LAKE-EFFECT SNOWFALL IN BUFFALO AND A LOOK AT THE RECORD BREAKING 1976-77 SNOWFALL SEASON

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ABSTRACT

It is the purpose of this paper to describe the 1976-77 record breaking snowfall season in Buffalo, NY. Because most of the snowfall comes from lake-effect storms, the synoptic pattern responsible for these storms and several examples of storms from previous winters are presented. The paralyzing effect of several of this season's snowstorms in Buffalo is described and the new snowfall records which were established are listed.

1. INTRODUCTION

When the snowfall climatology of Buffalo, New York is described, the term "lake-effect" must be included. Lake-effect snowfall occurs to the lee of each of the Great Lakes during the fall and winter seasons when cold Arctic air passing over the relatively warmer lake surface initiates vertical transport of heat and moisture. This mass transfer of energy can, and often does, result in the formation of clouds and resulting precipitation. Although these lake-effect precipitation systems are mesoscale in dimensions, normally extending inland less than 100 miles from the shoreline of the lake, the precipitation amounts can be quite large within the affected area. Adams, New York, for example (located 10 miles downwind of Lake Ontario) received over 68 inches of snow within a 24-hour period on January 9, 1976 from a lake-effect storm. There are numerous cities as well as several major transportation corridors which are located in these lake-effect snowbelts and during many of the lake-effect storms normal activities come to a complete standstill.

Buffalo, New York, at the eastern end of Lake Erie, plays host to numerous lake-effect snowstorms each year. The typical synoptic pattern responsible for lake-effect storms is illustrated in Fig. 1 for November 30, 1976. A large unseasonably cold arctic air mass had moved down into the eastern half of the United States lowering temperatures at 7:00 A.M. E.S.T. to 7°F at Kansas City, MO, -22°F at International Falls, MN, and 10°F at Detroit, MI and Cleveland, OH. The satellite photograph for November 30, 1976 (Fig. 2) dramatically illustrates the clouds forming over the lower Great Lakes and streaming inland under the influence of West-Southwesterly winds. The southern shoreline of Lakes Erie and Ontario and the western shoreline of Lake Michigan stand out clearly due to the adjacent snow covered land. The ice-free Finger Lakes region can also be clearly seen in the cloud free (but snow covered) region south of Lake Ontario. Buffalo was underneath the center of the clouds streaming in off Lake Erie on this day and received a 24-hour total of 19 inches of snow.

These synoptic conditions were repeated on numerous occasions during the winter of 1976-77. Ironically, although it was a drier than normal winter in much of the east (Wagner, 1977) the colder than normal synoptic pattern (with attendant frequent incursions of Arctic air) was ideal for the formation of lake-effect snowstorms.

2. NOTABLE LAKE-EFFECT SNOWSTORMS IN THE WEATHER RECORDS OF THE BUFFALO, NEW YORK AREA

With help from the media, much attention this past winter was centered on the frequent snowstorms striking Buffalo, New York. It is significant to note that it was the frequency of lake-effect storms and not the lake-effect phenomenon itself which was unusual for this portion of the country. In fact, an examination of weather records for Western New York reveals that there have been numerous lake-effect storms over the years which have paralyzed the Buffalo, New York area.

The first lake-effect snowfall of the season in the vicinity of Buffalo, New York usually occurs in mid-November. However, in 1930, a lake-effect snowstorm struck the region as early as October 18-19. Over four feet of snow occurred in the southern and western

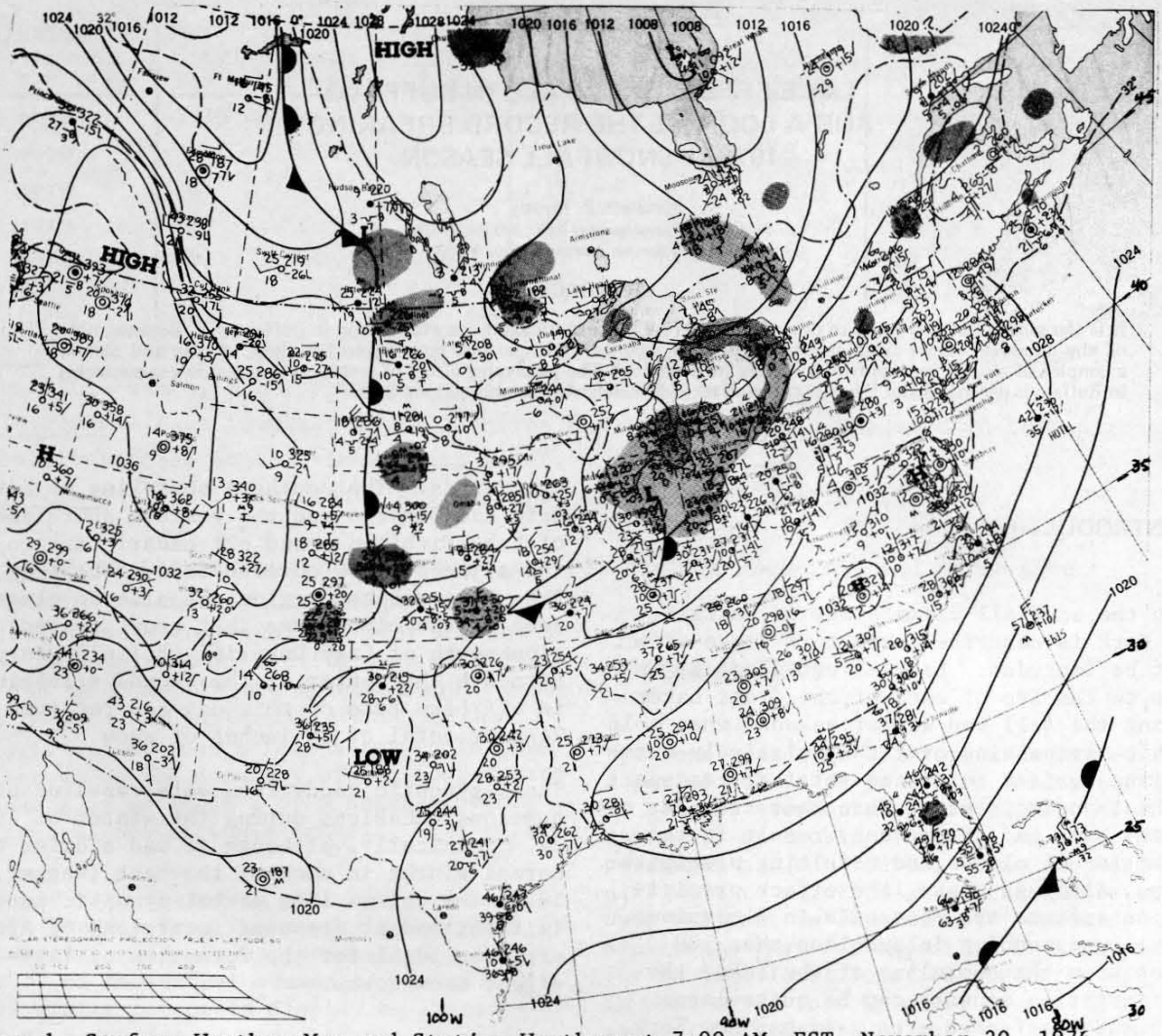

Figure 1. Surface Weather Map and Station Weather at 7:00 AM, EST, November 30, 1976.

suburbs of Buffalo during this weekend storm stranding many tourists who had been out enjoying the colorful autumn foliage.

Wiggin (1960) described two examples of a severe lake-effect storm occurrence in Buffalo. The first memorable storm noted by Wiggin occurred during December 8-10, 1937. A fall of three feet of snow was observed in North Buffalo and over four feet of snow in the northern suburbs. The second lake-effect storm described by Wiggin occurred on December 14-18, 1945. The airport measured 36.6 inches in this particular storm and falls in excess of 70 inches were reported just four to six miles to the south. The governor of New York declared a state of emergency for the western portion of New York and once again, activities slowed to a standstill.

A Lake Erie induced lake-effect snowstorm on November 22-23, 1956, which produced up to 48 inches of snow just to the south and west of Buffalo, repeated itself exactly one year later (November 22-23, 1957) in the same area and with similar magnitudes of observed snowfall. Perhaps the most intense lake-effect storm ever to hit the Buffalo, New York area lasted from December 5-11, 1958. A storm total of six feet (with some unofficial measurements of over eight feet) of snowfall was observed in the snowbelt just south of Buffalo. A lake-effect snowstorm November 23-24, 1970 produced only 24 inches of snow, however, the most memorable aspect of this storm was the extensive 12-foot drifts throughout the southern suburbs of Buffalo.

These are just a few of the lake-effect snowstorms which have hit the Buffalo region. It is significant to note that these storms which were described above were the most spectacular and that there have been many other (albeit, less dramatic) lake-effect snowstorms in this area since meteorological observations were first recorded.

Figure 2. GOES-1 Visible Satellite Photograph taken at 1600 GMT (11:00 AM, EST) on November 30, 1976

3. THE 1976-77 SNOWFALL SEASON IN BUFFALO, NEW YORK

The 1976-77 winter season in western New York is equaled by none in the history of meteorological observations for that region. The first snowfall occurred as early as mid-October and the last snowfall as late as mid-May. Three aspects of the past winter season are most noteworthy and will be described in this paper: (i) the lake-effect storm of November 29-December 2; (ii) the snowstorm of January 28-February 1; and, (iii) the new snowfall records which were set at Buffalo.

The lake-effect snowstorm originating over Lake Erie during November 29-December 2 paralyzed activities in the portions of the seven western counties of New York State. Snowfall amounts exceeded 48 inches in Hamburg, New York and at Buffalo International Airport (15 miles to the Northeast) the official storm total was 40.5 inches of snow. A satellite view of the storm during its second day is shown in Fig. 2. The New York State Thruway was closed for most of this storm period as plows struggled to remove the deep snow drifts.

The most devastating blizzard ever to strike Buffalo hit during the period January 28-February 1. By the end of this storm, President Carter had officially declared western New York to be a "Major Disaster Area" eligible for federal funding. This is the first time in the history of the United States that an area has been declared a federal disaster area based solely on the volume of snow which it has received.

The blizzard began on the morning of January 28th as a cold front moved across the area. The visibility dropped to zero at 11:38 A.M. and remained at zero for over 13 hours when it increased to only 3/8 of a mile. Winds gusting up to 85 miles per hour generated a numbing chill factor of -60°F. The winds gusted to over 50 miles per hour every day of this five day storm. When the storm hit the metropolitan area of Buffalo, thousands of motorists were forced to take any shelter they could find in churches, fire halls, restaurants, and private homes. Because the storm struck during the middle of the day, many workers were trapped in their offices. Buffalo International Airport reported a total of only 12.2 inches of new snow but the snow which had been deposited on the land and the frozen surface of Lake Erie during several earlier snowstorms quickly became airborne. This blowing and drifting snow created snow drifts in excess of 25 feet high, totally burying thousands of cars and many single-story buildings. Twenty-nine persons lost their lives in this storm with nine victims found in snow covered automobiles. The Mayor of the City of Buffalo and the Mayors of several nearby communities issued a total ban on vehicle operation (except for emergency vehicles) which was extended for a week after the storm ended (Fig. 3). The driving ban was issued so that the clean-up operations would not be hindered by the movement of private vehicles

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MODERATING

Partly sunny. High 25 (-4 C). Low 15-20 (-7 to -10 C). Details, Page 25.

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IT'S OK TO DRIVE—3 TO A CAR

Good Morning

People

Miss Mary Fachko is one of many persons manning the disaster hot line ordered opened here by President Jimmy Carter. She and the others provide information on most types of storm assistance available. Page 13.

In Our Area

A special grand jury probing the Buffalo Psychiatric Center takes a tour of the facility. Page 5.

Erie County legislators return to normal business and find themselves snowed under in budget woes. Page 15.

About 100 residents of Concord in Southern Erie County are still snowed in, but make the best of it. Page 15.

National Fuel Gas will resume piping substantial volumes of natural gas to area industries. Page 16.

In the Nation

A panel of experts summoned to Washington urge that the nationwide moratorium on flu vaccinations be lifted. Page 3.

Winter damage to the nation's economy is lending sun-

GM Profit In '76 Hits $2.9 Billion

Record Level Double '75's

DETROIT (AP) — General Motors Corp., completing a sensational recovery from a two-year recession, on Monday reported record net profits of $2.9 billion in 1976, more than double its depressed earnings in 1975.

The world's largest automaker also reported record sales of $47.2 billion, up 32 per cent from the previous high of $35.8 billion in 1973 and the $35.7 billion reported for 1975.

GM's 1976 profits, equal to $10.08 per share, compared with earnings of $1.25 billion, or $4.32 a share, in 1975. The previous earnings record was $2.4 billion set in 1973.

The auto giant posted record fourth quarter earnings of $797 million, or $2.77 per share, up 29 per cent from $618 million, or 2.14 a share, reported for the same 1975 period. The previous record for the quarter was $667 million set in 1972.

Record Quarter

GM sales in the final quarter of the year were $13.1 billion, a record for any quarter, topping the $12.5 billion reported for the second quarter of the year.

The company's earnings for all of 1976, in line with expectations by Wall Street analysts, exceeded GM's combined profits for 1974 and 1975 when the industry was mired in a severe slump brought on by

Courier-Express/Ron Schifferle

Richard Palmisano Alfred Morgante

Town of Tonawandan gets help from nephew, 5, as they attack roof-high drifts at 2388 Parker Blvd.

. . . however, progress is reported elsewhere on snow removal operations

Snow Fighters Glimpse 'Some Sort of Normalcy'

Makowski Lifts Ban But Imposes Some Restrictions

By SALLY FOX

Buffalo Mayor Stanley M. Makowski on Monday lifted the city driving ban but restricted traffic to vehicles carrying at least three persons and imposed other limitations.

Effective at 10 Monday night the mayor also prohibited parking on all bus routes and lowered the speed limit on all city streets from 30 to 20 miles an hour.

In announcing the new restrictions at a City Hall press conference, the mayor stressed

Pictures on Page 12
Related stories on
Pages 5, 10, 11, 13, 15, 16, 26

that city streets "cannot yet tolerate" a normal flow of traffic. He reiterated his "pleas to the public to stay off the streets and use public transportation."

Exempt Categories

The three-person-per-vehicle order does not apply to commercial vehicles travelling within the city.

Nor does it apply to persons in any of the categories previously exempt from the general driving ban: police and fire fighters, hospital and health personnel, security guards, postal workers, food distribution employes, public transportation and railroad workers, licensed taxi drivers, bank employes, government personnel, school teachers and news media workers.

However, Corporation Counsel Leslie G. Foschio stressed that all other persons will be subject to fines of up to $500 and jail terms of up to 90 days if con-

need of local industries and businesses who need to have employes available for work at this time."

Before issuing the order, the mayor closeted himself with his department heads for several hours to discuss street conditions and weigh the progress in snow removal efforts.

He said later that it was "upon

Rules for City Driving Listed

These are the rules that apply under the City of Buffalo restricted-traffic order issued by Mayor Stanley M. Makowski on Monday when he lifted the driving ban:

PARKING — Prohibited on all bus routes.

SPEED LIMIT—Maximum of 20 mph, for pedestrian safety.

CAR POOLS — Each vehicle must have at least three occupants unless driven by an exempt person.

EXEMPT — Commercial vehicles, and the same persons who were exempt under the driving ban.

PENALTY — Fine of up to $500 and jail term of up to 90 days.

Figure 3. Buffalo, NY Newspaper Headline Announcing End of Driving Ban -- One Week After End of Storm.

throughout the area. The Army flew in 300 men from Fort Bragg, NC, and the National Guard deployed personnel into the area to assist in snow removal. The total economic loss to the Buffalo area in storm damage, snow removal costs, lost wages, and lost production was estimated at 250 million dollars (Environmental Data Service, 1977). At the end of the storm period, I had the opportunity to be taken on a tour of the Buffalo area by meteorologists, Ben Kolker and Ed Sarnowski (both of the Buffalo National Weather Service Forecast Office) so that I could take photographs of the city as it began to dig out. Figures 4 through 8 illustrate some of the scenes observed in the Buffalo area following this blizzard.

In looking back over the entire winter season at Buffalo, several new snowfall records were established (Table 1). The snowfall amounts observed during the three successive months, November-January, were new records for Buffalo (observations go back to the

TABLE I- Snowfall Statistics for Buffalo, NY.

	1976-77 Snowfall (in inches)	Record Snowfall Prior to 1976-77 (in inches), Date
October	0.2	6.0, (1909)
November	31.3*	28.6, (1949)
December	60.7*	51.1, (1945)
January	68.3*	50.6, (1945)
February	22.7	54.2, (1958)
March	13.5	38.5, (1936)
April	2.2	15.7, (1885)
May	0.5	5.2, (1909)
Snowfall Season	199.4*	126.4, (1909-10)

* New Record, 1976-77

1870's). The annual snowfall record which was established in 1909-10 was exceeded by 73 inches during this past winter setting a new record of 199.4 inches of snow. Finally, the 53 consecutive days of observed snowfall at the Buffalo forecast office (December 20, 1976 through February 10, 1977) exceeded the old record (which had been

Figure 4. The Digging Out of Urban Streets Following the Jan. 28-Feb. 1 Snowstorm. (NOAA photo by Ken Dewey.)

Figure 5. Lake Erie Shore, Near Buffalo,NY -- Note resident had to dig out from attic to clear snow from the front door. (NOAA photo by Ken Dewey.)

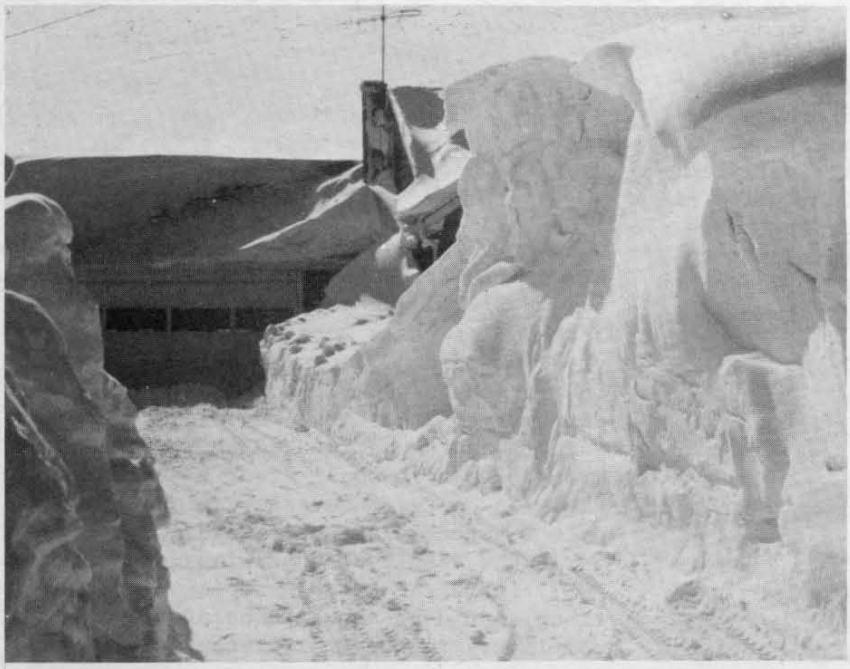

Figure 6. Buffalo, NY, Residential Area After the Blizzard -- Driveway had to be cleared of 10-foot snowdrifts.(NOAA photo by Ken Dewey.)

Figure 7. Suburban Buffalo, NY (Hamburg, NY) -- Snowdrifts as large as houses. (NOAA photo by Ken Dewey.)

Figure 8. Suburban Buffalo, NY (Hamburg, NY) -- Snow dirfted completely over two houses. Note chimney and crest of roof of first house is barely visible in center of photo and, only a portion of the roof edge of the second house is visible in the center of the left margin of the photo. (NOAA photo by Ken Dewey)

equalled on several occasions) by some 23 days. The amount of snowfall at Buffalo could have been even greater were it not for the fact that Lake Erie had frozen over (limiting the vertical transport of heat and moisture) by late January virtually ending this season's lake-effect snowfall. Although, it is no consolation for the residents of Buffalo, snowfall amounts just to the south and west of Buffalo were 75 inches greater for the 1976-77 snowfall season.

REFERENCES

Environmental Data Service, NOAA, 1977: *Storm Data - January 1977*, V 19, 9pp.

Wagner, J.A., 1977: The Record-Breaking Winter of 1976-77. *Weatherwise*, V 30, pp 65-69.

Wiggin, B.L., 1950: Great Snows of the Great Lakes. *Weatherwise*, V 3, pp 123-126.