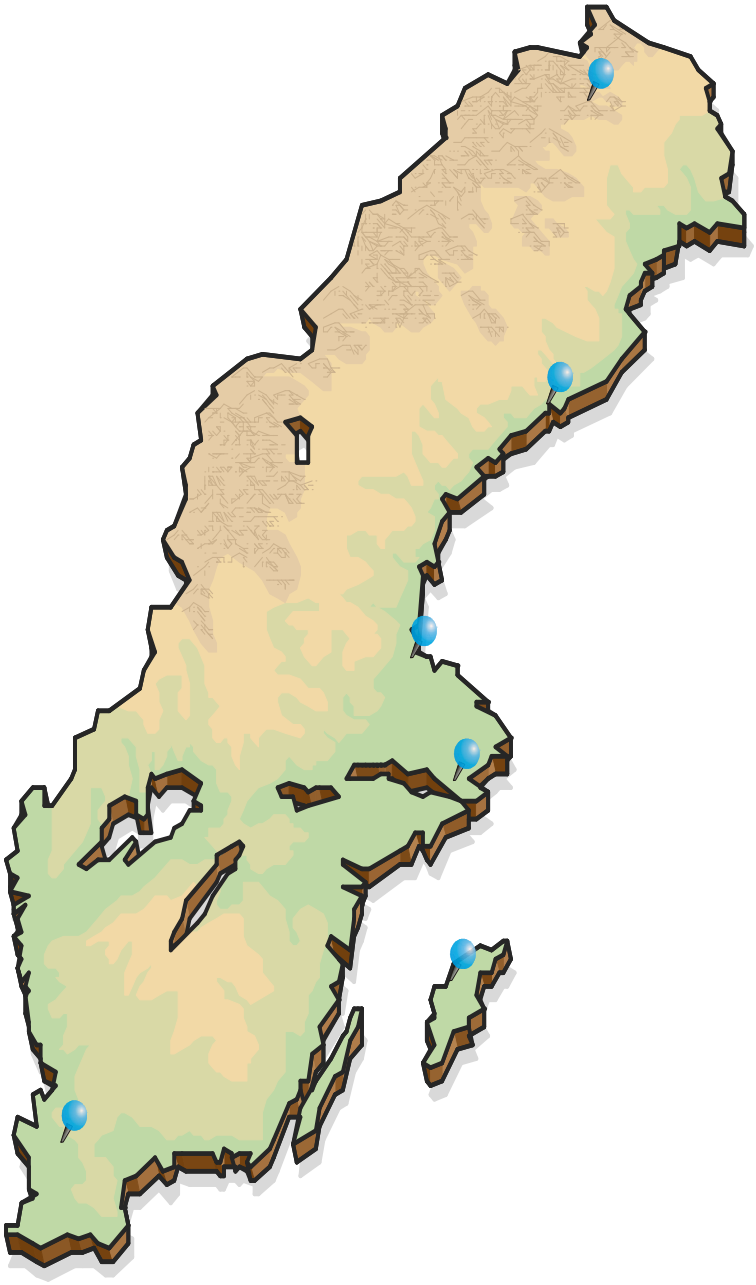
Radionuclide particles in ground level air in Sweden during 2018

GOLIATH M, HELLESEN C, KARLKVIST L, KASTLANDER J, OLSSON H, SÖDERSTRÖM C



FOI-R--4778--SE
ISSN 1650-1942 April 2019

Goliath M,Hellesen C,Karlkvist L,Kastlander J,Olsson H,Söderström C

Radionuclide particles in ground level air in Sweden during 2018

Titel	Radionuklider i markluft i Sverige, årsrapport 2018
Title	Radionuclide particles in ground level air in Sweden during 2018
Rapportnr/Report no	FOI-R--4778--SE
Månad/Month	April
Utgivningsår/Year	2019
Antal sidor/Pages	20
ISSN	ISSN-1650-1942
Uppdragsgivare/Customer	Swedish Radiation Safety Authority
Projektnr/Project no	E4485
Godkänd av/Approved by	Åsa Scott
Avdelning/Division	CBRN Defence and Security
Forskningsområde	CBRN-frågor

Abstract

Filtering of ground level air is performed continuously at six different locations in Sweden: Kiruna, Umeå, Gävle, Kista, Visby and Ljungbyhed. The filters are pressed into weekly samples and the contents of different radionuclides are measured by gamma spectroscopy. Precipitation is collected at four of the stations: Kiruna, Gävle, Kista and Ljungbyhed. The samples are ashed and the contents of radionuclides are measured. Weekly activity concentrations of ^{7}Be and ^{137}Cs during 2018 in air and precipitation are presented for the different stations. Other anthropogenic radionuclides detected are also presented.

Keywords

Airborne radionuclides, deposition, ^{7}Be, ^{137}Cs, ^{131}I, ^{60}Co

Sammanfattning

Stationer för filtrering av markluft finns på sex ställen i Sverige: Kiruna, Umeå, Gävle, Kista, Visby och Ljungbyhed. Filtren pressas och analyseras veckovis med hjälp av gammaspektroskopi med germaniumdetektor. Nederbörd samlas in på fyra av stationerna: Kiruna, Gävle, Kista och Ljungbyhed. Nederbördsproverna askas in och mäts därefter med hjälp av gammaspektroskopi.Veckovisa aktivitetskoncentrationer av ^{7}Be och ^{137}Cs under 2018 för luft och nederbörd presenteras för de olika stationerna. I de fall andra antropogena radionuklider detekterats presenteras även dessa.

Nyckelord

Luftburen radioaktivitet, deposition, ^{7}Be, ^{137}Cs, ^{131}I, ^{60}Co

Contents

1 Sampling and analysis procedures **7**

2 Concentrations of ^{7}Be in air **9**

3 Concentrations of ^{7}Cs in air **13**

4 Deposition measurements **17**

5 Other anthropogenic radionuclides detected **19**

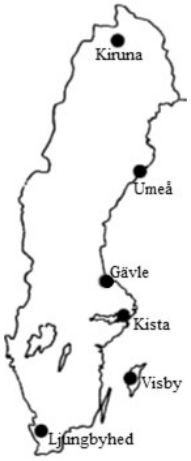
5.1 Detections of ^{131}I in March 2018 19

5.2 Other detections during 2018 19

1 Sampling and analysis procedures

Sampling of ground level air is performed at six different locations in Sweden, as follows:

Location	Latitude	Longitude	Height (asl)
Kiruna	67.84°N	20.42°E	415m
Umeå	63.85°N	20.34°E	46m
Gävle	60.67°N	17.19°E	7m
Kista	59.40°N	17.95°E	30m
Visby	57.61°N	18.32°E	59m
Ljungbyhed	56.08°N	13.22°E	45m



At five stations, 1000 $m^3\ h^{-1}$ of air is filtered through glass fibre filters (HB5773). At each station the filters are changed twice a week (Monday and Thursday or Friday) and sent by mail to FOI's laboratory in Kista for activity measurement and analysis. At the station in Kista 1600 $m^3\ h^{-1}$ of air is filtered and the filters are changed every 28th hour.

Weekly samples are made from each station by taking 3/4 of each filter (1/4 of the filter is archived) and compressing them together into a disc (60 mm diameter and 13 mm thick). These samples are measured 3-4 days after collection, on shielded High Purity Germanium (HPGe) detectors. From the station in Kista, the filters are assembled in a Marinelli-like geometry by pressing them into one circular disc (94 mm diameter, 16 mm thickness), placed on top of the detector, and into six rectangular bricks ($77 \times 48 \times 13$ mm) placed around the detector. Typical measurement times are between 72 and 96 hours.

At four of the stations (Kiruna, Umeå, Kista and Ljungbyhed) a small part of the air flow (12 $m^3\ h^{-1}$) downstream the filter is passed through an active charcoal cartridge in order to collect gaseous iodine. The cartridges are changed weekly but only analysed if particulate iodine has been detected in the filter.

The stations at Kiruna, Gävle, Kista and Ljungbyhed are each equipped with a stainless steel funnel (1 m radius) to collect precipitation. The precipitation is passed through a column consisting of a filter part, an an-ion exchanger part and a cat-ion exchanger part. The columns are changed weekly and sent by mail to FOI's laboratory in Kista. Four samples are combined to a monthly sample by ashing. The samples are measured on HPGe detectors. From these measurements the total deposition is calculated.

The particulate radionuclides detected in the filters are normally due to the naturally occurring radon daughters and ^{7}Be. In addition ^{137}Cs is commonly detected at most stations due to resuspension of the Chernobyl fallout. In Tables I and II and Figures I and II the activity concentrations of ^{7}Be and ^{137}Cs are presented. The precipitation measurement results are presented in Table III. Other anthropogenic radionuclides detected are presented in Table IV.

Uncertainties are given as relative combined standard uncertainty according to GUM. For a more detailed description of uncertainty estimations see FOI Report ”Implementation of uncertainty of measurement according to GUM” (FOI-D–0643–SE, internal report, in Swedish). The measurement software is Genie2000.

2 Concentrations of ^{7}Be in air

Table 2.1. ^{7}Be concentrations in Sweden, 2018

Week Starting	Kiruna	Umeå	Gävle	Kista	Visby	Ljungbyhed
1 Jan	1590 (2.7)	1090[5] (2.8)	960[5] (2.8)	1430 (2.8)	1560 (2.8)	1410 (2.8)
8 Jan	2010 (2.7)	3310 (2.7)	3220 (2.8)	3310 (2.8)	2990 (2.7)	5010 (2.7)
15 Jan	2760 (2.8)	2630 (2.8)	1820 (2.7)	2860 (2.8)	2060 (2.8)	1790 (2.8)
22 Jan	1140 (2.8)	1740 (2.7)	1110 (2.8)	1950 (2.8)	2520 (2.8)	3370 (2.8)
29 Jan	1190 (2.7)	1710 (2.8)	1290 (2.7)	1760 (2.8)	4530 (2.8)	2150 (2.7)
5 Feb	1760 (2.8)	2370 (2.8)	2130 (2.8)	2980 (2.8)	3440 (2.8)	3900 (2.8)
12 Feb	2440 (2.8)	2490 (2.8)	2340 (2.7)	2840 (2.8)	3220 (2.7)	2110 (2.8)
19 Feb	2060 (2.7)	2020 (2.7)	1910[6] (2.7)	3150 (2.8)	2960 (2.8)	2590 (2.8)
26 Feb	2180 (2.7)	2580 (2.7)	2780[7] (2.8)	3310 (2.8)	3230 (2.7)	3000 (2.8)
5 Mar	1330 (2.8)	1860 (2.7)	2300 (2.8)	3470 (2.8)	3290 (2.7)	2190 (2.8)
12 Mar	2450 (2.7)	2410 (2.7)	2110 (2.8)	2660 (2.8)	2830 (2.7)	2650 (2.8)
19 Mar	2370 (2.7)	2110 (2.7)	2020 (2.8)	2440 (2.8)	2480 (2.8)	2300 (2.8)
26 Mar	1680[1] (2.7)	1940 (2.8)	2110[1] (2.8)	2850 (2.8)	3040 (2.8)	3000 (2.8)
2 Apr	2670[2] (2.7)	2560 (2.7)	2100[2] (2.7)	3410 (2.8)	4220 (2.7)	4030 (2.7)
9 Apr	5970 (2.7)	4300 (2.7)	3190 (2.8)	5260 (2.8)	5670 (2.8)	4560 (2.7)
16 Apr	5200 (2.7)	3570 (2.7)	2180 (2.8)	3540 (2.8)	3080 (2.8)	2850 (4.9)
23 Apr	1150[3] (4.9)	820 (2.8)	1250 (2.8)	1370 (2.8)	1500 (2.7)	2320 (4.9)
30 Apr	2140[4] (2.9)	1390 (2.8)	1580 (2.8)	2500 (2.8)	3830 (2.8)	4550 (2.7)
7 May	4070 (2.8)	5870 (2.8)	5420 (2.8)	7400 (2.8)	8470 (2.8)	5970 (4.9)
14 May	5600 (2.7)	6080 (2.8)	5560 (4.9)	7510 (2.8)	7290 (2.7)	8120 (2.8)
21 May	4270 (4.9)	4700 (2.7)	4850 (2.8)	7000 (2.8)	7220 (2.8)	7070 (2.7)
28 May	4030 (2.8)	4270 (2.7)	4810 (4.9)	7010 (2.8)	7130 (5.4)	6990 (4.9)
4 Jun	1210 (4.9)	1950 (2.8)	1930 (2.8)	3570 (2.8)	4550 (2.8)	6840 (2.7)
11 Jun	2140 (5.1)	1960 (2.8)	2430 (4.9)	3600 (2.8)	3720 (2.8)	3580 (4.9)
18 Jun	1360 (2.8)	1690 (2.8)	1860 (4.9)	2190 (2.8)	2410 (2.7)	2670 (2.8)
25 Jun	2330 (5.3)	3150 (2.7)	2310 (2.8)	2580 (2.8)	2120 (4.9)	2640 (2.7)

Values are reported in $\mu Bq\,m^{-3}$
When ^{7}Be is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

[1]Eight days sampling 26/3-3/4
[2]Six days sampling 3/4-9/4
[3]Nine days sampling 23/4-2/5
[4]Five days sampling 2/5-7/5
[5]Six days sampling 2/1-8/1
[6]Nine days sampling 19/2-28/2
[7]Five days sampling 28/2-5/3

Table 2.2. ^{7}Be concentrations in Sweden, 2018

Week Starting	Kiruna	Umeå	Gävle	Kista	Visby	Ljungbyhed
2 Jul	4910 (2.7)	4190 (2.7)	3440 (2.8)	4880 (2.8)	4800 (4.9)	4660 (2.7)
9 Jul	5050 (4.9)	6950 (2.7)	4780 (2.8)	6120 (2.8)	6430 (2.7)	3630[12] (5.0)
16 Jul	5580 (2.8)	5010 (4.9)	5200 (2.8)	6980 (2.8)	7490 (2.7)	5060[13] (10.3)
23 Jul	5360 (2.7)	3910 (2.8)	3320[3] (5.0)	4940 (2.8)	5600 (4.9)	5870[14] (2.9)
30 Jul	3920 (2.7)	4430 (2.8)	3320[3] (5.0)	5330 (2.8)	5800 (2.8)	4600[15] (2.8)
6 Aug	2040 (4.9)	2850 (2.7)	2450 (2.8)	4250 (2.8)	4470 (2.8)	5010 (4.9)
13 Aug	1790 (2.8)	2140 (2.8)	1760[4] (2.8)	2960 (2.8)	2620 (2.7)	3060 (4.9)
20 Aug	1000 (2.7)	1900 (2.8)	2000[5] (2.8)	2960 (2.8)	3240 (2.8)	3010 (4.9)
27 Aug	2660 (2.7)	2360 (4.9)	1960 (2.8)	1780[8] (2.8)	3170 (2.8)	2230 (2.8)
3 Sep	3110 (2.7)	3050 (2.8)	2890 (4.9)	4250 (2.8)	4830 (2.7)	4860 (2.8)
10 Sep	2000 (2.8)	1440 (4.9)	1630 (2.8)	2790 (3.5)	2990 (2.8)	3390 (4.9)
17 Sep	960 (2.8)	2490 (4.9)	2260 (2.8)	4040 (3.1)	3600 (2.8)	3860 (2.7)
24 Sep	830 (2.7)	1150 (4.9)	1500 (2.8)	2140 (2.8)	2620 (2.8)	2460 (2.7)
1 Oct	830 (2.8)	1060 (4.9)	1070 (2.8)	1050 (2.8)	2160 (2.7)	2140 (2.8)
8 Oct	1200 (2.7)	2940 (4.9)	2920 (2.8)	4040[9] (2.8)	5560 (2.8)	5250 (2.7)
15 Oct	1520 (2.7)	1640 (4.9)	1800 (2.8)	3880 (2.8)	4360 (2.8)	4320 (2.7)
22 Oct	870 (2.7)	700 (2.8)	1100 (4.9)	1630 (4.0)	2270 (5.1)	1820 (2.7)
29 Oct	1410 (2.7)	1630 (2.8)	1620 (2.8)	2590[10] (2.8)	2700 (2.8)	2280 (2.7)
5 Nov	1190 (2.7)	980 (2.8)	1320 (4.9)	2540 (2.8)	3330 (2.8)	2840 (2.7)
12 Nov	900 (2.8)	1430 (4.9)	2110 (2.8)	2300 (2.8)	1980 (2.7)	2470 (2.8)
19 Nov	2120 (2.8)	2610 (2.8)	2910 (2.7)	7700[11] (2.9)	3370 (2.7)	3390 (4.9)
26 Nov	1170 (2.8)	1800 (2.8)	1480 (2.8)	2230 (2.9)	3020 (4.9)	3130 (4.9)
3 Dec	1180 (2.7)	930 (4.9)	850 (2.8)	1100 (3.1)	1250 (6.1)	1810 (2.8)
10 Dec	1930 (2.8)	980 (2.8)	840 (2.7)	950 (2.8)	1580 (4.9)	1130[16] (4.9)
17 Dec	1880 (2.7)	1390[1] (2.8)	1060[6] (2.8)	1640 (2.8)	1850 (4.9)	1650[17] (2.8)
24 Dec	720 (2.8)	910[2] (2.8)	1140[7] (2.8)	1610 (2.8)	1640 (2.7)	1900 (4.9)

Values are reported in $\mu Bq\,m^{-3}$
When ^{7}Be is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

[1]Eight days sampling 17/12-25/12
[2]Six days sampling 25/12-31/12
[3]Two weeks sampling 23/7-6/8
[4]Eight days sampling 13/8-21/8
[5]Six days sampling 21/8-27/8
[6]Four days sampling 17/12-21/12
[7]Eight days sampling 21/12-29/12
[8]Five days sampling 26/8-31/8
[9]Six days sampling 8/10-13/10
[10]Six days sampling 29/10-4/11
[11]Six days sampling 18/11-24/11
[12]Three days sampling 9/7-12/7
[13]Eleven days sampling 12/7-23/7
[14]Eight days sampling 23/7-31/7
[15]Six days sampling 31/7-6/8
[16]Six days sampling 10/12-16/12
[17]Eight days sampling 16/12-24/12

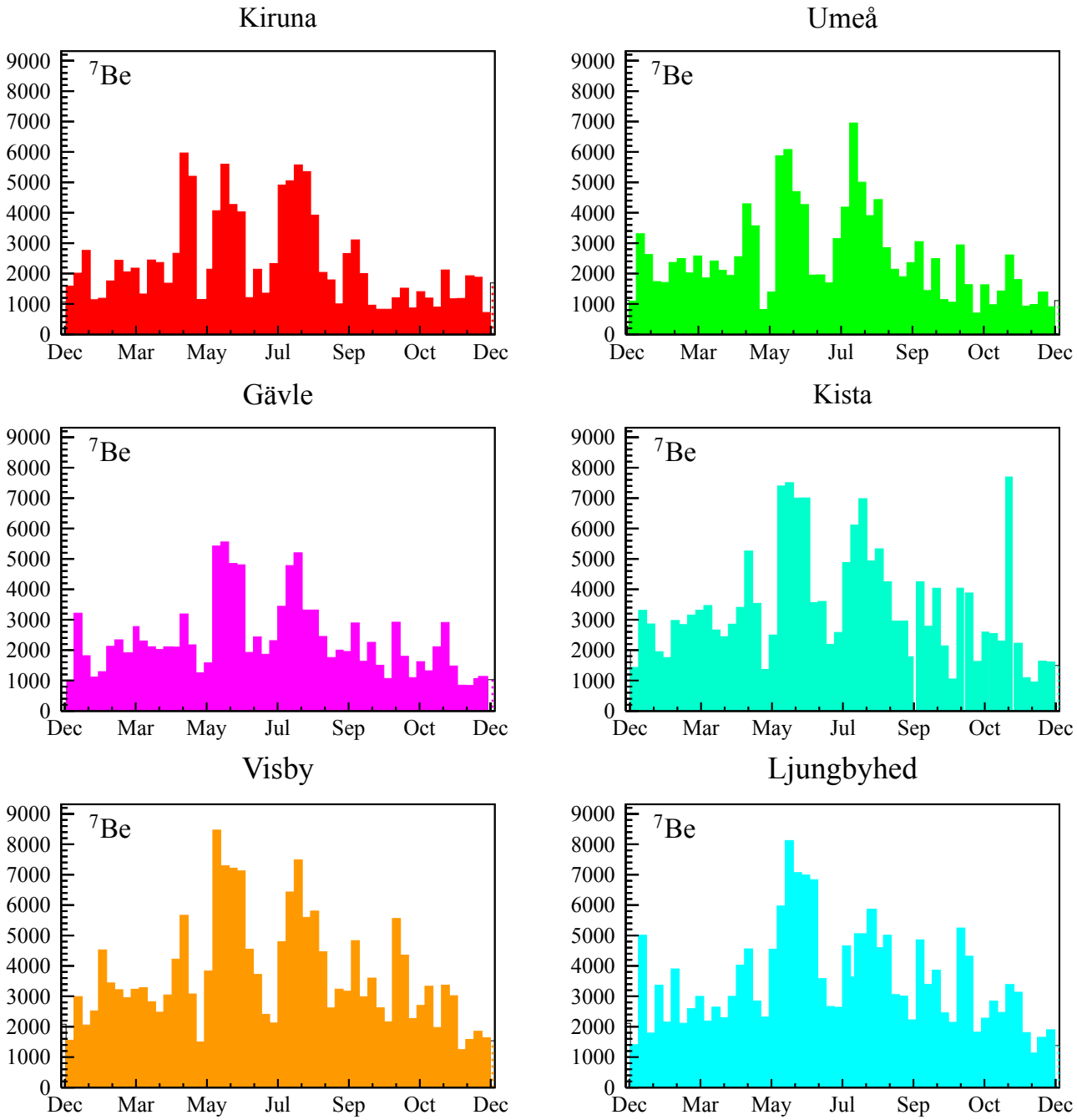


Figure 1. Activity concentrations (μBq m^{-3}) in ground level air of ^{7}Be in the Swedish network during 2018

3 Concentrations of ^{7}Cs in air

Table 3.3. ^{137}Cs concentrations in Sweden, 2018

Week Starting	Kiruna	Umeå	Gävle	Kista	Visby	Ljungbyhed
1 Jan	< 0.2	0.7[5] (10)	0.6[5] (12)	0.3 (7)	0.1 (37)	0.5 (27)
8 Jan	< 0.2	3.9 (4)	1.7 (8)	0.3 (8)	0.6 (6)	0.9 (9)
15 Jan	0.1 (38)	1.5 (5)	1.7 (5)	1.4 (4)	1.0 (8)	1.4 (7)
22 Jan	< 0.2	0.8 (6)	0.4 (29)	0.4 (6)	0.9 (7)	0.6 (26)
29 Jan	< 0.2	0.9 (7)	0.5 (10)	0.5 (6)	0.5 (22)	0.8 (6)
5 Feb	0.2 (29)	1.1 (11)	1.2 (7)	0.9 (4)	0.4 (14)	1.2 (11)
12 Feb	0.2 (27)	0.7 (5)	0.8 (13)	0.8 (4)	0.9 (8)	0.9 (9)
19 Feb	< 0.2	1.5 (6)	1.2[6] (6)	1.2 (4)	0.4 (16)	0.7 (23)
26 Feb	< 0.3	1.1 (6)	1.4[7] (6)	1.0 (4)	0.3 (19)	0.2 (38)
5 Mar	< 0.3	1.1 (10)	0.8 (8)	1.4 (4)	1.6 (6)	1.1 (13)
12 Mar	0.1 (73)	0.5 (22)	0.7 (19)	0.7 (5)	0.6 (11)	0.6 (11)
19 Mar	< 0.3	0.6 (9)	0.6 (12)	0.4 (7)	0.4 (13)	1.8 (5)
26 Mar	< 0.5[1]	1.1 (7)	2.4[1] (4)	0.7 (5)	0.6 (11)	0.7 (25)
2 Apr	< 0.4[2]	0.7 (10)	0.8[2] (10)	0.5 (5)	0.7 (9)	0.3 (20)
9 Apr	0.1 (30)	1.2 (7)	2.2 (5)	0.7 (5)	0.6 (12)	0.7 (10)
16 Apr	< 0.2	1.0 (7)	1.7 (9)	0.5 (6)	0.3 (19)	0.4 (18)
23 Apr	< 0.2[3]	0.9 (6)	1.7 (8)	0.2 (11)	0.3 (8)	0.2 (37)
30 Apr	< 0.3[4]	0.7 (10)	1.6 (8)	0.4 (7)	0.2 (21)	0.4 (17)
7 May	0.2 (14)	1.5 (10)	3.2 (4)	1.1 (4)	1.8 (4)	0.6 (18)
14 May	< 0.2	2.9 (6)	4.4 (4)	1.5 (4)	< 0.3	0.9 (9)
21 May	< 0.3	7.7 (3)	7.3 (4)	0.8 (5)	0.7 (10)	0.5 (14)
28 May	0.3 (18)	11.8 (3)	2.7 (4)	0.6 (6)	0.5 (14)	0.7 (12)
4 Jun	< 0.2	1.3 (8)	2.5 (5)	0.5 (7)	0.6 (12)	0.3 (26)
11 Jun	< 0.4	1.7 (8)	1.4 (7)	0.3 (9)	0.6 (11)	0.1 (69)
18 Jun	< 0.2	1.8 (5)	1.1 (7)	0.2 (9)	0.5 (15)	0.3 (31)
25 Jun	0.1 (50)	1.3 (7)	1.0 (15)	0.4 (7)	0.6 (14)	0.2 (17)

Values are reported in $\mu Bq\,m^{-3}$
When ^{137}Cs is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

[1]Eight days sampling 26/3-3/4
[2]Six days sampling 3/4-9/4
[3]Nine days sampling 23/4-2/5
[4]Five days sampling 2/5-7/5
[5]Six days sampling 2/1-8/1
[6]Nine days sampling 19/2-28/2
[7]Five days sampling 28/2-5/3

Table 3.4. ^{137}Cs concentrations in Sweden, 2018

Week Starting	Kiruna	Umeå	Gävle	Kista	Visby	Ljungbyhed
2 Jul	0.1 (51)	1.1 (7)	1.9 (8)	0.5 (6)	0.9 (6)	0.2 (48)
9 Jul	< 0.3	1.6 (6)	2.0 (7)	0.3 (10)	0.5 (7)	0.3[12](49)
16 Jul	0.3 (23)	1.5 (6)	1.9 (5)	0.3 (9)	1.1 (5)	0.4[13](17)
23 Jul	0.2 (31)	1.4 (10)	1.4[3] (4)	0.4 (9)	1.1 (10)	0.2[14](39)
30 Jul	< 0.5	1.2 (9)	1.4[3] (4)	0.3 (9)	0.2 (22)	< 0.3[15]
6 Aug	< 0.3	1.5 (6)	1.1 (11)	0.3 (9)	0.7 (9)	0.2 (43)
13 Aug	< 0.2	1.7 (8)	0.9[4] (8)	0.1 (21)	0.2 (26)	< 0.3
20 Aug	0.1 (54)	1.3 (7)	1.5[5] (7)	0.4 (8)	0.4 (10)	0.2 (35)
27 Aug	0.2 (19)	1.8 (6)	1.3 (12)	0.2[8] (11)	0.4 (15)	0.4 (17)
3 Sep	0.3 (16)	2.4 (4)	2.1 (5)	0.9 (4)	0.7 (12)	< 0.4
10 Sep	0.1 (54)	4.7 (3)	1.6 (6)	0.4 (10)	0.4 (28)	0.2 (40)
17 Sep	< 0.5	4.2 (4)	2.1 (8)	0.5 (6)	0.5 (13)	0.4 (10)
24 Sep	< 0.2	2.1 (5)	0.6 (20)	0.5 (7)	0.2 (12)	0.2 (15)
1 Oct	< 0.2	1.3 (7)	1.4 (11)	0.3 (8)	0.3 (12)	< 0.6
8 Oct	< 0.2	2.0 (5)	1.4 (10)	0.7[9] (5)	0.8 (8)	0.4 (17)
15 Oct	< 0.1	2.2 (4)	1.4 (6)	0.8 (5)	0.7 (17)	0.5 (7)
22 Oct	< 0.2	1.0 (6)	0.7 (7)	0.4 (6)	0.2 (14)	< 0.4
29 Oct	< 0.2	1.1 (10)	0.9 (16)	0.6[10](4)	0.5 (6)	0.4 (13)
5 Nov	< 0.2	1.2 (7)	1.0 (9)	0.5 (6)	0.7 (12)	0.3 (38)
12 Nov	< 0.4	1.2 (7)	0.6 (23)	0.6 (6)	0.4 (19)	0.6 (19)
19 Nov	< 0.2	1.4 (9)	1.6 (5)	1.0[11](6)	0.5 (16)	0.5 (18)
26 Nov	0.1 (47)	1.1 (12)	0.9 (5)	0.6 (6)	0.9 (7)	0.9 (11)
3 Dec	0.2 (14)	0.6 (8)	0.7 (7)	0.3 (9)	0.2 (16)	< 0.3
10 Dec	< 0.2	2.7 (4)	0.7 (5)	0.6 (4)	0.4 (16)	0.2[16](47)
17 Dec	0.2 (18)	1.5[1] (6)	0.8[6] (12)	1.1 (4)	1.6 (6)	0.9[17](7)
24 Dec	< 0.4	1.4[2] (4)	0.8[7] (5)	0.9 (4)	0.3 (20)	0.2 (42)

Values are reported in μBq m^{-3}
When ^{137}Cs is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

[1]Eight days sampling 17/12-25/12
[2]Six days sampling 25/12-31/12
[3]Two weeks sampling 23/7-6/8
[4]Eight days sampling 13/8-21/8
[5]Six days sampling 21/8-27/8
[6]Four days sampling 17/12-21/12
[7]Eight days sampling 21/12-29/12
[8]Five days sampling 26/8-31/8
[9]Six days sampling 8/10-13/10
[10]Six days sampling 29/10-4/11
[11]Six days sampling 18/11-24/11
[12]Three days sampling 9/7-12/7
[13]Eleven days sampling 12/7-23/7
[14]Eight days sampling 23/7-31/7
[15]Six days sampling 31/7-6/8
[16]Six days sampling 10/12-16/12
[17]Eight days sampling 16/12-24/12

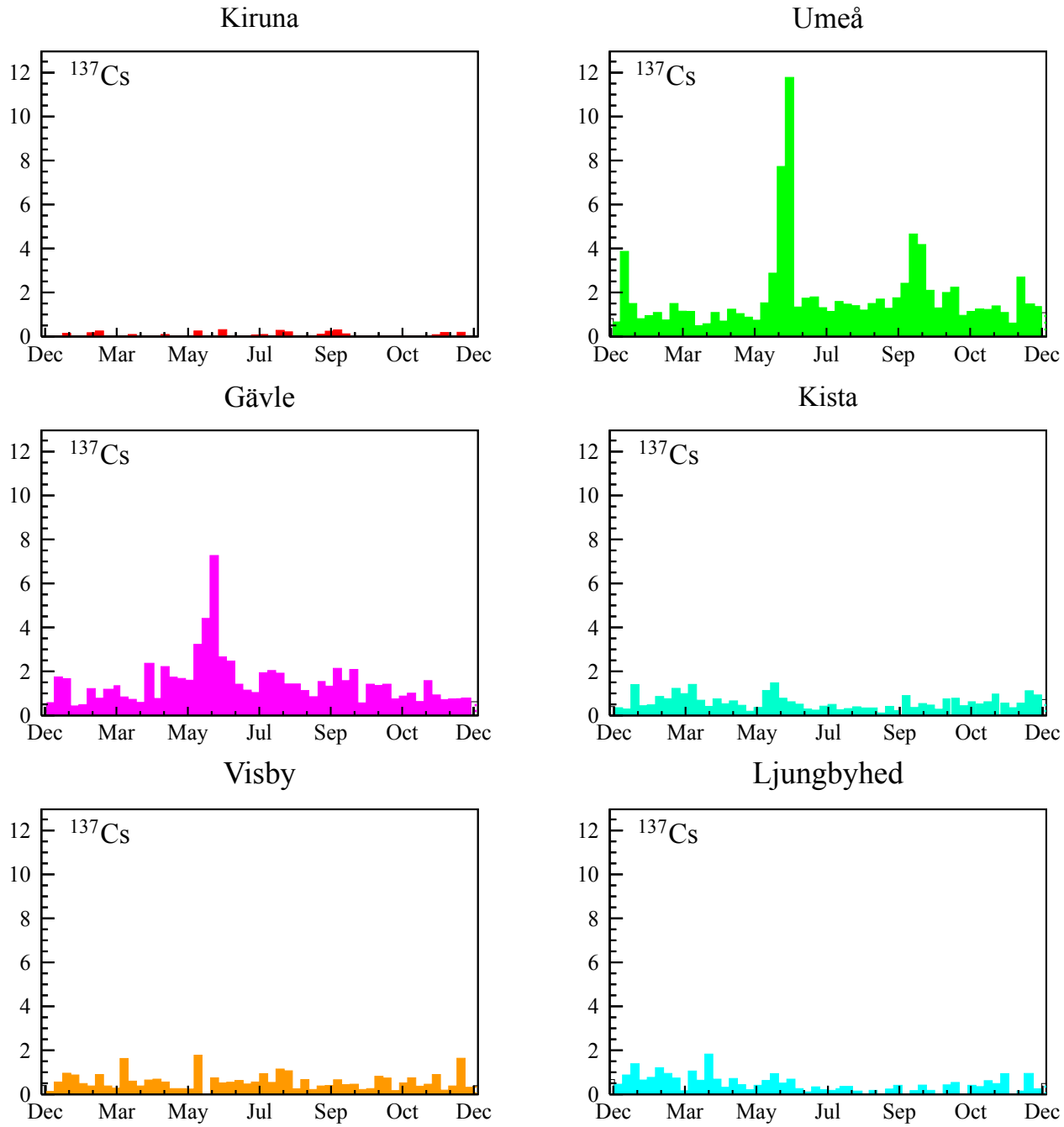


Figure 2. Activity concentrations (μBq m^{-3}) in ground level air of ^{137}Cs in the Swedish network during 2018

4 Deposition measurements

Table 4.1. Kiruna

Period	^{7}Be	^{137}Cs	Precipitation (mm)
1 Jan - 29 Jan	8800 (5)	< 7.8	30.0
29 Jan - 26 Feb	3900 (5)	< 7.7	2.0
26 Feb - 26 Mar	4400 (5)	< 7.0	8.0
26 Mar - 23 Apr	14 900 (5)	4 (57)	65.0
23 Apr - 21 May	72 800 (5)	3 (48)	8.0
21 May - 18 Jun	17 600 (5)	< 7.0	26.0
18 Jun - 16 Jul	110 200 (5)	8 (21)	229.0
16 Jul - 13 Aug	134 400 (5)	10 (18)	246.0
13 Aug - 10 Sep	30 800 (5)	4 (37)	120.0
10 Sep - 8 Oct	27 900 (5)	5 (35)	204.0
8 Oct - 5 Nov	15 200 (5)	< 7.8	38.0
5 Nov - 3 Dec	11 700 (5)	< 8.2	9.0
3 Dec - 31 Dec	7300 (5)	< 6.9	37.0

Values are reported in mBq m^{-2}
When the nuclide is not detected minimal detectable concentration (MDC) is given and indicated by ”<”
Relative combined standard uncertainty (1σ%) within brackets

Table 4.2. Gävle

Period	^{7}Be	^{137}Cs	Precipitation (mm)
26 Dec - 22 Jan	53 200 (5)	33 (8)	166.0
22 Jan - 19 Feb	59 600 (5)	28 (10)	183.0
19 Feb - 19 Mar	82 500 (5)	33 (8)	201.0
19 Mar - 16 Apr	15 600 (5)	17 (12)	100.0
16 Apr - 14 May	32 700 (5)	24 (10)	65.0
14 May - 11 Jun	76 800 (5)	60 (7)	50.0
11 Jun - 9 Jul	16 600 (5)	9 (21)	127.0
9 Jul - 6 Aug	38 000 (5)	28 (16)	94.0
6 Aug - 3 Sep	78 000 (5)	16 (15)	255.0
3 Sep - 1 Oct	15 600 (5)	16 (16)	185.0
1 Oct - 29 Oct	5300 (5)	< 6.6	149.0
29 Oct - 26 Nov	6100 (5)	7 (32)	81.0
26 Nov - 25 Dec	37 400 (5)	23 (10)	145.0
25 Dec - 21 Jan	15 600 (5)	8 (32)	123.0

Values are reported in mBq m^{-2}
When the nuclide is not detected minimal detectable concentration (MDC) is given and indicated by ”<”
Relative combined standard uncertainty (1σ%) within brackets

Table 4.3. Kista

Period	^{7}Be	^{137}Cs	Precipitation (mm)
18 Dec - 15 Jan	44 800 (11)	< 37.1	20.0
15 Jan - 12 Feb	35 200 (10)	< 35.4	23.0
12 Feb - 12 Mar	31 000 (8)	< 28.7	28.0
12 Mar - 9 Apr	8500 (8)	< 16.6	25.0
9 Apr - 4 May	20 000 (7)	< 21.5	33.0
4 May - 4 Jun	1700 (21)	< 16.7	8.0
4 Jun - 2 Jul	46 100 (5)	8 (13)	119.0
2 Jul - 30 Jul	20 900 (5)	9 (48)	37.0
30 Jul - 27 Aug	65 900 (5)	< 4.1	105.0
27 Aug - 24 Sep	9600 (5)	< 5.3	34.0
27 Aug - 24 Sep	9600 (5)	< 5.3	34.0
24 Sep - 22 Oct	200 (20)	< 13.6	4.0
22 Oct - 19 Nov	24 900 (5)	9 (22)	200.0
19 Nov - 17 Dec	49 200 (5)	5 (28)	101.0

Values are reported in mBq m^{-2}
When the nuclide is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

Table 4.4. Ljungbyhed

Period	^{7}Be	^{137}Cs	Precipitation (mm)
15 Dec - 8 Jan	67 000 (5)	3 (49)	205.0
8 Jan - 5 Feb	95 100 (5)	8 (26)	189.0
5 Feb - 5 Mar	13 000 (5)	< 8.5	33.0
5 Mar - 2 Apr	31 500 (5)	8 (24)	85.0
2 Apr - 30 Apr	14 800 (5)	18 (14)	101.0
30 Apr - 28 May	26 500 (5)	14 (16)	18.0
28 May - 25 Jun	26 400 (5)	5 (45)	30.0
25 Jun - 31 Jul	10 000 (5)	< 8.0	9.0
31 Jul - 20 Aug	27 500 (5)	8 (25)	182.0
20 Aug - 17 Sep	22 800 (5)	8 (10)	77.0
17 Sep - 15 Oct	22 900 (5)	6 (37)	150.0
15 Oct - 12 Nov	34 000 (5)	7 (30)	117.0
12 Nov - 10 Dec	47 300 (5)	< 21.6	139.0

Values are reported in mBq m^{-2}
When the nuclide is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

5 Other anthropogenic radionuclides detected

5.1 Detections of ^{131}I in March 2018

During week 10 (2018-03-05 - 2018-03-12), low concentrations of ^{131}I were detected in the stations in Umeå, Gävle and Kista. No source for the detections have been identified. Detections of low concentrations of ^{131}I within the network are not unusual.

Table 5.1. Concentrations of ^{131}I in March 2018.

Station	Sampling Period	^{131}I
Kista	4 Mar - 11 Mar	0.9 (10)
Kiruna	5 Mar - 12 Mar	$<$ 0.6
Ljungbyhed	5 Mar - 12 Mar	$<$ 1.0
Visby	5 Mar - 12 Mar	$<$ 1.0
Umeå	5 Mar - 12 Mar	0.6 (39)
Gävle	5 Mar - 12 Mar	1.1 (16)

Values are reported in µBq m^{-3}
When the nuclide is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

5.2 Other detections during 2018

During 2018, ^{131}I were detected in a few occasions in one station only. In addition, ^{60}Co was detected in Kista in one occasion in May. No sources for the detections have been identified.

Table 5.2. Other detections of ^{131}I, and a detection of ^{60}Co during 2018.

Station	Sampling Period	^{60}Co	^{131}I
Umeå	12 Feb - 19 Feb	$<$ 0.2	0.5 (27)
Gävle	19 Nov - 26 Nov	$<$ 0.2	1.0 (15)
Gävle	26 Nov - 3 Dec	$<$ 0.2	0.7 (22)
Kista	25 Mar - 1 Apr	$<$ 0.2	0.2 (46)
Kista	7 May - 13 May	0.4 (15)	$<$ 0.9
Visby	9 Apr - 16 Apr	$<$ 0.3	0.2 (68)

Values are reported in µBq m^{-3}
When the nuclide is not detected minimal detectable concentration (MDC) is given and indicated by "<"
Relative combined standard uncertainty (1σ%) within brackets

FOI, Swedish Defence Research Agency, is a mainly assignment-funded agency under the Ministry of Defence. The core activities are research, method and technology development, as well as studies conducted in the interests of Swedish defence and the safety and security of society. The organisation employs approximately 1000 personnel of whom about 800 are scientists. This makes FOI Sweden's largest research institute. FOI gives its customers access to leading-edge expertise in a large number of fields such as security policy studies, defence and security related analyses, the assessment of various types of threat, systems for control and management of crises, protection against and management of hazardous substances, IT security and the potential offered by new sensors.

FOI
Defence Research Agency
SE-164 90 Stockholm

Phone: +46 8 555 030 00
Fax: +46 8 555 031 00

www.foi.se