

Introduction

Downslope wind storms pose a threat to life and property in the lee of the Sierra Nevada, on average, 3 to 6 times per winter season. A downslope wind event in the lee of the Sierra is generally classified as having widespread wind gusts exceeding 50 mph with the primary wind direction being from the west to southwest. Forecasting high wind events has proven difficult due to the sensitive synoptic and mesoscale environment needed in producing the winds. A climatology of environmental conditions during or near the time of 21 previous downslope wind events in the Reno area was produced and is described in an upcoming Technical Attachment. Results from the high wind climatology show a strong correlation between high wind events and the -10C, -20C, and -30C temperatures above Reno. Wind speeds in the middle and upper levels and the 500 mb geopotential height also show a strong correlation with the occurrence of strong winds near Reno.

A high wind guide was developed from the results of the climatology study to assist forecasters in determining whether a High Wind Watch or High Wind Warning may be needed ([Table 1](#)). The first page of the high wind guide focuses on the level in millibars where the -10C, -20C, and -30C temperatures are encountered above Reno along with the 500 mb geopotential heights. The distribution in millibars where the -10C, -20C, and -30C temperatures were encountered in the 21 high wind events along with 500 mb geopotential heights are shaded in yellow. For example, the -10C temperature was encountered between 599 and 550 mb in 12 of the 21 high wind cases studied. The distribution of wind speeds at 700, 500, 600, and 300 mb, is also presented in the guide and shaded in yellow. The forecast data from the ETA and AVN is to be entered in the table from the 00 hour analysis time through the 42 hour forecast and is then compared to the climatological values to determine if threshold values have been met or exceeded. The same is done with the 500 mb geopotential heights and the 700, 600, 500, and 300 mb winds. The wind speed, geopotential heights, and the elevation where the temperatures were encountered in real time cases should be higher than the values found in the climatology for them to be considered favorable in the development of strong winds. Naturally, forecasters want to adjust model values if they are not accurately representing the state of the atmosphere.

The Weather Event Simulator (WES) was used to display two events where High Wind Warnings were issued. In one event, which occurred on November 7th, 2002, widespread wind gusts occurred in the lee of the Sierra, verifying High Wind Warnings. In the other case, which occurred on December 19th, 2002, high winds failed to develop and led to false alarms. In both events, looking at only the wind field would have suggested a high wind event would likely occur. If forecasters had used the high wind guide during these two events, the results would likely have prevented forecasters from issuing High Wind Warnings on December 19th while reinforcing the confidence in issuing warnings on November 7th.

Synoptic Evolution

On November 6th, 2002, a deep 500 mb trough and 180 kt jet streak was located over the eastern Pacific Ocean ([Figure 1](#)). Western Nevada was located in a 500 mb height and 700 mb potential temperature ridge ([Figure 2](#)). By 06Z on Nov 7th, 700 mb winds speeds stronger than 40 kts were forecast to develop over the Sierra and strengthen to over 50 kts by 12Z in both the ETA and AVN models. A completed high wind guide using data from the Nov 6th 12Z ETA and AVN is provided in [Table 2](#). Green shading represents values which met or exceeded high wind criteria compared to the climatology, while red shading indicates values below the climatological threshold. The completed guide shows temperatures and 500 mb heights would have met the criteria from 12Z on Nov 6th through 06Z on the 8th. However, the necessary wind speeds did not exceed the threshold until after 00z on the 7th. The table suggests strong winds would develop by 06Z on the 8th from the ETA and by 12Z in the AVN. Wind gusts exceeding High Wind Warning criteria did develop over a wide portion of the forecast area around 08Z on the 7th and continued into the 8th. The initialization time of 12Z on the 7th was used to train forecasters on the WES, as this time provides data at least 12 hours prior to the wind event. This also gives forecasters the opportunity to make a decision on whether a High Wind Watch or Warning is needed with sufficient lead time to protect life and property.

At 12Z on December 19th a deep 500 mb upper low was moving toward the Pacific Northwest coast while a 125 kt 300 mb jet streak approached central California ([Figure 3](#)). Once again, western Nevada was located in a 500 mb height and 700 mb potential temperature ridge ([Figure 4](#)). Based on the Dec 19th 12Z initialization time, the high wind guide was filled out and shows the 700 mb winds were forecast to increase to over 40 kts by 18Z and meet or exceed 50 kts by 00Z on the 20th ([Table 3](#)). The data shows wind speeds would meet or exceed the criteria after 18Z on the 19th before weakening below the threshold by 06Z on the 20th. The wind data implies there was less than a 12 hour window where strong winds were possible when compared to the climatological values. However,

the -10C, -20C, and -30C temperature data along with 500 mb heights showed the values to be well below those determined from the climatology during the period of expected peak winds. As a result, the data from the high wind guide suggests widespread wind gusts exceeding High Wind Warning criteria would not be met. Weather spotter reports and observations from this event did show 2 isolated locations in the forecast area to receive wind gusts that met high wind warning criteria, although they occurred for less than one hour. Once again the data used in the WES was provided to forecasters at least 12 hours prior to the occurrence of the strongest observed winds, providing enough time for forecasters to warn the public if needed.

Discussion

Strong downslope wind events occur in the lee in the Sierra several times a year. Based on a climatology of environmental conditions during high wind events in the Reno area, strong correlations have been found. The WES proved to be a successful training tool in teaching meteorologists to use the high wind guide as a new forecasting technique. The WES also allowed them to become comfortable and proficient with the new technique prior to forecasting real time events.

Figure 1

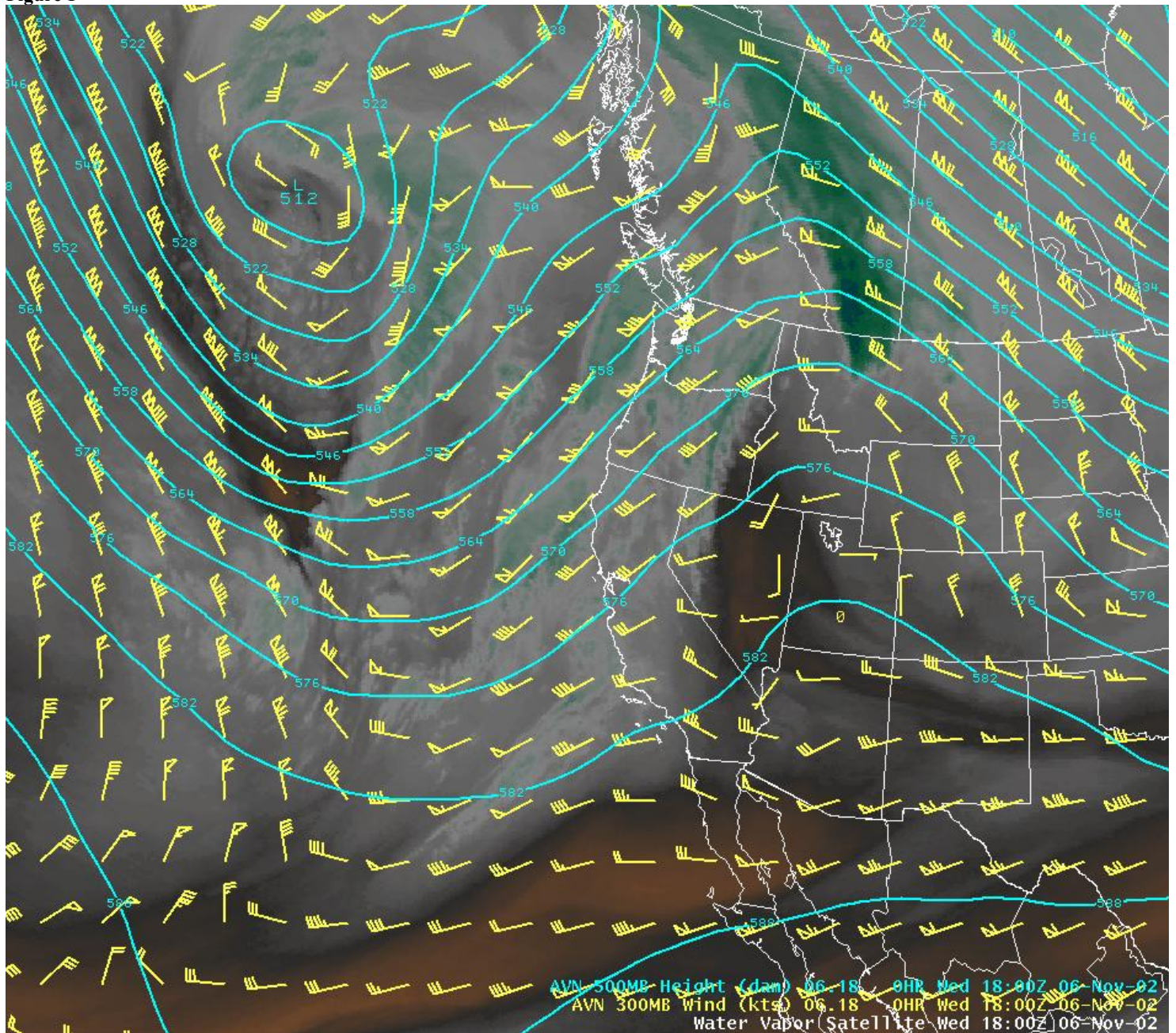


Figure 2

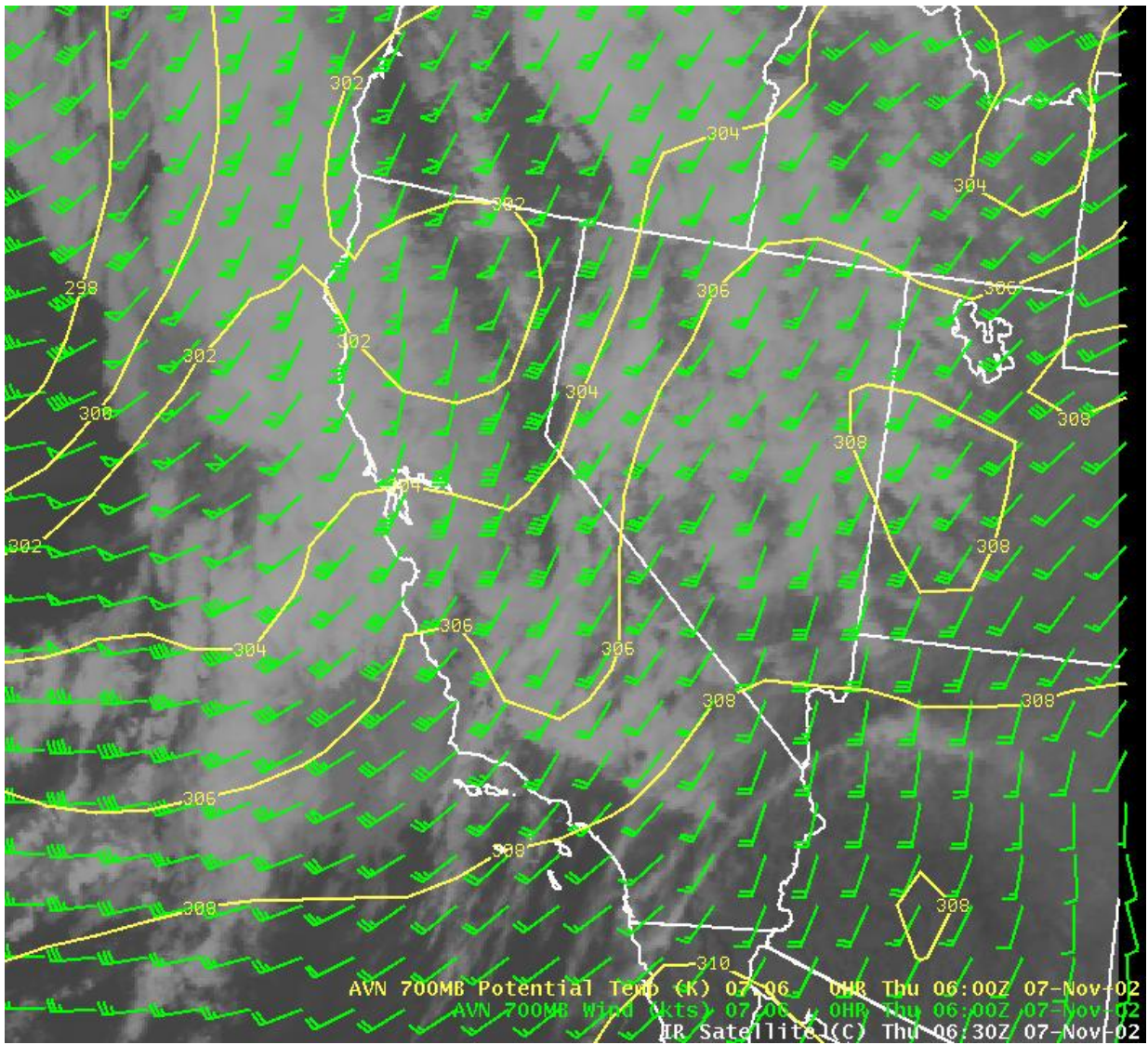


Figure 3

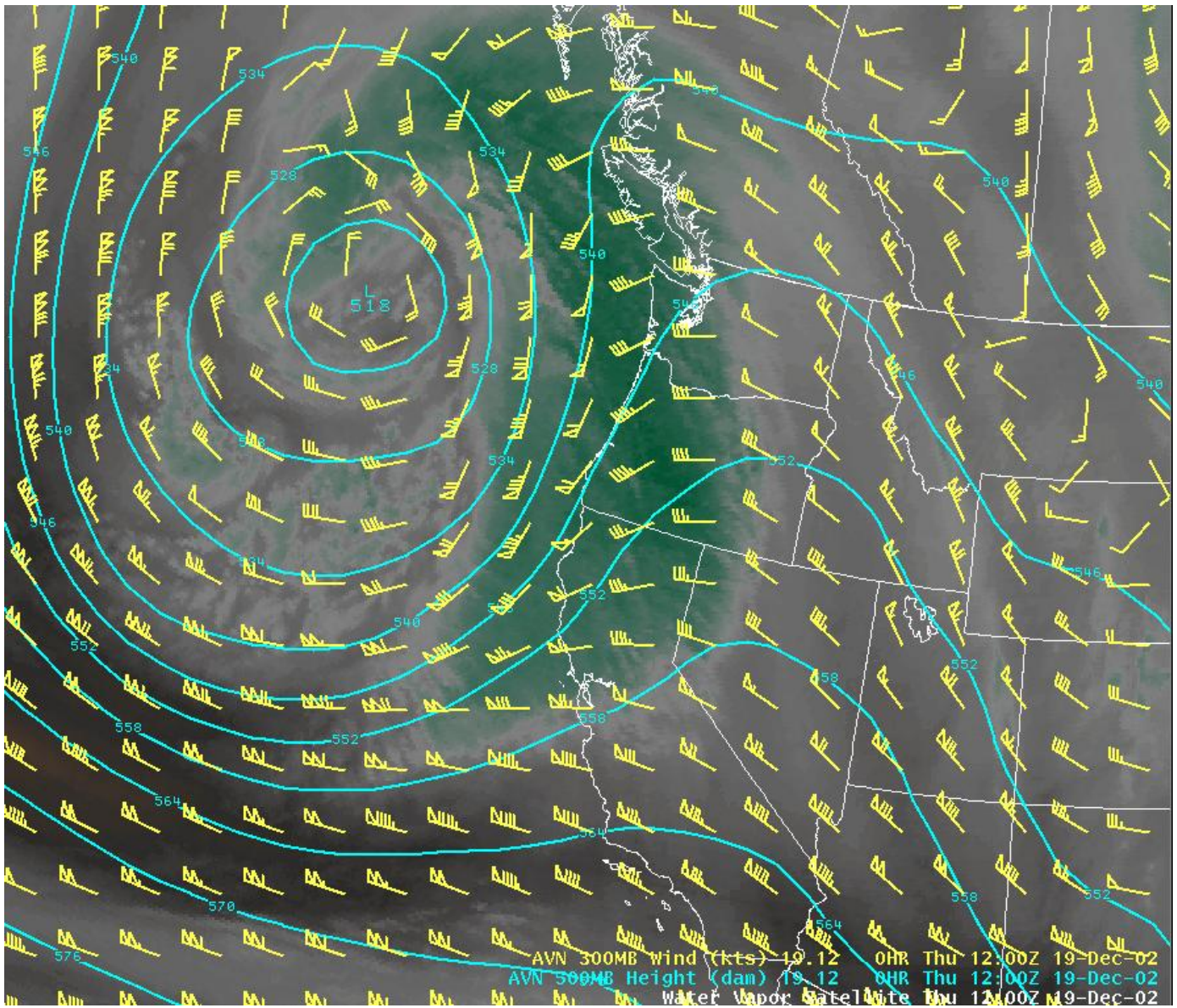


Figure 4

