Influences on Grid Editing for Significant Weather – A Review of the 5 January 2008 Winter Storm

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1. Introduction

On 5 January 2008, a winter storm impacted the Great Basin, including WFO Elko, NV (LKN). The CWA (county warning area) for WFO LKN includes Humboldt, Elko, Lander, Eureka, White Pine, and northern Nye Counties in central and northern NV (Fig. 1). This event started with High Wind Warnings on January 4th, and followed with Winter Storm Warnings and Snow and Blowing Snow Advisories on January 5th.

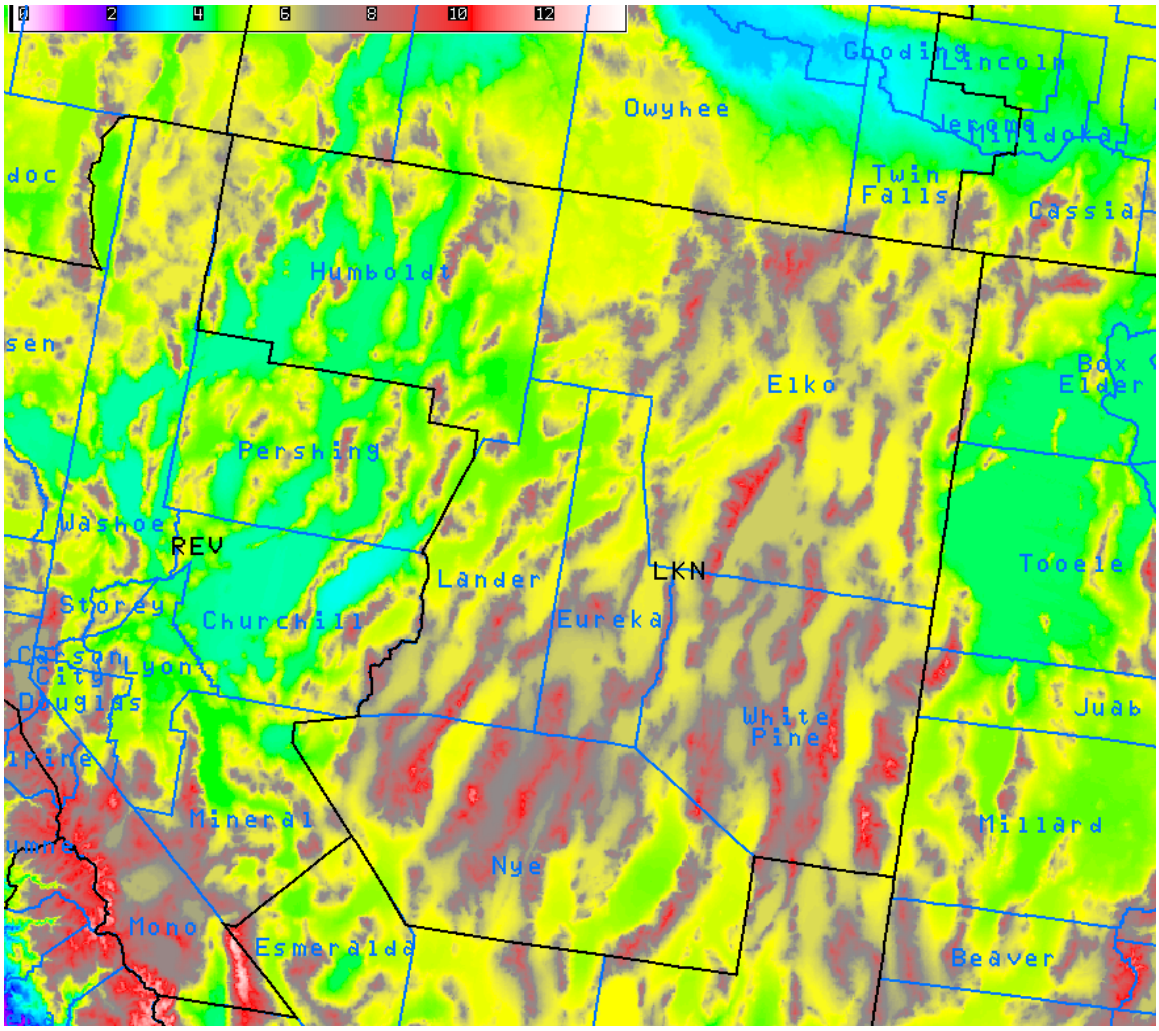

Figure 1: CWA map for WFO LKN (Elko, NV).

Grid editing for significant events requires extra time and sometimes extra staffing. This paper will examine circumstances surrounding this event, as well as challenges associated with grid editing for significant weather.

2. Overview

By 00Z on January 5th, a 140 knot upper level jet streak had pushed onshore over northern California and into northwestern Nevada on the south side of an upper level low that was centered off the coast of Washington and Oregon (Fig. 2). This jet streak was

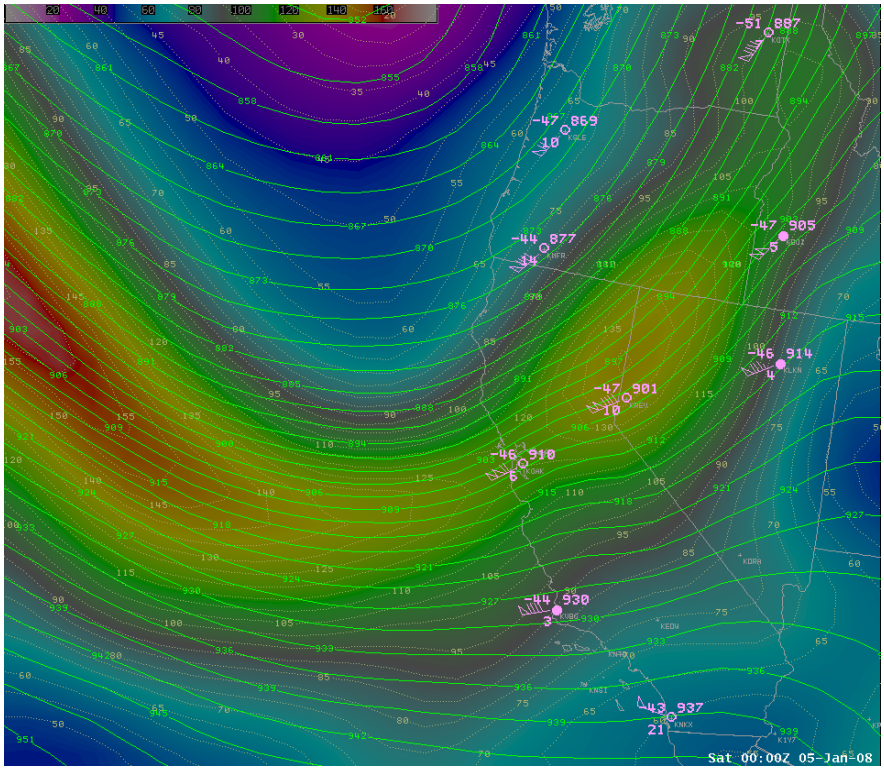

Figure 2: Upper air analysis for 00Z January 5th, 2008 at 300 mb (plotted), and the NAM (80-km) 300 mb geopotential heights and wind speed analysis for the same valid time.

ahead of a 170 knot jet streak that existed further west over the eastern Pacific Ocean. The 700 mb winds were forecast by the NAM (40 km) to be 60 to 80 knots across the forecast area by 03Z (Fig. 3). The synoptic scale lift across the area overnight was expected to be significant as noted by the favorable Q-vector convergence in the 80-km NAM (Fig. 4). The best frontogenesis, as forecast by the 40-km GFS (Fig. 5), was expected to be at around 650 mb. The front pushed through the area rather quickly, moving through Humboldt County around 03Z and reaching the Utah border by 12Z. The precipitation changed from rain to snow across the region as the band of precipitation moved through the area. This is evident in the radar reflectivity combined with the observations (Figs. 6, 7, 8, and 9).

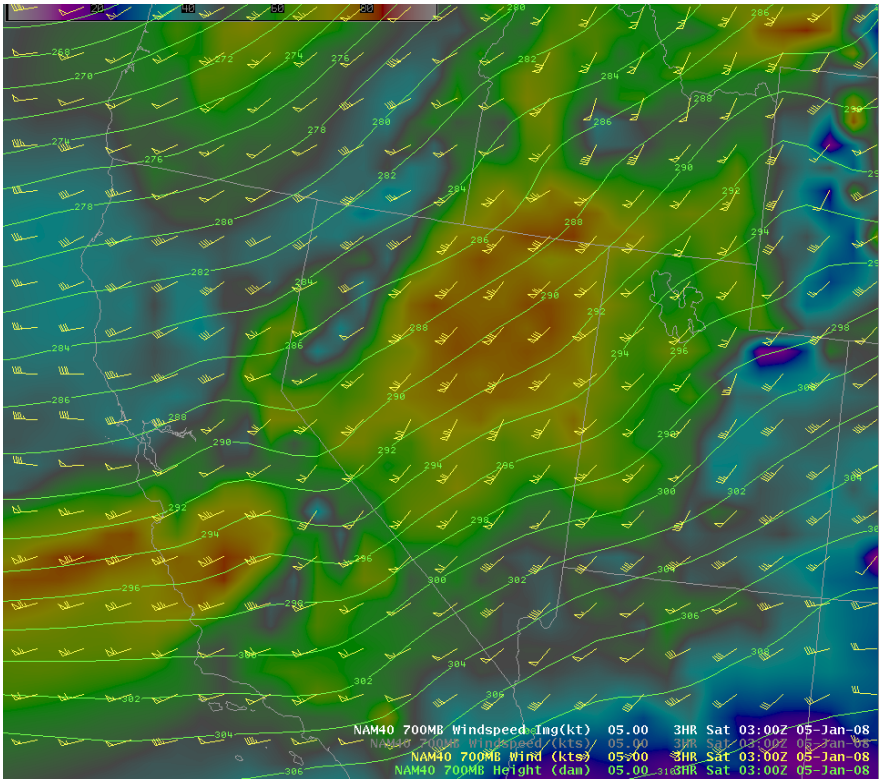

Figure 3: NAM40-km) 3 hour forecast of 700 mb wind, wind speed, and geopotential height valid 03Z January 5th, 2008.

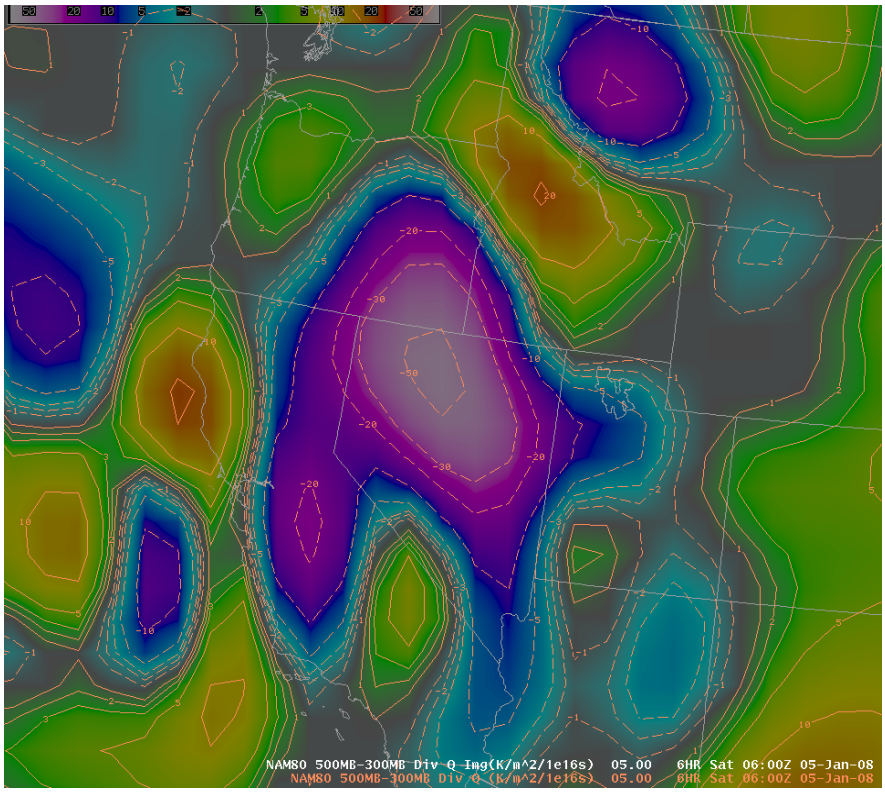

Figure 4: NAM (80-km) 6-hour forecast of Q-vector divergence in the 500-300 mb layer valid 06Z January 5th, 2008.

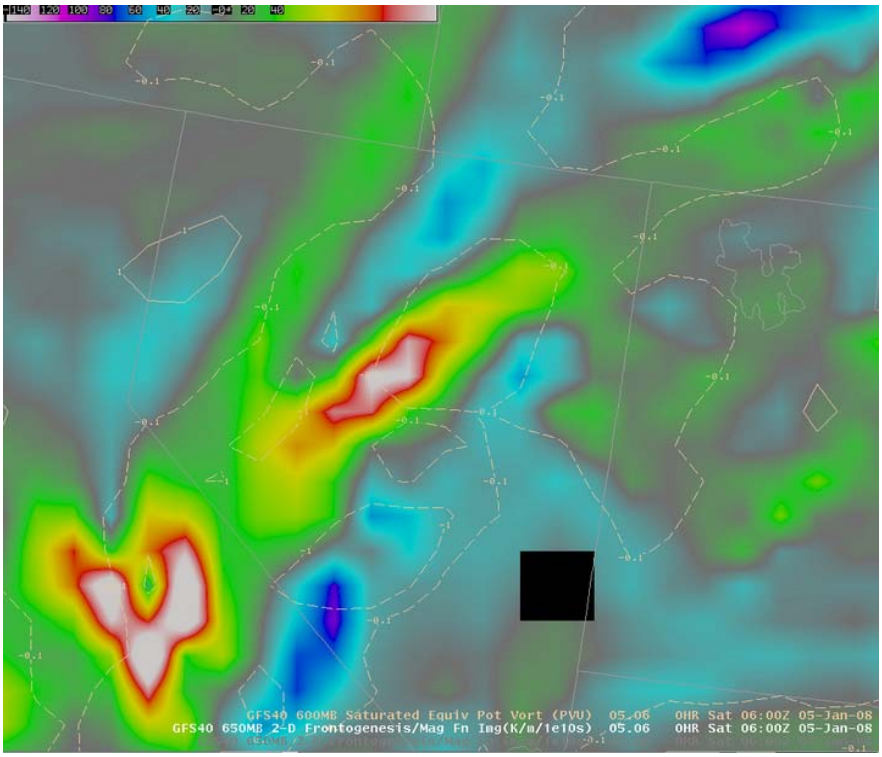

Figure 5:GFS (40-km) analysis of frontogenesis and equivalent potential vorticity at 650 mb valid 06Z January 5th, 2008.

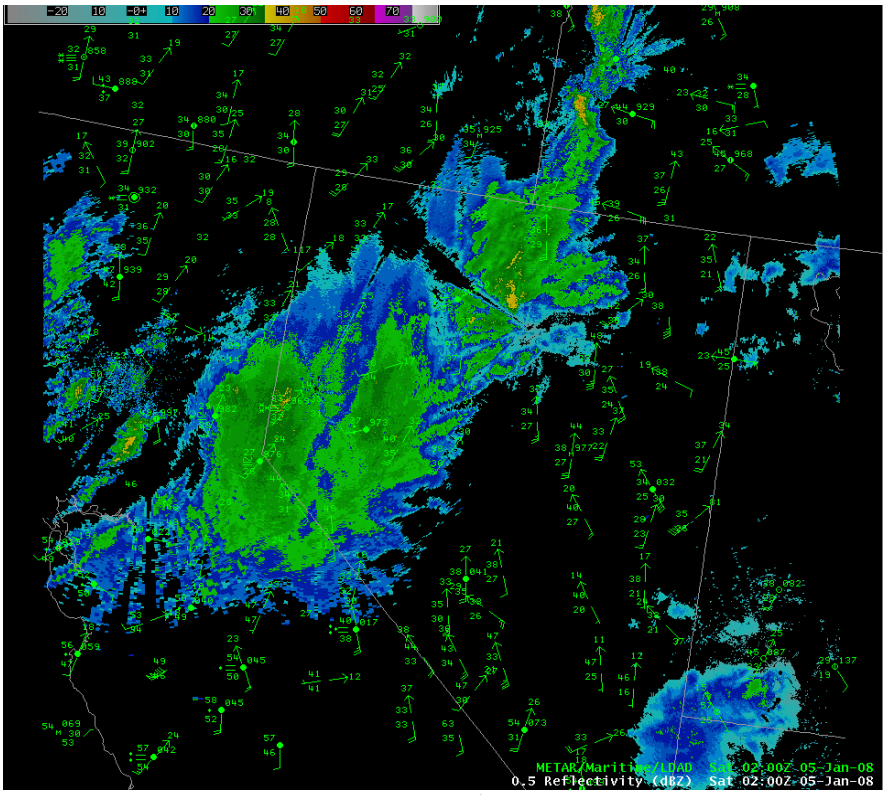

Figure 6: Regional mosaic of radar reflectivity at 0.5˚ and observation plot valid at 02Z on January 5th, 2008.

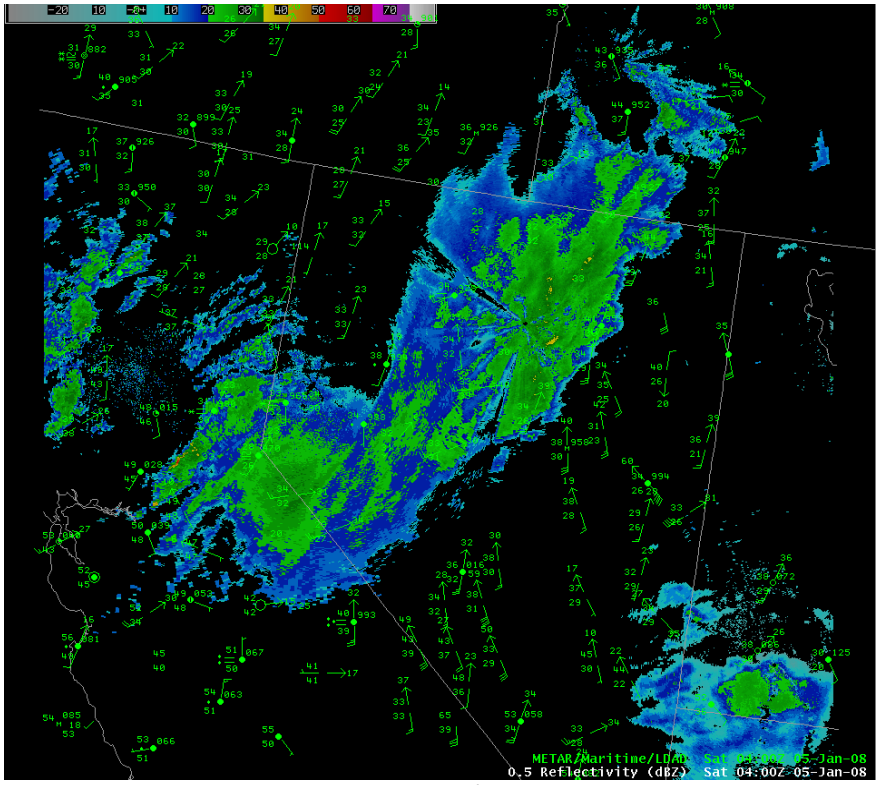

Figure 7: Regional mosaic of radar reflectivity at 0.5˚ and observation plot valid at 04Z on January 5th, 2008.

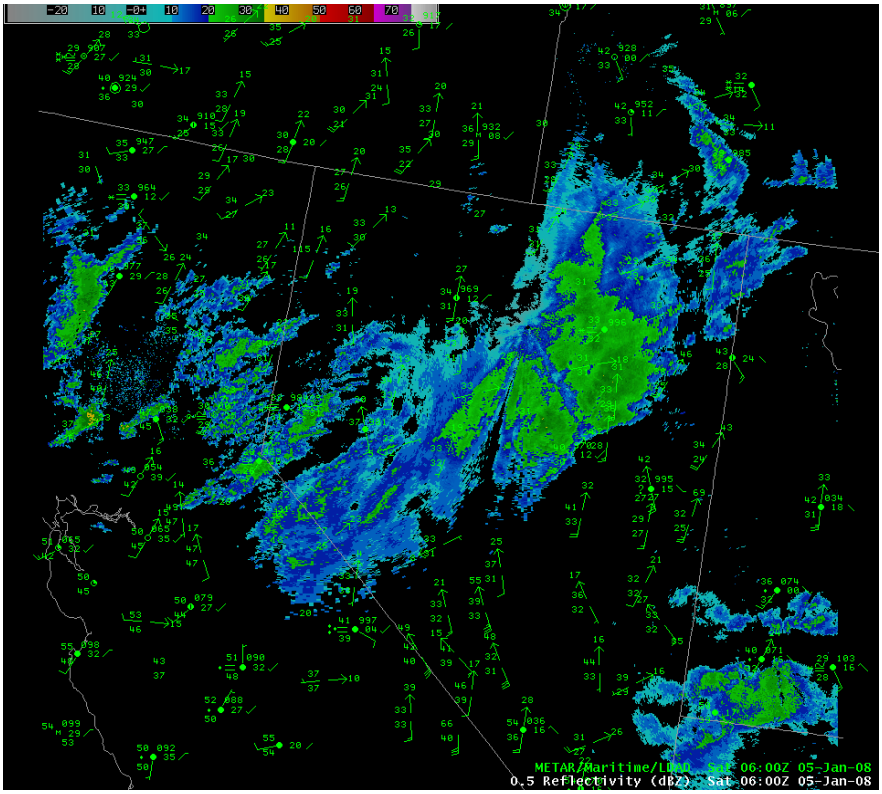

Figure 8: Regional mosaic of radar reflectivity at 0.5˚ and observation plot valid at 06Z on January 5th, 2008.

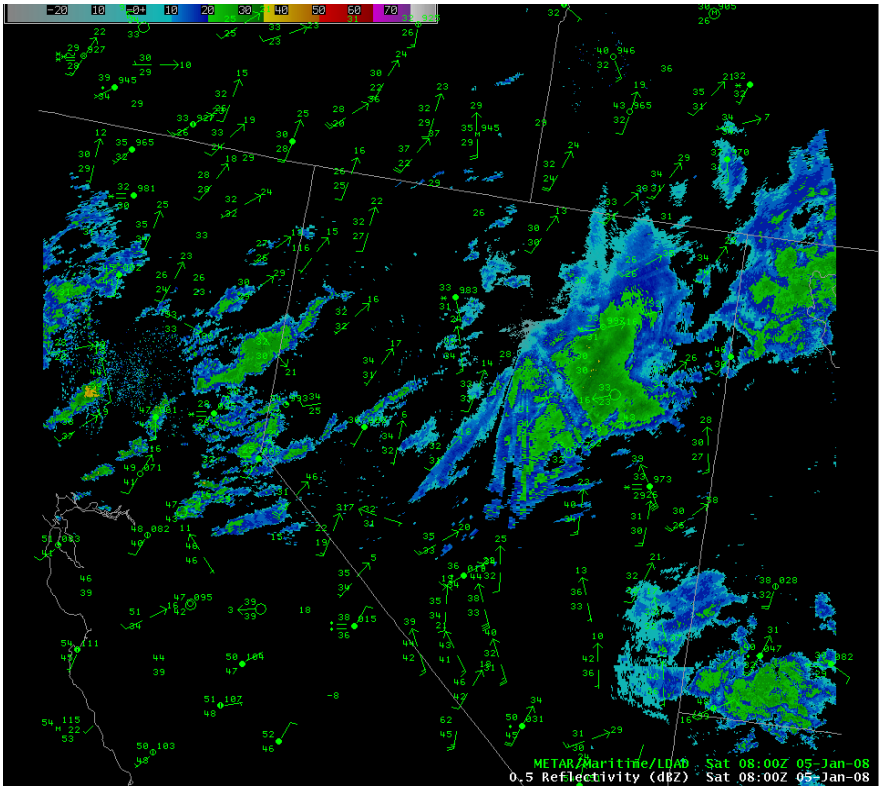

Figure 9: Regional mosaic of radar reflectivity at 0.5˚ and observation plot valid at 08Z on January 5th, 2008.

3. Products Issued

High Wind and Winter Storm Watches were issued approximately 48 hours in advance of the event. The watches were updated to warnings and advisories in the afternoon of January 3rd and in the morning of January 4th. The winds from this event caused power outages, blew a semi-truck over, and caused other damage. The highest wind gust recorded for this event occurred in western Eureka County at the Flat Springs RAWS site (elevation 7701 feet) where a gust to 104 mph was recorded. Snowfall from this event ended up being less than expected for most of the area as the abundant warm air contributed to a later transition to snow. Notable snowfall amounts of 8 and 7 inches fell in Lamoille of Elko County and Diamond Valley of Eureka County, respectively.

4. Gridded Forecasts

The gridded forecast from LKN reflected the event well. Sustained winds of 20 to 40 mph were generally observed across the area, which is close to what the gridded forecast contained (Fig. 10). In regards to the QPF (quantitative precipitation forecast) and SnowAmt (snow amount) grids, the forecast had positive and negative aspects on its journey from a day-4 forecast to verification. This paper will focus on the forecasts up to 60 hours in advance. First, an examination of the verifying QPE (quantitative precipitation estimate) is in order. The QPE indicates that precipitation fell in the far northwest portion of the CWA, or in Humboldt County, between 00Z to 06Z on the 5th of January (Fig. 11). Later in the night, between 06Z to 12Z, much of the rest of the CWA received precipitation (Fig. 12). The official gridded forecasts from WFO LKN can

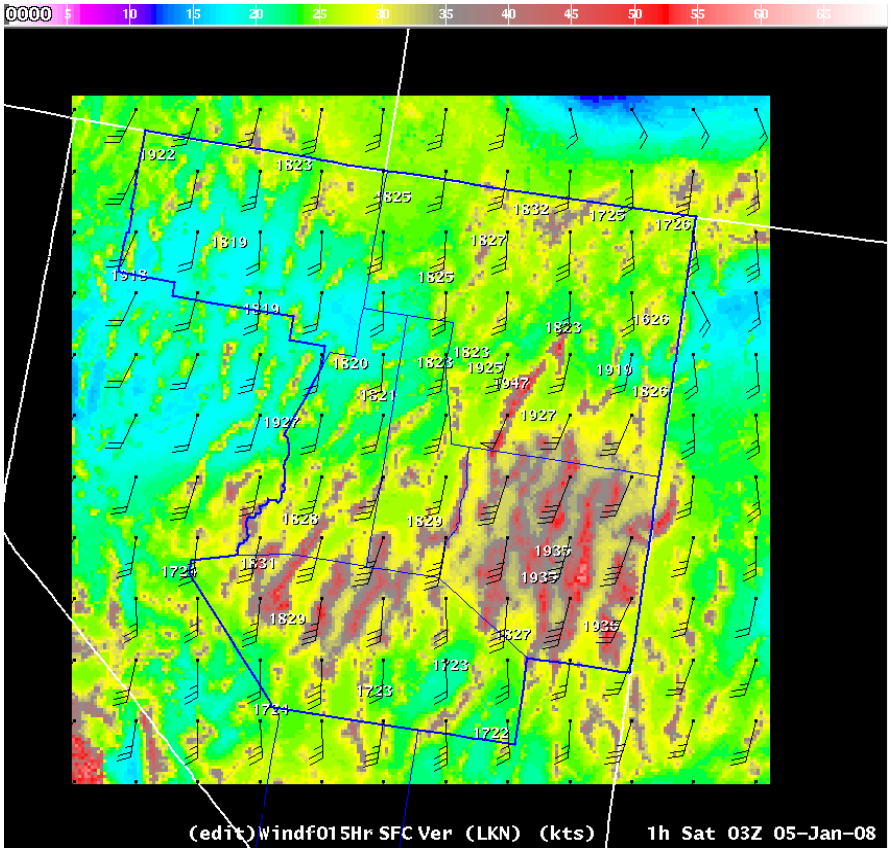

Figure 10: Official wind grid (15 hour forecast) valid at 03Z on January 5th, 2008.

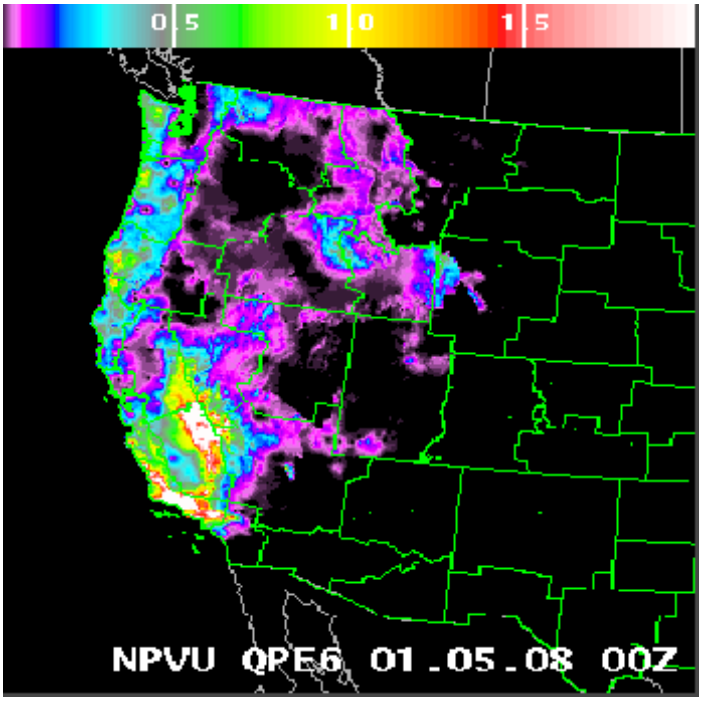

Figure 11: : Quantitative Precipitation Estimate (QPE) valid from 00Z to 06Z on January 5th, 2008.

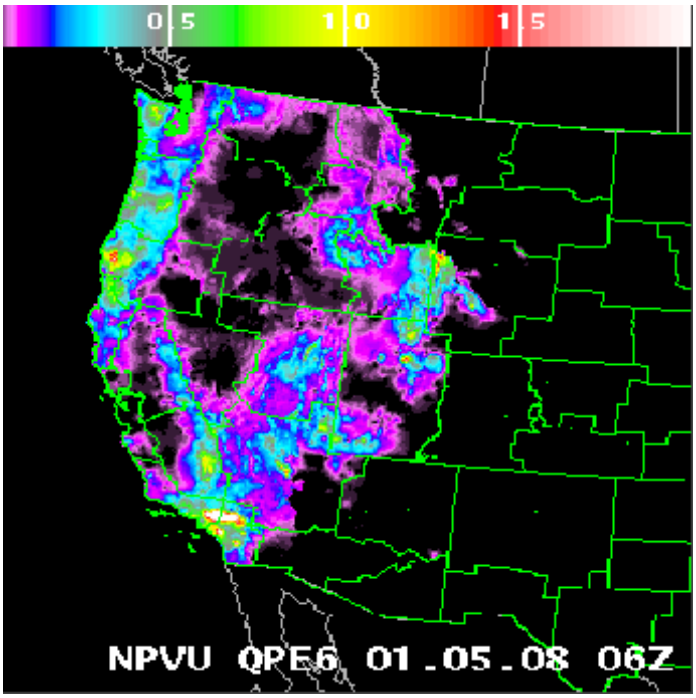

Figure 12: : Quantitative Precipitation Estimate (QPE) valid from 06Z to 12Z on January 5th, 2008.

be found in Figure 13. In this figure, the forecast length is listed below the image except for the lower-right image. The lower-right image is the QPE for this 6 hour period. It is apparent that the forecasts for this period had a few deficiencies. First, there was a collaboration issue with WFO BOI (Boise, ID). The values for the 54-60 hr forecast appear to be within the accepted tolerance (0.25") as WFO BOI had around 0.25" of liquid forecast, while WFO LKN had around 0.05". Examining the 66-72 hour forecast (Fig. 14), it is clear that WFO BOI had matched up with WFO LKN on the previous shift, but collaboration failed for the 54-60 hour forecast. That collaboration failure continued into the 42-48 hour forecast as well. Other than those issues, collaboration appeared to be successful for the rest of the borders and for the rest of the forecasts. Second, according to the QPE analysis, the QPF was slightly over-forecast across most of the CWA for all periods out to 54-60 hours. The most notable area of disparity is across the northern counties. Third, the 30-36 hour forecast increased QPF across Humboldt County compared to the 42-48 hr forecast. However, the verifying QPE shows that between 06 Z to 12 Z Humboldt County was almost completely dry. This raises the question: "What sign did the models give that would result in an increase in the QPF across Humboldt County?" The next section will address that question.

5. Model Data

The model forecasts for this event were relatively consistent. The GFS, out to 60 hours, continually had precipitation extending from the northeastern CWA to the southwest from 06Z to 12Z (Fig. 15). It was consistent in keeping Humboldt County relatively dry. The ECMWF was similar to the GFS, but had less QPF overall and displayed less of a

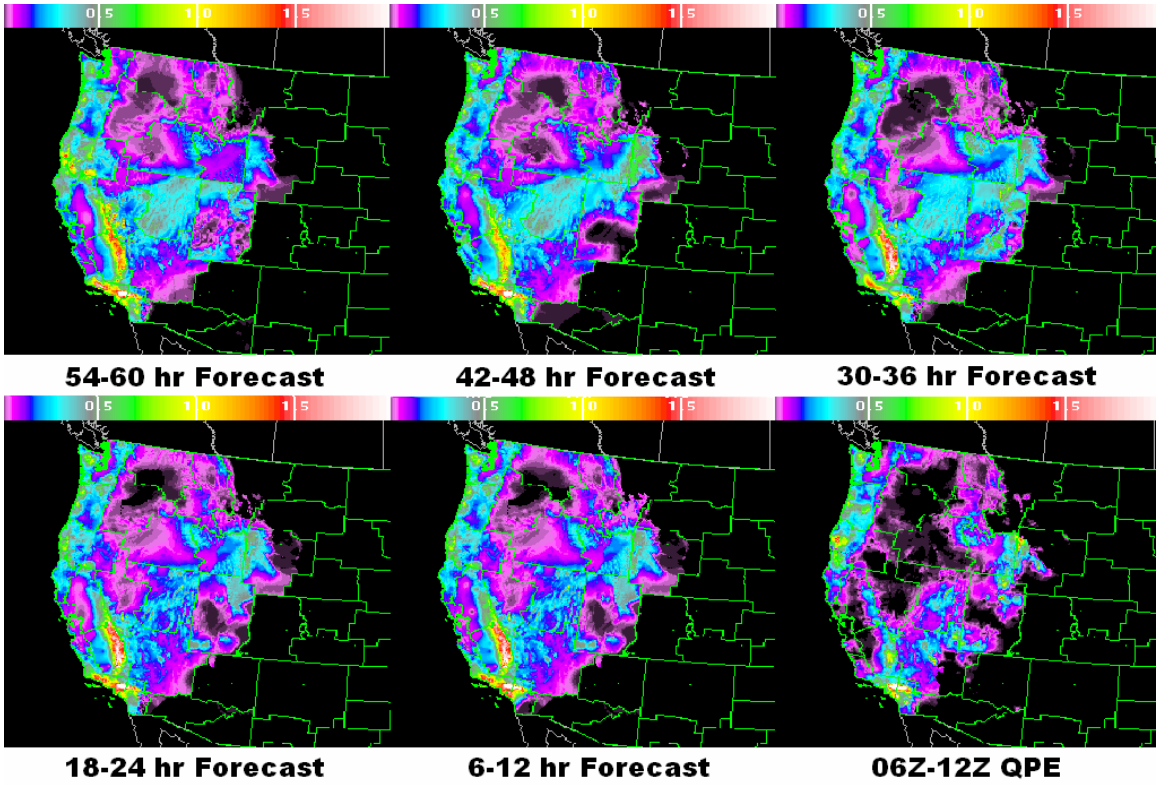

Figure 13: A mosaic showing the official forecasts valid 06Z to 12Z on January 5th, 2008, with the forecast lead time listed below the image. The only exception is the lower right part of the image where the QPE during this period exists.

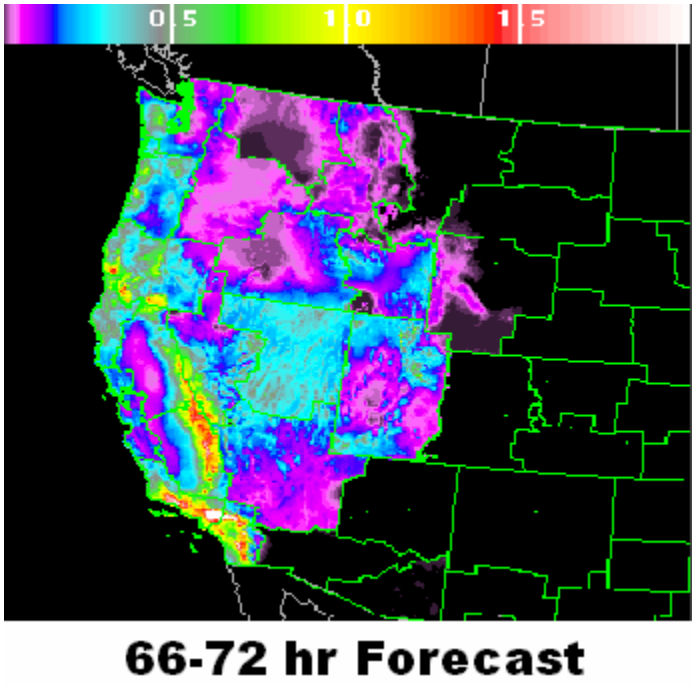

Figure 14: : The 66-72 hour official forecast valid 06Z to 12Z on January 5th, 2008.

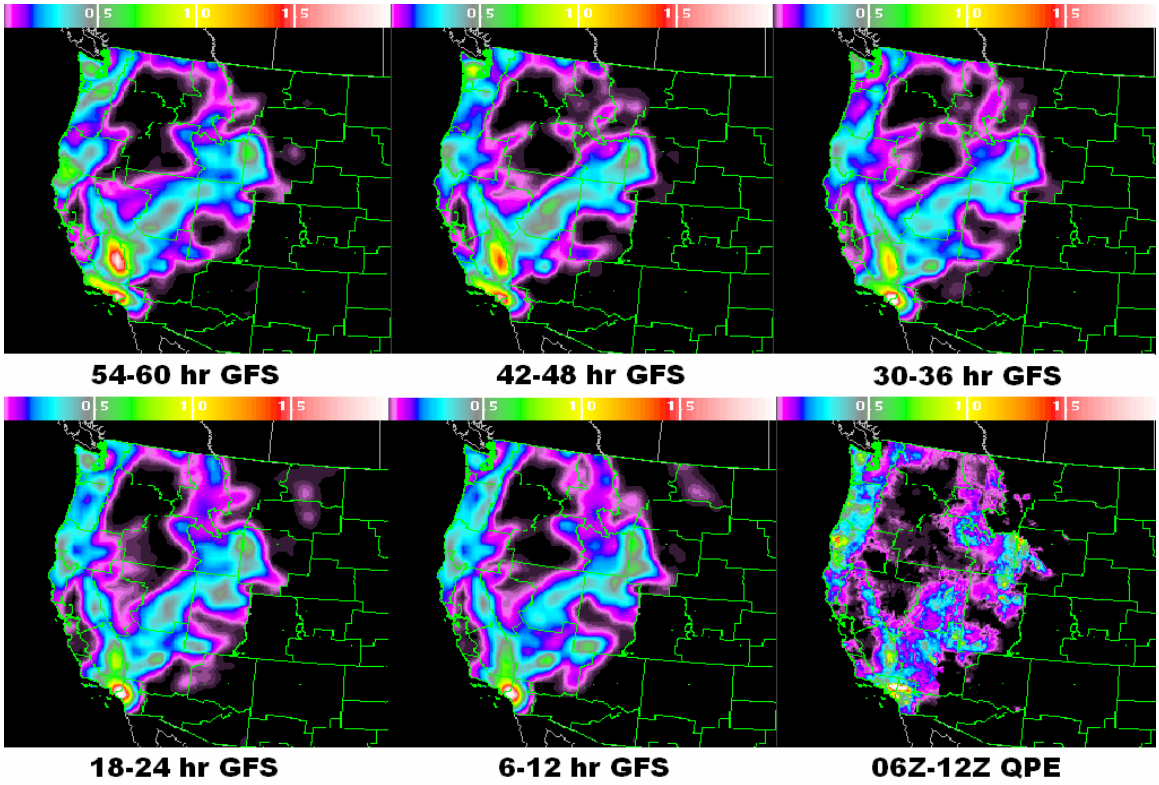

Figure 15: Same as Figure 13, except for the GFS.

banded structure (Fig. 16). (**Editor's Note:** The ECMWF only produces QPF in 12 hour amounts. The WR Verification Project produces 6 hour amounts by dividing the 12 hour amount by two in order to provide a gauge on ECMWF performance. This adjustment should be taken into account when evaluating the ECMWF QPF guidance.) The NAM was similar to the other two models in regards to regards to timing and placement, but had an even sharper contrast between Humboldt County and the rest the CWA (Fig. 17). Hence, the models did not increase QPF across the area although the official forecast did.

6. Winter Weather Products

It is likely that the QPF forecast for Humboldt County was influenced by the issuance of a Snow and Blowing Snow Advisory. A Snow and Blowing Snow Advisory was issued at 1427 LT on the afternoon of January 3rd, valid from 02 Z to 12 Z on the 5th of January. This product mentioned expected snow amounts of three to five inches, in addition to gusty winds.

7. Conclusion

Typically, the expected weather conditions (derived from model data, observations, etc.) birth the forecast grids and the grids then birth the products (Fig. 18). However, during significant weather events, when watches, warnings, or advisories are issued, the editing of the forecast grids often becomes the last of the three steps (Fig. 18). The forecaster will determine the expected weather, determine the significant weather products to be issued, and lastly edit the grids to match the significant weather products. This modified process can sometimes result in forcing the grids to match something that is not expected.

Forecasters are encouraged to revisit the middle step during various times in the grid editing process to ensure that the expected significant weather products are correct. The ideal methodology includes a continuous reassessment of all three parts of the process (Fig.

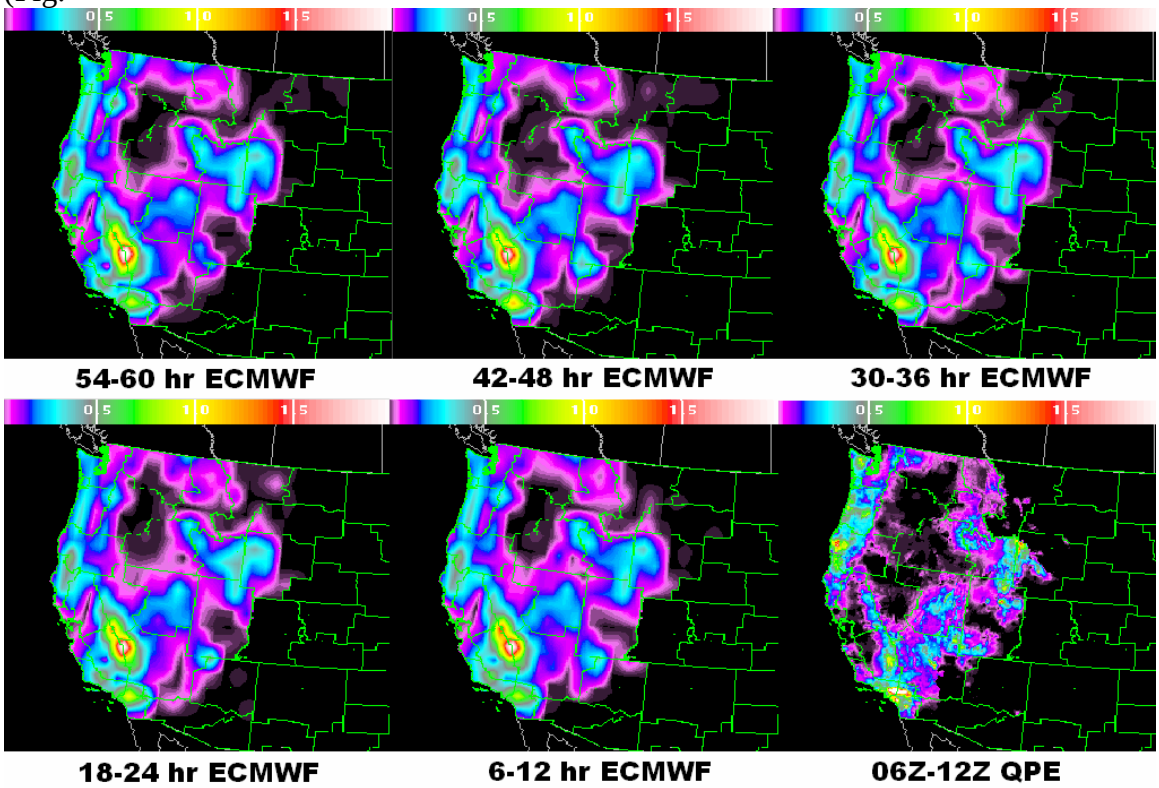

Figure 16: Same as Figure 13, except for the ECMWF. (Editor's Note: The ECMWF only produces QPF in 12 hour amounts. The WR Verification Project produces 6 hour amounts by dividing the 12 hour amount by two in order to provide a gauge on ECMWF performance. This adjustment should be taken into account when evaluating the ECMWF QPF guidance.)

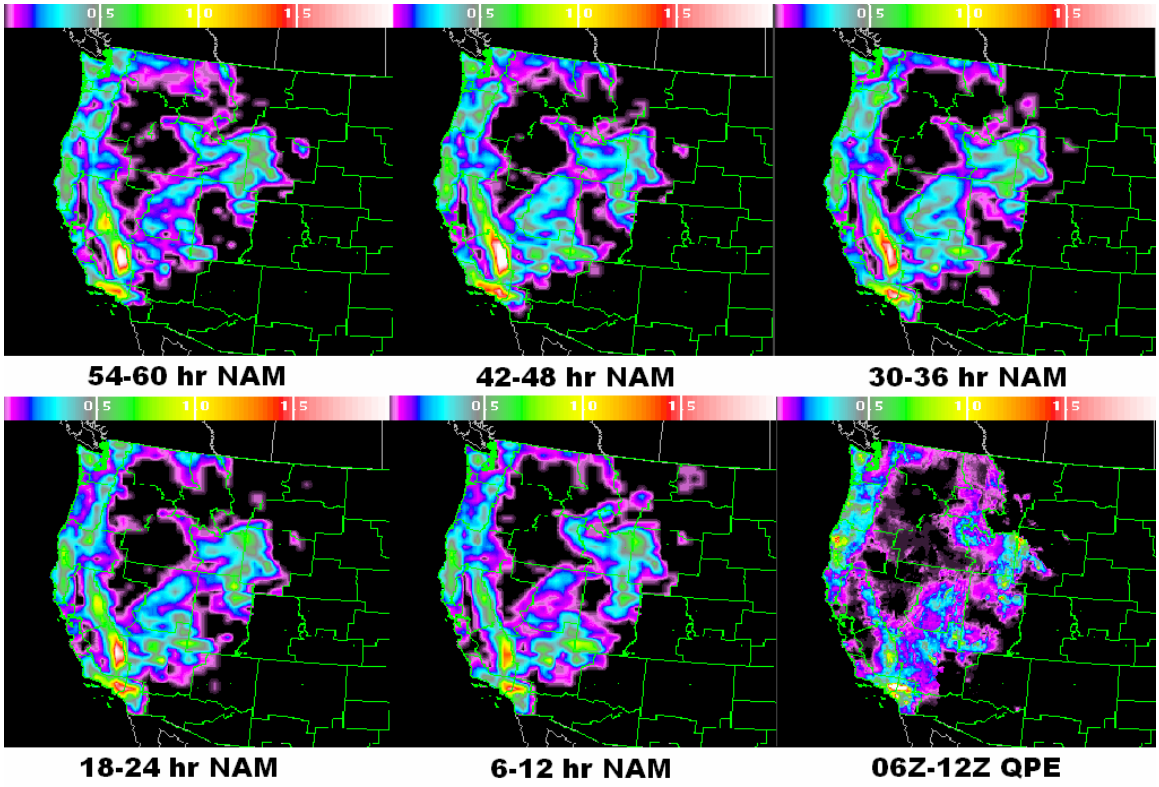

Figure 17: Same as Figure 13, except for the NAM.

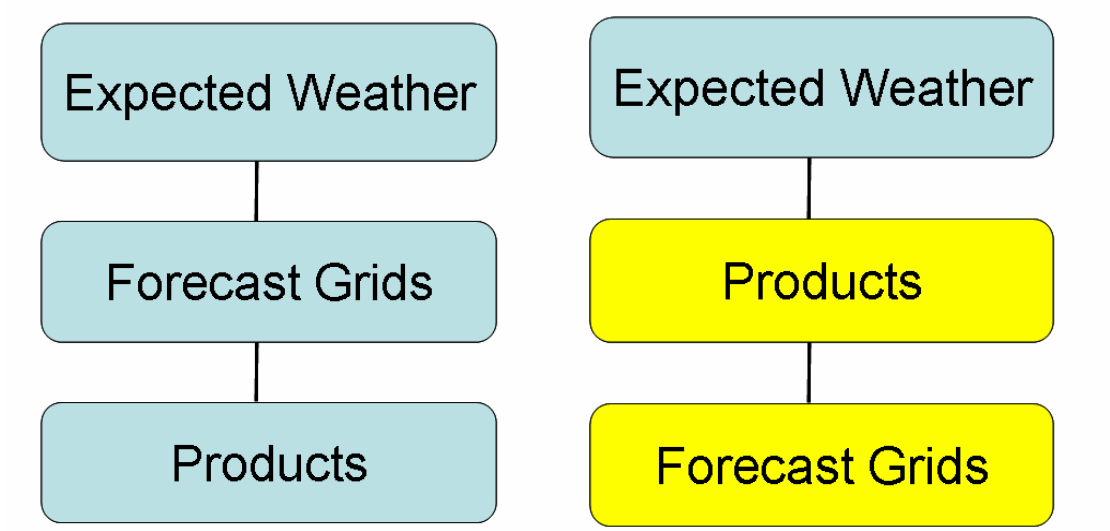

Figure 18: Flow charts showing the typical flow of products during benign weather conditions (left) and a possible flow of products during a significant weather event (right).

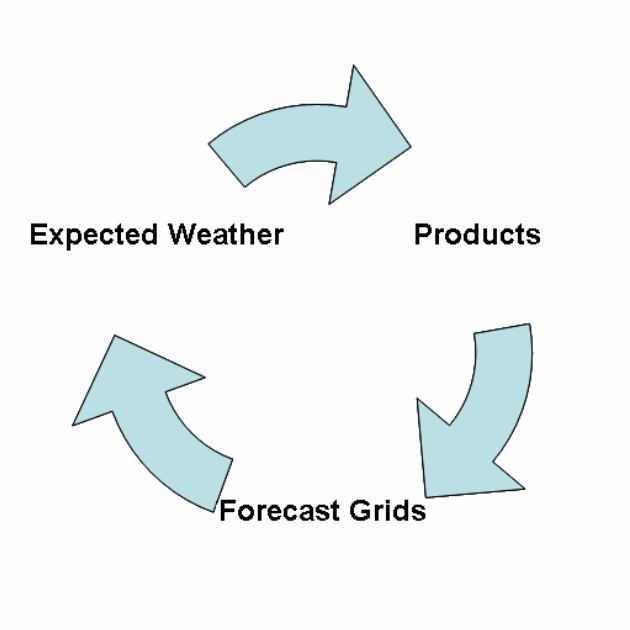

Figure 19: Flow chart showing the ideal methodology, including a continuous reassessment of all three parts of the process.

19). Editing the grids during significant weather events also requires more time, which can lead to less analysis time. Extra staffing will help ensure that the workload is distributed evenly and that all parts of the forecast process receive the attention that they require.