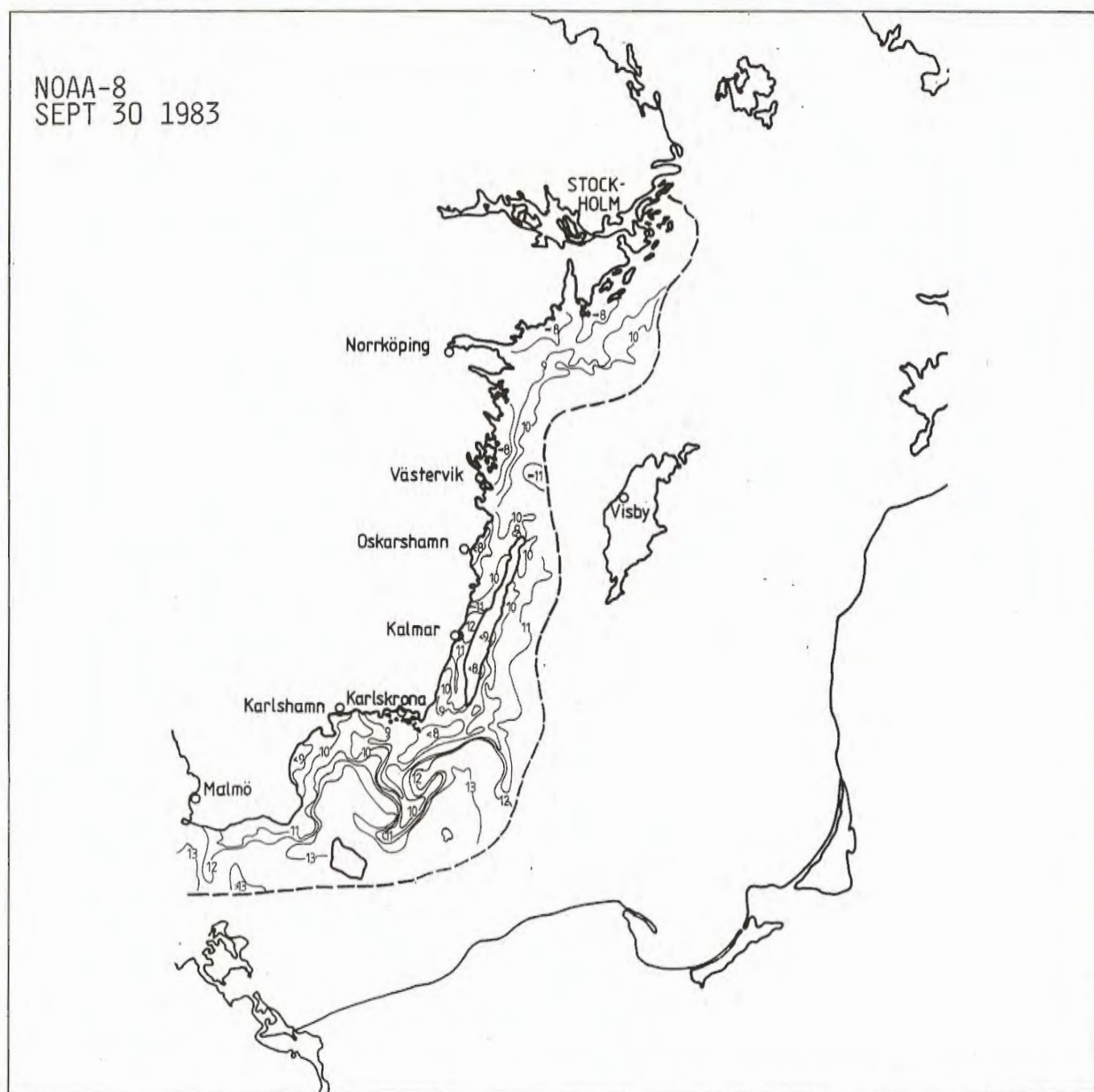




COASTAL UPWELLING IN THE BALTIC

- a presentation of satellite and in situ measurements of sea surface temperatures indicating coastal upwelling

by Lars Gidhagen

Part II

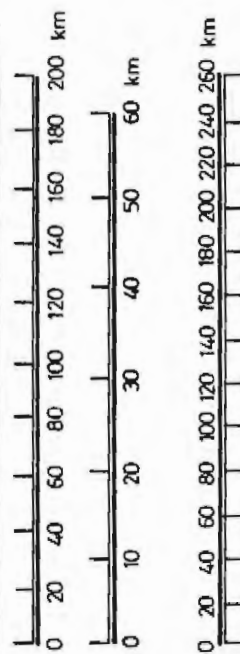


RHO 37

APP: 5, 6, 9, 10, 19, 20

APP: 14, 17, 18

APP: 23, 27, 28, 29, 30



COASTAL UPWELLING IN THE BALTIC

- a presentation of satellite and in situ measurements
of sea surface temperatures indicating coastal upwelling

by Lars Gidhagen

Part II

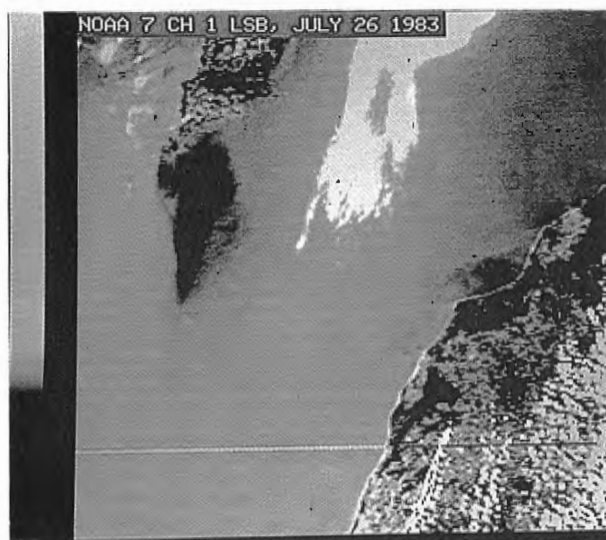
Documented scenes for the upwelling study

BB = Bothnian Bay, BS = Bothnian Sea, BP = Baltic Proper

<u>Date</u>	<u>Hour (GMT)</u>	<u>Cloudfree areas</u>
810803	0709	South BP
810923	0748	Southwest BS
810930	1205	Southwest BB, BS
811006	1232	BB, BS
811015	0750	Southwest BS (very small cloud-free areas)
811016	0744	BS
820713	1303	BS, north and central BP
820714	1251	BS, north and central BP
820716	1227	South BB, BS, north and central BP
820915	1203	North and central BP
830705	1319	South BP (very small cloudfree areas)
830706	1307	West BS, north BP
830707	0745	BB
830708	0722	BS, BP
830722	0723	West BS, northwest BP
830725	1237	West BB, northwest BS, central BP
830726	1224	BB, central BP
830822	0755	BB, north BP
830824	0712	South BB, north BS
830829	0704	BB, Central BP
830923	0807	Northwest BP, central BP
830928	0800	Central BP
830930	0717	Southwest BB, west BS, BP
831001	0654	BB

False colour scale

1	dark	grey		
2		grey		
3	dark	blue		
4		blue		
5	light	blue		colder
6	dark	violet		
7		violet		
8	light	violet		
9	dark	turquoise		
10		turquoise		
11	light	turquoise		
12	dark	green		
13		green		
14	light	green		
15		brown		warmer
16	yellowish	brown		
17		yellow		
18		orange		
19	light	red		
20	dark	red		



Channel 1(VIS). White illustrates high albedo.



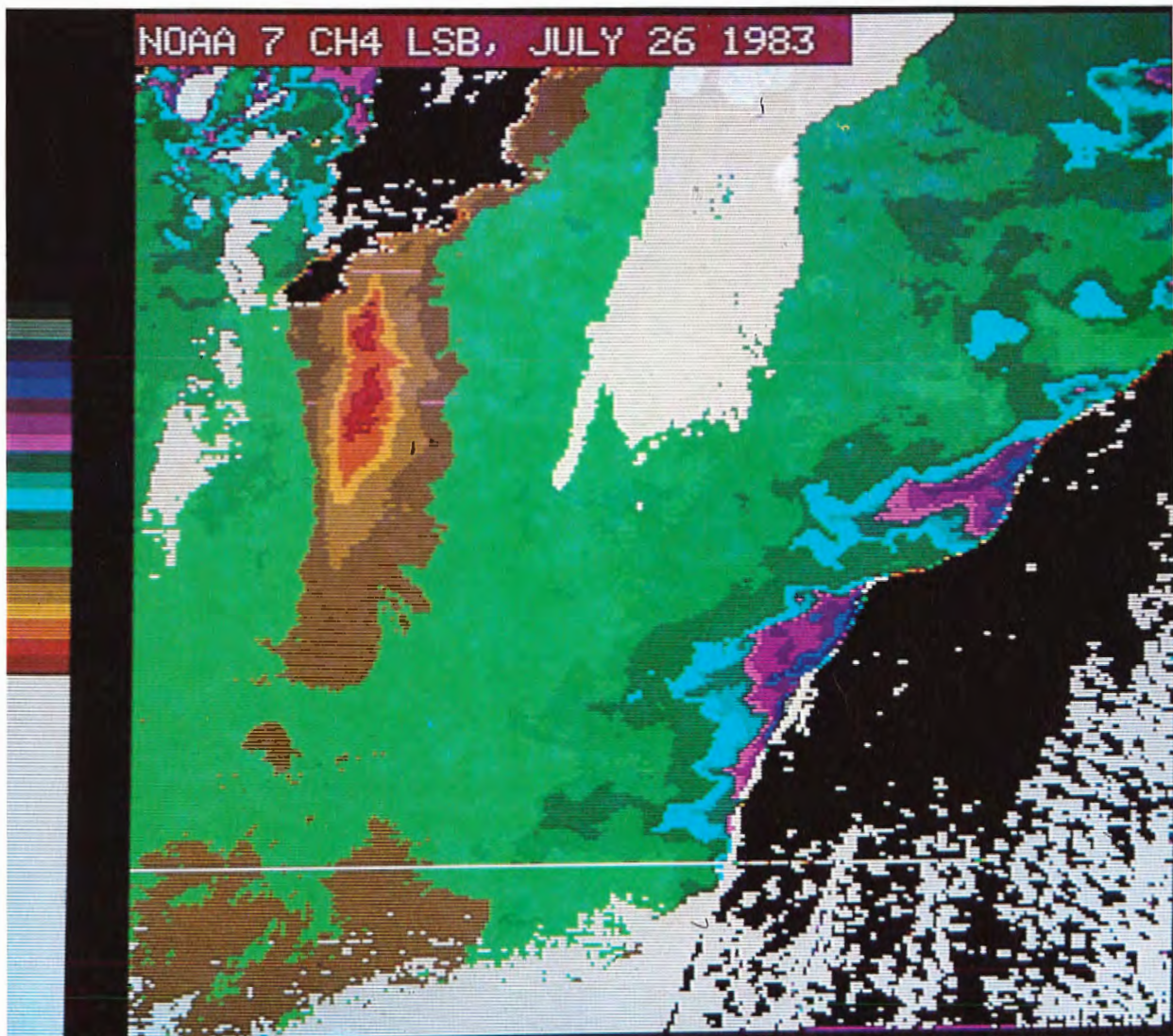
Channel 2(NIR). White illustrates low albedo.



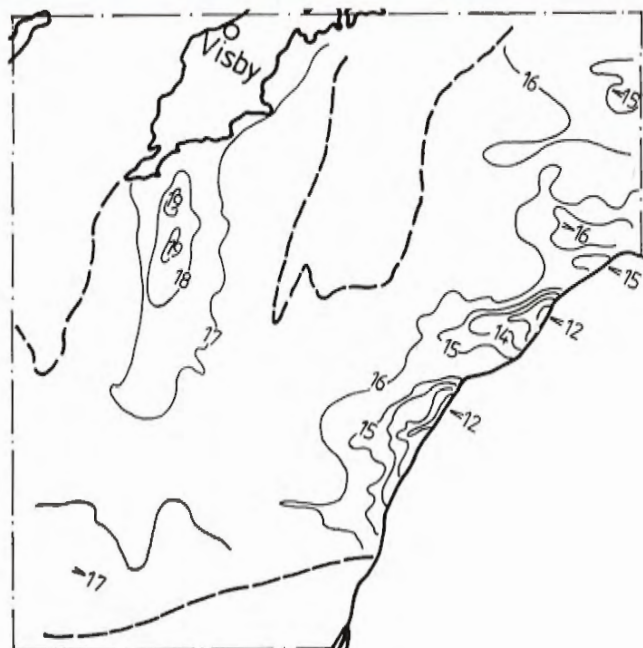
Channel 3(IR). White illustrates low temperatures.

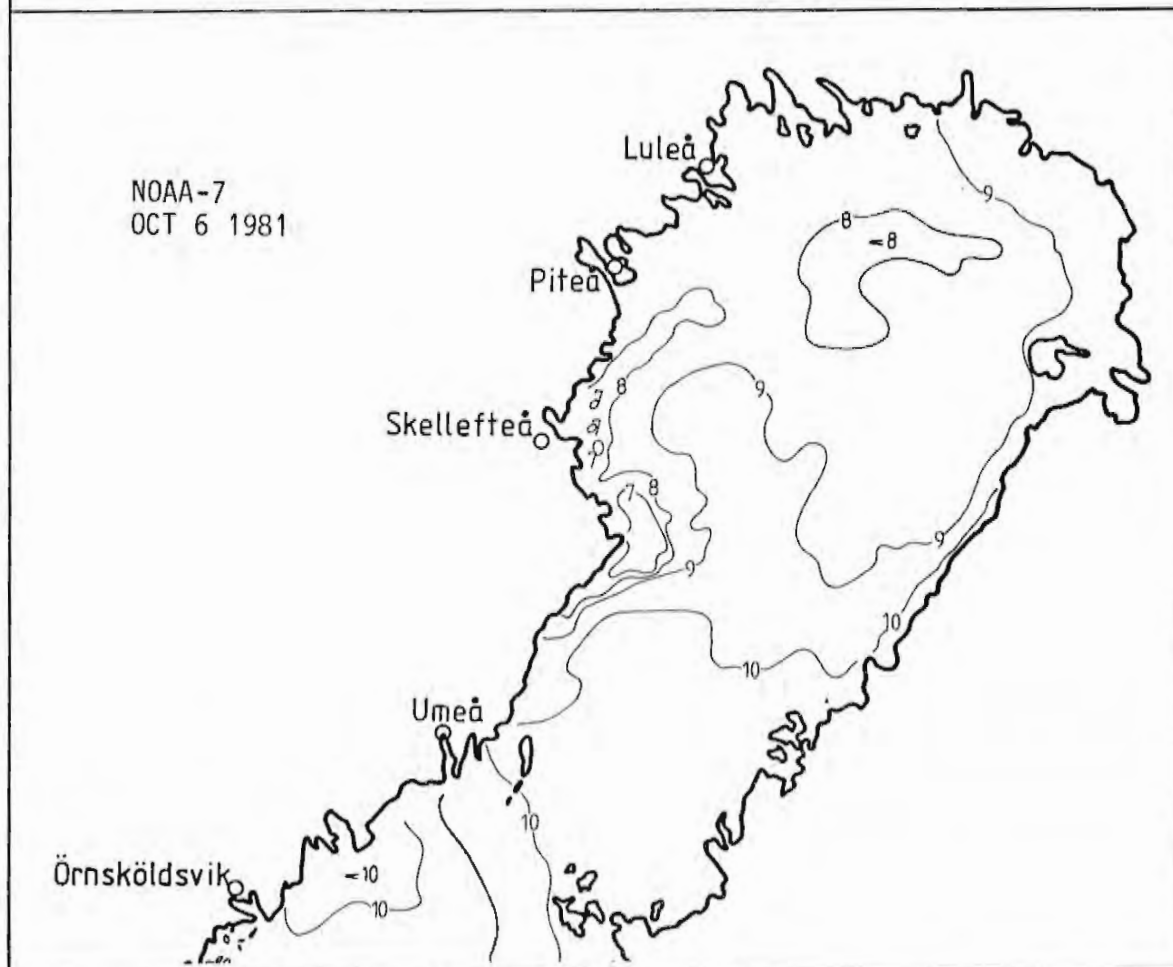
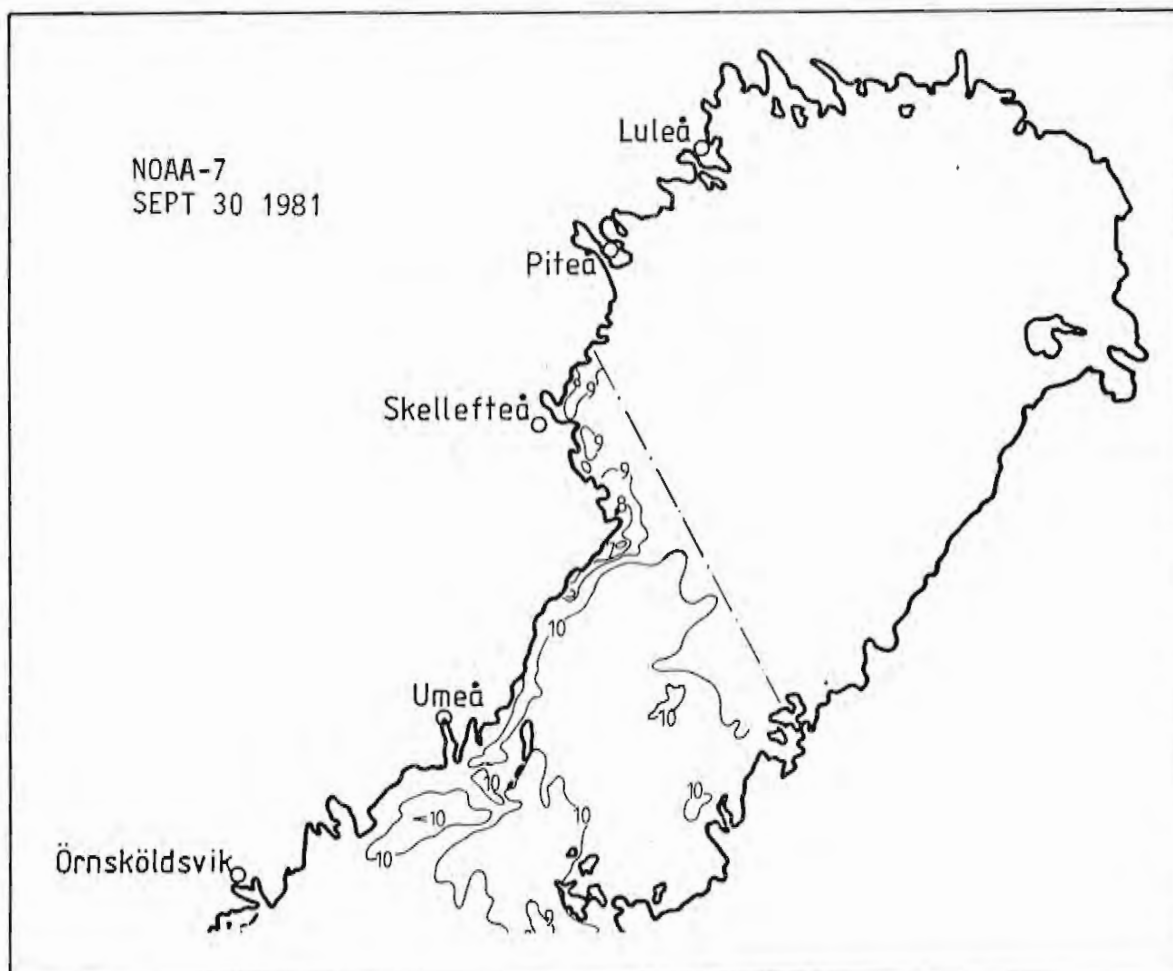


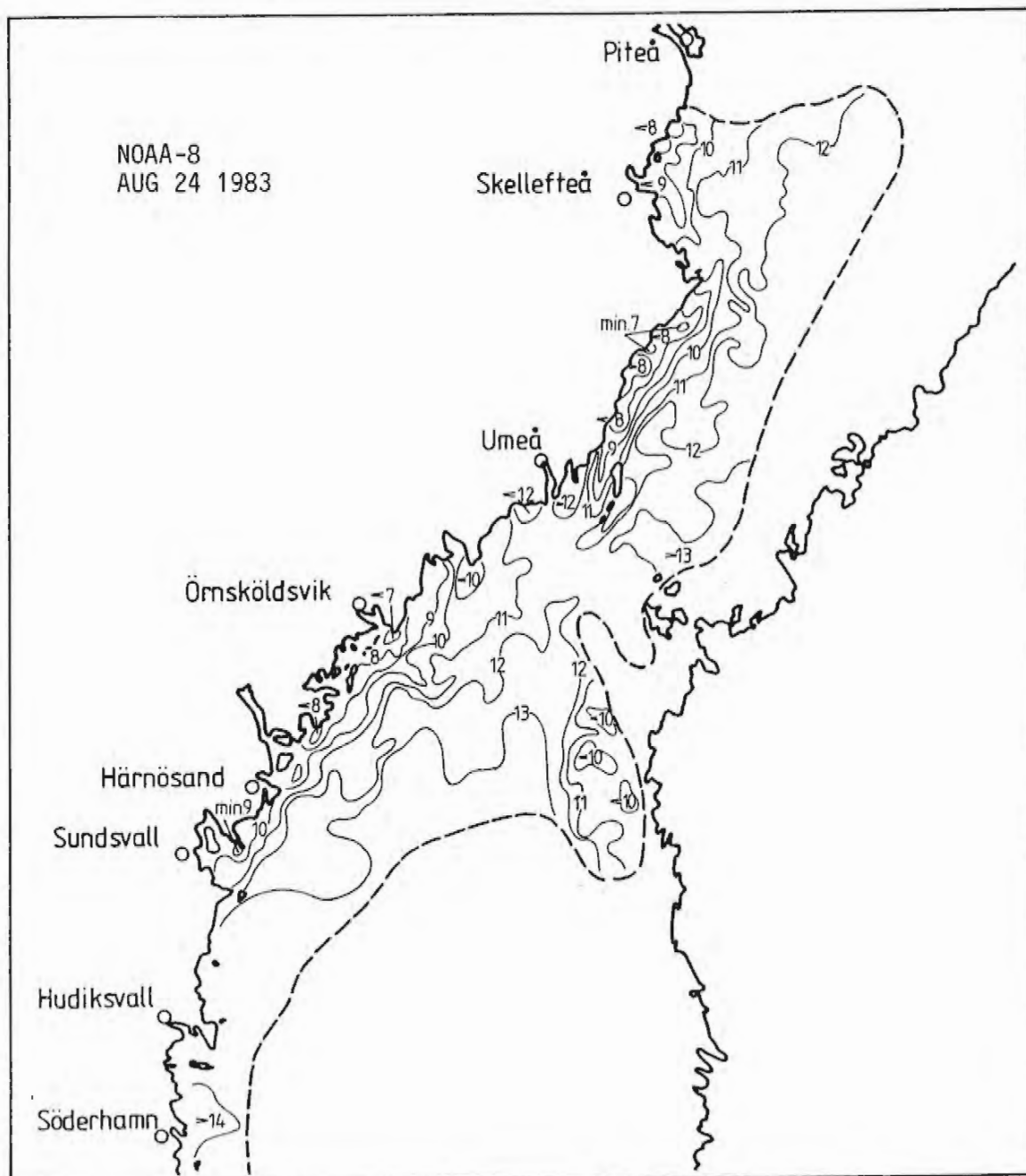
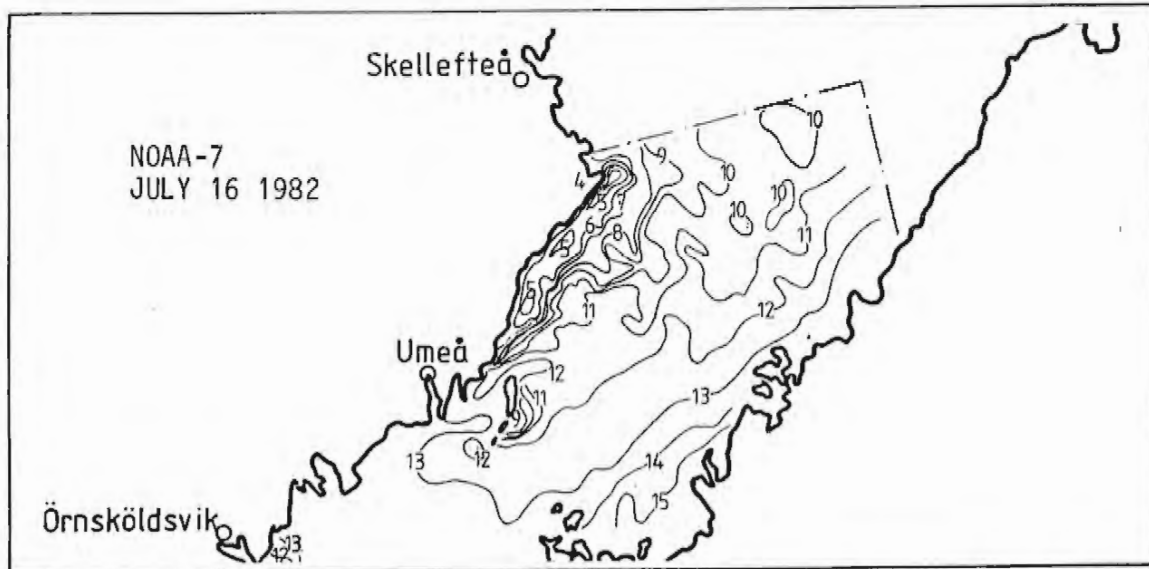
Channel 4(IR). White illustrates low temperatures.



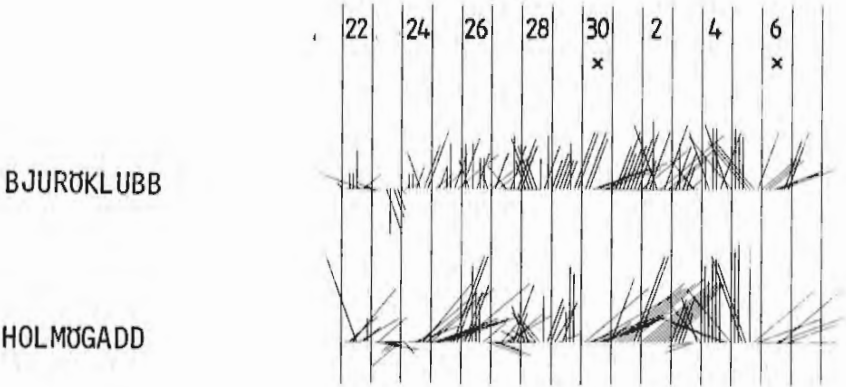
Channel 4. False colour image (above) and isotherm map (to the right) showing upwelling along the Latvian coast.



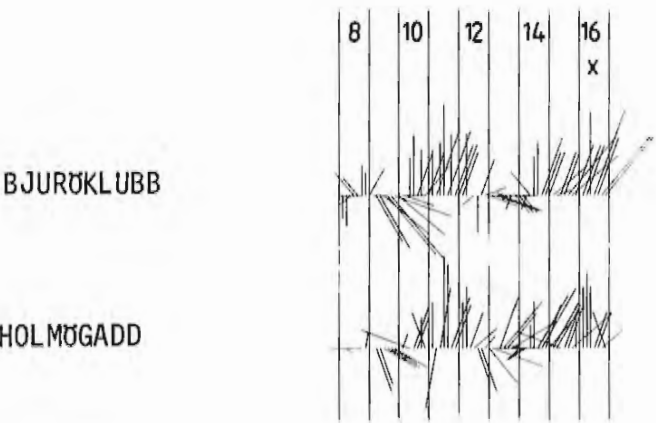




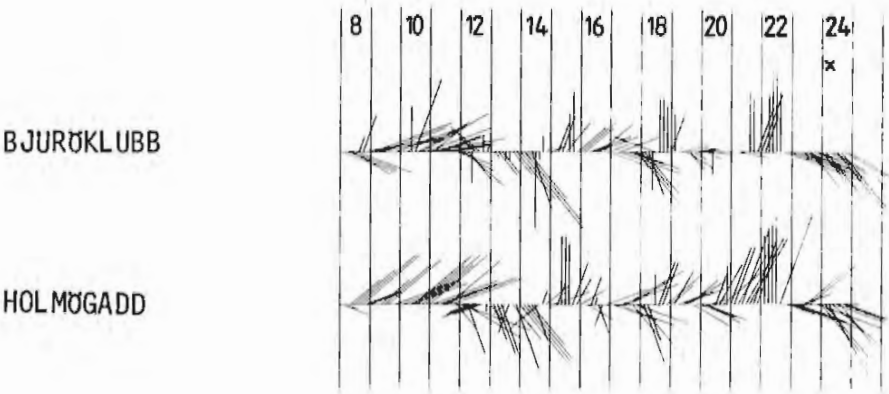
SEPTEMBER OCTOBER 1981



JULY 1982



AUGUST 1983



Wind vectors, north up.

Wind speed scale: 1 cm = 10 ms⁻¹

BJURÖKLUBB

1981

DATE: 810924			DATE: 810929			DATE: 811007			DATE: 811013		
DEPTH	TEMP	SAL	DEPTH	TEMP	SAL	DEPTH	TEMP	SAL	DEPTH	TEMP	SAL
M	C	°/oo	M	C	°/oo	M	C	°/oo	M	C	°/oo
0.5	9.4	3.39	0.5	8.8	3.48	0.5	8.2	3.61	0.5	6.7	3.66
10.0	9.3	3.40	10.0	8.4	3.57	10.0	8.1	3.62	10.0	6.6	3.68
20.0	8.3	3.70	20.0	7.7	3.70	20.0	6.0	3.81	20.0	5.7	3.75
40.0	3.8	3.89	40.0	3.7	3.88	40.0	2.2	4.08	40.0	4.0	3.87

BJURÖKLUBB

1982

DATE: 820717			DATE: 820721		
DEPTH	TEMP	SAL	DEPTH	TEMP	SAL
M	C	°/oo	M	C	°/oo
0.5	6.2	3.59	0.5	10.3	3.52
10.0	4.9	3.68	10.0	5.4	3.65
20.0	4.1	3.74	20.0	3.3	3.77
40.0	1.6	3.85	40.0	2.1	3.88

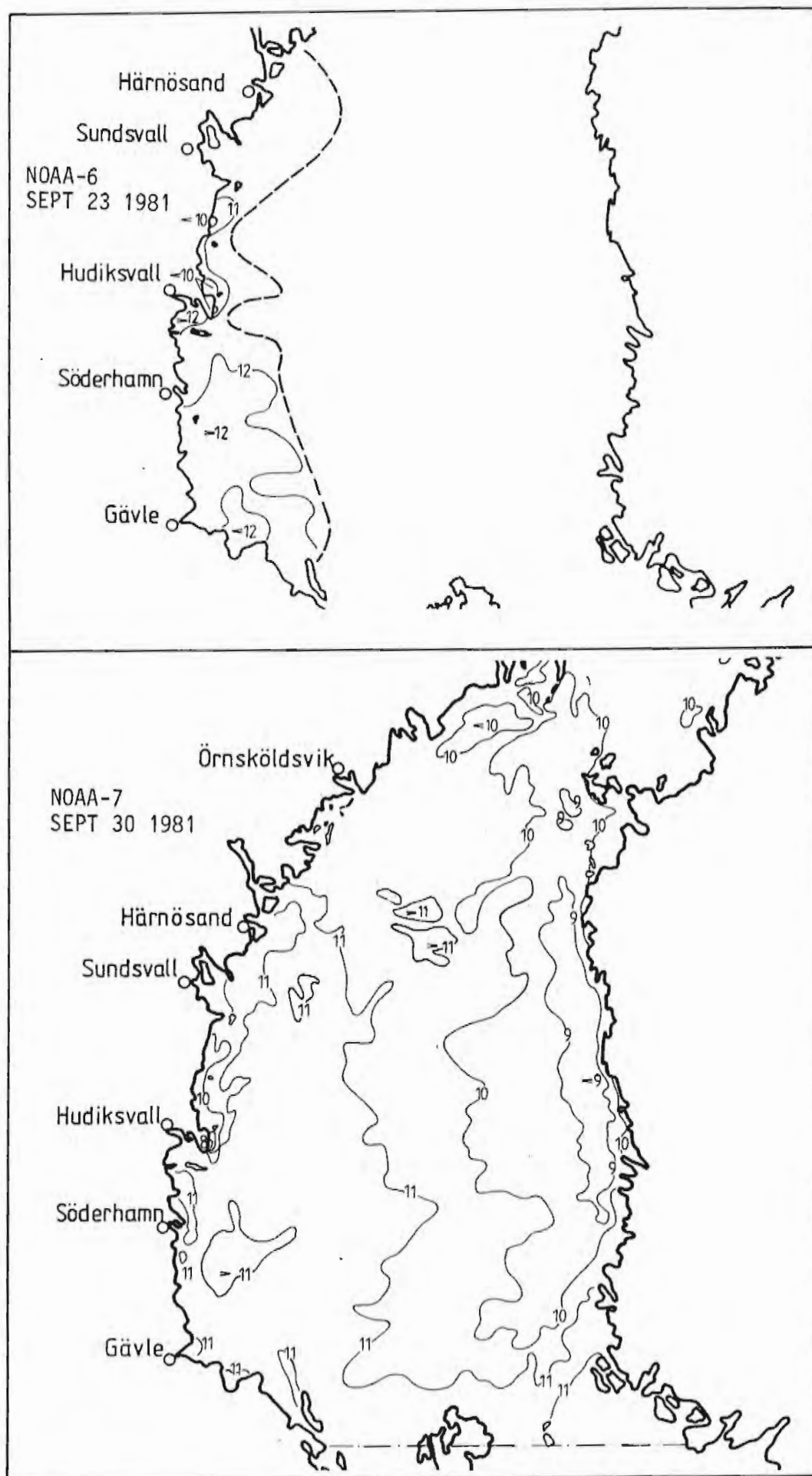
BJURÖKLUBB

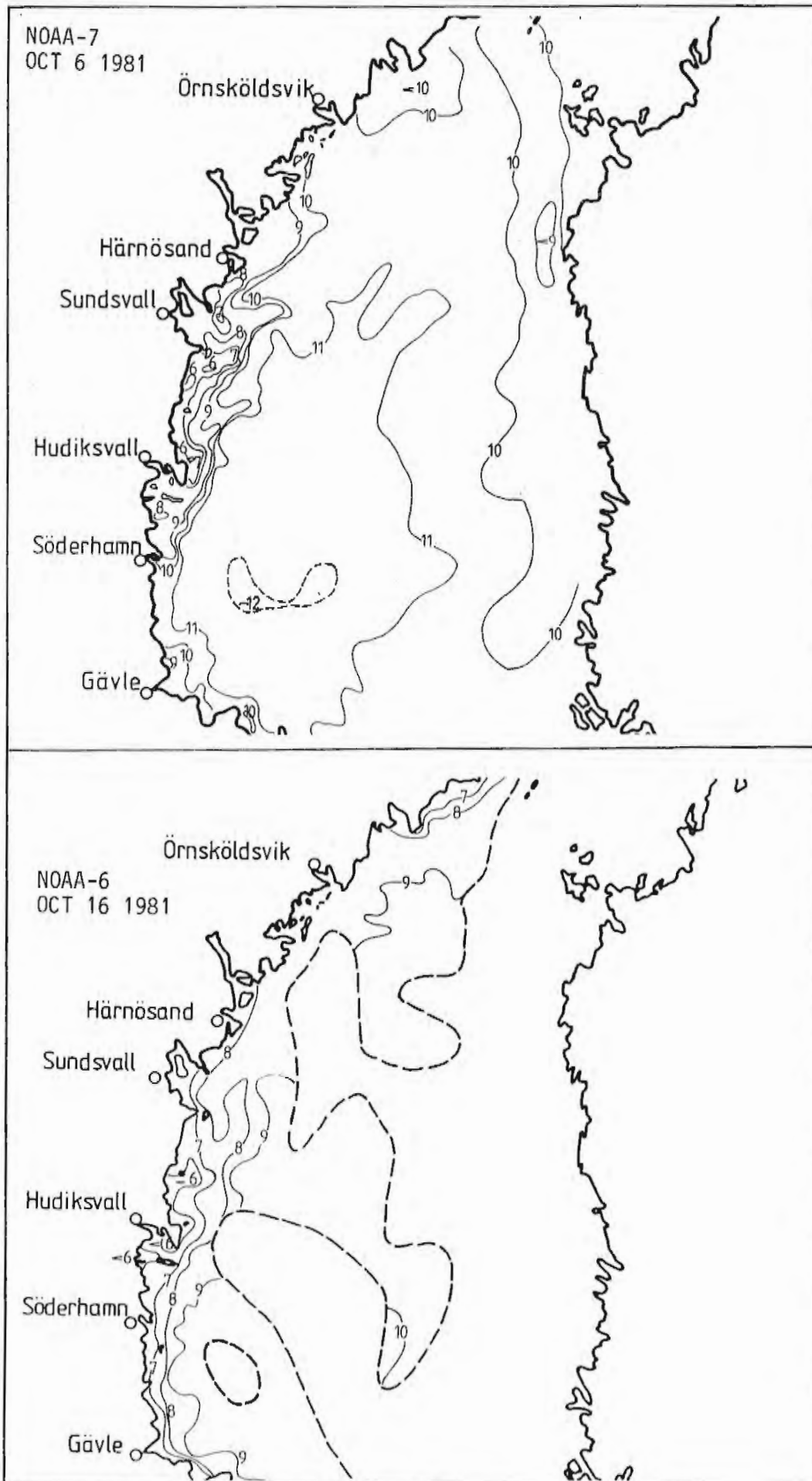
1983

DATE: 830817			DATE: 830823		
DEPTH	TEMP	SAL	DEPTH	TEMP	SAL
M	C	°/oo	M	C	°/oo
0.5	12.3	3.48	0.5	11.7	3.41
10.0	11.8	3.47	10.0	9.8	3.44
20.0	7.6	3.54	20.0	3.4	3.65
40.0	2.5	3.76	40.0	2.1	3.80

F9

DATE: 830823		
DEPTH	TEMP	SAL
M	C	°/oo
0.5	13.0	3.48
10.0	12.6	3.48
20.0	4.7	3.55
40.0	1.8	3.79
60.0	1.4	4.30
80.0	1.5	4.38
100.0	1.3	4.35

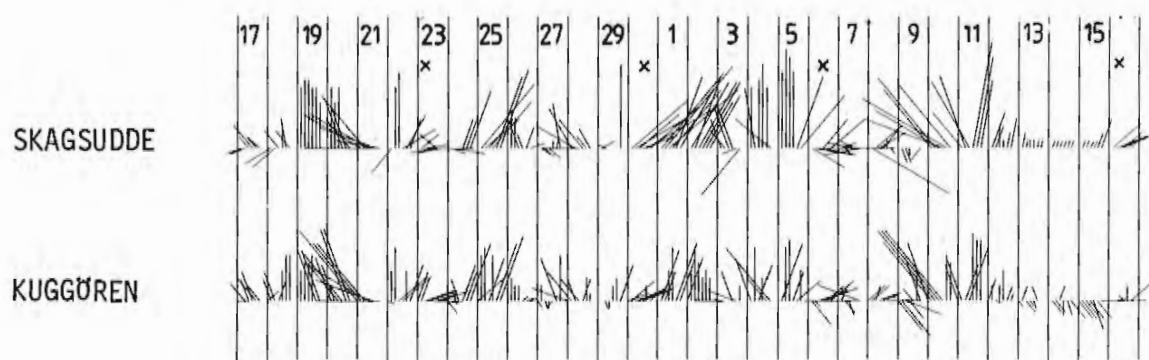




SEPTEMBER

OCTOBER

1981



Wind vectors, north up. Wind speed scale: 1 cm = 10 ms⁻¹.

STORJUNGFRUN

1981

DATE: 810917

DEPTH	TEMP	SAL
M	C	°/oo
0.5	11.7	5.55
10.0	11.4	5.61
20.0	11.0	5.71
40.0	9.5	5.94
60.0	6.7	5.97

DATE: 810926

DEPTH	TEMP	SAL
M	C	°/oo
0.5	12.0	5.40
10.0	11.8	5.42
20.0	11.3	5.70
40.0	5.7	6.00
60.0	4.7	6.02

DATE: 811006

DEPTH	TEMP	SAL
M	C	°/oo
0.5	11.4	5.52
10.0	11.4	5.53
20.0	11.2	5.57
40.0	5.1	6.03
60.0	4.6	6.05

DATE: 811015

DEPTH	TEMP	SAL
M	C	°/oo
0.5	9.7	5.71
10.0	9.7	5.71
20.0	8.6	5.84
40.0	5.1	6.04
60.0	5.1	6.04

SÖDERHAMN

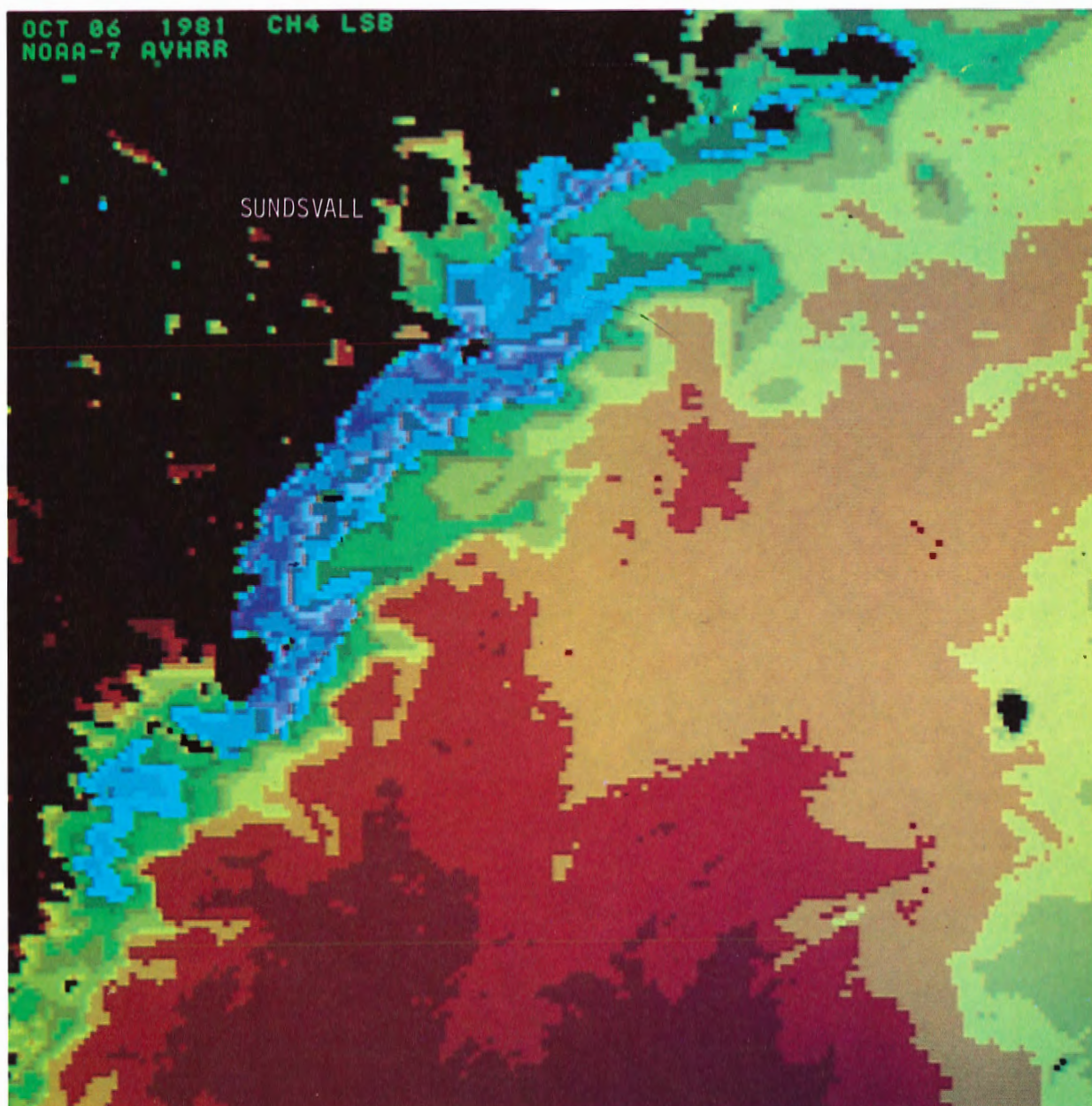
1981

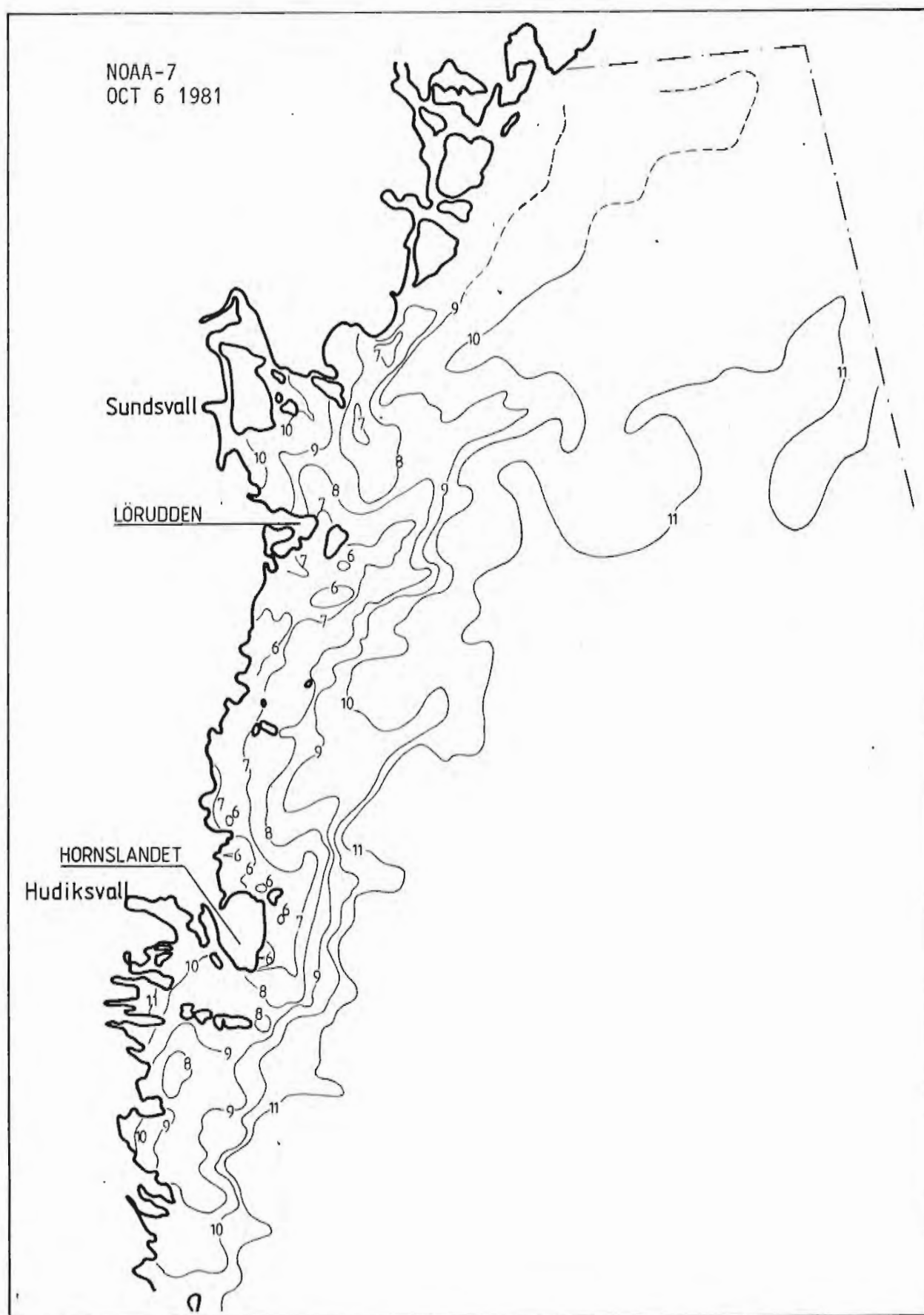
DATE: 810926

DEPTH	TEMP	SAL
M	C	°/oo
0.5	12.0	5.40
10.0	12.0	5.40
20.0	11.7	5.51
40.0	7.0	5.99
60.0	4.3	6.07
80.0	4.0	6.07

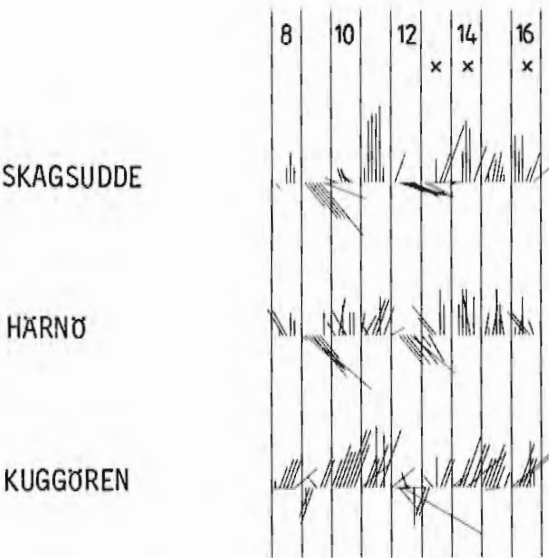
DATE: 811015

DEPTH	TEMP	SAL
M	C	°/oo
0.5	10.1	5.63
10.0	10.1	5.64
20.0	10.1	5.64
40.0	4.9	6.04
60.0	2.7	6.22
80.0	2.6	6.22





JULY 1982



Wind vectors, north up. Wind speed scale: 1 cm = 10 ms⁻¹.

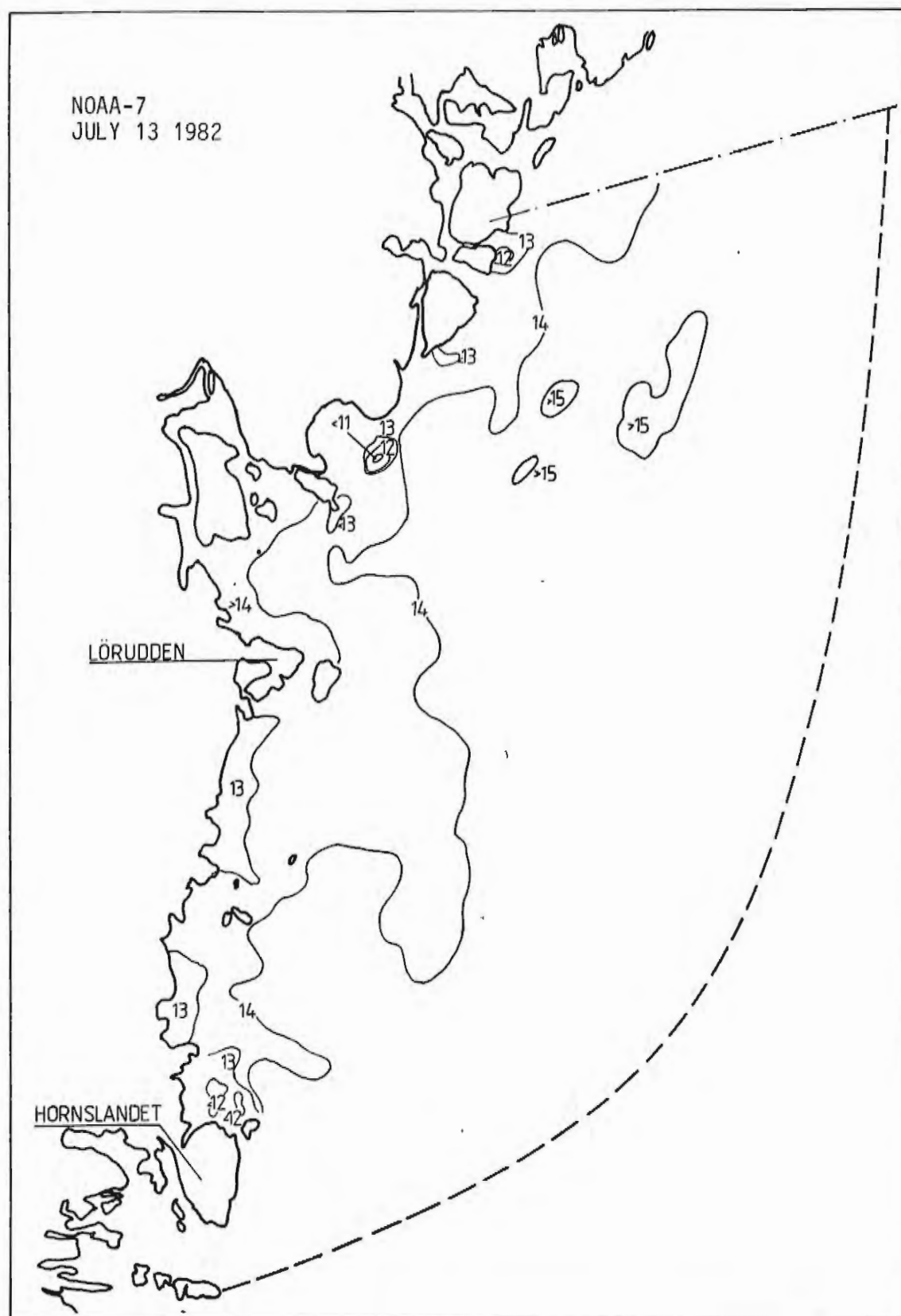
BRÄMÖN 1982

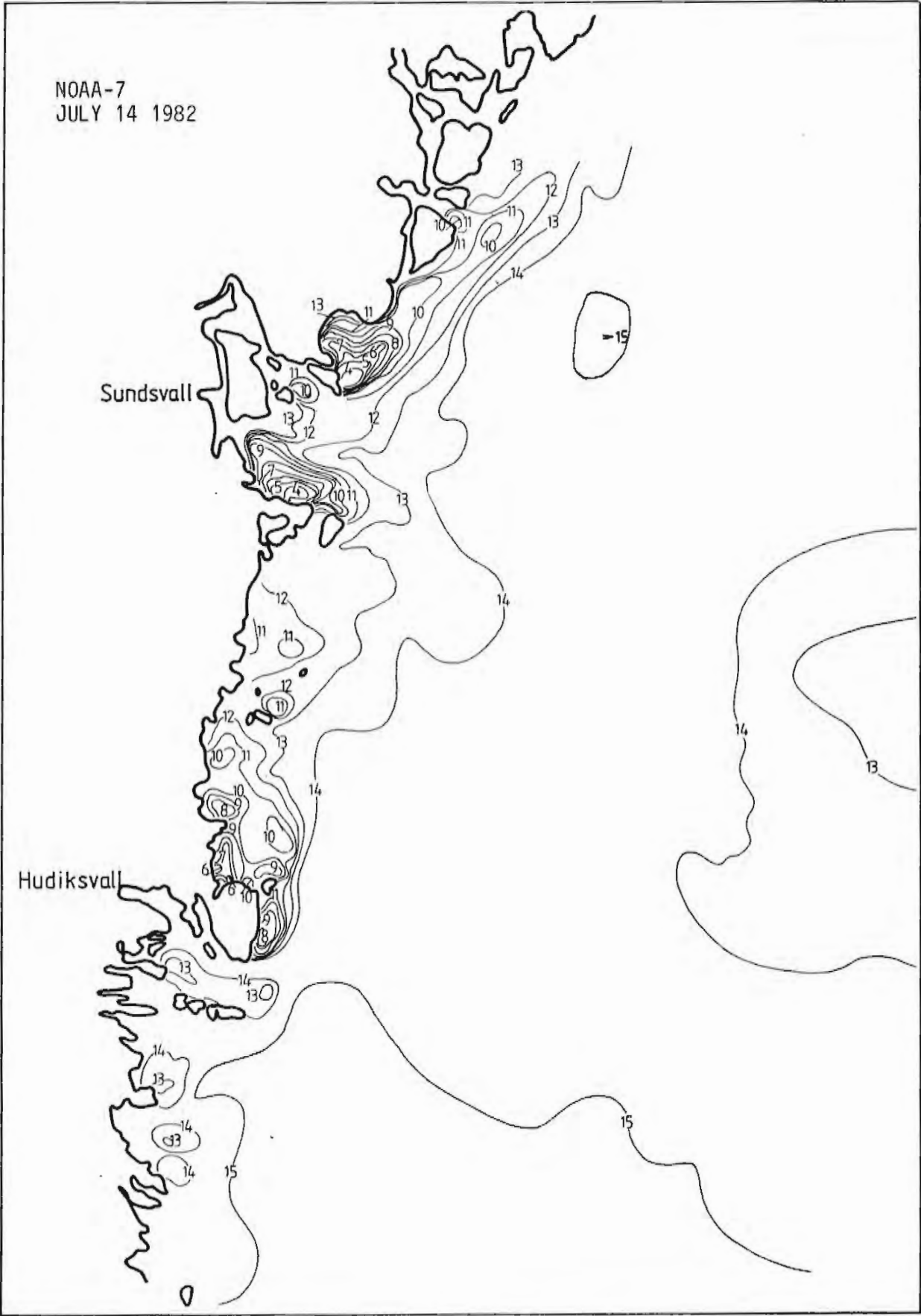
DATE: 820706

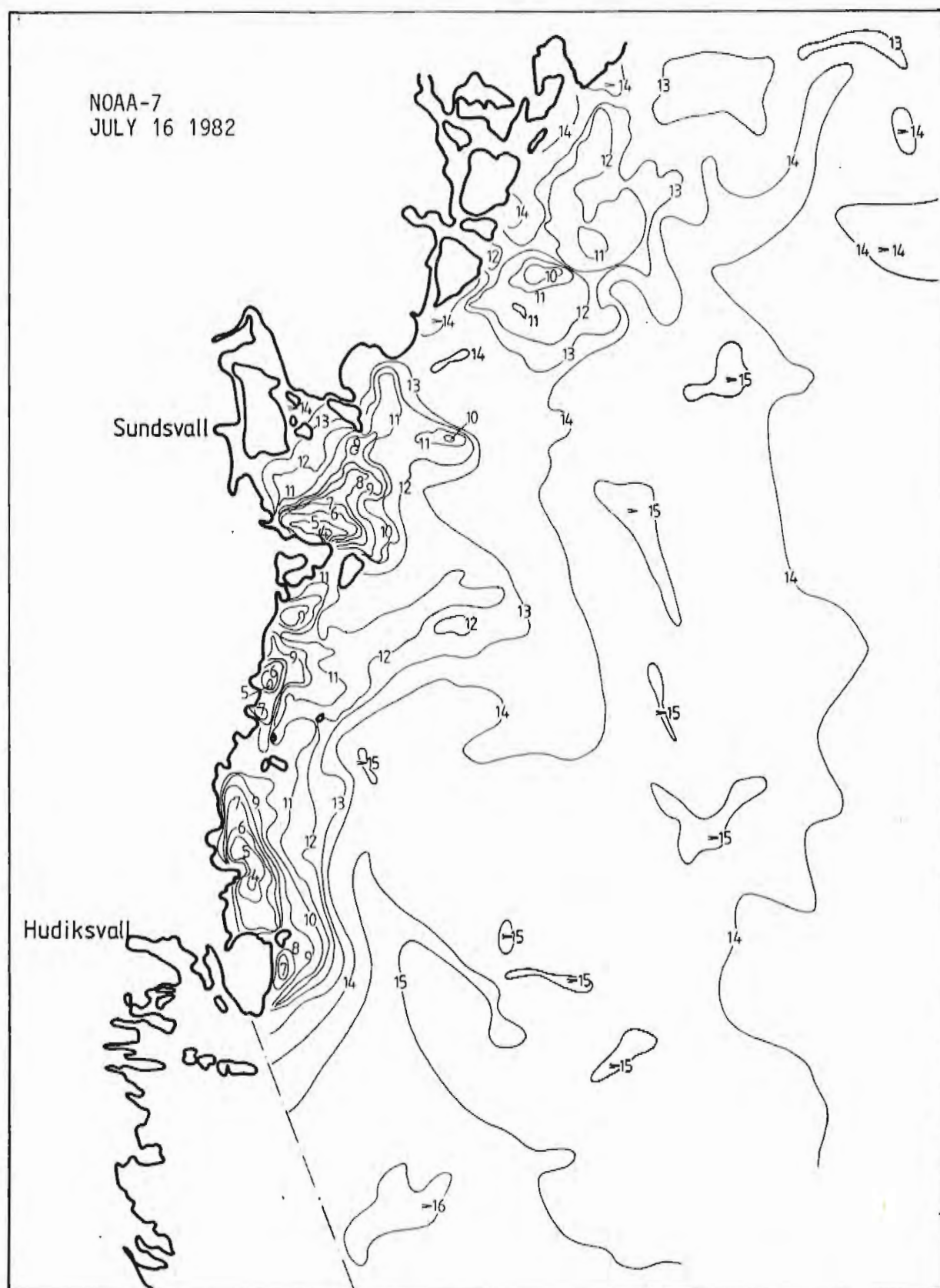
DEPTH	TEMP	SAL
M	C	°/∞
0.5	12.5	4.99
10.0	10.7	5.33
20.0	3.0	5.76
40.0	0.9	6.13
60.0	1.2	6.25
80.0	1.5	6.29

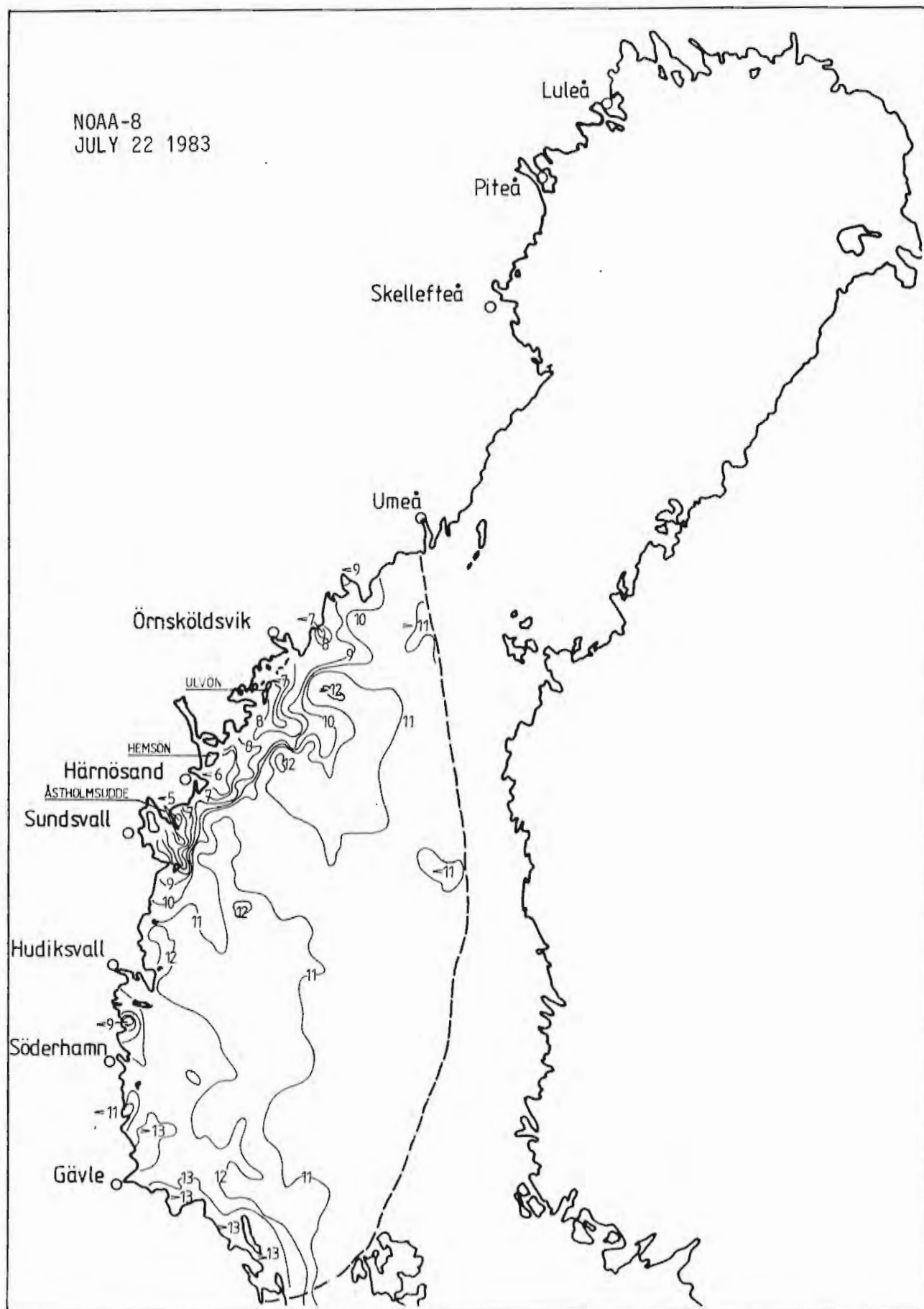
DATE: 820716

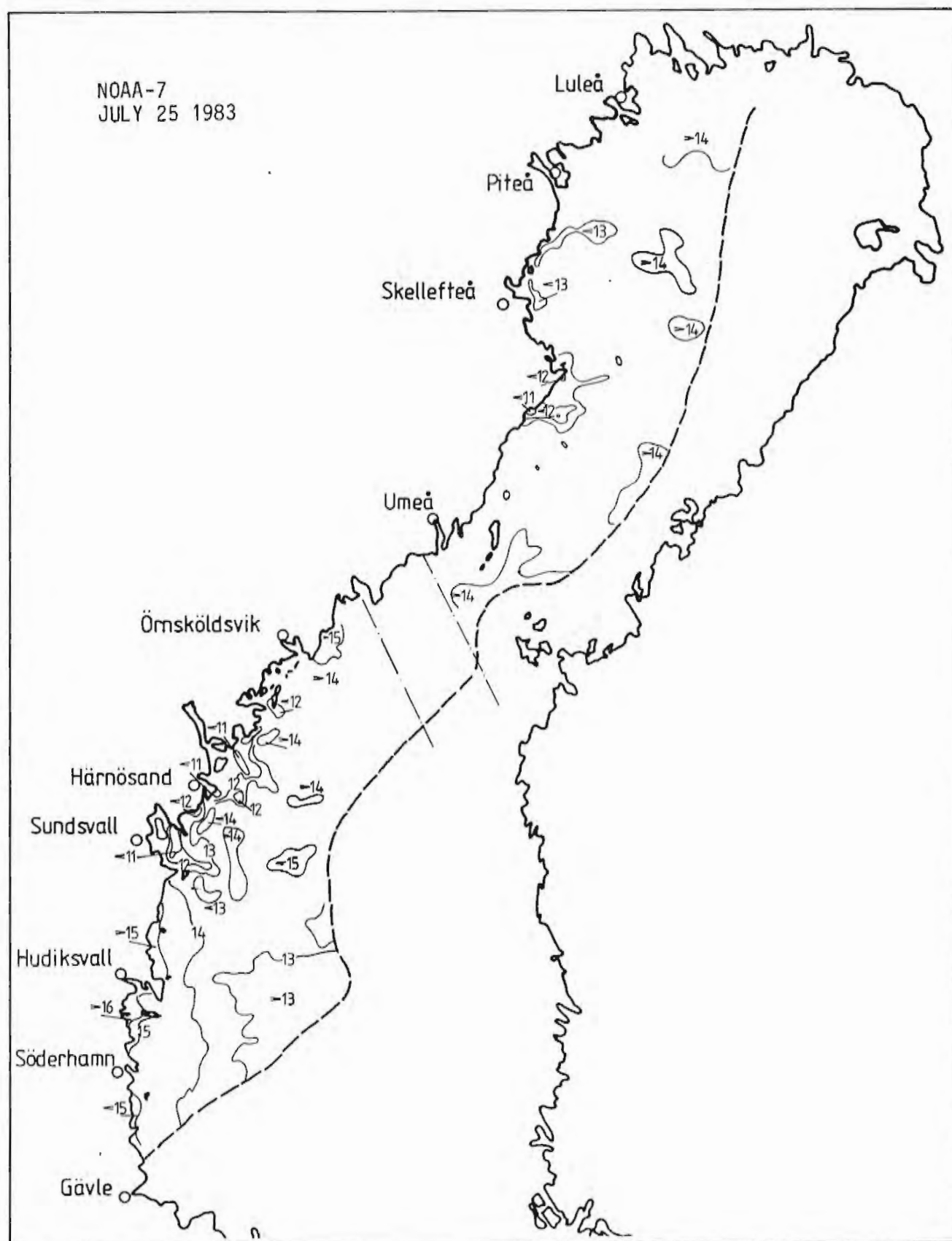
DEPTH	TEMP	SAL
M	C	°/∞
0.5	12.7	5.57
10.0	7.1	5.74
20.0	2.7	5.87
40.0	1.2	6.21
60.0	1.6	6.28
80.0	1.7	6.30











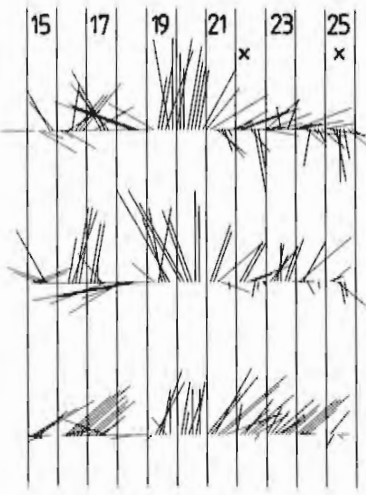
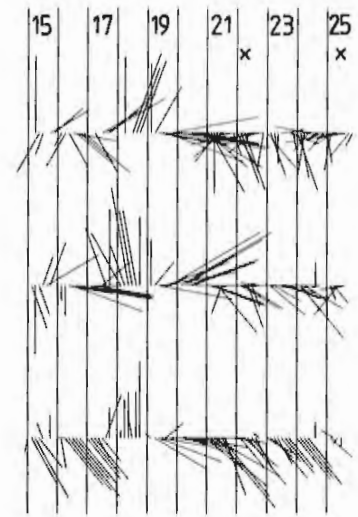
JULY

1983

SYDOSTBROTEN

SKAGSUDDE

HÆRNØ



Wind vectors, north up.

Wind vectors, east up.

Wind speed scale: 1 cm = 10 ms⁻¹.

1983

VAGØN

DATE: 830712

DEPTH	TEMP	SAL
M	C	°/∞
0.5	17.6	4.53
10.0	9.8	4.71
20.0	4.0	5.55
40.0	1.4	6.08
60.0	2.0	6.33
70.0	2.3	6.46

DATE: 830720

DEPTH	TEMP	SAL
M	C	°/∞
0.5	5.2	5.56
10.0	4.8	5.60
20.0	1.9	5.97
40.0	1.7	6.20
60.0	1.8	6.28
70.0	2.3	6.43

DATE: 830725

DEPTH	TEMP	SAL
M	C	°/∞
0.5	11.1	5.25
10.0	6.6	3.35
20.0	3.6	5.78
40.0	1.7	6.11
60.0	2.0	6.33
70.0	2.2	6.42

US 2

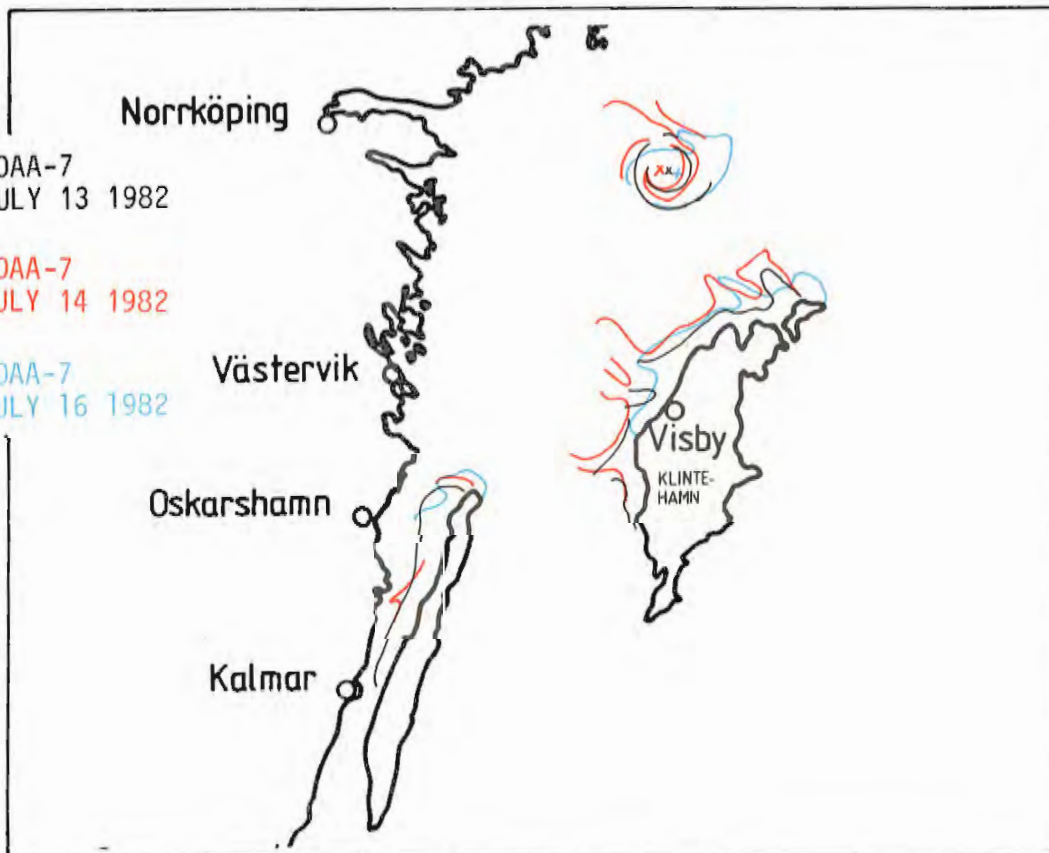
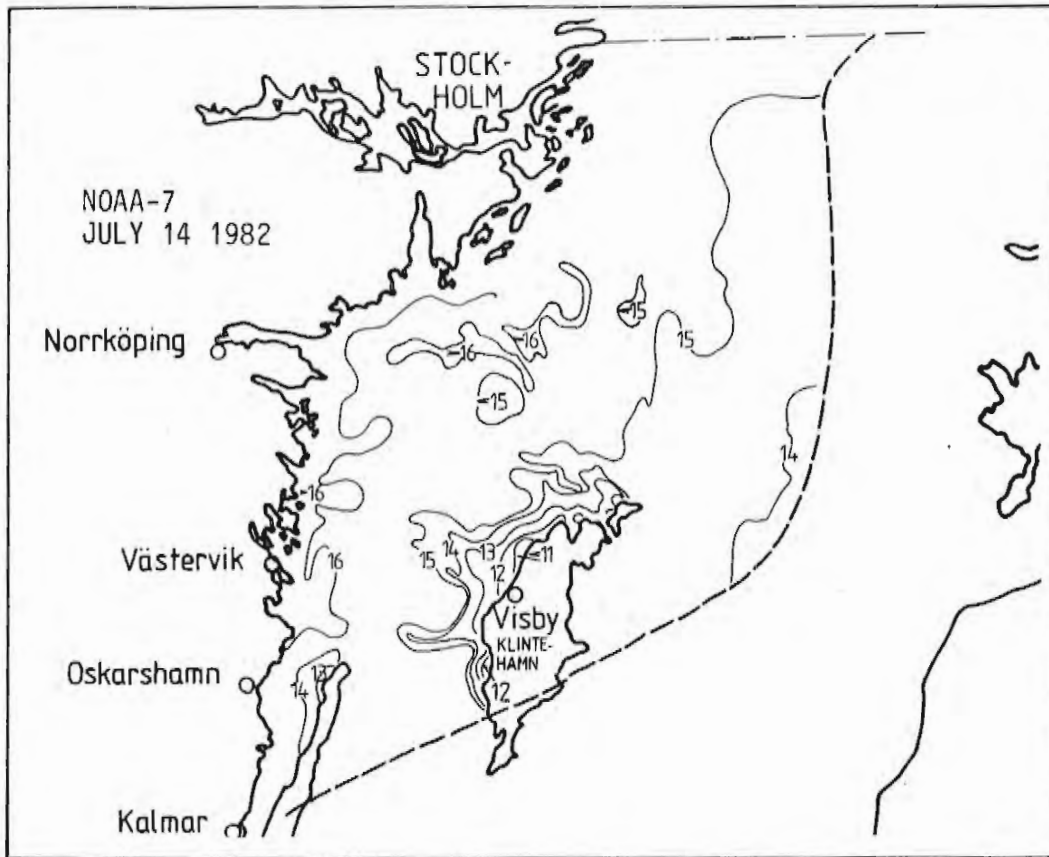
DATE: 830707

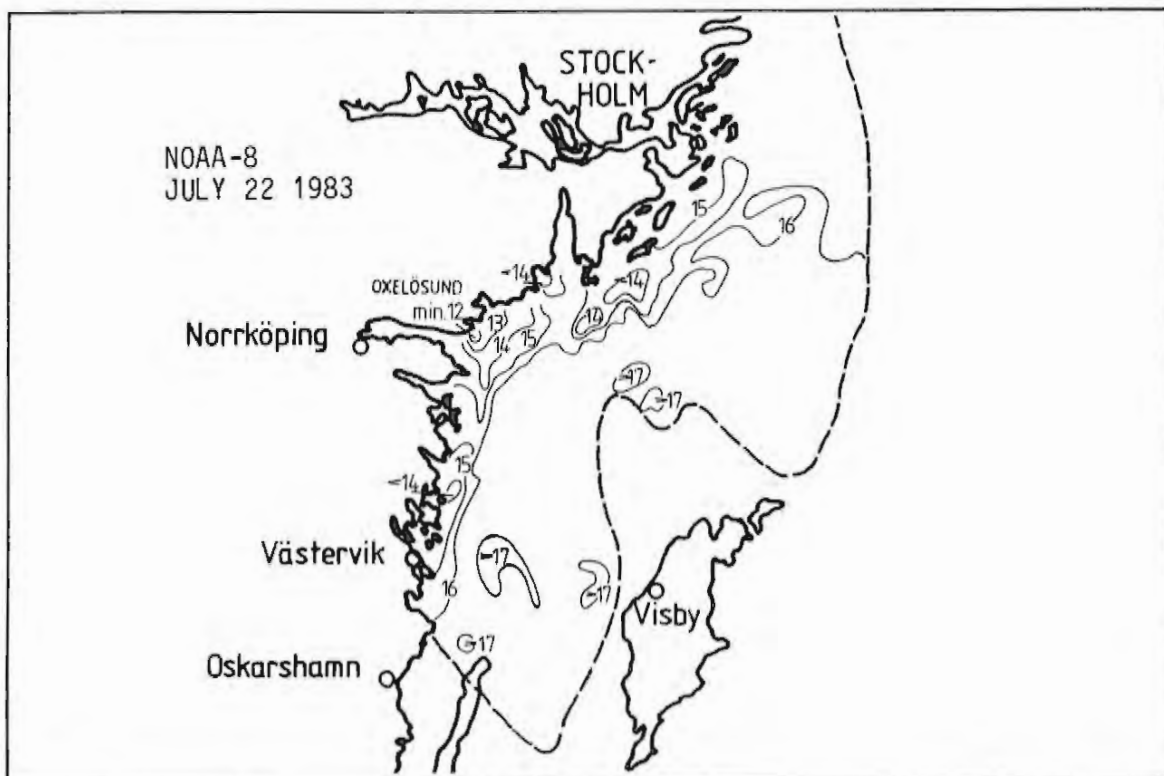
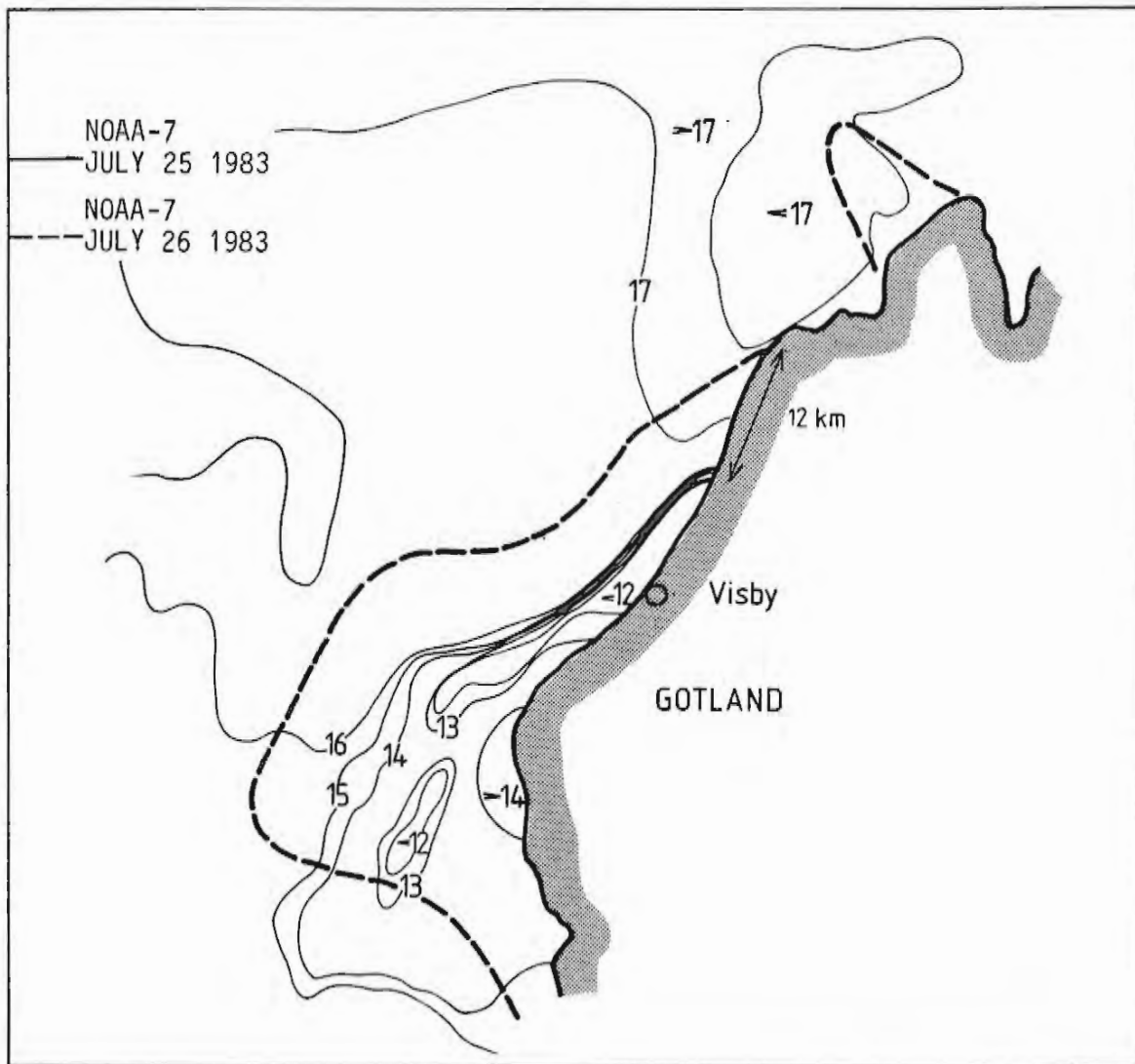
DEPTH	TEMP	SAL
M	C	°/∞
0.5	14.8	5.13
10.0	12.1	5.16
20.0	1.8	5.91
40.0	1.3	6.12
60.0	1.9	6.26
80.0	2.5	6.50
100.0	2.7	6.67
150.0	2.8	6.75

MS 2

DATE: 830722

DEPTH	TEMP	SAL
M	C	°/∞
0.5	11.0	5.05
10.0	10.8	5.04
20.0	2.7	5.84
40.0	1.5	6.11
60.0	1.9	6.22



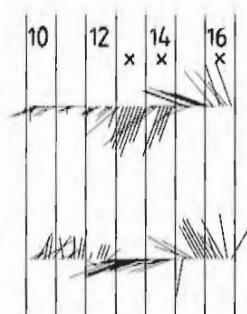


JULY

1982

GOTSKA SANDØN

HOBURG

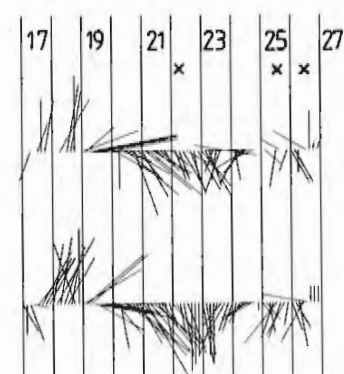


JULY

1983

GUSTAV DAHLEN

HOBURG



Wind vectors, north up. Wind speed scale: 1 cm = 10 ms⁻¹.

GRÄSSKÅREN

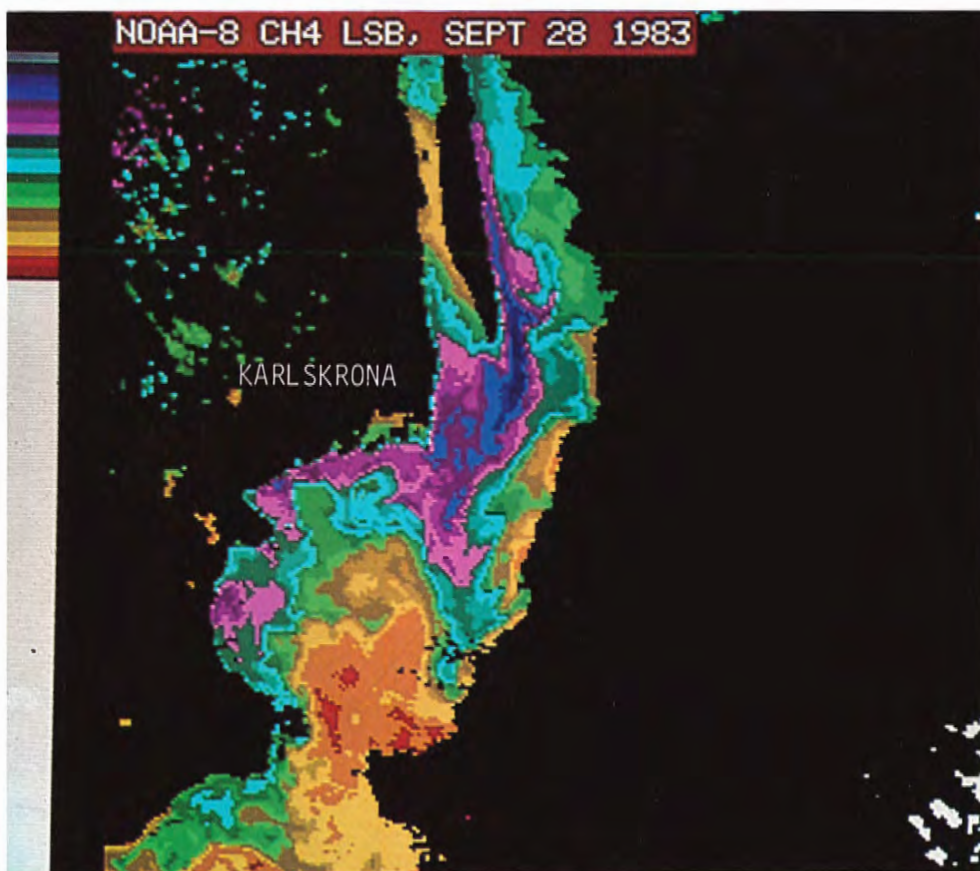
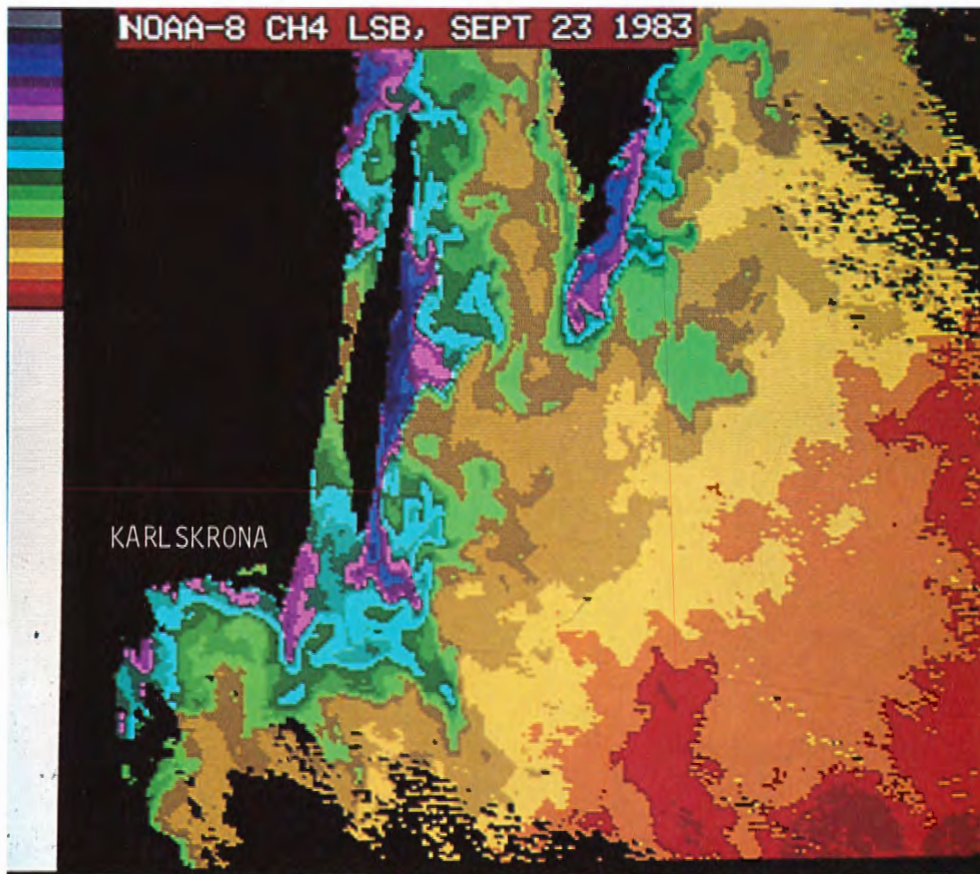
1983

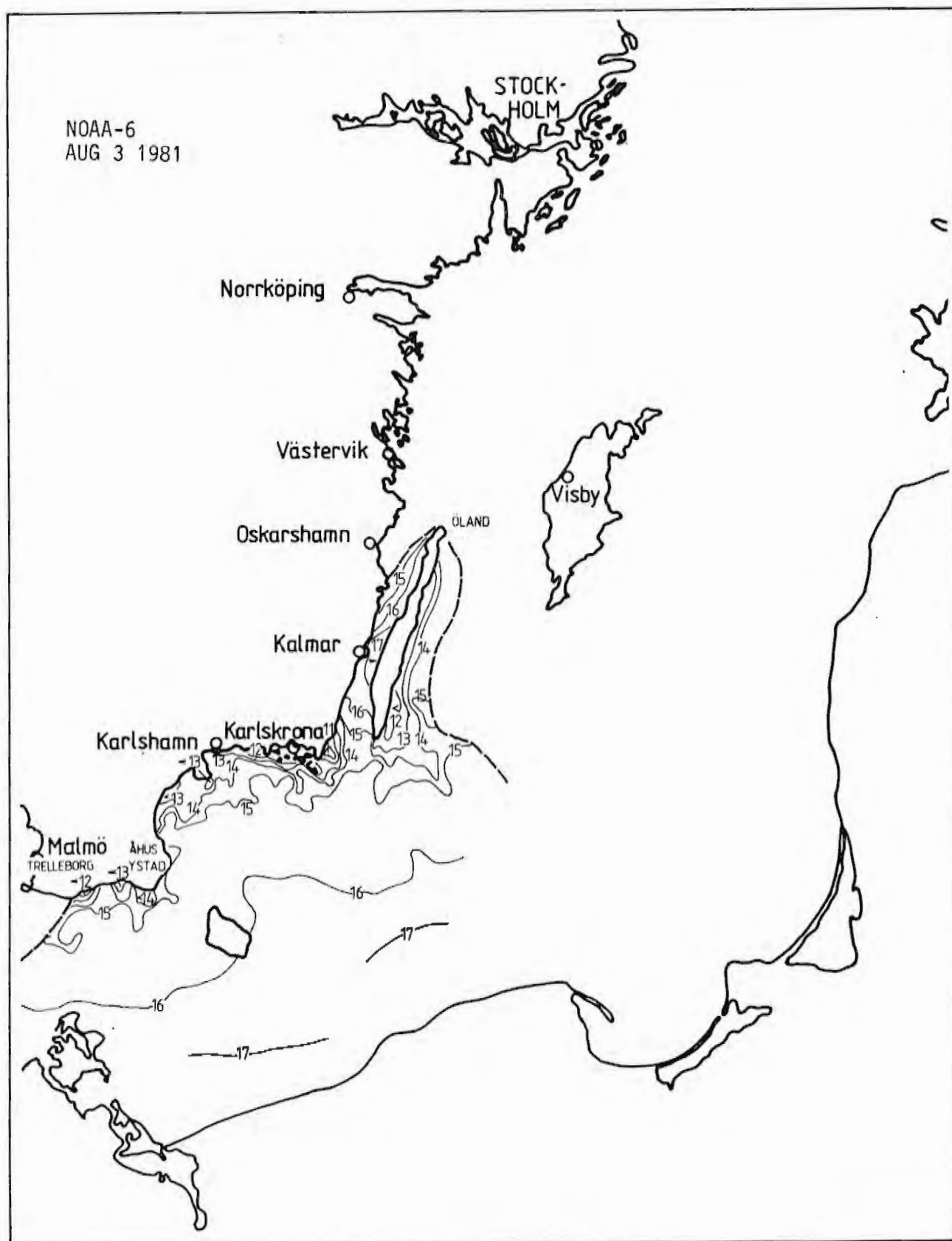
DATE: 830707

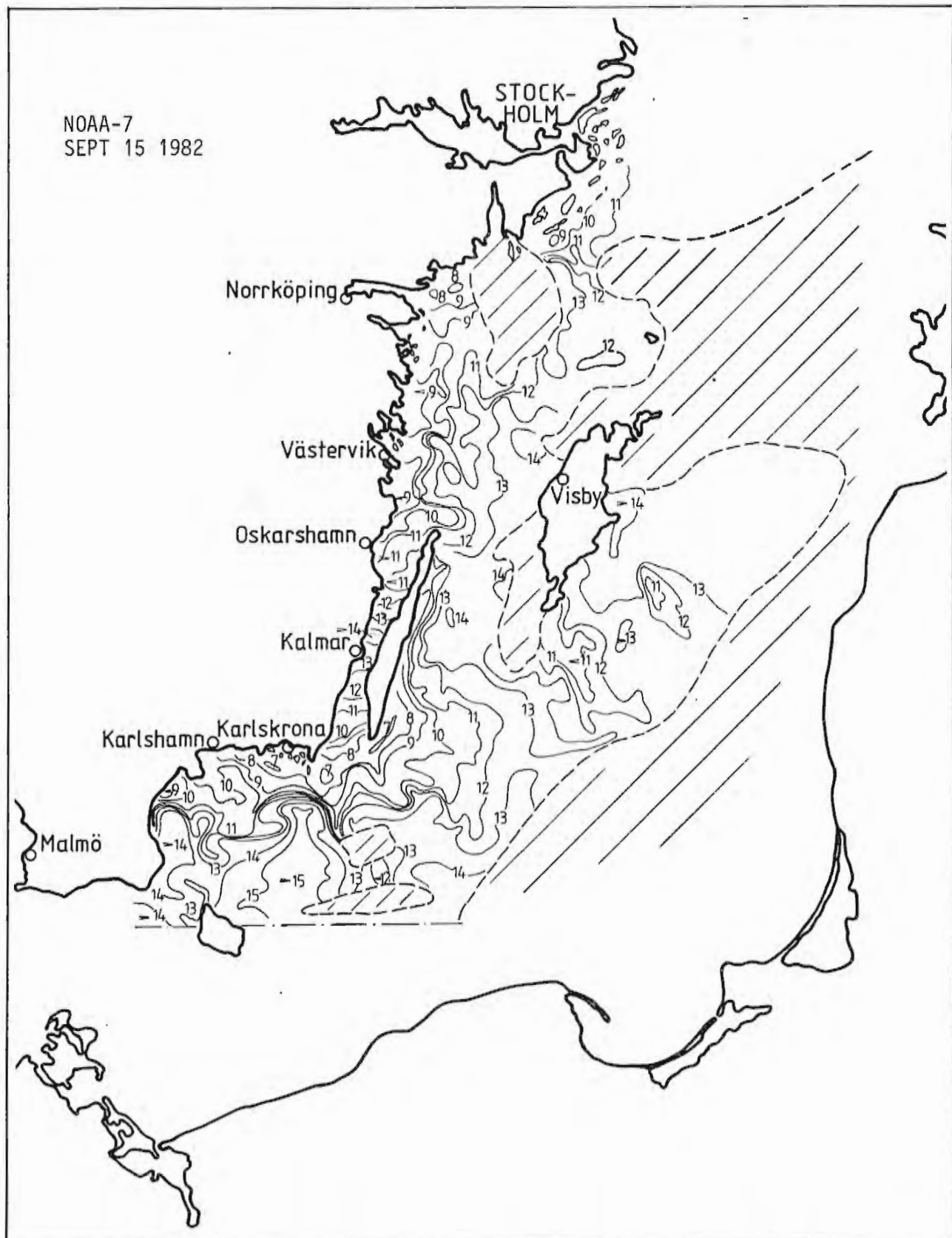
DEPTH	TEMP	SAL
M	C	°/∞
0.5	15.8	6.31
10.0	9.1	6.61
20.0	6.9	6.83
40.0	3.7	7.67
60.0	3.3	7.91

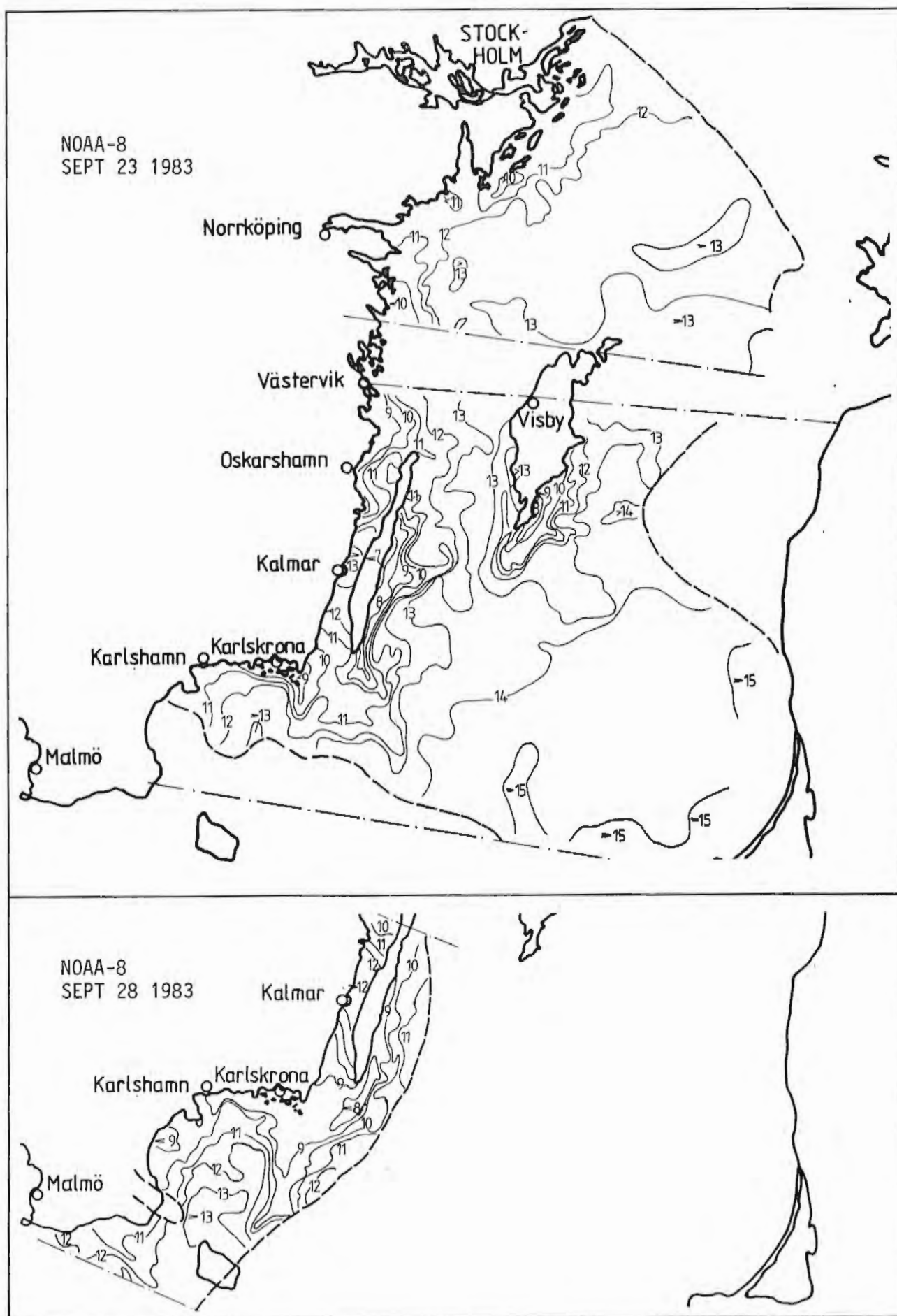
DATE: 830722

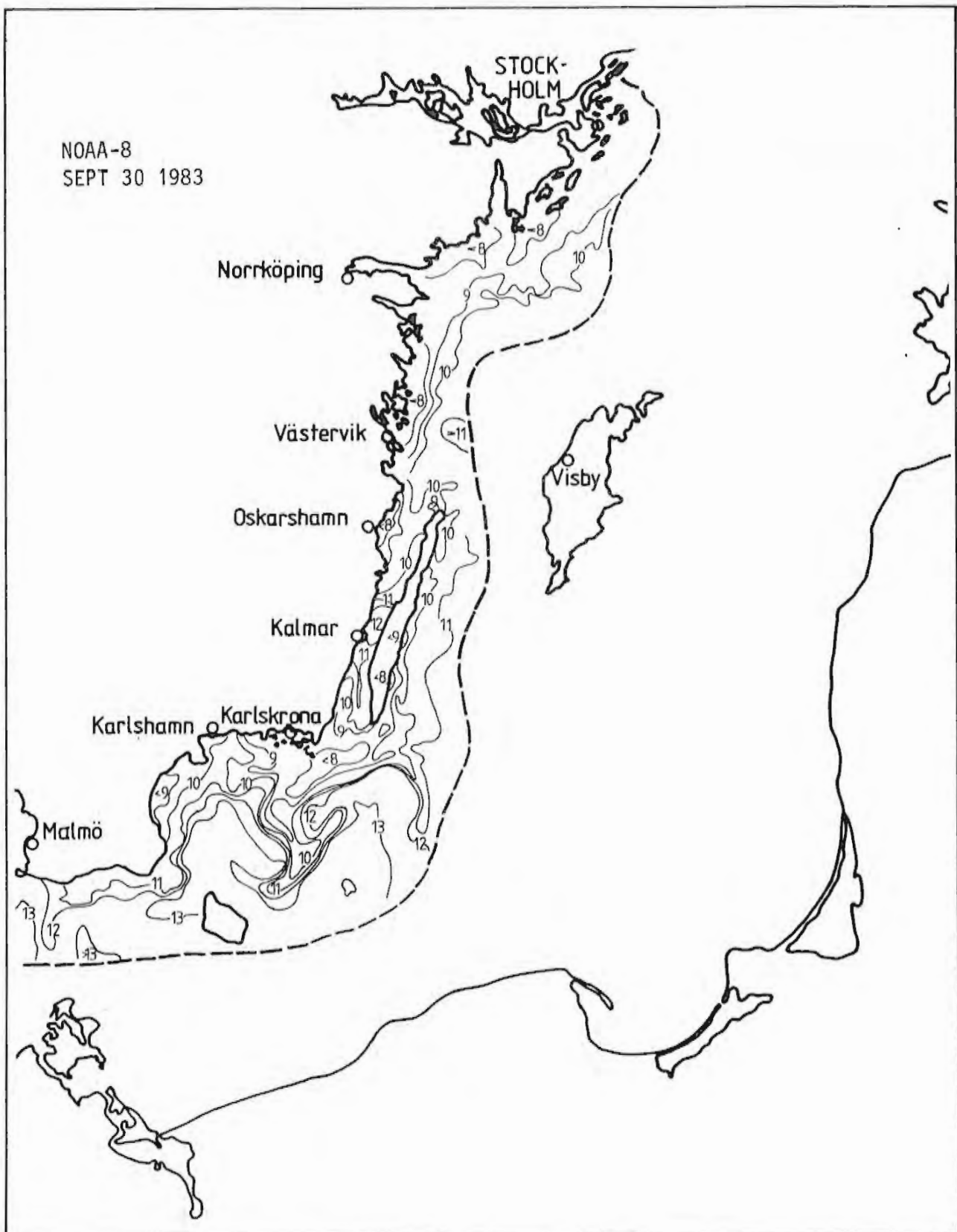
DEPTH	TEMP	SAL
M	C	°/∞
0.5	12.4	6.60
10.0	11.5	6.63
20.0	6.4	7.14
40.0	3.7	7.96
60.0	3.6	8.26











JULY AUGUST

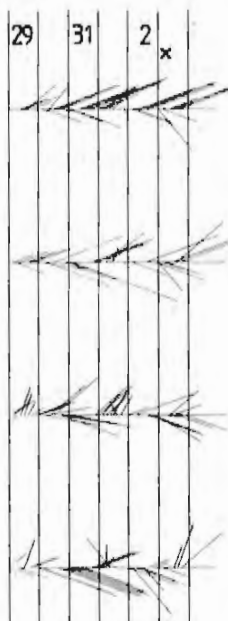
1981

ÖLANDS S UDDE

UNGSKÄR

HANÖ

FALSTERBO



HANÖBUKTEN

DATE: 810719

DEPTH	TEMP	SAL
M	C	°/oo
0.5	13.9	7.85
5.0	13.6	7.85
10.0	13.6	7.84
15.0	13.6	7.84
20.0	7.6	7.90
30.0	4.6	7.95
40.0	3.8	8.14
50.0	4.3	9.12

1981

KARLSKRONA

DATE: 810728

DEPTH	TEMP	SAL
M	C	°/oo
0.5	13.7	7.79
5.0	13.5	7.80
10.0	13.1	7.82
20.0	7.5	7.91
30.0	5.4	7.95

HANÖBUKTEN

DATE: 820827

DEPTH	TEMP	SAL
M	C	°/oo
0.5	14.2	7.65
5.0		
10.0	13.6	7.66
15.0		
20.0	11.6	7.70
30.0	5.4	7.82
40.0	4.1	8.14
50.0	4.6	9.00

1982

DATE: 820930

DEPTH	TEMP	SAL
M	C	°/oo
0.5	15.0	7.72
5.0		
10.0	14.9	7.72
15.0		
20.0	14.9	7.72
30.0	14.7	7.73
40.0	10.9	7.80
50.0	5.4	7.84

ÖLANDS S UDDE

DATE: 830913

DEPTH	TEMP	SAL
M	C	°/oo
0.5	14.7	7.89
10.0	13.8	7.93
20.0	8.8	7.91
40.0	4.9	8.21
50.0	4.4	8.43

1983

KARLSKRONA

DATE: 830917

DEPTH	TEMP	SAL
M	C	°/oo
0.5	13.1	8.07
5.0	13.1	8.08
10.0	12.4	8.10
20.0	8.6	8.27
30.0	8.4	8.29

SEPTEMBER

1 3 5 7 9 11 13 15 17

1982

GUSTAV DAHLEN

ØLANDS N UDDE

ØLANDS S UDDE

UNGSKÄR

HANØ

SEPTEMBER

10 12 14 16 18 20 22 24 26 28 30

1983

GUSTAV DAHLEN

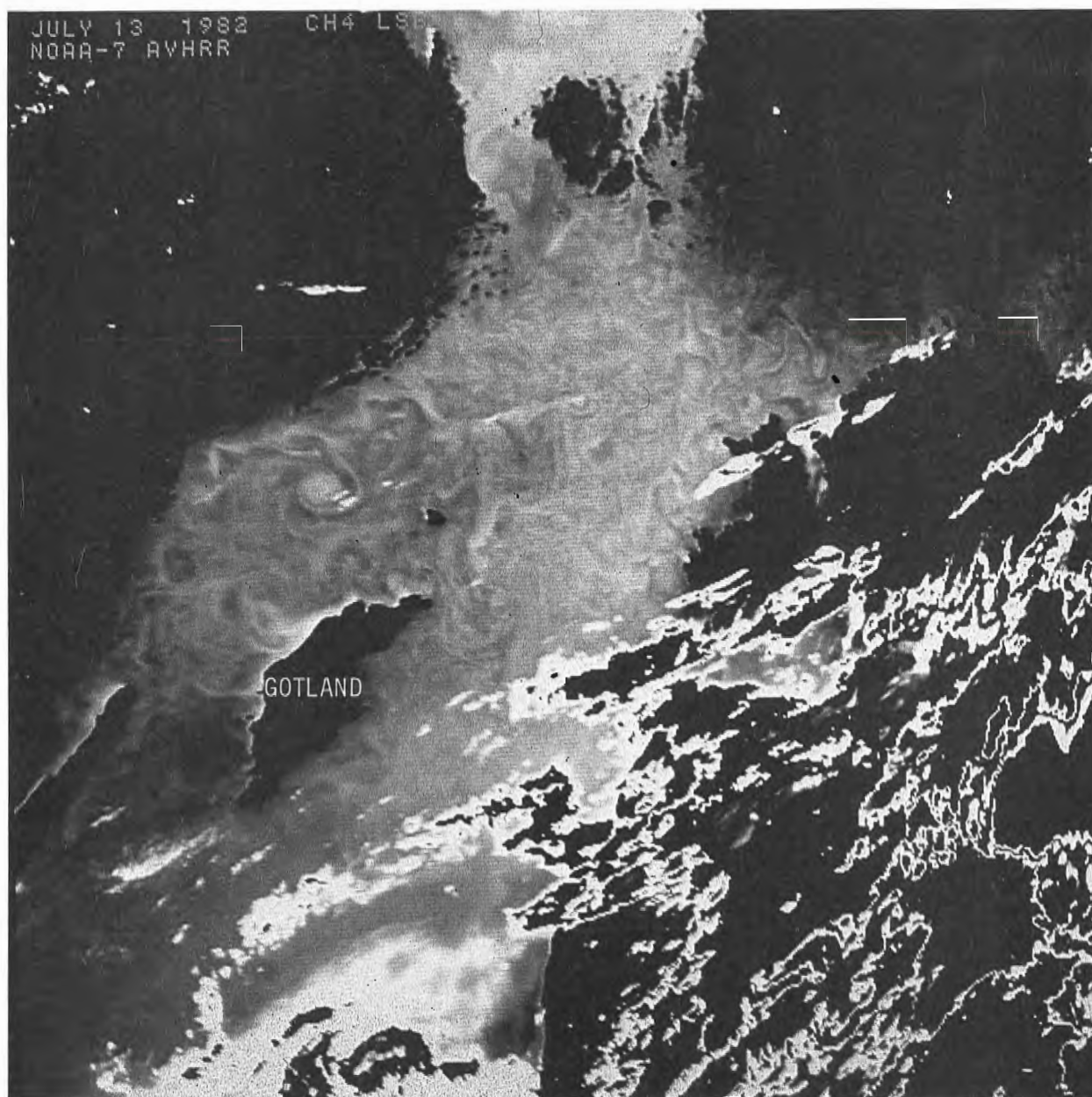
HOBURG

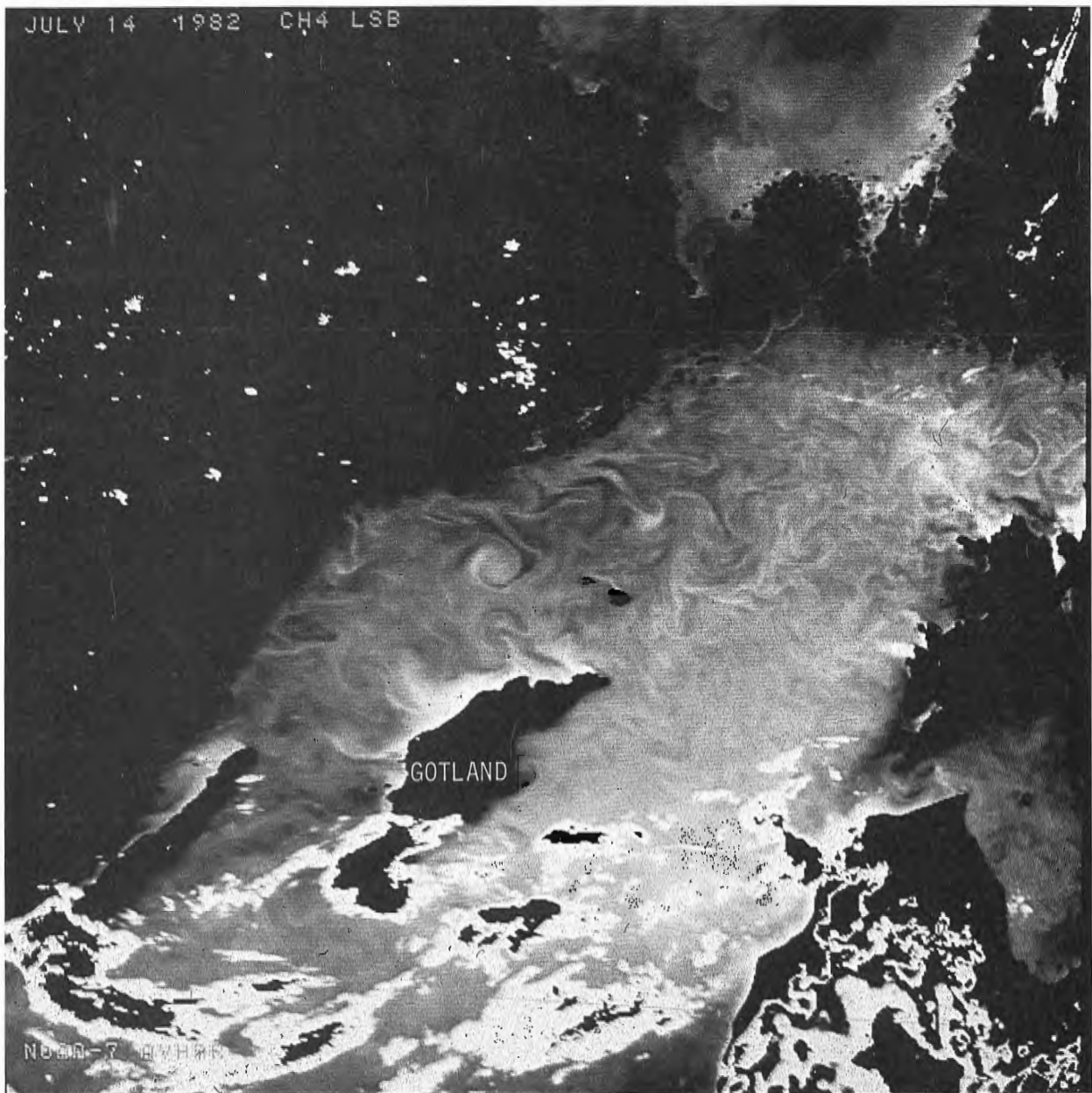
ØLANDS S UDDE

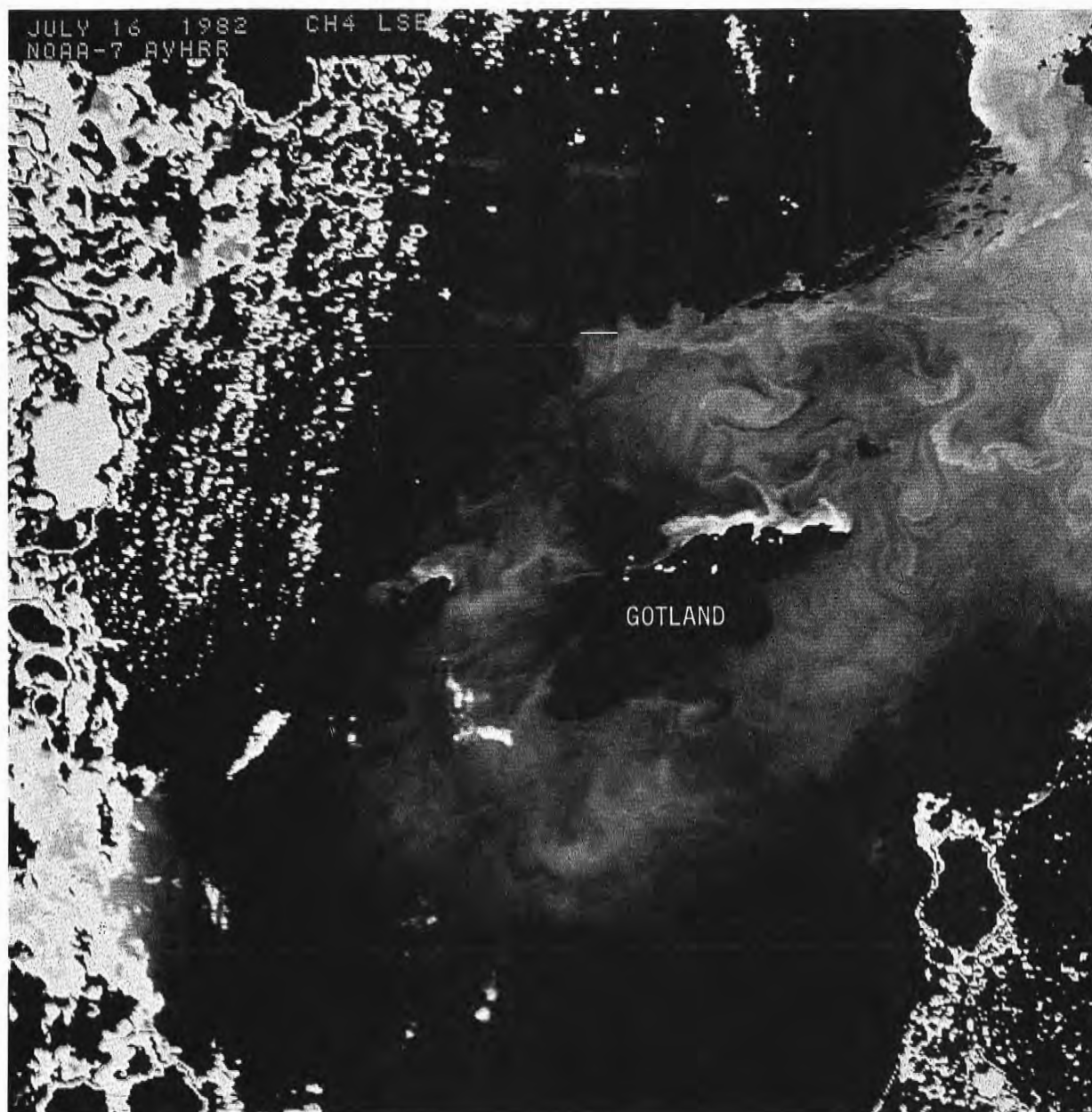
UNGSKÄR

SMYGEHUK

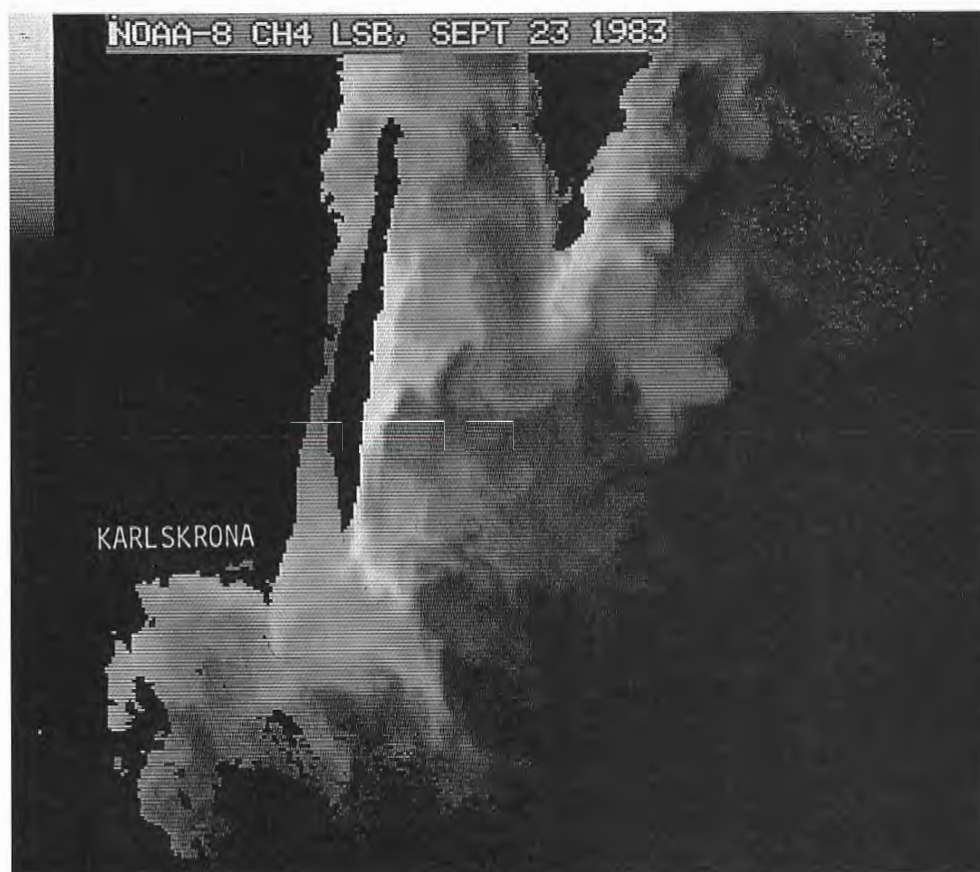
Wind vectors, north up. Wind speed scale: 1 cm = 10 ms⁻¹.

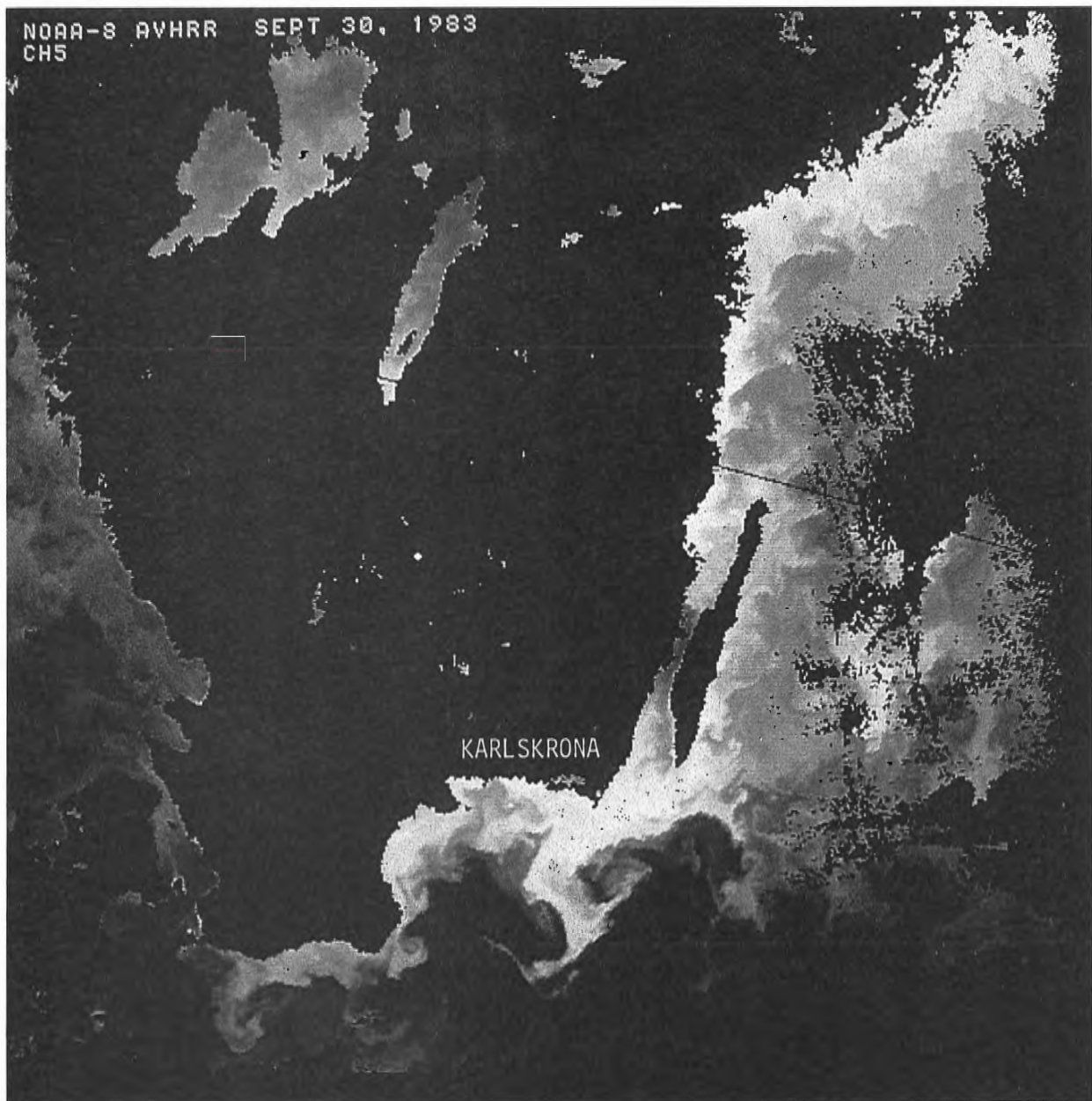




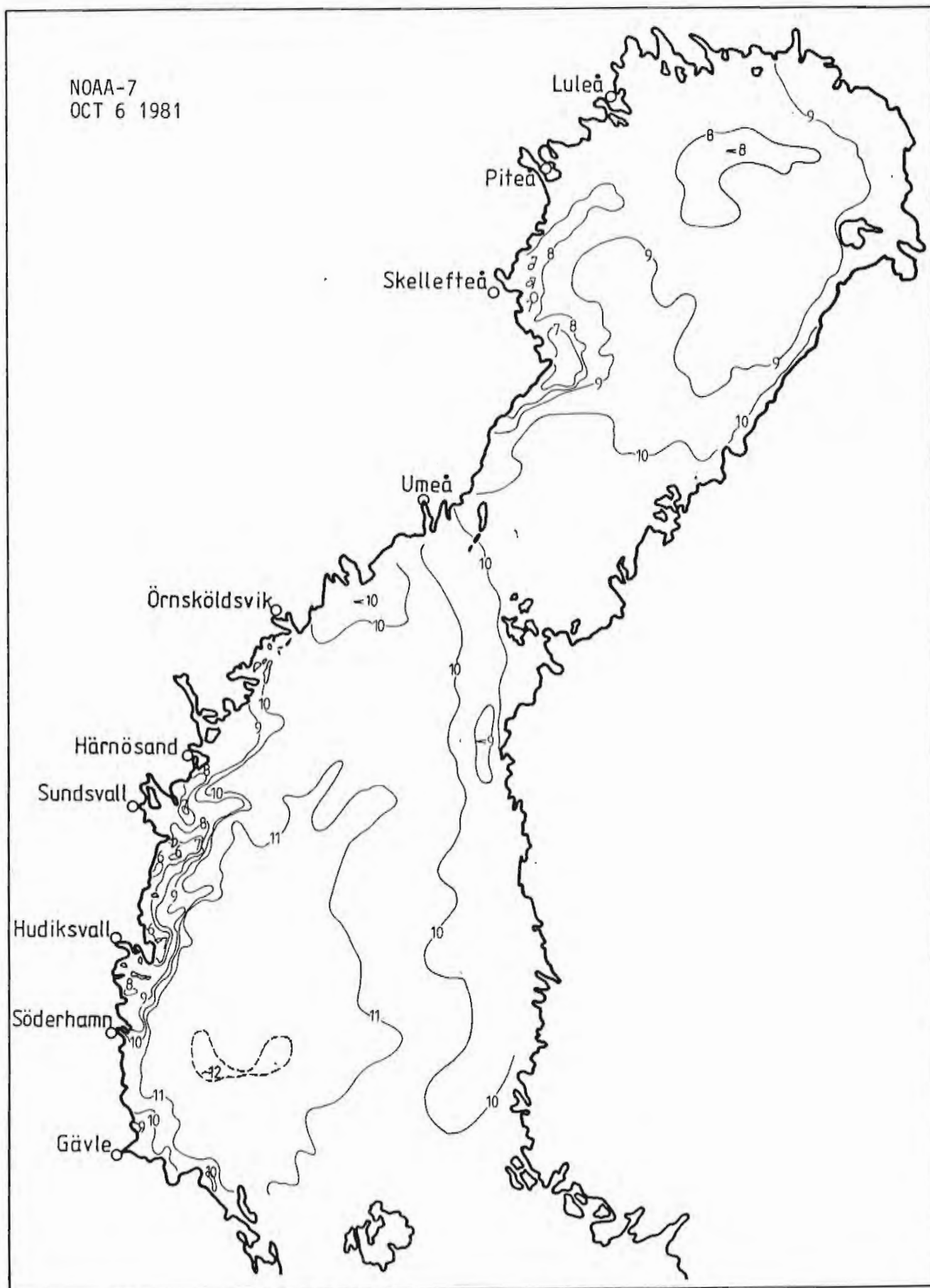


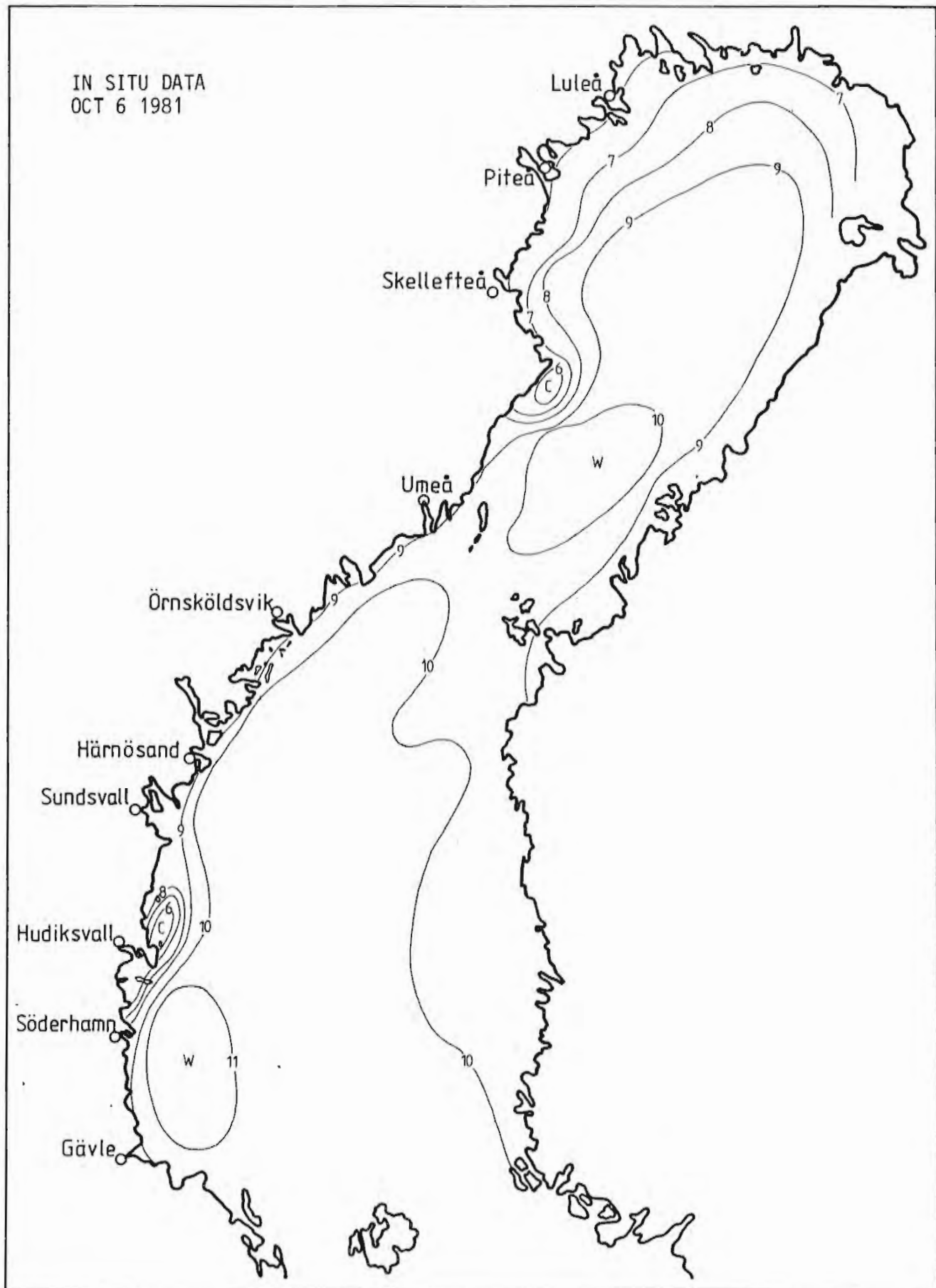


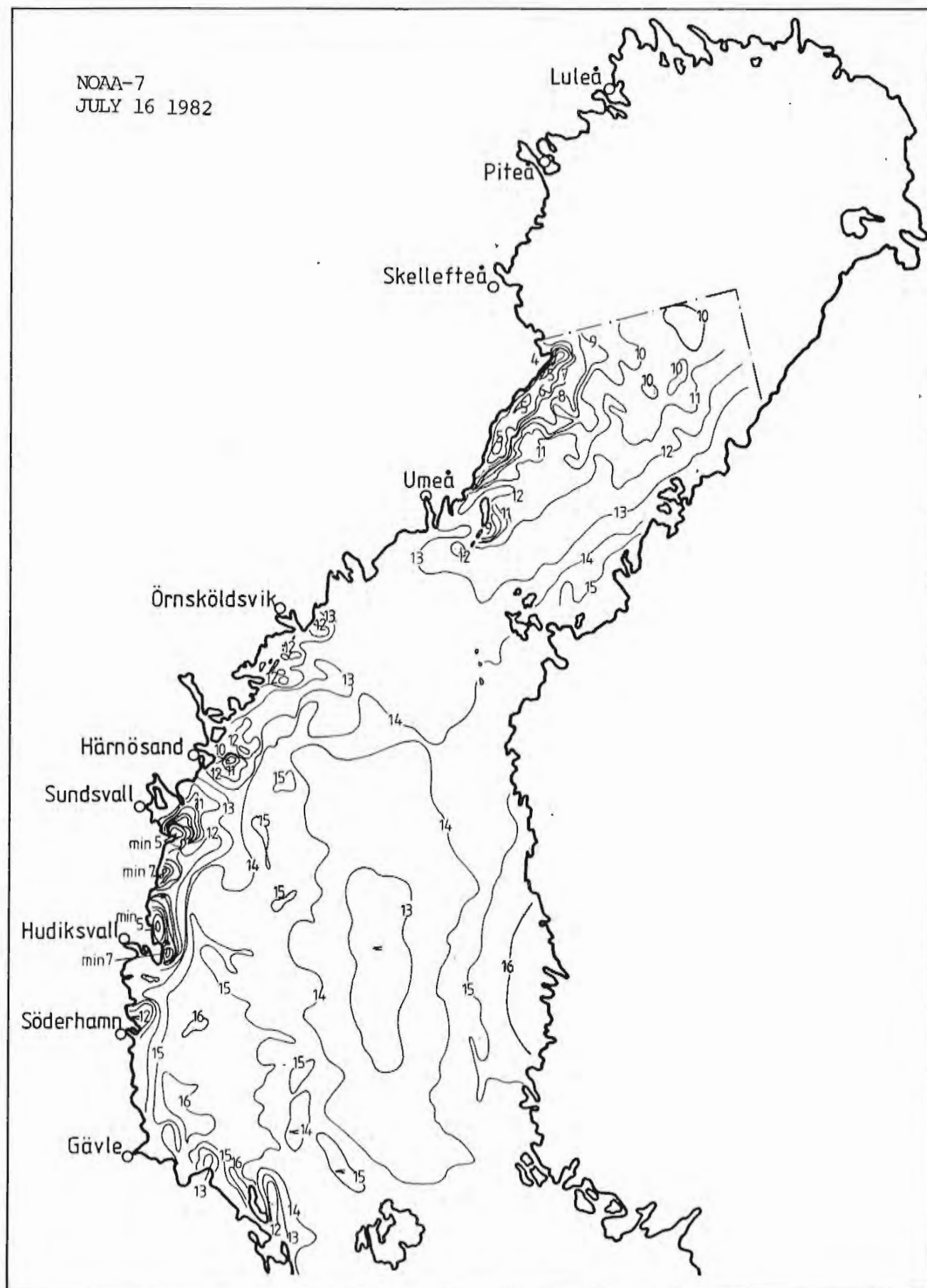


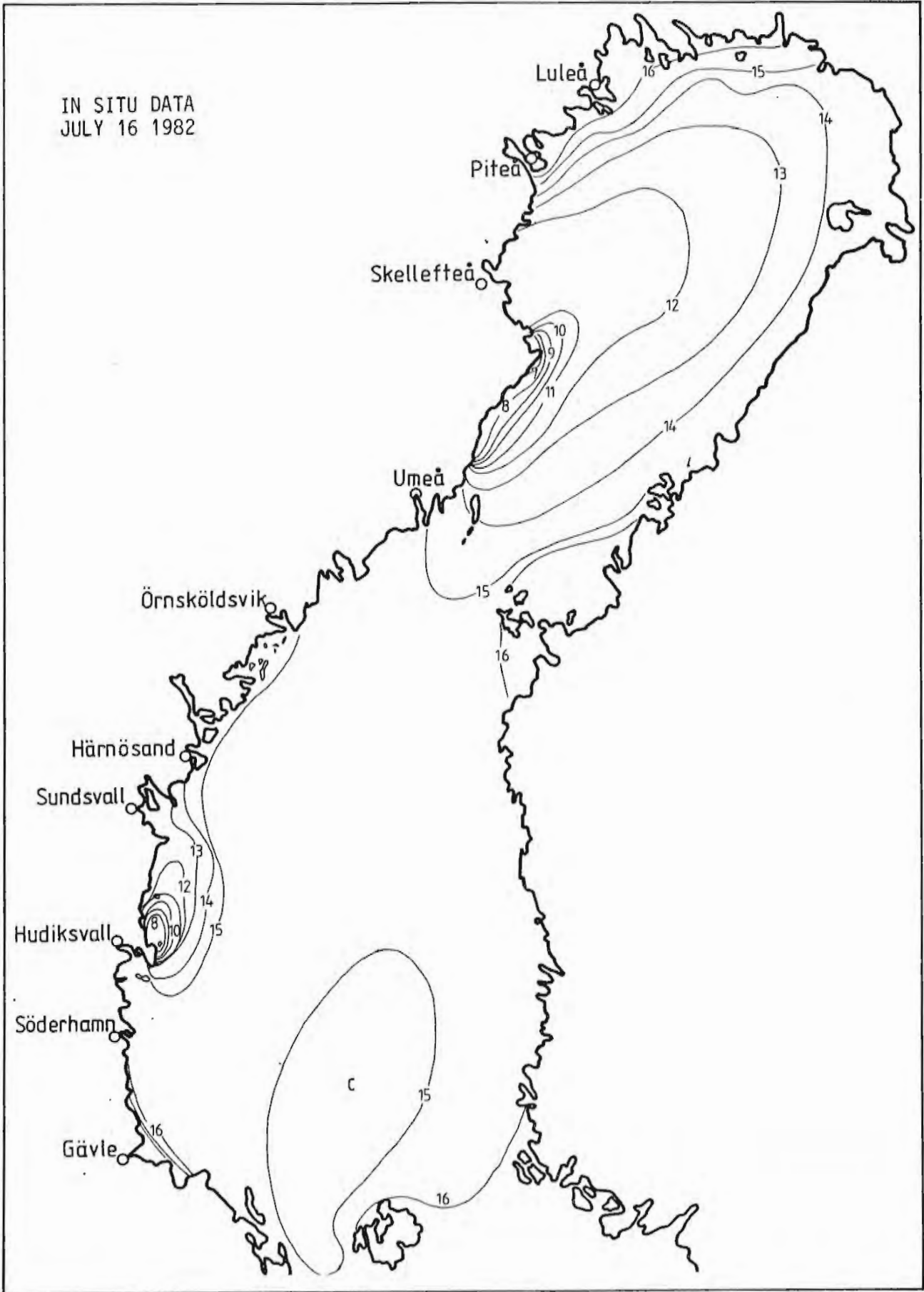


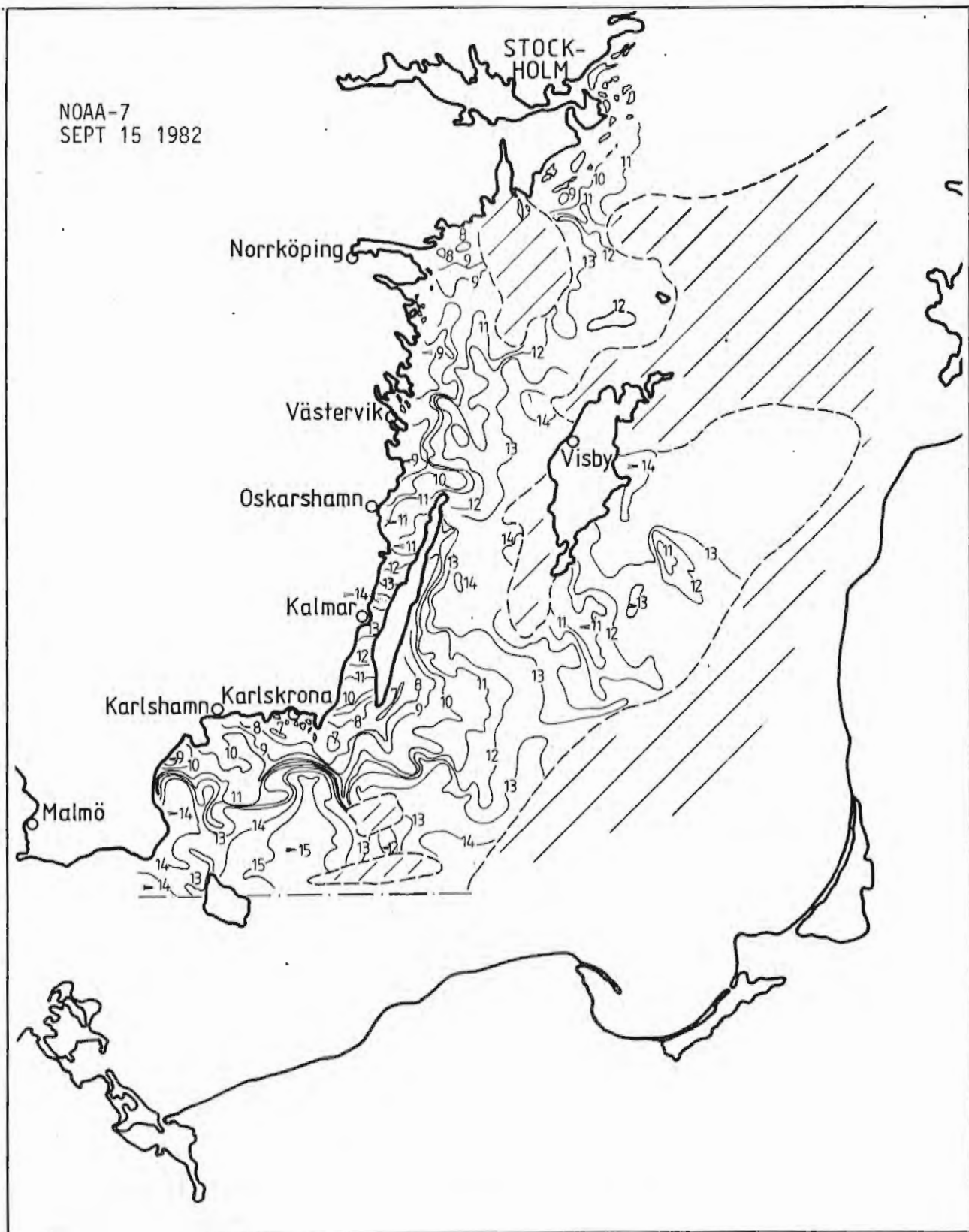


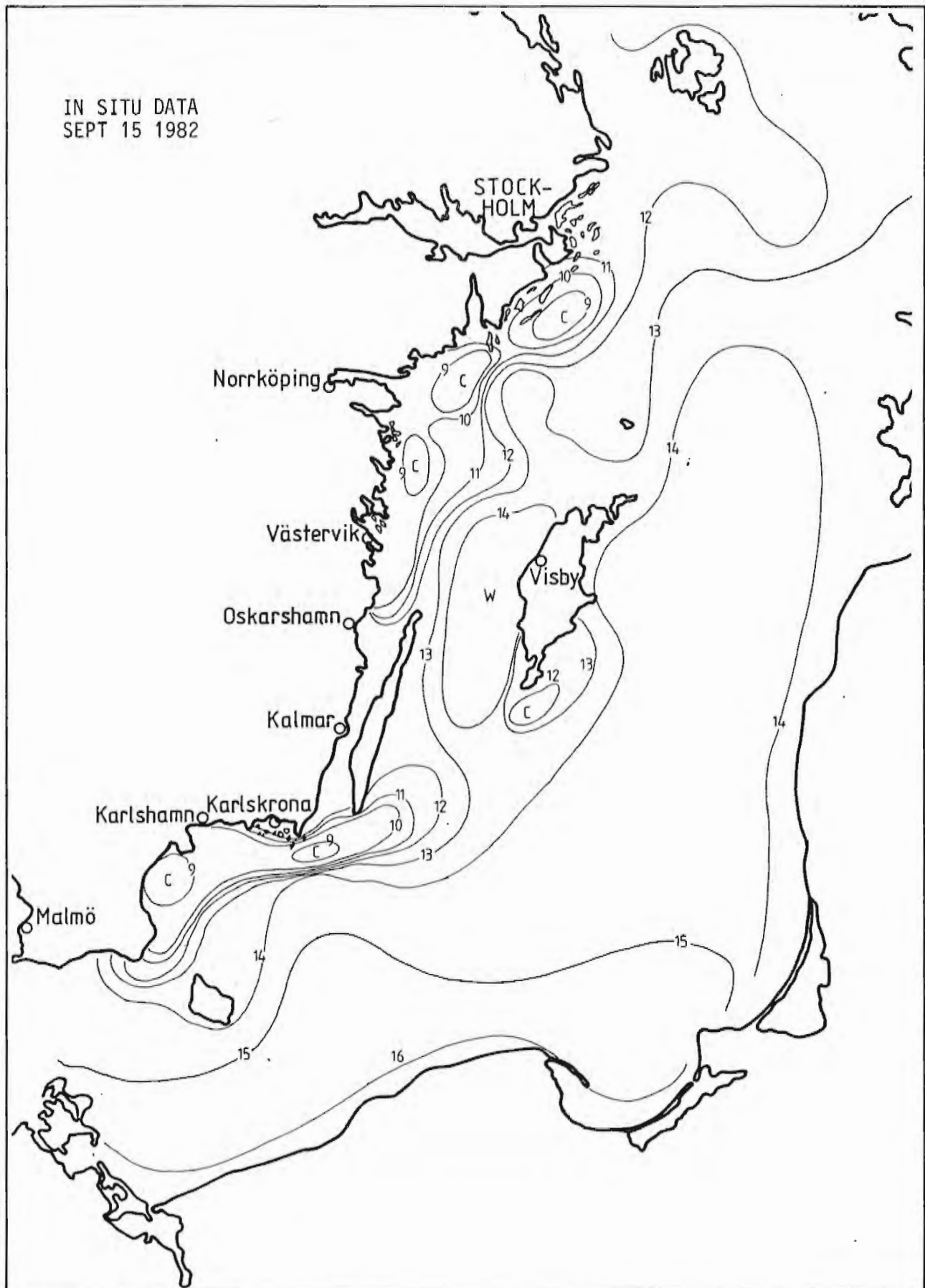


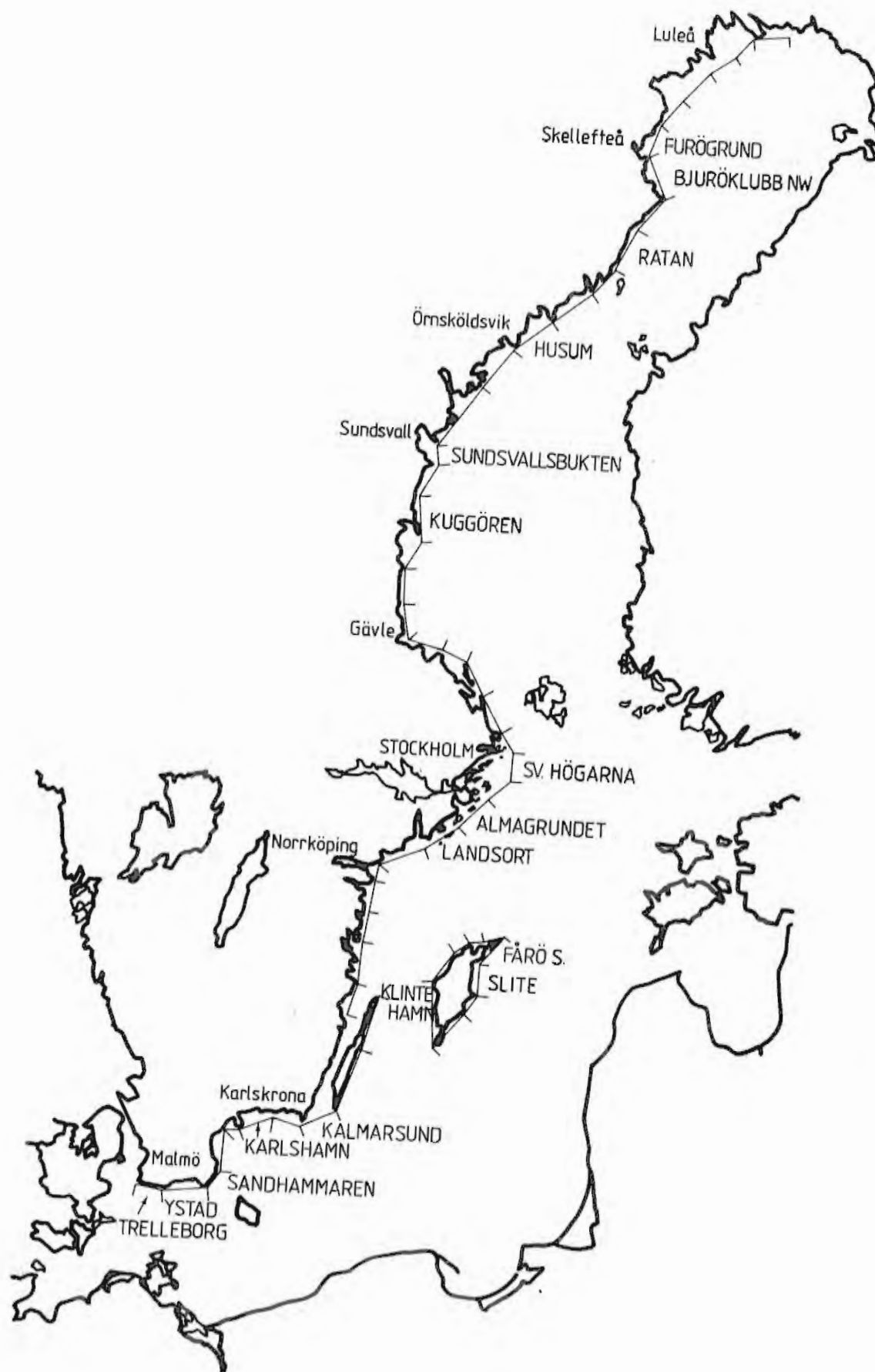










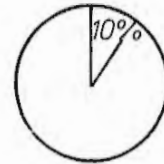
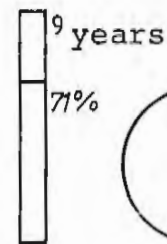
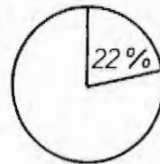
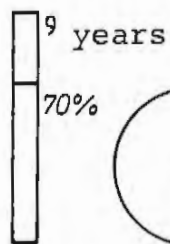
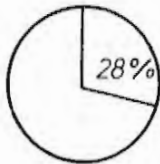
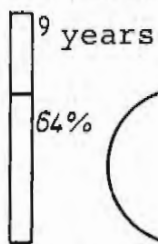


UPWELLING FREQUENCY IN PER CENT OF TIME

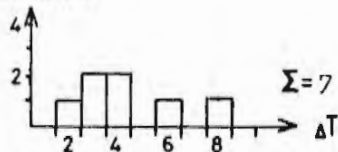
JULY	%	AUGUST	%	SEPTEMBER	%
1 TRELLEBORG	28	1 RATAN	25	1 KALMARSUND	37
YSTAD	28	2 KARLSHAMN	23	2 RATAN	30
3 RATAN	27	3 TRELLEBORG	22	3 KUGGÖREN	27
4 BJURÖKLUBB NW	22	YSTAD	22	LANDSORT NE	27
5 KARLSHAMN	18	5 FURÖGRUND	19	5 FURÖGRUND	25
6 KUGGÖREN	16	6 KUGGÖREN	16	6 ALMAGRUNDET	24
7 KALMARSUND	15	7 LANDSORT NE	15	7 KARLSHAMN	20
8 SUNDSVALLSB	7	8 KALMARSUND	13	BJURÖKLUBB NW	20
9 LANDSORT NE	5	9 BJURÖKLUBB NW	11	9 SUNDSVALLSB	18
10 FURÖGRUND	4	SANDHAMMAREN	11	10 HUSUM	14
11 HUSUM	2	11 SLITE	7	11 YSTAD	11
ALMAGRUNDET	2	12 ALMAGRUNDET	6	12 TRELLEBORG	10
KLINTEHAMN	2	SUNDSVALLSB	6	KLINTEHAMN	10
14 FARÖ S	0	14 KLINTEHAMN	5	14 SLITE	8
SV HÖGARNA	0	15 HUSUM	2	15 SV HÖGARNA	0
		16 SV HÖGARNA	0	FARÖ S	0
		FARÖ S	0		

Upwelling statistics 1973-1982: Measurement frequency, upwelling frequency in per cent of time, distribution of maximum temperature drop for each upwelling event.

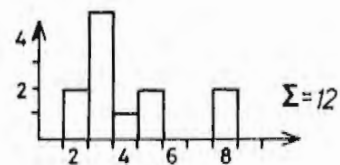
TRELLEBORG



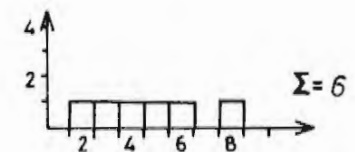
FREQUENCY



JULY

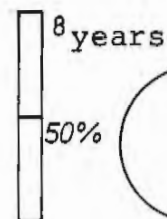
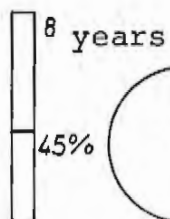
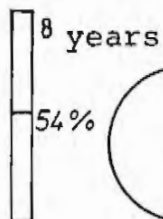


AUGUST

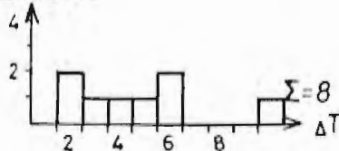


SEPTEMBER

YSTAD



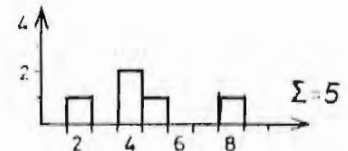
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JULY

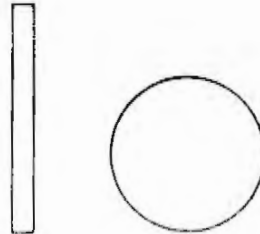
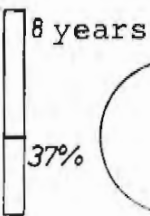
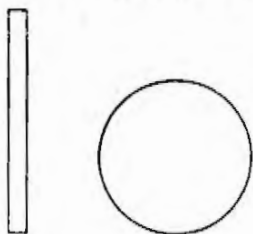


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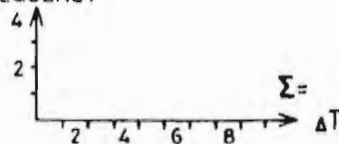


SEPTEMBER

SANDHAMMAREN



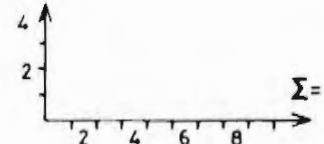
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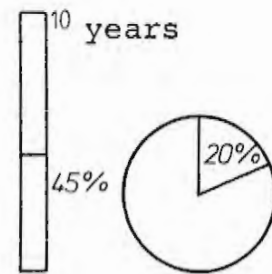
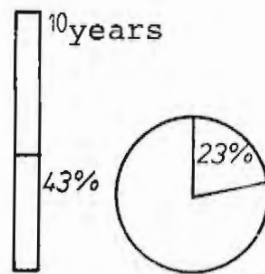
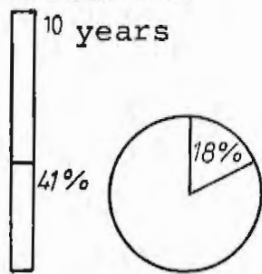


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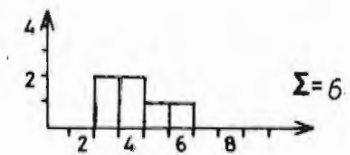
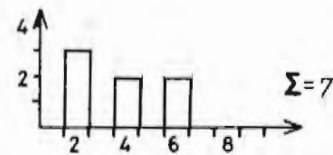
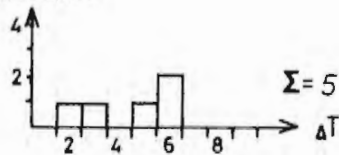


SEPTEMBER

KARLSHAMN



FREQUENCY

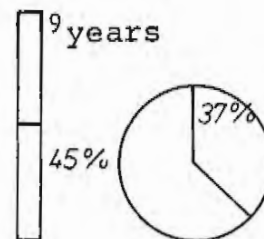
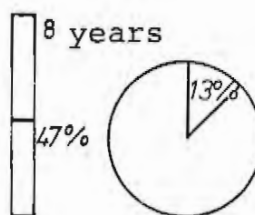
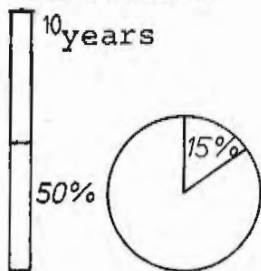


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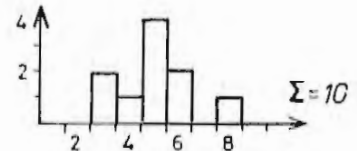
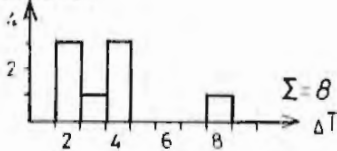
AUGUST

SEPTEMBER

KALMARSUND



FREQUENCY

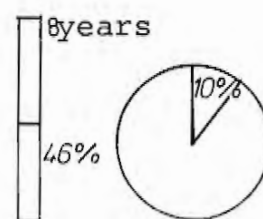
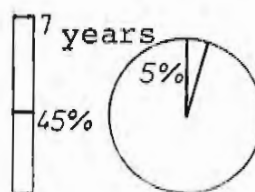
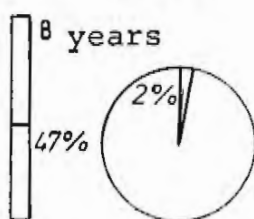


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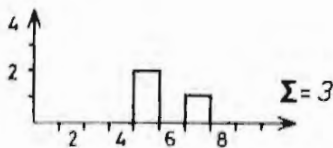
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SEPTEMBER

KLINTEHAMN



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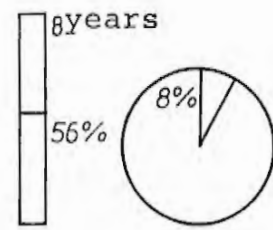
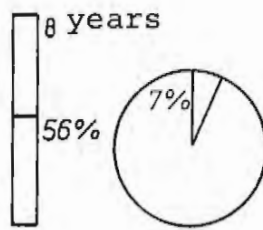
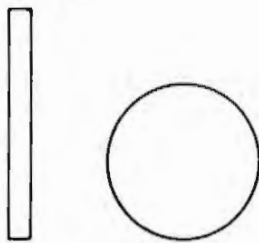


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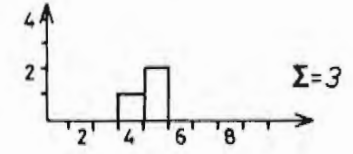
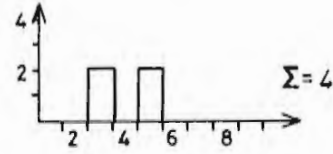
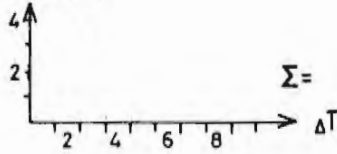
AUGUST

SEPTEMBER

SLITE



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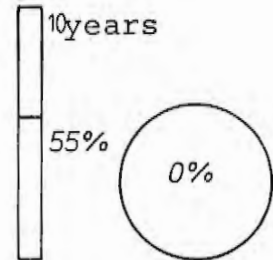
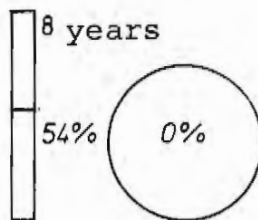
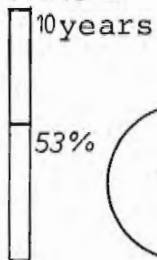


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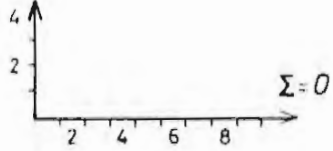
AUGUST

SEPTEMBER

FÄRÖ S.



FREQUENCY

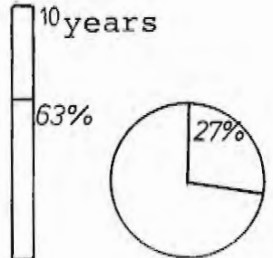
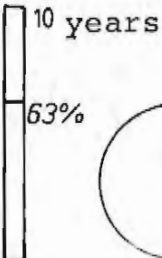
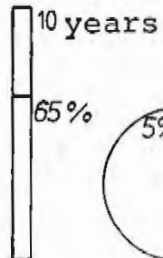


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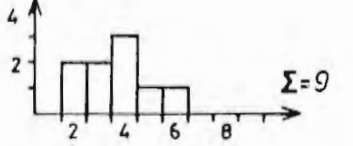
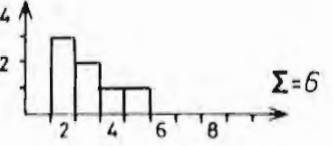
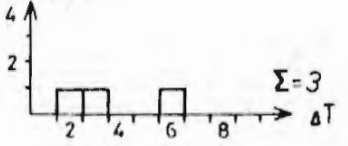
AUGUST

SEPTEMBER

LANDSORT



FREQUENCY

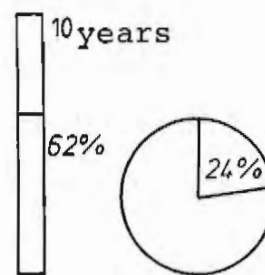
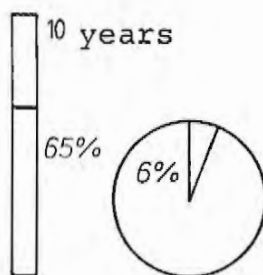
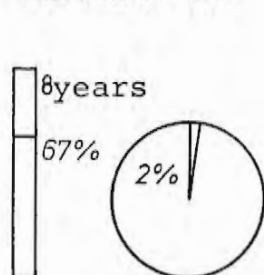


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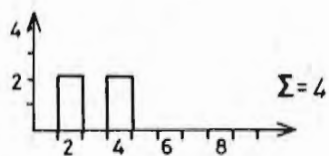
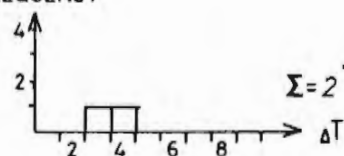
AUGUST

SEPTEMBER

ALMAGRUNDET



FREQUENCY

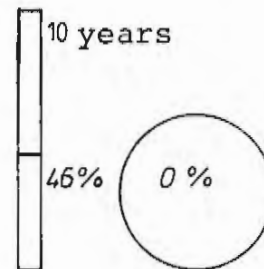
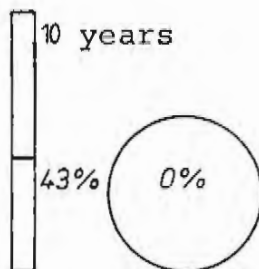
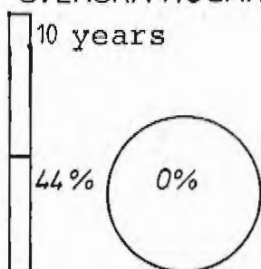


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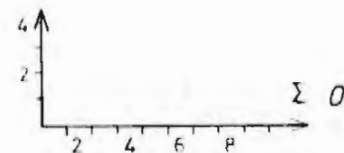
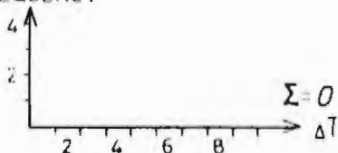
AUGUST

SEPTEMBER

SVENSKA HÖGARNA



FREQUENCY

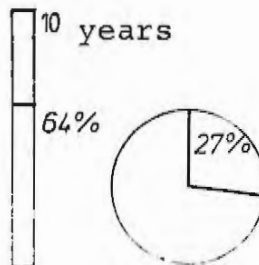
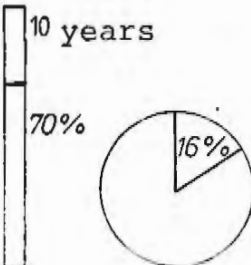
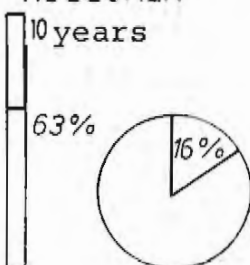


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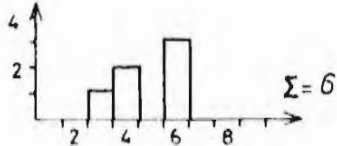
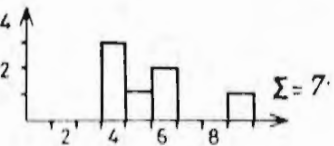
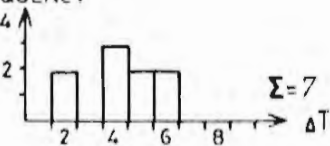
AUGUST

SEPTEMBER

KUGGÖREN



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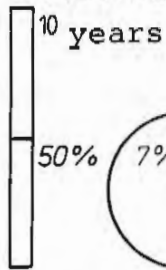


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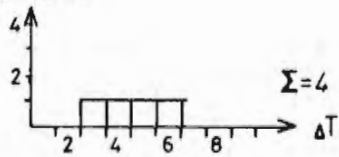
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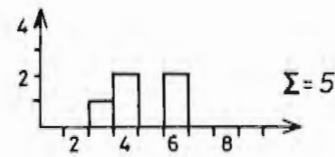
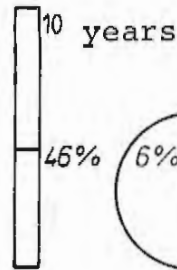
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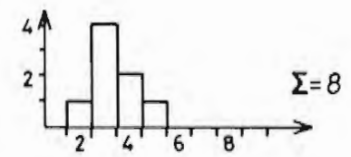
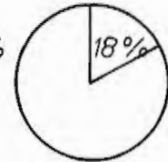
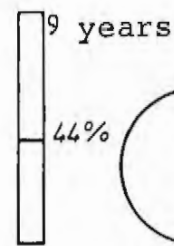
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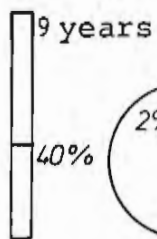


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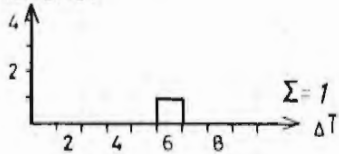


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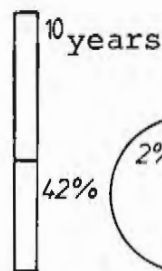
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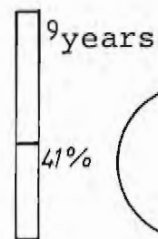
FREQUENCY



JULY

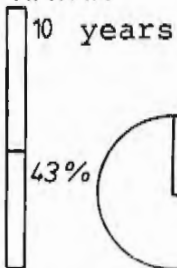


AUGUST



SEPTEMBER

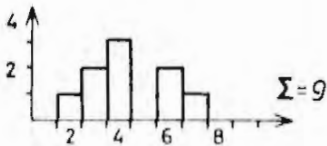
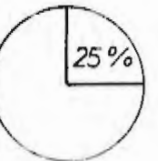
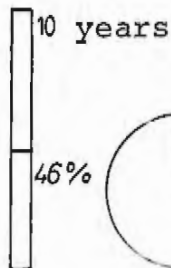
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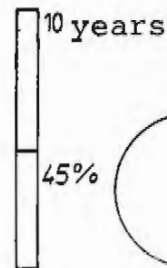
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JULY

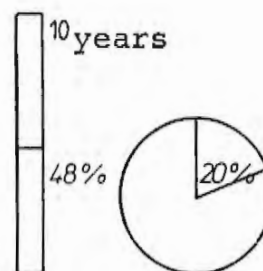
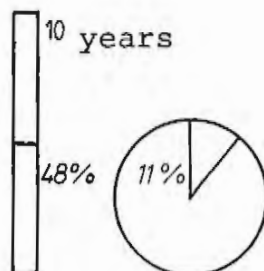
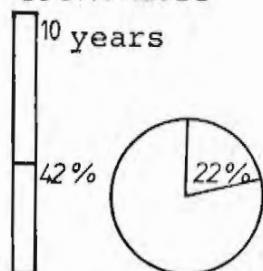


AUGUST

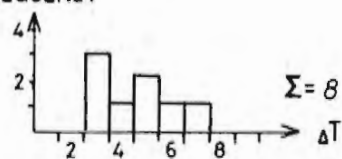


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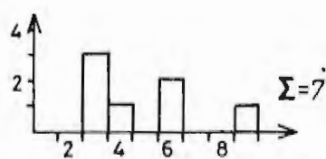
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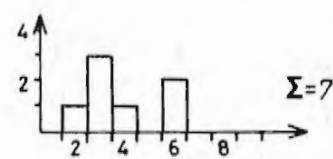
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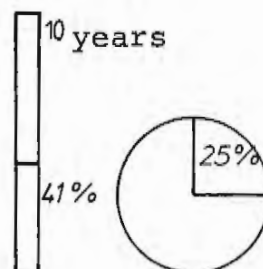
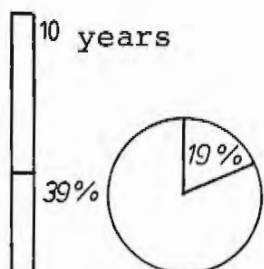
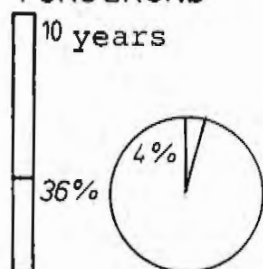


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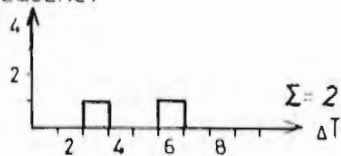


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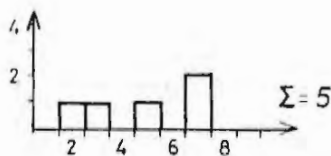
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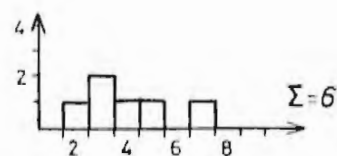
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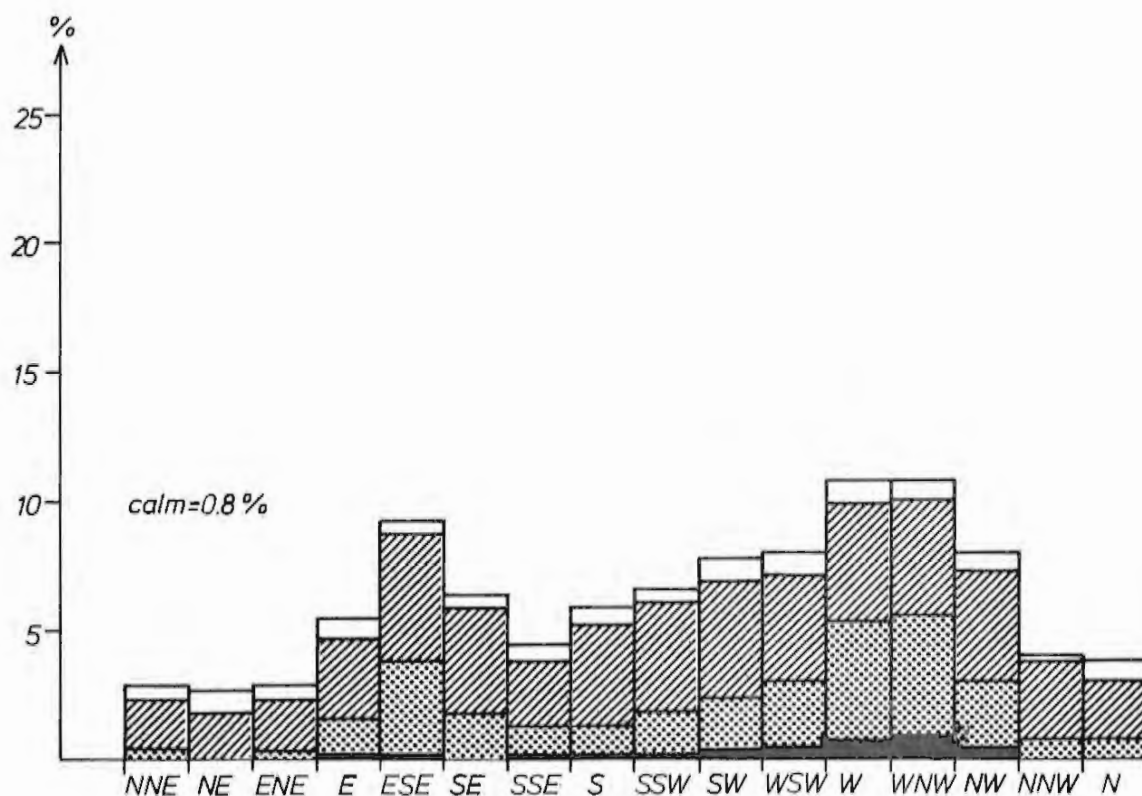
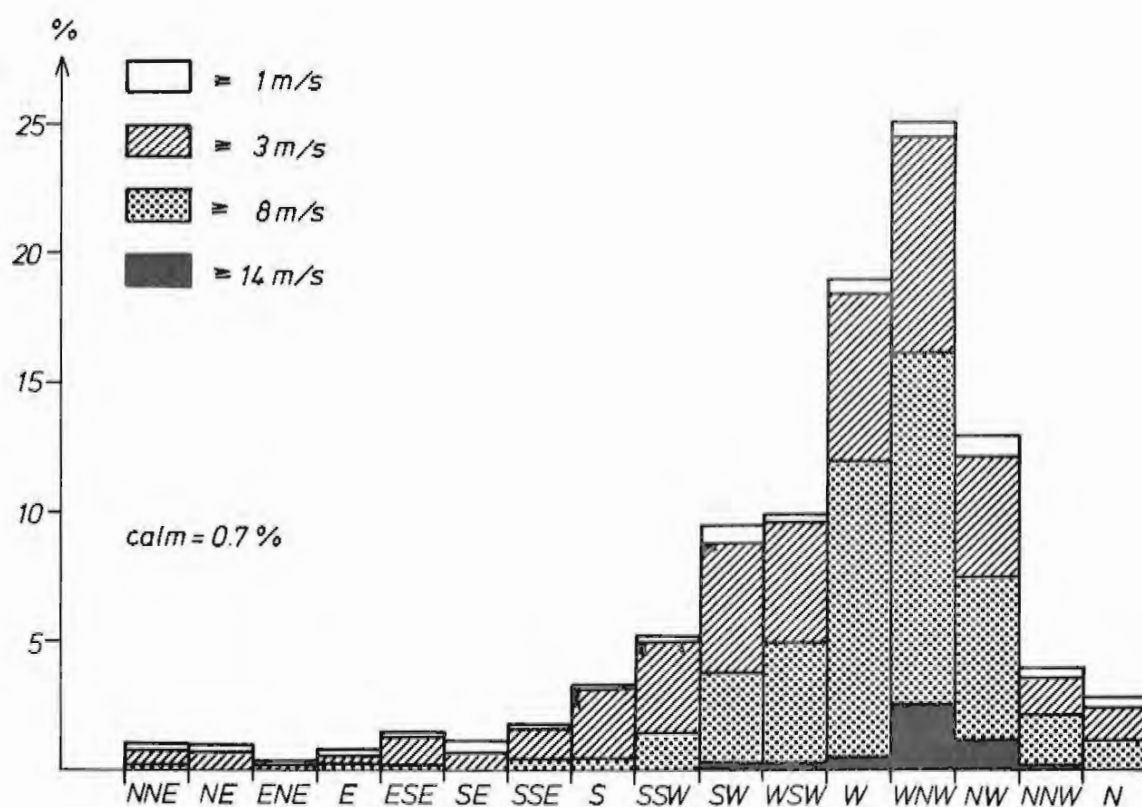
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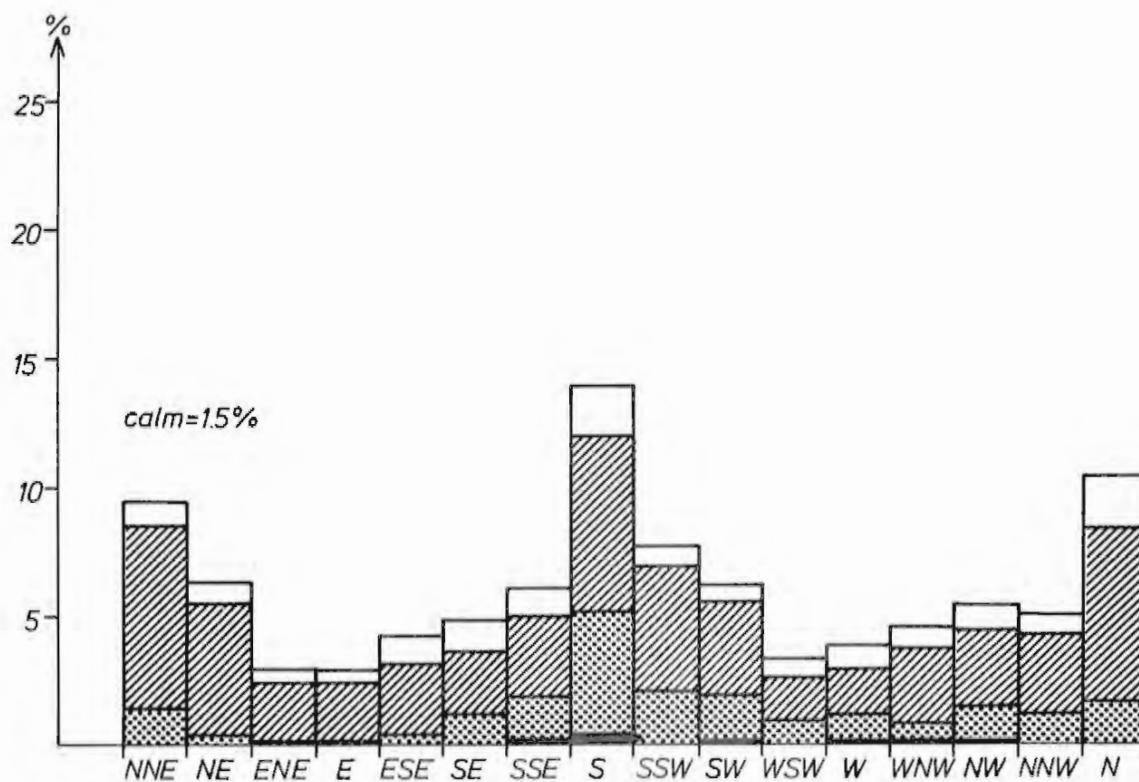
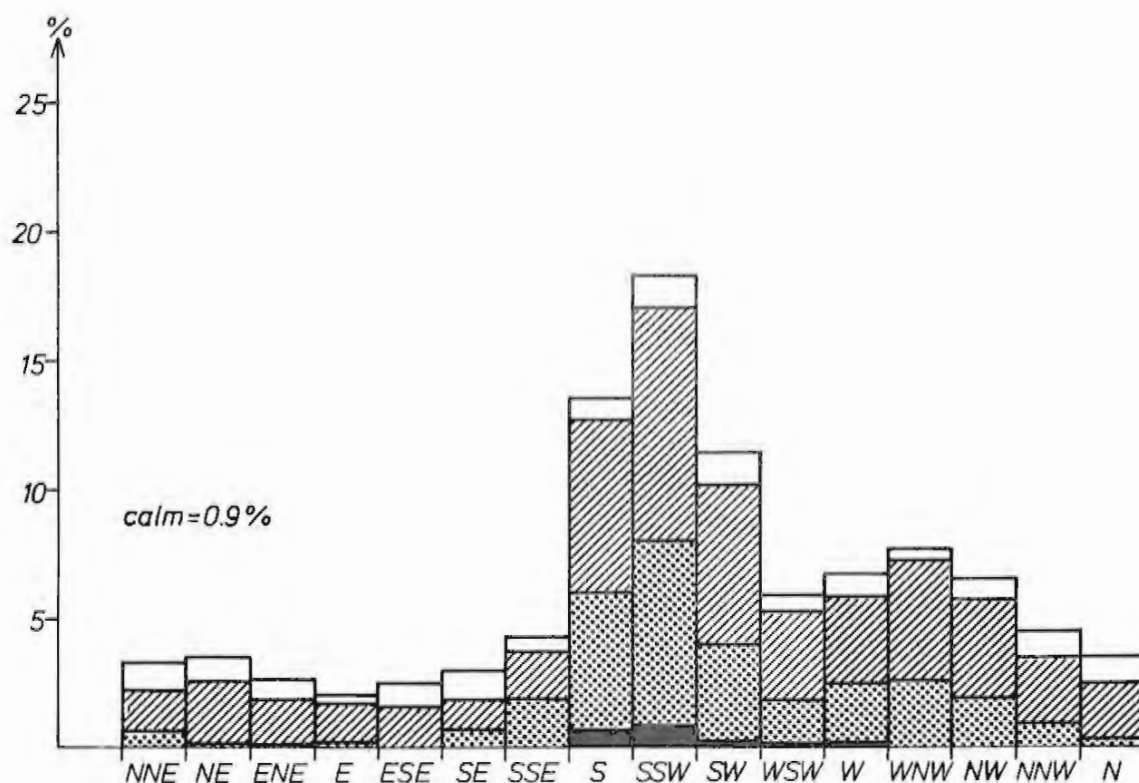
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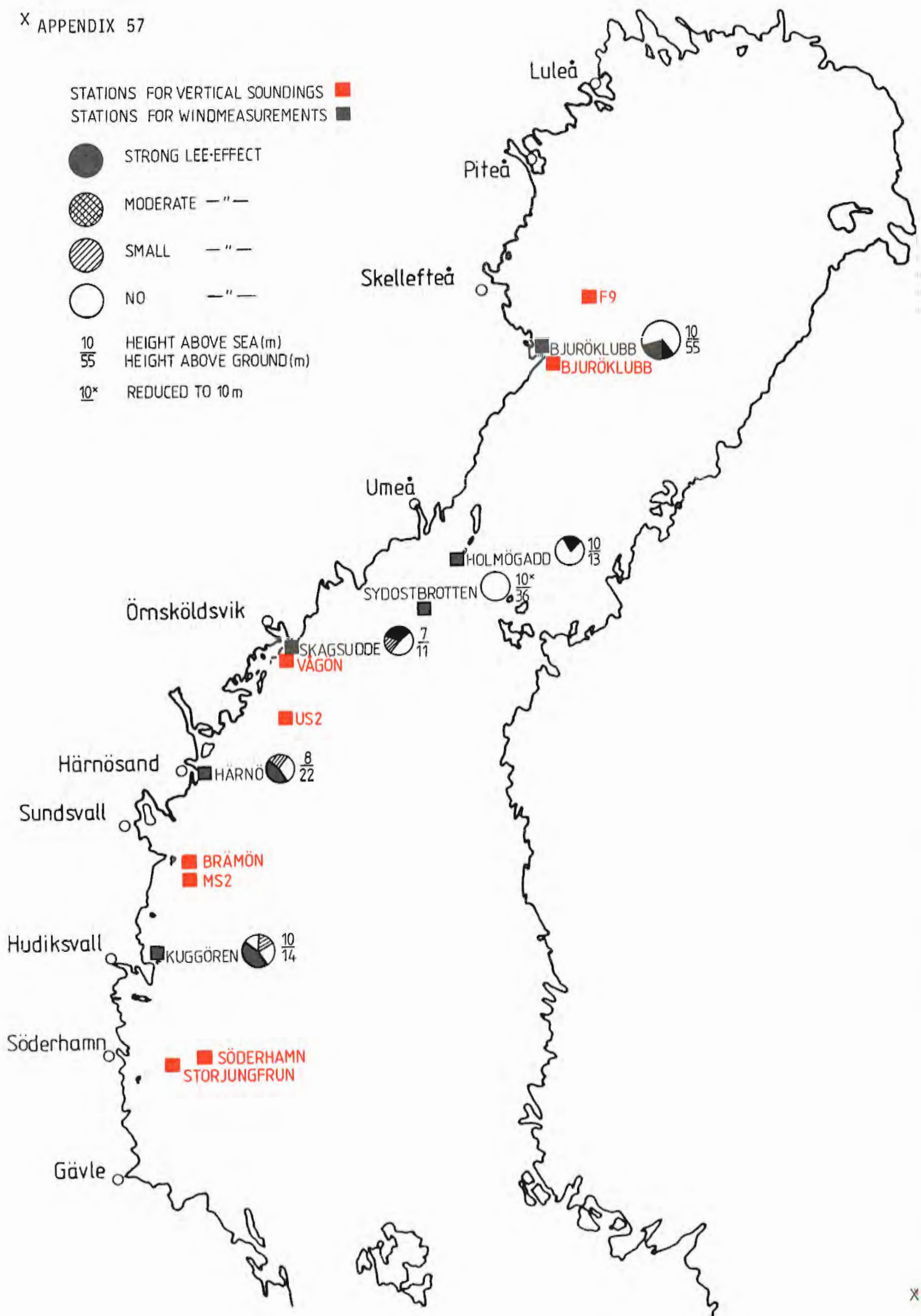
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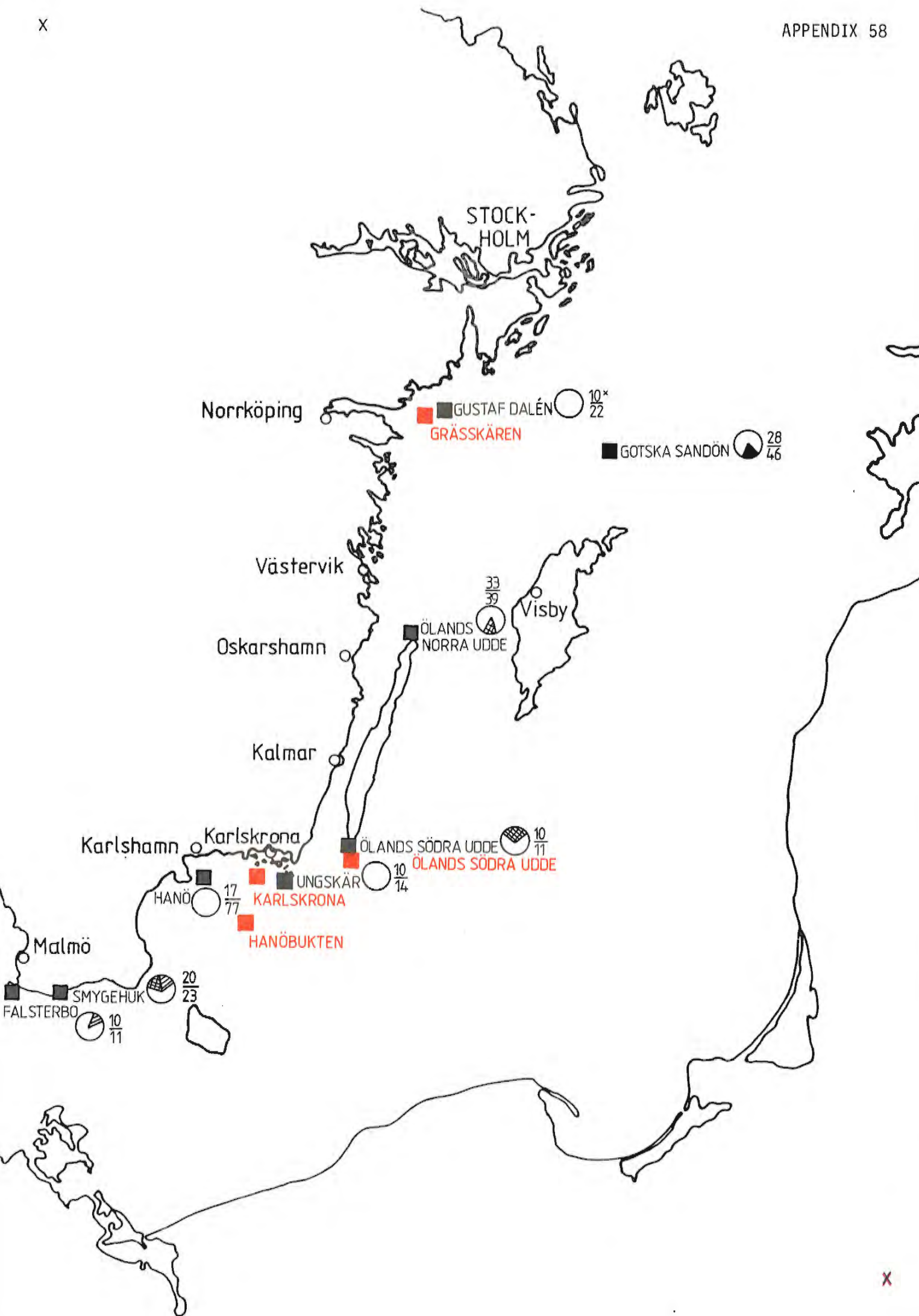


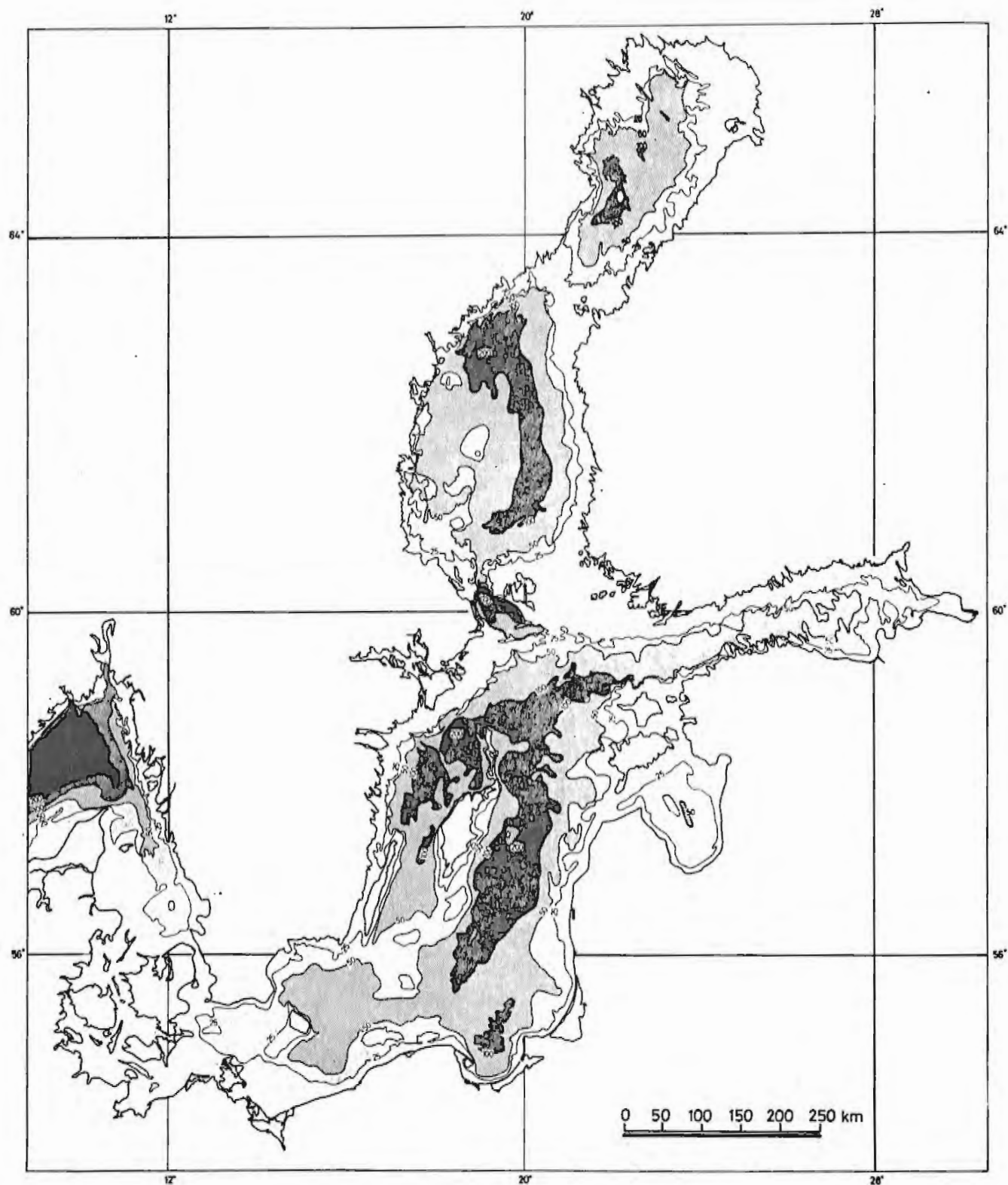
Wind statistics from Falsterbo station (represents Trelleborg coastal section) during July to September 1974-1982. Top diagram: 186 days of upwelling (calculated one day before the beginning to one day before the end of each upwelling event). Bottom diagram: 612 days of no upwelling.



Wind statistics from Holmögadd station (represents Ratan coastal section) during July to September 1974-1982. Top diagram: 219 days of upwelling (calculated one day before the beginning to one day before the end of each upwelling event). Bottom diagram: 579 days of no upwelling.







Bathymetric chart of the Baltic. The isobaths of 25, 50, 100 and 200 metres are marked.



SWEDISH METEOROLOGICAL AND HYDROLOGICAL INSTITUTE
S-60176 Norrköping, Sweden. Tel. +461158000. Telex 64400 smhi s.

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