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SHORT CONTRIBUTION

Three statistical models for simulation of the mean monthly wet bulb air temperature in Mexico

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RESUMEN

Se presentan tres modelos estadísticos para la estimación de la temperatura de bulbo húmedo media mensual ($T\omega$) en la República Mexicana. Se trata de funciones multilineales de parámetros como temperatura, precipitación y nubosidad, los cuales se miden rutinariamente en cerca de 1,500 estaciones climatológicas que hay en el país. Los tres modelos dan una buena estimación de $T\omega$.

ABSTRACT

Three statistical models for estimation of the mean monthly wet bulb air temperature ($T\omega$) in Mexico are presented. They are multi-linear functions of climatic parameters such as temperature, precipitation and cloudiness. These variables are routinely observed in about 1,500 climatological stations in Mexico. The three propossed models give a fairy good estimate of $T\omega$.

1. Background

Since only around 80 meteorological stations in Mexico make moisture measurements, recently some models have been proposed in order to etimate the humidity variables. Mosiño (1989) showed a method for estimation of both annual and monthly values of air vapor pressure, dew point and wet bulb temperature, and relative humidity, based on surface air temperature and place altitude records.

Arteaga *et al.* (1989) presented a linear regression model for mean monthly relative humidity in Mexico, with the thermal oscillation (ΔT, the diference of mean monthly maxima and minima air temperatures) as independent variable. They do not show however the accuracy of their model. Tejeda (1990) found for the Mexican Eastern slopes of the Sierra Madre facing of the Gulf of Mexico, that:

$$T\omega = -9.5 + 1.13T - 0.005r + 0.081M + 0.26N \tag{1}$$

where $T\omega$ is the mean monthly wet bulb temperature, T is the mean monthly air temperature, r is the mean monthly precipitation, M is the monthly average of partial cloudy days and N is the monthly average of cloudy days. In his calculations he used averages of 30 years (1941-1970) in a matrix for 84 rows (7 stations × 12 months). The linear correlation coefficients among the independent variables were all small. The general linear correlation coefficient of Eq. 1 model were of 0.98 and the standard regression error was of 0.8°C.

2. The models

For all Mexico and using the mean monthly data we have found the following expressions:

Model 1:

$$T\omega = A_o + A_1 T + A_2 \Delta T \tag{2}$$

Model 2:

$$T\omega = A_o + A_1 T + A_2 \Delta T + A_3 r \tag{3}$$

Model 3:

$$T\omega = A_o + A_1 T + A_2 \Delta T + A_3 M + A_4 N \tag{4}$$

The A_i are the regression coefficients (Tables 1, 2 and 3). Their evaluation was made by means of the information provided from the 56 Mexican meteorological stations reported by "Normales climatológicas 1941-1970" (*Ser. Meteor. Nal.,* 1982). The other letters have the same meaning that in the section **1** of this paper. N, M and r can not be independent variables in the same model, since r is correlated with N and M. Table 4 shows the comparisons of the accuracy of the three models.

Table 1. Regression coefficients of Model 1.

Month	A_o	A_1	A_2	Partial correlation coefficients of T	ΔT
January	-2.04	1.02	-0.18	0.92	0.22
February	-2.51	1.05	-0.22	0.88	0.25
March	-2.81	1.08	-0.29	0.82	0.32
April	-1.17	1.02	-0.36	0.78	0.36
May	-0.37	0.96	-0.32	0.76	0.28
June	4.14	0.84	-0.42	0.82	0.37
July	4.80	0.81	-0.40	0.82	0.28
August	2.60	0.86	-0.31	0.90	0.28
September	2.14	0.89	-0.31	0.92	0.30
October	1.76	0.91	-0.31	0.88	0.31
November	0.24	0.94	-0.24	0.84	0.19
December	-2.59	1.02	-0.14	0.91	0.12

Table 2. Regression coefficients of Model 2.

Month	A_0	A_1	A_2	A_3	Partial correlation coefficients of T	ΔT	r
January	-2.93	1.02	-0.15	0.03	0.93	0.15	0.11
February	-4.20	1.06	-0.16	0.06	0.90	0.15	0.16
March	-4.27	1.07	-0.24	0.08	0.85	0.28	0.22
April	-2.40	1.03	-0.36	0.04	0.80	0.40	0.14
May	-1.50	0.97	-0.30	0.02	0.79	0.27	0.13
June	2.55	0.84	-0.37	0.01	0.85	0.35	0.16
July	3.30	0.82	-0.35	0.01	0.84	0.25	0.12
August	1.23	0.90	-0.27	0.01	0.92	0.25	0.19
September	0.88	0.86	-0.23	0.01	0.94	0.25	0.32
October	1.07	0.87	-0.26	0.01	0.90	0.27	0.22
November	-0.47	0.93	-0.20	0.02	0.84	0.13	0.15
December	-3.30	1.01	-0.10	0.03	0.92	0.06	0.18

Table 3. Regression coefficients of Model 3.

Month	A_0	A_1	A_2	A_2	A_3	Partial correlation coefficients of T	ΔT	M	N
Jan	-6.8	1.06	-.10	.19	.18	.95	.10	.19	.24
Feb	-6.9	1.08	-.16	.26	.16	.91	.17	.21	.13
Mar	-6.0	1.08	-.24	.15	.18	.86	.28	.06	.09
Apr	-3.4	1.03	-.31	.01	.20	.80	.29	.00	.07
May	-5.6	1.04	-.27	.11	.23	.81	.23	.20	.08
Jun	-1.7	0.90	-.35	.21	.12	.84	.33	.10	.12
Jul	1.2	0.86	-.36	.01	.11	.80	.24	.01	.07
Aug	-2.7	0.92	-.26	.16	.12	.90	.24	.08	.13
Sep	-4.1	0.96	-.22	.15	.15	.94	.23	.09	.31
Oct	-4.1	0.97	-.22	.23	.10	.92	.22	.18	.09
Nov	-3.0	0.95	-.20	.19	.08	.85	.15	.10	.03
Dec	-6.5	1.04	-.09	.21	.11	.93	.07	.21	.10

Table 4. Comparisons of the Standard Regression Error and Determination Coefficients (R^2) from Models 1, 2 and 3.

Month	Determination Coefficients			Standard Regression Error of Models (°C)		
	Model 1	Model 2	Model 3	1	2	3
Jan	0.94	0.95	0.96	1.26	1.19	1.01
Feb	0.91	0.93	0.93	1.50	1.40	1.24
Mar	0.86	0.90	0.88	1.80	1.60	1.63
Apr	0.81	0.84	0.82	2.00	1.87	1.95
May	0.78	0.80	0.80	2.20	2.07	2.00
Jun	0.83	0.86	0.86	1.80	1.66	1.61
Jul	0.82	0.85	0.83	2.00	1.86	1.92
Aug	0.90	0.92	0.92	1.50	1.32	1.35
Sep	0.92	0.95	0.95	1.30	1.09	1.06
Oct	0.91	0.93	0.94	1.40	1.30	1.20
Nov	0.88	0.89	0.89	1.70	1.66	1.59
Dec	0.93	0.94	0.95	1.30	1.22	1.11

3. Concluding remarks

Three models are presented for mean monthly wet bulb temperature simulation in Mexico. They make use of information, which is available in about 1,500 Mexican hydrothermometric stations. Model 3 is more complex and accurate than model 2, which in turn is more complex and accurate than model 1. But, the three models give a fairly good approximation for mean monthly $T\omega$ for sites where no information on air humidity is observed. Once $T\omega$ is estimated, it is possible to determine the values of other air humidity parameters.

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