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Diffuse water emissions in E-PRTR

Dissemination document

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Diffuse water emissions in E-PRTR

Dissemination document

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Title
Diffuse water emissions in E-PRTR

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European Commission	1205118-000	1205118-000-ZWS-0018	133

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Summary
The E-PRTR Regulation No 166/2006 established a European Pollutant Release and Transfer Register (E-PRTR). This database must include releases of pollutants from diffuse sources where available. Article 8 of the Regulation establishes that the Commission will include data on releases from diffuse sources which has already been reported by Member States, and will disaggregate the information to an adequate geographical level whilst including information on the methodology used. When no data on releases from diffuse sources is available, the Commission is required to take actions to initiate reporting on diffuse sources. Therefore the European Commission launched this project. In this project available data on diffuse emissions to water has been collected, estimation methods to quantify diffuse emissions have been developed and forty maps have been prepared, covering the EU Member States and the EFTA countries on a River Basin District sub-unit scale for a selection of key sources and substances. The maps will be integrated in the E-PRTR website (http://prtr.ec.europa.eu/) by the European

Commission. In this document the maps, map descriptions and the fact sheets are put together as a complete background document. In a separate document, the project report, the project results are described.

References
Roovaart, J. van den, N. van Duijnhoven, M. Knecht, J. Theloke, P. Coenen, H. ten Broeke, 2013. Diffuse water emissions in E-PRTR, Dissemination document. Report 1205118-000-ZWS-0018, Deltares.

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Title
Diffuse water emissions in E-PRTR

Client	Project	Reference	Pages
European Commission	1205118-000	1205118-000-ZWS-0018	133

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	July 2013	J. van den Roovaart		S. de Rijk		G. Blom	
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Contents

1 Introduction

This document can be seen as a background report of the Diffuse water emissions in E-PRTR Project report. The objectives of this project are to:

1 Gather available data on diffuse releases to surface water with data sets available up to 2009 of the pollutants and sources for a selected set of source-substance combinations.
2 Propose alternative estimation methods where emission data are not available on the European scale.
3 Develop a methodology to derive disaggregated spatial data to obtain geographical information system layers.
4 Derive gridded emission map layers covering all EU27 Member States and the EFTA countries (Switzerland, Liechtenstein, Norway and Iceland) for the selected sectors and pollutants with the highest resolution possible. For the E-PRTR site, River Basin District (RBD) maps will be used as the reporting format.

The final outcome of the project and, in particular, the GIS layers derived, will be integrated in the E-PRTR register. The task of this integration does not fall within the scope of this project.

This dissemination report contains the fact sheets of the selected sources, the map descriptions and the source-substance maps produced within the project.

2 Atmospheric deposition

2.1 Fact sheet

Introduction

Atmospheric deposition can be described as the load of substances to surface water or soil via the atmosphere. Once emissions to air from sources (e.g. traffic, shipping, industries) have entered the atmosphere, the substances are distributed through the atmosphere and end up in the water and on the soil as a result of deposition in wet (precipitation) and dry form.

This factsheet sets out a method for calculating the atmospheric load to surface water for Nutrient-N, Cadmium, Lead and Mercury.

Explanation of calculation method

The data on atmospheric deposition are derived from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe [5]. The used datasets are based on the EMEP Unified model revision 1.7 on a 50 x 50 km grid.

For the emissions per River Basin District Subunits (RBDSU), the following pollutants from EMEP model results were taken into account: Nutrient-N, cadmium, lead and mercury. The input data were available on the EMEP 50km x 50km grid cell level.

The emissions per River Basin District Subunit area were calculated using following steps:

1. For this study, the EMEP 50km x 50km grids where intersected with the River Basin District Subunits (RBDSUs) using different GIS functionalities. Based on the available input data from EMEP, for each RBDSU, the total flux was calculated.
2. Calculation of the surface water area shares per RBDSU, where the surface is divided in a surface of water and not water (paved and unpaved) areas. The spatial data required for this purpose are described in section “spatial allocation”.
3. Calculation of the emission fluxes to the surface water per RBDSU based on the total EMEP fluxes per RBDSU (step 1) and the percentage of water surface (step 2) in the specific RBDSU.

   Emission per RBDSU = Flux_RBDSU x Share_surface_water_RBDSU

Activity rates

The percentage of surface water per RBDSU is the “activity rate” for the atmospheric deposition calculations. In Table 11 the inland surface water area per Member State and the percentage of the total area per Member State covered by surface water are shown [1, 2, 3]. For the Member States which designated also the coastal areas as a part of the River Basin Districts, also the atmospheric deposition on the coastal water is included in the calculation of the loads.

Table 1 Area of inland surface water (km²) and the percentage of inland surface water per Member State.

Member State	Area Inland Surface Water (km^2)	Percentage of Inland Surface Water (%)
Austria	913.92	1.09
Belgium	241.91	0.79
Bulgaria	1 046.64	0.94
Cyprus	21.12	0.23
Czech Republic	668.01	0.85
Denmark	755.69	1.74
Estonia	2 190.78	4.83
Finland	53 749.09	15.95
France	3 919.63	0.61
Germany	4 990.21	1.4
Greece	1 323.92	1
Hungary	2 618.28	2.82
Iceland	8 897.63	8.67
Ireland	12 253.43	17.53
Italy	2 372.66	0.79
Latvia	2 764.13	4.28
Liechtenstein	4.03	2.5
Lithuania	1 753.40	2.7
Luxembourg	9.82	0.38
Malta	0	0
Netherlands	3 578.50	9.58
Norway	35 082.78	10.88
Poland	5 663.53	1.82
Portugal	739.49	0.8
Romania	7 145.30	3
Slovakia	340.90	0.7
Slovenia	102.68	0.51
Spain	3 493.75	0.69
Sweden	66 249.44	14.75
Switzerland	817.28	1.98
United Kingdom	7 521.68	3.08

Emission factors
Not applicable. The emission factors are already taken into account in the model calculations.

Emissions
Table 2 shows the loads to the surface water on national level for the selected substances.

Table 2 Loads to surface water from atmospheric deposition per Member State in 2009 or 2010 (kg/y).*

Member State	Cadmium	Lead	Mercury	Nutrient-N	Unit
	2009			2010	
Austria	34	1 077	19	1 178	kg
Belgium	12	384	5,1	393	kg
Bulgaria	46	2 136	16	856	kg
Cyprus	0,3	14	0,2	7,0	kg
Czech Republic	32	907	16	841	kg
Denmark	18	689	8,4	739	kg
Estonia	76	2 584	37	1 935	kg
Finland	559	16 723	450	17 179	kg
France	98	3 954	49	4 316	kg
Germany	204	7 458	77	8 169	kg
Greece	62	2 972	37	1 026	kg
Hungary	119	3 224	50	3 013	kg
Ireland	207	7 251	168	7 712	kg
Italy	86	3 621	42	3 961	kg
Latvia	61	1 895	36	1 921	kg
Liechtenstein	0,1	3,5	0,1	5,2	kg
Lithuania	53	1 392	25	1 600	kg
Luxembourg	0,4	14	0,2	13	kg
Netherlands	207	7 201	69	7 711	kg
Norway	422	12 955	418	8 121	kg
Poland	425	7 955	123	6 555	kg
Portugal	16	793	7,7	371	kg
Romania	200	6 457	99	5 591	kg
Slovakia	22	587	8,2	374	kg
Slovenia	4,9	164	2,4	135	kg
Spain	62	2 549	29	2 007	kg
Sweden	679	22 836	592	20 613	kg
Switzerland	23	836	15	1 170	kg
United Kingdom	157	5 647	136	4 890	kg

*= no calculations were made for Malta and Iceland.

Spatial allocation

The spatial allocation of the gridded atmospheric deposition data from EMEP 50km x 50km level to the RBDSU level contains following steps:

1. Regionalization of gridded atmospheric deposition data from the 50km x 50km level [4, 5] to the RBDSU level.
   The regionalization is calculated based on the intersection (GIS functionalities) of the EMEP 50km x 50km level with the RBDSU-layer.
2. Calculation of the emission loads to the surface water based on the share of the surface water per RBDSU [6]. The surface water information is based on the CORINE land cover data [1,2,3].

Emission pathways to water

Not applicable. The model results are already calculated as discharges to surface water.

Literature

[1] CLC90, 2010: EEA: CORINE Land Cover 1990 (CLC90) http://www.eea.europa.eu/data-and-maps/ figures/geographic-view-of-corine-land-cover-clc90-switzerland , 02.07.2010.

[2] CLC2000, 2010: EEA: CORINE Land Cover 2000 100 m (CLC2000) - http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-clc2000-seamless-vector-database. 02.07.2010.

[3] CLC2006, 2010: EEA: CORINE Land Cover 2006 Version 02/2010 (CLC2006) - http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster , 02.07.2010.

[4] EMEP, 2005. Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe. (URL: http://www.emep.int/ , 2012).

[5] EMEP MSC-E: Meteorological Synthesizing Centre-East (URL: http://www.msceast.org/index.php?option=com_content&view=article&id=88&Itemid=29#bap, 2012).

[6] WISE River Basin Districts (RBDs) and/or their subunits (RBDSUs), Version 1.4 (06/2011) (URL: http://www.eea.europa.eu/data-and-maps/data/wise-river-basin-districts-rbds-1 , 20.12.2013).

2.2 Map 01 Nutrient-N emissions from atmospheric deposition

Short Title:	Nutrient-N emissions from atmospheric deposition, load to surface water (mgN/m^2 / RBDSU)
Full Title:	Map: Nutrient-N emissions from atmospheric deposition, load to surface water (mgN/m^2 / RBDSU)

Diffuse Sources / General information:
The map shows Nutrient-N emissions to surface water from atmospheric deposition of the EU27 and EFTA4 countries per River Basin District Subunit (RBDSU) level for the reference year 2010, available in 2013. Diffuse emissions of Nutrient-N are expressed in load to surface water (mgN/m2) per RBDSU.

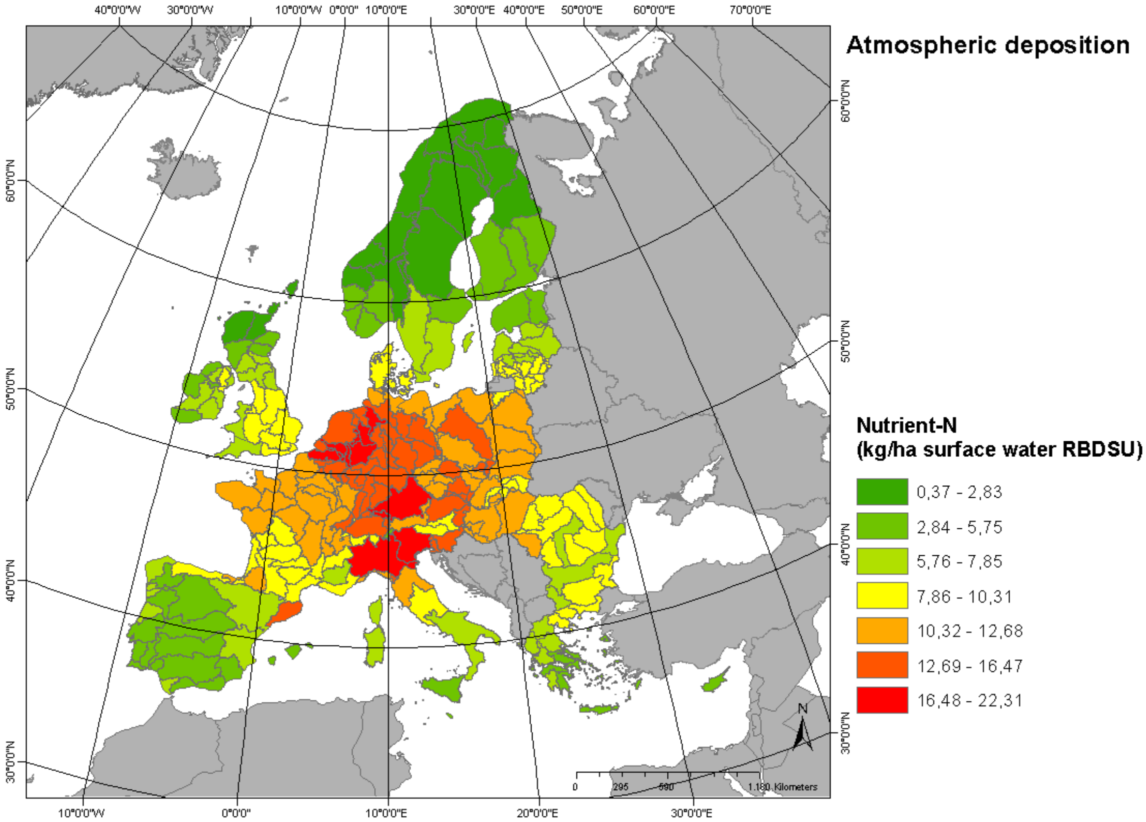
Diffuse Sources / Methodology:
Geographic Information System (GIS) overlay
Diffuse emissions of Nutrient-N to surface water from atmospheric deposition were spatially allocated to the RBDSU level based on the gridded data on atmospheric deposition available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). The diffuse Nutrient-N emissions were allocated to the RBDSU spatial level using GIS overlaying and visualization techniques. The used data are based on the EMEP Unified model revision 1.7, 50 km grid.
The data used is described and available on the EMEP (MSC-W modelled air concentrations and depositions) website.
The methodology applied and data used is described in detail in a source sector specific fact sheet.
Comparability
Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial variation of the emission loads on RBDSU level is linked to the spatial distribution of atmospheric deposition data across Europe.

The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.

Diffuse Sources / Source Data:
Map: Nutrient-N emissions from atmospheric deposition, load to surface water (mgN/m^2 / RBDSU)
Emissions data
Nutrient-N emissions to surface water from atmospheric deposition for the year 2010 are based on gridded data sets available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP).
The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.
Land use data
CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

Map 01



2.3 Map 02 Cadmium emissions from atmospheric deposition

Short Title:	Cadmium emissions from atmospheric deposition, load to surface water (mkg/m^2 / RBDSU)
Full Title:	Map: Cadmium emissions from atmospheric deposition, load to surface water (mkg/m^2 / RBDSU)

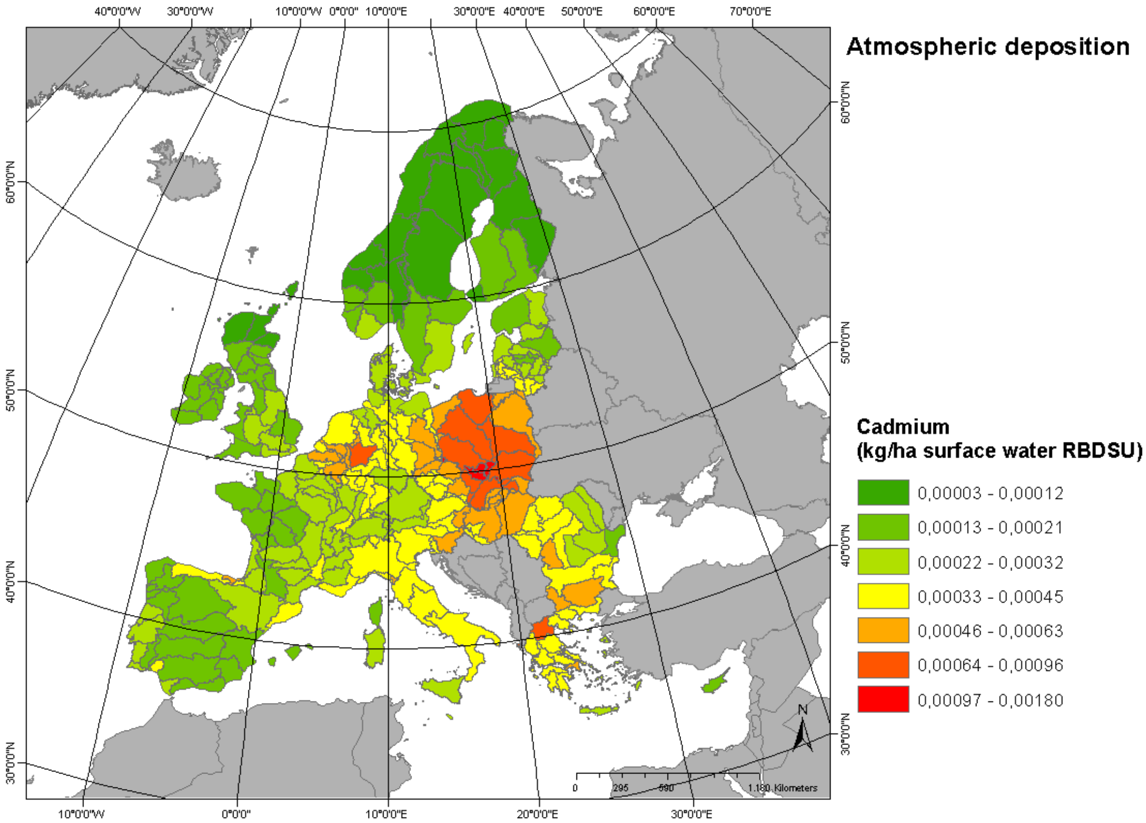
Diffuse Sources / General information:
The map shows cadmium emissions to surface water from atmospheric deposition of the EU27 and EFTA4 countries per River Basin District Subunit (RBDSU) level for the reference year 2009, available in 2013. Diffuse emissions of cadmium are expressed in load to surface water (mkg/m2) per RBDSU.

Diffuse Sources / Methodology:
Geographic Information System (GIS) overlay
Diffuse emissions of cadmium to surface water from atmospheric deposition were spatially allocated to the RBDSU level based on the gridded data on atmospheric deposition available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). The diffuse cadmium emissions were allocated to the RBDSU spatial level using GIS overlaying and visualization techniques. The used data are based on the EMEP Unified model revision 1.7, 50 km grid.
The data used is described and available on the EMEP (MSC-W modelled air concentrations and depositions) website.
The methodology applied and data used is described in detail in a source sector specific fact sheet.
Comparability
Considerable spatial variation is apparent. The main reason for the difference is:
- The spatial variation of the emission loads on RBDSU level is linked to the spatial distribution of atmospheric deposition data across Europe.

The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.

Diffuse Sources / Source Data:
Map: Cadmium emissions from atmospheric deposition, load to surface water (mkg/m^2 / RBDSU)
Emissions data
Cadmium emissions to surface water from atmospheric deposition for the year 2009 are based on gridded data sets available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP).
The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.
Land use data
CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

Map 02



2.4 Map 03 Lead emissions from atmospheric deposition

Short Title: Lead emissions from atmospheric deposition, load to surface water (kg/km^2 / RBDSU)

Full Title: Map: Lead emissions from atmospheric deposition, load to surface water (kg/km^2 / RBDSU)

Diffuse Sources / General information:
The map shows lead emissions to surface water from atmospheric deposition of the EU27 and EFTA4 countries per River Basin District Subunit (RBDSU) level for the reference year 2009, available in 2013. Diffuse emissions of lead are expressed in load to surface water (kg/km^2) per RBDSU.

Diffuse Sources / Methodology:
Geographic Information System (GIS) overlay
Diffuse emissions of lead to surface water from atmospheric deposition were spatially allocated to the RBDSU level based on the gridded data on atmospheric deposition available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). The diffuse lead emissions were allocated to the RBDSU spatial level using GIS overlaying and visualization techniques. The used data are based on the EMEP Unified model revision 1.7, 50 km grid.

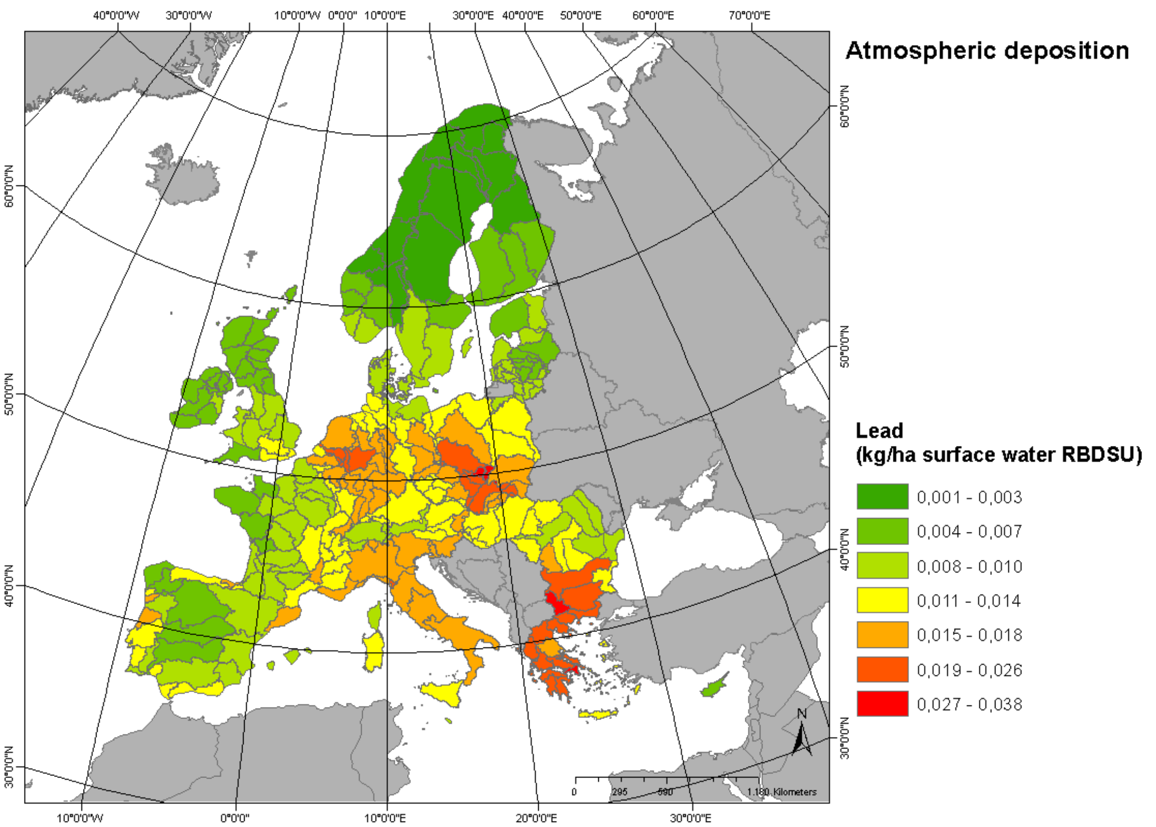
The data used is described and available on the EMEP (MSC-W modelled air concentrations and depositions) website.
The methodology applied and data used is described in detail in a source sector specific fact sheet.
Comparability
Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial variation of the emission loads on RBDSU level is linked to the spatial distribution of atmospheric deposition data across Europe.

The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.

Diffuse Sources / Source Data:
Map: Lead emissions from atmospheric deposition, load to surface water (kg/km^2/ RBDSU)
Emissions data
Lead emissions to surface water from atmospheric deposition for the year 2009 are based on gridded data sets available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP).
The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.
Land use data
CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

Map 03



2.5 Map 04 Mercury emissions from atmospheric deposition

Short Title: Mercury emissions from atmospheric deposition, load to surface water (g/km^2 / RBDSU)

Full Title: Map: Mercury emissions from atmospheric deposition, load to surface water (g/km^2 / RBDSU)

Diffuse Sources / General information:

The map shows mercury emissions to surface water from atmospheric deposition of the EU27 and EFTA4 countries per River Basin District Subunit (RBDSU) level for the reference year 2009, available in 2013. Diffuse emissions of mercury are expressed in load to surface water (g/km2) per RBDSU.

Diffuse Sources / Methodology:

Geographic Information System (GIS) overlay

Diffuse emissions of mercury to surface water from atmospheric deposition were spatially allocated to the RBDSU level based on the gridded data on atmospheric deposition available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). The diffuse mercury emissions were allocated to the RBDSU spatial level using GIS overlaying and visualization techniques. The used data are based on the EMEP Unified model revision 1.7, 50 km grid.

The data used is described and available on the EMEP (MSC-W modelled air concentrations and depositions) website.

The methodology applied and data used is described in detail in a source sector specific fact sheet.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial variation of the emission loads on RBDSU level is linked to the spatial distribution of atmospheric deposition data across Europe.

The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.

Diffuse Sources / Source Data:

Map: Mercury emissions from atmospheric deposition, load to surface water (g/km^2 / RBDSU)

Emissions data

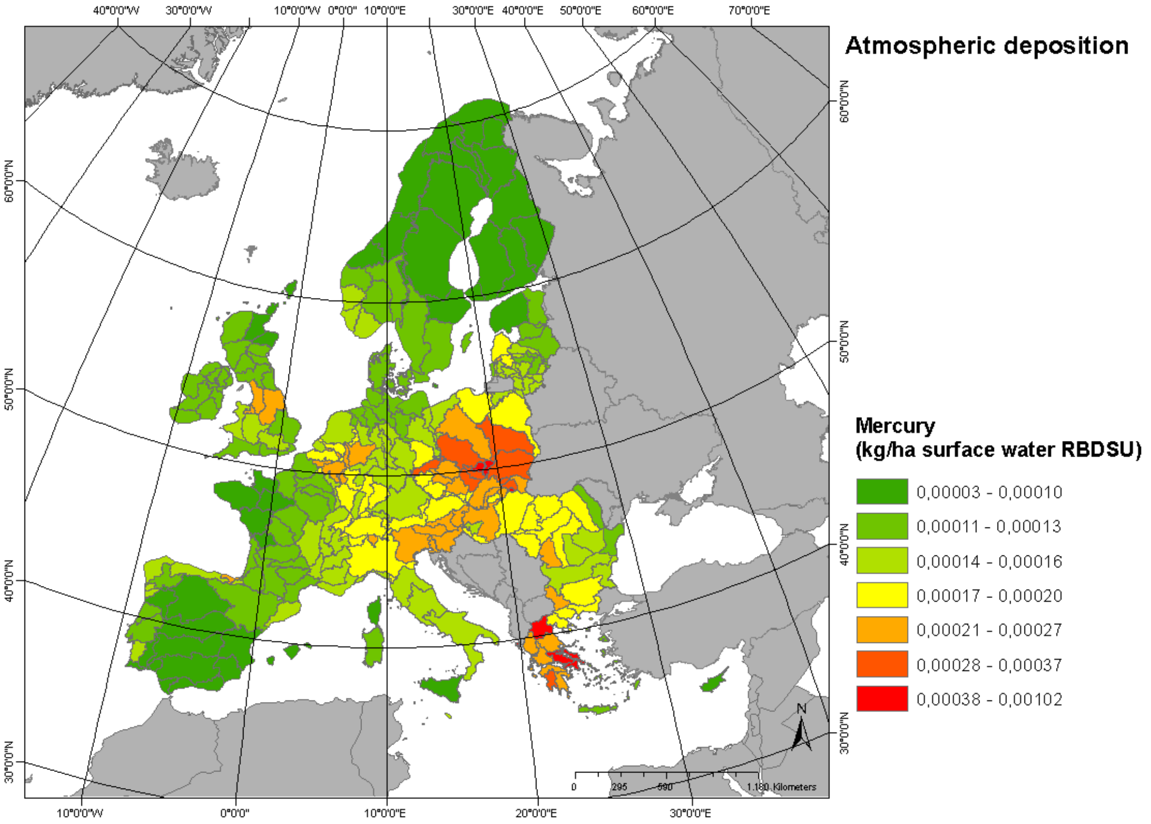
Mercury emissions to surface water from atmospheric deposition for the year 2009 are based on gridded data sets available from the Precipitation Chemistry Database of the Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP).

The methodology applied and data used is described on the EMEP (MSC-W modelled air concentrations and depositions) website.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

Map 04


Atmospheric deposition
Mercury
(kg/ha surface water RBDSU)
0,00003 - 0,00010
0,00011 - 0,00013
0,00014 - 0,00016
0,00017 - 0,00020
0,00021 - 0,00027
0,00028 - 0,00037
0,00038 - 0,00102

3 Agriculture

3.1 Fact sheet

Introduction

Agriculture is a known major source for nutrients, heavy metals and pesticides. Estimating emissions from this source is very complex, through interaction with soil and air. In addition, emissions are strongly influenced by regional and local conditions such as soil type, crop type, fertilizer, etc. Therefore, to quantify this source often models are used. Within this project use of applied modelling available on a European scale is preferred. Existing maps and background information of JRC are used for the quantification and spatial allocation of this pathway.

In Figure 1 the Nitrogen and Phosphorus flows in agricultural systems and emissions to compartments, including surface water, are shown.

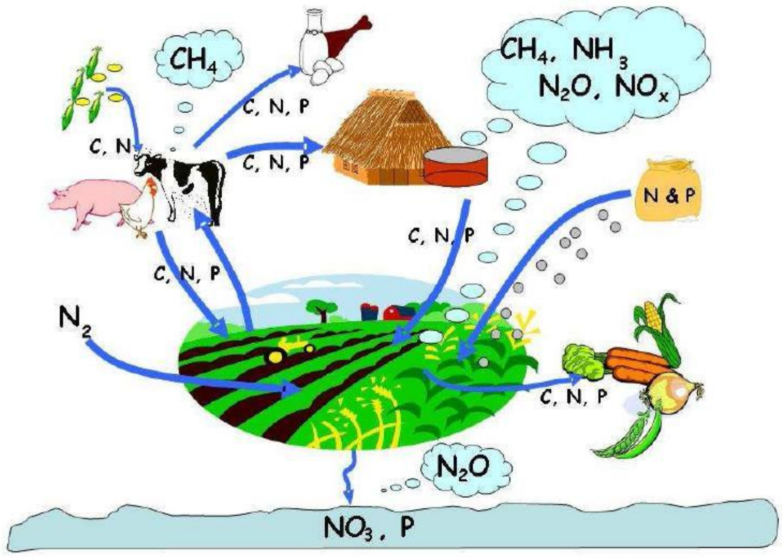


Figure 1 N, P and carbon flows in agricultural systems and emissions to the atmosphere, groundwater and surface water [1].

This factsheet describes a way to allocate the emissions to the European River Basin Districts by using model results for Nutrient-N and Nutrient-P.

This source includes emission released by agricultural activities as animal husbandry and manure management, crop production and agricultural soils. The main pollution sources are animal waste digestion (grazing animals), fertilization, livestock farms and field operation.

Explanation of the calculation method

The nutrient emissions are calculated by the of the JRC's GREEN model. The GREEN (Geospatial Regression Equation for European Nutrient losses) is based on a simplified conceptual approach distinguishing the different pathways in which nutrients reach surface waters. According to this approach, diffuse sources, including fertiliser applications (both mineral and organic forms), scattered dwelling, atmospheric deposition, are first reduced in the soil matrix and then once in the stream they undergo further reduction due to in-stream retention processes, while point sources, which include waste water treatment plants, industrial effluents and runoff from paved areas, reach directly the streams and are thus reduced only by the stream retention process. In the model, the driver behind the nutrient losses is the annual precipitation and the retention in water is linked to the river length.

In this project only the Nutrient emissions of agricultural sources are used: the fertilizer applications. The application of mineral fertiliser and manure varies considerably across European regions according to the production system, crop types, climatic conditions and soil characteristics. A reasonable estimation of fertiliser application at European level should consider these spatial variations.

The nutrient inputs from agriculture were estimated based on the Corine Land Cover map and the fertiliser rate by NUTS2 region and by crop type. In the first application of the model GREEN [4], the proportion of crop types per NUTS2 region, available in EUROSTAT, was considered within each arable land class of the CLC2000, respecting the total surface of arable land reported by the map, and the mineral and organic fertiliser application rate per NUTS2 region and per crop type was provided by the CAPRI project [5]. In the second application of the model GREEN, the nutrient inputs from agriculture were estimated using the CLC2000 and the FSS data on crop types and surface, respecting the total surface of arable land reported by the FSS database, and fertiliser rate calculated from International Fertiliser Association, FSS and OECD data. The second approach was developed in the context of the estimation of a spatially displayed nutrient balance for Europe. Details on the methodology are given in [4].

Activity rates

Not applicable. The activity rates are already taken into account in the model calculations.

Emission factors

Not applicable. The emission factors are already taken into account in the model calculations.

Emissions

Table 1 contains emission values of Nutrient-N and Nutrient-P calculated by the JRC's Green model. The emissions are expressed as loads to surface water.

Table 1 Loads to surface water from agriculture per Member State for Nutrient-N and Nutrient-P (t/y) in 2005.

Member State*	Nutrient-N	Nutrient-P
	ton/y	
Austria	57 792	4 344
Belgium	49 202	753
Bulgaria	50 094	1 611
Cyprus	726	20
Czech Republic	71 323	1 577
Denmark	103 932	2 223
Estonia	3 959	46
Finland	21 417	500
France	464 013	6 485
Germany	251 445	5 016
Greece	65 326	2 510
Hungary	40 004	1 214
Ireland	222 797	4 461
Italy	311 570	17 371
Latvia	32 983	158
Lithuania	32 983	725
Luxembourg	2 634	38
Netherlands	124 799	1 141
Norway	56 739	1 592
Poland	198 245	6 141
Portugal	7 645	34
Romania	122 524	7 452
Slovakia	18 438	671
Slovenia	21 169	1 995
Spain	110 577	4 599
Sweden	50 406	820
Switzerland	71 651	3 406
United Kingdom	555 904	12 572

*= no calculations were made for Malta, Liechtenstein and Iceland.

Spatial allocation

Diffuse emissions of Nutrient-P and Nutrient-N from agriculture to surface water were spatially allocated to the RBDSU level by the JRC based on the methodology described by Fayçal Bouraoui et al [2]. The diffuse emissions coming from fertilizer application were allocated to the RBDSU spatial level using GIS visualisation techniques. The main proxy data used for the spatial allocation of the nutrients to the RBDSU level [6], where the land use data, the fertilizer application rates from CAPRI [5] and population statistics [2, 3].

Emission pathways to water

Not applicable. The model results are already calculated as discharges to surface water.

Literature

[1] Directive 2005/69/EC of the European Parliament and of the Council, (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:323:0051:0054:EN:PDF).

[2] Bouraoui, F., Grizzetti, B., Aloe, A., Nutrient discharge from rivers to seas for year 2000, In: JRV Scientific and Technical Reports, 2009.

[3] Bouraoui, F., Grizzetti, B., Aloe, A., Spatialised European Nutrient Balance EUR Report 22692 EN., 2007.

[4] Grizzetti, B.,Bouraoui, F., Assessment of Nitrogen and Phosphorus Environmental Pressure at European Scale, EUR Report 22526 EN, 2006.

[5] Britz, W., 2004. CAPRI Modelling System Documentation, Final report of the FP5 shared cost project CAP-STRAT "Common Agricultural Policy Strategy for Regions, Agriculture and Trade", QLTR-2000-00394. Universität Bonn.

[6] WISE River Basin Districts (RBDs) and/or their subunits (RBDSUs), Version 1.4 (06/2011) (http://www.eea.europa.eu/data-and-maps/data/wise-river-basin-districts-rbds-1 , 20.12.2013).

3.2 Map 05 Nutrient-P emissions from agriculture

Short Title:	Nutrient-P emissions from agriculture (kg/ha surface water RBDSU)
Full Title:	Map: Nutrient-P emissions from agriculture, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:

The map shows Nutrient-P emissions to surface water from agriculture per River Basin District Subunit (RBDSU) level for the reference year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of Nutrient-P are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:

Map: Nutrient-P emissions from agriculture, load to surface water (kg/ha surface water RBDSU)

Geographic Information System (GIS) overlay

Diffuse emissions of Nutrient-P to surface water from agriculture were spatially allocated to the RBDSU level by the JRC based on the methodology described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). The diffuse Nutrient-P emissions coming from fertilizer application were allocated to the RBDSU spatial level using GIS visualization techniques.
The input data used in the GREEN calculation model is the fertilization rate. The methodology applied and data used is described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). For further information please visit the FATE website.
The specific Nutrient-N emission loads (kg/ha surface water RBDSU) where calculated based on the GREEN model results and CORINE Land Cover data.

Comparability

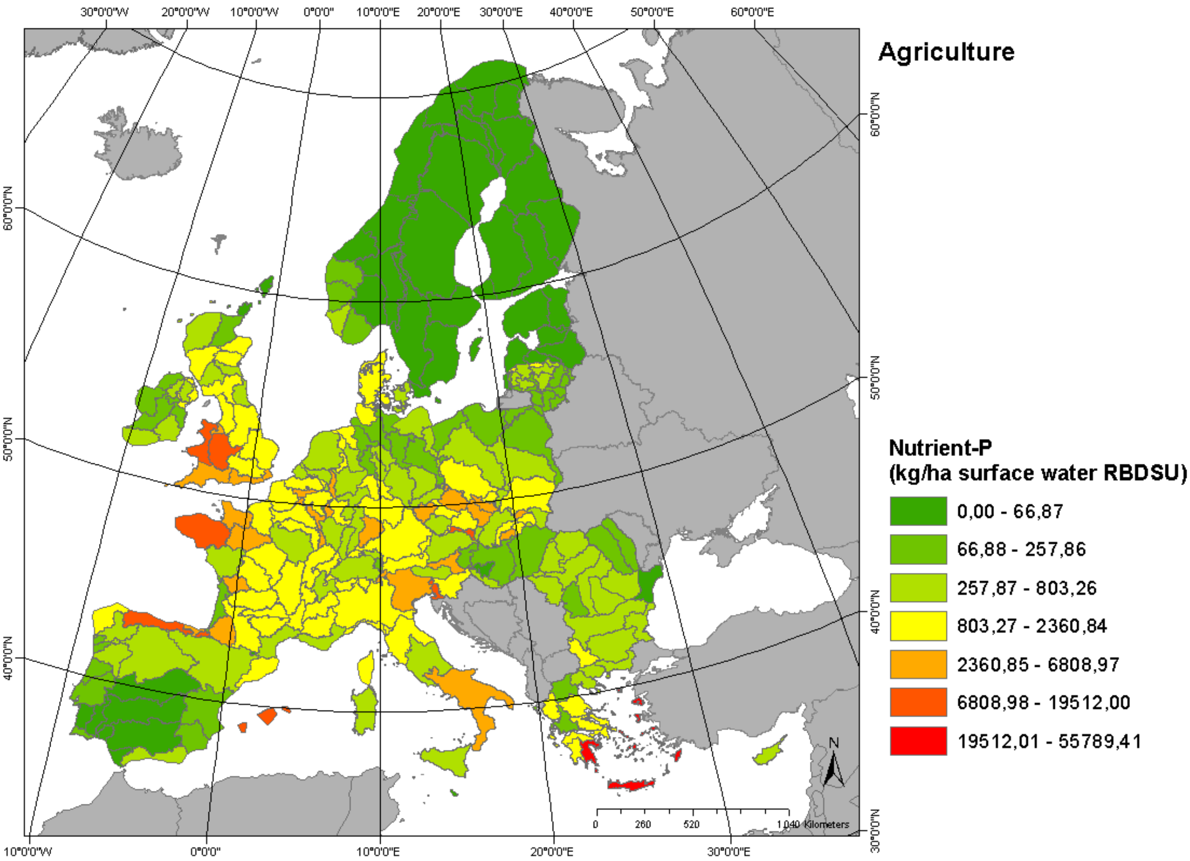
Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of agricultural sources across Europe, their spatial density and the level of their activities.

The methodology applied and data used is described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). For further information please visit the FATE website.

Diffuse Sources / Source Data:
Map: Nutrient-P emissions from agriculture, load to surface water (kg/ha surface water RBDSU)
Emissions data
Nutrient-P emissions to surface water from agriculture for the year 2005 are based on data sets calculated by the JRC and described in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports) and on CORINE land use data.
The methodology applied and data used is described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). For further information please visit the FATE website.
Land use data
CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

Map 05



3.3 Map 06 Nutrient-N emissions from agriculture

Short Title: Nutrient-N emissions from agriculture (kg/ha surface water RBDSU)
Full Title: Map: Nutrient-N emissions from agriculture, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows Nutrient-N emissions to surface water from agriculture per River Basin District Subunit (RBDSU) level for the reference year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of Nutrient-N are expressed in load to surface water (kg/ha surface water) per RBDSU.

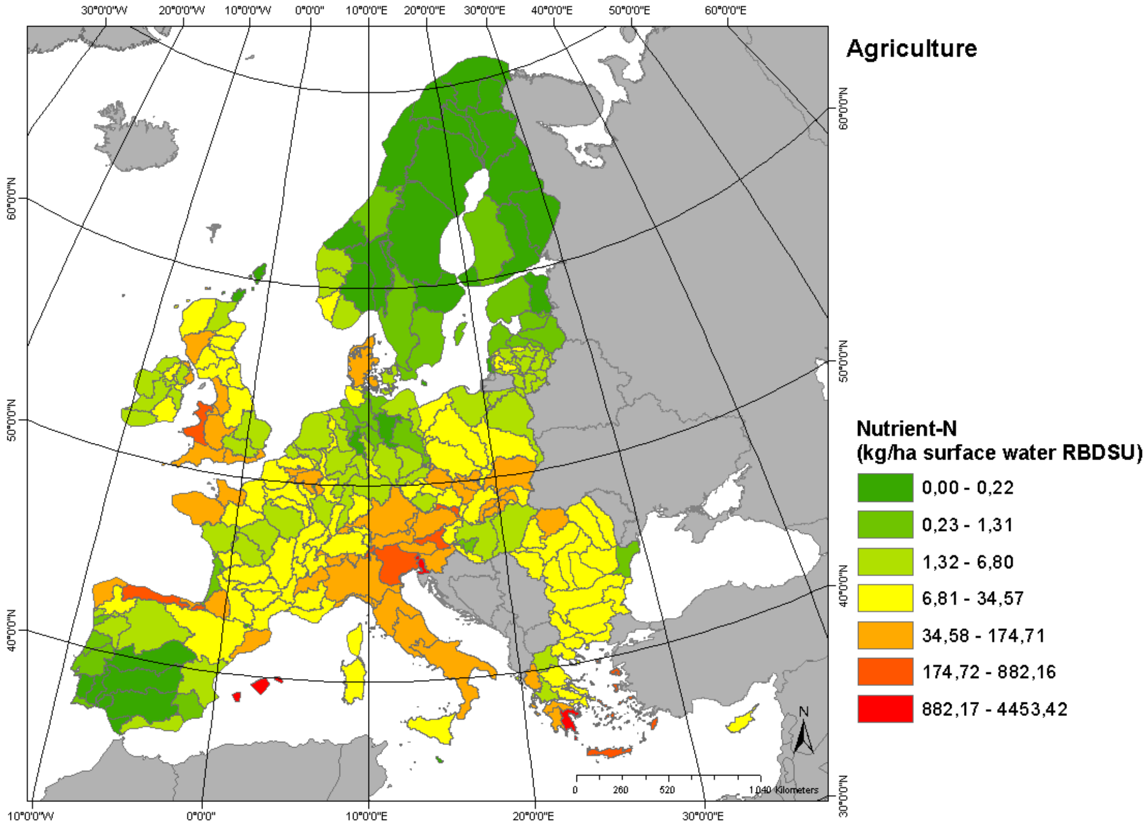
Diffuse Sources / Methodology:
Map: Nutrient-N emissions from agriculture, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of Nutrient-N to surface water from agriculture were spatially allocated to the RBDSU level by the JRC based on the methodology described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). The diffuse Nutrient-N emissions coming from fertilizer application were allocated to the RBDSU spatial level using GIS visualization techniques.
The input data used in the GREEN calculation model is the fertilization rate. The methodology applied and data used is described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). For further information please visit the FATE website.
The specific Nutrient-N emission loads (kg/ha surface water RBDSU) where calculated based on the GREEN model results and CORINE Land Cover data.
Comparability
Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of agricultural sources across Europe, their spatial density and the level of their activities.

The methodology applied and data used is described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). For further information please visit the FATE website.

Diffuse Sources / Source Data:
Map: Nutrient-N emissions from agriculture, load to surface water (kg/ha surface water RBDSU)
Emissions data
Nutrient-N emissions to surface water from agriculture for the year 2005 are based on data sets calculated by the JRC and described in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports).
The methodology applied and data used is described by Fayçal Bouraoui, Bruna Grizzetti and Alberto Aloe in Nutrient discharge from rivers to seas for year 2000 (JRC Scientific and Technical Reports). For further information please visit the FATE website.
Land use data
CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

Map 06


Agriculture
Nutrient-N
(kg/ha surface water RBDSU)
0,00 - 0,22
0,23 - 1,31
1,32 - 6,80
6,81 - 34,57
34,58 - 174,71
174,72 - 882,16
882,17 - 4453,42
N
0
260
520
1.040 Kilometers

4 Road transport

4.1 Fact sheet

Introduction

This factsheet sets out a method for calculating diffuse emissions resulting from road traffic sources. These sources include tyre wear, brake wear and engine oil leaks and cause emissions of heavy metals and polycyclic aromatic hydrocarbons (PAHs).

Another source of road traffic diffuse emissions is road surface wear, but this emission source is not incorporated in the emission calculation. The reason for omitting this source is that the emissions of PAHs resulting from road surface wear are low in comparison to the PAH emissions from engine leaks and tyre wear. Besides that, the top layer of roads consists mainly of asphalt, a mixture of >95% mineral constituents (stone, sand and filler) with a binding agent (<5%). This binding agent may contain tar and thus PAH, but it is assumed that most (if not all) countries within the EU27 + EFTA have replaced the PAH containing agents with substitutes that are free (or contain only traces) of PAHs.

Explanation of calculation method

The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated in the calculated emissions to surface water, see the section 'Activity rates' for an explanation. Emissions are calculated by multiplying an activity rate (AR), in the case of road traffic the mileages on roads in European Union (EU27) member states, by an emission factor (EF), expressed in emission per AR unit. The calculation method is shown in the formula below:

$$E_s = AR * EF * pathway$$

Where:

E_S	=	Emission of substance (pollutant) *s* to compartments (soil, surface water and sewers)
AR	=	Activity Rate, in this case the traffic performance (distance covered on the EU road network in 10^6 km)
EF	=	Emission Factor (kg/10^6 km)
pathway	=	Percentage of the emission allocated to compartment *x*

The emission calculated in this way is referred to as the total emission. A specific proportion of this total emission ends up in surface water: This is defined as the net emission to the surface water.

Activity rates

Total national traffic performance is chosen as the activity rate, since it adequately represents the road traffic activity and because it is the main cause of oil leakage, tyre and brake wear. In addition, total national traffic performance numbers can be easily produced by each EU Member State.

The activity rate consists of the traffic performance by light and heavy vehicles on urban roads, rural roads and highways in the year of which the emissions are calculated. Table 1 shows which vehicles belong to which vehicle class.

Table 1 Distribution of vehicles in light and heavy vehicles.

Vehicle	Vehicle Class
Passenger cars	Light
Motorcycles	Light
Mopeds	Light
Vans	Light
Special vehicles, light	Light
Light duty trucks	Light
Lorries	Heavy
Heavy duty trucks	Heavy
Buses	Heavy
Special vehicles, heavy	Heavy

Activity rates are calculated per Member State of the European Union (EU27) (Tremove-model, data for 2005 [5, 6]. Table 2 shows the light and heavy vehicles traffic performance for each Member State. Since it is expected that all emissions from urban driving end up in the sewers or the soil, the traffic performance for this road type is not shown. A significant part of the loads will be discharged to the surface water by the stormwater overflows and the separate sewer overflows. These pathways are not regarded in this project and no estimation methods have been developed in this project.

Table 2 Traffic performance (10^6 vehicle km) per Member State for the year 2005.

Member State	Traffic, light Highways (10^6 vkm)	Traffic, heavy Highways (10^6 vkm)	Traffic, light Rural roads (10^6 vkm)	Traffic, heavy Rural roads (10^6 vkm)
Austria	14 056	3 855	24 959	3 941
Belgium	25 897	4 794	33 151	3 101
Bulgaria	2 210	659	11 195	3 037
Cyprus	165	50	2 318	1 046
Czech Republic	5 265	1 858	29 004	8 305
Denmark	3 328	1 807	28 566	2 700
Estonia	340	86	4 739	1 809
Finland	2 581	847	35 470	6 568
France	77 777	24 710	280 212	25 512
Germany	201 675	50 170	248 264	24 033
Greece	4 635	2 047	37 849	5 351
Hungary	3 553	1 142	17 998	5 222
Ireland	190	139	19 942	4 253
Italy	84 114	27 263	353 199	17 494
Latvia	613	106	8 566	2 212
Lithuania	1 358	211	18 896	4 341
Luxembourg	1 096	262	2 434	985
Netherlands	39 361	9 613	52 288	7 383
Norway	4 426	1 112	23 023	3 363
Poland	6 263	1 259	87 448	26 140
Portugal	6 913	3 344	36 881	5 862
Romania	4 512	2 206	22 985	9 546
Slovakia	178	339	13 559	9 790
Slovenia	2 239	595	8 260	1 940
Spain	13 219	11 624	178 033	40 940
Sweden	8 333	2 122	42 942	6 453
Switzerland	18 286	2 762	32 710	2 230
United Kingdom	118 174	13 759	183 623	29 328

Emission factors
It has to be mentioned that the emission factors used are based on international literature in which measurement data on run off water from roads is often the basis. In general it seems impossible to calculate the emissions on the basis of the concentrations of the runoff water, because the lack of information about volume of the water, surface of the roads and local conditions. That is why the method is preferred that is based on the emission factors of the different sub sources in combination with the traffic performance data. With this method, an EU-wide calculation is achievable.

In this section it is explained how the EU road traffic emission factors are obtained. The data for the calculations were extracted from the 2008 PRTR from the Netherlands. The general applied method consists of dividing the emissions (based on international literature) by the traffic performance. In this way, an implied emission factor for road traffic is derived. This method is chosen because it is simple yet robust, it incorporates the whole domestic vehicle activities (and therefore is suited to conduct bottom-up emission calculations) and because the effects of policy measures are already accounted for.

Emissions and road transport related activities were obtained from international literature [1, 2 and 3]. Therefore, it is assumed that the derived implied emission factors are suitable for the calculation of diffuse emissions in the EU.

To obtain emission factors per pollutant, emissions for all sources calculated in the mentioned factsheets were added up and divided by the traffic performance (per road type) so that emission factors representative for all three sources summated are produced. The results are emission factors for each pollutant per road type, vehicle classification and compartment (see 'Emission pathways to water').

Effects of policy measures
EU Directive 2005/69/EC [4] specifies that on January 1, 2010, no new tyres are allowed to be launched on the market that are manufactured with aromatic oils containing more than 1 mg/kg Benzo(a)pyrene or more than 10 mg/kg EU-PAHs. The following compounds fall within the scope of PAH components regulated by the EU: Benzo(a)pyrene, Benzo(e)pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(j)fluoranthene, Benzo(k)fluoranthene and Dibenzo(a,h)anthracene. The effect of this policy measure has been incorporated into the emission factors.

The calculated emission factors
Table 3 contains the emission factors for rural roads.

Table 3 Calculated emission factors for rural roads (kg/10^6vkm).

Rural roads		
Substance	Emission Factor (kg/10^6 vkm)	
	Heavy	Light
Anthracene	1.69E-04	4.39E-05
Cadmium	4.71E-05	9.55E-06
Copper	4.19E-02	1.32E-02
Fluoranthene	4.72E-04	1.95E-04
Lead	8.40E-03	2.12E-03
Nickel	2.13E-03	4.13E-04
Zinc	7.14E-01	7.75E-02

In Table 4 the emission factors for highways are presented.

Table 4 Calculated emission factors for highways (kg/10^6vkm).

Highways		
Substance	Emission Factor (kg/10^6 vkm)	
	Heavy	Light
Anthracene	1.26E-04	3.19E-05
Cadmium	4.90E-05	1.00E-05
Copper	4.17E-02	1.33E-02
Fluoranthene	2.74E-04	9.77E-05
Lead	8.68E-03	2.21E-03
Nickel	2.15E-03	4.19E-04
Zinc	7.21E-01	7.85E-02

Emission pathways to water

The major part of the emissions from road traffic on highways and rural roads, will go to the soil, assumed is that only a smaller part will go directly to the surface water. For this project, a division is made between surface water and soil on the basis of the ratio of surface water/soil in a NUTS region. In regions without surface water, the loads running off the highways and the rural roads, will end up in the soil system. In regions with a lot of surface water, it is expected at least a (small) part of the loads will end up in the surface water. As an raw assumption the percentage of surface water in a NUTS region is regarded as the percentage of the loads that end up in the surface water. This may be improved on the basis of information of the Member States.

In some areas, a part of the runoff water coming from the highways and the rural roads will be collected and sometimes treated in a simple way (e.g. retention ponds). Because no data are available on a EU scale, in the calculations it was assumed that no purification took place. Table 5 shows the average percentage of surface water area per Member State.

Table 5 Percentage of total area of Member States that consists of surface water [4].*

Member State	Surface Water (%)	Member State	Surface Water (%)
Austria	1.09	Iceland	8.67
Belgium	0.78	Italy	0.79
Bulgaria	0.96	Liechtenstein	2.5
Switzerland	1.98	Lithuania	2.7
Cyprus	0.23	Luxembourg	0.38
Czech Republic	0.84	Latvia	4.28
Germany	1.39	Netherlands	9.58
Denmark	1.75	Norway	10.88
Estonia	4.82	Poland	1.82
Spain	0.71	Portugal	0.8
Finland	15.93	Romania	3
France	0.62	Sweden	14.75
Greece	1.01	Slovenia	0.51
Hungary	2.81	Slovakia	0.7
Ireland	16.61	United Kingdom	3.08

** for Malta is calculated with 0% inland surface water*

Emissions

Tables 6 and 7 contain emission values of the selected substances. Please note that these are the loads to surface water and thus emissions corrected for the percentage surface water area in the NUTS region.

Table 6 Loads to surface water per Member State (kg/y) from light vehicles.

Member State	Cadmium	Lead	Nickel	Anthracene	Fluoranthene	Copper	Zinc
	kg/y						
Austria	0.004	0.940	0.178	0.014	0.042	5.656	33.38
Belgium	0.005	1.031	0.195	0.015	0.046	6.204	36.62
Bulgaria	0.001	0.278	0.053	0.004	0.012	1.676	9.892
Cyprus	0.0001	0.013	0.002	0.0002	0.001	0.076	0.448
Czech Republic	0.003	0.644	0.122	0.009	0.028	3.874	22.87
Denmark	0.006	1.226	0.233	0.018	0.054	7.381	43.56
Estonia	0.002	0.542	0.103	0.008	0.024	3.263	19.26
Finland	0.061	13.41	2.543	0.194	0.593	80.72	476.4
France	0.022	4.826	0.915	0.070	0.213	29.04	171.4
Germany	0.063	13.92	2.639	0.201	0.615	83.78	494.5
Greece	0.004	0.939	0.178	0.014	0.042	5.650	33.35
Hungary	0.006	1.343	0.255	0.019	0.059	8.083	47.71
Ireland	0.035	7.799	1.479	0.113	0.345	46.94	277.0
Italy	0.035	7.635	1.448	0.110	0.338	45.95	271.2
Latvia	0.004	0.868	0.165	0.013	0.038	5.225	30.84
Lithuania	0.005	1.209	0.229	0.017	0.053	7.273	42.93
Luxembourg	0.0001	0.030	0.006	0.000	0.001	0.178	1.053
Netherlands	0.088	19.40	3.679	0.280	0.858	116.8	689.2
Norway	0.030	6.600	1.251	0.095	0.292	39.72	234.4
Poland	0.017	3.769	0.715	0.054	0.167	22.68	133.9
Portugal	0.004	0.774	0.147	0.011	0.034	4.660	27.50
Romania	0.008	1.823	0.346	0.026	0.081	10.97	64.76
Slovakia	0.001	0.213	0.040	0.003	0.009	1.279	7.549
Slovenia	0.001	0.118	0.022	0.002	0.005	0.712	4.203
Spain	0.013	2.916	0.553	0.042	0.129	17.55	103.6
Sweden	0.076	16.71	3.169	0.241	0.739	100.6	593.7
Switzerland	0.010	2.231	0.423	0.032	0.099	13.43	79.26
United Kingdom	0.093	20.54	3.895	0.297	0.908	123.6	729.7

Table 7 Loads to surface water per Member State (kg/y) from heavy vehicles.

Member State	Cadmium	Lead	Nickel	Anthracene	Fluoranthene	Copper	Zinc
	kg/y						
Austria	0.004	0.738	0.183	0.011	0.023	3.543	61.27
Belgium	0.003	0.541	0.134	0.008	0.017	2.601	44.97
Bulgaria	0.002	0.302	0.075	0.004	0.010	1.449	25.05
Cyprus	0.0001	0.022	0.005	0.0003	0.001	0.105	1.817
Czech Republic	0.004	0.750	0.186	0.011	0.024	3.602	62.28
Denmark	0.004	0.681	0.169	0.010	0.021	3.270	56.53
Estonia	0.004	0.795	0.197	0.012	0.025	3.817	66.00
Finland	0.058	10.27	2.543	0.149	0.324	49.32	852.7
France	0.015	2.659	0.659	0.039	0.084	12.77	220.9
Germany	0.051	9.017	2.234	0.131	0.285	43.32	749.0
Greece	0.004	0.642	0.159	0.009	0.020	3.085	53.34
Hungary	0.009	1.558	0.386	0.023	0.049	7.483	129.4
Ireland	0.038	6.682	1.655	0.097	0.211	32.10	555.1
Italy	0.017	3.069	0.760	0.045	0.097	14.74	254.9
Latvia	0.005	0.861	0.213	0.013	0.027	4.138	71.55
Lithuania	0.006	1.067	0.264	0.015	0.034	5.125	88.61
Luxembourg	0.0002	0.041	0.010	0.001	0.001	0.198	3.415
Netherlands	0.080	14.13	3.501	0.205	0.446	67.90	1174
Norway	0.024	4.225	1.047	0.061	0.133	20.30	351.0
Poland	0.024	4.328	1.072	0.063	0.137	20.79	359.5
Portugal	0.004	0.639	0.158	0.009	0.020	3.071	53.10
Romania	0.017	3.060	0.758	0.044	0.097	14.70	254.2
Slovakia	0.003	0.615	0.152	0.009	0.019	2.956	51.12
Slovenia	0.001	0.112	0.028	0.002	0.004	0.539	9.322
Spain	0.018	3.148	0.780	0.046	0.099	15.12	261.5
Sweden	0.062	10.98	2.719	0.159	0.347	52.74	911.9
Switzerland	0.005	0.858	0.212	0.012	0.027	4.121	71.26
United Kingdom	0.065	11.52	2.853	0.167	0.364	55.34	956.8

Spatial allocation

The methodology of the spatial allocation of the road transport emissions to the River Basin District Subunit level (RBDSU [7]) contains following main steps:

1. Regionalisation of national emission releases to NUTS level:
   - Allocation of the emission values based on traffic volume data for each road segment and also population density related to roads not covered by TRANS-TOOLS [8].
   - This calculation step allocates the share of the national totals of each substance to each road segment in the TRANS-TOOLS model [8] and to NUTS3 regions for the urban and rural traffic not covered by TRANS-TOOLS.

2. Gridding:
    - The spatial allocation of the regionalised emission values to the grid cell level is based on TRANS-TOOLS [8], GISCO (ROAD) road network [10] and gridded population density from JRC [9].
    - For the gridding the following underlying parameters are used:
        - Traffic volume and road network from TRANS-TOOLS [8] for highways and partly for rural roads;
        - Road network divided by road type from GISCO (ROAD)[10] for the roads not covered in TRANS-TOOLS (secondary and local roads) [8];
        - Gridded population density data as weighting factor for line sources in relation to rural and urban roads not covered by TRANS-TOOLS [8];
        - Degree of urbanization [14] for the categorization of the GISCO roads [10] and the categorization of the gridded population from JRC [9] into urban and rural.
        - The gridding methodology used is similar to the methodology and described in IER 2011 [11].
3. Regionalization of the gridded emission values to the RBDSU level:
    - Allocation of the gridded emission data to the RBDSU areas [7] based on different ArcGIS and database calculation steps [12-15].

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4.2 Map 07 Cadmium emissions from road transport

Short Title:	Cadmium emissions from road transport (kg/ha surface water RBDSU)
Full Title:	Map: Cadmium emissions from road transport, load to surface water (kg/ha surface water RBDSU)

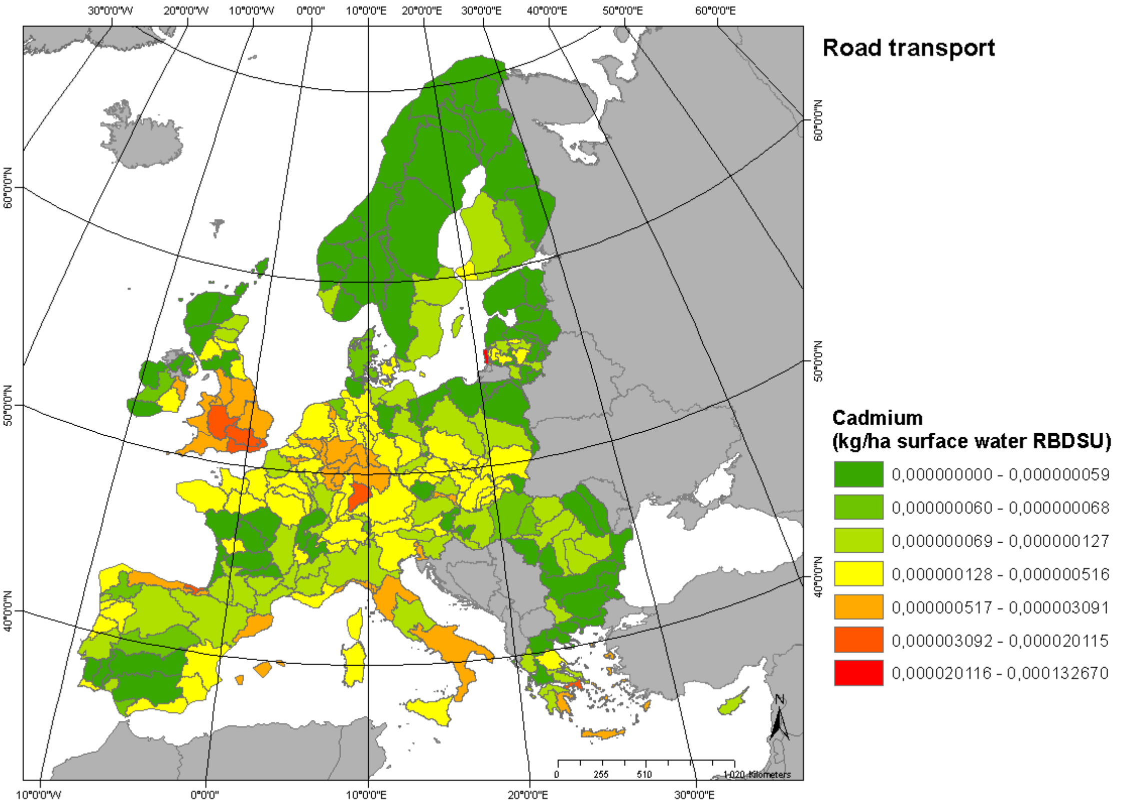
Diffuse Sources / General information:
The map shows the cadmium emissions to surface water from road transport per RBDSU for the year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of cadmium are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Cadmium emissions from road transport, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Emissions of cadmium to surface water from road transport were spatially allocated to the RBDSU level according to the data modelled by TREMOVE, due to the road network derived from the TRANS-TOOLS model and GISCO data set. The traffic density information was derived also from the TRANS-TOOLS model runs. The split into highway, rural and urban activities have been derived from the TREMOVE model. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.
Comparability
Considerable spatial variation is apparent. The main reasons for the differences are:

- The emissions from road transport are dependent on the density of the road network.
- The emissions from road transport are allocated by road class-specific mileages of different vehicle categories.
- The emissions from road transport not covered by traffic volume are dependent from the population density.

Diffuse Sources / Source Data:
Map: Cadmium emissions from road transport, load to surface water (kg/ha surface water RBDSU)
Emissions data
The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated. Cadmium emission loads to surface water from road transport data are national totals calculated for the NFR09 sources 1 A 3 b i Passenger cars, 1 A 3 b ii Light duty vehicles, 1 A 3 b iii Heavy duty vehicles, 1 A 3 b iv Mopeds & Motorcycles for the year 2005. The calculated national emission data are based on TREMOVE activity rates and emission factor data extracted from the 2008 PRTR Netherlands. Since the transport sector emissions are not included in the E-PRTR regulation reporting requirements, all emissions released are assumed to be from diffuse sources.
The methodology applied and data used is described in detail in the sector specific factsheet.
Activity data derived using transport models
TREMOVE: road type and pollutant specific split factors
TRANS-TOOLS: road network and traffic density data
Road network
Eurostat, GISCO: Road network from EuroRegional Map v31: Transport (TRANS)
Population data
JRC Population density disaggregated with Corine land cover 2000 and 2006: European Population Density Map 2000 and 2006
EUROSTAT GISCO - Statistical information on population data per commune (LAU2 level) for Switzerland (publicly not available).
EUROSTAT GISCO - Degree of Urbanization

Map 07



4.3 Map 08 Lead emissions from road transport

Short Title: Lead emissions from road transport (kg/ha surface water RBDSU)
Full Title: Map: Lead emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows the lead emissions to surface water from road transport per RBDSU for the year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of lead are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Lead emissions from road transport, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Emissions of lead to surface water from road transport were spatially allocated to the RBDSU level according to the data modelled by TREMOVE, due to the road network derived from the TRANS-TOOLS model and GISCO data set. The traffic density information was derived also from the TRANS-TOOLS model runs. The split into highway, rural and urban activities have been derived from the TREMOVE model. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The emissions from road transport are dependent on the density of the road network.
- The emissions from road transport are allocated by road class-specific mileages of different vehicle categories.
- The emissions from road transport not covered by traffic volume are dependent from the population density.

Diffuse Sources / Source Data:

Map: Lead emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Emissions data

The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated. Lead emission loads to surface water from road transport data are national totals calculated for the NFR09 sources 1 A 3 b i Passenger cars, 1 A 3 b ii Light duty vehicles, 1 A 3 b iii Heavy duty vehicles, 1 A 3 b iv Mopeds & Motorcycles for the year 2005. The calculated national emission data are based on TREMOVE activity rates and emission factor data extracted from the 2008 PRTR Netherlands. Since the transport sector emissions are not included in the E-PRTR regulation reporting requirements, all emissions released are assumed to be from diffuse sources.

The methodology applied and data used is described in detail in the sector specific factsheet.

Activity data derived using transport models

TREMOVE: road type and pollutant specific split factors

TRANS-TOOLS: road network and traffic density data

Road network

Eurostat, GISCO: Road network from EuroRegional Map v31: Transport (TRANS)

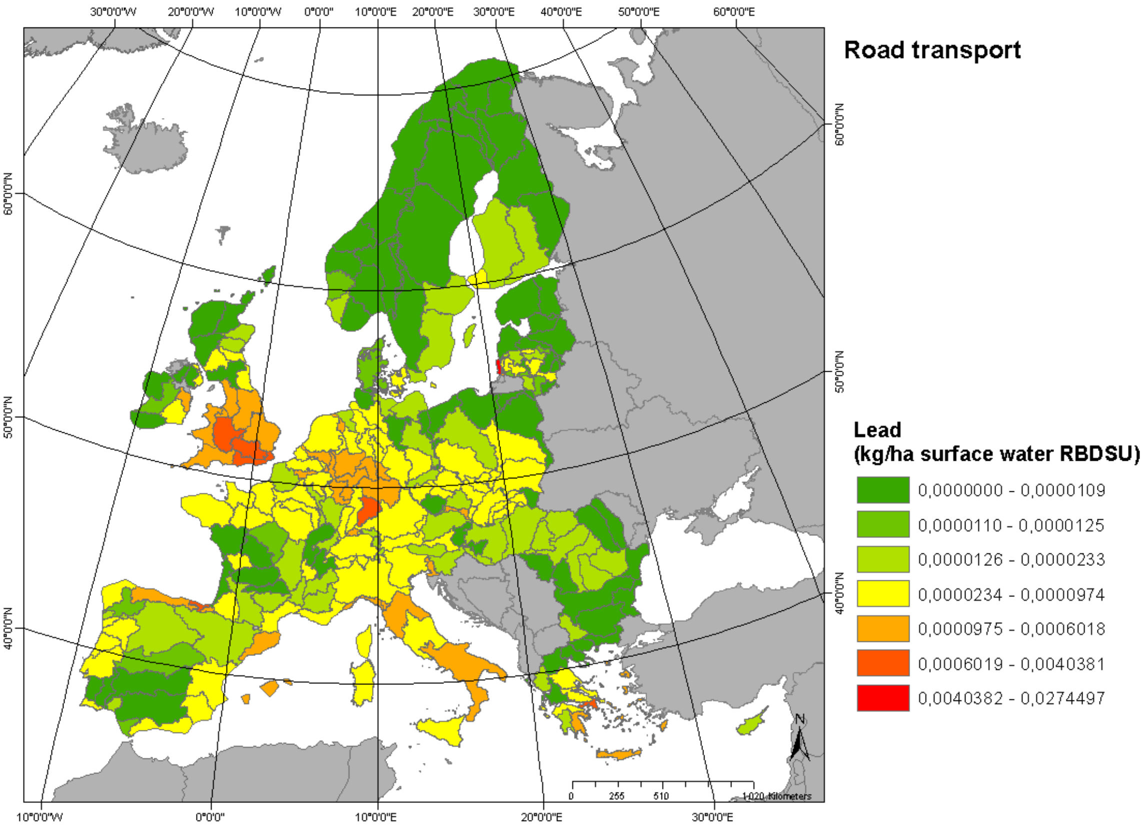
Population data

JRC Population density disaggregated with Corine land cover 2000 and 2006: European Population Density Map 2000 and 2006

EUROSTAT GISCO - Statistical information on population data per commune (LAU2 level) for Switzerland (publicly not available).

EUROSTAT GISCO - Degree of Urbanization

Map 8



4.4 Map 09 Nickel emissions from road transport

Short Title: Nickel emissions from road transport (kg/ha surface water RBDSU)
Full Title: Map: Nickel emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows the nickel emissions to surface water from road transport per RBDSU for the year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of nickel are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Nickel emissions from road transport, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Emissions of nickel to surface water from road transport were spatially allocated to the RBDSU level according to the data modelled by TREMOVE, due to the road network derived from the TRANS-TOOLS model and GISCO data set. The traffic density information was derived also from the TRANS-TOOLS model runs. The split into highway, rural and urban activities have been derived from the TREMOVE model. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The emissions from road transport are dependent on the density of the road network.
- The emissions from road transport are allocated by road class-specific mileages of different vehicle categories.
- The emissions from road transport not covered by traffic volume are dependent from the population density.

Diffuse Sources / Source Data:

Map: Nickel emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Emissions data

The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated. Nickel emission loads to surface water from road transport data are national totals calculated for the NFR09 sources 1 A 3 b i Passenger cars, 1 A 3 b ii Light duty vehicles, 1 A 3 b iii Heavy duty vehicles, 1 A 3 b iv Mopeds & Motorcycles for the year 2005. The calculated national emission data are based on TREMOVE activity rates and emission factor data extracted from the 2008 PRTR Netherlands. Since the transport sector emissions are not included in the E-PRTR regulation reporting requirements, all emissions released are assumed to be from diffuse sources.

The methodology applied and data used is described in detail in the sector specific factsheet.

Activity data derived using transport models

TREMOVE: road type and pollutant specific split factors

TRANS-TOOLS: road network and traffic density data

Road network

Eurostat, GISCO: Road network from EuroRegional Map v31: Transport (TRANS)

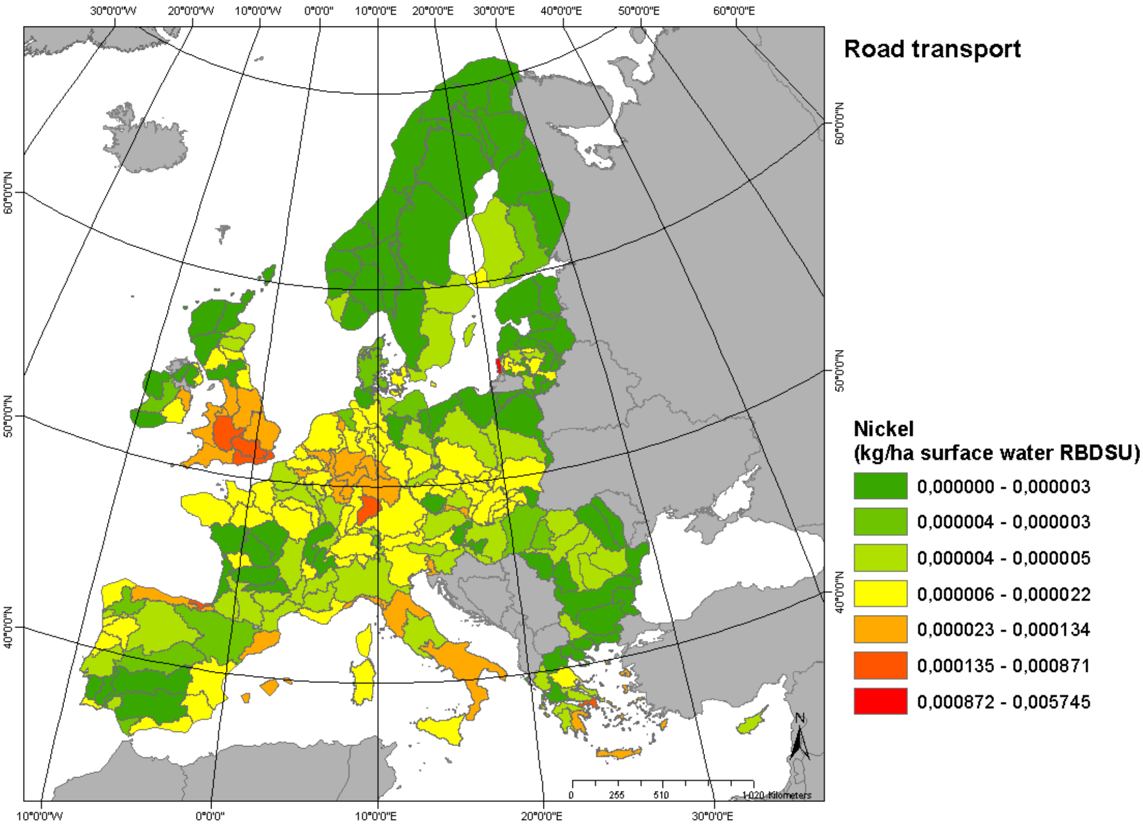
Population data

JRC Population density disaggregated with Corine land cover 2000 and 2006: European Population Density Map 2000 and 2006

EUROSTAT GISCO - Statistical information on population data per commune (LAU2 level) for Switzerland (publicly not available).

EUROSTAT GISCO - Degree of Urbanization

Map 09



4.5 Map 10 Anthracene emissions from road transport

Short Title: Anthracene emissions from road transport (kg/ha surface water RBDSU)

Full Title: Map: Anthracene emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:

The map shows the anthracene emissions to surface water from road transport per RBDSU for the year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of anthracene are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:

Map: Anthracene emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Geographic Information System overlay:

Emissions of anthracene to surface water from road transport were spatially allocated to the RBDSU level according to the data modelled by TREMOVE, due to the road network derived from the TRANS-TOOLS model and GISCO data set. The traffic density information was derived also from the TRANS-TOOLS model runs. The split into highway, rural and urban activities have been derived from the TREMOVE model. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The emissions from road transport are dependent on the density of the road network.
- The emissions from road transport are allocated by road class-specific mileages of different vehicle categories.
- The emissions from road transport not covered by traffic volume are dependent from the population density.

Diffuse Sources / Source Data:

Map: Anthracene emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Emissions data

The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated. Anthracene emission loads to surface water from road transport data are national totals calculated for the NFR09 sources 1 A 3 b i Passenger cars, 1 A 3 b ii Light duty vehicles, 1 A 3 b iii Heavy duty vehicles, 1 A 3 b iv Mopeds & Motorcycles for the year 2005.

The calculated national emission data are based on TREMOVE activity rates and emission factor data extracted from the 2008 PRTR Netherlands. Since the transport sector emissions are not included in the E-PRTR regulation reporting requirements, all emissions released are assumed to be from diffuse sources.

The methodology applied and data used is described in detail in the sector specific factsheet.

Activity data derived using transport models

TREMOVE: road type and pollutant specific split factors

TRANS-TOOLS: road network and traffic density data

Road network

Eurostat, GISCO: Road network from EuroRegional Map v31: Transport (TRANS)

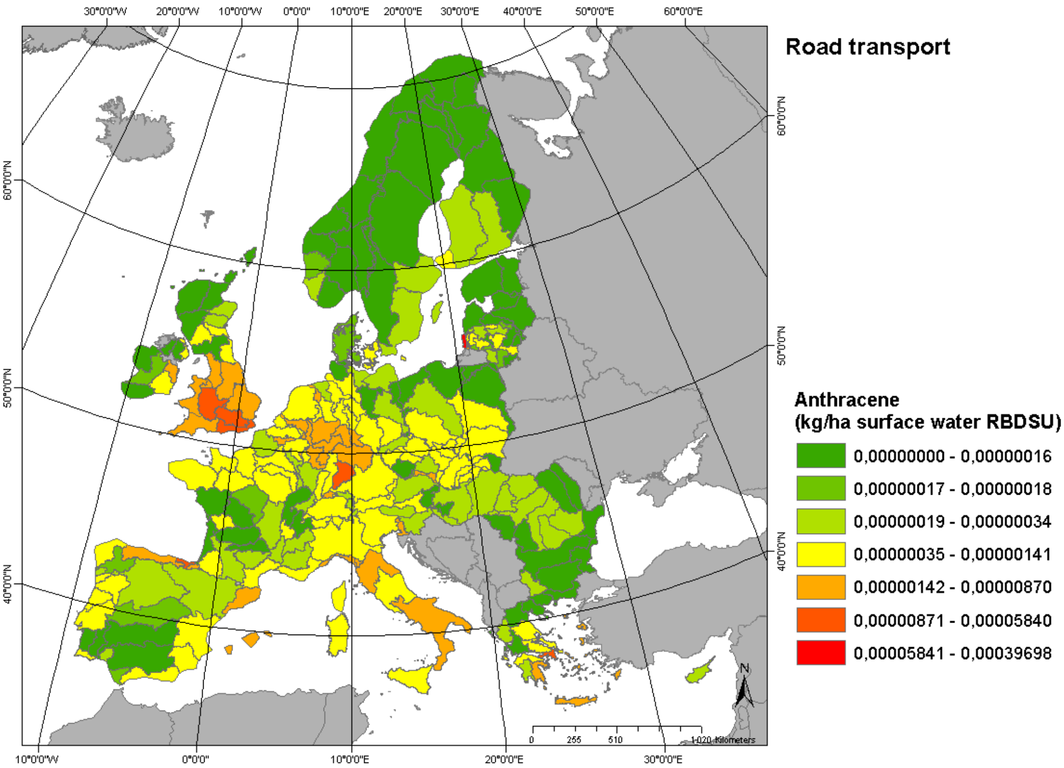
Population data

JRC Population density disaggregated with Corine land cover 2000 and 2006: European Population Density Map 2000 and 2006

EUROSTAT GISCO - Statistical information on population data per commune (LAU2 level) for Switzerland (publicly not available).

EUROSTAT GISCO - Degree of Urbanization

Map 10



4.6 Map 11 Fluoranthene emissions from road transport

Short Title:	Fluoranthene emissions from road transport (kg/ha surface water RBDSU)
Full Title:	Map: Fluoranthene emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows the fluoranthene emissions to surface water from road transport per RBDSU for the year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of fluoranthene are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Fluoranthene emissions from road transport, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Emissions of fluoranthene to surface water from road transport were spatially allocated to the RBDSU level according to the data modelled by TREMOVE, due to the road network derived from the TRANS-TOOLS model and GISCO data set. The traffic density information was derived also from the TRANS-TOOLS model runs. The split into highway, rural and urban activities have been derived from the TREMOVE model. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The emissions from road transport are dependent on the density of the road network.
- The emissions from road transport are allocated by road class-specific mileages of different vehicle categories.
- The emissions from road transport not covered by traffic volume are dependent from the population density.

Diffuse Sources / Source Data:

Map: Fluoranthene emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Emissions data

The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated. Fluoranthene emission loads to surface water from road transport data are national totals calculated for the NFR09 sources 1 A 3 b i Passenger cars, 1 A 3 b ii Light duty vehicles, 1 A 3 b iii Heavy duty vehicles, 1 A 3 b iv Mopeds & Motorcycles for the year 2005. The calculated national emission data are based on TREMOVE activity rates and emission factor data extracted from the 2008 PRTR Netherlands. Since the transport sector emissions are not included in the E-PRTR regulation reporting requirements, all emissions released are assumed to be from diffuse sources.

The methodology applied and data used is described in detail in the sector specific factsheet.

Activity data derived using transport models

TREMOVE: road type and pollutant specific split factors

TRANS-TOOLS: road network and traffic density data

Road network

Eurostat, GISCO: Road network from EuroRegional Map v31: Transport (TRANS)

Population data

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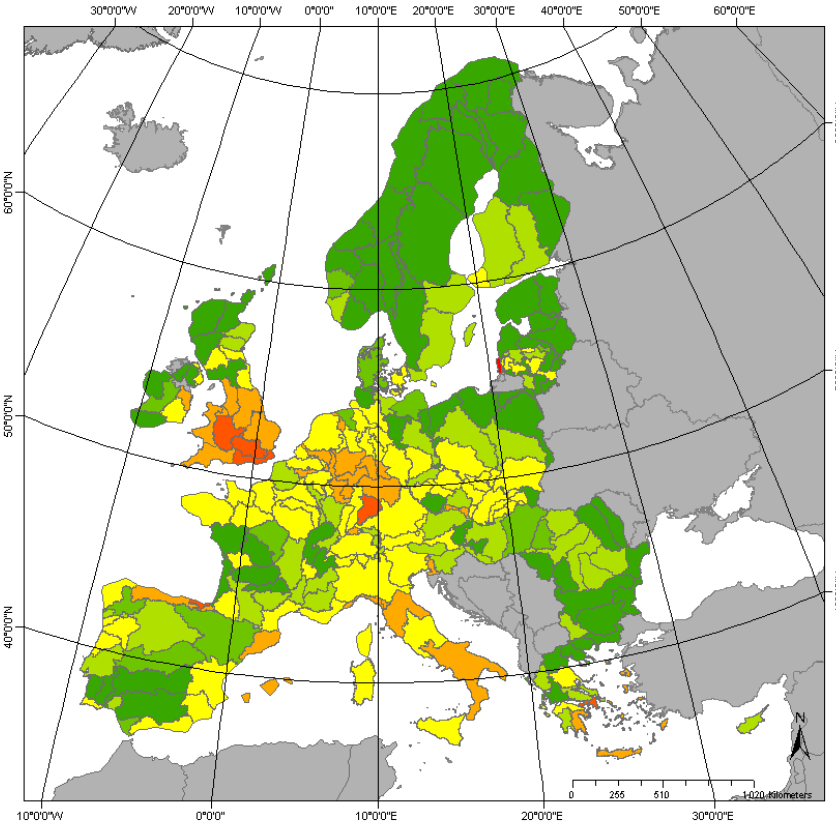
EUROSTAT GISCO - Statistical information on population data per commune (LAU2 level) for Switzerland (publicly not available).

EUROSTAT GISCO - Degree of Urbanization

Map 11



4.7 Map 12 Copper emissions from road transport

Short Title: Copper emissions from road transport (kg/ha surface water RBDSU)
Full Title: Map: Copper emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows the copper emissions to surface water from road transport per RBDSU for the year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of copper are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Copper emissions from road transport, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Emissions of copper to surface water from road transport were spatially allocated to the RBDSU level according to the data modelled by TREMOVE, due to the road network derived from the TRANS-TOOLS model and GISCO data set. The traffic density information was derived also from the TRANS-TOOLS model runs. The split into highway, rural and urban activities have been derived from the TREMOVE model. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The emissions from road transport are dependent on the density of the road network.
- The emissions from road transport are allocated by road class-specific mileages of different vehicle categories.
- The emissions from road transport not covered by traffic volume are dependent from the population density.

Diffuse Sources / Source Data:

Map: Copper emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Emissions data

The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated. Copper emission loads to surface water from road transport data are national totals calculated for the NFR09 sources 1 A 3 b i Passenger cars, 1 A 3 b ii Light duty vehicles, 1 A 3 b iii Heavy duty vehicles, 1 A 3 b iv Mopeds & Motorcycles for the year 2005. The calculated national emission data are based on TREMOVE activity rates and emission factor data extracted from the 2008 PRTR Netherlands. Since the transport sector emissions are not included in the E-PRTR regulation reporting requirements, all emissions released are assumed to be from diffuse sources.

The methodology applied and data used is described in detail in the sector specific factsheet.

Activity data derived using transport models

TREMOVE: road type and pollutant specific split factors

TRANS-TOOLS: road network and traffic density data

Road network

Eurostat, GISCO: Road network from EuroRegional Map v31: Transport (TRANS)

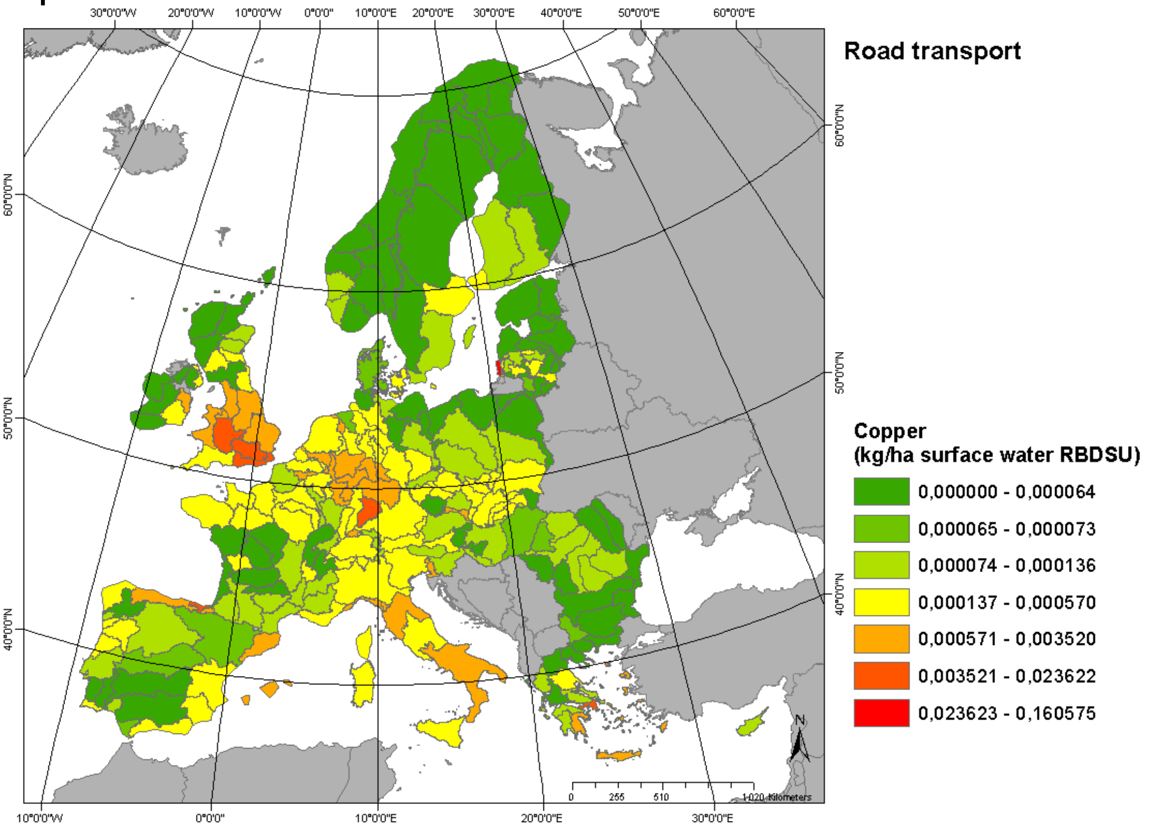
Population data

JRC Population density disaggregated with Corine land cover 2000 and 2006: European Population Density Map 2000 and 2006

EUROSTAT GISCO - Statistical information on population data per commune (LAU2 level) for Switzerland (publicly not available).

EUROSTAT GISCO - Degree of Urbanization

Map 12



4.8 Map 13 Zinc emissions from road transport

Short Title:	Zinc emissions from road transport (kg/ha surface water RBDSU)
Full Title:	Map: Zinc emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows the zinc emissions to surface water from road transport per RBDSU for the year 2005, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of zinc are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Zinc emissions from road transport, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Emissions of zinc to surface water from road transport were spatially allocated to the RBDSU level according to the data modelled by TREMOVE, due to the road network derived from the TRANS-TOOLS model and GISCO data set. The traffic density information was derived also from the TRANS-TOOLS model runs. The split into highway, rural and urban activities have been derived from the TREMOVE model. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The emissions from road transport are dependent on the density of the road network.
- The emissions from road transport are allocated by road class-specific mileages of different vehicle categories.
- The emissions from road transport not covered by traffic volume are dependent from the population density.

Diffuse Sources / Source Data:

Map: Zinc emissions from road transport, load to surface water (kg/ha surface water RBDSU)

Emissions data

The emissions are calculated separately for various vehicle categories (light and heavy) and road types (urban, rural and highways). Pollutants emitted on urban roads are not incorporated. Zinc emission loads to surface water from road transport data are national totals calculated for the NFR09 sources 1 A 3 b i Passenger cars, 1 A 3 b ii Light duty vehicles, 1 A 3 b iii Heavy duty vehicles, 1 A 3 b iv Mopeds & Motorcycles for the year 2005. The calculated national emission data are based on TREMOVE activity rates and emission factor data extracted from the 2008 PRTR Netherlands. Since the transport sector emissions are not included in the E-PRTR regulation reporting requirements, all emissions released are assumed to be from diffuse sources.

The methodology applied and data used is described in detail in the sector specific factsheet.

Activity data derived using transport models

TREMOVE: road type and pollutant specific split factors

TRANS-TOOLS: road network and traffic density data

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Eurostat, GISCO: Road network from EuroRegional Map v31: Transport (TRANS)

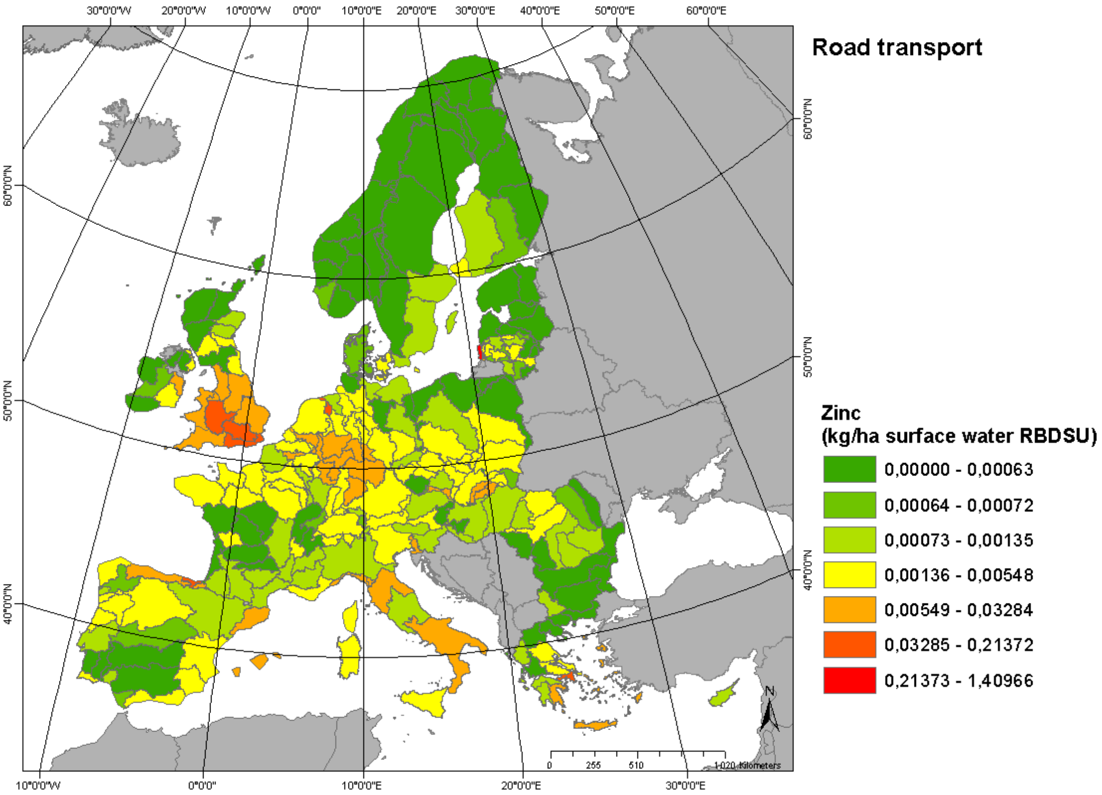
Population data

JRC Population density disaggregated with Corine land cover 2000 and 2006: European Population Density Map 2000 and 2006

EUROSTAT GISCO - Statistical information on population data per commune (LAU2 level) for Switzerland (publicly not available).

EUROSTAT GISCO - Degree of Urbanization

Map 13


Road transport
Zinc
(kg/ha surface water RBDSU)
0,00000 - 0,00063
0,00064 - 0,00072
0,00073 - 0,00135
0,00136 - 0,00548
0,00549 - 0,03284
0,03285 - 0,21372
0,21373 - 1,40966

5 UWWTPs not in E-PRTR

5.1 Fact sheet

Introduction

This factsheet sets out a method for calculating substances in effluent from Urban Waste Water Treatment Plants (UWWTP) emissions not covered by the E-PRTR. The E-PRTR collects a part of UWWTP emissions. Only UWWTPs with a capacity higher than 100 000-population equivalents (p.e.) and substance loads above the threshold values have to be reported to E-PRTR. Member States can report voluntary about UWWTPs below this capacity and about loads below the substance thresholds. A considerable part of the load is expected not to be reported to E-PRTR, for example the smaller UWWTPs and loads below the threshold value.

Besides the E-PRTR reports, every Member State has to report to the Urban Waste Water Directive every two years. In these reports all Member States report about the UWWTPs in their country (capacity, location, treatment way etc.). Both reports are used to estimate emissions for the not E-PRTR UWWTPs. This factsheet describes a method to estimate these emissions, which cause loads to surface water of nutrients, heavy metals and polycyclic aromatic hydrocarbons (PAHs).

Development of a methodology

The sewer system and Urban Waste Water Treatment Plants collect and treat polluted water, meeting requirements prior to discharge into surface water. Not all the pollution is removed (varying according to the substance in question and the kind of treatment), meaning that discharges from the system contribute to surface water pollution. This fact sheet presents a calculation method for emissions caused by effluents from UWWTPs, see figure 1.

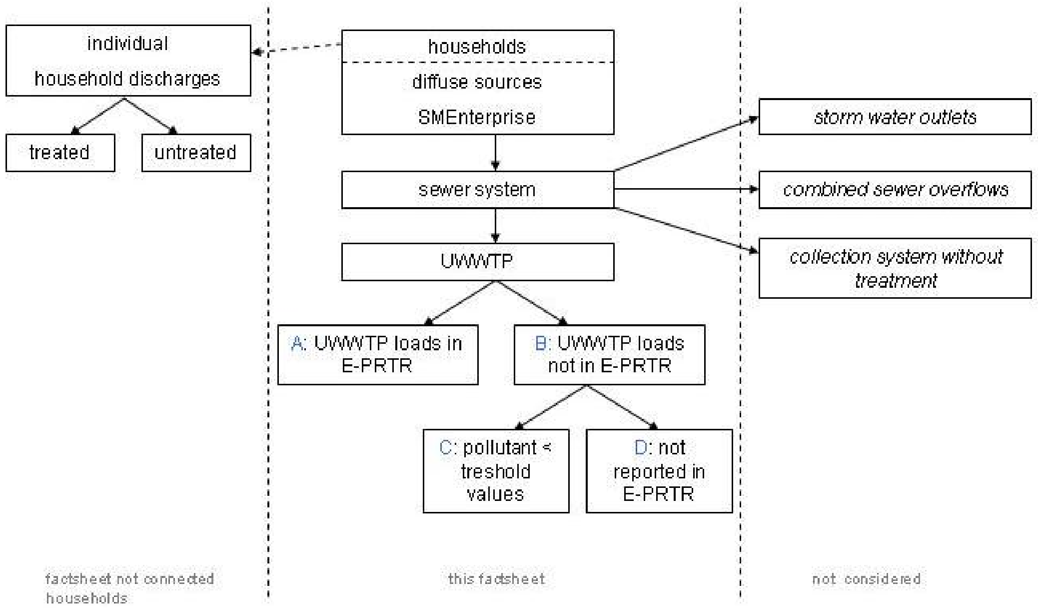


Figure 1 Emissions to and from a sewer system and the calculation thereof.

On the right sight of the figure, the untreated sewer discharge water of the sewer system; storm water outlets, combined sewer overflows and collection systems without treatment are represented. These sources are not presented in this factsheet or in other factsheets of this project, because the total load per substance to the sewer system has to be known. That information is not available in this project and calculations can not be made. The un-connected households, the left site of the figure, are not presented in this factsheet but in the factsheet "un-connected households".

Effluents of the treated wastewater are discharged to surface water. This factsheet describes a method to calculate the effluent per pollutant per UWWTP. The database of the Urban Waste Water Directive forms the base of the calculations (December, 2012 - Waterbase - UWWTD: Urban Waste Water Treatment Directive). The table T-UWWTPS shows a load entering the UWWTP (p.e.) or/and a capacity per UWWTP (p.e.).

Two different loads from UWWTPs can be distinguished:

A. UWWTP loads reported to E-PRTR. Mostly UWWTPs above a capacity threshold of 100 000 p.e. and with discharges above threshold values have to report their emissions. This loads are known already and will not be reported again.
B. UWWTP loads not reported to E-PRTR. A first analysis of the E-PRTR data of the UWWTPs makes clear that a lot of emissions are missing. There are two major gaps:
    C. Emissions of substances below the E-PRTR substance thresholds or emissions of the the smaller UWWTPs (below the E-PRTR UWWTP capacity threshold of 100.000 p.e).
    D. Emissions above the substance thresholds and above the E-PRTR capacity thresholds (>100.000 p.e.) which should be reported to E-PRTR, but are not reported by any reason. Comparing the E-PRTR reports and the UWWTD database, we can conclude a significant part of the large UWWTPs (> 100.000 p.e.) is missing in the E-PRTR reports.

Above mentioned gaps are relevant in the process of generating the "total" emissions from all UWWTPs in the EU. In this factsheet emissions are estimated for both gaps mentioned above (C and D).

Explanation of the calculation method
The effluents of the UWWTPs are calculated separately for the individual UWWTP. Emissions are calculated by multiplying an activity rate (AR), in this case the load entering a UWWTP (p.e.), by an emission factor (EF), expressed in the load per substance per UWWTP.
The calculation method is shown in the formula below:

Es = (ARa * EF)

Where:

E_s	=	Load of substance to surface water per UWWTP
$sum(AR_a)$	=	Activity rate, the load entering a UWWTP (p.e.)
EF	=	Emission factor (kilogram per substance/p.e.)

Per River Basin District the effluents of the UWWTPs in the district will be summarized per substance. Loads reported to E-PRTR are not calculated again. Only the not reported loads will be calculated.

Activity rates
There are a few activity rates relevant for this calculation method. The most important is the load entering a UWWTP (p.e.). This load is available from table T-UWWTPS in the UWWTP database [1]. If the load is not available, the organic design capacity (p.e.) of the UWWTP can be used instead. Sometimes the load entering a UWWTP is higher than the organic design capacity, but in most situations, the load is lower than the capacity.

Also the number of the UWWTPs is important. A few steps are taken to select the UWWTPs which are used to calculate the loads to surface water. UWWTPs who has been closed/deactivated (1080) or areas not connected to an UWWTP (3739) are not considered. In total 22084 of 27083 UWWTPs are considered for the calculations.

Only the EU Member States that have supplied information to the EU are represented In Waterbase UWWTP. For the not EU Member States, no information was available for the UWWTPs.

Emission factors
In this section it is explained how the emission factors are obtained in four steps:

1. Linking UWWTPs from different databases

Two databases are used to obtain the emission factors, the E-PRTR database [2] and the UWWTP database [1]. Both databases contain codes for the UWWTPs, but the used codes were not compatible. Therefore the UWWTPs were linked by using GIS. There might be a chance that wrong UWWTPs are linked to each other or UWWTPs are not linked because there are differences in coordinates between both databases for a number of UWWTPs.
Result: per UWWTP in the UWWTP database the reported E-PRTR load per substance.

2. Calculating the emission factor per substance (kg/p.e.)

Therefore, the load entering the UWWTP (p.e) divides the known E-PRTR or UWWTP load of the UWWTP for a substance.
Result: an emission factor for substance X per UWWTP (kg/p.e.).

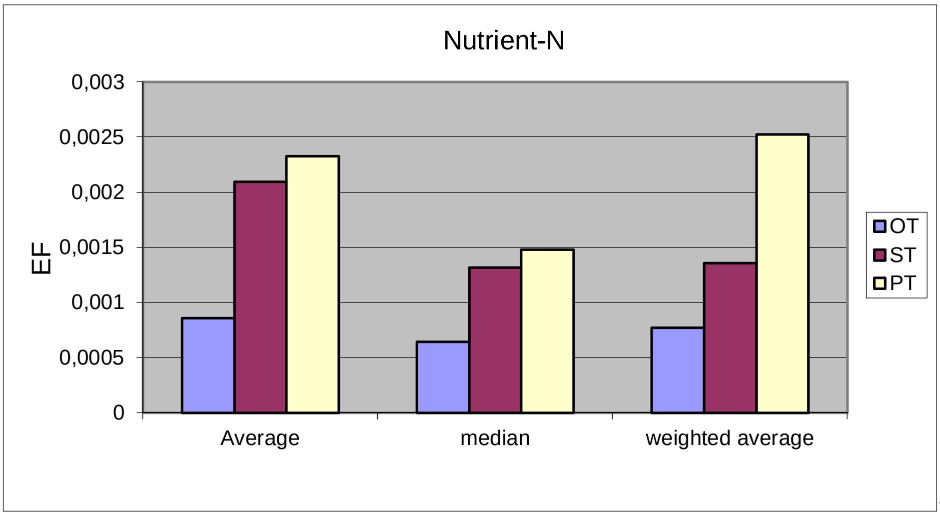
3. Calculating of emission factor

For every UWWTP in the database the treatment is known. There are three possible treatments in the database:

- <u>Primary treatment (PT)</u>: Treatment of urban waste water by a physical and/or chemical process involving settlement of suspended solids, or other process in which the BOD5 of the incoming waste water is reduced by at least 20% before discharge and the total suspended solids of the incoming waste water are reduced by at least 50%.
- <u>Secondary treatment (ST)</u>: Treatment of urban waste water by a process generally involving biological treatment with a secondary settlement or other process.
- <u>Other treatment (OT)</u>: Treatment of urban waste water by any process and/or disposal system which after discharge allows the receiving waters to meet the relevant quality objectives and the relevant provisions of this and other Community Directives. Other treatment is considered as more stringent treatment.

For every treatment way the weighted average is chosen, because normal averages and a median can give incorrect figures. For example figure 2. In this figure the calculated average, median and the weighted average for Nutrient-N and Nutrient-P is shown.

For both substances the average seems too high for the other and secondary treatment. The median and the weighted average are less low. The decision is made to use the weighted average, because for the most situations the weighted average was in between the median and the average. The emission factor calculated for larger UWWTPs has a bigger influence on the average than the emission factor for the smaller UWWTPs when the average emission factor is calculated. Therefore the weighted average is used, where instead of each of the data points contributing equally to the final average, some data points contribute more than others. The weighted average is calculated by dividing the total loads per substance by the total load entering the UWWTP.
Result: an emission factor for substance X per treatment class (kg/p.e.)



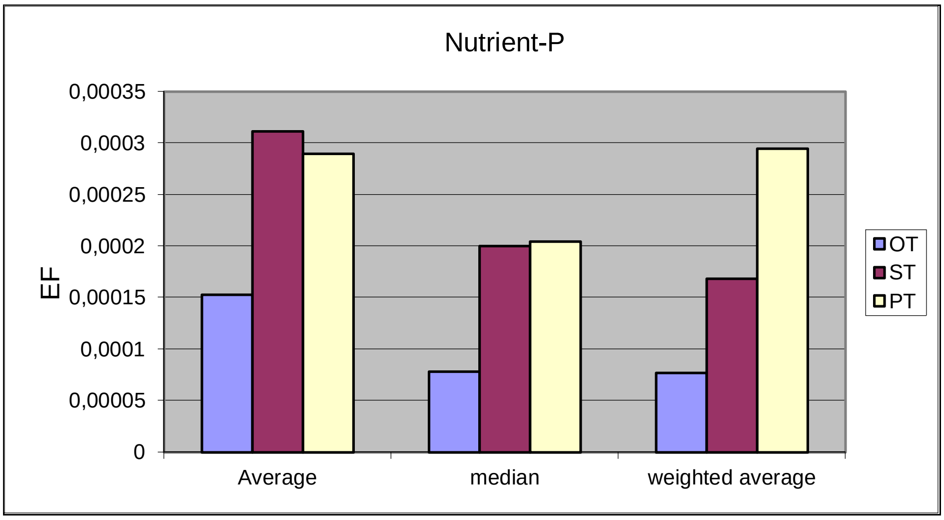


Figure 2 The calculated average, median and the weighted average for Nutrient-N and Nutrient-P for the loads in the Waterbase – UWWTP [1].

4. UWWTP capacity

Besides the way of treatment, there is another important difference between the UWWTPs: the capacity of the plant. For this factsheet we distinguish three classes of capacity:

1. Smaller than 15 000 p.e.
2. Between 15 000 and 100 000 p.e.
3. Bigger than 100 000 p.e.

Result: Per substance an emission factor in kg/p.e. per Treatment-class and capacity class.

Emission factors for Nutrients

In the latest UWWTP database, December 2012, for a lot of UWWTPs additional incoming and discharged loads are reported. These data are used to calculate emission factors for Nutrient-N, Nutrient-P and the total oxygen demand (TOC). In the UWWTP database the chemical oxygen demand (COD) is used. TOC is calculated as COD/3.

Table 1 shows the reported combinations of treatment ways and the calculated emission factors of the UWWTP effluent per UWWTP class. We see that for UWWTPs with “other treatment” as highest step, the lowest emission factor is calculated for Nutrient-N with a range from 0,76 – 0,81 kg/p.e. For treatment classes with PT or ST as highest treatment step, the emission factor for Nutrient-N is higher, range 1,2 – 1,8 kg/p.e. This means that loads to surface water will be lower when a higher level of treatment is operational. This applies for Nutrient-P and TOC as well.

Table 1 Emission factors of the UWWTP effluent for Nutrient-N, Nutrient-P and total organic carbon (TOC) for the different treatment ways and different UWWTP classes in kg/p.e.

Substance	UWTTP_class (p.e.)	OT	ST	PT
TOC	<15 000	3,631	5,960	12,565
	15 000 <> 100 000	3,331	5,613	*12,565*
	> 100 000	3,341	6,306	*12,565*
Nutrient-N	<15 000	0,814	1,557	1,839
	15 000 <> 100 000	0,761	1,274	*1,839*
	> 100 000	0,774	1,322	*1,839*
Nutrient-P	<15 000	0,167	0,237	0,226
	15 000 <> 100 000	0,075	0,160	*0,226*
	> 100 000	0,057	0,141	*0,226*

In the UWWTD database only UWWTPs, less than 15 000 p.e. have a primary treatment. There are a few larger UWWTPs with a primary treatment, but most of the larger UWWTP classes have higher treatment levels. There was not enough data (less than 10 UWWTPs) to calculate an EF for the primary treatment for the larger UWWTP classes. Therefore, the EF for the primary treatment of the small UWWTPs (< 15 000 p.e.) is also used for the larger UWWTP classes (> 15 000 p.e.).

Emission factors for heavy metals

For the heavy metals E-PRTR loads [2] and Dutch UWWTP loads [3] are used for the calculation of the emission factors. In the Netherlands, for every UWWTP loads are calculated yearly, bases on measurements. A weighted average emission factor on both loads is calculated for the treatment class “other treatment” only, as is shown in Table 2. There were not enough data available to calculate emission factors for primary and secondary treatment UWWTPs.

To extract emission factors for the secondary treatment, Dutch literature study [4] is used. In the Dutch emission calculations purification efficiency is used for the estimation of emission factors for UWWTPs with a secondary treatment for the heavy metals as shown in table 3. To calculate an Emission Factor for the secondary treatment, the purification efficiency for the other treatment class is calculated for the Dutch situation. These efficiencies are also shown in table 3. For the primary treatment class the same emissions factors are used as for the secondary treatment. To calculate an Emission Factor for the secondary treatment class, the next formula is used:

$$EF_{st} = PE_{ot} / PE_{st}: * EF_{ot}$$

Where:
EF_{st}: Emission Factor for secondary treatment
PE_{ot}: Purification Efficiency for other treatment
PE_{st}: Purification Efficiency for secondary treatment
EF_{ot}: Emission Factor for other treatment

Table 2 Emission factors of the UWWTP effluent for heavy metals for different treatment ways and different UWWTP classes in kg/p.e.

Substance	UWWTP class (p.e.)	OT	ST*
Cadmium	<15 000	0.0000909	0.0000810
	15 000 <> 100 000	0.0000692	0.0000768
	> 100 000	0.0001086	0.0001343
Copper	<15 000	0.0007763	0.0010429
	15 000 <> 100 000	0.0020081	0.0026878
	> 100 000	0.0007861	0.0010564
Mercury	<15 000	0.0000107	0.0000109
	15 000 <> 100 000	0.0000197	0.0000201
	> 100 000	0.0000159	0.0000168
Nickel	<15 000	0.0009679	0.0014530
	15 000 <> 100 000	0.0010530	0.0015815
	> 100 000	0.0007405	0.0010974
Lead	<15 000	0.0002781	0.0005729
	15 000 <> 100 000	0.0006665	0.0012919
	> 100 000	0.0005022	0.0008902
Zinc	<15 000	0.0051614	0.0062571
	15 000 <> 100 000	0.0058102	0.0067606
	> 100 000	0.0055516	0.0064437

*for PT the EF for ST is used.

Table 3 Purification efficiency for heavy metals for different treatment ways and different UWWTP classes in kg/p.e.

Substance	UWWTP class (p.e.)	Purification Efficiency	
		OT [3]	ST [4]
Cadmium	<15 000	53.48%	60%
	15 000 <> 100 000	66.56%	60%
	> 100 000	74.21%	60%
Copper	<15 000	94.05%	70%
	15 000 <> 100 000	93.69%	70%
	> 100 000	94.06%	70%
Mercury	<15 000	71.33%	70%
	15 000 <> 100 000	71.29%	70%
	> 100 000	73.62%	70%
Nickel	<15 000	61.81%	30%
	15 000 <> 100 000	58.15%	30%
	> 100 000	53.18%	30%
Lead	<15 000	90.07%	60%
	15 000 <> 100 000	90.11%	60%
	> 100 000	88.93%	60%

Substance	UWWTP class (p.e.)	Purification Efficiency	
		OT [3]	ST [4]
Zinc	<15 000	84.86%	70%
	15 000 <> 100 000	81.45%	70%
	>100 000	81.25%	70%

Emissions factors for PAHs
For the PAHs less data are available. Therefore only Dutch data are used [5], based on measurements in influent and estimated purification efficiencies of Dutch UWWTPs. For the UWWTPs for which influent concentrations are available, in combination with the purification efficiencies, effluent loads of the selected PAHs are calculated. The effluent loads of the individual UWWTPs are summarised and divided by the total amount of p.e. of the UWWTPs, resulting in an emission factor of the UWWTP effluent in kg/p.e. [3]. The results are shown in table 4. These Emission factors are used for all the different treatment ways and UWWTP classes, because PAHs will be especially attached to suspended matter. For the PAHs, the emission factors are less related to the way of treatment in the UWWTP than is the case for heavy metals and nutrients.

Table 4 Emission factors of the UWWTP effluent for PAHs in kg/p.e.

Substance	Emission Factor (kg/p.e.)
Anthracene	2.118E-07
Fluoranthene	1.334E-06

Emission pathways to water
Only the effluents of the UWWTPs are considered in this factsheet. The effluents are direct loads to surface water.

Emissions
With the emission factors and the loads (p.e.) per UWWTP, for all the 22084 UWWTPs the load of 11 substances are calculated. Only the loads not already reported in E-PRTR are reported in Table 5 (nutrients and PAHs) and Table 7 (heavy metals) and presented on the maps. In Table 6 and Table 8 the loads of the nutrients, PAHs and heavy metals as reported in the E-PRTR are shown. In Table 9 the total UWWTP loads of the EU Member States is shown. The percentages of this load reported in E-PRTR and the percentages calculated in this project are shown in Table 7 as well.

Table 5 Total load per Member State for nutrients in ton/year and PAH in kg/year for UWWTPs not reported in E-PRTR, 2010.

Member State*	Nutrient-N	Nutrient-P	TOC	Antracene	Fluoranthene
	ton/y			kg/y	
Austria	6 271	796	8 927	2.8	18
Belgium	4 573	598	7 108	1.8	11
Bulgaria	2 232	259	3 557	0.8	4.8
Cyprus	424	53	608	0.1	0.7
Czech Republic	6 746	748	7 187	1.9	12
Germany	44 491	5 116	77 355	24	147
Denmark	2 740	334	5 422	1.4	8.6

Member State*	Nutrient-N	Nutrient-P	TOC	Antracene	Fluoranthene
	ton/y			kg/y	
Estonia	1 005	114	1 237	0.2	1.5
Spain	47 752	4 988	70 824	12	77
Finland	4 838	487	4 787	1.3	8.3
France	52 245	6 050	75 635	16	98
Greece	3 587	366	5 387	2.3	14
Hungary	6 663	795	9 838	1.9	12
Ireland	2 714	352	3 826	0.6	3.7
Italy	64 361	8 954	90 877	15	94
Lithuania	1 552	152	2 133	0.5	3.2
Luxembourg	662	58	802	0.1	0.9
Latvia	1 855	144	1 716	0.3	1.8
Malta	52	5	76	0.0	0.1
Netherlands	7 334	757	10 301	3.5	22
Poland	68 250	8 133	105 827	13	82
Portugal	9 172	1 112	16 014	2.2	14
Romania	10 362	1 400	21 865	1.6	10
Slovenia	1 318	188	1 890	0.4	2.5
Slovakia	4 495	529	6 598	0.8	5.0
United Kingdom	35 240	4 569	53 571	11	87

**Only EU Member States that have supplied information to the EU are represented In Waterbase UWWTP. For the not EU Member States, no information was available. UWWTPs < 2 000 pe are included, when information is supplied by MS.*

Table 6 Total load per Member State for nutrients in ton/year and PAH in kg/year for UWWTPs reported in E-PRTR, 2010.

Member State*	Nutrient-N	Nutrient-P	TOC	Antracene	Fluoranthene
	ton/y			kg/y	
Austria	3 975	311	4 930		
Belgium	3 190	1 912	5 393		
Bulgaria	4 670	1 123	6 567		
Cyprus					
Czech Republic	4 534	262	3 691		2
Denmark	547	41	1 586		
Estonia	779	53	764		
Finland	5 392	67	3 077		
France	28 723	2 603	31 217		1
Germany	40 727	1 672	45 172		12
Greece	3 105	983	7 151		
Hungary	4 694	549	4 694		
Iceland	1 045	258			
Ireland	4 556	737	7 124	2	2
Italy	26 445	3 988	29 031	12	18
Latvia	1 090	44			
Lithuania	905	32	394		
Luxembourg	387	31	538		

Member State*	Nutrient-N	Nutrient-P	TOC	Antracene	Fluoranthene
	ton/y			kg/y	
Netherlands	8 857	1 067	15 522		
Norway	6 562	667			
Poland	15 909	455	11 958		
Portugal	9 843	1 012	15 789	5	4
Romania	7 625	880	12 484		
Slovakia	1 764	177	1 140		
Slovenia	1 037	164	622		
Spain	35 609	3 760	17 255	4	4
Sweden	5 749	90	6 076		6
Switzerland	7 208	252	4 035		
United Kingdom	103 324	13 711	63 409	39	2

Table 7 Total load per Member State for heavy metals in kg/year for UWWTPs not reported in E-PRTR in 2010.

Member State	Cadmium	Copper	Mercury	Nickel	Lead	Zinc
	kg/year					
Austria	1 240	12 530	217	8 406	5 105	49 950
Belgium	772	10 242	123	7 613	4 362	30 286
Bulgaria	198	4 576	62	3 021	2 640	14 023
Cyprus	53	763	7	538	362	3 204
Czech Republic	605	13 715	110	11 052	7 868	51 499
Germany	9 063	112 694	1 554	71 563	52 676	387 718
Denmark	560	8 492	105	6 016	3 359	35 876
Estonia	105	1 389	19	1 066	675	6 507
Spain	5 862	68 184	950	52 792	37 451	296 916
Finland	572	7 752	104	5 540	3 337	34 962
France	6 792	84 637	1 145	65 301	39 961	372 538
Greece	1 063	10 829	174	8 648	5 542	59 305
Hungary	853	11 331	149	8 611	5 123	51 944
Ireland	243	4 348	42	3 119	2 086	15 371
Italy	5 975	86 717	1 068	65 381	40 917	366 144
Lithuania	226	2 758	39	2 083	1 305	13 389
Luxembourg	55	1 219	13	767	486	4 120
Latvia	124	1 585	21	1 236	745	7 546
Malta	5	137	1	72	45	396
Netherlands	1 481	16 766	251	9 924	6 752	53 209
Poland	6 617	86 002	998	69 807	57 046	333 679
Portugal	1 056	14 354	159	11 244	8 573	56 303
Romania	805	10 749	132	8 678	6 610	42 677
Slovenia	192	2 767	33	2 114	1 486	11 014
Slovakia	364	6 365	66	4 730	3 407	23 885
United Kingdom	5 154	57 029	886	43 599	40 497	196 959

**Only the EU Member States that have supplied information to the EU are represented In Waterbase UWWTP. For the not EU Member States, no information was available.*

Table 8 Total load per Member State for heavy metals in kg/year for UWWTPs reported in E-PRTR in 2010.

Member State	Cadmium	Copper	Mercury	Nickel	Lead	Zinc
	kg/year					
Austria	16	2 818	915		3 091	87 564
Belgium		3 172	1 157	5	10 794	24 777
Bulgaria	2 001	6 771	5 038	2	15 484	234 424
Cyprus				2		
Czech Republic	298	4 384	2 577	94	2 827	14 572
Denmark						
Estonia		555			214	1 602
Finland	55	1 997	256	8	2 429	12 125
France	1 611	22 295	9 502	158	9 016	136 457
Germany	375	31 533	5 336	207	22 034	157 504
Greece						
Hungary		841	315	105	946	219
Iceland	13	331	133	20	98	531
Ireland	9	355	199	14	1 822	8 344
Italy	3 915	21 571	19 025	404	45 423	127 673
Latvia	7	566	145	9	271	3 660
Lithuania	7	1 086	45	8	910	6 131
Luxembourg						
Netherlands		4 117	1 750	16	4 340	48 145
Norway	5	2 499	140		871	5 596
Poland	570	5 176	4 351	375	5 914	61 900
Portugal	1 391	8 020	8 597	202	8 802	25 358
Romania	551	6 053	2 469		6 533	34 156
Slovakia	7			5		
Slovenia				3	47	1 322
Spain	63	8 617	1 185	33	23 816	96 231
Sweden		3 879	205	6	2 455	10 679
Switzerland	46	1 838	509	4	413	3 888
United Kingdom	296	76 613	6 602	87	24 269	152 917

Table 9 Total load per substance for UWWTPs in all EU Member States and the part which is reported in E-PRTR or calculated in this project in % in 2010.

Substance	UWWTP loads			
	E-PRTR	This Project	Total	Unit
Anthracene	35%	65%	177	kg
Fluoranthene	7%	93%	791	kg
Cadmium	13%	87%	61	ton
Copper	25%	75%	853	ton
Mercury	17%	83%	10	ton
Nickel	29%	71%	666	ton
Lead	17%	83%	409	ton
Zinc	33%	67%	3 775	ton
Nutrient-N	46%	54%	729	kton
Nutrient-P	44%	56%	84	kton
TOC	34%	66%	893	kton

Spatial allocation

The methodology of the spatial allocation of the UWWTP loads to the River Basin District Subunit level (RBDSU) level contains following main step:

1. Regionalization of the gridded emission values to the RBDSU level:
   Allocation of the emission loads available on UWWTP (point source) level to the RBDSU areas [5] based on different ArcGIS and database calculation steps [6 – 9].

Literature

[1] Waterbase – UWWTD: Urban Waste Water Treatment Directive, December 06, 2012 url:http://www.eea.europa.eu/data-and-maps/data/waterbase-uwwtd-urban-waste-water-treatment-directive. *On the database has been a filtering with QA/QC flags of the Cenia.cz, oktober 2012. Besides that loads from Denmark are divided by 1000 to get tons instead of kilograms.*

[2] E-PRTR, pollutant releases database, year 2010. url: http://prtr.ec.europa.eu/PollutantReleases.aspx .

[3] RWZI-base. Database with loads to surface water for nutrients and heavy metals for 370 Dutch UWWTPs. CBS, 2011.

[4] Diffuse bronnen van waterverontreiniging, CUWVO werkgroep VI, Den Haag. 1986 Pieters B.J., et all, Verbetering schatting effluentvrachten RWZI's, Grontmij, oktober 2011: Duijnhoven, N. van , Oplegnotitie 2: herberekening PAK effluenten EmissieRegistratie, 2012, 1204148-003-ZWS-0014.

[5] WISE River Basin Districts (RBDs) and/or their subunits (RBDSUs), Version 1.4 (06/2011) (URL: http://www.eea.europa.eu/data-and-maps/data/wise-river-basin-districts-rbds-1 , 20.12.2013).

[6] EUROSTAT Economically active population, 2008: Economically active population by sex and age, at NUTS levels 1, 2 and 3 (1000) from EUROSTAT for 2008 (EUROSTAT [lfst_r_lfp3pop] (URL:

http://appsso.EUROSTAT.ec.europa.eu/nui/show.do?dataset=lfst_r_lfp3pop&lang=en , 10.12.2010).

[7] CLC90, 2010: EEA: CORINE Land Cover 1990 (CLC90) (URL: http://www.eea.europa.eu/data-and-maps/ figures/geographic-view-of-corine-land-cover-clc90-switzerland , 02.07.2010).

[8] CLC2000, 2010: EEA: CORINE Land Cover 2000 100 m (CLC2000) (URL: http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-clc2000-seamless-vector-database , 02.07.2010).

[9] CLC2006, 2010: EEA: CORINE Land Cover 2006 Version 02/2010 (CLC2006) (URL: http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster , 02.07.2010).

5.2 Map 14 TOC emissions from UWWTPs not in E-PRTR

Short Title:	TOC emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)
Full Title:	Map: TOC emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows TOC emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of TOC are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: TOC emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Geographic Information System (GIS) overlay

Diffuse emissions of TOC to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:
Map: TOC emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

TOC emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

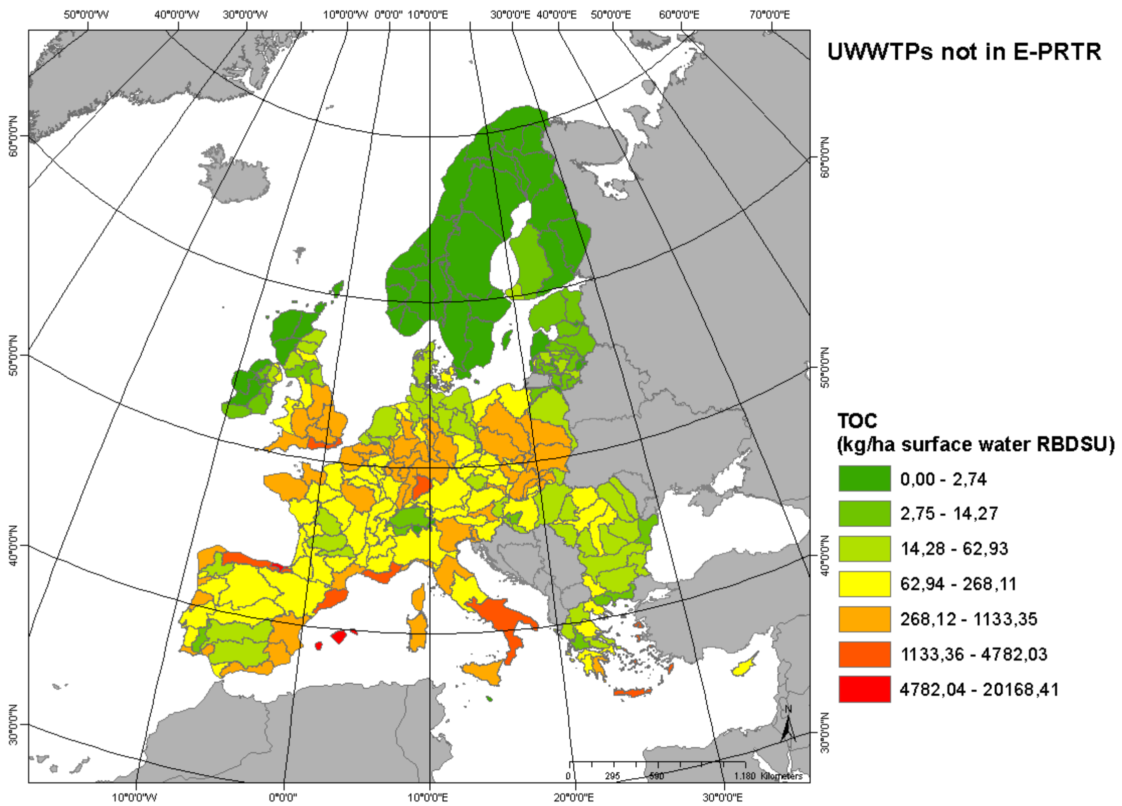
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 14



5.3 Map 15 Nutrient-P emissions from UWWTPs not in E-PRTR

Short Title: Nutrient-P emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)

Full Title: Map: Nutrient-P emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

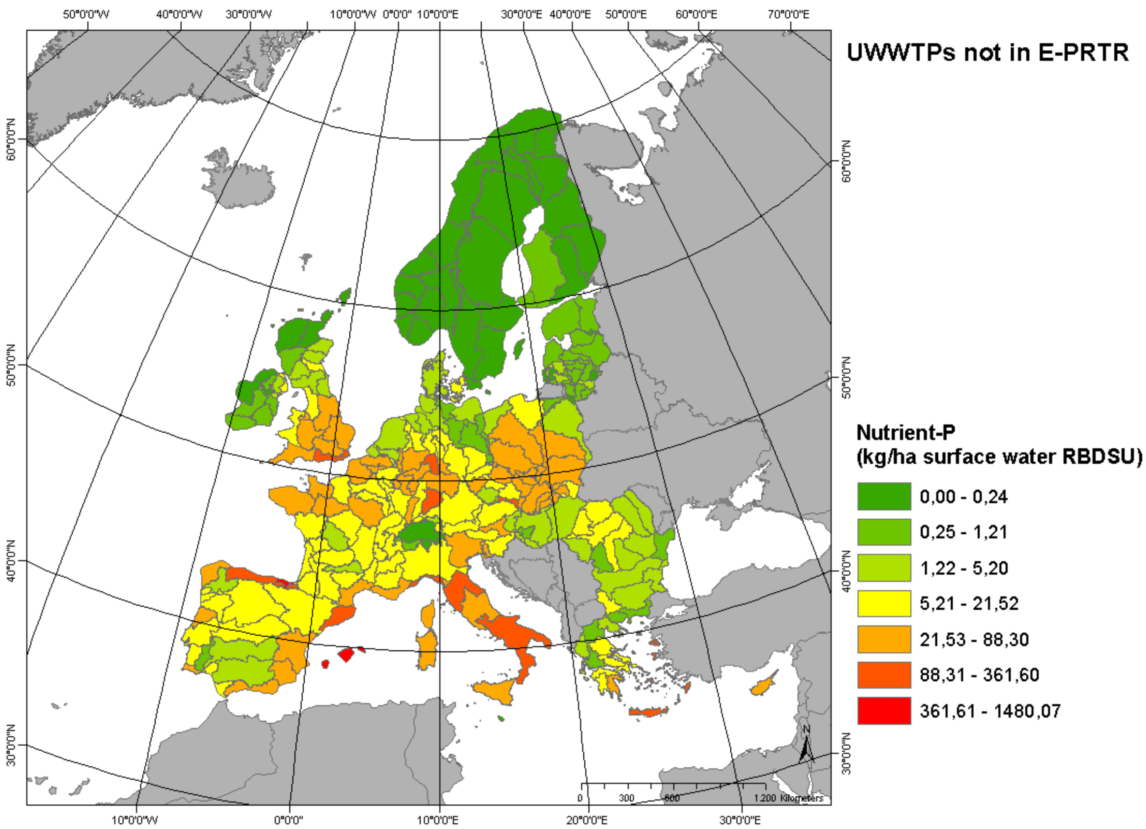
Diffuse Sources / General information:
The map shows Nutrient-P emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of Nutrient-P are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Nutrient-P emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of Nutrient-P to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.
Comparability
Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:
Map: Nutrient-P emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Emissions data
Nutrient-P emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.
Population data
Population statistics from EUROSTAT for the year 2008.
Facility data
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.
Land use data
CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 15



5.4 Map 16 Nutrient-N emissions from UWWTPs not in E-PRTR

Short Title:	Nutrient-N emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)
Full Title:	Map: Nutrient-N emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows Nutrient-N emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of Nutrient-N are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Nutrient-N emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of Nutrient-N to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources,

population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Nutrient-N emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Nutrient-N emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

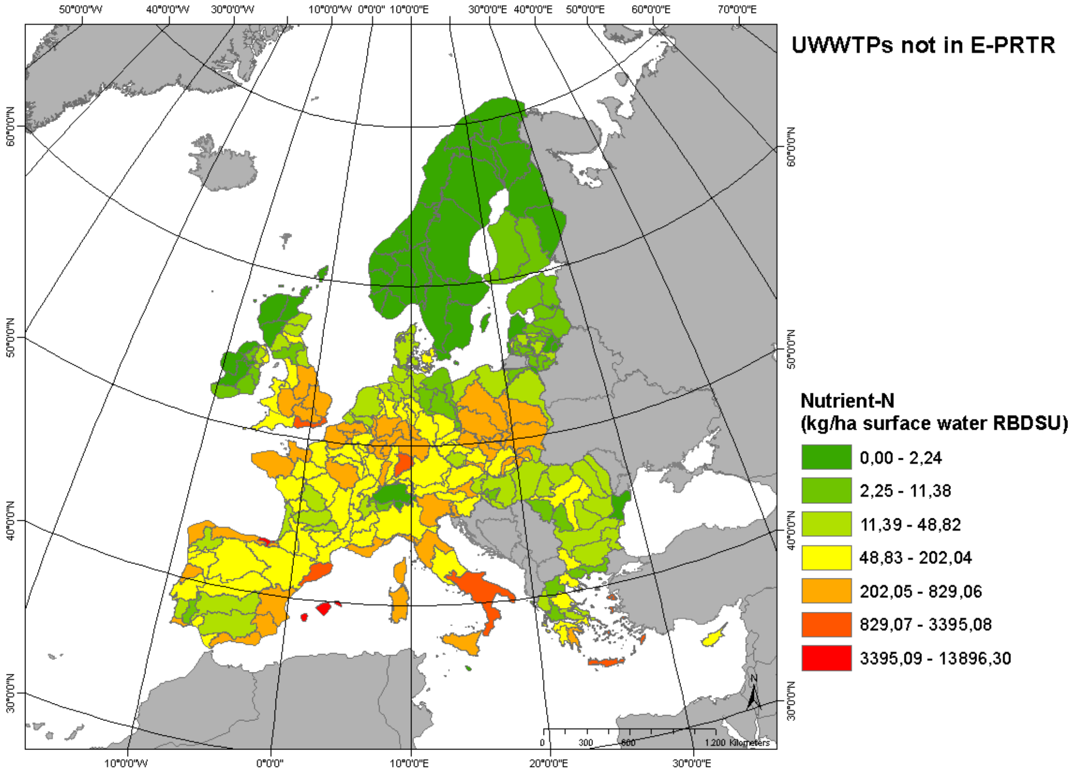
Facility data

Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 16



5.5 Map 17 Cadmium emissions from UWWTPs not in E-PRTR

Short Title:	Cadmium emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)
Full Title:	Map: Cadmium emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows cadmium emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of cadmium are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Cadmium emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of cadmium to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Cadmium emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Cadmium emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

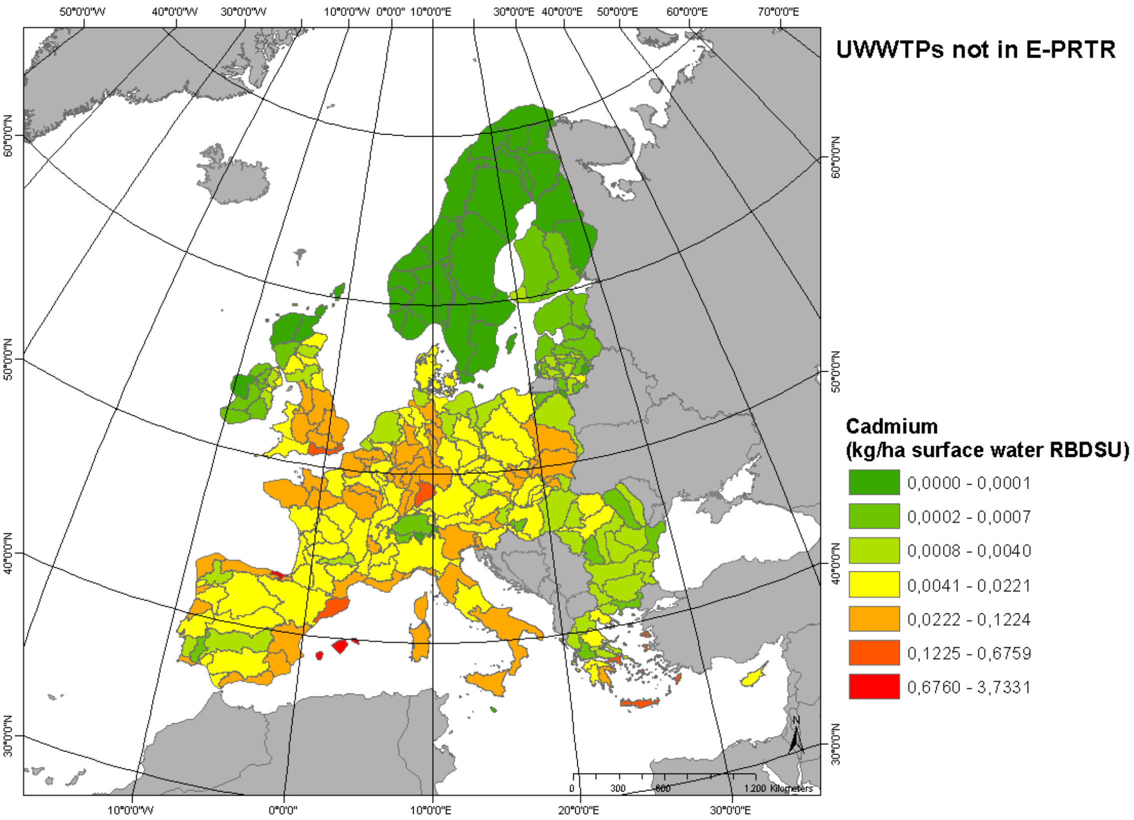
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 17



5.6 Map 18 Lead emissions from UWWTPs not in E-PRTR

Short Title: Lead emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)

Full Title: Map: Lead emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows lead emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of lead are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Lead emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of lead to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Lead emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Lead emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

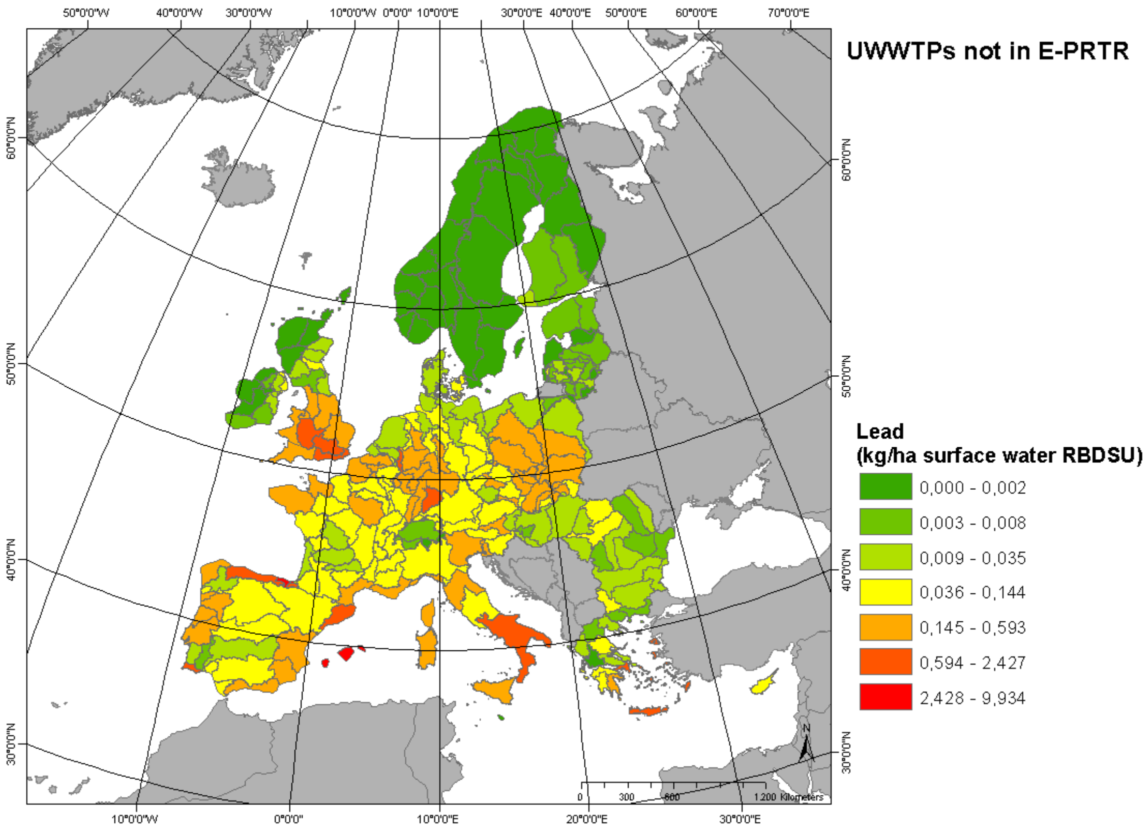
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 18



5.7 Map 19 Mercury emissions from UWWTPs not in E-PRTR

Short Title:	Mercury emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)
Full Title:	Map: Mercury emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows mercury emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of mercury are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Mercury emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of mercury to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Mercury emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Mercury emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

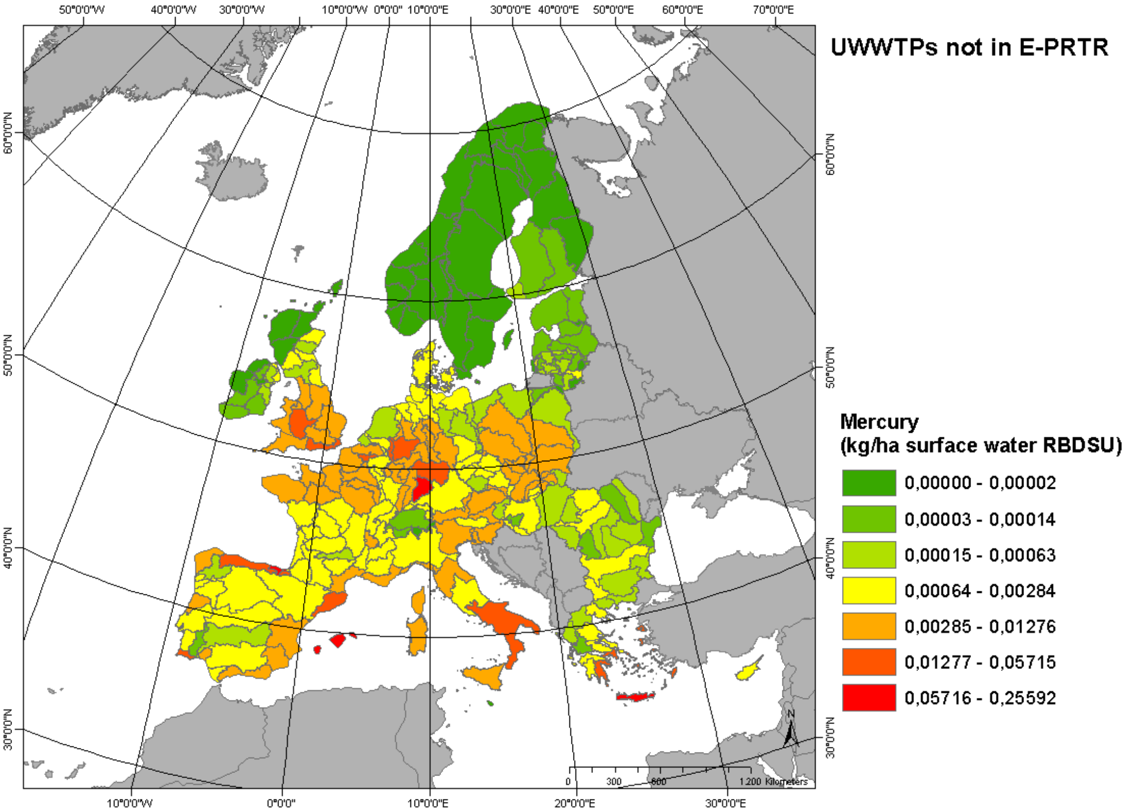
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 19



5.8 Map 20 Nickel emissions from UWWTPs not in E-PRTR

Short Title:	Nickel emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)
Full Title:	Map: Nickel emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:

The map shows nickel emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of nickel are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:

Map: Nickel emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Geographic Information System (GIS) overlay

Diffuse emissions of nickel to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Nickel emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Nickel emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

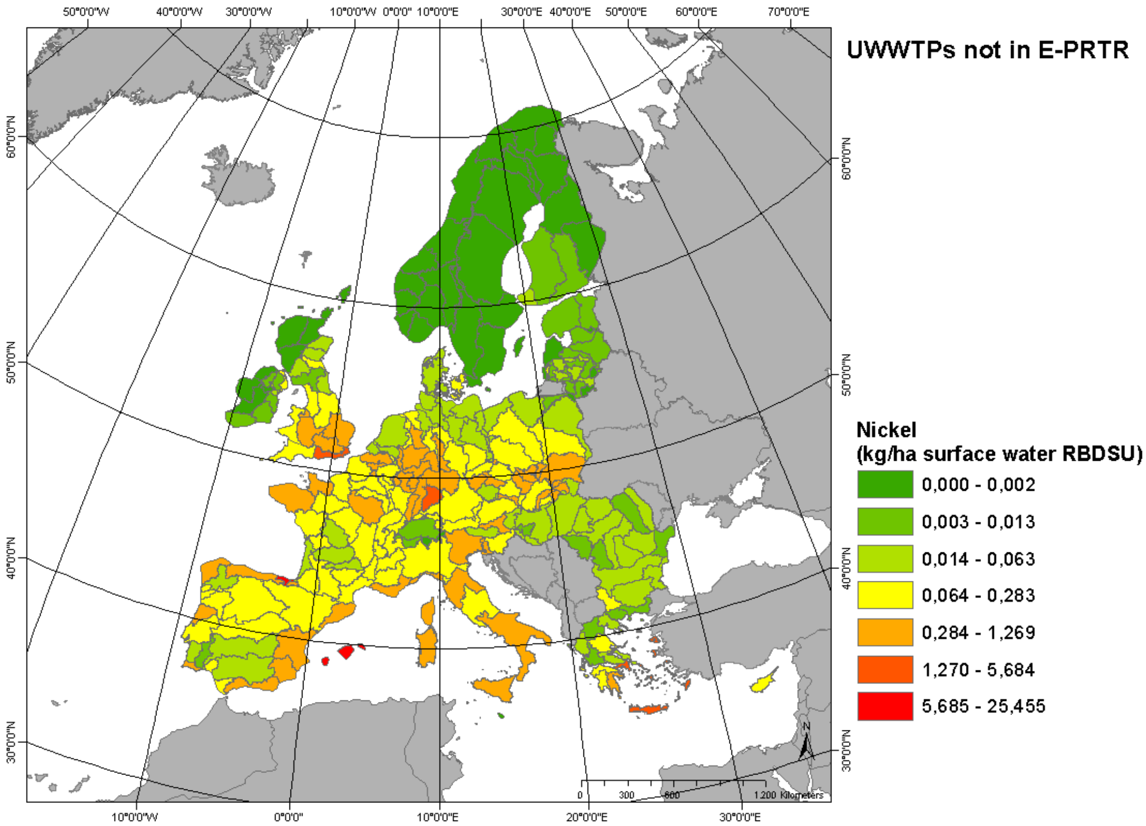
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 20



5.9 Map 21 Anthracene emissions from UWWTPs not in E-PRTR

Short Title: Anthracene emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)

Full Title: Map: Anthracene emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows anthracene emissions to surface water from UWWTPs countries per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of anthracene are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Anthracene emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of anthracene to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Anthracene emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Anthracene emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

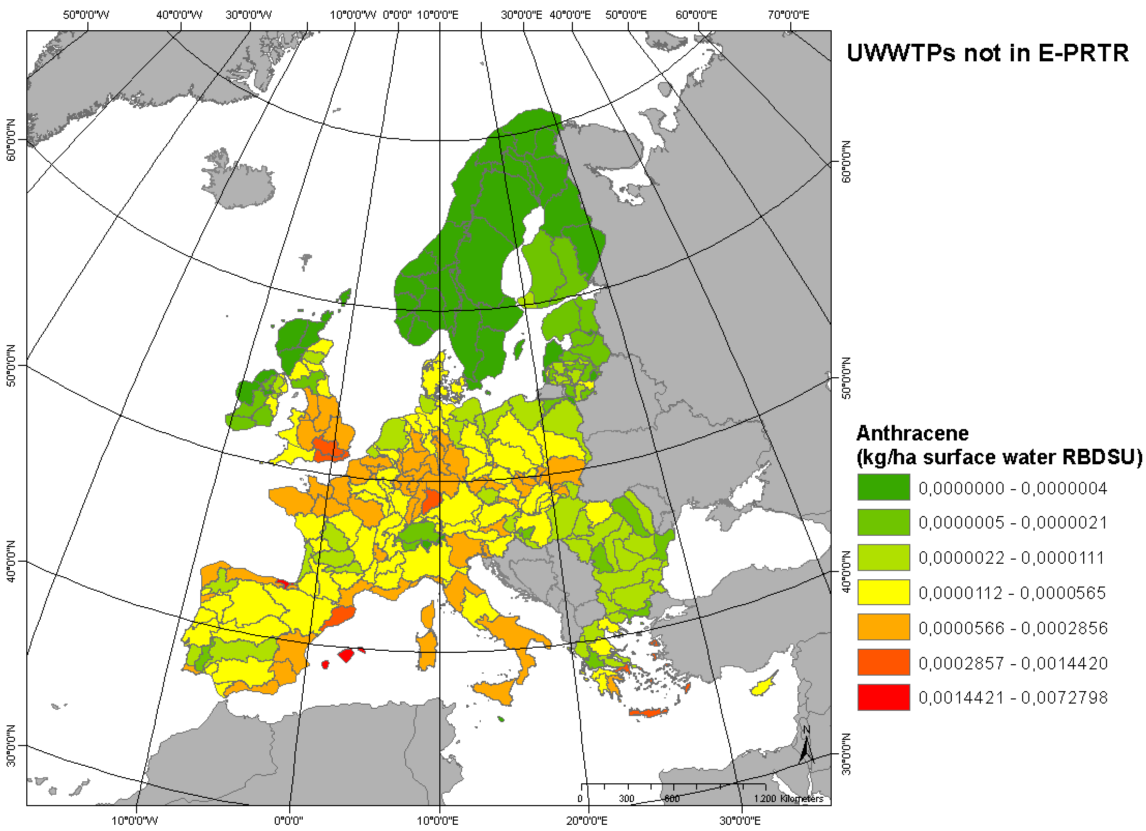
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 21



5.10 Map 22 Fluoranthene emissions from UWWTPs not in E-PRTR

Short Title: Fluoranthene emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)

Full Title: Map: Fluoranthene emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows fluoranthene emissions to surface water from UWWTPs countries per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of fluoranthene are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Fluoranthene emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of fluoranthene to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Fluoranthene emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Fluoranthene emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

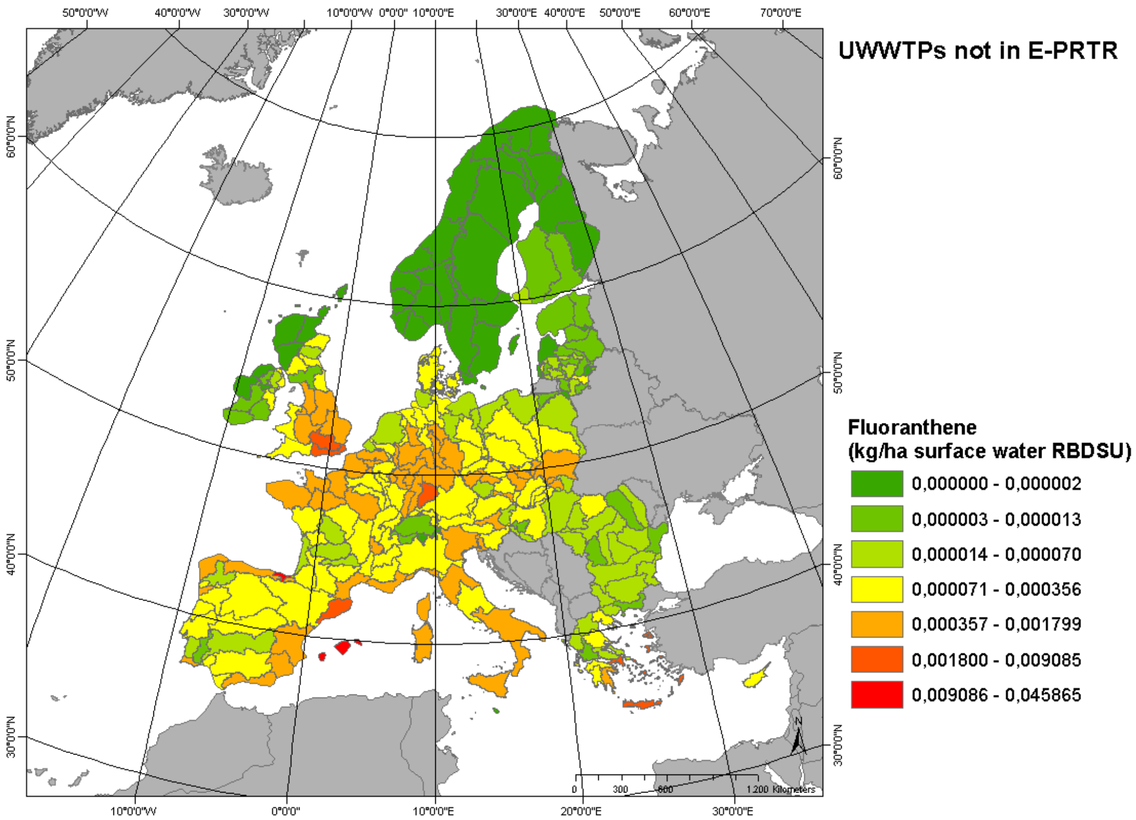
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 22



5.11 Map 23 Copper emissions from UWWTPs not in E-PRTR

Short Title:	Copper emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)
Full Title:	Map: Copper emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows copper emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of copper are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Copper emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of copper to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Copper emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Copper emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

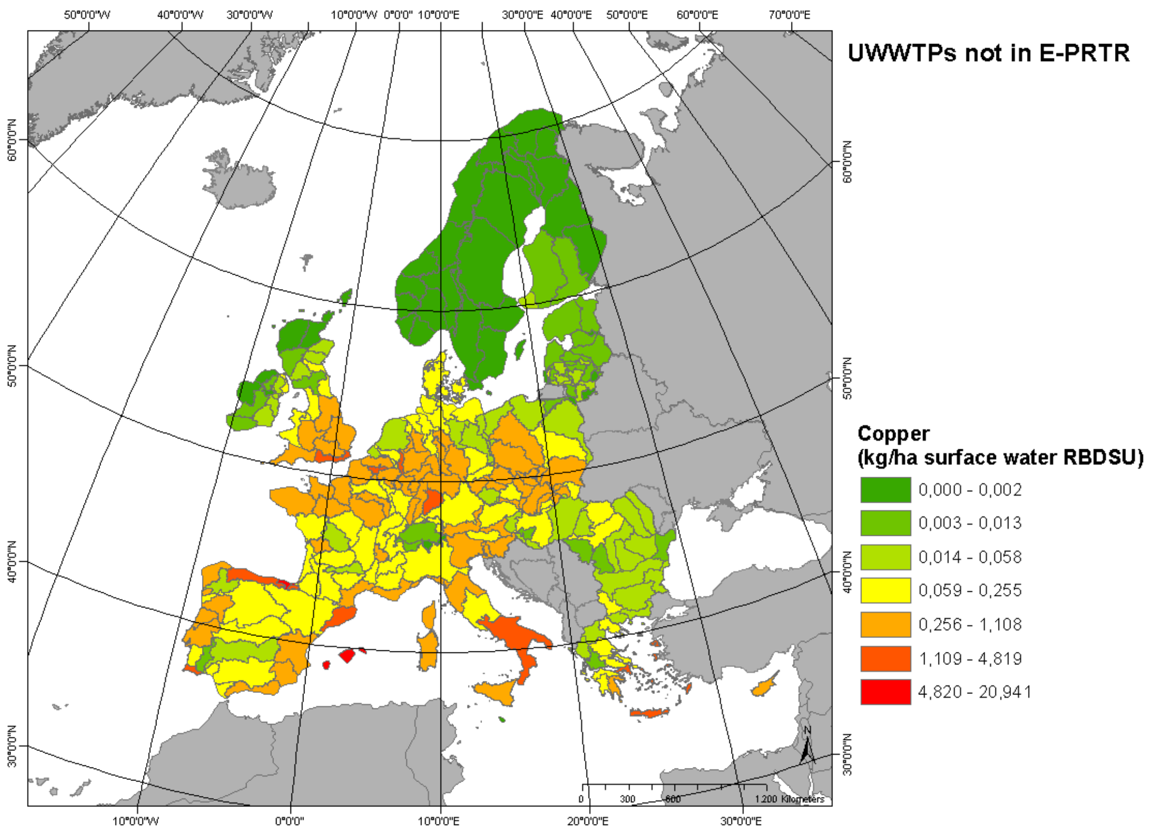
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 23



5.12 Map 24 Zinc emissions from UWWTPs not in E-PRTR

Short Title:	Zinc emissions from UWWTPs not in E-PRTR (kg/ha surface water RBDSU)
Full Title:	Map: Zinc emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows zinc emissions to surface water from UWWTPs per River Basin District Subunit (RBDSU) level for the reference year 2010, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of zinc are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Zinc emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System (GIS) overlay
Diffuse emissions of zinc to surface water from UWWTP were spatially allocated to the RBDSU level according to the Waterbase – UWWTD: Urban Waste Water Treatment Directive, and to the E-PRTR, using the geographical location of the emission sources, population statistics, and land use information. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions is dependent on distribution of UWWTPs across Europe, their spatial density and the level of their activities.
- The spatial variation is linked to the allocation of population data on the regional level.

Diffuse Sources / Source Data:

Map: Zinc emissions from UWWTPs not in E-PRTR, load to surface water (kg/ha surface water RBDSU)

Emissions data

Zinc emissions to surface water from UWWTPs for the year 2010 are based on data sets officially reported to the EU for the UWWTD. To select the UWWTPs which are used to calculate the loads to surface water, a few steps are taken, which are described in detail in the in a source sector specific fact sheet.

Population data

Population statistics from EUROSTAT for the year 2008.

Facility data

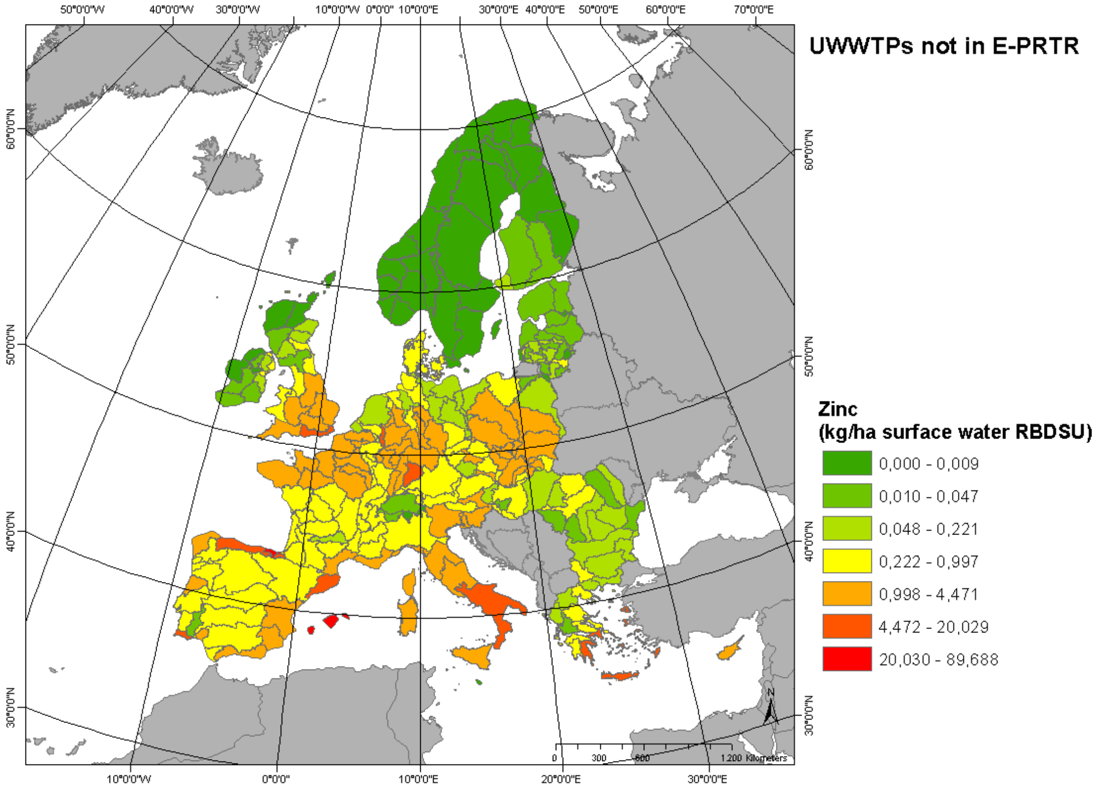
Waterbase – UWWTD: Urban Waste Water Treatment Directive data base for the reporting year 2010.

Land use data

CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries and to calculate the surface water areas by RBDSU.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 24


UWWTPs not in E-PRTR
Zinc
(kg/ha surface water RBDSU)
0,000 - 0,009
0,010 - 0,047
0,048 - 0,221
0,222 - 0,997
0,998 - 4,471
4,472 - 20,029
20,030 - 89,688

6 Un-connected households

6.1 Factsheet

Introduction

This factsheet covers emissions resulting from the discharge of domestic wastewater, not connected to a sewer system. This emission source is allocated to these “un-connected households”. The wastewater loads will reach the surface water directly, will infiltrate in the soil or will be collected and treated in e.g. septic tanks.

Domestic wastewater originates from dwellings, offices, shops and companies. The water primarily comprises tap water, including emissions due to corrosion of the pipe system, human excretions and food remains, dishwasher detergent and diffuse emissions from products (paint, oil, etc.). Non-domestic emissions from (small-scale) industries are not included.

This factsheet describes a method to estimate the emissions of nutrients, total organic carbon (TOC), heavy metals and polycyclic aromatic hydrocarbons (PAHs) from the un-connected households.

Development of a methodology

The sewer system and Urban Waste Water Treatment Plants collect and treat polluted water, meeting requirements prior to discharge into surface water. Not all the pollution is removed (varying according to the substance in question and the kind of treatment), meaning that discharges from the system contribute to surface water pollution. Not all the polluted water from households will reach the sewer system. A part of the households is not connected to a sewer system. This fact sheet presents a calculation method for emissions caused by un-connected households, see the left side of figure 1.

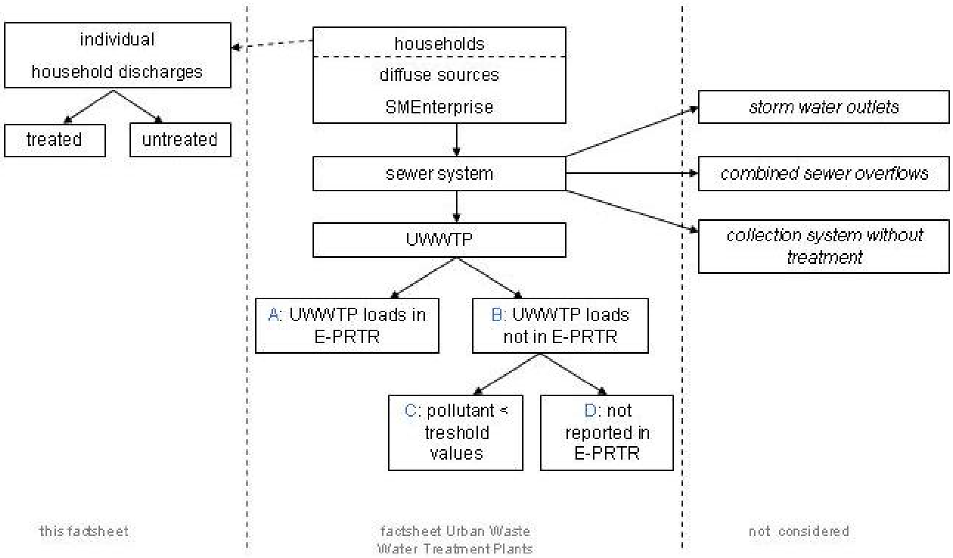


Figure 1 Emissions to and from a sewer system and the calculation thereof.

The loads of the UWWTPs, in the middle of figure 1, are described in the factsheet Urban Waste Water Treatment Plants. On the right sight of the figure, the untreated sewer discharge water of the sewer system; storm water outlets, combined sewer overflows and collection systems without treatment are represented. These sources are not presented in this factsheet or in other factsheets of this project, because the total load per substance to the sewer system has to be known. Such information is not available in this project and calculations can not be made.

Explanation of the calculation method

The emissions of the un-connected households are calculated by using the next formula:

Un-connected households: $Emission = AR \times EF \times \%\ WT \times PW_w$

Where:
AR = Number of inhabitants in the NUTS areas in 2008
EF = Emission factor per substance per inhabitant (kg)
%WT = % of the generated load per agglomeration without treatment in 2010
PW_w *= the pathway to surface water (in %)*

The calculation follows a number of steps:
1. Firstly, the percentage of the wastewater (in population equivalent: p.e.) from agglomerations that is not treated is determined. The wastewater not treated is the wastewater not collected through collecting systems and not addressed through IAS (Individual and other Appropriate System). These loads reach the surface water without treatment or will infiltrate in the soil. This information is taken from the UWWTD database [1]. Member states have reported the rate (%) of the untreated generated load per agglomeration.
2. The next step is the calculation of the amount of un-connected households (inhabitants). Therefore the number of inhabitants in the NUTS regions is multiplied by the percentage not treated in the NUTS region.
3. The third step is the calculation of the emissions for the un-connected households. Therefore the emissions are calculated by multiplying the result of step 2 by an emission factor (EF) for each substance, expressed in emission per inhabitant. The emission calculated in this way is referred to as the total emission per NUTS region. A certain part of the emissions will end up in the compartment surface water and a part in the compartment soil.
4. And finally, the emissions per nuts are calculated by multiplying the pathway to surface water (%) with the calculated emission in step 3.

The generated loads of wastewater are reported per agglomeration by Member States. For this factsheet, they have been aggregated or disaggregated to the finest NUTS region possible, NUTS3, because Member States have reported in three different NUTS levels.
The total emission per NUTS area is regionalised to the River Basin Districts and their subunits.

Activity rates
For the calculations, an emission factor per substance per inhabitant is used. Therefore the activity rate for this factsheet is the number of inhabitants per NUTS region [3]. For all Member States the number of inhabitants per NUTS region is available in EUROSTAT.

Emission factors

For the un-connected households two kinds of emission factors are used:

- Inhabitants per year

This emission factor is expressed in mg per inhabitant per year. Information on emission factors is taken from international studies about emissions from dwellings [2]. Emission factors for a large number of substances over a number of years based on extensive literature research on domestic wastewater are available. The emission factors for 2010 are shown in table 1.

Table 1 Emission factor per inhabitant per year (g/inhabitant, year), [2].

Substance	Emission Factor (g/inhabitant, year)
Nutrient-P	791
Nutrient-N	4 285
Total Organic Carbon	39 055
Cadmium	0.05
Copper	6.54
Mercury	0.018
Lead	0.79
Nickel	0.50
Zinc	10.29
Anthracene	0.000705
Fluoranthene	0.025

- % untreated wastewater per NUTS

In the database of the Urban Waste Water Directive [1] Member States report information about the percentage of the generated load per NUTS region without treatment (definition: rate of generated load of agglomerations not collected through collecting system and not addressed through IAS, in % of p.e.). In table 2, the information per Member State is aggregated to an average national percentage per Member State. In the percentages in Table 2, the loads addressed through septic tanks are not included. For the calculations the percentage of surface water per NUTS region is used. There might be some doubt about the accuracy of the figures in the UWWTP database. About half of the Member States have supplied a zero percentage of untreated wastewater in their country, which seems not very realistic. An explanation for this might be that in the UWWTP database mostly generated pollution from agglomerations > 2000 p.e. are included and not the smaller agglomerations.

Table 2 Percentage of the generated load of domestic wastewater without treatment per Member State [1].

Member State	Untreated load (%)		Member State	Untreated load (%)
Austria	0%		Italy	0.9%
Belgium	1.9%		Lithuania	0%
Bulgaria	41%		Luxembourg	0%
Cyprus	83%		Latvia	33%
Czech Republic	0%		Malta	0%
Germany	0%		Netherlands	0%
Denmark	0%		Poland	11%
Estonia	9.7%		Portugal	0.6%
Spain	1.1%		Romania	87%
Finland	0%		Sweden	0%

Member State	Untreated load (%)		Member State	Untreated load (%)
France	1.8%		Slovenia	28%
Greece	0%		Slovakia	1.2%
Hungary	0%		United Kingdom	0%
Ireland	0%			

Emission pathways to water
The loads without treatment will go merely to the soil system, but a (small) part may go to the surface water. For this project, the ratio of surface water/soil in a NUTS region is used to calculate emissions to surface water. The percentage of surface water in a NUTS region is taken as the percentage of the loads from the untreated households that end up in the surface water. Table 3 shows the average percentage of surface water area per Member State. It is realised this is a rough approximation, but additional data are not available.

Table 3 Percentage of total area of Member States that consists of surface water [4].*

Member State	Surface Water (%)		Member State	Surface Water (%)
Austria	1.09		Iceland	8.67
Belgium	0.78		Italy	0.79
Bulgaria	0.96		Liechtenstein	2.5
Switzerland	1.98		Lithuania	2.7
Cyprus	0.23		Luxembourg	0.38
Czech Republic	0.84		Latvia	4.28
Germany	1.39		Netherlands	9.58
Denmark	1.75		Norway	10.88
Estonia	4.82		Poland	1.82
Spain	0.71		Portugal	0.8
Finland	15.93		Romania	3
France	0.62		Sweden	14.75
Greece	1.01		Slovenia	0.51
Hungary	2.81		Slovakia	0.7
Ireland	16.61		United Kingdom	3.08

** for Malta is calculated with 0% inland surface water*

Emissions
The total emissions to surface water are calculated for all the River Basis Districts. In table 4 the total emissions per EU Member State are shown for nutrients and PAHs, in table 5 the total emissions for heavy metals. Please note that these are the loads to surface water and thus emissions corrected for the percentage surface water area in the NUTS region.

The calculated loads seem to be very low, mainly as a result of excluding septic tanks, the assumption only a very small percentage of the untreated wastewater will be discharged to the surface water and the low percentage of untreated wastewater reported by a number of Member States.

Table 4 Loads to surface water from un-connected households excluding septic tanks per Member State, nutrients (ton/y) and PAHs (g/y) in 2008.

Member State*	Nutrient-N	Nutrient-P	TOC	Anthracene	Fluoranthene
	ton/y			g/y	
Austria	0	0	0	0	0
Belgium	0.10	0.02	0.92	0.02	0.59
Bulgaria	61	11	553	10	354
Cyprus	6.4	1.2	59	1.06	38
Czech Republic	0	0	0	0	0
Germany	0	0	0	0	0
Denmark	0	0	0	0	0
Estonia	5.4	1.0	49	0.89	32
Spain	0.01	0.002	0.10	0.002	0.065
Finland	0	0	0	0	0
France	0.15	0.03	1.4	0.03	0.89
Greece	0	0	0	0	0
Hungary	0	0	0	0	0
Ireland	0	0	0	0	0
Italy	0.09	0.02	0.79	0.01	0.50
Lithuania	0	0	0	0	0
Luxembourg	0	0	0	0	0
Latvia	22	4.1	202	3.64	129
Malta	0	0	0	0	0
Netherlands	0	0	0	0	0
Poland	16	3.0	150	2.71	96
Portugal	0.01	0.002	0.10	0.002	0.062
Romania	48	8.8	435	7.85	278
Sweden	0	0	0	0	0
Slovenia	1.4	0.26	13	0.23	8.10
Slovakia	0.25	0.05	2.3	0.04	1.44
United Kingdom	0	0	0	0	0

**=Only the EU Member States that have supplied information to the EU are represented In Waterbase UWWTP. For the not EU Member States, no information was available.*

Table 5 Loads to surface water from un-connected households per Member State, heavy metals (kg/y).

Member State*	Cadmium	Copper	Lead	Mercury	Nickel	Zinc
	kg/y					
Austria	0	0	0	0	0	0
Belgium	0.001	0.15	0.02	0.00	0.01	0.24
Bulgaria	0.71	93	11	0.25	7.1	146
Cyprus	0.08	9.8	1.2	0.03	0.75	15
Czech Republic	0	0	0	0	0	0
Germany	0	0	0	0	0	0
Denmark	0	0	0	0	0	0
Estonia	0.06	8.3	1.00	0.02	0.63	13
Spain	0.00	0.02	0.00	0.00	0.00	0.03
Finland	0	0	0	0	0	0
France	0.00	0.23	0.03	0.00	0.02	0.37
Greece	0	0	0	0	0	0
Hungary	0	0	0	0	0	0

Member State*	Cadmium	Copper	Lead	Mercury	Nickel	Zinc
	kg/y					
Ireland	0	0	0	0	0	0
Italy	0.00	0.13	0.02	0.00	0.01	0.21
Lithuania	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0
Latvia	0.26	34	4.1	0.09	2.6	53
Malta	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0
Poland	0.19	25	3.0	0.07	1.9	39
Portugal	0.00	0.02	0.00	0.00	0.00	0.03
Romania	0.56	73	8.8	0.20	5.6	115
Sweden	0	0	0	0	0	0
Slovenia	0.02	2.12	0.26	0.01	0.16	3.3
Slovakia	0.00	0.38	0.05	0.00	0.03	0.59
United Kingdom	0	0	0	0	0	0

**Only the EU Member States that have supplied information to the EU are represented In Waterbase UWWTP. For the not EU Member States, not all the necessary information for the calculation of the loads was available.*

Spatial allocation

The methodology for the spatial distribution of emissions from un-connected households contains the following main steps:

1. Regionalisation of the national totals to the NUTS3 regions.
   The number of employees [3] and the population data [5] are used for the regionalisation of the diffuse releases from not connected households.
2. Gridding.
   The allocation of emissions regionalized on NUTS 3 level to a 5 km x 5 km grid cell resolution is based gridded population data [5] and information concerning the urbanization degree [4, 6]. The gridding methodology used is similar to the methodology and described in IER 2011 [8].
3. Regionalisation of the gridded emission values to RBDSUs.
   Allocation of the gridded emission data to the RBDSU areas [7] based on different ArcGIS [9-11] and database calculation steps.

Literature

[1] Waterbase – UWWTD: Urban Waste Water Treatment Directive, December 06, 2012. url: http://www.eea.europa.eu/data-and-maps/data/waterbase-uwwtd-urban-waste-water-treatment-directive.

[2] Netherlands National Water Board – Water Unit in cooperation with Deltares and TNO. Emission estimates for diffuse sources, Netherlands Emission Inventory, Domestic waste water, 2011.

[3] EUROSTAT Economically active population, 2008: Economically active population by sex and age, at NUTS levels 1, 2 and 3 (1000) from EUROSTAT for 2008 (EUROSTAT [lfst_r_lfp3pop] (URL: http://appsso.EUROSTAT.ec.europa.eu/nui/show.do?dataset=lfst_r_lfp3pop&lang=en , 10.12.2010).

[4] EUROSTAT-GISCO – The Degree of Urbanization (DGUR) classifies 2001 European census communes into three urbanization categories: densely, intermediate or thinly populated areas (URL:

http://epp.EUROSTAT.ec.europa.eu/portal/page/portal/gisco/popups/references/Population%20Distribution%20-%20Demography , 07.07.2010).

[5] EEA/JRC, 2010: EEA/Joint Research Centre (2010): Population density disaggregated with CORINE Land Cover 2000 (URL: http://www.eea.europa.eu/data-and-maps/data/population-density-disaggregated-with-corine-land-cover-2000-2 , 2010).

[6] GISCO, 2010: Geographic Information System of the European Commission (EUROSTAT), (URL: http://epp.EUROSTAT.ec.europa.eu/portal/page/portal/gisco/geodata/reference , 2010).

[7] WISE River Basin Districts (RBDs) and/or their subunits (RBDSUs), Version 1.4 (06/2011) (URL: http://www.eea.europa.eu/data-and-maps/data/wise-river-basin-districts-rbds-1 , 20.12.2013).

[8] IER, 2011: Theloke et al. (2011): Methodology development for the spatial distribution of the diffuse emissions in Europe - http://circa.europa.eu/Public/irc/env/e_prtr/library?l=/diffuse_releases_e-prtr/methodology_2011/_EN_1.0_&a=d.

[9] CLC90, 2010: EEA: CORINE Land Cover 1990 (CLC90) (URL: http://www.eea.europa.eu/data-and-maps/ figures/geographic-view-of-corine-land-cover-clc90-switzerland , 02.07.2010).

[10] CLC2000, 2010: EEA: CORINE Land Cover 2000 100 m (CLC2000) (URL http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-clc2000-seamless-vector-database , 02.07.2010).

[11] CLC2006, 2010: EEA: CORINE Land Cover 2006 Version 02/2010 (CLC2006) (URL: http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster , 02.07.2010).

6.2 Map 25 TOC emissions from un-connected households

Short Title: TOC emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: TOC emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows TOC emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of TOC are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: TOC emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Geographic Information System overlay:

TOC emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 level from EUROSTAT GISCO and raster population data from JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:
Map: TOC emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

TOC emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all relevant EU27 and EFTA4 countries.

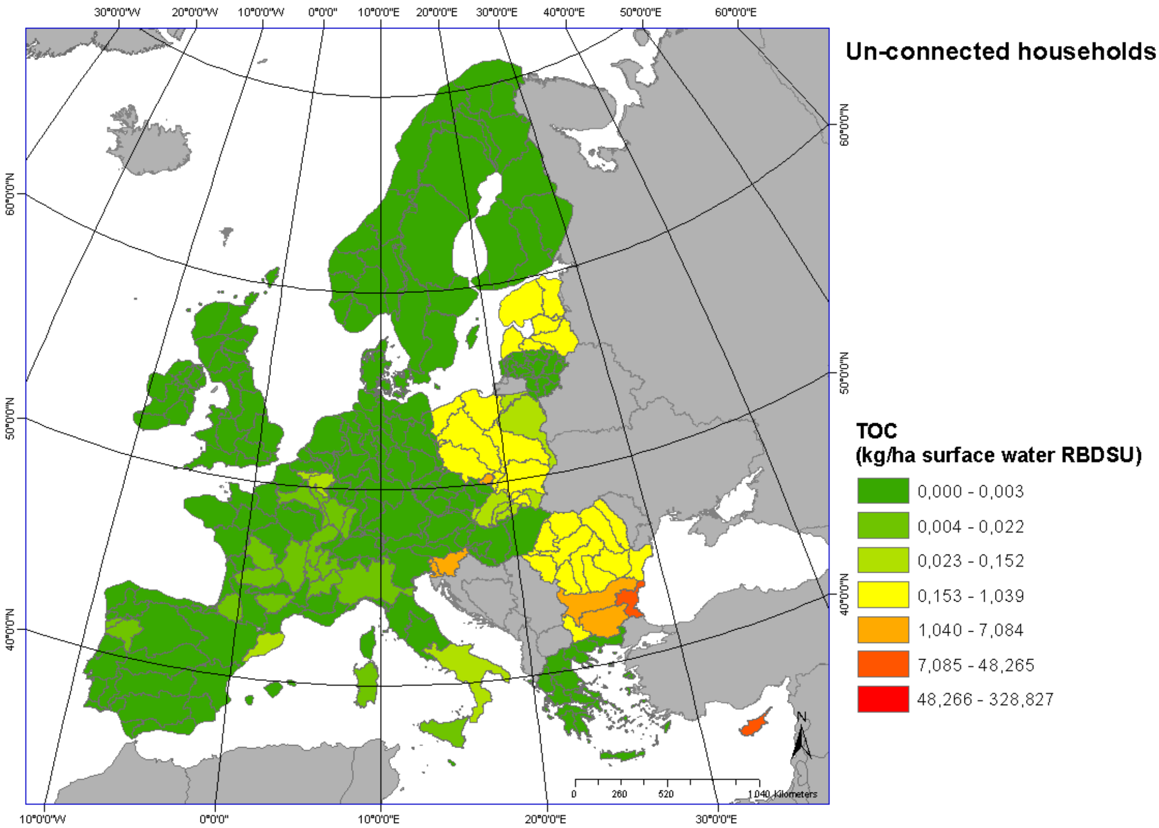
Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 25



6.3 Map 26 Nutrient-P emissions from un-connected households

Short Title: Nutrient-P emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: Nutrient-P emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows nutrient-P emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of nutrient-P are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Nutrient-P emissions from un-connected households not in E-PRTR, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Nutrient-P emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from

JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Nutrient-P emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Nutrient-P emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

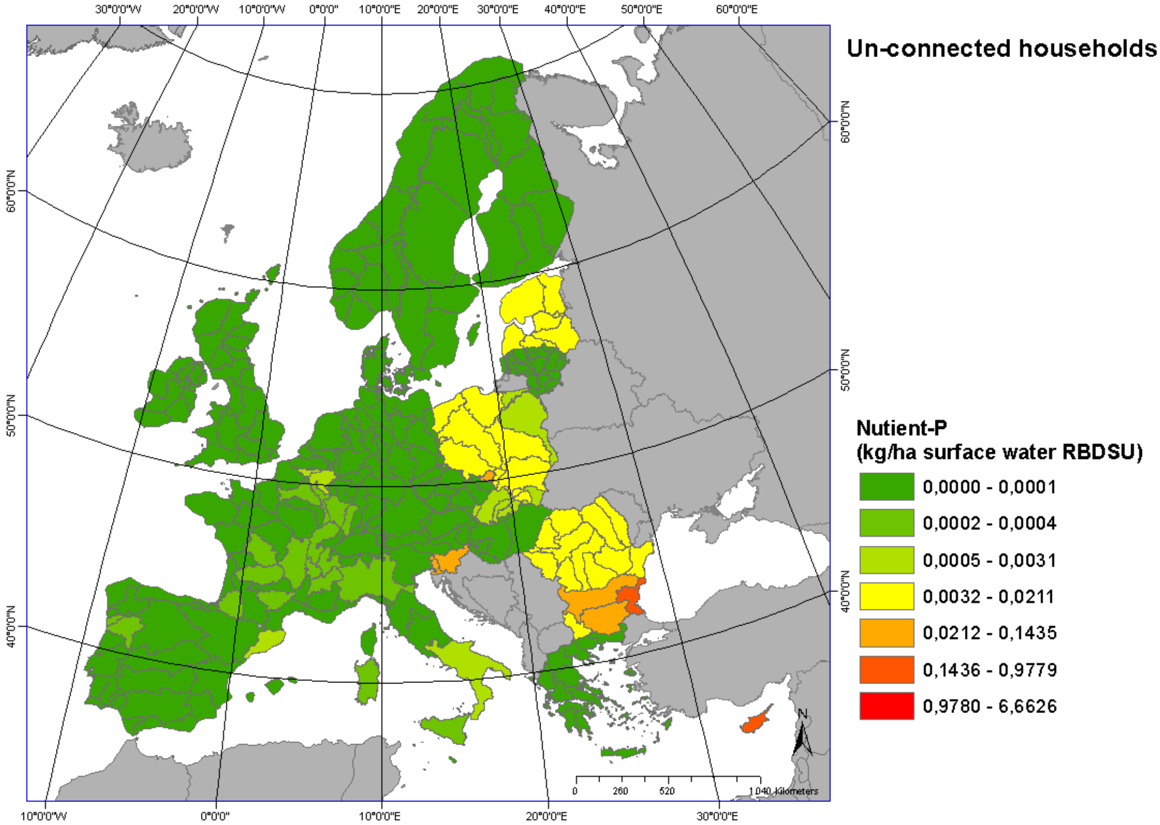
Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 26



6.4 Map 27 Nutrient-N emissions from un-connected households

Short Title: Nutrient-N emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: Nutrient-N emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows nutrient-N emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of nutrient-N are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Nutrient-N emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Nutrient-N emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from

JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Nutrient-N emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Nutrient-N emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

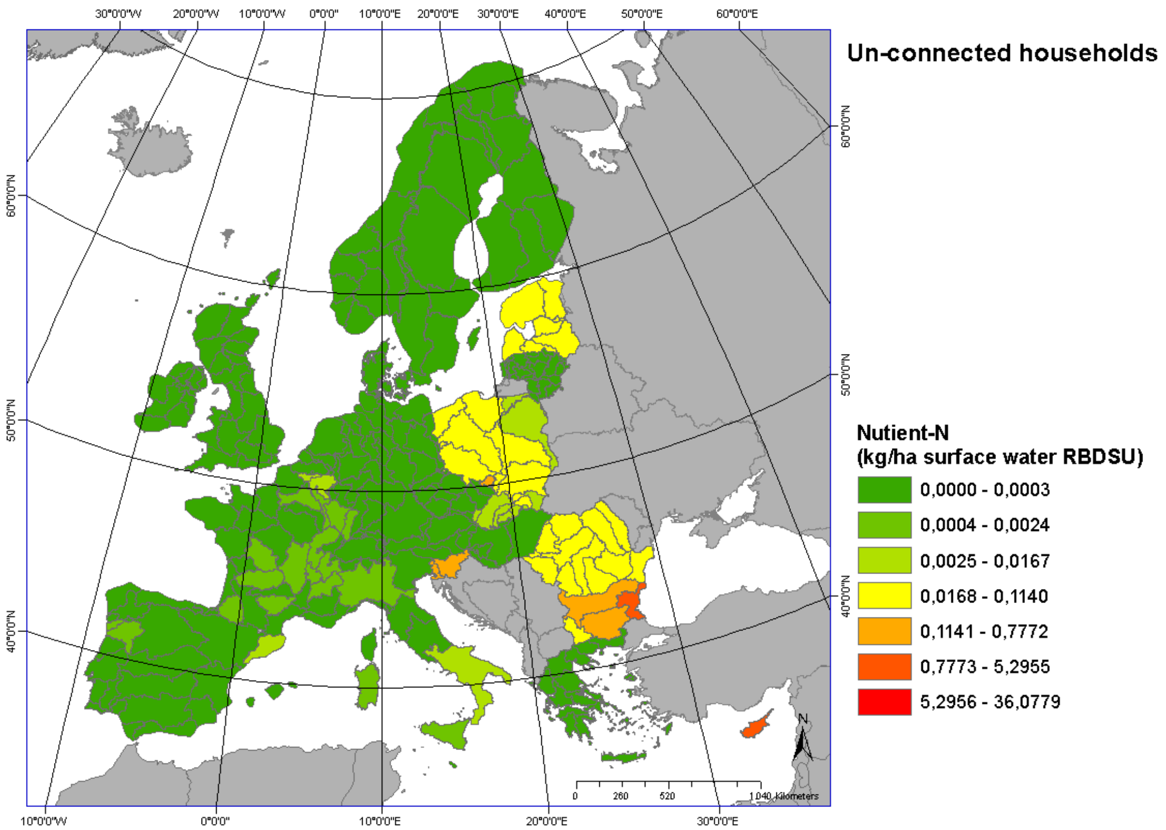
Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 27



6.5 Map 28 Cadmium emissions from un-connected households

Short Title: Cadmium emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: Cadmium emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows cadmium emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of cadmium are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Cadmium emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Cadmium emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from

JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Cadmium emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Cadmium emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

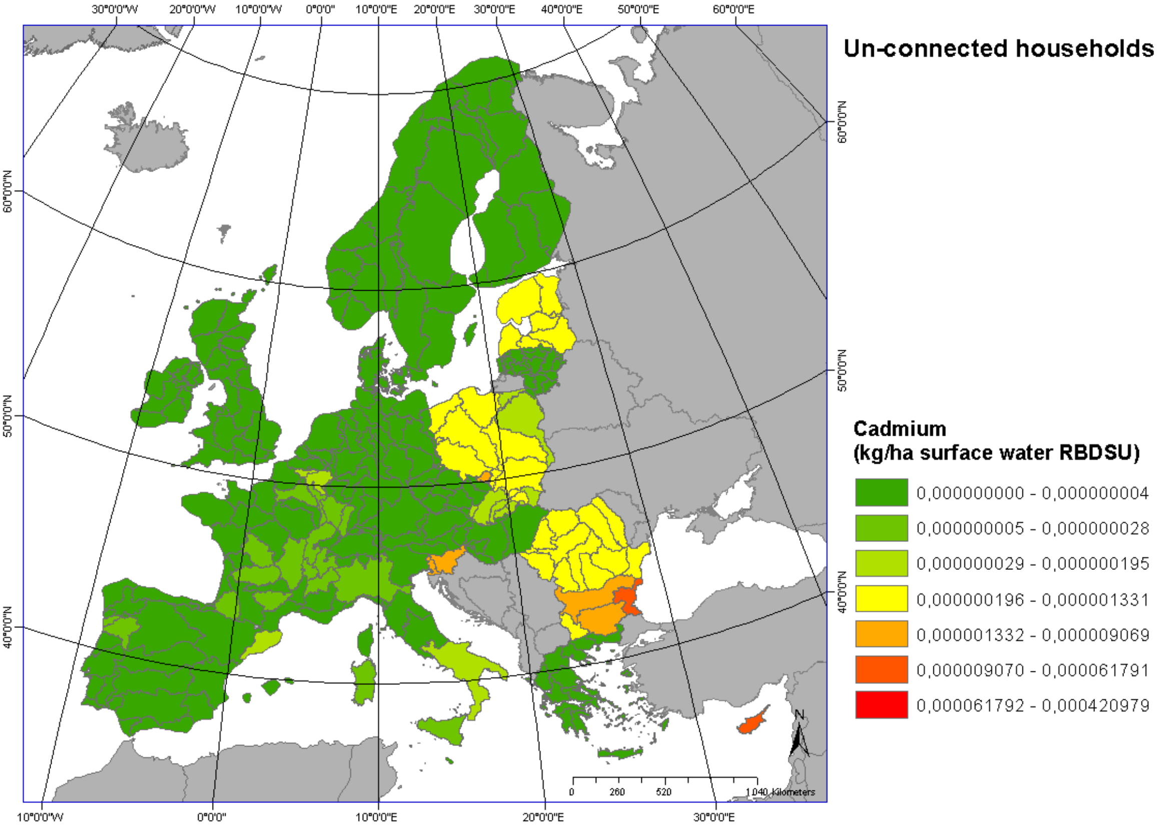
Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 28



6.6 Map 29 Lead emissions from un-connected households

Short Title: Lead emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: Lead emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows lead emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of lead are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Lead emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Lead emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Lead emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Lead emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.

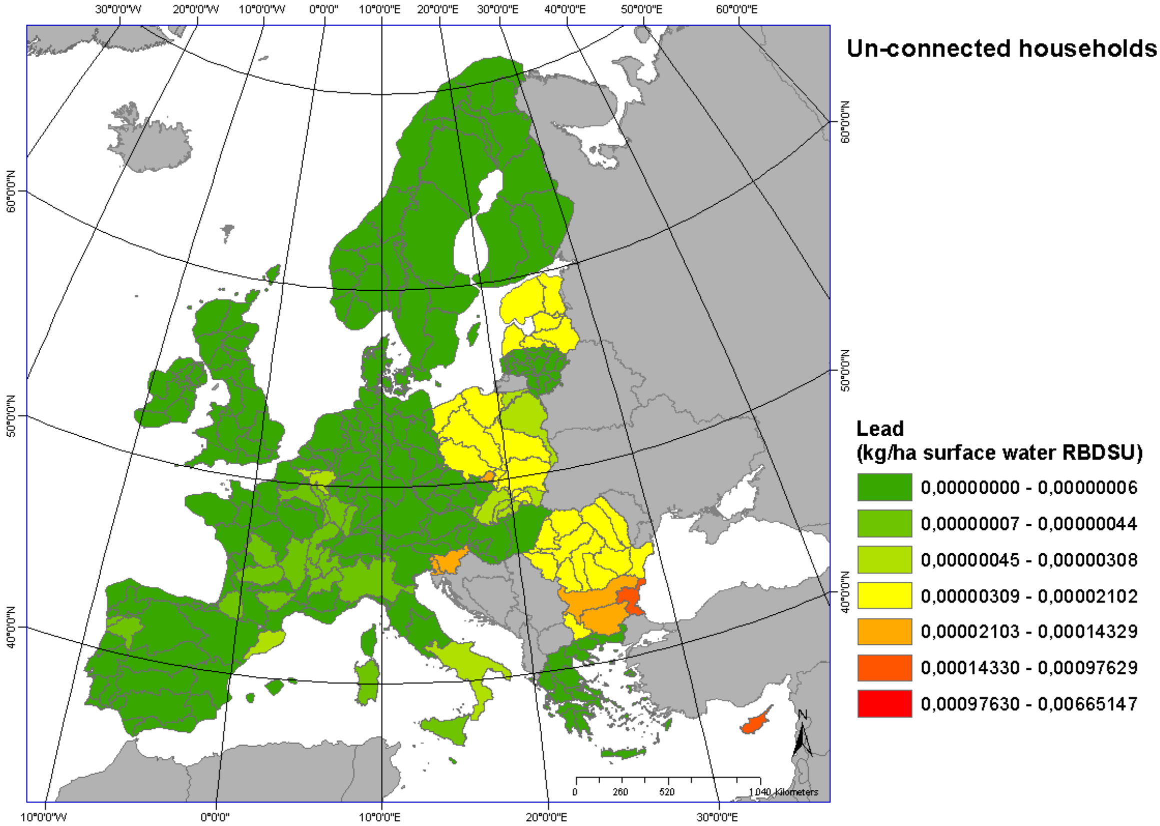
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 29



6.7 Map 30 Mercury emissions from un-connected households

Short Title:	Mercury emissions from un-connected households (kg/ha surface water RBDSU)
Full Title:	Map: Mercury emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows mercury emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of mercury are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Mercury emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Mercury emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Mercury emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Mercury emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.

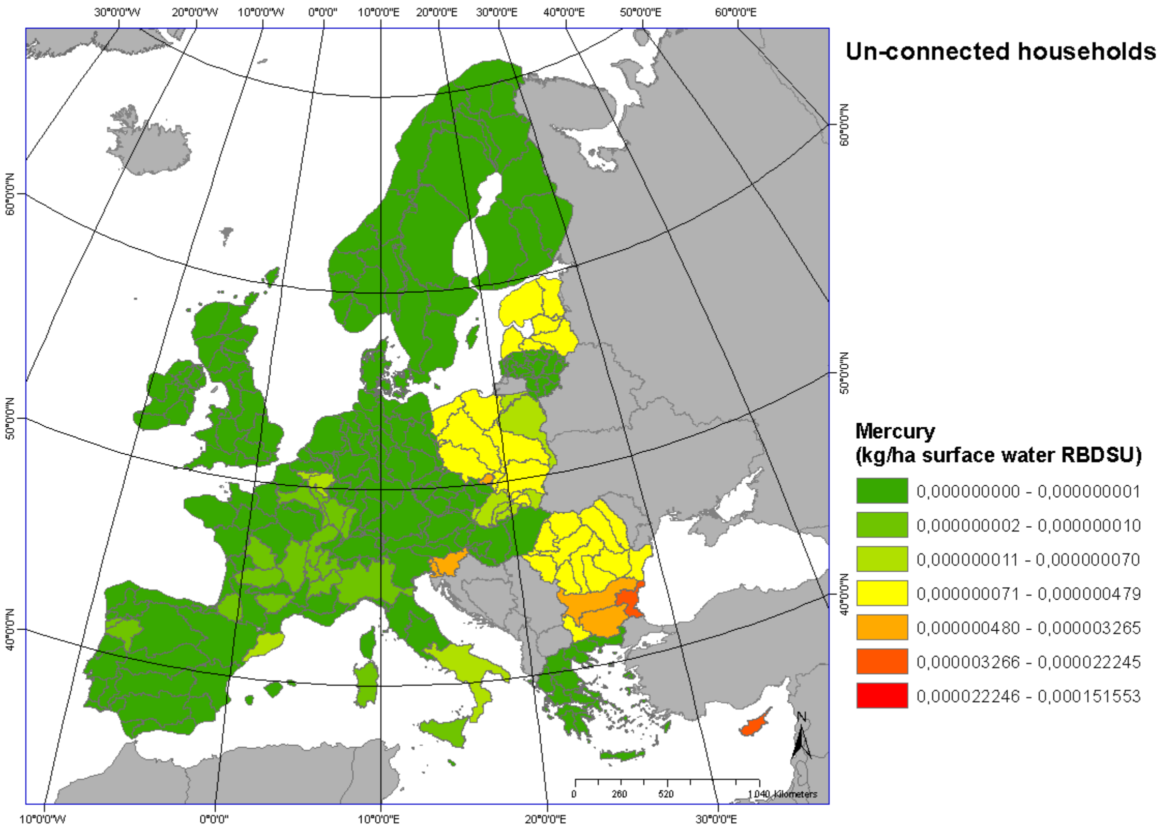
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 30



6.8 Map 31 Nickel emissions from un-connected households

Short Title: Nickel emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: Nickel emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows nickel emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of nickel are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Nickel emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Nickel emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Nickel emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Nickel emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.

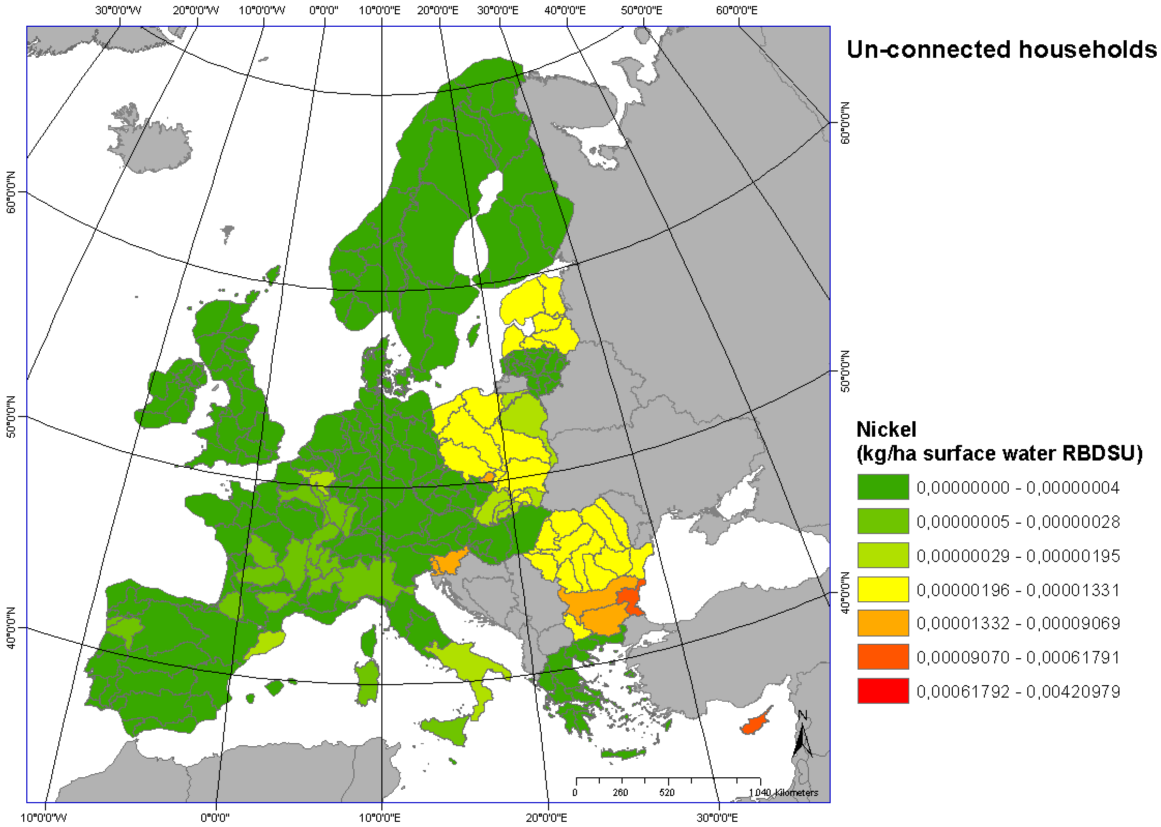
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 31



6.9 Map 32 Anthracene emissions from un-connected households

Short Title:	Anthracene emissions from un-connected households (kg/ha surface water RBDSU)
Full Title:	Map: Anthracene emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows anthracene emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of anthracene are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Anthracene emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Anthracene emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from

JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Anthracene emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Anthracene emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

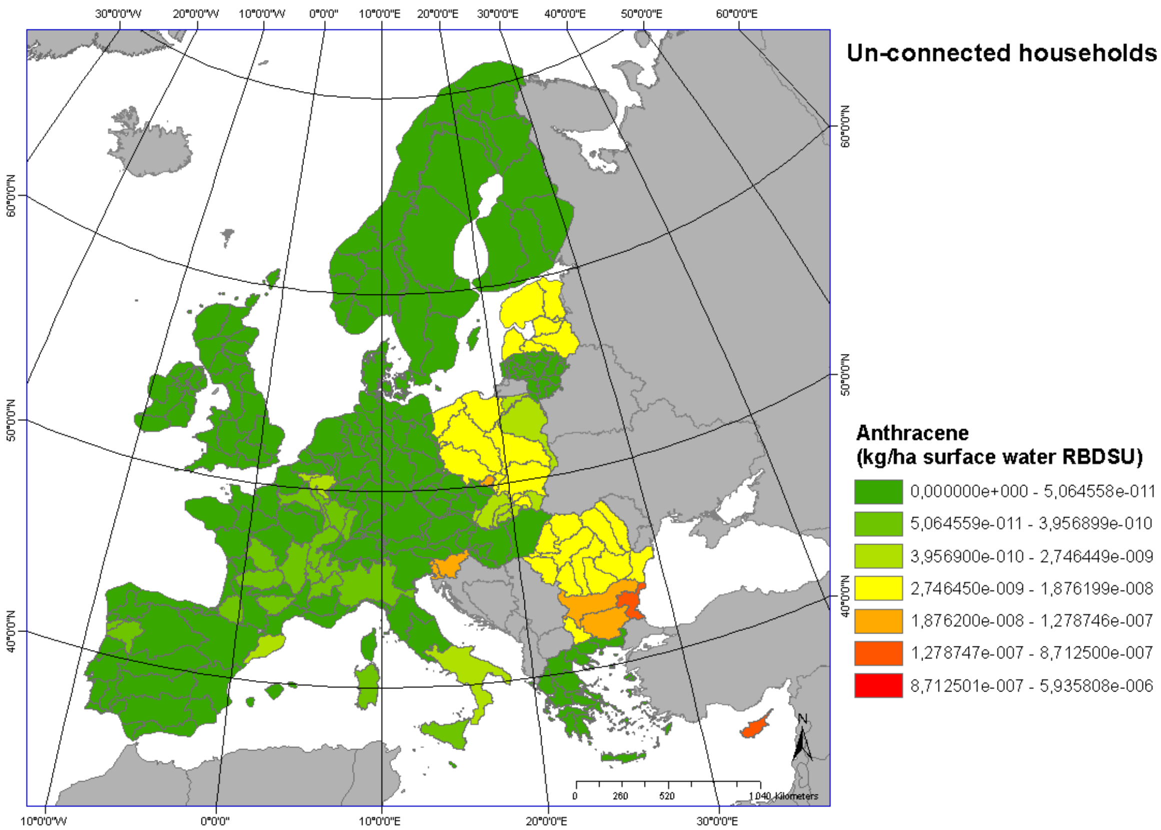
Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 32



6.10 Map 33 Fluoranthene emissions from un-connected households

Short Title: Fluoranthene emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: Fluoranthene emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows fluoranthene emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of fluoranthene are expressed in load to surface water (kg/ha surface water) per RBDSU.

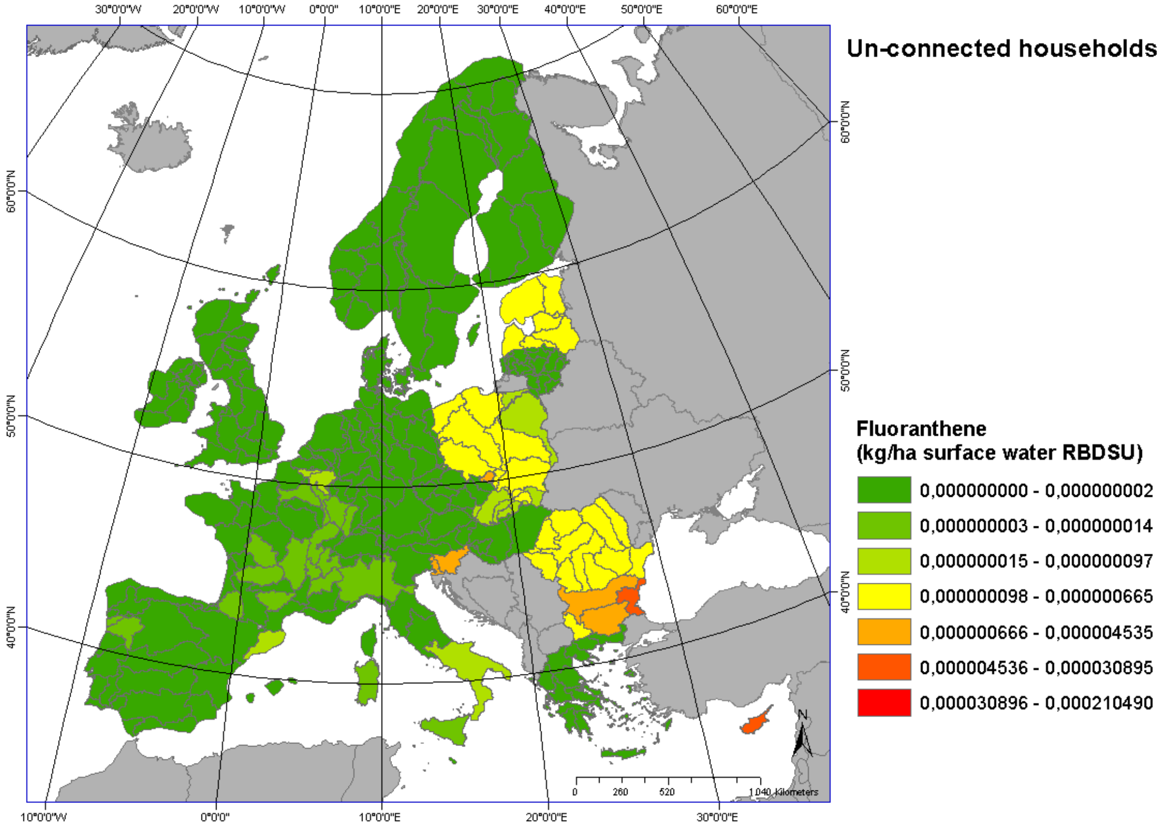
Diffuse Sources / Methodology:
Map: Fluoranthene emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Fluoranthene emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from

JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.
Comparability
Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:
Map: Fluoranthene emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Emissions data
Fluoranthene emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.
Employees
Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.
Population data
Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.
Land use data
CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.
A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 33



6.11 Map 34 Copper emissions from un-connected households

Short Title:	Copper emissions from un-connected households (kg/ha surface water RBDSU)
Full Title:	Map: Copper emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows copper emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of copper are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Copper emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Copper emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Copper emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Copper emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.

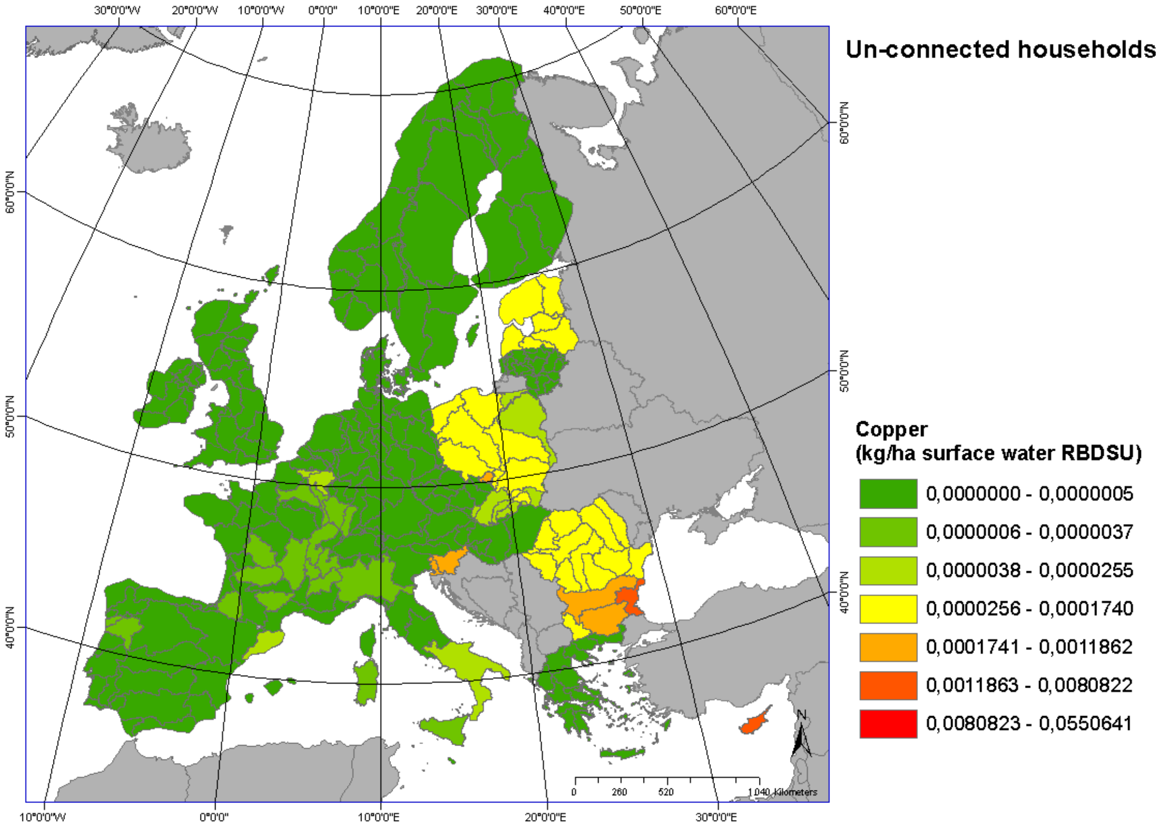
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 34



6.12 Map 35 Zinc emissions from un-connected households

Short Title: Zinc emissions from un-connected households (kg/ha surface water RBDSU)

Full Title: Map: Zinc emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows zinc emission loads to surface water from un-connected households per River Basin District Subunit (RBDSU) level for the reference year 2008, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of zinc are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Zinc emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Zinc emissions to surface water from un-connected households have been spatially allocated due to the information of number of employees on NUTS3 level from EUROSTAT, statistical population data on LAU2 from EUROSTAT GISCO and raster population data from JRC, in combination with land use data from CORINE. The emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific factsheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reasons for the differences are:

- The spatial pattern of emissions from un-connected households is dependent on heterogeneous horizontal distribution of the sources across Europe, on employees and population density and different use of fuel type in urban or rural areas

Diffuse Sources / Source Data:

Map: Zinc emissions from un-connected households, load to surface water (kg/ha surface water RBDSU)

Emissions data

Zinc emission loads to surface water from un-connected households for the year 2008 are based on national emission loads calculated based on emission factors from international studies about emissions from dwellings and activity rates (number of inhabitants per administrative unit) from Eurostat.

Employees

Number of employees from EUROSTAT is used on administrative level (NUTS3) for all EU27 and EFTA4 countries.

Population data

Statistical population data from EUROSTAT GISCO on LAU2 level and Raster Population Data with a spatial resolution 100 by 100 m from JRC are publicly not available.

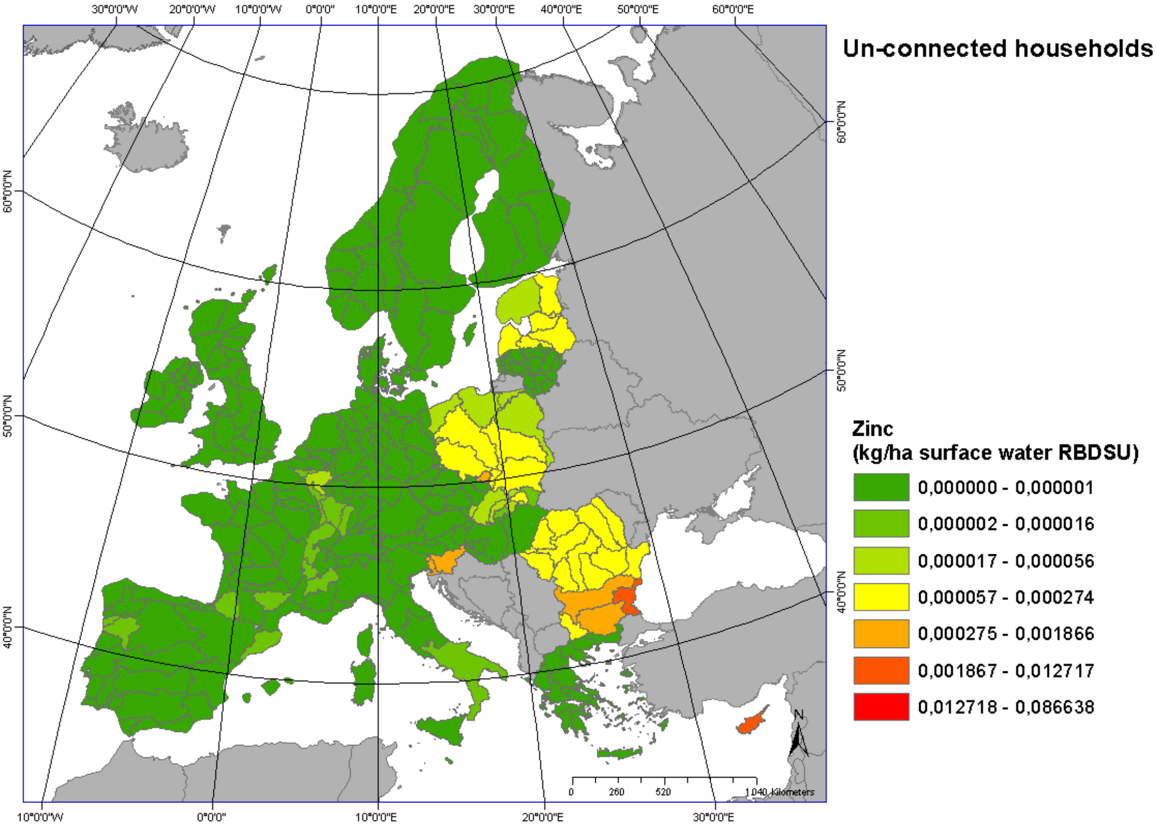
Gridded Population of the World (GPW, version 3) and Global Rural-Urban Mapping Project (GRUMP) provides the related split data in urban and rural population, which is useful for the allocation of certain fuel types used in un-connected households.

Land use data

CORINE Land Cover data (CLC_{2000}, CLC_{2006} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

A technical overview of the data used and the spatial allocation performed is available in the sector specific factsheet.

Map 35


Un-connected households
Zinc
(kg/ha surface water RBDSU)
0,000000 - 0,000001
0,000002 - 0,000016
0,000017 - 0,000056
0,000057 - 0,000274
0,000275 - 0,001866
0,001867 - 0,012717
0,012718 - 0,086638
30°0'0"W
20°0'0"W
10°0'0"W
0°0'0"
10°0'0"E
20°0'0"E
30°0'0"E
40°0'0"E
50°0'0"E
60°0'0"E
60°0'0"N
50°0'0"N
40°0'0"N
0
260
520
1 040 Kilometers
N

7 Inland navigation

7.1 Factsheet

Introduction

In this factsheet a method for the calculation of diffuse emissions resulting from inland navigation is provided. Inland navigation comprises shipping activities that are categorised in domestic as well as international navigation. Here, inland navigation is defined as *all* shipping (both domestic and international) activity on inland waters. Professional inland vessels cause emissions of PAHs, heavy metals and other substances resulting from the following sources:

- *Coatings (paint products applied to vessels):* Ships' outer hulls are fitted with coatings to protect against organisms growing on the hull. PAH-components and metals in the paint products leach out into the surrounding surface water, leading to diffuse emissions into surface waters.
- *Sacrificial anodes:* Anodes are mounted on vessels to serve as corrosion protection for the portion of the ship under the water line. While the anodes are protecting the metal, they gradually dissolve, leading to an emission of metals (mostly Zinc, Aluminium and Magnesium) into surface waters.
- *Bilge water:* Ships unintentionally collect bilge water (the bilge is the lowest compartment on a ship) while traveling. Bilge water is often contaminated with oil containing PAHs. Although boat owners are required to collect and deliver the bilge water, it is assumed that a certain amount still is discharged illegally, leading to diffuse emissions of PAHs into surface waters.
- *Sanitary wastewater:* Wastewater is generated during household activities (mainly toilet use). It is assumed that all wastewater is being discharged to the surface water. This results in emissions of Nutrient-N, Nutrient-P and TOC into the surface water.

Explanation of calculation method

The emissions are calculated for inland vessels. Emissions are calculated by multiplying an activity rate (AR), in the case of inland navigation the number of ton-kilometres (tkm; a ton-kilometre is one ton of cargo transported one km across the water) traversed by all professional vessels on inland waters within European Union (EU27 + EFTA countries), by an emission factor (EF), expressed in emission per AR unit. The calculation method is shown in the formula below:

$$E_S = AR \times EF$$

Where:

E_S	=	Emission of substance (pollutants) to surface waters
AR	=	Activity rate, in this case the traffic performance (distance covered on the EU surface inland surface waters in 10^6tkm)
EF	=	Emission factor (kg/10^6tkm)

The emission calculated in this way is referred to as the total emission. Because all emissions are released directly into surface waters, the total emission equals the net emission to surface waters.

Activity rates
As activity rate is chosen the amount of ton-kilometres traversed in inland navigation because it is a well-known unit of measurement within transport, it represents activities of vessels on inland waters and because the data is available for most EU member states. There is no distinction in type of inland vessels. Emissions are calculated for the inland navigation sector as a whole, therefore the total amount of ton-kilometres per EU member state is required. Activity rates are produced per Member State. Table 1 shows the national (tkm traversed by the national fleet of the specific Member State in the Member State inland waters), international (tkm traversed by the international fleet in the specific Member State) and total amount (sum of national and international fleet) of ton-kilometres traversed by inland vessels from EUROSTAT [6].

Table 1 Amount of ton-kilometres (10^6tkm) per Member State [6].

Member State	Amount of ton-kilometres (10^6 tkm) performed by all Inland navigation vessels in 2011[6]		
	National	International	Total
Austria	88	2 035	2 123
Belgium	3 905	5 346	9 251
Bulgaria	42	4 268	4 310
Cyprus	N.A.	N.A.	N.A.
Czech Republic	21	21	42
Denmark	N.A.	N.A.	N.A.
Estonia	N.A.	N.A.	N.A.
Finland	N.A.	N.A.	N.A.
France	5 332	3 697	9 029
Germany	10 405	44 622	55 027
Greece	N.A.	N.A.	N.A.
Hungary	4	1 836	1 840
Iceland	N.A.	N.A.	N.A.
Ireland	N.A.	N.A.	N.A.
Italy	N.A.	N.A.	N.A.
Latvia	N.A.	N.A.	N.A.
Liechtenstein	N.A.	N.A.	N.A.
Lithuania	N.A.	N.A.	N.A.
Luxembourg	0	305	305
Malta	N.A.	N.A.	N.A.
Netherlands	12 154	34 124	46 278
Norway	N.A.	N.A.	N.A.
Poland	106	55	161
Portugal	N.A.	N.A.	N.A.
Romania	3 599	7 810	11 409
Slovakia	4	927	931
Slovenia	N.A.	N.A.	N.A.
Spain	N.A.	N.A.	N.A.
Sweden	N.A.	N.A.	N.A.
Switzerland	N.A.	N.A.	N.A.
United Kingdom	N.A.	N.A.	N.A.

N.A.: not applicable

The countries that have an ‘N.A’ listing are countries that are expected to have no inland shipping of significance and therefore negligible emissions from this sector. It is estimated that with the available data >95% of the emissions are covered.

Emission factors
In this section it is explained how the EU inland navigation emission factors are obtained. The data for the calculations were extracted from the PRTR of the Netherlands. The general applied method consists of dividing the emissions (based on international literature) by the amount of ton-kilometres traversed. Emissions and ton- kilometres used are documented in the Dutch ‘Coatings, inland navigation’, ‘Bilge water, inland navigation’, ‘Sacrificial anodes, inland shipping’ and ‘Sanitary wastewater, inland shipping’ [1, 2, 3 and 4]. These factsheets contain emissions that were calculated with data obtained from international literature sources. Therefore, it is assumed that the derived implied emission factors are suitable for the calculation of diffuse emissions in the EU.

There is no distinction made between different types of inland vessels.

To obtain emission factors per pollutant, emissions for all sources calculated in the mentioned factsheets were added up and divided by the amount of ton-kilometres in inland waters so that emission factors representative for all four sources summated are compiled. The results are emission factors for each pollutant in kg/10^6 km.

Effects of policy measures
In this section the effect of measures that influence the emission factors are discussed. All the effects of the measures mentioned have been incorporated into the emission factors.

Coatings
Under the Environmentally Hazardous Substances Act, use of PAH-based coatings has been prohibited since 1 July 1997 [5]. This means that virtually all inland vessels were protected with a PAH-based coating up until 1996. After this period, the usage of PAH-based coatings will have gradually been replaced by alternatives. It is assumed that, since 2000, the percentage of PAH coatings is constant at 12%. The rest of the coatings is either bitumen- (23%) or epoxy-based (65%) [1].

Sacrificial anodes
There are no measures being taken that affect the use of sacrificial anodes; however, the technology in protecting ships from corroding continues to improve. There might be an increase in the usage of Aluminium anodes and impressed current systems, but this has not yet been incorporated into the calculations [2]. Zinc, as a pollutant, was because of a lack of reliable data not incorporated into the emission calculations. Additionally, Zinc constitutes less of a priority pollutant than PAHs.

Bilge water
Similar to sacrificial anodes discussed above, there is a continuing improvement in technology that reduces the amount of bilge water. This is accounted for by introducing a ‘technology-factor’ by which the emissions are reduced. This factor implies that over 50% of the bilge water production is prevented. Data about the collection of bilge water is not available for each Member State. For this project it is assumed a significant part of the bilge water is collected: 60% in 2010 [3].

Sanitary wastewater
No measures are reported for the emission of sanitary wastewater.

Calculated emission factors
In Table 2 and Table 3 the calculated emission factors are shown.

Table 2Implied emission factors (to surface water), inland navigation.

Pathway	Substance	Emission Factor (kg/10^{6}tkm)
Emissions to surface water	Fluoranthene	0.00154
	Anthracene	0.000773
	Nutrient-N	1.2
	Nutrient-P	0.19
	TOC	2.78

Table 3 Implied emission factors (to surface water), inland navigation, per emission source.

Emission source	Substance	Emission Factor (kg/10^{6}tkm)
Bilge water	Anthracene	0.000036
	Fluoranthene	0.000024
Coatings	Anthracene	0.000737
	Fluoranthene	0.00152
Sanitary wastewater	Nutrient-P	0.189
	Nutrient-N	1.2
	TOC	2.78

Emission pathways to water
Emissions from anodes and coatings result from contact of the ship with surface water, therefore these emissions are directly (for 100%) released into surface waters. Emissions of sanitary wastewater and bilge water are assumed to be partly collected and partly (illegally) released into surface waters. Collected bilge- and sanitary wastewater are treated; the pollutants therein are not released into the environment. The discharged part, however, is assumed to be directly released into surface waters.

Emissions
Table 4 contains emission values of the pollutants. The emissions are expressed as loads to surface water.

Table 4 Loads to surface water per Member State from inland shipping (kg/y).

Member State	TOC	Nutrient-N	Nutrient-P	Anthracene	Fluoranthene
	kg/year				
Austria	5 902	2 548	403	1.6	3.3
Belgium	25 718	11 101	1 758	7.2	14
Bulgaria	11 982	5 172	819	3.3	6.6
Czech Republic	117	50	8	0.03	0.06
France	25 101	10 835	1 716	7.0	14
Germany	152 975	66 032	10 455	43	85
Hungary	5 115	2 208	350	1.4	2.8
Luxembourg	848	366	58	0.24	0.47
Netherlands	128 653	55 534	8 793	36	71
Poland	448	193	31	0.12	0.25
Romania	31 717	13 691	2 168	8.8	18
Slovakia	2 588	1 117	177	0.72	1.4

Spatial allocation

The methodology of the spatial allocation of the emissions from inland navigation to the River Basin District Subunit level contains following main steps:

1. Regionalisation of the national emission values to NUTS3 level.
2. Gridding:

   - Calculation of the inland navigation emissions from navigable inland waterways (domestic shipping): First the traffic volume on the sections of the waterways in combination with the accessibility of the inland waterways is quantified. This information is available for traffic volume from TRANS-TOOLS and for accessibility of ship types to European inland waterways from the inland waterways institution of France (Voies Navigables de France [7]). Figure 1 shows the geographical course and accessibility of the inland waterways from VNF and Figure 2 the corresponding network where the traffic volume is covered by TRANS-TOOLS [8].
   - The traffic volume on specific waterway sections is used as an indicator for the emission quantity (proxy data).
   - The geo referencing of accessibility from VNF [7] is realized by using river network data from TRANS-TOOLS [8] in combination with the river geo data from e.g. EUROSTAT, GISCO [9]; Water-courses from EuroRegional Map v30: Hydrography (HYDR).
   - The combination of traffic volume data from TRANS-TOOLS with the accessibility of the inland waterways from VNF [7] and the geospatial inland waterways from river geo data were applied for the spatial allocation of emissions from shipping activities to the navigable rivers in Europe.
   - The gridding methodology used is similar to the methodology and described in IER 2011 [11].
3. Regionalisation of the gridded emission values to RBDSU level:
   - Allocation of the gridded emission data to the RBDSU areas [12] based on different ArcGIS and database calculation steps.

The main proxy data sets are:

- Traffic volume and accessibility of inland waterways [7];
- Geo-referenced data for rivers [9].

Table 5 shows the applied proxy data sets used for the spatial distribution of the emissions from domestic shipping activities.

Table 5 Proxy data sets used for the spatial distribution of domestic shipping activities.

Proxy Dataset	Data Source	Year	Extend
Traffic data on the sections of the waterways	Voies Navigables de France (VNF) [7]	2010	Selected countries
Traffic volume	TRANS-TOOLS [8]	2010	Selected countries
River geo data/geospatial inland waterways	GISCO (HYDR) [9]	2010	EU 27 + EFTA

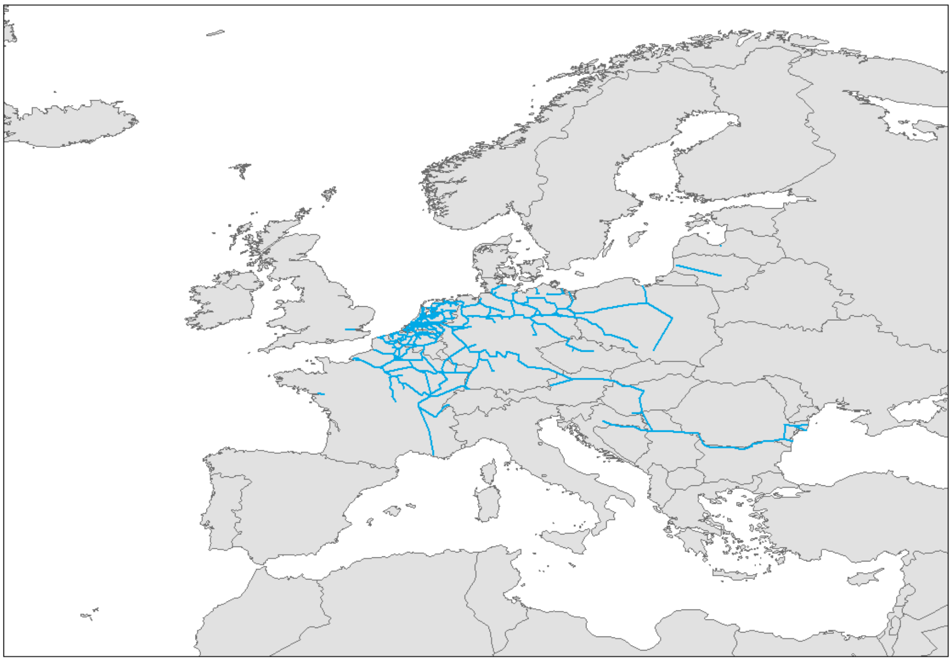


Figure 1 River network from TRANS-Tool [8].

Figure 2 Accessibility of the inland waterways from Voies Navigables de France [7].

Literature

[1] Netherlands National Water Board – Water Unit in cooperation with Deltares and TNO. Emission estimates for diffuse sources, Netherlands Emission Inventory, Coal tar based coating, inland navigation, 2011.

[2] Netherlands National Water Board – Water Unit in cooperation with Deltares and TNO. Emission estimates for diffuse sources, Netherlands Emission Inventory, Discharges of bilge water by inland navigation, 2011.

[3] Netherlands National Water Board – Water Unit in cooperation with Deltares and TNO. Emission estimates for diffuse sources, Netherlands Emission Inventory,Sacrificial anodes, inland navigation, 2011.

[4] Netherlands National Water Board – Water Unit in cooperation with Deltares and TNO. Emission estimates for diffuse sources, Netherlands Emission Inventory, Sanitary wastewater, inland navigation, 2011.

[5] AAPA World Port Ranking 2008 - http://aapa.files.cms-plus.com/Statistics/WORLD%20PORT%20RANKINGS%2020081.pdf (125 biggest ports).

[6] EUROSTAT 2011, Transport by type of vessel, National transport.

[7] VNF, 2010: Voies Navigables de France (VNF) - http://www.vnf.fr/, 05.07.2010.

[8] Trans-Tools, 2010 (URL: http://energy.jrc.ec.europa.eu/transtools/ , 2010).

[9] GISCO, 2010: Geographic Information System of the European Commission (EUROSTAT), http://epp.EUROSTAT.ec.europa.eu/portal/page/portal/gisco/geodata/reference , 2010).

[10] Voies Navigables d'Europe (VNE) (URL: http://www.vne-waterways.eu/ , 05.07.2010).

[11] IER, 2011: Theloke et al. (2011): Methodology development for the spatial distribution of the diffuse emissions in Europe - http://circa.europa.eu/Public/irc/env/e_prtr/library?l=/diffuse_releases_e-prtr/methodology_2011/_EN_1.0_&a=d

[12] WISE River Basin Districts (RBDs) and/or their subunits (RBDSUs), Version 1.4 (06/2011) (URL: http://www.eea.europa.eu/data-and-maps/data/wise-river-basin-districts-rbds-1 , 20.12.2013).

7.2 Map 36 TOC emissions from inland navigation

Short Title: TOC emissions from inland navigation (kg/ha surface water RBDSU)

Full Title: Map: TOC emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

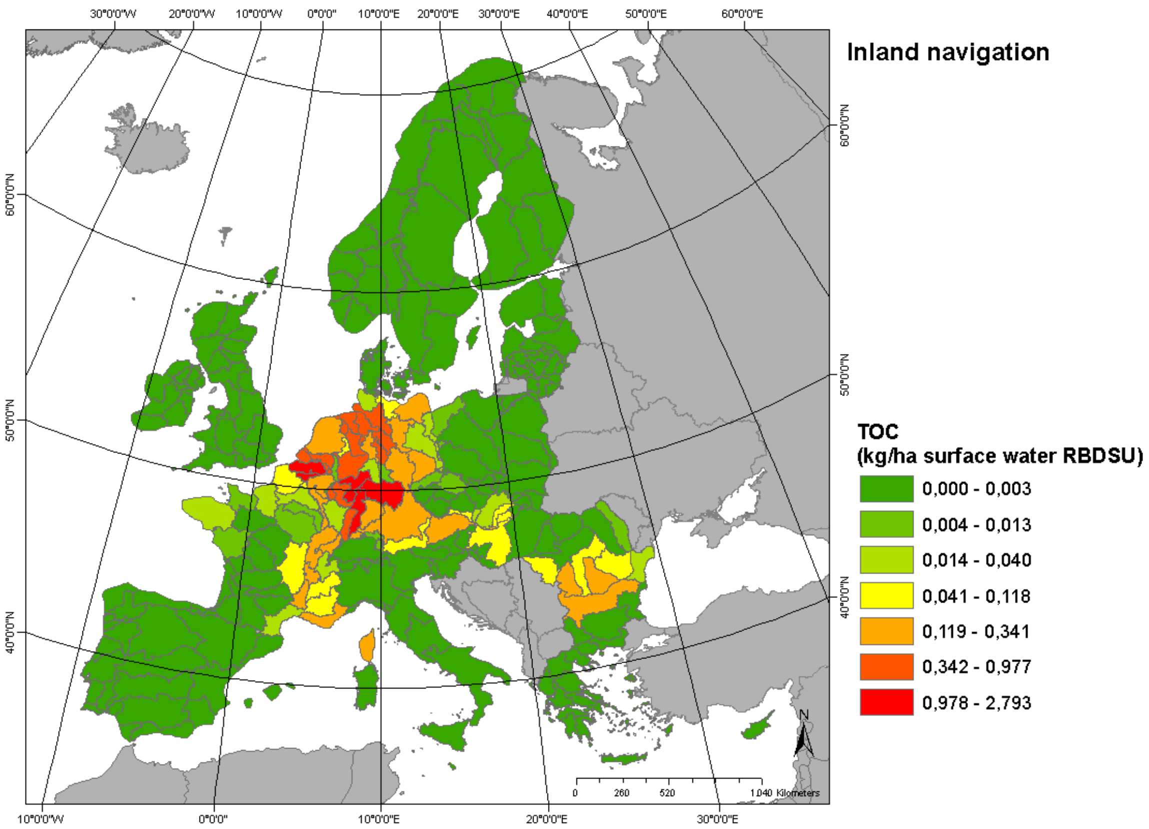
Diffuse Sources / General information:
The map shows TOC emissions to surface water from inland navigation per River Basin District Subunit (RBDSU) level for the reference year 2011, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of TOC are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: TOC emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Diffuse emissions of TOC to surface water from inland navigation were spatially allocated according to the spatial pattern of navigable inland waterways using georeferenced water course and shipping activity data. The national emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.
Comparability
Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions from inland navigation is mainly due to heterogeneous horizontal distribution of the navigation on inland waterways and the spatial differentiated density of the vessel traffic.

Diffuse Sources / Source Data:
Map: TOC emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)
Emissions data
Emission data used are calculated national totals for inland navigation (shipping) providing TOC emission loads to surface water for the year 2011. These data are based on national activity rates form Eurostat and emission factor data extracted from the 2008 PRTR Netherlands. The methodology applied and data used is described in detail in the sector specific factsheet.
Administrative boundaries data
EUROSTAT GISCO Administrative units and Statistical units
Activity data of inland navigation
TRANS-TOOLS river network traffic volume data
Voies Navigables d'Europe (VNE) information on accessibility of inland waterways
Water course information
EUROSTAT, GISCO: Water-courses from EuroRegional Map v30: Hydrography (HYDR) CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

Map 36



7.3 Map 37 Nutrient-P emissions from inland navigation

Short Title: Nutrient-P emissions from inland navigation (kg/ha surface water RBDSU)

Full Title: Map: Nutrient-P emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:

The map shows nutrient-P emissions to surface water from inland navigation per River Basin District Subunit (RBDSU) level for the reference year 2011, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of nutrient-P are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:

Map: Nutrient-P emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

Geographic Information System overlay:

Diffuse emissions of nutrient-P to surface water from inland navigation were spatially allocated according to the spatial pattern of navigable inland waterways using georeferenced water course and shipping activity data. The national emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions from inland navigation is mainly due to heterogeneous horizontal distribution of the navigation on inland waterways and the spatial differentiated density of the vessel traffic.

Diffuse Sources / Source Data:

Map: Nutrient-P emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

Emissions data

Emission data used are calculated national totals for inland navigation (shipping) providing nutrient-P emission loads to surface water for the year 2011. These data are based on national activity rates form Eurostat and emission factor data extracted from the 2008 PRTR Netherlands. The methodology applied and data used is described in detail in the sector specific factsheet.

Administrative boundaries data

EUROSTAT GISCO Administrative units and Statistical units

Activity data of inland navigation

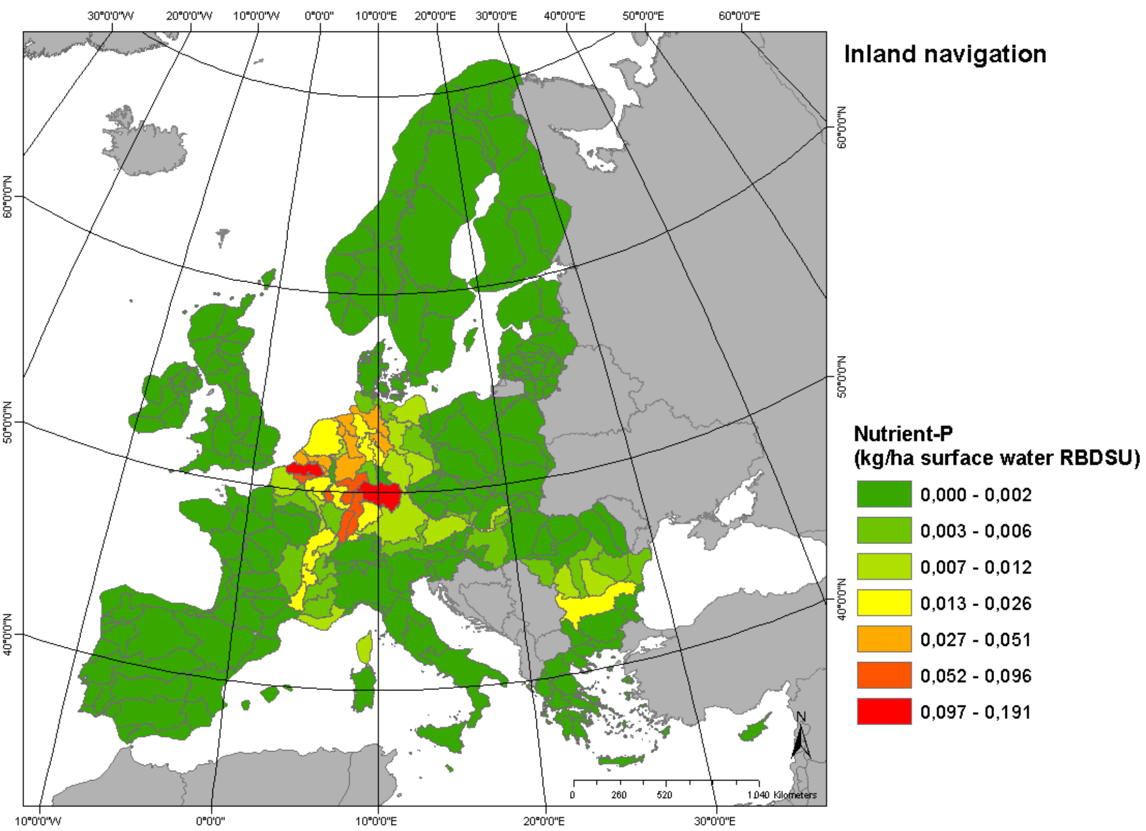
TRANS-TOOLS river network traffic volume data

Voies Navigables d'Europe (VNE) information on accessibility of inland waterways

Water course information

EUROSTAT, GISCO: Water-courses from EuroRegional Map v30: Hydrography (HYDR)
CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

Map 37



7.4 Map 38 Nutrient-N emissions from inland navigation

Short Title:	Nutrient-N emissions from inland navigation (kg/ha surface water RBDSU)
Full Title:	Map: Nutrient-N emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

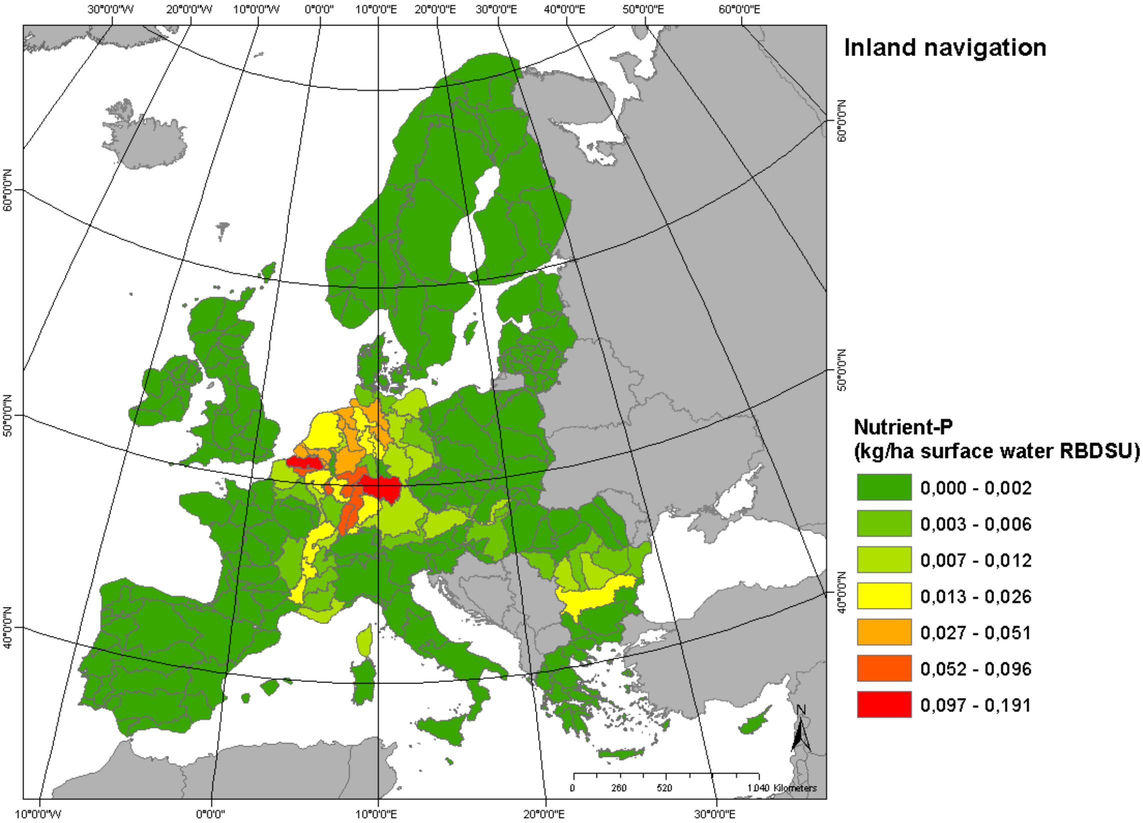
Diffuse Sources / General information:
The map shows nutrient-N emissions to surface water from inland navigation per River Basin District Subunit (RBDSU) level for the reference year 2011, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of nutrient-N are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Nutrient-N emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Diffuse emissions of nutrient-N to surface water from inland navigation were spatially allocated according to the spatial pattern of navigable inland waterways using georeferenced water course and shipping activity data. The national emissions were allocated to the RBDSU spatial level using GIS visualization techniques.
The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.
Comparability
Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions from inland navigation is mainly due to heterogeneous horizontal distribution of the navigation on inland waterways and the spatial differentiated density of the vessel traffic.

Diffuse Sources / Source Data:
Map: Nutrient-N emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)
Emissions data
Emission data used are calculated national totals for inland navigation (shipping) providing nutrient-N emission loads to surface water for the year 2011. These data are based on national activity rates form Eurostat and emission factor data extracted from the 2008 PRTR Netherlands. The methodology applied and data used is described in detail in the sector specific factsheet.
Administrative boundaries data
EUROSTAT GISCO Administrative units and Statistical units
Activity data of inland navigation
TRANS-TOOLS river network traffic volume data
Voies Navigables d'Europe (VNE) information on accessibility of inland waterways
Water course information
EUROSTAT, GISCO: Water-courses from EuroRegional Map v30: Hydrography (HYDR) CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

Map 38



7.5 Map 39 Anthracene emissions from inland navigation

Short Title:	Anthracene emissions from inland navigation (kg/ha surface water RBDSU)
Full Title:	Map: Anthracene emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows anthracene emissions to surface water from inland navigation per River Basin District Subunit (RBDSU) level for the reference year 2011, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of anthracene are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Anthracene emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay:
Diffuse emissions of anthracene to surface water from inland navigation were spatially allocated according to the spatial pattern of navigable inland waterways using georeferenced water course and shipping activity data. The national emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions from inland navigation is mainly due to heterogeneous horizontal distribution of the navigation on inland waterways and the spatial differentiated density of the vessel traffic.

Diffuse Sources / Source Data:

Map: Anthracene emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

Emissions data

Emission data used are calculated national totals for inland navigation (shipping) providing anthracene emission loads to surface water for the year 2011. These data are based on national activity rates form Eurostat and emission factor data extracted from the 2008 PRTR Netherlands. The methodology applied and data used is described in detail in the sector specific factsheet.

Administrative boundaries data

EUROSTAT GISCO Administrative units and Statistical units

Activity data of inland navigation

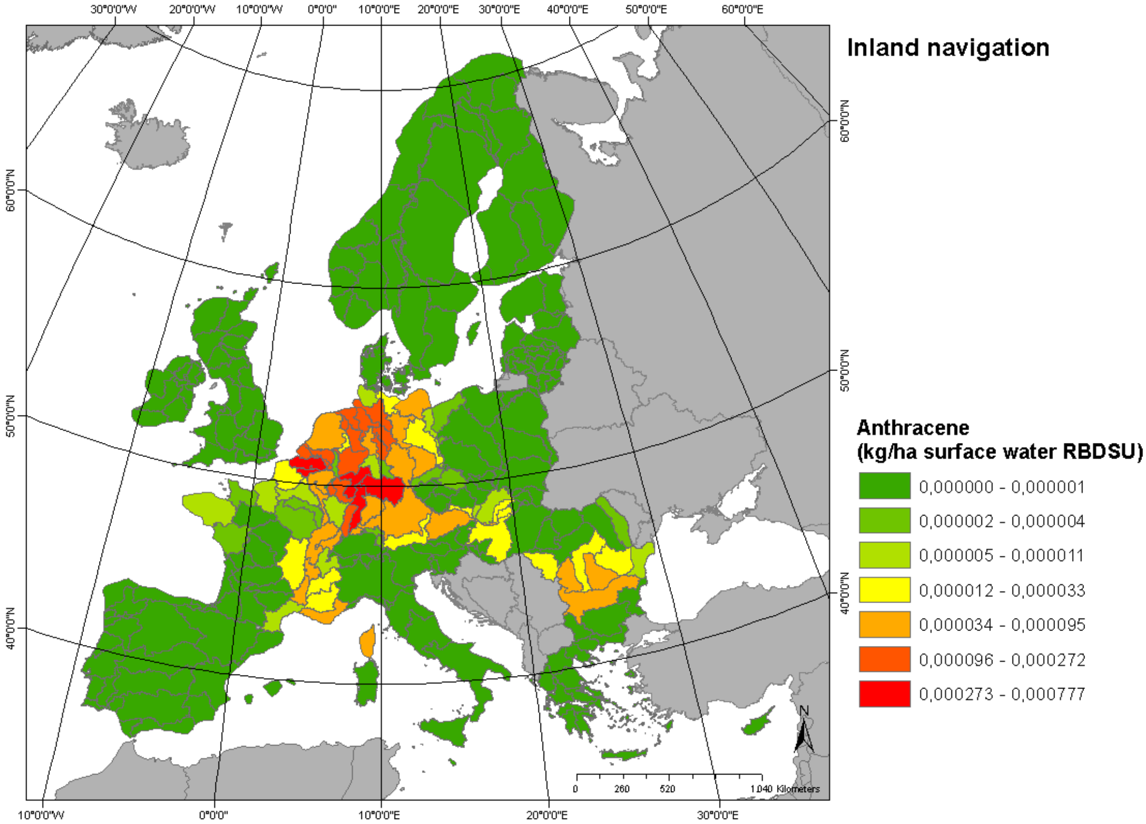
TRANS-TOOLS river network traffic volume data

Voies Navigables d'Europe (VNE) information on accessibility of inland waterways

Water course information

EUROSTAT, GISCO: Water-courses from EuroRegional Map v30: Hydrography (HYDR) CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

Map 39



7.6 Map 40 Fluoranthene emissions from inland navigation

Short Title: Fluoranthene emissions from inland navigation (kg/ha surface water RBDSU)

Full Title: Map: Fluoranthene emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

Diffuse Sources / General information:
The map shows fluoranthene emissions to surface water from inland navigation per River Basin District Subunit (RBDSU) level for the reference year 2011, for EU27 and EFTA countries with available data in 2013. Diffuse emissions of fluoranthene are expressed in load to surface water (kg/ha surface water) per RBDSU.

Diffuse Sources / Methodology:
Map: Fluoranthene emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)
Geographic Information System overlay
Diffuse emissions of fluoranthene to surface water from inland navigation were spatially allocated according to the spatial pattern of navigable inland waterways using geo referenced water course and shipping activity data. The national emissions were allocated to the RBDSU spatial level using GIS visualization techniques.

The methodology applied and data used is described in detail in a sector specific fact sheet. For further details please see the methodology report.

Comparability

Considerable spatial variation is apparent. The main reason for the difference is:

- The spatial pattern of emissions from inland navigation is mainly due to heterogeneous horizontal distribution of the navigation on inland waterways and the spatial differentiated density of the vessel traffic.

Diffuse Sources / Source Data:

Map: Fluoranthene emissions from inland navigation, load to surface water (kg/ha surface water RBDSU)

Emissions data

Emission data used are calculated national totals for inland navigation (shipping) providing fluoranthene emission loads to surface water for the year 2011. These data are based on national activity rates form Eurostat and emission factor data extracted from the 2008 PRTR Netherlands. The methodology applied and data used is described in detail in the sector specific factsheet.

Administrative boundaries data

EUROSTAT GISCO Administrative units and Statistical units

Activity data of inland navigation

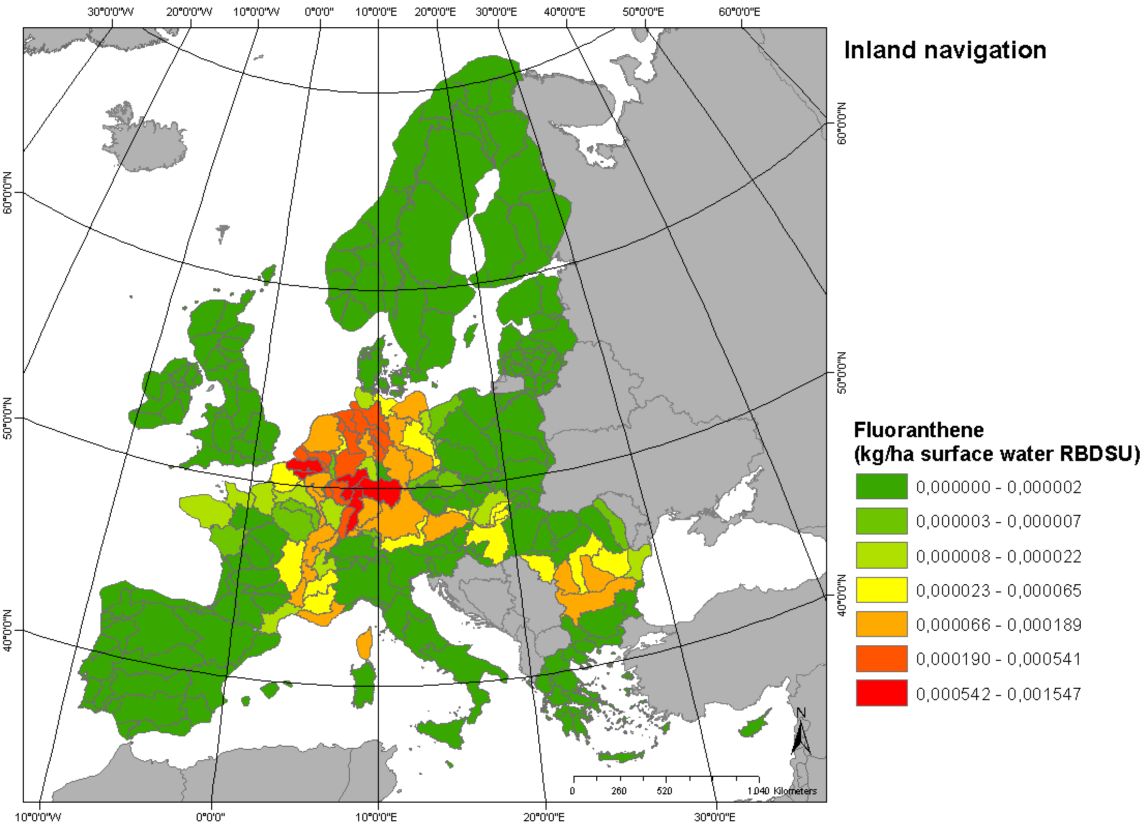
TRANS-TOOLS river network traffic volume data

Voies Navigables d'Europe (VNE) information on accessibility of inland waterways

Water course information

EUROSTAT, GISCO: Water-courses from EuroRegional Map v30: Hydrography (HYDR) CORINE Land Cover data (CLC_{2006}, CLC_{2000} and CLC_{CH1990} for Switzerland) are merged in order to cover all EU27 and EFTA4 countries.

Map 40


Inland navigation
Fluoranthene
(kg/ha surface water RBDSU)
0,000000 - 0,000002
0,000003 - 0,000007
0,000008 - 0,000022
0,000023 - 0,000065
0,000066 - 0,000189
0,000190 - 0,000541
0,000542 - 0,001547
0
260
520
1.040 Kilometers
N

8 Case study industry

8.1 Factsheet

Introduction
Reliable estimation of diffuse emissions from industries to surface waters is an extremely complex task. This is caused by a number of reasons. First of all, the heterogeneity of companies can be very large even in sectors that produce similar end products. The second reason is that large differences in level of emissions can be caused by differences in follow-up treatment of separate waste water flows, even within one facility of the same company. Lastly, there are large uncertainties about the destination of effluents of industries in the different Member States: to the sewer system or to surface waters.

Within the scope of the E-PRTR related diffuse releases (including emissions from point sources not covered in E-PRTR) only a rough indication for a potential method can be shown. This method could be applied on a wider scale in a later stage. The requirements of a methodology are; it should be simple, transparent, dependent on production or activity data that is freely and regularly – preferably yearly – accessible, covers the EU27 (and EFTA4) and individual Member States and not at the least gives good estimates.

The paper industry was chosen as a case study because this is a well defined sector and high data availability. Results from the proposed method can be checked easily using the E-PRTR reported emissions. It is recognized that the paper sector is for a large extend covered by the E-PRTR, but the relative homogeneity of the sector makes it very useful for the exploration of possibility's to estimate emissions from industry not covered by E-PRTR. If the explored methodology will not work in such a homogenous sector, it will certainly not work in other, more differentiated sectors.

Development of a methodology
The development of a methodology starts with the exploration of EU-wide (EU27+EFTA) available data. The calculation scheme is given in formula:

$E_{i,s,y} = P_i \times EF_{i,s} \times (1- CF_i)$ *(formula 1)*

Wherein:

$E_{i,s,y}$ = emission of substance (s) per industrial sector (i) for year (y); kg

P_i = production volume per sector (s); in mass unit paper produced per country per year

$EF_{i,s}$ = emission factor of substance (s) per production volume; kg/mass unit paper produced

CF_i = connection rate to collective sewer systems.

The disadvantage of formula 1 is that it is not possible to check which specific emission factors are to be used. No data on pollutant concentrations of effluents are available. The possible immediate effect of effluents on surface waters also will stay unclear by application of this method.

Activity data, in this case the production of paper and paperboard, was selected as the sole focus, were obtained from EUROSTAT [2].

The online database on the EUROSTAT website contains detailed information about the (yearly) production of paper and pulp per Member State. The production in 2009 was chosen as basis for the calculations, since the E-PRTR database did not yet contain the 2010 emissions (at the moment this part of the project was executed) and as such, no comparison for the year 2010 could be made.

Typical concentration ranges of nitrogen, phosphorus and total organic carbon (TOC) within the paper industry were explored by checking the BREFs [1] (all BREF documents are available online at http://eippcb.jrc.es/reference/). The BREF on paper production reports ranges in emission factor for above-mentioned pollutants; these are displayed in Table 1.

Table 1 Emission factor ranges for Pulp and Paper industry (source: BREF, 2001), COD: chemical oxygen demand; ADt; air-dried metric tonne.

Substance	Unit	Emission Factor	
		lower value	upper value
COD*	kg/ADt	2	6
Nutrient-N	g/ADt	5	100
Nutrient-P	g/ADt	1	30

*There is no emission factor of TOC available. To calculate emissions of TOC, the COD was divided by 3 (TOC = COD/3).

The unit ADt means “Air-dried (metric) tonne”, which is equivalent to a tonne of paper that contains 10% moisture and 90% pulp or paper (in the case of one tonne the mass would, respectively, be 100 and 900 kg). It is assumed that the unit ADt is interchangeable with ‘normal’ tonnes. This assumption is strengthened by the fact that in the BREF, for all pollutants mentioned, measurements on sub-processes in the production of paper show similar concentration ranges in kg/t.

The table shows a wide range in emission factors which reflect the wide range of different technologies to reduce emissions used in the paper industry. This implies that detailed information on the processes is needed to make a reliable estimate for the emissions.

Results

The proposed method has been used to calculate the emissions for the total paper industry (E-PRTR and non-E-PRTR) by applying an emission factor per production unit of paper by the total paper production per Member State. The EU27 paper production figures were obtained from the online EUROSTAT database. In Table 2 the production data for 2009 are shown.

Table 2 Production of paper and paperboard in EU27 Member States, 2009.

Member State	Production paper and paperboard (ton/y)
Austria	4 605 540
Belgium	1 990 000
Czech Republic	804 790
Finland	10 602 000
France	8 331 500
Germany	20 870 000
Hungary	461 000
Italy	8 404 170
Netherlands	2 609 000
Poland	3 274 960
Portugal	1 633 810
Rumania	250 000
Slovakia	920 980
Slovenia	732 000
Spain	5 700 100
United Kingdom	4 293 000
Bulgaria	216 900
Denmark	418 940
Estonia	63 380
Ireland	45 000
Greece	521 730
Cyprus	0
Latvia	54 000
Lithuania	85 800
Luxembourg	11 660
Malta	0
Sweden	10 932 000
EU27 total	87 832 240

The results from the emission calculation are presented in Tables 3 (TOC), 4 (Nutrient-N) and 5 (Nutrient-P). All emissions are in tonnes. Whenever a '-' is displayed in the E-PRTR emissions column, it means that the emissions were below the reporting limit. Emissions of TOC in the EU27 (total) as reported to the E-PRTR are almost 38000 tonnes in 2009. Emissions of Nutrient-N and Nutrient-P are 2000 and 200 tonnes, respectively.

Table 3 TOC emissions from E-PRTR and calculated according to production numbers.

Member State	Number of facilities reporting to E-PRTR for 2009	Reported E-PRTR emissions * (ton/y)	Emissions Calculated (ton/y)		Difference between E-PRTR emissions and emissions calculated (ton/y)	
			Emission Factor: 2 kg/ADt	Emission Factor: 6 kg/ADt	Emission Factor: 2 kg/ADt	Emission Factor: 6 kg/ADt
Austria	12	1775	3070	9211	1296	7436
Belgium	3	1344	1327	3980	-17	2636
Czech Republic	3	981	537	1610	-444	629
Finland	16	4530	7068	21204	2538	16674
France	24	5251	5554	16663	304	11412
Germany	63	8940	13913	41740	4974	32800
Hungary	1	667	307	922	-360	255
Italy	16	1145	5603	16808	4457	15663
Netherlands	10	531	1739	5218	1208	4687
Poland	5	1630	2183	6550	553	4920
Portugal	2	2179	1089	3268	-1090	1088
Romania	-	-	167	500	167	500
Slovakia	3	2152	614	1842	-1538	-310
Slovenia	3	214	488	1464	274	1250
Spain	11	959	3800	11400	2841	10441
United Kingdom	8	2230	2862	8586	632	6356
Bulgaria	2	130	145	434	15	304
Denmark	-	-	279	838	279	838
Estonia	-	-	42	127	42	127
Ireland	-	-	30	90	30	90
Greece	-	-	348	1043	348	1043
Cyprus	-	-	0	0	0	0
Latvia	-	-	36	108	36	108
Lithuania	-	-	57	172	57	172
Luxembourg	-	-	8	23	8	23
Malta	-	-	0	0	0	0
Sweden	4	3216	7288	21864	4072	18648
EU27 Total		37874	58555	137790	17194**	99916**

* Reporting limit (threshold) for TOC: 50 tonnes/year.

** This is the difference between the calculated total and the EU27 total.

In Figure 1 the data from the first three columns from Table 3 are presented.

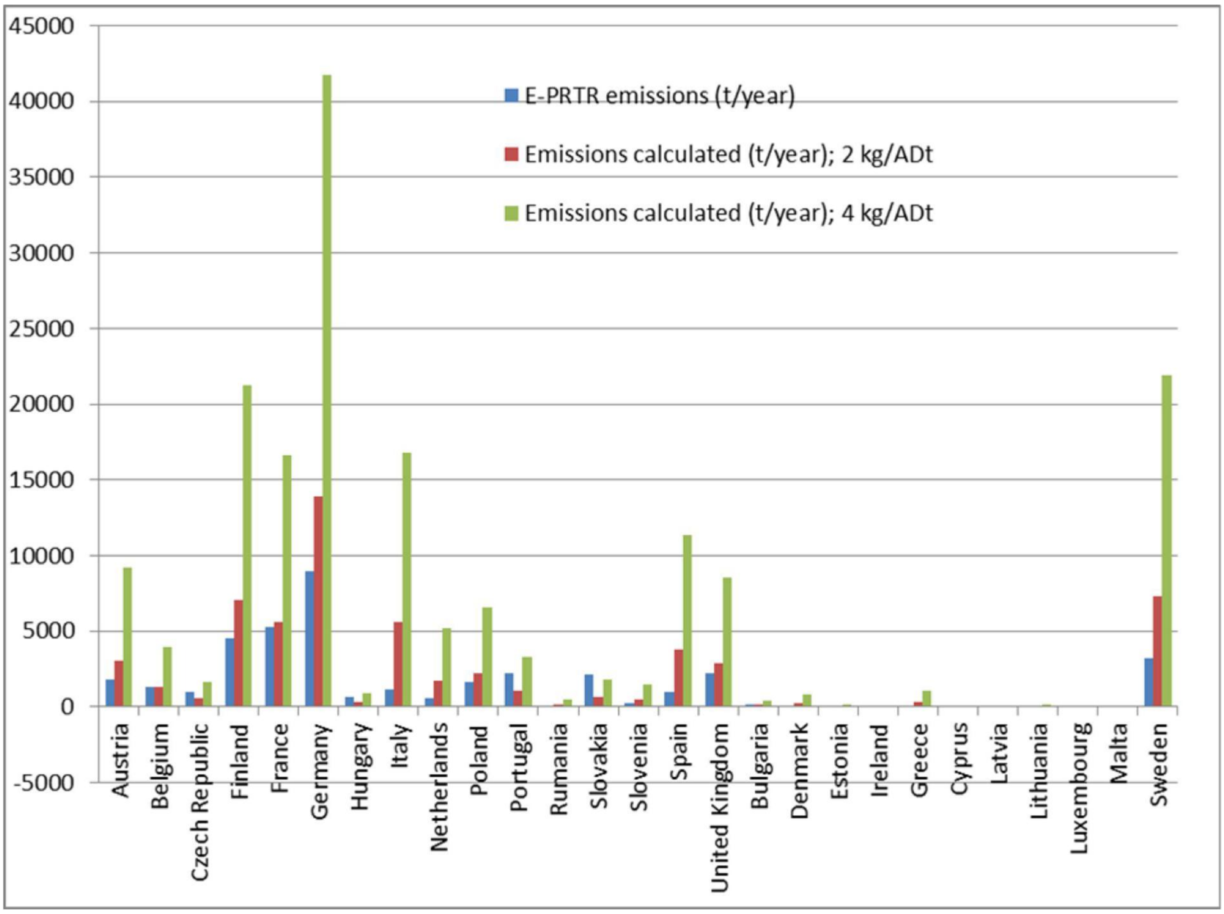


Figure 1 Reported E PRTR emissions of TOC from Paper and Pulp industry compared to estimates using a high and low emission factor (ton/y).

The graph shows that E-PRTR emissions of TOC for many Member States are below the estimate based on the lowest emission factor. This difference indicates the importance of the non E-PRTR emissions in the paper en pulp industry.

Table 4 Nutrient-N emissions from E-PRTR and calculated according to production numbers.

Member State	Number of facilities reporting to E-PRTR for 2009	Reported E-PRTR emissions* (ton/year)	Emissions calculated (ton/year)		Difference between E-PRTR emissions and emissions calculated (ton/year)	
			Emission factor: 5 g/ADt	Emission factor: 100 g/ADt	Emission factor: 5 g/ADt	Emission factor: 100 g/ADt
Austria	-	-	23	461	23	461
Belgium	-	-	10	199	10	199
Czech Republic	1	203	4	80	-199	-123
Finland	4	693	53	1060	-640	368
France	2	293	42	833	-251	540
Germany	1	75	104	2087	29	2012
Hungary	1	50	2	46	-48	-4

Member State	Number of facilities reporting to E-PRTR for 2009	Reported E-PRTR emissions* (ton/year)	Emissions calculated (ton/year)		Difference between E-PRTR emissions and emissions calculated (ton/year)	
			Emission factor: 5 g/ADt	Emission factor: 100 g/ADt	Emission factor: 5 g/ADt	Emission factor: 100 g/ADt
Italy	1	52	42	840	-10	788
Netherlands	-	-	13	261	13	261
Poland	1	94	16	327	-78	233
Portugal	1	52	8	163	-44	111
Romania	-	-	1	25	1	25
Slovakia	1	112	5	92	-107	-20
Slovenia	-	-	4	73	4	73
Spain	2	52	29	570	-24	518
United Kingdom	-	-	21	429	21	429
Bulgaria	1	175	1	22	-174	-153
Denmark	-	-	2	42	2	42
Estonia	-	-	0	6	0	6
Ireland	-	-	0	5	0	5
Greece	-	-	3	52	3	52
Cyprus	-	-	0	0	0	0
Latvia	-	-	0	5	0	5
Lithuania	-	-	0	9	0	9
Luxembourg	-	-	0	1	0	1
Malta	-	-	0	0	0	0
Sweden	2	185	55	1093	-130	908
EU27 total		2036	439	8783	-1597**	6747**

* Reporting limit (threshold) for Nutrient-N: 50 tonnes/year.

** This is the difference between the calculated total and the EU27 total.

Figure 2 shows the data from the first three columns from Table 4 graphical.

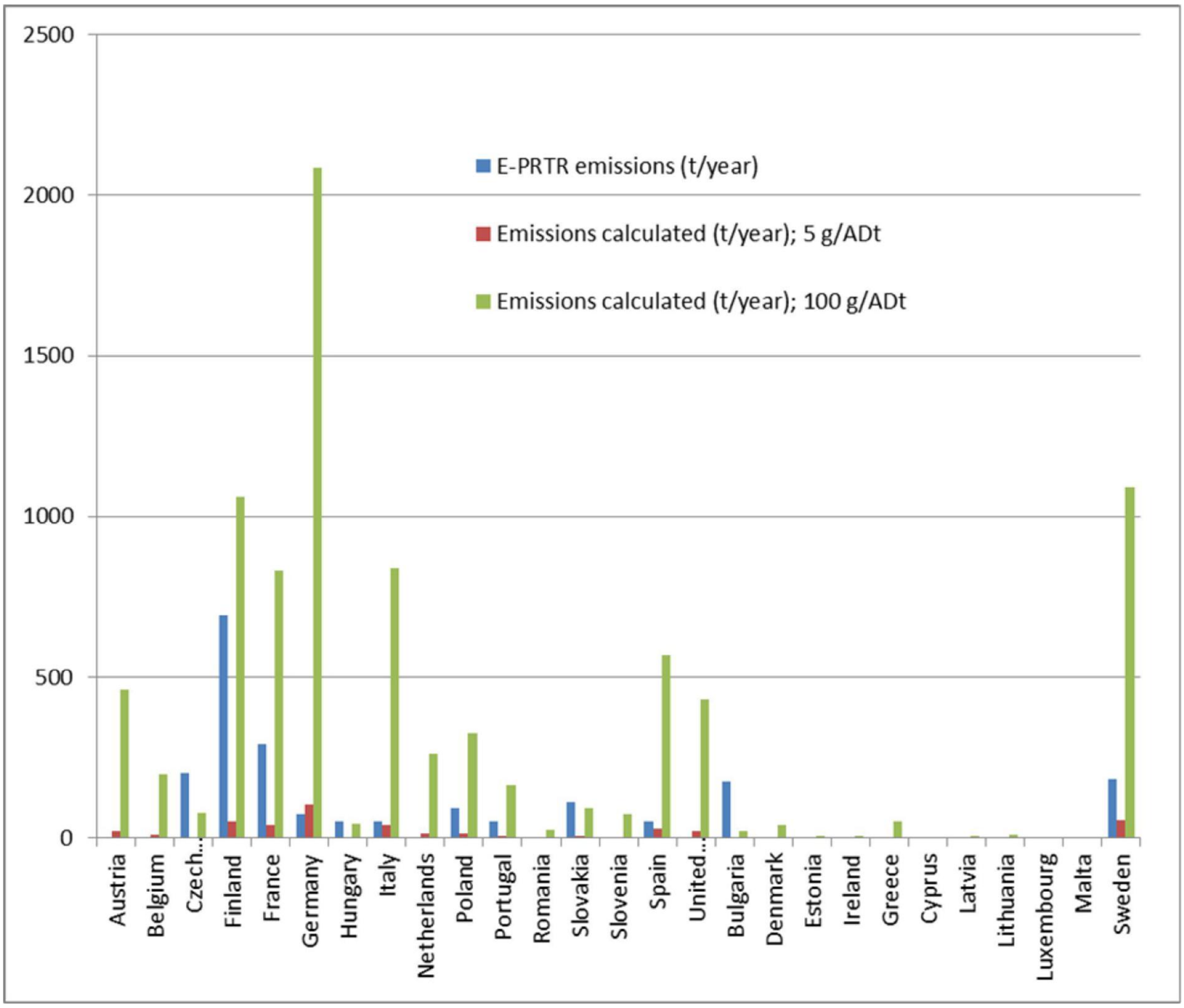


Figure 2 Reported E-PRTR emissions of Nutrient-N from Paper and Pulp industry compared to estimates using a high and low emission factor (ton/y).

The graph shows that E-PRTR emissions for many Member States are higher than the estimate based on the lowest emission factor. This indicates that the lower emission factor would under estimate the Nutrient-N emissions from the paper en pulp industry. Some Member States report Nutrient-N emissions even higher as based on the highest emission factor.

Table 5 Nutrient-P emissions from E-PRTR and calculated according to production numbers.

Member state	Number of facilities reporting to E-PRTR, for 2009	Reported E-PRTR emissions* (ton/y)	Emissions calculated (ton/year)		Difference between E-PRTR emissions and emissions calculated (ton/yr)	
			Emission factor: 1 g/ADt	Emission factor: 30 g/ADt	Emission factor: 1 g/ADt	Emission factor: 30 g/ADt
Austria	2	8	4.6	138.2	-3	130
Belgium	-	-	2.0	59.7	2	60
Czech Republic	1	14	0.8	24.1	-13	10
Finland	1	6	10.6	318.1	5	312
France	4	54	8.3	249.9	-46	196
Germany	2	13	20.9	626.1	8	613
Hungary	1	14	0.5	13.8	-14	-1
Italy	-	-	8.4	252.1	8	252
Netherlands	-	-	2.6	78.3	3	78
Poland	1	7	3.3	98.2	-4	91
Portugal	1	39	1.6	49.0	-37	10
Romania	-	-	0.3	7.5	0	8
Slovakia	2	22	0.9	27.6	-21	6
Slovenia	-	-	0.7	22.0	1	22
Spain	-	-	5.7	171.0	6	171
United Kingdom	1	6	4.3	128.8	-1	123
Bulgaria	-	-	0.2	6.5	0	7
Denmark	-	-	0.4	12.6	0	13
Estonia	-	-	0.1	1.9	0	2
Ireland	-	-	0.0	1.4	0	1
Greece	-	-	0.5	15.7	1	16
Cyprus	-	-	0.0	0.0	0	0
Latvia	-	-	0.1	1.6	0	2
Lithuania	-	-	0.1	2.6	0	3
Luxembourg	-	-	0.0	0.3	0	0
Malta	-	-	0.0	0.0	0	0
Sweden	-	-	10.9	328.0	11	328
EU27 total		183	88	2635	-95**	2452**

* Reporting limit (threshold) for Nutrient-P: 5 tonnes/year.

** This is the difference between the calculated total and the EU27 total.

Figure 3 shows the data from the first three columns from Table 5 graphical.

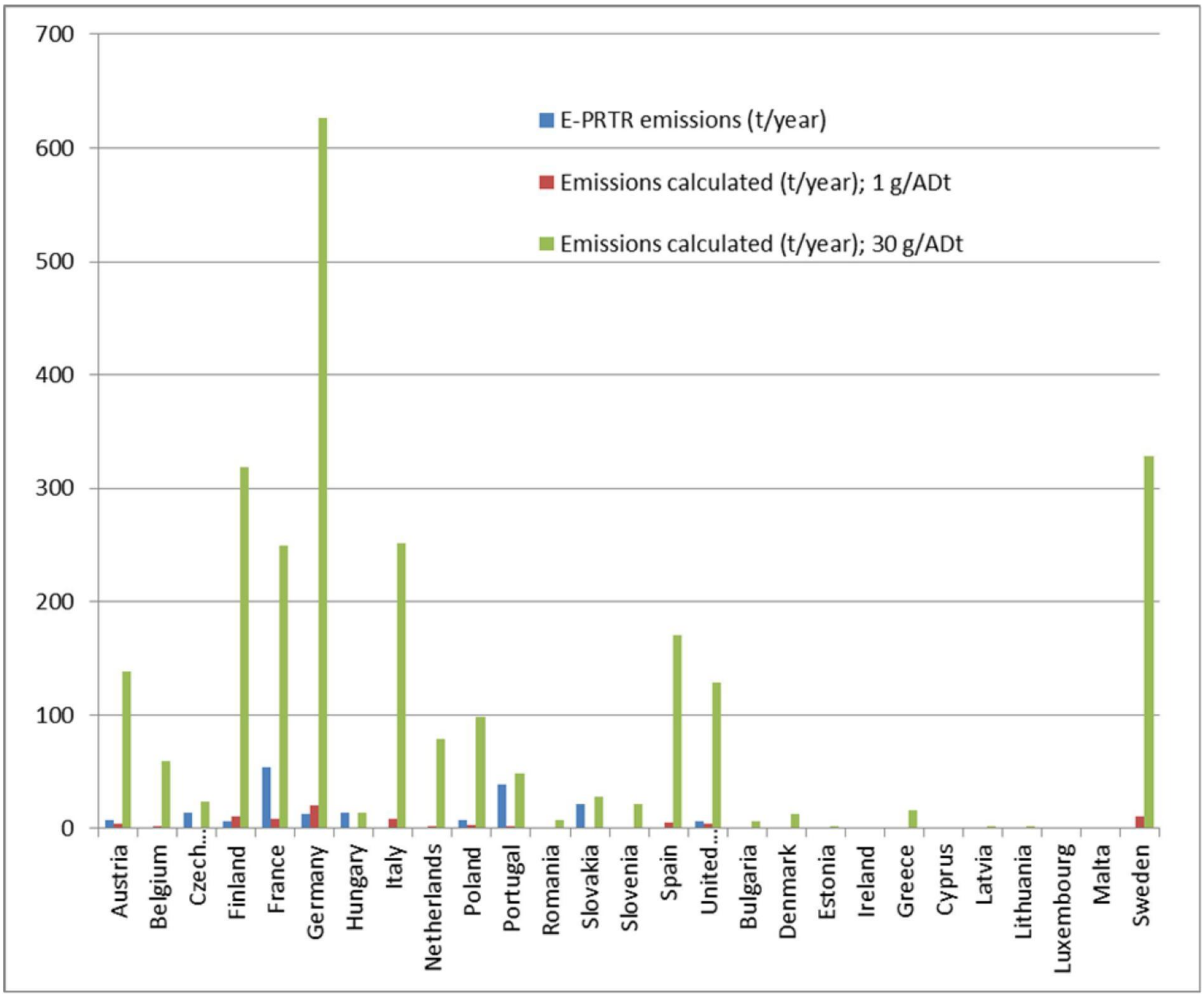


Figure 3 Reported E-PRTR emissions of Nutrient-P from Paper and Pulp industry compared to estimates using a high and low emission factor (ton/y).

The graph shows similar patterns as the former two.

The tables and figures show large differences between the emission reported to E-PRTR and the calculated emissions for the total paper industry (per Member State as well as for the EU27 total). For some Member States the calculated emissions are higher than what is reported in E-PRTR (so diffuse emission from non E-PRTR plants can be calculated). But for many Member States the calculated emissions are considerably lower than the reported E-PRTR emissions, so for these Member States the method is not applicable.

The reason for the differences per Member State is a result of the wide range in the emission factors (see Table 1). To narrow the range of the emission factor (to be applied for a specific Member State) detailed information on technologies in wastewater treatment in the paper industry is required. Furthermore the BREF on pulp and paper industry dates from 2001. Since that time developments in technologies are likely to have occurred, leading to a more efficient process with fewer emissions. Furthermore it can be expected that larger paper mills (E-PRTR) are using more state of the art abatement technologies as the non E-PRTR plants.

Reporting limits are 5 t/y for Nutrient-P and 50 t/y for Nutrient-N and TOC. These reporting limits introduce a systematic error since many of the emissions that were expected are missing. However, these emissions can in principle be estimated, for instance by calculating a ratio between N/P/TOC on facility level, so that when the TOC emissions are known, the other substances can be calculated.

The first conclusion however is that the proposed method results in emissions are not consistent to the reported ones and therefore not applicable without detailed information on the waste water technology in the different Member States. This does not mean however that the proposed method is without merit, the currently available data are just not detailed enough to make more accurate calculations.

On an EU-total basis, the emissions calculated for the non E-PRTR plants in principle can be allocated to the different Member States using employees as a proxy.

This calculation method for the emissions of non E-PRTR plants may be possible when estimates of the number of employees of paper plants within all individual Member States are available. From this the number the employees in E-PRTR and non E-PRTR plants should be separated. This number of employees per Member State in non E-PRTR plants could then be multiplied with the implied emission factor (E-PRTR emission/employee in the E-PRTR plants).
When a Member State has not reported any emissions to surface water for the sector, the average implied emission factor for all Member States could be used to calculate the non E-PRTR emissions in that specific Member State.

Although there are in principle possibilities to estimate emissions for the non E-PRTR industrial companies above mentioned shows a lot extra research is needed to define such an EU wide deployable method.

Spatial allocation
It is clear that when there is no possibility for reliable non E-PRTR sources emission estimates in a Member State, spatial allocation makes no sense.

If detailed and reliable data on waste water technology, location and number of employees of the plants in the sector are available these are the best way to spatial allocate the emissions.

An alternative would be to use the number of employees in the non E-PRTR part of the sector as a proxy. The number employees working in non E-PRTR plants could conservatively be estimated by assuming that all employees in a NUTS3 area are covered when at least 1 facility of a kind is present in that NUTS3 area. So the sum of all employees in all NUTS3 areas in a Member State wherein non E-PRTR emissions of a kind are reported are to be considered as non E-PRTR plant employees within this method.

The details on the spatial allocation of diffuse emissions would be identical to the method used in the framework of the E-PRTR Diffuse Emissions to Air – project [3].

General Conclusion

The case study for the paper industry shows that non E-PRTR emissions from industrial sectors can be estimated. The results for the paper industry indicate that the non E-PRTR facilities may contribute substantially to the total emissions of the paper and pulp industry. For a reliable estimation, however, detailed information on processes, water treatment technology and employee numbers are required. The exercise showed that even for a relative "uniform" sector the required data are not available at EU level, so no maps could be generated.

Possible solutions for some of the observed obstacles in using the proposed method are:

- Lower capacity- and or emission thresholds in the E-PRTR
- Include pollutant concentrations in waste water in E-PRTR or
- Include water consumption and wastewater emission in E-PRTR.

Literature

[1] BREF, Best available techniques REFerence document, European IPPC Bureau - Pulp and Paper industry, downloaded from http://eippcb.jrc.es/reference/pp.html; accessed at 19/01/2012.

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[3] IER, 2011, Theloke et al. (2011): Methodology development for the spatial distribution of the diffuse emissions in Europe (url: http://circa.europa.eu/Public/irc/env/e_prtr/library?l=/ diffuse_releases_e-prtr/methodology_2011/_EN_1.0_&a=d).