

Report

Dragosits, U.; Hallsworth, S.; Sutton, M.A. 2010 *Ammonia emissions from UK non-agricultural sources in 2008: contribution to the National Atmospheric Emission Inventory*. Edinburgh, NERC/Centre for Ecology and Hydrology, 15pp. (CEH Project number: C03614)

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Ammonia emissions
from UK non-agricultural sources in 2008:
contribution to the
National Atmospheric Emission Inventory

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April 2010

Client: AEA Technology	
Client Project number: 14714779	CEH Project number: C03614
Project Title: National Atmospheric Emissions Inventory (NAEI) and Greenhouse Gas Inventory (GHGI)	
Start date: 1-10-2008	Completion date: 30/09/2011
Client Project Officers: Anne Wagner (AEAT) for Defra	
CEH Project Officers: Ulli Dragosits(NH ₃ , CH ₄ , N ₂ O)/Amanda Thomson (LULUCF)	
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Reporting period: 01/09 – 01/10	
Report date: 30/04/2010	

EXECUTIVE SUMMARY

Estimation of total UK ammonia emissions from nature, waste disposal and other miscellaneous sources

1. Ammonia emission estimates were reviewed for natural sources, waste disposal and other miscellaneous sources regarding both source strength estimates (“emission factors”) and source populations for the UK, and brought up to date to 2008 (or the latest available data).
2. The emission sources listed above were assigned to the classification system used by the UNECE Emission Inventory Guidebook, and adjusted to match the system used by AEAT. The relevant categories (“SNAP codes”) in the guidebook are “use of solvents” (SNAP code 6), “waste disposal” (SNAP code 9) and other miscellaneous sources (SNAP code 11 or unclassified).
3. Ammonia emission estimates were included for the first time this year for nitrogen fertilisers applied in parks and gardens open to the public and large privately owned gardens. Emissions from nitrogen fertiliser application were also estimated for UK golf courses.

Emission source strength estimates

4. Emissions from biomass burning were revised completely, with burning of straw and stubble having been phased out. The revised estimate focuses on controlled burning of patches of heather (“muirburn”), a practice used in upland areas to regenerate growth. A best estimate has been calculated as 2.1 g NH₃-N (range 0.95-3.89 g) per square metre of burnt area.
5. Emissions from composting were revised with new data on the N content of materials composted. Volatilisation rates for in-vessel composting were revised from 39% to 42%, by combining experimental results from the literature with previously available data.
6. Emissions from household products were revised where practices have changed. For example, perming of hair has become less popular but colouring of hair is on the increase.
7. Emissions from human sweat have been revised where new publications have been available to update the ammonia content in sweat. Also, data on physical activity levels of the UK population have become available from new surveys.

Emission source populations

8. The overall horse population estimate for the UK has been updated with the latest available data on equines (i.e., including donkeys, mules etc) registered in the National Equine Database (NED), which is now complete and has been revised to remove historic records. This results in a total number 975,000 equines, a decrease by 244,000 compared with the previous best estimate.
9. In the UK, approximately 3,000 km² of heather are estimated to be managed by controlled burning on a rotational basis (muirburn”). By applying the best available emission factor of 2.1 g NH₃-N m⁻², a UK emission of 0.4 kt NH₃-N yr⁻¹ can be calculated, with an uncertainty range of 0.1-1.4 kt.
10. The amount of materials composted has increased again between the estimates for 2006 and 2007, from 3,206 kt to 3,424 kt. It is expected that this trend will continue for the foreseeable future. By combining the latest data with the revised emission estimates for composting, the UK total from this source has been calculated at 2.1 kt NH₃-N for 2007, an increase of nearly 25%.

11. The latest estimates of waste being land-filled show a slight decrease for the third year running, resulting in reduced NH₃ emissions from this source, down from 2.8 kt NH₃-N for 2006 to 2.5 kt NH₃-N for 2007. This trend appears to have been caused by increased recycling rates and reduced disposal to landfill in the UK.
12. The UK populations of cats are estimated to have decreased from 9.6 in 2006 to 7.2 million in 2007, a substantial decline of ~ 33%. However the impact of this change on UK emissions is very small in absolute terms, reducing from 1.1 kt NH₃-N in 2006 to 0.8 kt in 2007. By contrast, the dog population is estimated to have increased by 7%, from 6.8 to 7.3 million, which results in an increase in UK emissions from 4.3 to 4.7 kt NH₃-N
13. The source populations for other categories (e.g. human subcategories, seals, seabirds, wild geese) were also updated, however any changes are very small and have not resulted in substantial changes in emissions. No new data were found for pheasants, wild animals, non-agricultural fertiliser use, sewage works.

UK Emission estimates for 2008

14. Overall emissions from SNAP codes 6, 9 and 11 amount to 37.7 kt NH₃-N year⁻¹ for 2008, with a range of 18.1-77.2 kt NH₃-N year⁻¹. This constitutes a decrease of 3.5 kt NH₃-N yr⁻¹, compared with the estimate for the same sources for 2007 (36.3 kt NH₃-N yr⁻¹). The main changes to the inventory are decreases in emissions from horses due to a more reliable population estimate, and from biomass burning, due to a complete revision of the estimate. Other changes worth noting are increased emissions from composting (by 23%), and a decrease of emissions from landfill (by 8%) due to less material being land-filled. The latter two developments are linked, with materials being diverted from landfill to composting plants for recycling. Contributions to emissions from intensive nitrogen fertilisation of turfgrass on golf courses have been included in the inventory for the first time, as well as emissions from N fertiliser application in large gardens and parks.

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1. INTRODUCTION

Ammonia (NH₃) emissions are recognized as a major component in the assessment of transboundary air pollution fluxes for acidification and eutrophication. While most attention has been and is being given to agricultural sources, non-agricultural sources of ammonia represent around 20% of the total, but had received very little attention until the late 1990s in the UK, when Defra funded a review of the different sources by CEH (Sutton *et al.* 2000), and an assessment of the potential for reducing emissions from these sources, conducted by AEAT (Handley *et al.* 2001). Since 2003 (inventory year 2002), CEH has been providing annual updates on the following non-agricultural emission source categories for inclusion in the National Atmospheric Emission Inventory (NAEI):

- SNAP code 6 (solvent use): household cleaning materials, perming solutions, refrigeration etc
- SNAP code 9 (waste disposal): landfill, sewage works and sewage spreading, composting (excluding incineration)
- SNAP code 11 (other sources and sinks, including natural sources): non-agricultural horses, pets, wild mammals, seabirds, humans, biomass burning

The current contract (1-Oct-2008 – 30-Sep-2011) for the inventory years 2007-2009 exploits the expertise of CEH in non-agricultural sources of NH₃, focusing on emissions from nature, waste disposal and other miscellaneous sources, which complements the expertise of AEAT regarding combustion, industry and transport sources.

2. METHODOLOGY AND WORK SCHEDULE

Emission sources are referenced to the “SNAP code” (Selective Nomenclature of sources for Air Pollution) system recommended by the UNECE Emission Inventory Guidebook (2006) for the 2008 update.

An extensive literature search is conducted annually for new scientific publications on the sources under investigation, to improve existing estimates of source strength, as well as to scan the literature for new sources. In addition, a wide-ranging search for new source activity statistics is carried out for the annual inventory update. Any new information found is used in the inventory calculations, which result in “best estimates” for each source type. Low and high estimates are also calculated to provide a range/indication of the uncertainty.

The current report focuses on updating non-agricultural ammonia emissions for the inventory year 2008, both regarding new scientific information and assembling of data on source activities and calculation of annual UK emissions. The annual reports contain a short description of methodology, highlighting changes in source strength and source populations and their consequences on NH₃ emissions. This report incorporates the latest information available by the end of October 2009.

3. RESULTS

3.1. New emission source strength data

3.1.1. SNAP CODE 6 (SOLVENT AND OTHER PRODUCT USE)

Emissions from household products were revised with new information on ammonia content of hair colouring products (e.g. from Wella Corporation www.wellausa.com). It is estimated that approx. 2/3 of products on the market currently contain ammonia, with 1/3 being NH₃-free. Hair colouring products are often sold in single use bottles of 60ml, with an estimated average application rate of one per month per user. As a general rule, the NH₃ content is

higher for lighter hair colours, with products containing an estimated 0.3% - 1.3% NH₃ at application, with a best estimate of 0.8%. Assuming an average volatilisation of 20% with an uncertainty range of 10-30% (+/-25%), this results in an average emission of 1.1 g NH₃-N yr⁻¹ for every person using hair products.

3.1.2. SNAP CODE 9 (WASTE TREATMENT AND DISPOSAL, EXCLUDING INCINERATION)

Landfill

No new scientific literature was found which would merit changing the current approach.

Composting

Data on the types of materials composted in the UK were available from a survey of UK compost producers for 2007/08 by the Association for Organics Recycling (Smith *et al.* 2009), formerly the Composting Association, and were used to update the average N content of materials composted, which is unchanged from the previous year's estimate by Dragosits *et al.* (2009), at 1.17% N.

Landspreading of sewage sludge and sewage works

No new scientific literature was found which would merit changing the current approach.

3.1.3. SNAP CODES 11 AND 00 (OTHER SOURCES AND SINKS)

Only SNAP codes 11.3 (forest and other vegetation fires), and 11.7 (animals) are considered as relevant ammonia sources for the purpose of this report; semi-natural habitats such as woodlands, grasslands and wetlands are considered to be net sinks (Sutton *et al.* 2000).

Biomass burning

No new scientific literature was found which would merit changing the current approach.

Other animals

No new information was found on emission source strength for wild animals or seabirds.

Other sources – cigarette smoking

The latest smoking statistics available for the UK are from the General Household Survey 2007 (Robinson and Lader 2009). The smoking habits of the average cigarette smoker are almost unchanged from the previous value for 2006 (Goddard 2008), with a slight decrease in the average daily consumption from 16 to 15 cigarettes for men, and no change for women at 14 cigarettes. It should be noted that these statistics may not show any potential changes due the introduction of legal changes to smoking in public places (spring 2006 in Scotland, 2007 in England and Wales), as more up-to-date statistics become available.

For smokers under 16 years old, new statistics (NCSR 2009) show that the number of cigarettes per regular smoker has decreased, from 44.1 per week to 39.3 per week. The number of cigarettes smoked by occasional smokers also decreased, from 4.3 to 3.9 cigarettes per week. Overall these small changes result in a decrease in the average emission factor per young smoker.

Other human sources

New rates of sweating and associated N excretion during exercise from Meyer *et al.* (2007) were combined with similar numbers used in the previous years' inventories (derived from Czarnowski *et al.* 1995, Columbani *et al.* 1997). The number of hours spent exercising by the UK population was updated using data from the Health Survey for England 2006 (Craig and

Mindell 2008). This resulted in a revised emission estimate of 10.2 g NH₃-N person⁻¹ yr⁻¹, a decrease from the previous best estimate of 14.0 g NH₃-N person⁻¹ yr⁻¹.

No new information was included for other human emissions (breath, babies' nappies).

Golf courses, parks and gardens

Ammonia emission estimates for parks and gardens open to the public and large privately owned gardens, as well as for UK golf courses are included in the UK inventory for the first time.

Golf courses receive considerable amounts of N fertilisers, with Soldat et al. (2007) reporting 146 kg N ha⁻¹ yr⁻¹, and Wong et al (1998) and Shuman (2002) giving values of 125-250 kg N ha⁻¹ yr⁻¹ (average 188 kg) and 72-144 kg N ha⁻¹ yr⁻¹ (average 108 kg), respectively. An average value derived from all three studies is 147 kg N ha⁻¹ yr⁻¹ (range 72-250 kg N ha⁻¹ yr⁻¹). The average NH₃ volatilisation rate of 2.6% (range 2.2-3.4%) was derived from the emission factors from fertilised agricultural grassland (Misselbrook et al. 2008) from the UK inventory for 2007, and an estimated percentage of urea use of 5% (Sutton M.A., CEH Edinburgh, pers. comm.) Approx. 60% of the overall area of a golf course will receive fertiliser, however, there is a recent trend of the intensively managed (i.e. fertilised) area being decreased, due to environmental concerns. This results in an emission estimate of 4.1 kg N ha⁻¹ yr⁻¹ of fertilised grass, or 2.5 kg N ha⁻¹ yr⁻¹ of the total area of golf courses.

Public and private parks and gardens also receive applications of N fertiliser, and therefore an estimate of NH₃ emissions was calculated here, to assess the magnitude of this emission source. Recommendations for N applications range from 40 to 80 kg N ha⁻¹ yr⁻¹ (DeGomez, 2009). An average NH₃ volatilisation rate of 3% is estimated to result in an emission of 2.2 kg NH₃-N ha⁻¹ (range 1.2-2.4 kg) from parks and gardens.

3.2. New source data

Solvents/household products

Source numbers have been updated for SNAP code 6 (solvent use) with an estimated slight increase in the number of households in the UK for 2008 of nearly 25 million. There is still a trend towards smaller households in the UK, which should lead to a continuing increase in the number of households, for estimating emissions from household products that cause ammonia emissions, such as cleaning products, refrigeration, floor screeding etc.

Colouring of hair is on the increase, while at the same time, perming of hair has become less popular. Recent statistics for the use of hair products were collected from a variety of sources (e.g. U.S. Food and Drug Administration, NaturalNews.com (http://www.naturalnews.com/z023218_hair_dyes_cancer_health.html) and the hairstyle industry (http://www.hairstyles-7.com/hairarticles/hair_industry_statistics.php). These sources estimate that between 40 and 60% of women dye their hair, and in some countries up to 10% of men use hair colouring products. The application of these figures to the UK results in a total estimate of 14 t NH₃-N yr⁻¹ (range 1-54 t N yr⁻¹). This new estimate, derived by using a much larger body of evidence than the previous rough estimate, is very similar to the total derived in previous versions of the UK inventory, and improves confidence in the results.

Landfill

Source numbers have been updated for landfill (statistics: England: Defra (2009) latest available data for 2008; Scotland: SEPA (2009), data for 2008/2009; Northern Ireland: NIEA (2009), data for 2008; Wales: National Assembly for Wales (2009), data for 2008). The latest available figures for land-filled sewage sludge are also included in the total amount of landfill

(23 kt dry solids in the UK (2005 data for Great Britain, 2004 for Northern Ireland, (Defra 2007), together with municipal solid waste (MSW) data listed above. UK totals for 2008 amount to 18,115 kt MSW (inc. landfilled sewage sludge). Overall, emissions from landfill have decreased for the fourth year running, mainly due to another decrease in the overall amount of waste going to landfill in the UK. The current best estimate for 2008 is 2.3 kt NH₃-N year⁻¹ (range 1.1-4.6 kt), compared with 2.5 NH₃-N year⁻¹ kt in 2007.

Composting

The latest available data on amounts and types of waste composted in 2007/08 were taken from Smith *et al.* (2009) for the 2008 update of the inventory. The estimate of 4,475 kt of composted materials for 2007/8 matches well with other data sources and Smith *et al.* (2009) state that the questionnaire returns have been improving throughout the series of surveys. Based on these data, they were also able to revise the previous year's figures (2006/07) to 4,103 kt of composted materials, which represents an increase of 9% between the two years. Composting is still a growth area, and increases in emissions from this source are expected for some time to come.

For the derivation of emissions from composting facilities, the relative proportions of the composted material from Smith *et al.* (2009), which are similar to those from Nikitas *et al.* (2008). This resulted in a best estimate of 2.8 kt NH₃-N from composting for 2008, which represents an increase of 0.7 kt from the figures calculated for 2007 by Dragosits *et al.* (2009). Using the revised 2006/07 amount of materials composted (4,103 kt, Smith *et al.* 2009), the 2007 emissions were recalculated at 2.5 kt NH₃-N yr⁻¹, which results in a year-on-year increase of 0.4 kt NH₃-N yr⁻¹.

Landspreading of sewage sludge

No new data were found in amounts of sewage sludge, the 2005 data in Defra (2008) still appear to be the best available.

Biomass burning

No new data were found which merit an update of the 2007 estimate.

Parks & gardens + golf courses

Average golf course sizes are 0.5 km² for 18-hole courses and 0.24 km² for 9-hole courses (Scottish Agricultural College www.sac.ac.uk). According to figures from online directories of UK golf courses (www.sac.ac.uk, www.englishgolf-courses.co.uk, www.scottishgolfcourses.com, www.welshgolfcourses.com, www.irishgolfcourses.co.uk), there are approx. 2,600 golf courses in the country, of which ~80% are of the larger type, and covering an area of ~1,160 km². Using the best estimate of 2.5 kg NH₃-N ha⁻¹ yr⁻¹, this results in an emission of 0.3 kt NH₃-N yr⁻¹ (range 0.1-0.8 kt).

Parks and gardens are estimate to cover an area of ~2,200 km² in the UK (English Heritage <http://www.english-heritage.org.uk/>, parksandgardens.ac.uk). Applying the emission factor of 1.8 kg NH₃-N ha⁻¹ yr⁻¹ calculated in Section 3.1. (above) gives a total of 0.4 kt NH₃-N yr⁻¹ from this source (range 0.2-0.6 kt).

Humans

The UK population figures were updated to the latest available data, the mid-2008 estimate of 61,383,200 (ONS 2009). This constitutes an increase by approx. 408,000 people or 0.7%, compared with 2007. The emission source populations were also updated for the number of infants in the two age groups considered for babies' nappy emissions, as well as for adult and young smokers (11-15 years old).

The new more robust emission factors for human sweat (see Section 3.1) were applied to the UK population, separately for adults and children, which resulted in a new best estimate for this source of 0.6 kt NH₃-N yr⁻¹ (range 0.1-2.5 kt). Compared with the 2007 estimate of 0.9 kt (0.1-4.6 kt), this represents a decrease of 0.3 kt, or 30%, despite a small increase in the UK population between years. This is the largest relative change in emissions for all sources discussed in this report.

New data on adult cigarette smoking (Robinson and Lader 2009) show that the proportion of adults over 16 years old who smoke has declined from 23% to 22% for men and from 21% to 20% for women between 2006 and 2007. This results in a decrease in emissions from cigarette smoking of 8%, which amounts to an absolute change of 0.02 kt NH₃-N. Cigarette smoking emissions from young people also decreased by 13%, mainly due to a lower cigarette consumption per smoker (The proportion of young people < 16 years who smoke, is estimated to have stayed constant since 2007 (NCSR 2009), however there is a small increase in the absolute number of young smokers due to the general increase in the number of young people in the UK (ONS 2009)).

Overall, emissions from other human sources (breath, sweat, smoking and babies' nappies) are estimated at 0.95 kt NH₃-N yr⁻¹ for the UK in 2008, a decrease of 0.25 kt from 1.2 kt NH₃-N yr⁻¹ in 2007. This large relative decrease of > 20% is mainly due to a revision in the estimate of emissions from human sweat, and a slight decrease in emissions from smoking, despite an overall increase in the UK population by 0.6%.

Pets

New survey data from the Pet Food Manufacturers Association (PFMA) for 2008 estimate that there are 8.0 million dogs and 8.0 million cats in the UK, compared with 7.3 million dogs and 7.2 million cats for 2007. With the same emission estimate per animal used as in 2007, this represents an increase in both the estimated populations and NH₃ emissions of ~10% for dogs and ~11% for cats. The continuing fluctuations in the population numbers suggest that the survey sample size may not be large enough to show real trends, and this highlights the importance of including uncertainty estimates in the inventory. The best estimate of UK NH₃ emissions from cats is 0.9 kt NH₃-N yr⁻¹ for 2008 (range 0.4-1.4 kt NH₃-N yr⁻¹), compared with 0.8 kt (0.3-1.3) for 2007. Ammonia emissions from dogs for 2008 are estimated at 5.1 kt NH₃-N yr⁻¹ (range 2.1-8.9 kt NH₃-N yr⁻¹).

Seabirds

No new survey data were found, the estimate of 3 kt NH₃-N year⁻¹ for 2007 (Dragosits *et al.* 2009) was carried forward for the current inventory year.

Horses

The 2007 emission estimate of 12.8 kt NH₃-N year⁻¹ was retained as the current best estimate, as no new data were made available for 2008. It should be noted that this estimate includes emissions from all UK horses, a) those counted in the agricultural census and therefore included the agricultural emission inventory calculated by North Wyke Research (Misselbrook *et al.* 2009), and b) all other horses, i.e. the "non-agricultural" part of the UK horse emissions.

Wild animals

For the 2008 update, several new wild animal population estimates were included in the inventory:

For grey seals, SCOS (2009) gives a new best estimate of 160,100 animals (84,500-304,500). These figures replace the previous year's best estimate of 133,000 (107,000-171,000), however SCOS (2009) state that these new figures are due to the use of a different modelling approach rather than an indication of an increase in population. These new figures result in an increase in emissions from 59t to 70 t NH₃-N year⁻¹.

The new estimate of wild geese populations in the inventory is based on a combination of best estimates from different sources (Mitchell *et al.* 2008, Mitchell 2009, Fox *et al.* 2008, Hall 2008, Rowell *et al.* 2004). Overall, approx. 81,500 geese are estimated to be resident in the UK all year round (previous population of 121,000 from a number of sources, see Dragosits *et al.* 2009), with a further approx. 546,000 (previously 605,000) migratory geese overwintering in the UK. These winter visitors stay in the UK between September/October/November and March/April, depending on species. An average residence time of 6 months has been estimated for the purpose of the NH₃ inventory. In total, emissions from wild geese are estimated at 61 t NH₃-N (range 34-95 t) for 2007, compared with 72 t for 2007. This is perhaps on the conservative side due to a lack of data on emission source strength (Dragosits *et al.* 2007). While the total emission from wild geese is relatively small, it they are locally important sources in areas where they congregate in large numbers, e.g. in western Scotland and some Scottish islands (especially Islay).

No new data were found for other wild mammals or pheasants.

3.3. New UK emissions

UK emission totals for the selected sources were recalculated with the new source strength and source population data described above. Emission source strength and source population data as well as UK emission totals from SNAP codes 6, 9 and 11 are listed in Table 1 below. Overall emissions from SNAP codes 6, 9 and 11 (including unclassified sources under SNAP Code 00) amount to 37.7 kt NH₃-N year⁻¹ for 2008, with a range of 18.1-77.2 kt NH₃-N year⁻¹.

Table 1: Ammonia emissions from UK non-agricultural sources for 2008

2008 (Ammonia as NH ₃ -N)	emission estimates source-1			units as NH ₃ -N	number of sources			units	UK emissions 2008(kt NH ₃ -N yr-1)		
	best estimate	low	high		best estimate	low	high		best estimate	low	high
human breath	2.0	0.7	6.2	g person-1 yr-1	61,383,200	-	-	persons	0.125	0.043	0.381
human sweat	10.2	1.6	42.1	g person-1 yr-1	61,383,200	-	-	persons	0.60	0.09	2.49
infants emissions < 1yr	11.7	2.4	54.2	g infant-1 yr-1	788,100	-	-	children <1 yr	0.009	0.002	0.043
infants emissions 1-3 yrs	14.6	3.0	67.8	g infant-1 yr-1	1,487,900	-	-	children 1-3 yr	0.022	0.004	0.101
cigarette smoking (adults)	18.5	9.3	33.5	g smoker-1 yr-1	10,458,256	-	-	smokers	0.194	0.097	0.351
cigarette smoking (young people)	4.5	2.3	8.2	g smoker-1 yr-1	407,924	-	-	smokers	0.002	0.001	0.003
competition/race horses *	27.3	12.4	53.5	kg animal-1 yr-1	151,700	-	-	animals	4.1	3.1	5.3
other horses*	10.5	2.3	45.7	kg animal-1 yr-1	823,300	-	-	animals	8.7	4.8	15.8
dogs	0.638	0.296	1.01	kg animal-1 yr-1	8,000,000	7,200,000	8,800,000	animals	5.108	2.128	8.910
cats	0.111	0.052	0.16	kg animal-1 yr-1	8,000,000	7,200,000	8,800,000	animals	0.886	0.375	1.434
wild deer (large)	1.45	0.73	2.90	kg animal-1 yr-1	709,455	-	-	animals	1.03	0.4	2.7
wild deer (small)	0.58	0.29	1.16	kg animal-1 yr-1	750,000	-	-	animals	0.44	0.1	1.3
other major wild animals (mammals inc. seals)	-	-	-	-	-	-	-	-	0.98	0.25	2.77
wild geese	-	-	-	-	627,273	470,455	784,091	birds	0.06	0.03	0.09
seabirds	-	-	-	-	6,667,910	-	-	birds	2.96	1.98	5.91
biomass burning (heather burning, "muirburn")	2.10	0.95	3.89	g m-2 yr-1	200,000,000	120	360	burnt area in km ²	0.42	0.11	1.40
ecosystems	0	0	0	-	0	0	0	-	0	0	0
sewage works	-	-	-	-	-	-	-	-	1.2	0.7	4.9
sewage spreading	-	-	-	-	1147	1147	1147	kt total dry solids yr-1	3.3	0.8	7.1
landfill	0.13	-	-	kg t-1 landfilled	18,114,957	-	-	t landfilled (MSW + sludge)	2.3	1.1	4.6
appliances & household products	-	-	-	-	-	-	-	-	1.00	0.3	3.7
non-agricultural fertilizers (households)	-	-	-	-	-	-	-	-	0.23	0.1	0.5
composting	-	-	-	-	4,475,000	-	-	t of waste composted	2.79	1.21	4.33
pheasants	0.02	0.006	0.06	kg bird-1 yr-1	25,000,000	22,500,000	27,500,000	birds	0.50	0.14	1.65
parks and gardens	1.82	1.21	2.42	kg ha-1 yr-1	214,871	181,217	255,025	hectares	0.39	0.22	0.62
golf courses	2.48	0.87	6.56	kg ha-1 yr-1	116,126	-	-	hectares	0.29	0.10	0.76
TOTAL	-	-	-	-	-	-	-	-	37.66	18.11	77.20

* Note: The estimate of emissions from horses includes all horses in the UK, i.e. horses counted in the agricultural census are included in this estimate.

4. SUMMARY OF CHANGES AND CONSEQUENCES

SNAP code 6 (solvent and other product use)

Only minor changes were made to emissions from household products, by including new data on the number of households in the UK. Some of the estimates for individual sources changed – for example, perming solutions were reduced whilst hair colouring products were included – but this did not significantly affect the overall emissions from this category from last year.

SNAP code 9 (waste treatment and disposal)

Landfill emissions have decreased again from the 2007 emission estimate (2.5 kt NH₃-N) to 2.3 kt NH₃-N, mainly due to a decrease in the proportion of municipal solid waste being land-filled.

Composting emissions are estimated to have increased in line with recent trends in amounts of organic materials being composted, from 2.1 kt NH₃-N in 2007 to 2.8 kt NH₃-N in 2008. Emissions from this source are likely to continue to increase, due to increased pressure to divert compost-able materials from landfill.

SNAP code 11.3 (forest and other vegetation fires)

No new data were found for muirburn (burning of heather moorland), the 2007 value of 0.42 kt NH₃-N yr⁻¹ (range 0.11-1.40 kt), is still valid.

SNAP code 11.7.2 (mammals)

The major change in NH₃ emissions from (domestic) mammals is an increase in emissions from cats and dogs, by 11% and 10%, respectively, due to new population estimates. The best estimate for emissions from horses was not changed between 2007 and 2008, as no new data were made available.

SNAP code 11.7.3 (other animals)

Small changes in population data for have resulted in very minor increases in emissions from seals and similarly small decreases in emissions from wild geese.

SNAP code 00 (other sources)

Humans

Emissions from humans decreased by ~20%, from 1.2 kt NH₃-N yr⁻¹ in 2007 to 0.95 kt in 2008, mainly due to a revised smaller estimate of emissions from human sweat, and a small decrease in emissions from cigarette smoking. This is despite the continuing increase in the UK population by 408,000 persons or 0.7% from 2007 to 2008.

Gardens, parks and golf courses

Emissions from nitrogen fertilisers applied to public parks, gardens and golf courses are included in the NAEI for the first time for 2008. The best estimates of the annual emissions are 0.4 kt NH₃-N from parks and gardens and 0.3 kt NH₃-N from golf courses.

5. CONCLUSIONS

Non-agricultural NH₃ emissions from the use of solvents, waste disposal and other miscellaneous sources were recalculated, using the latest updates available for source strength estimates (“emission factors”) as well as source activity statistics/source populations, and brought up to date to 2008 (or the latest available data):

Overall emissions from SNAP codes 6, 9, 11 and other miscellaneous sources amount to 37.7 kt NH₃-N year⁻¹ for 2008, with a range of 18.1-77.2 kt NH₃-N year⁻¹. This constitutes an increase of ~1.4 kt NH₃-N compared with the estimate for the same sources for 2007 (36.3 kt NH₃-N). The main changes to the inventory are increases in NH₃ emissions from composting, cats and dogs, and decreases in emissions from landfill and human sweat. Emissions from golf courses, parks and gardens were included for the first time and are estimated to contribute 0.7 kt NH₃-N year⁻¹ to the total, due to mineral fertilisers being applied. Emissions from other sources not mentioned above changed only by small amounts.

ACKNOWLEDGEMENTS

The authors are grateful to Defra, who are funding this work as part of the National Atmospheric Emissions Inventory (NAEI), and to Ron Smith (CEH) for statistical advice.

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