

December 2008 Blizzard and Arctic Air Outbreak

By Andrew Zimmerman, General Forecaster

A strong arctic cold front and a Pacific trough (or shortwave in the middle-upper atmosphere) combined to produce blizzard conditions across northeast Montana on December 13, 2008. Extremely cold temperatures followed, and persisted through Christmas Eve as an arctic airmass remained entrenched over northeast Montana. This event brought heavy windblown snow to the region, the type of snow that is difficult to measure, bare spots adjacent to drifts of a few feet, and dangerously cold temperatures and wind chill readings.

Early December 2008 was warmer than average across northeast Montana. Winter weather still occurred in early December, despite warmer than normal temperatures, with several light snow events and even some freezing rain. Meanwhile, cold air began to gather over the Canadian Arctic. As the event neared, a large upper level ridge amplified over the eastern Pacific Ocean. At the same time an upper level trough deepened over northern Canada and moved south toward Hudson Bay (Figure 1). This pattern typically favors cold air outbreaks across northeast Montana, and this was no exception. A strong upper level shortwave trough was apparent over northern British Columbia by the morning of the 12th (Figure 1). This trough continued to dig south along the west coast settling over the Pacific Northwest by the morning of the 13th (Figure 2). As this trough moved south, it drove an intensifying arctic cold front south over the Canadian Prairies into the Northern High Plains (Figure 3). Pacific moisture flowed over the arctic airmass ahead of the trough producing widespread snow behind the cold front (Figure 4). The arctic high pressure system slowly moved into the area on the 14th bringing an end to the snow (Figure 5). Dangerously cold wind chill readings developed behind the cold front from the combination of a strong northerly wind and cold temperatures.

At the Glasgow forecast office, 10.5 inches of snow was recorded, but much of this snow was blown into large drifts and/or collected in drainages and along fence rows. Ten of the 10.5 inches of snow fell on the 13th. This ranked as the highest daily snowfall total in December since climate records began at Glasgow in 1893. Other snowfall amounts from the region included 11.0 inches 4 miles southwest of Hinsdale, 8.0 inches at Culbertson and Westby, 7.2 inches 35 miles south of Malta, 7.0 inches at Nashua, 6.0 inches at Flatwillow, and 5.0 inches at Sidney.

The temperature at Glasgow plummeted from 26° F at 12:56 am on the 12th to a -13° F at 11:59 pm on the 13th in the wake of the arctic front. The temperature was steady during the daylight hours on the 14th and then began to fall again reaching -32° F by the morning of the 15th. This was the first time Glasgow reached -30° F in December since 1996. Maximum temperatures of -12° F and -16° F on the 14th and 15th, respectively were record cold high temperatures for each day. The cold air remained over the area through the 24th before warming, in a relative sense, from Christmas Day through the end of the month. The period from the 14th to the 24th averaged -12.5° F, this was the second coldest on record for that time period. The warmest high temperature at Glasgow during that time period was 7° F on the 17th. Many locations reached -30° F

during this event with the coldest reading of -34°F recorded at Port of Morgan and Flatwillow on the morning of the 15th. Several record low temperatures were set from the 14th through the 16th, mostly in the record low maximum category, but a few record lows in addition (Table 1).

From the afternoon of the 14th through the day on the 15th, northwest winds of 20 to 35 mph combined with the bitter cold temperatures to produce wind chills of -35°F to -55°F across northeast Montana. The coldest reading was -55°F at the Lindsay Divide Department of Transportation site.

It was the final season of elk hunting, and ranchers had to take extra precautions to bring extra feed to their livestock. Some roads in the region were emergency travel only on Saturday and not much better on Sunday either. Many events from local activities, to school sporting events were cancelled. The wind chill temperatures continued to be a problem through much of the following week as well, and many schools cancelled their bus routes due to the blowing snow and extreme cold.

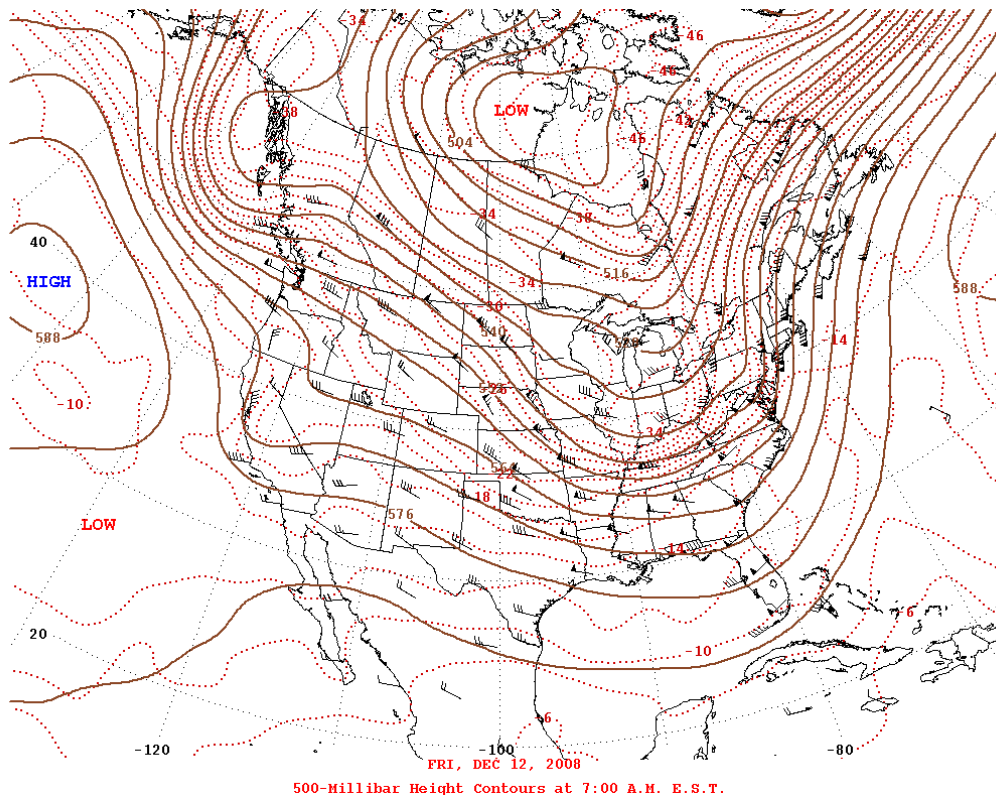


Figure 1. Upper level map at 7am EST December 12. A large upper ridge existed over the eastern Pacific while a closed upper low was deepening over Hudson Bay. A strong shortwave trough was over northern British Columbia at this time.

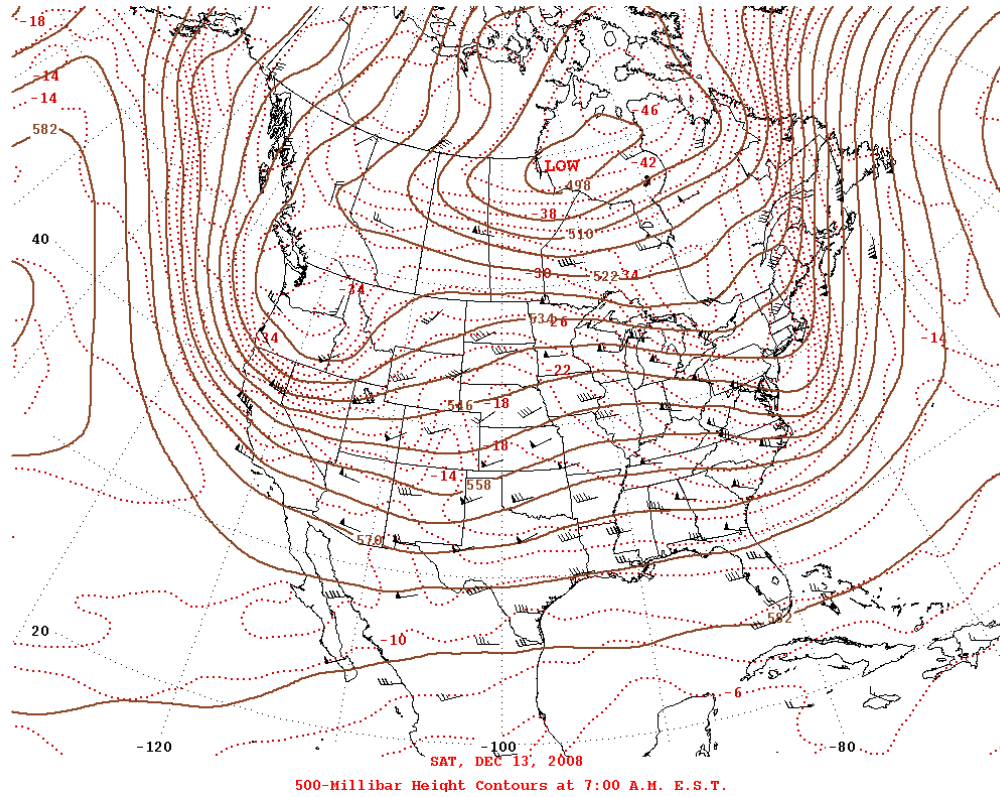


Figure 2. Upper level map at 7am EST December 13. The shortwave trough from the previous image has moved south and settled over the Pacific Northwest.

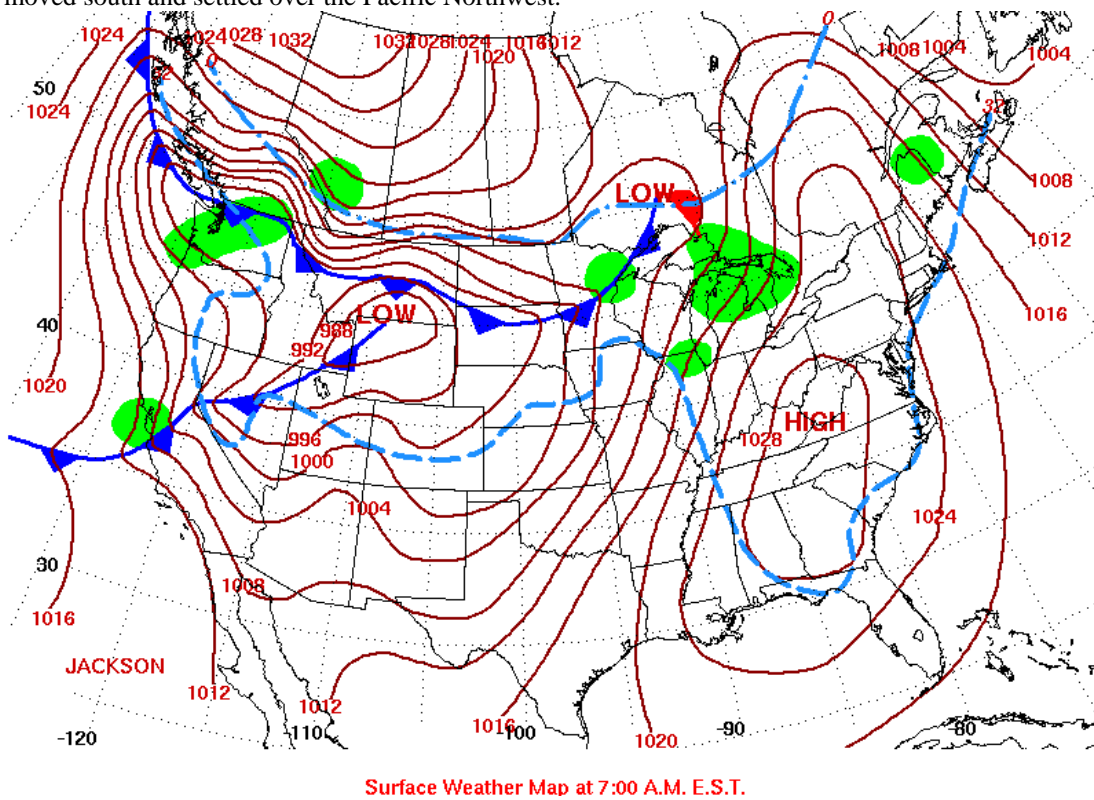
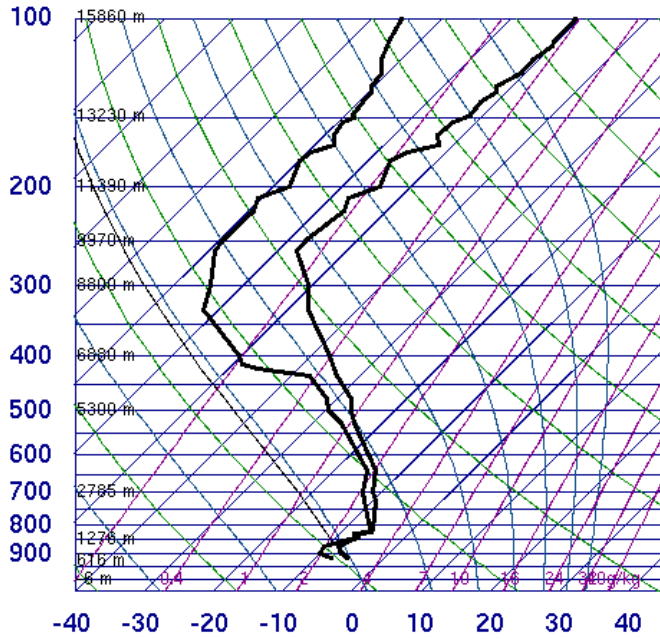


Figure 3. Surface map at 7am EST December 13. The arctic cold front has moved through northeast Montana. The tight pressure gradient over the area produced a strong northerly wind.

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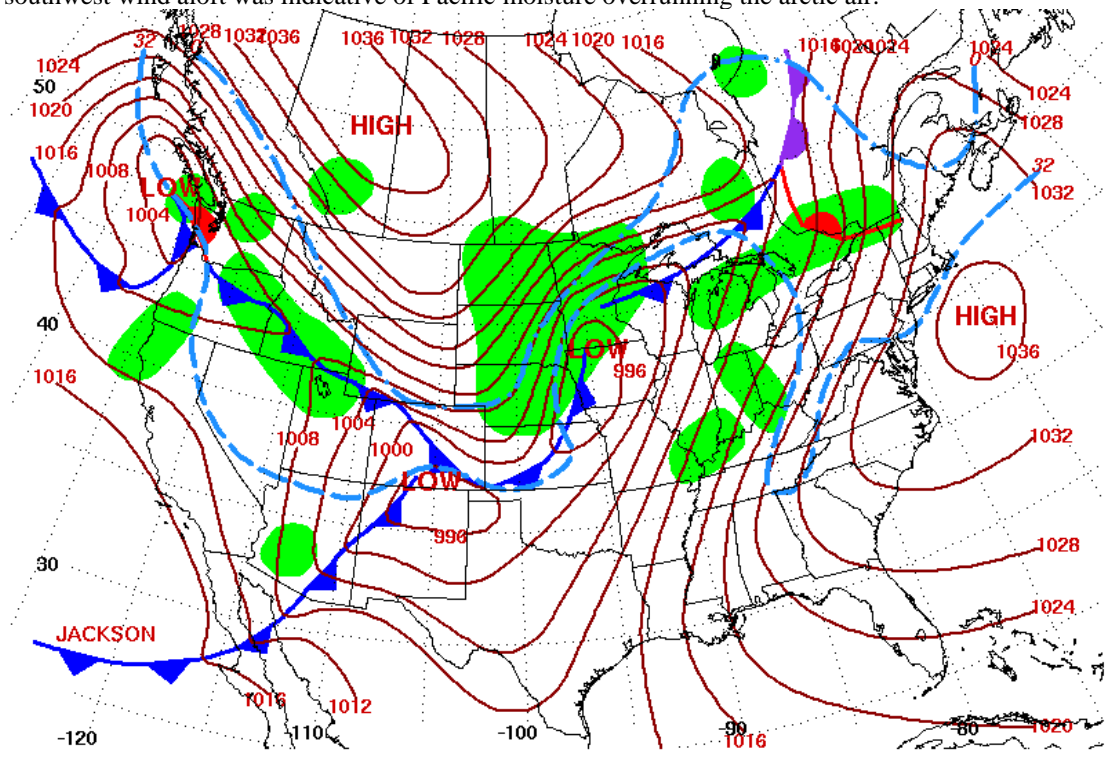


SLAT	48.20
SLOE	-106.62
SELV	693.0
SHOW	13.25
LIFT	16.90
LFTV	16.98
SWET	95.01
KINX	9.50
CTOT	18.30
VTOT	19.00
TOTL	37.30
CAPE	0.00
CAPV	0.00
CINS	0.00
CINV	0.00
EQLV	-9999
EGTV	-9999
LFCT	-9999
LFCV	-9999
BRCH	0.00
BRCV	0.00
LCLT	262.9
LCLP	855.5
MLTH	274.9
MLMR	2.07
THCK	5306.
PWAT	8.75

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University of Wyoming

Figure 4. Data from the Glasgow weather balloon launch at 5 am MST December 13, soon after the arctic front moved through. The east wind at the surface reveals arctic air immediately behind the front while a southwest wind aloft was indicative of Pacific moisture overrunning the arctic air.



Surface Weather Map at 7:00 A.M. E.S.T.

Figure 5. Surface map at 7am EST December 14. The arctic high was building into the area at this time. By the 15th (not shown) the center of the arctic high resided over northeast Montana.

	Glasgow		Culbertson		Sidney		Savage		Wibaux		Terry	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
12/14	-12	-29	-5	-17	1	-16	-3	-16	-10	-23	22	-14
12/15	-16	-32	-15	-26	-12	-25	-11	-25	-15	-28	-11	-24
12/16	-8	-25	-5	-33	-8	-22	-7	-23	-4	-25	-11	-28
	Glendive		Jordan		Flatwillow		Malta		Port of Morgan		Vida	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
12/14	7	-14	5	-15	-6	-23	13	-11	-13	-24	-14	-25
12/15	-10	-24	-12	-33	-9	-34	-10	-26	-16	-34	-11	-28
12/16	-8	-23	-9	-24	9	-25	-12	-30	-2	-24	-5	-24

Table 1. High and low temperatures at select locations across northeast Montana from December 14th through December 16th. Records are indicated in bold red. The years in the datasets from each location vary widely.