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A technique estimating daily catchment precipitation with elevation correction for conceptual simulation

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ABSTRACT. This paper aims at presenting a combinatorial technique of a similar Thiessen method and precipitation gauge station availability for estimating the daily catchment precipitation. The correction of the so obtained catchment precipitation for elevation variation is also included. By this double technique, it is preserved the real nature of precipitation information, which is usually required by the deterministic conceptual models. It can also handle successfully any change in the gauge network, that was the greatest limitation of the classic Thiessen method. The technique is achieved by using computers, and the proposed programming procedure can be applied on a microcomputer, even though combinatorial and sorting algorithms are developed in it.

1. Introduction

The hydrology of a drainage catchment, from precipitation through stream discharge at the lowest outfall, can be conceived as a series of interlinked processes and storages. In conceptual modelling, the catchment processes are described mathematically (e.g. by an equation for evaporation or a routing procedure for overland flow), and the storages are considered as reservoirs, for which water budgets are kept (Shaw 1984).

The above consideration of interdependent water budgets with as primary input the catchment precipitation, makes it necessary for the precipitation estimate be as true as possible.

The usual estimation techniques of catchment precipitation are the arithmetic average, the Thiessen polygons and the isohyetal method. Later, with the advent of computers, numerical methods were developed (Hutchinson & Walley 1972, Shaw & Lynn 1972), and recently the parametric ones, which introduce directly into the system rainfall-runoff the precipitation gauge station data without averaging them over the catchment area. These last methods consider the station weights as parameters of the above system, whose values are determined by the hydrometeorological and physiographic characteristics of the catchment (Ramaseshan & Amant 1977).

All the above mentioned methods can easily be implemented only when there are available precipitation records filled with data. When the precipitation records include incomplete data, these usually are estimated by an appropiate technique, and after that any method for determining catchment precipitation can be applied.

Though, most of the deterministic conceptual models require the catchment precipitation information to be real and daily, in this case the filling up of daily missing data is avoided because:

- the real nature of precipitation series elements is destroyed,
- the estimation techniques of daily missing data introduce computing errors.

The third reason is that most of these last techniques are applied with difficulty (e.g. the application of mulisite stochastic models).

In mountainous catchments orographic effects cause, generally, increase of precipitation with elevation. This fact must be taken into account in evaluating the true catchment precipitation. The precipitation gauge stations, that are usually installed on the valleys of the mountainous areas, cannot possibly catch and record the precipitation falling on higher elevations. Even though stations are installed on high elevations, these are susceptible to record errors. For this reason, we correct the precipitation for elevation increase from records of stations that are installed on lower elevations.

In hydrological modelling, the catchment precipitation is evaluated for mean catchment elevation (Table I) after a proper precipitation-elevation relationship is established.

Concequently in this work we have to deal with two problems, primo, the estimation of daily catchment precipitation from records including incomplete data and, secundo, the correction of catchment precipitation for mean catchment elevation from existing station data. This will enable us to preserve the real nature of the precipitation.

The possible station weights are evaluated by a Thiessen-like method, (which produces the matrix of these weights), while the possible corrective factors are determined from the rate of variation between precipitation and elevation, providing also the matrix of the aforesaid factors. The actual weights and corrective factors are determined from the matrixes of possible weights and factors through the stations' daily availability, which defines the existence or not of precipitation data on that particular day.

In turn, the actual weights and factors are used to compute the daily catchment precipitation for the mean catchment elevation. The proposed technique is simple and can be applied on a microcomputer, even though combinatorial and sorting algorithms develop in it.

2. Proposed Method

2.1. ESTIMATION TECHNIQUE OF DAILY CATCHMENT PRECIPITATION

For determining the daily catchment precipitation, the proposed technique is based on three assumptions that are similar to Thiessen's, namely:

i. A precipitation gauge station is significant when the distance between station and centre of any finite element of catchment is smaller than the corresponding distance of any other station to that same element.

ii. A precipitation gauge station near the centre of the catchment is more significant than one far removed from the centre. Stations outside of catchment are not equally significant with respect to the catchment precipitation.

iii. The significance of precipitation gauge station is affected by the shape of the catchment.

In other words how significant is a precipitation gauge station is determined by its influence area. For this reason, the catchment is divided into unit square elements (they may be rectangular). The element centers and the positions of stations are determined with the aid of x and y axes (Fig.1).

For every square element, the distance between the centre of element and every station position is computed. The weight 1 is attached to the nearest station (i. assumption). This procedure is repeated for all the square unit elements; by adding them we define the catchment area, while the sum of elements of every station divided by the total number of the elements gives the weights of stations.

The above computations are carried out for all the possible combinations of the available stations, resulting from the formation of the

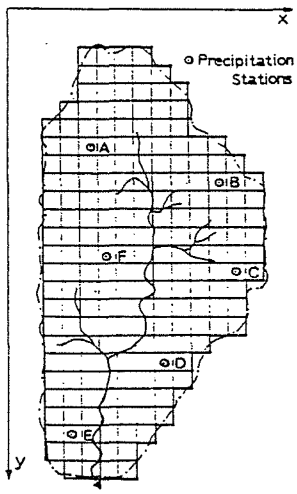

Fig.1. Grid unit square elements of catchment.

matrix, *WT(IR,IC)*, that includes all the possible weights. The row number required for any condition of station availability, described by matrix *JDAY(IC)* is based on the Chinese binary number given when the station availability is coded as 1 for available and 0 for not available. The dimensions *IR* and *IC* in the matrixes are: *IC*=1,...,*N* and *IR*=1,..., (2***N*)-1, where *N* is the number of stations. The row number *IR* is determined by the followig Fortran algorithm where items of availability code (e.g. 111111 or 101011, etc) are stored in consecutive words of the matrix *JDAY(IC)*:

```
   IR = 0
   DO 10 J = 1,N
   K = N - J
10 IR = IR + (2**K) * JDAY(J)
```

For instance, with 6 stations, the availability condition 111111 (all available) gives the row 63 (Table VIII) in the matrix *WT(IR,IC)*, while the condition 010111 (the first and third not available) gives the row 23 in the same matrix (Table VIII).

The station availability matrix, *JDAY(IC)*, is computed on a daily basis, while the *WT(IR,IC)* matrix is used as a look-up table from which the actual weights for each station can be obtained. The actual weights are used for computing the daily catchment precipitation from individual stations precipitation. In addition, the monthly and annual catchment can be computed, as well.

A station is available on a given day when it furnishes precipitation information for that day. In the opposite case, the station is unavailable and denotes the daily missing precipitation data. Even though, a station monthly precipitation is recorded as 0, while the nearby stations monthly precipitation has great values, there is a confusion about how correct is the recorded value. In this case, we reject the nil value and assume that the monthly and daily rainfalls for that month do not exist and that they are represented by the unavailability of their stations. By using this methodology, questionable or missing data are represented by the unavailability of their corresponding stations.

2.2 CORRECTION TECHNIQUE OF DAILY CATCHMENT PRECIPITATION FOR ELEVATION VARIATION

For determining daily catchment precipitation to mean catchment elevation the proposed technique includes:

- Computation of mean catchment elevation (Table I).
- Searching for a linear correlation between station elevation and mean annual station precipitation. The slope of regression line constitutes an initial estimate of rate, α, of the precipitation variation with elevation. The final estimate of the rate can be determined by trial and error procedure based on annual water balance considerations.
- Evaluation of weighted mean stations elevation, *H*, acccording to station availability. The matrix with possible weights, *WT(IR,IC)*, is used to estimate the possible weighted mean elevations of stations (equation 2.1). Every row of the matrix *WT(IR,IC)* is activated by the station availability condition *JDAY(IC)* and it gives the actual weighted mean elevation (of stations).

Because of the weighted mean stations elevation depends on the station availability, the correction factor λ of catchment precipitation for elevation variation takes a set of values according to the combinations of available stations. The matrix with possible values of the correction factor λ, is computed by the following Fortran algorithm:

```
   H = 0.
   DO 10 IC = 1,N
10 H = H + WT(IR,IC) * ELEV(IC)                                    (2.1)
   λ = 1.0 + (AVELEV - H) * α / AVCATR
```

where, N is the number of precipitation-gauge stations, $ELEV(IC)$ the matrix of stations elevations, $WT(IR,IC)$ the matrix of possible weights of the stations, *AVELEV* the mean catchment elevation, and *AVCATR* the annual catchment precipitation (without correction).

The parameter α is a monotonic function of "*AVELEV-H*", but its second derivative is negative, reflecting the fact that the rate of increase of mean precipitation with elevation decreases at high elevations.

The daily condition of station availability determines (from the matrix with possible correction factors) the actual correction factor, by which latter we multiply the daily catchment precipitation for that day.

3. Programming Procedure of the Method - Data Inputs

The method described previously can be easily applied on a microcomputer. For facility, we use six phases:

(a) WEIGHTS DETERMINATION

By using the geometric characteristics of the catchment we compute the station weights and we store them in order to use them subsenquently in the second phase.

The required data are:

- Dimensions of finite elements of catchment division dx, dy.
- The size of elements does not matter. A good choice for large basins is in the order of 500-1000 m.
- Rows number of elements for one of the axes x or y. Every row includes a set of elements depending on the size and shape of the catchment.
- Co-ordinates of the centre, first and last element for every row.
- Precipitation stations number and their co-ordinates.

(b) DETERMINATION OF DAILY CATCHMENT PRECIPITATION

Firstly we determine the daily condition of station availability, find the actual weight for this condition, and then compute the daily catchment precipitation from the precipitation of the individual stations. Afterwards the computation of monthly and annual catchment precipitation is a simple procedure.

The required data are:

- Number of precipitation stations.
- Common ending year of stations precipitation data.
- Beginning year of daily precipitation for every station, according to the files of precipitation data.
- Files of station daily precipitation.

(c) COMPUTATION OF ANNUAL CATCHMENT PRECIPITATION

The annual catchment precipitation can be computed from daily catchment precipitation which was obtained from phase (b) by a double summing. Firstly, the summing of daily catchment data for every month gives the monthly catchment precipitation, and in turn, the summation of monthly catchment precipitation of a year provides the annual catchment precipitation for that year.

If monthly or annual station precipitation data are available, the estimation procedure of annual catchment precipitation is simple and short, in contrast to the daily station data that require more processing and computation time, until they give the annual catchment precipitation. The mean annual catchment precipitation is the longterm actual average of precipitation.

(d) COMPUTATION OF PRECIPITATION VARIATION RATE WITH ELEVATION (α PARAMETER)

We compute the linear correlation coefficient between station elevation and mean annual precipitation for all the possible stations combinations. We then select the combination which presents:

- ∘ The highest linear correlation coefficient (maximum value 1.0).
- ∘ That one which includes as many nearby stations as possible.

The slope of linear regression line constitutes the variation rate of mean annual precipitation with station elevation. In case the above mentioned conditions cannot be satisfied, we make groups of nearby stations and search for any possible linear correlation between station precipitation and elevation. The mean average of slopes of the corresponding lines is the variation precipitation rate with elevation.

The required data are:

* Stations availability matrix.
* Mean annual station precipitation.
* Stations elevations.

(e) COMPUTATION OF CORRECTION FACTOR λ

In this phase, the correction factor λ is computed.

The required data are:

- Mean catchment elevation.
- Stations elevations.
- The variation precipitation rate, α, with elevation (phase (d)).
- The annual catchment precipitation (without correction) *AVCATR* (phase (c)).

(f) DETERMINATION OF CORRECTED DAILY CATCHMENT PRECIPITATION FOR MEAN CATCHMENT ELEVATION.

During this last phase, firstly, we determine the daily condition of station availability, find the actual factor λ (from the previous phase) and finally we compute the corrected daily catchment precipitation by multiplying the daily catchment precipitation (from phase (b)) by factor λ.

The required data are the same with those of the second phase.

4. Application

The described method has been applied on the Mesochora mountainous catchment of the Acheloos river of Greece (Fig 2), because a series of works are constructed there for diverting the river to the arid Thessaly plain. The catchment area is 632.8 km^2, it has intense topography and mean elevation 1390m (Table I).

In the catchment there are installed six precipitation stations (Fig.3). The station daily precipitation including incomplete data appears in the Tables II to VII. From the existing data, it is evaluated the daily catchment precipitation to mean catchment elevation for the calendar year 1964. In the tables, the missing data are presented by *****, while the symbol ● denotes the maximum daily value for every month. The availability and the possible weights of six stations are presented in the Table VIII, while the Table IX includes the estimates of the daily catch-

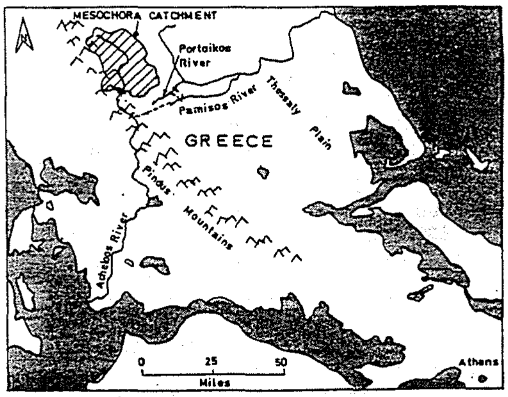

Fig 2. Location of the Mesochora catchment in Greece.

ment precipitation (without elevation correction) for the year 1964. The daily catchment precipitation series are complete because they did not coincide with any of the daily station data, which are missing that particular day from all stations. So, the monthly and annual catchment precipitation series are complete, while some of the monthly and annual station precipitation series denote nil data (presented by *****) because the daily series with no data cannot be added to give the monthly total.

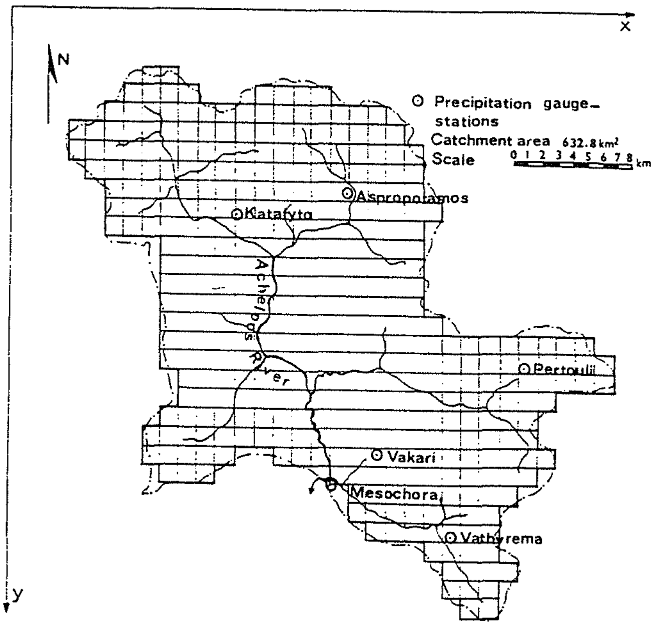

Fig. 3 Division of Mesochora catchment into square unit elements.

The mean annual catchment precipitation has been estimated to 1519.8 mm (from other study), while the linear correlation between annual precipitation and station elevation is considered for the following:

Stations	Elevation [m]	Annual precipitation [mm]
ASPROPOTAMOS	1050.0	969.2
KATAFYTO	980.0	1447.0
PERTOULI	1160.0	1556.0
VAKARI	1150.0	1716.7
MESOCHORA	780.0	1839.6
VATHYREMA	920.0	2071.3

TABLE I Computation of mean elevation of catchment

Countour elevation [m]	between countours Mean elevation z [m]	Area A [km^2]	Area [%]	$A\ z$	Mean catchment elevation [m]
<1000	800	64.50	10.19	51600	
1000-1500	1250	350.50	55.39	438125	$z_b = \frac{\Sigma A z}{\Sigma A}$ =
1500-2000	1750	201.50	31.84	352625	
>2000	2200	16.30	2.58	35860	= 1390
		632.80	100.00	878210	

Table VIII describes the results of the linear correlation that is, the correlation coefficient R_{xy}, and the a and b parameters of the regression line for three or more stations. We selected the combination of the three stations: Katafyto-Pertouli-Vakari, because this combination gives a rather good correlation coefficient (R_{xy}=0.775, R^2=0.60), while, these three stations are representative of the catchment. Concenquently, the precipitation variation

TABLE II Daily precipitation (in mm) by calendar year 1964 for Aspropotamos station

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.0	.0	15.0	.0	.0	.0	.0	15.6 ●	.0	.0	.0	55.0 ●
2	.0	.0	8.0	.0	.0	.0	.0	.0	9.2	.0	.0	.0
3	3.0 ●	.0	.0	.0	.0	.0	.0	.0	6.2	.0	15.2	.0
4	.0	.0	.0	34.0 ●	.0	.0	.0	.0	.0	.0	.0	.0
5	.0	.0	.0	8.0	.0	.0	.0	.0	.0	.0	4.2	.0
6	.0	.0	.0	2.0	.0	.0	.0	.0	.0	13.4	45.2	.0
7	.0	.0	.0	.0	.0	8.4	.0	.0	.0	.0	8.4	.0
8	.0	.0	5.0	.0	.0	5.2	.0	13.0	.0	3.0	.0	.0
9	.0	.0	.0	.0	.0	.0	.0	.0	.0	47.2 ●	.0	.0
10	.0	.0	.0	.0	.0	4.4	.0	13.7	.0	.0	65.6	.0
11	.0	.0	.0	.0	.0	.0	.0	5.2	.0	.0	.0	.0
12	.0	.0	.0	.0	.0	8.6	.0	.0	.0	.0	.0	.0
13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
14	.0	.0	.0	.0	.0	6.2	.0	.0	.0	3.2	.0	.0
15	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
16	.0	.0	29.0 ●	.0	11.0	.0	3.0	.0	.0	.0	.0	.0
17	.0	.0	8.0	5.0	8.0	.0	13.5 ●	.0	.0	.0	.0	.0
18	.0	15.0	.0	2.0	5.6	.0	.0	.0	.0	3.2	.0	.0
19	.0	14.0	.0	16.0	.0	.0	.0	.0	.0	.0	.0	.0
20	.0	47.0 ●	.0	.0	.0	.0	.0	.0	.0	15.2	.0	40.0
21	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.0
22	.0	.0	8.0	.0	3.4	.0	.0	.0	10.2 ●	.0	.0	.0
23	.0	.0	2.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
24	.0	.0	1.0	.0	4.6	24.6 ●	.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	.0	.0	.0	11.0	2.4	3.2	.0	.0	.0	.0	.0	.0
27	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
28	.0	.0	.0	3.2	.0	4.0	.0	.0	.0	.0	.0	.0
29	.0	.0	.0	.0	5.4	.0	.0	.0	.0	.0	.0	.0
30	.0		.0	.0	12.6 ●	4.2	.0	.0	.0	.0	75.0 ●	.0
31	.0		.0		.0		.0	.0		.0		.0
Σ	3.0	76.0	76.0	81.2	53.0	68.8	16.5	47.5	25.6	85.2	213.6	125.0

TABLE III Daily precipitation (in mm) by calendar year 1964 for Katafyto station

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.0	8.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	70.2 ●
2	.0	.0	.0	.0	.0	.0	.0	5.3	.0	.0	14.0	60.3
3	.0	.0	.0	.0	.0	.0	.0	.0	5.2	.0	.0	5.7
4	38.0	.0	.0	.0	.0	.0	.0	.0	14.5	.0	17.2	27.4
5	10.0	.0	30.0 ●	30.0 ●	.0	.0	.0	.0	.0	.0	.0	40.1
6	.0	.0	.0	4.3	.0	.0	.0	.0	.0	4.8	61.0 ●	8.0
7	.0	.0	.0	9.5	.0	.0	.0	.0	.0	1.9	19.4	.0
8	.0	.0	.0	10.1	.0	19.8 ●	.0	.0	.0	.0	.0	.0
9	.0	.0	7.5	5.2	.0	.0	.0	10.6	.0	59.0 ●	.0	.0
10	.0	.0	14.0	.0	.0	8.6	.0	7.8	.0	.0	.0	.0
11	.0	.0	.0	.0	.0	1.9	.0	.0	.0	.0	48.5	.0
12	.0	.0	.0	.0	.0	.0	.0	15.0 ●	.0	.0	33.2	.0
13	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.3	.0
14	.0	.0	26.8	.0	.0	.0	.0	.0	.0	.0	.0	.0
15	.0	.0	.0	.0	.0	8.2	.0	.0	.0	12.3	.0	.0
16	.0	.0	28.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
17	.0	.0	9.4	4.6	35.0 ●	.0	.0	.0	.0	.0	.0	.0
18	.0	.0	.0	.0	5.2	.0	21.2 ●	.0	.0	.0	.0	.0
19	.0	18.2	.0	.0	.0	.0	.0	.0	.0	22.6	.0	.0
20	.0	39.0 ●	.0	18.5	.0	.0	.0	.0	.0	6.5	.0	12.5
21	.0	19.5	.0	.0	.0	.0	.0	.0	.0	24.3	.0	7.8
22	.0	3.0	.0	.0	.0	.0	.0	.0	3.2	.0	.0	13.0
23	.0	.0	10.3	.0	5.6	.0	.0	.0	35.7 ●	7.1	.0	.0
24	.0	.0	.0	.0	.0	19.5	9.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	.0	17.8	.0	.0	1.3	.0	.0	.0
26	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	10.0
27	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	******
28	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	******
29	.0	4.2	10.0	.0	.0	.0	.0	.0	.0	.0	.0	******
30	13.0		.0	.0	19.2	.0	.0	.0	.0	.0	12.0	******
31	44.0 ●		.0		2.8		.0	.0		.0		******
Σ	105.0	91.9	136.2	82.2	67.8	75.8	30.2	38.7	59.9	138.5	235.6	******

TABLE IV Daily precipitation (in mm) by calendar year 1964 for Pertouli station

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.0	.0	13.4	9.2	.0	.0	4.6	.0	.0	.0	.0	69.5 •
2	2.0	.0	4.0	.0	.0	.0	.0	26.0 •	.0	.0	.0	50.3
3	16.0	.0	.0	.0	.0	.0	.0	.0	30.4	.0	15.0	25.0
4	28.0 •	.0	2.0	2.3	.0	.0	.0	.0	.0	.0	.0	18.0
5	.0	.0	.0	31.2 •	.0	.0	.0	.0	.0	.0	.0	24.5
6	.0	4.0	.0	.0	.0	.0	.0	.0	.0	7.8	48.4 •	5.0
7	.0	.0	49.0 •	7.5	.0	.0	.0	.0	.0	1.0	17.0	.0
8	.0	.0	24.6	.0	.0	5.4	.0	.0	.0	1.0	.0	.0
9	.0	.0	10.2	.0	.0	15.3 •	7.8	.0	.0	.0	.0	.0
10	.0	.0	16.7	.0	.0	1.5	.0	.0	.0	70.4 •	30.2	.0
11	.0	.0	.0	.0	.0	3.2	.0	8.6	.0	.0	43.0	.0
12	.0	.0	.0	2.3	28.0	12.7	.0	.0	.0	.0	.0	.0
13	.0	.0	.0	.0	.0	4.6	.0	.0	.0	.0	35.8	.0
14	.0	.0	19.4	.0	.0	9.8	.0	.0	.0	7.0	.0	.0
15	.0	.0	.0	.0	.0	15.2	.0	.0	.0	.0	.0	.0
16	.0	16.3	25.0	.0	8.6	.0	.0	.0	.0	.0	.0	.0
17	.0	1.0	.0	.0	32.4 •	3.0	.0	.0	.0	.0	.0	.0
18	.0	8.4	.0	.0	13.7	1.5	22.0 •	.0	.0	7.4	.0	.0
19	.0	.0	.0	8.4	3.2	.0	.0	.0	.0	2.0	2.0	.0
20	.0	23.7	.0	.0	.0	.0	.0	.0	.0	10.0	3.0	37.5
21	.0	28.0 •	.0	.0	.0	.0	.0	.0	.0	14.0	.0	10.6
22	.0	17.4	.0	.0	.0	.0	.0	.0	38.0 •	4.6	.0	22.0
23	.0	1.0	.0	.0	.0	.0	.0	.0	.0	5.0	.0	.0
24	.0	.0	.0	.0	5.2	6.5	.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	6.3	4.8	.0	.0	.0	.0	.0	3.0
26	.0	.0	.0	.0	11.4	1.4	11.0	.0	4.2	.0	.0	24.0
27	.0	8.0	.0	10.5	.0	4.5	2.3	4.6	3.4	.0	.0	43.5
28	10.0	.0	.0	.0	.0	.0	4.7	.0	6.6	.0	.0	8.4
29	26.0	.0	18.5	.0	.0	.0	.0	.0	.0	9.4	.0	.0
30	4.0		.0	.0	23.6	.0	.0	.0	.0	.0	15.8	1.4
31	.0		.0		.0		.0	.0		.0		.0
Σ	86.0	107.8	182.8	71.4	132.4	89.4	52.4	39.2	82.6	139.6	210.2	342.7

TABLE V Daily precipitation (in mm) by calendar year 1964 for Vakari station

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.0	.0	18.5	13.5	.0	.0	1.0	.0	.0	.0	.0	83.3 •
2	.0	.0	6.0	.0	4.2	.0	.0	3.6	3.0	.0	.4	40.8
3	.0	.0	.0	.0	.0	.0	.0	.0	37.0	.0	16.7	16.7
4	15.4	.0	.0	6.5	.0	.0	.0	4.5	.4	.0	.8	31.2
5	7.1	.0	3.9	36.0 •	.0	.0	.0	.0	.0	.0	.0	48.1
6	.0	.0	3.3	2.3	.0	.0	.0	.0	.0	8.4	58.6 •	10.1
7	1.7	1.7	27.2	9.0	.0	.2	.0	.0	.0	1.7	21.2	4.3
8	.0	.0	37.5 •	1.0	.0	7.9	.0	.0	.0	2.7	1.5	.0
9	.0	.0	15.0	1.2	.0	5.2	.3	.8	.0	1.0	.0	.0
10	.0	.0	14.5	.0	.0	7.5	.0	1.2	.0	78.7 •	13.7	.0
11	.0	.0	.0	.0	.0	10.0	.0	1.7	.0	.0	45.9	.0
12	.0	.0	.0	1.3	10.1	4.7	1.3	.0	.0	.0	.0	.0
13	.0	1.6	.0	.0	.0	4.0	2.1	.0	.0	.0	30.0	.0
14	.0	.0	10.0	.0	.0	1.4	.0	.0	.0	.0	.0	.0
15	.0	.0	13.0	.0	.0	10.9	.0	.0	.0	10.0	.0	.0
16	.0	17.3	30.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
17	.0	6.0	13.8	.0	******	.0	.0	.0	.0	.0	.0	5.0
18	.0	6.0	.0	.0	******	10.7	16.5 •	.0	.0	.0	.0	.3
19	.0	9.3	.0	2.1	.0	.0	.0	.0	.0	16.8	.0	.0
20	.0	64.0 •	.0	.0	.0	.7	.0	.0	.0	5.0	5.4	53.8
21	.0	26.0	.0	.0	.8	.0	.0	.0	.0	18.0	.0	9.4
22	.0	4.8	1.1	.0	.0	.8	.0	.0	41.2 •	4.5	.0	26.6
23	.0	5.5	6.5	.0	1.4	.0	.0	.0	2.8	15.6	.8	.0
24	.0	.0	1.0	.0	3.2	14.8 •	1.6	.0	.0	.0	.0	.9
25	.0	.0	.5	.0	3.8	6.5	******	.0	2.0	.0	.0	1.3
26	.0	.0	.0	15.0	5.6	.0	******	.0	.8	.0	.0	29.8
27	.0	.0	.0	.8	.0	1.0	******	5.0 •	3.4	.0	.0	56.7
28	.0	4.8	.0	.0	.0	.0	8.0	.0	.9	.7	.0	20.7
29	8.9	2.8	20.5	.0	.2	1.9	.0	.0	.0	.0	4.8	.0
30	28.4 •		.0	.0	19.5 •	.0	.0	.0	.0	.2	15.5	3.9
31	15.4		.0		5.3		.0	.0		.0		1.3
Σ	76.9	149.8	222.3	88.7	******	88.2	******	16.8	91.5	163.3	215.3	444.2

TABLE VI Daily precipitation (in mm) by calendar year 1964 for Mesochora station

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.0	.0	20.7	.0	4.3	.0	5.3	.0	.0	.0	.0	94.2 •
2	.0	.0	9.6	.0	.0	.0	3.3	8.5 •	5.8	.0	.4	52.7
3	30.0	.0	.0	.0	.0	.0	.0	.0	44.0 •	.0	19.2	16.6
4	.0	.0	3.6	.0	.0	.0	2.4	1.7	.0	.0	******	41.1
5	8.0	.0	.0	24.3 •	.0	.0	.0	.0	.0	.0	.0	60.5
6	3.6	.0	.0	.0	.0	.0	1.6	.0	.0	.0	******	6.8
7	1.8	.0	.0	.7	.0	10.2	.0	.0	.0	******	.6	.0
8	.0	5.0	.0	3.2	.0	9.8	.0	.0	.0	******	.1	.0
9	.0	.0	10.5	2.7	.0	9.9	.2	1.8	.0	******	******	.0
10	.0	.0	.0	.0	.0	3.1	.0	1.1	.0	******	******	.0
11	.0	.0	1.1	.0	.0	.6	.0	7.3	.0	******	.0	.0
12	.0	.0	2.2	1.0	2.5	.8	.8	.0	.0	******	******	.0
13	.0	1.4	6.3	.0	.0	8.9	1.2	.0	.0	******	.3	.0
14	.0	.0	******	.0	.0	1.6	.0	.0	.0	******	.0	.0
15	.0	.6	.0	.0	.0	12.0 •	.0	.0	.0	******	.0	.0
16	.0	19.5	.0	.0	7.3	.0	.0	.0	.0	******	.0	.0
17	.0	.5	14.5	.0	19.3 •	.3	.0	.0	.0	******	.0	7.8
18	.0	5.6	.0	.0	.0	9.7	16.6	.0	.0	******	.0	.3
19	.0	9.8	.0	2.8	.0	.0	.0	.0	.0	******	.0	.0
20	.0	80.0 •	.0	.0	.0	1.2	.0	.0	.0	******	.0	55.3
21	.0	35.0	22.8 •	.0	.0	.0	.0	.0	.0	******	.0	9.4
22	.0	.8	1.5	.0	.0	1.8	.0	.0	******	******	.0	27.3
23	.0	2.5	.6	.0	2.2	.3	.8	.0	4.0	******	.0	.0
24	.0	.0	.0	.0	7.3	1.4	1.2	.0	.0	******	.0	.9
25	.0	.0	12.4	.0	.4	.0	4.0	.0	.8	******	.0	1.4
26	.0	.0	.0	19.5	8.3	.0	18.0 •	.4	.5	******	.0	7.8
27	.0	3.4	.0	1.8	.0	.0	.0	.0	.6	******	.0	63.2
28	.0	.0	6.0	.0	.0	.0	14.2	.0	.4	******	.0	22.7
29	.0	3.5	******	.0	.0	.0	.0	.0	.0	******	7.8	.0
30	40.0 •		2.0	.0	11.6	.0	.0	.0	.0	******	20.4 •	6.7
31	14.8		1.5		.0		.0	.0		******		1.6
Σ	98.2	167.6	******	56.0	63.2	71.6	69.6	20.8	******	******	******	476.3

TABLE VII Daily precipitation (in mm) by calendar year 1964 for Vathyrema station

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.0	.0	20.1	22.1	.0	.0	3.2	.0	.0	.0	15.3	12.4
2	.0	.0	.0	.0	.0	.0	.0	11.3 •	.0	.0	28.4	30.3
3	6.2	.0	.0	.0	.0	.0	.0	2.1	34.2	2.4	.0	40.5 •
4	33.4	.0	.0	.0	.0	.0	.0	.0	.0	8.2	5.2	10.3
5	7.3	.0	4.2	41.2 •	.0	.0	.0	.0	.0	.0	.0	9.1
6	.0	.0	12.4	20.1	.0	.0	.0	.0	.0	10.3	16.3	.0
7	.0	9.4	46.2 •	3.2	.0	.0	.0	.0	.0	2.1	36.4 •	.0
8	.0	6.3	9.3	4.1	.0	13.8	.0	.0	.0	3.2	.0	.0
9	.0	.0	5.4	.0	.0	10.5	.0	.0	.0	4.1	.4	.0
10	.0	.0	.0	.0	.0	.0	.0	.0	.0	47.4 •	24.2	.0
11	.0	2.4	.0	.0	.0	6.4	.0	6.2	.0	.0	20.4	.0
12	.0	.0	.0	1.3	8.1	.0	.0	.0	.0	.0	.0	.0
13	.0	.0	14.1	.0	.0	.0	4.3	.0	.0	3.2	30.2	.0
14	.0	.0	16.3	.0	.0	.0	.0	.0	.0	.0	13.4	.0
15	.0	9.3	.0	.0	.0	14.6 •	.0	.0	.0	.0	.0	6.2
16	.0	4.4	40.0	.0	9.2	.0	.0	.0	.0	2.1	.0	.0
17	.0	16.4	14.4	.0	44.0 •	.0	.0	.0	2.4	.0	.0	.0
18	.0	5.2	.0	.0	5.2	.0	13.2	.0	.0	.0	.0	.0
19	.0	26.3	.0	4.8	2.4	.0	.0	.0	.0	22.4	5.1	.0
20	.0	70.4 •	.0	.0	.0	.0	.0	.0	.0	10.2	.0	8.4
21	.0	33.2	.0	.0	.0	.0	.0	.0	.0	21.4	.0	.0
22	.0	5.2	.0	.0	.0	.0	.0	.0	77.4 •	37.1	4.3	.0
23	.0	4.0	16.3	.0	3.1	.0	.0	.0	2.4	15.2	.0	.0
24	.0	.0	6.4	.0	6.3	10.2	.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	.0	1.3	6.2	.0	.0	.0	.0	.0
26	.0	5.4	.0	24.6	.0	2.5	.0	5.2	5.5	.0	.0	38.4
27	.0	.0	.0	.0	.0	.0	.0	.0	3.3	.0	.0	6.3
28	.0	.0	.0	.0	.0	.0	33.2 •	.0	.0	4.2	.0	.0
29	8.2	.0	13.2	.0	.0	.0	.0	.0	.0	11.4	11.4	.0
30	35.4 •		.0	.0	29.2	3.1	.0	.0	.0	14.2	16.2	4.1
31	8.2		.0		.0		.0	.0		4.4		.0
Σ	98.7	197.9	218.3	121.4	107.5	62.4	60.1	24.8	125.2	223.5	227.2	166.0

TABLE VIII Possible stations weights and corrective factors

N°	Station availability	STATION WEIGHTS						linear correlation coefficient	regression line y = a x + b		Corrective factor
		ASPROPOTAMI	KATAFYTO	PERTOULI	VAKARI	MESOCHORA	VATHYREMA				
IR	JDAY(IR,J)	WT(IR,1)	WT(IR,2)	WT(IR,3)	WT(IR,4)	WT(IR,5)	WT(IR,6)	Rxy	a	b	λ
1	000001	.00000	.00000	.00000	.00000	.00000	1.00000				1.32162
2	000010	.00000	.00000	.00000	.00000	1.00000	.00000				1.41742
3	000011	.00000	.00000	.00000	.00000	.78272	.21728				1.39660
4	000100	.00000	.00000	.00000	1.00000	.00000	.00000				1.16423
5	000101	.00000	.00000	.00000	.86914	.00000	.13086				1.18483
6	000110	.00000	.00000	.00000	.71852	.28148	.00000				1.23550
7	000111	.00000	.00000	.00000	.59012	.28148	.12840	-.46868	-.45174	2305.00	1.25570
8	001000	.00000	.00000	1.00000	.00000	.00000	.00000				1.15739
9	001001	.00000	.00000	.68148	.00000	.00000	.31852				1.20970
10	001010	.00000	.00000	.36049	.00000	.63951	.00000				1.32368
11	001011	.00000	.00000	.33086	.00000	.55802	.11111	-.66871	-.89807	2678.43	1.32074
12	001100	.00000	.00000	.26173	.73827	.00000	.00000				1.16244
13	001101	.00000	.00000	.25185	.65432	.00000	.09383	-.96301	-1.87020	3794.88	1.17727
14	001110	.00000	.00000	.26173	.45679	.28148	.00000	-.83792	-.55030	2270.88	1.23371
15	001111	.00000	.00000	.25185	.37531	.28148	.09136	-.67871	-.79624	2594.10	1.24815
16	010000	.00000	1.00000	.00000	.00000	.00000	.00000				1.28056
17	010001	.00000	.63704	.00000	.00000	.00000	.36296				1.29546
18	010010	.00000	.52099	.00000	.00000	.47901	.00000				1.34611
19	010011	.00000	.52099	.00000	.00000	.26173	.21728	-.42985	-1.32172	2966.69	1.32530
20	010100	.00000	.51358	.00000	.48642	.00000	.00000				1.22397
21	010101	.00000	.51358	.00000	.35556	.00000	.13086	-.32648	-.85682	2616.08	1.24457
22	010110	.00000	.50370	.00000	.37284	.12346	.00000	-.35020	-.37971	2036.07	1.25408
23	010111	.00000	.50370	.00000	.24444	.12346	.12840	-.34448	-.58433	2328.12	1.27429
24	011000	.00000	.61975	.38025	.00000	.00000	.00000				1.23372
25	011001	.00000	.59753	.19753	.00000	.00000	.20494	-.56633	-1.51198	3233.63	1.26464
26	011010	.00000	.49877	.20000	.00000	.30123	.00000	-.72111	-.76880	2362.48	1.29715
27	011011	.00000	.49877	.17037	.00000	.21975	.11111	-.55394	-.99251	2681.26	1.29421
28	011100	.00000	.50123	.15062	.34815	.00000	.00000	.77543	1.03989	432.79	1.22151
29	011101	.00000	.50123	.14074	.26420	.00000	.09383	-.45216	-1.01906	2770.28	1.23634
30	011110	.00000	.49136	.15062	.23457	.12346	.00000	-.45233	-.43876	2086.24	1.25162
31	011111	.00000	.49136	.14074	.15309	.12346	.09136	-.48144	-.73232	2456.95	1.26606
32	100000	1.00000	.00000	.00000	.00000	.00000	.00000				1.23266
33	100001	.62222	.00000	.00000	.00000	.00000	.37778				1.26626
34	100010	.52593	.00000	.00000	.00000	.47407	.00000				1.32025
35	100011	.51111	.00000	.00000	.00000	.27407	.21481	-.73461	-3.16104	4524.31	1.30240
36	100100	.49630	.00000	.00000	.50370	.00000	.00000				1.19819
37	100101	.49630	.00000	.00000	.37284	.00000	.13086	-.38555	-1.88073	3541.68	1.21879
38	100110	.49136	.00000	.00000	.35556	.15309	.00000	-.38031	-.93595	2438.20	1.23661
39	100111	.49136	.00000	.00000	.22716	.15309	.12840	-.43369	-1.28754	2904.54	1.25682
40	101000	.64444	.00000	.35556	.00000	.00000	.00000				1.20589
41	101001	.59012	.00000	.16790	.00000	.00000	.24198	-.50923	-2.33722	3970.65	1.24155
42	101010	.49136	.00000	.17531	.00000	.33333	.00000	-.53427	-1.21284	2663.72	1.28105
43	101011	.49136	.00000	.14568	.00000	.25185	.11111	-.54701	-1.58494	3158.29	1.27811
44	101100	.49383	.00000	.13086	.37531	.00000	.00000	.95882	6.20159	-5531.83	1.19713
45	101101	.49383	.00000	.12099	.29136	.00000	.09383	-.34238	-1.40927	3086.20	1.21196
46	101110	.48889	.00000	.13086	.22716	.15309	.00000	-.30596	-.66568	2209.34	1.23555
47	101111	.48889	.00000	.12099	.14568	.15309	.09136	-.42220	-1.08259	2726.12	1.24999
48	110000	.54815	.45185	.00000	.00000	.00000	.00000				1.25430
49	110001	.24444	.41481	.00000	.00000	.00000	.34074	-.99269	-8.43171	9787.02	1.28284
50	110010	.23457	.32593	.00000	.00000	.43951	.00000	-.94682	-2.94524	4177.31	1.32947
51	110011	.21975	.32593	.00000	.00000	.23951	.21481	-.74510	-3.13637	4506.43	1.31163
52	110100	.20000	.33333	.00000	.46667	.00000	.00000	.44910	1.98959	-731.33	1.21669
53	110101	.20000	.33333	.00000	.33580	.00000	.13086	-.31791	-1.49435	3082.75	1.23729
54	110110	.20000	.32346	.00000	.35309	.12346	.00000	-.37536	-.92587	2409.73	1.24680
55	110111	.20000	.32346	.00000	.22469	.12346	.12840	-.42703	-1.29767	2875.27	1.26701
56	111000	.21235	.43704	.35062	.00000	.00000	.00000	.29845	1.02648	232.57	1.22720
57	111001	.21235	.41481	.16790	.00000	.00000	.20494	-.45352	-1.98973	3555.32	1.25812
58	111010	.20000	.32593	.17531	.00000	.29877	.00000	-.53294	-1.20825	2652.13	1.29027
59	111011	.20000	.32593	.14568	.00000	.21728	.11111	-.54009	-1.58885	3130.50	1.28733
60	111100	.19753	.33333	.13086	.33827	.00000	.00000	.51220	1.91955	-660.50	1.21563
61	111101	.19753	.33333	.12099	.25432	.00000	.09383	-.25663	-.98574	2589.02	1.23046
62	111110	.19753	.32346	.13086	.22469	.12346	.00000	-.28516	-.61555	2136.01	1.24574
63	111111	.19753	.32346	.12099	.14321	.12346	.09136	-.39437	-1.02746	2634.26	1.26018

The values of corrective factor λ correspond to a = 1.04 for the stations combinations (availability).

TABLE IX Average Precipitation (in mm) by calendar year 1964 for the Catchment without an Elevation Correction

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.00	2.59	11.63	5.07	.53	.00	1.65	3.08	.00	.00	1.40	66.67 •
2	.24	.00	4.11	.00	.60	.00	.41	7.46 •	2.96	.00	7.23	40.71
3	6.80	.00	.00	.00	.00	.00	.00	.19	20.44	.22	9.58	13.01
4	20.94 •	.00	.69	7.93	.00	.00	.30	.85	4.75	.75	6.42	21.52
5	5.91	.00	10.65	26.98 •	.00	.00	.00	.00	.00	.00	.83	31.12
6	.44	.48	1.61	3.95	.00	.00	.20	.00	.00	7.29	51.55 •	5.48
7	.47	1.10	14.04	5.65	.00	2.95	.00	.00	.00	1.38	16.43	.62
8	.00	1.19	10.18	4.18	.00	11.69	.00	2.57	.00	1.70	.23	.00
9	.00	.00	7.60	2.19	.00	4.78	1.01	3.77	.00	29.63	.04	.00
10	.00	.00	8.63	.00	.00	5.29	.00	5.54	.00	32.98 •	22.37	.00
11	.00	.22	.14	.00	.00	3.09	.00	3.78	.00	.00	29.33	.00
12	.00	.00	.27	.71	5.88	4.01	.28	4.85	.00	.00	11.07	.00
13	.00	.40	2.07	.00	.00	2.23	.84	.00	.00	.30	21.22	.00
14	.00	.00	15.35	.00	.00	2.81	.00	.00	.00	1.48	1.22	.00
15	.00	.92	1.86	.00	.00	8.87	.00	.00	.00	6.64	.00	.57
16	.00	7.26	25.83 •	.00	4.96	.00	.59	.00	.00	.20	.00	.00
17	.00	2.54	9.70	2.48	26.81 •	.40	2.67	.00	.22	.00	.00	1.68
18	.00	6.00	.00	.40	5.39	2.91	15.14 •	.00	.00	1.53	.00	.08
19	.00	13.60	.00	5.26	.61	.00	.00	.00	.00	14.15	.71	.00
20	.00	50.24 •	.00	5.98	.00	.25	.00	.00	.00	8.61	1.14	31.78
21	.00	20.77	2.81	.00	.11	.00	.00	.00	.00	16.38	.00	12.24
22	.00	4.34	1.92	.00	.67	.34	.00	.00	25.42 •	5.18	.39	14.05
23	.00	1.58	6.22	.00	2.57	.04	.10	.00	12.66	8.37	.11	.00
24	.00	.00	.93	.00	3.47	15.18 •	3.29	.00	.00	.00	.00	.24
25	.00	.00	1.60	.00	1.36	7.39	1.56	.00	.81	.00	.00	.72
26	.00	.49	.00	8.98	3.68	1.03	5.51	.52	1.19	.00	.00	14.88
27	.00	1.39	.00	1.61	.00	.69	.34	1.27	1.27	.00	.00	23.77
28	1.21	.69	.74	.63	.00	.79	6.50	.00	.98	.57	.00	7.51
29	5.17	2.19	12.02	.00	1.10	.27	.00	.00	.00	2.21	2.69	.00
30	16.93		.25	.00	18.45	1.11	.00	.00	.00	1.38	26.83	2.14
31	19.01		.19		1.66		.00	.00		.41		.43
Σ	77.11	118.00	151.02	81.97	77.84	76.10	40.38	33.88	70.69	141.35	210.78	289.21

TABLE X Average Precipitation (in mm) by calendar year 1964 for the Catchment with an Elevation Correction

day	January	February	March	April	May	June	July	August	September	October	November	December
1	.00	3.26	14.65	6.38	.67	.00	2.07	3.88	.00	.00	1.76	84.02 •
2	.30	.00	5.18	.00	.76	.00	.51	9.40 •	3.73	.00	9.11	51.30
3	8.57	.00	.00	.00	.00	.00	.00	.24	25.76	.28	12.07	16.39
4	26.38 •	.00	.87	9.99	.00	.00	.37	1.08	5.98	.94	7.91	27.12
5	7.44	.00	13.42	34.00 •	.00	.00	.00	.00	.00	.00	1.05	39.22
6	.56	.61	2.02	4.98	.00	.00	.25	.00	.00	9.18	63.43 •	6.90
7	.59	1.39	17.70	7.12	.00	3.71	.00	.00	.00	1.70	20.70	.78
8	.00	1.50	12.83	5.27	.00	14.73	.00	3.24	.00	2.09	.29	.00
9	.00	.00	9.57	2.76	.00	6.02	1.27	4.75	.00	36.46	.05	.00
10	.00	.00	10.87	.00	.00	6.67	.00	6.98	.00	40.58 •	27.52	.00
11	.00	.28	.17	.00	.00	3.90	.00	4.76	.00	.00	36.96	.00
12	.00	.00	.34	.89	7.41	5.05	.36	6.11	.00	.00	13.62	.00
13	.00	.51	2.60	.00	.00	2.81	1.06	.00	.00	.37	26.75	.00
14	.00	.00	18.89	.00	.00	3.54	.00	.00	.00	1.82	1.54	.00
15	.00	1.16	2.35	.00	.00	11.17	.00	.00	.00	8.17	.00	.71
16	.00	9.15	32.54 •	.00	6.24	.00	.75	.00	.00	.24	.00	.00
17	.00	3.20	12.23	3.12	34.51 •	.50	3.36	.00	.28	.00	.00	2.12
18	.00	7.57	.00	.50	6.94	3.67	19.08 •	.00	.00	1.88	.00	.10
19	.00	17.13	.00	6.63	.76	.00	.00	.00	.00	17.41	.89	.00
20	.00	63.31 •	.00	7.54	.00	.31	.00	.00	.00	10.59	1.43	40.05
21	.00	26.18	3.55	.00	.14	.00	.00	.00	.00	20.15	.00	15.42
22	.00	5.47	2.42	.00	.85	.42	.00	.00	31.28 •	6.38	.50	17.70
23	.00	1.99	7.84	.00	3.23	.05	.12	.00	15.96	10.29	.14	.00
24	.00	.00	1.17	.00	4.38	19.13 •	4.14	.00	.00	.00	.00	.30
25	.00	.00	2.02	.00	1.71	9.31	2.01	.00	1.02	.00	.00	.91
26	.00	.62	.00	11.31	4.64	1.30	7.10	.66	1.50	.00	.00	18.75
27	.00	1.75	.00	2.03	.00	.87	.43	1.60	1.61	.00	.00	29.72
28	1.52	.87	.93	.80	.00	1.00	8.19	.00	1.23	.70	.00	9.38
29	6.51	2.76	14.79	.00	1.38	.34	.00	.00	.00	2.72	3.39	.00
30	21.33		.31	.00	23.25	1.40	.00	.00	.00	1.70	33.81	2.67
31	23.96		.23		2.10		.00	.00		.51		.54
Σ	97.18	148.71	189.50	103.30	98.97	95.89	51.08	42.70	88.33	174.18	262.90	364.11

rate with elevation is the slope α of the line and it has the value 1.04.

Finally, we computed the corrected elevation daily catchment precipitation for the calendar year 1964 (Table X), by multipling the corresponding daily catchment precipitation without correction (Table IX) by the actual value of the corrective factor λ, taken from the matrix of the possible factors (Table VIII) with criterion the station availability condition. By summing up the corrected daily and monthly catchment precipitation respectively we obtain the corrected monthly and annual ones (Table XI). The same Table describes the monthly and annual station precipitation, and the monthly and annual catchment precipitation without correction (the numbers in parenthesis).

TABLE XI Stations and catchment monthly precipitation (in mm) by calender year 1964

Stations	January	February	March	April	May	June	July	August	Septemb	October	November	December	Annual
ASPROPOT	3.00	76.00	76.00	81.20	53.00	68.80	16.50	47.50	25.60	85.20	213.60	125.00	871.40
KATAFYTO	105.00	91.90	136.20	82.20	67.80	75.80	30.20	38.70	59.90	138.50	235.60	******	*******
PERTOULI	86.00	107.80	182.80	71.40	132.40	89.40	52.40	39.20	82.60	139.60	210.20	342.70	1536.50
VAKARI	76.90	149.80	222.30	88.70	******	88.20	******	16.80	91.50	163.30	215.30	444.20	*******
MESOCHORA	98.20	167.60	******	56.00	63.20	71.60	69.60	20.80	******	******	******	476.30	*******
VATHYREMA	98.70	197.90	218.30	121.40	107.50	62.40	60.10	24.80	125.20	223.50	227.20	166.00	1633.00
MESOCHORA	(77.11)	(118.00)	(151.02)	(81.97)	(77.84)	(76.10)	(40.38)	(33.88)	(70.69)	(141.35)	(210.78)	(289.21)	(1368.35)
Catchment	97.18	148.71	189.50	103.30	98.97	95.89	51.08	42.70	88.33	174.18	262.90	364.11	1716.86

Also, it is to be noted that in this work, we have been restricted to an initial estimate of the corrective factor λ, and we did not proceed to factor refinements through the trial and error approach.

5. Conclusions

A technique that estimates the daily catchment precipitation from records with missing data has been presented. From the existing data, we corrected the catchment precipitation for elevation variation.

Although by this manner, maximum daily precipitation, if any, may be lost we would rather not fill the missing data with any technique, precisely in order to preserve the real value of the data, as we are required to by the deterministic conceptual models. On the other hand, the existence of a dense network of stations can cover this event.

The proposed method can be developed only by using computers (or micro-computers) in determining the weights for all the possible stations combinations, in order to average the precipitation over the catchment area and evaluate the weigthed mean elevation of the stations. Also, we must look for a linear correlation between station elevation and precipitation for various station combinations, so as to determine the best possible correlation.

Since the developed method can compute the weights for all possible stations combinations, it can also handle successfully any change in the gauge network, that was the greatest limitation of the Thiessen method (Linsley, Kohler and Paulhus 1988)

With this technique, in other work (Panagoulia 1990), there was estimated the daily precipitation of the Mesochora catchment in Central Greece, which was used as input to Snow Accumulation and Ablation model and in turn to the Soil Moisture Accounting model of NWSRFS.

The simulated catchment runoff (with the above referred models and catchment precipitation method) was very close to the observed discharge of Acheloos river at the outfall of Mesochora catchment. Especially, the estimated standard error of monthly runoff was less by about 40-45% than the corresponding one in other catchments in California (USA), when the same hydrological modeling was used, yet with different techniques of daily catchment precipitation estimation (Lettenmaier 1989).

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