A geospatial dataset of wildfires in Italy, 2007-2022

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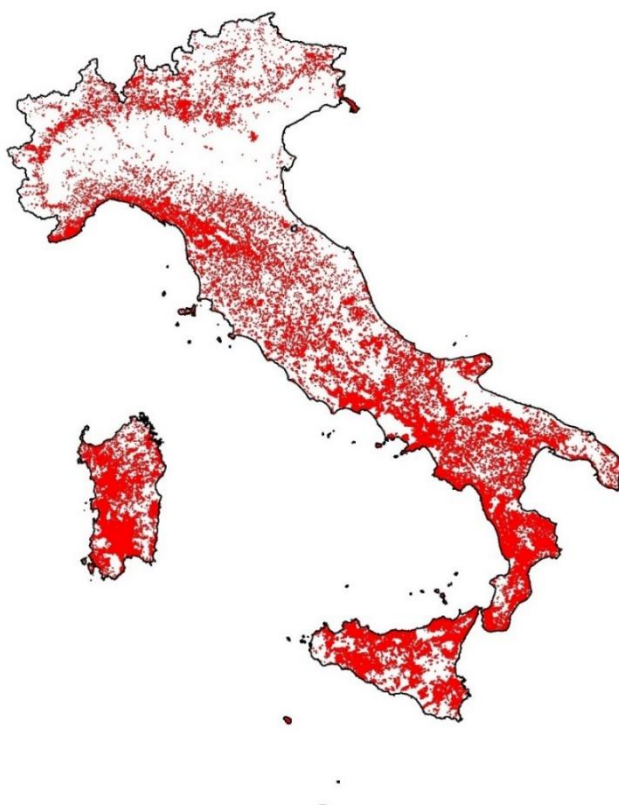[4]Department of Agricultural and Environmental Sciences, University of Milan, Milano, Italy
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Abstract

This report documents the creation of a geospatial dataset of wildfires that occurred in Italy over the period 2007-2022. The original wildfire data were provided by national and regional agencies. The dataset was standardized and went through several manual and automatic steps of data processing and quality control. While the dataset still presents some issues and limitations, it is a suitable product to carry out geospatial analyses of wildfires in Italy from 2007 to 2022. The geospatial dataset contains 106,978 fire records and a total burned area of 1,356,851 ha. The dataset described in this report is only available upon request due to legal restrictions.

1. Background

Researchers should frequently gather and merge different datasets on their own to obtain a multiannual national fire dataset for Italy due to the lack of a complete and harmonized national wildfire database. A previous spatial dataset of wildfires in Italy for the period 2007-2017 (hereafter referred to as the "2007-2017 dataset") was derived in 2019 by Jose V. Moris and Professor Davide Ascoli from the University of Turin. This dataset was initially generated to facilitate geospatial analyses of Italian wildfires, such as fire severity, fire spread, fire statistics, fire weather, fire emissions, impacts on ecosystem services, etc. The 2007-2017 dataset went through comprehensive data processing and quality control, and was used in the following publications: Colonico et al. (2022), Elia et al. (2022), Spadoni et al. (2023), Scarpa et al. (2024).

The new geospatial dataset of wildfires in Italy, 2007-2022, was built on the 2007-2017 dataset. First, the new dataset was extended by adding the wildfires that occurred in Italy between 2018 and 2022. Second, some wildfires and information regarding the period 2007-2017 were updated (e.g., adding missing dates or removing redundant fires), and the complete new dataset 2007-2022 went again throughout exhaustive data processing and quality control.

The purpose of this technical report is to document the creation of a geospatial dataset of wildfires in Italy over the period 2007-2022. This report has four specific objectives:
1. To describe the data sources, data processing and quality control applied to create the geospatial dataset.
2. To point out the major limitations of the dataset.
3. To provide a brief summary of the dataset and a comparison with official wildfire statistics.
4. To inform about metadata and data availability regarding the dataset.

2. Data sources

Original wildfire datasets were provided by different agencies responsible for wildfire management and reporting in Italy (Table 1). In regions with an ordinary status ("regione a statuto ordinario"), the spatial wildfire records were extracted from annual datasets of RAPF ("Rilievo delle Aree Percorse dal Fuoco") managed by CUFAA ("Comando Unità Forestali, Ambientali e Agroalimentari dell'Arma dei Carabinieri"), while in regions with an autonomous status ("regione a statuto speciale"), the different wildfire datasets were provided by regional agencies (Table 1). Wildfire datasets from the region of Trentino-Alto Adige were provided at province level by the Autonomous Provinces of Bolzano and Trento, respectively.

Table 1. Data sources to create the geospatial dataset of wildfires in Italy, 2007-2022.

Region	Category	Agency
Valle d'Aosta	Special status	Corpo Forestale della Valle d'Aosta
Province of Bolzano	Special status	Ripartizione Servizio Forestale
Province of Trento	Special status	Servizio Foreste
Friuli-Venezia Giulia	Special status	Corpo Forestale Regionale
Sardegna	Special status	Corpo Forestale e di Vigilanza Ambientale
Sicilia	Special status	Corpo Forestale della Regione Siciliana
Rest of Italy (15 regions)	Ordinary status	CUFAA

3. Data curation

3.1. Standardization

The dataset faced common problems derived from the compilation of data from multiple systems of fire records (Short, 2014). The original fire datasets consisted in fire polygons (i.e., vector data) representing the burned areas and their fire perimeters, with associated attribute tables describing each fire with a collection of multiple variables. The variables reported by different agencies and years were not consistent. Therefore, we decided to keep a minimum number of variables that could be retrieved consistently from all the original fire datasets: region, year and date (see Table 2). Other variables, such as ID, region code and burned area were reassessed by ourselves afterwards.

Table 2. Variables extracted and derived from the fire datasets and used to set up the geospatial dataset of wildfires in Italy, 2007-2022.

Variable	Type	Description
ID	Numeric	Unique id number of the fire (from 1 to 106,978)
COD_REG	Character	Region code according to ISTAT (e.g., 01 for Piemonte)
Region	Character	Name of the region (according to the original sources)
Province	Character	Name of the province (only for Bolzano and Trento)
Year	Numeric	Year in which the fire occurred (from 2007 to 2022)
Date	Character	Date in which the fire started or was reported (yyyy-mm-dd)
Area_ha	Numeric	Total burned area of the fire in hectares (6 decimals)

Geographical transformations were used to ensure all polygons were aligned according to the WGS84-UTM 32N projected coordinate system. When the dataset was complete, each fire record was given a unique id number in ascending order, given that it was not possible to obtain a unique id for every record by simply combining the rest of variables. In addition, a code (from 01 to 20) was assigned to each region according to ISTAT ("Istituto Nazionale di Statistica").

Italy is divided into 20 regions. Some fires spread over more than one region. For these fires, the region appearing within the original datasets was maintained. However, in some cases, the majority of the burned area could occur in another region. In consequence, some may have the name of a region despite only a small proportion of the burned area occurred within that region. Similarly, we decided not to extract geographical information regarding the province and municipality ("comune") in which the fires occurred. The reasons were several. (1) We wanted to keep the dataset as small and simple as possible. Any user can apply GIS functions, such as "join attributes by location", to derive this type of variable. (2) Depending on the algorithm applied (e.g., first feature, centroid, maximum overlap), the assigned province and municipality may change. This implies that the names of province and municipality could contradict the region for those fires that burned over different administrative units. (3) The borders of Italian provinces and municipalities can change over time. Thus, the year of reference is important to define the names and borders of provinces and municipalities. (4) The names of some provinces and municipalities include Italian characters. These characters are often not read correctly by some software. These names can create potential problems to users when using basic statistical and GIS functions, such as grouping or locating by name. Finally, we did include the name of the province for those fires reported inside the provinces of Bolzano and Trento. We did so because fires from both provinces came from different datasets and we did not want to lose the capacity to retrace any fire record from the original datasets.

All dates were reformatted as yyyy-mm-dd, except when dates were missing. Obvious errors in dates were corrected. When date and year did not match each other, and it was not possible to distinguish the source of disagreement, the year was adjusted to match the date. Fire areas were not retrieved from the original sources, but they were calculated by a GIS function once all issues in polygons were solved. Areas were calculated in hectares to 6 decimal places.

3.2. Data processing and quality control

Below is a summary of the main data processes carried out. We combined different automatic and manual steps in order to solve the main issues found in the original fire datasets and standardize the final dataset. The order of these processes does not entirely reflect the sequence in which they were performed.

1. The variables of the original datasets were filtered to keep: region, year, date, and area.

2. Where needed, geographical transformations were applied (WGS84-UTM 32N).

3. All original spatial datasets were merged into one unique dataset that includes all reported fire records in Italy between 2007 and 2022.

4. Fire records without an associated polygon were given a circular shape by using their point coordinates as center of the circle, and the reported burned area as circle area

5. Where needed, the names of regions were corrected and standardized according to ISTAT. We exclusively added Bolzano and Trento under the province field for the corresponding fire records.

6. Clear mistakes in dates were corrected. Dates were reformatted (yyyy-mm-dd). Disagreements between years and dates were solved to the best of our ability. Fire records with missing dates were identified. In some cases, we fixed missing dates by exploring ancillary data (e.g., newspapers). For fire records without information regarding the year, this was extracted from the date.

7. The areas of every fire record were calculated using QGIS and corroborated with R. Calculations regarding the areas were compared with the values included in the original datasets. Fires smaller than 1 m^2 (i.e., < 0.0001 ha) were removed.

8. Fires located entirely outside the borders of the Italian territory were deleted. We also removed a few fires that were positioned at sea or in another country due to errors in the coordinates, and for which we could not figure out the correct location.

9. We removed redundant fire records to the best of our ability. Exact duplicates were easily identified and removed using functions such as "delete identical" from ArcGIS. However, due to inconsistencies in the original datasets, many records were redundant but not identical (e.g., due to tiny changes in geometries). There was no simple process to remove them and we used different approaches. For example, identifying fires with the same or close dates and very similar area values within the same region. Manual inspection of attribute tables and visual inspection of fire polygons were applied as well.

10. Where appropriate, we combined several fire records into one. This was essentially a manual process. In some regions and years, fire records, and their corresponding spatial fire polygons were not delineated consistently. This means that, frequently, a single fire event was divided into two or more fire records, each one with its own data, id and spatial configuration. In some cases, it seems that the division of a single fire event into different records may reflect fire progression. In other cases, they seem to reflect a division of the burned area into different land use classes or another spatial classification. We tried to solve this issue by visually and individually examining all fire records > 100 ha (> 90 ha in the period 2007-2017). For some years and regions with more fire activity (e.g., Sicilia and Sardegna), we even inspected fire records > 70 ha. Where we detected fire records that were assumed to belong to the same fire event, we merged them into a single fire record (Figure 1). When the dates of the merged records differed, we chose the earliest one. If we were not sure about the merge, we decided not to proceed. During this process, we merged many other records found when inspecting large fire polygons.
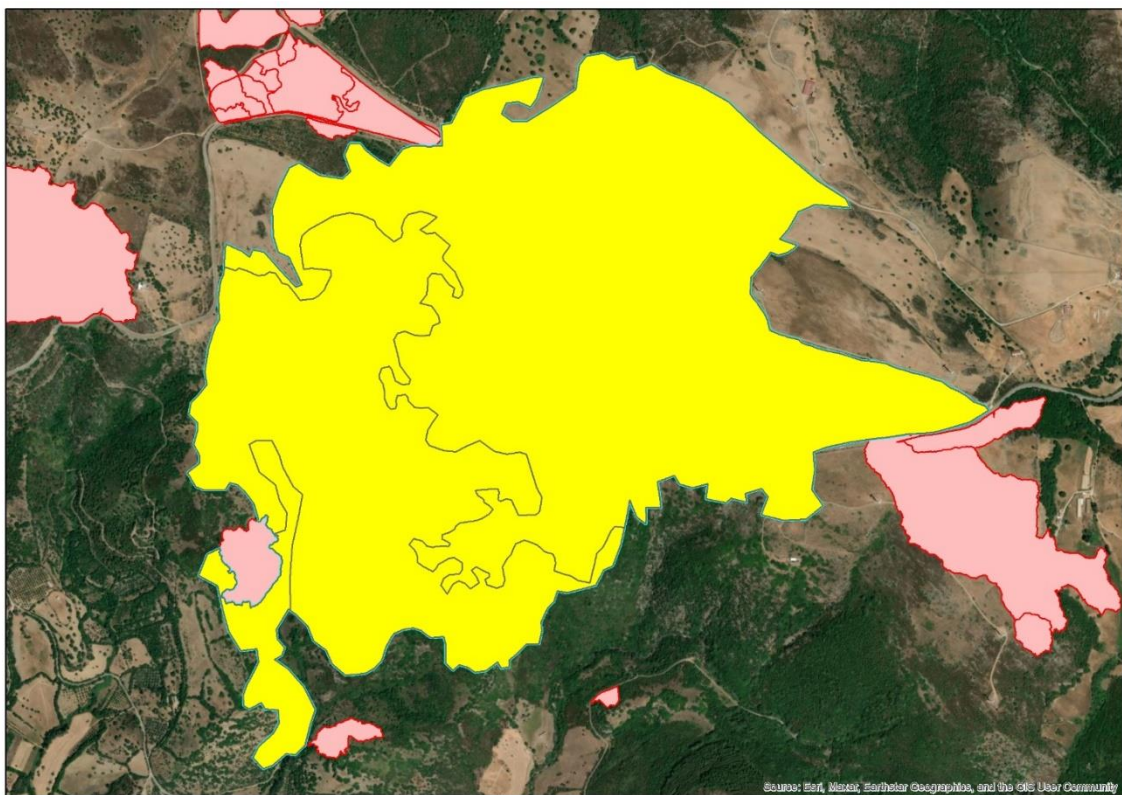
Figure 1. Example of a single fire event (in yellow) that was reported as three different records and polygons (separated by black lines) in one of the original fire datasets.

11. Geometry problems (e.g., corrupt or invalid geometries of the spatial polygons) were checked and solved with the functions "fix geometries" and "st_make_valid" from QGIS and the package simple feature (sf) of R, respectively. When obvious spatial errors in fire polygons were detected during visual inspections, these were also corrected (e.g., fire perimeters partially within the sea).

4. Errors and other issues

Some of the problems identified during the data processing were only partially solved. We focused on large fires when prioritizing the time and effort spent on manual processes. Therefore, the dataset may be of higher quality for fire records characterized by large burned areas (e.g., fires > 100 ha). Following is a list of the major errors, potential limitations and other issues that a user may have to

face, according to our own experience, when using the geospatial dataset of wildfires in Italy in 2007-2022.

1. The dataset does not include any coordinates of fire ignitions or fire discovery locations. The time (hour and minute) of fire detection is absent, as well as fire duration. Likewise, the cause of the fire (e.g., human or natural) is missing.

2. In total, 165 fire records have no date. Table 3 and Table 4 provide a summary of these fires.

Table 3. Number (#) of fires without date and associated burned area (BA) by region.

Region	# fires	BA (ha)
Piemonte	10	290.6
Lombardia	2	3.9
Liguria	2	0.4
Emilia-Romagna	3	6.4
Lazio	65	565.9
Molise	2	0.2
Campania	7	71.9
Basilicata	3	10.0
Calabria	12	155.6
Sicilia	59	1,348.2
TOTAL	**165**	**2,452.9**

Table 4. Number (#) of fires without date and associated burned area (BA) by year.

Year	# fires	BA (ha)
2007	2	28.9
2008	2	112.7
2011	4	151.1
2020	93	1,511.0
2021	64	649.3
TOTAL	**165**	**2,452.9**

3. Dates represent the days in which the fires started or were discovered (Table 2). Few records may include incorrect dates (e.g., mistyped dates). Nonetheless, the great majority of dates should be accurate.

4. In total, 627 fire records from Trentino-Alto Adige had no fire perimeters, and their polygons were created as circles. These fires burned 81.7 ha between 2007 and 2022.

5. We noticed that very few records are composed of non-continuous fire polygons that may not belong to the same event but possibly were grouped as a single record due to the spatial and temporal proximity of these polygons.

6. As described in Section 3.2. (Data processing and quality control), Point 10, numerous fire records were merged manually because we assumed that they were actually part of the same fire event. However, there are many other fire records with small burned areas that could not be merged following the same approach. The large number of fire records and the lack of an automatic process

prevented us from extending this task to the whole dataset. AI may help us fix this issue in the future. Consequently, dataset users must be aware that the number of fire records may overestimate the number of wildfire events in certain zones and periods.

7. A few fire polygons are characterized by unrealistic and simplified shapes. Users may need to use remote sensing images or other sources to obtain more accurate perimeters for those particular fires. Nonetheless, this is not a prominent problem in the dataset.

8. Despite our efforts to remove as many redundant fire records as possible, some are likely to persist in the dataset.

9. Some fire records were deleted during the data processing and quality control. Moreover, other fires, especially small ones, might be missing from the original datasets for one reason or another. By no means, this is a complete dataset of all wildfires reported in Italy between 2007 and 2022. Nevertheless, the dataset should provide a comprehensive source of information on the spatial and temporal distribution of wildfire activity in Italy for the period 2007-2022.

The final product is a polygon-based geospatial dataset, in which each record is associated with one or more polygons that represent the location of the area burned by a wildfire event. Each fire record includes the seven fields described in Table 2: ID, region code, region, province, year, date, and area.

5. Data comparison

In total, the geospatial dataset of wildfires in Italy, 2007-2022, contains 106,978 fire records that burned 1,356,851 ha (Table 5). In the period 2007-2022, Sardegna experienced the highest number of wildfire events (22,049 records), while Sicilia suffered the largest burned area (384,552 ha). The year 2007 showed the highest number of wildfires (14,305) and burned area (226,657 ha) within the spatial dataset (Figure 2). On average and according to the geospatial dataset, Italy experienced 6,686 wildfires and 84,803 burned hectares per year in the period 2007-2022, although with a strong interannual variability in number of fires and burned area (Figure 2). August and July were the months with the highest number of fires and burned area (Figure 3). Fire size distribution in a 10-base logarithmic scale reveals that wildfires between 1 and 10 hectares were the most common fire size class, and only 3 wildfires burned more than 10,000 ha between 2007 and 2022 in Italy (Figure 4). Table 6 shows the number of fire records per region and year in the geospatial dataset, while Table 7 shows the burned areas per region and year.

Italy reports every year the number of wildfires and burned areas per region to the European Forest Fire Information System (EFFIS). We used these EFFIS data to evaluate the completeness of the geospatial dataset. Table 8 shows the number of wildfires per region and year according to EFFIS, while Table 9 shows the corresponding burned areas per region and year as well. We confronted the geospatial dataset against EFFIS data for both metrics in Table 10 (number of fires) and Table 11 (burned area), respectively. The comparisons illustrate that for some regions and years, both data agree completely (differences are equal to zero), while in general, disagreements are very variable in time and space. Globally, the geospatial dataset includes 6.5% more fire events and 5.5% more burned area than the EFFIS official statistics for Italy from 2007 to 2022 (Table 12).
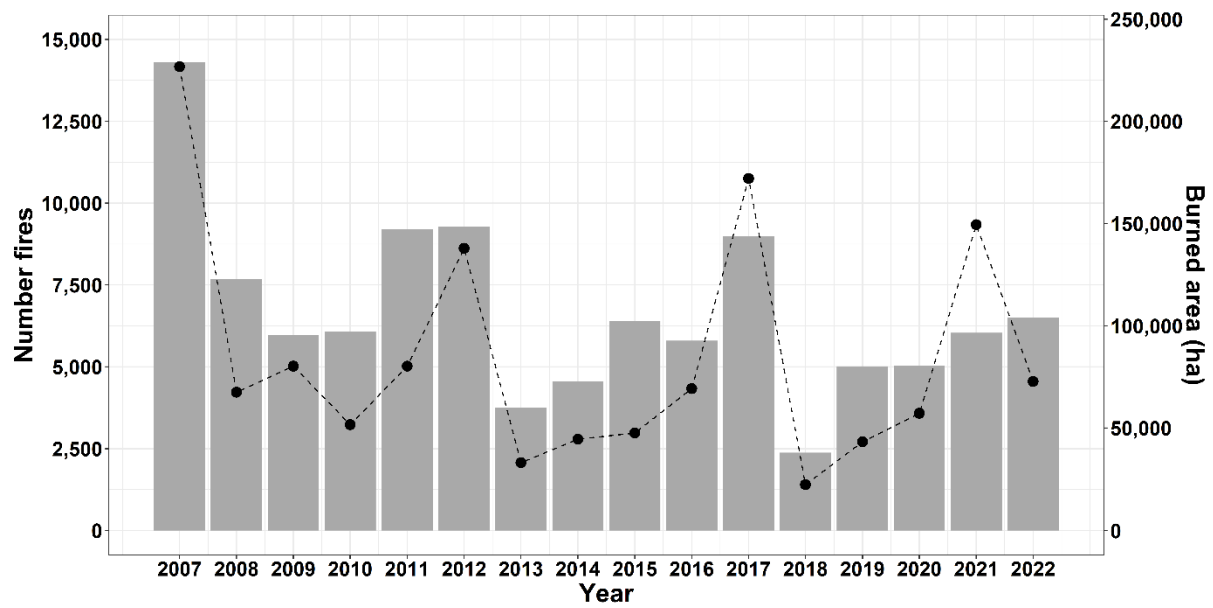
Figure 2. Number of fire records (grey bars) and burned area (black dots) per year in the geospatial dataset of wildfires in Italy, 2007-2022.
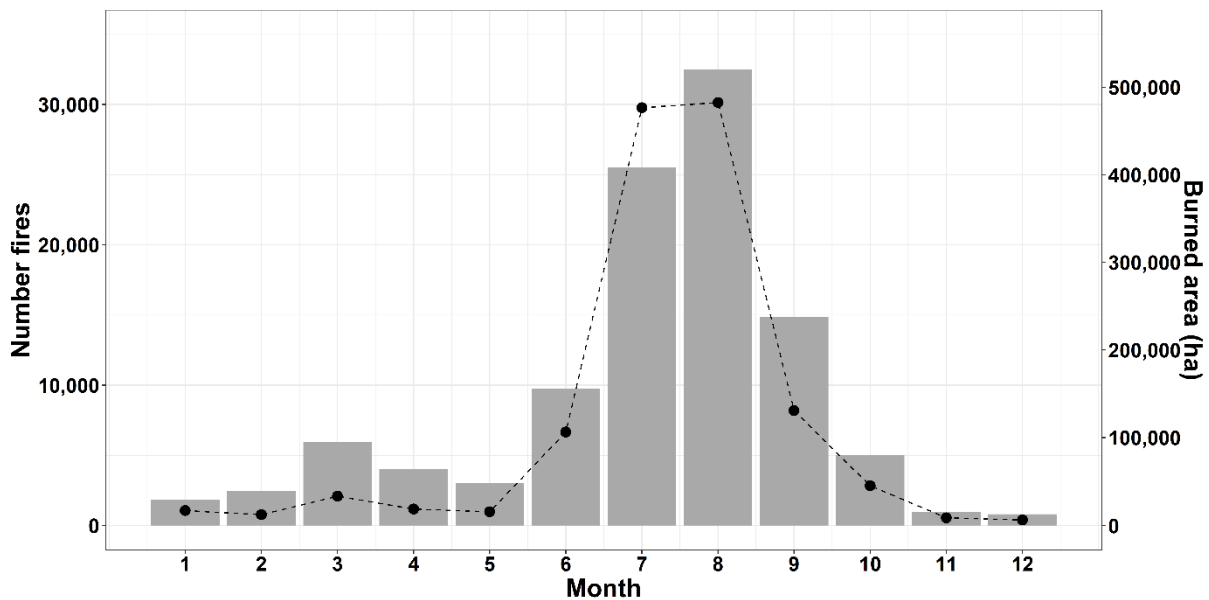
Figure 3. Number of fire records (grey bars) and burned area (black dots) per month in the geospatial dataset of wildfires in Italy, 2007-2022.
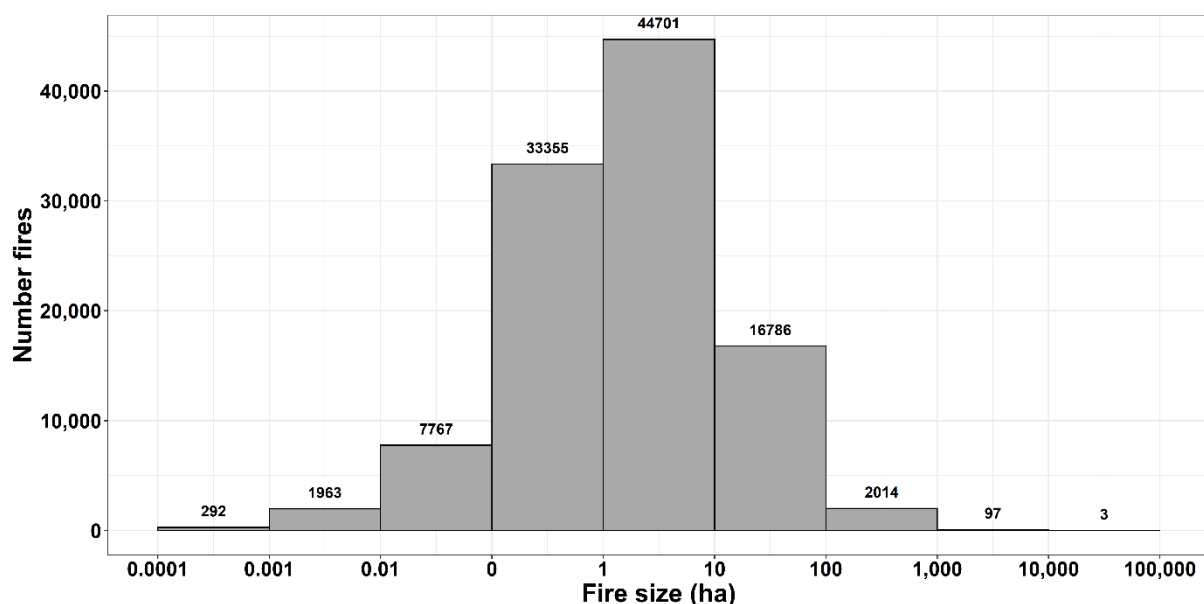
Figure 4. Number of fire records per fire size class in the geospatial dataset of wildfires in Italy over the period 2007-2022.

Table 5. Total number of fire records (# fires) and burned area (BA) per region in the geospatial dataset of wildfires in Italy over the period 2007-2022.

REGION	# fires	BA (ha)
Piemonte	2,784	32,872
Valle d'Aosta	154	306
Lombardia	3,009	20,889
Trentino-Alto Adige	836	571
Veneto	907	2,973
Friuli Venezia Giulia	1,168	5,156
Liguria	3,573	19,599
Emilia-Romagna	1,516	3,625
Toscana	6,730	21,222
Umbria	1,344	7,704
Marche	715	7,203
Lazio	6,738	89,489
Abruzzo	1,472	41,495
Molise	1,587	12,972
Campania	13,014	107,965
Puglia	6,920	93,159
Basilicata	3,633	45,438
Calabria	14,024	210,245
Sicilia	14,805	384,552
Sardegna	22,049	249,415
ITALY	**106,978**	**1,356,851**

Table 6. Number of fire records per region and year in the geospatial dataset of wildfires in Italy, 2007-2022.

REGION	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Piemonte	401	192	118	78	218	169	147	113	192	133	240	60	78	133	134	378
Valle d'Aosta	12	11	12	6	14	14	3	5	11	4	15	8	18	8	4	9
Lombardia	300	155	141	82	221	257	92	93	216	168	219	87	186	142	165	485
Trentino-Alto Adige	107	25	49	39	43	63	34	10	81	42	77	29	42	27	37	131
Veneto	96	52	101	25	68	164	30	15	57	35	55	8	11	44	50	96
Friuli Venezia Giulia	92	65	73	52	98	186	49	11	76	60	102	40	71	48	40	105
Liguria	438	290	338	113	295	354	138	98	227	222	335	95	132	91	165	242
Emilia-Romagna	202	131	87	19	116	166	34	25	51	51	133	12	51	82	159	197
Toscana	515	454	551	165	640	756	209	120	326	434	766	278	322	240	386	568
Umbria	261	115	58	40	122	183	21	7	58	16	97	34	64	51	95	122
Marche	176	36	18	9	85	70	14	4	26	3	45	14	53	29	84	49
Lazio	1,384	350	325	352	600	714	197	212	445	353	529	62	151	267	374	423
Abruzzo	413	98	35	64	134	153	41	21	84	39	136	18	44	61	88	43
Molise	500	166	49	74	128	140	63	32	69	32	99	8	6	67	98	56
Campania	2,351	808	911	542	1,409	1,179	319	308	992	707	1,193	113	508	704	558	412
Puglia	1,134	496	277	470	570	553	356	216	419	314	449	158	352	395	475	286
Basilicata	908	316	144	150	297	343	127	68	146	70	290	57	153	183	234	147
Calabria	2,047	1,281	724	648	1,218	1,067	291	491	862	965	1,485	274	674	589	723	685
Sicilia	759	1,295	513	1,144	1,007	1,241	456	921	838	1,013	1,251	561	846	949	937	1,074
Sardegna	2,209	1,344	1,440	2,004	1,919	1,507	1,141	1,787	1,217	1,137	1,477	460	1,256	932	1,233	986
ITALY	**14,305**	**7,680**	**5,964**	**6,076**	**9,202**	**9,279**	**3,762**	**4,557**	**6,393**	**5,798**	**8,993**	**2,376**	**5,018**	**5,042**	**6,039**	**6,494**

Table 7. Burned area (ha) per region and year in the geospatial dataset of wildfires in Italy, 2007-2022.

REGION	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Piemonte	3,459	2,473	373	236	1,168	1,422	704	170	3,298	1,385	10,945	399	2,527	727	958	2,628
Valle d'Aosta	9	13	8	3	55	54	5	6	11	9	31	2	5	2	5	88
Lombardia	1,598	1,148	397	318	1,301	1,338	493	456	2,403	1,544	4,128	1,212	1,264	1,331	246	1,713
Trentino-Alto Adige	123	3	5	5	16	54	42	2	24	9	70	1	20	5	13	180
Veneto	74	28	55	12	633	150	8	11	71	15	46	630	4	112	29	1,098
Friuli Venezia Giulia	165	68	355	37	373	783	1,440	11	91	73	104	16	118	70	103	1,350
Liguria	2,976	824	2,667	169	1,582	1,312	262	246	1,068	1,189	4,564	106	687	103	653	1,189
Emilia-Romagna	899	164	186	21	178	506	26	13	158	56	533	4	67	64	204	545
Toscana	1,128	988	1,837	142	964	2,830	145	95	425	974	3,352	1,468	1,801	360	875	3,836
Umbria	1,165	339	59	110	306	2,455	44	3	137	10	906	22	148	200	464	1,339
Marche	5,103	69	58	46	449	271	23	62	39	2	454	17	97	71	367	74
Lazio	14,020	2,800	2,528	3,155	6,899	8,080	1,405	1,151	5,966	3,978	19,415	577	1,585	3,558	7,840	6,532
Abruzzo	22,383	893	168	381	1,214	1,536	315	50	1,089	155	7,865	193	324	1,604	3,039	288
Molise	2,837	818	187	379	751	974	371	147	863	188	1,566	15	4	1,035	2,502	337
Campania	26,826	3,909	6,317	2,360	8,054	8,146	1,070	1,037	5,867	3,615	20,792	551	3,545	5,142	7,034	3,702
Puglia	20,151	8,763	4,439	5,069	6,934	8,273	3,351	1,182	3,136	3,152	6,630	644	3,447	3,613	9,875	4,502
Basilicata	8,030	5,715	1,079	2,110	3,143	6,179	948	523	1,581	881	6,611	310	1,413	1,293	3,835	1,788
Calabria	42,300	18,178	7,215	5,235	14,421	22,792	2,837	3,571	6,648	8,127	32,144	2,721	5,372	4,688	27,488	6,508
Sicilia	39,035	14,288	7,578	20,072	13,434	55,885	4,984	20,624	6,557	28,912	38,466	11,427	14,166	25,357	58,161	25,608
Sardegna	34,378	6,096	44,841	11,893	18,452	14,868	14,682	15,270	8,219	15,099	13,431	2,089	6,758	7,985	25,810	9,546
ITALY	**226,657**	**67,575**	**80,350**	**51,752**	**80,326**	**137,906**	**33,154**	**44,626**	**47,652**	**69,374**	**172,053**	**22,403**	**43,352**	**57,319**	**149,502**	**72,851**

Table 8. Number of wildfires per region and year that Italy reported to EFFIS from 2007 to 2022.

REGION	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Piemonte	398	157	117	66	209	166	147	109	180	151	266	60	154	134	139	380
Valle d'Aosta	12	11	13	7	16	12	4	6	14	6	14	8	11	43	4	9
Lombardia	264	153	138	82	227	262	92	93	225	136	220	85	187	143	168	486
Trentino-Alto Adige	87	25	48	39	43	49	38	10	89	30	78	34	55	32	41	144
Veneto	59	48	99	25	69	164	31	15	57	29	57	8	26	45	50	97
Friuli Venezia Giulia	92	66	73	53	98	181	51	12	76	50	99	35	71	66	40	105
Liguria	537	291	332	113	293	354	139	97	226	217	338	93	156	106	171	243
Emilia-Romagna	163	128	86	19	120	167	34	26	51	43	136	12	53	82	162	198
Toscana	580	456	549	165	646	756	209	113	328	421	769	279	324	242	405	571
Umbria	162	116	56	40	123	186	21	7	58	17	98	34	64	51	95	122
Marche	100	36	19	9	84	70	14	4	26	3	45	14	53	30	84	49
Lazio	778	347	325	354	609	715	198	211	456	326	548	62	234	303	341	423
Abruzzo	274	95	34	64	136	154	41	21	84	42	138	21	48	62	90	43
Molise	821	166	49	74	129	142	63	32	70	30	99	8	27	67	101	56
Campania	5,855	799	903	543	1,435	1,186	319	307	994	688	1,199	115	513	704	559	412
Puglia	605	486	277	473	580	557	357	217	420	329	454	160	355	395	476	286
Basilicata	425	307	142	150	295	343	126	68	146	69	288	57	185	184	238	147
Calabria	1,880	1,279	716	652	1,238	1,069	292	492	864	1,140	1,488	274	669	593	739	685
Sicilia	1,255	797	762	1,159	1,011	1,271	458	938	830	1,014	1,213	522	872	575	978	1,083
Sardegna	3,295	723	684	797	820	448	302	479	248	225	408	1,339	347	1,008	1,108	990
ITALY	**17,642**	**6,486**	**5,422**	**4,884**	**8,181**	**8,252**	**2,936**	**3,257**	**5,442**	**4,966**	**7,955**	**3,220**	**4,404**	**4,865**	**5,989**	**6,529**

Table 9. Burned area (ha) per region and year that Italy reported to EFFIS from 2007 to 2022.

REGION	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Piemonte	3,712	904	373	231	895	1,381	704	166	2,882	687	10,951	399	1,966	727	973	2,628
Valle d'Aosta	9	14	7	3	62	59	7	9	19	19	29	2	6	3	5	90
Lombardia	1,608	1,142	396	318	1,312	1,336	493	456	2,474	791	4,292	252	1,260	1,332	248	1,712
Trentino-Alto Adige	159	3	5	5	15	49	43	2	28	9	59	1	30	6	13	185
Veneto	100	28	54	12	625	150	8	11	71	13	46	630	31	112	29	1,098
Friuli Venezia Giulia	164	67	354	37	372	801	1,437	18	91	48	103	20	117	69	103	1,347
Liguria	5,056	824	2,644	169	1,517	1,310	262	223	1,057	1,107	4,558	99	725	117	711	1,189
Emilia-Romagna	1,002	156	171	21	182	506	26	36	158	44	534	3	69	64	205	546
Toscana	1,330	989	1,838	142	1,026	2,830	145	79	437	1,584	3,413	257	1,818	360	895	3,836
Umbria	1,410	341	55	110	306	2,454	44	3	137	10	931	22	146	199	463	1,338
Marche	4,748	69	63	46	449	272	23	62	39	2	454	17	91	71	367	73
Lazio	13,567	2,749	2,528	3,149	6,877	8,056	1,401	1,139	5,948	2,975	19,318	576	2,099	3,883	7,541	6,517
Abruzzo	21,167	616	159	379	1,216	1,530	313	50	1,084	191	8,215	202	403	1,705	3,062	287
Molise	3,990	813	186	377	748	932	368	145	860	147	1,559	15	196	1,029	2,561	335
Campania	19,216	3,956	6,202	2,351	8,126	8,099	1,064	1,028	5,853	2,908	20,485	548	3,013	5,109	7,001	3,683
Puglia	24,661	8,490	4,358	5,020	7,172	8,261	3,318	1,171	3,109	3,132	6,611	639	2,703	3,592	9,780	4,460
Basilicata	8,200	5,257	1,041	2,119	3,058	6,123	937	518	1,568	816	6,305	307	1,652	1,283	3,849	1,772
Calabria	43,126	18,009	7,201	5,208	14,436	22,578	2,809	3,537	6,581	7,933	32,060	2,695	5,295	4,565	28,482	6,490
Sicilia	46,611	20,223	8,198	16,385	10,090	55,593	5,089	20,555	6,547	27,728	38,363	9,128	13,276	23,447	59,872	24,561
Sardegna	34,295	4,127	37,104	6,582	10,228	8,511	10,588	6,919	2,573	9,415	7,843	2,123	3,632	7,985	25,806	9,542
ITALY	**234,130**	**68,777**	**72,937**	**42,664**	**68,712**	**130,831**	**29,079**	**36,127**	**41,516**	**59,559**	**166,129**	**17,934**	**38,526**	**55,657**	**151,964**	**71,651**

Table 10. Difference in number of wildfires per region and year between the dataset and EFFIS data from 2007 to 2022. Negative values indicate that the geospatial dataset contains less wildfire events than the official EFFIS data. Perfect agreements (i.e., differences equal to zero) are highlighted in yellow.

REGION	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Piemonte	3	35	1	12	9	3	0	4	12	-18	-26	0	-76	-1	-5	-2
Valle d'Aosta	0	0	-1	-1	-2	2	-1	-1	-3	-2	1	0	7	-35	0	0
Lombardia	36	2	3	0	-6	-5	0	0	-9	32	-1	2	-1	-1	-3	-1
Trentino-Alto Adige	20	0	1	0	0	14	-4	0	-8	12	-1	-5	-13	-5	-4	-13
Veneto	37	4	2	0	-1	0	-1	0	0	6	-2	0	-15	-1	0	-1
Friuli Venezia Giulia	0	-1	0	-1	0	5	-2	-1	0	10	3	5	0	-18	0	0
Liguria	-99	-1	6	0	2	0	-1	1	1	5	-3	2	-24	-15	-6	-1
Emilia-Romagna	39	3	1	0	-4	-1	0	-1	0	8	-3	0	-2	0	-3	-1
Toscana	-65	-2	2	0	-6	0	0	7	-2	13	-3	-1	-2	-2	-19	-3
Umbria	99	-1	2	0	-1	-3	0	0	0	-1	-1	0	0	0	0	0
Marche	76	0	-1	0	1	0	0	0	0	0	0	0	0	-1	0	0
Lazio	606	3	0	-2	-9	-1	-1	1	-11	27	-19	0	-83	-36	33	0
Abruzzo	139	3	1	0	-2	-1	0	0	0	-3	-2	-3	-4	-1	-2	0
Molise	-321	0	0	0	-1	-2	0	0	-1	2	0	0	-21	0	-3	0
Campania	-3,504	9	8	-1	-26	-7	0	1	-2	19	-6	-2	-5	0	-1	0
Puglia	529	10	0	-3	-10	-4	-1	-1	-1	-15	-5	-2	-3	0	-1	0
Basilicata	483	9	2	0	2	0	1	0	0	1	2	0	-32	-1	-4	0
Calabria	167	2	8	-4	-20	-2	-1	-1	-2	-175	-3	0	5	-4	-16	0
Sicilia	-496	498	-249	-15	-4	-30	-2	-17	8	-1	38	39	-26	374	-41	-9
Sardegna	-1,086	621	756	1,207	1,099	1,059	839	1,308	969	912	1,069	-879	909	-76	125	-4
ITALY	**-3,337**	**1,194**	**542**	**1,192**	**1,021**	**1,027**	**826**	**1,300**	**951**	**832**	**1,038**	**-844**	**614**	**177**	**50**	**-35**

Table 11. Difference in burned area (ha) per region and year between the dataset and EFFIS data from 2007 to 2022. Negative values indicate that the geospatial dataset contains less burned area than the official EFFIS data. Perfect agreements (i.e., differences equal to zero) are highlighted in yellow.

REGION	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Piemonte	-252	1,569	0	5	273	41	0	4	416	698	-6	0	562	0	-15	0
Valle d'Aosta	-1	-1	1	0	-7	-5	-2	-3	-8	-11	2	-1	0	-1	0	-1
Lombardia	-10	6	1	0	-11	2	0	0	-71	753	-164	960	4	0	-2	0
Trentino-Alto Adige	-36	0	0	0	1	5	-1	0	-4	0	11	0	-10	0	0	-5
Veneto	-27	0	1	0	8	0	0	0	0	2	-1	0	-27	0	0	0
Friuli Venezia Giulia	1	1	1	0	1	-18	3	-7	0	25	1	-4	1	0	0	4
Liguria	-2,080	0	23	0	65	2	0	23	11	82	6	8	-37	-14	-58	0
Emilia-Romagna	-103	8	15	0	-4	0	0	-23	0	12	-1	0	-2	0	-1	0
Toscana	-202	-1	-1	0	-62	0	0	16	-12	-611	-61	1,211	-17	0	-20	0
Umbria	-246	-2	4	0	-1	1	0	0	0	0	-25	0	1	1	1	2
Marche	355	0	-5	0	0	-1	0	0	0	0	0	0	6	0	1	0
Lazio	453	51	0	6	22	24	4	12	18	1,003	97	1	-514	-325	300	15
Abruzzo	1,216	277	9	2	-2	6	2	0	5	-36	-350	-9	-79	-101	-23	1
Molise	-1,153	5	1	2	3	42	3	2	3	41	7	0	-192	6	-59	2
Campania	7,610	-48	115	9	-72	47	6	9	14	707	307	3	532	33	33	20
Puglia	-4,510	273	81	49	-238	12	33	11	27	20	19	5	744	22	95	41
Basilicata	-169	458	38	-9	85	56	11	5	13	65	306	3	-240	10	-14	17
Calabria	-826	169	14	27	-15	214	28	34	67	194	84	26	76	123	-994	18
Sicilia	-7,576	-5,935	-620	3,687	3,344	292	-105	69	10	1,184	103	2,299	890	1,910	-1,711	1,047
Sardegna	83	1,969	7,737	5,311	8,224	6,357	4,094	8,351	5,646	5,684	5,588	-35	3,126	0	4	4
ITALY	**-7,473**	**-1,202**	**7,413**	**9,088**	**11,614**	**7,075**	**4,075**	**8,499**	**6,136**	**9,815**	**5,924**	**4,468**	**4,825**	**1,662**	**-2,462**	**1,200**

Table 12. Difference (Diff.) in the number of wildfires (# fires) and burned area (BA) per year between the geospatial dataset and EFFIS data (relative to EFFIS data). Positive percentages indicate that the geospatial dataset contains more fires and burned area than the official EFFIS data.

Year	Diff. # fires (%)	Diff. BA (%)
2007	-18.9	-3.2
2008	18.4	-1.7
2009	10.0	10.2
2010	24.4	21.3
2011	12.5	16.9
2012	12.4	5.4
2013	28.1	14.0
2014	39.9	23.5
2015	17.5	14.8
2016	16.8	16.5
2017	13.0	3.6
2018	-26.2	24.9
2019	13.9	12.5
2020	3.6	3.0
2021	0.8	-1.6
2022	-0.5	1.6
TOTAL	**6.5**	**5.5**

6. Metadata

The following metadata gives additional information about the geospatial dataset described in this report.

Tittle: A geospatial dataset of wildfires in Italy, 2007-2022.

Citation: Moris JV, Gamba R, Arca B, Bacciu V, Casula M, Elia M, Malanchini L, Spadoni GL, Vacchiano G, Ascoli D. 2024. A geospatial dataset of wildfires in Italy, 2007-2022. Technical report. Research project FIRE-BOX. https://doi.org/10.5281/zenodo.11528284

Purpose: to facilitate geospatial analysis of Italian fire activity over the period 2007-2022 based on available information from national and regional wildfire databases. It was originally generated to support the research project FIRE-BOX – Essential tools for wildland fire risk management in Italy (P2022MXRK9) funded by "Fondo per il Programma Nazionale Ricerca e progetti di Ricerca di Significativo Interesse Nazionale (PRIN)".

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Contacts: Davide Ascoli, d.ascoli@unito.it; Jose V. Moris, moris.josev@gmail.com.

Creation date: April 2024.

Version: 1.0.

Format: ESRI shapefile.

Geographical extent: Italy.

Temporal coverage: 2007-2022.

Projected Coordinate System: WGS84-UTM 32N (EPSG: 32632).

Unit: meter.

Spatial data organization: polygon (vector).

Attribute table: 106,978 records and 7 fields.

Attribute information: ID = unique id number of the fire; COD_REG = region code according to ISTAT; Region = name of the region; Province = name of the province; Year = year in which the fire occurred; Date = date in which the fire started or was reported; Area_ha = total burned area of the fire in hectares.

7. Data availability

The dataset described in this report is not publicly available due to legal restrictions. Some of the original fire datasets used to compile and prepare this geospatial dataset of wildfires in Italy 2007-2022 are not publicly available at the moment (June 2024). Consequently, we do not have the consent to publish the whole dataset in an open public repository. If you are interested in using the geospatial dataset for research or similar purposes, please contact Professor Davide Ascoli from the University of Turin in Italy (d.ascoli@unito.it).

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