

The Tendency of Climatic Elements and Water Balance in the Soil of the Area of Cacak

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Abstract: The analysis of climatic elements (1949-1999) of the area of Cacak has indicated an increasing trend of the air temperature and, decreasing one of rainfall. Water deficit in the soil and, consequently, the appearance of drought, could be assumed. However, water balancing of the area over a longer period of time has enabled a fuller defining of drought. In respect of the total annual values over the vegetation period, the potential evapotranspiration (ETP) and water deficits (D) have been manifest in the highly significant percent (ETP 86.5%, D 94.6%).

Key words: Key words: climatic elements, soil water balance, potential evapotranspiration, water deficits, trends.

Introduction

The phenomenon of drought, the consequences of its onset and, alleviation of its effects on agricultural production of a certain area, primarily depend on the natural and on antropogenous factors, as well.

The appearance of drought is primarily assumed to be the consequence of higher air temperatures and insufficient rainfall amounts. When climatic elements are manifested in such a way, the drought may appear periodically or regularly. Therefore, the analysis of rainfalls that fell over the summer months suggests that drought be a regular phenomenon in Serbia (Bosnjak, 1996). Due to comparatively small surfaces of arable land and, therefore, impossible intervention with moisture deficit, rainfall deficit is considered to be a major factor of drought onset (Savic et al., 1996).

The global climatic change and greenhouse effect, are evident. As a result, climatic changes on the regional and local levels take place, too. Air temperature

and rainfall trends have been presented, accordingly. Considering that these climatic elements contributed to a higher water amount in the soil and a certain value of evapotranspiration, the procedure of the soil water balancing of the area of Cacak and trends of potential evapotranspiration, water deficit, water surpluses as well as of real evapotranspiration, have been presented.

The insight into the trends of the climatic elements, those of the soil water balance for the area of Cacak informed us about the changes in climate and a natural soil water deficiency over vegetation period in light of agricultural production needs. The effects and presumable consequences of the impact of antropogenous factor, will be diminished.

Material and methods

The elements of climate, air temperatures and rainfalls (R) for the area of Cacak.(Agricultural Research Center, 1949-1999), are given by means of linear trend.

The potential evapotranspiration (ETP) and soil water balance of the area of Cacak, over a 51-year-old period of time, have been calculated, following Thornthwaite's method (Vlahinic, 1982). The reserve of the readily available soil water (REAW) amounted to 100 mm.

In addition to evapotranspiration (ETP), the elements of soil water balance, water deficits (D), surpluses (S) and the real evapotranspiration (ETR), are also presented by means of linear trend.

Results and discussion

The average sum of the annual rainfalls for the area of Cacak, has been found to amount to 717 mm (min 452 mm, max 1145 mm). The trend of the annual rainfall sums is decreasing, as indicated by the regression curve (Fig.1).

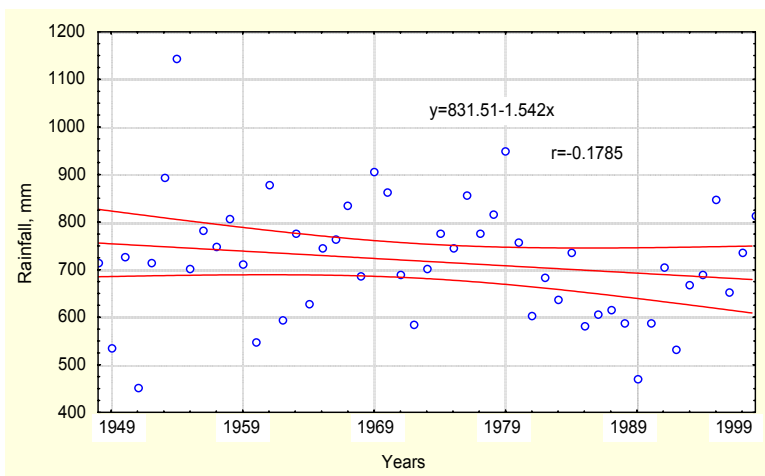


Fig.1. Regression curve of the annual rainfall sums for Cacak, 1949-1999

The mean annual air temperature for Cacak, has been found to amount to 10.7°C (min 9.3°C , max 12.7°C). The trend of the mean-annual air temperatures is increasing (Fig.2).

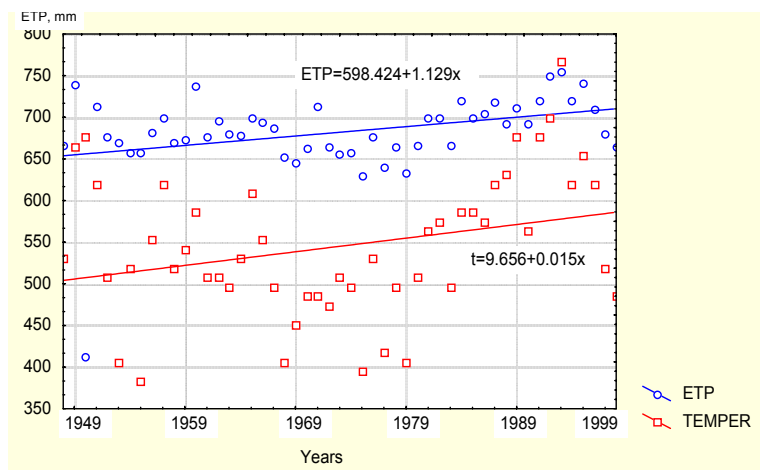


Fig.2. Original annual values of ETP and the mean annual air temperatures for Cacak, 1949-1999

As the plant need for water, the mean annual potential evapotranspiration (ETP) over the period analysed, has been found to amount to 681.9 mm (min 412 mm, max 755 mm). One can notice an increasing linear trend of the ETP annual values.

The balancing procedure has enabled us to define soil water deficits and surpluses.

Water deficit in the soil appears when the need for water (ETP) is higher than the totally available water for evapotranspiration.

The mean annual value of the soil water deficit (D) for the area of Cacak, has been found to amount to 132,7 mm (min 0.0 mm, max 353.0 mm). Linear trend of the annual water deficits, is increasing (Fig.3).

The onset of water surplus (S) in the soil, takes place when the totally available water for the evapotranspiration (the existing water reserve in the soil and that obtained from rainfalls) is higher than the actual needs for water (ETP) are. When the part of such available water is used to renew water reserves (REAW), 100 mm in our case, the water surplus in the soil is manifested (Vlahinic, 1982).

The mean annual value of the water surpluses (S) of the area of Cacak, has been found to amount to 168.2 mm (min 0.0 mm, max 487.0 mm). Thus, a decrease in the linear trend of the annual water surpluses (Fig.3).

The real evapotranspiration (ETR) has shown the real amount of the available to soil water, which is dependent upon the environment conditions (Vucic, 1976).

The mean annual value of the real evapotranspiration (ETR) for the area of Cacak, has been found to amount to 549.2 mm (min 387 mm, max 677 mm). The linear trend of the real evapotranspiration (ETR), is increasing (Fig.3).

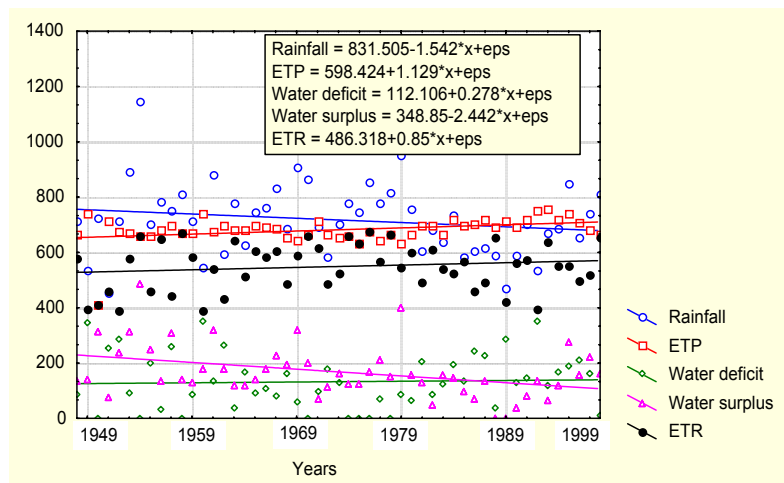


Fig.3. Linear trend of the annual rainfall values (R), potential evapotranspiration (ETP), water deficits (D), surpluses (S), real evapotranspiration (ETR) for Cacak, 1949-1999

Bearing in mind that balancing of soil water of the area of Cacak was calculated for each month over the 51-year-old period, the mean monthly values of all the elements included in the water balance, as well as the mean annual ones, are presented in Tab.1. The reliability of results can be examined by checking of the mean values of the elements concerned ($ETP = ETR + D$; $R = ETR + S$).

Table 1. The elements of the soil water balance for the area of Cacak, 1949-1999

Months	Air temperatures, t°C	Rainfall, mm	ETP, mm	Water deficit (D), mm	Water surplus (S), mm	ETR, mm
I	-0.6	44.4	1.1		37.3	1.1
II	1.3	41.2	5.2		34.3	5.2
III	5.8	47.7	21.7		27.6	21.7
IV	10.9	55.0	51.4		11.0	51.4
V	15.9	82.4	91.6	0.3	11.4	91.3
VI	19.3	89.4	117.9	8.8	2.5	109.1
VII	20.9	75.9	130.7	36.2	3.5	94.5
VIII	20.6	58.7	118.7	49.9	2.2	68.9
IX	16.2	51.8	79.3	30.1	0.2	49.2
X	11.1	56.6	44.0	6.7	3.2	37.3
XI	5.5	61.3	16.7	0.8	11.0	15.9
XII	1.2	52.9	3.6		24.0	3.6
Years	10.7	717.4	681.9	132.7	168.2	549.2

The objective of soil water balancing of the area of Cacak was establishing of water deficits in order to use irrigation, as a regular practice, and alleviate drought effects on agricultural crops. Therefore, it should be emphasized that, of the total mean annual water deficits (D), vegetation period is accounted for by 94.6%(Tab.1). The other elements of soil water balance, excepting surpluses in relation to the total mean annual values, have been achieved in a fairly high per cent throughout the vegetation period, with 57.6%, 86.5% and 84.5%, respectively, accounting for rainfalls (R), potential evapotranspiration (ETP) and real evapotranspiration (ETR), respectively. Water surpluses (S) are considerable beyond vegetation, i.e. 81.8% of the total mean annual water surpluses (Tab.1).

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TENDENCIJE ELEMENATA KLIME I BILANSA VODE ZEMLJIŠTA NA PODRUČJU ČAČKA

- originalni naučni rad -

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Prikazom tendencija srednjih godišnjih temperatura vazduha (rastuće), činioca godišnjih vrednosti potencijalne evapotranspiracije (rastuće), i sume godišnjih padavina (opadajuće), evidentirane su tendencije godišnjih manjkova vode i stvarne evapotranspiracije (rastuće) i godišnjih viškova vode (opadajuće), što ukazuje na prirodnu neobezbeđenost vodom zemljišta područja Čačka.