2.L(a) - Handling of Bulk Products

Short description

Under category *2.L(a) - Handling of Bulk Products* dust emissions from bulk material handling (loading and unloading) including agricultural bulk materials offsite the fields are reported. Emissions from quarrying and mining of minerals and from point source emissions are excluded.

Methodology

For 1990 to 1996, only simplified estimates without a differentiation of handled materials and products exist. For all following years, emissions are calculated using a tier1 method taking into account detailed data on handled materials and products.

Activity data

Official statistics are of limited use in determining handling of bulk products. There are only transport statistics available providing the amounts of several transported materials.

During a research project carried out by (Müller-BBM) [1)], activity data was derived from primary statistical data from the Federal Statistical Office for Germany (Satistisches Bundesamt, Destatis) and the Federal Motor Transport Authority (Kraftfahrt-Bundesamt, KBA). Here, data on goods transported by railways and ships is gathered by Destatis whereas data for road transport is collected by the KBA.

Here, for all years until 2009, the collection of data for transported goods followed the official **NST/R** (1968) **nomenclature and regulation** (Eurostat, 2015a) [2)].

As of 2010, statistical data following the newly implemented **NST-2007** [3)], [4)] **nomenclature and regulation** from Destatis and KBA is applied instead.

Table 1: Overview of primary activity data sources over time

1990-1996	simplified estimates without differentiation of handled materials
1997-2009	statistical data following NST/R nomenclature
as of 2010	statistical data following NST-2007 nomenclature

Here, NST/R allowed the distribution of a broad variety of goods and materials (e.g. barley, corn, oats, rice, rye, and wheat), whereas NST-2007 provides only a very condensed list of classes of goods (e.g. 'crops').

Due to these methodological breaks, activity data and emissions show inconsistencies (especially on the level of specific goods and materials) that cannot be eliminated at the moment. Nonetheless, on a aggregate level, these breaks are balanced out more or less automatically as the total amount of transported dry materials does not chnage too much with changing statistical approaches.

For estimating the amount of moved bulk materials as well as emissions from the loading and unloading of bulk materials, these primary activity data (PAD, including the amounts of imported and exported goods as well as goods transported within Germany) have to be calculated from the amounts of transported goods:

$$PAD_{material\ i} = PAD_{import} + PAD_{export} + 2 * PAD_{domestic\ handling}$$

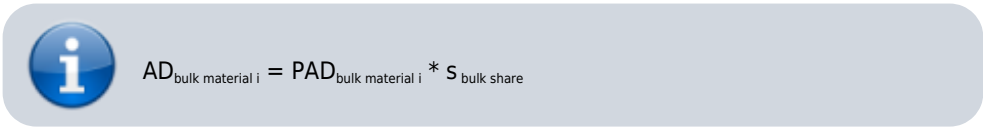
with

1. PAD_{import} = amount of imported good or material,
2. PAD_{export} = amount of exported good or material and
3. $PAD_{domestic\ handling}$ = amount of good or material transported only within Germany

As the basic statistics provide only total amounts of imported, exported and domestically transported dry goods without any distinction into bulk and packed goods, the shares of bulk goods had to be estimated via expert judgement during the workshop mentioned above.

During this workshop, experts, for comparable kinds of dry bulk material, discussed specific shares displaying which part of the total amount of dry material *i* loaded and/or unloaded within Germany might be transported as bulk material thus causing PM emissions.

So the activity data finally used for estimating specific particulate matter emissions for every bulk material is calculated as a specific share *s* of the amount of this material *i* loaded and/or unloaded within Germany:



$$AD_{\text{bulk material i}} = PAD_{\text{bulk material i}} * s_{\text{bulk share}}$$

Table 2: Amounts of dry, dusty bulk goods handled in Germany 2010-2021, in tonnes

	transport mode	2010	2015	2016	2017	2018	2019	2020	2021
other herbal products	inland vessel	5,523,633	5,711,645	6,541,031	6,529,161	38,829,323	39,189,603	38,498,874	34,508,319
	railways	1,242,916	1,242,916	170,158	807,829	17,868	470,000	547,545	532,253
	heavy-duty vehicle	20,847,400	30,967,600	29,445,800	28,094,800	34,166,200	34,166,200	22,918,493	24,118,587
	sea-going vessel	4,052,384	6,083,248	5,690,857	6,321,278	6,052,546	6,376,068	7,164,149	6,953,293
raw mineral chemicals	inland vessel	6,794,922	11,213,581	11,750,342	12,044,542	2,556,501	2,366,579	2,573,770	2,696,029
	railways	9,827,059	9,827,059	10,158,766	9,139,348	10,472,017	9,273,000	9,627,577	9,885,631
	heavy-duty vehicle	78,928,400	89,219,400	83,315,200	84,937,600	82,363,000	82,363,000	10,043,513	11,351,314
	sea-going vessel	5,550,621	8,904,300	8,692,669	8,768,942	8,741,513	7,905,516	7,888,208	8,131,408
raw organic chemicals	inland vessel	6,299,350	6,310,746	6,636,096	6,417,766	171,884	57,126	114,803	175,726
	railways	16,287,803	16,287,803	19,006,897	17,965,252	17,716,320	21,094,000	18,661,643	18,339,593
	heavy-duty vehicle	11,345,600	5,875,200	5,293,800	5,192,200	4,570,800	4,570,800	0	828,916
	sea-going vessel	3,638,264	2,630,859	2,502,315	2,690,538	3,182,266	2,478,579	2,341,016	2,413,459
iron ore	inland vessel	25,728,177	23,048,502	21,885,592	23,312,725	24,389,450	25,203,179	25,755,504	25,193,580
	railways	38,565,334	38,565,334	37,513,305	37,215,277	39,012,340	37,708,000	37,434,377	37,586,847
	heavy-duty vehicle	203,800	1,502,000	1,166,000	0	0	0	1,764,223	534,846
	sea-going vessel	13,922,885	12,702,983	13,397,347	14,028,077	14,444,514	13,967,430	13,365,447	14,810,135
crops	inland vessel	9,816,233	9,348,956	9,693,828	11,180,006	11,452,177	11,243,918	10,046,500	9,546,963
	railways	2,982,548	2,982,548	2,446,615	1,994,499	2,688,008	4,583,000	3,545,040	3,759,205
	heavy-duty vehicle	65,464,800	65,723,600	63,027,200	63,948,600	70,614,200	70,614,200	58,304,413	61,639,154
	sea-going vessel	9,319,143	7,155,770	7,103,932	10,159,483	10,599,072	12,142,981	10,735,948	8,851,781
potatoes	inland vessel	1,383	1,620	30	1,034	0	0	0	1,056
	railways	17,135	17,135	38,819	38,425	9,898	0	0	4,581,528
	heavy-duty vehicle	10,627,000	10,136,400	10,056,600	11,717,000	9,956,800	9,956,800	4,683,480	5,039,904
	sea-going vessel	29,296,456	26,293,129	29,732,990	23,583,567	23,943,784	21,170,067	20,406,870	22,490,149
coal products	inland vessel	2,409,311	1,961,483	1,315,205	1,665,936	1,871,597	1,361,655	2,003,004	2,129,778
	railways	22,499,503	22,499,503	8,513,061	9,144,558	7,120,072	6,721,000	6,610,955	6,456,917
	heavy-duty vehicle	11,801,600	12,236,800	10,278,800	10,415,800	15,401,600	15,401,600	7,065,314	8,549,595
	sea-going vessel	802,164	398,570	59,335	53,695	72,473	48,778	43,760	135,197

	transport mode	2010	2015	2016	2017	2018	2019	2020	2021
products from grinding & shelling mills	inland vessel	1,782,712	2,567,049	3,086,180	2,871,889	3,200,833	4,133,053	5,180,094	5,368,877
	railways	2,852	2,852	328,857	350,368	362,180	0	465,039	381,098
	heavy-duty vehicle	97,539,400	106,391,800	104,354,000	101,813,400	99,568,200	99,568,200	75,685,582	69,634,714
	sea-going vessel	3,104,125	3,995,488	3,971,495	3,638,766	3,903,447	3,525,359	3,586,612	3,747,650
mineral fertilisers	inland vessel	760,174	390,276	304,450	279,444	271,253	305,202	281,603	255,398
	railways	4,122,535	4,122,535	3,890,715	3,684,926	3,578,700	3,424,000	3,619,997	3,581,858
	heavy-duty vehicle	7,923,200	6,028,800	2,236,000	2,532,400	4,322,000	4,322,000	1,338,908	1,006,750
	sea-going vessel	117,224	563,030	348,447	395,809	507,459	409,515	256,924	323,622
natural sands, gravel & stones	inland vessel	40,518,020	40,340,856	38,487,658	35,673,470	34,713,430	31,927,501	33,178,046	36,072,381
	railways	56,517,180	56,517,180	48,907,929	46,590,830	45,317,601	43,958,000	43,837,499	39,960,787
	heavy-duty vehicle	1,655,747,400	1,875,461,200	1,780,682,400	1,810,580,800	1,853,177,400	1,853,177,400	1,669,958,849	1,672,131,248
	sea-going vessel	8,739,096	11,121,374	11,421,774	9,822,506	9,947,768	9,739,769	10,353,589	13,515,063
non-iron ores	inland vessel	1,512,246	2,991,850	3,399,513	2,909,452	3,186,877	2,964,925	2,827,648	3,199,797
	railways	29,742	29,742	15,232	6,651	7,972	8,000	6,642	16,877
	heavy-duty vehicle	705,600	788,600	2,480,600	1,321,000	0	0	0	827,676
	sea-going vessel	2,687,815	3,186,505	3,474,240	3,065,484	3,204,390	2,850,350	3,870,273	4,368,429
raw coals	inland vessel	36,652,759	36,960,623	37,127,495	39,825,584	39,049	0	0	0
	railways	58,433,815	58,433,815	69,687,308	73,653,317	69,222,607	67,749,000	61,034,978	51,142,196
	heavy-duty vehicle	10,561,400	9,592,600	10,288,800	14,056,000	13,275,800	13,275,800	11,858,051	16,057,484
	sea-going vessel	13,299,295	14,640,469	13,878,763	14,194,693	14,065,658	16,476,145	14,401,269	15,919,606
secondary raw materials	inland vessel	15,691,876	15,455,505	15,346,780	15,565,961	12,209,667	11,521,886	11,212,165	12,089,358
	railways	25,614,264	25,614,264	24,816,767	24,034,064	23,099,944	22,113,000	21,261,312	22,147,649
	heavy-duty vehicle	422,570,000	465,981,000	452,569,000	464,878,800	490,299,000	490,299,000	161,493,436	171,462,235
	sea-going vessel	5,047,097	5,440,262	6,098,151	5,739,258	6,094,992	5,810,444	5,057,435	4,173,386
rock & saline salt	inland vessel	2,769,356	5,367,045	4,297,737	4,588,453	3,959,354	3,939,437	3,651,498	4,115,651
	railways	3,067,187	3,067,187	2,413,134	2,963,318	2,258,785	2,575,000	2,362,886	2,603,115
	heavy-duty vehicle	21,579,000	18,284,800	11,550,200	13,746,800	7,887,600	7,887,600	7,238,776	10,591,977
	sea-going vessel	567,059	1,340,830	1,062,136	912,141	761,849	919,251	888,593	812,124
nitrogen fertilisers	inland vessel	5,737,386	5,636,147	5,616,853	5,321,196	5,267,318	5,104,076	4,930,755	4,742,988
	railways	15,708,472	15,708,472	15,592,709	15,550,134	14,971,021	14,091,000	13,614,102	14,066,445
	heavy-duty vehicle	37,454,600	44,977,200	61,230,200	64,460,400	71,366,600	71,366,600	28,434,989	30,619,530
	sea-going vessel	5,309,443	5,821,309	5,953,434	6,489,522	6,378,323	6,509,499	7,011,855	7,392,865
white cement, lime, cement	inland vessel	3,273,975	3,324,316	3,120,120	3,046,615	2,408,113	2,479,720	2,532,347	2,776,593
	railways	17,849,146	17,849,146	17,115,456	18,418,916	19,947,465	21,867,000	19,270,679	18,928,775
	heavy-duty vehicle	69,407,200	81,743,800	71,895,800	76,202,600	86,441,400	86,441,400	76,251,684	77,289,169
	sea-going vessel	1,544,488	2,130,253	2,171,491	1,954,095	2,699,787	2,757,516	2,470,814	2,552,567

	transport mode	2010	2015	2016	2017	2018	2019	2020	2021
sugar beet	inland vessel	0	5,003	0	1,035	6,362,106	6,366,439	6,426,328	6,396,070
	railways	123,598	123,598	96,747	29,869	46,870	24,000	64,094	37,555
	heavy-duty vehicle	26,946,200	27,903,200	31,496,200	20,903,200	36,601,000	36,601,000	22,159,060	32,853,554
	sea-going vessel	17	142	1,843	1,154	4,086	2,872	3,125	9,676

sources: annual data deliveries DESTATIS & KBA (for heavy-duty vehicles) to the inventory compiler

Emission factors

Emission factors are based on the methodology according VDI guidelines 3790. The values used here originate from a research project by (Müller-BBM, 2011) [5)] taking into account information of an expert panel of industry and administration. For details see the [*https://www.umweltbundesamt.de/publikationen/konsistenzpruefung-verbesserungspotenzial project report] (German version only).

Within the study, PM emission factors are estimated for each material or good that might be transported as dry and unpacked bulk. These very specific EF are than assigned to the classes of materials/goods available from the different different statistics (NST/R, NST-2007) to form implied Ef for these class of bulk material.

As NST/R provided a wide variaty of goods and materials, whereas NST-2007 provides only a very condensed list of classes of goods, the very specific EF derived during the study and the joint expert workshop have been aggregated in order to match the classes of goods following NST-2007.

Table 2: specific EF for PM emissions from NST/R crop products, in [kg/t], as used for 2021 estimates

	TSP	PM_{10}	$PM_{2.5}$
Other herbal products	0.032000	0.016000	0.003200
Chemische Grundstoffe. mineralisch	0.041000	0.020500	0.004100
Raw organic chemicals	0.024000	0.012000	0.002400
Iron ore	0.057000	0.028500	0.005700
Crops	0.045000	0.022500	0.004500
Potatoes	0.007000	0.003500	0.000700
Coal products	0.019000	0.009500	0.001900
Products from grinding and shelling mills	0.003000	0.001500	0.000300
Mineral fertilisers	0.024000	0.012000	0.002400
Natural sands. gravel. and stones	0.027000	0.013500	0.002700
Non-iron ores	0.066000	0.033000	0.006600
Raw coals	0.016000	0.008000	0.001600
Secondary raw materials	0.027000	0.013500	0.002700
Rock & saline salt	0.068000	0.034000	0.006800
Nitrogen fertilisers	0.024000	0.012000	0.002400
White cement. lime. cement	0.005000	0.002500	0.000500
Sugar beet	0.000240	0.000120	0.000024

Ratio TSP : PM_{10} : $PM_{2.5}$

The shares of PM_{10} and $PM_{2.5}$ of the entire amounts of emitted TSP have been set to fixed values used for the entire time series.

Assumptions:

1. TSP = 100%,
2. 50% of TSP are =< 10 µm. Therefore, the EF(PM_{10}) are assumed as 1/2 of the corresponding EF(TSP), and
3. 10% of TSP are =< 2.5 µm. Therefore, the EF($PM_{2.5}$) are assumed as 1/10 of the corresponding EF(TSP).

The ratios of TSP, PM_{10}, and $PM_{2.5}$ were also discussed in the research project mentioned above, but without generating any new data. Nonetheless, the ratios might be to low at the moment and will be checked furthermore.

Recalculations

Planned improvements

Although no specific improvement is planned, additional effort will be necessary to further minimise the inconsistencies in the activity data time series resulting from the different approaches applied.

[1), 5)] Müller-BBM, 2011: Dr. Matthias Bender, Ludger Gronewäller, Detlef Langer: Konsistenzprüfung und Verbesserungspotenzial der Schüttgutemissionsberechnung - Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit, Förderkennzeichen3708 49 107 2 - FB 00 1453 UBA; Müller- BBM GmbH, Im Auftrag des Umweltbundesamtes, Planegg/Dessau-Roßlau, Februar 2011 - URL: https://www.umweltbundesamt.de/publikationen/konsistenzpruefung-verbesserungspotenzial

[2)] Eurostat, 2015a: Standard Goods Classification for Transport Statistics/Revised (1967) NST/R - URL

[3)] Eurostat, 2015b: Standard Goods Classification for Transport Statistics, 2007 - URL: https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NST_2007&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC

[4)] Destatis, 2013: Statistisches Bundesamt, Verkehr, NST-2007: Einheitliches Güterverzeichnis für die Verkehrsstatistik – 2007 - URL: https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Transport-Verkehr/Gueterverkehr/Tabellen/nsz-2007.html