

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Jan 3, 1997

Topic: Early winter of 1996-97 around Minnesota

As mentioned previously, seasonal snowfall and snow cover has been remarkably high for many areas of Minnesota so far this winter. The cold and wet pattern of November has persisted right through the month of December as well. A preliminary summary for December shows that most communities recorded an average monthly temperature that was 3 to 6 degrees colder than normal and snowfall which was well above normal.

The 23.7 inches of snowfall at the MSP airport for the month of December is the most since 1969, and the 5th highest December total ever. Duluth reported nearly 39 inches of snowfall for December, the most since 1969. In addition, Sioux Falls, SD has recorded 19.5 inches, the largest total for December since 1968, while Fargo has recorded 20.4 inches which is more than any December total since WWII.

As a result of the above normal November and December snowfalls, the seasonal accumulation of snow going into the New Year is very high, 90th percentile or greater for many areas. In fact some areas along the northshore above Lake Superior just reported an additional snowfall of 13 to 18 inches this week. Seasonal total snowfall at International Falls is already over 54 inches, at Duluth over 55 inches and even at Fargo, ND (normally drier than many other areas) it is nearly 47 inches. Rochester reports over 37 inches of snowfall for the winter so far and the Twin Cities airport reports nearly 41 inches.

Snow removal budgets for many communities have already been exceeded as 4 inches or more of snow from individual storms has occurred with a higher frequency than normal. International Falls, Fargo (ND) and Duluth have already reported 5 such storms.

Topic: Depth of Ground Frost

A number of people have inquired about the depth of frozen soil following the recent cold spell during Christmas week. Several University of Minnesota research locations regularly record this information. Listed below are recent measurements. Data are based on conditions as of December 31, 1996...

Location	Depth of frozen soil (inches)	Snow Cover (inches)
Crookston	21	37
Morris	10	14
Lamberton	3	30
Waseca	12	18
St Paul	8	23
Rosemount	8	22

Further penetration of frost into deeper soil layers should be retarded by the ample blanket of snow cover for much of the winter.

Twin Cities Almanac for January 3rd:

The average MSP high temperature for January 3 is 21 degrees F (plus or minus 12 degrees standard deviation), while the average low is 4 degrees F (plus or minus 13 degrees standard deviation).

MSP Local Records for January 3rd:

MSP weather records for January 3rd include: highest daily maximum temperature of 43 degrees F in 1908; lowest daily maximum temperature of -12 degree F in 1919; lowest daily minimum temperature of -24 degree F in 1911; highest daily minimum temperature of 33 degrees F in 1992; record rainfall of 0.76 inches in 1906; and record snowfall of 9.0 inches in 1906. Maximum snow depth has been 19 inches in 1969 and 1970; there have been 12 measurable snowfalls since 1948.

Average dew point for January 3rd is 6 degrees, with a maximum of 31 degrees F and a minimum of -25 degrees F.

All-time state records for January 3rd:

Scanning the state climatic data base: the all-time high for January 3rd is 50 degrees F at Canby (Yellow Medicine County) and Madison (Lac Qui Parle County) in 1962; the all-time low is -48 degrees F at Pine River Dam (Crow Wing County) and Little Fork (Koochiching County) in 1911.

Words of the Week: Snoweaters and Fogeaters

Snoweaters are atmospheric phenomena which accelerate the melting of snow cover. Meteorologists sometimes refer to both wind and fog as snoweaters. Warm descending air on the leeward side of mountains (Chinook winds) or strong southerly winds coming from warmer latitudes can rapidly melt snow cover in the western or central plains states. These winds are sometimes referred to as snoweaters. Additionally, a fog which forms as a result of warm air advection can be called a snoweater, as the heat released by condensation helps accelerate the melting of snow covering the ground.

Fogeaters are basically any light source which is strong enough to penetrate a layer of fog. A strong airport beacon, a search light, or even a full moon might be referred to as a fogeater. The light passes through the fog (seemingly eating the fog along the path it travels) and gives the observer some perspective of how thick the fog layer is.

Outlook:

Starting late Friday or early Saturday, a storm will affect most of the state this weekend with snow or mixed precipitation and some significant accumulations likely in places. Winds will be increasing with this storm. Depending on the track that the storm takes across the Great Lakes, we will be subject to normal temperatures or below normal temperatures next week. Very cold arctic air is poised north of us and could be pulled down by strong northwesterly flow, but most of the forecast models suggest that zonal flow (parallel to lines of latitude) will prevail for most of the week. Less than normal precipitation is expected for Tuesday through Friday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Jan 10, 1997

Topic: Global Weather Highlights on the Web

Almost unprecedented flooding in the western U.S.; hot temperatures (102-104 F) in the agricultural regions of Brazil and Paraguay; persistent cold and snow in western and central Europe much like that which occurred during the Battle of the Bulge in WWII; and tropical storm impacts on Borneo and north Australia. Descriptions of these recent events and their impact can be found on the World Wide Web at NOAA's Climate Prediction Center.....

<http://nic.fb4.noaa.gov>

Look under the Analysis and Monitoring section.

Topic: Overlooked Minnesota Snowfall Records

Last weekend's snow storm left 28 inches at Browns Valley, 24 inches at Fergus Falls, 23 inches at Aitkin, 27 inches at Wheaton, and 21 inches at Alexandria. Some of these are record amounts for a single storm.

There has been a great deal of discussion about the abundant snowfall around the state this winter, with many communities already on a record setting pace of snow accumulation. But in northern Minnesota counties they should be getting used to it. Final climate statistics for last winter just published by the National Climatic Data Center show that several northern Minnesota communities recorded all-time seasonal snowfall totals during the winter of 1995-96. Listed below are some examples....

Community	County	1995-96 Total Snowfall (in)	Historical Rank
Roseau	Roseau	77.1	1st
International Falls	Koochiching	116.0	1st
Brimson	St Louis	119.3	1st
Duluth	St Louis	135.3	1st
Grand Marais	Cook	100.3	1st
Hibbing	St Louis	109.1	2nd
			('70-'71 was 110.6)
Lutsen	Cook	153.9	1st*
Tower	St Louis	111.5	2nd
			('49-'50 was 121.8)
Two Harbors	Lake	123.1	1st
Wolf Ridge	Lake	124.3	2nd
			('93-'94 was 140.2)
Bruno	Pine	99.8	1st
Grand Portage	Cook	92.9	3rd

\*The seasonal total at Lutsen last winter broke the all-time state record seasonal snowfall total set at Pigeon River Bridge (Cook County) in the winter of 1936-37. (I failed to mention this in highlighting the most memorable climate features of 1996 in Minnesota earlier on MPR)

Topic: Great Winter for Snow Shoveling

Not only have snowfall amounts been abundant this winter, but many young people who earn money snow shoveling are doing rather well as a result of the higher frequency of measurable snowfalls. Find below the number of measurable snowfalls recorded so far this winter (through January 7) in four Minnesota communities compared with the long term average number of such events...

Location	Number of Measurable Snowfalls (Oct. 1 to Jan. 7)	Historical Ave.
Twin Cities	24	17
Rochester	32	16
International Falls	41	28
Fargo-Moorhead	19	11

Note: In terms of snowfall frequency, January of 1886 in southeastern Minnesota produced one of the snowiest months ever for the cities of Winona and Red Wing. Winona recorded 19 measurable snowfalls, totaling 56 inches, while Red Wing recorded 16 measurable snowfalls, totaling nearly 53 inches. I don't suppose there were any snow shoveling ordinances in effect back then.

Twin Cities Almanac for January 10th:

The average MSP high temperature for January 10 is 22 degrees F (plus or minus 13 degrees standard deviation), while the average low is 5 degrees F (plus or minus 14 degrees standard deviation).

MSP Local Records for January 10th:

MSP weather records for January 3rd include: highest daily maximum temperature of 49 degrees F in 1990; lowest daily maximum temperature of -14 degree F in 1912; lowest daily minimum temperature of -27 degree F in 1977; highest daily minimum temperature of 33 degrees F in 1928; record rainfall of 1.13 inches in 1975; and record snowfall of 4.0 inches in 1975 and 1976. Maximum snow depth has been 18 inches in 1969; there have been 14 measurable snowfalls since 1948.

Average dew point for January 10th is 6 degrees, with a maximum of 39 degrees F and a minimum of -39 degrees F.

Coldest windchill conditions on January 10th occurred in 1982 with -65 to -75 F readings throughout parts of the day.

All-time state records for January 10th:

Scanning the state climatic data base: the all-time high for January 10th is 58 degrees F at Madison (Lac Qui Parle County) in 1990; the all-time low is -47 degrees F at Little Fork (Koochiching County) in 1912.

Words of the Week: Depression Storage

This term is used primarily by hydrologists to refer to the water stored in puddles, ditches and other small depressions in the local landscape. During the winter in agricultural landscapes where moldboard plowing or ridge tillage has been done on the soil, this small scale depression storage can add up to quite a bit of water. This must either be absorbed by the soil or drained before soils can be worked in the spring. In winters like this one, depression storage may be substantial and contribute to high volumes of

runoff before soils thaw out enough to allow infiltration.

Outlook:

Cold and windy this weekend with a chance for snow. Windchill values could be dangerously low in places. Some flurries will continue Sunday into Monday. Temperatures will be colder than normal early next week, then moderate toward the middle and end of the week. Little significant precipitation is seen after the weekend and for most of next week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Jan 17, 1997

Topic: Assessing the Severity of Winter Weather

There have been many comments in recent weeks about the severity of this winter. Most winters reach severe levels somewhere in the state, but it is far less frequent that we see widespread winter severity, affecting a majority of counties and communities in Minnesota. Unfortunately it is this latter category which is prevailing for the winter of 1996-97. What is meant by winter severity?

The severity of winter is manifested in a variety of ways..... video rentals, boot and glove sales, auto repairs, meeting cancellations, vacation bookings to the southern states, the length of the television weather report, and probably scores of other indicators.

Meteorologically and climatologically, the severity of winter is referred to by many different types of observations and measurements.

For example.....

Heating Degree Days:

A number of people are complaining about their heating bills being much higher this winter. A common index for gaging the heating season is the use of Heating Degree Days (HDD) which are based on the difference between the daily mean temperature and a base value of 65 degrees F. Thus, a daily maximum temperature of 20 degrees F and daily minimum temperature of 2 degrees F equate to a daily mean temperature of 11 degrees F. The difference between this value and the base of 65 degrees F is 54 Heating Degree Days. These values are often computed for the number of days between meter readings and then show up on your utility bill. The HDD values for the winter of 1996-1997 are running 10 to 15 percent higher (since July 1st) than the 30 year average values. For the month of November alone, HDD were 20 to 25 percent higher than average. No wonder the heating bills are high!

Ice Dams:

Insurance agents report a remarkably high frequency of complaints and claims for structural and cosmetic damage in homes and businesses due to ice dams on roofs. Like the winter of 1981-82, excessive snow loads and high winds have produced structural failure in some buildings. This problem can occur only when snowfall accumulations are well above normal and cold spells are unusually persistent, allowing for little intermittent thawing to occur. Roof steaming and shoveling businesses have reported almost unprecedented demand for services.

#### Winter Road Conditions:

Many snow removal and road maintenance budgets have been exhausted even though winter is only half over. In addition, the frequency of road closures has been remarkably high, primarily as a result of the abundant snow cover drifting about in the wind and sealing off pavement. This occurs with some frequency on a local scale, but this winter it has occurred practically statewide more than once. Incidentally MDOT operates a very good Web site on the Internet for accessing road conditions and closures at "<http://www.dot.state.mn.us/road.shtml>"

#### Windchill, Winter Storm, and Blizzard Warnings:

Record or near record setting windchill values, ranging from -60 to -80 degrees F, have already been reported more than once from a number of communities. In this regard, January of 1982 was similar across the state. The number of winter storm and blizzard warnings is already above average for an entire winter. Six blizzard warnings have been issued for western Minnesota counties, matching the number issued for the winter of 1968-1969. In fact, in terms of snowfall and snow depth, this winter is a close analogy to that of 1968-69 for many Minnesota communities.

#### The DNR Winter Severity Index:

This is used by wildlife biologists to assess the risk posed by winter weather to the mortality of certain animals, especially deer. It is based on the number of days with snow cover of 15 inches or greater and the number of days with minimum temperatures below zero. WSI values of 150 or greater are associated with adult deer mortality of 20 percent or higher. The present accumulation of the WSI is on pace to rival that of last winter in some areas, particularly southern and western counties. Last winter was severe enough to prompt a deer feeding program by the DNR.

#### The Pain in the Posterior Index (PIP):

Invented by Bill Gardner, staff writer for the St Paul Pioneer Press, this index is associated primarily with the inconvenience, aggravation, and discomfort caused by various winter conditions. These conditions include depth of snow cover, persistence of snow cover, magnitude and duration of cold daytime high temperatures and a dreariness factor. In this regard, the latest PIP for the Twin Cities is about 19 (check <http://www.pioneerplanet.com/archive/weather/pip.htm> for the exact value). This current value places this winter on the border of "serious pain" so far.

Perhaps a final measure of the severity of winter is simply the fact that Governor Carlson has just successfully petitioned the federal government for financial assistance through a disaster declaration. When was the last time this happened due to severe winter weather? I don't know.

#### Twin Cities Almanac for January 17th:

The average MSP high temperature for January 17 is 22 degrees F (plus or minus 14 degrees standard deviation), while the average low is 4 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records for January 17th:

MSP weather records for January 17 include: highest daily maximum temperature of 44 degrees F in 1894; lowest daily maximum temperature of -12 degrees F in 1962; lowest daily minimum temperature of -26 degrees F in 1967; highest daily minimum temperature of 33 degrees F in 1894; record rainfall of 0.63 inches in 1915; and record snowfall of 5.1 inches in 1932. Maximum snow depth on this date has been 20 inches in 1970; there have been 17 measurable snowfalls since 1948.

Average dew point for January 17th is 5 degrees F, with a maximum of 39 degrees F and a minimum of -37 degrees F.

Coldest windchill conditions on January 17th occurred in 1962 with -55 to -65 F readings throughout early parts of the day.

All-time state records for January 17th:

Scanning the state climatic data base: the all-time high for January 17th is 54 degrees F at Minnesota City (Winona County) in 1894; the all-time low is -52 degrees F at Tower (St Louis County) in 1982.

Word of the Week: Niphablepsia

Here's one for the master Scrabble players to use. A medical term derived from two Greek words: "nipha" meaning snow; and blepsia (after "blepharon" for eyelid) meaning affliction of the eye. Those who don't speak Classical Greek or medical jargon, use the more common term snow blindness to describe this condition. The reflection of sunlight from snow cover is so great as to cause impaired vision or even temporary blindness. This is more common on bright sunny winter days in areas where snow has drifted into a relatively uniform surface with little roughness to it. I am numerous citizens in Minnesota have been exposed to this condition so far this winter.

Outlook:

Warming trend statewide setting in for the weekend. Temperatures climbing into the teens and twenties for daytime highs. Chance of scattered snow flurries or possibly freezing drizzle early next week. But temperatures should remain much more hospitable than they were this past week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Jan 24, 1997

On this date in 1916, the temperature at Browning MT plunged 100 degrees in just 24 hours, from 44 degrees F above zero to 56 degrees F below zero. It was a record 24 hour temperature drop for the U.S. (courtesy of the Weather Channel and Aviation Weather at.....  
<http://www.awc-kc.noaa.gov/wxfact>)

Topic: New 24 hour snowfall record for the United States

Earlier this month, on January 11th, the National Weather Service Forecast Office in Buffalo, NY reported a 24 hour snowfall total at Montague, NY of 77 inches. This broke the old record 24 hour snowfall total for the U.S. which was 75.8 inches at Silver Lake, CO recorded on April 15, 1921. There is some dispute about whether this is a world record for 24 hours since snowfall measurements and historical records are sketchy and non standardized. I suspect that high elevations in major mountain ranges on Earth have recorded 100 or more inches in a 24 hour period, but I cannot find any specific records of such.

Topic: Playing It Safe In Winter

This winter has already produced great risks and hardship for many Minnesota citizens. It never hurts to be reminded of safety tips and precautions.

The Minnesota Department of Public Safety has an excellent Web site for information on winter hazards. The URL is.....

<http://www.dps.state.mn.us/winter.html>

Categories of information found there include: winter weather terminology; tips for outdoor safety; fire safety precautions; road and highway safety; and indoor air quality considerations.

Topic: Factors Affecting Spring Snowmelt Flooding Potential

The abundant snowfall and snow cover this winter has some communities concerned about the possibility of spring flooding. Though winter is just passed the half way point and the weather could change and ameliorate the threat of spring flooding, it is important to understand the features of our climate which most influence spring flooding potential in Minnesota.

Many years of experience in forecasting the flows on major Minnesota rivers have taught hydrologists to generally focus on five important factors which most affect the risk of flooding from snowmelt runoff in the spring.

Soil moisture recharge in the fall dictates how much storage capacity in the soil might be utilized by snowmelt. If soils are fully recharged, there is little else for melting snow to

do but runoff into streams and rivers. Soil moisture storage this fall was very good, with estimated recharge higher than normal.

Depth of soil frost is another important factor. Deep soil frost allows for little movement and redistribution of soil moisture, keeping the surface layer impenetrable to melting snow for a longer period of time. This too increases runoff. Soils are currently not frozen as deeply as they would normally be thanks to the insulating effect of the abundant snow cover. Many soils are only frozen to a depth of 3 to 8 inches.

The amount of snow cover, and more importantly the water content, is a very important factor in forecasting spring snowmelt runoff. The current snow cover is well above normal (greater than 90 percent of all years for many counties) on most Minnesota watersheds, including the upper Mississippi, the Minnesota and the Red River of the North. The water equivalence in the snow cover ranges from 3 to 5 inches in many places.

The speed or pace of the thawing period regulates the volume of runoff. Ideally, hydrologists like to see a gradual thaw, so that the landscape drains somewhat slowly but consistently over a period of time. This usually begins in March and April. A sharp and rapid warm up presents more risk of flooding as the snow pack melts more rapidly.

Lastly, a wetter than normal March and April can exacerbate spring snowmelt even if temperatures are not warm enough to do so. This precipitation can be substantial, even convective from thunderstorms. Precipitation from these storms can be absorbed by the snow cover, increasing its density, and accelerating the melting process while adding rapidly to the volume of runoff.

Twin Cities Almanac for January 24th:

The average MSP high temperature for this date is 22 degrees F (plus or minus 15 degrees standard deviation), while the average low is 5 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records for January 24th:

MSP weather records for this date include: highest daily maximum temperature of 57 degrees F in 1981; lowest daily maximum temperature of -16 degrees F in 1904; lowest daily minimum temperature of -33 degrees F in 1904; highest daily minimum temperature of 33 degrees F in 1919; record rainfall of 1.21 inches in 1967; and record snowfall of 6.0 inches in 1972. Maximum snow depth on this date has been 35 inches in 1982; there have been 19 measurable snowfalls since 1948.

Average dew point for January 24th is 7 degrees F, with a maximum of 35 degrees F and a minimum of -31 degrees F.

Coldest windchill conditions on January 24th occurred in 1904 with -70 to -75 F readings throughout parts of the day.

All-time state records for January 24th:

Scanning the state climatic data base: the all-time high for this date is 69 degrees F at Montevideo (Chippewa County) in 1981; the all-time low is -57 degrees F at Pokegama Falls (Itasca County) in 1904. Last year on this date, Tower, MN reported a low of -48 degrees F.

Words of the Week: Stagnation area

This is a term used in pollution meteorology and air quality studies. It refers to a region where the surface layer of the atmosphere is influenced for a period of time (usually 4 or more consecutive days) by high pressure, an inversion layer, calm or little wind, no frontal passages and no measurable precipitation. In these conditions, aerosols and particulates increase in concentration such that they reduce local visibility and sometimes produce a health hazard to those with respiratory ailments.

Pollution domes are often visible from aircraft over major metropolitan areas when these conditions persist, but stagnation areas can occur over agricultural and forested landscapes as well. They are just not as visible.

Outlook:

Dry and cold for most of Saturday and Sunday. Overnight lows will be well below zero. Increasing cloudiness by Monday and a chance for snow lingering into Tuesday. The major portion of the week will be colder than normal, with several overnight lows well below zero. Chances for snowfall return later in the week towards Friday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Jan 31, 1997

Find below a commentary on Ground-Hog Day. With the severity of this winter, I was wondering if humans ever had the capacity or genetic makeup to hibernate. After all several other mammals do.

The -50 degrees F reported at Embarrass, MN earlier this week wasn't much warmer than the -59 degrees F reported at Watson Lake in the SE Yukon Territory of Canada. In fact many parts of northern Canada reported windchill values of -100 to -115 degrees F this week. I wonder how long it takes for jello to set up there.

At least January of 1997 is over. It's got to get better now!

Topic: Preliminary January Summary

Looks like the mean temperature for January of 1997 was about 2 to 5 degrees colder than normal for most Minnesota communities, except for some of the NE communities where the mean temperature for January was actually very close to normal. Precipitation for the month, nearly all in the form of snow, was well above normal for all areas. The frequency of measurable snowfalls was very high, with some observers reporting snow on 14 or more days. Some western Minnesota communities reported very high total snowfalls. Crookston received over 21 inches, the most for the month since January 1969 (31 inches). Fergus Falls reported over 32 inches and Morris reported over 26 inches, the most January snowfall for both places since 1975.

Topic: Ground-Hog Day or Candlemas Day

"If groundhogs see their shadows on February 2  
Men can take for granted  
six more wintry weeks are due"

This Sunday, February 2nd marks another Ground-Hog Day or Candlemas Day, the half way point of winter, and last year the coldest day of winter, setting a state record of -60 degrees F at Tower, MN. In fact last year eleven Minnesota communities reported lows of -50 degrees F or colder on Ground-Hog Day.

Popularized by German communities in Pennsylvania, Ground-Hog Day festivals have flourished on the premise that this hibernating animal can predict the weather. When the ground hog or woodchuck emerges from its burrow on February 2nd, it may be frightened by its shadow if it is a bright clear day and retreat back into its burrow for another six weeks. If it is cloudy and dull no shadow can be projected, so the ground hog stays out for a while indicating that spring is just around the corner.

In Roman times, this date was known as the Feast of the Purification

of the Virgin Mary or the time according to Luke in the New Testament when the Presentation of Christ in the Temple took place. Later in pre-Reformation England it became Candlemas Day, the half way point of winter, when a church's annual stock of candles for the altar and other sacred uses was blessed. For centuries then, there were public ceremonies on this date and folklore evolved out of the historical observations of the weather.

"If Candlemas Day be fair and bright  
Winter will have another fight;  
But if Candlemas Day be clouds and rain  
Winter is gone, and will not come again."

Down through the centuries in Europe, Canada and the United States the behavior of hibernating animals (badgers, bears, woodchucks, etc) has been observed and associated with the weather that follows this date.

Historical frequencies of weather conditions, primarily cloud cover on Ground-Hog Day or Candlemas Day suggest that most of the time, between 70 and 80 percent, an animal will cast a shadow on this date in Minnesota and thus forecast for us a continuation of winter weather. Indeed, locally in the Twin Cities, the high temperature on February 2nd has been above the freezing mark (32 degrees F) only about 20 percent of the time and last year the afternoon high temperature was -17 degrees F. Who cares about watching what the ground hog does in weather like that.

Incidentally, a good Internet web site for historical information about Ground-Hogs Day is <http://www.njweb.com/ground.html>

Local Almanac:

Twin Cities Almanac for January 31st:

The average MSP high temperature for this date is 21 degrees F (plus or minus 13 degrees standard deviation), while the average low is 3 degrees F (plus or minus 14 degrees standard deviation).

MSP Local Records for January 31st:

MSP weather records for this date include: highest daily maximum temperature of 46 degrees F in 1995; lowest daily maximum temperature of -5 degrees F in 1918; lowest daily minimum temperature of -25 degrees F in 1994; highest daily minimum temperature of 34 degrees F in 1968 and 1993; record rainfall of 0.41 inches in 1941; and record snowfall of 6.2 inches in 1907. Maximum snow depth on this date has been 23 inches in 1969; there have been 11 measurable snowfalls since 1948.

Average dew point for January 31st is 4 degrees F, with a maximum of 35 degrees F and a minimum of -33 degrees F.

Coldest windchill conditions on January 31st occurred in 1918 with -50 to -55 F readings throughout parts of the day.

All-time state records for January 31st:

Scanning the state climatic data base: the all-time high for this date is 57 degrees F at Springfield (Brown County) in 1989; the all-time low is -55 degrees F at Embarrass and Tower (St Louis County) in 1996.

Word of the Week: Vorticity

This is a term used by meteorologists to describe the rotation of a fluid - and the atmosphere is a gaseous fluid. An example is the rotation of the atmosphere around relatively large scale low and high pressure cells. It is most often used to describe the rotational field about a vertical axis such as a surface low pressure system.

Vorticity in a counterclockwise rotation about a low pressure cell (storm system) in the northern hemisphere is defined as positive. Vorticity about a high pressure cell or clockwise rotation in the northern hemisphere is defined as negative.

This can be illustrated using the righthand rule. Hold out your righthand with the thumb pointed upward and curl your fingers slowly (they will rotate counterclockwise). This is an example of positive vorticity (with your thumb pointing upward), with your fingers pointed in the direction of the flow. Now place your righthand with your thumb pointed downward and slowly curl your fingers (they will rotate clockwise). This is an example of negative vorticity (your thumb pointed downwards), again with your fingers pointed in the direction of the flow.

A weather forecaster who describes the upstream weather pattern as having positive vorticity is referring to the approach of a storm (low pressure center and associated front), while the approach of negative vorticity usually brings high pressure and a more stable weather pattern. The relative strength of vorticity is sometimes observable in animated satellite views.

Vorticity is a standard calculation made by many of the numerical forecast models which provide guidance to meteorologists about what the future three dimensional states of the atmosphere might look like, in time steps ranging from 3 hours out to 72 hours.

Outlook:

More snow on the way for the weekend up north, with hit or miss snow possible in the south. Warming temperatures, with some thawing in areas of the state. Much of next week looks unsettled with respect to precipitation however. Low pressure may bring in some snow for mid-week and also later in the week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Feb 7, 1997

Topic: Pothole Prognostications

There is an interesting article about potholes and street maintenance in the February 4th edition of the St Paul Pioneer Press. As most Minnesotans know, fluctuating temperatures, especially freeze-thaw cycles and abundant moisture are the chief climatic adversaries of paved roads. When these conditions occur with a higher than normal frequency, then more than the usual number of potholes can be anticipated.

Asphalt is prone to more cracking as a result of moisture penetration through cracks to the underlying roadbed. Various freeze-thaw cycles produce thermal expansion and contraction in both the water and roadbed material, eventually producing cracks and cavities in the pavement. These cycles of thermal expansion and contraction can be short, caused by large day-night temperature differences or long, caused by episodic temperature variations (spells of abnormally warm days followed by abnormally frigid days, or vice versa). In addition, as the days grow longer and the sun angle gets higher in February and March, clear day solar radiation can produce dramatic heating of paved surfaces even on days when the observed air temperature never rises above freezing.

According to the Pioneer Press article, the number of pothole complaints and repairs in the Twin Cities is on the rise recently and street maintenance staff, using a "winter mix material" as filler, are having a hard time keeping up. How has the weather contributed to this problem? The answer, climatologically, appears to be more related to abundant moisture than freeze-thaw cycles.

Since November 1st, there have been 22 freeze-thaw cycles (the oscillation of temperature above and below the freezing mark of 32 degrees F) recorded at the MSP airport. This is significantly less than the historical average over this time period (Nov. 1 to Feb. 6) of 34 cycles. The less than normal frequency of freeze-thaw cycles holds true for other parts of the state as well. For example, the Fargo-Moorhead area has recorded 11 freeze-thaw cycles since November 1st, only about 40 percent of the historical average of 28. This weather pattern is not surprising as temperatures have averaged below normal for each of the three months, November, December and January in both metropolitan areas.

On the other hand, during the same period, moisture has been quite abundant. Currently, the Twin Cities is closing in on 60 inches of snow for the winter season, while in Fargo-Moorhead the snowfall total is approaching 80 inches. These values exceed the historical average winter snowfall. But perhaps more importantly, the number of days with recorded precipitation are dramatically greater this winter. MSP airport has recorded measurable precipitation on 46 days since November 1st, compared to a historical average of 32 days

over the same period (Nov. 1 to Feb. 6). Similarly, for the Fargo-Moorhead area, 31 days with measurable precipitation have been recorded since November 1st, compared to a historical average of only 23 days.

The high frequency of days with measurable precipitation has reduced the number of opportunities for paved surfaces to be plowed and allowed to dry off. As a result, ice and compacted snow has built up on many streets and roads. Because of this abundant surface moisture (in the form of snow and ice cover) and an increased frequency of freeze-thaw cycles in February and March (averaging about 25 occurrences in the MSP records), we might anticipate a continued increase in pothole complaints and repairs for the balance of winter.

Words of the Week: Frost Heaving

This is basically the lifting of a surface by the internal action of frost. It generally occurs as a result of freeze-thaw cycles. (It can also occur to a lesser extent by sublimation, ice forming from water vapor at high humidity)

During a thaw period water droplets can fill the pore spaces in soils or road pavements. This is especially true for macropores or the larger cracks and channels. Subsequent freezing then produces lenticular masses of ice or ice lenses which by expansion force the overlying material upward. Because moisture is not evenly distributed in the soil or pavement, this expansion is irregular and may produce considerable bumpiness in the surface. This is good for agricultural soils helping with drainage and aeration, but in pavements and roadbeds this process is very destructive.

Local Almanac:

Twin Cities Almanac for February 7th:

The average MSP high temperature for this date is 23 degrees F (plus or minus 13 degrees standard deviation), while the average low is 5 degrees F (plus or minus 14 degrees standard deviation).

MSP Local Records for February 7th:

MSP weather records for this date include: highest daily maximum temperature of 53 degrees F in 1987; lowest daily maximum temperature of -14 degrees F in 1933; lowest daily minimum temperature of -24 degrees F in 1972; highest daily minimum temperature of 36 degrees F in 1925; record rainfall of 0.94 inches in 1928; and record snowfall of 3.0 inches in 1892, 1904, and 1932. Maximum snow depth on this date has been 22 inches in 1967; there have been 8 measurable snowfalls since 1948.

Average dew point for February 7th is 5 degrees F, with a maximum of 38 degrees F and a minimum of -32 degrees F.

Coldest windchill conditions on February 7th occurred in 1933 with

-55 to -60 F readings throughout parts of the day.

All-time state records for February 7th:

Scanning the state climatic data base: the all-time high for this date is 62 degrees F at Browns Valley (Traverse County) and Madison (Lac Qui Parle County) in 1987; the all-time low is -53 degrees F at Leech Lake (Cass County) in 1899.

Outlook:

Dry and mild over the weekend with above normal temperatures most places. Turning cloudy later on Monday of next week, with snowfall likely off and on during the balance of the week, particularly up north. A trend toward colder temperatures will last most of the week as well.

To: Perry Finelli, Bob Potter, Jim Bickal, John Bischoff,  
and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Feb 14, 1997

The following material will be posted on WeatherTalk (found under news.mpr.org or www.mnonline.org) this Friday.

Happy Valentine's Day!

The climate outlook for March and the March through May period will be released by the Climate Prediction Center on Thursday afternoon (Feb. 13). If there are significant features worth mentioning on Morning Edition, I will let you know.

February has been somewhat friendlier in the weather department, bringing us no major storms and a few thawing days. The Twin Cities didn't record a minimum temperature below zero degrees F this month until Wednesday of this week (Feb. 12) when it dipped to -1 degrees F. On average the Twin Cities records 8 minimum temperatures below zero during the month of February. We may spend the latter half of the month catching up in this department, but I hope not.

Topic: Ice and Alfalfa Injury

Earlier this winter an MPR listener called to ask if we were recording an unusual number of freezing rain events in the state. Yes, indeed we are, and this has implications for Minnesota alfalfa producers, who are finding hay stocks to be somewhat short going into this spring.

Winter injury can be a problem for alfalfa producers, perhaps most commonly due to lethal soil temperatures (below 15 degrees F) which occur in the absence of protective snow cover. Tolerances to winter conditions vary across alfalfa varieties. Some are more winter hardy than others.

In many Minnesota counties which produce alfalfa, the abundant snow cover of this winter has helped prevent soil temperatures from dipping too low. On the other hand, the number of freezing rain and drizzle events this winter has placed a good deal of ice on the landscape in many areas, especially western Minnesota. Ice sheeting over the soil surface can be a serious problem for alfalfa because it reduces the gaseous exchange between the soil and the air. Ice sheets tend to persist longer in low lying areas or fields with poorly drained soils. In the presence of ice sheets, the gaseous by-products of plant respiration can build up in the soil and kill or damage alfalfa crowns. This is perhaps the real risk this winter, but the extent of injury cannot be assessed until later this spring when producers can dig up a few plants and check them for dead tissue and roots.

To illustrate how unusual the frequency of freezing precipitation has been this winter, we can use climatology. Below are the historical odds of freezing rain and drizzle events based on climatological records at MSP. There are very few locations in the state which have kept such records, so it is impossible to know what the spatial variation in this weather feature might be.

Monthly and Annual Frequencies of freezing precipitation at MSP:

(based on 1948-1996)

Months	Nov	Dec	Jan	Feb	Mar	Annual
	1 in 5yr	1 in 4yr	2 in 5yr	1 in 6yr	1 in 5yr	1-2/yr

Listed below are the specific freezing rain, freezing drizzle and ice storm events in Minnesota for the winter of 1996-97 so far, taken from the forecasts, advisories and warnings released by the National Weather Service.

Dates of Occurrence	Areas of Minnesota Affected
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November 14-15	SW, C
November 17	NC
November 19-20	Southern two-thirds
November 22-23	SW, SC, SE,
November 29	Statewide
December 10-12	WC, NW, NE
December 27-28	SE, SC
December 30	WC
January 1	NW, WC, NE
January 3	Statewide
January 21	NW, NC
January 30	NW, NC, NE, WC, C, EC

Five storms in November, 3 in December, and 4 in January total 12 freezing precipitation storms in the state for the winter so far. This is perhaps an unprecedented number for any single winter in recent memory.

Words of the Week: Rogue Clouds

This term appeared in some of the forecast discussion this week (Greg Tipton with the National Weather Service used it). These are rebel clouds which are left behind when a large cloud mass, usually associated with a surface low or upper air trough, exits the state. They may not last terribly long, as the drier air which usually follows a frontal passage mixes with them until they thin out and disappear. But at this time of year, these clouds can cause some local scale differences in overnight minimum temperatures. They provide a blanket effect to the loss of long wave radiation during the night and tend to keep the underlying surface warmer than the surrounding landscape. When rogue clouds are present overnight, minimum temperature differences within a county or region of the state can vary by 10 or more degrees, as they did on Wednesday morning of this week.

Local Almanac:

Twin Cities Almanac for February 14th:

The average MSP high temperature for this date is 25 degrees F (plus or minus 12 degrees standard deviation), while the average low is 8 degrees F (plus or minus 13 degrees standard deviation).

MSP Local Records for February 14th:

MSP weather records for this date include: highest daily maximum temperature of 48 degrees F in 1934 and 1954; lowest daily maximum

temperature of -5 degrees F in 1920; lowest daily minimum temperature of -21 degrees F in 1936; highest daily minimum temperature of 32 degrees F in 1911; record precipitation of 0.43 inches in 1950; and record snowfall of 6.4 also in 1950. Maximum snow depth on this date has been 21 inches in 1979; there have been 14 measurable snowfalls since 1948.

Average dew point for February 14h is 11 degrees F, with a maximum of 42 degrees F and a minimum of -33 degrees F.

Coldest windchill conditions on February 14th occurred in 1923 with -70 to -75 F readings throughout parts of the day.

All-time state records for February 14th (Valentines Day):

Scanning the state climatic data base: the all-time high for this date is 66 degrees F at Windom (Cottowood County) in 1954; the all-time low is -47 degrees F at Bagley (Clearwater County) in 1906.

Outlook:

Snow likely Friday and Saturday, especially up north. Some lingering snow flurries on Sunday. Temperatures will be normal or slightly below normal over the weekend. Then a warming trend for next week. A somewhat unsettled period appears ahead for Wednesday through Friday of next week. There will be increasing chances for precipitation with a pattern that favors above normal temperatures for much of next week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Feb 21, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

MPR Listener Question: "I sometimes hear meteorologists use the terms overforecast and underforecast. Exactly what do those words mean?"

This terminology is sometimes used to critique the forecast of another meteorologist or a National Weather Service numerical model. To overforecast means to predict a temperature or precipitation amount that is too large (high), while to underforecast means to predict something too small (low).

For example, the National Weather Service Forecast Models have been criticized this winter for overforecasting many daily maximum temperatures in Minnesota. That is to say predicting high temperatures much above which actually occurs. The forecasters at the National Weather Service have therefore on numerous occasions used the surface observations of temperature, along with other data to amend the model forecasts and lower the expected daily high temperatures.

Several reasons have been voiced as to why some of the forecast models have predicted temperatures too high this winter. Among them are.....

Some models do not consider the pronounced effect of snow cover on the landscape. Snow reflects 70 to 90 percent of the sun's energy.

Some models consider the presence of snow cover, but only update this information on a weekly basis, not capturing the changes which might occur during the week.

Some models consider the presence of snow cover, but not how deep it is or how long it has persisted. This feature can contribute to the persistence of a shallow cold layer of air near the surface.

The frequency of arctic air masses over the state this winter has been abnormally high, and some of these forecast models were developed from data sets which did not exhibit this high frequency. In other words, the models were calibrated and fit on data which was significantly different from that which is being observed this winter.

(My thanks to Richard Naistat, Science Operations Officer at the National Weather Service Forecast Office in Chanhassen, MN for helping me in answering this question.)

Topic: Preliminary Climate Summary for February

February broke the pattern of three consecutive months with colder than normal temperatures. The average temperature for February 1997 was slightly above the 30 year normal for most Minnesota communities. There were 3 to 6 days above the freezing mark, allowing for some

thawing, settling and evaporation of the snow cover. Precipitation for February was below normal for most places, but somewhat above normal in west central and southeastern counties.

Words of the Week: Pleion and Antipleion

In the old days before meteorologists and climatologists talked about significant climate departures as "anomalies", they used these terms to describe areas with abnormal and persistent positive and negative departures in the elements of climate. These terms were introduced by the famous Polish meteorologist, oceanographer and geologist, Henryk Arctowski (1871-1958) who was the first to keep an entire year of meteorological observations in the Antarctic.

Like the word anomaly, these words imply a character to the long term climate trend or pattern, such as a prolonged warm spell of many months. The pleion is taken from the Greek, meaning greater than average or normal, and antipleion means less than. Thus one signifies an area of positive departure in the pattern of temperature, pressure, or precipitation, while the other signifies an area of negative departure.

Using pleionic terminology for the current winter, Minnesota would be described as a pleion with respect to snowfall and snow cover, and an antipleion with respect to temperature.

Observer and Community Notes: Milan, MN

This week I would like to salute the Opjorden family of Milan, MN who are in their 105th consecutive year of making daily weather observations for their community in Chippewa County. There are perhaps 5 or 6 family generations who have participated diligently 365 days each year in recording daily high and low temperatures, along with precipitation since Mr. O.K. Opjorden's first observation was made in June of 1893. They have produced a sizable climatic record of considerably high quality for Chippewa County and western Minnesota.

For the winter of 1996-97 so far, Milan has recorded nearly 69 inches of snowfall. This is the 4th highest seasonal total since the winter of 1948-49 and they still have March and April to go.

Record climate values at Milan include: a high of 113 degrees on July 21, 1934 and a low of -42 degrees on February 16, 1936; rainfall of 9.78 inches on July 4, 1995; 46 inches of snow depth on February 12-13, 1994; 11 consecutive days with temperatures over 100 degrees F, July 7-17, 1936; and 9 consecutive days with temperatures below 0 degrees F, February 4-12, 1936.

Local Almanac:

Twin Cities Almanac for February 28th:

The average MSP high temperature for this date is 32 degrees F (plus or minus 12 degrees standard deviation), while the average low is 15 degrees F (plus or minus 12 degrees standard deviation).

MSP Local Records for February 28th:

MSP weather records for this date include: highest daily maximum temperature of 57 degrees F in 1932; lowest daily maximum temperature of -9 degrees F in 1962; lowest daily minimum temperature of -26 degrees F in 1962; highest daily minimum temperature of 38 degrees F in 1895; record precipitation of 0.51 inches in 1951; and record snowfall of 7.5 inches in 1906.

Maximum snow depth on this date has been 24 inches in 1962; there have been 12 measurable snowfalls since 1948.

Average dew point for February 28th is 15 degrees F, with a maximum of 40 degrees F and a minimum of -40 degrees F.

Coldest windchill conditions on February 28th occurred in 1962 with -60 to -65 F readings throughout the early morning hours of the day.

All-time state records for February 28th:

Scanning the state climatic data base: the all-time high for this date is 62 degrees F at Milan and St Peter in 1905, and again at Canby in 1932; the all-time low is -50 degrees F at Pokegama Dam (Itasca County) in 1897.

Outlook:

Some snow over the weekend most places, with a mixture of snow and rain in southern Minnesota. Temperatures should be above normal until Sunday or Monday, then trending near normal for most of next week. Somewhat drier Sunday but another episode of snow, sleet and rain due for Monday, followed by a respite until Thursday and Friday when another low pressure system will bring unsettled weather and precipitation to the state. It will be somewhat windy as well.

To: Perry Finelli, Bob Potter, Jim Bickal, John Bischoff,  
and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Feb 21, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

As we face the final weeks of this long hard winter in Minnesota, I was inspired to see these words from the writer Victor Hugo:

"laughter is the sun that drives winter from the human face."

This is a winter that we can be thankful for laughter. I know that I saw many more smiles when the temperature finally broke 40 degrees F this week in the Twin Cities.

Two MPR listener questions this week:

QUESTION 1:

"We have been complaining about our weather this winter, but I have heard that other places around the world are having unusual weather as well. What' going on with the weather elsewhere in the world and where can I find information about it?" (Chris in Eagan, MN)

After a wet fall and somewhat snowy start to winter, most of Europe has been experiencing warmer than normal and drier than normal wintertime conditions. In Northern Europe temperatures have recently been in the high 30s to low 40s F even north of the Arctic Circle.

Brazil has had a warm and wet crop season, with some soybean yields likely to be negatively affected. Both South Africa and northern Australia have had extremely wet summers as well, which may have some effect on their corn, cotton and sorghum crops.

Two good web sites to find up to date information about global agricultural conditions and weather/climate anomalies are...

[http://nic.fb4.noaa.gov:80/products/analysis\\_monitoring/GLOB\\_CLM/](http://nic.fb4.noaa.gov:80/products/analysis_monitoring/GLOB_CLM/)  
(This is the NOAA Climate Prediction Center)

<http://www.gov/oce/waob/jawf>  
(This is the Joint Agricultural Weather Facility of NOAA/USDA)

QUESTION 2:

"You have remarked about the large amount of snow and the frequency of snowfalls this winter. Can you predict whether or not any areas of the state will set records for snowfall amounts?" (Dale in Anoka, MN)

I am reluctant to do this because March can be such a wild month, weatherwise. However, since you asked, I will take a stab at it. A climatological approach is to assess what has happened so far this winter and then assume that something close to the historical average snowfall will occur over the remainder of the snow season. This is not a bad assumption since NOAA's Climate Prediction Center

has already forecasted no substantial deviations in precipitation for the month of March in our region of the country. Using this approach I can come up with an estimated seasonal snowfall total which can then be compared to the historical rankings. In the table below, I have summarized the seasonal snowfall totals for selected locations up through February 19th (Wednesday of this week). I then calculated the average snowfall which occurred from mid February to the end of winter for each year since 1948 at these locations. These figures were added to estimate a winter season total for 1996-97, which was then compared to the climate history and ranked against all other winters since that of 1948-49. All numbers are rounded off.

Location Name	1996-97 Snowfall 10/1-2/19 (inches)	Ave mid-Feb to June Total Snowfall ('48-'96) (inches)	Estimated 1996-97 Total (inches)	Historical Ranking of 1996-97 est. (1-49)
Twin Cities	57	19	76	9th
Rochester	61	17	78	1st
Intl Falls	69	21	90	10th
Duluth	99	26	125	3rd
St Cloud	49	16	65	6th
La Crosse	44	11	55	10th
Morris	55	13	68	6th
Sioux Falls	55	12	67	5th
Grand Forks	74	13	77	2nd
Fargo	78	12	90	2nd
Crookston	71	11	82	1st
Fergus Falls	77	13	90	1st

From the table, it appears that normal or above normal snowfall for the balance of the winter may produce record seasonal totals at Rochester, Duluth, Fargo, Grand Forks, Crookston, and Fergus Falls.

#### Words of the Week: Acicular Ice

After the Latin word "aciculus" meaning needle-like, this term refers to a type of ice which forms in fresh water (lakes and slow moving rivers) between the bottom of the ice layer and the contact point with the underlying water surface. This form of ice, sometimes also called "fibrous ice" or "satin ice" consists of long crystals or needles and sometimes hollow tubes extended from the undersurface of the ice cover. It is more visible in the late winter or early spring as lake ice cover begins to thin out.

#### Local Almanac:

Twin Cities Almanac for February 21st:

The average MSP high temperature for this date is 29 degrees F (plus or minus 11 degrees standard deviation), while the average low is 11 degrees F (plus or minus 13 degrees standard deviation).

MSP Local Records for February 21st:

MSP weather records for this date include: highest daily maximum temperature of 59 degrees F in 1930; lowest daily maximum temperature of -1 degrees F in 1963; lowest daily minimum temperature of -19 degrees F in 1939 and again in 1963; highest daily minimum

temperature of 44 degrees F in 1930; record precipitation of 0.50 inches in 1966 and 1981; and record snowfall of 5.5 inches in 1962. Maximum snow depth on this date has been 27 inches in 1967; there have been 14 measurable snowfalls since 1948.

Average dew point for February 21st is 13 degrees F, with a maximum of 39 degrees F and a minimum of -33 degrees F.

Coldest windchill conditions on February 21st occurred in 1963 with -55 to -65 F readings throughout the early parts of the day.

All-time state records for February 21st:

Scanning the state climatic data base: the all-time high for this date is 63 degrees F at Winona in 1930 and repeated at Lamberton, Tracy, Springfield, and Theilman in 1981; the all-time low is -51 degrees F at Meadowlands (St Louis County) in 1939 and just south of Baudette (Lake of the Woods County) in 1966.

Outlook:

Colder than normal and some snowfall this weekend, though nothing too heavy. Then, turning drier but cold, with below normal temperatures for the first part of next week. By mid to late in the week, another thaw period is likely with high temperatures reaching the 30s to 40s at least in southern sections.

Comment on Snow Melt:

Hydrologists have developed equations which help them to estimate how much snow melt runoff might occur under various weather conditions. The rate of snowmelt is primarily governed by air temperature and solar radiation, but can be greatly enhanced by wind and rain.

In open areas exposed to the sun, a 40 degree F day will just about melt an inch of snow, while the same conditions in a forested area will only melt about 0.5 inches of snow. These estimates are not very precise for several reasons, but they do reflect the relative difference in melting rates between two areas in the landscape. As snow ages or ripens, it melts more readily, such that a 40 degree F temperature later in the winter will more efficiently melt snow than one early in the winter.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Mar 7, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

MPR Listener Question: "It was 20 something below zero earlier this week in northern Minnesota. What is the latest calendar date (with respect to the winter season) that a temperature below zero has been recorded in Minnesota?"

Answer: Locally, the latest date that MSP has recorded a temperature below zero is March 31, 1969 when the overnight minimum was -1 degree F. On a statewide basis, Tower in northern Minnesota recorded a minimum temperature of -3 degrees F on April 19, 1897. This is the latest date I can find for such a temperature in the state archives.

Topic: Snowfall Update for the Winter of 1996-97

The National Weather Service reported a new seasonal snowfall record at Fargo, ND this week where 99.6 inches has been recorded so far this winter. In addition, Crookston, MN has recorded over 82 inches of snowfall and Ada, MN has recorded 90 inches. These are record seasonal snowfall amounts as well. Other communities in western and northwestern Minnesota have reported near record amounts of seasonal snowfall. Grand Forks, ND and Fergus Falls, MN both at 84 inches are very close to record amounts. Morris, MN with 69 inches of seasonal snowfall and Montevideo with 65 inches are close that additional March storms could push them past their historical seasonal snowfall records as well.

Topic: NOAA Weather Radio

I am a big fan of NOAA Weather Radio. Whenever people ask me what is the best source of updated weather information, I always mention NOAA Weather Radio. There are three reasons for this: (1) I have great respect for the meteorologists who work for the National Weather Service; (2) the NOAA Weather Radio broadcasts 24 hours each day, with updates every hour (even more frequently if severe or threatening weather is evident); (3) and you can pick up these radio broadcasts almost anywhere you go.

NOAA Weather Radio broadcasts in the VHF band, ranging from 162.4 to 162.55 MHz. There are over 400 transmitters throughout the United States, which provide this service to 70 to 80 percent of the country's population. So even if you are unlucky enough to live in an area that does not receive NOAA Weather Radio broadcasts, you are likely to travel through areas which do. Portable radios which receive the NOAA Weather band are great to take along on trips and vacations. They are available from several manufacturers.

Currently there are 11 transmitters operating in Minnesota, 7 in North Dakota, 5 in South Dakota, 4 in Iowa, and 10 in Wisconsin. In most cases, broadcasts from these transmitters can be picked up within a 40 mile radius. If you are traveling in the upper midwest or anywhere else in the country you can obtain a list of the NOAA Weather Radio transmitters on the Internet at the

following web site.....

<http://www.nws.noaa.gov/noaaradio.shtm>

Local Almanac:

Twin Cities Almanac for March 7th:

The average MSP high temperature for this date is 32 degrees F (plus or minus 11 degrees standard deviation), while the average low is 16 degrees F (plus or minus 12 degrees standard deviation).

MSP Local Records for March 7th:

MSP weather records for this date include: highest daily maximum temperature of 73 degrees F in 1987; lowest daily maximum temperature of 4 degrees F in 1932; lowest daily minimum temperature of -16 degrees F in 1960; highest daily minimum temperature of 41 degrees F in 1987; record precipitation of 0.95 inches in 1917; and record snowfall of 11.5 inches also in 1917.

Maximum snow depth on this date has been 23 inches in 1962; there have been 13 measurable snowfalls since 1948.

Average dew point for March 7th is 13 degrees F, with a maximum of 44 degrees F and a minimum of -25 degrees F.

Coldest windchill conditions on March 7th occurred in 1932, 1943, and 1967 when -45 to -50 degrees F values were reported in the morning hours.

All-time state records for March 7th:

Scanning the state climatic data base: the all-time high for this date is 78 degrees F at Marshall, New Ulm and St Peter in 1987; the all-time low is -38 degrees F at Little Fork (Koochiching County) in 1913.

Words of the Week: Rills and Rivulets

These terms are used to describe the overland flow of water, especially with respect to erosion. Rills, derived from a similar German word (rille meaning stream) are furrow-like and are defined by the Natural Resources and Conservation Service as narrow channeled flow less than 4 inches deep with uniform dimensions of size and spacing, which appear and disappear somewhat randomly on slopes from year to year. They are relatively short in length and terminate at a footslope where deposition occurs. Rills may conduct water only during spring snowmelt or precipitation runoff events.

Rivulets, derived from the Latin word rivulus, is not as well defined as rills, but refers to a small stream or brook. Rivulets may be larger or smaller flow channels which persist from year to year and terminate in larger streams or rivers. This term also implies that water is always present in the flow channel.

Both of these features will obviously be common in Minnesota this spring with the large quantities of snowmelt runoff that are expected to drain and leave signs of erosion on the landscape.

Outlook:

Some unsettled weather with various precipitation types will affect the state on Saturday and Sunday, and perhaps even Monday up north. Amounts are not expected to be great. Temperatures will generally be near or above seasonal normals, then cool off during next week. Precipitation chances increase by Wednesday and Thursday, especially up north.

To: Perry Finelli, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Mar 14, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

MPR Listener Question: How often are the winds calm in Minnesota?

First let me define calm. The National Weather Service measures wind with anemometers which have a start-up threshold of 1 mph. Thus when wind speed is less than this value, the cups on the instrument do not rotate, and the wind observation is noted as "calm." In the absence of an anemometer, some observations of wind are nevertheless recorded based on the Beaufort wind scale. On the Beaufort wind scale, when smoke is observed to rise vertically or the sea surface is mirrorlike, the wind is recorded as "calm."

Based on the local climate records from the MSP airport, a calm wind condition is reported only about 1.5 percent of the time, or about 131 hours per year. The month of highest frequency is July, when nearly 2.5 percent of the time a calm wind condition is reported. The month with the lowest frequency is January with 0.8 percent occurrence of calms. In terms of the daily pattern of wind speed, calms are reported most frequently between 11 pm and 5 am, especially in the summer months of July and August.

Topic: March 14-15 Anniversary Dates in Minnesota Weather History

On March 14, 1870 the term "blizzard" was first used in a written account of a major storm. The storm struck Minnesota and Iowa, with high winds and reduced visibility. Snowfalls up to 16 inches were recorded in some places. The Vindicator newspaper in Esterville, IA described the storm as a "blizzard" a term previously used in the sport of boxing to describe a volley of punches. Since that time, blizzard has been used more commonly to describe major winter storms of the midwest.

Saturday, March 15, 1941 is still remembered by long-time residents of northern Minnesota as perhaps the state's worst blizzard. Over 70 fatalities occurred in North Dakota and Minnesota, most as a result of people caught traveling in motor vehicles on Saturday night, when as much as eight foot drifts of snow piled up in places. Winds gusted to 85 mph at Grand Forks, 74 mph at Fargo and 75 mph at Duluth. These winds were described as "terrifying and highly destructive" by northern Minnesota weather observers. Temperatures dropped by 40 to 50 degrees over a 12 hour period and windchill values reached -60 to -70 degrees F. Many stranded motorists were rescued by farmers or railroad crews. Some people fishing on the ice in Lake Superior, were stranded on ice floes for a day or two and drifted several miles before being rescued. Governor Harold Stassen was critical of the Weather Bureau for "inadequate weather warnings", though they had predicted a cold wave and strong winds earlier on Saturday. As a result of this and other criticism, the Weather Bureau forecast districts were later broken down into smaller geographic regions, so that the Chicago district office no longer had responsibility for forecasting of Minnesota weather. (The above was partially taken from reports of the Minneapolis Star Tribune, Mar. 16-18, 1941, from The History of the U.S.

Weather Bureau by D.R. Whitnah, and from Minnesota Weather by R.A. Keen)

These and other significant historical weather events can be found over the Internet at the Aviation Weather Center's Weather Facts Web site....<http://www.awc-kc.noaa.gov/wxfact.html>

Local Almanac:

Twin Cities Almanac for March 14th:

The average MSP high temperature for this date is 36 degrees F (plus or minus 12 degrees standard deviation), while the average low is 20 degrees F (plus or minus 12 degrees standard deviation).

MSP Local Records for March 14th:

MSP weather records for this date include: highest daily maximum temperature of 62 degrees F in 1973 and 1990; lowest daily maximum temperature of 8 degrees F in 1906; lowest daily minimum temperature of -10 degrees F in 1897; highest daily minimum temperature of 45 degrees F in 1973; record precipitation of 0.81 inches in 1989; and record snowfall of 7.2 inches also in 1989.

Maximum snow depth on this date has been 26 inches in 1962; there have been 11 measurable snowfalls since 1948.

Average dew point for March 14th is 21 degrees F, with a maximum of 51 degrees F and a minimum of -16 degrees F.

Coldest windchill conditions on March 14th occurred in 1897 when -35 to -40 degrees F values were reported throughout parts of the date.

All-time state records for March 14th:

Scanning the state climatic data base: the all-time high for this date is 73 degrees F at Pipestone in 1935; the all-time low is -40 degrees F at Detroit Lakes (Becker County) in 1897.

Words of the Week: Ventometer and Ventose

These are both old words. Before the use of the term anemometer to describe an instrument for measuring wind speed, several countries called this instrument a ventometer, from the Latin words "ventus" meaning wind and "meter" for measure. For example, military history shows that a ventometer was used by the Italian and French military to measure wind velocity on their artillery target ranges during practice sessions.

The term "Ventose" dates from the Revolutionary calendar devised by the First French Republic (1793) following the French Revolution. This calendar divided the year into 12 months, each 30 days long, with five additional days each year for festivals (six in every 4th year). Further, each month was divided into 3 ten day periods, with weeks being abolished. The year began on the autumnal equinox (Sept 22 or so). Ventose was the 6th month of the year, covering the period from February 19 to March 20, typically a windy period in France, hence the name derived from the Latin word for windy or flatulent (ventosus). To this day, the term ventosity refers to windiness, and is derogatory when describing

a person who is too conceited or boastful.

Outlook:

Colder than normal for the coming weekend, as a polar air mass settles in following a major snow storm. Then warming up next week, starting on Monday with temperatures above normal across most of the state. Rather quiet in terms of weather fronts until later in the week, when an organized low pressure system will once again bring rain and snow to the state.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Apr 4, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

#### Anniversary Date:

On April 4th, 1933 the weather observer at Pigeon River Bridge (the immigration station) along the Canadian border in Cook County reported a Minnesota record 24 hour snowfall of 28 inches. This is somewhat analogous to the magnitude of the snowstorm which hit the northeastern U.S. earlier this week, setting April snowfall records there.

#### Preliminary March Weather Summary for Minnesota:

The mean temperature for the month of March 1997 ranged from 1 to 4 degrees colder than normal for most Minnesota communities, except in the heavily snow-blanketed northwest where temperatures were 5 to 7 degrees colder than normal. Total March precipitation was somewhat below the 30 year normal for most communities as well, with fewer than normal storms passing over the state. Despite this pattern, several observers reported above normal March snowfall totals including: 26 inches in the Fargo-Moorhead area, nearly 21 inches at Duluth, over 20 inches at La Crosse-La Cresecent, almost 19 inches at Rochester and 14 inches at MSP.

#### Sap Time:

The recent dramatic oscillations in daily temperatures above and below the freezing mark have instigated the flow of sap in maple trees. These temperature fluctuations stimulate pressure changes within the trees which cause the sap to run, especially in the morning hours when the temperature tends to warm up more rapidly. The wet late fall period and persistent snow cover of this winter are indicators that the maple sap flow may be abundant this spring. The University of Minnesota Landscape Arboretum in Chanhassen will be hosting their annual demonstration of tree tapping and maple sap harvesting techniques this weekend (April 5-6), each day from 10 am to 3 pm.

#### The Color of Precipitation:

Now that the National Weather Service has successfully deployed the new Doppler radar systems (WSR-88D) in all of their forecast offices, radar depictions of precipitation are more readily available to the public, especially so over Internet web sites. Video Integrator and Processor (VIP) displays depict the radar echo patterns as color coded contour maps. Radar summary charts and mapped displays are available at 35 minutes past each hour throughout the day.

The standard colors used in these maps infer the precipitation intensity associated with the echoes. Typically the blue colors indicate light rain or snow, green colors indicate light to moderate rain showers, yellow indicates moderate thunderstorms, and magenta and red indicate severe thunderstorms, with rainfall intensities of several inches per hour.

Some web sites which offer national, regional and local radar summaries and maps are:

<http://www.intellicast.com/weather/usa/radar>  
<http://cirrus.sprl.umich.edu/wxnet/wsi.html>  
<http://www.wcco.com/weather/mapsradar>  
<http://www.crhwnscr.noaa.gov/mpx/mpxnew.html#radar>

As we move into the convective storm season in Minnesota, it becomes more important for meteorologists to frequently use the Doppler radar to interpret strengthening or weakening of thunderstorms as they move across the state.

Local Almanac:

Twin Cities Almanac for April 4th:

The average MSP high temperature for this date is 49 degrees F (plus or minus 12 degrees standard deviation), while the average low is 31 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for April 4th:

MSP weather records for this date include: highest daily maximum temperature of 81 degrees F in 1921; lowest daily maximum temperature of 27 degrees F in 1920 and 1995; lowest daily minimum temperature of 5 degrees F in 1995; highest daily minimum temperature of 62 degrees F in 1921; record precipitation of 0.77 inches in 1932; and record snowfall of 7.2 inches in 1957.

Maximum snow depth on this date has been 9 inches in 1975; there have been 8 measurable snowfalls since 1948.

Average dew point for April 4th is 26 degrees F, with a maximum of 51 degrees F and a minimum of 2 degrees F.

All-time state records for April 4th:

Scanning the state climatic data base: the all-time high for this date is 89 degrees F at Tracy (Lyon County) in 1929; the all-time low is -17 degrees F at Tower (St Louis County) in 1975.

Words of the Week: Doppler Radar

This is the type of weather surveillance radar which takes advantage of the Doppler effect. It can determine the radial velocity of atmospheric targets moving directly toward or away from the radar unit based on the change in the frequency between the outgoing and returning (reflected) radar signal. Thus wind speeds associated with thunderstorms can be interpreted, and in particular rotating winds associated with funnel clouds and tornadoes can be seen on the Doppler radar displays.

Now that the major league baseball season has begun, Doppler radar are routinely used at most ballparks. They are positioned either behind home plate or in centerfield to measure the velocity of pitched balls, which typically range from 70 to 90 mph. In this position the radar gun cannot measure the speed of a throw from shortstop to first base, since the thrown ball crosses the radar beam rather than moving toward it or away from it.

Outlook:

Rainy, windy weekend in store for most of Minnesota, with the approach of a major storm system from the southwest. Late in the weekend temperatures will drop and some of the precipitation may turn over into snow. Drier conditions may prevail by Tuesday and Wednesday. The cooler air behind this system will lead to below normal temperatures for much of next week. Another low pressure systems will bring a chance for precipitation by Thursday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Apr 11, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

#### Flooding Considerations:

It is not unusual for a series of flood crests to occur on a major river in the spring. This is happening for some locations along the Minnesota and Red River this spring. Initial record breaking flood crests are being followed by lesser crests as ice dams and additional drainage from last weekends storm feed into tributaries and the main river channel causing the flow to modestly rise again. This prolongs the agony of dealing with the flood threat.

Another climate feature to bear in mind is the recent and now prolonged trend of below normal temperatures, projected to last through April 19th. This is slowing the melting and drainage of the watersheds and will prolong the period of flooding in many areas. In some cases, this condition has helped to reduce the projected flood crests somewhat as melting and runoff have slowed down. But in other cases, as on the Red River, the cold temperatures have exacerbated the formation of ice dams which tend to allow large flows to backup and then eventually surge down the main channel with a larger than expected crest.

#### Forecast Terminology:

Since April is the windiest month in Minnesota, it is a good time to review the wind terminology used by meteorologists.

National Weather Service Forecast Offices use certain descriptive terms in their public forecasts to define expected prevailing wind speeds. The National Weather Service Media Guide offers the following guidelines for interpreting forecasted wind speeds.

Expected Sustained Wind Speed	Descriptive terms used
0 mph	Calm conditions
1-5 mph	light, or light and variable
5-15 mph	no terms specified
15-25 mph	breezy (in mild weather) brisk or blustery (in cold weather)
20-30 mph	windy
30-40 mph*	very windy
40 mph or greater	strong, dangerous, or damaging

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\*At this level of expected winds, Forecast Offices are mandated to issue a wind advisory to the public.

#### How Long Does Winter Last in Minnesota?

How many times has this question been asked in the past few days, especially by newcomers?

Recent blizzard conditions, single digit and below zero low temperatures, daily highs in the teens and 20s, and windchill

values from -25 to -35 degrees F are conditions we expect for January or February, even March sometimes. But, not in April for crying out loud! Low temperature records were set for many locations on April 6-9 this week. But even more amazing were the record cold maximum temperatures recorded around the state.

On April 7th some extraordinary cold maximum temperatures were recorded for so late in the season. MSP recorded a high of 22 degrees F, the coldest maximum temperature ever recorded so late into spring (later than the 22 degrees F recorded on April 1, 1897). Similarly, on April 7 of this week, Crookston recorded a high temperature of 11 degrees F, record cold for so late into the spring (later than the 10 degree F maximum temperature on March 29, 1969); and Morris recorded a high temperature on April 7 of 18 degrees F, again a record for so late into spring (later than the 18 degree F reading on April 2, 1975).

How long can these winter-like conditions hold on in Minnesota? If we examine historical records there are climatic signs that winter can hang on for a very very long time. Some of these signs include.....

Below zero minimum temperatures as late as April 19th at Tower, MN. (1897)

Eighteen inches of snow as late as the first week of May and five inches of snow as late as Memorial Day at Virginia, MN. (1954 and 1946, respectively)

Snow flurries at Holman Field in downtown St Paul on June 1st, 1946.

Ice floes on Lake Superior on June 9, 1972 and even as late as July 3, 1876.

Periodically, it seems, Mother Nature likes to test our patience.

Local Almanac:

Twin Cities Almanac for April 11th:

The average MSP high temperature for this date is 53 degrees F (plus or minus 11 degrees standard deviation), while the average low is 34 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for April 11th:

MSP weather records for this date include: highest daily maximum temperature of 83 degrees F in 1968; lowest daily maximum temperature of 25 degrees F in 1940; lowest daily minimum temperature of 12 degrees F in 1940; highest daily minimum temperature of 57 degrees F in 1977; record precipitation of 0.91 inches in 1893; and record snowfall of 5.7 inches in 1929.

Maximum snow depth on this date has been 4 inches in 1980; there has been only 1 measurable snowfall on this date since 1948.

Average dew point for April 11th is 29 degrees F, with a maximum of 59 degrees F and a minimum of 2 degrees F.

All-time state records for April 11th:

Scanning the state climatic data base: the all-time high for this date is 92 degrees F at Browns Valley (Traverse County) and Madison (Lac Qui Parle County) in 1977; the all-time low is -4 degrees F at Baudette (Lake of the Woods County) in 1940.

Word of the Week: Meteograms

These are charts which depict various weather elements (meteorological parameters) for a given location over time based on National Weather Service forecast models. They are available in a variety of forms but only for major cities in the United States. Typically they show the expected pattern for air temperature, dew point, pressure, wind, sky condition, and precipitation. The graphic for each of these parameters may be plotted hour by hour, or in 3, 6, 12 or 24 hour time steps.

Sites on the World Wide Web which display meteograms include:

<http://www.crhnwscr.noaa.gov/mpx/mpxnew.html#forecast>  
(the National Weather Service Forecast Office, Chanhassen, MN)

<http://wxp.atms.purdue.edu/mos.shtml>  
(the Weather Processor at Purdue University)

Outlook:

Still some linger showers possible in the south early Saturday, then mostly sunny, breezy and cooler than normal for the weekend around the state. Some moderation in temperatures will begin on Monday, with a slow climb in daily maximums toward normal during next week. Another chance for mixed precipitation around the state by Wednesday and Thursday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Apr 18, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

Some Important Events to Remember Next Week:

Next week, April 21-25 is Severe Weather Awareness Week in Minnesota. There will be a test drill on Thursday, April 24 and a series of news releases to remind the public about severe weather watches and warnings, as well as precautions to take during severe weather.

In addition, next Tuesday, April 22nd is Earth Day a time to remember that we live on a planet of finite resources with abundant and varied biological organisms. Our misuse or abuse of them sets a poor example for future generations and simultaneously robs them of a chance to enjoy the same quality of life which we have. There will be many events around the state to commemorate this day. One way to help celebrate is to volunteer to help clean up after the floods, so that no possible sources of pollution or material of a wasteful nature is left on the flood plain in these major watersheds.

Lastly, April 25th is Minnesota Arbor Day, a day to celebrate all the positive attributes and contributions which trees make to the environment. Again, damaged or killed trees on the flooded watersheds in Minnesota may need to be replaced with new plantings later this spring. Perhaps you or a group you belong to could volunteer to do some of these plantings or to purchase the seedlings to do so.

Flood-Related Editorializing:

In the past week or so, there has been a variety of finger pointing and speculation about the floods and the flood forecasts. In my climatological view, there are no simple explanations, and though some of the speculations and criticisms will make officials perhaps stop and think, I am not sure they are doing any good for all the victims of these floods. I have been asked by some colleagues at the university and associates in the media to comment on these speculations and criticisms, so here goes.....

(1) An NBC news story line that global warming has produced an intensification of the hydrologic cycle, increasing the frequency of heavy precipitation events as well as the total quantity of precipitation annually falling on the landscape. This will lead to increased flooding.

Response: The frequency of heavy precipitation and the total quantity of precipitation is indeed higher in recent years for many locations in the U.S. But there is evidence to suggest that at times in the past, before the recent positive trend in greenhouse gases, the frequencies and magnitudes of precipitation were of equal or greater value. In Minnesota, for example, the period from the mid 1860s to mid 1870s was one of the wettest in history, but sparsely documented only in old pioneer records and diaries. Mother Nature can produce some astonishing weather without the help of the human race. Thus, the above speculation is highly uncertain and may be confounded by changes in the measurement of precipitation which have occurred over time.

(2) Newspaper stories have reported that the flood frequencies and flood magnitudes of major watersheds are increasing because of agricultural drainage and changes in landuse.

Response: Evidence suggests that there have been flood frequencies and magnitudes in the distant past which rival or exceed those of today. The 1820s, 1850s, and 1880s on the Red River of the North for example show documented accounts and evidence of great floods. For major watershed, the scale and the coincidence of weather elements which produce a flood would appear to outweigh significant effects of landuse or agricultural drainage, which may have more local scale effects. Again, the above speculation is highly uncertain and probably not a testable hypothesis on a landscape scale.

(3) Radio and newspaper accounts of faulty river gages have brought criticism to the organizations whose task it is to monitor, assess and forecast floods. Is this justified?

Response: As with much environmental monitoring, it is relatively easy to allocate or obtain the initial startup funds to deploy new technology to the field for measurement purposes. It is almost impossible to convince administrators that the maintenance and calibration costs are extensive (in many cases several times more than the startup cost) and need to become part of the annual operations budget of an organization. Otherwise, how can organizations or communities count on the data in a crisis when they really need it. At fault here perhaps, are administrators who can throw money at new projects and equipment but not show enough concern to maintain it with appropriate operational funding and staff resource allocation.

Local Almanac:

Twin Cities Almanac for April 18th:

The average MSP high temperature for this date is 58 degrees F (plus or minus 12 degrees standard deviation), while the average low is 38 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for April 18th:

MSP weather records for this date include: highest daily maximum temperature of 89 degrees F in 1985; lowest daily maximum temperature of 31 degrees F in 1953; lowest daily minimum temperature of 21 degrees F in 1953; highest daily minimum temperature of 61 degrees F in 1915; record precipitation of 0.98 inches in 1928; and record snowfall of 1.0 inches in 1898 and 1939.

Maximum snow depth on this date has been 4 inches in 1983; there have been 4 measurable snowfall on this date since 1948.

Average dew point for April 18th is 33 degrees F, with a maximum of 61 degrees F and a minimum of 3 degrees F.

All-time state records for April 18th:

Scanning the state climatic data base: the all-time high for this date is 94 degrees F at Marshall (Lyon County) in 1985; the all-time low is 2 degrees F at Gunflint Lake (Cook County) in 1983.

Words of the Week: Abraham's Tree

Yes, the first father of all Hebrews from the Old Testament (Genesis 17) resting at the base of the Hebrew family tree has a weather feature named after him.

This is the name given to a cloud form which consists of feather and plume like appendages of cirrus emanating from a point on the distant horizon. In mid latitudes this form is most often seen on the western or southern horizon with the approach of a warm front or as cirrus blowing out from the top of a distant thunderstorm cloud (cumulonimbus). Thus from the observer's perspective, rain is not very far away. In spring, as cloud ceilings rise and convective precipitation becomes more frequent we may see examples of Abraham's Tree in Minnesota. Some of the old forecast rules are "when Abraham's tree has its foot in the water" (emanates from a dark cloud base) it will soon rain, or "Abraham's tree is blooming; it is going to rain."

Outlook:

Some precipitation, albeit relatively light, will hang around northern and eastern parts of the state early in the coming weekend. Moderating temperatures early next week, but still somewhat below normal. Unfortunately, precipitation chances will increase later in the by Thursday and Friday, with perhaps a major spring storm system moving through the area.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Apr 25, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

Topic: Diking of a Different Sort

I flew an aerial reconnaissance of the Minnesota River and Red River watersheds with NOAA personnel on Tuesday (April 22nd) of this week. The scale of flooding in the Red River Valley is difficult to describe in any believable terminology. Flying at altitudes of just over 1000 feet, the view from horizon to horizon is practically all water, almost as if ancient glacial Lake Agassiz has returned for a short visit. Using both aerial and satellite imagery of the flood, a conservative estimate of the land area that is submerged is 3000 square miles. The landscape is eerie with very few signs of life in many places, except for large flocks of gulls swarming over the turbid waters.

This will perhaps be the most costly disaster in the history of North Dakota and Minnesota, with damage estimates already approaching \$2 billion. There have been many heart-breaking and heart-warming stories about the flooding and there is certainly a way to go yet before the rivers recede to their original channels. The physical diking of communities along the flood plains has met with mixed success.

It is perhaps time for a different sort of diking. I have always considered MPR listeners, including many of my own University of Minnesota colleagues, to be a community of concerned Minnesota citizens who value and respect the state's natural resources and heritage of mixed cultures. Whether or not we helped dike against the physical threat of the flood, we can now help dike against depression, despair and hopelessness that will face many of these communities in their efforts to clean up and rebuild. Federal and state funds provide a monetary assurance, but everyone knows that much more than that will be needed. If you have a knowledge, skill or resource available to you which might be of value in cleaning up, restoring, rebuilding, or attending to the physical and mental health of the peoples and communities affected, why not volunteer to use. This might prove to be the most successful diking against the flood and its impacts.

MPR listener question: With the cool spring in Minnesota, what is the latest date for having a daily maximum temperature which doesn't even reach the freezing mark of 32 degrees F?

Answer: I assume that this listener meant this to apply to our local Twin Cities records. In that context, the latest date (going all the way back to 1891) is April 30, 1909, when the high temperature in the Twin Cities only reached 31 degrees F.

MPR listener question: In the midst of the flooding tragedy, there has been speculation that it could have been worse with a wetter April. Is this true?

Answer: It is hard to say. The blizzard which struck the Red River Valley on April 5-6 deposited an additional 3 to 3.5 inches of water on the snow-laden landscape. These amounts from a single storm are approximately twice the normal April precipitation for that part of the state, and definitely contributed to the extensive flooding. On the

bright side, there has been no measurable precipitation in the Red River Valley since April 8th, a dry period of 16 consecutive days now. This is indeed unusual and has helped. Checking the Fargo, ND records back to 1942, there is only an 11 percent frequency for this kind of a dry period in April. Further up river near Crookston, MN where records go back even further to 1889, there is only a 20 percent frequency for a 16 day dry period in April. So the recent dry spell has been unusual and a blessing to those dealing with the flooding.

Local Almanac:

Twin Cities Almanac for April 25th:

The average MSP high temperature for this date is 61 degrees F (plus or minus 11 degrees standard deviation), while the average low is 41 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for April 25th:

MSP weather records for this date include: highest daily maximum temperature of 91 degrees F in 1962; lowest daily maximum temperature of 37 degrees F in 1950; lowest daily minimum temperature of 25 degrees F in 1907; highest daily minimum temperature of 65 degrees F in 1990; record precipitation of 1.47 inches in 1902; and record snowfall of 3.2 inches in 1950.

There have been 3 measurable snowfall on this date since 1948.

Average dew point for April 25th is 36 degrees F, with a maximum of 62 degrees F and a minimum of 13 degrees F.

All-time state records for April 25th:

Scanning the state climatic data base: the all-time high for this date is 96 degrees F at Madison (Lac Qui Parle County) in 1962; the all-time low is 5 degrees F at Leech Lake Dam (Cass County) in 1909.

Words of the Week: Freshet and Coulee

These old, rarely used words have a more gentle connotation associated with the surplus flows of water across a landscape, and not quite the same impact as using the words flood or crest.

Freshet is derived from Scottish and Middle English terms and has three meanings: (1) a running stream of fresh water which empties into salt water (as in Shakespeare's "He shall drink naught but brine; for I'll not show him where the quick freshets are"); or (2) in cold climates the annual spring rise in streambeds which occurs with snowmelt runoff; or (3) a sudden great rise in a stream when it overflows its banks due to heavy rain or snowmelt runoff, causing a local scale flood (much of this having occurred in Minnesota this spring).

Coulee is taken from the French word for flow and may refer to channeled flow or sheet flow off a landscape into a lowland area or basin. Coulee sometimes refers to a steep-sloped valley such as the Grand Coulee of the Columbia River basin in the western U.S.. Coulees feed into Devils Lake, ND which has no natural outlet and therefore has been growing in size due to abnormally wet years recently. With abundant snowmelt runoff this year, Devils Lake is expected to grow and perhaps surpass its maximum estimated historical size which

occurred in 1830.

Outlook:

Temperatures remaining somewhat cooler than normal through the weekend, warming early next week and falling again toward the end of the week. A generally dry weekend coming up, but there will be increasing chances for precipitation next week and by mid week some general shower activity statewide.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, May 2, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

Good News for Farmers:

On the Minnesota landscape away from the flooded watersheds, excellent progress has been made this week in planting crops. Soil tilth is good for tillage and seedbed preparation and soil temperatures have recently reached a level that is suitable to promote good germination. In fact, soil temperatures at the 4 inch depth have risen by 7 to 10 degrees F over the past week and now average in the high 40s to low 50s F. Assessment of alfalfa and pasture fields shows only mild to moderate winter injury from the harsh weather of the past several months. Fields that were initially set back by the record setting low temperatures of early April, seem to be bouncing back.

Preliminary April Climate Summary:

Virtually all communities in the state show a negative mean temperature departure for April, ranging from 3 to 5 degrees F colder than normal for most places. This is the fifth of the past six months which shows a negative temperature departure around the state. Precipitation for April was less than normal for many locations in the state, with the exception of various west central and northwestern communities that reported above normal precipitation, mostly thanks to the heavy blizzard snows of April 4-5.

Educational Material About River Forecasting on the Internet:

Thanks to Greg Spoden of the DNR-State Climatology Office, I learned of a National Weather Service Web site which contains a very well documented and illustrated lesson on river forecasting. All of the basics including the hydrologic cycle, flow measurements, data processing and forecast models are described. It is an excellent site for those schools that have built a lesson plan around the spring snowmelt floods in Minnesota. The URL for this site is...

<http://www.nws.noaa.gov/er/iln/theory.html>

MPR listener question: How fast do raindrops and hailstones fall? Sometimes when I am caught in storm, the rain and hail actually hurt.

Answer: The velocity of raindrops depends a great deal on their size and the winds associated with the rainstorm. Small droplets in a drizzle or light shower (.005 to .02 inches in diameter) may fall at speeds of only 2 to 5 mph. Large rain drops (.04 to .20 inches in diameter) from a typical thunderstorm may fall at speeds of 16 to 20 mph, or even faster if driven by wind gusts. Hail, ranging in size from 0.25 to over 1 inch in diameter may fall at even higher velocities yet. It is no wonder that these forms of precipitation sometimes hurt when they strike you.

Twin Cities Almanac for May 2nd:

The average MSP high temperature for this date is 63 degrees F (plus or minus 12 degrees standard deviation), while the average low is 42 degrees F (plus or minus 9 degrees standard deviation).

MSP Local Records for May 2nd:

MSP weather records for this date include: highest daily maximum temperature of 91 degrees F in 1959; lowest daily maximum temperature of 38 degrees F in 1909; lowest daily minimum temperature of 24 degrees F in 1961; highest daily minimum temperature of 70 degrees F in 1959; record precipitation of 1.49 inches in 1944; and record snowfall of 2.2 inches in 1954.

There have been two measurable snowfalls on this date since 1948.

Average dew point for May 2nd is 38 degrees F, with a maximum of 64 degrees F and a minimum of 16 degrees F.

All-time state records for May 2nd:

Scanning the state climatic data base: the all-time high for this date is 97 degrees F at Montevideo (Chippewa County) and at Morris (Stevens County) in 1959; the all-time low is 7 degrees F at Angus (Polk County) in 1907.

Words of the Week: Recurrence Interval and Exceedance Interval

In climatology and hydrology these terms have been used for many years to describe frequencies of weather parameters and events. The recurrence interval is often called the return period and refers to the average time interval between the occurrence of a given quantity and that of an equal or greater quantity. The exceedance interval is similar but refers to the average number of years between the occurrence of a given quantity or event and that of a greater magnitude. Both of these distribution parameters require the analysis of long term measurements.

In Minnesota for example, the recurrence interval for a rainfall rate of 2 inches per hour is about 25 years. The recurrence interval for a six inch rainstorm in a 24 hour period is about 100 years in southern MN.

The magnitude of floods on major watersheds can be characterized in the same way. However, the measurement record on floods is just over 100 years. The characterization of the flooding this spring in Minnesota as a "500 year flood" is speculation and not based on the statistics of a record period of that duration. In this sense, it is a highly uncertain statement.

Outlook:

A wetter pattern appears to be in store for the weekend in southern Minnesota. Showers may stay around through early Sunday. It will be mostly dry and cool in the north. By the middle of next week another weather disturbance will bring a chance for showers statewide. Temperatures will remain generally below seasonal normals for the first full week of May.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, May 9, 1997

The following material will be posted on WeatherTalk (found at the MPR Web Site under news.mpr.org or or at the MNONLINE Web Site www.mnonline.org) this Friday.

Topic: Weather Impacts on the Insurance Industry

There is an excellent article in the current Bulletin of the American Meteorological Society by Stanley Changnon et al, entitled "Effects of Recent Weather Extremes on the Insurance Industry: Major Implications for the Atmospheric Sciences."

The authors analyzed insurance industry records on annual property and crop losses related to weather extremes for the period from 1949-1994. Some of their findings include.....

\$40 billion in insured losses during the 1991-1994 period are much greater than any previous 4 year period.

Adjusted for current conditions the mean annual insured property losses during the 1970s and 1980s were approximately \$2 billion, while in recent years insured losses have totaled 4 to 5 times that.

In 1992 alone, property losses to hurricanes, tornadoes and weather related crop losses exceeded \$22 billion, the highest single year total ever.

Twenty catastrophic weather events, each producing property losses of \$1 billion or greater have occurred over the period from 1949-1994.

Recent years have seen a higher frequency of catastrophic losses due to weather, perhaps the most since the period from 1950-1954. But the authors conclude that their results do not indicate effects of any major climate changes. Rather, they point out that societal vulnerability has increased with population growth in the southern, southeastern and western U.S. where the risk of weather related property losses is higher.

The authors state that as a result of the financial losses suffered by the insurance industry in recent years (nine firms went bankrupt following the 1991-1994 period) many adjustments have been made: the reinsurance industry (which insures the insurance carrier) has raised rates (some doubled), cut the amount of reinsurance available, and more closely scrutinize the underwriting practices of insurance firms; some insurance companies have withdrawn coverage in storm-sensitive areas or capped the coverage limits; increased federal involvement is being discussed to help alleviate the potential insurer losses; states are considering ways to improve the access to basic coverage plans through regulation; governments at all levels are more seriously considering methods to mitigate the damage from weather extremes

and to improve and better enforce existing building codes.

Footnote: The flooding in the Pacific northwest in January, in the southeast in March, and in our region during April has already produced estimated losses in the \$2 to \$4 billion range.

Local Almanac:

Twin Cities Almanac for May 9th:

The average MSP high temperature for this date is 65 degrees F (plus or minus 12 degrees standard deviation), while the average low is 45 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for May 9th:

MSP weather records for this date include: highest daily maximum temperature of 91 degrees F in 1987; lowest daily maximum temperature of 40 degrees F in 1924; lowest daily minimum temperature of 27 degrees F in 1966; highest daily minimum temperature of 69 degrees F in 1896; record precipitation of 1.14 inches in 1918; and record snowfall of 0.4 inches in 1924.

Average dew point for May 9th is 39 degrees F, with a maximum of 66 degrees F and a minimum of 10 degrees F.

All-time state records for May 9th:

Scanning the state climatic data base: the all-time high for this date is 99 degrees F at Milan (Chippewa County) in 1928; the all-time low is 9 degrees F recorded at an elevation of 2010 ft by the U.S. Forest Service near Isabella (Lake County) in 1966.

Words of the Week: Clinometer, Alidade and Ceiling Projector

Sometimes frustrated middle school or high school mathematics students will ask, "what good is this trigonometry anyway?" The angular and distance relationships which are learned in trigonometry are very applicable in engineering, navigation, surveying, and of course meteorology.

For example, the ceiling projector (also called a ceiling light or cloud searchlight) is used in conjunction with a clinometer or alidade to determine the height of the cloud ceiling at night. The ceiling projector shines a narrow beam of light up to the cloud base. The angular elevation of this spot of light is measured by a clinometer (portable instrument) or alidade (fixed instrument) some distance away from the projector light but on the same horizontal plane. The cloud height  $Z$ , is determined by the relationship

$$Z = L \tan E$$

where  $L$  is the horizontal distance between the projector light

and the detecting instrument and  $E$  is the elevation angle of the spot of light.

One problem with the nighttime measurement of cloud ceiling is that when it happens to be snowing, specular reflectance of the falling snow flakes can cause a false light spot to form well below the cloud base and therefore give a ceiling height that is much too low.

Alidade is derived from French and Latin words which describe the revolving radius of a circle, while clinometer is derived from the Greek words *clino*, meaning bed or horizontal plane and *meter*, meaning to measure.

Outlook:

Mostly sunny, somewhat cool and pleasant for Saturday and Sunday, with increasing chances of precipitation late Sunday into Wednesday of next week. Temperatures may moderate somewhat during the week, but will likely remain below seasonal normals. Rainfall is likely to be above normal next week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, May 16, 1997

Topic: Late Season Snows

The progress of spring continues to be exceptionally slow this year. Earlier this week portions of Minnesota along the Canadian border and in the Arrowhead region reported some snow flurries. An MPR listener wanted to know how late into spring snowfall can occur in Minnesota.

Examining the local Twin Cities climate records shows that May snowfall totals of 3 inches have occurred in 1892, 1935, and 1946. The latest date in May with a measurable snowfall is May 20, 1892 when St Paul reported nearly 2 inches of snow. This record is disputed somewhat by St Paul weather historian Tom St Martin, who claims that the observer likely did not directly measure the snow on the ground but converted that which was caught in the rain gage using the 1:10 ratio rule for snowfall and total precipitation. Nevertheless other observers across southern and central Minnesota reported from 1 to 4 inches of snowfall on that date as well.

No measurable Twin Cities snowfalls have occurred in June, but snow flurries were reported in St Paul on June 1, 1946.

Expanding to the state climate data base shows that May snowfalls have occasionally been substantial in western Minnesota. On May 2-3, 1935 Fergus Falls reported nearly 8 inches of snow and Wheaton reported 11 inches. NE Minnesota often has May snowfalls. For example, May 1-8, 1954 there was snowfall measured each day at Virginia, MN, totaling nearly 18 inches. Measurable June snowfalls have occurred more than once at Tower, MN (St Louis County). On June 12, 1945 the observer at Tower recorded 0.2 inches of snow. In fact, earlier that same month on June 2nd, the observers at Babbitt, Tower, and Virginia reported 4 to 5 inch snowfalls, perhaps the most ever in June. The latest date I could find with any report of snow was June 27, 1992 when International Falls reported a trace.

Example of Minnesota's Natural Air Conditioning System:

Why head north in the spring and summer? Among several answers to this question, you would eventually hear someone say that it is cooler up north. Indeed it is, especially near Lake Superior. A very good example of this can be found in the climate records for May 17, 1987, almost exactly 10 years ago. While Redwood Falls and other communities in southern Minnesota were sweltering in 97 degree F temperatures, the afternoon brought fog, rain and a cooling easterly breeze (off Lake Superior) to the Duluth area, where it was only 51 degrees F. That's why most Minnesotans carry a parka or jacket when they head north, even in the summer.

Local Almanac:

Twin Cities Almanac for May 16th:

The average MSP high temperature for this date is 69 degrees F (plus or minus 11 degrees standard deviation), while the average low is 48 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for May 16th:

MSP weather records for this date include: highest daily maximum temperature of 94 degrees F in 1934; lowest daily maximum temperature of 48 degrees F in 1950; lowest daily minimum temperature of 31 degrees F in 1929; highest daily minimum temperature of 68 degrees F in 1962; record precipitation of 1.10 inches in 1905; and record snowfall of 0.1 inches in 1929.

Average dew point for May 16th is 42 degrees F, with a maximum of 71 degrees F and a minimum of 16 degrees F.

All-time state records for May 16th:

Scanning the state climatic data base: the all-time high for this date is 100 degrees F at Beardsley (Big Stone County) in 1934; the all-time low is 12 degrees F recorded at Meadowlands (St Louis County) in 1929.

Words of the Week: Saddle Point and Saddle-Back

These two terms must have been coined by cowboy meteorologists! The saddle point (sometimes called a col) refers to a point in the air pressure pattern depicted on a weather map. The lowest point of pressure in a trough or depression between two high pressure ridges is called a saddle point, while the highest point in a ridge (high pressure system) between two lows is also called a saddle point. Way back in 1916, A. J. Henry wrote of the low pressure saddle, " in summer the pressure saddle is more frequently the seat of local thunderstorms, which are repeated as long as this distribution of pressure lasts; it is the best breeding place for summer afternoon thunderstorms."

A similar concept is that of the saddle-back. It is a term used by both meteorologists and pilots to describe a certain type of cloud pattern that looks like a saddle. A saddle-back is the cloudless quiet air overlying a lower cloud deck but between two towering cumulus congestus or cumulonimbus clouds. Jet aircraft can often fly above these menacing cloud forms, but low flying aircraft will sometimes fly through the saddle-backs to avoid longer detours around the thunderheads.

Outlook:

Relatively nice weekend weather coming up, with highs in the 60s and 70s and lows in the 40s and 50s. Increasing chance

for rain Sunday into Monday, with some cooling. Another chance for rain by mid week as temperatures will return to a somewhat cooler than normal pattern.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, May 23, 1997

Positive attributes of cool spring temperatures:

-The cool temperatures of late do have some advantages:

-The size, color and duration of blooming plants are enhanced.

-We can open the windows and ventilate our homes, yet sleep comfortably during cool nights.

-Mosquito development is delayed.

-Most Minnesota public schools which are not air conditioned can still be comfortable enough for students and teachers to concentrate, and not wish they were outside.

-Winter damaged turf on golf courses can recover more easily.

-Soils will remain workable for seedbed preparation over a longer period of time.

-Many gardeners have waited patiently to put in sensitive seed or transplant tomatoes and other plants which they started indoors earlier this spring. The cold temperatures (lows in the 30s) experienced earlier this week are probably the last for many areas of the state. Today marks the latest spring date we have ever had a minimum temperature below 30 degrees F in the Twin Cities area.

Of course, some places in northern Minnesota have climates that are much more restrictive to garden crops. For example at Cloquet (not far from Duluth), frost has occurred on nearly every date in June at some time this century, as well on on 4 dates in July and 17 dates in August.

Climatology of the Memorial Weekend in Minnesota:

In the Twin Cities, about 35 percent of the time it rains on Memorial Day and about 28 percent of the time the temperature reaches 80 degrees.

Extremes for the upcoming Memorial Day Weekend, when many Minnesotans traditionally embark on their first camping weekend, have ranged from 24 degrees at Tower and Cook (1966 and 1981) in northeastern Minnesota to 107 degrees at Redwood Falls (1934). On May 31, 1946 Virginia, Minnesota recorded 4.6 inches of snow. So campers beware, be prepared for almost any kind of weather! But at least the cold temperatures have held back the mosquito populations so far.

Local Almanac:

Twin Cities Almanac for May 23rd:

The average MSP high temperature for this date is 71 degrees F

(plus or minus 8 degrees standard deviation), while the average low is 50 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for May 23rd:

MSP weather records for this date include: highest daily maximum temperature of 87 degrees F in 1950; lowest daily maximum temperature of 53 degrees F in 1924; lowest daily minimum temperature of 28 degrees F in 1963; highest daily minimum temperature of 67 degrees F in 1975; record precipitation of 1.10 inches in 1905; and no record of snow on this date.

Average dew point for May 23rd is 47 degrees F, with a maximum of 68 degrees F and a minimum of 23 degrees F.

All-time state records for May 23rd:

Scanning the state climatic data base: the all-time high for this date is 96 degrees F at Hallock and Worthington in 1928, at Canby in 1950 and at Argyle in 1980; the all-time low is 19 degrees F recorded at Roseau in 1917.

Words of the Week: Veering and Backing Winds

In meteorology these terms are used to describe the manner in which winds are shifting or changing. In the northern hemisphere, a veering wind is one which shifts in a clockwise direction, for example from south, through southwest to west. A backing wind is one which shifts in a counterclockwise manner, for example from south, through southeast to east. Low pressure systems which pass south of Minnesota tend to produce backing winds, while those that pass north of the state produce veering winds.

Outlook:

Afternoon temperatures will be in the 60s and 70s this weekend, with partly to mostly cloudy skies and a chance for showers and thunderstorms in southern Minnesota. Generally dry in the north. Temperatures will be just a few degrees below normal much of next week with chances for showers in southern counties. Warming toward the 80s into next weekend and the first few days of June.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, May 30, 1997

#### 1997 Spring Weather Anomaly:

This is the second year in a row with a very cold spring. An MPR listener called to ask how long it has been since we saw 80 degrees F here in the Twin Cities. The last such reading was October 1, 1996.

This is only the 10th year since 1891 that we have gone this long into spring without an 80 degree F temperature in the Twin Cities area. The longest wait for such warmth occurred in 1924 and 1935, when 80 degree F temperatures were not reached until June 12th.

Eighty degree F temperatures can sometimes take even longer to arrive in northern Minnesota. In 1935, Grand Rapids did not report 80 degrees F or greater until June 29; in 1947 it did not reach 80 degrees F or greater in Roseau until July 2; and Babbitt did not see 80 degrees F or greater in 1967 until July 9th.

#### MPR Listener Question:

MPR Listener Question: What is the northern most weather reporting station in Minnesota and what is the southern most? How many miles apart are they?

At 48 degrees 58 minutes north latitude, Caribou in northeastern Kittson County is the most northerly climate station in Minnesota. The most southerly stations are Harmony in Fillmore County and Spring Grove in Houston County. Both are located at 43 degrees and 34 minutes north latitude. The distance from Spring Grove to Caribou is roughly 450 miles. Obviously, Caribou is a much colder place on average than either Spring Grove or Harmony. However, it is also a much drier place. Average annual precipitation in both Spring Grove and Harmony is well over 30 inches, while at Caribou it is barely 19 inches.

#### Topic: The 1997 Atlantic Hurricane Season

Officially the 1997 Atlantic hurricane season begins next week. The past two seasons have been rather active and the forecast for 1997 suggests that this trend will continue. Dr. William Gray and his colleagues at Colorado State University have been providing hurricane forecasts for the National Climate Prediction Centers and National Hurricane Center for the past several years. To make these forecasts, Dr. Gray's team examines a number of weather features, including

global and regional patterns of temperature, rainfall, pressure and winds aloft. Their detailed forecasts and discussion are available over the Internet at.....

<http://typhoon.atmos.colostate.edu/forecasts>

Their forecast released last month called for 11 named storms, 7 hurricanes, and 3 intense hurricanes for the 1997 season. Should this occur, it would mark the third consecutive year with above normal hurricane activity and make the 1995-1997 period the most active three years in the modern record. Dr. Gray's team will issue the next forecast update on June 6th.

Just as our Congress considers passing a \$5.5 billion disaster relief bill (based on FEMA estimates) to assist with clean up and recovery from the three major flooding events which have already occurred this year, it would appear that there will be higher risks of further damages from an active 1997 Atlantic hurricane season.

Incidentally, for those who are interested in keeping up to date on the tropical weather in the Atlantic and Pacific, or in tracking the development of hurricanes, one of the best Internet sites is..

<http://cirrus.sprl.umich.edu/wxnet/tropical.html>

Local Almanac:

Twin Cities Almanac for May 30th:

The average MSP high temperature for this date is 75 degrees F (plus or minus 9 degrees standard deviation), while the average low is 53 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for May 30th:

MSP weather records for this date include: highest daily maximum temperature of 98 degrees F in 1934; lowest daily maximum temperature of 54 degrees F in 1922; lowest daily minimum temperature of 37 degrees F in 1947; highest daily minimum temperature of 69 degrees F in 1937; record precipitation of 1.80 inches in 1917; and no record of snow on this date.

Average dew point for May 30th is 51 degrees F, with a maximum of 68 degrees F and a minimum of 24 degrees F.

All-time state records for May 30th:

Scanning the state climatic data base: the all-time high for this date is 108 degrees F at Pipestone in 1934; the all-time low is

21 degrees F Bigfork (Itasca County) in 1964.

#### Words of the Week: Zonal and Meridional

Meteorologists will often use these terms to describe the upper level wind patterns which indicate the trajectory of air masses and weather systems. Zonal refers to a wind flow pattern which runs along parallels of latitude, that is easterly or westerly. For our midwest region, zonal would refer to a west to east flow trajectory which is associated with a somewhat moderate or quiet weather pattern and not much change in air mass. Meridional refers to a wind flow pattern which runs parallel to meridians of longitude, that is southerly or northerly. This pattern brings large changes in air mass and very active weather systems to our midwest region, with oscillating southerly and northerly winds every few days.

#### Outlook:

Significant warming trend beginning this weekend as a high pressure ridge builds over the midwest. Sunny with light winds and temperatures in the 70s, climbing into the 80s by Sunday and continuing for much of next week. In fact by mid week it will be downright warm and humid, conditions we have not seen yet this year. A modest chance for rainfall by midweek.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, June 6, 1997

Topic: Slow, Stressed and Stratospherically Priced Alfalfa

Due to winter injury and a cold dry spring, alfalfa fields across the state and region have been very slow to develop this year. New seedings from last year, or 1 and 2 year old stands are looking better than older stands. Southwestern counties in Minnesota were particularly hard hit by winter injury. In other parts of the state where spring rainfall is 3 to 4 inches short of normal, alfalfa has been stressed by the dryness. Still other areas have seen very cold temperatures in April and May injure and retard alfalfa stands. In fact, some areas reported the coldest May since 1968.

For livestock producers and the dairy industry, the impact of these unfortunate conditions is compounded by a hay shortage which is keeping the price of alfalfa near historically high values, currently about \$115 per ton. The only comparable years with such high prices were 1988 when drought caused alfalfa to reach over \$120 per ton, and 1989 when widespread severe winterkill pushed prices to over \$102 per ton.

Should 1997 continue to be dry, it will put considerable economic pressure on livestock and dairy industries to maintain high quality feed stocks.

MPR Listener Question: A listener in Duluth asks, why are weather service offices always located at airports?

This is a long and interesting story, but I will try to be brief. The National Weather Service originally evolved from the old U.S. Army Signal Corps in the late 1800s. Army forts along major rivers and in frontier territories had already been reporting weather for a number of years. In 1890 the "Weather Bureau" was established within the Department of Agriculture and one of its primary missions was to serve the weather information needs of farmers. As commercial aviation began to develop following World War I, more and more attention was given to servicing the weather information needs of pilots. The Air Commerce Act passed by Congress in 1926 actually modified the mission statement of the Weather Bureau stating.. "it shall be the duty of the .....Weather Bureau to furnish such weather reports, forecasts, warnings, and advices as may be required to promote the safety and efficiency of air navigation in the United States and above the high seas... and to establish (additional) meteorological offices and stations to do so..." There were no airport weather stations reporting weather in the U.S. in 1926. By 1930 there were 50, and today there are many hundreds.

In recognition of the high priority given to servicing aviation weather needs, the Weather Bureau was transferred to the

Department of Commerce in 1940 and became the National Weather Service. Today, a majority of the hourly weather reports available from the National Weather Service are representative of airport locations, but as many data users know, these stations are not particularly representative of the surrounding urban, agricultural or forested landscapes. The volunteer climate stations are primarily used to represent the environment of these other landscape positions.

Local Almanac:

Twin Cities Almanac for June 6th:

The average MSP high temperature for this date is 75 degrees F (plus or minus 10 degrees standard deviation), while the average low is 55 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for June 6th:

MSP weather records for this date include: highest daily maximum temperature of 95 degrees F in 1979 and 1987; lowest daily maximum temperature of 54 degrees F in 1901; lowest daily minimum temperature of 36 degrees F in 1897; highest daily minimum temperature of 74 degrees F in 1925; record precipitation of 1.59 inches in 1974.

Average dew point for June 6th is 53 degrees F, with a maximum of 71 degrees F and a minimum of 30 degrees F.

All-time state records for June 6th:

Scanning the state climatic data base: the all-time high for this date is 106 degrees F at Pipestone in 1933; the all-time low is 20 degrees F Remer (Cass County) in 1985.

Words of the Week: Horn Card

A couple of weeks ago we discussed veering winds (wind shifts in a clockwise direction) and backing winds (wind shifts in a counterclockwise direction). Many years ago sailors aboard trade ships used horn cards to remind them of wind conditions associated with tropical cyclones (storms). These were transparent disks with diagrams etched on each side to show average wind directions associated with pressure falls in a tropical cyclone. One side showed average wind directions for northern latitudes and the other side for southern latitudes. Sailors could use these cards to determine where their ships were located with respect to the storm field and to anticipate wind shifts as they moved through it.

**Outlook:**

The coming weekend appears to be dry except perhaps for southern counties which may see a thunderstorm or two. Temperatures will be somewhat below normal, then warming next week to above normal levels. An increasing chance for rain and thunderstorms toward the middle and end of the week, especially in western counties.

To: Perry Finelli, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, June 13, 1997

Topic: Dry weather

Odd as it may seem, as northwestern Minnesota counties are still recovering from spring flooding, parts of the state are becoming exceedingly dry. We mentioned the detrimental effect on the alfalfa hay crop last week. Farmers may ask for permission to cut CRP acres for hay. But impacts from this severe dry spell may be more far reaching.

The Minnesota State Climatology Office provides weekly updates on precipitation anomalies over the Internet at URL...

<http://www.soils.agri.umn.edu/research/climatology>

Their most recent summaries show that areas as far north as Grand Portage, as far west as Alexandria, and as far south as New Ulm are showing precipitation deficits from 3 to 5 inches below normal since April 1st. This is quite substantial, approaching historical records for dryness during this period. Some crops in these areas which were planted on time, but in dry soil, need additional moisture to germinate and develop normally. In addition, farmers who have relied on rainfall to activate applied herbicides for controlling weeds are still waiting. Lawns, trees and shrubs are showing the effects of dryness as well and are therefore requiring more watering.

Continuation of this trend may lead to increased fire danger for our state parks and national forests. Already the fire danger is moderate in some northern areas of the state. To provide guidance on fire weather potential to the US Forest Service, the National Weather Service carefully monitors temperature, humidity, wind, and rainfall in selected areas and uses various indices to forecast the chances for thunderstorms and their associated lightning strikes.

The Northland Fire Weather Page, maintained by the National Weather Service Forecast Office in Duluth, provides information and forecasts related to fire weather. The URL is.....

<http://www.crhnwscr.noaa.gov/dlh/firewx.htm#fuels>

In addition, the US Forest Service maintains information on current forest conditions, and fire research at their Web site..

<http://www.fs.fed.us/land/#fire>

Today and tomorrow (June 12-13) are fire weather anniversary dates of sorts. On these dates in 1889 one of the worst fires in the history of northeastern Minnesota took place. Thousands of acres of pine forests burned from the Two Harbors area to south of Duluth into Carlton County. Douglas County in Wisconsin also suffered extensive losses. The fires consumed millions of dollars in timber. In addition, scores of homes were destroyed and smoke was so thick that the sun was obscured and ships had trouble navigating the Duluth-Superior harbor.

Local Almanac:

Twin Cities Almanac for June 13th:

The average MSP high temperature for this date is 79 degrees F (plus or minus 9 degrees standard deviation), while the average low is 58 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for June 13th:

MSP weather records for this date include: highest daily maximum temperature of 100 degrees F in 1956; lowest daily maximum temperature of 49 degrees F in 1947; lowest daily minimum temperature of 37 degrees F in 1969; highest daily minimum temperature of 77 degrees F in 1956; record precipitation of 1.81 inches in 1892.

Average dew point for June 13th is 55 degrees F, with a maximum of 73 degrees F and a minimum of 33 degrees F.

All-time state records for June 13th:

Scanning the state climatic data base: the all-time high for this date is 104 degrees F at Redwood Falls in 1956; the all-time low is 23 degrees F Remer (Cass County) in 1985.

Words of the Week: The SWEAT Index and Total-Totals Index

The SWEAT Index was derived by the Air Force, not for putting cadets through basic training, but for indicating the potential for severe weather to pilots. This acronym stands for Severe Weather Threat Index and uses atmospheric stability, wind shear and wind speeds aloft (taken from radiosonde reports). In general the differences in temperature, dew point and winds measured at the 850 mb and 500 mb levels of the atmosphere are considered in this index. Values of 250 or greater indicate a potential for severe weather. The SWEAT Index is not used as much as it used to be, as more sophisticated indices have taken its place.

The Total-Totals Index is also used to assess the threat of severe weather. It too considers two different vertical layers in the atmosphere, 850 mb and 500 mb. The variables used are temperature and dew point. In general terms, this index is

calculated taking the sum of the temperature and dew point at 850 mb minus twice the temperature at 500 mb. Values of 55 or greater are considered strong indicators of severe weather potential.

These and other terms used by meteorologists in dealing with severe weather can be found at an Internet web site maintained by the National Severe Storms Laboratory in Norman, OK. The URL is

<http://www.nssl.noaa.gov/~nws/branick2.html>

**Outlook:**

Looks to be a bit warmer than normal and continued dry at least until late Sunday. Then an increasing chance for showers and thunderstorms, especially in southern counties through Tuesday. The balance of the week will see temperatures average somewhat below normal and above normal chances for thundershower activity, especially by next Saturday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, June 20, 1997

Topic: Hoping for a change in the weather pattern

Despite the fact that June has been tracking 2 to 3 degrees warmer than normal, last Saturday (June 14) saw some record and near record low temperatures. International Falls at 33 degrees F and Hibbing at 38 degrees F reported the second coldest June 14th in their local respective record books. Aitkin tied the record low for the date with 39 degrees F. Looks like the balance of June will track opposite to the first half of the month. Temperatures will tend toward below normal values and precipitation will be more frequent. This should help alleviate some of the plant stress and fire danger which has been aggravated by the prolonged spring dryness.

Topic: Remembering the Unusual Summer Solstice Frosts of 1992

The summer solstice is the date of the northernmost migration of the overhead sun (23.5 degrees N latitude) and the longest duration of daylight in the northern hemisphere. This Saturday, June 21st is the summer solstice. In Minnesota, daylength ranges from 15 to 16 hours on this date. If you add to the daylength the total minutes of twilight, when the sky is partially illuminated by the sun just beyond the horizon, it is really only dark overnight for about 6 hours. This is not a situation which should produce the coldest night of the summer, yet that is exactly what happened in 1992.

Widespread air frosts, ranging from 24 to 32 degrees F were reported in northern and central areas of the state, and ground frosts were reported in south-central and southeastern counties. A Canadian high pressure system with clear skies, light winds and very dry air contributed to these extraordinary overnight low temperatures. Dew points as low as 27 degrees F, more typical of late March, were measured, with overnight temperature drops of 25 to 40 degrees F. Many crops were damaged, but especially corn and soybeans in southern sections such as Dodge, Steele and Waseca Counties. Some of these crops were replanted, but many recovered from the frost, though their yield potential was reduced.

This was perhaps one of the most unusual weather events of our generation. In the Minnesota historical records, I can find only two other documentations of crop damaging frosts on the summer solstice, one in 1902 occurred in southwestern counties and the other one in 1916 occurred in northwestern Minnesota. However, neither was as widespread as the one in 1992. Incidentally in examining these frequencies of summer frost, I found reference to ground frosts outside the Twin Cities area on July 11, 1863!

MPR listener question:

A listener in Bemidji reported a barometric pressure reading of 28.72 inches during the April 5th blizzard in northwestern Minnesota this year. He asked if that could be a valid reading and if it was anywhere near a state record low barometric pressure?

I cross checked his barometric pressure during the storm with those reported by the Fargo and International Falls Weather Service Offices. Fargo reported a low pressure of 28.96 inches and International Falls 28.86 inches, both adjusted to mean sea level. This would indicate that the listener in Bemidji was measuring a value that was perhaps representative of the storm, though maybe a bit lower than reality. Though these are extraordinarily low pressure measurements (indicating the strength of the storm), they were not state records. The National Weather Service Office in Duluth measured a pressure of 28.57 inches during a severe winter storm on January 11, 1975.

Local Almanac:

Twin Cities Almanac for June 20th:

The average MSP high temperature for this date is 78 degrees F (plus or minus 9 degrees standard deviation), while the average low is 59 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for June 20th:

MSP weather records for this date include: highest daily maximum temperature of 98 degrees F in 1933; lowest daily maximum temperature of 54 degrees F in 1946; lowest daily minimum temperature of 41 degrees F in 1992; highest daily minimum temperature of 75 degrees F in 1943; record precipitation of 1.92 inches in 1927.

Average dew point for June 20th is 55 degrees F, with a maximum of 73 degrees F and a minimum of 35 degrees F.

All-time state records for June 20th:

Scanning the state climatic data base: the all-time high for this date is 104 degrees F at Olivia (Renville County) and Stewart (McLeod County) in 1988; the all-time low is 23 degrees F at Remer (Cass County) in 1985.

Words of the Week: Echelon Clouds

Originally derived from the french word for ladder, this is a cloud form which produces stair-steps or a terrace illusion to the observer. Aligned clouds, all having the same base elevation much higher than the observer on the ground, are viewed at a lower elevation angle with distance

towards the horizon. The observer sees an apparent stair-step effect as if the cloud base gets successively lower with distance to the horizon, even though all the clouds have the same base elevation. These formations can occur with fair weather cumulus or cirrus clouds over Minnesota.

Outlook:

Chance of showers and thundershowers Friday into Saturday, then drier on Sunday and Monday. Temperatures remaining somewhat cooler than normal right through next week. An increasing chance for showers and thundershowers again on Tuesday through Thursday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, July 4, 1997

Topic: Preliminary June Climate Summary

Following the climate trend set earlier this spring, the first half of June was very dry, creating many problems for agriculture around the state. But then, abruptly at mid month the rains finally came, too much in some cases. Much of the northern and central parts of the state ended up with above normal June rainfall. Many observers reported over 5 inches of rainfall for the month, and some reported from 7 to 9 inches (including observers in Clearwater, McLeod, Kandiyohi, and Cottonwood Counties). Some western and southeastern parts of the state remained dry however and reported below normal June rainfall. Nearly everyone reported a mean June temperature that was from 1 to 3 degrees warmer than normal. This helped slow developing crops to catch up a little bit. The abundant rains should also help boost the yields of the second crop of hay which will be cut this month.

Topic: Record July 1st rainfalls

Several communities across the central part of the state reported record amounts of rainfall for July 1st (Tuesday) as a large complex of thunderstorms moved through. Amounts ranging from 2 to 4 inches were reported. In addition, rainfall intensities exceeded 3 inches per hour in these storms, equaling or exceeding the expected 100 year rainfall intensity. The only similar rainfall intensities for the Twin Cities of somewhat recent vintage occurred back on July 23, 1987 when 10 inches of rainfall was recorded over a several hour period.

Local Almanac:

Twin Cities Almanac for July 4th:

The average MSP high temperature for this date is 82 degrees F (plus or minus 7 degrees standard deviation), while the average low is 62 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for July 4th:

MSP weather records for this date include: highest daily maximum temperature of 100 degrees F in 1949; lowest daily maximum temperature of 58 degrees F in 1967; lowest daily minimum temperature of 43 degrees F in 1972; highest daily minimum temperature of 77 degrees F in 1935; record precipitation of 2.27 inches in 1900.

Average dew point for July 4th is 59 degrees F, with a maximum of 77 degrees F and a minimum of 44 degrees F.

All-time state records for July 4th:

Scanning the state climatic data base: the all-time high for this date is 107 degrees F at Worthington (Nobles County) and at Pipestone (Pipestone County) in 1936; the all-time low is 27 degrees F at Tower (St Louis County) in 1972.

Some additional climatology for the July 4th holiday:

In the Twin Cities area it has rained measurably on July 4th 42 times since 1891, and on three occasions over 1 inch has been recorded. Locally it rained on 8 of the first 10 July 4th holidays this century.

The MSP maximum temperature has exceeded 90 degrees F 15 times on July 4th, while only 3 times has it been on the chilly side with a daytime high of 65 degrees F or less. July 4th, 1929 was both hot and chilly in Morris, MN depending on what time of day you were outside. The afternoon high was 90 degrees F, while the overnight low was 40 degrees F, a 50 degree swing in temperature.

In recent years dew point temperature has been uncomfortably high on July 4th, well into the 60s every year but one so far in the 1990s.

The most frequent wind directions on the evening of the 4th of July have been SE to S winds. So if you commonly observe the fireworks from a position N or NW of their launch you will most often have the plumes of debris and smoke coming at you.

Did you know that we had frost in northern Minnesota communities on July 4th of 1972? Some of the lows reported that day were..  
31 at Wannaska (Roseau County) 32 at Big Falls (Koochiching)  
30 at Cook (St Louis County) 31 at Cotton (St Louis)  
30 at Hoyt Lakes (St Louis) 27 at Tower (St Louis)

Word of the Week: Derecho (day-ray cho)

This is a Spanish word for "right ahead" or "straight ahead." It has become a severe weather term to describe a windstorm which accompanies a large mesoscale convective complex (MCC) such as the one which crossed the state on July 1st. These winds can be long-lived and very destructive as they move along with squall lines and thunderstorm systems. They are part of the family of downburst winds, often quite cool in terms of temperature. Their destructive pattern tends to be different than tornadic winds in that they scatter debris in a narrow vector rather than in all directions. The most severe recent episode of derechos winds was in July of 1995 when over 6 million trees were damaged or destroyed along a wide path in northern Minnesota.

Outlook:

A cool and somewhat breezy 4th of July, followed by a cool weekend and beginning of next week. Generally dry, with a chance of a few scattered showers in northern counties over the weekend.

Temperatures will average 4 to 8 degrees colder than normal.

A warming trend by Wednesday of next week, but also increasing chances for rainfall by midweek.

To: Perry Finelli, Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, July 11, 1997

Topic: Cold and Wet July

Let's give credit to the National Climate Prediction Center which released a summer outlook in the middle of June suggesting that our weather pattern would remain cooler than normal, but following a very dry spring, shift to wetter than normal for the balance of the summer. Indeed we have. Nearly two thirds of our weekly climate observers reported over an inch of rainfall during the first week of July, and approximately 25 percent of the observers reported over 2 inches.

The first week of July was also one of the coldest in state history. Listed below are the mean temperatures for the 4 coldest July weeks in the Twin Cities climate record (1891-1997)....

July 2-8, 1972 60.4 degrees F  
July 1-7, 1967 60.9 degrees F  
July 2-8, 1967 61.3 degrees F  
July 2-8, 1997 61.7 degrees F

The mean weekly temperature for this period of July is 72.2 degrees, so all of these averaged at least 10 degrees colder than normal.

In addition, International Falls, MN recorded a low temperature of 34 degrees F on July 7th this week, the coldest July temperature in their history. On the same morning, the observer 3 miles south of Tower, MN recorded a low temperature of 24 degrees F, tying the state record for the lowest temperature in July set at Remer (Cass County) on July 22, 1985.

Topic: Weather and Sport Fishing

There is an interesting article about forecasting the weather for sport fishing in the April edition of "Weather" magazine which is produced by the Royal Meteorological Society in England. Some private forecasters in the U.S. now offer a service to sport fishing enthusiasts which is based in part on the NOAA infra-red satellite imagery that depicts sea surface temperature conditions. Some fish species show a strong preference for certain water temperatures and are likely to be found in greater abundance where these temperatures prevail. For example, Kingfish prefer a range of 68 to 73 degrees F water temperature, while Sailfish are more tolerant of temperature differences and may be found in waters that range from 61 to 75 degrees F. Using this information and the local forecast, better guidance can be provided about which areas to fish on any given day.

Local Almanac:

Twin Cities Almanac for July 11th:

The average MSP high temperature for this date is 84 degrees F (plus or minus 8 degrees standard deviation), while the average low is 64 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for July 11th:

MSP weather records for this date include: highest daily maximum temperature of 106 degrees F in 1936; lowest daily maximum temperature of 66 degrees F in 1941; lowest daily minimum temperature of 49 degrees F in 1945; highest daily minimum temperature of 82 degrees F in 1936; record precipitation of 3.75 inches in 1909.

Average dew point for July 11th is 60 degrees F, with a maximum of 78 degrees F and a minimum of 42 degrees F.

All-time state records for July 11th:

Scanning the state climatic data base: the all-time high for this date is 110 degrees F in Cromwell Township (Clay County) in 1894; the all-time low is 30 degrees F at Meadowlands (St Louis County) in 1985.

Words of the Week: Pirry, Parry, or Perry

These are not all MPR news anchors! They are terms used by the Scottish and English to describe a sudden squall, or heavy fall of rain. Technically, they sometimes refer to squalls that approximate a "half gale" on the Beaufort wind scale (20-22 mph). Actually some of the brief storms which have occurred this month might be described as a "perry."

Outlook:

Warmer and more humid over the weekend with a good chance of thundershowers each day through Monday. Somewhat windy as well. Drier on Tuesday and Wednesday, with increasing chances for rainfall toward the end of next week, especially in northern counties. Temperatures will be close to seasonal normals for much of the week.

To: Perry Finelli, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, July 18, 1997

Topic: Anniversary Week for Minnesota's Top Three Rain Storms

(1) Today (July 18) is the anniversary of perhaps the most prolonged intense rainfall ever recorded in the state. This thunderstorm complex occurred in 1867 over western and central Minnesota, but was especially heavy in parts of Douglas, Pope and Stearns Counties, affecting the pioneer communities of Osakis, Westport, and Sauk Centre. Beginning late on Wednesday, July 17th, lasting all day July 18th, and into the early morning of Friday July 19th, heavy thunderstorms drenched the landscape with up to 36 inches of rainfall. Unfortunately measurements of the storm were not made by official rain gages in those days, but several people did record measurements via buckets and barrels which filled up. According to Tom St Martin, Minnesota weather historian, George B. Wright, a pioneer land surveyor in the area, documented the event and reported on it in some detail to the Minnesota Academy of Natural Sciences years later (1876). In his account, the Pomme de Terre, Chippewa, and Sauk Rivers, normally creeks at that time of year, became lakes several miles wide. The storm generated runoff caused the Mississippi to rise several feet, washing out bridges and logging booms right through the Twin Cities area. The total number of logs washed away was estimated to exceed 25 million. The mosquito population was reported as the worst ever for the balance of that 1867 summer.

(2) July 21-22, 1972 brought perhaps the most destructive flash flooding event, closing every major highway from Alexandria east to the Wisconsin border (except I35 north to Duluth) for a period of 3 to 16 days. The storm covered an area of approximately 1500 square miles, with the heaviest rainfall occurring over a stretch from Douglas and Otter Tail Counties east to Mille Lacs County. Greater than 13 inches of rainfall was recorded in the Fort Ripley area north of Little Falls. Damage estimates exceeded \$20 million. Timely advisories and forecasts, as well as actions by local law enforcement limited casualties of this storm. One person drowned driving into a washed out road.

(3) July 23, 1987 is a date most residents of the Twin Cities remember well. Ten inches of rainfall came in one storm, most of which occurred from 7 pm to 1 am. Rainfall intensity was 2.25 to 2.75 inches per hour for a period of three hours. The area covered by ten or more inches of rainfall was estimated to be 93 square miles. The storm damages were exacerbated by saturated ground as a result of earlier 2 to 6 inch rains on July 20-21. Damages were estimated to exceed \$25 million as over 8500 homes, over 250 commercial properties, dozens of public parks, and several waste water treatment plants experienced flooding. Many vehicles (including a Red Cross Blood Mobile with a day's worth of blood donations) were submerged when Nine Mile Creek flooded I494 to a depth of 9 feet.

It should not be surprising that many of the state's most intense rain storms have occurred in July. Examining the historical statistics on rainfall shows that although May and June show the highest frequencies of measurable rainfall, July and August show by far the highest frequencies of intense rainfall (greater than 2.50 inches). In part this is due to the fact that the atmosphere over Minnesota is more heavily laden with water vapor (called precipitable water) during these months.

Local Almanac:

Twin Cities Almanac for July 18th:

The average MSP high temperature for this date is 84 degrees F (plus or minus 7 degrees standard deviation), while the average low is 64 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for July 18th:

MSP weather records for this date include: highest daily maximum temperature of 101 degrees F in 1940; lowest daily maximum temperature of 64 degrees F in 1911; lowest daily minimum temperature of 52 degrees F in 1962 and again in 1984; highest daily minimum temperature of 78 degrees F in 1986; record precipitation of 2.94 inches in 1895.

Average dew point for July 18th is 62 degrees F, with a maximum of 79 degrees F and a minimum of 45 degrees F.

All-time state records for July 18th:

Scanning the state climatic data base: the all-time high for this date is 109 degrees F at Beardsley (Big Stone County) and Morris (Stevens County) in 1940; the all-time low is 32 degrees F at Floodwood (St Louis County) in 1910 and at Roseau (Roseau County) in 1912.

Word of the Week: Agglomeration

Contrary to some popular opinion, this is not what they served in the Ft Snelling Commissary to the frontier soldiers!

This is a term used in cloud physics to describe a precipitation process whereby water droplets or ice crystals grow in size by collision and assimilation with other precipitation particles. When two colliding water droplets form a new larger droplet this agglomeration process is called coalescence. When an ice crystal collides with a supercooled water droplet which is assimilated and freezes, this agglomeration process is called accretion which may eventually lead to formation of hail. Snowflakes are agglomerations of various ice crystals as well.

Outlook:

A good chance of showers and thunderstorms over the weekend and into Monday, especially in southern and western sections. Somewhat drier Tuesday through Thursday. Temperatures will be near normal to a few degrees below normal for this time of year and dew points will be lower than of late. Increasing chance of precipitation towards the end of the week.

Supplement to commentary for July 18, 1997

According to a recent release by the Climate Prediction Center (July 17th), the month of August is expected to be cooler than normal across the upper midwest and western plains states. This pattern is also expected to persist through September and October. The outlook did not favor significant deviations in the precipitation pattern. Actually a below normal temperature trend has already prevailed in Minnesota this month (despite the recent high temperatures). For the month so far, most communities, including the Twin Cities, are averaging 2 to 3 degrees F cooler than normal.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, July 25, 1997

Odd that in the middle of a wet and warm July week, some record low maximum temperatures would occur around the state. Tuesday's high temperature of 66 degrees F at St Cloud tied the record lowest maximum temperature for July 22nd (occurring in 1992), while the high temperature of 65 degrees F at Alexandria was a new record lowest maximum temperature for the date. In addition, the following locations set record low maximum temperatures on July 22nd, Hinckley and Floodwood with 64 degrees F, and Pine River Dam with 66 degrees F. MSP recorded a high of 67 degrees F on Tuesday, the third coldest daytime high ever for July 22nd.

Topic: El Nino

El Nino, Spanish for the Christ Child, is a name given to the tepid current in the eastern equatorial Pacific Ocean which reaches the coast of Peru and Ecuador near Christmas each year. This pattern typically diminishes the fish population in this area and produces a warmer and wetter than normal climate for the west coast of South America.

In the equatorial region of the Pacific Ocean the sea surface temperature pattern and the atmospheric pressure pattern are linked or coupled. As warm surface waters oscillate from west to east each year in a cyclical way, the pressure pattern follows a similar path. Meteorologists and climatologists call this pattern the Southern Oscillation Index (SOI). Typically the warmest waters reach the coast of Peru and Ecuador about Christmas time. However, many times these changes are relatively minor and do not bring major weather disruptions.

In more recent years, the most significant departures in this cyclical pattern have been termed El Nino or La Nina events. When the sea warms significantly in the eastern Pacific off South America, the pressure drops (SOI becomes negative) and the equatorial easterly winds weaken or even reverse, blowing from west to east. This condition is called an El Nino. This occurs anywhere from 2 to 7 years apart and may last for several months to more than one year. Historical analysis has shown that El Ninos have occurred this century in the following years: 1902, 1905, 1911, 1914, 1918, 1923, 1925, 1930, 1932, 1939, 1941, 1951, 1953, 1957, 1965, 1969, 1972, 1976, 1982, 1986, 1991, 1994, and now 1997.

When the opposite pattern occurs, colder than normal waters prevail off South America and the pressure increases (SOI becomes positive), the event is termed La Nina, but less is known about the overall weather impacts of this event. La Ninas have been recorded this century during the following years: 1904, 1909, 1910, 1915, 1917, 1924, 1928, 1938, 1950, 1955, 1956, 1964, 1970, 1971, 1973, 1975, 1988, and 1995.

The current El Nino event, described by the National Climate Prediction Center as the strongest since the winter of 1982-83, is expected to persist well into 1998. These strong El Ninos not only affect the weather in South America (warmer and wetter) but have global effects as well, in that they disrupt large scale atmospheric circulation patterns. Typically convection, or storminess increases in the central and eastern Pacific and diminishes in the western Pacific. Australia and Indonesia tend to have drier weather or even droughts. Other warm and dry patterns in South Africa have been associated with El Nino as well. For the United States, weather patterns which are correlated with El Nino events are strongest in the November through March period. These patterns include warmer than normal winters in the high plains and Pacific Northwest and wetter and cooler climates in the Gulf states of the southeast.

It is uncertain at this time whether the heavy rains in central Europe (Poland, Austria, Czechoslovakia), southern Japan and southern China this summer are related to El Nino. It is also uncertain whether our summer weather in the upper midwest has anything to do with the current El Nino. On the other hand, climatologists are attributing drier than normal conditions over Indonesia (Thailand and Sumatra) to the strong El Nino.

More information on El Nino, both current and historical, can be found at the following web sites....

<http://www.nic.fb4.noaa.gov>  
(NOAA Climate Prediction Center updates)

<http://www.pmel.noaa.gov/toga-tao>  
(NOAA Tropical Atmosphere Ocean Information)

Local Almanac:

Twin Cities Almanac for July 25th:

The average MSP high temperature for this date is 84 degrees F (plus or minus 7 degrees standard deviation), while the average low is 64 degrees F (plus or minus 5 degrees standard deviation).

MSP Local Records for July 25th:

MSP weather records for this date include: highest daily maximum temperature of 99 degrees F in 1941; lowest daily maximum temperature of 69 degrees F in 1915; lowest daily minimum temperature of 50 degrees F in 1891; highest daily minimum temperature of 77 degrees F in 1941; record precipitation of 0.77 inches in 1932.

Average dew point for July 25th is 60 degrees F, with a maximum of 77 degrees F and a minimum of 44 degrees F.

All-time state records for July 25th:

Scanning the state climatic data base: the all-time high for this date is 108 degrees F at Beardsley (Big Stone County) in 1941 and at Browns Valley (Traverse County) in 1976; the all-time low is 30 degrees F at Cloquet (Carlton County) in 1915.

#### Words of the Week: The Dvorak Technique

In 1975, Vern Dvorak, a meteorologist with the National Environmental Satellite Services, derived a method to analyze and predict tropical storm intensity based on real-time satellite imagery. Though over 20 years old, his technique is still used to assess the strength and project the future intensity of hurricanes, tropical cyclones and typhoons. His technique is based on pattern recognition of the storm size and shape using satellite imagery, especially the infrared. Some of the more important specific storm features used in his technique include an examination of the curvature and size of the outerband cloud circulation, the vertical depth of the clouds which compose these bands and the difference in temperature between the warm eye of the storm and the surrounding cloud tops. Though aircraft reconnaissance provides some of the most important data to assess storm intensity, the Dvorak technique is still used to examine the storm between aircraft flights or in tropical areas where instrumented aircraft are not available for storm studies, such as parts of the Pacific Basin. For example, Super Typhoon Rosie in the western Pacific was analyzed continuously by the Dvorak technique this week as it headed toward the south coast of Japan.

#### Outlook:

Looks like the wet period may be coming to an end over the weekend, perhaps on Sunday. With all of the residual moisture left from the storms, dew points will remain high until Monday, then fall into the 50s and low 60s. A dry spell may be in store for Monday through Thursday of next week, with temperatures a few degrees cooler than normal.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Aug 1, 1997

Topic: Preliminary July Climate Summary

I am not the only one who is happy to say goodbye and good riddance to July's weather. In brief, it started out stormy (windy with severe thunderstorms) and cold (near record cold the first week), followed by ugly (cloudy) and wet (frequent and excessive rainfall), then oppressive humidity (dew points above 75 degrees F) with abundant mosquitos and mold. I was provoked to write the following cynical verse about summer...

Summertime isn't always so sublime.  
Sometimes it's a crime.  
Wet basements. Damaged pavements. Insurance claimants.  
Saturated soil. Cars that boil. Food that spoils.  
Broken trees. July freeze. Plant disease.  
Running fans. Watering bans. Sweaty hands.  
Too much heat. Cannot sleep. Feeling cheap.  
Soccer rainout. Broken downspout. Many chores to count.  
Downed wires. Irritable drivers. Patience that tires.  
Forecasters mistakes. Hard to take. Give 'em a break.

July was one of the wettest on record for many locations. The preliminary data suggest it was the 7th wettest July for the state as a whole, averaging all reports. In central and east central Minnesota it was perhaps the wettest July ever, with numerous reports of total rainfall in excess of 10 inches. The following communities set rainfall records for the month: Delano at 10.19 inches, Hutchinson at 9.33 inches, Hastings at 13.51 inches, and Faribault with 8.71 inches. Many other locations recorded 10 inches or greater, ranking second behind the two other wet Julys of 1987 and 1972. The Twin Cities with 12.48 inches was second only to 17.9 inches recorded for July of 1987.

Rainfall intensity records were approached or exceeded as well, with numerous storms around the state dumping over 2 inches per hour and one storm (July 1st) in the Twin Cities exceeding 3 inches per hour, which surpasses the 100 year return period for 1 hour intensity. Some of these intense storms also delivered hail to western Minnesota counties, particularly Swift and Chippewa.

Rainfall frequency records were also broken. Rosemount recorded 20 days with measurable rainfall, MSP 18 days, La Crosse 18 days, St Cloud 16 days, and Red Wing 16 days. These all equalled or exceeded the station record for most wet days in the month of July. (These rainfall frequencies are considerably higher than those of coastal England in the summertime).

Lastly, several high dew point records were broken for numerous

communities around the state. Dew points in the high 70s, and even 80 degrees F were common during the second half of the month. Locally, the St Paul Climatological Observatory recorded 231 hours with dew points of 70 degrees F or greater during July. The average annual number of hours with dew points this high is only 97. Dew points of 75 degrees F or greater were recorded for 52 hours during the month, compared to an annual average for the Twin Cities of only 10 hours. No wonder everybody's air conditioning bills are so high.

Local Almanac:

Twin Cities Almanac for August 1st:

The average MSP high temperature for this date is 83 degrees F (plus or minus 7 degrees standard deviation), while the average low is 62 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for August 1st:

MSP weather records for this date include: highest daily maximum temperature of 101 degrees F in 1988; lowest daily maximum temperature of 61 degrees F in 1903; lowest daily minimum temperature of 49 degrees F in 1962; highest daily minimum temperature of 78 degrees F in 1964; record precipitation of 2.03 inches in 1975.

Average dew point for August 1st is 61 degrees F, with a maximum of 79 degrees F and a minimum of 44 degrees F.

All-time state records for August 1st:

Scanning the state climatic data base: the all-time high for this date is 110 degrees F at Montevideo (Chippewa County) in 1988; the all-time low is 31 degrees F at Cloquet (Carlton County) in 1920.

Words of the Week: Bai-u, Plum Rains and Mold Rains

Bai-u, pronounced "meiyu" is the name of the rainy season in southern Japan and eastern China (generally April through July), when abundant rainfall, suitable for the cultivation and transplanting of rice, usually occurs. These rains are sometimes referred to as plum rains when they coincide with the ripening of the plum crop, or mold rains when they lead to the outbreak of this form of plant disease.

This year, these rains have been more than simply abundant. They have been catastrophic in southeastern China and southern Japan, especially the island of Kyushu. Severe flooding and mudslides have caused casualties, ruined crops and washed out roads. While we have been complaining of our wet July in Minnesota, southeastern China has been reporting rainfalls of 6 to 14 inches per week, while southern Japan has reported mold rains of up to 16 to 30 inches per week.

#### Outlook:

Temperatures will be warm on Saturday, then near seasonal normals throughout much of next week. Generally dry Saturday, with an increasing chance for scattered showers and thunderstorms on Sunday. Humidity will increase somewhat, But generally drier weather for Monday through Wednesday.

#### Supplement:

Today, August 1st, marks the first day of totally automated precipitation measurements at the MSP airport. National Weather Service contractors will no longer make manual measurements of precipitation at the airport. This is a matter of concern for climatologists because the automated rain gages have been shown to be error prone, particularly in reading amounts that are much lower than what other gages catch. Twin Cities residents who rely on the MSP reports to track precipitation amounts and trends might want to check other local Metro area reports to get a more accurate estimate.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Aug 8, 1997

MPR listener question: A listener in Rosemount who has heard Bob Potter and I discuss the best day of the week for golf (based on absence of rain) asked, "what has been the wettest day of the week so far in 1997 based on the frequency of precipitation?"

A quick summary of the MSP Airport data for 1997 shows that Thursdays, Saturdays and Sundays have all been relatively wet, with 14 measurable precipitation events on each of those days. Monday has been the driest day of the week so far this year with only 8 measurable precipitation events.

Incidentally, the records also show that the three thunderstorms in July which each dumped more than 2.5 inches of rainfall on the Twin Cities was unprecedented in the historical record, not only for July, but for any month. Two of those storms came on Tuesdays.

Topic: The National Atmospheric Deposition Program and National Trends Network

We have spent a good deal of time talking about flooding and excessive rainfall this year in Minnesota. In fact, precipitation amounts, intensity and frequency have made the headlines this summer across the entire region. Real-time monitoring of precipitation by radar and ground-based observational networks allows meteorologists and climatologists to analyze storms and trends in precipitation on a daily basis.

Another, lesser known, but important national monitoring network provides information on atmospheric chemistry to researchers, regulatory agencies and industries. The National Atmospheric Deposition Program (NADP) was begun in 1978 to monitor particulate (dust, etc) and chemical constituents in the atmosphere through both wet (precipitation) and dry deposition (through settling and adsorption). The National Trends Network (NTN) for doing acid precipitation assessment was merged with NADP in 1982. Several federal and state agencies, along with local units of government and some industries cooperate in this monitoring program. Major contributions are made by the US Geological Survey, the EPA, USDA, US Forest Service, and the National Park Service.

Over 200 sites are monitored throughout the United States on a weekly basis, each Tuesday at 9 am. Weekly accumulations of dry and wet deposition are weighed and tested for acidity (pH), then transferred to the NADP Central Analytical Lab in Champaign, IL for more detailed determinations. These data are later loaded into a national database and are made available (some months later) over the Internet at the following Web site:

<http://nadp.nrel.colostate.edu/NADP>

Analysis of particulates and inorganic chemicals, including estimates of total deposition (kg/ha) and concentration (mg/L) are provided on a weekly, monthly and annual basis. Some of the measured concentrations include sulfate, nitrate, ammonium, chloride, and in some areas mercury.

Minnesota monitoring sites, operated in cooperation with MPCA are:  
Marcell Forestry Experiment Station (Itasca County)  
Hovland (Cook County)  
Fernberg (Lake County NE of Ely)  
Wolfe Ridge Environmental Learning Center (Lake County near Finland)  
Fond du Lac Reservation (Carlton County)  
Camp Ripley (Morrison County)  
Grindstone Lake (Pine County)  
Cedar Creek Natural History Area (Anoka County)  
Lamberton, Univ. of MN Southwest Experiment Station (Redwood County)

Monitoring of this type is relatively expensive and time consuming, but important in assessing the health of the environment, particularly in the context of the Clean Air Act (1990) passed by Congress. Analysis from the NADP/NTN data so far suggest that acid precipitation is not producing the suspected dire consequences on a national scale, but there are some regional and local effects to be concerned about. It is clear that acidic deposition affects aquatic systems much more than agricultural or forested landscapes. It does impact urban areas as well by increasing the corrosive and weathering actions of the atmosphere on metals, stone and painted surfaces. Sulfate concentrations appear to be greatest in the midwest and Ohio Valley areas, where sulfur emissions are now more attributable to burning of fossil fuels than any other natural sources (vegetation, microorganisms, volcanoes, etc). Some of the highest nitrate concentrations have been found in southern California, the Rocky Mountains and parts of the midwest. Recent research has also shown that the majority of mercury in streams and lakes has come from atmospheric deposition. In addition, studies have shown large variability in deposition of various chemicals among individual storms and across seasons of the year. In some cases, local emission sources heavily influence the geographic distribution of particulates and chemicals.

Local Almanac:

Twin Cities Almanac for August 8th:

The average MSP high temperature for this date is 83 degrees F (plus or minus 7 degrees standard deviation), while the average low is 63 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for August 8th:

MSP weather records for this date include: highest daily maximum temperature of 96 degrees F in 1894 and 1914; lowest daily maximum temperature of 66 degrees F in 1972; lowest daily minimum temperature of 50 degrees F in 1972; highest daily minimum

temperature of 75 degrees F in 1914; record precipitation of 2.22 inches in 1987.

Average dew point for August 8th is 59 degrees F, with a maximum of 73 degrees F and a minimum of 41 degrees F.

All-time state records for August 8th:

Scanning the state climatic data base: the all-time high for this date is 105 degrees F at Beardsley (Big Stone County) in 1936 and 1958; the all-time low is 33 degrees F at Thorhult (Beltrami County) in 1964.

Word of the Week: Hydrogenesis

This is an old word used to describe the process in which natural condensation occurs within the surface cracks and pore spaces of rocks and soils. When the air drops below the dew point within these spaces and cavities, condensation can occur. The liquid water can absorb soluble constituents on the rock or soil, and sometimes even percolate to deeper layers.

Outlook:

Looks like a some showers and thunderstorms over the weekend, especially up north. Perhaps showers will somewhat alleviate the fire danger in the far northeastern counties. Continued chance of scattered thundershowers Sunday and Monday, then drier Tuesday through Thursday. Temperatures will be near normal for this time of year.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Aug 15 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

MPR listener question: There have already been 3 nights with freezing temperatures in parts of northern Minnesota this month. Isn't this terribly unusual? I have heard that historical records show that frosts are possible in the north in late August, but this is still the first half of the month.

Yes, freezing temperatures are unusual in the first half of August for most places in Minnesota. They are far more common in the second half of the month. For example, during this century, Cloquet has recorded four days with freezing temperatures during the first half of August, but 24 such days have been recorded for the second half of the month. This relative frequency is similar for other locations in northern central and northeastern Minnesota with some exceptions. Embarrass and Tower (both in St Louis County) have recorded freezing temperatures quite frequently in early August. In fact since 1964, a period of 34 years, Tower has recorded 26 days with freezing temperatures during the first half of August.

August freezing temperatures are far less frequent in the central and southern counties of the state. Morris (Stevens County) in 1931, Pipestone in 1987, and Theilman (Wabasha County) in 1964 have all recorded a single occurrence of an August freeze this century.

The most recent occurrence of a widespread damaging early freeze was September 3, 1974 when crops were seriously affected in most counties.

Topic: David Ludlum (1910-1997): Weather Historian

David Ludlum is a name familiar to both historians and the professional meteorological community. He passed away this past May. His career is described in the recent issue of Weatherwise magazine.

He is remembered as the founder of Science Associates (1947), one of the first weather instrument retailers in the United States and as the founder of Weatherwise magazine (1948), which remains today the most popular magazine about that subject. (See <http://www.heldref.org/ww.wv.html>)

Ludlum was the author of 12 books about the weather, with particular emphasis on the weather history of the New England area. The American Weather Book, The Weather Factor, and The Audubon Society's Guide to North American Weather are

three of his most popular works.

His enthusiasm for weather and history was contagious, and his writing served as an impetus for many people to pursue a career in meteorology. His motivation for combining his interest in history and meteorology was taken from an Atlantic Monthly article of 1862: "A hard frost, a sudden thaw, a hot spell, a cold snap, a contrary wind, a long drought, a storm of sand - all these things have had their part in deciding the destinies of dynasties, the fortunes of races, the fate of nations. Leave the weather out of history, and it is as if night were left out of day, and winter out of the year."

Local Almanac:

Twin Cities Almanac for August 15th:

The average MSP high temperature for this date is 82 degrees F (plus or minus 7 degrees standard deviation), while the average low is 62 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for August 15th:

MSP weather records for this date include: highest daily maximum temperature of 103 degrees F in 1936; lowest daily maximum temperature of 63 degrees F in 1897; lowest daily minimum temperature of 47 degrees F in 1960; highest daily minimum temperature of 76 degrees F in 1937; record precipitation of 1.23 inches in 1966.

Average dew point for August 15th is 59 degrees F, with a maximum of 75 degrees F and a minimum of 41 degrees F.

All-time state records for August 15th:

Scanning the state climatic data base: the all-time high for this date is 108 degrees F at Beardsley (Big Stone County) in 1937 and at Madison (Lac Qui Parle County) 1988; the all-time low is 25 degrees F at Remer (Cass County) in 1985.

Words of the Week: Dog Days

The dog days of summer are usually associated with the greatest heat of the year, characterized by thunderstorm activity and high dew points. The origin of this term is both ancient and astrological:

WHEN SIRIUS RISING WITH THE SUN  
MARKS THE DOG DAYS WELL BEGUN

The ancient Greeks and Romans observed that one of the brightest of the stars, Sirius the Dog Star (located in the constellation Canis Major, Latin for Greater Dog) rose in conjunction with the sun during the six weeks of mid-summer. Hot and sultry weather,

which depleted the energy of humans and caused vegetation to wilt, was often experienced during this period and was attributed to the evil effects of Sirius. In the United States, the dog days occur between mid July and early September, while in western Europe they run from July 3rd to August 11th.

Sometimes this term has been misconstrued to refer to the time of summer when dogs are most apt to go mad. Like other mammals, dogs exposed to high temperatures and high dew points will exhibit stress symptoms such as increased panting, change in diet, increased thirst, and lethargic behavior, but I don't know that they go mad anymore frequently. Some researchers have associated higher crime rates in US cities with the dog days, and one researcher has found that aggression among Major League Baseball players is increased during this period of summer.

Though we felt the dog days of summer in Minnesota during July, so far in August, they have been relatively mild, with most locations reporting only one or two days with temperatures of 90 degrees F or greater.

#### Outlook:

Chance of showers and thunderstorms Saturday and perhaps in the southern counties on Sunday. Then, dry for most of next week. Temperatures will remain 5 to 10 degrees cooler than normal throughout the period. Unlike recent State Fair openings, it appears that this year will be dry with pleasant temperatures and dew points.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Aug 22, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

The State Fair opened this week and many Minnesotans take pride in their knowledge of state history, and in particular the history of the State Fair. Smart visitors to the State Fair are prepared for any kind of weather, wearing fanny packs and backpacks stuffed with umbrellas, sunglasses, sun block, chapstick, hats, and windbreakers. Bearing this in mind, I have prepared 10 questions related to State Fair weather conditions which listeners and web site readers can challenge themselves to answer.

#### State Fair Weather Trivia

1. What year has been the driest State Fair?
2. What year has been the wettest State Fair?
3. What has been the coldest temperature measured during the State Fair?
4. What has been the warmest temperature measured during the State Fair?
5. What has been the highest dew point measured during the State Fair?
6. During this year's State Fair (August 21 to Sept 1), which date has the highest climatological probability for rainfall and which date has the lowest?
7. Based on historical climatology, during the State Fair's 12 day run, how many days does it rain?
8. Thunderstorms have hampered the State Fair in the past. When was the heaviest thunderstorm and what was the total rainfall?
9. What is the prevailing wind direction during the State Fair?
10. What has been the coldest daytime temperature during the State Fair?

Answers:

1. 1968 with a rainfall total of 0.08 inches.
2. 1977 with a rainfall total of 9.48 inches.
3. 36 degrees F on September 1, 1974.
4. 97 degrees F on September 1, 1913
5. 77 degrees F (super sticky) on August 28, 1955.
6. 40 percent historical frequency on August 22 and 25 percent historical frequency on August 24.
7. On average 3-4 days with measurable rainfall.
8. 4.5 inches on the night of August 30, 1977 (MSP airport reported 7.28 inches).
9. South-southwest wind is most prevalent during the fair.
10. A chilly 58 degrees F on August 31, 1958

Local Almanac:

Twin Cities Almanac for August 22nd:

The average MSP high temperature for this date is 79 degrees F (plus or minus 8 degrees standard deviation), while the average low is 60 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for August 22nd:

MSP weather records for this date include: highest daily maximum temperature of 97 degrees F in 1898 and again in 1971; lowest daily maximum temperature of 60 degrees F in 1891; lowest daily minimum temperature of 46 degrees F in 1891, 1908, and 1923; highest daily minimum temperature of 80 degrees F in 1968; record precipitation of 3.32 inches in 1914.

Average dew point for August 22nd is 58 degrees F, with a maximum of 75 degrees F and a minimum of 39 degrees F.

All-time state records for August 22nd:

Scanning the state climatic data base: the all-time high for this date is 104 degrees F at Redwood Falls (Redwood County) in 1971; the all-time low is 26 degrees F at Cotton (St Louis County) in 1967.

Words of the Week: Fair Weather

The word fair is derived from old Middle English usage and has many different meanings. It may be used as an adjective, adverb, verb, or noun. Such as fair skin, to play fair, fair catch, to hit a ball fair, or to go to the fair, as is popular in Minnesota right now. In this context it is an exhibition of wares, farm products and amusements, along with competitions and food, food, food.

The word fair has been used to describe a particular weather condition for ages, as in "the weather faired as the night went on," or "fair skies are expected for star gazing," or "the parade will go on whether

the weather be fair or foul." Generally speaking to use the word fair a forecaster must ascertain that sky conditions will either be clear or with only a few higher level clouds, winds will be light, and temperature conditions will not deviate significantly from seasonal normals. To be honest, although this term is still used around the world in English speaking countries, National Weather Service personnel probably use it less today than they used to. This is due to the public expectations for more accurate forecasts and the implementation of technology that allows the forecaster to be more precise about specific weather elements and events, particularly their timing.

In the early days of the U.S. Weather Bureau (under the USDA) when forecasts were provided to local communities either by mailing them on postcards or sending them by telegraph, a system of flag signals was used to post the forecasts in town for local residents. Each town had a designated forecast displayman (maybe the postmaster, local weather observer, sheriff, banker, or train station manager). This person would receive the Weather Bureau Forecast and then display the appropriate flag or flags to designate expected conditions. A plain white flag alone would indicate fair weather; a blue flag would indicate that precipitation was expected. Various combinations of square flags, triangular flags, and colored flags would indicate other types of weather conditions. Even as late as the 1960s and 1970s a bank building in downtown Minneapolis would display a colored ball (weather ball) indicating what the weather was going to be.

At some of the early Minnesota State Fairs, a system of flags was probably used to indicate expected weather conditions. In fact during the early 1890s when there were two Weather Bureau Offices in the Twin Cities, one in St Paul and one in Minneapolis, there was quite a rivalry between forecasters in the two offices. There were competitions arranged and public debate about which office provided the public with the best forecasts.

Outlook:

Looks like a pretty darn nice weekend for the State Fair. Near normal temperatures, comfortable dew points and not much chance of rainfall through Sunday. Increased chances for rainfall by Monday and Tuesday of next week, with temperatures warming up a few degrees. Quiet weather during midweek, then increasing chances for showers toward Labor Day weekend.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Aug 29, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

Topic: Comparing the climates of Winnipeg, Canada and the Twin Cities in Minnesota

A recent short vacation trip to the beautiful city of Winnipeg, Canada prompted me to compare climate characteristics with those of the Twin Cities in Minnesota. Winnipeg tourism bureau claims that their city is one of the sunniest in Canada and certainly that is the case in the summer season, primarily May through September. They also have comfortable dew point temperatures, rarely reaching the 70s F like the Twin Cities sometimes do during sultry summer spells. In general, higher concentrations of atmospheric water vapor and associated cloud forms remain south of this Canadian city. At the summer solstice, days are longer by about 45 minutes in Winnipeg than in the Twin Cities. Conversely, at the winter solstice, days are about 45 minutes shorter in Winnipeg.

Below are listed some of the basic climate characteristics of the two cities:

Climate Feature	MSP	Winnipeg
Annual precipitation	28.32 in	20.70 in
Annual snowfall	53 in	49 in
Greatest 24 hr rainfall	10 in	3.31 in
Greatest 24 hr snowfall	28.4 in	14 in
Mean annual temperature	45 F	36 F
Mean January minimum temp	3 F	-12 F
Mean July maximum temp	84 F	79 F
Extreme minimum temp	-34 F	-49 F
Extreme maximum temp	108 F	105 F
Shortest day	8hr 45m	8hr 4m
Longest day	15hr 37m	16hr 23m

Local Almanac:

Twin Cities Almanac for August 29th:

The average MSP high temperature for this date is 79 degrees F (plus or minus 8 degrees standard deviation), while the average low is 59 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for August 29th:

MSP weather records for this date include: highest daily maximum temperature of 96 degrees F in 1969; lowest daily maximum temperature of 60 degrees F in 1915; lowest daily minimum temperature of 45 degrees F in 1911; highest daily minimum temperature of 74 degrees F in 1899; record precipitation of 2.05 inches in 1964.

Average dew point for August 29th is 58 degrees F, with a maximum of 76 degrees F and a minimum of 37 degrees F.

All-time state records for August 29th:

Scanning the state climatic data base: the all-time high for this date is 103 degrees F at Beardsley (Big Stone County) in 1921; the all-time low is 22 degrees F at Tower (St Louis County) in 1976.

Words of the Week: Prognostic Chart and Agnostic Chart

A prognostic chart, often referred to by meteorologists as a "prog" depicts the expected pressure pattern or height pattern of a given synoptic chart (typically scaled to a country, a continent, or an entire hemisphere) for some specified future time, perhaps 24 hours or even 196 hours ahead. Positions of weather fronts and cloud formations are often shown on these charts, which assist forecasters in determining the areal coverage of different weather types. Various progs are produced several times each day by the National Weather Service using a variety of models.

An agnostic chart, is the tongue-in-cheek term used by forecasters to refer to a prog which no one believes. This may be due to observed differences in the local weather conditions, errors in the forecast model, or bad initial measurements to set up the model run. I suppose economists must have a similar term for their bad forecasts.

Outlook:

Looks like some scattered showers may be around the state for part of Labor Day weekend, but temperatures will be warming up through much of next week. After a colder than normal August (3 to 5 degrees F below normal in most Minnesota communities), perhaps the first full week of September will see above normal temperatures.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Sep 5, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

#### Climate Records:

The first few days of September produced some unusual weather worth noting. For those who attended the last day of the State Fair on Labor Day, September 1st, MSP airport reported a dew point temperature of 75 degree F from noon to 2pm. This tied the record high dew point for the date and contributed mightily to the large consumption of cool beverages at the fair that day. In addition, the weather observer just south of Tower in St Louis County reported a morning low of 20 degrees F on September 3rd, setting a new state record low for that date, beating the 22 F reported at the same location in 1974.

#### Topic: The Galveston, TX Hurricane of September 8, 1900

This coming Monday is the 97th anniversary of perhaps the worst hurricane disaster in the United States. Saturday, September 8, 1900 was a day many vacationers and visitors had hoped to enjoy the last gasps of summer on Galveston Island in Texas. But a hurricane passed over that community in the late afternoon and early evening, packing 120 mph winds and a storm surge estimated at 20 feet. The entire community was wiped out, including over 3600 houses and scores of businesses. The population that day was estimated to be about 20,000 and over 6000 lost they lives, with estimated damages and losses at \$30 million.

Storm warnings had been issued by the Weather Bureau, but the intensity of the storm was far worse than expected. The Weather Bureau Office lost telegraph and phone lines with which to communicate and virtually all their instruments, mounted on the roof of the building, were blown away. Dr. I.M. Cline the chief of the Weather Bureau Office at Galveston allowed people to seek shelter in his home, one of the sturdier ones built some distance from the beach. But with over 50 people sheltered there, his home was swept away by the storm tide and adrift for over 3 hours. All but 18 of those sheltered in it died.

Though the hurricane dissipated with landfall, it remained a strong storm which tracked north into the Great Lakes region and later produced torrential rains across parts of central and eastern Minnesota. Rainfall totals of 5 to 7 inches were reported from the 9th to the 11th of September in the Twin Cities and surrounding areas. This is a rare example of how hurricanes in the Gulf of Mexico can indeed eventually affect our weather in the upper midwest.

#### Topic: Anticipating Fall Colors in Minnesota

Several MPR listeners have already asked when fall colors will be at their peak this year. The fall color change is primarily due to diminishing daylength, but former State Climatologist Earl Kuehnast found that the pace of color change is associated with cooler than normal overnight temperatures. Three to four nights with overnight low temperatures in the 30s F are closely correlated to the onset of fall color, while peak fall color usually occurs after 7 to 10 nights with such temperature.

The abundance and richness of the color somewhat depends on how healthy the vegetation is. Trees and shrubs under stress will often turn color earlier and drop their leaves faster. Healthy trees will change color more slowly. The average dates for the onset of fall colors by region are: September 19-24 in the far north; September 25-29 across the central counties, and September 30 to October 3rd across the southern counties. The duration of this spectacular scenery is primarily a function of weather conditions, with cool sunny days helping, and stormy windy days hindering.

Because some of the far northern counties have experienced very dry conditions this summer, there may be an earlier than normal onset of color change there. In addition, a number of overnight minimum temperatures in the 30s F have already occurred in some northern parts of the state, favoring a more rapid pace to the color change. Those citizens who typically go north in Minnesota to observe the color change may want to factor this into their plans and go a bit earlier than they normally would. It is too early to tell how rapidly fall colors will be appearing in other regions of the state.

Local Almanac:

Twin Cities Almanac for September 5th:

The average MSP high temperature for this date is 77 degrees F (plus or minus 10 degrees standard deviation), while the average low is 57 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for September 5th:

MSP weather records for this date include: highest daily maximum temperature of 98 degrees F in 1922; lowest daily maximum temperature of 58 degrees F in 1926; lowest daily minimum temperature of 36 degrees F in 1962; highest daily minimum temperature of 77 degrees F in 1912; record precipitation of 2.57 inches in 1946.

Average dew point for September 5th is 55 degrees F, with a maximum of 73 degrees F and a minimum of 35 degrees F.

All-time state records for September 5th:

Scanning the state climatic data base: the all-time high for this date is 103 degrees F at Tracy (Lyon County) in 1922; the all-time low is 24 degrees F at Tower (St Louis County) in 1993.

Words of the Week: Isophane or Isophene

These words are derived from Greek terms, iso meaning equal and phainein meaning to show. Either word is used to refer to a line drawn through geographical points on a map where a given seasonal phenological event occurs at the same time. For example, the dates of flowering for crab apple trees, or the blooming of lilacs in the spring might be depicted as isophanes on a map. Certainly the maps which commonly appear this time of year in our local newspapers showing where the fall colors are beginning, peaking, or ending might be considered a depiction of isophanes as well.

Outlook:

A slight chance of showers and thunderstorms in northern counties this weekend, but mostly dry and pleasant in the south. Temperatures will be near seasonal normals. Increasing chances for showers and thunderstorms early next week (Monday and Tuesday) with somewhat warmer than normal temperatures. May be some drier intervals during the middle of next week, then turning wet again toward the weekend.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Sep 12, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

MPR Listener Question: Nowadays, it seems that any hurricane of category 3 (111-130 mph winds, 9-12 ft storm surge) or greater which makes landfall in the United States surely causes at least \$1 billion in damages. When was the first time that hurricane losses exceeded \$1 billion?

According to the National Hurricane Center, Hurricane Betsy, a category 3 storm which struck the Louisiana coast on September 10, 1965, produced over \$1.4 billion in losses. This was the first time that loss estimates exceeded a billion dollars and Betsy remains one of the costliest hurricanes to hit the U.S. Hurricane Andrew in 1992 holds the record for greatest estimated losses at over \$30 billion.

Topic: Early fall brings a nice change in the weather

During September and October in Minnesota we tend to experience some of our finest weather. There are simple reasons for this: (1) There is a decline in convectively induced thunderstorm activity (shorter days, reduced surface heating); (2) the polar frontal boundary and jet stream which are conducive to the formation of mid latitude cyclonic storms remain to our north in Canada; (3) vegetation in the landscape tends to die (mature) or go into dormancy and therefore transpiration declines which reduces the amount of water vapor released to the lower layers of the atmosphere. These and other factors help to make the weather more pleasant in the early fall season. In fact, statistics show that the last few days of September and first few days of October have a higher frequency of clear skies than any other period of the year.

Topic: Source Regions for Mid-Latitude Weather Systems

I was prompted to comment about this by a science teacher from the Wolf Ridge Environmental Learning Center in Finland, MN.

Mid-latitude cyclones or low pressure systems tend to form most frequently in certain areas based on the position of the polar front (boundary between polar air and tropical air), the jet stream, and the variability in the land or ocean surface. Those low pressure systems which commonly affect Minnesota may have been born in the Gulf of Alaska, the plains of Alberta Canada, the Great Plains east of the Rockies, the desert southwest (AZ, NM) or the southern plains of Texas and Oklahoma.

Alberta or Colorado low pressure systems are probably two of the most common which affect Minnesota's weather. Those cyclones

which develop to the south or southwest of the state and then track northeasterly over the Great Lakes tend to bring the greatest amount of precipitation. This is due to the larger amounts of water vapor carried on southerly winds in the warm sector of the storm. As the fall progresses, the polar frontal boundary drops to lower latitude, as does the polar jet stream, such that low pressure systems will develop with increasing frequency over the Great Plains. This is particularly noticeable in November. Sometimes these cyclonic storms will be somewhat modest as they pass across the state, but will intensify over the Great Lakes. This, in part, is why November can be a dangerous month for shipping on the Great Lakes.

Local Almanac:

Twin Cities Almanac for September 12th:

The average MSP high temperature for this date is 72 degrees F (plus or minus 10 degrees standard deviation), while the average low is 53 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for September 12th

MSP weather records for this date include: highest daily maximum temperature of 94 degrees F in 1908 and 1948; lowest daily maximum temperature of 55 degrees F in 1923 and 1974; lowest daily minimum temperature of 36 degrees F in 1940; highest daily minimum temperature of 73 degrees F in 1931; record precipitation of 4.96 inches in 1903, the largest one day rainfall total ever in the month of September.

Average dew point for September 12th is 52 degrees F, with a maximum of 69 degrees F and a minimum of 31 degrees F.

All-time state records for September 12th:

Scanning the state climatic data base: the all-time high for this date is 102 degrees F at Beardsley (Big Stone County) in 1931; the all-time low is 17 degrees F at Remer (Cass County) in 1985.

Words of the Week: Cyclogenesis and Cyclolosis

These are terms used by meteorologists to refer to stages of an extratropical cyclone or low pressure system. Cyclogenesis may refer to the birth of a cyclone or the intensification of cyclonic flow (counterclockwise circulation) around a low pressure system. Typically the pressure gradient increases (central pressure drops), winds strengthen, and clouds become more pronounced during this phase. Cyclolosis refers to death or the weakening stage of a cyclone or low pressure system, when the pressure gradient relaxes, winds become lighter and clouds thinner and less organized.

Outlook:

A chance for showers and thunderstorms, primarily in eastern sections tonight. Mostly dry over the weekend. Temperatures will be above seasonal normals by a few degrees. Dry weather to start next week, but increasing cloudiness and a chance for showers Tuesday through Thursday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Sep 12, 1997

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Topic: Early fall brings a nice change in the weather

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Alberta or Colorado low pressure systems are probably two of the most common which affect Minnesota's weather. Those cyclones which develop to the south or southwest of the state and then track northeasterly over the Great Lakes tend to bring the greatest amount of precipitation. This is due to the larger amounts of water vapor carried on southerly winds in the warm sector of the storm. As the fall progresses, the polar frontal boundary drops to lower latitude, as does the polar jet stream, such that low pressure systems will develop with increasing frequency over the Great Plains. This is particularly noticeable in November. Sometimes these cyclonic storms will be somewhat modest as they pass across the state, but will intensify over the Great Lakes. This, in part, is why November can be a dangerous month for shipping on the Great Lakes.

Local Almanac:

Twin Cities Almanac for September 12th:

The average MSP high temperature for this date is 72 degrees F (plus or minus 10 degrees standard deviation), while the average low is 53 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for September 12th

MSP weather records for this date include: highest daily maximum temperature of 94 degrees F in 1908 and 1948; lowest daily maximum temperature of 55 degrees F in 1923 and 1974; lowest daily minimum temperature of 36 degrees F in 1940; highest daily minimum temperature of 73 degrees F in 1931; record precipitation of 4.96 inches in 1903, the largest one day rainfall total ever in the month of September.

Average dew point for September 12th is 52 degrees F, with a maximum of 69 degrees F and a minimum of 31 degrees F.

All-time state records for September 12th:

Scanning the state climatic data base: the all-time high for this date is 102 degrees F at Beardsley (Big Stone County) in 1931; the all-time low is 17 degrees F at Remer (Cass County) in 1985.

Words of the Week: Cyclogenesis and Cyclolosis

These are terms used by meteorologists to refer to stages of an extratropical cyclone or low pressure system. Cyclogenesis may refer to the birth of a cyclone or the intensification of cyclonic flow (counterclockwise circulation) around a low pressure system. Typically the pressure gradient increases (central pressure drops), winds strengthen, and clouds become more pronounced during this phase. Cyclolosis refers to death or the weakening stage of a cyclone or low pressure system, when the pressure gradient relaxes, winds become lighter and clouds thinner and less organized.

## Outlook:

A chance for showers and thunderstorms, primarily in eastern sections tonight. Mostly dry over the weekend. Temperatures will be above seasonal normals by a few degrees. Dry weather to start next week, but increasing cloudiness and a chance for showers Tuesday through Thursday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Sep 19, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

Topic: 1997 Continues To Be a Record-Setting Year

Numerous blizzards, with record snowfalls and spring flooding; record spring dryness; record July storm frequencies and total rainfall; record low temperatures in August: these are some of the more memorable weather features of 1997. Tuesday, September 16 this week produced weather conditions to add to this list. MSP set a new rainfall record for the date with 1.97 inches, most of which came in a 4 hour period. In addition the dew point temperature hit a balmy 72 degrees F, breaking the old high dew point record of 66 degrees F. No wonder it felt more like Florida than Minnesota on Tuesday!

Topic: Discriminating Fall Foliage

As Minnesotans begin to spend their weekends browsing the state for fall color displays, some may choose to wear sunglasses to enhance the view. Foresters, botanists and ecologists who carefully observe and study forest and vegetation types have for years used amber, yellow, or brown tinted sunglasses to enhance their eyesight. These colored lenses, sometimes referred to as "blue blockers", screen out the blue and haze that come from the scattering of blue light, especially under the lower sun angles of fall. This allows the human eye to better discriminate among the hues and subtle shades of pigment changes in the landscape foliage. The enhanced vision helps observers to better differentiate among mixed hardwoods, conifers, and understory. It is also helpful in detecting vegetation that has suffered from drought, nutrient deficiencies, or plant disease. Very slight deficiencies in chlorophyll (green) show up as lighter colors through these glasses. These glasses can be purchased for anywhere from \$5 to \$50. However, many Minnesotans will probably still prefer to view the natural, unfiltered fall colors with their naked eye.

Topic: Fall Lawn Care

Another response to fall is that homeowners start to fertilize their lawns. Lawns can use both ammonium and nitrate forms of nitrogen fertilizer, but ammonium forms are by far more stable and persistent in the soil. Fall is a good time to apply nitrogen because soil temperatures are dropping which means that the biological processes (involving soil bacteria) that transform ammonium forms of nitrogen (non mobile) to nitrate form (mobile form) are greatly reduced. In this condition, our lawns can use the nitrogen much more efficiently, since it won't be leached or denitrified (volatilized) and much of it will still be available next spring in the soil to "kick start" our lawn into action when the weather conditions become suitable. Mean

soil temperatures around the state at the 4 inch depth are currently ranging from the low to mid 60s F. In addition, following the abundant rains earlier this week, many soils are quite wet. This combination of soil temperature and moisture is currently not suitable for efficient fall fertilizer use, and most listeners may want to wait other week or two before they fertilize the lawn.

Twin Cities Almanac for September 19th:

The average MSP high temperature for this date is 71 degrees F (plus or minus 11 degrees standard deviation), while the average low is 51 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for September 19th

MSP weather records for this date include: highest daily maximum temperature of 94 degrees F in 1895; lowest daily maximum temperature of 48 degrees F in 1901; lowest daily minimum temperature of 33 degrees F in 1991; highest daily minimum temperature of 72 degrees F in 1891; record precipitation of 2.98 inches in 1901; and a trace of snowfall in 1927.

Average dew point for September 19th is 51 degrees F, with a maximum of 70 degrees F and a minimum of 28 degrees F.

All-time state records for September 19th:

Scanning the state climatic data base: the all-time high for this date is 104 degrees F at Beardsley (Big Stone County) in 1895; the all-time low is 20 degrees F which has occurred in a number of years, including: 1896 at Lambert (Red Lake County), 1897 at Tower (St Louis County), 1901 at Pokegama Dam (Itasca County), and 1929 at Cloquet (Carlton County).

Words of the Week: Leaching and Denitrification

These terms are only sometimes used by climatologists. They are used much more commonly by soil scientists and farmers when they are discussing fertilizer options. Leaching refers to the movement or washing out of soluble constituents (chloride, bromide, sulfate or nitrate) within the soil by percolation of water. Moisture moves through successive soil layers by gravity. In many agricultural soils the moisture is stored there until it is removed by plant roots during the growing season. But in some soils, deeper percolation occurs, depositing these soluble materials into aquifers which may be sources of drinking water or water for irrigation. Potential leaching losses are governed by soil moisture, soil texture as well as rainfall frequency and intensity.

Denitrification is the biological process in the soil where nitrate nitrogen is converted into a gas and lost through the soil surface to the atmosphere. This process occurs more rapidly under warm and moist conditions and in fine textured soils. Unlike leaching which represents an environmental concern with respect to ground water quality, denitrification losses are not an environmental threat but

nevertheless can represent an economic loss with respect to a farmers fertilizer program.

Outlook:

Unsettled with widely scattered showers through early Saturday. Then a cool dry air mass will settle over the state bringing perhaps a freeze by Sunday morning to most places. This may end the growing season for most agricultural areas. The cool and dry air will dominate until Tuesday when a warming trend sets in. Temperatures should climb next week to above seasonal normals and it will be mostly dry.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Sep 26, 1997

Announcement: 5th Annual Kuehnast Lecture

The 5th Annual Kuehnast Lecture will be held on the St Paul Campus of the University of Minnesota next Thursday, October 2, at 3:45 pm in room 335 Borlaug Hall. This is a public lecture supported by the Kuehnast Endowment (named for former State Climatologist Earl Kuehnast) and hosted by the Department of Soil, Water, and Climate. The speaker this year is Dr. Elisabeth Holland, atmospheric chemist with the National Center for Atmospheric Research in Boulder, CO. She recently directed the NATO Advanced Studies Institute on Soils and Global Change. The title of her presentation is, " Global Nitrogen Cycling: Acceleration and Consequences."

Review: The USA Today Weather Book (2nd edition) by Jack Williams

This version is new and improved over the 1992 version and is now available in bookstores. It is not intended as a textbook and therefore it lacks some elementary organization around meteorological and climatological history and principles. Yet, I highly recommend this book for the weather enthusiast and for earth science teachers.

The book is organized around weather phenomena that affect the USA. Cyclonic storms and fronts, types of precipitation, clouds forms, floods, droughts, thunderstorms, tornadoes, and hurricanes are the topics that occupy most of the pages. The next to last chapter of the book describes some of the modern technologies that help meteorologists make better forecasts. The last chapter is devoted to descriptions of El Nino, atmospheric ozone destruction, and the greenhouse effect.

There are two characteristics of William's book which I most admire: (1) the state-of-the-art graphics and illustrations that are second to none (done under the guidance of Richard Curtis who is the managing editor for graphics and photography at USA Today); and (2) the wide array of scientists from industry, universities and the National Oceanic and Atmospheric Administration who made contributions to the text.

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Topic: Anniversary week for two climatic benchmarks

Anybody remember 1942?

No, this is not a followup to the movie, "The Summer of '42." September 26, 1942 is a climatic benchmark of sorts in that it

marks the earliest fall occurrence of a significant snowfall in Minnesota. Though MSP officially recorded 1.7 inches (most of which fell from 8 pm on the 25th to 8 am on the 26th), many of the city parks reported 2 or more inches. Much of this melted during the day on the 26th, but the heavy wet snow damaged trees and shrubs which had not lost their leaves. Elsewhere around the state the snow was heavier yet and required some shoveling. At Bird Island in Renville County 8 inches fell, while at Sauk Center in Stearns County they recorded 9 inches.

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Subsequently, the climatological record for the Twin Cities shows that October hail storms only occur about once every 50 years. So they are indeed a rare October weather event.

Almanac Segment:

The average MSP high temperature for this date is 66 degrees F (plus or minus 10 degrees standard deviation), while the average low is 45 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for September 26th

MSP weather records for this date include: highest daily maximum temperature of 87 degrees F in 1923; lowest daily maximum temperature of 41 degrees F in 1942; lowest daily minimum temperature of 27 degrees F in 1965; highest daily minimum temperature of 59 degrees F in 1923; record precipitation of 1.81 inches in 1930; and 1.7 inches of snowfall in 1942.

Average dew point for September 26th is 46 degrees F, with a maximum of 70 degrees F and a minimum of 20 degrees F.

All-time state records for September 26th:

Scanning the state climatic data base: the all-time high for this date is 93 degrees F at Madison (Lac Qui Parle County) and Redwood Falls (Redwood County) in 1974; the all-time low is 11 degrees F at Crookston (Polk County) in 1893.

Words of the Week: Percent Possible Sunshine

This is a standard climate measurement made at National Weather Service Offices, but it is often misunderstood as a indicator of solar energy. It is the ratio of the actual duration of bright sunshine (unobstructed sunlight measured by a sunshine recorder) in hours and minutes compared to the astronomically possible duration of sunshine in hours and minutes taken from sunrise and sunset times for the local station. Thus, in the winter when only 8 hours of sunshine is possible for the Twin Cities, 7 hours of actual sunshine would equal 87.5 percent possible sunshine, while in summer when 15 hours of sunshine is possible, 7 hours of actual sunshine would only equal about 47 percent possible sunshine.

Incidentally, long term climate averages show that it is this time of year that we see the maximum percent possible sunshine in Minnesota (typically the last few days of September and first few days of October). Indeed, this climatology seems to be holding true this year!

#### Outlook:

Continued warmer than normal for Saturday, then increasing cloudiness Sunday and Monday with a chance for showers. A cooling trend will begin on Monday and really settle in by midweek, bringing temperatures from 8 to 12 degrees cooler than normal. There will be a threat of frost in places around the state by Thursday morning.

#### Note on Hurricane Nora:

Hurricane Nora, now a tropical storm (winds from 39 to 74 mph) will bring large amounts of rainfall to Arizona in the next day or two. Strong tropical cyclones (winds of 74 mph or greater) go by different names depending on where they occur. Those that occur in the Atlantic, Caribbean, Gulf of Mexico and Eastern North Pacific are called hurricanes (after a Spanish term). Those that occur in the Pacific west of the International Dateline are called typhoons (after a Chinese term). Those in the Indian Ocean are called cyclones, and those which affect Australia are termed willy-willy. Tropical cyclones need to reach tropical storm intensity (wind speeds of 39 to 74 mph) in order to acquire their own name such as Nora. So far this year there have been 25 named storms in the western Pacific, including 14 typhoons. There have been 14 named storms in the eastern Pacific, including 7 hurricanes, the most recent being Nora. There have only been 5 named storms in the Atlantic, 3 of which have become hurricanes.

The water vapor from Nora may actually get swept into the general circulation across the USA and therefore have some effect on the forecasted rainfall for our area by Sunday and Monday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Sep 26, 1997

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#### Announcement: 5th Annual Kuehnast Lecture

The 5th Annual Kuehnast Lecture will be held on the St Paul Campus of the University of Minnesota next Thursday, October 2, at 3:45 pm in room 335 Borlaug Hall. This is a public lecture supported by the Kuehnast Endowment (named for former State Climatologist Earl Kuehnast) and hosted by the Department of Soil, Water, and Climate. The speaker this year is Dr. Elisabeth Holland, atmospheric chemist with the National Center for Atmospheric Research in Boulder, CO. She recently directed the NATO Advanced Studies Institute on Soils and Global Change. The title of her presentation is, " Global Nitrogen Cycling: Acceleration and Consequences."

#### Review: The USA Today Weather Book (2nd edition) by Jack Williams

This version is new and improved over the 1992 version and is now available in bookstores. It is not intended as a textbook and therefore it lacks some elementary organization around meteorological and climatological history and principles. Yet, I highly recommend this book for the weather enthusiast and for earth science teachers.

The book is organized around weather phenomena that affect the USA. Cyclonic storms and fronts, types of precipitation, clouds forms, floods, droughts, thunderstorms, tornadoes, and hurricanes are the topics that occupy most of the pages. The next to last chapter of the book describes some of the modern technologies that help meteorologists make better forecasts. The last chapter is devoted to descriptions of El Nino, atmospheric ozone destruction, and the greenhouse effect.

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From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Oct 3, 1997

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I know that the equinox is when the length of day and night is equal because the sun is directly overhead at the equator. In the fall, this normally occurs on or about September 22nd. But reviewing the sunrise and sunset times in the Star Tribune newspaper, it would appear that the period of equal daylength and nightlength did not occur until September 26th this year. Why is this?

The answer to this question has to do with atmospheric refraction. In true Earth-Sun geometry, the sun passed over the equator on September 22nd at 6:56 pm local time and day/night were equal in both northern and southern hemispheres at 12 hours each. But this assumes that the Earth has no atmosphere. In reality, the apparent position of the sun, especially near the horizon at sunrise and sunset is affected by the atmosphere, which acts as a giant camera lens. On average, when we see the sun on the horizon, it is really about 34 minutes of arc below the horizon. Thus, we see the sunrise earlier and sunset later than it's true position. The refracted image of the sun near the horizon actually makes the daylength longer by a few minutes. This is why the sunrise/sunset tables in the local newspapers and the Minnesota WeatherGuide Calendar show a closer approximation to 12 hours of day and 12 hours of night on September 25th and 26th rather than on September 22nd. The sun's overhead path is already over the southern hemisphere by then (25th), but our daylength is increased just enough by the refraction of the sun's disk near the horizon that we experience 12 hours of light and 12 hours of dark.

Topic: Preliminary Climate Summary of September 1997

The data from climate observers around the state show that September averaged out to be from 1 to 4 degrees warmer than normal. Greatest temperature departures were in western and northwestern counties. Rainfall for the month was most generally below normal by 1 to 1.5 inches with some exceptions. MSP, Faribault, Rosemount, and Hastings reported somewhat above normal rainfall. Thankfully, International Falls, which has been having a very dry 1997 (barely 15 inches so far) reported well above normal September rainfall, with nearly 4 inches.

The above normal temperature conditions helped Minnesota's row crops reach maturation before first frost in most places. Harvest of soybeans is well underway in many places. Most field corn needs to dry out more before it is suitable for

combining. It appears that the weather was favorable for a prolific second generation of European Corn Borer which may yet have some effect on the corn harvest in terms of dropped ears.

Topic: October Heat

Though the Climate Prediction Center showed an outlook which favored colder than normal October temperatures for Minnesota, recent National Weather Service forecast guidance would suggest that at least the first half of the month will be warm and dry. This is good news for agriculture in terms of harvesting weather. In fact 80 degree F temperatures were common on Thursday of this week (Oct 2).

Temperatures of 80 degrees F or greater occur much more frequently during the first half of the month than the second. MSP records (1891-1997) show 81 occasions where daytime temperatures have reached 80 degrees or higher from October 1-15, but only 33 such occasions from October 15-31. For the Twin Cities, the latest date in the fall with a temperature of 80 degrees F or higher was October 31, 1950 when 83 degrees F was recorded.

Local Almanac:

Twin Cities Almanac for October 3rd:

The average MSP high temperature for this date is 66 degrees F (plus or minus 10 degrees standard deviation), while the average low is 46 degrees F (plus or minus 8 degrees standard deviation).

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MSP weather records for this date include: highest daily maximum temperature of 86 degrees F in 1976; lowest daily maximum temperature of 41 degrees F in 1935; lowest daily minimum temperature of 26 degrees F in 1996; highest daily minimum temperature of 65 degrees F in 1931; record precipitation of 2.62 inches in 1903; and there was a trace of snowfall on this date in 1935.

Average dew point for October 3rd is 42 degrees F, with a maximum of 62 degrees F and a minimum of 18 degrees F.

All-time state records for October 3rd:

Scanning the state climatic data base: the all-time high for this date is 95 degrees F at Ada (Norman County) in 1922 and again at Milan (Chippewa County) in 1938; the all-time low is 10 degrees F at Argyle (Marshall County) in 1989.

Word of the Week: RUSLE (Revised Universal Soil Loss Equation)

This equation is used far more by soil scientists than meteorologists. Originally developed in 1978 (Wischmeier and Smith) and published as USDA Agricultural Handbook 282, then revised in 1994 (Renard et al) and published in the Journal of Soil and Water Conservation, this equation provides a means to estimate soil erosion and to design conservation practices for limiting the loss of soil. Several factors and subfactors are considered by this equation: an R value (rainfall factor including intensity) is one of the primary factors, but others include, soil type, slope, tillage, canopy cover, residue cover, soil moisture, freezing and thawing, and surface roughness.

A paper published this year by Larson, Lindstrom and Schumacher (in Journal of Soil and Water Conservation) pointed out that the RUSLE based on long term climate records provides estimates of mean annual soil erosion, but conservation practices should really be based on the results obtained for some of the most intense rainstorms, because these are the ones which contribute to most of the excessive erosion losses. Conservation structures such as terraces and sedimentation ponds can help limit erosion losses from these rare, high intensity rainstorms. RUSLE can be used for this purpose in areas where rainfall intensity frequencies can be derived from historical records.

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To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Oct 10, 1997

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#### Warm October Continues:

Many records were set or tied this week around the state. High daytime and high nighttime temperatures were recorded, especially in southern Minnesota. In addition, record high dew points, all the way into the upper 60s were recorded on Tuesday and Wednesday. The Wednesday (Oct 8) minimum temperature reported from the MSP airport was 69 degrees F, the highest ever reported in the month of October.

The temperatures for the first 9 days of the month have averaged 8 to 11 degrees warmer than normal. Does this have anything to do with El Nino? I think not. The previous temperature records that were broken this week, occurred in years without an El Nino event. Temperature variations tend to increase a great deal in October anyway, as the shorter daylength combined with larger differences in air mass characteristics tend to make for rapid and very pronounced changes in air temperature.

#### No Fall Freeze Yet:

MSP, along with several other communities around the state, has not officially reported the first fall freezing temperature yet. The median date for this in the Twin Cities is October 10th, but there have been six years this century, when a fall freeze has not been recorded until November (1900, 1921, 1924, 1931, 1940, and 1958). In fact in 1900, MSP did not record a fall freezing temperature until November 7th. This will probably not happen this year. On average there are six freezing temperatures recorded in the Twin Cities during October, and forecast guidance suggests there will be a high probability for this next week.

#### Fall Color Updates for Travelers:

If you are traveling throughout the region or the country this fall and appreciate the beauty of the color change across America's landscape, you might want to keep abreast of what is happening in our national forests. The USDA Forest Service Office of Public Affairs maintains a web site with frequent updates on the status of fall foliage in the national forests. It is called the U.S. Forest Service Fall Color Hotline for 1997. The URL is

<http://www.fs.fed.us/recreation/fall.htm>

#### Local Almanac:

Twin Cities Almanac for October 10th:

The average MSP high temperature for this date is 62 degrees F (plus or minus 11 degrees standard deviation), while the average low is 42 degrees F (plus or minus 9 degrees standard deviation).

MSP Local Records for October 10th:

MSP weather records for this date include: highest daily maximum temperature of 90 degrees F in 1928; lowest daily maximum temperature of 38 degrees F in 1906; lowest daily minimum temperature of 25 degrees F in 1964; highest daily minimum temperature of 63 degrees F in 1930; record precipitation of 1.89 inches in 1898; and 2.5 inches of snowfall in 1977.

Average dew point for October 10th is 41 degrees F, with a maximum of 67 degrees F and a minimum of 19 degrees F.

All-time state records for October 10th:

Scanning the state climatic data base: the all-time high for this date is 93 degrees F at Tracy (Lyon County) in 1928; the all-time low is 8 degrees F at Roseau (Roseau County) in 1932.

Words of the Week: Official Categories of Forecasts

**Nowcasting** - This term refers to a weather statement which highlights current conditions and forecasts for the next few minutes to a few hours. Radar and satellite data are used for example to project when skies will clear, or severe weather will end.

**Short Range Forecasting** - This term refers to weather statements which describe forecasts for periods from 12 to 72 hours ahead. Several different forecast models are used for this purpose, all of which are updated every 12 hours. These models project weather conditions in 3 hr, 6 hr, or 12 hr time steps.

**Medium Range Forecasting** - This term refers to weather statements which describe forecasts for periods from 3 to 10 days ahead. Models used to make this forecast are run once per day and depict the weather conditions for either 12 hr or 24 hr time steps. The medium range forecast in Minnesota is often updated each evening using the European Center for Medium Range Weather Forecast model (ECMWF) run out to 6 days, while in the morning the medium range forecast is updated using the Medium Range Forecast (MRF) Model of the National Weather Service run out to 7 days.

**Long Range Forecasting (Outlooks)** - This term refers to weather statements which describe forecasts for periods longer than 10 days ahead. These are sometimes referred to as outlooks, since they provide information about expected temperature and precipitation departures from normal. These are released once per month, on or about the 15th.

**Outlook:**

A strong autumn storm system will affect the region over the weekend and into Monday. Rain showers will be widespread with strong winds. Temperatures will remain at or above normal for much of the weekend, but then drop sharply beginning Monday. Overnight lows by midweek will be in the 20s and 30s with daytime highs only in the 40s and 50s. It should be dry on Wednesday and Thursday.

To: Perry Finelli, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Oct 17, 1997

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Topic: October Warmth

The mean temperature for the first half of October was over 60 degrees F in the Twin Cities. This is about 8 to 9 degrees F warmer than normal and roughly equivalent to the first week of September. Thus far it has been the warmest October since 1963 and ranks among the 10 warmest this century.

Topic: Recent Monthly and Seasonal Outlooks

Thursday (October 16) the National Climate Prediction Center released the new monthly and seasonal outlooks for November and November-January, respectively. The November outlook favors above normal temperatures in northwestern Minnesota, but otherwise no increased probabilities for significant departures in temperature or precipitation across the state. The seasonal outlook for November through January favors above normal temperatures across most of the upper midwest, including Minnesota. The precipitation outlook favors a higher probability for drier weather to the west of Minnesota, and wetter weather to the south of our border, but no significant departures in precipitation are expected for us.

Topic: First Autumn Snowfalls

With the observation of snow showers and flurries in the Twin Cities on Monday of this week (October 13), albeit just a trace, several people called to ask when the first autumn snowfall usually occurs in the Twin Cities. This is difficult to answer because snowfall records, including trace amounts, are less available in the data archive than many other climatic measurements. Nevertheless, checking the MSP historical records (1891-1996) for first measurable snowfall in the autumn shows that the median date is November 6th. In half of the years since 1891 residents have seen measurable snowfall before this date. The earliest measurable snowfall in the autumn based on the MSP records was 0.4 inches on September 23 in 1985, while the earliest observation of a trace amount was September 19, 1927. On the other hand, there have been two years in the Twin Cities when there has been no measurable snowfall until December. In 1928 the first measurable snowfall occurred on December 2, and in 1963 the first measurable snowfall occurred on December 3.

Almanac Segment:

Twin Cities Almanac for October 17th:

The average MSP high temperature for this date is 60 degrees F (plus or minus 11 degrees standard deviation), while the average low is 41 degrees F (plus or minus 9 degrees standard deviation).

MSP Local Records for October 17th:

MSP weather records for this date include: highest daily maximum temperature of 84 degrees F in 1910; lowest daily maximum temperature of 33 degrees F in 1930; lowest daily minimum temperature of 22 degrees F in 1948; highest daily minimum temperature of 62 degrees F in 1910; record precipitation of 0.97 inches in 1968; and a trace of snowfall in 1990.

Average dew point for October 17th is 38 degrees F, with a maximum of 63 degrees F and a minimum of 8 degrees F.

All-time state records for October 17th:

Scanning the state climatic data base: the all-time high for this date is 90 degrees F at Long Prairie, Beardsley, and Moorhead in 1910; the all-time low is 2 degrees F at Bemidji and Cass Lake in 1952.

Footnote on records for this date: both the maximum and minimum record temperatures for this date occurred in very dry years and two of the driest Octobers on record, emphasizing how a dry atmosphere can magnify heat gain during the day and heat loss at night.

Words of the Week: Omega High

An omega high is a ridge of high pressure which disrupts the normal westerly flow pattern across North America. On a surface or upper air map of the pressure pattern it shows up as a feature which looks like the Greek letter omega. Persistent dry, fair weather under the high pressure ridge is often the case, lingering for days or sometimes week on end. This feature is also called a blocking high, because it prevents the normal progression of weather systems and fronts from west to east. Omega highs are more prevalent in the spring, summer, and fall than they are during the winter months.

Forecast for October 18-24:

High pressure will dominate the upper midwest for awhile. Therefore, it looks like a primarily dry week coming up. A chance for widely scattered showers late Saturday into Sunday, otherwise dry with below normal temperatures on most days. Some warming is expected towards the end of next week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Oct 24, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

MPR listener question:

It seems that Minnesota's weather during October is either gorgeous or dreary, but rarely somewhere in between. What are some of the all-time extreme weather conditions for this month?

Answer:

Our perceptions of the weather may be highly individualized. For me, any day which is suitable for outdoor activity during October is gorgeous.

Some extreme weather conditions around the state during October based on historical climate records are: an all-time high temperature of 98 degrees F at Beardsley on October 5, 1963; an all-time low temperature of -16 degrees F at Roseau on October 26, 1936; total snowfall of 15.5 inches at Isabella (Lake County) in October of 1995; and a temperature of 90 degrees F at Chatfield (Fillmore County) on October 28, 1927 which is the latest fall reading of such a temperature in the state's climate history.

Topic: Approaching the Dark Days or SAD days

As the shorter days become more evident (we are losing over 20 minutes per week in daylength now), some people begin to suffer from the deprivation of light, a malady called seasonal affected disorder (SAD). This can be both physical and mental, and in some cases lead to severe depression. The somewhat rapid loss in daylength which occurs this time of year is magnified by two other factors, a lowering sun angle (declination) and increased cloudiness. The lowered sun angle creates very long and longlasting shadows, especially on northerly slopes, such that some parts of the landscape are in shade for much of the day. In addition, the degree of cloudiness begins to increase, peaking during the month of November in Minnesota when two thirds of the days are mostly cloudy (8/10 sky cover or greater) and most of the remaining days are partly cloudy (4/10 to 7/10 sky cover). This produces a condition of highly diffuse light rather than direct sunlight. The average percent possible sunshine is less than 40 percent during November and perfectly clear days are almost unheard of. In this regard then, we not only lose daylength (or quantity of light), but we also lose out on direct sunlight (or the quality of light).

Twin Cities Almanac for October 24th:

The average MSP high temperature for this date is 55 degrees F (plus or minus 10 degrees standard deviation), while the average low is 36 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for October 24th:

MSP weather records for this date include: highest daily maximum temperature of 80 degrees F in 1989; lowest daily maximum temperature of 36 degrees F in 1926; lowest daily minimum temperature of 17 degrees F in 1960; highest daily minimum temperature of 56 degrees F in 1973; record precipitation of 1.00 inches in 1899; and 0.9 inches of snowfall in 1981. In fact there have been 4 measurable snowfalls in the Twin Cities on this date since 1948.

Average dew point for October 24th is 35 degrees F, with a maximum of 60 degrees F and a minimum of 11 degrees F.

All-time state records for October 24th:

Scanning the state climatic data base: the all-time high for this date is 87 degrees F at Beardsley (Big Stone County) in 1924; the all-time low is -5 degrees F at Isabella (Lake County) in 1976.

Words of the Week: Aeolian Sounds

These are sounds produced by the action or effect of the wind. I think that they tend to become more perceptible in the fall as wind speeds increase. Eddies or currents of air formed immediately beyond an obstructing object, such as the roof of a building, a chimney, a tree, or telephone wires can produce their own sound, with a pitch that varies directly with the wind speed and inversely with the diameter of the object obstructing the wind. This is what leads to the humming of wires, the whispering of pine trees, and the howling around rooftops. Other aeolian sounds such as the rattle of dried corn stalks in the field, the rustle of leaves down the sidewalk, the creaking and groaning of tree branches, and the flapping of flags are due to combinations of wind and other factors.

Outlook:

A colder than normal week ahead with unsettled weather. Chance of showers, both rain and snow through the weekend and again early next week. Much colder than normal, then moderating somewhat toward the end of next week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Oct 31, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

Preliminary October Climate Summary:

It would appear on the surface that October was a fairly normal month in terms of temperature. Most observers in the state report a mean October temperature which is only a degree or two either side of the 30 year normal. That number really masks the temperature behavior during the month, since the first half was dominated by very warm temperatures, averaging 8-10 degrees above normal, while the second half of the month was equally colder than normal. Extremes for the month were 93 degrees F at Waseca and Rochester (on the 3rd), and only 1 degree F at Embarrass on October 27th.

Precipitation during October was for the most part below normal, with some exceptions. Crookston and Fergus Falls in the NW reported over 4 inches, while Grand Meadow and Preston in the SE reported over 3 inches. Rochester and MSP reported traces of snow, while International Falls reported 1.3 inches, Duluth reported 1.2 inches, and St Cloud reported 0.3 inches of snow.

Topic: MPR listener question about first snow cover in Minnesota

After seeing a trace of snow reported in the Twin Cities earlier this month, a listener called to ask when winter snow cover usually begins and how early this has occurred in the historical records? This person must be a skier.

According to a study by former State Climatologist Earl Kuehnast, the average date for the occurrence of 1 inch snow cover in the Twin Cities is November 22, but it has occurred as early as October 13, in both 1959 and 1969 (though in neither case did the snow cover last all winter). The average duration for continuous winter snow cover in the Twin Cities is 100 days, but it has been as long as 136 days (Nov 27, 1964 to April 10, 1965). The latest spring date reported for a 1 inch snow cover is May 1, 1984. Anybody ever done some skiing in May?

Topic: Cloud Illustrations and Classifications

For those sky watchers who are fascinated by cloud formations, there are two Internet web sites which might be of interest:

Plymouth State College in Plymouth, NH keeps cloud photos and classification criteria available on their web site at:  
<http://vortex.plymouth.edu/cloud.html>

University of Illinois Dept of Atmospheric Sciences also keeps cloud images and classification schemes, along with explanations for the cloud forming processes (this is part of a lesson plan for teachers) on their web site at:  
[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/cld/home.html](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/cld/home.html)

Twin Cities Almanac for October 31st:

The average MSP high temperature for this date is 51 degrees F (plus or minus 11 degrees standard deviation), while the average low is 35 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for October 31st:

MSP weather records for this date include: highest daily maximum temperature of 83 degrees F in 1950; lowest daily maximum temperature of 30 degrees F in 1951; lowest daily minimum temperature of 16 degrees F in 1996; highest daily minimum temperature of 57 degrees F in 1933; record precipitation of 0.85 inches in 1991; and 8.2 inches of snowfall in 1991. In fact there have been 3 measurable snowfalls in the Twin Cities on this date since 1948.

\*Footnote to the Twin Cities almanac: last year's high temperature of 32 degrees F, low of 16 degrees F and daily mean temperature of 24 degrees F, tied for the coldest ever Halloween in the Twin Cities (in 1951 the daily mean was also only 24 degrees F).

Average dew point for October 31st is 34 degrees F, with a maximum of 60 degrees F and a minimum of 12 degrees F.

All-time state records for October 31st:

Scanning the state climatic data base: the all-time high for this date is 86 degrees F at Worthington (Nobles County) in 1950; the all-time low is -2 degrees F at Park Rapids (Hubbard County) in 1951.

Word of the Week: Saltation

Last week we talked about sounds made by the wind (flags flapping, wires humming, pine trees whispering). Wind also causes various visible types of motion. Two of the most conspicuous in the rural landscape are soil erosion (in extreme cases dust storms and sandstorms) and the drifting of snow. The movement of soil particles or snow across the landscape is often described as rolling, tumbling, drifting, or even creeping, especially when it is continually in motion by a constant wind. Occasionally, this motion is observed to be a series of leaps or jumps which only occur with strong gusts of wind. This type of motion is called saltation, taken from the Latin "saltare", meaning to dance. So in essence when we use this term we are describing dancing soil or dancing snow.

Outlook:

Halloween evening should see temperatures in the 40s under mostly cloudy skies. There is a chance for rain in most places and rain mixed with snow up north. Unsettled weather will prevail over the weekend as a large low pressure system moves across the area. Winds will pick up on Saturday and Sunday with chances for precipitation each day through Tuesday. Temperatures will fall to below normal by Sunday night and stay that way for much of next week. A warming trend may appear by Thursday or Friday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Dec 5, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

Topic: River Valleys as "Speaking Tubes"

I was prompted to consider this topic by a story I heard on NPR's "All Things Considered." A former meteorologist was studying the language of elephants in the wild, and especially their mating calls. He found that the females emit an extremely low tone (long sound wave) mating call at certain times of the year, but they wait to do so typically until sunset or shortly after. These sounds can be heard by male elephants from as far as 10 miles. He inferred that elephants were using their meteorological knowledge in two respects: (1) sound travels much farther over a landscape when there is a temperature inversion (colder, denser air near the surface) and this is often the case shortly after sunset; (2) surface winds often subside and calm after sunset and therefore permit sound to be detected at greater distances. In addition, sounds of longer wavelength tend to travel farther in the atmosphere than high pitched (short wavelength) sounds. On the other hand, perhaps elephants are simply in a more romantic mood after the sun goes down.

This story reminded me of a winter trip I made with the Cub Scouts to the St Croix River Valley. It was February and the river was quite frozen. In fact snowmobilers were making use of the frozen flat surface to race each other. We went for a night hike under clear and calm conditions, but on the return trip to camp, some of the boys got way behind the group. When we stopped to wait for them, we noticed that we could hear their conversation even though they were hundreds of yards behind. In the cold, stable night air it occurred to me that we were indeed inside of a "speaking tube" (a term coined by atmospheric physicist W.J. Humphreys of the National Weather Service in the 1930s) formed by the river valley. In this environment sound waves were being confined to the river valley and reflected not only from the frozen river, but from the banks and side slopes around us. In such an environment, sounds remain audible to the human ear over much greater distances than most other positions on the landscape.

Topic: Nicknames for Winter Storms

This month's Weatherwise magazine contains a very good article about the types of regional winter storms that occur throughout the United States. The names given to these storms are based on the region where they form, usually by the coincidence of colliding warm and cold air masses underneath a jet stream maximum. Some of the names described are: the Nor'easter which strikes the east coast; the Alberta Clipper which is common to the high plains and Great Lakes regions; the Texas Panhandler which forms locally and commonly affects the southern plains, though occasionally reaching the Great Lakes region or crossing the Gulf states; the Siberian Express or

arctic outbreak straight from the North Pole which is usually associated with very strong high pressure and northerly winds that descend on the central US; and the Chattanooga Choo Choo a strong low pressure system which forms on the western side of the Appalachians in eastern Tennessee and brings a wintry mix to the Ohio Valley and east coast.

Topic: Tracking the UN Convention on Climate Change

The media are extending quite a bit of coverage to the Convention on Climate Change which is taking place in Kyoto Japan. Teachers and others who may wish to track the negotiations and discussions among nations can find a web site in the United Kingdom with frequent updates, reports, proceedings, and even audio clips. This site is managed by the University of Leicester.

The URL is [www.geog.le.ac.uk/cti](http://www.geog.le.ac.uk/cti)

Twin Cities Almanac for December 5th.

The average MSP high temperature for this date is 30 degrees F (plus or minus 10 degrees standard deviation), while the average low is 16 degrees F (plus or minus 10 degrees standard deviation).

MSP Local Records for December 5th:

MSP weather records for this date include: highest daily maximum temperature of 51 degrees F in 1960; lowest daily maximum temperature of 7 degrees F in 1937, 1955 and 1958; lowest daily minimum temperature of -9 degrees F in 1977; highest daily minimum temperature of 33 degrees F in 1913, 1951, and 1980; record precipitation of 0.81 inches in 1909; and record snowfall of 7.0 inches in 1909.

There have been 13 measurable snowfalls in the Twin Cities on this date since 1948. The greatest snow depth on this date was 20 inches in 1991. The worst windchill conditions on this date were in 1972 with values from -40 to -45 degrees F.

Average dew point for December 5th is 17 degrees F, with a maximum of 49 degrees F and a minimum of -19 degrees F.

All-time state records for December 5th:

Scanning the state climatic data base: the all-time high for this date is 61 degrees F at Canby (Yellow Medicine County) in 1939: the all-time low is -33 degrees F at Cook (St Louis County) in 1964.

Words of the Week: Qanik and Aput

According to a new book, "Snow in America" (available from the Smithsonian Institution Press) these are Eskimo words used to describe snow. Qanik refers to snow in the air while aput refers to snow on the ground. The book also mentions that some studies by anthropologists have suggested that Eskimos may use over 200 different terms to describe snow. That sounds like overkill to me.

Outlook:

Unsettled with snow showers and snow flurries possible statewide on Saturday, then mostly dry on Sunday. Returning to unsettled conditions in southern Minnesota for the beginning of next week, slowly spreading into northern areas by Tuesday and Wednesday. May see some significant snow accumulations by late in the week, before changing over to a dry and warmer pattern by next weekend.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Nov 14, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

Topic: Snow Emergencies and Snow Plowing

Historically, many Minnesota cities have used a snowfall of 4 inches or greater as a criteria for declaring a snow emergency and thereby clearing streets for the snow plows to do their work. Recently I learned that the St Paul Public Works Department will now use a snowfall of 3 inches or greater as a criteria for declaring snow emergencies. I wondered how this might affect the frequency of declared snow emergencies based on the climatology of snowfall in the Twin Cities area.

An examination of the MSP airport records since 1948 shows that there have been 246 snowfalls of 3 inches or greater and 151 snowfalls of 4 inches or greater. This averages out to about three 4 inch snowfalls per year versus five 3 inch snowfalls per year. The worst case scenario for 3 inch snowfalls (highest frequency) was the winter of 1964-65 when 12 events of this magnitude occurred, albeit three of the snowstorms that winter lasted two days or more. In fact of the last 30 Twin Cities snowstorms of 3 inches or greater, nine have occurred in November and nine in March, so that the majority were on the tailends of the winter season. The public works department responds to these storms in different ways however. November snowfalls must be attended to rather rapidly to avoid compaction into ice which may have a washboard type of effect on vehicle traffic for the rest of the winter. On the other hand, March snowfalls are often followed by spells of very warm, sunny weather which rapidly melts the snow off roadways, alleviating the need to plow.

Topic: Climate Patterns and Salmon Populations

George Taylor, state climatologist in Oregon, wrote an interesting paper last year which showed a correlation between cool, wet climate patterns and runs of salmon in the Pacific Northwest (Columbia River) and Alaska (Bristol Bay). Higher populations and larger catches were associated with cool, wet weather patterns in both places, but the trends were distinctly out of phase. That is, a cool, wet climate pattern and associated good run of salmon in the Pacific Northwest occurred during the same year as a warm, dry climate pattern and associated poor run of salmon in Alaska, and vice versa. This pattern has repeated itself for most of this century. Dr. Taylor wondered if this shifting pattern in climate and salmon populations was also associated with the El Nino Southern Oscillation, but this remains to be proven.

MPR listener question: I read that the birth of the National Weather Service dates to 1870 when it was administrated through the U.S. Army Signal Corps. But, weren't there observational

networks in place around the country before this date?

Answer: There were weather observations made in this country prior to 1870, but not many as part of standardized networks. According to Paul Waite, retired State Climatologist in Iowa, most of the earliest weather records in the United States are from individual diaries. The earliest known weather diary dates back to 1644 and was kept by the Chaplain of a Swedish colony in what is now Wilmington, Delaware. Among other early American weather observers who kept diaries, one finds the names of Benjamin Franklin, George Washington, and Thomas Jefferson, the last of whom kept a continuous record from 1776 to his death on July 4, 1826. The first attempt at an organized network was in 1814 when the government issued an order for the U.S. Army medical corps to collect weather data at forts and barracks around the country. In 1847 the Smithsonian Institution began a limited network of weather observations as well. But an attempt at a coordinated national network, including all of the states, was not tried until 1870 when the U.S. Army Signal Corps began a program which evolved into the National Weather Service.

Twin Cities Almanac for November 14th.

The average MSP high temperature for this date is 41 degrees F (plus or minus 11 degrees standard deviation), while the average low is 26 degrees F (plus or minus 10 degrees standard deviation).

MSP Local Records for November 14th:

MSP weather records for this date include: highest daily maximum temperature of 71 degrees F in 1990; lowest daily maximum temperature of 12 degrees F in 1940; lowest daily minimum temperature of 0 degrees F in 1919; highest daily minimum temperature of 48 degrees F in 1930; record precipitation of 0.80 inches in 1926; and 2.5 inches of snowfall in 1951. In fact there have been 5 measurable snowfalls in the Twin Cities on this date since 1945. The greatest snow depth on this date was 8 inches in 1991. The worst windchill conditions on this date were in 1919, with values of -28 to -32 F.

Average dew point for November 14th is 26 degrees F, with a maximum of 53 degrees F and a minimum of -2 degrees F.

All-time state records for November 14th:

Scanning the state climatic data base: the all-time high for this date is 75 degrees F at Madison (Lac Qui Parle County) in 1990; the all-time low is -20 degrees F at Itasca State Park (Clearwater County) in 1940 and at Bigfork (Itasca County) in 1959.

Words of the Week: Robin Hood's wind

This is a term used to describe a raw and penetrating wind which usually occurs in saturated air with temperatures at or below freezing. Derivation of the term comes from the fact that this wind robs the heat from even the best dressed (rich) people, much like the legendary Robin Hood robbed from the rich to give to the poor.

Outlook:

It appears that the weekend will be cloudy, windy, snowy and cold for most of Minnesota. Temperatures will remain below seasonal normals for much of next week, but there should be a dry spell early in the week with some periods of sunshine. The degree of cold during the week will depend a good deal on how much snow is deposited on the landscape through the weekend.

To: Perry Finelli, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Nov 21, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

MPR listener question: I have heard that permanent snow cover sufficient for cross country skiing in Minnesota has arrived later than normal during strong El Nino episodes. Is this true?

Answer: Well, it depends on what data you examine. For the three strongest El Nino events (1899, 1941, and 1982), persistent snow cover has not occurred until early to mid December. But that is only from a sample of three episodes. If we consider all 23 El Nino episodes since 1899, the establishment of persistent winter snow cover has varied considerably, ranging from as early as November 1st to as late as December 12th. Bear in mind that the historical mean date for 1 inch snow cover in the Twin Cities is November 22nd.

MPR listener question: I have heard many times that El Nino episodes are associated with warmer than normal winters in Minnesota, but are there any correlations with seasonal snowfall?

The Midwest Climate Center in Illinois released a study earlier this fall which addresses this very question. For the most part, their study showed no significant correlations between El Nino episodes and departures in seasonal snowfall accumulations across the upper midwest. One exception was an area in west central Minnesota and the eastern Dakotas near the headwaters of the Red River of the North. This area showed a tendency toward less than normal seasonal snowfall totals during El Nino episodes. However, this study only took into account the eight most recent strong El Nino episodes so it is based on rather limited data.

Topic: Snowfalls over Thanksgiving weekend

Historical data for the Twin Cities (1891-1996) show that measurable snowfall on Thanksgiving Day itself occurs only about 20 percent of the time, but for the four day weekend as a whole, measurable snowfall occurs better than 60 percent of the time. For example, of the past ten Thanksgiving days, measurable snowfall occurred only in 1989 and 1993, but for the 4 day holiday period measurable snowfall was recorded in 8 of the past 10 years. This coming 1997 Thanksgiving holiday will likely follow this recent trend as the weather is expected to be rather unsettled.

Twin Cities Almanac for November 21st.

The average MSP high temperature for this date is 37 degrees F (plus or minus 11 degrees standard deviation), while the average low is 24 degrees F (plus or minus 10 degrees standard deviation).

MSP Local Records for November 21st:

MSP weather records for this date include: highest daily maximum temperature of 67 degrees F in 1990; lowest daily maximum temperature of 8 degrees F in 1921 and 1929; lowest daily minimum temperature of -1 degrees F in 1929; highest daily minimum temperature of 42 degrees F in 1963; record precipitation of 0.54 inches in 1994; and 4.8 inches of snowfall in 1989. There

have been 11 measurable snowfalls in the Twin Cities on this date since 1948. The greatest snow depth on this date was 8 inches in 1957 and 1981. The worst windchill conditions on this date were in 1929 with values from -33 to -35 degrees F.

Average dew point for November 21st is 20 degrees F, with a maximum of 49 degrees F and a minimum of -9 degrees F.

All-time state records for November 21st:

Scanning the state climatic data base: the all-time high for this date is 72 degrees F at Tracy, Lamberton, and Luverne (all in southwestern MN) in 1962. The all-time low is -25 degrees F at Tower (St Louis County) in 1978.

Word of the Week: Hythergraph

Rarely used anymore, but in the old glossary of meteorology this term referred to a climate diagram which showed temperature along one axis and some form of moisture, such as humidity or precipitation along the other axis. Certain climate zones could be characterized by the shape of a hythergraph using mean monthly values for example. Another form of hythergraph is the comfort chart which shows values of temperature vs values of humidity. For indoor environments in the winter our comfort zone is most tolerable from 68 to 70 degrees, if the indoor humidity remains between 35 and 60 percent. If humidities are lower than this range we tend to feel too cool, if higher than this range, we tend to feel too warm.

Outlook:

Chance of snow on Saturday with continued below normal temperatures over the weekend. A warming trend will start early next week and raise daytime highs above the freezing mark. Increasing chances for precipitation by Wednesday and for the balance of the Thanksgiving holiday.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Nov 28, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

Preliminary Climate Summary for November:

The preliminary climate data for November show average monthly temperatures ranging from 5 to 7 degrees colder than normal across most of the state. Several stations reported some days with below zero overnight lows. The month was drier than normal in many areas, particularly the southern half of the state. Parts of the north received above normal precipitation and abundant snowfall. Total monthly snowfall ranged from just 2 inches in far southern counties to over 20 inches in the northeast.

Topic: Ice Making Weather

This is the time of year that the frost layer in the soil begins to deepen and lake ice begins to thicken. Ice on the Mississippi River begins to develop more extensively as well. The Army Corps of Engineers usually closes the river for navigation near the end of November or first week of December.

Soil frost depths currently range from 1 to 4 inches depending on surface cover, and some places are still relatively free of any soil frost. Lake ice thickness is highly variable and still dangerous in many places, as usual for this time of year.

At mean daily temperatures of 20 degrees F or less ice formation begins in previously open water in a matter of 2 to 3 days. Successively lower daily mean temperatures will accelerate the process, along with the decreasing daylength this time of year. For example, 9-11 inches of lake ice will develop on previously open water in approximately 6 days at a daily mean of 10 degrees F, but will take over 11 days at a daily mean temperature of 20 degrees F. Mean daily temperatures even colder than 10 degrees further accelerate the ice forming process but not as much (at a daily mean temperature of 0 degrees F, 9-11 inches of ice still requires 4-5 days to form).

Bear in mind that there is no reliable method to estimate the rate of ice formation on individual lakes. Several factors such as lake depth, vegetation, water currents, exposure to wind and snow cover all influence the rate of ice formation. Ice chisels or augers should be used to check thickness of lake ice. A thickness of 12 inches or greater is enough to support vehicles according to DNR guidelines.

A warming trend is expected to prevail the rest of this month and the first week of December, slowing the development of lake ice, and perhaps in some cases even causing a retreat. Ice fishing and snowmobiling enthusiasts should be extremely careful and check local conditions before attempting to go out on any lakes.

Twin Cities Almanac for November 28th.

The average MSP high temperature for this date is 31 degrees F (plus or minus 11 degrees standard deviation), while the average low is 17 degrees F (plus or minus 11 degrees standard deviation).

MSP Local Records for November 28th:

MSP weather records for this date include: highest daily maximum temperature of 58 degrees F in 1941; lowest daily maximum temperature of 4 degrees F in 1896; lowest daily minimum temperature of -8 degrees F in 1891 and 1985; highest daily minimum temperature of 43 degrees F in 1913; record precipitation of 1.08 inches in 1987; and 7.3 inches of snowfall in 1983. There have been 11 measurable snowfalls in the Twin Cities on this date since 1948. The greatest snow depth on this date was 15 inches in 1983. The worst windchill conditions on this date were in 1985 with values from -28 to -33 degrees F.

Average dew point for November 28th is 16 degrees F, with a maximum of 43 degrees F and a minimum of -13 degrees F.

All-time state records for November 28th:

Scanning the state climatic data base: the all-time high for this date is 65 degrees F at Beardsley (Big Stone County) in 1933 and at Canby (Yellow Medicine County) in 1941; the all-time low is -36 degrees F at Bemidji (Beltrami County) in 1896.\*

\*Footnote: November 28, 1896 at Bemidji, MN was perhaps the coldest November date in Minnesota history with a morning low of -36 degrees F and a high temperature of -17 degrees F, giving a daily mean value of -27 degrees F. A questionable low of -45 degrees F and a high of -15 degrees F occurred at Pokegama Dam on November 30, 1896.

Word of the Week: Nordenskjold line

This climate term is named for the early 20th century Norwegian geologist and polar explorer, Otto Nordenskjold. He documented expeditions to Antarctica, Greenland, the Yukon, Tierra del Fuego and southern Chile. The term is used for the arctic tree line, denoting the boundary between the Boreal forest and tundra. By definition, the Nordenskjold line is drawn through geographic points where the mean temperature for the warmest month (usually July) is equal to  $51.4 - 0.1k$ , where  $k$  is equal to the mean temperature of the coldest month (usually January). This equation shows a climate warm enough to produce tree growth in the warmest month, but not cold enough in winter to kill all tree species. Formerly used to estimate the latitudinal limits of the Boreal forest, this term is rarely used anymore. Boreal forest and tundra boundaries are now more precisely discriminated by satellite imagery.

Outlook:

A warm and dry period is in store for the weekend and much of next week. Temperatures are expected to average from 6 to 12 degrees warmer than normal, with several daytime highs above the freezing mark.

To: Perry Finelli, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Nov 7, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

MPR listener question: A listener in Morris (west central MN) sent an email to mention that soils are already starting to freeze up for the winter there. He asks, isn't this unusually early for this to happen?

Answer: Yes, it is. Checking the historical records for the initial soil freezing dates, the earliest date in the Morris record is November 7, while the average date is November 24. Of course, the onset and rate at which soils freeze is dependent on many factors, including air temperature, snow cover, soil moisture, soil texture, and vegetative cover among others. Drier soils, without the presence of any vegetative cover or crop residue generally freeze first in the late fall because they more readily give up heat to the atmosphere. Average dates for initial soil freezing, and the range in dates, from earliest to latest for several Minnesota locations are shown in the table below:

The dates when soils initially freeze across the region, taken from Army Corps of Engineers frost tube records for the period 1971-1988.

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Location	Ave Date	Earliest Date	Latest Date
Crookston, MN	11/28	11/10	12/26
Morris, MN	11/24	11/7	1/7
Wheaton, MN	11/24	11/10	12/3
Fergus Falls, MN	11/26	11/9	12/30
Roseau, MN	12/6	10/28	12/30
Bemidji, MN	11/24	11/6	12/8
Brainerd, MN	12/1	11/18	12/14
Lamberton, MN	12/4	11/10	12/30
Winnebago, MN	12/2	11/11	12/25
Mankato, MN	12/21	12/7	1/12
Minneapolis, MN	12/8	11/13	1/8
St Cloud, MN	11/27	11/11	12/11
Int'l Falls, MN	12/8	11/23	12/26
Duluth, MN	12/2	10/31	1/18
St Paul, MN	12/6	11/7	1/2
Rochester, MN	12/6	11/9	1/10
Winona, MN	12/20	11/18	1/10

Topic: Heat Transfer

This refers to the exchange of energy in the form of heat between an object and its surroundings, the energy flow being from high to low temperature. This can take the form of conduction, convection, or radiation absorption. All three forms of heat transfer are utilized this time of year in the way we manage to keep our car windows clear so we can see out of them. In the absence of clouds, we try to park our cars so that they are facing the sun. With such an orientation, the direct sunlight (radiation) is absorbed by the windshield warming it up, and melting any residual ice or snow left from scrapping it clear before the morning commute. When the engine has warmed up, we turn on the defroster fan, and heated air is mixed and distributed across the inside of the windshield by convection. The warmer air can hold much more water vapor and therefore the condensation on the windshield more readily evaporates. Lastly, most rear window defoggers, composed of electrically heated wires or wire mesh, rely on conduction (molecular transfer

of energy) to heat the glass and evaporate any condensed droplets or ice crystals which may have formed.

This time of year, as we see the first measurable snowfalls occur, conduction is also in evidence when we find greater snow accumulations on grass surfaces than on bare soil or pavement. Heat stored in the soil is conducted much less efficiently to the surface through grass and therefore snow cover can build up more readily without melting.

Twin Cities Almanac for November 7th.

The average MSP high temperature for this date is 46 degrees F (plus or minus 11 degrees standard deviation), while the average low is 30 degrees F (plus or minus 9 degrees standard deviation).

MSP Local Records for November 7th:

MSP weather records for this date include: highest daily maximum temperature of 68 degrees F in 1915 and 1969; lowest daily maximum temperature of 15 degrees F in 1991; lowest daily minimum temperature of -6 degrees F in 1991; highest daily minimum temperature of 49 degrees F in 1977; record precipitation of 1.67 inches in 1915; and 4.2 inches of snowfall in 1947. In fact there have been 3 measurable snowfalls in the Twin Cities on this date since 1945. The greatest snow depth on this date was 16 inches in 1991.

Average dew point for November 7th is 30 degrees F, with a maximum of 54 degrees F and a minimum of -2 degrees F.

All-time state records for November 7th:

Scanning the state climatic data base: the all-time high for this date is 78 degrees F at Montevideo (Chippewa County) in 1931; the all-time low is -20 degrees F at Redby (Beltrami County) in 1936.

Words of the Week: Buys-Ballot's Law

This empirical law in meteorology, sometimes called the baric wind law, relates the horizontal wind field to the atmospheric pressure pattern. It was formulated in 1857 by Christoph H.D. Buys Ballot (pronounced Bowis-Ball-ott), then head of the Dutch Meteorological Services. Basically the law states that with your back to the wind, the pressure to your left is lower than the pressure to your right. This law is based on the known wind fields which circulate around low pressure and high pressure systems in the northern hemisphere. It is exactly reversed in the southern hemisphere. In the absence of any weather forecast, you can at least ascertain the direction of low pressure, where frontal activity such as precipitation may be occurring. If you place your back to the wind and are facing north, then low pressure and frontal activity is to the west and likely to be passing your way in the future. Conversely, if you find that you are facing south with your back to the wind, then low pressure is to the east and active weather systems are probably already heading away from you.

Outlook:

Perhaps some periods of sunlight this weekend, but there will be increasing clouds and chances for precipitation later into the weekend and early next week. Moderating temperatures will give way to colder air for much of next week and below normal daily highs and lows are expected.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Dec 12, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

"Winter gives the bone and sinew to literature, [while] summer the tissues and blood. The simplicity of winter has a deep moral."  
(from "The Snow-Walkers" by John Burroughs)

Topic: No Two Snowflakes are Alike, the Legacy of Wilson  
"Snowflake" Bentley

Wilson Bentley was a Vermont farmer and keen weather observer. From 1884 to 1931 he devoted himself to keeping photographic records of snow crystals and developing a scheme to classify them. He ended up producing over 6,000 microscopic photographs of snowflakes, many of which were published in various books and magazines, including the Monthly Weather Review. His photos showed an almost infinite variety of snowflakes and contributed to the popular belief that no two snowflakes are alike. He is often referred to as "Snowflake" Bentley in Vermont literature.

Actually, Bentley was a pioneer in the use of the camera to study weather. As recently as the 1980s the Air Force Geophysics Lab and the Cold Regions Research and Engineering Laboratory of the Army Corps of Engineers used a small video camera called a Fall Velocity Indicator (FVI) in conjunction with a strobe light to record and study the fall rate of snowflakes, their orientation, structure and density. Despite such experimentation, there are still no accepted standards for an automated measurement of snowfall rates, snow accumulation, and snow density.

Topic: Comparative Climate Data for U.S. Cities

The National Climatic Data Center (URL <http://www.ncdc.noaa.gov>) periodically publishes summaries of climatic data from cities with relatively long and uninterrupted observations. The most recent Comparative Climatic Data publication released by NCDC shows a number of top ten lists including driest cities, wettest cities, warmest cities, coldest cities, etc. Some of these are listed below, with additional notation on how places in Minnesota compare.....

Top 4 cities with the highest  
average percent possible sunshine

Yuma, AZ	90%
Tucson, AZ	86%
Las Vegas, NV	85%
Phoenix, AZ	85%
(Twin Cities	58%)

Top 4 cities with the most  
cloudy days per year

Quillayute, WA	241
Astoria, OR	239
Olympia, WA	229
Seattle, WA	227
(Twin Cities	164)

Top 4 cities with greatest  
number of rainy days annually

Quillayute, WA	211
Astoria, OR	192
Syracuse, NY	170
Elkins, WV	170
(Twin Cities	112)

Top 4 cities with least  
number of rainy days annually

Yuma, AZ	17
Las Vegas, NV	26
Bishop, CA	30
Santa Barbara, CA	31
(Argyle, MN	65)

Top 4 cities with highest  
average annual wind speed  
Blue Hill, MA 15.4 mph  
Dodge City, KS 14.0 mph  
Amarillo, TX 13.6 mph  
Rochester, NY 13.1 mph  
(Rochester, MN 12.7 mph)

Top 4 cities with largest  
seasonal snowfall totals (in.)  
Blue Canyon, CA 240.8  
Marquette, MI 123.7  
Sault Ste. Marie, MI 115.5  
Caribou, ME 111.7  
(Lutsen, MN 86.1)

Question from Bob Potter: Haven't the daily temperatures this month been unusually stable?

So far this month we have had 3 days when the daily temperature range was only 3 degrees F, with the latest example being Tuesday (December 9) which showed a high of 29 F and a low of 26 F. The average daily temperature range (difference between high and low) for early December is 14 to 15 degrees F. Historically over the past 106 years, there have only been 21 days in early December (1st-9th) with a narrow temperature range of 3 degrees F or less. So what we have been recording this year is indeed quite unusual. I attribute this to persistent cloudiness, trapped low level water vapor, and the absence of any strong frontal systems. I am sure that others are thinking it is El Nino!

Twin Cities Almanac for December 12th.

The average MSP high temperature for this date is 28 degrees F (plus or minus 12 degrees standard deviation), while the average low is 12 degrees F (plus or minus 13 degrees standard deviation).

MSP Local Records for December 12th:

MSP weather records for this date include: highest daily maximum temperature of 53 degrees F in 1968; lowest daily maximum temperature of 2 degrees F in 1932; lowest daily minimum temperature of -14 degrees F in 1903; highest daily minimum temperature of 37 degrees F in 1928; record precipitation of 0.49 inches in 1991; and record snowfall of 4.6 inches in 1941. There have been 15 measurable snowfalls in the Twin Cities on this date since 1948. The greatest snow depth on this date was 16 inches in 1950. The worst windchill conditions on this date were in 1932 with values from -55 to -60 degrees F throughout the early part of the day.

Average dew point for December 12th is 9 degrees F, with a maximum of 49 degrees F and a minimum of -19 degrees F.

All-time state records for December 12th:

Scanning the state climatic data base: the all-time high for this date is 64 degrees F at Tracy (Lyon County) in 1913: the all-time low is -39 degrees F at International Falls (Koochiching County) in 1995.

Word of the Week: Niphometrology

Adopted by participants at the Western Snow Conference in 1942, this term was used to refer to the science of snow measurement. It is a composite formed from the Greek root words nipho meaning snow and metron meaning to measure. This term never really caught on in the scientific community, perhaps because it sounded a bit too academic for a process as simple as sticking a yardstick in the snow.

Outlook:

Continued partly to mostly cloudy with a chance for rain or snow on Saturday. Temperatures will be increasing during the coming week, averaging perhaps 10 to 15 degrees warmer than normal. We may see some temperatures exceed 40 degrees F in places. Little chance for precipitation again until late next week.

To: Bob Potter, Jim Bickal, John Bischoff, and Stephanie Curtis  
From: Mark Seeley  
Re: Suggestions for MPR's Morning Edition, Friday, Dec 19, 1997

The following will be posted on the WeatherTalk web site (<http://www.mnonline.org>), also accessible through the Morning Edition section of MPR's web site (<http://news.mpr.org>).

MPR listener question: What have been the coldest and warmest weeks preceding Christmas Day in the Twin Cities climate record? The holiday season temperatures sure seem highly variable.

Answer: The coldest week preceding Christmas was in 1983 when the average temperature for the week was -13.3 degrees F or 31 degrees below normal. The average overnight low temperature during the week was -21 degrees F and the average daytime high was -5 degrees F. Over 18 inches of snow covered the ground at Christmas in 1983 and this contributed to the cold temperatures.

The warmest week preceding Christmas is a virtual tie between 1923 and 1931, both of which show an average temperature of 35 degrees F for the week. This is about 17 degrees F warmer than normal. In 1923 there was an absence of snow cover right through Christmas Day, followed by a storm on the 27th, while in 1931 after an exceedingly warm week, it snowed 1.5 inches on Christmas Eve.

MPR listener question: How often does a brown Christmas occur in the Twin Cities and how often does it actually snow on Christmas Eve or Christmas Day?

Answer: I assume this question refers to the absence of snow cover as a brown Christmas. Actually this happens fairly often, with about two years out of every 10 showing an absence of any measurable snow cover on Christmas Day. The two most recent brown Christmas Days in the Twin Cities area were 1988 and 1986.

Christmas Eve and Christmas Day snowfalls have been fairly frequent. Since 1948, snow has fallen either on Christmas Eve, Christmas Day, or both days in 22 of the 49 years. We may indeed see this happen again this year, at least in southern Minnesota.

MPR listener question: I have noticed frequent temperature inversions in recent weeks, manifested by the flat or downward motion in the smoke plume from the St Paul power plant along Shepard Road. Have we had an abnormally high frequency of temperature inversions?

Answer: I checked with colleagues at the National Weather Service Forecast Office on this one. Indeed we have been having a higher frequency of inversions this month, in fact nearly everyday. Absence of surface heating by direct sunlight, and a lack of strong cold fronts have contributed to the persistence of these inversions. Dr. Don Baker a colleague in climatology at the University of Minnesota, showed in a study some years ago, that the Twin Cities has a relatively high frequency of inversions on an annual basis. His data show that between 45 and 50 percent of all days exhibit a temperature inversion (within 500 ft of

the surface) of at least a few hours duration.

Twin Cities Almanac for December 19th.

The average MSP high temperature for this date is 25 degrees F (plus or minus 13 degrees standard deviation), while the average low is 11 degrees F (plus or minus 14 degrees standard deviation).

MSP Local Records for December 19th:

MSP weather records for this date include: highest daily maximum temperature of 52 degrees F in 1923; lowest daily maximum temperature of -11 degrees F in 1983; lowest daily minimum temperature of -29 degrees F in 1983; highest daily minimum temperature of 38 degrees F in 1923; record precipitation of 0.51 inches in 1968; and record snowfall of 6.4 inches in 1951. There have been 18 measurable snowfalls in the Twin Cities on this date since 1948. The greatest snow depth on this date was 18 inches in 1983. The worst windchill conditions on this date were in 1916 with values from -60 to -65 degrees F throughout the early part of the day.

Average dew point for December 19th is 10 degrees F, with a maximum of 35 degrees F and a minimum of -31 degrees F.

All-time state records for December 19th:

Scanning the state climatic data base: the all-time high for this date is 58 degrees F at Winnebago (Faribault County) in 1923: the all-time low is -52 degrees F at Tower (St Louis County) and Mora (Kanabec County) in 1983.

Word of the Week: Taiga

This is a Russian word (pronounced ti-ga) used to refer to the Boreal woodlands or open forest which lies just south of the tundra in high latitudes. It consists of coniferous trees growing in cold and swampy soils, occupied by lichens. In these areas trees can grow for a limited time each year. The landscape is often flooded in the spring by north flowing rivers. Some climatologists refer to these areas as subarctic climates.

Outlook:

Chance for light snowfall over the weekend, especially in southern areas. It may be rather windy Saturday and Sunday as well. Temperatures will remain above normal to start next week, then cool down toward Christmas day. Increased chances for snowfall in southern counties around Christmas Day, but remaining mostly dry up north.

WeatherTalk for December 26, 1997

Topic: The weather of 1997 revisited

The dominant weather story in 1997 was the record setting flooding which occurred on the upper Minnesota River and in the Red River Valley. Though the flooding was primarily the result of record or near record snow cover across large areas of western Minnesota, it was exacerbated by the strong spring blizzard of April 5-6. In fact, the National Weather Service issued 12 blizzard warnings in parts of western Minnesota during the winter of 1996-97.

Other weather patterns and anomalies worth noting in 1997...

An unusually persistent cold and dry pattern from early April to mid June which delayed crop germination and made for a rather small hay crop.

A near record setting wet July for many Minnesota counties. The Twin Cities recorded three rainfall events exceeding 2.5 inches, and one that produced 3 inches in one hour which caused some local flooding and many wet basements. The 12.56 inches at the MSP airport marked the second wettest July in history.

Tower, MN recorded a low of 24 degrees F on July 7th, tying the state record low for the month.

Farmers enjoyed one of the best fall harvesting seasons in recent memory, with pleasant temperatures, sunny skies and an absence of wet spells.

December 1997 is proving to be one of the warmest in state history, especially for northern Minnesota. International Falls has recorded the warmest December since 1923.

What was the wettest day of the week in 1997? Saturdays of course, with 45 percent reporting measurable precipitation. The driest day was Wednesday, with only 25 percent reporting precipitation.

MPR listener questions: A listener in Red Wing, MN writes to ask two questions: (1) The CBC in Canada seem to broadcast windchill in different units than in the United States. How are these to be understood? (2) What is responsible for the rare conditions when vertical beams of light can be seen reflected from suspended ice crystals in the lower atmosphere?

Answer (1): The CBC broadcasts windchill equivalence temperatures in degrees Celsius, and sometimes also broadcasts a windchill factor estimated in watts/square meter, which is a different way of expressing heat loss. These scales are distinctly different from what our National Weather Service uses. A comparison can be made using the Twin Cities weather conditions from this date (December 26) last year.

National Weather Service reported -20 degrees F with 7 mph wind, giving a windchill equivalence of -35 degrees F.

CBC would have reported the same conditions as -29 degrees C with

11 km/hr wind, giving a windchill equivalence of -32 degrees C, and a windchill factor of 1780 watts/square meter.

The interpretation of these values and public advisory criteria used by the American and Canadian weather services are essentially the same, both stating that citizens would be advised that unprotected skin could freeze over several minutes of exposure in such conditions.

An explanation of the Canadian windchill usage is give at the following URL: <http://www.tor.ec.gc.ca/comm/windchil.html>

Answer (2): Tiny ice crystals of hexagonal shaped plates and hollow tubes form in saturated air at very cold temperatures (less than -4 degrees F). These crystals are so light that their fall velocity is very small and they may be suspended in the lower atmosphere for some period of time. Light from roadside billboards or car headlights may strike these crystals in such a way that the light is reflected as vertical beams. That may or may not be the right answer, but that's the best I can come up with on question 2.

Almanac Segment:

Twin Cities Almanac for December 26th.

The average MSP high temperature for this date is 25 degrees F (plus or minus 12 degrees standard deviation), while the average low is 8 degrees F (plus or minus 14 degrees standard deviation).

MSP Local Records for December 26th:

MSP weather records for this date include: highest daily maximum temperature of 51 degrees F in 1936; lowest daily maximum temperature of -9 degrees F in 1934; lowest daily minimum temperature of -27 degrees F in 1996; highest daily minimum temperature of 38 degrees F in 1959; record precipitation of 0.57 inches in 1936; and record snowfall of 5.1 inches in 1988. There have been 17 measurable snowfalls in the Twin Cities on this date since 1948. The greatest snow depth on this date was 20 inches in 1983. The worst windchill conditions on this date were in 1925 with values from -54 to -58 degrees F during the morning and early afternoon.

Average dew point for December 26th is 10 degrees F, with a maximum of 46 degrees F and a minimum of -23 degrees F.

All-time state records for December 26th:

Scanning the state climatic data base: the all-time high for this date is 57 degrees F at Fairmont (Martin County) and Zumbrota (Goodhue County) in 1936: the all-time low is -50 degrees F at Tower (St Louis County) in 1993.

Words of the Week: Chionophile and Chionophobe

Taken from the Greek word for snow, "chiono" (ki-o-no), these are combination words used by ecologists and biologists to describe the character of certain plant or animal species. A chionophile is a snow-loving species and thrives well in over winter snow cover; while a chionophole is a snow-hating

species which does not do well in snow. I think that most Minnesotans are chionophiles.

Forecast for December 27-January 2:

The trend of above normal temperatures is likely to continue through the end of the month. Rather quiet weather in southern Minnesota over the holidays, with a chance for snow in northern counties over the weekend and early next week. Most active weather will remain south of our state.

WeatherTalk for December 26, 1997

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