Report

Dragosits, U.; Luk, J.; Sutton, M.A.. 2009 *Ammonia emissions from UK non-agricultural sources in 2007: contribution to the National Atmospheric Emission Inventory.* NERC/Centre for Ecology & Hydrology, 16pp. (Report Number: AS 08/08, CEH Project number: C03614)

Ammonia emissions from UK non-agricultural sources in 2007: contribution to the National Atmospheric Emission Inventory

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June 2009

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_2O)/Amanda Thomson (LULUCF)	
Main authors: Dragosits U., Luk J. and Sutton M.A.	
Reporting period: 10/08 – 12/08	
Report date: 30/06/2009	
Report Number: AS 08/08	

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 2007 (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).

Emission source strength estimates

3. 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 2.1g NH_3-N (range 0.95-3.89 g) per square metre of burnt area.
4. 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.

Emission source populations

5. 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.
6. In the UK, approximately 3,000 km^2 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 NH_3-N m^{-2}, a UK emission of 0.4 kt NH_3-N yr^{-1} can be calculated, with an uncertainty range of 0.1-1.4 kt.
7. 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 NH_3-N for 2007, an increase of nearly 25%.
8. The latest estimates of waste being land-filled show a slight decrease for the third year running, resulting in reduced NH_3 emissions from this source, down from 2.8 kt NH_3-N for 2007 to 2.5 kt NH_3-N for 2007. This trend appears to have been caused by increased recycling rates and reduced disposal to landfill in the UK.
9. 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 NH_3-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 NH_3-N

10. 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 2007

11. Overall emissions from SNAP codes 6,9 and 11 amount to 36.3 kt NH_3-N $year^{-1}$ for 2007, with a range of 17.4-76.5 kt NH_3-N $year^{-1}$. This constitutes a decrease of 3.5 kt NH_3-N yr^{-1}, compared with the estimate for the same sources for 2006 (39.8 kt NH_3-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 causally linked, with materials being diverted from landfill to composting plants for recycling.

CONTENTS

1. INTRODUCTION

Ammonia (NH_3) 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 NH_3, 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 2007 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 2007, 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 NH_3 emissions. This report incorporates the latest information available by the end of October 2008.

3. RESULTS

3.1. New emission source strength data

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

No new scientific information suitable for inclusion into the inventory calculations was found.

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

Additional data on N content of materials composted as well as NH_3 volatilisation rates from a large in-vessel composting experiment (de Guardia *et al.* 2007) were incorporated into the calculations for composting emissions. The estimates provided by de Guardia *et al*. (2007) are broadly in line with literature data already used in the calculation of composting emissions for the NAEI. They were used together with previous data by Kirchmann and Widen (1994) and Beck-Friis *et al*. (2001) to revise the average volatilisation rates for in-vessel composting at 39% (previously 42%).

In terms of the types of materials composted in the UK, data from a survey of UK compost producers for 2005/06 by the Composting Association (Nikitas *et al*. 2008) were used to update the average N content of materials composted. The resulting value of 1.16% N estimated from the data provided by Nikitas *et al*. (2008) is similar to that of recent years, as calculated by Dragosits *et al*. (e.g. 2005, 2006) under the previous NAEI contract (Note: no new survey data were available for the inventory update carried out in 2007).

Landspreading of sewage sludge and sewage works

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

Biomass burning

Field burning of cereal straw and stubble is not permitted in England and Wales except under (very rare) special exemptions, and strongly discouraged in Scotland and Northern Ireland (e.g., see http://www.netregs.gov.uk/netregs/). The previous estimate of ammonia emissions from cereal/stubble burning are now considered out of date. A revised biomass burning estimate is now included under SNAP Code 11.3 (Forest and other vegetation fires).

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

For the 2007 inventory, a completely revised estimate for controlled biomass burning has been produced, on the assumption that this is dominated by muirburn, i.e., burning of heather moorlands. The NH_3 emissions during muirburn operations are due to inefficient/low temperature burning with high CO/CO_2 ratios. As there are no data available from specific measurements of emissions from heather burning, the estimates have to be based on the available fuel. The current best estimate and uncertainty range calculated by J.N. Cape (CEH Edinburgh, pers. comm.) and U. Dragosits is based on a range of literature values for vegetation fires (e.g. Allen 1964, Andreae *et al*. 1994, Andreae and Merlet 2001, Bertschi *et al.* 2003, de Castro *et al.* 2007, Delmas *et al*. 1995a and 1995b, Goode *et al*. 1997, Griffith *et al.* 1991, Hegg *et a*l. 1988, Hurst *et al*. 1994, Korontzi *et al*. 2004, Lebel *et al*. 1991, Lee and Atkins 1994, Lobert *et al*. 1990 and 1991, Mendoza *et al*. 2005, Paton-Walsh *et al*. 2004, Wiedinmyer *et al*. 2006, Yokelson *et al.* 1997 and 1999). The best estimate is based on an

emission of 2.1 g NH_3-N per square metre of burnt heather moorland (range 0.95-3.89 g NH_3-N m^{-2}), and assumes that only the heather is burnt, not the underlying peat.

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 2006 (Goddard 2008). The smoking habits of the average cigarette smoker are almost unchanged from the previous value for 2005 (Goddard 2006): the average daily consumption increased from 15 to 16 cigarettes for men, and appears unchanged for women at 14 cigarettes. It should be noted that these statistics pre-date the new smoking laws, which are expected to result in larger changes as more up-to-date statistics become available.

For smokers under 16 years old, new statistics (NCSR 2008) show that the number of cigarettes per regular smoker has increased slightly, from 43.5 per week to 44.1 per week. The number of cigarettes smoked by occasional smokers also increased, from 3.4 to 4.3 cigarettes per week. Overall these small changes are estimated to result in a very slight increase in the average emission factor per young smoker, however this is more than offset by a decrease in the percentage of young people who smoke (see Section 3.2.)

Other human sources

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

3.2. New source data

Solvents

Source numbers have been updated for SNAP code 6 (solvent use) with a new estimate of the number of households in the UK for 2006/7 of 24,836,000 (Jones 2008). This represents an increase of 37,000 households (0.1%) compared with 2005/06 (ONS 2006), resulting in a small increase in the estimated UK NH_3 emission from household products. There is still a trend towards smaller households in the UK, which should lead to a continuing increase in the number of households.

Landfill

Source numbers have been updated for landfill (statistics: England: Defra (2008) latest available data for 2007; Scotland: SEPA (2008), data for 2007/2008; Northern Ireland: EHS (2008), data for 2006/7; Wales: National Assembly for Wales (2008), data for 2006/07). 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 are shown in Table 2. Overall, emissions from landfill have decreased slightly for the third year running, mainly due to another decrease in the overall amount of waste going to landfill in the UK. The current best estimate for 2007 is 2.5 kt NH_3-N $year^{-1}$ (range 1.3-5.1 kt), compared with 2.8 NH_3-N $year^{-1}$ kt in 2006.

Composting

For NH_3 emissions from composting, the latest available data on amounts and types of waste composted in 2005/2006 were taken from Nikitas *et al*. (2008) for the 2007 update of the inventory. The estimate of 3.4 kt of composted materials for 2005/6 resulting from this exercise is probably on the conservative side, however Nikitas *et al*. (2008) state that the questionnaire returns have been improving throughout the series of Composting Society surveys and match well with other data sources. 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 were derived from Nikitas *et al*. (2008) and are very similar to those derived from Boulos *et al*. (2006) previously. This resulted in a best estimate of 2.1 kt NH_3-N from composting for 2007, which represents an increase by 0.5 kt from 2006.

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

Upland heath occupies approx 2-3 million hectares in the UK, some of which is managed by controlled burning on a rotational basis ("muirburn"), to regenerate growth. According to the Scottish Moorland Forum (www.moorlandforum.org.uk), approx. 2,400 km^2 of heather are burnt periodically. With 80% of upland moorland located in Scotland, and assuming that the practice of muirburn is carried out similarly for the same vegetation type across the whole of the UK, this results in an estimated UK area managed by muirburn of 3,000 km^2.

The frequency of burning to provide optimum conditions for regeneration of heather is considered to be every 10-15 years, however there is evidence that the average frequency is below that (Hester and Sydes, 1992). The actual area burned does vary from year to year depending on weather conditions and the burning frequency, and is estimated at between 120 and 360 km^2 yr^{-1} here, with a best estimate of 200 km^2, given an average burning frequency of 15 years with an uncertainty range 10-20 years.

The application of the best estimate of 2.1 g NH_3-N m^{-2} of muirburn (range 0.95-3.89 g, see Section 3.1.3.) results in a UK estimate of 0.42 kt NH_3-N (range (0.11-1.4 kt). This is a significant source of ammonia emissions in otherwise nitrogen-poor landscapes.

Humans

The UK population figures were updated to the latest available data, the mid-2007 estimate of 60,975,400 (ONS 2008). This constitutes an increase by approx. 388,000 people or 0.6%, compared with 2006. 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).

New data on adult cigarette smoking (Goddard 2008) show that the proportion of adults over 16 years old who smoke has declined from 25% to 23% for men and from 23% to 21% for women between 2005 and 2006. This results in a decrease in emissions from cigarette smoking of 4%, which amounts to an absolute change of 0.01 kt NH_3-N.

Overall, emissions from other human sources (breath, sweat, smoking and babies' nappies) are estimated at 1.2 kt NH_3-N yr^{-1} for the UK in 2007, in line with the 0.6% increase in the UK population from 2006.

Pets

New estimates from the Pet Food Manufacturers Association (PFMA) for 2008 amount to 7.3 million dogs and 7.2 million cats, compared with 6.8 million dogs and 9.6 million cats from the previous data for 2004. With the same emission estimate per animal used as in 2006, this represents an increase in both the estimated dog population and NH_3 emission of ~7% and a decrease of ~33% for cats. While a 7% increase in the population of dogs over four years appears to be a credible rate of change, a decrease in the estimate for cats by one third may be due to changes in the methodology rather than a real decrease in the number of animals (see Table 1 for historical estimates of the UK cat and dog population). However, this highlights the importance of including uncertainty estimates in the inventory. The best estimate of UK NH_3 emissions from cats is 0.8 kt NH_3-N yr^{-1} for 2007 (range 0.3-1.3 kt NH_3-N yr^{-1}),

compared with 1.06 kt (0.45-1.72) for 2004-2006. Ammonia emissions from dogs for 2007 are estimated at 4.7 kt NH_3-N yr^{-1} (range 1.9-8.1 kt NH_3-N yr^{-1}).

Table 1: Historical UK pet population estimates (source: Pet Food Manufacturers Association)

Year	dogs (millions)	dog owning households (millions)	cats (millions)	cat owning households (millions)
1965	4.7	Unavailable	4.1	Unavailable
1975	5.7	Unavailable	4.5	Unavailable
1980	5.6	4.8	4.9	3.7
1981	5.7	4.7	5.2	3.7
1982	5.8	4.7	5.3	3.8
1983	5.9	4.8	5.4	3.9
1984	6.1	4.9	5.9	4.1
1985	6.3	5.0	6.1	4.1
1986	6.9	5.1	6.1	4.2
1987	7.2	5.3	6.5	4.4
1988	7.3	5.9	6.7	4.5
1989	7.4	6.0	6.9	4.6
1990	7.4	5.9	6.8	4.6
1991	7.3	5.9	6.9	4.7
1992	7.3	5.8	7.0	4.7
1993	7.3	5.4	7.1	4.6
1994	6.9	5.3	7.2	4.7
1995	6.7	5.2	7.2	4.8
1996	6.6	5.4	7.7	4.9
1997	6.6	5.1	7.7	4.9
1998	6.9	5.4	8.0	5.1
1999	6.7	5.3	7.7	5.0
2000	6.5	5.1	8.0	5.0
2001	6.1	4.8	7.5	4.8
2002	6.1	4.8	7.5	4.5
2003	6.5	5.2	9.2	6.0
2004	6.8	5.2	9.6	6.1
2008	7.3	Unavailable	7.2	Unavailable

Seabirds

The data from the latest seabird census for the British Isles, carried out between 1998 and 2002 (Mitchell *et al*. 2004) are still the most accurate and up-to-date estimates available for most seabird species. New population estimates have however been included for Northern Gannets (*Morus bassanus*) from Mavor *et al*. (2008), showing a slight decrease in the UK gannet population by approx. 4000 individuals. The resulting new best estimate of NH_3 emissions from seabirds was revised to 2.96 kt NH_3-N $year^{-1}$, i.e. an insignificant change from the previous best estimate of 0.01 kt.

Horses

The new National Equine Database (NED), which collects data on all horses (and other equines such as donkeys and mules) registered in the national equine passport scheme, is complete (pers. comm. Oct. 2008), with approx. 975,000 equines currently believed to be alive in the UK (compared with a total of 1.2 million records in the database). Compared with the previous best estimate of 1,190,000 derived for 2006 (pers. comm. Nov. 2007), when the NED was not fully completed, this represents a decrease of 215,000 horses or ~18%.

This results in a new estimate of UK horse emissions of 12.8 kt NH_3-N $year^{-1}$, a decrease of 2.7 kt from the previous estimate, with an associated uncertainty range of 7.9-21.1 kt NH_3-N.

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*. 2008), and b) all other horses, i.e. the "non-agricultural" part of the UK horse emissions.

Wild animals

For the 2007 update, several new wild animal population estimates were included in the inventory:

For grey seals, SCOS (2008) gives a range of 107,000-171,000 animals. The best estimate of 133,000 seals represents an increase by 5000 animals or 4%, with a corresponding increase in emissions from 56 to 59 t NH_3-N $year^{-1}$.

The new estimate of wild geese emissions in the inventory is based on a combination of best estimates from different sources (Wildfowl & Wetlands Trust WWT, RSPB and The Goose Forum of the Scottish Executive), using a combination of geese counts and population estimates. For 2007, updated figures from the RSPB were included in the population estimates for several species of wild geese. Overall, approx. 121,000 geese are estimated to be resident in the UK all year round, with a further approx. 605,000 migratory geese over-wintering 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 NH_3 inventory. In total, emissions from wild geese are estimated at 72 t NH_3-N (range 41-113 t) for 2007, compared with 68 t for 2006. 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 2 below. Overall emissions from SNAP codes 6, 9 and 11 (including unclassified sources under SNAP Code 00) amount to 36.3 kt NH_3-N $year^{-1}$ for 2007, with a range of 17.4-76.5 kt NH_3-N $year^{-1}$.

Table 2: Ammonia emissions from UK non-agricultural sources for 2007

	emission estimates source^{-1}				number of sources				UK emissions 2007(kt NH_3-N yr^{-1})		
source	best estimate	low	high	units as NH_3-N	best estimate	low	high	units	best estimate	low	high
human breath	2.0	0.7	6.2	g person-1 yr-1	60,975,400	-	-	persons	0.12	0.04	0.38
human sweat	14.0	2.1	74.9	g person-1 yr-1	60,975,400	-	-	persons	0.86	0.13	4.57
infants emissions < 1yr	11.7	2.4	54.2	g infant-1 yr-1	755,700	-	-	children <1 yr	0.009	0.002	0.041
infants emissions 1-3 yrs	14.6	3.0	67.8	g infant-1 yr-1	1,448,600	-	-	children 1-3 yr	0.021	0.004	0.098
cigarette smoking (adults)	19.2	9.6	34.8	g smoker-1 yr-1	10,868,248	-	-	smokers	0.209	0.104	0.378
cigarette smoking (young people)	5.1	2.5	9.2	g smoker-1 yr-1	413,523	-	-	smokers	0.002	0.001	0.004
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	0.64	0.30	1.01	kg animal-1 yr-1	7,300,000	6,570,000	8,030,000	animals	4.7	1.9	8.1
cats	0.11	0.05	0.16	kg animal-1 yr-1	7,200,000	6,480,000	7,920,000	animals	0.8	0.3	1.3
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
seals)	-	-	-	-	-	-	-	-	0.97	0.26	2.68
wild geese					726,060	544,545	907,575	birds	0.07	0.04	0.11
seabirds	-	-	-	-	6,667,910	-	-	birds	2.96	1.98	5.91
biomass burning (heather burning, "muirbur	2.10	0.95	3.89	g m-2 yr-1	200	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	20,141,657	-	-	landfilled (MSW + sludge)	2.5	1.3	5.1
appliances &household products	-	-	-	-	-	-	-	-	1.00	0.3	3.8
non-agricultural fertilizers	-	-	-	-	-	-	-	-	0.23	0.1	0.5
composting					3,424,000			t of waste composted	2.09	0.90	3.26
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
TOTAL	-	-	-	-	-	-	-	-	**36.28**	**17.43**	**76.48**

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.

SNAP code 9 (waste treatment and disposal)

Landfill emissions have decreased again from the 2006 emission estimate (2.8 kt NH_3-N) to 2.5 kt NH_3-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 1.6 kt NH_3-N in 2006 to 2.1 kt NH_3-N in 2007. 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)

The NH_3 emission estimate for biomass burning was completely revised during the inventory compilation for the year 2007. As field burning of straw and stubble is no longer permitted in some parts of the UK (e.g. England since 1992) and strongly discouraged in others, the estimate for biomass burning from agricultural sources was discontinued, and replaced by a newly derived estimate for burning of heather moorland ("muirburn") in the upland areas of the UK. The new best estimate is 0.42 kt NH_3-N yr^{-1} (range 0.11-1.40 kt), which replaces any previous estimates.

For continuity reasons, the muirburn emission estimate should be added to all inventory years since 1990 as a constant value, as there appears to have been little change in the extent of muirburn over the last few decades, according to the data sources available for this study. The estimate for straw burning (1.6 kt NH_3-N) should be included for the years 1990-1991 or 1992, and either discontinued, as most of the UK cereal is grown in England (~85% during the period 1990-1992), or phased out gradually over the next few years from 15% to 0%.

SNAP code 11.7.2 (mammals)

The major change in NH_3 emissions from (domestic) mammals is a decrease in emissions from horses, due to new reliable data on the UK horse population, from the horse passport scheme. Overall emissions from horses (including agricultural horses, which are part of the total population for this source) decreased from 15.5 kt NH_3-N to 12.8 kt NH_3-N, the largest absolute decrease in the 2007 inventory (of all sources included in this report).

Emissions of NH_3 from cats show the largest relative decrease from any of the sources included in this report for 2007, inventory at -33%. However, in absolute terms, the decrease amounts to only 0.25 t NH_3-N yr^{-1}. By contrast, emissions from dogs are estimated to have increased by 0.3 kt NH_3-N yr^{-1}, a relative decrease if ~7%. Both are due to new estimates in the UK cat and dog population rather than new data on emission source strength.

SNAP code 11.7.3 (other animals)

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

SNAP code 00 (other sources)

Emissions from humans overall stayed constant at 1.2 kt NH_3-N yr^{-1}, due to an overall increasing trend in the UK population from 2006 to 2007 by approximately 388,000 persons offset by decreasing emissions from cigarette smoking.

5. CONCLUSIONS

Non-agricultural NH_3 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 2007 (or the latest available data):

Overall emissions from SNAP codes 6, 9, 11 and other miscellaneous sources amount to 36.3 kt NH_3-N $year^{-1}$ for 2007, with a range of 17.4-76.5 kt NH_3-N $year^{-1}$. This constitutes a decrease of ~3.5 kt NH_3-N compared with the estimate for the same sources for 2006 (39.8 kt NH_3-N). The main changes to the inventory are increases in NH_3 emissions from composting and dogs, and decreases in emissions from horses, biomass burning, landfill and cats. Emissions from biomass burning were revised completely, with stubble burning of agricultural fields being removed from the inventory, and emissions from controlled burning of heather moorland ("muirburn") included for the first time. 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), to Ron Smith (CEH) for statistical advice and to Brian Chambers (ADAS) for advice on sewage..

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