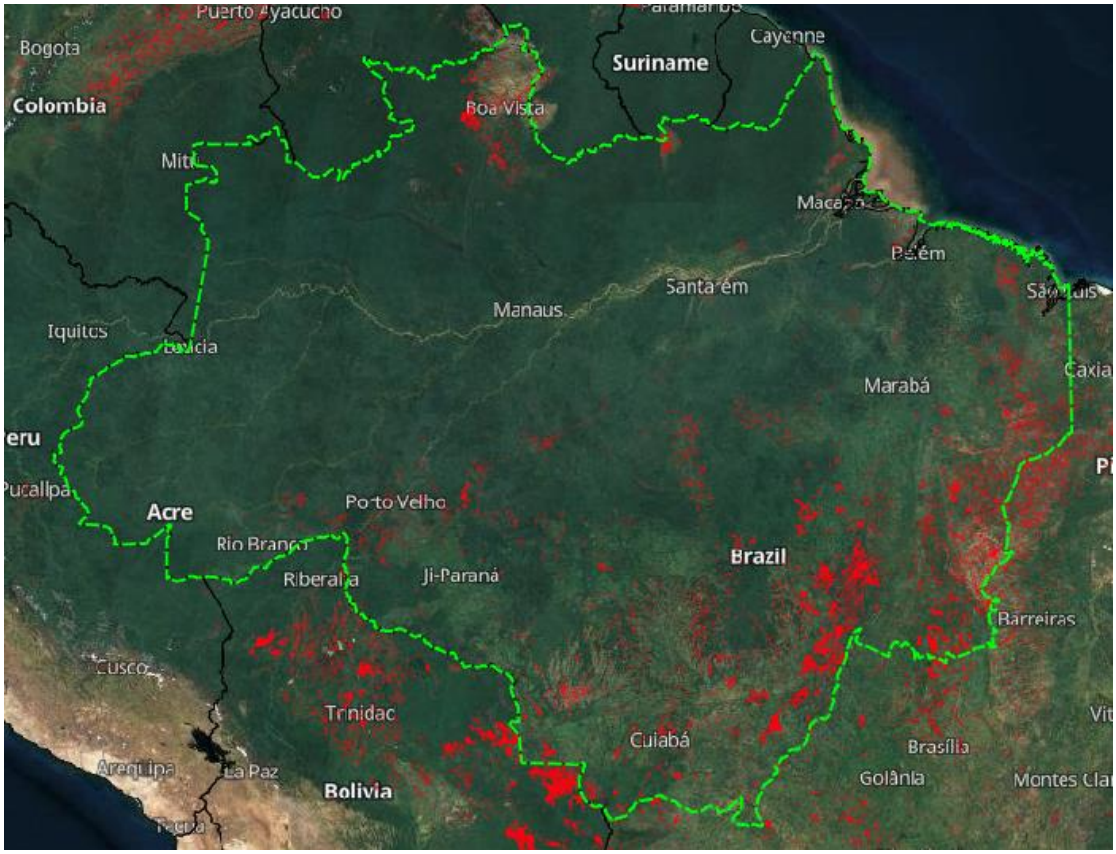


Figure 10 GWIS burnt areas for 2019 in Brazilian Legal Amazon

For the number of forest fires, values larger than those in 2019 only occurred before the year 2005, while the total burnt area in 2019, estimated in about 21.7 Mha, was only surpassed by that of the years 2007 and 2010 in the time series 2001-2018 (see Figure 11). The number of fires in 2010 and 2019 was lower than in the period 2001-2005, while the burnt area was among the highest in the whole time series. The high values of burnt areas are explained by the occurrence of large fire events that resulted in a large total burnt area in the region. The year 2010 was an exceptionally dry year with very large wildfire episodes. The average fire size in 2010 was 631 ha, while the average fire size in the series 2001-2018, excluding 2010 is 288 ha. The average fire size in 2019 was 402 ha, above the average fire size of the reference period 2001-2018. This shows that 2019 was a critical year characterized by large fire episodes. The cumulative trends in the burnt areas and the number of fires shows how 2019 departs from the average trend of the previous years in July, maintaining higher values of bot variables until the end of the year (see Figure 11).

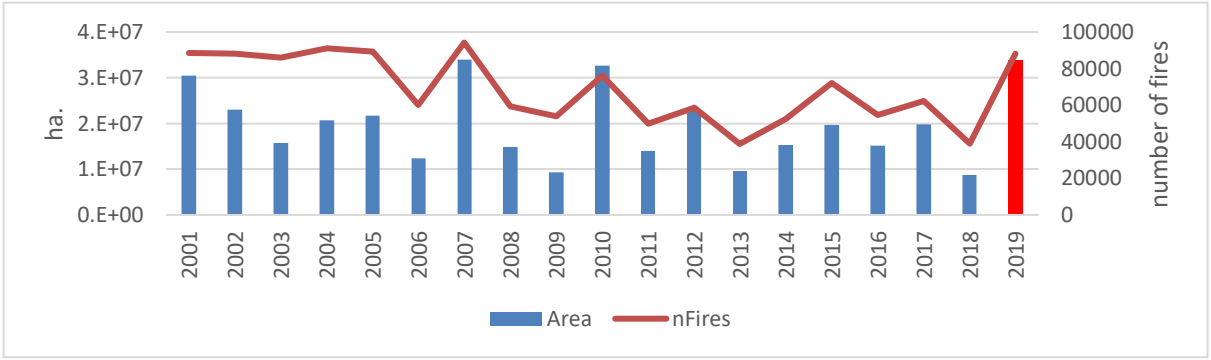
Figure 11 Trend of number of fires and burnt areas (above) and cumulative trends of number of fires and burnt areas of 2019 compared to the historical average 2001-2018 (below).

5 Wildfires in Brazil

5.1 Trends in the number of fires and burnt areas

Since the Brazilian Legal Amazon area is a considerable proportion of the area of Brazil, the peaks of fire activity in 2007 and 2010 are present in both the BLA region and the country. The spatial extent of the burnt areas in the country is presented in Figure 12. Although most of the burnt areas occurred in the center of the country, the fire activity and the resulting burnt areas show a wide spread from north to south, including the humid Amazon forest. The 2019 fire season in Brazil shows a large burnt area and a relatively low number of fires (see **Error! Reference source not found.**). The trends in number of fires and burnt areas, as compared to the period 2001-2018, show that 2019 was a critical year in terms of burnt areas, with an estimated burnt area over 33 Million ha, only surpassed by the values reached in 2007. The number of fires was also high, only surpassed by the number of fires in 2005 and 2007. It is noticeable that, in 2019, the total amount of burnt area at the end of the year was considerable higher that the average in the period 2001-2018, while the number of fires is less than the average. This fact points to an average fire size in 2019 bigger than the normal trend in 2001-2018.

Figure 12 GWIS burnt areas for 2019 in Brazil



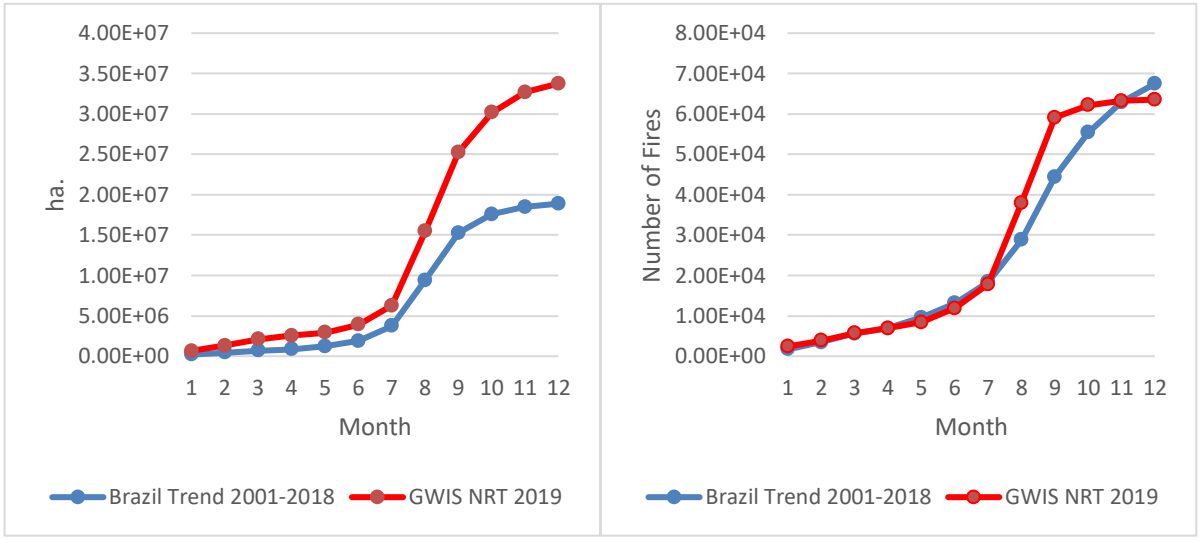


Figure 13 Trend of number of fires and burnt areas (above) and trend of 2019 data as compared to the historical average.

The trends of the number of fires in Brazil and the Brazilian Legal Amazon region are similar. Out of the total burn area in Brazil in 2019 (33.7 Mha), nearly 63% (21.7Mha) of the area was burnt in the Brazilian Legal Amazon region, while 12 Mha were burnt outside it.

The burnt area estimated by GWIS (33.7Mha) is similar to the one declared by the Brazilian Instituto Nacional de Pesquisas Espaciais (INPE), 31.84Mha, despite the fact that both assessment systems using different methodologies.

6 Wildfires in Bolivia

6.1 Trends in the number of fires and burnt areas

In 2019, Bolivia experienced larger fires than the average fires registered in the period 2001-2018. The total burnt area in the country in 2019 (8 Mha), is the second highest value for burnt areas reached in the country, and is only comparable to that of 2010 (9 Mha), in the time series 2001-2018 (see Figure 15). The number of fires was also high in 2019, only surpassed by the number of fires in 2002, 2004 and 2010. The spatial distribution of burnt areas in Bolivia in 2019 is shown in Figure 14. Many of the large fires occurred in the south east of the country, in areas where the occurrence of wildfires is not frequent (see Figure 9).

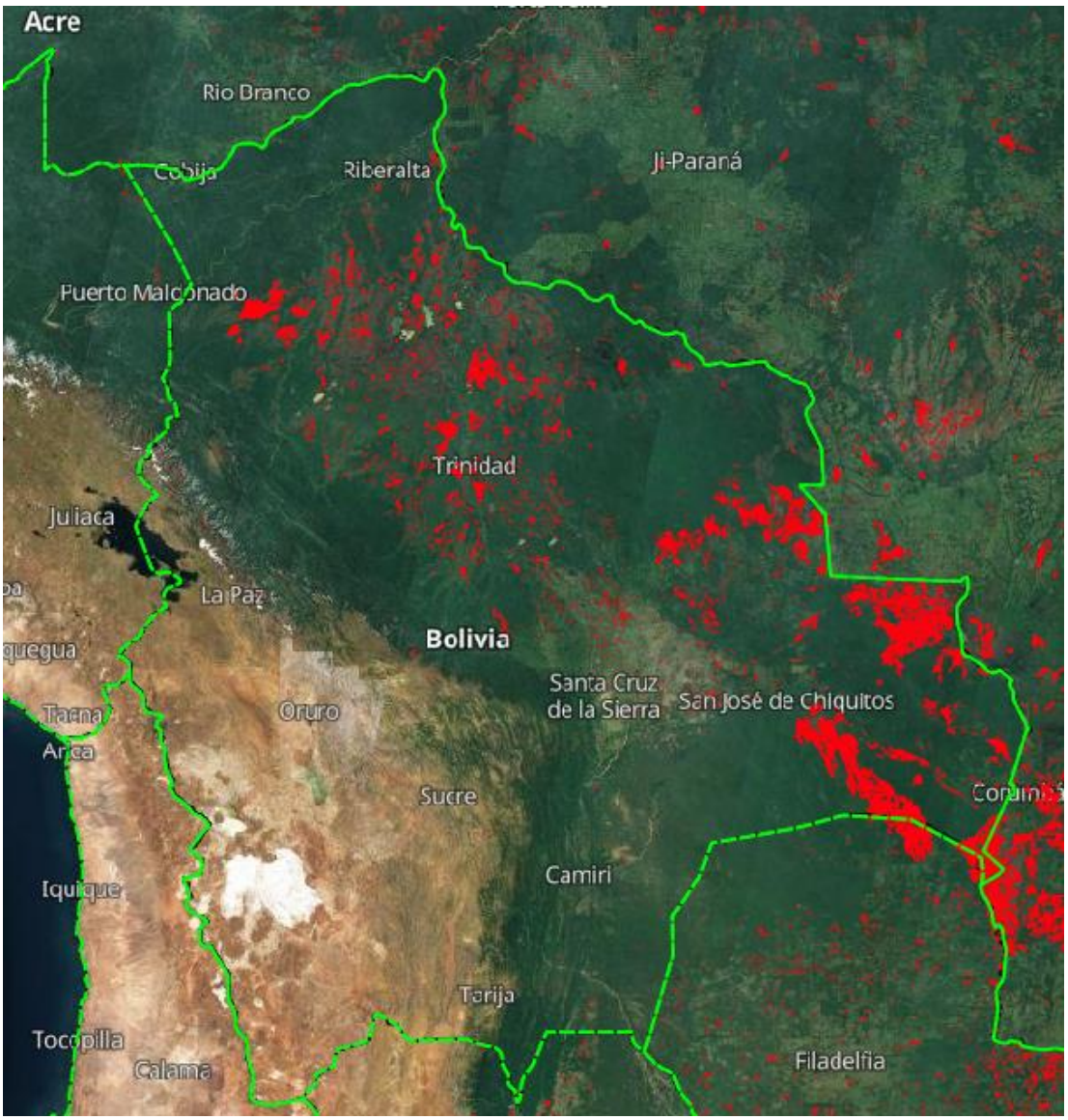


Figure 14 GWIS burnt areas for 2019 in Bolivia

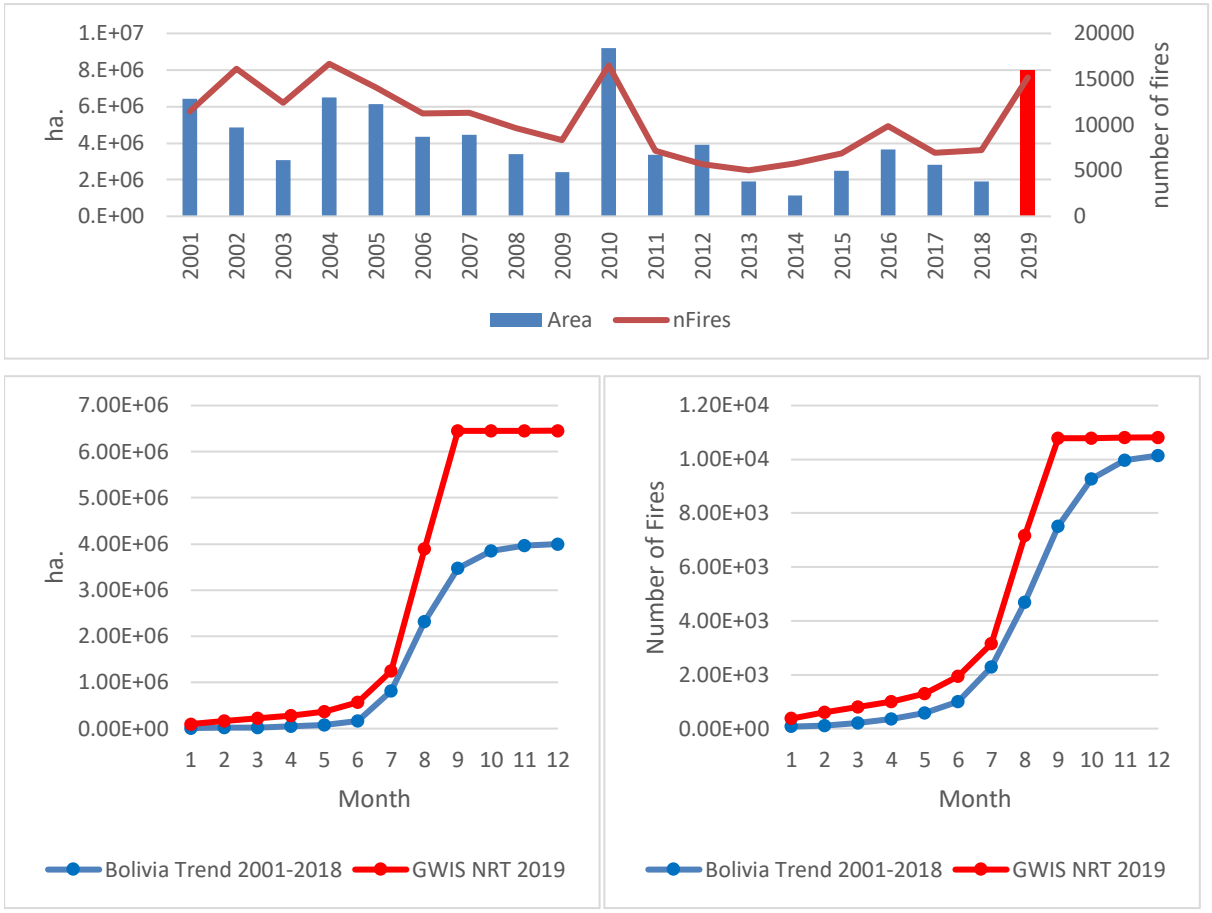


Figure 15 Trend of number of fires and burnt areas (above) and trend of 2019 data as compared to the historical average.

The burnt area and the number of fires in 2019 are above the average of the trend for the period 2001-2018, as shown in Figure 15. Most of the fires and the burnt area they produced was concentrated in the months of July, August and September.

7 Wildfires in Paraguay

7.1 Trends in the number of fires and burnt areas

The 2019 wildfire season in Paraguay resulted in a total burnt area of approximately 3.6 Million ha, which is above the average in the time series 2001-2018. In comparison to the number of fires in previous years, the number of fires in 2019 was not very high, pointing to the fact that the average fire size in 2019 was larger than the average fire size registered in the period 2001-2018 (see Figure 17). The fire season of 2019 was characterized by large uncontrolled fires that resulted in a considerable large burnt area that spread all across the country as shown in Figure 16. The spatial distribution of fires resembles that of a typical fire season, as most fires burnt in areas with a high burning frequency (see Figure 9), except for some large fire episodes in the Central-East part of the country.

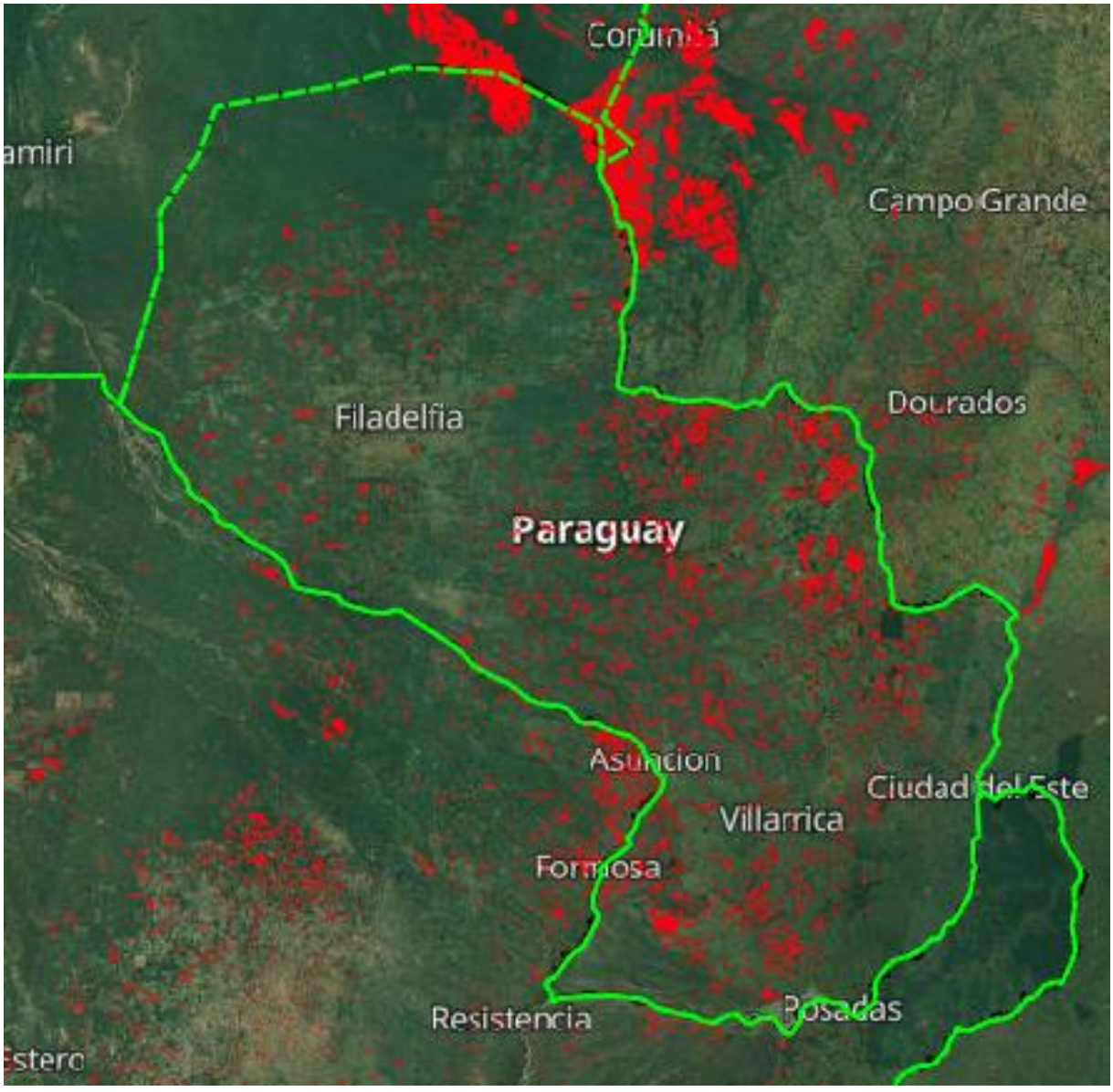


Figure 16 GWIS burnt areas for 2019 in Paraguay

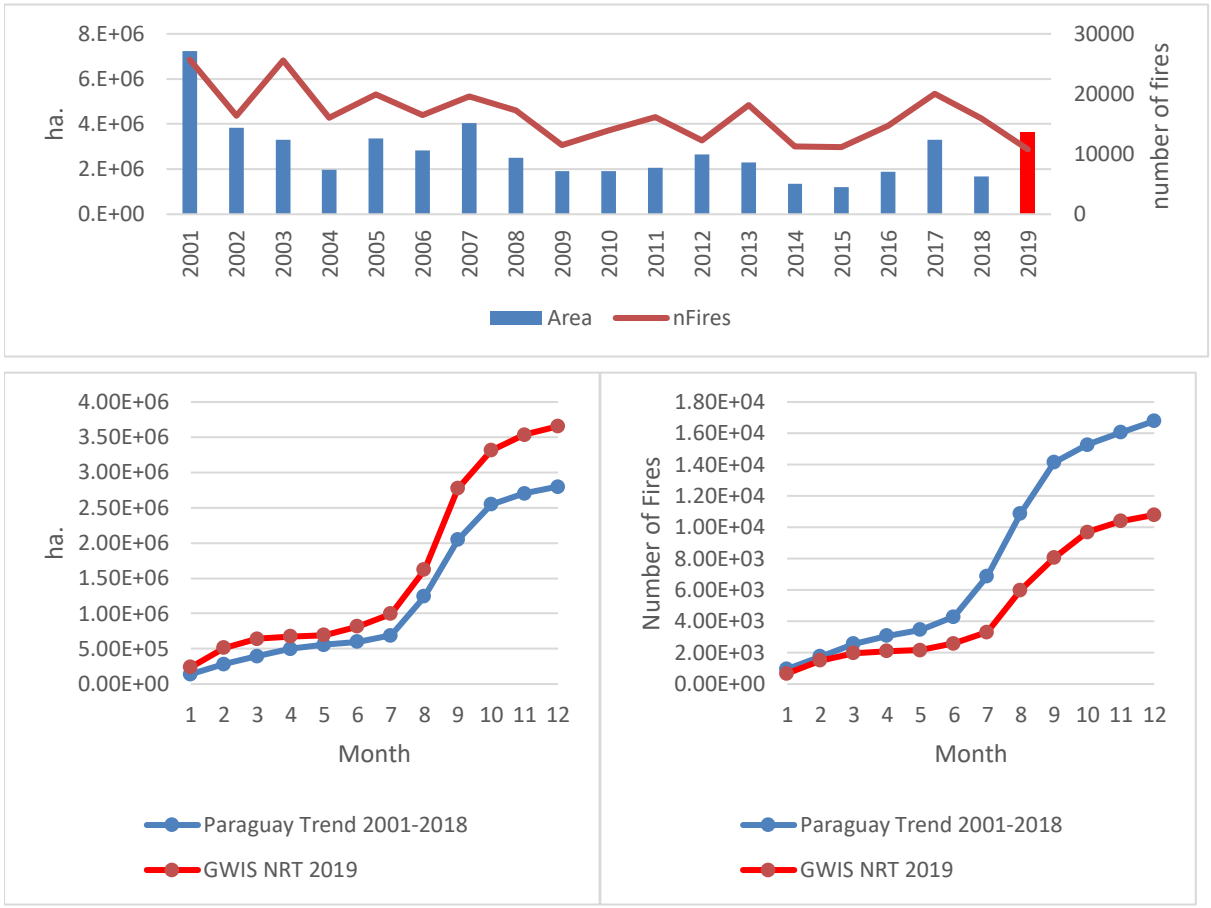


Figure 17 Trend of number of fires and burnt areas (above) and trend of 2019 data as compared to the historical average.

8 Wildfires in Peru

8.1 Trends in the number of fires and burnt areas

The spatial distribution of fires in Peru in 2019 was typical of the fire activity in the country; wildfire occurred in areas that are prone to wildfire activity (see Figure 9). However, wildfire activity in the country is closely related to human practices, which use fire as a tool in agriculture or forestry. Peru had three peaks of burnt areas in 2005, 2010 and 2016. These peaks are also related with an increase in the number of fires. The year 2019 showed an increase of the burnt areas and number of fires, as compared to the average number of fires and the average burnt area in the period 2001-2018. Despite this increase, 2019 cannot be considered an anomalous year.

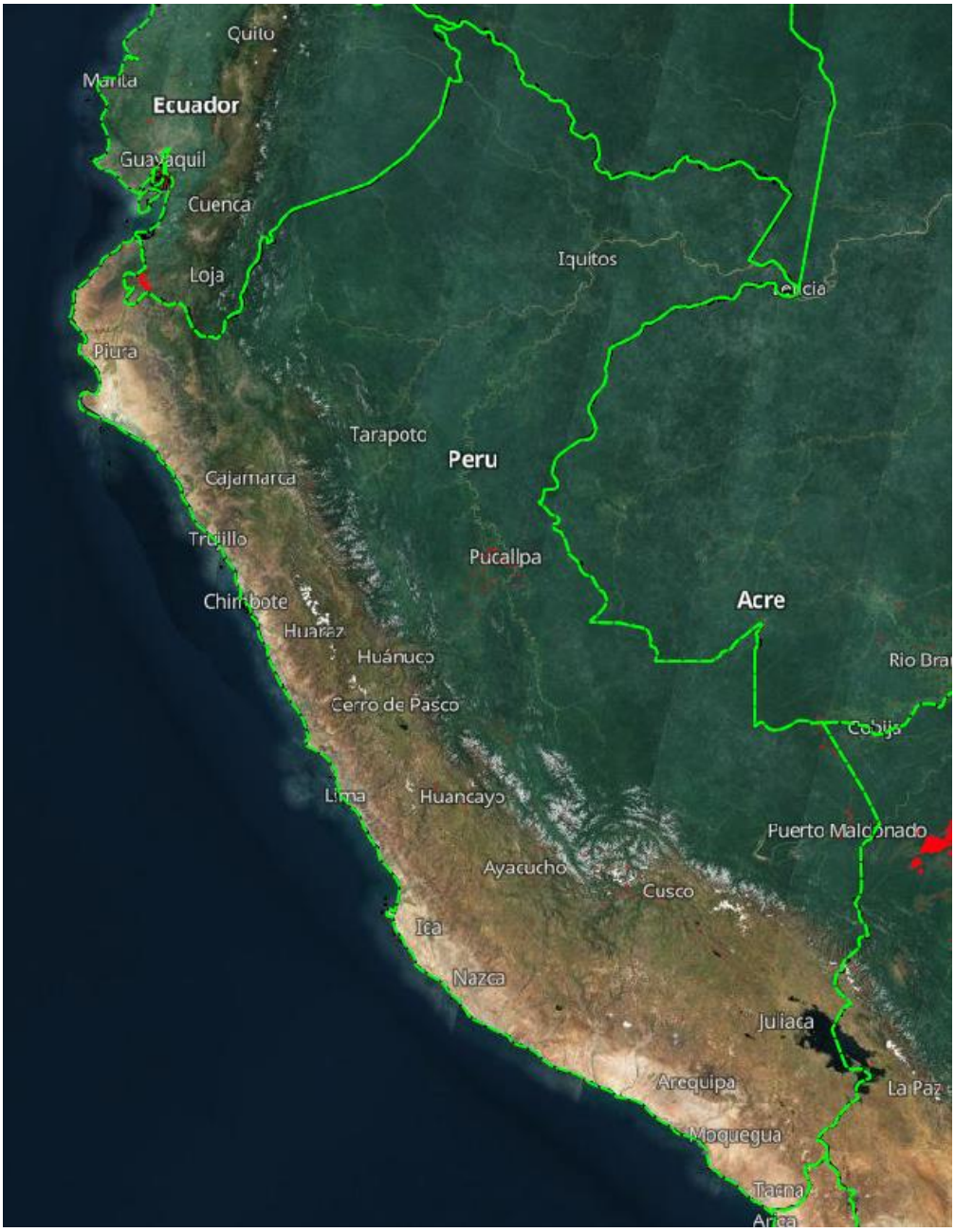


Figure 18 GWIS burnt areas for 2019 in Peru

Since Peru has an annual average fire size of 103ha, the plots in Figure 19 were generated with GWIS MODIS instead of the GWIS NRT. Despite the small average fire size in Peru, our results show that, in 2019, the fire

activity in the country increased compared to that of the last 8 years, except for 2016 (**Error! Reference source not found.**). As in other countries in the Amazon region, 2010 was one of the worst years in the time series 2001-2018. The increase in fire activity in the country is probably not related with uncontrolled wildfires but with an increase of human activities, instead.

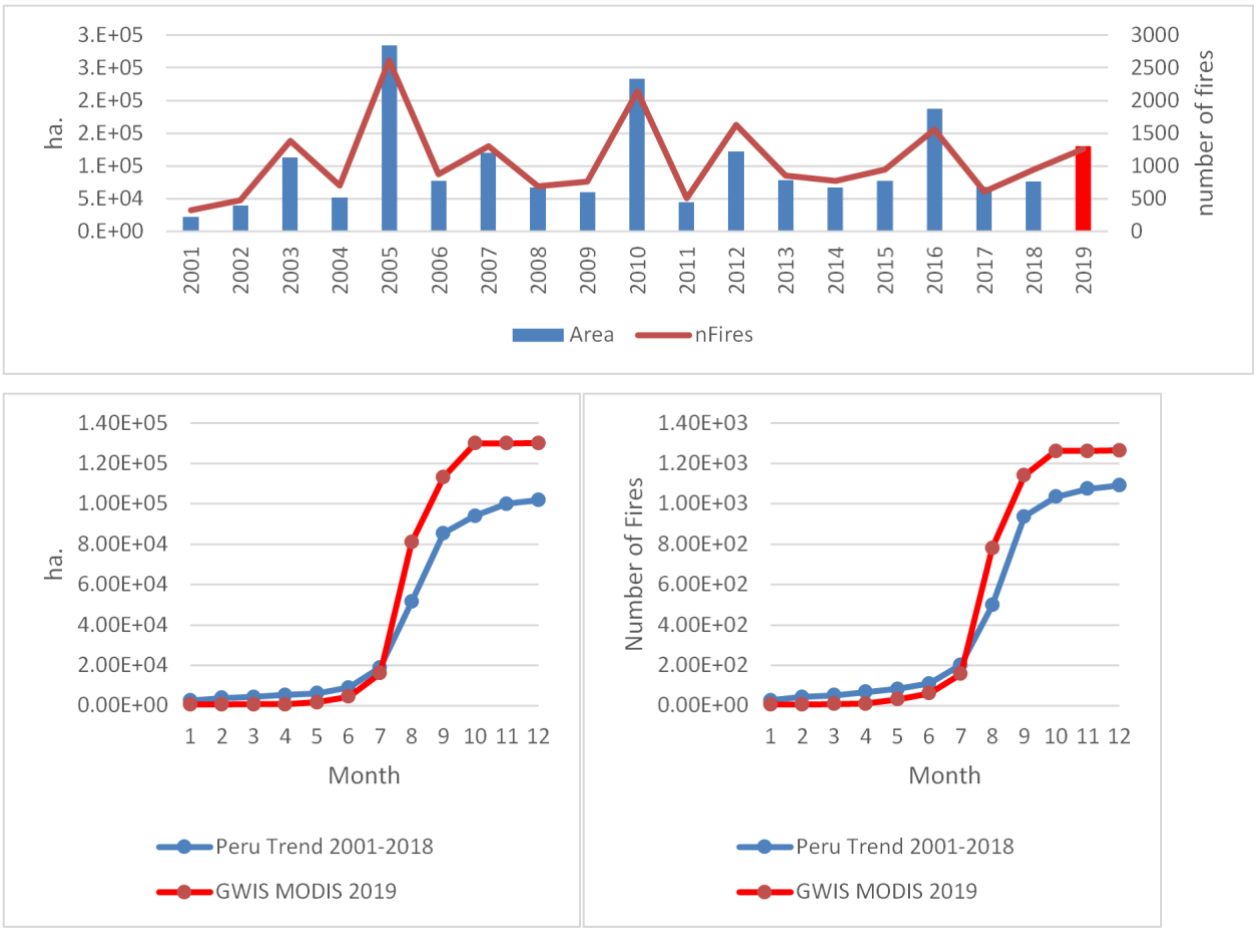


Figure 19 Trend of number of fires and burnt areas (above) and trend of 2019 data as compared to the historical average.

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