THE UNIVERSITY OF MICHIGAN

COLLEGE OF LITERATURE, SCIENCE, AND THE ARTS
Department of Geography

Technical Report

A DIGITAL TERRAIN LIBRARY

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ORA Project 08055

under contract with:

U. S. ARMY RESEARCH OFFICE (DURHAM)
CONTRACT NO. DA-31-124-ARO-D-456
DURHAM, NORTH CAROLINA

administered through:

OFFICE OF RESEARCH ADMINISTRATION ANN ARBOR

March 1968

INTRODUCTION

Several years ago a number of investigators began exploring digital computer approaches to the analysis of topographical data. Unfortunately the investigators involved often found it impractical to include their data in the published reports. As a consequence each study began anew with compilations of information. This first came to our attention in attempting to evaluate several computer programs which had been assembled for the manipulation of geographical information. At that time it seemed desirable to have available several standard, modest-sized, sets of topographical information on punched cards. This need has not declined appreciably in the interim, although it is now possible to obtain digitalized versions of the contours pertaining to entire topographic sheets if the study objectives are of military interest, and if one is prepared to cope with the several reels of magnetic tape currently required to describe one topographic map. The need for a digital terrain library of modest size for exploratory investigations has remained. The current effort is an attempt in this direction and was undertaken as a more or less isolated sub-project of a larger study. In keeping with these general objectives, the size of each described portion of terrain is relatively small. The specific parcels were chosen to represent distinct physiographic types by selection from the U.S. Geological Survey set of 100 topographic maps illustrating physiographic features in the United States. No attempt at analysis of the resulting data are reported in this document. Requests for additional copies of the report or for copies of the data tape should be addressed to the Cartography Laboratory, Department of Geography, The University of Michigan, Ann Arbor, Michigan.

SELECTION OF AREAS

The choice of areas to be digitized is best described as a browsers selection of interesting terrain from the 100 USGS physiographic features quadrangles, with some attention to map scale. A few sheets were chosen for their relevance to other portions of the study, but this has not been an overriding concern. Within each map sheet an attempt was made to isolate relatively "pure" terrain types, with a balance between fineness of detail and size of area. A strict requirement was that each area be rectangular. After some experimentation a square area (10 in. on a side, digitized every 1/8th in.) was found to be the most practical compromise between ease of computer storage and manipulation, fineness of detail, and amount of ground covered.

DATA RECORDING

Elevations were recorded by overlaying each selected area with a transparent plastic sheet containing a square grid. Elevations were estimated at each grid intersection and were recorded on large sheets of ruled paper for subsequent keypunching. Contours were estimated to the nearest half contour interval. This method has been described in detail by Dr. Wood, and the reader is referred to his report. The use of a uniform grid interval for the data recording allows one to use a positional (matrix) notation which is readily adaptable to computer manipulation and analyses. Discretization of any continuous signal of course acts as a filter and introduces aliasing effects at the Nyquist interval. The regular grid employed in this project therefore acts as a two-dimensional filter but no effort has been made to compensate for this effect. Data checking was provided by examination of computer drawings produced from each deck of cards (Figure 1). As illustrated by the figure, gross errors are immediately apparent and easily corrected. This method of error detection was found to be relatively inexpensive, especially when one considers that in excess of 100,000 elevations are involved, and that the graphic plotting program was available in house prior to initiation of the project. Minor errors are not detected by this tactic of course. The several pages in the Appendix describe each individual topographic matrix in greater detail. Further information can be obtained by consulting the individual topographical maps and the U.S. Geological Survey descriptive folder "A Set of One Hundred Topographic Maps Illustrating Specified Physiographic Features" by W. B. Upton, Jr., 1955. Most of the selected areas are also illustrated in the Atlas of Landforms. The original intention was to digitize a larger number of topographic features than has been achieved. The recording is, of course, very tedious. Nevertheless it is our hope that the small library made available here will provide an incentive for further work along these lines.

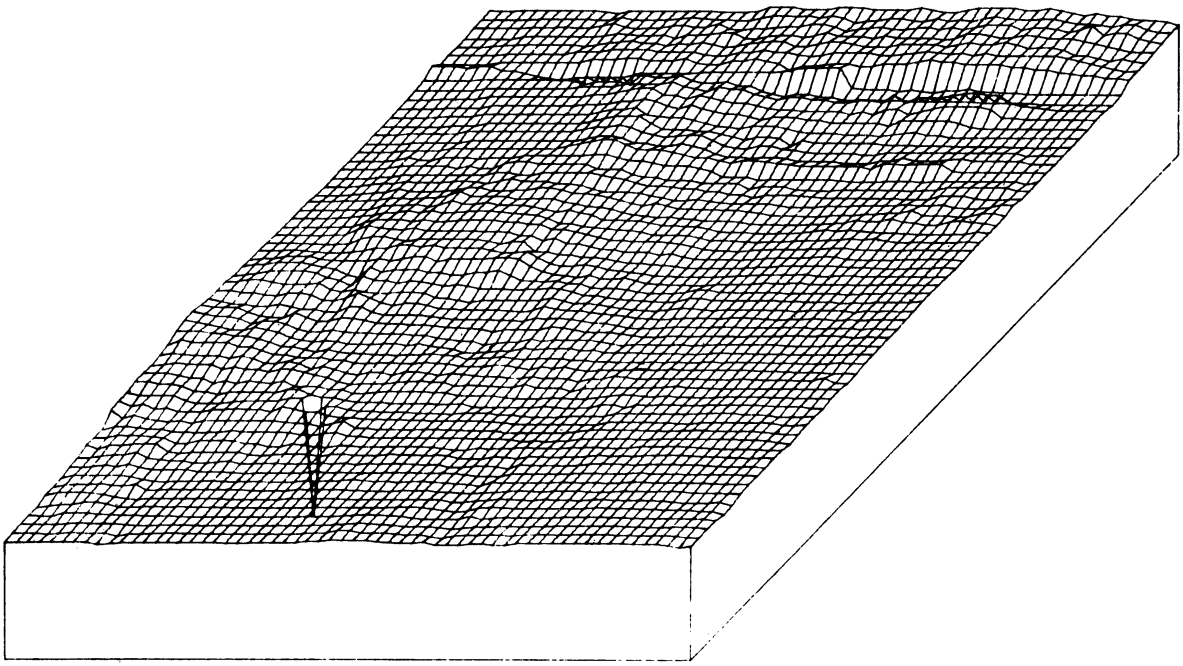

Figure 1. The figure illustrates the use of a computer drawing for the rapid detection of errors in data recording.

ACKNOWLEDGMENT

We wish to thank the following individuals who have assisted on this project: F. Asadi, A. Brazel, V. Herzog, S. Gale, M. Landman, F. Rens, and S. Riesmann.

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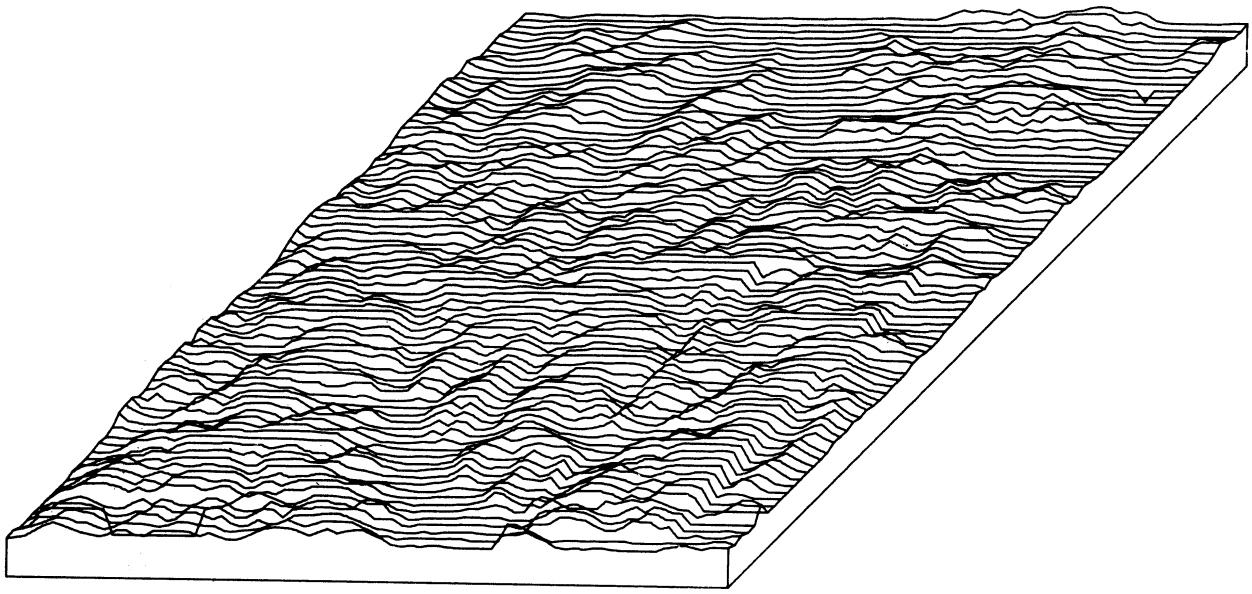
APPENDIX

DESCRIPTION OF SPECIFIC TOPOGRAPHIC MATRICES

The data matrices have been written on one reel of magnetic tape as simple (BCD) card images, one card per record, with a file mark at the end of each matrix. Each matrix is preceded by a title card which also contains the format and number of rows and columns in the matrix. Consequently, the number of card images in each file is equal to the number of rows times the number of cards per row plus one. Each card of each matrix row is numbered, as are the individual rows, and the individual matrices, in columns 75 through 80 of the cards. The illustrations accompanying the matrix descriptions were produced as a part of the data checking procedure and have quite arbitrary vertical exaggerations. Minor errors still evident in the illustrations have been corrected on the cards.



ALMA, WISCONSIN

ALMA, Wisconsin

1/62,500 USGS Quadrangle, 20' contours

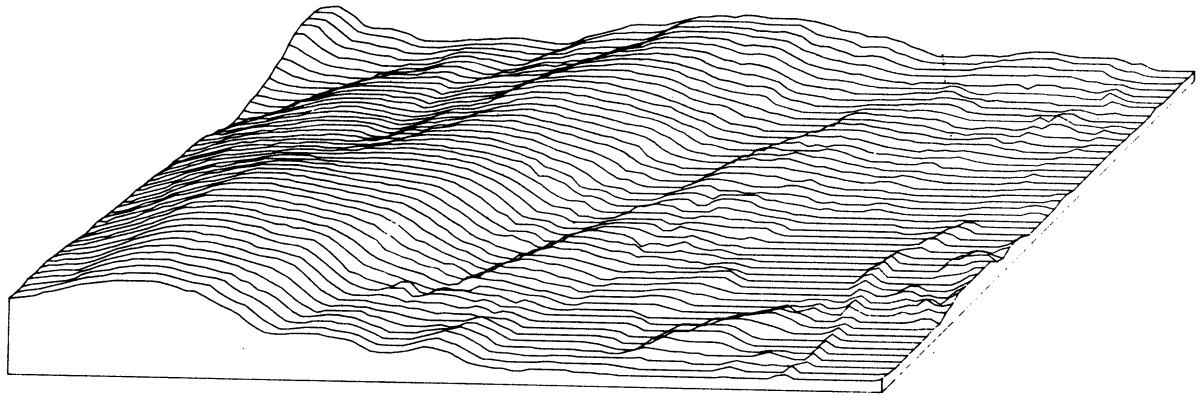
Map coordinates (X and Y), counterclockwise, of the area digitized,

in inches from the SW corner of the map:

(1.6, 9.4), (6.5, 9.4), (9.5, 17.4), (1.6, 17.4)

Digitized every 1/10 th inch on the map (520.8' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(4 (18 F 4 /), 8 F 4)



AYER,MASS. CONTINENTAL GLACIATED TERRAIN - 2ND SO ROWS

AYER, Massachusetts

1/24,000 USGS Quadrangle, 10' contour interval

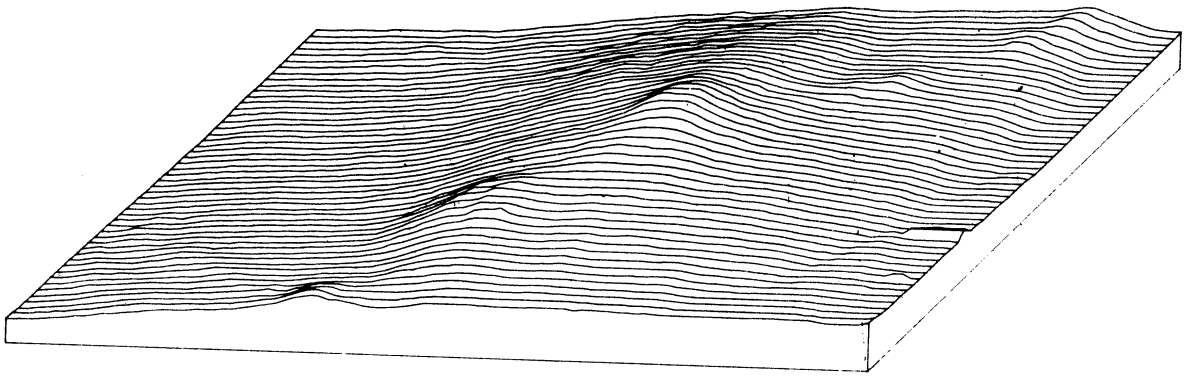
Map coordinates (X and Y), counterclockwise, of the area digitized,

in inches from the SW corner of the map:

(9.4, 2.4), (14.4, 2.4), (14.4, 7.4), (9.4, 7.4)

Digitized every 1/20 th inch on the map (100' on the ground) which yields a matrix of 100 rows by 100 columns. The Fortran format for one row is:

(4 (24 F 3 /), 4 F 3)



BRAY.CALIF. VOLCANIC TOPOGRAPHY - 1ST 50 ROWS

BRAY, California

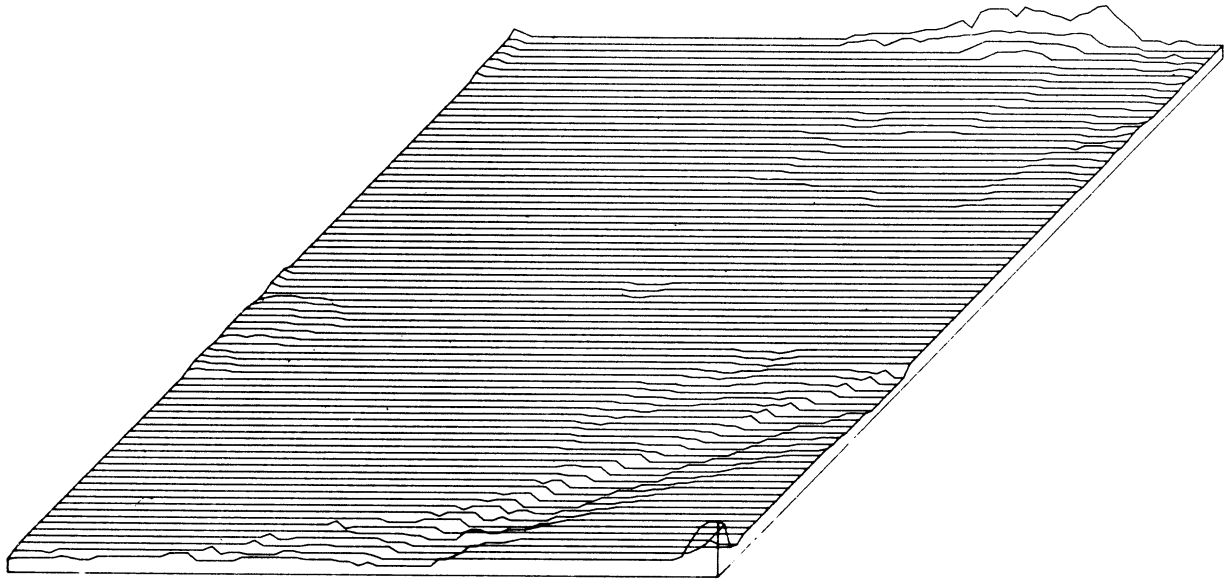
1/62,500 USGS Quadrangle, 40' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the map:

(7.4, 2.5), (12.4, 2.5), (12.4, 7.5), (7.4, 7.5)

Digitized every 1/20 th of an inch (260.4' on the ground) which yields a matrix of 100 rows by 100 columns. The Fortran format for one row is:

(5 (18 F 4 /), 10 F 4)



CAMDEN.MO. FLOOD PLAIN

CAMDEN, Missouri

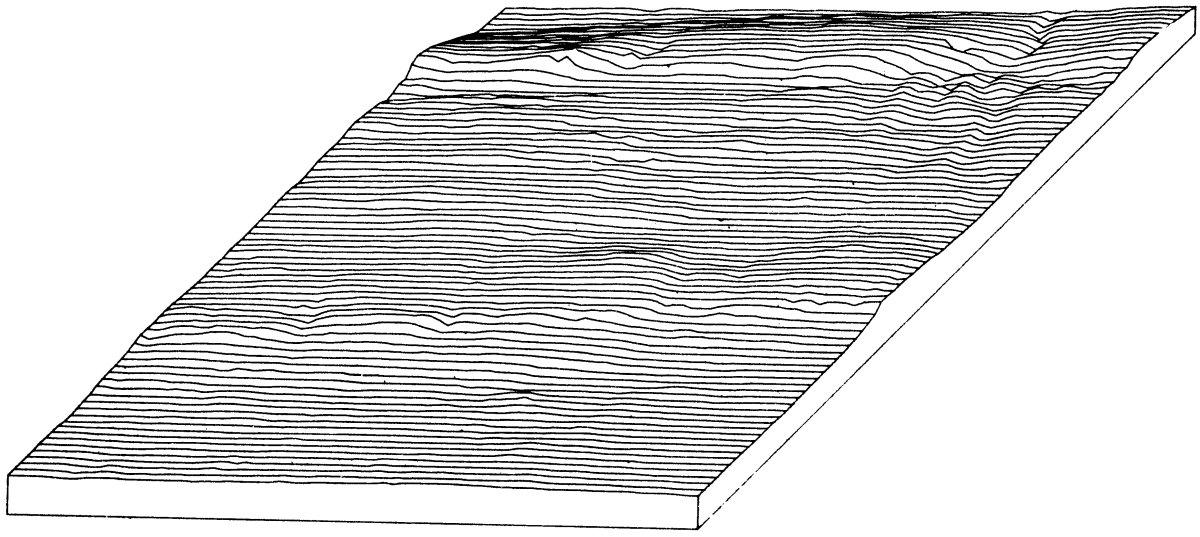
1/24,000 USGS Quadrangle, 10' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the map:

(5.20, 2.35), (15.20, 2.35), (15.20, 12.35), (5.20, 12.35)

Digitized every 1/8 th inch on the map (250' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(3 (24 F 3 /), 8 F 3)



DELAWARE ,MICH.

DELAWARE, Michigan

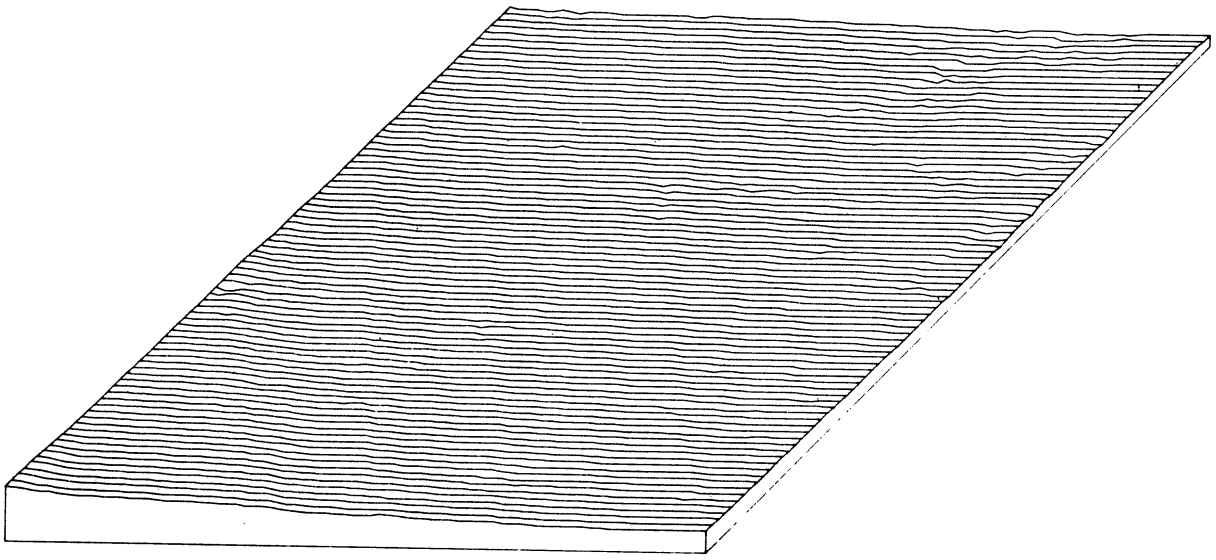
1/24,000 USGS Quadrangle, 20' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the map:

(1.2, 6.8), (9.2, 6.8), (9.2, 14.8), (1.2, 14.8)

Digitized every 1/10 th inch on the map (200' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(4 (18 F 4 /), 8 F 4)



EMERADO N.D. GLACIAL LAKE AGASSIZ

EMERADO, North Dakota

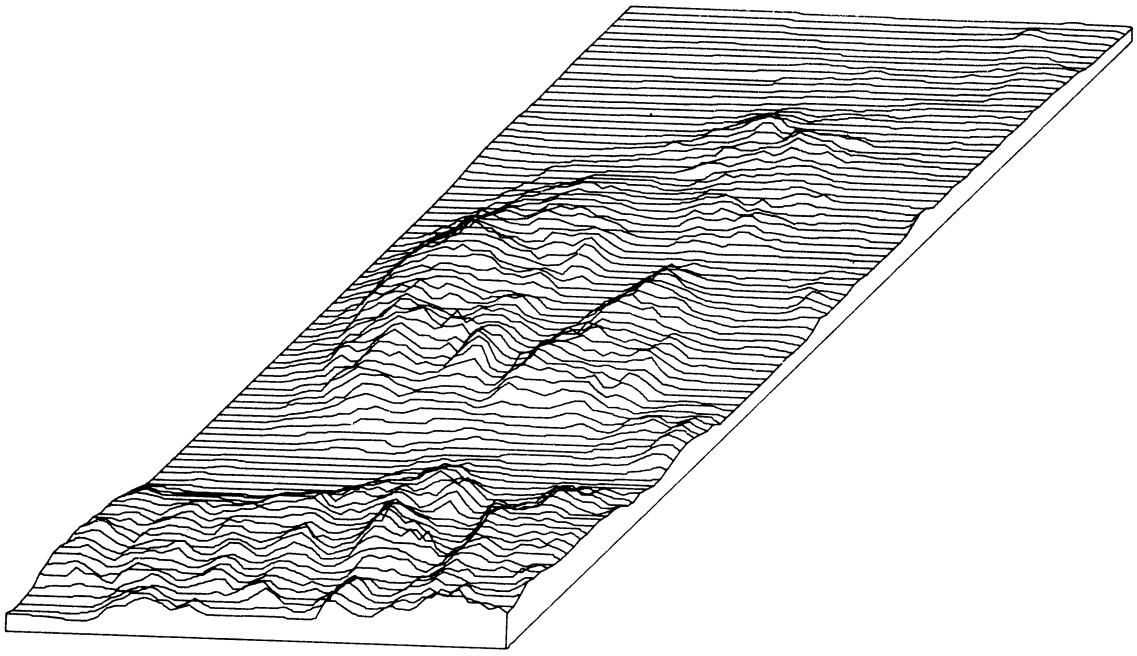
1/62,500 USGS Quadrangle, 10' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the map:

(1.85, 5.15), (11.85, 5.15), (11.85, 15.15), (1.85, 15.15)

Digitized every 1/8 th of an inch (651.04' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(4 (18 F 4 /), 8 F 4)



EMMET COUNTY . MICH.

Emmet County, Michigan

CHEBOYGAN, Michigan 1/250,000 USGS Quadrangle, 50' contour interval

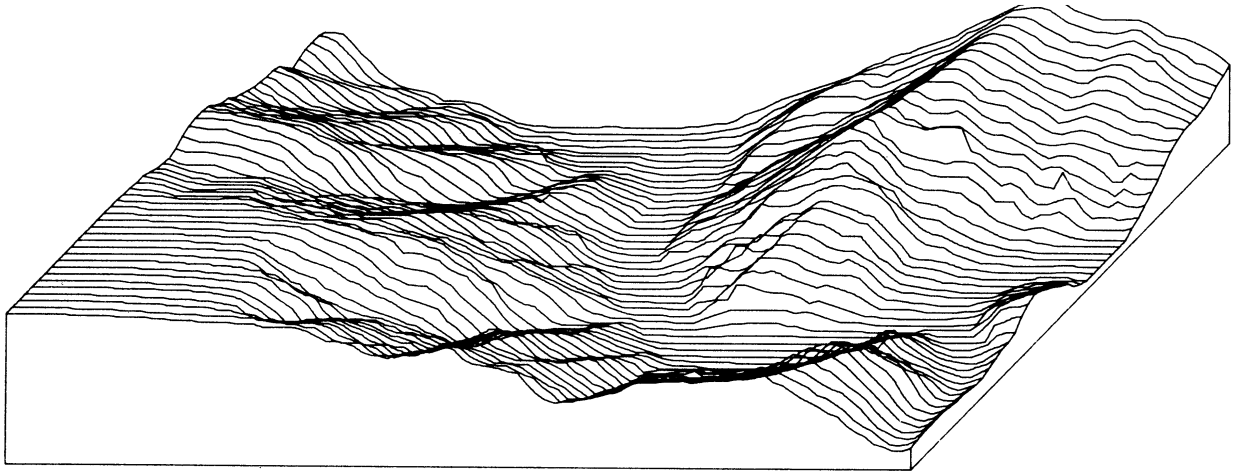
Map coordinates (X and Y), counterclockwise. of the area digitized,

in inches from the SW corner of the map:

(3.5, 8.5), (4.6, 8.7), (4.6, 10.5), (3.5, 10.4)

Digitized every 1/10 th inch on the map (2083.3' on the ground) which yields a matrix of 95 rows by 56 columns. The Fortran format for one row is:

(3 (18 F 4 /), 2 F 4)



FLAMING GORGE.UTAH -WYOM. CANYON. 2ND 50 ROWS

FLAMING GORGE, Utah-Wyoming

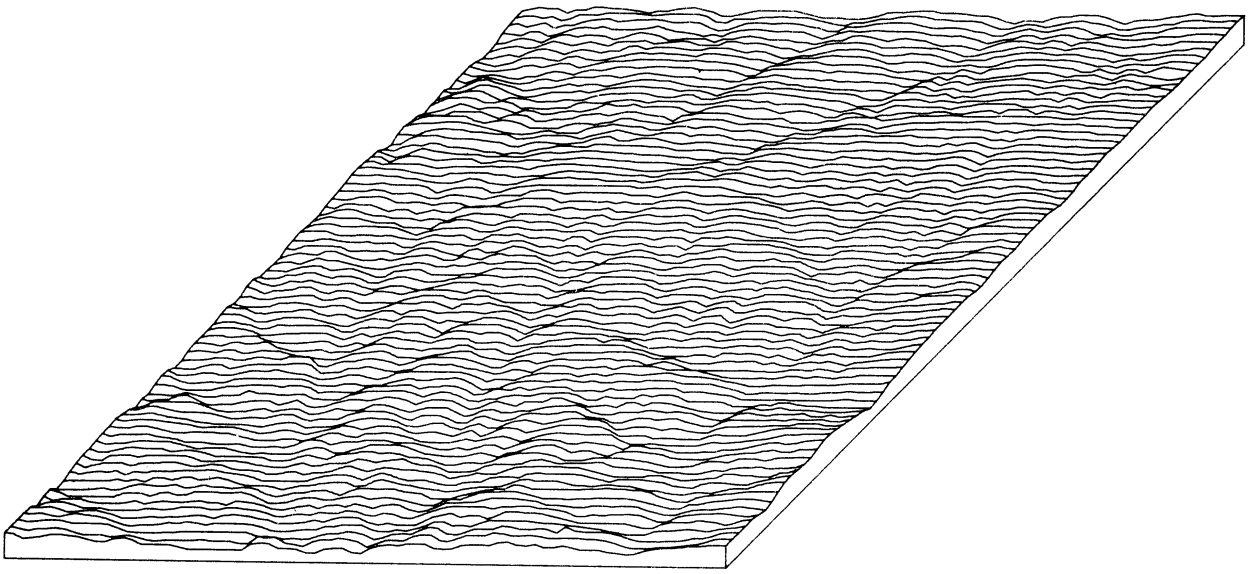
1/24,000 USGS Quadrangle, 40' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the map:

(0.00, 2.45), (5.00, 2.45), (5.00,7.45), (0.00, 7.45)

Digitized every 1/20 th inch on the map (100' on the ground) which yields a matrix of 100 rows by 100 columns. The Fortran format for one row is:

(5 (18 F 4 /), 10 F 4)



HILLSBORO.KY.

HILLSBORO, Kentucky

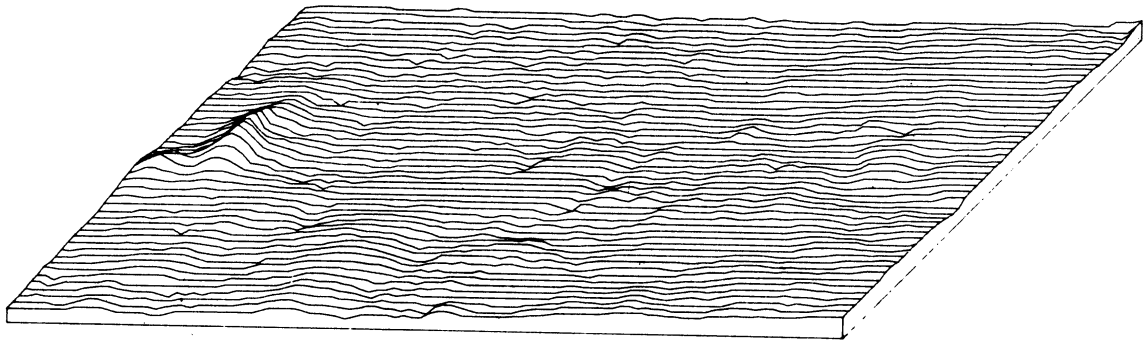
1/24,000 USGS Quadrangle, 20' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the map:

(2.7, 13.3), (10.7, 13.3), (10.7, 21.3), (2.7, 21.3)

Digitized every 1/10 th inch on the map (200' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(3 (24 F 3 /), 8 F 3)



MAMMOTH CAVE.KY. KARST TOPOGRAPHY. 2ND 50 ROWS

MAMMOTH CAVE, Kentucky

1/62,500 USGS Quadrangle, 20' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized,

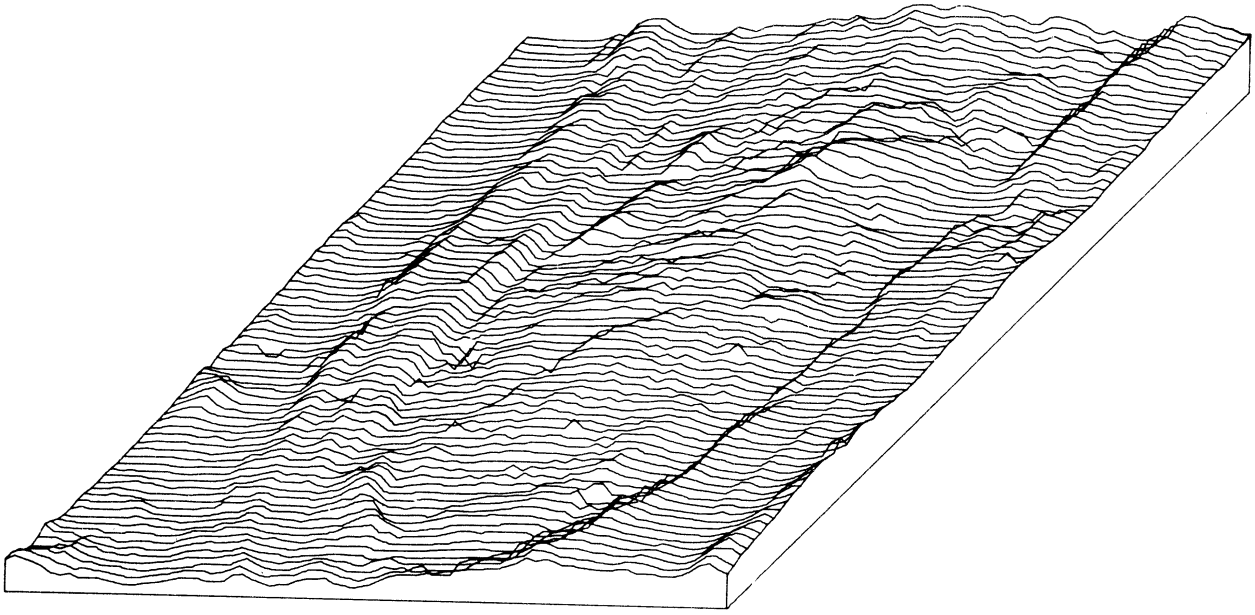
in inches from the SW corner of the map:

(3.90, 1.35), (8.90, 1.35), (8.90, 6.35), (3.90, 6.35)

Digitized every 1/20 th inch on the map (260.4' on the ground) which yields a

matrix of 100 rows by 100 columns. The Fortran format for one row is:

(4 (24 F 3 /), 4 F 3)



MAVERICK SPRING.WYM.

MAVERICK SPRINGS, Wyoming

1/24,000 USGS Quadrangle, 20' contour interval

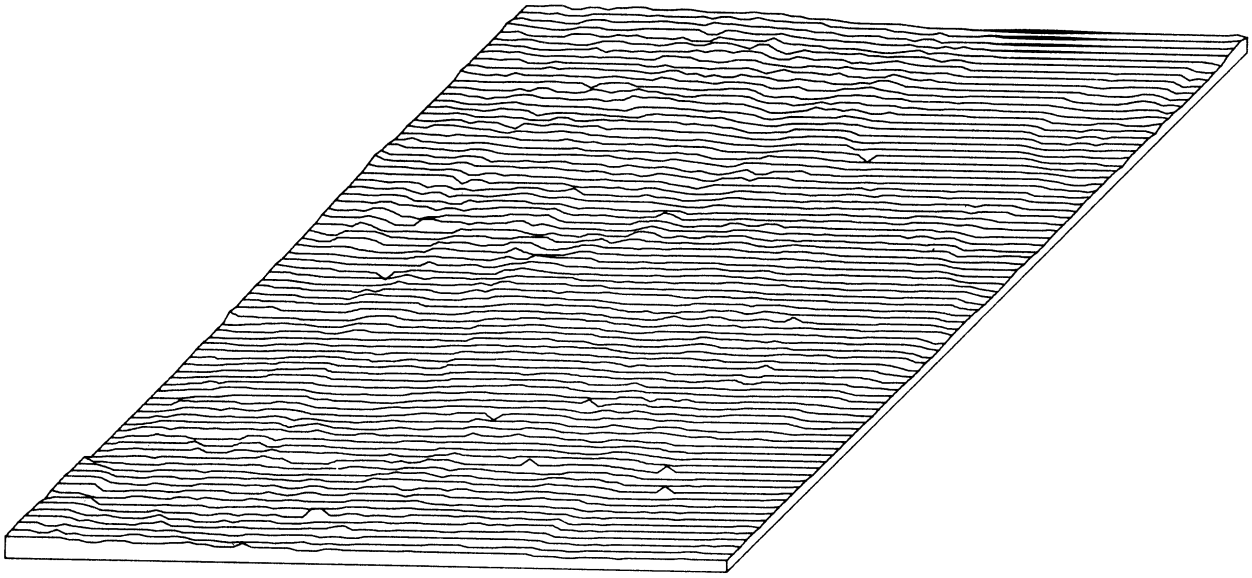
Map coordinates (X and Y), counterclockwise, of the area digitized,

in inches from the SW corner of the map:

(2.10, 15.40), (7.50, 9.50), (13.35, 14.95), (7.90, 20.80)

Digitized every 1/10 th inch on the map (200' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(4 (18 F 4 /), 8 F 4)



MENNAN BUTTE. IDAHO. LAVA FLOW

MENAN BUTTES, Idaho

1/24,000 USGS Quadrangle, 10' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized,

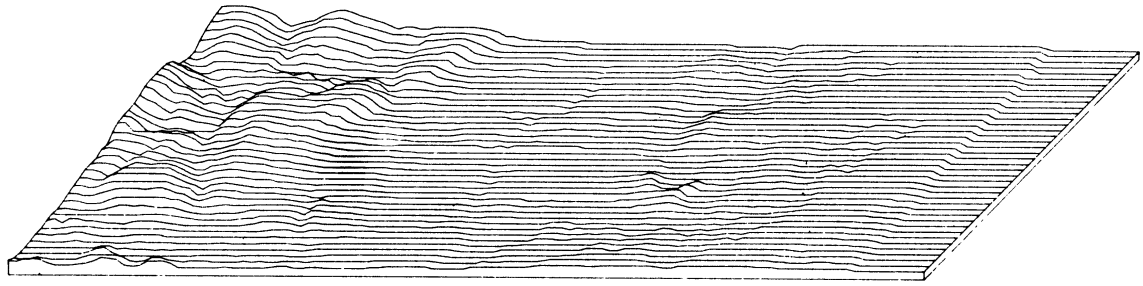
in inches from the SW corner of the map:

(10.7, 13.7), (18.7, 13.7), (18.7, 22.7), (10.7, 22.7)

Digitized every 1/10 th inch on the map (200' on the ground) which yields a

matrix of 80 rows and 80 columns. The Fortran format for one row is:

(4 (18 F 4 /), 8 F 4)



MOBILE.PLAB. MOBILE COAST SHORELINE - 1ST 40 ROWS

MOBILE, Alabama

1/62,500 USGS Quadrangle, 10' contour interval

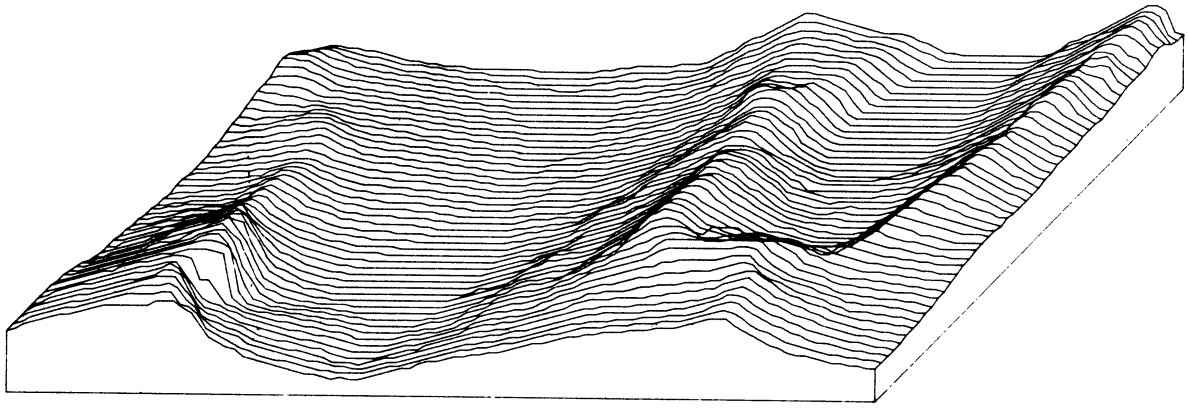
Map coordinates (X and Y), counterclockwise, of the area digitized,

in inches from the SW corner of the map:

(4.65, 2.20), (12.15, 2.20), (12.15, 9.70), (4.65, 9.70)

Digitized every 1/16 th inch on the map (325.5' on the ground) which yields a matrix of 120 rows by 120 columns. The fortran format for one row is:

(5 (24 F 3))



ALPINE GLACIATION, MT.BONNVILLE -1ST.50 ROWS

MOUNT BONNEVILLE, Wyoming

1/62,500 USGS Quadrangle, 50' contour interval

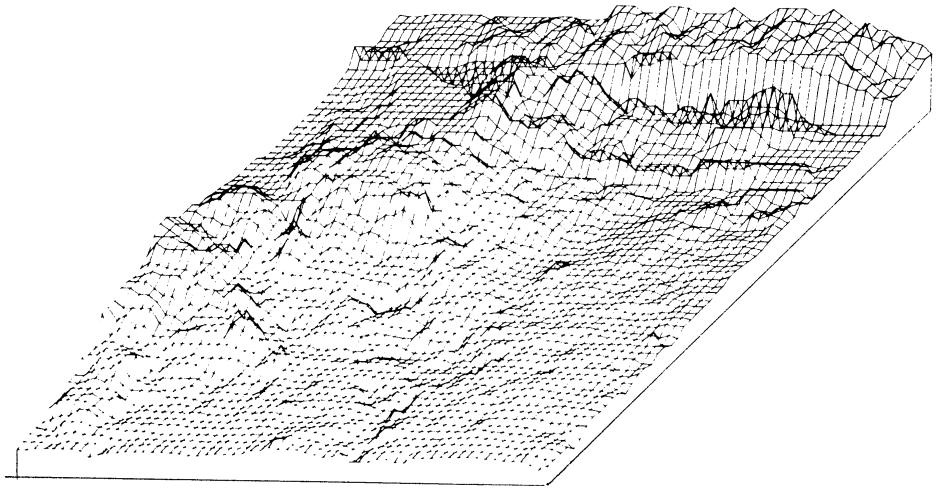
Map coordinates (X and Y), counterclockwise, of the area digitized,

in inches from the SW corner of the map:

(6.75, 8.65), (9.25, 8.65), (9.25, 11.15), (6.75, 11.15)

Digitized every 1/40 th inch on the map (130.2' on the ground) which yields a martix of 100 rows by 100 columns. The Fortran format for one row is:

(5 (18 F 4 /), 10 F 4)



Ogemaw County, Michigan

TRAVERSE CITY 1/250,000 USGS Quadrangle, 50' contour interval

TAWAS CITY 1/250,000 USGS Quadrangle, 50' contour interval

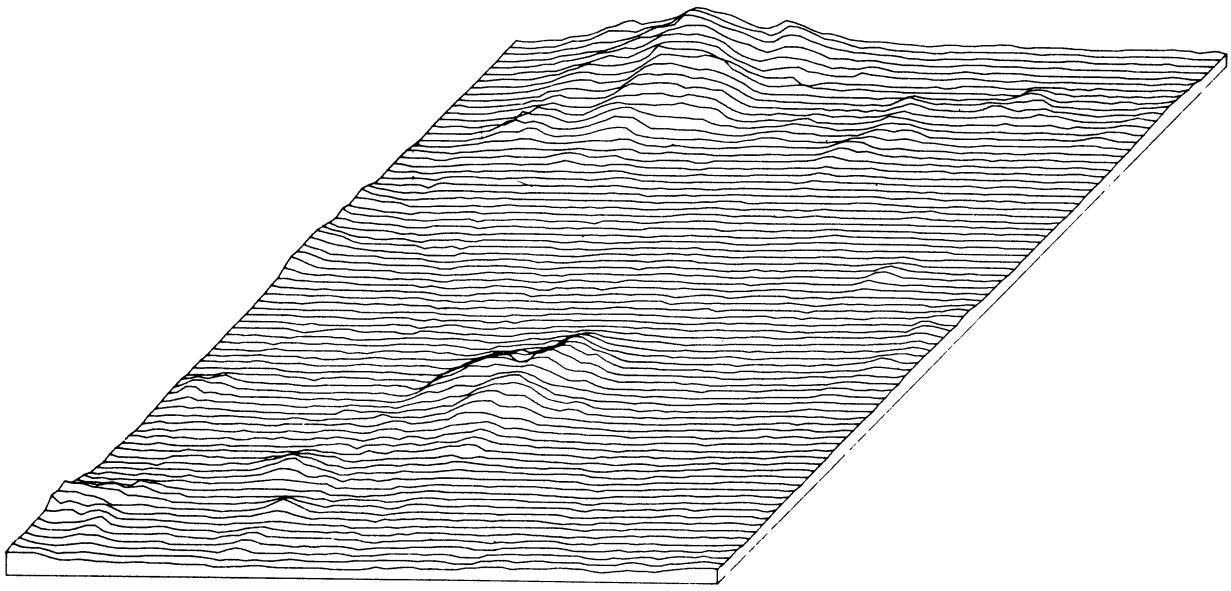
Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the maps:

Traverse city:(20.55,2.8),(25.15,2.8),(25.15,8.9),(20.55,8.9)

Tawas city:(0.0,2.8),(1.5,2.8),(1.5,8.8),(0.0,8.8)

Digitized every 1/10 th of an inch (2083.3' on the ground) which yields a matrix of 60 rows and 61 columns. The fortran format for one row is:

(3 (18 F 4 /) , 7 F 4)



PEAKS OF OTTER, Virginia

1/62,500 USGS Quadrangle, 40' contour interval

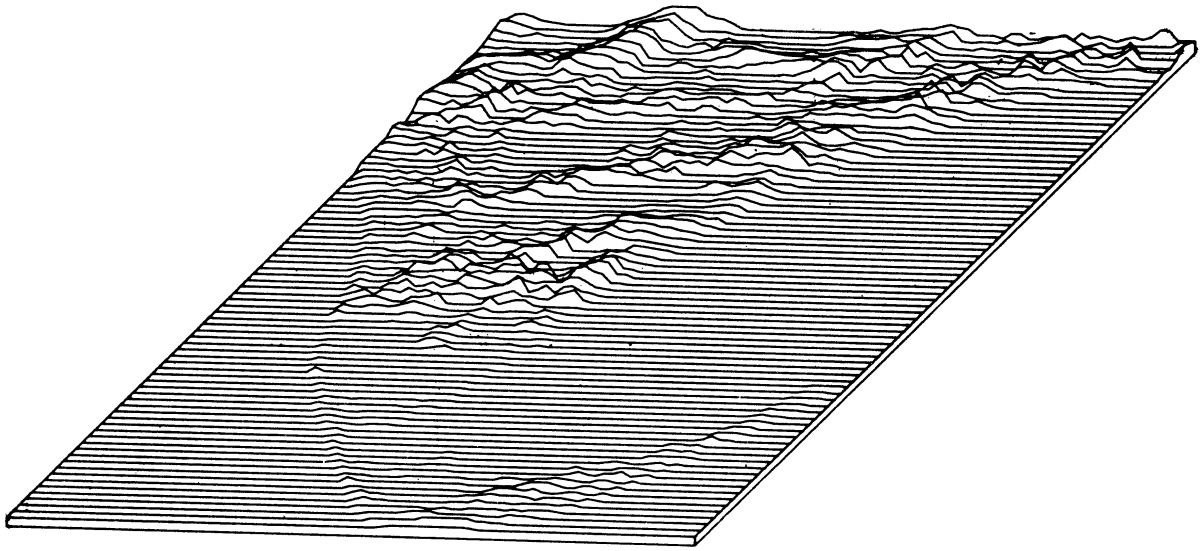
Map coordinates (X and Y), counterclockwise, of the area digitized,

in inches from the SW corner of the map:

(2.1, 2.6), (2.0, 3.4), (7.5, 3.4), (7.5, 2.6)

Digitized every 1/10 th inch on the map (520.8' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(4 (18 F 4 /), 8 F 4)



PROVINCE.MASS.

PROVINCETOWN, Massachusetts

1/24,000 USGS Quadrangle, 10' contour interval

Map coordinates (X and Y), counterclockwise, of the area digitized, in inches from the SW corner of the map:

(4.40, 3.55), (12.4, 3.55), (12.4, 11.55), (4.40, 11.55)

Digitized every 1/10 th inch on the map (200' on the ground) which yields a matrix of 80 rows by 80 columns. The Fortran format for one row is:

(2 (36 F 2 /), 8 F 2)