THE MINNEAPOLIS SNOW EVENT -- WHAT DID THE SATELLITE IMAGERY TELL US?

By

Charles Kadin (1)
National Earth Satellite Services (NESS)
Synoptic Analysis Branch
Camp Springs, Maryland 20233

ABSTRACT

On January 20, 1982, a heavy snowfall blanketed Minneapolis with an accumulation of 17 inches. The storm was associated with an upper level disturbance and had no frontal reflection at the surface. In the enhanced IR satellite imagery, this upper level disturbance was observed as a comma-shaped cloud pattern. The heaviest precipitation occurred along the southern edge of the tight IR temperature gradient of the comma head eastward to the edge of the dry slot. The recognition of this heavy snowfall pattern utilizing IR imagery allowed the path and timing of the snowfall to be forecast. Other cases have shown a similar pattern with the heaviest precipitation occurring along the southern edge of the tight IR temperature gradient.

1. INTRODUCTION

At 12Z on January 20, 1982, an area of predominantly light snow over the northern Plains evolved into a major snow event for part of the upper Midwest. Minneapolis, bearing the brunt of it, received snowfall at the rate of 1 to 3 inches per hour, ending up with a total of 17 inches.

Surface observations at 12Z revealed light snow extending across Montana, the northern Plains, and upper Midwest. The only station reporting heavy snow was FSD (Sioux Falls, SD). The most striking feature on the surface analysis (Figure 1) was a 1038mb high centered over southern Canada, which resulted in a rather cold northeast to easterly flow across the region. At higher levels, the 850mb chart (Figure 2) showed strong warm advection over the northern Plains while the 500mb LFM (Figure 3) showed vorticity maxima over Montana and Nebraska.

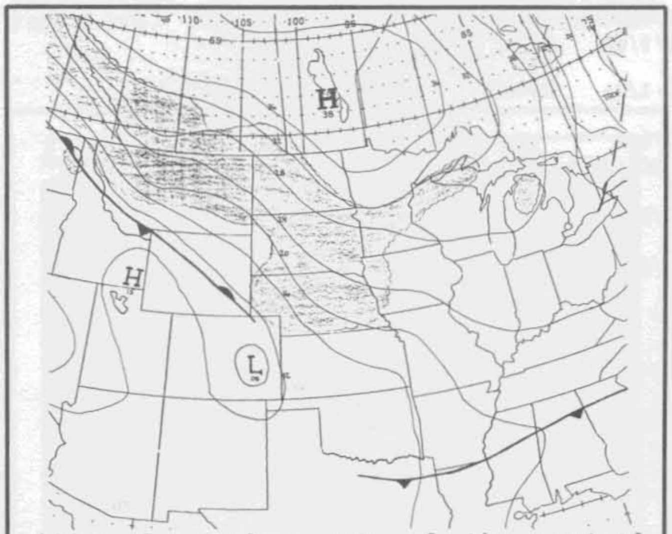

Figure 1. Surface map of the central U.S., 12Z January 20, 1982 with isobaric and frontal analysis. Areas of snow are indicated.

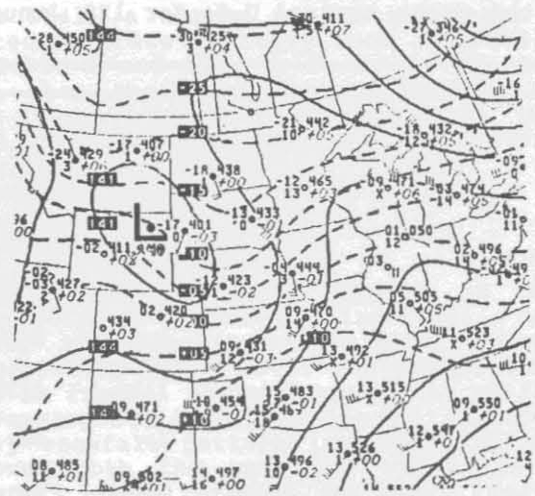

Figure 2. 850mb Height and Temperature chart of the north central U.S. for 12Z January 20, 1982.

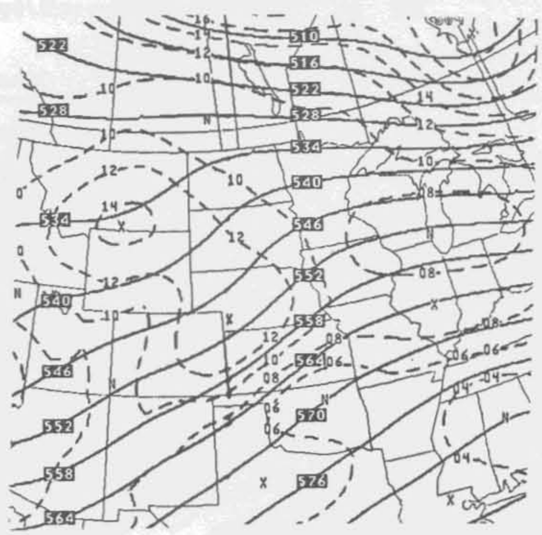

Figure 3. LFM 500mb chart of the north central U.S., showing 500mb heights and vorticity for 12Z, January 20, 1982.

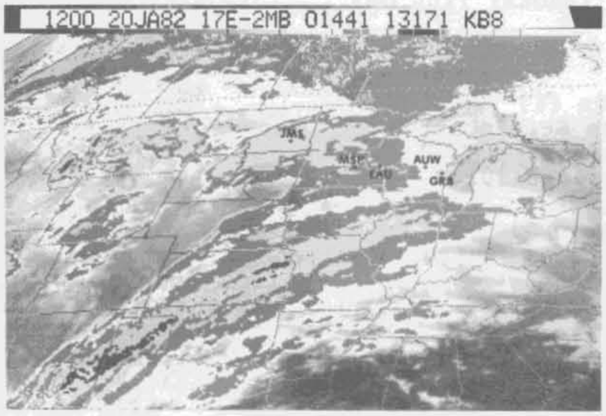

Figure 4. IR (Infrared) satellite image of the north central U.S. for 12Z January 20, 1982.

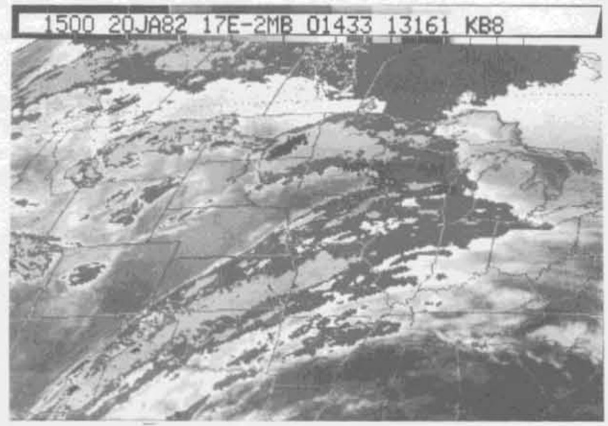

Figure 5. IR satellite image of the north central U.S. for 15Z January 20, 1982.

Table 1

Hourly Observations of Weather and Visibilities

	12Z	15Z	16Z	17Z	18Z	19Z	20Z	21Z
JMS	s-	2s-	2vs-	2vs-	1vs-	s-	2 1/2s-	5s-
ABR	s-	3/4s-Bs	1/2s-	1/2s-	11/4s-	3s-	2s-	2s-
HON	s-	1/2s	3s-	3s-	3s-	6s-		
FSD	s+	2s-	5/8s-	4s-	5s-	s-	4s-	5s-
AXN		1s-	3/4vs-	3/4s-	3/4s-	1vs-	3/4s-	3/4s-
RWF	s-	1/2s-F	3/4s-F	1 1/2s-BS	11/4s-BS	2s-BS	1 1/2s-	5s-
MSP	s-	3/8s INC1	1/4s+ INC2	1/4s+	3/8s INC 3/9/18	3/8s INC2	1/2s INC2	3/4s-INC 2/5/24
STC		3/4s	3/4s	3/4s	1 1/2s	3/4s-	3/4s-	1s-
EAU		1s-	1/2s	3/8sf	3/8sf INC1/2/14	M	3/8s INC2/3/17	3/8s
LSE				2s-	3/4s-f	M	1 1/2s-	3s-
AUW			10s-	3/4s-f	3/4s-f	1/2s	3/8s	3/8s
RST		10s-	1s-	1s-	s-	1 1/2s-	5s-	3s-
GRB					1s-	1s-	1/2s	1/2s
OSH				1/2s	3/4s-	5s-f	1s-	3/4s-

JMS-Jamestown, ND.
AXN-Alexandria, MN.
STC-St. Cloud, MN.
AUW-Wausau, WI.
OSH-Oshkosh, WI.
ABR-Aberdeen, SD.
RWF-Redwood Falls, MN.
EAU-Eau Claire, WI.
RST-Rochester, MN.
FSD-Sioux Falls, SD.
HON-Huron, SD.
MSP-Minneapolis, MN.
LSE-LaCrosse, WI.
GRB-Green Bay, WI.

The satellite imagery (Figure 4) indicated the presence of two PVA (positive vorticity advection) areas. The positions of the PVA and vorticity centers were relatively close to the 500mb positions, although the Nebraska center appeared further north. These vorticity maxima were associated with a comma shaped pattern of enhanced cloudiness. The comma head cloud associated with the Nebraska vorticity maximum extended across the Dakotas and Minnesota. To the south the enchanced cloud band extending from New Mexico to northern Indiana was associated with the upper level jet stream. Although ample moisture was available at low levels (as evidenced by the surface observations), a high level dry slot could be seen along the South Dakota-Nebraska border northeast of the vorticity maximum. The monitoring of satellite imagery and surface reports continued after 12Z. As a result of the monitoring, a relationship was established to help locate potential heavy snow areas utilizing IR satellite imagery. This relationship was used to forecast the snow's progression.

2. ANALYSIS

Upon initial inspection of the satellite imagery, one might expect the significant precipitation to occur within the enhanced area of the comma cloud associated with the positive vorticity advection. This area denotes the coldest tops, therefore it is presumed that the greatest vertical motion and maximum precipitation would be expected to occur within this region. While light snow did occur within this enhanced cloud area, the heavy snow was observed south of the enhancement along the southern edge of the comma head. It is interesting to note, for example, that Jamestown, ND (JMS) under the cold enhancement consistently reported light snow (Table 1 and Figure 5). Meanwhile, stations along the path of the southern edge of the comma head where a tight temperature gradient existed reported an increase in intensity of the snowfall (Table 1 and Figure 4 through 7). This is indicated by the difference in cloud top temperatures between the enhancement and the leading edge of the accompanying dry slot.

With the appearance of the colder cloud top temperatures, and a more distinct comma head, (Figure 4 and Figure 5) the number of stations reporting moderate or heavy snow increased (refer to Table 1). During the period when the dark gray enhancement decreased in areal coverage and the comma head remained distinct, there were still a number of stations that reported moderate to heavy snow (see 16Z-21Z on Table 1 and Figures 5, 6, & 7). After 21Z, when the cloud top temperatures became significantly warmer and the comma head less distinct, only light to moderate snow was reported.

3. CONCLUSIONS

The value of satellite imagery in cases like this is extremely important, especially when dealing with heavy snowfall triggered by upper level disturbances that have no frontal reflections at the surface. On January 20, 1982, the recognition of the heavy snowfall pattern in the IR pictures allowed both the path and timing of the snowfall to be forecast for short time intervals with good results. In similar situations where a well defined cloud pattern is accompanied by heavy precipitation, the recognition of these cloud signatures will be valuable for analysis and short range forecasting.

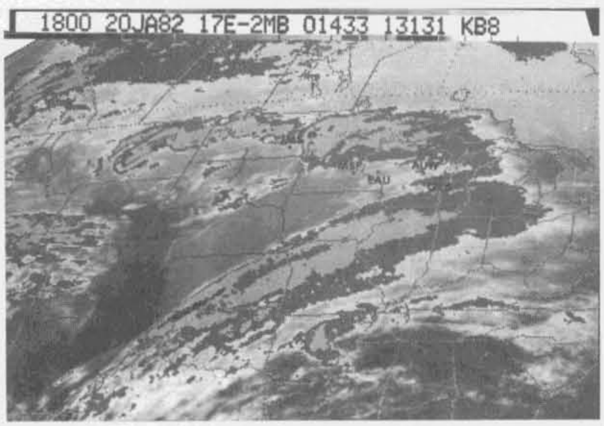

Figure 6. IR satellite image of the north central U.S. for 18Z January 20, 1982.

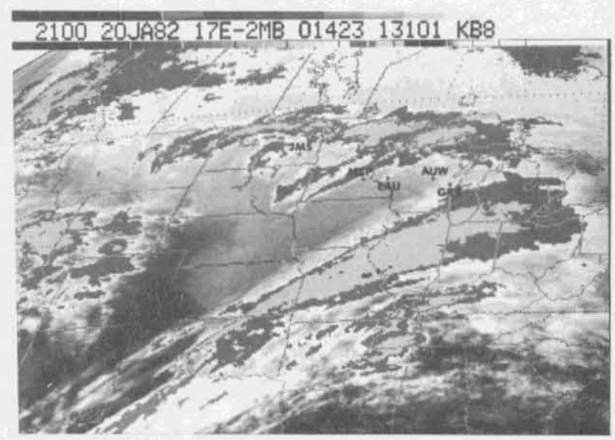

Figure 7. IR satellite image of the north central U.S. for 21Z January 20, 1982.

ACKNOWLEDGEMENTS

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FOOTNOTES

1. *Charles Kadin received a B.S. degree in meteorology from the City College of New York in 1976, and a M.S. degree in meteorology from the Pennsylvania State University in 1978, where he also taught undergraduate laboratory courses. After spending some time as a forecaster in the private sector, he joined the staff at the Synoptic Analysis Branch of NESS in January of 1980.*

A COOL JULY MORNING

By Mark D. Shulman

A large high pressure system dropped southeastward out of Canada, producing ideal conditions for radiational cooling for north central and northeastern United States. Record low temperatures for July 2, 1982 were tied or broken at the following stations:

City	New Record	Old Record
Beckley, W. Va.	47	50 in 1976
Chicago, Ill.	52	53 in 1959
Elkins, W. Va.	44	44 in 1965 (tied)
Grand Rapids, Mich.	45	46 in 1949
Greensboro, N.C.	55	57 in 1952
Huntington, W. Va.	51	52 in 1948
Muskegon, Mich.	45	48 in 1946
New Brunswick, N.J.	45	51 in 1937
Scranton, Pa.	46	48 in 1978
Toledo, Oh.	48	49 in 1965

The reading at New Brunswick, NJ was the coldest ever observed for any July day. The previous record low was 46° set on July 9, 1923. Temperatures in the mid to upper 30°'s were observed in parts of northwestern New Jersey and northeastern Pennsylvania, with readings of 35°F in English Center and 36°F in Germania, Pennsylvania.