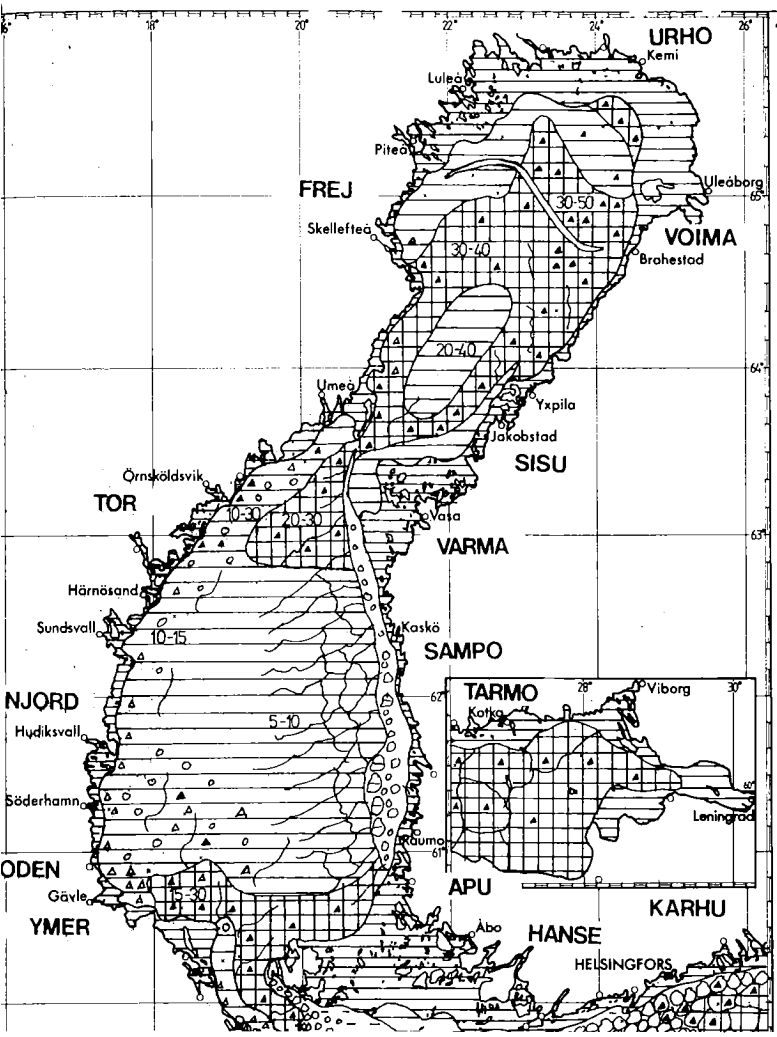
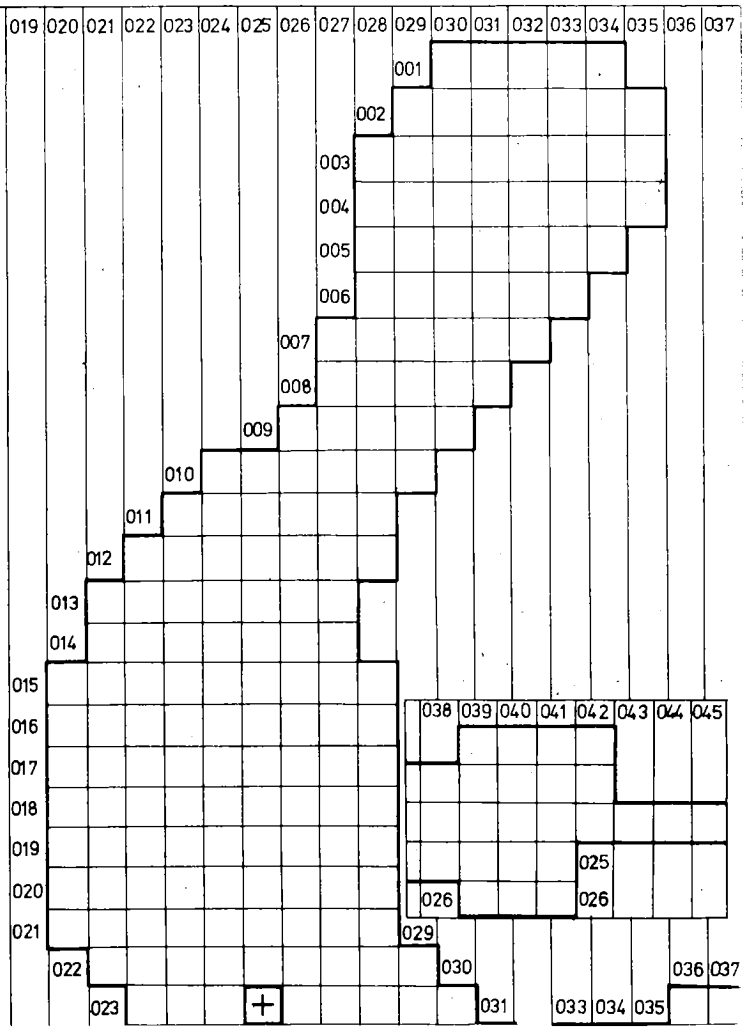
STYRELSEN FÖR VINTERSJÖFARTSFORSKNING
Sjöfartsverket Sverige, Sjöfartsstyrelsen Finland
Forskningsrapport nr 34





BASIS

A data bank for Baltic sea ice and sea surface temperatures

Ingemar Udin
Jörgen Sahlberg
Jan-Eric Lundqvist
Sulo Uusitalo
Ari Seinä
Matti Leppäranta

Norrköping 1981

WINTER NAVIGATION RESEARCH BOARD
Swedish Administration of Shipping and Navigation, Finnish Board of Navigation
Research Report No 34

BASIS

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FOREWORD

The Winter Navigation Research Board presents its report no. 34. The report decribes a joint Swedish-Finnish project which has resulted in a comprehensive digital data bank (BASIS) for sea ice and sea surface temperature for the Baltic. The project has among others comprised the timeconsuming and tedious work of digitizing sea ice information from charts, control procedures and final formation of a common data bank. The work has been equally divided between the Finnish Institute of Marine Research and the Swedish Meteorological and Hydrological Institute. The preparation of this report has also been a joint work of the two institutes.

BASIS is designed for easy computer processing and can be used for many different purposes of interest for winter navigation and ice climatology. As a first result a sea ice atlas for the Baltic area is planned to be published within short.

The Winter Navigation Research Board wishes to express its thanks to the authors and the many individuals that have been engaged in the development of these digital data for the Baltic area.

Norrköping and Helsinki, March 1981

Kaj Janérus Jan-Erik Jansson

ABSTRACT

A digital data bank for ice conditions and surface temperature over the Baltic Sea, Skagerrak, Kattegat and Lake Vänern has been formed jointly by SMHI (Swedish Meteorological and Hydrological Institute) and Finnish Institute of Marine Research in a winter navigation research program. Data are given in a geographical grid with the sides 30 minutes along parallels and 15 minutes along meridians in a code which gives information, in case of ice, about ice type, concentration and dominant thickness or, in the case of no ice, about surface temperature. Data have been extracted from reanalyzed ice and surface temperature maps with a frequency of two data sets (maps) per week. At present 16 ice seasons have been coded, controlled, corrected and stored on magnetic tapes. The content is approximately 900 data sets or 3 million digits. A statistical analysis has started and a new sea ice atlas for the region above will follow this report. The work will continue in order to cover the whole climatological period 1960 - 1990.

SAMMANFATTNING

En digital databank över isförhållandena och ytvattentemperaturen i Östersjön, Skagerack, Kattegatt och Vänern har skapats av SMHI (Sveriges Meteorologiska och Hydrologiska Institut) och Finska Havsforskningsinstitutet gemensamt i ett vintersjöfartsforskningsprogram. Data finns i ett geografiskt gridnät där sidorna är 30' i latitudinell led och 15' i longitudinell led i en kod som, vid is, ger information om isslag, koncentration och dominant istjocklek. Om is inte förekommer anges istället ytvattentemperaturen. Data har hämtats från omarbetade is- och ytvattentemperaturkartor. Frekvensen i tiden är två kartor per vecka. För närvarande finns 16 års data digitaliserade, kontrollerade, rättade och upplagda på magnetband. Banken innehåller cirka 900 kartbilder eller 3 miljoner sifferuppgifter. En statistisk bearbetning har påbörjats och en ny isatlas för det nämnda området planeras följa denna rapport. Arbetet fortsätter och målet är att hela den klimatologiska perioden 1960-90 skall inkluderas i databanken.

TIIVISTELMÄ

Itämeren, Skagerrakin, Kattegatin ja Vänern-järven jääolosuhteita sekä veden pintalämpötilaa kuvaava tietokonerekisteri on konstruoitu Merentutkimuslaitoksen ja SMHI:n (Ruotsin meteorologinen ja hydrologinen laitos) välisenä yhteistyönä. Aineisto on digitalisoitu hilaverkkoon, jonka solmupisteiden väli on 30' pituusasteissa ja 15' leveysasteissa. Numeerinen koodi kuvaa jään laatua, konsentraatiota ja paksuutta tai, mikäli jäätä ei ole, pintalämpötilaa. Aineisto pohjautuu analysoituihin jää- ja lämpötilakarttoihin. Kultakin talvelta on digitalisoitu kaksi karttaa viikkoa kohti. Tähän mennessä on 16 talvea koodattu, viety rekisteriin ja tarkistettu; tiedon kokonaismäärä on 900 karttaa eli noin kolme miljoonaa lukua. Aineiston tilastollinen käsittely on aloitettu, ja tätä raporttia seuraa pian uusi Itämeren jääatlas. Karttojen digitalisointi jatkuu, ja tavoitteena on saada rekisteriin koko klimatologinen perusjakso 1960-1990.

BASIS - a data bank for Baltic sea ice and sea surface temperatures

TABLE OF CONTENT

1. INTRODUCTION

1.1 General

Sea ice data are geophysical data often available in map form and in qualitative rather than quantitative form (Figure 1). Terms like open pack ice, consolidated pack ice, grey ice, grey-white ice are often used in the sea ice community. One reason for this terminology is the difficulty in measuring and determining sea ice parameters over large areas with a sufficient accuracy. Anyhow, when studying an ice chart ice concentration, thickness, amount of ridged ice etc. can be estimated from the ice symbols and quantified. The accuracy can also be increased by going back to journals and original observations.

For many purposes, e.g. statistical analysis, climatology, ice research and development and planning of shipping in ice covered waters, it is more suitable and sometimes necessary to have sea ice data in numerical form and available on computer media for simple handling.

1.2 Data bank

Within a Swedish-Finnish winter navigation research program it was decided to build up a joint data bank with ice data from the Baltic Sea, Skagerrak, Kattegat and Lake Vänern. It was also decided to include surface temperature (SST) from the same region for the period October - May. Initially it was planned to use the data mainly for sea ice statistics and an ice atlas directed to winter shipping. The coding of data therefore reflects that purpose to a certain degree.

The work on the data bank has comprised many different steps, such as

- construction of a suitable grid and numerical code

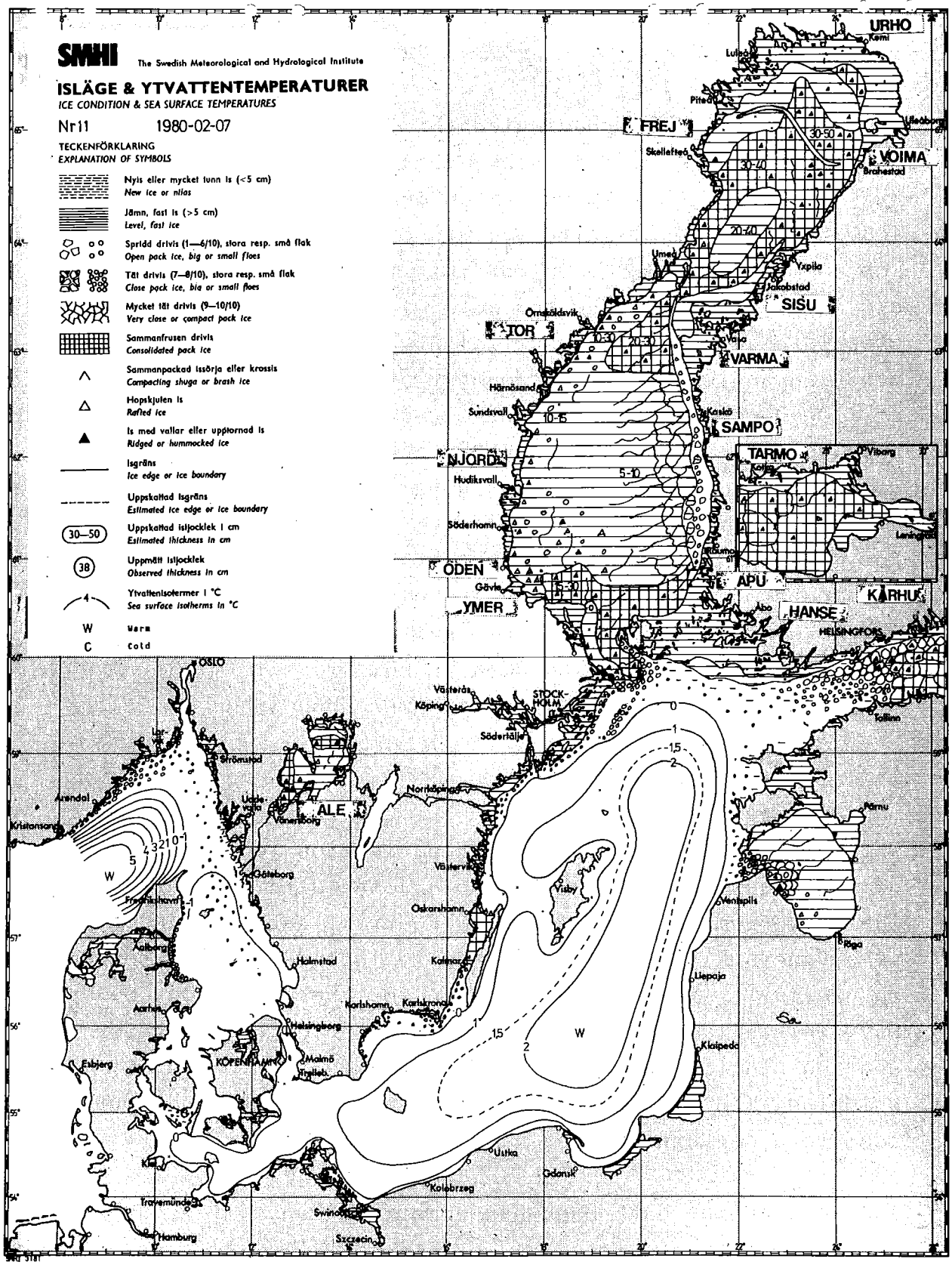

Figure 1a An ice chart for the Baltic region from Feb 7 1980 issued by SMHI.

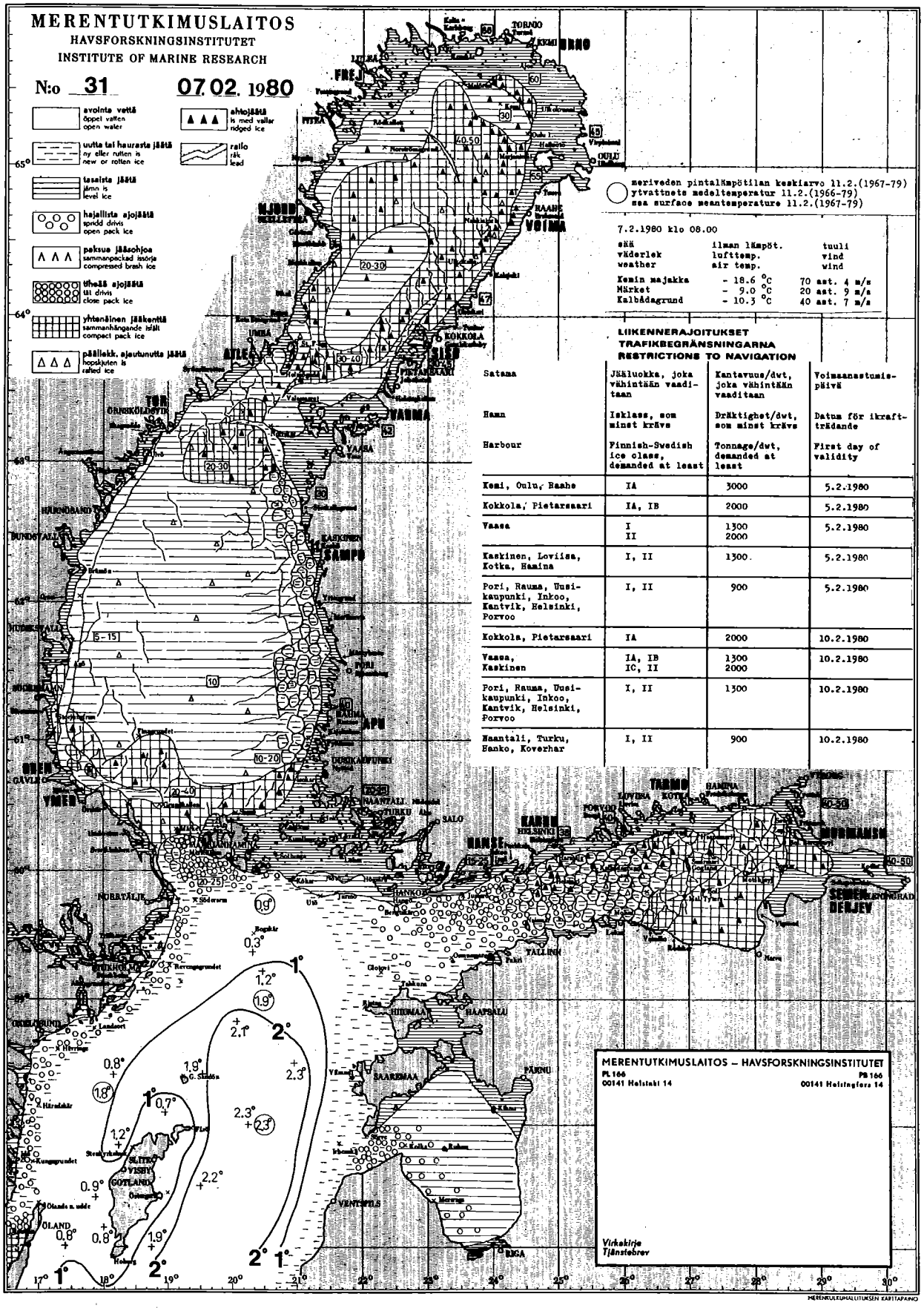

Figure 1b An ice chart for the Baltic issued by FIMR.

- correcting and updating of ice charts with later available ice information

- manual digitizing of ice charts in grid points

- punching of data

- control and correction of data

- storage of controlled data.

The work has been done jointly by Finnish Institute of Marine Research (FIMR) and SMHI (Swedish Meteorological and Hydrological Institute). As a first phase the data from the ice seasons 1963/64 - 1978/79 have been digitized and stored. Consequently data from 16 ice seasons are available for the time being. FIMR has been responsible for half of the data material and SMHI the other. At least until 1990 further data will be added to the bank after each ice season.

1.3 Earlier statistical work

Some statistical analyses of ice data for the region have been done earlier. Jurva (1937) described the time development of ice seasons through a number of ice phases which were defined on the basis of extension and thickness of fast ice at the Finnish coast and presented in this work the first ice atlas for the Baltic Sea. Östman (1937) described the ice conditions at the Swedish coasts for the period 1870/71 - 1934/35 and presented mean dates for ice formation and decay, mean ice thickness, mean sea traffic period etc. Palosuo (1953) continued Jurva's work and studied ice conditions in the central Baltic during severe winters. Statistical analysis of ice conditions along the Swedish and Finnish coasts for the whole climatological period 1930-1960 were presented by Palosuo (1965) and Thorslund (1966). Ice statistics for Lake Vänern were given by Lundqvist (1969).

Statistical work of ice conditions in the open sea are sparse. Thorslund (1967) described the extension of sea ice in the region for the data bank. He based his work on ice maps from the winters 1951/52 - 1966/67 and presented statistical maps over the extension of all kind of ice and of consolidated ice. Prior to 1960's the amount of ice data from the open sea was rather small. The present data bank will thus give a new and important insight into the statistical features of the ice cover in the region.

Surface temperature data for coastal stations have been available since the first coastal observation station in the Baltic Sea started its work at the end of the 19th century. Mean SST values for selected stations have been presented e.g. by MVC (1975). Temperature data for the open sea are available only since the 1960's when the operational ice services extended their activities and started to analyse SST maps systematically. Grönvall and Palosuo (1976) presented the first SST atlas. The data period was, however, only nine years.

2. CODING OF DATA

2.1 Grid

The grid was chosen to be 15' in latitude and 30' in longitude direction (Figure 2). At latitude 60° a grid cell is thus a 27.8 x 27.8 km square. The total number of grid points is 612.

2.2 Numerical code

The numerical code has been constructed to suit information from maps. The goal has been to record quantitative ice information but also qualitative data have been included. The purpose has been to make the code simple while still including as much information as possible. The final code describes both ice and sea surface temperature. Each group of information consists of five digits. When SST is coded only the first three digits are used

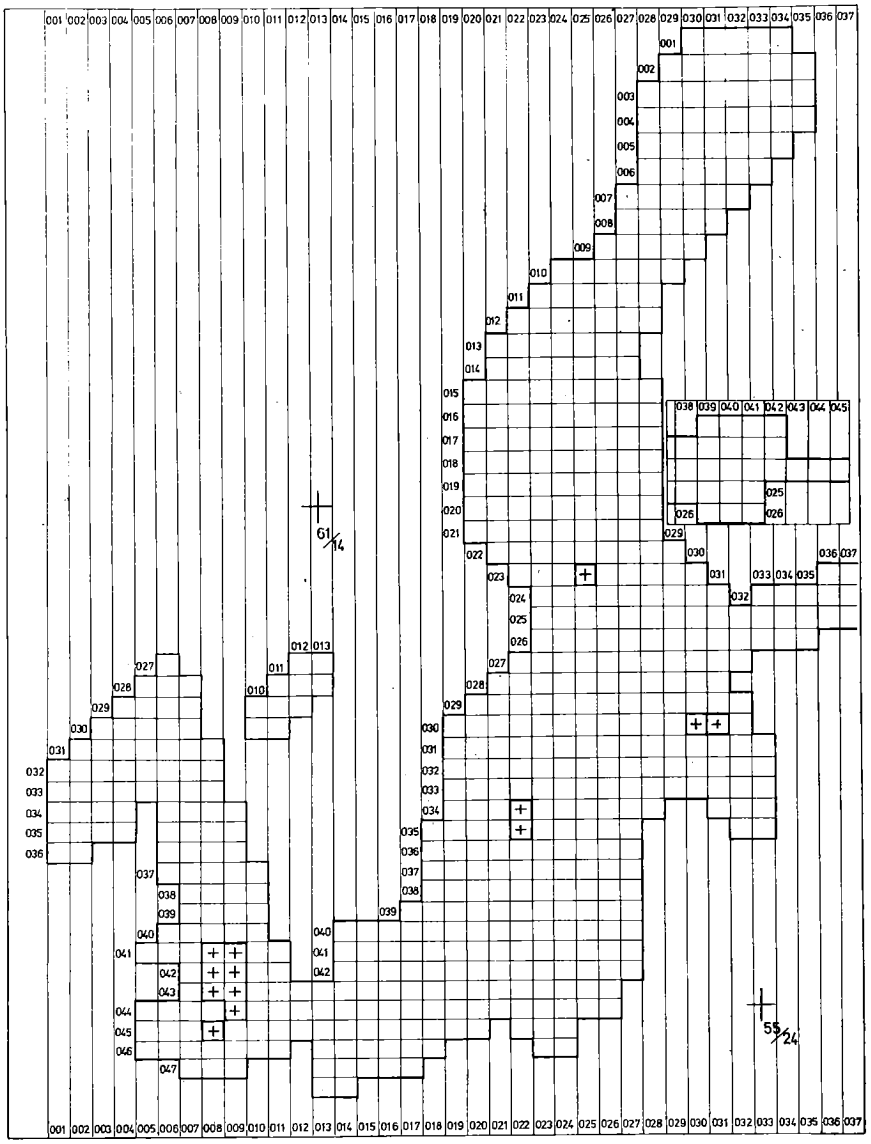

Figure 2 Grid for the data bank.

(TTTXX). When ice is coded two types of ice and ice thickness can be described in each grid point (ICDic). A brief outline of the code and the content in the data bank is obtained from Figure 3. Very briefly it can be said that the first digit gives the type of ice or indicates SST. The second digit gives more detailed information such as ice concentration and amount of ridged ice. Ice thickness is described by the third digit, but in the case of a lead or an ice edge in the grid point, concentration of open water is given instead of thickness. The fourth and fifth digits are used if more than one type of ice occurs in the grid cell. The last digits can also be used to indicate the reliability of data. A more detailed description of the code is given in Appendix A.

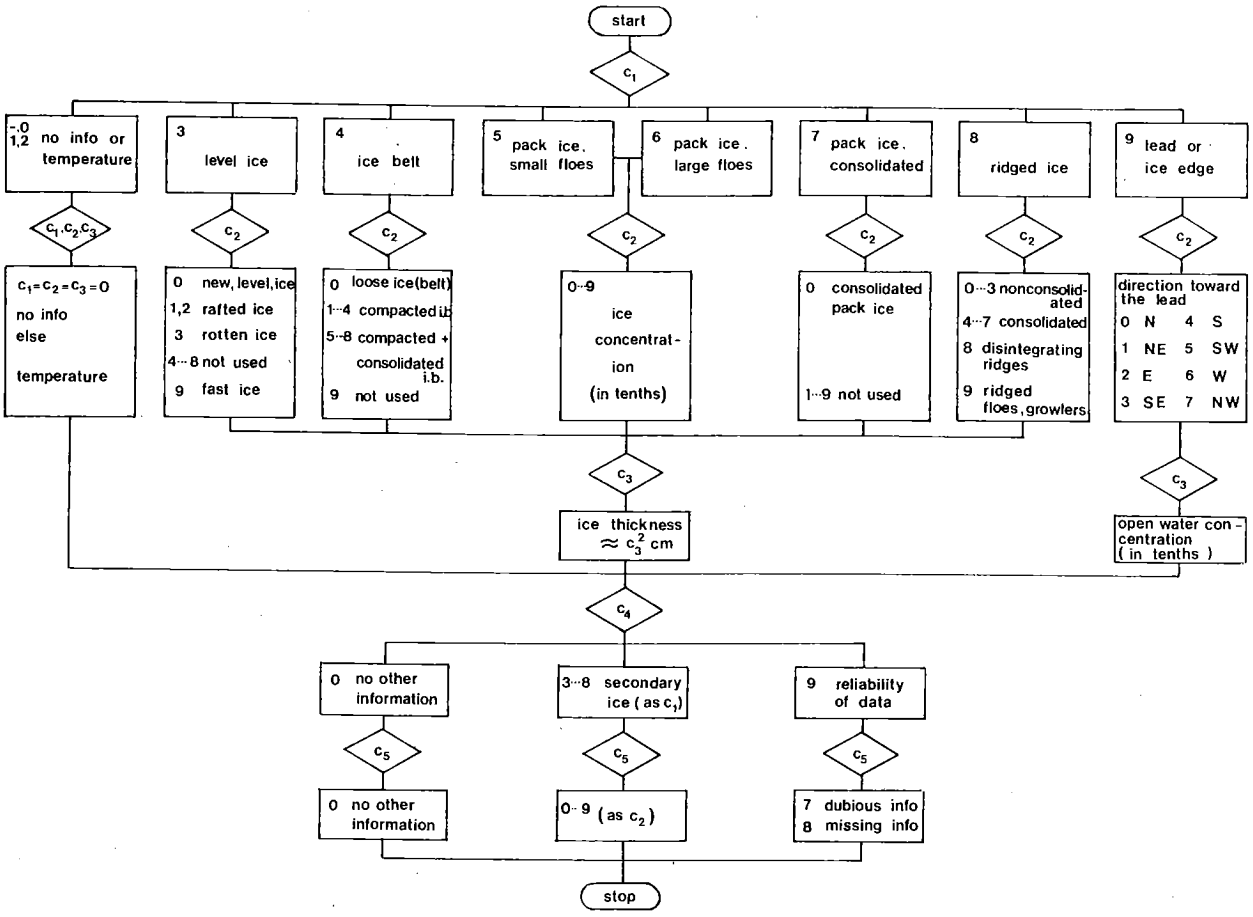

Figure 3 Flow chart for the code.

2.3 Heading

Data are digitized in latitudinal lines. Each line starts with heading information, containing map number, row and column number, number of data groups on the line etc. After the heading the 5 digits data groups follow.

Heading information is also given to each data set (or map). The heading contains map number, year, month, date, hour, kind of information, institute responsible for coding etc. Some information in the headings are given to allow an automatic control of data (see chapter 4). Figure 4 shows an example of a part of a digitized map. For further details see Appendix A.

FIRST CARD

ICE AND TEMPERATURE DATA PUNCHING FORM

Record type	Card type	Date of year	Ice + = 001 Ice = 002 Ice − = 003	Year	Month	Country	Day	Hour
	1	94	0,02	9,79	0,4	1	0,2	0,8

DATE OF CHART Year 1979 - Mo 04 - Day 02

NEXT CARDS

Record type	Card type	Date of year	Chart row number	Chart column number	Number of info-groups on card	Punched by F or S	Ice or temperature infogroup												
1	2	3	7	10	13	15	16	21	26	31	36	41	46	51	56	61	66	71	76
	0	94	1	30	5	1	3,9,8,0,0	3,9,8,0,0	3,9,8,0,0	3,9,8,0,0	3,9,8,0,0								
		94	2	29	7	1	3,9,8,0,0	3,9,8,0,0	7,0,8,8,6	7,0,8,8,6	3,9,8,8,5	3,9,8,0,0	3,9,8,0,0						
		94	3	28	8	1	3,9,8,0,0	3,9,8,0,0	9,2,1,8,4	9,5,1,8,5	7,0,8,8,5	9,2,1,8,4	7,0,8,8,4	3,9,8,0,0					
		94	4	28	8	1	3,9,8,8,5	7,0,9,8,6	7,0,9,8,4	9,1,1,7,0	9,5,1,7,0	9,2,1,7,0	7,0,8,8,5	3,9,8,0,0					
		94	5	28	7	1	3,9,9,8,6	7,0,9,8,5	7,0,9,8,4	7,0,9,0,0	9,1,1,7,0	9,7,2,8,4	3,9,8,8,4						
		94	6	28	6	1	7,0,9,8,5	9,0,9,8,4	7,0,9,8,4	7,0,9,0,0	9,3,2,7,0	9,7,1,3,9							
		94	7	27	6	1	7,0,8,8,4	7,0,8,8,4	7,0,8,8,4	9,3,1,8,4	9,3,3,6,9	9,6,1,3,9							
		94	8	27	5	1	7,0,8,8,5	7,0,8,0,0	7,0,7,0,0	9,3,2,6,9	9,7,1,3,9								
		94	9	26	5	1	3,9,8,8,5	6,7,6,8,6	9,3,1,6,9	9,3,3,6,9	9,7,2,3,9								

Figure 4 Punching form with digitized ice data for April 2 1979.

3. SOURCES OF INFORMATION AND MANUAL PROCESSING

3.1 Data published by different countries around the Baltic Sea during 1963-1979

The basic sources for the data bank have been the Finnish and Swedish ice and SST charts. In analysing and reanalysing the charts a lot of additional information has been used.

Ice charts and ice reports from the countries around the Baltic Sea have been important sources (Table 1). For all the years present in the data bank both charts and reports have been published in Finland, Sweden, Poland and Federal Republic of Germany (FRG). Material from Soviet Union has been available from the year 1972 onwards. Democratic Republic of Germany has only published

ice reports. Denmark and Norway have material only for the hard winters. Most countries have in their daily ice reports a verbal description of general ice conditions and a numerical description of ice conditions at different sea routes using the Baltic Sea ice code, SMHI (1959). The code has three numbers: the first gives ice conditions, the second state of ice development and the third the effect of ice on navigation. In addition the publications on ice conditions along the Finnish coast (FIMR 1964-1980) and along the Swedish coast (SMHI 1964-1980) have been used. They include data on ice and snow thickness, the times of freezing and break-up of ice and the number of ice days.

Table 1 The institutes which publish data on the ice conditions in the Baltic Sea, Kattegat and Skagerrak.

Country	Institute	Report	Chart	Telex	Comments
Democratic Republic of Germany	Wasserwirtschaftsdirektion Küste (Water Board for Management, Department for Coastal Hydrography), Warnemünde	Yes	No	Yes	
Denmark	Statens istjeneste, (Ice Council) Copenhagen	Yes	Yes	Yes	During hard winters only
Federal Republic of Germany	Deutsches Hydrographisches Institttut, (German Hydrographical Institute), Hamburg	Yes	Yes	Yes	
Finland	Merentutkimuslaitos (Institute of Marine Research), Helsinki	Yes	Yes	Yes	
Norway	Havnedirektøren (Board of Navigation), Oslo	Yes	Yes	Yes	During hard winters only
Poland	Institut Meteorologii i Gospodarki Wodnej (Institute of Meteorology and Water Management), Gdynia	Yes	Yes	Yes	
Sweden	Sveriges Meteorologiska och Hydrologiska Institut (The Swedish Meteorological and Hydrological Institute), Norrköping	Yes	Yes	Yes	Data also from Lake Vänern
USSR	Gosudarstvennyj Okeanograficeskij Institut, Leningradskij otdel, Gidrometeorologiceskaja sluzba (State Oceanographic Institute, Leningrad Branch, Hydrometeorological Service), Leningrad	Yes	Yes	No	Reports and charts from 1972 onwards

SST data have been published in Finland, Sweden, USSR, Poland, FRG and Denmark in the printed ice charts. In addition SMHI has issued sea surface temperature analyses twice weekly since November 1972. Data have also been taken from the Finnish and Swedish coastal stations (FIMR (1964-1969), SMHI (1971-1980)). The SST observation network is shown in Figure 5. Sea Fish Laboratory, Havs-

fiskelaboratoriet (1964-1980) , has published SST measurements by Swedish research vessels. The Danish Meteorological Institute has published the SST of the Danish coastal stations and light vessels for the whole data bank period, Det Danske Meteorologiske Institut (1964-1980).

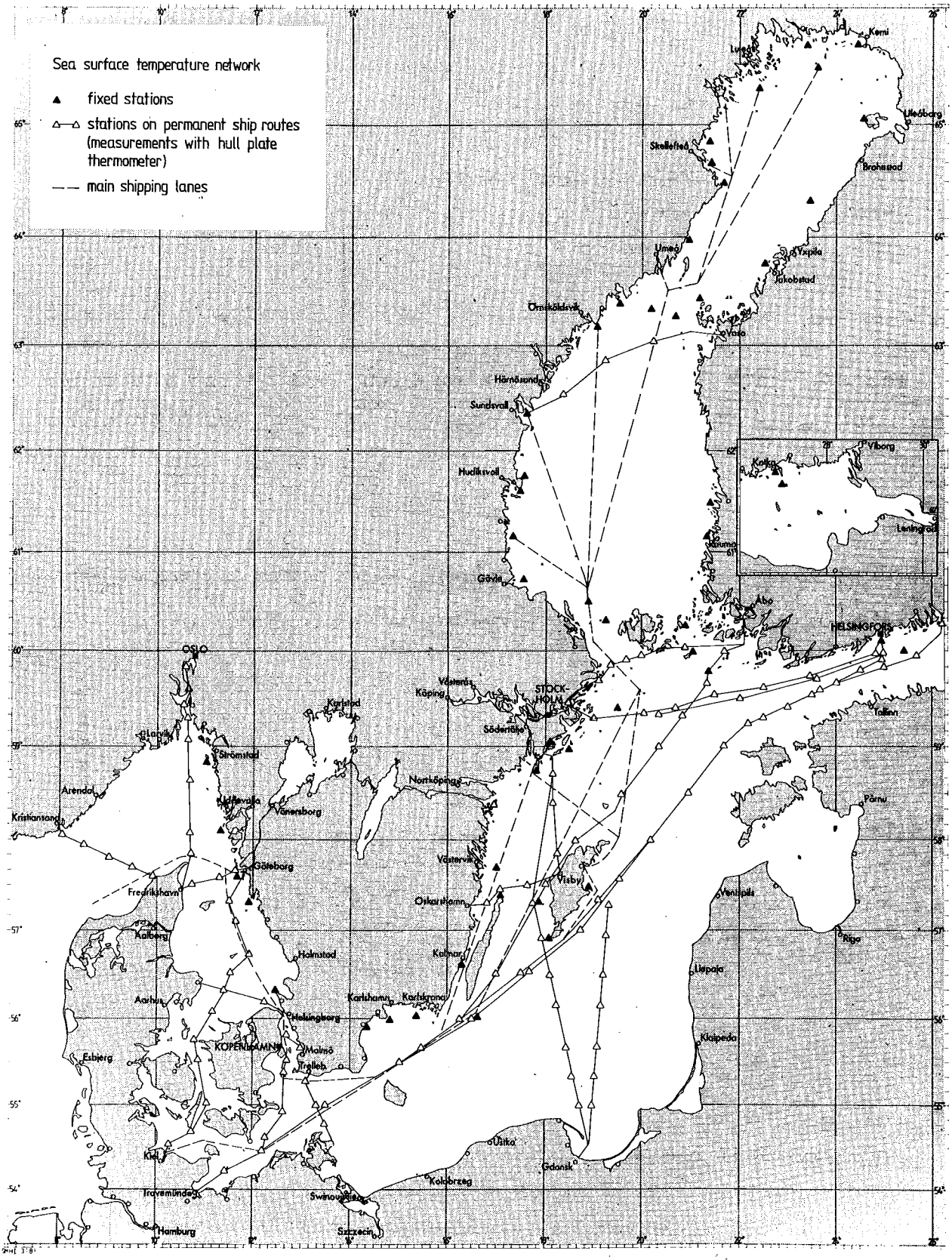

Figure 5 Sea surface temperature network in the Baltic Sea, Skagerrak and Kattegat.

3.2 Additional unpublished information in Finland

FIMR has in different places along the Finnish coast ice observation stations which make daily observations during the ice season (Figure 6). The observers fill up a log with different columns for fast ice, pack ice, ridges, direction of ice drift, amount of pack ice and open water

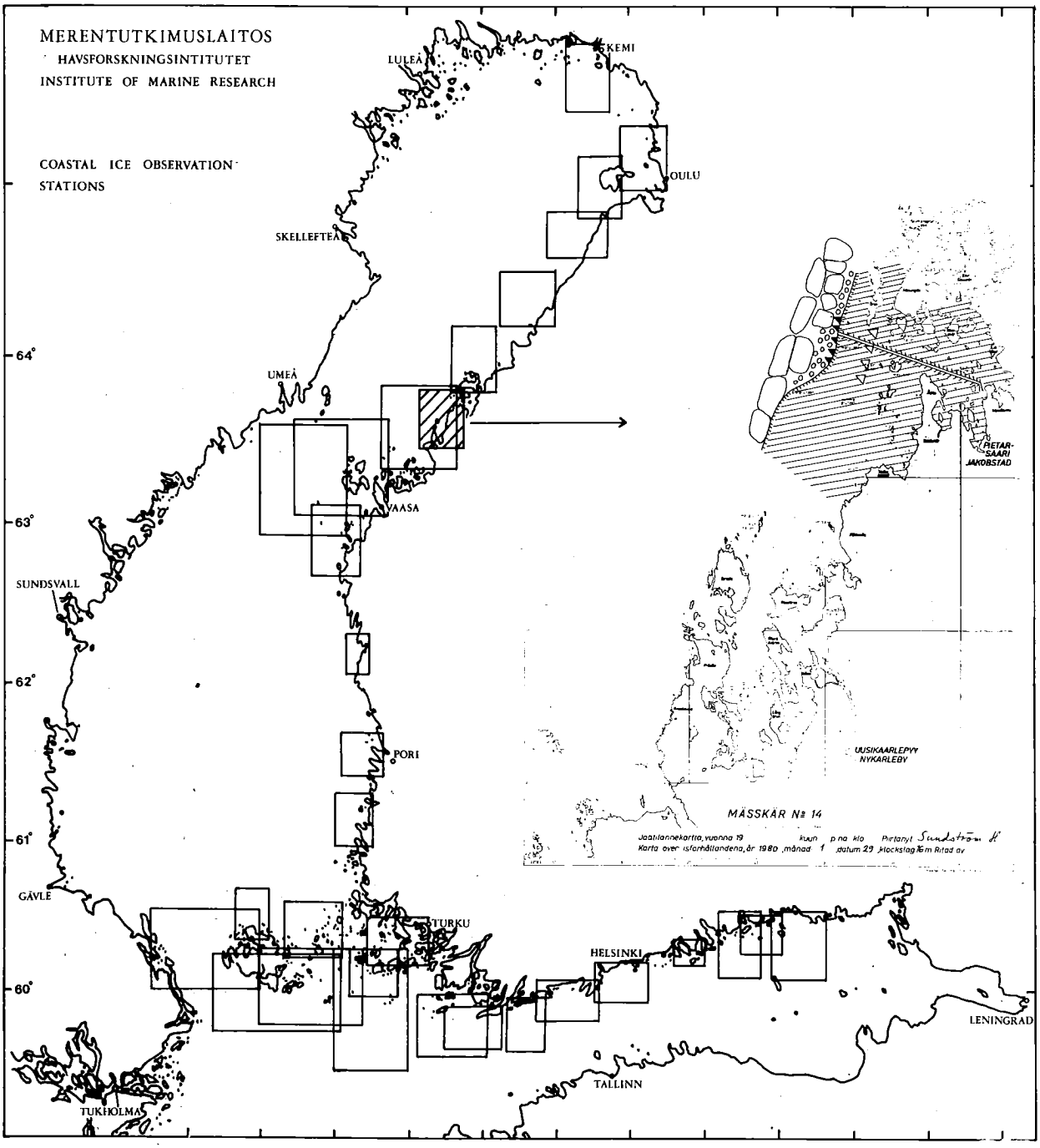

Figure 6 Coastal ice observation stations in Finland with an example of ice data from Mässkär.

and thickness of ice and snow. From the middle of 1960's thickness of snow ice (frozen slush) and position of the water line have also been observed. At least once a week a chart of the ice conditions at the observation area has been drawn (Figure 6). During the period 1963-78 70 different observation stations have been working and their number has varied yearly between 32 and 58.

The coast guard has sent ice information twice a week from their operating areas in the Gulf of Bothnia and Gulf of Finland. Harbour authorities have given ice information via telex from areas outside the winter traffic harbours. The icebreakers have reported ice conditions by telex three times a day (5, 8 and 12 GMT). After large changes of the ice conditions the icebreakers have sent xerox-charts from their areas of operation. FIMR has made ice reconnaissance flights over sea areas covered by ice almost every week. The observations of these flights are available in chart form. Unfortunately satellite pictures have been at disposal from the winters 1967-68 and 1971-72 only.

There are Finnish vessels which have made ice diaries. The diaries include ship's position, quality of ice and now and then thickness of ice. Diaries of the FIMR Ice Service have also been used, which include e.g. all information received via telephone.

The SST data for the fixed Finnish stations have been published until 1966 only. Thus the original observation forms of the stations have had to be used. The FIMR Ice Service SST stations (Figure 5) make measurements 2-7 times a week. They operate normally from autumn until freezing. Harmaja, however, operates all the year. Information is sent by telex to the Ice Service.

There are Finnish vessels making SST measurements by hull plate thermometers (Figure 5). They measure the temperature of the ship's hull beneath the water-line giving the surface temperature with a sufficient accuracy (Uusitalo 1975). Before these easily handled thermometers were in use, temperature observations were made by a bucket and

a thermometer. The data have been delivered on Sundays and Wednesdays to the Ice Service by telex. FIMR has also measured SST with airborne precision radiation thermometer once or twice a week from August to January when the weather has permitted.

Almost all the unpublished data have also been delivered to institutes in countries around the Baltic Sea by telex for routine use.

3.3 Additional unpublished information in Sweden

SMHI has an ice observation net along the Swedish coast (Figure 7). It consists of

- pilots giving ice information from their areas of operation
- personnel at light houses reporting ice conditions in sight
- recident people on outer islands and coastal areas also reporting ice in sight of their stations.

Ice information in Baltic Ice Code or in plain language is transmitted every day by telex or telephone to SMHI. Some stations also measure the thickness of ice and snow, position of the water line and give information on ice quality. At a few stations also maps over the ice condition are prepared. The total number of stations along the Swedish coast and in the large lakes has been approximately 90 during the period 1963-80. The stations have reported ice from more than 400 fairway sections, harbours and coastal regions.

Swedish icebreakers have sent ice information three to four times a day via telegraphy. Ice data from helicopter reconnaissances have been transmitted in map form by telecopier during the 1970's. Also ice data from air reconnaisance with small aeroplanes, ordered by the Swedish Icebreaking Service, have been transmitted to SMHI as well as reports from the Swedish Air Force. Before the more regular flights with helicopter and small aeroplanes were made, rough ice data were received from the regular

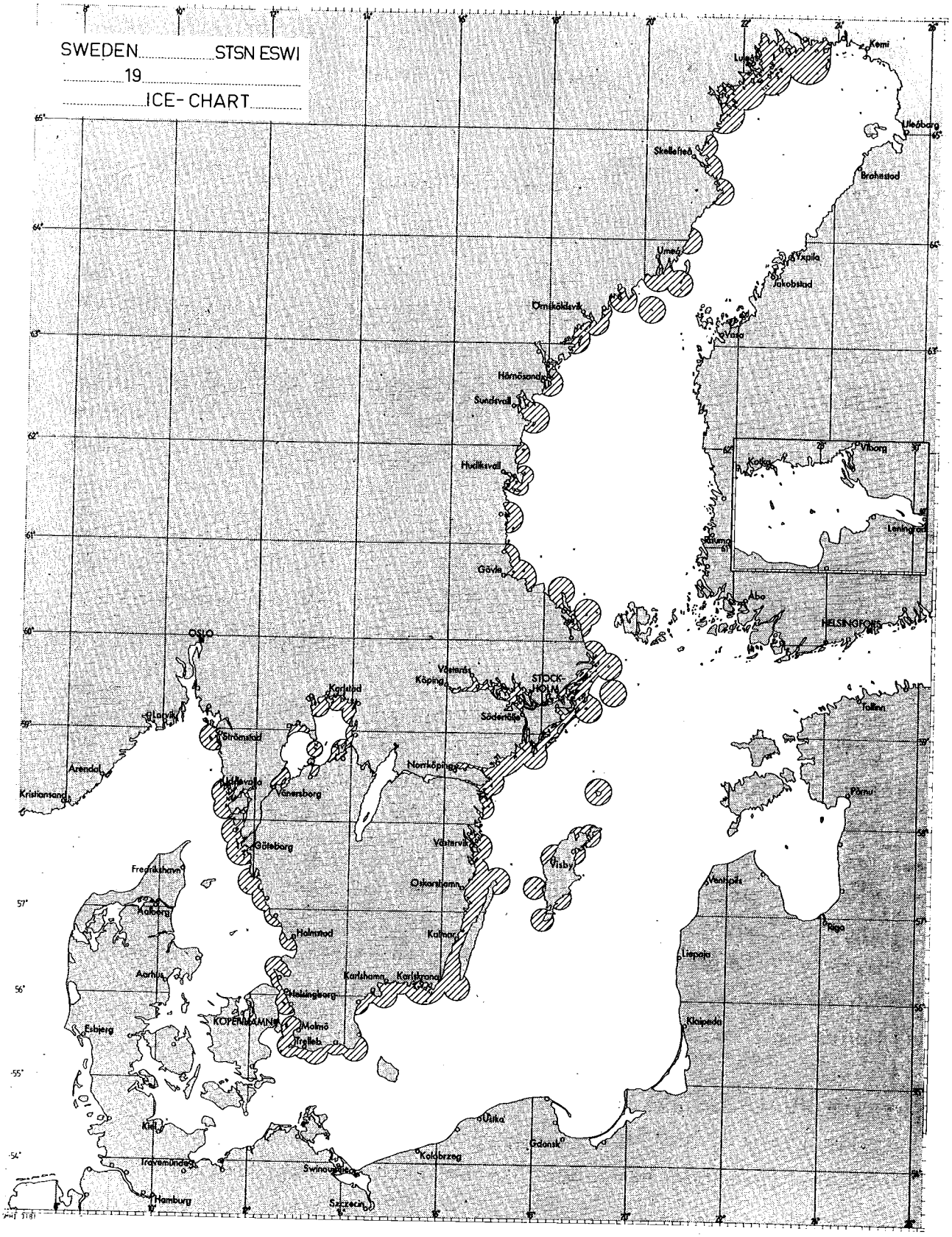

Figure 7 The coastal ice observation network in Sweden.

air traffic over Swedish waters. The last few years (from 1978) ice information in map form via telecopier have also been received from patrol flights made by the Swedish coast guard.

Some merchant vessels have reported ice quality, form, thickness and concentration and transmitted the information to SMHI via radiotelephone.

Satellite pictures (APT-pictures) have been received at SMHI and used for ice mapping since 1967. Mostly pictures from the U.S. satellites have been used but also Russian data have been received during the last few years.

Swedish SST data have been described by Thompson, Udin and Omstedt (1974) and the observation net is seen in Figure 5. Before 1972 no SST analyses were made and therefore data are available in log form only.

3.4 Manual processing and comments on data

On the basis of the published and unpublished data the routine ice charts have been reworked and corrected from errors and imperfections. The redrawn charts have been digitized in the 30' x 15' squares and to the code described in the previous chapter. In general it can be said that all the important information is found in the ice charts, except for some details present in the second and fifth digits of the ice code (Figure 3). Such details are: the width of slush belts and ridge index. This extra information has been taken from ice reports, telex reports from icebreakers and reports from ice observation stations.

Normally the primary ice is the ice type that covers the largest area in the square, leads have however been reported though not dominant. Some practices for digitizing have been slightly different at the two institutes. Ridged ice and slush belt are secondary information in the SMHI material and often primary in the FIMR material. SMHI has interpolated thickness data in a higher degree than FIMR.

The SST is representative for the middle of the square. If a point is situated on land the surface temperature represents the coastal surface temperature. The Swedish data contains at present only ice information.

4. DATA HANDLING

After the manual processing the computer handling of data starts. Different programs have been developed for forming the data bank. They have been described in more detail by Uusitalo (1979) and Sahlberg and Udin (1981) and their main tasks are

- transferring of punched data to disc and magnetic tape
- control of data
- updating of stored data.

The data are punched on cards or written in tape cassette and thereafter controlled and stored on a temporary disc-file (Figure 8). Errors detected in the data are printed and the values are corrected by going back to the original material. After correction the disc file is updated. When no errors are indicated the data are formatted in chart pictures, sorted in the right order and stored on a magnetic tape. The tape is the final storage media of the data bank.

4.1 Control of data

When forming a data bank different sources of errors exist, some of which depend on lack of knowledge of the parameters. Errors of those types cannot be corrected. Others can be introduced during the data handling. Digits have been written in wrong positions when digitizing, errors have been made during punching etc. Many of such errors can be detected by control programs and later on corrected. More than 20 different checks are made to minimize the errors in the data bank (Table 2).

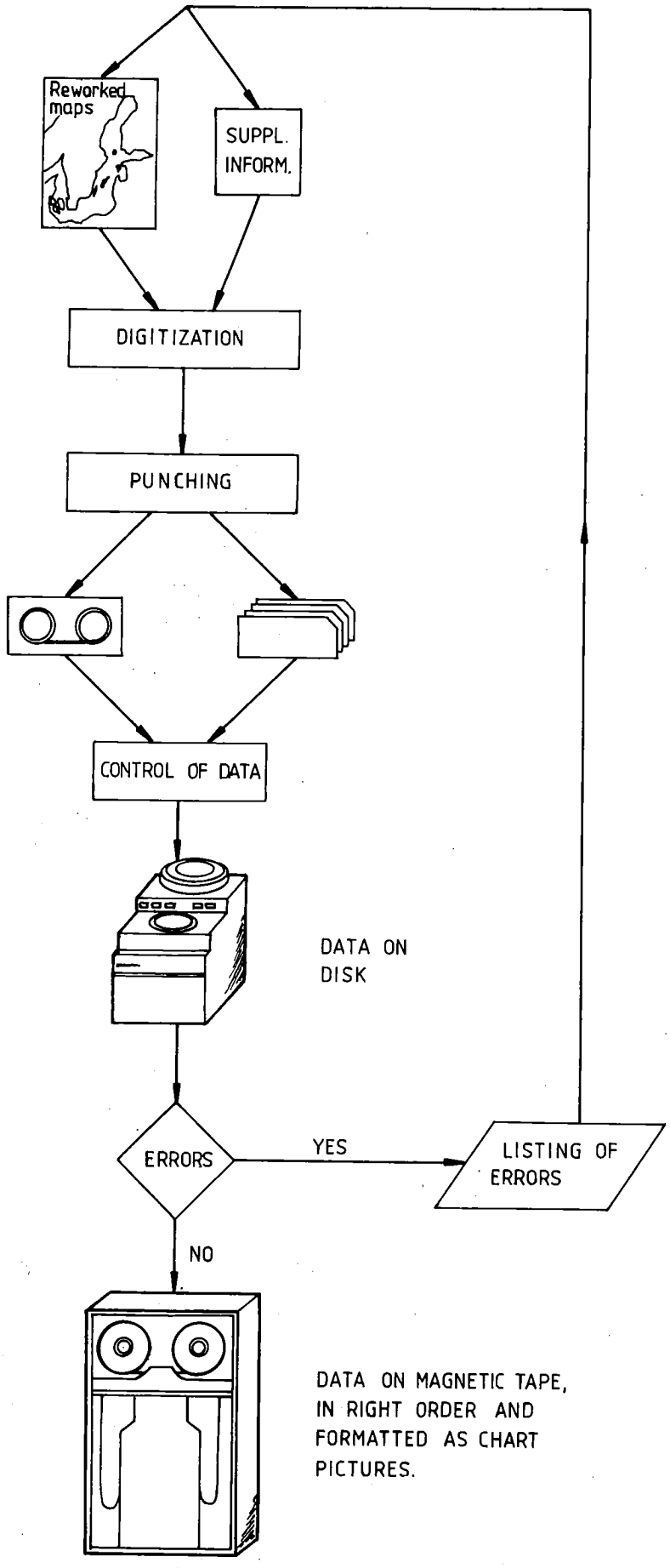

Figure 8 Diagram over data handling.

Table 2 Data control

A. Control of header card:	
- map number	0 - 366
- code for type of data	1 - 3
- year	1960 - 1982
- month	1 - 12
- day	1 - 31
- hour	8
- year, month, day equals	map number
B. Control of data cards:	
- map number equals	map number of header card
- row number	1 - 48
- column number	1 - 45
- number of information groups equal	given value
C. Control of information: (ICdic = $C_1C_2C_3C_4C_5$; $C_{12} = C_1C_2$; $C_{45} = C_4C_5$)	
- C_1 not equal 9 if C_2 equals	8 - 9
- C_4 not equal	1 - 2
- C_{12} not equal	71 - 79
- C_{12} not equal	34 - 38
- C_{12} not equal	49
- C_{45} not equal	71 - 79
- C_{45} not equal	34 - 38
- C_{45} not equal	90 - 96
- C_{45} not equal	49
D. Control of continuity:	
- time difference between maps less than	10 days

Besides the automatic control of data some errors have been detected under the further processing of data. These errors have also been corrected.

The data bank contains at present more than 900 maps. Each map contains 612 grid points with 5 digits in each point. The total number of digits is thus approximately 3 millions. Some of these may still be wrong but the automatic and manual control of data have diminished the errors in the data bank substantially.

5. SUMMARY AND PLANNED ACTIVITIES

The data bank, BASIS, now contains sea ice data twice weekly from the ice season 1963/64 to 1978/79. SST data are included in the Finnish part of the material but not yet in the Swedish part. The SST has not been controlled. Thus, so far, BASIS is only a sea ice data bank.

The code used for digitization is in many parts good but during the work some drawbacks have been recognized.

- Ice thickness should be given more accurately than only one digit allows
- Ice thickness should be reported also when the code reports a lead or an ice edge

- Total ice concentration should be included in the code. With the present code the total concentration may only be determined with certain assumptions
- Ridges should be coded in a better, more quantitative way e.g. ridge frequency and mean height. The problem is, however, to receive such ridge information accurately enough by the routine ice observations today.

In order to remove the drawbacks of the code a new version will have to be designed. The version shall be compatible with the first. If a suitable international code should be available its use for BASIS would be considered. The drawbacks in the code are planned to be changed in a way which makes it possible to run the different codes together in the future.

Activity will increase on the SST side. The Swedish SST data are digitized and punched but not controlled, corrected and included in the bank. The Finnish data will be controlled. It is also planned to continue the work on BASIS with the aim to cover the whole climatological period 1960-1990.

A statistical work has been going on with data from BASIS. A number of sea ice parameters can be studied and a new ice atlas for the region will follow this report.

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Code for digitizing ice data and surface temperatures from maps

Grid

The waters dealt with by the data bank code are all waters surrounding Sweden and Finland situated between the latitudes $53^{o}52.5'N$ and $65^{o}52.5'N$ and longitudes $7^{o}45'E$ and $30^{o}15'E$ and Lake Vänern, see Figure 2. The area is covered by a grid or a network of lines running along longitudes and latitudes forming curved quadrilaterals resembling squares with sides of 15' height along longitudes and of 30' width along latitudes. The number of points with ice or SST data is 612. The center point coordinates of the squares in the grid are related as follows:

$$\phi = 66^{o} - r \cdot 15'$$
$$\lambda = 7^{o}30' + c \cdot 30'$$

where r is the row number and c the column number.

Period

Reworked historical ice maps from 1963 and forward have been used. The work has been divided between FIMR and SMHI. The division of the work and the content of the bank is shown in table A 1.

Work on the data bank will continue in order to cover the climatological period 1960-1990.

Table A1 · Content of BASIS at present

SEASON	SMHI	FIMR	NUMBER OF MAPS	FIRST MAP	LAST MAP
1963/64		X	55	14 NOV	21 MAY
1964/65	X		50	27 NOV	21 MAY
1965/66		X	58	11 NOV	30 MAY
1966/67	X		51	6 DEC	26 MAY
1967/68		X	55	20 NOV	27 MAY
1968/69	X		62	30 OCT	3 JUN
1969/70	X		54	24 NOV	1 JUN
1970/71	X		57	9 NOV	1 JUN
1971/72		X	60	28 OCT	23 MAY
1972/73		X	55	2 NOV	14 MAY
1973/74		X	57	12 NOV	27 MAY
1974/75	X		53	18 NOV	19 MAY
1975/76		X	60	3 NOV	27 MAY
1976/77	X		62	28 OCT	31 MAY
1977/78		X	55	17 NOV	25 MAY
1978/79	X		58	16 NOV	4 JUN

The code in general

The data in a grid point is described with a code consisting of five digits, $C_1C_2C_3C_4C_5$. The first three form one group with main information and the following two another with additional information. When coding water temperatures (TTTXX) the first three digits are used. If ice exists in the square and exceeds ten percent of the area SST is no more coded.

When coding ice conditions (ICDic) the two first digits are used for the primary ice type in the grid cell and the third to describe the thickness of that ice. The following two digits describe the secondary ice type. If only one type of ice exists in the grid point the last digits are coded with zeros.

Exceptions are made for leads and ice edges (9RKic), where the first digit always is 9. The second depends on main direction of the most dominating ice. (See further below). The third digit gives the open water concentration and the last two describe the dominating ice.

Information on punched cards or tape

Every card contains information of succeeding points along a latitudinal line. When it is necessary, the information on one line can be punched on further cards, which all contain information about line numbers, column numbers etc. As every card has an identification number the order of cards is unimportant. Points with no information are coded blanks (= 0).

The position of information on punched cards

First card (Header card)

1	type of post (is left blank)
2	type of card (always = 1)
3-6	Identification number for the map. Number of day of the year. The digits are adjusted to the right, e.g. if the identification number for the map is 8 the digit is put in position 6 (3, 4 and 5 are left blanks)
7-9	code (ice and water = 001, ice = 002, water = 003)
10-12	year e.g. 1971 is coded 971
13-14	month e.g. June is coded 06
15	1 = Sweden, 2 = Finland
16-17	day e.g. the 8 is coded 08
18-19	time, whole hour in GMT (usually 8)

Second and following cards (data cards)

1	type of post (is left blank)
2	type of card (always = 0)
3-6	see above
7-9	line number, corresponding to latitude line. The digits are adjusted to the right.
10-12	column number, corresponding to longitude line. The numbers are adjusted to the right.
13-14	number of information groups on the card i.e. the sum of all grid points in the latitudinal line intended to digitize.
15	1 = Sweden, 2 = Finland
16-20	5-digits temperature- and ice information group
21-26	5-digits group etc
.	
.	
.	
76-80	

The temperature code $C_1C_2C_3C_4C_5$ = TTTXX

The sea surface temperature is given in the first group (TTT) in tenths of degrees. TTT is then always less than 300.

i.e. 12.3°C → 123
2.3°C → 023
0.3°C → 003

0.0°C is always coded -00.
If the temperature is negative, a minus sign will be placed in the first position.
i.e. -0.8°C → -08

XX is coded 00 or supplementary information may be coded (see below).

Ice code $C_1C_2C_3C_4C_5$ = ICDic

IC and ic give ice type and concentration. IC is the primary ice type.

I = 3 new ice, level ice, rafted ice, fast ice

IC = 30 new ice, level ice
= 31 rafted ice (<50% of grid cell)
= 32 " " (>50% of grid cell)
= 33 fragile spring ice (rotten ice)
= 34 -
= 35 -
= 36 -
= 37 -
= 38 -
= 39 fast ice

I = 4 belts of slush and shuga

IC = 40 loose slush and shuga
= 41 compact shuga, width 0 - 1/2 nautical miles
= 42 " " , " 1/2 - 1 "
= 43 " " , " 1 - 3 "
= 44 " " , " > 3 "
= 45 compact, frozen shuga, width 0 - 1/2 nautical miles
= 46 " , " " , " 1/2 - 1 "
= 47 " , " " , " 1 - 3 "
= 48 " , " " , " > 3 "
= 49 -

I = 5 pack ice, small and medium floes (< 500 m)

		ice concentration
IC = 50	pack ice, small and medium floes	< 1/10
= 51	" " , " "	1 - 2/10
= 52	" " , " "	2 - 3/10
= 53	" " , " "	3 - 4/10
= 54	" " , " "	4 - 5/10
= 55	" " , " "	5 - 6/10

= 56	" " , " "	6 - 7/10
= 57	" " , " "	7 - 8/10
= 58	" " , " "	8 - 9/10
= 59	" " , " "	9 -10/10

I = 6 pack ice, large floes (> 500 m)

		ice concentration
IC = 60	pack ice, large floes	< 1/10
= 61	" " , " "	1 - 2/10
= 62	" " , " "	2 - 3/10
= 63	" " , " "	3 - 4/10
= 64	" " , " "	4 - 5/10
= 65	" " , " "	5 - 6/10
= 66	" " , " "	6 - 7/10
= 67	" " , " "	7 - 8/10
= 68	" " , " "	8 - 9/10
= 69	" " , " "	9 -10/10

I = 7 consolidated pack ice

IC = 70 consolidated pack ice

= 71	-
= 72	-
= 73	-
= 74	-
= 75	-
= 76	-
= 77	-
= 78	-
= 79	-

I = 8 ridged ice

		ridge concentration
IC = 80	ridged ice, not consolidated	1 - 3/10
= 81	" " , " "	4 - 6/10
= 82	" " , " "	7 - 8/10
= 83	" " , " "	9 -10/10
= 84	ridged ice, consolidated	1 - 3/10
= 85	" " , "	4 - 6/10
= 86	" " , "	7 - 8/10

= 87 " " , " 9 -10/10
= 88 disintegrating ridges
= 89 ridged floes, growlers

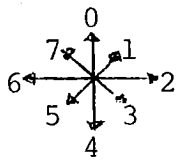
D - ice thickness (thickness = D^2)

D = 0 no information on thickness
= 1 thickness 1 - 2 cm
= 2 " 3 - 6 "
= 3 " 7 - 12 "
= 4 " 13 - 20 "
= 5 " 21 - 30 "
= 6 " 31 - 42 "
= 7 " 43 - 56 "
= 8 " 57 - 72 "
= 9 > 73 "

Leads and edges $C_1C_2C_3C_4C_5$ = 9RKic

First digit equals 9 indicates leads or ice edges.
R = direction
K = concentration of open water in the square

R
direction perpendicular to the dominant ice type from the ice towards the open water according to figure.



K
K = 0 < 1/10 open water
= 1 1 - 2/10 " "
= 2 2 - 3/10 " "
= 3 3 - 4/10 " "
= 4 4 - 5/10 " "
= 5 5 - 6/10 " "
= 6 6 - 7/10 " "
= 7 7 - 8/10 " "
= 8 8 - 9/10 " "
= 9 9 -10/10 " "

Additional information

ic gives additional ice information in accordance to the code for IC.

Supplementary information

i = 9 extra information (only i)

ic = 90 -
= 91 -
= 92 -
= 93 -
= 94 -
= 95 -
= 96 -
= 97 information uncertain
= 98 information missing
= 99 grid point on land

Examples.

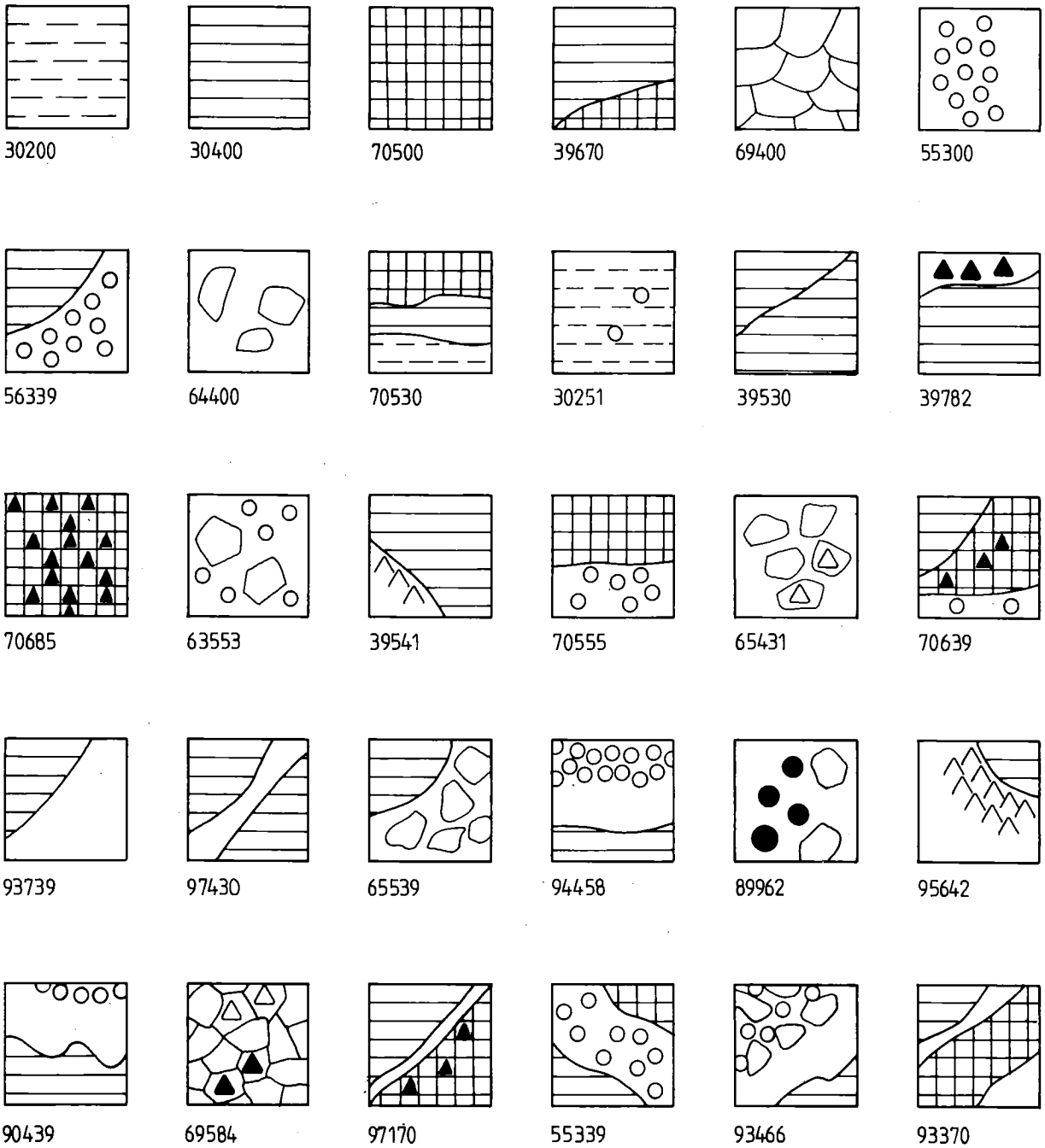


Figure A1 Examples of coding.

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