



**Western Region Technical Attachment
No. 95-23
October 3, 1995**

**1994-1995 WINTER STORM VERIFICATION STUDY
FOR UTAH'S WASATCH FRONT**

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Introduction

A verification study was completed for snow events along the Wasatch Front for the 1993-1994 winter season. As a result of this study, several new station policies were implemented to help improve the winter weather products. A follow-up study was conducted for this past winter season and is intended to help determine if any improvements were made, as well as provide basic verification information.

This paper describes a verification study for snow events along the Wasatch Front (Zone 3) during the 1994-1995 winter season. This winter was much wetter than average. Salt Lake City received 85.2 inches of snow. The average annual snowfall at Salt Lake City is 58.2 inches. The following data were examined in the verification process: Zone Forecast Products (ZFPs), Local Forecast Products (LFPs), Winter Storm Watches/Warnings (WSWs), Monthly Climatic Summaries, and the Salt Lake City surface observations. Observed snowfall reports from the entire metropolitan area of Zone 3 were used for this study.

There were 25 events of observed accumulating snow along the Wasatch Front during this winter season. The breakdown was as follows:

- ▶ 13 Warning events: Snow accumulation of 4 inches or more in 12 hours or 6 inches or more in 24 hours.
- ▶ 6 Advisory events: Snow accumulations of 1-3 inches in 12 hours.
- ▶ 6 Light/Non Events: Snow accumulations of 1 inch or less, or accumulating snow in the forecast with none observed.

The timing of the snow events and forecast snow amounts were closely scrutinized. An event was considered to be a complete hit if the timing was good and the correct amounts were forecast. It was considered a 1/2 hit if the timing was good but the amounts were wrong, and vice versa. This rating process was very subjective. Timing was considered "good" if snow actually began at the Salt Lake City International Airport during the period it was forecast. The forecast snow amounts were compared to observations and spotter reports across the

Wasatch Front area (Zone 3), and considered to be on target if amounts were generally within the range given by forecasts issued prior to the onset of snow. Out of the 25 events, 14 were considered hits. The forecasters did an excellent job with the timing, as 20 out of the 25 cases were rated as good. Forecast snowfall amounts were good in 11 cases, but there was still a tendency to under-forecast the amounts. Nine events were under-forecast, while only three were over-forecast. In two situations, there was a problem with precipitation type, which greatly impacted the forecast amounts.

Events of Warning Magnitude

There were 13 events during the 1994-1995 winter season that qualified as winter storms. Only three of these events were covered by warnings that were preceded by watches. In one particularly well forecast event, a watch was issued 24 hours before the onset of snow, followed by a warning issued 15 hours before snow began. For one event, a Heavy Snow Warning was issued before the onset of snow, but it was not preceded by a watch. Two other cases had a Snow Advisory in place before snow began (no watches). Seven of these events were essentially missed, with a Snow Advisory or Heavy Snow Warning issued after the snow began. (In one case, nothing was issued at all.) However, it is important to point out that snow was mentioned in the forecasts leading up to these seven events.

Seven warnings were issued during the 1994-1995 winter season, all of which were Heavy Snow Warnings. (Note: if an issuance was a continuation from the previous shift or an upgrade from a Snow Advisory after snow began, it was not counted). Four of these warnings verified, and three were preceded by watches. In two other cases where watches were followed by warnings, Snow Advisories would have been sufficient.

NWSFO Salt Lake City continued to do a good job in issuing Winter Storm Watches. Five of the six watches issued were upgraded to warnings when the event was within 15 hours of occurring. Three of the events qualified as winter storms, with two in the advisory category. Because a watch only indicates the potential for heavy snow, at least five of these issuances were warranted.

Snow Advisories

There were six events of advisory magnitude (1-3 inches in 12 hours). Five of these had snow in the forecast well before the onset of the event. In three of these cases, issuances were made before the onset of snow (two advisories and one warning). Two other events had advisories that were issued after the onset of snow. One event was missed entirely, with no issuances at all.

A total of thirteen snow advisories were issued during this time period. (Warnings which were downgraded to advisories near the end of an event were not included in this total). Four of these advisories verified in the advisory category, while six verified in the warning category. Two of the advisories were issued with lead time prior to the onset of snow. One issuance had an 8-1/2 hour lead time. Ten of the advisories were issued after snow had already started, and one was issued when no snow occurred.

Summary and Conclusions

1. There was a great improvement in the use of Heavy Snow Warning vs. Winter Storm Warning. If snow is the only hazardous winter event anticipated with the storm, a Heavy Snow Warning should be issued. All the issuances for this winter season were Heavy Snow Warnings. Once, during a particularly severe storm with heavy snow and very high winds, a Heavy Snow Warning was correctly upgraded to a Winter Storm Warning.
2. Forecasters were consistent in situations in which a warning was in effect, and at the next regular forecast issuance time the snow was expected to continue with less than four additional inches anticipated. In the past, some forecasters would downgrade to an advisory, while others would continue the warning. During this winter, the warning was correctly continued at all times.
3. Snow was almost always in the forecast before the onset of an event. However, there was still a serious problem with the timely issuances of warnings and advisories. There continues to be a tendency to hold off on issuing warnings and advisories until the snow has already begun. Only six of the 13 warning criteria events had an issuance before snow began, while only two of the 13 advisories issued were put out before the onset of an actual snow event.
4. Only six Winter Storm Watches were issued last winter season, despite that fact that there were thirteen warning events. It must be remembered that a Winter Storm Watch only indicates the potential for heavy snow. A watch that is not followed up by a warning is not necessarily a bad forecast.
5. Forecasters continued to under-forecast snow amounts. Events were only over-forecast three times. However, it should be pointed out that 11 of the 25 cases had forecast snow amounts rated as good.

The results of this study will be presented to the NWSFO Salt Lake City staff prior to the 1995-1996 cool season. An effort will be made to continue this study this winter.