Late Night Heat Burst in Western Minnesota on July 16-17, 2006

Residents of west central and central Minnesota were treated to an unusual meteorological phenomenon late Sunday night of July 16th and early Monday morning of the 17th. Dying thunderstorms and a very warm and dry lower and middle atmosphere led to the occurrence of severe heat bursts, mainly in a northeasterly swath from near Canby, in Yellow Medicine County, to near Paynesville, in southwestern Stearns County. Evidence of the bursts were detected by weather observing equipment at Canby, Montevideo, Benson, Appleton, Willmar, and Paynesville.

A heat burst is characterized by a dramatic, almost instantaneous, rise in temperature and fall in dew point temperature. Most, but not all, heat bursts are also accompanied by a drop in surface pressure, little to no precipitation, and gusty, rapidly shifting winds. The most dramtic heat bursts can even cause severe wind gusts that result in property damage. Although no damage was reported, observing equipment at the Canby Airport reported wind gusts to 63 mph as a result of the heat burst.

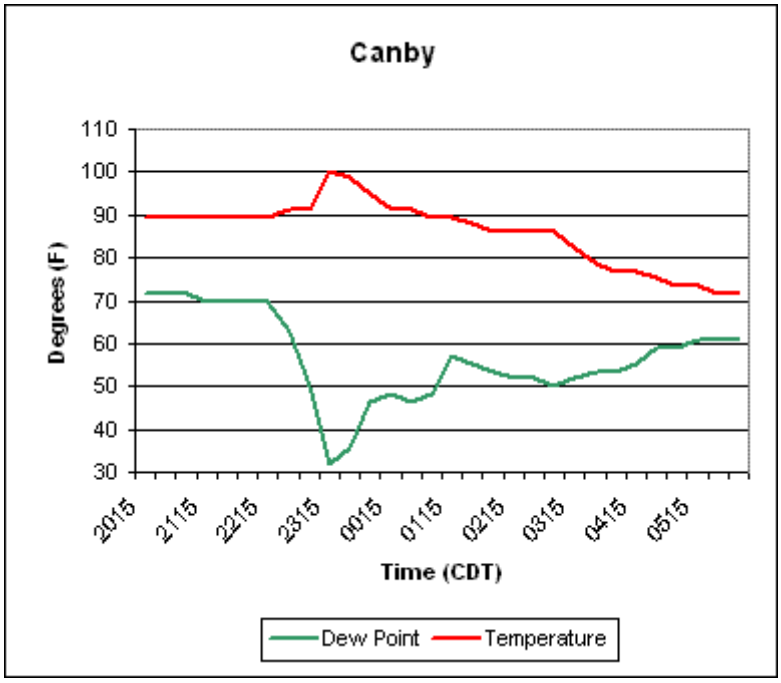
Heat bursts are typically a late spring and summer, as well as a late evening and nighttime, phenomenon. The two primary reasons for this are the onset of the nighttime inversion and thunderstorm climatology. Most heat bursts are also detected in the Plains states, but heat bursts have also been recorded overseas, including the United Kingdom and Yemen.

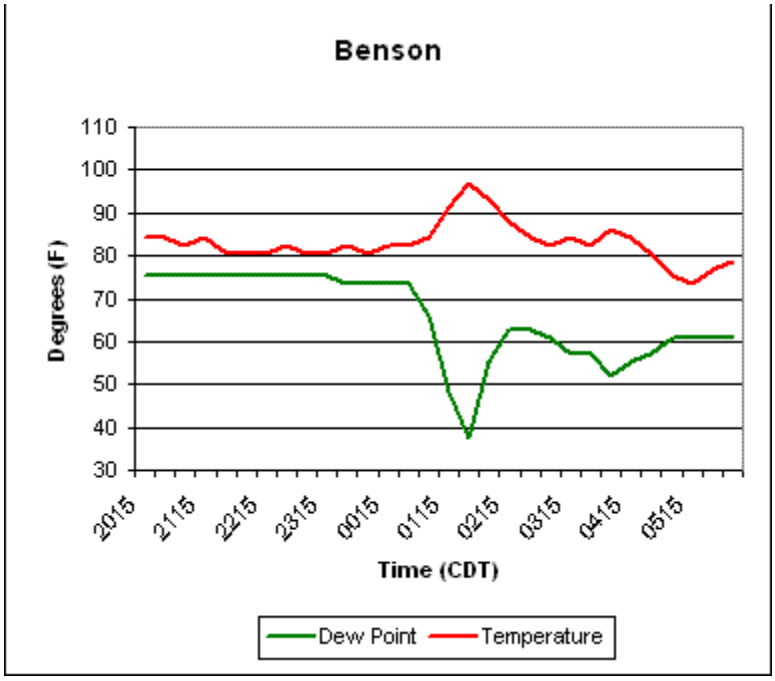
Although many regard the heat burst as a fairly rare phenomenon, heat bursts actually occur more often than many may think. Areas that have a dense observation network, such as the state of Oklahoma, typically detect multiple heat burst occurrences per year. In other areas of the Plains, where observation networks are less dense, heat bursts are difficult to detect and are not reported to the National Weather Service unless they result in wind damage or happen to affect one of the few observing stations.

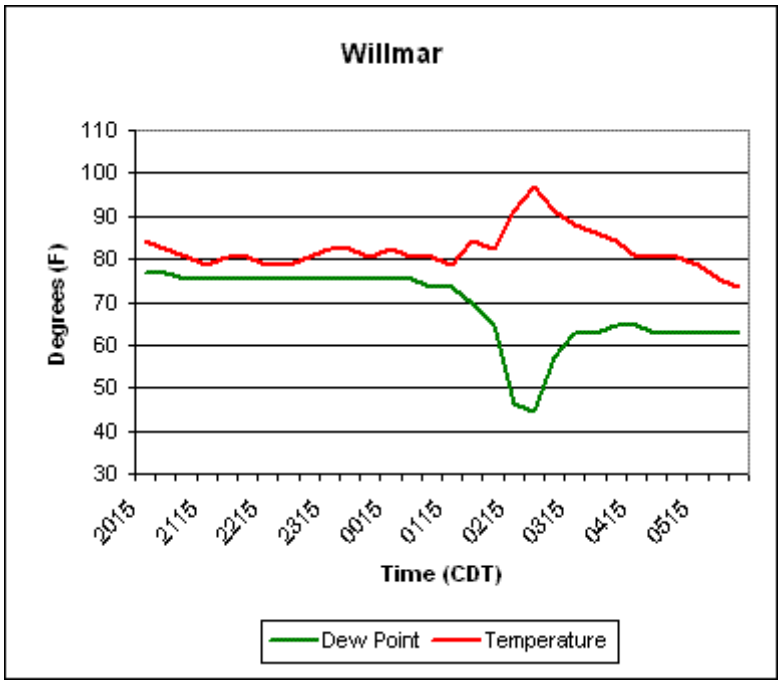
Specific information on the Sunday night and Monday morning heat bursts detected at each affected observing station are found below. The increase in temperature and decrease in dew point, as a result of the bursts, are denoted in parentheses to the right of the maximum temperature and minimum recorded dew point.

Location	Time	Temp	Dew Point	Max Wind Gust
Canby	1115 PM	100 (+9)	32 (-38)	63 mph
Appleton	1255 AM	91 (+14)	54 (-22)	37 mph
Montevideo	115 AM	90 (+6)	52 (-16)	23 mph
Benson	135 AM	97 (+15)	37 (-36)	37 mph
Willmar	235 AM	97 (+18)	45 (-28)	44 mph
Paynesville	235 AM	88 (+7)	57 (-15)	24 mph

Here are a few meteograms (temporal traces of temperature and dew point) from the affected stations.

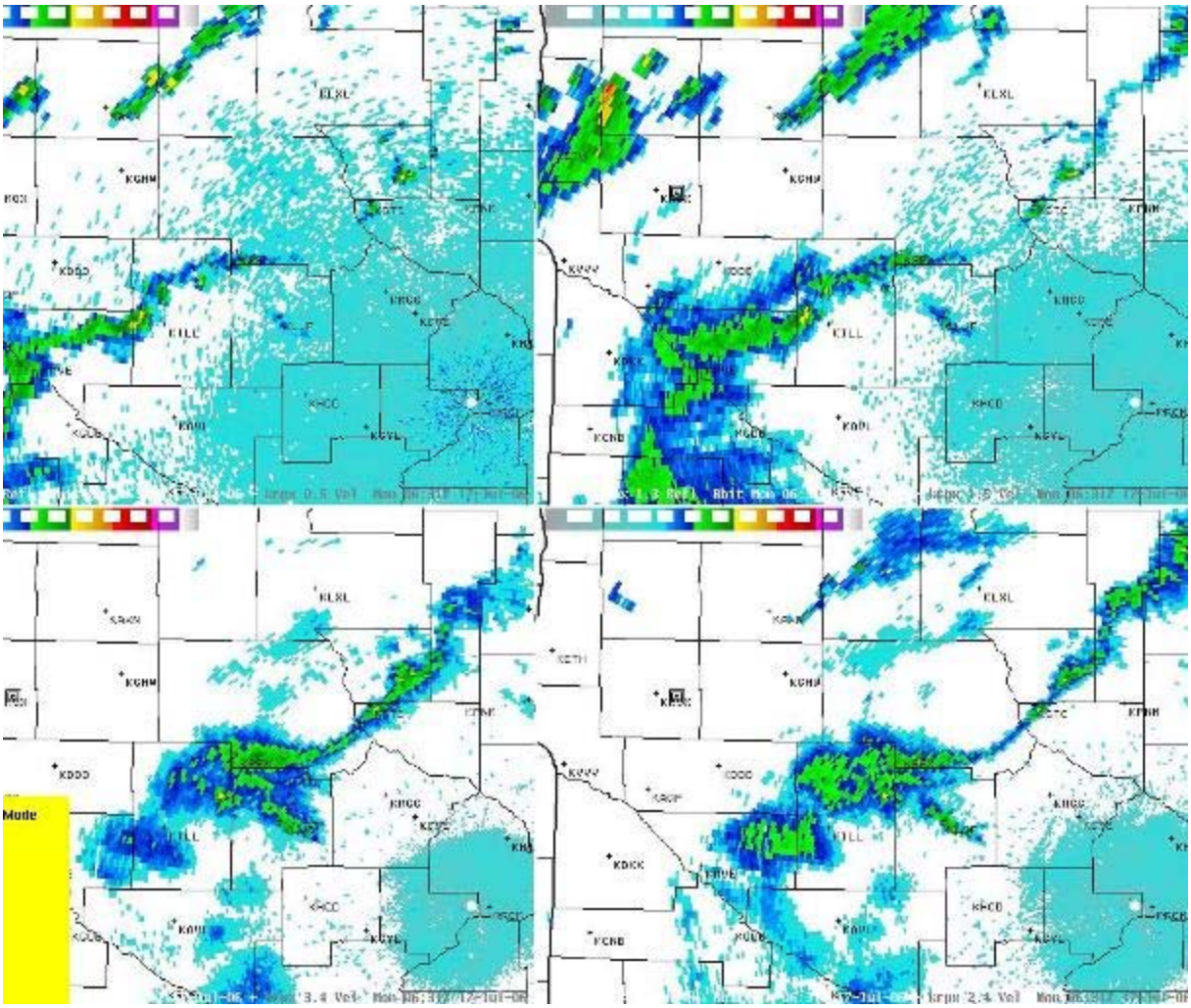






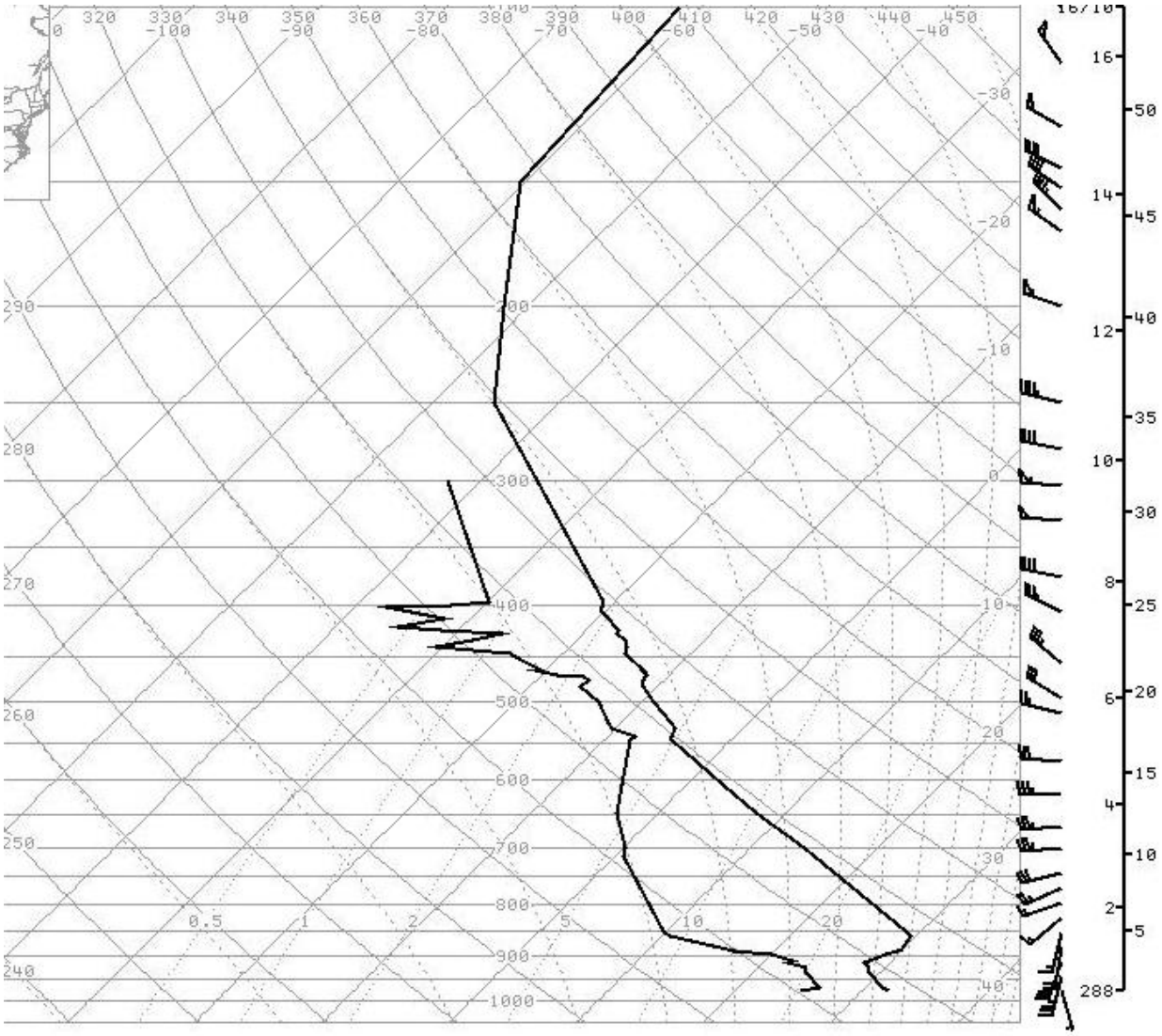
This particular series of heat bursts occurred as decaying thunderstorms in eastern South Dakota moved into western and central Minnesota shortly before midnight. Research has shown that the radar echoes associated with heat burst activity often take on a thin, wavy, snake-like appearance. The radar echoes from both the Chanhassen radar and the Aberdeen, South Dakota radar had this appearance. The following radar image is from

the Chanhassen radar at 131 am Monday morning, immediately prior to the Willmar heat burst. Note the snake-like appearance of the radar echo.



With the unseasonably hot temperatures the region had experienced the past several days, very warm, dry, and unstable air was in place over the area. Data from Sunday night's weather balloons at Chanhassen and Aberdeen, South Dakota showed that the warm and dry air extended from the surface to 17,000 and 20,000 feet, respectively. The following is a Skew-T/Log-P plot of the temperature and dew point data from Sunday night's weather balloon in Chanhassen, which is a depiction of the vertical temperature and dew point profile. Note how the temperature profile (the right black trace) exhibits a strong lean to the left through the bottom half of the picture; also, how far apart the dew point profile (the left black trace)

and the temperature profile are throughout much of the lower half of the image.



When the thunderstorms in South Dakota and western Minnesota began to decay, downdrafts formed beneath them, and due to the unstable air in place, the air accelerated rapidly. Evaporation of rain beneath the decaying thunderstorm also fueled the downward acceleration. As the downdrafts approached the surface, they warmed and dried, which caused the drastic increase in temperature and drop in dew point.