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HEAT, MOISTURE AND TRANSFER OF WATER-SOLUBLE COMPOUNDS IN PEAT SOILS

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Abstract. On the basis of theoretical analysis of literature and data obtained from monitoring the problem of two dimensional interdependent heat-mass transfer in the soil top layer accounting for the exchange of heat and moisture with a soil air stratum have been formulated. Regularities in the temperature and moisture modes changes in the top layer of soil were observed in monitoring and a computer simulation method was elaborated. A considerable amplitude of daily temperature fluctuations on the ameliorated peat soil surface can be one of the basic reasons for the degradation of ameliorated peat soils.

Keywords: ameliorated peat soils degradation, droughts and frosts, temperature and moisture modes, water-soluble compounds.

INTRODUCTION

Unlike mineral soils, peats have a series of features. These features are stipulated, first of all, by a sharp change of the characteristics of heat-mass transfer and soil structure at the change of temperature-moisture characteristics. After drainage, peat-mire soils become ecologically labile. They are exposed to wind erosion, frost, droughts. Organic matter of these soils is intensely mineralized. To solve this problem, implicated in title of this work it is necessary to elaborate methods for forecasting and optimisation of temperature and moisture characteristics of soils. Thus, it is necessary to note, that the dynamics of temperature and moisture field directly affects re-distribution of mineral water-soluble compounds in the soil surface layer. They are applied to the ground as fertilizers, or get there as technogenic contaminants. Scientifically justified prognosis of temperature or moisture characteristics and transport of water-soluble compounds should be based on the solutions for interrelated transport of heat and water-soluble compounds. To solve these problems, it is necessary to take into account conjugated flows of heat and moisture on the soil surface defined by meteorological conditions, and also to consider availability of heterogeneous horizontal top layer of soil.

METHODS

Test sites were built to observe temperature and moisture profiles characteristics of peat soils. One group of test locations was located in IPNRUE ASB territory where peat was poured into the stratum. Others including sites with peat poured into stratum and drained peat bogs, were located in the buffer zone of the Beresinsky State natural conservation area. In 1996-1998 temperature and heat fluxes monitored in the top layers of peat soils by means of an automatic registration system were periodically carried out. Moisture mode was controlled by a periodical collection of samples.

Considering the above, the problem of two dimensional interrelated heat mass transfer in the top soil layer accounting for the exchange of heat and moisture with a soil and air was formulated. Thus, it is supposed, that heat in the soil is transferred mainly conductively and moisture is transferred by means of moisture conductivity affected by the complete chemical potential μ_M, that depends on moisture content u and gravity potential gh, where g is free fall acceleration, h - height in relation to a standard level. It is also supposed that alongside with a fluid flow in the soil, there is a steam flow under the influence of partial steam pressure gradient P_p. The partial steam pressure P_p in the soil is a function of temperature and moisture content. A specific view on this function is determined by the influence of saturated steam pressure on temperature and isotherms of sorption - desorption of moisture by the soil.

Boundary conditions on the soil surface are assumed on the basis of data on the radiative and convective heat exchange, and also on the convective exchange by the steam of the soil air stratum with the soil surface. Horizontal surface run-off can also be evaluated, if the slope angle of relief is preset on the soil surface. At a lower boundary of an active layer, the level of ground waters stagnation is set.

Mathematically, the problem is described in the following way:

$$\frac{\partial T}{\partial \tau} C_{\mathrm{ef}} \rho = \frac{\partial}{\partial x}\left[\lambda(u,T)\frac{\partial T}{\partial x}\right] + \frac{\partial}{\partial y}\left[\lambda(u,T)\frac{\partial T}{\partial y}\right] \quad (1)$$

$$\frac{\partial u}{\partial \tau}\rho_{\mathrm{ck}} = \frac{\partial q_{\mathrm{wx}}}{\partial x} + \frac{\partial q_{\mathrm{wy}}}{\partial y} \quad (2)$$

$$q_{\mathrm{wx}} = -a_{\mathrm{w}}(u)\rho_{\mathrm{ck}}\left(\frac{\partial u}{\partial x}\right) - \lambda_{\mathrm{p}} f'_{2\mathrm{u}}(u,T)\frac{\partial u}{\partial x} - \lambda_{\mathrm{p}} f'_{2\mathrm{T}}(u,T)\frac{\partial T}{\partial x} \tag{3}$$

$$q_{\mathrm{wy}} = -a_{\mathrm{w}}(u)\rho_{\mathrm{ck}}\left(\frac{\partial u}{\partial y} - \frac{g}{\frac{\partial \mu_{\mathrm{M}}}{\partial u}}\right) - \lambda_{\mathrm{p}} f'_{2u}(u,T)\frac{\partial u}{\partial y} - \lambda_{\mathrm{p}} f'_{2T}(u,T)\frac{\partial T}{\partial y} \tag{4}$$

$$q_{\mathrm{R}}+q_{\mathrm{K}}+q_{\varphi}+q_{\mathrm{Ty}}=0 \qquad \text{at } y = 0; \tag{5}$$

$$q_{\mathrm{wy}} - K_{\mathrm{w}}\frac{\partial P_{\mathrm{p}}}{\partial y} = 0 \qquad \text{at } y = 0;$$

$$T = T_{\mathrm{C}};\ \ \mu_{\mathrm{M}} = 0 \qquad \text{at } y = H; \tag{6}$$

$$\mu_{\mathrm{M}} = \mathrm{f}_1(u);\ \ P_{\mathrm{p}} = \mathrm{f}_2(u, T); \tag{7}$$

where: T - temperature; u - ground moisture content; ρ - soil density; ρ_{ck} - soil skeleton density; $\lambda(u,T)$ - thermal conductivity of the soil; $C_{\mathrm{ef}}(u,T)$ - effective specific heat of the soil; a_{w} - diffusion coefficient of moisture; λ_{p} - coefficient of water vapour permeability; $\mathrm{f}_1(u)$, $\mathrm{f}_2(u,T)$ - functions expressing relation between matrix potential and steam tension on moisture content and temperature; q_{R} - aggregate radioactive flow; q_{k} - heat convective flow; q_{φ} - flow of heat at the expense of evaporation and condensation of moisture; q_{Ty} - convective flow of heat on the soil surface; K_{w} - turbulent diffusion coefficient.

On the basis of combined Eqs(1-4), the algorithm and computer programme to calculate processes of heat and moisture transport in the top soil layer taking into consideration local meteorological conditions were elaborated. The designed programme was tested on a number of problems for which solution could have been received by some older methods. Results showed stability and convergence of the calculating scheme. Matching of test calculations for the thermal field with reference methods showed a satisfactory accuracy of the newly designed method.

With the help of a sectional computational method, it is possible to calculate temperature, moisture content, flows of moisture in the top soil layer in relation to meteorological and hydrological requirements, and also to the terrain relief. It is also possible to take into account surface run-off. It allows for a more precise forecast migration of radionuclides and electrolytes in the soil as a result of connective transport. For the calculation of connective transport, it is necessary to define linear speed of porous moisture in a soil. Assuming that all moisture in the soil is of identical mobility, linear speed of moisture can be calculated from the formula:

$$V = \frac{q_\mathrm{w}}{\rho_\mathrm{ck} U} \tag{8}$$

where: q_w - moisture flow density.

However, taking into consideration data from literature [1], and data from our experience, there is a considerable proportion of moisture in the soil, which remains in a fixed state at filtration. Therefore, calculation of periopheral speed of moisture in the soil requires the following formula:

$$V = \frac{q_\mathrm{w}}{\rho_\mathrm{ck}(u - u_\mathrm{nf})} \tag{9}$$

where: u_nf - amount of a moisture that does not take part in filtration.

Thus it is necessary to suggest, that water-soluble compounds are both in the mobile and fixed state of moisture and can be transferred from one state to the other at definite velocity defined by the coefficient of mass transfer. For some simplification of the model let us assume, that mass transfer between water-soluble compounds, bound by the solid phase and located in the porous solution, occurs through an interlayer of the fixed moisture. We assume then, that distribution coefficients and diffusion of water-soluble compounds, both in mobile state, and fixed porous moisture, have identical value. When a complex of water-soluble compounds is available in the porous solution it is also necessary to take into account mutual effect of these compounds on their distribution coefficients.

Taking into account the above supposition the system of differential equations, featuring changes in the concentration of water-soluble compounds in a soil due to vertical filtration will have the following form:

$$\frac{\partial C_\mathrm{li}}{\partial \tau} = D_\mathrm{pi} \frac{\partial^2 C_\mathrm{li}}{\partial x^2} \frac{q_\mathrm{wy}}{\rho_\mathrm{ck}(W - W_\mathrm{nf})} \frac{\partial C_\mathrm{li}}{\partial x} + \frac{\alpha_\mathrm{f1} u_\mathrm{nf}}{(u - u_\mathrm{nf})}(C_\mathrm{nfi} - C_\mathrm{li}) \tag{10}$$

$$\frac{\partial C_\mathrm{ffi}}{\partial \tau} = D_\mathrm{pi} \frac{\partial^2 C_\mathrm{fi}}{\partial x^2} + \frac{\alpha_\mathrm{f2}}{u_\mathrm{nf}} \left(\frac{C_\mathrm{2i}}{K_\mathrm{di}(C_\mathrm{i}, C_\mathrm{j} \ldots, C_\mathrm{k})} - C_\mathrm{nfi} \right) - \alpha_\mathrm{fi}(C_\mathrm{nfi} - C_\mathrm{li}) \tag{11}$$

$$\frac{\partial C_\mathrm{2i}}{\partial \tau} = -\alpha_\mathrm{f2} \left(\frac{C_\mathrm{2i}}{K_\mathrm{di}(C_\mathrm{i}, C_\mathrm{j} \ldots, C_\mathrm{k})} - C_\mathrm{nfi} \right) \tag{12}$$

where C_li, C_2i, C_ffi - concentration of water-soluble compounds in mobile porous moisture, in solid and fixed porous moisture, accordingly; D_pi - diffusion constant of water-soluble compounds in porous moisture; α_f1 and α_f2 - coefficients of mass transfer of water-soluble compounds at the transition from mobile porous moisture into a fixed one and from fixed porous moisture into a solid soil phase K_{di} $(C_i, C_j \dots C_k)$ - distribution coefficient of water-soluble compounds as a function of concentration of all water-soluble compounds in a porous solution.

Such a system of differential equations should be for all the compounds which are in a soil. For the prognosis of the allocation dynamics of water-soluble compounds, it is necessary to compose a complete set of equations including Eqs (10-12), and also the Eqs (1-4), stated above to show the dynamics of a moisture field. Decisions on such a system are based only on the numerical methods with the help of a computer. It is necessary to note, that now for the solution of similar tasks, the problem is not just mathematical complications. Main difficulties are connected with data support of mathematical models. To supply data for these mathematical models of heat and mass transfer, experimental studies of the relations between empirical data and formula for all the indispensable parameters and performances for peat soils were obtained. The indicated relations are given below.

The functions for the approximation of μ_M (u) and P_p (u,T) are as follows:

$$\mu_M = 10\left[-\frac{a_1^3}{(u-a_2)^3}+\alpha_3\right] \tag{13}$$

$$T_p = T_{po}\exp\left(\frac{L_u}{R(T_o+273)}\,\frac{T-T_o}{(T+273)}-\frac{\mu}{R(T+273)}\right) \tag{14}$$

where: T_{po} - steam tension at T_o, °C, R - universal gas constant.

For lowland sedge peat the values of stationary coefficients comprise the following values:

$$a_1 = 1.7;\ \ a_2 = 0.2;\ \ a_3 = 2.25\ 10^{-3}.$$

While calculating temperature and moisture profiles of concrete soil, it is necessary to establish performance of heat and moisture transfer in these soils as a function of moisture content, density and organic and mineral components, and also functions expressing interrelation between moisture content and matrix potential of moisture. For peat soils incorporation of a sand component, the thermal conductivity coefficient is given by a function:

$$\lambda = a_o + a_1\,\rho_w + a_2\,\rho_s\,\rho_p + a_3\,\rho_s\,\rho_w + a_4\,\rho_s^{\,2} + a_5\,\rho_p^{\,2} + a_6\,\rho_w^{\,2} \tag{15}$$

where ρ_s, ρ_p, ρ_w - content of sand, peat and water accordingly (kg m^{-3}) in a volume unit of mass, λ - thermal conductivity, W(m K)$^{-1}$. Coefficients in the Eq. (15) assume the following values:

$$a_o = 1.98\ 10^{-2};\ a_1 = 6.58\ 10^{-4};\ a_2 = -1.22\ 10^{-6};\ a_3 = 8.69\ 10^{-7};\ a_4 = 7.43\ 10^{-7};$$
$$a_5 = 2.11\ 10^{-7};\ a_6 = -1.24\ 10^{-7}.$$

At negative temperature:

$$a_o = 2.38\ 10^{-2};\ a_1 = 5.37\ 10^{-4};\ a_2 = -3.47\ 10^{-6};\ a_3 = 2.75\ 10^{-6};\ a_4 = 8.81\ 10^{-7};$$
$$a_5 = 2.04\ 10^{-7};\ a_6 = 1.71\ 10^{-6}.$$

The Eq.(15) allows to define thermal conductivity coefficient of peat-mineral systems with extensive variation in the relation between peat and sand components, moisture content and density of organic-mineral skeleton in the fields of positive and negative temperatures in these systems.

On the basis of the experimental data a complex of heat-mass transfer in peat soils is obtained in relation to moisture content, temperature, density, distribution of organic and mineral components. On the basis of this complex, the data supporting mathematical models of heat and moisture transfer in peat soils such as empirical-formula relations of the characteristic features of heat and moisture transfer were obtained from the relevant parameters. Definition of soil heat capacity per unit in relation to moisture content, density and distribution of organic and mineral components can be done by the following formulae:

at positive temperature:

$$C_{vb} = \rho_s\, C_s + \rho_p\, C_p + \rho_w\, C_w; \tag{16}$$

at negative temperature:

$$C_{vb} = \rho_s\, C_s + \rho_p\, C_p + \rho_p\, u\, C_w + (\rho_w - \rho_p u)\, C_i \tag{17}$$

where C_s, C_p, C_w and C_i - specific heat capacity levels of sand ($C_s = 0.8$ J kg^{-1} K^{-1}), peat ($C_p = 2.0$ J kg^{-1} K^{-1}), water ($C_w = 4.18$ J kg^{-1} K^{-1}) and ice ($C_i = 2.0$ J kg^{-1} K^{-1}), respectively; u - amount of non-freezing water in peat (u = 0.4 kg kg^{-1}). At the transition from a thawed state into frozen state and vice versa, the heat of transition phase L_i (L_i=334 J kg^{-1}) is accounted for by:

$$Q_f = (\rho_w - \rho_p\, u)\, L_i. \tag{18}$$

Application of Eqs (15-18) assumes that density of organic-mineral skeleton and moisture content are known. They may vary during process of heat-mass transfer. Relations between moisture content and matrix potential and density of organic-mineral soils at minimum static load are expressed by the formulae:

$$u = 0.075\,A\left(-\frac{\mu}{g} + 0.002\right)^{\frac{1}{6}} + 1.7(1 - A)\left(-\frac{\mu}{g} + 0.044\right)^{-\frac{1}{3}} \tag{19}$$

where A - abundance of mineral component, g - free fall acceleration.

$$\rho = a_o + a_1 u + a_2\, uA + a_3 A_2 \tag{20}$$

where the coefficients have following values:

$$a_o = 227;\ a_1 = 85.1;\ a_2 = 410;\ a_3 = 808;\ \rho \text{ - kg m}^{-3}.$$

The volumetric content of soil components ρ_s, ρ_p and ρ_w are calculated by the formulae:

$$\rho_s \frac{\rho}{1+u} A \tag{21}$$

$$\rho_p = \frac{\rho}{1+u}(1-A) \tag{22}$$

$$\rho_w = \frac{\rho}{1+u} u . \tag{23}$$

The diffusion constant of moisture of peat - mineral soils in relation to moisture content and component composition is approximated by the formula:

$$a_w = 10^{-10}\left\{0.1\left\{\exp\left[4.395\frac{u}{1.04-A} - 0.52\frac{u^2}{(1.04-A)^2}\right] + 10\right\}\right\} . \tag{24}$$

The boundary conditions for the top soil layer are assumed regarding hydrological requirements at the lower boundary and meteorological conditions at the ground air stratum. Hydrological requirements are characterised by the groundwater level H and are set by the values of matrix potential and moisture content at the depth H:

$$u(H) = A(0.002)^{-\frac{1}{6}} 0.075 + (1-A)(0.044)^{-\frac{1}{3}} 1.7 . \tag{25}$$

As for the thermal problem, the value of temperature on the base surface of an acitve stratum T is set. Requirements on the soil surface are determined by the assignment of convective heat and steam flows and also by the radiation balance. The convective heat flow is calculated by the formula:

$$q_k = -\alpha_k (T_n - T_2) \tag{26}$$

where α_k - heat convection coefficient, W m^{-2} K^{-1}; T_n - ground surface temeprature; T_2 - temperature of air at the height of 2 m.

Heat convection coefficient α_k depending on wind velocity and time of day is calculated by the formulae:

$$\alpha_k = 4.0 + 2.0\, V_B \text{ (night time)} \tag{27}$$

$$\alpha_k = 8.5 + 2.0\, V_B \text{ (daylight).} \tag{28}$$

Flow of moisture on the surface depends on evaporation or condensation. The relevant heat flow is also calculated by the formulae:

$$q_\mathrm{w} = -\frac{\alpha_\mathrm{k}}{C_\mathrm{p}}(e_\pi - e_2) \tag{29}$$

$$q_\mathrm{j} = -\frac{\alpha_\mathrm{k}}{C_\mathrm{p}}(e_\pi - e_2) L_\mathrm{v} \tag{30}$$

where: C_p - heat air capacity at constant pressure; e_π - specific humidity on the ground surface; e_2 - specific humidity in a ground stratum at the height of 2 m; L_v - heat of water vaporisation ($L_v = 2500$ J kg^{-1}).

Radiation balance is calculated by the formula:

$$q_\mathrm{R} = (1-r)\, I + d(B_A - B_o) \tag{31}$$

where: r - albedo; I - aggregate solar radiation (direct and dispersed), W m^{-2}; B_o - radiation of ground; B_A - flow of colliding radiation of an atmosphere; d - soil absorptive power.

For the calculation I, the following formula will be used:

$$I = I^* \,(0.944 - 0.063\, \iota_L) \sin h \tag{32}$$

where: I* - solar constant (1.26 kW m^{-2}); ι_L - parameter of turbidity of atmosphere (2.4); h - solar angle above horizon.

The calculation sin h is done by the formula:

$$\sin h = \sin\varphi \sin S + \cos\varphi \cos\sigma \cos\frac{2\pi}{N}t \tag{33}$$

where: φ - geographic latitude of a place of observation, S - sun declination, N - earth-rotation period (24 h), $\frac{2\pi}{N}t$ - hour angle; t - time digitised from midday.

Sun declination is calculated by the formula:

$$S = 23.5 \sin(Ds - 81.5)\frac{\pi}{2}\frac{1}{91.5} \tag{34}$$

where: Ds - a sequence number of a day of the year.

Radiation of a soil surface is calculated by the Stefan-Boltzmann's formula:

$$B_o = \sigma T_\pi^{\,4} \tag{35}$$

where: σ - Stefan-Boltzmann constant ($\sigma = 5.67\ 10^{-8}$ W m^{-2}K^{-4}), T_π - Kelvin temperature of the surface, K.

The colliding radiation of atmosphere is calculated by the formula:

$$B_A = \sigma T_2^{\,4}(\alpha_1 + B_1 \sqrt{P_p}) \tag{36}$$

where: T_2 - air temperature at 2 m, K; P_p - partial steam pressure in millibars at the altitude of 2 m, $a_1 = 0.526$; $B_1 = 0.065$.

Registration of influence of clouds on the radiation balance is done with the help of coefficients of cloudiness for short-wave radiation K_k and long-wave-K_d:

$$q_R = K_k\,(1\text{-}r)\,I + K_d\,(B_A\text{-}B_o). \tag{37}$$

According to literature [2], changes of intensity in the short-wave radiation due to cloudiness correspond to changes in the coefficient K_k from 1 (cloudless sky) to 0.5 (at the cloudiness Cb and Cu in 10 balls). Changes of intensity of long-wave radiation due to cloudiness correspond to the change of K_d ranging from 1 to 0.15.

Calculation of temperature and moisture modes of peat soils is carried out by numerical methods on a computer using the designed programme. Calculation input data are: degree of mineralization of a peat soil and, surface albedo, groundwater level, diurnal variation of temperature and air humidity at 2 m, wind velocity, cloudiness, latitude of terrain, day of the year, temperature on the surface base of an active stratum. The computed parameters are: diurnal variation of temperature, moisture content, thermal and moisture flows on the soil surface distribution of temperature and moisture content at the ground top layer.

RESULTS

Applying the designed procedure of calculation, computer simulation of temperature and moisture modes of peat soils at varied meteorological and hydrological parameters has been accomplished together with component composition of the soil. To compare calculation data of temperature and moisture modes in the top layer of peat soil with the experimental data calculation was conducted for the meteorological parameters gathered on the following days: 17-19.V.1997 at the Berezinskiy nature park. On the indicated dates, at experimental platforms, there was a clear calm weather and at night, frost up to 2 °C was observed on the ground. Calculating data on diurnal variation of temperature and air humidity at 2 m data registered by the meteorological station of the Berezinskiy nature park were used. Initial distribution of temperature and peat ground humidity corresponds to the experimental data from the test sites. In the basic version of calculation, it was accepted that no cloudiness exists, the wind speed is 0, the ground-water level is 1 m, the surface albedo = 0.03. Except for the basic version, a series of calculations was carried out, where one of the indicated parameters varied, and also diurnal variation of temperature at the height of 2 m shifted by +3 and -3 °C.

The results of computer simulation are shown in Figs 1-7.

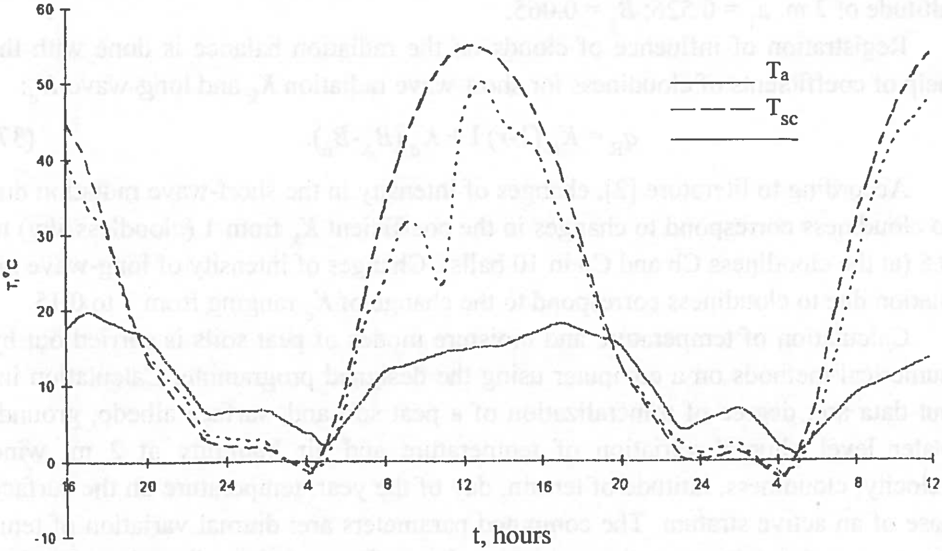

Fig. 1. Comparison of calculated and natural daily temperature course data on the peat soil surface: T_a - air temperature at the height of 2 m; T_{sc} - soil surface temperature (calculated data): T_{sn} - soil surface temperature (natural data).

In Fig. 1, calculation data of diurnal temperature variation on the surface of peat soil in comparison to similar data from a full-scale observations at the experimental site are given. The calculated and experimental data on diurnal temperature variation on the surface of peat soil correspond well.

Figs 2 and 3 show calculation data on the temperature dynamics and moisture field in the top layer of peat soil. The introduced data prove that the amplitude of temperature variation on the soil surface is about 50 °C. At the depth of 10 cm it is about 5 °C, and at the depth of 25 cm diurnal temperature oscillations attenuate. Moisture content of the surface layer of peat soil varies from 0.25 up to 0.5 kg kg^{-1} in one day. Daily fluctuations of moisture content in the surface layer do not spread deeper than 2 cm.

Calculation data on diurnal course of radiative, convective heat flows and heat flows at the expense of evaporation or moisture condensation on the surface of

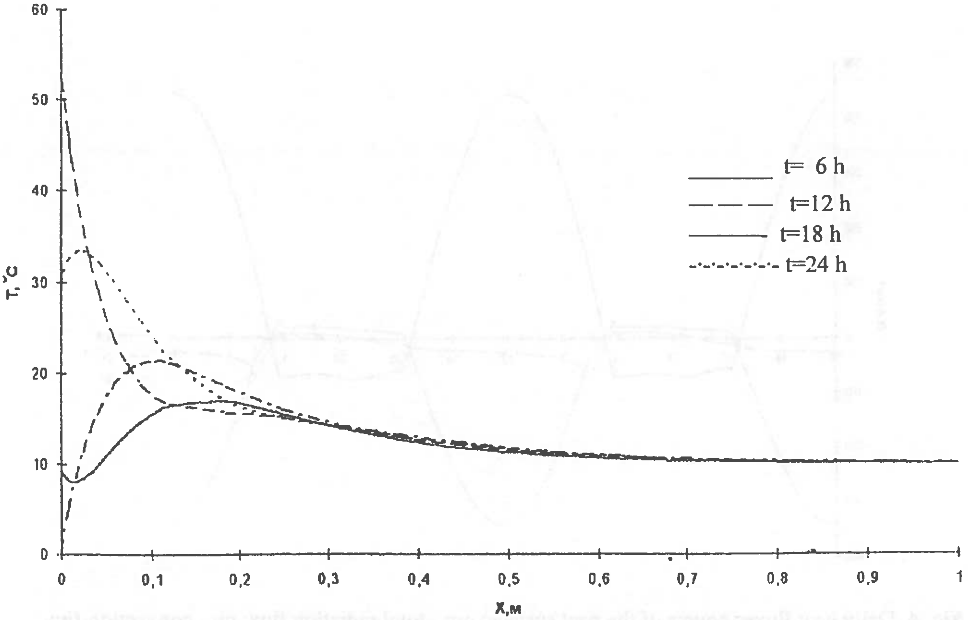

Fig. 2. Dynamics of temperature regime in peat soil.

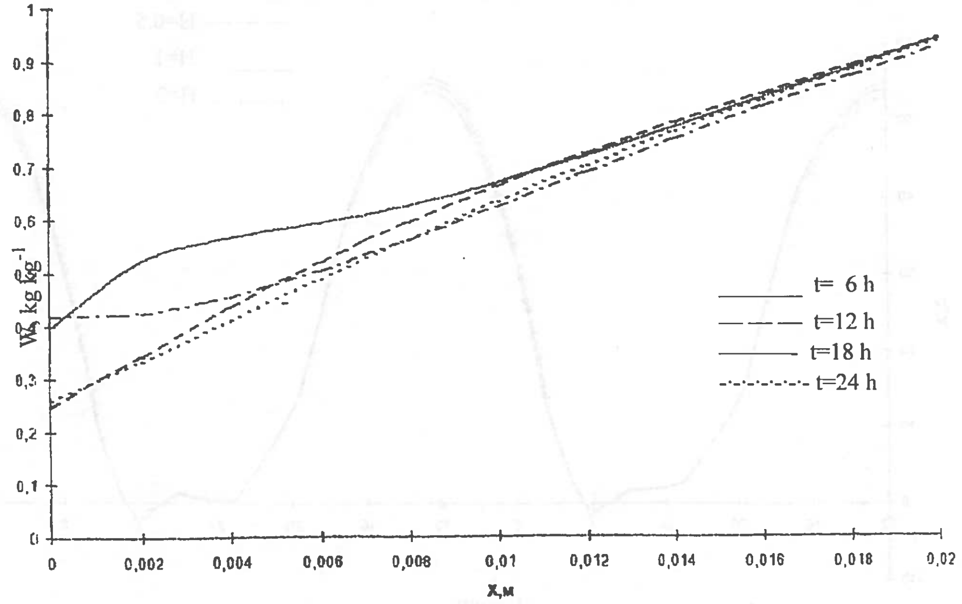

Fig. 3. Dynamics of moisture regime in peat soil.

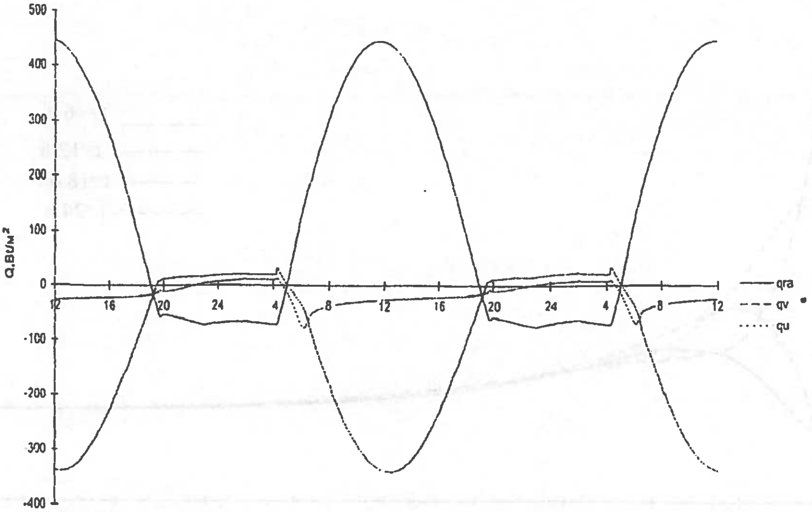

Fig. 4. Daily heat fluxes course of the peat surface: qra - total radiation flux; qv - convection flux; qu - heat flux due to evaporation and moisture condensation.

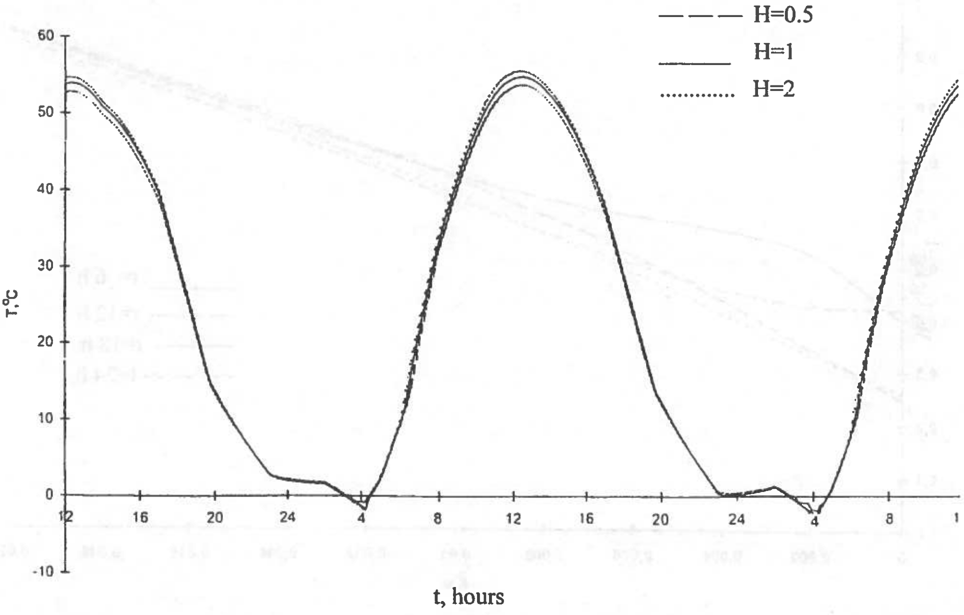

Fig. 5. Daily temperature course on the peat surface at various ground waters table H.

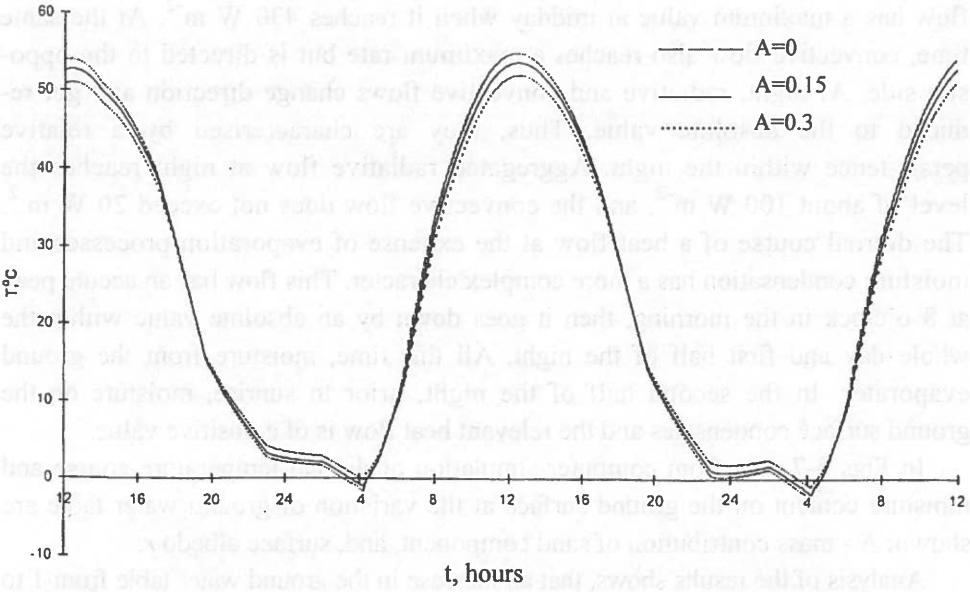

Fig. 6. Daily temperature course on the peat surface at various share of sand component A.

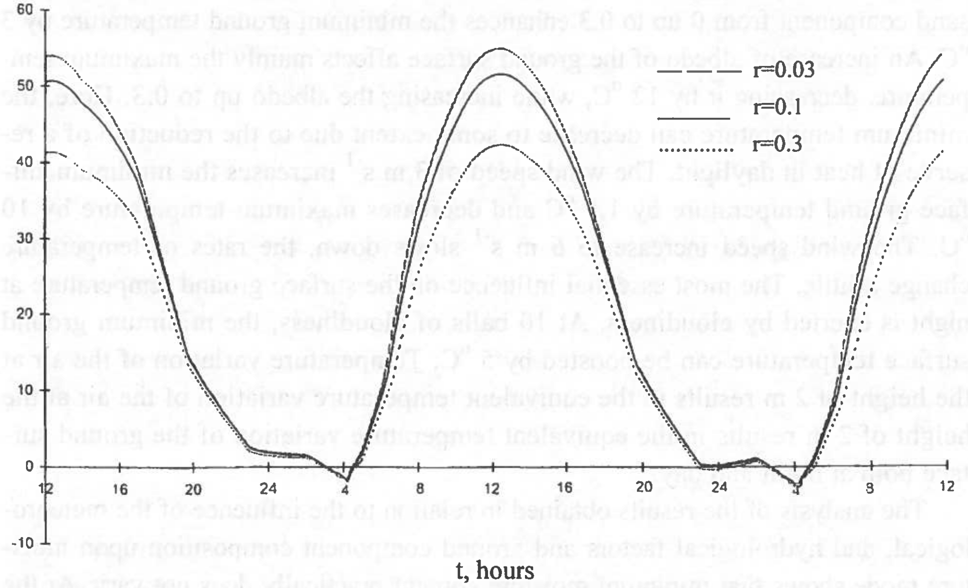

Fig. 7. Daily temperature course on the surface of peat soil at various albedo r.

peat soil are given in Fig. 4. According to the data provided, aggregated radiation flow has a maximum value at midday when it reaches 430 W m^{-2}. At the same time, convective flow also reaches a maximum rate but is directed to the opposite side. At night, radiative and convective flows change direction and get reduced to the absolute value. Thus, they are characterised by a relative persis-tence within the night. Aggregated radiative flow at night reaches the level of about 100 W m^{-2}, and the convective flow does not exceed 20 W m^{-2}. The diurnal course of a heat flow at the expense of evaporation processes and moisture condensation has a more complex character. This flow has an accute peak at 8 o'clock in the morning, then it goes down by an absolute value within the whole day and first half of the night. All this time, moisture from the ground evaporates. In the second half of the night, prior to sunrise, moisture on the ground surface condensates and the relevant heat flow is of a positive value.

In Figs 5-7 data from computer simulation of diurnal temperature course and moisture content on the ground surface at the variation of ground water table are shown: A - mass contribution of sand component, and, surface albedo *r*.

Analysis of the results shows, that an increase in the ground water table from 1 to 0.5 m enhances minimum temperature on the surface of peat ground water lowering up to 2 m reduces minimum surface temperature of the ground by 0.25 °C and increases maximum temperature by 0.75 °C. Increased contribution of mass share of sand component from 0 up to 0.3 enhances the minimum ground temperature by 3 °C. An increase of albedo of the ground surface affects mainly the maximum temperature, decreasing it by 12 °C, while increasing the albedo up to 0.3. Here, the minimum temperature can decrease to some extent due to the reduction of a reserve of heat in daylight. The wind speed of 3 m s^{-1} increases the minimum surface ground temperature by 1.5 °C and decreases maximum temperature by 10 °C. The wind speed increase to 6 m s^{-1} slows down, the rates of temperature change a little. The most essential influence on the surface ground temperature at night is exerted by cloudiness. At 10 balls of cloudiness, the minimum ground surface temperature can be boosted by 5 °C. Temperature variation of the air at the height of 2 m results in the equivalent temperature variation of the air at the height of 2 m results in the equivalent temperature variation of the ground surface both at night and day.

The analysis of the results obtained in relation to the influence of the meteorological, and hydrological factors and ground component composition upon moisture mode shows that minimum moisture content practically does not vary. At the same time, maximum moisture content is higher when temperature of the ground at night is lower. This is especially clearly traced in the case of variations in cloudiness.

This sectional regularity can be explained by moisture condensation on the ground surface at night. This assumption is also confirmed by the data comparing flows of moisture on the ground surface when other factors vary.

CONCLUSIONS

Thus, applying the computer simulation method, it is possible to estimate the impact of various meteorological, hydrological factors and properties of peat soils on the change of temperature and moisture modes of these soils. That will allow to forecast extreme climatic phenomena on ameliorated soils (droughts and frosts) and to reduce economical losses related to these phenomena.

It should be noted that similar regularities of the impact of different factors on temperature and moisture modes are found in literature. However, estimations are given only either at a qualitative level, or at the empirical one. The designed procedure of computer simulation allows to establish concrete quantitative relations and to reveal optimum alternatives of impact on the temperature and moisture modes of ameliorated soils.

Attention should be paid to the fact that considerable amplitude of daily temperature fluctuations (up to 50 °C) at the ameliorated peat soils results in irreversible changes of aqueous-physical and structural properties of thin surface layer of these soils. We assume this to be one of the basic reasons for the ameliorated peat soil degradation.

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