Interpretation of long-term measurements of radiatively active trace gases and ozone depleting substances (Part 2 of 3)

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4 Regional Emission Estimates

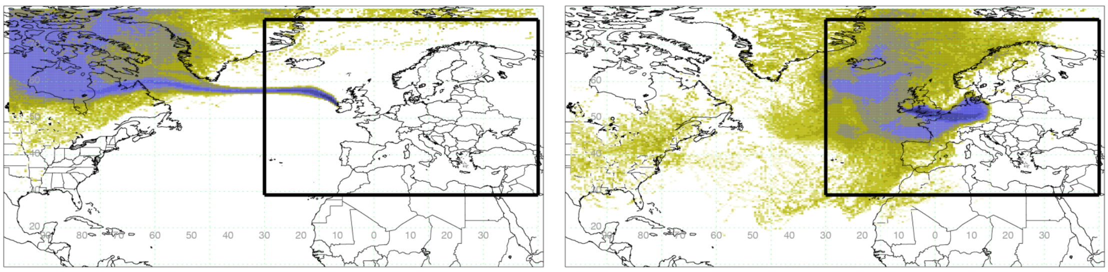
By removing the time-varying baseline concentrations from the raw measurement data, a time-series of excursions from the baseline for each observed gas has been generated from 1990 onwards or from when observations were started. The observed deviations from baseline are averaged over each three-hour period. These perturbations are driven by emissions on regional scales that have yet to be fully mixed on the hemisphere scale. Henceforth these above-baseline measurements are referred to as simply the observations.

4.1 Inversion methodology

The observation time-series, together with the transport (dilution) matrix obtained from the NAME model (history of the air's movement over the last 12 days arriving at Mace Head), was used to estimate the emission distribution of each gas over NW Europe (NWEU). The iterative best-fit technique, simulated annealing (Press *et al* 1992), was used to derive these regional emission estimates based on a statistical skill score (cost function) comparing the observed and modelled time-series at Mace Head. The technique starts from a set of random emission maps, it then searches for the emission map that leads to a modelled time series at Mace Head that most accurately mimics the observations.

The aim of the inversion method is to estimate the spatial distribution of emissions across a defined geographical area. In the equation to solve (Eq. 1) the set of observations (*o*) and the dilution matrix (*D*) as estimated using the NAME model are known. The observations are in volume mixing ratios. The dilution matrix has units [s/m] and is calculated from the time-integrated air concentrations produced by the NAME model. The dilution matrix has *t* rows equal to the number of 3-hour periods considered and has *n* columns equal to the number of grid points in the defined geographical domain. This matrix dilutes a continuous emission of 1 g/m^2s over a given grid to an air concentration [g/m^3] at the receptor during a 3-hour period. The observations are converted from volume mixing ratio [ppb] to air concentration [g/m^3] using the modelled temperature and pressure at the observation point.

$$D\,\underline{e} = \underline{o} \qquad \ldots 1$$



(a) (b)

Figure 1: Examples of 3-hour air history maps derived from NAME (a) baseline period (b) regionally polluted period. The air-history maps describe which surface areas in the previous 12-days impact the observation point at a particular time.

The inversion domain is chosen to be a smaller subset of the full domain used for the air history maps. It covers 30°W – 42°E longitude and 29.3°N – 77.3°N latitude and is shown as the black box in Figure 1. The smaller domain covers all of Europe and extends a reasonable distance into the Atlantic. The inversion domain needs to be smaller to ensure re-circulating air masses are fully represented but also because emission sources very distant from Mace Head have little discernible impact on the concentration at the station, i.e. the signal would be too weak to be seen. The inversion method assumes baseline concentration air enters the inversion domain regardless of direction. For the eastern and southern edges in particular this will be incorrect. Emissions in Russia and around the Black Sea would be expected to elevate the atmospheric concentrations along the eastern edge, and due to the latitudinal gradient it would be reasonable to assume below mid-latitudinal baseline concentration air enters from the south. This issue is overcome in the inversion by solving for but not analysing the estimated emissions in any grid on the edge of the inversion domain. It is assumed that the error of above or below baseline concentration air entering the domain will be absorbed into the solutions in these edge grids. This assumption has been tested by comparing the solutions for UK with this domain to those obtained when a significantly larger inversion domain is used. The results of this comparison are discussed later in the sensitivity section.

In order for the best-fit algorithm to provide robust solutions for every area within the domain, each region needs to significantly contribute to the air concentration at Mace Head on a reasonable number of time periods. If the signal from an area is only rarely or poorly seen at Mace Head, then its impact on the cost function is minimal and the inversion method has little skill at determining its true emission.

The contribution that different grid boxes make to the air concentration at Mace Head varies from grid to grid. Grid boxes that are distant from the observation site contribute little to the observation, whereas those that are close have a large impact. In order to balance the contribution from different grid boxes, those that are more distant are grouped together into increasingly larger blocks. The grouping varies for each time period considered and between the different gases due to varying meteorology and the impact of missing observations respectively. The underlying horizontal grid resolution is 40km (= *x*) and is equal to the resolution of the NAME output. The grouping creates blocks that have a resolution of *x*, 2*x*, 4*x*, 8*x*, 16*x* and 32x.

An *emission sensitivity* level [g/m^2/s] has been estimated for each gas. Below this level the impact of the emission at the receptor is assumed lost within the baseline noise of the observation. The *dilution sensitivity limit* threshold (3.4 s/m), as derived in the baseline analysis, is used again. Baseline noise is defined as the standard deviation of baseline observations about the defined smoothed baseline value.

For each grid box the number of times it provides a contribution to Mace Head above the *dilution sensitivity limit* threshold is calculated from the dilution matrix. If this is below the minimum number required (arbitrarily defined as 240 3-hour time periods, i.e. 30 days) then a grid resolution twice as coarse is considered. This process is repeated until the condition is satisfied or until the grid resolution is 32 times the original (32*x*) (Figure 2), where *x* = ~40 km.

The inversion process works by iteratively choosing different emissions, varying the emission magnitudes and distributions, with the aim of minimising the mismatch between the observations and the modelled concentrations. No *a priori* conditions are set. The relative skill of a derived emission map is tested by comparing the modelled and observed time-series using a cost function that combines four different statistics. Other cost functions were investigated, for example *RMSE*, using the pseudo observation test (see below) but were found to be less accurate at recreating a prescribed emission distribution.

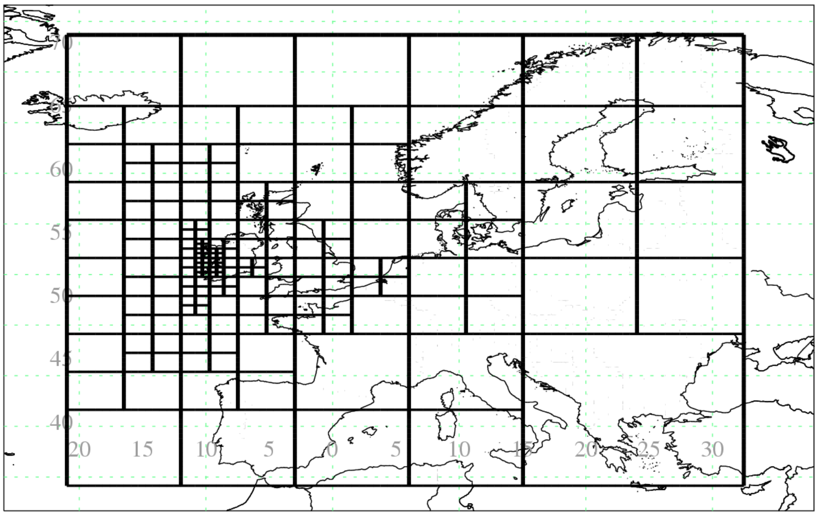


Figure 2: Example of the distribution of the different sized regions used by the inversion method to estimate regional emissions (1*x* by 1*x* through to 32*x* by 32*x*, *x* = ~40 km).

Cost function: $\left[5(1-r)\right]+\left[0.5\ NMSE\right]+\left[4(1-fac2)\right]+\left[20(1-facNoise)\right]$

where,
r = Pearson correlation coefficient

NMSE = Normalised Mean Square Error: $\left(\frac{Mean\ Square\ Error}{AvgObs\ x\ AvgModel}\right)$

fac2 = Fraction within a factor of 2 of observations

facNoise = Fraction of model values within *Noise* of the observations

Noise = Standard deviation of baseline observations about the defined smoothed baseline value. Note observations below the *Noise* level are considered to have a magnitude equal to the *Noise* level with respect to the *fac2* calculation.

The iteration process is repeated until the future potential improvement in skill in the emission map is estimated to be negligible, i.e. the solution has converged to within defined limits.

To simulate uncertainties in the meteorology, dispersion and observations a time-series of random noise is applied to the observations. The random element is multiplicative and taken from a log-normal distribution with mean 1 and variance one fifth of the *Noise*. Any observations that are negative are set to zero.

Any periods that were classed as baseline but were removed by the statistical filtering are removed from the analysis as these are considered to be unrepresentative of baseline air. Times when the air is classed as 'local' are likewise removed from the analysis. A 3-hour period is classed as 'local' if the contribution from the 9 grids surrounding Mace Head is above fifteen times the *dilution sensitivity limit*. The local times represent periods when the emissions from the local area (120 km x 120 km area centred on Mace Head) would have a dominate effect on the observations. These are typically characterised by low wind speeds, low boundary layer heights and thus poor dispersion conditions. During such times the meteorological models used, with horizontal resolutions of between 40 and 80 km, are poor at correctly resolving the local flows as they are dominated by sub-grid scale processes, e.g. land-sea breezes. For example, 86% (87%) of the CH_4 (N_2O) observations were retained for analysis.

For each time period solved for, the whole inversion process is repeated multiple times (up to 52) to give an indication of the potential uncertainty in the emission solution, each time with a different random starting point and a different time-series of random noise. Solutions are calculated for three-year periods covering the period when observations are available. After solutions have been estimated for a particular three-year period, the period is moved on by one month and the process repeated, e.g. Jan'95 – Dec'97, Feb'95 – Jan '98, etc.

An annual estimate of emission is calculated by averaging all of the solutions that contain a complete calendar year within the solved-for time period. The range for each year for each geographical region is calculated from the same sample of solutions and is taken as the 5^{th} and 95^{th} percentile solutions.

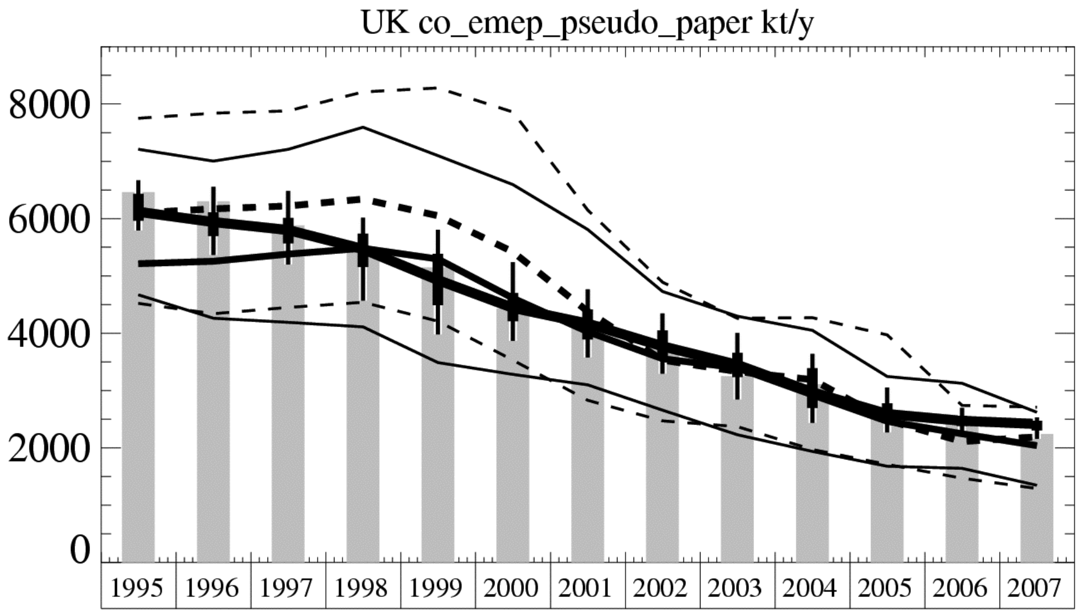


Figure 3: Time-series of annual emission estimates using model-derived pseudo observations. The grey columns are the EMEP inventory values. The solid line with 5^{th}, 25^{th}, median, 75^{th} and 95^{th} percentiles is the case with no noise and the same meteorology. The solid line is the case with noise and the same meteorology. The dashed line is with noise and different meteorology (UKMO used to create pseudo observations and ERAI dilution matrix used within the inversion). The 5^{th} and 95^{th} estimates provide the uncertainty ranges in each case and are shown as thinner lines with the same style.

To assess the ability of the inversion system to correctly estimate emissions on the regional scale it was first applied to model derived pseudo observations. The carbon monoxide (CO) emissions from the EMEP program (**www.emep.int**) were used to calculate a model time-series at Mace Head. Time-series' were derived using both ERAI (ECMWF ERA Interim meteorology) and UKMO (Met Office Unified Model meteorology). The inversion system was tested using the ERAI dilution matrix applied to, firstly, the pseudo observations derived using ERAI and then to the pseudo observations derived using UKMO. The latter test investigates the ability of the inversion system to estimate emissions with a system that has errors. The impact of applying random noise to the system is investigated by solving with and without noise. Figure 3 shows the time-series of emission estimates and true emissions for NWEU in this idealised case study.

The median emission total when no noise is added to the pseudo observations is excellent and the uncertainty bars are small. When noise is added to the measurements the median fit is still good but the uncertainty range is larger (solid lines). When a different meteorology is used to derive the pseudo observations and noise is added (dashed line) the fit is still good but the uncertainty range is at its largest. However in every case the uncertainty range completely encompasses the true solution and gives confidence that the methodology is able to recreate the correct emission total within the estimated uncertainty range.

Figure 4 is an example of the observed and modelled time series of air concentration for CH_4 for the first three months of 2006 at Mace Head. The magnitudes and patterns are similar and demonstrate that the inversion process is able to derive an emission map that produces a good match to the observations.

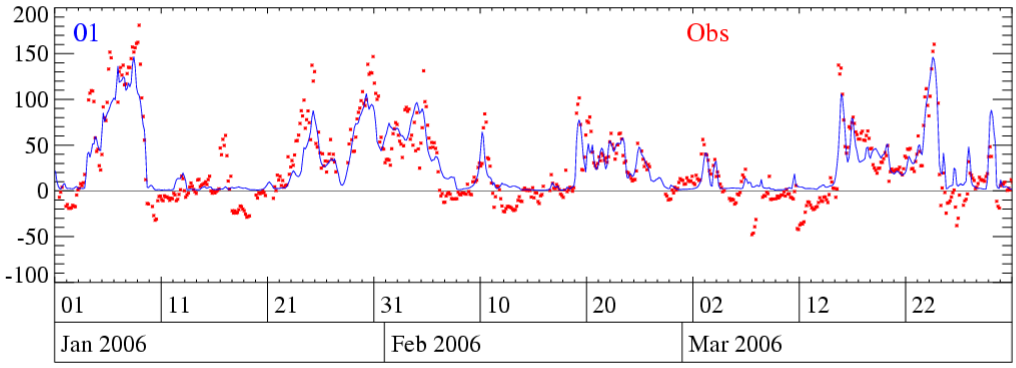


Figure 4: Time series of observed and best-fit modelled CH_4 concentrations (deviation from baseline) at Mace Head for the first three months of 2006 (solid line = NAME-inversion solution, open circles = observations).

Emission totals from specific geographical areas are calculated by summing the emissions from each 40 km grid box in that region. The regions covering UK and NW Europe are shown in Fig. 5.

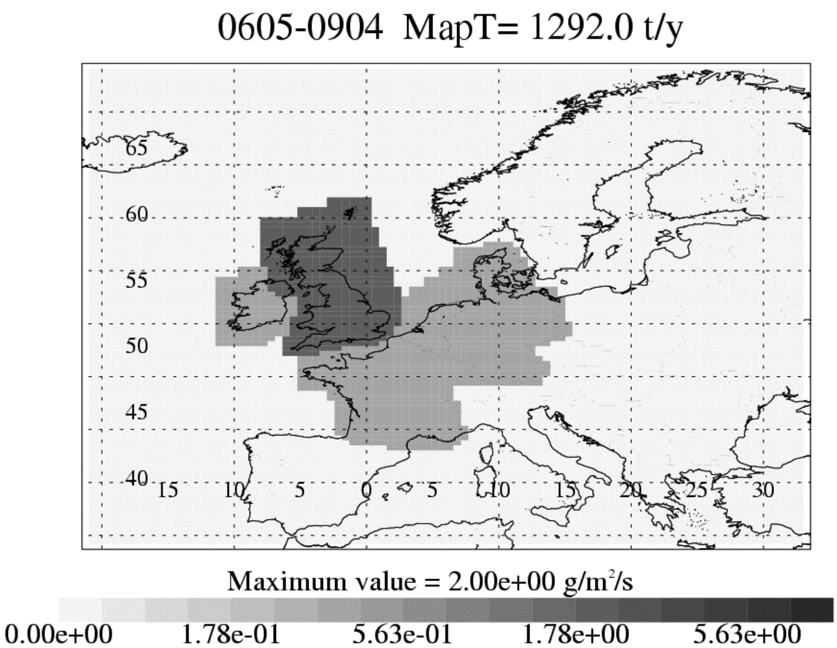
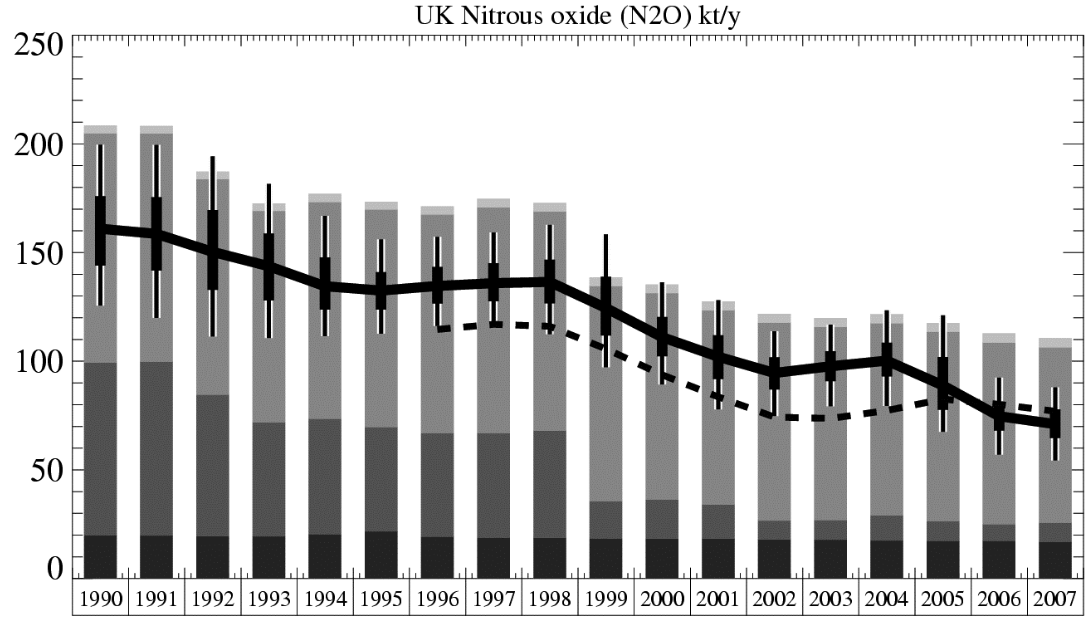


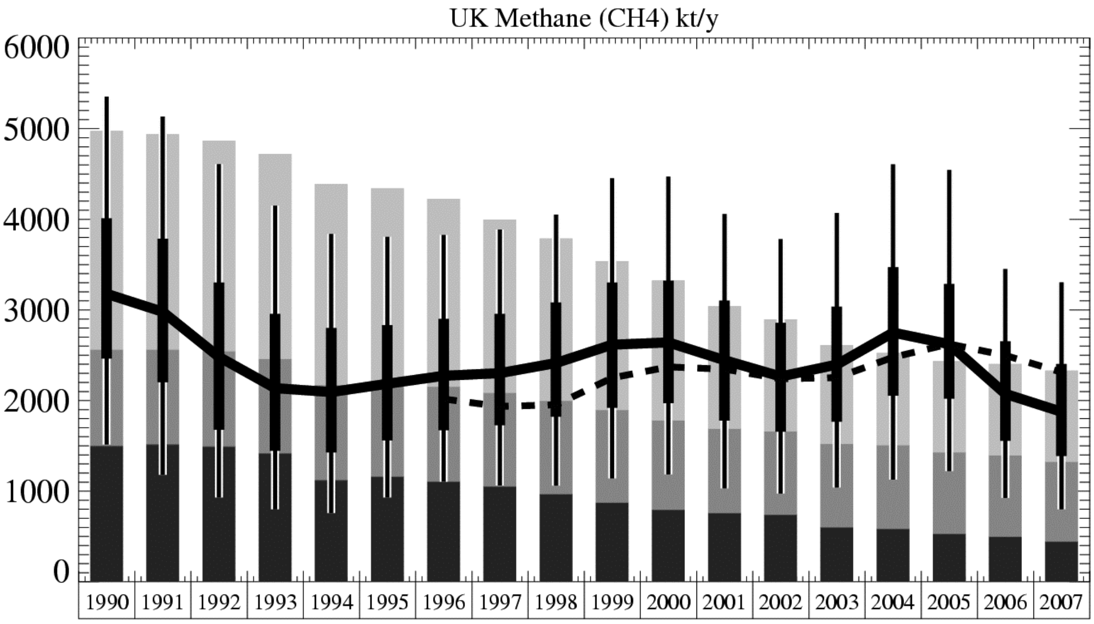
Figure 5: Geographical areas used to define regional totals

4.2 Sensitivities and uncertainties in the inversion methodology

There is no absolute, analytical method of defining the uncertainties associated with these best-fit estimates. They occur due to errors in the inversion process, in the meteorology, in the transport parameterisations in NAME and in the observations. Nevertheless, these uncertainties can be assessed by conducting suitable sensitivity experiments. This section discusses the sensitivities of the inversion results to the choice of meteorology, domain size and a bias in the baseline concentration and discusses other areas of potential uncertainty and how these have been minimised.



Figures 6: Emission estimates for N_2O for the UK. The annual NAME-inversion results using ERAI (UKMO) are shown as a solid (dashed) line with uncertainty bars showing the median, 5^{th}, 25^{th}, 75^{th} and 95^{th} percentiles. The UNFCCC inventory estimates for different sectors are shown as cumulative columns (from the bottom: energy, industry, agriculture, waste).



Figures 7: Emission estimates for CH_4 for the UK. The annual NAME-inversion results using ERAI (UKMO) are shown as a solid (dashed) line with uncertainty bars showing the median, 5^{th}, 25^{th}, 75^{th} and 95^{th} percentiles. The UNFCCC inventory estimates for different sectors are shown as cumulative columns (from the bottom: energy, industry (negligible), waste, agriculture).

The NAME-inversion results for the UK for N_2O and CH_4 using both ECMWF ERA-Interim (ERAI) and UK Met Office (UKMO) meteorology are presented (Fig. 6 and 7). Although there are differences, within the uncertainty ranges there is good agreement between the solutions using different meteorologies. The largest difference occurs in the period 1995-2001 which coincides with the significant upgrade in the Met Office meteorology model in 2002. In the early years of the comparison the UKMO results are generally lower than the ERAI results, in the latter years the reverse is the case. It is thought that the reasons for these differences are linked to the definition of the boundary layer height in the two models and how these have evolved over the years within the UKMO.

The inversion method assumes that baseline concentration air enters the domain. This does not always hold true. It is assumed that above (below) baseline air entering the domain will lead to elevated (depressed) emission estimates only at the edge of the domain. Therefore the inversion domain solved for is significantly larger than the NWEU domain and it is assumed that the majority of these edge effects will not impact on the analysis of NWEU and UK emission totals. Fig. 8-9 show the sensitivity of the NAME-inversion UK estimates to a systematic bias in the baseline estimate, both positive and negative, and to using a larger domain for the inversion calculation. The baseline concentration was first increased and then decreased by 1 baseline noise std. Each three-year period (1989-2008) using ERAI was solved three times with no additional noise and the median annual estimate calculated as before. The dark grey dash-dot line shows the impact of lowering the baseline and the dark grey dashed line the impact of increasing the baseline. The estimates as presented in Fig. 6 and 7 are also shown for comparison. For CH_4 the changes in the baseline are comfortably within the 25-75th percentile uncertainty ranges, showing that a bias of this magnitude is captured by the uncertainty analysis. For N_2O the addition or subtraction of a bias in the baseline has an impact that is sometimes larger than the 5-95th percentile uncertainty ranges. Therefore the N_2O totals are susceptible to a bias in the baseline concentration and this could lead to an increase of up to 20% in the UK uncertainty estimates. The light grey lines (Figures 8-9) show the impact of increasing the domain as well as having a bias in the baseline concentration. The results are similar to those when the standard domain is used (dark grey) and demonstrate that the inversion solution is largely insensitive to the domain size chosen. For N_2O the impact is to lower the UK estimates more noticeably in the earlier years, there is no impact for CH_4 outside the uncertainty ranges already presented.

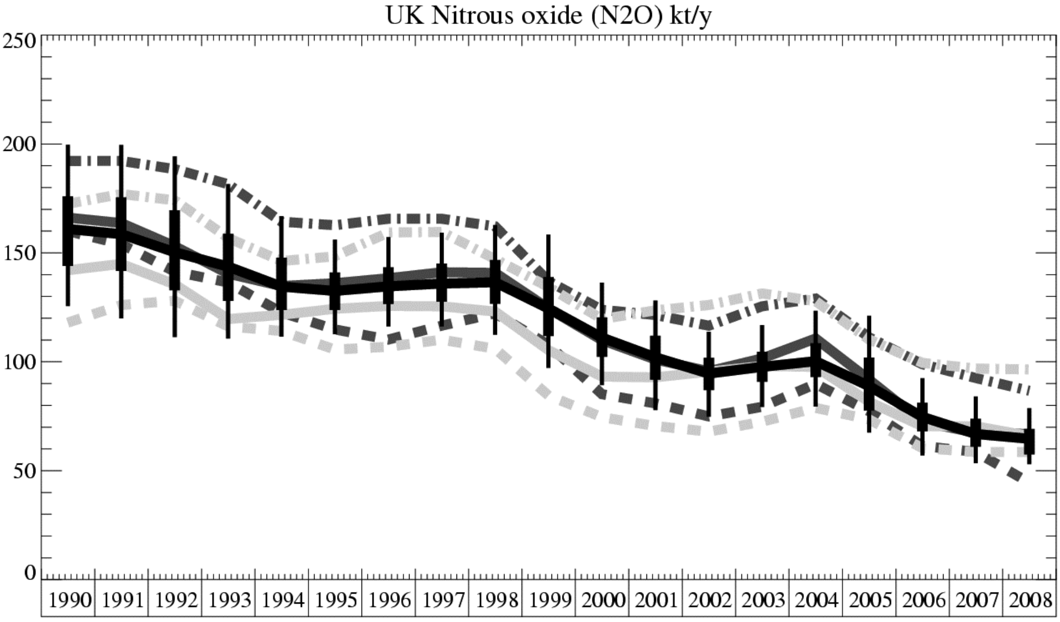


Figure 8: Sensitivity of UK N_2O NAME-inversion emissions. Whisker plot = same data as plotted in Fig. 6. Dark grey (same domain, no noise) solid line: normal baseline; dash-dot line: low baseline (normal baseline – 1std); dash line: high baseline (normal baseline + 1std). Light grey (larger domain, no noise) solid line: normal baseline; dash-dot line: low baseline (normal baseline – 1std); dash line: high baseline (normal baseline + 1std).

All of the emissions are assumed constant in time and are geographically static within each 3-year study period. This is clearly a significant simplification. A sudden, but subsequently maintained, change in emissions, will be picked up by solving multiple 3-year periods covering slightly different time periods, i.e. solving for a 3-year period and then advancing by one month. Enhanced emissions in any particular season, e.g. increased N_2O emissions in spring following fertilizer application, will not be resolved.

All areas of the domain are assumed to impact reasonably equally on Mace Head. The grouping of grid cells together, so that each area contributes approximately equally to the observations, attempts to ensure this but clearly there will be some variability. Also large grid cells could have significant variability actually within the grid itself especially if there are significant orographic features within the grid, e.g. the

Alps. This may lead to errors if certain parts of the grid are more frequently sampled than others. However because of the large travel distances and therefore time elapsed between emission in these large grids and measurement the impact of this will be small. Also by only reporting emissions within NWEU this issue is assumed small.

The inversion method makes no distinction between anthropogenic and natural sources and thus its estimates are for the combined total, making direct comparisons with the UNFCCC inventory difficult. For most of the gases analysed here the natural emissions are estimated to be small in comparison to the anthropogenic emissions. For example, for CH_4 the natural emissions in NWEU are estimated to be 240 kt/yr (Bergamaschi *et al* 2005).

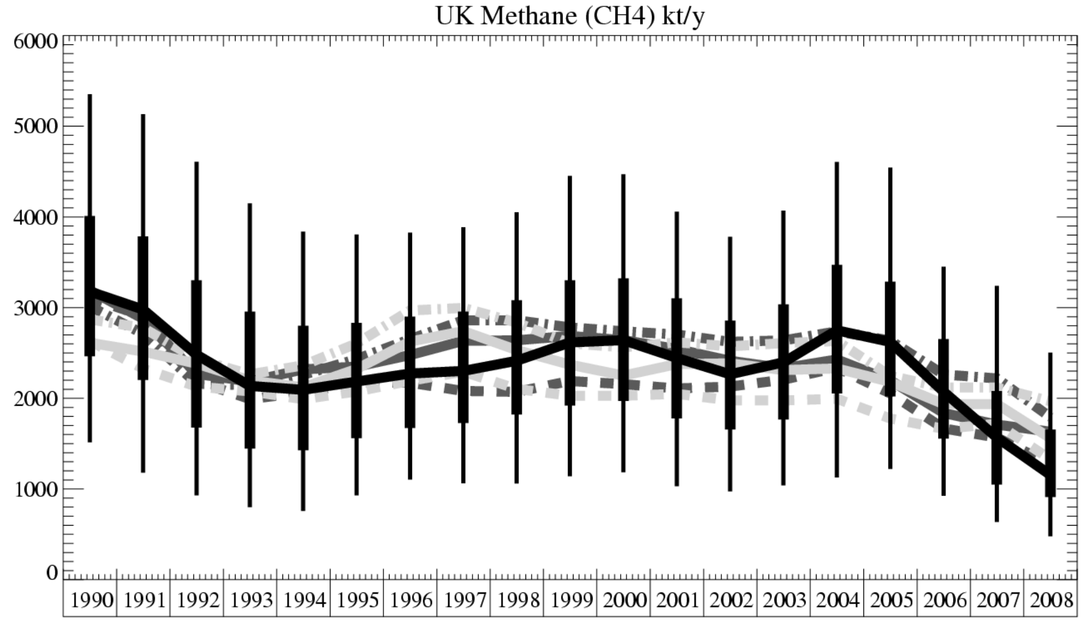


Figure 9: Sensitivity of UK CH_4 NAME-inversion emissions. Whisker plot = same data as plotted in Fig. 6. Dark grey (same domain, no noise) solid line: normal baseline; dash-dot line: low baseline (normal baseline – 1std); dash line: high baseline (normal baseline + 1std). Light grey (larger domain, no noise) solid line: normal baseline; dash-dot line: low baseline (normal baseline – 1std); dash line: high baseline (normal baseline + 1std).

It is also important to recognise that the release of certain gases to the atmosphere, e.g. N_2O released from agricultural practices, may occur many miles from its actual source and therefore adds to the uncertainty of using the maps to attribute emissions to particular regions. The area considered to be the UK includes the waters directly surrounding the UK (Fig. 5) and so the impact of this is considered to be small for the UK. This would be problematic if the individual contributions of Belgium or The Netherlands for example were presented and is the reason why only the NWEU total is considered. The most significant region in relation to this issue is the border between Northern Ireland and Ireland, however due to the proximity to Mace Head and the corresponding high resolution of the output there the impact is assumed small.

The transport modelling and thus the inversion algorithm also assume that the loss processes associated with each gas are negligible within the regional domain. Given the atmospheric lifetimes of most of the gases studied here this is considered to be a robust assumption.

4.3 Results

4.3.1 CFC

4.3.1.1 CFC-11

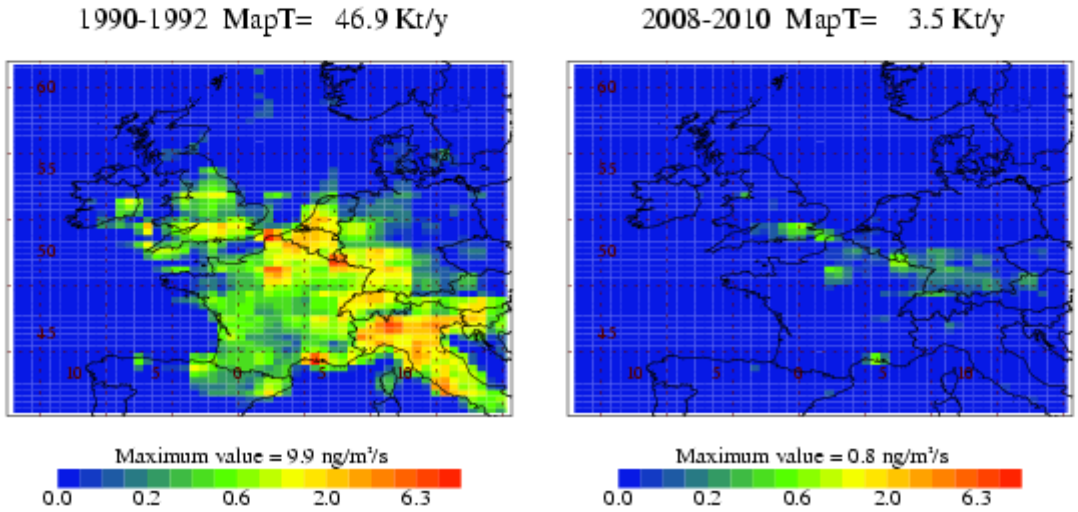


Figure 10: NAME-inversion emission estimates for 1990-92 (left) and 2008-10 (right).

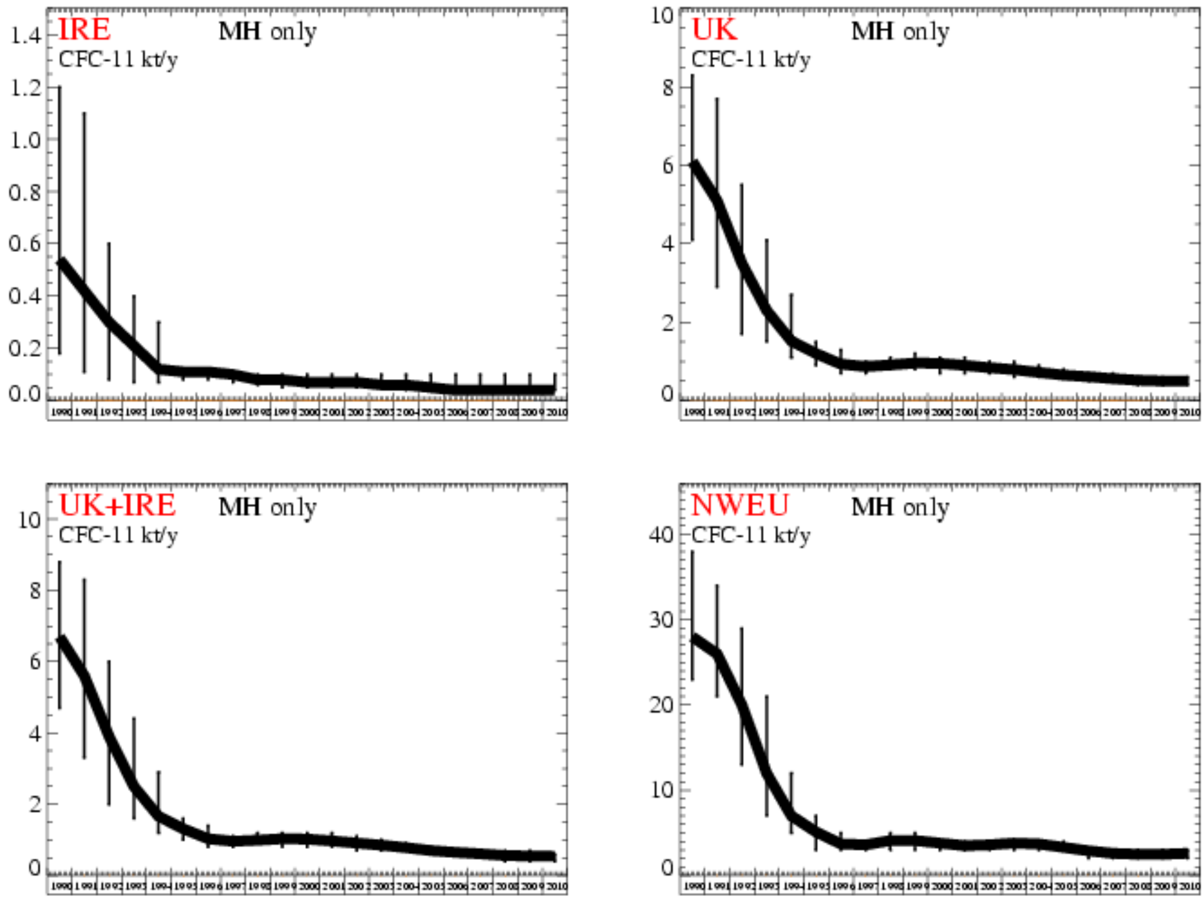


Figure 11: Emission estimates for IRE, UK, IRE+UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	1990	0.54	(0.18- 1.2)	6.1	(4.1- 8.3)	6.7	(4.7- 8.8)	28.	(23.- 38.)	144
kt/y	1991	0.42	(0.11- 1.1)	5.1	(2.9- 7.7)	5.6	(3.3- 8.3)	26.	(21.- 34.)	288
kt/y	1992	0.30	(0.08- 0.6)	3.5	(1.7- 5.5)	3.9	(2.0- 6.0)	20.	(13.- 29.)	300
kt/y	1993	0.21	(0.07- 0.4)	2.3	(1.5- 4.1)	2.5	(1.6- 4.4)	12.	(7.- 21.)	300
kt/y	1994	0.12	(0.07- 0.3)	1.52	(1.1- 2.7)	1.66	(1.2- 2.9)	7.0	(5.- 12.)	300
kt/y	1995	0.11	(0.08- 0.1)	1.20	(0.9- 1.5)	1.31	(1.0- 1.6)	5.1	(3.- 7.)	300
kt/y	1996	0.11	(0.08- 0.1)	0.93	(0.7- 1.3)	1.03	(0.8- 1.4)	3.7	(3.- 5.)	300
kt/y	1997	0.10	(0.07- 0.1)	0.87	(0.7- 1.0)	0.96	(0.8- 1.1)	3.6	(3.- 4.)	300
kt/y	1998	0.08	(0.06- 0.1)	0.91	(0.8- 1.1)	0.99	(0.9- 1.2)	4.1	(3.- 5.)	300
kt/y	1999	0.08	(0.05- 0.1)	0.96	(0.8- 1.2)	1.03	(0.8- 1.2)	4.1	(3.- 5.)	300
kt/y	2000	0.07	(0.05- 0.1)	0.95	(0.7- 1.1)	1.02	(0.8- 1.2)	3.8	(3.- 4.)	300
kt/y	2001	0.07	(0.05- 0.1)	0.90	(0.7- 1.1)	0.97	(0.8- 1.2)	3.5	(3.- 4.)	300
kt/y	2002	0.07	(0.05- 0.1)	0.84	(0.7- 1.0)	0.91	(0.7- 1.1)	3.6	(3.- 4.)	300
kt/y	2003	0.06	(0.05- 0.1)	0.79	(0.6- 1.0)	0.85	(0.7- 1.0)	3.8	(3.- 4.)	300
kt/y	2004	0.06	(0.04- 0.1)	0.72	(0.6- 0.9)	0.78	(0.7- 0.9)	3.7	(3.- 4.)	300
kt/y	2005	0.05	(0.04- 0.1)	0.65	(0.6- 0.8)	0.70	(0.6- 0.8)	3.3	(3.- 4.)	300
kt/y	2006	0.04	(0.03- 0.1)	0.61	(0.5- 0.7)	0.65	(0.6- 0.7)	2.9	(2.- 3.)	300
kt/y	2007	0.04	(0.03- 0.1)	0.56	(0.5- 0.7)	0.61	(0.5- 0.7)	2.6	(2.- 3.)	300
kt/y	2008	0.04	(0.03- 0.1)	0.52	(0.4- 0.6)	0.56	(0.4- 0.7)	2.5	(2.- 3.)	308
kt/y	2009	0.04	(0.03- 0.1)	0.50	(0.4- 0.6)	0.55	(0.4- 0.7)	2.5	(2.- 3.)	164
kt/y	2010	0.04	(0.04- 0.1)	0.50	(0.4- 0.6)	0.54	(0.4- 0.6)	2.6	(2.- 3.)	13

Table 1: CFC-11 emission estimates for UK, IRE and NWEU with uncertainty (5th – 95th %ile).

The emissions of CFC-11 in both the UK and NWEU as a whole fell very significantly between 1990 and the late 1990s . This clearly shows the impact of the Montreal Protocol which banned the use of this gas in developed countries from 1995 onwards. The residual emissions reflect the leakage from old appliances e.g. fridges.

4.3.1.2 CFC-12

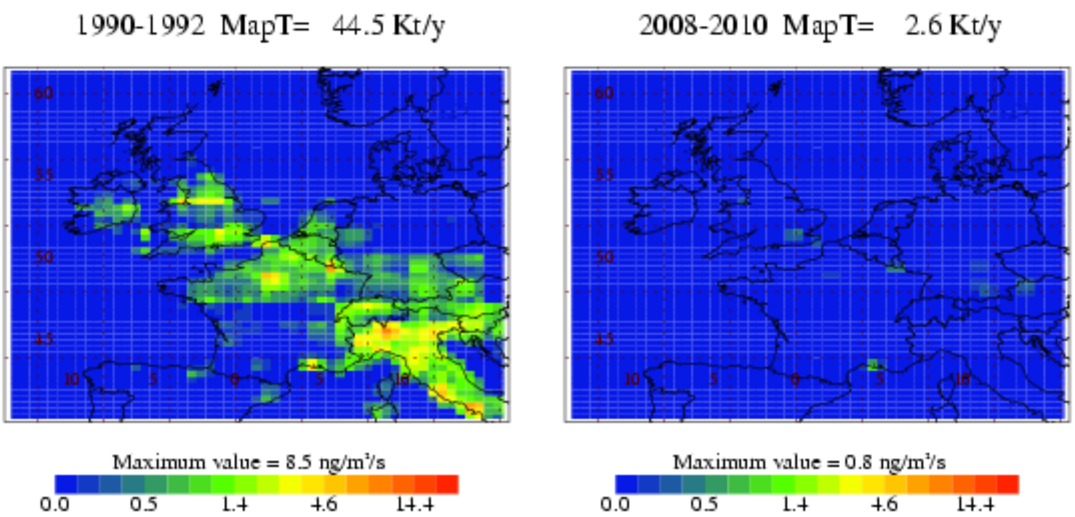


Figure 12: NAME-inversion emission estimates for 1990-92 (left) and 2008-10 (right).

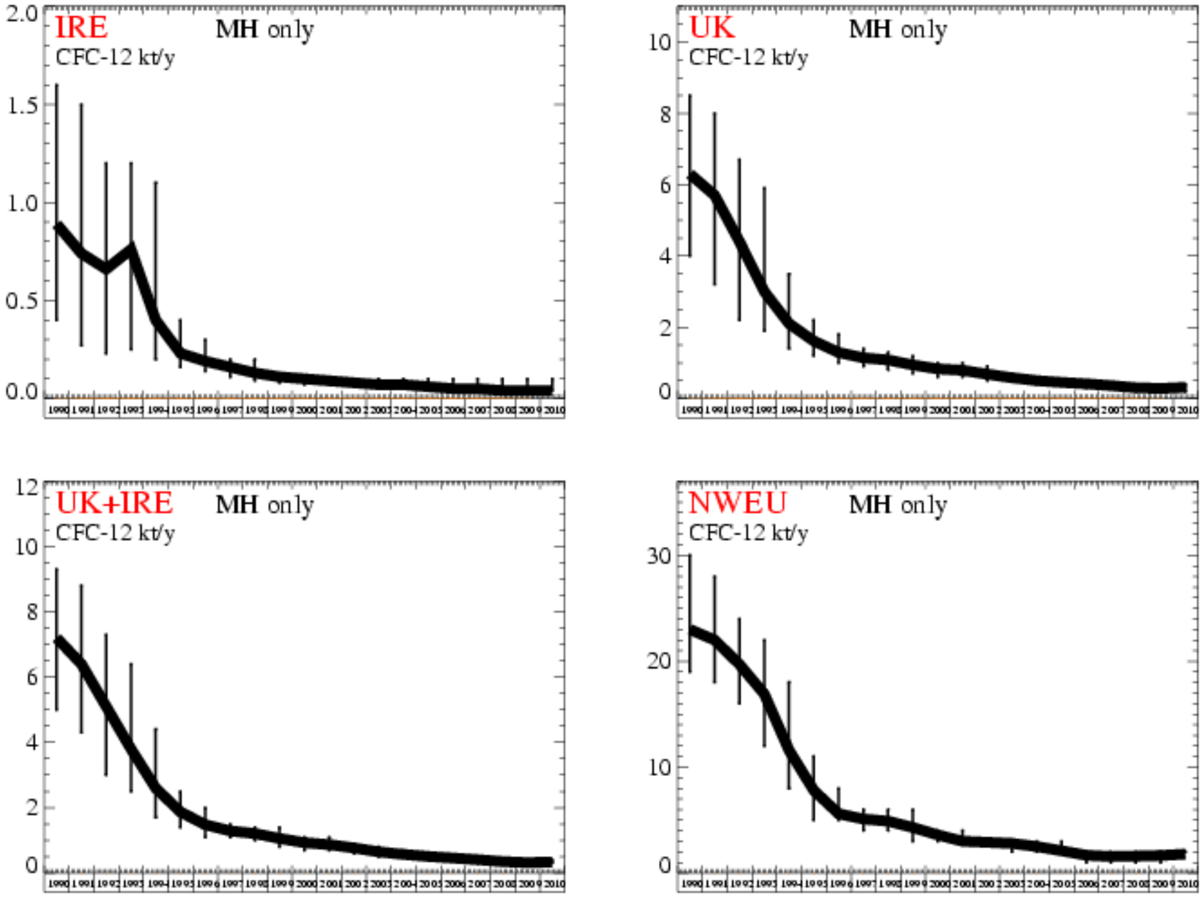


Figure 13: Emission estimates for IRE, UK, IRE+UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	1990	0.89	(0.40- 1.6)	6.3	(4.0- 8.5)	7.2	(5.0- 9.3)	23.0	(19.- 30.)	144
kt/y	1991	0.74	(0.27- 1.5)	5.7	(3.2- 8.0)	6.4	(4.3- 8.8)	22.0	(18.- 28.)	288
kt/y	1992	0.66	(0.23- 1.2)	4.4	(2.2- 6.7)	5.1	(3.0- 7.3)	19.7	(16.- 24.)	300
kt/y	1993	0.76	(0.25- 1.2)	3.0	(1.9- 5.9)	3.8	(2.5- 6.4)	16.9	(12.- 22.)	300
kt/y	1994	0.40	(0.20- 1.1)	2.1	(1.4- 3.5)	2.6	(1.7- 4.4)	11.6	(8.- 18.)	300
kt/y	1995	0.23	(0.16- 0.4)	1.61	(1.2- 2.2)	1.87	(1.4- 2.5)	7.8	(5.- 11.)	300
kt/y	1996	0.19	(0.14- 0.3)	1.29	(1.0- 1.8)	1.48	(1.1- 2.0)	5.6	(5.- 8.)	300
kt/y	1997	0.16	(0.11- 0.2)	1.14	(0.9- 1.4)	1.29	(1.1- 1.5)	5.1	(4.- 6.)	300
kt/y	1998	0.13	(0.09- 0.2)	1.08	(0.8- 1.3)	1.21	(1.0- 1.4)	4.9	(4.- 6.)	300
kt/y	1999	0.11	(0.08- 0.1)	0.94	(0.7- 1.2)	1.06	(0.8- 1.4)	4.3	(3.- 6.)	300
kt/y	2000	0.10	(0.07- 0.1)	0.83	(0.6- 1.0)	0.93	(0.7- 1.1)	3.6	(3.- 4.)	300
kt/y	2001	0.09	(0.07- 0.1)	0.79	(0.6- 1.0)	0.87	(0.7- 1.1)	3.0	(3.- 4.)	300
kt/y	2002	0.08	(0.06- 0.1)	0.68	(0.5- 0.9)	0.77	(0.6- 0.9)	2.9	(3.- 3.)	300
kt/y	2003	0.07	(0.06- 0.1)	0.58	(0.5- 0.7)	0.65	(0.5- 0.8)	2.8	(2.- 3.)	300
kt/y	2004	0.07	(0.05- 0.1)	0.50	(0.4- 0.6)	0.57	(0.5- 0.7)	2.5	(2.- 3.)	300
kt/y	2005	0.06	(0.04- 0.1)	0.45	(0.4- 0.5)	0.51	(0.4- 0.6)	2.1	(2.- 3.)	300
kt/y	2006	0.05	(0.04- 0.1)	0.41	(0.3- 0.5)	0.46	(0.4- 0.5)	1.68	(1.- 2.)	300
kt/y	2007	0.05	(0.04- 0.1)	0.36	(0.3- 0.4)	0.41	(0.3- 0.5)	1.56	(1.- 2.)	300
kt/y	2008	0.04	(0.03- 0.1)	0.30	(0.2- 0.4)	0.35	(0.3- 0.4)	1.60	(1.- 2.)	308
kt/y	2009	0.04	(0.03- 0.1)	0.28	(0.2- 0.3)	0.32	(0.3- 0.4)	1.66	(1.- 2.)	164
kt/y	2010	0.04	(0.04- 0.1)	0.31	(0.2- 0.4)	0.34	(0.3- 0.4)	1.79	(2.- 2.)	13

Table 2: CFC-12 emission estimates for UK, IRE and NWEU with uncertainty (5th – 95th %ile).

The emissions of CFC-12 in both the UK and NWEU as a whole fell very significantly betwwen1990 and the late 1990s. This clearly shows the impact of the Montreal Protocol which banned the use of this gas in developed countries from 1995 onwards. The residual emissions reflect the leakage from old appliances.

4.3.1.3 CFC-113

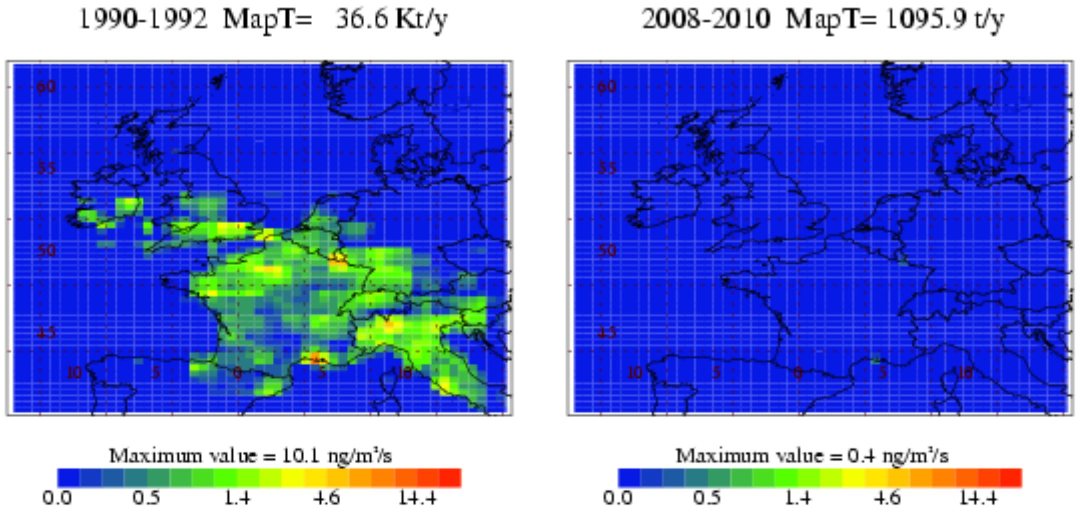


Figure 14: NAME-inversion emission estimates for 1990-1992 (left) and 2008-2010 (right).

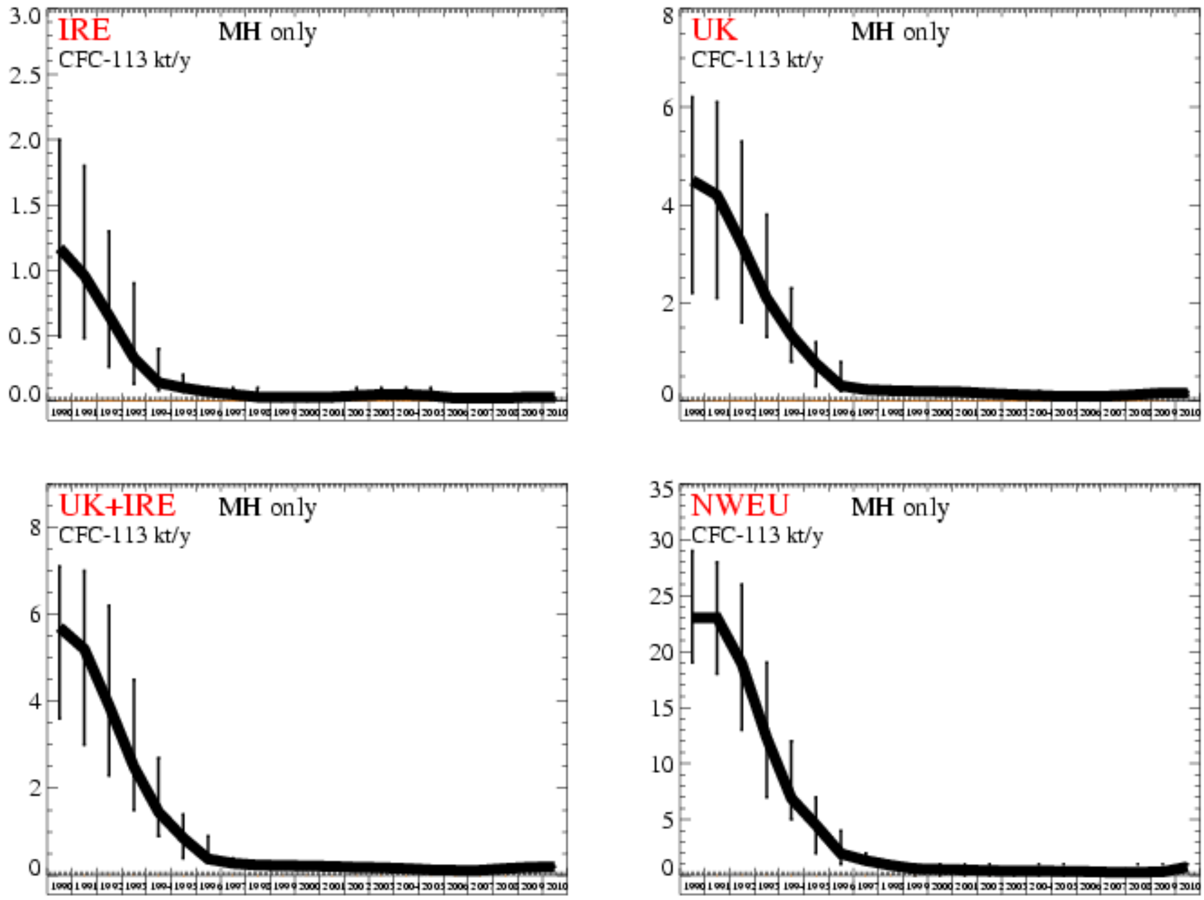


Figure 15: Emission estimates for UK (left) and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	1990	1.17	(0.49- 2.0)	4.5	(2.2- 6.2)	5.7	(3.6- 7.1)	23.	(19.- 29.)	144
kt/y	1991	0.96	(0.48- 1.8)	4.2	(2.1- 6.1)	5.2	(3.0- 7.0)	23.	(18.- 28.)	288
kt/y	1992	0.65	(0.26- 1.3)	3.2	(1.6- 5.3)	3.9	(2.3- 6.2)	18.9	(13.- 26.)	300
kt/y	1993	0.33	(0.13- 0.9)	2.1	(1.3- 3.8)	2.5	(1.5- 4.5)	12.3	(7.- 19.)	300
kt/y	1994	0.14	(0.08- 0.4)	1.34	(0.8- 2.3)	1.46	(0.9- 2.7)	6.9	(5.- 12.)	300
kt/y	1995	0.10	(0.07- 0.2)	0.76	(0.3- 1.2)	0.86	(0.4- 1.4)	4.5	(2.- 7.)	300
kt/y	1996	0.07	(0.05- 0.1)	0.31	(0.2- 0.8)	0.38	(0.3- 0.9)	1.95	(1.- 4.)	300
kt/y	1997	0.05	(0.03- 0.1)	0.23	(0.2- 0.3)	0.28	(0.2- 0.4)	1.34	(1.- 2.)	300
kt/y	1998	0.03	(0.02- 0.1)	0.21	(0.2- 0.3)	0.24	(0.2- 0.3)	0.92	(1.- 1.)	300
kt/y	1999	0.03	(0.02- 0.0)	0.20	(0.2- 0.2)	0.23	(0.2- 0.3)	0.60	(0.- 1.)	300
kt/y	2000	0.03	(0.02- 0.0)	0.19	(0.2- 0.2)	0.22	(0.2- 0.3)	0.55	(0.- 1.)	300
kt/y	2001	0.03	(0.02- 0.0)	0.18	(0.1- 0.2)	0.21	(0.2- 0.2)	0.50	(0.- 1.)	300
kt/y	2002	0.04	(0.03- 0.1)	0.15	(0.1- 0.2)	0.19	(0.2- 0.2)	0.44	(0.- 1.)	300
kt/y	2003	0.05	(0.03- 0.1)	0.13	(0.1- 0.2)	0.18	(0.1- 0.2)	0.41	(0.- 0.)	300
kt/y	2004	0.05	(0.03- 0.1)	0.11	(0.1- 0.2)	0.16	(0.1- 0.2)	0.42	(0.- 1.)	300
kt/y	2005	0.04	(0.01- 0.1)	0.09	(0.1- 0.1)	0.13	(0.1- 0.2)	0.37	(0.- 1.)	300
kt/y	2006	0.02	(0.01- 0.0)	0.09	(0.1- 0.1)	0.12	(0.1- 0.1)	0.35	(0.- 0.)	300
kt/y	2007	0.02	(0.01- 0.0)	0.10	(0.1- 0.1)	0.12	(0.1- 0.2)	0.29	(0.- 0.)	300
kt/y	2008	0.02	(0.01- 0.0)	0.13	(0.1- 0.2)	0.16	(0.1- 0.2)	0.29	(0.- 1.)	308
kt/y	2009	0.03	(0.02- 0.0)	0.16	(0.1- 0.2)	0.19	(0.1- 0.2)	0.33	(0.- 1.)	164
kt/y	2010	0.03	(0.02- 0.0)	0.16	(0.1- 0.2)	0.20	(0.2- 0.2)	0.77	(1.- 1.)	13

Table 3: CFC-113 emission estimates for UK and NWEU with uncertainty (5^{th} – 95^{th} percentile).

The emissions of CFC-113 in both the UK and NWEU as a whole fell very significantly between 1990 and the mid-1990s. This clearly shows the impact of the Montreal Protocol which banned the use of this gas in developed countries from 1995 onwards. The residual emissions reflect the leakage from old appliances.

4.3.1.4 CFC-114

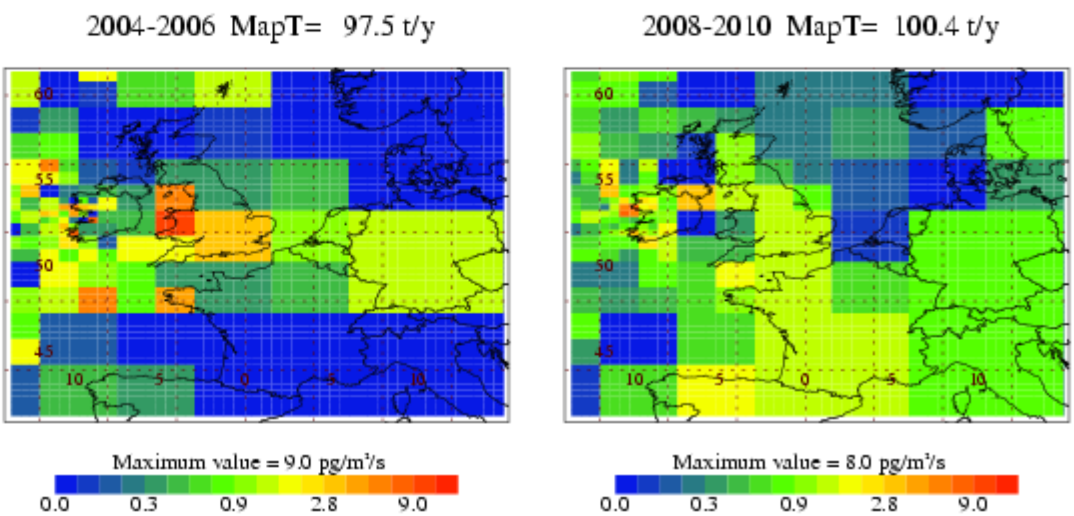


Figure 16: NAME-inversion emission estimates for 2004 - 2006 (left) and 2008 - 2010 (right).

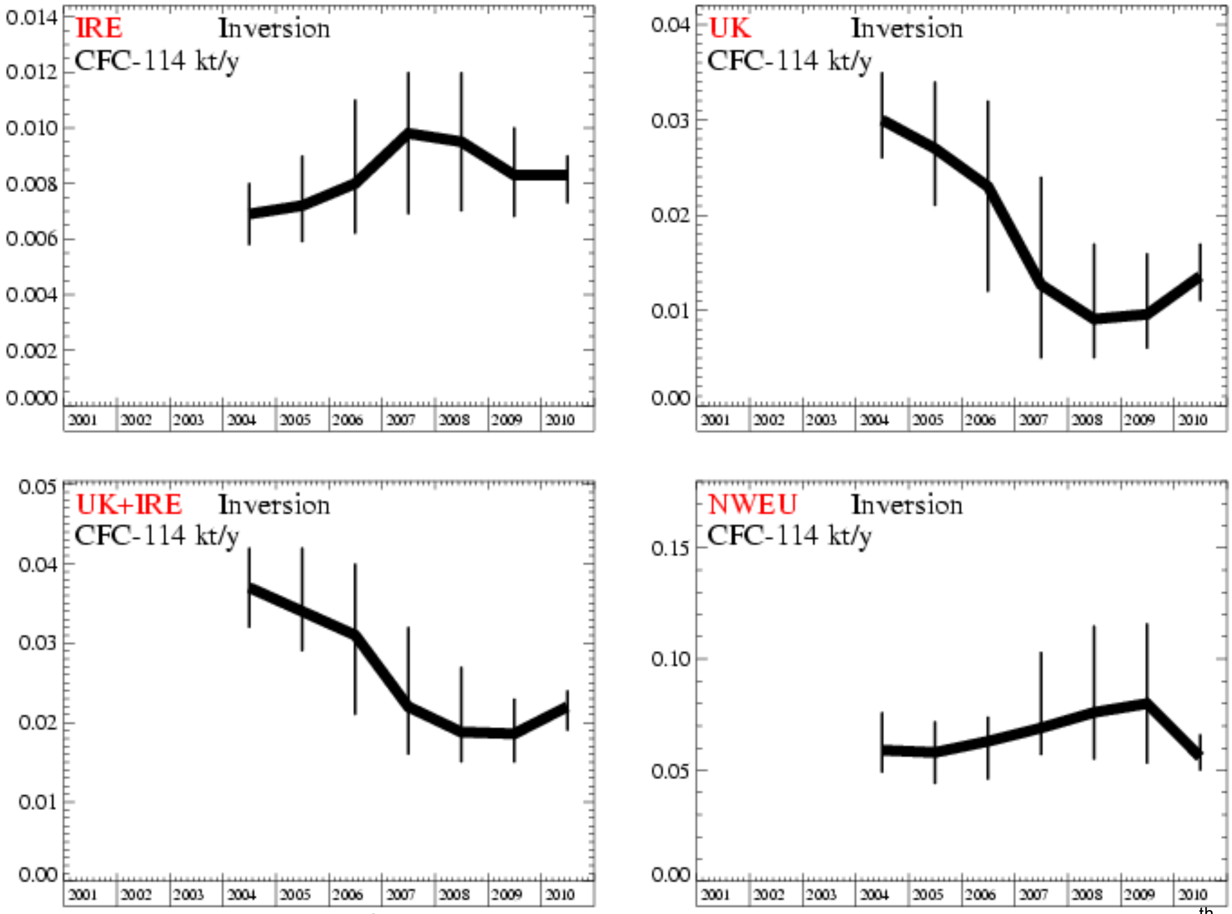


Figure 17: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE (5th-95th)	UK (5th-95th)	UK+IRE (5th-95th)	NWEU (5th-95th)	Number
t/y	2004	6.9 (5.8- 8.)	30. (26.- 35.)	37. (32.- 42.)	59. (49.- 76.)	26
t/y	2005	7.2 (5.9- 9.)	27. (21.- 34.)	34. (29.- 42.)	58. (44.- 72.)	182
t/y	2006	8.0 (6.2- 11.)	23. (12.- 32.)	31. (21.- 40.)	63. (46.- 74.)	325
t/y	2007	9.8 (6.9- 12.)	13. (5.- 24.)	22. (16.- 32.)	69. (57.- 103.)	325
t/y	2008	9.5 (7.0- 12.)	9.1 (5.- 17.)	19. (15.- 27.)	76. (55.- 115.)	325
t/y	2009	8.3 (6.8- 10.)	9.6 (6.- 16.)	19. (15.- 23.)	80. (53.- 116.)	169
t/y	2010	8.3 (7.3- 9.)	14. (11.- 17.)	22. (19.- 24.)	56. (50.- 66.)	13

Table 4: CFC-114 emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th %ile).

4.3.1.5 CFC-115

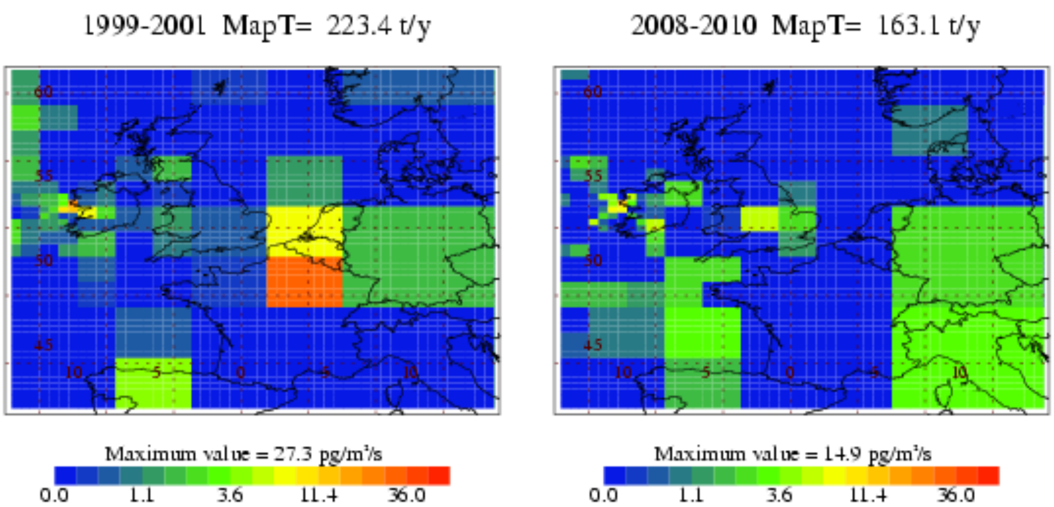


Figure 18: NAME-inversion emission estimates for 1999-2001 (left) and 2008-2010 (right).

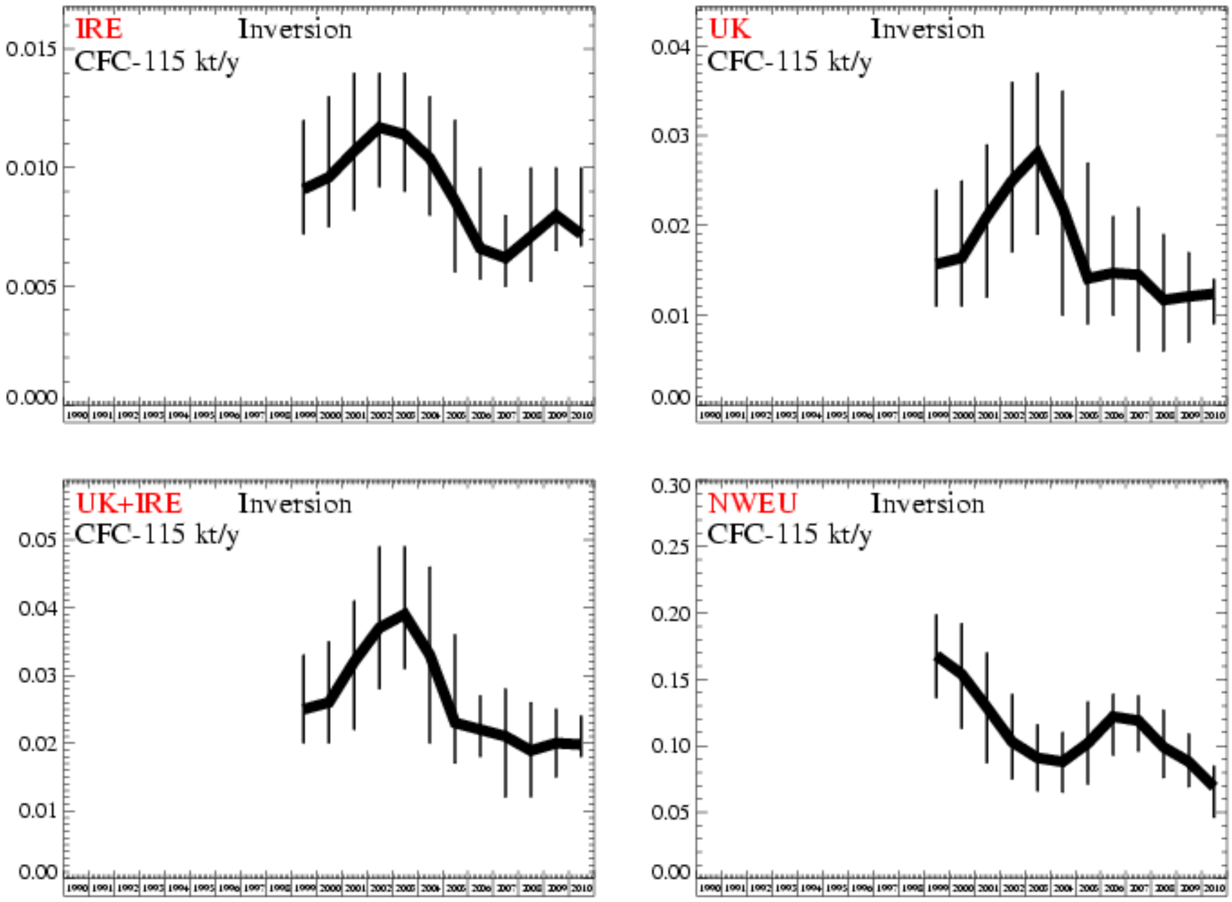


Figure 19: Emission estimates for IRE, UK, IRE+UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1999	9.1	(7.2- 12.)	15.7	(11.- 24.)	25.	(20.- 33.)	168.	(136.- 199.)	156
t/y	2000	9.6	(7.5- 13.)	16.4	(11.- 25.)	26.	(20.- 35.)	154.	(113.- 192.)	312
t/y	2001	10.7	(8.2- 14.)	21.	(12.- 29.)	32.	(22.- 41.)	129.	(87.- 170.)	325
t/y	2002	11.7	(9.2- 14.)	25.	(17.- 36.)	37.	(28.- 49.)	103.	(75.- 139.)	325
t/y	2003	11.4	(9.0- 14.)	28.	(19.- 37.)	39.	(31.- 49.)	91.	(66.- 116.)	325
t/y	2004	10.4	(8.0- 13.)	22.	(10.- 35.)	33.	(20.- 46.)	88.	(65.- 110.)	325
t/y	2005	8.6	(5.6- 12.)	14.1	(9.- 27.)	23.	(17.- 36.)	102.	(71.- 133.)	325
t/y	2006	6.6	(5.3- 10.)	14.7	(10.- 21.)	22.	(18.- 27.)	122.	(93.- 139.)	325
t/y	2007	6.2	(5.0- 8.)	14.5	(6.- 22.)	21.	(12.- 28.)	119.	(96.- 138.)	325
t/y	2008	7.1	(5.2- 10.)	11.7	(6.- 19.)	19.	(12.- 26.)	99.	(76.- 127.)	325
t/y	2009	8.0	(6.5- 10.)	12.1	(7.- 17.)	20.	(15.- 25.)	88.	(69.- 109.)	169
t/y	2010	7.2	(6.7- 10.)	12.4	(9.- 14.)	20.	(18.- 24.)	69.	(46.- 85.)	13

Table 5: CFC-115 emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th %ile).

4.3.1.6 CFC-13

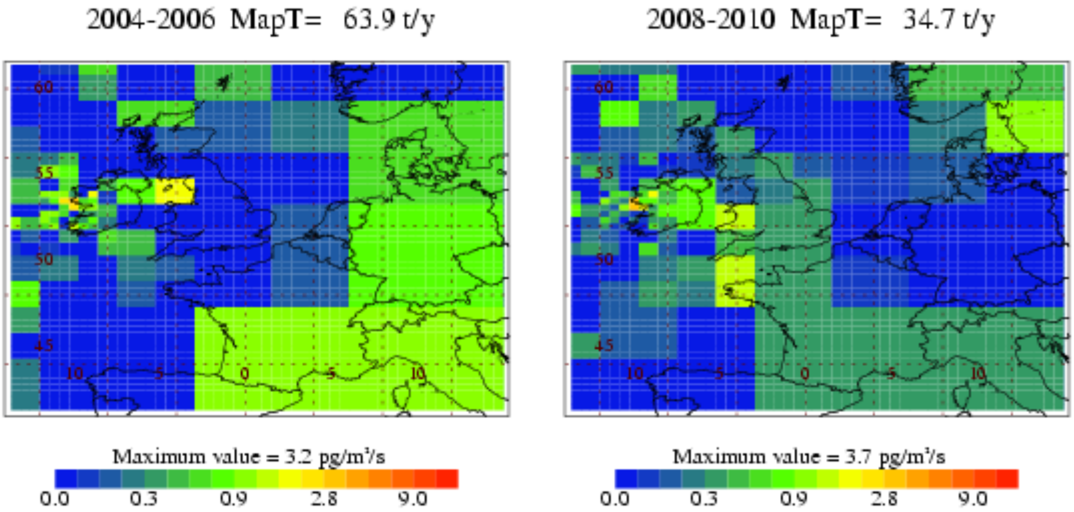


Figure 20: NAME-inversion emission estimates for 2004 - 2006 (left) and 2008 – 2010 (right).

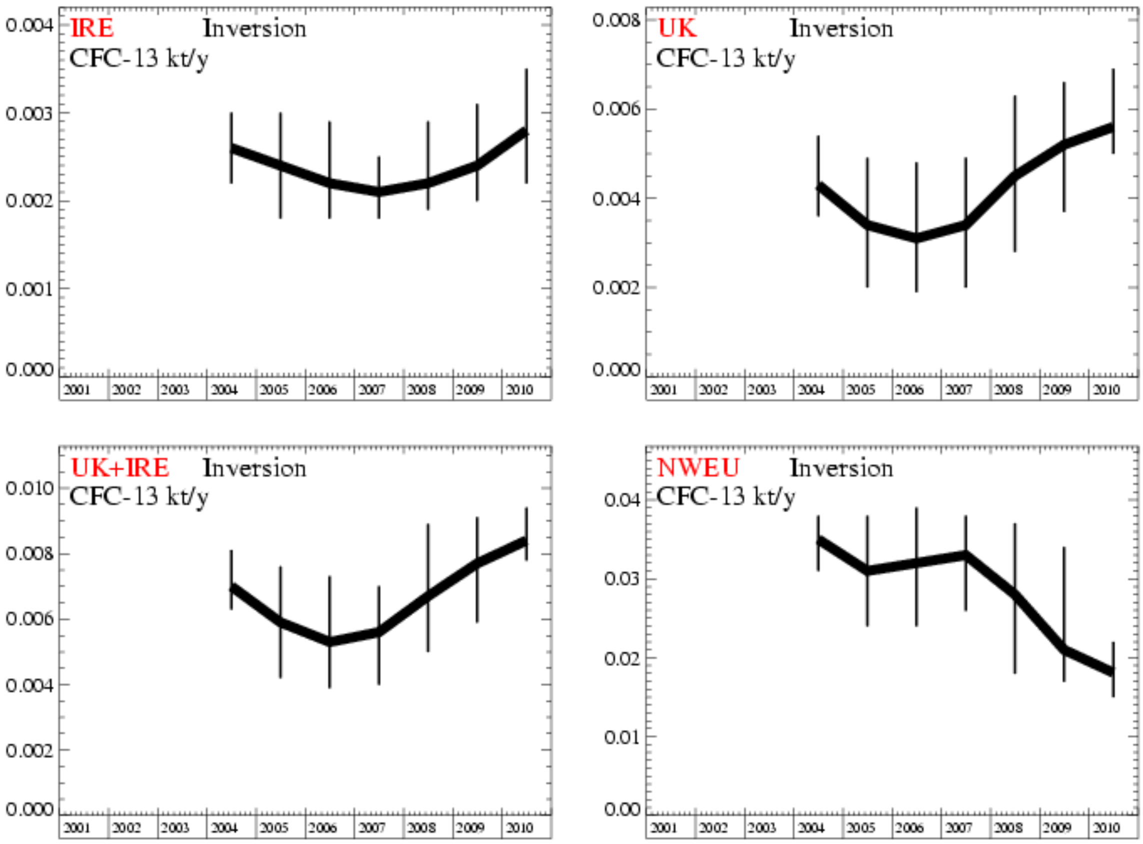


Figure 21: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	2004	2.6	(2.2- 3.0)	4.3	(3.6- 5.4)	7.0	(6.3- 8.1)	35.	(31.- 38.)	26
t/y	2005	2.4	(1.8- 3.0)	3.4	(2.0- 4.9)	5.9	(4.2- 7.6)	31.	(24.- 38.)	182
t/y	2006	2.2	(1.8- 2.9)	3.1	(1.9- 4.8)	5.3	(3.9- 7.3)	32.	(24.- 39.)	325
t/y	2007	2.1	(1.8- 2.5)	3.4	(2.0- 4.9)	5.6	(4.0- 7.0)	33.	(26.- 38.)	325
t/y	2008	2.2	(1.9- 2.9)	4.5	(2.8- 6.3)	6.7	(5.0- 8.9)	28.	(18.- 37.)	325
t/y	2009	2.4	(2.0- 3.1)	5.2	(3.7- 6.6)	7.7	(5.9- 9.1)	21.	(17.- 34.)	169
t/y	2010	2.8	(2.2- 3.5)	5.6	(5.0- 6.9)	8.4	(7.8- 9.4)	18.	(15.- 22.)	13

Table 6: CFC-13 emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th %ile).

4.3.2 HCFC

4.3.2.1 HCFC-124

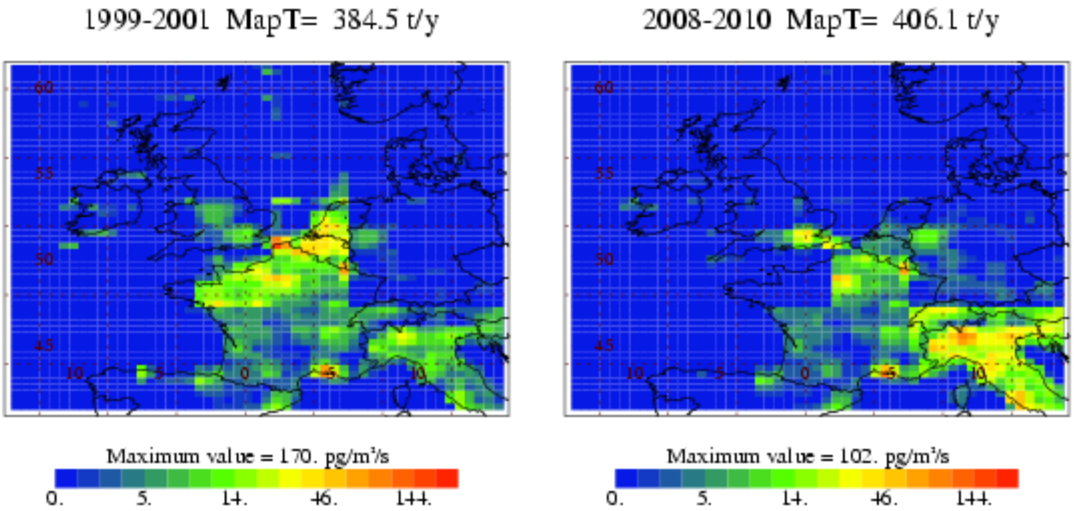


Figure 22: NAME-inversion emission estimates for 1999-2001 (left) and 2008-2010 (right).

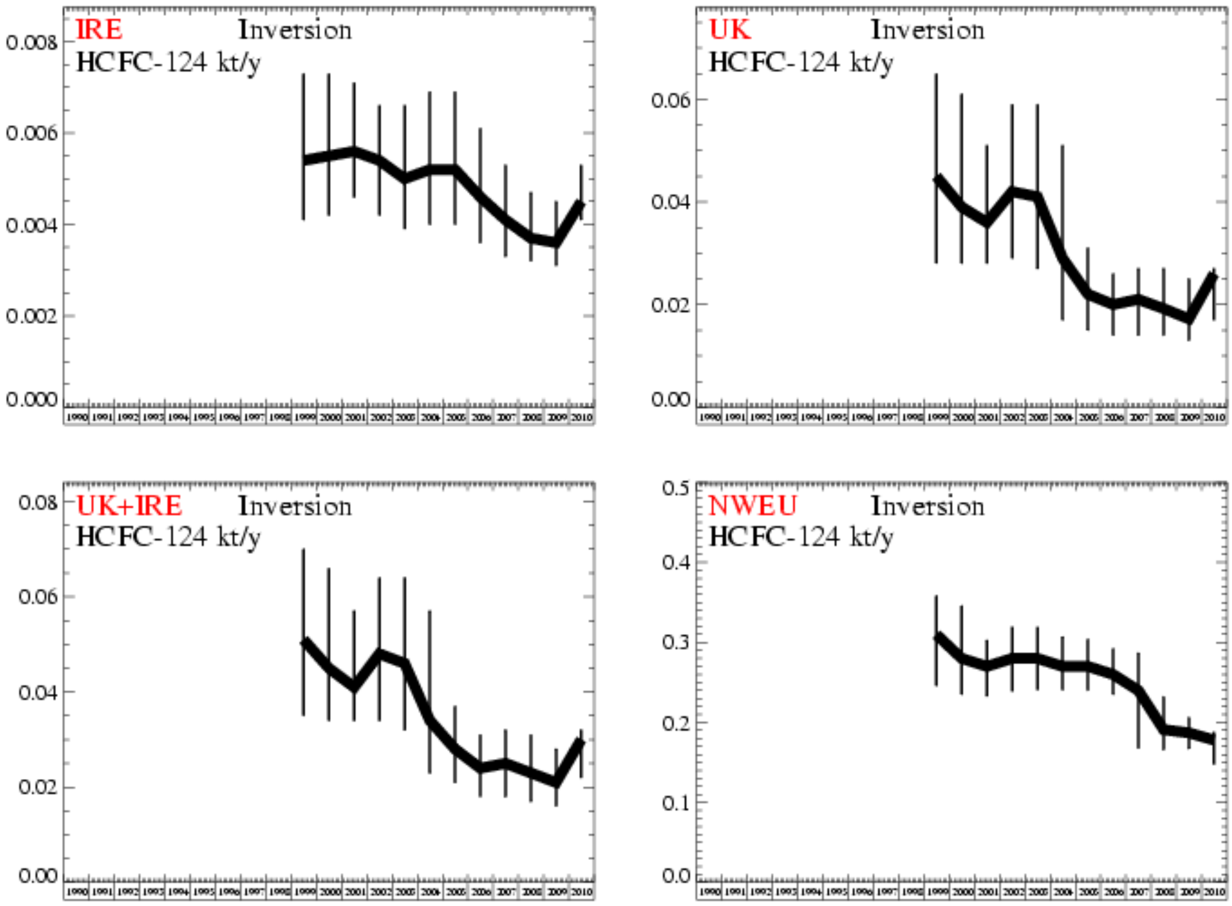


Figure 23: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1999	5.4	(4.1- 7.3)	45.	(28.- 65.)	51.	(35.- 70.)	310.	(246.- 358.)	156
t/y	2000	5.5	(4.2- 7.3)	39.	(28.- 61.)	45.	(34.- 66.)	280.	(235.- 346.)	312
t/y	2001	5.6	(4.6- 7.1)	36.	(28.- 51.)	41.	(34.- 57.)	270.	(233.- 303.)	325
t/y	2002	5.4	(4.2- 6.6)	42.	(29.- 59.)	48.	(34.- 64.)	280.	(239.- 319.)	325
t/y	2003	5.0	(3.9- 6.6)	41.	(27.- 59.)	46.	(32.- 64.)	280.	(241.- 319.)	325
t/y	2004	5.2	(4.0- 6.9)	29.	(17.- 51.)	34.	(23.- 57.)	270.	(241.- 307.)	325
t/y	2005	5.2	(4.0- 6.9)	22.	(15.- 31.)	28.	(21.- 37.)	270.	(240.- 304.)	325
t/y	2006	4.6	(3.6- 6.1)	20.	(14.- 26.)	24.	(18.- 31.)	260.	(235.- 292.)	325
t/y	2007	4.1	(3.3- 5.3)	21.	(14.- 27.)	25.	(18.- 32.)	240.	(168.- 287.)	325
t/y	2008	3.7	(3.2- 4.7)	19.	(14.- 27.)	23.	(17.- 31.)	191.	(166.- 232.)	325
t/y	2009	3.6	(3.1- 4.5)	17.	(13.- 25.)	21.	(16.- 28.)	187.	(167.- 206.)	169
t/y	2010	4.5	(4.1- 5.3)	26.	(17.- 27.)	30.	(22.- 32.)	178.	(148.- 188.)	13

Table 7: HCFC-124 emission estimates for IRE, UK and NWEU with uncertainty (5^{th} – 95^{th} %ile).

Both the UK and the NWEU emissions of this gas have fallen since records began in 1998.

4.3.2.2 HCFC-141b

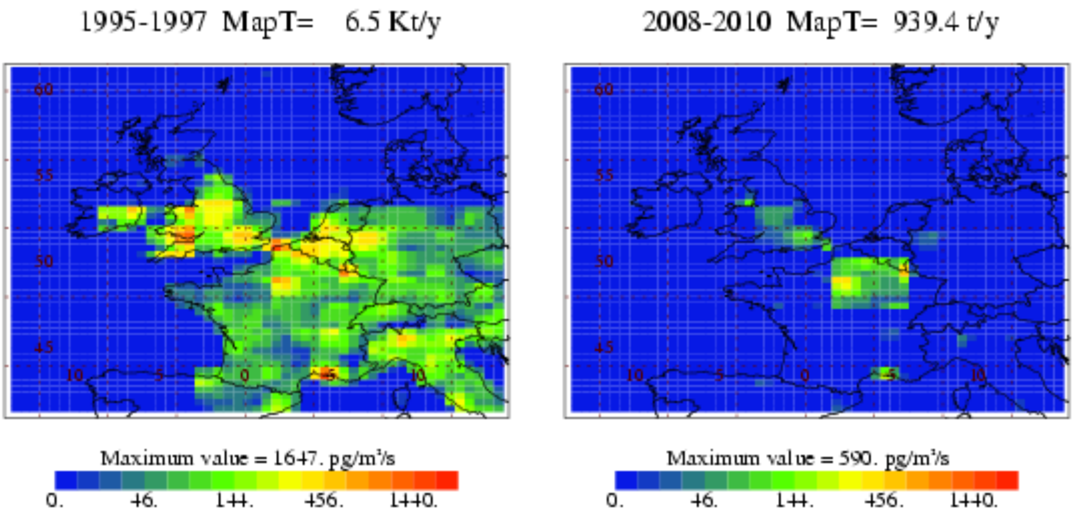


Figure 24: NAME-inversion emission estimates for 1995-1997 (left) and 2008-2010 (right).

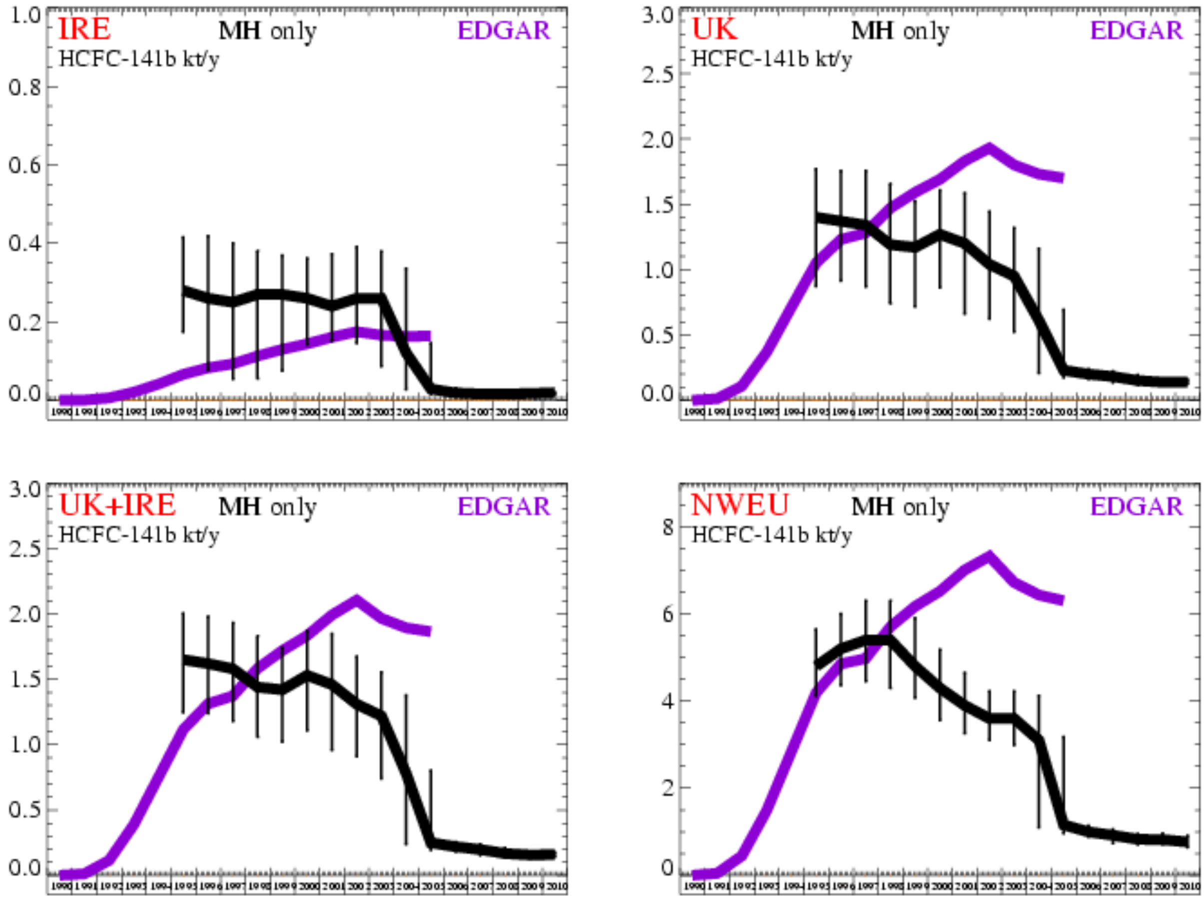


Figure 25: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1995	280.	(175.- 416.)	1400.	(874.-1769.)	1650.	(1246.-2004.)	4800.	(4120.-5652.)	39
t/y	1996	260.	(78.- 419.)	1370.	(914.-1756.)	1620.	(1241.-1981.)	5200.	(4358.-6006.)	195
t/y	1997	250.	(55.- 400.)	1340.	(871.-1756.)	1580.	(1180.-1933.)	5400.	(4452.-6304.)	325
t/y	1998	270.	(56.- 381.)	1190.	(740.-1656.)	1440.	(1061.-1830.)	5400.	(4295.-6304.)	325
t/y	1999	270.	(75.- 369.)	1170.	(717.-1525.)	1420.	(1023.-1740.)	4800.	(4072.-5907.)	325
t/y	2000	260.	(142.- 362.)	1270.	(864.-1607.)	1530.	(1108.-1870.)	4300.	(3563.-5186.)	325
t/y	2001	240.	(151.- 373.)	1200.	(662.-1584.)	1460.	(959.-1849.)	3900.	(3258.-4651.)	325
t/y	2002	260.	(146.- 391.)	1040.	(624.-1443.)	1310.	(910.-1676.)	3600.	(3107.-4228.)	325
t/y	2003	260.	(87.- 380.)	950.	(523.-1318.)	1220.	(742.-1555.)	3600.	(2986.-4228.)	325
t/y	2004	121.	(28.- 336.)	610.	(207.-1161.)	780.	(241.-1378.)	3100.	(1107.-4125.)	325
t/y	2005	29.	(16.- 146.)	230.	(175.- 694.)	250.	(194.- 803.)	1160.	(971.-3182.)	325
t/y	2006	18.7	(13.- 31.)	200.	(165.- 238.)	220.	(182.- 258.)	1000.	(883.-1144.)	325
t/y	2007	16.4	(11.- 22.)	182.	(136.- 221.)	198.	(153.- 238.)	920.	(736.-1060.)	325
t/y	2008	16.5	(11.- 22.)	151.	(120.- 194.)	168.	(137.- 210.)	830.	(713.- 954.)	325
t/y	2009	17.2	(13.- 22.)	139.	(115.- 163.)	157.	(133.- 180.)	820.	(706.- 966.)	169
t/y	2010	19.5	(15.- 21.)	138.	(126.- 159.)	159.	(142.- 176.)	770.	(649.- 911.)	13

Table 8: HCFC-141b emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th %ile).

The impact of the Montreal Protocol driven phase-out of this gas in 2005 from developed (Annex 1) countries is clearly seen in the UK and NWEU time-series of emissions.

4.3.2.3 HCFC-142b

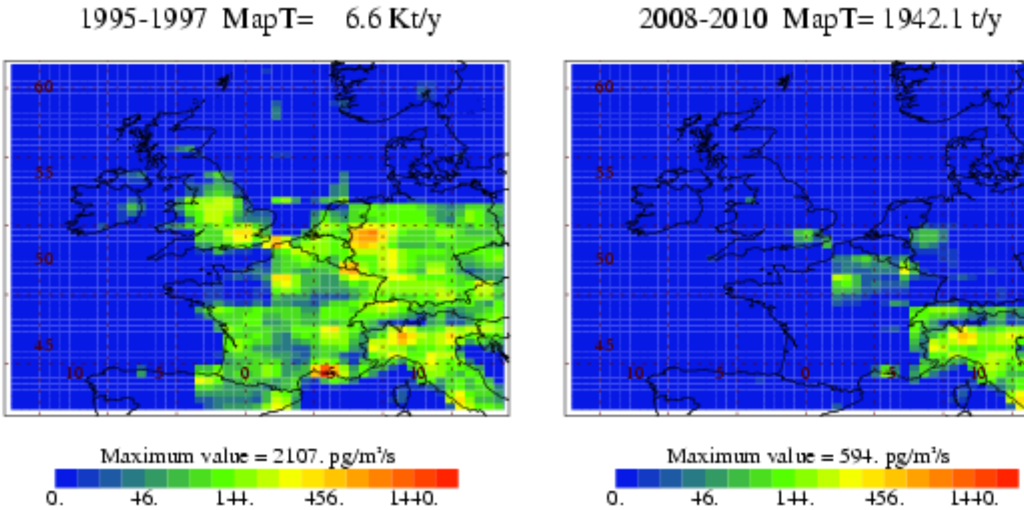


Figure 26: NAME-inversion emission estimates for 1995-1997 (left) and 2008-2010 (right).

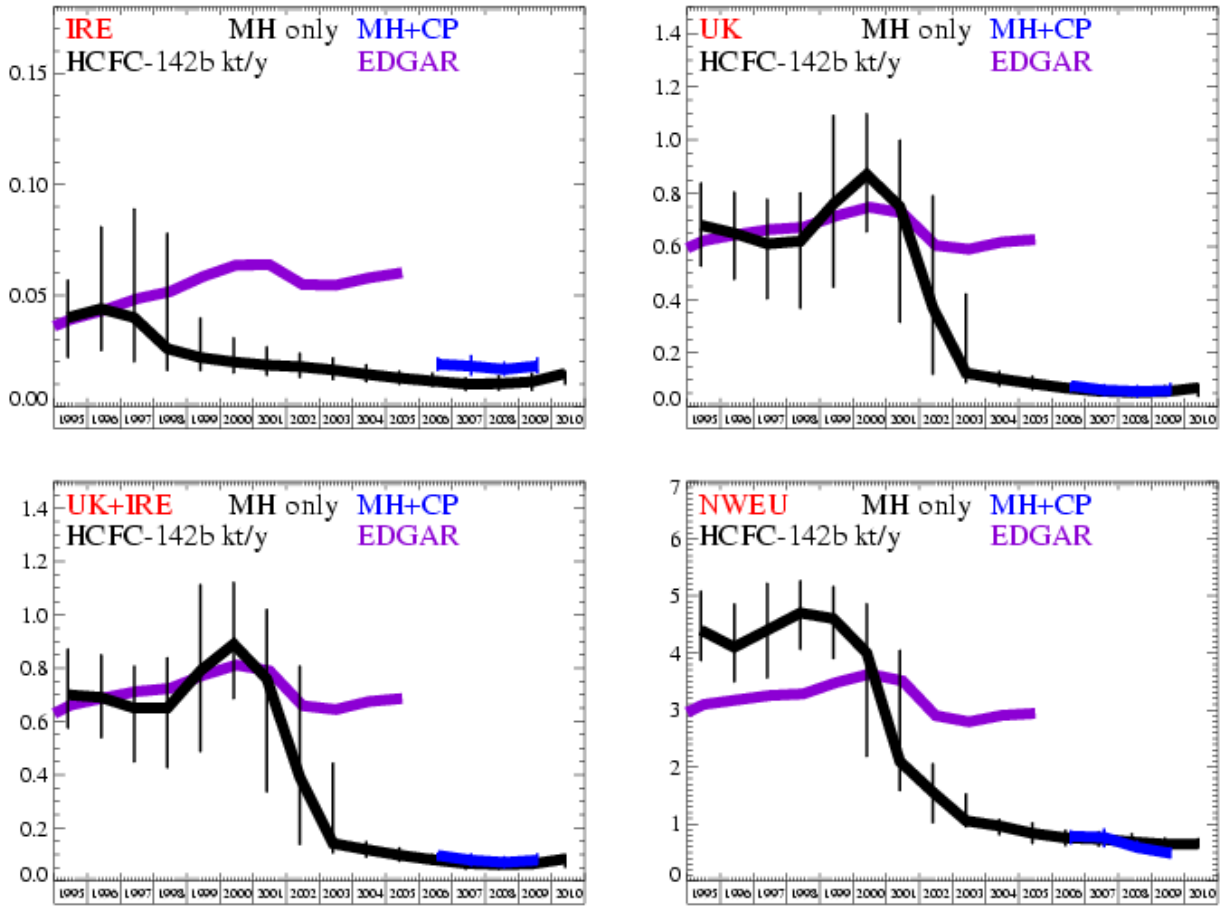


Figure 27: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1995	40.	(22.- 57.)	680.	(526.- 839.)	700.	(574.- 873.)	4400.	(3859.-5089.)	39
t/y	1996	44.	(25.- 81.)	650.	(477.- 804.)	690.	(538.- 850.)	4100.	(3488.-4866.)	195
t/y	1997	40.	(20.- 89.)	610.	(403.- 778.)	650.	(448.- 808.)	4400.	(3560.-5221.)	325
t/y	1998	26.	(16.- 78.)	620.	(368.- 803.)	650.	(426.- 840.)	4700.	(4056.-5269.)	325
t/y	1999	22.	(16.- 40.)	760.	(446.-1093.)	790.	(487.-1114.)	4600.	(3896.-5163.)	325
t/y	2000	20.	(15.- 31.)	870.	(654.-1099.)	890.	(685.-1122.)	4000.	(2184.-4866.)	325
t/y	2001	18.6	(14.- 27.)	750.	(315.-1000.)	760.	(336.-1022.)	2100.	(1583.-4049.)	325
t/y	2002	17.9	(13.- 24.)	370.	(119.- 791.)	390.	(137.- 808.)	1560.	(1018.-2063.)	325
t/y	2003	16.4	(12.- 22.)	125.	(89.- 423.)	142.	(106.- 444.)	1060.	(948.-1534.)	325
t/y	2004	14.5	(11.- 19.)	104.	(76.- 133.)	119.	(90.- 149.)	970.	(813.-1096.)	325
t/y	2005	12.8	(10.- 16.)	86.	(62.- 114.)	98.	(74.- 127.)	840.	(658.-1030.)	325
t/y	2006	11.4	(9.- 15.)	69.	(51.- 89.)	81.	(62.- 102.)	760.	(624.- 893.)	325
t/y	2007	10.1	(7.- 13.)	57.	(38.- 80.)	67.	(45.- 91.)	740.	(615.- 871.)	325
t/y	2008	10.2	(7.- 14.)	53.	(36.- 74.)	63.	(45.- 85.)	690.	(584.- 841.)	325
t/y	2009	11.1	(7.- 15.)	55.	(41.- 78.)	65.	(52.- 88.)	650.	(576.- 761.)	169
t/y	2010	14.8	(10.- 16.)	70.	(36.- 85.)	84.	(51.- 101.)	650.	(585.- 752.)	13

Table 9: HCFC-142b emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th percentile).

The impact of the Montreal Protocol driven phase-out of this gas in 2005 from developed (Annex 1) countries is clearly seen in the UK and NWEU time-series of emissions.

4.3.2.4 HCFC-22

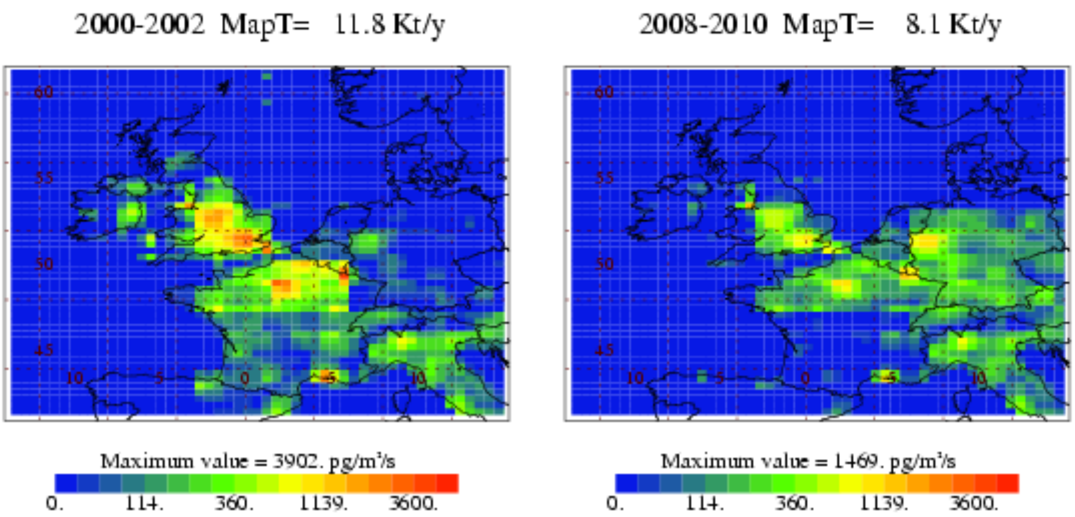


Figure 28: NAME-inversion emission estimates for 2000-2002 (left) and 2008-2010 (right).

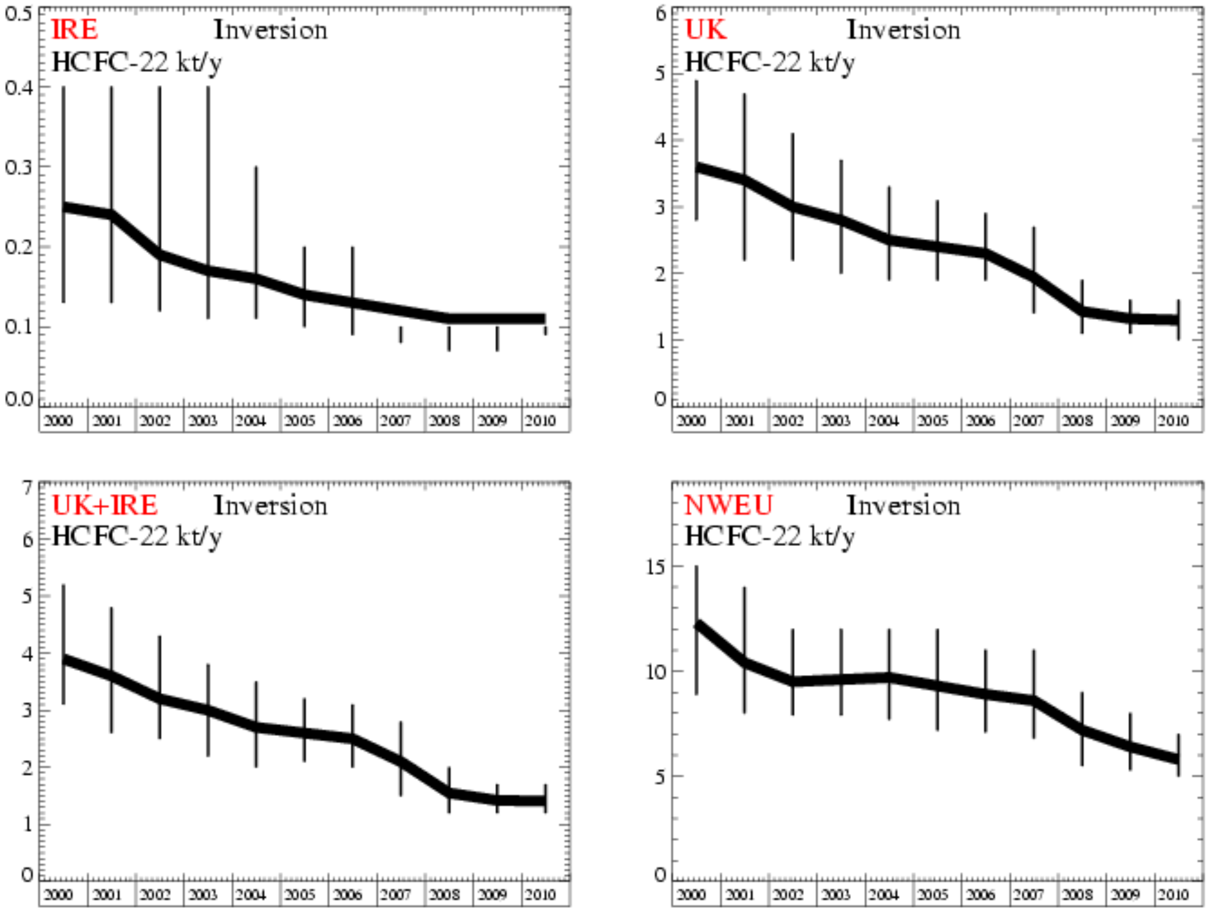


Figure 29: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	2000	0.25	(0.13- 0.4)	3.6	(2.8- 4.9)	3.9	(3.1- 5.2)	12.3	(8.9- 15.)	132
kt/y	2001	0.24	(0.13- 0.4)	3.4	(2.2- 4.7)	3.6	(2.6- 4.8)	10.4	(8.0- 14.)	264
kt/y	2002	0.19	(0.12- 0.4)	3.0	(2.2- 4.1)	3.2	(2.5- 4.3)	9.5	(7.9- 12.)	275
kt/y	2003	0.17	(0.11- 0.4)	2.8	(2.0- 3.7)	3.0	(2.2- 3.8)	9.6	(7.9- 12.)	275
kt/y	2004	0.16	(0.11- 0.3)	2.5	(1.9- 3.3)	2.7	(2.0- 3.5)	9.7	(7.7- 12.)	273
kt/y	2005	0.14	(0.10- 0.2)	2.4	(1.9- 3.1)	2.6	(2.1- 3.2)	9.3	(7.2- 12.)	261
kt/y	2006	0.13	(0.09- 0.2)	2.3	(1.9- 2.9)	2.5	(2.0- 3.1)	8.9	(7.1- 11.)	250
kt/y	2007	0.12	(0.08- 0.1)	1.9	(1.4- 2.7)	2.1	(1.5- 2.8)	8.6	(6.8- 11.)	253
kt/y	2008	0.11	(0.07- 0.1)	1.4	(1.1- 1.9)	1.6	(1.2- 2.0)	7.2	(5.5- 9.)	289
kt/y	2009	0.11	(0.07- 0.1)	1.3	(1.1- 1.6)	1.4	(1.2- 1.7)	6.4	(5.3- 8.)	169
kt/y	2010	0.11	(0.09- 0.1)	1.3	(1.0- 1.6)	1.4	(1.2- 1.7)	5.8	(5.0- 7.)	13

Table 10: HCFC-22 emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th %ile).

The emissions of this gas are significant across the NWEU, although they have been consistently falling from when records began in 1999. In the UK the emissions have more than halved.

4.3.3 HFC

4.3.3.1 HFC-125

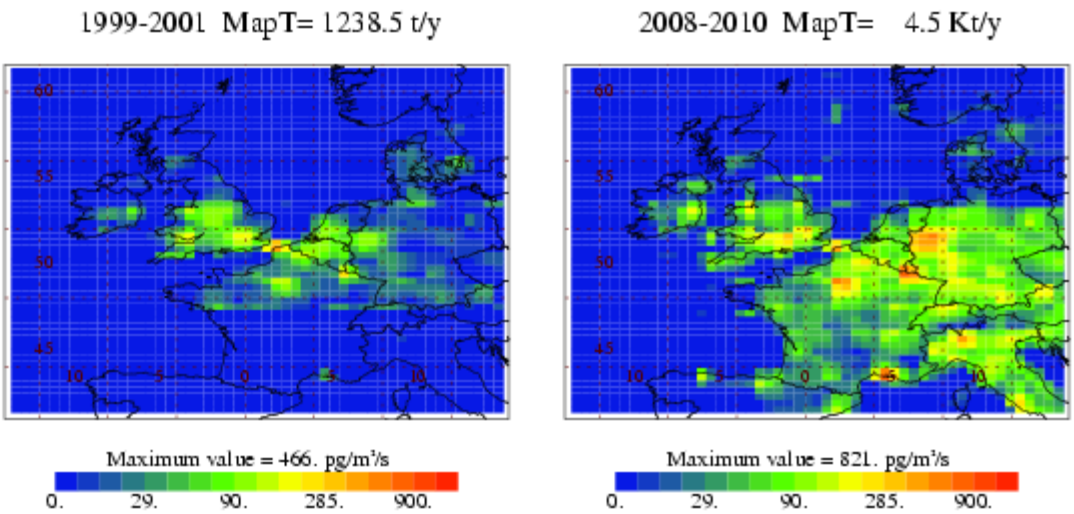


Figure 30: NAME-inversion emission estimates for 1999-2001 (left) and 2008-2010 (right).

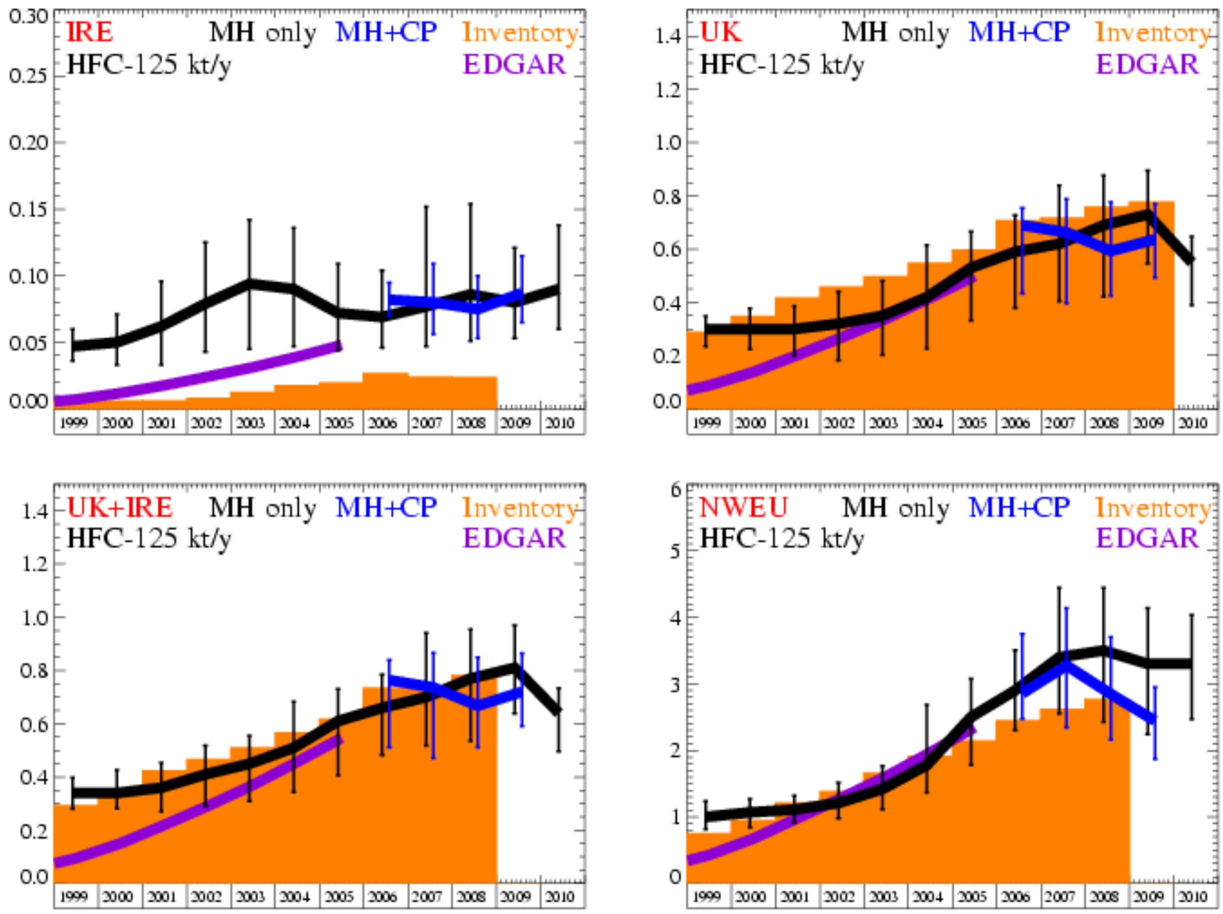


Figure 31: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1999	47.	(36.- 60.)	300.	(234.- 349.)	340.	(280.- 398.)	1000.	(818.-1238.)	156
t/y	2000	50.	(33.- 71.)	300.	(225.- 377.)	340.	(282.- 426.)	1070.	(846.-1269.)	312
t/y	2001	62.	(33.- 96.)	300.	(201.- 386.)	360.	(271.- 454.)	1110.	(920.-1322.)	325
t/y	2002	79.	(43.- 125.)	320.	(183.- 441.)	410.	(293.- 519.)	1210.	(980.-1517.)	325
t/y	2003	94.	(45.- 142.)	350.	(203.- 481.)	450.	(310.- 556.)	1420.	(1115.-1766.)	325
t/y	2004	90.	(47.- 136.)	420.	(227.- 615.)	510.	(343.- 682.)	1780.	(1366.-2687.)	325
t/y	2005	72.	(44.- 109.)	530.	(332.- 667.)	610.	(406.- 730.)	2500.	(1783.-3076.)	325
t/y	2006	69.	(46.- 104.)	590.	(380.- 727.)	660.	(483.- 785.)	2900.	(2304.-3505.)	325
t/y	2007	77.	(47.- 152.)	620.	(404.- 839.)	700.	(519.- 941.)	3400.	(2552.-4444.)	325
t/y	2008	86.	(51.- 154.)	690.	(421.- 876.)	770.	(535.- 955.)	3500.	(2425.-4444.)	325
t/y	2009	80.	(53.- 121.)	730.	(546.- 896.)	810.	(639.- 970.)	3300.	(2244.-4140.)	169
t/y	2010	90.	(60.- 138.)	550.	(389.- 648.)	640.	(496.- 733.)	3300.	(2466.-4035.)	13

Table 11: HFC-125 emission estimates for IRE, UK and NWEU with uncertainty (5^{th} – 95^{th} %ile).

The UK and NWEU have seen strong growths in emissions of this gas. It is used as a replacement for some of the CFCs and HCFCs.

4.3.3.2 HFC-134a

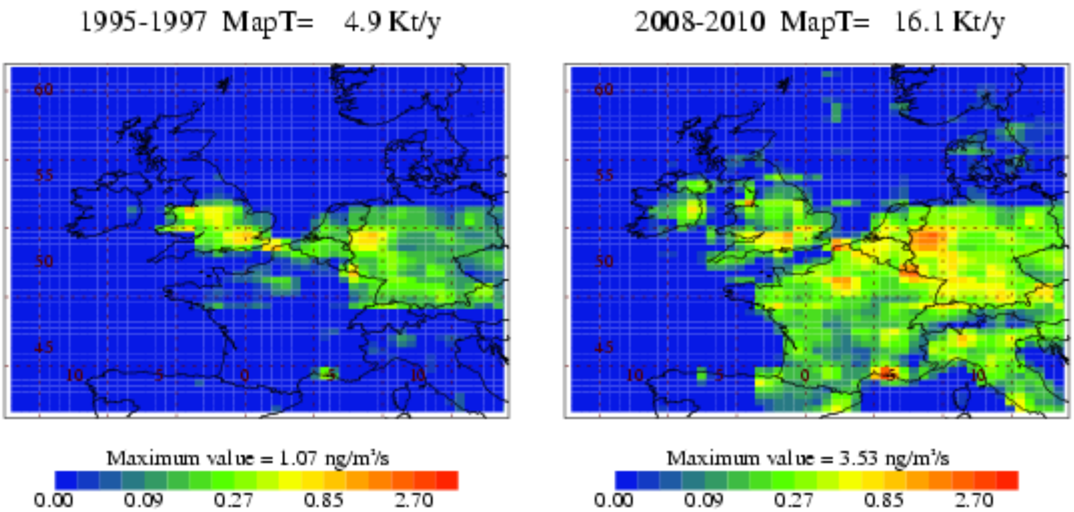


Figure 32: NAME-inversion emission estimates for 1995-1997 (left) and 2008-201 (right).

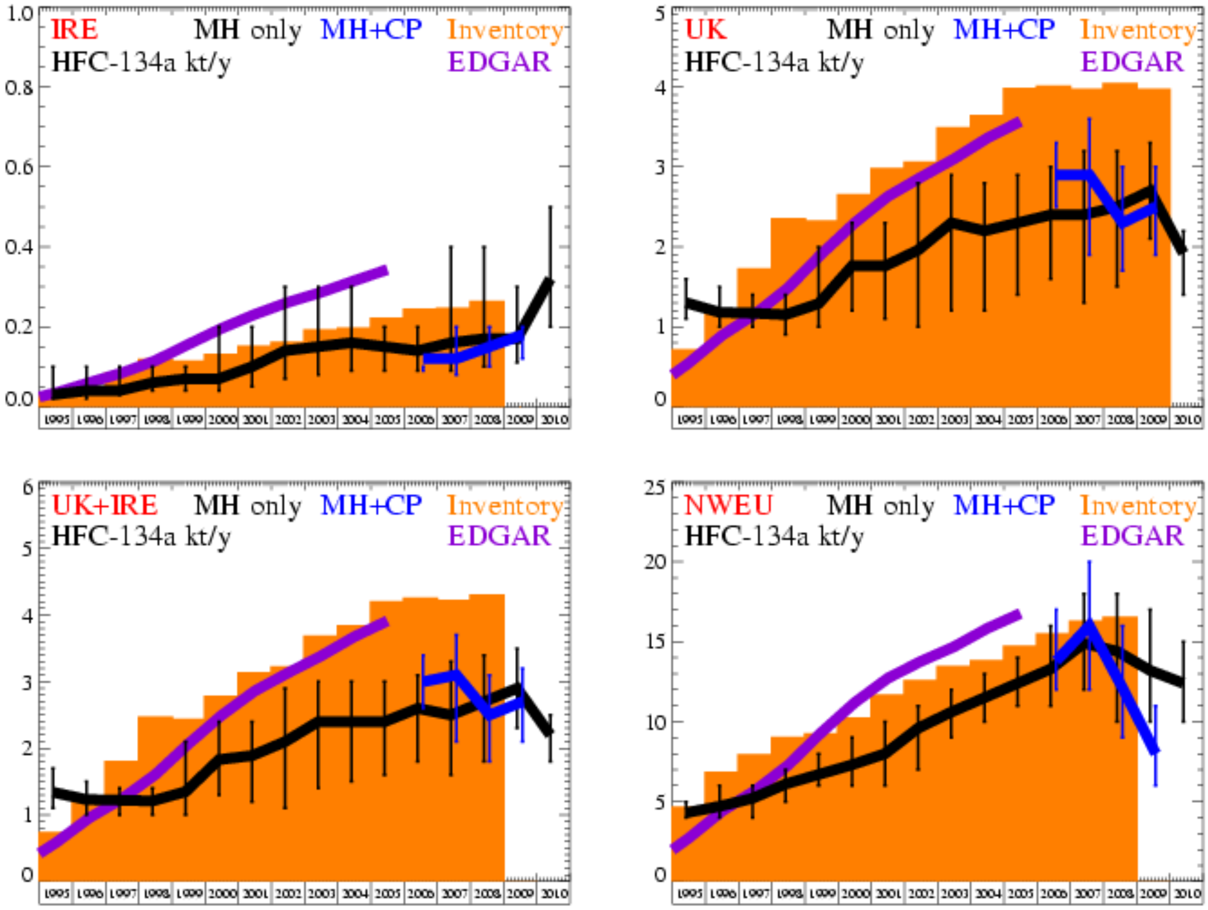


Figure 33: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	1995	0.03	(0.02- 0.1)	1.30	(1.1- 1.6)	1.34	(1.1- 1.7)	4.3	(4.- 5.)	39
kt/y	1996	0.04	(0.02- 0.1)	1.18	(1.0- 1.5)	1.23	(1.0- 1.5)	4.7	(4.- 6.)	195
kt/y	1997	0.04	(0.03- 0.1)	1.17	(1.0- 1.4)	1.22	(1.0- 1.4)	5.2	(4.- 6.)	325
kt/y	1998	0.06	(0.04- 0.1)	1.15	(0.9- 1.4)	1.21	(1.0- 1.4)	6.1	(5.- 7.)	325
kt/y	1999	0.07	(0.04- 0.1)	1.29	(1.0- 2.0)	1.35	(1.0- 2.1)	6.7	(6.- 8.)	325
kt/y	2000	0.07	(0.04- 0.2)	1.76	(1.2- 2.3)	1.83	(1.3- 2.4)	7.3	(6.- 9.)	325
kt/y	2001	0.10	(0.05- 0.2)	1.76	(1.1- 2.3)	1.89	(1.2- 2.4)	8.0	(6.- 10.)	325
kt/y	2002	0.14	(0.07- 0.3)	1.96	(1.0- 2.8)	2.1	(1.1- 2.9)	9.6	(7.- 11.)	325
kt/y	2003	0.15	(0.08- 0.3)	2.3	(1.2- 2.9)	2.4	(1.4- 3.0)	10.6	(9.- 12.)	325
kt/y	2004	0.16	(0.09- 0.3)	2.2	(1.2- 2.8)	2.4	(1.5- 3.0)	11.5	(10.- 13.)	325
kt/y	2005	0.15	(0.09- 0.2)	2.3	(1.4- 2.9)	2.4	(1.6- 3.0)	12.4	(11.- 14.)	325
kt/y	2006	0.14	(0.09- 0.2)	2.4	(1.6- 3.0)	2.6	(1.8- 3.1)	13.3	(11.- 16.)	325
kt/y	2007	0.16	(0.09- 0.4)	2.4	(1.3- 3.2)	2.5	(1.6- 3.3)	14.9	(12.- 18.)	325
kt/y	2008	0.17	(0.10- 0.4)	2.5	(1.5- 3.2)	2.7	(1.8- 3.4)	14.4	(10.- 18.)	325
kt/y	2009	0.17	(0.11- 0.3)	2.7	(2.1- 3.3)	2.9	(2.3- 3.5)	13.2	(10.- 17.)	169
kt/y	2010	0.32	(0.20- 0.5)	1.92	(1.4- 2.2)	2.2	(1.8- 2.5)	12.4	(10.- 15.)	13

Table 12: HFC-134a emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5th – 95th percentile).

The NAME-inversion results show that emissions of HFC-134a rose steadily from 1995 until 2009. There is an indication that emissions in 2010 may have declined but more data are required to confirm this change. The inventory estimates for the UK show a steady rise up until 2005 after which the emissions have remained largely unchanged, but are consistently higher than the inversion estimates. The agreement in the trend in the NWEU across the whole time-series is excellent although the inversion results are marginally lower in magnitude.

4.3.3.3 HFC-143a

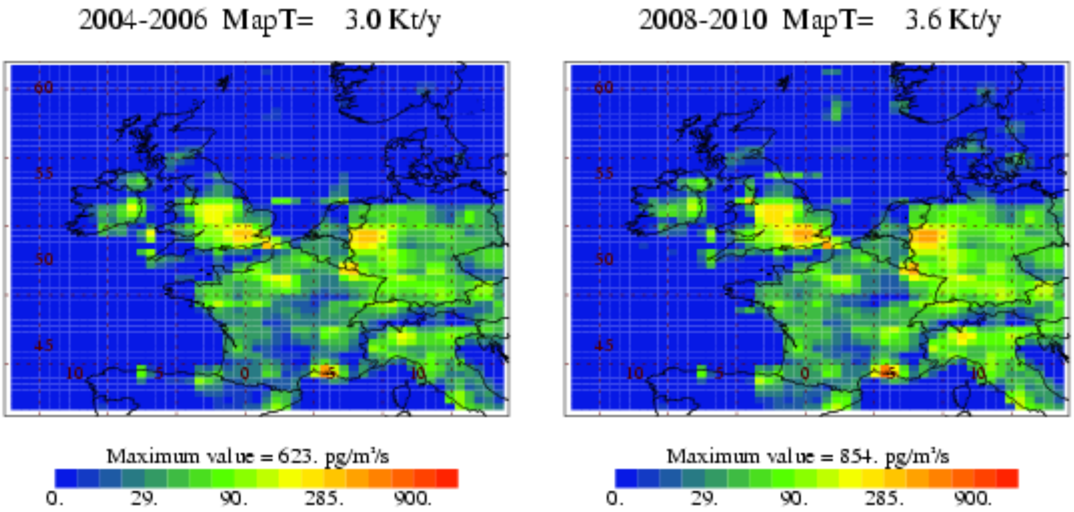


Figure 34: NAME-inversion emission estimates for 2004 – 2006 (left) and 2008 – 2010 (right).

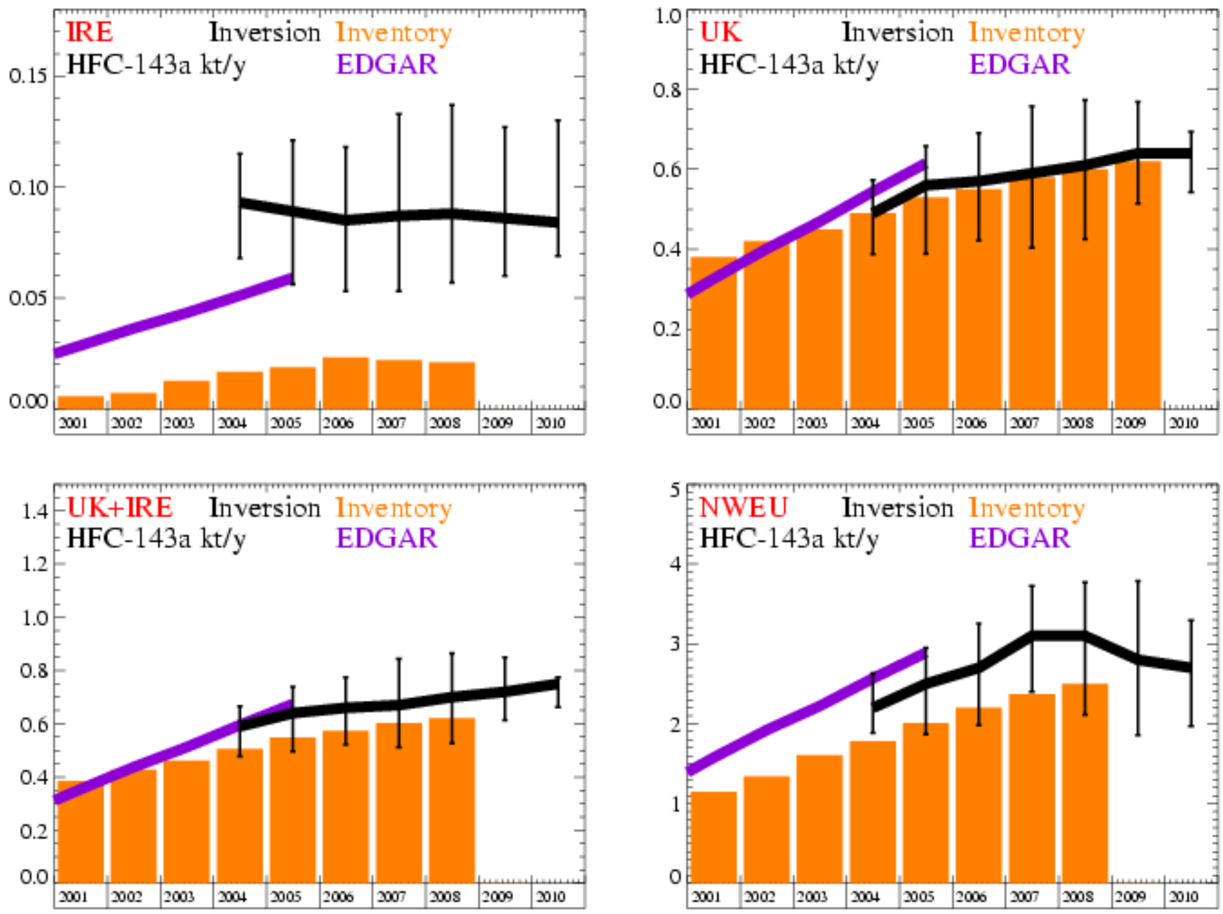


Figure 35: Emission estimates for IRE, UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK (5th-95th)		UK+IRE (5th-95th)		NWEU (5th-95th)		Number
t/y	2004	93.	(68.- 115.)	490.	(388.- 573.)	590.	(478.- 666.)	2200.	(1883.-2633.)	26
t/y	2005	89.	(56.- 121.)	560.	(389.- 658.)	640.	(496.- 739.)	2500.	(1868.-2948.)	182
t/y	2006	85.	(53.- 118.)	570.	(422.- 691.)	660.	(522.- 774.)	2700.	(1983.-3254.)	325
t/y	2007	87.	(53.- 133.)	590.	(403.- 758.)	670.	(511.- 844.)	3100.	(2400.-3727.)	325
t/y	2008	88.	(57.- 137.)	610.	(425.- 773.)	700.	(526.- 864.)	3100.	(2114.-3769.)	325
t/y	2009	86.	(60.- 127.)	640.	(514.- 769.)	720.	(614.- 849.)	2800.	(1855.-3785.)	169
t/y	2010	84.	(69.- 130.)	640.	(543.- 694.)	750.	(662.- 775.)	2700.	(1972.-3294.)	13

Table 13: HFC-143a emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th percentile).

4.3.3.4 HFC-152a

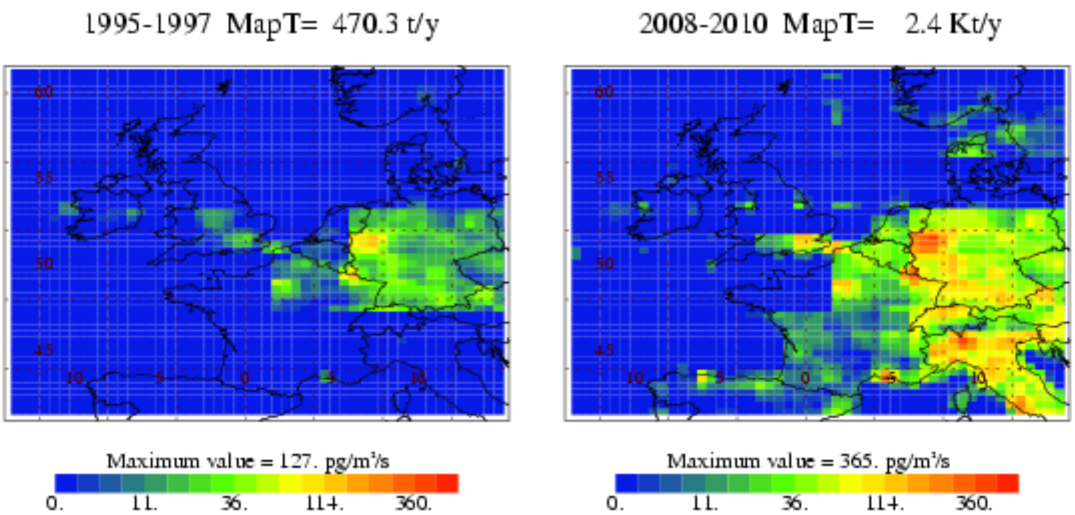


Figure 36: NAME-inversion emission estimates for 1995 -1997 (left) and 2008 – 2010 (right).

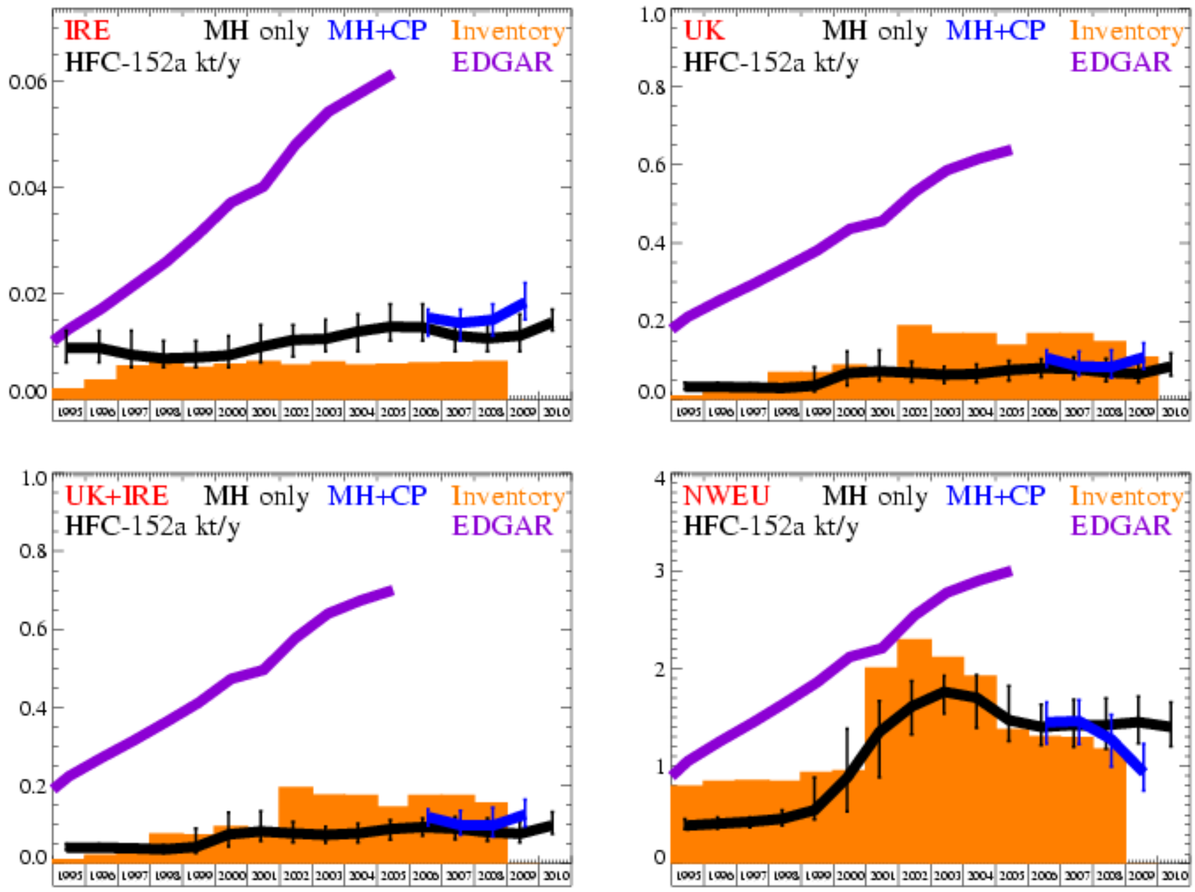


Figure 37: Emission estimates for IRE, UK, UK+IRE and NWEU (uncertainty 5th - 95th %iles).

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1995	9.7	(7.- 13.)	32.	(25.- 44.)	41.	(35.- 51.)	390.	(353.- 457.)	39
t/y	1996	9.7	(7.- 13.)	32.	(24.- 43.)	41.	(34.- 51.)	410.	(359.- 476.)	195
t/y	1997	8.4	(6.- 13.)	31.	(23.- 40.)	40.	(31.- 49.)	430.	(371.- 477.)	325
t/y	1998	7.7	(6.- 11.)	29.	(20.- 39.)	37.	(27.- 48.)	460.	(390.- 549.)	325
t/y	1999	7.9	(6.- 11.)	35.	(20.- 83.)	43.	(27.- 91.)	550.	(454.- 883.)	325
t/y	2000	8.3	(6.- 12.)	67.	(36.- 123.)	75.	(44.- 132.)	880.	(535.-1382.)	325
t/y	2001	9.9	(7.- 14.)	72.	(48.- 126.)	83.	(58.- 135.)	1350.	(884.-1669.)	325
t/y	2002	11.2	(8.- 14.)	68.	(45.- 97.)	78.	(55.- 108.)	1610.	(1325.-1873.)	325
t/y	2003	11.4	(9.- 15.)	63.	(41.- 84.)	74.	(53.- 95.)	1760.	(1538.-1926.)	325
t/y	2004	12.8	(9.- 16.)	65.	(43.- 90.)	78.	(55.- 103.)	1700.	(1390.-1933.)	325
t/y	2005	13.7	(11.- 18.)	75.	(48.- 99.)	89.	(61.- 112.)	1470.	(1256.-1821.)	325
t/y	2006	13.6	(11.- 18.)	80.	(57.- 103.)	94.	(72.- 117.)	1400.	(1216.-1632.)	325
t/y	2007	12.0	(9.- 15.)	78.	(51.- 108.)	90.	(62.- 120.)	1420.	(1194.-1682.)	325
t/y	2008	11.5	(9.- 15.)	69.	(46.- 104.)	81.	(58.- 117.)	1420.	(1173.-1695.)	325
t/y	2009	12.0	(9.- 16.)	65.	(44.- 97.)	77.	(55.- 109.)	1450.	(1232.-1713.)	169
t/y	2010	14.5	(13.- 17.)	84.	(60.- 118.)	98.	(76.- 133.)	1400.	(1199.-1655.)	13

Table 14: HFC-152a emission estimates for IRE, UK, IRE+UK and NWEU with uncertainty (5th – 95th percentile).

4.3.3.5 HFC-23

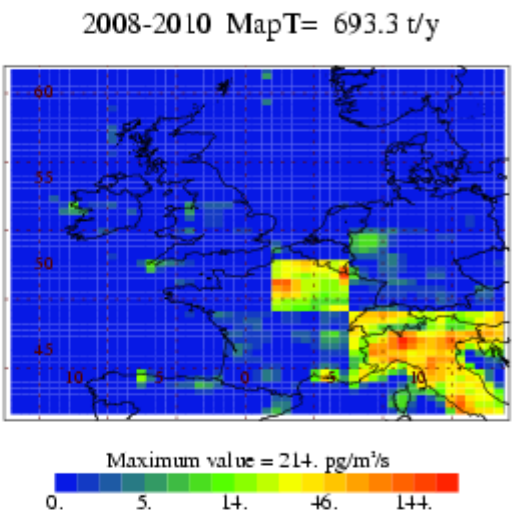


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Figure 38: NAME-inversion emission estimates for 2008 - 2010.

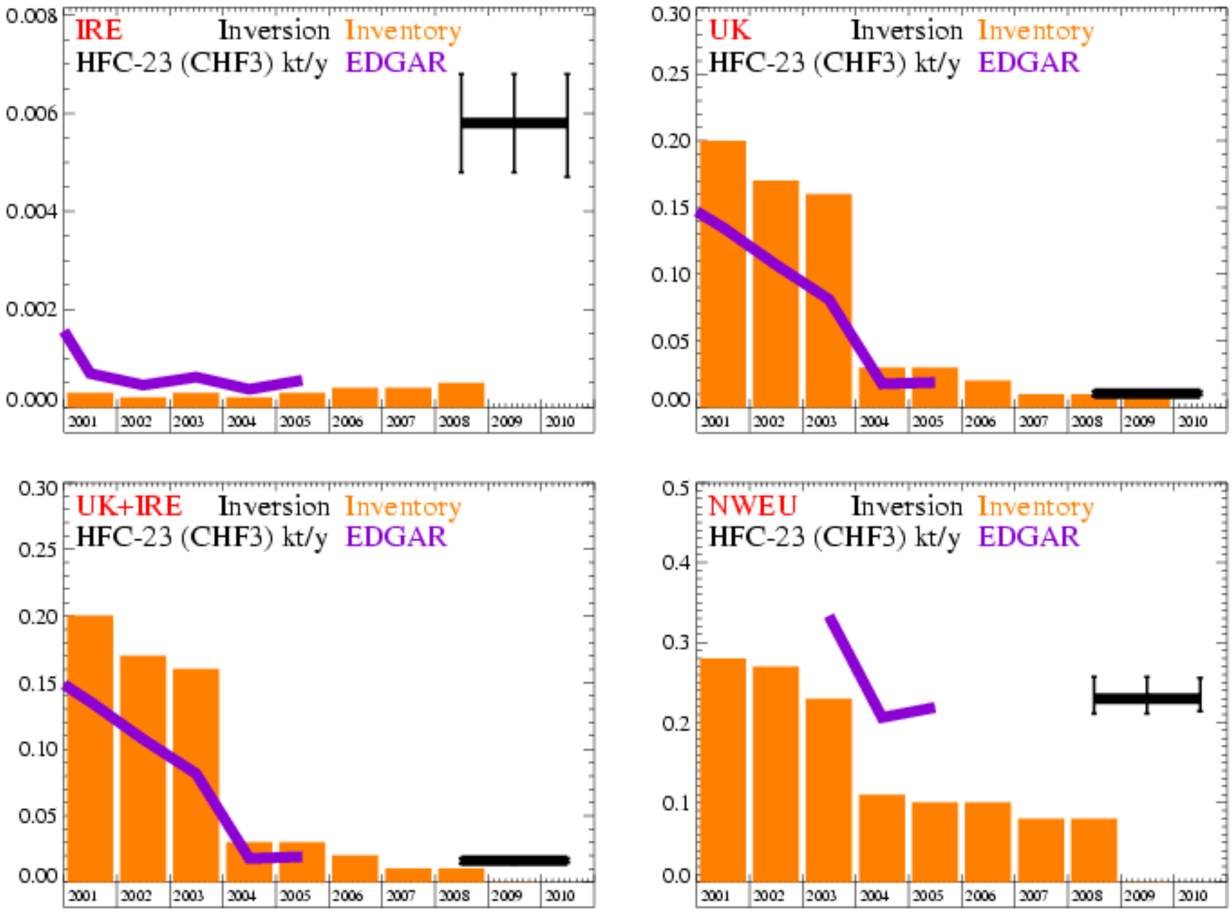

Figure 39: Emission estimates for IRE, UK and NWEU (uncertainty 5th - 95th percentiles).

Unit	Year	IRE (5th-95th)	UK (5th-95th)	UK+IRE (5th-95th)	NWEU (5th-95th)	Number
t/y	2008	5.8 (4.8- 6.8)	10.3 (8.3- 12.)	16.2 (14.- 18.)	230. (211.- 257.)	39
t/y	2009	5.8 (4.8- 6.8)	10.3 (8.3- 12.)	16.2 (14.- 18.)	230. (211.- 257.)	39
t/y	2010	5.8 (4.7- 6.8)	10.4 (9.3- 12.)	16.3 (15.- 18.)	230. (214.- 256.)	13

Table 15: HFC-23 emission estimates for UK and NWEU with uncertainty (5th – 95th percentile).

4.3.3.6 HFC-32

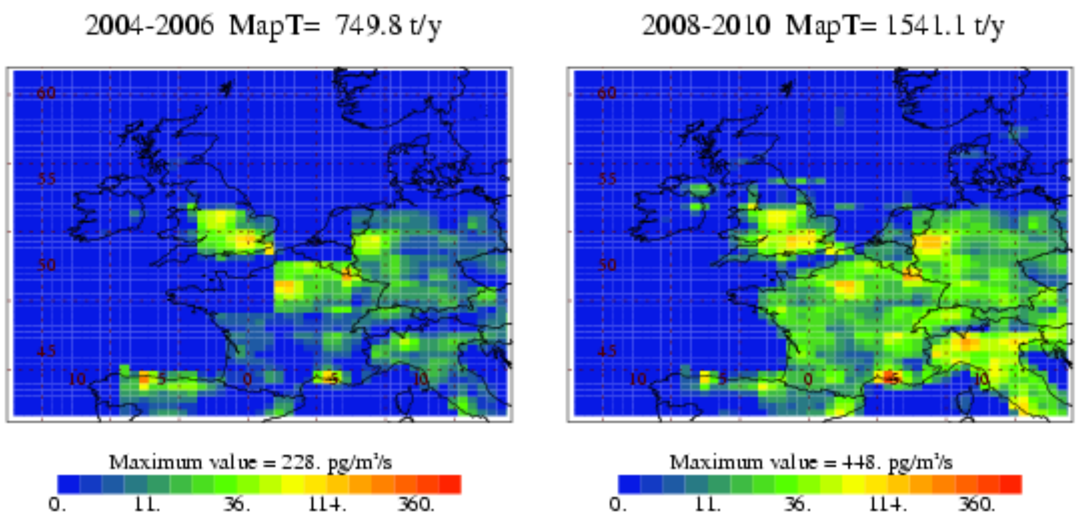

Figure 40: NAME-inversion emission estimates for 2004 - 2006 (left) and 2008 – 2010 (right).

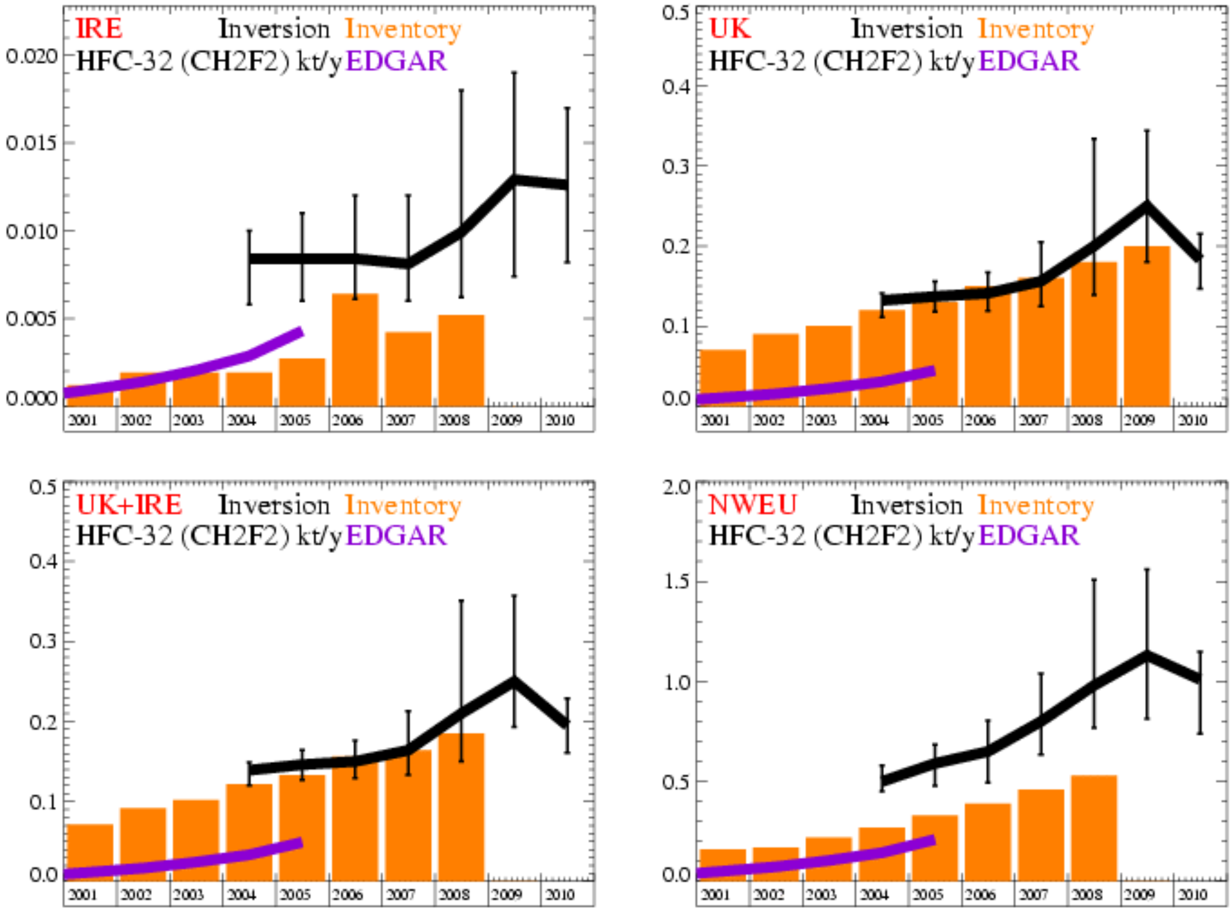

Figure 41: Emission estimates for IRE, UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE (5th-95th)		UK (5th-95th)		UK+IRE (5th-95th)		NWEU (5th-95th)		Number
t/y	2004	8.4	(5.8- 10.)	132.	(111.- 141.)	139.	(120.- 149.)	500.	(450.- 580.)	13
t/y	2005	8.4	(6.0- 11.)	137.	(118.- 156.)	146.	(127.- 164.)	590.	(479.- 685.)	169
t/y	2006	8.4	(6.1- 12.)	141.	(119.- 167.)	150.	(129.- 176.)	650.	(493.- 805.)	325
t/y	2007	8.1	(6.0- 12.)	156.	(125.- 205.)	164.	(133.- 213.)	800.	(634.-1039.)	325
t/y	2008	9.9	(6.2- 18.)	200.	(139.- 334.)	210.	(150.- 351.)	980.	(768.-1509.)	325
t/y	2009	12.9	(7.4- 19.)	250.	(180.- 344.)	250.	(193.- 357.)	1130.	(814.-1561.)	169
t/y	2010	12.6	(8.2- 17.)	183.	(147.- 215.)	195.	(161.- 229.)	1010.	(739.-1149.)	13

Table 16: HFC-32 emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th %iles).

4.3.3.7 HFC-365mfc

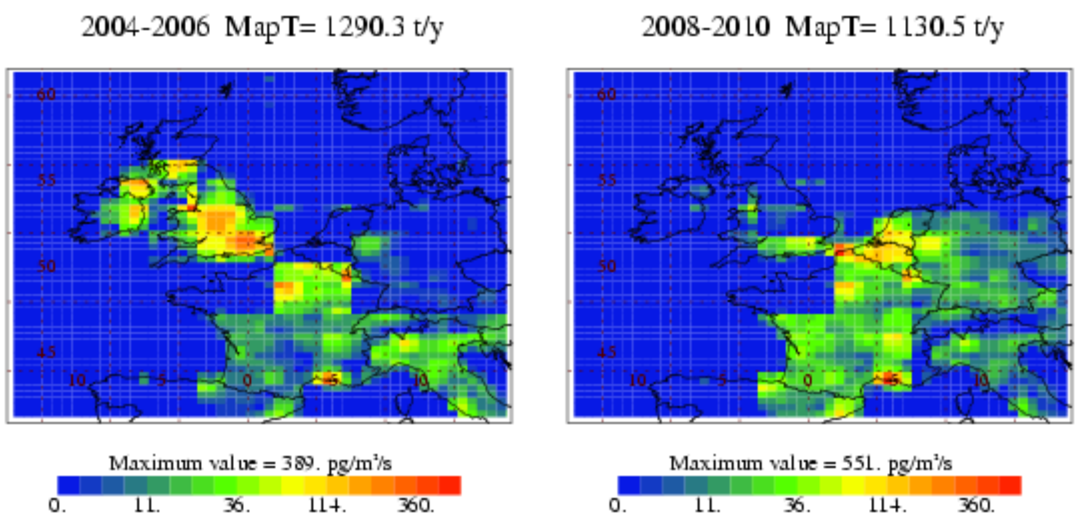

Figure 42: NAME-inversion emission estimates for 2004 – 2006 (left) and 2008 – 2010 (right).

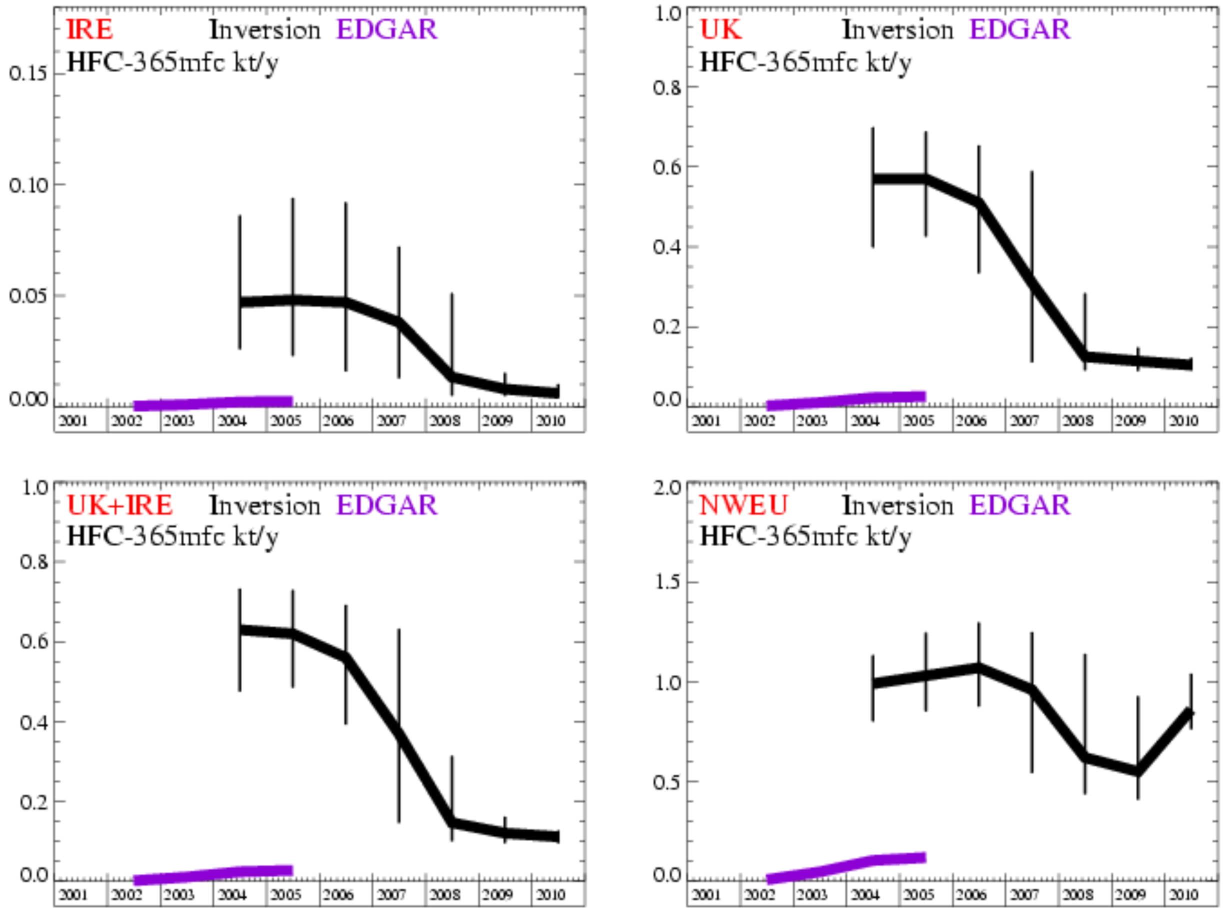

Figure 43: Emission estimates for IRE, UK and NWEU (uncertainty 5th - 95th %iles).

Unit	Year	IRE (5th-95th)	UK (5th-95th)	UK+IRE (5th-95th)	NWEU (5th-95th)	Number
t/y	2004	47. (26.- 86.)	570. (399.- 699.)	630. (476.- 732.)	990. (802.-1132.)	130
t/y	2005	48. (23.- 94.)	570. (426.- 688.)	620. (486.- 729.)	1030. (853.-1246.)	286
t/y	2006	47. (16.- 92.)	510. (335.- 653.)	560. (393.- 691.)	1070. (877.-1295.)	325
t/y	2007	38. (13.- 72.)	310. (112.- 589.)	370. (148.- 632.)	960. (544.-1247.)	325
t/y	2008	13.3 (5.- 51.)	125. (91.- 283.)	147. (101.- 313.)	620. (438.-1138.)	325
t/y	2009	7.9 (5.- 15.)	114. (90.- 147.)	121. (97.- 162.)	550. (411.- 927.)	169
t/y	2010	6.0 (4.- 10.)	104. (91.- 121.)	112. (97.- 127.)	860. (763.-1038.)	13

Table 17: HFC-365mfc emission estimates for IRE, UK and NWEU (uncertainty 5th – 95th %iles).

4.3.4 PFC

4.3.4.1 PFC-14

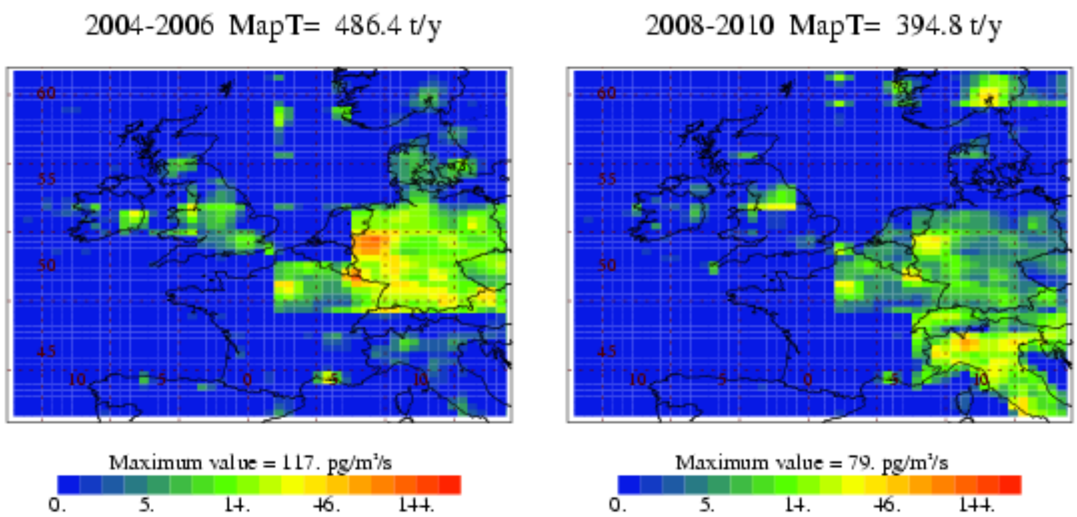

Figure 44: NAME-inversion emission estimates for 2004 -2006 (left) and 2008 -2010 (right).

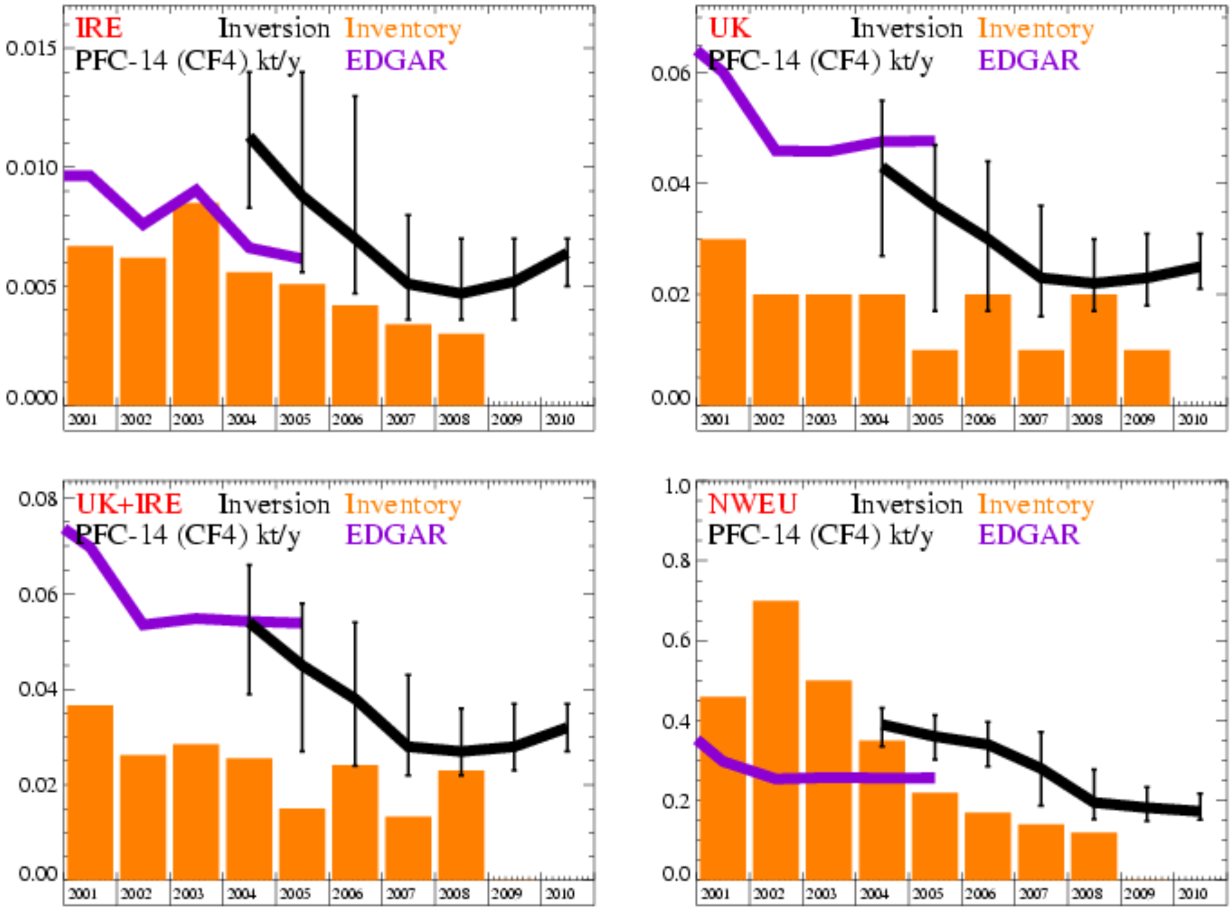

Figure 45: Emission estimates for IRE, UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	2004	11.3	(8.3- 14.)	43.	(27.- 55.)	54.	(39.- 66.)	390.	(335.- 431.)	26
t/y	2005	8.8	(5.6- 14.)	36.	(17.- 47.)	45.	(27.- 58.)	360.	(302.- 413.)	182
t/y	2006	7.0	(4.7- 13.)	30.	(17.- 44.)	38.	(24.- 54.)	340.	(286.- 397.)	325
t/y	2007	5.1	(3.6- 8.)	23.	(16.- 36.)	28.	(22.- 43.)	280.	(187.- 372.)	325
t/y	2008	4.7	(3.6- 7.)	22.	(17.- 30.)	27.	(22.- 36.)	195.	(153.- 277.)	325
t/y	2009	5.2	(3.6- 7.)	23.	(18.- 31.)	28.	(23.- 37.)	182.	(149.- 233.)	169
t/y	2010	6.4	(5.0- 7.)	25.	(21.- 31.)	32.	(27.- 37.)	173.	(152.- 218.)	13

Table 18: PFC-14 emission estimates for IRE, UK and NWEU (uncertainty: 5th – 95th percentile).

4.3.4.2 PFC-116

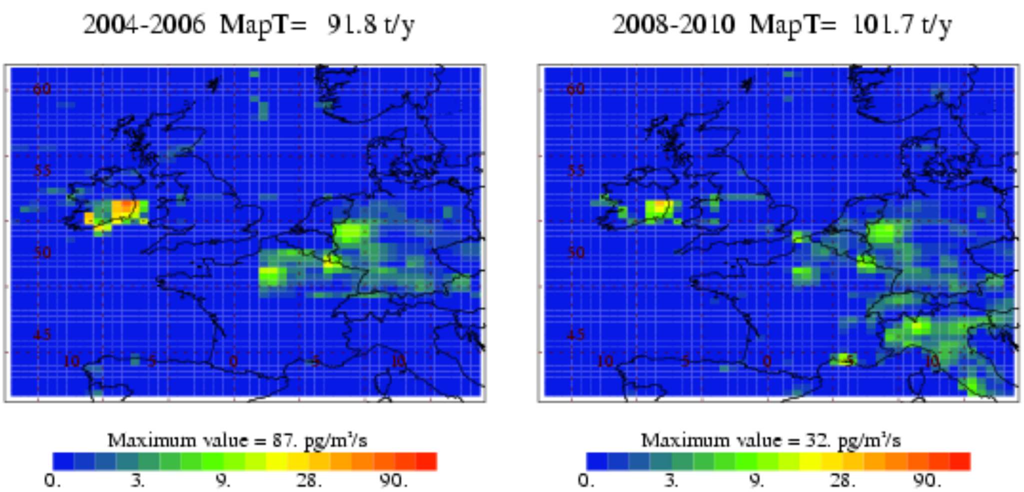

Figure 46: NAME-inversion emission estimates for 2004 -2006 (left) and 2008 – 2010 (right).

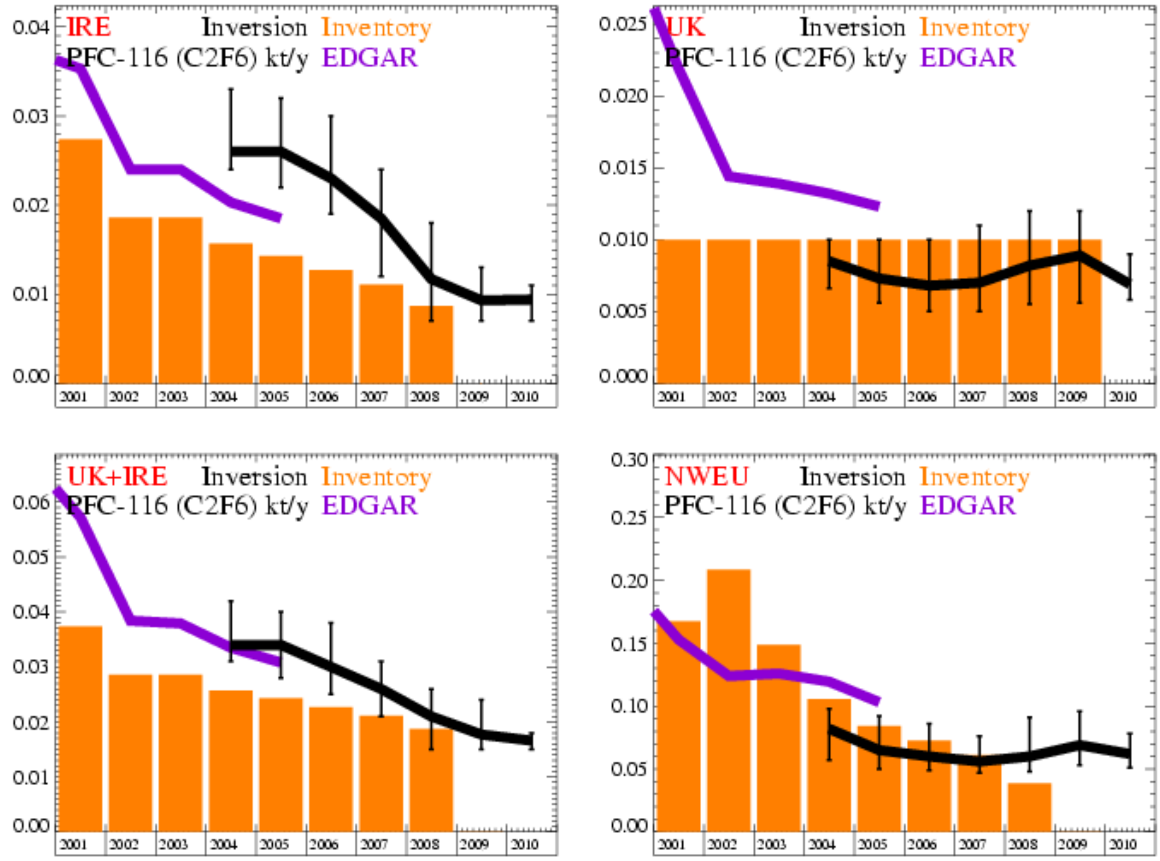

Figure 47: Emission estimates for IRE, UK and NWEU (uncertainty: 5th and 95th percentiles).

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	2004	26.	(24.- 33.)	8.5	(6.6- 10.)	34.	(31.- 42.)	82.	(57.- 98.)	26
t/y	2005	26.	(22.- 32.)	7.3	(5.6- 10.)	34.	(28.- 40.)	65.	(50.- 92.)	182
t/y	2006	23.	(19.- 30.)	6.8	(5.0- 10.)	30.	(25.- 38.)	60.	(49.- 86.)	325
t/y	2007	18.5	(12.- 24.)	7.0	(5.0- 11.)	26.	(21.- 31.)	56.	(47.- 76.)	325
t/y	2008	11.7	(7.- 18.)	8.2	(5.5- 12.)	21.	(15.- 26.)	60.	(48.- 91.)	325
t/y	2009	9.3	(7.- 13.)	8.9	(5.6- 12.)	18.	(15.- 24.)	69.	(53.- 96.)	169
t/y	2010	9.4	(7.- 11.)	6.9	(5.8- 9.)	17.	(15.- 18.)	62.	(51.- 78.)	13

Table 19: PFC-116 emission estimates for UK and NWEU with uncertainty (5th – 95th percentile).

4.3.4.3 PFC-218

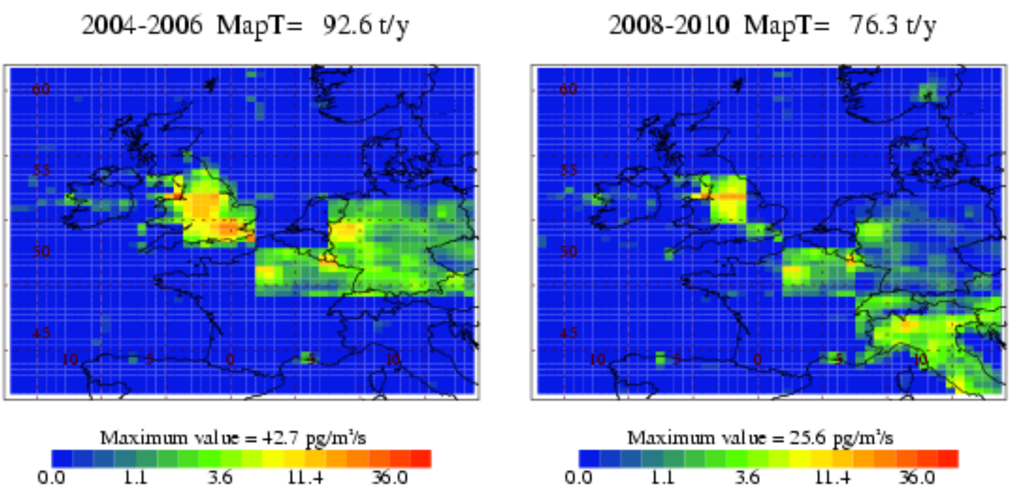

Figure 48: NAME-inversion emission estimates for 2004 – 2006 (left) and 2008 – 2010 (right).

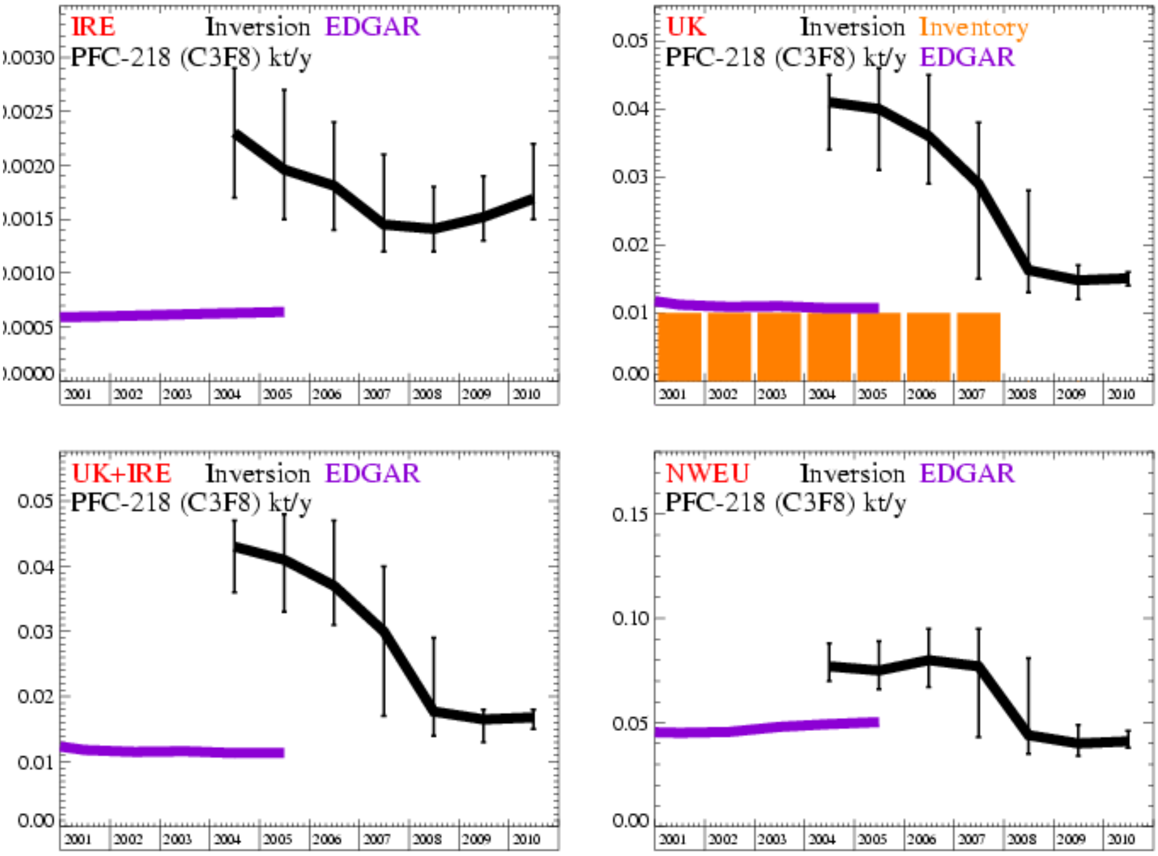

Figure 49: Emission estimates for IRE, UK and NWEU (uncertainty: 5th and 95th percentiles).

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	2004	2.3	(1.7- 2.9)	41.	(34.- 45.)	43.	(36.- 47.)	77.	(70.- 88.)	26
t/y	2005	1.96	(1.5- 2.7)	40.	(31.- 46.)	41.	(33.- 48.)	75.	(66.- 89.)	182
t/y	2006	1.81	(1.4- 2.4)	36.	(29.- 45.)	37.	(31.- 47.)	80.	(67.- 95.)	325
t/y	2007	1.45	(1.2- 2.1)	29.	(15.- 38.)	30.	(17.- 40.)	77.	(43.- 95.)	325
t/y	2008	1.41	(1.2- 1.8)	16.	(13.- 28.)	18.	(14.- 29.)	44.	(35.- 81.)	325
t/y	2009	1.52	(1.3- 1.9)	15.	(12.- 17.)	17.	(13.- 18.)	40.	(34.- 49.)	169
t/y	2010	1.69	(1.5- 2.2)	15.	(14.- 16.)	17.	(15.- 18.)	41.	(38.- 46.)	13

Table 20: PFC-218 emission estimates for IRE, UK and NWEU (uncertainty 5th – 95th percentile).

4.3.4.4 SF_6

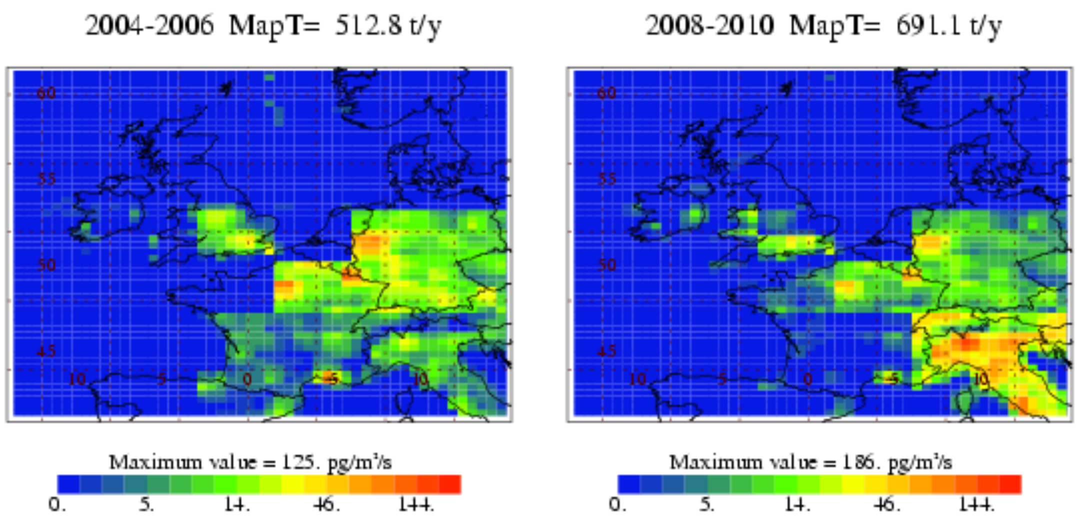

Figure 50: NAME-inversion emission estimates for 2004 -2006 (left) and 2008 – 2010 (right).

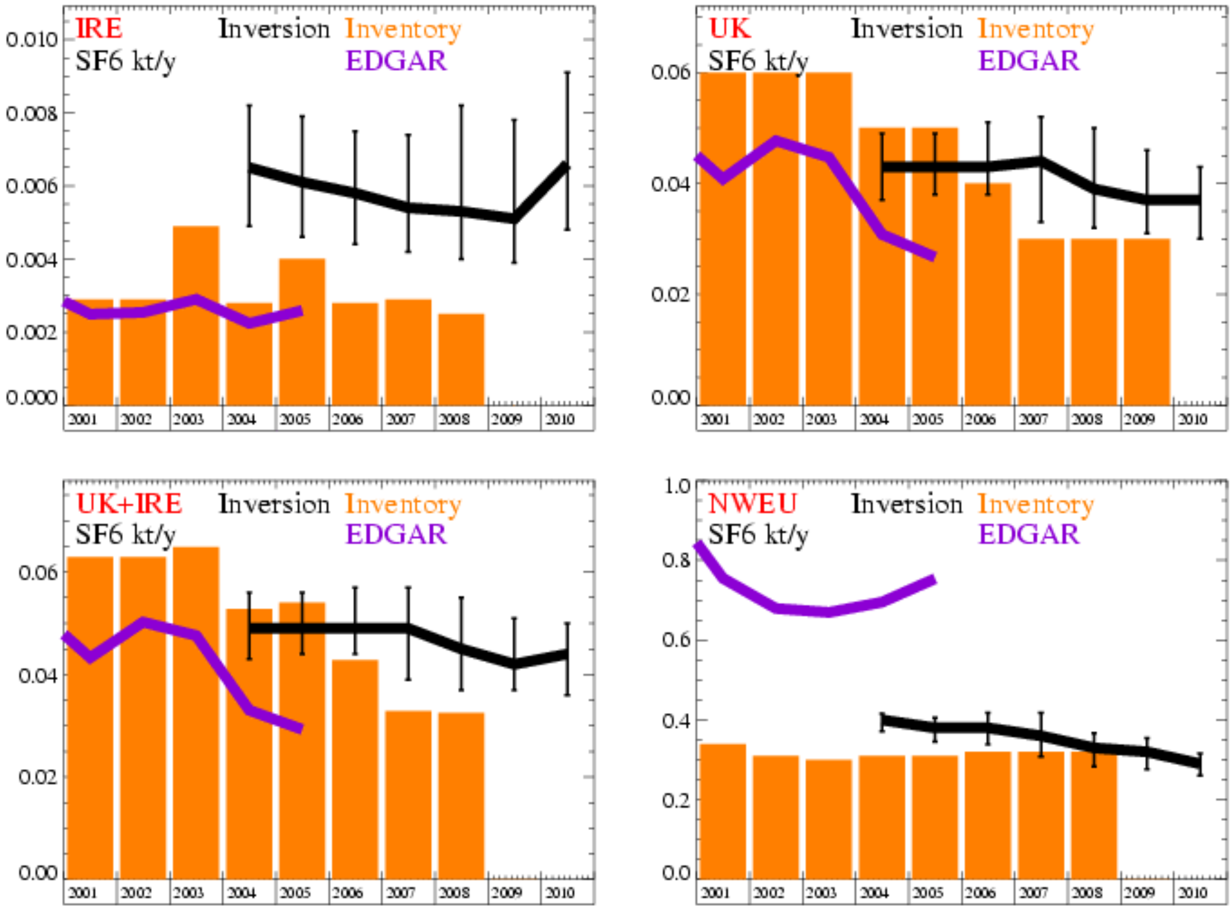

Figure 51: Emission estimates for UK (left) and NWEU (right). The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE (5th-95th)	UK (5th-95th)	UK+IRE (5th-95th)	NWEU (5th-95th)	Number
t/y	2004	6.5 (4.9- 8.2)	43. (37.- 49.)	49. (43.- 56.)	400. (371.- 416.)	26
t/y	2005	6.1 (4.6- 7.9)	43. (38.- 49.)	49. (44.- 56.)	380. (346.- 405.)	182
t/y	2006	5.8 (4.4- 7.5)	43. (38.- 51.)	49. (44.- 57.)	380. (339.- 418.)	325
t/y	2007	5.4 (4.2- 7.4)	44. (33.- 52.)	49. (39.- 57.)	360. (308.- 418.)	325
t/y	2008	5.3 (4.0- 8.2)	39. (32.- 50.)	45. (37.- 55.)	330. (283.- 367.)	325
t/y	2009	5.1 (3.9- 7.8)	37. (31.- 46.)	42. (37.- 51.)	320. (276.- 355.)	169
t/y	2010	6.6 (4.8- 9.1)	37. (30.- 43.)	44. (36.- 50.)	290. (261.- 316.)	13

Table 21: SF_6 emission estimates for UK and NWEU with uncertainty (5th – 95th percentile).

4.3.5 Chlorine compounds

4.3.5.1 CH_3Cl

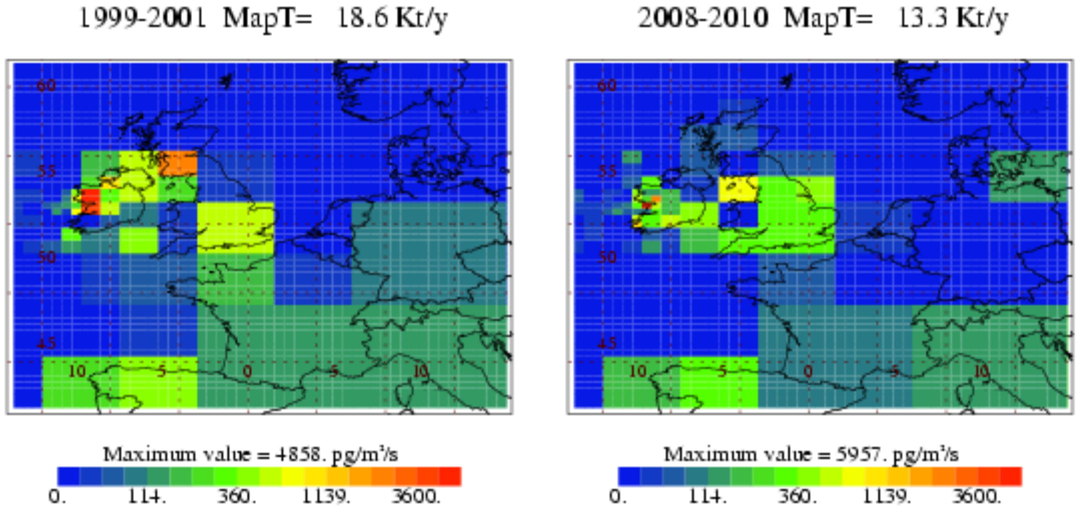

Figure 52: NAME-inversion emission estimates for 1999 - 2001 (left) and 2008 – 2010 (right).

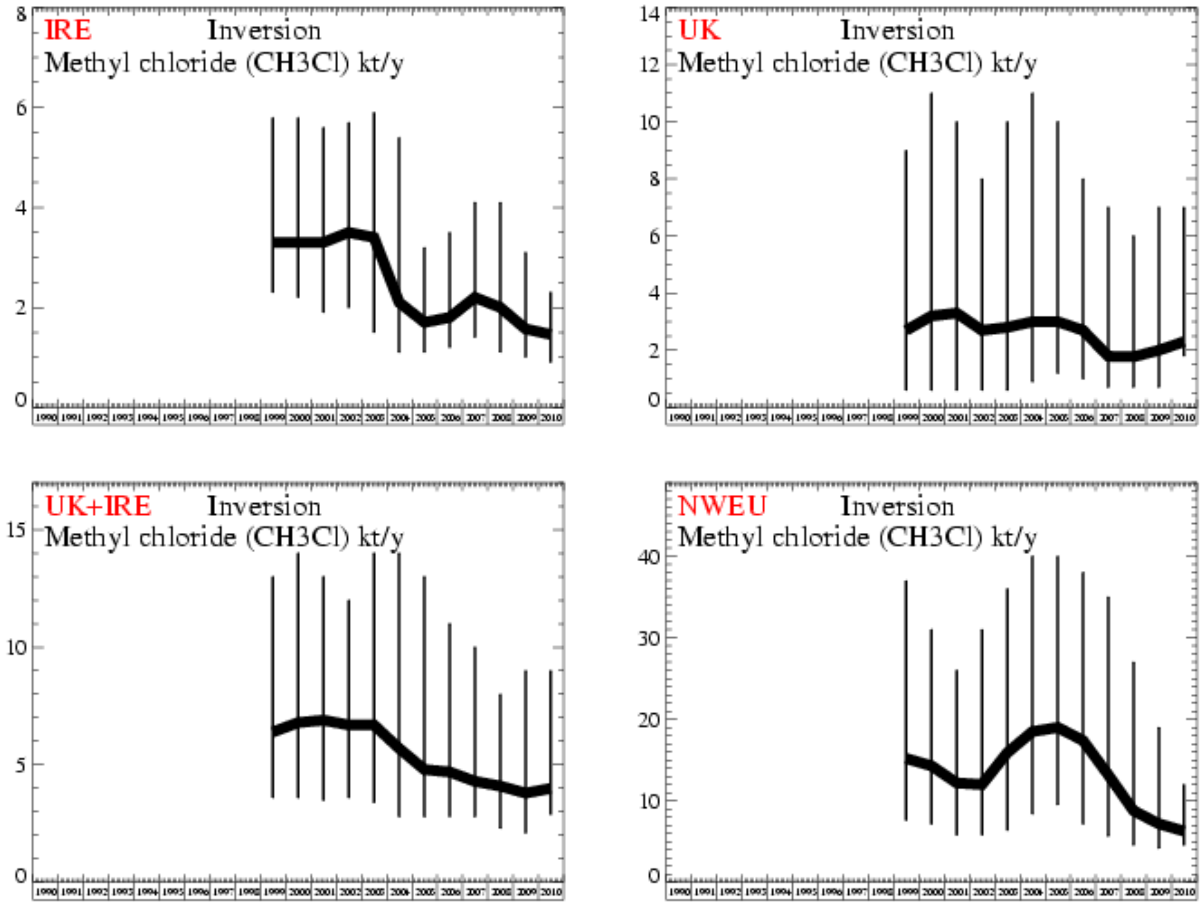

Figure 53: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	1999	3.3	(2.3- 5.8)	2.7	(0.6- 9.)	6.4	(3.6- 13.)	15.2	(7.6- 37.)	156
kt/y	2000	3.3	(2.2- 5.8)	3.2	(0.6- 11.)	6.8	(3.6- 14.)	14.3	(7.1- 31.)	312
kt/y	2001	3.3	(1.9- 5.6)	3.3	(0.6- 10.)	6.9	(3.5- 13.)	12.2	(5.8- 26.)	325
kt/y	2002	3.5	(2.0- 5.7)	2.7	(0.6- 8.)	6.7	(3.6- 12.)	12.0	(5.8- 31.)	325
kt/y	2003	3.4	(1.5- 5.9)	2.8	(0.6- 10.)	6.7	(3.4- 14.)	15.9	(6.4- 36.)	325
kt/y	2004	2.1	(1.1- 5.4)	3.0	(0.9- 11.)	5.7	(2.8- 14.)	18.5	(8.4- 40.)	325
kt/y	2005	1.7	(1.1- 3.2)	3.0	(1.2- 10.)	4.8	(2.8- 13.)	19.0	(9.5- 40.)	325
kt/y	2006	1.8	(1.2- 3.5)	2.7	(1.0- 8.)	4.7	(2.8- 11.)	17.4	(7.2- 38.)	325
kt/y	2007	2.2	(1.4- 4.1)	1.8	(0.7- 7.)	4.3	(2.8- 10.)	13.2	(5.7- 35.)	325
kt/y	2008	2.0	(1.1- 4.1)	1.8	(0.7- 6.)	4.1	(2.3- 8.)	8.8	(4.6- 27.)	325
kt/y	2009	1.6	(1.0- 3.1)	2.0	(0.7- 7.)	3.8	(2.1- 9.)	7.2	(4.2- 19.)	169
kt/y	2010	1.5	(0.9- 2.3)	2.3	(1.8- 7.)	4.0	(2.9- 9.)	6.3	(4.6- 12.)	13

Table 22: CH_3Cl emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5^{th} – 95^{th} percentile).

4.3.5.2 CH_2Cl_2

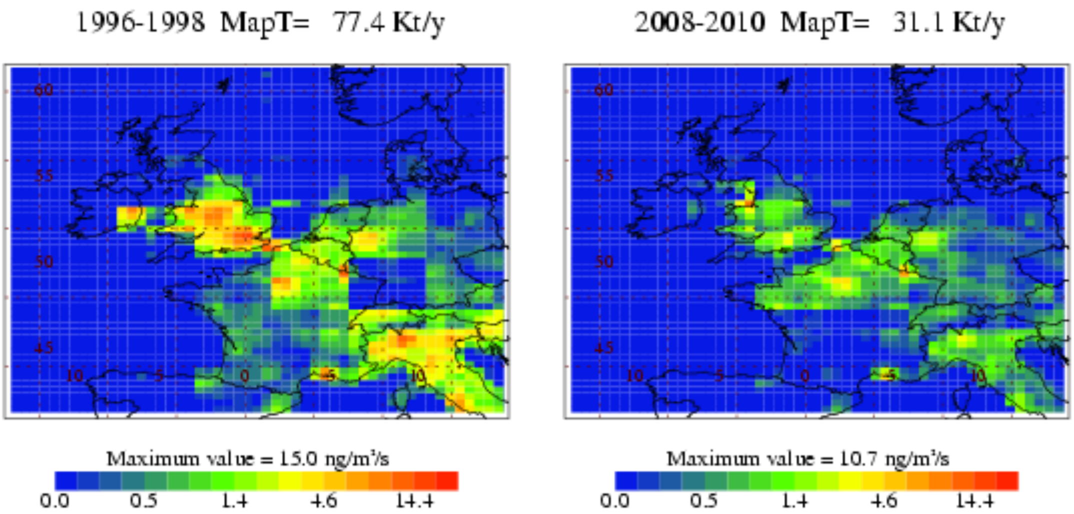

Figure 54: NAME-inversion emission estimates for 1996 -1998 (left) and 2008 – 2010 (right).

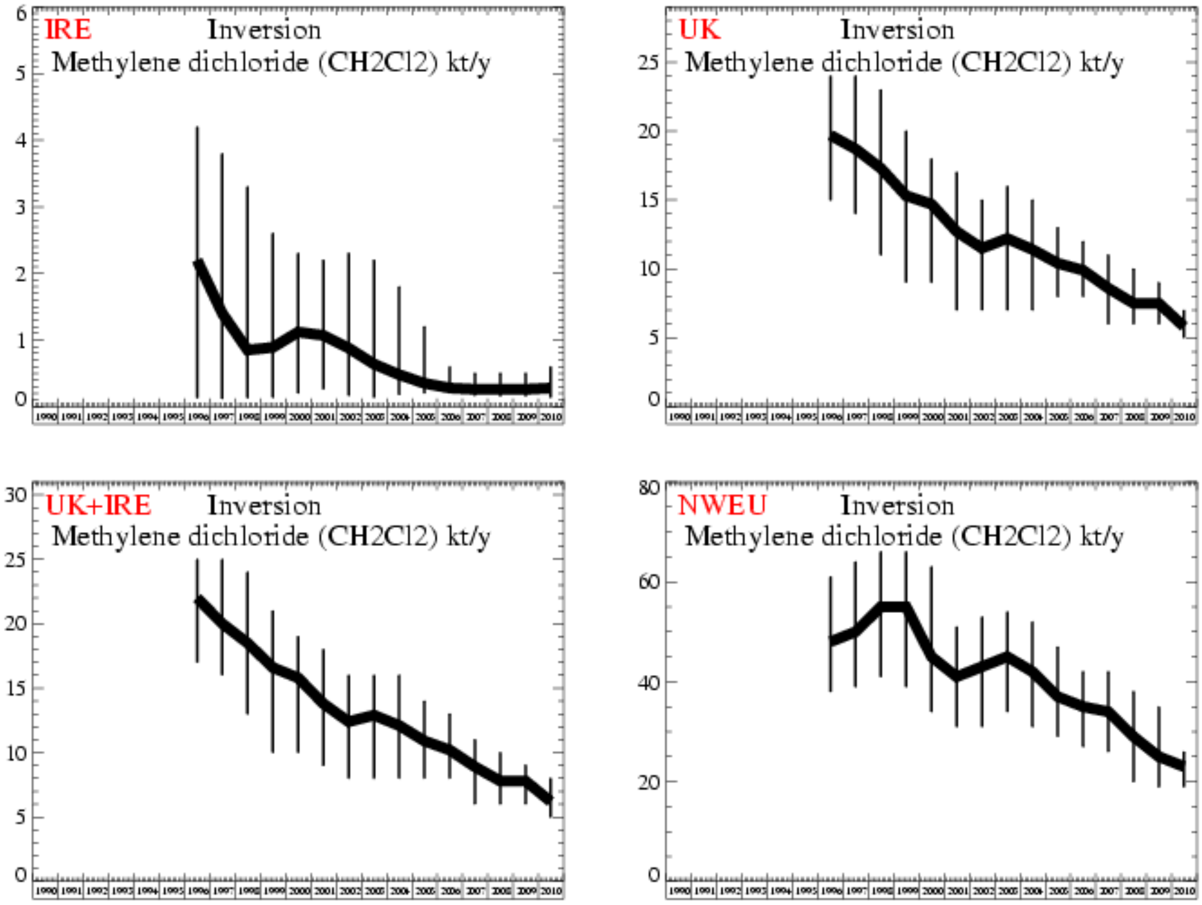

Figure 55: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5^{th} and 95^{th} percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	1996	2.20	(0.13- 4.2)	19.7	(15.- 24.)	22.	(17.- 25.)	48.	(38.- 61.)	130
kt/y	1997	1.40	(0.12- 3.8)	18.7	(14.- 24.)	20.	(16.- 25.)	50.	(39.- 64.)	286
kt/y	1998	0.85	(0.13- 3.3)	17.3	(11.- 23.)	18.5	(13.- 24.)	55.	(41.- 66.)	325
kt/y	1999	0.89	(0.14- 2.6)	15.3	(9.- 20.)	16.6	(10.- 21.)	55.	(39.- 66.)	325
kt/y	2000	1.12	(0.20- 2.3)	14.7	(9.- 18.)	15.8	(10.- 19.)	45.	(34.- 63.)	325
kt/y	2001	1.07	(0.26- 2.2)	12.7	(7.- 17.)	13.8	(9.- 18.)	41.	(31.- 51.)	325
kt/y	2002	0.88	(0.17- 2.3)	11.5	(7.- 15.)	12.4	(8.- 16.)	43.	(31.- 53.)	325
kt/y	2003	0.64	(0.14- 2.2)	12.2	(7.- 16.)	12.9	(8.- 16.)	45.	(34.- 54.)	325
kt/y	2004	0.48	(0.18- 1.8)	11.4	(7.- 15.)	12.1	(8.- 16.)	42.	(31.- 52.)	325
kt/y	2005	0.35	(0.20- 1.2)	10.4	(8.- 13.)	10.9	(8.- 14.)	37.	(29.- 47.)	325
kt/y	2006	0.28	(0.20- 0.6)	9.9	(8.- 12.)	10.2	(8.- 13.)	35.	(27.- 42.)	325
kt/y	2007	0.26	(0.17- 0.5)	8.6	(6.- 11.)	8.9	(6.- 11.)	34.	(26.- 42.)	325
kt/y	2008	0.26	(0.16- 0.5)	7.5	(6.- 10.)	7.8	(6.- 10.)	29.	(20.- 38.)	325
kt/y	2009	0.26	(0.16- 0.5)	7.5	(6.- 9.)	7.8	(6.- 9.)	25.	(19.- 35.)	169
kt/y	2010	0.28	(0.14- 0.6)	5.8	(5.- 7.)	6.2	(5.- 8.)	23.	(19.- 26.)	13

Table 23: CH_2Cl_2 emission estimates for IRE, UK, NWEU and NWEU with uncertainty (5^{th} – 95^{th} percentile).

4.3.5.3 $CHCl_3$ (chloroform)

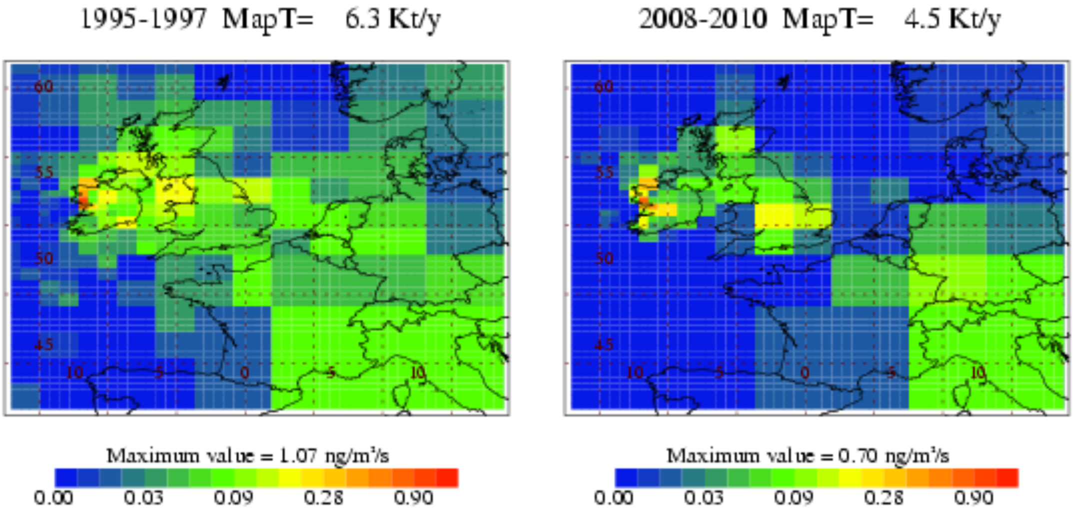

Figure 56: NAME-inversion emission estimates for 1995 -1997 (left) and 2008 – 2010 (right).

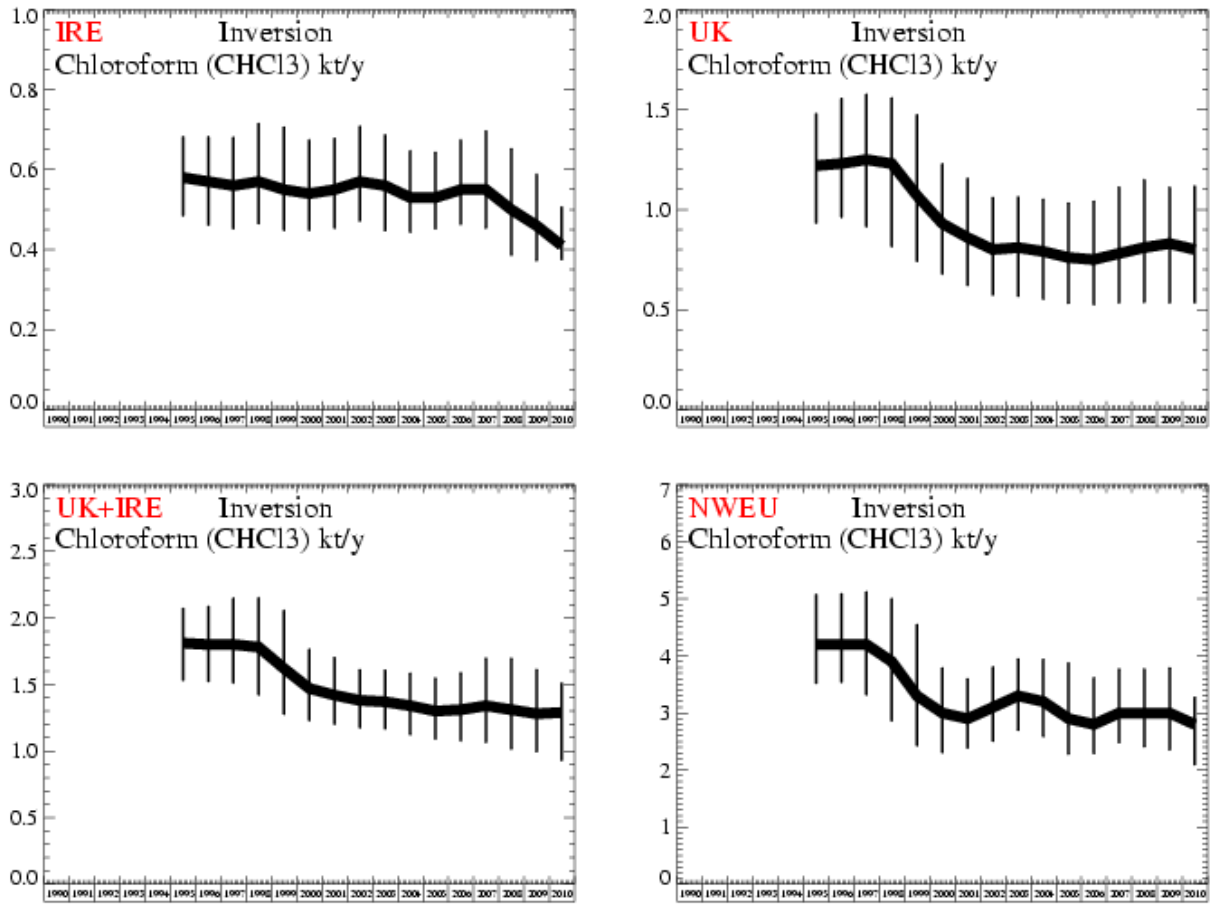

Figure 57: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1995	580.	(484.- 683.)	1220.	(932.-1480.)	1810.	(1530.-2073.)	4200.	(3516.-5076.)	143
t/y	1996	570.	(460.- 683.)	1230.	(960.-1557.)	1800.	(1519.-2088.)	4200.	(3534.-5096.)	299
t/y	1997	560.	(451.- 681.)	1250.	(913.-1578.)	1800.	(1509.-2148.)	4200.	(3316.-5126.)	325
t/y	1998	570.	(464.- 716.)	1230.	(814.-1560.)	1780.	(1420.-2154.)	3900.	(2853.-5003.)	325
t/y	1999	550.	(448.- 707.)	1070.	(739.-1476.)	1620.	(1274.-2059.)	3300.	(2426.-4557.)	325
t/y	2000	540.	(448.- 675.)	930.	(675.-1230.)	1470.	(1228.-1765.)	3000.	(2305.-3793.)	325
t/y	2001	550.	(453.- 679.)	860.	(619.-1156.)	1420.	(1199.-1703.)	2900.	(2385.-3603.)	325
t/y	2002	570.	(471.- 709.)	800.	(572.-1062.)	1380.	(1174.-1611.)	3100.	(2503.-3814.)	325
t/y	2003	560.	(447.- 687.)	810.	(565.-1064.)	1370.	(1165.-1610.)	3300.	(2693.-3952.)	325
t/y	2004	530.	(443.- 648.)	790.	(551.-1052.)	1340.	(1123.-1587.)	3200.	(2583.-3942.)	325
t/y	2005	530.	(451.- 644.)	760.	(529.-1035.)	1300.	(1088.-1547.)	2900.	(2275.-3883.)	325
t/y	2006	550.	(462.- 675.)	750.	(525.-1043.)	1310.	(1073.-1590.)	2800.	(2287.-3617.)	325
t/y	2007	550.	(453.- 697.)	780.	(534.-1114.)	1340.	(1066.-1697.)	3000.	(2474.-3774.)	325
t/y	2008	500.	(386.- 653.)	810.	(535.-1150.)	1310.	(1015.-1698.)	3000.	(2405.-3773.)	325
t/y	2009	460.	(372.- 589.)	830.	(534.-1112.)	1280.	(994.-1614.)	3000.	(2351.-3793.)	169
t/y	2010	410.	(374.- 507.)	800.	(534.-1118.)	1290.	(928.-1510.)	2800.	(2091.-3277.)	13

Table 24: $CHCl_3$ emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5^{th} – 95^{th} percentile).

4.3.5.4 CCl_4 (carbon tetrachloride)

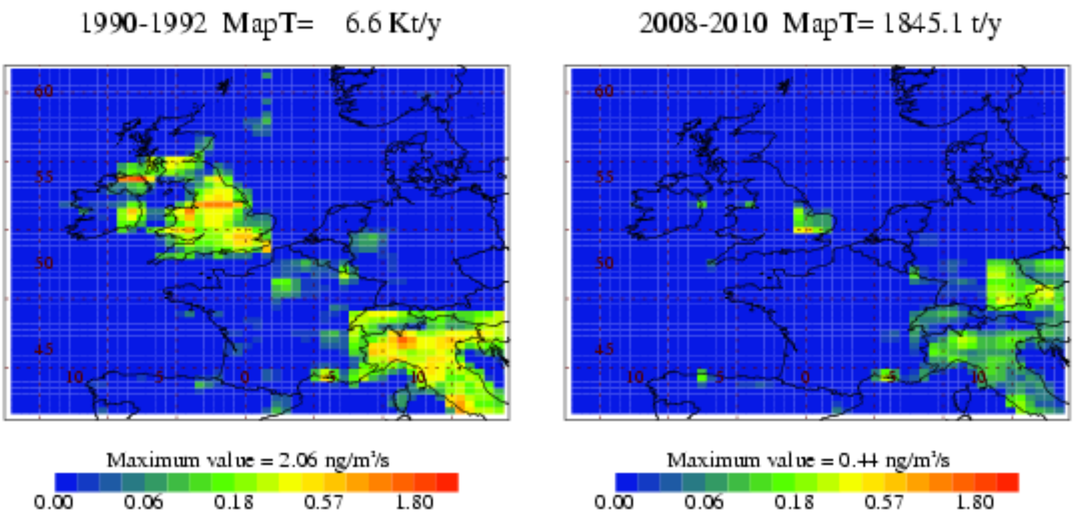

Figure 58: NAME-inversion emission estimates for 1990 -1992 (left) and 2008 -2010 (right).

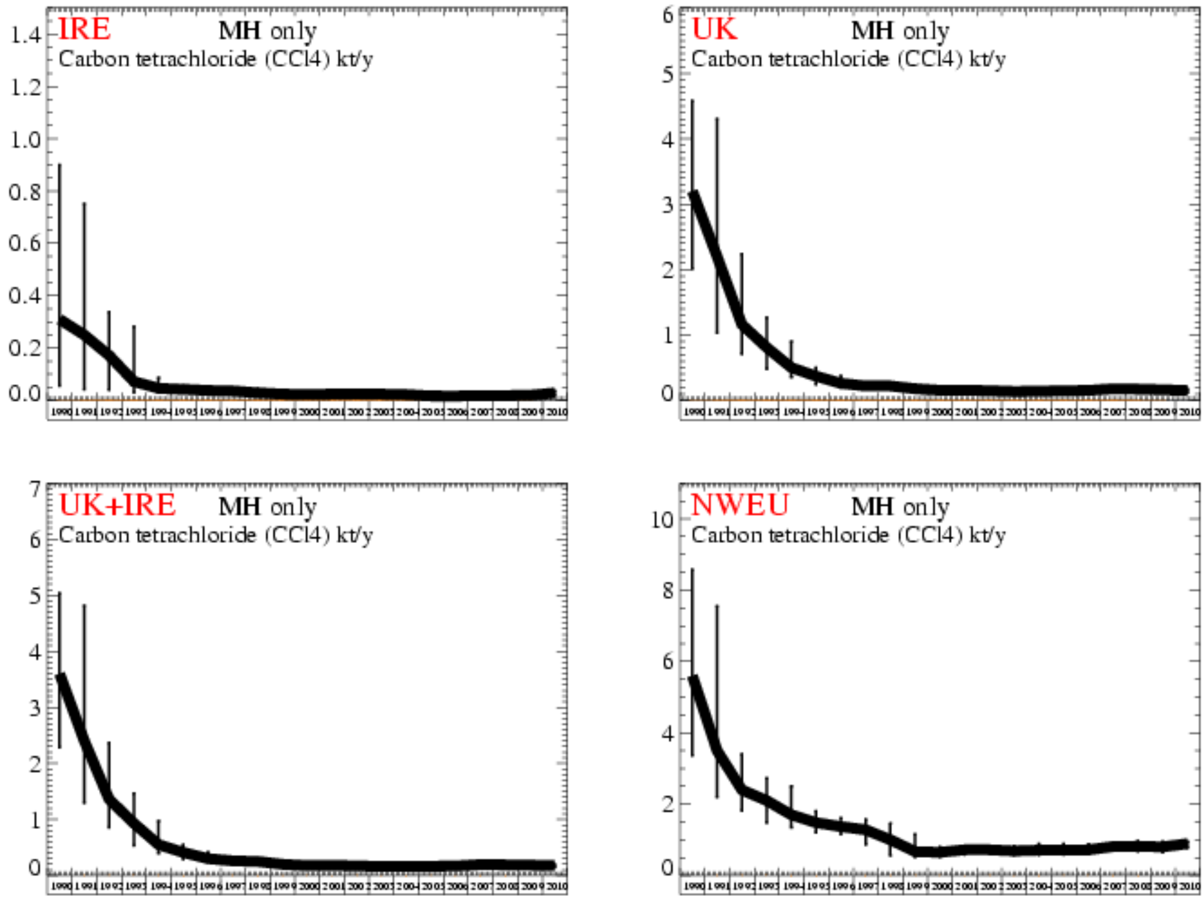

Figure 59: Emission estimates for UK (left) and NWEU (right). The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1990	310.	(56.- 900.)	3200.	(2009.-4581.)	3600.	(2289.-5038.)	5600.	(3367.-8577.)	132
t/y	1991	250.	(42.- 752.)	2200.	(1034.-4304.)	2400.	(1293.-4817.)	3500.	(2200.-7556.)	264
t/y	1992	172.	(40.- 338.)	1160.	(708.-2240.)	1360.	(857.-2369.)	2400.	(1816.-3408.)	275
t/y	1993	72.	(30.- 283.)	810.	(479.-1269.)	930.	(535.-1466.)	2100.	(1475.-2736.)	275
t/y	1994	46.	(30.- 87.)	500.	(358.- 901.)	550.	(398.- 972.)	1700.	(1345.-2507.)	275
t/y	1995	42.	(32.- 55.)	370.	(246.- 500.)	410.	(289.- 546.)	1480.	(1203.-1810.)	275
t/y	1996	38.	(31.- 51.)	260.	(199.- 378.)	300.	(240.- 421.)	1370.	(1157.-1615.)	275
t/y	1997	36.	(27.- 48.)	220.	(184.- 270.)	260.	(220.- 308.)	1280.	(865.-1579.)	275
t/y	1998	29.	(20.- 43.)	220.	(173.- 265.)	250.	(198.- 297.)	1000.	(555.-1461.)	275
t/y	1999	24.	(18.- 33.)	178.	(132.- 244.)	200.	(155.- 271.)	670.	(511.-1156.)	275
t/y	2000	23.	(18.- 30.)	154.	(127.- 199.)	177.	(152.- 221.)	650.	(522.- 804.)	275
t/y	2001	24.	(18.- 31.)	155.	(131.- 192.)	179.	(154.- 217.)	720.	(587.- 821.)	275
t/y	2002	25.	(19.- 31.)	148.	(122.- 185.)	172.	(144.- 211.)	720.	(609.- 815.)	275
t/y	2003	24.	(19.- 30.)	135.	(102.- 162.)	160.	(127.- 192.)	690.	(575.- 820.)	275
t/y	2004	22.	(14.- 29.)	140.	(103.- 176.)	162.	(127.- 194.)	710.	(576.- 893.)	275
t/y	2005	17.	(13.- 23.)	148.	(120.- 176.)	165.	(141.- 194.)	710.	(588.- 893.)	275
t/y	2006	17.	(13.- 22.)	152.	(129.- 191.)	169.	(144.- 210.)	720.	(596.- 881.)	275
t/y	2007	18.	(14.- 23.)	177.	(140.- 208.)	194.	(158.- 227.)	810.	(696.- 926.)	275
t/y	2008	18.	(14.- 28.)	171.	(133.- 209.)	191.	(156.- 227.)	820.	(671.- 960.)	291
t/y	2009	19.	(14.- 30.)	162.	(122.- 203.)	184.	(148.- 218.)	800.	(652.- 959.)	159
t/y	2010	28.	(20.- 36.)	151.	(117.- 174.)	177.	(144.- 198.)	890.	(777.- 958.)	13

Table 25: CCl_4 emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5th – 95th percentile).

4.3.5.5 CH_3CCl_3 (methyl chloroform)

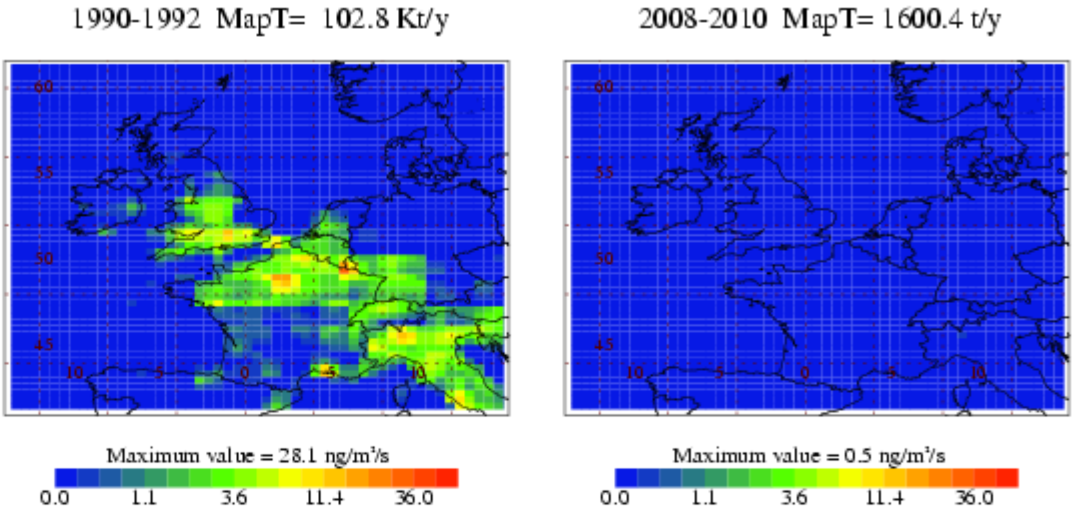

Figure 60: NAME-inversion emission estimates for 1990 1992 (left) and 2008 – 2010 (right).

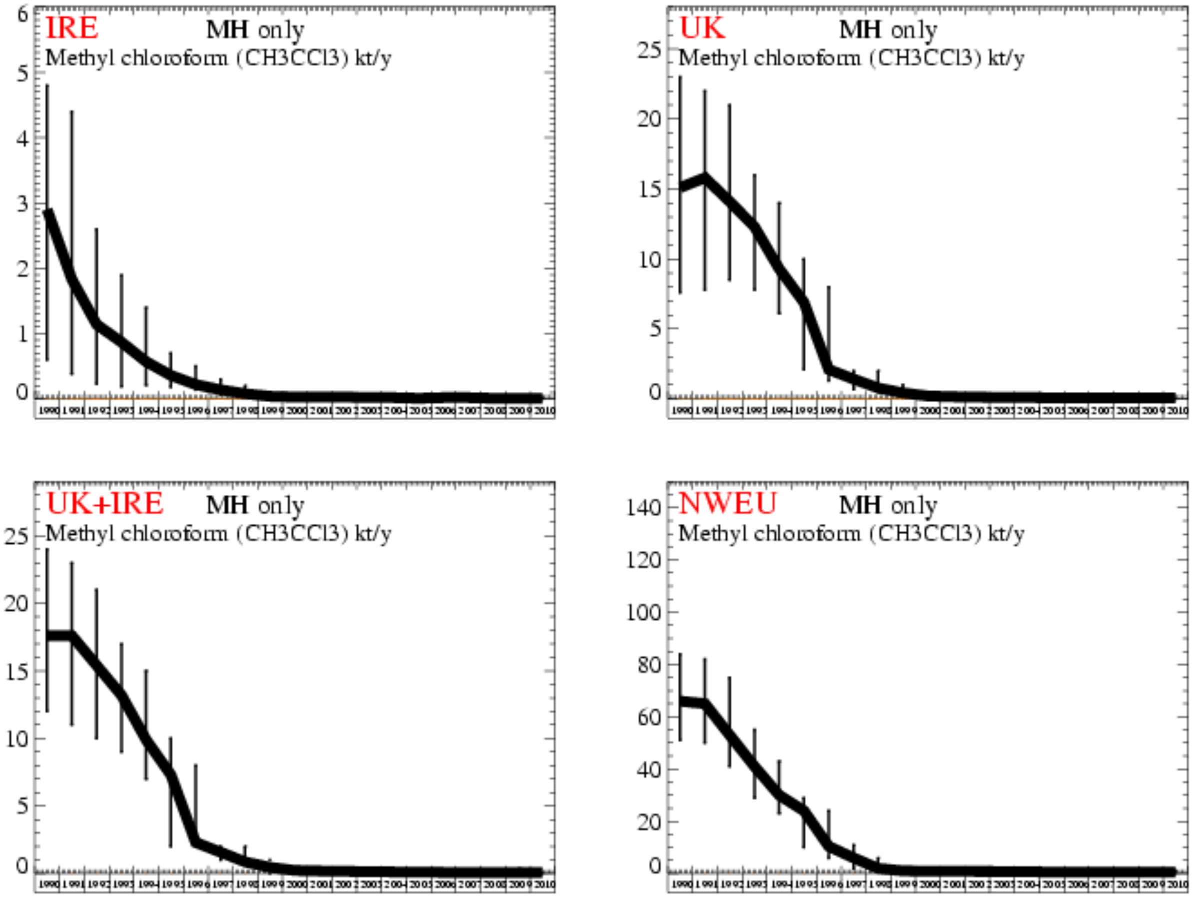

Figure 61: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	1990	2.9	(0.60- 4.8)	15.1	(7.6- 23.)	17.6	(12.- 24.)	66.	(51.- 84.)	144
kt/y	1991	1.83	(0.38- 4.4)	15.8	(7.8- 22.)	17.6	(11.- 23.)	65.	(50.- 82.)	288
kt/y	1992	1.14	(0.23- 2.6)	14.1	(8.5- 21.)	15.4	(10.- 21.)	53.	(41.- 75.)	310
kt/y	1993	0.87	(0.19- 1.9)	12.3	(7.8- 16.)	13.2	(9.- 17.)	41.	(29.- 55.)	322
kt/y	1994	0.57	(0.21- 1.4)	9.3	(6.1- 14.)	9.9	(7.- 15.)	30.	(23.- 43.)	325
kt/y	1995	0.36	(0.18- 0.7)	6.9	(2.1- 10.)	7.3	(2.- 10.)	24.	(10.- 29.)	325
kt/y	1996	0.22	(0.14- 0.5)	2.1	(1.3- 8.)	2.3	(2.- 8.)	10.4	(6.- 24.)	325
kt/y	1997	0.14	(0.07- 0.3)	1.42	(0.7- 2.)	1.58	(1.- 2.)	6.0	(2.- 11.)	325
kt/y	1998	0.08	(0.04- 0.2)	0.78	(0.5- 2.)	0.86	(1.- 2.)	1.96	(1.- 6.)	325
kt/y	1999	0.04	(0.02- 0.1)	0.43	(0.2- 1.)	0.46	(0.- 1.)	1.04	(1.- 2.)	325
kt/y	2000	0.03	(0.02- 0.0)	0.21	(0.1- 0.)	0.23	(0.- 0.)	0.88	(1.- 1.)	325
kt/y	2001	0.03	(0.02- 0.0)	0.16	(0.1- 0.)	0.19	(0.- 0.)	0.85	(1.- 1.)	325
kt/y	2002	0.03	(0.02- 0.0)	0.13	(0.1- 0.)	0.16	(0.- 0.)	0.82	(1.- 1.)	325
kt/y	2003	0.02	(0.01- 0.0)	0.11	(0.1- 0.)	0.14	(0.- 0.)	0.79	(1.- 1.)	313
kt/y	2004	0.02	(0.01- 0.0)	0.10	(0.1- 0.)	0.12	(0.- 0.)	0.71	(1.- 1.)	301
kt/y	2005	0.01	(0.01- 0.0)	0.08	(0.1- 0.)	0.10	(0.- 0.)	0.56	(0.- 1.)	300
kt/y	2006	0.02	(0.01- 0.0)	0.07	(0.0- 0.)	0.09	(0.- 0.)	0.50	(0.- 1.)	289
kt/y	2007	0.02	(0.01- 0.0)	0.08	(0.1- 0.)	0.09	(0.- 0.)	0.55	(0.- 1.)	277
kt/y	2008	0.01	(0.01- 0.0)	0.08	(0.1- 0.)	0.09	(0.- 0.)	0.55	(0.- 1.)	291
kt/y	2009	0.01	(0.01- 0.0)	0.08	(0.1- 0.)	0.09	(0.- 0.)	0.52	(0.- 1.)	159
kt/y	2010	0.01	(0.01- 0.0)	0.07	(0.0- 0.)	0.08	(0.- 0.)	0.54	(0.- 1.)	13

Table 26: CH_3CCl_3 emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5^{th} – 95^{th} percentile).

4.3.5.6 $CHClCCl_2$

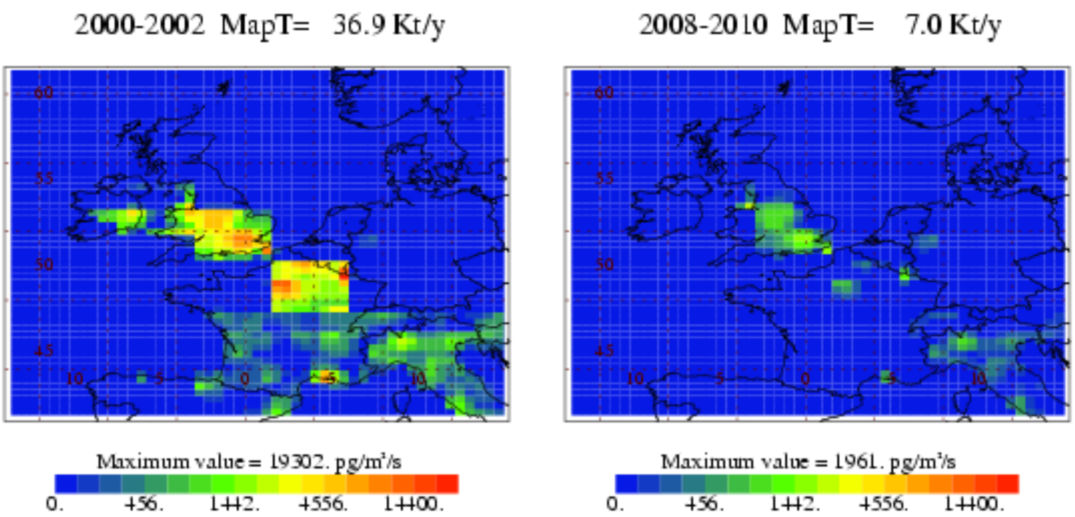

Figure 62: NAME-inversion emission estimates for 2000 – 2002 (left) and 2008 – 2010 (right).

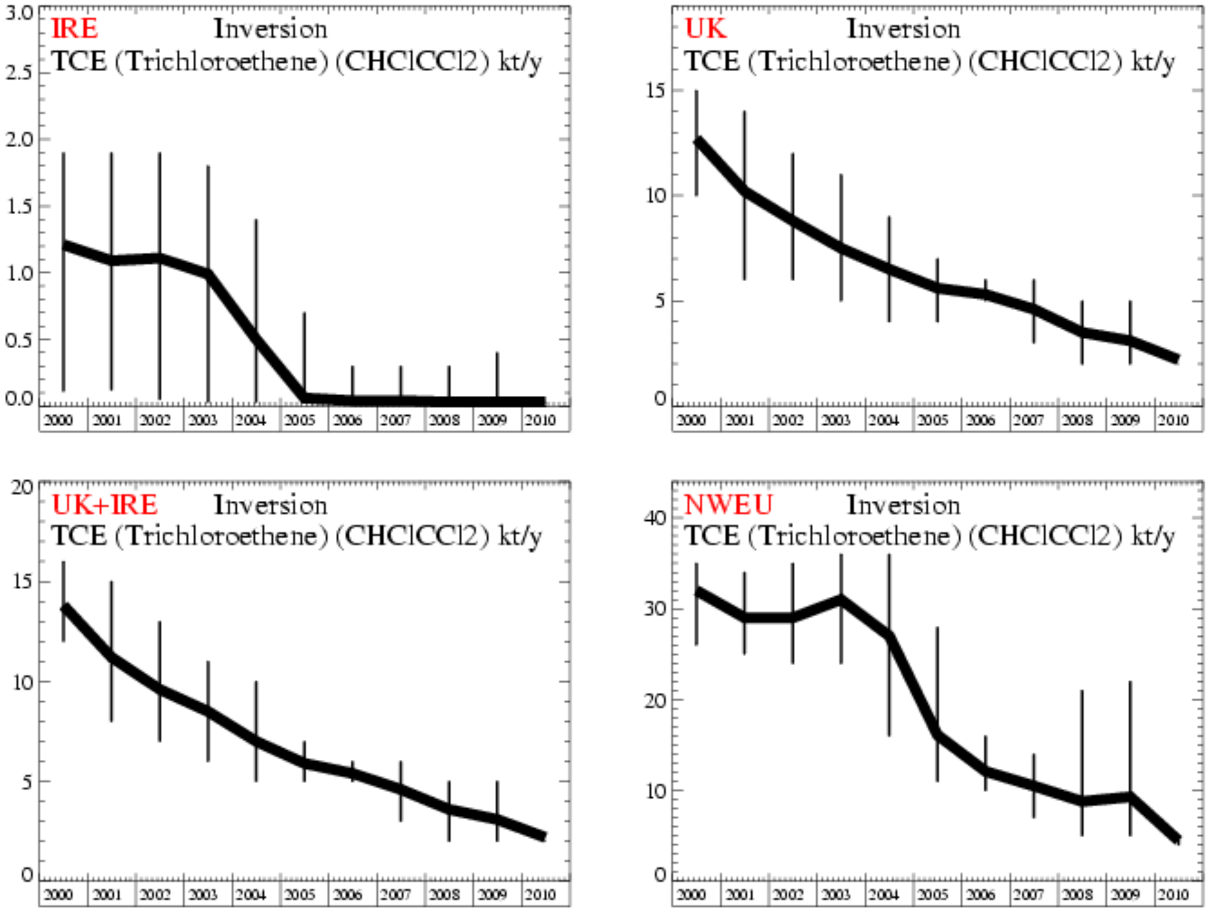

Figure 63: Emission estimates for UK (left) and NWEU (right). The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	2000	1.21	(0.11- 1.9)	12.7	(10.- 15.)	13.8	(12.- 16.)	32.	(26.- 35.)	65
kt/y	2001	1.09	(0.12- 1.9)	10.2	(6.- 14.)	11.2	(8.- 15.)	29.	(25.- 34.)	221
kt/y	2002	1.11	(0.05- 1.9)	8.8	(6.- 12.)	9.6	(7.- 13.)	29.	(24.- 35.)	325
kt/y	2003	0.99	(0.03- 1.8)	7.5	(5.- 11.)	8.5	(6.- 11.)	31.	(24.- 36.)	318
kt/y	2004	0.50	(0.03- 1.4)	6.5	(4.- 9.)	7.0	(5.- 10.)	27.	(16.- 36.)	306
kt/y	2005	0.06	(0.03- 0.7)	5.6	(4.- 7.)	5.9	(5.- 7.)	16.1	(11.- 28.)	300
kt/y	2006	0.04	(0.03- 0.3)	5.3	(5.- 6.)	5.4	(5.- 6.)	12.1	(10.- 16.)	300
kt/y	2007	0.04	(0.02- 0.3)	4.6	(3.- 6.)	4.6	(3.- 6.)	10.5	(7.- 14.)	301
kt/y	2008	0.03	(0.02- 0.3)	3.5	(2.- 5.)	3.6	(2.- 5.)	8.8	(5.- 21.)	313
kt/y	2009	0.03	(0.02- 0.4)	3.1	(2.- 5.)	3.1	(2.- 5.)	9.3	(5.- 22.)	169
kt/y	2010	0.03	(0.03- 0.0)	2.2	(2.- 2.)	2.2	(2.- 2.)	4.5	(4.- 5.)	13

Table 27: $CHClCCl_2$ emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5th – 95th percentile).

CCl_2CCl_2

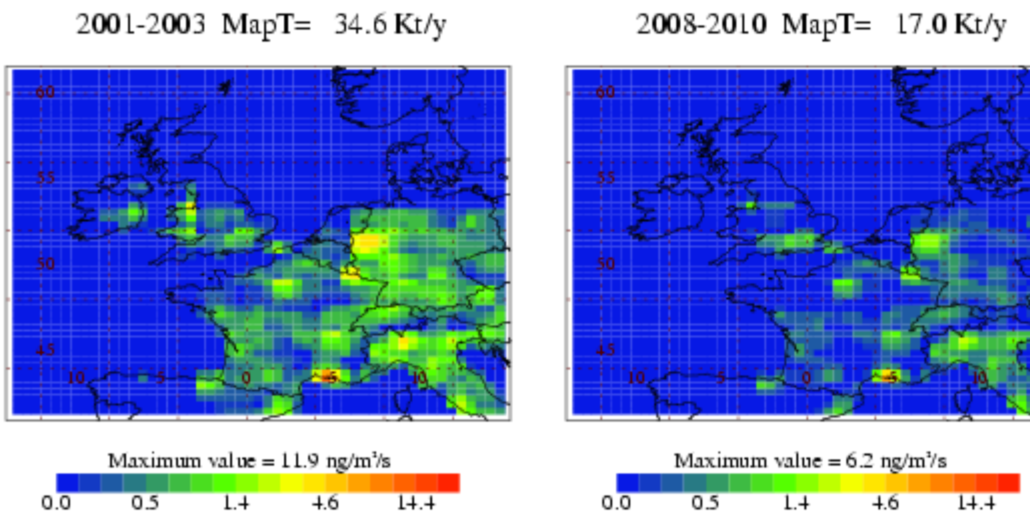

Figure 64: NAME-inversion emission estimates for 2001 – 2003 (left) and 2008 – 2010 (right).

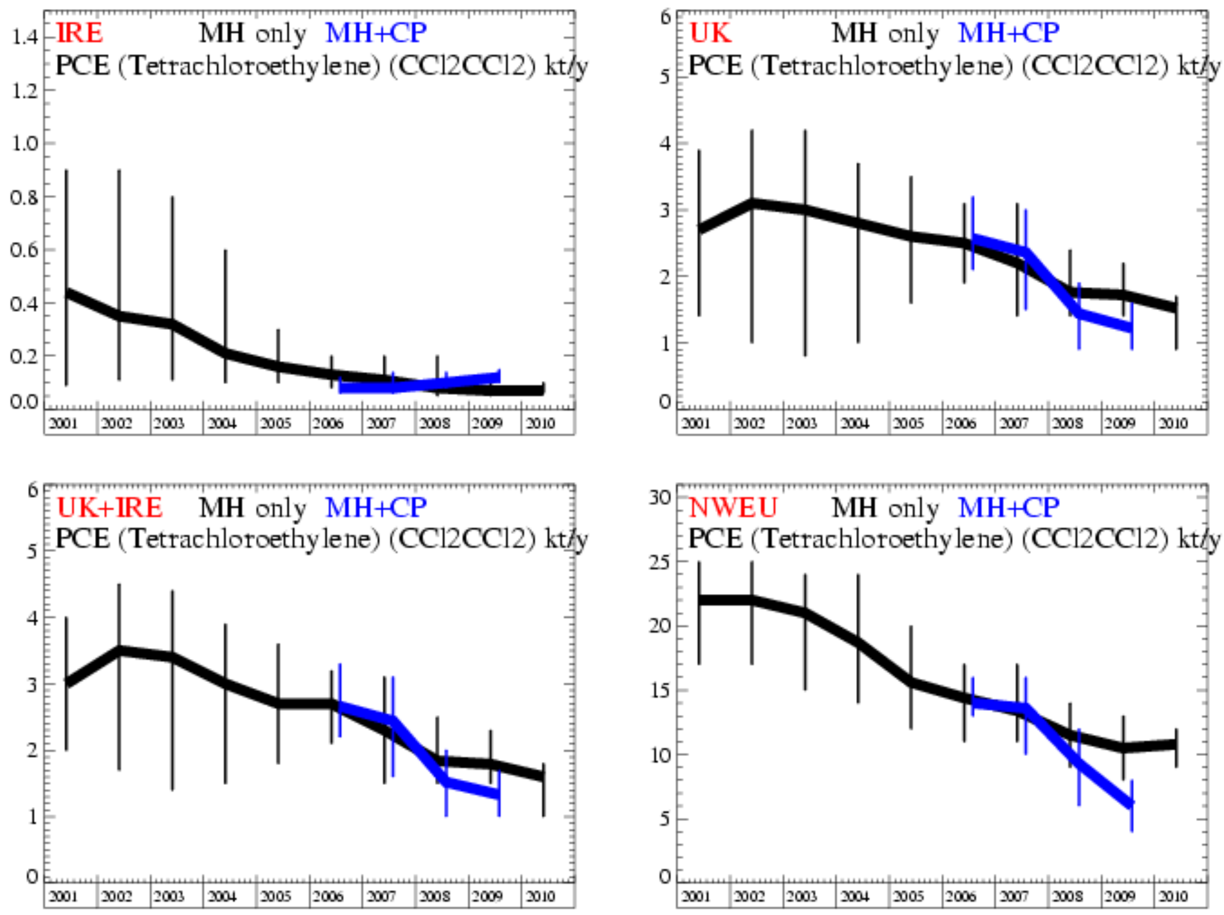

Figure 65: Emission estimates for IRE, UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
kt/y	2001	0.44	(0.09- 0.9)	2.7	(1.4- 3.9)	3.0	(2.0- 4.0)	22.	(17.- 25.)	52
kt/y	2002	0.35	(0.11- 0.9)	3.1	(1.0- 4.2)	3.5	(1.7- 4.5)	22.	(17.- 25.)	208
kt/y	2003	0.32	(0.11- 0.8)	3.0	(0.8- 4.2)	3.4	(1.4- 4.4)	21.	(15.- 24.)	325
kt/y	2004	0.21	(0.10- 0.6)	2.8	(1.0- 3.7)	3.0	(1.5- 3.9)	18.7	(14.- 24.)	325
kt/y	2005	0.16	(0.10- 0.3)	2.6	(1.6- 3.5)	2.7	(1.8- 3.6)	15.6	(12.- 20.)	325
kt/y	2006	0.13	(0.08- 0.2)	2.5	(1.9- 3.1)	2.7	(2.1- 3.2)	14.4	(11.- 17.)	325
kt/y	2007	0.11	(0.07- 0.2)	2.2	(1.4- 3.1)	2.3	(1.5- 3.1)	13.4	(11.- 17.)	325
kt/y	2008	0.08	(0.05- 0.2)	1.8	(1.4- 2.4)	1.8	(1.5- 2.5)	11.5	(9.- 14.)	325
kt/y	2009	0.07	(0.05- 0.1)	1.7	(1.4- 2.2)	1.8	(1.5- 2.3)	10.5	(8.- 13.)	169
kt/y	2010	0.07	(0.06- 0.1)	1.5	(0.9- 1.7)	1.6	(1.0- 1.8)	10.8	(9.- 12.)	13

Table 28: CCl_2CCl_2 emission estimates for UK and NWEU with uncertainty (5th – 95th percentile).

4.3.6 Bromine compounds

4.3.6.1 Halon-1211 (CF_2ClBr)

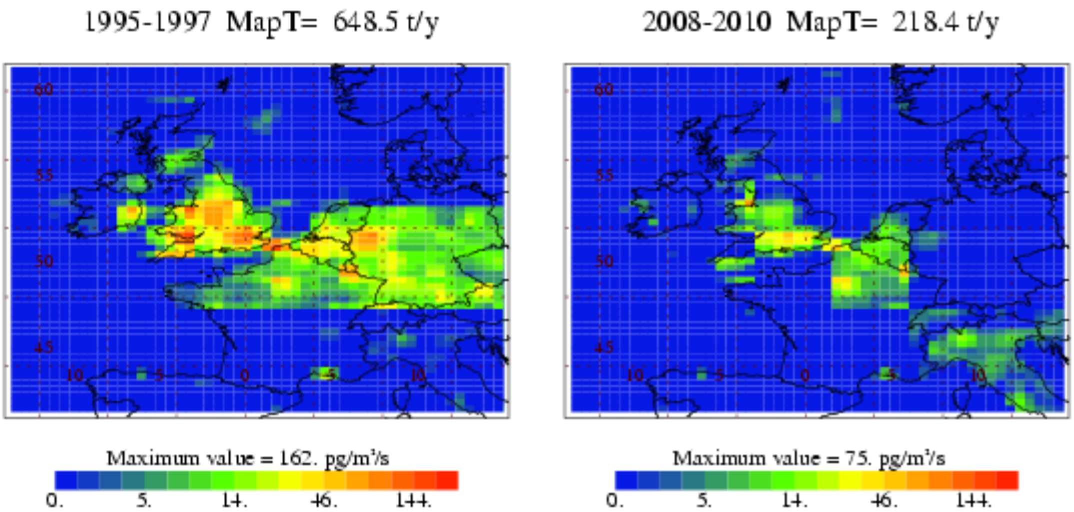

Figure 66: NAME-inversion emission estimates for 1995 – 1997 (left) and 2008 – 2010 (right).

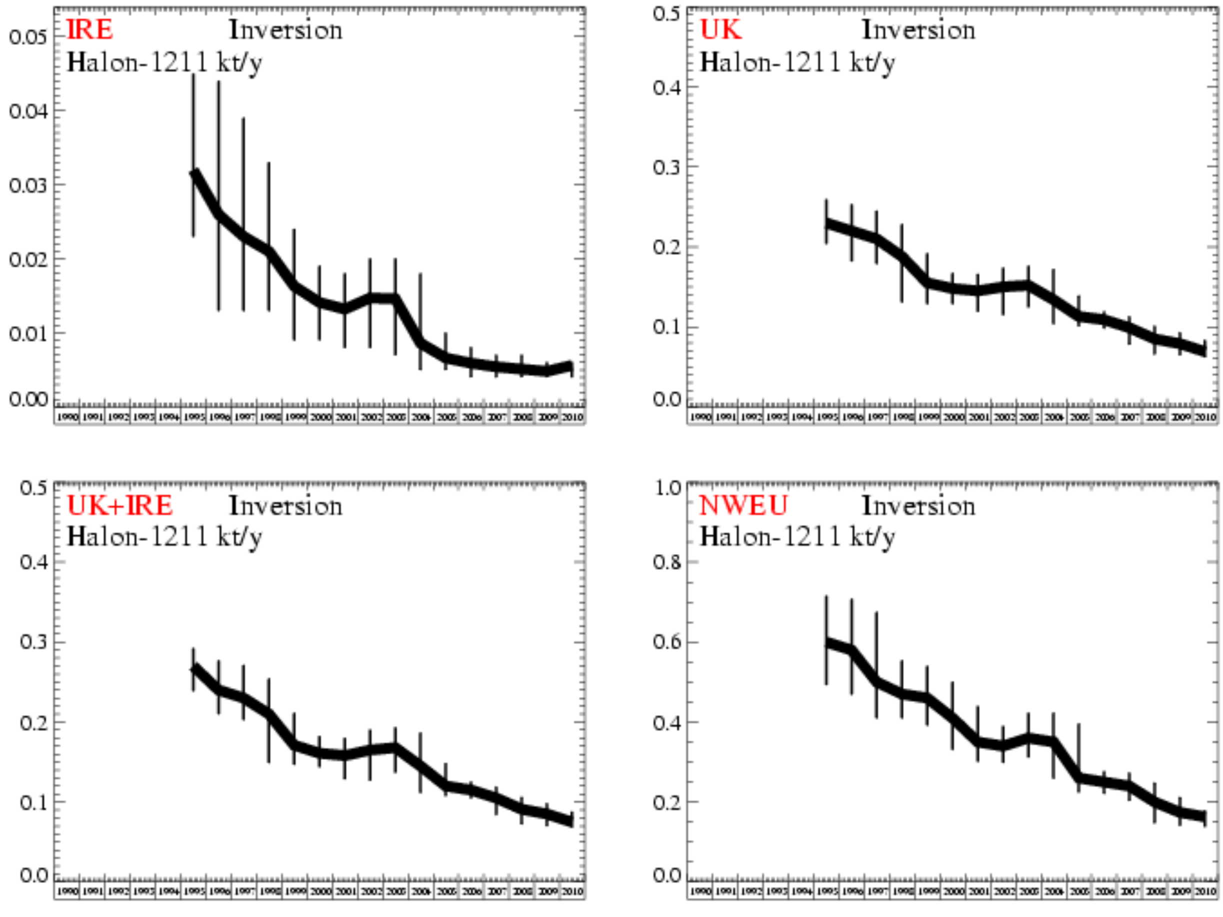

Figure 67: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1995	32.	(23.- 45.)	230.	(204.- 259.)	270.	(239.- 292.)	600.	(493.- 715.)	39
t/y	1996	26.	(13.- 44.)	220.	(182.- 253.)	240.	(210.- 277.)	580.	(469.- 707.)	195
t/y	1997	23.	(13.- 39.)	210.	(179.- 245.)	230.	(203.- 271.)	500.	(410.- 675.)	325
t/y	1998	21.	(13.- 33.)	188.	(131.- 228.)	210.	(149.- 254.)	470.	(410.- 554.)	325
t/y	1999	16.3	(9.- 24.)	155.	(129.- 192.)	171.	(147.- 211.)	460.	(392.- 540.)	325
t/y	2000	14.1	(9.- 19.)	148.	(129.- 167.)	161.	(144.- 182.)	410.	(331.- 500.)	325
t/y	2001	13.2	(8.- 18.)	145.	(119.- 166.)	158.	(129.- 180.)	350.	(301.- 439.)	325
t/y	2002	14.7	(8.- 20.)	150.	(115.- 174.)	165.	(127.- 190.)	340.	(298.- 389.)	325
t/y	2003	14.6	(7.- 20.)	152.	(125.- 176.)	168.	(137.- 193.)	360.	(312.- 422.)	325
t/y	2004	8.6	(5.- 18.)	134.	(104.- 172.)	145.	(112.- 186.)	350.	(260.- 422.)	325
t/y	2005	6.6	(5.- 10.)	113.	(101.- 139.)	120.	(108.- 148.)	260.	(225.- 395.)	325
t/y	2006	5.9	(4.- 8.)	109.	(98.- 119.)	115.	(105.- 125.)	250.	(221.- 276.)	325
t/y	2007	5.4	(4.- 7.)	99.	(78.- 113.)	105.	(84.- 119.)	240.	(203.- 273.)	325
t/y	2008	5.1	(4.- 7.)	85.	(66.- 101.)	91.	(72.- 106.)	200.	(148.- 248.)	325
t/y	2009	4.8	(4.- 6.)	79.	(65.- 93.)	85.	(70.- 98.)	174.	(141.- 212.)	169
t/y	2010	5.6	(4.- 6.)	69.	(62.- 83.)	75.	(68.- 88.)	163.	(139.- 178.)	13

Table 29: Halon-1211 emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5^{th} – 95^{th} percentile).

4.3.6.2 Halon-1301 (CF_3Br)

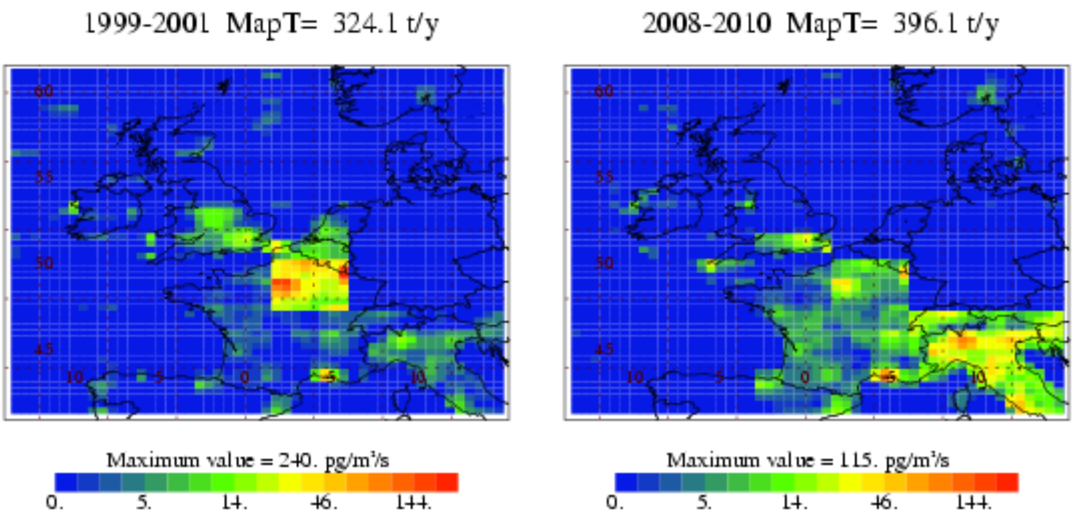

Figure 68: NAME-inversion emission estimates for 1999 – 2001 (left) and 2008 – 2010 (right).

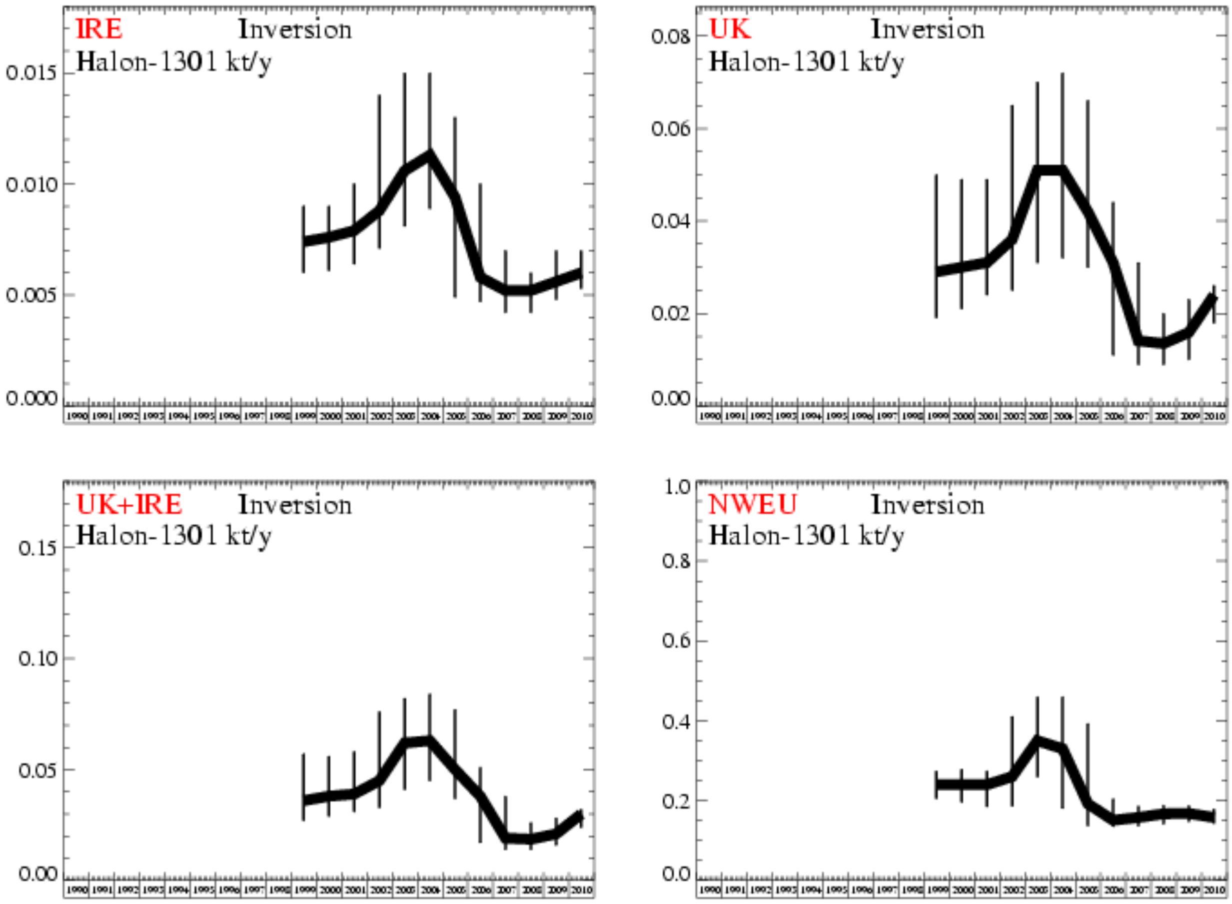

Figure 69: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
t/y	1999	7.4	(6.0- 9.)	29.	(19.- 50.)	36.	(27.- 57.)	240.	(205.- 274.)	156
t/y	2000	7.6	(6.1- 9.)	30.	(21.- 49.)	38.	(29.- 56.)	240.	(196.- 278.)	312
t/y	2001	7.9	(6.4- 10.)	31.	(24.- 49.)	39.	(31.- 58.)	240.	(185.- 274.)	325
t/y	2002	8.8	(7.1- 14.)	36.	(25.- 65.)	45.	(33.- 76.)	260.	(186.- 411.)	325
t/y	2003	10.6	(8.1- 15.)	51.	(31.- 70.)	62.	(41.- 82.)	350.	(260.- 460.)	325
t/y	2004	11.3	(8.9- 15.)	51.	(32.- 72.)	63.	(45.- 84.)	330.	(181.- 460.)	325
t/y	2005	9.4	(4.9- 13.)	42.	(30.- 66.)	50.	(37.- 77.)	192.	(138.- 393.)	325
t/y	2006	5.8	(4.7- 10.)	31.	(11.- 44.)	38.	(17.- 51.)	151.	(135.- 204.)	325
t/y	2007	5.2	(4.2- 7.)	14.	(9.- 31.)	19.1	(14.- 38.)	158.	(136.- 186.)	325
t/y	2008	5.2	(4.2- 6.)	14.	(9.- 20.)	18.6	(14.- 26.)	167.	(142.- 188.)	325
t/y	2009	5.6	(4.8- 7.)	16.	(10.- 23.)	21.	(16.- 28.)	168.	(148.- 187.)	169
t/y	2010	6.0	(5.3- 7.)	24.	(18.- 26.)	30.	(24.- 32.)	158.	(143.- 179.)	13

Table 30: Halon-1301 emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5th – 95th percentile).

4.3.7 Hydrocarbons, oxides of carbon and nitrous oxide

4.3.7.1 Methane

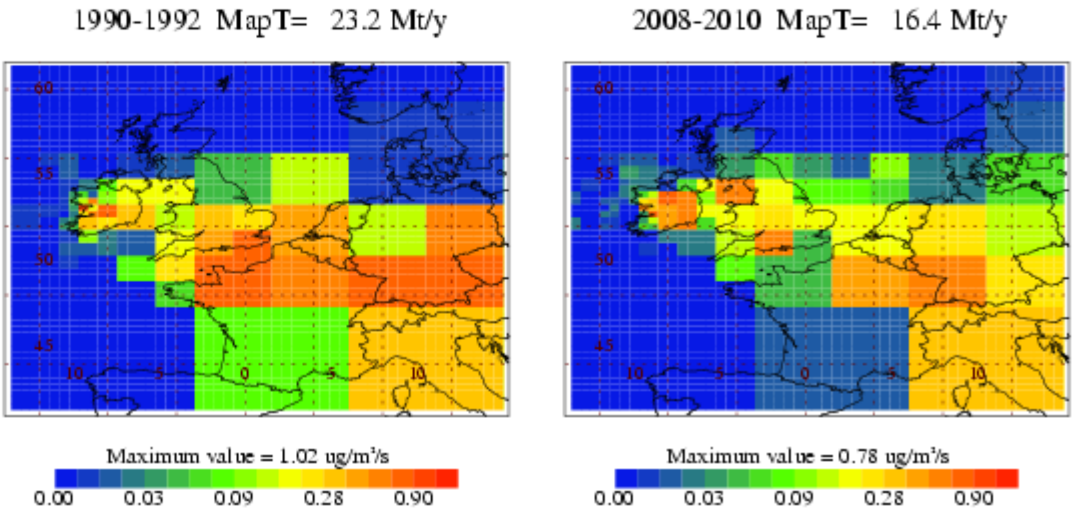

Figure 70: NAME-inversion emission estimates for 1990 – 1992 (left) and 2008 – 2010 (right).

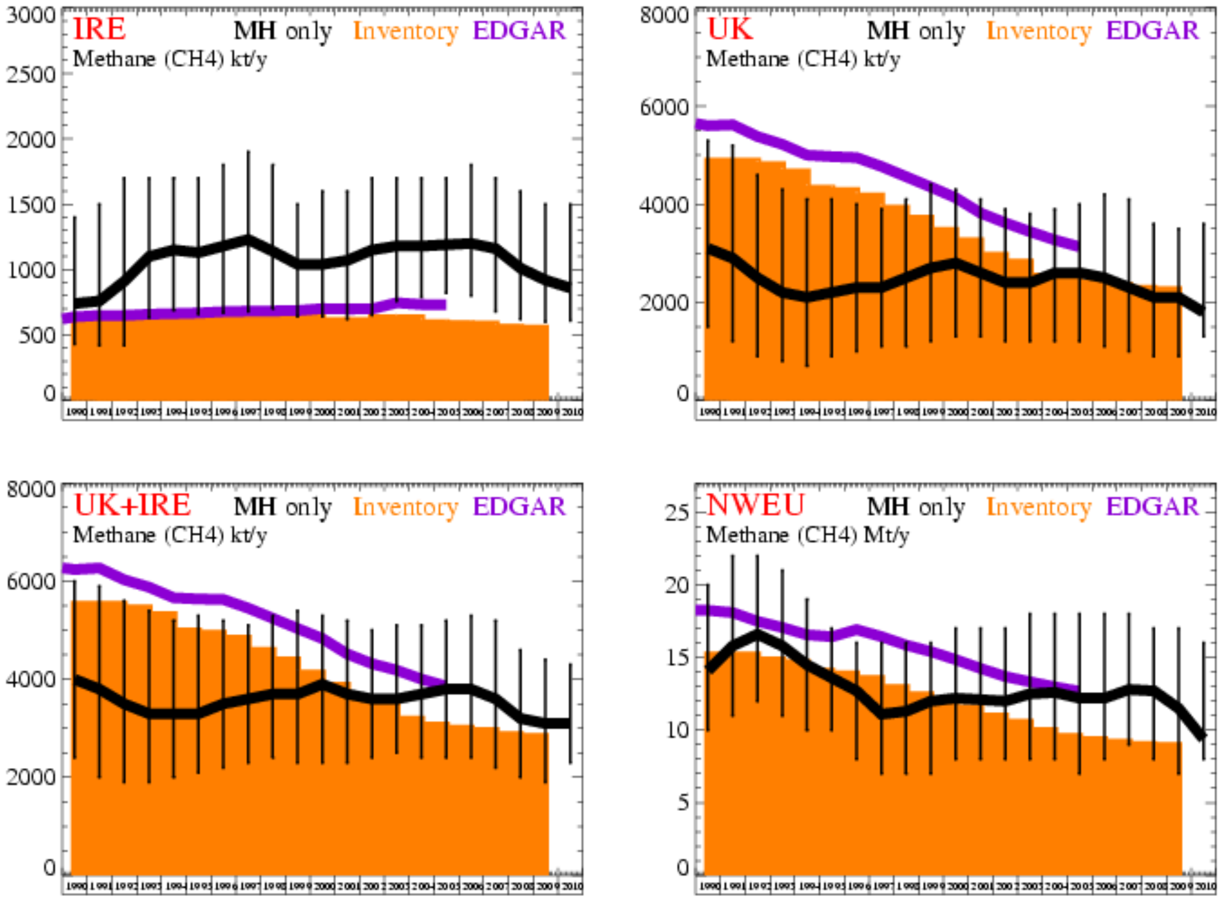

Figure 71: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
Mt/y	1990	0.74	(0.43- 1.4)	3.1	(1.5- 5.3)	4.0	(2.4- 6.0)	14.1	(10.- 20.)	156
Mt/y	1991	0.76	(0.42- 1.5)	2.9	(1.2- 5.2)	3.8	(2.0- 5.9)	15.8	(11.- 22.)	312
Mt/y	1992	0.91	(0.42- 1.7)	2.5	(0.9- 4.6)	3.5	(1.9- 5.6)	16.6	(12.- 22.)	325
Mt/y	1993	1.10	(0.63- 1.7)	2.2	(0.8- 4.3)	3.3	(1.9- 5.4)	15.8	(11.- 21.)	325
Mt/y	1994	1.15	(0.69- 1.7)	2.1	(0.7- 4.1)	3.3	(2.0- 5.2)	14.5	(10.- 19.)	325
Mt/y	1995	1.13	(0.66- 1.7)	2.2	(0.9- 4.1)	3.3	(2.1- 5.3)	13.6	(10.- 17.)	325
Mt/y	1996	1.18	(0.67- 1.8)	2.3	(1.0- 4.0)	3.5	(2.2- 5.2)	12.7	(8.- 16.)	325
Mt/y	1997	1.23	(0.68- 1.9)	2.3	(1.1- 3.9)	3.6	(2.3- 5.1)	11.1	(7.- 16.)	325
Mt/y	1998	1.14	(0.70- 1.8)	2.5	(1.1- 4.1)	3.7	(2.4- 5.3)	11.3	(7.- 16.)	325
Mt/y	1999	1.04	(0.64- 1.5)	2.7	(1.2- 4.4)	3.7	(2.3- 5.4)	12.0	(7.- 16.)	325
Mt/y	2000	1.04	(0.64- 1.6)	2.8	(1.3- 4.3)	3.9	(2.3- 5.3)	12.2	(8.- 17.)	325
Mt/y	2001	1.07	(0.62- 1.6)	2.6	(1.3- 4.1)	3.7	(2.3- 5.2)	12.1	(8.- 17.)	325
Mt/y	2002	1.15	(0.65- 1.7)	2.4	(1.2- 3.9)	3.6	(2.4- 5.0)	12.0	(8.- 17.)	325
Mt/y	2003	1.18	(0.76- 1.7)	2.4	(1.2- 3.8)	3.6	(2.5- 5.1)	12.5	(8.- 18.)	325
Mt/y	2004	1.18	(0.79- 1.7)	2.6	(1.2- 3.9)	3.7	(2.4- 5.1)	12.6	(8.- 18.)	325
Mt/y	2005	1.19	(0.82- 1.7)	2.6	(1.2- 4.0)	3.8	(2.4- 5.2)	12.2	(7.- 18.)	325
Mt/y	2006	1.20	(0.80- 1.8)	2.5	(1.1- 4.2)	3.8	(2.4- 5.3)	12.2	(8.- 18.)	325
Mt/y	2007	1.16	(0.68- 1.7)	2.3	(1.0- 4.1)	3.6	(2.2- 5.2)	12.8	(9.- 18.)	315
Mt/y	2008	1.01	(0.62- 1.6)	2.1	(0.9- 3.6)	3.2	(2.0- 4.6)	12.7	(8.- 17.)	307
Mt/y	2009	0.92	(0.60- 1.5)	2.1	(0.9- 3.5)	3.1	(1.9- 4.4)	11.5	(7.- 17.)	159
Mt/y	2010	0.86	(0.61- 1.5)	1.8	(1.3- 3.6)	3.1	(2.3- 4.3)	9.4	(8.- 16.)	13

Table 31: Methane emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5^{th} – 95^{th} percentile).

4.3.7.2 Ethane (C_2H_6)

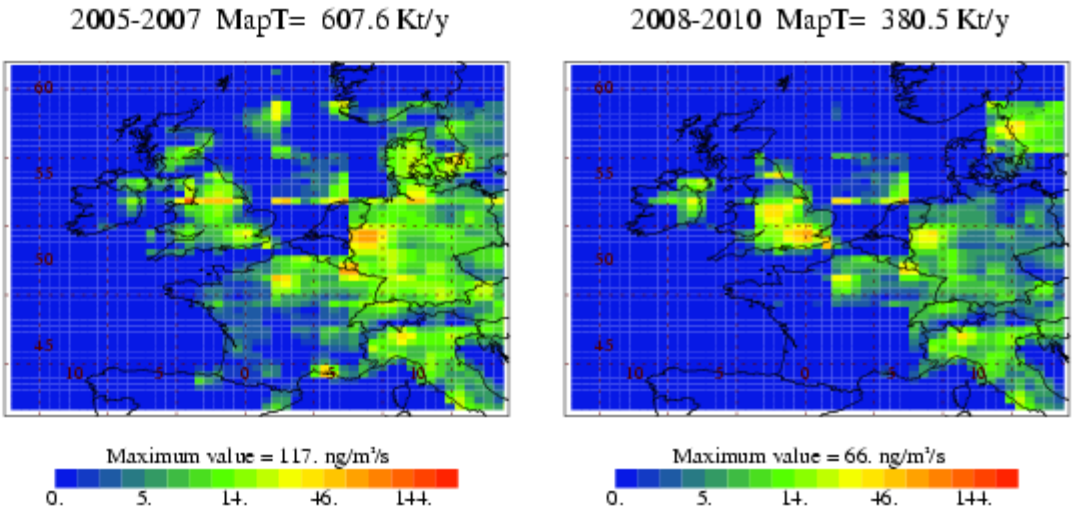

Figure 72: NAME-inversion emission estimates for 2005 – 2007 (left) and 2008 – 2010 (right).

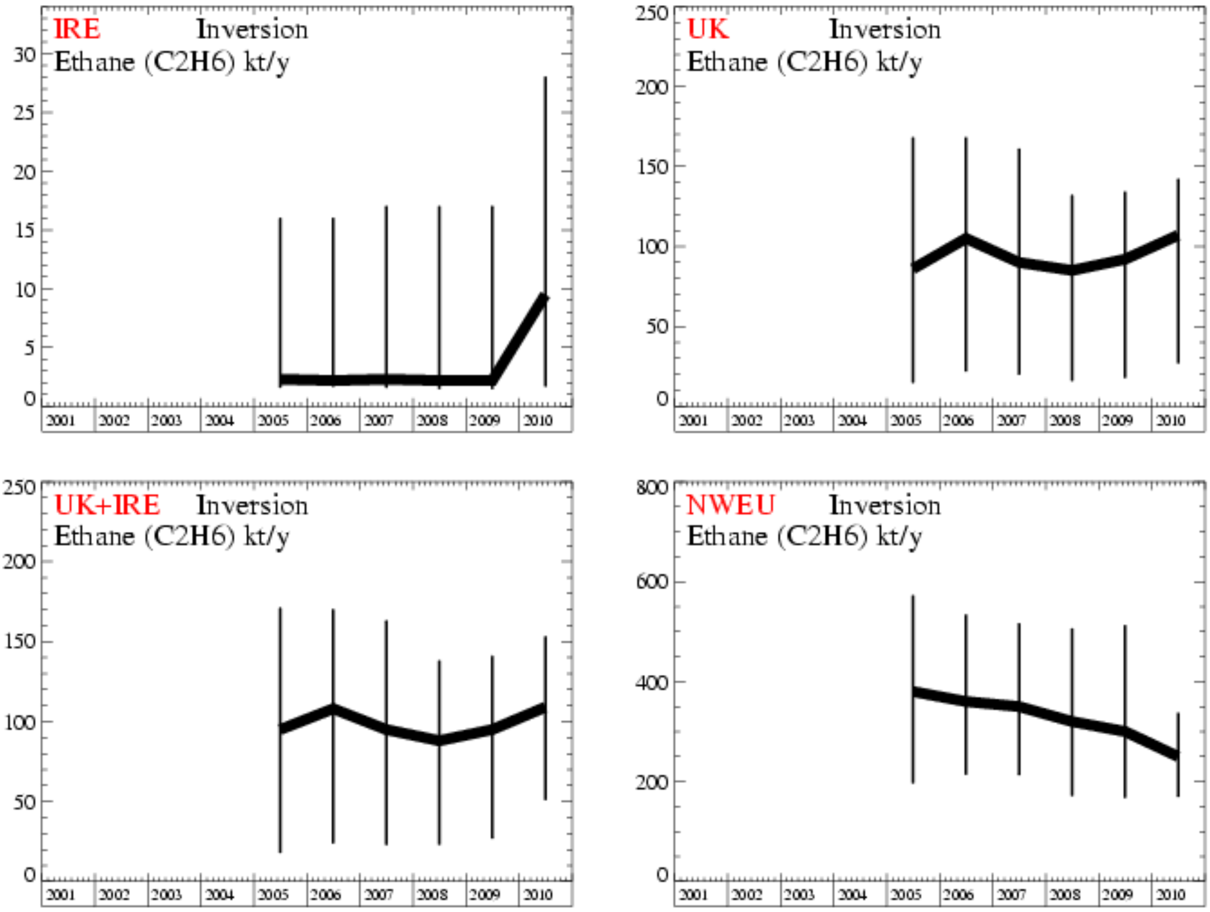

Figure 73: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE (5th-95th)	UK (5th-95th)	UK+IRE (5th-95th)	NWEU (5th-95th)	Number
kt/y	2005	2.3 (1.6- 16.)	86. (15.- 168.)	95. (18.- 171.)	380. (197.- 572.)	39
kt/y	2006	2.2 (1.7- 16.)	105. (22.- 168.)	108. (24.- 170.)	360. (214.- 533.)	195
kt/y	2007	2.3 (1.6- 17.)	90. (20.- 161.)	95. (23.- 163.)	350. (213.- 516.)	325
kt/y	2008	2.2 (1.5- 17.)	85. (16.- 132.)	88. (23.- 138.)	320. (172.- 506.)	325
kt/y	2009	2.2 (1.5- 17.)	92. (18.- 134.)	95. (27.- 141.)	300. (168.- 512.)	169
kt/y	2010	9.5 (1.7- 28.)	107. (27.- 142.)	109. (51.- 153.)	250. (170.- 337.)	13

Table 32: Ethane emission estimates for IRE, UK and NWEU (uncertainty 5th – 95th percentile).

4.3.7.3 Benzene (C_6H_6)

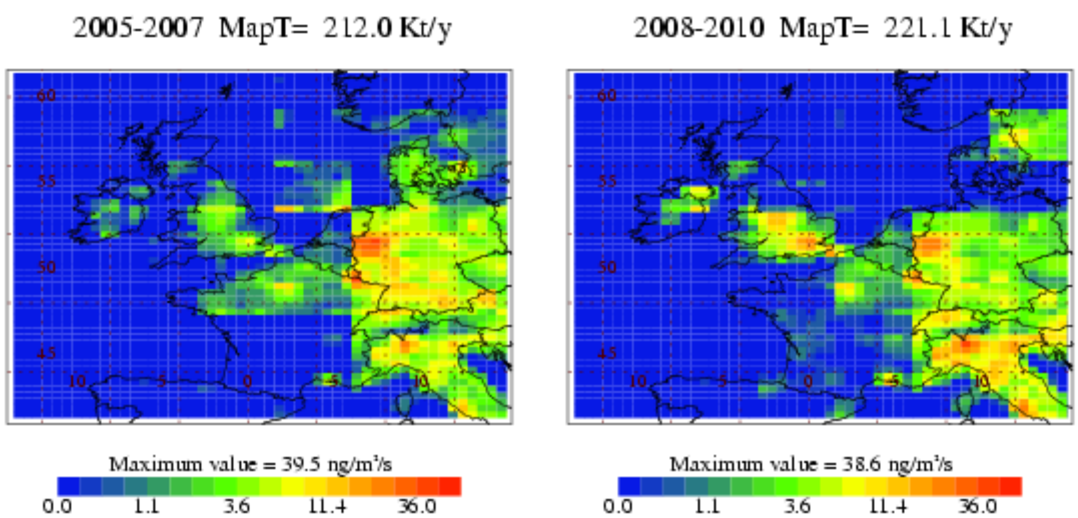

Figure 74: NAME-inversion emission estimates for 2005 – 2007 (left) and 2008 – 2010 (right).

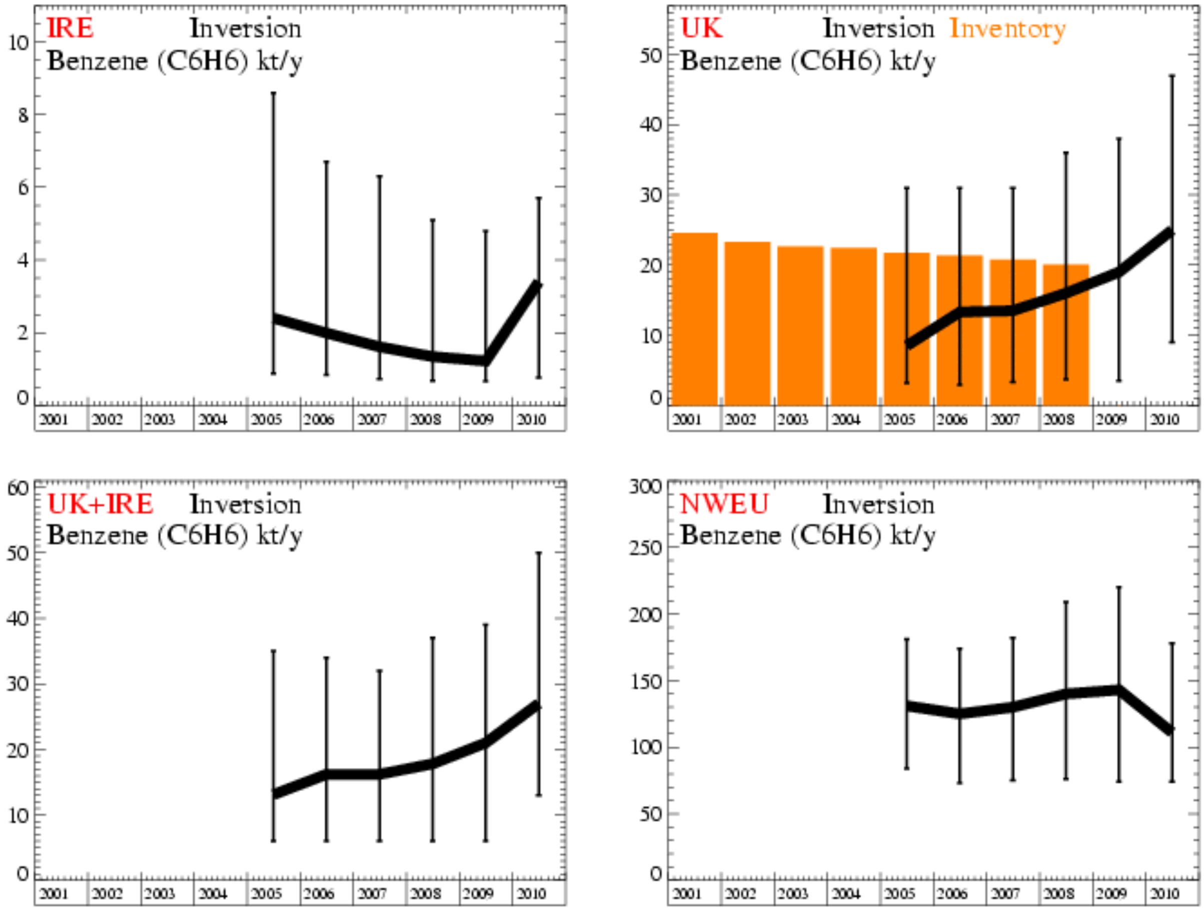

Figure 75: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE (5th-95th)	UK (5th-95th)	UK+IRE (5th-95th)	NWEU (5th-95th)	Number
kt/y	2005	2.4 (0.88- 8.6)	8.5 (3.2- 31.)	13.1 (6.- 35.)	131. (84.- 181.)	39
kt/y	2006	1.99 (0.84- 6.7)	13.3 (2.9- 31.)	16.2 (6.- 34.)	125. (73.- 174.)	195
kt/y	2007	1.61 (0.72- 6.3)	13.5 (3.3- 31.)	16.2 (6.- 32.)	130. (75.- 182.)	325
kt/y	2008	1.34 (0.68- 5.1)	16.0 (3.7- 36.)	17.8 (6.- 37.)	140. (76.- 209.)	325
kt/y	2009	1.22 (0.67- 4.8)	19.0 (3.5- 38.)	21.0 (6.- 39.)	143. (74.- 220.)	169
kt/y	2010	3.4 (0.76- 5.7)	25. 0 (9.0- 47.)	27.0 (13.- 50.)	111. (74.- 178.)	13

Table 33: Emission estimates for IRE, UK and NWEU with uncertainty (5th – 95th percentile).

4.3.7.4 Carbon monoxide (CO)

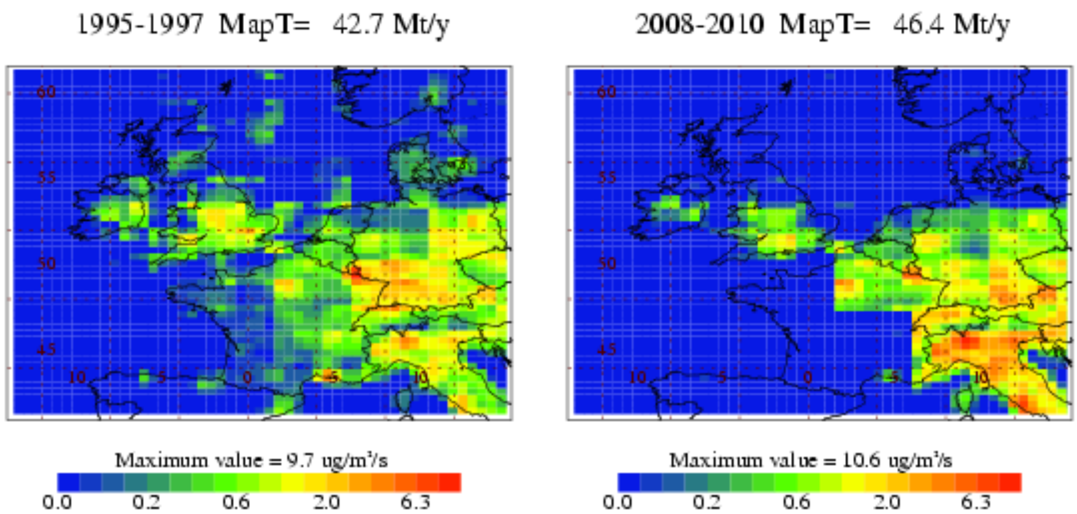

Figure 76: NAME-inversion emission estimates for 1995 – 1997 (left) and 2008 – 2010 (right).

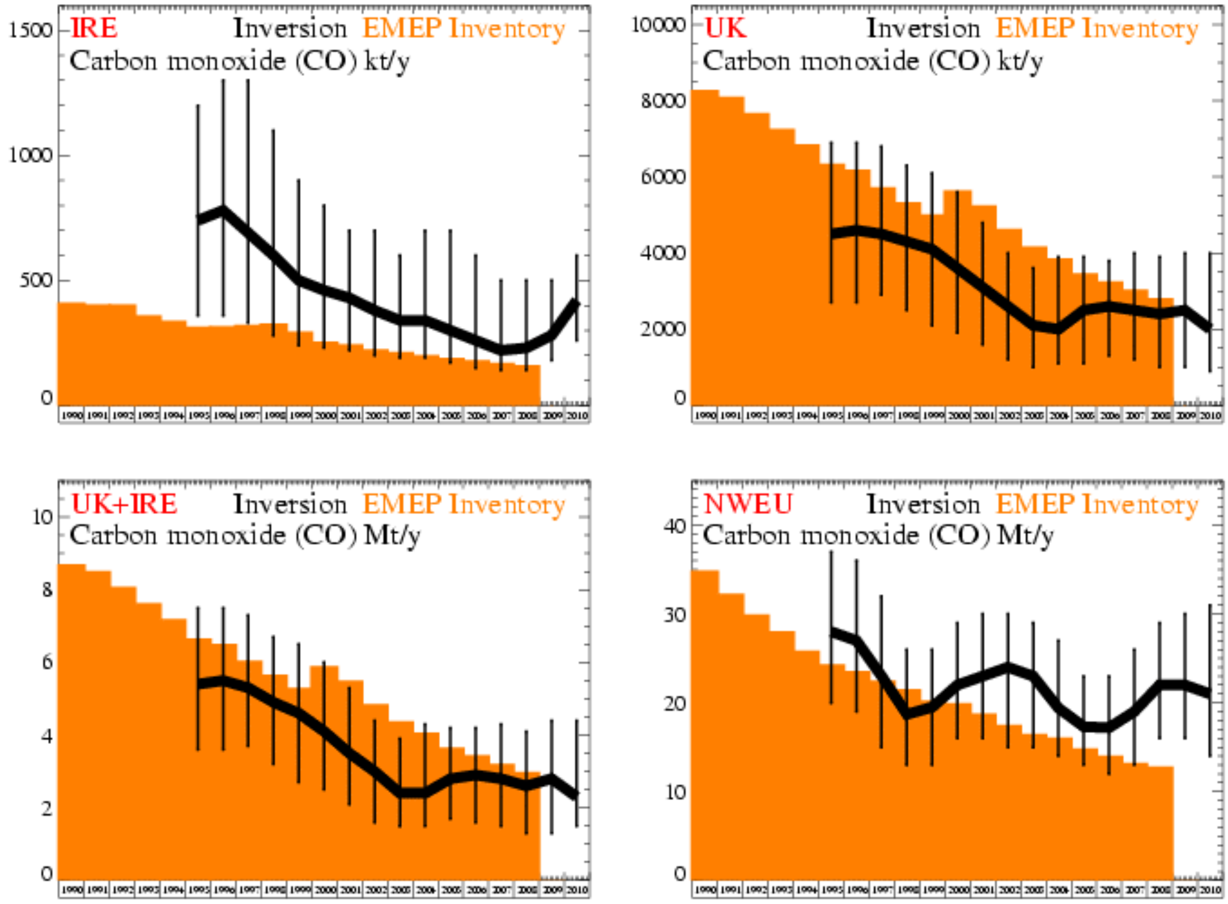

Figure 77: Emission estimates for UK (left) and NWEU (right). The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
Mt/y	1995	0.74	(0.36- 1.2)	4.5	(2.7- 6.9)	5.4	(3.6- 7.5)	28.	(20.- 37.)	143
Mt/y	1996	0.78	(0.36- 1.3)	4.6	(2.7- 6.9)	5.5	(3.6- 7.5)	27.	(19.- 36.)	299
Mt/y	1997	0.69	(0.33- 1.3)	4.5	(2.9- 6.8)	5.3	(3.7- 7.3)	23.	(15.- 32.)	325
Mt/y	1998	0.60	(0.28- 1.1)	4.3	(2.5- 6.3)	4.9	(3.2- 6.7)	19.	(13.- 26.)	325
Mt/y	1999	0.50	(0.24- 0.9)	4.1	(2.1- 6.1)	4.6	(2.7- 6.5)	20.	(13.- 26.)	325
Mt/y	2000	0.46	(0.23- 0.8)	3.6	(1.9- 5.6)	4.1	(2.5- 6.0)	22.	(16.- 29.)	325
Mt/y	2001	0.43	(0.22- 0.7)	3.1	(1.6- 4.8)	3.5	(2.1- 5.3)	23.	(16.- 30.)	325
Mt/y	2002	0.38	(0.20- 0.7)	2.6	(1.2- 4.0)	3.0	(1.6- 4.4)	24.	(15.- 30.)	325
Mt/y	2003	0.34	(0.19- 0.6)	2.1	(1.0- 3.6)	2.4	(1.5- 3.9)	23.	(15.- 29.)	325
Mt/y	2004	0.34	(0.19- 0.7)	2.0	(1.1- 3.9)	2.4	(1.5- 4.3)	19.	(14.- 27.)	325
Mt/y	2005	0.30	(0.17- 0.7)	2.5	(1.1- 3.9)	2.8	(1.7- 4.2)	17.	(13.- 23.)	325
Mt/y	2006	0.26	(0.15- 0.6)	2.6	(1.3- 3.8)	2.9	(1.6- 4.2)	17.	(12.- 23.)	325
Mt/y	2007	0.22	(0.14- 0.5)	2.5	(1.2- 4.0)	2.8	(1.5- 4.3)	19.	(13.- 26.)	325
Mt/y	2008	0.23	(0.14- 0.5)	2.4	(1.0- 3.9)	2.6	(1.3- 4.1)	22.	(16.- 29.)	325
Mt/y	2009	0.28	(0.18- 0.5)	2.5	(1.0- 4.0)	2.8	(1.3- 4.4)	22.	(16.- 30.)	169
Mt/y	2010	0.42	(0.26- 0.6)	2.0	(0.9- 4.0)	2.3	(1.5- 4.4)	21.	(14.- 31.)	13

Table 34: emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5th – 95th percentile).

4.3.7.5 Carbon dioxide (CO_2)

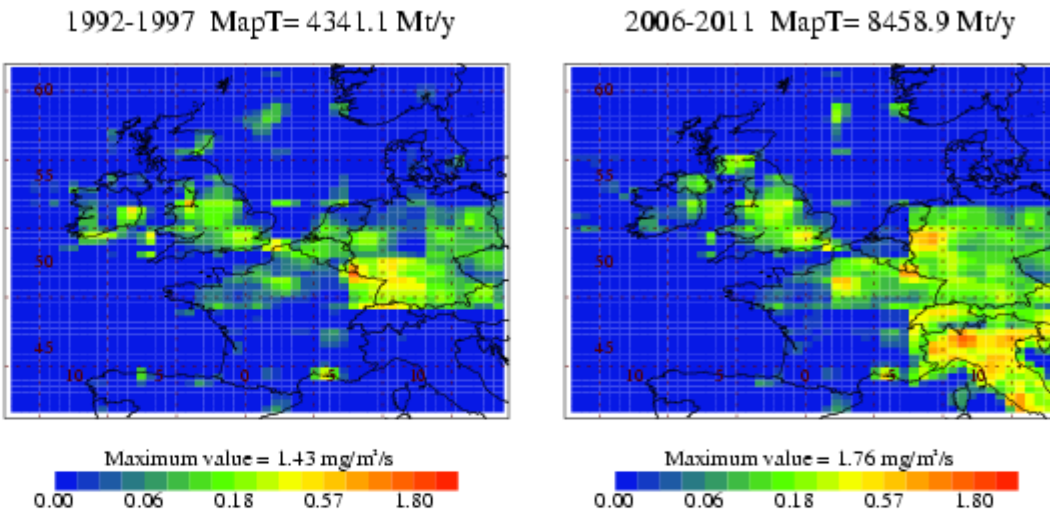

Figure 78: NAME-inversion emission estimates for 1992 – 1997 (left) and 2006 – 2011 (right).

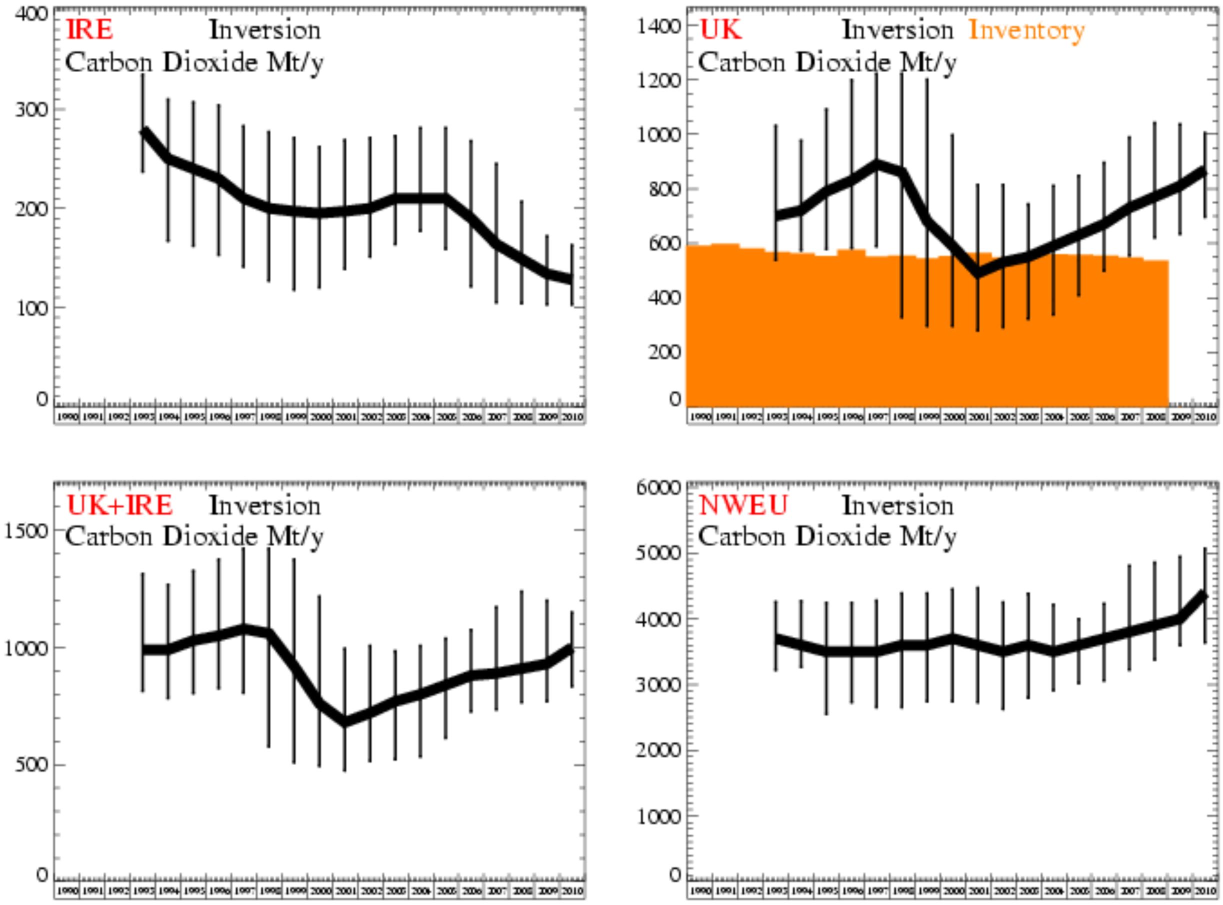

Figure 79: Emission estimates for IRE, UK and NWEU. The uncertainty bars represent the 5th and 95th percentiles. Winter-time observations only to minimise biogenic signal.

Unit	Year	IRE	(5th-95th)	UK	(5th-95th)	UK+IRE	(5th-95th)	NWEU	(5th-95th)	Number
Mt/y	1993	280.	(237.- 335.)	700.	(538.-1031.)	990.	(814.-1315.)	3700.	(3221.-4258.)	13
Mt/y	1994	250.	(167.- 310.)	720.	(574.- 977.)	990.	(784.-1268.)	3600.	(3264.-4275.)	26
Mt/y	1995	240.	(162.- 307.)	790.	(578.-1092.)	1030.	(805.-1328.)	3500.	(2554.-4244.)	39
Mt/y	1996	230.	(153.- 304.)	830.	(581.-1199.)	1050.	(825.-1377.)	3500.	(2731.-4244.)	52
Mt/y	1997	210.	(141.- 283.)	890.	(588.-1222.)	1080.	(806.-1423.)	3500.	(2653.-4279.)	52
Mt/y	1998	200.	(127.- 277.)	860.	(328.-1222.)	1060.	(577.-1423.)	3600.	(2653.-4392.)	52
Mt/y	1999	197.	(118.- 271.)	680.	(297.-1201.)	920.	(508.-1377.)	3600.	(2741.-4392.)	52
Mt/y	2000	195.	(120.- 262.)	590.	(297.- 997.)	760.	(493.-1218.)	3700.	(2741.-4453.)	52
Mt/y	2001	197.	(139.- 269.)	490.	(279.- 815.)	680.	(473.- 996.)	3600.	(2730.-4470.)	52
Mt/y	2002	200.	(151.- 271.)	530.	(292.- 815.)	720.	(515.-1008.)	3500.	(2624.-4250.)	52
Mt/y	2003	210.	(164.- 273.)	550.	(322.- 743.)	770.	(522.- 985.)	3600.	(2800.-4383.)	52
Mt/y	2004	210.	(177.- 281.)	590.	(337.- 811.)	800.	(533.-1008.)	3500.	(2911.-4216.)	52
Mt/y	2005	210.	(159.- 281.)	630.	(409.- 848.)	840.	(613.-1039.)	3600.	(3018.-4000.)	52
Mt/y	2006	190.	(121.- 268.)	670.	(498.- 896.)	880.	(725.-1076.)	3700.	(3061.-4233.)	52
Mt/y	2007	164.	(105.- 245.)	730.	(554.- 988.)	890.	(736.-1174.)	3800.	(3226.-4810.)	52
Mt/y	2008	149.	(104.- 207.)	770.	(620.-1041.)	910.	(766.-1239.)	3900.	(3380.-4856.)	39
Mt/y	2009	134.	(103.- 172.)	810.	(634.-1037.)	930.	(769.-1201.)	4000.	(3594.-4946.)	26
Mt/y	2010	128.	(103.- 163.)	870.	(696.-1005.)	1000.	(833.-1151.)	4400.	(3636.-5071.)	13

Table 35: Carbon dioxide emission estimates for UK and NWEU with uncertainty (5th – 95th percentile). Winter-time observations only to minimise biogenic signal.

4.3.7.6 Nitrous oxide (N_2O)

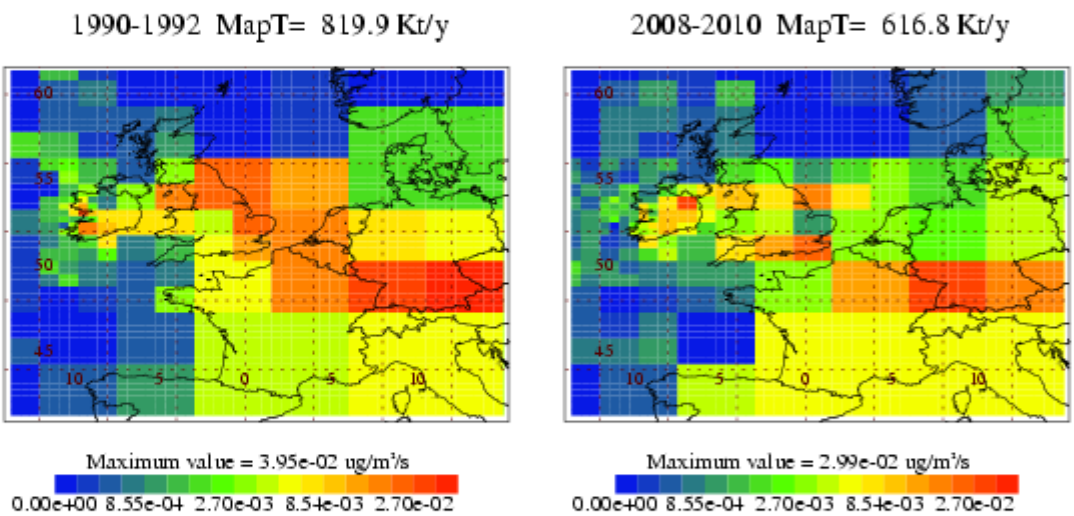

Figure 80: NAME-inversion emission estimates for 1990 – 1992 (left) and 2008 – 2010 (right).

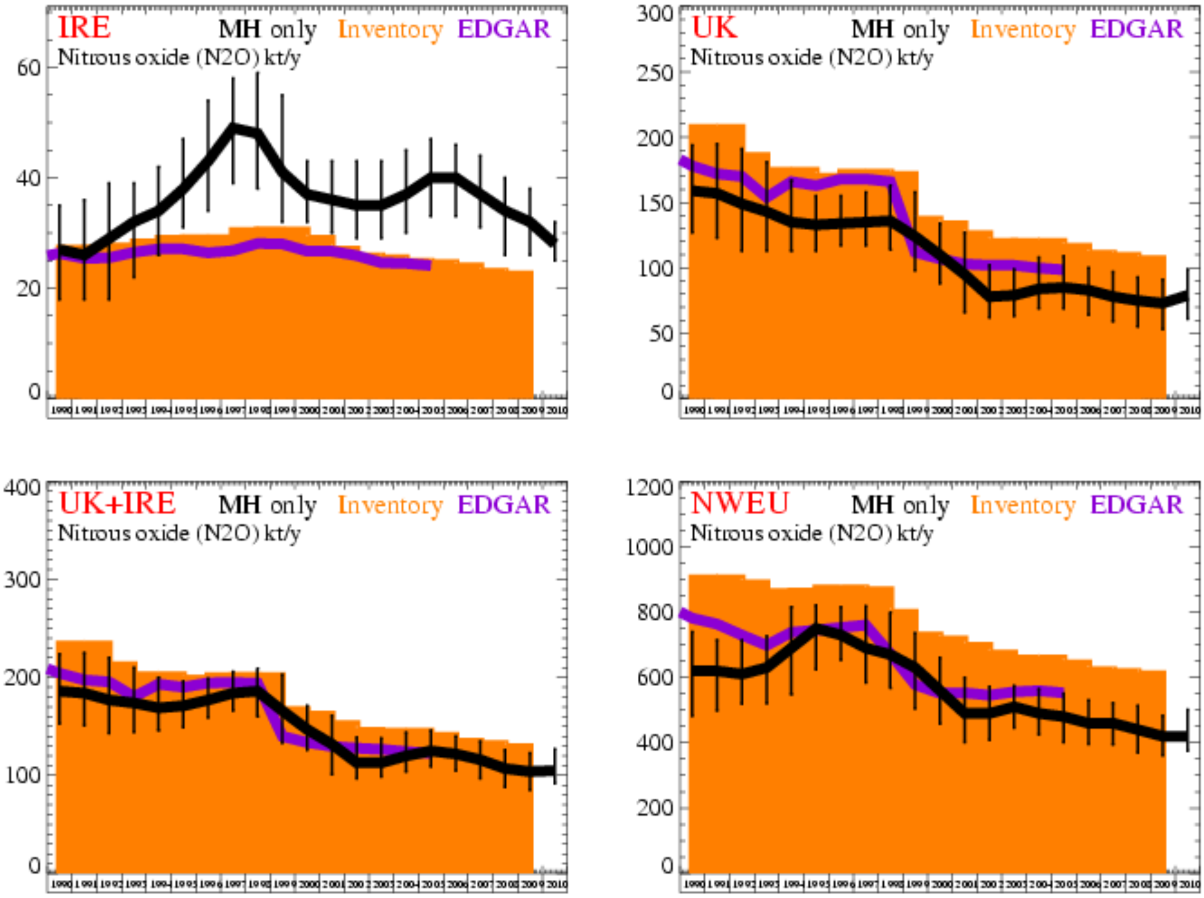

Figure 81: Emission estimates for IRE, UK, UK+IRE and NWEU. The uncertainty bars represent the 5th and 95th percentiles.

Unit	Year	IRE (5th-95th)	UK (5th-95th)	UK+IRE (5th-95th)	NWEU (5th-95th)	Number
kt/y	1990	27. (18.- 35.)	159. (127.- 194.)	186. (153.- 224.)	620. (482.- 740.)	156
kt/y	1991	26. (18.- 36.)	157. (123.- 195.)	184. (151.- 225.)	620. (498.- 715.)	312
kt/y	1992	29. (18.- 39.)	149. (113.- 191.)	177. (143.- 220.)	610. (519.- 714.)	325
kt/y	1993	32. (22.- 39.)	143. (113.- 181.)	174. (144.- 210.)	630. (520.- 727.)	325
kt/y	1994	34. (26.- 42.)	135. (113.- 167.)	169. (146.- 200.)	690. (548.- 815.)	325
kt/y	1995	38. (31.- 47.)	133. (113.- 155.)	171. (149.- 196.)	750. (625.- 821.)	325
kt/y	1996	43. (34.- 54.)	134. (117.- 155.)	177. (159.- 199.)	730. (653.- 816.)	325
kt/y	1997	49. (39.- 58.)	135. (117.- 158.)	184. (166.- 206.)	690. (584.- 818.)	325
kt/y	1998	48. (38.- 59.)	136. (114.- 163.)	186. (160.- 209.)	670. (568.- 799.)	325
kt/y	1999	41. (32.- 55.)	124. (98.- 158.)	166. (133.- 203.)	630. (504.- 736.)	325
kt/y	2000	37. (32.- 43.)	110. (88.- 134.)	147. (126.- 171.)	560. (458.- 660.)	325
kt/y	2001	36. (30.- 43.)	95. (66.- 127.)	132. (101.- 161.)	490. (402.- 599.)	325
kt/y	2002	35. (29.- 43.)	78. (62.- 102.)	113. (97.- 139.)	490. (409.- 572.)	325
kt/y	2003	35. (29.- 43.)	79. (63.- 99.)	113. (99.- 138.)	510. (446.- 575.)	325
kt/y	2004	37. (30.- 45.)	84. (69.- 108.)	120. (104.- 144.)	490. (425.- 565.)	325
kt/y	2005	40. (33.- 47.)	85. (69.- 109.)	125. (109.- 146.)	480. (401.- 551.)	325
kt/y	2006	40. (33.- 46.)	83. (64.- 100.)	122. (105.- 140.)	460. (396.- 531.)	325
kt/y	2007	37. (31.- 44.)	78. (59.- 97.)	116. (97.- 135.)	460. (394.- 522.)	319
kt/y	2008	34. (26.- 40.)	75. (55.- 93.)	107. (88.- 126.)	440. (370.- 513.)	315
kt/y	2009	32. (26.- 38.)	73. (53.- 91.)	104. (85.- 123.)	420. (362.- 483.)	164
kt/y	2010	28. (25.- 32.)	79. (61.- 99.)	105. (92.- 127.)	420. (376.- 502.)	13

Table 36: Nitrous oxide emission estimates for IRE, UK, UK+IRE and NWEU with uncertainty (5th – 95th percentile).