NUMERICAL METHODS TO ANALYZE THE HYDRAULICS STABILITY OF THE RAZELM-SINOE HYDROTECHNICAL COMPLEX

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Abstract
Because of the low water levels on Sf. Gheorghe channel and from the Razelm-Sineo hydrotechnical complex, as well as because of the phenomenon of the Black Sea waters continuous raising, overlapped with the storm periods, there is the risk of producing seashore erosion and consequently of salty water getting into the Razelm-Sineo hydrotechnical complex, causing the ecosystem ecological equilibrium breakage.
The present paper aims to analyse the complex phenomena producing in the Danube Delta and especially in the Razelm-Sineo hydrotechnical complex, in the context of some critical flows sampling to agriculture, so that to protect the Razelm-Sineo ecosystem.
In this respect, in order to solve the research theme, a Soil – Water – Balance numerical computation model was proposed; with its help, the phenomenon of drought in the area was analysed, but it was especially used to analyse the possibilities of sampling the irrigation water, so that the hydraulics and ecological equilibrium of the Razelm-Sineo ecosystem not to be affected.
The computation numerical model was adjusted to the concrete conditions of the area taken into study, by establishing the soil and studied crops characteristics, by creep of the cultural coefficients for different vegetative stages, of the productive answer coefficient for different irrigation norms and establishing the hydraulics working regime of this assembly of hydrotechnical works.

Keywords: hydrological balance, drought, cultural coefficient, evapo-transpiration, hydraulics regime, irrigation norm.

1. INTRODUCTION
In the context of the Danube Delta ecological stability, of the seashore stability as well as of the ecological equilibrium of the Dobrogea plateau, the Razelm-Sineo hydrotechnical complex has two important functions: - it is flow regulator of the Sf. Gheorghe channel waters into the Razelm lake, with the discharge in the lakes Golovita-Zmeica and Sineo, then the waters are discharged into the Black Sea so that the freshwaters levels should always be higher than the level of the salty water of the Black Sea[1]. - it represents the water source for irrigating the 121089 ha on the Dobrogea plateau[2].
Because of the meteorological and hydrological drought period and also because of the higher and higher requirements determined by the population, industry and especially agriculture consumption, the water flows at the Danube Delta ingress and, implicitly, in the Razelm-Sineo hydrotechnical complex, have considerably decreased.

2. MATERIAL AND METHOD
The Soil – Water – Balance numerical computation program used is a computation programs system for the hydrological balance equation of the soil, it estimates the hydric content of the soil as well as some other parameters, in conditions of drought and irrigation[3].
The programs package is made of a main BALANCE.EXE program, an ADAM.EXE independent program used for the analysis of agricultural drought and a CYEM.EXE program used to evaluate the agricultural productivity; these programs are correlated in cascade with the main program, meaning, each output from the main program can represent inputs for the derived programs (fig.1).
Inputs for the SOIL - WATER - BALANCE program:
- climatic data – daily rainfalls (raw or calculated);
- maximum evapo- transpirations of the datum crop (daily or monthly);
- studied crop characteristics;
- soil characteristics;
- vegetative stages.

Outputs provided by the program:
- daily values of the soil hydric content;
- daily shortage;
- real daily evapo- transpirations of the studied agricultural crop;
- real daily evapo- transpirations of the studied crop;
- percolative losses;
- hydrological balance in case of drought and irrigation;
- the drought beginning and end data;
- total length of agricultural drought;
- relative severity of drought;
- drought index;
- agricultural production got for different irrigation norms;
- irrigation period length;
- number of waterings;
- irrigation norms;
- cultural coefficient for different vegetative stages;
- productive answer coefficients.

Of a real importance in program achieving is the cultural coefficient determining for different vegetative stages Kc (fig.2).

Fig. 1 general structure with the prop of the links between program’s

Fig. 2 - Impact 4 unit structure

The cultural Kc coefficients are used to transform the maximum evapo-transpirations of the datum crop (pasture) Eto into the maximum evapo-transpirations of the studied crop Etm. These cultural coefficients can be taken from the specialty literature if they exit, if not, they are obtained through … for the area considered for the study (fig.3).
Fig 3 – Kc crop coefficients during different vegetative periods

The Soil – Water – Balance computation program updates the database daily, function on the inputs and outputs, so that, it can provide precise data regarding the agricultural drought or for the next day anytime, or data with regard to the setting of the irrigation norms corresponding to a threshold value imposed by the water users[4].

3. RESULTS AND DISCUSSIONS

At the execution of the hydrological balance, the program automatically transform the data which are provided into the requested format, meaning that in practice, the only transformation is that refering to the evapotranspiration, the program turns the monthly data into daily data and, gradually, with the help of the coefficients Kc, it turns the data Eto into Etmt values. At this point, it checks up for each single day if the period is dry or wet from climatological point of view. The computation program advantage is that starting from a value of the irrigation norm IW = 0 mm, the values IW = 49,8 mm, IW = 146,5 mm and IW = 245,4 mm can be successively determined, and can be administrated so that a value equal to the value of the minimum limit, considered as being of 50% from the SW value, to be reached (fig.4.5.6).

Fig 4 – Water content in the soil (SW) for different water irrigation administration Tulcea, 1961, : IW=49,8mm

Fig 5 - Water content in the soil (SW) for different water irrigation administration Tulcea, 1961, : IW=146,5mm

Fig 6 - Water content in the soil (SW) for different water irrigation administration Tulcea, 1961, : IW=245,4mm

In fig.7, the crop agricultural variations Ya(%) are presented, function on the hydric content of
soil, at different values of the Smin minimum limit for maize crop[5].

![Graph](image_url)

**Fig 7 – Agricultural crop variation at different values of the Semin irrigation intervention Crop Maize-Tulcea**

It is noticed that for values of Smin = 0.6 – 0.7 U, agricultural crop values obtained are of 60–80% from the potential value, values considered acceptable both from the point of view of hydraulics stability maintenance of the Razelm-Sinoe ecosystem and from the point of view of ecological equilibrium maintenance in case of severe drought, in an area considered the most droughty in Romania.

This methodology has a large aplicability for different geographical areas, because the mathematical model offers the possibility to interpret the physical mechanism of the plants water consumption, especially at compresorial level[6].

4. REFERENCES