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TRITER

A GRAVITATIONAL TERRAIN CORRECTION PROGRAM
FOR IBM COMPATIBLE PERSONAL COMPUTERS

VERSION 2.22

SEPTEMBER 1988

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APPLICATIONS SECTION

GEOPHYSICS DIVISION

GEOPHYSICS AND TERRAIN SCIENCES BRANCH

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DISCLAIMER

This program is made available at a nominal charge which covers only the costs of handling. We do not warrant that it will be free from error or suitable for everyone's purposes. This program is not to be distributed to third parties.

Any difficulties with the use of this software please contact James Rupert at (613) 992-6433.

1.Ø INTRODUCTION

Gravity observations must be reduced to a equipotential surface, such as the geoid, in order to be useful to the geoscientist. The reductions that are applied to a gravity observation are the latitude, earth tide, free-air, and often Bouguer and terrain corrections.

The latitude correction compensates for the rotation of the earth, as well as the equatorial bulge, which produce an increase in the value of gravity with latitude. This increase has its maximum rate of change at 45^0 latitude with an approximate value of Ø.ØØØ82 mGal/m in the north-south direction.

The earth-tide correction compensates for changes in gravity due to the relative position and influences of the sun and moon. This correction has a maximum amplitude of approximately Ø.3 mGal.

The free-air correction is used to reduce the observations to a common datum to compensate for changes due to elevation differences between gravity stations. A typical rate of change in gravity due to elevation is Ø.3Ø85 mGal/m, added when above the datum.

The Bouguer correction accounts for the mass attraction of material between the datum and the actual elevation of the station. This assumes that the material is an infinite horizontal slab. A typical value for the Bouguer correction is Ø.112 mGal/m, subtracted when above the datum.

The terrain correction corrects for surface irregularities in the vicinity of the gravity station. The upward attraction due to hills and the lack of attraction in valleys result in terrain corrections always being added to the observed gravity reading. If a gravity station was located on a tall (three thousand metres) mountain peak, this correction could be in the 1ØØ.Ø mGal range. Since the terrain correction can be orders of magnitude larger than the other corrections, it is very important to terrain correct gravity readings that have been taken in areas of rapidly changing topography. Non-terrain corrected Bouguer anomalies in an area of rapidly changing topography can display false anomalies (Figure 1). These anomalies can be smoothed considerably when the terrain corrections are applied to the Bouguer values (Figure 2). This report describes one software system to do this, using an IBM compatible personal computer.

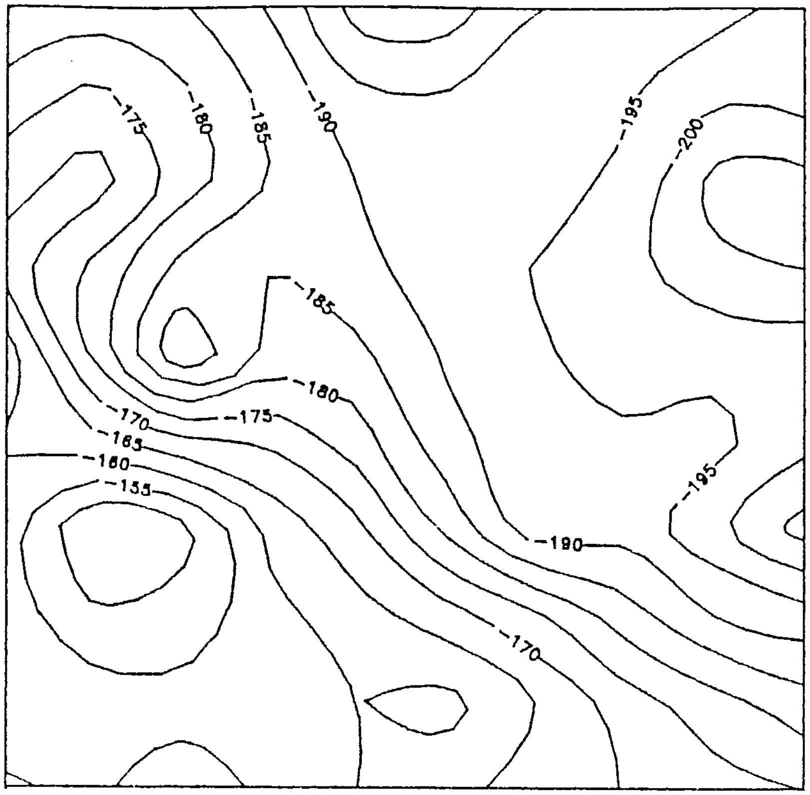

Figure 1: Non-terrain corrected Bouguer gravity anomaly contour map.

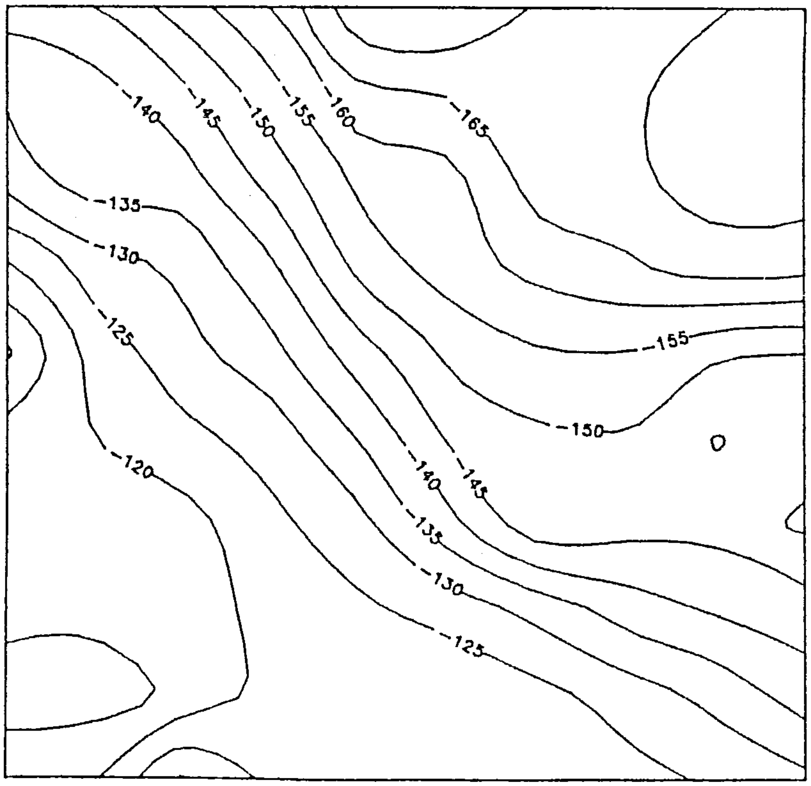

Figure 2: Terrain corrected Bouguer anomaly contour map using the same area as figure 1.

2.Ø PROGRAM DESCRIPTION

2.1 SUMMARY

TRITER is a FORTRAN program, which uses sloping-top triangular prisms close to the observed gravity station and a line mass approximation far from the station to estimate the gravitational terrain correction. It was developed to use an irregularly spaced data set of terrain values, which models the actual topography. It can also use a gridded elevation data set near the station to enhance the irregularly spaced data. The gridded data set is supplied from picking elevations from the supplied template laid over a 1:5Ø,ØØØ topographic map. A topographic map at a different scale may be used if the user manufactures their own template.

Once the elevations have been read into the program, the digital terrain locations are passed to a triangulation routine, which computes a Delaunay tessellation on the two-dimensional data set. This routine returns the location and elevation of the vertices of triangles that have as near as possible equal angles at their vertices. These sloping-top triangular prisms are then used to calculate the gravitational attraction of their mass at the gravity station location.

The program produces a one page summary listing per station, which includes the station information, the terrain correction information and a histogram of the gravitational attraction versus radial distance.

2.2 DETAILED DESCRIPTION

TRITER first collects the terrain data that fall within a specified radius surrounding the gravity station. It then triangulates the terrain data, which includes the gravity station position and elevation. The triangulation is preformed by a two-dimensional Delaunay tessellation given by Watson (1982). This produces a list of triangles, which have as-near-as-possible equal angles at their vertices. These triangular surfaces are then used to calculate the vertical component of the gravitational attraction of the topography that they represent.

If a triangle is within fifteen kilometres of the gravity station or the triangle's area is greater than half a square kilometre, then a vertical sloping-top triangular prism is formed. If the triangle is located greater than fifteen kilometres away from the gravity station and its area is less than half a square kilometre, then the gravitational attraction of the prism is small and it is approximated by a line mass in order to speed the computation.

The vertical sloping-top triangular prisms are formed by using the position and the elevation of the triangle's vertices as the surface for the sloping top of the triangular prism. The horizontal surface of the vertical prism is formed by the positions of the triangle's vertices projected vertically upward or downward to the horizontal plane which passes through the elevation of the gravity station. The edges of the vertical prism are formed by the three vertical planes that pass through the three pairs of the vertices (Figure 3). The vertical component of the gravitational attraction of each vertical sloping-top triangular prism is then calculated using the algorithm given by Woodward (1978).

When triangular prisms are used to calculate the gravitational attraction of the topography, there are four possible cases. These are;

1) All of the vertices are on land
2) One of the vertices is beneath the ocean surface
3) Two of the vertices are beneath the ocean surface
4) All of the vertices are beneath the ocean surface

When all of the vertices are on land, only one attraction of a vertical triangular prism with a sloping top is calculated. This calculation is preformed between the two surfaces A_1 A_2 A_3 and B_1 B_2 B_3, as in Figure 3, with the density of the host rock.

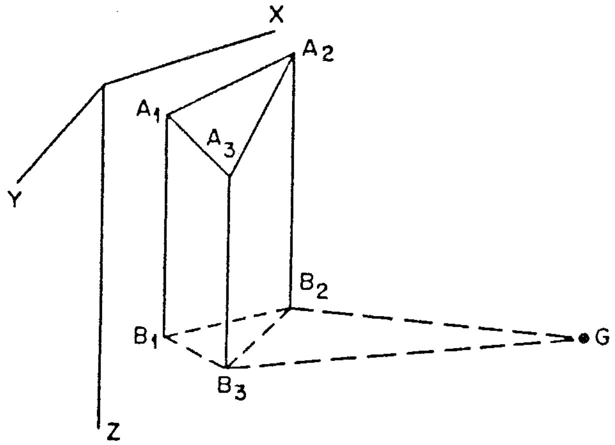

Figure 3: Vertical triangular prism with a sloping top and all vertices on land.
G - gravity station.
$A_1A_2A_3$ - plane which models the topography.
$B_1B_2B_3$ - horizontal plane at the elevation of gravity station G.

When one of the three vertices is located beneath the ocean surface the triangular prism formed by these vertices is divided into three smaller triangular prisms,in order that the contribution of the water can be modelled. In Figure 4, the gravity station G lies in the horizontal plane B_1 B_2 B_3. The surface A_1 A_2 A_3 represents the topography with point A_3 lying beneath the ocean surface and the surface S_1 S_2 S_3 represents the horizontal ocean surface. First, the attraction of the prism formed between the two planes A_1 A_2 A_3 and B_1 B_2 B_3 is calculated with the density of the host rock to compensate for the lack of rock. The attraction of the prism formed by the surfaces S_1 S_2 A_3 and C_1 C_2 B_3 is calculated using the density of the water and is then subtracted from the attraction of the first prism. The third prism is formed by the surfaces S_1 S_2 S_3, the ocean surface, and C_1 C_2 B_3 and its attraction is calculated with the density of water which is then added to the result. This will cause the volume between S_1 S_2 S_3 and S_1 S_2 A_3 to be calculated with a density which is the difference between the model density of rock and water.

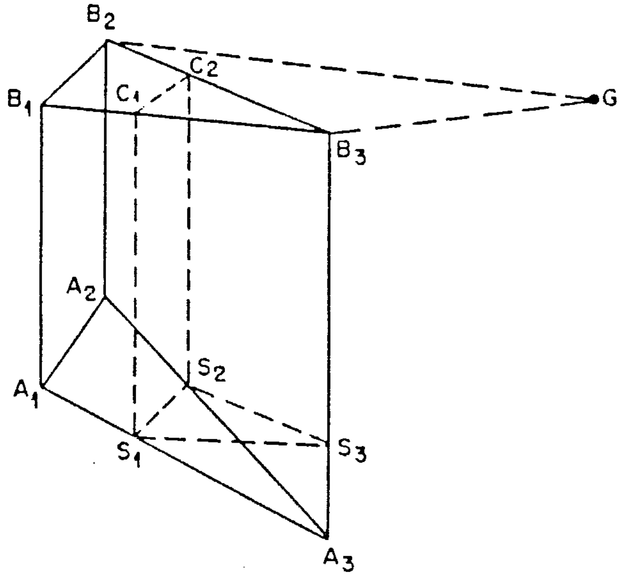

Figure 4: Vertical triangular prism with a sloping top with two vertices on land.
G - gravity station.
$A_1A_2A_3$ - plane which models the topography, A_3 lies beneath the ocean surface.
$B_1B_2B_3$ - horizontal plane at the elevation of gravity station G.
$S_1S_2S_3$ - horizontal plane at mean sea level.

The third case, when two vertices are beneath the ocean surface (Figure 5), calculates the attraction of the prism after it is divided into four vertical triangular prisms. Thus, the part of the prism that is beneath the ocean surface can be calculated with a lower density to compensate for the presence of the water. The first prism is between the surfaces A_1 A_2 A_3, which represents the topography with points A_2 and A_3 beneath the ocean surface, and B_1 B_2 B_3, which is the horizontal plane at the same elevation as the gravity station. Its attraction is calculated using the density contrast between rock and water. The second prism is between the surfaces A_1 S_2 S_5 and B_1 C_1 C_2 and is calculated with the density of water. This is added to the first calculated attraction.

The third vertical triangular prism is calculated between the surfaces S_1 S_3 S_4, the ocean surface, and B_1 B_2 B_3 at a density of 1.03 gm/cc and is added to the sum of the first two prism's gravitational attractions. The fourth prism has the surfaces S_1 S_2 S_5 and B_1 C_1 C_2 and is calculated with the density of 1.03 gm/cc, which is subtracted from the attraction of the first three prisms.

This will calculate the gravitational attraction for the volume between A_1 S_2 S_3 S_4 S_5 and B_1 B_2 B_3, with the density of rock, and the volume between S_1 S_3 S_4 S_5 and S_2 A_2 A_3 S_5, with the density contrast between rock and water.

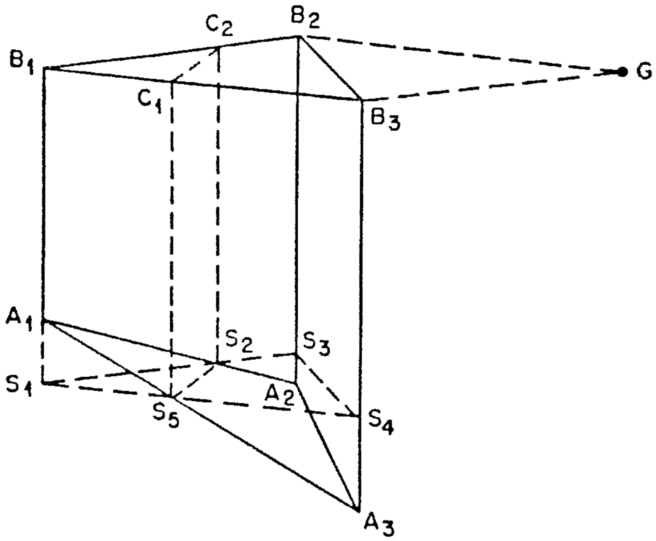

Figure 5: Vertical triangular prism with a sloping top with one vertex on land.
G - gravity station.
$A_1A_2A_3$ - plane which models the topography, A_2 and A_3 beneath the ocean surface.
$B_1B_2B_3$ - horizontal plane at the elevation of gravity station G.
$S_1S_2S_3S_4$ - horizontal plane at mean sea level.

The fourth case, where all three vertices are beneath the ocean surface, requires the original prism to be divided into two prisms to compensate for the presence of the water (Figure 6). The first prism is formed between the surfaces A_1 A_2 A_3, the topography beneath the ocean surface, and B_1 B_2 B_3, the horizontal plane which passes through the gravity station elevation. Its attraction is calculated with the density contrast between rock and water. The second prism is formed between the surfaces S_1 S_2 S_3, the ocean surface, and B_1 B_2 B_3 and is calculated at the density of water. This compensates for the water between the surfaces A_1 A_2 A_3 and S_1 S_2 S_3.

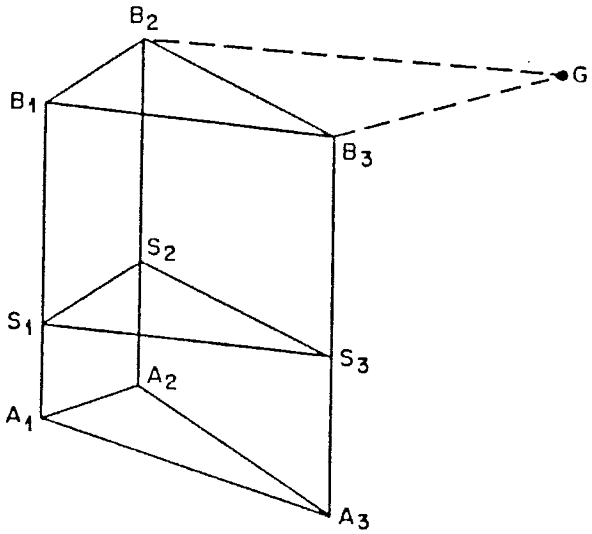

Figure 6: Vertical triangular prism with a sloping top with no vertices on land.
G - gravity station.
$A_1A_2A_3$ - plane which models the topography, A_1,A_2,A_3 beneath the ocean surface.
$B_1B_2B_3$ - horizontal plane at the elevation of gravity station G.
$S_1S_2S_3$ - horizontal plane at mean sea level.

The line mass approximation of the vertical component of the gravitational attraction is a simplification of the gravitational attraction of a right rectangle presented by Nagy (1966). When it is used, only two possible cases exist. These are whether or not the average elevation of the three vertices is above or below mean sea level. When the average elevation is above sea level then the gravitational attraction is calculated using the line mass approximation between the elevation of the gravity station and the average elevation of the triangles vertices.

When the average elevation is below mean sea level then two line mass approximations are used (Figure 7). The first uses the total elevation of the station and depth of water, the distance between Z_1 and Z_2, using the density of water. The second uses only the height of the station above mean sea level, distance between S_1 and Z_2, and uses the difference in density between rock and water.

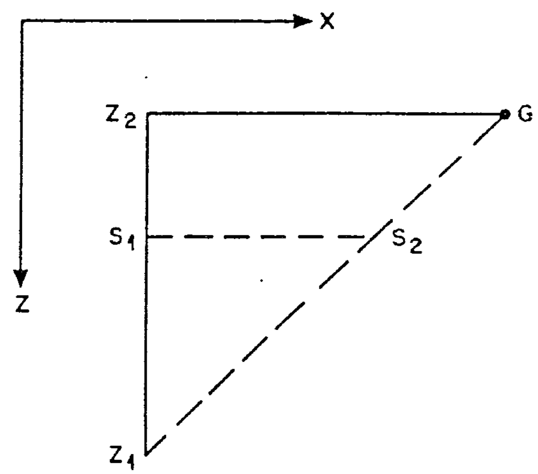

Figure 7: Line mass approximation when average elevation is below mean sea level.
G - gravity station.
GZ_2 - horizontal plane at the gravity station elevation.
S_1S_2 - horizontal plane at mean sea level.
Z_1Z_2 - average elevation of triangle's vertices below gravity station G.
S_1Z_2 - elevation of gravity station G above mean sea level.

The sum of all the calculated gravitational attractions of the triangular prisms and line mass approximations out to the specified radius is the approximate terrain correction for the gravity station.

2.3 PROGRAM CONSIDERATIONS

The calculated gravitational terrain correction may vary slightly with a small change in the input elevation data. This will most likely happen when a regularly spaced elevation data file is used.

The triangulation of a symmetric pattern of regularly spaced elevations can have two possible solutions for every four closest neighbours. The diagonal between the four closest neighbours can be formed sloping down to the right or to the left. When a slight change in the input elevation data is made, it may allow a diagonal between the four closest neighbours to be formed between the other pair of points. This causes the modelled terrain surface to change in shape and can result in changes to the calculated terrain correction.

When terrain corrections are to be calculated near a large lake which has its surface above sea level, you may wish to use the actual lake depths instead of the equivalent rock density for the elevation points located in the lake. To use the actual lake depths you will have to change the datum for the elevations from sea level to the elevation of the lake surface. This will make all the lake depths negative, therefore the program will calculate the prisms formed over the lake using the supplied density for water. For fresh water this density should be set to 1.Ø gm/cc.

3.Ø OPERATING SYSTEM REQUIREMENTS

An IBM PC or compatible computer with a minimum of 512k bytes of RAM. A PC that is based on the 8Ø286 or 8Ø386 processor is recommended.

DOS 2.1 or later.

A math co-processor is recommended but is not necessary.

The program was compiled using the Microsoft FORTRAN Optimizing Compiler version 4.Ø1.

4.Ø INPUT FILES

4.1 STATION FILE

The station file contains a list of station records, followed, if required, by the station's local grid that will be used in the calculation of the station's terrain correction.

The format of the station file is:

LINE 1: STNID
LINE 2: STNLAT, STNLONG, STNELEV, RADIUS, CUNIT, EUNIT
LINE 3: GRDTYPE, GRDLAT, GRDLONG
LINE 4: local grid elevations or another STNID

where

STNID	is an character*8Ø variable used to identify the station.	
STNLAT	is a real number for the station's north-south position in the units specified by CUNIT. If geographical units are specified, the latitude is in decimal degrees with positive north.	
STNLONG	is a real number for the station's east-west position in the units specified by CUNIT. If geographical units are specified, the longitude is decimal degrees with positive west.	
STNELEV	is a real number for the station's elevation in the units specified by EUNIT.	
RADIUS	is a real number for the radial distance in the units specified by CUNIT, over which the terrain correction computation will be calculated. If geographic units are specified, this distance is in kilometres.	
CUNIT	is an integer which describes the coordinates units. Its values are	1 -- metres 2 -- feet 3 -- geographic units 4 -- kilometres 5 -- miles 6 -- yards
EUNIT	is an integer which describes the elevation units. Its values are	1 -- metres 2 -- feet
GRDTYPE	is a integer to describe the type of local grid used. Its values are	Ø -- no local grid, 1 -- 5ØØ metre grid, 2 -- 125 and 5ØØ metre grid.
GRDLAT	is a real number for the north-south position of the local grid's north-west corner. This has to be in the same units and coordinate system as STNLAT.	
GRDLONG	is a real number for the east-west position of the local grid's north-west corner. This has to be in the same units and coordinate system as STNLONG.	

If GRDTYPE is Ø, then another STNID record can follow the GRDTYPE record. If GRDTYPE is 1 or 2, the local grid records will follow the GRDTYPE record. The local grid consists of 12 records for a type 1 grid and 32 records for a type 2 grid. Each record contains 12 elevation picks in 12I6 format.

4.1.1 ELEVATION TEMPLATE PICKING

The picking of elevations using the supplied template for the local grid is from left to right and from top to bottom (west to east, north to south). To pick off the elevations from a 1:50,000 map sheet, place the centre of the template at the location of the gravity station. The orientation of the template's top row should be in the east-west direction. The 500 metre grid (large squares) elevations are picked at the location of the + on the template. The 125 metre grid (small squares) elevations are picked at the centre of the square. The north-west corner grid location, position 1 below, is used in the station file to determine the grid orientation.

To pick elevations from a topographical map at a scale other than 1:50,000 the user will have to manufacture a corresponding template.

The picking of the elevations using the template for the type 2 grid is as follows:

1 2 3 4 5 6 7 8 9 10 11 12

13 14 15 16 17 18 19 20 21 22 23 24

25 26 27 28 29 30 31 32 33 34 35 36

37 38 39 40 41 42 43 44 45 46 47 48

53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68

69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84

49 50 51 52 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 117 118 119 120

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116

125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140

141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156

121 122 123 124 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 189 190 191 192

173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188

197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212

213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228

193 194 195 196 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 261 262 263 264

245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260

269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284

285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300

265 266 267 268 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 333 334 335 336

317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332

337 338 339 340 341 342 343 344 345 346 347 348

349 350 351 352 353 354 355 356 357 358 359 360

361 362 363 364 365 366 367 368 369 370 371 372

373 374 375 376 377 378 379 380 381 382 383 384

4.1.2 NOTES ON ELEVATION PICKS

All elevations are entered in either metres or feet above sea level. Ocean depths are entered in the same units as the elevations and are negative. Lake, river and glacier depths are converted to equivalent rock elevations.

Equivalent rock elevations are calculated by the following formula:

$$ER = SE - D + D * DD / RD \quad ,$$

where
ER ... is the equivalent rock elevation
SE ... is the surface elevation
D ... is the lake, river or glacier depth
DD ... is the density of water (1.Ø gm/cc) or ice (Ø.9 gm/cc)
RD ... is the density of rock (2.67 gm/cc)

4.1.3 EXAMPLE STATION FILE

```
                                         Column Position
123456789 123456789 123456789 123456789 123456789 123456789 123456789 123456789
300270 WITHOUT LOCAL GRID
50.3718   123.0502    2362.50    10.0   3   1
0 0.0 0.0
300270 WITH A TYPE 1 LOCAL GRID
50.3718   123.0502    2362.50    10.0   3   1
1 50.3967   123.0890
  1676   1890   1981   2088   2134   1951   1737   1646   1737   2073   2073   1890
  1646   1737   1835   1926   2103   1951   1814   1768   1996   2073   2012   1783
  1692   1722   1829   1829   2073   2027   1981   1859   2012   1920   1753   1469
  1768   1951   2012   2006   2128   2164   2042   2042   1981   1835   1804   1579
  1554   1768   1804   1829   2075   2173   2088   2072   2015   1981   1935   1996
  1494   1661   1673   1862   1920   2183   2207   2212   2256   2164   2210   2179
  1615   1652   1875   1951   1907   2194   2282   2283   2423   2454   2316   2164
  1682   1804   2134   1981   1999   2210   2248   2195   2256   2350   2286   2362
  1631   1951   2195   2057   2134   2179   2195   2073   1984   2210   2042   2012
  1615   1884   1951   2134   1996   1935   2012   1920   1865   1981   1798   1737
  1433   1646   1966   2042   1774   1753   1722   1829   1859   1832   1798   1768
  1265   1554   1768   1951   1707   1585   1402   1570   1829   1646   1847   1862
300270 WITH A TYPE 2 LOCAL GRID
50.3718   123.0502    2362.50    10.0   3   1
2 50.3967   123.0890
  1676   1890   1981   2088   2134   1951   1737   1646   1737   2073   2073   1890
  1646   1737   1835   1926   2103   1951   1814   1768   1996   2073   2012   1783
  1692   1722   1829   1829   2073   2027   1981   1859   2012   1920   1753   1469
  1768   1951   2012   2006   2128   2164   2042   2042   1981   1835   1804   1579
  1554   1768   1804   1829   2042   2103   2164   2219   2240   2210   2179   2134
  2088   2067   2073   2067   2063   2063   2057   2045   2012   2057   2134   2225
  2240   2210   2179   2134   2103   2088   2079   2079   2076   2073   2067   2054
  1935   1996   2103   2195   2225   2231   2195   2149   2118   2097   2088   2088
  2082   2079   2073   2070   1890   1966   2073   2134   2195   2231   2210   2164
  2118   2103   2088   2094   2097   2100   2103   2097   2015   1981   1935   1996
  1494   1661   1673   1862   1856   1920   2012   2057   2149   2201   2225   2179
  2152   2149   2143   2146   2134   2140   2149   2164   1862   1890   1966   2027
  2103   2164   2225   2210   2195   2188   2185   2188   2182   2176   2225   2240
  1878   1890   1951   1996   2088   2149   2225   2240   2225   2225   2240   2225
  2225   2219   2225   2256   1884   1890   1951   2042   2103   2195   2286   2316
  2316   2332   2316   2286   2271   2256   2256   2286   2256   2164   2210   2179
  1615   1652   1875   1951   1884   1887   1935   2012   2103   2240   2316   2347
  2347   2313   2316   2323   2323   2316   2301   2332   1856   1859   1951   2027
  2097   2195   2256   2301   2307   2301   2292   2286   2280   2274   2301   2316
  1896   1914   1951   2018   2088   2149   2210   2271   2280   2274   2262   2249
  2256   2262   2286   2301   1914   1920   1966   2027   2088   2149   2179   2240
  2262   2256   2249   2240   2243   2249   2262   2286   2423   2454   2316   2164
  1682   1804   2134   1981   1926   1951   1981   2073   2134   2164   2188   2243
  2271   2256   2240   2231   2228   2225   2228   2256   1945   1954   2027   2088
  2149   2195   2210   2256   2271   2256   2228   2219   2210   2210   2207   2204
  1951   1981   2057   2134   2179   2210   2210   2240   2271   2256   2225   2195
  2188   2179   2179   2176   1981   2042   2088   2149   2179   2195   2195   2204
  2262   2277   2225   2188   2164   2158   2149   2149   2256   2350   2286   2362
  1631   1951   2195   2057   2134   2179   2195   2073   1984   2210   2042   2012
  1615   1884   1951   2134   1996   1935   2012   1920   1865   1981   1798   1737
  1433   1646   1966   2042   1774   1753   1722   1829   1859   1832   1798   1768
  1265   1554   1768   1951   1707   1585   1402   1570   1829   1646   1847   1862
```

4.2 IRREGULARLY SPACED ELEVATION FILE

The irregularly spaced elevation file is a user-supplied file that contains randomly distributed elevation picks. These picks should highlight the major topographic features around the gravity station.

This file is necessary in areas where the topography is very irregular. Up to 2900 elevations can be used for each station but the file itself may contain as many elevations as the user wishes.

This file is read using a free format. The order of the variables, if geographical units are **not** being used, is east-west position (X), north-south position (Y), elevation (Z). If geographical units are being used the order is LATITUDE, LONGITUDE, ELEVATION. The geographical co-ordinates are in decimal degrees with north and west being positive. The elevations must be in the same units as described on the station file.

The vertical information is either elevations or ocean depths. Lake, river and glacier depths must be converted to equivalent rock elevations (section 4.1.2).

4.2.1 EXAMPLE IRREGULARLY SPACED ELEVATION FILE RECORDS

```
50.22768 123.31250 1722.0
50.20089 123.22920 1707.0
50.12946 123.17360 1189.0
50.12054 123.13190  838.0
50.08482 123.09030 1036.0
50.20982 123.06250 1433.0
50.15625 123.02080 1524.0
50.12054 122.97920  625.0
50.12054 122.93750  692.0
50.17411 122.89580  884.0
50.21875 122.84030  945.0
50.34375 123.29860 2256.0
50.32589 123.27080 1981.0
50.30803 123.24310 1524.0
50.29018 123.21530 1250.0
50.27232 123.18750 1186.0
50.25446 123.15970 1042.0
50.48661 123.14580 1631.0
50.46875 123.11810 1006.0
```

4.3 SYSTEM DEFAULT FILE

The system default file contains information on printer commands and default file names. The default system file name is **DEFAULT.CFG**. This file in not necessary for the program to execute.

An example system default file follows;

```
                                   COLUMN
            1234567890123456789012345678901234567890123456789
LINE 1 :STATION.TST
LINE 2 :TERRAIN.TST
LINE 3 :LPT1
LINE 4 :     2     1     1
LINE 5 :    27    64    32    32    32    32    32    32    32    32
LINE 6 :    15    32    32    32    32    32    32    32    32    32
LINE 7 :    18    32    32    32    32    32    32    32    32    32
LINE 8 :      2.670
LINE 9 :      1.030
```

Line 1 contains the default file name of the station file.

Line 2 contains the default file name of the irregularly spaced elevation file.

Line 3 contains the default file name for the output summary file or the printer's port name.

Line 4 contains the number of codes for the printer initialization, compressed printing on and compressed printing off, respectively.

Line 5 contains the decimal equivalent codes for the printer initialization, padded with 32's (blanks).

Line 6 contains the decimal equivalent codes for compressed printing on, padded with 32's (blanks).

Line 7 contains the decimal equivalent codes for compressed printing off, padded with 32's (blanks).

Line 8 contains the value for the density of rock in grams per cubic centimetre.

Line 9 contains the value for the density of water in grams per cubic centimetre.

The printer codes shown in the above example are for an EPSON compatible parallel printer.

5.0 OUTPUT SUMMARY FILE

The output summary file contains information on the gravity stations and the computed terrain corrections. A histogram of gravitational attraction versus radial distance is supplied, so that the user may get a feel for the amount of digital terrain required to define the terrain correction adequately.

The file contains codes to switch the printer to and from compressed printing mode. The default codes are for an IBM compatible printer. It may be necessary to change these printer codes for use on a non-IBM compatible printer. This may be done from the main menu of the program. Remember to save these codes to the default system file for later use.

5.1 EXAMPLE OUTPUT SUMMARY FILE

```
LISTING OF TERRAIN CORRECTIONS PRODUCED BY THE PROGRAM TRITER                                                    PAGE    1
DATE OF RUN 16/ 9/1987

STATION I.D.                     : 300270 WITHOUT LOCAL GRID
LATITUDE                         :   50.37180       OR          50 22.30800
LONGITUDE                        :  123.05020       OR         123  3.01200
UTM ZONE                         :         10
NORTHING                         :    5579752
EASTING                          :     496439
ELEVATION                        :  2362.50 metres OR  7750.98 feet
MAXIMUM RADIUS                   :   25.000 kilometres
NUMBER OF ELEVATIONS USED        :       1832
NUMBER OF TRIANGULAR PRISMS USED :       3573
TERRAIN CORRECTION COMPUTED      :      27.10 mGals

HISTOGRAM OF GRAVITATION ATTRACTION VERSUS RADIAL DISTANCE IN KILOMetreS

DIST   NUMBER  CONTRIB
RANGE  TRIANG  (mGals)      EACH * EQUALS  0.08472 mGals
                       |----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
 0- 1     10     8.472 :****************************************************************************************************
 1- 2     17     2.745 :********************************
 2- 3     34     2.382 :****************************
 3- 4     44     1.861 :**********************
 4- 5     59     1.482 :*****************
 5- 6     70      .933 :***********
 6- 7     87      .747 :********
 7- 8     94      .652 :*******
 8- 9    104      .541 :******
 9-10    128      .616 :*******
10-11    138      .620 :*******
11-12    145      .619 :*******
12-13    159      .523 :******
13-14    180      .481 :*****
14-15    188      .431 :*****
15-16    193      .723 :********
16-17    219      .671 :*******
17-18    224      .552 :******
18-19    236      .479 :*****
19-20    251      .429 :*****
20-21    254      .368 :****
21-22    232      .286 :***
22-23    202      .212 :**
23-24    182      .164 :*
24-25    123      .106 :*
```

6.0 PROCEDURE TO RUN THE PROGRAM TRITER

First boot the computer with DOS 2.1 or later. Then create the required data files.

Place the **TRITER EXE** diskette in the default floppy diskette drive and enter **TRITER<cr>**. Once the program has been loaded, a banner page will be displayed and you will be prompted to enter a **<cr>**. Before entering a **<cr>**, the **TRITER EXE** diskette can be removed and replaced by a data diskette. It is recommended that the diskette drive or hard disk directory that contains the data be set as the default directory path.

After entering a **<cr>** the main menu will be displayed. This menu displays the programs default file names and printer codes. An example screen is below.

```
TRITER -- GRAVITY TERRAIN CORRECTION PROGRAM

A -- Change gravity station file              : STATION.TST
B -- Change irregularly spaced elevation file : TERRAIN.TST
C -- Change output summary file               : LPT1


D -- Change printer initialization codes      :  27  64
E -- Change printer compressed on codes       :  15
F -- Change printer compressed off codes      :  18


G -- Change the rock density (gm/cc)          :     2.670
H -- Change the water density (gm/cc)         :     1.030


X -- EXECUTE the program using the parameters above
Q -- QUIT the program and return to DOS

Enter A to F, Q or X :
```

To change an input or output file name, enter the letter that precedes the description, i.e. **A**, **B** or **C**. You will then be prompted for the new file name.

The output summary file may be sent directly to a printer by entering the printers name without the colon, i.e. LPT1 or COM1.

To change the density of rock or water, enter the letter which precedes the description, i.e. **G** or **H**. You will then be prompted to enter the new density.

To change the printer codes enter **D**, **E**, or **F** depending on which code you wish to change. A screen similar to the following will be displayed.

```
To set the printer codes you first tell the program
how many codes that you wish to enter. Then you enter the
codes as integer base ten numbers representing the ASCII
characters that you wish to send to the printer.

The maximum number of codes is 1Ø.
The range of a code is Ø to 255.

The printer initialization codes are :
Number of codes :  2
The decimal values are  :   27  64

Enter the new number of codes (negative to leave unchanged) : 2

Enter code #  1 : 27
```

Once you have entered the required parameters, enter **X** to execute the program. If you have changed any of the default file names or printer codes, you will be asked if you wish to save the parameters as the new defaults. If you answer **Yes**, then the program will pause and ask you to the place the data diskette into the default drive. Once the program has written the new defaults, it will pause again so that you may replace the diskette with the proper data diskette, if necessary.

If you respond with **No** to saving the new defaults, the program will then calculate the terrain corrections.

The program will display messages about its progress. These messages include the station identifier of the terrain correction that is being computed, a running count of the elevations that will be used in the calculation of the terrain correction, indication when working on triangulation, indication while computing the terrain correction and the results of the calculation.

Responding to the main menu with a **Q** will terminate the program immediately.

It may take about 3Ø minutes per station if it is using 24ØØ irregularly spaced elevations on a 4 MHz computer. Therefore, when execution is finished the PC's bell will sound.

7.Ø REFERENCES

Nagy, D., 1966, The Gravitational Attraction of a Right Rectangular Prism, Geophysics, Vol. 31, pp. 362-371.

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