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POTENTIAL EVAPOTRANSPIRATION IN EGYPT

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ABSTRACT

Potential evapotranspiration varied form 84 cm / yr at Saint Catherine in Sinai to 144 cm/ yr at Aswan in southern part of Egypt. This variation is mainly due to the difference *in temperature values between these two regions.*

INTRODUCTION

From the average temperture records of 70 climatological stations available allover Egypt, potential evapotranspiration was calculated, using Thornthwaite, (Thornthwaite *et al.*, 1955).

The total water loss are the combined results of may factors, namely precipitation, temperature, humidity and wind velocity, Among these temperture can be assumed as the most important one (Meinzer, 1942).

Heat is the source of energy that causes evaporation. Many instruments designed to integrate the effect of the various climatic factors affecting evaporation and record a directly measurable water loss (Wisler *et al.*, 1940). Output records of all these instruments require the use of some coefficients or other adjustments to reduce probable errors in observed loss. Table (1) illustrates the readings obtained through different methods.

Table (1) : The readings obtained through different methods.

Station	Evaporation (cm / yr)		
	Piche	Pan Class A	Thornthwaite
Giza	430	281	111
Kharga	1073	527	137
El Tahrir	453	273	98
Baltim	-	265	102

THORNTHWAITE METHOD :

Direct measurement of evapotranspiration under various physical and climatological of large areas is extremely difficult, expensive and time consuming.

Thornthwaite *et al.* (1957) developed a method, using rainfall and runoff data of several drainage basins to obtain an emperical relationship between potenial evapotranspiration and mean air temperature with certain adjustments for duration, Earth's Iatitudes and soil moisture content.

The following set equations are used :

$$i = (T_m/5)^{1.514}$$

$$I = \sum_{n=1}^{12} i_n$$

$$a = (6.75x10)^{I^3} - (7.7x10^{-5})\, I^2 + (1.73x10^{-2})\, I + 0.43$$

$$UPE = 1.6\,(10\,T\,/I)^{a}$$

PE= (b/30) UPE

where T_m = mean monthly temperature in°C

i = monthly heat index which is a function of T_m

I = sum of the 12 monthly values of i

a = an emperical exponent that depends on I

T = mean temperature (°C) during the month

UPE=monthly unadjusted potential evapotranspiraion in cm.

b = an adjustment factor giving the duration of sunshine and latitude.

PE = Monthly potential evaptranspiration in cm.

Mean monthly temperature values of 70 climatological stations, convering Egypt, were used to estimate evaptranspiration phenomemon by the Thornthwaite's method. The results are contoured in Fig. 1. The lowest value obtained is defined around Saint Catherine in Sinai at high elevation and amounted to 84 cm / year. The highest value is in the extreme south-eastern part of Egypt (Red Sea Coast) and amounted to 149 cm /year. Generally potential evapotranspiration value increased progressively from the coast of the Mediterranean Sea were it recorded 94 cm /yr. Around Ras El Hekma, through 109 cm / yr at latitude of Cairo 119 cm /yr. at the latitude of Assiut to 144 cm /year at Aswan district.

The plotting of the monthly evapotranspiration versus the average monthly temperature at several stations Fig. 2 (a to e) showed loops of different shapes. The variation in the form of temperature loop depends on temperature state at a particular station. The seasonal march from the minimum temperature in

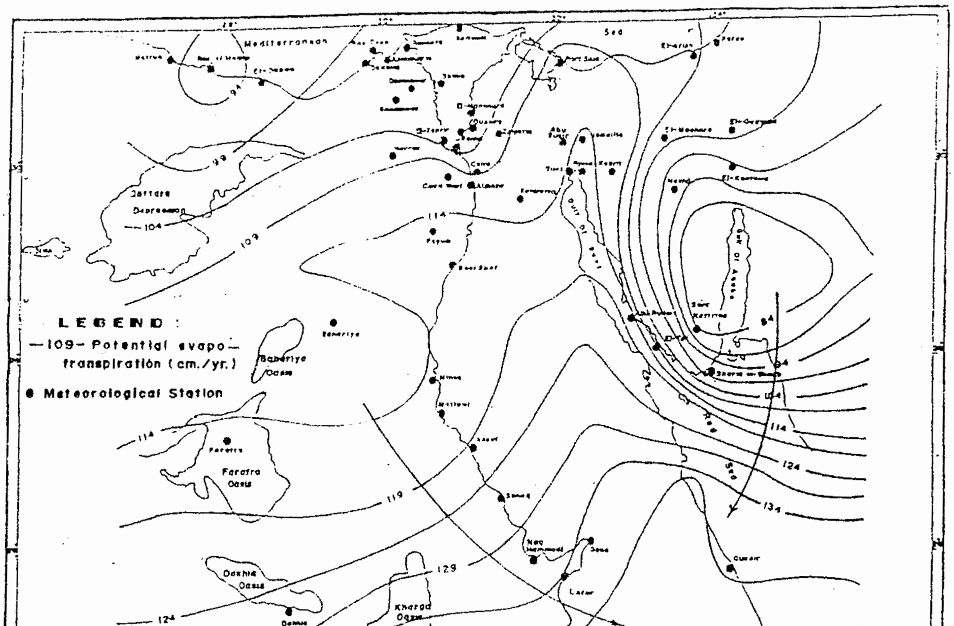

Fig.(1) : Evapotranspiration Map of Egypt

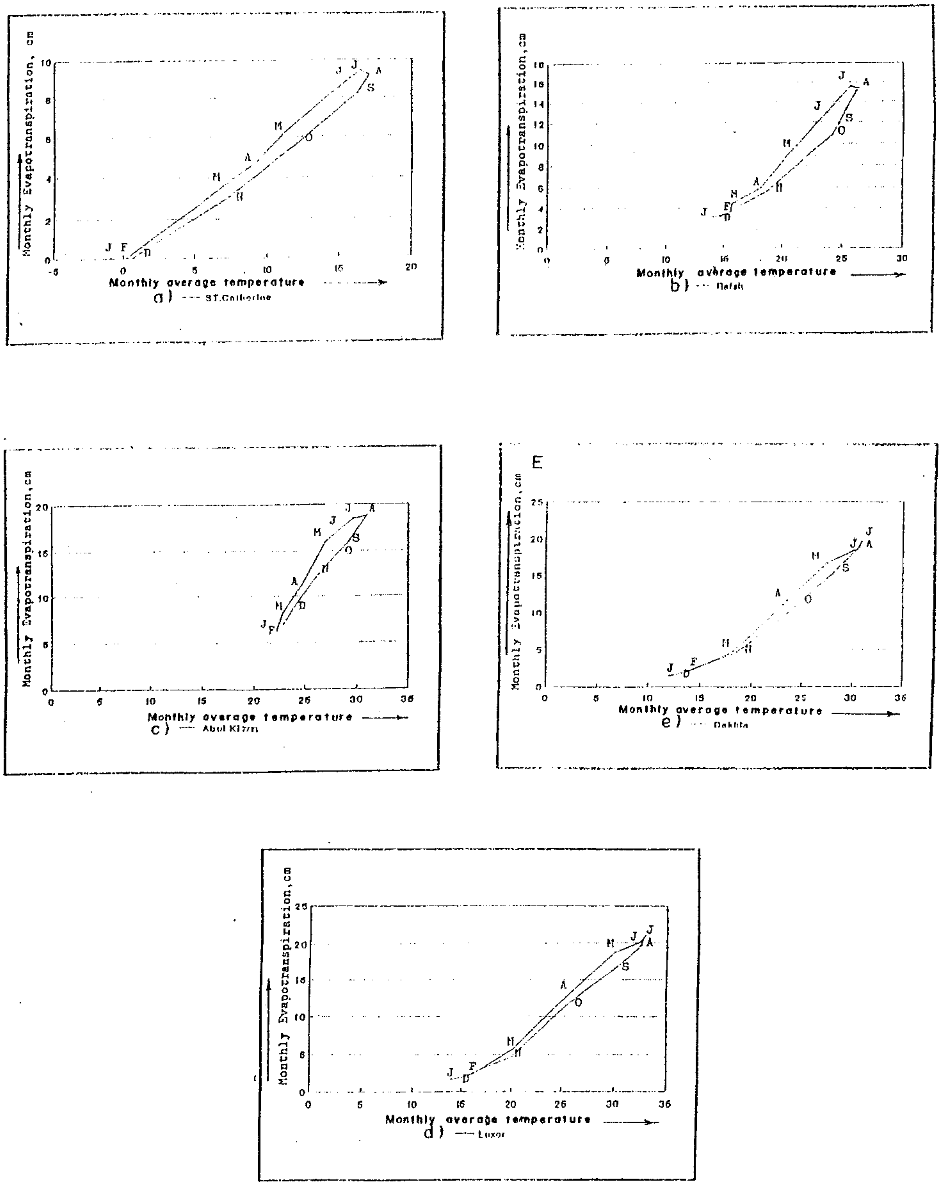

Fig.(2): Average Monthly Temperature

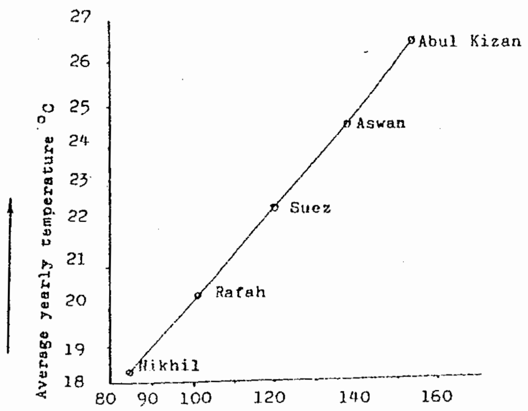

Fig. 3 : Yearly Evapotranspiration in cm.

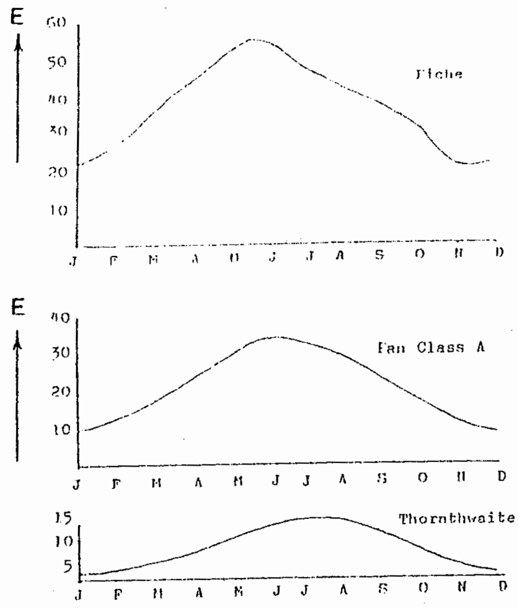

Fig. 4 : El-Tahrir station, Monthly Evaporation in cm.

January to the maximum one in July was fairy regular. From July to September, there is an inversion in direction of increasing. After September, temperatures decreased steadily towards the minimum of the preceeding Januray.

The plotting of average yearly evapotranspiration against temperature at several stations produced a straight line Fig. 3 indicates the dependence of evapotranspiration on temperature variation of a particular station.

Comparison of the results obtained at one station, using Piche, Pan Class A and Thorthwaite reveals on overestimation by both Piche and Pan Class A methods (Fig. 4). An interesting shift in the maximum value, obtained by the three mentioned methods, is noticed. It occurs during May- June in the Piche's graph, shifts to June- July in the Pan Class A graph and to July - August in the Thornthwaite one.

CONCLUSIONS

The application of Thornthwait's technique to calculate potential evapotranspiration in Egypt showed the simplicity of this method. The results obtained are considered to be within reasonable level when they are compared with the other methods. Estimation of potential evapotranspiration at any point can be easily obtained from the provided maps.

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الملخص العربى

إحتمالات البخر والنتح بجمهورية مصر العربية

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تتراوح إحتمالات البخر و النتح من ٨٤ سم / سنه عند سانت كاترينب سيناء إلى ١٤٤ سم / سنه في أسوان عند الحد الجنوبي لجمهورية مصر العربية . وهذا التفاوت يرجع أساساً إلي التفاوت أو الإختلاف في قيم درجات الحرارة بين هاتين المنطقتين .