

Temperature versus elevation relationships for Puerto Rico^{1, 2}

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ABSTRACT

Relationships among mean daily maximum-, mean daily minimum-, mean daily average-, absolute highest-, absolute lowest temperature (°C) versus elevation (m) were determined for January through December for Puerto Rico. These relationships were found to be linear, $Y = A + BX$. The coefficient of correlation varied from -0.43 to -0.96 . Examples are presented to estimate potential evapotranspiration (PET) and to develop PET model as a function of incident solar radiation and elevation.

RESUMEN

Relación entre temperatura y elevación en Puerto Rico

La relación entre las temperaturas (°C) media diaria, máxima diaria, mínima diaria, más alta y más baja para cada mes contra la elevación (m) se determinaron de enero a diciembre para Puerto Rico. Se encontró que estas relaciones son lineales. El coeficiente de correlación varió de -0.43 a -0.96 .

INTRODUCTION

Water consumptive use by crops in any particular location is probably affected more by temperature, which for long-time periods is a good measure of solar radiation, than any other factor. Abnormally low temperatures may retard plant growth and unusually high temperatures may produce dormancy. Temperature is one of the most dynamic properties of weather and is subject to daily and seasonal changes. Irrigation planning can be delayed or underestimated if temperature data for various locations in a particular locality is not available.⁴

The objective of this study was to establish relationships among monthly temperature (°C) and elevation (m) for Puerto Rico with avail-

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⁴Hargreaves, G. H. and Z. A. Samani, 1986. Simplified irrigation scheduling and crop selection for El Salvador. Utah State University, Logan-Utah. Personal communication - November 5.

TABLE 1.—Relationships among temperature (Y) and elevation (X) for Puerto Rico¹

Month	Regression coefficients ²																			
	Mean daily T Max, °C				Mean daily T Min, °C				Mean daily T Avg, °C				Highest Temp, °C				Lowest Temp, °C			
	A	B, -10 ⁻⁵	r	R ²	A	B, -10 ⁻⁵	r	R ²	A	B, -10 ⁻⁵	r	R ²	A	B, -10 ⁻⁵	r	R ²	A	B, -10 ⁻⁵	r	R ²
Jan.	29.24	770	0.85	0.73	18.58	544	0.67	0.44	23.91	657	0.91	0.84	33.80	598	0.72	0.51	12.95	557	2.53	0.28
Feb.	29.37	752	0.85	0.72	18.37	558	0.68	0.46	23.88	655	0.92	0.84	34.39	686	0.75	0.56	12.63	542	0.50	0.25
Mar.	30.08	711	0.84	0.71	18.71	590	0.69	0.48	24.37	646	0.92	0.85	35.04	619	0.77	0.59	12.94	528	0.46	0.21
April	30.59	687	0.84	0.71	19.90	686	0.79	0.63	25.21	645	0.94	0.88	35.57	716	0.80	0.64	14.35	562	0.49	0.24
May	31.16	707	0.87	0.76	21.23	608	0.79	0.63	26.20	659	0.96	0.92	35.62	540	0.67	0.44	15.54	541	0.50	0.25
June	31.76	686	0.85	0.73	21.92	577	0.77	0.59	26.85	634	0.95	0.91	35.98	552	0.67	0.44	16.74	535	0.55	0.30
July	32.07	717	0.80	0.64	22.14	591	0.76	0.58	27.03	645	0.95	0.90	36.17	612	0.70	0.49	16.90	420	0.43	0.19
Aug.	32.12	682	0.87	0.75	22.21	585	0.76	0.58	27.18	635	0.95	0.89	36.38	678	0.76	0.58	17.27	546	0.54	0.29
Sept.	32.12	696	0.89	0.79	21.95	586	0.78	0.62	27.04	644	0.95	0.91	36.50	624	0.68	0.46	16.81	475	0.48	0.23
Oct.	31.84	705	0.89	0.79	21.48	553	0.75	0.56	26.65	642	0.95	0.90	36.01	602	0.71	0.50	16.57	446	0.53	0.28
Nov.	30.89	706	0.87	0.75	20.68	562	0.74	0.55	25.79	644	0.93	0.87	35.39	701	0.76	0.57	15.41	609	0.60	0.35
Dec.	29.83	744	0.85	0.73	19.52	547	0.69	0.47	24.78	664	0.89	0.78	34.22	482	0.64	0.41	14.19	552	0.60	0.36
Annual	30.92	714	0.75	0.56	20.56	582	0.59	0.35	25.74	648	0.75	0.56	35.42	617	0.66	0.44	15.19	527	0.42	0.18

¹With temperature data from climatology to the U.S. No. 86-45: Puerto Rico and U.S. Virgin Islands.

² $Y = A + BX$, where Y = Temperature, °C; X = Elevation, m; A and B = Regression coefficients; R² = coefficient of determination; r = negative coefficient of correlation. All regression coefficients were significant at P = 0.01.

able temperature data. We also estimated missing temperature data with these relationships.

MATERIALS AND METHODS

Available temperature data⁵ and Publication No. 86-45 of the Weather Bureau, U.S. Department of Commerce⁶ were used to determine relationships among monthly temperature (Y) and elevation (X) for Puerto Rico with linear regression analysis. We used these relationships to estimate missing mean maximum temperature (TMAX), mean minimum temperature (TMIN) and mean average temperature (T) for January through December. Thirty-nine locations were considered. These weather stations⁶ were Aceituna, Adjuntas, Barceloneta 2NNW, Bayamón Hato Tejas, Cabo Rojo, Calero Camp, Caonillas Villalba, Carite Plant I, Cataño, Central San Francisco, Coamo Dam, Ensenada, Guajataca Dam, Guayabal Reservoir, Guayanilla, Gurabo, Indiera Baja, Jájome Alto, La Fe, Maricao, Maricao Fish Hatchery, Matrullas Dam, Maunabo 1SW, Mora Camp, Naguabo 6W, Paraíso, Peñuelas Salto Garzas, Puerto Real, Río Blanco Lower, Río Blanco Upper, San Lorenzo Espino, San Sebastián, Santa Isabel 3NW, Santa Rita, Toa Baja Constancia, Toro Negro Plant 2, Villalba, Yabucoa INNE, Yauco 1S.

RESULTS AND DISCUSSION

Table 1 shows mean daily maximum-, mean daily minimum-, mean daily average-, absolute highest- and lowest temperature (°C) versus elevation (m) relationships for January through December. It was found that temperature is negatively correlated with elevation. The relationships were linear. All regression coefficients were significant at $P=0.01$.

For various months, the coefficient of correlation varied from 0.89 to 0.96 for mean daily average temperature; 0.80 to 0.89 for mean daily maximum temperature; 0.67 to 0.79 for mean daily minimum temperature; 0.64 to 0.80 for highest temperature and 0.43 to 0.60 for lowest temperature. The coefficient of determination (R^2) varied from 0.78 to 0.92 for mean daily average temperature; 0.64 to 0.79 for mean daily maximum temperature; 0.44 to 0.63 for mean daily minimum temperature; 0.41 to 0.64 for highest temperature and 0.19 to 0.36 for lowest temperature. These coefficient of correlations imply that these relationships gave best estimates of mean daily temperature for January through December compared to highest and lowest monthly temperatures.

TMAX and TMIN, T estimates are indicated in tables 2, 3 and 4.

⁵Temperature data: Puerto Rico and U.S. Virgin Islands, updated 1984. National Climatic Data Center, Asheville, NC 28801.

⁶Climatology of the United States No. 86-45 of Puerto Rico and U.S. Virgin Islands. In: Climatic Summary of the U.S.-Supplement for 1951 through 1960. U.S. Department of Commerce, Washington, D.C.

TABLE 2.—Generation of missing climatic data for Puerto Rico with temperature versus elevation relationships:
mean daily maximum temperature (°C)

Weather station ^a	Elevation m	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1 ^a Aceituna	652.5	24.2	24.5	25.4	26.1	26.5	27.3	27.4	27.7	27.6	27.2	26.3	25.0
2 Adjuntas	450.0	25.8	26.0	26.9	27.5	28.0	28.7	28.8	29.1	29.0	28.7	27.7	26.5
6 Barceloneta 2 NNW	22.8	29.1	29.2	29.9	30.4	31.0	31.6	31.9	32.0	32.0	31.7	30.7	29.7
8 Bayamón Hato Tejas	54.0	28.8	29.0	29.7	30.2	30.8	31.4	31.7	31.8	31.7	31.5	30.5	29.4
9 Cabo Rojo	75.0	28.7	28.8	29.5	30.1	30.6	31.2	31.5	31.6	31.6	31.3	30.4	29.3
11 Calero Camp	73.8	28.7	28.8	29.6	30.1	30.6	31.3	31.5	31.6	31.6	31.3	30.4	29.3
13 Caonillas Villalba	180.0	27.9	28.0	28.8	29.4	29.9	30.5	30.8	30.9	30.9	30.6	29.6	28.5
16 Carite Plant 1	288.0	27.0	27.2	28.0	28.6	29.1	29.8	30.0	30.2	30.1	29.8	28.9	27.7
17 Cataño	6.0	29.2	29.3	30.0	30.5	31.1	31.7	32.0	32.1	32.1	31.8	30.8	29.8
19 Central San Francisco	9.0	29.2	29.3	30.0	30.5	31.1	31.7	32.0	32.1	32.1	31.8	30.8	29.8
21 Coamo Dam	55.5	28.8	29.0	29.7	30.2	30.8	31.4	31.7	31.7	31.7	31.4	30.5	29.4
28 Ensenada	7.5	29.2	29.3	30.0	30.5	31.1	31.7	32.0	32.1	32.1	31.8	30.8	29.8
31 Guajataca Dam	196.8	27.7	27.9	28.7	29.2	29.8	30.4	30.7	30.8	30.8	30.5	29.5	28.4
32 Guayabal Reservoir	81.0	28.6	28.8	29.5	30.0	30.6	30.2	31.5	31.6	31.6	31.3	30.3	29.2
34 Guayanilla	9.0	29.2	29.3	30.0	30.5	31.1	31.7	32.0	32.1	32.1	31.8	30.8	29.8
36 Gurabo	48.0	28.9	29.0	29.7	30.3	30.8	31.4	31.7	31.8	31.8	31.5	30.6	29.5
38 Indiera Baja	840.0	22.8	23.1	24.1	24.8	25.2	26.0	26.0	26.4	26.3	25.9	25.0	23.6
40 Jájome Alto	715.5	23.7	24.0	25.0	25.7	26.1	26.9	26.9	27.2	27.1	26.8	25.8	24.5
44 La Fe	45.0	28.9	29.0	29.8	30.3	30.8	31.5	31.7	31.8	31.8	31.5	30.6	29.5
50 Maricao	450.0	25.8	26.0	26.9	27.5	28.0	28.7	28.8	29.1	29.0	28.7	27.7	26.5
51 Maricao Fish Hatchery	450.0	25.8	26.0	26.9	27.5	28.0	28.7	28.8	29.1	29.0	28.7	27.7	26.5
52 Matrullas Dam	750.0	28.7	28.8	29.6	30.1	30.7	31.3	31.6	31.6	31.6	31.3	30.4	29.3
53 Maunabo 1 SW	15.0	29.1	29.3	30.0	30.5	31.1	31.7	32.0	32.0	32.0	31.7	30.8	29.7
57 Mora Camp	123.0	28.3	28.4	29.2	30.3	30.9	31.2	31.3	31.3	31.0	30.0	28.9	30.0
58 Naguabo 6 W	30.0	29.0	29.1	29.9	30.4	30.9	31.6	31.9	31.9	31.9	31.6	30.7	29.6
59 Paráiso	45.0	28.9	29.0	29.8	30.3	30.8	31.5	31.7	31.8	31.8	31.5	30.6	29.5
61 Peñuelas Salto Garzas	345.9	26.6	26.8	27.6	28.2	28.7	29.4	29.6	29.8	29.7	29.4	28.4	27.3
64 Puerto Real	4.5	29.2	29.3	30.0	30.6	31.1	31.7	32.0	32.1	32.1	31.8	30.9	29.8

67 Río Blanco Lower	39.0	28.9	29.1	29.8	30.3	30.9	31.5	31.8	31.9	31.8	31.6	30.6	29.5
68 Río Blanco Upper	432.0	25.9	26.1	27.0	27.6	28.1	28.8	29.0	29.2	29.1	28.8	27.8	26.6
78 San Lorenzo Espino	381.0	26.3	26.5	27.4	28.0	28.5	29.1	29.3	29.5	29.5	29.2	28.2	27.0
79 San Sebastián	67.5	28.7	28.9	29.6	30.1	30.7	31.3	31.6	31.7	31.7	31.4	30.4	29.3
80 Santa Isabel 3 NW	8.4	29.2	29.3	30.0	30.5	31.1	31.7	32.0	32.1	31.8	30.8	29.8	30.9
81 Santa Rita	52.5	28.8	29.0	29.7	30.2	30.8	31.4	31.7	31.8	31.8	31.5	30.5	29.4
82 Toa Baja Constancia	15.0	29.1	29.3	30.0	30.5	31.1	31.7	32.0	32.0	32.0	31.7	30.8	29.7
83 Toro Negro Plant 2	675.0	24.0	24.3	25.3	26.0	26.4	27.1	27.2	27.5	27.4	27.1	26.1	24.8
85 Villalba	156.0	28.0	28.2	29.0	29.5	30.1	30.7	31.0	31.1	31.0	30.7	29.8	28.7
87 Yabucoa 1 NNE	30.0	29.0	29.1	29.9	30.4	30.9	31.6	31.9	31.9	31.9	31.6	30.7	29.6
88 Yauco 1 S	7.5	29.2	29.3	30.0	30.5	31.1	31.7	32.0	32.1	31.8	30.8	29.8	29.8

¹Table 1.

²Locations of these weather stations are identified in *J. Agric. Univ. P. R.*, 70 (4): 267-75. Elevation (m) of weather stations is above sea level.

³These numbers correspond to weather station number in table 1 of *J. Agric. Univ. P. R.*, 70 (4): 267-75.

TABLE 3.—Generation of missing climatic data for Puerto Rico with temperature versus elevation relationships:
mean daily minimum temperature (°C)

Weather station ^a	Elevation												
	m	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1 ^a Aceituna	652.5	15.0	14.7	14.9	15.4	17.3	18.2	18.3	18.4	18.1	17.9	17.0	16.8
2 Adjuntas	450.0	16.1	15.9	16.1	16.8	18.5	19.3	19.5	19.6	19.3	19.0	18.2	17.1
6 Barceloneta 2 NNW	22.8	18.5	18.2	18.6	19.7	21.1	21.8	22.0	22.1	21.8	21.4	20.6	19.4
8 Bayamón Hato Tejas	54.0	18.3	18.1	18.4	19.5	20.9	21.6	21.8	21.9	21.6	21.2	20.4	19.2
9 Cabo Rojo	75.0	18.2	18.0	18.3	19.4	20.8	21.5	21.7	21.8	21.5	21.1	20.3	19.1
11 Calero Camp	73.8	18.2	18.0	18.3	19.4	20.8	21.5	21.7	21.8	21.5	21.1	20.3	19.1
13 Caonillas Villalba	180.0	17.6	17.4	17.6	18.7	20.1	20.9	21.1	21.2	20.9	20.5	19.7	18.5
16 Carite Plant 1	288.0	17.0	16.8	17.0	17.9	19.5	20.3	20.4	20.5	20.3	19.9	19.1	17.9
17 Cataño	6.0	18.5	18.3	18.7	19.9	21.2	21.9	22.1	22.2	21.9	21.4	20.6	19.5
19 Central San Francisco	9.0	18.5	18.3	18.7	19.8	21.2	21.9	22.1	22.2	21.9	21.4	20.6	19.5
21 Coamo Dam	55.5	18.3	18.1	18.4	19.5	20.9	21.6	21.8	21.9	21.6	21.2	20.4	19.2
28 Ensenada	7.5	18.5	18.3	18.7	19.8	21.2	21.9	22.1	22.2	21.9	21.4	20.6	19.5
31 Guajataca Dam	196.8	17.5	17.3	17.5	18.5	20.0	20.8	21.0	21.1	20.8	20.4	19.6	18.4
32 Guayabal Reservoir	81.0	18.1	17.9	18.2	19.3	20.7	21.5	21.7	21.7	21.5	21.0	20.2	19.1
34 Guayanilla	9.0	18.5	18.3	18.7	19.8	21.2	21.9	22.1	22.2	21.9	21.4	20.6	19.5
36 Gurabo	48.0	18.3	18.1	18.4	19.6	20.9	21.6	21.9	21.9	21.7	21.2	20.4	19.3
38 Indiera Baja	840.0	14.0	13.7	13.8	14.1	16.1	17.1	17.2	17.3	17.0	16.0	16.0	14.9
40 Jájome Alto	715.5	14.7	14.4	14.5	15.0	16.9	17.8	17.9	18.0	17.8	17.5	16.7	15.6
44 La Fe	45.0	18.3	18.1	18.4	19.6	21.0	21.7	21.9	21.9	21.7	21.2	20.4	19.3
50 Maricao	450.0	16.1	15.9	16.1	16.8	18.5	19.3	19.5	19.6	19.3	19.0	18.2	17.1
51 Maricao Fish Hatchery	450.0	16.1	15.9	16.1	16.8	18.5	19.3	19.5	19.6	19.3	19.0	18.2	17.1
52 Matrullas Dam	750.0	14.5	14.2	14.3	14.8	16.7	17.6	17.7	17.8	17.6	17.3	16.5	15.4
53 Maunabo 1 SW	15.0	18.5	18.3	18.6	19.8	21.1	21.8	22.1	22.1	21.9	21.4	20.6	19.4
57 Mora Camp	123.0	17.9	17.7	18.0	19.1	20.5	21.2	21.4	21.5	21.2	20.8	20.0	18.8
58 Naguabo 6 W	30.0	18.4	18.2	18.5	19.7	21.0	21.7	22.0	22.0	21.8	21.3	20.5	19.4
59 Paraiso	45.0	18.3	18.1	18.4	19.6	21.0	21.7	21.9	21.9	21.7	21.2	20.4	19.3
61 Peñuelas Salto Garzas	345.9	16.7	16.4	16.7	17.5	19.1	19.9	20.1	20.2	19.9	19.6	18.7	17.6
64 Puerto Real	4.5	18.6	18.3	18.7	19.9	21.2	21.9	22.1	22.2	21.9	21.5	20.7	19.5

67	Río Blanco Lower	39.0	18.4	18.2	18.5	19.6	21.0	21.7	21.9	22.0	21.7	21.3	20.5	19.3
68	Río Blanco Upper	432.0	16.2	16.0	16.2	16.9	18.6	19.4	19.6	19.7	19.4	19.1	18.3	17.2
78	San Lorenzo Espino	381.0	16.5	16.2	16.5	17.3	18.9	19.7	19.9	20.0	19.7	19.4	18.5	17.4
79	San Sebastián	67.5	18.2	18.0	18.3	19.4	20.8	21.5	21.7	21.8	21.6	21.1	20.3	19.2
80	Santa Isabel 3 NW	8.4	18.5	18.3	18.7	19.8	21.2	21.9	22.1	22.2	21.9	21.4	20.6	19.5
81	Santa Rita	52.5	18.3	18.1	18.4	19.5	20.9	21.6	21.8	21.9	21.6	21.2	20.4	19.2
82	Toa Baja Constanca	15.0	18.5	18.3	18.6	19.8	21.1	21.8	22.1	22.1	21.9	21.4	20.6	19.4
83	Toro Negro Plant 2	675.0	14.9	14.6	14.7	15.3	17.1	18.0	18.2	18.3	18.0	17.7	16.9	15.8
85	Villalba	156.0	17.7	17.5	17.8	18.8	20.3	21.0	21.2	21.3	21.0	20.6	19.8	18.7
87	Yabucoa 1 NNE	30.0	18.4	18.2	18.5	19.7	21.0	21.7	22.0	22.0	21.8	21.3	20.5	19.4
88	Yauco 1 S	7.5	18.5	18.3	18.7	19.8	21.2	21.9	22.1	22.2	21.9	21.4	20.6	19.5

¹Table 1.

²Locations of these weather stations are identified in *J. Agric. Univ. P. R.*, 70 (4): 267-75. Elevation (m) of weather stations is above sea level.

³These numbers correspond to weather station number in table 1 of *J. Agric. Univ. P. R.*, 70 (4): 267-75.

TABLE 4.—Generation of missing climatic data for Puerto Rico with temperature versus elevation relationships¹:
mean daily average temperature (°C)

Weather station ²	Elevation m	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1 ³ Aceituna	652.5	19.6	19.6	20.2	21.0	21.9	22.7	22.8	23.0	22.8	22.5	21.6	20.5
2 Adjuntas	450.0	21.0	20.9	21.5	22.3	23.2	24.0	24.1	24.3	24.1	23.8	22.9	21.8
6 Barceloneta 2 NNW	22.8	23.8	23.7	24.2	25.1	26.0	26.7	26.9	27.0	26.9	26.5	25.6	24.6
8 Bayamón Hato Tejas	54.0	23.6	23.5	24.0	24.9	25.8	26.5	26.7	26.8	26.7	26.3	25.4	24.4
9 Cabo Rojo	75.0	23.4	23.4	23.9	24.7	25.7	26.4	26.5	26.7	26.6	26.2	25.3	24.3
11 Calero Camp	73.8	23.4	23.4	23.9	24.7	25.7	26.4	26.6	26.7	26.6	26.2	25.3	24.3
13 Caonillas Villalba	180.0	22.7	22.7	23.2	24.0	25.0	25.7	25.9	26.0	25.9	25.5	24.6	23.6
16 Carite Plant 1	288.0	22.0	22.0	22.5	23.4	24.3	25.0	25.2	25.4	25.2	24.8	23.9	22.9
17 Cataño	6.0	23.9	23.8	24.3	25.2	26.2	26.8	27.0	27.1	27.0	26.6	25.8	24.7
19 Central San Francisco	9.0	23.9	23.8	24.3	25.2	26.1	26.8	27.0	27.1	27.0	26.6	25.7	24.7
21 Coamo Dam	55.5	23.5	23.5	24.0	24.9	25.8	26.5	26.7	26.8	26.7	26.3	25.4	24.4
28 Ensenada	7.5	23.9	23.8	24.3	25.2	26.2	26.8	27.0	27.1	27.0	26.6	25.7	24.7
31 Guajataca Dam	196.8	22.6	22.6	23.1	23.9	24.9	25.6	25.8	25.9	25.8	25.4	24.5	23.5
32 Guayabal Reservoir	81.0	23.4	23.3	23.8	24.7	25.7	26.3	26.5	26.7	26.5	26.1	25.3	24.2
34 Guayanilla	9.0	23.9	23.8	24.3	25.2	26.1	26.8	27.0	26.8	26.7	26.3	25.4	24.4
36 Gurabo	48.0	23.6	23.6	24.1	24.9	25.9	26.5	26.7	26.9	26.7	26.3	25.5	24.5
38 Indiera Baja	840.0	18.4	18.4	18.9	19.8	20.7	21.5	21.6	21.8	21.6	21.3	20.4	19.2
40 Jájome Alto	715.5	19.2	19.2	19.7	20.6	21.5	22.3	22.4	22.6	22.4	22.1	21.2	20.0
44 La Fe	45.0	23.6	23.6	24.1	24.9	25.9	26.6	26.7	26.9	26.8	26.4	25.5	24.5
50 Maricao	450.0	21.0	20.9	21.5	22.3	23.2	24.0	24.1	24.3	24.1	23.8	22.9	21.8
51 Maricao Fish Hatchery	450.0	21.0	20.9	21.5	22.3	23.2	24.0	24.1	24.3	24.1	23.8	22.9	21.8
52 Matrullas Dam	750.0	19.0	19.0	19.5	20.4	21.3	22.1	22.2	22.4	22.2	21.8	21.0	19.8
53 Maunabo 1 SW	15.0	23.8	23.8	24.3	25.1	26.1	26.8	26.9	27.1	26.9	26.6	25.7	24.7
57 Mora Camp	123.0	23.1	23.1	23.6	24.4	25.4	26.1	26.2	26.4	26.2	25.9	25.0	24.0
58 Naguabo 6 W	30.0	23.7	23.7	24.2	25.0	26.0	26.7	26.8	27.0	26.8	26.5	25.6	24.6
59 Paraíso	45.0	23.6	23.6	24.1	24.9	25.9	26.6	26.7	26.9	26.8	26.4	25.5	24.5
61 Peñuelas Salto Garzas	345.9	21.6	21.6	22.1	23.0	23.9	24.7	24.8	25.0	24.8	24.4	23.6	22.5
64 Puerto Real	4.5	23.9	23.9	24.3	25.2	26.2	26.8	27.0	27.2	27.0	26.6	25.8	24.8

67 Río Blanco Lower	39.0	23.7	23.6	24.1	25.0	25.9	26.6	26.8	26.9	26.8	26.4	25.5	24.5
68 Río Blanco Upper	432.0	21.1	21.1	21.6	22.4	23.4	24.1	24.2	24.4	24.3	23.9	23.0	21.9
78 San Lorenzo Espino	381.0	21.4	21.4	21.9	22.8	23.7	24.4	24.6	24.8	24.6	24.2	23.3	22.3
79 San Sebastián	67.5	23.5	23.4	23.9	24.8	25.8	26.4	26.6	26.8	26.6	26.2	25.4	24.3
80 Santa Isabel 3 NW	8.4	23.9	23.8	24.3	25.2	26.1	26.8	27.0	27.1	27.0	26.6	25.7	24.7
81 Santa Rita	52.5	23.6	23.5	24.0	24.9	25.9	26.5	26.7	26.8	26.7	26.3	25.5	24.4
82 Toa Baja Constancia	15.0	23.8	23.8	24.3	25.1	26.1	26.8	26.9	27.1	26.9	26.6	25.7	24.7
83 Toro Negro Plant 2	675.0	19.5	19.5	20.0	20.9	21.8	22.6	22.7	22.9	22.7	22.3	21.4	20.3
85 Villalba	156.0	22.9	22.9	23.4	24.2	25.2	25.9	26.0	26.2	26.0	25.6	24.8	23.7
87 Yabucoa 1 NNE	30.0	23.7	23.7	24.2	25.0	26.0	26.7	26.8	27.0	26.8	26.5	25.6	24.6
88 Yauco 1 S	7.5	23.9	23.8	24.3	25.2	26.2	26.8	27.0	27.1	27.0	26.6	25.7	24.7

¹Table 1.

²Locations of these weather stations are identified in *J. Agric. Univ. P. R.*, 70 (4): 267-75. Elevation (m) of weather stations is above sea level.

³These numbers correspond to weather station number in table 1 of *J. Agric. Univ. P. R.*, 70 (4): 267-75.

Example I: The Fortuna Substation, Juana Díaz, P. R. is located at an elevation of 12 m and is identified as station No. 7292-Ponce 4E by U.S. Department of Commerce.⁶ Estimated monthly temperature for this location:

Table 1 indicates linear relationships between temperature (Y) and elevation (X), $Y = A + B X$. With values of A, B from table 1 and $X = 12$, temperatures are calculated and shown in table 5. The observed temperature values are also given in table 5.

Example II: Estimate potential evapotranspiration (PET) for January with information in table 1.

Hargreaves and Samani⁴ indicated the following relationships to estimate PET:

$$PET = 0.0023 \times R_a \times (T + 17.8) \times (TMAX - TMIN)^{0.5} \dots /1/$$

$$PET = 0.0135 \times R_a \times (T + 17.8) \dots \dots \dots /2/$$

where, PET is potential evapotranspiration (mm per day); R_a is extraterrestrial radiation (mm per day); T is mean daily average temperature in °C, TMAX and TMIN are mean daily maximum and minimum temperatures in °C. R_a for Puerto Rico (18°N) is 11.68 for January, 13.02 for February, 14.65 for March, 15.83 for April, 16.30 for May, 16.38 for June, 16.38 for July, 15.80 for August, 15.23 for September, 13.62 for

TABLE 5.—Observed and estimated temperatures at Fruits Substation Juana Díaz, Puerto Rico¹

Month	Temperature °C ²									
	Mean Average		Mean Maximum		Mean Minimum		Absolute Highest		Absolute Lowest	
	OBS	EST	OBS	EST	OBS	EST	OBS	EST	OBS	EST
Jan	24.3	23.8	30.1	29.1	18.6	18.5	36.1	33.7	13.3	12.9
Feb	24.3	23.8	29.9	29.3	18.6	18.3	35.0	34.3	12.2	12.6
Mar	24.6	24.3	30.3	30.0	18.9	18.6	34.4	35.0	13.3	12.9
April	25.4	25.1	30.7	30.5	20.3	19.8	34.4	35.5	14.4	14.3
May	26.4	26.1	31.2	31.1	21.8	21.2	35.6	35.6	16.1	15.5
June	27.1	26.8	31.7	31.7	22.6	21.9	36.7	35.9	14.4	16.7
July	27.3	26.9	32.1	32.0	22.6	22.1	36.7	36.1	14.4	16.8
Aug	27.6	27.1	32.5	32.0	22.6	22.1	37.8	36.3	16.1	17.2
Sept	27.4	27.0	32.4	32.0	22.4	21.9	36.7	36.4	18.3	16.8
Oct	27.0	26.6	32.0	31.8	21.9	21.4	36.7	35.9	16.1	16.5
Nov	26.2	25.7	31.5	30.8	21.0	20.6	36.7	35.3	15.6	15.3
Dec	25.2	24.7	30.7	29.7	19.6	19.5	35.6	34.2	12.8	14.1
Annual	26.1	25.7	31.3	30.8	20.9	20.5	36.0	35.3	14.8	15.1

¹ Weather station No. 7292 PONCE 4E at an elevation of 21 m.

² Temperature values were estimated using relationships between temperature (°C) and elevation (m) given in table 1. Observed temperature is from climatology of the U.S. No. 86-45—Puerto Rico and U.S. Virgin Islands.⁶

October, 12.11 for November, 11.29 mm per day for December, respectively. R_s is incident solar radiation.

PET was calculated with equations /1/ and /2/, values of R_s , T, TMAX and TMIN. PET values are given below:

Equation /1/: PET = 2.4 mm/day for January

Equation /2/ and $R_s = 6.9$: PET = 3.4 mm/day for January

Example III: Develop PET model as a function of incident solar radiation (R_s) and elevation (X) with temperature versus elevation relationships in table 1. Temperature (T, °C) and elevation (X, m) is defined by the following relationship:

$$T = A + B \times r X \dots\dots\dots /3/$$

where A, B are regression coefficients defined by table 1 for January through December. Combining equations /2/ and /3/, we obtain:

$$PET_{NEW} = 0.0135 \times R_s \times (A + B \times X + 17.8) \dots\dots\dots /4/$$

Rearranging:

$$PET_{NEW} = R_s \times (0.0135 \times A + 0.0135 B \times X + 17.8 \times 0.0135) . /5/$$

or

$$PET_{NEW} = R_s \times ((0.2403 + 0.0135 \times A) + (0.0135 \times B) X) . /6/$$

or

$$PET_{NEW} = R_s \times (A^1 + B^1 \times X) \dots\dots\dots /7/$$

where, $A^1 = 0.2403 + 0.0135 A$, and $B^1 = 0.0135 B$. For January through December, equation /7/ reduces to:

$$PET_{NEW}_i = R_s \times (A_i^1 + B_i^1 \times X) \dots\dots\dots /8/$$

where $i = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12$ for January, February, March, April, May, June, July, August, September, October, November, December, respectively. Introducing values of A_i and B_i from table 1, we obtain values of A_i^1 and B_i^1 and equation /8/ reduces to the following equations:

$$\text{January: } PET_{JAN} = R_s \times (0.563085 - 8.8695 \times 10^{-5} \times X) . /9/$$

$$\text{February: } PET_{FEB} = R_s \times (0.56268 - 8.8425 \times 10^{-5} \times X) . /10/$$

$$\text{March: } PET_{MAR} = R_s \times (0.569295 - 8.721 \times 10^{-5} \times X) . /11/$$

$$\text{April: } PET_{APR} = R_s \times (0.580635 - 8.7075 \times 10^{-5} \times X) . /12/$$

$$\text{May: } PET_{MAY} = R_s \times (0.594 - 8.8965 \times 10^{-5} \times X) \dots\dots /13/$$

$$\text{June: } PET_{JUN} = R_s \times (0.602775 - 8.559 \times 10^{-5} \times X) \dots /14/$$

$$\text{July: } PET_{JUL} = R_s \times (0.605205 - 8.7075 \times 10^{-5} \times X) \dots /15/$$

$$\text{August: } PETAUG = R_s \times (0.60723 - 8.5725 \times 10^{-5} \times X) . /16/$$

TABLE 6.—Temperature and potential evapotranspiration (PET) for 36 weather stations in Puerto Rico with Hargreaves and Samani model

Weather station (elevation, m) ¹	Parameter ²	Units	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
3. ^a Aguirre (15.0)	TMAX	°C	29.9	29.8	30.2	30.6	31.2	31.7	32.1	32.5	32.5	32.3	31.7	30.7
	TMIN	°C	20.0	19.9	20.5	21.5	22.7	23.7	23.6	23.7	23.2	22.9	22.1	21.0
	TAVG	°C	25.0	24.9	25.3	26.0	27.9	27.6	27.9	28.1	27.9	27.6	26.9	25.9
	PETHS1	mm/day	3.62	4.02	4.52	4.80	4.89	4.90	5.02	4.96	4.87	4.35	3.87	3.54
		mm/month	112.2	112.6	140.1	144.0	151.6	147.0	155.6	153.8	146.1	134.9	116.1	109.1
4. Aibonito (690.0)	TMAX	°C	22.8	23.3	24.4	25.5	26.5	27.1	26.8	27.2	27.1	26.6	25.1	23.8
	TMIN	°C	16.6	16.7	16.9	14.7	18.9	19.6	19.7	20.1	19.9	19.7	19.0	17.6
	TAVG	°C	19.7	20.0	20.7	20.1	22.7	23.3	23.3	23.7	23.5	23.1	22.0	20.7
	PETHS1	mm/day	2.50	2.90	3.55	4.54	4.19	4.23	4.14	4.02	3.88	3.36	2.73	2.49
		mm/month	77.5	81.2	110.1	136.2	129.9	126.9	128.3	124.6	116.4	104.2	81.9	77.2
5. Arecibo 2 ESE (4.5)	TMAX	°C	28.6	28.4	29.3	30.1	30.9	31.7	31.8	31.9	32.0	31.8	30.5	29.3
	TMIN	°C	18.2	17.7	17.9	18.9	20.4	21.1	21.4	21.6	21.6	21.1	20.2	19.2
	TAVG	°C	23.4	23.1	23.6	24.5	25.6	26.4	26.6	26.8	26.8	26.4	25.4	24.2
	PETHS1	mm/day	3.58	4.01	4.71	5.14	5.28	5.42	5.41	5.21	5.05	4.54	3.85	3.47
		mm/month	110.9	112.3	146.0	154.2	163.7	162.6	167.7	161.5	151.5	140.7	115.5	107.5
7. Barranquitas (540.0)	TMAX	°C	23.7	23.8	25.2	25.9	26.3	27.0	26.6	27.2	27.1	26.8	26.1	24.1
	TMIN	°C	15.6	15.6	15.9	16.8	17.9	18.6	18.8	18.9	18.8	18.6	17.7	16.6
	TAVG	°C	19.6	19.6	20.5	21.4	22.1	22.8	22.7	23.1	22.9	22.7	21.9	20.3
	PETHS1	mm/day	2.85	3.22	3.93	4.32	4.35	4.44	4.26	4.26	4.09	3.65	3.20	2.70
		mm/month	88.4	90.2	121.8	129.6	134.8	133.2	132.0	132.1	122.7	113.2	96.0	83.7
10. Caguas (75.0)	TMAX	°C	29.0	29.3	30.2	30.9	31.4	31.7	32.0	32.4	32.4	32.1	30.9	29.7
	TMIN	°C	16.4	16.3	16.7	18.1	20.2	21.0	20.9	20.8	20.7	19.3	19.1	17.3
	TAVG	°C	22.7	22.8	23.4	24.5	25.8	26.4	26.5	26.6	26.6	25.7	25.0	23.5
	PETHS1	mm/day	3.86	4.39	5.10	5.51	5.46	5.45	5.55	5.49	5.31	4.87	4.11	3.77
		mm/month	119.7	122.9	158.1	165.3	169.3	163.5	172.1	170.2	159.3	150.9	123.3	116.87
12. Canóvanas 2N	TMAX	°C	28.4	28.7	29.4	30.1	31.1	31.4	31.1	31.5	31.6	31.5	30.2	28.9

(9.0)	TMIN	°C	18.6	18.4	18.8	19.9	21.3	22.1	22.4	22.7	22.0	21.4	20.6	19.6
	TAVG	°C	23.5	23.5	24.1	25.0	26.2	26.7	26.8	27.1	26.8	26.5	25.4	24.2
	PETHS1	mm/day	3.48	3.97	4.60	4.97	5.15	5.12	4.96	4.84	4.83	4.40	3.72	3.38
15. Carite Camp Tunnel (600.0)		mm/month	107.9	111.2	142.6	149.1	159.7	153.6	153.8	150.0	144.9	136.4	111.6	103.2
	TMAX	°C	25.4	25.4	26.2	26.2	26.5	26.5	26.8	27.6	27.8	27.6	27.2	26.1
	TMIN	°C	16.4	16.1	16.5	17.3	18.5	19.4	19.7	19.8	19.6	19.2	18.4	17.5
	TAVG	°C	20.9	20.8	21.4	21.8	22.4	22.9	23.2	23.7	23.7	23.4	22.8	21.8
	PETHS1	mm/day	3.12	3.53	4.11	4.30	4.18	4.09	4.12	4.19	4.17	3.75	3.36	3.01
18. Cayey 1 NW (420.0)		mm/month	96.7	98.9	127.4	129.0	129.6	122.7	127.7	129.9	125.1	116.3	100.8	93.3
	TMAX	°C	26.9	27.4	28.3	29.0	29.2	29.5	29.7	30.1	30.2	29.7	28.9	27.6
	TMIN	°C	15.1	14.8	15.2	16.8	18.3	19.2	19.4	19.5	19.0	18.4	17.4	16.2
	TAVG	°C	21.0	21.1	21.8	22.9	23.8	24.4	24.6	24.8	24.6	24.1	23.2	21.9
	PETHS1	mm/day	3.58	4.13	4.82	5.17	5.14	5.09	5.12	5.03	4.96	4.41	3.86	3.48
20. Cidra 3 E (420.0)		mm/month	111.0	115.6	149.4	155.1	159.3	152.7	158.7	155.9	148.8	136.7	115.8	107.9
	TMAX	°C	25.9	25.7	27.6	27.9	28.5	28.4	28.9	29.0	28.0	28.9	28.0	26.5
	TMIN	°C	15.7	14.8	16.5	18.0	19.1	19.2	19.1	18.7	18.7	18.6	17.3	16.6
	TAVG	°C	20.8	20.2	22.0	22.9	23.8	23.8	24.0	23.9	23.9	23.6	22.6	21.6
	PETHS1	mm/day	3.32	3.75	4.82	4.80	4.80	4.76	4.77	4.68	4.68	4.25	3.69	3.21
22. Coloso (15.0)		mm/month	103.0	105.0	136.4	144.6	148.8	144.0	147.6	147.9	140.4	131.8	110.7	99.5
	TMAX	°C	29.9	29.9	30.6	31.0	31.5	32.3	32.6	32.6	32.4	32.2	31.4	30.5
	TMIN	°C	16.8	16.6	17.2	18.4	20.0	20.6	20.9	21.1	20.8	20.3	19.5	18.5
	TAVG	°C	23.4	23.3	23.9	24.7	25.8	26.4	26.8	26.8	26.6	26.4	25.4	24.3
	PETHS1	mm/day	4.01	4.48	5.14	5.49	5.54	5.70	5.72	5.50	5.30	4.77	4.15	3.84
23. Comerio Falls (150.0)		mm/month	124.3	125.4	159.3	164.7	171.7	171.0	177.3	170.5	159.0	147.9	124.5	119.0
	TMAX	°C	27.2	27.2	28.2	29.0	29.6	30.3	32.2	30.4	30.3	29.9	28.8	27.8
	TMIN	°C	18.1	17.9	18.1	19.3	20.7	21.6	21.8	21.8	21.6	21.0	20.1	19.1
	TAVG	°C	22.6	22.5	23.1	24.1	25.2	25.9	27.0	26.1	25.9	25.4	24.5	23.4
	PETHS1	mm/day	3.27	3.68	4.37	4.76	4.80	4.85	5.44	4.68	4.54	4.04	3.48	3.16
	mm/month	101.4	103.0	135.5	142.8	148.8	145.5	168.6	145.1	136.2	125.2	104.4	98.0	

TABLE 6.—Continued

Weather station (elevation, m) ^a	Parameter ^b	Units	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
24. Corozal 4 W (120.0)	TMAX	°C	28.0	28.2	28.9	29.8	30.6	31.1	30.8	30.8	31.1	30.9	29.8	28.6
	TMIN	°C	16.8	16.5	16.9	17.9	19.4	20.2	20.6	20.8	20.4	19.9	19.1	17.7
	TAVG	°C	22.4	22.4	22.9	23.9	25.0	25.6	25.7	25.8	25.8	25.4	24.4	23.2
	PETHS1	mm/day	3.61	4.12	4.76	5.23	5.37	5.39	5.24	5.02	4.99	4.50	3.84	3.51
		mm/month	112.0	115.4	147.6	157.0	166.5	161.7	162.4	155.6	149.7	139.5	115.2	108.8
25. Dorado 4 W (7.5)	TMAX	°C	27.7	27.9	28.8	29.3	30.0	30.8	30.4	30.8	31.1	30.8	29.5	28.3
	TMIN	°C	19.6	19.3	19.5	20.5	21.8	22.4	22.7	22.9	22.5	21.9	21.3	20.4
	TAVG	°C	23.6	23.6	24.1	24.9	25.9	26.6	26.6	26.9	26.8	26.4	25.4	24.4
	PETHS1	mm/day	3.17	3.64	4.30	4.62	4.70	4.83	4.63	4.57	4.59	4.11	3.45	3.09
		mm/month	98.3	102.0	133.3	138.6	145.7	145.0	143.5	141.7	137.7	127.4	103.5	95.8
27. Dos Bocas (60.0)	TMAX	°C	29.4	29.7	30.6	31.3	31.7	32.7	35.7	32.5	32.9	32.6	31.6	30.5
	TMIN	°C	27.5	16.9	17.3	18.3	19.8	20.5	21.1	21.2	20.7	20.4	19.9	18.5
	TAVG	°C	23.4	23.3	23.9	24.8	25.8	26.6	28.4	26.8	26.8	26.5	25.7	24.5
	PETHS1	mm/day	3.82	4.39	5.12	5.59	5.64	5.85	6.64	5.46	5.47	4.84	4.14	3.80
		mm/month	118.4	123.0	158.7	167.7	174.8	175.5	205.8	169.3	164.1	150.0	124.2	117.8
29. Fajardo (12.0)	TMAX	°C	28.3	28.4	28.8	29.3	30.2	30.6	30.9	31.3	31.3	31.1	30.1	28.9
	TMIN	°C	20.8	20.6	21.1	22.1	23.3	24.1	24.3	24.3	24.7	23.1	22.3	21.7
	TAVG	°C	24.6	24.5	24.9	25.7	26.7	27.3	27.6	27.8	27.5	27.1	26.2	25.3
	PETHS1	mm/day	3.10	3.54	4.02	4.27	4.38	4.35	4.42	4.37	4.38	3.99	3.42	3.02
		mm/month	96.1	99.1	124.6	128.1	135.8	130.5	137.0	135.5	131.4	123.7	102.6	93.6
30. Garzas DAM (745.5)	TMAX	°C	23.8	24.2	24.8	25.6	25.9	27.1	27.3	27.2	27.1	26.7	25.8	24.7
	TMIN	°C	14.0	13.9	14.4	14.4	16.3	17.2	17.1	17.4	17.1	16.7	15.9	15.1
	TAVG	°C	18.9	19.1	19.6	20.0	21.1	22.1	22.2	22.3	22.1	21.7	20.8	19.9
	PETHS1	mm/day	3.08	3.55	4.05	4.59	4.54	4.72	4.80	4.57	4.42	3.90	3.38	3.04
		mm/month	95.5	99.4	125.6	137.7	140.7	141.6	148.8	141.7	132.6	120.9	101.4	94.2
33. Guayama	TMAX	°C	29.8	29.8	30.4	30.6	31.0	31.5	31.7	32.2	32.2	31.9	31.3	30.1

(58.5)	TMIN	°C	21.3	21.0	21.4	22.1	23.0	23.6	23.9	24.1	23.6	23.4	22.8	22.1
	TAVG	°C	25.5	25.4	26.9	26.4	27.0	27.8	27.8	28.1	27.9	27.7	27.1	26.1
	PETHS1	mm/day	3.39	3.83	4.42	4.69	4.75	4.80	4.79	4.77	4.71	4.14	3.63	3.23
		mm/month	105.1	107.2	137.0	140.7	147.3	144.0	148.5	147.9	141.3	128.3	108.9	100.1
34b. Guineo Reservoir (900.0)	TMAX	°C	21.7	21.8	22.6	23.2	23.8	24.7	25.2	25.3	25.0	24.6	23.7	22.5
	TMIN	°C	13.4	13.0	13.1	14.1	15.6	16.6	16.9	16.8	16.5	16.1	15.4	14.4
	TAVG	°C	17.6	17.4	17.8	18.6	19.7	20.7	21.0	21.2	20.8	20.3	19.6	18.4
	PETHS1	mm/day	2.72	3.12	3.69	3.99	4.03	4.13	4.21	4.10	3.94	3.47	3.00	2.68
		mm/month	84.3	87.4	114.4	119.7	125.0	123.9	130.5	127.1	112.2	107.6	90.0	83.1
37. Humacao 1 SW (30.0)	TMAX	°C	27.8	28.2	29.2	29.9	30.1	30.6	30.8	31.2	31.0	30.7	29.6	28.2
	TMIN	°C	17.8	17.9	18.7	20.3	21.9	22.9	22.7	22.4	22.1	21.3	20.1	18.6
	TAVG	°C	22.8	23.0	23.9	25.1	26.0	26.8	26.8	26.8	26.5	26.0	24.8	23.4
	PETHS1	mm/day	3.45	3.92	4.55	4.84	4.70	4.66	4.78	4.81	4.64	4.21	3.66	3.32
		mm/month	107.0	109.8	141.1	145.2	145.7	139.8	148.2	149.1	139.2	130.5	109.8	102.9
39. Isabela 4 SW (126.0)	TMAX	°C	28.4	28.4	29.2	29.8	30.3	30.9	31.2	31.4	31.6	31.3	30.2	29.1
	TMIN	°C	18.6	18.4	18.7	19.4	20.6	21.2	21.8	21.7	21.4	20.9	20.5	19.5
	TAVG	°C	23.5	23.4	23.9	24.6	25.4	26.1	26.5	26.5	26.5	26.1	25.4	24.3
	PETHS1	mm/day	3.48	3.39	4.55	4.97	5.04	5.17	5.13	5.02	4.94	4.42	3.75	3.38
		mm/month	107.9	108.9	141.1	149.1	156.2	155.1	126.0	155.6	148.2	137.0	172.5	104.8
41. Jayuya (120.0)	TMAX	°C	26.1	26.5	28.2	28.7	29.1	30.2	29.8	30.3	29.9	29.7	20.1	27.1
	TMIN	°C	17.3	16.3	16.4	17.5	18.9	19.9	19.7	19.4	19.1	18.4	18.3	17.1
	TAVG	°C	21.7	21.4	22.3	23.1	24.0	25.1	24.8	24.9	24.5	24.1	23.2	22.1
	PETHS1	mm/day	3.15	3.74	4.64	4.97	5.00	5.16	5.15	5.13	4.85	4.41	3.57	3.28
		mm/month	97.7	104.7	125.2	149.1	155.0	154.8	159.7	159.0	145.8	136.7	107.1	101.7
43. Juana Díaz Camp (60.0)	TMAX	°C	30.8	30.8	31.2	31.6	31.7	32.3	33.1	32.9	32.4	32.2	31.7	31.2
	TMIN	°C	18.7	18.5	18.8	19.8	21.2	21.9	22.2	22.1	21.7	21.5	20.6	19.5
	TAVG	°C	24.7	24.6	25.0	25.7	26.4	27.1	27.6	27.5	27.1	26.8	26.1	25.3
	PETHS1	mm/day	3.98	4.45	5.07	5.45	5.37	5.47	5.63	5.43	5.15	4.57	4.09	3.83
		mm/month	123.4	124.6	157.2	163.5	166.5	164.1	174.5	168.3	154.5	151.0	122.7	118.7

TABLE 6.—Continued

Weather station (elevation, m) ¹	Parameter ^a	Units	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
44. Juncos 1 E (81.0)	TMAX	°C	29.9	30.0	30.7	31.3	31.7	32.0	32.3	32.4	32.3	31.9	31.1	30.2
	TMIN	°C	15.8	15.8	16.2	17.2	19.2	19.7	19.6	19.8	20.1	19.3	18.2	16.9
	TAVG	°C	22.9	22.9	23.5	24.3	25.4	25.8	25.9	26.1	26.2	25.6	24.7	23.6
	PETHS1	mm/day	4.11	4.60	5.30	5.76	5.73	5.77	5.87	5.65	5.40	4.83	4.25	3.92
		mm/month	127.4	128.8	164.3	172.8	177.6	173.1	182.0	175.2	162.0	149.7	127.5	121.5
45. Lajas (30.0)	TMAX	°C	29.9	30.2	30.8	31.3	31.7	32.4	33.0	32.5	31.9	31.5	31.2	30.4
	TMIN	°C	16.0	15.9	15.8	18.1	19.8	20.6	20.0	20.1	20.3	19.8	18.3	16.8
	TAVG	°C	22.9	23.0	23.3	24.7	25.8	26.5	26.5	26.3	26.1	25.6	24.8	23.6
	PETHS1	mm/day	4.08	4.62	5.36	5.63	5.64	5.74	6.02	5.65	5.24	4.66	4.26	3.97
		mm/month	126.5	129.4	166.1	169.0	174.8	172.2	186.6	175.2	157.2	144.5	127.8	123.1
47. Lares (360.0)	TMAX	°C	28.7	28.8	29.7	30.1	30.6	31.3	31.4	31.6	31.5	31.4	30.4	19.1
	TMIN	°C	15.7	15.2	15.6	16.4	17.6	18.2	18.7	18.8	18.4	20.5	17.7	16.6
	TAVG	°C	22.2	22.0	22.6	23.2	24.1	24.8	25.0	25.2	25.0	25.9	24.1	22.9
	PETHS1	mm/day	3.87	4.40	5.12	5.52	5.66	5.79	5.76	5.58	5.41	4.52	4.17	3.73
		mm/month	120.0	123.2	158.7	165.6	175.5	173.7	178.6	173.0	162.3	140.1	125.1	115.6
48. Manatí (75.0)	TMAX	°C	28.2	28.7	29.4	30.2	31.2	31.9	31.8	31.9	31.8	31.6	30.2	28.7
	TMIN	°C	17.9	17.6	17.9	19.0	20.1	21.1	21.3	21.5	21.2	20.6	19.9	18.8
	TAVG	°C	23.0	23.1	23.7	24.6	26.5	26.5	26.5	26.5	26.5	26.1	25.1	23.8
	PETHS1	mm/day	3.52	4.08	4.75	5.17	5.42	5.51	5.41	5.23	5.07	4.55	3.82	3.38
		mm/month	109.1	114.2	147.3	155.1	168.0	165.3	167.7	162.1	152.1	141.1	114.6	104.8
54. Mayagüez (24.0)	TMAX	°C	29.9	30.2	30.8	31.2	31.6	32.2	32.2	32.4	32.5	32.1	31.1	30.4
	TMIN	°C	17.4	17.1	17.2	18.1	19.4	20.2	20.1	20.3	20.3	20.2	19.4	18.4
	TAVG	°C	23.6	23.6	24.0	24.6	25.5	26.1	26.1	26.3	26.4	26.1	25.3	24.4
	PETHS1	mm/day	3.94	4.48	5.19	5.61	5.67	5.77	5.77	5.58	5.41	4.74	4.09	3.79
		mm/month	122.1	125.4	160.9	168.3	175.8	173.1	178.9	173.0	162.3	146.9	122.7	117.5

60. Patillas DAM (721.0)	TMAX	°C	28.2	28.5	29.1	29.2	29.8	29.9	30.0	30.8	30.9	30.4	29.6	28.7
	TMIN	°C	19.8	19.2	19.2	19.9	20.9	21.6	21.8	22.1	21.9	21.4	21.2	20.7
	TAVG	°C	24.0	23.9	24.1	24.6	25.4	25.8	25.9	26.4	26.4	25.9	25.4	24.7
	PETHS1	mm/day	3.26	3.80	4.44	4.71	4.83	4.72	4.72	4.76	4.65	4.11	3.84	3.12
		mm/month	101.1	106.4	137.6	141.3	149.8	141.6	146.1	147.6	139.5	127.4	104.4	96.7
62. Ponce 4 E (12.0)	TMAX	°C	30.1	29.9	30.3	30.7	31.2	31.7	32.1	32.5	32.4	32.0	31.5	30.7
	TMIN	°C	18.6	18.6	18.9	20.3	21.8	22.6	22.6	22.6	22.4	21.9	21.0	19.6
	TAVG	°C	24.3	24.3	24.6	25.5	26.5	27.1	27.4	27.5	27.4	27.0	26.3	25.2
	PETHS1	mm/day	3.83	4.25	4.83	5.08	5.09	5.11	5.24	5.19	4.99	4.45	3.98	3.72
		mm/month	118.7	119.0	137.6	152.4	157.8	153.3	162.4	160.9	149.7	138.0	119.4	115.3
65. Quebradilla (111.6)	TMAX	°C	27.8	27.9	28.6	29.2	29.9	30.6	30.8	30.9	30.8	30.6	29.6	28.6
	TMIN	°C	18.2	17.8	17.9	19.0	20.2	20.9	21.4	21.4	20.9	20.5	20.1	19.1
	TAVG	°C	23.0	22.9	23.3	24.1	25.0	25.7	26.1	26.2	25.9	25.5	24.8	23.8
	PETHS1	mm/day	3.40	3.88	4.52	4.86	5.01	5.10	5.05	4.93	4.82	4.30	3.67	3.32
		mm/month	105.4	108.6	140.1	145.8	155.3	153.0	156.6	152.8	144.6	133.3	110.1	102.9
66. Ramey Air Force Base (71.1)	TMAX	°C	26.8	26.8	27.5	28.0	28.8	29.5	29.7	30.1	30.1	29.8	28.7	27.6
	TMIN	°C	20.3	20.1	20.3	21.3	22.4	23.1	23.4	23.3	23.2	22.9	22.3	21.2
	TAVG	°C	23.6	23.5	23.9	24.6	25.6	26.3	26.6	26.7	26.7	26.3	25.5	24.4
	PETHS1	mm/day	2.84	3.20	3.76	4.01	4.10	4.22	4.19	4.19	4.04	3.63	3.05	2.78
		mm/month	88.0	89.6	116.7	120.3	127.1	126.6	129.9	129.9	122.7	112.5	91.5	86.2
71. Río Piedras (30.0)	TMAX	°C	28.3	28.4	29.3	29.8	30.5	31.2	31.1	31.4	31.6	31.3	30.2	29.1
	TMIN	°C	18.1	17.6	18.2	19.1	20.7	21.5	21.9	21.8	21.6	21.1	20.2	19.1
	TAVG	°C	23.2	23.0	23.8	24.4	25.6	26.3	26.5	26.1	26.6	26.2	25.2	24.1
	PETHS1	mm/day	3.51	4.02	4.67	5.05	5.09	5.17	5.07	5.01	4.91	4.39	3.80	3.44
		mm/month	108.9	112.6	144.8	151.5	157.8	155.0	157.2	155.3	147.3	136.1	114.0	106.6
75. San Germán (114.0)	TMAX	°C	30.4	30.6	30.8	31.2	31.6	32.3	32.8	32.9	32.4	32.3	31.6	31.1
	TMIN	°C	16.6	16.7	17.2	18.2	19.9	20.6	20.3	20.4	20.7	20.2	19.2	17.6
	TAVG	°C	23.5	23.6	24.0	24.7	25.8	26.4	26.6	26.7	26.6	26.2	25.4	24.4
	PETHS1	mm/day	4.12	4.62	5.19	5.57	5.58	5.72	5.91	5.70	5.31	4.78	4.24	4.02
		mm/month	127.7	129.4	160.9	167.1	173.0	171.6	183.2	176.7	159.3	148.2	127.2	124.6

TABLE 6.—Continued

Weather station (elevation, m) ¹	Parameter ²	Units	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	
84. Utuado (129.9)	TMAX	°C	29.7	30.1	31.1	31.5	31.8	32.8	32.9	32.8	32.8	32.6	31.5	30.1	
	TMIN	°C	14.4	14.5	14.5	16.6	18.2	18.7	18.7	18.9	18.7	18.2	17.5	15.6	
	TAVG	°C	22.1	22.3	22.8	24.0	25.0	25.8	25.8	27.9	25.8	25.4	24.5	22.9	
	PETHS1	mm/day		4.18	4.75	5.58	5.89	5.92	6.18	6.20	5.92	5.72	5.12	4.41	4.02
		mm/month		129.6	133.0	173.0	176.7	183.5	185.4	192.2	183.5	171.6	158.7	132.3	124.6

Caution: These values are only for Puerto Rico.

¹Locations of these weather stations are identified in table 1 and isohyetal charts in *J. Agric. Univ. P. R.*, 70 (4): 267-75. Elevation (m) of weather station is above sea level.

²TMAX = Mean daily maximum temperature °C, TMIN = Mean daily minimum temperature °C, T or TAVG = Mean daily average temperature °C, PETHS1 = Potential evapotranspiration defined by equation /1/, mm/day or mm/month.

³These numbers correspond to weather stations in table 1 and isohyetal charts in *J. Agric. Univ. P. R.*, 70 (4): 267-75.

$$\text{September: PETSEP} = R_s \times (0.60534 - 8.694 \times 10^{-5} \times X) \quad /17/$$

$$\text{October: PETOCT} = R_s \times (0.600075 - 8.667 \times 10^{-5} \times X) \quad /18/$$

$$\text{November: PETNOV} = R_s \times (0.588465 - 8.694 \times 10^{-5} \times X) \quad /19/$$

$$\text{December: PETDEC} = R_s \times (0.57483 - 8.964 \times 10^{-5} \times X) \quad /20/$$

$$\text{Annual: PETANUAL} = R_s \times (0.58779 - 8.748 \times 10^{-5} \times X) \quad /21/$$

where $PETNEW_1$ = Potential evapotranspiration in mm per day, R_s = Incident solar radiation in mm per day and X = elevation in m. Equations /9/ to /21/ are only valid for Puerto Rico.

Equations /9/ to /21/ are valid only for Puerto Rico and for $4.5 \leq X \leq 900$. Eq. /1/ can not be used to develop equations /9/ to /21/ because coefficient of correlation between $(TMAX - TMIN)$ versus elevation is very poor (table 1) for all months. This is explained by the fact that R_s varies at all locations in Puerto Rico. When the temperature data are not available, equations /9/ to /21/ are useful because elevation of a location is readily available from property records, U.S. Weather Bureau, U.S. Geological Survey, USDA-SCS, or another local government agency in Puerto Rico. It is not possible to combine equations /9/ to /21/ into one equation as the relationships among temperature versus elevation are different for January through December.

Example IV: Estimate PET for 36 locations in Puerto Rico with the Hargreaves and Samani model.

Hargreaves and Samani⁴ indicated following relationship:

$$PET = 0.0023 \times R_a \times (T + 17.8) \times (TMAX - TMIN^{0.5}) \quad /1/$$

R_a for Puerto Rico is given in example II. T , $TMAX$ and $TMIN$ ($^{\circ}C$) are from Climatology of the United States No. 86-45 for Puerto Rico.⁵

⁶ PET for 36 locations in Puerto Rico was estimated with equation /1/ and temperature data. These PET values are shown in table 6.

