European Commission

JRC TECHNICAL REPORT

Analysis of wildfires in the Amazon region by July 15, 2020

2020

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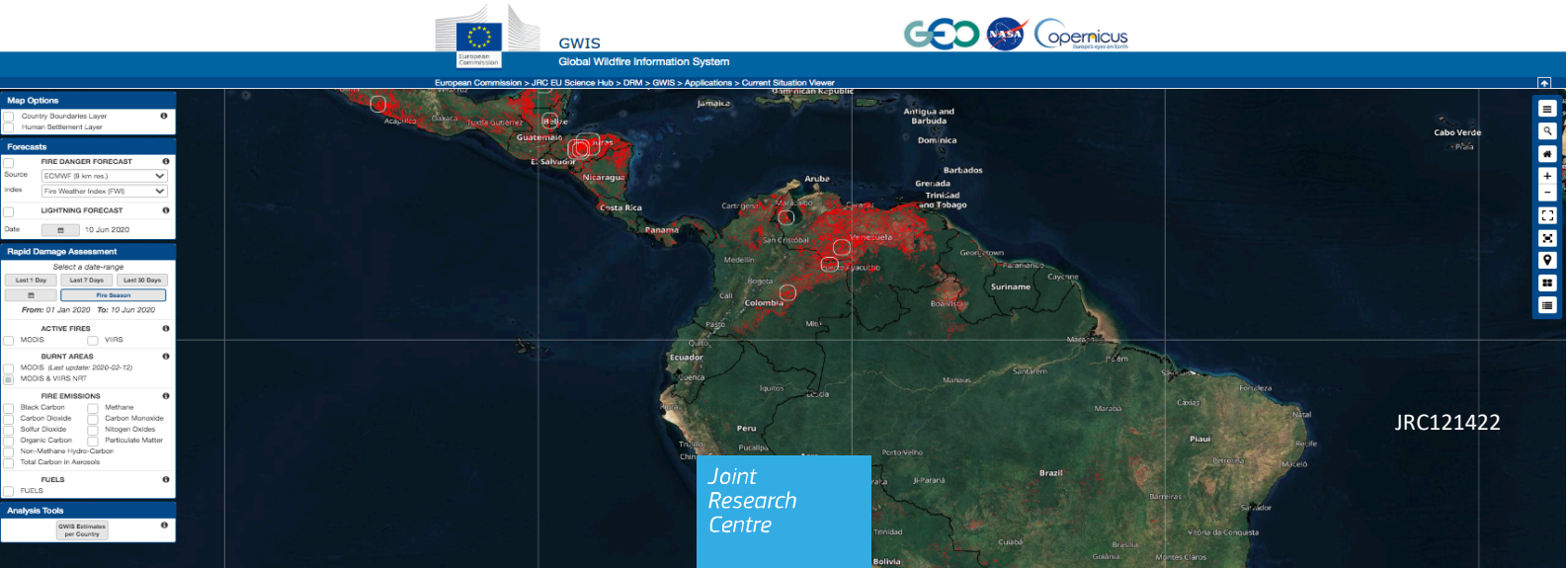

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Contents

Executive summary

This report describes the trends of wildfires in the Amazon in 2020 through the comparison with the fire activity in the region in previous fire seasons. 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].

- The Brazil Legal Amazon shows similar trends as those in previous years, with active fire hot spots above the norm in June. About 2.1 Million ha have been burnt so far in the region.
- The 2020 wildfire season in Brazil is similar to those of past years, but below the impact of the 2019 season, so far. In Brazil, 1.2 Mha of burnt areas have been mapped in June 2020, above the values of 2019. Overall, 3.6 Mha of burnt areas have been mapped in GWIS until July 15, 2020.
- Bolivia had above normal fire activity until May, while burnt areas by 15th of July are at around 640000 ha, which is average when compared to the past years.
- In Colombia, the current fire season has been more severe than the last two years, 2018 and 2019, with larger burnt areas and a higher number of fires. Nearly 3 Mha have burnt in the country until July 15, 2020.
- Paraguay, with 1.8 Mha burnt until now, shows high fire activity with larger fires than in 2018 and 2019, and an increase of burnt areas between March and June, reaching values about 2 times those of the past years.
- Peru shows slightly above average fire activity, with about 200000 ha of burnt areas mapped until now.
- Venezuela, with about 6.8 Mha burnt in the country until now, showed high fire activity until July 15, 2020.
- The number of active fire hot spots detected by satellites is above the norm in June 2020. Until July 15, 2020, over 18 Mha have been burnt in the above countries, while the core of the wildfire season is about to start in July and will peak in the period August – October in all the countries except for Colombia and Venezuela, in which the core of the wildfire season is November – April.
- Seasonal fire weather forecast shows above average temperature and below average precipitation in many areas of the region in the coming months.

1 https://gwis.jrc.ec.europa.eu

1 Wildfires in the Amazon Region

In the Amazon natural fires are rare in absence of humans, in this way fires are often used as a tool for clearing forested areas which are then used for non-forestry purposes, such as crops or cattle rising. Usually, the variability in the rate of deforestation is related to the number of fires and the area they burn.

The Amazon region expands in eight countries: Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname and French Guiana (territory of France). Most of the region is in Brazil, specifically in the Brazilian Legal Amazon (BLA)[2], and in areas of Peru and Bolivia. Figure 1 shows the geographical extent of these areas.

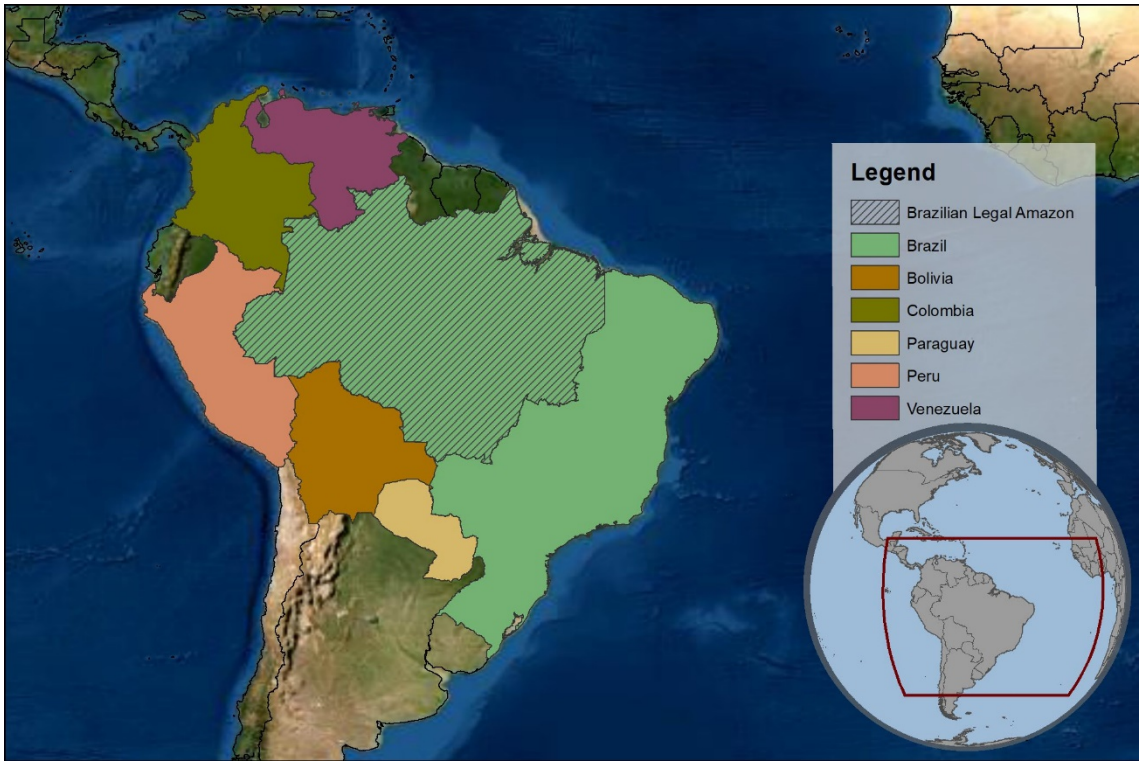


Figure 1. Areas analyzed in this document: Brazil, Bolivia, Peru, Paraguay and the Brazilian Legal Amazon within Brazil.

This report provides an insight of the fires which took place in Amazon region during 2020 and analyzes the fire seasonality based on remote sensing data processed at the JRC's Global Wildfire Information System (GWIS).

In the first sections of this report (Section2), we present trends on the number of fires and the burnt areas in the Brazilian Legal Amazon, Brazil, Bolivia, Colombia, Paraguay, Peru and Venezuela in 2020 as compared to the trends in past years. Paraguay has been included in this report due to the high fire activity observed this year, even though it is not part of the Amazon region.

This section is followed by a fire weather forecast (Section 3), a methods section (Section 0), a historical overview of number of fires and burnt areas in the region (Section 5) and the analysis of fire seasonality (Section 0).

[2] The Brazilian Legal Amazon is a geopolitical region in Brazil, established in the article 2 of the complementary law 124, of 2007, that includes 772 municipalities over 9 states. It comprises approximately five million square kilometres, which correspond to 59% of the Brazilian territory (IBGE, 2019)

2 Trends in the number of fires and burnt areas

2.1 Wildfires in the Brazilian Legal Amazon Region

Figure 2 shows the spatial distribution of burnt areas for 2020 produced by the Near-Real Time (NRT[3]) process in GWIS, and Figure 3 shows the trends of number of fires and burnt areas for the last three years up to 15 July 2020 using the same methodology.

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 3 and 4, 2020 is, until June, a year that is slightly above the average in both number of fires and burnt areas, when the core of the fire season in the region is about to start. Figure 28 and 29 show how the number of fires and burnt areas reach maximum values in the months of August to October.

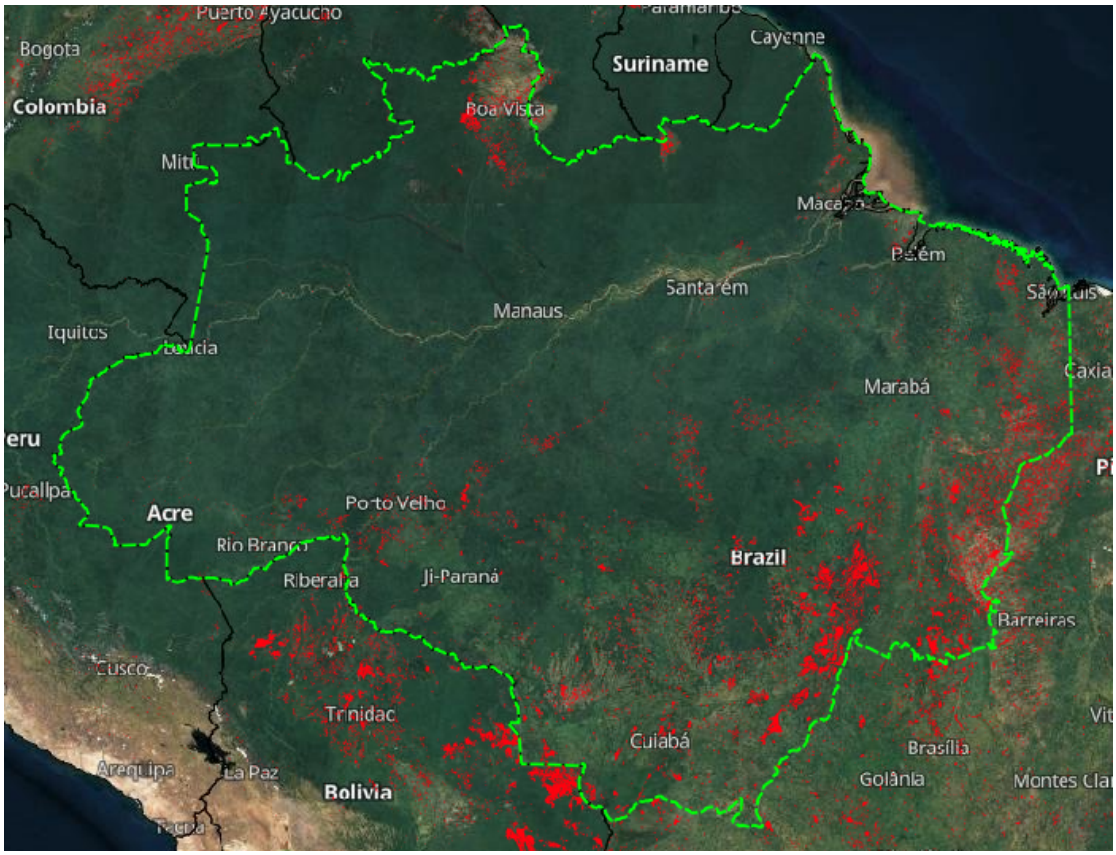


Figure 2. GWIS burnt areas for 2020 in Brazilian Legal Amazon (BLA). Burnt areas until 15th July.

The 2020 fire season in the BLA has followed similar trends of the last years, as shown in Figure 3. By the end of June, about 1.7 Million ha, which is below the values of 2019 and similar to the values in 2018 for the same month. Until 15 July 2020, about 2.1 Million ha of burnt areas have been mapped by GWIS in the region. By the end of June, the number of fires mapped in GWIS in 2020 (5357 fires) is slightly lower than in 2019 (6178 fires) and is above those of 2018 for the same period (4847 fires). So far, the fire season in the BLA follows that of previous fire seasons. The average fire size is below that of the previous two years, especially that of 2019 which was a critical year (Figure 3).

[3] GWIS NRT process uses active fire detections from the NASA VIIRS and MODIS sensors to generate single fire events from which an estimate of the burnt area caused by the fire is obtained. https://gwis.jrc.ec.europa.eu/about-gwis/technical-background/rapid-damage-assesment/?edit

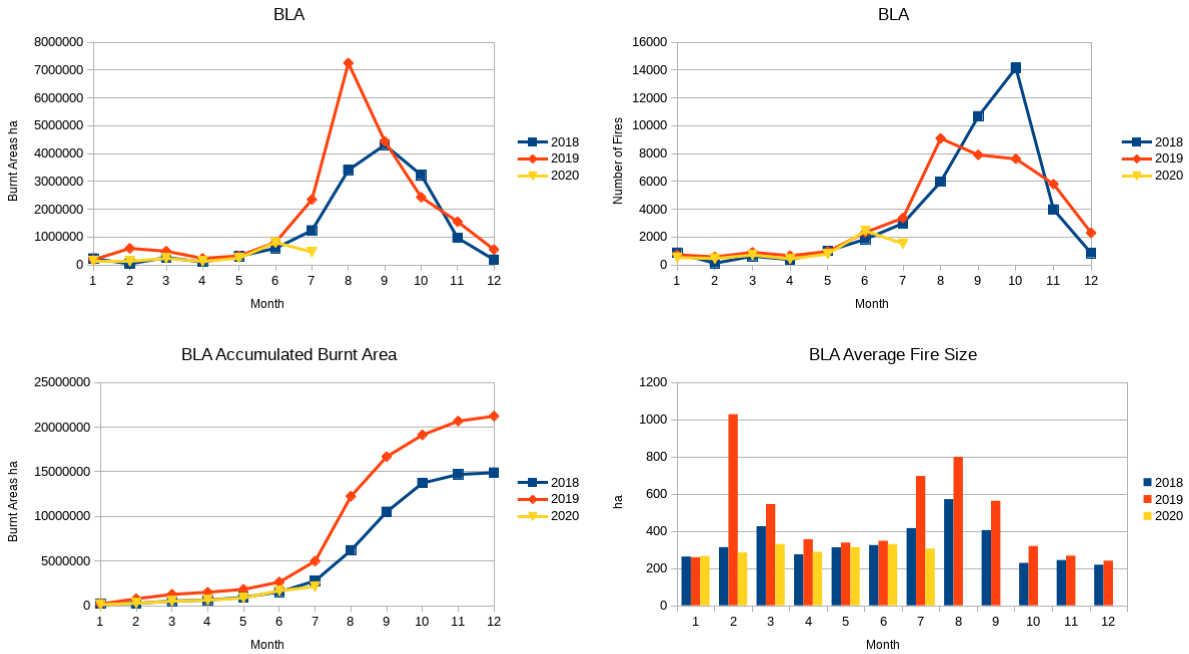
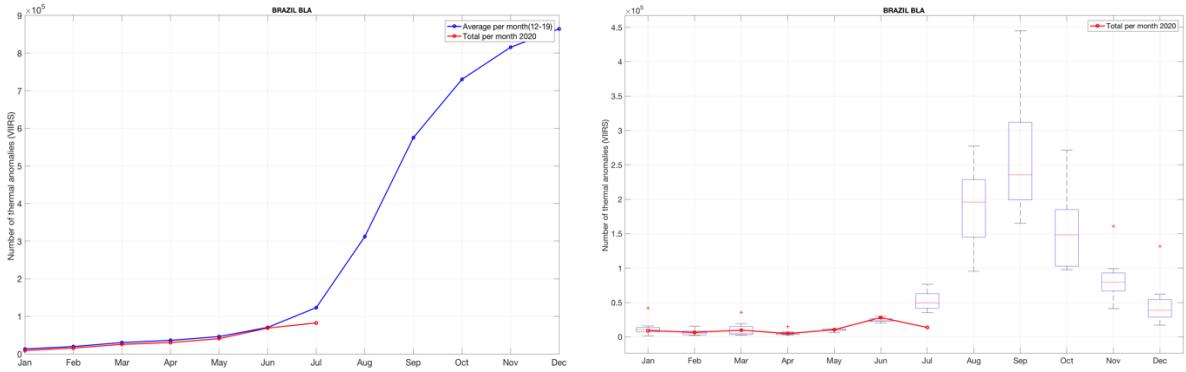


Figure 3. Trend of number of fires and burnt areas in the Brazilian Legal Amazon (BLA). Data obtained on 15 July 2020;.

In addition to the above figures, we present the number of active fire spots retrieved directly by the VIIRS sensor[4], which are often used for reporting as provided by the NASA FIRMS system. VIIRS active fire spots do not represent complete fire events but individual locations on the ground (with a spatial resolution of 375m) that are detected as burning by the sensor on a specific timing. They do represent a valuable source of information to look at trends of fire activity in a region or country as they are capable of detecting the small burns, typical of intensively managed areas below the sensing capabilities of burned area products.

In terms of active fire spots detected by VIIRS, 2020 presents a higher number of active fire spots in May and June (with a peak in June) compared with the period between 2012 and 2019 as shown in Figure 4.



[4] https://gwis.jrc.ec.europa.eu/about-gwis/technical-background/active-fire-detection/

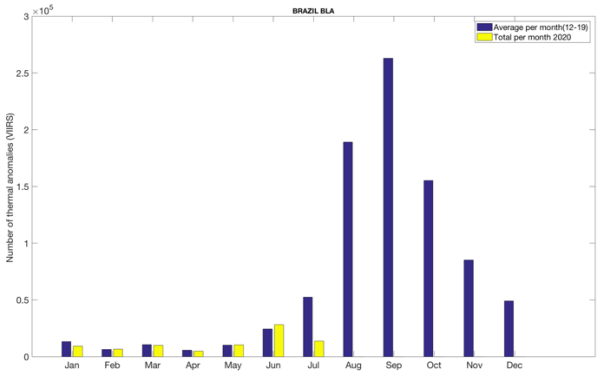


Figure 4. Active burning spots detected by VIIRS sensor in Brazil up to date. Note that data from 15 July onwards are not yet available.

2.2 Wildfires in Brazil

Since the Brazilian Legal Amazon area is a considerable a proportion of the area of Brazil, the peaks of fire activity resemble those of the Brazilian Legal Amazon presented above. The spatial extent of the burnt areas in the country produced by the Near-Real Time (NRT) process in GWIS is presented in Figure 5. Although most of the burnt areas occurred in the center of the country (Cerrado Biome), the fire activity and the resulting burnt areas show a wide spread from north to south, including the humid Amazon forest.

Figure 5. GWIS burnt areas for 2020 in Brazil. Data obtained on 15 July 2020.

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% (21.7 Mha) of the area was burnt in the Brazilian Legal Amazon region, while 12 Mha were burnt outside it.In 2019, the burnt area estimated by GWIS (33.7 Mha) was similar to the one declared by the Brazilian Instituto Nacional de Pesquisas Espaciais (INPE), 31.84 Mha, despite the fact that both assessment systems using different methodologies.

The 2020 fire season in Brazil has followed similar trends to those of the last 2 years, as shown in Figure 6. In June, about 1.2 Mha were burnt, which is above the values of 2019 and 2018 for the same month. Until 15 July 2020, about 3.6 Mha of burnt areas have been mapped by GWIS in the country.

In 2020, from January to June, the number of fires mapped in GWIS was above that of 2018 and 2019 for the same period. In June the number of fires in 2020 was the highest of all the three years. In terms of active fire spots detected by VIIRS, 2020 presents a higher number of active fire spots in the period between March and June (with a peak in June) compared with the period between 2012 and 2019 as shown in Figure 7

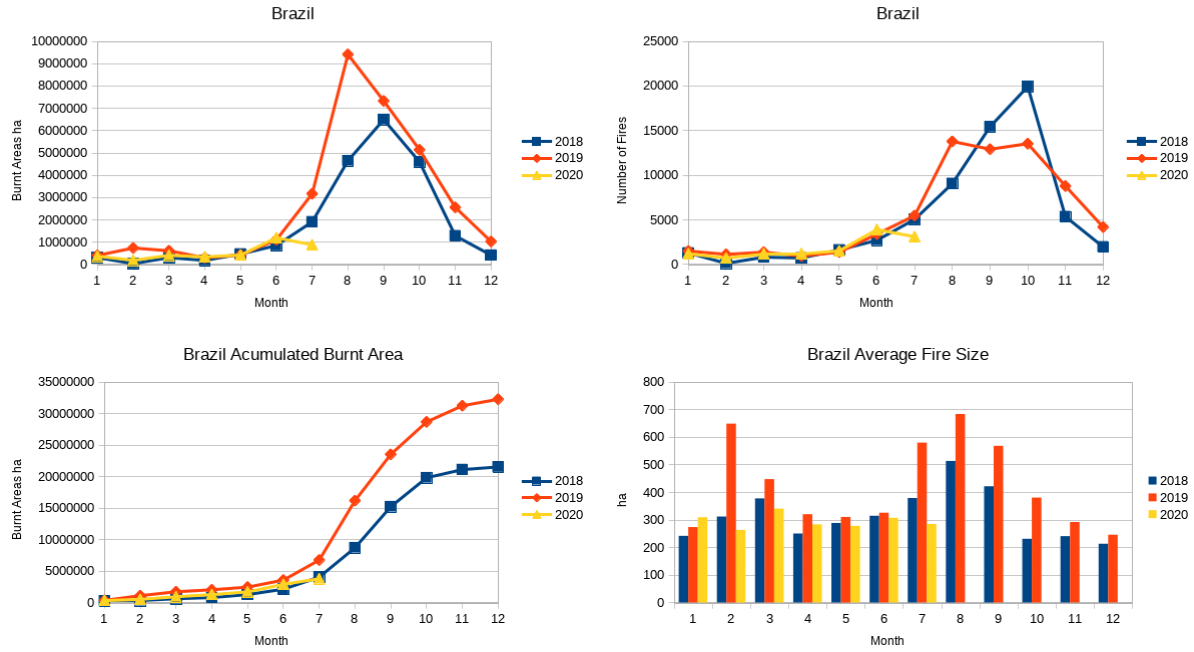
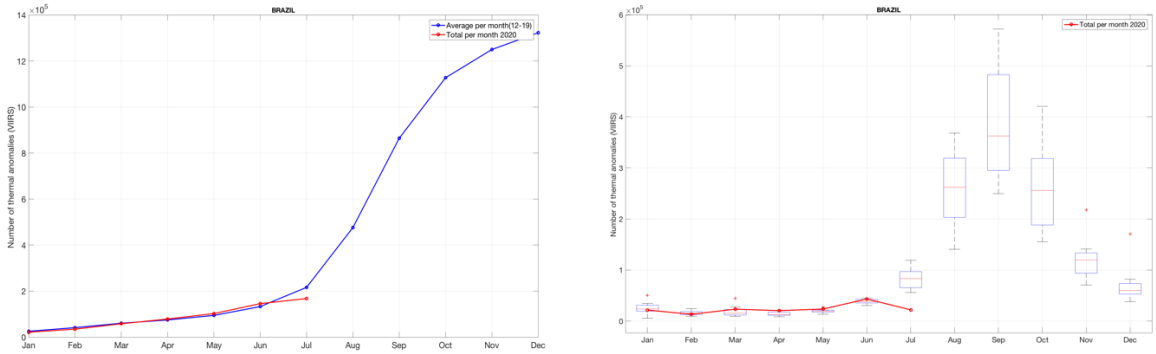


Figure 6. Trend of number of fires, burnt areas and fire size as compared to data in the last two years. Data obtained on 15 July 2020.



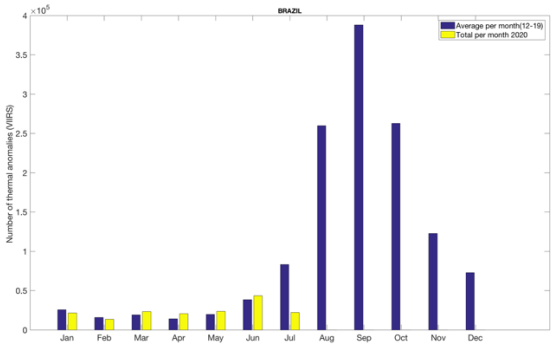


Figure 7. Active burning spots detected by VIIRS in Brazil up to date. Note that data from 15 July onwards are not yet available

It is noticeable how both the number of fires and burned area trends in the GWIS NRT and VIIRS match in showing very similar trends. The added value of the GWIS NRT is that it permits counting fires, estimating the fire size and the burnt areas in near real time. For instance, Figure 6 shows how the number of fires in 2019 is below 2018, but the opposite happens with the burnt area for the same years. Therefore the average fire size increases and describes a year (2019) with bigger fires and higher value of total burnt area.

2.3 Wildfires in Bolivia

In 2019, Bolivia experienced larger fires than the average fires registered in the period 2001-2018 (see Fig. 30). Many of the large fires occurred in the south east of the country, in areas where the occurrence of wildfires is not frequent. Most of the wildfire activity and the burnt area were concentrated in the months of July, August and September. The total burnt area in the country in 2019 was around 8 Mha, 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 (Figure 27). 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 2020 produced by the Near-Real Time (NRT) process in GWIS is shown in Figure 8. The 2020 fire season in Bolivia has followed similar trends of the last 3 years, as shown in Figure 9 with higher values of burnt area in March and April comparing with the two last years

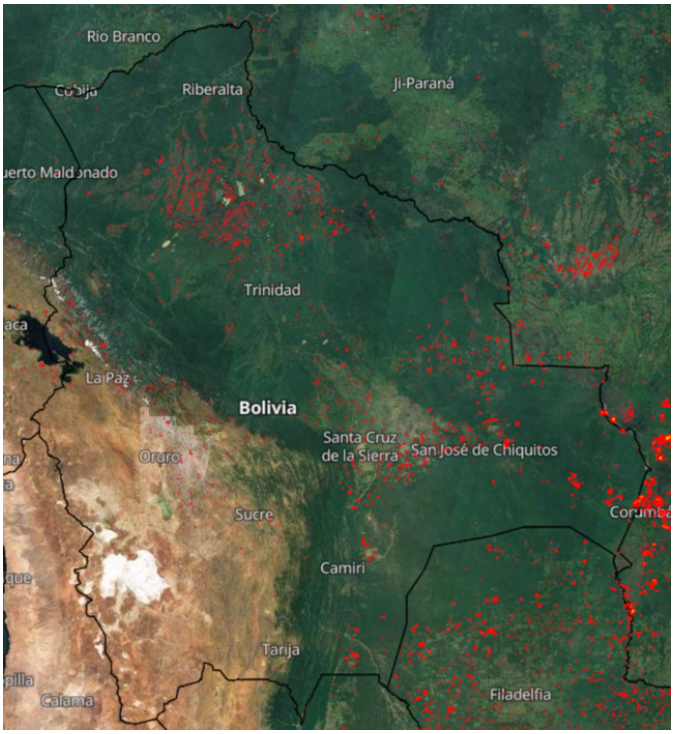


Figure 8. GWIS burnt areas for 2020 in Bolivia. Data obtained on 15 July 2020.

In Bolivia, about 640 000 hectares of surface have been burnt from the beginning of the year until 15 July 2020,. This value is above that of 2018 but below the one of 2019 for the same period. In terms of active fire spots detected by VIIRS, 2020 presents a higher number of active fire spots in the period between January and May compared with the period between 2012 and 2019 as shown in Figure 10.

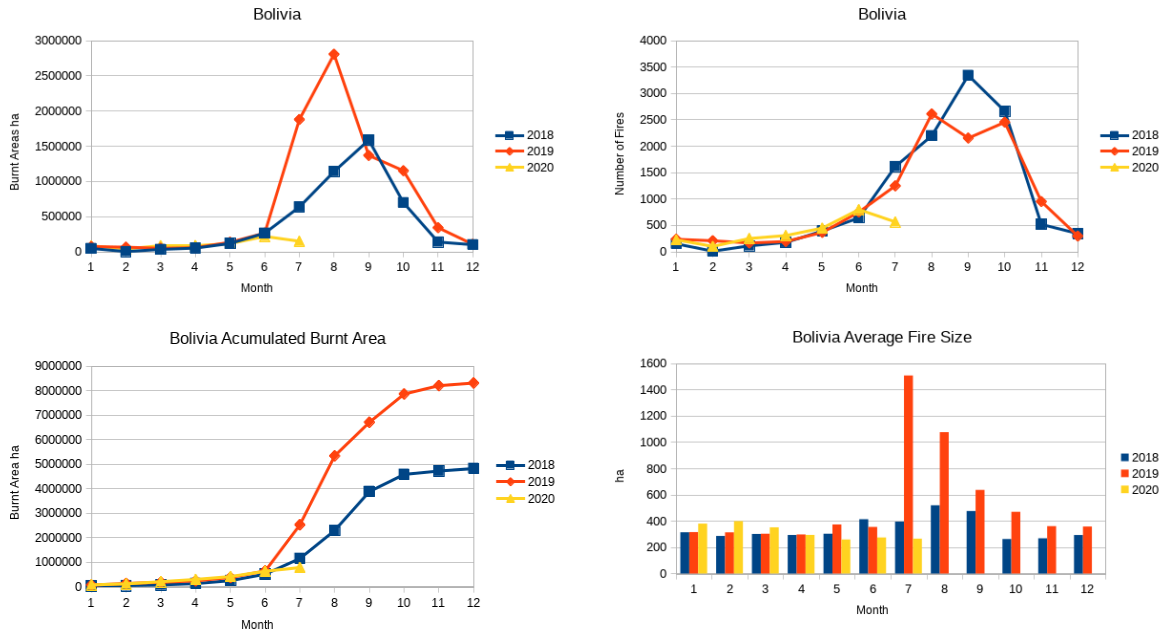
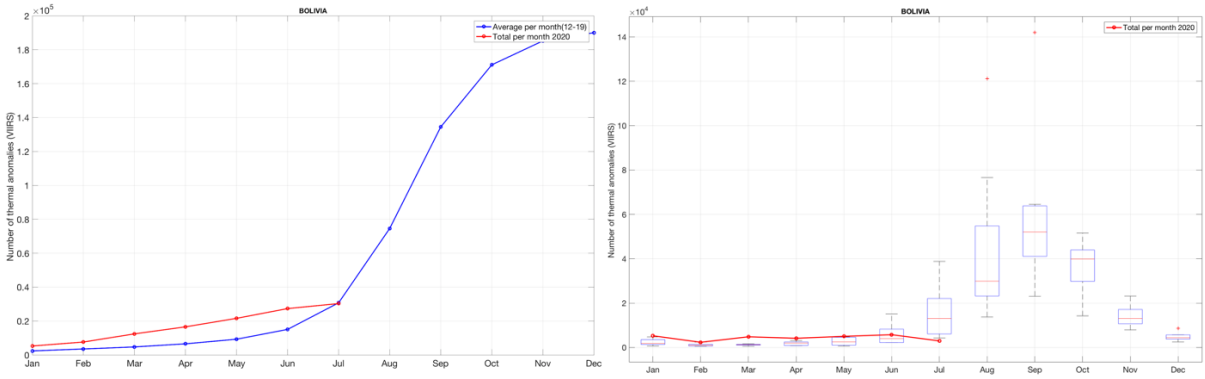


Figure 9. Trend of number of fires, burnt areas and fire size as compared to data in the last two years. Data obtained on 15 July 2020.



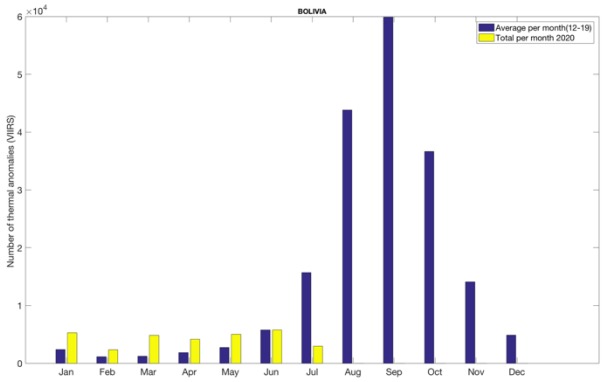


Figure 10. Active burning spots detected by VIIRS in Bolivia up to date. Note that data from 15 July onwards are not yet available.

2.4 Wildfires in Colombia

The spatial distribution of burnt areas in Colombia in 2020 produced by the Near-Real Time (NRT) process in GWIS is shown in Figure 11.The current fire season has been more severe than the last two years, 2018 and 2019, with larger burnt areas and number of fires. About 3 Mha of burnt areas have been mapped in the country. Figure 12, shows how the number of fires is considerable higher in March of 2020. The same happens with the burnt area and the average monthly fire size. This fact points out to a considerable increase of fire activity, see Figure 12 and 13, having more uncontrolled fires. The fires are mainly located on the center and south-west of the country, while fire activity is also present in the north. This region is part of the designated "Llanos", a complex savanna ecosystem which undergoes periodic, human-induced and natural biomass burning during the dry season, usually between November and April.

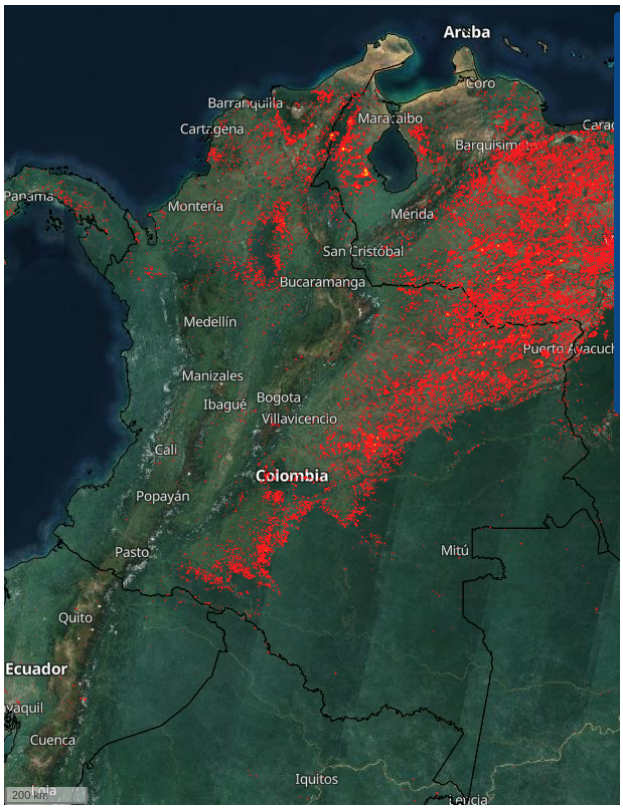


Figure 11. GWIS burnt areas for 2020 in Colombia. Data obtained on 15 July 2020.

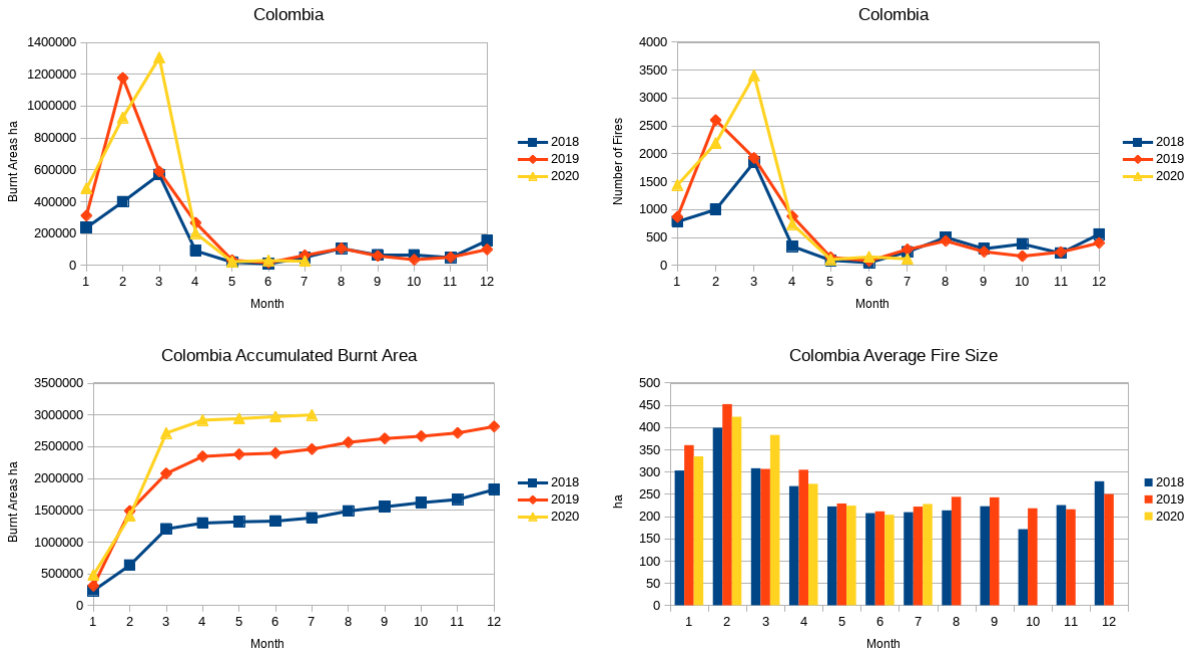


Figure 12. Trend of number of fires, burnt areas and fire size as compared to data in the last two years. Data obtained on 15 July 2020.

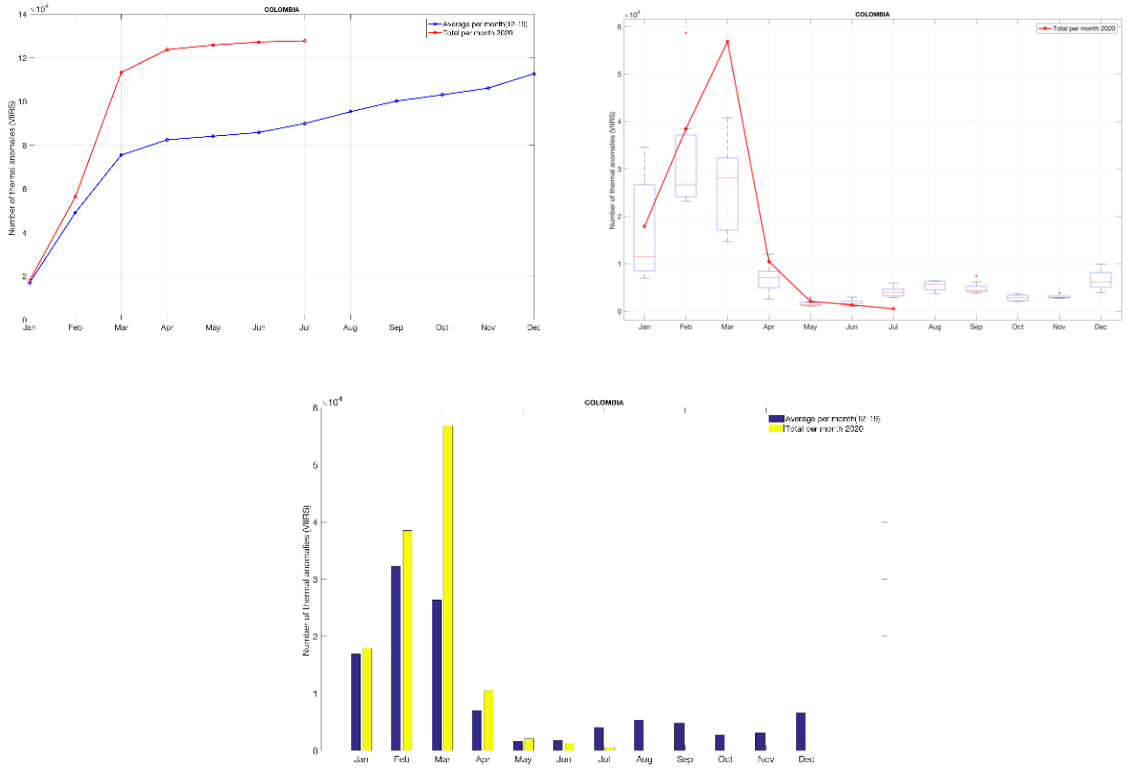


Figure 13. Active burning spots detected by VIIRS in Colombia up to date. Note that data from 15 July onwards are not yet available.

2.5 Wildfires in Paraguay

The wildfire season in Paraguay during 2019 resulted in a total burnt area of approximately 3.6 Mha, which is above the average in the time series 2001-2018 (Figure 27). In comparison to the number of fires in previous years, 2019 was considerable above the norm, pointing to the fact that the average fire size in 2019 was larger than the average fire size registered in the period 2001-2018 (Figure 30). 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. The spatial distribution of fires resembles that of a typical fire season, as most fires burnt in areas with a high burning frequency (Figure 31), except for some large fire episodes in the Central-East part of the country.

In 2020, the spatial extent of the burnt areas in the country produced by the Near-Real Time (NRT) process in GWIS is presented in Figure 14. The 2020 fire season in Paraguay has been atypical as compared with 2018 and 2019 (see Figure 15). Until 15 July 2020, almost 2 Mha of burnt areas have been mapped by GWIS in the country, doubling the values of 2018 and 2019 for the same period. In terms of active fire spots detected by VIIRS, 2020 presents the same trend of the burned area and number of fires shown in Figure 15, with a higher number of active fire spots in the first six months of the year when compared with the period between 2012 and 2019, as shown in Figure 16.

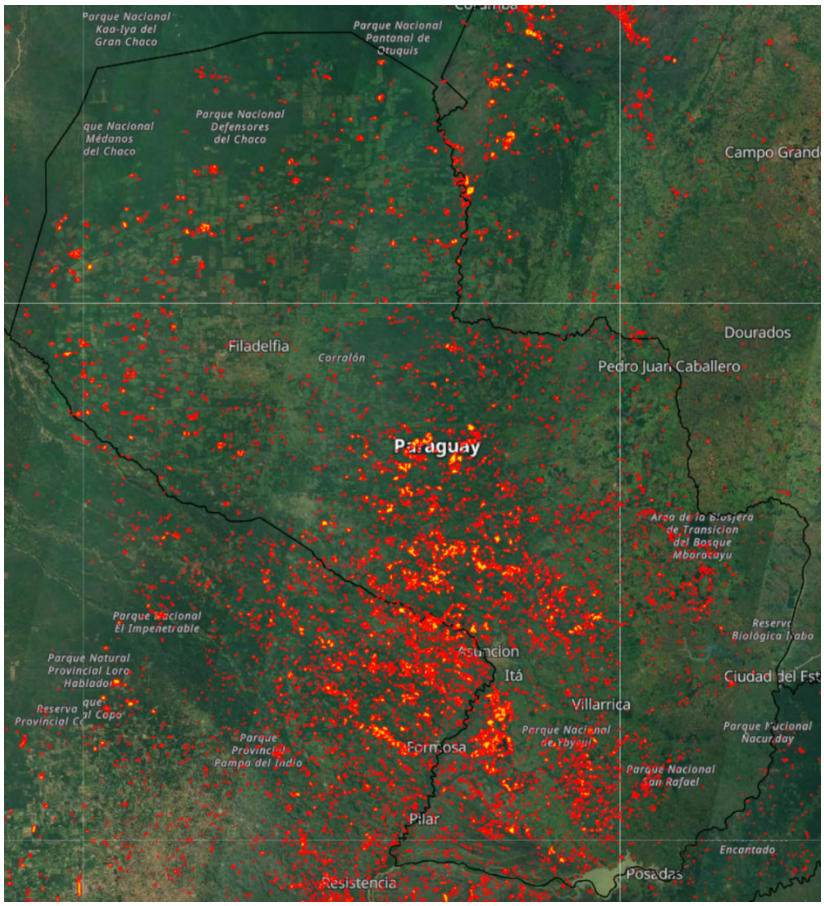


Figure 14. GWIS burnt areas for 2020 in Paraguay. Data obtained on 15 July 2020.

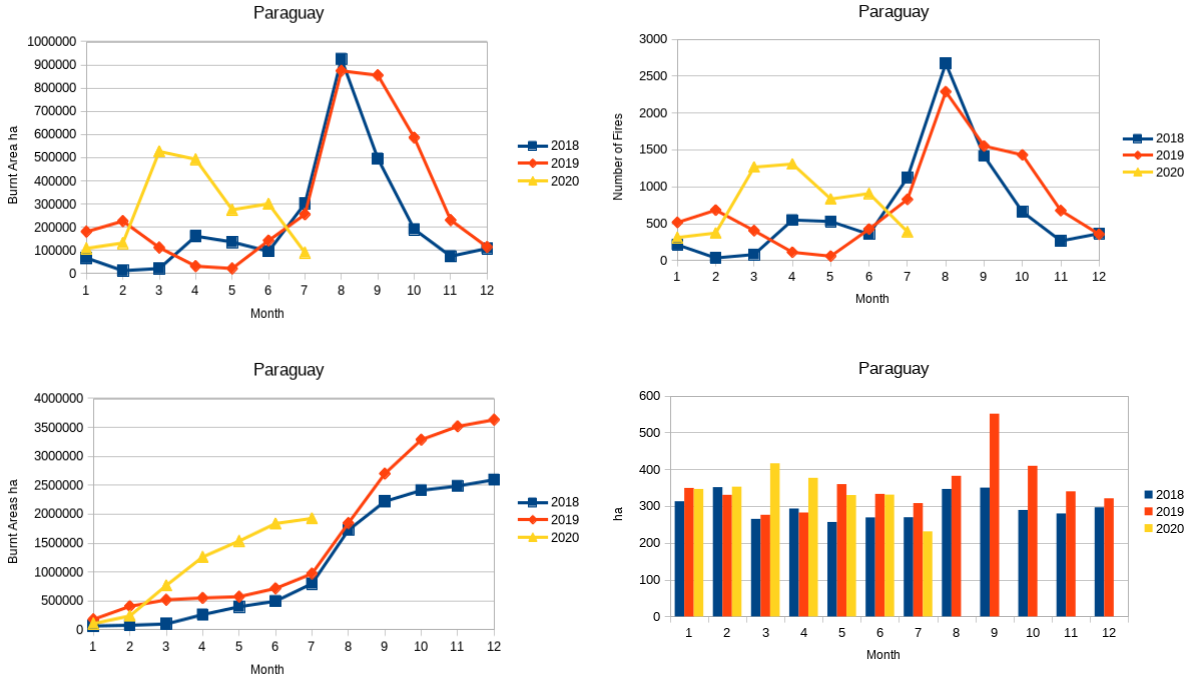
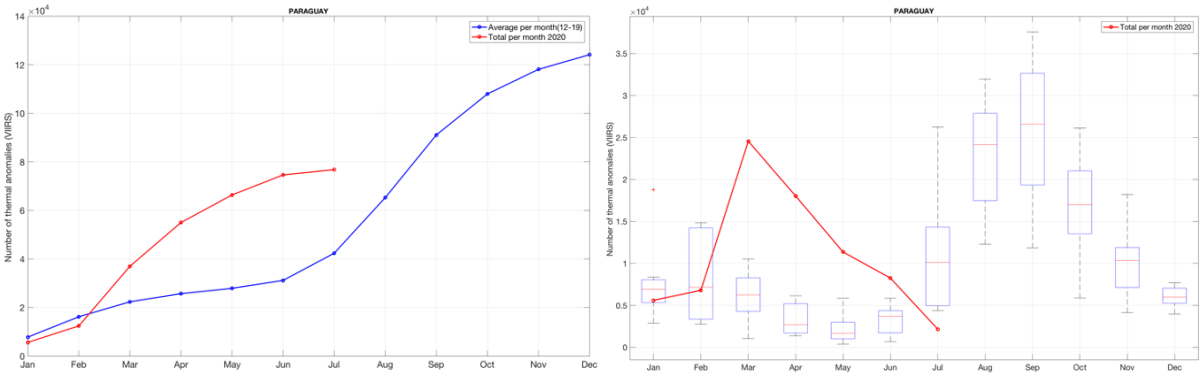


Figure 15. Trend of number of fires, burnt areas and fire size as compared to data in the last two years. Data obtained on 15 July 2020.



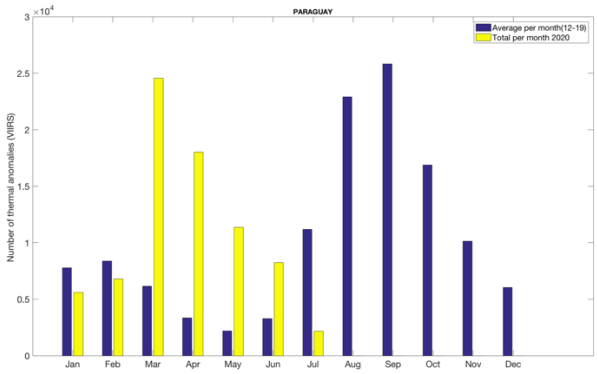


Figure 16. Active burning spots detected by VIIRS in Paraguay up to date. Note that data from 15 July onwards are not yet available.

2.6 Wildfires in Peru

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. 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. 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 (Figure 27). 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.

The spatial extent of the burnt areas in the country in 2020 produced by the Near-Real Time (NRT) process in GWIS is presented in Figure 17. The 2020 fire season in Peru has followed similar trends of the last 3 years, as shown in Figure 18 but with higher values of burnt area in the first six months of the year compared with 2018 and 2019. Until 15 July 2020, about 185 thousand ha of burnt areas have been mapped by GWIS in the region above those of 2018 and 2019. In terms of active fire spots detected by VIIRS, 2020 presents a higher number of active fire spots in the period between January and June compared with the period between 2012 and 2019 as shown in Figure 19.

Figure 17. GWIS burnt areas for 2020 in Peru. Data obtained on 15 July 2020.

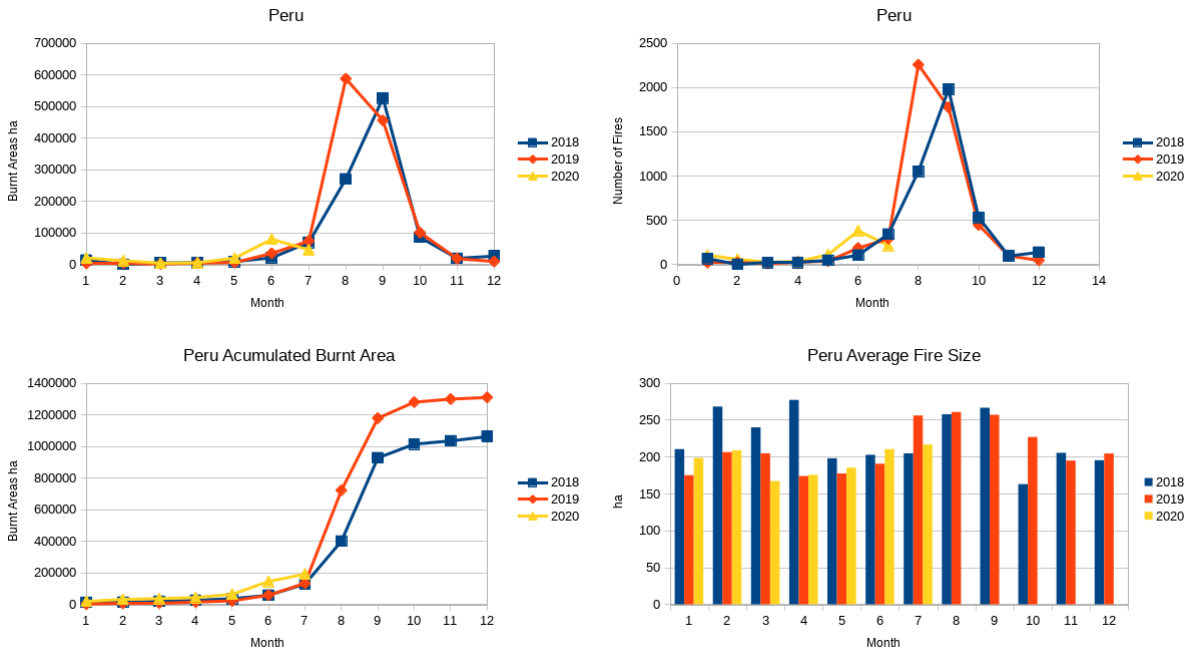


Figure 18. Trend of number of fires, burnt areas and fire size as compared to data in the last two years. Data obtained on 15 July 2020.

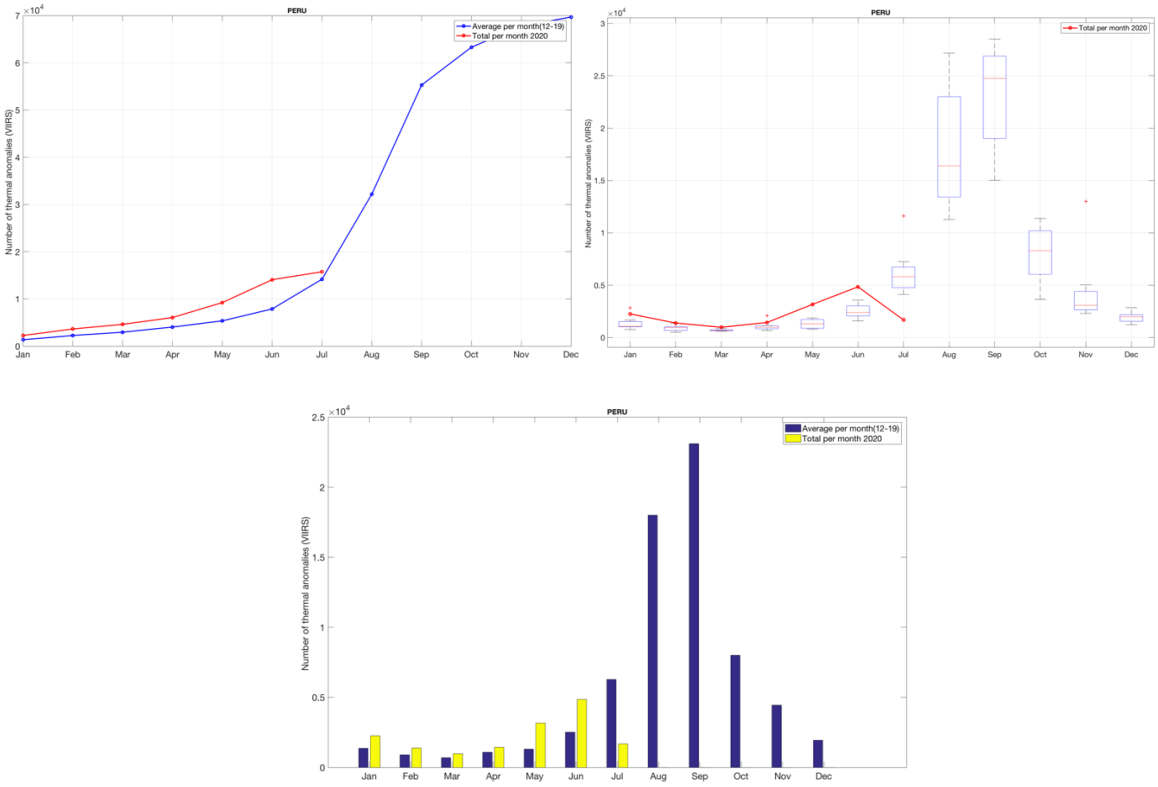


Figure 19. Active burning spots detected by VIIRS in Peru up to date. Note that data from 15 July onwards are not yet available.

2.7 Wildfires in Venezuela

In 2020, wildfires in Venezuela are spread all over the central and northern areas of the country, with very large fires on the west of the country, such as those on the west side of Maracaibo lake. (Figure 20). This region is part of the designated "Llanos", a complex savanna ecosystem where it undergoes periodic, human-induced and natural biomass burning during the dry season, usually between November and April.

The current fire season for 2020 is above the last two years in all terms, see Figure 21 and 22. The total burnt area is slightly above the previous year, 2019, and considerable higher than that of the 2018 fire season. Besides, the number of fires also increased. Looking at the average fire size, the largest fires occurred in March, instead of February, as in 2018 and 2019. The average fire size was like previous years until February, afterwards the monthly average fire size in 2020 is above the 2018 and 2019. During March, there was an increase of burnt areas, number of fires, and size of the fires.

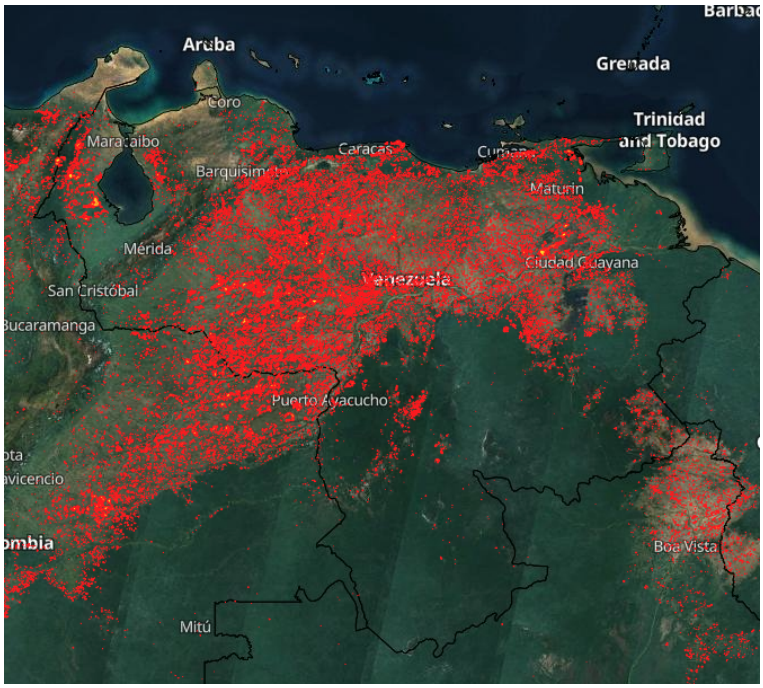


Figure 20. GWIS burnt areas for 2020 in Venezuela. Data obtained on 15 July 2020.

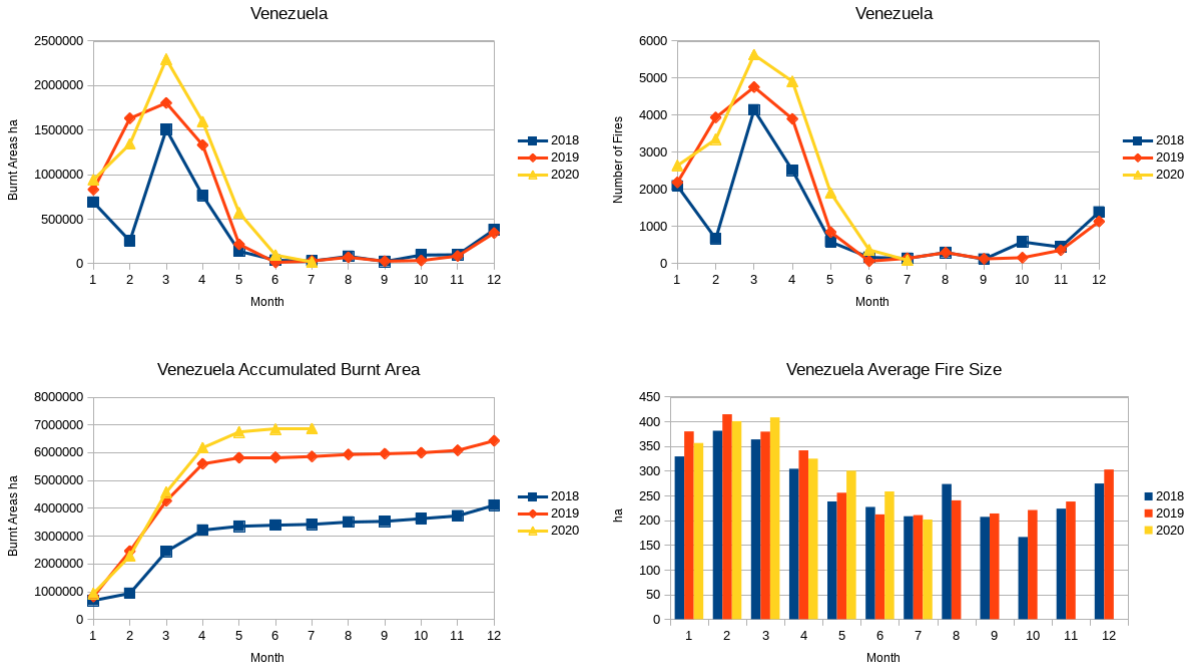


Figure 21. Trend of number of fires, burnt areas and fire size as compared to data in the last two years. Data obtained on 15 July 2020

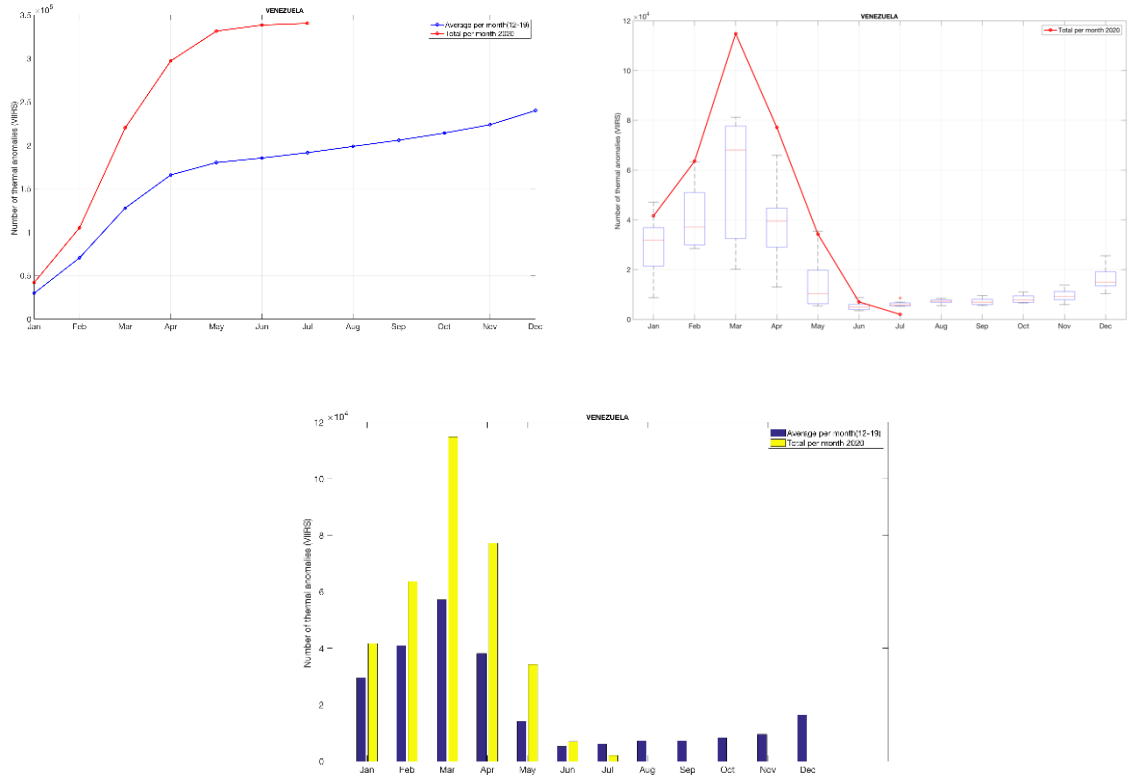


Figure 22. Active burning spots detected by VIIRS in Venezuela up to date. Note that data from 15 July onwards are not yet available.

3 Fire danger and fire weather forecast in the Amazon region

This section provides information on the seasonal weather forecast in the Amazon regions for the current and next months. In addition to this information, daily fire danger forecast is provided online in GWIS[5]

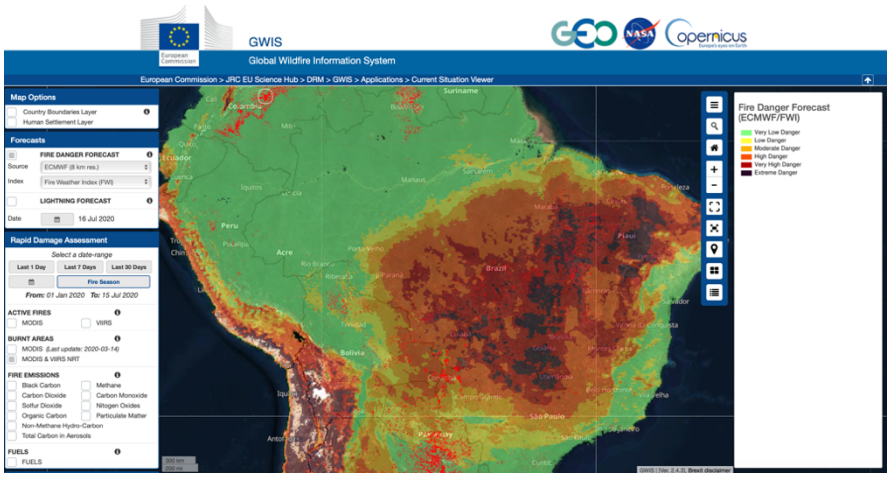
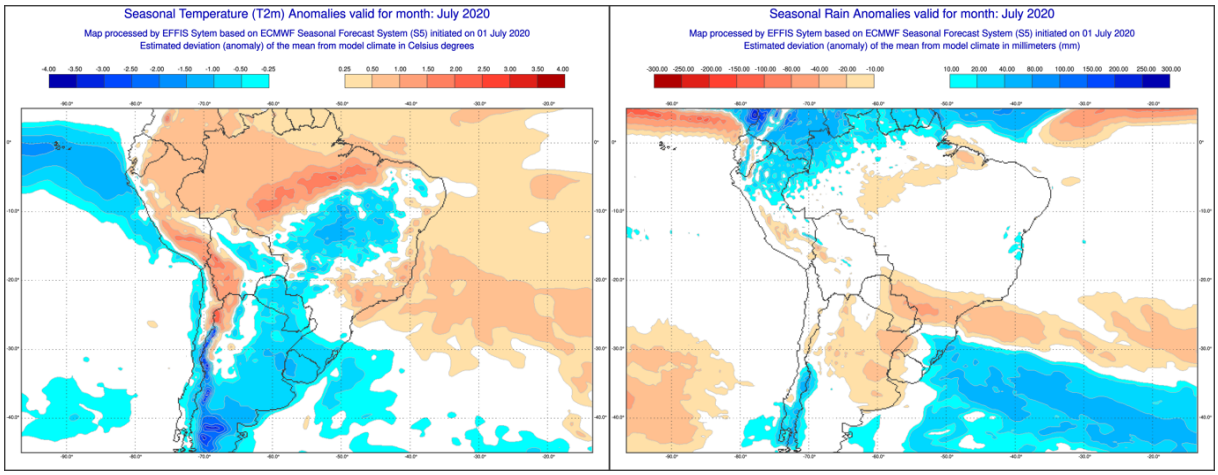


Figure 23. Fire Danger Forecast in the Amazon region for July 16, 2020.

The seasonal fire weather forecast for July and August is presented in Figure 24. The overall trend is of above average temperatures in the north of Brazil and areas of Peru and Bolivia, while there are no noticeable precipitation anomalies. In August, the forecast is above average temperatures and precipitation deficit in the border regions of Brazil with Bolivia and Paraguay. Typically, August marks the start of the core fire season in most of the countries in the region.



[5] https://gwis.jrc.ec.europa.eu/static/gwis_current_situation/public/index.html

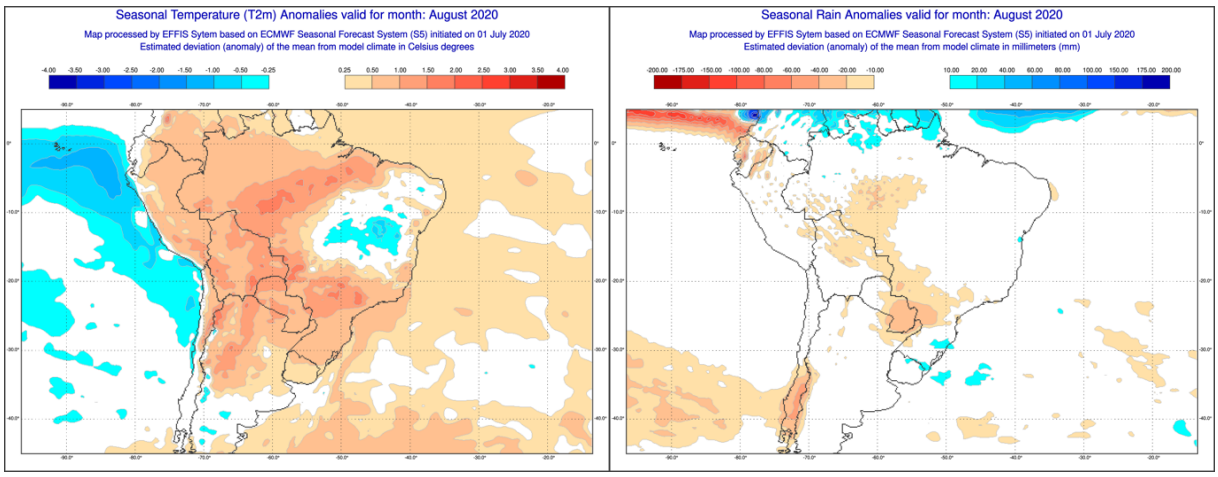


Figure 24. Seasonal anomalies for July and August 2020.

4 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.

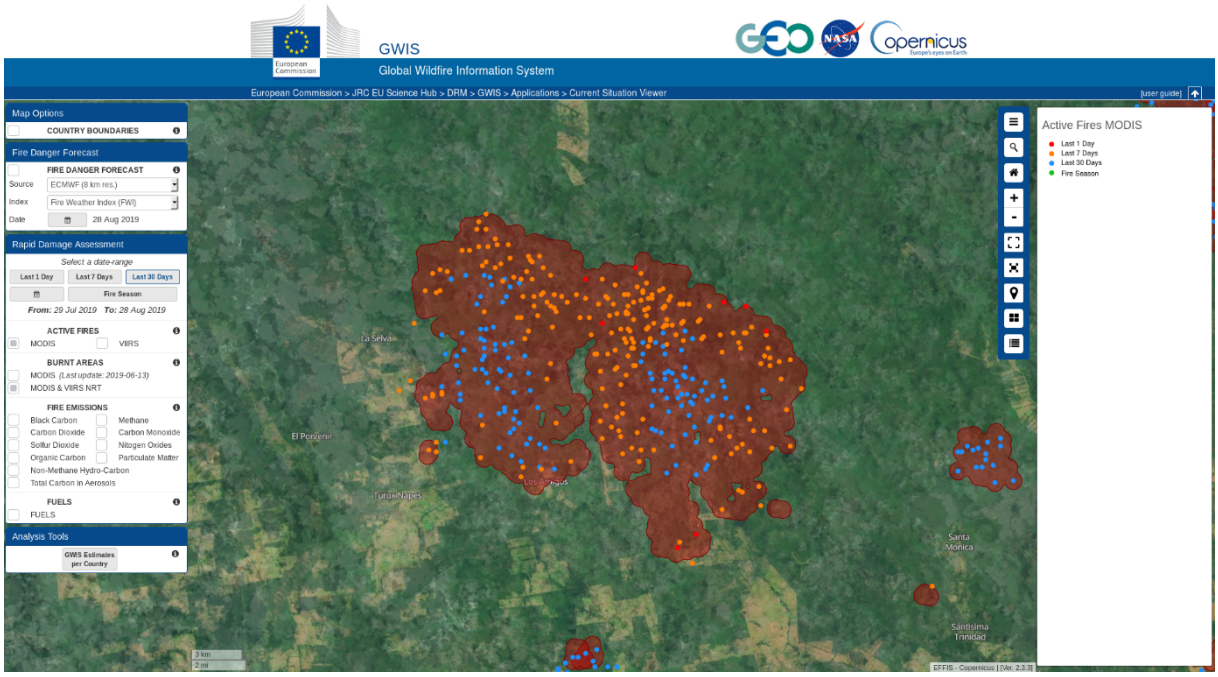


Figure 25. Screenshot from the GWIS Current Viewer. Active fires from MODIS are visualized with points in different colors. The polygons on the background are the fires counted by GWIS in near-real time.

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[6] 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 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.

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

[6] 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.

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.

5 Historical trends of the number of fires and burnt areas in the Amazon region

The number of fires in 2019 was compared to the historical data for the years 2001 to 2019 in all the countries and in the Brazilian Legal Amazon Region. The resulting graph is presented in Figure 26. 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.

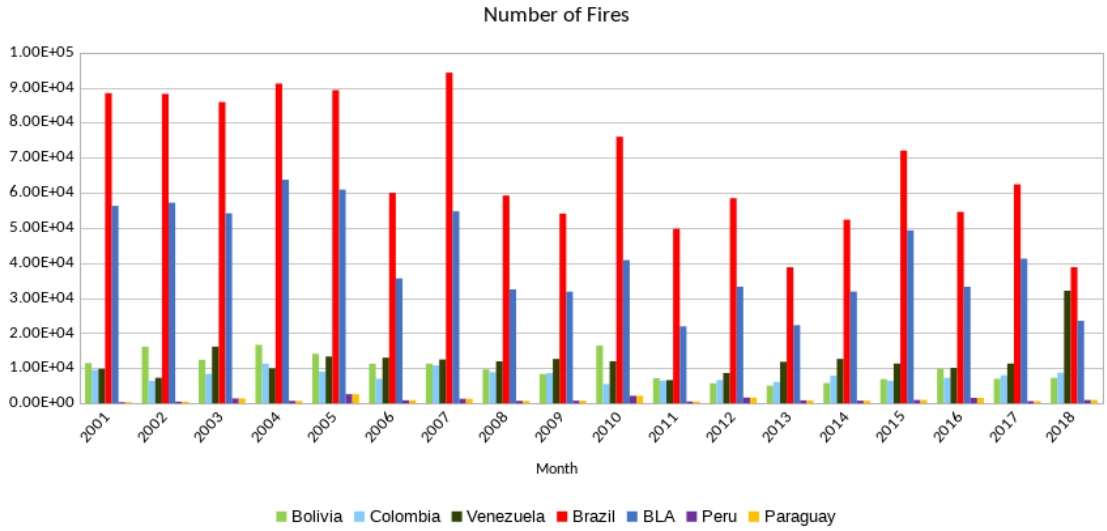


Figure 26. Trends of number of fires per country in the period 2001-2019.

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 27 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. **Error! Reference source not found.**.

Figure 27. Trends of burnt areas per country in the period 2001-2019.

6 Seasonality of fires, burnt areas and fire size in the Amazon region

Figure 28 and 29 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.

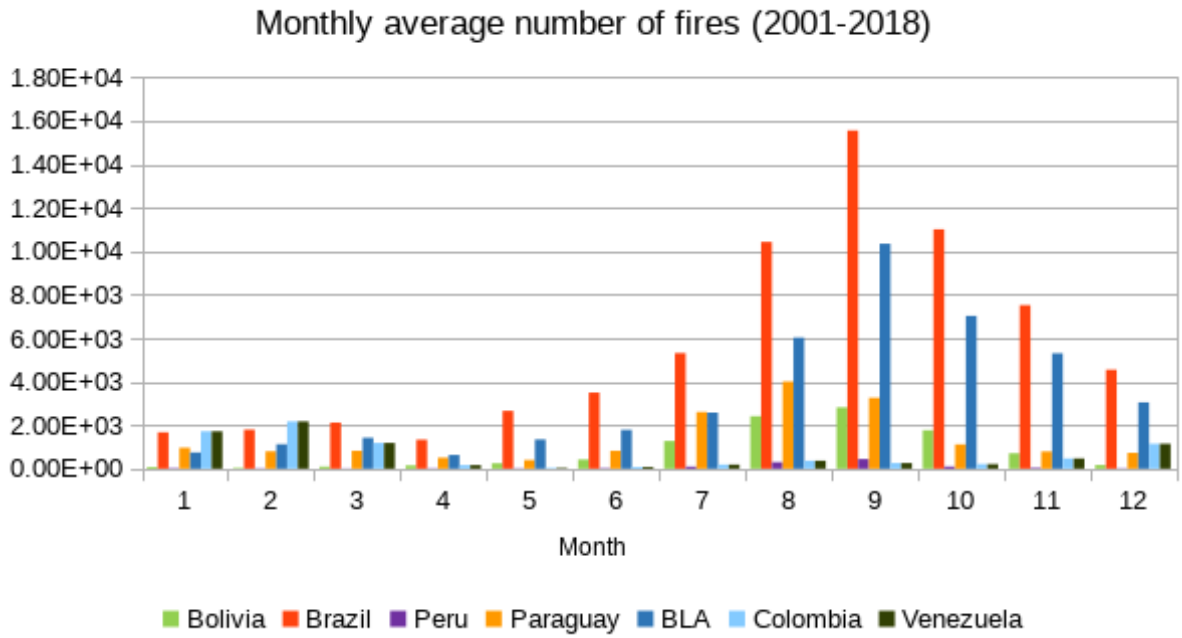


Figure 28. Average number of fires per month.

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.

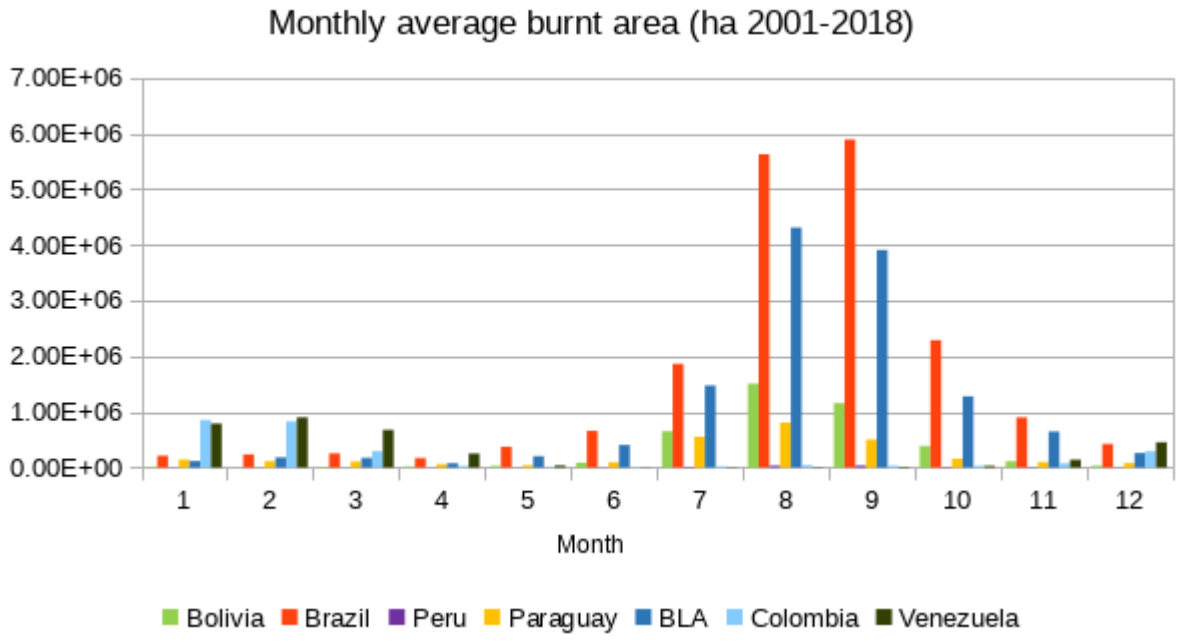


Figure 29. Average burnt areas per month.

The largest fires, as shown in Figure 30, 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. The spatial distribution of the fire frequency and seasonality is shown in Figure 31. This shows, for instance, that most of the big fires in Bolivia 2019 took place in areas that rarely burnt in previous years

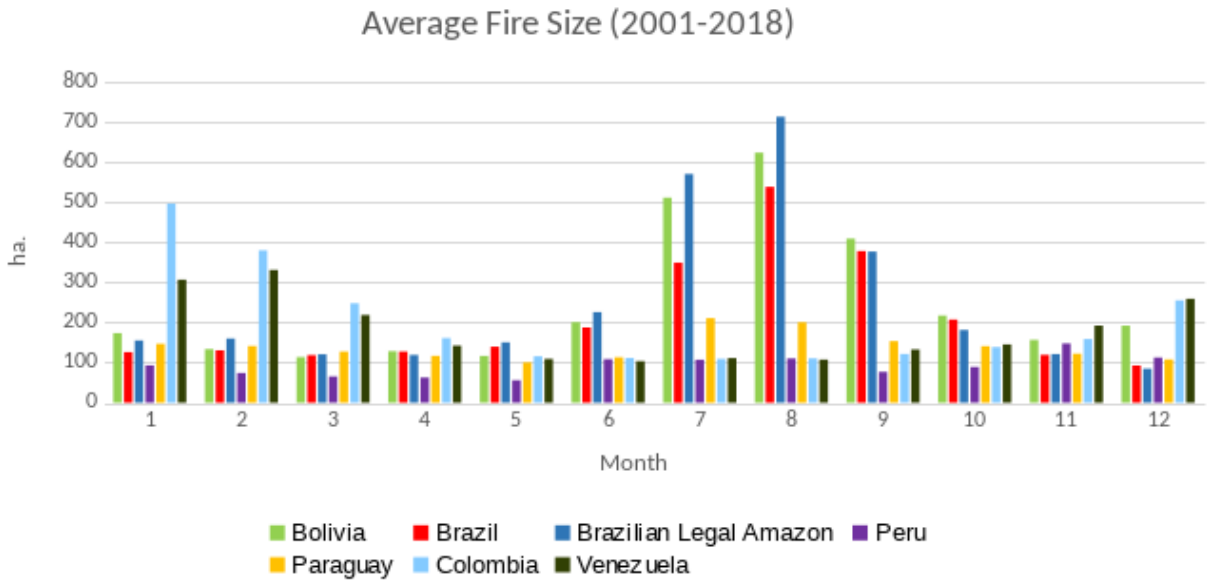


Figure 30. Average fire size per country in the period 2001-2018.

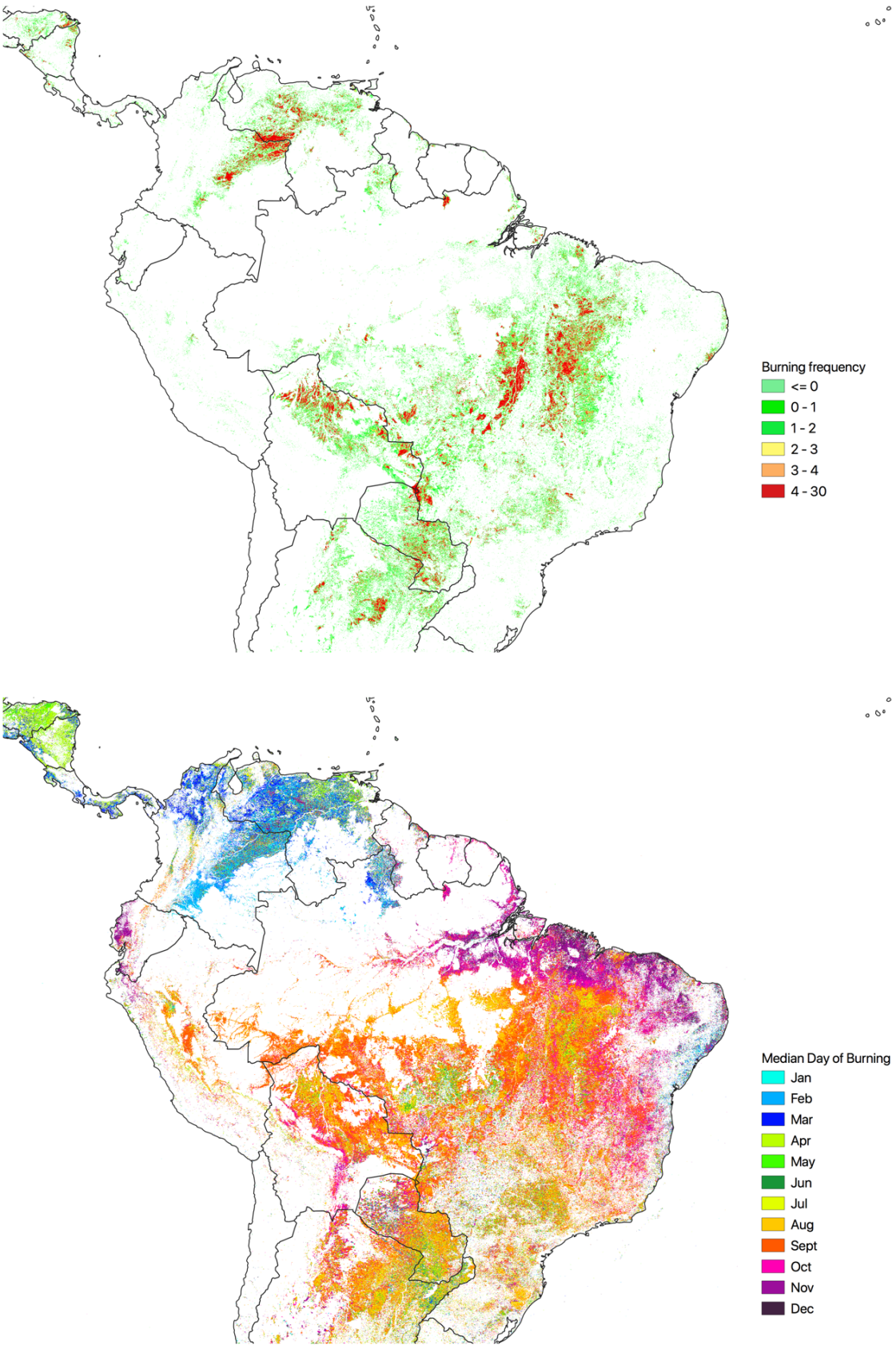


Figure 31. Burning frequency and Median day of burning in the Amazon region.

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