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DISPLAY PROGRAMS USED FOR EDITING OCEANOGRAPHIC AND BATHYMETRIC DATA

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RESEARCH AND DEVELOPMENT

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BURLINGTON, ONTARIO

DISPLAY PROGRAMS USED FOR EDITING OCEANOGRAPHIC AND BATHYMETRIC DATA

by

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ABSTRACT

This report presents a series of computer programs used to display bathymetric and oceanographic data during the editing stage of the data as well as during the final file copy stage. The data editing programs of the data use line printer plots, while the calcomp plots are used for final display of the data. Program examples in this report use oceanographic and bathymetric data collected in Hudson and James Bays.

ACKNOWLEDGMENTS

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1. INTRODUCTION

When a gridded depth file (or bathymetry) is created for a selected area, the gridded depth values have to be checked to ensure their validity. This can be simplified by presenting the data in map form by use of either a line printer or Calcomp plotter. A line printer map of the depth values is produced by program MARR, while a Calcomp plot is produced by program GEØBAT. Oceanographic cruise sounding data or individual soundings located in the same area can also be used to verify or check the gridded depth values. The "General Cruise Surveillance Program" (GENCRUS) will perform that task. In the majority of cases gridded depth values for a selected area, for which only oceanographic data is available, will have to be subdivided into smaller areas or zones. The bathymetry thus obtained, or zone bathymetry, can then be used with program "Heat and Freshwater Budget" (SALT) (S.J. Prinsenberg and R. Gottinger, 1978) for volumetric calculations. Program ZØNSEL will add a zone number to each cell depth in order to more easily keep track of the cell distribution. Apart from checking sounding and cell depths, program GENCRUS also writes disc files of station or profile parameters suitable for plotting with the charting sub-system (Gottinger, 1978). Upon request, a map may be printed showing the influence of each station of a cruise on the entire survey area. For oceanographic profile data, the programs will display station or profile data on the line printer as well as on the Calcomp plotter.

Program PLTPRØ was written to display oceanographic profile data and gives the user the option of displaying either sigma-t or conductivity apart from temperature and salinity. The line printer display of this program is mainly used to edit the data after it has been placed on the data base. A common scale for each of the parameters may be chosen for all the profiles, or the program will choose a scale for each individual profile based on the range of available values. Edited profiles may be displayed for publications on the line printer or Calcomp plotter.

2. BATHYMETRIC FILES

Oceanographic surveys were conducted in the Hudson/James Bay region to study the effects of hydroelectric development on the aquatic environment. Some surveys cover the entire Hudson Bay region, while others study sections of the area in more detail. In order to display the survey results, different display files were created which contained the bathymetry of the particular area to the same spacial detail as the oceanographic data.

The first bathymetric gridded data file created was for the whole of Hudson Bay. Contour charts from GEBCØ and individual soundings from Hydrographic charts covering Hudson Bay were used. A grid size of 25 km was used and the origin was established at $50^{\circ}06'45''$ and $94^{\circ}47'30''$ by varying the bathymetry origin (constants C_1 and C_2) to get the best possible fit along the shorelines. The grid size varies with latitude but is 25 km at latitude $57^{\circ}50'$. This file is called 003/096,HUDSØN-ZØNE-BATHYMETRY,01,RØBT,I and was used for program SALT, which calculates the salinity and heat content of particular oceanographic data files.

The second bathymetric file created includes James Bay in its entirety and the southern part of Hudson Bay north to latitude 58° and west to longitude 86°. Depths of the gridded cells were created from a tape containing soundings of James Bay which were obtained during the Hydrographic winter surveys of 1975 and 1976. This tape was obtained from the Canadian Hydrographic Service (CHS), Central Region. The grid size is 11.27 km at latitude $61^{\circ}10'$, giving an average grid size of 12.5 km. The common row of this file and of the Hudson Bay file is located at latitude $55^{\circ}10'$ with an overlapping cell at $81^{\circ}45'$ longitude. This file is called 003/096,JAMES-ZØNE-BATHYMETRY,01,RØBT,I.

The two files have cell centre lines at some common latitude and longitude which will be needed when the bathymetric files are used in future modelling studies. Although a cell centre may have the same latitude and longitude values in both files, it may not have the same depth value, as a cell in the Hudson Bay file represents an area four times larger than that of a cell in the James Bay file.

The procedure of the common row alignment and cell size determination for both bathymetries follows.

Chart 5000 covers the entire Hudson Bay and sets mid-latitude at 57°50'. Latitude 55°10' was chosen as a common row for both bathymetries. The scale factor at latitude 55°10' with respect to 57°50' mid-latitude is 1.07274, giving an actual grid size of 25.0 X 1.07274 = 26.82 km at that latitude.

Looking at chart 5003 (mid-latitude 61°21'), the scale factor at latitude 55°10' (common row) is 0.8401. In order to obtain a grid size of 26.827 km on chart 5003 (1:1,000,000) at latitude of 55°10', the grid size should be 26.82 X 0.8401 = 22.53 km.

As a check on the procedure: on latitude 57°50' (mid-latitude of chart 5000) the scale factor of 1.10960 should give a grid size of 25 km. It gives 22.53 X 1.10960 = 24.999 km. The two files thus have a common row of cells at latitude 55°10' with the cell size of 26.82 km for the Hudson Bay file and half of 26.82 km for the James Bay file.

The James Bay portion of the foregoing bathymetric file was used to obtain a "25-km grid" of depth values and merge it with the Hudson Zone Bathymetry. The file created by program GEØBAT is 003/096,HUDSØN-GRID-SØUNDINGS,01,RØBT,I and is used for display purposes only. Another file, for just the James Bay region, was also created by program GEØBAT (003/096, JAMES-GRID-SØUNDINGS,01,RØBT,I).

Lastly, a bathymetric data file for the area of the northeastern corner of James Bay was created using a 5-km grid size. The same Hydrographic sounding data tapes mentioned previously were used to create this file (003/090,GEØRGE-ZØNE-BATHYMETRY,01,RØBT,I) with some additional sounding values obtained from harbour charts.

3. DISPLAY OF BATHYMETRIC AND OCEANOGRAPHIC DATA

In order to display, check, and subsequently edit bathymetric data, the following programs were written. Program GEØBAT writes a permanent bathymetric data file and, in conjunction with the charting sub-system, a Calcomp plot showing the gridded depth values (Figure 1) is produced. Subroutine MERCAT is needed to convert the Mercator coordinates to geographics. The equivalent line printer plot (Figure 2) was produced by program MARR, using the zone bathymetry card deck produced by GPCP (Gottinger, 1978). Row and column numbers are displayed and used to identify each individual sounding. The gridded depth values represent an approximate area of 12.5 x 12.5 kilometres, although the actual magnitude changes slightly with latitude.

A total area covered by the two above display programs can be split up into zones so that averaging of oceanographic parameters can be done for each zone. The cells will thus, in addition to a row and column number, also have a zone number. Program ZØNSEL performs this function. Figure 3 shows a line printer plot of a zone layout for James Bay. Program ZØNSEL will handle complicated zone layouts, while program ADDZØN may be used for zone boundaries which follow meridians and/or parallels (Gottinger, 1978). ZØNSEL can handle up to 18 zones, but every row of the bathymetry and their respective end points has to be listed.

The bathymetric soundings obtained during an oceanographic survey can be checked (sub-program SCAN) against the gridded cell depth for the same area as obtained from Hydrographic charts. The oceanographic data is stored on a data base which contains location, time, and depth (profile, sounding, ice) information. Each station can be called up by using the record number of the data file. Each station also has its particular "station number" but, when the sounded depth or the position is found to be in error, the station is flagged by the record number so that the data base can be more easily updated. Table 1 shows an example of the output of program GENCRUS. Position errors were found for consecutive stations 9 and 10 in the James Bay Winter 1975 File; these stations can be found on this file at record numbers 20 and 26, respectively.

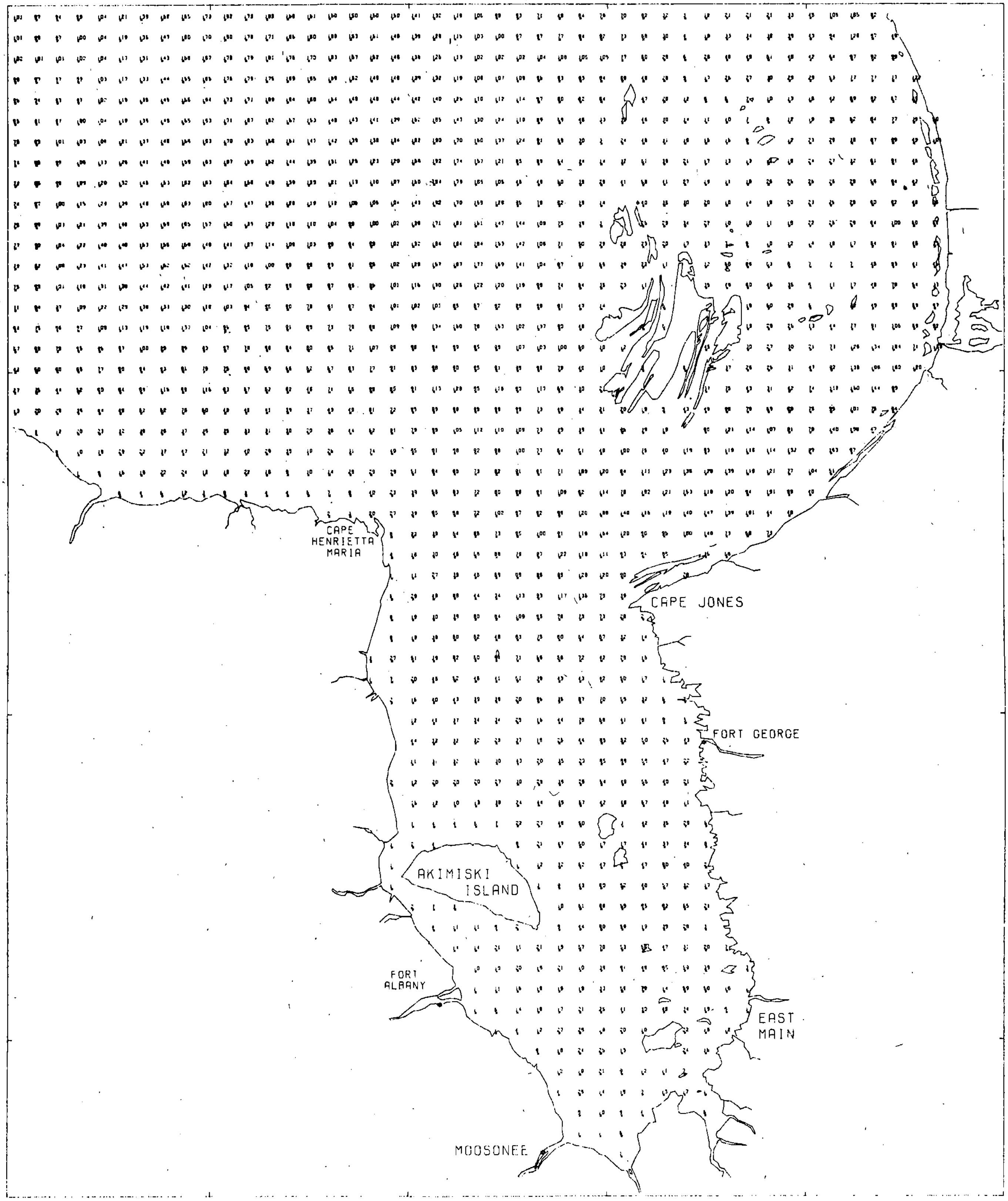

Figure 1: Calcomp Plot of the Bathymetry of James Bay and the Southern Part of Hudson Bay.

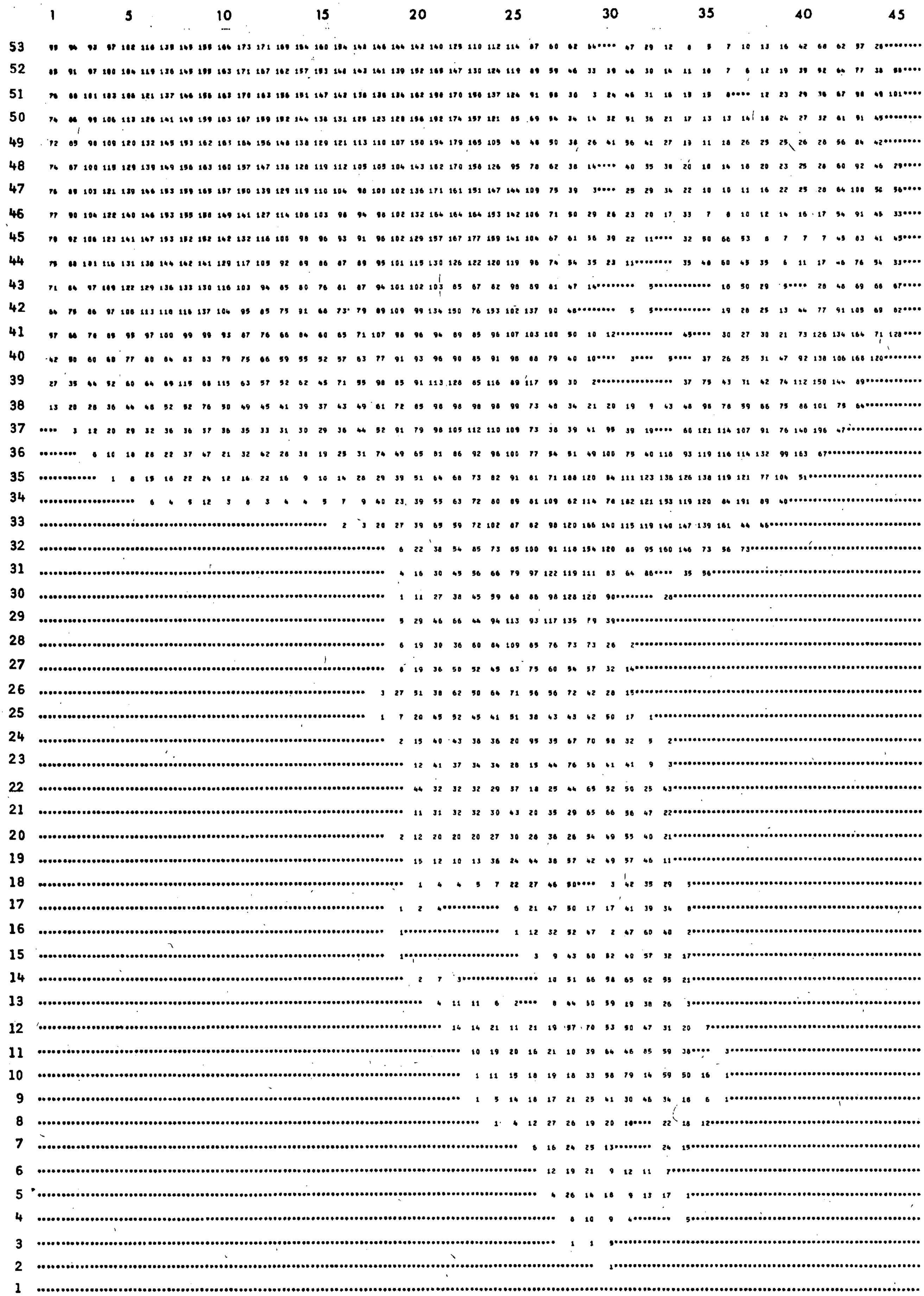

Figure 2: Line Printer Plot of the Bathymetry of James Bay and the Southern Part of Hudson Bay

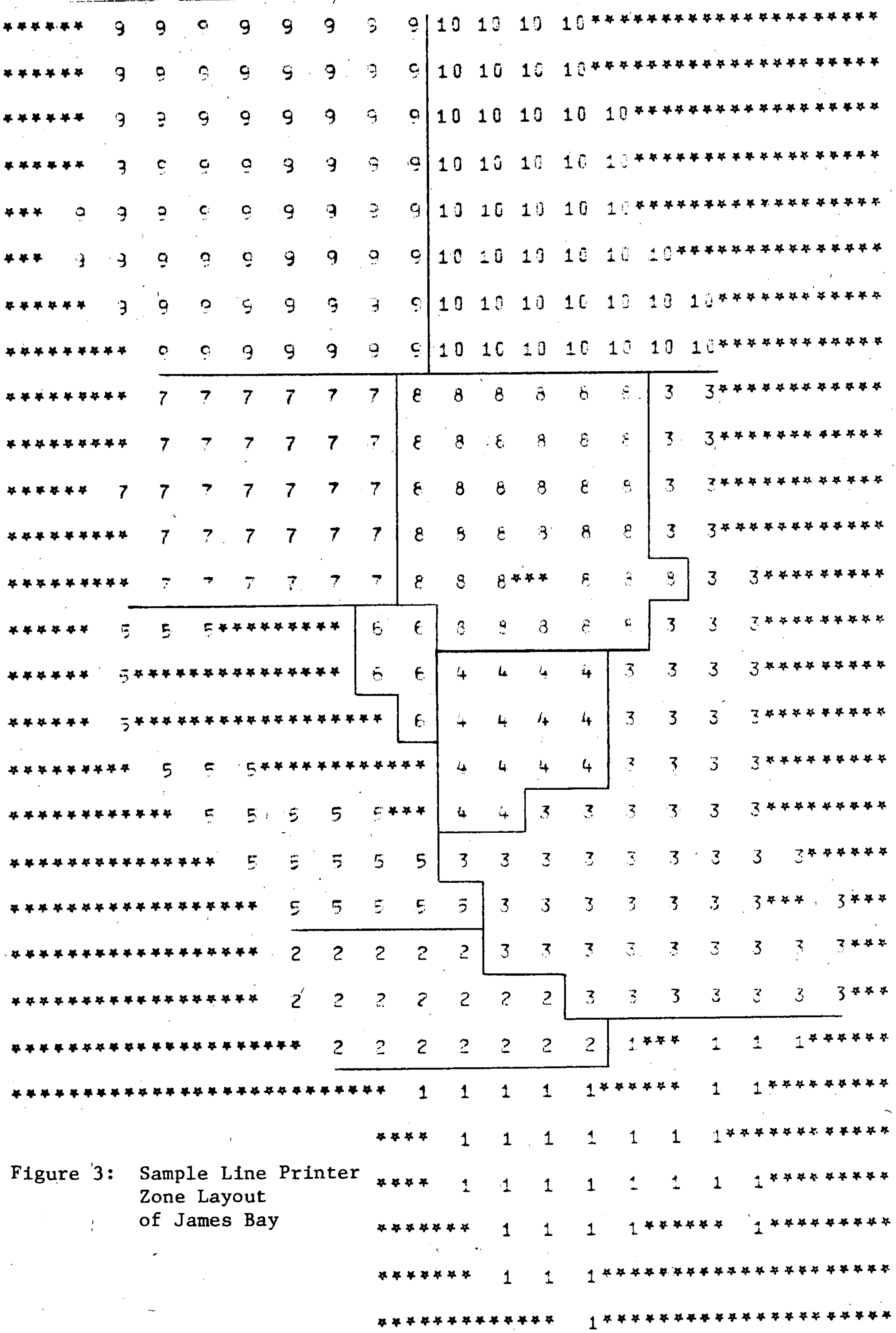

Figure 3: Sample Line Printer Zone Layout of James Bay

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JAMES BAY WINTER 1975 FILE. CREATED FEB. 2, 1977.

CNS	STA NO	DATE	LATITUDE	LONGITUDE	CELL	BATHY	SND	TEMP	SAL	REMARKS
1	519	21 2 75	51 43.00	79 50.00	(30, 6)	9	20	13	13	
2	520	21 2 75	51 43.40	79 13.00	(33, 6)	7	17	10	10	
3	518	21 2 75	51 43.00	80 18.00	(28, 6)	19	21	15	15	
4	521	23 2 75	51 47.50	79 8.00	(33, 6)	7	13	10	10	
5	530	23 2 75	51 51.50	79 1.10	(34, 7)	15	13	10	10	
6	522	28 2 75	52 14.00	80 30.00	(27,10)	19	17	15	15	
7	523	28 2 75	52 14.00	79 50.00	(30,10)	58	57	50	50	
8	525	5 3 75	52 15.00	79 0.00	(34,10)	50	25	10	10	
20	524	5 3 75	52 11.50	78 45.00	(35, 9)		POSITION	IN	ERROR	
26	5204	6 3 75	52 19.50	78 42.00	(35,10)		POSITION	IN	ERROR	
11	504	2 4 75	54 46.00	81 32.00	(22,30)	39	46	40	40	
12	503	2 4 75	54 46.00	80 57.00	(25,30)	68	94	65	65	
13	505	4 4 75	54 37.00	82 0.00	(20,29)	29	19	16	16	
14	512	4 4 75	53 50.00	79 21.00	(32,22)	25	33	30	30	
15	502	5 4 75	54 46.00	80 24.00	(27,30)	98	104	100	100	
16	506	5 4 75	53 50.00	81 50.00	(21,22)	32	24	20	20	
17	501	5 4 75	54 46.00	80 0.00	(29,30)	120	102	70	70	
18	507	5 4 75	53 50.00	81 26.00	(22,22)	32	34	30	30	
19	508	5 4 75	53 50.00	80 57.00	(25,22)	37	24	20	20	
20	511	5 4 75	53 50.00	79 37.00	(31,22)	50	48	40	40	
21	509	5 4 75	53 50.00	80 33.00	(27,22)	25	32	25	25	
22	5109	9 4 75	53 59.00	79 27.00	(32,24)	5	16	14	14	
185	5112	9 4 75	54 0.00	79 9.00	(33,24)	2	14	12	12	SOUNDING OR CELL DEPTH OUT OF RANGE
24	5114	9 4 75	54 6.00	79 31.00	(32,25)	1	20	18	18	
25	5103	9 4 75	53 49.00	79 16.00	(33,22)	43	15	12	12	
26	5115	10 4 75	54 12.00	79 36.00	(31,25)	17	6	13	13	
27	5117	10 4 75	54 8.00	79 20.00	(32,25)	1	6	5	5	
28	5116	10 4 75	53 42.40	79 15.00	(33,21)	22	10	8	8	
29	5205	12 4 75	52 25.00	78 58.00	(34,11)	38	44	4	4	
205	5206	12 4 75	52 24.00	78 40.00	(36,11)		POSITION	IN	ERROR	
207	5207	12 4 75	52 22.00	78 50.00	(35,11)		POSITION	IN	ERROR	
215	5208	14 4 75	52 10.00	78 41.00	(35, 9)		POSITION	IN	ERROR	
223	5210	14 4 75	52 29.50	78 43.00	(35,12)		POSITION	IN	ERROR	
225	5212	14 4 75	52 33.00	78 51.50	(35,12)		POSITION	IN	ERROR	
35	531	14 4 75	52 54.00	79 25.00	(32,15)	57	65	60	60	

Table 1: Diagnostics of Oceanographic Stations for the James Bay Winter 1975 Survey

Similarly, the sounding depth of consecutive station 23 at record number 185 was found to be in error. The position check provided in program GENCRUS only checks if the station lies in the specified survey area. Small errors in position are not detected. However, a Calcomp plot produced by program GENCRUS and the charting sub-system will plot the station number or any parameter value from the data base for that station at its true position (Figure 4). In order to preview the influence of the individual profile stations on the entire survey area, a map showing the nearest station for each cell may be printed (Figure 5). Table 2 shows the consecutive station number used in that map. In case the influence of a cell has to be over-written, its input cards can then be changed before they are used with program SALT.

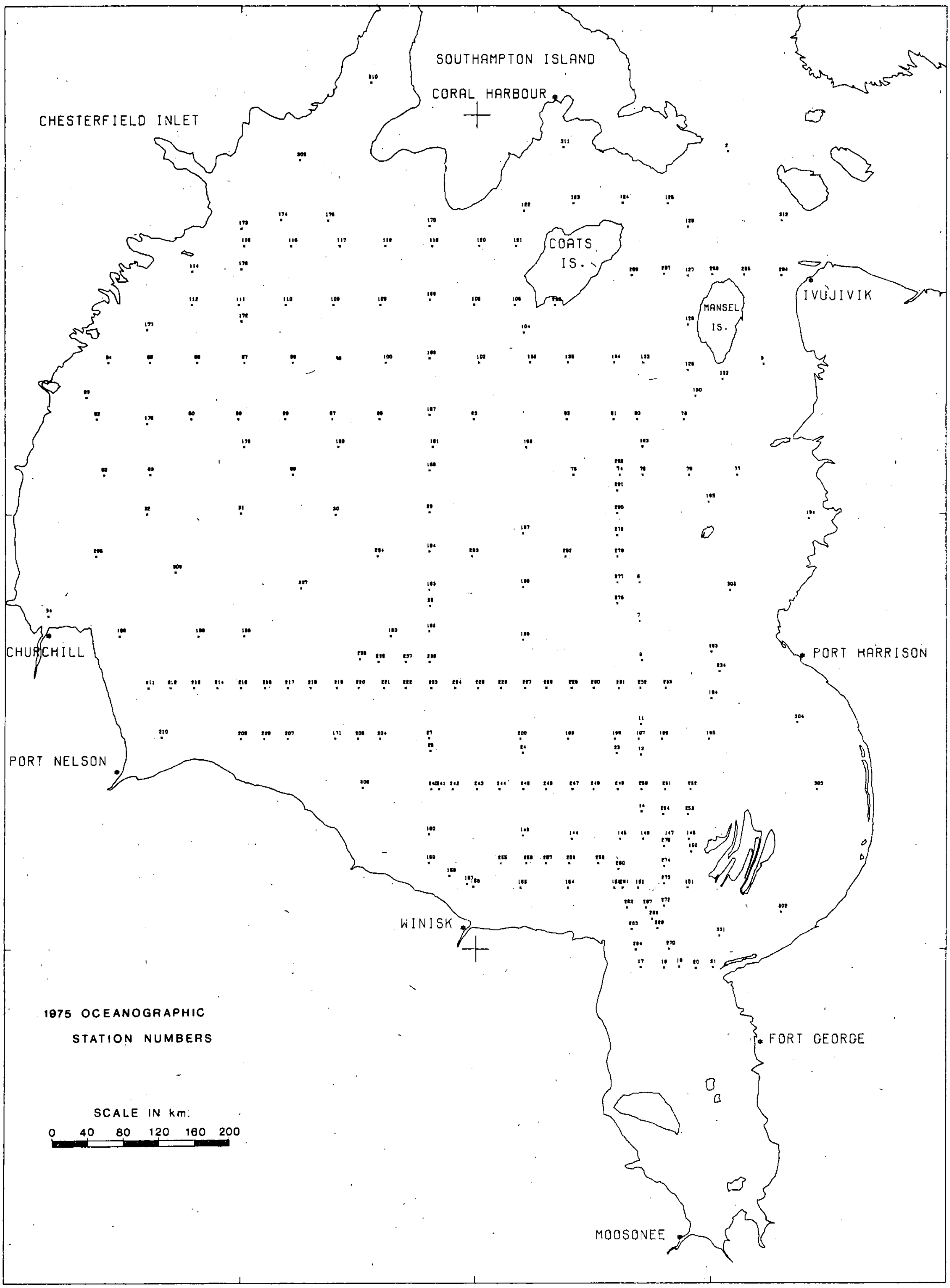

Figure 4: Oceanographic Station Number Plot

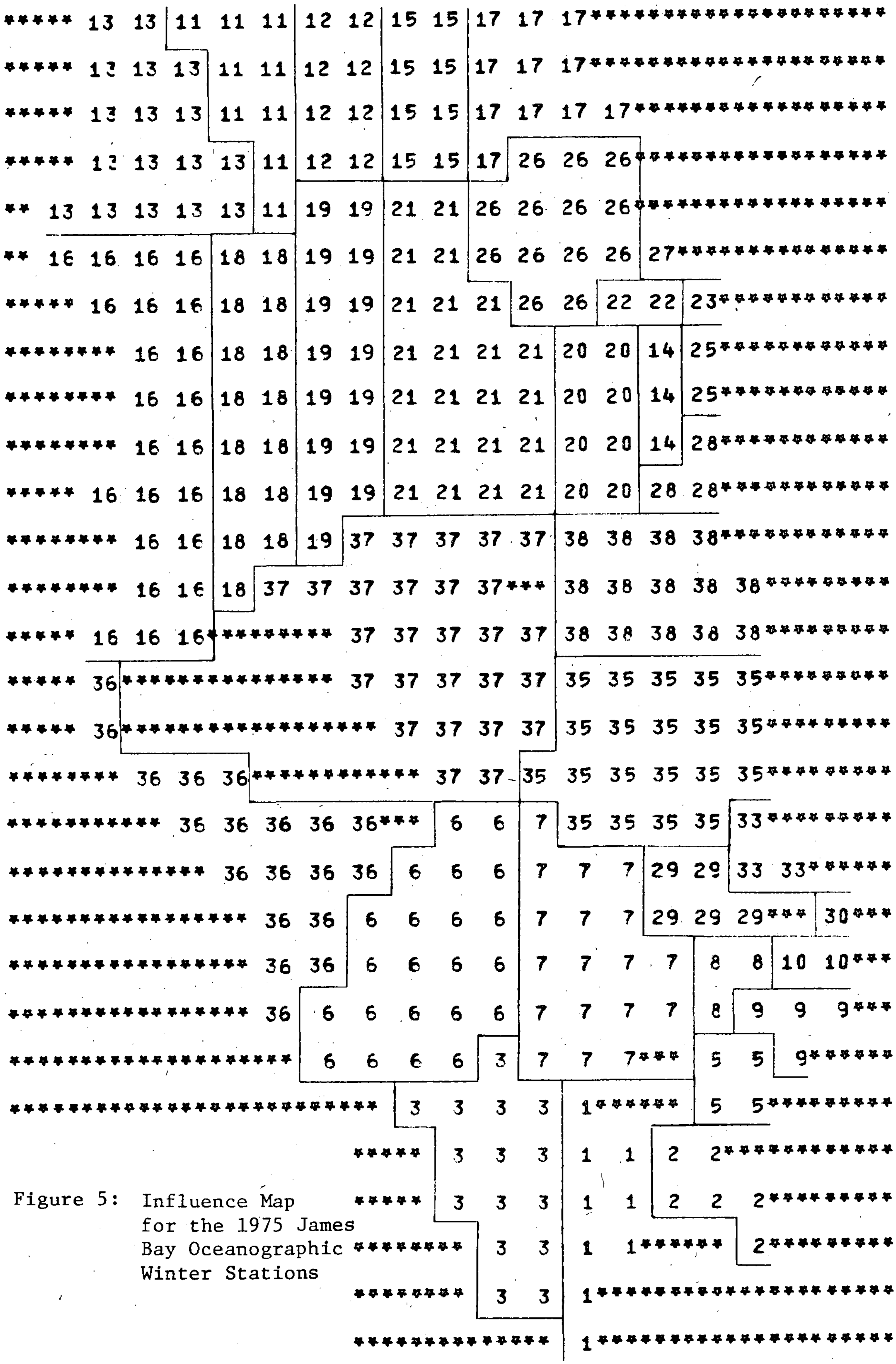

Figure 5: Influence Map for the 1975 James Bay Oceanographic Winter Stations

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JAMES BAY WINTER DATA COLLECTED FROM THE PETREL IN 1975 AND SUBSEQUENTLY RUN THROUGH PROGRAM OCEANS TO OBTAIN DATA AT STANDARD DEPTHS.

CNS	STA NO	DATE	LATITUDE	LONGITUDE	CELL	BATHY	SND	TEMP	SAL
1	519	21 2 75	51 43.00	79 50.00	(30, 6)	9	20	20	20
2	520	21 2 75	51 43.40	79 13.00	(33, 6)	7	17	17	17
3	518	21 2 75	51 43.00	80 18.00	(28, 6)	19	21	21	21
4	521	23 2 75	51 47.50	79 8.00	(33, 6)	7	13	13	13
5	530	23 2 75	51 51.50	79 1.10	(34, 7)	15	13	13	13
6	522	28 2 75	52 14.00	80 30.00	(27,10)	19	17	17	17
7	523	28 2 75	52 14.00	79 50.00	(30,10)	58	57	57	57
8	525	5 3 75	52 15.00	79 0.00	(34,10)	50	25	25	25
9	524	5 3 75	52 11.50	78 45.00	(35, 9)	6	15	15	15
10	5204	6 3 75	52 19.50	78 42.00	(35,10)	16	13	13	13
11	504	2 4 75	54 46.00	81 32.00	(22,30)	38	46	46	46
12	503	2 4 75	54 46.00	80 57.00	(25,30)	68	94	94	94
13	505	4 4 75	54 37.00	82 0.00	(20,29)	29	19	19	19
14	512	4 4 75	53 50.00	79 21.00	(32,22)	25	33	33	33
15	502	5 4 75	54 46.00	80 24.00	(27,30)	98	104	104	104
16	506	5 4 75	53 50.00	81 50.00	(21,22)	32	24	24	24
17	501	5 4 75	54 46.00	80 0.00	(29,30)	120	102	102	102
18	507	5 4 75	53 50.00	81 26.00	(22,22)	32	34	34	34
19	508	5 4 75	53 50.00	80 57.00	(25,22)	37	24	24	24
20	511	5 4 75	53 50.00	79 37.00	(31,22)	50	48	48	48
21	509	5 4 75	53 50.00	80 33.00	(27,22)	25	32	32	32
22	5109	9 4 75	53 59.00	79 27.00	(32,24)	5	16	16	16
23	5112	9 4 75	54 0.00	79 9.00	(33,24)	2	14	14	14
24	5114	9 4 75	54 6.00	79 31.00	(32,25)	1	20	20	20
25	5103	9 4 75	53 49.00	79 16.00	(33,22)	43	15	15	15
26	5115	10 4 75	54 12.00	79 36.00	(31,25)	17	6	6	6
27	5117	10 4 75	54 8.00	79 20.00	(32,25)	1	6	6	6
28	5116	10 4 75	53 42.40	79 15.00	(33,21)	22	10	10	10
29	5205	12 4 75	52 25.00	78 58.00	(34,11)	38	44	44	44
30	5206	12 4 75	52 24.00	78 40.00	(36,11)	3	9	9	9
31	5207	12 4 75	52 22.00	78 50.00	(35,11)	0	29	29	29
32	5208	14 4 75	52 10.00	78 41.00	(35, 9)	6	8	8	8
33	5210	14 4 75	52 29.50	78 43.00	(35,12)	7	9	9	9
34	5212	14 4 75	52 33.00	78 51.50	(35,12)	7	21	21	21
35	531	14 4 75	52 54.00	79 25.00	(32,15)	57	65	65	65
36	658	28 2 75	52 31.00	81 17.00	(23,12)	14	20	20	20
37	641	28 2 75	53 6.00	80 31.00	(27,17)	53	60	60	60
38	644	28 2 75	53 20.00	79 28.00	(32,18)	35	60	60	60

Table 2: Oceanographic Station Listing used in the Station's Influence Figure 5

4. DISPLAY OF PROFILE DATA

Program PLTPRØ was written to display and edit oceanographic profile data after it has been placed on the data base. Subroutine SETDAT, when called, returns a complete profile from the O&AS data base, and the program is set up to give the user the choice of displaying either conductivity or sigma-t with temperature and salinity (Figure 6). For the first run it has been found best to let the program choose its own scale. After editing individual profiles, the arrays may be grouped and a common scale may be chosen, so that they can be directly compared to each other (Peck, 1977). Since the data base provides random access, very little effort is needed to accomplish this. PLTPRØ uses scaling factors and base values (subroutine RANGE) to place curves relative to each other to avoid interference. If other parameters are to be displayed, subroutine RANGE has to be modified or bypassed.

1038 50

HUDSON BAY-PROCESSED DATA-1975-PROFILES. CSTD FISH 10 9 1975 232 1 1 58 4.99 81 30.49
2S BAIRD 137.7

	DPTH	TEMP	SAL	COND
0	0.0	7.900	28.451	-99.000
1	13.9	7.620	28.590	29.864
2	13.7	7.630	28.590	29.875
3	14.4	7.650	28.606	29.864
4	14.7	7.640	28.614	29.864
5	15.6	7.200	28.807	29.703
6	17.6	6.020	29.098	29.049
7	18.0	2.019	30.140	27.290
8	19.7	1.180	30.401	26.400
9	20.4	0.290	30.540	26.390
10	21.0	-0.150	30.694	25.607
11	22.5	-0.200	30.750	25.671
12	24.0	-0.400	30.818	25.510
13	24.1	-0.590	30.883	25.414
14	26.0	-0.790	31.044	25.382
15	27.7	-0.700	31.109	25.500
16	27.7	-0.640	31.162	25.595
17	29.4	-0.900	31.300	25.542
18	30.0	-1.020	31.338	25.424
19	30.9	-1.100	31.348	25.392
20	32.0	-1.110	31.358	25.371
21	33.3	-1.160	31.424	25.382
22	34.2	-1.220	31.502	25.392
23	35.2	-1.270	31.539	25.382
24	36.2	-1.300	31.555	25.371
25	36.9	-1.300	31.627	25.424
26	39.7	-1.310	31.711	25.478
27	41.9	-1.350	31.795	25.510
28	43.6	-1.380	31.886	25.553
29	44.7	-1.430	31.909	25.532
30	46.8	-1.460	31.999	25.575
31	48.9	-1.520	32.107	25.607
32	51.3	-1.460	32.129	25.671
33	52.8	-1.480	32.223	25.725
34	55.4	-1.400	32.268	25.821
35	57.2	-1.380	32.364	25.907
36	59.3	-1.370	32.426	25.961
37	61.5	-1.360	32.501	26.025
38	63.7	-1.370	32.556	26.057
39	65.7	-1.350	32.592	26.100
40	67.2	-1.350	32.649	26.143
41	68.9	-1.360	32.704	26.175
42	71.3	-1.360	32.746	26.207
43	72.9	-1.340	32.753	26.229
44	74.9	-1.350	32.807	25.261
45	76.8	-1.360	32.817	26.261
46	78.5	-1.360	32.875	26.304
47	79.9	-1.370	32.900	26.315
48	81.9	-1.380	32.925	26.325
49	82.7	-1.380	32.954	26.347
50	82.8	-1.380	32.954	26.347

LENGTH OF 1 UNIT OF TEM IS *********

LENGTH OF 1 UNIT OF SAL IS *******************

LENGTH OF 1 UNIT OF CON IS *******************

Figure 6: - Line Printer Output for CTD Profile Data

5. CONCLUSION

The ten programs and sub-routines described and listed in this report are used to display bathymetric and oceanographic data files during the editing process. The line printer plots are used primarily for editing, while the Calcomp plots are used in addition for display purposes in the publication and analysis of the data. The programs were designed so that future numerical modelling, as well as the Heat and Freshwater Content Program (SALT), can easily be adapted to the format of the oceanographic and bathymetric data.

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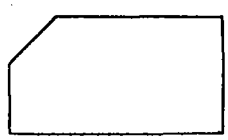
Prinsenberg, S.J. and R. Gottinger. Heat and Fresh Water Content of Hudson and James Bays. Manuscript Report Series, Ocean and Aquatic Sciences, Central Region, Department of Fisheries and Environment, Burlington. To be published.

APPENDIX

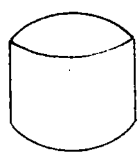
This appendix contains the program subroutines and their general descriptions and listings of the following programs:

A general flowchart (Figure 7) shows the order by which the programs are used. The input and output symbols used are:

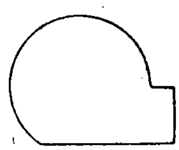
1) cards,



2) disc,

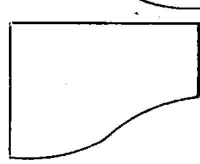


3) tape,



4) printer, and

5) data record.



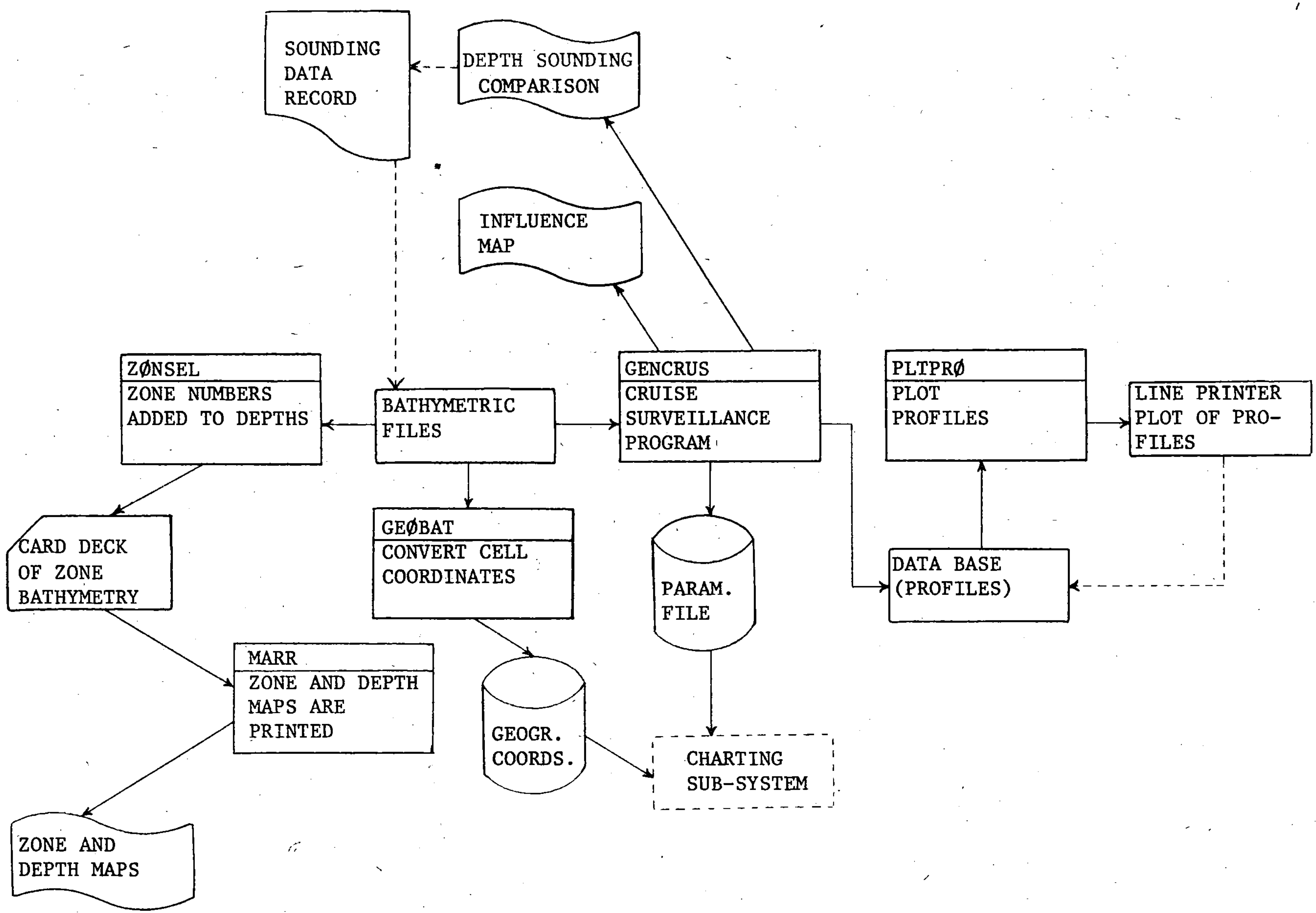


Figure 7: System Flowchart

PROGRAM GEØBAT

The purpose of this program is to display bathymetric values on the Calcomp plotter, which is very useful in developing new bathymetries when the plots are to the same scale as the original chart. By varying the bathymetry origin (constants C_1 and C_2), it is possible to place the origin and thus all cell centres of the chart to get optimum coverage of shorelines and islands. If plotted at scale with an outline of an existing chart, it is very easy to add or correct existing cell depths. There is also a 3-colour display routine available for easy contouring and display of basins and shallows. Subroutine CATMER is a straightforward conversion from Mercator coordinates to geographics. Cell numbers are converted to X and Y before entering subroutine CATMER (Gottinger R. and A.C. Zingaro, 1978). Chart and bathymetry parameters are the same as in program PERMA, except for the opposite signs of C_1 and C_2.

Input

Disc file containing the zone bathymetry.

Output

Disc file suitable for plotting with the charting sub-system.

Main Parameters

GX, GY = Geographic coordinates of a cell in decimal degrees;

FBØ = depth of cell;

ZBØ = two-dimensional array containing both cell depth and cell number for every cell of the bathymetry (cell number is removed in Do Loop 300); and

X, Y = Mercator coordinates of the center of the cell at scale.

Note

The limits for each binary write are the maximum number of cells per row.

```
      PROGRAM GEOBAT
C
C *** PROGRAM GEOBAT CONVERTS CELL COORDINATES OF BATHYMETRY VALUES
C *** (MERCATOR) TO THEIR CORRESPONDING GEOGRAPHIC POSITIONS.
C *** INPUT: ZONE BATHYMETRY
C *** OUTPUT: DEPTH VALUES IN GEOGRAPHIC COORDINATES AND A DISC
C *** FILE IN BINARY, SUITABLE FOR PLOTTING DEPTH VALUES WITH
C *** THE CHARTING SUB-SYSTEM
C
      DIMENSION GX(46), GY(46), FBO(46), ITITLE(20)
      COMMON /MER/ MSCL,OL,ON,C1,C2,FLAT
      REAL LAT,LON
      INTEGER ZBO(46,63),FBO
C
C *** READ IN CHART AND BATHYMETRY PARAMETERS. NOTE: C1 AND C2 CARRY
C *** OPPOSITE SIGNS AS COMPARED WITH OTHER PROGRAMS.(INVERSE)
C
      READ (60,60) MSCL,OL,ON,C1,C2
      READ (60,70) (ITITLE(N),N=1,20)
      WRITE (61,80) ITITLE
C
C *** READ IN BATHYMETRY DIMENSIONS, NO.OF ZONES AND CELL SIZE.
C
      READ (30) (ITITLE(N),N=1,20),ICODE,JMAX,IMAX,IZMAX,FLAT
      WRITE (61,90) ICODE,IMAX,JMAX,IZMAX,FLAT,MSCL
      WRITE (20) (ITITLE(K),K=1,20),ICODE,JMAX,IMAX
      DEG = .0174532925
      OL = OL*DEG
      ON = ON*DEG
C
C *** CALCULATING CELL SIZE TO CHART SCALE.
C
      DLAT = (FLAT/MSCL)*1000.
      DO 30 I=1,JMAX
      READ (30) (ZBO(N,I),N=1,IMAX)
      DO 20 J=1,IMAX
      ZBO(J,I) = MOD(ZBO(J,I),1000)
   20 CONTINUE
   30 CONTINUE
      DO 50 K=1,JMAX
      DO 40 L=1,IMAX
      IO = L
      JO = K
C
C *** CELL NUMBERS ARE CONVERTED TO CHART SCALE X AND Y.
C
      X = (IO+C1)*DLAT
      Y = (JO+C2)*DLAT
C
      CALL CATMER (LAT,LON,X,Y)
C
      FBO(L) = ZBO(L,K)
      GX(L) = LAT
      GY(L) = LON
   40 CONTINUE
C
C *** EACH ROW IS WRITTEN ONTO A DISC FILE. THE LINE PRINTER
C *** OUTPUT HAS BEEN INCLUDED FOR CHECKING PURPUSES ONLY.
C
      WRITE (20) (GX(M),GY(M),FBO(M),M=1,IMAX)
      WRITE (61,100) (GX(M),GY(M),FBO(M),M=1,45)
   50 CONTINUE
      ENDFILE 20
      REWIND 20
      STOP
C
   60 FORMAT (I10,2F10.6,2F10.2)
   70 FORMAT (20A4)
   80 FORMAT (//10X,20A4)
   90 FORMAT (/10X,4I10,F9.2,I10/)
  100 FORMAT (2X,5(2F10.6,I5))
      END
```

PROGRAM ZØNSEL

The purpose of this program is to add zone numbers to an existing bathymetry. For boundaries following meridians and/or parallels, program ADDZØN may be used (see Gottinger, 1978). Program ZØNSEL will handle any zone configuration; however every row of the bathymetry and their respective end points for each zone (maximum 18) have to be listed. Figure 3 shows a sample zone layout for James Bay.

Main Parameters

ICØDE	=	Not used presently;
IMAX	=	number of cells per column;
JMAX	=	number of cells per row;
IZMAX	=	maximum number of zones;
DLAT	=	cell size in km at mid-latitude;
ZBØ	=	one-dimensional array (JMAX) containing one row of the bathymetry;
KBØ	=	current cell depth;
IZ	=	one-dimensional array containing the zones per row;
IST	=	one-dimensional array containing the end points of each cell (in cell units) of the current row; and
ISQ	=	reference number of the row.

Note

If 2 cards per row are used, both cards must have the same sequence number.

```
      PROGRAM ZONSEL
C
C *** THIS IS A GENERAL ZONE SELECTION PROGRAM. IT ADDS ZONE
C *** NUMBERS TO BATHYMETRIC DEPTH VALUES.
C
      DIMENSION ZBO(300), IST(18), IZ(18), IT(20)
      INTEGER ZBO
      READ (60,90) IT
      READ (60,100) ICODE,IMAX,JMAX,IZMAX,DLAT
      WRITE (40) (IT(K),K=1,20),ICODE,IMAX,JMAX,IZMAX,DLAT
      DO 80 I=1,IMAX
      READ (30) (ZBO(N),N=1,JMAX)
C
C *** ZONES AND THEIR RESPECTIVE STARTING POINTS (IN CELL UNITS)
C *** ARE READ IN.  MAXIMUM 2 CARDS PER ROW (18 VALUES).
C
      READ (60,110) (IZ(K),IST(K),K=1,9),ISQ
      IF (IFECF(60).EQ.-1) STOP 001
      JSQ = I
      IF (IST(9).EQ.0.OR.IST(9).EQ.JMAX) GO TO 20
C
C ** IF 2 CARDS PER ROW ARE USED, THEY MUST HAVE THE SAME
C *** SEQUENCE NUMBER.
C
      READ (60,110) (IZ(K),IST(K),K=10,18),ISQ
   20 IF (JSQ.EQ.ISQ) GO TO 30
      WRITE (61,120)
      STOP 111
   30 IB = 1
      M = 1
      DO 60 K=1,18
      IE = IST(K)
      DO 50 L=IB,IE
      IF (ZBO(M).EQ.0) GO TO 40
C
C *** THE ZONE IS REMOVED, LEAVING THE DEPTH.
C
      KBO = MOD(ZBO(M),1000)
      ZBO(M) = KBO+IZ(K)*1000
   40 M = M+1
   50 CONTINUE
      IB = IE+1
      IF (M.GT.JMAX) GO TO 70
   60 CONTINUE
C
C *** PRINTOUT IS INCLUDED AS A SEQUENCE CHECK CNLY.
C
   70 WRITE (61,130) (ZBO(J),J=133,150)
      WRITE (40) (ZBO(L),L=1,JMAX)
   80 CONTINUE
      ENDFILE 40
      STOP
C
   90 FORMAT (20A4)
  100 FORMAT (4I5,F5.2)
  110 FORMAT (18I4,4X,I4)
  120 FORMAT (1H1,5HWRONG)
  130 FORMAT (1X,18I7)
      END
```

PROGRAM MARR

The purpose of this program is to display the zone number and depth of each cell on the line printer for a given bathymetric file. This is a general display program and will accept a bathymetric card file with up to 4 cards per row and up to 3 blank spaces between the rows. Sequence numbers for both rows and columns are also displayed. Since bathymetric values are conventionally read starting from the bottom, one row at a time, the entire array has to be stored to display the map (see Figure 2).

Input

Card deck containing zone bathymetry.

Output

Line printer map of zone layout and cell depths for the zone bathymetry.

Main Parameters

IDEPTH	=	Two-dimensional array containing zone bathymetry;
IZØNE	=	two-dimensional array containing zone numbers;
IRØW	=	one-dimensional array containing sequence numbers;
IBUF	=	one-dimensional array containing the current card image of the bathymetry;
ID	=	number of cards per row;
IS	=	number of blank spaces between rows;
KP	=	page number;
KL	=	row identifier; and
LIMIT	=	number of lines per page.

```
      PROGRAM MARR
C
C *** THIS IS A PROGRAM DISPLAYING THE ZONE NUMBER AND THE DEPTH
C *** FOR EACH CELL FOR A GIVEN BATHYMETRIC CARD FILE ON THE LINE
C *** PRINTER. THIS IS A GENERAL DISPLAY PROGRAM WHICH WILL HANDLE
C *** UP TO 4 CARDS PER ROW WITH UP TO 3 BLANK SPACES BETWEEN THE
C *** ROWS. IT ELIMINATES THUS THE TASK OF KEEPING TRACK OF THE
C *** NUMBER OF CELLS PER ROW AND COLUMN. MORE THAN ONE BATHYMETRIC
C *** FILE MAY BE PROCESSED AT ANY ONE RUN.
C
      DIMENSION IDEPTH(40,48)
      DIMENSION IZONE(40,48)
      DIMENSION IBUF(20)
      DIMENSION IDD(2), IROW(48)
      DIMENSION IFORM(5)
      LOGICAL FLAG
      DATA IFORM/4H    ,4H,10X,4H,I5,,4H2X,2,4H4I4)/
      DATA IFORM1/4H(1H /
      DATA IFORM2/4H(1H0/
      DATA IFORM3/4H(1H-/
      CALL FORMS (1)
      LC = 60
      LP = 61
      IFEND = 0
      KO = -1
      KP = 1
      FLAG = .FALSE.
      DO 20 KK=1,48
      M = KK
   20 IROW(KK) = M
C
C *** HEADER RECORDS IS READ IN AND DECODED
C
      READ (LC,210) IBUF
      IF (IFEOF(LC).EQ.-1) STOP 10
      DECODE (80,230,IBUF) IDD,ID,IS
      IF (IDD(1).NE.4HDENS.OR.IDD(2).NE.4HITY=) STOP 01
   30 CONTINUE
C
C *** CHECKING VALIDITY OF THE SPECIFIED SPACING
C
      IF(IS.EQ.0)IS = 1
      IF (IS.NE.1.AND.IS.NE.2.AND.IS.NE.3) STOP 40
C
C *** SELECT APPROPRIATE FORMAT
C
      IF(IS.EQ.1)IFORM(1) = IFORM1
      IF(IS.EQ.2)IFORM(1) = IFORM2
      IF(IS.EQ.3)IFORM(1) = IFORM3
      LIMIT = (80/IS)+1
C
C *** MAXIMUM NUMBER OF CARDS PER ROW IS CHECKED
C
      IF (ID.NE.2.AND.ID.NE.3.AND.ID.NE.4) STOP 30
   40 CONTINUE
      M = 1
   50 CONTINUE
      DO 70 I=1,ID
      READ (LC,210) IBUF
      IFEND = IFEOF(LC)
      IF (IFEND.EQ.-1) GO TO 80
      DECODE (80,230,IBUF) IDD,IC,IT
C
C *** TESTING FOR NEW HEADER RECORD
C
      IF (IDD(1).EQ.4HDENS.AND.IDD(2).EQ.4HITY=) GO TO 200
      K = I*12
      J = K-11
```

```
C
C *** DEPTH AND ZONE ARRAYS ARE SET UP
C
      DECODE (80,240,IBUF) (IZONE(M,L),IDEPTH(M,L),L=J,K)
      DO 60 L=J,K
      IF(IZONE(M,L).EQ.0)IZONE(M,L) = -10000
      IF(IDEPTH(M,L).EQ.0)IDEPTH(M,L) = -10000
   60 CONTINUE
   70 CONTINUE
      M = M+1
      IF (M.GE.LIMIT) GO TO 80
      GO TO 50
   80 CONTINUE
      M = M-1
      KO = KO+1
      MP = M
      IF(ID.EQ.2.OR.ID.EQ.3)I = 1
      IF(ID.EQ.4)I = 2
      DO 110 J=1,I
      WRITE (LP,260)
      WRITE (LP,250) KP
      M = MP
      K = 24*J
      N = K-23
   90 CONTINUE
      IF (M.LE.0) GO TO 100
      KL = M+(KO*(LIMIT-1))
C
C *** ZONE MAP IS PRINTED
C
      WRITE (LP,IFORM) KL,(IZONE(M,L),L=N,K)
      M = M-1
      GO TO 90
  100 WRITE (LP,220) (IROW(L),L=N,K)
  110 CONTINUE
      DO 140 J=1,I
      WRITE (LP,260)
      WRITE (LP,250) KP
      M = MP
      K = 24*J
      N = K-23
  120 CONTINUE
      IF (M.LE.0) GO TO 130
      KL = M+(KO*(LIMIT-1))
C
C *** DEPTH MAP IS PRINTED
C
      WRITE (LP,IFORM) KL,(IDEPTH(M,L),L=N,K)
      M = M-1
      GO TO 120
C
C *** CELL NUMBERS ARE PRINTED AT THE BOTTOM OF THE PAGE
C
  130 WRITE (LP,220) (IROW(L),L=N,K)
  140 CONTINUE
      IF (ID.NE.3) GO TO 190
      M = MP
      WRITE (LP,260)
      WRITE (LP,250) KP
  150 CONTINUE
      IF (M.LE.0) GO TO 160
      KL = M+(KO*(LIMIT-1))
      WRITE (LP,IFORM) KL,(IZONE(M,L),L=25,36)
      M = M-1
      GO TO 150
```

```
  160 WRITE (LP,220) (IROW(L),L=25,36)
      M = MP
      WRITE (LP,260)
      WRITE (LP,250) KP
  170 CONTINUE
      IF (M.LE.0) GO TO 180
      KL = M+(KO*(LIMIT-1))
      WRITE (LP,IFORM) KL,(IDEPTH(M,L),L=25,36)
      M = M-1
      GO TO 170
  180 WRITE (LP,220) (IROW(L),L=25,36)
  190 IF (IFEND.EQ.-1) STOP 20
      KP = KP+1
      IF (.NOT.FLAG) GO TO 40
      FLAG = .FALSE.
      ID = IC
      IS = IT
      GO TO 30
  200 CONTINUE
      FLAG = .TRUE.
      GO TO 80
C
  210 FORMAT (20A4)
  220 FORMAT (//18X,24I4)
  230 FORMAT (2A4,I1,7X,I1,63X)
  240 FORMAT (12(2I3),8X)
  250 FORMAT (1H ,I10)
  260 FORMAT (1H1)

      END
```

PROGRAM GENCRUS

This program is a general surveillance program and can be used either to check the station parameters of oceanographic survey data files or write permanent files to display various parameters with the charting sub-system (R. Gottinger and A.C. Zingaro, 1978).

The program will perform the following tasks:

1) List station number, date, position, and cell number for all or non-repetitive profiles (switch 1).
2) List sounding depths and cell depths for each station and, if both depths are not within a certain tolerance, a message will be written. A position check is also included.
3) Write permanent files (or data files) for up to 3 surveys in a format suitable to display various parameters on the Calcomp plotter for part of or the entire cruise. Also, more than one permanent file for a single cruise can be written (pre-selected profiles).
4) Display a line printer map of the entire area to show which of the included profiles influenced each gridded cell of the entire survey area (switch 2).
5) Allow the user to override the influence array (up to 16 cells). The input cards can then be used with program SALT.
6) List the last depth at which both temperature and salinity, or whichever second parameter is retrieved, were measured (profile depth).

In conclusion, it should be noted that a maximum of 9 output files may be written. The data set identifier of the first output file is 31, and they are incremented by 1 and will only interfere at 40 with the first input file. (Two data files with the same identifier are illegal in computer work.)

Main Parameters

ZBØ = Two-dimensional array containing the zone bathymetry;

T = one-dimensional array containing the profile temperatures;

Z = one-dimensional array containing the profiles depths;

P = one-dimensional array containing the other parameter to be retrieved;

SND = one-dimensional array containing sounding depths of the profile stations;

NSTAT = one-dimensional array containing profile station numbers;

ISTAT, JSTAT = one-dimensional arrays containing X and Y coordinates in cell units of the profile stations; and

GX, GY = one-dimensional arrays containing geographic coordinates of the profile stations.

Note

Parameters in common block SET 1, SET 2, and SET 3 are part of sub-routine SETDAT of the O&AS data base. Parameters in common block MER are constants unique to the bathymetry and are described in subroutine MERCAT.

```
      PROGRAM GENCRUS
C
C *** THIS PROGRAM WILL CHECK CRUISES FOR VALIDITY OF BASIC DATA,
C *** WRITE UP TO 3 PERMANENT FILES IN A FORMAT SUITABLE TO PLOT
C *** STATIONS AND THEIR RESPECTIVE PARAMETERS WITH THE CHARTING
C *** SUB-SYSTEM. IT WILL ALSO, UPON REQUEST, PRINT OUT A MAP
C *** SHOWING THE INFLUENCE OF THE PROFILE STATIONS ON THE ENTIRE
C *** SURVEY AREA. DIAGNOSTICS FOR SOUNDINGS AND POSITION CHECKS
C *** ARE ALSO PROVIDED.
C
      INTEGER ZBO
      LOGICAL MOVE
      DIMENSION IBUF(320), T(104), P(104), Z(104), SND(250)
      DIMENSION GX(250), GY(250), ITITLE(20)
      COMMON /SET1/ IT(10),PAR(104,10),IQ(104,3),NAME(80)
      COMMON /SET2/ ITS(10),ITB(10),SP(10),BP(10),IQS(3),IQB(3)
      COMMON /SET3/ IPAR(104,10),IFM(10)
      COMMON /S/ ZBO(48,57),ISOUND,IMAX,JMAX,IN,IOV,MAP
      COMMON /VARS/ NSTAT(250),ISTAT(250),JSTAT(250),NO(150)
      COMMON /MER/ M,OL,ON,C1,C2,FLAT
C
      LOC = 4
      NP = 10
      IPF = 31
C
C *** BASIC CONTROL PARAMETERS ARE READ
C
      READ (60,290) IDS1,MAP,IOV
C
C *** CHART PARAMETERS ARE READ IN
C
      READ (60,300) M,OL,ON,C1,C2
C
C *** THE GRID SIZE IS READ FROM THE BATHYMETRY FILE
C
   20 REWIND 22
      READ (22) (ITITLE(N),N=1,20),ICODE,JMAX,IMAX,IZMAX,FLAT
C
C *** THE BATHYMETRY DEPTHS ARE READ IN
C
      DO 40 I=1,JMAX
      READ (22) (ZBO(N,I),N=1,IMAX)
      DO 30 J=1,IMAX
C
C *** THE ZONE IS REMOVED, LEAVING THE DEPTH
C
      ZBO(J,I) = MOD(ZBO(J,I),1000)
   30 CONTINUE
   40 CONTINUE
   50 REWIND IPF
      DO 60 M=1,250
      GX(M) = 0.0
      GY(M) = 0.0
   60 NSTAT(M) = 0
C
C *** THE FILE HEADER RECORD OF THE DATA BASE FILE, CONTAINING DEPTH
C *** PROFILES, IS READ AND WRITTEN ONTO THE LINE PRINTER
C
      BUFFER IN (IDS1,0) (IBUF(1),IBUF(320))
      IF (IFUNIT(IDS1)) 250,70,250
   70 WRITE (61,310) (IBUF(I),I=1,41)
      L = 1
      Z(1) = 0.
      WRITE (61,320)
C
      WRITE (61,330)
```

```
C
C *** THE RECORD NUMBER OF THE FIRST PROFILE WANTED, AND THE NUMBER OF
C *** PROFILES FOLLOWING IT ARE READ IN.  THE LAST CARD HAS JEND=1 TO
C *** SAY THAT NO MORE PROFILES ARE WANTED.
C
      IDH = 4H
      DECODE (4,360,IBUF(1) )MAXREC
      ENCODE (2,340,IDH) IDS1
   80 READ (60,350) ISTART,NPRO,JEND,IEND
      IF (IFECF(60).EQ.-1) GO TO 250
C
C *** CHECKING IF THE SPECIFIED RECORD NUMBER LIES WITHIN THE
C *** DATA FILE LIMITS. MAXREC = LAST RECORD NUMBER ON DISC FILE.
C
      IF (ISTART.GE.2.AND.ISTART.LT.MAXREC) GO TO 90
      WRITE (61,370)
      GO TO 80
   90 JP = 0
C
      CALL SKIP (IDH,3,ISTART)
C
C *** S/R SETDAT RETRIEVES A PROFILE
C *** INFORMATION IN THE PROFILE HEADER IS DECODED
C
  100 CALL SETDAT (ICNS,NP,ND,IDS1)
C
      IF (ND.NE.-1) GO TO 110
      NSTAT(L) = 0
      GO TO 240
  110 DECODE (160,380,NAME(1) )IDAY,MON,IYR,NSTAT(L),JRET,JREP,LT,FLT,LO
     $,FLO,SND(L)
      IF (ISENSWCH(1)) 140,140,120
  120 MSTAT = NSTAT(L)
C
C *** DO LOOP REJECTS REPEATED PROFILES
C
      ICK = 0
      DO 130 K=1,250
      IF ((MSTAT-NSTAT(K)).NE.0) GO TO 130
      ICK = ICK+1
      IF (ICK.GT.1) GO TO 100
  130 CONTINUE
  140 LO = LT*1000+(FLT+0.05)*10.
      LN = LO*1000+(FLO+0.05)*10.
      GX(L) = LT*1.0+FLT/60.
      GY(L) = LO*1.0+FLO/60.
      I = 1
C
C *** ARRAY T(N) CONTAINS THE TEMPERATURES AT EACH DEPTH NO., Z(N)
C *** CONTAINS THE DEPTHS, AND P(N) THE SALINITY (OR THE
C *** PARAMETER DEFINED BY LOC)
C
      DO 150 N=1,104
      T(N) = PAR(I,3)
      Z(N) = PAR(I,2)
      P(N) = PAR(I,LOC)
      I = I+1
  150 CONTINUE
C
C *** THE LAST DEPTH AT WHICH TEMPERATURE AND SALINITY WERE
C *** MEASURED ARE DETERMINED (NT,NS)
C
```

```
      DO 160 K=1,104
      NT = K
      IF (T(K).GT.-80.0) GO TO 160
      GO TO 170
  160 CCNTINUE
  170 DO 180 J=1,104
      NS = J
      IF (P(J).GT.-80.0) GO TO 180
      GO TO 190
  180 CCNTINUE
  190 CONTINUE
      NT = NT-1
      NS = NS-1
      KTD = Z(NT)
      KSD = Z(NS)
C
C *** S/R MERCAT IS CALLED TO DETERMINE IN WHICH CELL THE STATION LIES
C
      CALL MERCAT (X,Y,IO,JO,LO,LN)
C
C *** TEST FOR ADEQUATE BATHYMATRY DIMENSION
C
      IF (IO.LE.0.OR.IO.GT.IMAX.OR.JO.LE.0.OR.JO.GT.JMAX) GO TO 210
C
C *** THE BATHYMETRY AND SOUNDING DEPTHS ARE PRINTED, AND THEN THEY
C *** ARE COMPARED
C
      ISTAT(L) = IO
      JSTAT(L) = JO
      IBATHY = ZBO(IO,JO)
      ISOUND = SND(L)
      IF (ISOUND.EQ.0) GO TO 200
C
C *** IF THE SOUNDING DEPTH IS WITHIN 15 PERCENT OF THE CELL
C *** DEPTH, THE PROGRAM WILL LIST THAT PROFILE. OTHERWISE
C *** THE ADJACENT CELLS ARE CHECKED TO SEE WHETHER ONE OF THEM
C *** IS DEEP ENOUGH TO ACCOMMODATE THE SOUNDING.
C
      LIMB = ZBO(IO,JO)*115/100
      IBRAN = ZBO(IO,JO)*85/100
      IF ((ISCUND.LE.LIMB).AND.(ISOUND.GE.IBRAN)) GO TO 220
C
      CALL SCAN (IO,JO,MOVE)
C
      IF (MOVE) GO TO 220
  200 WRITE (61,390) ICNS,NSTAT(L),IDAY,MON,IYR,LT,FLT,LO,FLO,IO,JO,
     $IBATHY,ISOUND,KTD,KSD
      GO TO 230
  210 WRITE (61,400) ICNS,NSTAT(L),IDAY,MON,IYR,LT,FLT,LO,FLO,IO,JO
      GO TO 230
  220 WRITE (61,410) L,NSTAT(L),IDAY,MON,IYR,LT,FLT,LO,FLO,IO,JO,IBATHY,
     $ISOUND,KTD,KSD
```

```
  230 L = L+1
      JP = JP+1
      IF (JP.NE.NPRO) GO TO 100
      IF (JEND.EQ.1) GO TO 240
      GO TO 80
  240 IN = L-1
      IUP = IN/25.+1.0
  250 J = 1
      M = 25
      DO 260 N=1,IUP
      WRITE (IPF) (GX(I),GY(I),NSTAT(I),I=J,M)
      J = J+25
      M = M+25
  260 CONTINUE
      ENDFILE IPF
      REWIND IPF
C
C *** POSITIVE SWITCH WILL CALL S/R FILLA TO READ IN CARDS
C *** FOR OVERWRITING THE WEIGHTED ARRAY AND SUBSEQUENTLY
C *** PRINT A MAP (MAP=1)
C
      IF (ISENSWCH(2).GT.0) CALL FILLA
C
C *** IEND=1 IS TO SAY THE NEXT INPUT FILE IS TO BE PROCESSED
C
      IF (IEND.EQ.1) GO TO 270
      IPF = IPF+1
      GO TO 80
  270 IDS1 = IDS1+10
      IPF = IPF+1
      READ (60,350) ISTART,NPRO,JEND,IEND
      IF (IFECF(60).EQ.-1) GO TO 280
      IF (IEND.EQ.2) GO TO 280
      REWIND IDS1
      IF (ISENSWCH(2).GT.0) GO TO 20
      GO TO 50
  280 STOP
C
  290 FORMAT (3I5)
  300 FORMAT (I10,2F10.4,2F5.1)
  310 FORMAT (1H1,5(/),2X,A4/2X,20A4/2X,20A4/)
  320 FORMAT (1HR)
  330 FCRMAT (1H0,2X,76HCNS  STA NO    DATE   LATITUDE   LONGITUDE    CE
     $LL    BATHY   SND  TEMP   SAL,10X,8HREMARKS /)
  340 FCRMAT (I2)
  350 FORMAT (4I5)
  360 FCRMAT (I4)
  370 FCRMAT (//10X,27HSTARTING RECORD BEYOND FILE//)
  380 FORMAT (80X,2I3,4X,I2,4X,I4,I2,2X,I1,1X,2(I3,F6.2,2X),12X,F6.1)
  390 FCRMAT (1X,I4,1X,I6,I6,I2,I3,1X,2(I3,F6.2,2X),2X,1H(,I2,1H,,I2,1H)
     $,4I6,2X,35HSOUNDING OR CELL DEPTH OUT OF RANGE)
  400 FORMAT (1X,I4,1X,I6,I6,I2,I3,1X,2(I3,F6.2,2X),2X,1H(,I2,1H,,I2,1H)
     $,10X,17HPOSITION IN ERROR)
  410 FORMAT (1X,I4,1X,I6,I6,I2,I3,1X,2(I3,F6.2,2X),2X,1H(,I2,1H,,I2,1H)
     $,4I6)
      END
```

PROGRAM PLTPRØ

This program writes out on the line printer the complete data profile returned by subroutine SETDAT. Subroutine SETDAT is part of the O&AS data base, and, when called, returns one complete data profile of a cruise. The user has the option to specify a scaling factor for some or all of the three parameters. Either sigma-t or conductivity may be displayed apart from temperature and salinity. The program is used for editing only and is thought to be a forerunner of program PUBPRØ, which is used for displaying profile data in publications.

Main Parameters

A = One-dimensional array containing the distinguishing number for each parameter in the proper location for a scale of 80 characters;

DEP, TEM, SAL, CØN, SIG = one-dimensional arrays containing measured and derived parameters of the O&AS profile data base: depth, temperature, salinity, conductivity, and sigma-t;

NFLAG = control parameter giving the choice of plotting either conductivity or sigma-t; and

NARR = one-dimensional array containing the unit length of the parameters plotted, represented by a string of asterisks.

Note

Parameters in common block SET 1, SET 2, and SET 3 are part of subroutine SETDAT of the O&AS data base.

```
      PROGRAM PLTPRO
C
C *** A PROGRAM THAT WRITES OUT,ON THE LINE PRINTER, THE COMPLETE
C *** DATA PROFILE RETURNED BY S/R  SETDAT
C
      INTEGER A,PLT
      INTEGER TEMB,SALB,CONB
      DIMENSION IBUF(320), TEM(104), SAL(104), CON(104), SIG(104),
     $ A(100), PLT(7), DEP(104)
      DIMENSION NAM(4), NARR(100)
      COMMON /SET1/ IT(10),PAR(104,10),IQ(104,3),NAME(80)
      COMMON /SET2/ ITS(10),ITB(10),SP(10),BP(10),IQS(3),IQB(3)
      COMMON /SET3/ IPAR(104,10),IFM(10)
      DATA PLT/1H1,1H2,1H3,1H4,1H5,1H6,1H7/
      DATA NAM/3HTEM,3HSAL,3HCON,3HSIG/
C
C *** PROCESS FILE HEADER RECORD
C
      BUFFER IN (20,0) (IBUF(1),IBUF(320))
      IF (IFUNIT(20)) 20,40,30
   20 STOP 001
   30 STOP 002
   40 WRITE (61,250) (IBUF(I),I=1,41)
C
C *** INITIALIZING FLAGS FOR THE SCALING FACTORS
C
      IFLG1 = 1
      IFLG2 = 1
      IFLG3 = 1
      IFLG4 = 1
C
C *** ISTART = RECORD NO. OF FIRST PROFILE TO BE RETRIEVED
C *** NOPRO = NO. OF PROFILES TO BE RETRIEVED
C
   50 CONTINUE
      READ (60,260) ISTART,NOPRO,NFLAG
      IF (IFECF(60).EQ.-1) STOP
C
C *** THE SCALES CAN BE FIXED FOR ALL PROFILES BY READING THEM IN.
C *** IF THEY ARE BLANK, S/R RANGE SETS THE SCALES FOR EACH PROFILE.
C
C ** CHECKING IF THE SPECIFIED RECORD NUMBER LIES WITHIN THE
C *** DATA FILE LIMITS
C
      READ (60,270) TEMS,TEMB,SALS,SALB,CONS,CONB,SIGS,NSIGB
      IF(TEMS.EQ.0.0)IFLG1 = 0
      IF(SALS.EQ.0.0)IFLG2 = 0
      IF(CONS.EQ.0.0)IFLG3 = 0
      IF(SIGS.EQ.0.0)IFLG4 = 0
C
      DECODE (4,280,IBUF(1) )MAXREC
      IF (ISTART.LT.2) GO TO 50
      IF (ISTART.GT.MAXREC) GO TO 50
      CALL SKIP (2H20,3,ISTART)
      IDS1 = 20
      NP = 10
      ICNT = 0
C
C *** ND = NUMBER OF DEPTHS
C
   60 CALL SETDAT (ICNS,NP,ND,IDS1)
      WRITE (61,290)
```

```
      WRITE (61,300) ICNS,ND
      WRITE (61,310) (NAME(I),I=1,37)
C
C *** SET THE SURFACE VALUE FOR EACH PARAMETER
C
      DEP(1) = 0.0
      TEM(1) = SP(3)
      SAL(1) = SP(4)
      CON(1) = SP(5)
      SIG(1) = -10.0
      I = 1
      IK = 0
C
C *** THE OTHER VALUES FOR THE PARAMETERS ARE SET
C
      DO 70 M=2,104
      DEP(M) = PAR(I,2)
      TEM(M) = PAR(I,3)
      SAL(M) = PAR(I,4)
      CON(M) = PAR(I,5)
      SIG(M) = -10.0
      I = I+1
   70 CONTINUE
C
C *** NFLAG GIVES THE CHOICE OF PLOTTING EITHER CON OR SIG
C
      IF (NFLAG.EQ.0) GO TO 100
      DO 80 K=1,104
C
C *** IF SAL OR TEMP ARE -10.0, SIGMAT IS NOT CALLED
C
      IF (TEM(K).LT.-9.0.OR.SAL(K).LT.-9.0) GO TO 80
      CALL SIGMAT (TEM(K),SAL(K),XSO,XST)
      SIG(K) = XST
   80 CONTINUE
C
C *** SINCE SIG(1) IS 0.0, IT IS SET TO -10.0, SO THAT IT WILL BE
C *** IGNORED, AND WILL NOT THROW THE SCALE OFF
C
      DO 90 NN=1,104
      CON(NN) = SIG(NN)
      CONS = SIGS
      CONB = NSIGB
   90 CCNTINUE
  100 CONTINUE
C
C *** S/R RANGE IS CALLED TO DETERMINE THE SCALES FOR EACH
C *** PARAMETER FOR ONE PLOT.  THE SCALES VARY FROM PLOT TO PLOT
C
      IF (TEMS.EQ.0.0) CALL RANGE (TEM,TEMS,TEMB)
      IF (SALS.EQ.0.0) CALL RANGE (SAL,SALS,SALB)
      IF (CONS.EQ.0.0) CALL RANGE (CON,CONS,CONB)
C
C *** THE PLOT OF PARAMETER CON IS MOVED 7 SPACES TO THE RIGHT
C *** BECAUSE IT INTERFERES TOO MUCH WITH THE TEM PLOT
C
      CONB = CONB-7
      IF (NFLAG.GE.0) GO TO 110
      WRITE (61,330)
      GO TO 120
  110 WRITE (61,320)
  120 NDD = ND+1
      DO 200 L=1,NDD
C
C *** EACH LINE OF THE PLOT STARTS AND ENDS WITH A .
C
```

```
      A(1) = 1H.
      A(100) = 1H.
      DO 130 J=2,99
  130 A(J) = 1H
C
C *** EACH PARAMETER IN TURN IS SCALED TO FIT ON A PLOT OF LENGTH
C *** 100 USING THE VALUES CALCULATED IN S/R RANGE
C *** ANY VALUES WHICH ARE TOO LARGE OR TOO SMALL ARE SET TO THE
C *** UPPER OR LOWER LIMITS OF THE PLOT
C
      JT = IFIX(TEMS*TEM(L)+0.5)-TEMB
      IF(JT.LT.2)JT = 2
      IF(JT.GT.99)JT = 99
      JS = IFIX(SALS*SAL(L)+0.5)-SALB
      IF(JS.LT.2)JS = 2
      IF(JS.GT.99)JS = 99
      JP = IFIX(CONS*CON(L)+0.5)-CONB
      IF(JP.LT.2)JP = 2
      IF(JP.GT.99)JP = 99
C
C *** IF MORE THAN ONE PARAMETER IS TO BE PLOTTED AT THE SAME POINT,
C *** THEN THEIR VALUES ARE ADDED TOGETHER, SO THAT COMBINATIONS
C *** MAY BE DISTINGUISHED (WHERE TEM=1, SAL=2, AND CON=4)
C
      IF (JT.NE.JS) GO TO 140
      IF (JT.NE.JP) GO TO 150
      A(JT) = PLT(7)
      GO TO 190
  140 IF (JT.NE.JP) GO TO 160
      A(JT) = PLT(5)
      A(JS) = PLT(2)
      GO TO 190
  150 CONTINUE
      A(JT) = PLT(3)
      A(JP) = PLT(4)
      GO TO 190
  160 IF (JS.NE.JP) GO TO 170
      A(JS) = PLT(6)
      GO TO 180
  170 CONTINUE
      A(JS) = PLT(2)
      A(JP) = PLT(4)
  180 A(JT) = PLT(1)
  190 CONTINUE
C
C *** ONE LINE OF THE PLOT IS PRINTED,ALONG WITH THE TRUE VALUES
C *** OF THE PARAMETERS.
C
      WRITE (61,340) IK,DEP(L),TEM(L),SAL(L),CON(L),A
      IK = IK+1
  200 CONTINUE
C
C *** THE LENGTH OF ONE UNIT OF EACH PARAMETER IS PRINTED BELOW THE
C *** PLOT WITH THE ACTUAL LENGTH REPRESENTED BY A LENGTH OF * S.
C *** THIS IS CALCULATED USING THE SCALING FACTORS
C
      WRITE (61,350)
```

```
      DO 240 K=1,3
      IF(K.EQ.1)NT = IFIX(TEMS+0.5)
      IF(K.EQ.2)NT = IFIX(SALS+0.5)
      IF(K.EQ.3)NT = IFIX(CONS+0.5)
      DO 210 I=1,100
      NARR(I) = 1H
  210 CONTINUE
      IF (NT.LE.100) GO TO 220
      NT = 100
      WRITE (61,360)
  220 DO 230 M=1,NT
      NARR(M) = 1H*
  230 CONTINUE
      LL = K
      IF((K.EQ.3).AND.(NFLAG.LT.0))LL = K+1
      WRITE (61,370) NAM(LL),(NARR(I),I=1,100)
      WRITE (61,350)
  240 CONTINUE
      IF(IFLG1.EQ.0)TEMS = 0.0
      IF(IFLG2.EQ.0)SALS = 0.0
      IF(IFLG3.EQ.0)CONS = 0.0
      IF(IFLG4.EQ.0)SIGS = 0.0
      ICNT = ICNT+1
C
C *** IF THE COUNT IS LESS THAN THE NUMBER OF PROFILES WANTED,
C *** ANOTHER PROFILE IS RETRIEVED
C
      IF (ICNT.LT.NOPRO) GO TO 60
      GO TO 50
C
  250 FORMAT (1H1,5(/),2X,A4/2X,20A4/2X,20A4)
  260 FORMAT (3I5)
  270 FORMAT (4(F6.2,I5))
  280 FORMAT (I4)
  290 FORMAT (1H1)
  300 FORMAT (1X,2I10)
  310 FORMAT (/5X,31A4,A2/5X,5A4//)
  320 FORMAT (4X,27H  DPTH    TEMP    SAL     COND/)
  330 FORMAT (4X,27H  DPTH    TEMP    SAL     SIGT/)
  340 FORMAT (1X,I2,1X,F6.1,3F7.3,1X,100A1)
  350 FORMAT (1H0)
  360 FORMAT (5X,28HCOMPUTED SCALE EXCEEDS RANGE)
  370 FORMAT (1X,20HLENGTH OF 1 UNIT OF ,A3,4H IS ,100A1)
      END
```

SUBROUTINE SIGMAT

This function subroutine computes sigma-t of sea water using Knudsen's modified formula and is referenced in program SALT (Prinsenberg, S. and R. Gottinger, 1978).

Main Parameters

XT, XS	=	Input values of temperature and salinity;
XSØ	=	sigma-t value for zero temperature value; and
XST	=	output sigma-t value.

```
      SUBROUTINE SIGMAT (XT,XS,XSO,XST)
C
C *** THIS FUNCTION SUBROUTINE COMPUTES SIGMA-T OF SEA WATER
C *** USING KNUDSENS MODIFIED EQUATION.
C
C *** REF.: MANUSCRIPT REPORT SERIES NO. 15 (OCEANS IV) BY
C *** H.E. SWEERS, MARINE SCIENCES BRANCH, EMR.
C
      XSO = ((6.76786136E-6*XS-4.82496140E-4)*XS+0.814876577)*XS-0.
     $0934458632
      E1 = (((-1.43803061E-7*XT-1.98248399E-3)*XT-0.545939111)*XT+4.
     $53168426)*XT
      B1 = ((-1.0843E-6*XT+9.8185E-5)*XT-4.7867E-3)*XT+1.0
      B2 = ((1.667E-8*XT-8.164E-7)*XT+1.803E-5)*XT
      E2 = (B2*XSO+B1)*XSO
      XST = E1/(XT+67.26)+E2
      RETURN
      END
```

SUBROUTINE MERCAT

This subroutine is part of the charting sub-system and is used to calculate Mercator coordinates X and Y of a sample position from its geographic coordinates with respect to chart scale M and origin ØL and ØN. Subsequently, it can be used to assign cell numbers to those Mercator coordinates. The cells are numbered starting from the lower left-hand corner of the bathymetry. This corner is located C_2 cell units up (or down) and C_1 cell units right (or left) from the chart origin, the intersection of reference latitude and reference meridian.

For theory and documentation, see the charting sub-system.

Main Parameters

X,Y	=	Mercator coordinates of sample position at chart scale;
IØ,JØ	=	cell numbers of sample position;
LAT,LØNG	=	geographic coordinates of sample position;
M	=	chart scale; and
ØL,ØN	=	latitude and longitude of chart origin.

```
      SUBROUTINE MERCAT (X,Y,IO,JO,LAT,LONG)
C
C *** S/R CONVERTS GEOGRAPHIC COORDINATES TO MERCATOR COORDINATES AT
C *** CHART SCALE AND SUBSEQUENTLY TO CELL NUMBERS IO AND JO.
C *** GE1,BLN, AND A ARE GEODETIC CONSTANTS FOR CLARKE SPHEROID 1866.
C *** CONSTANTS TO EVALUATE XO AND XI WERE PRECOMPUTED. THIS VERSION
C *** OF MERCAT IS USED TO ASSIGN CELL NUMBERS TO PROFILE STATIONS.
C
C *** REF.: US COAST AND GEODETIC SURVEY SPECIAL PUBLICATION NO 67.
C
C                  *****  DESCRIPTION OF VARIABLES  *****
C
C *** OL,ON = LATITUDE AND LONGITUDE OF CHART ORIGIN IN DECIMAL DEG.
C *** DLAT = BATHYMETRY CELL SIZE AT CHART ORIGIN (KM)
C *** FLAT = GRID SIZE AT CHART SCALE
C *** X,Y = MERCATOR COORDINATES AT CHART SCALE
C *** C1,C2 = DIFFERENCE IN CELLS BETWEEN CHART AND BATHYMETRY ORIGIN
C *** M = NATURAL SCALE OF CHART
C *** XO,XI = CONFORMAL LATITUDES
C
C                  *****           ****           *****
C
      COMMON /MER/ M,OL,ON,C1,C2,DLAT
C
C *** THE PARAMETERS IN COMMON BLOCK /MER/ ARE CHART DEPENDENT
C *** AND WILL HAVE TO BE CHANGED FOR EACH CHART
C
      DATA IP/1/
      IF (IP.GT.1) GO TO 20
      GE1 = .67686579973E-2
      BLN = 2.718281828
      A = 6378206.4
      DEG = .0174532925
      RAD = 57.295779513
      PI2 = 1.570796327
C
C *** IF SUBROUTINE IS ONLY USED TO CALCULATE X AND Y, DLAT IS SET
C *** TO 10.0 BY DEFAULT
C
      IF(DLAT.LE.0.0) DLAT=10.0
      FLAT = (DLAT/M)*1000.
      OL = OL*DEG
      ON = ON*DEG
      SO = SIN(OL)
      CO = COS(OL)
      SO2 = SO*SO
      EX1 = SQRT(1.-GE1*SO2)
      C = (A*CO)/(M*EX1)
      XO = OL-(.0033939028*SIN(2.*OL)-0.0000047997*SIN(4.*OL))
   20 ILAT = LAT*0.001
      ALAT = (LAT-ILAT*1000)*0.1
      AL = (FLOAT(ILAT)+ALAT/60.)*DEG
      XI = AL-(.0033939028*SIN(2.*AL)-0.0000047997*SIN(4.*AL))
      ILON = LONG*0.001
      DLON = (LONG-ILON*1000)*0.1
      AO = (FLOAT(ILON)+DLON/60.)*DEG
      X = C*(ON-AO)
      ART = (PI2-XI)*0.5
      BAT = (PI2-XO)*0.5
      TP = (COS(ART)/SIN(ART))/(COS(BAT)/SIN(BAT))
      Y = C*ALOG(TP)
C
C *** MERCATOR COORDINATES X AND Y ARE CONVERTED TO
C *** CELL NUMBERS IO AND JO
C
      IO = (X/FLAT)+C1
      JO = (Y/FLAT)+C2
      IP = IP+1
      RETURN
      END
```

SUBROUTINE SCAN

This subroutine is included mainly to provide a more efficient check on the validity of a sounding depth. Since a cell depth represents the average depth of an entire cell, it happens that, despite the allowed tolerance, both depths from a bathymetric file and from an oceanographic station can differ considerably. This may be due to a rough bottom topography or a station situated close to a cell boundary (Gottinger, 1978). If one of the adjoining cells is deep enough to accommodate the sounding, the program will proceed with the calculations. Otherwise, the station will be flagged, and a check of either the cell depth or the sounding depth is needed.

Main Parameters

II, JJ = one-dimensional arrays containing parameters to be added to the current cell coordinates to obtain the adjoining cell coordinates;

ISØUND = sounding of the current profile station in meters;

IMAX = number of cells per column; and

JMAX = number of cells per row.

```
      SUBROUTINE SCAN (I,J,MOVE)
C
C *** SCAN IS CALLED IF THE SAMPLING DEPTH DOES NOT FALL WITHIN
C *** A CERTAIN RANGE.THE ADJOINING CELLS ARE SEARCHED AND IF ONE OF
C *** THEM IS DEEP ENOUGH MOVE IS ASSIGNED VALUE .T. WHICH ALLOWS
C *** THE COMPUTATION TO CONTINUE. OTHERWISE MOVE IS .F. AND
C *** THE MAIN PROGRAM FLAGS THAT DEPTH.
C
      LOGICAL MOVE
      DIMENSION II(8), JJ(8)
      COMMON /S/ NO(48,57),ISOUND,IMAX,JMAX
      DATA II/0,1,1,1,0,-1,-1,-1/
      DATA JJ/1,1,0,-1,-1,-1,0,1/
      MOVE = .TRUE.
      DO 10 K=1,8
      IO = I+II(K)
      JO = J+JJ(K)
      IF ((JO.LT.1).OR.(JO.GT.JMAX)) GO TO 10
      IF ((IO.LT.1).OR.(IO.GT.IMAX)) GO TO 10
      IBRAN = NO(IO,JO)
      IF (ISOUND.LE.IBRAN) RETURN
   10 CONTINUE
      MOVE = .FALSE.
      RETURN
      END
```

SUBROUTINE RANGE

This subroutine establishes a scaling factor for each profile if no scaling factor was specified in the main line (left blank). The constants and limits of the plots have been chosen to place the parameter curves of temperature, salinity, and conductivity (or sigma-t) relative to each other in the best possible way. For different parameters, or if only a certain part of the curve is to be emphasized, the subroutine has to be modified.

Main Parameters

- VAL = One-dimensional array containing the parameter value;
- XMIN, XMAX = minimum and maximum value of the parameter;
- DIFF = difference between minimum and maximum value of the parameter with an appropriate percentage added; and
- S = scaling factor.

```
      SUBROUTINE RANGE (VAL,S,B)
C
C *** THIS SUBROUTINE ESTABLISHES A SCALING FACTOR FOR EACH
C *** PROFILE, IF NO SCALING FACTOR WAS SPECIFIED IN THE MAIN LINE.
C
      INTEGER B
      DIMENSION VAL(104)
      XMIN = 10000.
      XMAX = -10000.
C
C     FIND THE MAXIMUM AND MINIMUM VALUES OF THE PARAMETER.
C
      DO 10 L=1,104
C
C *** IF A VALUE IS -10.0, IT IS IGNORED
C
      IF (VAL(L).LE.-10.0) GO TO 10
      XMIN = AMIN1(XMIN,VAL(L))
      XMAX = AMAX1(XMAX,VAL(L))
   10 CONTINUE
C
C *** FIND THE DIFFERENCE BETWEEN THE MAXIMUM AND MINIMUM, AND
C *** ADD 30 PERCENT
C
      DIFF = (XMAX-XMIN)*1.2
C
C *** DETERMINE THE SCALING FACTOR FOR A RANGE OF 100
C
      S = 100.0/DIFF
      IF(S.GT.80.0)S = 80.0
C
C *** THE MINIMUM VALUE IS SCALED DOWN
C *** IF THE MINIMUM VALUE IS POSITIVE, 1 PERCENT IS SUBTRACTED, SO THAT
C *** VALUES WILL NOT BE ON THE EDGE OF THE PLOT
C *** IF IT IS NEGATIVE, 30 PERCENT IS ADDED, TO BRING THE VALUES
C *** INTO A POSITIVE RANGE.
C
      IF(XMIN.GT.0.0)B = IFIX(S*XMIN*.99)
      IF(XMIN.LE.0.0)B = IFIX(S*XMIN*1.3)
      RETURN
      END
```

SUBROUTINE FILLA

This subroutine is a modified version of subroutine FILL used in program SALT. Contrary to subroutine FILL, the entire bathymetry is stored to enable the user to print an influence map (maximum of 44 cells per row). There is no limit to the number of cells that can be overwritten. However, program SALT will limit that number to 20. The main parameters are the same as in subroutine FILL and are described in program SALT.

<u>Main Parameters</u>

- ZBØ = Two-dimensional array containing the station number for each cell by which it is influenced;
- II, JJ = one-dimensional arrays containing the coordinates of the cells (in cell units) which are to be overwritten;
- KC = one-dimensional array containing the corresponding station numbers to be inserted into those cells;
- IØV = control parameter indicating that the array is to be overwritten; and
- MAP = a positive value will print a map showing the nearest station for each cell.

```
      SUBROUTINE FILLA
C
C *** FOR EACH CELL NO(I,J) HAVING A POSITIVE VALUE (DEPTH IN METRES)
C *** SUBROUTINE CALCULATES IN CELL UNITS THE (DISTANCE)**2 TO EACH
C *** STATION AND DETERMINES THE NEAREST STATION.
C *** IF THERE IS ANOTHER STATION AT ESSENTIALLY THE SAME DISTANCE
C *** FROM THE CELL AS THE NEAREST STATION,THEN THE PSEUDO-RANDOM
C *** SIGN OF THE CONSTANT RAN DETERMINES THE CHOICE BETWEEN
C *** STATIONS FOR THAT CELL.
C
C *** THIS VERSION OF FILL IS USED TO PREVIEW AND CHANGE
C *** THE STATION INFLUENCE OF A CRUISE
C
      INTEGER RAN,ZBO
      DIMENSION II(5), JJ(5), KC(5)
      COMMON /S/ ZBO(48,57),ISOUND,IMAX,JMAX,IN,IOV,MAP
      COMMON /VARS/ NSTAT(250),ISTAT(250),JSTAT(250),NO(150)
      WRITE (61,120)
      REWIND 22
      READ (22)
      RAN = 1
      DO 70 J=1,JMAX
      READ (22) (NO(M),M=1,IMAX)
      DO 60 I=1,IMAX
      IF (NO(I).NE.0) GO TO 20
      ZBO(I,J) = -1000
      GO TO 60
   20 MINDSQ = 1000000
      DO 50 K=1,IN
      RAN = -RAN
      IMIS = I-ISTAT(K)
      JMJS = J-JSTAT(K)
      KDISSQ = IMIS*IMIS+JMJS*JMJS
      IF (KDISSQ-MINDSQ) 40,30,50
   30 IF (RAN) 40,40,50
   40 MINDSQ = KDISSQ
      KNEAR = K
   50 CONTINUE
      ZBO(I,J) = KNEAR
   60 CONTINUE
   70 CONTINUE
C
C *** IF SOME CELLS OF THE WEIGHTED ARRAY ARE TO BE
C *** OVERWRITTEN, CARDS CONTAINING THIS INFORMATION
C *** ARE READ IN HERE
C
      IF (IOV.EQ.0) GO TO 100
   80 READ (60,130) (II(L),JJ(L),KC(L),L=1,5),IND
      IF (IND.EQ.1) GO TO 100
      DO 90 M=1,5
      I = II(M)
      J = JJ(M)
      IF (I.EQ.0) GO TO 90
      ZBO(I,J) = KC(M)
   90 CONTINUE
      GO TO 80
C
C *** MAP GREATER 0 WILL GIVE A MAP SHOWING THE NEAREST STATION
C *** FOR EACH CELL
C
  100 IF (MAP.EQ.0) RETURN
      L = JMAX
      WRITE (61,140)
  110 WRITE (61,150) (ZBO(K,L),K=1,44)
      L = L-1
      IF (L.GT.0) GO TO 110
      RETURN
C
  120 FORMAT (1HQ)
  130 FORMAT (5(3I5),4X,I1)
  140 FORMAT (1H1)
  150 FORMAT (1H0,44I3)
      END
```