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An Intense Spring Snowfall Event over the Northern Colorado Mountains

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Introduction

Intense snow fell during the late afternoon and evening hours of 6 April 2010 over the Park and Gore mountain ranges in northwest Colorado. Snowfall rates in excess of 10 cm per hour were observed for several hours with over 60 cm of snow accumulating at a few locations. While heavy snow fell elsewhere across the region during a two day period surrounding this event, the intensity was not matched.

Snowpack Telemetry (SNOTEL) Sites and Topography

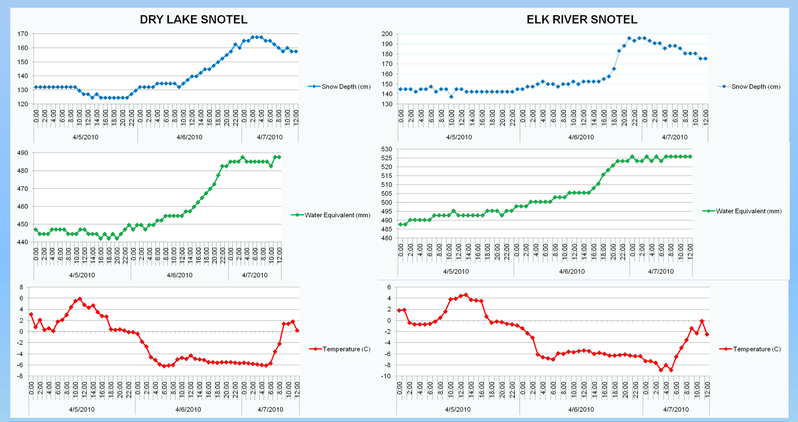

Figure 1: Snow Depth (cm), Snow Water Equivalent (mm) and Temperature (C) data from selected SNOTEL sites near the Park Range in western Colorado. Dry Lake and Elk River SNOTELS are displayed.

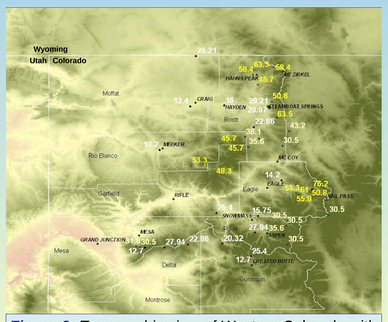

Figure 2: Topographic view of Western Colorado with snowfall amounts from various SNOTELS displayed.

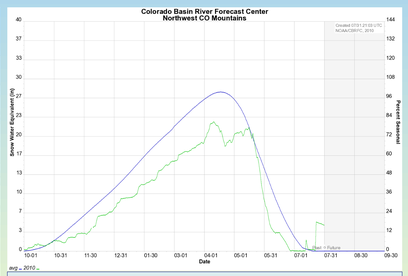

Figure 3: Compilation of SNOTEL sites across the Park Range in western Colorado. Notice sudden spike in Snow Depth at the beginning of April. Sites include: Tower, Buffalo Park, Elk River, Rabbit Ears Pass, Columbine and Lost Dog.

Model Information

- Forecasted 300 hPa Jet analysis (Figure 4) from the 1200 UTC NAM12 displayed below.
- Main jet well south of the intense snowfall, although minor speed max (15-20 m/s) observed exiting southern Wyoming.

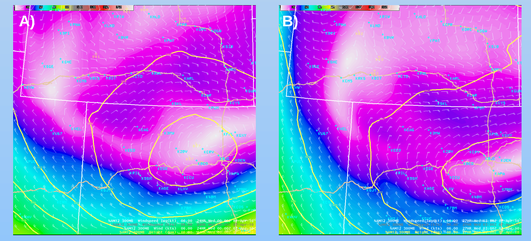

Figure 4: 300 hPa Heights (dam) and Wind (kts). The winds are imaged. A) 0000 UTC 07 Apr 2010; B) 0300 UTC 07 Apr 2010.

- Forecasted 500 hPa Heights and Vorticity fields (Figure 5) from the 1200 UTC NAM12 displayed below.
- Energy wrapping around deep upper level low pressure system over the Dakota's dropped southwest across eastern Wyoming.
- Potent shortwave forecasted to arrive during period of observed heavy snowfall.

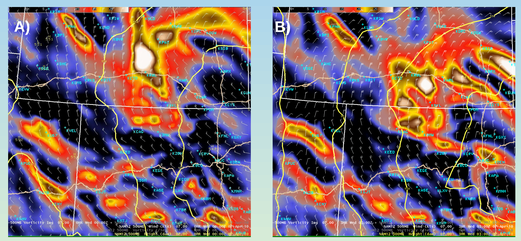

Figure 5 : 500 hPa Heights (dam), Wind (kts) and Vorticity ($1e^{-5}s^{-1}$). Vorticity is imaged. A) 0000 UTC 07 Apr 2010; B) 0300 UTC 07 Apr 2010.

- Jet featured on forecasted 700 hPa field (Figure 6) from the 1200 UTC NAM12 displayed below.
- This jet exceeded 30 ms^{-1} as it progressed through the Park and Gore Ranges in northwest Colorado.
- Timing of this feature corresponded favorably with period of intense snowfall.
- Enhanced Orographics!
- Associated convergence zone/trough over northwest Colorado also noted.

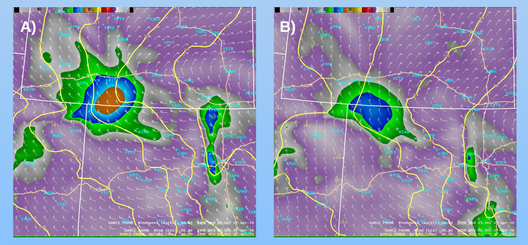

Figure 6: 700 hPa Heights (dam) and Wind (kts). The winds are imaged. A) 0000 UTC 07 Apr 2010; B) 0300 UTC 07 Apr 2010.

- Forecasted 700 hPa Heights, Wind (kts) and Snowfall (in) (Figure 7) from the 1200 UTC NAM12 displayed below.
- Models did a good job picking up on general location for snowfall.
  - Forecasted snowfall intensity was not captured.
- Three hourly forecasts showed band of snowfall shifted south and waned during the evening hours.

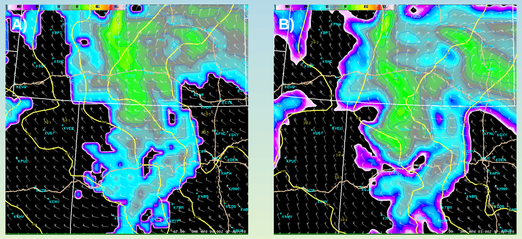

Figure 7: 700 hPa Heights (dam), Wind (kts) and Snowfall (in). Snowfall imaged. A) 0000 UTC 07 Apr 2010; B) 0300 UTC 07 Apr 2010 .

- Deep moisture and area of Isentropic Lift (Figure 8) displayed below, occurred during intense snowfall.

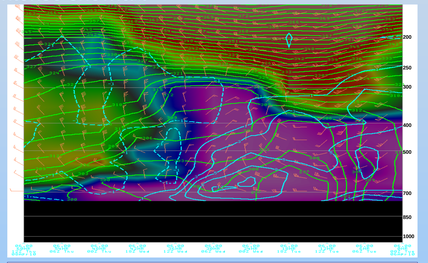

Figure 8: Model time section over the Park Range depicting Relative Humidity (image), Wind (kts), Equivalent Potential Temperature (K), and Omega (-ubar s^{-1})

Figure 9: Remnants of an Avalanche on Sand Mountain (23 km WNW of Steamboat Springs, CO) that occurred 2 days after the storm. (Photo Courtesy of Art Judson.)

Conclusion

Reasons for the intense snowfall over the Park and Gore Ranges in northwest Colorado:

- Deep wrap-around moisture and dynamics west of deepening low in central Plains.
- Good dynamical support – Good isentropic lift and 300 hPa jet maximum.
- Strong orographics – 700 hPa jet.
- Crystal development in favorable dendritic growth regime.
- Several locations received upwards of 60 cm of snow during this event, with over 40 cm falling in just a few hours at several locations.