SUPPLEMENT No. 401

Weather Conditions on the Northern Baltic at September 28, 1994.

Estonian Meteorological and Hydrological Institute.

Tallinn 1995.

ESTONIAN METEOROLOGICAL AND HYDROLOGICAL INSTITUTE

WEATHER CONDITIONS ON THE NORTHEN BALTIC AT SEPTEMBER 28, 1994

Tallinn

Stormy night on Baltic sea September 27-28, 1994.

Meteorological conditions.

September 27, in the morning at 06 GMT, a new Low formed over South Norway.The developing Low moved quickly towards east-northeast and reached September 28 at 00 GMT Aland archipelago.
During this period south, soutwesterly winds gradually icreased.

Wind.

About weather conditions at night of the shipwreck of the ferry "Estonia" we can judge by data observed on meteorological station Ristna (peninsula Kõpu, Hiiumaa), the nearest available station to the place of the shipwreck and characterising best of all the weather condition in the Northen Baltic.

Tab.1 Wind speed in **Ristna** and theoretical heights of waves in Northen Baltic

Data	Time (GMT)	Direction	Mean speed (m/s)	Gusts (m/s)	Height of waves, mean/max (m)
27.09.	11	SW	12	16	2-4/ 5
"	14	SW	12	16-17	2-4/ 5
"	17	SW	8	12-16	2-4/ 5
"	20	S, SW	8	14-15	2-4/ 5
"	23	SW	16	21-22	4-6/ 7
28.09.	02	SW	15	22-23	5-7/ 8
"	05	W	18	24-29	6-7/ 9
"	08	W	17	26	6-7/ 9
"	11	W	12	18	4-6/ 7

Additional storm information from observation stations:

1.Ristna - Sept. 27	20.45 GMT	230°	9-16 m/s
- Sept. 28	02.36 GMT	240°	15-25 m/s
"	03.00 GMT	260°	20-29 m/s
2.Vilsandi -Sept.27	21.25GMT	230°	15-20 m/s
Sept.28	03.30GMT	240°	15-20 m/s
"	07.25GMT	260°	20-27 m/s

We can see that before midnight (GMT) the speed of the SW wind was up to 20 - 22 m/s in gusts.
Maximum wind speeds - 25 -30 m/s in gusts were observed between 00 and 03 GMT (02-05 local time) September 28, which was connected with passing of the cold front.

Waves.

The (theoretical) height of waves is determined by method of the State Oceanografical Institute USSR. By this method were made wave height field maps, taking into concideration direction,speed and time of affect of the wind. From these maps were taken the heights, given in the table above and which were dominating in the "Estonia" shipwreck region at night September 28 1994 .
The dominating theoretical height of waves in the evening September 27 in the Northen Baltic was about 2-4 m, increased toward midnight and at the time of the shipwreck it was 4 - 5m. Early in the morning September 28 wave heights at the mentioned place were not more than 5 - 7 m.

The maximum wave heights in the Northen Baltic could be 6 - 7 m before and up to 9 m after shipwreck.

Forecasts.

In the morning September 27 were given galewarnings and forecast about increasing soutwesterly wind 12-17 m/s and wave heights 2-3 m at the Northen Baltic in the afternoon.
At 12.30 (GMT) September 27 a new warning was given about increasing SW wind to 17-20 m/s in the evening and veering to W in the morning September 28.

Tiiu Marmor
Chief of the hydrological forecast section

Ivo Saaremäe
Vice director of the Meteorological Centre

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The BALTIC SEA STORM on 28.9.1994

An investigation into the weather situation which developed in the northern Baltic at the time of the accident to m/s Estonia

Marja-Leena Komulainen

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THE BALTIC SEA STORM ON 28.09.1994

Abstract

At the time m/s Estonia sunk the weather was stormy. This storm was caused by a depression, typical for the time of year, which moved across the Baltic Sea and Gulf of Bothnia on the night 28.09., when the accident occurred. On the evening preceding the accident the wind in the accident area blew ahead of the front from the south or south-south-east with a mean speed varying between 12 and 15 m/s. According to the weather data the front passed the accident location at about 19 UTC, after which the prevailing wind direction was from between south-west and west. At 21 UTC the mean wind speed in the accident area was approx. 18 m/s, with gust up to 24 m/s. At 00 UTC (02 local time) a south-westerly wind with a mean speed of approx. 20 m/s prevailed, the strongest gust measured between 00 and 03 UTC being 29 m/s at Ristna. At 03 UTC the wind blew from the west, later veering further to between west and north-west, at which time the mean wind speed was 23 m/s, with a gust maximum of over 27 m/s. At Finnish stations the highest wind speeds were measured at about 06 UTC (08 local time). In the early hours of the morning the sea temperature was approx. 13 deg. C and the air temperature about 10 deg. C International shipping receives weather information through various different channels. Over the Baltic Sea region weather forecasts and warnigs in English are disseminated by coastal radio stations. On 27.09. and 28.09. gale warnings issued by FMI were transmitted over VHF channels by Helsinki and Mariehamn coastal radio stations. The storm warning was heard on the Finnish Broadcasting Company's Radio Suomi in Finnish and Riksradio in Swedish as part of the regular marine weather broadcasts. Strong wind and gale forecasts are issued in English by the Navtex system. According to an agreement made in 1983, Sweden coordinates weather warning activities on this system in the Baltic Sea region. The Baltic area has recently seen the emergence of several newly-independent countries. Coordination of the wind forecasts and warnings issued by different countries for international shipping in the same area needs to be strengthened.

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CONTENTS

1. INTRODUCTION

2. DEVELOPMENT OF THE WEATHER SITUATION
2.1 The weather from 18 UTC on 27.9.1994 onwards

3. METEOROLOGICAL DATA
3.1 Weather observations from synoptic and automatic stations (see Annex 1)
3.2 Surface weather analyses
3.3 Upper air analyses
3.4 Satellite images (see Annex 2)
3.5 Weather radar images (see Annex 3)
3.6 Lightning location data (see Annex 4)
3.7 Verbal and tabular weather forecasts (see Annex 5)
3.8 Other data (see Annex 6)

4. SUMMARY
ACKNOWLEDGEMENTS
REFERENCES
ANNEX 1 Weather observations from synoptic and automatic stations
ANNEX 2 Satellite images
ANNEX 3 Weather radar images
ANNEX 4 Lightning location data
ANNEX 5 Verbal and tabular weather forecasts
ANNEX 6 Other data

1. INTRODUCTION

Early on the morning of 28th. September, 1994, the Finnish Meteorological Institute (hereafter FMI) received news of the occurrence of a major marine disaster, the loss of the m/s Estonia, off the island of Utö.

The FMI put at the disposal of the Ministry of Communications and the international commission of inquiry its expertise to carry out an analysis of the weather situation prevailing on the night of the accident (letter no. 14/090/94 dated 3.10.1994 from the FMI to Minister Ole Norrback). In support of this, observations from FMI weather stations near the location of the accident, weather map material and Doppler weather radar network data for the hours preceding and following the accident have been collated in this report. FMI marine weather forecasts from the preceding evening and the night of the accident have also been included. The weather analysis has been made with especial care regarding the track of the deepening depression and the movement of the associated fronts. Changes in the direction and speed of the wind affected the formation of waves and e.g. the drift direction of the lifeboats and rafts.

Finnish marine lifesaving centres receive wind forecasts for different sea areas twice daily. The Archipelago and Åland coast guard districts received such wind forecasts from FMI on 27.9.1994, the day preceding the accident, at about 9.30 and 21.30 local time. (In this report, local time is used to denote Finnish local time, 2 hours ahead of UTC). In addition to these, the Finnish Broadcasting Company broadcast marine weather forecasts and a storm warning for the area at 19.10 and 22.10 in Finnish and at 19.10 and 22.05 (all times local) in Swedish. Helsinki coastal radio broadcast forecasts and warnings in English at 21.33 and Mariehamn coastal radio at 22.33 local time. Supplementary information for those taking part in the rescue operations was given by FMI Central Weather Service marine forecasters and by forecasters at the Southern Finland Regional Office and its subsidiary unit at Turku. A marine weather facsimile service was also initiated to aid the rescue work.

2. DEVELOPMENT OF THE WEATHER SITUATION

At 00 UTC on 27.9.1994 (02.00 local time) a wave on the polar front was situated in the vicinity of the British Isles; to the north of the wave, and associated with it, was a trough in the cold air-mass. The trough is denoted on the synoptic charts as an occlusion, as the trough and polar-front wave together constitute a so-called "instant occlusion" (Pearson and Stewart, 1992). The depression had already begun to deepen (Fig. 1A). At 12 UTC the deepening low, with a central pressure of 987 hPa, was situated near Oslo and was moving eastwards. The associated polar front wave and trough also moved east (Fig. 1B). 12 hours later, at 00 UTC on 28.9.1994, the low centre of 982 hPa was to be found

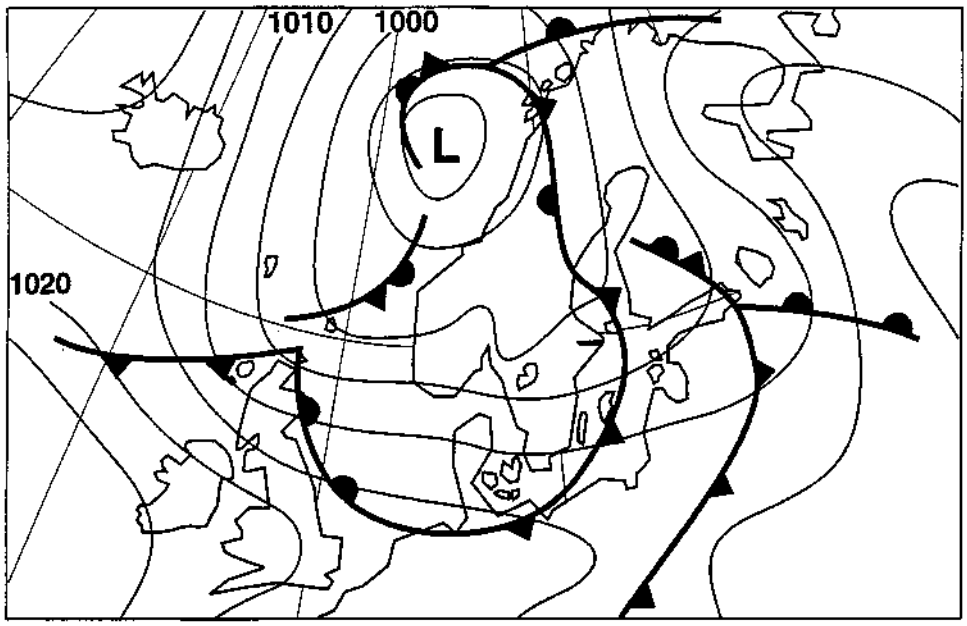

Fig. 1A)
Synoptic weather situation
27.9.94 00 UTC

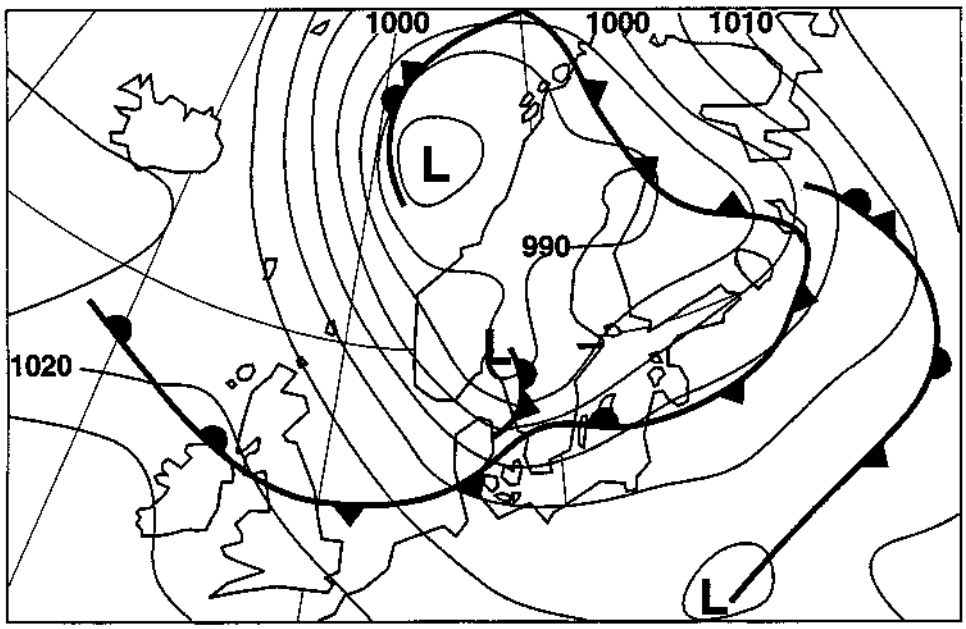

Fig. 1B)
Synoptic weather situation
27.9.94 12 UTC

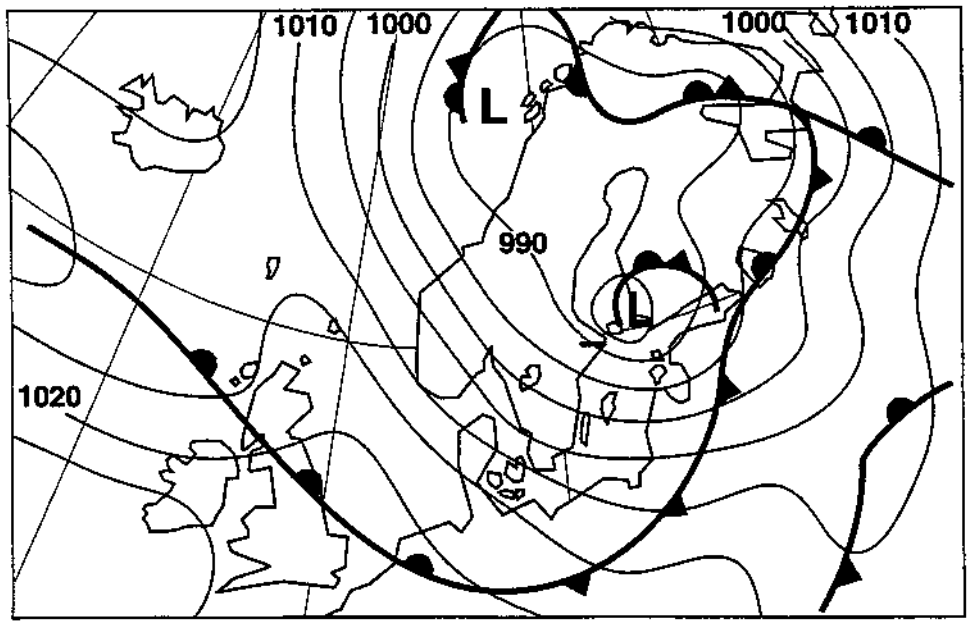

Fig. 1C)
Synoptic weather situation
28.9.94 00 UTC

north of Åland in the southern Gulf of Bothnia. At this time the actual wave on the polar front was already moving away to the east of Finland, but the depression situated in the cold air-mass, together with the trough, moved more slowly. The depression deepened slightly still further (Fig. 1C). The synoptic weather situation at the time of the accident is depicted in Fig. 2. The track of the low centre can best be seen from Fig. 3F. The fronts in the vicinity of the area of the accident are also shown in Figs. 3A - 3F. The position of the centre of the low is marked in the figures with an asterisk. In this particular weather situation the passage of the fronts was not associated with sudden changes in wind speed or direction. Statistically, the tracks of depressions at the end of September and during October run from the south of Iceland over southern Scandinavia and then in a north-easterly direction, so that the track taken by this depression was quite usual. Central pressures below 980 hPa are unusual: depressions this deep cross Finland on average twice in October. Storm-force winds may be associated with them. The central pressure of the low on 28.9 was 981 hPa. The strongest momentary gust measured in connection with this low, 29 m/s, was recorded at the Ristna weather station between 00 and 03 UTC. At that time the ten-minute average wind speeds measured by weather stations in the northern Baltic Sea were in the range 17 - 23 m/s.

2.1 The weather from 18 UTC (20 local time) on 27.9.1994 onwards

The synoptic weather situation near the time of the accident is depicted in Fig. 2. The front is shown as an unbroken thick line. To the rear of the front the winds have strengthened and veered (turned clockwise) to the south-west. The arrows mark the position of a dry and gusty airstream which has intruded between the front and the centre of the depression as a narrow tongue of clearer weather. Shower clouds are associated with the cloudy area of the depression, but before 00 UTC on 28.9. no lightning was observed in the sea area; after that time lightning was observed locally inland over south-western Finland. In the series of figures 3A - 3F are shown the locations of the weather observation stations surrounding the accident area. The wind speed and direction, as well as the sea temperature, have been plotted at each station location. The convention shows the wind blowing towards the station. The wind speed is depicted with barbs and black triangular flags. A black flag indicates a wind speed of 25 m/s (50 kt), a long barb a speed of 5 m/s (10 kt) and a short barb a speed of 2 - 3 m/s (5 kt). The wind information from the stations has been shown in the figures at 3-hourly intervals. The frontal zone movement can be seen from Figs. 3A - 3D; the front is estimated to have passed over the accident location at approximately 19 UTC (21.00 local time), after which the wind veered south-west and strengthened. Before the passage of the front the wind backed (turned counter-clockwise), and for a period of about two hours probably blew from the south or south-south-east. As is usual during the passage of a front, the wind veered, in

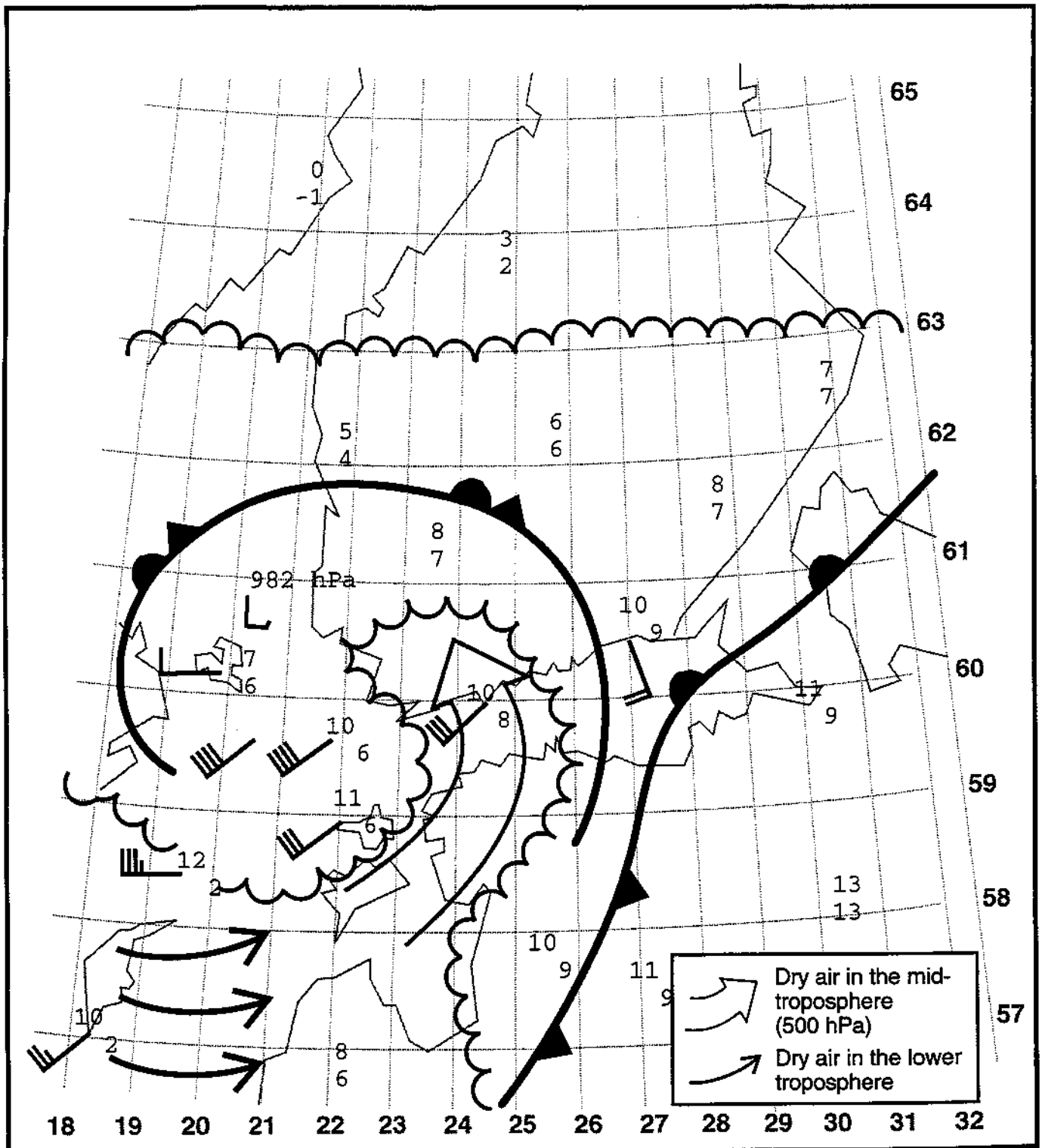

Fig.2. Synoptic weather situation at the time of the accident, 00UTC on 28.9.1994. Values of temperature (upper value), dew-point (lower value) and wind are plotted at selected locations. The wind speed is in knots, with the longer barb representing 10 kt, and the shorter 5 kt.

this case to between south-west and west. At Bogskär a momentary gust maximum of 24.6 m/s was recorded at 21.26 UTC (23.26 local time). At this time the wind in the area of the accident was blowing from between south-west and west at an average speed of about 18 m/s. The wind continued to strengthen, by 00 UTC (02.00 local time) attaining a mean speed of 20 m/s at the location of the accident, and 3 hours later 23 m/s. At 04.39 UTC (06.39 local time) the weather station at Nyhamn recorded a mean speed of 24.8 m/s from the west-north-west. At 06 UTC Nyhamn's mean wind speed was 24 m/s, and at about the same time (05.25 UTC) a maximum gust of 27.7 m/s was measured at Bogskär. The anemometer height at Nyhamn is 50 m and at Bogskär 31 m. In stable conditions the readings from these two stations have to be subjected to a reduction of about 20% in order to make them comparable with wind speeds at the internationally-agreed height of 10 m. Since the prevailing weather situation was showery and unstable, it is possible that the wind at sea level may also have momentarily reached the previously-mentioned gust strengths. According to the observations, the wind was at its strongest during the rescue operations on the morning of 28.9. The sea surface temperature in the northern Baltic Sea was 14 deg. C during the evening of 27.9, after midnight 13 deg. C and 12 deg. C on the morning of 28.9. On the night of the accident the air temperature in the area varied between 12 deg. C and 8 deg. C.

3. METEOROLOGICAL DATA

3.1 Weather observations from synoptic and automatic stations

Finnish synoptic weather stations, making weather observations at 3-hourly intervals, are situated at Utö and Russarö in the neighbourhood of the accident. Finnish automatic marine weather stations (AWS = automatic weather station) are located at Tulliniemi, Vänö, Fagerholm, Bogskär and Nyhamn. Observations from Kumlinge and Harmaja AWS's have been made use of in the investigation, as have also wind readings from the Sottunga wind-energy experimental station. Observations at 3-hourly intervals from the Ristna synoptic station as well as hourly observations from the Prangli and Osmussaare AWS's have been obtained from Estonia (Eesti Vabariik). Additionally weather observations from certain Swedish stations (Gotska Sandön, Svenska Högarna and Söderarm) have been plotted on the weather charts at three-hourly intervals (Figs. 3A, 3B, 3C, 3D, 3E, 3F). Time-series from certain of the observation stations in the vicinity of the accident have been included (Annex 1).

3.2 Surface weather analyses

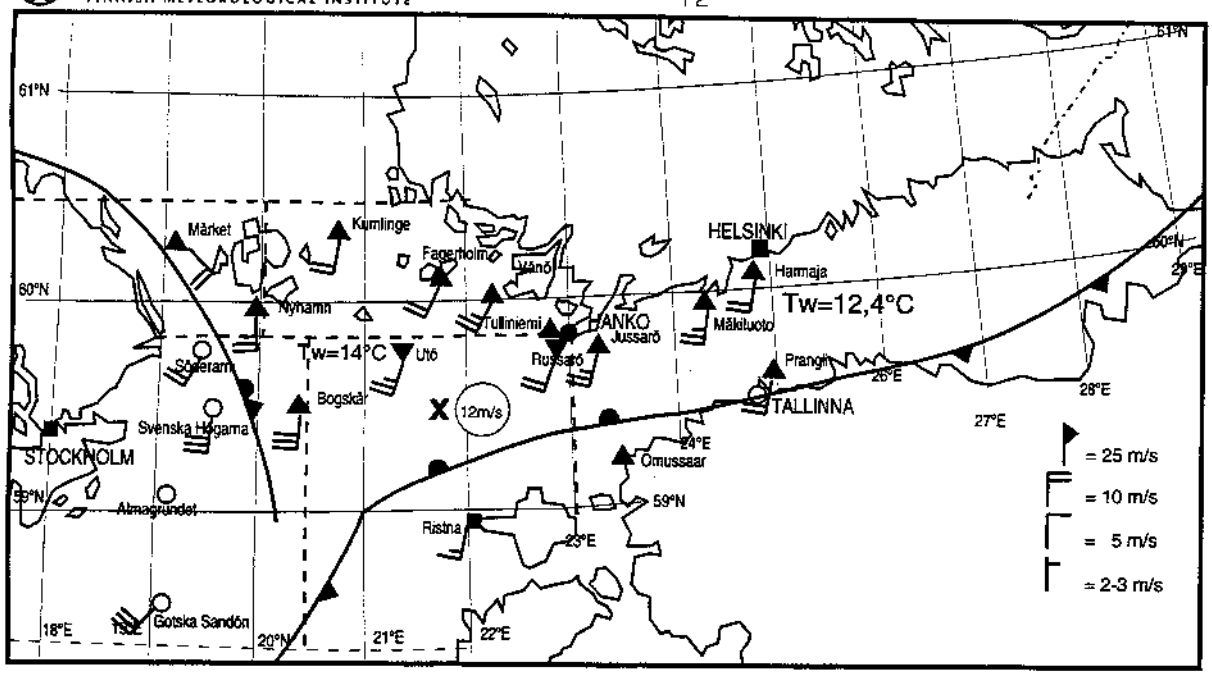

Fig. 3A)
Synoptic weather situation
27.9.1994 18UTC

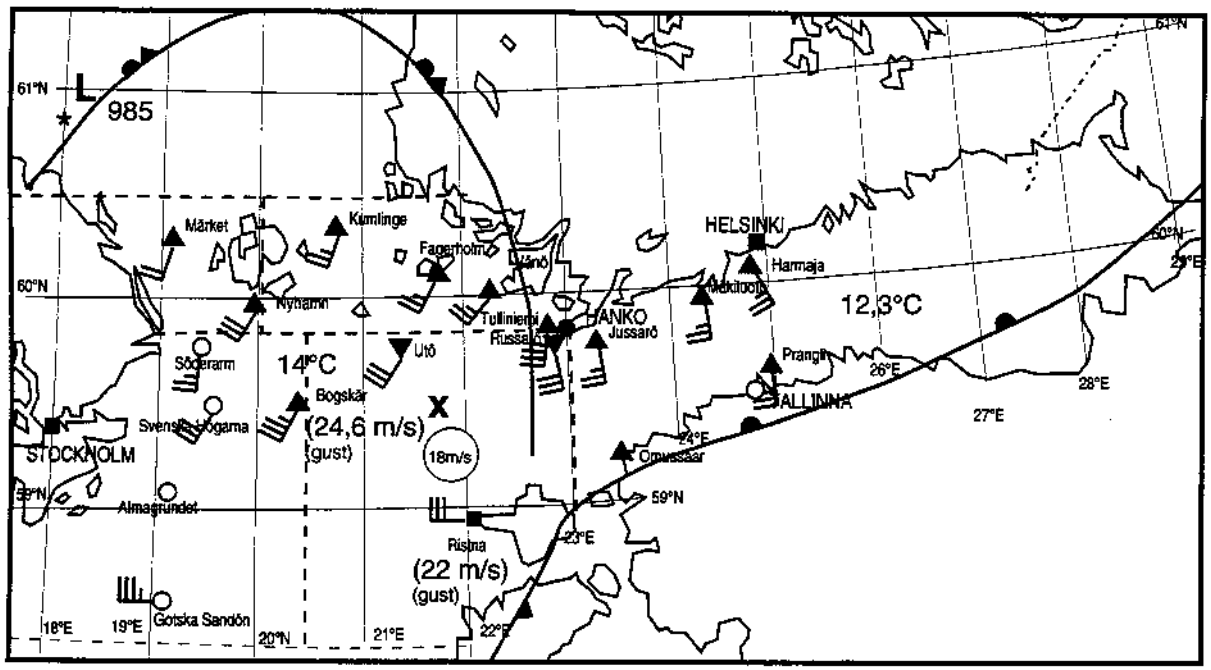

Fig. 3B)
Synoptic weather situation
27.9.1994 21UTC

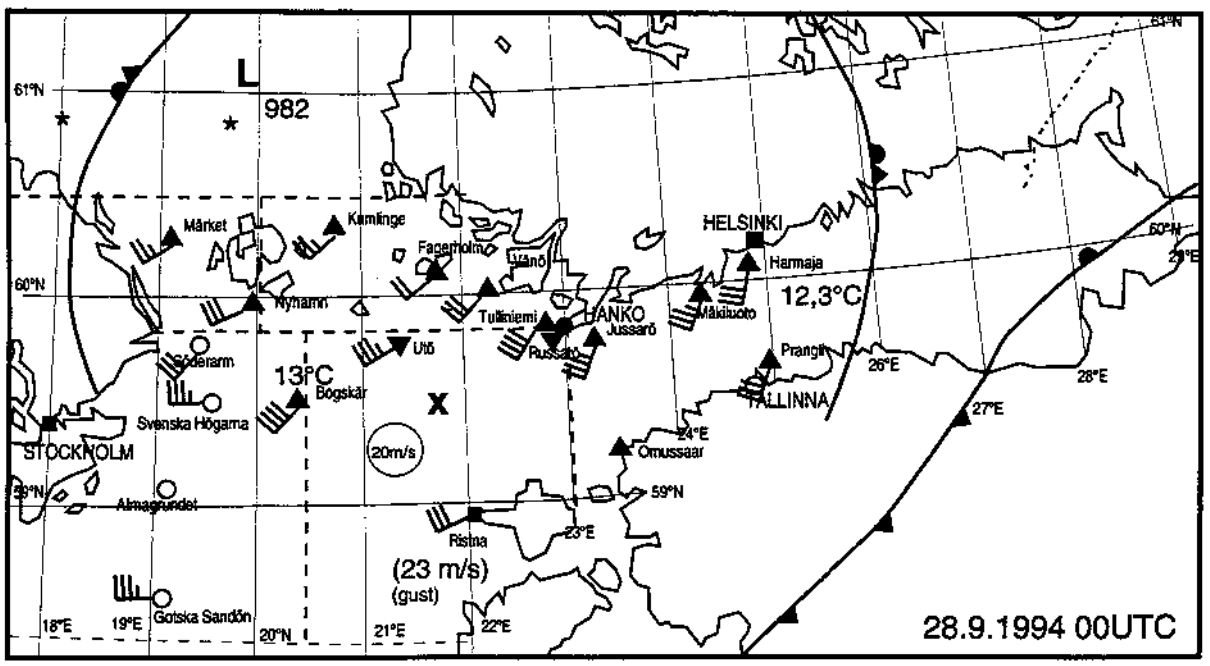

Fig. 3C)
Synoptic weather situation
28.9.1994 00UTC

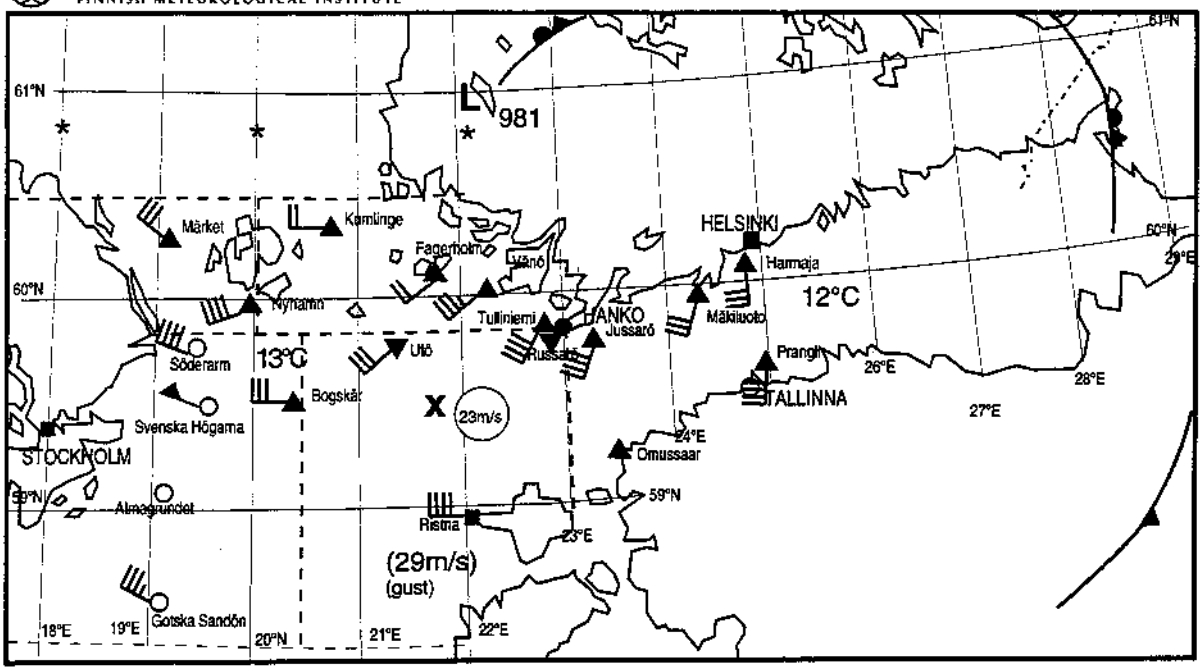

Fig. 3D)
Synoptic weather situation
28.9.1994 03UTC

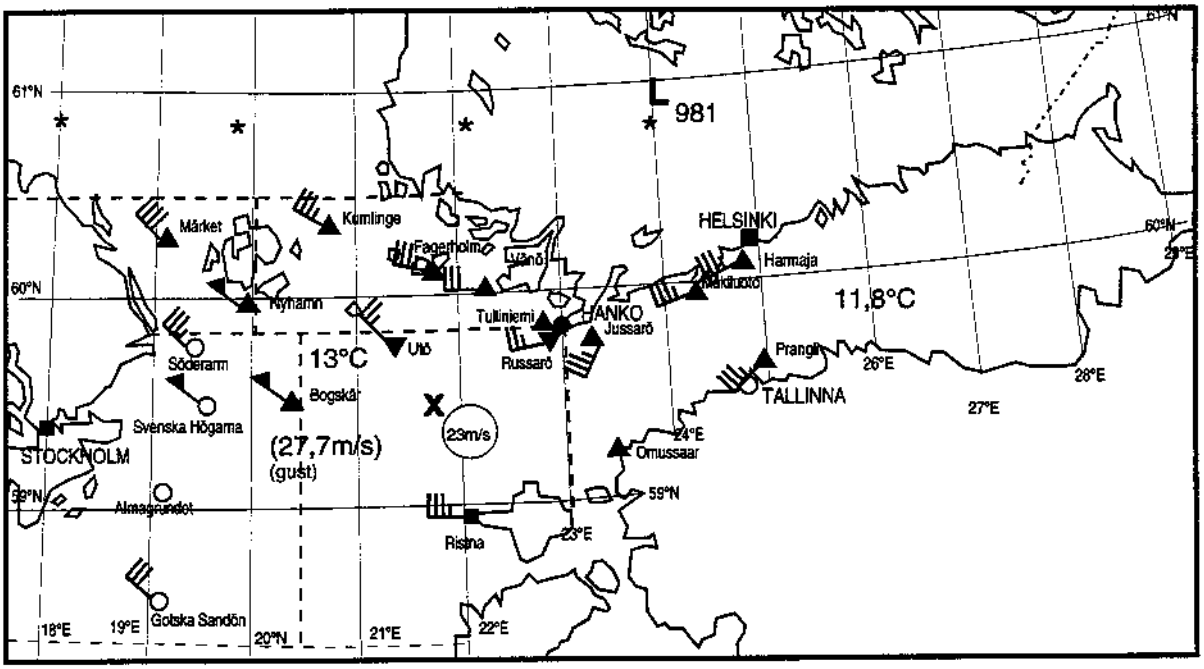

Fig. 3E)
Synoptic weather situation
28.9.1994 06UTC

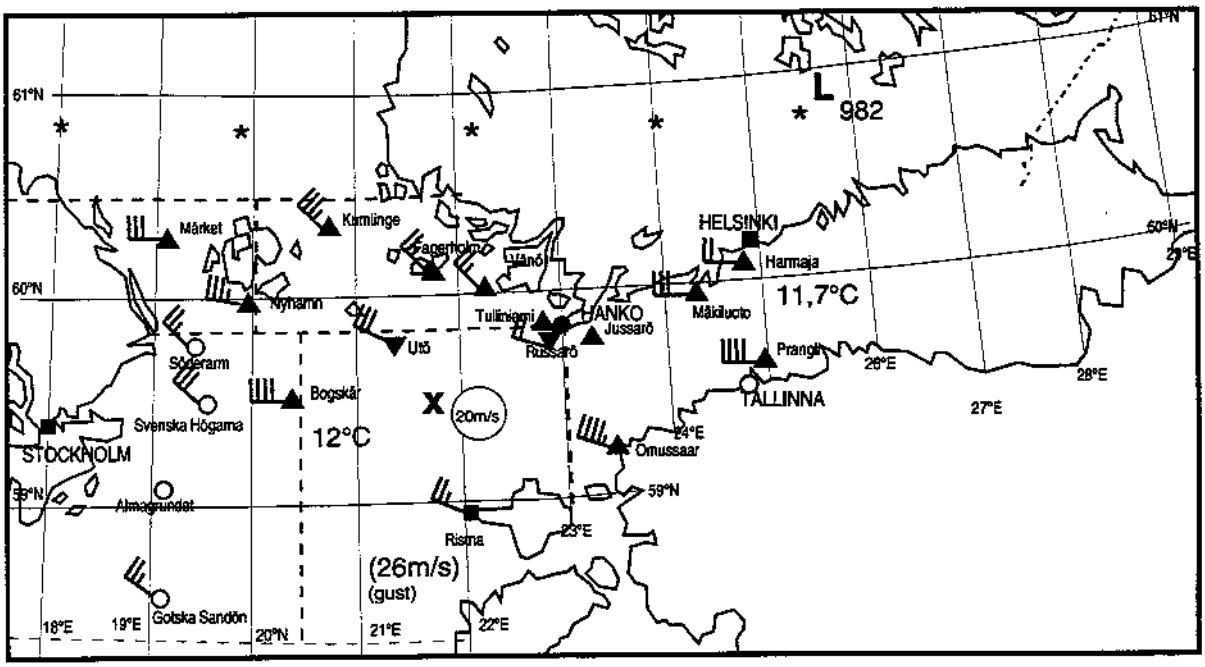

Fig. 3F)
Synoptic weather situation
28.9.1994 09UTC

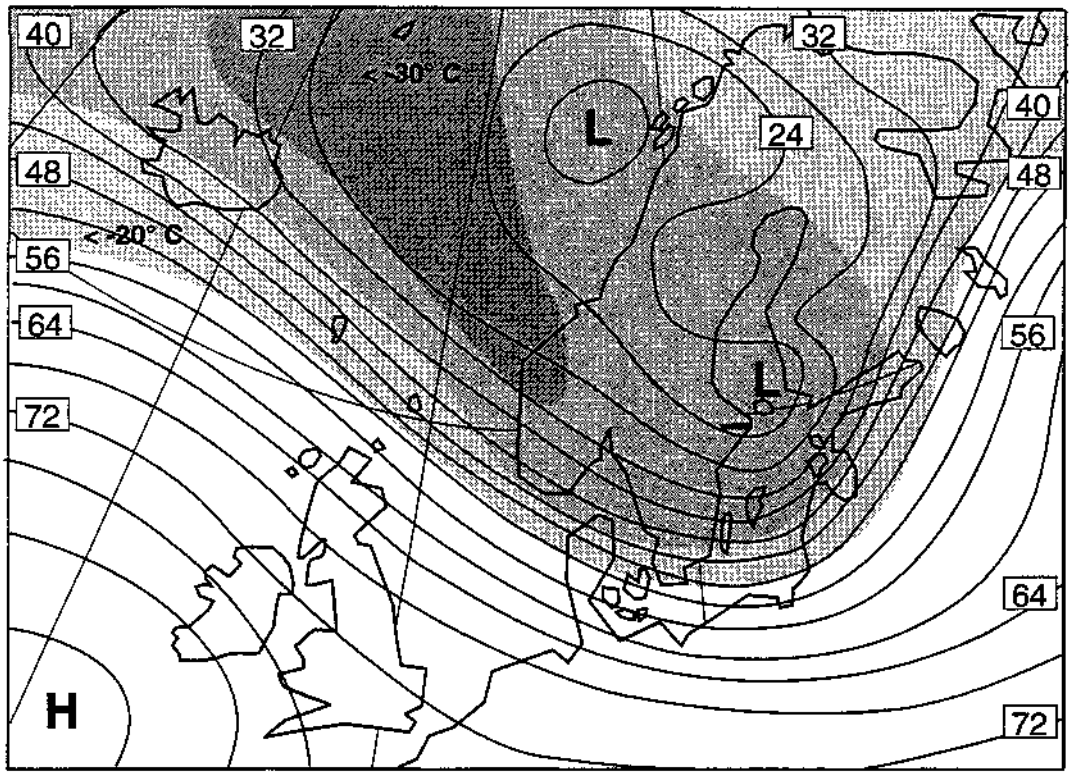

Fig. 4A) 500hPa height isopleths and temperature analysis for 00UTC on 28.9.1994

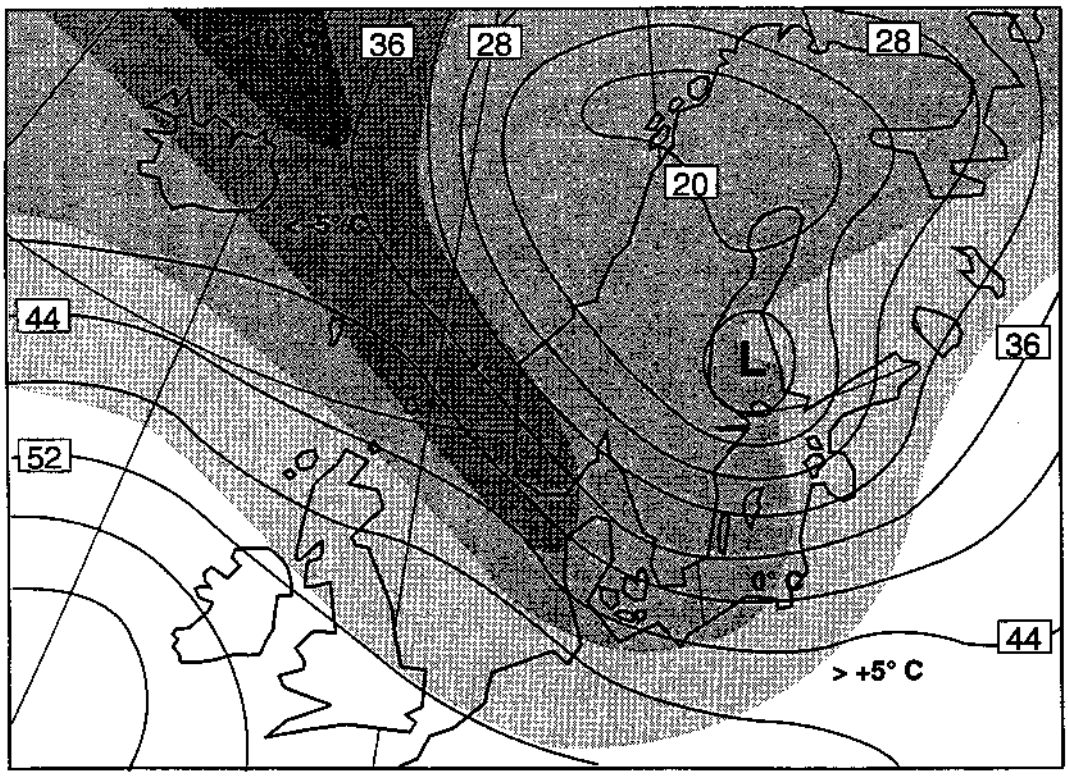

Fig. 4B) 850hPa height isopleths and temperature analysis for 00UTC on 28.9.1994

The analyses in Figs. 1, 2 and 3 have been prepared on the basis of FMI Central Weather Service chart material.

3.3 Upper air analyses

Fig. 4A shows the 500 hPa height isopleths and temperature analysis for 00 UTC on 28.9., while Fig. 4B depicts the corresponding 850 hPa analysis. These have been prepared on the basis of FMI Central Weather Service upper-air analysis material. In the figures cold air can be seen to flow from the north-west towards southern Scandinavia and the Baltic Sea. A cold air-mass aloft is a prerequisite for gusty winds.

3.4 Satellite images

Satellite images received from NOAA are for the times of 06.46 UTC on 27.9.1994 and 06 UTC on 28.9.1994. The developing cloud and frontal area over southern Scandinavia can be seen from the images to move over the period of a day to Finland. The satellite images can be found in Annex 2.

3.5 Weather radar images

The composite image covering Southern Finland contains data from the three Finnish radars at Anjalankoski, Ikaalinen and Vantaa, as well as from the Swedish radars at Arlanda, Hudiksvall, Örnsköldsvik and Gotland. The series contains images from data at 01.00, 01.30, 02.00 and 03.00 local time (23.00, 23.30, 00.00 and 01.00 UTC). The movement of the frontal and rain areas can be seen from the images. At 00 UTC the centre of the depression is situated, according to the weather observations, to the north of Åland (cf. Fig. 3C). Rain shower echoes are present in the accident area. The radar image series may be found in Annex 3.

3.6 Lightning location data

Data from the lightning locator system for the period 00 - 03 UTC on 28.9.1994 are presented in Annex 4.

3.7 Verbal and tabular weather forecasts

Verbal and tabular marine weather forecasts issued by the FMI Central Weather Service, together with the forecast for drifting issued by the Southern Finland Regional Office are appended in Annex 5.

3.8 Other data

Data from Sweden and Estonia (Eesti Vabariik) and drifting calculations made by Environmental Impact Assessment Centre of Finland Ltd (Ympäristövaikutusten Arviointikeskus) are given in Annex 6.

4. SUMMARY

At the time m/s Estonia sunk the weather was stormy. This storm was caused by a depression, typical for the time of year, which moved across the Baltic Sea and Gulf of Bothnia on the night of 28.9, when the accident occurred. On the evening preceding the accident the wind in the accident area blew ahead of the front from the south or south-south-east with a mean speed varying between 12 and 15 m/s. According to the weather data the front passed the accident location at about 19 UTC, after which the prevailing wind direction was from between south-west and west. At 21 UTC the mean wind speed in the accident area was approx. 18 m/s, with gusts up to 24 m/s. At 00 UTC (02 local time) a south-westerly wind with a mean speed of approx. 20 m/s prevailed, the strongest gust measured between 00 and 03 UTC being 29 m/s at Ristna. At 03 UTC the wind blew from the west, later veering further to between west and north-west, at which time the mean wind speed was 23 m/s, with a gust maximum of over 27 m/s. At Finnish stations the highest wind speeds were measured at about 06 UTC (08 local time). In the early hours of the morning the sea temperature was approx. 13 deg. C and the air temperature about 10 deg. C.

Over 900 persons died and 136 survived in the accident (Pelastustieto 8/94). International shipping receives weather information through various different channels. Over the Baltic Sea region weather forecasts and warnings in English are disseminated by coastal radio stations. On 27.9 and 28.9 gale warnings issued by FMI were transmitted over VHF channels by Helsinki and Mariehamn coastal radio stations. The storm warning was heard on the Finnish Broadcasting Company's Radio Suomi in Finnish and on Riksradio in Swedish as part of the regular marine weather broadcasts. Strong wind and gale forecasts are issued in English by the Navtex system. According to an agreement made in 1983, Sweden coordinates weather warning activities on this system in the Baltic Sea region (Kjellegård, 1983). The Baltic area has recently seen the emergence of several newly-independent countries. Coordination of the wind forecasts and warnings issued by different countries for international shipping in the same area needs to be strengthened.

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SYNOPTIC AND AUTOMATIC WEATHER STATIONS

Time series of the weather observations on 27.9-28.9 1994 are drawn from some of the observation stations in the vicinity of the accident area.

Synoptic weather stations (wind, air pressure, temperature, visibility, sea state):
Utö (59°47´N 21°2´E),
Russarö (59°46´N 22°57´E),
Ristna (58°55´N 22°04´E)

Automatic weather stations (AWS stations):
Bogskär (59°30´N 20°21´E),
Vänö (59°52´N 22°12´E),
Prangli (59°39´N 24°58´E)
Harmaja (60°06´N 24°59´E)

Wind speed observations represent 10-minute averages. The max.wind speed is the strongest 10-minute mean value during 3 hours interval. The max. gust speed is the measured strongest 2 seconds gust. Air temperatures and sea water temperatures are given in centigrades. Visibilities and sea states are given in meters.

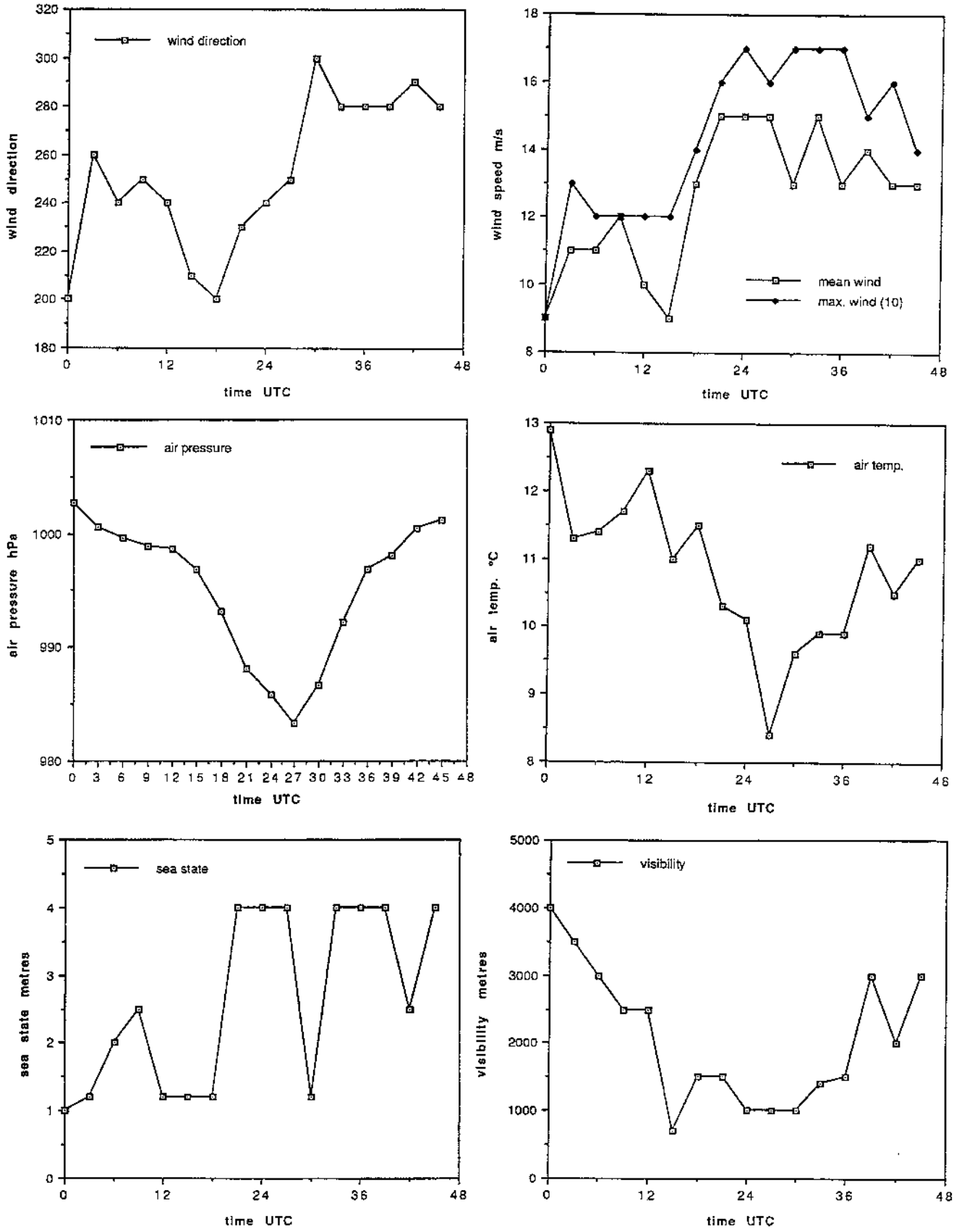


Fig. 5. Utö synoptic station weather observations 27.9-28.9 1994

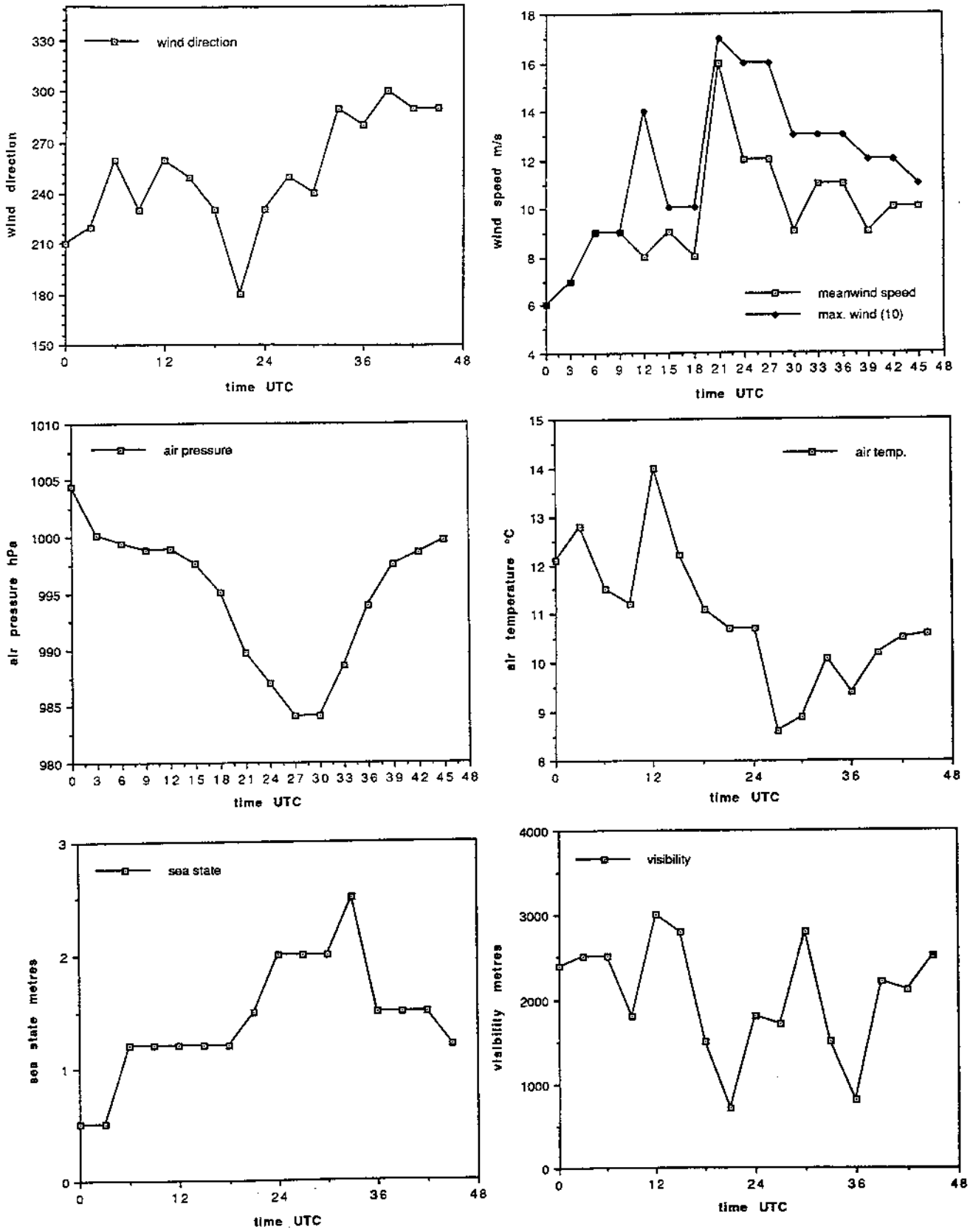


Fig. 6. Russarö synoptic station weather observations 27.9-28.9 1994

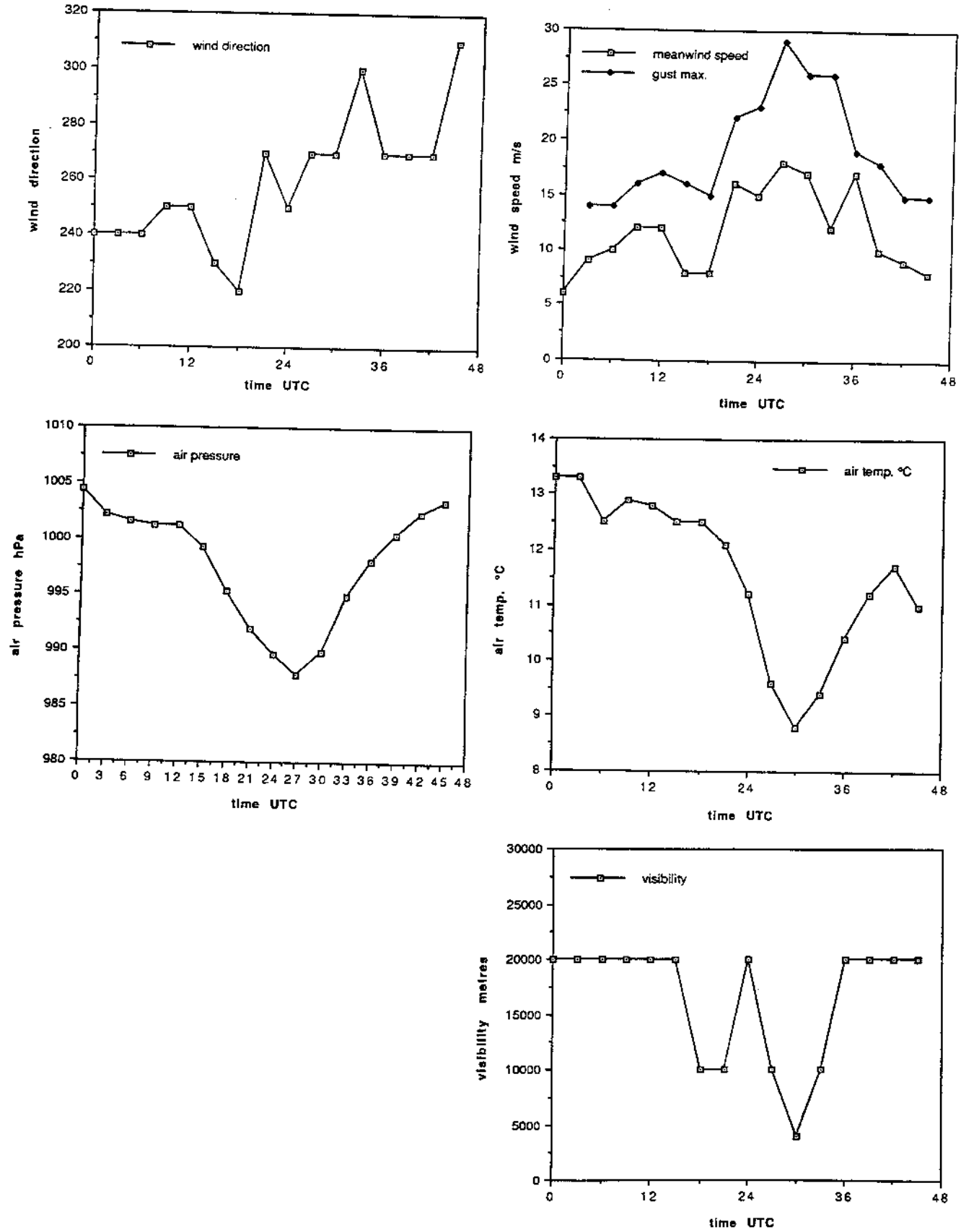


Fig. 7. Ristna synoptic station weather observations 27.9-28.9 1994

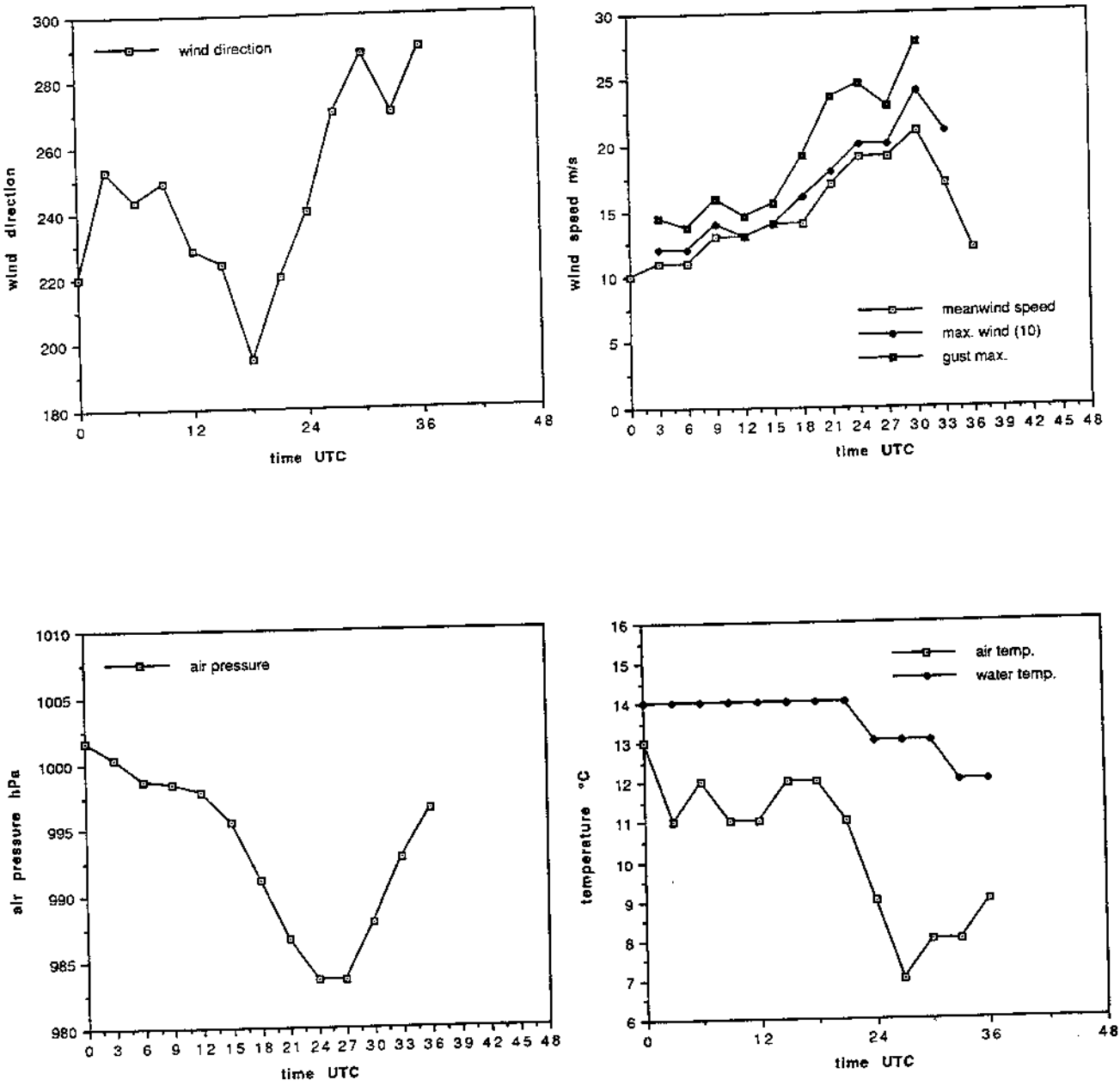
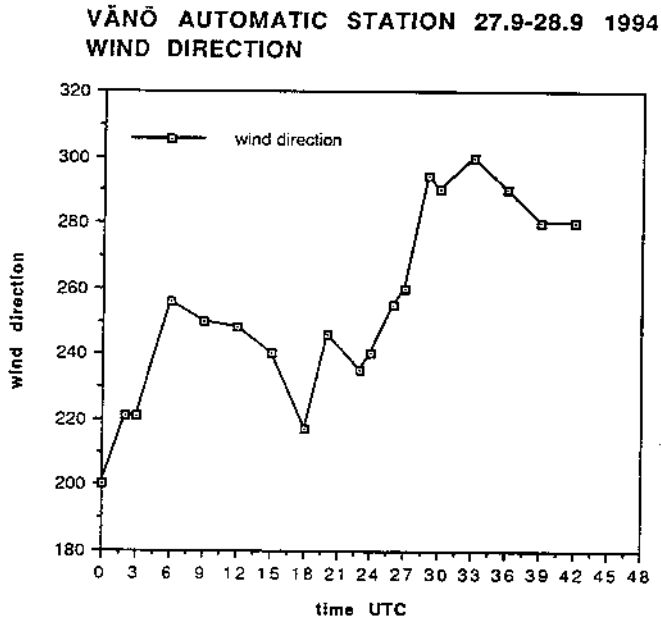


Fig. 8. Bogskär automatic station weather observations 27.9-28.9 1994



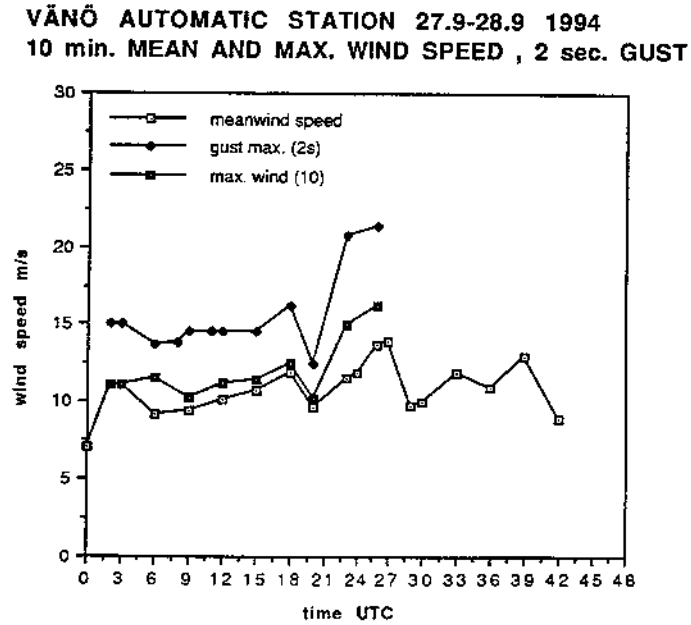


Fig. 9. Vänö automatic station weather observations 27.9-28.9 1994

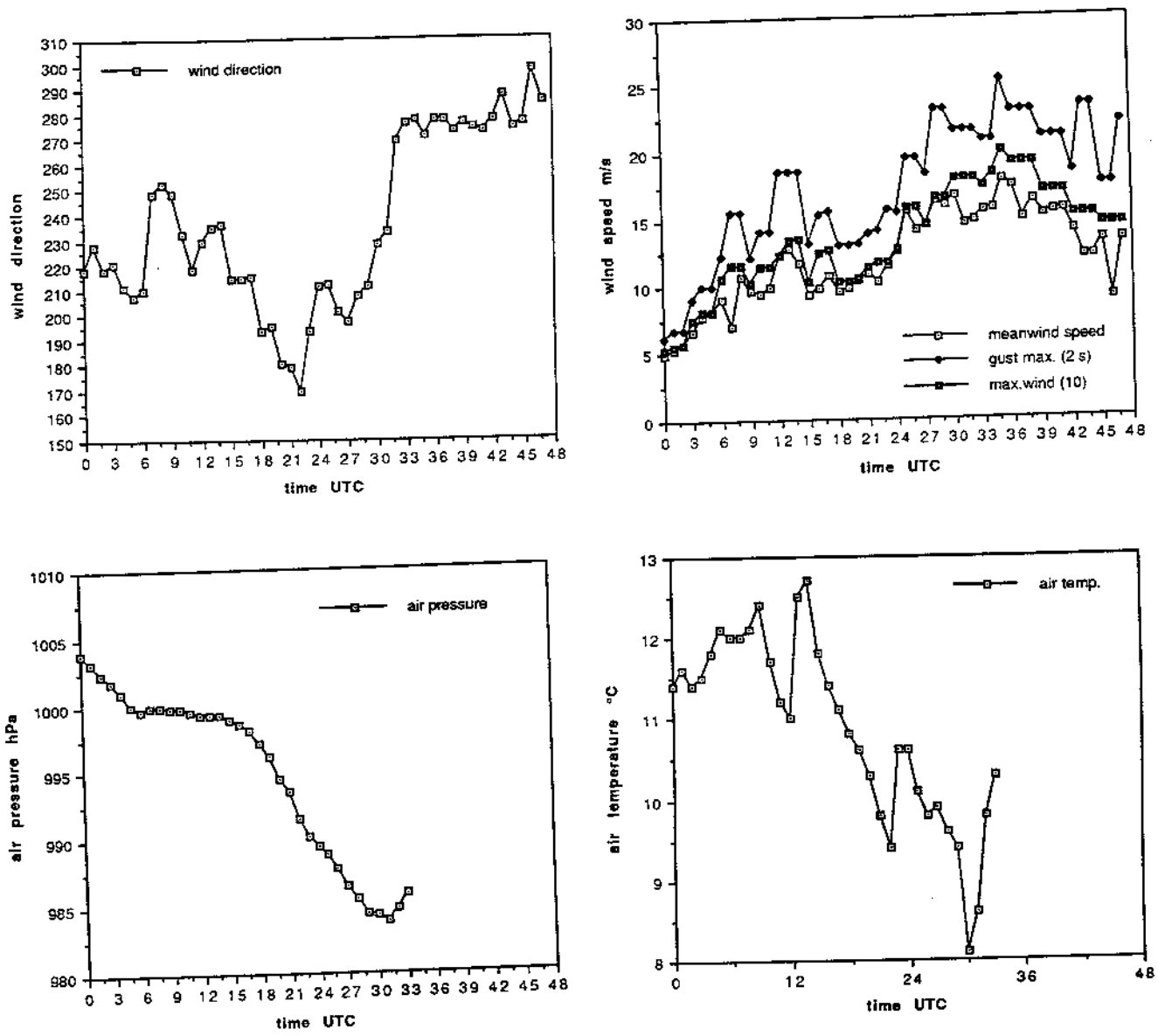


Fig. 10. Prangli automatic station weather observations 27.9-28.9 1994

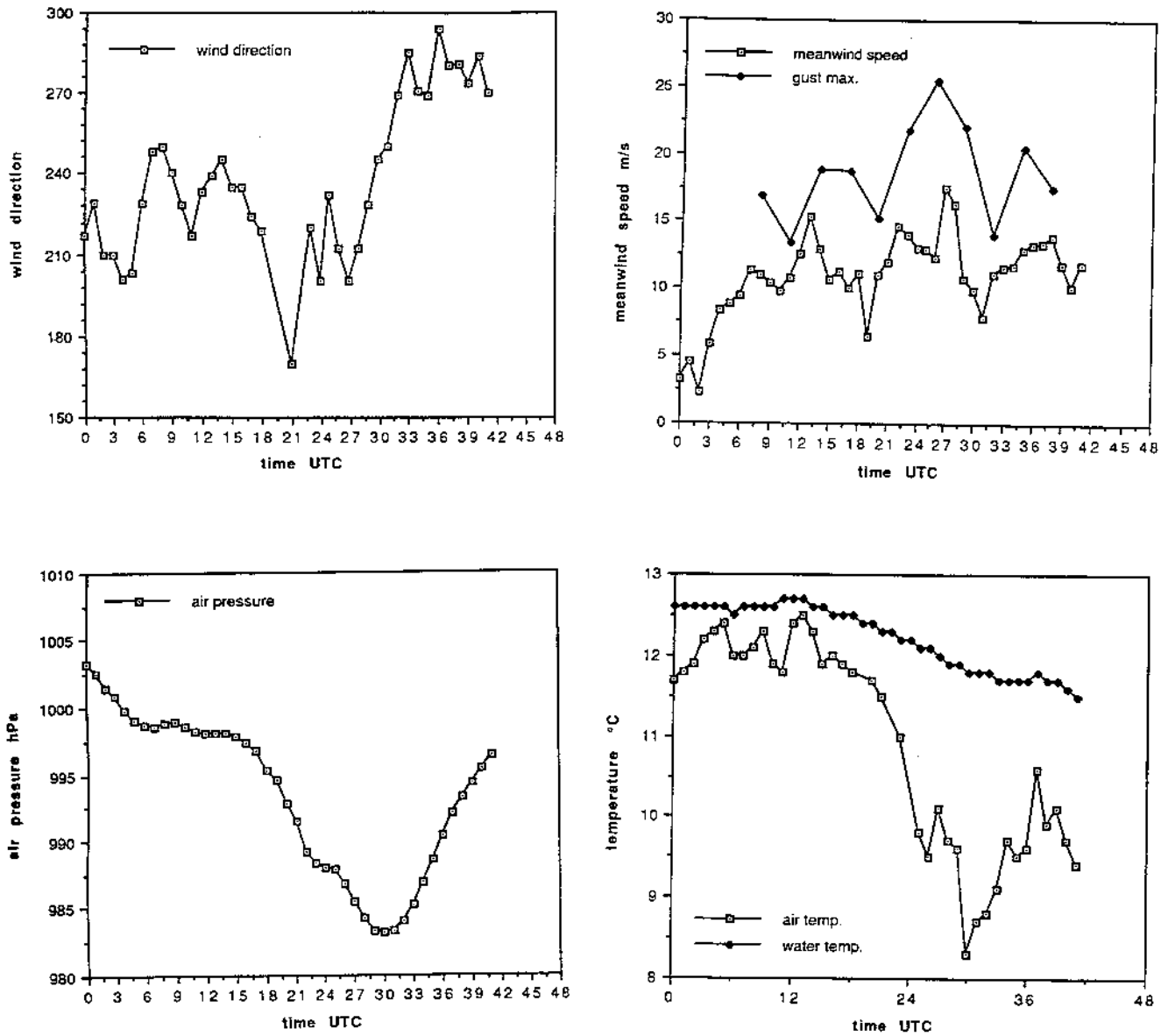


Fig. 11. Harmaja automatic station weather observations 27.9-28.9 1994

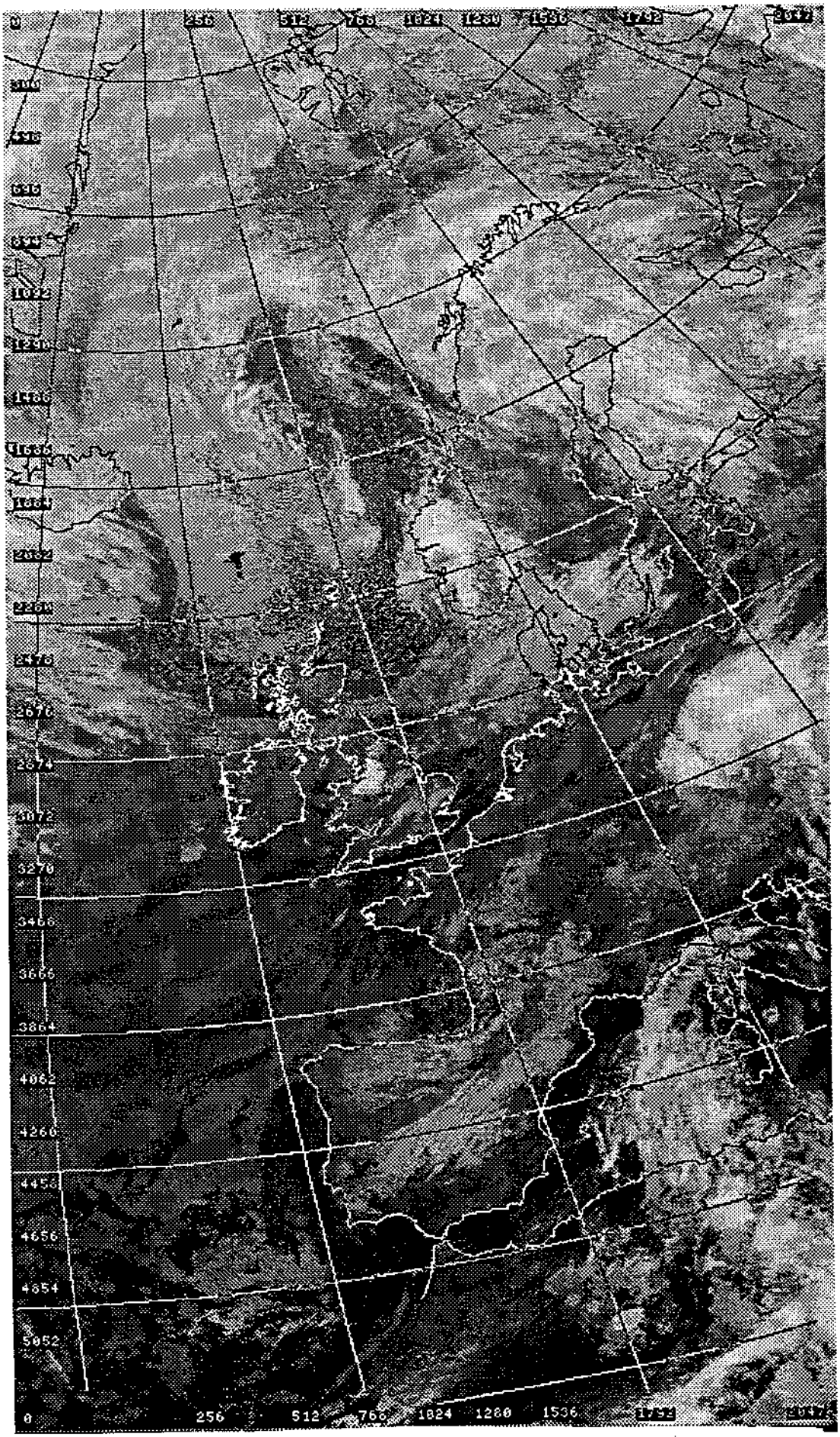


Fig. 12. The satellite image received from NOAA (at 06.46 UTC on 27.9.1994)

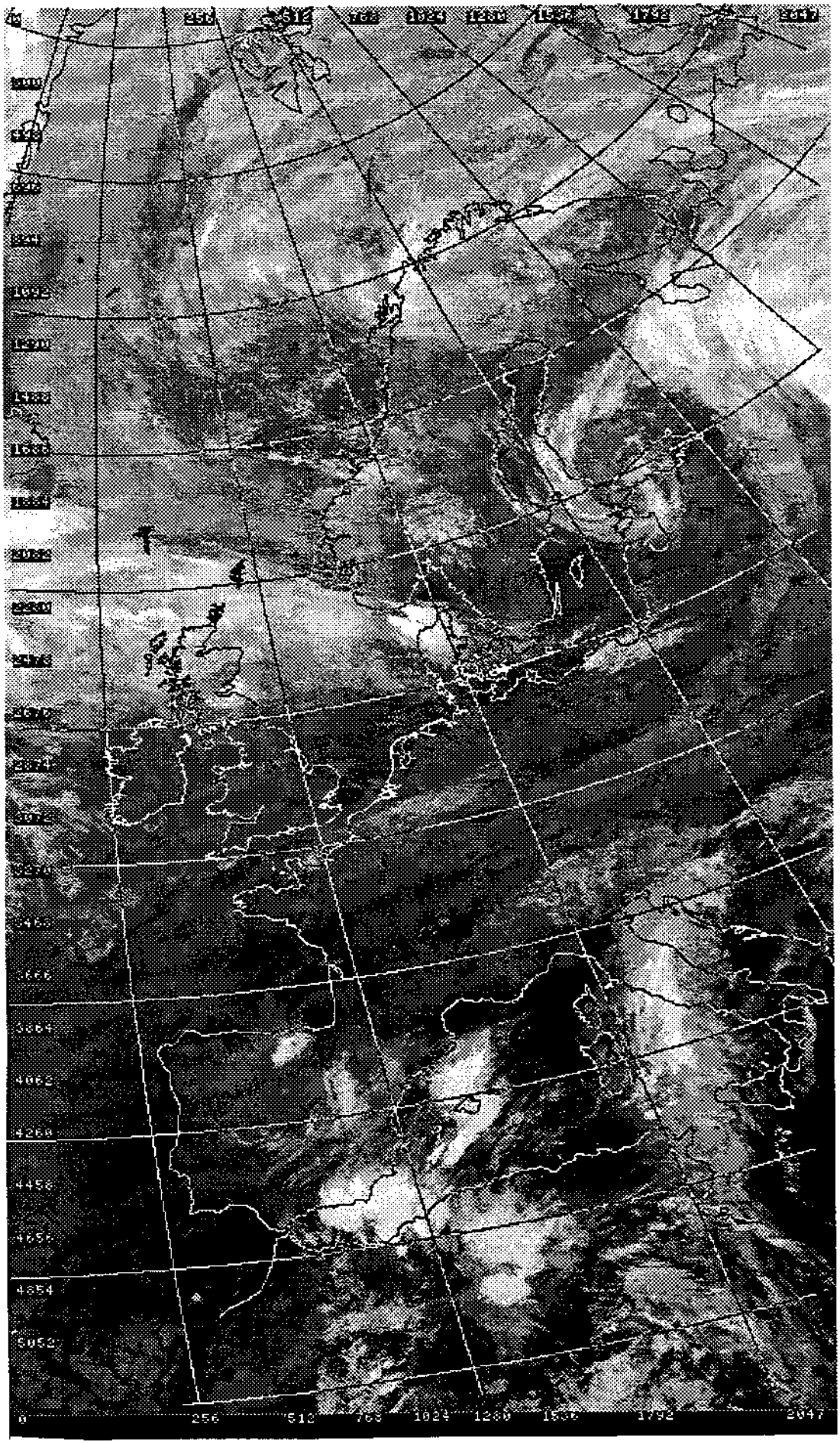


Fig. 13. The satellite image received from NOAA (at 06.00 UTC on 28.9.1994)

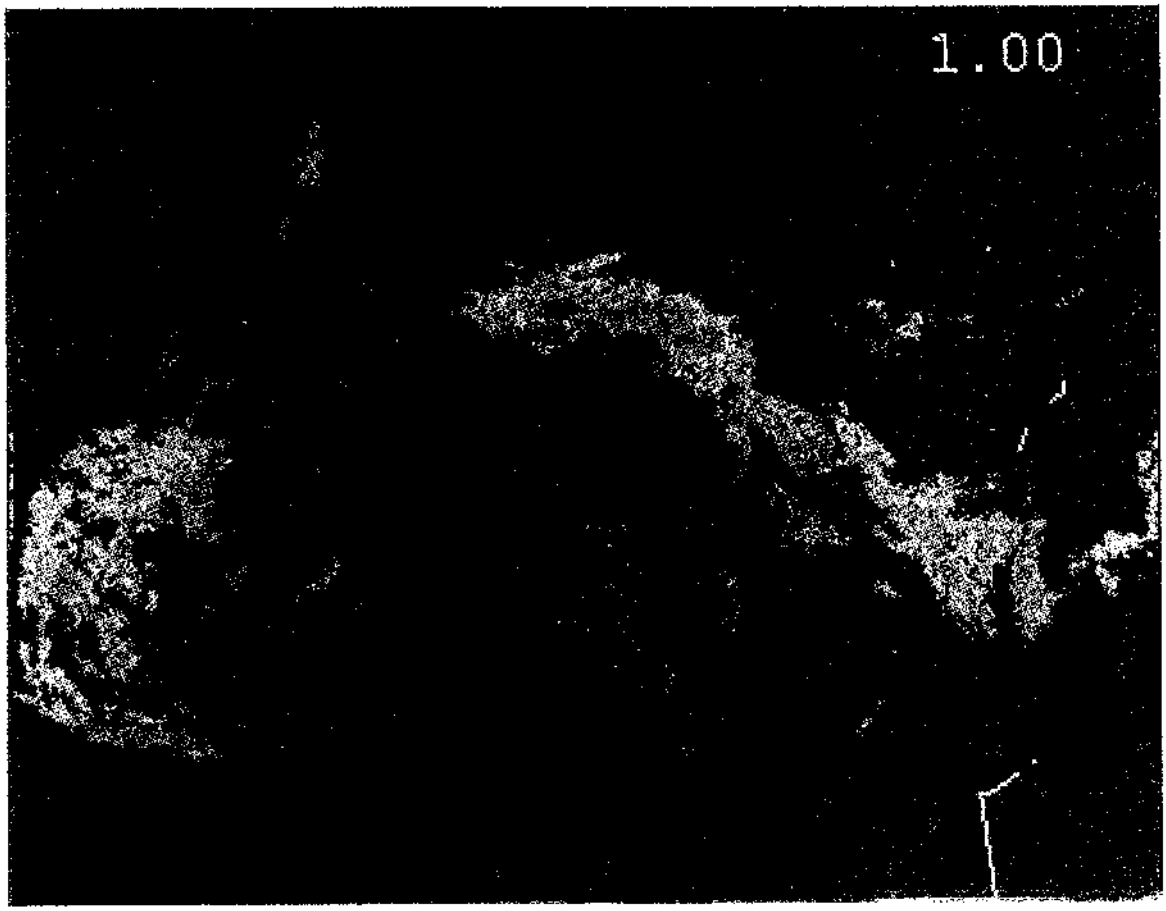


Fig. 14 A). The composite image on 27.9.1994 at 23.00 UTC (28.9.1994 01.00 local time).

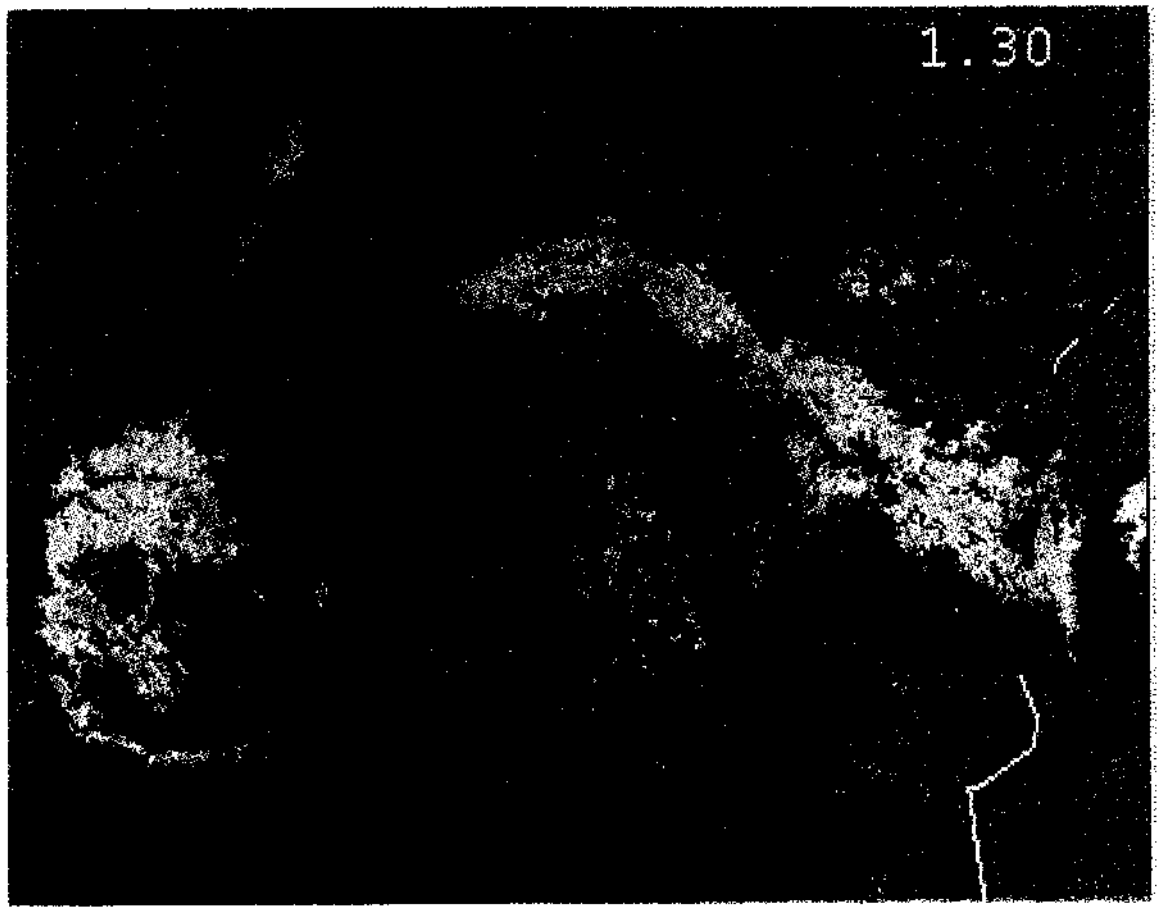


Fig. 14 B). The composite image on 27.9.1994 at 23.30 UTC (28.9.1994 01.30 local time.

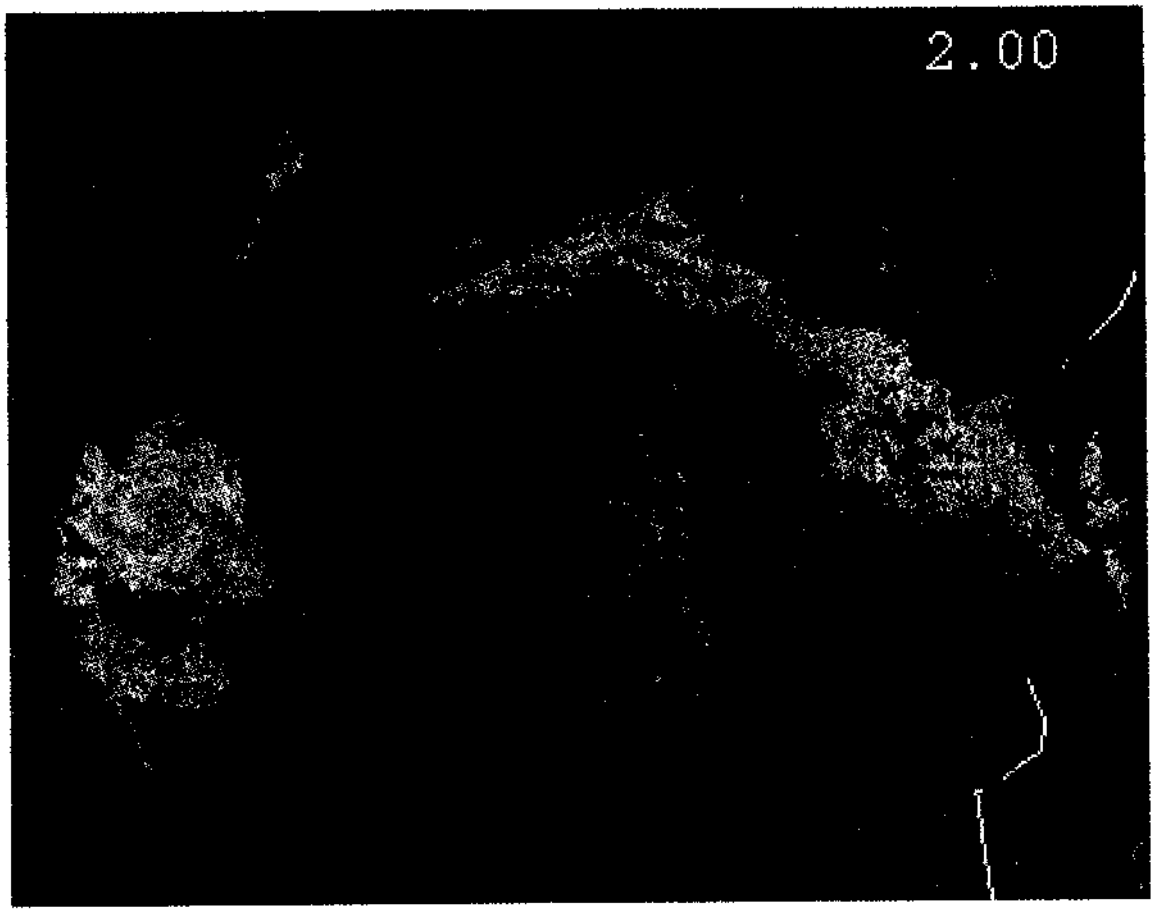


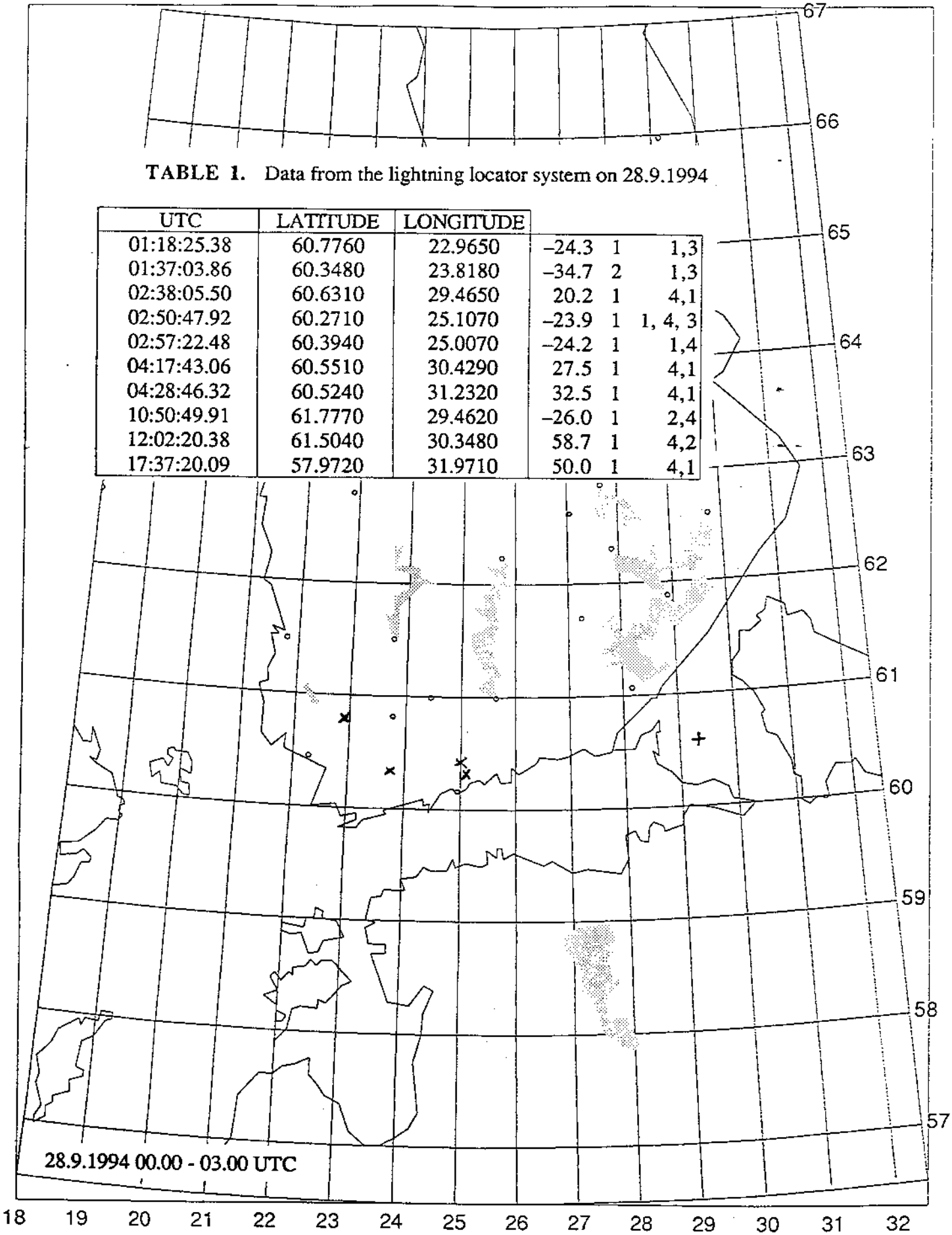
Fig. 14 C). The composite image on 28.9.1994 at 00.00 UTC (02.00 local time).

Fig. 14 D). The composite image on 28.9.1994 at 01.00 UTC (03.00 local time).

Fig. 14 A), B), C), D). The composite image contains data from the three Finnish radars at Anjalankoski, Ikaalinen and Vantaa, as well as from the Swedish radars at Arlanda, Hudiksvall, Örnsköldsvik and Gotland. The series contains images from data on 27.9.1994 at 23.00 and 23.30 UTC, on 28.9.1994 at 00 and 01 UTC (local time 28.9.1994 01.00, 01.30, 02.00 and 03.00).

TABLE 1. Data from the lightning locator system on 28.9.1994

UTC	LATITUDE	LONGITUDE			
01:18:25.38	60.7760	22.9650	−24.3	1	1,3
01:37:03.86	60.3480	23.8180	−34.7	2	1,3
02:38:05.50	60.6310	29.4650	20.2	1	4,1
02:50:47.92	60.2710	25.1070	−23.9	1	1, 4, 3
02:57:22.48	60.3940	25.0070	−24.2	1	1,4
04:17:43.06	60.5510	30.4290	27.5	1	4,1
04:28:46.32	60.5240	31.2320	32.5	1	4,1
10:50:49.91	61.7770	29.4620	−26.0	1	2,4
12:02:20.38	61.5040	30.3480	58.7	1	4,2
17:37:20.09	57.9720	31.9710	50.0	1	4,1



ILMATIETEEN LAITOKSEN SALAMANPAIKANNIN 1:5 000 000

VERBAL AND TABULAR WEATHER FORECASTS

The marine weather forecasts given by the FMI Central Weather Service on the evening of 27.9.1994, i.e. "Sääennuste merenkulkijoille" in Finnish at 19.00 and 22.00 (local time), "Väderrapporten för sjöfarande" in Swedish at 19.00 and 22.00 (local time) and "Weather forecast for shipping" in English at 17 and 20 UTC, had the same contents. An additional verbal forecast was made for marine lifesaving units at 07.05 on 28.9.1994. Before that, information on weather conditions had been given by telephone. The FMI Regional Office for Southern Finland had made forecasts for drifting earlier in the morning, and the Central Weather Service initiated a marine weather facsimile service.

FPFI43 EFKL DDHH00

Sääennuste merenkulkijoille 27.09.1994 klo 19

Myrskyvaroitus:
Suomenlahti, Pohjois-Itämeri, Ahvenanmeri ja Saaristomeri sekä Selkämeren eteläosa: Länsi- tai luoteismyrskyä 21 m/s.

Kovan tuulen varoitus:
Selkämeren pohjoisosa: Länsi- tai luoteistuulta 16 m/s.

Huomautus veneilijöille:
Merenkurkku ja Perämeri:
Myöhemmin huomenna länsituulta 11 m/s.
Saimaa: Etelän puoleista tuulta 11 m/s.

Pohjois-Euroopassa on laaja matalapaineen alue. Voimakas osakeskus liikkuu yöllä Selkämeren yli itään ja huomenna edelleen kohti Keski-Suomea. Toinen osakeskus on Pohjois-Ruotsissa.

Odotettavissa huomiseen iltaan asti:

Suomenlahti:
Yöllä etelä- tai lounaistuulta 12-16 m/s, aamulla sekä aamupäivällä tuuli kääntyy lännen puolelle ja on 15-21 m/s. Yöllä ja aamulla sadetta ja ajoittain huono näkyvyys. Päivällä näkyvyys paranee lännestä alkaen.

Pohjois-Itämeri, Ahvenanmeri ja Saaristomeri:
Etelä- tai lounaistuulta, myöhemmin yöllä sekä aamulla länteen tai luoteeseen kääntyvää tuulta 15-21 m/s. Keskiviikkoiltaa kohden tuuli heikkenee vähän. Sadetta ja ajoittain huono näkyvyys, huomenna näkyvyys paranee.

Selkämeri:
Etelän ja idän välistä tuulta 7-14 m/s, myöhemmin yöllä länteen tai luoteeseen kääntyvää tuulta, aamusta alkaen 11-16, eteläosassa paikoin 21 m/s. Sadetta ja ajoittain huono näkyvyys, huomenna näkyvyys paranee.

Merenkurkku ja Perämeri:
Yöllä ja aamulla suunnaltaan vaihtelevaa tuulta 3-9 m/s, päivällä tuuli kääntyy lännen puolelle ja voimistuu vähitellen, keskiviikkoiltaa kohden tuulta on paikoin 11 m/s. Kohtalainen tai hyvä näkyvyys, yöllä ja aamulla utuista.

000 59540
FPFI44 EFKL DDHH00

Väderrapporten för sjöfarande 27.09.1994 kl.19

Stormvarning:
Finska viken, norra Östersjön, Ålands hav och Skärgårdshavet samt södra Bottenhavet: Västlig eller nordvästlig storm 21 m/s.

Varning för hård vind:
Norra Bottenhavet: Västlig eller nordvästlig vind 16 m/s.

Meddelande för båtförare:
Kvarken och Bottenviken: Senare i morgon västlig vind 11 m/s.
Saimen: Vind omkring syd 11 m/s.

Nordeuropa hör till ett omfattande lågtrycksområde. Ett kraftig delcentrum passerar i natt södra Bottenhavet österut och rör sig i morgon fortfarande mot mellersta Finland. Ett annat delcentrum befinner sig i Nordsverige.

Utsikter till i morgon kväll:

Finska viken:
I natt sydlig eller sydvästlig vind 12-16 m/s, i morgon bitti och på förmiddagen vridande till omkring väst 15-21 m/s. I natt och i morgon bitti regn och tidvis dålig sikt. På dagen västerifrån bättre sikt.

Norra Östersjön, Ålands hav och Skärgårdshavet:
Sydlig eller sydvästlig vind, senare i natt och i morgon bitti vridande till väst eller till nordväst 15-21 m/s. Mot onsdag kväll något avtagande. Regn och tidvis dålig sikt, i morgon bättre sikt.

Bottenhavet:
Vind mellan syd och ost 7-14 m/s, senare i natt vridande till väst eller till nordväst och tilltagande, från i morgon bitti 11-16, i södra del lokalt 21 m/s. Regn och tidvis dålig sikt, i morgon bättre sikt.

Kvarken och Bottenviken:
I natt och i morgon bitti varierande vind 3-9 m/s, på dagen vridande till omkring väst och småningom tilltagande, mot onsdag kväll lokalt 11 m/s. Måttlig till god sikt, i natt och i morgon bitti disigt.

FPFI45 EFKL DDHH00

27.09.1994 2.

Weather forecast for shipping 271700 UTC

Warnings:

Gulf of Finland, Northern Baltic, Sea of Aaland and Archipelago, Southern Sea of Bothnia:
West to northwest gale 21 m/s.

Northern Sea of Bothnia:
West to northwest near gale 16 m/s.

Inference:
Wide area of low pressure over Northern Europe. Vigorious center of low moving over Sea of Bothnia towards east. Another minor low over Northern Sweden.

Forecast for next 24 hours:

Gulf of Finland:
By night south to southwest 12-16 m/s. Tomorrow morning veering to west 15-21 m/s. By night and tomorrow morning rain and at times poor vis. By day vis getting better from west.

Northern Baltic, Sea of Aaland and Archipelago:
South to southwest, after midnight and tomorrow morning veering to west or northwest 15-21 m/s. Later in the afternoon somewhat decreasing. Rain with at times poor vis, tomorrow vis getting better.

Sea of Bothnia:
South to east 7-14 m/s. After midnight backing to west or northwest, from morning on 11-16, in the southern part locally 21 m/s. Rainwith at times poor vis, tomorrow vis. getting better.

The Quark and Bay of Bothnia:
By night and tomorrow morning variable 3-9 m/s. By day becoming mainly west and gradually increasing, later in the afternoon locally 11 m/s. Moderate to good vis, by night and tomorrow morning misty.

ILMATIETEEN LAITOS
SÄÄPALVELUTOIMISTO
28.09.1994 KLO 7.05

ENNUSTE POHJOISITÄMERELLE, AHVENANMERELLE JA SAARISTOMERELLE.

Lännen ja luoteen välinen tuuli on voimakkaimmillaan lähituntien aikana. Pohjoisitämerellä, ja myös Saaristomerellä Utön läheisyydessä 20-25 m/s. (kymmenen minuutin keskituuli) Tuuli on puuskaista. Tuuli alkaa aamupäivästä lähtien hitaasti heiketä, mutta on vielä iltapäivällä 16-21 m/s, illalla 13-18 m/s. Aluksi sadekuuroja ja näkyvyys ajoittain huono. Päivällä näkyvyys paranee.

THE WIND FORECAST TO THE FINNISH MARINE LIFESAVING CENTRES

The wind forecast for different sea areas, based on the high resolution limited area model of Finland (HIRLAM), checked by the Central Weather Service of the Finnish Meterorological Institute on 27.9.1994 . The forecast was sent to the Finnish marine lifesaving centres at about 10 pm local time. The wind direction is given in degrees and the wind speed represents ten-minute averages (meter/second).

TUULIENNUSTE MERIALUEILLE (m/s) 18 27 9 94
POHJAUTUU HIRLAM-mallin 12z-RUTIINIIN

	VVKK 9409	PPTT 2718	PPTT 2800	PPTT 2806	PPTT 2812	PPTT 2818	PPTT 2900	PPTT 2906
PERÄMERI	B1N	23009	22007	30006	29006	29009	27009	26009
	B1S	21009	21006	32006	29007	29009	27010	26011
MERENKURKKU	B2	20006	09005	35007	29008	28009	27010	26011
SELKÄMERI	B3N	17004	03007	34012	29012	30013	28012	28012
	B3S	16007	29009	32016	27015	29014	27014	27012
SAARISTOMERI	B4E	20009	24016	28019	27015	28014	27013	27011
AHVENANMERI	B4W	15010	25016	30017	28015	28015	27014	27011
POHJ.-ITÄMERI	B7	18013	26020	27021	27018	28017	27015	27011
SUOMENLAHTI	B5W	23012	23016	26020	27018	27015	27014	26010
	B5E	21012	19015	22016	27019	26017	26014	25012

The used abbreviations:

VV year (vuosi)
KK month (kuukausi)
PP day (päivä)
TT UTC- time (UTC-aika)
B1N Bay of Bothnia northern part (Perämeren pohjoisosa)
B1S Bay of Bothnia southern part (Perämeren eteläosa)
B2 The Quark (Merenkurkku)
B3N Sea of Bothnia northern part (Selkämeren pohjoisosa)
B3S Sea of Bothnia southern part (Selkämeren eteläosa)
B4E Sea of the Archipelago (Saaristomeri)
B4W Sea of Åland (Ahvenanmeri)
B7 Northern Baltic (Pohjois-Itämeri)
B5W Gulf of Finland western part (Suomenlahden länsiosa)
B5E Gulf of Finland eastern part (Suomenlahden itäosa)

For example:
B7 = Northern Baltic 27.9.1994 at 18 UTC (at 20 o´clock local time) 18013 means 180° 13 m/s = South 13 m/s. The next value 28.9.1994 at 00 UTC (at 02 o´clock local time) 26020 means that the wind is veering to west-south-west and increasing, the mean wind is 20 m/s.The wind is gradually increasing and 28.9.1994 at 06 UTC blows westerly wind 21 m/s. The storm warning will be given in Finland, when 10-minute averages are 21 m/s or more.

COORDINATES OF THE PLACE OF THE ACCIDENT 59°23N 21°41E (at 02 local time)

DRIFTING OF RAFTS

TIME	WIND		DRIFTING		DISTANCE	LONGITUDE		LATITUDE	
HRS	DIRECTION	SPEED	DIRECTION	SPEED	NAUT.MILES	DEGREE	MIN	DEGREE	MIN
0	240.	15.00	68.	0.58	0.0	21.0	41.0	59.0	23.0
3	268.	12.13	92.	0.48	3.4	21.0	47.2	59.0	24.3
6	300.	13.00	123.	0.49	2.8	21.0	52.7	59.0	24.2
9	288.	15.27	117.	0.59	2.9	21.0	57.4	59.0	22.6
12	280.	18.00	111.	0.69	3.4	22.0	3.4	59.0	21.1
15	280.	17.00	112.	0.67	4.0	22.0	10.7	59.0	19.6
18	280.	16.00	112.	0.64	3.9	22.0	17.8	59.0	18.1
21	275.	14.94	108.	0.61	3.7	22.0	24.7	59.0	16.7
24	270.	14.00	103.	0.57	3.5	22.0	31.3	59.0	15.7

Speed of wind and flow is given in m/s.
Distance = drift in nautical miles during 3 hours. Total distance = 27.68 nautical miles

DRIFTING OF LIFEBOATS

TIME	WIND		DRIFTING		DISTANCE	LONGITUDE		LATITUDE	
HRS	DIRECTION	SPEED	DIRECTION	SPEED	NAUT.MILES	DEGREE	MIN	DEGREE	MIN
0	240.	15.00	90.	0.38	0.0	21.0	41.0	59.0	23.0
3	268.	12.13	118.	0.30	2.2	21.0	45.3	59.0	23.0
6	300.	13.00	150.	0.33	1.8	21.0	48.4	59.0	22.2
9	288.	15.27	138.	0.38	1.9	21.0	50.2	59.0	20.5
12	280.	18.00	130.	0.45	2.2	21.0	53.1	59.0	18.9
15	280.	17.00	130.	0.43	2.6	21.0	57.1	59.0	17.2
18	280.	16.00	130.	0.40	2.5	22.0	0.8	59.0	15.6
21	275.	14.94	125.	0.37	2.3	22.0	4.3	59.0	14.1
24	270.	14.00	120.	0.35	2.2	22.0	7.8	59.0	12.8

Speed of wind and flow is given in m/s.
Distance = drift in nautical miles during 3 hours. Total distance = 27.68 nautical miles

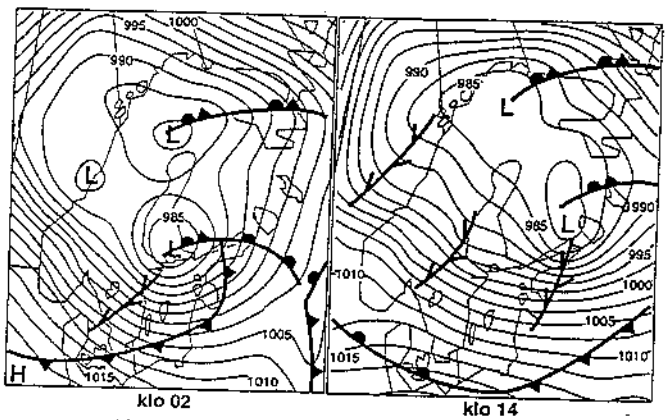
MESSAGE SENT TO:
Fax: 949 108064
921 2500950
Tel 949 485942

The above drifting forecast has been made at the FMI Regional Office for Southern Finland.

MERISÄÄFAX

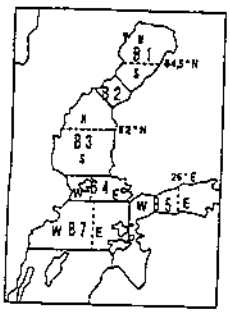
Tuulivaroitukset voi tarkistaa numerosta 970 81 eller 970 82 (noin 5 mk/min)

Merisääneteorologi 24 h/vrk 0600-1-0600 (noin 15 mk/min)



klo 02 klo 14

Keskiviikkona 28.09.1994

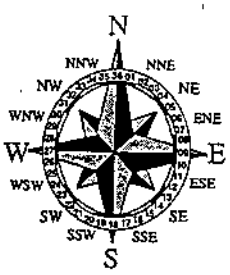


	klo 08		klo 14				klo 20				klo 02			
	DDD	FF	DDD	FF	FX	W	DDD	FF	FX	W	DDD	FF	FX	W
B1N Perämeren pohjoisosa	W	07	WNW	07	09	S	WNW	08	11	-	WNW	08	11	-
B1S Perämeren eteläosa	NW	06	WNW	07	10	S	WNW	08	10	-	W	08	10	-
B2 Merenkurkku	NW	06	WNW	06	10	S	WNW	07	11	-	W	07	11	-
B3N Selkämeren pohjoisosa	N	09	WNW	08	13	S	WNW	10	14	-	W	10	13	S
B3S Selkämeren eteläosa	NNW	15	WNW	13	17	S	WNW	12	16	-	W	11	14	-
B4E Saaristomeri	W	17	W	16	16	S	W	12	16	-	W	11	14	-
B4W Ahvenanmeri	WNW	17	W	16	15	S	W	11	15	-	W	09	13	-
B7W Pohjois-Itämeren länsiosa	W	18	W	16	17	S	W	14	16	-	W	10	13	-
B7E Pohjois-Itämeren itäosa	W	18	W	17	21	S	W	14	16	-	W	12	14	-
B5W Suomenlahden länsiosa	WSW	12	W	17	21	S	W	09	18	S	W	09	13	-
B5E Suomenlahden itäosa	SSW	12	WSW	14	17	S	W	11	18	S	W	10	14	S

ILMATIETEEN LAITOS
Sääpalvelutoimisto

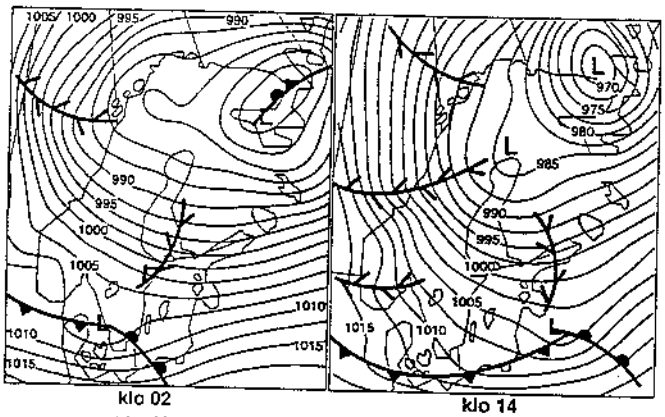
Ennuste tehty 28.09.1994
© IL/Meriasa

MERISÄÄFAX



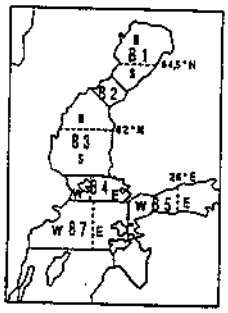
Tuulivaroitukset voi tarkistaa numerosta 970 81 eller 970 82 (noin 5 mk/min)

Merisääneteorologi 24 h/vrk 0600-1-0600 (noin 15 mk/min)



klo 02 klo 14

Torstaina 29.09.1994



	klo 08				klo 14				klo 20				klo 02			
	DDD	FF	FX	W	DDD	FF	FX	W	DDD	FF	FX	W	DDD	FF	FX	W
B1N Perämeren pohjoisosa	W	06	10	S	W	06	10	S	W	05	10	-	NNW	06	11	-
B1S Perämeren eteläosa	W	06	10	S	W	07	10	S	W	06	10	S	NW	07	10	-
B2 Merenkurkku	W	07	12	-	W	08	12	S	W	07	13	-	NW	09	14	-
B3N Selkämeren pohjoisosa	W	10	13	-	W	10	14	S	W	11	15	S	NW	12	16	-
B3S Selkämeren eteläosa	W	10	13	S	W	09	14	S	W	11	15	S	WNW	12	16	-
B4E Saaristomeri	W	09	13	-	W	08	13	S	WNW	09	14	S	W	11	15	-
B4W Ahvenanmeri	W	08	12	-	W	07	12	S	W	08	14	-	W	10	15	-
B7W Pohjois-Itämeren länsiosa	W	07	11	-	W	07	12	S	WNW	09	14	-	WNW	11	15	-
B7E Pohjois-Itämeren itäosa	W	09	13	-	W	08	13	S	WNW	10	14	S	W	12	15	S
B5W Suomenlahden länsiosa	WSW	08	12	-	W	07	11	S	W	07	12	S	W	08	13	S
B5E Suomenlahden itäosa	WSW	10	13	-	WSW	08	11	S	WSW	07	12	S	W	08	12	S

ILMATIETEEN LAITOS
Sääpalvelutoimisto

Ennuste tehty 28.09.1994
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OTHER DATA

Data from the Swedish Meteorological and Hydrological Institute (SMHI) is given on page 6/2 and data from the Estonian Meteorological and Hydrological Institute (EMHI) is given on page 6/3.

On pages 6/4 and 6/5 there are the calculations for the drifting of the lifeboats and rafts as well as the calculations for the drifting of the oil spill, made by Environmental Impact Assessment Centre of Finland Ltd (Ympäristövaikutusten Arviointikeskus Oy). The calculations are based on the wind data of the Finnish Meteorological Institute.

SMHI
Sjöfart

Svante Andersson

Observationer från några svenska synopstationer i samband med Estonias förlisning 27-28 september.

Nedan anges medelvind samt den maximala medelvind som noterats sedan tidigare synop.

Datum/kl UTC	Söderarm riktning medelvind (m/s)	Svenska Högarna	Gotska Sandön
27/ kl 15 UTC	SW 09 max 12	SW 12 max 14	WSW 11 max 12
27/ kl 18 UTC	SW 11 max 13	SSW 14 max 16	SW 16 max 16
27/ kl 21 UTC	S 13 max 17	SW 16 max 18	W 17 max 20
28/ kl 00UTC	SW 14 max 15	W 17 max 18	W 17 max 18
28/ kl 03 UTC	W 20 max 20	WNW 24 max 24	WNW 16 max 18
28/ kl 06 UTC	WNW 17 max 20	WNW 18 max 25	WNW 12 max16
28/ kl 09 UTC	WNW 12 max 17	WNW 14 max 18	WNW 11 max 15

FROM

OCT.17.94 2:38P P.001

EMHI | Date: Oct 17,1994 | No. | Number of pages, incl. this one:

To: F M I	From: Estonian Meteorological and Hydrological Institute
Telefax No. 358 0 179 581	Meteorological Centre
Att: Maija Komulainen	Originator: Helve Kotli
	Phone (372) 2 44 40 59
Ref. Your: The phonecall from Mr.E.Hyvönen	Fax (372) 2 44 94 84

Dear Mrs.M.Komulainen,

According to your request I am informing You about the weather conditions Sept 27 and 28,1994 at the Meteorological station Ristna (58°55'N 22°04'):

Date Time	Air temp (°C)	pressure(mb)	Wind direction	speed metres per second mean	max in gusts a.	b.
27.09						
02	13,3	1004,4	SW	6		
05	13,3	1002,1	SW	9	14	
08	12,5	1001,5	SW	10	12	(14)
11	12,9	1001,1	WSW	12		(16)
14	12,8	1001,1	SW	12	16	(17)
17	12,5	999,3	SW	8	12	(16)
20	12,5	995,3	SSW	8	14	(15)
23	12,1	991,9	W	16	21	(22)
28.09						
02	11,2	989,7	WSW	15	22	(23)
05	9,6	987,9	W	18	24	(29)
08	8,8	989,9	W	17		(26)
11	9,4	994,9	WNW	12	18	(26)
14	10,4	998,1	W		16	(19)
17	11,2	1000,4	W	10	15	(18)
20	11,7	1002,3	W	9		(15)
23	11,0	1003,4	NW	8	14	(15)

Attention: a. means maximum wind speed in gusts at the observation moment
b. maximum wind speed in gusts during the last three hours

Ristna Station has transmitted storm warnings:
27.09.94 at 20.45 wind 230 degrees 9 to 16 metres per second
28.09.94 at 02.36 wind 240 degrees 15 to 25 metres per second
at 03.00 260 degrees 20 to 29 metres per second in gusts
at 03.33 the last warning was cancelled

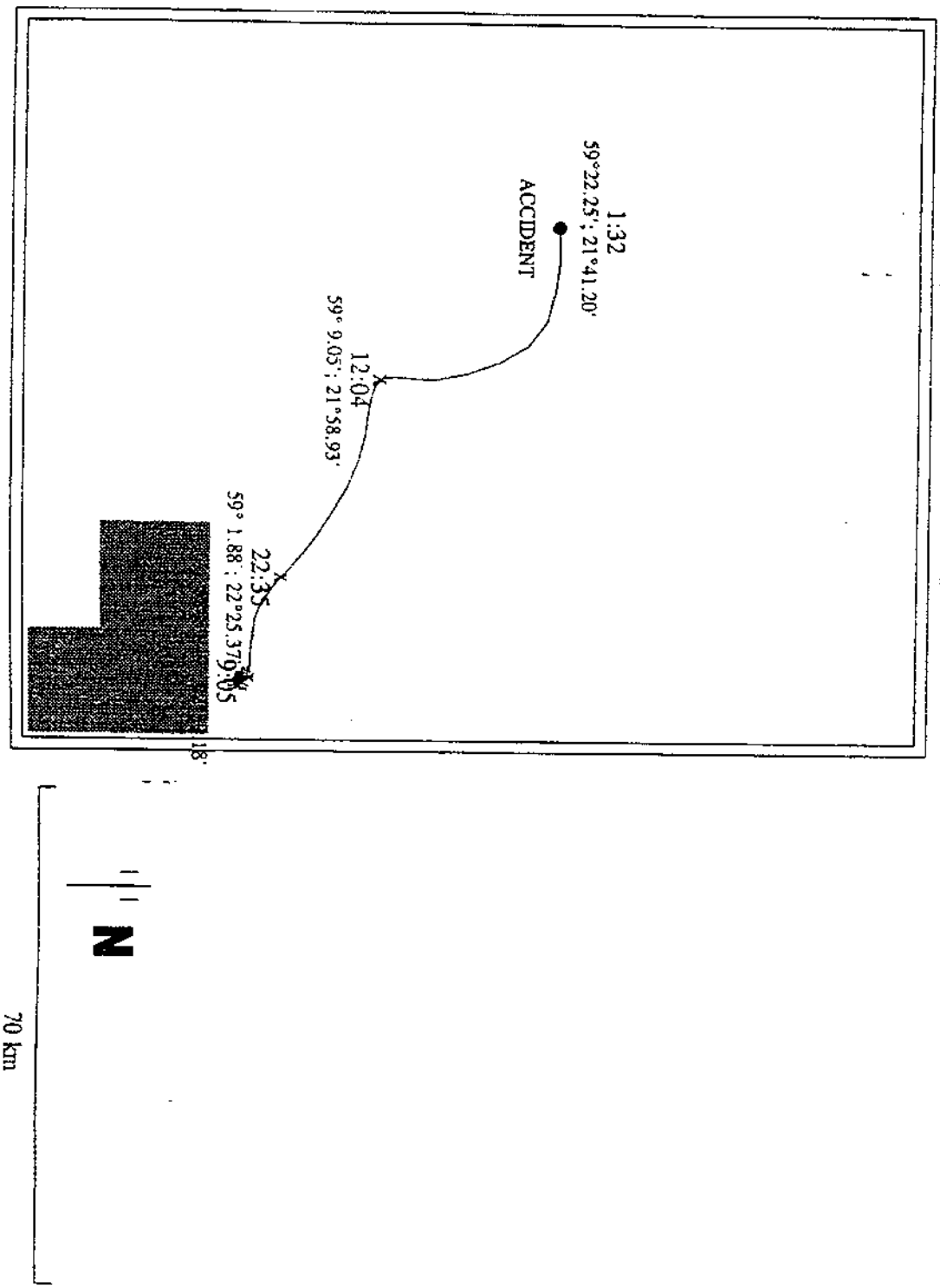
Yours sincerely

Helve Kotli

Director

Estonia, effect of flow and wind

Estonia, virtaus + tuulivaikutus



Annex 6/5

YVA Oy / EIA Ltd. 70018682 8.03

Estonia, spreading of the oil

Estonia, öljyn leviäminen