



**Western Region Technical Attachment
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WINTER STORM VERIFICATION STUDY

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Introduction

Watches, warnings, and advisories for snow events are among the most important forecast products issued by the Weather Service Forecast Office (WSFO) in Salt Lake City. However, unlike other forecast parameters (i.e. temperatures, probability of precipitation), there is no verification program in place for these events.

Using data from the 1993-1994 winter season, a verification study was performed for snow events along the Wasatch Front. The 1993-1994 winter was drier than average. Salt Lake City received only 38.8 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. Results of this study were discussed at a lead forecaster meeting. New recommendations and policies for the 1994-1995 winter season resulted from this discussion. This verification study will be continued for the 1994-1995 winter season.

Events of Warning Magnitude

There were six events during the 1993-1994 winter season that qualified as winter storms (4 inches or more of snow in 12 hours). A Winter Storm Warning or Heavy Snow Warning should have been issued for these events. Of these, only two were covered by warnings which were preceded by watches. The other four events were essentially missed, with Snow Advisories issued after snow had already started. For the biggest snow event of the season at Salt Lake City (9.9 inches in less than 10 hours), a snow advisory was not issued until snow had already fallen for nearly 3 hours. It was upgraded to a Heavy Snow Warning 2-1/2 hours later.

Five warnings were issued during the 1993-1994 winter season (if an issuance was a continuation from the previous shift, it was not counted), three of which were Heavy Snow Warnings and two were Winter Storm Warnings. Two of these warnings verified, both of which were preceded by watches. In two other cases in which watches were followed by warnings, Snow Advisories would have been sufficient. As mentioned above, for the biggest snow storm of the season in Salt Lake City, a warning was issued as an upgrade from a previously issued Snow Advisory, but only after the event was half over. No watch preceded this event.

WSFO Salt Lake City did a very good job in issuing Winter Storm Watches. All four that were issued were upgraded to warnings when the event was within 12 hours of occurring. Two events qualified as winter storms, with the other two in the advisory category. Because a watch only indicates the potential for heavy snow, all of these issuances were warranted.

Snow Advisories

Seven 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.) One advisory was issued with excellent lead time (11-1/2 hours) prior to the onset of snow. However, the event would have verified as a warning. The other six advisories were issued after the snowfall had already begun. Three of these events would have verified a warning, and in one case the advisory was upgraded to a warning later during the event. Only two advisories verified in the advisory category, while the remainder verified in the warning category.

Summary and Conclusions

1. The use of Heavy Snow Warning vs. Winter Storm Warning did not appear to be consistent. If snow is the only hazardous winter event anticipated with the storm, then a Heavy Snow Warning is justified. However, for events having more than one winter hazard (i.e. high winds and snow, or snow and freezing rain), a Winter Storm Warning should be issued.
2. There was little consistency 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 4 additional inches anticipated. At times the warning was downgraded to an advisory, at other times the warning was continued. This year, the warning will be continued as long as the snow is perceived as a continuation of the same event.
3. When we do not expect an event to meet warning criteria, but more than 1 inch of snow is anticipated, an effort must be made to issue a Snow Advisory before the onset of precipitation. Last year, only one snow advisory was issued with lead time. There appears to be a tendency to hold off on issuing advisories until the snow has already begun. In every case where greater than 1 inch but less than 4 inches of snow fell, an advisory was issued, but with little or no lead time. However, it should be pointed out that snow was indicated in the zone and local forecasts for all these events. The result was a False Alarm Ratio (FAR)=0, but a Probability of Detection (POD)=0 for the advisories.
4. The biggest problems last year, generally speaking, were under-forecasting, and the lack of lead time for advisories. Events were only over-forecast twice.
5. The biggest event of the season was a lake-effect event that was not forecast well, either for lead time or magnitude. Obviously, such a mesoscale event is very difficult to anticipate, especially without an adequate radar. A better performance may be expected with this type of event this coming season due to the new Doppler Weather Radar.