

Modeling and study the influence of land hydro-reclamation in catchment's scale.

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In connection with a discordance of availability in a nature of the different factors of life (air, water, food, space, home, socio-cultural factors, knowledges, the environment thermodynamic state etc.) to needs of the people, necessity arises in a modification of a nature - creation of artificial systems ensuring regulating of the factors, which availability in a nature is limiting for mankind (first of all food, home factors).

So long as these systems did not render noticeable action on the life factors, which amount and quality in a nature was sufficient, the necessity of the registration of the ecological requirements was not realized. Therefore systems were designed on sufficing only direct functions, fulfilled by them, which evaluation, as a rule, was reduced to economic indexes. However extension of economic activity, in particular realization extensive hydroreclamative actions for the purposes of an agriculture, affects diverse line-ups of processes on the extremely large spaces of a natural environment, which influence gains an interstate character and in the issue affects the Earth as a whole. In these conditions opposite extremes have begun to be exhibited - acceptance in attention of only ecological indexes, ignoring necessity of life factors production. Obviously, however, that the decision making in systems of any level of scale should be based to the simultaneous registration both socio-economic, and ecological purposes, being founded in the issue on the conscious compromise between their requirements ensuring necessary availability simultaneously of all factors of life.

All set enumerated above concerns to the agricultural reclamation too. Land drainage ensuring the lowering of redundant ground waters up to levels, optimal for growing of agricultural plants, in connection with availability of complicated chains of direct and feed-backs connections with other subsystems inevitably carries on to change of the remaining characteristics of a water regime: soils humidity, ground and river run-off, evaporation and chemical and temperature regime, connected with it, both on the drained territories, and on adjacent lands. For all that all these changes are not always favorable for the natural environment - agricultural plants water use competes to other customers: a drinking water-supply, fish facilities etc. In particular it appears hardly by the large scale reclamation of bogs - in Byelorussian Polesje there are reclaimed till 40-50% of catchment squares.

For solution of various problems, connected with change of a water regime because of a river catchment reclamation: evaluations of a state and comparison with not drained catchments, prognosis of their evolution and development decision making systems, ensuring compromise in conditions of multi-criteria, satisfying simultaneously economic (the cultures productivity) and ecological criteria, with allowance for all subsystems of a catchment (drainage network, reclaimed soil, agricultural vegetation, environment) and flowing in them processes of dynamics of water, heat, nutritious elements etc. For a solution of the above mentioned tasks the models of a various type are used:

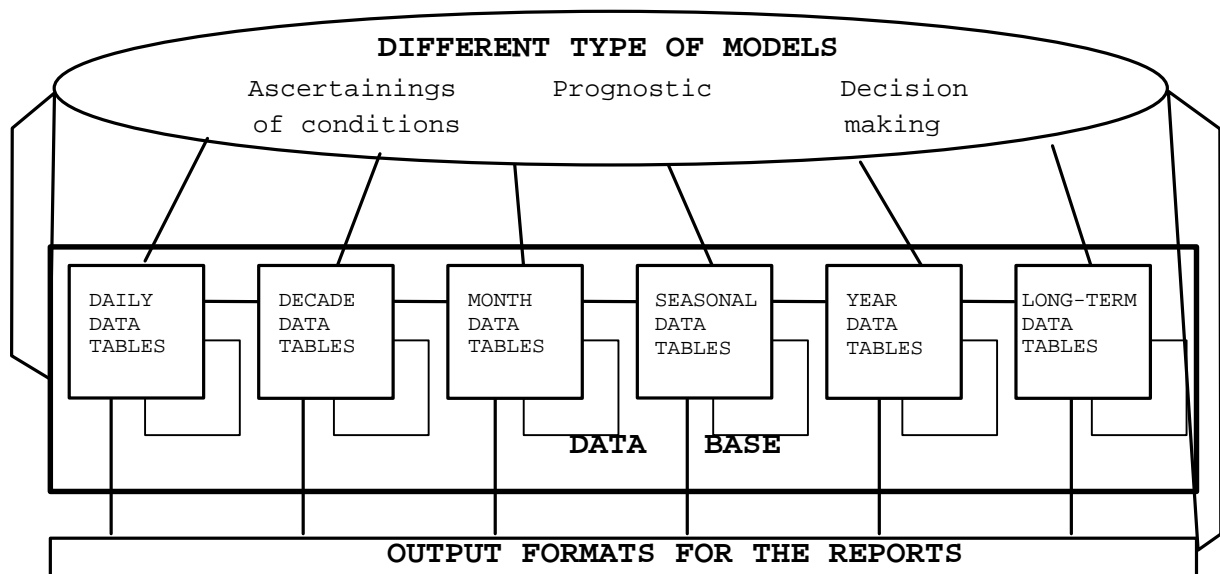
- phenomenological - with distributed parameters (equation Saint Venan's for channels and Boussinesk's for ground water dynamics),
- with lumped parameters (compartment models),

- with parametrized associations of a various degree of parametrizing, till to “black box”;
- nonphysical models: - statistical (aleatory variables, casual processes), regressive equations,
 - artificial neural network.

For the information supply of these models - their identifications (learning) are used data of 20 years monitoring of the natural environment main characteristics being carried out on two near located catchments: the rivers Narev (Baltic Sea basin), being in a natural state and river Yaselda (Black Sea basin), straightened and having catchment melioration up to 50%.

On compared catchments (bogs and adjacent territories) the synchronous observations of the meteorological factors (temperature, humidity of an atmospheric air and soils on various heights, actinometric characteristics) on 4 agrowaterbalace sites, ground and pressure water levels on 150 observant wells and holes, precipitations, soil waters stores on catchments on square 50 000 ha; in evaporation, infiltration and capillary inflow on 90 evaporators-lyzimeters with various ground water levels, supported in them, cultures, norms of fertilizers; by discharge and levels of water in the rivers on 5 waterposts, and also for chemical regime of waters, productivity of cultures are carried on.

In connection with a varieties of the tasks and used models for convenience of their identification (learning) on the base of long-term monitoring data the relation's type of data base is created. In this database the basic hydrological indexes represent discrete time series with characteristic time of the order day, for a base structure of storage the daily data annual table (12 months*31 day) on all aspects and items of observations is accepted(for hourly observing in database there is 24 such tables).The language of demands allows to realize operations above tables (hydrological and waterbalance accounts), aggregate data in time (decade, month, year, several years), and also to organize data structures required for various used models with conceptual scheme is represented on fig.



- operations of an aggregateness of data in time (average, max, min, dispersion, etc.);
- operations above the tables without reformatting(algebraic conversions, average, interpolation,smoothing, summing);
- creation of data structures for diferent models (time slice, time series, etc.);
- creating of different type tables, graphics.

Fig. The structure of nformation support models of reclaimed agricultural objects

On the data base of long-term monitoring the comparison of reclaimed catchment and being in a natural condition catchment is realized on a series of criteria: hydrological indexes, micro-climatic performances, hydrochemistry, productivity, which outcomes are reduced in a table .

Comparison of water catchment area

	<i>Narev</i>					<i>Yaselda</i>				
The hydrological characteristics										
Precipitation, mm	564									
Evaporation, mm	434 (75% from precipitation)					460 (60% from precipitation)				
River flow, mm	162 (56% - surface flow)					186 (5% - surface flow)				
Qmax, l/s/km ²	43					22				
Overflow from lower layer, mm	10					60				
Underground water level, cm	near surface					107				
						(Adjacent territory: 0.1km - 79cm; 1km - 38cm; 3km - 5-9cm)				
Soil humidity, %	85-100					65-80				
The microclimatic characteristics										
Air humidity at the height of 2m:(bog / adjacent territory):										
Absolute, mbar	12.4/12.2					12.7/12.9				
Relative, %										
Radiating balance, Kcal/cm ²										
	79/77					82/82				
	42.2					41.2/41.9				
Crop capacity of agricultural plants, t/ha										
Winter rye	1.9					2.6				
Barley	2.3					3.1				
Potatoes	19.2					19.8				
Grass from bogs	0.6					7.0				
Concentration of main ions in channels, mg/l										
Chemical substances	Ca ²⁺	Mg ²⁺	K ⁺	Na ⁺	NH ₄ ⁺	HCO ₃ ⁻	SO ₄ ²⁻	Cl ⁻	NO ₃ ⁻	PO ₄ ³⁻
<i>Narev</i>	48.9	5.1	0.9	2.9	0.9	153.0	5.8	9.4	6.7	0.18
<i>Yaselda</i>	62.7	6.1	1.4	4.7	0.6	127.8	10.4	8.5	9.7	0.20

It is visible from the table 1, that in consequence of soils reclamation and agricultural use there were hydrological regime modifications: having practically identical precipitation, on which the influence of a catchment reclamation had no effect, basic account component of a water balance - evaporation has increased due to more intensive plants water use. On the average for several years there was also increase of a stratum of a run-off at the expense of greater reclamateness. The magnification account component of a water balance was compensated by magnification of inflow from a underlying layer. In consequence of above-stated on reclaimed catchment were generated new conditions of ground water levels dynamics - its year average depth was lowered on 1 m from surface. The modification of a water condition has changed microclimatic characteristics: it has become more continental on reclaimed catchment.

However on adjacent territory modifications of hydrological and microclimatic characteristics fast damp.

Magnification of soils reclamation and the importation of fertilizers has lead to increase water mineralization in the river on 70%, however the content of various compounds has not exceeded admissible concentration.

In an outcome of shaping of a more favorable water condition on reclaimed catchment the productivity of all kinds of agricultural plants has increased.

As a whole it is possible to make a conclusion, that reclaiming actions have not break the system stability, and the occurred modifications can have various evaluations in connection with inconsistency of criteria and preferences of the various experts.