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AN EXAMINATION OF A MESOSCALE SNOW EVENT NEAR SOUTHERN LAKE MICHIGAN ON FEBRUARY 10, 1988

Michael F. Kochis
National Weather Service Forecast Office
Milwaukee, Wisconsin

1. Synoptic Situation

The synoptic picture on the morning of February 10th was not particularly threatening. An Arctic high pressure system was situated over the Northern Plains and Wisconsin was experiencing strong cold air advection. Light snow, not induced by the lake effect, began across southern Wisconsin around 09Z, probably in response to the influx of the cold air. The gradient winds over all but the southeast corner of Wisconsin were north to northeast at less than 10 mph, while Milwaukee's winds were northwest around 10 mph. An examination of the wind field at the stations around the south third of Lake Michigan from 09Z to 18Z indicated the formation of a shallow mesolow centered over south central portions of the lake (Fig. 1-4). Lake water temperature was near 0°C while 850 mb temperatures were -10° to -12°C. Strong 850 cold air advection was just upstream however, with temperatures at Green Bay of -20°C (Fig. 5).

2. Mesolow and Snow Band Development

The formation of the mesolow was critical to the later development of the heavy snow band along the west shore of Lake Michigan. The low probably developed as a direct result of the strong temperature contrast between the land and the relatively warm waters of Lake Michigan, and the presence of weak surface gradient winds. Land temperatures ranged from around -10°C to -15°C while lake temperatures were much warmer. As cold land breezes all around the lake converged toward the warmer air over the water, a cyclonic circulation developed in the south with a low pressure trough stretching northward over the open waters of the lake. The presence of a stronger surface wind would probably have prevented the formation of the low regardless of the temperature contrast. In any event, the low probably did not extend through the boundary layer (around 2,000 feet). The Sangster winds showed no sign of the circulation (Fig. 6-8).

Advection would place the -20°C 850 mb isotherm over the mesolow by 15Z. It is commonly accepted that a 20° difference in lake water temperature and 850 mb temperature is required for the onset of heavy lake effect snow (Rothrock, 1969). SWIS images at 15Z indicated a well formed mesolow over southern Lake Michigan. A band of dense convective type clouds north of the low stretched northeastward along the trough and probably was created by the converging land breezes (Fig. 9).

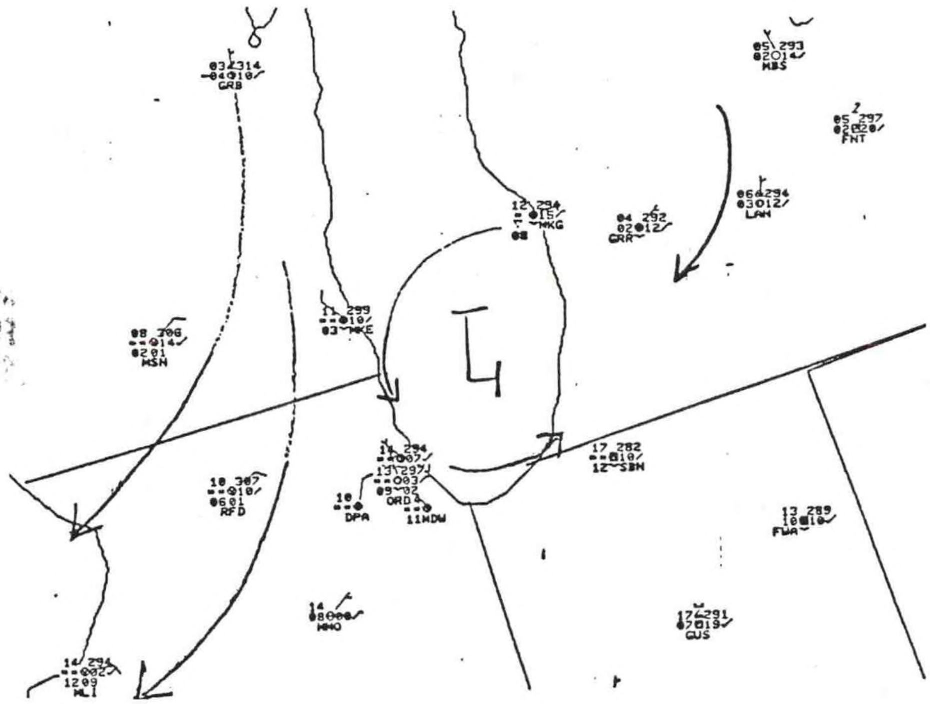

Fig. 1 Surface plot for 09Z, February 10, 1988.

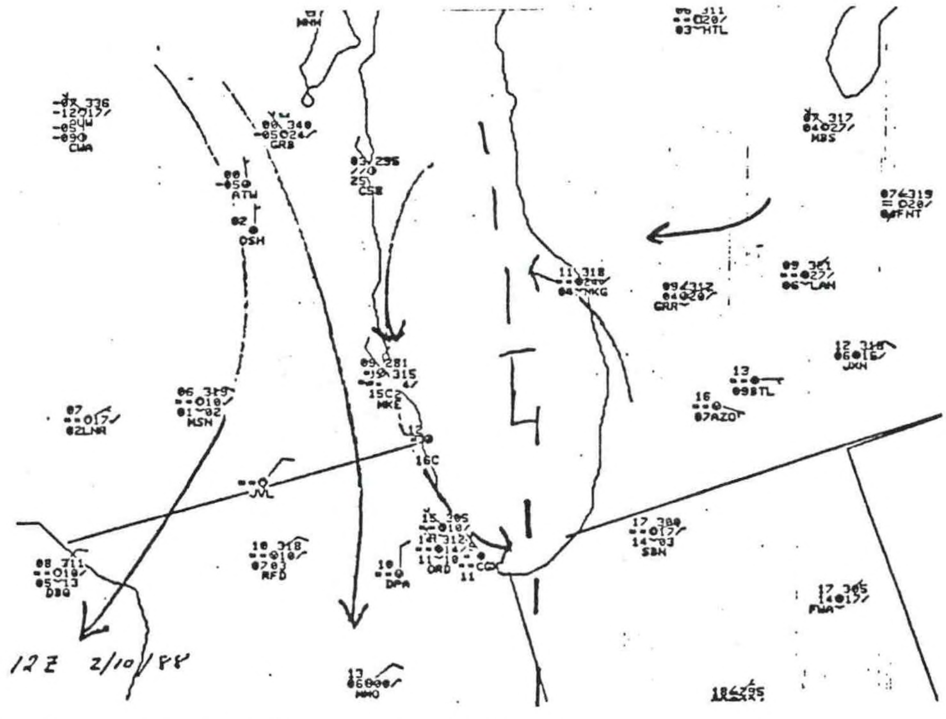

Fig. 2 Same as Fig. 1, except for 12Z.

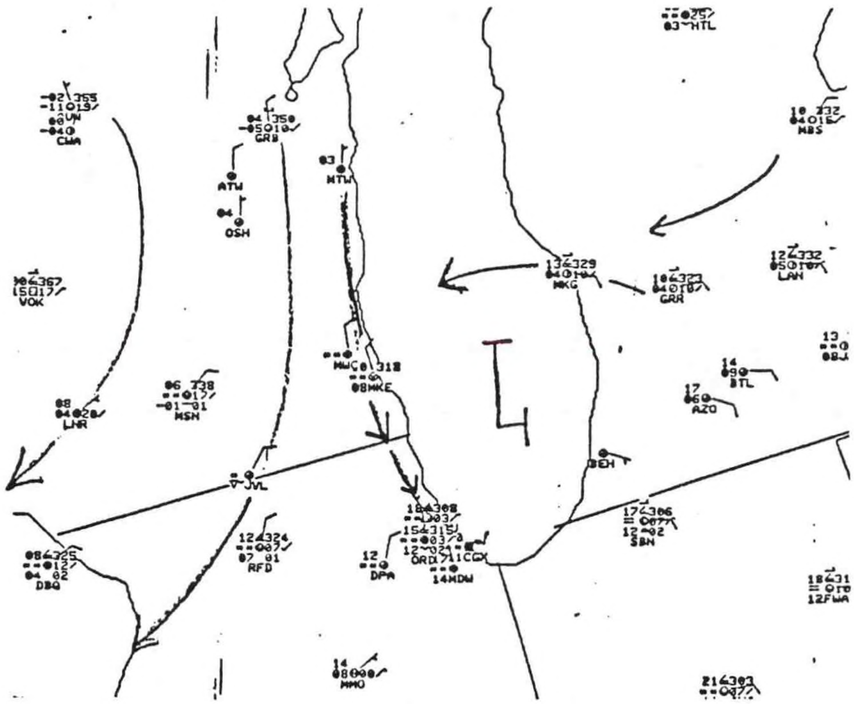

Fig. 3 Same as Fig. 1, except for 15Z.

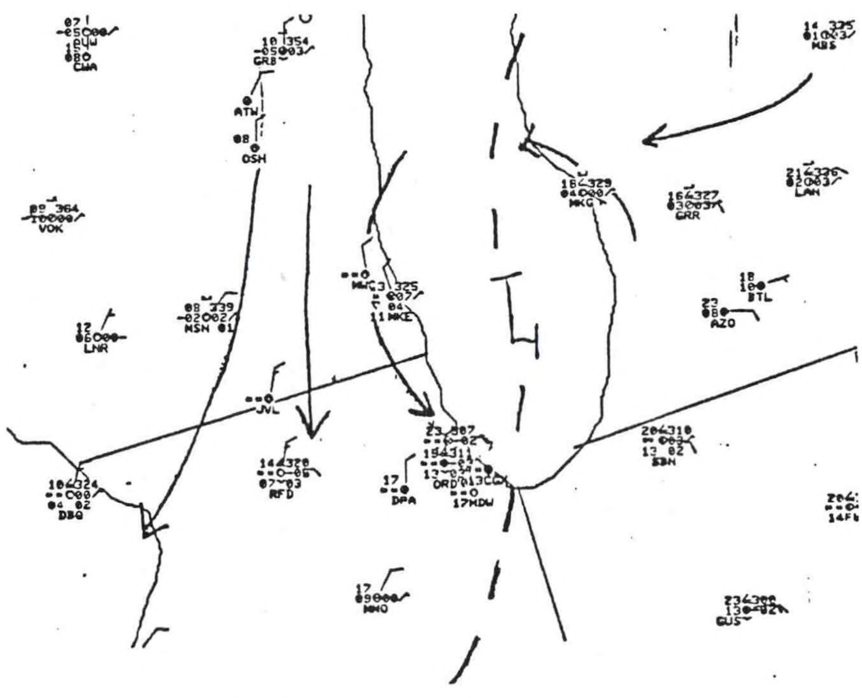

Fig. 4 Same as Fig. 1, except for 18Z.

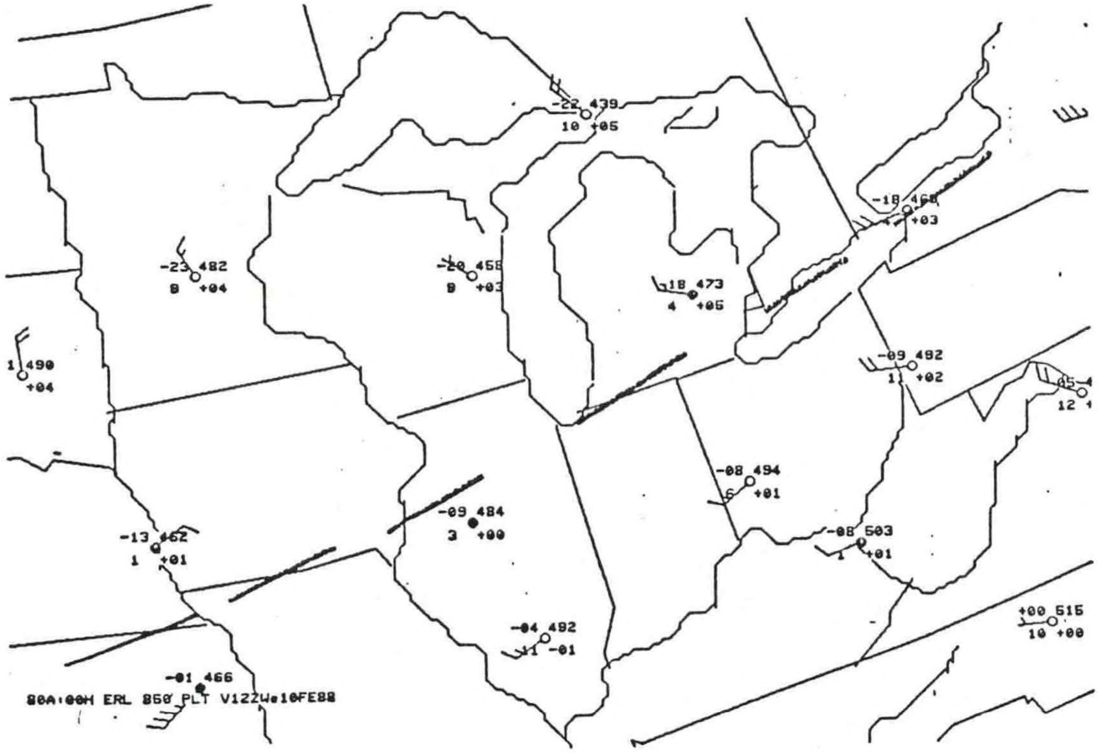

Fig. 5 850 mb Chart for 12Z, February 10, 1988. Dashed line indicates wind shift line.

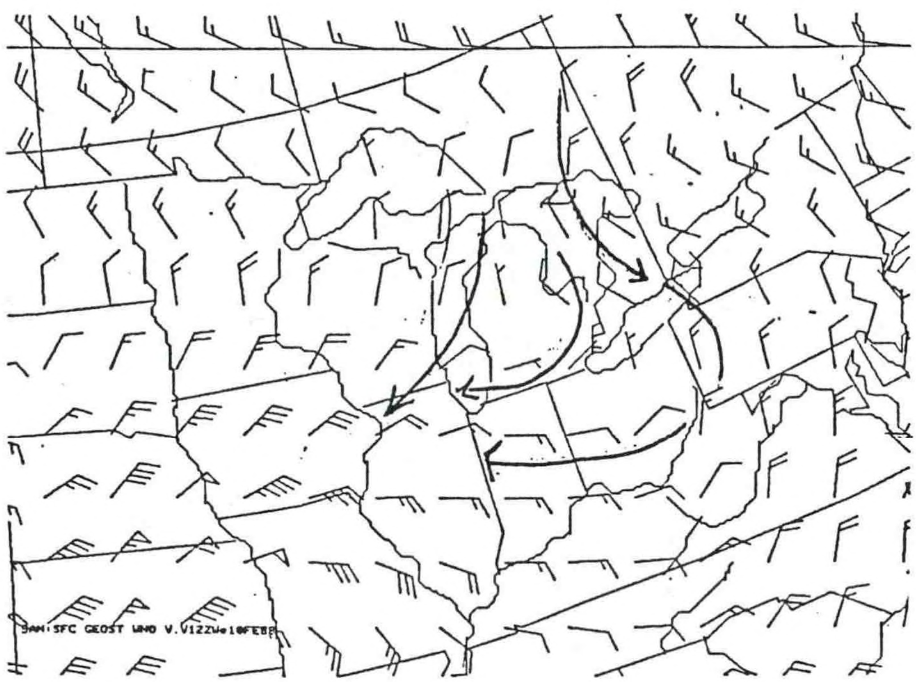

Fig. 6. Sangster winds for 12Z, February 10, 1988.

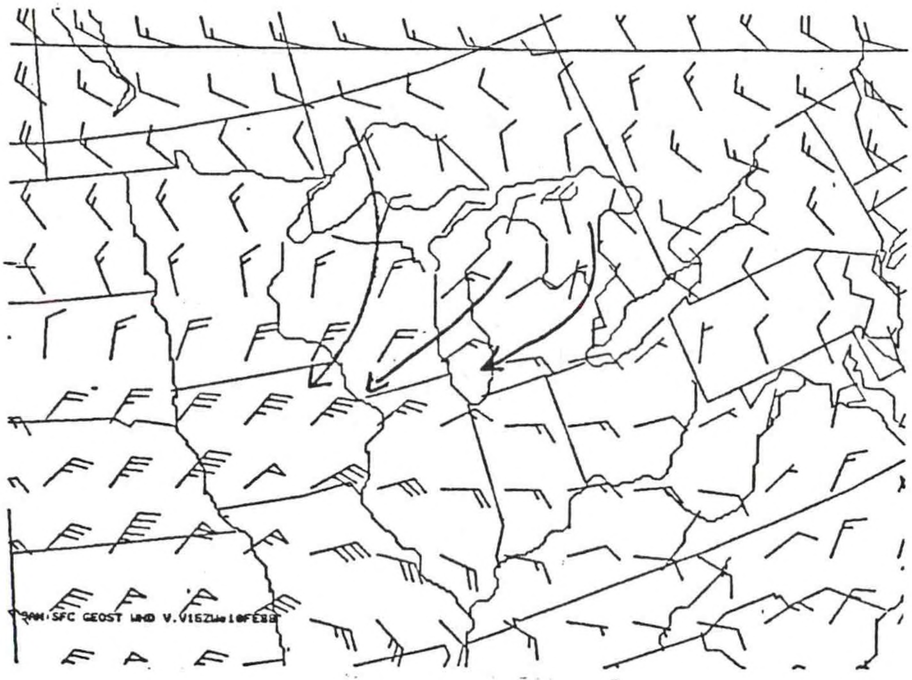

Fig. 7 Same as Fig. 6, except for 15Z.

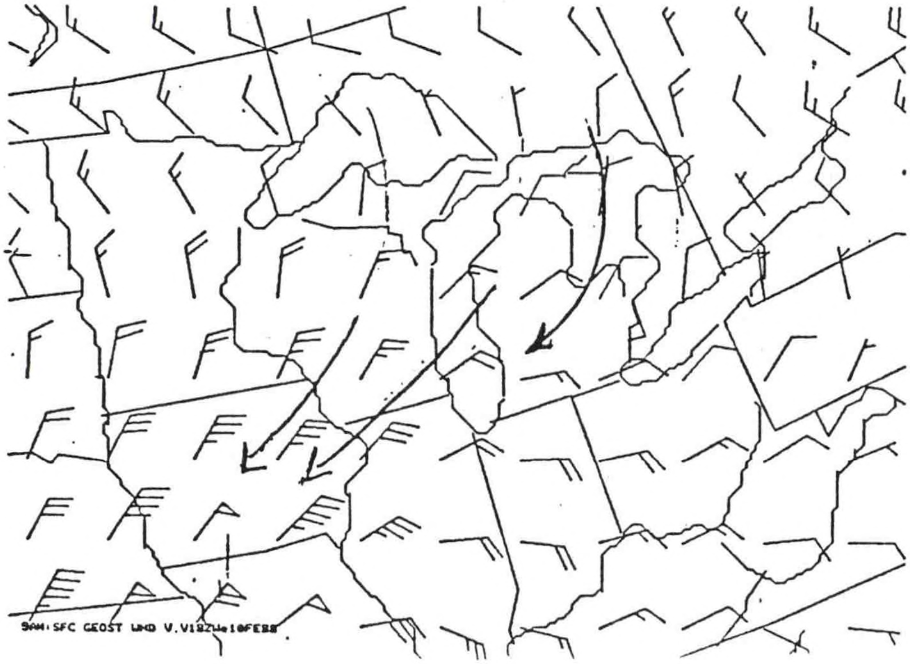

Fig. 8 Same as Fig. 6, except for 18Z.

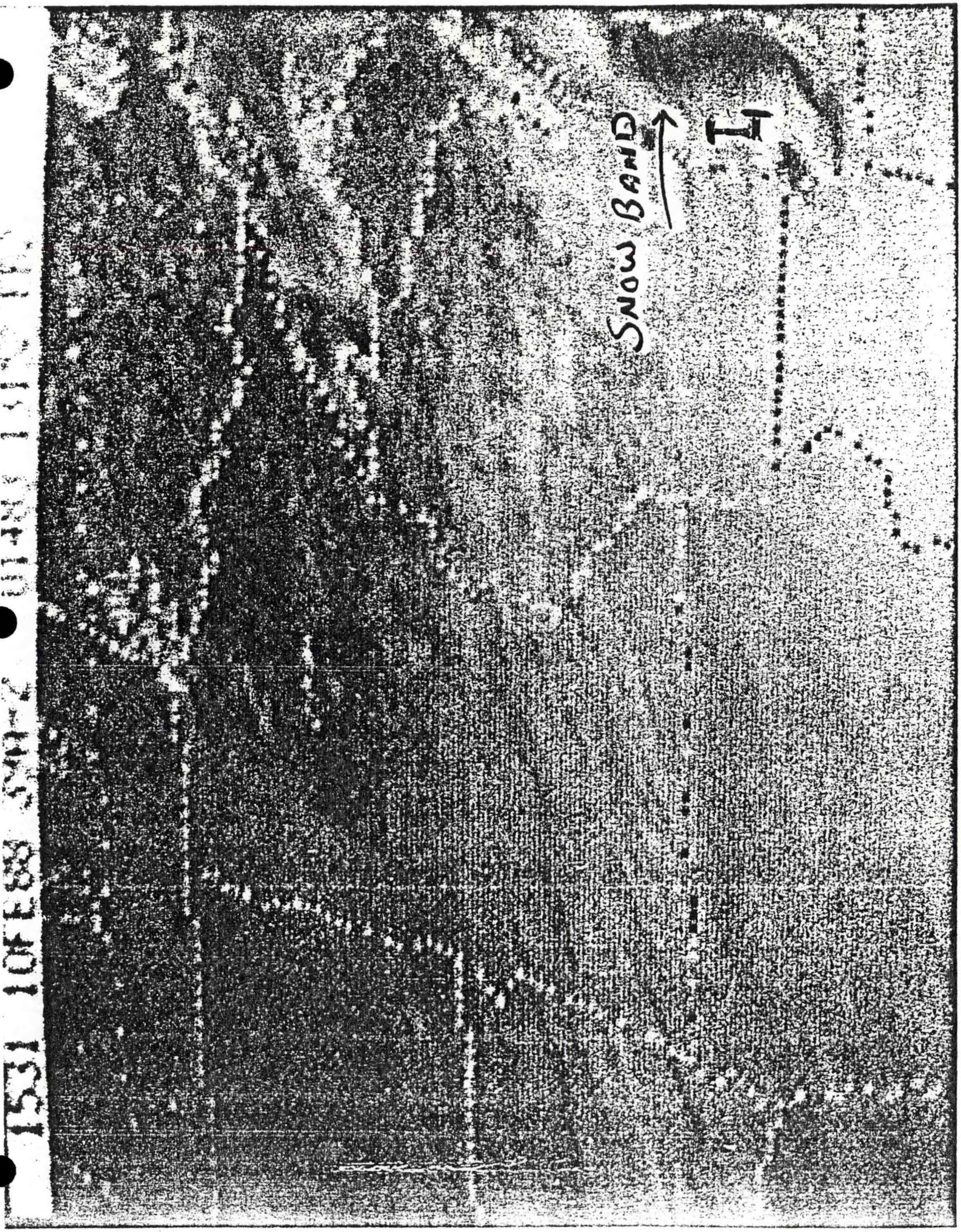

Fig. 9 Visible satellite picture for 1531Z, February 10, 1988, with mesolow, convective development and heavy snow band indicated.

Heavy snow was falling from the band of clouds. The circulation around the low pushed the southern edge of the snow band onto the west shore so that by 1840Z heavy snow began at Milwaukee. The presence of surface wind convergence along the west shore of Lake Michigan not only kept the snow band in place for six hours, but also aided in maintaining its intensity. Around 02Z on February 11, surface winds shifted to the northeast at Milwaukee as an increase in the gradient winds overcame the weak circulation induced by the mesolow, and little new snow accumulations were received.

3. Conclusion

Heavy snow bands would likely have developed over central Lake Michigan without the presence of the mesolow given the strength of the 850 mb cold air advection. However, it is questionable that the bands would have moved onshore over eastern Wisconsin without the pressure of the low forcing convergence and convective type development. The low itself which formed because of the strong temperature gradient between land and water, could only have done so in the presence of weak surface flow. Total snow accumulations at Milwaukee's Mitchell International Airport (three miles inland) were about seven inches, although much heavier amounts were received closer to the lake.

It is interesting to note that Milwaukee received its heaviest snow accumulation with a surface wind from the northwest, rather than from the northeast as one might expect. This would indicate the importance of surface wind convergence in heavy lake snow events. When winds shifted to the northeast and that convergence was no longer a factor, the heaviest snows ended, though all other factors remained relatively unchanged.

4. Reference

Rothrock, H. J., 1969: An aid in forecasting significant lake snow. WB Technical Memorandum NWS CR-30, National Weather Service Central Region, Scientific Services Division, Kansas City, MO.