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WINTER TEMPERATURES AND SNOWFALL AT CENTRAL PARK 1869 - 1976

Walter J. Blake, WSO Newark, N.J.
and
Stanley E. Wasserman, DATAC, Eastern Region

Spar (1954) and Spar and Mayer (1973) have shown an apparent cycle to the January mean temperature in New York City, with a period of about twenty years. This cycle is superimposed on a linear upward trend of about 3.3°F per century. The authors stated they "know of no reason why January temperatures in New York City should exhibit a twenty-year cycle, and therefore can have no confidence in the persistence of such a cycle in the future." They went on to state "Nevertheless, the existence of such periodic behavior, even for a short time, is of considerable interest from the viewpoint of long-range weather prediction and can hardly be ignored."

If mean winter temperatures can be predicted, then perhaps something can be stated about the expected mean winter snowfall, given the predicted mean winter temperature.

This study presents the relationship between observed mean winter temperature at Central Park, N. Y. and observed total winter snowfall for the same location.

The observed mean temperature for a winter was computed by first averaging the daily maximum and minimum temperatures. These values were then averaged for the period December 1 through the end of February to obtain the average winter temperature. The total winter snowfall is obtained by adding the daily observed snowfalls for the same period.

A scatter diagram illustrates the relationship between the mean winter temperature and the total winter snowfall (Figure 1). The linear regression equation determined for the 107 data points plotted on the scatter diagram is:

$$y = 90.07 - 2.08x$$

where y = total winter snowfall (inches) and x = mean winter temperature (degrees F). The correlation coefficient (r) between the two variables is -0.52. The mean winter temperature for the 107 years is 32.9°F, with a standard deviation of 3.0°F. The mean winter snowfall is 21.7 inches, with a standard deviation of 12.0 inches.

What can we conclude from information in the scatter diagram and the statistics presented above? The relationship between the mean winter temperature and total winter snowfall at Central Park, N.Y. is such that 27% of the year-to-year variation (r^2) in winter snowfall is

explained by the year-to-year variation in mean winter temperature. This should not be surprising, especially for New York City where the mean winter temperature is close to the critical freezing value of 32°F. Fifteen winters were more than one standard deviation (3.0°F) colder than normal, seventeen winters were more than one standard deviation warmer than normal out of 107 years of data. For these 32 cases, one can clearly see the skill we would have in predicting above or below average winter snowfall if we could predict when the mean winter temperature would deviate by more than one standard deviation from the 32.9°F normal temperature. For the fifteen cold winters, twelve had snowfall exceeding the normal value of 21.7 inches. The mean snowfall for these fifteen cold winters was 31.8 inches. For the seventeen warm winters, fifteen had less than the normal amount of snowfall. The mean snowfall for the seventeen warmer winters was 13.5 inches.

Even if we could predict an unusually cold or warm winter, there is still the small possibility that we would be in gross error in predicting snowfall. In 1871-72, for example, the mean winter temperature was a cold 29.3°F, but only 8.7 inches of snow fell. In 1948-49, the mean winter temperature was a very warm 38.5°F and yet 42.4 inches of snow fell, making this one of the biggest snowfall winters in New York. How can these anomalies occur? For a cold winter, when we would expect a lot of snow, the storm tracks could well miss New York City, resulting in below normal precipitation. For a warm winter, when little snow is expected, heavy snow could occur during a few days when the temperature is below freezing. This, in fact, happened in the 1948-49 warm winter when most of the snow fell during a few days in December.

What can we say about expected snowfall if we did not predict an unusually cold or warm winter and our snow predictions were based on predicted temperature only? If we predict the mean winter temperature to be near normal (say from 30.9°F to 34.9°F), we would have to predict a near normal amount of snowfall, but we should not be surprised if we were in considerable error. In the temperature range of 30.9°F to 34.9°F, snowfall for individual years varied considerably from the average (See Figure 1). For the fifty-five cases in this temperature range, the mean snowfall was 21.4 inches. The mean snowfall for the twenty-six cases in which the temperature was a little colder than normal (30.9°F to 32.8°F) was 23.2 inches, somewhat higher than the 18.7 inches mean snowfall for the twenty-seven cases in which the temperature was a little warmer than normal (33.0°F to 34.9°F).

REFERENCES

Spar, J., 1954: "Temperature Trends in New York City," Weatherwise, Vol. 7, No. 6, pp. 149 thru 151.

Spar, J., and J. A. Mayer, 1973: "Temperature Trends in New York City: A Postscript," Weatherwise, Vol. 26, No. 3, pp. 128 thru 130.

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Attachment: Figure 1

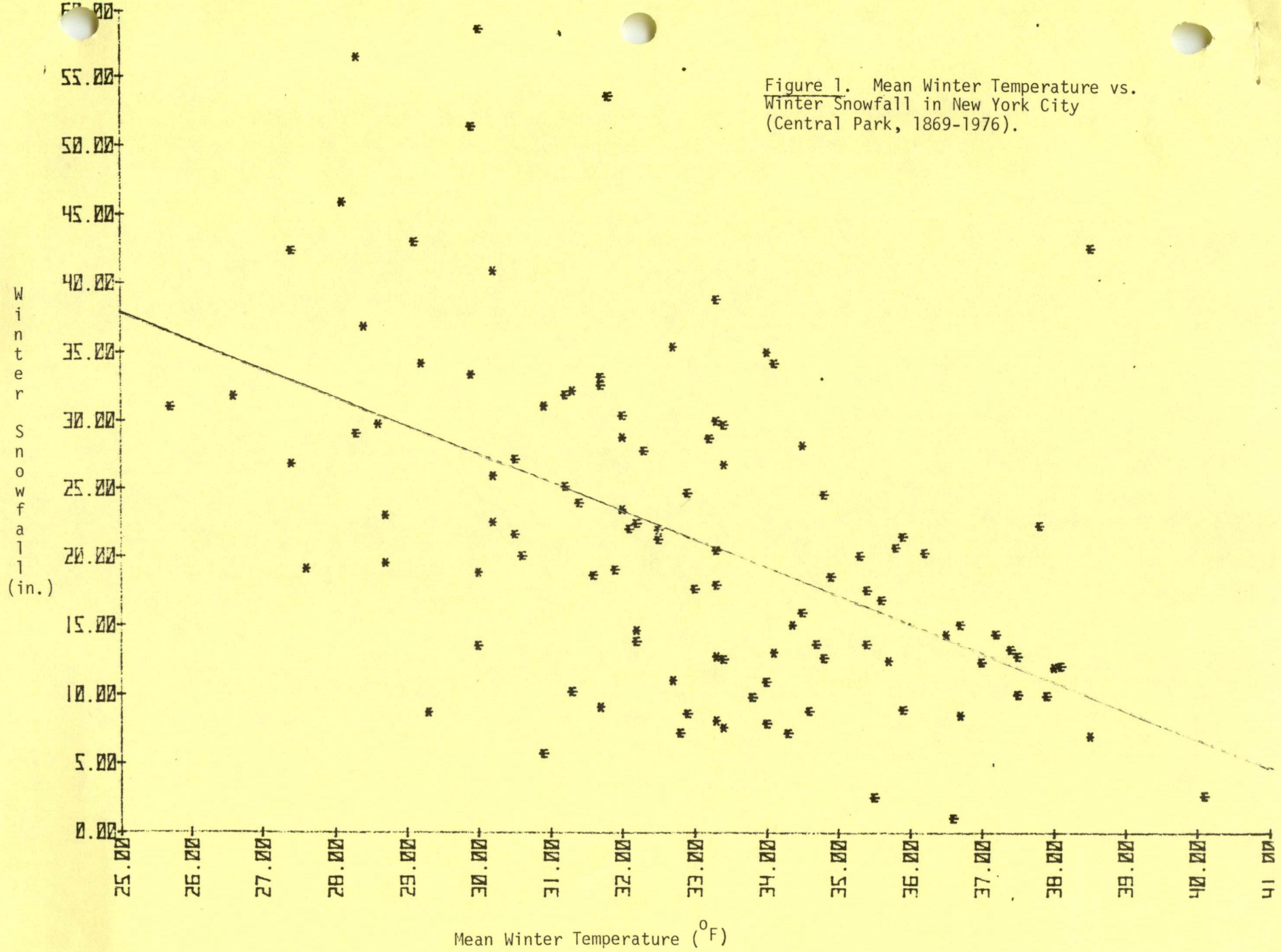

Figure 1. Mean Winter Temperature vs. Winter Snowfall in New York City (Central Park, 1869-1976).