# LAKE EFFECT SNOW SQUALL DEVELOPMENT OVER AND ALONG THE SOUTHERN SHORES OF LAKE ONTARIO AND ERIE

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Lake effect snow squall development is not well understood, yet in any given winter squall activity is responsible for producing large amounts of snow in highly localized areas on the lee shores of the Great Lakes. Rochester, New York is located in a squall-prone area on the southern shores of Lake Ontario where numerous lake effect snow storms are commonly experienced.

In an attempt to monitor this storm activity WOKR-TV installed a 5.2 centimeter Enterprise Radar unit which is particularly well suited to detecting snow. A Technology Service Corporation Colorizer is used to process the precipitation echoes and a time lapse module is employed to sequence the radar imagery through time. During an eight hour period an edit is taken once every 10 minutes reducing the precipitation event to approximately 30 seconds of uninterrupted motion.

Time lapse radar sequences of lake effect snow squall development and movement provide the Meteorologist with a valuable new tool for studying the development and movement of this highly localized weather phenomenon. The radar sequence allows the Meteorologist to permanently capture the dynamic development and the ensuing motion associated with the event. The entire time lapse sequence may then be studied and traditional synoptic analyses employed. Together they present a revealing picture of mesoscale events.

In this context lake effect snow squall activity has several distinguishing features that identify it from other forms of precipitation.

Snowbands are remarkably persistent. They produce several hours (4 to 30) of continuous snowfall in one or several localized areas downwind of the lake. Bands may undulate back and forth over a specific area but more often than not remain fixed over an explicit location.

Squall bands generally develop out over the lake near the downwind shoreline. As development continues they proceed inland downwind in the direction of the 850 and 700 mb contours. In a few cases squall development occurs over the lake, moves toward the shoreline, fails to penetrate the shoreline and then rapidly breaks up.

Lake effect squalls are characterized by a single band or multiple bands of snow. The majority of the bands are narrow compared to their length generally in ratios of 1:10 or 3:10. Nearly all of these bands proceed inland from the lake and then break up at some point well away from the shore. The longest snow squall bands generally run WSW or west to ENE or east and are normally the single band variety. They often follow the lakeshore (Figure 1). The multiple band variety is often shorter and generally form with the major axis running from NW to SE (Figure2). This

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orientation brings their snowfall inland from the shore.

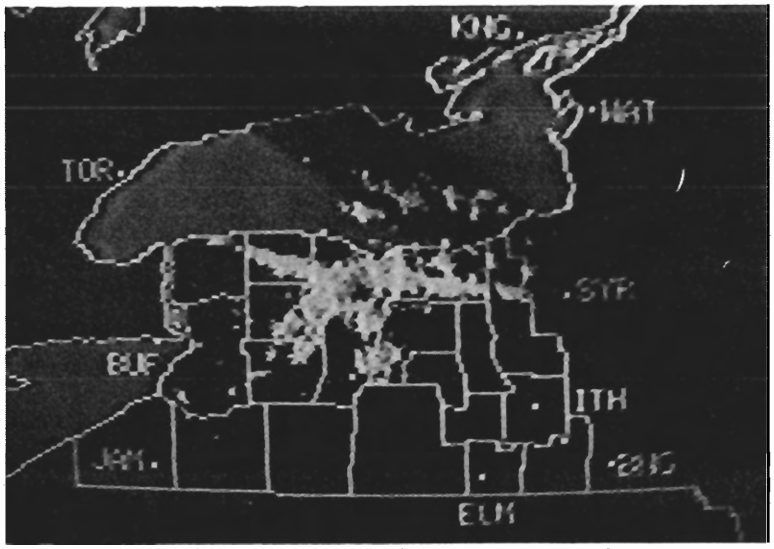


Figure 1. Long narrow bands over and near Lake Ontario.

The direction of the squall nearly always parallels the wind flow at the 850 and 700 mb levels. The length of the squall appears to be proportional to the velocity of the winds at 850 and 700 mb. The surface winds near the squalls tend to show convergence patterns. The strength of the surface winds in the convergence pattern tends to be proportional to the dynamic development of the squall.

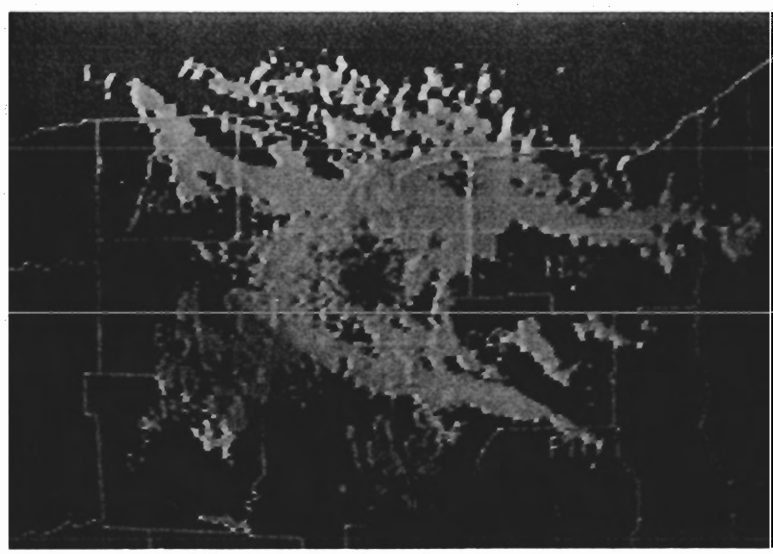

Figure 2. Multiple squall band devlopment on the southern shore of Lake Ontario.

The time frame for snow squall development, movement and dissipation is most closely associated with the onset, direction, and departure of favorable 850 and 700 mb wind patterns. The onset of lake effect snow squall activity begins when the wind patterns at 850 and 700 mb produce parcel trajectories which allow large volumes of lake-warmed moisture-laden air to be rapidly advected inland over extremely cold land surfaces. When cold, relatively dry arctic air is available for transport the stage is set for lake effect downwind of the 850 and 700 mb flow. Cold arctic air displaces the warmer-moister residual lake air upward and downwind producing squalls near and along the shoreline as well as inland. The onset of lake effect precipitation according to Holroyd (1971) is common when the temperature difference between the lake surface and the 850 mb level is greater than 13°C.

Lake effect snow squalls have been known to produce blizzard or near blizzard conditions on occasions. On November 6, 1982 such a squall developed over the Buffalo metropolitan area and eventually extended into Rochester, New York (Figure 3). The combination of cold air passing over

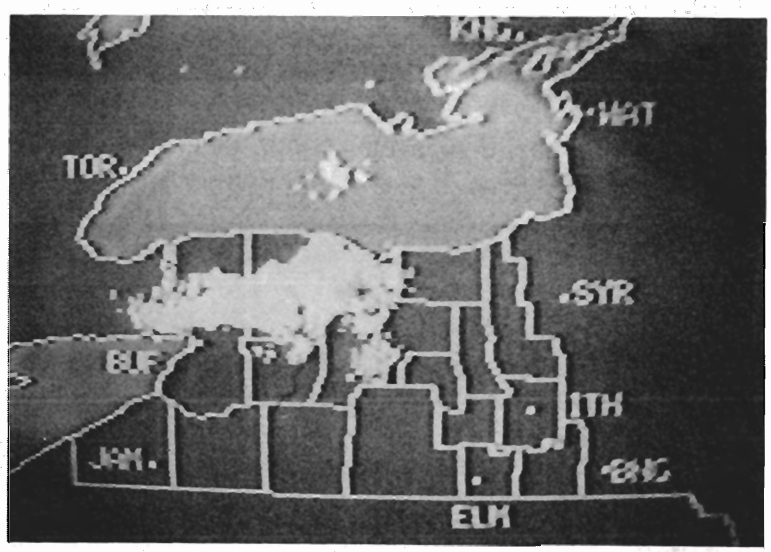


Figure 3. Large squall 2200Z GMT 5 November 1982

the relatively warm waters of Lake Erie exceeded 13°C. The 850 and 700 mb wind flow exceeded 40 knots and more importantly, lined up. This resulted in over 12 inches of snowfall directly downwind of Lake Erie with the snow continuing to fall as long as the flow at 850 and 700 mb continued to advect cold arctic air over the lake surface.

Figures 4 and 5 show the southward migration of the squall over Western New York between 0000Z GMT and 0200Z GMT respectively. Note the location formation, and direction of the squall bands over Lake Ontario just south of Trenton and Kingston, Ontario, Canada.

Time lapse radar sequences provide added dimension to features only briefly mentioned in traditional synoptic forecasts. The development, motion and dissipation of mesoscale features can be studied within the synoptic framework. Together, they provide the Meteorologist with a better understanding of atmospheric dynamics within his forecast area, and in time will lead to higher quality forecasts for the public.

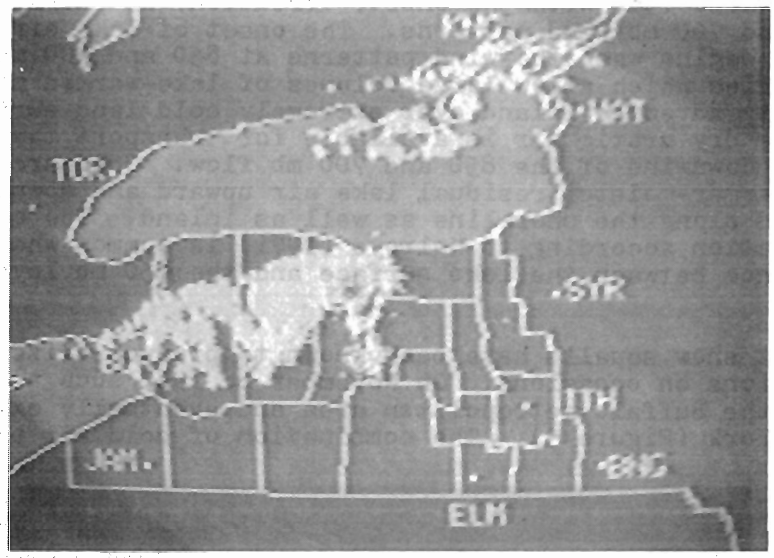


Figure 4. Large squall 0000Z GMT 6 November 1982

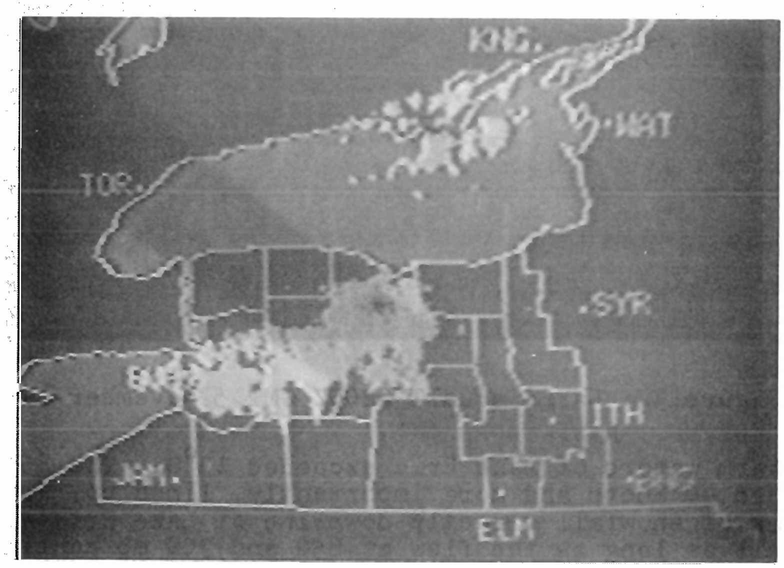


Figure 5. Large squall 0200Z GMT 6 November 1982

References

**Holroyd**, Edmond, 1971: The Meso and Microscale Structure of Great Lakes Snowstorm Bands-- A Synthesis of Ground Measurements, Radar Data, and Satallite Observations. A Doctoral Dissertation, Department of Atmospheric Sciences, S.U.N.Y. Albany, New York.