1.A.3.a i (ii) - Internatinal Civil Aviation: Cruise

Short description

Method	AD	EF	Key Category for
T1, T2, T3	NS, M	CS, D, M	*not included in key category analysis*

In NFR category *1.A.3.a i (ii) - Internatinal Civil Aviation: Cruise* emissions from international flights from German airports during cruise stage (above 3,000 feet of altitude) are reported.

In the following, information on sub-category specific activity data, (implied) emission factors and emission estimates are provided.

Methodology

Actitvity Data

Specific jet kerosene consumption during LTO-stage is calculated within TREMOD AV as described in the superordinate chapter on civil aviation.

Table 1: annual jet kerosene consumption during cruise-stage, in terajoules

1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019

source: Knörr et al. (2019c) [1)] & Gores (2019) [2)]

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Emission factors

All country specific emission factors used for emission reporting were basically ascertained within UBA project FKZ 360 16 029 [3)] and have since then been compiled, revised and maintained in TREMOD AV [4)].

For more information, please see superordinate chapter on civil aviation.

Table 2: Annual country-specific emission factors, in kg/TJ

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
NH_3																		
NMVOC																		
NO_x																		
SO_x																		
PM^1																		

BC[2]																		
CO																		

[1] EF(TSP) also applied for PM,,10,, and PM,,2.5,, (assumption: > 99% of TSP consists of PM,,2.5,,) [2] estimated via a f-BC of 0.48 as provided in [5)], Chapter: 1.A.3.a, 1.A.5.b Aviation, page 49: “Conclusion”.

> **NOTE:** For the country-specific emission factors applied for particulate matter, no clear indication is available, whether or not condensables are included.

Trend discussion for Key Sources

> NFR 1.A.3.a i (ii) - International Civil Aviation - Cruise is **not included in the national emission totals** and hence **not included in the key category analysis**.

Recalculations

Activity data have been revised for all years within TREMOD AV to keep in line with information available from the 2019 EMEP/EEA Guidebook [6)] and Eurocontrol's AEM model [7)].

Table 3: Revised kerosene usage in 1.A.3.a i (ii), in terajoules

	= 1990	**= 1995**	**= 2000**	**= 2005**	**= 2006**	**= 2007**	**= 2008**	**= 2009**	**= 2010**	**= 2011**	**= 2012**	**= 2013**	**= 2014**	**= 2015**	**= 2016**	**= 2017**
~ Submission 2020	> 150,852	> 187,855	> 243,544	> 288,819	> 304,276	> 315,598	> 319,033	> 310,713	> 305,632	> 291,248	> 314,638	> 320,599	> 307,487	> 306,766	> 331,644	> 365,499
~ Submission 2019	> 152,682	> 186,400	> 243,292	> 289,459	> 305,085	> 316,427	> 319,258	> 310,547	> 304,170	> 286,922	> 313,516	> 321,015	> 307,488	> 305,071	> 330,738	> 367,231
~ absolute change	> -1,830	> 1,455	> 252	> -640	> -809	> -829	> -224	> 167	> 1,462	> 4,326	> 1,122	> -416	> -0,79	> 1,695	> 907	> -1,732
~ relative change	> -1.20%	> 0.78%	> 0.10%	> -0.22%	> -0.27%	> -0.26%	> -0.07%	> 0.05%	> 0.48%	> 1.51%	> 0.36%	> -0.13%	> -0.0003%	> 0.56%	> 0.27%	> -0.47%

In parallel, the majority of **country-specific emission factors** has been revised within TREMOD AV based on information available from the 2019 EMEP/EEA Guidebook [8)] and Eurocontrol's AEM model [9)].

Table 4: Revised country-specific emission-factors, in [kg/TJ]

< NMVOC																
~ Submission 2020	> 13.4	> 9.5	> 5.9	> 5.4	> 5.3	> 5.2	> 5.1	> 5.0	> 4.9	> 4.8	> 4.7	> 4.7	> 4.6	> 4.7	> 4.5	> 4.5
~ Submission 2019	> 13.5	> 9.0	> 5.6	> 5.2	> 5.1	> 4.9	> 4.8	> 4.7	> 4.7	> 4.6	> 4.4	> 4.5	> 4.5	> 4.5	> 4.4	> 4.5
~ absolute change	> -0.05	> 0.48	> 0.36	> 0.24	> 0.27	> 0.29	> 0.30	> 0.25	> 0.25	> 0.24	> 0.26	> 0.23	> 0.14	> 0.19	> 0.02	> 0.00
~ relative change	> -0.39%	> 5.36%	> 6.42%	> 4.62%	> 5.31%	> 5.98%	> 6.26%	> 5.24%	> 5.37%	> 5.27%	> 5.75%	> 5.23%	> 3.18%	> 4.18%	> 0.39%	> 0.07%
< NO,,x,,																
~ Submission 2020	> 308	> 313	> 319	> 330	> 331	> 334	> 335	> 339	> 346	> 349	> 354	> 354	> 354	> 354	> 359	> 361
~ Submission 2019	> 313	> 317	> 329	> 335	> 336	> 339	> 341	> 344	> 350	> 352	> 359	> 364	> 368	> 374	> 378	> 380
~ absolute change	> -5.05	> -3.50	> -9.68	> -5.31	> -5.00	> -5.19	> -5.11	> -4.91	> -4.69	> -3.15	> -5.07	> -10.16	> -13.33	> -19.30	> -19.11	> -19.37

~ relative change	> -1.61%	> -1.10%	> -2.94%	> -1.58%	> -1.49%	> -1.53%	> -1.50%	> -1.43%	> -1.34%	> -0.89%	> -1.41%	> -2.79%	> -3.62%	> -5.17%	> -5.05%	> -5.09%
< Sulphur oxides - SO,,x,,																
~ Submission 2020	> 19.7	> 19.5	> 19.5	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6	> 19.6
~ Submission 2019	> 25.1	> 15.2	> 8.5	> 6.3	> 5.9	> 5.5	> 5.1	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7	> 4.7
~ absolute change	> -5.45	> 4.30	> 11.08	> 13.28	> 13.71	> 14.13	> 14.55	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98	> 14.98
~ relative change	> -21.7%	> 28.2%	> 131%	> 209%	> 232%	> 257%	> 287%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%	> 322%
< Black carbon - BC																
~ Submission 2020	> 1.91	> 2.01	> 2.08	> 1.97	> 1.95	> 1.93	> 1.90	> 1.88	> 1.86	> 1.84	> 1.83	> 1.82	> 1.78	> 1.79	> 1.79	> 1.80
~ Submission 2019	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23	> 2.23
~ absolute change	> -0.32	> -0.22	> -0.15	> -0.26	> -0.28	> -0.30	> -0.33	> -0.36	> -0.37	> -0.39	> -0.40	> -0.42	> -0.45	> -0.44	> -0.44	> -0.44
~ relative change	> -14.3%	> -9.8%	> -6.8%	> -11.6%	> -12.5%	> -13.5%	> -15.0%	> -16.0%	> -16.7%	> -17.5%	> -18.0%	> -18.7%	> -20.1%	> -19.9%	> -19.7%	> -19.5%
< Particulate matter - PM																
~ Submission 2020	> 3.98	> 4.19	> 4.33	> 4.11	> 4.07	> 4.02	> 3.95	> 3.91	> 3.87	> 3.84	> 3.81	> 3.78	> 3.72	> 3.72	> 3.74	> 3.74
~ Submission 2019	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65	> 4.65
~ absolute change	> -0.67	> -0.46	> -0.32	> -0.54	> -0.58	> -0.63	> -0.70	> -0.74	> -0.78	> -0.81	> -0.84	> -0.87	> -0.93	> -0.93	> -0.91	> -0.91
~ relative change	> -14.3%	> -9.8%	> -6.8%	> -11.6%	> -12.5%	> -13.5%	> -15.0%	> -16.0%	> -16.7%	> -17.5%	> -18.0%	> -18.7%	> -20.1%	> -19.9%	> -19.7%	> -19.5%
< Carbon monoxide - CO																
~ Submission 2020	> 71.0	> 60.3	> 44.9	> 40.0	> 39.2	> 38.3	> 37.4	> 36.4	> 35.9	> 35.6	> 35.5	> 35.6	> 35.3	> 35.5	> 33.5	> 33.6
~ Submission 2019	> 72.0	> 59.8	> 44.3	> 40.2	> 39.2	> 38.2	> 37.1	> 36.8	> 36.4	> 36.2	> 35.8	> 35.6	> 35.1	> 35.1	> 35.1	> 35.5
~ absolute change	> -0.97	> 0.48	> 0.55	> -0.21	> 0.00	> 0.17	> 0.32	> -0.41	> -0.47	> -0.59	> -0.28	> -0.05	> 0.19	> 0.40	> -1.55	> -1.90
~ relative change	> -1.35%	> 0.81%	> 1.24%	> -0.53%	> 0.01%	> 0.44%	> 0.87%	> -1.11%	> -1.29%	> -1.63%	> -0.78%	> -0.14%	> 0.54%	> 1.15%	> -4.42%	> -5.35%

For more information on recalculated emission estimates for Base Year and 2018, please see the pollutant specific recalculation tables following chapter 8.1 - Recalculations].

Uncertainties

For uncertainties information, please see main chapter on civil aviation.

Planned improvements

For information on planned improvements, please see main chapter on civil aviation.

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