THEORETICAL ASPECTS IN CLIMATE'S ARIDITY EVALUATION IN REPUBLIC OF MOLDOVA'S TERRITORY

Maria Nedealcov[1]

Резюме: Степень аридности конкретного региона определяется обычно как соотношение температурно-влажностных характеристик. В данной работе предлагается использование нового климатического индекса – Индекса засушливых периодов (Izu), который отражает реальный процесс аридизации на современном этапе, особенно в южной части Республики Молдова.

Key words: Dry period index (Izu), aridization, evaporability, humidity deficit, pluviometric deficit, dry days.

Rezumat: Gradul de ariditate pentru o anumită regiune concretă se determină de obicei prin raportul dintre caracteristicile umidităţii şi a celora de căldură. În această lucrare, se propune utilizarea unui nou indice climatic – Indicele perioadelor uscate (Izu), ce reflectă intensificarea adecvată a procesului de aridizare la etapa actuală, mai ales în partea de sud a Republicii Moldova.

Cuvinte cheie: Indicele perioadelor uscate (Izu), aridizare, evaporabilitate, deficit de umiditate, deficit pluviometric, zile uscate.

Introduction

Aridity level for a certain given region is determined by relation between humidity and heat characteristics. Republic of Moldova's territory is fully provided by heat resources, but insufficiently with humidity ones. Investigations in this field show us that negative humidity balance is dominant in regional aspect, e.g. precipitation sum does not provide for heat and energy potential of the territory, which is able to evaporate bigger amounts of water than it gets in the form of precipitations.

Previous investigations executed in this field show us [2] that precipitation deficit in warm season (April-October) according to multiyear data is equal to 163 mm at North and 457 mm at South, which as a matter of fact is reflecting necessary climatic norms for irrigation in this region.

[1] *Institute of Ecology and Geography AS RM*
Chisinau mun., Republic of Moldova,
marianeadealcov@yahoo.com

Another parameter of air humidity which is of big practical. importance is saturation deficit, its regime being of interest taking into account the aspects of precipitation's regime and increased temperatures in warm seasonPoor irrigation facilities' infrastructure conditions saturation' deficit study which offers us pragmatic vision on relation between maximum tension and real tension of water vapors. In case when there are bug differences between these two and evaporation process – evotranspiration is intensified, and when the differences are little and these processes are diminished then cultures' growth and development are substantially influenced.

Saturation deficit values show a constant increasing trend, especially since the beginning of 80s XXth century and a more pronounced increasing trend in the first decade of XXIst century (in central and southern parts) shows intensification of aridization process on Republic of Moldova's territory. Thus, in order to adequately identify aridization process, we need to elaborate new indexes which would be able to take into account both thermal maximums and pluviometric deficit.

Materials and methods

In context of climatic changes it is important to know number of dry days for active period of vegetation and for May-August period which is critical from the point of view of aridity and dryness for many agricultural plants' growth and development. We should mention, that "dry days" are considered the days with increased thermic fund (T air $>25^0$C) and decreased air's relative humidity (Ur<30%), the impact of these days on plants is considered negative for ontogeny phases progress.

As dry days duration in May-August is directly influencing principal ontogeny phases of agricultural plants, we proposed for the first time dry periods index (*Izu*), which represents relation between their sums registered in given years to their multiyear average for the above-mentioned period. It is calculated by the following formula:

$$Izu = \frac{\sum zu_{(V-VIII)}}{\overline{X}\, zu_{(V-VIII)}},$$

where $\Sigma zu_{(V\text{-}VIII)}$ – is dry days sum registered during the period (May-August), when intensive growth and development of agricultural plants takes place, $\overline{X}\ zu_{(V\text{-}VIII)}$ – dry days' multiyear average (May- August).

Table 1 Qualificatives of dry periods indexes (*Izu*) after M. Nedealcov

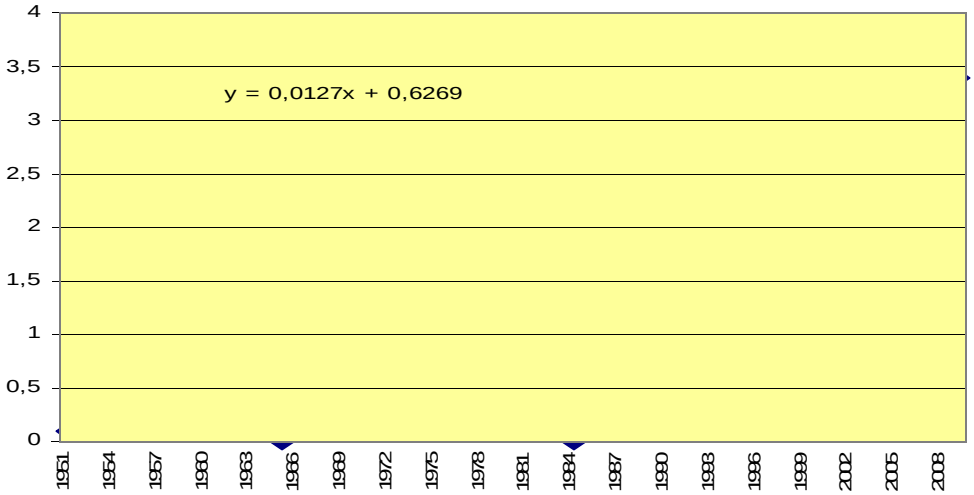
Values, zu	**Qualificatives, *Izu***
0,1-1,0	**normal period**
1,1-2,0	**moderate dry period**
2,1-3,0	**Significant Dry Period**
3,1-4,0	**Dangerous Dry Period**
>4,1	**Exceptional Dry Period**

Izu qualificatives allow identifying aridity of the periods with dry days. Thus, in case of values *Izu*= 2,1 the number of dry days exceeds twice their multiyear average, installing significant dry period. (tab. 1).

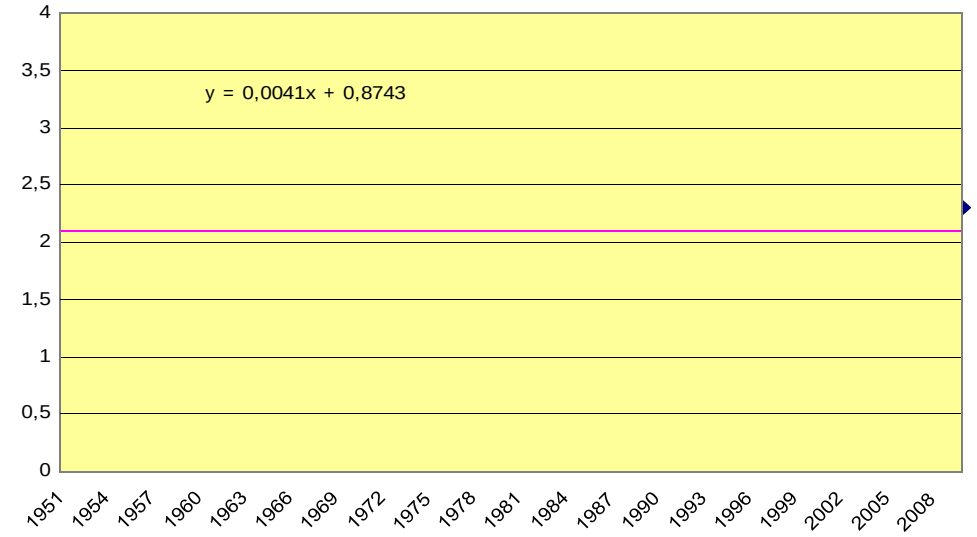
According to *Izu* time series evaluation (fig.1 a, b, c) on republic's territory exceptional dry periods are characteristic for Central and Southern parts, in certain drought years only significant and dangerous dry periods had been installed. Obtained results confirm aridity process intensification especially in central and southern part of republic [1].

The theory of stochastic processes plays an essentially role in analysis, modeling and prediction of time series for dry days manifestation phenomena. From this point of view time series that characterize dry periods can be interpreted as stochastic process realization. In hypothesis that stochastic process is stationary and conceptual time series can treated as a realization of stochastic process response to uncorrelated entrance as a type of random noise.

a


y = 0,0127x + 0,6269
4
3,5
3
2,5
2
1,5
1
0,5
0
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1994
1997
2000
2003
2006
2009

b


y = 0,0041x + 0,8743
4
3,5
3
2,5
2
1,5
1
0,5
0
1951
1954
1957
1960
1963
1966
1969
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c

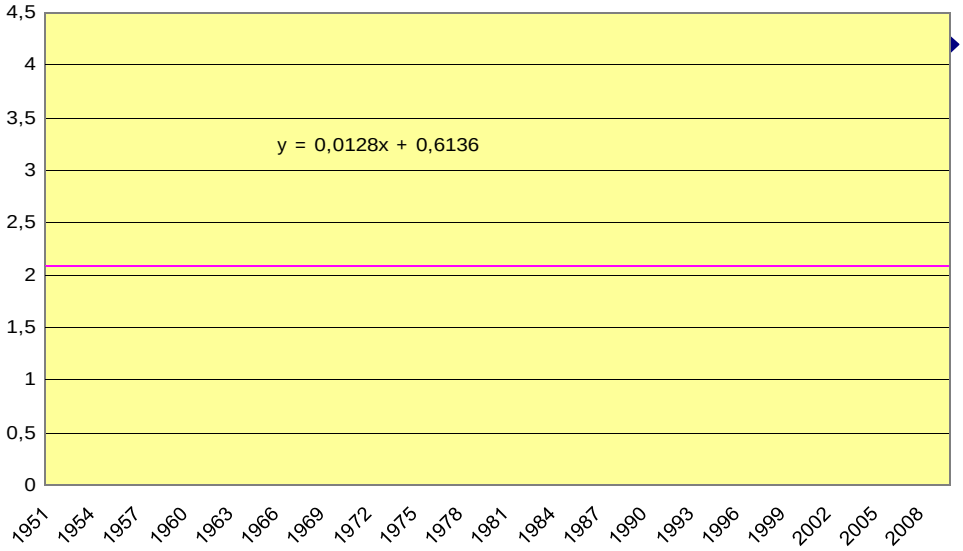
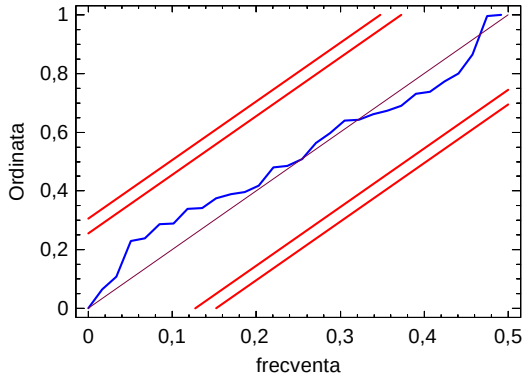


Fig.1. Temporal evaluation of Dry Periods Index (*Izu*) from Republic of Moldova's territory (a-Briceni, b-Chişinău, c-Cahul)

Calculation of residual part of time series and presentation of confidence level show us that they represent random noise of aleatory process of dry days manifestation on Republic of Moldova's territory (fig.2 a, b, c).

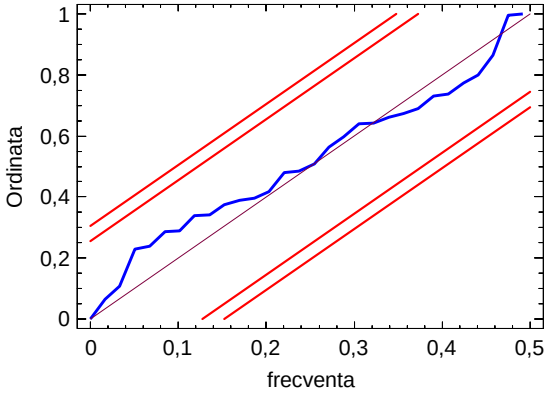
a

seria reziduala (zgomotul) pentru numarul zilelor uscate (Briceni)



b

Seria reziduala (zgomotul) pentru numarul ziilelor uscate (Chisinau)



c

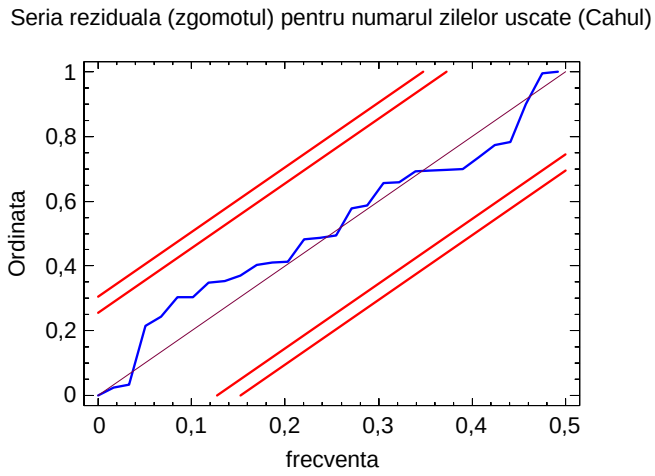
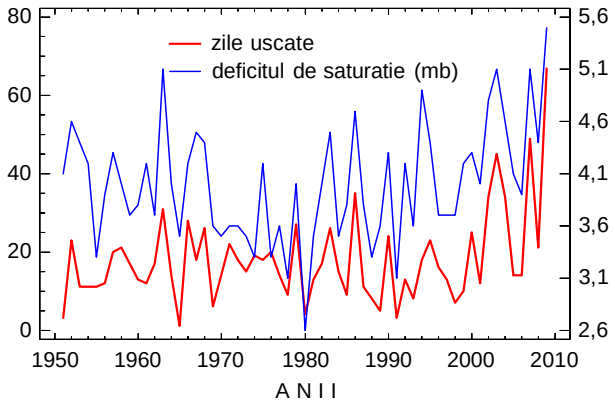


Fig.2. Residual series analysis for dry days on Republic of Moldova's territory (a-Briceni, b-Chişinău, c-Cahul)

Estimation of simultaneous evolution of saturation deficit duration (mb) with dry periods number indicates at increasing values of these two climatic components, starting with 80s XX century, and up till the end of the first decade of XXI century more essential values on practically whole republic's territory were registered (fig.3).

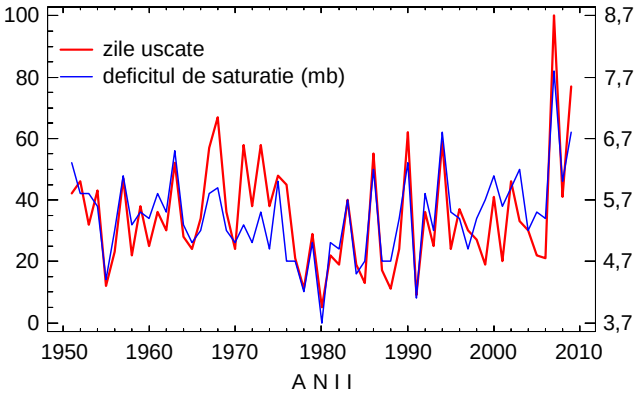
Correlation of annual values of saturation deficit with number of dry days indicates a close correlative link between these two parameters (0.8) on the whole of republic's territory.

A Evolutia deficitului de saturatie si a zlelor uscate (Briceni)



b

Evolutia deficitului de saturatie si a zilelor uscate (Chisinau)



c

Evolutia deficitului de saturatie si a zilelor uscate (Cahul)

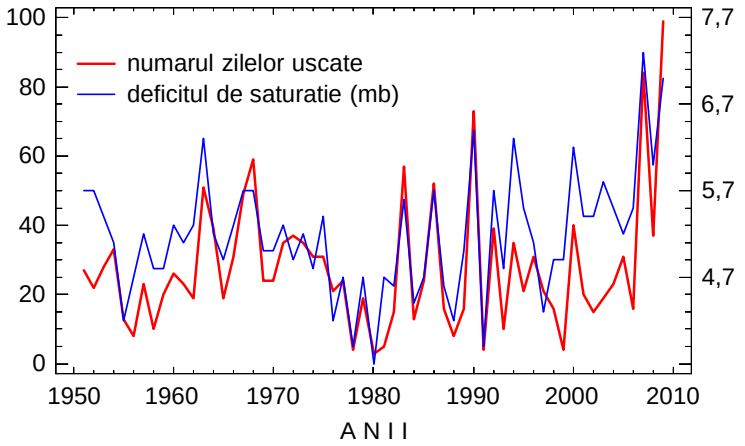


Fig.3. Evolution of saturation deficit (mb) and dry days on Republic of Moldova's territory (a-Briceni, b-Chişinău, c-Cahul)

Identification of increased frequency of dry periods with humidity deficit especially in first years of XXI century is quite important for aridization mitigation for the period of agricultural plants growth and development, for emplacement and ameliorative decision-making.

Bibliography

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