Documentation of Historical Forest Fires and Hazard: Case of Gironde and Les Landes, France

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Abstract

Forest fire is becoming an important research topic because of climate change and its impact on population. In this study, historical database about forest fire incidents was created for Gironde and Les Landes (1989 to 2022). To the knowledge of the authors, this database did not exist before. The database is essential in showing spatial and temporal distribution of forest fires and helps in decision-making. The database was created from newspapers and crosschecked with burned areas visible on Landsat and Sentinel-2 satellite images. Several factors were used to generate a forest fire hazard map such as vegetation water content utilizing Normalized Difference Moisture Index (NDMI), type of vegetation, topography, and barriers to the expansion of fire (proximity to water bodies and roads). All layers were converted to raster format and reclassified to a common scale. Weighted overlay in GIS was used to generate the final forest fire hazard map. Results showed that, temporally most forest fires occurred during March-April and July-August and majority are in Gironde. The hazard map highlights that most of Les Landes and Gironde departments are vulnerable to this hazard because of their extended forest areas and high dryness. The accuracy assessment showed that supervised classification had the best accuracy followed by the Burned Area Detection Index (BADI) and the manual digitization. Data from French institutions and higher-resolution satellite images could improve the accuracy of the historical forest fires database. The output from the study was made available to the public for further exploration (https://firemap.saro.app/).

1. Introduction

Forest fires are natural disasters known for their extended impact, burning hectares and potentially causing human losses and economic damage. Burnt areas are important for many applications such as the estimation of vegetation cover, emissions of trace gases and aerosols (GreenHouse Gases - GHGs), and input for climate and carbon-cycle models (Copernicus, 2023). Numerous studies have focused on understanding the causes of fires and predicting where they may occur (Arfa et al., 2019). A large portion of these studies centered around the Mediterranean region because it is the most impacted region (Bouisset, 2011; Darques, 2013; Meddour-Sahar et al., 2010; San-Miguel-Ayanz et al., 2019).

Historical records showed that forest fires occurred in France in the past such as the one in August 1949 (Deville, 2009). A report by San-Miguel-Ayanz et al. (2019) indicated that the past evolution of forest fires in France witnessed a decrease in their area but an increase in their number. Gironde and Les Landes (south-west of France) have been heavily impacted by forest fires (San-Miguel-Ayanz et al., 2019). However, there is no comprehensive study documenting the history of forest fires in the region. Therefore, there is a need to complement regional efforts with local initiatives that document the spatial and temporal occurrences of forest fires, and this is the main objective of this study. In addition to this, the study aims to identify areas that are vulnerable to forest fires based on multi-criteria and make the results available online for the public.

1.1 Forest fire hazard map

In general, a hazard map is created to show the level of vulnerability of an area. Several methods are used to create hazard maps such as spatial analysis (Cherki, 2013; Sauvagnargues et al., 2013), computation of annual relative greenness (Cheret et al., 2011), mapping wildland-urban interfaces (Lampin-Maillet et al., 2010), models (Rahmani and Benmassoud, 2019) or using artificial intelligence (Razavi-Termeh et al., 2020). To perform these techniques, satellite images like QuickBird and Pelican (Sauvagnargues et al., 2013), MODIS (Cheret et al., 2011), or SPOT 5 (Lampin-Maillet et al., 2010) are widely used.

1.2 Mapping Forest Fires

After having performed hazard analysis, when forest fires start and burn hectares of forest, it also appears important to extract them to understand what areas have been impacted. To do so, it is possible to manually digitize the forest fires or to automatically extract them (Abdikan et al., 2022; Farhadi et al., 2023; Lohar et al., 2021). The automatic extraction of forest fires saves time and money.

There are many efforts made to detect burning areas in near-real time. For instance, Fire Information for Resource Management System (FIRMS) from NASA provides images from the MODIS spectroradiometer aboard Terra and Aqua satellites and Visible Infrared Imaging Radiometer Suite (VIIRS) aboard JPSS-1 satellite ("NASA-FIRMS," n.d.). The program makes global fire data available within 3 hours of satellite observation (Earth Data, 2023). The fire data in FIRMS covered the period since 2000 whereas this study deals with historical data since 1989.

The European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) developed also the Copernicus Sentinel-3 NRT Fire Radiative Power (FRP) program. The Copernicus NRT S3 FRP processor identifies the location and quantifies the radiative power, of any hotspot present on land and ocean, that radiates a heating signal within a pixel size of 1 km^2 (Eumetsat, 2023). The NRT S3 FRP product will become operational after a higher level of quality and maturity is reached (Eumetsat, 2023). The Copernicus Global Land Service also provides bio-geophysical products for global land surface including global burn areas based on Sentinel-3/OLCI and SLSTR (300 m) (Copernicus, 2023). However, the data covered only monthly composite, January 2019 onwards.

The common data usually used for forest fires is mainly optical satellite imagery. However, some studies used radar data. Qarallah et al. (2023) and Lohar et al. (2021) used Landsat-8 and Sentinel-2 to perform burned areas extraction. Both found that Sentinel-2 has higher accuracy and shows better results than Landsat-8 mainly because of the spatial resolution which is of 10-20 m for the first one and 30 m for the second one. Most of the papers used Landsat or Sentinel imagery in the literature reviewed. Other papers use MODIS (low spatial resolution) or PlanetScope (very high spatial resolution but not free) which seems to be less used. Landsat and Sentinel-2 imagery are widely used because they are freely available.

Previous missions like Landsat (thermal band) offered a spatial resolution of 100 m. The reason why thermal sensors are usually of lower spatial resolution than optical sensors is the fact that optical sensors receive reflected signals whereas thermal ones receive emitted radiation which is less strong from small areas. However, sophisticated techniques have been developed to enhance the spatial resolution of thermal bands. A new thermal satellite called HOTSAT-1 with a very high spatial resolution of 3.5 m was launched in June 2023 by SatVu. It offers new opportunities for monitoring forest fires and hot areas.

1.3 Indices for Forest Fire

In addition to the direct extraction methods, several indices are used to extract burned areas from satellite imagery products.
The most common indices used to identify burned areas are the Normalized Burned Regions (NBR) (Abdikan et al., 2022; Belenguer-Plomer et al., 2019; Lohar et al., 2021; Qarallah et al., 2023), Mid-Infrared Burn Index (MIRBI) (Bastarrika et al., 2014) and Burned Area Index (BAI) (Collins et al., 2018; da Penha Pacheco et al., 2023; Deshpande et al., 2022; Farhadi et al., 2023). Farhadi et al. (2023) compared these indices (BAIS2, NBR, NDSWIR, and MIRBI) and found that the Burned Area Detection Index (BADI) is more accurate than these indices. This means this index is the most accurate one cited in the literature at this time. Therefore, it was used in this study.

1.4 Accuracy Assessment

After having extracted the burned areas, the accuracy is assessed to verify the validity and relevance of the outcomes. The method used to assess accuracy depends on the technique. It appears most of the papers reviewed use a confusion matrix with the Kappa coefficient, overall accuracy, user accuracy, producer accuracy, omission, and commission errors (Abdikan et al., 2022; da Penha Pacheco et al., 2023; Deshpande et al., 2022; Farhadi et al., 2023; Qarallah et al., 2023). The Dice coefficient is less used (Belenguer-Plomer et al., 2019; Cabral et al., 2018; da Penha Pacheco et al., 2023) as well as the spectral separability (da Penha Pacheco et al., 2023; Glushkov et al., 2021; Holden et al., 2005).

2. Materials and Method

2.1 Study Area

Located in the southwest of France, in the Nouvelle-Aquitaine region, the departments of Les Landes and Gironde border the Atlantic Ocean and have an oceanic climate. France is divided into 18 regions. These regions are subdivided into 101 departments. It is on these two departments that this study focused. They represent the second main impacted area by forest fires in France which is known for their annual forest fires (San-Miguel-Ayanz et al., 2019). The most important forest fire occurred in 1949. 82 people were killed including 25 firefighters (INA, 2022). It devastated more than 50000 ha and led to the destruction of hundreds of farms. With time, forest fires were better handled and the recent forest fire that happened in 2022 did not make any victims thanks to the preventive evacuation of 50000 inhabitants. Still, it affected more than 30000 ha but only destroyed a few buildings and camping sites (Préfet de la Gironde, 2023). This event was qualified by Jonathan Lenoir, a CNRS researcher as a “carbon bomb that explodes” due to the amount of carbon dioxide released that was stocked by the maritime pine trees. This impacted the economy of several industries like paper, chemical, or woodwork. Biodiversity is also heavily impacted as the newly growing vegetation adapts to the forest fire context through time and becomes more Mediterranean, losing its identity. It also destroyed a rich flora and fauna ecosystem as every forest fire devastates all or a part of the animals and vegetation (Géorisques, 2024). It also impacted the tourism industry as the forest of Les Landes is famous for its maritime pine trees (Seibt, 2022).

The Gironde is the biggest department of France with 9976 km^2 and a population of 1601800 inhabitants in 2021 (INSEE, 2021). It is famous for its main city, Bordeaux, and is a well-known tourist destination famous for wine, gastronomy, and its closeness to the Atlantic Ocean. The Landes is the second biggest department with an area of 9243 km^2 and a population of 409000 inhabitants according to the website Landes Attractivité (2023). 60% of its area is covered by pine forest, which is the biggest in Europe. It also includes the “Parc Naturel Régional des Landes de Gascogne”. Many beach resorts are located on its coast and are known as the European surfing capital. This makes it an important tourist destination.

2.2 Data

Forest fire data are needed to know when and where they happened. Only fires with a surface area of more than 100 hectares (ha) were selected because getting the data for all the forest fires in Les Landes and Gironde was not possible. The data was gathered from online websites, newspapers, reports, and personal knowledge. The sources of data include the BDIFF (IGN, 2024a), ORRNA (ORRNA, 2024), and DDRM Gironde official report (DDRM de la Gironde, 2021).

Vector and raster data such as land use, vegetation, and terrain were downloaded from IGN (National Institute of Geographic and Forest Information) and used in the creation of the hazard map. Historical Landsat 5 TM, 7 ETM+, 8 OLI, and 9 OLI-2 satellite images were downloaded from the United States Geological Survey (USGS) website and used to identify forest fires between 1989 and 2022. Moreover, a second set of images was downloaded for July to extract fire locations for summer because it is the main season of forest fires. The choice of data was governed by its free availability.

2.3 Methodology

2.3.1 Forest Fire Database Creation: Forest fire events in Les Landes and Gironde were compiled from historical records since 1989. This included a comprehensive search in various newspapers, reports, and personal diaries. Thirty-two events were identified with their dates and approximate locations. Landsat images for all events were downloaded and manual digitization was used to create spatial data for the events together with their attribute (Figure 1).

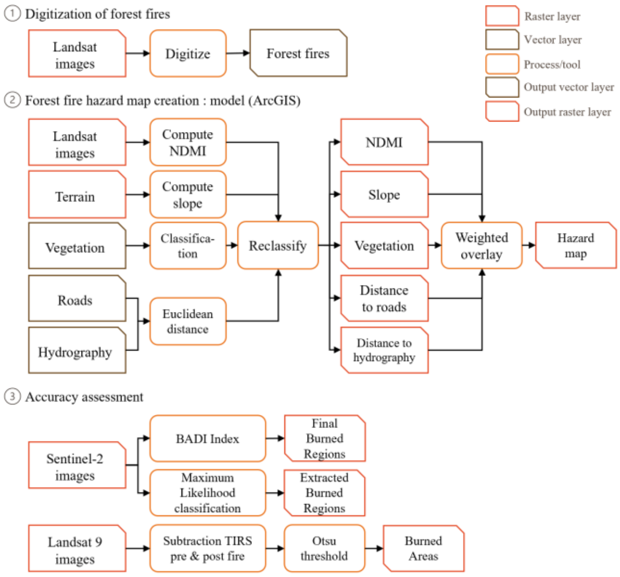

Figure 1. Methodology

2.3.2 Hazard Map Creation: After the digitization, a forest fire hazard map was created using a model builder and weighted overlay in ArcGIS software. The main steps of the process are depicted in Figure 1. The Normalized Difference Moisture Index (NDMI) which measures the vegetation moisture level was computed using Landsat images. It is a common index used in the literature (Malakhov and Tsychuyeva, 2020). Equation 1 shows the NDMI.

$$NDMI = \frac{NIR-SWIR}{NIR+SWIR}, \quad (1)$$

where NIR = Near InfraRed band
SWIR = Short-Wave InfraRed band

Generally, there is less probability of forest fires happening if the moisture is too high. This is the first parameter. The slope was calculated from the terrain data. The slope depicts the impact of wind on the ignition: the higher the slope, the lower the chance of fire starting and vice versa. The types of vegetation species are also considered, the fire will spread quicker or slower depending on the kind of vegetation species. Finally, the roads and hydrography play a role as they represent barriers to the expansion of fires and cannot represent places where a fire could start. To depict this, the Euclidean distance was computed using a pixel size of 25 m for roads (Romero-Calcerrada et al., 2010) and a distance of 250 m for water bodies (Conedera et al., 2015). Sometimes, these values are selected empirically depending on the nature of the obstacle.
All factors involved in the forest fire hazard map (Figure 1) were converted to raster format and reclassified to a common scale of 1 to 5, where 1 means less probability and 5 means higher probability. All of them are equally divided into 5: hydrography between 0 and >100m, roads between 0 and >200m, vegetation was classified in function of the vulnerability of each essence to be burned, slope between 0 and 48m, and the NDMI between -0,6 and 0,6. After the reclassification, the last step is to use the “Weighted overlay” tool with the five previous layers created. The weight applied to each of them is: 25% hydrography, 25% roads, 10% NDMI, 10% slope, and 30% vegetation. The weight of the classes is similar to the one applied by Ozenen et al. (2021). Setiawan et al. (2004) also applied the highest percentage to the vegetation. The weight depicts the relative importance of the factor. The final hazard map was created based on the weighted overlay.

A website was created to make the historical forest fire maps and the hazard map available to the public. This may help in the utilization of the database by decision-makers and other groups who are interested in forest fire control.

2.3.3 Accuracy Assessment of the Database: Three different accuracy assessment methods were applied to compare the results of forest fire identification (Figure 1). The comparison was made in the area of La Teste de Buch, a city located near Bordeaux, where an important forest fire happened in 2022.

The first one is the BADI index. It is performed using Sentinel-2 images. The BADI index is computed following Farahdi et al. (2023) methodology to finally get the Final Burned Regions (FBR). To perform a verification of the output, 360 points, with a minimum distance of 500 meters between them, were created randomly on Sentinel-2 image using QGIS software to check if a point is burned or not using the binary FBR map. There was no previous study/map in the area to use it as ground truth. The field calculator was also used to verify that no other word has been miswritten to just have “Burned” or “Unburned”. A confusion matrix is then computed and the Overall Accuracy, User Accuracy, Producer Accuracy, Kappa Coefficient (Farhadi et al., 2023), Omission Error (absent data), and Commission Errors (excess data) were all calculated.

A second accuracy assessment (Figure 1) was performed to compare Landsat-9 thermal band and Sentinel-2 results. The first step is to clip the extent of the area where the forest fire happened so that no other parameter (for example water) could be included. For each fire event, pre-fire and post-fire images were selected and the difference in digital numbers was calculated using the raster calculator. An Otsu threshold (Otsu, 1979) was applied to separate areas considered as burned and unburned. The output was finally converted to polygons to extract the burned areas. To verify the results, a column was added to the point layer created by the BADI index and filled with the areas considered as burned and unburned. The same process was applied to the manually digitized forest fires from Landsat data.

Finally, a supervised classification (maximum likelihood algorithm) was performed using ENVI software. Nine classes were defined: sand, Garonne (referring to the Garonne River), lake, agriculture, burned areas, water, urban, bare land, and forest. A total of 30 areas of interest (signatures) were created for each class. Another 30 ground truths were used for each class for validation. A confusion matrix was computed to assess the accuracy of the classification.

2.4 Results

2.4.1 Development of a Geospatial Database about Fire Occurrences: A list of 32 forest fires compiled from various sources between 1949 and 2022 was created. The forest fire of 1949 was not digitized because no satellite image exists for this date. Table 1 shows a sample of this database. It includes information such as date, name (location), area, cause (reason why the forest fire started), and source (Table 1). It was not possible to retrieve the precise date of two forest fires and a date corresponding to the first day of the month was assigned to indicate the month it happened. It was found that 7 forest fires happened in "Champs de Tir et Polygone d'Essai de Captieux" which is a military area. So, the reason for 22% of these fires is linked to this activity. An important and recent forest fire happened in Landiras and La-Teste-de-Buch in 2022 which burned more than 17000 ha. It is the biggest one that has happened since 1949. Seasonally, 81% of forest fires occur during March-April and July-August and this is probably due to a temperature increase during summer associated with dryness. According to the IGN (2024b), 90% of forest fires are due to human activities. The remaining 10% is due to lightning. In 70% of cases, they are due to an economic (agriculture, electric networks, …) or daily activity (smoking, barbecues, campfires, …). The rest is caused by "malicious acts", it is to say, people who intentionally set fires.

Date	Location	Area (ha)	Cause	Source
25/08/1949	Landes de Gascogne forest massif fire	~50000	Intentional	Canopée (2023)
18/07/1989	Le Porge and Lacanau fire	3637	/	DDRM Gironde
01/06/2004	Champs de Tir et Polygone d'Essai de Captieux fire	122	/	DDRM Gironde
28/09/2011	Camp de Souge fire	108	Unintentio nal	DDRM Gironde /BDIFF
12/07/2022	Landiras fire	12552	/	ORRNA

Table 1. Sample of forest fire database (full table Appendix A)

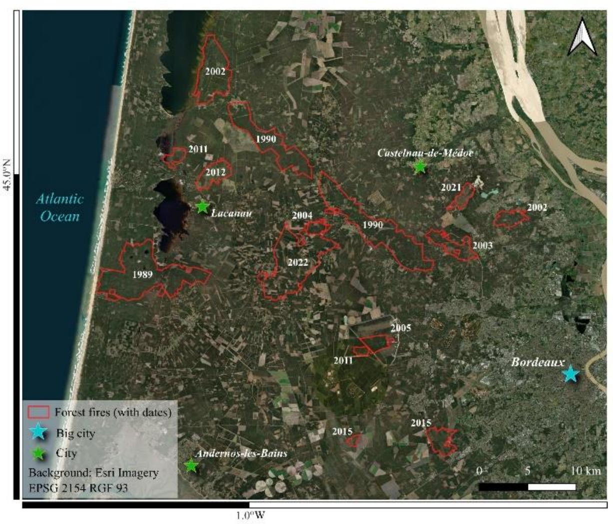

Figure 2. Sample of digitized forest fires.

A sample of the digitized forest fires is shown in Figure 2. It highlights their closeness to the cities and depicts the important number of events that happened there since 1989.

For each year, the areas burned were aggregated (Figure 3). The year 2022 burned was not included in the graph because it is so large and makes other values invisible. It was the biggest event since 1949. There is no general trend in the number of areas burned since 1989 (Figure 3). However, despite the absence of visual trends, these variations can be correlated to the weather conditions. 1989 is the first of two consecutive years to witness an episode of extreme summer dryness (Canopée, 2023), which can explain the size of the area burned (8816 ha) by fires during these two years. The same scenario happened in 2003 with very high summer temperatures. However, in 2017, these fires can be related to their location which is a military area. Finally, 2022 has been a year of record drought and heatwaves since 2003 (Canopée, 2023) which mainly explains the burning of 30000 ha.

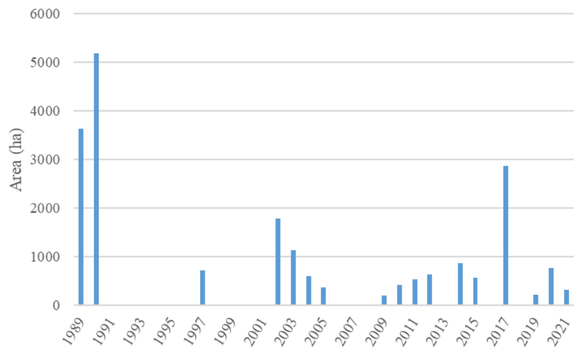

Figure 3. Areas burned between 1989 and 2021.

2.4.2 Forest Fire Hazard Map: The fire hazard map (Figure 4) highlights three levels of vulnerability: low, moderate, and high which can be selected independently. It shows an important vulnerability over all the areas studied to this risk, especially in the ones including the forest areas. Vegetation essences like the "pin maritime" are widespread in this area and increase this vulnerability. The areas without color are not considered as vulnerable as they are clearly visible around Bordeaux city and in the southeast of Les Landes. They are located around cities and outside of forest areas (Figure 4).

A website that included the output from this study was created and made available online in French and English: https://firemap.saro.app/.

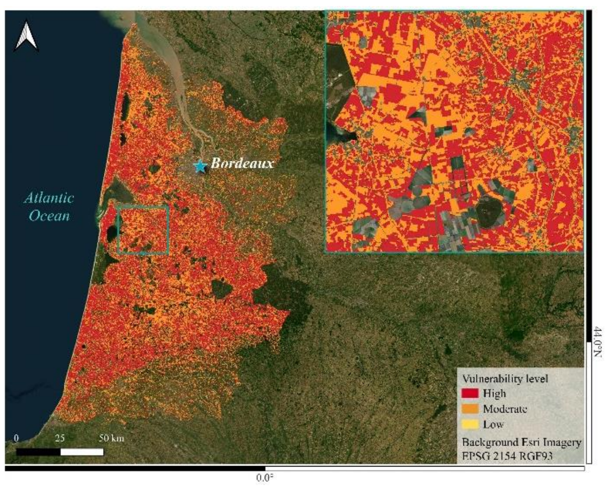

Figure 4. Fire hazard map.

2.4.3 Accuracy Assessment: Several metrics such as user accuracy, producer accuracy, overall accuracy, kappa coefficient, and omission and commission error were utilized to compare the three methods that were used to extract forest fire locations (Table 2, 3, 4).

	Burned	Unburned	Total	User accuracy
Burned	122	5	127	96.09%
Unburned	25	208	233	89.27%
Total	147	213	360	
User accuracy	82.99%	97.65%		
Overall accuracy = 91.67%				
Kappa coefficient = 0.82				
Omission error		Commission error		
Burned	Unburned	Burned	Unburned	
17%	2%	3%	10%	

Table 2. Confusion matrix for BADI index (Sentinel-2)

	Burned	Unburned	Total	User accuracy
Burned	88	39	127	69.29%
Unburned	138	95	233	40.77%
Total	226	134	360	
User accuracy	38.94%	70.89%		
Overall accuracy = 50.83%				
Kappa coefficient = 0.08				
Omission error		Commission error		
Burned	Unburned	Burned	Unburned	
61%	29%	30%	59%	

Table 3. Confusion matrix for subtraction (Landsat-9)

	Burned	Unburned	Total	User accuracy
Burned	127	0	127	100%
Unburned	38	195	233	83.69%
Total	165	195	360	
User accuracy	76.97%	100%		
Overall accuracy = 89.44%				
Kappa coefficient = 0.78				
Omission error		Commission error		
Burned	Unburned	Burned	Unburned	
23%	0%	0%	16%	

Table 4. Confusion matrix for manual digitization from Landsat satellite images.

The confusion matrices highlight that the BADI method (Table 2) and the manual digitization (Table 4) are the ones having the highest overall accuracies: 91.67 % and 89.44% respectively. The kappa coefficients (0.82 and 0.78) show also higher values for both methods. Commission and omission errors show the opposite with better overall values for BADI than for manual digitization which confirms that not a lot of pixels were added or missing regarding the original classes. Generally, the BADI method shows the highest accuracy. This is in line with a study conducted by Farhadi et al. (2023), where the overall accuracy obtained is very similar (92.15%). However, the user accuracy (91.63) and producer accuracy (92.47) obtained are higher.
Regarding the subtraction method made with Landsat images (Table 3), it has the lowest overall accuracy with 50.83% and a kappa coefficient of 0.08, which indicates that it is not accurate. The producer and user accuracies are also low (38.94% and 40.77%) (Table 3). The spatial resolution of Landsat images thermal band (TIRS) is low (100 m) in comparison to Sentinel-2 optical imagery (10 m), and this could be a reason for the low accuracy (Table 3).

Figure 5. Burned areas extraction and manual digitization of the forest fire in Landiras, 2022.

Figure 5 shows and validates the result from the accuracy assessment. The BADI method used with Sentinel-2 is more accurate regarding the delineation of forest fires. It is better than manual digitization as it includes the gaps in unburned areas.

Finally, the last method performed is the maximum likelihood algorithm (Figure 6). The overall accuracy is 96.75% with a kappa coefficient of 0.81. The producer and user accuracy are all high except for agricultural, urban, and bare land areas because they have similar spectral reflectance. The omission and commission errors show the same result but with a commission error of 33.73% for burned areas as they were confused with nearly all the other classes except for sand and Garonne.
Figure 6 shows that the classification of the Sentinel-2 image provides more accurate results for the extraction of the burned areas than the BADI method. Small areas like the urban and sand are confused but overall, the result is more precise and accurate.

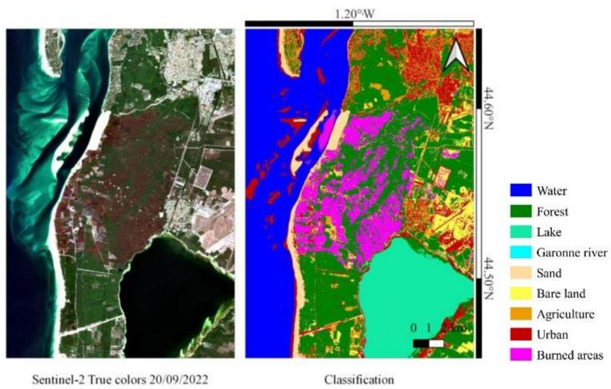

Figure 6. Classification result of Sentinel-2 image, Landiras, 2022

A limitation of this study was the difficulty of getting accurate forest fire data from French institutions. All the data used came from free online websites and official reports. Unfortunately, they are incomplete. Some newspapers and reports describe broadly where forest fires occurred, but there is no map or accurate locations associated with the reports. This makes it difficult to geocode the events. In addition, it is difficult to create maps for forest fires for dates before the Landsat data is available (before 1972).

Automatic detection of forest fires needs conversion of the data from raster to vector to allow adding of attribute data. Although manual digitization shows good accuracy, human errors have to be considered as well as the spatial resolution of satellite images.

3. Conclusions

Most of the forest fire events that happened since 1989 are located in the Gironde department and occurred between March and April or July and August. However, the area which had the biggest forest fire is Les Landes and this is agreed with the hazard map generated. The accuracy performed using different methods showed that the supervised classification performed with the maximum likelihood algorithm was more accurate than the manual digitization. The BADI index also revealed its efficiency but is still less accurate than the supervised classification. The creation of a website showing a summary of the historical forest fires since 1989 and the hazard map provides valuable information for the monitoring of forest fires in the southwest of France (https://firemap.saro.app/). Previous applications did not exist in this region despite the publication of official reports on the subject. Adding links with an application could help in building a comprehensive list of forest fire events.
The development of such a database appears necessary because forest fires happen every year in this area, especially when there are droughts and heat waves. It could help policymakers to predict future events and protect the population. In addition, the temporal mapping of fire areas will help in understanding their evolution, identifying the types of vegetation/trees that are affected, and factors that reduce their expansion.

Future work could quantify the accuracy and cost of delineating forest fires using manual digitization or automatic classification. The rich historical data in reports, newspapers, and diaries could be explored and geocoded to provide further statistical and spatial analysis. The use of higher-resolution data or local institutional resources would further strengthen future studies as well. Finally, adding forest fires of less than 100ha would also expand knowledge and precise potential future action plans.

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Appendix A. List of Forest Fires in the Area

Date	Location	Area (ha)	Cause	Source
25/08/1949	Landes de Gascogne forest massif fire	~50000	Intentional	Canopée (2023)
18/07/1989	Le Porge and Lacanau fire	3637	/	DDRM Gironde
31/03/1990	Salaunes fire	5179	/	DDRM Gironde
14/04/1997	Saint Michel de Rieufret fire	714	/	DDRM Gironde
28/03/2002	Arsac fire	369	/	DDRM Gironde
22/04/2002	Carcans fire	1413	/	DDRM Gironde
23/03/2003	Saint Aubin du Médoc fire	648	/	DDRM Gironde
23/08/2003	Champs de Tir et Polygone d'Essai de Captieux fire	475	/	DDRM Gironde
01/06/2004	Champs de Tir et Polygone d'Essai de Captieux fire	122	/	DDRM Gironde
01/08/2004	Champs de Tir et Polygone d'Essai de Captieux fire	237	/	DDRM Gironde
08/08/2004	Sainte Hélène fire	234	/	DDRM Gironde
16/08/2005	Souge fire	366	/	DDRM Gironde
28/06/2009	Meilhan fire	193	Natural	BDIFF
12/04/2010	Garrosse fire	130	Unknown	BDIFF
29/04/2010	Le Teich fire	111	Unintentional (work)	DDRM Gironde /BDIFF
04/09/2010	Sanguinet fire	170	Unknown	DDRM Gironde /BDIFF
02/07/2011	Lacanau fire	306	Unknown	DDRM Gironde /BDIFF
04/07/2011	Luxey fire	108	Unknown	BDIFF
28/09/2011	Camp de Souge fire	108	Unintentional	DDRM Gironde /BDIFF
16/08/2012	Lacanau fire	634	Unknown	DDRM Gironde /BDIFF
24/04/2014	Champs de Tir et Polygone d'Essai de Captieux fire	856	/	DDRM Gironde
24/07/2015	Saint Jean d'Illac fire	562	Unknown	DDRM Gironde /BDIFF
30/03/2017	Champs de Tir et Polygone d'Essai de Captieux fire	1293	/	DDRM Gironde
20/04/2017	Cissac Médoc fire	1075	Unknown	DDRM Gironde /BDIFF
04/07/2017	Champs de Tir et Polygone d'Essai de Captieux (Callen) fire	491	Unintentional (individuals)	DDRM Gironde /BDIFF
04/09/2019	Bédenac fire	205	/	ORRNA
27/07/2020	Le Tuzan fire	285	Unknown	ORRNA /BDIFF
04/09/2020	Champs de Tir et Polygone d'Essai de Captieux fire	350	/	ORRNA
17/09/2020	Lapouyade fire	120	Unintentional	ORRNA /BDIFF
03/04/2021	Avensan fire	303	Unknown	ORRNA /BDIFF
12/07/2022	Landiras fire	12552	/	ORRNA
12/07/2022	La-Teste-de-Buch fire	5709	/	ORRNA
12/07/2022	Hostens, Saint-Magne, Belin-Béliet fire	7448	/	ORRNA
12/09/2022	Saumos fire	3248	/	ORRNA