

# **Swiss parameters to determine "Natural Disturbances" under the Paris Agreement 2021–2030: background level and margin**

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## Background

As a result of climate change and the general warming both the severity and frequency of natural disturbances is increasing. This can have a significant impact on the carbon balance particularly in forest ecosystems (Arias et al. 2021). For reporting GHG emissions by sources and removals by sinks in national greenhouse gas inventories under the Kyoto Protocol (KP), Parties had the option to exclude emissions from natural disturbances for Forest Management or for Afforestation/Reforestation (or both) in years for which the emissions resulting from natural disturbances exceed a background level plus a margin (IPCC 2014). Under the Paris Agreement, countries might continue to apply this provision.

Under the KP, Switzerland applied the default method to calculate background level and margin described in the Annex to Decision 2/CMP.7 with the reference period 1990-2009. In this document, the values have been updated for possible use under the Paris Agreement 2021-2030, based on the same methodology but with an extended reference period, i.e. 1990-2020. This document describes the methodology and the derived parameters.

## Natural disturbances definition

For accounting of natural disturbances (ND) under the KP, ND were defined in paragraph 1(a) in Annex A to decision 2/CMP.7 as "non-anthropogenic events or non-anthropogenic circumstances. For the purposes of this decision, these events or circumstances are those that cause significant emissions in forests and are beyond the control of, and not materially influenced by, a Party. These may include wildfires, insect and disease infestations, extreme weather events and/or geological disturbances, beyond the control of, and not materially influenced by, a Party. These exclude harvesting and prescribed burning".

Switzerland defined in the update of its second Initial Report under the Kyoto Protocol the types of natural disturbances to be excluded from accounting to include "Wildfires, insect pests, disease infestations, extreme weather events, and geological disturbances" (FOEN 2016a, b). This definition applies further.

## Methodology

### *Data*

Only wildfires are explicitly monitored including the year and total affected area of events (Table 1). These data are available from the Swissfire database (Pezzatti et al. 2019). Table 1 shows the time series since 1990 on total emissions, i.e. the sum of CO<sub>2</sub>eq emissions due to wildfires accounting for total tree biomass, standing and lying dead wood and litter (CH<sub>4</sub> and N<sub>2</sub>O only) and from CO<sub>2</sub> emissions due to other causes of natural disturbance. The emission factor for total emissions due to wildfire is based on data reported in Switzerland's NID (Tables 6-16 on living biomass and 6-17 on dead wood and litter in FOEN 2024).

Emissions due to other causes of natural mortality are based on data from the National Forest Inventory (NFI). In addition to the definition provided in section 12.1 in FOEN (2016b), these include also age-related mortality, which may be accelerated by increased stress due to drought or other

agents. Consistent with IPCC (2014) they exclude emission resulting from harvesting and prescribed burning. The data in Table 1 represent emission factors based on annualized values on total biomass (i.e., above- and belowground parts of trees) derived from data of two consecutive NFIs and weighted with annual harvest statistics data (see section 2.5 in Didion et al. 2023).

### *Calculation*

For each year, wildfire CO<sub>2</sub> equivalent emissions of CH<sub>4</sub> and N<sub>2</sub>O (CO<sub>2</sub> emissions are included elsewhere) are derived using global warming potentials of 28 and 265 (paragraph 37 in the Annex of 18/CMA.1). Total emissions are converted to emissions per hectare based on the area of productive forest in a given year (cf chp. 6.4.2.2 in FOEN 2024).

The default method to calculate background level and margin described in the Annex to Decision 2/CMP.7 was applied to the total emissions presented in Table 1. After three iterations based on twice the standard deviation around the mean no outliers remained, and background level (mean of the reference period without outliers) and margin (two times the standard deviation of the reference period without outliers) were calculated (Figure 1).

Table 1. Annual total area affected by wildfires, total emissions from wildfires, area of productive forest, area-specific total emissions from wildfires, area-specific total emissions due to other causes of natural mortality, and total emissions in the period 1990-2020. Shaded values of total emissions indicate years that were identified as outliers in three iterations.

Year	Area affected by wildfires	Emissions due to wildfires (CH <sub>4</sub> and N <sub>2</sub> O)	Area of productive forest	Area-specific emissions due to wildfires (CH <sub>4</sub> and N <sub>2</sub> O)	Area-specific emissions due to other causes of natural mortality	Total emissions
	kha	Gg CO <sub>2</sub> eq yr <sup>-1</sup>	kha	kg CO <sub>2</sub> eq yr <sup>-1</sup> ha <sup>-1</sup>	kg CO <sub>2</sub> yr <sup>-1</sup> ha <sup>-1</sup>	kg CO <sub>2</sub> eq yr <sup>-1</sup> ha <sup>-1</sup>
1990	1.067	26.171	1145.434	22.849	1896.980	1919.829
1991	0.070	1.743	1147.753	1.519	1374.461	1375.980
1992	0.028	0.694	1150.071	0.604	1347.088	1347.691
1993	0.018	0.451	1152.357	0.392	1314.133	1314.525
1994	0.233	5.876	1154.547	5.089	1396.578	1401.667
1995	0.363	9.203	1156.679	7.956	1417.328	1425.284
1996	0.233	5.927	1158.802	5.115	1576.153	1581.267
1997	1.390	35.563	1160.886	30.634	1729.329	1759.963
1998	0.198	5.074	1162.866	4.363	1911.562	1915.925
1999	0.011	0.288	1164.839	0.247	1865.269	1865.516
2000	0.047	1.206	1166.812	1.034	3644.747	3645.780
2001	0.013	0.329	1168.785	0.282	2233.717	2233.998
2002	0.418	10.653	1170.758	9.100	1797.766	1806.865
2003	0.527	13.449	1172.730	11.468	2020.426	2031.894
2004	0.025	0.628	1174.703	0.535	2036.030	2036.565
2005	0.041	1.056	1176.678	0.897	2085.003	2085.900
2006	0.112	2.850	1178.633	2.418	2062.362	2064.780
2007	0.238	6.053	1180.463	5.128	2058.393	2063.521
2008	0.039	0.981	1182.325	0.829	1903.447	1904.276
2009	0.050	1.283	1184.184	1.083	1765.087	1766.170
2010	0.026	0.668	1186.015	0.563	1855.266	1855.829
2011	0.171	4.380	1187.836	3.687	1835.764	1839.452
2012	0.026	0.664	1189.662	0.559	1685.035	1685.593
2013	0.024	0.624	1191.354	0.524	1728.420	1728.944
2014	0.043	1.111	1192.936	0.932	1777.214	1778.145
2015	0.045	1.160	1194.386	0.971	1646.517	1647.488
2016	0.256	6.563	1195.574	5.489	1612.910	1618.4
2017	0.106	2.705	1196.684	2.261	1695.581	1697.842
2018	0.055	1.414	1197.596	1.180	2885.066	2886.246
2019	0.016	0.408	1198.511	0.341	2560.848	2561.188
2020	0.011	0.270	1199.409	0.225	2665.294	2665.519

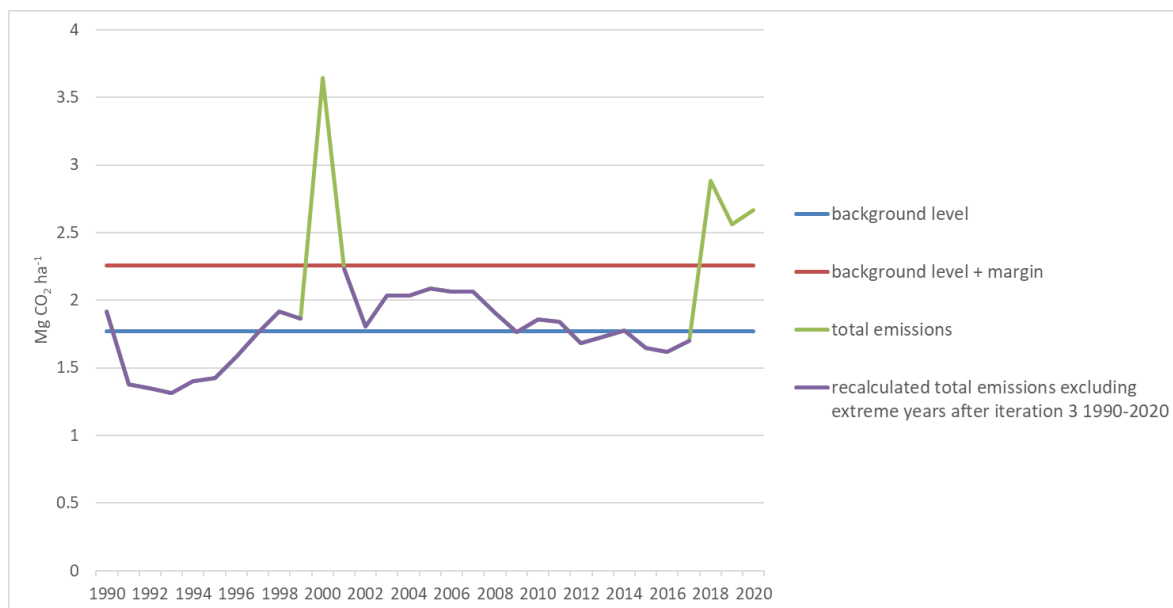


Figure 1. Total emissions in the period 1990-2020 including identified outliers, background level and margin applicable for productive forest in Switzerland.

### Background level and margin

The background level applicable for productive forest in Switzerland based on the period 1990-2020 is 1.769 Mg CO<sub>2</sub> ha<sup>-1</sup> and the margin is 0.486 Mg CO<sub>2</sub> ha<sup>-1</sup>. Thus, emissions from natural disturbances in productive forests above 2.225 Mg CO<sub>2</sub> ha<sup>-1</sup> (equal to background level plus margin) could potentially be excluded from the inventory.

## References

- Arias PA et al. (2021) Technical Summary. In: Masson-Delmotte V et al. (eds) Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p 33–144. doi:10.1017/9781009157896.002
- Didion M, Thürig E, Rösler E (2023) Data on C stocks and C stock changes in living tree biomass on forest land prepared for the Swiss NIR 2024 (GHGI 1990–2022). Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf. avl. online at <http://www.climatereporting.ch>.
- FOEN (Federal Office for the Environment) (2016a) Switzerland's Second Initial Report under the Kyoto Protocol. Report to facilitate the calculation of the assigned amount pursuant to Article 3, paragraphs 7bis, 8 and 8bis, of the Kyoto Protocol for the second commitment period 2013–2020., <https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-kyoto-protocol/second-commitment-period/initial-reports>.
- FOEN (Federal Office for the Environment) (2016b) Switzerland's Second Initial Report under the Kyoto Protocol. Report to facilitate the calculation of the assigned amount pursuant to Article 3, paragraphs 7bis, 8 and 8bis, of the Kyoto Protocol for the second commitment period 2013–2020. Update following the in-country review by an expert review team coordinated by the UNFCCC secretariat. <https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-kyoto-protocol/second-commitment-period/initial-reports>.
- FOEN (Federal Office for the Environment) (2024) Switzerland's Greenhouse Gas Inventory 1990–2022. National Inventory Document. Federal Office for the Environment, Bern. <http://www.climatereporting.ch>.
- IPCC (2014) 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds). IPCC, Switzerland. <http://www.ipcc-nggip.iges.or.jp/public/kpsg/>. <http://www.ipcc-nggip.iges.or.jp/public/kpsg/>.
- Pezzatti GB, Bertogliati M, Gache S, Reinhard M, Conedera M (2019) Swissfire: technisch modernisiert und dank Archivrecherchen inhaltlich erweitert [*Swissfire: technically updated and enhanced through archive research*]. Schweizerische Zeitschrift für Forstwesen 170: 234–241. doi:10.3188/szf.2019.0234