Radioactivity in the Risø District July-December 2008

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Risø-R-Report

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Risø-R-1675(EN)
June 2009

Risø DTU
National Laboratory for Sustainable Energy

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Title: Radioactivity in the Risø District July-December 2008
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Abstract (max. 2000 char.): The environmental surveillance of the Risø environment was continued in July - December 2008. The mean concentrations in air were: 0.27±0.15 μBq m^{-3} of ^{137}Cs, 2.8±0.83 mBq m^{-3} of ^{7}Be and 0.18±0.13 mBq m^{-3} of ^{210}Pb (±1 S.D.; N = 26). The depositions by precipitation at Risø in the second half of 2008 were: 0.046 Bq m^{-2} of ^{137}Cs, 456 Bq m^{-2} of ^{7}Be, 28.8 Bq m^{-2} of ^{210}Pb and < 1.0 kBq m^{-2} of ^{3}H. The average background dose rate (TLD) at Risø (Zone I) was 69 nSv h^{-1} compared with 56±6.2 nSv h^{-1} (±1 S.D.; N = 4) in the four zones around Risø.

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Table 1. Radionuclides in ground level air collected at Risø (cf. Figs. 1, 1.1 and 1.2), July - December 2008. (Unit: $\mu Bq\ m^{-3}$)

Date		^{7}Be	^{137}Cs	^{210}Pb
30-Jun-08 –	04-Jul-08	2792	0.174	117
04-Jul-08 –	15-Jul-08	2846	0.131	136
15-Jul-08 –	21-Jul-08	1400	0.098	79
21-Jul-08 –	28-Jul-08	2589	0.329	174
28-Jul-08 –	04-Aug-08	4255	0.328	238
04-Aug-08 –	12-Aug-08	2895	0.178	164
12-Aug-08 –	18-Aug-08	3615	0.249	164
18-Aug-08 –	25-Aug-08	2837	0.131	149
25-Aug-08 –	01-Sep-08	2117	0.112	149
01-Sep-08 –	08-Sep-08	3707	0.146	238
08-Sep-08 –	15-Sep-08	2421	0.203	162
15-Sep-08 –	22-Sep-08	3707	0.511	308
22-Sep-08 –	30-Sep-08	3997	0.353	529
30-Sep-08 –	06-Oct-08	2189	0.091	73
06-Oct-08 –	14-Oct-08	2636	0.212	280
14-Oct-08 –	21-Oct-08	4186	0.197	204
21-Oct-08 –	27-Oct-08	3074	0.190	147
27-Oct-08 –	03-Nov-08	2634	0.380	102
03-Nov-08 –	10-Nov-08	3328	0.424	449
10-Nov-08 –	17-Nov-08	2817	0.156	92
17-Nov-08 –	24-Nov-08	1523	0.149	41
24-Nov-08 –	01-Dec-08	1843	0.319	139
01-Dec-08 –	08-Dec-08	1738	0.418	146
08-Dec-08 –	16-Dec-08	3922	0.726	431
16-Dec-08 –	22-Dec-08	2708	0.363	19
22-Dec-08 –	29-Dec-08	1779	0.366	7
Mean		2829	0.267	182
SD		828	0.150	129

Table 2.1. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), July - December 2008. (Unit: Bq m^{-3})

Month	^{7}Be	^{137}Cs	^{210}Pb
July	1336	0.156	64
August	1370	0.163	75
September	1263	0.117	73
October	1461	0.057	58
November	910	0.106	110
December	991	0.102	76

Table 2.2. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), July - December 2008. (Unit: Bq m^{-2})

Month	Precipitation (m)	^{7}Be	^{137}Cs	^{210}Pb
July	0.026	35	0.0041	1.7
August	0.118	162	0.0193	8.8
September	0.056	70	0.0065	4.0
October	0.046	67	0.0026	2.7
November	0.057	52	0.0061	6.3
December	0.069	69	0.0071	5.3
Sum	0.373	456	0.0457	28.8

Table 2.3. Tritium in precipitation collected at Risø (cf. Figs. 1, 2.3.1 and 2.3.2). July - December 2008. (Unit: kBq m^{-3})

Month	1 m^2 rain collector	10 m^2 rain collector
January	< 2.7	< 2.7
February	< 2.7	< 2.7
March	< 2.7	< 2.7
April	< 2.7	< 2.7
May	< 2.7	< 2.7
June	< 2.7	< 2.7
Double determinations		

Table 2.4. Tritium in precipitation collected at Risø (cf. Fig. 1). July – December 2008. (Unit: kBq m^{-2})

Month	Precipitation (m)	1 m^2 rain collector	10 m^2 rain collector
January	0.026	< 0.071	< 0.071
February	0.118	< 0.32	< 0.32
March	0.056	< 0.149	< 0.149
April	0.046	< 0.123	< 0.123
May	0.057	< 0.154	< 0.154
June	0.069	< 0.186	< 0.186
Sum	0.373	< 1.0	< 1.0

Table 3.1. Radionuclides in sediment samples collected at Bolund in Roskilde Fjord.(cf. Fig. 3.1) July - December 2008. (Unit: Bq kg^{-1} dry)

Date	^{137}Cs	K*
29 July	3.0	15.5

*Unit: g kg^{-1} dry

Table 4.1. Radionuclides in seawater collected in Roskilde Fjord (cf. Fig. 4.1) June - December 2008. (Unit: Bq m^{-3})

Location	Date	^{137}Cs	Salinity in $^{o}/_{oo}$
Risø pier	2 June	12.2	12.0

Table 4.2. Tritium in seawater collected in Roskilde Fjord (Risø pier) (cf. Fig. 4.2) July - December 2008.

Month	kBq m^{-3}	Salinity in $^{o}/_{oo}$
July	< 2.7 *	12.4
August	< 2.7 *	13.2
September	< 2.7 *	13.0
October	< 2.7 *	12.8
November	< 2.7 *	13.1
December	< 2.7 *	12.5

* Double determinations

*Table 5.1. Radionuclides in grass collected at Risø (near the Waste Treatment Station (cf. Fig. 1)), January - June 2008. (*Measured on bulked ash samples)*

Week no. or month	Date	K (g kg^{-1} fresh)	^{137}Cs (Bq kg^{-1} fresh)	^{137}Cs (Bq m^{-2})
28	7 July	6.0	<0.6	
29	14 July	5.3	<0.8	
30	21 July	5.4	<0.7	
31	28 July	6.4	<0.7	
32	4 August	3.7	<0.5	
33	11 August	3.2	<0.6	
34	18 August	5.5	<1.0	
35	25 August	3.8	<0.5	
36	1 September	5.7	<0.6	
37	8 September	4.7	<0.6	
38	15 September	6.9	<0.9	
39	22 September	6.6	<0.6	
40	29 September	5.1	<0.5	
41	6 October	4.0	<0.4	
42	13 October	5.3	<0.6	
43	30 October	5.2	<0.6	
44	27 October	4.7	<0.4	
45	3 November	5.0	<0.5	
46	10 November	5.2	<0.5	
47	17 November	2.6	<0.4	
48	24 November	2.6	<0.6	
49	1 December	4.0	<0.4	
50	8 December	4.6	<0.3	
51	15 December	6.3	<0.6	
52	22 December	4.0	<0.5	
53	30 December	3.1	<0.3	
*July		6.2	0.036 B	0.0097
*August		4.3	0.096	0.040
*September		6.5	0.057	0.0170
*October		5.2	0.031 A	0.0140
*November		4.2	0.108	0.047
*December		4.6	0.058	0.029

Table 5.2. Radionuclides in Fucus vesiculosus collected at Bolund in Roskilde Fjord. July - December 2008. (Unit: Bq kg^{-1} dry)

Date	^{137}Cs	K*	% dry matter
29 July	3.2	22	28
*Unit: g kg^{-1} dry			

Table 7.1. Waste water collected at Risø (cf. Fig. 1), July - December 2008.

Week number	eqv. mg KCl l^{-1}	^{137}Cs (Bq m^{-3})	^{131}I (Bq m^{-3})	^{226}Ra (Bq m^{-3})
28	84	<123	<126	690 A
29	78	<123	<126	1450
30	73	<122	<129	380
31	65	<120	<127	<230
32	100	<130	<137	780
33	65	<115	<116	<220
34	67	<124	<126	330 B
35	58	<116	<129	460 A
36	63	<125	<124	330 B
37	60	<114	<120	<220
38	67	<113	<124	<210
39	67	<125	<121	580 A
40	74	<114	<122	440
41	70	<111	<120	420 A
42	73	<119	<130	500
43	102	<105	<107	<200
44	104	<127	<129	840
45	86	<120	<125	990
46	89	<114	<116	500
47	75	<106	<108	900 B
48	66	<106	<114	360 A
49	97	<106	<119	340 A
50	600	<83	<91	620
51	322	<98	<106	280 B
52	114	<115	<123	580
53	108	<81	<123	490
Mean	109			
SE	22			

Table 8.1. Background dose rates around the border of Risø (cf. Fig. 8.1) measured with thermoluminescence dosimeters (TLD) in the period May 2008 – October 2008. (Results are normalized to nSv h^{-1})

Location	nSv h^{-1}
1	46
2	47
3	48
4	56
5	50
6	54
Mean	50

Table 8.2. Background dose rates around Risø (cf. Fig. 8.2 and Fig. 1) measured with thermoluminescence dosimeters (TLD) in the period May 2008 – October 2008. (Results are normalized to nSv h^{-1})

Risø zone	Location	nSv h^{-1}
I	1	40
I	2	55
I	3	134
I	4	66
I	5	52
Mean		69
II	P1	51
II	P2	73
II	P3	70
II	P4	-
Mean		65
III	P1	53
III	P2	53
III	P3	59
Mean		55
IV	P1	42
IV	P2	47
IV	P3	53
IV	P4	58
IV	P5	52
IV	P6	38
IV	P7	59
Mean		50
V	P1	55
V	P2	60
V	P3	67
V	P4	42
V	P5	59
V	P6	-
V	P7	51
V	P8	64
V	P9	68
V	P10	61
Mean		58

Table 8.3. Terrestrial dose rates at the Risø zones (cf. Fig. 8.2 and Fig. 1) July - December 2008. Measured with a NaI(Tl) detector. (Unit: nSv h^{-1})

Risø zone	Location	July	October
I	1	36	39
I	2	47	47
I	3	308	378
I	4	43	40
I	5	42	40
Mean		96	109
II	P1	38	41
II	P2	41	40
II	P3	36	37
II	P4	40	39
Mean		39	39
III	P1		43
III	P2		44
III	P3		42
Mean			43
IV	P1		37
IV	P2		45
IV	P3		39
IV	P4		39
IV	P5		37
IV	P6		35
IV	P7		40
Mean			39
V	P1		37
V	P2		44
V	P3		50
V	P4		49
V	P5		44
V	P6		41
V	P7		41
V	P8		40
V	P9		42
V	P10		34
Mean			42

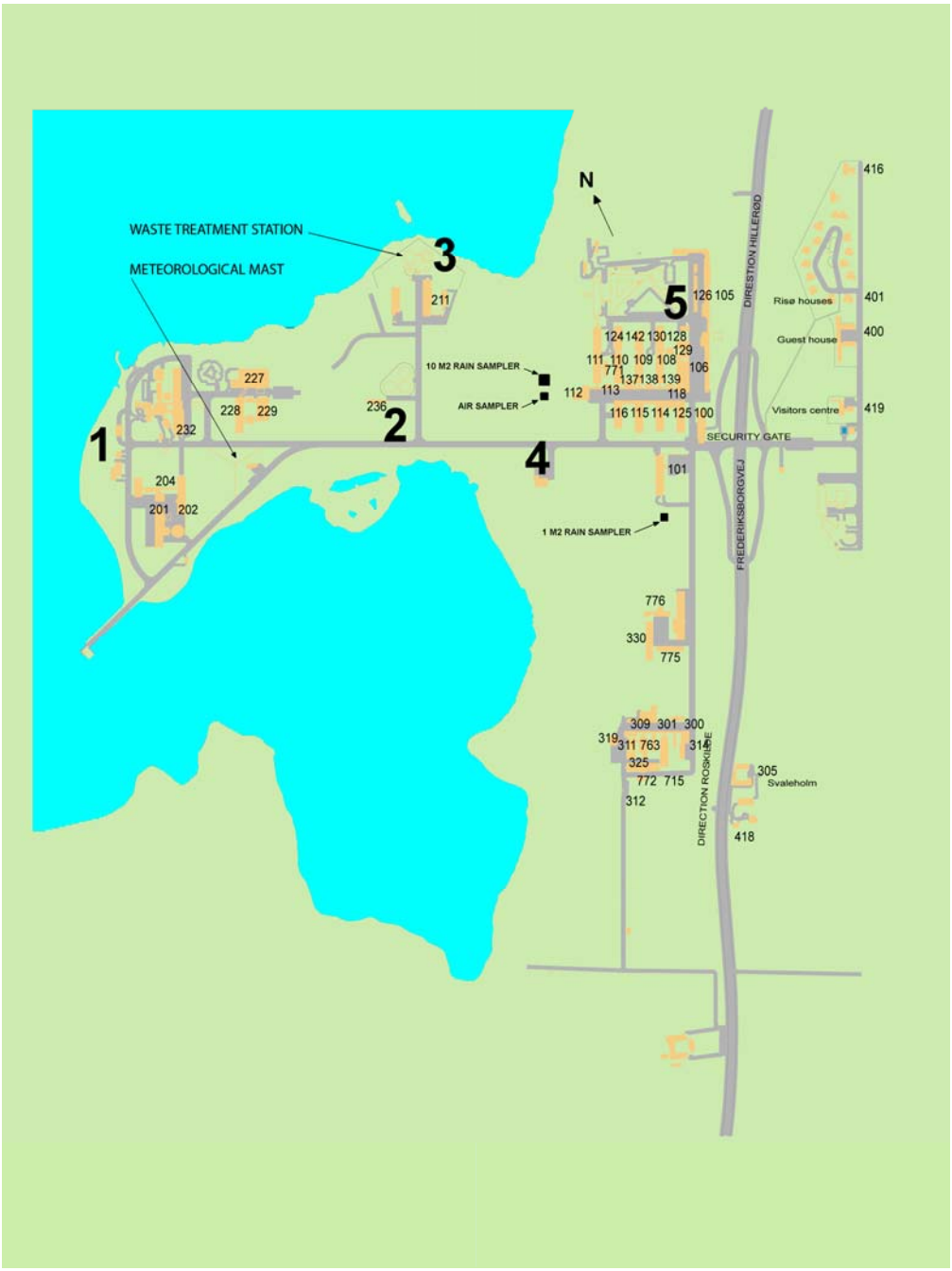


Fig. 1. Map of Risø, with building numbers.
1-5: Locations for gamma-background measurements (cf. Tables 8.2 and 8.3)

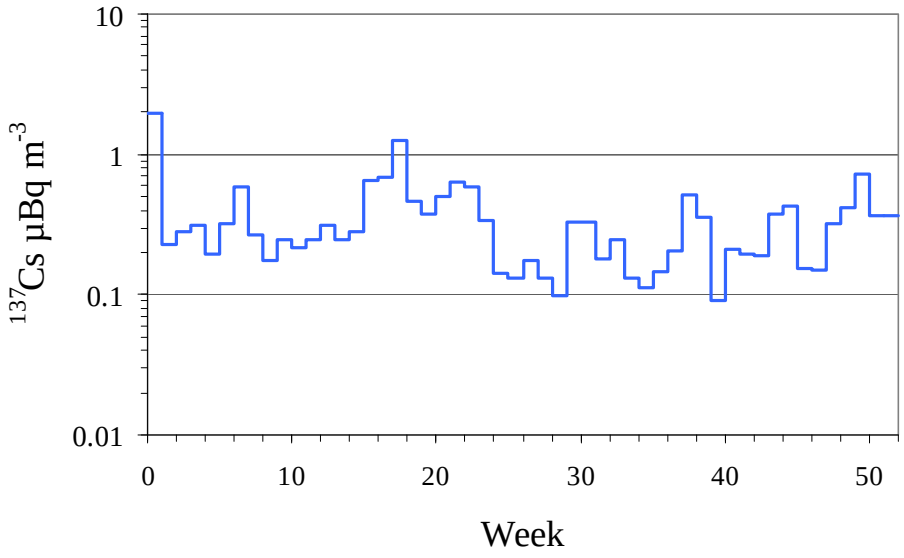
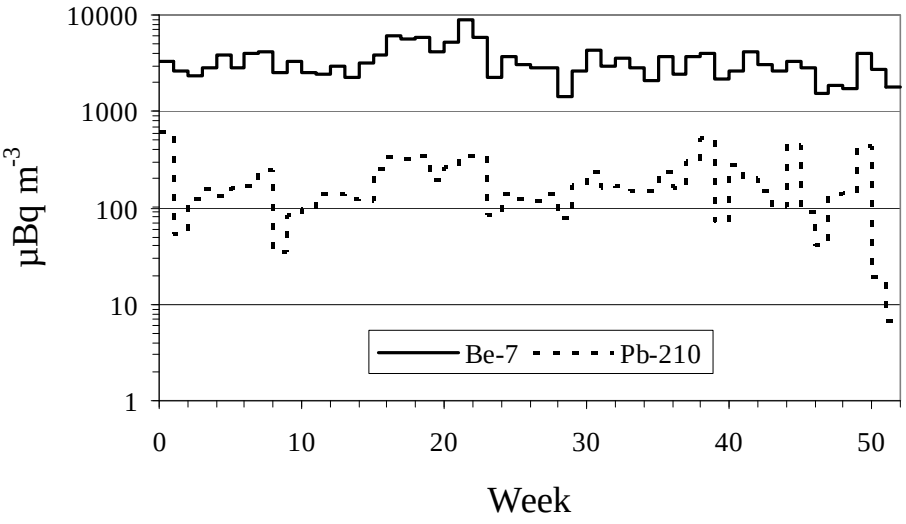


Fig. 1.1. Caesium-137 in ground level air collected at Risø in January-December 2008. (Unit: µBq m^{-3})

Fig. 1.2. Beryllium-7 and lead-210 in ground level air collected at Risø in January-December 2008. (Unit: µBq m^{-3})



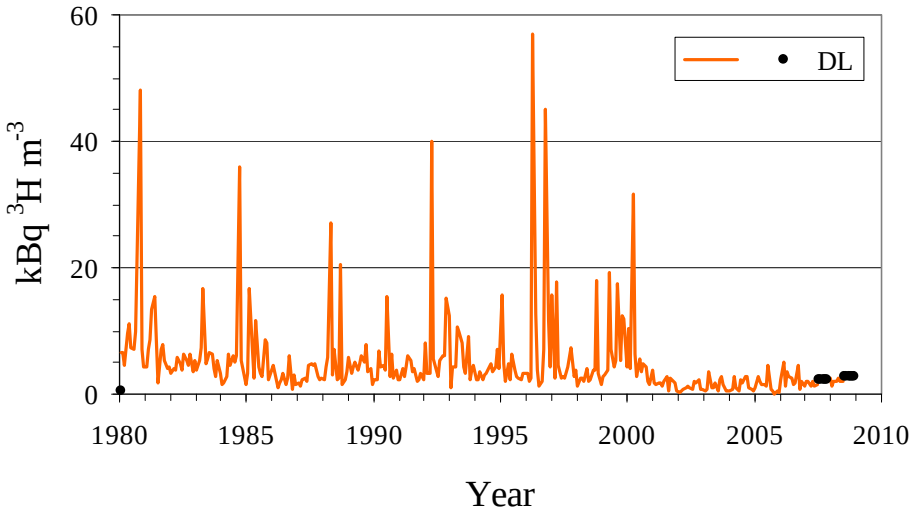
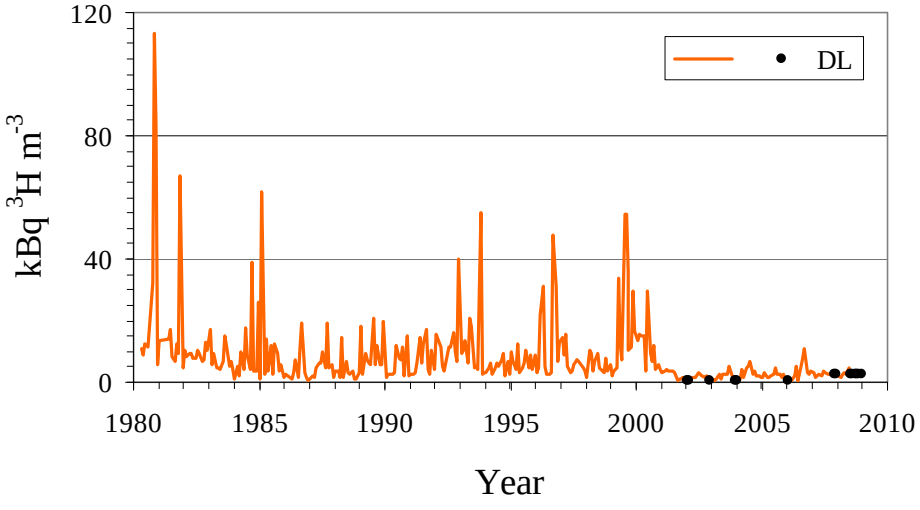


Fig. 2.3.1. Tritium in precipitation collected at Risø (1 m^2 rain collector) 1980 - 2008. (Unit: kBq m^{-3}; DL = detection limit)

Fig. 2.3.2. Tritium in precipitation collected at Risø (10 m^2 rain collector) 1980 - 2008. (Unit: kBq m^{-3}; DL = detection limit)



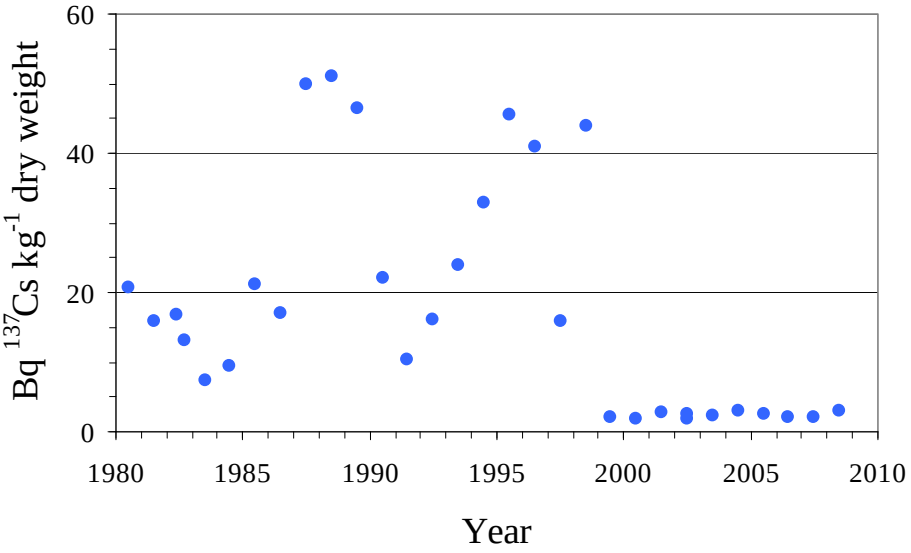


Fig. 3.1. Caesium–137 in sediment samples collected at Bolund in Roskilde Fjord. 1980 – 2008. (Unit: Bq kg^{-1} dry matter)

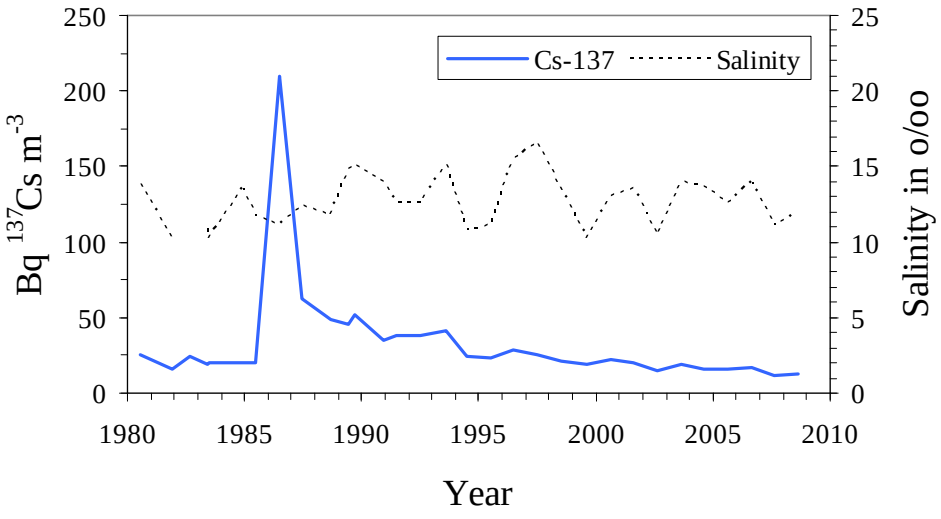
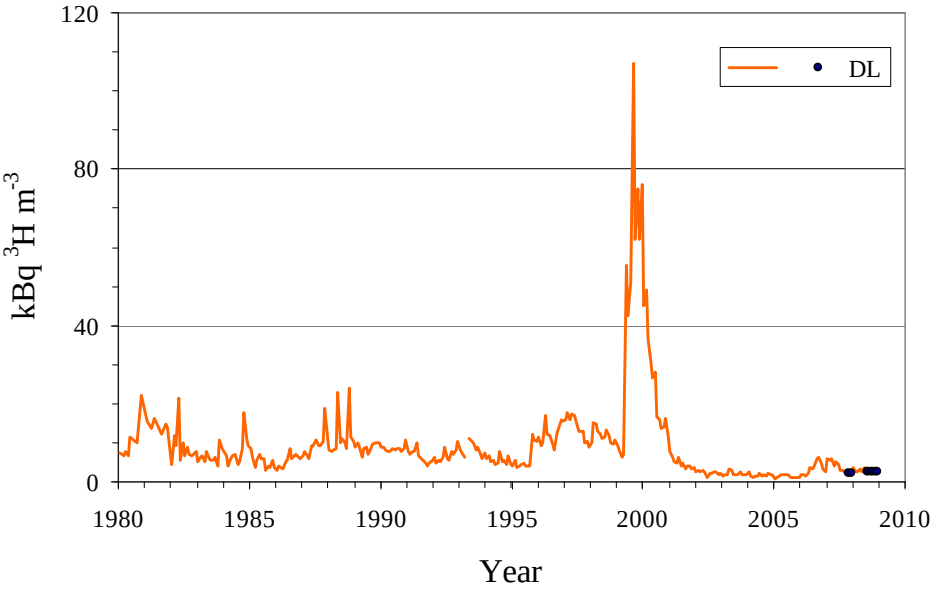


Fig. 4.1. Caesium–137 in seawater collected in Roskilde Fjord 1980 - 2008. (Unit: Bq m^{-3})

Fig. 4.2. Tritium in seawater collected in Roskilde Fjord 1980 - 2008. (Unit: kBq m^{-3}; DL = detection limit)



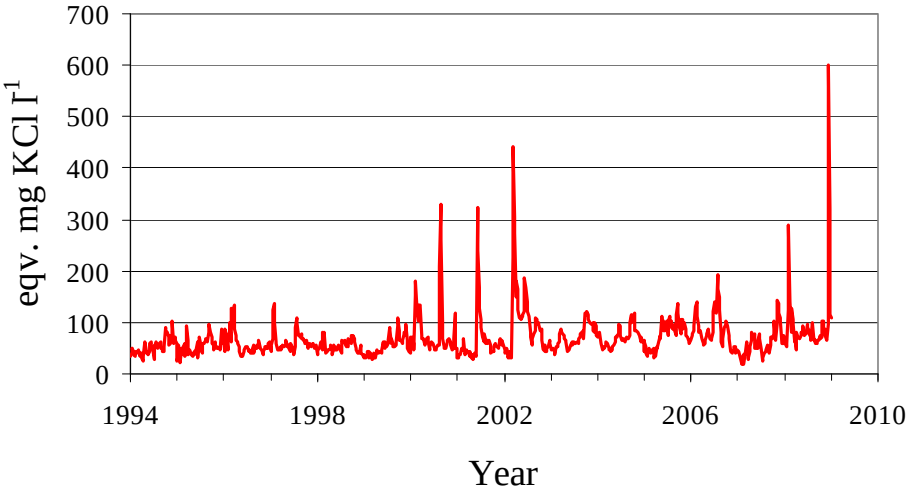


Fig. 7.1. Total-beta radioactivity in waste water collected at Risø 1994 - 2008. (Unit: eqv. mg KCl l^{-1})

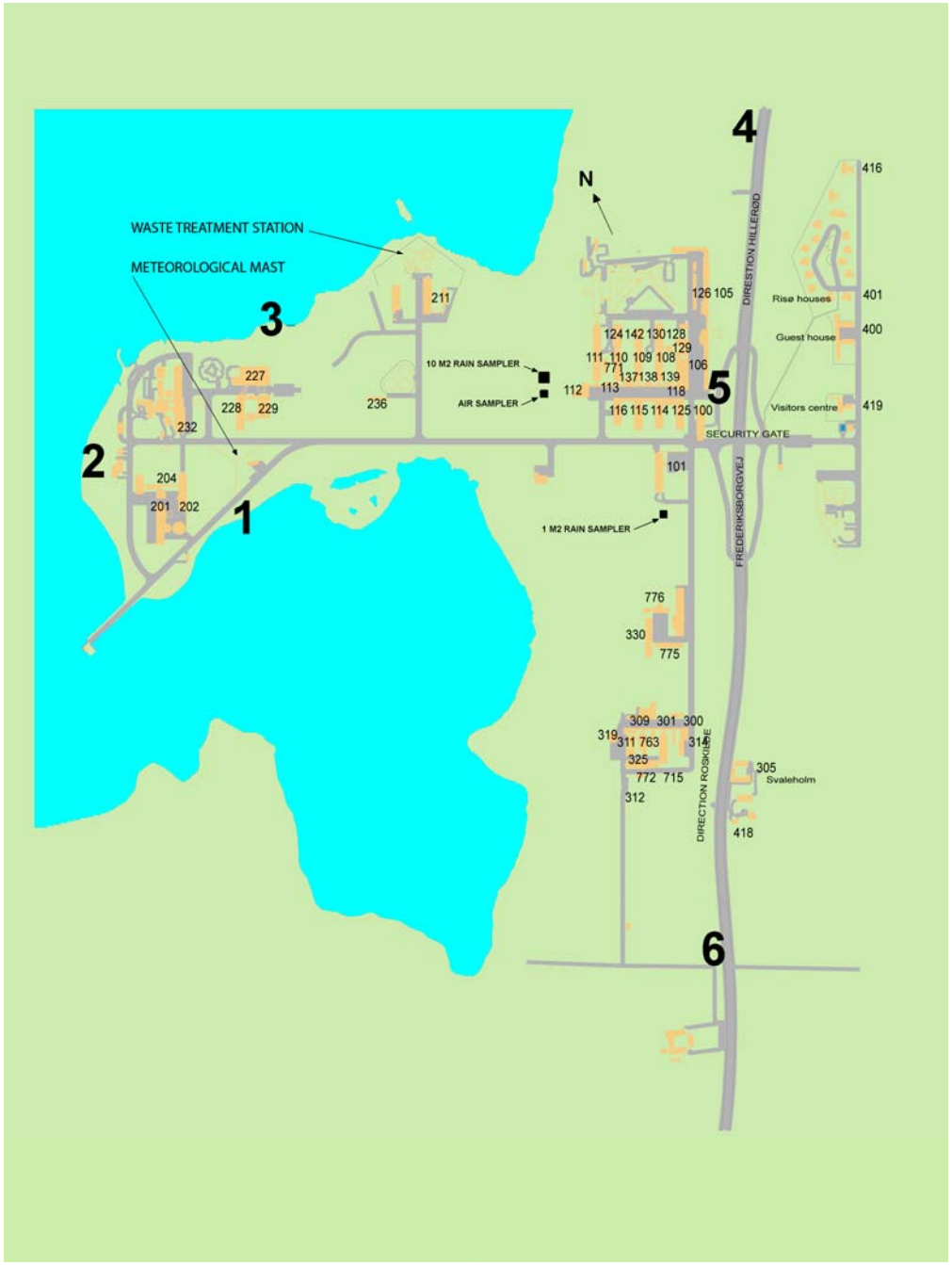


Fig. 8.1. Locations (1-6) for TLD measurements around the the border of Risø (cf. Table 8.1).

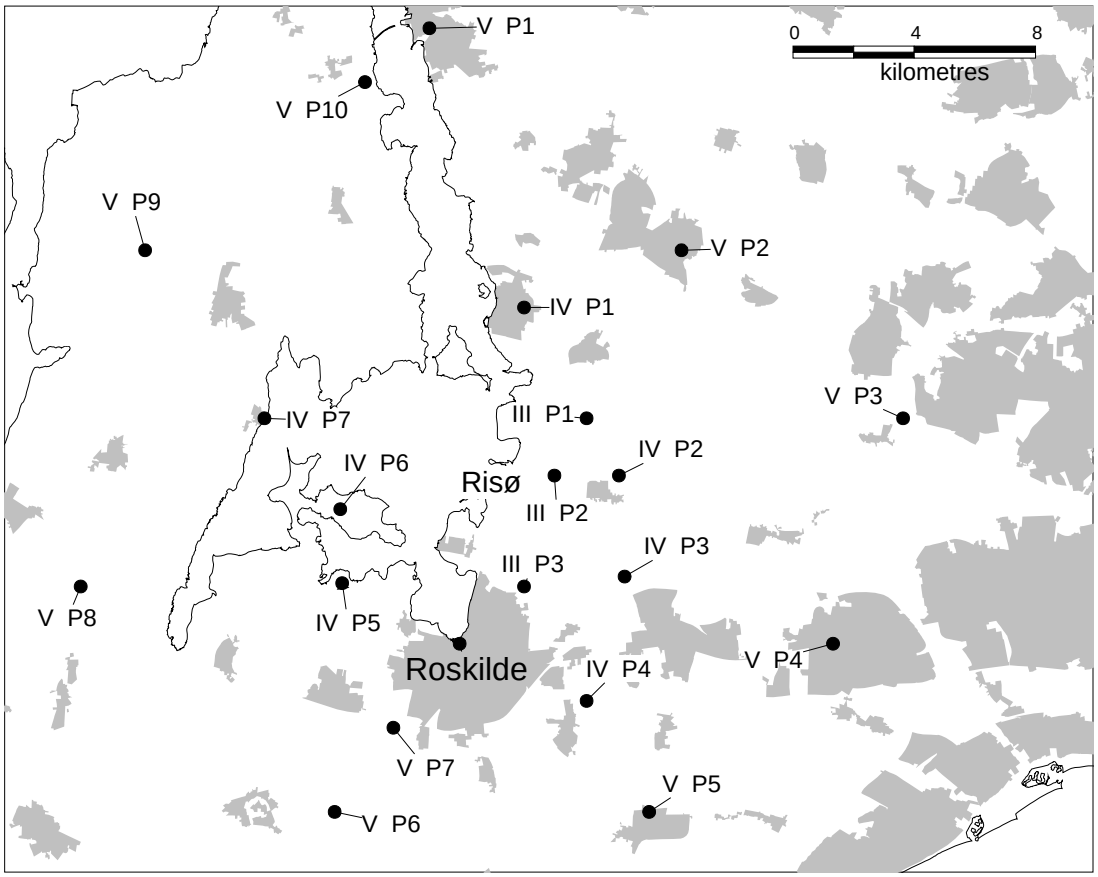


Fig. 8.2. The environment of Risø. Locations for measurements of background radiation.

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