Department of Energy and Climate Change

MONITORING OF RADIOACTIVITY IN AIR AND RAINWATER IN THE UK

ANNUAL RESULTS REPORT 2011

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Abstract (100-200 words as desired):

Analysis of samples of atmospheric particulate material and rainwater collected from seven sites in the United Kingdom has continued during 2011. Due to the nuclear incident which occurred at Fukushima, Japan, increases in some radionuclides were detected from March to May. The results presented in this report show the increase in radioactivity measured in air and rain followed by the return to normal levels by June 2011. Outside this period the results are comparable to those reported for 2010 with the trend of slowly declining levels of anthropogenic radioactivity in the environment being generally maintained.

Executive Summary

This report presents the results obtained from the analysis of samples of atmospheric particulate material and rainwater collected from 7 sites around the United Kingdom during 2011.

Samples were analysed for beryllium-7, caesium-137 and (for some sites) a number of other analytes (gross alpha and beta activities, tritium, strontium-90, plutonium-238/239/240 and americium-241).

Where comparison of the 2011 results with previous years has been performed, this has been done by calculating the 10 year running mean and setting the significance level at the mean plus 2 standard deviations. Setting a significance level allows any uncertainties against the measured value to be accounted for and allows identification of elevated radioactivity levels in the presence of declining background.

Due to the nuclear incident which occurred at Fukushima, Japan, increases were detected in some radionuclides (including Caesium-137 and Iodine-131) from March to May. The results presented in this report show the increase in radioactivity followed by the return to normal levels by June 2011. An increased level of monitoring was undertaken during this period to provide information and help understand the impact of the incident. Specific comments on individual 2011 results can be found in the discussion section of this report. Outside the period March to May measurements are comparable with those taken in 2010, continuing the trend of slowly declining levels of anthropogenic radioactivity in the environment.

Monitoring of Radioactivity in Air and Rainwater in the UK
Annual Results Report 2011

Contents

1. Introduction

A programme for monitoring of radioactivity in air and rainwater was established in the United Kingdom (UK) in the 1950's and is currently managed by the Environment Agency (EA) on behalf of DECC (Department of Energy and Climate Change).
The contract to carry out this work was awarded by competitive tender to the Health Protection Agency (HPA) in November 2008. The previous contracts were held by AMEC, Winfrith Environmental Level Laboratory (1999-2008) and AEA-T (and predecessor organisations) who undertook the contract from 1954 to1998. HPA commenced sampling and analysis in January 2009.

Samples of airborne particulates and rainwater are collected at 7 sites in the UK located at Aberporth (Ceredigion, Wales), Chilton (Oxfordshire, England), Orfordness (Suffolk, England) Conlig (Co. Down, N. Ireland), Dishforth (N. Yorkshire, England), Eskdalemuir (Dumfries, Scotland) and Lerwick (Shetland Islands, Scotland). The site locations and sampling programme can be found in Figure 1 and Table 1 respectively. The air and rainwater samples are securely packaged by site staff and returned to HPA Glasgow laboratories for analysis of beryllium-7 (Be-7) caesium-137 (Cs-137) and tritium (H-3) as well as a few other analytes at specific locations.

This report presents the analytical results of samples collected during calendar year 2011. A synopsis of the sampling schedules and analysis methods is given in section 2 and discussed in section 4 of this report. This section also provides a comparison of 2011 data with that from previous years.

In recent years there had been a general decline in the measured levels of anthropogenic radioactivity monitored by this programme. Previous measurements clearly show the influence of atmospheric testing of nuclear weapons (above ground weapons testing officially ceased on 16th October 1980 when a nuclear explosion was carried out at the Lop Nor test site in China) and later the incident at the civil nuclear reactor Chernobyl Unit 4, which took place on 26th April 1986. This resulted in a significant release of radioactivity to the atmosphere. During 2011 due to the nuclear incident at Fukushima, Japan, increased levels of radioactivity were measured from March to May before returning to previous levels by June 2011.

2 Sampling and Analysis

Airborne particulate material and rainwater samples are collected from 7 sites around the UK (Table 1, figure 1) and returned to HPA laboratories in Glasgow for preparation and analysis. Methods are outlined below.

All test methods are accredited by UKAS to the ISO 17025 standard.

2.1 Airborne Particulate Sampling

Atmospheric particulate sampling uses centrifugal fans and motors to pull air through melt-blown Polypropylene air filter material. The filter material has been tested and retains over 99.5% of particulates of 0.423µm aerodynamic diameter and above, under test conditions. Air samplers are housed in wooden cases; the air intake duct is positioned in a vertical position approximately 1metre above the ground to avoid fouling. Air filters are run continuously, excluding a few minutes down-time during the filter change procedure. Filters are changed weekly at 6 of the locations, with the Conlig filter being changed dependent on a defined pressure drop. The mass of air sampled at each site varies depending on the specific performance parameters of the filter motor unit. Normally for each site this is approximately 3000 to 4500 kg/day except at Chilton where approximately 15000 kg/day are sampled.

Air sampling is subject to occasional stoppages for a number of reasons ranging from local interruptions to electricity supply to mechanical failure. Reported results account for these interruptions.

Air filters are generally bulked and analysed quarterly, with the exception of the Chilton filter which is bulked and analysed on a monthly basis. The quarterly Chilton result can be inferred from the monthly results and compared with those from other locations.

2.2 Rainwater sampling

Rainwater samples are collected using polythene funnels which drain into polythene collection bottles ranging in size from 2.5 l (tritium collection), 5 l (quarterly gamma spec.) to 25 l (monthly Aberporth and Chilton gamma spec). A suitable carrier solution is added to the sample bottle directly before deployment in the field to reduce loss by adsorption on to the walls of the sample bottle. The measured samples include all material deposited by wet and dry deposition.

Rainwater samples are collected continuously at all sites and bulked quarterly at HPA labs. In addition, separate monthly samples are taken at Aberporth and Chilton sites, and an annual bulk sample is also taken at Aberporth. Sample collection bottles are deployed at Aberporth, Eskdalemuir and Orfordness for analysis of tritium.

2.3 Radiochemical Analysis

A summary of the sample preparation and analytical methods used is given below.

Individual air filters are bulked and ashed in a muffle furnace before leaching with concentrated mineral acids to extract the radioactivity into solution.

Rainwater samples are filtered prior to evaporation which concentrates the radionuclides. Particulates from the filtered rainwater undergo a leach using concentrated mineral acids to extract the radionuclides into solution which is combined with the evaporated water sample.

Gamma ray emitting radionuclides such as Cs-137 and Be-7 are measured in both air and rainwater samples by placing the prepared sample into a suitable geometry before assessing the activity by high resolution gamma spectrometry.

Sr-90 is determined in a sample by oxalate precipitation followed by purification using a crown-ether resin and then separating and counting of the yttrium-90 daughter products after a suitable period of in-growth.

Gross alpha and gross beta measurements are carried out by evaporating a known volume of the sample on to a stainless steel planchet before assessing the activity with a gas-flow proportional counter.

Plutonium-238/239/240 and Americium-241 are all determined by separation from the sample using various selective ion exchange resins to remove interferants. The purified fractions of the sample are then electro-deposited on to a stainless steel disc and counted by alpha spectrometry.

2.4 Changes and Additions to the Programme

As part of the monitoring undertaken for the nuclear incident which occurred at Fukushima, Japan, a number of the weekly air filter samples collected through March to May were analysed individually, rather than waiting to be bulked over the quarter, thus enabling a faster provision of data, with better temporal resolution and preventing loss of short lived radionuclides through radioactive decay. More frequent analysis of collected rainwater was also undertaken. See section 4.8 for these additional results.

For the normal programme a pre-generated calendar of sample change dates is sent to each site for the start of each year. On occasions these dates change due to a variety of reasons. In addition air filter units can suffer from mechanical failures (drive belt breakage, wear and tear of bearings etc), electrical failures (power cuts etc) and planned interruptions (general site maintenance, filter unit maintenance etc). Where disruptions to the planned programme occur, the changes are reflected in the reported results for each site. Comments for each site are provided below for 2011.

Aberporth

- The air sampler unit broke down on 17th January 2011 and was not able to be replaced until 4th April 2011.
- The frequency of the tritium sample changes increased to weekly due to a request for additional monitoring of the Fukushima incident.
- There were reported stoppages of the air sampling unit on 26th April, 27th and 28th May, 6th to 7th August 2011 due to power outages.
- The air sampler unit stopped on the 8th November 2011 due to a broken drive belt. The unit was brought back into operation by site staff on 22nd December 2011.
- The annual special sample bottle had overflowed during the weekend of 19th to 21st December 2011 due to a full sample bottle. The site was unable to confirm how much sample had been lost.

Chilton

- The frequency of air sampler changes was increased from once to twice weekly from 29th March 2011 due to a request for additional monitoring of the Fukushima incident.
- The January rainwater sampling started on 24th December 2010 to accommodate the festive holiday period. The February rainwater sample bottle was damaged in transit and an unknown amount of the sample was lost. There was sufficient sample left to process and all contract limits of detection were achieved. Improvements have been made to bottle packaging to minimise the chance of this occurring again.

- The quarterly rainwater sample was not changed by the site until 11th April 2011 due to limited staff availability over the holiday period.
- The monthly rainwater sample for April was not changed until the 16th May 2011 which resulted in a reduced sampling period (22 days) for the May sample. A low water volume (410 ml) and recorded rainfall (12.1mm) was noted by the site for the May sample.

Conlig

- As only one rainwater collection system is utilised at Conlig a decision was made to not include the normal rainwater carriers for the samples collected over the period 11th March to 17th May 2011. This was to prevent the potential loss of any radioiodine which may have been present as a result of the Japan incident.
- There was a reported stoppage of the air sampler unit on 14th to 16th July 2011.

Dishforth

- The air sampler unit did not run during Q1 due to a mechanical breakdown in December 2010.
- There were reported stoppages of the air sampling unit on 27th May, 17th to 20th June, 9th to 10th July, 1st to 2nd September, 3rd to 4th October and 5th to 9th December 2011 due to calibration tests, power failures and faulty drive belts.

Eskdalemuir

- The air sampler unit experienced stoppages on the following dates: 4th, 5th, 7th and 8th February and 20th March, 7th, 8th and 23rd May, 13th, 28th and 29th June, 2nd, 6th and 17th July, 2nd and 6th August, 6th, 7th, 29th, 30th October, 19th and 20th and, 25th November, 1st and 25th December2011 due to power failures on site and broken drive belt. Disruptions to the power supply are a common occurrence due to the remote nature of this site.
- The frequency of the tritium sample changes increased to weekly from 29th March due to a request for additional monitoring of the Fukushima incident
- Lower air flow readings were experienced on the air sampler unit on 15th November 2011 due to damage to the air sampler unit housing.

Lerwick

- There were reported stoppages of the air sampler unit on the 13th July and 26th August 2011 as a result of the drive belt failing.

Orfordness

- The tritium sample for this site was used in the additional monitoring undertaken for the Fukushima incident.
- There were reported stoppages of the air sampler on 12th April, 6th to 9th May and 15th November 2011due to broken drive belts.
- There are no results available for the Q2 air sample due to the sampling being lost during processing at the HPA laboratory.
- Low pressure readings were noted by HPA staff on receipt of the air filter for week beginning 25th July 2011.

Where possible, all of the factors above have been accounted for in the final reported results for the relevant samples. Where the duration of a disruption was unknown, HPA staff have made a reasonable estimate based on information provided by site staff. All sites working in GMT have had their high volume air sampler run times compensated accordingly.

3 Calculation and Presentation of Results

Sampling of air and rainwater is carried out by site operators (currently MET Office, Babcock Communications and Northern Ireland Environment Agency staff) and includes a number of factors with associated uncertainties e.g. atmospheric temperature and pressure. These uncertainties have not been considered in this report.

The analytical uncertainties quoted in this report contain an estimate of all sources of uncertainty except those caused by sub-sampling in the analytical process. The uncertainties are calculated at the 95% confidence level.

Limits of detection are calculated following the procedure described by T J Summerling and S C Darby (NRPB R-113) [1] as agreed with the Environment Agency Programme Manager. In addition HPA undertook a comparison of the calculation of decision thresholds and detection levels for radioactive counting experiments between the methods described in ISO 11929-7 [2] and NRPB R-113. For cases where the decision threshold is based on counting statistics of a measured background, it has been demonstrated that the two methods are identical. A document summarising HPA's analysis of the 2 methods has been passed to the Environment Agency Programme Manager [3].

Reported results have been decay corrected to the mid-point of the sampling period and any missed sampling time is accounted for.

For consistency results are presented in a similar format to that produced by the previous contractor.

Statistical data presented in this report have been derived from a database of results produced from 1987 to date. Trending of results is carried out on data collected over a 10 year period (current year plus previous 9 year's results) to produce a 10 year running mean. This is compared to the current year's data and a significance level set at the 10 year running mean plus 2 standard deviations.

All Limits of Detection quoted depend on the collection of an adequate sample size. Air collection disruptions and low rainfall will both reduce the sample size available and thus increase the analytical detection limit.

4 Results and Discussion

4.1 Cs-137 concentrations in air and rainwater

The Cs-137 found in both air particulate and rainwater samples derives from anthropogenic sources including discharges from nuclear installations, fallout from the Chernobyl incident and nuclear weapons testing.

Table 2 shows the Cs-137 results from monthly rainwater and bulked air filter samples at Chilton and monthly rainwater samples at Aberporth. Most rainwater samples at both Chilton and Aberporth were below the analytical limit of detection, as were the Chilton air particulate concentrations. However due to the nuclear incident which occurred at Fukushima, Japan there are some positive results for the months March to May (see also section 4.8).

The monthly airborne particulate results are shown graphically in Figure 2. Figure 3 illustrates the monthly measurements from 1987 until the end of 2011, along with the 10 year running mean. This graph indicates the continued plateau in the airborne concentrations of Cs-137 mentioned in previous annual reports, with results being around or below the limit of detection. It clearly shows the increase in activity as a result of Fukushima. The 10 year mean illustrated does not include the Fukushima data.

Further statistical analysis of the past 10 years data (2002-2011) are presented in Table 2. Most air and rain results from Chilton and most rainwater results from Aberporth are below the significance level. Higher values were recorded in March and April due to the effects of Fukushima. Due to a short count time the December limit of detection was higher than expected.

The results from analysis of airborne particulates for Cs-137 at all the collection sites are shown in Table 3 and illustrated in Figure 4. Most results are below the analytical limit of detection and individual significance levels, although the effect of Fukushima can clearly be seen in the elevated results for Q1 and Q2. The Q1 result from Aberporth has a higher than expected limit of detection due to a small sample size

Tables 4 and 5 display the rainwater concentration and deposition of Cs-137 in quarterly samples. All results are below the analytical limit of detection. All concentration values are below the significance level based on the 10 year mean for each station.

4.2 Be-7 concentrations in air and rainwater

Beyllium-7 is a naturally occurring gamma-emitting radionuclide which is produced during cosmic ray interactions with nitrogen and oxygen in the upper atmosphere. It has a relatively short half-life of 53.2 days and is measured and reported to ensure a consistency in monitoring across the programme; it can also provide a context against which the anthropogenic radioactivity can be compared.

The Be-7 results from Chilton monthly air filter and rainwater samples and the monthly rainwater from Aberporth are shown in Table 6.

Chilton Be-7 results in air range between 0.000491 ± 0.000049 (November) to 0.00135 ± 0.00013 (July) Bq kg^{-1}. These are all below the significance level and 10-year mean. This pattern of results is consistent with previous data, illustrated in Figure 5.

Chilton Be-7 in rain ranges between 0.38 ± 0.23 and 2.52 ± 0.53 Bq l^{-1} for January and March respectively. Chilton March and November Be-7 results are above the significance level. Figure 6 illustrates Be-7 concentrations in Chilton air since 1990 and shows 2011 results are

consistent with previous years. The Aberporth monthly Be-7 results for April exceeds the significance level.
Quarterly Be-7 measurements in air at all sites are shown in Table 7. Excluding the Q1 Aberporth result, all other results are below the significance levels. The slightly elevated Q1 Aberporth result may indicate some atmospheric process causing more efficient mixing of tropospheric air (where Be-7 is produced) with stratospheric air (where the samplers are situated).

The corresponding quarterly Be-7 results in rainwater are shown in Table 8. A similar pattern to the airborne particulate pattern is observed where results are below the significance levels, The situation is less clear with the rainfall data as the levels can be influenced by seasonal variations in rainfall. Table 9 shows the calculated Be-7 deposition results for all sites. It should be noted that periods of low rainfall are known to be associated with elevated levels of Be-7 in rain.

4.3 Other gamma emitting radionuclides

During the analysis of all samples for gamma emitting radionuclides, any artificial nuclides above the detection limit are quantified. Apart from the effects of Fukushima from March to May (see section 4.8), no samples have produced results above the detection limit during 2011. Table 10 shows the annual results for Be-7 and Cs-137 in Chilton rainwater. No other artificial gamma emitting radionuclides were detected.

4.4 Sr-90 concentration in Chilton rainwater

The annual sample for analysis of strontium-90 activity at Chilton was made by bulking the monthly rainwater samples collected during 2011. Results are shown in Table 11.

No Sr-90 was measured in this sample, so was reported at the limit of detection. The result is slightly above the 10-year mean and below the significance level, continuing the downward trend year on year. Strontium in the atmosphere is mainly from anthropogenic sources.

4.5 Gross alpha and gross beta in Chilton rainwater

The annual sample for analysis of gross alpha and beta particle activity at Chilton was made by bulking the monthly rainwater samples collected during 2011. Samples were counted using a low background, gas flow proportional counter. These results are presented in Table 12. Figure 7 illustrates the annual gross beta results from 1996-2011 along with the 10 year running mean.

Gross alpha activity was reported at limit of detection. Gross beta activity was quantified in the sample at very low levels. The gross alpha result is less than the 10 year mean and the significance level. The gross beta is lower than both the 10-year mean and the significant level.

It should be noted that the World Health Organisation guideline value for drinking water is < 0.5 Bq l^{-1} and < 1.0 Bq l^{-1} for gross alpha and gross beta respectively. 2011 results are significantly below this level.

4.6 Pu-238/239/240 and Am-241 in Aberporth air and rainwater

The 2011 results for plutonium-238/239/240 and americium-241 in air particulate and rainwater samples are shown in Table 13.

Analysis of Pu-238/239/240 and Am-241 in air returned a result below the analytical limit of detection. Both Pu-239/240 and Am-241 were quantified in the rainwater sample at very low levels, consistent with previous measurements.

4.7 Tritium in rainwater

Quarterly concentrations of tritium in rainwater are shown in Table 14. All results were below the analytical limit of detection and during 2011 no results were detected above the significance level.

Tritium in the environment can be from natural or anthropogenic sources. Small quantities are produced by cosmic ray reactions with gases in the upper atmosphere, which are then deposited by rain.

4.8 Fukushima nuclear incident monitoring

The individual results for additional monitoring undertaken to understand the effects of the Fukushima reactor incident are shown in tables 15-22. The air particulate results show the presence of the short-lived radionuclides Iodine-131, Iodine-132 and Tellurium-132 and the longer lived radionuclides Caesium-134 and Caesium-137. Where individual weekly measurements were made at the end of May it can be seen that the levels of these nuclides all decreased to below the normal analytical limit of detection. The only finite result found in rainwater was 0.89 ± 0.33 Bql^{-1} I-131 at Eskdalemuir collected between 28th and 31st March 2011.

Some influence of the Fukushima incident can be seen in the normal bulked quarterly air particulate results for Quarter 1 and Quarter 2 through the presence of Cs-137 at low, but quantifiable levels. The Cs-137 was being sampled at the end of Quarter 1 and the beginning of Quarter 2 as evidenced by the individual results presented in tables 15-22. As it has a half life of approximately 30 years, it is still present at the time all the filters for the quarter were bulked and re-analysed. By this point any short lived radionuclides had decayed away.

5 Conclusion

Samples of rainwater and airborne particulates have been collected during 2011 for seven sites around the UK. There were some disruptions to the sampling programme due to mechanical and electrical failures of air samplers and some variable collection periods for rainwater samples. Overall these were of a minor nature allowing a large dataset to be collected for 2011.

Samples were analysed for beryllium-7, caesium-137 and (for some sites) a number of other analytes (gross alpha and beta activity, tritium, strontium-90, plutonium-239/240 and americium-241).

Beryllium-7 results were broadly similar to recent historic values with only one result just exceeding the significance level.

For Cs-137, most air and rainwater results were below the analytical limit of detection. Results were comparable to the 10-year means and no results required further investigation or explanation when compared to the significance level.

Comparison of the 2011 results with those from previous years has been done where possible by calculating the 10 year running mean and setting a significance level at the mean plus 2 standard deviations. This helps to account for results which are close to the analytical detection limits, where uncertainties are large compared to the result. The significance level allows identification of any comparatively high levels of radioactivity in the presence of declining background levels.

The results show that there was a temporary increase in the measured levels of anthropogenic radioactivity in air particulate and rainwater samples taken during 2011 due to the Fukushima incident. Following this incident measured levels returned to normal.

Outside the period March to May the results are comparable to the previous 10 year's data and show a continuing decline of anthropogenic radioactivity in the environment.

6 References

1. Statistical Aspects of the Interpretation of Counting Experiments Designed to Detect Low Levels of Radioactivity, T J Summerling and S C Darby, NRPB R-113

2. International Standards Organisation. Determination of the detection limits and decision threshold for ionizing radiation measurements — Part 7: Fundamentals and general applications. ISO/FDIS11929-7.

3. Davidson M, A comparison of two methods for calculating limits of detection for measurements of radioactivity- HPA internal document (November 2008).

4. AA Dale/DEFRA, Monitoring of Radioactivity in Air and Rainwater in the UK, Annual Results Report 2008, DEFRA/RWP/09.001 (July 2009)

5. L Mitchell/DECC, Monitoring of Radioactivity in Air and Rainwater in the UK, Annual Results Report 2009, HPA/MR/4/6602

6. L Mitchell/DECC, Monitoring of Radioactivity in Air and Rainwater in the UK, Annual Results Report 2010, HPA/MR/4/6661

Table 1 Sampling Programme

Airborne Particulates

Station	Latitude	Longitude	Height above ground	Sampling Frequency
Lerwick, Shetland	N60^{o}:08':20"	W1^{o}:11':01"	approx. 1m	weekly
Eskdalemuir, Dumfries	N55^{o}:18':43"	W3^{o}:12':22"	approx. 1m	weekly
Conlig, Co Down	N54^{o}:37':50"	W5^{o}:40':56"	approx. 1m	weekly*
Dishforth, N Yorks	N54^{o}:08':05"	W1^{o}:24':52"	approx. 1m	weekly
Orfordness, Suffolk	N52^{o}:06':18"	W1^{o}:35':03"	approx. 1m	weekly
Aberporth, Ceredigion	N52^{o}:08':23"	W4^{o}:34':11"	approx. 1m	weekly
Chilton, Oxon	N51^{o}:34':23"	W1^{o}:18':34"	approx. 1m	weekly

* The air filter at Conlig is monitored twice-weekly and changed if airflow falls by 30% of its original value.

Rainwater

Station	Latitude	Longitude	approx. mean annual rainfall (mm)	Sampling Frequency
Lerwick, Shetland	N60^{o}:08':20"	W1^{o}:11':01"	1260	quarterly
Eskdalemuir, Dumfries	N55^{o}:18':43"	W3^{o}:12':22"	1840	quarterly
Conlig, Co Down	N54^{o}:37':50"	W5^{o}:40':56"	935	quarterly
Dishforth, N Yorks	N54^{o}:08':05"	W1^{o}:24':52"	655	quarterly
Orfordness, Suffolk	N52^{o}:06':18"	W1^{o}:35':03"	600	quarterly
Aberporth, Ceredigion	N52^{o}:08':23"	W4^{o}:34':11"	930	quarterly & monthly
Chilton, Oxon	N51^{o}:34':23"	W1^{o}:18':34"	745	quarterly & monthly

Table 2 Monthly Cs-137 concentrations at Chilton and Aberporth

Sampling Period 2011	Chilton			Aberporth	
	Cs-137 in air (Bq kg^{-1})	Rainfall (mm)	Cs-137 in rain (Bq l^{-1})	Rainfall (mm)	Cs-137 in rain (Bq l^{-1})
Jan	< 0.00000020	103.4	< 0.0080	88.6	< 0.0022
Feb	< 0.00000018	47.8	< 0.012	52.2	< 0.012
Mar	0.00000207 ± 0.00000031	6.2	< 0.020	23.8	< 0.019
Apr	0.00000443 ± 0.00000050	41.2	< 0.020	19.4	0.045 ± 0.025
May	0.00000048 ± 0.00000019	12.1	< 0.18	41.7	< 0.017
Jun	< 0.00000018	39.1	< 0.0062	95.5	< 0.012
Jul	< 0.00000012	48.1	< 0.014	49.8	< 0.020
Aug	< 0.000000096	44.3	< 0.0091	57.4	< 0.013
Sep	< 0.000000083	69.2	< 0.0078	62.5	< 0.0078
Oct	< 0.00000018	26.5	< 0.017	86.4	< 0.0073
Nov	< 0.00000020	25.0	< 0.017	66.8	< 0.0068
Dec	< 0.00000081	99.0	< 0.0060	141.8	< 0.0091
Annual mean	0.000000752 ± 0.000000069	-	< 0.026	-	0.0143 ± 0.0029
10 year mean	0.00000046	-	0.015	-	0.012
10 year mean exc Fukushima	0.00000041	-	-	-	-
Significance Level	0.00000074	-	0.053	-	0.038

Note: 'less than' values are taken to be the reported result for the calculation of annual and 10 year mean values. Significance values are based on the mean plus 2 standard deviations. For Chilton, the April 2007 rainwater result has been excluded from running mean due to an unavoidably high limit of detection. Due to the positive Chilton air filter results in March and April 2011 being due to the Fukushima incident a 10 year mean has been calculated with and without them. For Aberporth the positive rainwater result in April 2011 due to Fukushima has been excluded from the running mean.

Table 3 Quarterly concentration of Cs-137 in air at all sites

Sample station	Cs-137 in air (Bq kg^{-1})				10 year mean (Bq kg^{-1})	10 year mean exc Fukushima (Bq kg^{-1})	Significance level (Bq kg^{-1})
	Q1	**Q2**	**Q3**	**Q4**			
AB	< 0.0000040	0.00000131 ± 0.00000051	< 0.00000064	< 0.00000081	0.00000067	-	0.0000012
CH	0.00000082 ± 0.00000022	0.00000170 ± 0.00000018	< 0.0000010	< 0.00000040	0.00000064	0.00000061	0.0000011
CO	< 0.0000010	0.00000228 ± 0.00000064	< 0.00000054	< 0.00000015	0.00000075	0.00000071	0.0000012
DI	-	0.00000119 ± 0.00000078	< 0.0000010	< 0.00000079	0.00000073	-	0.0000011
ES	< 0.0000010	0.00000296 ± 0.00000074	< 0.0000010	< 0.00000094	0.00000068	0.00000062	0.0000011
LE	0.00000169 ± 0.00000078	0.00000305 ± 0.00000095	< 0.00000060	< 0.00000065	0.00000080	0.00000072	0.0000013
OR	< 0.0000010	-	< 0.00000055	< 0.00000087	0.00000081	-	0.0000011

Note: The following results have been excluded from the running mean. For Aberporth the Q1 result has been excluded due to an unavoidably high Limit of Detection as a result of a small sample. For Chilton, Conlig, Eskdalemuir and Lerwick 10 year means have been calculated with and without the positive results due to the Fukushima incident.

Table 4 Quarterly concentration of Cs-137 in rainwater at all sites

Sample station	Cs-137 in rainwater (Bq l^{-1})				10 year mean (Bq l^{-1})	Significance level (Bq l^{-1})
	Q1	**Q2**	**Q3**	**Q4**		
AB	< 0.020	< 0.013	< 0.011	< 0.018	0.039	0.11
CH	< 0.033	< 0.020	< 0.020	< 0.015	0.039	0.098
CO	< 0.012	< 0.020	< 0.020	< 0.019	0.029	0.068
DI	< 0.018	< 0.011	< 0.018	< 0.017	0.039	0.098
ES	< 0.012	< 0.014	< 0.012	< 0.012	0.015	0.032
LE	< 0.016	< 0.018	< 0.016	< 0.015	0.026	0.056
OR	< 0.020	< 0.021	< 0.014	< 0.015	0.054	0.12

Table 5 Quarterly Cs-137 deposition by rainwater at all sites

Sample Station	**Q1**		**Q2**		**Q3**		**Q4**	
	Rainfall (mm)	Cs-137 (Bq m^{-2})	Rainfall (mm)	Cs-137 (Bq m^{-2})	Rainfall (mm)	Cs-137 (Bq m^{-2})	Rainfall (mm)	Cs-137 (Bq m^{-2})
AB	76.8	< 1.5	115.1	< 1.5	255.8	< 2.8	296.2	< 5.3
CH	157.4	< 5.2	92.4	< 1.8	161.4	< 3.2	150.5	< 2.3
CO	203.6	< 2.4	205.5	< 4.1	246.5	< 4.9	315.7	< 6.0
DI	102.2	< 1.8	103.6	< 1.1	176.8	< 3.2	197.2	< 3.4
ES	740.6	< 8.9	437.9	< 6.1	558.5	< 6.7	766.9	< 9.2
LE	278.3	< 4.5	218.4	< 3.9	253.6	< 4.1	288.2	< 4.3
OR	118.0	< 2.4	137.5	< 2.9	120.8	< 1.7	67.5	< 1.0

Table 6 Monthly Be-7 concentrations at Chilton and Aberporth

Sampling Period 2011	Chilton			Aberporth	
	Be-7 in air (Bq kg^{-1})	Rainfall (mm)	Be-7 rain (Bq l^{-1})	Rainfall (mm)	Be-7 in rain (Bq l^{-1})
Jan	0.000793 ± 0.000084	103.4	0.38 ± 0.23	88.6	0.84 ± 0.11
Feb	0.000570 ± 0.000061	47.8	1.20 ± 0.35	52.2	0.62 ± 0.21
Mar	0.00108 ± 0.00012	6.2	2.52 ± 0.53	23.8	1.04 ± 0.31
Apr	0.000645 ± 0.000068	41.2	0.65 ± 0.23	19.4	3.68 ± 0.95
May	0.00118 ± 0.00013	12.1	< 2.7	41.7	1.73 ± 0.52
Jun	0.000731 ± 0.000076	39.1	0.43 ± 0.14	95.5	1.55 ± 0.47
Jul	0.00135 ± 0.00013	48.1	1.45 ± 0.62	49.8	1.29 ± 0.40
Aug	0.000572 ± 0.000056	44.3	0.46 ± 0.25	57.4	1.07 ± 0.38
Sep	0.00131 ± 0.00013	69.2	0.85 ± 0.26	62.5	1.36 ± 0.29
Oct	0.000790 ± 0.000079	26.5	< 0.68	86.4	0.49 ± 0.26
Nov	0.000491 ± 0.000049	25.0	2.48 ± 0.67	66.8	0.98 ± 0.25
Dec	0.000713 ± 0.000082	99.0	0.48 ± 0.15	141.8	0.50 ± 0.18
Annual mean	0.000852 ± 0.000027	-	1.19 ± 0.17	-	1.26 ± 0.12
10 year mean	0.00153	-	0.93	-	1.4
Significance Level	0.00255	-	2.01	-	2.9

Note: For Chilton the April 2007 rainwater result has been excluded from running mean due to an outlying result

Table 7 Quarterly concentrations of Be-7 in airborne particulates

Sample station	Be-7 in air (Bq kg^{-1})				Annual mean (Bq kg^{-1})	Significance level (Bq kg^{-1})
	Q1	**Q2**	**Q3**	**Q4**		
AB	0.00324 ± 0.00042	0.000525 ± 0.000061	0.00102 ± 0.00011	0.00140 ± 0.00016	0.00155 ± 0.00012	0.0030
CH	0.00081 ± 0.00011	0.000852 ± 0.000055	0.001077 ± 0.000064	0.000665 ± 0.000042	0.000851 ± 0.000036	0.0049
CO	0.000819 ± 0.000098	0.000339 ± 0.000042	0.00104 ± 0.00012	0.000819 ± 0.000080	0.000754 ± 0.000059	0.0029
DI	-	0.000466 ± 0.000060	0.000575 ± 0.000081	0.000648 ± 0.000076	0.000563 ± 0.000032	0.0021
ES	0.00101 ± 0.00012	0.000728 ± 0.000083	0.00103 ± 0.00012	0.00130 ± 0.00015	0.001017 ± 0.000066	0.0022
LE	0.00106 ± 0.00013	0.000518 ± 0.000063	0.00126 ± 0.00014	0.00109 ± 0.00013	0.000982 ± 0.000060	0.0023
OR	0.00089 ± 0.00010	-	0.00111 ± 0.00013	0.00127 ± 0.00016	0.001090 ± 0.000057	0.0031

Table 8 Quarterly concentrations of Be-7 in rainwater at all sites

Sample station	Be-7 in rain (Bq l^{-1})				Annual mean (Bq l^{-1})	Significance level (Bq l^{-1})
	Q1	**Q2**	**Q3**	**Q4**		
AB	1.56 ± 0.51	1.45 ± 0.38	0.55 ± 0.31	1.66 ± 0.65	1.31 ± 0.24	2.5
CH	< 0.89	0.99 ± 0.58	0.61 ± 0.54	0.93 ± 0.45	0.86 ± 0.26	3.0
CO	0.79 ± 0.38	1.14 ± 0.56	0.80 ± 0.49	0.86 ± 0.47	0.90 ± 0.24	2.4
DI	1.04 ± 0.25	1.71 ± 0.35	< 0.43	1.09 ± 0.53	1.07 ± 0.18	4.0
ES	0.97 ± 0.27	1.30 ± 0.33	1.69 ± 0.41	1.59 ± 0.49	1.39 ± 0.19	1.9
LE	1.42 ± 0.48	2.58 ± 0.54	0.67 ± 0.37	< 0.57	1.31 ± 0.22	2.7
OR	1.28 ± 0.59	2.42 ± 0.40	1.00 ± 0.41	1.10 ± 0.39	1.45 ± 0.23	3.7

Table 9 Quarterly Be-7 deposition by rainwater at all sites

Sample Station	**Q1**		**Q2**		**Q3**		**Q4**	
	Rainfall (mm)	Be-7 (Bq m^{-2})	Rainfall (mm)	Be-7 (Bq m^{-2})	Rainfall (mm)	Be-7 (Bq m^{-2})	Rainfall (mm)	Be-7 (Bq m^{-2})
AB	76.8	120 ± 39	115.1	167 ± 44	255.8	141 ± 79	296.2	490 ± 200
CH	157.4	< 140	92.4	91 ± 54	161.6	99 ± 88	150.5	140 ± 68
CO	203.6	161 ± 77	205.5	230 ± 120	246.5	200 ± 130	315.7	270 ± 150
DI	102.2	106 ± 26	103.6	177 ± 36	176.8	< 76	197.2	220 ± 110
ES	740.6	720 ± 200	437.9	570 ± 150	558.5	940 ± 230	766.9	1220 ± 380
LE	278.3	390 ± 140	218.4	560 ± 120	253.6	170 ± 94	288.2	<170
OR	118.0	151 ± 70	137.5	333 ± 55	120.8	121 ± 50	67.5	74 ± 26

Table 10 Annual concentrations of gamma emitting radionuclides in Chilton rainwater

Sample station	Radionuclide activity (Bq l^{-1})	
	Be-7	**Cs-137**
Chilton	2.23 ± 0.37	< 0.00070
10-year mean	2.23 ± 0.13	< 0.0018
Significance level (+2σ)	3.1	< 0.0033

Table 11 Annual concentration and deposition of Sr-90 in Chilton rainwater

Sample station	Sr-90 in rain (Bq l^{-1})	10 year mean (Bq l^{-1})	Significance level (Bq l^{-1})	Rainfall (mm)	Sr-90 deposition (Bq m^{-2})
Chilton	< 0.0013	0.0016	0.0061	561.9	< 0.73

Table 12 Annual concentration of gross alpha and gross beta in Chilton rainwater

Sample station	Gross alpha (Bq l^{-1})	Gross beta (Bq l^{-1})
Chilton	< 0.033	0.040 ± 0.030
10 year mean	0.040	0.10
Significance level (+2σ)	0.072	0.20

Table 13 Annual concentrations of Pu-238,239+240 and Am-241 in Aberporth air particulates and rainwater

Sample station	Air		
	Pu 238 (Bq kg^{-1})	Pu 239+240 (Bq kg^{-1})	Am-241 (Bq kg^{-1})
Aberporth	< 0.0000000030	< 0.0000000030	< 0.0000000030
10 year mean	-	0.00000000094	0.0000000026
Significance level (+2σ)	-	0.0000000026	0.0000000093

Sample station	Rain			
	Rainfall (mm)	Pu 238 (Bq l^{-1})	Pu 239+240 (Bq l^{-1})	Am-241 (Bq l^{-1})
Aberporth	746	< 0.0000020	0.0000040 ± 0.0000019	0.0000132 ± 0.0000057
10 year mean		-	0.000020	0.000039
Significance level (+2σ)		-	0.000066	0.000124

Table 14 Quarterly tritium concentrations in rainwater

Sample station	Q1 H-3 (Bq l^{-1})	Q2 H-3 (Bq l^{-1})	Q3 H-3 (Bq l^{-1})	Q4 H-3 (Bq l^{-1})	10 year mean (Bq l^{-1})	Significance level (+2σ) (Bq l^{-1})
Aberporth	< 0.91	< 1.0	< 0.94	< 0.87	1.2	2.4
Eskdalemuir	< 0.91	< 1.0	< 0.94	< 0.88	1.5	4.1
Orfordness	< 0.87	< 1.0	< 0.94	< 0.87	1.1	2.4

Table 15 Plutonium 238 and 239/240 in EURATOM, Chilton air filters

HPA Sample Reference	Site sample description	Pu-238 (Bqkg-1)	Pu-239/240 (Bqkg-1)
11-7007	Chilton- March	< 0.0000000011	< 0.0000000011
11-7008	Chilton- April	< 0.0000000011	< 0.0000000011
11-7009	Chilton- May	< 0.0000000013	< 0.0000000013

Table 16 Japan Incident Monitoring – Aberporth Results

HPA Sample Reference	Sample Details	Radionuclide (Bq kg^{-1} air)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/106	Air filter 04/04/2011 to 11/04/2011	0.0000816 ± 0.0000090	< 0.0000039	< 0.0000058	0.0000311 ± 0.0000031	0.0000336 ± 0.0000036
JP/122	Air filter 11/04/2011 to 18/04/2011	0.0001682 ± 0.0000017	< 0.0000027	< 0.0000038	0.00000816 ± 0.00000080	0.00000833 ± 0.00000098
JP/154	Air filter 18/04/2011 to 26/04/2011	0.0000144 ± 0.0000046	< 0.000021	< 0.000025	0.0000072 ± 0.0000011	0.0000076 ± 0.0000018
JP/165	Air filter 26/04/2011 to 03/05/2011	0.0000055 ± 0.0000033	< 0.0000090	< 0.000012	0.0000104 ± 0.0000013	0.0000121 ± 0.0000019
JP/174	Air filter 03/05//2011 to 09/05/2011	< 0.0000017	< 0.0000048	< 0.0000059	0.00000222 ± 0.00000042	0.00000256 ± 0.00000080
JP/186	Air filter 31/05/2011 to 06/06/2011	< 0.0000018	< 0.0000031	< 0.0000039	< 0.0000013	< 0.0000011
HPA Sample Reference	Sample Details	Radionuclide (Bql^{-1} rainwater)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/36	Rainwater 04/01/2011 to 29/03/2011	< 8.6	Not Measured	Not Measured	Not Measured	< 1.8
JP/87	Rainwater 29/03/2011 to 05/04/2011	0.78 ± 0.55	< 2.6	< 3.2	< 0.35	< 0.40
JP/176	Rainwater 03/05/2011 to 09/05/2011	< 0.37	< 0.96	< 1.4	< 0.13	< 0.19

Table 17 Japan Incident Monitoring – Chilton Results

HPA Sample Reference	Sample Details	Radionuclide (Bq kg^{-1} air)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/04	Air filter 28/02/2011 to 07/03/2011	< 0.0000049	Not Measured	Not Measured	Not Measured	< 0.00000051
JP/05	Air filter 07/03/2011 to 14/03/2011	< 0.0000026	Not Measured	Not Measured	Not Measured	< 0.00000049
JP/47	Air filter 14/03/2011 to 21/03/2011	< 0.0000052	Not Measured	Not Measured	Not Measured	< 0.00000098
JP/74	Air filter 21/03/2011 to 28/03/2011	0.000069 ± 0.000015	< 0.0000073	< 0.0000071	0.00000271 ± 0.00000061	0.00000249 ± 0.00000071
JP/82	Air filter 28/03/2011 to 31/03/2011	0.00070 ± 0.00015	< 0.000021	< 0.000024	0.0000367 ± 0.0000078	0.0000376 ± 0.0000090
JP/86	Air filter 31/03/2011 to 04/04/2011	0.000153 ± 0.000031	< 0.0000038	< 0.0000042	0.0000201 ± 0.0000041	0.0000241 ± 0.0000050
JP/102	Air filter 04/04/2011 to 07/04/2011	0.000300 ± 0.000061	< 0.0000078	< 0.0000074	0.000049 ± 0.000011	0.000059 ± 0.000012
JP/109	Air filter 07/04/2011 to 11/04/2011	0.000168 ± 0.000034	< 0.0000064	< 0.0000080	0.0000416 ± 0.0000090	0.0000400 ± 0.0000090
JP/126	Air filter 11/04/2011 to 14/04/2011	0.000076 ± 0.000016	< 0.000022	< 0.000027	0.0000178 ± 0.0000038	0.0000176 ± 0.0000040
JP/142	Air filter 14/04/2011 to 18/04/2011	0.0000378 ± 0.0000078	< 0.0000098	< 0.000011	0.0000151 ± 0.0000031	0.0000149 ± 0.0000031
JP/145	Air filter 18/04/2011 to 21/04/2011	0.0000196 ± 0.0000044	< 0.0000060	< 0.0000061	0.0000069 ± 0.0000015	0.0000080 ± 0.0000018
JP/166	Air filter 21/04/2011 to 26/04/2011	0.0000074 ± 0.0000035	< 0.000034	< 0.000033	0.0000059 ± 0.0000013	0.0000060 ± 0.0000016
JP/179	Air filter 26/04/2011 to 03/05/2011	0.0000041 ± 0.0000032	< 0.000030	< 0.000029	0.0000113 ± 0.0000024	0.0000120 ± 0.0000026

Table 18 Japan Incident Monitoring – Conlig Results

HPA Sample Reference	Sample Details	Radionuclide (Bq kg^{-1} air)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/59	Air filter 30/12/2010 to 31/03/2011	(see note below)				
JP/76	Air filter 31/03/2011 to 03/04/2011	0.000227 ± 0.000023	< 0.0000098	< 0.000011	0.0000281 ± 0.0000032	0.0000294 ± 0.0000043
JP/85	Air filter 03/04/2011 to 09/04/2011	0.000302 ± 0.000029	0.0000067 ± 0.0000035	0.0000045 ± 0.0000021	0.000115 ± 0.000011	0.000109 ± 0.000011
JP/110	Air filter 09/04/2011 to 16/04/2011	0.0000479 ± 0.0000052	< 0.0000033	< 0.0000044	0.0000228 ± 0.0000023	0.0000207 ± 0.0000025
JP/143	Air filter 16/04/2011 to 23/04/2011	0.0000125 ± 0.0000020	< 0.0000047	< 0.0000059	0.00000531 ± 0.00000055	0.00000629 ± 0.00000090
JP/172	Air filter 23/04/2011 to 08/05/2011	0.0000022 ± 0.0000014	< 0.0000068	< 0.0000078	0.00000857 ± 0.00000090	0.0000087 ± 0.0000011
HPA Sample Reference	Sample Details	Radionuclide (Bql^{-1} rainwater)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/118	Rainwater 31/03/2011 to 16/04/2011	< 0.54	< 2.4	< 2.4	< 0.19	< 0.20

Note: The Conlig filter, HPA sample reference JP/59 had been running for 3 months at date of analysis. Although radioactivity was detected on the filter, this was likely to have been deposited towards the end of the collection period, in line with other air monitoring data observed around the UK. Standard practice is to decay correct short lived nuclides to the midpoint of the collection period. That is inappropriate in this case and will lead to analytical results which suggest very high concentrations of short lived radionuclides. For completeness the total activity of selected radionuclides on the filter at the end of the run period (31/03/11) was:

I-131 6.96 ± 0.67 Bq/filter
Cs-134 0.452 ± 0.057 Bq/filter
Cs-137 0.563 ± 0.083 Bq/filter

Table 19 Japan Incident Monitoring – Dishforth Results

HPA Sample Reference	Sample Details	Radionuclide (Bq kg^{-1})				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/103	Air filter 06/04/2011 to 11/04/2011	0.000111 ± 0.000012	< 0.0000053	< 0.0000078	0.0000370 ± 0.0000041	0.0000372 ± 0.0000047
JP/155	Air filter 11/04/2011 to 18/04/2011	0.0000139 ± 0.0000090	< 0.000073	< 0.00019	0.0000067 ± 0.0000011	0.0000069 ± 0.0000020
JP/156	Air filter 18/04/2011 to 26/04/2011	< 0.0000022	< 0.000016	< 0.000022	0.00000207 ± 0.00000065	0.00000236 ± 0.00000069
JP/167	Air filter 26/04/2011 to 03/05/2011	0.0000037 ± 0.0000029	< 0.000011	< 0.000016	0.0000090 ± 0.0000012	0.0000083 ± 0.0000020
JP/180	Air filter 03/05/2011 to 09/05/2011	< 0.0000047	< 0.000017	< 0.000025	0.00000286 ± 0.00000098	0.0000033 ± 0.0000020
JP/184	Air filter 09/05/2011 to 16/05/2011	< 0.0000024	< 0.0000061	< 0.0000090	< 0.0000015	< 0.0000013

Table 20 Japan Incident Monitoring – Eskdalemuir Results

HPA Sample Reference	Sample Details	Radionuclide (Bq kg^{-1} air)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/48	Air filter 21/03/2011 to 28/03/2011	0.0000048 ± 0.0000022	Not Measured	Not Measured	Not Measured	< 0.00000090
JP/77	Air filter 28/03/2011 to 04/04/2011	0.000300 ± 0.000029	0.0000109 ± 0.0000051	0.0000087 ± 0.0000026	0.0000379 ± 0.0000037	0.0000451 ± 0.0000045
JP/107	Air filter 04/04/2011 to 11/04/2011	0.000100 ± 0.000011	< 0.000014	< 0.000017	0.0000504 ± 0.0000049	0.0000505 ± 0.0000054
JP/123	Air filter 11/04/2011 to 18/04/2011	0.0000166 ± 0.0000020	< 0.0000035	< 0.0000044	0.00000963 ± 0.00000098	0.0000093 ± 0.0000011
JP/157	Air filter 18/04/2011 to 25/04/2011	0.0000086 ± 0.0000042	< 0.000022	< 0.000028	0.00000514 ± 0.00000090	0.0000049 ± 0.0000016
JP/168	Air filter 25/04/2011 to 02/05/2011	0.0000053 ± 0.0000029	< 0.000011	< 0.000014	0.0000186 ± 0.0000020	0.0000182 ± 0.0000024
JP/175	Air filter 02/05/2011 to 09/05/2011	< 0.0000016	< 0.0000052	< 0.0000066	0.00000404 ± 0.00000052	0.00000441 ± 0.00000098
JP/183	Air filter 09/05/2011 to 16/05/2011	< 0.0000017	< 0.0000042	< 0.0000056	< 0.00000098	< 0.00000082
HPA Sample Reference	Sample Details	Radionuclide (Bql^{-1} rainwater)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/61	Rainwater 28/03/2011 to 31/03/2011	0.89 ± 0.33	Not Measured	Not Measured	Not Measured	< 0.19
JP/88	Rainwater 31/03/2011 to 11/04/2011	< 0.42	< 1.3	< 1.3	< 0.16	< 0.16
JP/138	Rainwater 11/04/2011 to 18/4/2011	< 0.32	< 2.1	< 2.7	< 0.24	< 0.22
JP/177	Rainwater 25/04/2011 to 09/05/2011	< 0.33	< 1.5	< 1.9	< 0.13	< 0.12

Table 21 Japan Incident Monitoring – Lerwick Results

HPA Sample Reference	Sample Details	Radionuclide (Bq kg^{-1} air)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/03	Air filter 14/03/2011 to 21/03/2011	< 0.0000020	Not Measured	Not Measured	Not Measured	< 0.00000090
JP/26A	Air filter 21/03/2011 to 28/03/2011	0.000673 ± 0.000063	0.0000337 ± 0.0000060	0.0000246 ± 0.0000038	0.0000331 ± 0.0000033	0.0000407 ± 0.0000042
JP/78	Air filter 28/03/2011 to 04/04/2011	0.000255 ± 0.000026	< 0.0000057	< 0.0000065	0.0000530 ± 0.0000051	0.0000536 ± 0.0000056
JP/104	Air filter 04/04/2011 to 11/04/2011	0.000118 ± 0.000013	< 0.0000050	< 0.0000073	0.0000435 ± 0.0000043	0.0000458 ± 0.0000051
JP/127	Air filter 11/04/2011 to 18/04/2011	0.0000158 ± 0.0000023	< 0.0000044	< 0.0000067	0.00000898 ± 0.00000098	0.0000098 ± 0.0000014
JP/158	Air filter 18/04/2011 to 25/04/2011	0.0000176 ± 0.0000052	< 0.000022	< 0.000030	0.0000086 ± 0.0000012	0.0000097 ± 0.0000018
JP/169	Air filter 25/04/2011 to 02/05/2011	< 0.0000045	< 0.000018	< 0.000028	0.0000112 ± 0.0000016	0.0000124 ± 0.0000017
JP/181	Air filter 02/05/2011 to 09/05/2011	< 0.0000040	< 0.000018	< 0.000021	0.00000247 ± 0.00000073	< 0.0000011
JP/187	Air filter 31/05/2011 to 06/06/2011	< 0.0000026	< 0.0000090	< 0.000013	< 0.0000014	< 0.0000011

Table 22 Japan Incident Monitoring – Orfordness Results

HPA Sample Reference	Sample Details	Radionuclide (Bq kg^{-1} air)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/49	Air filter 21/03/2011 to 28/03/2011	0.0000432 ± 0.0000045	Not Measured	Not Measured	0.00000144 ± 0.00000048	0.00000187 ± 0.00000067
JP/79	Air filter 28/03/2011 to 04/04/2011	0.000132 ± 0.000013	< 0.0000016	< 0.0000020	0.0000143 ± 0.0000016	0.0000184 ± 0.0000020
JP/108	Air filter 04/04/2011 to 11/04/2011	0.000109 ± 0.000011	< 0.0000098	< 0.000013	0.0000428 ± 0.0000041	0.0000434 ± 0.0000044
JP/124	Air filter 11/04/2011 to 18/04/2011	0.0000313 ± 0.0000032	< 0.0000028	< 0.0000036	0.0000141 ± 0.0000014	0.0000126 ± 0.0000013
JP/159	Air filter 18/04/2011 to 25/04/2011	0.0000113 ± 0.0000033	< 0.000019	< 0.000020	0.00000776 ± 0.00000098	0.0000089 ± 0.0000014
JP/170	Air filter 26/04/2011 to 03/05/2011	0.0000033 ± 0.0000017	< 0.0000078	< 0.0000098	0.00000833 ± 0.00000098	0.0000082 ± 0.0000013
JP/182	Air filter 03/05/2011 to 09/05/2011	< 0.0000038	< 0.000015	< 0.000020	0.00000343 ± 0.00000090	0.0000036 ± 0.0000017
JP/185	Air filter 09/05/2011 to 16/05/2011	< 0.0000015	< 0.0000040	< 0.0000049	0.00000114 ± 0.00000029	0.00000072 ± 0.00000052
JP/188	Air filter 31/05/2011 to 06/06/2011	< 0.0000022	< 0.0000074	< 0.0000098	< 0.0000011	< 0.00000098
HPA Sample Reference	Sample Details	Radionuclide (Bql^{-1} rainwater)				
		I-131	Te-132	I-132	Cs-134	Cs-137
JP/56	Rainwater 04/01/2011 to 29/03/2011	< 19	Not Measured	Not Measured	Not Measured	Not Measured

Figure 1 Sampling Station Locations

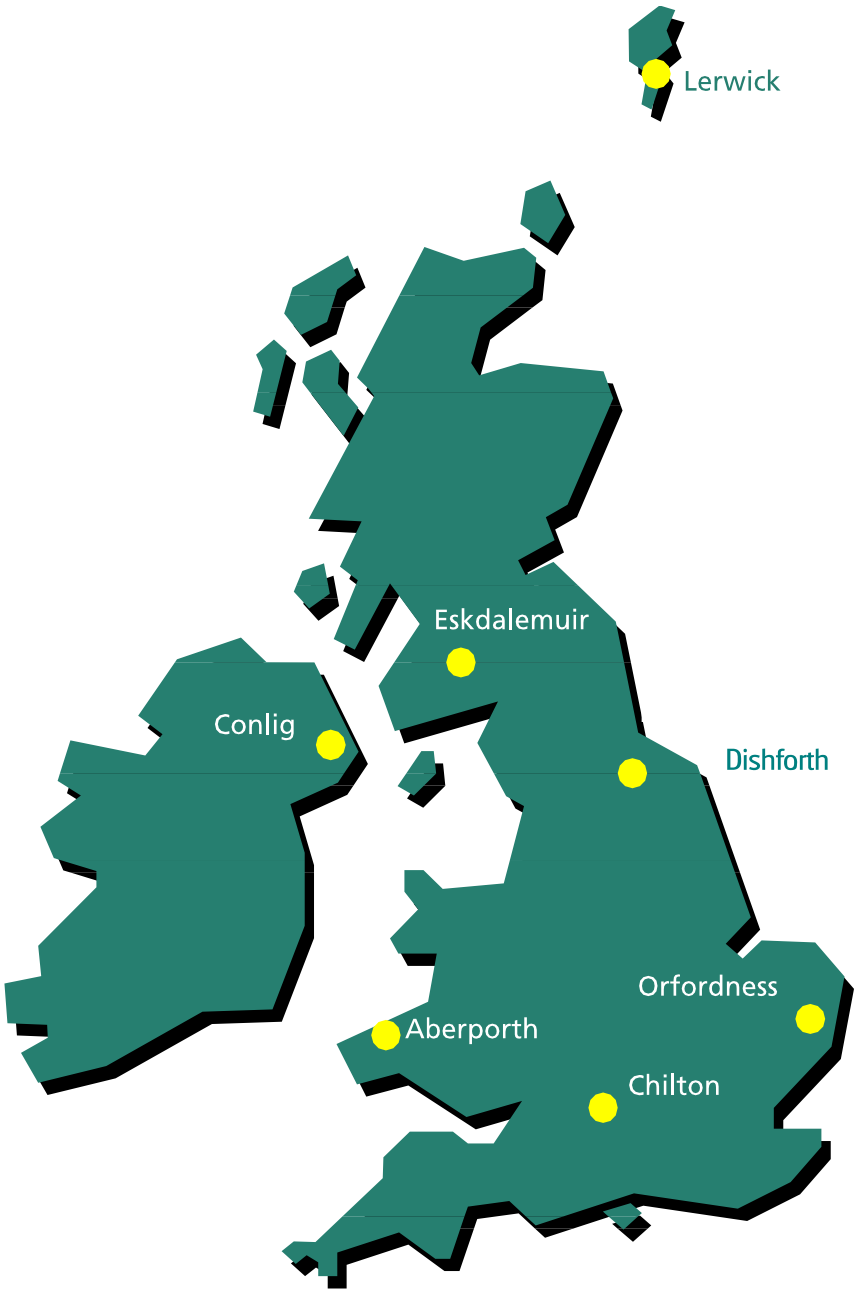

Figure 2 Monthly Cs-137 concentrations in air at Chilton

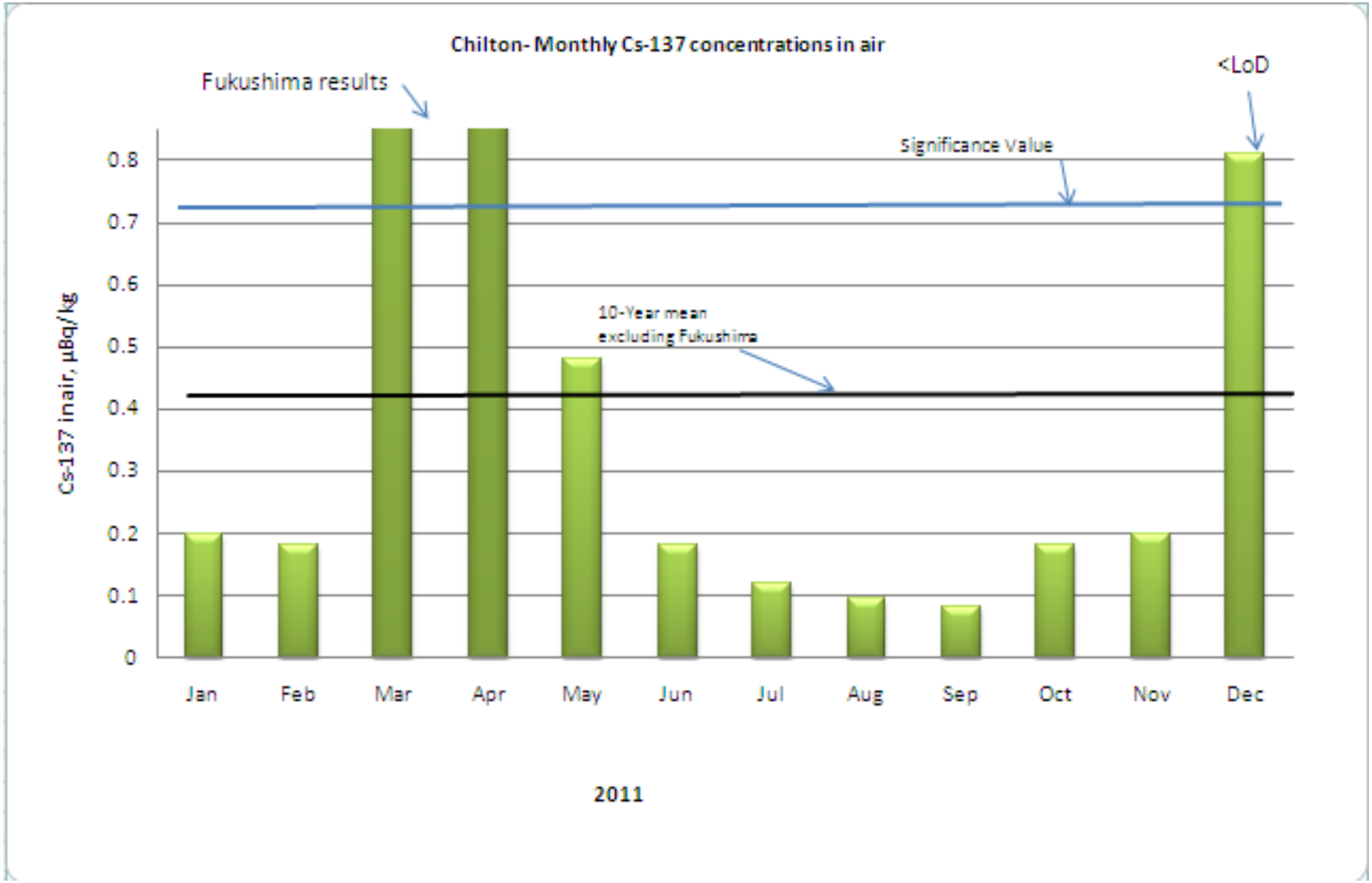

Figure 3 Cs-137 concentrations in air at Chilton. Monthly measurements from 1987 until end 2011

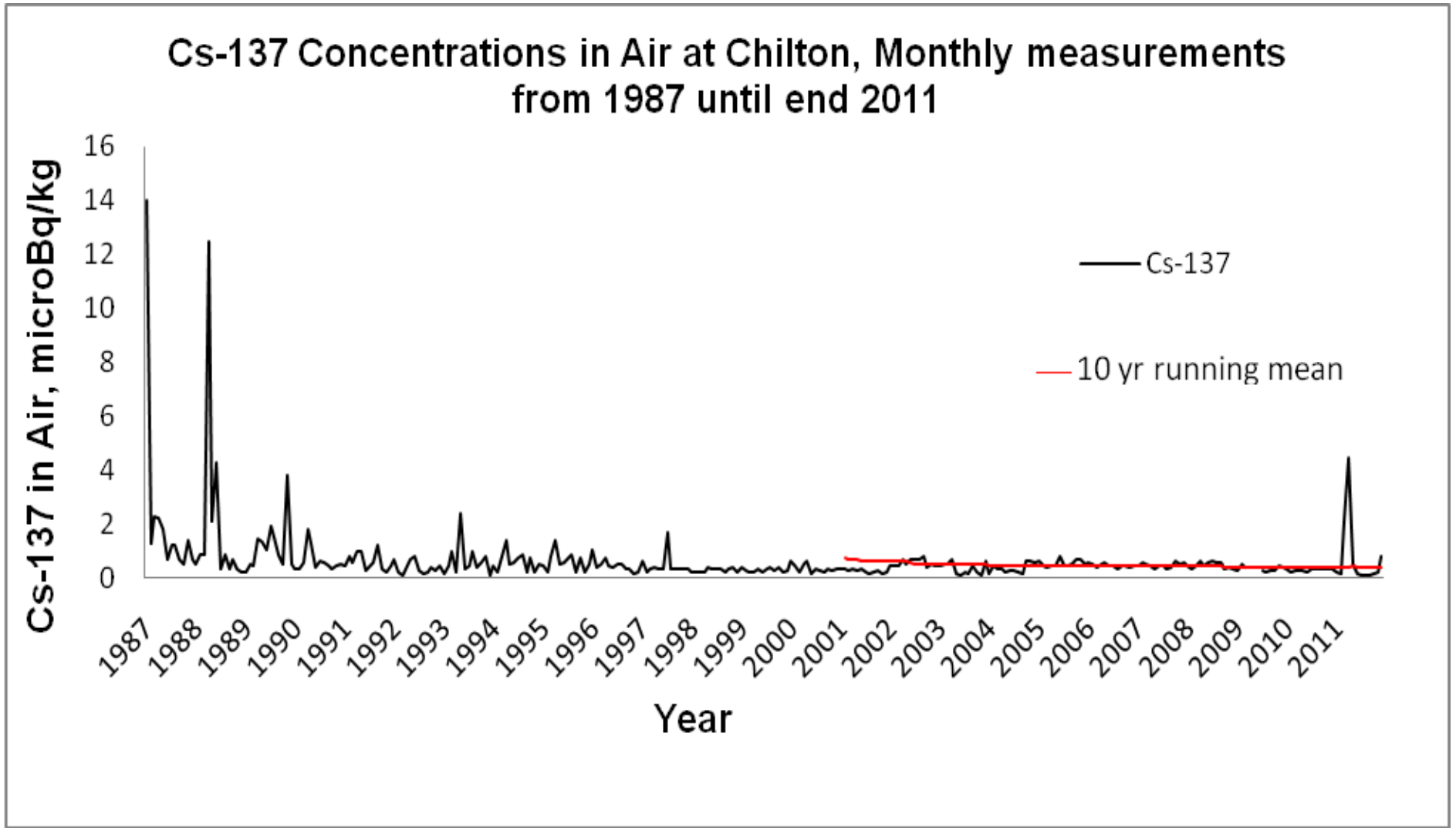

Figure 4 Quarterly Cs-137 concentrations in air at all stations for 2011

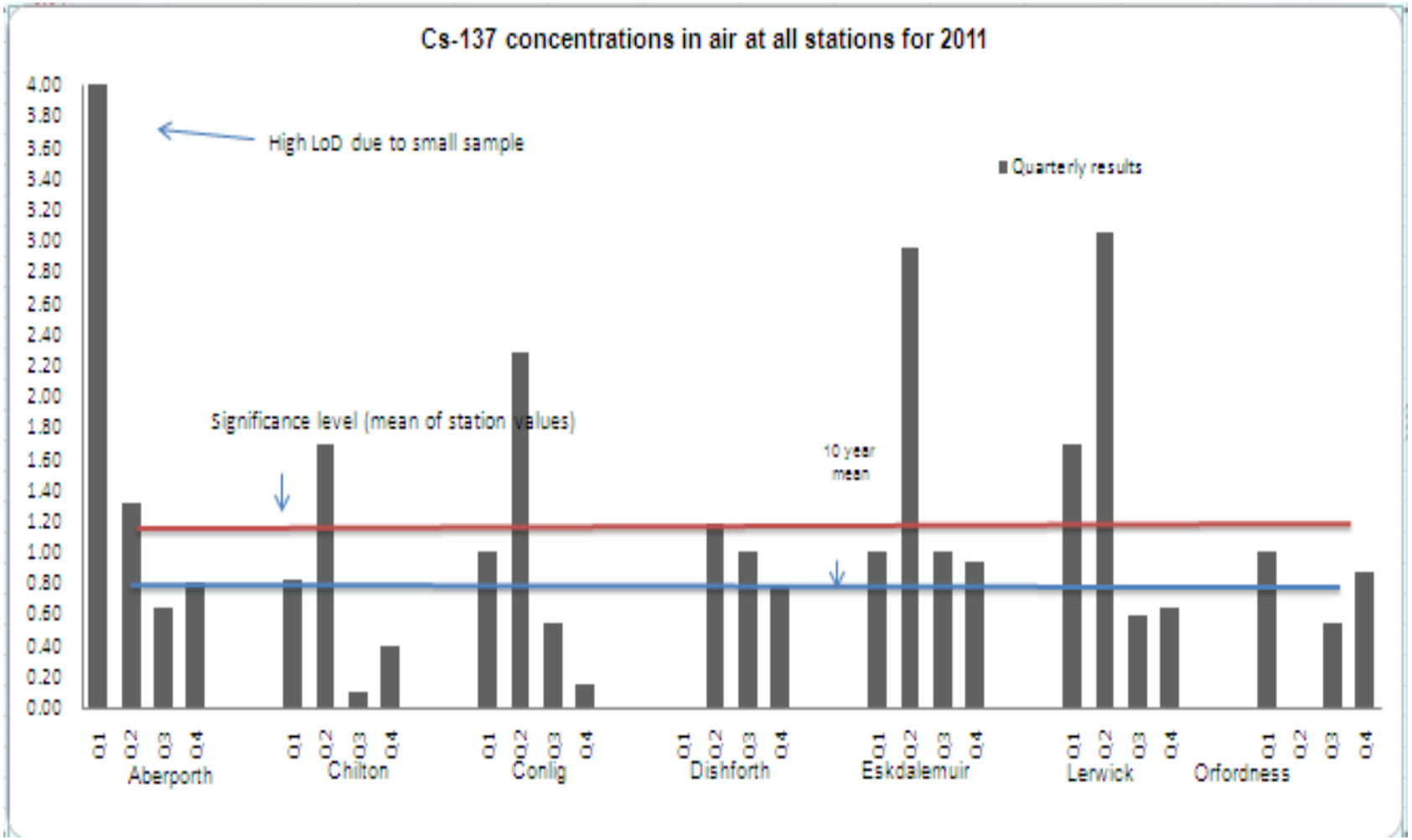

Figure 5 Be-7 Concentrations in Air at Chilton

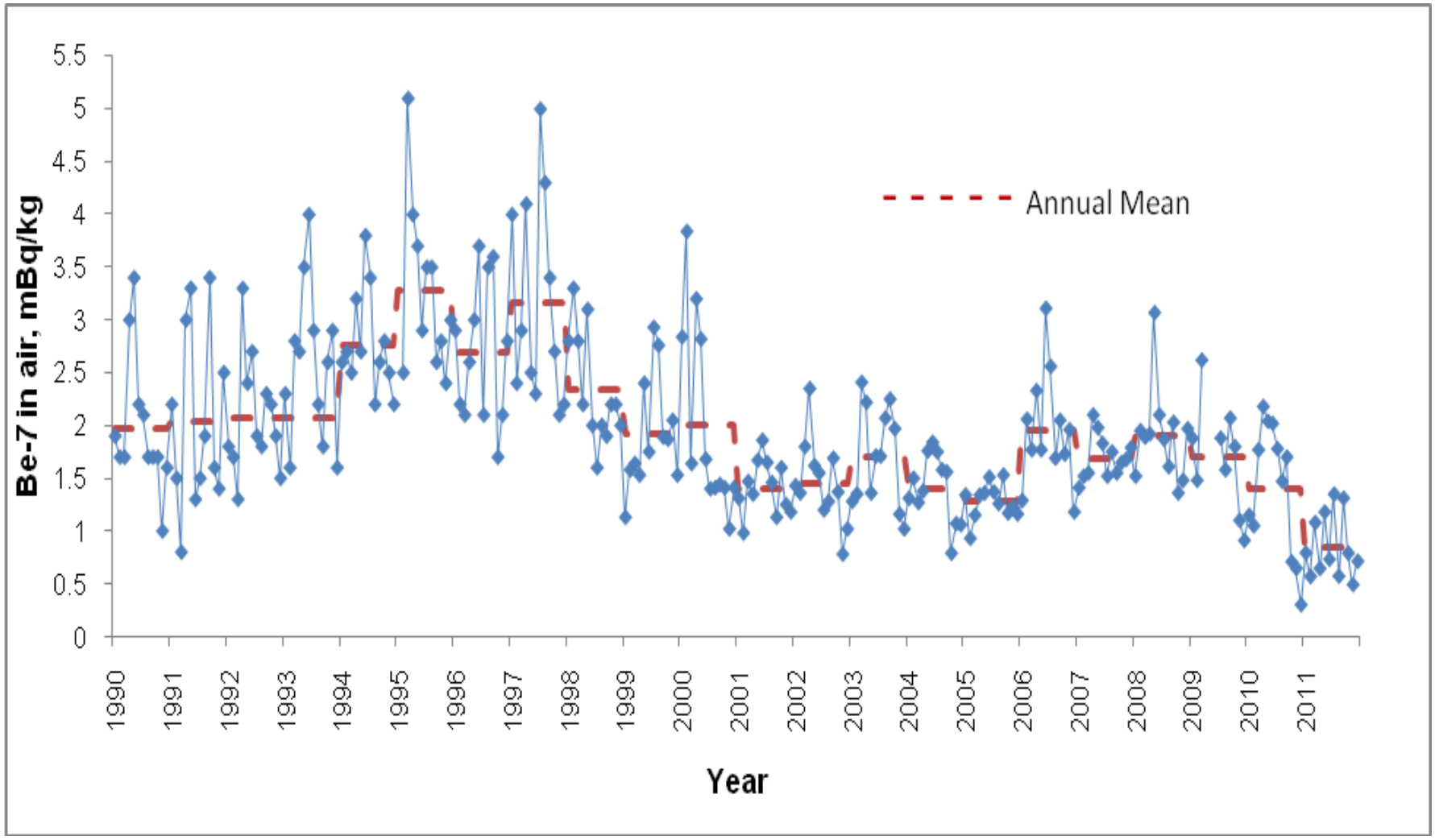

Figure 6 Be-7 Concentrations in Rain at Chilton

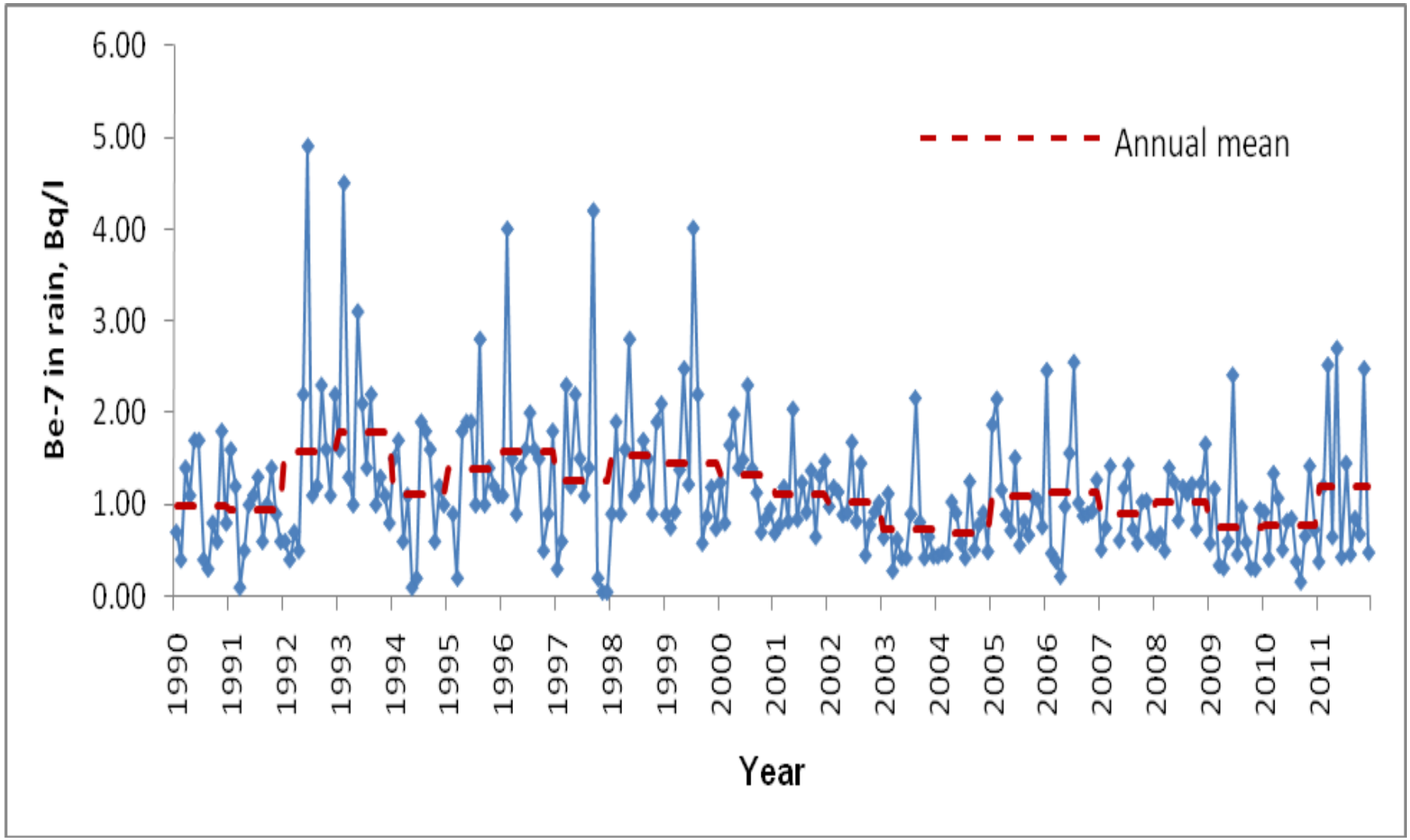

Figure 7 Annual concentration of gross beta activity in rainwater at Chilton