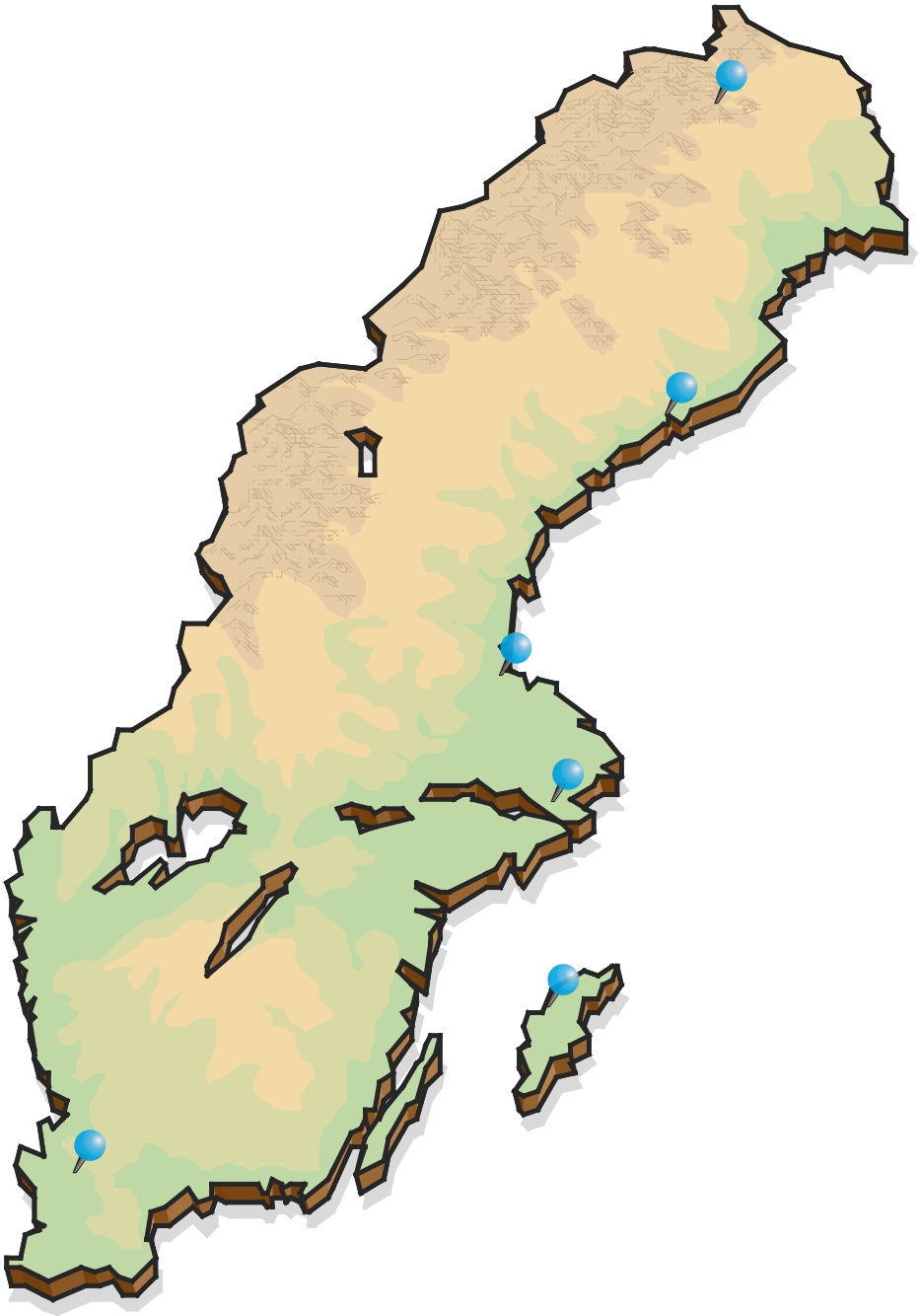
Quarterly report on measurements of radionuclides in ground level air in Sweden

Catharina Söderström
Rune Arntsing
Peter Jansson
Karin Lindh

Second quarter 2005



FOI-R--1708--SE
ISSN 1650-1942

Systems Technology
User report

September 2005

FOI is an assignment-based authority under the Ministry of Defence. The core activities are research, method and technology development, as well as studies for the use of defence and security. The organization employs around 1350 people of whom around 950 are researchers. This makes FOI the largest research institute in Sweden. FOI provides its customers with leading expertise in a large number of fields such as security-policy studies and analyses in defence and security, assessment of different types of threats, systems for control and management of crises, protection against and management of hazardous substances, IT-security an the potential of new sensors.

FOI
Defence Research Agency
Systems Technology
SE-164 90 Stockholm

Tel: +46-8-5550 3000
Fax: +46-8-5550 3397

www.foi.se

Quarterly report on measurements of radionuclides in ground level air in Sweden

Second quarter 2005

FOI-R--1708--SE
ISSN 1650-1942

Systems Technology
User report

September 2005

Issuing organization	Report number, ISRN	Report type
FOI – Swedish Defence Research Agency Systems Technology SE-164 90 Stockholm	FOI-R--1708--SE	User report
	Research area code 3. NBC Defence and other hazardous substances	
	Month year September 2005	**Project no.** E62001
	Sub area code 31 Nuclear Defence Research	
	Sub area code 2	

Author/s (editor/s)	Project manager
Catharina Söderström Rune Arntsing Peter Jansson Karin Lindh	Katarina Wilhelmsen
	Approved by Monica Dahlén
	Sponsoring agency Swedish Radiation Protection Authority
	Scientifically and technically responsible

Report title

Quarterly report on measurements of radionuclides in ground level air in Sweden. Second quarter 2005.

Abstract (not more than 200 words)

Filtering of ground level air is performed weekly at six different locations in Sweden: Kiruna, Umeå, Gävle, Ursvik, Visby and Ljungbyhed. The filters are pressed and the contents of different radionuclides are measured by gamma spectroscopy. Precipitation is also collected at four of the stations: Kiruna, Gävle, Ursvik and Ljungbyhed, the samples are ashed and the contents of radionuclides are measured. The levels of Be-7 and Cs-137 in air and precipitation are presented for the different stations.
Other antropogenic radionuclides detected, if any are also presented.

Keywords

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

Further bibliographic information	Language English

ISSN 1650-1942	Pages 8 p.
	Price acc. to pricelist

Utgivare FOI - Totalförsvarets Forskningsinstitut - Systemteknik 164 90 Stockholm	**Rapportnummer, ISRN** FOI-R--1708--SE	**Klassificering** Användarrapport
	Forskningsområde 3. Skydd mot NBC och andra farliga ämnen	
	Månad, år September 2005	**Projektnummer** E62001
	Delområde 31 N-forskning	
	Delområde 2	

Författare/redaktör Catharina Söderström Rune Arntsing Peter Jansson Karin Lindh	**Projektledare** Katarina Wilhelmsen
	Godkänd av Monica Dahlén
	Uppdragsgivare/kundbeteckning SSI
	Tekniskt och/eller vetenskapligt ansvarig

Rapportens titel (i översättning)

Radionuklider i markluft i Sverige. Kvartalsrapport, andra kvartalet 2005.

Sammanfattning (högst 200 ord)

Stationer för filtrering av markluft finns på sex olika ställen i Sverige: Kiruna, Umeå, Gävle, Ursvik, Visby och Ljungbyhed. Filtren pressas och analyseras veckovis med hjälp av gammaspektroskopi med germaniumdetektor. Nederbörd samlas in på fyra av dessa stationer: Kiruna, Gävle, Ursvik och Ljungbyhed. Nederbördsproven askas in och mäts med hjälp av gammaspektroskopi.
Halterna av Be-7 och Cs-137 presenteras för luft och nederbörd för de olika stationerna. I de fall andra antopogena radionuklider detekteras presenteras även dessa.

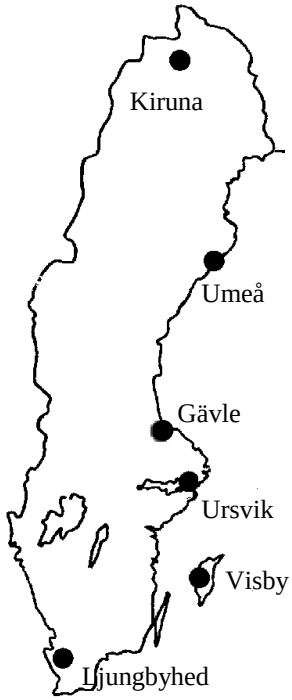
Nyckelord

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

Övriga bibliografiska uppgifter	**Språk** Engelska
ISSN 1650-1942	**Antal sidor:** 8 s.
Distribution enligt missiv	**Pris: Enligt prislista**

Sampling and analysis procedures

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



Kiruna:	67.84° N	20.42° E
Umeå:	63.85° N	20.34° E
Gävle:	60.40° N	17.14° E
Ursvik:	59.39° N	17.96° E
Visby:	57.63° N	18.32° E
Ljungbyhed:	56.08° N	13.23° E

At all stations, 1000 m^3/h of air is filtered through a glass fibre filter (Camfil type CS 5.0). At each station the filters are changed twice weekly (Monday and Thursday or Friday) and sent by mail to our laboratory at Ursvik for measurement and analysis.

Weekly samples are made from each station by taking 3/4 of each filter (1/4 of the filter is left for the archive) and compress them together into a small disc (diameter 60 mm, thickness 13 mm). These samples are measured, 3-4 days after the collection, on well shielded High Purity Germanium (HPGe) detectors.

At four of the stations (Kiruna, Umeå, Ursvik and Ljungbyhed) a small part of the air flow (12m^3/h) that has passed the filter is taken through a charcoal cartridge in order to collect gaseous iodine. The cartridges are changed weekly but only analysed if particulate iodine in greater amount has been detected in the filter.

The stations at Kiruna, Gävle, Ursvik and Ljungbyhed are each equipped with a big stainless steel funnel (1m radius) to collect precipitation. Which is passed through a cartridge consisting of a filter part, an an-ion part and a cation part. The cartridges are changed weekly and sent by mail to our laboratory. 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.

Radionuclides seen in the filters are normally only the naturally occurring radon daughters and ^{7}Be. Most of our stations also detect ^{137}Cs, which is due to resuspension of the Chernobyl fallout. In tables I and II the concentrations of ^{7}Be and ^{137}Cs are presented. The depositions at the stations where we collect precipitation are presented in table III. Sometimes we also detect other anthropogenic radionuclides and in that case these are presented in Table IV.

Table I

^{7}Be concentrations in Sweden, second quarter 2005

Week starting	*Kiruna*		*Umeå*		*Gävle*		*Ursvik**		*Visby*		*Ljungbyhed*	
4-apr	1180	(0.2)	2510[5]	(0.2)	2190	(0.2)	2880	(0.1)	3110	(0.2)	3640	(0.1)
11-apr	1470	(0.2)	1080[6]	(0.2)	1330	(0.2)	1470	(0.2)	2020	(0.3)	2300	(0.2)
18-apr	2690	(0.1)	3390	(0.1)	4160	(0.1)	4200	(0.1)	2040	(0.2)	3690	(0.1)
25-apr	2970[1]	(0.2)	3540	(0.1)	4680	(0.1)	5380	(0.1)	4950	(0.2)	5350	(0.1)
2-may	2540[2]	(0.1)	2680	(0.1)	2640	(0.2)	2710	(0.2)	1850	(0.3)	3010	(0.1)
9-may	1520	(0.2)	2410[7]	(0.2)	2820	(0.2)	2840	(0.2)	2660	(0.2)	2500	(0.3)
16-may	1290	(0.2)	2240[8]	(0.2)	2820	(0.2)	3400	(0.1)	-	(0.2)	3130	(0.1)
23-may	1430	(0.2)	1660	(0.2)	2400	(0.3)	2830	(0.2)	3450[13]	(0.2)	2850	(0.2)
30-may	1870[3]	(0.2)	2030[3]	(0.2)	2000[3]	(0.2)	2190[3]	(0.1)	1850[3]	(0.3)	1770[14]	(0.2)
6-jun	1800[4]	(0.2)	1490[9]	(0.2)	1940[4]	(0.2)	2090[4]	(0.2)	2250[4]	(0.2)	2370[15]	(0.2)
13-jun	3180	(0.1)	3260[10]	(0.1)	3040	(0.2)	3380	(0.2)	3130	(0.2)	2630[16]	(0.1)
20-jun	1630	(0.2)	2040[11]	(0.2)	2310	(0.2)	2970	(0.1)	2800	(0.2)	2340	(0.1)
27-jun	2840	(0.1)	2820[12]	(0.1)	2050	(0.2)	-	(0.1)	1990	(0.3)	2010	(0.2)

Values are given in µBq/m^3.
Error estimates (1σ %) are given in brackets.

* Due to relocalization the high-sensitivity sampler at Ursvik has been closed during this period. Sampling in Ursvik has therefore been performed with an older sampler of the same type as samplers at the other stations.

[1] Four days filter, 25 – 29/4
[2] Ten days filter, 29/4 – 9/5
[3] Eight days filter 30/5 – 7/6
[4] Six days filter 7-13/6
[5] Four days filter, 4 - 8/4
[6] Ten days filter, 8 - 18/4
[7] Eight days filter, 9 - 17/5
[8] Six days filter, 17 - 23/5
[9] Three days filter, 7 - 10/6
[10] Ten days filter, 10 - 20/6
[11] Eight days filter, 20 - 28/6
[12] Six days filter, 28/6 – 4/7
[13] Six days filter, 24 - 30/5
[14] Six days filter, 30/5 – 5/6
[15] Four days filter, 5 - 9/6
[16] Eleven days filter, 9 - 20/6

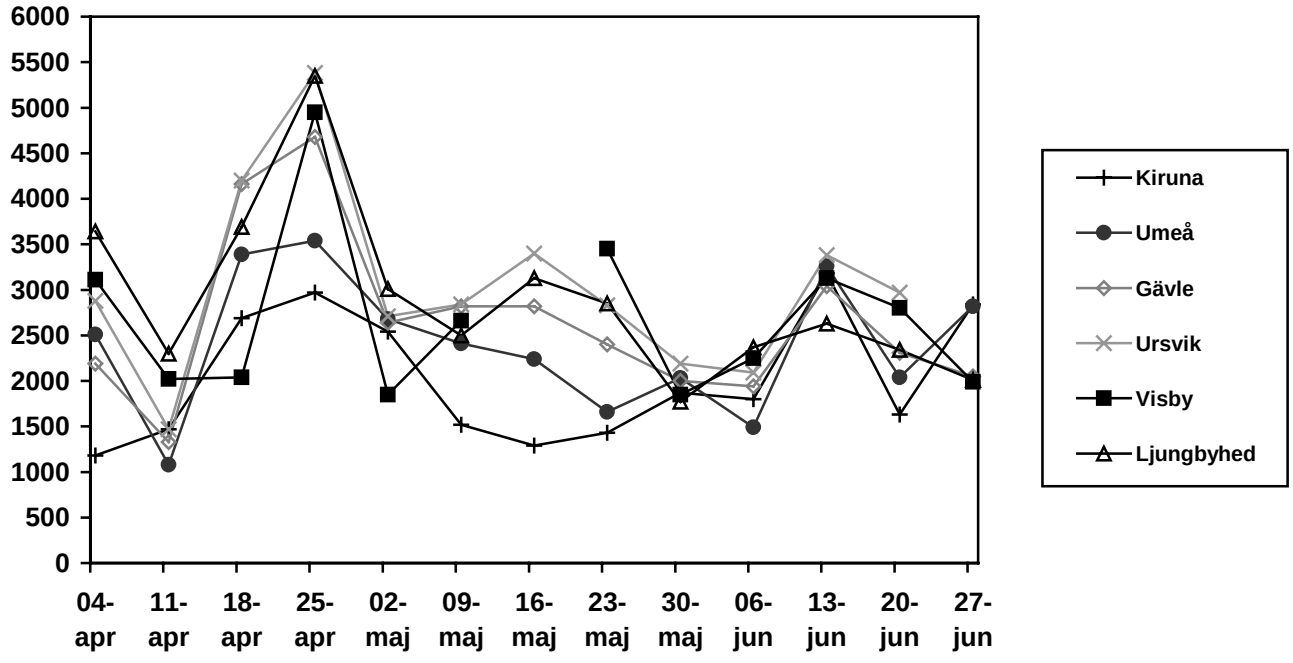


Table II

^{137}Cs concentrations in Sweden, second quarter 2005

Week starting	*Kiruna*	*Umeå*	*Gävle*	*Ursvik*	*Visby*	*Ljungbyhed*
4-apr	0.1 (34)	2.4[5] (4)	3.4 (2)	0.6 (8)	1.3 (11)	0.8 (7)
11-apr	<0.1	2.1[6] (3)	5.9 (2)	0.6 (9)	0.9 (15)	0.7 (9)
18-apr	0.1 (39)	1.4 (4)	5.4 (2)	1.1 (7)	0.3 (16)	1.0 (5)
25-apr	<0.2[1]	2.6 (2)	13.1 (1)	1.3 (4)	1.1 (13)	1.2 (5)
2-may	0.2[2] (24)	2.7 (3)	3.7 (3)	0.6 (17)	0.5 (29)	0.5 (12)
9-may	<0.1	2.2[7] (7)	7.4 (3)	0.6 (12)	0.7 (18)	0.6 (22)
16-may	<0.1	3.2[8] (2)	6.7 (3)	0.7 (8)	-	0.3 (17)
23-may	<0.1	5.2 (1)	4.6 (4)	0.5 (15)	0.9[13] (14)	0.4 (12)
30-may	0.1[3] (31)	3.5[3] (2)	4.6[3] (2)	1.4[3] (3)	0.8[3] (20)	0.1[14] (27)
6-jun	0.4[4] (16)	4.2[9] (3)	7.9[4] (1)	1.4[4] (5)	1.2[4] (5)	0.5[15] (29)
13-jun	0.5 (10)	22.4[10] (1)	5.5 (2)	1.0 (12)	0.8 (17)	0.4[16] (8)
20-jun	1.6 (5)	9.8[11] (1)	3.5 (2)	0.6 (7)	0.9 (14)	0.4 (13)
27-jun	0.4 (11)	2.8[12] (2)	2.9 (2)	-	0.2 (61)	0.4 (15)

Values are given in µBq/m^3.
Error estimates (1σ %) are given in brackets.

* Due to relocalization the high-sensitivity sampler at Ursvik has been closed during this period. Sampling in Ursvik has therefore been performed with an older sampler of the same type as samplers at the other stations.

[1] Four days filter, 25 – 29/4
[2] Ten days filter, 29/4 – 9/5
[3] Eight days filter 30/5 – 7/6
[4] Six days filter 7-13/6
[5] Four days filter, 4 - 8/4
[6] Ten days filter, 8 - 18/4
[7] Eight days filter, 9 - 17/5
[8] Six days filter, 17 - 23/5
[9] Three days filter, 7 - 10/6
[10] Ten days filter, 10 - 20/6
[11] Eight days filter, 20 - 28/6
[12] Six days filter, 28/6 – 4/7
[13] Six days filter, 24 - 30/5
[14] Six days filter, 30/5 – 5/6
[15] Four days filter, 5 - 9/6
[16] Eleven days filter, 9 - 20/6

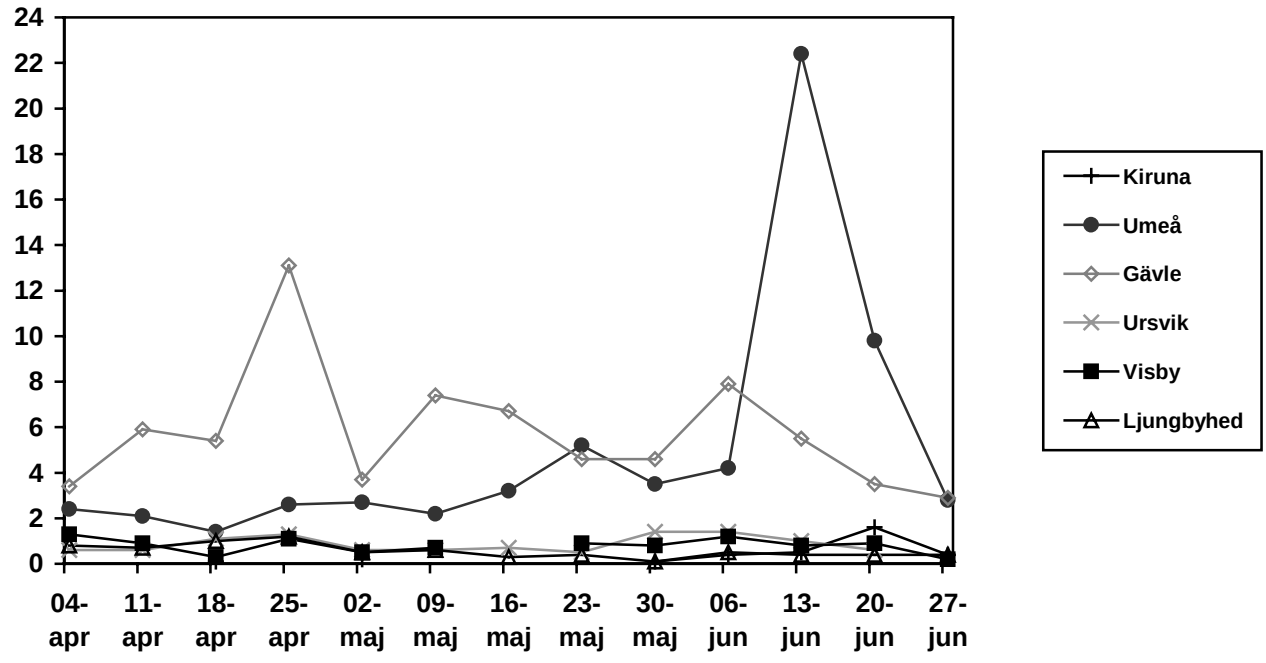


Table III

Deposition measurements, second quarter 2005

Kiruna

Weeks	*Period*	*^{7}Be*	*^{137}Cs*	*Precipitation (mm)*
11 – 14	14/3 – 11/4	15700 (0.8)	22 (36)	46.2
15 – 18	11/4 – 9/5	23500 (0.9)	<15	23.6
19 – 22	9/5 – 7/6	64500 (0.4)	22 (33)	73.2
23 – 26	7/6 – 4/7	44400 (0.5)	34 (18)	25.9

Gävle

Weeks	*Period*	*^{7}Be*	*^{137}Cs*	*Precipitation (mm)*
14 – 17	4/4 – 2/5	6500 (0.9)	96 (3)	7.6
18 – 21	2/5 – 30/5	24500 (0.8)	184 (5)	31.5
22 – 25	30/5 – 27/6	60400 (0.4)	216 (4)	64.0

Ursvik

Weeks	*Period*	*^{7}Be*	*^{137}Cs*	*Precipitation (mm)*
13 – 16	29/3 – 25/4	11200 (0.7)	10 (23)	10.2
17 – 20	25/4 –23/5	21600 (0.7)	16 (32)	27.0
21 – 24	23/5 – 20/6	70400 (0.4)	56 (23)	63.7

Ljungbyhed

Weeks	*Period*	*^{7}Be*	*^{137}Cs*	*Precipitation (mm)*
12 – 15	21/3 – 18/4	13000 (0.7)	11 (26)	5.4
16 – 19	18/4 – 16/5	80300 (0.3)	22 (28)	33.4
20 – 23	16/5– 17/6	75300 (0.3)	28 (17)	51.6

Values are given in mBq/m^2.

Error estimates (1σ %) are given in brackets.

Table IV

Other anthropogenic radionuclides detected, second quarter 2005

Week starting	*Station*	*Isotope*	*Concentration*	*Note*
18-apr	Gävle	^{131}I	1.0 (25)	(1)
9-may	Gävle	^{131}I	1.3 (38)	(1)

Values are given in μBq/m^3.
Error estimates (1σ %) are given in brackets.

(1) The activities of ^{131}I found in Gävle have been shown to correspond to administration of cancer treatment doses for thyroidea cancer at the Gävle-Sandviken County Hospital (ref. Erlandsson et al., "I-131 in air filters at Gävle", presented at NSRP 13th meeting in Åbo, 25-29 August 2002).