Chapter 7 Changes in dune volume and dune position: tables and graphs.

The dune is an integrated part of the beach system. Usually, sand is transported to the beach by the waves, and transported further inland over the dunes and through breaches in the dunes by the wind. The integrated amount of windblown sand over the three years test is listed in table 7.1, based on laser scanning. The changes are of same magnitude as those in the beach, see chapter 8. When dealing with the sediment budget for the beach it is therefore necessary also to include the inland sand transport.

	Total [m3]	per m[m3/m]
Ref 1	54.240	30
Rør 1	198.685	42
Ref 2	921	1
Rør 2	42.043	47
Ref 3	57.397	32
Total amount	353.286	

Table 7.1. Accumulated sand over three years from the dune foot (level + 4.00 at Jan 05) and 300 meter inwards in the hinterland.

7.1 The lower part of the dune: changes in volume and dune foot position.

A: Cumulative changes.

The lower part of the dune has been measured just as extensively as the beach, while the upper part, see section 7.2 only is measured in the beginning and at the end of the test.

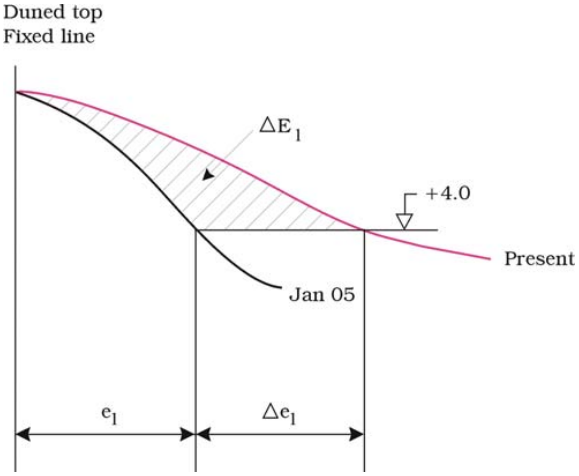


Figure 7.1 Definition of the two quantities ΔE1 and Δe1.

The surveys presented in this chapter are related to the two quantities ΔE1 and Δe1, which represent the changes in the volume of sand above the 4.0 meter level above MSL, and the instantaneous position of the dune foot, defined as the 4.0 meter level.
Figure 7.2 a-l shows the development in ΔE1 and Δe1 from January 2005, where the test began.

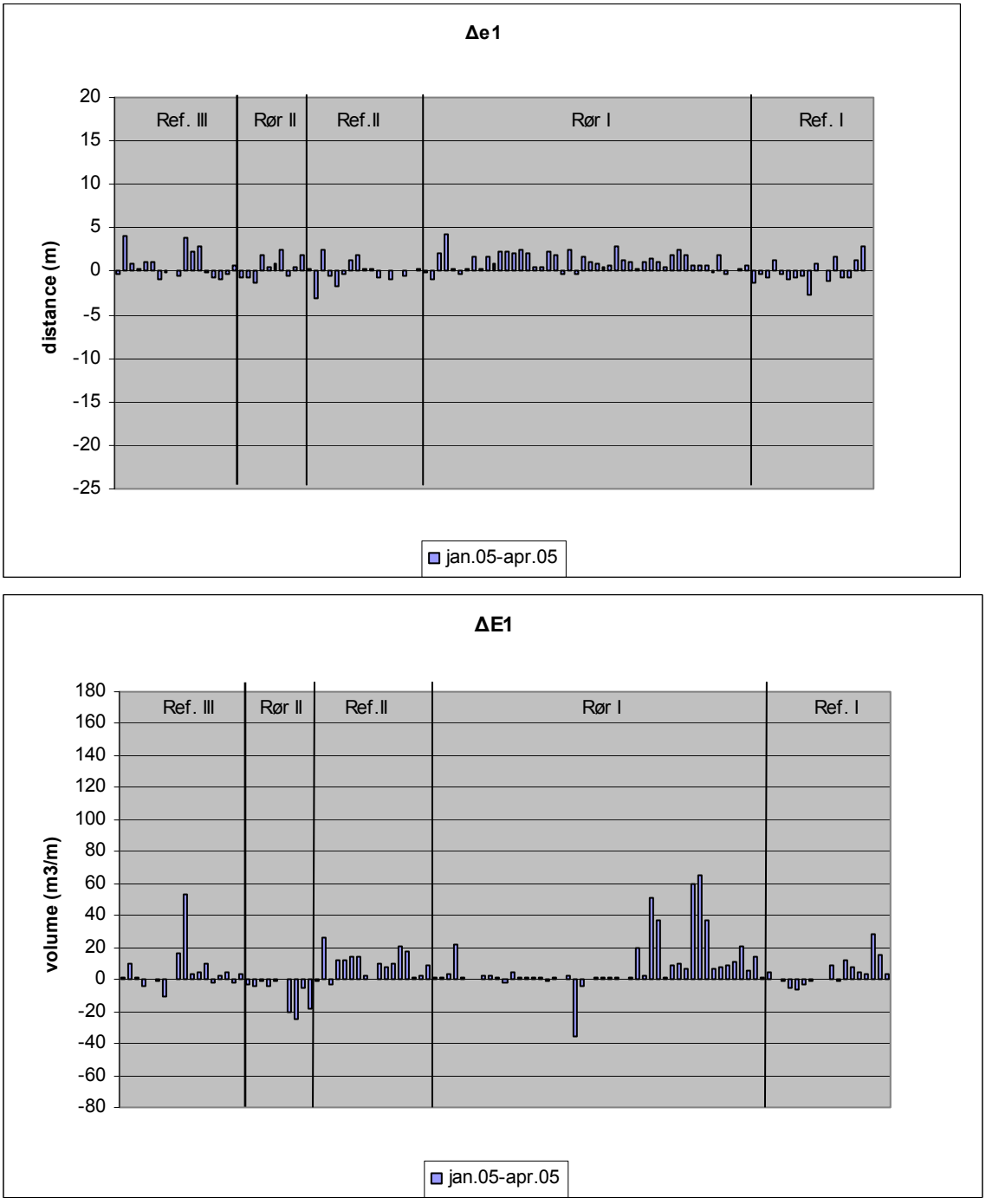
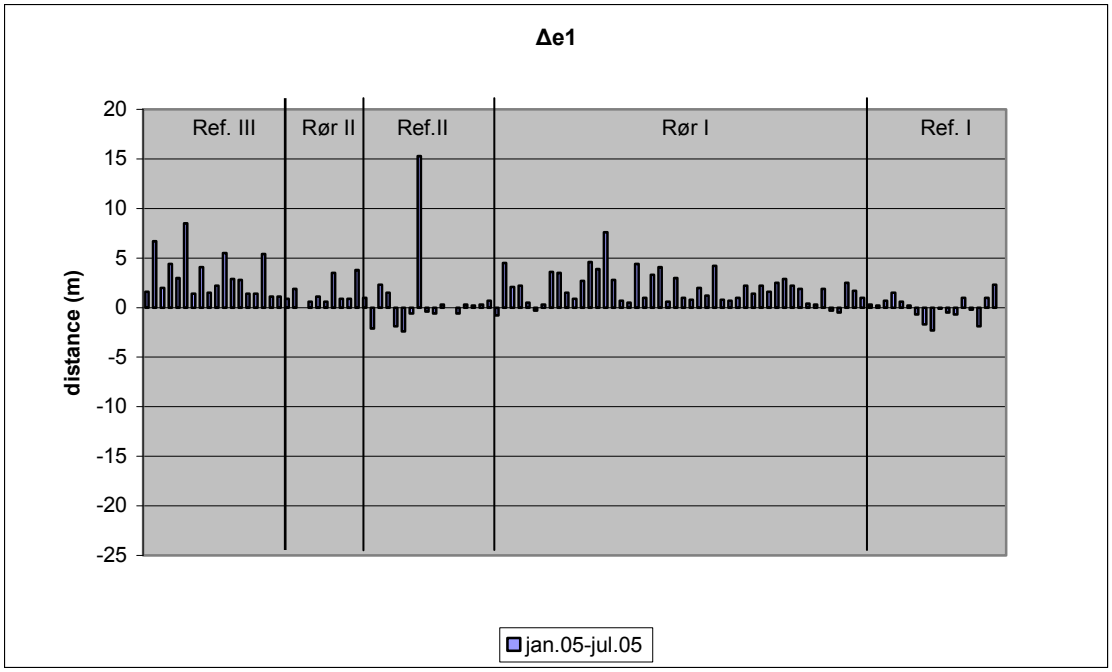


Figure 7.2 a.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-jul.05

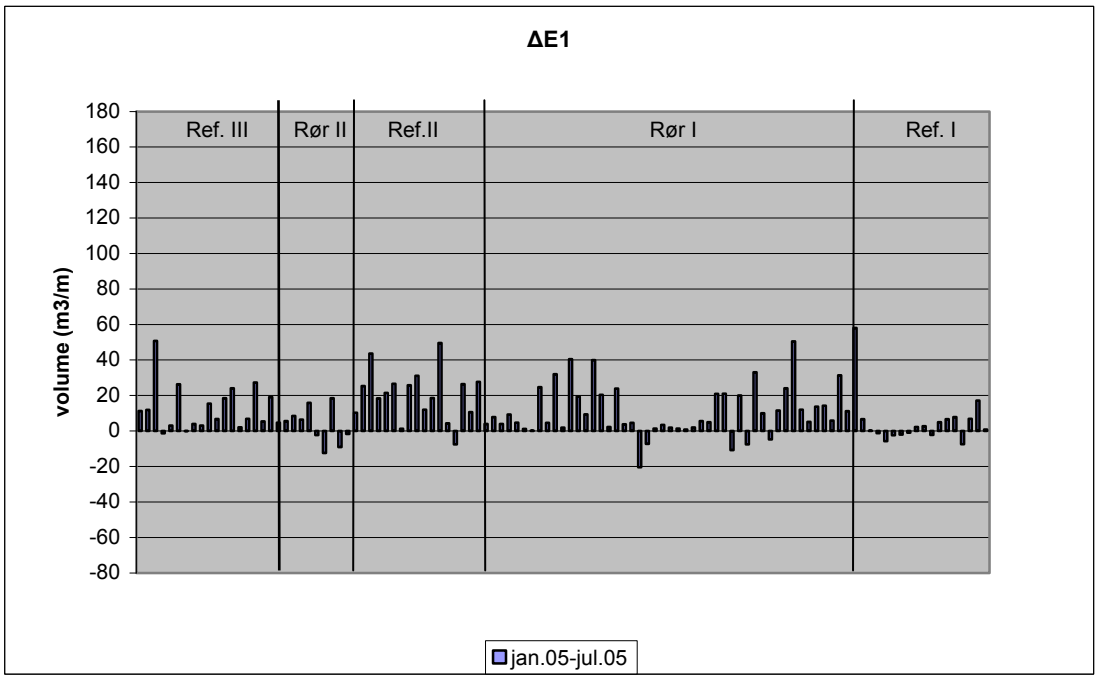
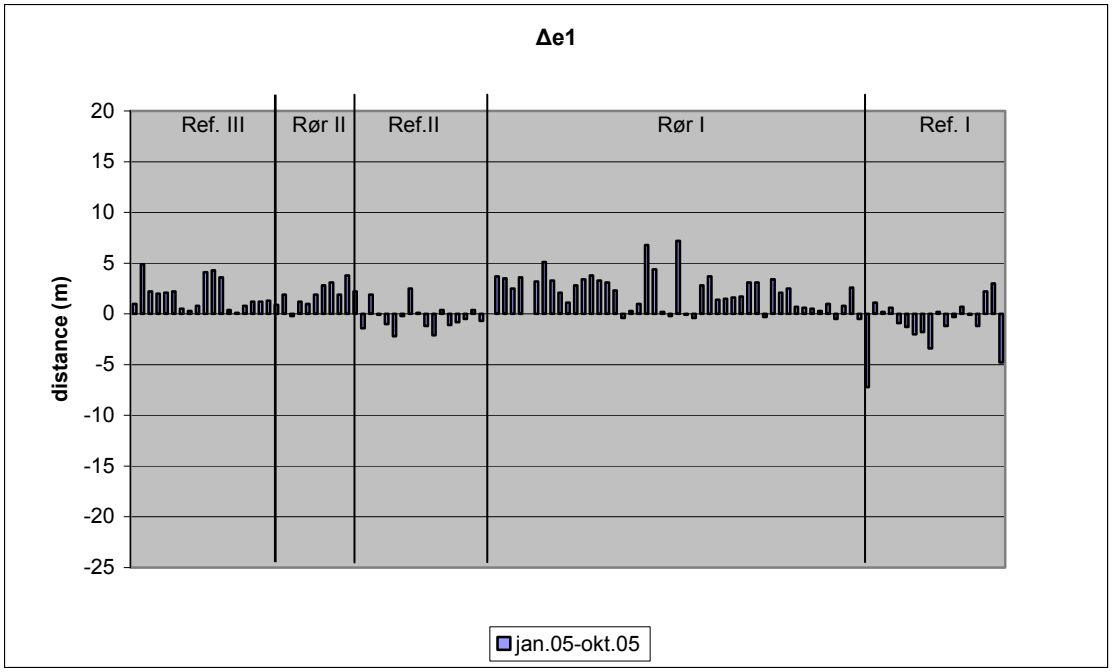

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-jul.05

Figure 7.2 b.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-okt.05

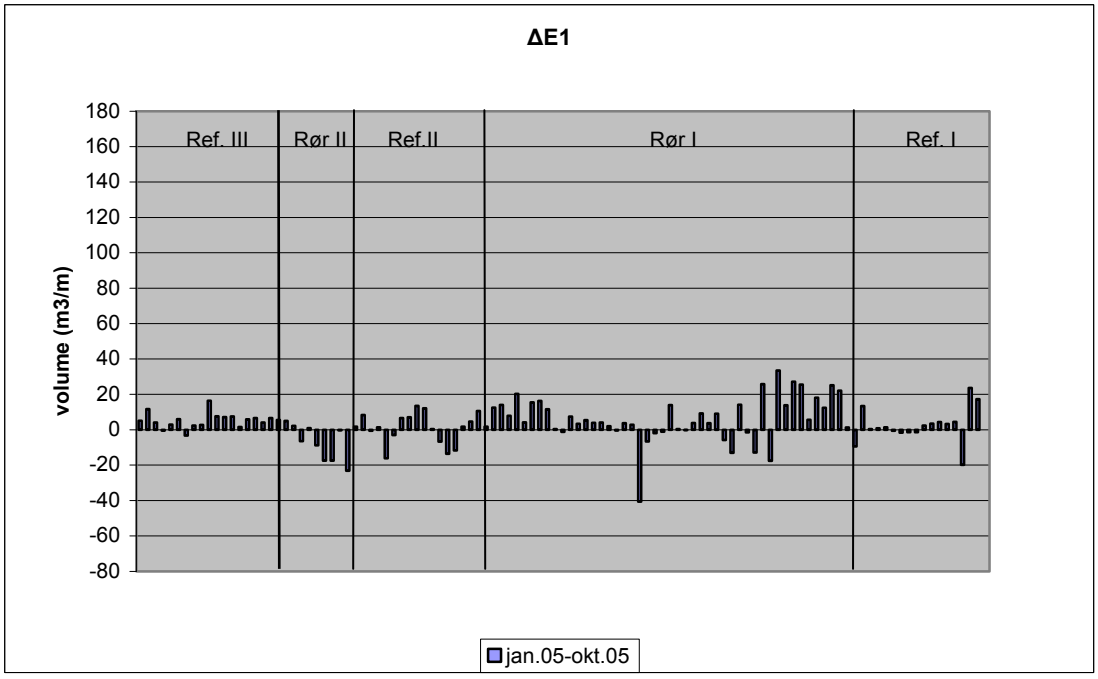
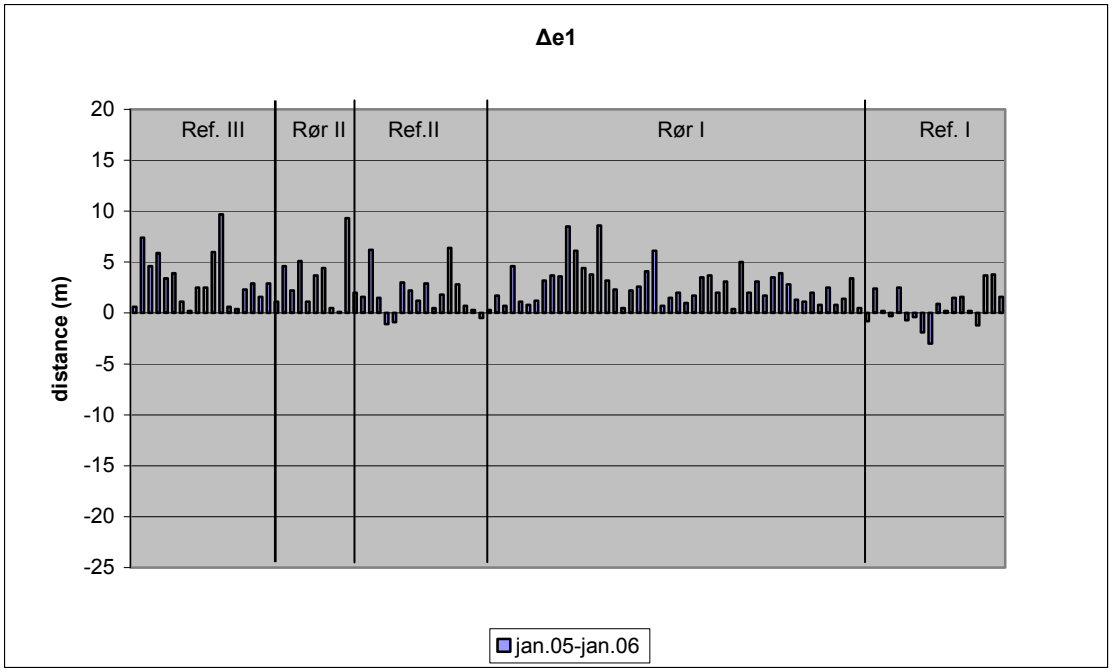

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-okt.05

Figure 7.2 c.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-jan.06

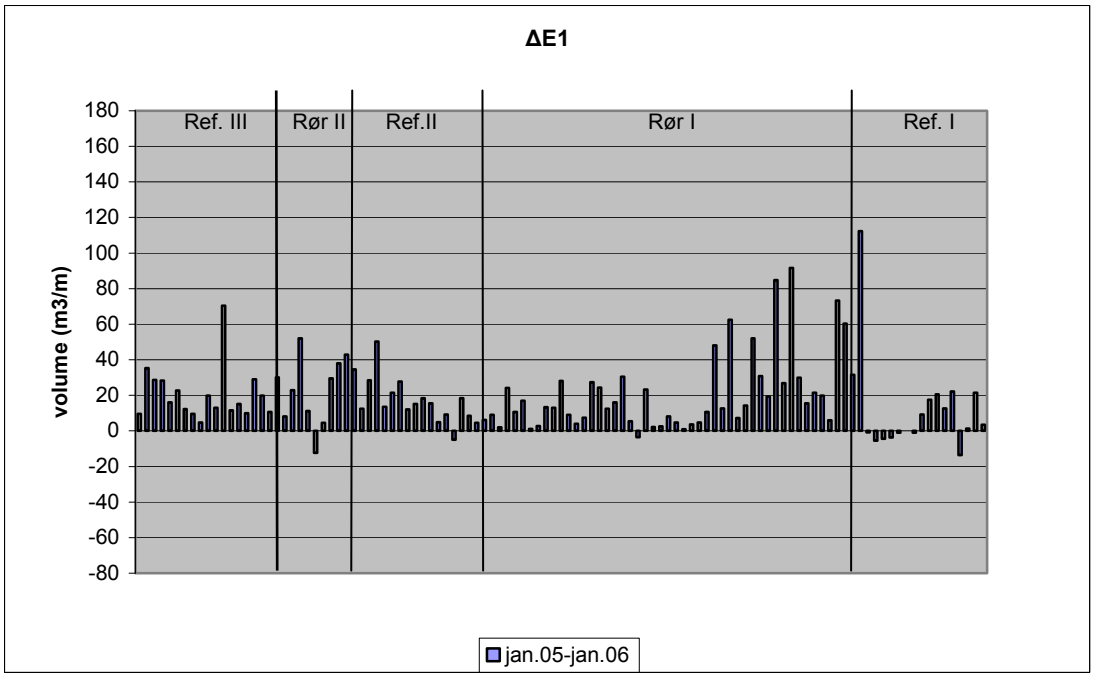
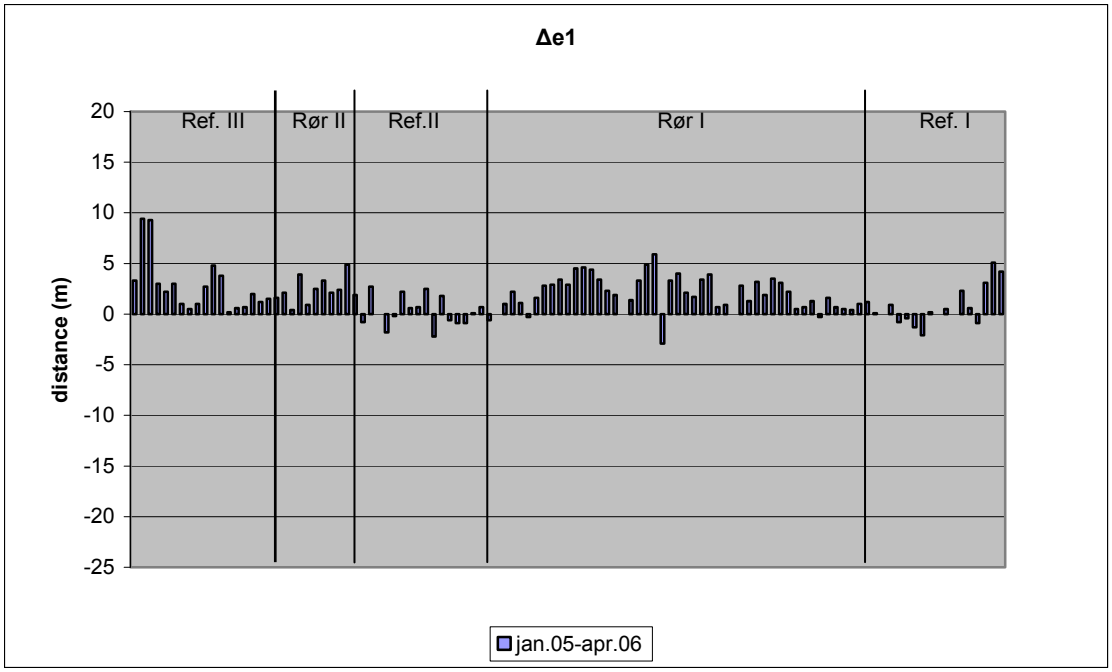

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-jan.06

Figure 7.2 d.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
20
15
10
5
0
-5
-10
-15
-20
-25
distance (m)
jan.05-apr.06

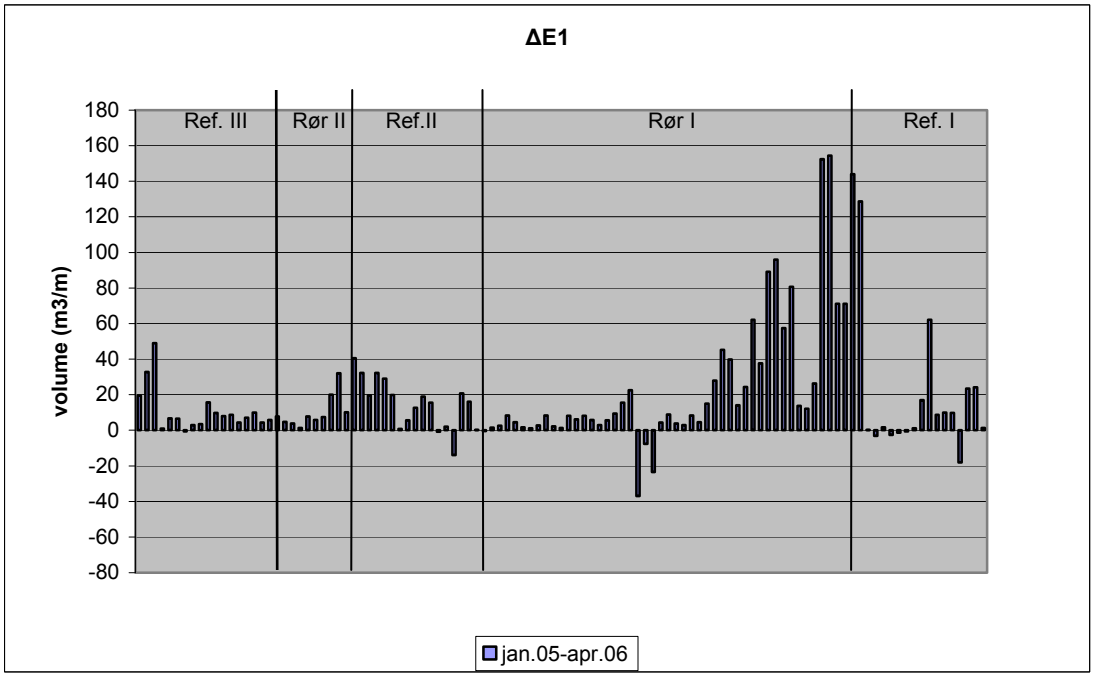
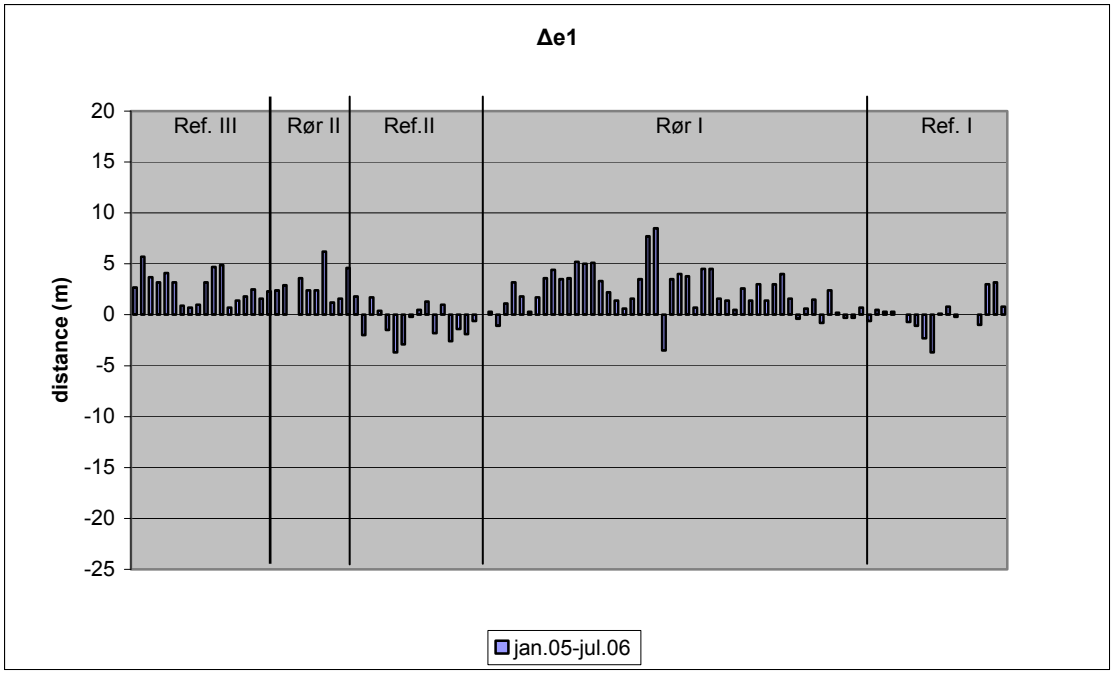

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
volume (m3/m)
jan.05-apr.06

Figure 7.2 e.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-jul.06

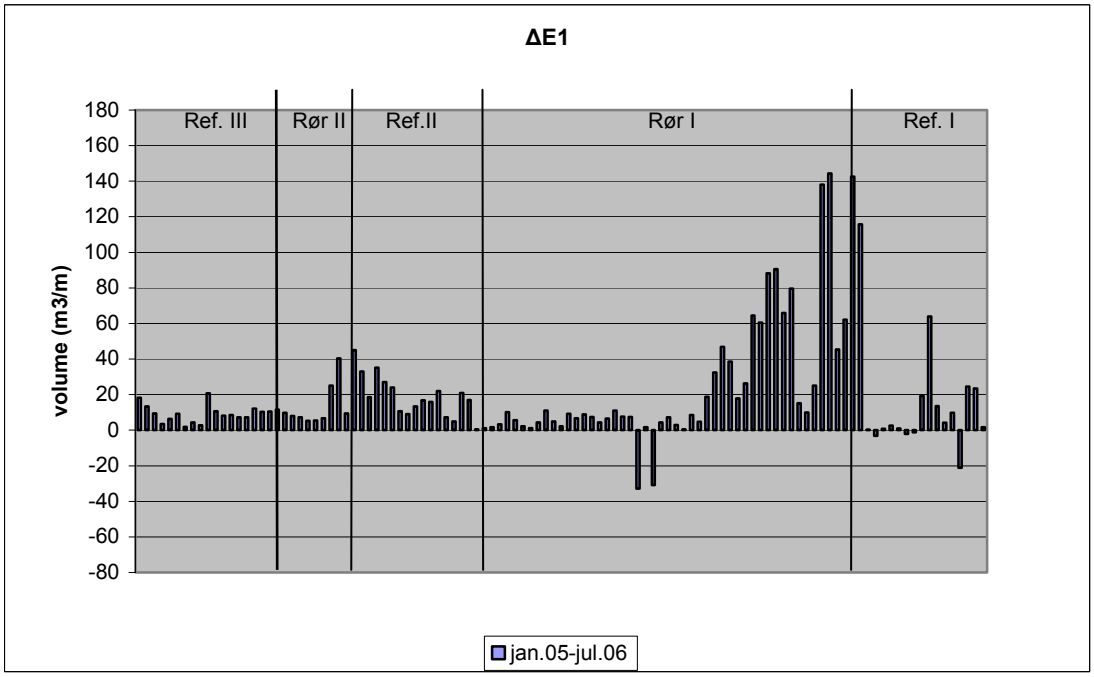
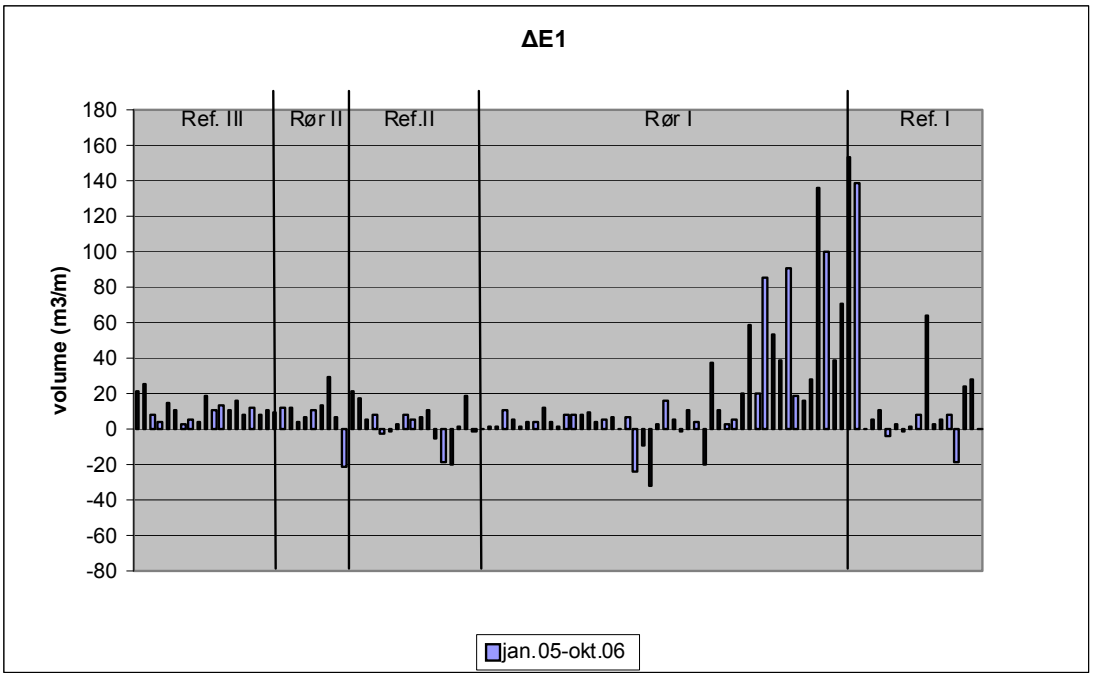

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-jul.06

Figure 7.2 f.


ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-okt.06

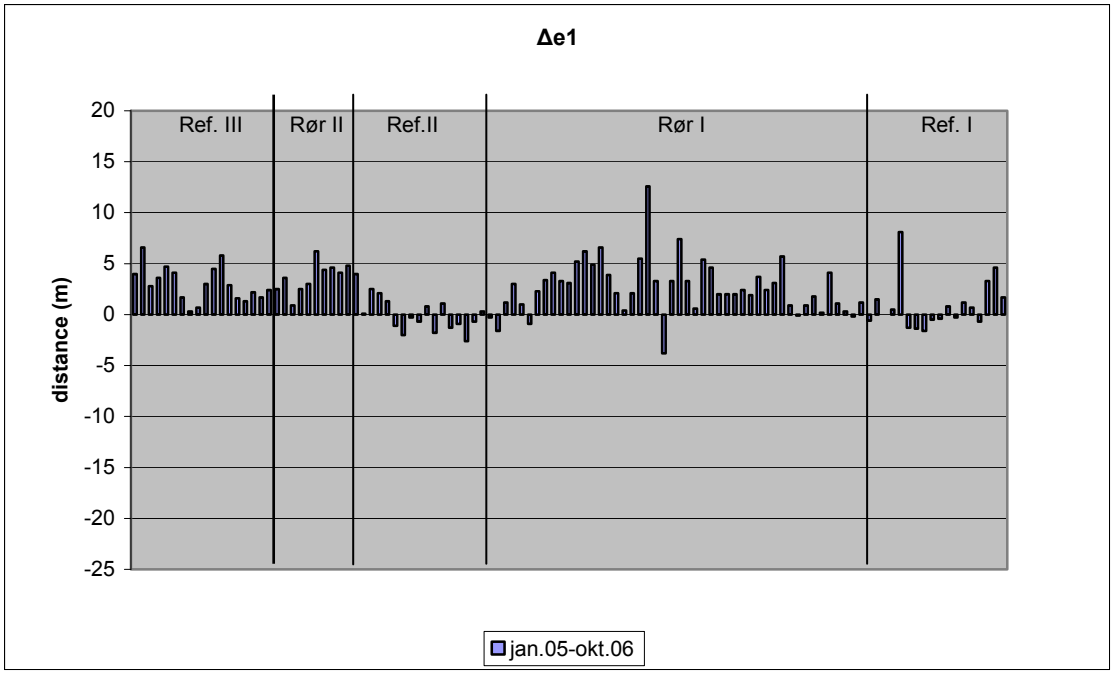

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-okt.06

Figure 7.2 g.

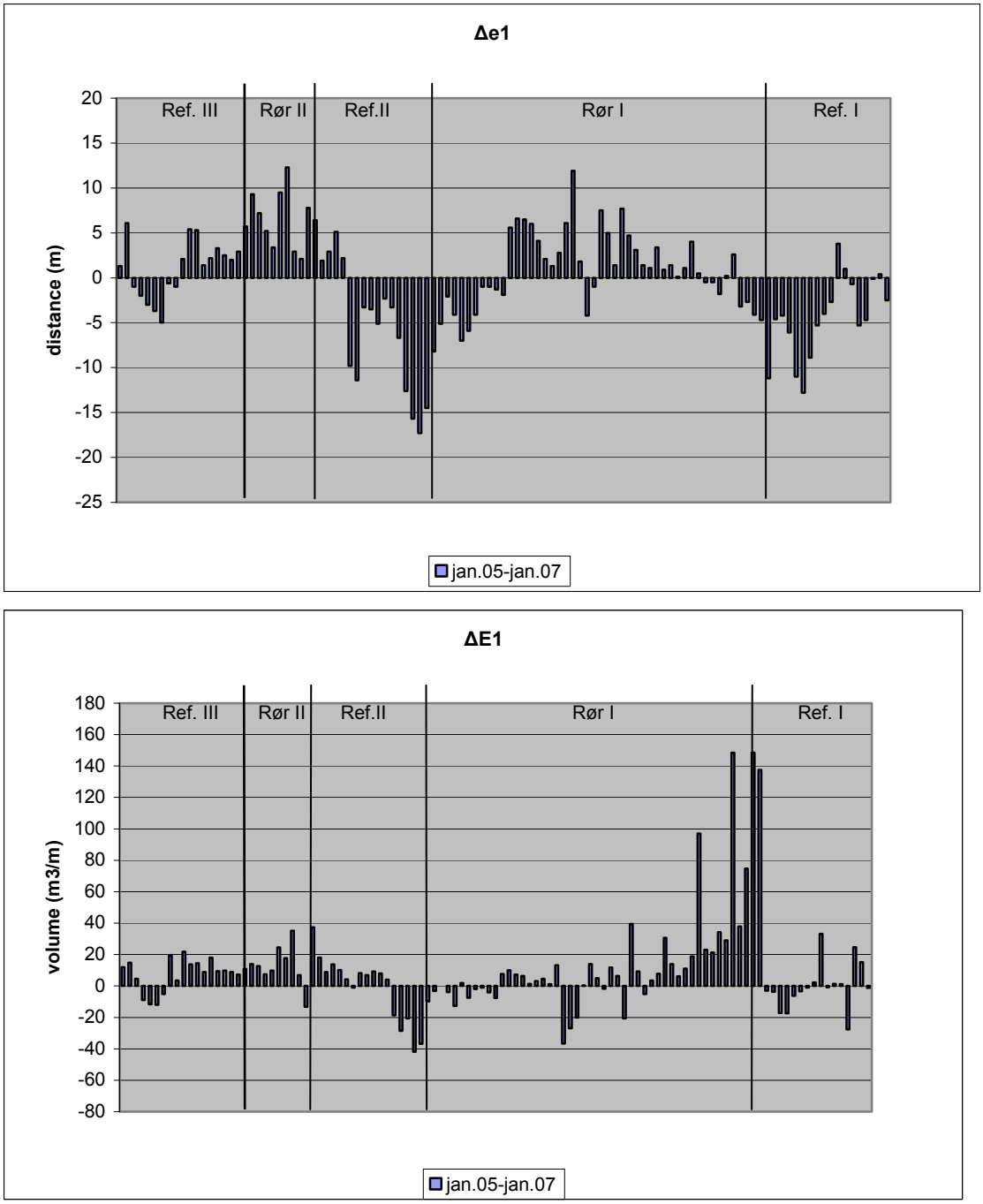
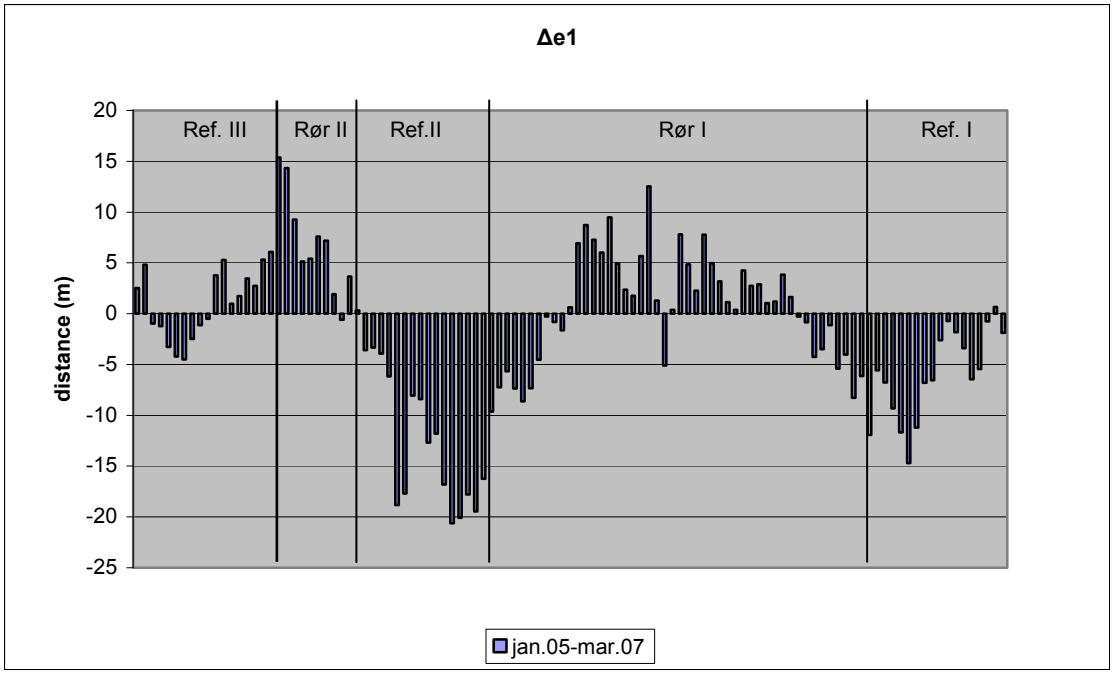

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-jan.07
ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-jan.07

Figure 7.2 h.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-mar.07

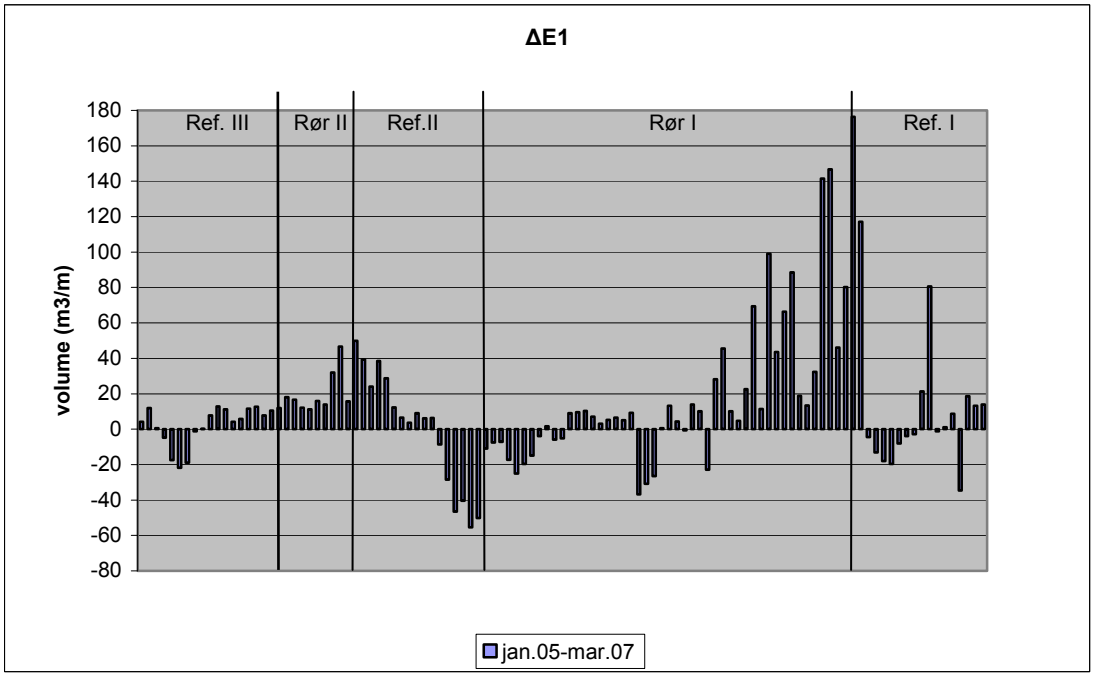

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-mar.07

Figure 7.2 i.

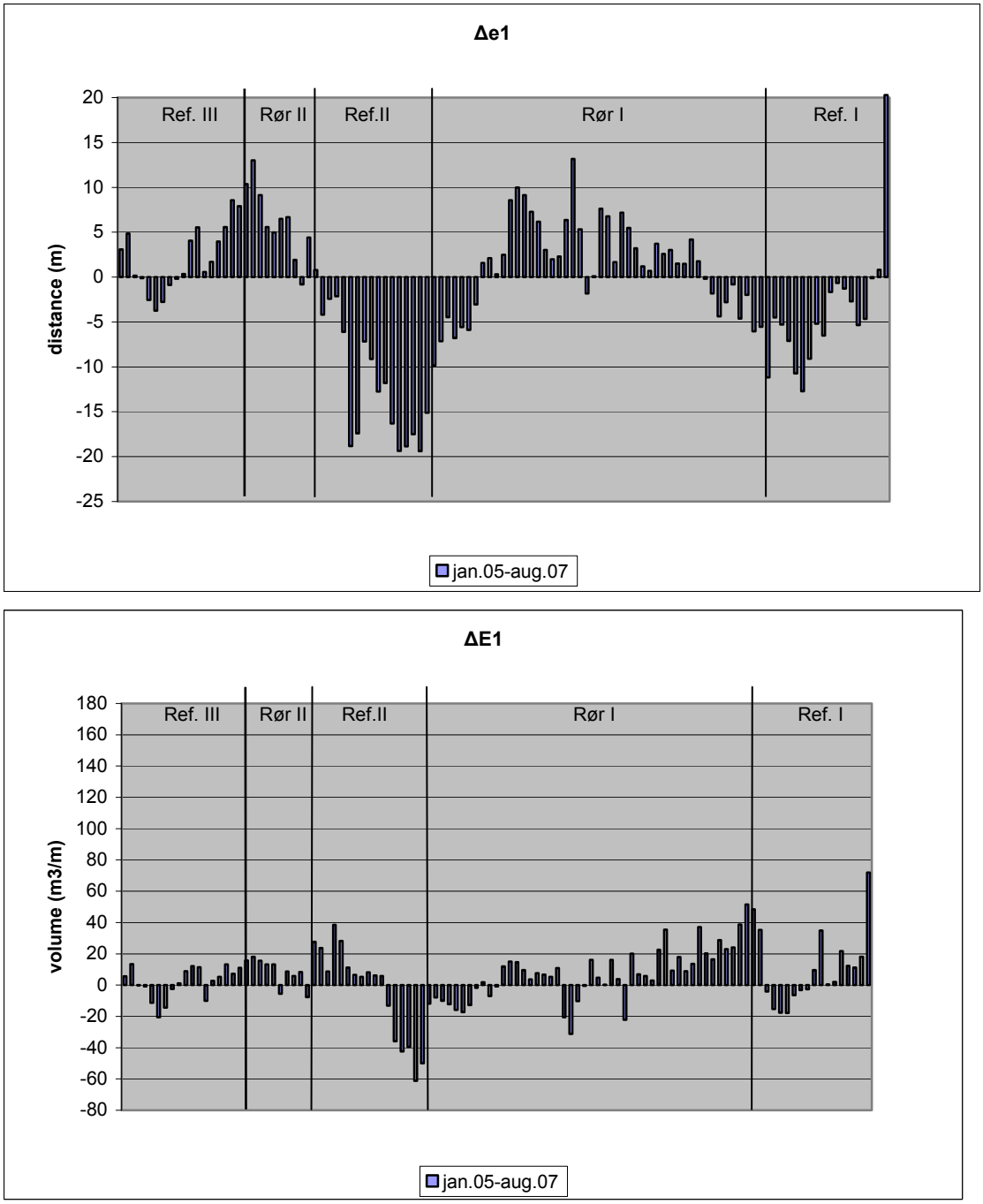

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-aug.07
ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-aug.07

Figure 7.2 j.

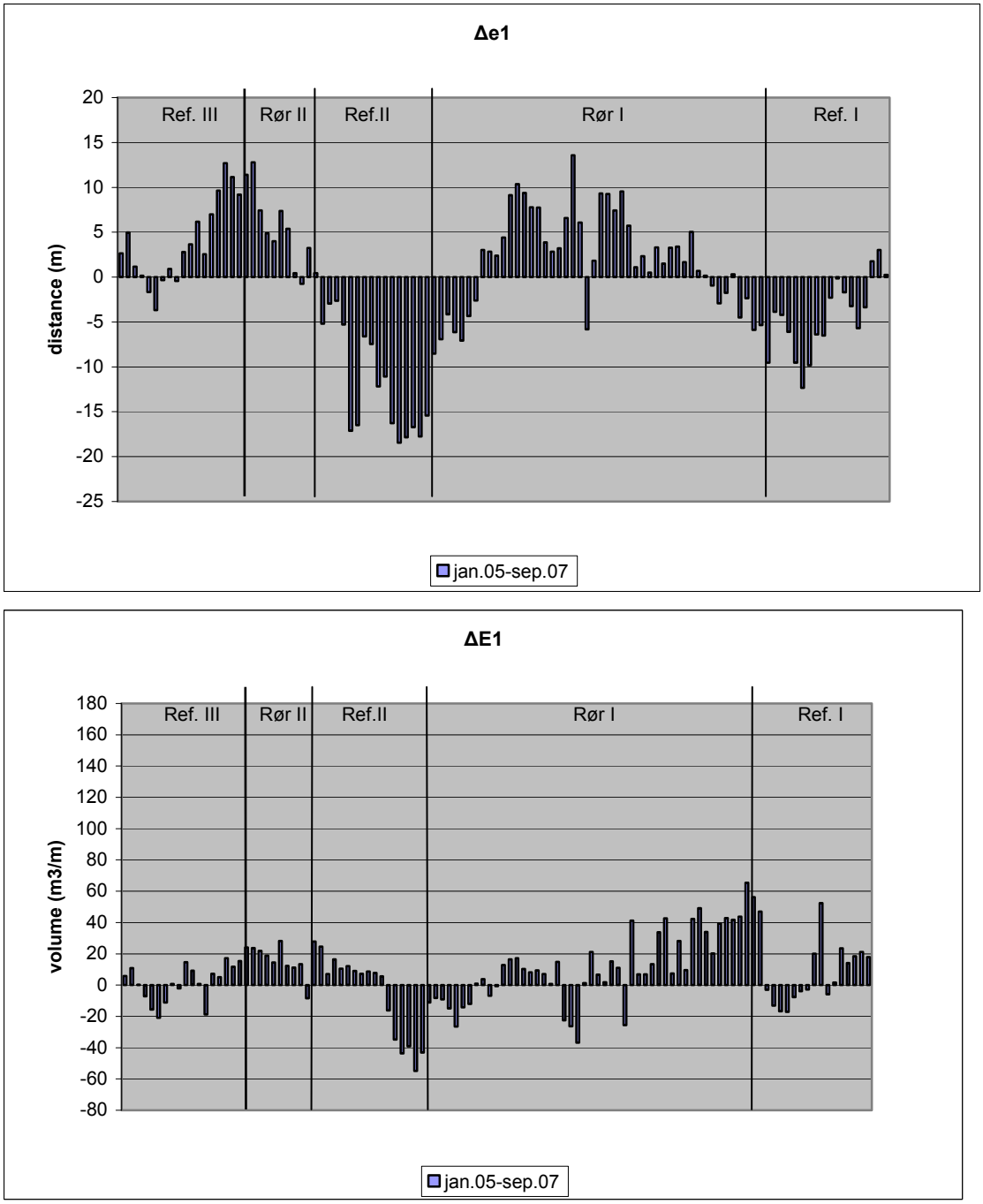
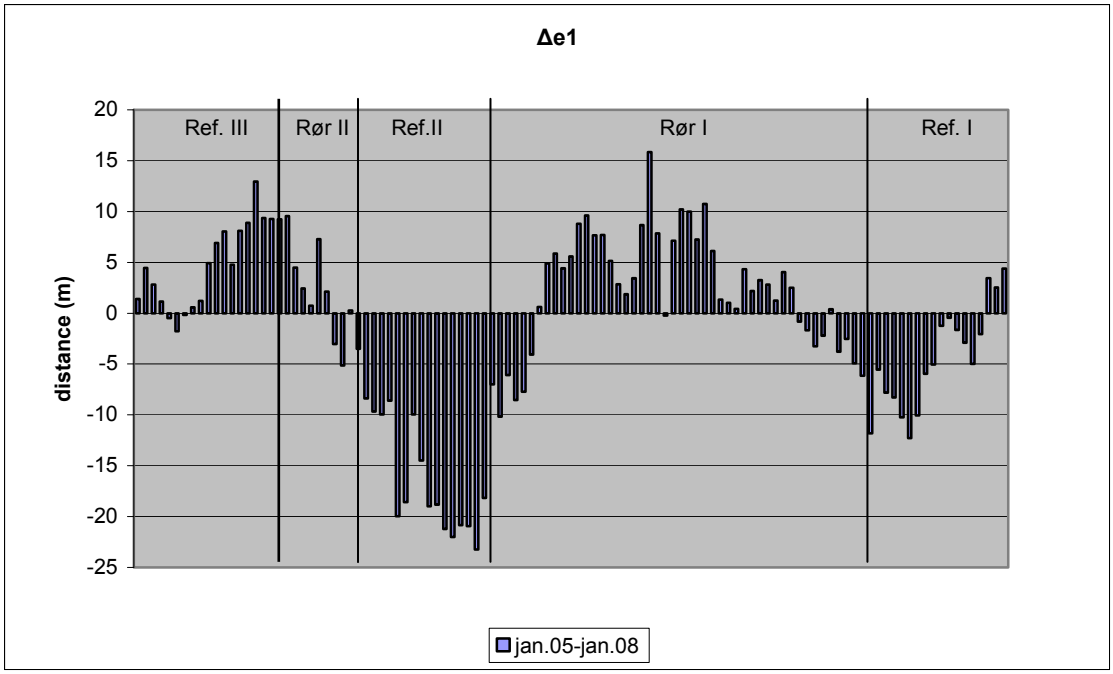

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-sep.07
ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-sep.07

Figure 7.2 k.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-jan.08

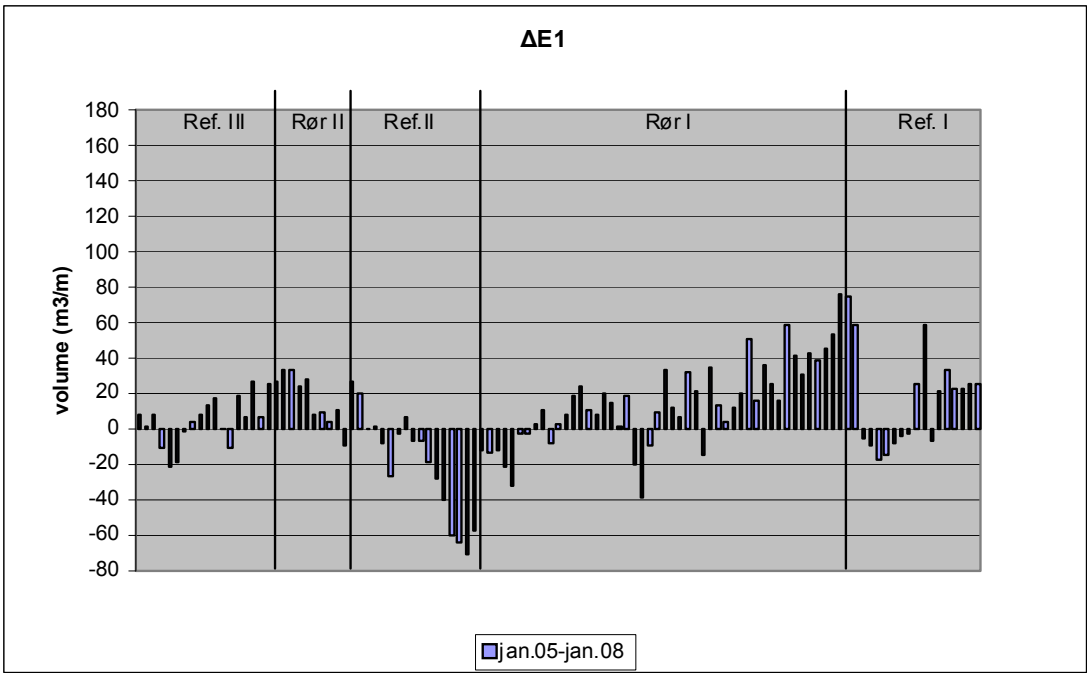

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.05-jan.08

Figure 7.2 l.

D- or E-profiles?

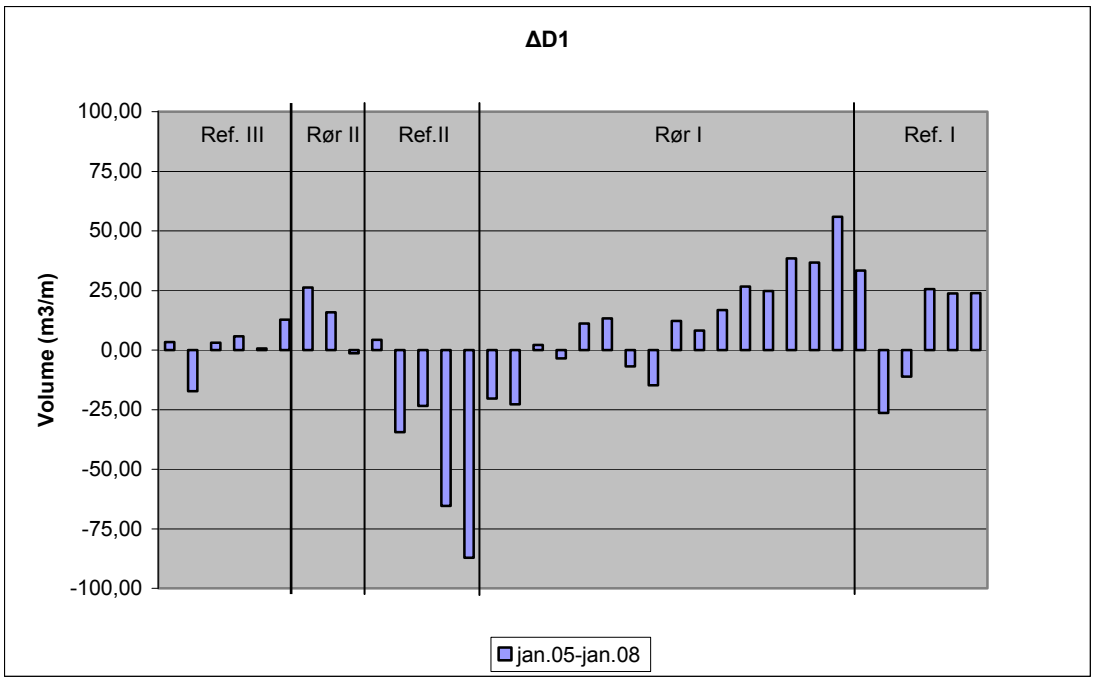
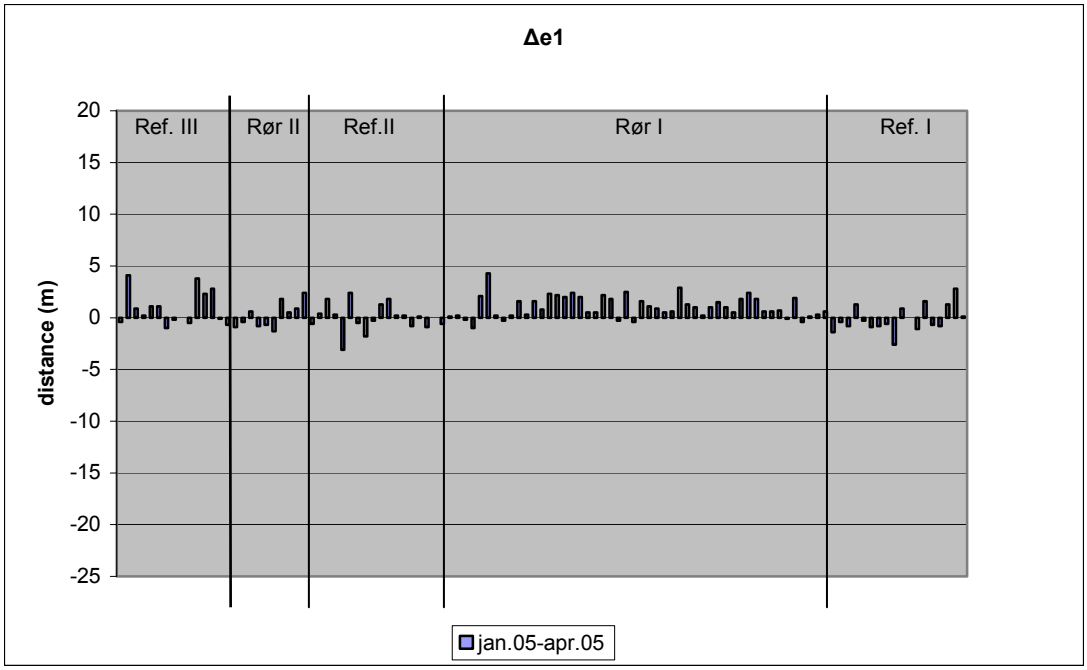


Fig 7.2 m. Variation in D1 along the site.

As shown in figure 7.1 and 7.2, we have worked with two different formulations of the dune volume. As seen by comparison of fig 7.2 l and m, they give qualitatively exactly the same variation, while there are some small differences quantitatively. So lucky wise you get the same information from both formulations.

B. Consecutive temporal changes in the dune foot movement and volume changes of dune:


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.05-apr.05

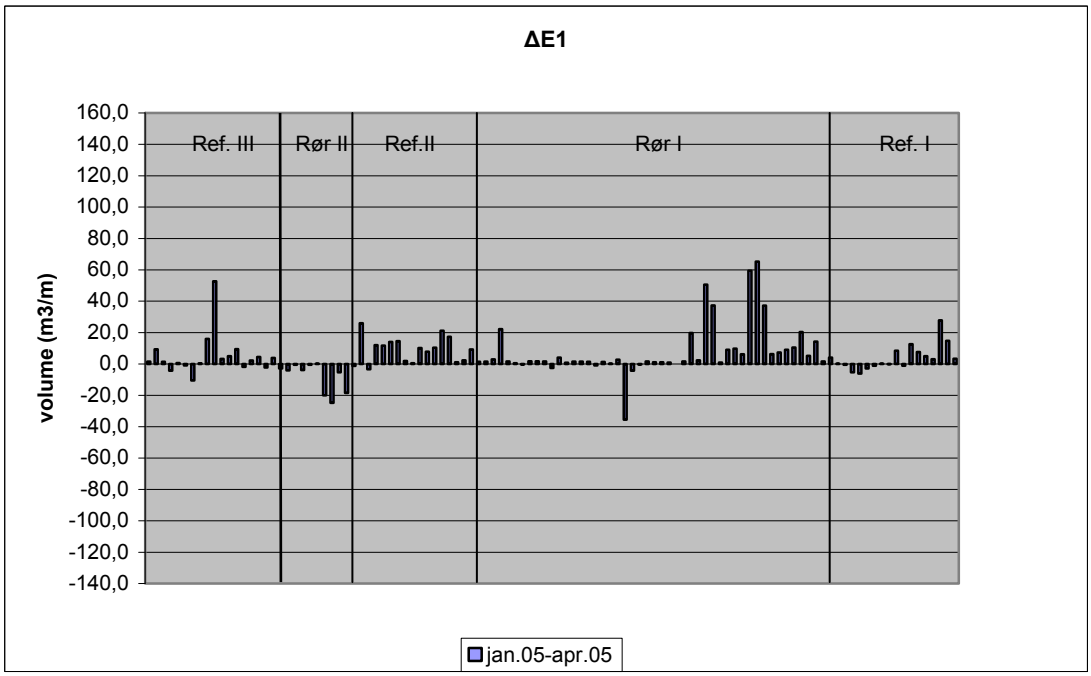

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
160,0
140,0
120,0
100,0
80,0
60,0
40,0
20,0
0,0
-20,0
-40,0
-60,0
-80,0
-100,0
-120,0
-140,0
jan.05-apr.05

Fig. 7.3 a.

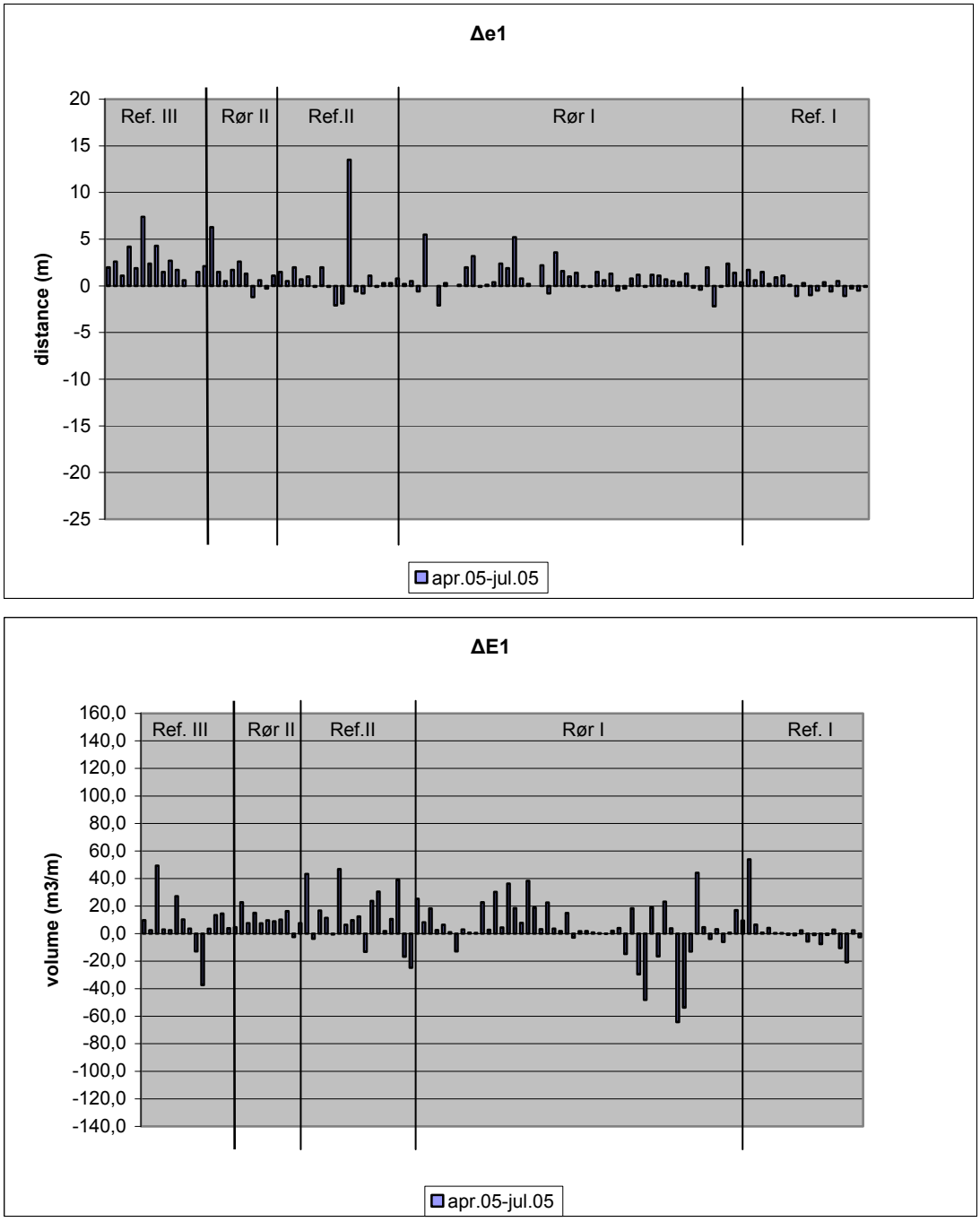
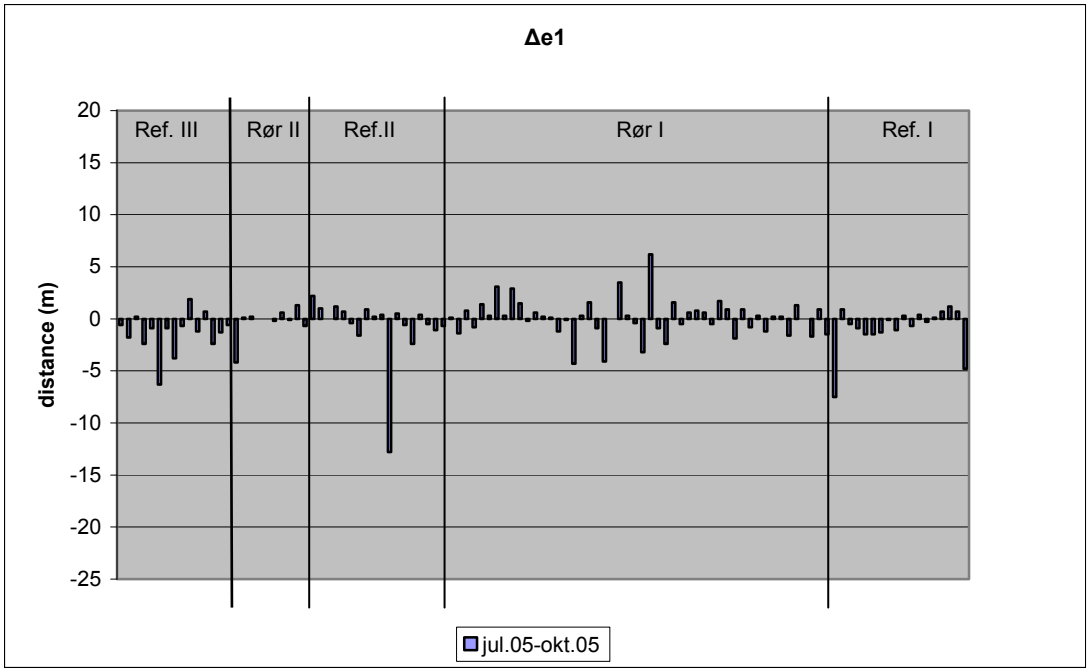

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
20
15
10
5
0
-5
-10
-15
-20
-25
distance (m)
apr.05-jul.05
ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
160,0
140,0
120,0
100,0
80,0
60,0
40,0
20,0
0,0
-20,0
-40,0
-60,0
-80,0
-100,0
-120,0
-140,0
volume (m3/m)
apr.05-jul.05

Fig. 7.3 b.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jul.05-okt.05

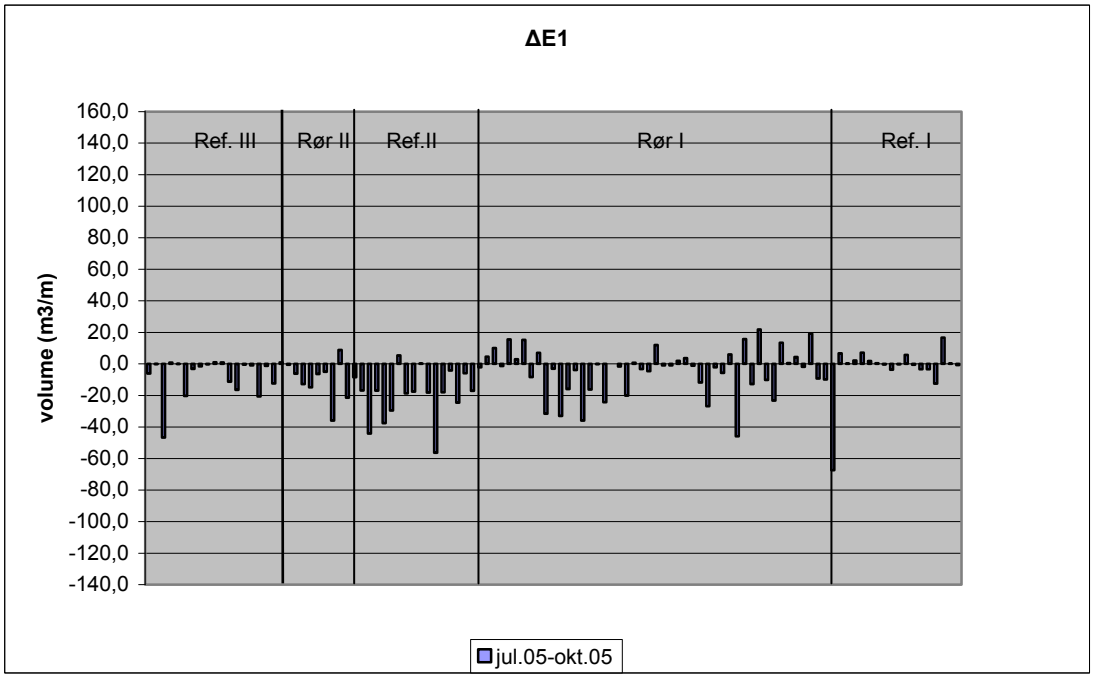

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
160,0
140,0
120,0
100,0
80,0
60,0
40,0
20,0
0,0
-20,0
-40,0
-60,0
-80,0
-100,0
-120,0
-140,0
jul.05-okt.05

Fig. 7.3 c.

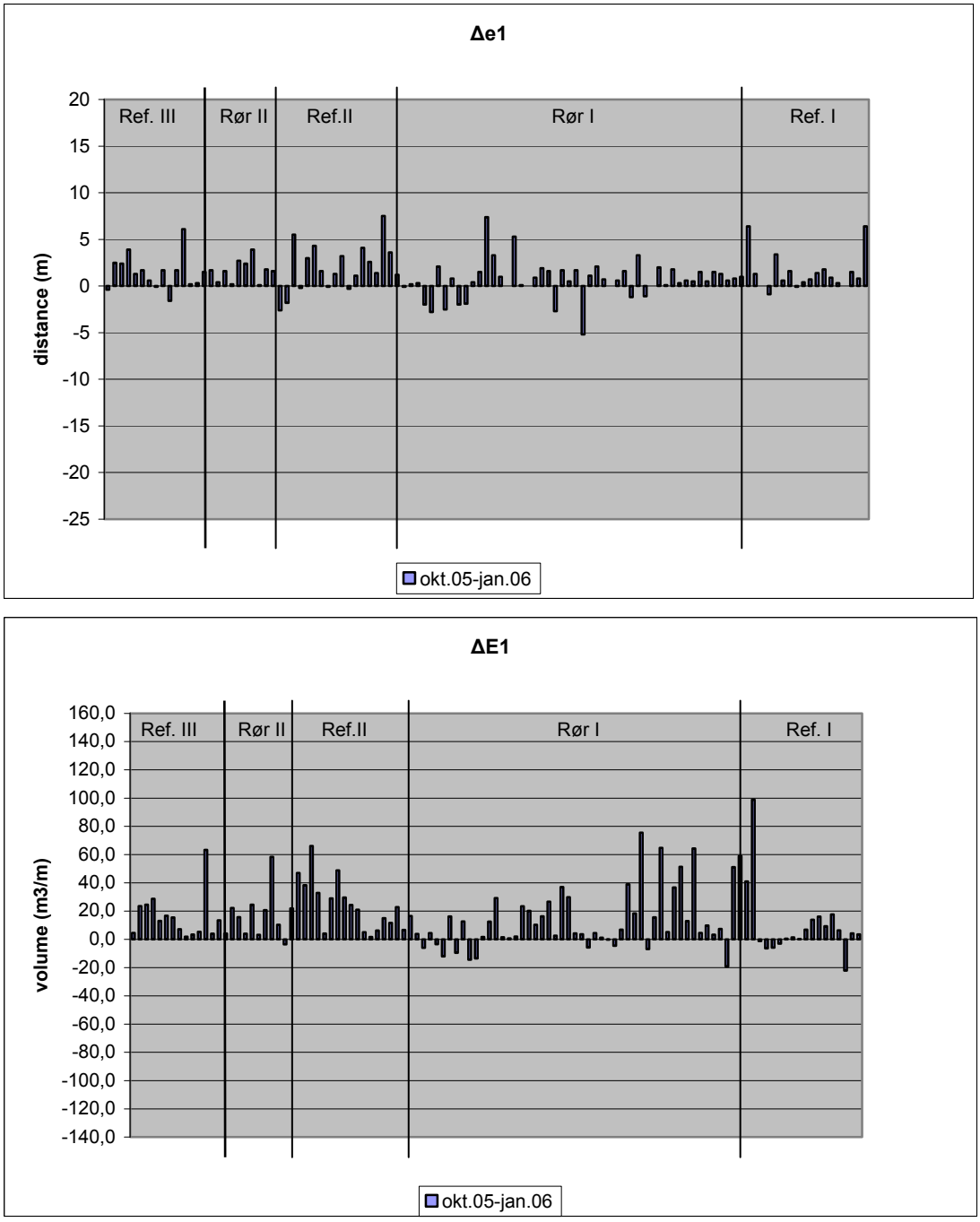
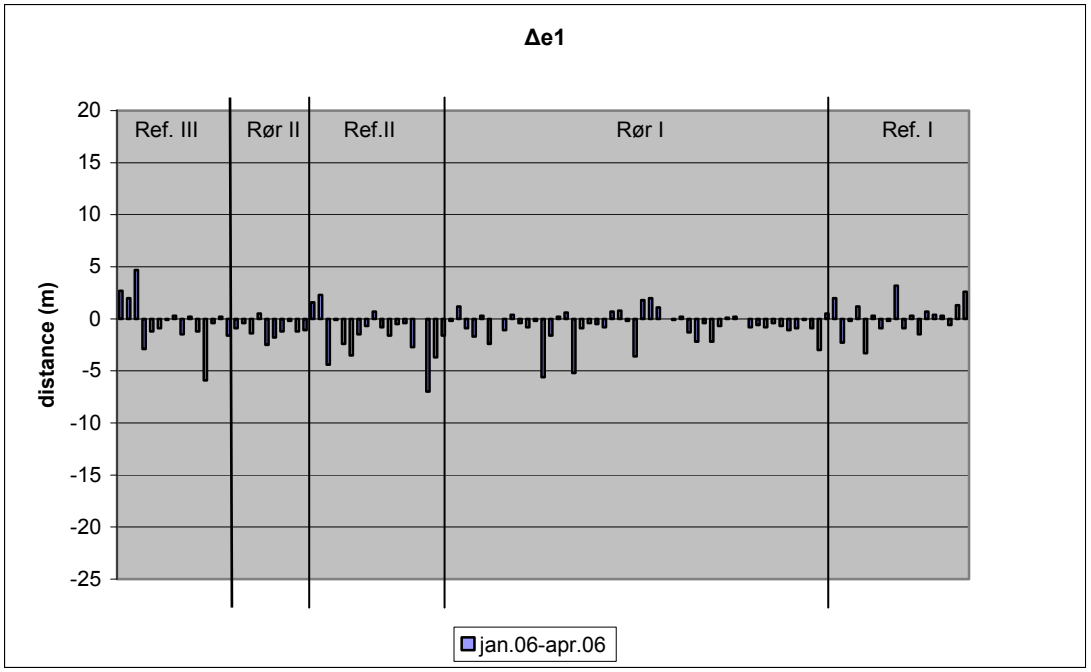

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
okt.05-jan.06
ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
160,0
140,0
120,0
100,0
80,0
60,0
40,0
20,0
0,0
-20,0
-40,0
-60,0
-80,0
-100,0
-120,0
-140,0
okt.05-jan.06

Fig. 7.3 d.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.06-apr.06

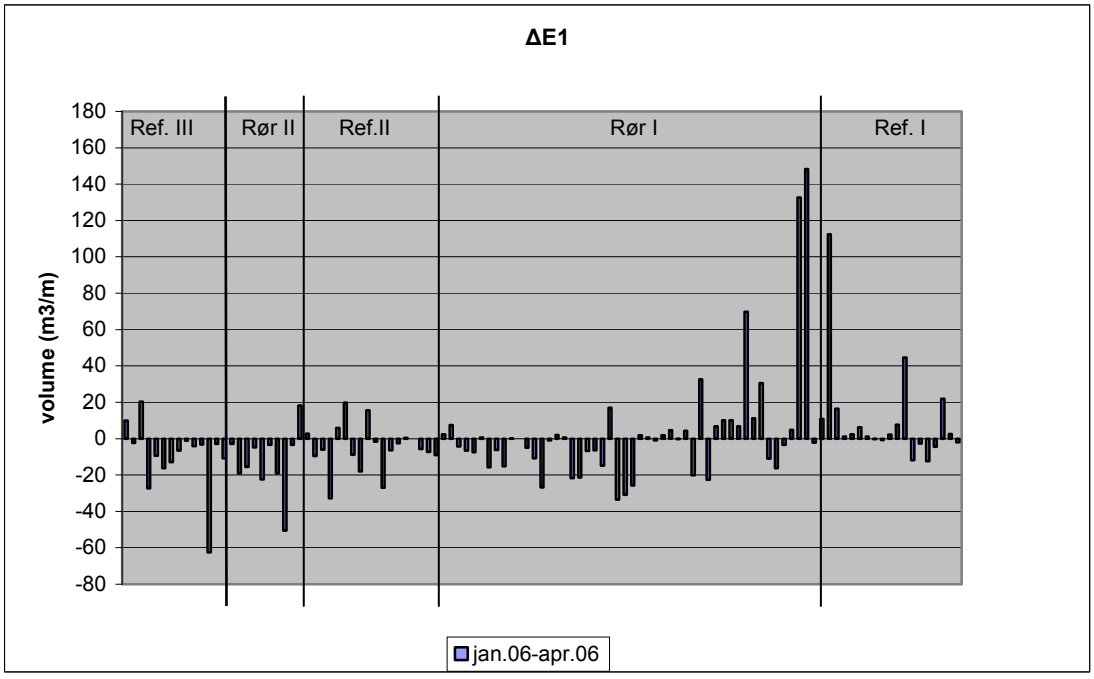
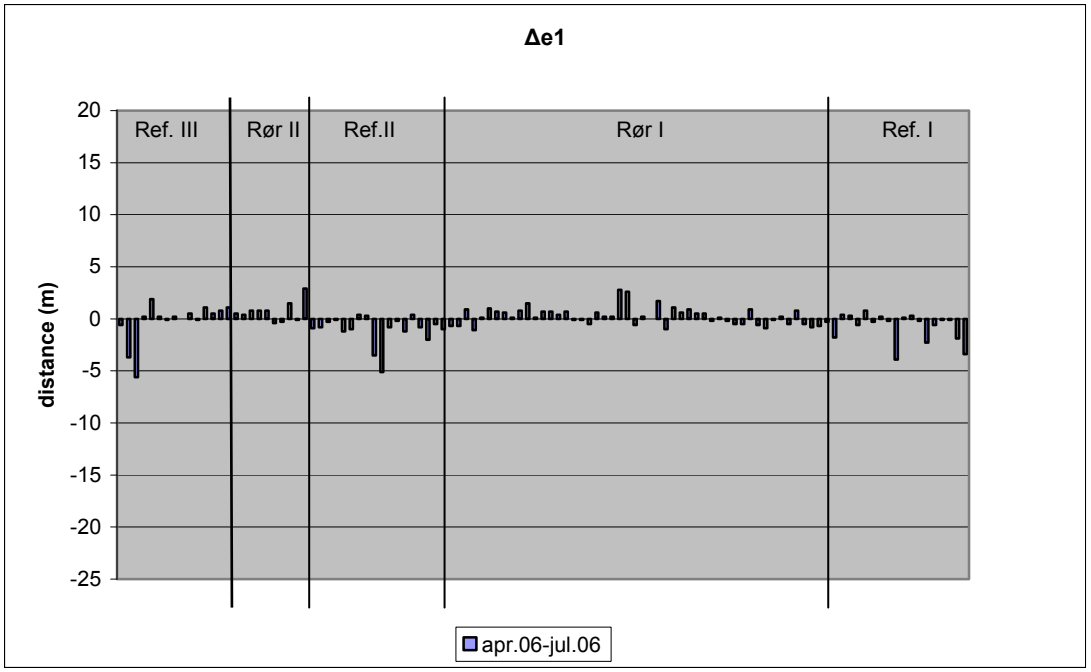

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.06-apr.06

Fig. 7.3 e.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
20
15
10
5
0
-5
-10
-15
-20
-25
distance (m)
apr.06-jul.06

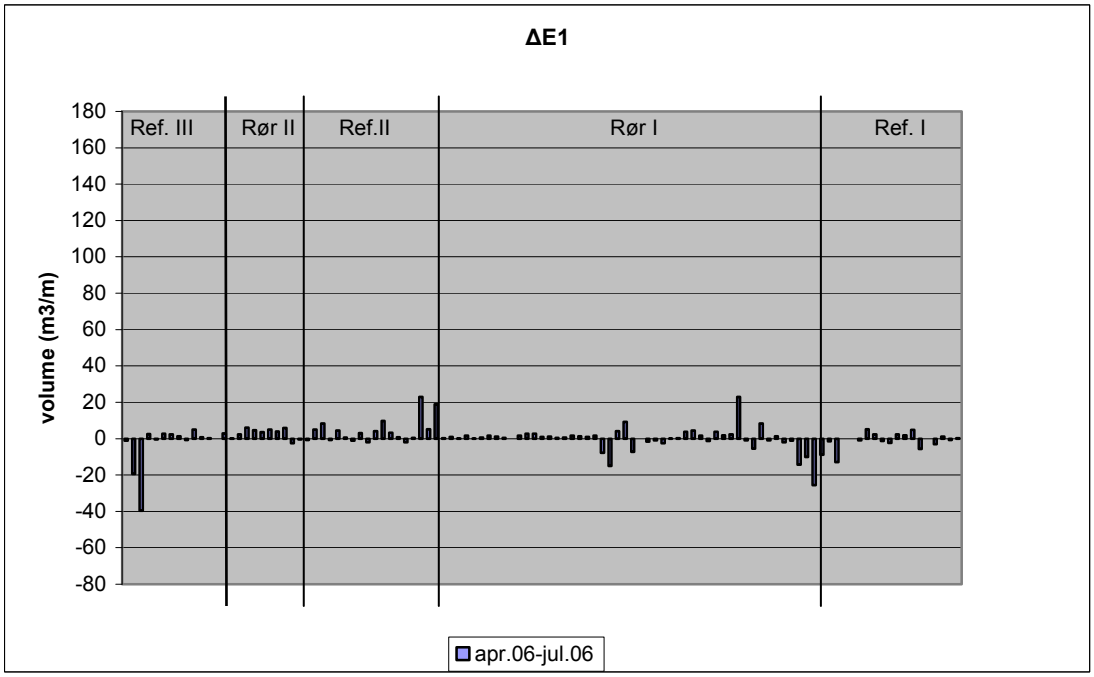
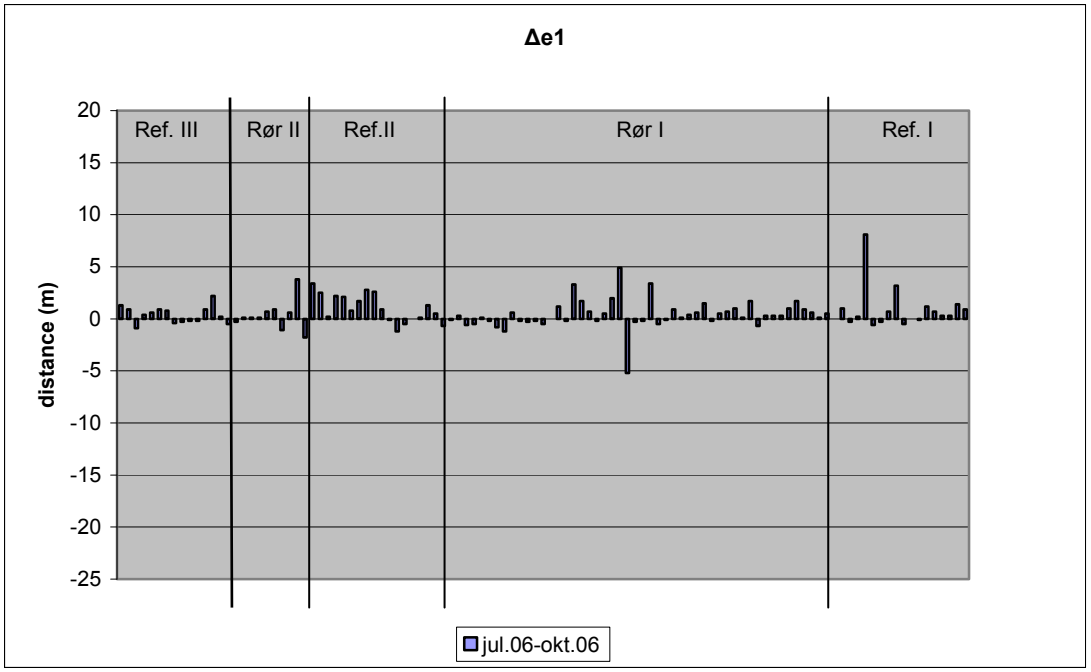

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
volume (m3/m)
apr.06-jul.06

Fig. 7.3 f.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jul.06-okt.06

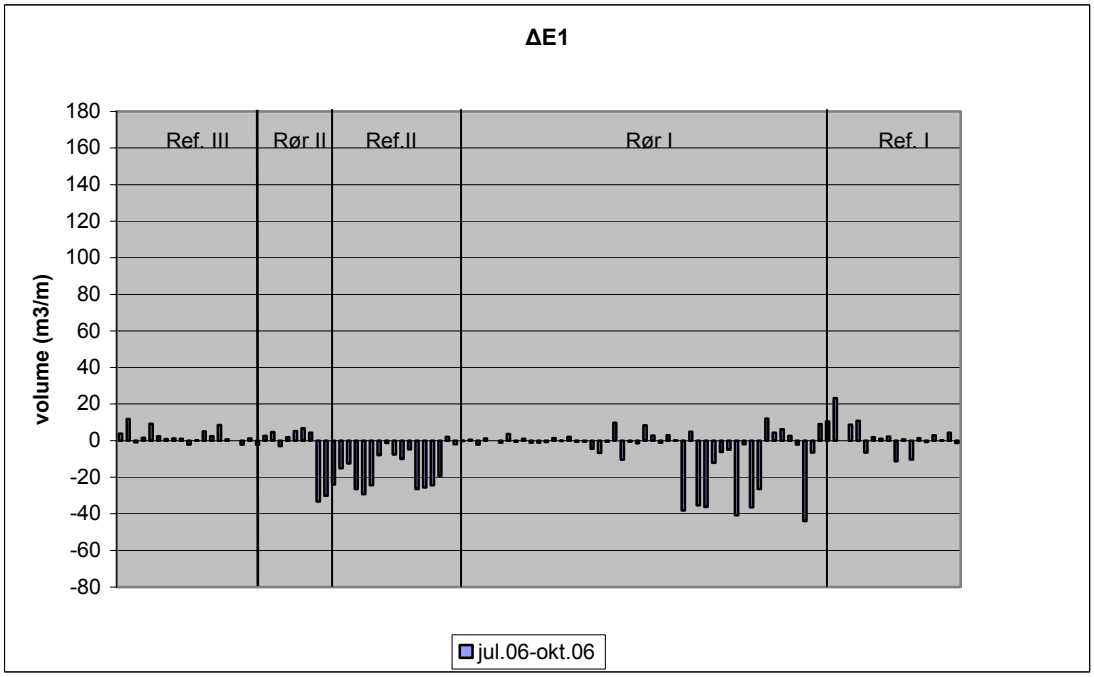

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jul.06-okt.06

Fig. 7.3 g.

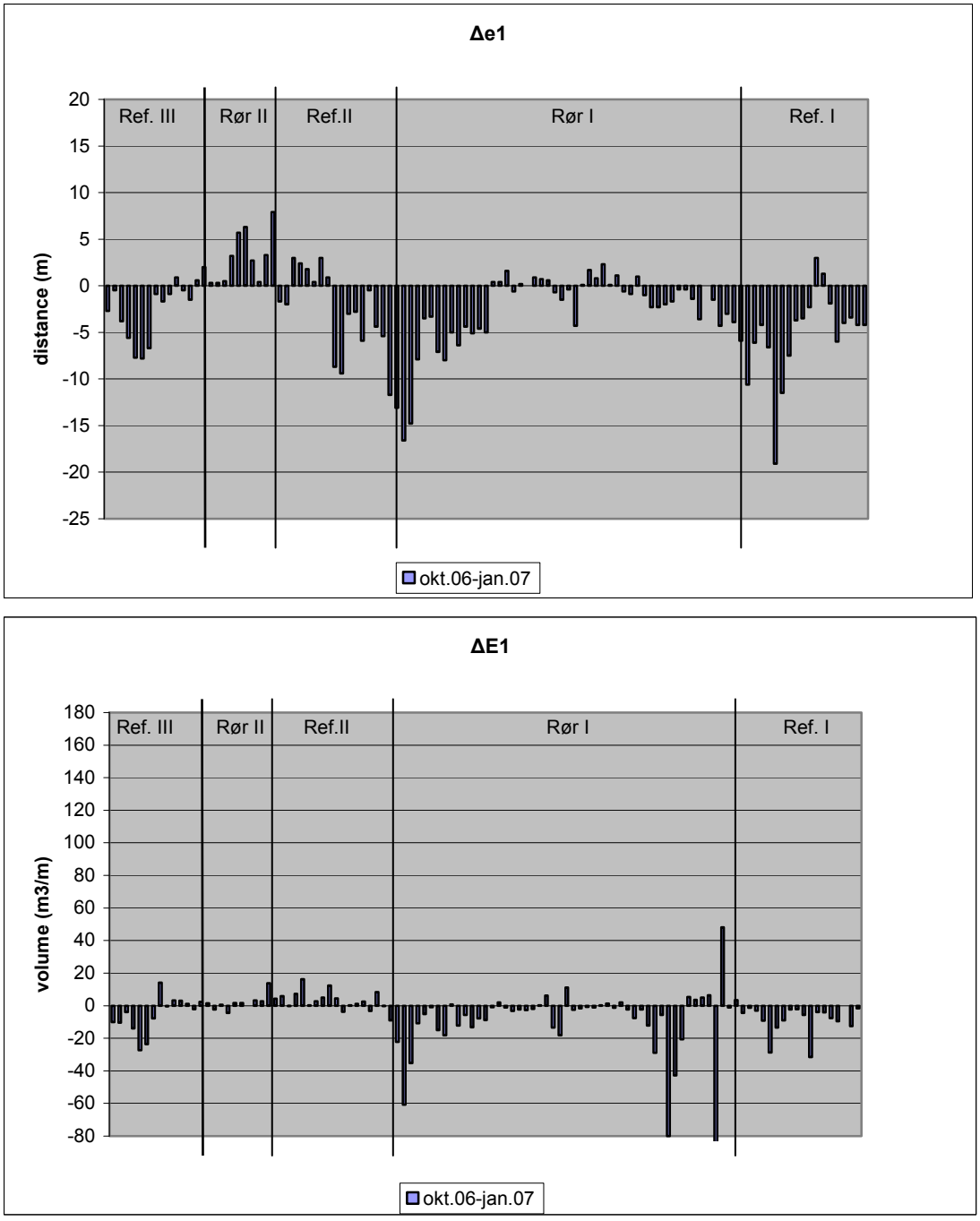
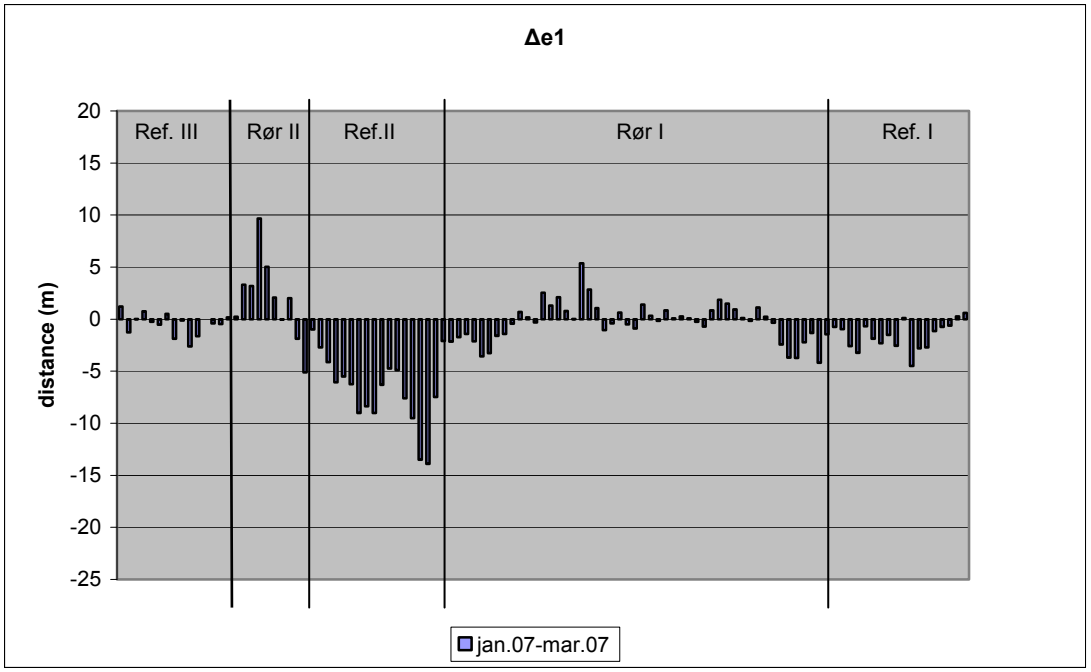

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
okt.06-jan.07
ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
okt.06-jan.07

Fig. 7.3 h.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
jan.07-mar.07

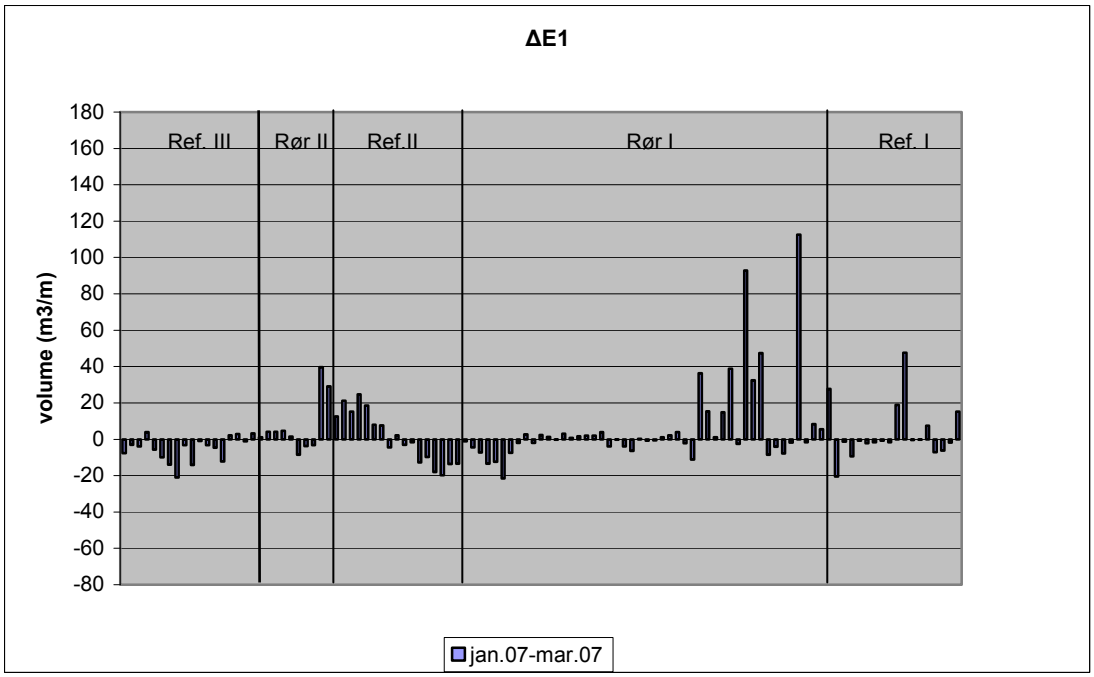
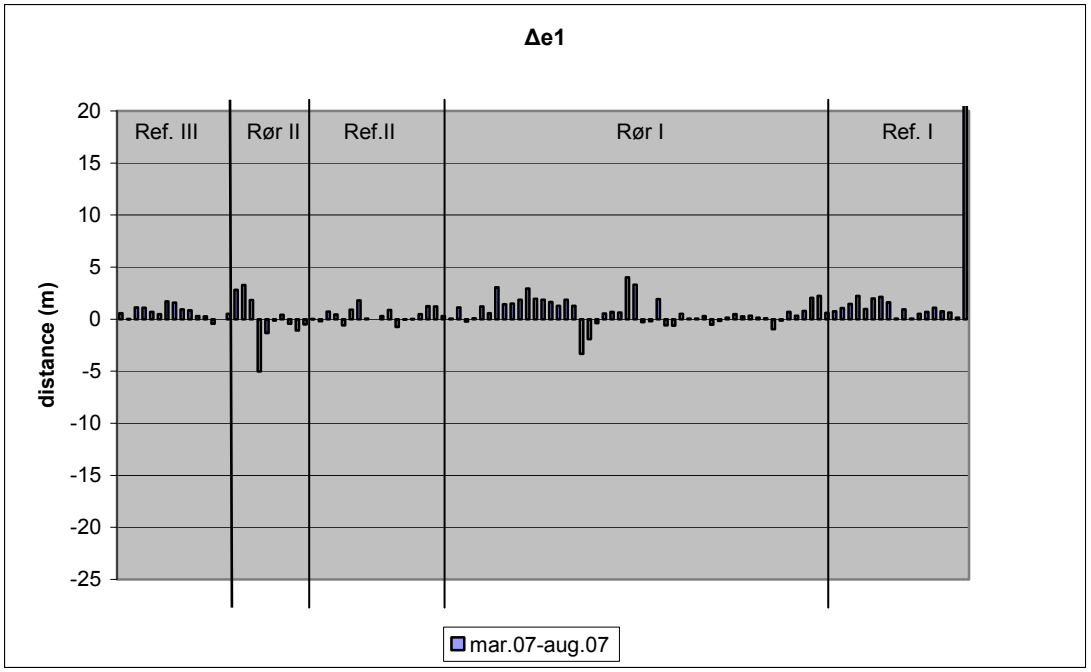

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
jan.07-mar.07

Fig. 7.3 i.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
20
15
10
5
0
-5
-10
-15
-20
-25
distance (m)
mar.07-aug.07

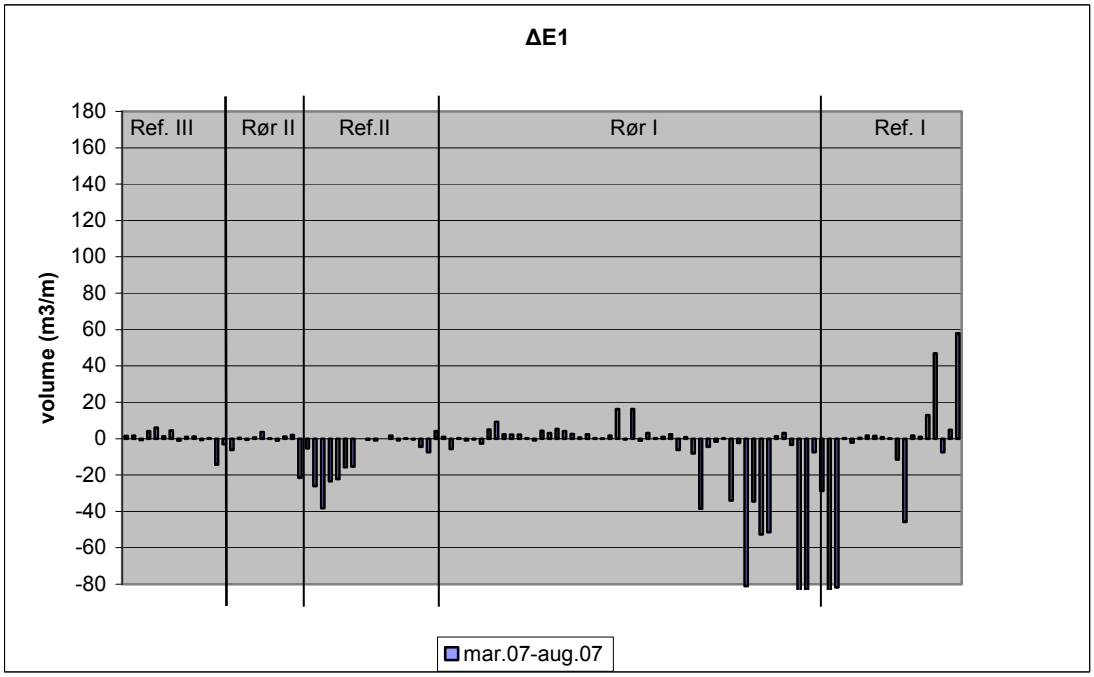

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
volume (m3/m)
mar.07-aug.07

Fig. 7.3 j.

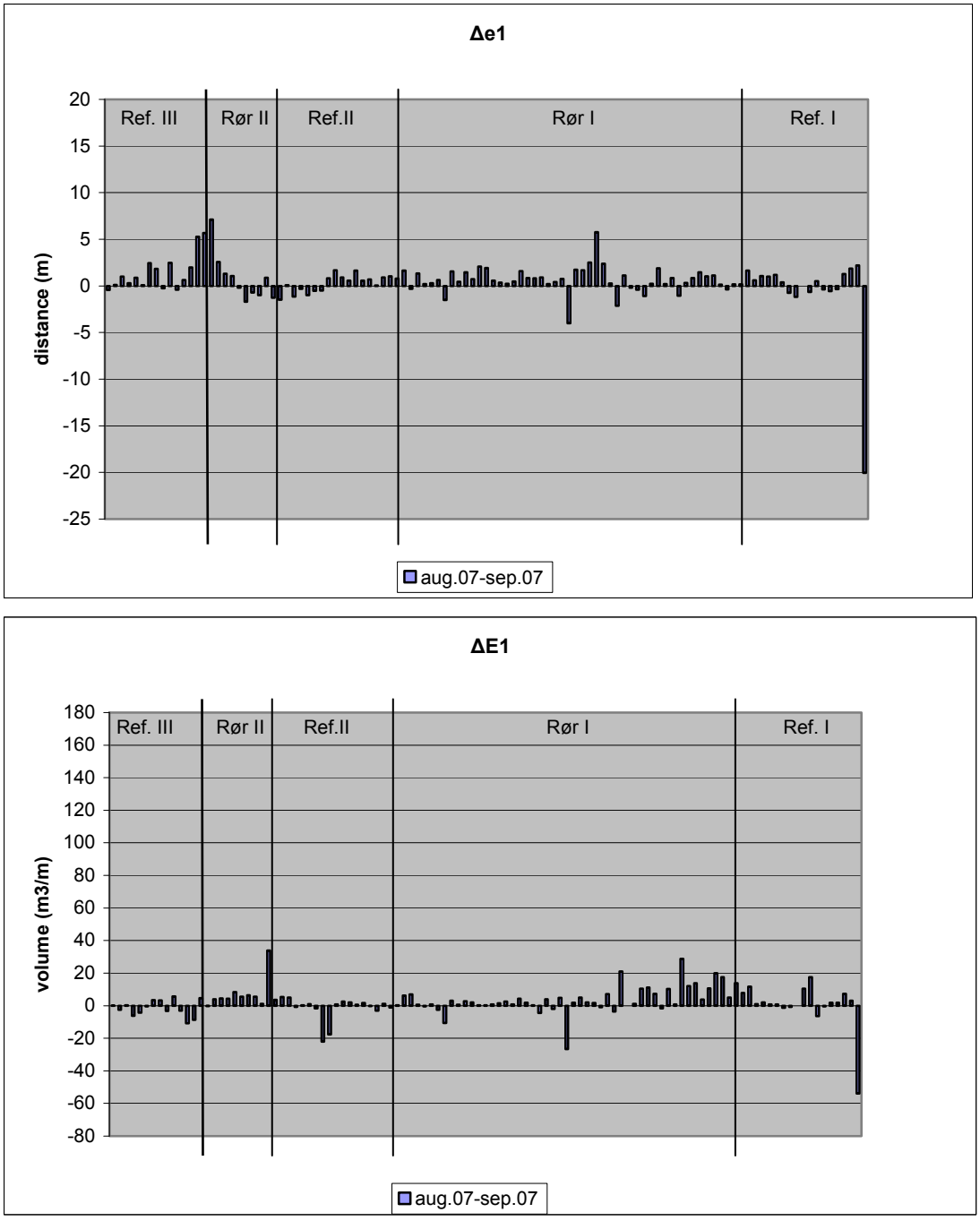
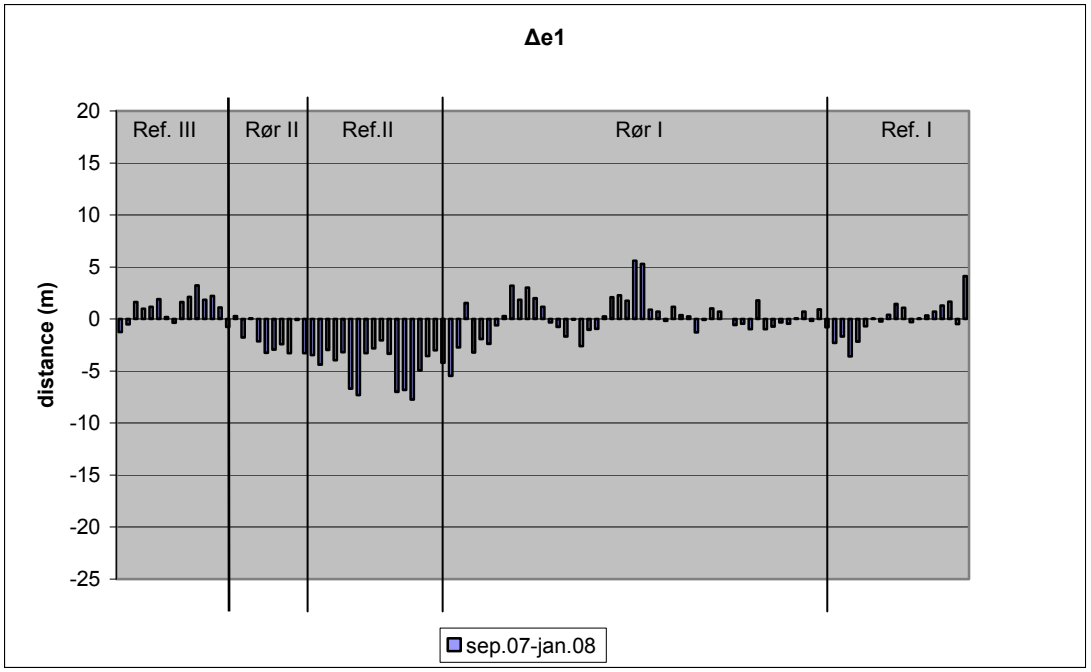

Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
20
15
10
5
0
-5
-10
-15
-20
-25
aug.07-sep.07
ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
volume (m3/m)
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
aug.07-sep.07

Fig. 7.3 k.


Δe1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
20
15
10
5
0
-5
-10
-15
-20
-25
distance (m)
sep.07-jan.08

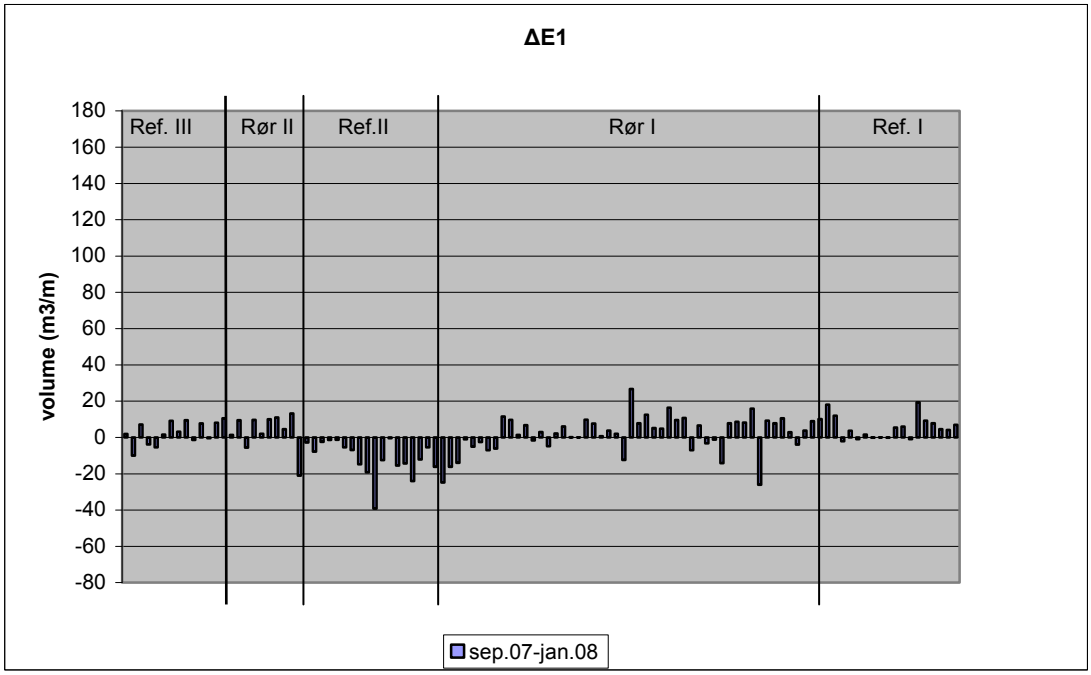
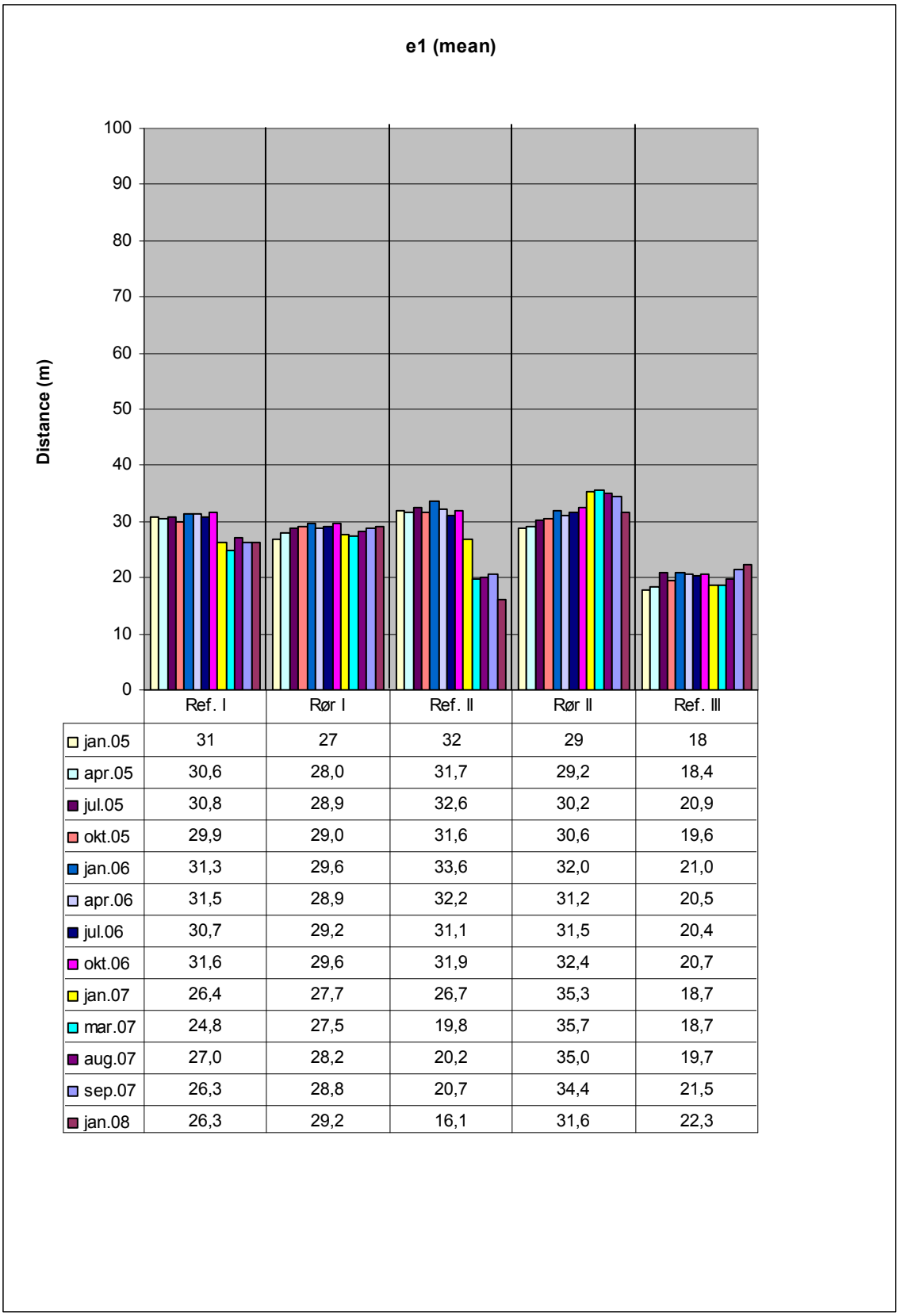

ΔE1
Ref. III
Rør II
Ref.II
Rør I
Ref. I
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
volume (m3/m)
sep.07-jan.08

Fig. 7.3 l.

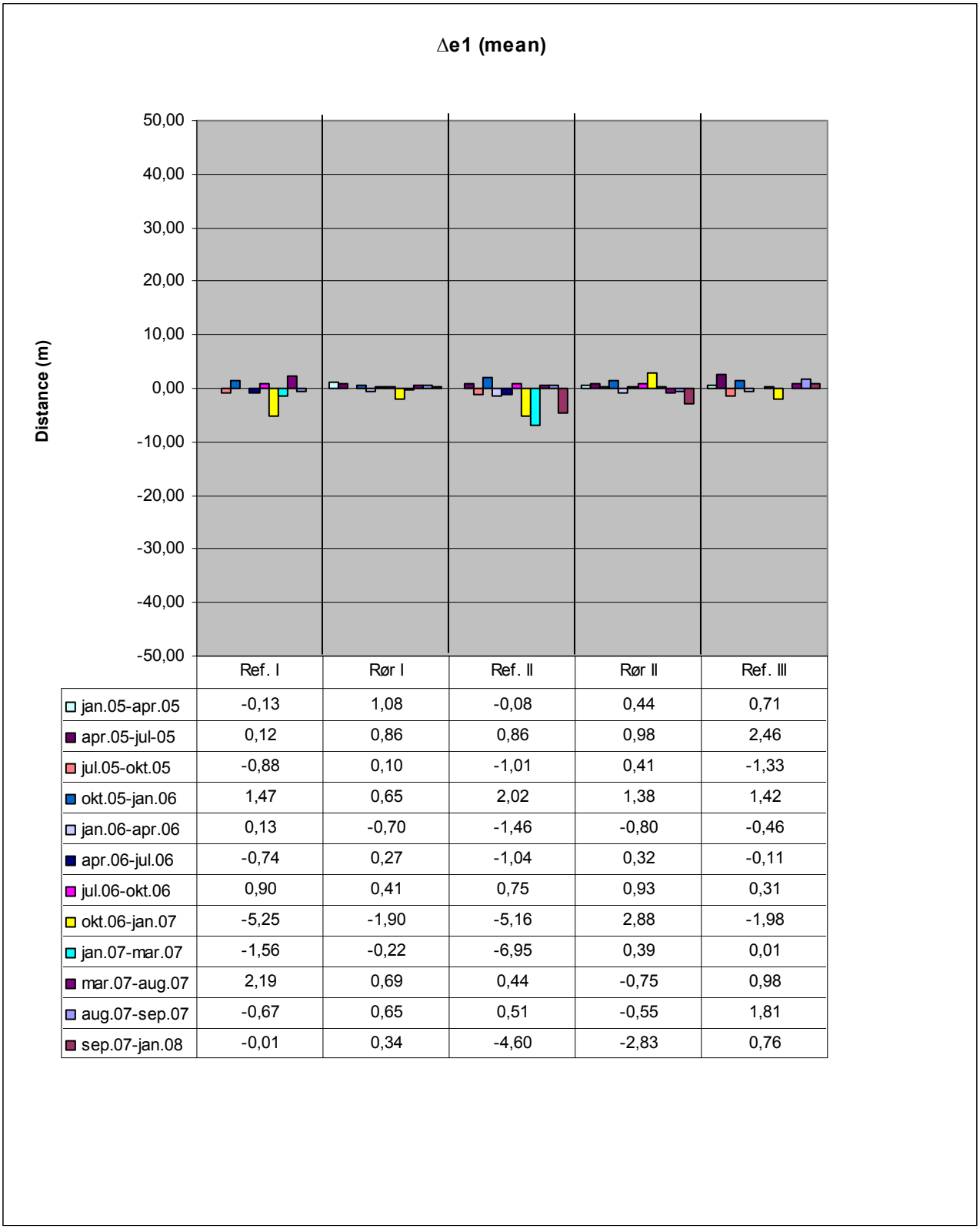
	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	-0,1	1,1	-0,1	0,4	0,7
jan.05-jul.05	0,0	1,9	0,8	1,4	3,2
jan.05-okt.05	-0,9	2,0	-0,2	1,8	1,8
jan.05-jan.06	0,6	2,7	1,8	3,2	3,3
jan.05-apr.06	0,7	2,0	0,3	2,4	2,8
jan.05-jul.06	0,0	2,3	-0,7	2,7	2,7
jan.05-okt.06	0,9	2,7	0,0	3,7	3,0
jan.05-jan.07	-4,4	0,8	-5,1	6,5	1,0
jan.05-mar.07	-5,9	0,5	-12,1	6,9	1,0
jan.05-aug.07	-3,8	1,2	-11,6	6,2	2,0
jan.05-sep.07	-4,4	1,9	-11,1	5,6	3,8
jan.05-jan.08	-4,4	2,2	-15,7	2,8	4,6

Figure 7.4: Average changes in dune foot position from January 2005 along each individual stretch.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05	31	27	32	29	18
apr.05	30,6	28,0	31,7	29,2	18,4
jul.05	30,8	28,9	32,6	30,2	20,9
okt.05	29,9	29,0	31,6	30,6	19,6
jan.06	31,3	29,6	33,6	32,0	21,0
apr.06	31,5	28,9	32,2	31,2	20,5
jul.06	30,7	29,2	31,1	31,5	20,4
okt.06	31,6	29,6	31,9	32,4	20,7
jan.07	26,4	27,7	26,7	35,3	18,7
mar.07	24,8	27,5	19,8	35,7	18,7
aug.07	27,0	28,2	20,2	35,0	19,7
sep.07	26,3	28,8	20,7	34,4	21,5
jan.08	26,3	29,2	16,1	31,6	22,3

Figure 7.4: Average length of dune slope along each individual stretch.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	-0,13	1,08	-0,08	0,44	0,71
apr.05-jul-05	0,12	0,86	0,86	0,98	2,46
jul.05-okt.05	-0,88	0,10	-1,01	0,41	-1,33
okt.05-jan.06	1,47	0,65	2,02	1,38	1,42
jan.06-apr.06	0,13	-0,70	-1,46	-0,80	-0,46
apr.06-jul.06	-0,74	0,27	-1,04	0,32	-0,11
jul.06-okt.06	0,90	0,41	0,75	0,93	0,31
okt.06-jan.07	-5,25	-1,90	-5,16	2,88	-1,98
jan.07-mar.07	-1,56	-0,22	-6,95	0,39	0,01
mar.07-aug.07	2,19	0,69	0,44	-0,75	0,98
aug.07-sep.07	-0,67	0,65	0,51	-0,55	1,81
sep.07-jan.08	-0,01	0,34	-4,60	-2,83	0,76

Figure 7.4: Average changes in dune foot position with time along each stretch.

The average changes in the dune volume are shown in figure 7.6. Here the D-profiles have been used, see figure 7.5 for details.

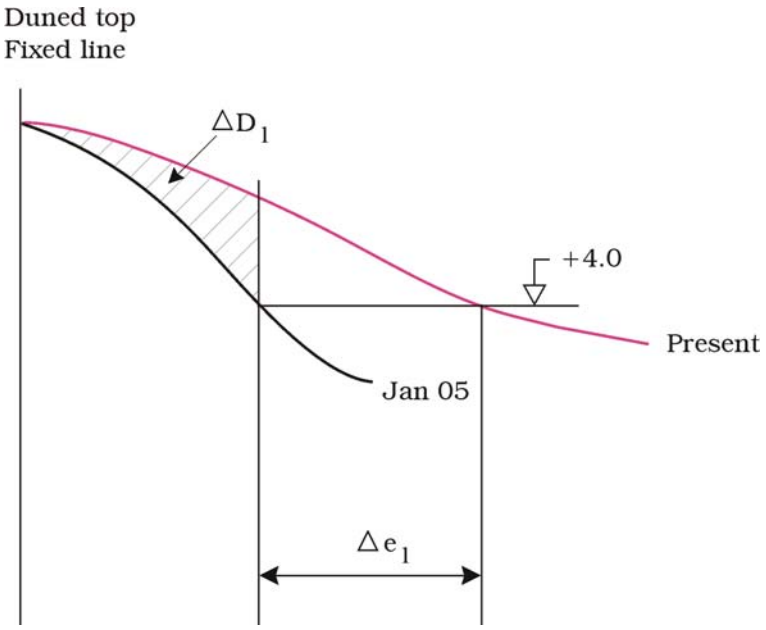
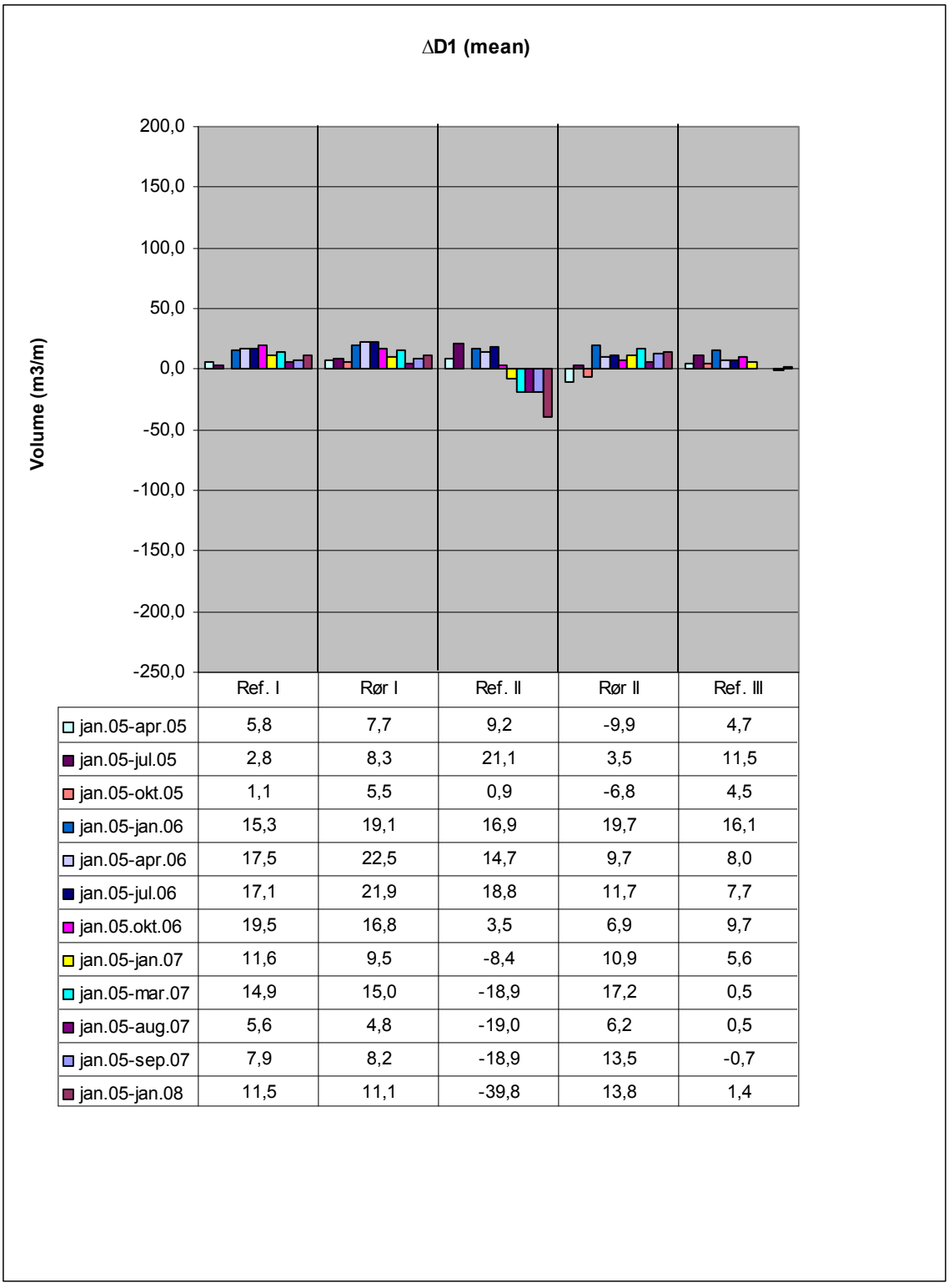
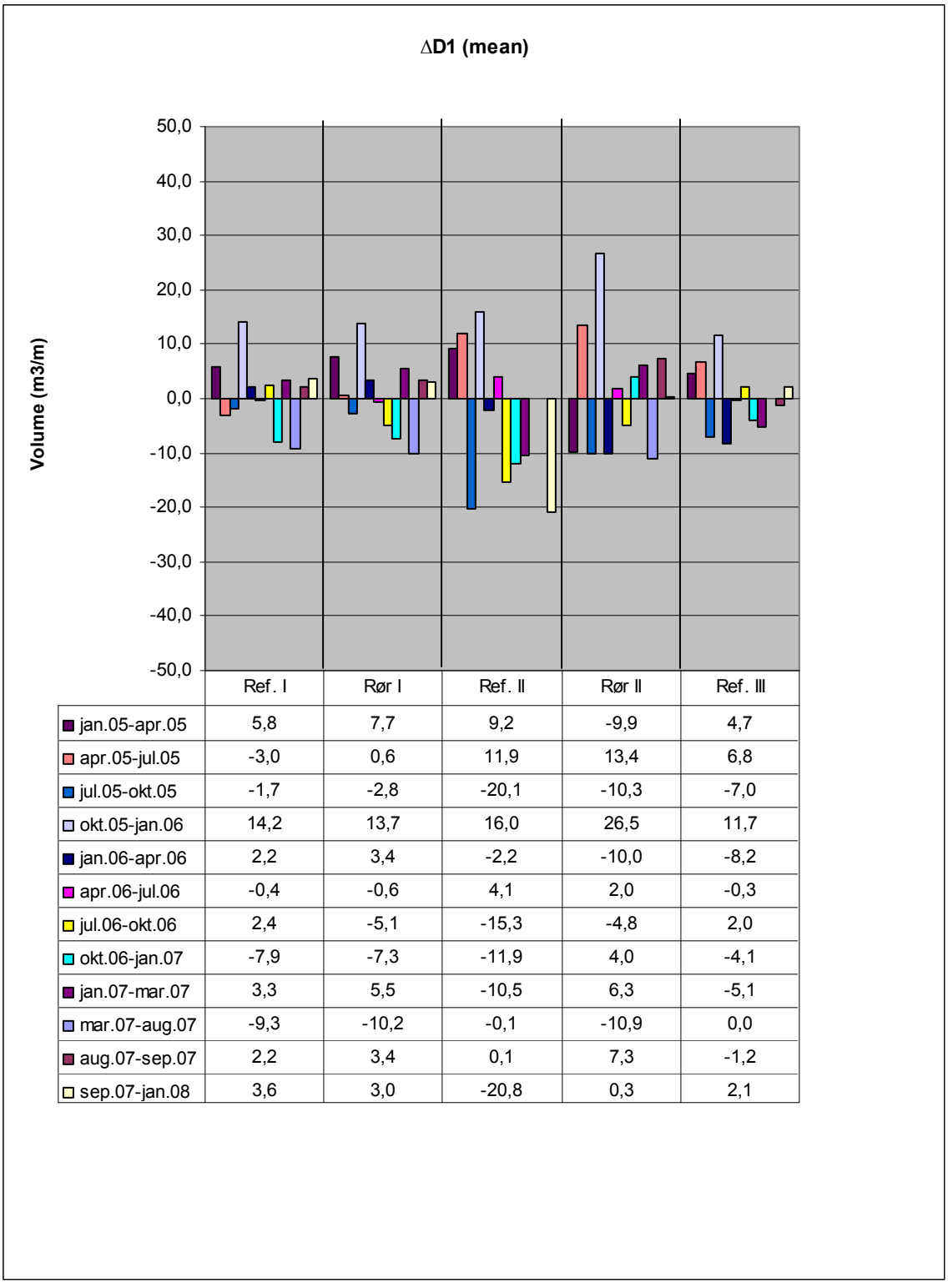


Fig. 7.5: The definition of the dune volume ΔD1.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	5,8	7,7	9,2	-9,9	4,7
jan.05-jul.05	2,8	8,3	21,1	3,5	11,5
jan.05-okt.05	1,1	5,5	0,9	-6,8	4,5
jan.05-jan.06	15,3	19,1	16,9	19,7	16,1
jan.05-apr.06	17,5	22,5	14,7	9,7	8,0
jan.05-jul.06	17,1	21,9	18,8	11,7	7,7
jan.05.okt.06	19,5	16,8	3,5	6,9	9,7
jan.05-jan.07	11,6	9,5	-8,4	10,9	5,6
jan.05-mar.07	14,9	15,0	-18,9	17,2	0,5
jan.05-aug.07	5,6	4,8	-19,0	6,2	0,5
jan.05-sep.07	7,9	8,2	-18,9	13,5	-0,7
jan.05-jan.08	11,5	11,1	-39,8	13,8	1,4

Figure 7.6: Average changes in dune volume along each stretch from January 2005.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	5,8	7,7	9,2	-9,9	4,7
apr.05-jul.05	-3,0	0,6	11,9	13,4	6,8
jul.05-okt.05	-1,7	-2,8	-20,1	-10,3	-7,0
okt.05-jan.06	14,2	13,7	16,0	26,5	11,7
jan.06-apr.06	2,2	3,4	-2,2	-10,0	-8,2
apr.06-jul.06	-0,4	-0,6	4,1	2,0	-0,3
jul.06-okt.06	2,4	-5,1	-15,3	-4,8	2,0
okt.06-jan.07	-7,9	-7,3	-11,9	4,0	-4,1
jan.07-mar.07	3,3	5,5	-10,5	6,3	-5,1
mar.07-aug.07	-9,3	-10,2	-0,1	-10,9	0,0
aug.07-sep.07	2,2	3,4	0,1	7,3	-1,2
sep.07-jan.08	3,6	3,0	-20,8	0,3	2,1

Figure 7.7: Average changes in dune volume along each stretch with time.

7.2 The upper part of the dune.

The upper part of the dune has not been measured as extensively as the others, only at the beginning and at the end of the test. Fig7.8 shows how E0 around the dune top is defined. Since there is a little bit of uncertainty about the exact location of the basic line, the values given in the graphs below, figure 7.9 and 7.10 are not 100% exact.

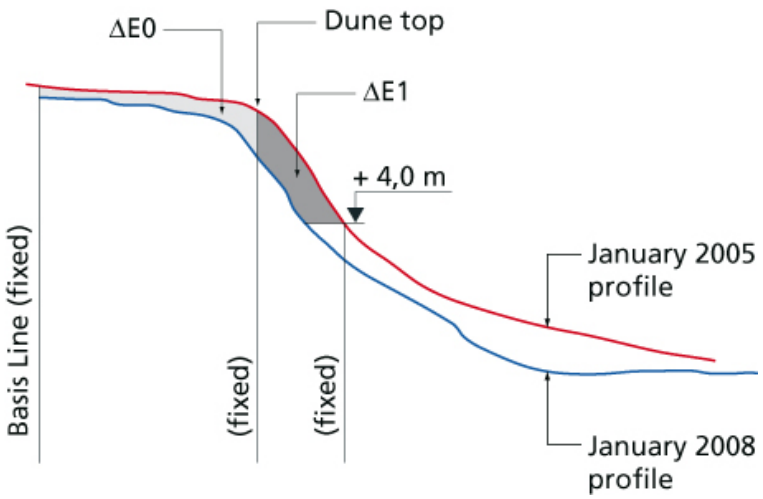


Fig 7.8 Definition of the dune top volume E0.

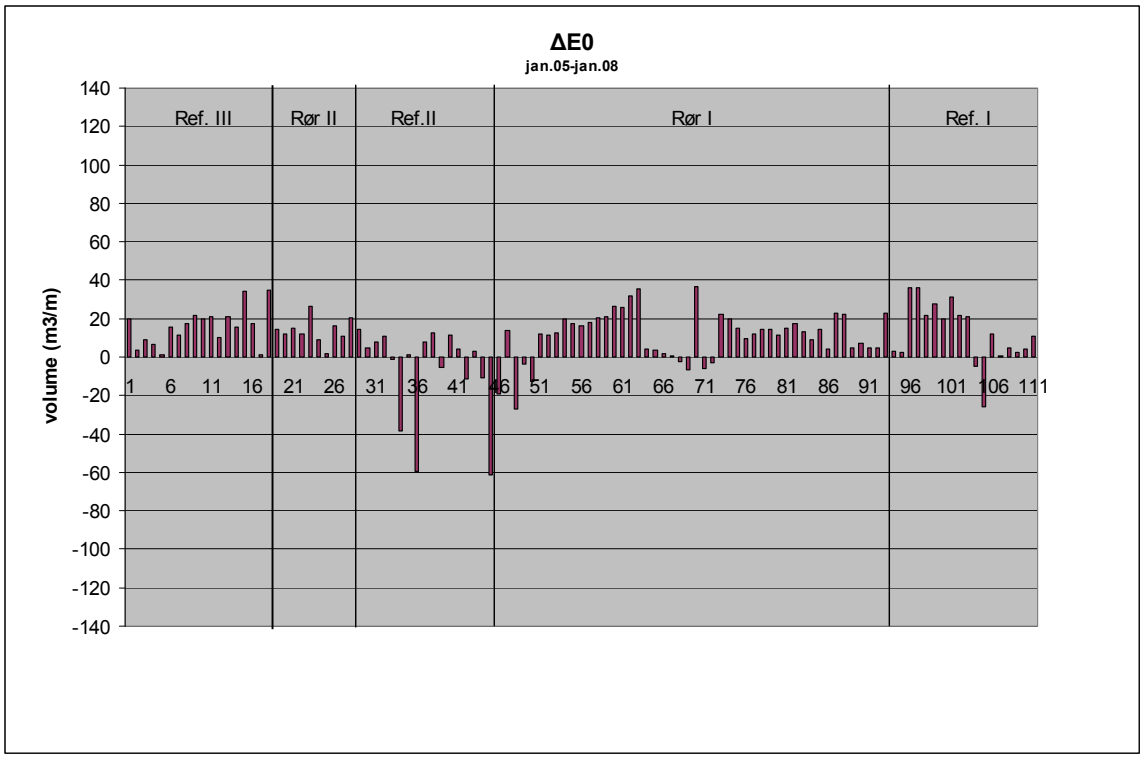
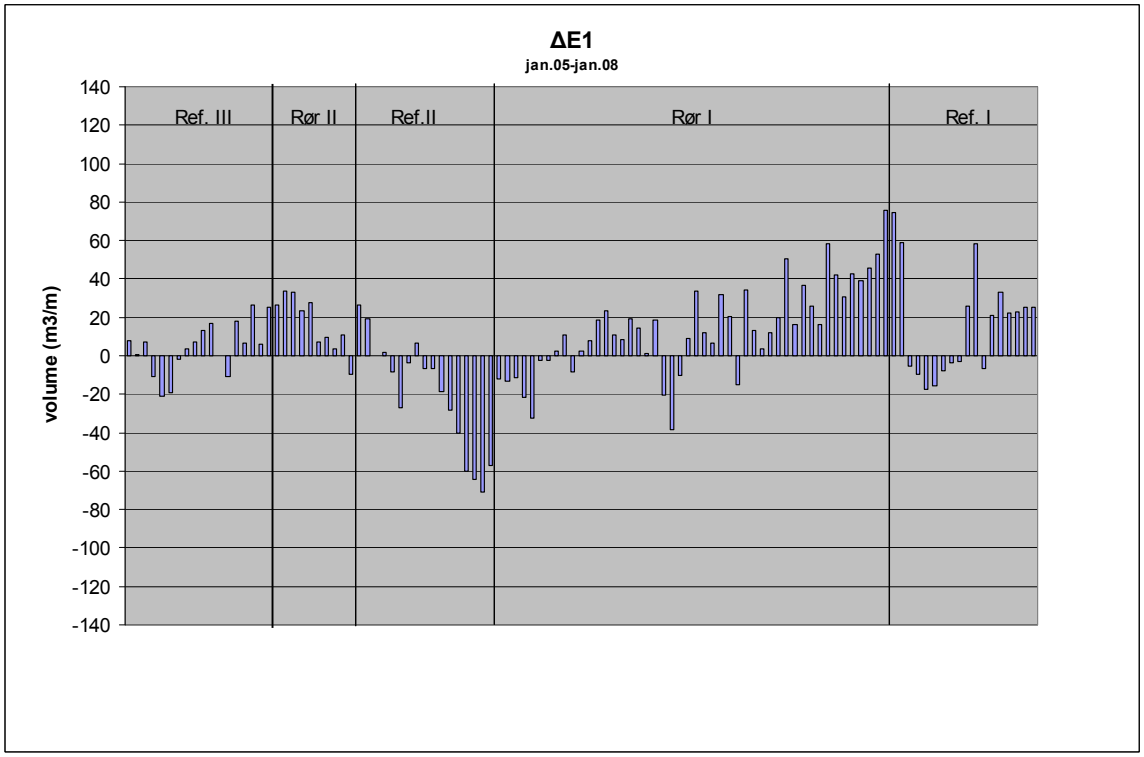


Figure 7.9: Sand accumulated behind the defined dune top.



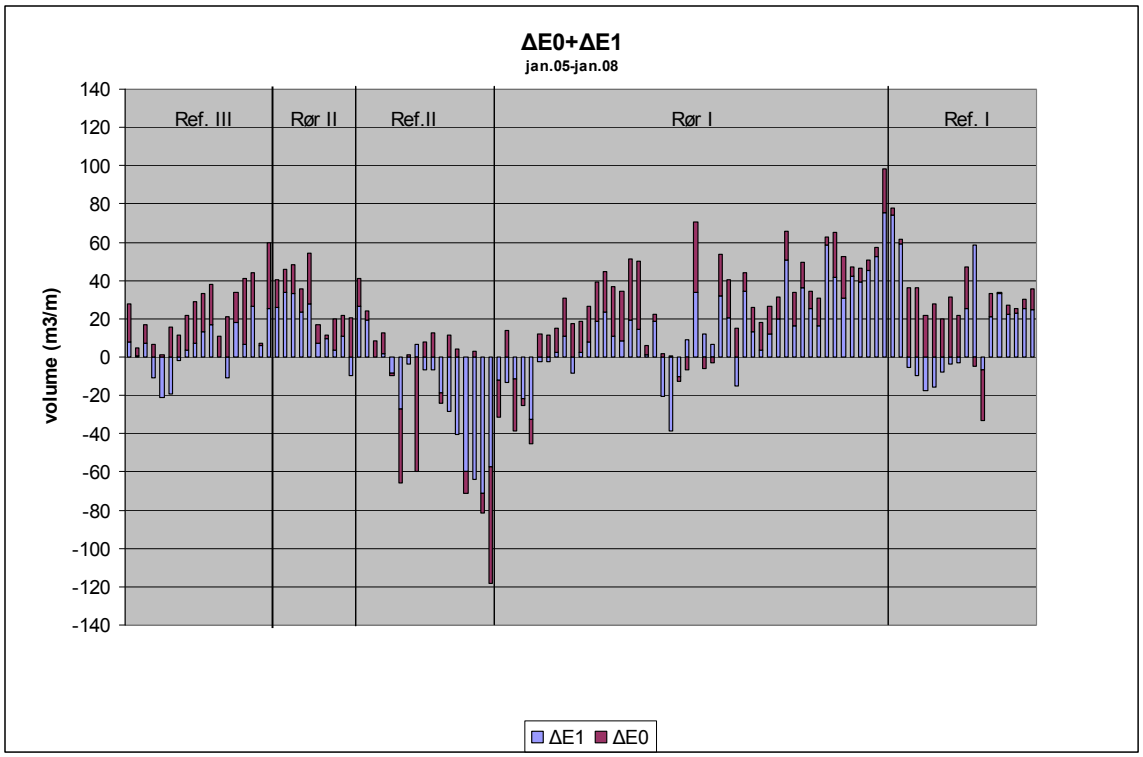


Figure 7.10: The total amount of accumulated sand in the dune above the dune foot.

Chapter 8 Changes in beach volume and beach position: tables and graphs.

The beach is that location, where the impact of the tubes should be most obvious. The width of the beach is usually defined as the distance from the water line (MWL) to the dune foot, which we have defined as +4.00 m.
With reference to section 7.1, the value e2 corresponds to the width of the beach according to the definition above. . However, since the dune foot during the three years of test can move back and forth, SIC preferred to fix the location of the dune foot to be that occurring at the start of the test, January 2005, and further to define the beach as that part of the coast which extend 100 meter seawards from the January 2005 foot-location. The volume of sand in this beach is called D2, see figure 6.1. This definition might cause some problems like that not all the beach may be part of D2, if the beach becomes wider than 100 meters. On the other hand side, if you have a narrow beach, part of the shore face (even the inner bar) may be included.

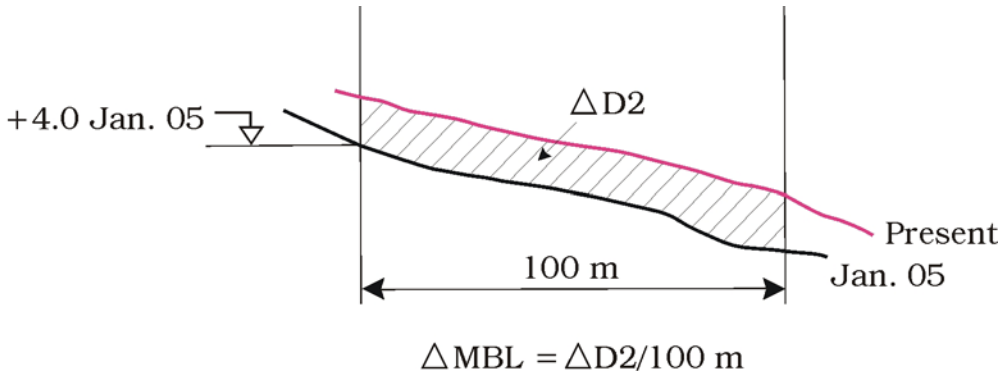


Figure 8.1: Definition of Mean Beach Level (MBL) and ΔD2.

In this section both profiles are presented for reasons of completeness. The D- profiles make sense in the way that they are related to the fixed location of the tubes, while the E-profiles are related to how the volume of the beach changes, while the location of this beach moves back and forth.

8.1 Changes in beach volume, the D2-variation.

Figure 8.2 presents the changes in the Mean Beach level (MBL), defined as the average value of D2 over 100 meters. So D2 in cbm/m can be obtained from MBL by multiplying by 100 meter. Figure 8.2 is constructed such, that first the beach mean level is presented. Next the changes during the coming period are shown, and after that the new resulting MBL is depicted. The changes from one period to the next are averaged over 300 meters to get a less fluctuating picture. The MBL-plots are still for every 100 meters.

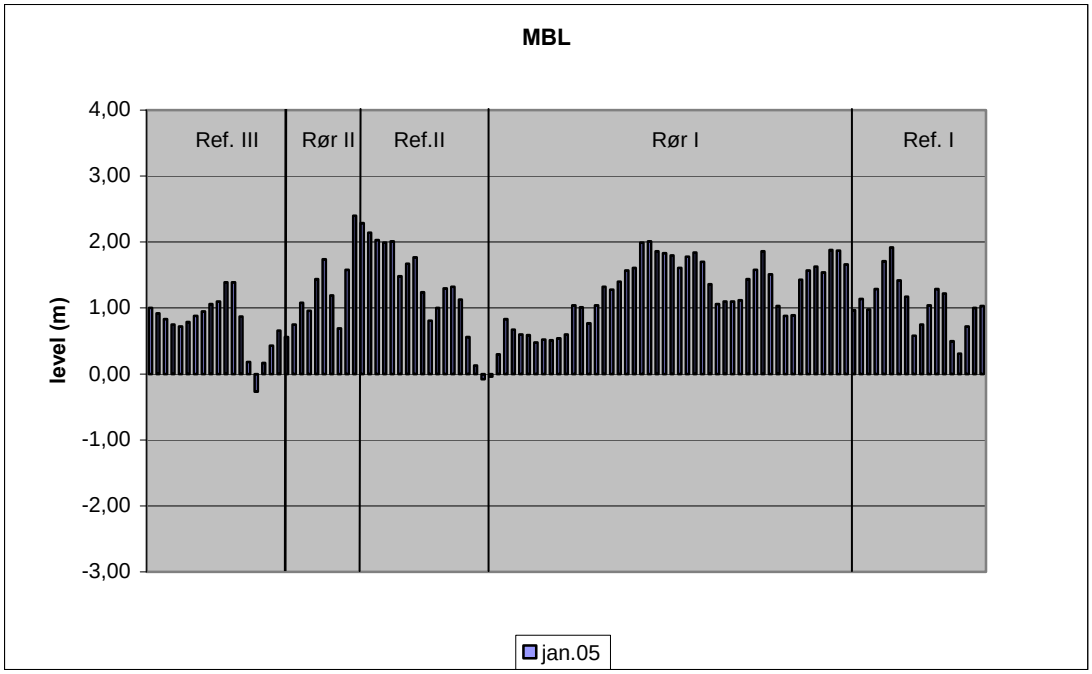
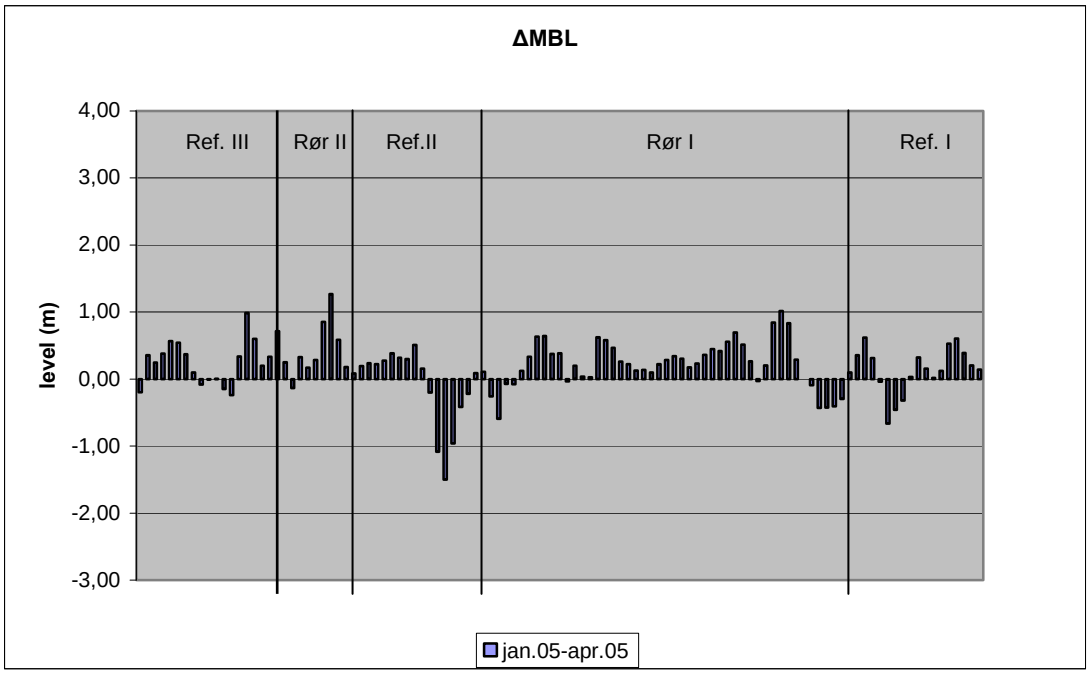


Fig. 8.2 a.


ΔMBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-apr.05

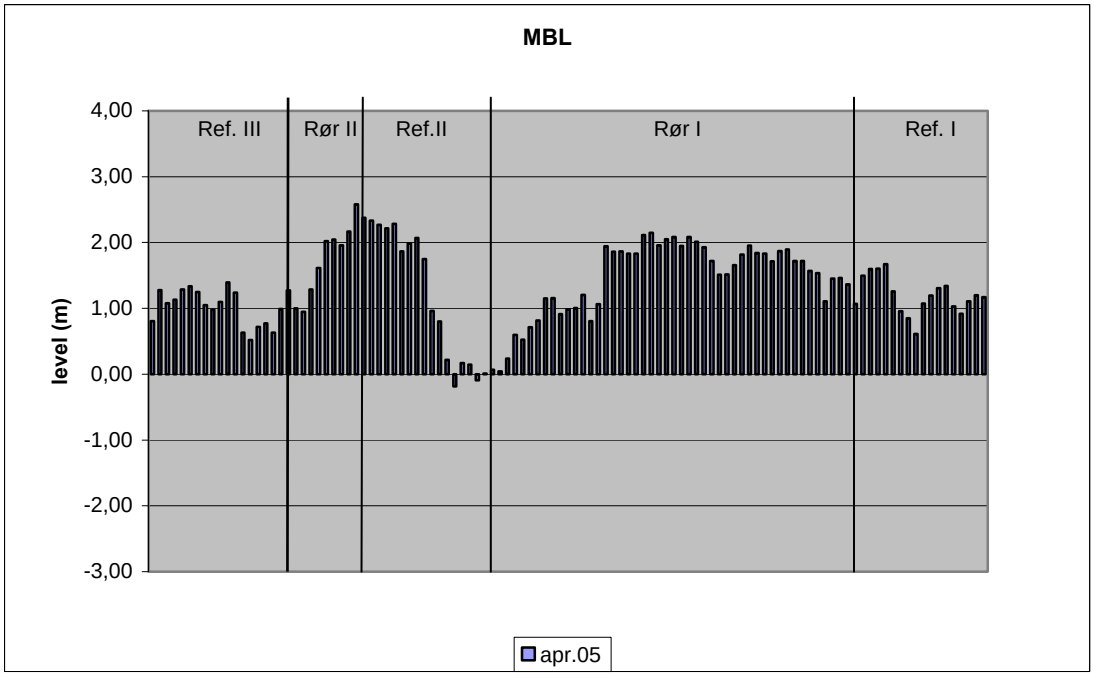

MBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
apr.05

Fig. 8.2 b.

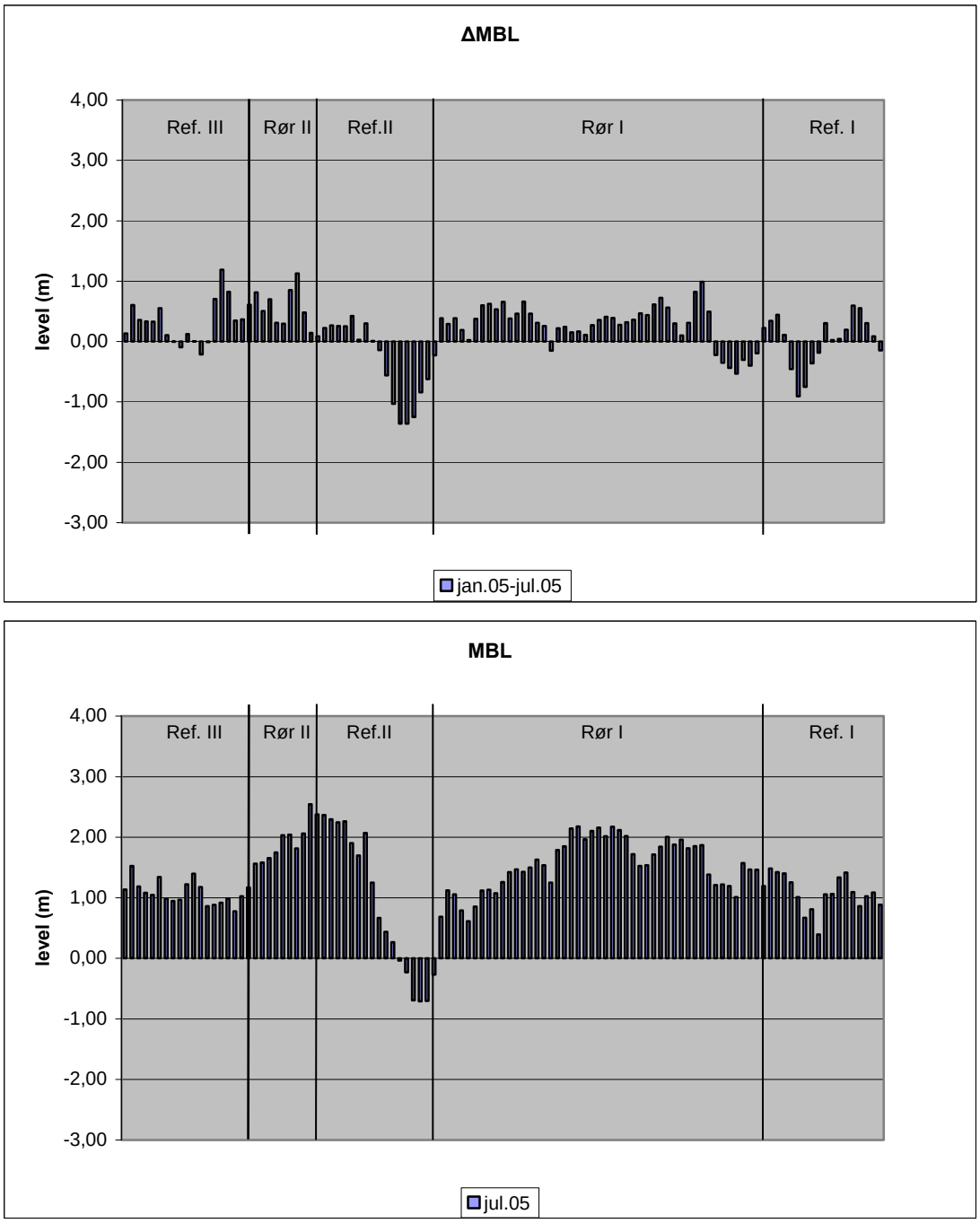

ΔMBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-jul.05
MBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jul.05

Fig. 8.2 c.

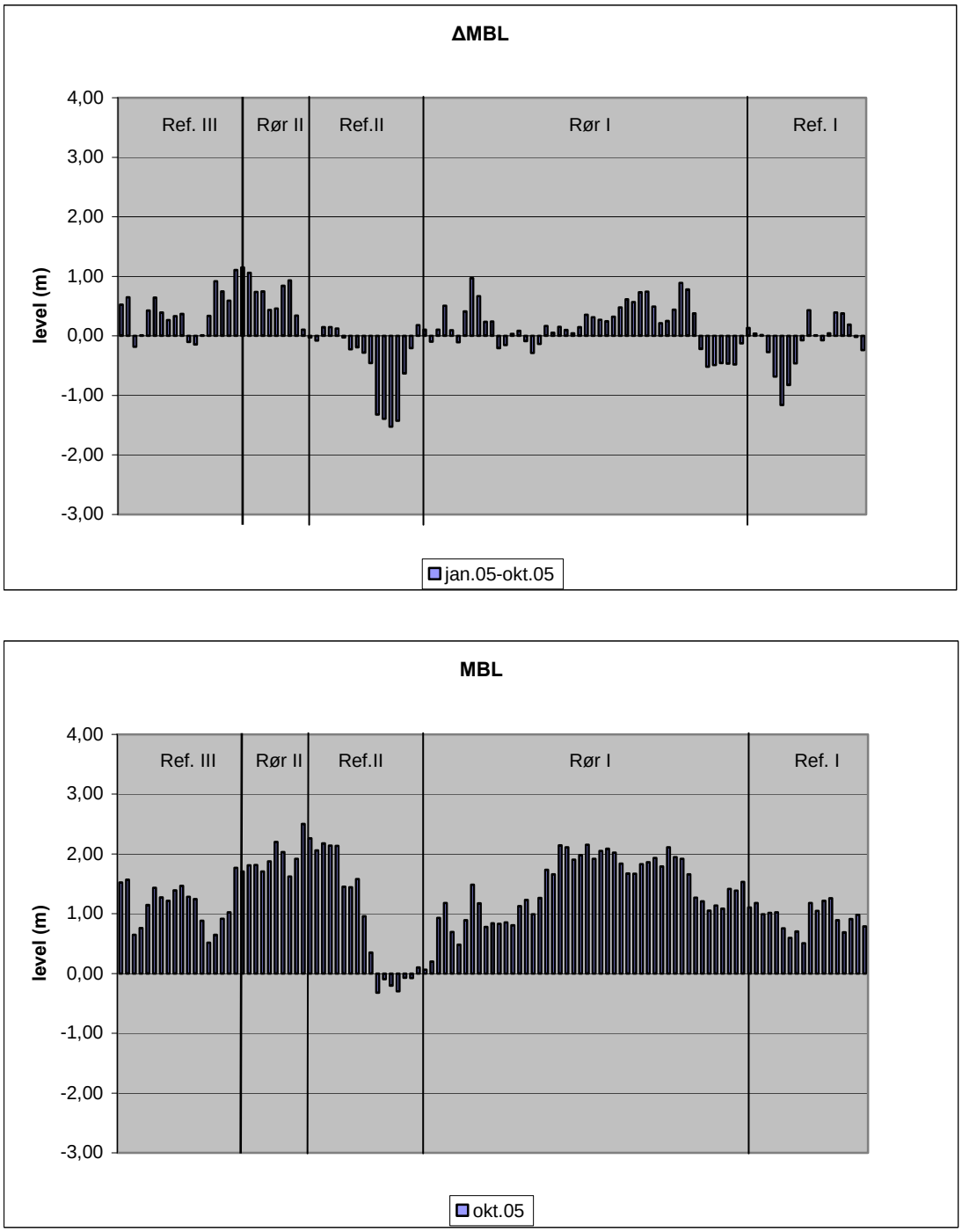
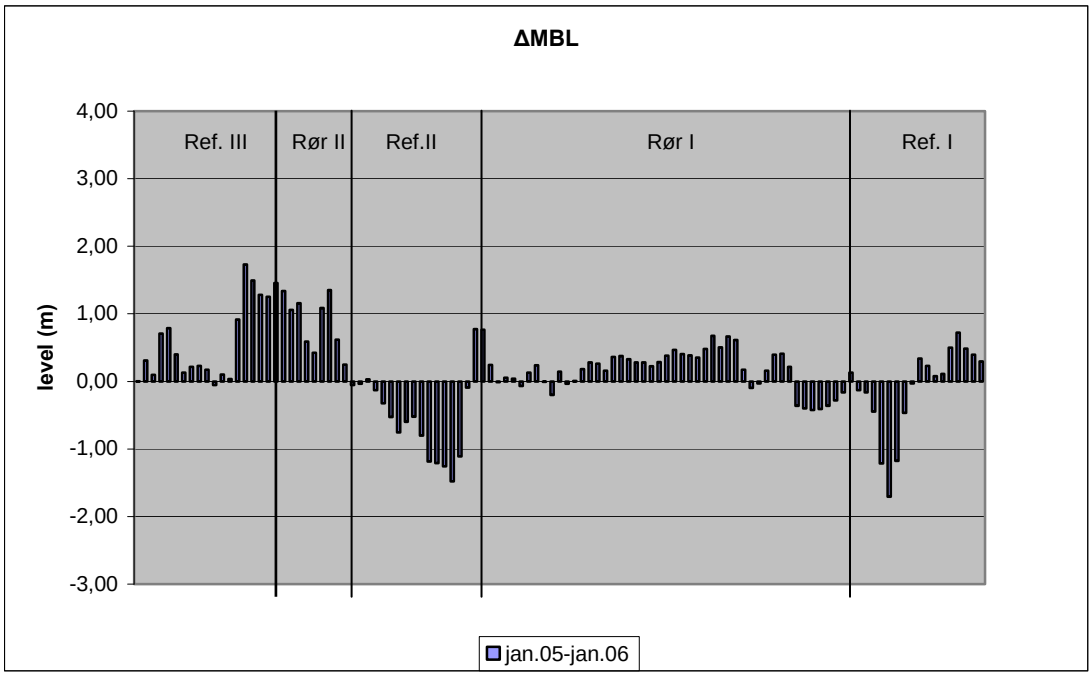

ΔMBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-okt.05
MBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
okt.05

Fig. 8.2 d.


ΔMBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-jan.06

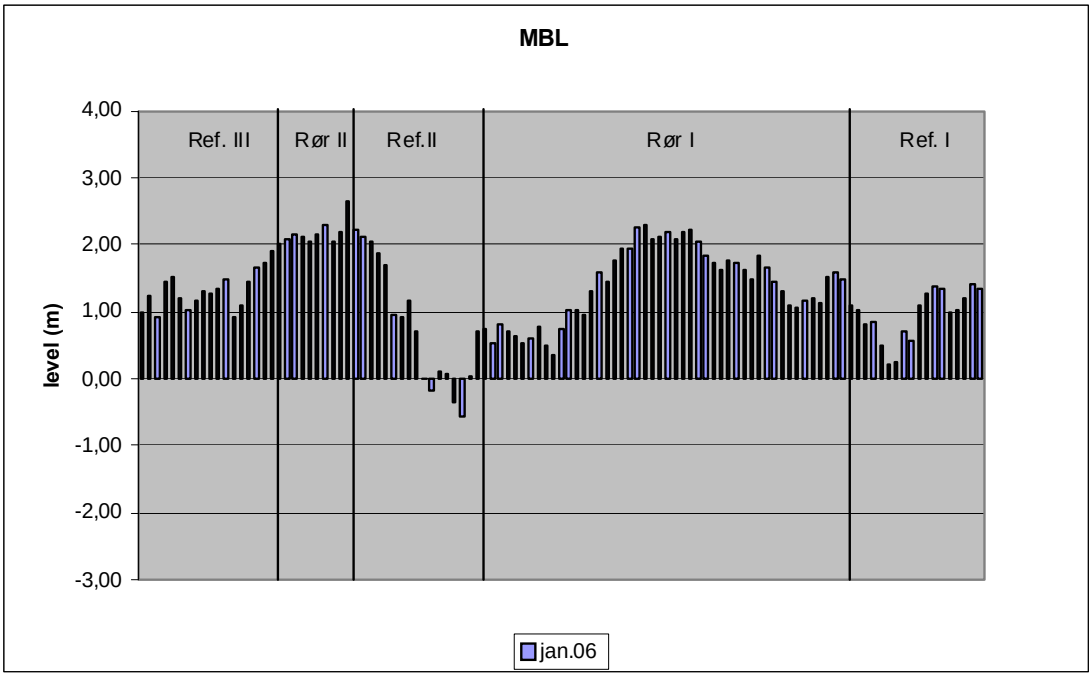
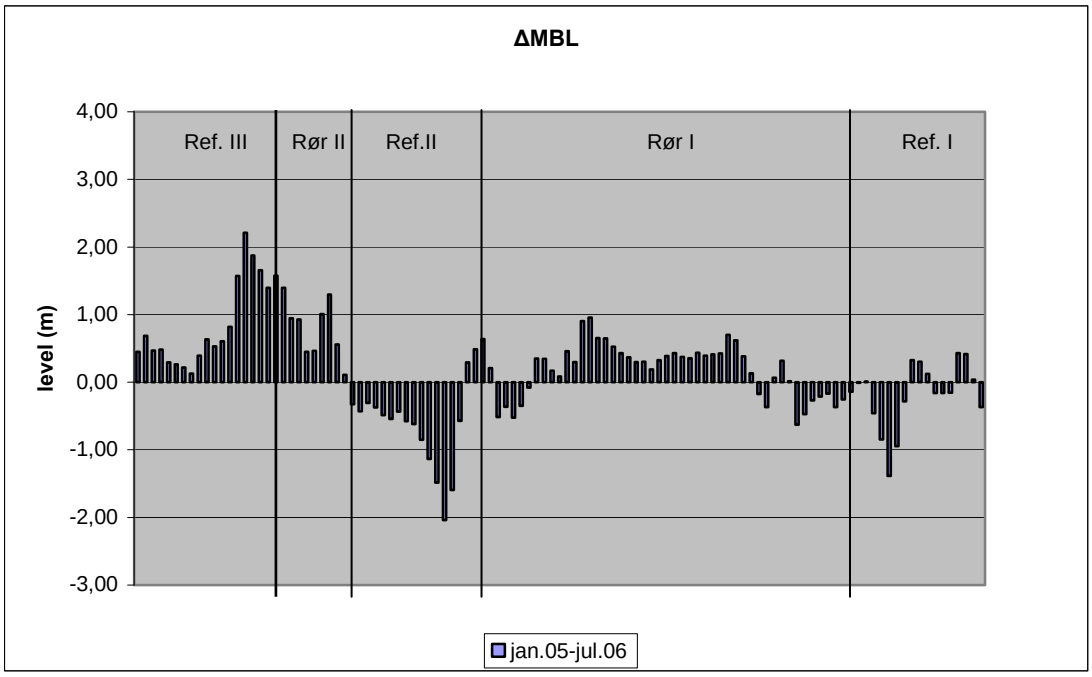

MBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.06

Fig. 8.2 e.


ΔMBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-jul.06

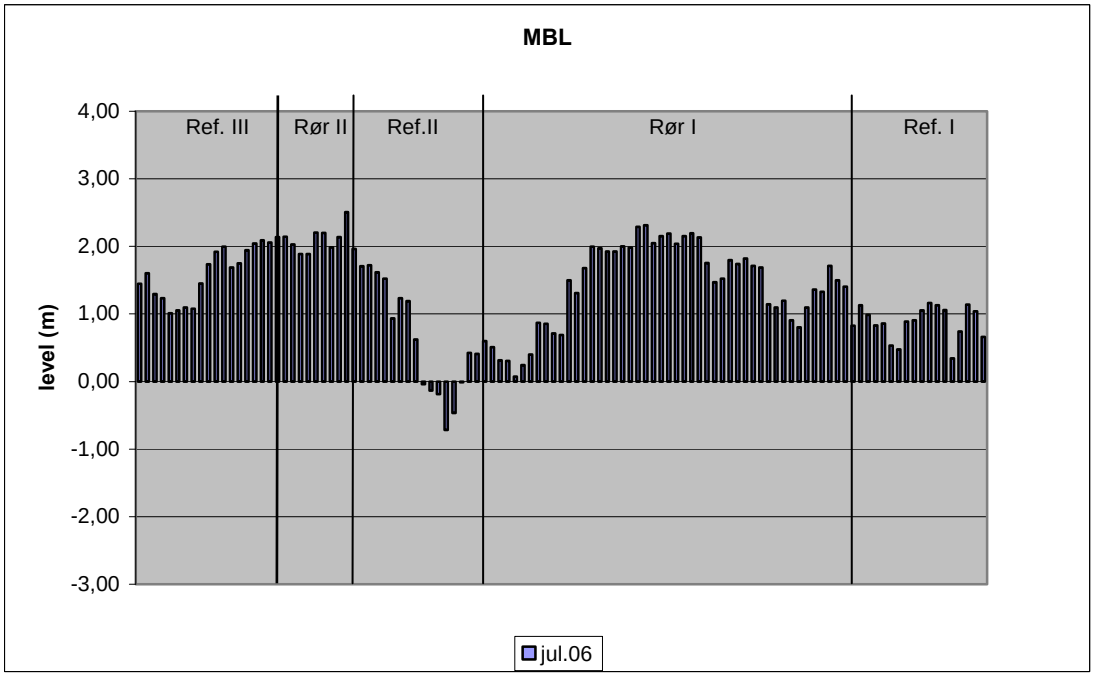
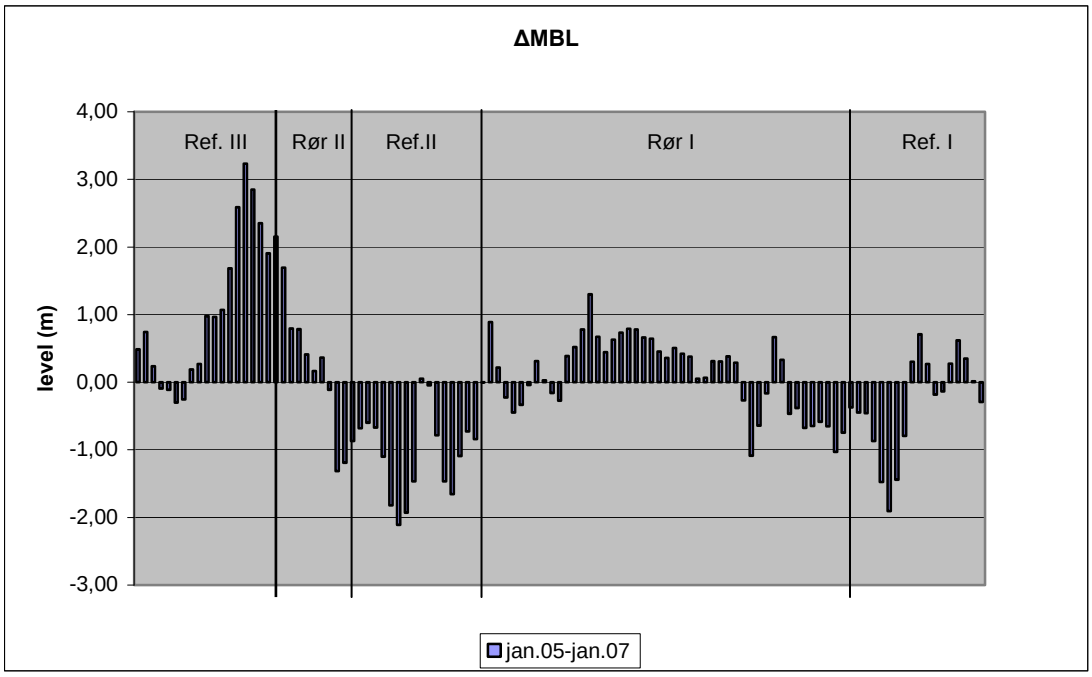

MBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jul.06

Fig. 8.2 f.


ΔMBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-jan.07

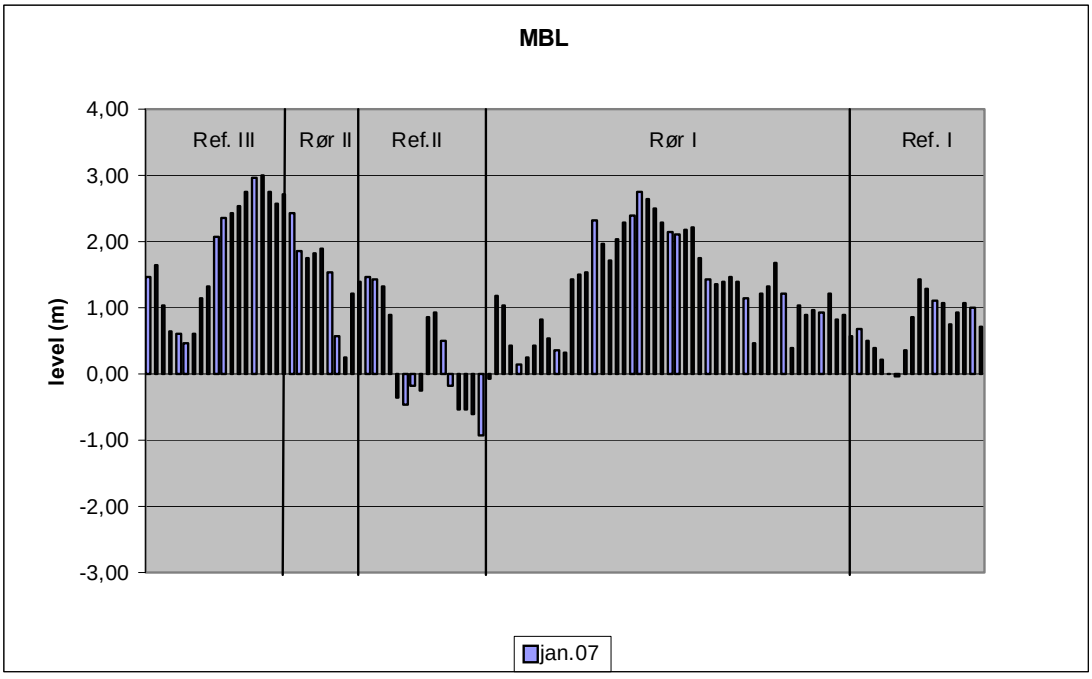
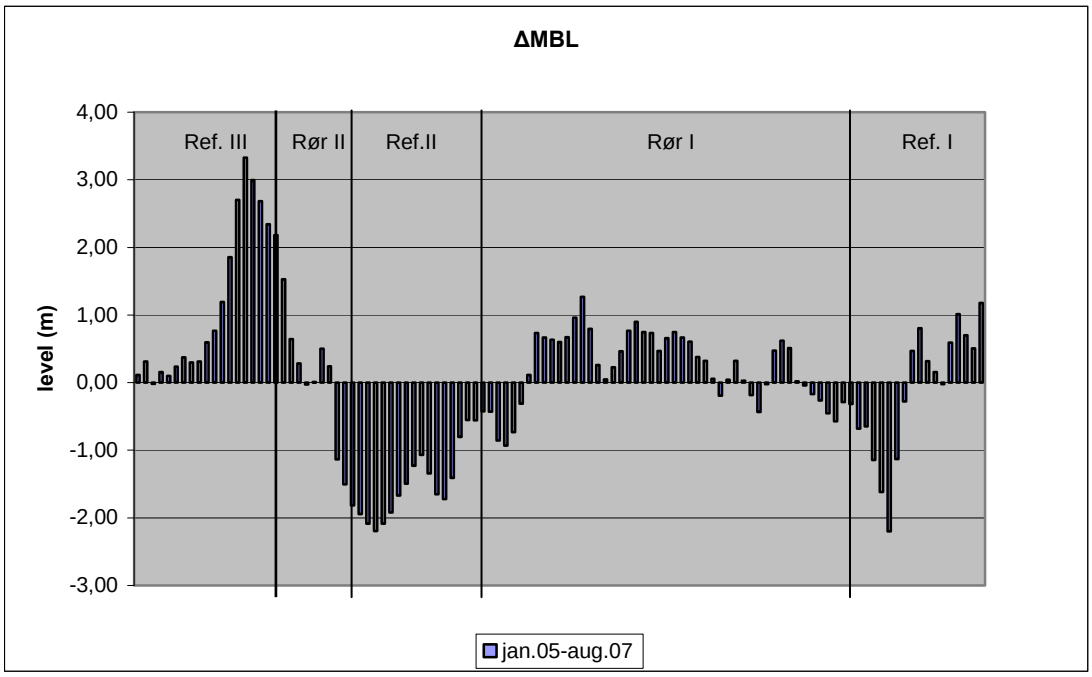

MBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.07

Fig. 8.2 g.



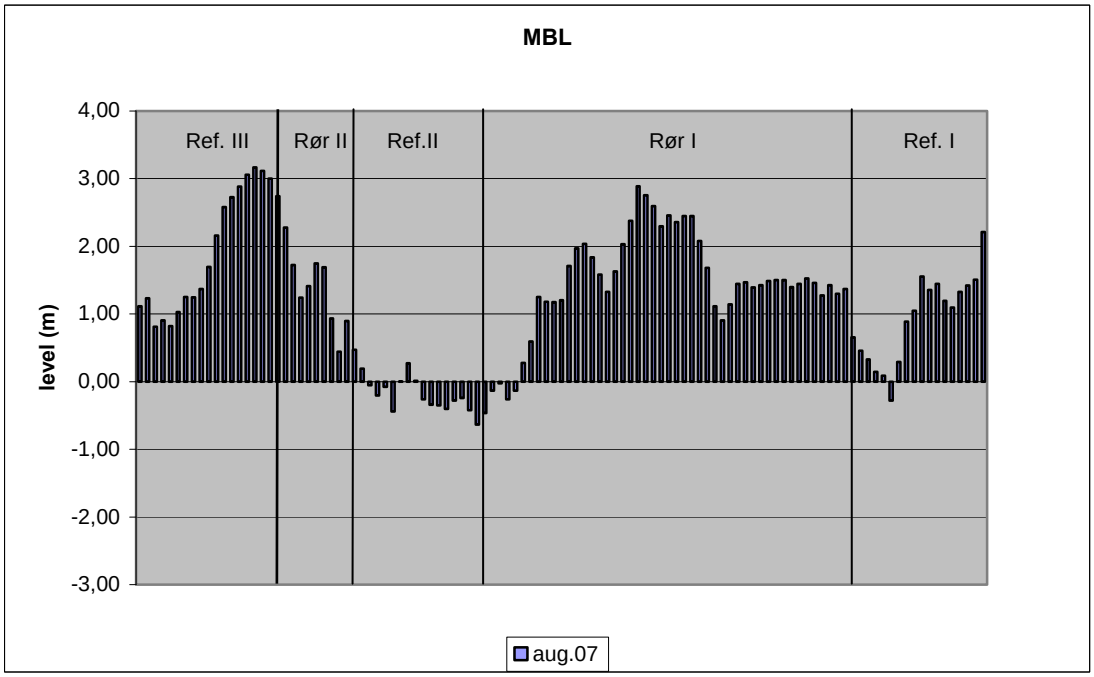
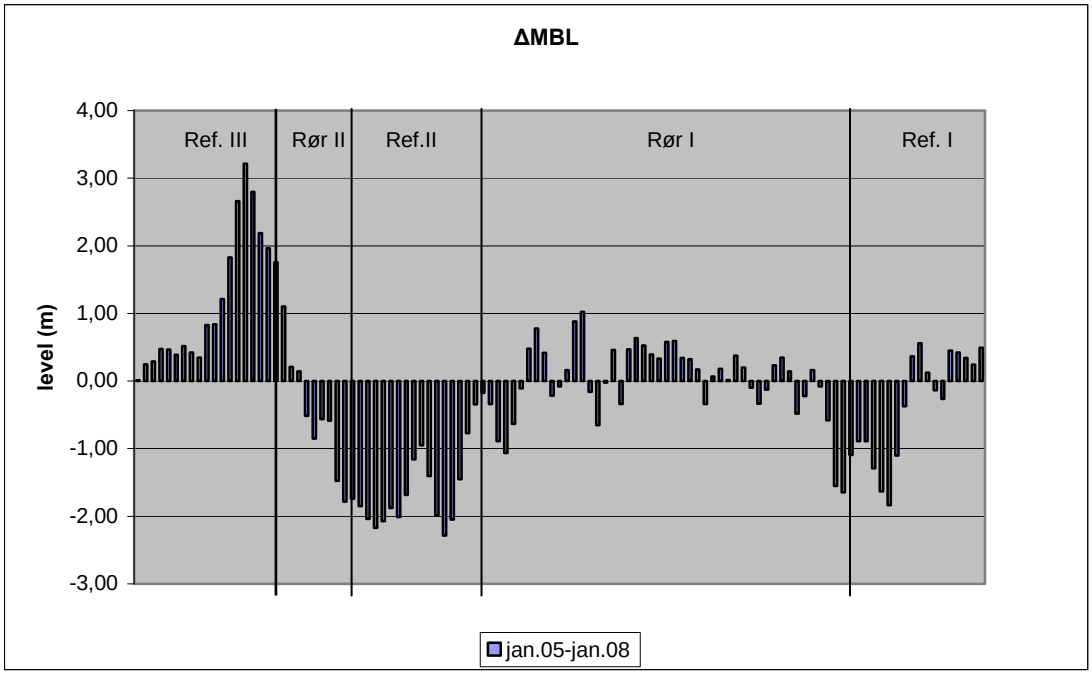


Fig. 8.2 h.


ΔMBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-jan.08

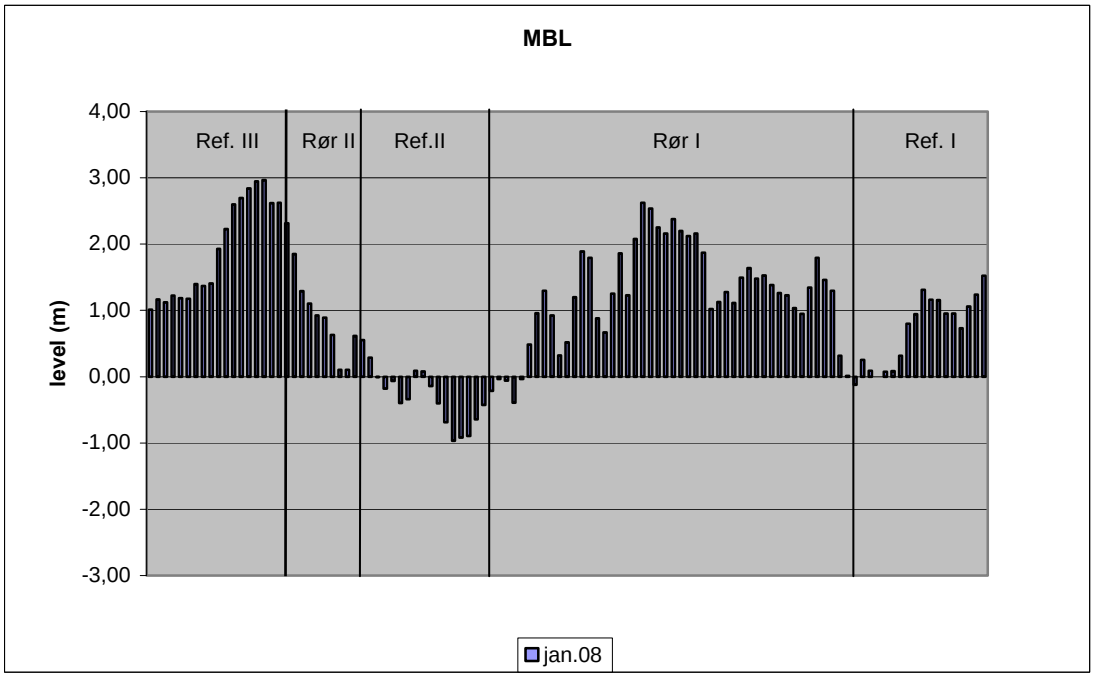
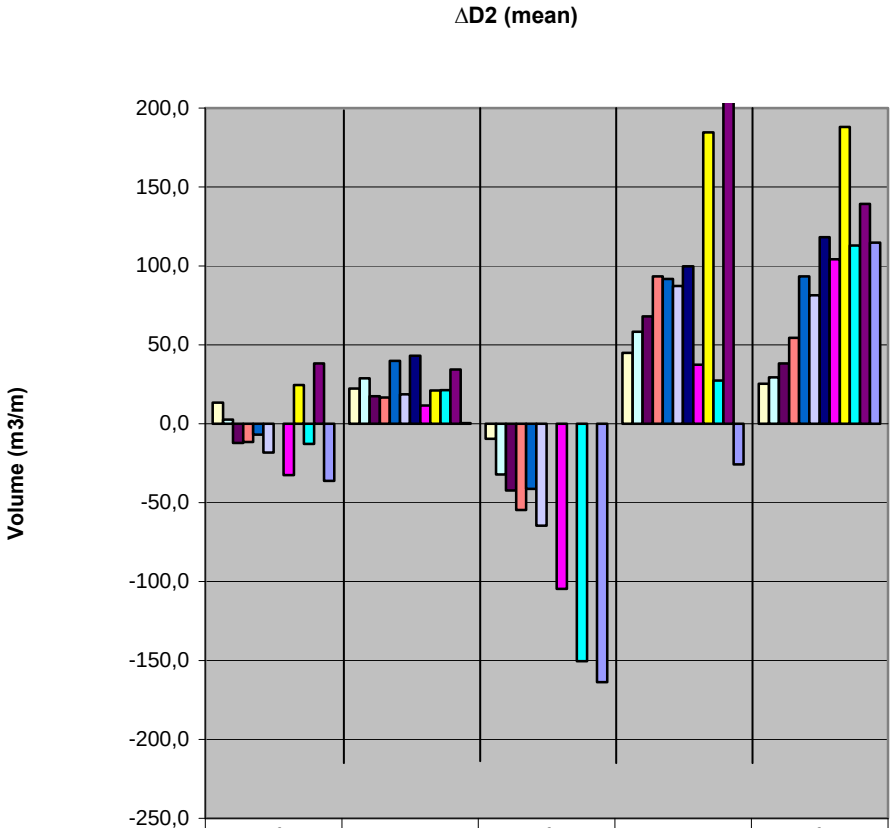

MBL
4,00
3,00
2,00
1,00
0,00
-1,00
-2,00
-3,00
level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.08

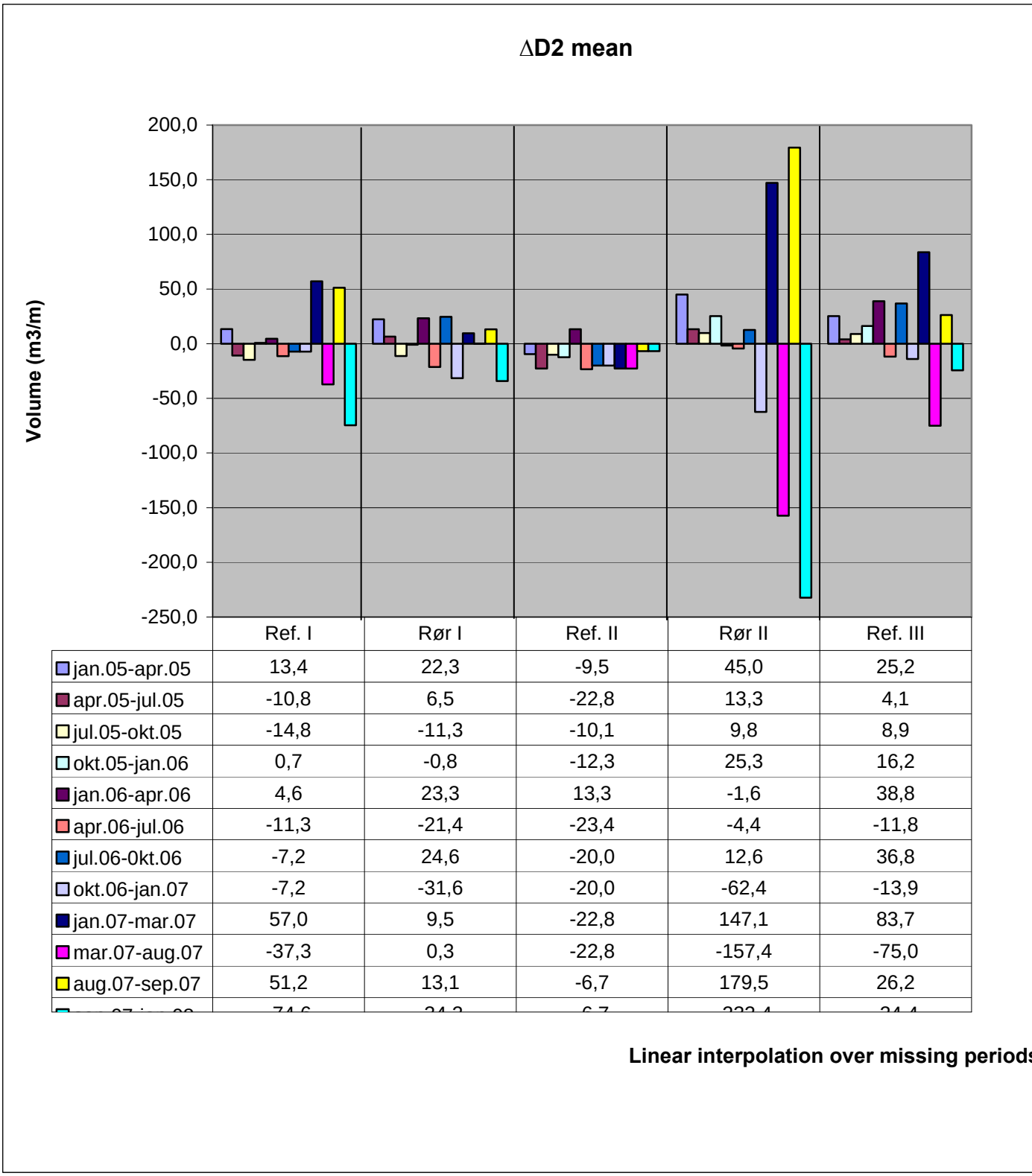
Fig. 8.2 i.

Figure 8.3 is an integrated table of the changes from January 05 to the time of measurements for each stretch with time. Figure 8.4 is like figure 8.3, but now showing the consequent changes.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	13,4	22,3	-9,5	45,0	25,2
jan.05-jul.05	2,6	28,8	-32,2	58,3	29,3
jan.05-okt.05	-12,2	17,5	-42,3	68,1	38,2
jan.05-jan.06	-11,5	16,7	-54,6	93,3	54,4
jan.06-apr.06	-6,9	39,9	-41,3	91,7	93,2
jan.05-jul.06	-18,2	18,5	-64,7	87,3	81,5
jan.05-okt.06	0,0	43,2	0,0	99,9	118,2
jan.05-jan.07	-32,5	11,5	-104,8	37,5	104,3
jan.05-mar.07	24,4	21,1	0,0	184,6	188,0
jan.05-aug.07	-12,8	21,3	-150,3	27,2	113,0
jan.05-sep.07	38,3	34,5	0,0	206,7	139,2
jan.05-jan.08	-36,3	0,3	-163,8	-25,7	114,8

Figure 8.3.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	13,4	22,3	-9,5	45,0	25,2
apr.05-jul.05	-10,8	6,5	-22,8	13,3	4,1
jul.05-okt.05	-14,8	-11,3	-10,1	9,8	8,9
okt.05-jan.06	0,7	-0,8	-12,3	25,3	16,2
jan.06-apr.06	4,6	23,3	13,3	-1,6	38,8
apr.06-jul.06	-11,3	-21,4	-23,4	-4,4	-11,8
jul.06-0kt.06	-7,2	24,6	-20,0	12,6	36,8
okt.06-jan.07	-7,2	-31,6	-20,0	-62,4	-13,9
jan.07-mar.07	57,0	9,5	-22,8	147,1	83,7
mar.07-aug.07	-37,3	0,3	-22,8	-157,4	-75,0
aug.07-sep.07	51,2	13,1	-6,7	179,5	26,2

Linear interpolation over missing periods

Figure 8.4

Finally fig 8.5 shows the same data of MBL like those presented in figure 8.2, but smoothened out, so the figure gives the average value over 300 meters instead of every 100 meters. This figure is introduced to have an easier overlook of the gross-behavior without too many details of the beach along the test site. In this way large scale features like migrating undulations should easier be identified. Further figure 8.5 shows the consequent changes while figure 8.2 shows the cumulated changes from January 2005.

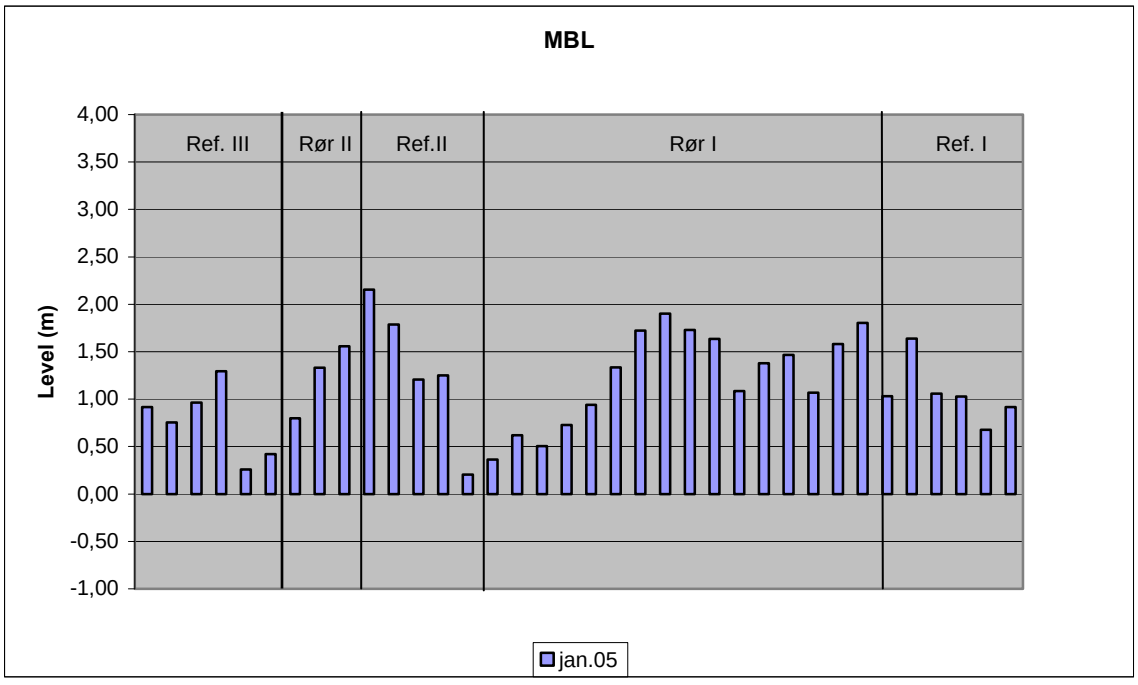
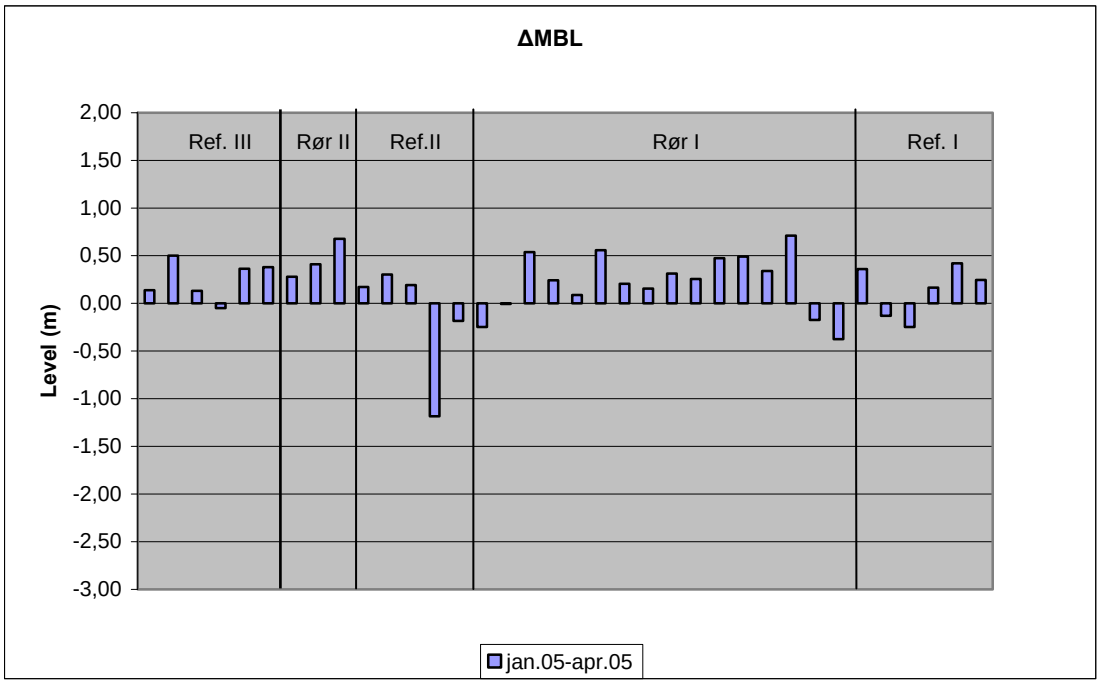


Fig. 8.5a.


ΔMBL
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-apr.05

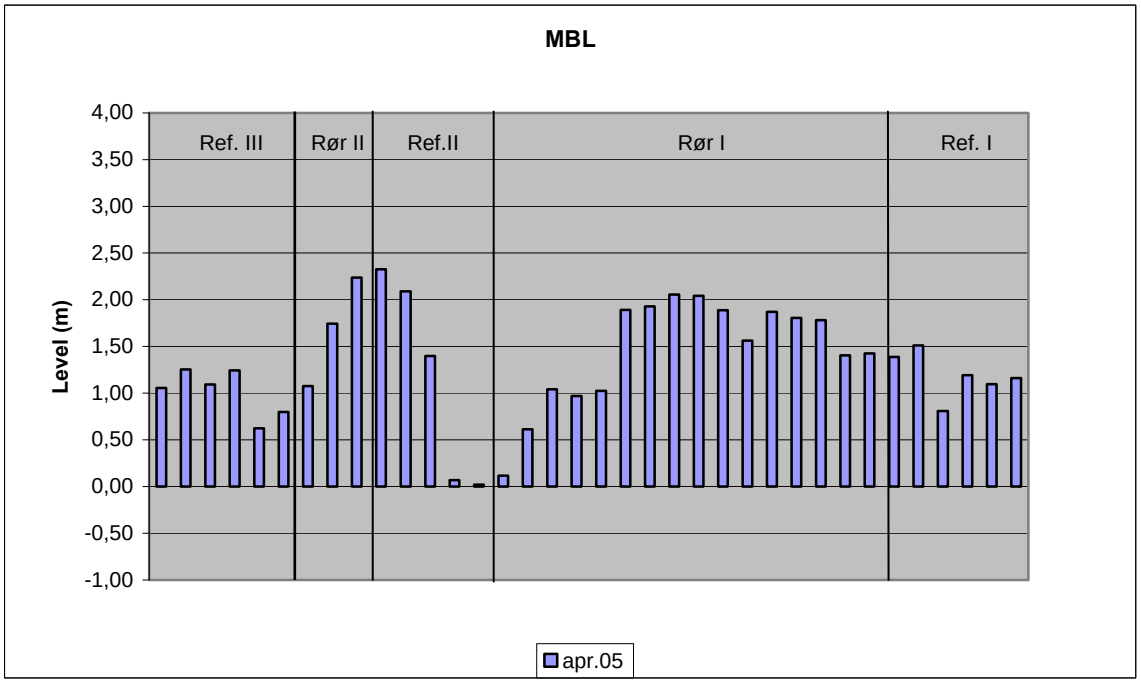
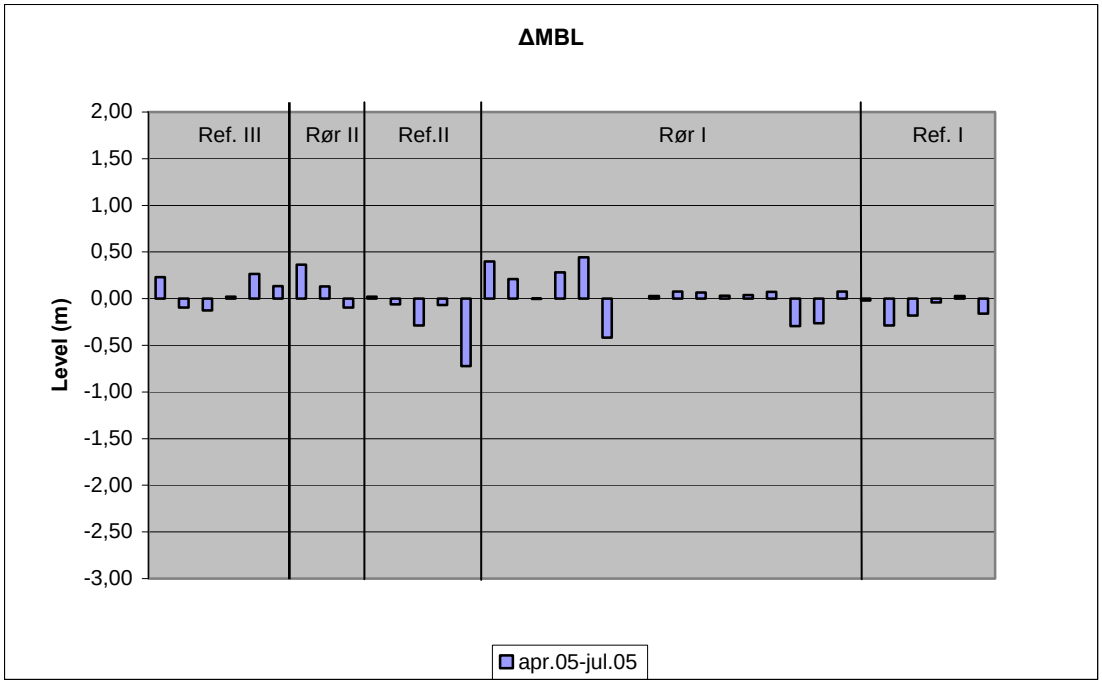

MBL
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
Level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
apr.05

Fig. 8.5b.


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
apr.05-jul.05

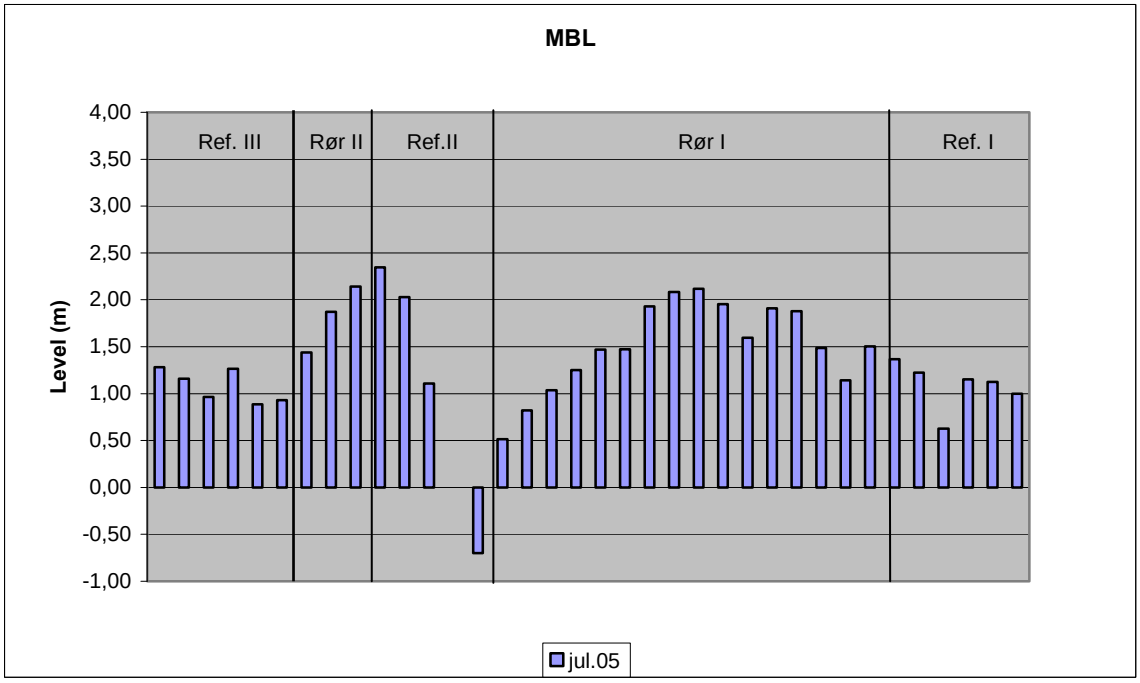
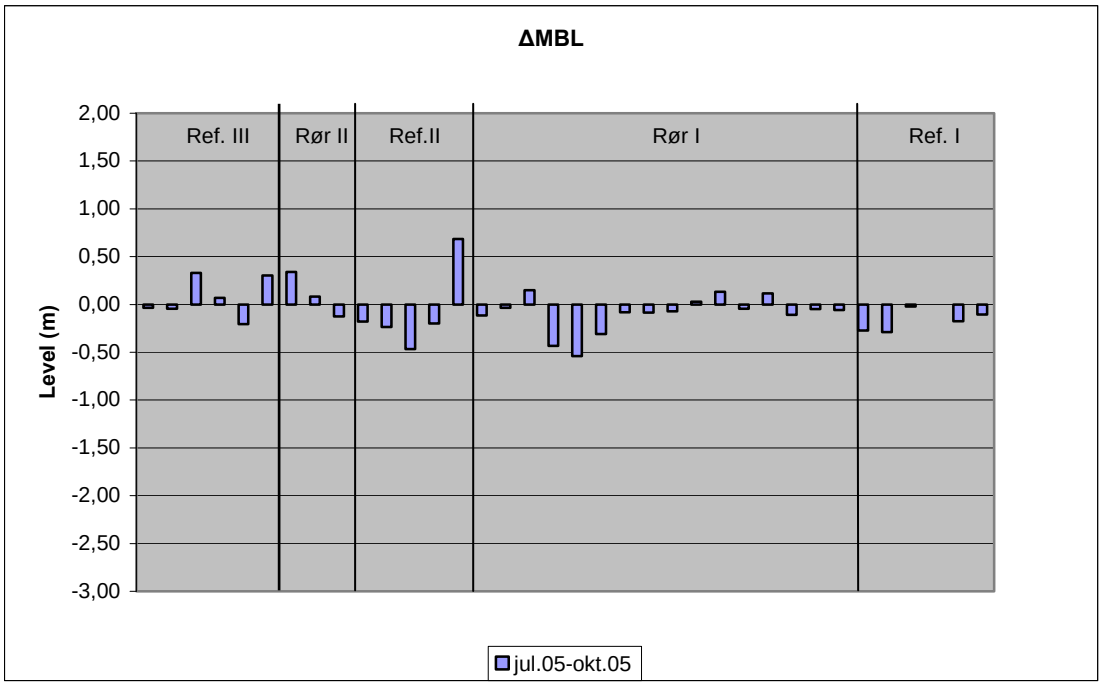
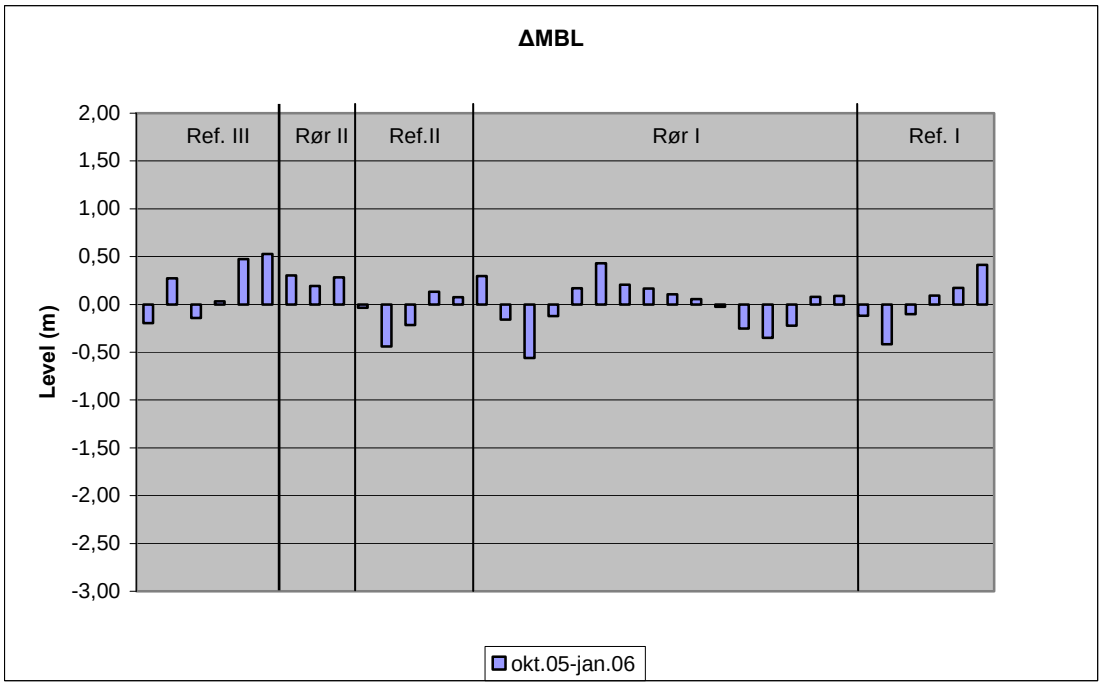

MBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
Level (m)
jul.05

Fig. 8.5c.


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
jul.05-okt.05


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
okt.05-jan.06

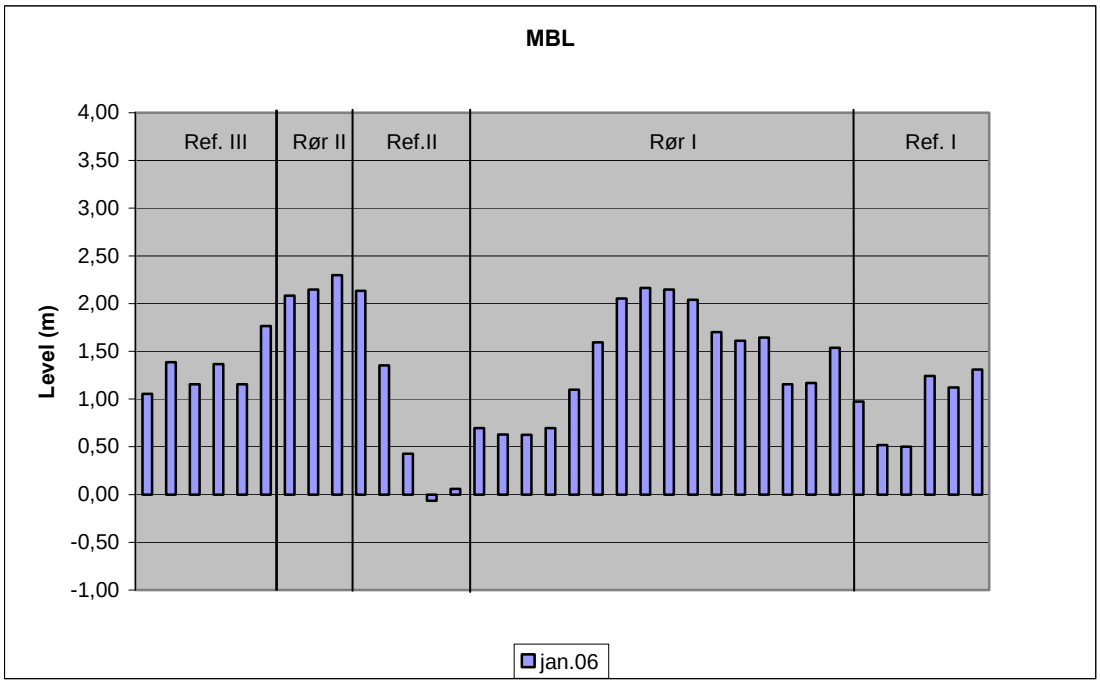
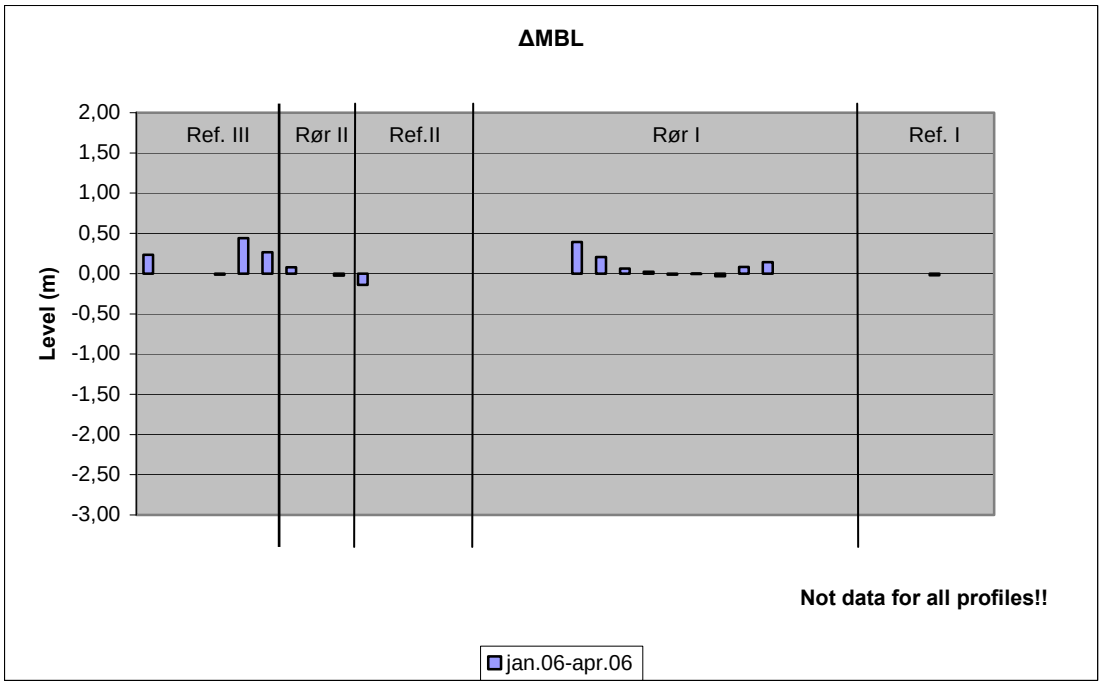
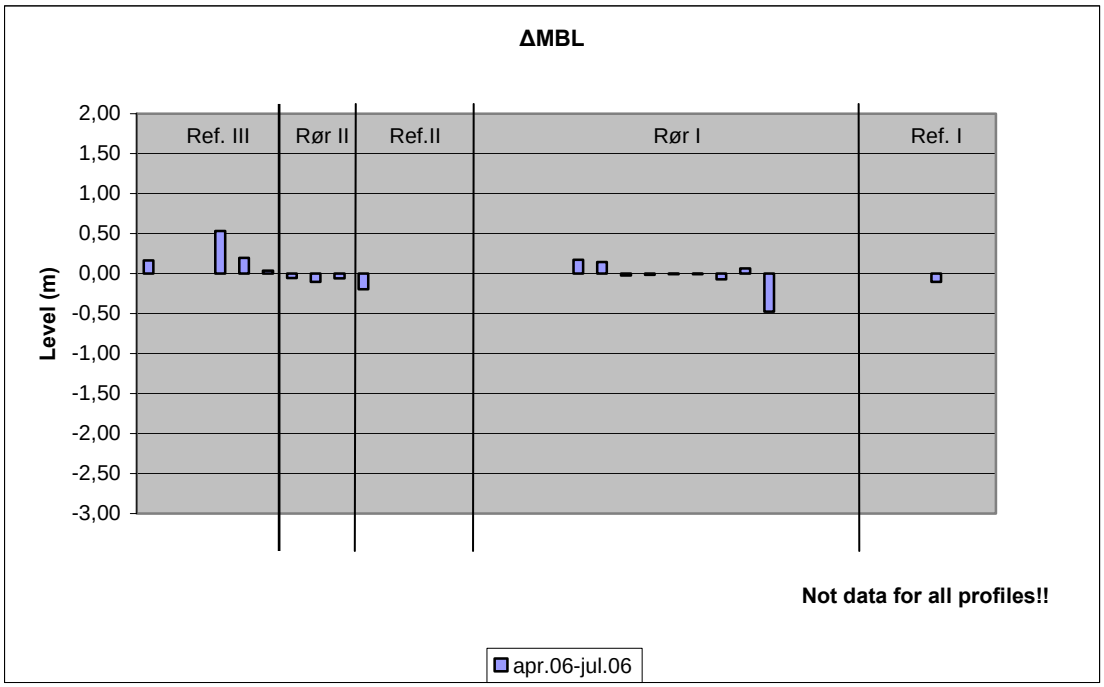

MBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
Level (m)
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
jan.06

Fig. 8.5d.


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
Level (m)
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Not data for all profiles!!
jan.06-apr.06


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
Not data for all profiles!!
apr.06-jul.06

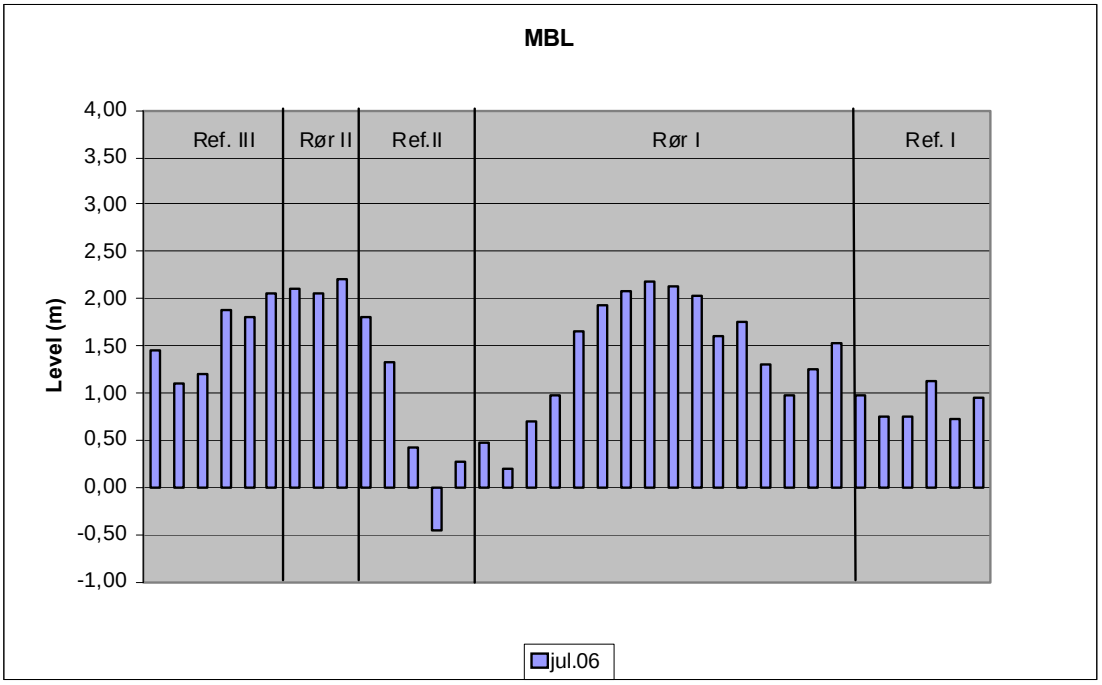
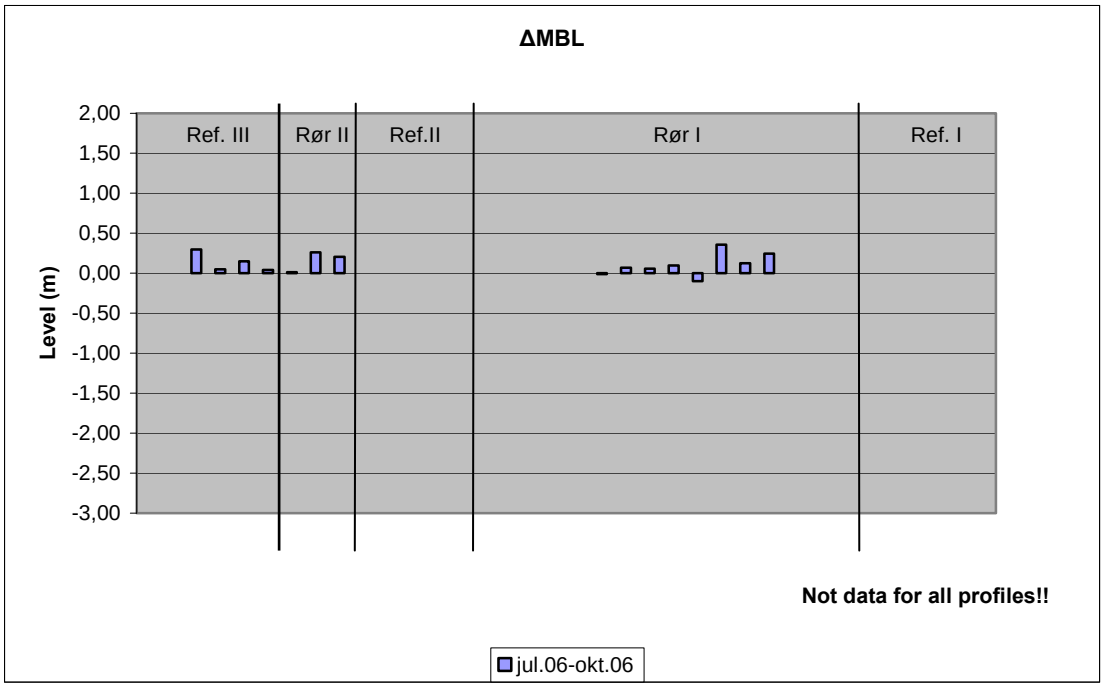
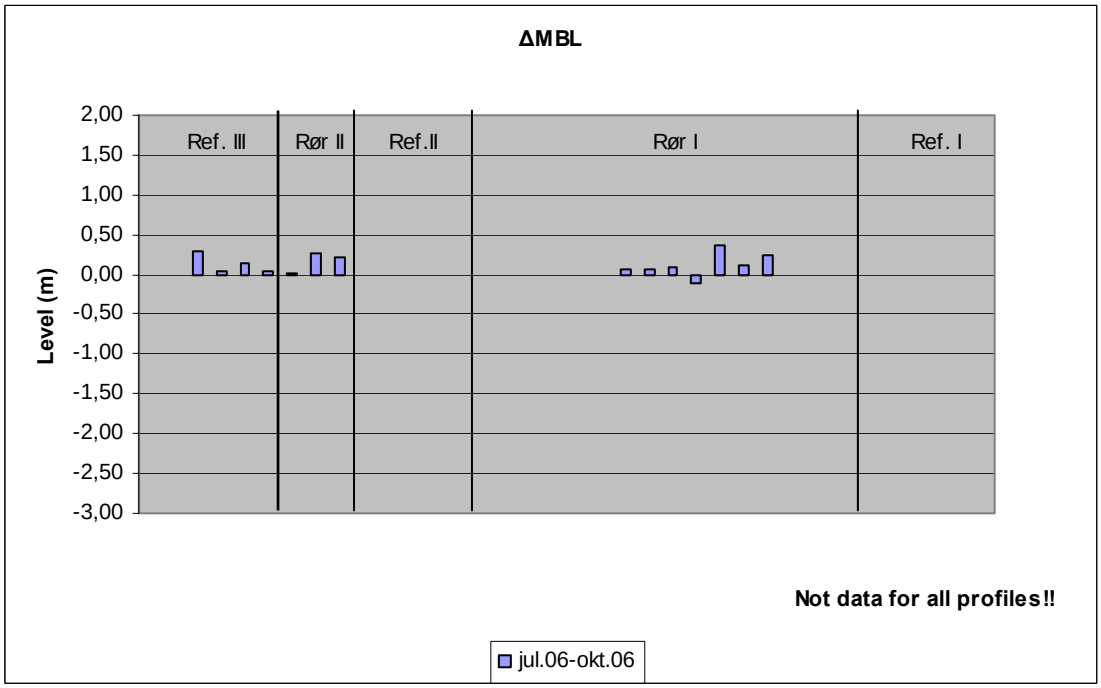
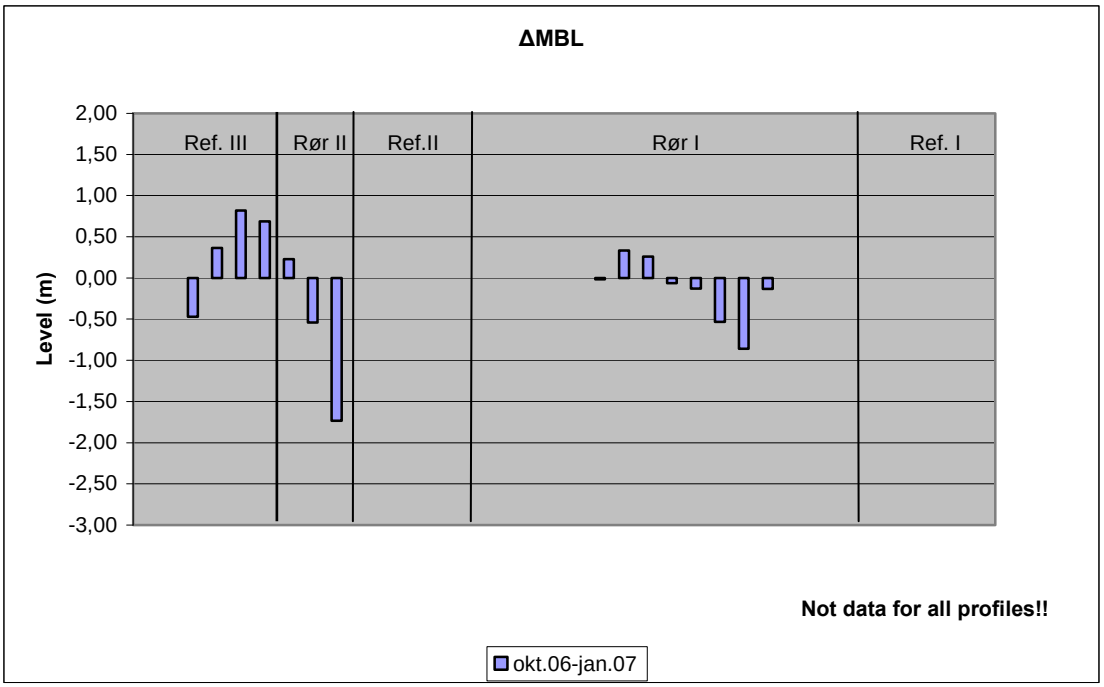

MBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
Level (m)
jul.06

Fig. 8.5e.


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
Not data for all profiles!!
jul.06-okt.06


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
Not data for all profiles!!
jul.06-okt.06


ΔMBL
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
Not data for all profiles!!
okt.06-jan.07

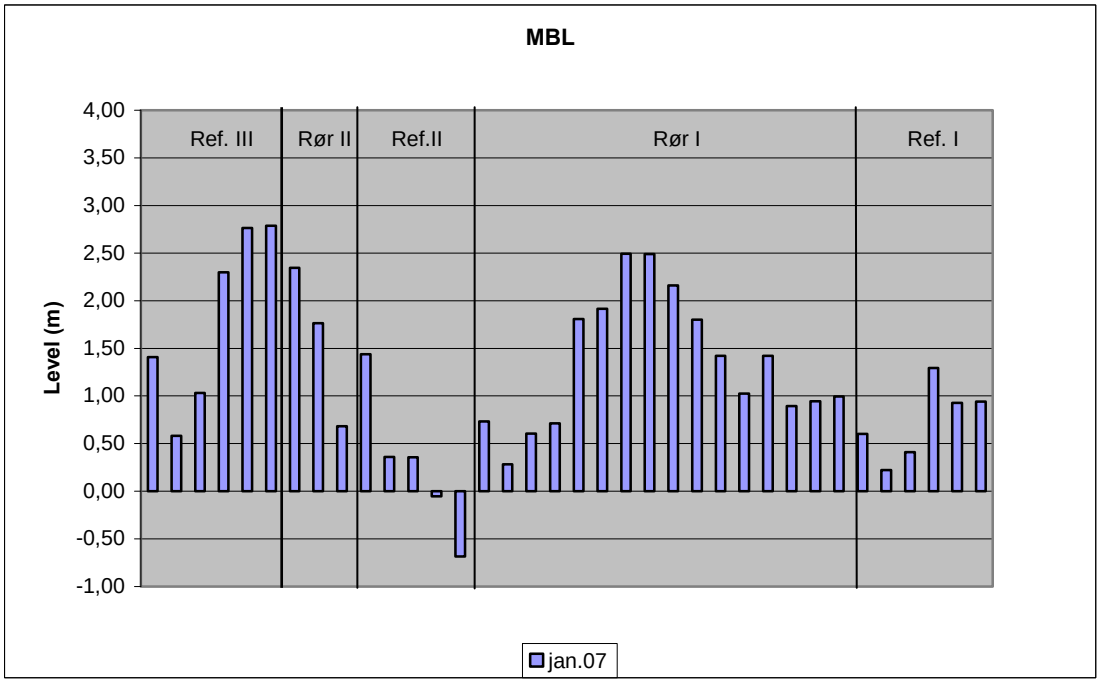

MBL
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
Level (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.07

Fig. 8.5f.

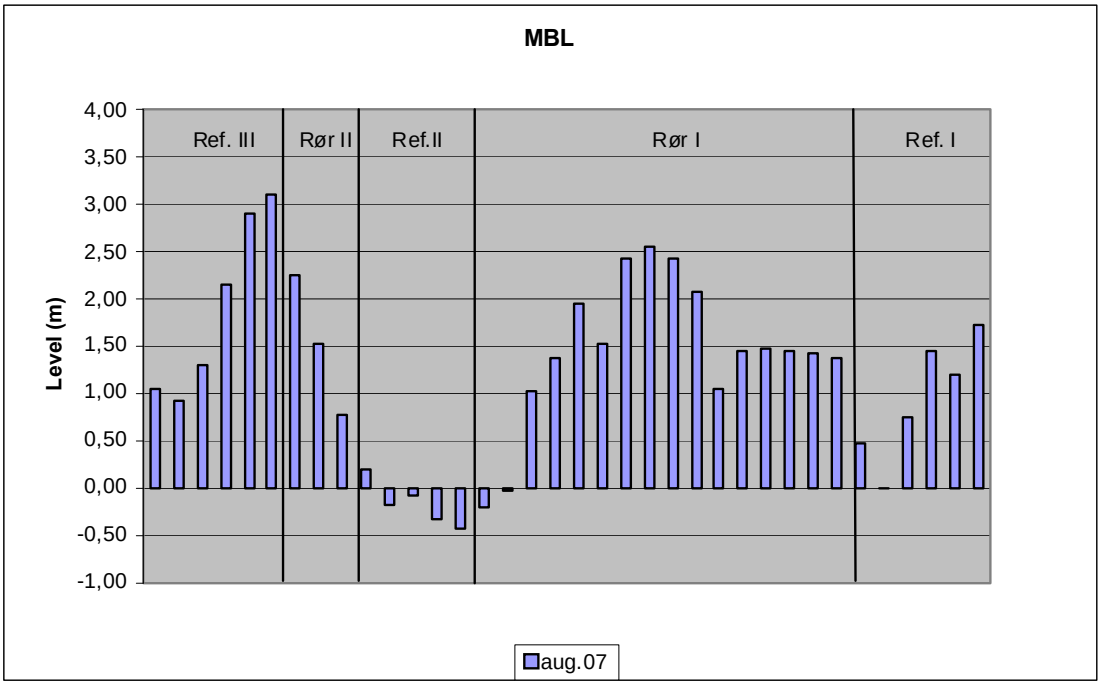
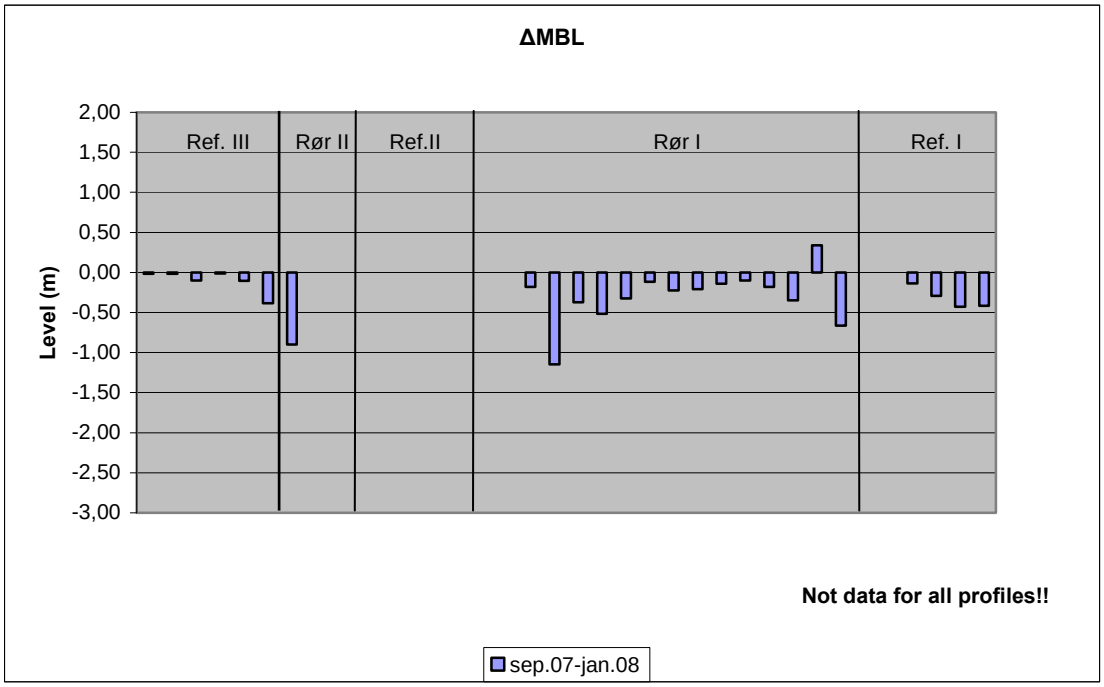

MBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
Level (m)
4,00
3,50
3,00
2,50
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
aug.07

Fig. 8.5g.


ΔMBL
Ref. III
Rør II
Ref.II
Rør I
Ref. I
Level (m)
2,00
1,50
1,00
0,50
0,00
-0,50
-1,00
-1,50
-2,00
-2,50
-3,00
Not data for all profiles!!
sep.07-jan.08

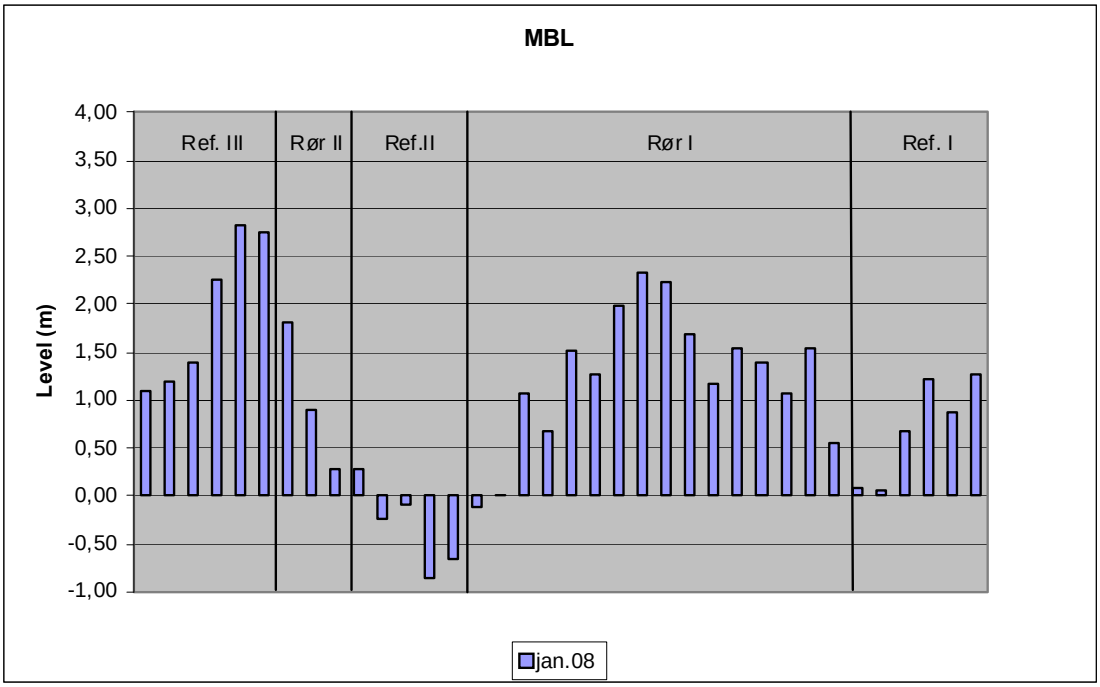


Fig. 8.5h.

8.2 Changes in the beach width e2.

The width of the beach is defined in figure 8.6. After many negotiations, the definition became a little bit strange, and the width is defined as the distance from the dune foot position *January 2005* and to the present position of the waterline at MSL.

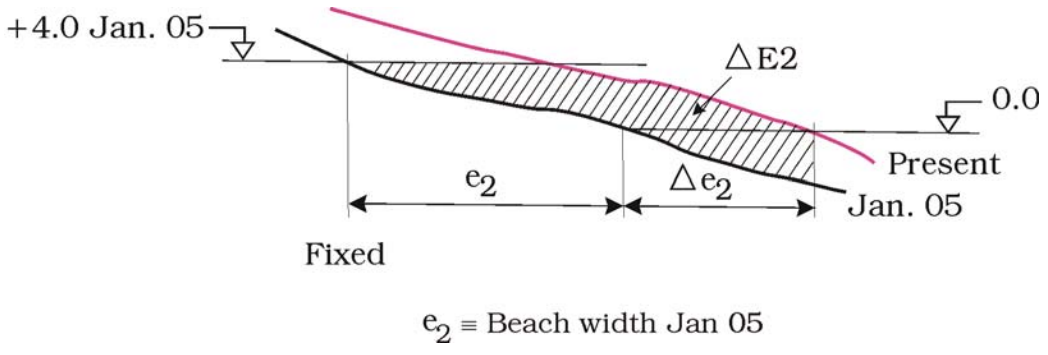


Fig. 8.6: Definition of beach width e2+Δe2 and change in beach volume ΔE2.

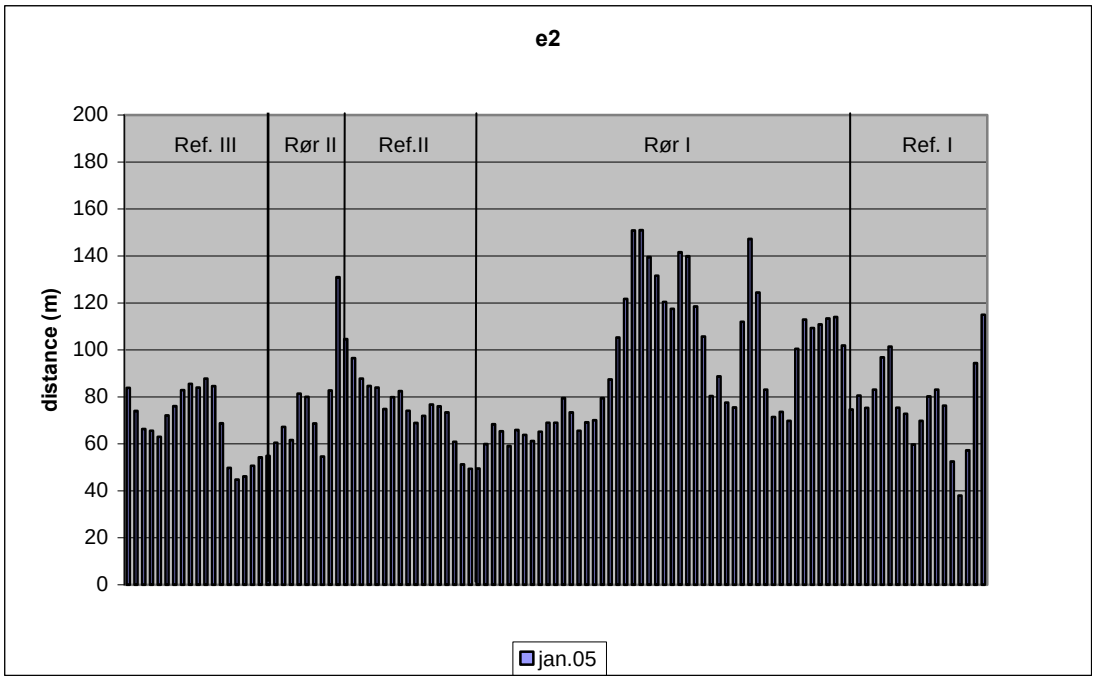

e2
distance (m)
200
180
160
140
120
100
80
60
40
20
0
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05

Figure 8.7A.

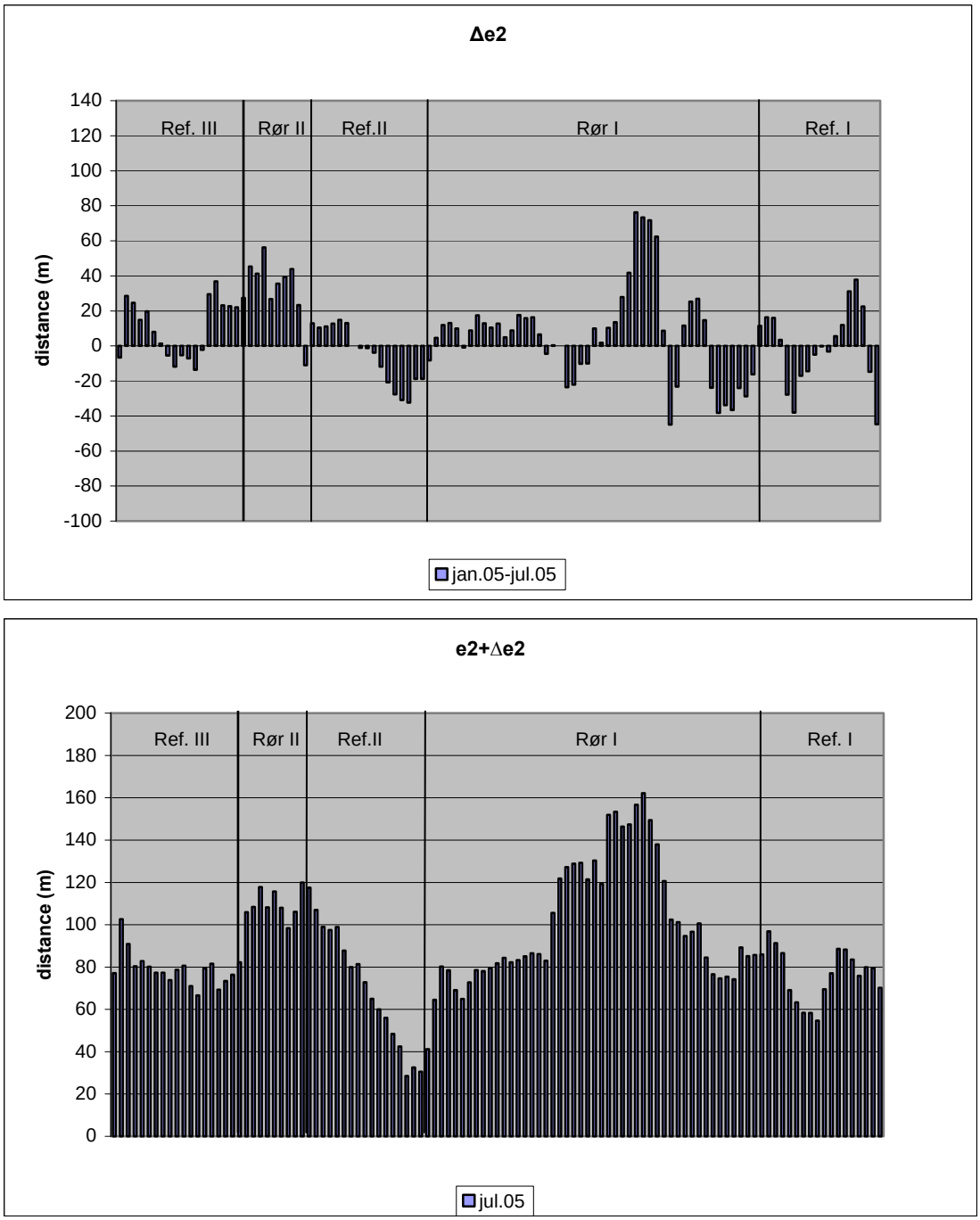

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-jul.05
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
jul.05

Figure 8.7B.

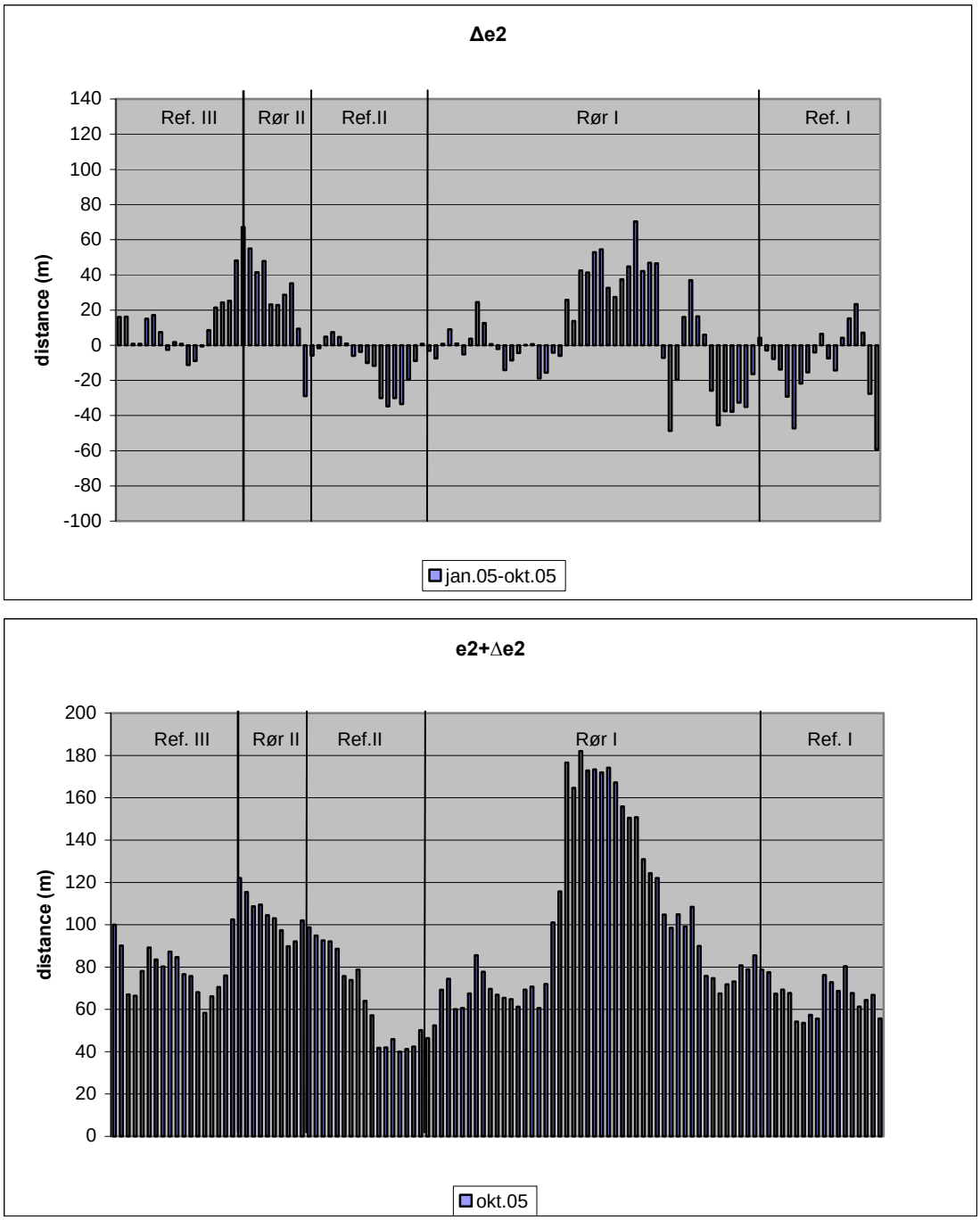
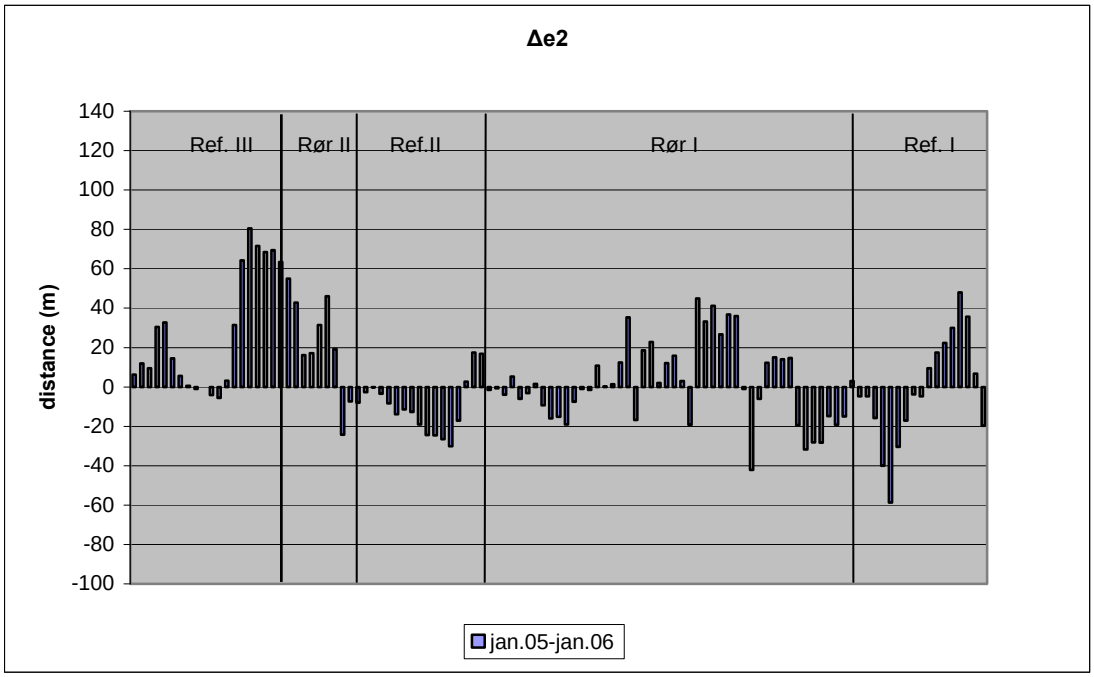

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-okt.05
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
okt.05

Figure 8.7C.


Δe2
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
distance (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-jan.06

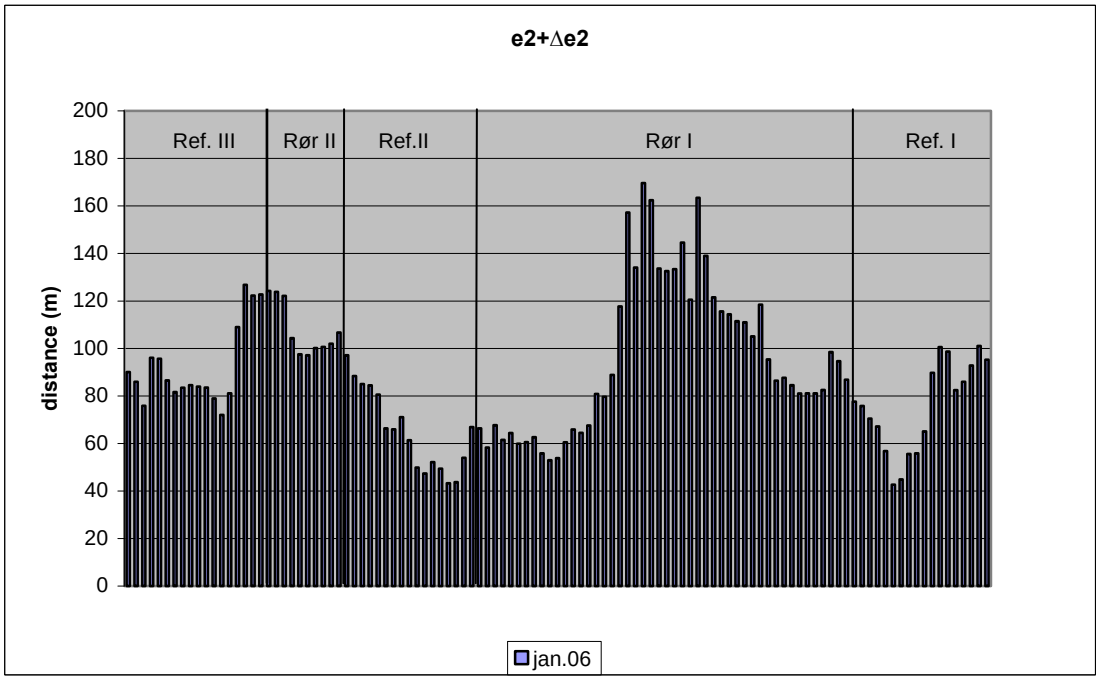

e2+Δe2
200
180
160
140
120
100
80
60
40
20
0
distance (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.06

Figure 8.7D.

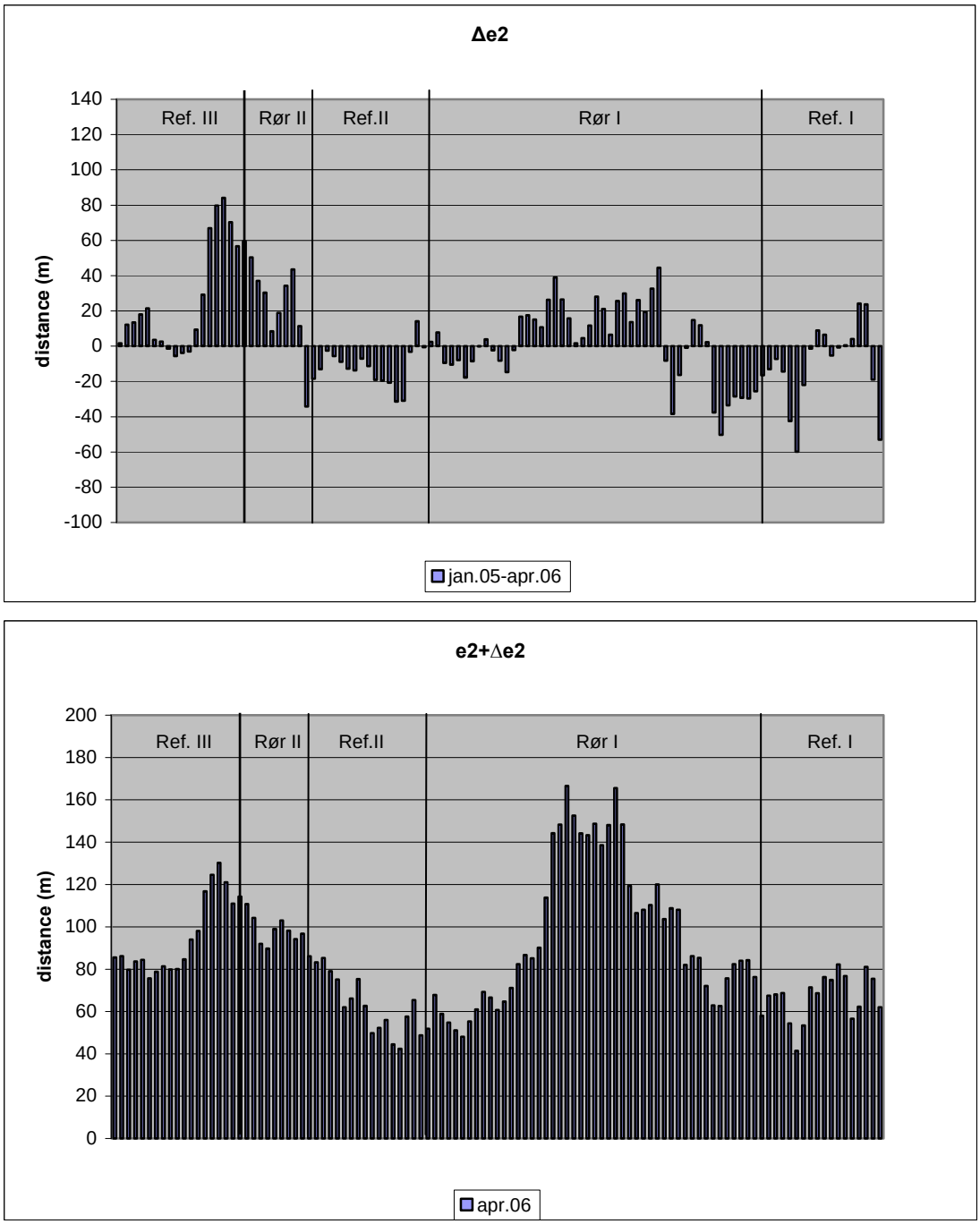
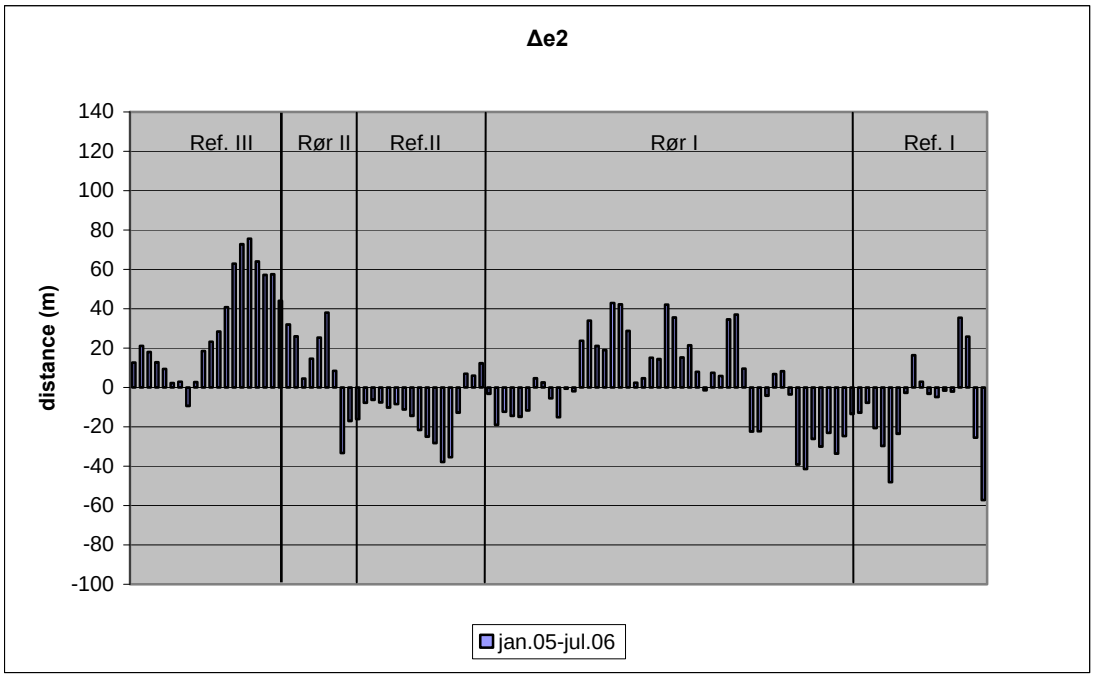

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-apr.06
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
apr.06

Figure 8.7E.


Δe2
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
distance (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jan.05-jul.06

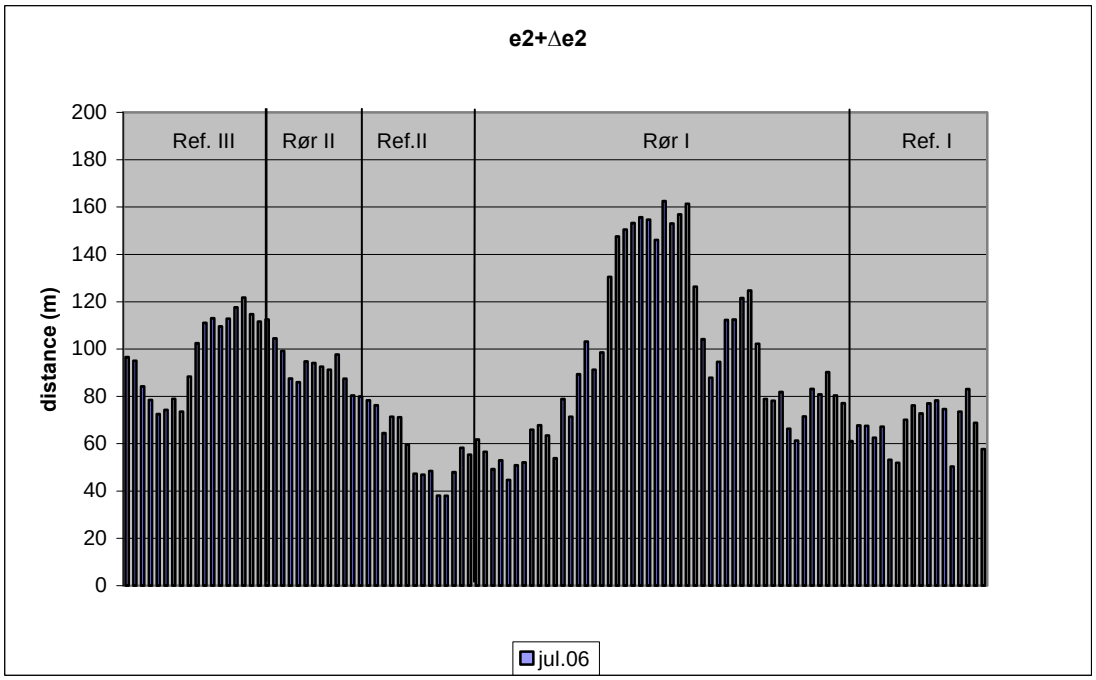

e2+Δe2
200
180
160
140
120
100
80
60
40
20
0
distance (m)
Ref. III
Rør II
Ref.II
Rør I
Ref. I
jul.06

Figure 8.7F.

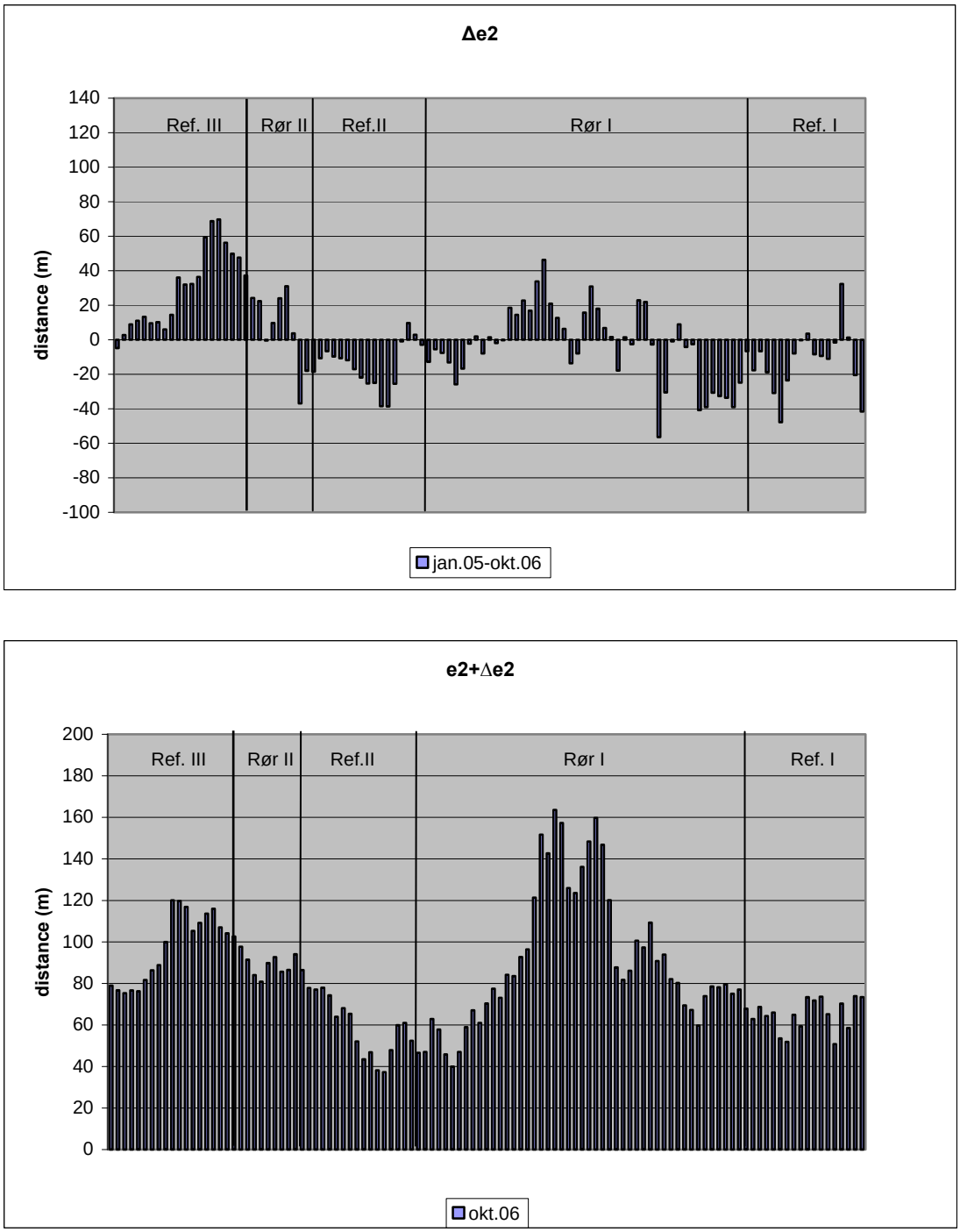

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-okt.06
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
okt.06

Figure 8.7G.

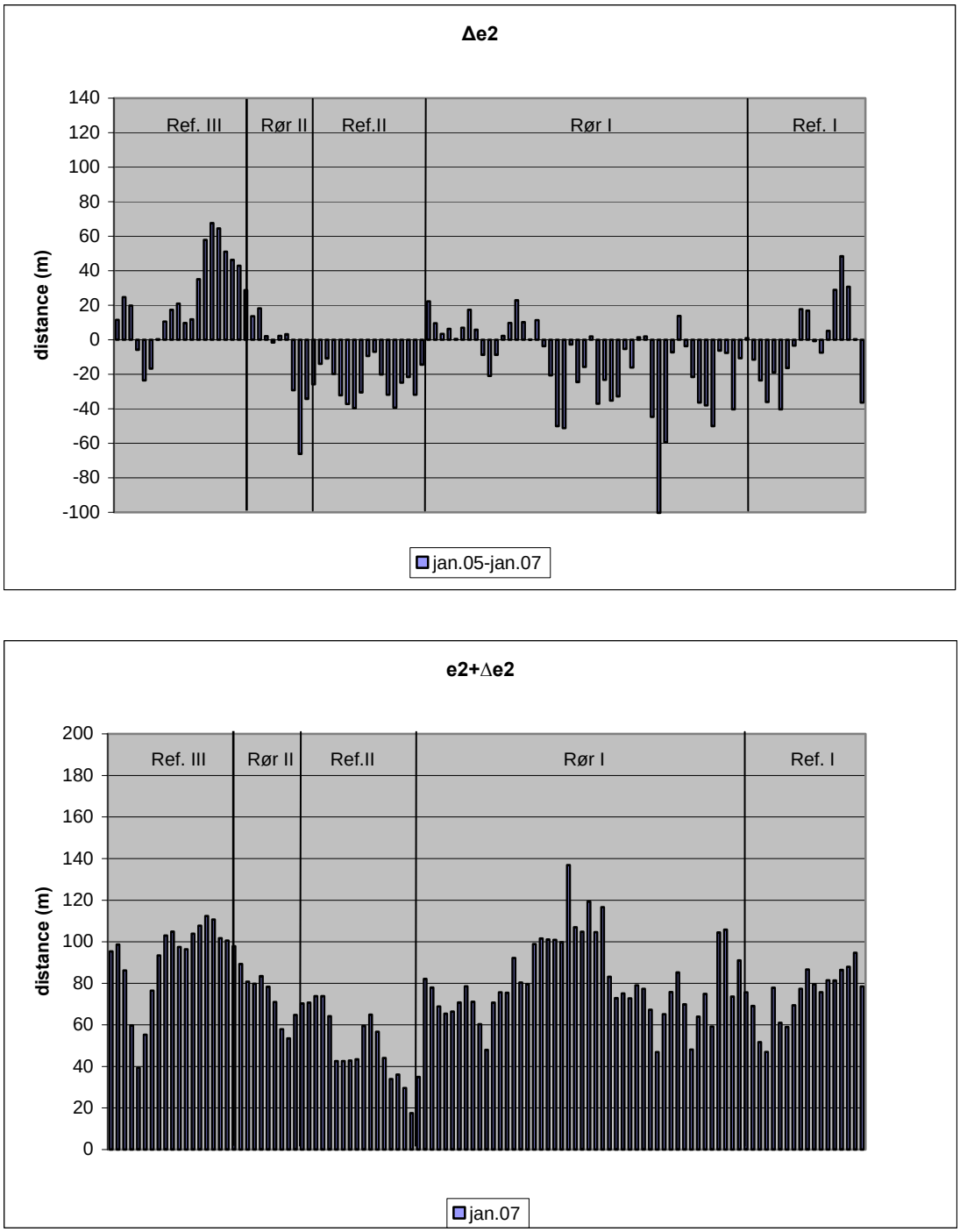

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-jan.07
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
jan.07

Figure 8.7H.

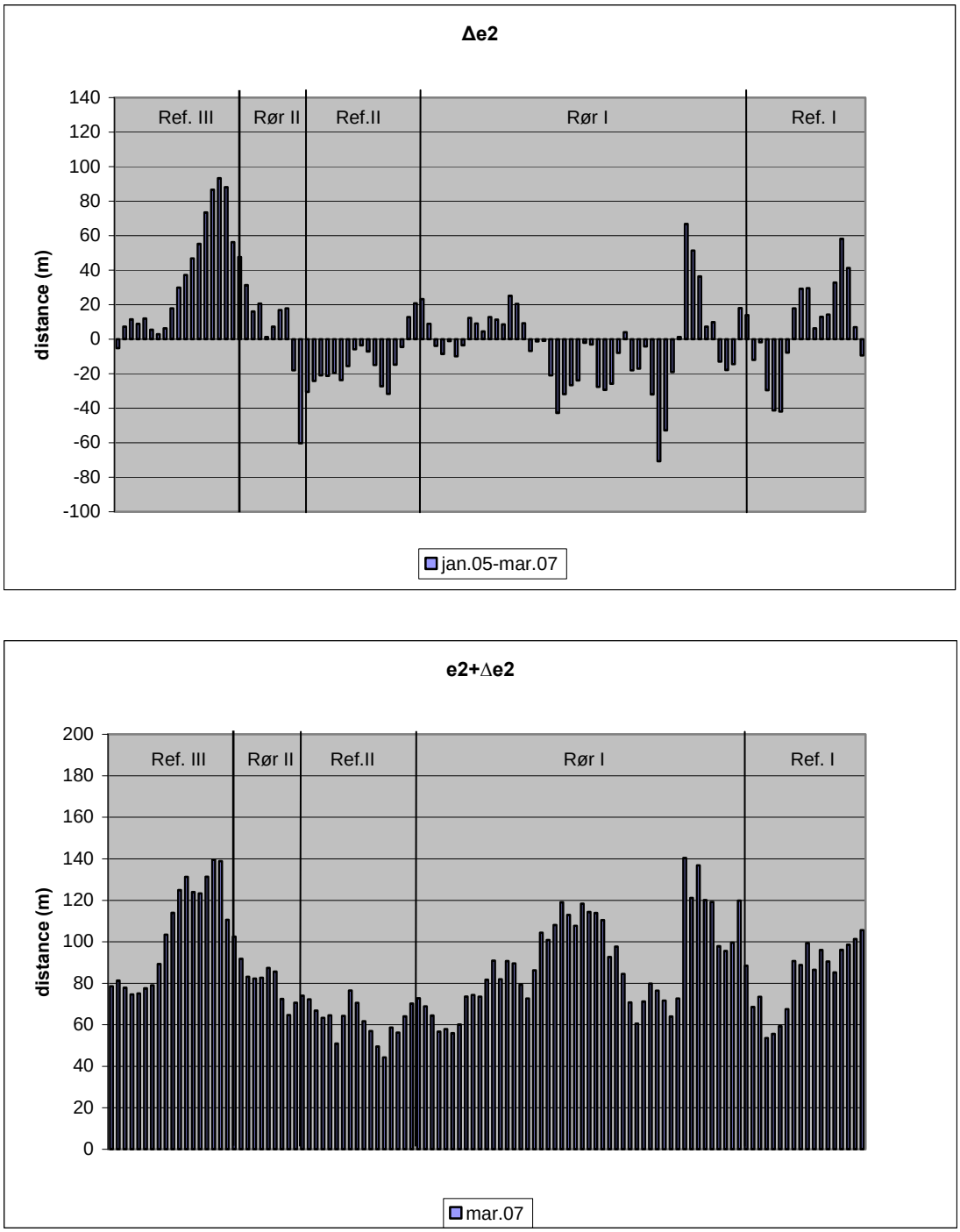

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-mar.07
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
mar.07

Figure 8.7I.

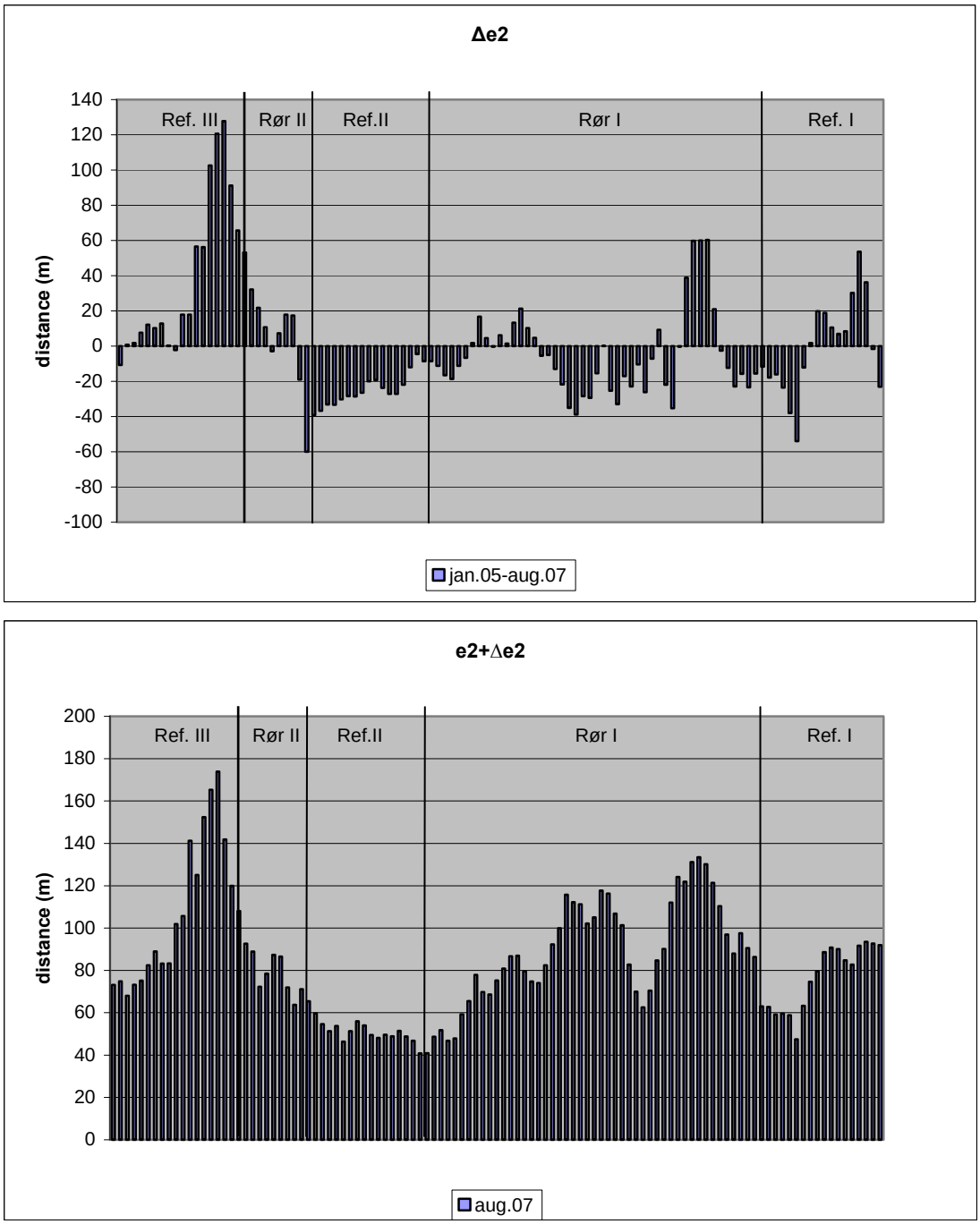

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-aug.07
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
aug.07

Figure 8.7J.

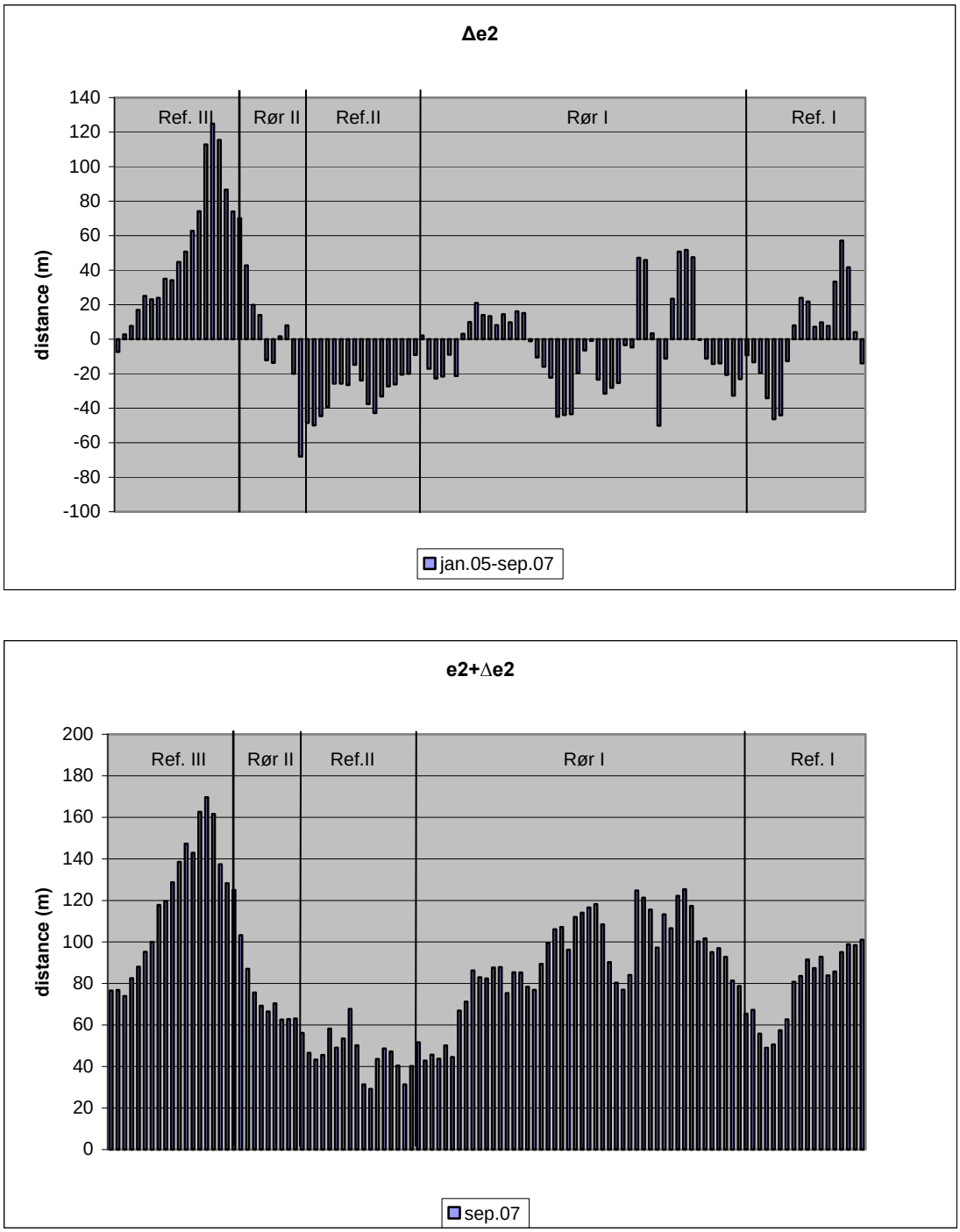
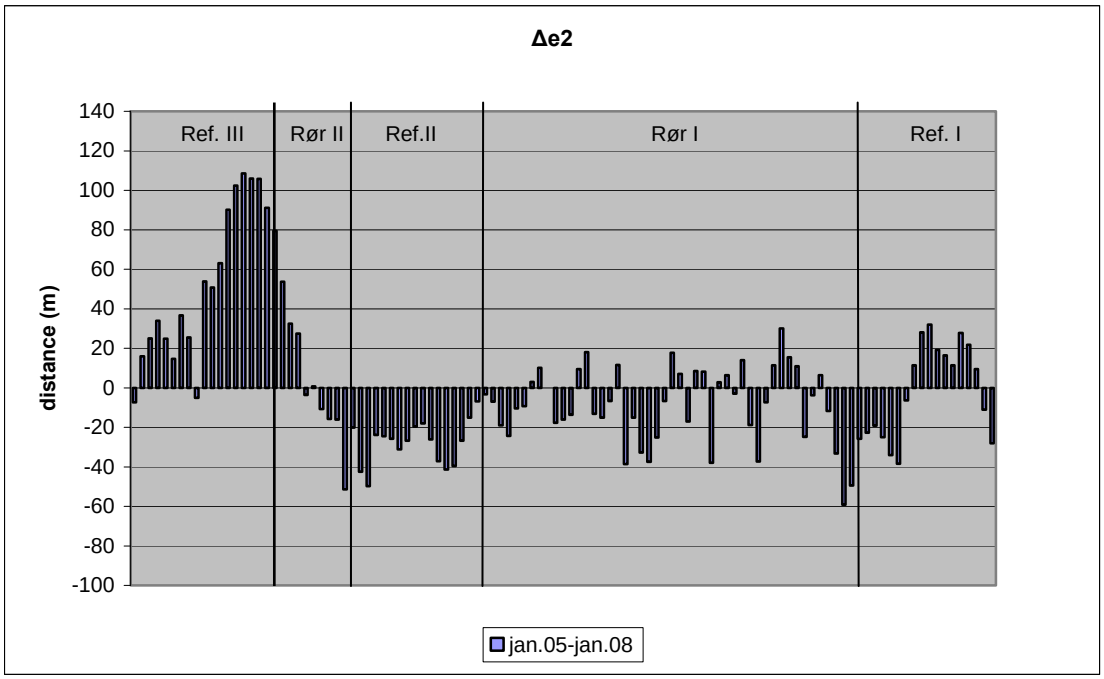

Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
jan.05-sep.07
e2+Δe2
Ref. III
Rør II
Ref.II
Rør I
Ref. I
distance (m)
200
180
160
140
120
100
80
60
40
20
0
sep.07

Figure 8.7K.



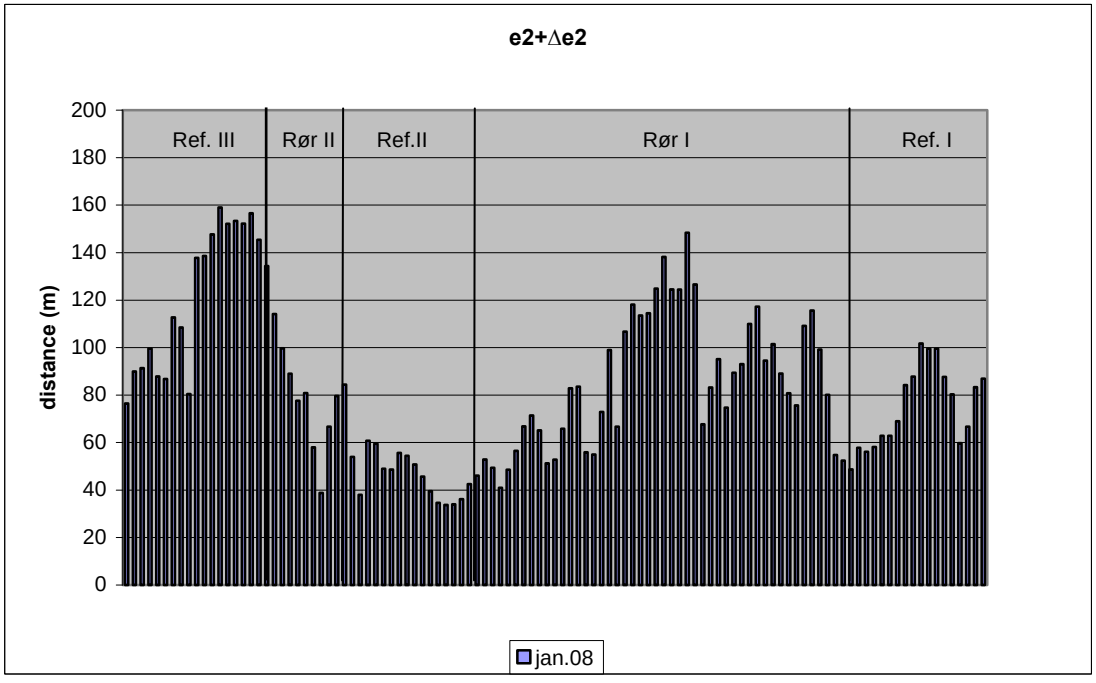
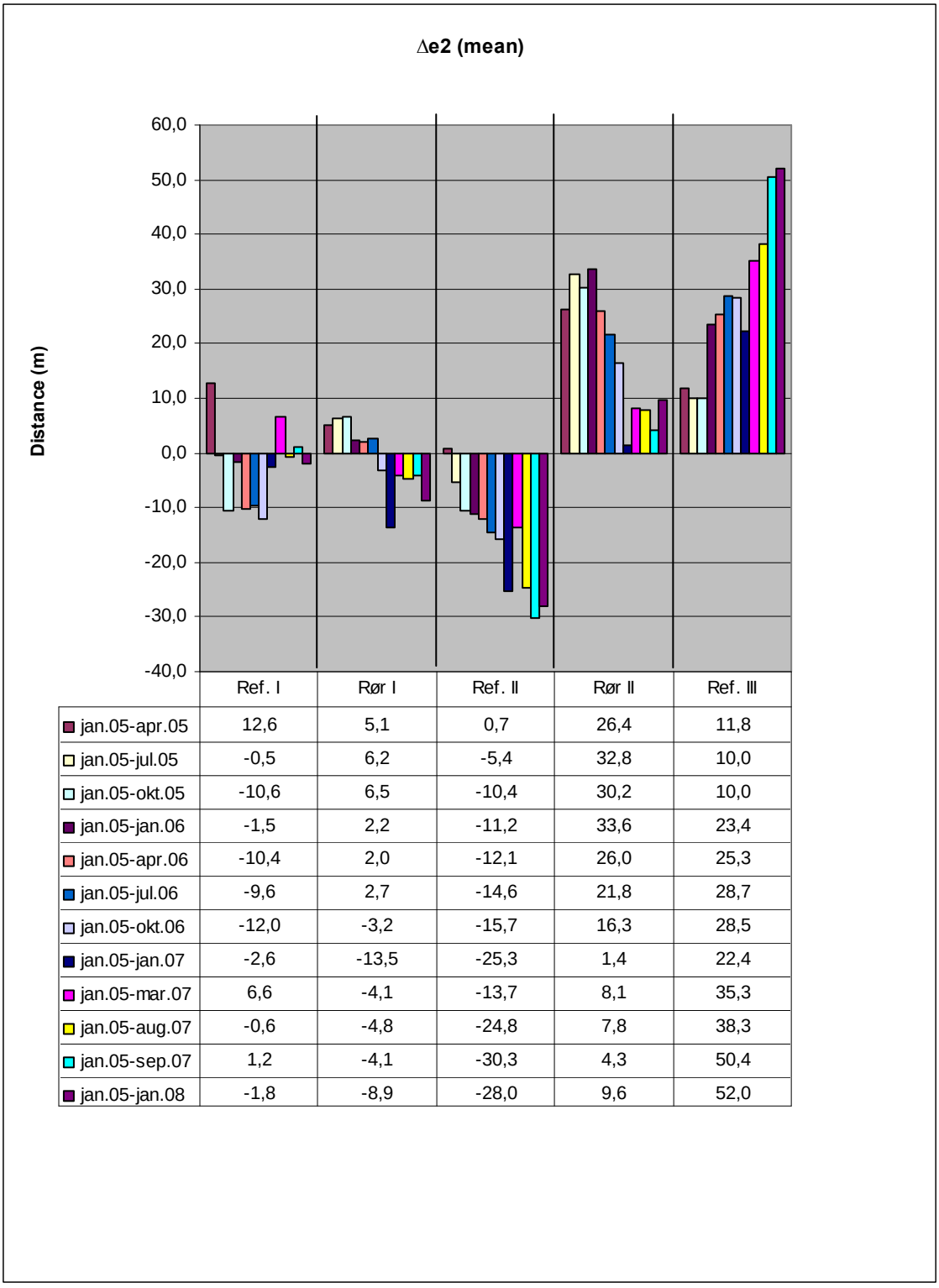
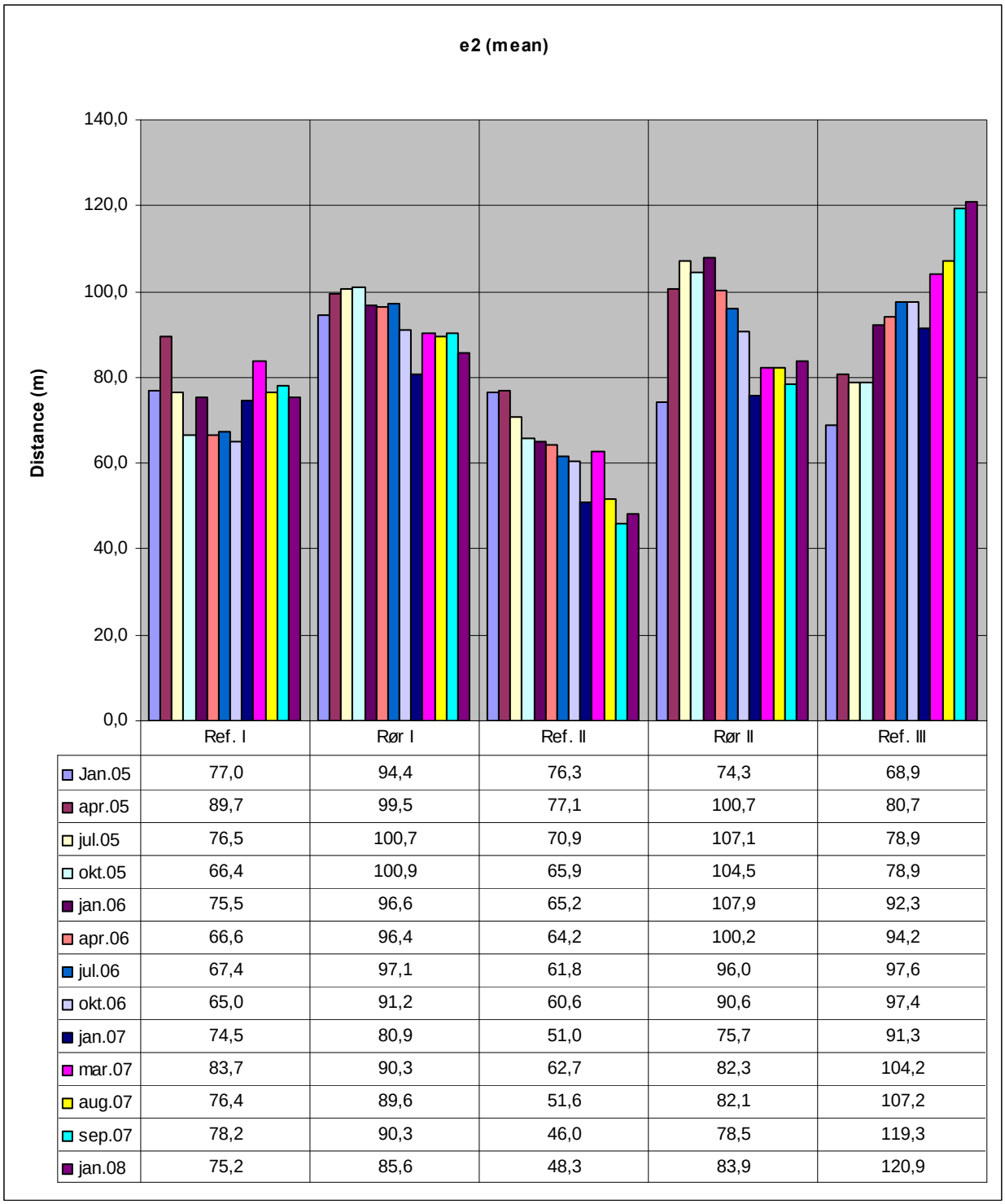


Figure 8.7L. Changes in beach width during the test.

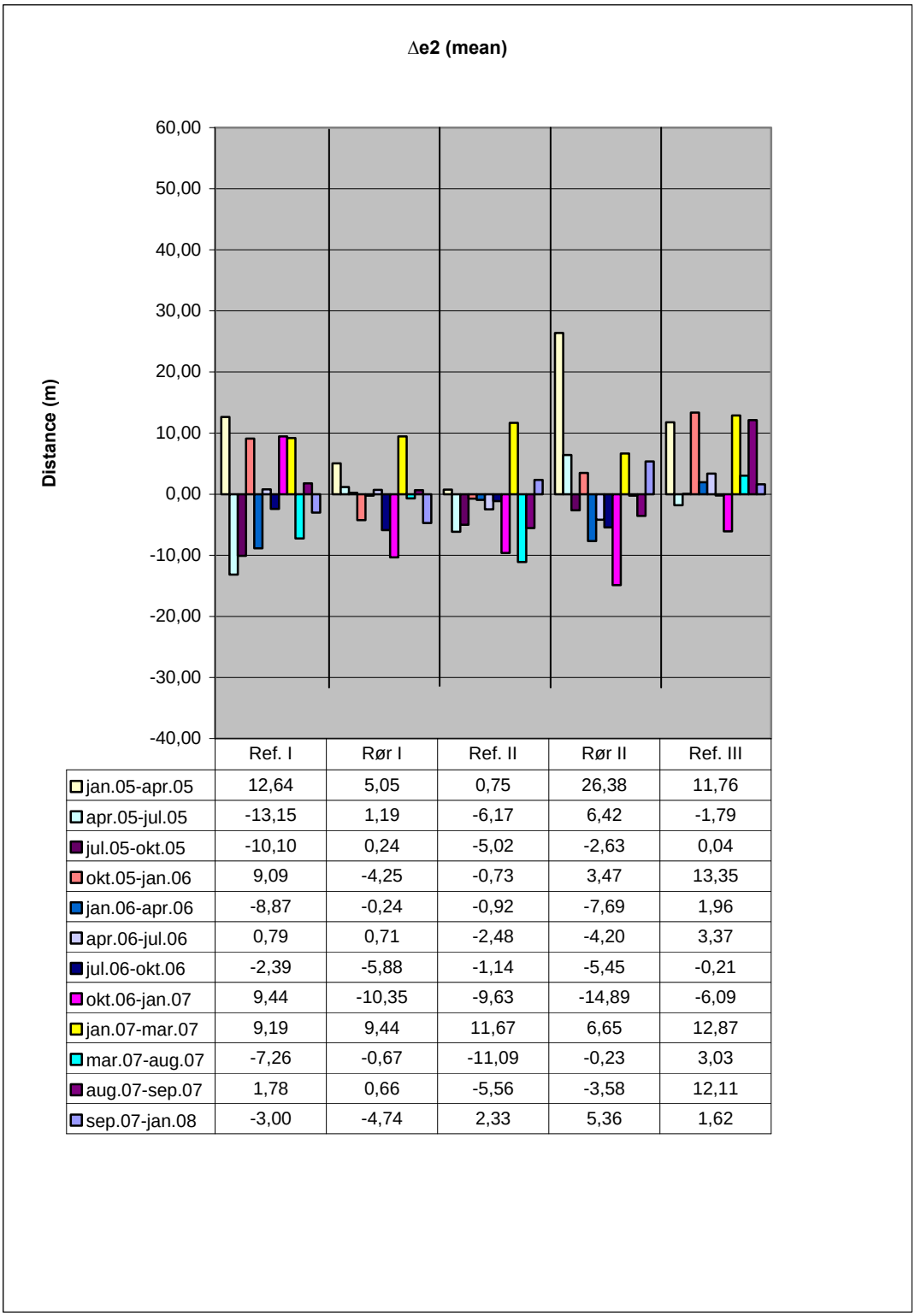


	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	12,6	5,1	0,7	26,4	11,8
jan.05-jul.05	-0,5	6,2	-5,4	32,8	10,0
jan.05-okt.05	-10,6	6,5	-10,4	30,2	10,0
jan.05-jan.06	-1,5	2,2	-11,2	33,6	23,4
jan.05-apr.06	-10,4	2,0	-12,1	26,0	25,3
jan.05-jul.06	-9,6	2,7	-14,6	21,8	28,7
jan.05-okt.06	-12,0	-3,2	-15,7	16,3	28,5
jan.05-jan.07	-2,6	-13,5	-25,3	1,4	22,4
jan.05-mar.07	6,6	-4,1	-13,7	8,1	35,3
jan.05-aug.07	-0,6	-4,8	-24,8	7,8	38,3
jan.05-sep.07	1,2	-4,1	-30,3	4,3	50,4
jan.05-jan.08	-1,8	-8,9	-28,0	9,6	52,0

Table 8.1: Average changes in dune foot position from January 2005 along each individual stretch. Below: Table 8.2: total average beach width.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
Jan.05	77,0	94,4	76,3	74,3	68,9
apr.05	89,7	99,5	77,1	100,7	80,7
jul.05	76,5	100,7	70,9	107,1	78,9
okt.05	66,4	100,9	65,9	104,5	78,9
jan.06	75,5	96,6	65,2	107,9	92,3
apr.06	66,6	96,4	64,2	100,2	94,2
jul.06	67,4	97,1	61,8	96,0	97,6
okt.06	65,0	91,2	60,6	90,6	97,4
jan.07	74,5	80,9	51,0	75,7	91,3
mar.07	83,7	90,3	62,7	82,3	104,2
aug.07	76,4	89,6	51,6	82,1	107,2
sep.07	78,2	90,3	46,0	78,5	119,3
jan.08	75,2	85,6	48,3	83,9	120,9



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	12,64	5,05	0,75	26,38	11,76
apr.05-jul.05	-13,15	1,19	-6,17	6,42	-1,79
jul.05-okt.05	-10,10	0,24	-5,02	-2,63	0,04
okt.05-jan.06	9,09	-4,25	-0,73	3,47	13,35
jan.06-apr.06	-8,87	-0,24	-0,92	-7,69	1,96
apr.06-jul.06	0,79	0,71	-2,48	-4,20	3,37
jul.06-okt.06	-2,39	-5,88	-1,14	-5,45	-0,21
okt.06-jan.07	9,44	-10,35	-9,63	-14,89	-6,09
jan.07-mar.07	9,19	9,44	11,67	6,65	12,87
mar.07-aug.07	-7,26	-0,67	-11,09	-0,23	3,03
aug.07-sep.07	1,78	0,66	-5,56	-3,58	12,11
sep.07-jan.08	-3,00	-4,74	2,33	5,36	1,62

Table 8.3*: Average changes in beach width with time along each stretch.*

Chapter 9 Changes in offshore volume: tables and graphs.

Whether the tubes at all can have an impact seawards of the beach is touched in chapter 10. SIC would like to have these soundings to get a full account of the sand budget. For this expert, the main reason for doing the offshore survey is to get a detailed picture of the bottom bathymetry offshore like migrating bars, rips etc.

9.1 The near shore coastal region D3 (0-300 meters).

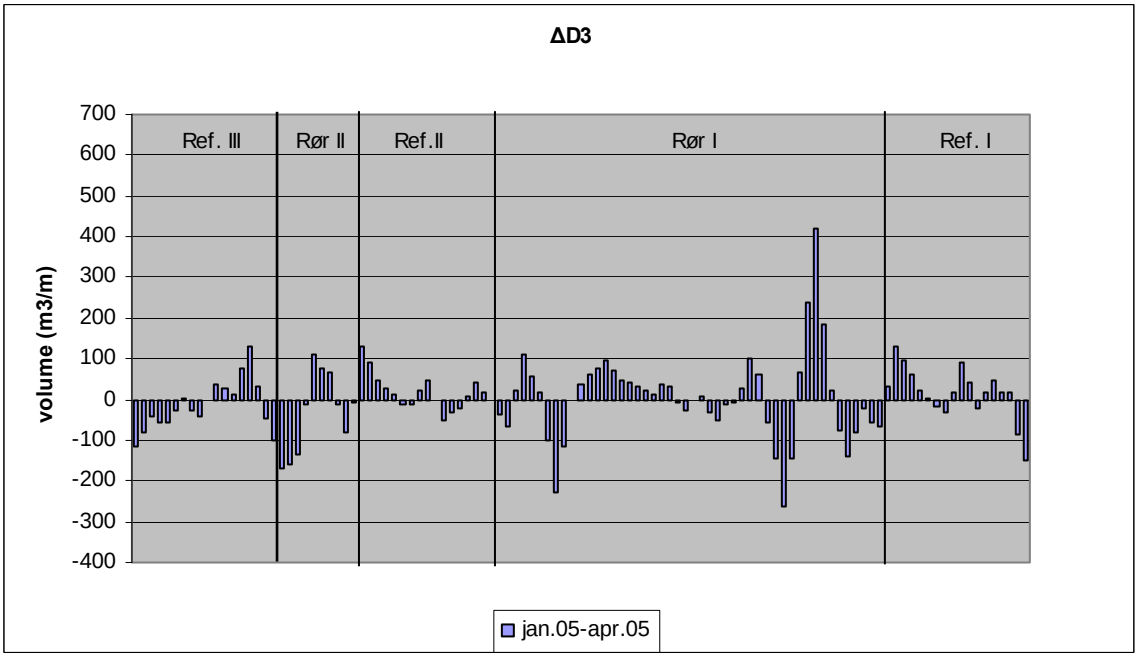


Figure 9.1A.

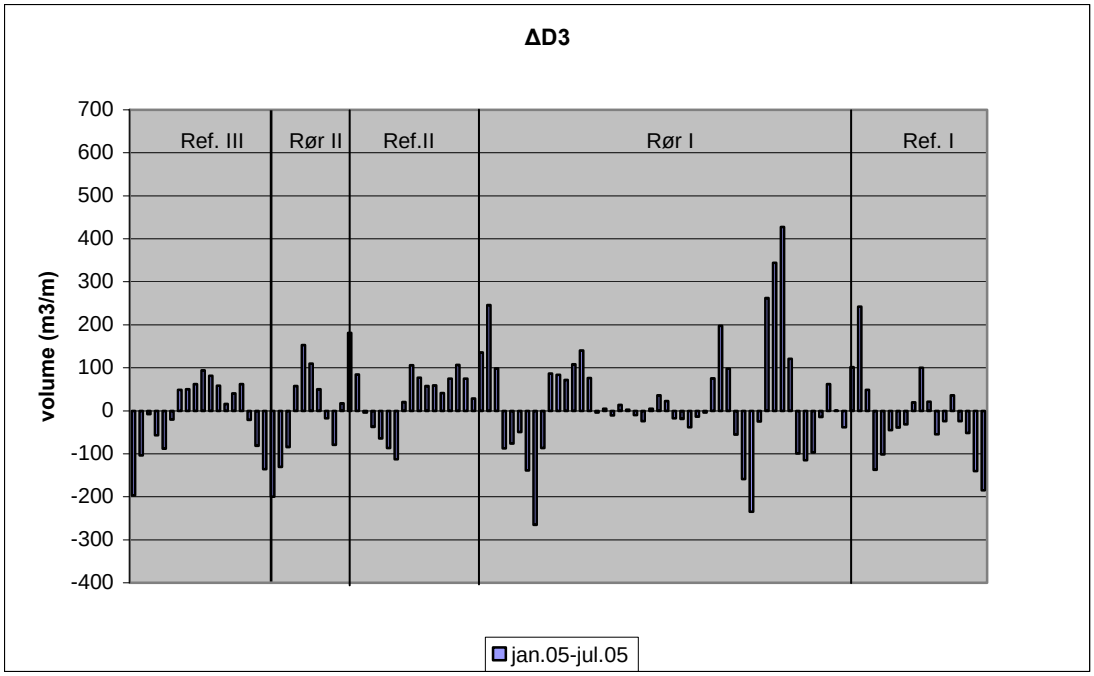


Figure 9.1B.

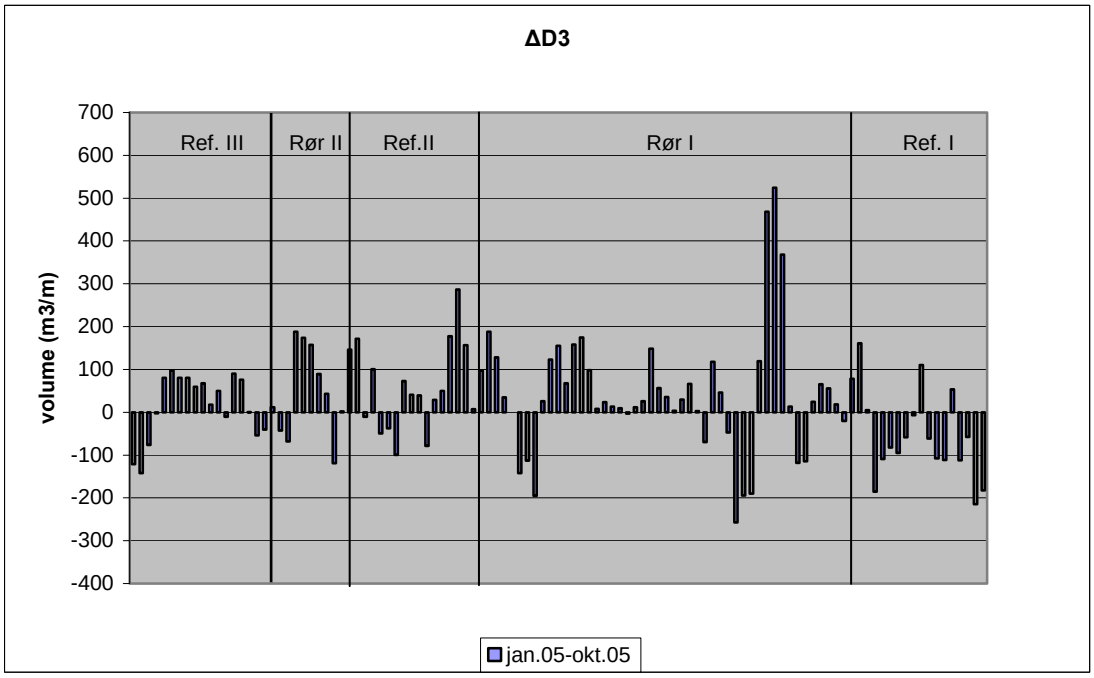


Figure 9.1C.

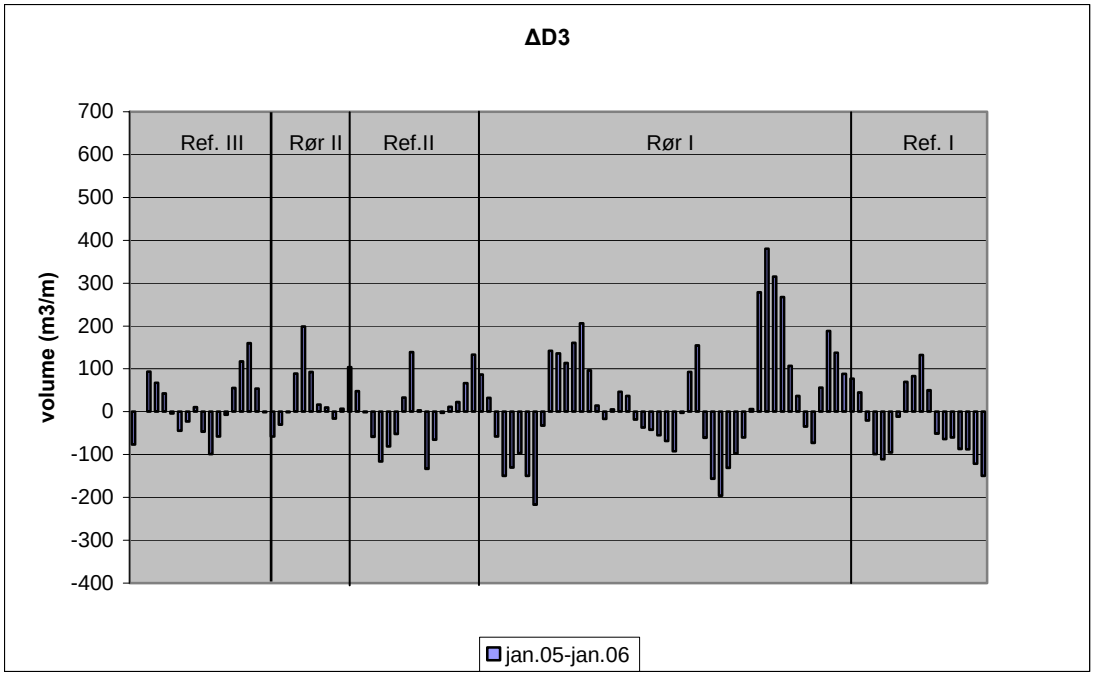


Figure 9.1D.

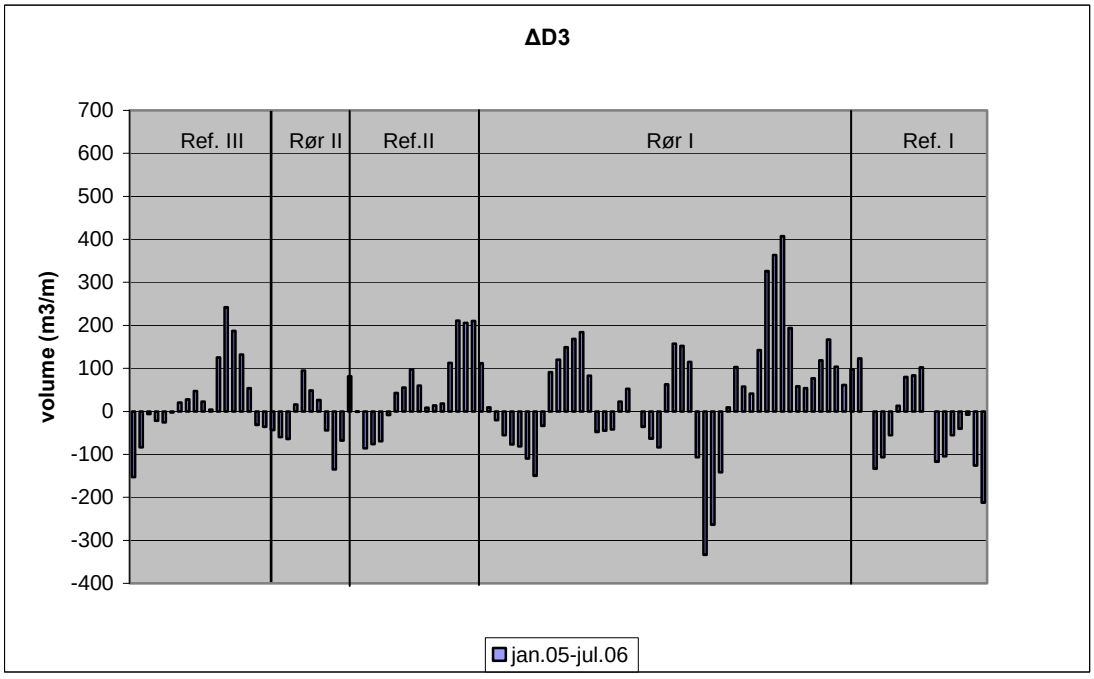


Figure 9.1E.

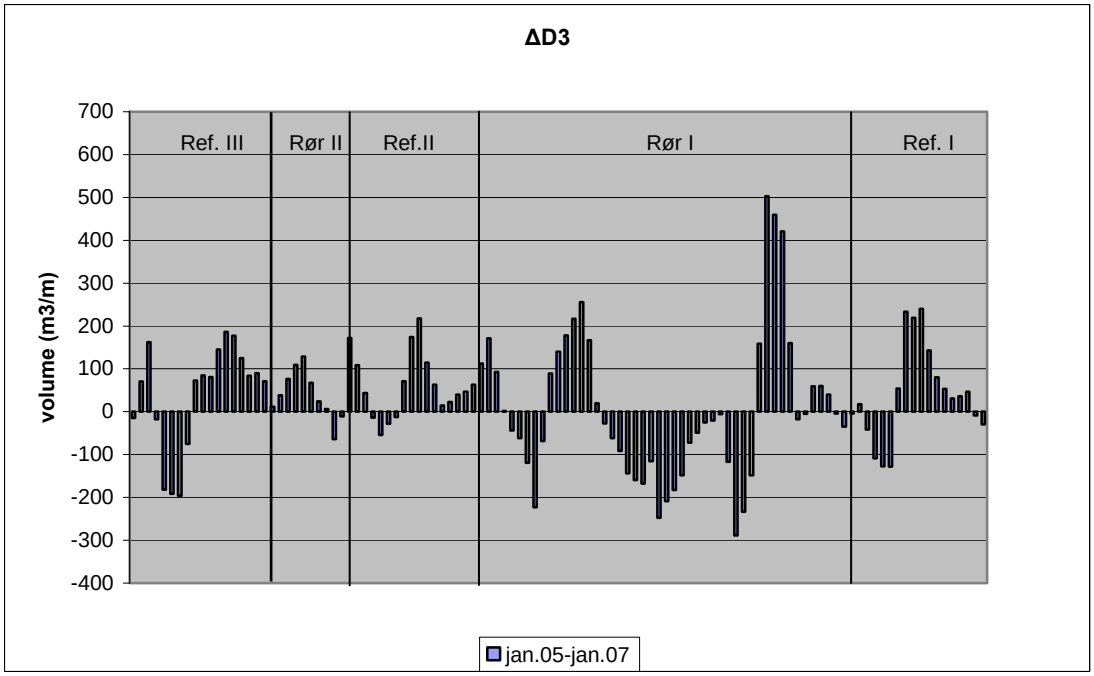


Figure 9.1F.

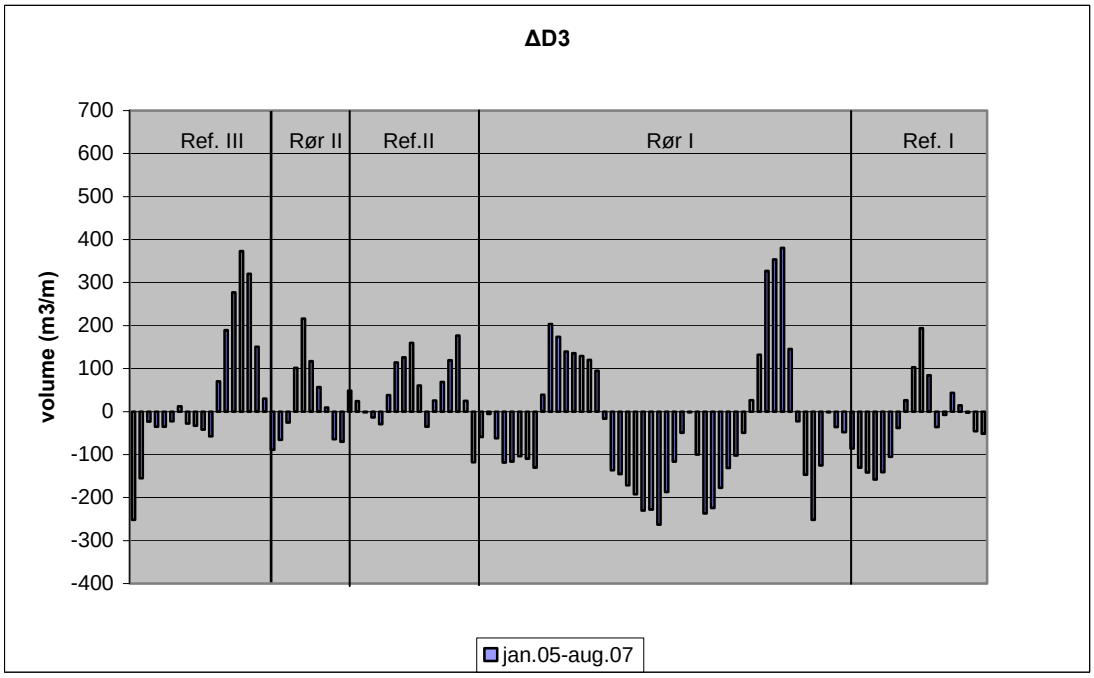


Figure 9.1G.

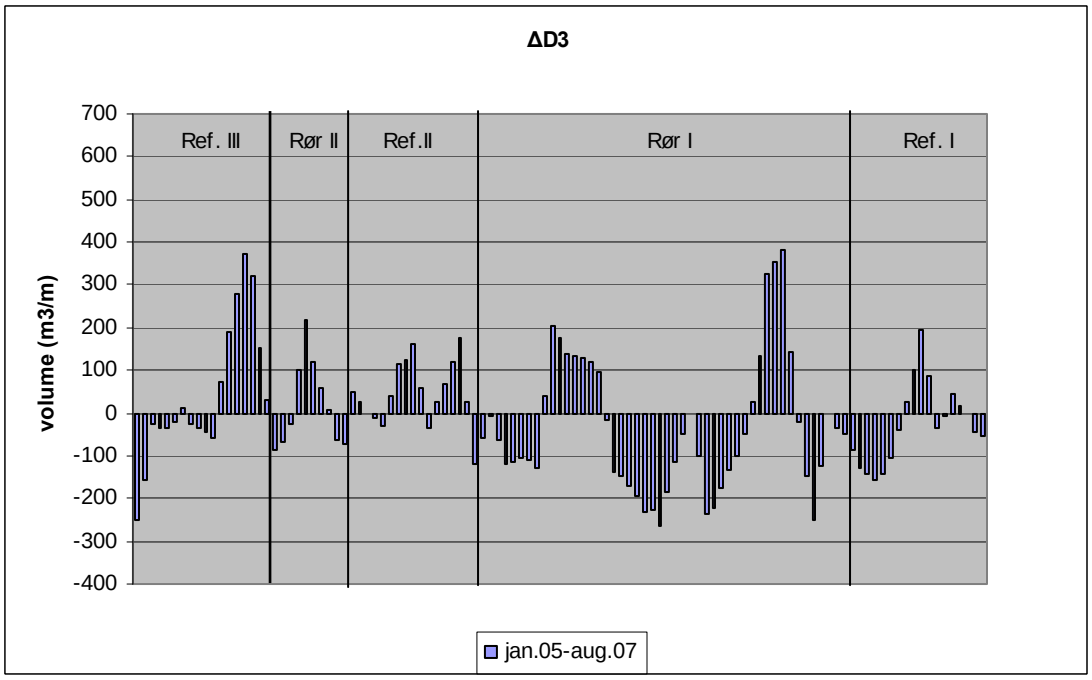


Figure 9.1H.

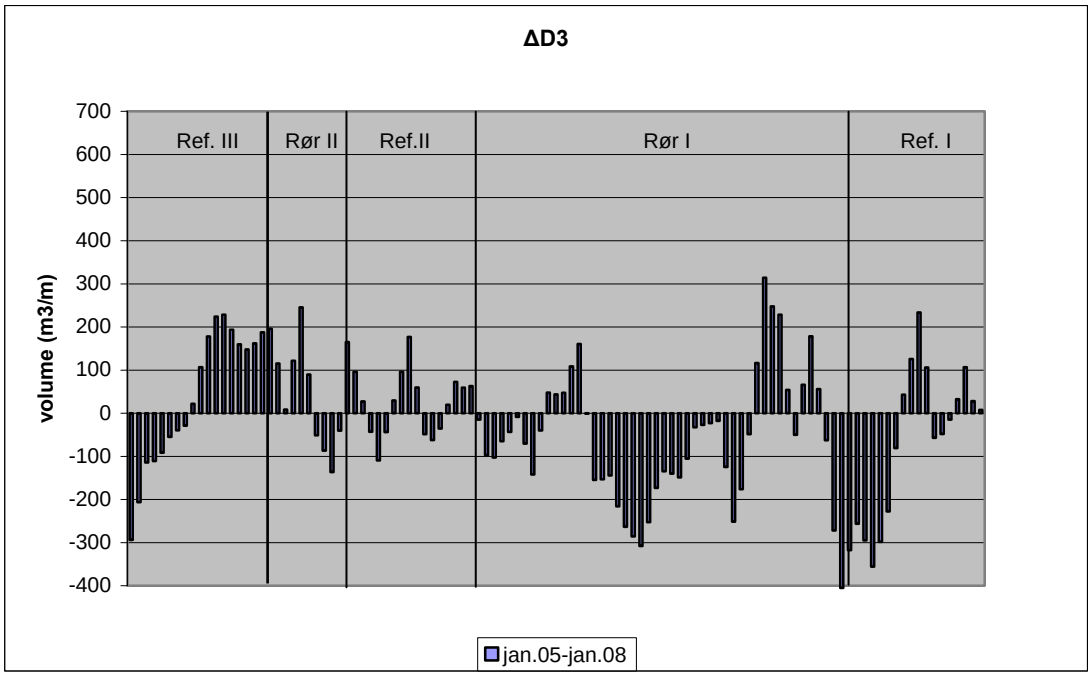
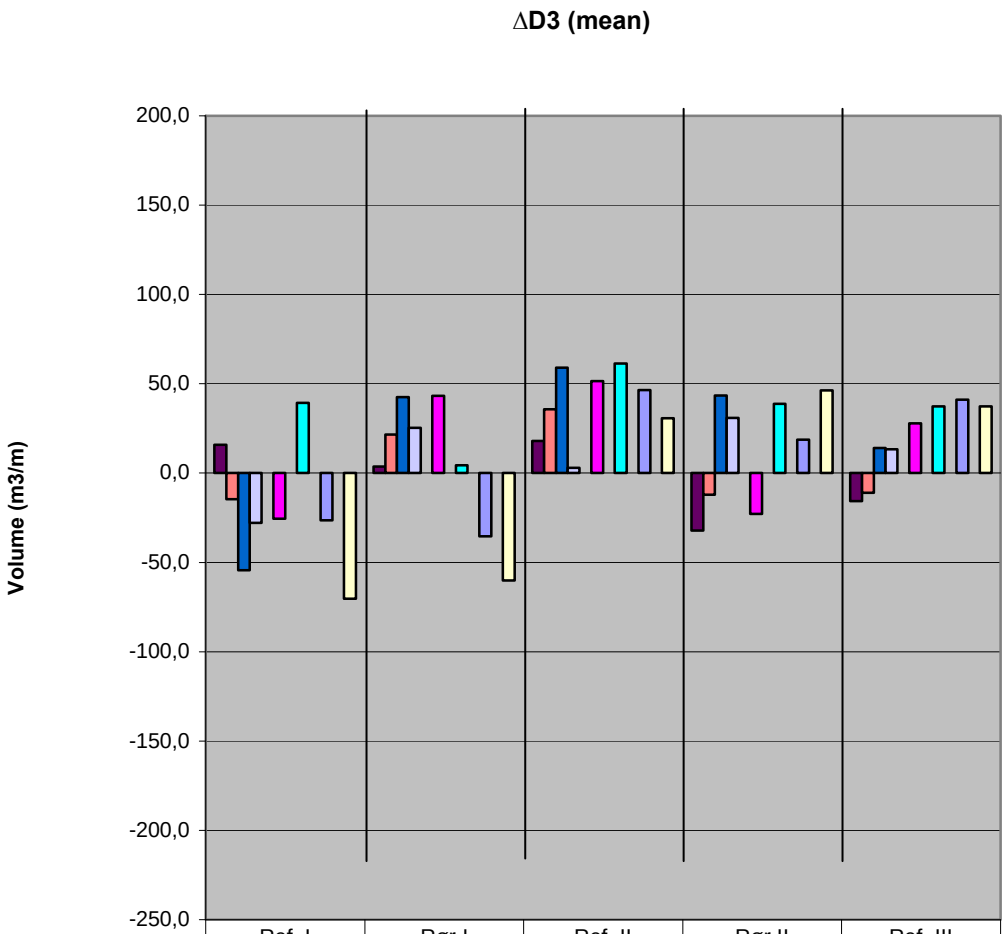


Figure 9.1I.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05-apr.05	15,8	3,6	18,0	-32,1	-15,7
jan.05-jul.05	-14,7	21,6	35,7	-12,2	-10,9
jan.05-okt.05	-54,3	42,6	58,9	43,5	14,1
jan.05-jan.06	-27,9	25,3	2,9	30,9	13,4
jan.05-apr.06	0,0	0,0	0,0	0,0	0,0
jan.05-jul.06	-25,6	43,2	51,5	-22,9	27,9
jan.05-okt.06	0,0	0,0	0,0	0,0	0,0
jan.05-jan.07	39,3	4,4	61,3	38,7	37,4
jan.05-mar.07	0,0	0,0	0,0	0,0	0,0
jan.05-aug.07	-26,5	-35,3	46,5	18,7	41,1
jan.05-sep.07	0,0	0,0	0,0	0,0	0,0
jan.05.jan.08	-70,3	-60,1	30,8	46,3	37,4

Figure 9.2.

9.2. The outer coastal profile D4 (300-600 meters)

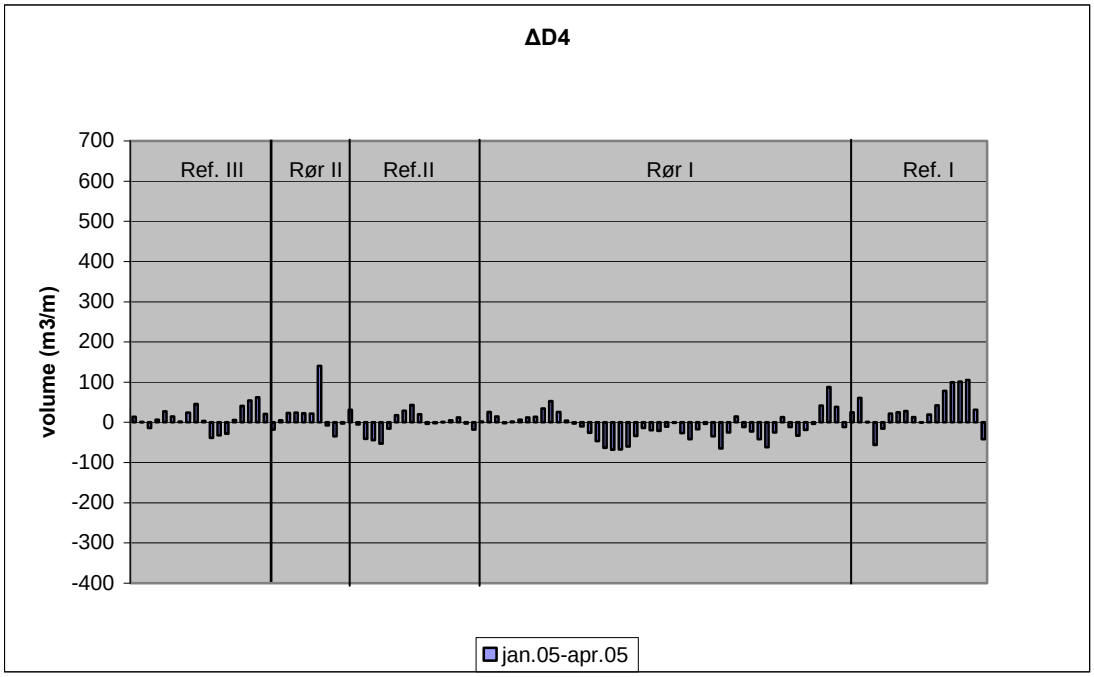


Figure 9.3A.

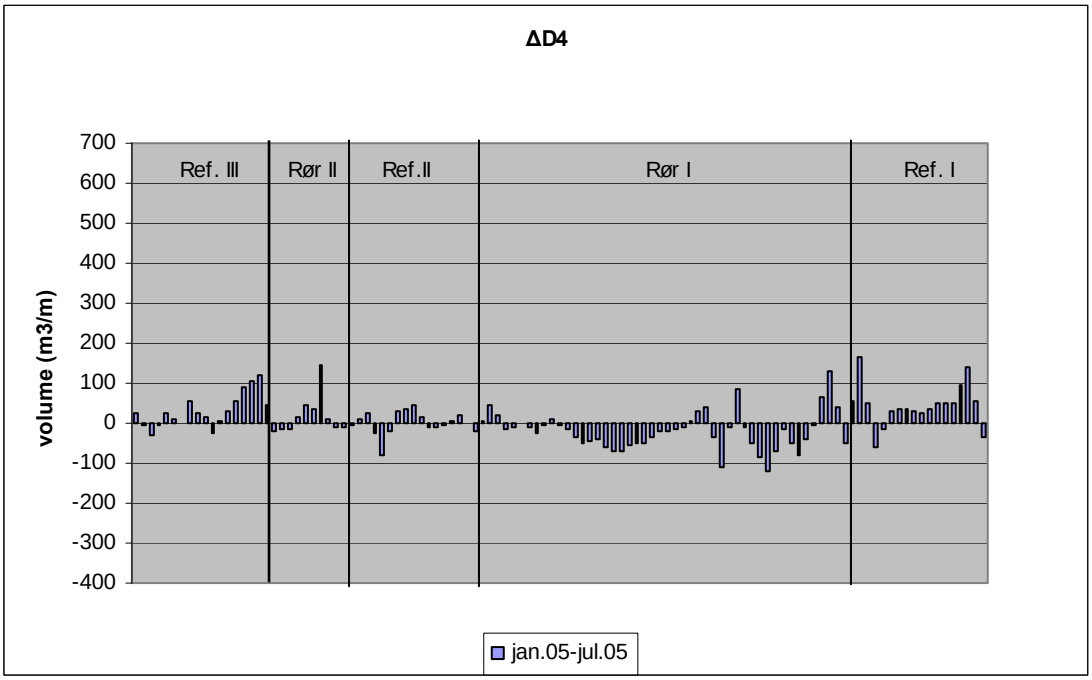


Figure 9.3B.

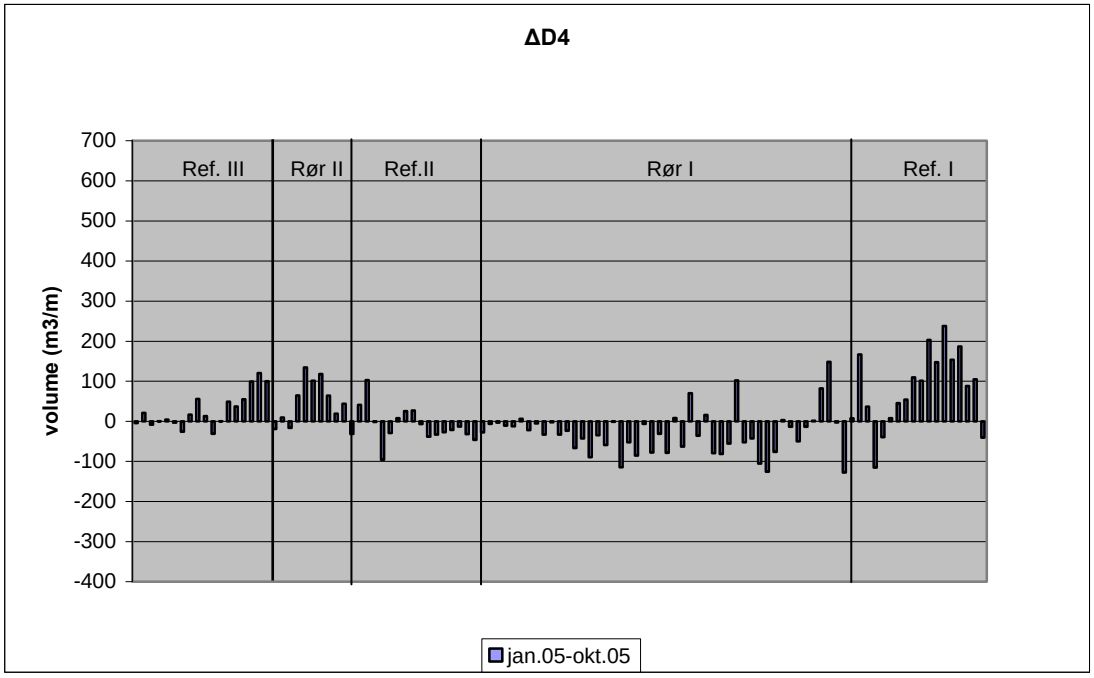


Figure 9.3C.

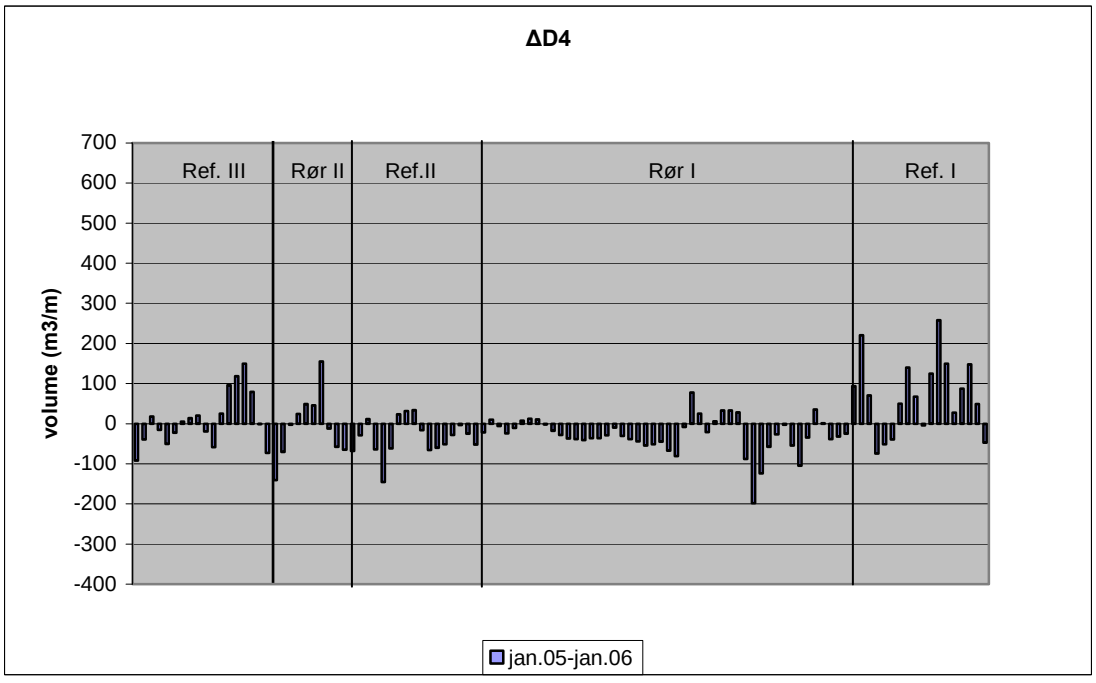


Figure 9.3D.

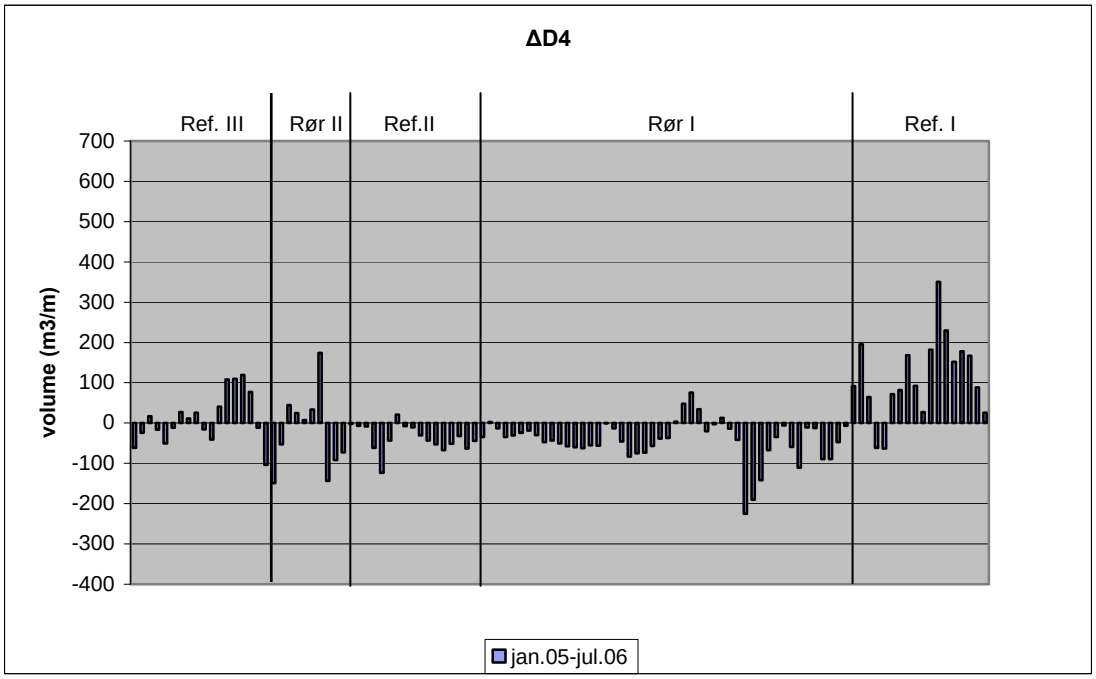


Figure 9.3E.

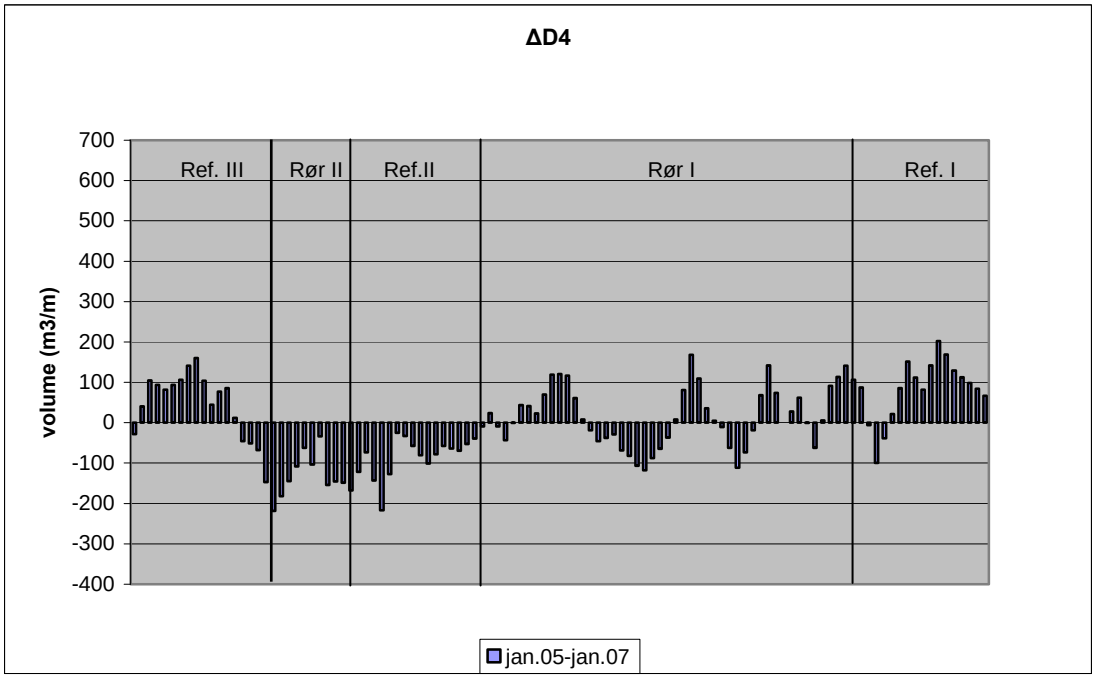


Figure 9.3F.

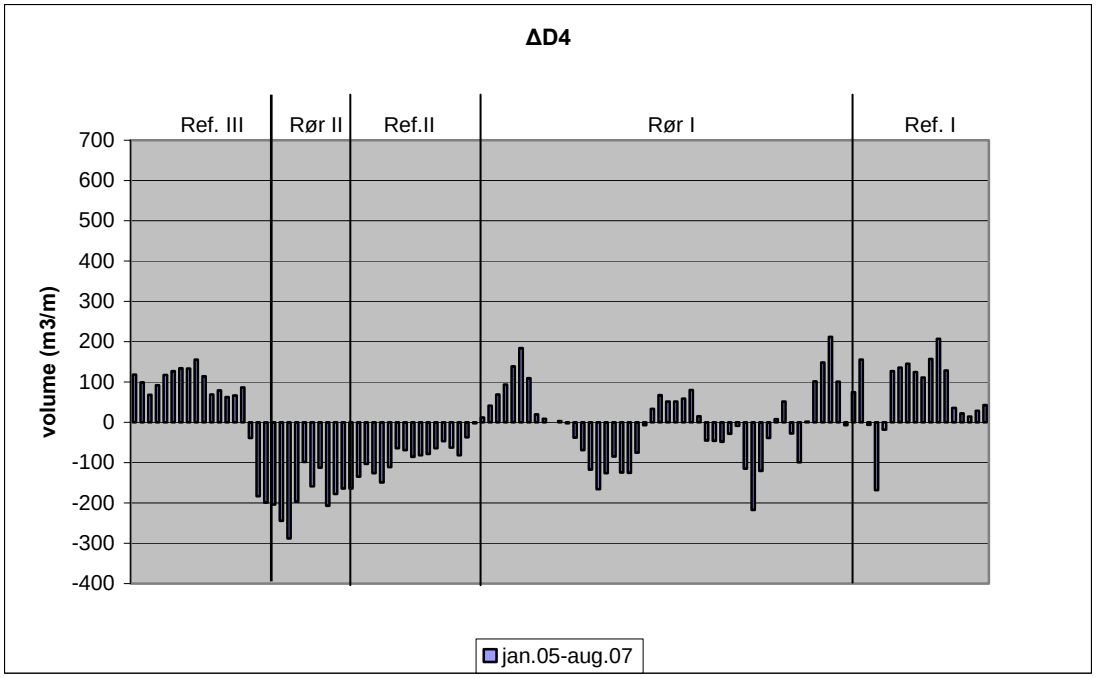


Figure 9.3G.

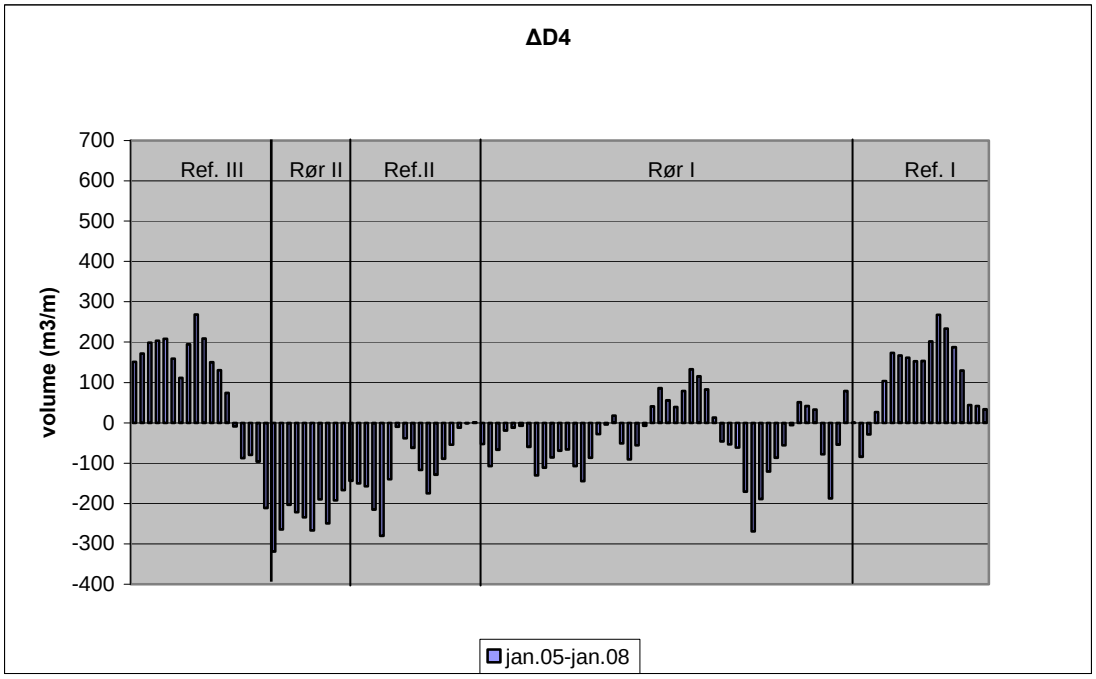
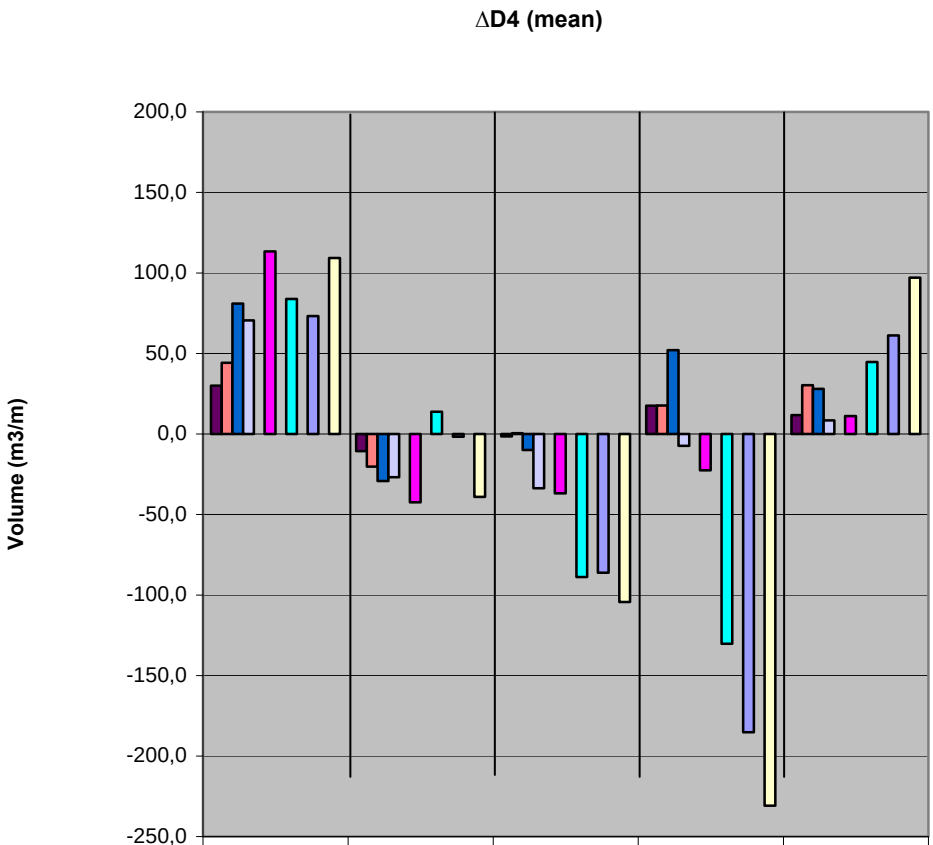


Figure 9.3H.



	Ref. I	Rør I	Ref. II	Rør II	Ref. III
jan.05.apr.05	30,1	-10,6	-1,5	17,5	11,8
jan.05-jul.05	44,3	-20,2	0,5	17,6	30,3
jan.05-okt.05	81,0	-29,1	-9,9	52,1	27,9
jan.05-jan.06	70,6	-26,8	-33,6	-7,4	8,5
jan.05.apr.06	0,0	0,0	0,0	0,0	0,0
jan.05-jul.06	113,4	-42,4	-36,9	-22,6	11,1
jan.05-okt.06	0,0	0,0	0,0	0,0	0,0
jan.05-jan.07	83,8	13,8	-88,8	-130,3	44,7
jan.05-mar.07	0,0	0,0	0,0	0,0	0,0
jan.05-aug.05	73,2	-1,7	-86,1	-185,2	61,2
jan.05-sep.07	0,0	0,0	0,0	0,0	0,0
jan.05-jan.08	109,3	-39,1	-104,4	-230,7	97,1

Figure 9.4.

9.3. The total offshore changes (0-600 meters).

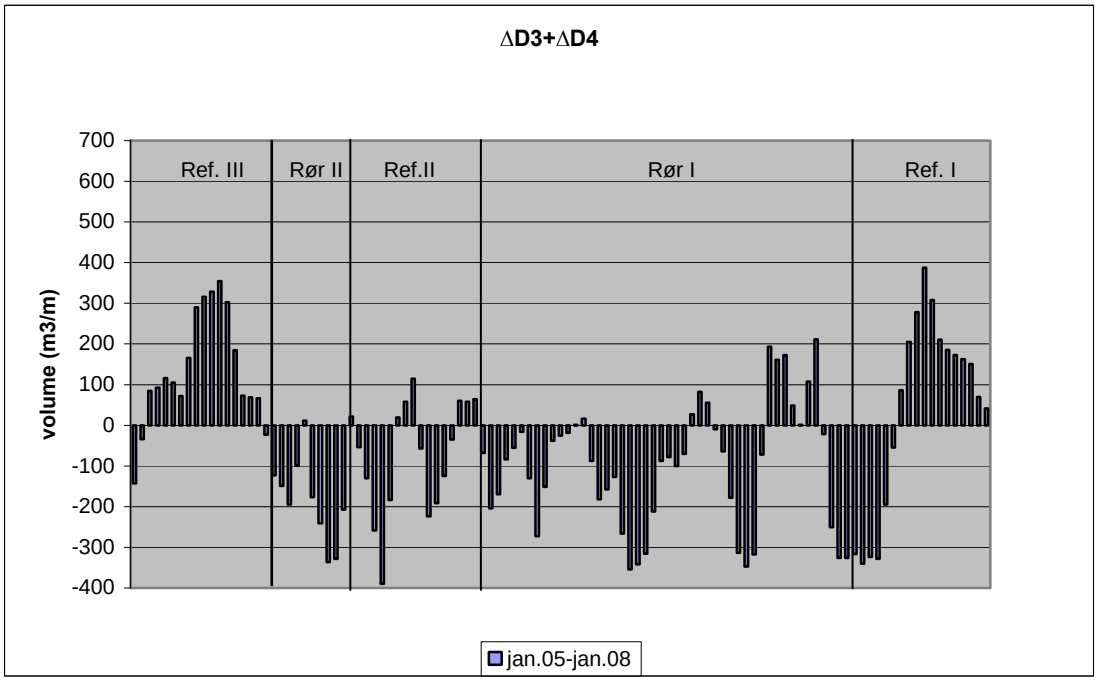


Figure 9.5.

9.4. The offshore Bathymetry.

Figure 9.6 shows the offshore bathymetry based on the soundings performed through the test. These soundings are being used extensively in chapter 11.

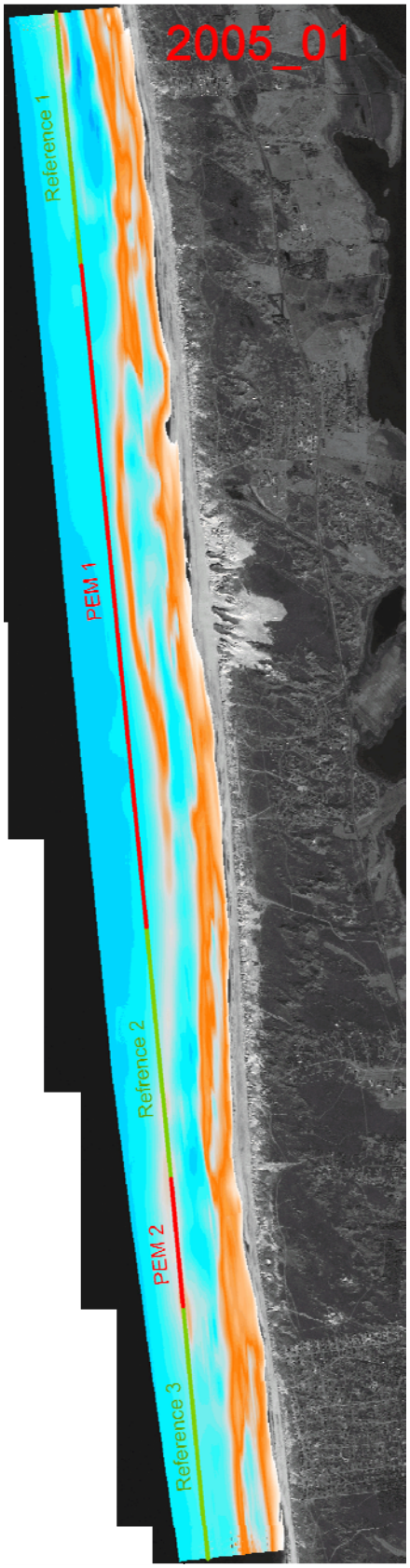


Fig. 9.6A: Jan. 2005

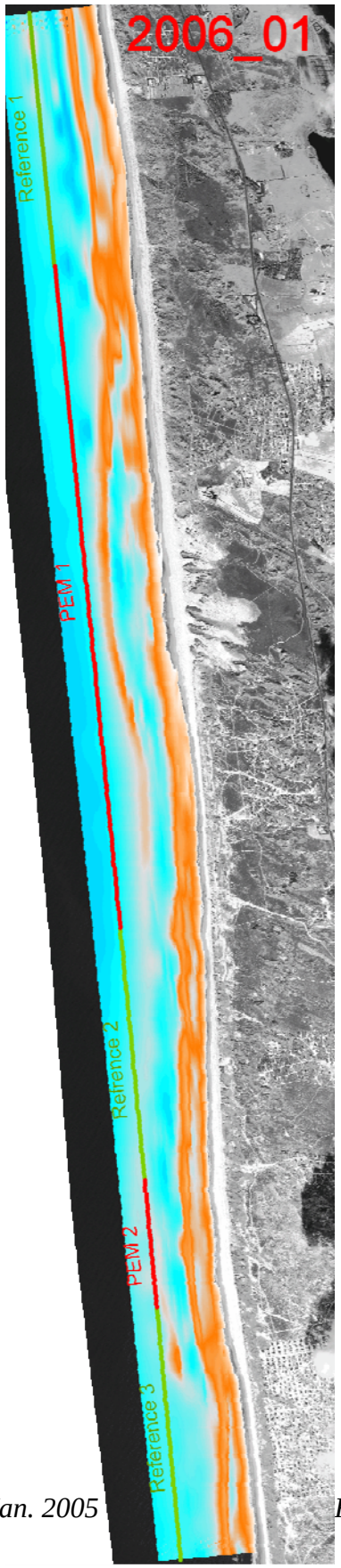


Fig.9.6B: Jan2006.

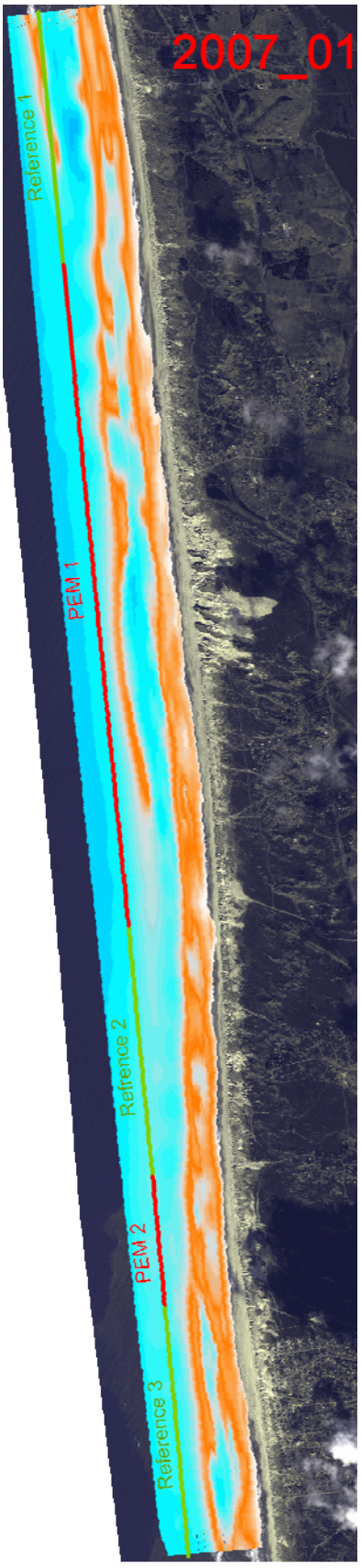


Fig. 9.6C: Jan 2007.

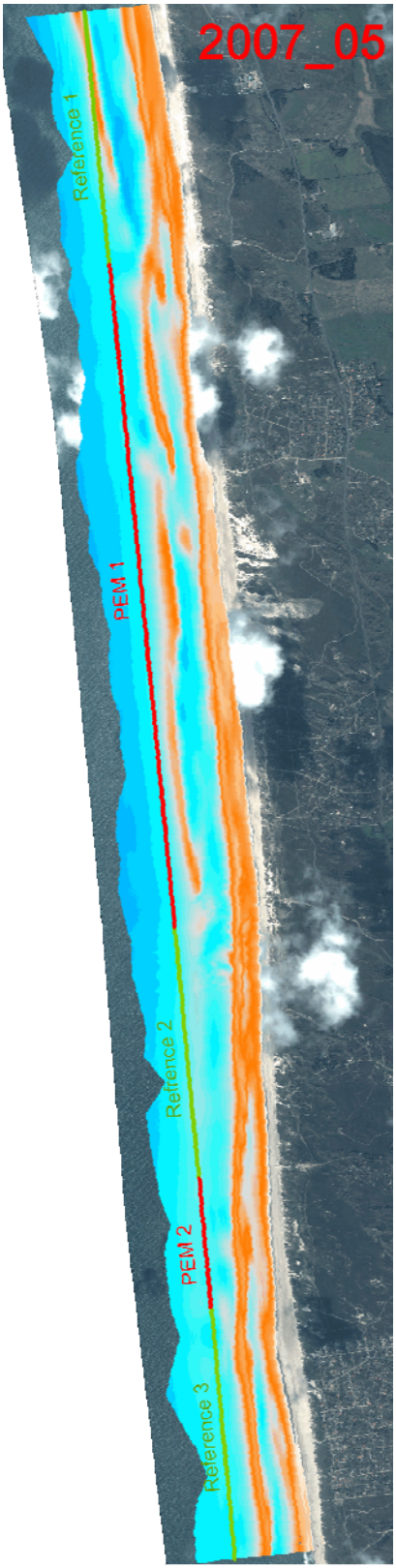
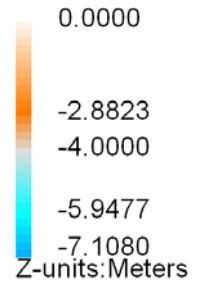


Fig. 9.6D: May 2007



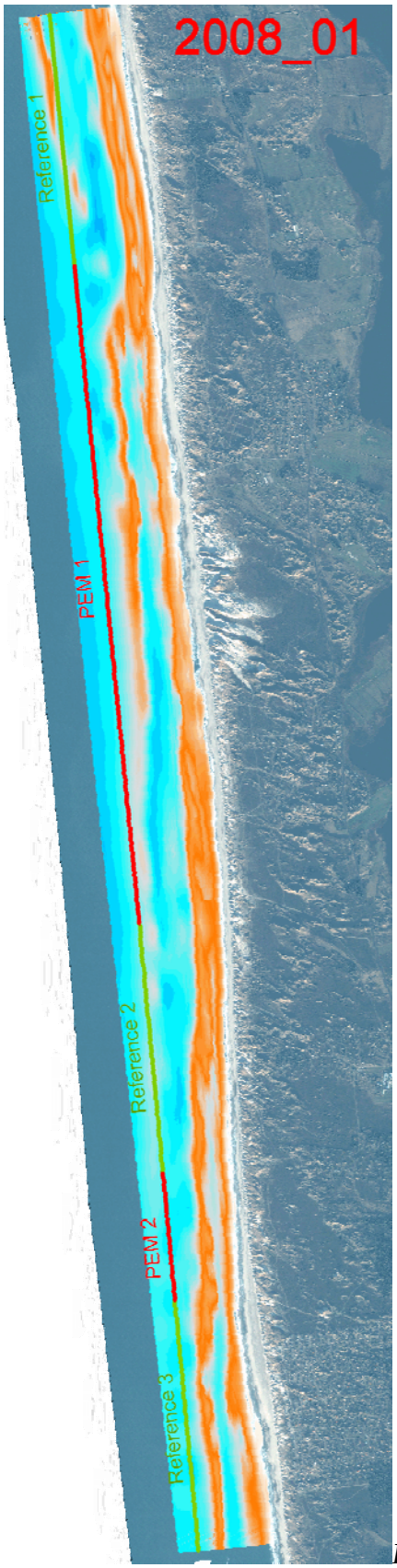


Fig. 9.6E: Jan. 2008.