

Evaluation of the Change in Some Meteorological Variables Measured with the Automatic Station at the Yabu Meteorological Station, Cuba

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Abstract

For this work, the Regressive Objective Regression (ROR) methodology was used to model the three meteorological variables: extreme temperatures, maximum and minimum temperatures, and maximum rainfall within 24 hours. For this purpose, a step variable was designed, which takes a value of zero before the change, that is, before 2023, month 8, day 31, and takes a value of 1 after this date, which corresponds to the new automatic station. It can be seen that the model depends on temperatures and rainfall regressed over 11 years. Specifically, the new station represents a 1.39°C drop in minimum temperature. The trend is positive but very small and highly significant at 100%. For maximum temperature, the trend is positive but very small and highly significant at 100%. Similarly, for minimum temperature, the new station represents a 1.48°C drop. It is further confirmed that with the automatic station, both maximum and minimum temperatures are below what was measured at the previous station used by meteorologists. For maximum rainfall over 24 hours, the trend is positive but very small and highly significant. The new meteorological station reports a 2.9 mm decrease in rainfall. In the short term, the errors are smaller, and the impact of using the automatic station results in small and non-significant parameters. Therefore, it can be concluded that the average values from the Yabu station can be used, combined with the new data, at least in the short term.

Keywords: Change of Season, Extreme Temperatures, Trend, Maximum Rainfall in 24 Hours, Cuba

1. Introduction

Meteorological stations change location over time, and it becomes necessary to evaluate measurements under new conditions. The Yabu meteorological station ceased its usual operations in 2023, month 8, day 31, and from then on, data collection began using an automatic station. Therefore, it is necessary to evaluate the recordings obtained with this new technique. Therefore, the objective of our work will be to assess this change in the main variables, such as extreme temperatures (maximum and minimum), as well as the maximum rainfall within 24 hours.

2. Materials and Methods

For this work, the Regressive Objective Regression Methodology (ROR) was used to model the three meteorological variables,

namely, extreme temperatures, maximum, minimum, and maximum rainfall in 24 hours [1-3]. For this purpose, a step variable was designed, which takes the value of zero before the change, that is, before 2023, month 8, day 31, and takes the value of 1 after this date, which corresponds to the new automatic station. It should be noted that gaps are observed in the automatic data collection due to the lack of electricity at some stages, which complicates the study. However, the results obtained were good.

3. Results and Discussion

The model for minimum temperature explains 99.3% of the variability with an error of 2.3547. Fisher's F value is 92,717, significant at 100%. The model is as follows the Table 1 below. As can be seen, the model depends on temperatures regressed over 11 years.

In particular, Step.2023.08.31 represents a drop of 1.39°C with the use of the automatic station from that date onwards. It can be seen, for example, that the variable step4097 represents a drop of 4.4°C

and is a case that has occurred in the station's history. The trend is positive but very small and highly significant at 100%.

Modelo		Coeficientes no estandarizados		Coeficientes estandarizados	t	Sig.
		B	Error estándar	Beta		
1	DS	5,850	,162	,206	36,005	,000
	DI	5,837	,162	,205	35,929	,000
	Tendencia	2,743E-5	,000	,015	4,924	,000
	Lag4015Tmin	,194	,014	,191	13,897	,000
	Lag4016Tmin	,040	,015	,039	2,587	,010
	Lag4018Tmin	,200	,011	,197	18,583	,000
	Lag4029Tmin	,268	,009	,265	31,026	,000
	Step.2023.08.31	-1,387	,240	-,006	-5,786	,000
	Step4097	-4,416	2,355	-,002	-1,875	,061
Step4043	,100	2,357	,000	,043	,966	
a. Variable dependiente: Tmin						
b. Regresión lineal a través del origen						

Table 1: Co-efficients^{a, b}

In the case of the Maximum Temperature, Table 2., the explained variance is 99.7 with an error of 2.37, Fisher's F is 210068 significant at 100%. The trend is positive but very small and highly significant at 100%, as in the Minimum Temperature. The new station

represents a drop of 1.48 °C, then it is corroborated that with the automatic station both the maximums and minimums are below what were measured with the previous station where meteorologists were used to measure.

Modelo		Coeficientes no estandarizados		Coeficientes estandarizados	t	Sig.
		B	Error estándar	Beta		
1	DS	8,694	,262	,203	33,211	,000
	DI	8,686	,262	,203	33,178	,000
	Tendencia	3,171E-5	,000	,012	5,644	,000
	Lag4015Tmax	,164	,012	,163	13,302	,000
	Lag4016Tmax	,096	,013	,095	7,261	,000
	Lag4018Tmax	,218	,010	,216	22,048	,000
	Lag4029Tmax	,229	,009	,228	26,552	,000
	Step.2023.08.31	-1,478	,241	-,004	-6,119	,000
	Step4097	-8,969	2,375	-,003	-3,777	,000
	Step4043	-10,707	2,375	-,003	-4,508	,000
	a. Variable dependiente: Tmax					
b. Regresión lineal a través del origen						

Table 2: Coeficientes^{a, b}

For the 24-hour maximum rainfall (Table 3), a model was obtained that explains 50.7% of the rainfall with an error of 9.7 mm. Fisher's F is 143, significant at 100%. The trend is positive but very small

and highly significant. The new weather station reports a 2.9 mm decrease in rainfall.

Modelo		Coeficientes no estandarizados		Coeficientes estandarizados	t	Sig.
		B	Error estándar	Beta		
DS		1,729	,275	,109	6,289	,000
DI		2,077	,275	,131	7,549	,000
Tendencia		7,860E-5	,000	,079	3,466	,001
Lag4015r24h		,026	,008	,025	3,051	,002
Lag4016r24h		,028	,008	,027	3,286	,001
Lag4017r24h		,029	,008	,029	3,461	,001
Lag4018r24h		,022	,008	,021	2,579	,010
Lag4020r24h		,033	,008	,032	4,003	,000
Lag4029r24h		,032	,008	,032	3,924	,000
Lag3650r24h		,032	,008	,031	3,877	,000
Step.2023.08.31		-2,938	,885	-,026	-3,321	,001
Step7937		236,283	9,697	,186	24,366	,000
Step8322		122,317	9,686	,096	12,628	,000
Step8594		72,740	9,686	,057	7,510	,000
Step8685		55,601	9,686	,044	5,740	,000
Step8885		63,073	9,686	,050	6,512	,000
Step11342		107,126	9,686	,084	11,060	,000
Step11564		61,137	9,688	,048	6,310	,000
Step11574		85,584	9,686	,067	8,836	,000
Step12205		62,868	9,690	,049	6,488	,000
Step12535		84,651	9,700	,066	8,727	,000
Step12578		117,940	9,688	,093	12,174	,000
Step12927		90,766	9,693	,071	9,364	,000
Step12932		61,951	9,690	,049	6,393	,000
Step13082		104,293	9,686	,082	10,767	,000
Step13180		76,387	9,686	,060	7,886	,000
Step4169		95,651	9,698	,075	9,863	,000
Step4301		94,806	9,687	,074	9,787	,000
Step7230		160,427	9,686	,126	16,563	,000
Step8350		93,509	9,686	,073	9,654	,000
Step10416		162,450	9,686	,128	16,772	,000
a. Variable dependiente: r 24h						
b. Regresión lineal a través del origen						

Table 3: Coeficientes^{a, b}

The model for these variables is very long-term (11 years in advance). It was analyzed that the short-term model results in smaller errors, and the impact of using the automatic station results in small, non-significant parameters. Therefore, it can be concluded that the mean values from the Yabu station can be used, combined with the new data, at least in the short term.

4. Conclusions

- As can be seen, the model depends on temperatures and precipitation returned over 11 years. In particular, the new automatic station represents a 1.39°C drop in minimum

temperature. The trend is positive but very small and highly significant at 100%.

- In the case of maximum temperature, the trend is positive but very small and highly significant at 100%, as is the case with minimum temperature. The new station represents a drop of 1.48°C. It is then confirmed that with the automatic station, both the maximum and minimum temperatures are below what was measured with the previous station used by meteorologists.
- For the maximum rainfall over 24 hours, the trend is positive but very small and highly significant. The new meteorological

station reports a 2.9 mm decrease in rainfall.

- In the short term, the errors are smaller, and the impact of using the automatic station results in small and non-significant parameters. Therefore, it can be concluded that the average values from the Yabu station can be used, combined with the new data, at least in the short term.

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