

Global Wildfire Information System

Country Profiles

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Version 0



Department of Geography,
Environment, and Spatial Sciences
MICHIGAN STATE UNIVERSITY

Contact information

Name: Global Wildfire Information System

Address: <https://gwis.jrc.ec.europa.eu>

Email: jrc-effis@ec.europa.eu

Tel.: +39 0332 786138

EU Science Hub

<https://ec.europa.eu/jrc>

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Authors:

San-Miguel-Ayanz, J¹, Artes, T. ¹, Oom, D. ¹, Ferrari, D. ⁴, Branco, A. ², Pfeiffer, H. ², Liberta, G. ¹, De Rigo, D. ², Durrant, T. ³, Grecchi, R. ², Maianti, P. ², Boca, R. ²

Boschetti, L. ⁴, Sparks, A. ⁴, Roy, D.P. ⁵

¹ European Commission, Joint Research Centre (JRC), Ispra, Italy

² ARCADIA SIT, Milan, Italy

³ Engineering Ingegneria Informatica S.p.A. Rome, Italy

⁴University of Idaho, College of Natural resources, Moscow, ID, USA

⁵Michigan State University, Department of Geography, Environment and Spatial Sciences, East Lansing, MI, USA

⁶University of Maryland, Department of Geographical Sciences, College Park, MD, USA

Table of Contents

1. GWIS Country Profile Web Interface	4
2. Home	4
3. Continent overview.....	5
4. Country overview	6
5. Country maps.....	7
6. Country charts.....	8
6.1 Multi-year charts	8
6.2. Single-year charts.....	9
7. Downloads	11
8. Documents”	12
8.1.Datasets	12
8.1.1. Burned area: MODIS Collection 6 burned area product	12
8.1.2. Number of fires and fire size: GlobFire Database	12
8.1.3. Landcover data: ESA CCI land cover classification	12
8.1.4. Country boundaries: GADM v3.6 level 1 administrative areas	13
8.2. Processing chain for producing burned area statistics and maps from MCD64A1	13
8.2.1. Pre-processing	13
8.3 Generation of burned area datasets	13
8.3.1 Production of summary text files with monthly burned area stratified by landcover and GADM administrative unit.....	13
8.3.2 Production of burned area raster files for map generation	13
References.....	15
List of Tables.....	15
List of Figures	15
List of Abbreviations/Acronyms.....	15

1. GWIS Country Profile Web Interface

The GWIS country profile application aims at providing a synoptic view of wildfire trends, seasonality and spatial arrangement of fires and burnt areas per country and sub-country level, for all countries globally. This guide describes the web interface and different maps and charts, as well as information on the methodology used to produce the charts and maps. The GWIS Country Profile application is freely accessible at: <https://gwis.jrc.ec.europa.eu/static/country.profile/>

The navigation panel, on the upper left corner of the page, allows the user to access several sections under the main MENU. The navigation tools, as depicted on the left hand side of Figure 1, allow the user to access the following sections: “**Home**” (access to data for each continent), “**Continent overview**” (general statistics on burnt areas and number of fires per continent), “**Country overview**” (general description of land cover in the countries) the “**Country maps**” (maps of burnt areas and burnt area frequency and seasonality), the “**Country charts**” (single-year or multi-year charts of burnt areas, number of fires, seasonality, fire size distribution, etc.), the “**Downloads**” (access to download of maps and datasets) and Documents (access to the guide to the portal).

2. Home

Figure 1 shows the GWIS country profile home page. By clicking on one of the continents, the user is led to the “Continent overview” page. It is possible to use the pull-down menus, under each of the continent maps, to select the display of data for a single country within the continent and go to the “Country overview” for the selected country.

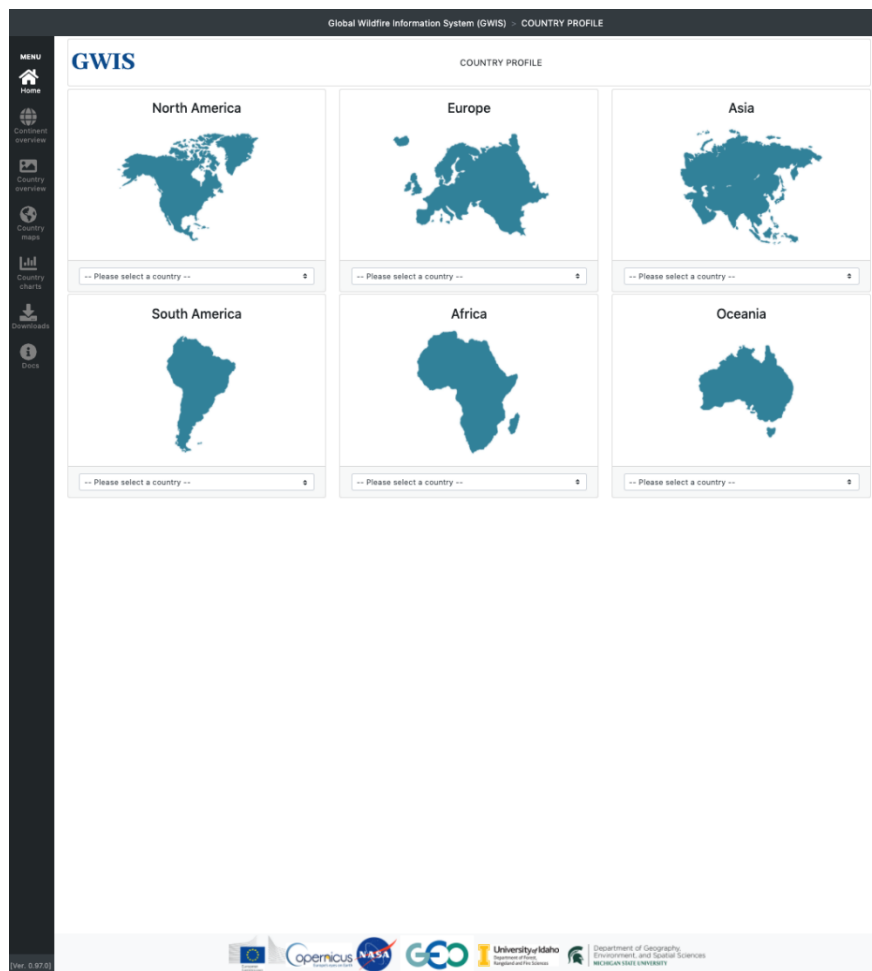


Figure 1. GWIS country profiles Home page

3. Continent overview

The “Continent overview” page shown in Figure 2 provides statistics on burnt areas and number of fires for a selected year of the overview period in comparison with the average values of the period. The navigation menu permits the user to switch to the overview of different continents.

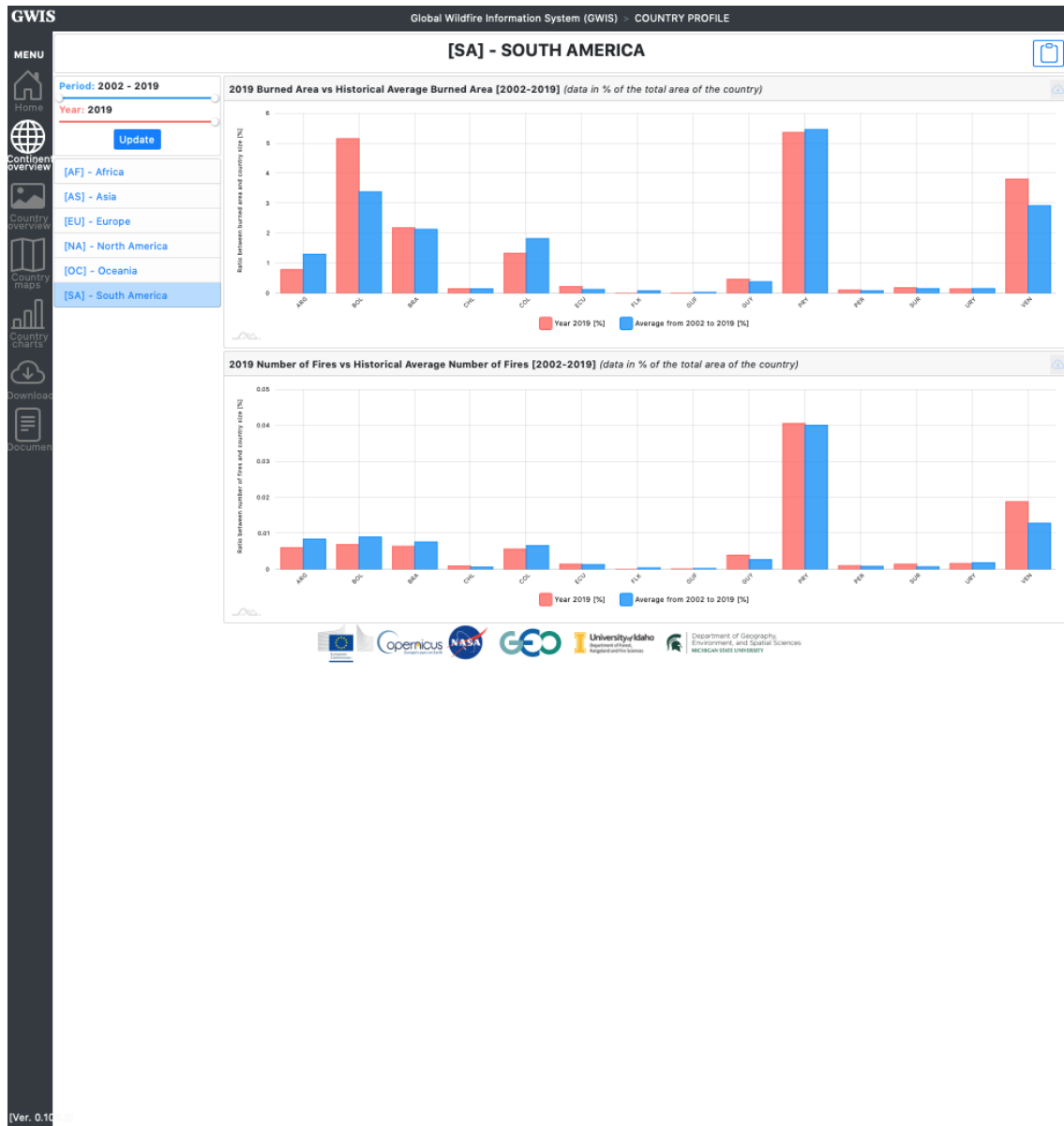


Figure 2. GWIS Continent overview

4. Country overview

The “Country overview” provides basic information of the displayed country, including data on population, area and landcover. The interface allows users to select a country or region/state within the country (Figure 3, left column). It displays the landcover of the country with a chart of the area under the different landcover classes. The map display allows the user to perform typical functions such as zoom in/out and display the legend of the map. Source: World Bank for population and CCI Landcover for the land cover classes.

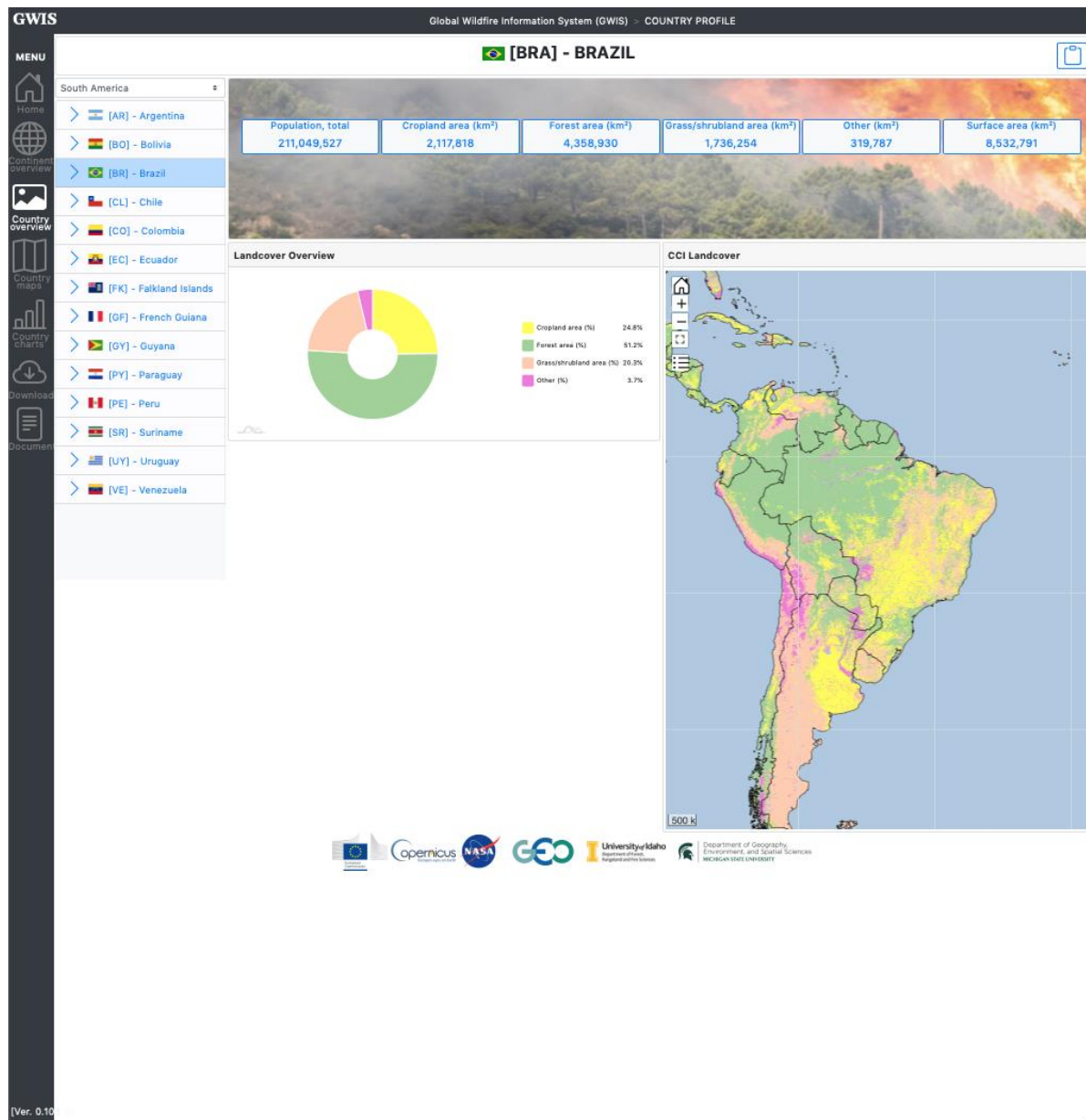


Figure 3. Main interface of the GWIS country profile. Users can select area and year of interest and system will automatically generate summary figures and maps. All figures and data are available for download.

5. Country maps

The “Country maps” section depicts information on burnt area extent and seasonality for a user’s selected country or sub-country area. It provides the following maps derived from the MCD64A1 burnt area product at full spatial resolution (nominal 500m, actual 463 m). The user can select to display the legend, as in Figure 4. The tools on the image menu permit to synchronize the other maps to the one selected by the user. The following maps are provided:

- *Monthly burned area*: burned area map for user-selected year and month, displaying the decade of detection within the month. Unmapped pixels (i.e. pixels with limited observations due to persistent cloud cover) are displayed in white.
- *Cumulative burned area*: cumulative burned area map for a user-selected year, displaying the month of detection.
- *Fire frequency*: burned area map showing the number of times a pixel was detected as burned over the entire MODIS burned area record (2002-most recent full year), displayed using a rainbow scale.
- *Median day of burning*: burned area map where for each pixel that was detected as burned at least once in the burned area record (2002-most recent full year), the month of the median day of burning is displayed.

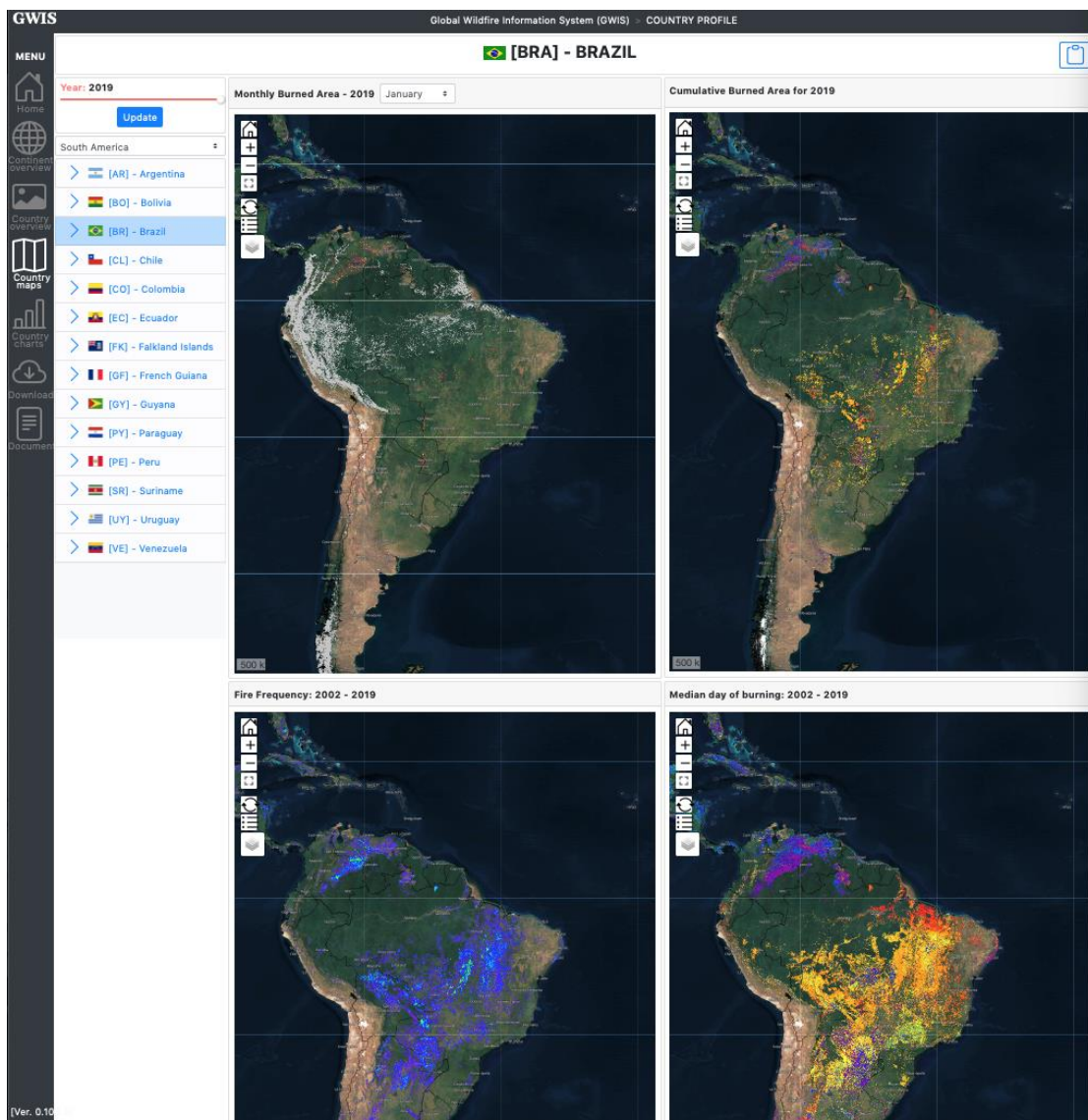


Figure 4. Burned area maps in the GWIS country profile web interface. Maps are generated based on a user selected area and time period. All maps are available for download in GeoTiff format.

6. Country charts

6.1 Multi-year charts

This section provides general statistics on number of fires, burnt areas, land cover damage, seasonality and fire size for a period selected by the user and its comparison with a year, which can also be selected by the user, as presented in Figure 5 and described below.



Figure 5. Multi-year country charts.

Multi-year burned area figures are generated based on a user selected area and time period. All figures and data are available for download.

- *Yearly Burned Area & Number of Fires:* total yearly burned area (ha) and number of fires for user-selected period and administrative area. Burnt areas are computed from MODIS MCD64 A1 and number of fires from the GlobFire database.
- *Yearly Burned Area Seasonality:* total monthly burned area (ha) for user-selected period and administrative area, where red bars indicate months that comprise the fire season and blue bars indicate months outside the fire season. The fire season is defined as the month or months that account for 80% of the total annual burned area (Archibald et al. 2013).
- *Yearly Burned Area by Landcover:* yearly burned area (ha) by landcover class in user-selected period and administrative area. See Table 1 for landcover classes.
- *Yearly Burned Area by Landcover (100%):* proportional yearly burned area (% of yearly total) by landcover class for user-selected year and administrative area
- *Average Monthly Burned Area by Landcover & No Data:* average monthly burned area (ha) by landcover class in user-selected period and administrative area. No data (unmapped pixels), as a proportion of total land area, is also displayed. See Table 1 for landcover classes.
- *Average Monthly Burned Area by Landcover (100%):* average proportional monthly burned area (% of monthly total) by landcover class for user-selected period and administrative area.
- *Average Monthly Burned Area & Number of Fires:* Average monthly burnt area and number of fires per user-selected administrative region and period. Burnt areas are computed from MODIS MCD64 A1 and number of fires from the GlobFire database.
- *Average Monthly Burnt Area Seasonality & Number of Fires:* Average monthly burned area (ha) for user-selected period and administrative area, where red bars indicate months that comprise the fire season and blue bars indicate months outside the fire season. The fire season is defined as the month or months that account for 80% of the total annual burned area (Archibald et al. 2013). Monthly number of fires from GlobFire database.
- *Monthly Burned Area vs Historical:* total monthly burned area (ha) for user-selected year and administrative area, displayed as a solid black line. The minimum and maximum burned area (ha) from the MODIS record, calculated for the user-selected period, for each month are shown in red, excluding the user-selected year. The 10th percentile and 90th percentile burned area (ha) from the MODIS record, calculated from the user-selected period, for each month are shown in blue, excluding the user-selected year.
- *Yearly Emissions & Burned Area:* Yearly estimates of emissions from GFEDv4s for several pollutants and burned area from MCD64A1.
- *Fire Size Distribution & % Contribution to Total Burnt Area:* Bars showing the number of fires in a fire size class interval and red line showing the % contribution of fire class to the cumulative burnt area per user-selected administrative region and period.
- *Average Monthly Fire Size Distribution vs Historical :* Average monthly size (ha) for user-selected year and administrative area, displayed as a solid black line. The minimum and maximum fire size (ha) from the GlobFire database, calculated for the user-selected period, for each month are shown in red, excluding the user-selected year. The 10th percentile and 90th percentile fire size (ha) from the GlobFire database, calculated from the user-selected period, for each month are shown in blue, excluding the user-selected year.
- *Average Monthly Fire Size per year:* Average monthly fire size distribution for the user-selected administrative level and period of years.

6.2. Single-year charts

This section provides a series of graphs of a single year, which can be selected by the user, with information on monthly burnt areas, number of fires, seasonality, monthly land cover damage, fire size distribution and average size distribution, as presented in Figure 6, and described below.



Figure 6. Single-year charts. Single year burnt area figures generated for a user-selected area and year. All figures and data are available for download.

- *Monthly Burned Area by Landcover & No Data:* monthly burned area (ha) by landcover class for user-selected year and administrative area. No data (unmapped pixels), as a proportion of total land area, is also displayed. See Table 1 for landcover classes. Burned areas and no data are computed from MODIS MCD64 A1.
- *Monthly Burned Area by Landcover (100%):* proportional monthly burned area (% of monthly total) by landcover class for user-selected year and administrative area.

- *Monthly Burned Area Seasonality & Number of Fires*: total monthly burned area (ha) for user-selected year and administrative area, where red bars indicate months that comprise the fire season and blue bars indicate months outside the fire season, and number of fires. Burnt areas are computed from MODIS MCD64 A1 and number of fires from the GlobFire database. The fire season is defined as the month or months that account for 80% of the total annual burned area (Archibald et al. 2013).
- *Average Monthly Fire Size & Number of Fires*: Distribution of average monthly fire size and number of fires per month for user selected year and administrative area.
- *Monthly Emissions & Burned Area*: Monthly estimates of emissions from GFEDv4s for several pollutants and average burned area from MCD64A1.
- *Fire Size Distribution and % Contribution to Total Burnt Area*: bars showing the number of fires in a fire size class interval and red line showing the % contribution of fire class to the cumulative burnt area
- *Average Monthly Fire Size Distribution*: Distribution of monthly fire size per selected administrative area and year, showing the total burned area per fire size class for each month.

7. Data Download

MCD64 A1 (2002-2019)

Description: Complete dataset of burned area [ha] for all years (2002-2019) for all countries and sub-national administrative units (GADM level 0 and level 1 administrative units).

File name: MCD64A1_burned_area_full_dataset_2002-2019.zip

File type: ZIP

File size: 9.1 MB

Citation: Boschetti, L., Sparks, A., Roy, D.P., Giglio, L., San-Miguel-Ayanz, J., GWIS national and sub-national fire activity data from the NASA MODIS Collection 6 Burned Area Product in support of policy making, carbon inventories and natural resource management, developed under NASA Applied Sciences grant #80NSSC18K0400, Using the NASA Polar Orbiting Fire Product Record to Enhance and Expand the Global Wildfire Information System (GWIS).

GlobFire (2001-2020)

Complete dataset of burned area [ha], number of fires and fire size for all years (2001-2020) for all countries and sub-national administrative units (GADM level 0 and level 1 administrative units".

File name: Full_GlobFireV2_Jan2021.zip

File type: ZIP.

Download: https://qwis-reports.s3-eu-west-1.amazonaws.com/GlobFireV2/Full_GlobFireV2_Jan_2021.zip

Citation: Artes et al. 2019. A global wildfire dataset of fire events for the analysis of fire regimes and fire behavior. (<https://doi.org/10.1038/s41597-019-0312-2>)

8. Documents

Provides access to this GWIS country profiles user's guide.

8.1. Datasets

8.1.1. MCD64 A1 Burned area: MODIS Collection 6 burned area product

For burnt area statistics, the current version of the GWIS country profiles makes use of the MODIS Collection 6 500 m (actual spatial resolution is 463 m) burned area product (MCD64A1), which uses a combination of surface reflectance data and 1km MODIS active fire data to detect and map burned areas (Giglio et al. 2018a). The algorithm applies dynamic thresholds to composite MODIS Terra and Aqua imagery generated from a burn-sensitive spectral band index derived from MODIS 1240 and 2130 nm Terra and Aqua bands, and a measure of temporal variability. Cumulative MODIS 1 km active fire detections are used to guide the selection of burned and unburned training samples and to guide the specification of prior burned and unburned probabilities, allowing the algorithm to adapt to numerous pre- and post-fire conditions (Giglio et al. 2018a). For every pixel detected as burned an approximate day of burning is assigned. This product has a sinusoidal projection and is distributed in $\sim 10^\circ \times 10^\circ$ tiles according to the MODIS tiling scheme (Figure 7) (Giglio et al. 2018b). A Stage 3 validation assessment conducted globally found the Collection 6 MCD64A1 product has a global 40.2% commission error and 72.6% omission error (Boschetti et al. 2019). Additional information and data download links can be accessed here: <https://modis-land.gsfc.nasa.gov/burn.html>

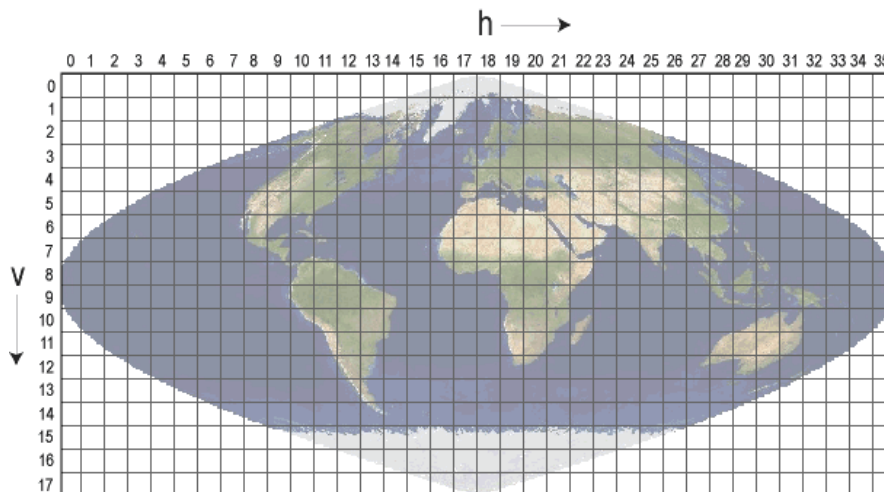


Figure 7. MODIS tiling scheme.

8.1.2. Number of fires and fire size: GlobFire Database

The GlobFire database Artes et al. (2019) is used to derive the number of fires and fire size that are used in the application as described in for the creation of the GlobFire database.

8.1.4. Global Fire Emissions Database, Version 4 (GFEDv4)

Emissions data are based on the Global Fire Emissions Database, Version 4.1 (GFED4s). As described in the GFED website, Estimates after 2017 are based on relations between MODIS active fire detections and GFED4s for 2003-2016. Because the underlying burned area data was upgraded (from C5.1 to C6), GFED we cannot maintain consistency and uses this approach until GFED5 becomes available. For additional information, please refer to

Randerson et al. 2012, Giglio et al. 2013, van der Werf et al. 2017 and <https://www.geo.vu.nl/~gwerf/GFED/GFED4/>.

8.1.3. Landcover data: ESA CCI land cover classification

The ESA Climate Change Initiative 300m landcover product (ESA, 2017) was used to delineate landcover. This product consists of global landcover maps produced annually from 1992-2015 at 300m spatial resolution (see Table 1 for landcover classes). Yearly ESA CCI landcover products from 2002-2015 were acquired from: <https://www.esa-landcover-cci.org/>. Currently, GWIS uses the latest version of CCI land cover, CCI2018.

8.1.4. Country boundaries: GADM v3.6 level 1 administrative areas

The GADM v3.6 level 1 administrative areas were used to delineate countries (level 0) and sub-country regions (level 1). GADM shapefiles were acquired from: <https://gadm.org/>

8.2. Processing chain for producing burned area statistics and maps from MCD64A1

8.2.1. Pre-processing

8.2.1.1 Resampling and reclassification of the 300 m CCI landcover product

Input: Yearly 300m CCI landcover product

Output: Yearly landcover, resampled to 463 m spatial resolution using nearest neighbor resampling and reclassified using a crosswalk lookup table (Table 1), in the MODIS sinusoidal projection and tiled according to the MODIS tiling scheme (Figure 1).

8.2.1.2 Reprojection and rasterization of the GADM level 1 shapefiles

Input: GADM level 1 shapefiles

Output: GADM level 1 administrative areas at 463 m spatial resolution in the MODIS sinusoidal projection and tiled according to the MODIS tiling scheme (Figure 1).

8.3 Generation of burned area datasets

8.3.1 Production of summary text files with monthly burned area stratified by landcover and GADM administrative unit

Inputs: Collection 6 MCD64A1 monthly burned area data, resampled CCI landcover product, rasterized GADM level 1 administrative areas. Note: At the time of processing ESA CCI landcover products were available from 2002-2015. Consequently, the 2015 landcover product was used for landcover stratification for years greater than 2015.

Output: Tabular monthly burned area by GADM level 1 administrative unit and landcover class.

8.3.2 Production of burned area raster files for map generation

Input: Collection 6 MCD64A1 monthly burned area data

Outputs: 1. Monthly burned area raster, where burned area pixel value delineates the Julian day of detection.

2. Cumulative burned area raster for each year, where burned area pixel value delineates the Julian day of detection.

3. Burned area frequency raster, where pixel value delineates the number of times a pixel was detected as burned over the entire MODIS burned area record (2002-most recent full year).

4. Median day of burning raster, where for each pixel that was detected as burned at least once in the entire MODIS burned area record (2002-most recent full year), pixel value is delineated by the median Julian day of burning.

Table 1. Landcover class crosswalk table between ESA CCI landcover classes and landcover classes used for GWIS country profiles. IPCC landcover classes also shown.

ESA CCI Landcover class	ESA CCI Class Code	IPCC class	GWIS class	
Cropland, rainfed	10	Cropland	Cropland	
Herbaceous cover	11	Cropland		
Tree or shrub cover	12	Cropland		
Cropland, irrigated or post-flooding	20	Cropland		
Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous cover) (<50%)	30	Cropland		
Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%) / cropland (<50%)	40	Cropland		
Tree cover, broadleaved, evergreen, closed to open (>15%)	50	Forest	Forest	
Tree cover, broadleaved, deciduous, closed to open (>15%)	60	Forest		
Tree cover, broadleaved, deciduous, closed (>40%)	61	Forest		
Tree cover, broadleaved, deciduous, open (15-40%)	62	Forest		
Tree cover, needleleaved, evergreen, closed to open (>15%)	70	Forest		
Tree cover, needleleaved, evergreen, closed (>40%)	71	Forest		
Tree cover, needleleaved, evergreen, open (15-40%)	72	Forest		
Tree cover, needleleaved, deciduous, closed to open (>15%)	80	Forest		
Tree cover, needleleaved, deciduous, closed (>40%)	81	Forest		
Tree cover, needleleaved, deciduous, open (15-40%)	82	Forest		
Tree cover, mixed leaf type (broadleaved and needleleaved)	90	Forest		
Mosaic tree and shrub (>50%) / herbaceous cover (<50%)	100	Forest		
Mosaic herbaceous cover (>50%) / tree and shrub (<50%)	110	Grassland		Grass/ Shrubland
Shrubland	120	Grassland		
Evergreen shrubland	121	Grassland		
Deciduous shrubland	122	Grassland		
Grassland	130	Grassland		
Lichens and mosses	140	Grassland		
Sparse vegetation (tree, shrub, herbaceous cover) (<15%)	150	Grassland		
Sparse tree (<15%)	151	Grassland		
Sparse shrub (<15%)	152	Grassland		
Sparse herbaceous cover (<15%)	153	Grassland		
Tree cover, flooded, fresh or brakish water	160	Forest	Forest	
Tree cover, flooded, saline water	170	Wetlands	Other	
Shrub or herbaceous cover, flooded, fresh/saline/brakish water	180	Wetlands		
Urban areas	190	Settlement		
Bare areas	200	Other land		
Consolidated bare areas	201	Other land		
Unconsolidated bare areas	202	Other land		
Water bodies	210	Wetlands		
Permanent snow and ice	220	Other land		

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List of Tables

Table 1. Landcover class crosswalk table between ESA CCI landcover classes and landcover classes used for GWIS country profiles.....	9
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List of Figures

Figure 1. MODIS tiling scheme.....	3
Figure 2. Main interface of the GWIS country profile	6
Figure 3. Multi-year burned area figures in the GWIS country profile web interface	7
Figure 4. Burned area maps in the GWIS country profile web interface	8

List of Abbreviations/Acronyms

CCI	Climate Change Initiative
ESA	European Space Agency
GWIS	Global Wildfire Information System
IPCC	Intergovernmental Panel on Climate Change
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration

