MATHEMATICAL-CARTOGRAPHICAL MODELLING OF THE VERTICAL STRUCTURE OF THE MOUNTAINOUS LANDSCAPE ON THE COMPUTER (ON THE EXAMPLE OF EASTERN PART OF THE CAUCASUS MINOR)

Nablyev Alpasha Alibek
Baku State University
Geographical Faculty
370145, Baku, Z. Halilov Street, 23

The investigation of the vertical structure of the landscapes of mountainous countries was the subject of the research of R.A. Elinevsky (1968), I.S. Shukin and O.E. Shukina (1959), B.I. Alekseev and E.N. Lukashov (1969), E.P. Miller (1974) and others. With the aim of determining the regularities of the distribution of (quantitative) data of the landscape structure on the gynsometrical levels of the relief, the gynsometric map of the township of the Caucasus Minor and the large-scale landscape map of the Caucasus Minor composed by Prof. M.A. Myseilov and M.A. Suleymanov (1975, 1981) had been used by us applied quantitative data of the landscape structure were as follows:

1. Areas of the individual uruchish in square km, where \( S_1 \)

2. The average arithmetical numbers of contours: \( \bar{S}_{a2} = \frac{\sum S_i}{\sum S_i/N} \)

3. The general entropy: \( H_g = \frac{\sum S_i \log_2 S_i}{\sum S_i \log_2 S_{a2}} \)

4. Maximal entropy: \( H_m = \frac{\sum S_i \log_2 S_i}{\sum S_i \log_2 S_{a2}} \)

5. Relative entropy: \( H_r = \frac{H_m - H_g}{H_m} \)

6. Average square declination:

\[ \beta = \left[ \frac{\sum (S_i - \bar{S}_{a2})^2}{(N-1)} \right]^{1/2} \]

7. Coefficient of variation:

\[ C_V = \frac{\sigma}{\bar{S}_{a2}} \]

8. Limits of the individual contours of landscape group in square km.

9. The number of individual contours - \( N \)

10. Coefficient of landscape unhomogeneity:

\[ K_{UV} = \sum_{i<j} \sum_{i<j} m_i \cdot m_j / \sum_{i<j} \frac{S_i \cdot S_j}{N} \]

where \( i < j < N \), \( m_{ij} = S_i / 100 \% / N \)

\( S_i \) - is the square of several genetic groups of landscapes (urochish) in the local zones; \( N \) - number of genetic group of landscapes (urochish) \( \sum m_{ij} \) - number of addition from the quantity of pairs. On the basis of above-mentioned data the fortran-program on the computer US-1035 was composed catalogizing on the packet of discs 5261 with the serial number "GEO LAND" had been done and for output data on the packet the continuous complex of data "BSCAN" was created. For conducting the calculation of the data the task in US of UC of 5.1 version had been composed by us. Results of calculations had been given in the table 1.

### Table 1.

<table>
<thead>
<tr>
<th>Gypsumetrical levels</th>
<th>The quantitative data of the landscape structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H(m) )</td>
<td>1</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
</tr>
<tr>
<td>1. milk 200</td>
<td>1769</td>
</tr>
<tr>
<td>2. 200 - 400</td>
<td>3766</td>
</tr>
<tr>
<td>3. 400 - 600</td>
<td>2345</td>
</tr>
<tr>
<td>4. 600 - 1000</td>
<td>2856</td>
</tr>
<tr>
<td>5. 1000 - 1400</td>
<td>2400</td>
</tr>
<tr>
<td>6. 1400 - 1800</td>
<td>2416</td>
</tr>
<tr>
<td>7. 1800 - 2200</td>
<td>1553</td>
</tr>
<tr>
<td>8. 2200 - 2600</td>
<td>928</td>
</tr>
<tr>
<td>9. 2600 - 3000</td>
<td>771</td>
</tr>
<tr>
<td>10. 3000 - 3400</td>
<td>431</td>
</tr>
<tr>
<td>11. 3400 - 3800</td>
<td>1000</td>
</tr>
</tbody>
</table>

On the basis of the received results one may come to the following results: 1. With increase of the height of the place the average amount of the squares of the individual group of landscapes;

2. The change of the general entropy according to the relief is similar to the change of the square of the hypsometrical level as the both data in the middle mountain receive maximal amount;

3. Maximal entropy also gets its maximum in the middle mountain.

4. The amount of the middle square declination gradually decreases with the increase of the height of the place;

5. In the distribution of the coefficient of the variation the decrease on the height of the relief is also observed;

6. Limits of the squares of contours are characterised by the accidental variation. 7. Distribution of the quantities of contours are similar to the distribution of the the amount of the squares of the contours and the general entropy. 8. Coefficients of the landscape unhomogeniosty are not regular distributed according to the height of the relief.

Results of the conducted investigations can be used while doing the meliorative works in the mountainian and pre-mountain-
nian conditions, while working out schemes of the regional planning while doing the erectional works in the mountainian conditions, while recreational evaluation of the territory with the aim of rest and tourism. Besides these, the developed method might be applied in the course of analysis of the vertical structure of the soil—plant cover, types of relief, types of quantitary layers and in the process of analysis of the other elements of the geographical landscapes. In the final stage of the investigation one can come in to the following results on the basis of received results: maps of landscape structures of gysometrical levels of the researched territories had been composed on the printer of the personal computer IBM PC AT.

**RESEARCH EXAMPLE**

Hypsographical map of Physical-Geographical Field of The Caucasus Minor (within the limits of Azerbaijan Republic)

The map of the distribution of the coefficient of unhomogeneity the landscape (according to squares)

---

- Plains
- Fore mountainious
- Low mountains
- Middle mountains
- High mountain
EXAMPLE FORTRAN PROGRAM PRICLAN

DIMENSION ABSVAR(990), SVVAR(990),
* W(990), V(990), T(100), AKORRX(990),
* VKORRV(990), X(990), AEN(990),
* UZUN(990), NK(990), NN(990),
* GRAINA(1000, 10), SUMGR(1000)

DO 44 KK = 1, N

FORMAT(1H0.4, A1)

PRINT 20, TT

READ(5, 20) TT

FORMAT(1H0.4, A1)

NN(KK), NK(KK), X(KK), AEN(KK),

UZUN(KK), DADe5 20) TT 20

CONTINUE

DO 623 I = 1, N

SUMGR(I) = 0.0

CONTINUE

623

CONTINUE

CALL FORMA(NN, NK, X, AEN, UZUN, SUMGR, N)

DO 66 L1 = 1, N

IF(L1 .EQO 1) GO TO 985

IF(L1 .EQO 2) GO TO 986

IF(L1 .EQO 3) GO TO 987

986

CONTINUE

DO 867 L2 = 1, N

X(L2) = AEN(L2)

CONTINUE

987

CONTINUE

985

SYM = 0.

XMIN = X(1)

XMAX = XMIN

DO 77 I = 1, N

IF(X(I) .LT. XMIN) XMIN = X(I)

IF(X(I) .GT. XMAX) XMAX = X(I)

CONTINUE

PRINT 88, XMIN, XMAX

FORMAT(1H0.4, A1)

WRITE(6, 88) XMIN, XMAX

CONTINUE

400 FORMAT(1H0.4, A1)

WRITE(6, 400) XMIN, XMAX

CONTINUE

4

CONTINUE

955

SYM = 0.

XMIN = X(1)

XMAX = XMIN

DO 77 I = 1, N

IF(X(I) .LT. XMIN) XMIN = X(I)

IF(X(I) .GT. XMAX) XMAX = X(I)

CONTINUE

PRINT 88, XMIN, XMAX

FORMAT(1H0.4, A1)

WRITE(6, 88) XMIN, XMAX

CONTINUE

4

CONTINUE

SUBROUTINE FORMA(NN, NK, PLOSAD, SIRINA, DILNA, GRANIS, N)

DI~lliNSION DILNA(1000), SIRINA(1000), GRANIS(1000), PLOSAD(1000), TT(77),

S(1000), NK(1000), NN(1000)

DO 3 I = 1, N

GRANIS(I) = GRANIS(I) * 2.0

SIRINA(I) = SIRINA(I) * 2.0

DILNA(I) = DILNA(I) * 2.0

PLOSAD(I) = PLOSAD(I) * 4.0

CONTINUE

3

CONTINUE

DO 4 I = 1, N

S(I) = DILNA(I) / SIRINA(I)

GrK(I) = GRANIS(I) / (S(I) / 2.0)

XS(I) = 1.24 * PLOSAD(I) / DILNA(I) * S(I)

CONTINUE

WRITE(6, 5)( S(I), I = 1, N)

WRITE(6, 5)( SPK(I), I = 1, N) / (XS(I), I = 1, N)

5

FORMAT(12F10.4, 12F10.4 / 12F10.4)

SUBROUTINE KABKAZ(NM, S)

DIMENSION SQ(990), W(50)

WN = 0.

AN = N

DO 33 I = 1, N

S(I) = S(I) / (2.0 / AN)

AM(I) = S(I) / (100.0 / AN)

SUM = SUM + AM(I) * AM(I)

CONTINUE

33

CONTINUE

ODNOR = SUM / (AN * (AN - 1.0) / 2.0)

WRITE(6, 5) WN, SUM, ODNOR

5

FORMAT(1H0.4, A1)

WRITE(6, 5) WN, SUM, ODNOR

CONTINUE

RETURN

END

EXAMPLE SYSTEMIC PROCEDUR

READ 50, X, AEN, UZUN, SUMGR, NM

CONTINUE

STOP

END

EXEC FORTGCLG, PARM.FORT=SOURCE, SYSPRINT DD SYSOUT=SER=GEOLAN

DSN=PRICLAN (PRICLAND)

IGO.SYSIN DD UNIT=SYSDA, VOL=SER=GEOBAB

DSN=LAN.

DATA (LAND oBASE),

175

FORMAT(1H0.4, A1)

WRITE(6, 50) HDOI1, HDELTA

RETURN

END

EXEC FORTGCLG, PARM.FORT=SOURCE, SYSPRINT DD SYSOUT=P

FORT.SYSIN DD UNIT=SYSDA, VOL=SER=GEOLAN,

DSN=PRICLAN (PRICLAND)

DSN=LAN.

DATA (LAND oBASE),

175

FORMAT(1H0.4, A1)

WRITE(6, 50) HDOI1, HDELTA

RETURN

END

EXEC FORTGCLG, PARM.FORT=SOURCE, SYSPRINT DD SYSOUT=P

FORT.SYSIN DD UNIT=SYSDA, VOL=SER=GEOLAN,

DSN=PRICLAN (PRICLAND)

DSN=LAN.

DATA (LAND oBASE),

175

FORMAT(1H0.4, A1)

WRITE(6, 50) HDOI1, HDELTA

RETURN

END

EXEC FORTGCLG, PARM.FORT=SOURCE, SYSPRINT DD SYSOUT=P