

Documentation for the  
Global Fire Emissions Indicators, Grids: 1997-2015

**November 2017**

Center for International Earth Science Information Network (CIESIN),  
Columbia University

**Abstract**

This document outlines the basic methodology and data sets used to construct the Global Fire Emissions Indicators, Grids, v1 (1997-2015), along with use cases, limitations, and use constraints.

**Data set citation:** Giglio, L., J. T. Randerson and G. R. van der Werf. 2017. Global Fire Emissions Indicators, Grids: 1997-2015. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). <https://doi.org/10.7927/H400002V>. Accessed DAY MONTH YEAR.

**Suggested citation for this document:** Center for International Earth Science Information Network (CIESIN), Columbia University. 2017. Documentation for the Global Fire Emissions Indicators, Grids: 1997-2015. Palisades NY: NASA Socioeconomic Data and Applications Center (SEDAC). <https://doi.org/10.7927/H4QF8QTF>. Accessed DAY MONTH YEAR.

We appreciate feedback regarding this data set, such as suggestions, discovery of errors, difficulties in using the data, and format preferences. Please contact:

NASA Socioeconomic Data and Applications Center (SEDAC)  
Center for International Earth Science Information Network (CIESIN)  
Columbia University  
Phone: 1 (845) 365-8920  
Email: [ciesin.info@ciesin.columbia.edu](mailto:ciesin.info@ciesin.columbia.edu)

## Contents

I.	Introduction.....	2
II.	Data and Methodology.....	2
III.	Data Set Description(s).....	4
IV.	How to Use the Data.....	6
V.	Potential Use Cases.....	6
VI.	Limitations.....	6
VII.	Acknowledgments.....	6
VIII.	Disclaimer.....	6
IX.	Use Constraints.....	7
X.	Recommended Citation(s).....	7
XI.	Source Code.....	7
XII.	References.....	7
XIII.	Documentation Copyright and License.....	8
	Appendix 1. Data Revision History.....	8
	Appendix 2. Contributing Authors & Documentation Revision History.....	8

## I. Introduction

The Global Fire Emissions Indicators, Grids: 1997-2015 contain a time-series of rasters from 1997 to 2015 for total area burned (hectares) and total carbon content (metric tons). The annual total area burned raster is the sum of monthly rasters, which are products of the Cell Area and Burn Fraction (fraction of the cell area burned in the month). There are two groups of total carbon content (TCC) rasters, annual totals for all fire types and annual totals for each of six fire types which include Agricultural, Boreal, Tropical Deforestation, Peat, Savanna, and Temperate forest fires. The annual TCC raster for all fire types is the sum of monthly carbon emission rasters. The annual TCC raster for each fire type is the product of Dry Matter, Burn Fraction, and Fire Type Contribution.

## II. Data and Methodology

This data set is based on the fourth-generation global fire emissions database version 4.0 (GFED4), Giglio et al., (2013), available at <http://www.globalfiredata.org>.

### Input data

The input data are taken from the fourth-generation global fire emissions database version 4.0 (GFED4) time series data consisting annual data bundles from 1997 to 2015. We downloaded files in Hierarchical Data Format (HDF) 5 containing 245 variables organized into burned area and emissions:

1. The burned area files consist of two data sets for each month of the year: burned fraction and burned area source. The burned fraction is the proportion of each grid cell that burned in that month according to GFED4s burned area data. The burned area source indicates what data was used to construct the burned area maps, excluding small fires. The Along-Track Scanning Radiometer (ATSR) and the Tropical Rainfall Measuring Mission (TRMM) Visible and Infrared Scanner (VIRS) data were used before 2001 and Moderate-Resolution Imaging Spectroradiometer (MODIS) data after 2001.
2. The emissions files consist of 5 data sets for each month of the year: emissions (Carbon with units of  $g C m^{-2} month^{-1}$  and Dry Matter (DM) with units of  $kg DM m^{-2} month^{-1}$ ); small fire fraction; daily fraction; diurnal cycle; and partitions for both C and DM data sets: AGRI (Agricultural waste burning), BORF (Boreal forest fires), DEFO (Tropical forest fires [deforestation and degradation]), PEAT (Peat fires), SAVA (Savanna [grassland, and shrubland fires]), and TEMF (Temperate forest fires).

## Methods

Carbon Content (CC) was estimated from Carbon Dioxide (CO<sub>2</sub>), Carbon Monoxide (CO), and Methane (CH<sub>4</sub>) Emission Factors (EFs), for each of the biomes with conversion factors assuming that these species represent the main bulk of carbon emissions during a fire.

Biome	Tropical Forest	Temperate Forest	Boreal Forest	Savanna	Peat	Agricultural Waste
CC	0.4917505	0.4894161	0.4649894	0.4882731	0.522823	0.4803520

By converting DM emissions to trace gas or aerosol emissions, CC can be estimated. In order to perform this conversion, DM values ( $kg DM/m^2/month$ ) are multiplied with emission factors.

$$E_{CO}(x, y, time) = \sum_{sources} EF_{CO_{source}} \times DM(x, y, time) \times contr_{source}(x, y, time)$$

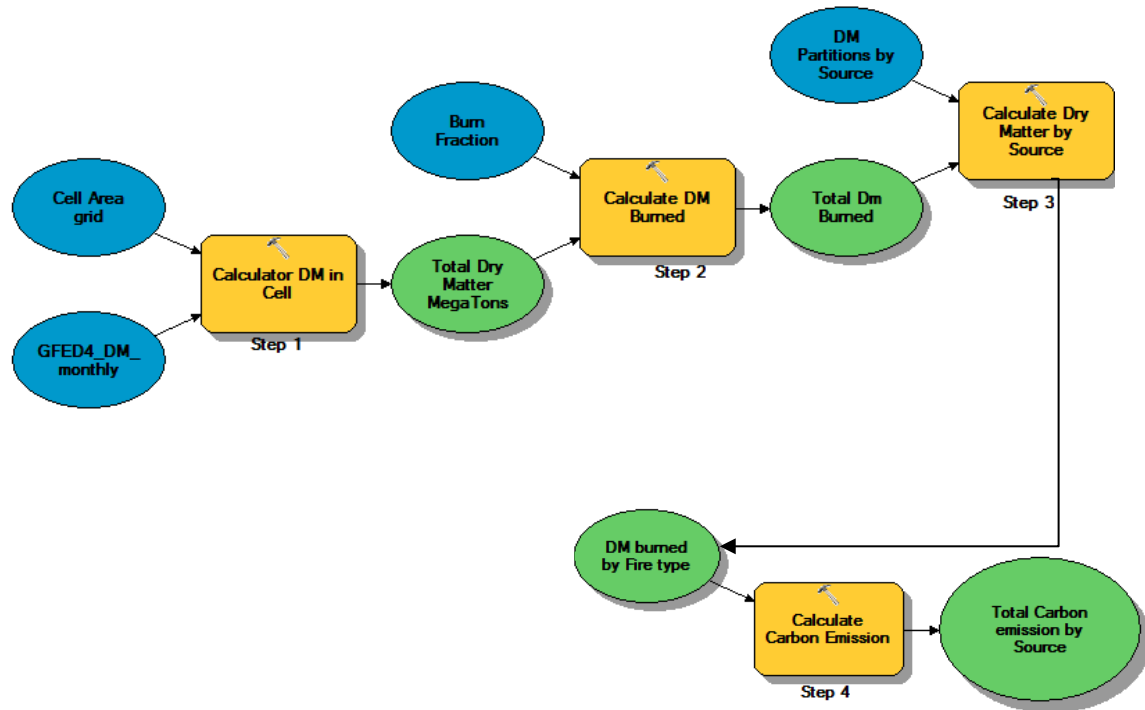
Where:

$E$  is emissions

$EF$  is the emission factor

$Contr$  is the contribution of the various sources (SAVA, DEFO, etc.)

The processing steps (in Arc Model Builder) to derive monthly carbon emission rasters are as follows:



### III. Data Set Description(s)

#### Data set description:

The global fire emissions raster data consists of total carbon content and total area burned yearly from 1997 to 2015. The annual total carbon content (TCC) represents carbon burned (metric tons) for all fire types, and for each of the six fire types. The annual total area burned is for all fire types and represents the total area (hectares) in each 0.25 degree x 0.25 degree grid cell. The raster is a product of the Cell Area grid and the Burn Fraction grid.

#### Data set web page:

<http://sedac.ciesin.columbia.edu/data/set/sdei-global-fire-emissions-indicators-grids-1997-2015>

#### Data set format:

The data are available in GeoTIFF format as downloadable zip files. Each downloadable is a compressed zip file, containing: 1) Global GeoTIFF for the year, 2) PDF documentation. The data files include:

1. Annual total area burned for all fire types (hectares)
2. Annual total carbon content for all fire types (metric tons)
3. Annual total carbon content (metric tons) for AGRI fires (Agricultural waste burning)
4. Annual total carbon content (metric tons) for BORF fires (Boreal forests)
5. Annual total carbon content (metric tons) for DEFO fires (Tropical Deforestation and Degradation)
6. Annual total carbon content (metric tons) for PEAT fires
7. Annual total carbon content (metric tons) for SAVA fires (Savanna, grassland and shrubland)
8. Annual total carbon content (metric tons) for TEMF fires (Temperate forests)

**Data set downloads:**

- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-tcc-all-geotiff.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-tcc-agri-geotiff.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-tcc-borf-geotiff.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-tcc-defo-geotiff.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-tcc-peat-geotiff.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-tcc-sava-geotiff.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-tcc-temf-geotiff.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-yXXXX-area-burned-geotiff.zip

where XXXX are years 1997 through 2015

Additional zip files are also available that provide the raster data in NetCDF format for all 18 years:

- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015-tcc-all-netcdf.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015-tcc-agri-netcdf.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015-tcc-borf-netcdf.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015-tcc-defo-netcdf.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015-tcc-peat-netcdf.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015-tcc-sava-netcdf.zip
- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015-tcc-temf-netcdf.zip

- sdei-global-fire-emissions-indicators-grids-1997-2015-gfed4-y1997-y2015- area-burned-netcdf.zip

## **IV. How to Use the Data**

The raster data are in GeoTIFF format and can be used directly in mapping and geospatial analysis.

## **V. Potential Use Cases**

These data are also processed for country level statistics in the data set Global Fire Emissions Indicators, Country-Level Tabular Data, v1 (1997–2015) (see <http://sedac.ciesin.columbia.edu/data/set/sdei-global-fire-emissions-indicators-country-level-1997-2015>). Similar processing of the gridded data could be done for other administrative areas or geographies. The spatial resolution of the data is at 0.25 degrees and is not recommended for small area analysis. The data may be useful for environmental monitoring or decision support in relation to fire control.

## **VI. Limitations**

The spatial resolution of the data at 0.25 degrees makes it relatively course for small area analysis. The carbon content estimates are based on general equations of carbon to biomass as well as burn fractions from several sources. While these may represent broad land use types and scales, they may not be suitable for small area studies.

## **VII. Acknowledgments**

The data were created by Louis Giglio, James T. Randerson, and Guido R. van der Werf.

Funding for the dissemination of this data set was provided under the U.S. National Aeronautics and Space Administration (NASA) contract NNG13HQ04C for the continued operation of the Socioeconomic Data and Applications Center (SEDAC), which is operated by the Center for International Earth Science Information Network (CIESIN) of Columbia University.

## **VIII. Disclaimer**

CIESIN follows procedures designed to ensure that data disseminated by CIESIN are of reasonable quality. If, despite these procedures, users encounter apparent errors or misstatements in the data, they should contact SEDAC User Services at

[ciesin.info@ciesin.columbia.edu](mailto:ciesin.info@ciesin.columbia.edu). Neither CIESIN nor NASA verifies or guarantees the accuracy, reliability, or completeness of any data provided. CIESIN provides this data without warranty of any kind whatsoever, either expressed or implied. CIESIN shall not be liable for incidental, consequential, or special damages arising out of the use of any data provided by CIESIN.

## IX. Use Constraints

Users are free to use, copy, distribute, transmit, and adapt the work for commercial and non-commercial purposes, without restriction, as long as clear attribution of the source is provided.

## X. Recommended Citation(s)

### Data set(s):

Giglio, L., J. T. Randerson and G. R. van der Werf. 2017. Global Fire Emissions Indicators, Grids: 1997-2015. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). <https://doi.org/10.7927/H400002V>. Accessed DAY MONTH YEAR.

### Scientific publication:

Giglio, L., J. T. Randerson and G. R. van der Werf. 2013. Analysis of Daily, Monthly, and Annual Burned Area Using the Fourth-Generation Global Fire Emissions Database (GFED4). *Journal of Geophysical Research* 118 (1): 317-328. <https://doi.org/10.1002/jgrg.20042>.

## XI. Source Code


No source code is provided.

## XII. References

Giglio, L., J. T. Randerson and G. R. van der Werf. 2013. Analysis of Daily, Monthly, and Annual Burned Area Using the Fourth-Generation Global Fire Emissions Database (GFED4). *Journal of Geophysical Research* 118 (1): 317-328. <https://doi.org/10.1002/jgrg.20042>.

Additional information on the data set may be obtained from:  
<http://www.globalfiredata.org/>

### **XIII. Documentation Copyright and License**

Copyright © 2017. The Trustees of Columbia University in the City of New York. This document is licensed under a Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>). 

#### **Appendix 1. Data Revision History**

No revisions have been made to this data set.

#### **Appendix 2. Contributing Authors & Documentation Revision History**

Revision Date	Contributors	Revisions
November 30, 2017	Malanding Jaiteh	This document is the 1 <sup>st</sup> instance of documentation