REGIONAL METHODS OF COMPUTATIONS OF MEAN SUMMER TEMPERATURE AND INTRAANNUAL COURSE OF GLOBAL RADIATION WITHIN CENTRAL ASIA

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In the mathematical model of glaciermelt elaborated by V.Konovalov (Konovalov 1985), the initial formula for determining daily amounts of global radiation Q_s in clear days is as follows.

$$Q_s = J_s T_1 / \pi * \int_0^{\tau_s} \frac{\sinh_s}{\rho(z,t) + \sinh_s} [\sinh_s + 0.38\rho(z,t)] dt_1 \qquad (1)$$

Where
J_s = meteorological solar constant,
T_1 = duration of day, equal to 1440 min.,
τ_s = time of sunset, or sunrise,
t_1 = time during the day, expressed through the periodical function of hour's angle,
r = general transparency of atmosphere, and
h_s = the angle of sun's height, z - is the altitude above sea level.

The intraannual course of the general transparency of atmosphere at different altitudes (Konovalov 1985) describes the following expression.

$$\rho(z,t) = 0.383 - 0.068z + (0.036 + 0.031z - 0.084z^2) * \cos [2\pi(t-373 + 59.5z - 11.7z^2) / T_2] \qquad (2)$$

Here, T_2 = 365 days. Analysis of the formula (2) showed that $\rho(z,t) > 0$ at 0 5.19km. For practical applications it was accepted that, at z >5.19 kmasl, r is constant equaled in value to z = 5.19km.

After some mathematical transformations, it is not difficult to derive analytical formulae for determining the underintegral expression in the right part of (1). Those formulae were used for the calculation of

$$Q_s = Q_s (z, t, j)$$

within Central Asian by means of a special computer's routine. This routine also envisages the calculation of incoming Q_s on slopes of different inclination and exposition, taking into account the actual conditions of cloudiness. For some points within Central Asia, Q_s was calculated with measurements of global radiation. The relative deviations between measured and calculated values of Q_s are presented in the Table 1.

To develop the regional method of calculation of mean summer temperature as a function of altitude z, latitude j, longitude l were used the data of 198 meteorological points, located inside of altitudinal range from 0.3 km till 4.9 km above sea level. Twelve points on glaciers were also included in this set of data.

Ultimately, for the calculation of mean summer air temperature within Central Asian territory the following expression was derived.

$$\Theta_s = 70.56 - 0.517*10^{-2} z - 0.407 *10^{-6} z^2 - 1.102 j + 0.0409 l, \quad (3)$$

where
Θ_s = summer mean temperature,°C,
z = altitude, masl,
j = latitude, and
l = longitude.

The correlation relationship for (3) equalled 0.98 and the root mean square error was 1.37°C. The calculations' quality according to (3) were estimated by comparing Θ_s values derived by the proposed formula, with the same characteristics determined by the well-known method of A. Krenke (1982). These values are presented in the Table 2. As anybody can see, the correspondence between the compared characteristics is rather satisfactory. That permits us to recommend our simple and effective method for wide application.

REFERENCES

Konovalov, V.G., 1985. *Tayanie i stok s lednikov v basseynakh rek Sredney Azii* (Melting and Glacial Runoff Processes in the Central Asia River Basins). Leningrad, Gidrometeoizdat.

Krenke, A.N., 1982. *Massobmen v lednikovykh sistemakh na territorii SSSR* (Mass-exchange in the Glaciers Systems over the USSR Territory). Leningrad, Gidrometeoizdat.

Table 1. Relative Deviations (%) between Measured and Calculated Monthly Sums of Global Radiation

Points	z kmasl.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Chardjou	0.188	-10	-9	-3	0	2	3	6	0	-4	-13	-14	-12
Ashgabat	0.227	-5	-6	1	4	7	9	11	8	5	-6	-7	-3
Termez	0.309	-9	-6	1	2	6	4	5	3	-2	-8	-11	-12
Kairak-kum	0.347	-8	-11	-3	1	3	7	8	5	-1	-10	-11	-9
Tashkent	0.478	-9	-10	-3	3	7	5	6	7	0	-8	-10	-9
Fergana	0.578	-1	-8	-7	4	7	7	8	4	0	-7	-11	-10
Samarkand	0.689	-5	-3	3	7	8	5	9	5	3	-6	-9	-7
Bishkek	0.756	-12	-10	0	3	7	9	8	6	1	-10	-12	-12
Alma-Aty	0.847	-6	-5	2	4	7	8	8	7	1	-9	-9	-7
Kyzylcha	2.076	-15	-18	-8	-10	-4	-3	-2	0	-3	-12	-14	-15
Big Almaty Lake	2.516	0	-11	-4	-3	1	5	6	6	2	-9	-11	-22
Tienshan	3.610	-7	-6	-3	-2	1	3	4	1	-2	-8	-12	-10
Lednik Fedchenko	4.169	-5	-5	-5	-2	-1	2	4	2	0	-8	2	-3

Table 2. Comparisons of Θ_s Calculations by Formula (3) and Krenke's Method, °C

Z kmasl	φ NL	λ EL	Θ_s by (3)	Θ_s by Krenke	Difference, °C	Z kmasl	φ NL	λ EL	Θ_s by (3)	Θ_s by Krenke	Difference, °C
3.96	39.0	66.8	3.6	3.4	0.2	3.98	38.2	65.3	4.0	4.1	-0.1
4.04	39.1	67.3	3.3	2.7	0.6	3.82	38.1	64.8	4.9	5.5	-0.6
3.89	39.3	67.3	3.9	3.7	0.2	3.76	38.1	64.5	5.4	6.0	-0.6
4.10	39.1	67.9	2.8	2.2	0.6	3.85	37.1	67.7	5.3	6.3	-1.0
4.10	39.2	68.8	2.6	2.1	0.5	3.83	37.8	65.3	5.1	5.8	-0.7
4.10	39.9	69.6	3.1	1.4	1.7	3.95	37.6	65.5	4.6	5.0	-0.4
4.26	39.5	70.4	1.9	0.5	1.4	3.95	37.8	65.6	4.5	4.8	-0.3
4.36	39.6	71.1	1.1	-0.5	1.6	3.77	38.0	66.1	5.6	6.1	-0.5
4.29	40.1	71.8	1.4	-0.4	1.8	3.91	38.0	67.0	4.9	5.0	-0.1
4.35	39.9	72.3	1.3	-0.7	2.0	3.67	38.5	68.8	6.1	6.5	-0.4
4.05	40.4	73.6	3.0	1.4	1.6	3.94	38.4	67.9	4.4	4.3	0.1
4.15	40.7	74.3	2.0	0.3	1.7	3.85	38.7	68.7	5.0	4.8	0.2
4.09	38.9	68.8	3.1	2.5	0.6	3.83	38.7	69.2	5.0	5.0	0.0
3.98	38.3	67.6	4.2	4.1	0.1	4.03	39.2	70.3	3.6	2.8	0.8
3.97	38.0	65.6	4.1	4.4	-0.3	4.23	39.3	70.4	2.1	1.0	1.1