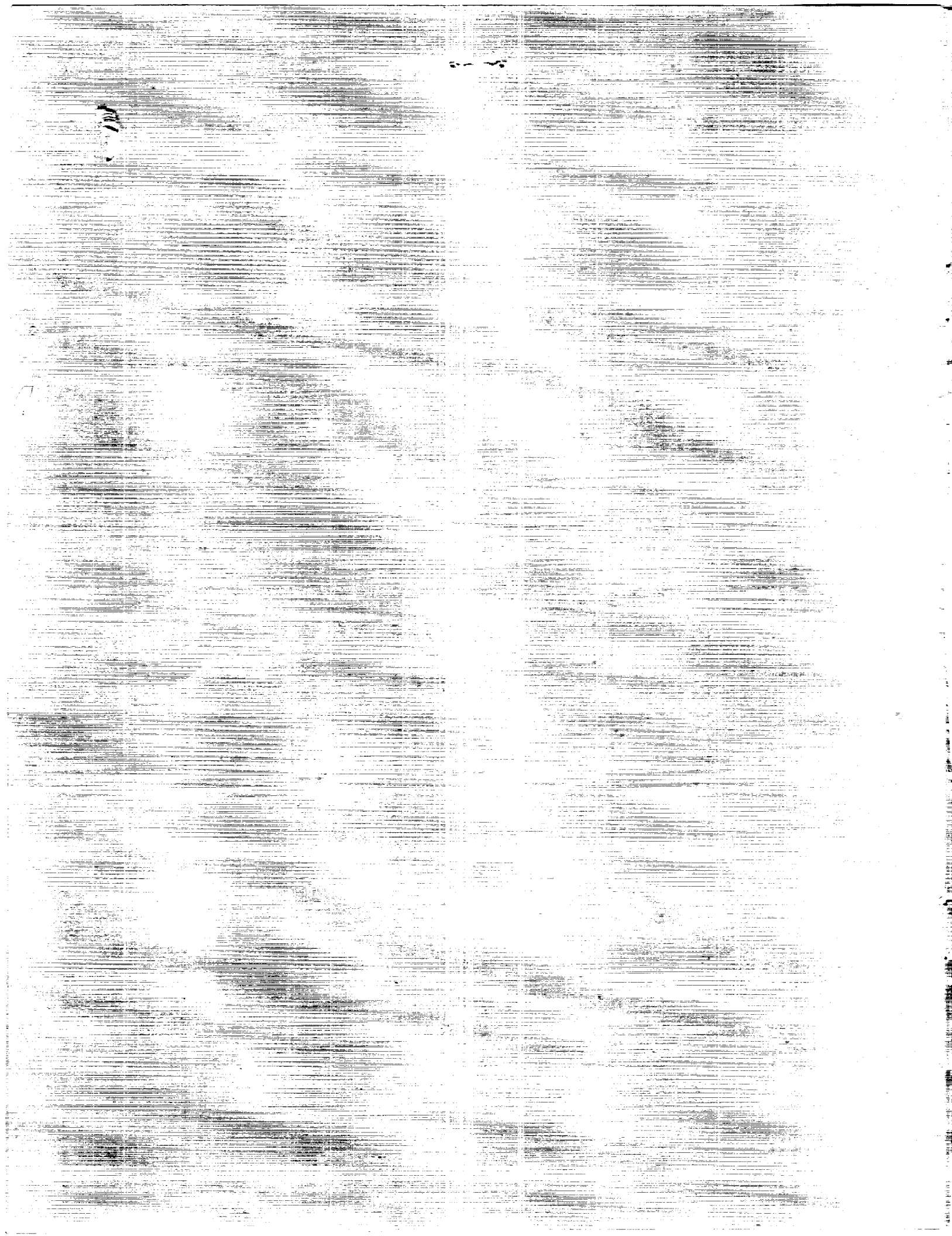# Satellite Radar Altimetry Over Ice

Volume 4—Users' Guide for Antarctica Elevation Data From Seasat

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Satellite Radar Altimetry Over Ice

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PREFACE

A gridded surface-elevation data set and a geo-referenced data base for the Seasat radar altimeter data over Greenland are described in this volume. It is intended to be a "user's guide" to accompany the data provided to data centers and other users. The grid points are on a polar stereographic projection with a nominal spacing of 20 km. The gridded elevations are derived from the elevation data in the geo-referenced data base by a weighted fitting of a surface in the neighborhood of each grid point. The gridded elevations are useful for the creating of large-scale contour maps, and the geo-referenced data base is useful for regridding, creating smaller-scale contour maps, and examinating individual elevation measurements in specific geographic areas. Tape formats are described, and a FORTRAN program for reading the data tape is listed and provided on the tape. For more details of the data processing procedures and corrections that were derived and applied to the data, see Volume 1 of this series.

SECTION 1.0

INTRODUCTION

This volume is the second in a series documenting the data-processing methods and ice data products derived from satellite radar altimeter measurements over the ice sheets of Greenland and Antarctica and surrounding sea ice. A gridded elevation data set and a geo-referenced data base for the Seasat radar altimeter data over Greenland are described in this volume. It is intended to be a "user's guide" to accompany the data provided to data centers and distributed to various users on a magnetic tape. The gridded elevations are useful for creating large-scale contour maps, and the geo-referenced data base is useful for regridding, creating smaller-scale contour maps, and examinating individual elevation measurements in specific geographic areas. For more details of the data processing procedures and corrections that were derived and applied to the data, see Volume 1 of this series.

The gridded elevations are on a polar stereographic projection with a nominal spacing of 20 km between grid points. The gridded elevation value for each grid point is derived from the geo-referenced data base by a weighted fitting of a biquadratic function (or a bilinear function) to the elevation data that fall within a certain radius of the grid location. The geo-referenced data base contains surface elevations ordered in geographic bins.

The input Seasat radar altimeter data, in the form of Geophysical Data Records (GDR's) and Sensor Data Records (SDR's) produced by NASA's Seasat project at the Jet Propulsion Laboratory, was obtained from the NOAA Environmental Satellite Data and Information Service (EDIS) archive on about 1000 magnetic tapes. Development of the data processing methods, the production of higher-level geophysical data products, and analysis and evaluation of the data have been supported at the Goddard Space Flight Center by funding for research and data analysis, provided primarily by NASA's Ocean Processes Program and by the Climate program. Computer programming and technical assistance has been provided by the EG&G Washington Analytical Services Center, Inc. through December 1988 and by ST Systems Corporation since January 1989. Numerous other individuals have provided valuable assistance.

Results have been reported in refeered scientific literature (e.g., Brenner et al., 1983; Martin et al., 1983; Zwally et al., 1983; Thomas et al., 1983; and Gundestrup et al., 1986). In addition, elevation data in various forms have been provided to other scientists and placed in the National Snow and Ice Data Center (NSIDC) and the National Space Science Data Center (NSSDC). The purpose of this series of reports is to document technical details and provide guidance to users of the ice data products.

While all reasonable quality-control efforts have been made to eliminate erroneous data, some data of questionable quality is likely to have persisted, particularly in the lower-level data products. Users should apply normal standards of scientific caution in their use of the data.

The current list of reports is:

<u>Satellite Radar Altimetry over Ice,Volume 1: Processing and Corrections of Seasat Data over Greenland</u>, July 1989. NASA Ref. Publ. _____.

<u>Satellite Radar Altimetry over Ice, Volume 2: User's Guide for Greenland Elevation Data from Seasat</u>, July 1989. This volume.

<u>Satellite Radar Altimetry over Ice, Volume 4: User's Guide for Antarctica Elevation Data from Seasat</u>, July 1989. NASA Ref. Publ. _____.

Volume 3 will be the Antarctic equivalent of Volume 1. Additional volumes will include descriptions of the data sets being produced by NASA from the radar altimeter data acquired by the U.S. Navy's GEOSAT, using methods similar to those for the Seasat data.

The Seasat spacecraft (e.g., Lame and Born, 1982 and Lame et al., 1980) was launched in late June 1978, and during its brief, 110-day lifetime, collected 90 days of nearly continuous radar altimeter data from July 9 through October 10 between the latitudes of 72°S and 72°N. Although designed only for measurements over water, the Seasat radar altimeter (MacArthur, 1978; Tapley et al., 1982; and Townsend, 1980), acquired more than 600,000 useful altimeter range measurements over the continental ice sheets of Greenland and Antarctica.

Over sloping and undulating surfaces, such as ice covered land, or surfaces with highly variable reflecting characteristics, such as in regions of sea ice, the range to the surface and the characteristics of the received radar pulse changed faster than the response capability of the altimeter electronics. Consequently, it has been necessary to correct each range value for lags of the altimeter range servo-tracking circuitry by a procedure called retracking (Martin et al., 1983). The retracking correction typically had a mean value of + 1.4 m as applied to the surface elevation, a standard deviation of 2.9 m, and maximum and minimum values of ± 15 m. In addition, the pulse-limited footprint (1.6 km minimum diameter), which was located near the satellite nadir point over the relatively flat ocean, was in general located anywhere within the beam-limited footprint (22 km in diameter) over sloping surfaces. The resulting slope-induced error, which was nearly 80 m over slopes of 0.8 degree, can be partially corrected using the procedures described in Brenner et al., 1983. Corrections are also made for errors in orbit determination, atmospheric propagation path-length variations, and earth and ocean tides.

Elevation measurements were obtained at 0.1-sec intervals, corresponding to 662 m intervals along the subsatellite ground track. The precision of the corrected range measurements is about 1.6 m overall with a minimum of about 0.25 m in the smoothest regions of the ice sheets (Zwally et al., 1983). The 5- to 10-cm precision over the ocean is for 1-sec data averages. The absolute accuracy of the elevations is primarily determined by the limitations on the correction methods for the slope-induced errors and by uncertainties in the geoid reference level.

The principal ice data sets produced and retained are:

Level 4: Contour maps and gridded elevations with respect to earth ellipsoid and sea level (e.g., this volume and Volume 2).

Level 3: Geo-referenced data base including all individual elevation measurements (including time, latitude/longitude positions, and slope-correction estimates) accessible by geographic cells (e.g., this volume and Volume 2).

Level 2: Ice Data Records (IDR's). Orbital-format data records including altimeter parameters, corrected elevations, latitude/longitude positions, AGC, applied corrections, retracking beta parameters, and estimates of along-track and cross-track slope corrections. (See Volumes 1 and 3.)

Level 1: Waveform Data Records (WDR's). Orbital-format data records including waveform amplitudes by gate, ranges, AGC, and latitude/longitude positions. (See Volumes 1 and 3.)

Altimeter Sensor Data Records (SDR's)

The magnetic tape with the gridded elevation and geo-referenced data base was generated on an IBM 3081. The data sets are contained on several files of this unlabeled, 6250-bpi tape. The geo-referenced data base is written on the first two files (see Tables 2 and 3). A FORTRAN program, which can be used to unload and read the data base on files 1 and 2 on the IBM 3081, is written on file 3 in ASCII. A listing of this source may also be found in the Appendix. The elevation grid over the Antarctic ice sheet is written on files 4 and 5 (see Tables 4 and 5). It is important to note that the elevations in the data base are relative to the ellipsoid, while the grid elevations are relative to sea level. The Goddard Earth Model 10-B (GEM10-B) geoid grid which

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was used to obtain elevations relative to sea level is written on files 6 and 7 (see Tables 6 and 7). File 8 contains detailed information in ASCII concerning the location of various revs and the number of points in the geo-referenced data base in order of geographical area. File 9 contains a narrative description of the tape including the version number, dates of the data, and specific information on the sources used to reduce the raw data to surface measurements and grid values (see Table 8). All files except files 3, 8 and 9 have been written in IBM binary integer format. Blocksizes vary for each file and are given in the tables of file descriptions.

SECTION 2.0

GEO-REFERENCED DATA BASE

The geo-referenced data base contains surface height measurements derived from Seasat altimetry data, ordered by geographic areas or "bins". The distribution of the Seasat data used in the data base is shown in Figure 1. Figures 2 through 9 show the configuration of the 36,180 bins in the vicinity of Antarctica. Bin sizes vary in order to compensate for the higher data density near Seasat's maximum extent in latitude. Each bin is assigned a number starting with 1 at the Greenwich meridian. Bin numbers increment first in an eastward direction and then from south to north. The starting bin numbers for each row are indicated in the left margin of the map in the figures, while the number of data points is printed within the appropriate bin. Table 1 is a sample page of the information contained on file 8 of the tape and summarizes the number of points and the rev numbers found in each bin, along with the geo-referenced coordinates of the southwestern-most corner of the bin. Only bins which contain data are listed on file 8 of the tape. The table is written as fixed block in ASCII with a record length of 132 bytes and blocksize of 19,008 bytes.

The geo-referenced data base is structured such that the data are ordered first by bin number and then by time within each bin. Each data point within each bin contains information relating to the position, rev number, surface height relative to the ellipsoid, slope correction and orbit adjustment. Corrections which have been applied to the surface elevations are indicated by the altimetry data status word in the data base header record found on file 1 of the accompanying tape. A detailed explanation of all the corrections may be found in Reference 5. The orbit adjustment has been applied to the surface elevation when it was available. Records for which the orbit adjustment is unavailable (as indicated by a value of -999999999 in bytes 21-24) have the unadjusted surface elevation in bytes 9-12. The user should be aware that using all the surface elevation values without checking if the orbit adjustment was valid or not will result in an inconsistent data set. The slope correction values are supplied on each data record but have not been applied to the surface elevation. The orbit adjustment will improve on the radial accuracy of the orbit. The slope correction will compensate for the fact that the original altimeter height is measured to the closest point within the radar beam, which is not necessarily the subsatellite point. When the slope correction is unavailable a value of –999999999 is placed in that field. In order to obtain a slope corrected surface elevation relative to the ellipsoid the following algorithm would be used:

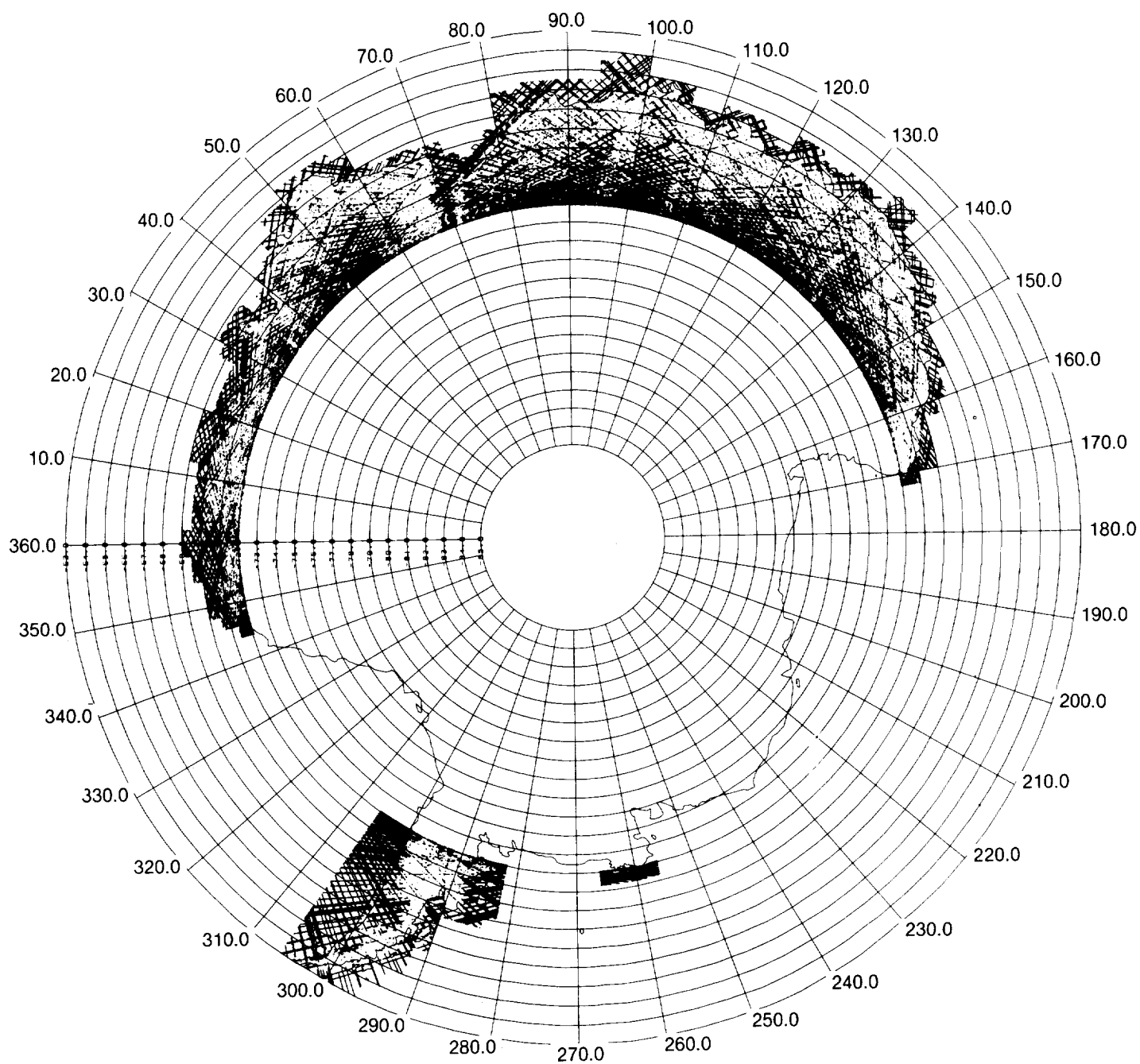$$\Delta H_{COR} = H_{DB} - \Delta H_{SLOPE} \qquad (1)$$
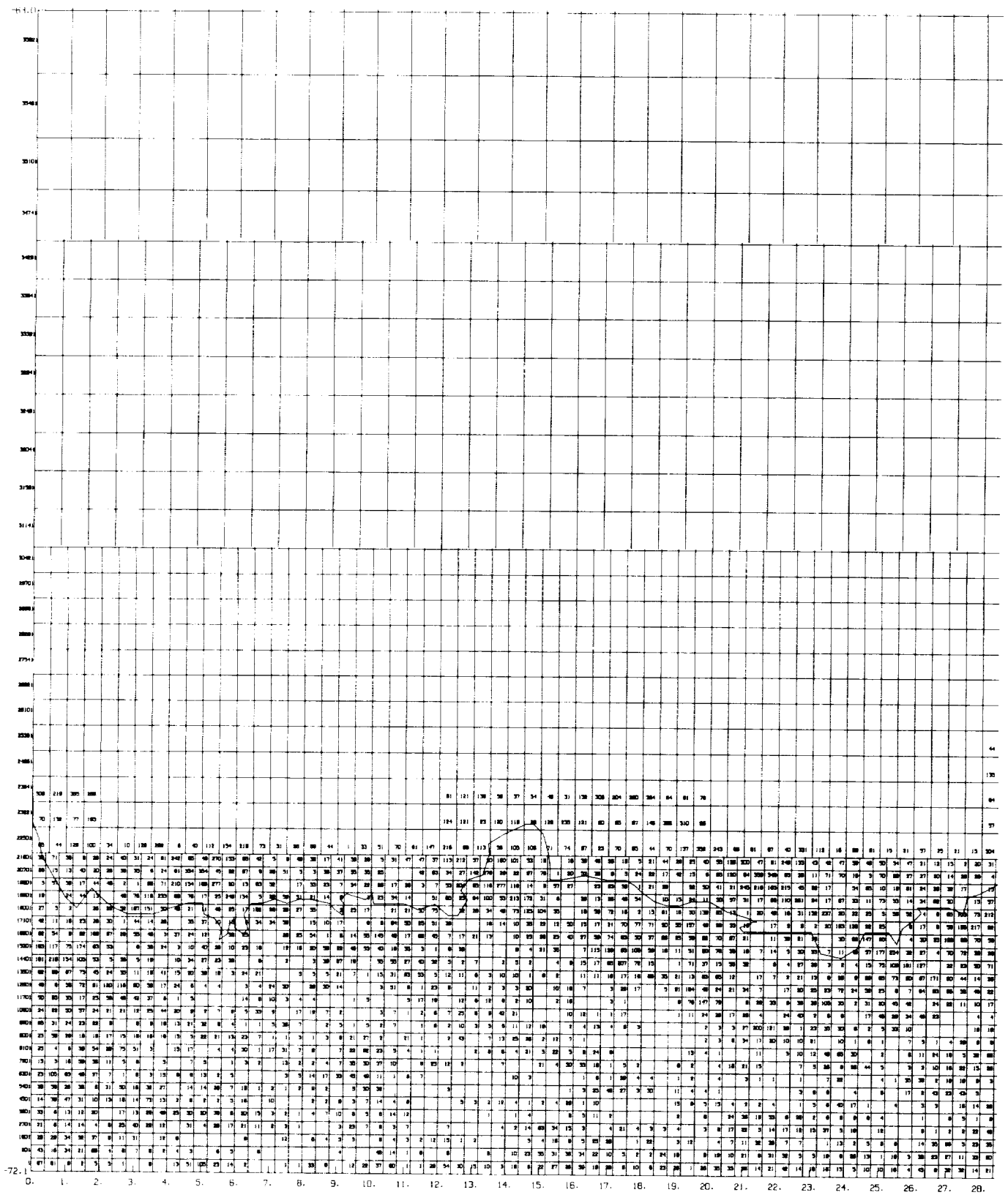
Figure 1. Seasat Antarctic Groundtracks.

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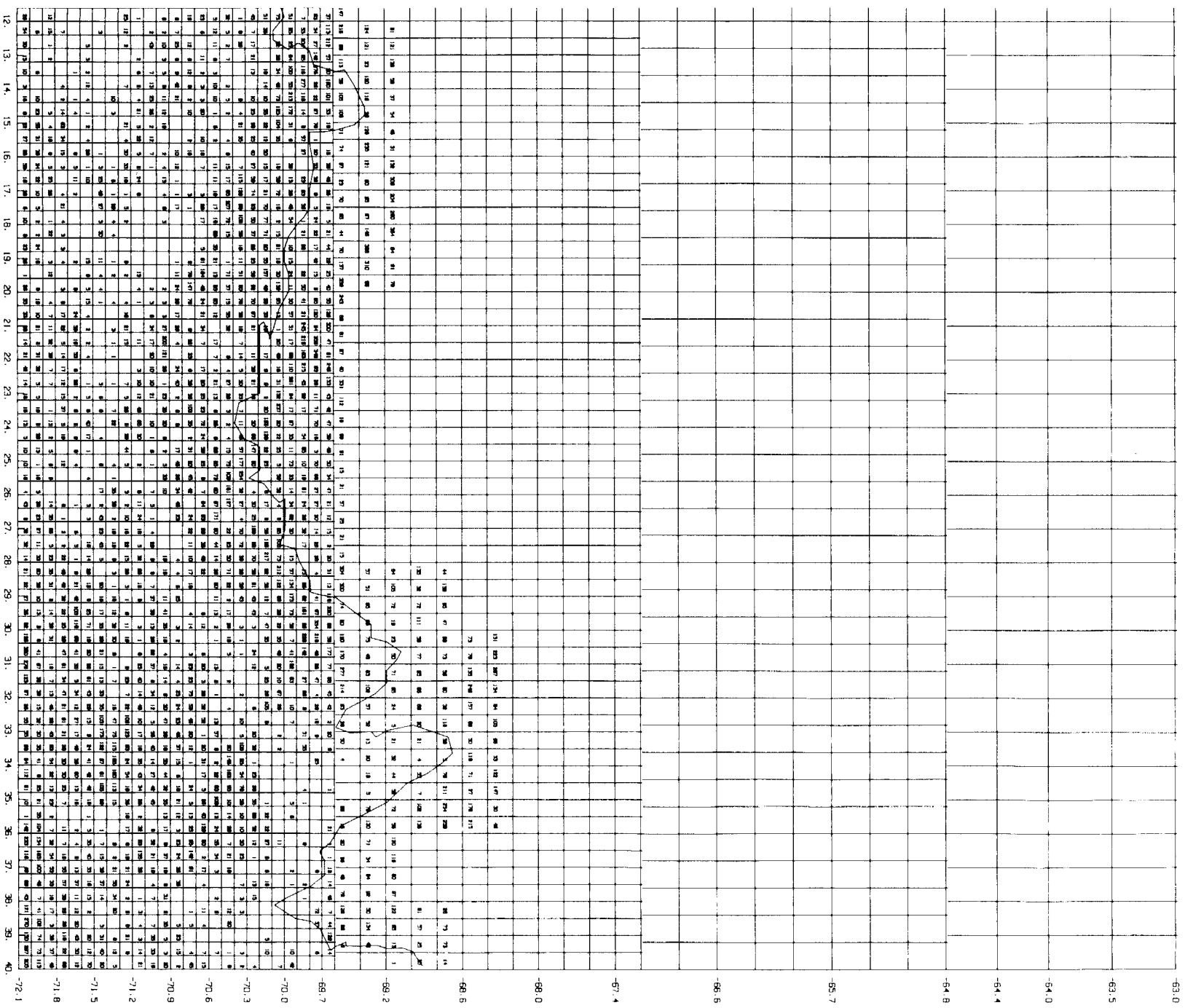
Figure 2. Seasat Antarctic Geo-referenced Data Base Configuration: 0°E-40°E.
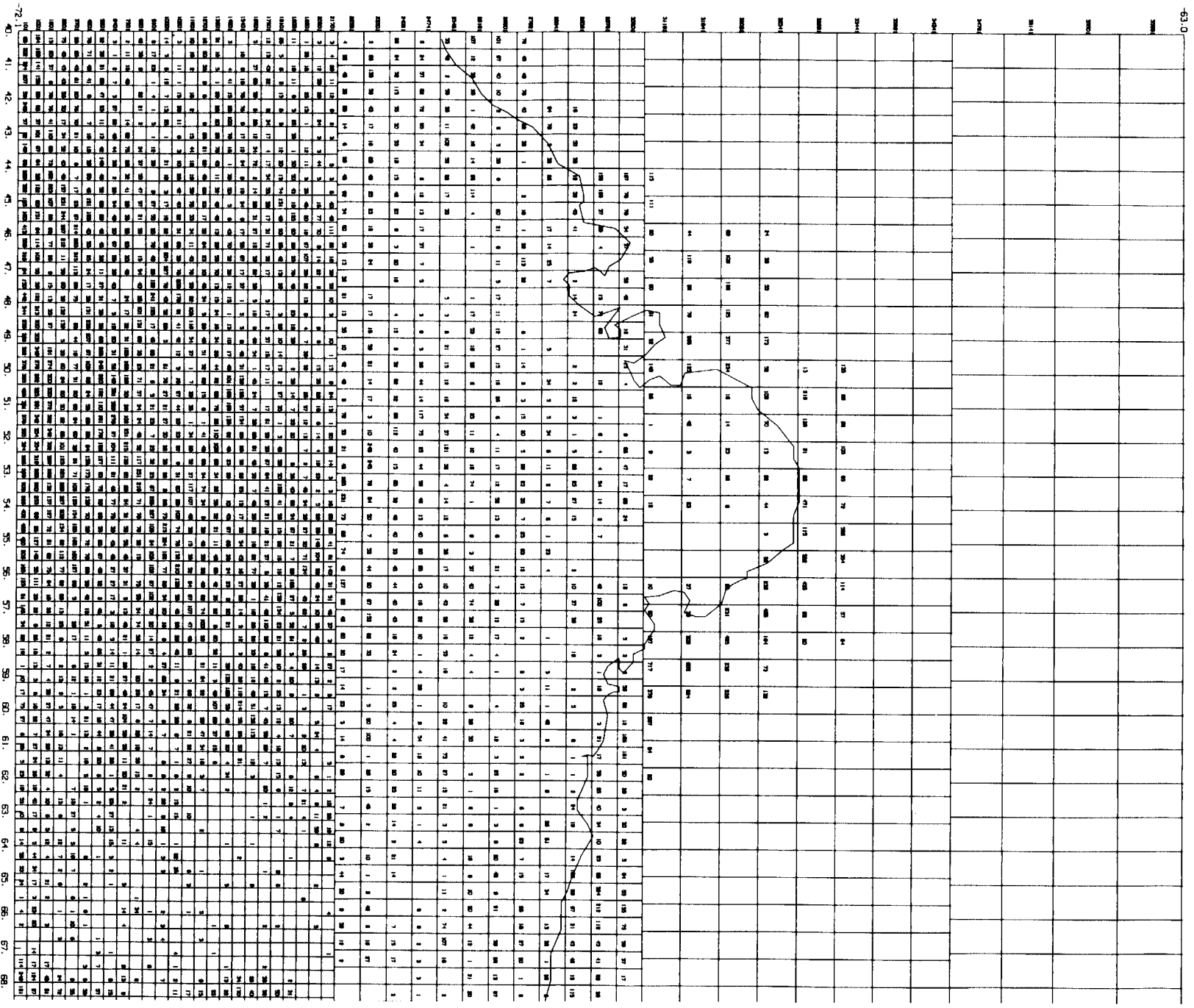
Figure 3. Seasat Antarctic Geo-referenced Data Base Configuration: 40°E-80°E.

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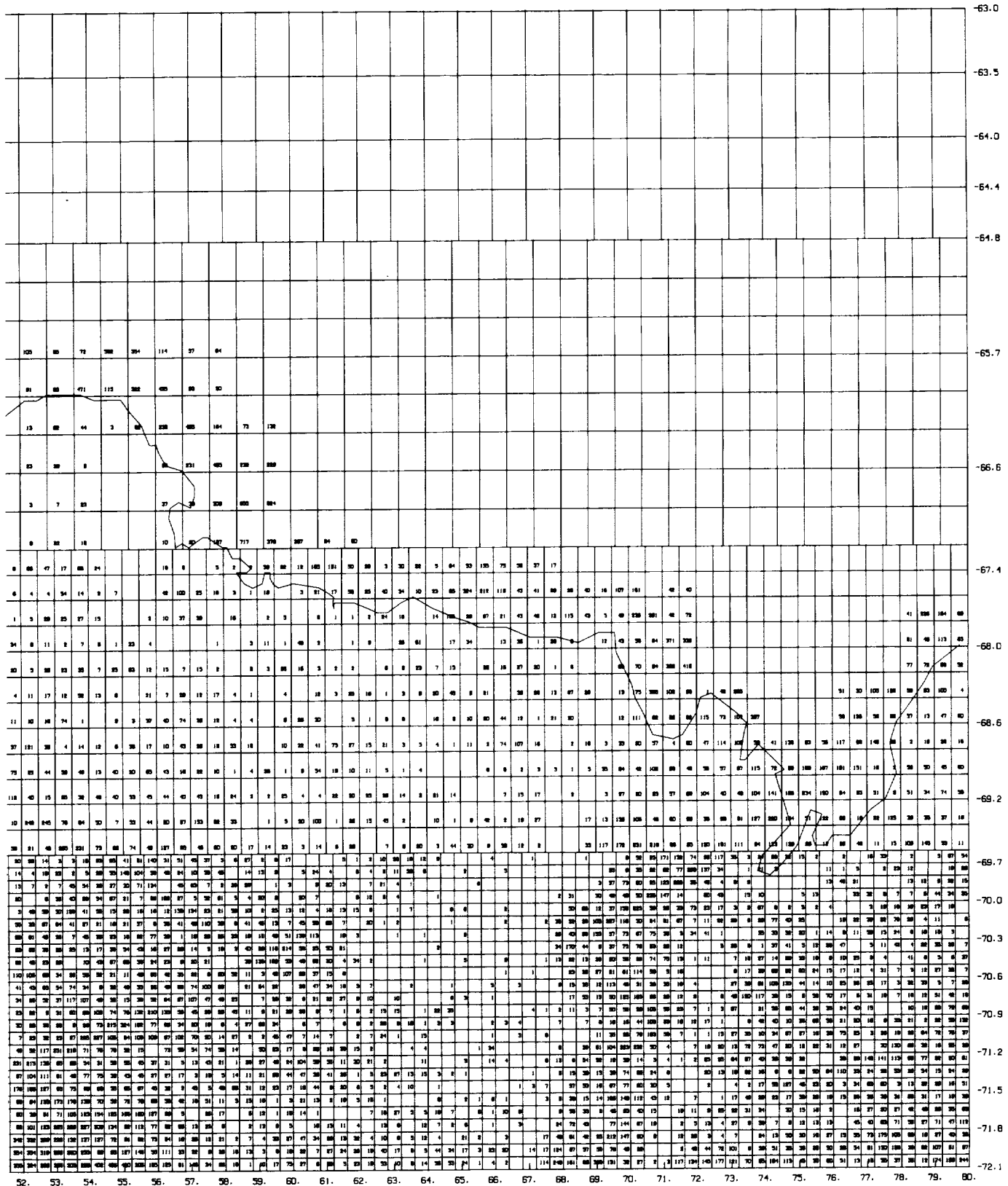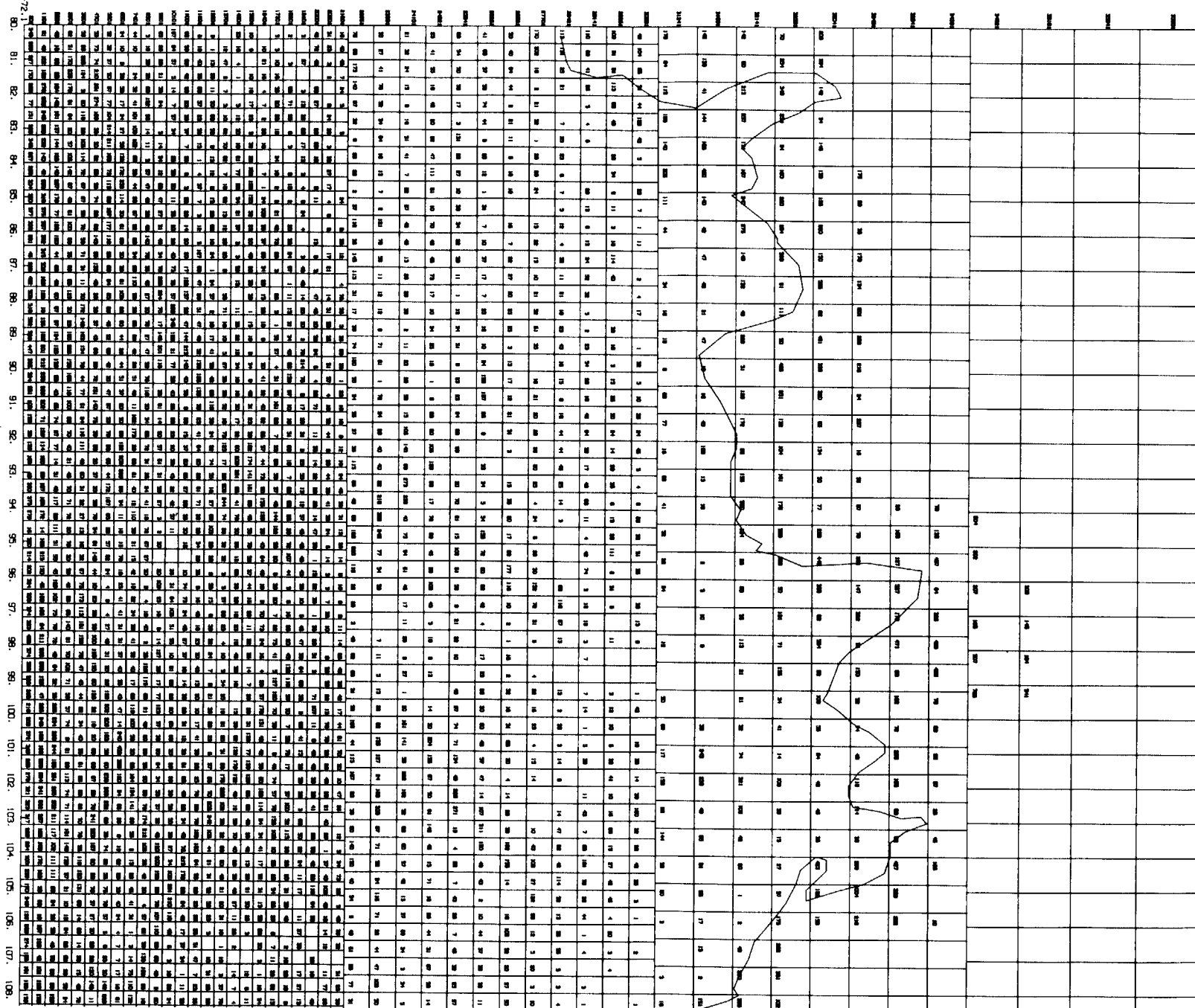
Figure 4. Seasat Antarctic Geo-referenced Data Base Configuration: 80°E-120°E.

12
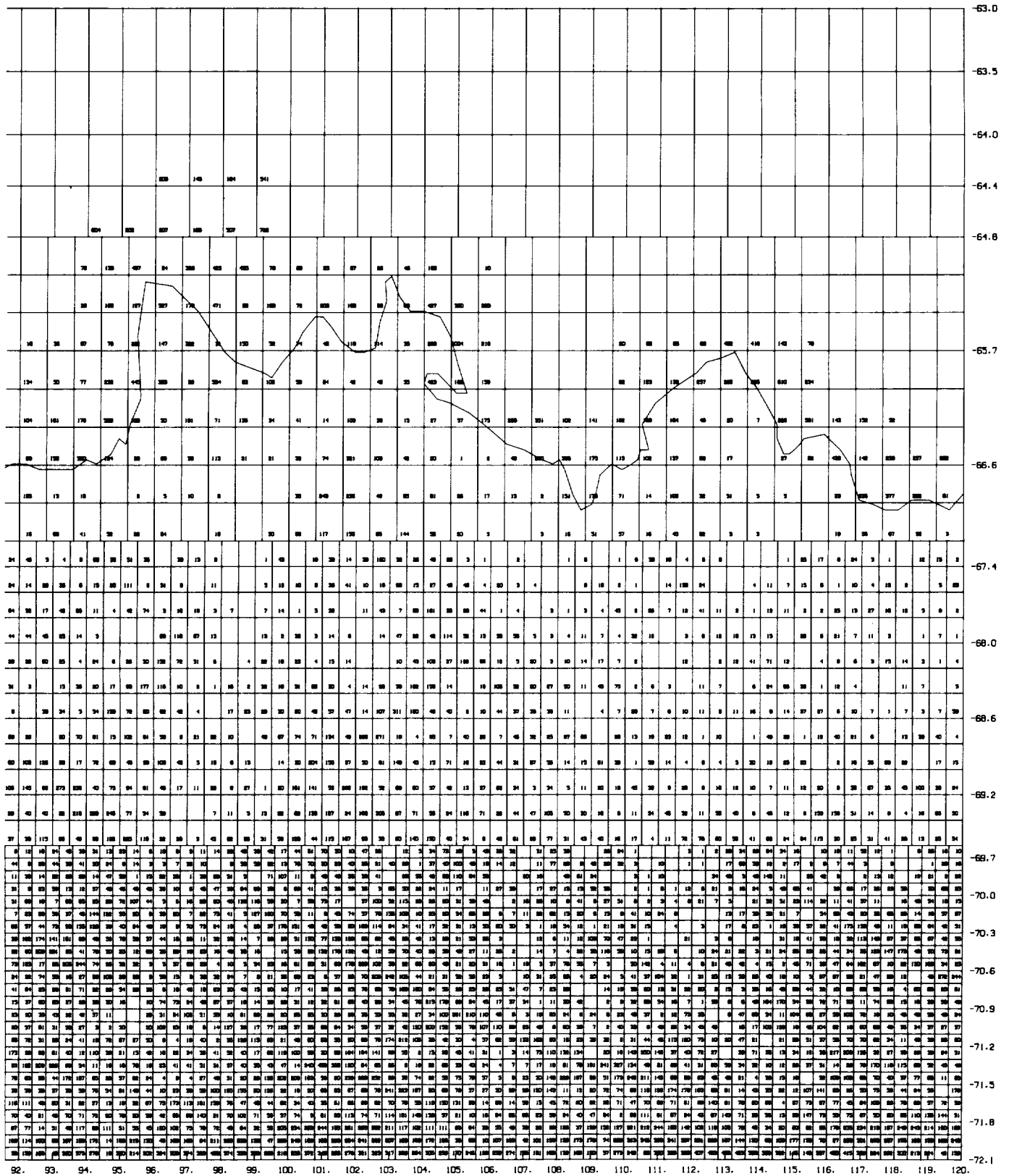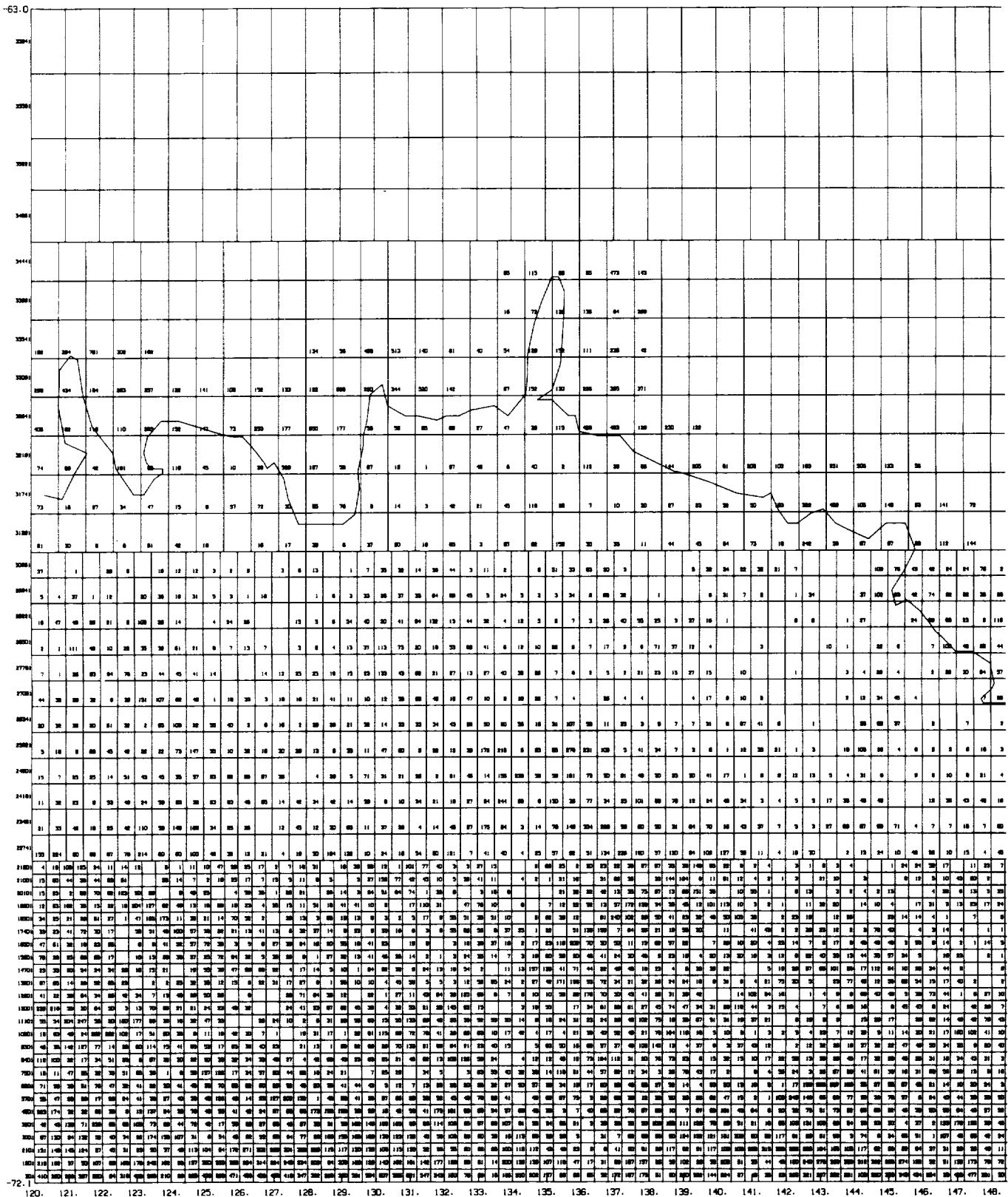
Figure 5. Seasat Antarctic Geo-referenced Data Base Configuration: 120°E-160°E.
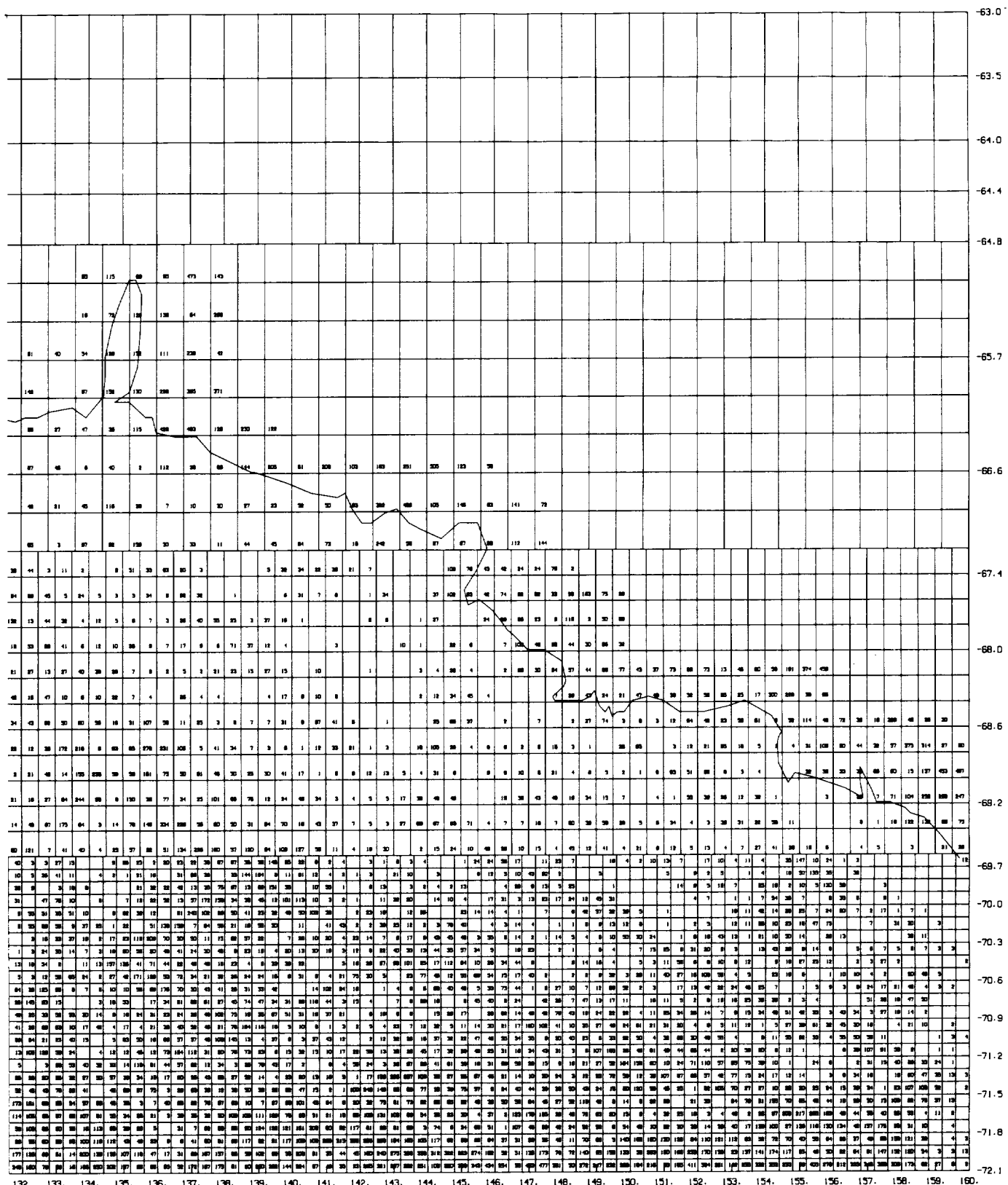
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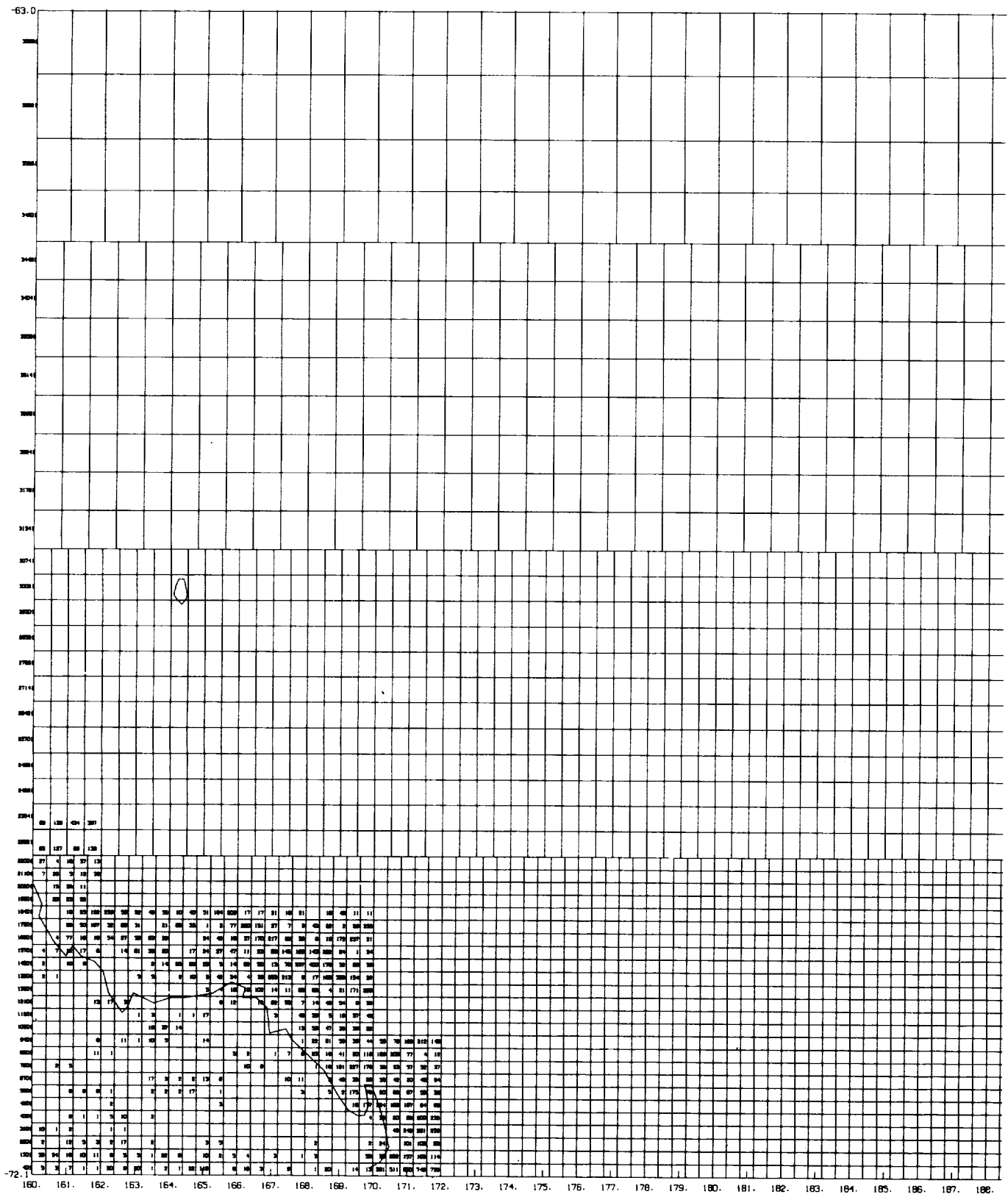
Figure 6. Seasat Antarctic Geo-referenced Data Base Configuration: 160°E-200°E.

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Y-axis (right): -63.0, -63.5, -64.0, -64.4, -64.8, -65.7, -66.6, -67.4, -68.0, -68.6, -69.2, -69.7, -70.0, -70.3, -70.6, -70.9, -71.2, -71.5, -71.8, -72.1

X-axis (bottom): 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200.

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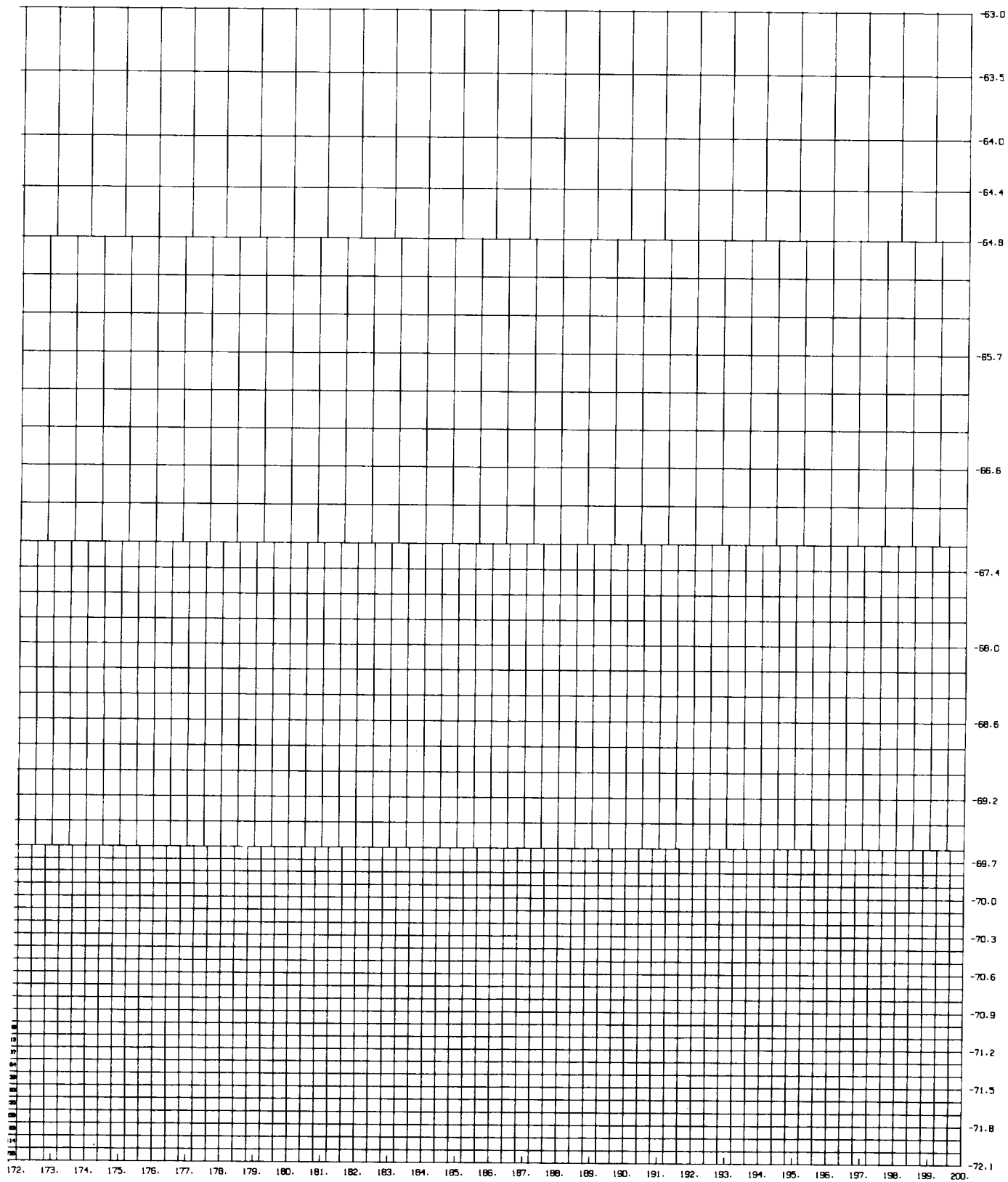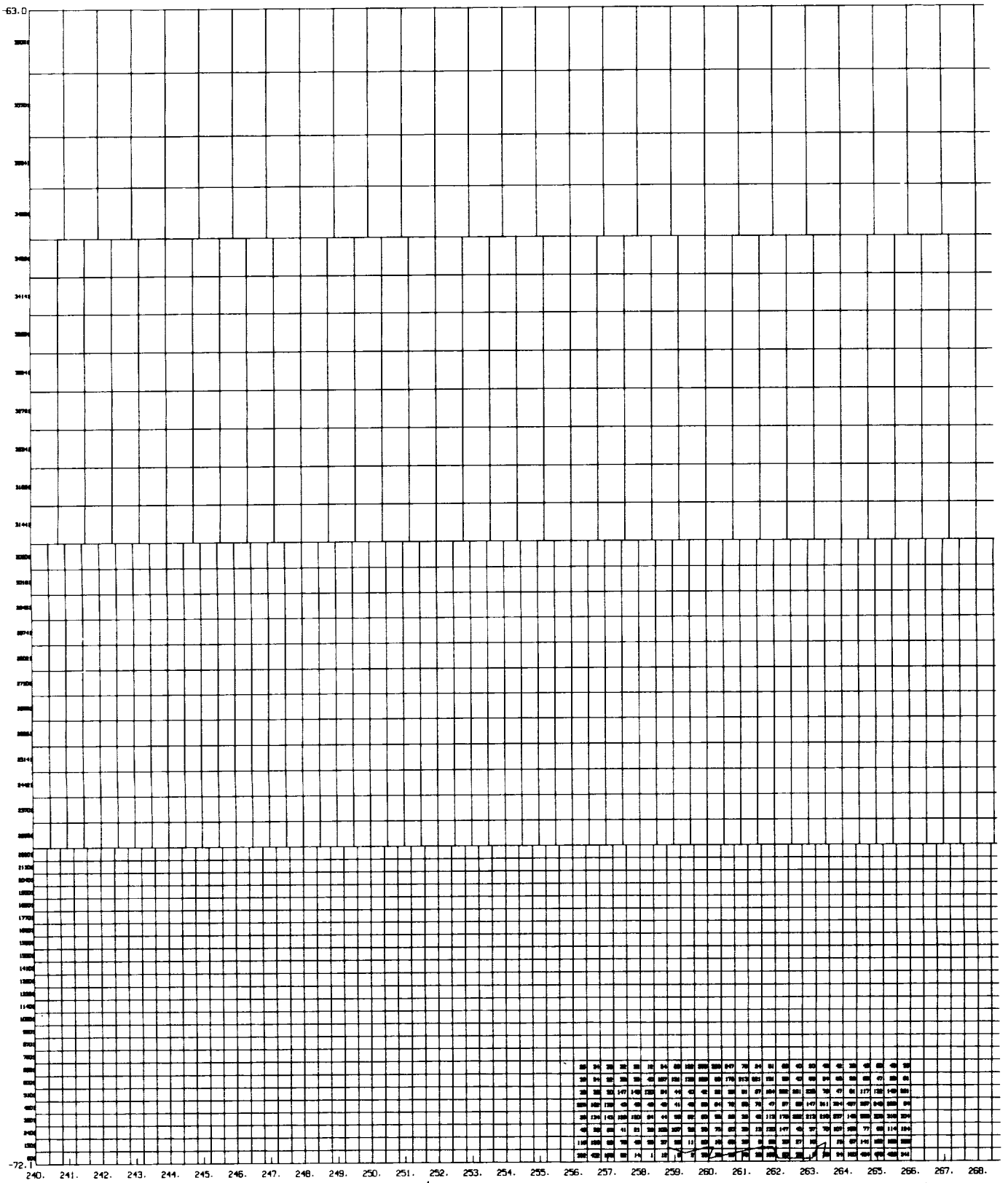
Figure 7. Seasat Antarctic Geo-referenced Data Base Configuration: 240°E-280°E.

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-63.0
-63.5
-64.0
-64.4
-64.8
-65.7
-66.6
-67.4
-68.0
-68.6
-69.2
-69.7
-70.0
-70.3
-70.6
-70.9
-71.2
-71.5
-71.8
-72.1

252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280.

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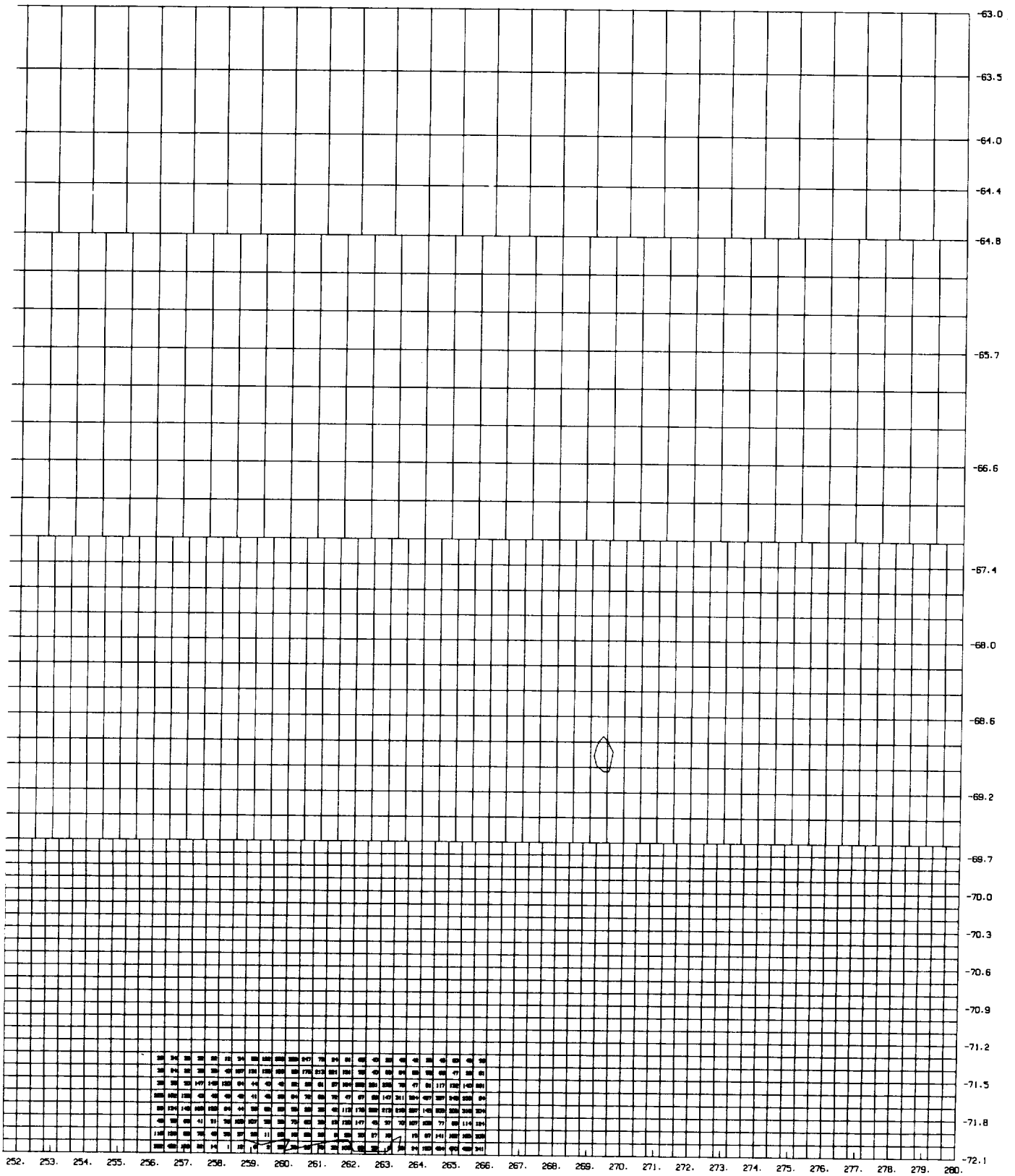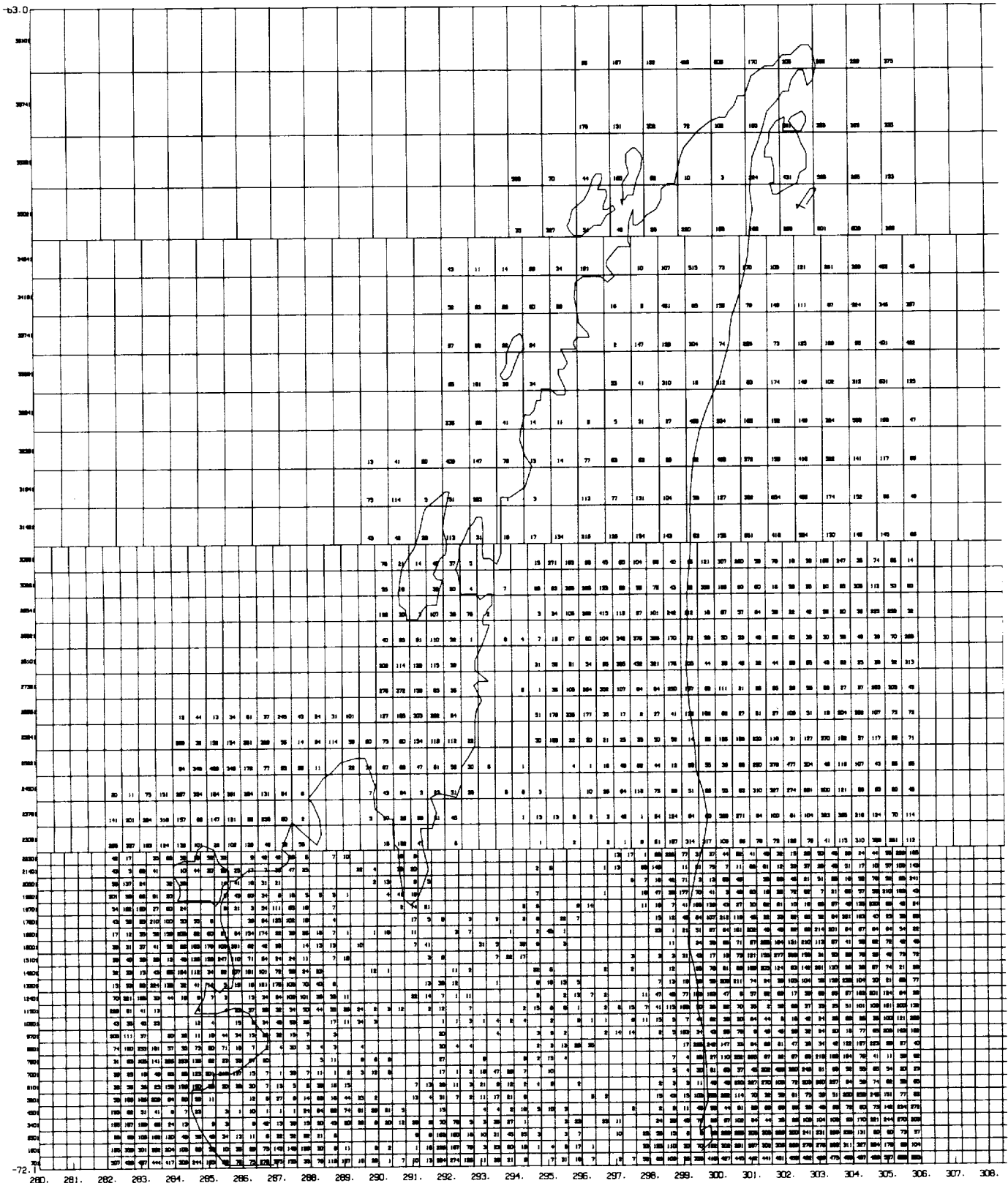
Figure 8. Seasat Antarctic Geo-referenced Data Base Configuration: 280°-320°E.

Right axis (latitude): -63.0, -63.5, -64.0, -64.4, -64.8, -65.7, -66.6, -67.4, -68.0, -68.6, -69.2, -69.7, -70.0, -70.3, -70.6, -70.9, -71.2, -71.5, -71.8, -72.1

Bottom axis (longitude): 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320.
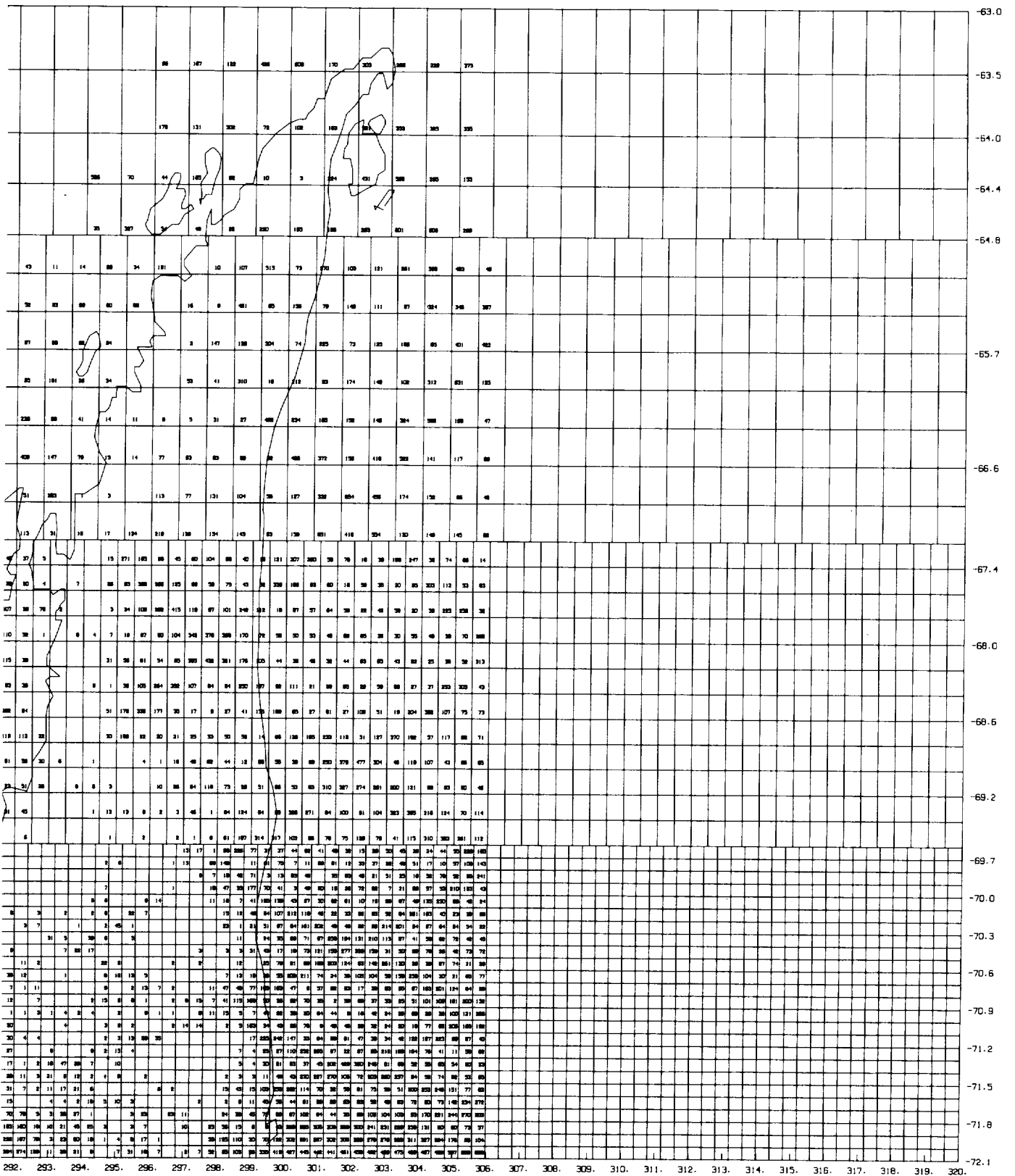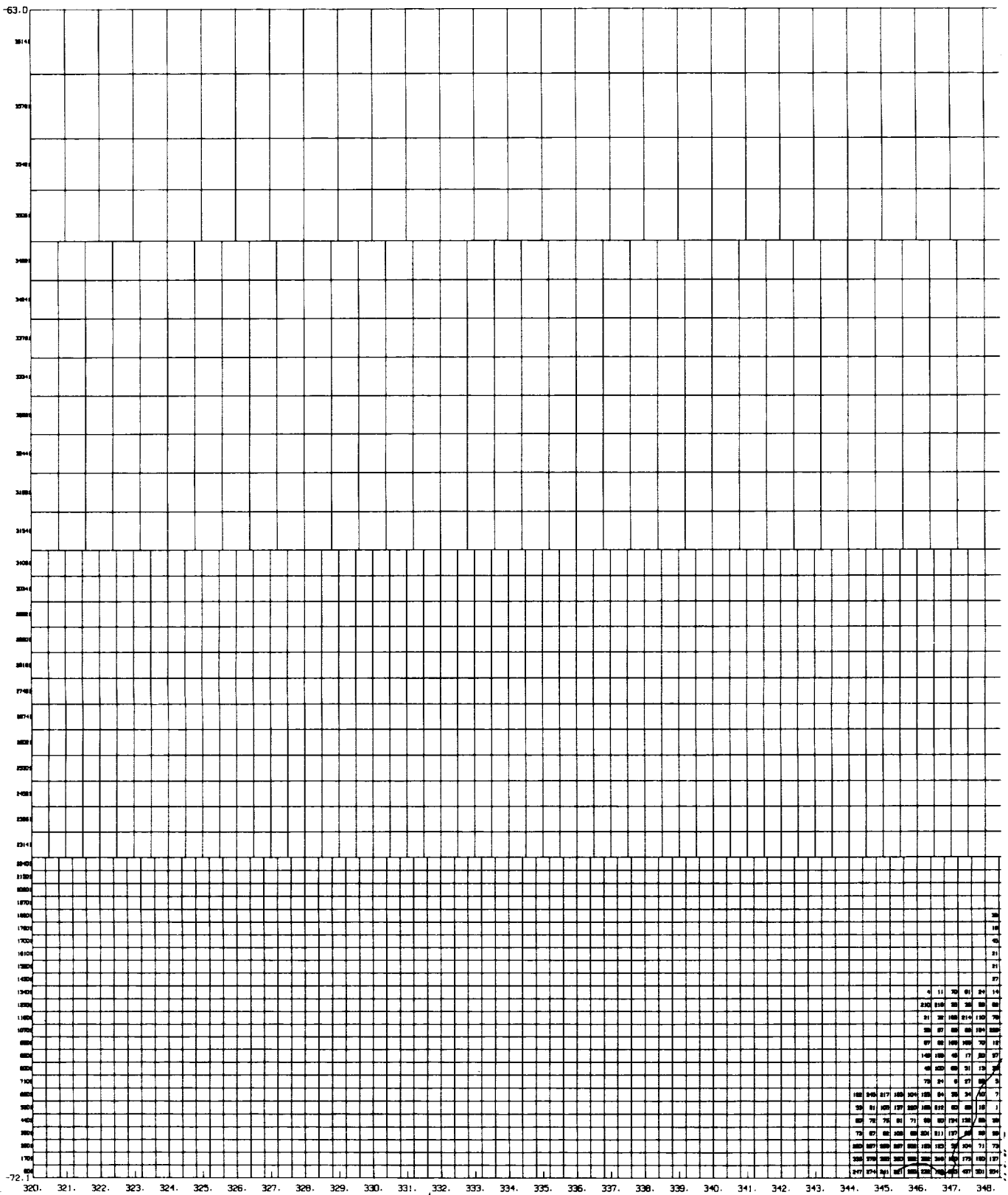
Figure 9. Seasat Antarctic Geo-referenced Data Base Configuration: 320°E-360°E.

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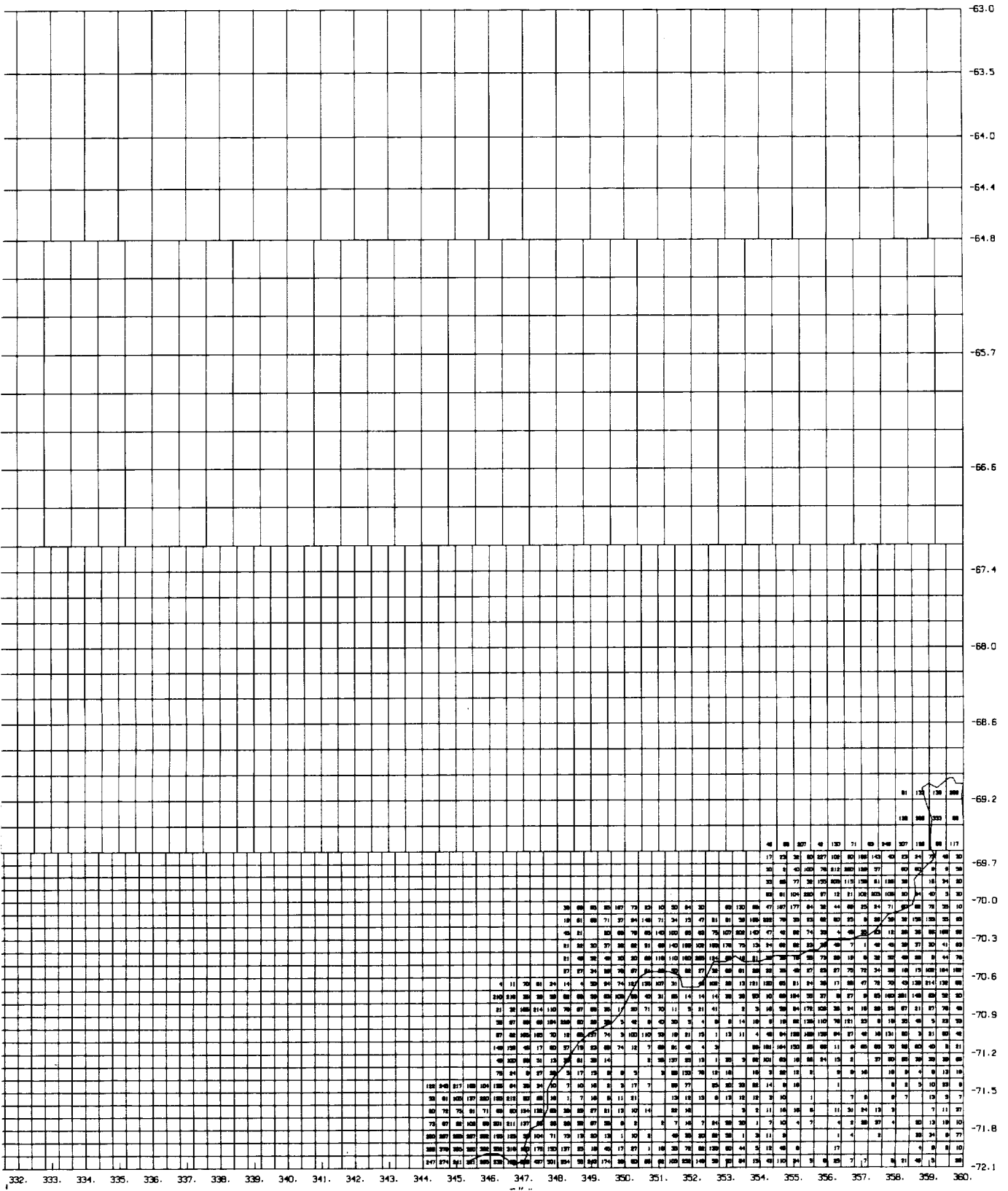
where

ΔH_{COR}	is the surface elevation with the slope correction applied
H_{DB}	is the surface elevation in the data base
ΔH_{SLOPE}	is the slope correction.

To remove the orbit adjustment the following algorithm should be used:

$$\Delta H_{UNADJ} = H_{DB} + \Delta H_{ORB} \qquad (2)$$

where

H_{UNADJ}	is the surface elevation without the orbit adjustment
H_{DB}	is the surface elevation in the data base
ΔH_{ORB}	is the orbit adjustment

The data base is designed to be used on a direct-access device, so that data from one or several bins may be accessed without the need to read all the records prior to the location desired. This is achieved by dividing the data base into three sections.

The first section of the data base, a header which may be found on file 1 of the accompanying tape, gives a summary of its configuration: the locations of the corners of the data base, the number of latitude rows, the width in degrees of each of these rows, and the number of longitude divisions in each row. These pieces of information give the layout of the data base, as depicted in Figures 2 through 9. Information pertaining to the size of the data base, the starting record of the bin directory, and the corrections applied to the data are also contained in this header.

Following the header and contained on file 2 of the tape are the altimetry data ordered by bin number and within each bin by time. The altimetry data are subdivided into two subgroups for each bin which contains data. The first subgroup consists of one logical record which indicates the number of data points contained in the bin. The second subgroup consists of the actual altimetry data (position, rev number, surface height, orbit adjustment and slope correction), with each record corresponding to a data point.

The final section, a bin directory also contained on file 2, starts at the logical record indicated in the data base header. The directory contains an entry for each bin, and starting with the first bin, indicates the record number in the data base at which the start of the data from a particular bin may be found. Bins which contain no data have a zero entered in the directory. Tables 2 and 3 summarize the structure of the data base header and data base in greater detail.

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The data base may be used to locate data within any desired area. The following example demonstrates how this may be done. The limits of the desired area are used in conjunction with the header information to determine exactly which bin numbers contain the data. Using the southernmost latitude of the desired area along with the width of the latitude rows, establishes the southernmost row which contains the data. Longitude limits of the desired area are then checked in conjunction with the size and location of the longitude divisions in that row. When the longitude limit of the desired area for that latitude group is exceeded, the process starts again with the next latitude row to the north. These steps are repeated until the northernmost boundary limit of the desired area is reached.

Equipped with the bin numbers which contain the data, the directory, which gives the logical record on the direct-access disk at which each bin begins, is read. If the directory value for the bin is non-zero, this logical record is then read to determine the number of records which follow and are contained in the same bin. The subsequent data is then read for each bin.

Software has been developed for use on the IBM 3081 which reads the geo-referenced data base on the first two files. A program which reads and prints out the contents of every bin given the southeastern and northwestern latitude-longitude limits of a desired area is listed in the Appendix and may be found on file 3 of the accompanying tape. The file is in ASCII, is fixed-blocked with a record length of 80 bytes, and is blocked at 3,200 bytes. Latitudes should be input in degrees North and longitudes in positive degrees East. The subroutine RANDRD along with its entry point RANDWR read and write one logical record of data, respectively, utilizing a system supplied direct access FORTRAN I/O package which includes DREAD and DWRITE. The entry points BLKRD and BLKWR read and write blocks of data at a time.

SECTION 3.0
POLAR STEREOGRAPHIC ELEVATION GRID

A grid was generated using the corrected and adjusted surface elevations in the geo-referenced data base after applying the slope correction. Data for which either the orbit adjustment or slope correction were unavailable were not used for the grid. Elevations in the grid were obtained by taking data located in the vicinity of each grid point and fitting them to a bilinear or biquadratic surface to determine the surface height at the grid point. GEM 10-B geoid values were subtracted from the elevations so that they are relative to sea level (see Section 4.0).

The accompanying grid was generated in a tangent polar stereographic projection where the plane of projection is located at the geographic South Pole (the projection latitude) and is normal to the earth's axis. Figure 10a depicts the concept behind this type of projection. A straight line is drawn from the North Pole (pole of projection), through a point of the earth's surface, Q, to the projection plane which is tangential to the South Pole. The projection plane is in turn divided into square grids from the pole to the Equator with the South Pole at the center. Three projection parameters define the size of the plane and the orientation of the plane and grid size:

S — a conversion factor from half-inch grids at the projection latitude to the desired grid size;

ϕ_P — the minimum latitude extent of the map perimeter for the projection latitude located at the North Pole; the maximum latitude extent for the projection latitude located at the South Pole;

G — the Greenwich orientation in degrees.

In the case of Antarctica, where 20 km grid cells were decided as being optimum for the data distribution, values of S=1.65, ϕ_P = -50°, and G=270° were chosen.

These three parameters are sufficient to define a grid of the southern hemisphere, from the South Pole to –50° latitude where the number of grids of desired size from the pole to the Equator may be represented by:

$$D = \frac{2R}{S \times 10^6} . \tag{3}$$

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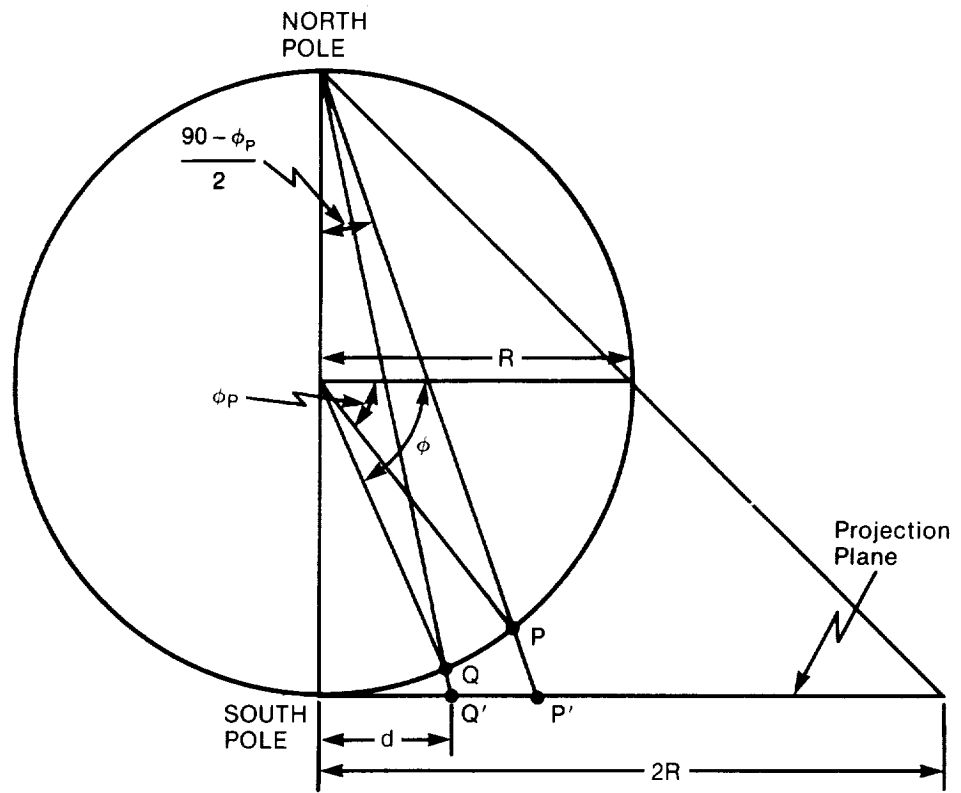
(a)
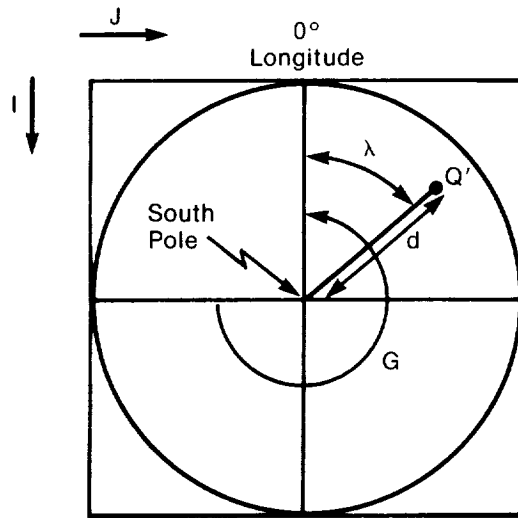
(b)

Figure 10.   Polar Stereographic Projection of Point Q with Latitude ϕ and Longitude λ onto Projection Plane with Map Perimeter -50°.

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where R is the radius of the earth measured in one half-inch grid cells and was chosen to be consistent with polar stereographic projections described in other documents.

The integer number of grids of desired size from the pole to the map perimeter is:

$$N = D \times \tan \frac{90 - |\phi_P|}{2} . \tag{4}$$

The grid, defined by I and J axes, with the origin in the upper left corner (see Figure 10b), represents the coordinates of the South Pole as:

$$Ip = N + 1 \tag{5}$$
$$Jp = N + 1 .$$

Any point with latitude ϕ and longitude λ which is located in the southern hemisphere south of ϕ_P is positioned at the following I, J coordinates:

$$I = INT[d \times A \times \cos(X) + Ip + 0.5] \tag{6}$$
$$J = INT[d \times \sin(X) + Jp + 0.5]$$

where

$$d \text{ is } D \times \tan \frac{90 - |\phi_P|}{2}$$

X is λ + G

A is +1 if $\phi_p \geq 0$

A is –1 if $\phi_p < 0$.

The included grid was generated such that smoothed heights relative to the ellipsoid are located at each of the I, J coordinates within Antarctica. Grid locations outside Antarctica and any undefined points within Antarctica are indicated by a –100000000. Figure 11 depicts a topographic map obtained from this grid contoured at 100-m intervals.

File 4 of the accompanying tape contains a grid header which gives information defining the polar stereographic projection used. File 5 contains the grid points which were obtained using either a biquadratic or bilinear fit. Details concerning the gridding procedure may be found in Reference 5. Data are stored on file 5 such that the information for ten grid points is contained in one block of data. The order of grid points is first from decreasing to increasing I, then from decreasing to increasing J. Tables 4 and 5 give detailed description of files 4 and 5.
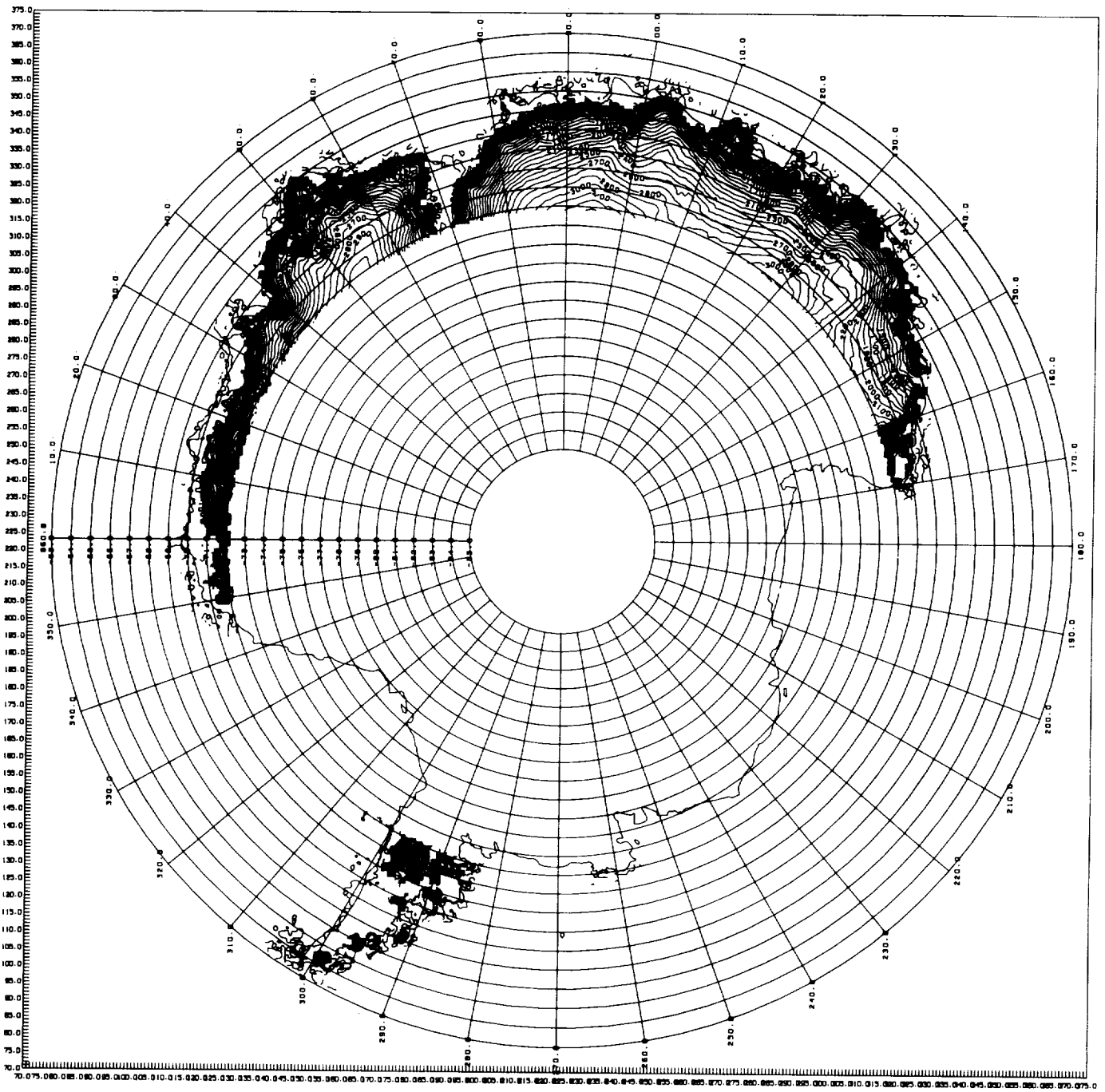
Figure 11. Seasat Antarctic Topographic Map Contoured in 100-Meter Intervals.

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SECTION 4.0

GEOID GRID

In order to obtain ice sheet elevations relative to sea level, the geoid was subtracted from each grid elevation. Geoid values were bilinearly interpolated from the 1x1-degree GEM10-B (Goddard Earth Model 10-B) geoid grid. Figure 12 shows a contour of this geoid in the vicinity of Antarctica. Files 6 and 7 of the accompanying tape contain the header information and GEM 10-B 1x1-degree grid. Tables 6 and 7 give detailed descriptions of these files. Any values of the geoid not located on the map in Figure 11 are set equal to –100000000 in the grid.

Figure 12. GEM10-B Geoid in Vicinity of Antarctic Contoured in 2-Meter Intervals.

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TABLES

Table 1: Seasat Antarctic Geo-referenced Data Base **

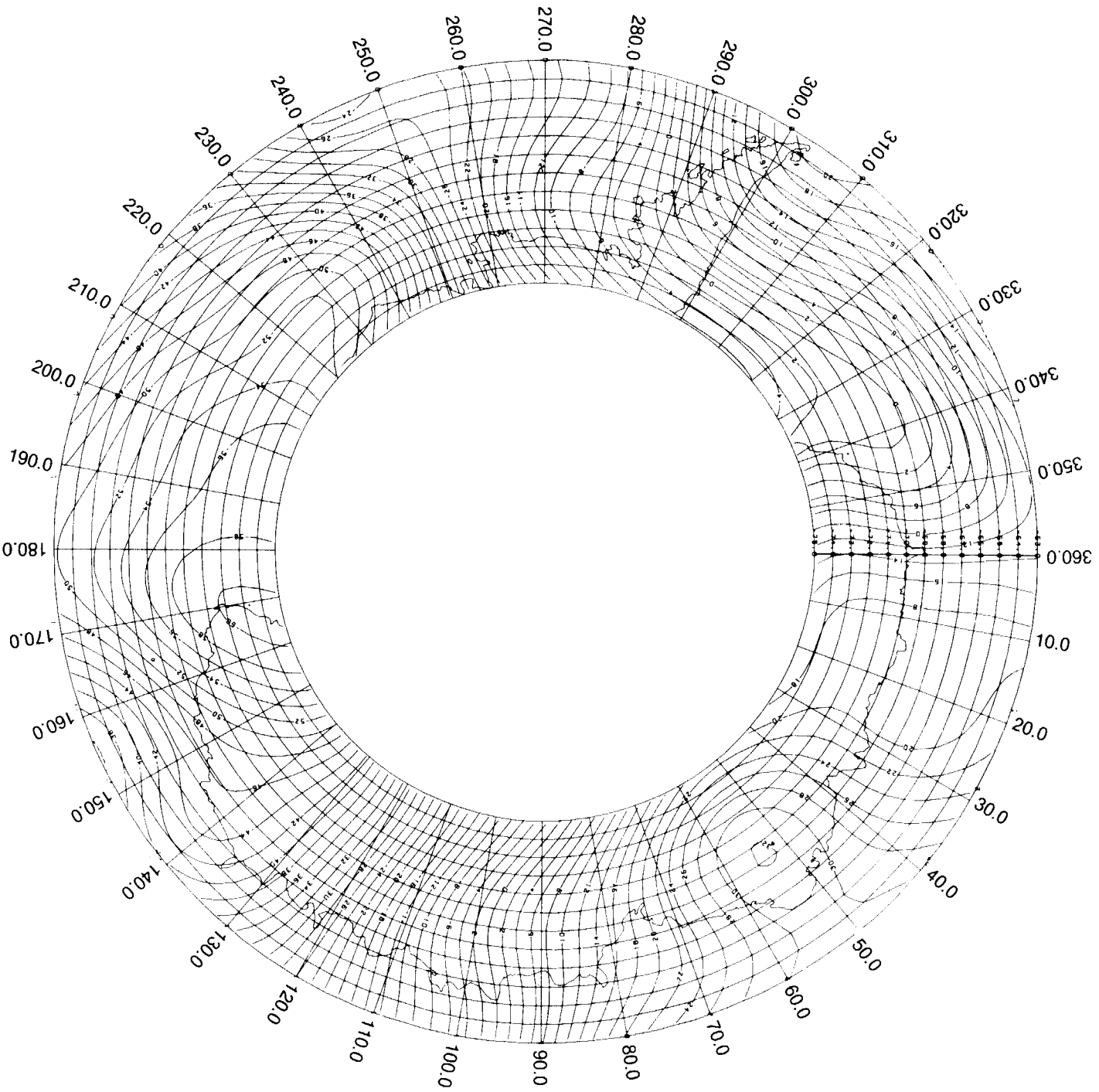| BIN NUMBER	NUMBER PTS	LAT-LONG SW CORNER	REV (NUMBER PTS)
1	67	-72.10 0.0	163(3) 206(4) 249(1) 292(3) 493(5) 522(1) 536(1) 565(5) 852(7) 1153(15) 1196(4) 1239(14)
2	81	-72.10 0.40	1282(4) 206(11) 292(3) 450(4) 493(10) 536(1) 163(4) 766(8) 809(9) 852(6) 1153(6) 1282(1) 565(18) 766(5)
3	9	-72.10 0.80	1239(2) 1239(10) 694(3) 1153(3) 1196(10) 1210(12)
4	2	-72.10 1.20	163(5) 421(12) 421(3) 1153(18) 1167(12) 1196(9)
5	5	-72.10 1.60	163(5) 249(3) 1339(6) 1411(7) 1425(10)
6	5	-72.10 2.00	163(1) 1296(7) 1339(5) 1454(1) 1497(1)
7	1	-72.10 2.40	622(9) 1167(11) 1167(4) 1468(1)
9	9	-72.10 3.20	579(3) 665(7)
11	13	-72.10 4.00	163(11) 1339(1)
12	51	-72.10 4.40	163(16)
13	105	-72.10 4.80	1210(14)
14	23	-72.10 5.20	177(5) 421(9) 421(3) 1425(4) 1468(1) 1253(7)
15	14	-72.10 5.60	622(2) 1253(4) 1253(1) 665(3) 708(18)
16	2	-72.10 6.00	249(1) 263(7) 622(2)
19	1	-72.10 7.20	579(1) 708(6)
20	1	-72.10 7.60	421(1) 464(2) 421(2) 507(2) 579(1) 593(3)
21	33	-72.10 8.00	177(7) 1425(1) 708(6) 794(2) 837(1) 1167(12)
22	8	-72.10 8.40	665(4) 263(7)
24	12	-72.10 9.20	177(2) 665(9)
25	22	-72.10 9.60	464(10) 1253(5)
26	37	-72.10 10.00	263(2) 1339(2)
27	60	-72.10 10.40	622(6) 421(5) 708(6) 579(2) 593(2) 1253(8) 1210(2) 1167(1) 507(2) 837(10) 1253(7) 1339(5)
28	1	-72.10 10.80	220(1)
29	1	-72.10 11.20	263(5)
30	29	-72.10 11.60	421(7) 392(4) 421(2) 392(4) 679(7) 1224(3)
31	54	-72.10 12.00	421(10) 593(6) 708(5) 277(10) 392(3) 679(1)
32	30	-72.10 12.40	1425(10) 1468(9) 1353(10) 1425(9)
33	15	-72.10 12.80	679(11) 1339(11) 679(2) 1468(2)
34	10	-72.10 13.20	1425(7) 1468(12) 1425(4)
35	3	-72.10 13.60	679(2) 1339(3)
36	16	-72.10 14.00	148(6) 679(1)
37	6	-72.10 14.40	148(5) 837(8) 837(2)
38	22	-72.10 14.80	392(12) 679(2) 679(6) 636(2)
39	27	-72.10 15.20	148(1) 220(6) 263(4)
40	26	-72.10 15.60	148(2) 234(3) 263(4)
41	59	-72.10 16.00	1267(1) 1267(6) 392(9) 636(2) 722(10) 1224(1) 277(6) 277(9)
42	19	-72.10 16.40	148(6) 1224(17) 1396(4) 1396(4) 1310(5) 1396(1)
43	28	-72.10 16.80	794(4) 435(4) 1353(4) 837(2)
44	6	-72.10 17.20	277(11) 564(8) 679(9) 1310(5)
45	10	-72.10 17.60	234(3) 794(4) 1396(1)
46	8	-72.10 18.00	722(1) 1396(5)
47	23	-72.10 18.40	277(10) 435(3) 722(5) 1439(2)
48	29	-72.10 18.80	722(3) 679(7) 722(5) 593(7) 679(11) 722(10) 277(2) 593(7) 1310(10)

** Sample of ASCII Contents on File 8

Record Format:	Fixed Block
Record Length:	132 Bytes
Blocksize:	19008 Bytes

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Table 2. Seasat Geo-referenced Data Base Header Description

FILE 1:   GEO-REFERENCED DATA BASE HEADER RECORD
                Record Format: One logical record corresponds to one physical record
                Blocksize: 424 Bytes

Bytes	FORTRAN Variable Type	Description
1-4	I*4	Number of latitude rows in the data base (49).
5-8	I*4	Northwestern-most latitude of data base in degrees North (x 10^5) (-6299999).
9-12	I*4	Northwestern-most longitude of data base in degrees East (x 10^5) (0).
13-16	I*4	Southeastern-most latitude of data base in degrees North (x 10^5) (-7209998).
17-20	I*4	Southeastern-most longitude of data base in degrees East (x 10^5) (36000000).
21-216	I*4	Width of each latitude row in degrees (x 10^5), starting with the southernmost row. This is dimensioned by the number of latitude rows in the data base.
217-412	I*4	The number of longitude divisions in each latitude row, starting with the southernmost row. This is dimensioned by the number of latitude rows in the data base.
413-416	I*4	Logical record in data base at which directory starts.
417-420	I*4	Size of the data base, including the directory, in blocks.
421-424	I*4	Status word for altimetry data.

```
|—————————|
0               31
```
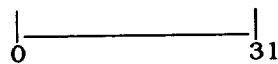
Table 2. Seasat Geo-referenced Data Base Header Description (Cont.)

(421-424 cont.)

Bits	Value	Description
0–23	0	Unused
24	1	Slope correction applied
	0	Slope correction not applied
25	1	Orbit adjustment applied
	0	Orbit adjustment not applied
26	1	Solid tides removed
	0	Solid tides not removed
27	1	Retracking correction applied
	0	Retracking correction not applied
28	1	Center of gravity bias applied
	0	Center of gravity bias not applied
29	1	Tropospheric correction applied
	0	Tropospheric correction not applied
30	1	Ionospheric correction applied
	0	Ionospheric correction not applied
31	1	Time bias applied
	0	Time bias not applied

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Table 3. Seasat Geo-referenced Data Base Description

FILE 2:   GEO-REFERENCED DATA BASE
Record Format: 595 logical records correspond to one physical record
Blocksize: 19040 Bytes

Subgroup 1: One logical record for each bin containing data

Bytes	FORTRAN Variable Type	Description
1–4	I*4	Indicates the number of logical records which follow which are located in the bin
5–32		Unused

Subgroup 2:   One logical record for each data point in the bin

Bytes	FORTRAN Variable Type	Description
1–4	I*4	North latitude of datum point in degrees (x 10^6)
5–8	I*4	East longitude of datum point in degrees (x 10^6)
9–12	I*4	Surface height relative to the ellipsoid in cm.
13–16	I*4	Height sigma, arbitrary value of 1.0 m used (x 10^5)
17–18	I*2	Rev number
19–20	I*2	Used for temporary flags when gridding the data
21–24	I*4	Orbit adjustment in meters (x 10^5) (–999999999 if unavailable)
25–28	I*4	RMS of orbit adjustment in meters (x 10^5) (–999999999 if unavailable)
29–32	I*4	Slope correction in meters (x 10^5) (–999999999 if unavailable)

NOTE: Subgroups 1 and 2 are repeated for as many bins with data.

Table 3. Seasat Geo-referenced Data Base Description (Cont.)

Subgroup 3:   Directory

Bytes	FORTRAN Variable Type	Description
1–4	I*4	Record number at which data for bin 1 starts
5–8	I*4	Record number at which data for bin 2 starts
9–12	I*4	Record number at which data for bin 3 starts
13–16	I*4	Record number at which data for bin 4 starts
17–20	I*4	Record number at which data for bin 5 starts
21–24	I*4	Record number at which data for bin 6 starts
25–28	I*4	Record number at which data for bin 7 starts
29–32	I*4	Record number at which data for bin 8 starts

NOTE: The directory contains as many 32-byte logical records as necessary to designate the record locations of all bins.

Table 4. Elevation Grid Header Description

FILE 4:   ELEVATION GRID HEADER RECORD
Record Format: One logical record corresponds to one physical record
Blocksize: 80 Bytes

Bytes	FORTRAN Variable Type	Description
1–4	I*4	Number of latitude increments in the grid for a non-polar stereographic grid (294)
5–8	I*4	Number of longitude increments in the grid for a non-polar stereographic grid (294)
9–12	I*4	Starting north latitude of grid in degrees North (x 10^6) (this will be approximate for a polar stereographic grid) (-73000000)
13–16	I*4	Starting east longitude of grid in degrees East (x 10^6) (this will be approximate for a polar stereographic grid) (-1800000000)
17–20	I*4	Ending north latitude of grid in degrees North (x 10^6) (this will be approximate for a polar stereographic grid) (-63000000)
21–24	I*4	Ending east longitude of grid in degrees East (x 10^6) (this will be approximate for a polar stereographic grid) (1800000000)
25–28	I*4	Status word for data used to generate grid. A zero in any bit position indicates that the correction is not applied.

```
|————————————|
0            31
```
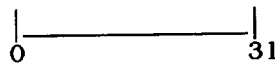
Bits	Value	Description
0-23		Unused
24	1	Slope correction applied
	0	Slope correction not applied
25	1	Orbit adjustment applied
	0	Orbit adjustment not applied
26	1	Solid tides removed
	0	Solid tides not removed
27	1	Retracking correction applied
	0	Retracking correction not applied
28	1	Center of gravity bias applied
	0	Center of gravity bias not applied
29	1	Tropospheric correction applied
	0	Tropospheric correction not applied
30	1	Ionospheric correction applied
	0	Ionospheric correction not applied
31	1	Time bias applied
	0	Time bias not applied

Table 4. Elevation Grid Header Description (Cont.)

Bytes	FORTRAN Variable Type	Description
29–32	I*4	Polar stereographic grid size conversion and scaling factor from half-inch grids on projection plane to the desired grid size (x 10^6) (1650000)
33–36	I*4	The number of grids of desired size from the pole to the equator based on the grid size conversion and scaling factor (x 10^6) (608754894)
37–40	I*4	Latitude of the map perimeter in degrees North (x 10^6) (-500000000)
41–44	I*4	Greenwich orientation in degrees (x 10^6) (270000000)
45–48	I*4	Polar stereographic switch (1) =0, grid has constant increment in latitude and longitude =1, grid is in polar stereographic projection
49–52	I*4	Number of I-axis divisions to the extent of the map perimeter (445)
53–56	I*4	Number of J-axis divisions to the extent of the map perimeter (445)
57–60	I*4	J coordinate of the projected pole (223)
61–64	I*4	I coordinate of the projected pole (223)
65–68	I*4	Minimum J index of the grid (76)
69–72	I*4	Maximum J index of the grid (369)
73–76	I*4	Minimum I index of the grid (76)
77–80	I*4	Maximum I index of the grid (369)

Table 5. Elevation Grid Description

FILE 5:   ELEVATION GRID DATA RECORD
Record Format: 10 logical records correspond to one physical record
Blocksize: 1800 Bytes

Bytes	FORTRAN Variable Type	Description
1-4	I*4	Condition number of the matrix used in the least squares solution to the function (x 10^6)
5-8	I*4	Capsize in degrees latitude - radius from grid location defining area from which data was used to define grid (x 10^6)
9-12	I*4	North latitude of grid point in degrees (x 10^6)
13-16	I*4	East longitude of grid point in degrees (x 10^6)
17-20	I*4	Height values of the grid at location relative to sea level in meters (x 10^5)
21-24	I*4	Number of data values that were used to calculate grid value
25-28	I*4	Number of parameters used to define function, NPT, (equals 0, 3, or 6)
29-52	I*4	Six gridding function coefficients. If NPT is < 6 then the rest of the coefficients are initialized to zero. (x 10^5)
53-76	I*4	Set of null coefficients associated with any negligible singular values (see SVD reference). If NPT is < 6 then rest of coefficients are initialized to zero (x 10^6)
77-80	I*4	Distance in km from grid locations to closest data point (x 10^6)
81-84	I*4	North latitude of closest data point to grid location in degrees (x 10^6)
85-88	I*4	East longitude of closest data point to grid location in degrees (x 10^6)
89-92	I*4	Height associated with closest data point to grid location in meters (x 10^5)
93-96	I*4	Standard deviation of the data with respect to the gridding function in meters (x 10^6)
97-180	I*4	Correlation matrix from solution. This is a symmetrical 6 X 6 matrix so only the upper triangular portion is stored. The order of storage is elements 1-6 are the first row elements, 7-11 columns 2-6 of second row etc. (x 10^5)

NOTE: Ten of the above-mentioned 180-byte logical records make up one block of data.

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Table 6. Geoid Grid Header Description

FILE 6: GEOID GRID HEADER RECORD
Record Format: One logical record corresponds to one physical record
Blocksize: 80 Bytes

Bytes	FORTRAN Variable Type	Description
1-4	I*4	Number of latitude increments in the grid for a non-polar stereographic grid (16)
5-8	I*4	Number of longitude increments in the grid for a non-polar stereographic grid (361)
9-12	I*4	Starting north latitude of grid in degrees $(x \ 10^6)$ (this will be approximate for a polar stereographic grid) (-750000000)
13-16	I*4	Starting east longitude of grid in degrees $(x \ 10^6)$ (this will be approximate for a polar stereographic grid) (0)
17-20	I*4	Ending north latitude of grid in degrees North $(x \ 10^6)$ (this will be approximate for a polar stereographic grid) (-60000000)
21-24	I*4	Ending east longitude of grid in degrees East $(x \ 10^6)$ (this will be approximate for a polar stereographic grid) (3600000000)
25-28	I*4	Unused
29-32	I*4	Polar stereographic grid size conversion and scaling factor from half-inch grids on projection plane to the desired grid size $(x \ 10^6)$ (1650000)
33-36	I*4	The number of grids of desired size from the pole to the equator based on the grid size conversion and scaling factor $(x \ 10^6)$ (608754894)
37-40	I*4	Latitude of the map perimeter in degrees North $(x \ 10^6)$ (-500000000)
41-44	I*4	Greenwich orientation in degrees East $(x \ 10^6)$ (2700000000)
45-48	I*4	Polar stereographic switch (1) =0, grid has constant increment in latitude and longitude =1, grid is in polar stereographic projection
49-52	I*4	Number of I-axis divisions to the extent of the map perimeter (445)

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Table 6. Geoid Grid Header Description (Cont.)

Bytes	FORTRAN Variable Type	Description
53-56	I*4	Number of J-axis divisions to the extent of the map perimeter (445)
57-60	I*4	J coordinate of the projected pole (223)
61-64	I*4	I coordinate of the projected pole (223)
65-68	I*4	Minimum J index of the grid (59)
69-72	I*4	Maximum J index of the grid (386)
73-76	I*4	Minimum I index of the grid (59)
77-80	I*4	Maximum I index of the grid (386)

Table 7. Geoid Grid Description

FILE 7: GEOID GRID RECORD
         Record Format: 200 logical records correspond to one physical record
         Blocksize: 2400 Bytes

Bytes	FORTRAN Variable Type	Description
1-4	I*4	North latitude of grid point in degrees North (x 10^6)
5-8	I*4	East longitude of grid point in degrees East (x 10^6)
9-12	I*4	Value of geoid in meters (x 10^5)

NOTE: Two hundred of the above-mentioned 12-byte logical records make up one block of data.

Table 8. Narrative Description of Tape

FILE 9:   NARRATIVE DESCRIPTION
             Record Format: One logical record corresponds to one physical record
             Blocksize: 80 Bytes

Record 1:

Bytes	FORTRAN Variable Type	Description
1-8	A*8	Satellite name
9-11	A*3	Version number of this tape
12-17	A*6	Date of release of this data (YYMMDD)
18-80	A*63	Differences between this data release and previous versions

Record 2:

Bytes	FORTRAN Variable Type	Description
1-80	A*1	Continuation of differences between this data release and previous versions

Record 3:

Bytes	FORTRAN Variable Type	Description
1-10	A*10	Orbit used to compute surface elevations
11-20	A*10	Geoid used to compute elevations relative to sea level
21-40	A*20	Source of ocean tides
41-60	A*20	Source of troposphere correction
61-80	A*20	Source of ionosphere correction

Table 8. Narrative Description of Tape (Cont.)

Record 4:

Bytes	FORTRAN Variable Type	Description
1-10	A*10	Surface used for orbit adjustment
11-40	A*30	NASA publication number and title for documentation describing data on tape
41-46	A*6	Beginning day of data (YYMMDD)
47-52	A*6	End day of data (YYMMDD)
53-80	A*28	Name of mission

APPENDIX

Program to Load Data Base onto Direct Access Device and Read Data for Specific Area

```
     ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
 1   C
 1   C FUNCTION: GIVEN THE LATITUDE AND LONGITUDE LIMITS OF A RECTANGULAR AREA,
 1   C           THIS PROGRAM DETERMINES WHICH DATA BASE BINS ARE CONTAINED IN
 1   C           THE AREA AND PRINTS OUT THE CONTENTS OF THOSE BINS.
 1   C
 1   C INPUT -    UNIT 5  : GSELAT-SOUTHEASTERN NORTH LATITUDE OF DESIRED AREA
 1   C                      GSELON-SOUTHEASTERN EAST LONGITUDE OF DESIRED AREA
 1   C                      GNWLAT-NORTHWESTERN NORTH LATITUDE OF DESIRED AREA
 1   C                      GNWLON-NORTHWESTERN EAST LONGITUDE OF DESIRED AREA
 1   C           UNIT 12 - SCRATCH DISK FOR DATA BASE (U/19040 - 3350 DISK)
 1   C           UNIT 20 - DATA BASE HEADER (1ST FILE OF TAPE)
 1   C           UNIT 21 - DATA BASE ENTIRES AND DIRECTORY (2ND FILE OF TAPE)
 1   C
 1   C     REVISED-6/17/87 TO READ ANTARCTIC D.B.  PGMR - J.A. MAJOR
 1   C     REVISED-12/17/86 FOR WDCG TAPE          PGMR - J.A. MAJOR
 1   C
 7         DOUBLE PRECISION XLAT,XLON
 7         INTEGER*2 IPASS,IFLAGS
 7         LOGICAL*1 LKICK
 7         DIMENSION IDIR(36180),LONDIV(49),WIDLAT(49),IWDLAT(49),IDRD(8),
 6        .    IHEAD(106),NRECNO(100),SIZE(49),IIBIN(100)
 7         DIMENSION ZNWLON(2),ZSELON(2)
 7         DIMENSION JJBIN(100),LKICK(100)
 7         COMMON/RANBLK/LAT,LON,IHT,ISIG,IPASS,IFLAGS,IORB,IORBR,ISLCR,
 6        .    IREC
 7         COMMON/CHEAD/IG,IWNLAT,IWNLON,ISELAT,ISELON,IWDLAT,LONDIV,IDRREC,
 6        .    NBUF,IPRFLG
 7         EQUIVALENCE (IDRD(1),LAT),(IHEAD(1),IG)
 7         DATA IFIL1/20/,IFIL2/21/,IOUT6/6/,NBINS/36180/,IN5/5/,
 6        .    N100/100/
 7         DATA LKICK/100*.FALSE./
 1   C
 1   C READ LIMITS OF DESIRED AREA
 7         READ(IN5,10002) GSELAT,GSELON,GNWLAT,GNWLON
 7         WRITE(IOUT6,10003) GSELAT,GSELON,GNWLAT,GNWLON
 1   C
 1   C READ HEADER FROM DATA BASE TAPE
 7         READ(IFIL1,10001) IHEAD
 1   C CONVERT PROPER HEADER VALUES TO FLOATING POINT
 7         WNLAT = IWNLAT*1.E-5
 7         WNLON = IWNLON*1.E-5
 7         SELAT = ISELAT*1.E-5
 7         SELON = ISELON*1.E-5
 7         DO 50 I=1,IG
 7         WIDLAT(I) = IWDLAT(I)*1.E-5
 1   50    CONTINUE
 7         WRITE(IOUT6,10000) WNLAT,WNLON,SELAT,SELON,IG,WIDLAT,LONDIV,
```

```
START
COL    ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
  6           .   NBUF,IDRREC,IPRFLG
  1    C COMPUTE THE SIZE OF THE LONGITUDE DIVISIONS FOR EACH BIN GROUP
  7           DO 100 I=1,IG
  7           SIZE(I) = (SELON-WNLON) / LONDIV(I)
  1    100    CONTINUE
  7           WRITE(IOUT6,10004)  SIZE
  1    C DUMP REMAINING DATA TO DIRECT ACCESS DISK
  7           REWIND IFIL1
  7           CALL BLKRD(IFIL2,NBUF)
  1    C
  1    C READ DIRECTORY AND PRINT OUT ITS CONTENTS
  7           DO 200 I=1,NBINS
  7           IREC = (I-1)/8 + IDRREC
  7           CALL RANDRD
  7           IWICH = MOD(I-1,8) + 1
  7           IDIR(I) = IDRD(IWICH)
  1    200    CONTINUE
  7           WRITE(IOUT6,2210)
  7           WRITE(IOUT6,2220) IDIR
  1    C
  1    C DETERMINE BIN NUMBER LOCATED AT SOUTHWEST CORNER OF DESIRED AREA
  1    C  AND STORE THE START RECORD OF THAT BIN
  7           NBIN = 0                                                        DATA 112
  7           XNWLON = DMOD(GNWLON+360.D0,360.D0)                             DATA 113
  7           XSELON = DMOD(GSELON+360.D0,360.D0)
  7           IF(GNWLAT.LE.SELAT .OR. GSELAT.GE.WNLAT .OR. GNWLON.GE.SELON
  6           .  .OR. GSELON.LE.WNLON) GO TO 900
  7           DIF = GSELAT - SELAT
  7           ADD = 0.0
  7           DO 320 IB=1,IG
  7           ADD = ADD + WIDLAT(IB)
  7           IBGRP1 = IB
  7           IF(DIF .LT. ADD) GO TO 325
  1    320    CONTINUE
  7           IBGRP1 = IG
  1    325    CLAT1 = ADD - WIDLAT(IBGRP1)
  7           CNWLAT = GNWLAT
  7           IF(GNWLAT .GT. WNLAT) CNWLAT = WNLAT                            DATA 129
  1    C                                                                      DATA 130
  1    C CHECK IF GREENWICH SPLITS THE CAPSIZE REGION                         DATA 131
  7           IF(GNWLON .GT. GSELON) GO TO 327                                DATA 132
  7           IF(GNWLON.LT.0.D0 .AND. GSELON.GE.0.D0) GO TO 327              DATA 133
  7           IA = 1                                                          DATA 134
  7           ZNWLON(1) = XNWLON                                              DATA 135
  7           ZSELON(1) = XSELON                                              DATA 136
  7           GO TO 328                                                       DATA 137
  1    C REGION SPLIT....DIVIDE INTO TWO PIECES                               DATA 138
  1    327    IA = 2                                                          DATA 139
  7           ZNWLON(1) = XNWLON                                              DATA 140
  7           ZSELON(1) = 360.D0                                             DATA 141
  7           ZNWLON(2) = 0.D0                                               DATA 142
  7           ZSELON(2) = XSELON                                              DATA 143
  1    C                                                                      DATA 144
  1    C LOOP OVER THE AREA(S) CONTAINED BY THE CAPSIZE REGION
```

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Program to Load Data Base onto Direct Access Device and Read Data for Specific Area (Cont.)

```
START
  COL   ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
    1   328     CONTINUE
    7           DO 700 M=1,IA                                                  DATA 145
    7           CLAT = CLAT1                                                   DATA 146
    7           IBGRP = IBGRP1                                                 DATA 147
    7           CSELON = ZSELON(M)                                            DATA 148
    7           IF(ZSELON(M) .GT. SELON) CSELON=SELON                          DATA 149
    7           CNWLON = ZNWLON(M)                                            DATA 150
    7           IF(ZNWLON(M) .LT. WNLON) CNWLON=WNLON                          DATA 151
    7           DIF = CNWLON - WNLON                                          DATA 152
    1   330     IBIN = 0                                                      DATA 153
    7           IF(IBGRP .EQ. 1) GO TO 345
    7           IFIN = IBGRP - 1
    7           DO 340 J=1,IFIN
    1   340     IBIN = IBIN + LONDIV(J)
    1   345     IBIN = IBIN + DIF/SIZE(IBGRP) + 1.0
    7           IF(IBIN .GT. NBINS) GO TO 360
    7           NBIN = NBIN + 1
    7           IF(NBIN .GT. N100) GO TO 980
    7           IIBIN(NBIN) =IBIN
    7           NRECNO(NBIN)=IDIR(IBIN)
    1   C LOCATE ALL BINS WITHIN LATITUDE GROUP WHICH ARE CONTAINED IN DESIRED AREA
    7           NLON = DIF/SIZE(IBGRP)
    7           CLON = WNLON + NLON*SIZE(IBGRP)
    1   350     CLON = CLON + SIZE(IBGRP)
    7           IF(CLON .GT. CSELON) GO TO 360
    7           IF(CLON. EQ. SELON) GO TO 360
    7           IBIN = IBIN + 1
    7           IF(IBIN .GT. NBINS) GO TO 360
    7           NBIN = NBIN + 1
    7           IF(NBIN .GT. N100) GO TO 980
    7           IIBIN(NBIN) =IBIN
    7           NRECNO(NBIN)=IDIR(IBIN)
    7           GO TO 350
    1   C PROCEED TO NEXT BIN GROUP AND DETERMINE IF OUTSIDE DESIRED AREA
    1   360     CLAT = CLAT + WIDLAT(IBGRP)
    7           TOTLAT = SELAT + CLAT + .0001
    7           IBGRP = IBGRP + 1
    7           IF(IBGRP .GT. IG) GO TO 700
    7           IF(TOTLAT .LT. CNWLAT) GO TO 330
    1   700     CONTINUE
    1   C REMOVE DUPLICATE OCCURANCES OF BIN NUMBERS DUE TO GREENWICH CROSSING
    7           DO 440 I=1,NBIN
    7           DO 420 K=1,NBIN
    7           IF(LKICK(I)) GO TO 420
    7           IF(I .EQ. K) GO TO 420
    7           IF(IIBIN(I) .NE. IIBIN(K)) GO TO 420
    7           LKICK(K) = .TRUE.
    1   420     CONTINUE
    1   440     CONTINUE
    7           NJBIN = 0
    7           DO 450 I=1,NBIN
    7           IF(LKICK(I)) GO TO 450
    7           NJBIN = NJBIN+1
    7           JJBIN(NJBIN) = IIBIN(I)
```

```
START
 COL   ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
  1    450    CONTINUE
  7           WRITE(IOUT6,30000) NJBIN,(JJBIN(J),J=1,NJBIN)
  1    C
  1    C STORE RECORD NUMBER OF BIN TO BE READ; IF ZERO, THEN BIN CONTAINS
  1    C    NO DATA...PROCEED TO NEXT BIN
  7           DO 550 I=1,NBIN
  7           IF(LKICK(I)) GO TO 550
  7           IREC = NRECNO(I)
  7           IF(IREC .NE. 0) GO TO 460
  7           WRITE(IOUT6,40000) IIBIN(I)
  7           GO TO 550
  1    C FIRST RECORD OF BIN TELLS HOW MANY RECORDS IN THE BIN
  1    460    CONTINUE
  7           CALL RANDRD
  7           IEND = LAT
  7           WRITE(IOUT6,2400) IIBIN(I),NRECNO(I),LAT
  7           WRITE(IOUT6,2100)
  1    C PRINT OUT CONTENTS OF ONE ENTIRE BIN
  7           DO 500 J=1,IEND
  7           IREC = IREC + 1
  7           CALL RANDRD
  7           ORBIT = IORB*1.E-5
  7           ORBITR = IORBR*1.E-5
  7           SLPCOR = ISLCR*1.E-5
  7           SIGH = ISIG*1.E-5
  7           XLAT = LAT*1.D-6
  7           XLON = LON*1.D-6
  7           WRITE(IOUT6,2200) IREC,XLAT,XLON,IHT,IPASS,ORBIT,ORBITR,SLPCOR,
  6          .  SIGH
  1    500    CONTINUE
  1    550    CONTINUE
  7           STOP
  1    C
  1    C AREA REQUESTED OUTSIDE OF DATA BASE AREA
  1    900    WRITE(IOUT6,90000)
  7           STOP
  1    C TOO MANY BINS FOR ARRAY WHICH STORES DIRECTORY
  1    980    WRITE(IOUT6,81000) N100
  7           STOP
  1    C
  2     2200 FORMAT(I10,2F10.4,I10,I8,2F10.3,F10.3,F11.3)
  2     2100 FORMAT(/4X,'IREC',5X,'LAT',9X,'LONG',7X,'HEIGHT',3X,'REV #',
  6          .    4X,'ORB ADJ',2X,'ORB RMS',2X,'SLOPE CORR',4X,'SIGMA')
  2     2210 FORMAT(///' DIRECTORY FOR DATA BASE (IDIR):'/)
  2     2220 FORMAT(13I10)
  2     2300 FORMAT(///' DIRECTORY STARTS AT LOGICAL RECORD',I10,
  6          .    3X,'NUMBER OF BUFFERS:',I6//)
  2     2400 FORMAT(/' FOR BIN NUMBER',I6,2X,' LOGICAL RECORD STARTS AT',I10,
  6          .    2X,' # RECS IN BIN:',I10)
  1    10000 FORMAT(//' HEADER INFORMATION FROM DATA BASE TAPE'/
  6          .    2X,'NW LATITUDE & LONGITUDE (WNLAT, WNLON):',2F10.4/
  6          .    2X,'SE LATITDUE & LONGITUDE (SELAT, SELON):',2F10.4/
  6          .    2X,'LAT WIDTH OF EACH OF THE',I4,' BIN GROUPS:'/
  6          .    6(1X,8F9.2/),F10.2/2X,'LONGITUDE DIVISIONS IN EACH BIN GROUP',
```

```
START
 COL    ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
  6            . ' (LONDIV):'/6(1X,8I6/),I6/2X,'NUMBER OF BUFFERS:',I6,3X,
  6            . 'LOGICAL RECORD AT WHICH DIRECTORY STARTS:',I10//
  6            . ' ALTIMETRY DATA STATUS WORD',Z10//)
  1     10001 FORMAT(120A4)
  1     10002 FORMAT(4F10.3)
  1     10003 FORMAT(//' SOUTHEASTERN CORNER OF DESIRED AREA (LAT,LON):',2F10.3
  6            . /' NORTHWESTERN CORNER OF DESIRED AREA (LAT,LON):',2F10.3/)
  1     10004 FORMAT(/' SIZE OF EACH BIN GROUP AS DETERMINED FROM HEADER:'/
  6            . 7(1X,8F9.3/)/)
  1     30000 FORMAT(//' THE FOLLOWING ',I6,' BINS CONTAIN DATA IN THE DESIRED'
  6            . ,' AREA:'/10(10I10/))
  1     40000 FORMAT(/' BIN ',I6,' CONTAINS NO DATA')
  1     81000 FORMAT(//' ** NUMBER OF BINS CONTAINED IN AREA EXCEEDS',I5,
  6            . ' . INCREASE SIZE OF NRECNO ARRAY'/' PROGRAM TERMINATING')
  1     90000 FORMAT(///' AREA SELECTED IS OUTSIDE DATA BASE AREA'/
  6            . ' PROGRAM TERMINATING')
  7            END
  1 CC
  1 CC
  1 CC
  7            SUBROUTINE RANDRD
  1 C
  1 C FUNCTION: THIS ROUTINE USES THE DIRECT ACCESS I/O PACKAGE (DAIO)
  1 C             AND ENTRY POINTS TO ACHIEVE SEVERAL THINGS:
  1 C                 1) RANDRD - READS THE IREC TH LOGICAL RECORD FROM DISK
  1 C                 2) RANDWR - WRITES THE IREC TH LOGICAL RECORD TO DISK
  1 C                 3) BLKRD  - TRANSFERS THE DESIRED PHYSICAL RECORDS
  1 C                             OR BLOCKS FROM UNIT NIN TO DISK
  1 C                 4) BLKWR  - TRANSFERS THE DESIRED PHYSICAL RECORDS
  1 C                             OR BLOCKS FROM DISK TO UNIT NOUT
  7            COMMON/FERMSG/IMES(26)
  7            REAL A,BUF(8,595),TBUF(8,595)
  7            INTEGER DISK
  7            COMMON/RANBLK/A(8),IREC
  7            EQUIVALENCE (TBUF(1,1),BUF(1,1))
  7            DATA NREC/595/,NWORDS/8/,KBUF/1/,DISK/12/
  7            LOGICAL WSWTCH
  7            K=1
  7            GO TO 10
  7            ENTRY RANDWR
  7            WSWTCH=.TRUE.
  7            K=2
  4        10 IBUF=(IREC-1)/NREC+1
  7            IF (IBUF.NE.KBUF) GO TO (50,90),K
  4        20 JREC=IPEC-(IBUF-1)*NREC
  7            GO TO (30,70),K
  4        30 DO 40 I=1,NWORDS
  4        40 A(I)=BUF(I,JREC)
  7            RETURN
  1 50         IF (WSWTCH) CALL DWRITE(DISK,KBUF,BUF)
  7            KBUF=IBUF
  7            WSWTCH=.FALSE.
  7            CALL DREAD(DISK,KBUF,BUF,&60)
  7            GO TO 20
```

Program to Load Data Base onto Direct Access Device and Read Data for Specific Area (Cont.)

```
   4      60 PRINT 1000,IMES
   7         STOP
   4      70 DO 80 I=1,NWORDS
   4      80 BUF(I,JREC)=A(I)
   7         RETURN
   1   90    CALL DWRITE(DISK,KBUF,BUF)
   7         KBUF=IBUF
   7         GO TO 20
   2    1000 FORMAT(1H0,Z8,I6,20A4,4(1X,Z8))
   7         ENTRY BLKRD(NIN,NBUF)
   7         KBUF=NBUF
   7         DO 205 J=1,NBUF
   7         READ(NIN,1200,END=204) TBUF
   3     205 CALL DWRITE(DISK,J,BUF)
   3     204 WRITE(6,1100) J
   2    1100 FORMAT(' NUMBER OF BUFFERS READ ',I5)
   2    1200 FORMAT(18(255A4),170A4)
   7         RETURN
   7         ENTRY BLKWR(NOUT,NBUF)
   7         DO 200 J=1,NBUF
   7         CALL DREAD(DISK,J,BUF,&60)
   3     200 WRITE(NOUT) BUF
   7         RETURN
   7         END
```