Case Study of the 12-13 November 2011 Windstorm in South Central Colorado

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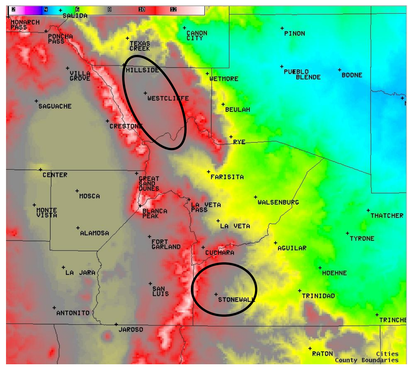
Background

An unusually strong windstorm struck portions of south central Colorado on 12-13 November 2011. One period of strong winds occurred during the morning and afternoon of 12 November. A stronger and more devastating event occurred during the night of 12-13 November 2011. During this second event, winds in excess of 40 m/s (105 mph) were observed near Stonewall. Significant wind damage was also reported near Westcliffe.

The second event was more extreme than most windstorms in the WFO Pueblo forecast area:

- Magnitude of the event
- Damaging winds occurred in locations which typically do not get strong winds, such as the Stonewall area, the city of Westcliffe and locations to the east of Westcliffe.

This poster will focus on the second, more extreme windstorm.



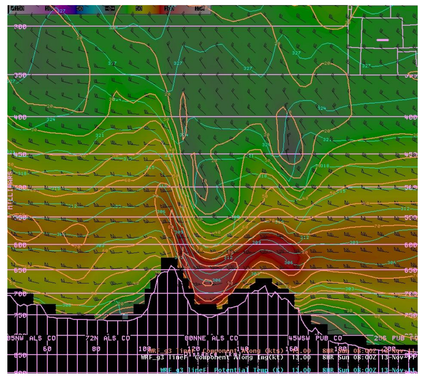
Map showing the approximate areas of the extreme winds (ovals), from the second event, discussed in this poster. Map background is topography in thousands of feet MSL. (One thousand feet equals 304.8 m).

Example of damage near Stonewall, CO during the night of 12-13 November 2011.

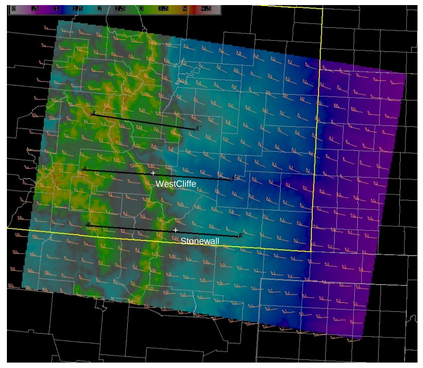
Local WRF simulations

Output from locally run nonhydrostatic version of the WRF. Plots are from the inner most grid which has a 4km grid spacing. Orange lines and background are winds parallel to the cross section in knots. Blue lines are potential temperature in K. Wind barb are in knots and show the ambient winds. (1 knot = 0.514 m/s). For example, wind barbs pointing upward indicate a north wind.

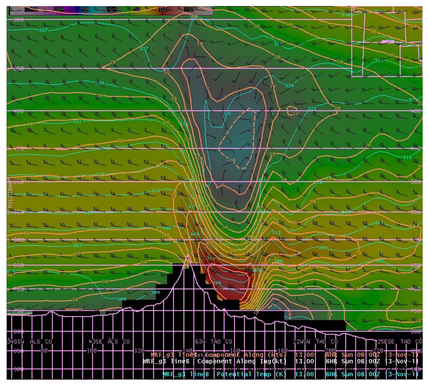
These simulations are run twice daily in real time to provide guidance to forecasters.



Cross section through Westcliffe (line F) at 0800 UTC 13 November 2011.



The inner most domain of the local WRF which has a 4km grid spacing. The barbs are the 600mb winds and background is the model topography. Cross section F is the one through Westcliffe and B is the cross section through Stonewall.



Cross section through Stonewall (line B) at 0800 UTC 13 November 2011

Summary

Simulations show a downslope windstorm with winds near the surface in excess of 100 knots (~50ms^{-1}). A critical layer with near zero along-cross section velocities is present. Substantial reverse shear (both ambient winds and winds along the cross section) upstream of the barrier is evident from 500mb to 300mb. Winds at the barrier top are near 60 knots (30 m/s). Ambient winds decrease to 15 to 25 knots (7.5 to 15m/s) at 300mb.

The synoptic pattern has a shortwave moving across the northern Rockies, reaching South Dakota/Nebraska region at the time of the second windstorm. Over south central Colorado, there was warming associated with the trough passage at 500mb and above, and winds shifted to a north to northwesterly direction. Below 500mb, the trough passage resulted in an increase in the north to south temperature gradient which may have slightly increased wind speeds.

The eastward tilt of the trough wind height allowed for the cross barrier winds to decrease with height. The warming associated with the trough passage resulted in an increase of stability in the layer above the mountain top. Both reverse shear and stability above the barrier are important elements for mountain wave induced windstorm.

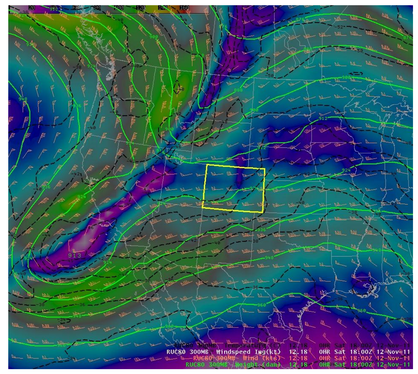
The magnitude of the reverse shear in very unusual for south central Colorado. Typically, mountain wave induced wind storms have weak reverse to neutral wind shear associated with a better defined mountain top inversion.

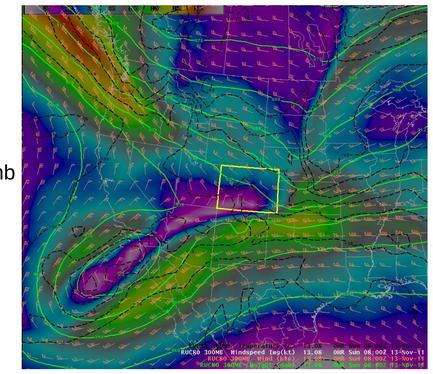
Synoptic pattern

12 November 2011 1800 UTC

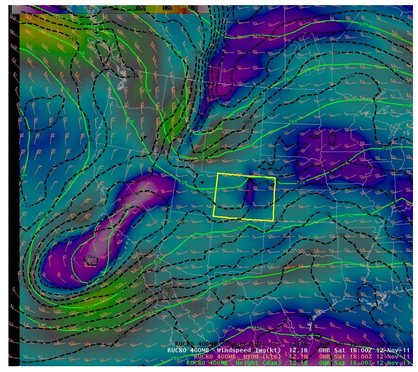
13 November 2011 0800 UTC
(time of WRF cross sections)

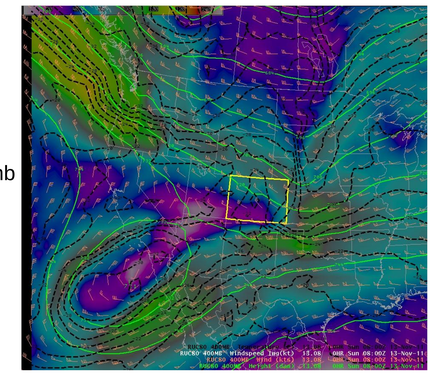
300 mb



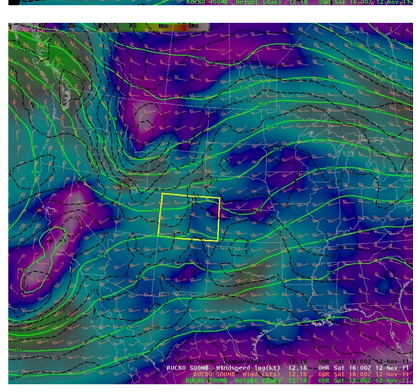


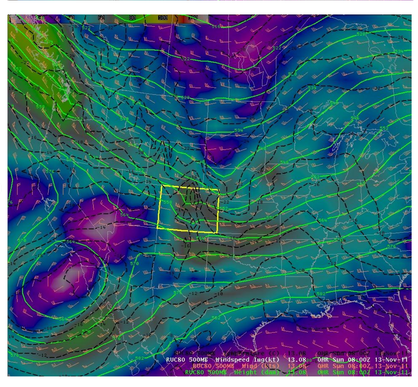
400 mb



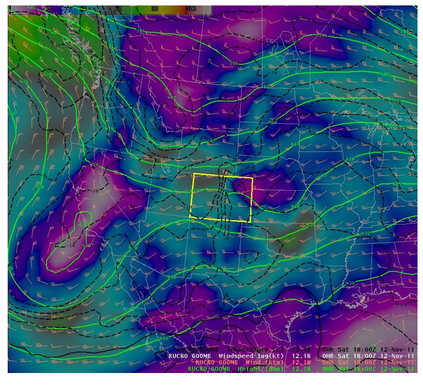


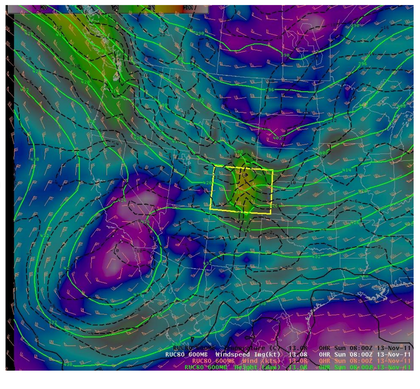
500 mb





600 mb





Plots from RUC initial analysis mapped to 80km grid spacing. Blue lines are height (dm), black lines are temperature (degrees C), wind barbs (knots), and background image is wind speed (knots). (1 knot = 0.514 m/s)