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 2010-2019, in tonnes

	transport mode	2010	2015	2016	2017	2018	2019
other herbal products	inland vessel	5.523.633	39.189.603	38.498.874	34.508.319	30.305.094	30.305.094
	railways	1.242.916	470.000	547.545	532.253	445.547	445.547
	heavy-duty vehicle	20.847.400	34.166.200	22.918.493,25	24.118.587,36	35.511.099,79	35.511.099,79
	sea-going vessel	4.052.384	6.376.068	7.164.149	6.953.293	6.614.999	6.614.999
raw mineral chemicals	inland vessel	6.794.922	2.366.579	2.573.770	2.696.029	11.798.872	11.798.872
	railways	9.827.059	9.273.000	9.627.577	9.885.631	10.634.917	10.634.917
	heavy-duty vehicle	78.928.400	82.363.000	10.043.512,6	11.351.314,18	63.713.624,39	63.713.624,39
	sea-going vessel	5.550.621	7.905.516	7.888.208	8.131.408	7.386.700	7.386.700
raw organic chemicals	inland vessel	6.299.350	57.126	114.803	175.726	6.667.823,3	6.667.823,3
	railways	16.287.803	21.094.000	18.661.643	18.339.593	0	0
	heavy-duty vehicle	11.345.600	4.570.800	0	828.915,62	12.601.907,86	12.601.907,86
	sea-going vessel	3.638.264	2.478.579	2.341.016	2.413.459	2.463.615	2.463.615
iron ore	inland vessel	25.728.177	25.203.179	25.755.504	25.193.580	22.796.286,2	22.796.286,2
	railways	38.565.334	37.708.000	37.434.377	37.586.847	38.252.864	38.252.864
	heavy-duty vehicle	203.800	NE	1.764.223,28	534.846,2	1.680.884,75	1.680.884,75
	sea-going vessel	13.922.885	13.967.430	13.365.447	14.810.135	14.761.129	14.761.129
crops	inland vessel	9.816.233	11.243.918	10.046.500	9.546.963	7.715.976,9	7.715.976,9
	railways	2.982.548	4.583.000	3.545.040	3.759.205	2.985.786	2.985.786
	heavy-duty vehicle	65.464.800	70.614.200	58.304.412,81	61.639.153,5	58.957.569,61	58.957.569,61
	sea-going vessel	9.319.143	12.142.981	10.735.948	8.851.781	7.672.262	7.672.262
potatoes	inland vessel	1.383	0	0	1.056	0	0
	railways	17.135	0	0	4.581.528	4.896.748	4.896.748
	heavy-duty vehicle	10.627.000	9.956.800	4.683.479,8	5.039.904,39	9.621.800,34	9.621.800,34
	sea-going vessel	29.296.456	21.170.067	20.406.870	22.490.149	20.701.636	20.701.636

	transport mode	2010	2015	2016	2017	2018	2019
coal products	inland vessel	2.409.311	1.361.655	2.003.004	2.129.778	1.560.991,4	1.560.991,4
	railways	22.499.503	6.721.000	6.610.955	6.456.917	8.421.754	8.421.754
	heavy-duty vehicle	11.801.600	15.401.600	7.065.313,67	8.549.595,42	13.182.781,81	13.182.781,81
	sea-going vessel	802.164	48.778	43.760	135.197	25.450	25.450
proiducts from grinding and shelling mills	inland vessel	1.782.712	4.133.053	5.180.094	5.368.877	5.275.004,5	5.275.004,5
	railways	2.852	0	465.039	381.098	349.419	349.419
	heavy-duty vehicle	97.539.400	99.568.200	75.685.582,42	69.634.714,07	99.763.916,17	99.763.916,17
	sea-going vessel	3.104.125	3.525.359	3.586.612	3.747.650	3.788.108	3.788.108
mineral fertilisers	inland vessel	760.174	305.202	281.603	255.398	197.705	197.705
	railways	4.122.535	3.424.000	3.619.997	3.581.858	3.224.654	3.224.654
	heavy-duty vehicle	7.923.200	4.322.000	1.338.907,89	1.006.750,39	1.814.963,65	1.814.963,65
	sea-going vessel	117.224	409.515	256.924	323.622	311.822	311.822
natural sands, gravel and stones	inland vessel	40.518.020	31.927.501	33.178.046	36.072.381	35.475.138,6	35.475.138,6
	railways	56.517.180	43.958.000	43.837.499	39.960.787	41.345.431	41.345.431
	heavy-duty vehicle	1.655.747.400	1.853.177.400	1.669.958.848,9	1.672.131.248,33	1.838.142.737,04	1.838.142.737,04
	sea-going vessel	8.739.096	9.739.769	10.353.589	13.515.063	12.463.686	12.463.686
non-iron ores	inland vessel	1.512.246	2.964.925	2.827.648	3.199.797	3.043.061,9	3.043.061,9
	railways	29.742	8.000	6.642	16.877	61.486	61.486
	heavy-duty vehicle	705.600	NE	0	827.676,19	512.050,57	512.050,57
	sea-going vessel	2.687.815	2.850.350	3.870.273	4.368.429	4.621.799	4.621.799
raw coals	inland vessel	36.652.759	0	0	0	19.571	19.571
	railways	58.433.815	67.749.000	61.034.978	51.142.196	48.277.288	48.277.288
	heavy-duty vehicle	10.561.400	13.275.800	11.858.051,12	16.057.484,06	12.593.015,33	12.593.015,33
	sea-going vessel	13.299.295	16.476.145	14.401.269	15.919.606	16.187.881	16.187.881
secondary raw materials	inland vessel	15.691.876	11.521.886	11.212.165	12.089.358	15.101.718,2	15.101.718,2
	railways	25.614.264	22.113.000	21.261.312	22.147.649	20.565.387	20.565.387
	heavy-duty vehicle	422.570.000	490.299.000	161.493.436,36	171.462.234,65	502.448.809,36	502.448.809,36
	sea-going vessel	5.047.097	5.810.444	5.057.435	4.173.386	3.427.249	3.427.249
rock & saline salt	inland vessel	2.769.356	3.939.437	3.651.498	4.115.651	3.977.617,5	3.977.617,5
	railways	3.067.187	2.575.000	2.362.886	2.603.115	3.017.352	3.017.352
	heavy-duty vehicle	21.579.000	7.887.600	7.238.776,07	10.591.976,8	11.820.822,05	11.820.822,05
	sea-going vessel	567.059	919.251	888.593	812.124	1.116.411	1.116.411

	transport mode	2010	2015	2016	2017	2018	2019
nitrogen fertilisers	inland vessel	5.737.386	5.104.076	4.930.755	4.742.988	4.466.441,8	4.466.441,8
	railways	15.708.472	14.091.000	13.614.102	14.066.445	12.318.493	12.318.493
	heavy-duty vehicle	37.454.600	71.366.600	28.434.988,59	30.619.530,39	68.151.043,89	68.151.043,89
	sea-going vessel	5.309.443	6.509.499	7.011.855	7.392.865	7.239.705	7.239.705
white cement, lime, cement	inland vessel	3.273.975	2.479.720	2.532.347	2.776.593	2.978.725,6	2.978.725,6
	railways	17.849.146	21.867.000	19.270.679	18.928.775	18.679.111	18.679.111
	heavy-duty vehicle	69.407.200	86.441.400	76.251.684,33	77.289.168,89	99.899.784,63	99.899.784,63
	sea-going vessel	1.544.488	2.757.516	2.470.814	2.552.567	2.172.344	2.172.344
sugar beet	inland vessel	0	6.366.439	6.426.328	6.396.070	5.912.658,8	5.912.658,8
	railways	123.598	24.000	64.094	37.555	0	0
	heavy-duty vehicle	26.946.200	36.601.000	22.159.059,85	32.853.553,74	31.023.481,64	31.023.481,64
	sea-going vessel	17	2.872	3.125	9.676	3.277	3.277

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 2009 estimates

	TSP	PM10	PM2.5
for barley			
inland ship	0.038	0.019	0.004
railway	0.038	0.019	0.004
maritime ship	0.038	0.019	0.0038
heavy-duty vehicle	0.038	0.019	0.004
for oats			
inland ship	0.018	0.009	0.002
railway	0.018	0.009	0.002
maritime ship	0.018	0.009	0.00179
heavy-duty vehicle	0.018	0.009	0.002
for corn			
inland ship	0.029	0.014	0.003
railway	0.029	0.014	0.003
maritime ship	0.029	0.014	0.00287
heavy-duty vehicle	0.029	0.014	0.003

	TSP	PM10	PM2.5
for rice			
inland ship	0.015	0.008	0.002
railway	0.015	0.008	0.002
maritime ship	0.015	0.008	0.00151
heavy-duty vehicle	0.015	0.008	0.002
for rye			
inland ship	0.038	0.019	0.004
railway	0.038	0.019	0.004
maritime ship	0.038	0.019	0.0038
heavy-duty vehicle	0.038	0.019	0.004
for wheat			
inland ship	0.038	0.019	0.004
railway	0.038	0.019	0.004
maritime ship	0.038	0.019	0.0038
heavy-duty vehicle	0.038	0.019	0.004

Here, in order to match the new NST-2007 classes for goods and materials, the very specific emission factors used in fomer submissions were converted to aggregated implied emission factors.

Table 3: IEFs used for emission estimates as of 2010, in [kg/t]

	Heavy-duty vehicles			Railways			Inland vessels			Sea vessels		
	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5
Other herbal products	0.032000	0.016000	0.003200	0.024000	0.012000	0.002400	0.022000	0.011000	0.002200	0.028000	0.014000	0.002800
Chemische Grundstoffe. mineralisch	0.041000	0.020500	0.004100	0.031000	0.015500	0.003100	0.029000	0.014500	0.002900	0.036000	0.018000	0.003600
Raw organic chemicals	0.024000	0.012000	0.002400	0.018000	0.009000	0.001800	0.017000	0.008500	0.001700	0.021000	0.010500	0.002100
Iron ore	0.057000	0.028500	0.005700	0.042000	0.021000	0.004200	0.040000	0.020000	0.004000	0.050000	0.025000	0.005000
Crops	0.045000	0.022500	0.004500	0.034000	0.017000	0.003400	0.031000	0.015500	0.003100	0.039000	0.019500	0.003900
Potatoes	0.007000	0.003500	0.000700	0.005000	0.002500	0.000500	0.005000	0.002500	0.000500	0.006000	0.003000	0.000600
Coal products	0.019000	0.009500	0.001900	0.014000	0.007000	0.001400	0.013000	0.006500	0.001300	0.017000	0.008500	0.001700
Products from grinding and shelling mills	0.003000	0.001500	0.000300	0.003000	0.001500	0.000300	0.003000	0.001500	0.000300	0.003000	0.001500	0.000300
Mineral fertilisers	0.024000	0.012000	0.002400	0.018000	0.009000	0.001800	0.017000	0.008500	0.001700	0.021000	0.010500	0.002100
Natural sands. gravel. and stones	0.027000	0.013500	0.002700	0.020000	0.010000	0.002000	0.019000	0.009500	0.001900	0.023000	0.011500	0.002300
Non-iron ores	0.066000	0.033000	0.006600	0.049000	0.024500	0.004900	0.046000	0.023000	0.004600	0.058000	0.029000	0.005800
Raw coals	0.016000	0.008000	0.001600	0.016000	0.008000	0.001600	0.020000	0.010000	0.002000	0.028000	0.014000	0.002800
Secondary raw materials	0.027000	0.013500	0.002700	0.020000	0.010000	0.002000	0.019000	0.009500	0.001900	0.023000	0.011500	0.002300
Rock & saline salt	0.068000	0.034000	0.006800	0.051000	0.025500	0.005100	0.047000	0.023500	0.004700	0.059000	0.029500	0.005900
Nitrogen fertilisers	0.024000	0.012000	0.002400	0.018000	0.009000	0.001800	0.017000	0.008500	0.001700	0.021000	0.010500	0.002100
White cement. lime. cement	0.005000	0.002500	0.000500	0.004000	0.002000	0.000400	0.003000	0.001500	0.000300	0.004000	0.002000	0.000400
Sugar beet	0.000240	0.000120	0.000024	0.000180	0.000090	0.000018	0.000170	0.000085	0.000017	0.000210	0.000105	0.000021

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

With both **activity data** and **emission factors** remaining unrevised, no recalculations have been carried out.

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)] MÜLLERBBM2011
[2)] Eurostat, 2015a: Standard Goods Classification for Transport Statistics/Revised (1967) NST/R - URL: http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NSTR_1967&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC
[3)] Eurostat, 2015b: Standard goods classification for transport statistics, 2007 - URL: http://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
[5)] MÜLLERBBM2011