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by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Irrigation Engineering

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R. Kern Stutler

R. Kern Stutler

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ABSTRACT

Estimation of Evaporation and

Evapotranspiration in Colombia

by

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Utah State University, 1970

Major Professor: Dr. E. C. Olsen III
Thesis Director: J. E. Christiansen
Department: Agricultural and Irrigation Engineering

A formula for estimating class A pan evaporation from sheltered evaporation was developed using data from ten climatological stations in Venezuela. The formula is of the form:

$$Ev = K E_{vf} C_{ef}$$

where

Ev = pan evaporation,

K = a constant,

E_{vf} = sheltered evaporation,

C_{ef} = a coefficient based on the amount of Fuess or sheltered evaporation.

Using this formula the pan evaporation was estimated for 17 stations in Venezuela and 20 stations in Colombia where measured sheltered evaporation data were available. Using Christiansen's formula the potential evapotranspiration was also estimated from the pan

evaporation and compared to that estimated by Christiansen's formula using climatic data.

Using the Christiansen-Pardo formula, sheltered evaporation was estimated for 26 stations in Colombia. From this estimated sheltered evaporation the pan evaporation was estimated using the new formula and compared with the pan evaporation estimated by the Christiansen formula from climatic data.

(103 pages)

INTRODUCTION

The republic of Colombia, located in the northwest corner of South America, is one of the many developing Latin American countries. In recent years agriculture has received a great deal of attention and support from the government through the Colombian Agrarian Reform Institute, INCORA. The emphasis on agricultural development includes planning and some initial construction on a total of approximately 363,000 hectares of irrigated lands. To provide a sound basis for this planning, as well as for the management of developed irrigation, reliable estimates of evaporation and evapotranspiration are essential.

Because it integrates many of the climatic factors affecting evapotranspiration, or consumptive use by crops, pan evaporation has been considered to be a good indicator of potential evapotranspiration and much work has been done to correlate the two, with particular emphasis on the evaporation as measured by the U.S. Weather Bureau standard class A pan.

In Colombia, pan evaporation data are very limited. Numerous pan installations have been made in recent years, but generally, available data are limited to periods of six months to a year. Most of the available evaporation data with more than one year of record are those measured by a Wild type evaporimeter in a shelter. This is commonly referred to as "Fuess" evaporation.

In order to relate these data to consumptive use, they first need to be correlated with pan evaporation. The objectives of this study then, are to:

1. Develop a formula to express the relationship of sheltered evaporation to pan evaporation.

2. Estimate the pan evaporation and evapotranspiration for stations in Colombia with measured sheltered evaporation using the above formula.

3. Estimate the sheltered evaporation for stations where no evaporation measurements are made, using the relationship previously developed by Pardo in 1968. From this estimated sheltered evaporation, estimate the pan evaporation and evapotranspiration.

REVIEW OF LITERATURE

The literature on evaporation and evapotranspiration is quite extensive with a large portion of the existing literature being published during the past 50 years. The literature for the years 1800 to 1958 has been compiled by Robinson and Johnson (1961), and many of the more recent publications have been included in a bibliography by Christiansen and Lauritzen (1963). According to Akke, cited by Blaney and Criddle (1962), the effect of sunshine and heat in stimulating transpiration was studied in England as early as 1691.

Since 1935 sufficient investigation has been carried out and data have become available so that designers, engineers and scientists have been able to rely on such information. In turn this has generated more interest in and need for further research and data, thus the increase in later years of literature on the subject.

Evaporation

Evaporation is defined as the natural process by which water is changed from a liquid to a vapor. Studies of evaporation have taken a theoretical approach where evaporation theories have been investigated and an empirical approach where climatological data have been used to arrive at methods or formulas for estimating evaporation.

Evapotranspiration

Evapotranspiration is the combination of water transpired through

the leaves of a growing plant and that evaporated from the soil and plant leaves. The term potential evapotranspiration applies to conditions with full vegetative cover and where soil moisture is not a limiting factor.

Evaporation measurements

Pan evaporation. The standard U.S. Weather Bureau Class A pan as described by Kohler et al. (1958) is the most widely used in the United States. This same type of pan is being used at several locations in Venezuela as well as other countries in South America. Recent installations have been made at various climatological stations in Colombia but very limited data are available at present. The Venezuelan installations are in general quite good but some variations have been noted in pan color, installation and operation by Stutler (1970).

Evaporation from the pan is influenced by its relative position with respect to the ground surface, depth of water in the pan, color of interior and exterior, surroundings, etc.

Evaporation in shelter. A widely used method of measuring evaporation in Venezuela and Colombia and perhaps other South American countries is with evaporimeters placed in an instrument shelter. This is a Wild type instrument and as noted by Stutler (1970) is either from the Fuess or SIAP company. The sheltered evaporation measured by either of these two makes has come to be commonly referred to as "Fuess evaporation."

The Fuess evaporimeter consists of a circular evaporation pan 250 sq. cm. in area and 10 mm. deep. Attached to this pan and supported above it is a plastic water supply bottle, which maintains the water level in the pan at approximately a constant level. As the water evaporates from the pan, which rests on a balance, it actuates a needle which may be read on a scale, or on the recording models, it registers the movements on a paper recorder.

The SIAP instrument also has a 250 square cm. circular evaporation pan, but it has no water supply bottle and has a cylindicial shield around the pan. The water level in the pan constantly varies, decreasing as evaporation takes place then suddenly increasing when it is filled. As evaporation takes place, the change in weight actuates a needle which is read on a scale calibrated in mm. of evaporation. These are seldom provided with a recorder.

The Piche evaporimeter is also used under shelter in many countries in South America. It consists of a graduated tube 30 cm. long with the lower end covered by a paper disk from which the water evaporates. While this is generally located in a shelter it may be used outside as well.

Evapotranspiration measurements

The various methods of measuring evapotranspiration as reviewed by Tanner (1967) are divided into three classes: (1) water balance or hydrological methods, (2) micrometeorological methods

and (3) empirical methods. While the first two are rational approaches the third is empirical and depends on relating the empirical factor to actual measurements of evapotranspiration.

The water balance methods include natural catchment, soil moisture depletion measurements, and the use of lysimeters. The micrometeorological methods most commonly used are the profile methods, also referred to as aerodynamic or mass transfer methods, the energy balance method and combinations of these two. These are discussed later in the review.

Theoretical methods of estimating evaporation and/or evapotranspiration

Vapor transfer. Several theoretical methods based on vapor transfer theory have been developed. The methods and formulas of Meyer, Rowher, Penman and Harbeck are discussed by Christiansen and Mehta (1965).

Energy balance. The energy balance approach is perhaps the best theoretical approach to the estimation of evaporation and evapotranspiration, requiring simpler measurements than those for the vapor transfer. The methods all start from the basic equation $LE = R_N - G - H$, which says that the energy available or used in evaporation water is equal to the net radiation less energy used to heat the soil and air. Fritschen (1966) discusses the advantages and disadvantages of these meteorological methods and states that the energy balance method in combination with the Bowen ratio may be the most

promising. He concludes that the method gives good results under both humid and arid conditions providing the basic assumptions are met.

Combination methods. Several combinations of the aerodynamic and energy balance have been used. One of these, the Penman method, is discussed by Pardo (1968) and C. M. H. von Bavel (1966). It is stated by von Bavel that this is the only method that has a physically sound basis and yet does not require highly specialized measurements, which is a serious limitation of most of the theoretical approaches. However, even for this combination method, the minimum data required are not available in many areas. He concludes that it is a sound and proven method with general validity, its use restricted only by available data.

Empirical methods of estimating evaporation and evapotranspiration

Many empirical formulas relating climatological data to evaporation and potential evapotranspiration have been developed. Among these are the methods of Lowry, Johnson and Thornthwaite. These are reviewed by Christiansen and Mehta (1965).

Blaney-Criddle. Perhaps one of the most widely used formulas is that of Blaney-Criddle (1962) for estimating consumptive use or evapotranspiration. The formula was developed utilizing the results from experimental studies in the United States and several foreign countries which show the relationship between temperature, length of growing season, monthly percentage of annual daytime hours, and consumptive

use of water. The formula developed is

$$U = K F$$

where

U = water use in inches,

K = empirical seasonal coefficient,

F = sum of monthly factors (f) for the season (sum of the products of mean monthly temperature (t) in degrees F and monthly percentage of annual daytime hours (p)).

The equation for monthly or short period consumptive use in inches is $u = k f$.

Hargreaves. Hargreaves (1956, 1968), gives a method for estimating evapotranspiration from Class A pan evaporation and presents a formula to estimate pan evaporation, when these data are not available, based on mean temperature and mean relative humidity. He also presents a modification to the formula for estimating evapotranspiration suggested by J. E. Christiansen which incorporates the factors for wind, sunshine and elevation.

The original equation is of the form

$$E_v = m (T - 32)$$

where

E_v is the mean monthly evaporation in inches,

T is the average mean monthly temperature, in ^{o}F,

m is an empirical coefficient depending on two factors:

c a function of relative humidity and d a monthly daytime coefficient, where m = cd.

The formula for estimating pan evaporation in metric units is

$$E_p = 17.4\ d\ T(1.0 - Hn)$$

where

E_p = Class A pan evaporation in mm.,

T = mean monthly temperature ^{o}C,

d = monthly daytime coefficient,

Hn = mean monthly relative humidity expressed as a decimal.

Christiansen. Christiansen (1960) studying the evaporation at five stations in northern Utah found that he could express the monthly evaporation by an equation of the form

$$Ev = K\ R\ C_t\ C_w\ C_s\ C_h\ C_m$$

where

Ev is the monthly pan evaporation,

K is a constant selected so that the mean value of each of the coefficients is 1.0,

R is the energy from the solar radiation during the month and expressed as an equivalent depth of evaporation,

C_t is a coefficient for temperature, expressed by a linear equation as a function of the mean monthly temperature,

C_w, C_s & C_h are similar coefficients for wind, sunshine percentage

and relative humidity,

C_m = a monthly coefficient to correct for heat storage and other seasonal effects.

Jensen-Haise. Jensen and Haise (1963) present a method for estimating potential evapotranspiration based on solar radiation and mean air temperature. Their equation is as follows:

$$E_{tp} = (0.014\ T - 0.37)\ R_s$$

in which

E_{tp} = potential evapotranspiration in inches per day,

T = mean air temperature in ^{o}F,

R_s = solar radiation in inches per day.

In areas where solar radiation is not measured they suggest the use of an equation proposed by Angstrom with constants developed by S. Fritz and J. H. MacDonald (Jensen and Haise, 1963). This formula is as follows:

$$R_s = R_{so}\ (0.35 + 0.615)$$

in which

R_s = solar radiation under existing conditions,

R_{so} = solar radiation on cloudless days,

S = the fraction of possible sunshine for the time period.

Grassi. Grassi (1964) developed three formulas for predicting actual evapotranspiration from climatic data. These were developed on the basis of theoretical radiation at the top of the atmosphere, measured solar radiation, and pan evaporation. Grassi concluded that these

formulas should give reliable results in areas where the climatological conditions are not greatly different from those in the Western United States.

Christiansen. Christiansen (1968) presented a formula for estimating pan evaporation from extraterrestrial radiation and climatic data which he concluded should provide reliable estimates of pan evaporation for a wide range of climatic conditions and latitudes. This was based on former work by graduate students working under his direction; Patil (1962), Patel and Christiansen (1963), Mathison (1963), Al-Barrak (1964), Palayasoot (1965), Mehta (1965) and Chindasnguan (1966) plus the analysis of additional data. A reanalysis of all these data gave the following revised formulas and coefficients:

$$Ev = 0.473\ R\ C_T\ C_W\ C_H\ C_S\ C_E\ C_M$$

where

R = extraterrestrial radiation expressed as equivalent depth of evaporation in the same units as Ev.

and the coefficients expressed in dimensionless form are as follows:

C_T = $0.393 + 0.5592\ (Tc/To) + .04756\ (Tc/To)^2$,

Tc = mean temperature in ^oC and $To = 20^o\ C$,

C_W = $0.708 + 0.3276\ (W/Wo) - 0.036\ (W/Wo)^2$,

W = mean wind velocities above the evaporation pan,

Wo = 96.56 km per day,

C_H = $1.250 - 0.348\ (H/Ho) + 0.120\ (H/Ho)^2 - 0.0218\ (H/Ho)^4$,

H = mean relative humidity at noon,

Ho = 40% or 0.40,

C_S = $0.542 + 0.64\ (S/So) - 0.4992\ (S/So)^2 + 0.3174\ (S/So)^3$,

S = mean sunshine percentage,

So = 80% or 0.80,

C_E = $0.970 + 0.030\ (E/Eo)$,

E = elevation,

Eo = 305 meters.

Christiansen and Hargreaves. Christiansen and Hargreaves (1969) present further modified equations for estimating evaporation and evapotranspiration. Three formulas were presented for estimating pan evaporation and four for estimating the potential evapotranspiration.

Christiansen. Recently Christiansen (1970a) has done some additional modifying of his equations to make the equations for estimating pan evaporation and the ones for estimating evapotranspiration compatable whether based on measured or theoretical radiation, or measured or estimated pan evaporation. The equations are given in the following form:

For pan evaporation

$$Ev = K_1\ R_t\ C_{tv}\ C_{hv}\ C_{wv}\ C_s\ C_e$$

where

K_1 = .350,

R_t = extraterrestrial radiation expressed as an equivalent depth of evaporation.

$$Ev = K_2 R_s C_{tv} C_{hv} C_{wv}$$

where

K_2 = 0.761,

R_s = measured or estimated incoming solar radiation,

R_s may be estimated from the equation

$$R_s = K_3 R_t C_s C_e$$

where $K_3 = 0.460$.

The equation for the coefficients of the pan evaporation formulas are as follows:

$$C_{tv} = 0.644 + .210\ (TM/25) + .146\ (TM/25)^2$$

where

TM = mean temperature in ^{o}Centigrade.

$$C_{hv} = 1.20 - .20\ (HM/.70)^3$$

where

HM = mean relative humidity expressed as a decimal.

$$C_{wv} = 0.70 + 0.36\ (WKH/8) - .06\ (WKH/8)^2$$

where

WKH is the mean wind velocity in km per hour at a height of 10 meters.

For potential evapotranspiration using the pan evaporation as a base:

$$E_{tp} = K_4 \, Ev \, C_{ttv} \, C_{wtv} \, C_{htv}$$

where

$K_4 = 0.8$

and the equations for the coefficients are as follows:

$$C_{ttv} = 1.041 - .047 \, (TM/25) + .006 \, (TM/25)^2$$

$$C_{wtv} = 1.071 - .096 \, (WKH/8) + .030 \, (WKH/8)^2 - .005 \, (WKH/8)^3$$

$$C_{htv} = .910 + .070 \, (HM/.70)^2 + .020 \, (HM/.70)^3$$

For potential evapotranspiration using radiation as a base:

$$E_{tp} = K_5 \, R_t \, C_{tt} \, C_{wt} \, C_{ht} \, C_s \, C_e$$

where

$K_5 = 0.28$,

R_t = extraterrestrial radiation expressed in equivalent depth of evaporation.

$$E_{tp} = K_6 \, R_s \, C_{tt} \, C_{wt} \, C_{ht}$$

where

$K_6 = 0.609$,

R_s = measured or estimated incoming radiation at the earth's surface expressed in equivalent depth of evaporation.

The equations for the coefficients are as follows:

$$C_{tt} = .670 + .193 \, (TM/25) + .137 \, (TM/25)^2$$

$$C_{ht} = 1.10 - .10 \, (HM/.70)^4$$

$$C_{wt} = .75 + .31 \, (WKH/8) - .06 \, (WKH/8)^2$$

The coefficients for sunshine percentage and elevation remain:

$C_s = 0.48 + .66\ (S/.5) - .14\ (S/.5)^2$,

$C_e = .970 + .03\ (EL/305)$.

Guillen. Guillen (1967) developed equations for estimating Fuess evaporation from climatological data based on 10 year average records for 22 stations in Venezuela. He also attempted to relate Fuess evaporation to pan evaporation. His formula for estimating the Fuess evaporation is as follows:

$$EV = K\ C_T\ C_H\ C_W\ C_S\ C_M\ C_{DP}$$

in which

EV = evaporation in mm per day,

K = 2.957.

and the coefficients are:

$C_H = 2.12 - 1.75\ H^2$,

$C_T = -0.490 + 0.0621\ T$,

$C_S = 0.53 + 0.784\ S$,

$C_W = 0.728 + 0.0494\ W$,

$C_{DP} = 1.15 - 0.015\ DP$,

C_M = monthly coefficient.

in which

T = mean temperature in degrees C,

H = mean relative humidity expressed as a decimal,

W = mean wind velocity in kilometers per hour, measured at 2 meters above the ground,

S = sunshine percentage expressed as a decimal.

Guillen concluded that the most significant factor in the relationship of pan evaporation to Fuess evaporation was humidity and expressed the relationship between Fuess evaporation and pan evaporation as estimated from the Christiansen formula as follows:

$$EVP = 1.796 \cdot EVF \cdot C_H$$

where

EVP = estimated pan evaporation,

EVF = measured Fuess evaporation in mm/day,

C_H = -0.548 + 0.01935 HM.

where

HM = mean relative humidity in percent.

Pardo. Pardo (1968) developed equations for estimating sheltered evaporation from climatic data based on data from 20 stations in Colombia. His equation is

$$Ev = K\, C_{VPD}\, C_T$$

in which

Ev = evaporation in mm per day,

K = a constant whose average value is 1.510,

C_{VPD} = -0.113 + 0.318 VPD,

C_T = -0.70 + 0.085 T.

where

VPD = vapor pressure deficit, in mm of Hg.,

T = mean temperature in ^{o}C.

This equation fit the Colombian data better than the earlier equation developed by Guillen using the Venezuelan data.

Chanduvi-Aciena (1969), using data from 12 stations in Peru, compared the measured Piche evaporation with the evaporation and/or evapotranspiration estimated by 24 different formulas. He concluded that Christiansen's and Mathison's formulas gave the best estimates of Piche evaporation. His data did not include any measured pan evaporation so no comparisons were possible between measured Piche and pan evaporation.

Estimation of solar radiation

Pizarro. Pizarro (1967) developed an equation for calculating the solar radiation reaching the earth's surface based on the theoretical extraterrestrial radiation at the top of the atmosphere, geographical parameters and climatological data. His formula may be written

$$Ra = 0.6237\ R\ C_S\ C_E$$

in which

Ra = radiation at the earth's surface in langleys per day,

R = theoretical radiation at the top of the atmosphere in langleys per day,

C_S = sunshine coefficient in which S is the ratio of sunshine hours to theoretical daytime hours,

C_E = elevation coefficient, in which E is the elevation in feet.

Then $C_S = 0.32 + 0.85\ S$

and $C_E = 0.97 + 0.00003\ E$

Christiansen modified Pizarro. Christiansen (1970b) has modified Pizarro's equation as follows:

$$R_a = 0.460\ R\ C_S\ C_E$$

where

$$C_S = 0.48 + .66\ (S/.5) - .14\ (S/.5)^2$$

$$C_E = .970 + .030\ (EL/305)$$

EL being the elevation in meters.

Pardo (1968) cites an equation given by Frank and Lee and gives a method developed by Christiansen for calculation of theoretical radiation at the top of the atmosphere expressed in langleys per day (calories/cm^2/day). This is as follows:

$$R = 120\ [DL \sin (LA) \sin (DE) + 7.6394 \cos (LA) \cos (DE) \sin (OM)]/ES$$

in which

$$OM = \text{Arc tan} \frac{\sqrt{1 - \tan^2 (LA) \tan^2 (DE)}}{\text{Abs}\ [\tan (LA) \tan (DE)]}$$

and

R = extraterrestrial radiation in langleys per day

DL = day length (theoretical sunshine), in hours

LA = latitude in radians

DE = mean monthly declination of the sun, in radians

ES = square of the monthly relative value of the distance from the earth to the sun, dimensionless.

The radiation may be expressed as an equivalent depth of evaporation by dividing the radiation by the heat of vaporization of water in calories/gm. The heat of vaporization is computed by the expression

$$HV = 595.9 - 0.55\ T$$

where

T is the mean temperature in ^{o}C.

PROCEDURE

The first step in the present study was to analyze the data from 10 climatological stations in Venezuela where measurements of both sheltered and class A pan evaporation were available. A considerable amount of these data was already tabulated and key-punched. Additional data were collected by the author and Prof. J. E. Christiansen on a recent trip to Venezuela and processed for use in this study. The stations used are given in Table 1. The data used were monthly means, with a total of 308 months.

Table 1. Selected climatological stations in Venezuela with measured pan and sheltered evaporation

Station No.	Name	Agency[a]	Lat.	Elev.	Months of data
25	Cua	MOP	10.15	240	23
26	Jusepin	U. de O.	9.60	146	13
27	Mayalito	MOP	9.52	270	4
28	San Juan de los Morros	MOP	9.90	430	18
29	Zonaz Aridas	MAC	10.15	580	51
30	Sta. Cruz	MOP	10.18	438	61
31	Cagua	Shell Foundation	10.18	432	60
33	Yaritagua	MAC	10.05	381	18
34	Punta de Piedras	MOP	10.90	10	11
35	Barcelona	MOP	10.18	7	49

[a]MOP Ministry of Public works
U. de O. Eastern University
MAC Ministry of Agriculture and Livestock

Computer program 600 (Table 2) was written to compute the ratio of the pan evaporation to the sheltered evaporation. This was done for each month of data. The average of these ratios was computed for each month of the year. The overall average for the station was also computed. The data used, with their computer symbol are as follows:

TM mean monthly temperature, in ^{o}C,

TX mean maximum temperature, in ^{o}C,

TI mean minimum temperature, in ^{o}C,

HM mean average relative humidity, in percent,

HX mean maximum relative humidity, in percent,

HI mean minimum relative humidity, in percent,

W10 mean wind velocity measured at 10 meters height, in km per hour,

EVP monthly class A pan evaporation, in mm,

EVF monthly sheltered evaporation, in mm,

RSL measured incoming solar radiation, in langleys per day,

SH mean sunshine hours, in hours per day,

PPT monthly precipitation, in mm.

These computed ratios of EVP/EVF were then plotted against the climatic parameters that were measured at all of the stations being used in the study: wind velocity, relative humidity, temperature, days of precipitation, percentage of sunshine hours and sheltered evaporation.

Table 2. Computer programs used in the study and given in Appendix A

Program No.	Purpose	Data
600	Compute ratios of measured pan evaporation to measured sheltered evaporation.	10 stations in Venezuela
503	Solve four simultaneous equations.	
607	Compare measured pan evaporation with that estimated by Christiansen-Guillen formula and the new Stutler formula.	10 stations in Venezuela
608	To check the Christiansen-Pardo formula and compare pan evaporation as estimated by the Christiansen formula and the new Stutler formula.	17 stations in Venezuela
609	To estimate pan evaporation by the Stutler formula from measured sheltered evaporation, and by the Christiansen formula and estimate potential evapotranspiration by two formulas.	20 stations in Colombia
610	To estimate sheltered evaporation by the C-P and the C-G formulas, estimate pan evaporation by the Stutler formula and the Christiansen formula and estimate the potential evapotranspiration by two formulas.	26 stations in Colombia

From these it was observed that the most uniform and most consistent relationship was that of the computed ratio EVP/EVF to the measured sheltered evaporation. Figure 1 shows only the overall average of the ten stations plotted for clarity, along with the curve drawn to fit the data.

Computer program 503 was used to determine the equation of this curve. Two alternative forms of equations were tried; $y = AX^3 + BX^2 + CX + D$ and $y = A/X + BX^2 + CX + D$. The latter form was found to fit the data better than the first. This form then was used to express a coefficient as a function of the sheltered evaporation, EVF.

The form of the equation arrived at for estimating the pan evaporation from measured sheltered evaporation is

$$Evp = K E_{vf} C_{ef}$$

C_{ef} is a coefficient of the form as described previously.

Computer program 607 was then written to include the pan evaporation as estimated by the Christiansen-Guillen formula as well as the pan evaporation estimated by the new formula and compute the ratio of the measured pan evaporation to that estimated by the two formulas. A station constant was introduced in this program to bring the overall average of the measured pan evaporation to computed pan evaporation equal to 1.0. These station constants were different for each formula.

In an attempt to improve the formula by the addition of a coefficient based on one of the climatic factors, the ratios were plotted as a function of wind velocity, temperature, relative humidity and percentage

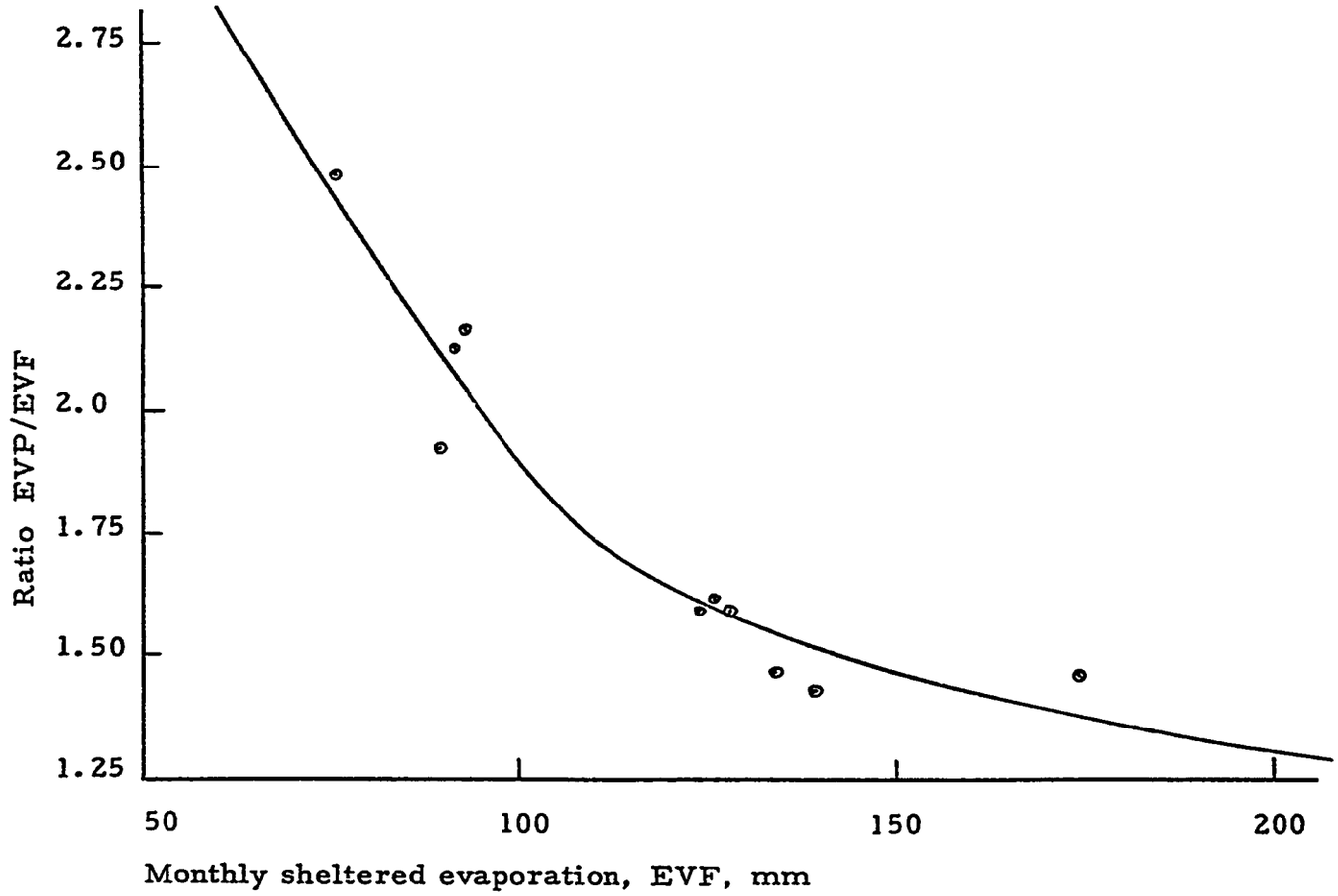

Figure 1. Relationship of ratio of pan evaporation to sheltered evaporation to the measured sheltered evaporation. Averages for 10 stations in Venezuela.

of sunshine hours. None of these indicated a relationship that could be used to improve the formula. However, the ratios for any one month were generally above or below the overall station average for most of the ten stations. Therefore, a monthly constant was added to the formula. The absolute error was used as a measure of how well the computed values compared with the measured pan evaporation.

As a check on the Christiansen-Pardo equation using Venezuela data, and to compare the pan evaporation as estimated by the new formula and Christiansen's formula, computer program 608 was written. This program used six years of data from 17 Venezuelan Ministry of Defense climatological stations tabulated and used by Rujirakul (1970).

Station constants were introduced for the Christiansen-Pardo formula to make the overall ratio of the measured sheltered evaporation to the computed equal to 1.0 for each station. Monthly coefficients were also introduced. The absolute error in decimal form was used to measure how well the estimated fit the measured evaporation.

Computer program 609 was written to estimate the class A pan evaporation form the measured sheltered evaporation by the newly developed formula. This program used the data from 20 stations in Colombia used by Pardo (1968), as given in Table 3. The program also estimated the evapotranspiration for these same stations by two of Christiansen's formulas; one based on pan evaporation and one based on the theoretical incoming radiation.

Table 3. Selected climatological stations in Colombia with measured evaporation (from Pardo, 1968, p. 26)

Station No.	Name	Latitude	Elevation	Yrs. of data
31	Chinchina	4.88	1360	11
32	Blonay	7.58	1235	8
33	Libano	4.90	1495	8
34	La Florida	2.45	1789	8
35	Tibacuy	4.35	1525	8
36	Pueblo Bello	10.43	980	7
37	Chapeton	4.47	1200	8
38	Ospina Perez	1.27	1700	7
39	Salazar	7.73	1000	5
40	Yolombo	6.60	1540	4
41	Bertha	5.88	1764	5
42	Jardin	5.57	1630	5
43	Llanadas	5.22	1870	5
44	San Vicente	6.95	1200	3
45	Naranjal	4.95	1400	4
46	Anolaima	4.75	1726	5
47	Sevilla	4.28	1550	5
48	Restrepo	3.65	1670	5
49	Dolores	3.53	1590	3
50	Gigante	3.65	1500	5
51	Tambo	2.38	1750	5

Some additional or slightly different computer symbols were used in programs 609 and 610, than those previously defined. These are as follows:

VP	vapor pressure, in mm of Hg.,
VPD	vapor pressure deficit, in mm of Hg.,
RM	monthly theoretical radiation expressed as an equivalent depth of evaporation, in mm,
EVFMG	monthly sheltered evaporation estimated by the C-G formula, in mm,
EVFMP	monthly sheltered evaporation estimated by the C-P formula, in mm,
EVPR	monthly pan evaporation estimated from the theoretical radiation by the Christiansen formula, in mm,
EVPK	monthly pan evaporation estimated from the sheltered evaporation by the Stutler formula, in mm,
ETC	monthly potential evapotranspiration estimated from the theoretical radiation by Christiansen's formula,
ETKP	potential evapotranspiration computed from the estimated pan evaporation,
SP	sunshine percentage.

Computer program 610 was written to estimate the sheltered evaporation using the data from 26 Colombian stations shown in Table 4 by the C-P and C-G formulas. It also estimated the pan evaporation

Table 4. Climatological stations in Colombia with no measured evaporation

Station No.	Name	Latitude	Elevation	Yrs. of Data
61	Santander	3.02°	1050	6
62	Paraguaycito	4.40	1250	3
63	Palmira (Est. Ag.)	3.42	1006	7
64	Ambalema (Pajonales)	4.77	250	5
65	Calarca (La Bella)	4.53	1500	6
66	Popayan (Univ.)	2.43	1760	7
67	Manizales	5.07	2153	8
68	Est. Jaramillo	7.92	1450	13
69	Medellín	6.27	1475	4
70	Bajo Calima	3.98	40	3
71	Tolú	9.52	4	4
72	Funza	4.70	2550	7
73	Ubaté	5.32	2600	7
74	Andagoya	5.10	60	7
75	Tibú	8.62	55	3
76	El Centro	6.93	114	7
77	San Jeronimo	6.45	764	5
78	Monteria	8.77	15	3
79	Usme (Est. de Papas)	4.37	3120	4
80	Quibdo	5.68	43	4
81	Aracataca	10.58	28	4
82	Sonsón	5.72	2350	5
83	Las Palomas	5.13	2700	4
84	Cartagena	10.43	3	4
85	Bogotá (Cd. Univ.)	4.55	2560	7
86	Manaure	11.75	1	2

from these two estimates by the Stutler formula and the pan evaporation by the Christiansen formula. The potential evapotranspiration is estimated by the Christiansen formulas based on pan evaporation and climatic data.

Because this group of stations covered a much wider range of elevation and temperature than any other group used in the study, the ratios of the pan evaporation as estimated by the Stutler and Christiansen formulas were plotted against temperature and elevation. These are shown in Figures 2 and 3.

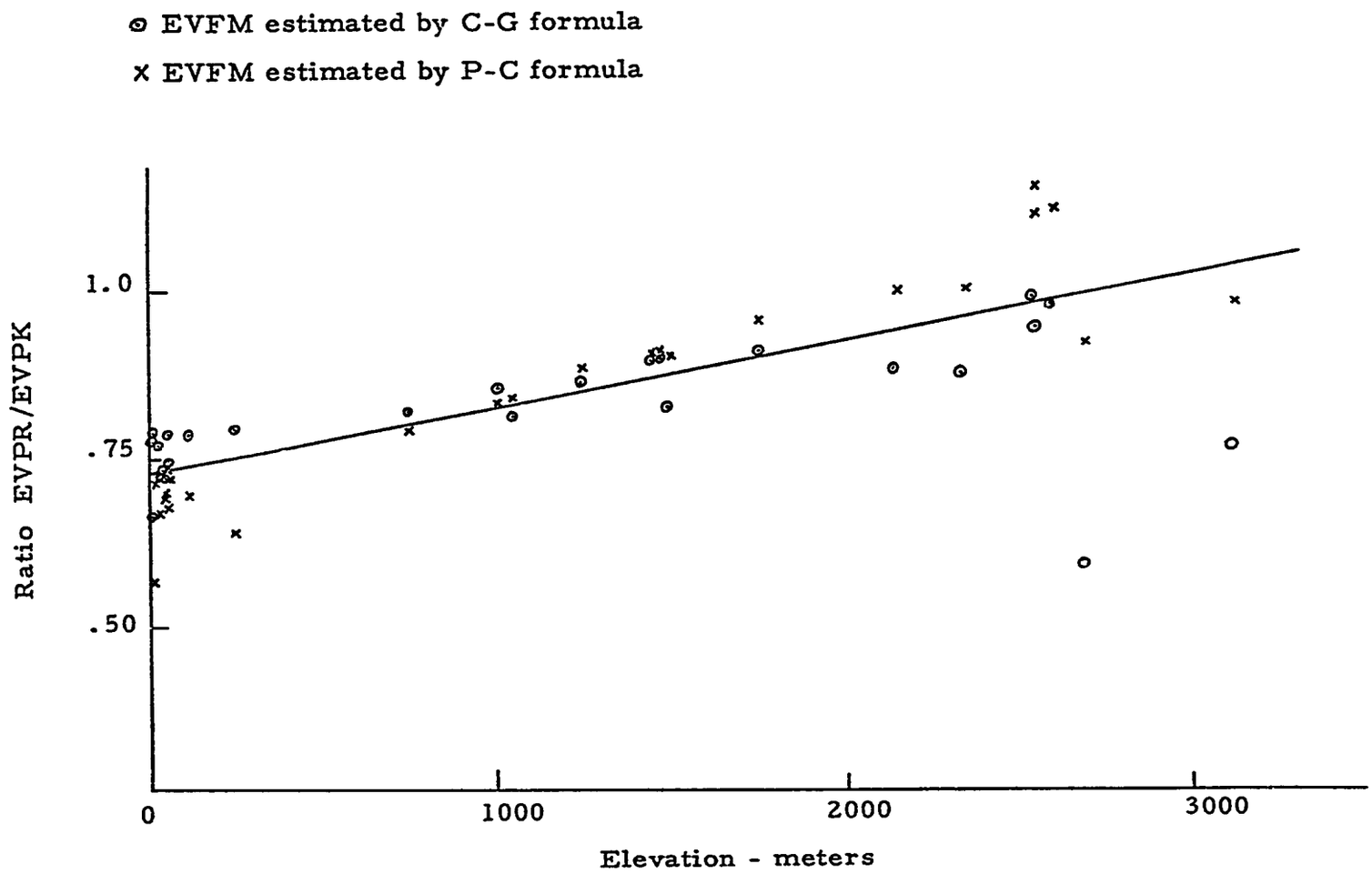

Figure 2. Relationship of ratio of pan evaporation as estimated by Christiansen formula and Stutler formula to elevation for 26 Colombian stations.

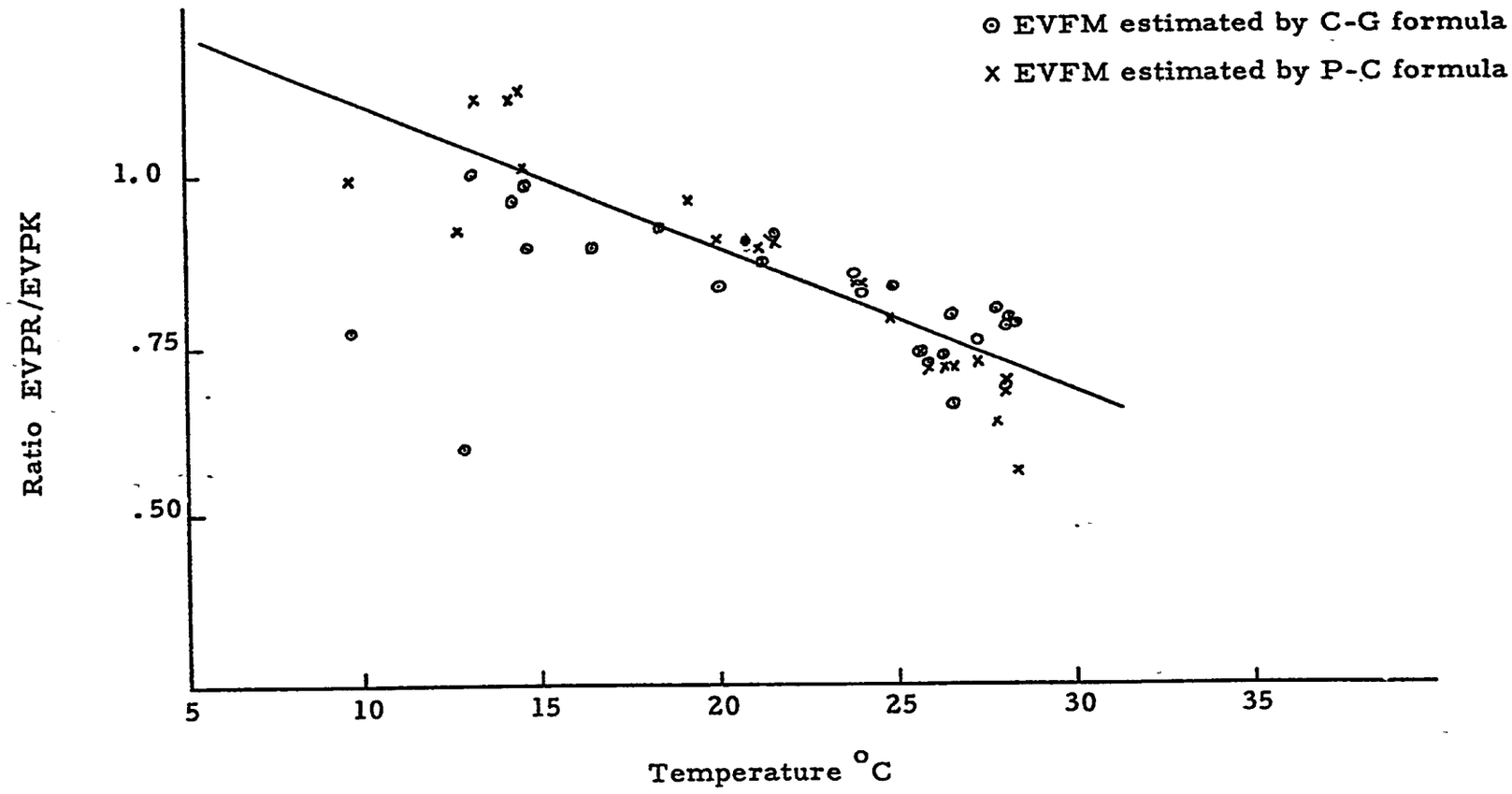

Figure 3. Relationship of ratio of pan evaporation as estimated by Christiansen formula and Stutler formula to mean temperature for 26 stations in Colombia.

RESULTS AND DISCUSSION

New formula

The final formula developed to estimate class A pan evaporation from sheltered evaporation, called the Stutler formula, is

$$Evp = K\, E_{vfm}\, C_{ef}\, C_m\, C_{st}$$

where

Evp = class A pan evaporation, mm per month.

K = 1.740

E_{vfm} = sheltered evaporation, mm per month.

C_m = monthly coefficient, tabulated in Table 5.

C_{st} = station constant, tabulated in Table 6.

C_{ef} = a coefficient based on the sheltered evaporation, expressed by the following equation.

$$C_{ef} = 0.71 + 0.537\,(110/E_{vfm}) - 0.365\,(E_{vfm}/110) + .118\,(E_{vfm}/110)^2$$

The absolute error, expressed as a decimal in the programs and a percent in Table 7, was used as a measure of how well the formula fit the data. A comparison of these in Table 7 shows that for every station the Stutler formula has the least error. It should be noted that, other than the addition of a station constant, no attempt was made to adjust or improve the other formula.

Table 5. Monthly coefficients for the Stutler formula, Venezuelan data

Month	
January	.974
February	1.007
March	1.10
April	1.054
May	1.018
June	.92
July	.989
August	1.007
September	1.007
October	1.038
November	.909
December	.909

Table 6. Station constants for the Guillen and Stutler formulas, Venezuelan data

Station No.	Guillen formula	Stutler formula
25	1.142	.9508
26	.944	.8741
27	1.644	1.1683
28	1.389	.9865
29	1.553	1.1313
30	1.071	.8704
31	1.645	1.1071
33	1.120	.9779
34	.921	1.0427
35	1.165	.9662

Table 7. Comparison of Guillen and Stutler formulas

Station No.	Average absolute error (Guillen)	Average absolute error (Stutler)
25	7.7%	4.9%
26	14.4	6.5
27	9.2	2.6
28	14.8	4.8
29	10.7	7.2
30	13.5	5.0
31	17.0	5.7
33	15.1	7.4
34	10.4	5.7
35	12.2	5.7
Overall Average	13.12%	5.79%

Table 8. Comparison of measured sheltered evaporation and sheltered evaporation as estimated by the Christiansen-Pardo formula and comparison of pan evaporation estimated by the Christiansen formula and the Stutler formula. Data from 17 Ministry of Defense stations in Venezuela

Station No.	EVF	EVFP	Avg. abs. error %	EVPC	EVPK	EVPC/EVPK
1	4.33	4.33	19.96	5.731	6.812	.841
2	3.97	3.97	15.53	6.198	6.512	.952
4	2.68	2.68	19.85	5.560	5.731	.970
6	4.46	4.46	14.22	5.332	6.873	.776
8	6.81	6.81	9.39	7.190	8.874	.810
9	3.24	3.24	18.28	4.957	6.061	.818
10	5.31	5.31	17.76	6.512	7.253	.898
11	2.54	2.54	19.86	5.013	5.625	.891
12	4.89	4.89	21.59	5.975	7.124	.839
13	2.61	2.61	16.79	4.875	5.636	.865
14	5.52	5.52	18.41	5.446	8.096	.673
16	2.80	2.80	15.06	4.973	5.787	.859
18	2.72	2.72	12.22	4.793	5.698	.841
19	4.84	4.84	13.80	5.748	7.207	.798
20	5.10	5.10	23.23	5.839	8.140	.717
21	2.51	2.51	14.30	4.471	5.584	.801
22	3.73	3.73	17.94	4.954	6.403	.774
Average	4.00	4.00	16.95	5.504	6.671	.831

Evaporation is in mm per day.

EVF = measured sheltered evaporation.
EVFP = estimated sheltered evaporation by C-P formula.
EVPC = pan evaporation estimated by Christiansen formula.
EVPK = pan evaporation estimated by Stutler formula.

For the new formula, the station constant, Table 6, varied from a minimum of 0.8704 for Santa Cruz, No. 30, to a maximum of 1.1683 for Mayalito, Station No. 27. This variation does not seem to be a function of the measured climatic factors, but rather is more likely influenced by those that aren't measured, such as difference in the immediate surroundings, exposure conditions, and perhaps even the instrument shelters and instrumentation.

The monthly coefficients varied from a minimum of .909 in November to a maximum of 1.10 in March. (Table 5)

The station constant probably has more influence on the ratio of pan evaporation to sheltered evaporation than does the monthly coefficient. Since the station constant is not known for the stations where pan evaporation estimates are desired, a value of unity was used for the product of the station constant and the monthly coefficient in following programs.

Ministry of Defense data in Venezuela

The results of the comparison of the measured sheltered evaporation to that computed by the C-P formula are summarized in Table 8 along with the pan evaporation as estimated by the new formula and the Christiansen formula.

The sheltered evaporation as computed by the C-P formula does not fit the Venezuelan data as well as the Colombian data from which it was developed. The overall average absolute error is 16.95 percent

for the 17 Venezuelan stations.

The average ratio of the pan evaporation computed by the Christiansen formula from the theoretical radiation to that computed by the new formula is 0.831.

Colombian stations with measured sheltered evaporation

Table 9 summarizes the results of estimating the pan evaporation and evapotranspiration for the 20 stations in Colombia where measured sheltered evaporation data were available. The overall average of the ratio of the pan evaporation estimated by the Christiansen formula to that estimated by the Stutler formula is 0.932. This is higher than the value of the same ratio for the Venezuelan data of 0.831. This difference might be explained by the difference in evaporimeters used in the two countries. In general the Fuess instrument is used in the Ministry of Defense stations in Venezuela, whereas the SIAP is the common instrument in the installations of the National Coffee Institute in Colombia.

It should be noted that the ratio of the evapotranspiration computed by the Christiansen formula based on theoretical radiation to that estimated with the pan evaporation as a base is the same as the ratio of the pan evaporation as computed by the two formulas. This is evidence that the formulas of Christiansen, at least for this range, are compatable; that is, the evapotranspiration will be estimated to be the same, whether the pan evaporation or the theoretical radiation is used as the basis.

Table 9. Comparison of pan evaporation as estimated by the Christiansen formula and from measured sheltered evaporation using the Stutler formula

Station No.	Elev	EVPR	EVPK	EVPR/ EVPK	ETC	ETK	ETC/ ETK
31	1360	147.48	159.45	.925	120.94	130.80	.925
32	1235	129.40	138.46	.935	107.86	115.46	.934
33	1495	124.93	129.15	.967	105.81	109.52	.966
34	1789	143.82	132.14	1.088	118.01	108.42	1.089
35	1525	141.06	151.04	.934	116.06	124.33	.934
36	980	141.67	155.17	.913	117.76	129.04	.913
37	1200	135.30	161.32	.839	112.24	133.91	.838
38	1700	143.49	140.33	1.023	118.26	115.72	1.022
39	1000	139.21	158.31	.879	114.25	130.06	.878
41	1764	137.30	149.99	.915	114.11	124.68	.915
42	1630	127.46	139.97	.911	106.86	117.40	.910
43	1870	132.44	140.56	.942	110.49	117.34	.942
44	1200	133.74	142.82	.936	111.33	118.95	.936
45	1400	144.23	151.56	.952	119.36	125.48	.951
46	1726	140.81	141.22	.997	116.48	116.95	.996
47	1550	129.70	140.89	.921	108.01	117.41	.920
48	1670	135.83	146.61	.927	113.79	122.88	.926
49	1590	165.71	171.86	.964	132.72	137.69	.964
50	1500	128.48	156.40	.821	105.94	129.01	.821
51	1750	132.31	148.26	.892	109.97	123.32	.892
Averages		137.72	147.78	.932	114.01	122.42	.933

Evaporation and evapotranspiration are in mm per month.

EVPR = estimated pan evaporation based on theoretical radiation.

EVPK = pan evaporation estimated from sheltered evaporation by new formula.

ETC = potential evapotranspiration based on theoretical radiation.

ETK = potential evapotranspiration estimated from pan evaporation, EVPK.

Colombian stations with no measured sheltered evaporation

The sheltered evaporation as computed from the C-P and C-G formulas and the estimated pan evaporation and evapotranspiration for the 26 Colombian stations are given in Table 10. The overall ratio of the pan evaporation estimated by the Christiansen formula to that computed from the sheltered evaporation as estimated by the two different formulas is nearly the same, 0.845 as compared with 0.863. However, the ratio using the C-P estimate varies over a much wider range between stations than does the one using the C-G estimate. This would indicate that the C-G formula might be better for estimating the sheltered evaporation. Again it should be noted from Table 15 (Appendix) that the ratios of the evaporation and the evapotranspiration are the same.

From Figures 2 and 3 it appears that there is a relationship between the ratios of the pan evaporation as computed from the theoretical radiation to that computed from sheltered evaporation and the temperature and/or elevation. Since temperature and elevation are related, probably a correction for one would also correct for the other. There could be several possible explanations for this apparent relationship.

1. A correction for temperature or elevation needs to be made in the formulas for estimating the sheltered evaporation.

2. A correction for temperature or elevation needs to be made

in the formula for estimation of pan evaporation from sheltered evaporation, as the one developed in this study was based on a very limited range of temperature and elevation.

3. Some corrections may also be necessary for temperature or elevation in the Christiansen formulas.

Without some measured pan evaporation for a basis of comparison, it is difficult to say what corrections should be made. Recent analysis of data from Ecuador by Christiansen (1970 b) indicates that his coefficient for elevation tends to overcorrect and that it would appear that a better fit would be obtained if the elevation coefficient was eliminated.

Table 10. Estimated pan evaporation and evapotranspiration for 26 stations in Colombia with no measured evaporation

Station No.	Elev.	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC
61	1050	155.32	177.03	179.50	.877	.865	145.63	147.69	127.74
62	1250	150.57	165.11	165.71	.912	.909	135.05	135.55	123.12
63	1006	158.75	198.24	183.67	.801	.864	158.81	147.13	127.15
64	250	172.34	271.51	218.18	.635	.790	214.76	172.68	136.41
65	1500	142.21	145.28	156.93	.979	.906	121.45	131.19	118.84
66	1760	156.37	155.06	162.37	1.008	.963	126.59	132.57	127.66
67	2153	135.95	130.67	140.44	1.040	.968	109.07	117.22	113.44
68	1450	153.38	151.46	161.79	.950	.948	132.27	132.54	125.62
69	1475	167.19	180.98	180.23	.924	.928	144.94	144.35	133.91
70	40	127.57	157.92	158.41	.808	.805	133.94	134.37	108.10
71	4	128.50	163.33	177.40	.787	.724	137.97	149.87	108.44
72	2550	147.26	120.03	134.71	1.227	1.093	99.04	111.15	121.53
73	2600	157.66	131.11	150.20	1.203	1.050	106.71	122.25	128.36
74	60	134.31	170.92	165.09	.786	.814	143.85	138.95	112.94
75	55	157.27	228.99	197.05	.687	.798	185.16	159.47	127.19
76	114	158.88	225.97	198.56	.703	.800	182.78	160.62	128.53
77	764	162.12	201.51	191.77	.805	.845	162.52	154.70	130.79
78	15	147.15	199.28	196.14	.738	.750	162.07	159.62	119.79
79	3120	101.99	104.94	110.20	.972	.925	90.53	95.05	87.88
80	43	132.26	166.75	166.78	.793	.793	139.96	140.02	110.93

Table 10. Continued

Station No.	Elev.	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC
81	28	158.20	203.48	196.94	.777	.803	167.21	161.86	129.96
82	2350	134.94	119.19	135.66	1.132	.995	100.79	114.72	114.07
83	2700	83.56	108.45	116.26	.770	.719	94.17	100.94	72.48
84	3	165.41	196.59	201.57	.841	.821	161.08	165.19	135.51
85	2560	140.52	133.84	139.29	1.050	1.009	107.13	111.48	112.46
86	1	175.71	287.34	226.05	.612	.777	228.32	180.21	140.05
Averages		146.36	173.27	169.65	.845	.863	141.99	139.28	120.11

Evaporation and evapotranspiration are in mm per month.

EVPR = EVR = pan evaporation estimated by Christiansen formula based on theoretical radiation.

EVPKP = EKP = pan evaporation estimated by Stutler formula from sheltered evaporation estimated by Pardo formula.

EVPKG = EKG = pan evaporation estimated by Stutler formula from sheltered evaporation estimated by Guillen formula.

ETKP = evapotranspiration estimated from pan evaporation estimated by Pardo and Stutler formulas.

ETKG = evapotranspiration estimated from pan evaporation estimated by Guillen and Stutler formulas.

ETC = evapotranspiration estimated by the Christiansen formula based on theoretical radiation.

SUMMARY AND CONCLUSIONS

A formula was developed for estimating class A pan evaporation from the sheltered or Fuess evaporation, using 308 months of data from ten stations in Venezuela.

The new formula was used to estimate pan evaporation from measured sheltered evaporation for 17 Ministry of Defense stations in Venezuela. A comparison of this to the pan evaporation as estimated from climatic factors by the Christiansen formula gave an average ratio of 0.831.

A check on the Christiansen-Pardo formula indicated that it does not fit the Venezuelan data as well as the Colombian data.

The pan evaporation was estimated for 20 Colombian stations with sheltered evaporation data using the new formula. This was compared to that estimated from theoretical radiation and climatic factors, giving an average ratio of 0.932, as compared with 0.831 for the Venezuelan stations.

For an additional 26 Colombian stations the sheltered evaporation was estimated using the Christiansen-Pardo formula and the Christiansen-Guillen formula, from which the pan evaporation was estimated using the new formula. These compared with the pan evaporation computed using the Christiansen formula gave ratios of 0.845 and 0.863 respectively.

In all cases the ratio of the pan evaporation as computed by the Christiansen formula to that estimated from sheltered evaporation by the Stutler formula is less than unity. In other words, the pan evaporation estimated by the Stutler formula is generally more than that computed using the Christiansen formula. This is partly explained due to the fact that the Christiansen formula is for standard conditions of pan exposure, whereas the Stutler formula was developed from data under existing conditions, some of which are known not to be standard.

The potential evapotranspiration was estimated by the Christiansen formula first using the estimated pan evaporation as the basis and then using the theoretical radiation as a basis. The ratios of these were the same as the ratios of the pan evaporations, indicating that the revised Christiansen formulas are compatable and give consistent results whether using evaporation or theoretical sunshine as a basis.

The Colombian stations have a wide range of temperature and elevation and indicate that some additional corrections for temperature or elevation would improve the formula. Additional data including measured pan evaporation are needed to verify this.

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APPENDICES

Appendix A

Computer Programs

```
C     PROGRAM 600 TO DETERMINE THE RELATION BETWEEN PAN AND SHELTERED
C     EVAPORATION FOR TEN VENEZUELAN STATIONS
      DIMENSION X(15),SX(15),AX(15),SSX(15),AAX(15),OSX(15),OAX(15)
  100 FORMAT(I3,I2,I3,F6.2,2I3,3F5.1,3I3,F4.1,I4,F4.1,I4,I5,F5.1,I4)
  101 FORMAT(I3,I4,I4,F6.2,2I3,3F5.1,3F5.2,2F6.1,F4.1,F6.1,F5.1,F4.1,F6.
     1,F7.2)
  102 FORMAT(1H1*RATIOS OF PAN EVAPORATION TO FUESS EVAPORATION IN VENEZ
     1UELA*///)
  103 FORMAT(1H0,*STA YR  FL   LAT DA MO   TM   TX   TI   HM   HX   HI
     1 WIN  EVP    S   PSL  PPT  OP   EVF EV/EVF*///)
  104 FORMAT(2I3)
  105 FORMAT(23X,3F5.1,3F5.2,2F6.1,F4.1,F6.1,F5.1,F4.1,F6.1,F7.2)
  107 FORMAT(I2)
   16 READ(5,107)NN
      IF(NN.EQ.0) GO TO 60
      DO 22 I=1,15
      OSX(I)=0.
      OAX(I)=0.
   22 CONTINUE
      XX=0.
      WRITE(6,102)
      WRITE(6,103)
      DO 40 L=1,NN
   25 READ(5,104)M,N
      DO 10 I=1,15
      SSX(I)=0.
      AAX(I)=0.
   10 CONTINUE
      DO 30 J=1,M
      DO 11 I=1,15
      X(I)=0.
      SX(I)=0.
      AX(I)=0.
   11 CONTINUE
      DO 35 K=1,N
      READ(5,100)NST,NYR,LF,XLA,MD,MO,TM,TX,TI,NHM,NHX,NHI,WIN,NEV,SH,
     1NPSL,IP,OP,NEVF
      XX=XX+1.
      EVF=NEVF
      EV=NEV
      HM=NHM/100.
      HX=NHX/100.
      HI=NHI/100.
      PSL=NPSL
      PPT=IP
      RA=EV/EVF
      NYR=NYR+60
      X(1)=TM
      X(2)=TX
      X(3)=TI
      X(4)=HI
      X(5)=HX
      X(6)=HM
      X(7)=WIN
      X(8)=SV
      X(9)=SH
      X(10)=PSL
      X(11)=PPT
      X(12)=OP
      X(13)=EVF
      X(14)=X(8)/X(13)
      WRITE(6,101) NST,NYR,LF,XLA,MD,MO, (X(I),I=1,14)
      DO 12 I=1,13
      SX(I)=SX(I)+X(I)
   12 CONTINUE
   35 CONTINUE
      DO 13 I=1,13
      AX(I)=SX(I)/M
      AX(14)=SX(8)/SX(13)
   13 CONTINUE
      WRITE(6,105) (AX(I),I=1,14)
      DO 14 I=1,13
      SSX(I)=SSX(I)+SX(I)
   14 CONTINUE
   30 CONTINUE
      FM=M
      FN=N
      DO 34 I=1,13
      AAX(I)=SSX(I)/(FM*FN)
   34 CONTINUE
      AAX(14)=SSX(8)/SSX(13)
      WRITE(6,105) (AAX(I),I=1,14)
      DO 20 I=1,13
      OSX(I)=OSX(I)+SSX(I)
   20 CONTINUE
   40 CONTINUE
      DO 21 I=1,13
      OAX(I)=OSX(I)/XX
   21 CONTINUE
      OAX(14)=OSX(8)/OSX(13)
      WRITE(6,105) (OAX(I), I=1,14)
      GO TO 16
   60 STOP
      END
```

```
C     PROGRAM 503 TO SOLVE FOUR SIMULTANEOUS EQUATIONS (MATRICS)
      COMMON A(4,4),B(4),X(4)
      DATA (B(I),I=1,4)/1.87,1.0,.851,.80/,((A(I,J),I=1,4),J=1,4)/.125,
     11.0,3.375,8.0,.25,1.0,2.25,4.0,.5,1.0,1.5,2.0,4*1.0/
      CALL INVER
      DO 1 I=1,4
      SUM=0.0
      DO 2 J=1,4
    2 SUM=SUM+A(I,J)*B(J)
    1 X(I)=SUM
      WRITE (6,100)(X(I),I=1,4)
  100 FORMAT (1H0,4F15.6)
      STOP
      SUBROUTINE INVER
      COMMON A(4,4),B(4),X(4)
      NX=4
  12  DET=1.0
      DO 601 L=1,NX
      DET=DET*A(L,L)
      A(L,L)=1.0/A(L,L)
      DO 602 I=1,NX
      IF(I-L) 603,602,603
  603 A(I,L)=A(I,L)*A(L,L)
      DO 605 J=1,NX
      IF(J-L) 604,605,604
  604 A(I,J)=A(I,J)-A(I,L)*A(L,J)
  605 CONTINUE
  602 CONTINUE
      DO 607 J=1,NX
      IF(J-L) 608,607,608
  608 A(L,J)=-A(L,L)*A(L,J)
  607 CONTINUE
  601 CONTINUE
      RETURN
      END
```

```
C     PROGRAM 607 TO ESTIMATE PAN EVAPORATION FROM SHELTERED EVAPORATION
C     WITH A COEFFICIENT FOR EVAPORATION ONLY
      DIMENSION X(20), SX(20), AX(20), SSX(20), AAX(20),CGST(36)
      DIMENSION OSX(20), OAX(20),  DEC(12),ES(12),DER(12).
      DIMENSION CST(36)
      DIMENSION CM(12)
  100 FORMAT(I3,I2,I3,F6.2,2I3,3F5.1,3I3,F4.1,I4,F4.1,I4,I5,F5.1,I4)
  101 FORMAT(I3,I8,F6.2,2I3,3F5.1,3F5.2,F6.1,F5.0,F5.3,2F5.0,F4.0,2F5.0,
     12F7.3,F6.3,F7.3,F6.3)
  102 FORMAT(1H1'TABLE      COMPARISON OF MEASURED PAN EVAPORATION TO EST
     1IMATED PAN EVAPORATION FROM SHELTERED EVAPORATION BY TWO FORMULAS'
     2,)
  103 FORMAT(1H0,'STA      EL    LAT DA MO    TM    TX    TI    HM    HX    HI
     1 WIN   EVP     S   RSL   PPT   DP   EVF   EPC EV/EVF EV/EPC   EPR EV/EPCG
     2 EPCG',/)
  104 FORMAT(2I3)
  105 FORMAT(1H0,'STATION AVERAGE',7X,3F5.1,3F5.2,F6.1,F5.0,F5.3,2F5.0,F
     14.0,2F5.0,2F7.3,F6.3,F7.3,F6.3,///)
  107 FORMAT (I2)
  108 FORMAT(12F6.3)
  109 FORMAT(12F6.5)
  110 FORMAT(1H ,'            VENEZUELA DATA',///)
      CGST(25)=1.142
      CGST(26)=1.0*.944
      CGST(27)=1.0*1.644
      CGST(28)=1.0*1.389
      CGST(29)=1.0*1.553
      CGST(30)=1.0*1.071
      CGST(31)=1.0*1.645
      CGST(33)=1.0*1.104*1.015
      CGST(34)=1.0*.921
      CGST(35)=1.0*1.165
      CST(25)=.9206*.996*1.037
      CST(26)=.846*1.018*1.015
      CST(27)=1.1154*1.033*1.014
      CST(28)=.9645*.996*1.027
      CST(29)=1.0898*1.005*1.033
      CST(30)=.8509*.999*1.024
      CST(31)=1.0897*1.003*1.013
      CST(33)=.9655*.996*1.017
      CST(34)=1.0245*.992*1.026
      CST(35)=.9586*1.0*1.008
      CM(1)=.974
      CM(2)=1.007
      CM(3)=1.1
      CM(4)=1.054
      CM(5)=1.018
      CM(6)=.92
      CM(7)=.989
      CM(8)=1.007
      CM(9)=1.007
      CM(10)=1.038
      CM(11)=.909
      CM(12)=.909
      READ (5,106) (DEC(M),M=1,12)
      READ (5,109) (ES(M),M=1,12)
      DO 80 KK=1,5
      WRITE(6,102)
      WRITE(6,110)
      WRITE(6,103)
      DO 70 JJ=1,2
   16 READ(5,107) NN
      DO 37 I=1,20
      OSX(I)=0.
      OAX(I)=0.
   37 CONTINUE
      SM=0.
      DO 40 L=1,NN
   25 READ(5,104) MM,N
      DO 10 I=1,20
      SSX(I)=0.
      AAX(I)=0.
   10 CONTINUE
      DO 30 J=1,MM
      DO 11 I=1,20
      X(I)=0.
      SX(I) = 0.
      AX(I) = 0.
   11 CONTINUE
```

```
      DO 35 K=1,N
      READ(5,100)NST,NYR,LE,XLA,MD,MO,TM,TX,TI,NHM,NHX,NHI,W10,NEV,SH,
     1NRSL,IP,DP,NEVF
      XM = MO
      M = MO
      DER(M)=(DEC(M))/57.2958
      Z= -TAN(XLA/57.2958)*TAN(DER(M))
      OM   = ATAN(SQRT(1.0-Z*Z)/ABS(Z))
      DL   = OM/0.1309
      IF (Z) 17,18,18
   17 DL   = 24.-DL
   18 SINO = SIN(OM)
      S=SH/DL
      EV = NEV*1.0
      EVF = NEVF*1.0
      CEF=.71+.537*(110./EVF)-.365*(EVF/110.)+.118*(EVF/110.)**2
      HM=NHM/100.
      HX=NHX/100.
      HI=NHI/100.
      IF(HM)19,19,20
   19 HM=(HX+HI)/2
   20 CONTINUE
      RSL=NRSL
      PPT=IP
      RA = EV/EVF
      NYR=NYR+60
      EPC=1.74*EVF*CEF*CST(NST)*CH(M)
      ERR=ABS(EV-EPC)/EV
      RC=EV/EPC
      CH=-0.548 + 1.935*HM
      EPCG=1.796*EVF*CH*CGST(NST)
      RCG=EV/EPCG
      ERRG=ABS(EV-EPCG)/EV
      X(1) = TM
      X(2) = TX
      X(3) = TI
      X(6) =  HI
      X(4) =  HM
      X(5) =  HX
      X(7) = W10
      X(8) = EV
      X(8)=S
      X(10) =  RSL
      X(11) = PPT
      X(12) = DP
      X(13) = EVF
      X(14)=EPC
      X(15) = X(8)/X(13)
      X(16)=X(8)/X(14)
      X(17)=ERR
      X(18)=PCG
      X(19)=ERRG
      X(20)=EPCG
      DO 12 I= 1,14
      SX(I) = SX(I) + X(I)
   12 CONTINUE
      SX(17)=SX(17)+X(17)
      SX(19)=SX(19)+X(19)
      SX(20)=SX(20)+X(20)
   35 CONTINUE
      DO 13 I= 1,14
      AX(I) = SX(I)/N
   13 CONTINUE
      AX(15) = SX(8)/SX(13)
      AX(16)=SX(8)/SX(14)
      AX(17)=SX(17)/N
      AX(18)=SX(8)/SX(20)
      AX(19)=SX(19)/N
      WRITE(6,101)NST,LE,XLA,MD,MO,(AX(I),I=1,19)
      DO 14 I= 1,14
      SSX(I) = SSX(I) + SX(I)
   14 CONTINUE
      SSX(17)=SSX(17)+SX(17)
      SSX(19)=SSX(19)+SX(19)
      SSX(20)=SSX(20)+SX(20)
   30 CONTINUE
      FM=MM
      FN=N
      DO 36 I=1,14
      OSX(I)=OSX(I)+SSX(I)
   36 CONTINUE
```

```
      OSX(17)=OSX(17)+SSX(17)
      OSX(19)=OSX(19)+SSX(19)
      OSX(20)=OSX(20)+SSX(20)
      SM=SM +FM+FN
   40 CONTINUE
      DO 38 I=1,14
      OAX(I)=OSX(I)/SM
   38 CONTINUE
      OAX(15)=OSX(8)/OSX(13)
      OAX(16)  =OSX(8)/OSX(14)
      OAX(17)=OSX(17)/SM
      OAX(18)=OSX(8)/OSX(20)
      OAX(19)=OSX(19)/SM
      WRITE(6,105) (OAX(I),I=1,19)
   70 CONTINUE
   80 CONTINUE
   60 STOP
```

```
C     PROGRAM 608 CHECK ON PARDO EQUATION FOR ESTIMATING SHELTERED
C     EVAPORATION USING DATA FROM VENEZUELA MINISTRY OF DEFENSE STATIONS
C     AND TO ESTIMATE EVAPOTRANSPIRATION
      DIMENSION DEC(15),ES(15),DER(15),X(27),A(27),SU(27),SUM(27),AV(27)
      DIMENSION XP(22),CMP(12)
  100 FORMAT(I3,2F3.0,F3.1,F5.0,F3.0,2I3,F3.0,3F4.1,3F3.2,F4.1,F3.1,
     1F5.1,F6.0,F4.0,F3.0,F5.1)
  102 FORMAT(12F6.3)
  103 FORMAT(12F6.5)
  104 FORMAT(1H1'TABLE      DATA AND COMPUTED EVAPORATION AND EVAPOTRANS
     1PIRATION FOR 17 MINISTRY OF DEFENSE STATIONS IN VENEZUELA.'/)
  105 FORMAT(1H0'ST     ELEV    TM    TX   W10   HM   HI   SP VPDMB     PD    EV
     1F     RMD   .RSD    EVC EV/EC   EVPR   EVPS   EVPK ER/EK    ETR    ETS    E
     2TK TP/TK'/)
  110 FORMAT(I3,2F5.0,I6)
  107 FORMAT(1H0'MEAN     '  ,3F5.1,3F4.2,F6.2,3F7.3,11F6.3)
  106 FORMAT(I3,I9,3F5.1,3F4.2,F6.2,2F6.3,F7.3,11F6.3,/)
  130 FORMAT(1H 'MONTHLY CONSTANT, XP, AND ERROR, PERCENT',28X,F6.3,F12.
     13,/)
  131 FORMAT(1H 'OVERALL CONSTANT, XP, AND ERROR, PERCENT',28X,F6.3,F12.
     13,/)
      EQUIVALENCE(X(1),TM),(X(2),TX),(X(3),W10),(X(4),HM),(X(5),HI),(X(6
     1),SP),(X(7),VPDMB),(X(8),PD),(X(9),EVF),(X(10),RMD),(X(11),RSD),(X
     2(12),EVFC),(X(14),FVPR),(X(15),EVPS),(X(16),EVPK),(X(18),ETR),(X(1
     39),ETS),(X(20),ETK)
      DATA(XP(NST),NST=1,22)/.7884,.9668,1.,1.1912,1.,.7644,1.,1.1191,.8
     1193,1.3976,.7152,.7825,.5855,1.1835,1.,1.7107,1.,.4875,.8402,.9035
     2,.8190,.9869/
      DATA (CMP(M), M=1,12)/1.057,1.099,1.103,1.029,.972,.944,.897,.842,
     1.803,.795,.811,.914/
      READ(5,102) (DEC(M),M=1,12)
      READ(5,103) (ES(M),M=1,12)
      NM=12
      NY=6
      M1=1
      WRITE(6,104)
      WRITE(6,105)
      DO 27 K=1,17
      READ(5,110) NST,XLA,XLM,LE
      XLA=XLA+XLM/60.
      DO 20 I=1,22
   20 SUM(I) = 0.
      XX=72.
      DO 26 L=1,NM
      DO 23 I=1,22
      X(I)=0.
   23 SU(I)=0.
      XN=6.
      DO 25 J=1,NY
      READ(5,100) NST,XLD,XLM,XLO,EL,ZA,NYR,MO,DM,TM,TX,TI,HM,HX,HI,WA,
     1CLC,SHM,RSLM,PM,DP,EVFM
```

```
      XLA=XLD+XLM/60.
      LF=FL
      M = MO
      XM = MO
      M1=MO
      DER(M)=(DEC(M))/57.2958
      Z= -TAN(XLA/57.2958)*TAN(DER(M))
      DM    = ATAN(SQRT(1.0-Z*Z)/ABS(Z))
      DL    = DM/0.1509
      IF (Z) 12,13,13
   12 DL    = 24.-DL
   13 SINO = SIN(DM)
      RLD=120.*(DL*SIN(XLA/57.2958)*SIN(DER(M))+3.8197*COS(XLA/57.2958)*
     1COS(DER(M))*2.*SINO)/ES(M)
      RMD=10.*RLD/(595.9-0.55*TM)
      RSL=RSLM/DM
      RSD=10.*RSL/(595.9-0.55*TM)
      SH=SHM/DM
      SP=SH/DL
      S=SP
      PD=PM/DM
      EVF=FVFM/DM
      W10=WA*(10./ZA)**.25
      IF (W10 - 7.15)  35,35,36
   35 W2M=.250*W10+.039*W10**2
      GO TO 14
   36 W2M=.797*W10-1.50
   14 CONTINUE
      W2MP=14.91*W2M
      WFD=1.0 + 0.0099 * W2MP
      TKM=273.16+TM
      TKI=273.16+TI
      TKX=273.16+TX
      EAM=EXP(47.226-6463./TKM-3.927*ALOG(TKM))-(.061+.0002*TM**2)
      EAI=EXP(47.226-6463./TKI-3.927*ALOG(TKI))-(.061+.0002*TI**2)
      EAX=EXP(47.226-6463./TKX-3.927*ALOG(TKX))-(.061+.0002*TX**2)
      VPMM=0.5*(HI*EAX+HX*EAI)
      VPDMB=1.337*(EAM-VPMM)
      VPMMD=EAM-VPMM
      CTP=-0.70+.085*TM
      CVPD=-.113+.318*VPMMD
      WKH=W10
      CTV=.844+.21*(TM/25.)+.145*(TM/25.)**2
      CHV=1.20-.20*(HM/.70)**3
      CTT=.670+.193*(TM/25.)+.137*(TM/25.)**2
      CHT=1.10-.10*(HM/.70)**4
      CTTV=1.041-.047*(TM/25.)+.006*(TM/25.)**2
      CHTV=.910+.070*(HM/.70)**2+.02*(HM/.70)**3
      CWV=.70+.36*(WKH/8.)-.06*(WKH/8.)**2
      CWT=.75+.31*(WKH/8.)-.06*(WKH/8.)**2
      CWTV=1.071-.096*(WKH/8.)+.030*(WKH/8.)**2-.005*(WKH/8.)**3
      CF=.970+.030*(FL/305.)
      CS=.43+.66*(S/.5)-.14*(S/.5)**2
      XS=0.460
      XKT=.22
      XKS=.761
      XKV=.350
      XKTV=.80
```

```
      RSC=XS*RMD*CE*CS
      IF(PSD) 18,13,19
   18 RSD=RSC
   19 CONTINUE
      XKV=.35J
      EVPS=XKS*PSD*CWV*CHV*CTV
      EVPR=XKV*RMD*CTV*CWV*CHV*CS*CF
      EVFC=1.510*CVPD*CTP*XP(NST)*CMP(M)
      CEF=.71+.537*(110./EVFM)-.365*(EVFM/110.)+.118*(EVFM/110.)**2
      EVPK=1.74*EVFM*CEF/DM
      ETR=XKT*RMD*CTT*CWT*CHT*CS*CE
      ETK=XKTV*EVPK*CTTV*CWTV*CHTV
      ETS=.60)*RSD*CTT*CWT*CHT
      X(13)=EVF/EVFC
      X(17)=EVPR/EVPK
      X(21)=ETR/ETK
      X(22)=ABS(100.*(EVF-EVFC)/EVF)
      DO 40 I=1,22
   40 SU(I) = SU(I) + X(I)
   25 CONTINUE
      DO 41 I=1,22
      A(I) = SU(I)/XN
   41 SUM(I)=SUM(I)+SU(I)
      A(13)=SU(9)/SU(12)
      A(17)=SU(14)/SU(16)
      A(21)=SU(18)/SU(20)
      AXS=A(13)
   28 CONTINUE
   26 CONTINUE
   29 DO 42 I=1,22
   42 AV(I) = SUM(I)/XX
      AV(13)=SUM(9)/SUM(12)
      AV(17)=SUM(14)/SUM(16)
      AV(21)=SUM(18)/SUM(20)
      AVX=AV(13)
      WRITE(6,106)NST,LE,(AV(I),I=1,21)
   27 CONTINUE
      STOP
      END
```

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UNTV&C 1109 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
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```
C     PROGRAM 609  COMPARISON OF PAN EVAPORATION AS COMPUTED BY THE
C     CHRISTIANSEN AND STUTLER FORMULAS USING COLOMBIAN DATA COMPILED
C     BY PARDO.
      DIMENSION OSX(20),OAX(20)
      DIMENSION X(20),SX(20),AX(20),DM(12)
  100 FORMAT(I3,F6.2,I5,I3,8F5.1,2F5.2,2F6.2)
  102 FORMAT(I3,F5.1,F4.2,F5.1,F4.1,F4.2,4F7.2,F8.3,2F7.2,F8.3)
  103 FORMAT(1H1'TABLE      DATA AND COMPARISON OF PAN EVAPORATION AND E
     1VAPOTRANSPIRATION AS ESTIMATED')
  104 FORMAT(1H0'MO    TM   HM    VP VPD    S    RMDM    EVFM    EVPK    EVPR FP
     1R/FPK     ETK     ETC ETC/ETK')
  105 FORMAT(1H0'STATION',I3,1X,'AVERAGES, ELEVATION =',I6,/)
  106 FORMAT(3X,F5.1,F4.2,F5.1,F4.1,F4.2,4F7.2,F8.3,2F7.2,F8.3///)
  107 FORMAT(1H0'OVERALL AVERAGES',/)
  108 FORMAT(1H ,11X,'BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMB
     1IAN STATIONS'/)
      DATA (DM(M), M=1,12)/31.,28.,31.,30.,31.,30.,31.,31.,30.,31.,30.,
     131./
      EQUIVALENCE(X(1),TM),(X(2),HM),(X(3),VP),(X(4),VPD),(X(5),S),(X(6)
     1,RMDM),(X(7),EVFM),(X(8),EVPK),(X(9),EVPR),(X(11),ETK),(X(12),ETC)
      DO 17 I=1,13
      OSX(I)=0.
      OAX(I)=0.
   17 CONTINUE
      DO 80 N=1,10
      WRITE(6,103)
      WRITE(6,108)
      WRITE(6,104)
      DO 70 K=1,2
      DO 15 I=1,13
      SX(I)=0.
      AX(I)=0.
   15 CONTINUE
      DO 40 J=1,12
   20 READ(5,100) NST,XLA,LE,MO,TM,TX,TI,HMP,VPD,VP,SP,DP,EVFD,WKH,RMD,
     1RAMD
      M = MO
      S=SP/100.
      HM=HMP/100.
      EVFM=EVFD*DM(M)
      RMDM=RMD*DM(M)
      VPMMD=VPD
      EL=LE
      CWV=1.
      CWT=1.
      CTV=.644+.21*(TM/25.)+.146*(TM/25.)**2
      CHV=1.20-.20*(HM/.70)**3
      CTT=.670+.193*(TM/25.)+.137*(TM/25.)**2
      CHT=1.10-.10*(HM/.70)**4
      CTTV=1.041-.047*(TM/25.)+.006*(TM/25.)**2
      CHTV=.910+.070*(HM/.70)**2+.02*(HM/.70)**3
      CE=.970+.030*(EL/305.)
      CS=.49+.66*(S/.5)-.14*(S/.5)**2
      CEF=.71+.537*(110./EVFM)-.365*(EVFM/110.)+.118*(EVFM/110.)**2
      XS=0.460
      XKV=.350
      XKTV=.90
      XKT=0.29
      EVPR=XKV*RMD*CTV*CWV*CHV*CS*CF*DM(M)
      EVPK=1.74*EVFM*CEF
      ETC=XKT*RMD*CTT*CWT*CHT*CS*CE*DM(M)
      ETK=XKTV*EVPK*CTTV*CHTV
      X(10)=X(9)/X(8)
      X(13)=X(12)/X(11)
      WRITE(6,102) MO,(X(I),I=1,13)
      DO 30 I=1,13
      SX(I)=SX(I)+X(I)
   30 CONTINUE
   40 CONTINUE
      DO 41 I=1,13
```

```
      AX(I)=SX(I)/12
   41 CONTINUE
      AX(10)=SX(9)/SX(8)
      AX(13)=SX(12)/SX(11)
      WRITE(6,105) NST,LF
      WRITE(6,106) (AX(I),I=1,13)
      DO 44 I=1,13
      OSX(I)=OSX(I)+SX(I)
   44 CONTINUE
   70 CONTINUE
   80 CONTINUE
      DO 46 I=1,13
      OAX(I)=OSX(I)/240.
   46 CONTINUE
      OAX(10)=OSX(9)/OSX(8)
      OSX(13)=OSX(12)/OSX(11)
      WRITE(6,107)
      WRITE(6,106) (OAX(I),I=1,13)
   10 STOP
      END

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C     PROGRAM 610 TO ESTIMATE PAN EVAPORATION ADN POTENTIAL EVAPOTRANSPIRATION
C     FROM DATA COMPILED BY STUTLER USING GUILLEN AND PARDO FORMULAS TO ESTIMATE
C     SHELTERED EVAPORATION
      DIMENSION DEC(12), ES(12),DER(12)
      DIMENSION X(20), SX(20), AX(20),DM(12)
      DIMENSION DSX(20), DAX(20)
  100 FORMAT(I3,F6.2,I5,I3,3F5.1,F5.2,2F5.1,F4.0,F5.2)
  102 FORMAT(I3,F5.1,F4.2,F5.1,F4.1,F4.2,F5.1,6F7.2,2F8.3,3F7.2,2F8.3)
  103 FORMAT(1H1'TABLE       DATA AND COMPARISON OF PAN EVAPORATION AND
     1EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMUL
     2AS',//)
  104 FORMAT(1H0'MO    TM   HM    VP VPD    S    DP      RM  EVFMP  EVFMG    FV
     1PR  EVPKP   EVPKG EVR/EKP EVR/EKG    ETKP    ETKG     ETC ETC/ETP ETC/
     2ETG'/)
  106 FORMAT(12F6.3)
  107 FORMAT(12F6.5)
  108 FORMAT(1H 'STATION',I3,1X,'AVERAGES')
  109 FORMAT(3X,F5.1,F4.2,F5.1,F4.1,F4.2,F5.1,6F7.2,2F8.3,3F7.2,2F8.3//)
      DATA (DM(M), M=1,12)/31.,28.,31.,30.,31.,30.,31.,31.,30.,31.,30.,
     131./
      EQUIVALENCE(X(1),TM),(X(2),HM),(X(3),VP),(X(4),VPD),(X(5),S),(X(6)
     1,DP),(X(7),RM),(X(8),EVFMP),(X(9),EVFMG),(X(10),EVPR),(X(11),EVPKP
     2),(X(12),EVPKG),(X(15),ETKP),(X(16),ETKG),(X(17),ETC)
      READ(5,106) (DEC(M),M=1,12)
      READ(5,107) (ES(M),M=1,12)
      DO 43 I=1,19
      DSX(I)=0.
      DAX(I)=0.
   43 CONTINUE
      DO 80 K=1,13
      WRITE(6,103)
      WRITE(6,104)
      DO 70 KK=1,2
      DO 15 I=1,19
      X(I)=0.
      SX(I)=0.
      AX(I)=0.
   15 CONTINUE
      DO 40 J=1,12
      READ(5,100) NST,XLA,LE,MO,TM,TX,TI,HM,VP,SH,DP,W
      M=MO
      EL=LE
      DER(M)=(DEC(M))/57.2958
      Z= -TAN(XLA/57.2958)*TAN(DER(M))
      OM   = ATAN(SQRT(1.0-Z*Z)/ABS(Z))
      DL   = OM/0.1309
      IF (Z) 12,13,13
   12 DL   = 24.-DL
   13 SINO = SIN(OM)
      RLO=120.*(DL*SIN(XLA/57.2958)*SIN(DER(M))+3.8197*COS(XLA/57.2958)*
     1COS(DER(M))*2.*SINO)/ES(M)
      RMO=10.*RLO/(595.9-0.55*TM)
      S=SH/DL
      IS=SH
      TKM=273.16+TM
      EAM=EXP(47.226-6463./TKM-3.927*ALOG(TKM))-(.061+.0002*TM**2)
      VPMM=HM*EAM
```

```
      VPMMD=FAM-VPMM
      VPD=VPMMD
      CTP=-0.70+.085*TM
      CVPD=-.113+.318*VPMMD
      CWT=1.
      CWV=1.0
      CTV=.644+.21*(TM/25.)+.146*(TM/25.)**2
      CHV=1.20-.20*(HM/.70)**3
      CTT=.670+.193*(TM/25.)+.137*(TM/25.)**2
      CHT=1.10-.10*(HM/.70)**4
      CTTV=1.041-.047*(TM/25.)+.006*(TM/25.)**2
      CHTV=.910+.070*(HM/.70)**2+.02*(HM/.70)**3
      CTG=.0621*TM-.490
      CDPG=1.15-.015*DP
      CWG=1.0
      CHG=2.12-1.75*(HM)**2
      CE=.970+.030*(EL/305.)
      IF(IS.EQ.0) GO TO 14
      CSG=0.53+.784*S
      CS=.48+.66*(S/.5)-.14*(S/.5)**2
      GO TO 16
   14 CS=1.
      CSG=1.0
   16 CONTINUE
      RM=RMD*DM(M)
      XS=0.460
      RSC=XS*RMD*CE*CS
      IF(PSD) 18,18,19
   18 RSD=RSC
   19 CONTINUE
      XKV=.350
      XKS=.620
      EVPR=XKV*RMD*CTV*CWV*CHV*CS*CE*DM(M)
      EVFDG=2.957*CTG*CHG*CWG*CSG*CDPG
      EVFDP=1.51*CVPD*CTP
      EVFMP=EVFDP*DM(M)
      EVFMG=EVFDG*DM(M)
      CEFP=.71+.537*(110./EVFMP)-.365*(EVFMP/110.)+.118*(EVFMP/110.)**2
      CEFG=.71+.537*(110./EVFMG)-.365*(EVFMG/110.)+.118*(EVFMG/110.)**2
      EVPKP=1.74*CEFP*EVFMP
      EVPKG=1.74*CEFG*EVFMG
      X(13)=EVPR/EVPKP
      X(14)=EVPR/EVPKG
      XKT=.28
      XKTV=.80
      ETC=XKT*RMD*CTT*CWT*CHT*CS*CE*DM(M)
      ETKP=XKTV*EVPKP*CTTV*CHTV
      ETKG=XKTV*EVPKG*CTTV*CHTV
      X(18)=ETC/ETKP
      X(19)=ETC/ETKG
      WRITE(6,102) MO,(X(I),I=1,19)
      DO 30 I=1,19
      SX(I)=SX(I)+X(I)
   30 CONTINUE
   40 CONTINUE
      DO 41 I=1,19
      AX(I)=SX(I)/12
   41 CONTINUE
```

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      AX(13)=SX(10)/SX(11)
      AX(14)=SX(10)/SX(12)
      AX(18)=SX(17)/SX(15)
      AX(19)=SX(17)/SX(16)
      WRITE(6,108)NST
      WRITE(6,109) (AX(I),I=1,19)
      DO 42 I=1,19
      OSX(I)=OSX(I)+SX(I)
   42 CONTINUE
   70 CONTINUE
   80 CONTINUE
      DO 44 I=1,19
      OAX(I)=OSX(I)/312
   44 CONTINUE
      OAX(13)=OSX(10)/OSX(11)
      OAX(14)=OSX(10)/OSX(12)
      OAX(18)=OSX(17)/OSX(15)
      OAX(19)=OSX(17)/SX(16)
      WRITE(6,109)(OAX(I),I=1,19)
   10 STOP
      END

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Appendix B

Tables

TABLE 11-1 COMPARISON OF MEASURED PAN EVAPORATION TO ESTIMATED PAN EVAPORATION FROM SHELTERED EVAPORATION BY TWO FORMULAS
VENEZUELA DATA

STA	EL	LAT	DA	MO	TM	TX	TI	HM	HX	HI	W10	EVP	S	RSL	PPT	DP	EVF	EPC	EV/EVF	EV/EPC	ERR	EV/EPCG	ERRG
25	240	10.15	31	1	24.0	31.0	17.1	.69	.96	.39	6.1	192.	.640	377.	24.	5.	126.	186.	1.518	1.031	.043	.949	.091
25	240	10.15	28	2	25.0	32.0	17.6	.66	.97	.38	6.7	203.	.668	421.	20.	4.	137.	200.	1.476	1.015	.073	1.010	.071
25	240	10.15	31	3	26.2	33.7	19.4	.62	.93	.35	8.4	266.	.695	466.	3.	1.	209.	277.	1.272	.963	.038	.952	.051
25	240	10.15	30	4	27.5	34.2	20.3	.61	.91	.37	8.0	250.	.597	439.	4.	1.	204.	260.	1.225	.965	.037	.944	.059
25	240	10.15	31	5	28.2	34.7	21.2	.62	.90	.37	6.7	240.	.490	404.	107.	6.	194.	244.	1.234	.984	.016	.922	.092
25	240	10.15	30	6	25.8	30.7	20.7	.77	.94	.50	3.9	137.	.461	408.	250.	23.	70.	146.	1.962	.942	.064	1.011	.011
25	240	10.15	31	7	25.5	30.8	20.4	.81	.97	.52	3.7	151.	.529	432.	156.	18.	62.	152.	2.422	.995	.039	1.152	.130
25	240	10.15	31	8	25.9	31.9	19.8	.79	.96	.47	3.9	158.	.568	433.	102.	12.	74.	162.	2.142	.977	.026	1.065	.060
25	240	10.15	30	9	26.2	32.5	19.8	.78	.97	.46	3.4	176.	.560	428.	88.	12.	74.	162.	2.385	1.090	.083	1.207	.173
25	240	10.15	31	10	26.4	33.1	19.9	.74	.96	.40	4.3	189.	.620	423.	58.	8.	104.	185.	1.817	1.019	.019	1.002	.002
25	240	10.15	30	11	26.1	32.5	20.0	.74	.99	.42	4.9	192.	.650	389.	47.	12.	113.	167.	1.699	1.150	.131	.937	.067
25	240	10.15	31	12	24.1	30.4	17.4	.71	.98	.43	5.5	176.	.596	362.	20.	3.	114.	167.	1.544	1.051	.049	.911	.097
STATION AVERAGE					25.9	32.2	19.6	.72	.95	.43	5.4	191.	.577	419.	89.	10.	120.	191.	1.588	1.000	.049	1.000	.077
26	146	9.60	30	4	28.4	33.7	22.9	.63	.87	.39	15.9	269.	.663	512.	1.	3.	260.	306.	1.035	.880	.137	.909	.100
26	146	9.60	31	5	27.9	33.2	23.2	.65	.90	.41	14.5	213.	.531	474.	120.	17.	202.	228.	1.079	.955	.047	.885	.136
26	146	9.60	30	6	26.4	30.2	22.6	.71	.91	.52	11.0	142.	.430	435.	185.	26.	96.	147.	1.479	.964	.037	1.044	.042
26	146	9.60	31	7	26.6	30.6	22.5	.69	.86	.52	10.7	147.	.448	435.	313.	22.	81.	150.	1.815	.977	.023	1.360	.265
26	146	9.60	31	8	26.9	31.7	22.1	.66	.82	.50	9.5	152.	.536	471.	107.	21.	97.	162.	1.567	.940	.064	1.268	.211
26	146	9.60	30	9	27.2	32.4	22.2	.71	.90	.49	9.6	183.	.593	450.	82.	14.	123.	175.	1.488	1.045	.108	1.046	.052
26	146	9.60	31	10	27.0	32.4	21.9	.72	.90	.49	10.2	183.	.654	431.	115.	10.	125.	182.	1.462	1.009	.040	1.028	.117
26	146	9.60	30	11	26.7	31.6	21.6	.72	.91	.51	10.5	156.	.597	386.	81.	15.	103.	149.	1.512	1.051	.046	1.008	.272
26	146	9.60	31	12	25.6	30.9	19.9	.71	.92	.50	11.6	185.	.699	400.	72.	10.	147.	170.	1.262	1.090	.074	.878	.122
STATION AVERAGE					26.9	31.9	21.9	.70	.90	.49	11.2	180.	.592	436.	110.	14.	133.	180.	1.352	1.000	.065	1.000	.144

TABLE II-2 COMPARISON OF MEASURED PAN EVAPORATION TO ESTIMATED PAN EVAPORATION FROM SHELTERED EVAPORATION BY TWO FORMULAS
VENEZUELA DATA

STA	EL	L.T	DA	MO	TM	TX	TI	HM	HX	HI	W10	EVP	S	RSL	PPT	DP	EVF	EPC	EV/EVF	EV/EPC	ERR	EV/EPCG	ERRG
27	270	9.52	31	5	29.7	35.5	22.5	.59	.00	.00	8.7	271.	.652	404.	70.	5.	154.	259.	1.760	1.045	.043	1.004	.004
27	270	9.52	31	10	26.6	32.7	19.8	.79	.99	.55	6.1	181.	.696	413.	15.	3.	51.	186.	3.549	.975	.025	1.226	.184
27	270	9.52	30	11	26.7	33.1	20.3	.73	1.00	.46	7.1	173.	.692	366.	92.	7.	69.	176.	2.507	.981	.020	.982	.018
27	270	9.52	31	12	25.5	31.8	19.2	.68	.98	.45	9.2	193.	.794	367.	12.	2.	99.	196.	1.949	.983	.018	.850	.163
STATION AVERAGE					27.0	33.3	20.4	.70	.74	.36	7.8	204.	.708	387.	47.	4.	93.	204.	2.193	1.000	.026	1.000	.092
28	430	9.90	31	1	24.2	31.6	16.3	.64	.97	.42	6.4	196.	.792	377.	39.	3.	134.	198.	1.461	.993	.034	.855	.174
28	430	9.90	28	2	25.5	32.5	17.0	.58	.94	.40	7.4	217.	.792	424.	4.	1.	160.	221.	1.359	.982	.047	.959	.099
28	430	9.90	31	3	27.2	33.7	18.0	.51	.85	.37	8.2	283.	.813	450.	0.	0.	219.	298.	1.295	.951	.052	1.182	.154
28	430	9.90	30	4	27.7	34.1	20.2	.50	.76	.32	6.3	261.	.671	424.	11.	3.	198.	263.	1.318	.993	.007	1.260	.206
28	430	9.90	31	5	27.7	32.6	21.4	.59	.90	.47	5.7	223.	.550	385.	213.	9.	153.	220.	1.456	1.018	.017	.983	.042
28	430	9.90	30	6	26.7	29.5	20.5	.76	.97	.57	4.7	153.	.466	368.	233.	18.	86.	161.	1.769	.951	.129	.757	.347
28	430	9.90	31	7	24.8	29.5	20.0	.78	.97	.56	4.4	161.	.587	408.	298.	16.	61.	157.	2.648	1.031	.030	1.105	.095
28	430	9.90	31	8	24.9	29.3	19.6	.81	.97	.57	3.8	166.	.594	403.	154.	18.	56.	156.	2.973	1.069	.064	1.158	.137
28	430	9.90	31	10	26.0	30.8	19.7	.78	.96	.55	4.2	180.	.662	399.	139.	11.	67.	169.	2.687	1.067	.063	1.120	.107
28	430	9.90	30	11	25.2	31.7	18.7	.71	.99	.47	4.5	157.	.710	360.	15.	6.	82.	157.	1.915	1.003	.003	.929	.076
28	430	9.90	31	12	24.5	31.5	16.7	.65	.98	.50	5.2	185.	.752	355.	18.	2.	123.	178.	1.504	1.037	.036	.849	.177
STATION AVERAGE					25.9	31.4	18.9	.67	.94	.48	5.6	199.	.665	398.	115.	8.	123.	199.	1.622	1.000	.048	1.000	.148

TABLE 11-3 COMPARISON OF MEASURED PAN EVAPORATION TO ESTIMATED PAN EVAPORATION FROM SHELTERED EVAPORATION BY TWO FORMULAS
VENEZUELA DATA

STA	EL	LAT	DA	MO	TM	TX	TI	HM	HX	HI	W10	EVP	S	RSL	PPT	DP	EVF	EPC	EV/EVF	EV/EPC	ERR	EV/EPCG	ERRG
29	580	10.15	31	1	22.9	30.0	16.6	.78	.90	.62	9.3	180.	.660	0.	7.	3.	75.	188.	2.392	.960	.079	.889	.128
29	580	10.15	29	2	23.1	31.0	16.8	.76	.89	.59	10.4	195.	.724	0.	3.	2.	85.	201.	2.287	.971	.059	.887	.136
29	580	10.15	31	3	23.9	31.9	17.7	.73	.83	.53	11.7	259.	.664	0.	3.	2.	112.	240.	2.272	1.062	.074	.937	.069
29	580	10.15	30	4	23.9	31.3	19.6	.77	.85	.62	10.4	204.	.454	0.	67.	9.	82.	208.	2.473	.930	.089	.946	.054
29	580	10.15	34	5	24.0	30.2	20.2	.81	.90	.69	11.8	179.	.463	0.	88.	11.	63.	187.	2.838	.962	.071	.988	.089
29	580	10.15	30	6	23.1	29.0	19.8	.84	.92	.74	12.1	163.	.487	0.	120.	19.	47.	156.	3.426	1.041	.089	1.146	.141
29	580	10.15	31	7	23.2	29.0	19.4	.86	.92	.75	10.1	163.	.519	0.	140.	22.	44.	165.	3.716	.992	.038	1.192	.164
29	580	10.15	31	8	23.3	29.8	19.3	.84	.92	.71	10.5	189.	.618	0.	73.	15.	54.	177.	3.484	1.068	.063	1.156	.148
29	580	10.15	30	9	23.9	31.1	19.2	.82	.89	.67	11.6	191.	.620	0.	34.	9.	64.	185.	2.992	1.031	.074	1.034	.076
29	580	10.15	31	10	24.5	31.5	19.2	.79	.87	.62	9.3	197.	.527	0.	29.	9.	69.	195.	2.861	1.012	.088	1.053	.138
29	580	10.15	30	11	24.1	31.0	18.6	.79	.89	.63	7.9	162.	.604	0.	62.	10.	59.	163.	2.771	.995	.050	1.016	.061
29	580	10.15	31	12	22.9	29.8	17.6	.79	.91	.64	7.8	151.	.632	0.	29.	8.	60.	164.	2.523	.922	.092	.922	.085
STATION AVERAGE					23.6	30.5	18.7	.80	.89	.65	10.1	185.	.591	0.	54.	10.	68.	185.	2.734	1.000	.072	1.000	.107
30	438	10.18	31	1	25.1	31.7	19.2	.63	.94	.43	10.8	198.	.760	402.	3.	1.	157.	193.	1.187	1.027	.039	.920	.109
30	438	10.18	28	2	26.0	32.5	19.7	.58	.87	.43	12.0	216.	.773	445.	9.	0.	184.	212.	1.178	1.022	.025	1.078	.099
30	438	10.18	31	3	26.8	33.1	20.1	.56	.83	.40	12.4	271.	.784	483.	59.	0.	229.	276.	1.185	.982	.046	1.138	.117
30	438	10.18	30	4	27.3	33.0	21.4	.60	.83	.43	10.4	228.	.592	432.	189.	5.	192.	230.	1.192	.993	.051	1.031	.155
30	438	10.18	31	5	26.7	32.3	21.9	.66	.90	.46	8.3	189.	.514	405.	382.	10.	139.	185.	1.361	1.020	.065	.971	.058
30	437	10.18	30	6	25.4	30.6	21.0	.75	.96	.52	6.6	143.	.483	406.	205.	18.	90.	144.	1.594	.995	.049	.932	.076
30	437	10.18	31	7	24.9	30.4	20.6	.76	.98	.53	6.6	153.	.525	403.	180.	16.	83.	150.	1.847	1.020	.071	1.066	.141
30	437	10.18	31	8	25.1	30.6	20.5	.75	.97	.52	6.4	154.	.587	419.	179.	15.	84.	154.	1.830	1.004	.027	1.065	.171
30	437	10.18	30	9	25.1	30.8	20.1	.77	.98	.51	5.9	144.	.586	408.	144.	15.	76.	149.	1.899	.964	.083	1.058	.168
30	437	10.18	31	10	25.5	31.7	20.1	.75	.99	.50	6.3	160.	.666	409.	145.	11.	93.	163.	1.724	.979	.072	.999	.166
30	438	10.18	30	11	25.6	31.7	19.9	.72	.98	.48	6.9	147.	.685	379.	94.	7.	105.	149.	1.399	.986	.031	.880	.142
30	438	10.18	31	12	25.4	31.6	19.4	.67	.97	.47	8.8	168.	.739	375.	25.	2.	140.	166.	1.201	1.014	.042	.824	.205
STATION AVERAGE					25.7	31.6	20.3	.69	.93	.48	8.4	180.	.636	414.	138.	9.	129.	180.	1.388	1.000	.050	1.000	.135

TABLE 11-4 COMPARISON OF MEASURED PAN EVAPORATION TO ESTIMATED PAN EVAPORATION FROM SHELTERED EVAPORATION BY TWO FORMULAS
VENEZUELA DATA

STA	EL	LAT	DA	MO	TM	TX	TI	HM	HX	HI	WIO	EVP	S	RSL	PPT	DP	EVF	EPC	EV/EVF	EV/EPC	ERR	EV/EPCG	ERRG
31	432	10.18	31	1	24.5	30.3	18.6	.67	.81	.53	11.9	214.	.654	0.	3.	1.	125.	216.	1.716	.992	.048	.782	.276
31	432	10.18	29	2	25.3	31.6	19.1	.63	.78	.48	14.0	235.	.672	0.	0.	0.	137.	231.	1.714	1.015	.029	.867	.164
31	432	10.18	31	3	26.2	32.6	19.6	.59	.73	.45	14.4	278.	.508	0.	0.	0.	161.	273.	1.728	1.019	.062	.966	.192
31	432	10.18	30	4	26.8	32.8	20.9	.60	.74	.47	12.8	243.	.393	0.	39.	4.	131.	238.	1.854	1.022	.065	1.022	.108
31	432	10.18	31	5	26.5	31.9	21.1	.66	.78	.54	10.2	201.	.347	0.	111.	10.	90.	201.	2.238	.999	.071	1.063	.200
31	432	10.18	30	6	25.0	29.8	20.3	.72	.82	.61	7.3	166.	.385	0.	182.	16.	59.	161.	2.836	1.029	.084	1.155	.131
31	432	10.18	31	7	24.9	29.7	20.1	.73	.82	.65	7.8	179.	.466	0.	184.	16.	62.	176.	2.899	1.015	.060	1.143	.121
31	432	10.18	31	8	25.1	30.1	20.2	.73	.84	.62	7.3	172.	.513	0.	138.	13.	60.	178.	2.848	.965	.078	1.138	.120
31	432	10.18	30	9	25.1	30.4	19.8	.74	.84	.65	6.4	163.	.451	0.	148.	14.	50.	169.	3.278	.960	.042	1.254	.203
31	432	10.18	31	10	25.5	30.9	20.0	.73	.84	.62	6.8	184.	.569	0.	147.	11.	60.	183.	3.094	1.007	.059	1.230	.183
31	432	10.18	30	11	25.2	30.8	19.7	.71	.83	.60	7.4	159.	.578	0.	49.	6.	68.	166.	2.337	.961	.044	.964	.134
31	432	10.18	31	12	24.6	30.4	18.9	.69	.83	.56	9.0	181.	.646	0.	15.	2.	95.	183.	1.909	.989	.038	.826	.206
STATION AVERAGE					25.4	30.9	19.9	.68	.81	.57	9.6	198.	.515	0.	85.	8.	91.	198.	2.166	1.000	.057	1.000	.170
33	381	10.05	31	1	24.8	31.0	19.9	.76	.93	.48	14.8	201.	.665	261.	5.	3.	120.	188.	1.668	1.067	.066	.899	.115
33	381	10.05	28	2	25.1	31.8	19.8	.70	.90	.42	17.8	222.	.728	303.	3.	2.	141.	207.	1.577	1.076	.066	.988	.089
33	381	10.05	31	3	26.0	32.7	20.2	.70	.88	.41	19.1	285.	.707	301.	3.	2.	188.	263.	1.512	1.081	.075	.944	.059
33	381	10.05	30	4	26.3	31.5	21.6	.78	.92	.54	16.7	220.	.473	116.	91.	10.	132.	212.	1.662	1.040	.063	.855	.155
33	381	10.05	31	5	25.9	30.5	21.8	.82	.94	.61	13.6	163.	.401	125.	90.	16.	90.	179.	1.804	.912	.097	.861	.154
33	381	10.05	30	6	24.4	29.4	21.6	.84	.94	.68	10.0	120.	.398	0.	206.	21.	58.	142.	2.078	.846	.183	.960	.120
33	381	10.05	31	7	24.5	28.9	21.4	.84	.94	.65	9.5	138.	.485	93.	206.	23.	49.	147.	2.798	.943	.062	1.299	.230
33	381	10.05	31	8	24.8	29.8	21.2	.83	.95	.64	9.0	150.	.540	193.	116.	18.	51.	151.	2.946	.997	.030	1.373	.271
33	381	10.05	30	9	24.8	30.9	20.8	.83	.97	.60	8.8	159.	.567	254.	94.	16.	60.	157.	2.630	1.009	.069	1.232	.190
33	381	10.05	31	10	25.4	30.9	21.1	.81	.97	.59	9.2	156.	.578	0.	131.	11.	72.	171.	2.167	.914	.094	1.056	.053
33	381	10.05	30	11	24.7	30.6	20.8	.83	.96	.60	8.9	128.	.533	161.	73.	13.	63.	144.	2.032	.889	.125	.954	.048
33	381	10.05	31	12	24.7	30.6	23.3	.79	.95	.54	11.3	156.	.600	164.	39.	8.	91.	160.	1.720	.977	.024	.863	.159
STATION AVERAGE					25.1	30.7	21.1	.79	.93	.56	12.6	178.	.556	178.	88.	12.	94.	178.	1.896	1.000	.074	1.000	.151

TABLE 11-5 COMPARISON OF MEASURED PAN EVAPORATION TO ESTIMATED PAN EVAPORATION FROM SHELTERED EVAPORATION BY TWO FORMULAS
VENEZUELA DATA

STA	EL	LAT	DA	MO	TM	TX	TI	HM	HX	HI	W10	EVP	S	RSL	PPT	DP	EVF	EPC	EV/EVF	EV/EPC	ERR	EV/EPCG	ERRG
34	10	10.90	31	1	27.6	31.8	22.4	.75	.92	.55	10.1	260.	.813	432.	3.	2.	189.	248.	1.376	1.047	.045	.921	.086
34	10	10.90	28	2	27.0	30.0	22.8	.72	.79	.51	8.8	261.	.747	414.	40.	7.	188.	256.	1.388	1.020	.019	.993	.007
34	10	10.90	31	3	27.8	31.9	23.5	.67	.88	.48	7.7	275.	.754	479.	5.	4.	221.	318.	1.244	.866	.155	1.005	.005
34	10	10.90	30	4	28.0	31.3	23.8	.77	.90	.50	10.8	278.	.670	482.	15.	4.	223.	307.	1.247	.906	.104	.800	.250
34	10	10.90	31	5	29.0	32.5	24.4	.76	.93	.48	10.6	272.	.728	504.	4.	1.	209.	280.	1.301	.972	.029	.853	.173
34	10	10.90	30	6	28.3	31.3	24.5	.74	.92	.52	5.4	209.	.515	456.	60.	13.	142.	202.	1.472	1.036	.034	1.007	.007
34	10	10.90	31	7	28.7	31.2	24.6	.72	.90	.51	5.3	244.	.676	490.	6.	5.	163.	231.	1.497	1.055	.052	1.071	.066
34	10	10.90	31	8	28.9	32.2	24.9	.67	.90	.49	2.9	228.	.664	478.	80.	8.	148.	225.	1.541	1.014	.014	1.244	.196
34	10	10.90	30	9	29.2	32.9	25.0	.69	.85	.51	3.8	248.	.697	485.	25.	5.	163.	235.	1.521	1.053	.051	1.169	.144
34	10	10.90	31	10	29.7	33.3	25.4	.75	.92	.54	4.9	262.	.706	444.	1.	1.	172.	250.	1.523	1.049	.047	1.020	.019
34	10	10.90	30	11	28.5	31.6	24.5	.76	.92	.55	1.0	192.	.609	357.	159.	10.	102.	177.	1.882	1.085	.078	1.233	.189
STATION AVERAGE					28.4	31.8	24.2	.73	.89	.51	6.5	248.	.689	456.	36.	5.	175.	248.	1.421	1.000	.057	1.000	.104
35	7	10.18	31	1	26.7	32.2	19.0	.68	.91	.42	9.4	192.	.779	81.	17.	2.	135.	195.	1.418	.987	.028	.877	.167
35	7	10.18	28	2	27.0	32.4	19.0	.64	.91	.39	8.4	201.	.785	91.	5.	3.	146.	207.	1.376	.970	.033	.965	.177
35	7	10.18	31	3	28.0	33.3	19.6	.59	.86	.40	10.8	260.	.807	90.	0.	0.	191.	262.	1.359	.990	.024	1.091	.124
35	7	10.18	30	4	28.6	33.5	21.5	.61	.89	.43	10.6	240.	.681	87.	13.	2.	166.	231.	1.448	1.040	.082	1.095	.173
35	7	10.18	31	5	29.0	33.7	22.2	.62	.88	.44	9.2	227.	.639	87.	41.	7.	157.	217.	1.444	1.044	.087	1.057	.202
35	7	10.18	30	6	27.6	31.9	21.6	.73	.91	.51	7.4	170.	.532	108.	123.	15.	90.	160.	1.889	1.065	.065	1.043	.072
35	7	10.18	31	7	27.0	31.7	21.0	.79	.93	.52	6.8	161.	.563	103.	128.	17.	77.	164.	2.077	.983	.074	1.014	.054
35	7	10.18	31	8	26.8	31.9	20.2	.78	.92	.50	6.8	158.	.568	144.	110.	16.	81.	169.	1.955	.937	.069	.978	.044
35	7	10.18	30	9	26.8	34.1	21.2	.78	.93	.50	6.9	166.	.647	286.	136.	14.	86.	172.	1.930	.964	.038	.963	.071
35	7	10.18	31	10	27.7	33.6	20.5	.74	.91	.47	7.7	176.	.676	203.	20.	10.	102.	188.	1.717	.938	.071	.931	.081
35	7	10.18	30	11	27.6	32.8	20.7	.71	.92	.46	7.7	162.	.663	82.	58.	10.	97.	161.	1.663	1.002	.053	.974	.095
35	7	10.18	31	12	27.2	32.7	19.7	.71	.90	.44	7.9	169.	.751	95.	38.	4.	107.	167.	1.572	1.013	.078	.915	.097
STATION AVERAGE					27.6	32.8	20.5	.69	.90	.45	8.5	195.	.683	111.	52.	8.	126.	195.	1.550	1.000	.057	1.000	.122

TABLE 12 DATA AND COMPUTED EVAPORATION AND EVAPOTRANSPIRATION FOR 17 MINISTRY OF DEFENSE STATIONS IN VENEZUELA.

ST	ELEV	TM	TX	W10	HM	HI	SP	VPDMB	PD	EVF	RMD	RSD	EVC	EV/EC	EVPP	EVPS	EVPK	ER/EK	ETR	ETS	ETK	TR/TK
1	7	26.3	32.0	9.1	.75	.46	.72	10.91	1.771	4.330	14.889	8.468	4.329	1.000	5.731	6.473	6.812	.841	4.612	5.208	5.485	.841
2	590	23.0	29.1	15.0	.76	.45	.65	9.47	1.305	3.968	14.857	9.886	3.970	1.000	6.198	7.999	6.512	.952	4.861	6.277	5.115	.950
4	1035	23.6	26.9	12.2	.89	.48	.68	6.71	2.322	2.676	14.793	7.955	2.677	1.000	5.560	5.516	5.731	.970	4.506	4.469	4.653	.968
6	50	27.5	33.1	5.7	.75	.47	.72	10.83	2.863	4.457	14.989	7.448	4.457	1.000	5.332	5.284	6.873	.776	4.367	4.327	5.639	.774
8	20	27.7	33.0	10.5	.74	.48	.72	11.30	.985	6.812	14.846	9.356	6.811	1.000	7.190	8.805	8.874	.810	5.444	6.665	6.719	.810
9	8	26.9	30.5	7.5	.81	.54	.63	7.81	2.662	3.244	14.877	7.378	3.244	1.000	4.957	5.081	6.061	.818	4.105	4.207	5.027	.816
10	7	27.1	30.4	21.7	.92	.64	.76	7.55	1.305	5.311	14.818	7.307	5.309	1.000	6.512	6.204	7.253	.898	5.000	4.766	5.568	.898
11	43	26.7	29.4	7.8	.90	.65	.62	7.50	1.429	2.543	14.863	8.859	2.544	1.000	5.013	6.191	5.625	.891	4.128	5.098	4.636	.890
12	40	23.2	32.8	11.9	.75	.57	.59	11.34	1.472	4.892	14.892	8.111	4.891	1.000	5.975	6.905	7.124	.839	4.712	5.444	5.628	.837
13	442	24.5	31.0	4.5	.76	.45	.70	9.69	2.574	2.606	14.859	7.332	2.606	1.000	4.875	4.597	5.636	.865	4.060	3.832	4.703	.863
14	70	26.1	31.7	10.5	.41	.49	.66	9.40	3.477	5.521	14.904	7.577	5.520	1.000	5.446	5.661	8.096	.673	4.412	4.583	6.543	.674
16	1473	19.0	28.5	8.3	.90	.53	.60	5.58	4.614	2.800	14.852	8.577	2.799	1.000	4.973	5.263	5.787	.859	4.124	4.365	4.806	.858
18	33	27.1	32.4	6.7	.73	.51	.56	10.03	6.399	2.719	15.049	6.535	2.719	1.000	4.793	4.490	5.698	.841	3.952	3.704	4.711	.839
19	404	26.2	31.4	10.7	.61	.45	.53	11.61	1.939	4.842	14.981	6.457	4.842	1.000	5.748	5.300	7.207	.798	4.501	4.148	5.664	.795
20	73	27.0	32.4	10.7	.76	.52	.66	10.16	3.676	5.100	14.990	8.415	5.100	1.000	5.839	6.745	8.140	.717	4.633	5.346	6.421	.721
21	907	22.1	28.6	5.1	.81	.47	.59	7.94	4.262	2.510	15.017	7.270	2.509	1.000	4.471	4.181	5.584	.801	3.778	3.537	4.734	.798
22	190	25.1	31.5	9.3	.82	.59	.57	8.16	3.073	3.735	14.984	7.421	3.733	1.000	4.954	5.144	6.403	.774	4.073	4.231	5.269	.773

TABLE 13-1 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	20.7	.74	13.3	4.7	.55	442.37	66.34	164.28	157.09	.956	133.77	127.91	.956
2	20.9	.72	13.1	5.0	.54	419.44	63.56	162.34	150.33	.926	131.59	121.86	.926
3	21.1	.74	13.6	4.7	.46	482.67	65.10	163.42	161.39	.987	133.07	131.35	.987
4	20.6	.78	14.0	3.9	.37	466.80	56.40	157.14	135.14	.860	129.74	111.57	.860
5	20.6	.79	14.3	3.7	.40	467.79	53.32	154.81	137.96	.891	128.28	114.29	.891
6	20.5	.77	14.1	4.3	.42	441.90	55.20	156.24	137.33	.879	128.36	112.82	.879
7	20.8	.75	13.5	4.6	.49	461.59	66.03	164.07	155.75	.949	133.90	127.12	.949
8	20.9	.74	13.4	4.7	.53	477.40	67.89	165.35	166.81	1.009	134.68	135.87	1.009
9	20.6	.75	13.5	4.4	.47	469.20	65.40	163.63	154.43	.944	133.91	126.38	.944
10	20.1	.79	13.7	3.7	.43	472.75	54.25	155.52	143.29	.921	128.63	118.50	.921
11	20.0	.80	13.9	3.5	.41	434.70	47.10	149.93	127.82	.853	124.55	106.16	.852
12	20.5	.77	13.8	4.0	.50	434.31	55.80	156.69	142.57	.910	129.06	117.42	.910
STATION 31 AVERAGES. ELEVATION = 1360													
	20.6	.76	13.7	4.3	.46	455.91	59.70	159.45	147.48	.925	130.80	120.94	.925
1	19.0	.82	13.4	2.9	.49	426.25	34.72	139.43	125.83	.902	116.93	105.50	.902
2	19.2	.79	13.1	3.5	.50	409.08	39.48	143.60	127.60	.889	119.08	105.80	.888
3	19.9	.77	13.2	3.9	.42	478.02	44.64	147.93	144.28	.975	121.80	118.79	.975
4	20.0	.81	14.2	3.3	.29	469.50	30.00	135.11	117.77	.872	112.65	98.17	.871
5	20.1	.82	14.4	3.2	.34	476.47	31.62	136.61	125.24	.917	114.23	104.69	.917
6	19.8	.83	14.4	3.0	.38	453.00	31.20	136.22	121.89	.895	114.23	102.18	.895
7	19.6	.80	13.8	3.4	.41	471.82	33.79	138.59	135.61	.979	115.31	112.81	.978
8	19.8	.80	13.8	3.5	.45	482.67	35.34	139.98	144.84	1.035	116.20	120.22	1.035
9	20.2	.79	14.0	3.7	.46	468.00	39.00	143.19	143.31	1.001	118.64	118.73	1.001
10	20.1	.81	14.2	3.3	.44	464.39	35.65	140.25	135.73	.968	117.00	113.19	.967
11	19.7	.84	14.4	2.8	.41	420.90	24.60	129.93	115.30	.887	109.34	96.99	.887
12	19.1	.84	13.9	2.7	.43	417.57	25.42	130.73	115.44	.883	110.12	97.19	.883
STATION 32 AVERAGES. ELEVATION = 1235													
	19.7	.81	13.9	3.3	.42	453.14	33.79	138.46	129.40	.935	115.46	107.86	.934

TABLE 13-2 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMOM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	18.6	.84	13.6	2.6	.46	441.13	23.25	128.60	125.87	.979	108.55	106.20	.978
2	18.7	.85	13.6	2.4	.46	418.60	24.36	129.70	117.71	.908	109.81	99.60	.907
3	19.0	.86	14.1	2.4	.42	491.74	26.04	131.34	130.66	.995	111.42	110.78	.994
4	18.8	.88	14.4	1.9	.35	465.90	19.50	124.80	112.20	.899	106.90	96.02	.898
5	18.8	.89	14.5	1.8	.37	466.86	18.91	124.19	113.83	.917	106.58	97.59	.916
6	18.8	.86	14.1	2.4	.42	441.30	22.80	128.15	119.65	.934	108.75	101.48	.933
7	18.8	.81	13.4	3.1	.51	460.97	32.24	137.18	143.12	1.043	114.66	119.60	1.043
8	18.8	.81	13.3	3.2	.55	476.47	31.62	136.61	152.61	1.117	113.99	127.32	1.117
9	18.9	.83	13.7	2.8	.52	468.60	30.00	135.11	142.61	1.056	113.64	119.91	1.055
10	18.6	.88	14.1	2.0	.42	472.13	21.08	126.42	122.82	.972	108.05	104.89	.971
11	18.5	.88	14.3	1.9	.36	434.10	17.40	122.62	104.72	.854	105.20	89.76	.853
12	18.8	.87	14.2	2.1	.41	433.69	19.84	125.15	113.35	.906	106.74	96.60	.905
STATION 33 AVERAGES, ELEVATION = 1495													
	18.8	.85	13.9	2.4	.44	455.12	23.92	129.15	124.93	.967	109.52	105.81	.966
1	17.4	.80	11.8	3.0	.51	453.84	18.29	123.55	142.93	1.157	102.94	119.08	1.157
2	17.5	.76	11.3	3.5	.51	426.44	22.40	127.75	140.02	1.096	105.26	115.39	1.096
3	17.4	.76	11.4	3.6	.45	483.91	17.36	122.58	150.88	1.231	100.96	124.28	1.231
4	17.3	.79	11.7	3.1	.36	461.40	16.20	121.35	128.07	1.055	100.92	106.51	1.055
5	17.5	.78	11.6	3.2	.37	457.25	20.46	125.79	129.81	1.032	104.31	107.65	1.032
6	17.5	.75	11.2	3.7	.44	429.90	28.80	133.98	134.38	1.003	110.05	110.40	1.003
7	17.6	.69	10.5	4.8	.50	450.12	48.67	151.19	157.37	1.041	121.79	126.79	1.041
8	17.9	.64	10.0	5.6	.49	469.65	54.87	155.99	170.01	1.090	124.05	135.21	1.090
9	18.0	.67	10.2	5.0	.49	468.00	48.90	151.37	166.22	1.098	121.39	133.31	1.098
10	17.5	.76	11.1	3.5	.43	478.33	22.94	128.29	147.58	1.150	105.68	121.58	1.151
11	17.1	.80	11.6	2.9	.39	444.90	18.00	123.25	125.24	1.016	102.87	104.53	1.016
12	17.3	.80	12.0	2.9	.46	447.02	15.50	120.61	133.35	1.106	100.80	111.44	1.106
STATION 34 AVERAGES, ELEVATION = 1789													
	17.5	.75	11.2	3.7	.45	455.90	27.70	132.14	143.82	1.088	108.42	118.01	1.089

TABLE 13-3 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMOM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	18.9	.77	12.8	3.8	.60	444.23	50.22	152.41	154.37	1.013	125.72	127.33	1.013
2	19.3	.77	12.9	3.8	.52	420.84	54.60	155.78	140.05	.899	128.34	115.38	.899
3	19.6	.75	12.7	4.2	.45	482.67	56.42	157.15	155.11	.987	128.60	126.94	.987
4	19.1	.80	13.3	3.3	.33	465.30	40.80	144.73	124.72	.862	120.47	103.80	.862
5	19.1	.80	13.5	3.4	.35	465.31	38.44	142.70	128.24	.899	118.53	106.59	.899
6	18.7	.79	13.0	3.4	.38	438.90	40.50	144.47	125.15	.866	119.97	103.92	.866
7	18.8	.74	12.3	4.3	.43	458.49	48.98	151.43	144.47	.954	123.77	118.09	.954
8	19.1	.71	12.0	4.8	.43	475.23	57.35	157.84	154.68	.980	127.88	125.33	.980
9	19.5	.70	11.9	5.2	.42	468.90	60.00	159.79	155.27	.972	128.67	125.05	.972
10	19.3	.76	12.5	3.9	.41	473.99	51.15	153.14	145.08	.947	125.80	119.19	.947
11	18.8	.80	13.2	3.2	.41	436.80	37.50	141.88	126.36	.891	118.31	105.35	.890
12	19.0	.80	13.2	3.3	.52	436.79	48.67	151.19	139.17	.921	125.78	115.77	.920
STATION 35 AVERAGES, ELEVATION = 1525													
	19.1	.77	12.8	3.9	.44	455.62	48.72	151.04	141.06	.934	124.33	116.06	.934
1	19.3	.73	12.3	4.6	.73	409.51	77.19	171.55	152.69	.890	139.51	124.19	.890
2	20.2	.70	12.5	5.3	.74	398.16	82.04	174.64	155.16	.888	140.81	125.11	.889
3	21.0	.72	13.1	5.0	.66	473.06	95.79	183.06	176.57	.965	148.28	143.03	.965
4	21.0	.78	14.3	4.0	.51	472.20	69.90	166.72	151.21	.907	137.58	124.76	.907
5	20.9	.86	15.7	2.7	.44	485.46	46.19	149.20	132.45	.888	126.22	111.97	.887
6	21.0	.85	16.0	2.8	.43	464.70	40.20	144.22	127.86	.887	121.73	107.85	.886
7	21.1	.82	15.6	3.5	.52	482.67	49.60	151.92	149.65	.985	126.76	124.82	.985
8	21.0	.84	15.7	3.0	.52	488.56	44.33	147.68	146.23	.990	124.17	122.89	.990
9	20.8	.86	15.9	2.6	.48	466.20	36.00	140.57	131.16	.933	118.97	110.93	.932
10	20.4	.87	15.8	2.4	.47	454.46	33.48	138.31	123.87	.896	117.68	105.31	.895
11	20.2	.86	15.4	2.6	.54	405.90	33.90	138.69	118.26	.853	117.49	100.12	.852
12	19.9	.80	14.0	3.5	.67	399.59	54.25	155.52	134.95	.868	129.26	112.14	.868
STATION 36 AVERAGES, ELEVATION = 980													
	20.6	.81	14.7	3.5	.56	450.04	55.24	155.17	141.67	.913	129.04	117.76	.913

TABLE 13-4 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	19.7	.81	13.9	3.2	.53	444.23	58.28	158.53	138.29	.872	132.28	115.36	.872
2	20.0	.79	13.8	3.6	.48	420.56	57.68	158.09	130.18	.823	131.03	107.88	.823
3	20.2	.80	13.9	3.4	.43	482.98	62.00	161.23	141.52	.878	134.16	117.73	.878
4	19.9	.83	14.5	2.9	.36	465.90	50.40	152.55	121.91	.799	128.17	102.38	.799
5	20.2	.82	14.6	3.2	.40	465.93	56.11	156.92	129.46	.825	131.28	108.27	.825
6	20.1	.79	14.1	3.7	.45	440.10	59.70	159.57	132.39	.830	132.23	109.70	.830
7	20.1	.77	13.6	4.2	.48	459.73	73.16	168.91	146.36	.867	138.76	120.24	.867
8	20.4	.73	13.3	4.9	.49	476.16	87.73	178.18	159.49	.895	144.85	129.66	.895
9	20.7	.74	13.4	4.7	.46	469.50	86.10	177.18	153.35	.865	144.31	124.91	.866
10	20.1	.81	14.1	3.3	.41	473.99	62.93	161.89	135.30	.836	134.91	112.73	.836
11	19.6	.84	14.5	2.7	.37	436.50	46.50	149.45	113.73	.761	126.01	95.84	.761
12	19.7	.83	14.4	2.9	.43	436.48	51.46	153.38	121.61	.793	128.99	102.23	.793
STATION 37 AVERAGES. ELEVATION = 1200													
	20.1	.80	14.0	3.6	.44	456.00	62.67	161.32	135.30	.839	133.91	112.24	.838
1	18.9	.81	13.1	3.0	.49	460.35	35.96	140.53	142.24	1.012	117.52	118.92	1.012
2	18.9	.78	12.4	3.5	.44	430.64	36.96	141.41	133.70	.945	116.92	110.54	.945
3	18.8	.80	12.8	3.1	.38	485.46	29.76	134.88	138.66	1.028	112.40	115.53	1.028
4	18.8	.83	13.3	2.9	.34	460.20	21.90	127.25	122.35	.961	106.90	102.75	.961
5	19.0	.80	13.1	3.2	.44	453.53	24.49	129.82	137.15	1.056	108.12	114.20	1.056
6	19.1	.75	12.3	4.1	.47	424.80	42.30	145.99	140.36	.961	119.60	114.99	.961
7	19.3	.70	11.6	4.9	.53	445.47	50.22	152.41	161.29	1.058	122.98	130.15	1.058
8	19.5	.66	10.8	5.6	.53	467.17	64.79	163.20	176.09	1.079	130.12	140.41	1.079
9	19.7	.70	11.5	4.8	.49	468.60	50.10	152.32	165.90	1.089	122.93	133.91	1.089
10	19.2	.78	12.4	3.4	.43	482.05	37.82	142.16	148.91	1.047	117.66	123.24	1.047
11	18.6	.82	13.0	2.8	.40	450.90	21.90	127.25	126.70	.996	106.78	106.29	.995
12	18.8	.83	13.5	2.7	.41	454.46	21.39	126.73	128.59	1.015	106.68	108.21	1.014
STATION 38 AVERAGES. ELEVATION = 1700													
	19.0	.77	12.5	3.7	.45	456.97	36.47	140.33	143.49	1.023	115.72	118.26	1.022

TABLE 13-5 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	20.0	.79	14.0	3.8	.43	425.94	41.23	145.09	124.56	.859	120.06	103.06	.858
2	21.0	.78	14.1	4.0	.47	409.36	54.32	155.57	127.77	.821	128.25	105.32	.821
3	21.8	.74	14.0	4.8	.43	478.64	68.20	165.56	152.01	.918	134.80	123.77	.918
4	21.6	.81	15.1	3.6	.28	470.40	48.30	150.89	118.78	.787	125.35	98.64	.787
5	21.7	.79	15.3	4.1	.33	477.71	49.29	151.68	129.85	.856	125.32	107.26	.856
6	21.7	.76	14.8	4.6	.41	454.50	55.50	156.46	139.92	.888	128.20	113.82	.888
7	21.9	.73	14.2	5.3	.50	473.37	70.37	167.04	161.86	.969	135.33	131.13	.969
8	22.2	.72	14.3	5.7	.53	484.22	81.22	174.13	172.21	.989	140.51	138.96	.989
9	22.4	.72	14.4	5.5	.52	468.90	79.20	172.84	164.87	.954	139.76	133.32	.954
10	22.0	.78	14.9	4.1	.47	464.69	64.48	162.98	146.54	.899	134.34	120.77	.899
11	21.3	.83	15.3	3.2	.40	420.90	45.30	148.47	117.11	.789	124.23	97.94	.788
12	21.1	.82	15.1	3.2	.40	417.26	45.88	148.95	116.07	.779	124.57	97.03	.779

STATION 39 AVERAGES, ELEVATION = 1000

	21.6	.77	14.6	4.3	.43	453.82	58.61	158.31	139.21	.879	130.06	114.25	.878

1	17.7	.77	12.2	3.5	.58	435.55	51.46	153.38	148.46	.968	126.87	122.80	.968
2	17.8	.75	11.7	3.9	.54	414.96	56.84	157.46	142.34	.904	129.09	116.70	.904
3	18.2	.77	11.4	3.5	.51	479.88	69.13	166.20	159.15	.958	136.97	131.17	.958
4	18.1	.81	12.2	2.9	.39	466.80	47.70	150.42	131.95	.877	125.69	110.24	.877
5	18.3	.81	12.5	3.0	.36	470.27	44.02	147.42	130.19	.883	123.07	108.66	.883
6	17.9	.80	12.0	3.0	.36	445.20	41.10	144.98	122.84	.847	120.86	102.39	.847
7	17.6	.78	11.4	3.3	.42	464.38	44.02	147.42	139.51	.946	1[illegible].00	115.46	.946
8	17.7	.79	11.5	3.0	.43	478.02	46.19	149.20	142.40	.954	124.17	118.50	.954
9	17.9	.80	11.8	3.0	.39	467.70	44.70	147.98	134.06	.906	123.36	111.75	.906
10	18.1	.81	12.2	2.9	.39	469.03	41.23	145.09	132.49	.913	121.32	110.77	.913
11	17.9	.82	12.3	2.7	.45	429.00	37.50	141.88	126.37	.891	119.07	106.03	.890
12	17.9	.80	12.2	3.0	.54	427.49	45.26	148.44	137.82	.928	123.75	114.88	.928

STATION 41 AVERAGES, ELEVATION = 1754

	17.9	.79	11.9	3.1	.45	454.02	47.43	149.99	137.30	.915	124.68	114.11	.915

TABLE 13-6 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	18.3	.79	12.5	3.4	.47	437.41	41.23	145.09	135.25	.932	120.37	112.19	.932
2	18.6	.79	12.8	3.3	.42	416.36	38.92	143.12	124.05	.867	118.87	103.03	.867
3	18.9	.80	13.0	3.3	.34	480.81	40.30	144.30	131.44	.911	120.11	109.39	.911
4	18.6	.84	13.4	2.5	.29	466.80	32.10	137.05	112.52	.821	115.77	95.00	.821
5	18.8	.85	13.7	2.5	.31	469.34	31.31	136.32	115.85	.850	115.36	97.98	.849
6	18.7	.83	13.4	2.7	.40	444.00	34.50	139.23	123.53	.887	117.10	103.86	.887
7	18.3	.80	13.0	3.2	.49	463.45	39.37	143.51	143.53	1.000	119.64	119.64	1.000
8	18.5	.82	13.0	2.9	.50	477.71	38.75	142.97	146.72	1.026	119.79	122.90	1.026
9	18.3	.83	13.1	2.7	.45	468.00	35.70	140.30	135.50	.966	117.99	113.92	.965
10	18.2	.84	13.1	2.5	.39	469.96	31.93	136.89	126.94	.927	115.62	107.17	.927
11	18.1	.84	13.3	2.5	.38	430.50	28.50	133.69	115.27	.862	112.86	97.26	.862
12	18.4	.83	13.1	2.8	.40	429.35	32.24	137.18	118.96	.867	115.27	99.93	.867
STATION 42 AVERAGES. ELEVATION = 1630													
	18.5	.82	13.1	2.9	.40	454.47	35.40	139.97	127.46	.911	117.40	106.86	.910
1	19.2	.83	13.8	2.8	.41	439.89	34.72	139.43	127.23	.913	117.18	106.89	.912
2	19.6	.79	13.8	3.6	.40	417.76	33.60	138.42	126.73	.916	114.79	105.08	.915
3	19.8	.81	14.0	3.3	.35	481.74	37.51	141.89	136.71	.963	118.34	113.99	.963
4	19.6	.83	14.2	2.8	.31	466.80	34.20	138.96	121.50	.874	116.88	102.15	.874
5	19.9	.82	14.3	3.1	.33	468.72	33.48	138.31	127.66	.923	115.80	106.85	.923
6	19.9	.81	14.0	3.3	.37	443.10	35.40	140.03	128.83	.920	116.69	107.33	.920
7	19.9	.78	13.6	3.9	.43	462.52	45.88	148.95	148.13	.995	122.91	122.23	.994
8	19.8	.79	13.6	3.7	.48	477.40	45.26	148.44	156.67	1.055	122.87	129.66	1.055
9	19.9	.79	13.6	3.6	.45	468.90	42.00	145.74	149.40	1.025	120.81	123.82	1.025
10	19.5	.82	13.7	3.0	.37	471.51	33.17	138.03	133.76	.969	115.56	111.95	.969
11	19.4	.84	14.0	2.6	.33	432.90	27.90	133.12	113.91	.856	112.31	96.06	.855
12	19.4	.83	14.0	2.8	.36	431.83	30.38	135.46	118.71	.876	113.97	99.83	.876
STATION 43 AVERAGES. ELEVATION = 1870													
	19.7	.81	13.9	3.2	.38	455.26	36.12	140.56	132.44	.942	117.34	110.49	.942

TABLE 13-7 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	21.4	.79	15.3	4.0	.50	430.90	49.29	151.68	138.97	.916	125.50	114.96	.916
2	22.2	.79	15.7	4.1	.48	412.72	49.28	151.67	133.57	.881	125.34	110.36	.880
3	22.7	.79	16.1	4.4	.42	480.19	46.19	149.20	149.50	1.002	122.97	123.20	1.002
4	22.1	.83	16.2	3.4	.33	469.80	37.50	141.88	125.42	.884	118.62	104.81	.884
5	22.1	.82	16.3	3.6	.36	475.54	37.20	141.62	132.51	.936	118.11	110.48	.935
6	21.6	.82	16.4	3.5	.34	451.20	33.60	138.42	121.58	.878	115.72	101.60	.878
7	21.7	.79	16.2	4.3	.41	470.27	41.54	145.35	142.50	.980	120.09	117.72	.980
8	21.6	.80	16.1	4.0	.45	482.36	39.37	143.51	148.25	1.033	118.97	122.88	1.033
9	21.5	.83	16.1	3.3	.43	468.90	36.30	140.83	136.84	.972	117.96	114.56	.971
10	21.2	.85	16.2	2.9	.41	466.86	30.69	135.75	128.52	.947	114.54	108.38	.946
11	21.3	.85	16.5	2.9	.41	424.80	28.20	133.41	116.85	.876	112.55	98.52	.875
12	21.6	.81	16.2	3.7	.47	422.22	35.96	140.53	130.32	.927	117.01	108.48	.927
STATION 44 AVERAGES. ELEVATION = 1200													
	21.7	.81	16.1	3.7	.42	454.65	38.76	142.82	133.74	.936	118.95	111.33	.936
1	21.0	.77	14.2	4.4	.56	442.06	51.77	153.62	154.97	1.009	126.04	127.14	1.009
2	20.9	.77	13.8	4.2	.50	419.44	52.08	153.86	144.89	.942	126.37	119.00	.942
3	21.1	.78	14.2	4.0	.49	432.67	54.25	155.52	158.88	1.022	128.19	130.95	1.022
4	20.5	.82	14.6	3.1	.41	466.80	43.50	146.99	134.28	.914	122.96	112.29	.913
5	20.6	.82	14.8	3.1	.39	468.10	43.40	146.91	132.48	.902	123.00	110.88	.901
6	20.8	.81	14.6	3.5	.44	442.50	44.70	147.98	134.75	.911	123.11	112.08	.910
7	20.7	.77	14.0	4.1	.51	461.90	52.39	154.10	154.14	1.000	126.89	126.92	1.000
8	20.8	.77	13.9	4.2	.52	477.40	54.56	155.75	161.65	1.038	127.91	132.74	1.038
9	20.6	.79	14.0	4.0	.47	469.20	53.40	154.87	151.29	.977	127.63	124.67	.977
10	20.2	.81	14.2	3.3	.43	472.75	48.36	150.94	140.62	.932	125.81	117.18	.931
11	19.9	.81	14.1	3.2	.41	434.40	42.90	146.49	124.89	.853	122.37	104.29	.852
12	20.6	.79	14.3	3.8	.47	434.00	49.29	151.68	137.95	.909	125.52	114.14	.909
STATION 45 AVERAGES. ELEVATION = 1400													
	20.6	.79	14.2	3.7	.47	455.93	49.22	151.56	144.23	.952	125.48	119.36	.951

TABLE 13-8 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	19.4	.79	13.3	3.4	.53	442.37	43.09	146.65	146.95	1.002	121.78	122.01	1.002
2	18.8	.77	13.0	4.0	.48	419.16	38.08	142.39	136.21	.957	117.28	112.19	.957
3	19.5	.76	13.0	4.1	.50	482.05	41.54	145.35	162.52	1.118	119.33	133.43	1.118
4	18.6	.83	13.3	2.6	.35	465.60	27.90	133.12	123.39	.927	112.18	103.93	.926
5	18.8	.80	13.1	3.3	.39	466.55	29.76	134.88	135.58	1.005	112.21	112.78	1.005
6	18.8	.77	12.6	3.7	.40	440.70	33.90	138.69	132.55	.956	114.41	109.35	.956
7	18.9	.73	12.2	4.5	.46	460.35	39.37	143.51	153.04	1.066	116.85	124.62	1.067
8	18.9	.72	12.0	4.7	.48	476.16	44.33	147.68	162.94	1.103	119.89	132.30	1.104
9	19.1	.72	12.0	4.7	.46	468.60	46.50	149.45	158.65	1.062	121.29	128.77	1.062
10	18.8	.81	12.6	3.0	.45	472.75	39.68	143.77	143.23	.996	120.09	119.61	.996
11	18.3	.85	13.2	2.3	.39	434.70	30.00	135.11	116.09	.859	114.58	98.40	.859
12	18.6	.85	13.4	2.4	.40	434.31	28.83	134.01	118.59	.885	113.51	100.40	.884
STATION 46 AVERAGES, ELEVATION = 1726													
	18.9	.78	12.8	3.6	.44	455.27	36.91	141.22	140.81	.997	116.95	116.48	.996
1	19.4	.80	13.5	3.4	.42	444.85	37.82	142.16	131.87	.928	118.17	109.59	.927
2	19.5	.79	13.3	3.6	.46	421.12	38.08	142.39	131.33	.922	117.95	108.78	.922
3	19.9	.79	13.7	3.6	.42	482.99	41.23	145.09	146.44	1.009	120.27	121.37	1.009
4	19.1	.83	13.7	2.8	.27	465.30	30.90	135.94	112.38	.827	114.35	94.49	.826
5	19.3	.82	13.9	3.0	.39	465.00	32.55	137.46	129.17	.940	115.27	108.29	.939
6	19.4	.82	13.8	3.0	.38	438.90	33.30	138.14	121.61	.880	115.67	101.80	.880
7	19.6	.78	13.4	3.7	.44	458.80	40.61	144.57	142.31	.984	119.50	117.63	.984
8	19.5	.77	13.2	3.9	.46	475.23	43.71	147.17	151.43	1.029	121.20	124.71	1.029
9	19.5	.78	13.3	3.7	.40	468.90	41.40	145.24	140.26	.966	120.07	115.95	.966
10	19.1	.82	13.3	3.0	.36	473.99	36.27	140.80	129.14	.917	117.79	108.01	.917
11	18.7	.83	13.4	2.7	.30	437.10	29.40	134.54	107.98	.803	113.32	90.91	.802
12	19.0	.83	13.7	2.8	.33	437.41	32.24	137.18	112.44	.820	115.40	94.56	.819
STATION 47 AVERAGES, ELEVATION = 1550													
	19.3	.81	13.5	3.3	.39	455.80	36.46	140.89	129.70	.921	117.41	108.01	.920

TABLE 13-9 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVFM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	20.0	.81	14.0	3.4	.48	448.57	48.98	151.43	142.26	.939	126.09	118.43	.939
2	20.3	.81	14.0	3.4	.51	423.64	50.12	152.33	137.67	.904	126.78	114.55	.904
3	20.4	.81	14.1	3.3	.51	483.91	56.11	156.92	157.63	1.005	130.67	131.23	1.004
4	19.8	.83	14.2	2.8	.38	464.40	44.40	147.74	129.58	.877	124.22	108.91	.877
5	19.8	.84	14.4	2.7	.39	462.83	40.30	144.30	129.29	.896	121.59	108.89	.896
6	19.5	.84	14.1	2.8	.41	436.20	37.50	141.88	124.15	.875	119.44	104.46	.875
7	19.5	.82	13.9	3.1	.45	456.01	41.54	145.35	136.88	.942	121.61	114.48	.941
8	19.4	.81	13.8	3.2	.47	473.68	44.64	147.93	145.89	.986	123.62	121.88	.986
9	19.6	.82	14.0	3.0	.46	468.90	42.60	146.24	142.29	.973	122.50	119.15	.973
10	19.4	.83	14.1	2.9	.43	476.16	39.06	143.24	137.88	.963	120.43	115.88	.962
11	19.4	.84	14.3	2.7	.37	440.40	33.60	138.42	118.86	.859	116.78	100.23	.858
12	19.7	.84	14.4	2.8	.43	441.44	39.37	143.51	127.63	.889	120.77	107.36	.889
STATION 48 AVERAGES, ELEVATION = 1670													
	19.7	.82	14.1	3.0	.44	456.34	43.18	146.61	135.83	.927	122.88	113.79	.926
1	20.2	.70	14.1	5.9	.47	449.19	46.19	149.20	157.18	1.053	120.36	126.81	1.054
2	21.2	.63	12.8	7.4	.57	424.20	80.36	173.58	171.45	.988	137.18	135.50	.988
3	21.7	.64	12.7	7.1	.55	484.53	88.35	178.56	194.27	1.088	141.20	153.62	1.088
4	20.8	.80	13.7	3.5	.39	464.70	57.00	157.58	138.96	.882	130.67	115.20	.882
5	21.0	.73	13.5	5.1	.41	463.14	68.51	165.78	152.41	.919	134.44	123.60	.919
6	21.0	.65	12.7	6.8	.47	436.20	96.90	183.72	161.54	.879	145.81	128.21	.879
7	21.2	.61	12.0	7.7	.53	456.32	132.99	204.88	182.03	.888	160.90	142.96	.888
8	21.3	.61	11.6	7.3	.53	473.99	120.90	197.74	189.11	.956	155.39	148.60	.956
9	21.7	.60	11.8	7.7	.54	469.80	112.20	192.68	190.88	.991	150.96	149.53	.991
10	21.3	.69	12.7	5.7	.48	477.09	79.67	173.14	172.92	.999	138.85	138.68	.999
11	20.6	.81	13.8	3.2	.44	441.30	44.10	147.49	134.65	.913	122.86	112.14	.913
12	20.4	.77	14.1	4.1	.46	442.37	33.17	138.03	143.13	1.037	113.63	117.82	1.037
STATION 49 AVERAGES, ELEVATION = 1590													
	21.0	.69	13.0	6.0	.49	456.90	80.03	171.86	165.71	.964	137.69	132.72	.964

TABLE 13-10 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS FOR 20 COLOMBIAN STATIONS

MO	TM	HM	VP	VPD	S	RMDM	EVPM	EVPK	EVPR	EPR/EPK	ETK	ETC	ETC/ETK
1	19.9	.78	13.4	3.7	.49	448.57	58.28	158.53	144.71	.913	131.07	119.63	.913
2	19.9	.74	12.8	4.5	.42	423.36	58.88	166.03	135.17	.814	135.39	110.23	.814
3	20.3	.74	12.9	4.5	.37	483.91	72.23	168.29	148.59	.883	137.07	121.03	.883
4	19.6	.79	13.2	3.5	.25	464.40	51.60	153.49	115.56	.753	127.21	95.75	.753
5	19.4	.80	13.2	3.4	.30	462.83	51.15	153.14	121.31	.792	127.20	100.75	.792
6	19.0	.80	13.1	3.2	.30	435.90	47.70	150.42	111.84	.744	125.35	93.19	.743
7	18.8	.77	12.7	3.8	.33	455.70	49.29	151.68	126.65	.835	124.97	104.35	.835
8	18.9	.75	12.5	4.1	.36	473.37	57.04	157.61	138.45	.878	129.19	113.49	.878
9	19.4	.74	12.7	4.4	.34	468.90	60.30	160.00	136.40	.852	130.65	111.39	.853
10	19.6	.77	13.0	3.9	.34	476.16	59.21	159.21	135.30	.850	131.02	111.34	.850
11	19.1	.81	13.3	3.2	.29	440.10	44.70	147.98	111.48	.753	123.47	92.99	.753
12	19.3	.81	13.5	3.2	.32	441.13	47.74	150.45	116.31	.773	125.57	97.06	.773
STATION 50 AVERAGES, ELEVATION = 1500													
	19.4	.77	13.0	3.8	.34	456.19	55.68	156.40	128.48	.821	129.01	105.94	.821
1	18.6	.83	13.2	2.6	.43	454.77	36.58	141.08	130.65	.926	118.84	110.01	.926
2	18.8	.81	13.1	3.1	.45	427.00	37.52	141.90	128.76	.907	118.53	107.53	.907
3	19.0	.81	13.3	3.1	.38	484.53	39.37	143.51	136.99	.955	119.91	114.44	.954
4	18.5	.84	13.3	2.5	.32	462.00	32.40	137.32	116.44	.848	116.10	98.40	.848
5	18.4	.82	13.0	2.8	.37	457.56	37.51	141.89	125.29	.883	119.07	105.11	.883
6	18.3	.78	12.2	3.4	.41	429.90	46.80	149.69	128.19	.856	123.98	106.17	.856
7	18.3	.71	11.4	4.6	.47	449.81	67.59	165.14	152.00	.920	133.79	123.17	.921
8	18.4	.69	10.9	5.0	.47	469.65	75.95	170.74	162.69	.953	137.37	130.91	.953
9	18.3	.72	11.2	4.3	.42	468.30	69.00	166.11	150.02	.903	135.13	122.06	.903
10	18.0	.82	12.2	2.6	.39	478.64	49.60	151.92	131.92	.868	127.55	110.82	.868
11	17.6	.85	12.8	2.3	.34	445.50	32.40	137.32	112.20	.817	116.50	95.14	.817
12	17.9	.87	13.3	2.1	.36	447.64	27.28	132.53	112.52	.849	113.02	95.89	.848
STATION 51 AVERAGES, ELEVATION = 1750													
	18.3	.80	12.5	3.2	.40	456.27	46.00	148.26	132.31	.892	123.32	109.97	.892
OVERALL AVERAGES													
	19.6	.79	13.5	3.6	.44	455.18	45.60	147.78	137.72	.932	122.42	114.01	.933

TABLE 14-1 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	PM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	23.8	.80	16.8	4.4	.00	11.0	453.55	80.04	89.21	150.83	173.38	179.09	.870	.842	143.28	148.00	124.62	.870	.842
2	23.8	.81	16.6	4.2	.00	10.0	427.02	68.37	79.50	140.22	165.68	173.03	.846	.810	137.38	143.47	116.23	.846	.810
3	24.0	.81	17.5	4.2	.00	13.0	486.23	77.67	85.11	160.33	171.86	176.57	.933	.908	142.46	145.36	132.86	.933	.908
4	23.8	.80	16.9	4.4	.00	14.0	465.31	77.46	82.39	154.74	171.72	174.86	.901	.885	141.91	144.51	127.85	.901	.885
5	23.9	.82	17.0	4.0	.00	14.0	462.34	72.27	80.81	150.14	168.31	173.87	.892	.864	140.01	144.63	124.84	.892	.863
6	23.9	.81	17.0	4.2	.00	8.0	435.04	74.20	88.28	143.14	159.60	178.52	.844	.802	140.60	149.00	118.63	.844	.802
7	23.8	.78	16.5	4.9	.00	9.0	455.09	88.75	98.44	155.01	178.81	184.63	.867	.840	146.81	151.59	127.25	.867	.839
8	25.1	.76	16.5	5.7	.00	6.0	474.41	114.74	115.18	169.58	194.15	194.41	.873	.872	158.11	158.32	138.09	.873	.872
9	24.7	.74	16.0	6.1	.00	8.0	471.18	115.09	110.87	170.56	194.35	191.87	.878	.889	157.39	155.38	138.12	.878	.889
10	23.9	.75	15.4	5.6	.00	15.0	479.80	103.12	94.13	169.20	187.39	182.10	.903	.929	152.39	148.08	137.59	.903	.929
11	23.0	.79	15.0	4.6	.00	20.0	444.77	77.33	74.66	149.09	171.64	169.90	.869	.878	141.08	139.66	122.54	.869	.877
12	24.0	.79	16.6	4.7	.00	18.0	446.74	86.60	82.94	150.99	177.49	175.21	.851	.862	146.16	144.29	124.31	.851	.862
STATION 61 AVERAGES																			
	24.0	.79	16.6	4.8	.00	12.2	458.46	86.30	90.13	155.32	177.03	179.50	.877	.865	145.63	147.69	127.74	.877	.865
1	21.2	.73	13.3	5.1	.63	10.0	445.05	77.76	92.01	167.17	171.91	180.79	.972	.925	139.50	146.70	135.66	.972	.925
2	21.2	.73	13.4	5.1	.55	11.0	421.37	70.23	76.82	150.56	166.95	171.30	.902	.879	135.47	139.01	122.17	.902	.879
3	21.6	.73	13.9	5.2	.49	15.0	483.57	82.29	78.55	167.29	174.80	172.42	.957	.970	141.76	139.83	135.67	.957	.970
4	20.7	.79	14.3	3.8	.34	23.0	466.07	53.24	46.46	129.90	154.75	149.42	.833	.863	128.04	123.63	106.64	.833	.863
5	21.4	.77	14.6	4.4	.41	18.0	466.34	67.27	62.36	143.72	164.93	161.49	.871	.890	135.45	132.63	118.03	.871	.890
6	21.3	.76	14.2	4.6	.48	14.0	440.17	67.22	69.91	145.57	164.89	166.73	.883	.873	135.01	136.52	119.19	.883	.873
7	21.4	.73	13.5	5.2	.53	15.0	459.92	80.00	78.67	163.09	173.35	172.50	.941	.945	140.63	139.94	132.31	.941	.945
8	21.6	.73	13.7	5.2	.53	14.0	476.38	82.29	82.17	169.06	174.80	174.72	.967	.968	141.76	141.70	137.11	.967	.968
9	21.3	.74	13.8	4.9	.44	15.0	469.65	73.29	69.50	157.28	168.99	166.45	.907	.921	137.52	135.46	124.74	.907	.921
10	20.8	.77	14.1	4.2	.46	20.0	474.57	61.68	60.33	151.31	161.00	160.03	.940	.946	132.34	131.54	124.37	.940	.945
11	20.2	.81	14.3	3.4	.41	23.0	437.08	44.19	45.04	125.04	147.57	148.26	.847	.843	123.00	123.58	104.20	.847	.843
12	20.9	.79	14.3	3.9	.51	14.0	437.42	56.66	66.57	141.85	157.33	164.44	.902	.863	130.14	136.02	117.32	.901	.862
STATION 62 AVERAGES																			
	21.1	.76	13.9	4.6	.48	16.1	456.47	68.01	69.03	150.57	165.11	165.71	.912	.909	135.05	135.55	123.12	.912	.908

TABLE 14-2 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	24.0	.69	15.9	6.9	.40	10.0	450.99	131.21	107.94	165.59	203.81	190.20	.812	.871	162.82	151.95	132.28	.812	.871
2	24.1	.69	15.4	7.0	.47	10.0	425.50	120.02	96.45	154.13	197.22	183.45	.782	.840	157.53	146.53	123.11	.782	.840
3	24.3	.70	16.0	6.9	.45	10.0	485.87	131.64	104.19	172.31	204.05	188.01	.844	.916	163.41	150.56	137.98	.844	.916
4	24.0	.72	16.4	6.3	.38	13.0	465.20	114.02	83.17	147.62	193.74	175.36	.762	.842	156.11	141.30	118.95	.762	.842
5	23.7	.71	16.0	6.4	.36	12.0	464.13	117.39	87.93	148.32	195.87	178.31	.757	.832	157.43	143.32	119.21	.757	.832
6	23.3	.71	15.4	6.2	.40	10.0	437.06	109.15	88.78	144.11	190.33	178.83	.757	.806	153.07	143.82	115.90	.757	.806
7	23.7	.67	15.0	7.2	.50	7.0	457.20	134.89	115.78	170.95	206.02	194.76	.829	.877	163.74	154.79	135.79	.829	.877
8	23.7	.65	15.0	7.7	.49	6.0	475.10	143.48	120.17	178.30	211.30	197.27	.844	.904	167.04	155.95	140.95	.844	.904
9	24.1	.67	15.3	7.4	.45	8.0	479.44	137.33	108.29	170.22	207.50	190.40	.820	.894	164.83	151.24	135.21	.820	.894
10	23.5	.72	15.6	6.1	.42	15.0	478.26	110.51	85.61	159.51	191.69	176.88	.832	.902	154.58	142.63	128.62	.832	.902
11	23.5	.74	15.8	5.6	.43	17.1	442.64	98.33	77.58	146.31	184.86	171.80	.791	.852	149.96	139.36	118.68	.791	.852
12	23.6	.72	15.7	6.1	.42	13.0	443.68	111.94	88.62	147.71	192.53	178.73	.767	.826	155.23	144.10	119.09	.767	.826
STATION 63 AVERAGES																			
	23.8	.70	15.6	6.6	.44	10.9	458.13	121.64	97.04	158.75	198.24	183.67	.801	.864	158.81	147.13	127.15	.801	.864
1	28.3	.67	19.1	9.5	.00	3.0	446.02	232.54	171.31	170.03	291.23	230.29	.584	.738	230.00	181.87	134.29	.584	.738
2	27.9	.66	18.4	9.6	.00	5.0	422.77	207.26	148.05	161.08	261.89	214.20	.615	.752	206.38	168.80	126.94	.615	.752
3	28.3	.66	18.9	9.9	.00	5.0	486.16	234.86	169.57	186.73	301.10	228.99	.620	.815	237.15	180.36	147.08	.620	.815
4	28.0	.63	19.0	9.1	.00	10.0	469.81	210.83	145.21	176.64	265.63	212.39	.665	.832	210.44	168.26	139.94	.665	.832
5	27.3	.72	19.6	7.6	.00	12.0	470.28	175.14	129.98	168.45	233.21	203.08	.722	.829	187.06	162.89	135.11	.722	.829
6	27.6	.69	19.5	8.6	.00	9.0	444.43	195.04	143.91	169.41	250.00	211.57	.658	.777	198.72	168.17	130.69	.658	.777
7	27.9	.63	18.0	10.4	.00	6.0	464.30	250.49	172.10	180.64	316.67	230.89	.570	.782	247.60	180.53	141.24	.570	.782
8	28.3	.63	18.1	10.7	.00	6.0	480.32	261.82	175.54	188.39	335.00	233.52	.562	.807	251.80	182.49	147.22	.562	.807
9	27.9	.66	18.5	9.6	.00	7.0	472.53	222.06	156.39	180.04	278.22	219.68	.647	.820	219.25	173.12	141.88	.647	.820
10	27.1	.72	19.3	7.5	.00	11.0	476.32	171.18	130.63	169.92	230.19	203.46	.738	.835	184.69	163.24	136.33	.738	.835
11	27.3	.70	19.4	8.2	.00	7.0	433.22	182.19	141.07	159.78	238.83	209.80	.669	.762	190.46	167.30	127.42	.669	.762
12	27.6	.69	19.2	8.6	.00	4.0	439.10	201.54	157.37	162.03	256.16	220.34	.633	.735	203.62	175.15	128.80	.633	.735
STATION 64 AVERAGES																			
	27.8	.68	18.9	9.1	.00	7.1	459.10	212.50	153.43	172.34	271.51	218.18	.635	.790	214.76	172.68	136.41	.635	.790

TABLE 14-3 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMC	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	19.9	.81	13.4	3.3	.00	15.0	443.86	43.61	61.46	139.65	147.08	160.84	.949	.868	122.65	134.12	116.42	.949	.868
2	20.2	.81	13.7	3.4	.00	15.0	427.57	41.25	56.39	133.10	145.11	157.51	.917	.845	120.95	131.28	110.91	.917	.845
3	20.6	.81	13.8	3.5	.00	16.0	482.96	48.51	53.98	154.05	151.06	162.63	1.020	.947	125.84	135.48	128.30	1.020	.947
4	19.9	.84	14.1	2.8	.00	20.0	465.69	34.73	49.78	140.70	139.44	152.07	1.009	.925	117.47	128.11	118.47	1.009	.925
5	20.1	.83	14.0	3.0	.00	21.0	466.20	39.68	53.07	143.36	143.77	154.62	.997	.927	120.67	129.77	120.28	.997	.927
6	19.9	.83	13.9	3.0	.00	15.0	440.12	37.22	55.05	134.81	141.64	156.13	.952	.863	118.92	131.08	113.14	.951	.863
7	20.1	.81	13.9	3.4	.00	17.0	459.86	44.97	60.45	145.25	148.21	160.11	.980	.907	123.55	133.48	121.06	.980	.907
8	20.6	.77	13.4	4.2	.00	13.0	476.23	59.89	74.79	159.36	159.71	169.96	.998	.938	131.32	139.76	131.03	.998	.937
9	20.0	.81	13.5	3.3	.00	17.0	469.06	42.86	58.02	147.87	146.46	158.34	1.010	.934	122.11	132.02	123.26	1.009	.934
10	19.8	.83	13.7	2.9	.00	23.0	473.78	37.87	49.90	144.84	142.20	152.16	1.019	.952	119.41	127.77	121.57	1.018	.951
11	19.5	.84	13.6	2.7	.00	25.0	436.21	32.60	43.88	130.71	137.51	147.30	.951	.887	115.92	124.17	110.13	.950	.887
12	19.6	.83	13.6	2.9	.00	23.0	436.18	36.59	49.07	132.82	141.17	151.50	.941	.877	118.58	127.25	111.52	.940	.876
STATION 65 AVERAGES																			
	20.0	.82	13.7	3.2	.00	18.4	455.91	41.66	56.36	142.21	145.28	156.93	.979	.906	121.45	131.19	118.84	.979	.906
1	19.1	.78	13.9	3.6	.00	19.0	454.63	45.25	58.25	149.41	148.43	158.51	1.007	.943	122.71	131.04	123.51	1.007	.943
2	19.3	.76	13.1	4.0	.00	15.0	427.11	46.44	60.19	144.08	149.40	159.92	.964	.901	122.70	131.34	118.33	.964	.901
3	19.5	.77	13.4	3.9	.00	22.0	484.84	50.64	58.66	162.41	152.74	158.81	1.063	1.023	125.80	130.79	133.76	1.063	1.023
4	19.7	.77	13.7	4.0	.00	20.0	462.54	50.57	59.86	155.55	152.68	159.68	1.019	.974	125.71	131.47	128.07	1.019	.974
5	19.2	.78	13.6	3.7	.00	20.0	458.06	45.98	57.75	150.83	149.03	158.14	1.012	.954	123.18	130.71	124.67	1.012	.954
6	18.9	.75	12.9	4.1	.00	17.0	439.29	48.80	61.64	145.55	151.30	160.97	.962	.904	123.94	131.87	119.24	.962	.904
7	19.1	.69	12.2	5.1	.00	13.0	450.51	65.76	78.42	161.71	163.88	172.34	.987	.938	131.85	138.66	130.13	.987	.938
8	19.3	.62	11.8	6.4	.00	11.0	470.24	84.31	97.59	178.29	176.07	181.14	1.013	.984	139.01	143.02	140.77	1.013	.984
9	19.3	.65	11.9	5.9	.00	13.0	469.71	74.77	82.87	174.17	169.97	175.17	1.025	.994	135.23	139.37	138.58	1.025	.994
10	19.1	.76	12.8	4.0	.00	24.0	479.18	49.80	55.91	161.02	152.08	156.77	1.059	1.027	124.94	128.79	132.28	1.059	1.027
11	18.9	.79	13.1	3.4	.00	25.0	445.78	40.25	48.31	144.23	144.26	150.30	1.000	.956	119.69	125.20	119.65	1.000	.956
12	19.2	.77	12.9	3.8	.00	24.0	448.08	48.29	55.05	149.22	150.39	156.13	.989	.956	124.33	128.64	122.95	.989	.956
STATION 66 AVERAGES																			
	19.2	.74	12.9	4.3	.00	18.6	456.66	54.24	64.13	156.37	155.06	162.37	1.008	.963	126.59	132.57	127.66	1.008	.963

TABLE 14-4 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMC	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKC	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	16.6	.73	10.8	3.0	.58	14.0	433.48	27.72	47.14	149.60	132.95	149.97	1.118	.991	110.69	124.85	123.72	1.118	.991
2	16.7	.74	10.8	3.0	.51	15.0	417.23	25.52	39.94	134.48	130.83	143.99	1.028	.934	108.91	119.86	111.95	1.028	.934
3	16.7	.78	10.9	3.1	.44	13.0	480.47	29.78	40.18	148.80	134.90	144.18	1.103	1.032	111.93	119.63	123.47	1.103	1.032
4	16.3	.82	11.3	2.5	.31	24.0	465.07	21.19	26.79	119.53	126.53	132.06	.945	.905	106.45	111.10	100.54	.945	.905
5	16.6	.82	11.3	2.5	.35	23.0	466.62	23.22	30.33	125.77	128.57	135.42	.978	.929	108.12	113.87	105.74	.978	.929
6	16.4	.81	11.1	2.7	.37	21.0	441.06	23.01	31.33	122.84	128.36	136.34	.957	.901	107.61	114.30	102.97	.957	.901
7	16.6	.77	10.6	3.3	.46	19.0	469.61	30.72	41.94	145.70	135.78	145.69	1.073	1.000	112.32	120.52	120.54	1.073	1.000
8	16.7	.76	10.5	3.4	.49	19.0	475.81	32.84	43.80	156.01	137.72	147.24	1.133	1.060	113.55	121.40	128.64	1.133	1.060
9	16.3	.78	10.6	3.1	.43	21.0	467.34	25.68	35.47	142.33	131.96	140.10	1.079	1.016	109.56	116.32	118.18	1.079	1.016
10	15.9	.82	10.8	2.4	.40	26.0	470.45	20.20	27.46	130.77	125.52	132.70	1.042	.985	105.67	111.71	110.07	1.042	.985
11	16.0	.82	10.9	2.5	.40	23.0	432.13	19.96	28.67	120.80	125.27	133.79	.964	.903	105.44	112.61	101.66	.964	.903
12	16.5	.81	11.0	2.7	.51	17.0	431.67	24.25	39.71	135.73	129.59	143.80	1.047	.944	108.62	120.53	113.76	1.047	.944
STATION 67 AVERAGES																			
	16.4	.80	10.9	2.8	.44	20.0	454.00	25.43	36.05	135.95	130.67	140.44	1.040	.968	109.07	117.22	113.44	1.040	.968
1	20.6	.72	12.8	5.1	.58	16.0	425.01	74.12	78.50	157.27	159.54	172.39	.928	.912	137.29	139.53	127.36	.928	.912
2	21.1	.70	12.8	5.6	.57	16.0	408.57	77.51	76.26	154.63	171.75	170.94	.901	.905	138.17	137.52	124.45	.901	.905
3	21.2	.72	13.1	5.3	.52	18.0	477.99	80.85	75.75	171.91	173.89	170.61	.989	1.008	140.69	138.03	139.09	.989	1.008
4	20.9	.77	13.8	4.3	.39	22.0	470.34	60.57	53.38	143.98	150.20	154.86	.899	.930	131.67	127.27	118.33	.899	.930
5	20.8	.79	14.0	4.1	.45	23.0	477.96	59.76	54.97	151.20	158.88	155.99	.952	.969	131.02	128.63	124.67	.952	.969
6	20.8	.78	14.0	4.1	.51	20.0	454.79	56.86	59.52	151.98	157.48	159.43	.965	.953	129.86	131.47	125.32	.965	.953
7	20.9	.77	13.8	4.3	.60	19.0	473.62	62.59	69.60	173.33	161.65	166.52	1.054	1.023	132.85	136.86	139.98	1.054	1.023
8	21.0	.73	13.3	5.0	.61	19.0	483.94	75.56	77.40	182.57	170.48	171.68	1.071	1.063	138.38	139.35	148.20	1.071	1.063
9	20.5	.75	13.5	4.3	.51	20.0	468.01	59.82	51.15	159.07	159.66	160.61	.996	.990	130.88	131.67	130.40	.996	.990
10	19.9	.80	13.7	3.5	.42	24.0	463.21	46.18	46.53	137.85	149.19	149.48	.924	.922	123.99	124.23	114.55	.924	.922
11	20.1	.80	13.9	3.5	.43	22.0	419.41	46.08	47.81	126.06	149.11	150.50	.845	.838	123.89	125.05	104.72	.845	.837
12	20.3	.78	13.7	3.9	.48	19.0	415.84	54.54	58.26	133.68	155.74	158.51	.858	.843	128.52	130.81	110.31	.858	.843
STATION 68 AVERAGES																			
	20.7	.76	13.5	4.4	.51	19.8	453.22	62.79	63.25	153.38	161.46	161.79	.950	.948	132.27	132.54	125.62	.950	.948

TABLE 14-5 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	PM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	21.0	.64	12.9	6.7	.00	9.0	434.52	102.55	177.35	164.02	167.11	190.15	.877	.853	148.11	156.52	129.83	.877	.863
2	21.6	.66	12.9	6.6	.00	9.0	414.93	95.01	97.14	156.22	182.59	183.86	.856	.850	145.17	146.18	124.20	.856	.850
3	21.6	.66	12.6	6.6	.00	8.0	480.93	105.19	109.14	181.37	188.60	190.90	.960	.948	149.94	151.77	143.96	.960	.949
4	21.7	.71	14.1	5.5	.00	16.0	469.65	87.18	85.69	169.67	177.84	176.93	.955	.960	143.36	142.62	136.94	.955	.960
5	21.6	.72	14.1	5.4	.00	18.0	472.95	95.56	83.29	169.44	176.85	175.43	.958	.966	142.99	141.85	137.01	.958	.966
6	21.6	.69	13.8	6.0	.00	17.0	448.35	92.30	96.98	164.89	180.95	177.72	.911	.928	145.06	142.47	132.18	.911	.928
7	21.4	.64	13.0	6.3	.00	14.0	467.51	108.54	101.44	177.83	190.51	186.40	.933	.954	150.79	147.46	140.68	.933	.954
8	21.7	.67	13.4	6.4	.00	13.0	480.81	103.34	90.74	180.02	187.52	180.02	.960	1.000	149.47	143.49	143.49	.960	1.000
9	21.4	.67	13.2	6.3	.00	17.0	469.23	95.90	88.88	174.54	183.12	178.89	.954	.976	146.03	142.65	139.27	.954	.976
10	21.2	.73	14.0	5.1	.00	19.0	469.14	77.76	77.82	165.19	171.91	171.95	.961	.961	139.50	139.53	134.05	.961	.961
11	21.2	.73	14.0	5.1	.00	18.0	423.29	75.25	76.62	150.80	170.28	171.17	.886	.881	138.18	138.90	122.37	.886	.881
12	21.0	.71	13.9	5.4	.00	17.0	426.28	81.58	89.60	152.29	174.35	179.33	.873	.849	140.69	144.71	122.89	.874	.849
STATION 69 AVERAGES																			
	21.4	.69	13.5	6.0	.00	14.6	455.16	92.53	91.27	167.19	180.98	180.23	.924	.928	144.94	144.35	133.91	.924	.928
1	25.9	.84	21.5	4.0	.00	22.0	449.31	81.63	74.42	133.25	174.38	169.73	.764	.785	145.65	141.77	111.23	.764	.785
2	26.2	.86	20.9	3.6	.00	22.0	424.80	65.99	63.74	122.99	164.04	162.46	.750	.757	137.92	136.60	103.33	.749	.756
3	27.1	.88	21.9	3.2	.00	23.0	486.62	69.52	67.32	138.89	165.78	164.96	.838	.842	140.22	139.53	117.36	.837	.841
4	27.1	.90	22.4	2.7	.00	27.0	468.27	53.89	55.38	129.04	155.24	156.38	.831	.825	132.28	133.25	109.82	.830	.824
5	26.7	.89	22.2	2.9	.00	27.0	467.15	59.18	58.54	130.00	159.19	158.72	.817	.819	135.22	134.82	110.30	.816	.818
6	26.6	.88	22.0	2.9	.00	27.0	449.50	56.58	56.35	127.34	157.27	157.10	.778	.779	133.60	133.46	103.81	.777	.778
7	26.5	.87	22.4	3.4	.00	27.0	460.37	59.75	57.73	131.98	166.62	161.78	.792	.816	140.54	136.46	111.23	.791	.815
8	26.2	.89	22.0	2.8	.00	28.0	477.40	55.67	54.69	131.53	156.59	155.85	.840	.844	133.17	132.47	111.67	.839	.843
9	26.3	.89	21.8	2.8	.00	27.0	471.91	54.54	55.44	130.27	155.74	156.42	.836	.833	132.36	132.94	110.59	.836	.832
10	25.5	.91	21.3	2.2	.00	27.0	477.88	49.33	50.10	125.15	144.33	152.32	.867	.822	123.71	130.56	107.13	.866	.820
11	25.3	.90	21.4	2.4	.00	28.0	441.20	43.08	49.18	117.25	146.55	151.60	.800	.773	125.27	129.50	100.03	.799	.772
12	25.6	.90	21.5	2.5	.00	28.0	441.84	46.25	51.70	118.13	149.25	153.56	.791	.769	127.44	131.12	100.74	.790	.768
STATION 70 AVERAGES																			
	26.2	.88	21.8	2.9	.00	26.2	453.94	57.95	58.30	127.57	157.92	158.41	.808	.805	133.94	134.37	106.10	.807	.805

TABLE 14-6 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HH	VP	VPD	S	DP	PM	EVFMP	EVFMC	EVPR	EVPRP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	25.7	.83	24.4	3.0	.00	1.0	417.56	57.73	88.00	115.44	158.16	178.35	.730	.647	134.04	151.15	97.74	.729	.647
2	25.6	.87	24.5	3.2	.00	1.0	404.00	56.43	92.21	113.33	157.16	174.75	.721	.649	132.72	147.58	95.62	.720	.648
3	27.2	.87	25.0	3.6	.00	1.0	477.91	81.33	132.32	145.15	174.20	186.92	.805	.750	146.67	157.38	117.30	.804	.749
4	27.6	.85	24.6	4.2	.00	3.0	474.67	90.03	172.65	143.03	179.59	187.12	.796	.764	150.17	156.47	119.53	.796	.764
5	27.7	.86	24.8	3.9	.00	6.0	435.49	87.25	98.73	144.51	177.89	184.78	.812	.782	149.26	155.05	121.16	.812	.781
6	26.2	.87	24.4	3.3	.00	8.0	463.42	65.09	82.64	131.58	163.41	175.02	.805	.752	137.69	147.68	110.93	.804	.751
7	26.2	.83	24.6	3.1	.00	9.0	481.25	61.46	80.91	174.56	160.84	173.93	.837	.774	136.21	147.30	113.84	.836	.773
8	26.3	.88	24.4	3.1	.00	7.0	489.57	62.22	83.70	135.94	161.38	175.72	.849	.779	136.65	149.73	115.84	.848	.779
9	26.0	.83	24.2	3.0	.00	8.0	469.27	58.04	79.59	130.52	158.35	172.45	.824	.757	134.14	146.08	110.46	.823	.756
10	25.6	.89	24.0	2.7	.00	9.0	460.14	51.86	75.09	124.79	153.53	170.18	.813	.733	130.61	144.77	106.04	.812	.732
11	25.7	.89	23.9	2.7	.00	6.0	413.11	50.53	76.32	112.26	152.73	170.98	.735	.657	129.91	145.43	95.38	.734	.656
12	25.8	.87	23.9	3.2	.00	4.0	407.03	54.04	88.39	114.87	162.68	178.59	.706	.643	137.34	150.78	96.89	.705	.643
STATION 71 AVERAGES																			
	26.3	.87	24.4	3.3	.00	5.2	453.76	65.50	86.63	128.50	163.33	177.40	.787	.724	137.97	149.87	108.44	.786	.724
1	12.5	.72	8.3	3.0	.00	9.0	439.82	14.51	32.30	145.01	119.55	137.23	1.213	1.057	98.02	112.52	118.95	1.214	1.057
2	12.8	.73	8.6	3.0	.00	12.0	417.05	13.77	29.07	136.96	118.74	134.24	1.153	1.020	97.69	110.34	112.62	1.154	1.021
3	13.5	.75	8.7	2.9	.00	13.0	479.53	16.96	34.63	156.37	122.16	139.35	1.280	1.122	100.91	115.11	129.21	1.280	1.123
4	13.8	.76	9.3	2.8	.00	20.0	463.48	16.93	30.69	150.39	122.13	135.75	1.231	1.108	101.15	112.44	124.59	1.232	1.108
5	13.9	.76	9.3	2.9	.00	21.0	464.14	17.95	31.68	150.88	123.19	136.67	1.225	1.104	102.01	113.18	124.98	1.225	1.104
6	13.1	.72	8.8	3.2	.00	22.0	439.13	15.74	28.54	146.04	121.93	133.73	1.198	1.092	99.88	109.55	119.67	1.198	1.092
7	12.4	.73	8.2	2.9	.00	21.0	457.29	13.50	25.45	149.09	118.45	130.77	1.259	1.140	97.42	107.56	122.68	1.259	1.141
8	12.4	.71	8.1	3.1	.00	13.0	473.02	14.64	30.35	157.10	119.68	135.43	1.313	1.160	97.86	110.74	128.51	1.313	1.160
9	12.3	.72	8.1	3.0	.00	15.0	465.06	13.13	27.25	152.98	118.11	132.50	1.295	1.155	96.87	108.68	125.53	1.296	1.155
10	13.2	.78	9.1	2.5	.00	19.0	470.34	13.50	27.59	147.62	118.45	132.83	1.246	1.111	98.82	110.62	123.19	1.247	1.112
11	13.2	.78	9.0	2.5	.00	20.0	432.73	13.06	26.24	135.84	117.97	131.53	1.151	1.073	98.43	109.73	113.35	1.152	1.033
12	13.2	.76	8.7	2.7	.00	14.0	432.52	14.93	31.51	138.80	119.99	136.51	1.157	1.017	99.48	113.17	115.11	1.157	1.017
STATION 72 AVERAGES																			
	13.0	.74	8.7	2.9	.00	15.6	452.91	14.97	29.61	147.26	120.03	134.71	1.227	1.093	99.04	111.15	121.53	1.227	1.093

TABLE 14-7 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	14.2	.70	9.2	3.6	.00	4.0	437.13	24.82	49.43	151.97	130.15	151.79	1.168	1.001	105.81	123.40	123.59	1.168	1.002
2	14.6	.70	9.5	3.7	.00	6.0	415.60	24.61	46.17	145.57	129.94	149.18	1.120	.976	105.58	121.21	118.31	1.121	.976
3	15.4	.69	9.4	4.1	.00	9.0	479.54	33.65	55.83	171.94	138.47	156.71	1.242	1.097	112.04	126.81	139.16	1.242	1.097
4	15.0	.71	9.5	3.7	.00	11.0	464.83	27.78	47.75	162.61	133.01	150.46	1.223	1.081	108.31	122.52	132.45	1.223	1.081
5	14.9	.71	9.9	3.7	.00	10.0	466.75	28.08	49.39	162.97	133.29	151.76	1.223	1.074	108.56	123.60	132.77	1.223	1.074
6	14.5	.72	9.5	3.5	.00	8.0	441.35	23.87	45.48	151.58	129.72	148.63	1.173	1.020	105.61	121.48	123.93	1.173	1.020
7	14.0	.73	9.4	3.2	.00	6.0	460.53	21.02	43.77	155.23	126.36	147.22	1.228	1.054	103.67	120.78	127.39	1.229	1.055
8	14.2	.71	9.3	3.5	.00	5.0	475.28	23.90	47.79	163.80	129.24	150.49	1.267	1.088	105.38	122.70	133.60	1.268	1.089
9	14.2	.69	9.2	3.8	.00	7.0	466.37	24.91	46.74	163.51	130.23	149.64	1.256	1.093	105.58	121.32	132.60	1.256	1.093
10	14.4	.71	9.4	3.6	.00	14.0	469.05	25.06	43.12	162.25	130.38	146.67	1.244	1.106	106.27	119.55	132.29	1.245	1.107
11	14.5	.71	9.5	3.6	.00	13.0	430.33	24.82	43.04	149.13	130.15	146.61	1.146	1.017	106.07	119.48	121.57	1.146	1.017
12	14.5	.69	9.2	3.8	.00	6.0	429.38	27.61	51.32	151.38	132.85	153.27	1.139	.988	107.65	124.20	122.71	1.140	.988
STATION 73 AVERAGES																			
	14.5	.71	9.4	3.7	.00	8.2	453.01	25.85	47.49	157.66	131.11	150.20	1.203	1.050	106.71	122.25	128.36	1.203	1.050
1	27.0	.86	23.3	3.7	.00	24.0	443.65	80.40	70.96	130.80	173.60	167.44	.753	.781	145.80	140.62	109.77	.753	.781
2	27.3	.85	23.6	3.8	.00	23.0	421.37	75.22	66.33	124.99	170.26	164.28	.734	.761	142.94	137.92	104.85	.734	.760
3	27.4	.88	24.4	3.3	.00	21.0	485.29	70.99	70.92	139.64	167.46	167.41	.834	.834	141.58	141.54	117.94	.833	.833
4	27.4	.85	24.0	3.8	.00	24.0	470.00	81.54	70.11	139.70	174.33	166.86	.801	.837	146.33	140.07	117.17	.801	.837
5	27.5	.88	24.4	3.3	.00	26.0	471.54	71.83	64.88	135.95	168.02	163.27	.809	.833	142.04	138.02	114.82	.808	.832
6	27.0	.88	24.1	3.2	.00	25.0	445.62	65.52	62.40	127.19	163.71	161.51	.777	.787	138.49	136.63	107.49	.776	.787
7	27.2	.86	23.5	3.8	.00	26.0	465.35	82.31	68.98	137.76	174.82	166.10	.788	.829	146.78	139.46	115.58	.787	.829
8	27.4	.85	23.0	4.1	.00	26.0	480.70	90.90	72.22	145.08	180.12	168.28	.805	.862	150.66	140.76	121.27	.805	.862
9	27.3	.86	23.6	3.8	.00	25.0	472.20	80.60	68.42	140.07	173.73	165.72	.806	.845	145.85	139.12	117.50	.806	.845
10	27.2	.85	23.3	4.1	.00	25.0	475.39	88.80	71.48	142.90	178.84	167.78	.799	.852	149.63	140.38	119.48	.799	.851
11	26.8	.88	23.1	3.2	.00	26.0	436.39	63.97	60.55	124.05	162.63	160.18	.763	.774	137.61	135.54	104.87	.762	.774
12	26.7	.88	23.2	3.2	.00	25.0	435.66	65.31	53.46	123.60	163.57	162.27	.756	.762	138.43	137.33	104.49	.755	.761
STATION 74 AVERAGES																			
	27.2	.87	23.6	3.6	.00	24.7	453.60	76.45	67.56	134.31	170.92	165.09	.786	.814	143.85	138.95	112.94	.785	.813

TABLE 14-8 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	26.9	.74	20.5	6.9	.00	9.0	423.42	159.74	127.60	144.74	218.57	201.66	.662	.718	176.47	162.82	116.85	.662	.718
2	27.3	.75	20.9	6.8	.00	9.0	438.24	149.41	115.03	139.27	209.39	194.32	.665	.717	169.48	157.28	112.72	.665	.717
3	28.1	.76	21.4	8.6	.00	12.0	479.82	205.97	140.88	174.37	260.57	209.68	.669	.832	207.57	167.03	138.91	.669	.832
4	29.0	.75	22.4	7.5	.00	13.0	474.59	181.84	126.12	167.56	238.54	200.79	.702	.834	192.63	162.15	135.31	.702	.835
5	29.1	.75	23.2	7.6	.00	13.0	483.91	189.95	130.94	171.20	245.42	203.65	.698	.841	198.16	164.43	138.24	.698	.841
6	28.7	.77	22.2	8.0	.00	15.0	461.07	190.76	125.91	165.03	246.14	200.67	.670	.822	197.64	161.14	132.52	.671	.822
7	28.4	.72	21.5	8.1	.00	14.0	479.59	199.12	133.17	172.26	252.87	204.94	.681	.841	202.53	164.14	137.97	.681	.841
8	28.6	.72	21.7	9.2	.00	17.0	489.79	202.53	127.96	176.27	257.13	201.88	.686	.873	205.88	161.65	141.15	.686	.873
9	28.5	.72	22.0	8.2	.00	14.0	471.09	193.85	129.43	169.55	248.91	202.75	.681	.836	199.33	162.37	135.78	.681	.836
10	27.8	.83	23.5	4.8	.00	18.0	464.28	109.36	91.20	145.33	190.85	180.30	.761	.806	158.45	149.69	120.60	.761	.806
11	27.4	.82	23.0	4.9	.00	18.0	418.61	107.22	89.22	131.77	189.78	179.09	.694	.736	157.11	148.26	109.04	.694	.735
12	26.6	.81	21.8	5.0	.00	13.0	413.89	106.99	98.85	129.89	189.65	184.87	.685	.703	156.64	152.69	107.25	.685	.702
STATION 75 AVERAGES																			
	28.0	.75	22.0	7.0	.00	13.7	455.60	165.12	119.69	157.27	228.99	197.05	.687	.798	185.16	159.47	127.19	.687	.798
1	28.1	.72	21.1	8.0	.00	4.0	433.77	191.64	152.08	155.78	246.92	216.81	.631	.718	197.84	173.72	124.82	.631	.719
2	28.3	.73	21.3	7.8	.00	9.0	415.12	170.37	128.34	148.28	229.58	202.11	.646	.734	184.45	162.37	119.14	.646	.734
3	28.5	.73	21.9	7.9	.00	9.0	483.01	192.83	143.49	173.23	247.99	211.30	.699	.820	199.18	169.72	139.14	.699	.820
4	28.4	.77	22.4	6.7	.00	13.0	472.67	155.92	116.79	162.34	219.37	195.35	.740	.831	178.47	158.87	132.01	.740	.831
5	28.1	.76	22.3	6.8	.00	15.0	478.06	162.99	118.04	164.99	224.23	196.07	.736	.841	181.86	159.02	133.80	.736	.841
6	27.9	.77	22.1	6.5	.00	16.0	453.79	147.45	108.58	154.29	213.81	190.57	.722	.810	174.00	155.09	125.55	.722	.810
7	27.9	.74	21.6	7.3	.00	14.0	472.98	173.39	124.38	165.96	231.86	199.77	.716	.831	186.94	161.07	133.81	.716	.831
8	28.4	.74	21.5	7.5	.00	15.0	485.29	183.32	125.46	172.01	239.76	200.40	.717	.858	193.18	161.47	138.60	.717	.856
9	27.6	.75	21.5	6.9	.00	16.0	471.70	155.66	112.21	162.86	219.19	192.68	.743	.845	177.34	155.89	131.76	.743	.845
10	27.5	.77	21.8	6.3	.00	19.0	469.82	145.62	104.52	158.45	212.65	188.21	.745	.842	173.15	153.25	129.01	.745	.842
11	27.5	.78	22.2	6.1	.00	15.0	427.48	134.43	103.74	142.55	205.74	187.75	.693	.759	168.06	153.36	116.42	.693	.759
12	27.8	.76	22.0	6.7	.00	9.0	424.97	157.59	127.60	145.77	220.49	201.67	.661	.723	178.90	163.62	118.27	.661	.723
STATION 76 AVERAGES																			
	28.0	.75	21.8	7.0	.00	12.7	457.39	164.27	122.10	158.88	225.97	198.56	.703	.800	182.78	160.62	128.53	.703	.800

TABLE 14-9 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	PM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	25.2	.67	17.2	7.9	.00	4.0	435.32	162.58	143.32	163.82	223.94	211.20	.732	.776	177.61	167.50	129.93	.732	.776
2	25.6	.67	17.1	8.1	.00	5.0	415.94	154.09	130.62	157.75	218.14	203.46	.723	.775	172.91	161.28	125.04	.723	.775
3	25.9	.67	17.0	8.3	.00	8.0	482.60	176.80	140.91	184.19	234.50	209.70	.785	.878	185.81	166.15	145.94	.785	.878
4	25.2	.73	18.0	6.5	.00	13.0	470.71	127.38	108.13	168.24	201.54	190.31	.835	.884	162.61	153.55	135.74	.835	.884
5	24.9	.74	19.7	5.1	.00	16.0	475.02	121.90	102.36	167.12	198.32	186.94	.843	.894	160.56	151.35	135.30	.843	.894
6	24.7	.75	18.6	5.8	.00	14.0	450.42	110.38	99.85	156.24	191.62	184.88	.815	.845	155.66	150.18	126.91	.815	.845
7	24.3	.73	18.0	6.1	.00	13.0	469.53	117.75	105.93	164.80	195.90	189.03	.841	.872	158.26	152.71	133.13	.841	.872
8	24.9	.70	17.7	7.1	.00	11.0	482.65	141.91	120.41	176.20	210.26	197.45	.838	.892	168.23	157.98	140.98	.838	.892
9	24.8	.75	17.3	5.9	.00	15.0	470.67	111.76	97.85	163.59	192.42	184.28	.850	.888	156.29	149.67	132.86	.850	.888
10	24.7	.80	18.6	4.7	.00	18.0	470.12	89.77	84.21	154.09	179.43	176.00	.859	.876	148.10	145.27	127.15	.859	.875
11	24.5	.79	18.7	4.8	.00	15.0	438.72	89.31	86.99	141.68	179.15	177.73	.791	.797	147.42	146.25	116.56	.791	.797
12	24.6	.75	17.8	5.8	.00	10.0	426.63	112.65	108.02	147.69	192.94	190.25	.765	.776	156.75	154.56	119.98	.765	.776
STATION 77 AVERAGES																			
	24.9	.73	17.9	6.4	.00	11.8	456.52	126.35	110.63	162.12	201.51	191.77	.805	.845	162.52	154.70	130.79	.805	.845
1	25.8	.71	21.8	7.2	.00	.0	422.09	152.58	145.13	144.57	217.14	212.33	.666	.681	174.02	170.17	115.86	.666	.681
2	25.9	.66	20.3	8.5	.00	1.0	407.1[illegible]	164.75	142.69	145.51	225.48	210.81	.645	.690	178.17	166.58	114.98	.645	.690
3	26.8	.68	21.1	8.5	.00	1.0	478.94	190.19	160.15	171.67	245.63	222.25	.699	.772	194.92	176.36	136.23	.699	.772
4	25.8	.74	23.1	6.5	.00	5.0	473.28	131.59	123.21	157.60	204.04	199.09	.772	.792	164.98	160.98	127.43	.772	.792
5	25.4	.79	23.9	5.1	.00	9.0	482.68	103.18	103.98	150.97	187.42	187.89	.805	.803	154.04	154.42	120.05	.805	.803
6	25.4	.84	23.9	3.9	.00	7.0	460.16	74.30	89.23	134.76	169.66	179.10	.794	.752	141.87	149.70	112.57	.794	.752
7	25.4	.81	23.6	4.6	.00	9.0	478.78	92.62	99.32	146.08	181.16	184.56	.806	.791	149.87	152.69	120.81	.806	.791
8	26.3	.81	23.4	4.9	.00	11.0	488.01	103.25	100.32	151.61	187.47	185.74	.809	.816	154.90	153.47	125.23	.808	.816
9	25.2	.80	23.1	4.8	.00	11.0	469.51	92.44	93.93	144.49	181.05	181.94	.798	.794	149.33	150.07	119.14	.798	.794
10	25.7	.77	21.9	5.7	.00	6.0	462.84	117.95	116.32	149.04	196.02	195.07	.760	.764	160.00	159.23	121.64	.760	.764
11	26.1	.79	22.4	5.3	.00	4.0	417.30	108.65	112.38	132.37	190.62	192.79	.694	.687	156.51	158.29	108.66	.694	.686
12	25.7	.74	21.9	6.4	.00	4.0	412.59	134.36	128.37	137.11	205.70	202.12	.667	.678	166.35	163.46	110.88	.667	.678
STATION 78 AVERAGES																			
	25.8	.76	22.5	6.0	.00	5.7	454.44	122.16	117.84	147.15	199.28	196.14	.738	.750	162.07	159.62	119.70	.739	.750

TABLE 14-10 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	9.6	.87	8.5	1.2	.42	6.0	440.41	1.40	7.08	112.59	134.50	111.24	1.077	1.012	90.43	96.27	97.39	1.077	1.012
2	9.8	.82	8.4	1.6	.56	5.0	417.03	2.29	9.62	127.63	135.58	114.15	1.209	1.118	89.75	97.03	108.50	1.209	1.118
3	10.4	.85	8.8	1.4	.33	10.0	478.56	2.92	9.60	115.88	106.33	114.12	1.090	1.015	91.24	97.93	99.41	1.090	1.015
4	10.2	.86	8.5	1.3	.20	18.0	461.46	2.29	6.34	92.81	105.58	110.38	.879	.841	90.95	95.09	79.92	.879	.841
5	10.1	.87	8.6	1.2	.25	20.0	461.33	2.01	6.15	97.61	105.24	110.16	.927	.886	90.39	95.25	84.36	.927	.886
6	9.4	.85	8.3	1.2	.24	22.0	435.16	1.26	4.03	91.26	104.33	107.67	.875	.848	89.99	92.87	78.70	.874	.847
7	9.2	.91	8.4	.8	.18	25.0	454.58	.53	2.60	80.08	103.43	105.96	.774	.756	90.90	93.12	70.31	.774	.755
8	9.0	.90	8.3	.9	.23	24.0	470.72	.49	2.49	90.86	103.39	105.82	.879	.859	90.55	92.68	79.51	.878	.858
9	9.2	.85	8.2	1.3	.27	17.0	464.36	1.13	4.08	102.50	104.17	107.73	.984	.951	89.56	92.62	88.11	.984	.951
10	9.7	.86	8.4	1.3	.21	19.0	469.75	1.68	5.11	95.31	104.85	108.95	.909	.875	90.39	93.93	82.14	.909	.875
11	10.1	.84	8.4	1.5	.31	16.0	433.11	2.58	7.61	104.41	105.93	111.85	.986	.933	90.62	95.69	89.32	.986	.933
12	10.2	.85	8.6	1.4	.40	8.0	433.24	2.60	9.77	112.87	105.95	114.32	1.065	.987	90.95	98.13	96.86	1.065	.987
STATION 79 AVERAGES																			
	9.7	.86	8.4	1.3	.30	15.8	451.64	1.76	6.21	101.99	104.94	110.20	.972	.925	90.53	95.05	87.88	.971	.925
1	25.5	.85	22.9	3.7	.00	14.0	439.79	72.39	80.62	127.53	168.39	173.75	.757	.734	141.22	145.71	106.88	.757	.733
2	25.5	.85	23.0	3.4	.00	17.0	418.60	60.56	66.91	119.54	160.19	164.68	.746	.726	134.82	138.59	100.53	.746	.725
3	25.5	.86	22.8	3.4	.00	18.0	483.59	67.04	72.84	138.10	164.77	168.69	.838	.819	138.67	141.97	116.14	.837	.818
4	25.4	.85	23.3	3.6	.00	18.0	469.85	69.19	72.63	135.97	166.24	168.55	.818	.807	139.43	141.37	113.97	.817	.806
5	25.8	.86	23.5	3.5	.00	22.0	472.81	69.57	69.03	135.84	166.50	166.13	.816	.818	140.07	139.76	114.19	.815	.817
6	26.1	.82	22.4	4.6	.00	23.0	447.75	92.02	76.17	137.12	180.83	170.89	.758	.802	149.93	141.72	113.67	.758	.802
7	25.4	.83	21.9	4.1	.00	25.0	466.92	82.06	70.64	139.08	174.65	167.22	.796	.832	145.48	139.28	115.79	.796	.831
8	25.6	.83	22.3	4.2	.00	27.0	481.24	84.10	68.69	143.93	175.94	165.89	.818	.868	146.50	138.14	119.79	.818	.867
9	25.9	.85	22.4	3.8	.00	24.0	471.43	73.58	67.06	137.81	169.18	164.78	.815	.836	141.80	138.11	115.43	.814	.836
10	25.4	.87	22.9	3.2	.00	24.0	472.83	60.93	62.63	132.63	160.46	161.68	.827	.820	135.55	136.58	111.94	.826	.820
11	25.8	.88	24.0	3.0	.00	17.0	433.11	56.67	67.53	120.46	157.30	165.11	.766	.730	133.29	139.90	101.97	.765	.729
12	25.4	.88	23.8	2.9	.00	19.0	431.64	55.65	65.94	119.79	156.58	164.00	.761	.726	132.75	139.05	100.86	.760	.725
STATION 80 AVERAGES																			
	25.6	.85	22.9	3.6	.00	20.7	457.46	70.31	70.06	132.26	166.75	166.78	.793	.793	139.96	140.02	110.93	.793	.792

TABLE 14-11 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	27.1	.77	21.3	6.2	.70	2.0	411.67	139.11	142.86	154.12	208.58	210.91	.739	.731	169.93	171.83	125.55	.739	.731
2	27.4	.81	23.4	5.2	.71	2.0	400.34	105.07	118.82	144.65	189.11	196.52	.765	.736	156.02	162.14	119.31	.765	.736
3	28.0	.71	20.7	8.2	.72	1.0	475.76	196.60	176.11	194.54	251.85	233.96	.774	.832	200.91	186.94	155.44	.774	.832
4	28.8	.76	22.8	7.1	.65	4.0	475.93	170.43	144.33	181.49	229.63	211.83	.790	.857	186.06	171.64	147.05	.793	.857
5	23.4	.80	23.3	5.8	.57	12.0	483.37	139.92	110.53	168.85	208.47	191.71	.810	.881	171.20	157.43	138.63	.810	.881
6	27.6	.83	23.9	4.7	.51	12.0	468.06	103.15	89.37	146.37	187.41	179.19	.781	.817	155.63	148.80	121.49	.781	.816
7	28.0	.82	23.6	5.1	.59	7.0	486.37	118.66	111.95	164.36	196.43	192.54	.837	.854	162.48	159.26	135.90	.836	.853
8	28.2	.80	22.6	5.7	.53	7.0	492.04	135.85	114.68	165.22	206.60	194.12	.800	.851	169.70	159.45	135.68	.800	.851
9	28.4	.83	23.4	4.9	.55	13.0	463.36	112.96	94.64	153.47	193.12	182.37	.795	.842	160.20	151.28	127.25	.794	.841
10	28.3	.85	23.5	4.3	.54	16.0	457.42	100.78	86.54	144.70	186.01	177.45	.778	.815	155.40	148.25	120.81	.777	.815
11	27.7	.85	23.8	4.2	.58	9.0	403.08	91.07	93.47	130.75	180.22	181.67	.725	.720	150.68	151.90	109.25	.725	.719
12	28.0	.80	22.7	5.7	.73	1.0	401.79	132.83	143.07	149.93	204.78	211.05	.732	.710	168.25	173.40	123.16	.732	.710
STATION 81 AVERAGES																			
	28.0	.80	22.9	5.6	.62	7.2	453.01	128.87	118.87	158.20	203.48	196.94	.777	.803	167.21	161.86	129.36	.777	.803
1	14.3	.80	10.3	2.4	.00	10.0	434.96	16.04	36.49	133.83	121.18	140.99	1.104	.949	101.58	118.19	112.20	1.104	.949
2	14.5	.83	10.7	2.1	.00	13.0	414.15	12.53	29.68	127.96	117.39	134.80	1.047	.912	99.37	114.12	104.07	1.047	.912
3	14.6	.85	11.2	1.9	.00	15.0	478.60	12.19	30.23	138.30	117.02	135.32	1.182	1.022	99.74	115.33	117.83	1.181	1.022
4	14.5	.85	11.4	1.9	.00	19.0	465.12	11.52	26.95	134.16	116.28	132.21	1.154	1.015	99.12	112.70	114.32	1.153	1.014
5	14.6	.85	11.4	1.9	.00	20.0	467.99	12.19	27.78	135.23	117.02	133.01	1.156	1.017	99.74	113.36	115.22	1.155	1.016
6	15.0	.82	10.9	2.3	.00	17.0	443.27	16.12	33.07	134.66	121.27	137.93	1.110	.976	102.23	116.28	113.51	1.110	.976
7	14.9	.79	10.7	2.7	.00	19.0	462.49	19.51	36.09	145.67	124.81	140.65	1.167	1.036	104.19	117.40	121.61	1.167	1.036
8	15.2	.78	10.4	2.9	.00	13.0	476.65	21.98	41.93	152.76	127.33	145.69	1.200	1.049	105.90	121.16	127.06	1.200	1.049
9	14.8	.80	10.7	2.5	.00	20.0	466.52	17.44	32.35	144.88	122.66	137.28	1.181	1.055	102.75	114.99	121.36	1.181	1.055
10	14.2	.86	10.9	1.7	.00	23.0	467.75	10.15	23.87	132.13	114.75	129.22	1.151	1.023	98.21	110.59	113.03	1.151	1.022
11	14.1	.86	11.0	1.7	.00	22.0	428.18	9.58	23.16	120.72	114.10	128.51	1.058	.939	97.67	110.00	103.30	1.058	.939
12	14.1	.84	10.6	1.9	.00	19.0	426.84	11.69	27.07	124.01	116.46	132.33	1.065	.937	98.99	112.48	105.39	1.065	.937
STATION 82 AVERAGES																			
	14.6	.83	10.9	2.2	.00	17.4	452.71	14.25	30.72	134.94	119.19	135.66	1.132	.995	100.79	114.72	114.07	1.132	.994

TABLE 14-12 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	HM	VP	VPD	S	UP	RM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	12.5	.87	9.6	1.4	.29	10.0	437.48	5.71	14.97	92.53	109.65	120.03	.844	.771	94.44	103.38	79.66	.843	.770
2	12.7	.86	9.5	1.5	.21	16.0	415.52	6.06	12.93	86.19	110.06	117.82	.783	.732	94.42	101.08	73.92	.783	.731
3	13.2	.86	10.1	1.6	.13	17.0	478.91	7.78	14.18	88.30	112.05	119.19	.788	.741	96.05	102.17	75.66	.788	.741
4	12.9	.92	10.4	.9	.07	25.0	463.67	3.07	13.40	118.35	106.52	118.34	1.111	1.000	93.40	103.76	103.65	1.110	.999
5	13.1	.91	10.4	1.0	.09	22.0	465.30	4.08	9.80	72.22	107.72	114.35	.670	.632	94.07	98.85	63.00	.670	.631
6	12.7	.93	10.0	1.2	.10	20.0	439.80	4.68	10.02	71.39	108.44	114.60	.658	.623	94.05	99.40	61.87	.658	.623
7	13.0	.88	9.9	1.3	.15	19.0	459.30	5.99	12.53	84.80	109.97	117.39	.771	.722	94.99	101.39	73.20	.771	.722
8	12.7	.88	9.7	1.3	.16	17.0	474.17	5.46	12.35	88.48	109.36	117.19	.809	.755	94.50	101.27	76.41	.809	.755
9	13.2	.90	10.2	1.1	.22	17.0	465.97	4.76	12.98	92.94	108.53	117.89	.856	.788	94.41	102.54	80.77	.856	.788
10	12.4	.92	10.0	.9	.12	27.0	468.73	2.68	7.60	74.42	106.05	111.85	.702	.665	93.07	98.15	65.23	.701	.665
11	12.4	.92	10.0	.9	.08	24.0	430.38	2.59	7.48	64.02	105.95	111.71	.604	.573	92.98	98.03	56.12	.604	.572
12	12.7	.91	10.1	1.0	.11	17.0	429.78	3.59	10.14	69.06	107.15	114.74	.645	.602	93.63	100.26	60.28	.644	.601
STATION 83 AVERAGES																			
	12.8	.89	10.0	1.2	.14	19.3	452.41	4.70	11.53	83.56	108.45	116.26	.770	.719	94.17	100.94	72.48	.770	.718
1	25.8	.80	22.7	5.0	.96	.0	412.08	102.78	150.36	157.82	187.19	215.69	.843	.732	154.26	177.75	130.02	.843	.732
2	26.3	.79	20.0	5.6	.85	.0	400.54	109.15	137.34	154.32	190.90	207.51	.808	.744	156.20	169.78	126.24	.808	.744
3	25.5	.79	20.0	5.1	.76	.0	474.96	104.45	133.63	172.60	188.16	205.26	.917	.841	154.62	168.67	141.80	.917	.841
4	26.4	.81	21.6	4.9	.70	1.0	474.73	101.12	120.90	166.35	186.21	197.74	.893	.841	153.84	163.36	137.39	.893	.841
5	27.4	.77	23.4	6.3	.79	6.0	488.49	143.97	145.22	189.87	211.61	212.40	.897	.894	172.32	172.97	154.61	.897	.894
6	27.5	.79	23.0	5.8	.50	10.0	467.45	127.94	102.38	152.35	201.87	186.95	.755	.815	165.43	153.21	124.83	.755	.815
7	26.9	.77	21.8	6.1	.65	9.0	485.35	135.92	123.93	176.47	206.69	199.51	.854	.885	168.39	162.58	143.79	.854	.884
8	27.1	.78	22.6	5.9	.65	5.0	491.29	132.58	128.81	176.84	204.69	202.38	.864	.874	167.29	165.41	144.51	.864	.874
9	27.2	.78	22.5	5.9	.61	13.0	468.97	129.89	108.41	165.89	203.02	190.47	.817	.871	165.91	155.65	135.54	.817	.871
10	26.2	.77	22.3	5.9	.78	14.0	457.07	125.21	121.23	173.71	200.26	197.93	.867	.878	163.35	161.45	141.68	.867	.878
11	26.2	.80	23.1	5.1	.78	9.0	408.33	104.35	116.97	149.76	188.11	195.45	.796	.766	154.93	160.98	123.32	.796	.766
12	25.8	.79	22.1	5.2	.80	1.0	401.94	108.31	137.46	148.96	190.42	207.58	.782	.718	156.41	170.51	122.33	.782	.717
STATION 84 AVERAGES																			
	26.5	.79	22.1	5.6	.74	5.7	452.60	118.81	127.22	165.41	196.59	201.57	.841	.821	161.08	165.19	135.51	.841	.820

TABLE 14-13 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

MO	TM	FM	VP	VPD	S	DP	RM	EVFMP	EVFMG	EVPR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
1	13.9	.61	9.2	4.6	.48	3.0	440.77	30.75	46.07	159.18	135.81	149.10	1.172	1.068	107.85	118.41	126.44	1.172	1.068
2	14.1	.62	8.6	4.6	.45	12.0	417.79	28.35	39.47	146.95	133.56	143.59	1.100	1.023	106.30	114.28	116.98	1.101	1.024
3	14.8	.64	8.9	4.5	.38	15.0	480.20	34.80	42.44	159.39	139.50	146.11	1.143	1.091	111.47	116.75	127.40	1.143	1.091
4	14.9	.65	11.0	4.3	.21	20.0	463.82	31.65	30.68	123.80	136.64	135.74	.906	.912	109.76	109.04	99.47	.906	.912
5	14.6	.67	9.1	4.1	.25	20.0	464.23	30.26	31.59	129.37	135.35	136.58	.956	.947	109.05	110.04	104.27	.956	.948
6	14.0	.64	8.7	4.3	.23	19.0	438.17	27.96	31.31	131.06	133.18	136.33	.984	.961	106.55	109.07	104.89	.984	.962
7	13.5	.63	8.2	4.3	.33	19.0	457.48	26.24	30.95	140.49	131.53	135.99	1.068	1.033	105.05	108.61	112.24	1.068	1.033
8	13.7	.61	8.0	4.6	.39	14.0	473.42	29.25	38.05	157.38	134.40	142.36	1.171	1.106	106.77	113.10	125.06	1.171	1.106
9	13.7	.61	8.2	4.6	.32	15.0	466.28	28.31	33.27	143.79	133.51	138.12	1.077	1.041	106.07	109.72	114.26	1.077	1.041
10	14.0	.69	9.0	3.7	.25	21.0	470.89	24.52	27.19	127.44	129.85	132.45	.981	.962	105.30	107.41	103.38	.982	.963
11	13.8	.68	9.2	3.8	.30	21.0	433.38	23.39	27.18	124.66	123.73	132.43	.968	.941	104.14	107.13	100.88	.969	.942
12	14.0	.64	9.7	4.3	.39	14.0	433.25	28.89	38.41	142.75	134.06	142.68	1.065	1.001	107.26	114.15	114.24	1.065	1.001
STATION 85 AVERAGES																			
	14.1	.64	8.8	4.3	.34	16.7	453.30	28.70	34.72	140.52	133.84	139.29	1.050	1.009	107.13	111.48	112.46	1.050	1.009
1	27.3	.62	17.2	10.3	.72	1.0	404.50	240.75	198.63	174.01	302.34	253.35	.576	.687	235.99	197.76	135.81	.576	.687
2	27.1	.71	18.7	7.8	.72	.0	395.28	160.41	154.22	158.45	222.43	218.23	.712	.726	177.94	174.58	126.76	.712	.726
3	28.1	.65	17.8	10.0	.65	.0	473.15	241.78	189.27	195.40	303.80	244.83	.643	.798	238.71	192.37	153.54	.643	.798
4	28.4	.63	18.9	9.0	.51	.0	476.30	213.21	155.99	176.49	268.18	219.41	.658	.804	212.95	174.22	140.15	.658	.804
5	29.4	.67	20.7	10.1	.57	2.0	493.05	262.05	179.39	197.48	335.39	236.56	.589	.835	264.49	186.55	155.74	.589	.835
6	29.8	.67	20.3	10.4	.59	3.0	473.32	264.63	176.88	193.21	339.84	234.57	.569	.824	267.86	184.88	152.30	.569	.824
7	30.4	.60	19.3	13.0	.71	.0	491.42	355.15	237.79	226.34	573.41	298.24	.395	.759	443.56	230.70	175.08	.395	.759
8	29.9	.71	21.2	9.2	.73	3.0	494.64	241.68	189.57	210.94	303.65	245.09	.695	.861	242.01	195.33	168.13	.695	.861
9	28.8	.78	22.8	6.5	.56	9.0	468.26	155.49	119.92	165.80	219.07	197.16	.757	.841	178.64	160.77	135.19	.757	.841
10	27.1	.84	23.5	4.3	.44	15.0	452.43	94.18	78.57	130.76	182.10	172.43	.718	.758	151.84	143.79	108.98	.718	.758
11	27.1	.79	21.2	5.8	.59	9.0	401.31	122.19	108.37	136.79	198.49	190.45	.689	.718	162.75	156.16	112.13	.689	.718
12	26.5	.79	20.0	5.7	.69	5.0	393.50	123.72	128.60	142.85	199.39	202.26	.716	.706	163.09	165.44	116.83	.716	.706
STATION 86 AVERAGES																			
	28.3	.71	20.1	8.5	.62	3.9	451.43	206.27	159.77	175.71	287.34	226.05	.612	.777	228.32	180.21	140.05	.613	.777

TABLE 15 DATA AND COMPARISON OF PAN EVAPORATION AND EVAPOTRANSPIRATION AS ESTIMATED BY STUTLER AND CHRISTIANSEN FORMULAS

ST	TM	HM	VP	VPD	S	DP	RM	EVFMP	EVFMG	EVFR	EVPKP	EVPKG	EVR/EKP	EVR/EKG	ETKP	ETKG	ETC	ETC/ETP	ETC/ETG
61	24.0	.79	16.6	4.8	.00	12.2	458.46	66.30	90.13	155.32	177.03	179.50	.877	.865	145.63	147.69	127.74	.877	.865
62	21.1	.76	13.9	4.6	.48	16.1	456.47	68.01	69.03	150.57	165.11	165.71	.912	.909	135.05	135.55	123.12	.912	.908
63	23.8	.70	15.6	5.5	.44	10.9	458.13	121.64	97.04	158.75	198.24	183.67	.801	.864	158.81	147.13	127.15	.801	.864
64	27.8	.68	18.9	9.1	.00	7.1	459.10	212.50	153.43	172.34	271.51	218.18	.635	.790	214.76	172.68	136.41	.635	.790
65	20.0	.82	13.7	3.2	.00	18.4	455.91	41.66	56.36	142.21	145.28	156.93	.979	.906	121.45	131.19	118.84	.979	.906
66	19.2	.74	12.9	4.3	.00	18.5	455.66	54.24	64.13	156.37	155.06	162.37	1.008	.963	126.59	132.57	127.66	1.008	.963
67	16.4	.90	10.9	2.8	.44	20.0	454.00	25.43	36.06	135.95	130.67	140.44	1.040	.968	109.07	117.22	113.44	1.040	.968
68	20.7	.76	13.5	4.4	.51	19.9	453.22	62.79	63.25	153.38	161.46	161.79	.950	.948	132.27	132.54	125.62	.950	.948
69	21.4	.69	13.5	6.0	.00	14.6	455.16	92.53	91.27	167.19	180.98	180.23	.924	.928	144.94	144.35	133.91	.924	.928
70	26.2	.89	21.8	2.9	.00	26.2	458.94	57.95	58.30	127.57	157.92	158.41	.808	.805	133.94	134.37	108.10	.807	.805
71	26.3	.87	24.4	3.3	.00	5.2	453.76	65.50	86.63	128.50	163.33	177.40	.787	.724	137.97	149.87	108.44	.786	.724
72	13.0	.74	8.7	2.9	.00	16.6	452.81	14.97	29.61	147.26	120.03	134.71	1.227	1.093	99.04	111.15	121.53	1.227	1.093
73	14.5	.71	9.4	3.7	.00	8.2	453.01	25.85	47.49	157.66	131.11	150.20	1.203	1.050	106.71	122.25	128.36	1.203	1.050
74	27.2	.87	23.6	3.6	.00	24.7	458.60	76.45	57.56	134.31	170.92	165.09	.786	.814	143.85	138.95	112.94	.785	.813
75	26.0	.75	22.0	7.0	.00	13.7	455.60	165.12	119.69	157.27	228.99	197.05	.687	.798	185.16	159.47	127.19	.687	.798
76	28.0	.75	21.9	7.0	.00	12.7	457.39	164.27	122.13	158.88	225.97	198.56	.703	.800	182.78	160.62	128.53	.703	.800
77	24.9	.73	17.9	6.4	.00	11.8	456.52	126.35	110.63	162.12	201.51	191.77	.805	.845	162.52	154.70	130.79	.805	.845
78	25.8	.76	22.5	6.0	.00	5.7	454.44	172.16	117.84	147.15	199.28	196.14	.738	.750	162.07	159.62	119.79	.739	.750
79	9.7	.95	8.4	1.3	.30	15.8	451.64	1.76	6.21	101.99	104.94	110.20	.972	.925	90.53	95.05	87.88	.971	.925
80	25.6	.95	22.3	3.6	.00	20.7	457.46	70.31	70.06	132.26	166.75	166.78	.793	.793	139.96	140.02	110.93	.793	.792
81	28.0	.90	22.9	5.6	.62	7.2	453.01	128.87	118.87	158.20	203.48	196.94	.777	.803	167.21	161.86	129.96	.777	.803
82	14.6	.83	10.8	2.2	.00	17.4	452.71	14.25	30.72	134.94	119.19	135.66	1.132	.995	100.79	114.72	114.07	1.132	.994
83	12.8	.89	10.0	1.2	.14	19.3	452.41	4.70	11.53	83.56	108.45	116.26	.770	.719	94.17	100.94	72.48	.770	.718
84	26.5	.79	22.1	5.6	.74	5.7	452.63	118.81	127.22	165.41	196.59	201.57	.841	.821	161.08	165.19	135.51	.841	.820
85	14.1	.69	9.8	4.3	.34	16.7	453.30	28.70	34.72	140.52	133.84	139.29	1.050	1.009	107.13	111.48	112.46	1.050	1.009
86	28.3	.71	20.1	8.5	.62	3.9	451.43	206.27	159.77	175.71	287.34	226.05	.612	.777	228.32	180.21	140.05	.613	.777
OVERALL AVERAGES																			
	21.9	.78	16.5	4.6	.18	14.2	455.11	82.98	78.45	146.36	173.27	169.65	.845	.863	141.99	139.23	120.11	.846	.862

VITA

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