11 - Natural Sources

11.B - Forest Fires

Short Description

In Germany’s forests prescribed burning is not applied. Therefore, all forest fires are categorized as wildfires (include emissions from forest fires occurring naturally or caused by humans). - Note that emissions reported here are not accounted for the national totals.

Method	AD	EF	Key Category
CS, T2, T1	CS	D	*not included in key category analysis*

Legend T = key source by Trend / L = key source by Level

Methods D: Default RA: Reference Approach T1: Tier 1 / Simple Methodology * T2: Tier 2* T3: Tier 3 / Detailed Methodology * C: CORINAIR CS: Country Specific M: Model as described in the EMEP/CORINAIR Emission Inventory Guidebook - 2019, in the group specific chapters.

AD:- Data Source for Activity Data NS: National Statistics RS: Regional Statistics IS: International Statistics PS: Plant Specific data AS: Associations, business organisations Q: specific questionnaires, surveys

EF - Emission Factors D: Default (EMEP Guidebook) C: Confidential CS: Country Specific PS: Plant Specific data

Methodology

For calculating the emissions of wildfires a country specific Tier2 approach was used. The mass of carbon emitted M(C) was calculated using the adapted equation follows the methodology of Seiler and Crutzen (1980) [1)].

$M(C) = 0.45 * A * B * \beta$

where:

0.45 = average fraction of carbon in fuel wood;

A = forest area burnt in [m²];

B = mean above-ground biomass of fuel material per unit area in [kg/m²];

β = burning efficiency (fraction burnt) of the above-ground biomass.

The data on forest areas burnt for the period 1990 to 2021 have been taken from the German forest fire statistic (BLE, 2022)[2] managed by the Federal Agency for Agriculture and Food. The mean above-ground biomass of fuel material was determined from the pools above ground biomass, dead wood and litter. The mean above-ground biomass and dead wood biomass was derived for each year by linear extrapolation and interpolation between the

- German National Forest Inventories of 1987, 2002, 2012 (Bundeswaldinventuren 1987, 2002, 2012),
- the inventory study 2008 and,
- the carbon inventory 2017.

Biomass of Litter was derived for each year by linear interpolation between 1990 and 2006 and extrapolation from 2007 based on the both Forest soil inventories (BZE I Wald (1990) and BZE II Wald (2006)).

Pursuant to König (2007) [3], 80% of the forest fires in Germany are surface fires and 20% crown fires. In accordance to the IPCC Good Practice Guidance for LULUCF (2003) a burning efficiency of 0.15 was used for surface fires and an efficiency of 0.45 was used for crown fires.

The emissions for the pollutants were calculated by multiplying the mass of carbon with the respective emission factors from table 3-3 (EMEP/EEA, 2019)[4].

For the calculation of particulate emissions (TSP, PM_{10} and $PM_{2.5}$) the burnt biomass was multiplied with the respective emission factors from table 3-5 (EMEP/EEA, 2019). Those particulate emission factors have been estimated by averaging the emission factors from the US Environmental Protection Agency (USEPA, 1996) [5] methodology, since no better information is available. Those emission factors are assumed to be the same for all types of forest.

The Guidebook does not indicate whether EFs have considered the condensable component (with or without).

Activity data

The data on forest areas burnt for the period 1990 to 2021 are based on the German forest fire statistic (BLE, 2021) managed by the Federal Agency for Agriculture and Food.

Table 1: Area of forest burnt from 1990 until the latest reporting year, in [ha]

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Area of forest burnt	1606	920	4908	1493	1114	592	1381	599	397	415	581
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Area of forest burnt	122	122	1315	274	183	482	256	539	757	522	214
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	
Area of forest burnt	269	199	120	526	283	395	2349	2711	368	148	

Emission factors

For the year 2021 the estimated emission factors from table 2 were applied.

Table 2: Emission factors applied for 2021

Pollutant	**EF**$_{2021}$ **[kg/ha forest area burnt] ^ | NO<sub>x**	155.19
CO	5,535.19	
NMVOC	488.86	
SO_x	37.25	

NH_3	41.9	
TSP	879.42	
PM_{10}	569.04	
$PM_{2.5}$	465.58	
BC	41.90	

In addition, a large-scale fire, which occurred in September 2018, is reported under 11.B. A detailed description can be found in the NIR 2020 in Chapter 6.8.2.5 [6], because a large amount of CO_2 emissions were released.

The burned area of the drained moor, which is used as a military facility, covered 1,221 ha. This fire was extensively investigated and documented by the Federal Office for Infrastructure, Environmental Protection and Services of the German Armed Forces. The emissions are calculated according to IPCC GL (2006), chapter 2, form 2.27 [7].

The product MB×Cf is set to 336 t dm ha-1 according to Table 2.6 and formula 2.7, 2013 IPCC Wetlands Supplement [8], i.e. it is assumed that the moor was completely drained during the fire.

For the calculation of CO emissions the EF according to Table 2.7, 2013 IPCC Wetlands Supplement 207 g $(kg\ dm)^{-1}$, is taken into account. This results in 85 kt CO. For other emissions from land fires on drained organic soils no Tier-1 emission factors exist and are therefore not reported (NO).

1)
Seiler, Wolfgang, and Paul J. Crutzen. “Estimates of gross and net fluxes of carbon between the biosphere and the atmosphere from biomass burning.” Climatic change 2.3 (1980): 207-247.
2)
BLE (Bundesanstalt für Landwirtschaft und Ernährung), (2022, 30. Juni), 2022: Waldbrandstatistik der Bundesrepublik Deutschland für das Jahr 2021, Bonn: 21 p. Retrieved July 2022, https://www.ble.de/DE/BZL/Daten-Berichte/Wald/wald_node.html
3)
König, H.-C., 2007. Waldbrandschutz - Kompendium für Forst und Feuerwehr. 1. Fachverlag Matthias Grimm, Berlin, 197 S.
4)
EMEP/EEA, 2019: https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/11-natural-sources/11-b-forest-fires/view
5)
USEPA, 1996: Compilation of Air Pollutant Emission Factors Vol.1. Stationary, Point and Area Sources. Report AP-42, fifth edition
6)
NIR (2020): National Inventory Report 2020 for the German Greenhouse Gas Inventory 1990-2018. Available in April 2020
7)
IPCC (Intergovernmental Panel on Climate Change) (2006): 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use. Eds.: Eggleston S., Buendia L., Miwa K., Ngara T., Tanabe K. (Eds). IEA/OECD, IPCC National Greenhouse Gas Inventories Programme, Technical Support Unit, Hayama, Kanagawa, Japan. http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
8)
IPCC (Intergovernmental Panel on Climate Change) (2014b): 2013 Supplement to the IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G.(eds). Published: IPCC, Switzerland http://www.ipcc-nggip.iges.or.jp/public/wetlands/index.html