LCA Commons data in openLCA

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Abbreviations

LCA - *Life Cycle Assessment*
USDA - *United States Department of Agriculture*
NREL- *National Renewable Energy Laboratory*
NAL - *National Agricultural Library*

The LCA Commons database

The LCA Commons is a database providing US representative LCA data. The 9200 datasets have been developed by the different US governmental agencies such as USDA, National Renewable Energy Laboratory (NREL),National Agricultural Library (NAL) and US Forest service [1] and have been created with varying modeling perspectives and nomenclature frameworks. The database is available for free on the LCA Collaboration Server (https://www.lcacommons.gov/lca-collaboration/search). The version described here is created by GreenDelta GmbH based on the public version, with the idea to better align the datasets with the openLCA LCIA methods and to create one integrated and more homogeneous database. The changes will be documented in this report.

[1] Environmental Protection Agency (EPA) also provided about 400 datasets from the USEEIO (United States Environmentally Extended Input-Output Model); these datasets have been excluded from this database because they are based on input-output matrices and all the products flows are expressed in terms of monetary value being not comparable with the rest of LCA Commons datasets.

Description of LCA Commons modifications in openLCA version

Starting from the original LCA Commons database, modifications have been applied to flows and processes (i.e., datasets) in order to:

1. make the database usable with Impact Assessment method package of openLCA
2. improve the readability and usability of the database for the users.

2.1 Flows

2.1.1 Elementary flows

The original version of the LCA Commons database includes elementary flows coming from different LCA software providers. Four main types of elementary flows are present in the original database (Fig. 2.1):

- Flows present in the original database but not used in any processes; these flows have been deleted;
- Flows that already belong to the openLCA Impact Assessment method package;
- Flows that can be mapped to the openLCA Impact Assessment method package; they have been mapped by considering flow name, category and units;
- Flows that cannot be mapped to the openLCA Impact Assessment method package. For example, flows coming from Gabi database cannot be mapped to openLCA method because of different categorization.

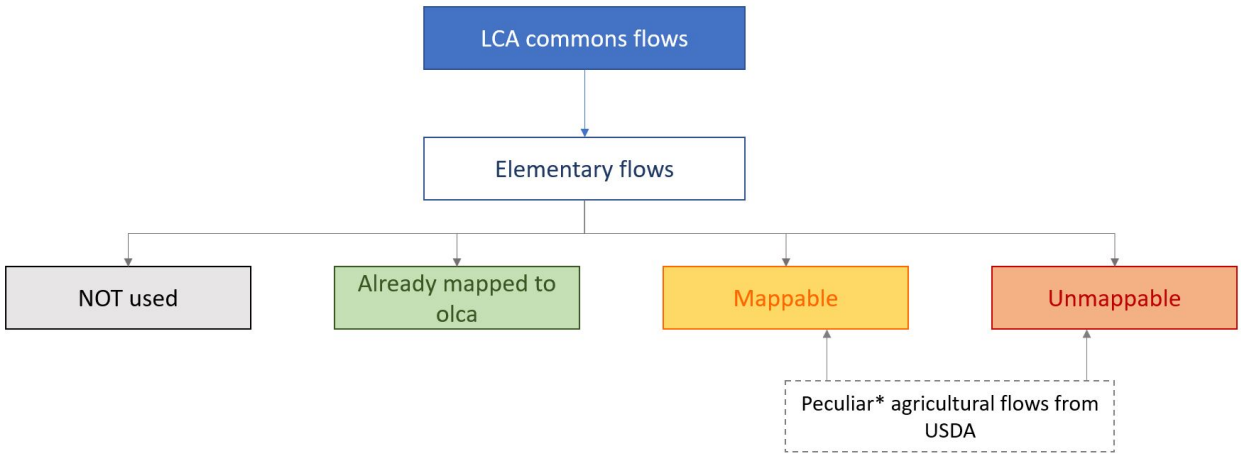

Figure 2.1: Groups of elementary flows present in the original LCA Commons database (**Peculiar* flows include emissions due to fertilizers and pesticides application, and to the burning of crop residues left on the field. These flows have been deeply modified and the modifications are described in section 2.1.1).

An additional group includes agricultural flows present in USDA agricultural datasets about field crop production (stored in the folder 'University of Washington Design for Environment Laboratory'). These datasets include emissions into the environment due to pesticides and fertilizers application and to the burning of crop residues left on the field. These datasets present pesticides, fertilizers and emissions from burning disaggregated into their components, namely active ingredients in the case of pesticides and active elements for fertilization (N, K, C etc.) in the case of fertilizers. These "active ingredient sub-flows" are typically hard to link to LCIA method characterization factors, and for this reason, we modified them to improve this link.[1]

For each of the three categories, we adopted a different procedure. As for **emissions due to fertilizers application**, in the original database they are dis-aggregated into their main components (e.g., in the case of ammonium nitrate, the components are H, N and O), and the name of the flow is composed of the name of the fertilizer, application method and timing of the application (e.g., *Ammonium nitrate; broadcast w/ incorp. in fert. in spr. bef. plant.*). In the openLCA version of the database, we aggregated the components by summing their amounts (but keeping the sum visible) and we just keep the name of the fertilizer (e.g., Ammonium nitrate) (Figure 2.2). Some of the flows in this group have been mapped to the openLCA Impact Assessment method package, some others flows could not. See Table A.1 for a complete overview.

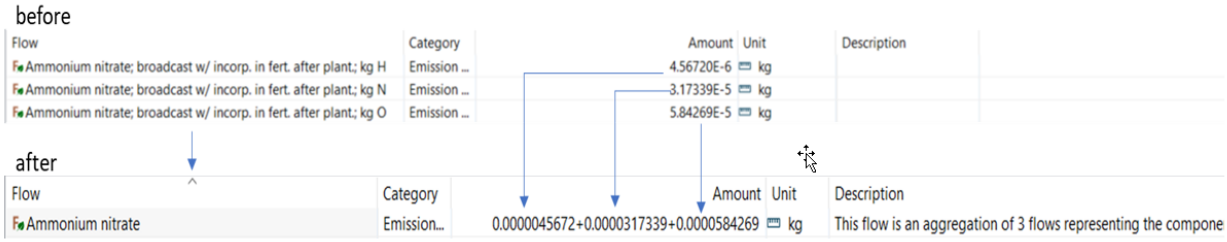

Figure 2.2: Changes in the flows describing the emissions due to fertilizer application. The fertilizer components have been summed up. The sum is visible in openLCA and the procedure and the information included in the original version of the LCA Commons database are included in the description.

The second group of agricultural flows regards pesticides. In USDA datasets, **emissions due to pesticides application** are expressed in terms of active ingredient (AI). The active ingredient is usually one of the components of a pesticide and therefore represents only a fraction of its amount. The USDA documentation [2] reports the minimum, maximum and average fractions of AI for the pesticides included in the LCA Commons database (see Table A.2). Starting from this documentation, we assumed the average fractions of AIs to obtain the entire amount of each pesticide. For those pesticides for which we could not find the average AI content, we assumed it to be equal to 100%. As for fertilizers, the original names of these emissions included the substance and the type of application (Figure 2.3). In the openLCA version of the database, we kept only the substance name.

[1] For more details, see here: https://www.lcacommons.gov/content/lca-commons-life-cycle-inventory-data-documentation
[2] Cooper, J.S., E. Kahn, M. Noon (2012) LCA Digital Commons Unit Process Data: field crop production Version 1 (June 2012), prepared for the United States Department of Agriculture National Agricultural Library under specific cooperative agreement 58-8201-0-149

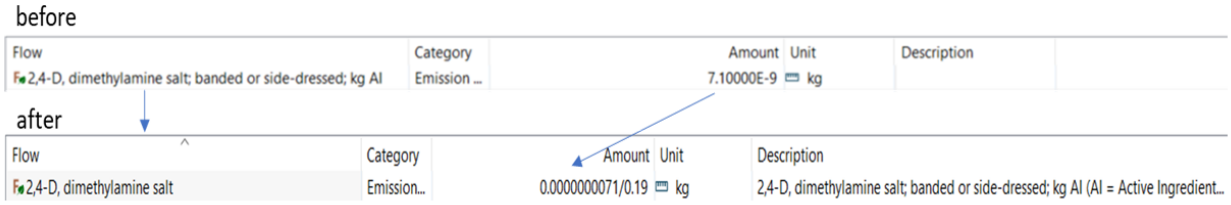

Figure 2.3: Changes in the flows describing the emissions due to pesticides application. The amount of active ingredient (AI) has been converted into the amount of the whole pesticide considering the average AI content reported in Table A.2 (AI content is the number at the denominator). The ratio is visible in openLCA and the procedure and the information included in the original version of the LCA Commons database are included in the description.

A third and last category regards the **emissions from residues burning**. In the original version of the database, they were expressed in kg of C and/or in kg of N (Figure 2.4). The amount has been adapted to the whole substance emitted by considering the fraction of C (or N) in the molecule (see Table A.3).

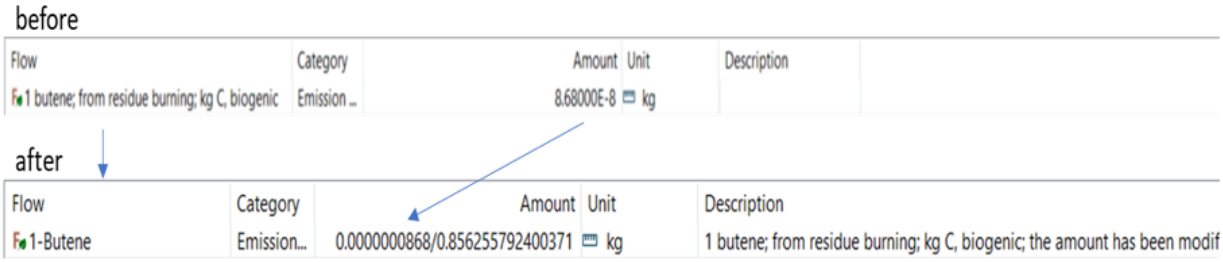

Figure 2.4: Changes in the flows describing the emissions due to to burning of crop residues. The amount originally expressed in kg of C (or kg of N) has been converted into the amount of the whole substance considering its C (or N) content reported in Table A.3 (C content is the number at the denominator). The ratio is visible in openLCA and the procedure and the information included in the original version of the LCA Commons database are included in the description.

Within this last category, some emissions were split into two flows, one representing the emissions of C (kg of C) and the other one representing the remaining amount (kg except C). In these cases, the two flows have been summed up (Figure 2.5 and Table A.4).

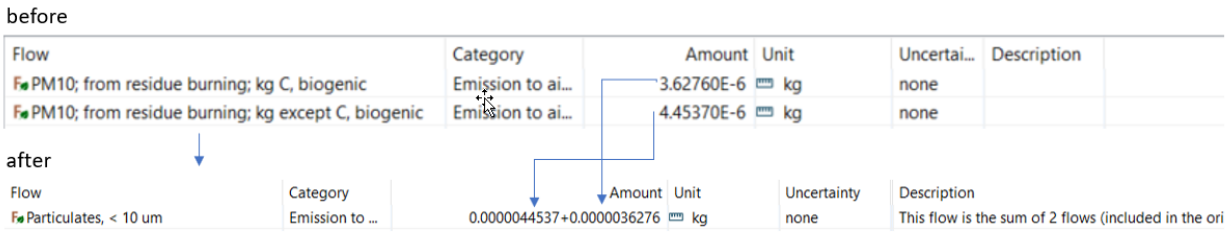

Figure 2.5: Changes in the flows describing the emissions due to to burning of crop residues expressed in kg of C and kg except C. The amounts of the two flows present in the original database (kg of C and kg except C) have been summed up. The sum is visible in openLCA and the procedure and the information included in the original version of the LCA Commons database are included in the description.

For all the three groups of flows, the original information (i.e., name and amount) is stored in the exchange description (i.e., every time one of these flows is used in a dataset, we reported the original information in the description in the inputs/output column). Additionally, in a single dataset the user can find these agricultural flows repeated several times (Figure 2.6). Each repetition represents a specific combination of (fertilizer or pesticide) application method and timing.

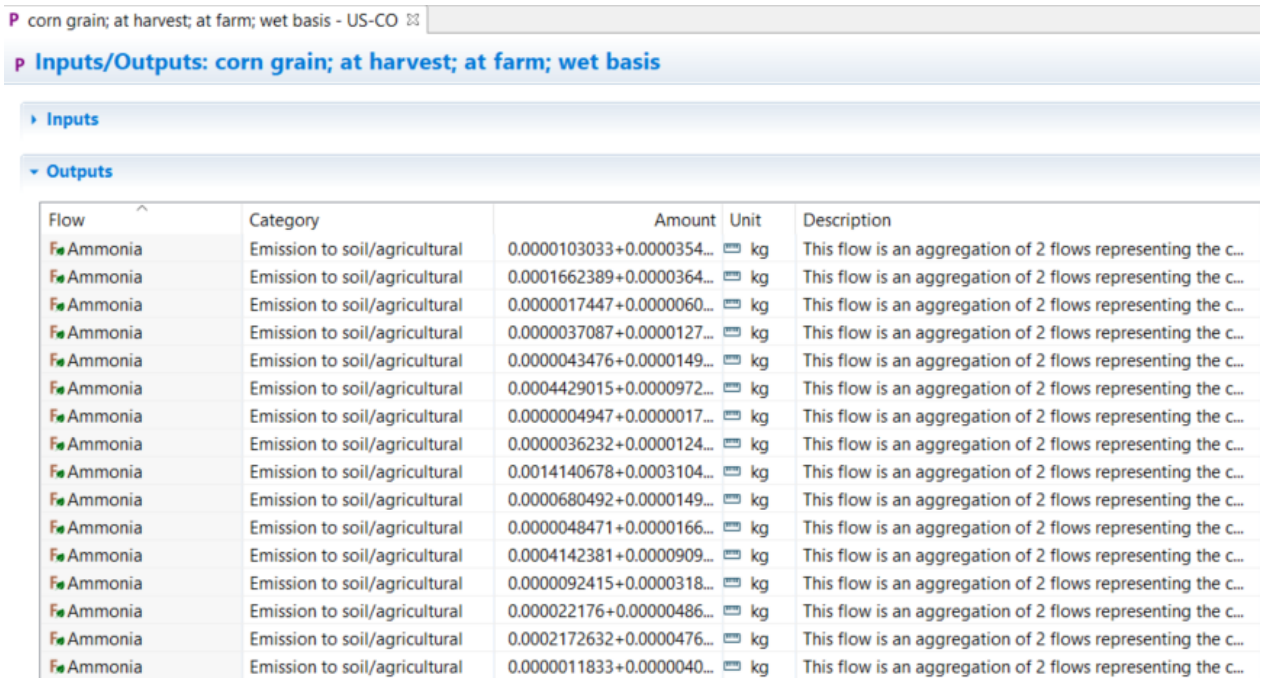

Figure 2.6: USDA agricultural flows can appear multiple times in the same dataset. Each row represents a specific combination of (fertilizer or pesticide) application method and timing.

2.1.2 Product flows

Product flows have not been significantly modified. Main changes are:

- few duplicates flows have been unified;

- LCA Commons includes some product flows without providers. For those openLCA users who hold and ecoinvent license, we linked part of those flows (about 240) to suitable ecoinvent (version 3.5) processes.

Processes

Concerning the LCA Commons processes, some modifications to the process organization and to the process and folder names have been introduced.
The processes have been primarily grouped according to the data providers (availabla in the LCA Collaboration Server, https://www.lcacommons.gov/lca-collaboration/search): NETL, NREL, North Carolina State University, US Forest service, University of Arkansas, University of Washington Design for Environment Laboratory and University of Washington biofuels Laboratory. Within each data provider folder, you can find one or more of the following sub-folders:

- Agriculture, forestry and fishing
- Construction
- Energy
- Manufacturing
- Mining
- Transportation and Warehousing
- Waste Management and Remediation Services
- Water supply; sewerage, waste management and remediation activities

These sub-folders are also used to organize product flows. To obtain this final list of sub-folders, some folders present in the original version of the database have been unified (e.g., folders including agricultural processes), deleted or named differently (e.g., the subfolders are classified according to the categories of the International Standard Industrial Classification Of All Economic Activities).[1] Additionally, we fixed some metadata details (e.g., *Time* in the General information section).

[1] www.fao.org/economic/

Connection with ecoinvent (version 3.5)

The LCA Commons database includes product flows, whose provider is not available (about 1500 flows). About half of these flows provided by the USDA represents farm datasets that do not exist within the LCA Commons (i.e., they are left for future work)[1]. For the remaining flows, we looked for providers in the ecoinvent database (version 3.5, cut-off, unit processes). We created a second version of LCA Commons for openLCA, in which some of those flows have been linked to suitable ecoinvent processes. The (provider) processes have been selected by flow name proximity and location. For flows named 'CUTOFF...' (in LCA Commons) we usually selected the 'market for' option of ecoinvent to include the transportation; otherwise we used the production, but in case more than one type of production process is available in ecoinvent, we selected again the "market for" option. The link between the two databases is done via the so-called *bridge processes* (all stored in the dedicated folder 'Bridge processes'). These processes includes the ecoinvent 3.5 flows as inputs (with the related provider) and the LCA Commons flow (without provider) as outputs. This trick allows to keep all the information (flow UUIDs, location etc.) from the two database. This second version of the LCAcommons database is accessible only to openLCA users that hold an ecoinvent licence.

[1] Cooper, J.S., E. Kahn, M. Noon (2012) LCA Digital Commons Unit Process Data: field crop production Version 1 (June 2012), prepared for the United States Department of Agriculture National Agricultural Library under specific cooperative agreement 58-8201-0-149

Support

GreenDelta GmbH, developer of openLCA, offers openLCA users prioritised and guaranteed professional openLCA support via the GreenDelta helpdesk (openlca.org/helpdesk). Public (*User2User*) support for openLCA is available via ask.openlca.org.

Annex: List of changed agricultural flows from USDA

Table A.1 summarizes the emissions due to fertilizer application included in USDA agricultural datasets. In particular, we reported the original name of the substance (i.e., the complete name of each flows also had the type and timing of fertilizer application), the name and the UUID in the actual version of the database and in the last column we highlight whether a flow is mapped to the openLCA method and therefore if it will be considered in the impact assessment.

Table A.1: Emissions from fertilizer application (USDA).The last column *Mapped* indicates if a flows has been mapped to openLCA methods.

original name	used name	UUID	Mapped
Ammonium nitrate	Ammonium nitrate	ba175784-d300-475f-82b8-5f1efe8d5398	YES
Anhydrous ammonia	Ammonia	d8997408-a915-4c5a-be0d-b6733dca498b	YES
Aqueous ammonia	Ammonia	d8997408-a915-4c5a-be0d-b6733dca498b	YES
Diammonium phosphate	Phosphoric acid	2d098ca9-f784-4ee9-81fd-e65df70846c0	YES
Urea	Urea	cdc1b6d4-b9f8-4efb-a244-206bf29bbf3e	YES
Ammonium sulfate	Ammonium sulfate	dd2b0e3e-0ed1-3416-8b3e-a3b102dbdfc1	NO
Monoammonium phosphate	Monoammonium phosphate	f0626488-992f-3f7b-8028-dd494d6c0a8c	NO
Nitrogen sol.	Nitrogen solutions	57a15062-fa7c-37e1-b589-0cd147dce7e1	NO
Other sing. K nut.	Other single K nutrients	f322395f-144b-3a29-b587-a6d58cba1e3d	NO
Other sing. phos.	Other single phosphates	b020f7a7-aad4-3f91-9ec6-990a043286b2	NO
Potassium chloride	Potassium chloride	6683c1a3-008b-3a4b-b411-528f0ce9ea7e	NO
Sodium nitrate	Sodium nitrate	e0a983fc-faff-3e2a-b456-012f6fe234e4	NO
Superphos. grds.<= 22%	Superphosphate grades 22% and under	7ac2c45f-d96c-3d33-9469-4a5d801b29ce	NO
Superphos. grds.>22%	Superphosphate grades over 22%	4145784b-97dd-350f-a086-386ff1b28c45	NO

Table A.2 summarizes the emissions due to pesticide application included in USDA agricultural datasets. The table reports statistics on the active ingredient contents of the involved pesticides.

Table A.2: Emissions from pesticide application (USDA) and information about active ingredient (AI) fractions, espressed in % of mass (oLCA means openLCA

CAS number	avg. AI	min AI	max AI	Name	mapped in oLCA
002430-72-4	34	2	99	1,1-Dimethylpiperidinium chloride	YES
000008-68-2	21	0	98	1-Naphthaleneacetamide	YES
000009-47-7	22	0	100	2,4-D	YES
000192-84-4	35	0	97	2,4-D, 2-ethylhexyl ester	YES
000200-83-1	19	0	97	2,4-D, dimethylamine salt	YES
000009-48-4	56	1	99	2,4-D-butyl	YES
000009-48-6	87	51	98	4-(2,4-Dichlorophenoxy)butyric acid	YES
007175-14-2	13	0	98	Abamectin	YES
003056-01-1	60	0	99	Acephate	YES
013541-02-7	19	0	100	Acetamiprid	YES
003425-68-1	48	7	97	Acetochlor	YES
005059-46-6	50	0	100	Acifluorfen	YES
001597-26-8	31	0	96	Alachlor	YES
000011-60-3	18	5	96	Aldicarb	YES
000800-20-9	59	0	10	Aliphatic petroleum hydrocarbons	NO
000083-41-8	64	0	98	Ametryn	YES
015011-47-9	49	2	95	Aminopyralid	NO
003308-96-1	36	2	100	Amitraz	YES
000008-65-0	19	0	94	Azinphos-Methyl	YES
013186-03-8	18	0	96	Azoxystrobin	YES
000010-12-9	16	12	22	Barban	YES
008305-59-6	20	0	99	Bensulfuron-methyl	YES
002505-78-0	99	99	99	Bentazon	YES
000259-31-9	22	1	100	Benzene, pentachloronitro-	NO
000008-26-8	22	1	100	Benzene, pentachloronitro-	NO
000006-58-0	11	0	100	Benzoic acid	YES
006835-93-5	10	0	99	beta-Cyfluthrin	YES
008265-70-3	8	0	99	Bifenthrin	YES
012540-19-5	71	18	98	Bispyribac-sodium	YES
000168-98-5	53	11	98	Bromoxynil	YES
005663-49-8	32	2	97	Bromoxynil octanoate	YES
000168-99-2	32	2	97	Bromoxynil octanoate	YES
006932-77-0	55	25	99	Buprofezin	YES
000275-84-1	22	1	27	Butoxone	NO
000007-56-5	5	0	65	Cacodylic acid	YES
000006-32-2	13	0	99	Carbaryl	YES
000156-36-2	19	0	95	Carbofuran	YES
012863-90-1	11	0	90	Carfentrazone-ethyl	YES
005459-38-8	20	2	88	Chlorethoxyfos	YES

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Table A.2 (continued)

CAS number	avg. AI	min AI	max AI	Name	mapped in oLCA
012245-37-0	21	1	97	Chlorfenapyr	YES
009098-23-4	20	3	98	Chlorimuron-ethyl	YES
000189-74-6	41	0	99	Chlorothalonil	YES
000292-18-2	10	0	100	Chlorpyrifos	YES
006490-27-3	52	9	98	Chlorsulfuron	YES
009912-92-2	32	13	96	Clethodim	YES
010551-20-9	42	6	98	Clodinafop-propargyl	YES
008177-78-1	31	3	90	Clomazone	YES
000170-21-6	26	0	98	Clopyralid	YES
014715-03-4	58	8	98	Cloransulam-methyl	YES
002042-75-2	36	0	96	Copper hydroxide	NO
000775-89-7	11	2	26	Copper sulfate (anhydrous)	YES
002172-54-2	61	10	97	Cyanazine	YES
011313-67-9	19	2	99	Cyclanilide	YES
011313-67-9	28	2	97	Cyhalofop-butyl	YES
005231-50-8	27	0	99	Cypermethrin	YES
005291-86-5	5	0	100	Deltamethrin	YES
000191-80-9	7	0	100	Dicamba	YES
001000-78-9	20	0	97	Dicamba-potassium	YES
000198-26-0	55	23	92	Dicamba-sodium	YES
005340-43-3	7	0	50	Dichlorprop-dimethylammonium	YES
005133-82-3	53	20	99	Diclofop-methyl	YES
014570-12-9	91	84	97	Diclosulam	YES
000011-53-2	11	0	95	Dicofol	YES
000014-16-2	62	9	86	Dicrotophos	YES
004986-68-7	50	0	100	Difenzoquat	YES
003536-73-5	36	0	99	Diflubenzuron	YES
010929-39-3	35	17	93	Diflufenzopyr-sodium	YES
008767-46-8	55	25	97	Dimethenamid	YES
016351-51-8	43	1	97	Dimethenamid-p	YES
005529-06-7	50	22	98	Dimethipin	YES
000006-05-5	34	0	98	Dimethoate	YES
000230-06-5	9	0	100	Dimethylamine 3,6-dichloro-o-anisate	NO
000014-42-8	27	1	81	Disodium methanearsonate	YES
000029-80-4	6	0	98	Disulfoton	YES
000033-05-1	37	0	99	Diuron	YES
000094-42-9	17	0	93	Dyphonate	YES
015556-99-8	30	0	97	Emamectin benzoate	YES
000011-52-7	17	0	96	Endosulfan	YES
000014-57-3	25	7	80	Endothall	YES

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Table A.2 (continued)

CAS number	avg. AI	min AI	max AI	Name	mapped in oLCA
000075-99-4	46	0	99	EPTC	YES
006623-00-4	4	0	99	Esfenvalerate	YES
005528-36-6	46	10	96	Ethalfluralin	YES
001667-28-0	40	0	87	Ethephon	YES
015323-39-1	43	5	97	Etoxazole	YES
011315-84-0	50	0	100	Fenoxaprop P	YES
006644-12-4	24	5	93	Fenoxaprop-ethyl	YES
003951-54-8	36	1	92	Fenpropathrin	YES
012006-83-3	18	0	99	Fipronil	YES
015806-26-0	53	23	98	Flonicamid	YES
014570-12-1	14	0	99	Florasulam	YES
007924-14-6	8	0	93	Fluazifop-p-butyl	YES
007962-25-6	68	40	97	Fluazinam	YES
018127-41-9	52	4	93	Flucarbazone-sodium	YES
009896-74-9	27	1	98	Flumetsulam	YES
008754-61-7	39	1	99	Flumiclorac pentyl ester	YES
010336-10-7	39	0	98	Flumioxazin	YES
000216-41-2	65	13	97	Fluometuron	YES
006937-78-7	10	9	10	Fluroxypyr	YES
008140-63-3	20	0	99	Fluroxypyr-meptyl	YES
006633-29-5	51	2	98	Flutolanil	YES
017315-95-4	37	2	99	Foramsulfuron	YES
007670-36-3	11	0	99	gamma-Cyhalothrin	YES
007718-28-2	18	1	95	Glufosinate-ammonium	YES
000107-18-6	70	1	99	Glyphosate	YES
006925-44-6	31	28	34	Glyphosate diammonium salt	NO
007090-11-1	40	2	58	Glyphosate potassium salt	NO
003864-19-0	30	0	84	Glyphosate-isopropylammonium	YES
008159-18-3	51	40	58	Glyphosate-trimesium	YES
010078-42-1	52	0	99	Halosulfuron-methyl	YES
008140-58-8	61	27	90	Imazamethabenz	YES
011431-13-9	31	3	97	Imazamox	YES
010409-84-8	10	0	24	Imazapic	YES
008133-43-1	42	0	99	Imazapyr	YES
008133-53-7	26	1	98	Imazaquin	YES
008133-57-5	27	1	99	Imazethapyr	YES
013826-14-3	22	0	100	Imidacloprid	YES
017358-44-6	11	0	94	Indoxacarb	YES
014111-22-0	31	3	98	Isoxaflutole	YES
007750-16-4	43	24	95	Lactofen	YES

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Table A.2 (continued)

CAS number	avg. AI	min AI	max AI	Name	mapped in oLCA
009146-50-6	11	0	98	Lambda-cyhalothrin	YES
000033-05-2	33	0	99	Linuron	YES
000012-17-5	28	0	100	Malathion	YES
000009-47-6	48	0	97	MCPA	YES
000203-94-5	26	0	96	MCPA, dimethylamine salt	YES
000365-34-3	23	22	24	MCPA, sodium salt	NO
002945-04-1	53	0	98	MCPA-2-ethylhexyl	YES
002654-42-7	56	34	74	MCPA-isooctyl	YES
024573-59-4	10	10	10	Mepiquat pentaborate	YES
020846-52-8	15	2	96	Mesosulfuron-methyl	YES
010420-68-8	23	0	96	Mesotrione	YES
005783-71-1	15	0	99	Metalaxyl	YES
007063-01-0	16	0	97	Metalaxyl-M	YES
001026-59-6	46	3	72	Methamidophos	YES
001675-27-5	15	0	99	Methomyl	YES
000029-80-0	30	0	84	Methyl parathion	YES
002108-76-9	49	0	98	Metribuzin	YES
007422-36-6	44	0	99	Metsulfuron-methyl	YES
000221-26-1	30	1	96	Molinate	YES
000216-38-6	38	0	59	MSMA	YES
000030-07-5	20	0	95	Naled	YES
011199-10-4	55	1	98	Nicosulfuron	YES
002731-41-2	62	5	98	Norflurazon	YES
011671-44-6	15	0	99	Novaluron	YES
002313-52-0	20	10	42	Oxamyl	YES
004287-40-3	25	0	99	Oxyfluorfen	YES
000191-04-5	29	0	46	Paraquat dichloride	YES
004048-74-1	24	0	97	Pendimethalin	YES
005264-55-1	8	0	99	Permethrin, mixed cis,trans	YES
000029-80-2	15	0	95	Phorate	YES
000191-80-1	47	0	97	Picloram	YES
024397-32-8	22	5	98	Pinoxaden	YES
008620-95-0	55	8	99	Primisulfuron-methyl	YES
004119-80-7	75	60	91	Profenofos	YES
000728-71-6	64	8	97	Prometryn	YES
000191-22-9	37	8	97	Propachlor	NO
000070-99-8	51	10	99	Propanil	YES
000231-23-8	47	3	95	Propargite	YES
005121-84-2	51	0	98	Propazine	YES
006020-79-1	24	0	99	Propiconazole	YES

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Table A.2 (continued)

CAS number	avg. AI	min AI	max AI	Name	mapped in oLCA
018127-41-7	42	5	95	Propoxycarbazone-sodium	YES
009412-53-5	39	2	96	Prosulfuron	YES
017892-87-6	21	1	98	Prothioconazole	YES
017501-31-0	20	0	98	Pyraclostrobin	YES
012963-01-9	12	0	98	Pyraflufen-ethyl	YES
036540-01-9	19	2	99	Pyrasulfotole	NO
005551-23-9	59	44	91	Pyridate	YES
009573-76-1	3	0	99	Pyriproxyfen	YES
012334-31-8	54	2	97	Pyrithiobac-sodium	YES
008408-70-4	31	0	98	Quinclorac	YES
007657-81-8	50	0	100	Quizalofop, ethyl	YES
012293-14-0	27	1	99	Rimsulfuron	YES
007405-18-2	20	11	50	Sethoxydim	YES
000012-23-9	29	0	46	Simazine	YES
008739-21-9	49	16	96	S-Metolachlor	YES
007217-80-0	39	16	95	Sodium bentazon	YES
000777-50-9	31	2	100	Sodium chlorate	YES
000013-74-8	35	18	45	Sodium N-methyldithiocarbamate	YES
016831-69-8	16	0	90	Spinosad	YES
012283-63-5	16	0	91	Sulfentrazone	YES
014177-63-1	62	24	98	Sulfosulfuron	YES
000770-43-9	55	0	100	Sulfur	YES
010753-49-3	28	0	99	Tebuconazole	YES
011241-02-8	54	23	99	Tebufenozide	YES
009618-25-5	21	2	93	Tebupirimfos	YES
007953-83-2	25	2	94	Tefluthrin	YES
001307-17-9	36	15	89	Terbufos	YES
015371-92-4	21	0	99	Thiamethoxam	YES
005170-75-2	46	8	99	Thidiazuron	YES
007922-72-3	42	0	98	Thifensulfuron methyl	YES
002824-97-6	43	10	97	Thiobencarb	YES
005966-92-0	47	2	95	Thiodicarb	YES
008782-08-0	60	35	84	Tralkoxydim	YES
006684-12-6	5	0	100	Tralomethrin	YES
000230-31-5	33	10	96	Tri-allate	YES
008209-75-5	58	9	92	Triasulfuron	YES
010120-04-0	38	2	98	Tribenuron-methyl	YES
000007-84-8	78	71	100	Tribufos	YES
005533-50-3	76	29	99	Triclopyr	YES
014151-72-7	20	0	98	Trifloxystrobin	YES

Continued on next page

Table A.2 (continued)

CAS number	avg. AI	min AI	max AI	Name	mapped in oLCA
029033-21-4	61	1	94	Trifloxysulfuron-sodium	YES
000158-20-8	21	0	99	Trifluralin	YES
002135-13-3	73	59	79	Urea, sulfate	NO
000192-97-7	37	1	96	Vernolate	YES
137497-61-1	7	0	88	Zeta-Cypermethrin	YES

Table A.3 and Table A.4 summarizes the emissions from residue burning. Table A.3 includes those flows that are expressed in kg of C or kg of N in the original LCAcommons database. For these flows the amount has been adapted to the whole substance. Table A.4 includes the emissions expressed in kg of C and kg except C, that have been summed in the openLCA version of the database.

Table A.3: Emissions from residues burning (USDA) with information about the fraction of C or N considered when updating the amount. The last group of three flows, instead, was expresses in kg C and kg except C, and the two amounts have been summed up.

Name	UUID	Formula	g/mol	% of C
1 butene	0aa4a379-3db3-4aad-950c-1bc4a58c6519	C4H8	56.1	85.6%
1.3 butadiene	8a970585-5ce2-4226-b60d-df1c34649a56	C4H6	54.1	88.8%
Acetaldehyde	fc9f9a81-c4b9-4dce-bc20-9f04e05ca2f1	C2H4O	44.05	54.5%
Acetic acid	c5cc0625-6e01-4639-b053-5d1d9d22a53c	C2H4O2	60.05	40.0%
Acetone	7a2d7097-20c4-4b5f-b2ee-bcfc2ba1378f	C3H6O	58.08	62.04%
Acetylene	e64254e3-07d3-4330-b6de-6a858f108124	C2H2	26.04	92.3%
Benzene	5e883a00-04e6-4d96-8dce-12d7117c6635	C6H6	78.11	92.3%
Carbon dioxide	7ed0c917-a8d2-4dee-8f70-0a5571d27131	CO2	44.01	27.3%
Carbon monoxide	099b36ab-4c03-4587-87f4-2f81e337afb8	CO	28.01	42.88%
Cis 2 butene	6dc21bad-2b80-4794-9f2f-590fe60b6c55	C4H8	56.11	85.6%
Cyclopentane	ebbc255e-91d4-3a0e-ba95-437a3ffcb76e	C5H10	70.13	85.6%

Continued on next page

Table A.3 (continued)

Name	UUID	Formula	g/mol	% of C
Ethane	e7e0031e-791d-42f4-b26c-ec322db637bc	C2H6	30.07	79.9%
Ethylene	87f683ed-44ae-41a6-b4bc-230622f8cfef	C2H4	28.05	85.6%
Formaldehyde	9167dca7-615e-435c-8ba6-dbbf50e50e34	H2CO	30.03	40.0%
Formic acid	e7f7fd97-a1c8-4be9-8a21-68ef06437d20	CH2O2	46.02	26.1%
Furan	142ce3b0-4bd6-47a3-9991-7c657c947ffe	C4H4O	68.08	70.6%
I butane	fa5512cf-04a2-4014-8e96-d3e2d137f0df	C4H10	58.12	82.7%
I butene	d8126779-4743-43ec-8d92-d07050cca303	C4H8	56.11	85.6%
I pentane	b661daa9-d1d9-45a1-890b-21c178058330	C5H12	72.15	83.2%
Isoprene	bf633941-aa40-4c37-b361-b5cbfb1089f5	C5H8	68.12	88.2%
Methane	20408dd0-8534-11e0-9d78-0800200c9a66	CH4	16.04	74.9%
Methanol	1d2439de-751b-469a-ba3e-fda8fe9802b2	CH4O	32.04	37.5%
N butane	fa5512cf-04a2-4014-8e96-d3e2d137f0df	C4H10	58.12	82.7%
N pentane	2f052025-4072-4d8e-b22d-68d50bfb260c	C5H12	72.15	83.2%
Phenol	63974d2c-11f3-45eb-be9c-726261b04d85	C6H6O	94.11	76.6%
Propane	9beb60a3-3a8c-4345-9a0e-107eec2f709f	C6H6O	44.1	81.7%
Propylene	23856318-9583-426b-ab04-12e4506b60a8	C3H6	42.1	85.6%
Toluene	77f17646-cede-4a49-99dd-55950098b077	C7H8	92.1	91.3%
Trans 2 butene	3184ec67-cc20-4dba-ab1a-d29f67c1edcb	C4H8	56.1	85.6%
Propanenitrile	7e2eafe9-e932-3e32-8b9e-16ff72f80630	C3H5N	55.1	65.4%
Propenenitrile	b840ad05-aa69-47a2-9509-e64e2b3b71b9	C3H3N	53.1	67.9%

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Table A.3 (continued)

Name	UUID	Formula	g/mol	% of C
Acetonitrile	f7553ef8-e4f3-4b9c-98be-81fa36315648	C2H3N	41.05	58.5%
Hydrogen cyanide	4883af97-e245-4b84-acof-19705a71a6b9	HCN	27.03	44.4%
		Formula	**g/mol**	**% of N**
Nitrogen dioxide	003697f1-54e9-409e-8179-23a95e99e4d7	NO2	46.0	30.5%
Ammonia	0f440cc0-0f74-446d-99d6-8ff0e97a2444	NH3	17.03	82.2%
Dinitrogen monoxide	afd6d670-bbb0-4625-9730-04088a5b035e	N20	44.01	63.6%

Table A.4: Emissions to be summed (expressed in kg C and kg except C)

Name	UUID
PM10	d42f8d08-08f6-42ef-ae04-dc2025462880
PM2.5	66f50b33-fd62-4fdd-a373-c5b0de7de00d
NMVOCs	33b38ccb-593b-4b11-b965-10d747ba3556

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