A Technical Analysis of the July 19th, 2011 Dew Point Measurement at Moorhead Municipal Airport, MN (JKJ)

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The Event: The dew point sensor at the Moorhead Municipal Airport (KJKJ) reached 88 degrees from 7 to 9 pm on July 19, 2011. This is a summary of details regarding the measurement.

On July 19, multiple reports of dew point temperatures of 80 degrees or greater were reported across Minnesota. The Minneapolis-St. Paul International Airport (KMSP) saw a record dew point temperature of 82 degrees. Fargo saw a record of 83 degrees that day. An NDAWN weather station approximately seven miles to the southeast at Sabin, MN measured a dew point temperature of 87. The high dew point readings were well covered by local media and weather blogs. The 88 degree dew point measurement was reported about, but oddly most missed that Madison, MN reached a dew point temperature of 88 the day before.

One aspect that was notable was the longevity of the event. There were eight hours of dew point temperatures of 80 degrees or higher at the Twin Cities International Airport. The longest stretch on record was in 1995 when there were ten hours straight of a dew point temperature of 80 degrees at the Twin Cities. Since 1945 there have only been 28 hours where the dew point temperature has reached the 80 degree mark at the Twin Cities.

In the days following the July 19th event, an effort was taken to verify the reading at Moorhead. In the past, dew point readings at automated stations located near small airports have been considered questionable due to their surroundings. The Minnesota State Climatology Office requested that photos be taken of the Moorhead Airport automated sensor, to describe the surroundings and have the instrument inspected if possible.

Mark Ewens (DAPM) for Grand Forks NWS took the lead on checking the station. On Saturday, July 23, four days after the event he took 23 photographs of the site (see photographs at the end of article) and described the surroundings.

"On Saturday evening (July 23) I had the opportunity to stop by the Moorhead Airport and take pictures of the AWOS siting. Find attached a few of the 23 digitals I captured.

My preliminary assessment is that while not optimal, the AWOS is sited properly. Properly being somewhat relative, as it is located near a drainage ditch and within 10 meters of a paved roadway. Based on my experience with such sites, it is a very typical AWOS installation.

From the agricultural standpoint, the crops nearest the temp / dew-point sensor are sugar beets, well into the maturation process. This suggests the beets are nearing maximum transpiration. However, as these beets are downwind [for this particular event] they likely have

little impact. Immediately surrounding the AWOS are grasses; from my limited knowledge it looks like the classic Kentucky Blue and Fescue so common to the area. I would appear the amount of clover present is not as widespread, dense nor as tall originally reported. However, the ditch within 10 meters of the sensors was quite wet and likely had standing water in it on Tuesday.

Upwind, there are additional beets approximately 75 meters east and southeast of the AWOS. At the time of the peak Td, the wind was from the southeast (140 - 150 degrees) at 3 to 4 m/s. This suggests little turbulent eddy diffusion, although at an air temperature of 35C convective mixing would be fairly substantial. So, there would be a well mixed skin layer, exceeding the 3 meter height of the sensor.

We have limited modeling capabilities at the WFO, but I should be able to reconstruct a meteorological sounding for Moorhead that will help us determining the mixing layer and diffusion."

Next was the issue about whether the instrument was operating properly. Both KJKJ and the Fargo NWS ASOS (KFAR) use similar technology with a Vaisala HUMICAP sensor. Moorhead uses a Vaisala HMP35C. The HMP35C is a Vaisala sensor that had a Platinum Resistance Thermometer (PRT) for measuring temperature and a HUMICAP-H sensor for measuring relative humidity.

http://www.vaisala.fi/files/National_Weather_Service_Relies_on_Vaisala_Instruments_for_Dewpoint_Measurement.pdf

The sensor does not measure dew point temperature directly; rather the relative humidity is measured from which the dew point is calculated. According to Ewens, the sensor at KJMJ is not aspirated.

Mark Ewens spoke with Jim Larson, the MN-DOT technician who did the calibration at KJKJ on July 21.

"The system was +0.9F higher than the standard, well within the stated tolerances. The only issue was there was minor damage to the radiation shield of the temp / dew-point sensor, but in the opinion of the tech it was not of a sufficient nature to seriously detract from the readings. Further, the tech did confirm the ditch near the AWOS was filled with water on Tuesday afternoon."

Next the Fargo ASOS (KFAR) accuracy was inquired about. The Electronics Systems Analyst stated that the sensor for KFAR was last fully calibrated on 12/16/2010. It is calibrated every eighteen months. The last accuracy check was on 6/16/2011 and is accomplished on a quarterly basis. For documentation on the proper siting of ASOS instruments see: http://www.ofcm.gov/siting/pdf/fcm-s4-1994(Siting).pdf

The analyst had these interesting comments about the measurements about the Moorhead sensor:

"… Measurement range is from -80 F to 86 F. Accuracy depends on the actual ambient at the time and the spread between the ambient and DP. I suspect it will be around 2-3 F (About 95 F ambient and DP 88 F (?) give a spread of 7 at >32 = 2.0 accuracy (+/-). This means it could have been a DP of 90 to 86."

Mark Ewens discovered a difference between the specifications between the KFAR and KJMJ sensors…

"…It would appear that the 83F is basically within the operating range of the (KFAR) sensor. The Fargo ASOS utilizes the same technology as the Moorhead AWOS, so the values should be consistent within the realm of equipment standards. Both measure RH then back-calculate Td. The Moorhead specifications are actually 'tighter' than those of the Fargo ASOS humi-cap system. I am told by our Electronics Systems Analyst that there is a 2 to 3F error range The AWOS RH is accurate to within 2% up to 90%, then 3% between 90% and saturation.

Therefore, taking air-temperature of 90 and an RH of 91 (reported 94 - 3) yields a Td of 87F. Assuming worse case error with the Fargo ASOS sensor, a Td 83F + max error of 3F equals a Td of 86F. This makes the variance 1F"

Thus, the measurements between the two stations were nearly within the error range of the sensors.

For further study some questions arise, such as are the sensors in KFAR and KJMJ the exact same Visalia HUMICAP model? When were the older sensors using chilled mirror technology replaced? The Weather Underground historian mentioned a 90 degree dew point temperature at Appleton, Wisconsin on July 13, 1995. What kind of sensor was in place at that time, what were the standards of that sensor and what did land surrounding the sensor look like?

The Minnesota State Climatology Office would like to thank Mark Ewens from the National Weather Service, and North Dakota State Climatologist Adnan Akyuz for their assistance in preparing this report.

Close up of the KJMJ sensor at the Moorhead Airport. (Note: All photos are from Mark Ewens, DAPM NWS Grand Forks and were taken on July 23, 2011)

KJMJ at the Moorhead Airport with a view to the north.
Courtesy: Mark Ewens NWS GFK

MJMJ at the Moorhead Airport with a view to the east. Clover is growing around the station.

Courtesy: Mark Ewens NWS GFK

MJMJ at the Moorhead Airport looking to the southwest showing sugarbeets in the background.

Courtesy: Mark Ewens NWS GFK

MJMJ at the Moorhead Airport looking to the northwest showing sugarbeets in the background. Clover is growing in the foreground.

Courtesy: Mark Ewens NWS GFK