Snow Study

CLASSIFICATION AND PREDICTION OF SNOWSTORM SEVERITY

by William W. Dovico (1)
National Weather Service
Allentown, PA 18105

ABSTRACT

A snowstorm severity index has been developed to measure the extent of drifting and snow depth from a snowstorm and in turn the impact the storm may have on a community. Snowstorms can be climatologically classified as to their severity at other times and places by using the index. The index was developed by considering various meteorological parameters that might produce severe snowstorms. A least-squares regression analysis was used to determine the meteorlogical parameter (predictors) responsible for determining the predictand (snowstorm severity). The analysis was performed in three case studies with similar results. A nomogram is provided for quick estimations of severity indices and suggestions made on how the index can be used to help minimize weather-related industrial losses.

1. INTRODUCTION

I often pondered which snowstorm was the most severe in Bucks County, where I used to live. My curiosity was increased when an old-timer would talk about a snowstorm he remembered, or declared that snowstorms were more severe in his day. So I set about determining what meteorological factors are responsible for producing a severe snowstorm. Some snowstorms can be quite severe in localized areas, making quantitative meteorological analysis difficult. This would appear to make a uniform definition hard to come by. There is not much doubt, however, that snowfall, expecially blowing and drifting snow, can seriously affect a community. One of the more noticeable impacts of a "severe" snowstorm is the closing of schools. Although such closings are influenced by non-meteorology factors, it may be assumed that meteorology plays a very important, and possibly major role. For this reason, snowstorm severity is defined in this paper as the number of days schools were closed for a given storm. Generally schools or other institutions are closed in response to the length of time roads are blocked due to drifting snow. A severity index was developed from these data that could be used as a climatological bench mark for future storms. It is meant to be a universally adaptable index. This bench mark utilizes snow depth and extent of drifting. Using the principles of this index, snowstorms can be classified at other times and places.

2. SOURCES OF DATA

This investigation of snowstorm severity was at first confined to rural upper Bucks County in southeastern Pennsylvania, The school district of Palisades High School. The dates school was closed due to inclement weather in the period 1956-1977 were obtained and various meteorological parameters were considered for each storm. This 22-year period was chosen because roads and snow removal equipment did not change significantly during that period. The number of days a school was closed for each storm was obtained from the high school's record for the years 1972-1977 and tuhe rest of the data, 1956-1972, from the Daily Intelligencer (the Doylestown daily newspaper) There admittedly may be some errors in newspaper reports, buit for this study, the reports of school closings were considered reliable enough to provide reasonable accuracy. Highway data was obtained from the Daily Intelligencer for 1956-1973 and the Pennsylvania Department of Transportation (Penn DOT) for 1974-1977. The Department unfortunately keeps records only one to two years, so information was supplemented by newspaper reports. The data are identified as the length of time roads were closed for each storm, and were used to slightly adjust the severity index, defined as the *predictand.*

The factors considered to be important in producing a severe snowstorm are windspeed, snowfall, and temperature. These factors and the most important aspects of each were determined partially from climatological observations which I kept for 16 years in upper Bucks County. I was able to predetermine some of the most important of these various weather factors by examining graphs of these factors versus the predictand. Later these results would be formalized by application of linear regressions (section 3).

The temperature used in the data sets was the average temperature that occurred during the period of snowfall. The data were recorded by the author at his NWS cooperative weather observing station from 1961-1977 and by the nearby Allentown-Bethlehem-Easton (ABE) airport Weather Service Office for 1956-1960. Temperature is considered important in determining the ability of snow to drift by regulation of its intergranular bonding (2). Based on this author's climatological observations, ground surface temperature appeared to have little to do with the extent of drifting because temperature was generally below freezing at the onset of the storm. In those few cases when the ground temperature was at or above freezing, the snow accoumulated anyway, and the air temperature during the snowfall was sufficiently below freezing to allow drifting. Temperatures were also sufficiently low following all snowfalls to allow continued drifting providing the winds were strong enough.

Snowfall data consisted of the total depth measured for a particular storm The total snowfall determines the amount of snow available for drifting. Snow already on the ground prior to the snowstorm probably did not contribute to severity in any of the snowstorms considered because it was either packed too hard or had already drifted. In principle, a snow layer could exist prior to a storm such that its intergranular bonding was low enough to allow it to drift. In such a case, the depth of this snow layer would have to be included in the snowfall depth. The period of time it took the snow to fall did not seem to make a difference in the extent of drifting. Also, the time of day the storm began was irrelevant because of the magnitude of the storms considered. Time of day is only important in small snowfalls when snowfall might affect traffic during rush hours but not be heavy enough to close school.

Aspects of the wind that seemed to contribute to the severity of a snowstorm were: the average 24-hour windspeed during the snowfall, the average 24-hour windspeed the day after the snowfall, the highest average 24-hour windspeed during the 48-hour period the day of and the day after the snowfall, and the maximum sustained windspeed during that 48-hour period. the 24-hour average windspeed two days after the snowfall was not considered because observations by the author indicated that the snow had drifted about as much as it was going to drift by the end of one day after the snowfall. The maximum sustained windspeed appeared to make only a slight contribution because it was of too short a duration (1 or 5 minutes) to produce large drifts, though it was in most cases proportional to the 24-hour averages. In any case, windspeed was considered a possible criteria for severity. The 24-hour windspeed average during the snowfall seemed important because it took a longer period than 1 or 5 minutes to build significant drifts. Averages between 5 minutes and 24-hours were unobtainable. The 24-hour average windspeed after the snowfall continued drifting the snowfall, and therefore was important in determining the length of time roads remained blocked and achools closed. The maximum 24-hour average in the 48-hour period, which was simply the greater of the two values mentioned above, seemed even more important than the 24-hour average during the snowfall because it did not matter as much when the strong wind occurred as long as it occurred the day during or the day after the snowfall. Consequently, it was the magnitude of this value that contributed most to the height of the drifts.

3. METHOD

A least-squares regression analysis using National Weather Service observations, was used to determine a best set of weather factors (predictors) responsible for determining the predictand, school closing days. I looked for a relationship in the general form:

$$y = A_o + a_1x_1 + a_2x_2^2 + \ldots b_1x_2 + b_2x_2^2 + \ldots c_1x_3 + c_2x_3^2 + \ldots \quad (1)$$

The variable y is defined as the number of days school was closed, which is the Severity Index SI. This Severity Index is in effect a climatological measure of snow depth and extent of drifting. Now, x_1, abbreviated as V_d, is the 24-hour average windspeed in mph during the snowfall, x_2 or V_a is the 24-hour average windspeed in mph the day after the snowfall, x_3 or V_{d+a} is the maximum 24-hour average windspeed in mph in the 48-hour period covering the day during, and the day after the snowfall (or the greater value of V_d and V_a), x_4 or V_m is the maximum sustained windspeed in mph in the 48-hour period, x_5 or S is the total snowfall in inches during the storm, and x_6 or T is the average temperature in degrees Fahrenheit during the snowfall.

A statistical evaluation was done on this regression formula by considering the mean square error S, where the square of S is an average measure of how far data points lie from the regression line which is an expectation of error while R^2, the square of the multiple correlation coefficient, indicates how well the data fit the points. A trial-and-error method was used to test various predictors in linear and higher order terms. Sometimes all predictors were considered linearly and then one of them removed, one at a time. All predictors to the second and higher powers were tried. Some predictors were included as a first-order term while others were included at a higher power. In the process some were omitted entirely while others were retried in linear or in higher power exponential form, etc. In each case, I tried to minimize the mean square error S of the regression equation (1) while maximizing the square of the multiple correlation coefficient R^2.

Analysis was carried out on the PSU 360/168 RJE terminal using Minitab II, which uses a statistical package available to Penn State University users (3). A check was done to make sure the program was not just fitting a good line through unimportantly related data. One storm was removed randomly from the file of storms and an equation obtained from a regression on the new file. Subsequently, the data from the removed storm were inserted into the new equation. The index generated agreed to within 0.1 days with the actual number of school closing days.

4. RESULTS

The equation found to give the best agreement between various predictors and snowstorm severity for Buicks County, PA, is:

$$\begin{array}{llllll} SI = - .7716 & - .06384V_a & - .2457V_{d+a} & + .2865S & + .3002T & + \\ (1.82) & (.106) & (.121) & (.0888) & (.182) & \\ .004V_a^{2} & + .00774V_{d+a}^{2} & - .00647S^2 & - .00787T^2 & & \\ (.00357) & (.00354) & (.00324) & (.00388) & & (2) \end{array}$$

The numbers in parentheses refer to the standard deviation of the coefficients which can be used as a measure of importance of each predictor. These numbers are often divided into the coefficient, and the resulting value is called the T-ratio. The larger the T-ratio, the more important the predictor. For this equation, most T-ratios were greater than two, a good indication that all the predictors are very important. Also, for the entire equation the mean square error S = .529 and the square of the multiple correlation coefficient R^2 = 92.8%, or 88.4% adjusted for degrees of freedom; these values represent the best of all trials. Equation (2) yields a predictand that on an average is within +/- .3 days of the observed range of SI values 0 to 6.1 days. According to the T-ratio, the most important predictors were the 24-hour windspeed average the day after the snowfall V_a, the maximum 24-hour windspeed average in the 48-hour period the day during and the day after the snowfall V_{d+a}, the depth of snowfall during the storm S, and the average temperature during the snowfall T. V_a was important because it determined how long drifting continued after the snowfall, and thus how long the roads remained blocked. V_{d+a} was important because it determined the amount of drifting. T was important because it determined the ability of the snow to drift. The two windspeed factors and the temperature were exponential in this study, and this is in agreement with certain underlying physical processes which are taking place that have previous to this study been shown to be exponential (2). A snow surface is eroded when the windspeed and the surface roughness are sufficient to develop a shear stress great enough to break particles free from the surface. The magnitude of critical shear stress will vary with the degree of intergranular bonding in the surface layer. At low temperatures, this intergranular bonding is small; thus the snow particles are cohesionless (2). At temperatures above about 28 degrees F, this intergranular bonding increases exponentially; thus the temperature contribution in this study is exponential. Therefore, higher windspeeds are needed to move the snow mass. That windspeed is exponential may possibly arise from the fact that the wind-drag equation ($F_d = C_d V^2$), is exponential, where V is the windspeed, F_d the drag force exerted by the wind on a surface and C_d is the drag coefficient (2). Though it never occurred in this case study, the temperature could average several degrees above freezing the day after a snowfall. Intergranular bonding of the snow layer would be so great in this situation that no drifting would occur regardless of how high the wind speeds were. In this situation, an accurate snowstorm severity index could be determined by allowing V_a equal 0 which would no allow drifting the day after the snowfall. The snowfall predictor was exponential, possibly because a small change in snowfall at low depths makes a large difference in the severity of drifting, while the same small changes at large amounts (probably over 12 inches) make less of a change in the severity of drifting.

5. OTHER CASE STUDIES

The analysis described in the previous section was repeated with data from Centre County, PA. The number of days school was closed was obtained from the Centre Daily Times newpaper from 1959-1977 and the windspeed, snowfall, and temperature data, from the Penn State University's climatological observations. Highway data was unobtainable except for 1973-1977, which I obtained from Penn Dot. See table 2.

The method was also applied in the case of the length of time the Doylestown to Lansdale Railroad was blocked due to snowstorms from 1888-1914. This railroad is located in southeastern Pennsylvania, in Bucks and Montgomery Counties. The time periods the railroad was blocked were obtained from the Daily Intelligencer and the windspeed, snowfall, and temperature data from the NWS Philadelphia City Office weather observations. In this case, only the maximum five-minute sustained velocities the day during and the day after the snowfall could be obtained for all the storms considered in that period. Therefore these five-minute maximum sustained velocities were used in place of 24-hour averages and the predictors called V_d', V_a', and V_{d+a}'. However, as mentioned before, these values are, for the most part, proportional to the 24-hour average windspeeds. See table 3.

In both case studies the most important predictors were the same as in the Bucks County case. The equation that gave the best results for Centre County was:

$$\begin{array}{llllll} SI = 3.344 & - .5913V_a' & + .7104V_{d+a}' & + .1952S & - .3699T & + \\ (1.03) & (.455) & (.504) & (.0578) & (.116) & \\ .0434V_a'^{2} & - .04608V_{d+a}'^{2} & - .00371S^2 & + .00775T^2 & & \\ (.0357) & (.0376) & (.00229) & (.00267) & & (3) \end{array}$$

In this equation, the mean square error (S) = .390 and the square of the multiple correlation coefficient (R^2) = 81.0%, or 68.3% adjusted for degrees of freedom, the best values obtained from all trials. This equation yields a predictand that on an average is within +/- .2 of the observed values 0 to 3.0 days.

In this equation the predictors are the same as in equation (2) and give small error values. The equation that gave the best results for the Boylestown to Lansdale Railroad was:

$$\begin{array}{llllll} SI = & & & & & \\ - 93.78 & + .6481V_a & + 3.891V_{d+a} & - .00516V_a^{2} & - .04764V_{d+a}^{2} & - \\ (1.74) & (.0273) & (.000367) & (.000960) & & \\ .0015S^2 & + .00519T^2 & & & & \\ (00017) & (.000121) & & & & (4) \end{array}$$

The S value for this equation was an extremely low .0367 and near perfect R^2 value of 100.0%, or 99.9% adjusted for degrees of freedom. Predictands from this equation are within +/- .03 of the observed values 0 to 3.5 days. Again, equation (3) says the same thing, although for only eight storms. The predictors are the same. The best S and R^2 values occur when these predictors are included in exponential form, though the coefficients are different because of the difference in magnitude of the predictors' values. This greatly increased confidence in the results of the Bucks County data (equation 2).

These equations are somewhat complicated, and it would be nice to look at them in a conventional household way with a graph. So a nomogram is presented (figure 1) relating two factors, V_{d+a} in mph and S in inches, to the severity index of a storm. The equation of these lines using Bucks County data is:

$$SI = .1958 - .2523V_{d+a} + .3440S + .01058V_{d+a}^2 - .00806S^2. \quad (5)$$

For this equation,
S = .782 and R^2 = 79.5%, or 74.6% adjusted for degrees of freedom.

It will be noted in figure 1 that equal severity index lines are more horizontal at low SI values and more vertical at high SI values. This is because at low windspeeds the amount of snow is very important in determining severity, and at high windspeeds of much less importance. It should also be noted, however, that this nomogram is less accurate than the full equation (1) because a predictor (temperature) is not included. Hence S is larger and R^2 smaller than for the full equation.

It can be seen from the S value, however, that the nomogram can predict severity values within significantly less than +/- 1.0 of the value calculated by equation (2).

An interesting climatological feature can be seen in comparing severity index of Bucks County versus Centre County for snowstorms occurring over the past 20 years (see tables 4 and 5). The lowest severity index for Centre County is 1.5 as opposed to Bucks County's 1.0 indicating snowstorms are more frequent in Centre County due to the lower temperatures there. However, the indexes for the top fifteen storms for Bucks County are higher than the corresponding top fifteen storms for Centre County. This indicates Bucks County is prone to more severe snowstorms, probably because of it's closer proximity to the path of the coastal cyclones, which produce most of central and eastern Pennsylvania's snowstorms. Thus, the severity index discussed here is a good indicator of the magnitude and frequency of snowstorms for a particular location.

6. CONCLUSION

Equations (2), (3), and (4) resemble each other and gave the lowest S values and highest R^2 values in that form. Equation (3) had six terms because there were only eight storms on which to perform a regression. The same meteorological factors, V_a, V_{d+a}, S, and T, gave the highest T-ratios and lowest standard deviation of coefficients in all three equations, thus indicating that they were the most important factors in predicting snowstorm severity, with V_a and V_{d+a} being the most important. S and T were the second and third most important, respectively.

Equation (1) cannot predict the number of days that school will be closed in all school districts, but the predictand can be used as a standard of storm severity which is now called the severity index (SI) of a snowstorm. Equation (2) is useful not only as a standard for measuring that severity, but can be used to predict the severity of an approaching snowstorm, given the ability to predict the various meteorological parameters. It is a better measure of the impact the storm will have on a community. Another resulting benefit of this relationship is the ability to predict the likelihood of roads being blocked before a snowstorm hits. There are other promising industrial benefits.

Using equation 2, the severity of a few famous snowstorms have been compared by determining the severity index of each. See Table 4.

The NWS cooperative station at Bucksville in southeastern Pennsylvania reported that three-foot snowdrifts were common in the storm of February 11, 1983 (severity index 3.4). The station reported that snowdrifts of five to six feet were common in the blizzard of January 30, 1966 (severity index 6.0) with some drifts reaching seven feet. The Daily Intelligencer of March 13, 1888 reported snowdrifts of around ten feet to be fairly common during the famous blizzard that occurred on the date. The severity index for this storm is 8.1 when computed for southeastern Pennsylvania. This adds credance to the accurate representation of severity by the index discussed in this paper. Table 5 indicates the depths of snowdrifts that occur with a range of severity indices.

Here, therefore, is a scale to classify snowstorms by their severity as Fujita (4) has done in classifying tornadoes by their severity. And the next time an old-timer declares that snowstorms were more severe in his day than modern times, settle the discussion once and for all with the nomogram presented.

ACKNOWLEDGMENTS

I give my sincere appreciation to Dr. Toby Carlson for his valuable guidance in computer programming and assistance in preparing this report.

I would expecially like to thank the Doylestown Daily Intelligencer, the Centre Daily Times, the National Weather Service at ABE and PHL airports, and the Penn State University weather observatory for supplying me with almost all of my data.

I would also like to thank Mr. Murphey, superintendent of the Penn DOT office in Doylestown, Mr. Zazworsky, superintendent of the Penn DOT office in Clearfield County, Mr. Nickischer, principal of Palisades High School, and my father, who helped maintain the climatological record at the NWS cooperative observing station,

Bucksville, the data from which was used in this study.

FOOTNOTES AND REFERENCES

1. *William W. Dovico received his B.S. degree in 1978 at the Pennsylvania State University. He began his career with Accu-Weather, State College, PA, and was a private meteorological consultant in Hintnersville. He has since been employed by the NWS in a thunderstorm research project at the Kennedy Space Center, Cape Canaveral, FL, at the National Meteorological Center, Camp Springs, MD, and presently at the weather Service Office, Allentown, PA.*

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3. *Ryan, T., Jr., 1976: Minitab II. Penn State Univ. Computer Center, August.*

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Table 1. Data Table for Bucks County

Date of Storm	SI Number of Days School Closed (days)	V_d 24 hr. Windspeed Average During Snowfall (mph)	V_a 24 hr. Windspeed Average 1 day After Snowfall (mph)	V_{d+a} Max. 24 hr. Ave. Windspeed in 48 hr. Period (mph)	V_m Fastest Mile of Wind in 48 hr. period (mph)	S Snowfall Depth (Inches)	T Avg. Temp. During Snowfall (Degrees Fahrenheit)
Feb. 16, 1958	6.1	29.3	28.4	29.3	39	16	19
Jan. 30, 1966	6.0	27.9	26.9	27.9	46	12.5	18
Mar. 4, 1960	4.1	24.4	23.4	24.4	39	17	18
Dec. 25, 1966	4.0	12.1	24.0	24.0	31	18.5	21
Feb. 4, 1961	3.4	20.7	9.6	20.7	28	19	26
Dec.12, 1960	3.3	24.1	22.1	24.1	46	14	18
Jan. 13, 1964	3.3	24.0	14.3	24.0	31	12	18
Jan. 20, 1961	3.0	22.4	5.3	22.4	33	16	14
Mar. 20, 1958	2.8	17.2	20.4	20.4	29	25	31
Feb. 9, 1969	2.3	20.2	24.7	24.7	38	8	32
Feb. 19, 1972	2.3	24.1	24.0	24.1	35	10.5	28
Mar. 19, 1956	2.2	18.4	10.5	18.4	24	15.5	24.5
Dec. 4, 1957	2.1	19.7	17.8	19.7	31	10	29.5
Feb. 7, 1967	2.0	17.0	5.6	17.0	31	11.5	13
Mar. 2, 1969	1.8	16.8	15.0	16.8	22	17	31
Jan. 23, 1966	1.4	17.5	15.2	17.5	30	9.5	31.5
Dec. 17, 1973	1.3	16.4	12.9	16.4	22	7.5	29
Mar. 6, 1962	1.2	26.9	17.8	26.9	36	8	33
Jan. 7, 1977	1.1	13.8	11.9	13.8	29	6	27
Jan. 26, 1966	1.0	9.0	16.8	16.8	33	3.5	14
Feb. 2, 1976	1.0	23.4	3.6	23.4	39	3	18
	0.0	0.0	0.0	0.0	0	0	35

Table 2. Data Table for Centre County

Date of Storm	SI Number of Days School Closed (days)	V_d 24 hr. Windspeed Average During Snowfall (knots)	V_a 24 hr. Windspeed Average 1 Day After Snowfall (knots)	V_{d+a} Max, 24hr. Average Windspeed in 48 hr. Period (knots)	S Snowfall Depth (inches)	T Average Temperature During Snowfall (Degrees Fahrenheit)
Jan. 30, 1966	3.0	3.9	21.4	21.4	9.8	9
Feb. 11, 1970	2.0	7.0	14.0	14.0	12.4	31
Feb. 19, 1972	2.0	5.1	10.0	20.0	13.3	19
Mar. 4, 1971	2.0	9.5	17.4	17.4	14.7	24
Jan. 13. 1964	2.0	11.3	9.6	11.3	27.5	10
Nov. 13, 1969	1.5	8.8	7.7	8.8	22.4	31
Mar. 7, 1962	1.5	10.3	3.0	10.3	17.5	29
Jan. 10, 1977	1.0	5.8	15.6	15.6	5.2	20
Mar. 18, 1977	1.0	8.2	6.7	8.2	4.5	32
Feb. 6, 1976	1.0	4.4	3.7	4.4	8.6	20
Jan. 9, 1974	1.0	4.9	3.2	4.9	5.2	18
Nov. 30, 1972	1.0	3.6	8.2	8.2	8.7	29
Feb. 9, 1971	1.0	5.7	11.1	11.1	9.3	27
Mar. 7, 1967	1.0	3.0	3.2	3.2	14.0	31
Mar. 6, 1965	1.0	3.5	2.1	3.5	15.9	28
Mar. 4, 1960	1.0	3.8	6.0	6.0	9.0	16
Feb. 4, 1961	1.0	3.4	3.4	3.4	16.7	17
Jan. 27, 1963	0.5	1.5	13.0	13.0	7.7	19
Dec. 7, 1962	0.5	13.5	19.8	19.8	5.3	29
Feb. 19, 1964	0.3	4.6	5.3	5.3	11.1	29
	0.0	0.0	0.0	0.0	0.0	35

Table 3. Data Table for Doylestown to Lansdale Railroad

Date of Storm	SI Number of Days Railroad Blocked Days	V_d Max. 5 Minute Sustained Wind-Speed During Snowfall (mph)	V_a Max. 5 Minute Sustained Wind-Speed 1 day After Snowfall Period (mph)	V_{d+a} Max. 5 Minute Sustained Wind-Speed in 48 hr. (mph)	S Snowfall Depth (Inches)	T Average Temperature During Snowfall (Degrees Farenheit)
Mar. 12, 1888	3.5	47	47	47	17	14
Feb. 7, 1895	2.5	38	38	38	10	6
Feb. 13, 1899	3.3	42	42	42	20	6
Jan. 26, 1905	1.3	47	36	47	12	14
Feb. 5, 1907	0.2	38	28	38	6	15
Dec. 26, 1909	1.5	36	26	36	18	28
Jan. 14, 1910	0.0	32	29	32	11	27
Mar. 2, 1914	3.2	45	36	45	10	19

Table 4. Severity index (SI) for some famous storms

SI	Storm
8.3	March 2-4, 1966, North Dakota Blizzard
7.0	Blizzard of March 1888 in New York City
6.8	Blizzard of March 1888 in Philadelphia
6.1	Jan. 25-26, 1978, Indianapolis, Indiana
5.8	Feb. 6-7, 1978, Boston, Massachusetts
5.2	Jan. 10-11, 1977, Buffalo, New York
5.2	Jan. 16-17, 1977, Buffalo, New York
5.3	Jan. 27-28, 1977, Buffalo, New York
4.2	Chicago snowstorm of Jan. 1967
3.6	Lindsey storm, New York City 1969
3.3	Feb. 24-26, 1969, Boston, Massachusetts
2.5	Knickerbocker snowstorm, Jan. 28, 1922, Washington, DC

Equation 2 applied to the recent east coast snowstorm of 11-12 Feb. 1983 yields the following severity index results:

SI	Storm
3.8	New York City
3.4	Philadelphia
2.6	Baltimore
2.5	Washington

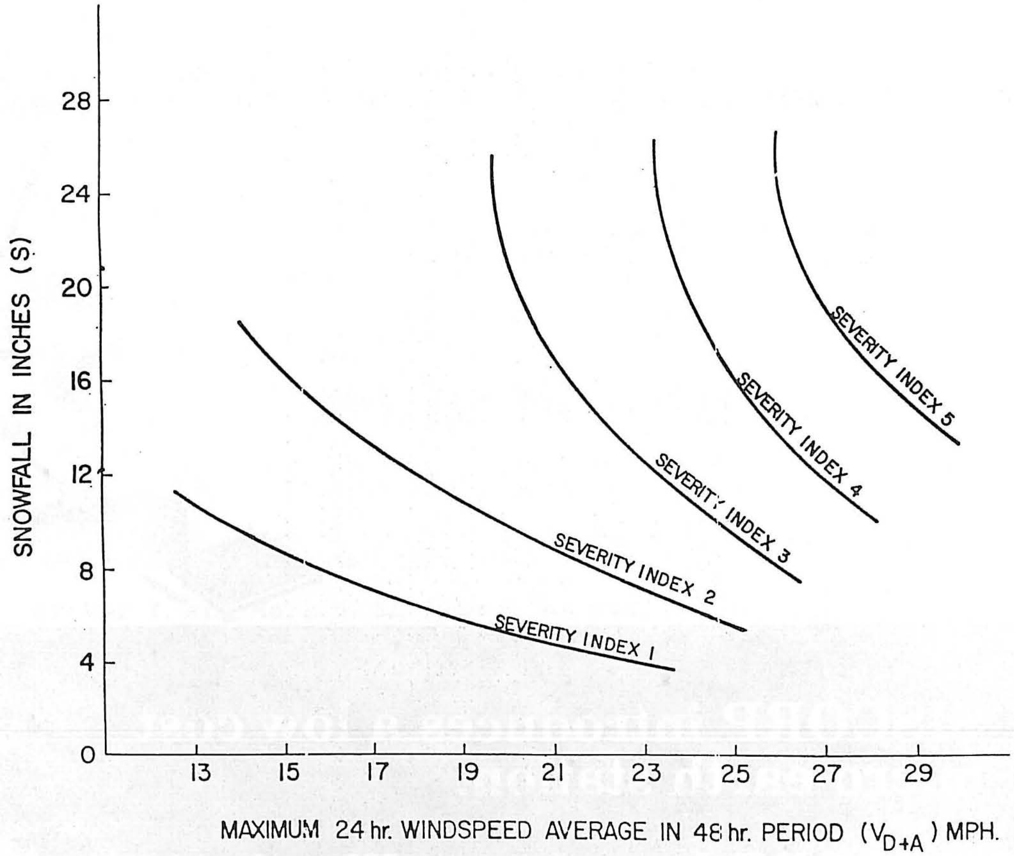
Table 5. Relation of severity index (SI) to depth of snowdrifts in southeastern Pennsylvania

SI	Average Height of Snowdrifts
1.0	1 ft. drifts common, some to 2 ft.
2.0	2 ft. drifts common, some to 3 ft.
3.0	3 ft. drifts common, some to 4 ft.
4.0	4 ft. drifts common, some to 5 ft.
5.0	5 ft. drifts common, some to 6 ft.
6.0	6 ft. drifts common, some to 7 ft.
7.0	6 ft. to 8 ft. common, some to 10 ft.
8.0	6 ft. to 10 ft. common, some to 12 ft.

Table 6. The most severe snowstorms at Philadelphia, Pennsylvania

Rank	Severity Index	Date	V_a	V_{d+a}	S	T
1	6.8	Mar. 12,1888	33.8 mph	36.0 mph	10½ inches	19 °F
2	5.9	Feb. 13, 1899	15.6	30.3	19	7
3	4.8	Jan. 25, 1905	21.9	30.9	13	15
4	4.1	Feb. 7, 1895	25.1	25.1	7	7
5	3.8	Feb. 14, 1940	28.8	28.9	7½	25
6	3.7	Jan. 30, 1966	25.6	27.1	8½	21
7	3.7	Jan. 28, 1922	23.4	28.8	12½	29
8	3.5	Dec. 26, 1909	20.0	25.2	21	29
9	3.5	Mar. 1, 1941	13.1	24.3	10	24
10	3.5	Feb. 7, 1978	22.3	22.3	13	21
11	3.4	Feb. 11, 1983	18.2	18.2	21	21
12	3.3	Mar. 2, 1914	20.0	28.1	7	20
13	3.3	Jan. 25, 1935	12.2	23.5	17	23
14	3.3	Apr. 3, 1915	13.9	27.9	19½	30
15	3.2	Feb. 18, 1902	19.7	25.8	10	26
16	3.2	Dec. 11, 1960	19.2	22.7	14½	21
17	3.0	Feb. 16, 1958	23.4	24.5	13	21
18	2.7	Dec. 24, 1966	22.1	22.1	13	23
19	2.7	Feb. 6, 1907	13.4	19.0	12½	18
20	2.6	Jan. 19, 1961	17.6	17.6	13	19

V_a = 24-hour average windspeed the day after the snowfall (mph)
V_{d+a} = maximum 24-hour average windspeed for the 48-hour period the day of and day after the snowfall (mph)
S = snowfall (inches)
T = average temperature during the snowfall (°F)



<u>CORRECTION</u>

CLASSIFICATION AND PREDICTION OF SNOWSTORM SEVERITY by William W. Dovico

The Snowstorm Severity Index (SSI) Nomogram was omitted from the May 1985 Digest. It should be placed after page 38.

Mr. William T. Parker, MIC/AM for Wyoming, (right) presenting award to Mr. Wilson Sellner (left). Mr. Sellner was selected as the individual, not a member of the professional meteorological family, who made the greatest contribution to operational meteorology.