# Can Blowing Snow Forecasts be Significantly Improved across the Rocky Mountain Region and Northern High Plains?


Matthew Brothers[1], Andrew Lyons[1], Rob Cox[1], Bart Geerts[2], Zachary Lebo[2], Robert Capella[2], Ethan Collins[2], and Trevor Alcott[3]

*National Weather Service, Weather Forecast Office, Cheyenne, Wyoming[1]*

*University of Wyoming, Department of Atmospheric Science, Laramie, Wyoming[2]*

*Earth Systems Research Laboratory, Model Development Branch, Boulder, Colorado[3]*


## Blowing Snow:

Snow lifted from the surface by the wind to a height of 6 feet or more and reducing visibility below 7 SM.

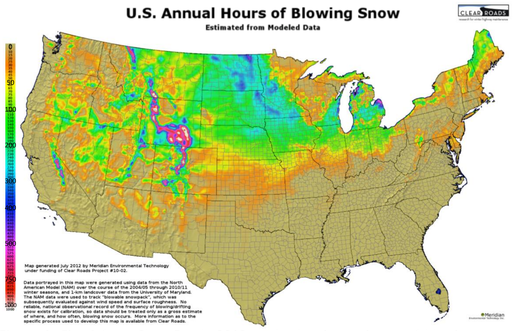



**Figure 1:** Fig. 4 from Clear Roads 2012 study showing estimate of blowing snow frequency across the CONUS based on NAM and snow cover data.

GFE uses Baggaley method which inputs: dynamic snow depth, temperature, wind speed & snow age.

- **Accurate grids of these inputs are required to create accurate blowing snow forecast in GFE.**

Blowing snow is very sensitive to temperatures near freezing and **rapidly decreases** above 28°F.

Snow crusts at 35°F and greater making blowing snow very difficult **without** new snow.

Models tend to under-predict winds in CYS CWA.

**CYS Wind Tools:**

**Arlington**:
850mb CAG-CPR HGT
750mb CAG-CPR HGT

**Bordeaux**:
850mb CAG-CPR HGT
ARL-BRX MSLP
800mb Wind Speed

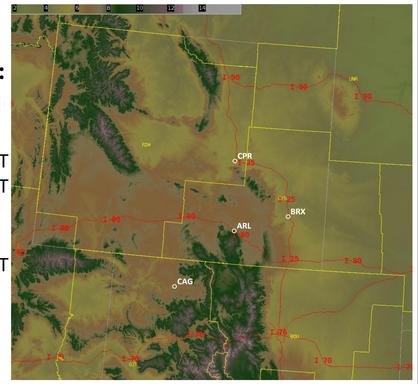



**Figure 2:** Topographic map of the Central Rocky Mountain Region.

## References


Baggaley, D. G., and J. M. Hanesiak, 2005: An empirical blowing snow forecast technique for the Canadian arctic and the prairie provinces. Wea. Forecasting, **20**, 51-62.

Vionnet, Y., G. Guyomarc'h, F. Naaim Bouvet, E. Martin, Y. Durand, H. Bellot, C. Bel, and P. Pugliese, 2013a: Occurrence of blowing snow events at an alpine site over a 10-year period: Observations and modelling, Advances in Water Resources, **55**, 53-63

Clear Roads 2012: Mapping Weather Severity Zones. http://clearroads.org/wp-content/uploads/dlm_uploads/MappingWeatherSeverityZones-Fin alReport.pdf

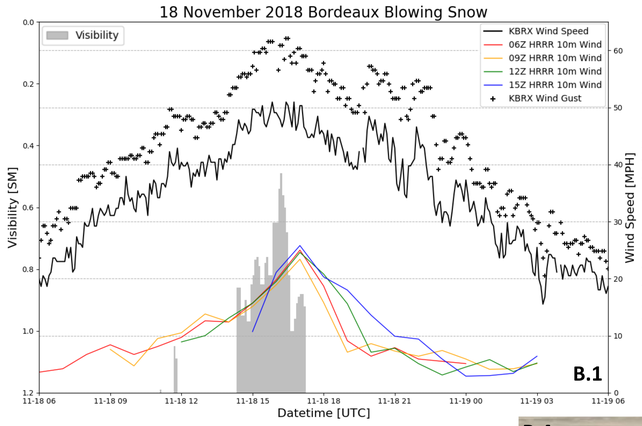
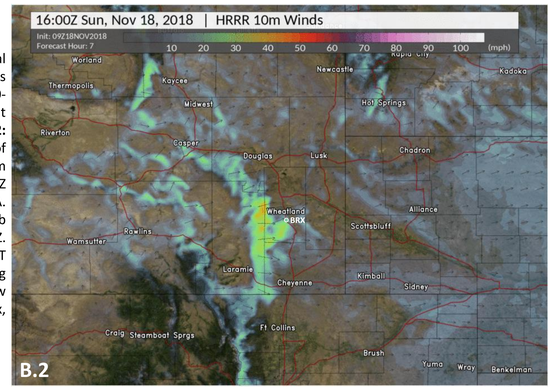
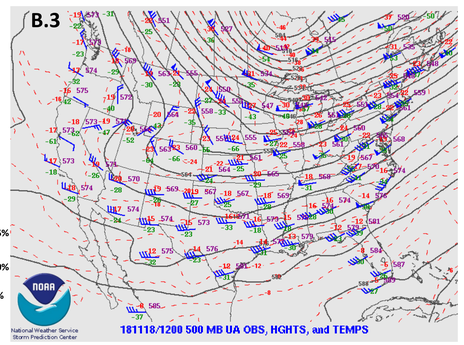




**Figure B.1:** Temporal plot of observations and forecast HRRR 10-m wind speeds at KBRX. **Figure B.2:** Spatial plot of forecast HRRR 10-m wind speeds at 1600Z across the CYS CWA. **Figure B.3:** 500-mb chart from 1200Z. **Figure B.4:** WYDOT webcam view during the blowing snow event at Bordeaux, WY.




## Bordeaux Blowing Snow 11 November 2018

- High Wind Warning in effect.
- 40 MPH sustained winds for 11 hours with gusts up to 67 MPH.
- 7 to 12 inches of snow fell the day before with temps in the teens.
- Event ended as temps began rising.

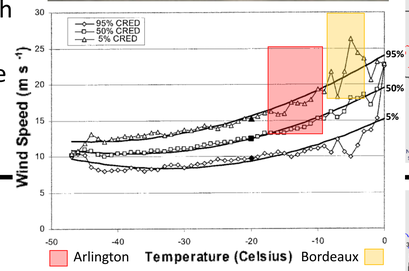
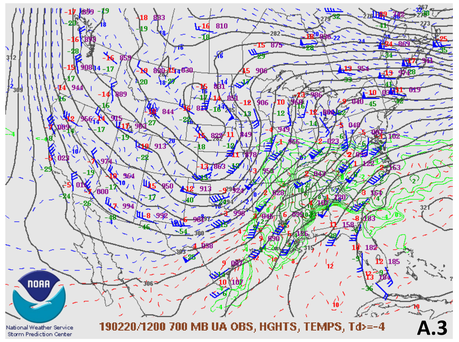




**Figure 3:** Fig. 3 from Baggaley and Hanesiak (2005) showing credibility (CRED) of blowing snow (%) based on temperature and wind speed modified to show the observation space of both events presented.

## Arlington Blowing Snow 20 February 2019

- Winter Weather Advisory for blowing snow & High Wind Warning in effect.
- Wind gusts up to 55 MPH with visibility reduced below ¼ mile.
- Minimal new snow & single digit temps leading up to event.

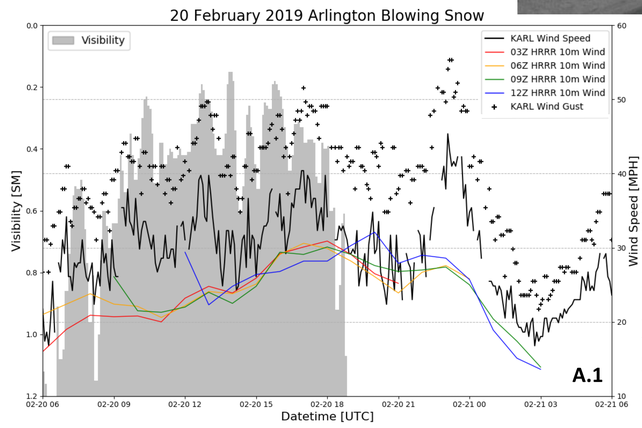
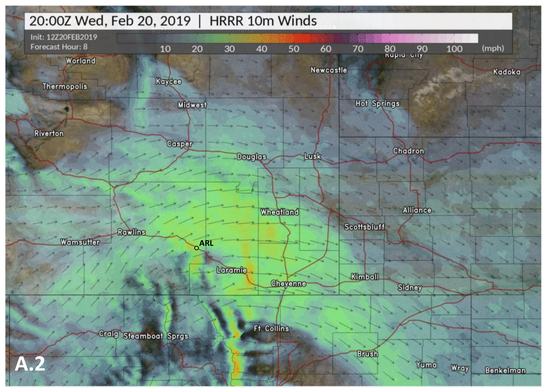




**Figure A.1:** Temporal plot of observations and forecast HRRR 10-m wind speeds at KARL. **Figure A.2:** Spatial plot of forecast HRRR 10-m wind speeds at 2000Z across the CYS CWA. **Figure A.3:** 700-mb chart from 1200Z. **Figure A.4:** WYDOT webcam view during the blowing snow event at Arlington, WY.




## CSTAR Project

Improved operational prediction of blowing and falling snow and extreme wind events in the Rocky Mountain region and northern High Plains

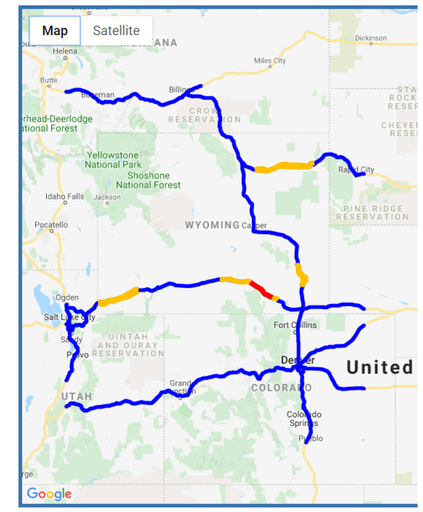



**Figure 4:** Example of web portal to display current and forecast road conditions. Road segments with vary in color depending on severity of winter hazards.

Design web portal to display current and forecasted road conditions based on various hazards:

- Blowing Snow
- Strong Winds (Cross Road Component)
- Snow Squalls

Develop HRRR-based blowing snow parameter based on:

- Snow Depth/Cover (updates once per 24 hour cycle)
- Surface Wind Speed (driftability index)
- Snow Age
- Snow Surface Temp (current and past 25 hours)
- Current Surface Air Temp

…and examine the accuracy of HRRR forecast for occurrences and intensity (Ns) of blowing snow.

- **The current HRRR visibility diagnostic does not account for attenuation due to blowing snow!**

Further examination of cases using high resolution simulations

**Driftability Concept:** (Vionnet et al., 2013a)

$$U_{5th} = \frac{ln(2.868) - ln(1+D)}{0.085}$$

$$D = \begin{cases} 0.75d - 0.5s + 0.5 & \text{(dendritic snow)} \\ -0.583g_s - 0.833s + 0.833 & \text{(non-dendritic snow)} \end{cases}$$

$U_{5th}$ – Threshold Wind Speed at 5-m  D – Driftability Index
d – Dendricity  s – Sphericity  gs – Grain Size