

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 4, 2002

Topic: Harsh Treatment for a Meteorologist

The Star Tribune ran an article this week about Luis Carlos Austin, a weather forecaster in Rio De Janeiro Brazil. He forecasted heavy rain for the city on New Year's Eve. This never materialized but caused a great deal of public concern for flooding. So they Mayor of the city may prosecute him for sounding a false alarm. Perhaps he should move to Minnesota where the public is a little more forgiving...

Topic: Snowfall Statistics

During MPR's Midday program last week when reviewing the weather of 2001, the question arose as to the snowiest month of the year. This varies around the state and in fact even varies for the Twin Cities depending on what period of record is examined. For example, listed below are the average snowfall values for the Twin Cities for two time periods used to define climate normals (three complete decades), 1941-1970 and 1971 to 2000. In addition I have shown the complete 117 year averages for monthly snowfall in the Twin Cities.

Twin Cities average monthly snowfall for 1941-1970

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Amounts (in.)	0.4	5.9	8.7	8.2	7.9	11.1	2.4	0.2
Ave Total Seasonal Snowfall =	44.8							

Twin Cities average monthly snowfall for 1971-2000

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Amounts (in.)	0.6	9.9	10.1	13.5	7.9	10.5	3.0	0.1
Ave Total Seasonal Snowfall =	55.6							

Twin Cities average monthly snowfall for 1884-2001

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Amounts (in.)	0.6	6.2	8.8	10.2	7.7	9.3	3.4	0.2
Ave Total Seasonal Snowfall =	45.7							

As you can see, the snowiest month of the year in the most recent three decades (now used as Twin Cities climate normals) is January with an average snowfall of 13.5 inches, followed by March at 10.5 inches, and December at 10.1 inches. Though the amounts vary, this rank order is also true for the long-term historical averages of 117 years. However when the climate normals for the Twin Cities were from the 1941-1970 period the snowiest month as March at 11.1 inches, followed by December at 8.7 inches and January at 8.2 inches.

The snowiest month of any winter has shown great variability as well. In the 117 year Twin Cities record, January has been the snowiest month of the winter 35 times, followed by March which was the snowiest month of the winter 30 times. There have been three seasons (1906-07, 1956-57, and 1982-83) when believe it or not April was the snowiest month. The complete break down on the frequency for snowiest months in the Twin Cities is listed below:

Number of times each month has recorded the most snowfall for a given winter season (Nov-Apr) in the Twin Cities 1884-2001.

Nov	Dec	Jan	Feb	Mar	Apr
13	23	35	14	30	3

*note in 1923 January and March tied as the snowiest month.

As to the question in which month do the heaviest daily snowfalls occur.....this too varies, depending on amount. The tables below show the number of daily 4 inch, 8 inch, and 12 inch snowfalls that have occurred by month over the past 50 years in the Twin Cities...

Number of daily snowfalls equal to or greater than 4.0 inches...

Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
0	1	31	20	32	20	36	11	0

Number of daily snowfalls equal to or greater than 8.0 inches..

Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
0	1	5	2	4	2	12	1	0

Number of daily snowfalls equal to or greater than 12 inches..

Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
0	0	2	1	2	0	4	1	0

From these data it is easy to see that moderate snowfalls of 4 inches or more are typical of November, January and March. Heavier snowfalls of 8 inches or more clearly show a tendency to occur in March.

Topic:

MPR listener question: Now that January has arrived, how often does it measurably snow during the month?

Answer: The average number of days with measurable snowfall in the Twin Cities during January is nine, ranging from two to nineteen.

Twin Cities Almanac for January 4th:

The average MSP high temperature for this date is 21 degrees F (plus or minus 13 degrees F standard deviation), while the average low is 5 degrees F (plus or minus 14 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 41 degrees F in 1898; lowest daily maximum temperature of -10 degrees F in 1924; lowest daily minimum temperature of -23 degrees F in 1924; highest daily minimum temperature of 31 degrees F in 1926 and 1992; record precipitation of 0.57 inches in 1997; and record snowfall of 6.0 inches in 1910. There have been twenty-eight measurable snowfalls on this date since 1891, most recently 0.2 inches in 2000. Record snow depth on this date is 20 inches in 1970.

Average dew point for today's date is 5 degrees F, with a maximum of 37 degrees F in 1946 and a minimum of -39 degrees F in 1924.

All-time state records for January 4th:

Scanning the state climatic data base: the all-time high for this date is 49 degrees F at Springfield (Brown County) in 1964; the all-time low is -48 degrees F at Leech Lake in 1896 and again at Red Lake in 1968.

Word of the Week: Snowboard

Long before the popularity of snowboarding down a slippery slope, this term applied to making a standard weather observation of snowfall. It is typically composed of a solid, flat painted material (such as plywood), approximately 2 ft by 2 ft square, laid flat on the ground or snow surface to measure a fresh fall of snow with a ruler. Typically the measurement is made to the nearest tenth of an inch. The board is swept clear after each occurrence so a new measurement can be made.

Outlook:

Chance of light snow Saturday, continuing Sunday in the north. This frontal system may produce some mixed precipitation. Temperatures will be warmer than normal over the weekend and continue that way into next week. There will be another chance for snow by mid-week most places.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 11, 2002

Topic: Record warmth this week

Following Monday morning, January 7th when Hibbing reported a temperature of -11 degrees F (lowest in the contiguous 48 states that morning), southwesterly winds began to bring in warm, mild Pacific air and temperatures climbed. By Tuesday, the temperature at Hibbing had climbed 56 degrees to 45 F, setting a new high temperature record for January 8th. Many other locations around the region set high temperature records that day, including....

Bemidji 46 F Warroad 43 F Roseau 41 F
Detroit Lakes 46 F (tied record)
Bismarck, ND 63 F (new record high for month of January)
Grand Forks, ND 48 F Baudette 41 F Park Rapids 45 F
Big Fork 45 F Grand Rapids 48 F International Falls 43 F
Fergus Falls 46 F (tied record) Alexandria 47 F
Wadena 45 F Brainerd 48 F Cloquet 46 F (tied record)
Aitkin 48 F Sioux Falls, SD 57 F Yankton, SD 59 F
Marshall 52 F Redwood Falls 50 F Pipestone 52 F
Windom 55 F Worthington 55 F Olivia 50 F
Hutchinson 48 F New Ulm 54 F (tied record)
Fairmont 57 F Albert Lea 54 F Faribault 48 F
Austin 54 F Winona 48 F Rochester 47 F
Sioux City, IA 64 F Decorah, IA 54 F Spencer, IA 64 F
St James 59 F (tied all-time state record for Jan 8th set in 1902)

Following the record warmth during the day Tuesday, January 8th, many locations set records for warm overnight low temperatures (including both MSP and Duluth with a balmy low of 34 degrees F). Wednesday, January 9th brought more record high temperatures to the region, but not as numerous as the previous day. Those reporting record high temperatures on Wednesday included....

MSP 49 F Austin 48 F Albert Lea 48 F (tied record)
Willmar 45 F Faribault 50 F Mora 52 F
Fairmont 52 F Duluth 42 F Eau Claire, WI 48 F
La Crosse, WI 53 F Sioux City, IA 55 F (tied record)
Des Moines, IA 57 F Mason City, IA 49 F

The warmth continued to set records on Thursday morning as well, with new record high minimums reported at Montevideo (36 F) and Willmar (34 F).

Topic: Greenland's ice sheet fluctuations

Recent research has pointed out that some of the coastal portions of the Greenland ice sheet may be thinning, while some of the more continental areas seem stable or even growing. Some scientists

have been inclined to attribute this to global climate change, while others speculate that these variations may be due to other causes. A recent paper in Science magazine (by Mark Fahnestock et al) suggests that thinning and movement of the Greenland ice sheet may be due to geothermal heat sources from volcanic activity underneath. This adds another layer of complexity to explaining fluctuations in ice sheet.

MPR listener question: How deeply does the soil freeze in Minnesota during the winter?

Answer: There is great variability from year to year depending on snow cover, temperature conditions and soil type and condition. Typically in the Twin Cities area the soil will freeze to a maximum depth between 25 and 35 inches. Winters with consistent snow cover to serve as insulation have prevented the soil from freezing much below 4 inches in some winters. Conversely, open winters with very arctic like temperatures have caused some soils to freeze as deeply as 70 inches or more.

Twin Cities Almanac for January 11th:

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

MSP weather records for this date include: highest daily maximum temperature of 44 degrees F in 1986; lowest daily maximum temperature of -19 degrees F in 1912; lowest daily minimum temperature of -31 degrees F in 1977; highest daily minimum temperature of 32 degrees F in 1928 and 1992; record precipitation of 0.47 inches in 1930; and record snowfall of 6.0 inches in 1905. There have been forty-two measurable snowfalls on this date since 1891, most recently 1.5 inches in 1999. Record snow depth on this date is 17 inches in 1969.

Average dew point for today's date is 5 degrees F, with a maximum of 36 degrees F in 1980 and a minimum of -38 degrees F in 1977.

All-time state records for January 11th:

Scanning the state climatic data base: the all-time high for this date is 56 degrees F at Canby (Yellow Medicine County) in 1990; the all-time low is -52 degrees F at Bagley (Clearwater County) in 1912.

Word of the Week: Kaikias

This is the Greek word for the cruel and cold northeast wind. It is depicted on the ancient Tower of Winds in Athens as an old man, clad but with bare arms. He is tipping a shield full of hailstones over the countryside. This wind often brings hail, snow, and thunderstorms to Greece. Indeed it brought significant snows

to Greece and Turkey on Sunday this past week. The head of Greece's National Weather Service called it one of the worst winter outbreaks in the past 50 years. Snow covered the Acropolis in Athens. A number of people died from exposure as temperatures fell to teens and twenties, about 20 to 30 degrees F colder than normal. The cold outbreak lingered earlier this week and froze some of the canals in Venice, Italy.

Outlook:

Chances of snowfall on Saturday, especially up north, with a continuation of above normal temperatures. More chances for snowfall late Sunday through Tuesday morning, then a dramatic decline in temperatures next week to below normal values with increasing chances for considerable snowfall as we approach next weekend.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 18, 2002

Topic: New Minnesota History Center Exhibit Opens

This Sunday, January 20th, a new exhibit opens at the Minnesota History Center in St Paul. It is called "Weather Permitting" and is needless to say about my favorite topic. There was a nice article about it by Bill Gardner in the Wednesday Pioneer Press this week. This exhibit highlights our attitudes about weather, and the impact of weather on Minnesota history, particularly weather or weather-related disasters. Much of our culture has been shaped by the vagaries of Minnesota weather. Features of the exhibit include remembrances of tornadoes, droughts, floods, heat waves, and winter storms. I encourage everybody to go see it.

Topic: New Monthly and Seasonal Climate Outlooks

The new monthly and seasonal climate outlooks from the Climate Prediction Center were released on Thursday this week. The balance of winter should track near normal with respect to both temperature and precipitation (snowfall) through April according to the CPC. States south and east of Minnesota are favored to see above normal temperatures. This is a prevalent trend for Minnesota as well, but it is apparently expected to end.

Topic: Recent snowfall

The snowfall that occurred Sunday night into Monday brought 2-5 inches to many places in Minnesota and western Wisconsin. Some locations even reported new record amounts for January 14th, including Madison with 7 inches and Milan with 5 inches. Owatonna reported 4 inches of new snow, which tied the record amount for January 14th. The 5 plus inches which fell in the Twin Cities brought the seasonal snowfall total up to 23.6 inches.

Topic: 20th Anniversary of the Twin Cities snowiest week

Next week marks the 20th anniversary of the snowiest week in Twin Cities history, that of January 18-24, 1982. The week was preceded by a blizzard on the 15th and 16th which ushered in very cold arctic air. Then on January 20th (Wednesday) the cities were paralyzed by 17.4 inches of snowfall. In fact a band of 14 inches or more fell from Glencoe NE toward Chippewa Falls, WI. Two days later, on the 22nd (Friday) before the previous snow had been entirely dealt with, another 18.5 inches of snowfall hit the Twin Cities. By the weekend roughly 40 inches of snow had fallen

during the week, producing drifts over 10 ft high. The month produced a grand total of 46.4 inches of snow, the highest of any January on record in the Twin Cities. Numerous buildings were damaged by the excessive snowload and eight people died of heart attacks while shoveling snow. The depth of snow on the ground in the Twin Cities reached an all-time record of 38 inches.

My son and I used a ladder to get onto the porch roof, removed all the snow by shovel, then simply walked off the porch room onto the mound of snow we had created in the front yard.

Topic: Warm winter

Earlier this week it was revealed that the Twin Cities has set a climate record for the latest subzero reading, surpassing the winter of 1954-55 when a subzero temperature reading did not occur until January 15th. The first subzero reading in the Twin Cities (MSP airport) did not occur until Friday, January 18th this winter. This caused me to examine the mean daily temperatures since November 1st. As expected, the period from November 1st to January 15th has been the warmest such period in the Twin Cities climate record (back to 1891). The warmest five such periods and their respective mean temperatures are shown below....

Winter season (Nov 1 - Jan 15) Mean Temp (F)

2001-2002	34.4
1913-1914	33.2
1931-1932	32.3
1999-2000	31.5
1899-1900	30.2

The warm winter trend may be ending....as evidence, both Tower and Embarrass, MN reported lows of -26 degrees F on Friday morning (Jan 18) and this reading was noted as the nation's low.

MPR listener question: Has Minnesota ever seen 70 degrees F in the month of January?

Answer: No, but it has come close to that. On January 24, 1981 Montevideo on the upper reaches of the Minnesota River valley reported a high of 69 degrees F, truly remarkable for what is historically the coldest week of the year. This temperature is approximately 45 degrees F above normal!

MPR listener question: What is the latest date that Lake Calhoun and Lake Harriet have ice over?

Answer: According to the Minnesota State Climatology Office, the latest date for both lakes occurred last month when they

were reported to be ice covered by December 31st. Records go back to 1962, so the result of extra warm winters like those of 1930-31 or 1877-78 is not accounted for.

Incidentally, the earliest date for complete ice cover on Lake Calhoun and Lake Harriet is November 25th. This occurred in 1996.

Twin Cities Almanac for January 18th:

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

MSP weather records for this date include: highest daily maximum temperature of 48 degrees F in 1891; lowest daily maximum temperature of -16 degrees F in 1994; lowest daily minimum temperature of -31 degrees F in 1967; highest daily minimum temperature of 32 degrees F in 1944; record precipitation of 0.31 inches in 1895; and record snowfall of 3.1 inches also in 1895. There have been thirty-one measurable snowfalls on this date since 1891, most recently 0.2 inches last year. Record snow depth on this date is 10 inches in 1956.

Average dew point for today's date is 7 degrees F, with a maximum of 39 degrees F in 1973 and a minimum of -40 degrees F in 1967.

All-time state records for January 18th:

Scanning the state climatic data base: the all-time high for this date is 54 degrees F at Beardsley (Big Stone County) in 1908; the all-time low is -48 degrees F at Cotton (St Louis County) in 1967.

Word of the Week: shrammed

This is an old English word passed along to me by Michael Russelle of the USDA-Agricultural Research Service working in my department. It means benumbed, shrunken, or shiveled by the cold, or "chilled to the bone" is probably the more common expression. Of course, this is something that hasn't happened to us much this winter. But, wait until the second half of January.

Outlook:

Chance of light snow Saturday in the west and north, with cooler temperatures. Increasing chances statewide for snowfall on Sunday and Monday. Another chance for significant snowfall by Wednesday of next week. Temperatures will generally be near normal during the week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 25, 2002

Topic: Warm January Continues

Much of the country east of the Rockies experienced a relatively warm Tuesday earlier this week with highs well above the long-term averages at many locations. Strong southerly winds across with essentially no snow cover caused temperatures to soar to record readings. Record high temperatures were either tied or set on Tuesday in Iowa at Burlington (61 degrees), Cedar Rapids (58 degrees), Waterloo (60 degrees), Des Moines (59 degrees), Dubuque (55 degrees) and Mason City (51 degrees). In Minnesota, St James tied a record high for January 22nd with 52 F.

Topic: 230 years ago: The Washington and Jefferson Snowstorm

On January 27, 1772, the famous "Washington and Jefferson Snowstorm" occurred. So named because an account of this appears in both gentlemen's diaries, a total snowfall ranging from 30 to 36 inches was reported at both Washington's home in Mt Vernon and at Jefferson's home at Monticello. Colonists were unable to travel around Virginia for two weeks because of the depth of snow and the colonial postal service did not resume for five weeks. To this day these figures, though unofficial, remain the highest snowfall amounts reported in those areas from a single storm.

An interesting footnote to this storm concerning Jefferson's life: Jefferson and his 22 year-old bride Martha had just been married at her family plantation (The Forest) near Williamsburg on New Year's Day. It was a cold and snowy January throughout the colonies and they travelled the 130 miles to Monticello (near Charlottesville) very slowly, arriving just ahead of this famous storm which caused them to be homebound for two weeks. Nine months later, their first child, daughter Martha, was born in September.

Topic: Missing winter? Try Quebec's Ice Hotel

For the second year running, Quebec, Canada is home to North America's only Ice Hotel. Patterned after its counterpart in Sweden, the Ice Hotel is built from 350 tons of ice and over 10,000 tons of snow. It is open from January to the end of March (weather permitting).

Covering nearly 30,000 square feet, there are 21 rooms and 10 suites to choose from. Furnishing are carved from ice, including the beds which are covered with foam pads and deer skins. Guests sleep in arctic-rated sleeping bags since room temperatures only range from 17 to 21 degrees F. The

hotel includes two art galleries, a movie theatre, a spa, and an Ice Bar where they serve vodka shooters in hollowed out ice cubes.

Apparently an ecotourism idea of some merit, the first Ice Hotel was a roaring success last winter, drawing over 40,000 visitors. This year they hope to do even better. If you are interested you can go to their web site at...

<http://www.icehotel-canada.com>

MPR listener question: With barely 25 inches of snowfall this winter in the Twin Cities, these warm temperatures and increasing daylength, is that all there is to winter? Or do you think we will still see a good deal of snow?

Answer: A number of people have been voicing the opinion that winter is all but over. I don't think so. Just look at some other winters when most of the snowfall did not occur until the second half of winter. Abundant total snowfall for the February-April period in the Twin Cities occurred in the following years...

1909.....	36.4 inches
1908.....	36.6 inches
1893.....	37.9 inches
1917.....	38.1 inches
1899.....	38.8 inches
1936.....	38.8 inches
1989.....	40.8 inches
1952.....	41.0 inches
1985.....	41.0 inches
1983.....	46.9 inches
1965.....	50.8 inches
1951.....	51.2 inches
1962.....	54.7 inches

In fact the latest forecast models suggest that we may see more snow near the end of January and first week of February.....

Twin Cities Almanac for January 25th:

The average MSP high temperature for this date is 20 degrees F (plus or minus 15 degrees F standard deviation), while the average low is 4 degrees F (plus or minus 15 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 58 degrees F in 1944; lowest daily maximum temperature of -16 degrees F in 1904; lowest daily minimum temperature of -31 degrees F in 1904; highest daily minimum temperature of 42 degrees F in 1944; record precipitation of 0.50 inches in 1950; and record snowfall of 7.5 inches also in 1950. There have been thirty-seven measurable snowfalls on this date since 1891, most recently 4.0 inches in 1998. Record snow

depth on this date is 32 inches in 1982.

Average dew point for today's date is 5 degrees F, with a maximum of 48 degrees F in 1944 and a minimum of -35 degrees F in 1972.

All-time state records for January 25th:

Scanning the state climatic data base: the all-time high for this date is 67 degrees F at Springfield (Brown County) in 1981; the all-time low is -55 degrees F at Pokegama Falls (Itasca County) in 1904.

Words of the Week: a peel-a-bone day

This is an old Scottish expression revisited in some poetry in this month's Weatherwise magazine (article by Shirley Byers Lalonde). It is only used to describe the very harsh, bone chilling kind of conditions produced by a strong, damp wind. The descriptive inference is that the cold is so extreme it peels your skin away to the bone....in other words there is no protection from it.

Outlook:

A chance of light snow in the north on Saturday and Sunday, with very mild temperatures in the south....some possibly record-setting. Increasing wind and clouds over most of the state Monday, with a chance for statewide snow through Wednesday. This will be followed by a strong cold front, bringing very cold air to the state for the end of next week...much more like real winter.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 1, 2002

Topic: Miscellaneous news

Tomorrow, February 2nd is the 6th anniversary for the all-time state low temperature record of -60 degrees F at Tower (1996). On that date, scores of reporters assisted the observer at Tower in reporting this frigid low which broke the nearly 100-year old state record of -59 F at Leech Lake Dam on February 9, 1899.

On Monday of this week there was snow reported around the San Francisco Bay area in California and by Tuesday evening, snow was reported dusting the beaches of Malibu in southern California, a rare event for them. The jet stream was positioned directly over California with a strong north to south orientation, drawing down very cold arctic air from higher latitudes.

Wednesday brought freezing rain to Kansas and upstate New York. Ice as thick as 1/2 inch coated power lines and streets in places. Many schools, government buildings and businesses were closed as a result.

Topic: Congratulations to Gary McDevitt

Friend and colleague, Gary McDevitt, hydrologist at the National Weather Service in Chanhassen recently won the prestigious Isaac M. Cline award for hydrology. His expertise in forecasting the many flood crests on Minnesota watersheds last spring was cited as exemplary service to citizens of the state. The Cline Award is an annual national competition for service to the public by meteorologists and hydrologists and is roughly equivalent to winning the Oscar in the Motion Picture industry. Gary is now on his third decade of service to the Minnesota community and much deserving of this award as one of the best public servants I know.

Topic: Preliminary climate summary for January 2002

Following the warm pattern established in November and continued in December, January will go down as one of the warmest (perhaps top 10) in history. In fact, for the Twin Cities record it will likely be the 4th warmest January since 1891 (only 1931, 1990, and 1944 were warmer). Record high maximum temperatures were reported around the state on the 8th and 9th (50s F) as well as the 25th and 26th (50s F to 61 F). Most observers reported a January mean temperature that was 9 to 11 degrees F above normal. When combined with the

previous two months, the November through January period is likely the warmest such period in the Minnesota record books on a statewide basis.

January precipitation was generally less than normal. Most places reported six days or less with measurable precipitation. Total snowfall ranged from less than 1 inch in some western and southern counties to a little over 10 inches in the Lake Superior northshore area.

Topic: Some notes on Duluth Weather

With MPR's Morning Edition broadcasting from this port city next week, I thought it might be useful to highlight some of the weather history from Duluth. This city was one of the first 24 in the United States to establish an official government weather service as part of the old Army Signal Corp. The office was set up on October 18, 1870. Regular observations were taken routinely and reported to the regional office in Chicago. Of course the main purpose was to serve the shipping interests of the Great Lakes. These historical observations at Duluth provide the longest continuous weather records for the western shores of Lake Superior.

All-time weather extremes at Duluth include: a 106 degrees F on July 13, 1936; a -41 degrees F on January 2, 1885; 5.20 inches of rainfall on July 21, 1909; 24.1 inches of snowfall on November 1, 1991 (storm total 36.9 inches a state record); lowest barometric pressure of 28.57 inches on January 11, 1975. Duluth has reported snowfall as late as June 2nd (0.2 inches in 1945) and as early as August 31st (Trace in 1949). Frost has been reported as late as June 21st and as early as August 27th. To my knowledge Duluth has never reported a tornado, though a handful of them have been reported from St Louis County.

One of the more unusual weather reports from Duluth shows that on July 4th, 1876 residents made ice cream for the holiday by using ice harvested from the harbor waters.... must have been a cold summer on Lake Superior. More information on weather and climate can be found at the web site of the National Weather Service Office in Duluth..

<http://www.crh.noaa.gov/dlh/duluth.htm>

Some famous Duluth area storms:

March 8-9, 1892....a blizzard which brought 70 mph winds and snow drifts of 20 ft or more, which blocked even second story windows of city buildings.

November 27-28, 1905.. a deep low pressure system brought 60 mph winds to Duluth. Lasting 13 hours, these winds

were accompanied by snows (up to 7 inches) and a 41 degree F drop in temperature. The ship Mataafa struck a pier entering Duluth harbor and broke in two.

November 9-10, 1913..the famous "Fresh Water Fury" storm struck the Great Lakes with hurricane force winds. Three ships were sunk on Lake Superior.

March 14-15, 1941..a blizzard struck the Duluth area with winds to 75 mph.

December 5-8, 1950..another blizzard delivered 25.2 inches of snow to the Duluth area.

November 28, 1960..a strong low pressure system passing to the south brought easterly gales to the northshore area (winds up to 70 mph), producing 30 to 40 ft waves on Lake Superior. Massive property damage along the shoreline areas occurred. Grand Marais was under 3 ft of water at one time.

March 23-24, and 26-29, 1975, hurricane winds with 20 ft waves damaged shoreline areas along Lake Superior. Duluth received over a ft of snow from each storm.

November 10-11, 1975..the famous Edmund Fitzgerald storm on Lake Superior..

March 3-4, 1985..another blizzard delivered over 2 ft of snow to some northshore areas. Second story high drifts were reported in Duluth.

September 18, 1991...earliest substantial snow storm ever, delivered 2.5 inches to Duluth...

October 31-November 2, 1991...Halloween Blizzard brought 36.9 inches of snowfall to Duluth, the most ever from one storm.

November 27, 2001...strong northeasterly winds produced massive waves in the Duluth area, severely damaging the ship canal walkway and shoreline areas.

MPR listener question: What is the current depth of frozen soil around the state?

Answer: Obviously with the warm temperature trend it is considerably less than normal. According to recent data from the Minnesota State Climatology Office, the depth of frozen soil ranges from 4 to 9 inches in southern counties, and from 12 to 18 inches in central and northern counties. The shallow depth of freezing may mean earlier spring field working opportunities for the state's farmers.

Twin Cities Almanac for February 1st:

The average MSP high temperature for this date is 21 degrees F (plus or minus 14 degrees F standard deviation), while the average low is 3 degrees F (plus or minus 15 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 54 degrees F in 1931; lowest daily maximum temperature of -12 degrees F in 1996; lowest daily minimum temperature of -28 degrees F in 1951; highest daily minimum temperature of 33 degrees F in 1892; record precipitation of 0.89 inches in 1922; and record snowfall of 4.3 inches in 1899: There have been thirty-two measurable snowfalls on this date since 1891, most recently 2.2 inches in 1989. Record snow depth on this date is 12 inches in 1950.

Average dew point for today's date is 3 degrees F, with a maximum of 35 degrees F in 1931 and a minimum of -35 degrees F in 1951.

All-time state records for February 1st:

Scanning the state climatic data base: the all-time high for this date is 60 degrees F at St Peter (Nicollet County) in 1931; the all-time low is -58 degrees F at Tower (St Louis County) in 1996.

Words of the Week: Fresh Water Fury

This name was given to the strong November gales that sometimes blow across the Great Lakes, producing massive waves and causing many shipwrecks. A book by this name written by Frank Barcus in 1986 (Wayne State University Press) described the tragic Great Lakes storm of November 9-10, 1913 when 17 ships were sunk and over 270 sailors lost their lives.

Outlook:

Somewhat above normal temperatures, cloudiness and frequent chances for snowfall will characterize the next week. Chances for snow are best in the north and central counties this weekend, then again statewide by the middle of next week.

To: Perry Finelli, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 8, 2002

On Monday (Feb 4th) this week Embarrass, MN reported a low of -27 degrees F, while Tower, MN reported -28 degrees F, the lowest temperature in the lower 48 states on that date. These are also the coldest temperatures of the winter reported anywhere in Minnesota.

Conversely, on Wednesday (Feb 6th), southerly winds and abundant sunshine brought record warmth to some communities. International Falls reported a record high of 44 degrees F, Grand Forks (ND) reported a record high of 47 degrees F, while Hutchinson and Olivia reported record highs of 54 degrees F, and Willmar reported a record high of 52 F.

And on Thursday (Feb 7th) Willmar and Olivia reported record highs of 57 degrees F, while Pipestone tied their record high (1987) with 55 degrees F.

Topic: Happy Birthday earlier this week

Tuesday, February 5th was National Meteorologist's Day, the anniversary of when in February 1870 that the U.S. Congress sent legislation for President U.S. Grant's signature forming a telegraphic weather service within the U.S. Army Signal Service. This organization was a predecessor to the present National Weather Service. The day has been said to also commemorate the birthday of Dr. John Jeffries in 1744. He was one of America's first weather observers, taking daily weather observations in Boston starting in 1774. Later as a loyalist he moved back to England where he, along with Frenchman Jean-Pierre Blanchard, became the first to cross the English Channel in a balloon in 1785.

Topic: EPA web site

The EPA now offers a web site to obtain the daily air quality index and forecast for major U.S. cities. The web address is....

www.epa.gov/airnow

Speaking of air quality, Salt Lake City, the site of the Winter Olympics has been suffering under stagnant high pressure for several days, with spells of smog, smoke, and fog which have diminished their air quality. Thankfully, a rapidly moving frontal system will bring increasing winds and some snow to the area on Friday, perhaps clearing the air a bit for the first Olympic weekend activities.

Topic: Forecasting Partners for the Salt Lake City Winter Olympics

A unique blend of public, private, and education institutions will provide weather services for the 19th Winter Olympic Games hosted by Utah starting this week. The National Weather Service will provide travel forecasts for visitors, satellite and radar updates for event managers, and basic meteorological and hydrological model guidance for 1 to 7 days ahead. A team of 13 private meteorologists will provide specific forecasts for each competitive venue during the games. They will focus on briefing the managers, judges and competitors for each outdoor event on expected conditions day to day and whether or not there will be changing weather conditions which may effect competitors performance or the safety of specatotors. They will also forecast specifically for the opening and closing ceremonies. Lastly, meteorologists and students from the University of Utah will be responsible for measuring and monitoring the environmental conditions on site at each of the venues. In this context athletic performances can be gaged against the environmental conditions under which they were achieved. All in all, the weather effects on the coming Olympic Games should be well documented and perhaps studied more than those of any previous competitions.

MPR listener question: It seems that we hardly ever get any significant snowfalls in February. What is the greatest daily snowfall in the Twin Cities during February?

Answer: You are quite right. Compared to other months, daily snowfall extremes during February are rather small. The greatest daily amount I can find in the Twin Cities record (1891-2002) is 9.3 inches which fell on February 9, 1909.

Twin Cities Almanac for February 8th:

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

MSP weather records for this date include: highest daily maximum temperature of 50 degrees F in 1991; lowest daily maximum temperature of -19 degrees F in 1899; lowest daily minimum temperature of -29 degrees F in 1899; highest daily minimum temperature of 36 degrees F in 1966; record precipitation of 1.08 inches in 1966; and record snowfall of 5.0 inches in 1905: There have been eighteen measurable snowfalls on this date since 1891, most recently 1.3 inches last year. Record snow depth on this date is 22 inches in 1967.

Average dew point for today's date is 3 degrees F, with a maximum of 39 degrees F in 1966 and a minimum of -32 degrees F in 1971.

All-time state records for February 8th:

Scanning the state climatic data base: the all-time high for this date is 66 degrees F at Madison (Lac Qui Parle County)

and Wheaton (Traverse County) in 1991; the all-time low is -55 degrees F at Warroad (Roseau County) in 1933.

Word of the Week: Cacimbo

This is a word used in central Africa to refer to a spell of poor air quality caused by fog, mist, or smoke. A cacimbo obscures the view of most landscape features that are visible on clear days. It is not wise to travel on a cacimbo day...

Outlook:

A significant snowfall with plenty of wind looks to be in store for the weekend. Temperatures may fall to near normal levels following this storm. There will be another chance for snow in the north early next week, and statewide again by the middle of the week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 15, 2002

On Monday (Feb 11th) record high temperatures were set in the Red River Valley of eastern North Dakota at Fargo (55 degrees F) and Grand Forks (50 degrees F) and in northern Minnesota at International Falls (42 degrees F). A record high temperature of 48 degrees F was also reported at Pine River Airport (Cass County) in Minnesota.

On Thursday this week (Feb 14) more record high temperatures were reported in North Dakota at Fargo (43 degrees) and Grand Forks (40 degrees). The minimum temperature on Thursday at Minneapolis-St. Paul, MN was only 33 degrees, which set a high low temperature record for the date.

Topic: More on ice buildings

Earlier this winter we spoke about the ice hotel in Quebec Canada as a unique tourist attraction. This hotel is made out of ice blocks and snow. The cities of Hancock and Houghton on the Keweenaw Peninsula of upper Michigan have taken up the challenge. Each city now displays a building made entirely of snow. The one in Hancock houses a display of ice sculptures, including furniture made of ice. The building in Houghton houses a display of historical photos about past winter festivals in that part of Michigan. Each building is expected to last until March, but they may become winter traditions in these two Michigan towns.

Topic: New Monthly and Seasonal Climate Outlooks

The Climate Prediction Center released the new monthly and seasonal climate outlooks on Thursday afternoon (Feb 14th). The outlooks suggest that warmer than normal temperature trends will continue to dominate over the western Great Lakes region, including Minnesota for the March through May period. This is suggested by the absence of snow cover, and relatively dry soils. The sun's daily energy, amplified by a higher elevation angle and longer daylength, will be used for heating the soil rather than melting snow cover or evaporating ponded water.

The outlook for precipitation suggests near normal amounts for the same period.

Topic: Comments on last weekend's storm

Though the media meteorologists as well as those employed by the National Weather Service were criticized for over-forecasting the winter storm last weekend, I would like to emphasize that their mistake was on the side of public safety. They forecast

not just for the Twin Cities, but for a very large fraction of the state. In reality, the storm brought fierce winds, very poor visibility, and considerable snowfall to many areas of the state, especially in the western, central and southwestern counties. Many places reported 3 to 6 inches of snow. Springfield and Lambert reported 7 inches of snow. Though the Twin Cities metro area reported very little, Cokato in Wright County, just west of Minneapolis reported 6 inches. The storm system track did not favor the Twin Cities with appreciable snowfall or even dangerous driving conditions, but our friends in greater rural Minnesota undoubtedly had a better appreciation for the meteorologists who gave them some warning of pretty dangerous conditions for their areas of the state.

MPR listener question: Many places around the state have reported temperatures in the 50s F this month, and we at Southwest State University in Marshall have already recorded a high of 61 degrees F (back on Feb 9th). What is the all-time state high temperature for the month of February?

Answer: Though it has been warm this month, with some daily highs that are close to 20 degrees warmer than normal, we have not seen any temperatures yet close to the February state record of 70 degrees F reported at Lake Wilson (Murray County) on February 23rd of 2000. Incidentally, the previous old record for February was from St Peter, MN where on February 26th of 1896 the temperature reached 68 degrees F.

Twin Cities Almanac for February 15th:

The average MSP high temperature for this date is 24 degrees F (plus or minus 13 degrees F standard deviation), while the average low is 7 degrees F (plus or minus 15 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 63 degrees F in 1921; lowest daily maximum temperature of -11 degrees F in 1936; lowest daily minimum temperature of -22 degrees F in 1939; highest daily minimum temperature of 37 degrees F in 1921, 1981, and 1984; record precipitation of 0.87 inches in 1967; and record snowfall of 8.5 inches also in 1967: There have been twenty-seven measurable snowfalls on this date since 1891, most recently 1.0 inches in 2000. Record snow depth on this date is 21 inches in 1979.

Average dew point for today's date is 11 degrees F, with a maximum of 44 degrees F in 1921 and a minimum of -25 degrees F in 1946.

All-time state records for February 15th:

Scanning the state climatic data base: the all-time high for this date is 67 degrees F at Winona (Winona County) in 1921; the all-time low is -53 degrees F at Ada (Norman County) in 1936.

Word of the Week: Cx

If Ci is the international meteorological code for cirrus clouds and Cu is the code for cumulus clouds, what is Cx? Well, interestingly enough it is not the abbreviation for any cloud type, but it is increasingly used in the meteorological and climatological community as an abbreviation for climate change. So if you overhear any conversations among scientists using the term CX, you'll know that they are talking about climate change.

Outlook:

Continued warmer than normal temperatures but increasing chances for precipitation for much of next week, especially Tuesday through Thursday. This may occur in the form of rain or snow.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 22, 2002

Topic: Wetter weather this week

A large storm system over the nation's midsection spread heavy rain northward into the Midwest on Tuesday. Usually, this region receives snow, but daily rainfall records were set at La Crosse, WI (0.96 inches) Rochester, MN (0.67 inches), Rushford, MN (0.58 inches), and Wabasha, MN (0.62 inches)

The winds shifted to the north on Wednesday ushering in cold air to collide with the humid air left over from Tuesday. This produced some significant snowfalls across the central and eastern sections of the state. Tofte along the Lake Superior shoreline recorded a new record snowfall for February 20th with 5.5 inches. Two Harbors recorded over 4 inches. Much of northwestern Wisconsin reported from 5 to 9 inches of new snowfall as well. These were the most significant snowfalls yet this month.

Topic: Mildest Winter Continues

Sunday and Monday brought some additional record-setting temperatures to the region in terms of record high temperatures (Fargo, Grand Forks) and record warm low temperatures (Twin Cities). Though the mild winter has produced some economic hardship for those who depend on winter tourism, for the state overall, the net economic effect has been significantly positive in terms of energy use for heating buildings and homes. For the period from November to mid-February the total number of Heating Degree Days, commonly used as an indication of energy consumption for heating, shows a value that is 23 percent below the historical average. In addition, the cost of keeping roads clear of snow and ice has been thousands to millions of dollars less than that of an average winter. So with the economic downturn having a number of negative consequences we should not discount the good fortune provided by Mother Nature.

Topic: History of Ice and Boat Traffic on Lake Pepin

Lake Pepin in southeastern Minnesota is known for providing a great environment for outdoor recreation, both in the summer and the winter. The surface of the lake usually freezes early in December and the ice typically becomes thick, averaging up to 24 inches. This allows cars to travel on the lake in some winters, when the lake is used for ice fishing, skating, ice boat sailing and cross-country skiing.

The lake usually opens in March, when the barge traffic resumes. Fishing, sail-boating, and water skiing are commonly seen in the summer months.

Being part of the navigable Mississippi River channel, records of steamboat and barge traffic have been kept there for over 150 years. In pioneer times it was a distinct honor as well as an economic advantage to be the first steamboat to pass through Lake Pepin on the way to St Paul in the late winter or early spring. Ice would typically close the lake to boat traffic by the last week of November (26th). Conversely, the lake would open for boat traffic as soon as the loss of ice conditions allowed, typically around the 2nd week of April (11th). Today, with the trend toward warmer and shorter winters, these average dates have changed somewhat. Lake ice more typically prevents boat traffic by the first week of December, while the lake is ice-free typically by mid March (17th). After the record-setting mild winter of 1999-2000, Lake Pepin opened to boat traffic on February 29th!

Often the dates associated with the closing and opening of Lake Pepin for boat traffic are an indication of the severity or length of the winter season. For example, extreme cold in late October and early November closed the lake to navigation by November 14th in 1873, while the mildest winter of the 19th Century allowed the first steamboat to pass through the lake on March 9, 1878.

On the other hand, sometimes the closing and opening dates for navigation on Lake Pepin are simply indications of unusual water conditions. For example, the closing of the lake on November 2, 1882 was strictly because of very low water, while the opening of the lake on May 11, 2001 (the latest ever) was the result of the persistent spring flood levels in 2001.

MPR listener question: How can I estimate the wind speed from visual observations?

Answer: This is difficult to answer. There is no visual technique that is very precise. You can categorically estimate wind speed in some cases. For example, when you observe smoke or stack plumes maintaining a somewhat continuous column as they rise through the air, the wind speed is typically less than 10 mph. Small branches on trees often move when wind speeds exceed 15 mph, and small trees move when wind speeds exceed 25 mph. Empty garbage cans blow about the yard when wind speeds exceed 30 mph. I don't know about full garbage cans!

Twin Cities Almanac for February 22nd:

The average MSP high temperature for this date is 29 degrees F

(plus or minus 12 degrees F standard deviation), while the average low is 11 degrees F (plus or minus 13 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 57 degrees F in 1930; lowest daily maximum temperature of 1 degree F in 1914; lowest daily minimum temperature of -16 degrees F in 1910; highest daily minimum temperature of 38 degrees F in 1930; record precipitation of 1.13 inches in 1922; and record snowfall of 5.3 inches in 1913. There have been thirty-three measurable snowfalls on this date since 1891, most recently 0.3 inches in 2001. Record snow depth on this date is 27 inches in 1967.

Average dew point for today's date is 14 degrees F, with a maximum of 37 degrees F in 1906 and a minimum of -21 degrees F in 1965.

All-time state records for February 22nd:

Scanning the state climatic data base: the all-time high for this date is 66 degrees F at Meadowlands (St Louis County) in 1961; the all-time low is -46 degrees F at Bemidji in 1939.

Word of the Week: nib-nebs

This is a Scottish term for Jack Frost, cold personified. It derives from nib meaning to poke or point, and neb meaning kiss. One possible connotation is that when kissed by Jack Frost you are poked by his cold nose. Nib-nebs has certainly been absent this winter, but is likely to return next week.

Outlook:

Chance of more rain, freezing rain, and snow this weekend statewide, but mostly on the light side. Snowfall may be more consistent in the northern counties. Dramatically cooler temperatures will emerge on Sunday and carry into next week, with some lows below zero and generally stronger winds, a late February taste of real winter.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, March 1, 2002

Topic: Preliminary Climate Summary for February

All observers around the state reported a warmer than normal February. Temperature extremes ranged from 65 degrees F at Worthington on the 24th to -28 degrees F at Tower on the 4th. The mean monthly temperature ranged from 7 to 10 degrees above normal, following the pattern established during the record warm November and consistent throughout this winter. Locally, the Twin Cities reported the 5th warmest February since 1891, and it was equally the 5th warmest on a statewide basis. Combined with the earlier warmer than normal months, the state recorded the 2nd warmest December through February period (warmest was 1997-1998) and the warmest ever November through February period (surpassing 1930-1931) in the modern record. The winter of 1877-1878 holds the record for the warmest ever November through March period, so that March 2002 will have to be unusually warm to approach this record.

Precipitation for February 2002 was generally less than normal. Exceptions were found in eastern and northeastern counties, as well as a few southeastern counties. Hinckley for example reported 2.40 inches, or 1.64 inches above normal, while Lanesboro reported 2.80 inches of precipitation, a value that is 1.91 inches above normal. Total snowfall for the month was less than normal in most places, but there were exceptions to this. Northwestern and north-central counties reported just 2-3 inches, while northeastern areas reported 6-12 inches. Central and southern counties generally reported 4-9 inches. Portions of Pine County, between Hinckley and Moose Lake reported the most snowfall, ranging from 15 to 19 inches.

For our friends in upper Michigan it was a challenging February, with many lake-effect snowfalls. Marquette had 0.8 inches of snow by Thursday evening (Feb 28th), which boosted the monthly snowfall total for February to 91.9 inches, setting the all-time snowfall record for any month at that location.

Topic: Rwanda, Africa, Lightning Capital of the World

NASA scientists who have been studying the frequency of lightning strikes using satellite data have discovered that Rwanda in east-central Africa sees the most lightning strikes on an annual basis. Formerly, climatologists thought that Florida recorded the most lightning strikes per year. But the low latitude position of Rwanda (about 2 degrees South latitude), combined with its topography

and proximity to the Lake Victoria and the Indian Ocean produces a highly convective environment year-round, so that thunderstorms are most numerous. The average lightning strikes per year in Florida is about 35 per square km, while in Rwanda it is 83 strikes per square km.

MPR listener question: How many times have we seen 20 or more inches of snowfall in the month of March and do you think it will happen this year?

Answer: For the Twin Cities, 20 or more inches of snowfall has occurred in March only 9 times since 1885, most recently in 1989 with 22.9 inches. The outlook favors colder and wetter than normal conditions for the first half of March, but I don't know that this will translate into 20 inches of snow.

Twin Cities Almanac for March 1st:

The average MSP high temperature for this date is 32 degrees F (plus or minus 12 degrees F standard deviation), while the average low is 15 degrees F (plus or minus 13 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 59 degrees F in 1990; lowest daily maximum temperature of 0 degree F in 1962; lowest daily minimum temperature of -32 degrees F in 1962; highest daily minimum temperature of 35 degrees F in 1983 and 1992; record precipitation of 1.62 inches in 1965; and record snowfall of 6.6 inches in 1932. There have been nineteen measurable snowfalls on this date since 1891, most recently 1.3 inches in 1998. Record snow depth on this date is 23 inches in 1962 and 1967.

Average dew point for today's date is 14 degrees F, with a maximum of 41 degrees F in 1992 and a minimum of -34 degrees F in 1962.

All-time state records for March 1st:

Scanning the state climatic data base: the all-time high for this date is 70 degrees F at Milan (Chippewa County) in 1992; the all-time low is -47 degrees F at Bigfork (Itasca County) in 1962.

Word of the Week: Udometer

Rarely used anymore, this was one of the original names given to the rain gauge. It is Latin in derivation, from udus meaning moist or wet and metre, meaning to measure. Some references show the first udometers were used in parts of Asia in the 1400s.

Outlook:

Colder than normal weather continuing into the weekend and next

week. Chances for snowfall Saturday and again much of next week.
We may see colder temperatures during the first week of March
than we have any other week of the winter.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, March 8, 2002

Topic: Cold start to March

High temperatures on Sunday across the Plains and Mississippi Valley ranged from 25 to 30 degrees below the average highs for early March. Record cold high temperatures were set in Minnesota at Rochester (6 degrees F) and Minneapolis-St. Paul (7 degrees F); and in Iowa at Des Moines (9 degrees F).

On Sunday evening several locations in the Midwest set record low temperatures in Iowa at Dubuque (10 degrees below zero) and Mason City (6 degrees below zero) and in Illinois at Peoria (zero degrees). Also on Sunday night, The temperature at La Crosse, WI finally fell below zero degrees for the first time this winter, marking the latest date for the first subzero reading as well as the end of the longest stretch of 368 days without reaching zero. Typically, La Crosse has 23 subzero days each winter.

Finally, on Wednesday, Flag Island, MN reported the lowest temperature in the contiguous 48 states with a -9 degrees F reading.

Typically in March we gain about 15 to 16 degrees F in the daily mean temperature and of course we see an increase of 1.5 hours in daylight by the end of the month....something to look forward to.

Topic: Record cold of March 1843

Though this March has produced some record-setting cold temperatures in places, it cannot touch March of 1843. That particular March is the coldest in the record books for much of the upper midwest including the Twin Cities (Ft Snelling), Madison, WI, and Omaha, NE (Ft Croghan). Widespread snow cover across the region combined with an anchored high pressure ridge drawing down air from high latitudes in Canada resulted in record setting cold. Low temperatures recorded at Ft Snelling included -16, -20, -16, -17, -20, -18, -15, -15, and -11 degrees F on 1st, 2nd, 3rd, 8th, 13th, 16th, 23rd, 26th, and 30th of the month. Seven of these low temperatures have withstood the test of time and are still records for the respective dates (after 160 years of weather!), including the -11 degrees F on March 30th which remains the latest date ever for a reading below zero. The highest temperature recorded at Ft Snelling during March of 1843 was 28 degrees F and the monthly mean value was 4.7 degrees F, fully 26 degrees colder than normal. The March mean temperature at Madison, WI was 13 degrees F, 33 degrees F colder than normal, and the same mean temperature of 13 degrees F was reported at Ft Croghan (Omaha,

NE), a value that is 37 degrees F colder than normal. It was reported in one climatological study of that period that on March 1st all of the Great Lakes were covered with ice. Though snowfall records were not routinely kept at that time, it is estimated that Ft Snelling received 90-95 inches of snowfall that winter, including 12 inches in March. Of course we should remember that it was still the Little Ice Age in 1843!

MPR listener question: Is freezing rain a common occurrence in the month of March?

Answer: According to National Weather Service records for the Twin Cities, freezing rain occurs in the month of March with a frequency close to 1 in 4 years. This frequency is close to that of the month of November, but is not the highest frequency of any month. That distinction belongs to December which has a frequency of freezing rain about once every 2.5 years.

Twin Cities Almanac for March 8th:

The average MSP high temperature for this date is 33 degrees F (plus or minus 10 degrees F standard deviation), while the average low is 17 degrees F (plus or minus 11 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 69 degrees F in 2000; lowest daily maximum temperature of 10 degree F in 1908 and 1932; lowest daily minimum temperature of -7 degrees F in 1967; highest daily minimum temperature of 44 degrees F in 1898; record precipitation of 0.94 inches in 1999; and record snowfall of 12.5 inches also in 1999. There have been twenty-four measurable snowfalls on this date since 1891, most recently a record 12.5 inches in 1999. Record snow depth on this date is 22 inches in 1962.

Average dew point for today's date is 15 degrees F, with a maximum of 42 degrees F in 1988 and a minimum of -17 degrees F in 1967.

All-time state records for March 8th:

Scanning the state climatic data base: the all-time high for this date is 80 degrees F at Mankato in 1987; the all-time low is -35 degrees F at Big Falls (Koochiching County) in 1943.

Words of the Week: Blackthorn winter

"Tossing his mane of snows in wildest eddies and tangles,
Lion-like, March cometh in, hoarse, with tempestuous breath,
Through all the moaning chimneys, and thwart all the hollows and angles,
Round the shuddering house, threatening of winter and death....."

(From "In Earliest Spring" by William Dean Howells, 1837-1920)

Last week I referred to the first week of March with the old

expression "in like a lion", something derived from the above poem. Basically, this acknowledges how winter-like March can be, especially the first part of the month. Indeed, it has been this year, with some of the coldest weather of the year. You might say it is Minnesota winter, Chapter II....

Such a period in England might be referred to as blackthorn winter. This was pointed out to me by my colleague Dr. Michael Russelle of the USDA Agricultural Research Service in St Paul. It is an old English expression for a second or short winter, usually bringing a week or two of cold, windy and dry conditions in the early spring (March or April). The dryness from this cold condition can lead to problems with the skin, throat and eyes.

Outlook:

March will continue behaving like a lion this weekend with snow across the state on Saturday, strong winds, and colder than normal temperatures. Chances for more light snow in the north on Monday, then again towards the end of next week. Temperatures will continue to average colder than normal.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, March 15, 2002

Happy St Patrick's Day (this Sunday)...the windiest holiday on the calendar... and likely a white one this year...

Quite a storm this week...following a strong winter storm last weekend which brought freezing rain, sleet and snow.. a whopper of a snow storm passed across the central part of the state on Thursday (March 14) bringing record snowfall amounts to many places, bottling up traffic, and causing a power outage in Owatonna. The following are the snowfall totals which set NEW RECORDS for March 14 and 15.....

MSP (Chanhassen) 10.8 inches (9.0 on Mar 14th, a new record)
St Cloud 17.5 inches
Litchfield 15.0 inches
Milaca 11.0 inches
Little Falls 10.0 inches (tied record amount from 1957)
Redwood Falls 12.0 inches
Olivia 17.0 inches
Gaylord 11.0 inches
Mora 18.0 inches
Hutchinson 15.0 inches
Cambridge 14.0 inches
Willmar 17.5 inches
Canby 16.0 inches
New London 15.0 inches
Madison 13.0 inches
Vesta 12.0 inches
Granite Falls 13.0 inches
Dawson 21.0 inches

The snowfall at Canby produced a water equivalence of 1.55 inches, a new precipitation record for March 14th. The 21 inches at Dawson was the heaviest snowfall (anytime of year) ever for that community.

Anniversary of remarkable temperature change....

On this date in 1897, Detroit Lakes in Becker County reported a morning low of -43 degrees F, but by the next afternoon (March 16) the temperature was 45 degrees F, a rise of 88 degrees F in one and a half days! Typical March in Minnesota!

An Innovation Award for the U.K. Met Office

The United Kingdom Meteorological Office was recently nominated for a technology innovation award. They have worked with the St Vincent School for the Blind in England to develop a curriculum in meteorology using braille based maps and graphics.

Thus the "visualization" of weather features can be achieved in a tactile manner. Remarkable achievement I think!

Topic: Anniversary of a famous blizzard

On this date in 1941, one of the most sudden and severe blizzards in modern times struck North Dakota and Minnesota. The storm hit on a Saturday night while many were traveling, and thus claimed 71 lives. Winds gusts were of hurricane force. Grand Forks reported a gust of 85 mph, Fargo a gust of 74 mph, and Duluth a gust of 75 mph. Though snowfall amounts were generally modest, snow drifts twelve feet high were reported in north central Minnesota. Crookston in Polk County of the Red River Valley caught the most snow recording 12 inches. The associated cold front moved very rapidly, averaging 30 mph as it crossed Minnesota in just seven hours. The temperature dropped 18 degrees in 5 minutes when the storm hit the Duluth harbor.

In the aftermath of this blizzard (and that of the Armistice Day Blizzard the previous November), the National Weather Service Office in Chicago relinquished forecast jurisdiction to the Minneapolis Office.

MPR listener question: When does the historical frequency for snowfall in the Twin Cities start to tail off in the spring? For example, how often does it snow in March versus April?

Answer: The average number of days with snowfall in March ranges from 6 to 7 historically, while the average for April is just 1 to 2 days in the Twin Cities area. The historical frequency of snowfall on a daily basis really tails off after April 16th, dropping from about 10 percent before that date (approximately 1 year out of 10) to just around 4 percent in the second half of April (approximately 1 year out of 25). The other feature about the spring snowfalls is that they are very shortlived. The snow cover usually melts away in a day or two, unless there has been an exceptionally large amount, such as the 10.5 inches on March 24-25 of 1996 which took 7 days to disappear, or the nearly 14 inches on April 14 of 1983 which took 6 days to disappear.

Twin Cities Almanac for March 15th:

The average MSP high temperature for this date is 36 degrees F (plus or minus 11 degrees F standard deviation), while the average low is 20 degrees F (plus or minus 12 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 69 degrees F in 1927; lowest daily maximum temperature of 8 degree F in 1900; lowest daily minimum temperature of -7 degrees F in 1897; highest daily minimum temperature of 42 degrees F in 1927; record precipitation

of 0.85 inches in 1945; and record snowfall of 5.0 inches in 1899. There have been twenty-five measurable snowfalls on this date since 1891, most recently 1.5 inches in 1998. Record snow depth on this date is 24 inches in 1962.

Average dew point for today's date is 20 degrees F, with a maximum of 50 degrees F in 1930 and a minimum of -11 degrees F in 1979.

All-time state records for March 15th:

Scanning the state climatic data base: the all-time high for this date is 72 degrees F at Pipestone and Tracy in 1930, at Winnebago and New Ulm in 1935, and most recently at Browns Valley in 1981; the all-time low is -49 degrees F at Pokegama Falls in 1897.

Words of the Week: Wetzel Ingredients Method

Almost sounds like a cookbook..and it is sort of..except it's for meteorologists, not cooks...

This refers to a method of forecasting winter season precipitation developed by Suzanne Wetzel, a former graduate student in atmospheric science at the University of Wisconsin-Madison. It is an analysis of ingredients which contribute to the development and intensity of a winter storm. These include, forced ascent of air, atmospheric stability, available moisture (water vapor), cloud microphysics (ice particle size and growth), and temperature of the air. As a newer method of forecasting it has not established a long track record of success, but it is being utilized by the National Weather Service.

Outlook:

A brief quiet spell on Saturday, then a chance for more snow and/or rain on Sunday, Monday, and Tuesday around the state. More precipitation is also possible on Thursday and Friday as well. Looks like a wetter than normal March is in the cards. Temperatures will moderate, but still average colder than normal for most of the week.

Temperatures will continue to be colder than normal next week with more chances for snow.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, March 22, 2002

Topic: Snow in Abundance

Marquette, MI has recorded an exceptionally snowy winter. With 60 inches of snowfall so far in March, their winter total is now over 277 inches, breaking the record for seasonal snowfall of 272 inches set in 1996-1997. A warmer than normal Lake Superior has fueled this abundant snow season by releasing large quantities of water vapor to storm systems passing over the lake. At one time earlier this month, Marquette reported a snow depth of 5.5 feet. How would you like to shovel that!

Topic: Cold temperatures earlier this week

Edmonton, Alberta reported a morning low of -35 degrees F on Monday, March 18th, a new record low for that city. Later in the week, the same air mass passed across northern Minnesota producing a Wednesday morning low of -6 degrees F at Flag Island in Lake of the Woods. Then on Thursday morning (March 21) Cook, MN reported a low of -8 degrees F. This was the first time this month that a Minnesota weather station has reported the lowest morning temperature in the contiguous 48 states.

The cold front on Thursday was strong enough to produce some record setting cold maximum temperatures around the state and region. The following were all record cold maximum temperatures reported for March 21st....

Redwood Falls 13 F	Alexandria 13 F
Hutchinson 12 F	Willmar 12 F
Grand Rapids 12 F	Montevideo 16 F (tied 1951)
Sioux Falls 13 F	

MSP reported the 2nd coldest ever maximum temperature for March 21st with 15 F, as did St Cloud with 13 F.

MPR listener question: March has seemed much more like Minnesota winter than any other month so far. How often has the March mean temperature been colder than the February mean temperature in the Twin Cities climate record?

Answer: Interesting question, especially following the 5th warmest February (mean temperature 28.4 degrees F) since 1891. So far, the temperature in March is tracking to average about 25 or 26 degrees F, which would place it colder than last month and among the coldest 25 percent historically. Typically we gain about 1.5 hours of day length in March, as well as about 15 degrees F in daily average temperature. Because of this it

is difficult to contemplate March being colder than February. But, it has happened six times. Each of these years is listed below, with the mean February and March temperatures side by side..

Year	February Mean Temp	March Mean Temp
1837	23.8 F	22.9 F
1867	15.7 F	12.9 F
1877	30.6 F	22.2 F
1931	32.0 F	31.4 F
1954	31.8 F	27.9 F
1984	27.5 F	24.8 F

Note that in 1877, 1931, and 1954, February mean temperature was near a record high, and very close to the historical average for March, so that it was relatively easy climatologically for March to turn out colder. 1867 was a desperately cold winter, and even though February was colder than normal, March was in relative terms even colder...and it looks like 2002 may add a 7th case to this unusual temperature and unexpected temperature pattern for these two months in the Twin Cities.

(Note: In 1998, the February and March mean temperatures were exactly equal at 31.9 degrees F)

MPR listener question: We saw temperatures above 50 degrees F last month (February) in the Twin Cities, but have yet to see this so far in March. Checking the records, last March (2001) did not see a temperature of 50 degrees F in the Twin Cities. If the cool weather trend holds up this month we may not see a temperature reading of 50 degrees F or higher for the second consecutive March. Is this pattern of low March temperatures in back to back years unusual?

Answer: Yes, the pattern is unusual in climate history, but it has happened before. There have been 13 years since 1891 when March has failed to bring a temperature reading of 50 F or higher to the Twin Cities. There were two occasions of back to back years: 1950 and 1951 and 1969 and 1970. In fact, except for one lone reading of 50 degrees F on March 30, 1952, there would have been back to back to back years without 50 F in March (1950, 1951, 1952).

Twin Cities Almanac for March 22nd:

The average MSP high temperature for this date is 42 degrees F (plus or minus 12 degrees F standard deviation), while the average low is 24 degrees F (plus or minus 10 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 71 degrees F in 1945; lowest daily maximum temperature of 14 degrees F in 1940; lowest daily minimum temperature of -4 degrees F in 1940; highest daily minimum temperature of 44 degrees F in 1910 and 1935; record precipitation of 1.40 inches in 1952; and record snowfall of 13.7 inches also in 1952. There have been twenty-four measurable snowfalls on

this date since 1891, most recently 0.2 inches in 1993. Record snow depth on this date is 20 inches in 1951 and 1965.

Average dew point for today's date is 23 degrees F, with a maximum of 50 degrees F in 1939 and a minimum of -10 degrees F in 1944.

All-time state records for March 22nd:

Scanning the state climatic data base: the all-time high for this date is 81 degrees F at Pipestone in 1939; the all-time low is -30 degrees F at Pokegama Falls and Pine River Dam way back in 1888.

Words of the Week: Freshet

This term actually has three definitions for the climatologist: (1) it refers to the annual spring rise of streams in cold climates when they are discharging the melting snow pack from the surrounding landscape; (2) it refers to minor stream flooding as a result of heavy rainfall or rapidly melting snow cover; and (3) it refers simply to a small fresh water stream, even ones that are ephemeral in nature. Many of these are likely to form as we melt the current snow cover around Minnesota.

Outlook:

Generally a dry week ahead with a chance for rain or snow in northeast sections by late Tuesday. A warming trend will start Wednesday allowing more daytime temperatures to reach the 40s and 50s F. A chance for rain by Friday of next week.

To: The Morning Edition Crew
From: Mark Seeley, Dept of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, March 29, 2002

Topic: More Snow for Marquette, Michigan

The National Weather Service this week announced that the seasonal snowfall at Marquette, MI has surpassed 300 inches, a record by over 27 inches. This is a remarkable amount of snow for any place in the United States, except for some higher mountain elevations in the west.

Topic: Preliminary Climate Summary for March 2002

March brought a sudden reversal in temperature trend to the state of Minnesota. After consistently warmer than normal temperatures from November through February, over 75 percent of the days in March registered below normal temperatures. Most Minnesota communities reported a mean monthly temperature that was 7 to 10 degrees less than normal. Temperature extremes for the month ranged from 59 degrees F at Browns Valley (Traverse County) on the 13th to -28 degrees F at Tower and Warroad on the 2nd.

Precipitation in March was generally less than normal around the state, except for eastern sections which showed amounts from 0.50 to 1.00 inches above normal. Parts of the Red River Valley were the driest with just 0.2 to 0.3 inches of precipitation to report. Parts of central and southeastern Minnesota reported 2.0 to 3.0 inches. The greatest amount of precipitation in one day occurred at Cokato on the 15th when 1.89 inches fell (primarily in the form of snow). Total snowfall for the month was mixed, but most generally above normal thanks to two major winter storms (March 7-9 and 14-15). Many communities, including the Twin Cities reported total snowfall ranging from 10 to 20 inches. Duluth reported nearly 28 inches and Bruno in Pine County reported nearly 34 inches for the month.

One of the most distinguishing features of this March in the Twin Cities area is the fact that the mean monthly temperature was nearly the lowest of the winter season (November through March), something that has never occurred in the 182 year old climate history here. This was primarily due to the fact that November through February was exceptionally unusual, record-setting in many instances. The March mean temperature will likely fall in the coldest 20 percent historically, but enough to be colder than the other months of winter.

MPR listener question: What were the temperature and dew point conditions in southern Minnesota preceding

the now famous outbreak of tornadoes on March 29, 1998?

Answer: That's right, today marks the 4th anniversary of those most unusual March tornadoes. Temperatures across the southern part of the state that afternoon were in the high 60s F to low 70s F, with dew points in the low 50s F. These are high values for late March, but not typically associated with tornado outbreaks. There were at least 7 different tornadoes detected across southern Minnesota that day, the most destructive passing through St Peter. These were undoubtedly caused by a high degree of atmospheric instability.

Twin Cities Almanac for March 29th:

The average MSP high temperature for this date is 45 degrees F (plus or minus 12 degrees F standard deviation), while the average low is 28 degrees F (plus or minus 10 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 83 degrees F in 1986; lowest daily maximum temperature of 13 degrees F in 1969; lowest daily minimum temperature of -5 degrees F in 1969; highest daily minimum temperature of 57 degrees F in 1910; record precipitation of 0.79 inches in 1998; and record snowfall of 11.0 inches also in 1924. There have been thirteen measurable snowfalls on this date since 1891, most recently 0.3 inches in 1983. Record snow depth on this date is 27 inches in 1965.

Average dew point for today's date is 25 degrees F, with a maximum of 56 degrees F in 1910 and a minimum of -13 degrees F in 1969.

All-time state records for March 29th:

Scanning the state climatic data base: the all-time high for this date is 83 degrees F at Winona in 1910, later tied in 1986 at MSP, Gaylord, Stillwater, and St Paul's Holman Field; the all-time low is -23 degrees F at Itasca State Park in 1921.

Words of the Week: Snow banner

This term refers to the snow that is seen blowing from a hill or mountain crest, often fanning out into a banner shape. Sometimes from high mountain tops this is mistaken for volcanic smoke. Other terms used to describe this feature are snow smoke and snow plume.

Outlook:

Somewhat of a warming trend continuing, with temperatures near seasonal normals. There will be a chance for precipitation Monday through Wednesday of next week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, April 12, 2002

Topic: Soil thawing out

Many places around the state report that soils are thawing out rapidly. Most southern counties report no remaining soil frost and across central and northern Minnesota the top layers of the soil (8 to 12 inches) have thawed. Because of this, the rains this week have been soaking in, a good sign for farmers who have been concerned about moisture recharge prior to spring planting. It is always gratifying to the farmer and gardener alike to see worms forced out of the soil by recent rains. That means the growing season is not far off. Many observers have reported amounts in excess of 1.0 inches this week.

Topic: A white April in Marquette, MI

With 6 more inches of snowfall so far this month, the record seasonal snowfall at Marquette, Michigan continues to increase, now at 307 inches. They still report nearly 2.5 ft of snow cover in the 2nd week of April.

Topic: Reputation at stake

On Wednesday of this week (4/10) Flag Island, MN reported the lowest temperature in the 48 contiguous states with a reading of 21 degrees F, the third time this month that our state has reported the lowest temperature in the lower 48 states. Since January, Minnesota has reported the lowest temperature in the 48 contiguous states only 11 times. Excluding Alaska, this is about half the historical frequency for our state to lead the nation in cold temperatures and a severe blow to our reputation.

Topic: Snow cover detrimental to the Siberian Tiger

A recent report by the World Wildlife Federation suggests that recent severe winters in eastern Russia present a threat to the Siberian Tiger. Snow depths during the past two winters in Siberia have exceeded 5 feet at times, leading to higher than usual mortality of deer, elk, and wild boar, all of which are primary food sources for the Siberian Tiger. This is the largest of the cat family at well over 600 pounds, and such an animal requires a great amount of food. It is well adapted to stalking prey in the winter season as its orange and black coat lightens up to blend in with the snow cover. But there must be a minimal population of prey to sustain a marginal population of Siberian Tigers which are estimated to just number in the hundreds now.

MPR listener question: what are the all-time extreme statewide temperatures for the month of April?

Answer: The highest temperature ever recorded in April was 101 degrees F at Hawley (Clay County) on April 22, 1980. This was a precursor to a drought year in the Red River Valley with a good deal of wind erosion in the spring. The hot spell in April was clearly a "dry heat" as the dew points were in the teens F, producing relative humidities as low as 10 percent in the Red River Valley counties. Several observers reported only a trace or a few hundredths of an inch total precipitation for the month of April.

The lowest temperature ever observed in April was -22 degrees F at Tower (St Louis County) on April 6, 1982 and at Karstad (Kittson County) on April 6, 1979. On both of these days snow cover was still abundant.

Twin Cities Almanac for April 12th:

The average MSP high temperature for this date is 55 degrees F (plus or minus 12 degrees F standard deviation), while the average low is 35 degrees F (plus or minus 8 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 83 degrees F in 1931; lowest daily maximum temperature of 28 degrees F in 1950; lowest daily minimum temperature of 12 degrees F in 1962; highest daily minimum temperature of 60 degrees F in 1941; record precipitation of 0.67 inches in 1983; and record snowfall of 6.0 inches in 1962. There have been just six measurable snowfalls on this date since 1891, most recently 0.8 inches in 2000. Record snow depth on this date is 3.0 inches in 1962.

Average dew point for today's date is 31 degrees F, with a maximum of 61 degrees F in 1941 and a minimum of -1 degrees F in 1950.

All-time state records for April 12th:

Scanning the state climatic data base: the all-time high for this date is 90 degrees F at Beardsley (Big Stone County) in 1931; all-time low is -6 degrees F at Roseau in 1950.

Word of the Week: Fallstreaks

Also called virga, these are visible wisps or streaks of water droplets or ice crystals falling out of a cloud base into drier air, so that they evaporate in short order before hitting the ground. They become more commonly visible during the spring months when altocumulus and cirrocumulus clouds occur with a higher frequency. Sometimes these streaks take on a hook shape because the terminal velocity of the droplet or ice

crystal decreases as it evaporates while falling through the dry air.

Outlook:

Looks like a relatively cloudy weekend with some chance for showers late Saturday and Sunday, and particularly warm and humid by late Sunday. Temperatures will average several degrees warmer than normal through much of the weekend and next week. There will be increasing chance for showers and thunderstorms, perhaps even severe ones for Monday through Wednesday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, April 19, 2002

Topic: New Monthly and Seasonal Climate Outlook

On Thursday of this week the Climate Prediction Center released the outlook for May and the May-July time period. It stipulates equal chances for warmer or colder than normal climate conditions. There is a similar outlook (equal chances for wetter or drier than normal conditions) for precipitation.

Topic: Costing our National Weather Service

Having just recently filed the year 2001 incomes taxes, I could help but think of the following....

Our Federal income taxes help to pay the costs of providing us with the best weather services in the world. The base operational budget for the National Weather Service during the last year was approximately \$693 million. This translates to a service that provides environmental data, local weather watches and warnings, forecasts and outlooks, as well atmospheric and hydrological research, for a modest cost to each U.S. citizen of approximately \$2.46 per year? I think this is a good buy for a great service.

Topic: Severe Weather Awareness and NOAA Weather Radio

Having heard messages all week concerning Severe Weather Awareness, I am reminded to encourage MPR listeners to consider a NOAA Weather Radio. This is a great source of weather information in general, but especially good for your protection from severe weather. Weather radios range in cost from \$25 to \$100, and most are portable so you can take it with you when traveling. Get one with an alarm setting to go off whenever a warning is issued in your area. More information on weather radios can be found at the National Weather Service web site...

<http://205.156.54.206/nwr/index.html>

Topic: April making its mark on weather history

Monday and Tuesday (April 15-16) brought record setting weather to the state...

April 15th..highest temperature ever measured in the state on this date is now the 93 F at Faribault reported on Monday this week. This is also the earliest ever 90 F for the state in the spring.

April 15th..also brought a high of 91 F to the Twin cities, a record for the date and the earliest ever spring temperature so high.

The dew point temperatures of 61 degrees F on Monday (15th) and 62 degrees F on Tuesday (16th) reported at MSP were also records, indicating great amounts of water vapor in the atmosphere.

Over 3 dozen communities around the region reported record high temperatures on Tax Filing Day....April 15th...including....

Eau Claire, WI 91 F Madison, WI 87 F La Crosse, WI 90 F
Estherville, IA 91 F Des Moines, IA 87 F Mason City, IA 91 F
Decorah, IA 91 F Spencer, IA 91 F Sioux City, IA 96 F
Sioux Falls, SD 96 F Yankton, SD 91 F Vermillion, SD 87 F
Marshall, MN 88 F Worthington, MN 90 F Windom, MN 90 F
Jackson, MN 91 F Wadena, MN 79 F Austin, MN 90 F
Winona, MN 90 F St Cloud, MN 84 F MSP, MN 91 F
Redwood Falls, MN 91 F Albert Lea, MN 90 F Farimont, MN 91 F
Cambridge, MN 90 F Faribault, MN 93 F Hutchinson, MN 90 F
Litchfield, MN 84 F Little Falls, MN 82 F Mankato, MN 91 F
Mora, MN 84 F New Ulm, MN 91 F Owatonna, MN 90 F
Red Wing, MN 91 F St James, MN 91 F Hibbing, MN 80 F
Brainerd, MN 84 F Grand Rapids, MN 81 F Aitkin, MN 82 F
Moose Lake, MN 82 F Waseca, MN 92 F Lamberton, MN 92 F
April 15th....MSP dew point of 61 F ties the record for the date

In addition, relatively recent Aprils have brought many other weather records. Last April (2001) was the 2nd wettest statewide in history and for many communities it was the wettest ever (8.30 inches at Canby and 8.42 inches at St Cloud for example). April of 1997 saw the greatest floods in 100 years on the upper Minnesota River and the Red River of the North, with a severe blizzard visiting the Red River Valley on the 6th. April of 1983 brought 21.8 inches of snowfall to the Twin Cities, 13.6 of which fell on the 14th (both record amounts). April 1980 brought temperatures as high as 101 degrees F to the Red River Valley, the only case historically of 100 degrees F temperatures in April, and a value roughly 45 degrees warmer than normal. And finally, April 3, 1982 brought a morning low of 7 degrees F and an afternoon high of 78 degrees F to Lamberton, MN coming close to setting a record low and record high on the same day!

MPR listener question: Why do clouds appear white even at night?

Answer: Clouds are composed of tiny water droplets or ice crystals which mostly scatter white light rather than absorb it. This is due to the size distribution of the droplets or crystals. Thus white light sources from the ground will be scattered in much the same manner as sunlight. Moonlight (which is reflected sunlight) is also highly scattered by clouds, so that their appearance on a moonlit night is white as well.

Twin Cities Almanac for April 19th:

The average MSP high temperature for this date is 59 degrees F (plus or minus 12 degrees F standard deviation), while the average low is 39 degrees F (plus or minus 9 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 87 degrees F in 1985; lowest daily maximum temperature of 35 degrees F in 1928; lowest daily minimum temperature of 19 degrees F in 1928; highest daily minimum temperature of 67 degrees F in 1985; record precipitation of 1.27 inches in 1970; and record snowfall of 1.2 inches in 1982. There have been just six measurable snowfalls on this date since 1891, most recently 1.2 inches in 1983. Record snow depth on this date is 3.0 inches in 1983.

Average dew point for today's date is 35 degrees F, with a maximum of 62 degrees F in 1957 and a minimum of 6 degrees F in 1988.

All-time state records for April 19th:

Scanning the state climatic data base: the all-time high for this date is 95 degrees F at Canby, Lamberton, and Springfield in 1985; all-time low is -3 degrees F at Tower in 1897.

Word of the Week: Disdrometer

This is an instrument used to measure the drop size distribution of precipitation. Some designs calibrate rain drop impact on a sensitive surface with drop size diameter, while other designs utilize video detection of the size and shape of drops as they pass through an optical sensor. We are entering the season of convective precipitation (thunderstorms) when drop size distribution favors the larger droplets held aloft by updraft winds.

Outlook:

A big cool down is coming for the weekend. Temperatures will be below normal most places with a chance for showers in the west and south on Sunday into Monday, possibly mixed with light snow. Temperatures will moderate and perhaps climb to near normal by Wednesday, with a chance for showers statewide by then.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, April 26, 2002

Earlier this week when light snow occurred over the far northern Red River Valley, Gillam, in northeast Manitoba reported nearly 6 inches of snowfall with an overnight low of just 8 degrees F, ..a measure of the cold air that is still north of us this late into April. Further evidence of the cold air was seen on Thursday morning this week, when International Falls reported a new record low for April 25th of 19 degrees F. And finally, on Friday morning, Embarrass, MN reported a low temperature of just 8 degrees F, setting a new all-time state record low for April 26th (breaking the old record of 12 degrees F at the same location back in 1996)....

Topic: April 2002 behaving like a winter month

Just as March brought us much more winter-like weather in the Twin Cities (and statewide for that matter) with nearly 16 inches of snowfall and temperatures that averaged 7 to 8 degrees F cooler than normal, April is strikingly unusual as well.....not just because of the 14 plus inches of snowfall, but because of the temperature variation as well....

Earlier this week a civil engineer pointed out to me the unusual behavior of temperature so far this month. Not that the month has averaged colder than normal (as March did), but because of the daily deviations (both positive and negative) from normal. The average daily departure from normal so far in April has been nearly 10.5 degrees F. This represents a great amount of variability, much more typical of a winter month (Dec-Feb) than a spring month. Extremes have ranged from 16 degrees F colder than normal back on the 3rd to 27 degrees F warmer than normal on the 15th (when the mercury hit 91 F). Over the 18th and 19th of the month there was a 48 degrees F drop in temperature in the Twin Cities area. The closest April with an equivalent variation in daily temperature was back in 1977 when the average daily departure was plus or minus 10 degrees F.

MPR listener question: It has seemed terribly windy this month in Minnesota. Good for kite flying, but not much else. Is it unusual to have so much wind in April?

Answer: Not at all. Past studies by my colleague Dr. Don Baker of the Department of Soil, Water, and Climate have shown that April is the windiest month of the year for most places in the region including the Twin Cities, Rochester, Sioux Falls, Fargo, International Falls, Duluth,

and Redwood Falls. In fact on Wednesday of this week, winds were so strong that they brought a halt to planting and tillage in many agricultural areas. Some reported wind gusts on Wednesday night included....

MSP 43 mph St Cloud 45 mph Duluth 40 mph
Rochester 49 mph Fargo-Moorhead 52 mph Austin 45 mph
Crookston 50 mph Fergus Falls 60 mph Wheaton 45 mph
International Falls 39 mph Sious Falls 47 mph Willmar 49 mph
Marshall 52 mph and St Paul (U of MN) 47 mph

A complete wind climatology for the state has only recently been completed. Statistics on wind direction and wind speed for over 80 different locations are available at the following web site.....

http://www.134.84.160.120/snow_fence/Components/Wind/windmap.htm

Twin Cities Almanac for April 26th:

The average MSP high temperature for this date is 62 degrees F (plus or minus 11 degrees F standard deviation), while the average low is 41 degrees F (plus or minus 8 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 85 degrees F in 1970; lowest daily maximum temperature of 32 degrees F in 1950; lowest daily minimum temperature of 26 degrees F in 1950; highest daily minimum temperature of 60 degrees F in 1915 and 1990; record precipitation of 1.26 inches in 1893; and record snowfall of 3.0 inches also in 1893. There have been just three measurable snowfalls on this date since 1891. Record snow depth on this date is 0.5 inches in 1893.

Average dew point for today's date is 36 degrees F, with a maximum of 61 degrees F in 1938 and a minimum of 6 degrees F in 1933.

All-time state records for April 26th:

Scanning the state climatic data base: the all-time high for this date is 94 degrees F at Marshall (Lyon County) in 1962; all-time low is 12 degrees F at Embarrass in 1996.

Word of the Week: Muggish

A cousin to the word muggy, this is an Old English word to describe a dark and cloudy night when the air feels close, moist, and warm. It is often uncomfortable and produces the curly look even among those of us with notoriously straight hair. This was certainly the case on Tuesday night and Wednesday morning this week as clouds rolled in and the overnight dew point slowly rose to an astonishing 55 degrees F by 4 am in the Twin Cities, producing a muggish feeling

for those who couldn't sleep.

Outlook:

A cool, unsettled period of weather is on the horizon. A chance of rain or snow Friday night through Monday, especially across southern Minnesota. Another chance for rain showers later next week. Temperatures will average several degrees F colder than normal, then moderate by midweek to near normal.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, May 3, 2002

Embarrass, MN reported the lowest temperature in the conterminous United States on May 1st with 13 degrees F... a nice start to the month, following a colder than normal April....

Update from Marquette, MI....snow season total is at 318.6 inches, a new record total by a long shot (old record was 272.2 inches). Nine daily snowfall records have been set there this year, along with new record totals for the months of February and March.

Topic: May snowfalls

As a follow-up to a Pioneer Press story this week (by Bill Gardner) about May snowfalls in the Twin Cities area, I have a few additions. Since the establishment of Ft Snelling in 1819, there is documentation of at least 25 measurable May snowfalls in the Twin Cities area. Overall, including just trace amounts (usually noted as flurries), there have been 57 years when snow was observed in the month of May in the 182 years since the establishment of Ft Snelling. The last time there was measurable snowfall during May was from 9:00 pm to 10:00 pm on the 5th in 1991 when 0.3 inches was recorded at the MSP airport with a temperature of 35 degrees F. The largest amount from a single May storm is 3.0 inches which occurred in 1830, 1892, 1935, and 1946. The last year in that list, 1946 was especially notable because on June 1st of that year, Holman field in St Paul reported 38 degrees F with snow flurries from 2:24 am to 2:55 am, just barely into the month of June, but nevertheless the only documented observation of snow in the Twin Cities area during June. June of 1946 also brought snow flurries to Park Rapids, Willmar, and Gull Lake.

Topic: Preliminary April Climate Summary

April was an exceedingly variable month, with samples of weather which would characterize any other month of the year. Most places reported a mean April temperature that ranged from 1 to 3 degrees F cooler than normal. Extremes for the month ranged from 92 degrees F at Waseca, Lamberton, and Winnebago on the 15th to just 0 degrees F at Embarrass on the 6th.

Minnesota reported the lowest temperature in the conterminous United States (48 states) on the following dates.....

April 1st....Grand Marais 3 degrees F

April 5th....Flag Island and Silver Bay 9 degrees F

April 6th....Embarrass 0 degrees F

April 10th...Flag Island 21 degrees F

April 23rd...Silver Bay 14 degrees F

April 26th...International Falls 15 degrees F

Precipitation in April was generally above normal around the state, except in some northern locations. Stillwater, Preston, Rushford, and La Crescent all reported over 4 inches. Much of this precipitation occurred as snow. The Twin Cities reported the 2nd snowiest April of all-time with 20.2 inches, as did St Cloud with 15.3 inches. Duluth reported nearly 12 inches, while Alexandria had 15.5 inches. Others reporting higher than normal amounts of April snow included Stillwater with nearly 15 inches, Litchfield with 16 inches, and Zumbrota with 11 inches.

April generally brings the strongest winds to the region and this year was no exception. Many stations reported a number of days with 25-30 mph winds and several reported wind gusts of 45 mph or greater, including a 60 mph gust at Fergus Falls.

Topic: Kudos to the U.K. Meteorological Office

Cheers for the Meteorological Office of the United Kingdom. They were recently recognized with an innovation award for developing classroom training materials for the blind and partially sighted. These materials contain maps, charts, information sheets, and classroom activity all in Braille.

MPR listener question: After a highly variable April, I couldn't help but wonder what the state extremes of temperature are for the month of May. Do you know?

Answer: Yes, indeed. They are not as extreme as April (101 F and -22 F), but nevertheless quite a range. The all-time high is 112 degrees F at Maple Plain on May 31, 1934. The all-time low is 4 degrees F at Pine River Dam on May 1, 1909. I doubt either of these records will be broken this month!

Twin Cities Almanac for May 3rd:

The average MSP high temperature for this date is 65 degrees F (plus or minus 12 degrees F standard deviation), while the average low is 43 degrees F (plus or minus 9 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 93 degrees F in 1949; lowest daily maximum temperature of 35 degrees F in 1954; lowest daily minimum temperature of 18 degrees F in 1967; highest daily minimum temperature of 65 degrees F in 1959; record precipitation of 1.72 inches in 1912; and record snowfall of 0.2 inches in 1954. This is the only snowfall on this date in the climate record since 1891.

Average dew point for today's date is 39 degrees F, with a maximum of 66 degrees F in 1938 and a minimum of 13 degrees F in 1957.

All-time state records for May 3rd:

Scanning the state climatic data base: the all-time high for this date is 97 degrees F at Bird Island and Willmar in 1949; all-time low is 6 degrees F at Fosston and Crookston (Polk County) in 1967.

Words of the Week: Meteorological Philately

Yes, indeed there are stamp collections with the theme of meteorology. Several governments have issued stamps in recent years to illustrate the many elements of weather. In the United Kingdom this past year, the 2nd most popular selling stamps were those depicting the weather types indicated by a barometer. More on these stamps can be found at the following web sites (courtesy of Pete Boulay from the MN State Climatology Office).....

<http://www.linns.com/print/archives/20020429/news4.asp>

<http://www.norvic-philatelics.co.uk/weather.htm>

Raino Heino, Research Manager for the Finnish Meteorological Service and delegate to the World Meteorological Organization recently won an award at an international stamp collecting exhibition for his life-long work in meteorological philately. His collection of weather stamps is titled "Weather from Gods to Satellites."

Outlook:

A warming trend will start this weekend taking temperatures to near seasonal normals and above. Daytime highs in the 60s and 70s F will become more common. There is a chance for showers and thunderstorms Saturday and Sunday, especially in southern and eastern counties. A better chance for showers statewide by the middle of next week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, May 10, 2002

Topic: Cold spring continues

Temperatures much below normal have dominated the Minnesota landscape so far this May. Embarrass reported the lowest temperature in the 48 conterminous states on May 3rd with a reading of 10 degrees F, while Silver Bay reported the lowest on May 5th with 19 degrees F. Overall temperatures around the state are averaging from 7 to 10 degrees F cooler than normal through the first ten days of the month.

Topic: Temperature characteristics of May

For many locations in Minnesota, May is the month with the largest average daily temperature range, typically 20 to 25 degrees F (difference between the maximum and minimum). What causes this? Several factors come to mind. Crops are rarely fully leafed out, so much of the landscape is still composed of bare soil, which more readily stores heat during the day and surrenders it at night. Perennial vegetation is not yet fully utilizing soil moisture as well, since it is still relatively early in the growing season. Therefore the release of water vapor into the atmosphere by growing vegetation is somewhat limited. Sun elevation angle is increasing, as is day length, providing the sun with more time to heat the Earth's surface. The change in air masses that accompanies a frontal passage can still be rather dramatic in May, modifying the air temperature significantly in just a few hours.

Though these are all good reasons to expect a relatively large range in daily temperatures, I think one of the primary factors is water vapor. The difference between average air temperature and average dew point (the temperature at which the air is saturated) is large during May and the relatively drier air can heat and cool more readily as a result. Western locations in the state show many days with daily temperature ranges in May of 40 to 50 degrees F. An example is Milan, in Chippewa County. On May 16, 1934 a chilly morning low of 34 degrees F was recorded, followed hours later by an afternoon high of 100 degrees F.....a rise of 66 degrees F. The dew point was only in the mid 30s F that day.

Topic: Summer vacations for the weather-oriented

The current edition of Weatherwise magazine (May/June) has a wonderful article which highlights vacation tours and destinations for the weather enthusiast. There are a

number of companies which offer storm chasing tours with ample photo opportunities. Some of these have names like Tornado Alley Safari or Tempest Tours. There are also a number of museums and science centers (listed by region) described, all of which are showing special weather exhibits this summer. Among these you will find the Science Museum of Minnesota which offers a number of weather-related exhibits, as well as the Bakken Library and Museum in Minneapolis which is hosting a special exhibit devoted to Benjamin Franklin's invention of the lightning rod on the 250th anniversary of his famous kite experiment. There is a special lecture at the Bakken by lightning expert Philip Krider on Saturday May 11th.

MPR listener question: Seems like we are off to a very wet start this May. What is the wettest May in the Twin Cities record?

Answer: Well, this can be answered from two perspectives: total precipitation in May; or greatest number of rainy days in May. The greatest total precipitation in May was 10.33 inches in 1906. The greatest number of rainy days in May is 20 which occurred in 1938.

Twin Cities Almanac for May 10th:

The average MSP high temperature for this date is 66 degrees F (plus or minus 10 degrees F standard deviation), while the average low is 45 degrees F (plus or minus 8 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 90 degrees F in 1987; lowest daily maximum temperature of 43 degrees F in 1902; lowest daily minimum temperature of 28 degrees F in 1907; highest daily minimum temperature of 68 degrees F in 1896; record precipitation of 1.40 inches in 1986; and record snowfall of a trace in 1853, 1946, 1948, 1960, and 1966.

Average dew point for today's date is 40 degrees F, with a maximum of 68 degrees F in 1911 and a minimum of 14 degrees F in 1946.

All-time state records for May 10th:

Scanning the state climatic data base: the all-time high for this date is 97 degrees F at Beardsley in 1928; all-time low is just 11 degrees F at Roseau in 1981.

Word of the Week: Hailstreak

This is the term used to describe a elongated area of the landscape hit by a single volume of hail from a convective storm. It often takes an elongated shape due to the movement of the parent thunderstorm cell. This was the

case on Wednesday around Minnesota when several hailstreaks were observed around the state, including some that had 1.5 to 1.75 inch diameter hailstones.

Outlook:

Chance of showers statewide on Saturday for the Fishing Opener. More sun on Sunday, Mother's Day, but cool temperatures will remain, with highs in the 50s F most places. Chance of scattered showers next week with temperatures slowly climbing into the 60s F, perhaps reaching the 70s F late in the week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, May 17, 2002

Topic: New Monthly and Seasonal Climate Outlook

The Climate Prediction Center released the new monthly and seasonal outlooks on Thursday (May 16) of this week. They show equal chances of above or below normal values for temperature and precipitation in our area during the June through August period. One noteworthy statement in their prognostic discussion is that abundant soil moisture conditions to the south and east of Minnesota may mean an amplified effect for warm spells this summer during which the combination of temperature and excess humidity will promote a higher heat index value.

Topic: 20th Anniversary of the Weather Channel

The Weather Channel celebrates its 20th Anniversary of continuous television broadcasting this month. It is now viewed with some regularity in 85 million U.S. homes. It also boasts one of the 20 most popular web sites in America with more than 350 million hits each month. It definitely has had an effect on popularizing the profession of meteorology.

Topic: The story of Cyclone Day at Codell, KS

Previous to 1916 only one tornado had occurred on the Kansas prairie near the town of Codell. This was an F3 tornado on May 15, 1885.

May 20, 1916...1917...1918

An F2 (winds 113-157 mph) tornado passed across north-central Kansas and struck the town of Codell on May 20, 1916 at about 7 pm in the evening. No deaths were reported but some farms were damaged. The following year on May 20th at 6:15 pm an F3 tornado (winds 158-206 mph) of immense diameter (perhaps 1000 yards) again struck Codell causing extensive damage to several farms in the area. And again the next year (1918), at about 8:15 pm on May 20th, an F4 (winds 207-260 mph) tornado struck Codell, this time destroying many town buildings and killing 9 people. After back to back to back tornadoes at nearly the same time, on the same date, three consecutive years, residents nicknamed May 20th Cyclone Day (or some called it Cyclone Night). In those days such storms were more frequently referred to as cyclones. For two generations, residents of this Kansas town were quite apprehensive about the May 20th date on the calendar. Following the F4 tornado on May 20th, 1918, there was not another tornado in the area until May 12, 1934. Since 1880,

thirteen tornadoes have occurred in Rooks County (home to Codell) Kansas. The only F4 tornadoes occurred on May 20, 1918 and May 10, 1985.

Topic: Mid May contrasts in Climate

As the northern hemisphere summer approaches, contrasting air masses can bring extremes of temperature. Churchill, Manitoba reported a temperature of just 18 degrees F with a wind chill of 5 degrees F on Thursday morning (May 16), while New Delhi, India reported a temperature of 105 degrees F with a dew point of 71 degrees F and a heat index of 116 degrees F on the same date. In fact the early heat wave in India has produced nearly 400 heat related deaths so far this week. The onset of the summer monsoon season later this month will hopefully alleviate those conditions in India.

Topic: North Pole web cam

NOAA has a new web site showing current pictures from its weather station at the North Pole. Pictures are updated every six hours. Meteorological measurements are made there continuously by automated equipment. The temperature there on Thursday, May 16th was 18 degrees F with low clouds and blowing snow.

This site can be found at...

http://www.arctic.noaa.gov/gallery_np.html

MPR listener question: Which county has reported the most tornadoes in Minnesota?

Answer: The best source for this answer is the tornado history book called Significant Tornadoes, written by Thomas Grazulis and published just a few years ago. He has documented all Minnesota tornadoes since 1880. According to his statistics Freeborn County along the Iowa border (home to the city of Albert Lea) has reported the most tornadoes with 45 in the past 122 years. Polk County in northwestern Minnesota is second with 39 tornadoes, while Stearns County in central Minnesota is third with 38 tornadoes. Cook County along the Superior shore has reported the fewest with just two.

Twin Cities Almanac for May 17th:

The average MSP high temperature for this date is 70 degrees F (plus or minus 10 degrees F standard deviation), while the average low is 49 degrees F (plus or minus 8 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 93 degrees F in 1987; lowest daily maximum temperature of 48 degrees F in 1916; lowest daily minimum temperature of 31 degrees F in 1915; highest daily minimum temperature of 69 degrees F in 1911; record precipitation

of 1.17 inches in 1938.

Average dew point for today's date is 45 degrees F, with a maximum of 69 degrees F in 1996 and a minimum of 21 degrees F in 1973.

All-time state records for May 17th:

Scanning the state climatic data base: the all-time high for this date is 100 degrees F at New Ulm and Pipestone in 1934; all-time low is just 16 degrees F at Tower in 1983.

Words of the Week: graupel, soft hail, snow pellets, tapioca snow

Last week we reported on a number of hail reports from around the state, but in fact some of the observed frozen precipitation was not hail (solid lumps of ice), but was a softer aggregate formed from the collision of supercooled water droplets with ice crystals. Gary McDevitt of the National Weather Service pointed this out to me. Such aggregates are small (2 to 5 mm in diameter), opaque, and easily crush in your hand. They often form in clouds when the air temperature hovers around 32 degrees F, and typically they partially melt as they fall to Earth.

Outlook:

A cool, dry weekend is in store. Some freezing temperatures will be common in northern counties, with widely scattered frosts in southern counties. A warm up should begin on Monday as daytime highs rise back into the 60s and 70s F. There will be a chance for showers and thunderstorms by Wednesday and Thursday next week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, May 24, 2002

HEADLINES: RECORD LOWS THIS WEEK.....COOL AND WINDY SPRING..
A WETTER CLIMATE....NEW GLOBAL CLIMATE FORECASTS..
MEMORIAL WEEKEND....ALMANAC....MISTPOUFFER...

Record low temperatures were reported this week from Fargo, ND, Grand Forks, ND, International Falls, MN, and Eau Claire, WI. Coldest reading around the region was 16 degrees F at Embarrass on May 20th.

Topic: Two words for this spring: Cool and Windy

Temperatures continue to average cooler than normal this May, as they did for most of March and much of April. Average temperatures this month range from 5 to 8 degrees cooler than the historical average for May. So far this month, Minnesota has reported the lowest temperature in the 48 conterminous states on five dates, the 3rd (10 degrees F at Embarrass), the 5th (19 degrees F at Silver Bay), the 18th (21 degrees F at Baudette and Grand Marais), the 20th (16 degrees F at Embarrass), and the 21st (21 degrees F at Silver Bay). The reading of 16 F at Embarrass on Monday (May 20th) was a new statewide record low for the date. Reports from the Twin Cities airport show a mean daily temperatures of less than 50 degrees F on 13 different days this month, the most since May of 1967. While we have been shivering, Alaska has been recording many high temperatures in the 70s and 80s F, with 82 degrees F at Fairbanks on Tuesday (May 21st) of this week.

Though the mean wind speeds this spring have not been unusual by themselves, we have seen 30 days with peak wind speeds of 30 mph or more, including 40 and 50 mph gusts during April and May. This is unusual and has produced some difficult driving and field working conditions in the western parts of the state because of blowing soil.

Topic: A wetter climate

Clearly Minnesota exhibits a wetter climate now. Nearly all of the new climate normals (averages for the most recent 30 years, 1971-2000) show an increase in average annual precipitation. If we dissect this trend we find three distinct features that are contributing to this increased wetness.....(1) more days per year with measurable rainfall... (2) an increase in the precipitation delivered by convective storms and showers (thunderstorms)...and (3) an increase in average seasonal snowfall.

Take the number of days per year when measurable precipitation

is recorded...It has ranged as low as 34 days at Ortonville in 1976 (about 9 percent of all days in the year) to as high as 161 days at Duluth in 1965 (about 44 percent of all days in the year). But over time, the number of days with measurable rain has been increasing. Since 1980 the Twin Cities have averaged 119 wet days per year based on days with measurable precipitation (just under 33 percent of all days). Prior to 1980 the historical average was just 109 days per year (just under 30 percent of all days). This is a substantial increase, and I might add that all of these additional wet days do not fall on weekends as some would believe.

Concerning the amount of precipitation from convective showers (thunderstorms)...a paper in the Bulletin of the American Meteorological Society last year documented a significant trend in the contribution of thunderstorms to total annual precipitation. The trend is upward by 10 to 37 percent in the midwest since 1950. This means a larger fraction of our annual precipitation is derived from thunderstorms, which commonly produce an erosive type of rainfall. A cursory scan of the climate record at Waseca for example, shows that there have been 18 thunderstorms that delivered 3.0 inches or more of rainfall since 1914 (88 years), but 6 of these have occurred since 1990.

The other interesting feature of the wetter climate in Minnesota is an increase in mean seasonal snowfall amounts. Most locations in the state show a positive trend in mean seasonal snowfall, despite many of the recent wimpy winters. Most locations have shown an increase equivalent to about 1 additional inch of snowfall for each decade. For the Twin Cities the 118 year grand mean value for seasonal snowfall is 45.7 inches, but the average value for seasonal snowfall since the winter of 1970-71 has been 56.6 inches.

Topic: Long Range Forecasts from the U.K. Met Office

The United Kingdom Meteorological Office announced this week that it is expanding into the field of long range climate forecasting. It will now issue a 3 month climate forecast (temperature and precipitation) for all regions of the world based on analysis of climatic trends and the use of long-range forecast models. These products will be released monthly during the last week of the month on their web site . The web link is.....

<http://www.meto.govt.uk/weather/seasonal/index.html>

Incidentally, their climate forecast for May, June, July in Minnesota calls for near normal temperatures and less than normal precipitation.

MPR listener question: This question was forwarded from an inquiry received by Craig Edwards, chief at the National Weather

Service Forecast Office in Chanhassen, MN. Is Memorial Day (Monday) always the nicest day of the three day holiday weekend? Or is my memory playing tricks on me?

Answer: Greg Spoden of the Minnesota State Climatology Office analyzed Memorial Weekends since 1971, the year the holiday was designated as the last Monday in May. He used the Twin Cities climate records and found that the frequency of measurable rainfall over the Friday through Monday period shows some very interesting differences. Saturday shows a 52 percent occurrence of rainfall, Sunday a 50 percent occurrence, Friday a 42 percent occurrence, but Monday shows only a 29 percent occurrence. So, I guess for planning purposes, outdoor events are least impacted on Monday of the holiday weekend.

Incidentally, the only occurrence of snowfall on Memorial Day was in 1992 (May 25th) when Mankato, New Ulm, and Waseca reported over 1 inch of snow.

Twin Cities Almanac for May 24th:

The average MSP high temperature for this date is 71 degrees F (plus or minus 9 degrees F standard deviation), while the average low is 51 degrees F (plus or minus 7 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 86 degrees F in 1977; lowest daily maximum temperature of 49 degrees F in 1893; lowest daily minimum temperature of 32 degrees F in 1925; highest daily minimum temperature of 64 degrees F in 1928 and 1944; record precipitation of 1.27 inches in 1937. There was 0.1 inches of snowfall on this date back in 1925.

Average dew point for today's date is 48 degrees F, with a maximum of 71 degrees F in 1989 and a minimum of 20 degrees F in 1925.

All-time state records for May 24th:

Scanning the state climatic data base: the all-time high for this date is 98 degrees F at Beardsley in 1928; all-time low is 22 degrees F at Cloquet in 1917 and at Roseau and Itasca State Park in 1930.

Words of the Week: Mistpouffers, Seneca guns, and moodus sounds

Pete Boulay of the Minnesota State Climatology office brought this to my attention. These are all words that refer to mysterious and unexplained sounds from the atmosphere commonly heard along coastal regions. Along the Atlantic seaboard, particularly New York, Connecticut, and North Carolina, these sounds are like that of distant thunder and are thought to emanate from micro tremors below the water surface.

Outlook:

Only scattered showers for the upcoming weekend, mostly north and southeastern counties. Though the Memorial weekend will start out somewhat cool, a warm up is on the way, especially starting on Monday. Temperatures will climb into the 70s and 80s F next week, with a chance for showers and thunderstorms by Thursday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, May 31, 2002

Topic: May climate summary

Average temperatures for the month of May were 4 to 8 degrees F cooler than normal around the state. Extremes during the month ranged from 91 degrees F at Olivia on the 29th to just 10 degrees F at Embarrass on the 3rd. Five times during the month Minnesota reported the lowest temperature in the 48 conterminous states.

Precipitation for May was generally less than normal in most places. Driest spots were in the far northern counties which reported just 1 to 2 inches. On the other hand Moorhead reported nearly 5 inches, mostly due to thunderstorms near the end of the month. Some places reported measurable May snowfalls including Roseau with 3 inches, Duluth with 1.5 inches and Babbitt with 1.0 inches.

High winds were a common occurrence in the midwest during May. The highest reported was from Moorhead, MN with a thunderstorm gust of 84 mph on the 28th. The table below shows the number of days with peak wind speeds (WS) of 30 mph, 40 mph and the maximum wind gust for several locations.....

Location	Days with WS	Days with WS	Peak Gust (mph)
	30 mph or greater	40 mph or greater	
Twin Cities	9	2	47
St Cloud	11	4	54
Duluth	9	2	52
Rochester	13	7	53
Intl Falls	5	1	43
Fargo, ND	14	8	48
La Crosse, WI	10	1	48
Sioux Falls, SD	16	4	45

The month was noteworthy for many hail storms, nearly all prior to the emergence of crops. Some killing frosts in the northwest on May 24th proved damaging to emerged sugarbeets and several thousand acres will have to be replanted. The first two tornadoes of the season, one in Wilkin County and one in Kittson County were also reported on the 28th and 29th, respectively.

Topic: Want to be a television forecaster? This contest may interest you.

ITV is the most watched independent television network in the United Kingdom. Its most popular daytime show "This Morning" is conducting a unique search for a new morning on air meteorologist. It was announced this week that they are accepting resumes and VHS video tapes for screening of applicants. Twenty semi-finalists will be selected to attend a special workshop put on by the Met Office.

Then five finalists will be invited to do forecasts on the show with a viewer vote to decide the winner, who will then in turn be offered a contract. "This Morning" is broadcast live each weekday from Liverpool's Albert Dock to millions of U.K. viewers.

MPR listener question: What are the all-time state extremes of temperature during the month of June?

Answer: The all-time high for June is 110 degrees F at Canby (Yellow Medicine County) on June 29, 1931. It is quite interesting that this value is less than the state record for May of 112 degrees F at Maple Plain on May 31, 1934. The all-time low temperature for June is 15 degrees F at Bigfork (Itasca County) on June 1, 1964.

Twin Cities Almanac for May 31st:

The average MSP high temperature for this date is 74 degrees F (plus or minus 9 degrees F standard deviation), while the average low is 54 degrees F (plus or minus 8 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 106 degrees F in 1934; lowest daily maximum temperature of 55 degrees F in 1897; lowest daily minimum temperature of 38 degrees F in 1897; highest daily minimum temperature of 75 degrees F in 1934; record precipitation of 2.39 inches in 1965.

Average dew point for today's date is 50 degrees F, with a maximum of 73 degrees F in 1918 and a minimum of 27 degrees F in 1924.

All-time state records for May 31st:

Scanning the state climatic data base: the all-time high for this date is 112 degrees F at Maple Plain in 1934; all-time low is 22 degrees F at Milan and Campbell in 1897 and at Bigfork in 1964.

Words of the Week: Dove's law

19th Century meteorologist Heinrich Wilhelm Dove was Director of the Royal Prussian Meteorological Institute. He wrote the book "The Law of Storms" in 1828 and described the rotational winds associated with tropical and mid latitude cyclonic storms in both the northern hemisphere and southern hemisphere, as well as the general progression of such storms from west to east in the middle latitudes. One of the principles he stated is that the wind turns with the sun during a storm, eventually ending up from the northwest in the northern hemisphere and from the southwest in the southern hemisphere following the passage of a cold front. Dove's law was used mainly by sailors in navigating the seas during the 19th Century.

Outlook:

Increasing cloudiness over the weekend starting late on Saturday, with a chance for showers and thunderstorms Sunday and Monday, some could be heavy. Temperatures will be cooling down and average below normal during the first week of June. There will be an increasing chance for showers and thunderstorms later next week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, June 7, 2002

Topic: A full blown climate and culture conference

Australia announced a first of a kind conference this past week to be held in September, 2002. Titled "Climate and Culture in Australia," this conference will have papers and presentations on a wide ranging array of topics including climate and history, climate and art, climate and literature (poetry), climate and politics, climate and archaeology, climate and economics, climate and transportation, climate and agriculture, climate and music, and climate and diet, among many others. Sounds like an interesting conference to me!!!! Organizers are advertising that there will be plenty of drinks, nibbles, mingling, and memory making.....

Topic: Cold daytime temperatures in June due to persistent cloudiness

The weather on Monday and Tuesday of this week more closely resembled a cloudy April or October rather than June. Many locations set new record cold daytime high temperatures on those days. The table below shows the record temperatures that occurred..

June 3rd record cold daytime highs...

Red Wing 54 F Willmar 54 F Alexandria 53 F Cloquet 46 F

June 4th record cold daytime highs...

MSP 56 F (tied 1935) Rochester 57 F La Crosse, WI 59 F
Winona 55 F Austin 57 F (tied 2000) Owatonna 55 F
Red Wing 54 F (tied 1990)

While southeastern Minnesota locations shivered in damp 50 degrees F weather on Wednesday, northern cities enjoyed sunny skies and temperatures in the low to mid 70s F (International Falls reported 72 F)

All of the record cold daytime temperatures are roughly 20 to 25 degrees F colder than normal for early June. In order to get record cold daytime highs in the month of June it is necessary to have persistent cloud cover, a feature that dominated southern Minnesota on Tuesday and Wednesday of this week. The sun's elevation angle is so high and the days are so long in June, that any break in cloudiness will typically send temperatures soaring by several degrees F. In fact, an examination of all the record cold daytime temperatures for the Twin Cities during June shows that each occurred under persistently overcast skies, with few exceptions. Only four dates in

June, show record cold daytime highs reported in the absence of total overcast. These then were at least partially the result of cold air advection after the passage of a cold front (June 14, 1917, June 28, 1923, June 8, 1937, and June 29, 1959). Of the 30 daily record cold daytime highs, 21 were set on days with precipitation. The most common wind directions for cold June daytime temperatures are northeasterly and northwesterly.

Topic: Getting wet this month

Although Iowa, Illinois, and Wisconsin received most of the headlines this week for wet weather (up to 8 inches in spots), portions of southern Minnesota certainly received a heavy dose as well. Many places reported over 2 inches. Others with even heavier amounts included Rochester with 3.64 inches, La Cresent with 3.58 inches, Faribault with 3.75 inches, Rosemount with 3.12 inches, Zumbrota with 3.42 inches, Byron with 3.13 inches, Farmington with 4.12 inches, Red Wing with 4.07 inches, and Wabasha with 5.66 inches.

MPR listener question: What is the seasonal distribution for the occurrence of tornadoes in Minnesota? Is June the peak month? What is the peak time of day for tornadoes to occur in Minnesota?

Answer: Yes, indeed June is the peak month. Historically, about one third of all tornadoes in Minnesota have occurred in the month of June, followed by about one fifth in July, and the next most frequent month May shows about one sixth of all tornadoes.

The peak time of occurrence for tornadoes in Minnesota is 4:00 to 7:00 pm, when approximately half of all the tornadoes in history have been reported.

Twin Cities Almanac for June 7th:

The average MSP high temperature for this date is 75 degrees F (plus or minus 9 degrees F standard deviation), while the average low is 55 degrees F (plus or minus 8 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 94 degrees F in 1987 and 1988; lowest daily maximum temperature of 55 degrees F in 1901; lowest daily minimum temperature of 35 degrees F in 1998; highest daily minimum temperature of 71 degrees F in 1959; record precipitation of 2.91 inches in 1984.

Average dew point for today's date is 54 degrees F, with a maximum of 72 degrees F in 1914 and a minimum of 30 degrees F in 1938.

All-time state records for June 7th:

Scanning the state climatic data base: the all-time high for this date is 100 degrees F at Madison (Lac Qui Parle County) in 1987; all-time low is 22 degrees F at Tower (St Louis County) in 1897.

Words of the Week: Vestigial clouds

Taken as much from poetry as meteorology these words are used to describe remnants or leftover clouds from the passage of a frontal system or the backside of a cumulonimbus (thunder cloud) well after the main body of cloud(s) has moved on. Turbulent eddies or massive convection sometimes cause cloud segments to become decoupled from the main cloud mass and they may drift alone and persist for some hours before finally evaporating.

Outlook:

Partly cloudy and warmer over the weekend, with a chance for showers and thunderstorms mostly in the north. There will be an increasing chance for showers Monday and Tuesday after which temperatures will cool back down into the 70s F during the day for later next week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, June 14, 2002

HAPPY FATHER'S DAY ON SUNDAY

Topic: New monthly and seasonal climate outlook

The Climate Prediction Center released the new monthly and seasonal outlooks this past Thursday. The outlook for the period from July through September in our region calls for near normal temperature and rainfall, with the possible exception of southeastern Minnesota which has a higher probability for above normal rainfall during the summer, primarily as a result of surplus soil moisture to the south and east of the state. The wet trend this month has certainly improved soil moisture conditions around the state.

Topic: 10th Anniversary of a very cold summer

Friday of next week (June 21st) marks the summer solstice, the longest day of the year. Yet, ten years ago (1992) the summer solstice brought a singular climatic event to the state of Minnesota.....a widespread frost. A state record low for the date of 25 degrees F occurred at Brimson in St Louis County, but more importantly crops were damaged by frost all over central and southern Minnesota. Places as far south as Preston (Fillmore County) and Zumbrota (Goodhue County) reported lows of 33 degrees F with lots of ground frost. This is the only instance of frost on the summer solstice in Minnesota history (or at least since pioneer settlement). New low temperature records were set all over the state by several degrees. For example even the Twin Cities airport recorded a low of 39 degrees F that morning, fully 5 degrees F colder than the previous record.

This frost was a precursor to the coldest July every recorded in Minnesota and the 2nd coldest growing season ever. Later when analysis was done, the cold growing season was blamed in part on the 1991 eruption of Mt Pinatubo in the Phillippines. This eruption ejected so much material into the atmosphere that solar radiation was partially blocked out in the northern hemisphere for months.

Topic: Flooding in northern Minnesota

A stationary front earlier in the week parked over the Minnesota-Canadian border produced abundant thunderstorms with heavy rain over northwestern and north-central counties. Beginning early Sunday morning (June 9th), some parts of Kittson, Roseau, Lake of the Woods, and Koochiching Counties recorded 30 to 35 hours of

rainfall over the next two days, ending on the morning of June 11th. Imbedded in these systems were heavy thundershowers, some of which inundated parts of Norman, Clay, and Mahnomen Counties. Many locations reported over 8 inches of rain in these area, and one spot along Hwy 11 in Lake of the Woods County reported nearly 15 inches.

Though these counties were clearly drier than normal before these rains came, the watersheds in the area were overwhelmed with runoff. Rivers like the Wild Rice near Hendrum, Two Rivers near Hallock, Roseau River in Roseau, and the Marsh River near Shelly all went well beyond flood stage. The Roseau River gage approached 23 feet, a level never before seen on that river. In fact, the flood stage reported on all of these rivers ranked in the top 10 ever on these watersheds. The table below shows the reported flood crest and historical ranking on the river gage.....

Marsh River at Shelly near 25 ft (2nd all time to 25.7 in 1997)
Roseau River at Roseau just over 23 ft (new all time record high)
Wild Rice River at Hendrum near 30.0 Ft (7th highest all-time)
Two Rivers at Hallock 808.5 ft (7th highest all-time)

Nearly all of the previous highest flood crests on these northern rivers were due to spring snowmelt flooding and not thunderstorm flooding. In this respect, this June flash flooding is highly unusual and rivals the worst all-time in the state. Other flash floods of this magnitude include July 21-22, 1972 when over 13 inches fell in parts of Morrison and Todd Counties west of Little Falls, and June 28-July 2, 1975 when 12-14 inches of rain fell in parts of Clay County north of Hawley. By comparison, this June's storm system probably affected a larger fraction of the Minnesota landscape than these other historical flashfloods.

Total 24-hr rainfall amounts in excess of 3 inches were reported from many locations including International Falls, Baudette, Roseau, Red Lake Falls, Crookston, and Moorhead. 24-hr totals in excess of 4 inches were reported from Ada and Flag Island. The 2-3 day total rainfalls ranged from 6 to 10 inches in many counties, and over 12 inches in some. This is roughly equivalent to half a years precipitation. The all-time wettest June at Roseau was 8.28 inches of rainfall in 1925 and at Ada 8.22 inches in the same year. These values were eclipsed by a three day storm in 2002.....certainly one for the record books.

A indication of the overall wet climate pattern for the Red River Valley can be found in the rank order of flood crests measured at Two Rivers in Hallock. Five of the top ten historical flood crests have occurred since 1996.

MPR listener question: What is the average duration of rainfall from a thunderstorm over any particular spot on the landscape?

Answer: Good question. I never thought much about this one. Studies from the Storm Prediction Center in Oklahoma suggest

that the average duration of rainfall from a single thunderstorm ranges from 1 to 3 hours. There is a latitude effect as well. Thunderstorms at lower latitudes, subtropical or tropical in nature tend to form into larger cells, both vertically and horizontally. Therefore they have greater longevity before they disperse. Thunderstorm cells at higher latitudes tend to be smaller in size and move faster across the landscape, so that they tend to run their course more rapidly. Certainly the ones over northern Minnesota earlier this week took their time and were quite abnormal in this regard.

Twin Cities Almanac for June 14th:

The average MSP high temperature for this date is 75 degrees F (plus or minus 9 degrees F standard deviation), while the average low is 59 degrees F (plus or minus 7 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 98 degrees F in 1987; lowest daily maximum temperature of 60 degrees F in 1917 and 1947; lowest daily minimum temperature of 44 degrees F in 1909, 1917, and 1927; highest daily minimum temperature of 73 degrees F in 1893; record precipitation of 2.48 inches in 1924.

Average dew point for today's date is 56 degrees F, with a maximum of 74 degrees F in 1981 and a minimum of 33 degrees F in 1961.

All-time state records for June 14th:

Scanning the state climatic data base: the all-time high for this date is 105 degrees F at Montevideo (Chippewa County) in 1979; all-time low is 29 degrees F at International Falls in 1909 and at Cloquet, Isabella, and International Falls in 1958.

Words of the Week: Rogue thunderstorms

This term is used by meteorologists and sailors as well. It refers to the odd thunderstorm cell that is not associated with a frontal system or upper air trough, but simply develops as a result of instability in a warm, humid atmosphere. As such, it is likely not to have been forecasted.

Outlook:

Kind of a quiet period coming up with cooler than normal temperatures. some change for widely scattered showers Saturday, especially in northern counties. drier for much of next week, with a warming trend and increasing chances for showers and thunderstorms by the summer solstice (June 21st).

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, June 28, 2002

Topic: What a June it has been!

This June will go down as one of the wettest months in Minnesota history. Averaging all data reported across the state, there have only been 18 months historically when the statewide average exceeded 6.0 inches for any given month. Distributionally, this breaks out to be 11 Junes, 3 Julys, 2 Septembers, 1 August, and 1 May. The all-time wettest month ever across the state was June 1914, with a statewide average of 7.40 inches. Twenty-two communities reported over 10 inches of rain that month. The all-time wettest month for any individual station in Minnesota was 22.70 inches in July, 1972 at Isle, MN on the southeastern shore of Lake Mille Lacs.

This June will likely be added to the above list of wettest months. Portions of Lake of the Woods, Roseau, Norman, and Mahnomen Counties in northern Minnesota have exceeded 15 inches of precipitation for the month. Over a dozen communities elsewhere have reported in excess of 10 inches. Numerous daily record values were registered as well, including back to back records of 2.21 and 3.04 inches on the 9th and 10th at International Falls. The Twin Cities registered 8.31 inches of rainfall, the 5th wettest June since 1891, while the University of Minnesota St Paul Campus recorded 9.60 inches a new record for June.

Many of these heavy rains occurred with exceedingly high dew points (water vapor values), over 70 F in most cases. The Twin Cities recorded new high dew point records of 73 F on the 10th and 75 F on the 23rd. The Heat Index value approached 100 F on the 23rd thanks to the combination of temperature on high dew point.

Temperatures for the month of June averaged from 2 to 4 degrees F above normal. Extremes ranged from 95 F at Milan on June 9th to 29 degrees F at Embarrass on June 17th.

Topic: July 4th climatology

For the Twin Cities area rain has occurred on this holiday 46 times since 1891, the highest frequency of precipitation for all major holidays of the year. The longest streak of rainy Independence Days was six consecutive years from 1900 to 1905, with July 4th, 1900 being the wettest ever as 2.27 inches of rain fell from a thunderstorm. The holiday was rainfree for six consecutive years from 1939 to 1944 and again from 1952 to 1957. The last time it rained on the 4th of July was 1997.

In terms of temperature, the average high temperature for the date is 82 F and the average low 62 F. The average dew point is 59 F, but has been as high as 77 F. The Heat Index (derived from temperature and humidity or dew point) has been uncomfortably high on the 4th of July a number of times. HI values above 90 F have occurred on 20 occasions since 1891. There have been seven July 4th holidays when the HI value exceeded 100 F, most recently 1999 when it hit 108 degrees F. The worst case was a Heat Index of 112 F in 1949. This was the cause of 12 heat related fatalities that year. The coldest daytime temperature on July 4th was just 58 degrees F in 1967.

The outlook for this July 4th looks like temperatures in the 80s F with a chance for showers later in the day.

MPR listener question: Do you think the fires in the western states have anything to do with the frequent reddish sunsets and even reddish moon we have been seeing?

Answer: This could very well be the case. The NOAA satellite imagery clearly shows the smoke plumes from these fires diffusing to the east and north. Another feature to the west of us is drought, especially South Dakota, Montana and Wyoming. Perhaps some wind blown soil is also contributing to the optical properties of the atmosphere that are giving us this reddish color.

Incidentally, the satellite images of these fires in real time can be found at the University of Wisconsin Space Science and Engineering Center web site....

<http://cimss.ssec.wisc.edu/goes/burn/wfabba.html>

Twin Cities Almanac for June 28th:

The average MSP high temperature for this date is 81 degrees F (plus or minus 8 degrees F standard deviation), while the average low is 61 degrees F (plus or minus 7 degrees F standard deviation).

MSP weather records for this date include: highest daily maximum temperature of 102 degrees F in 1931; lowest daily maximum temperature of 64 degrees F in 1923; lowest daily minimum temperature of 47 degrees F in 1895 and 1924; highest daily minimum temperature of 82 degrees F in 1931; record precipitation of 2.33 inches in 1920.

Average dew point for today's date is 59 degrees F, with a maximum of 77 degrees F in 1996 and a minimum of 33 degrees F in 1925.

All-time state records for June 28th:

Scanning the state climatic data base: the all-time high for this date is 108 degrees F at Canby (Yellow Medicine County) in 1931; all-time low is 27 degrees F at Cook in 1983 and at Tower in 1993 (both in St Louis County)

Words of the Week: The Mean Heat Index

This is a new term used by the National Weather Service in reference to how the combination of temperature and humidity feels over the entire course of a day (both daytime and nighttime). It differs from the regular Heat Index which typically gives a value for an hour or a moment in time. The National Weather Service considers a Mean Heat Index value of 85 F or higher to be dangerous, especially to elderly people.

The Mean Heat Index is now a daily forecast product projected from 3-7 days ahead and indicating the probability of values hitting 85 F, 90 F, or 95 F for any area of the country. This forecast can be viewed on the Internet at the National Weather Service Hydrometeorological Prediction Center web site.....

<http://cimss.ssec.wisc.edu/goes/burn/wfabba.html>

It should be a value guide for those working in the health care industries in helping to anticipate heat-related workloads, which may be a problem given the warm outlook for the first part of July.

Outlook:

Generally dry and sunny, with a warming trend over the weekend. Some chance of showers in northern counties. Many areas will see temperatures in the 90s F leading up to Independence Day. There will be an increasing chance for showers by the 4th and 5th of July.

To: Perry Finelli, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, July 5, 2002

Topic: July Heat Waves

Earlier this week as we entered the month of July we were reminded of how sweltering it can be. Many places around the state reported temperatures in the mid 90s F, with dew points in the 70s F, producing Heat Index values over 100 F.

Perhaps the worst of all heat waves usually occur in July. There are various definitions used for heat waves. Climatologists often refer to a period with high temperatures and humidity (dew point) of 4 days duration or longer as a heat wave. Both the magnitude (maximum Heat Index Value) and duration of a heat wave can lead to serious health consequences. Effects are amplified if the overnight Heat Index does not drop below 85 F.

Scanning the Twin Cities historical climate record shows a number of July Heat Waves have occurred, some with dire consequences manifested in heat related illness and even death.....

Year	July Dates	Maximum Heat Index	Comments
1901	12-24	119 F	
1905	15-18	108 F	2 deaths, many ill
1916	26-30	109 F	
1917	24-29	113 F	
1921	9-13	102 F	
1930	8-11	101 F	
1931	14-28	104 F	
1932	16-21	104 F	
1934	18-24	109 F	9 deaths
1935	23-31	107 F	4 deaths, including a ice delivery man
1936	7-22	110 F	over 100 deaths
1937	6-14	101 F	3 deaths
1940	19-24	109 F	9 deaths, sleeping in city parks allowed
1941	22-31	117 F	9 deaths
1943	9-22	102 F	
1948	5-11	104 F	
1949	1-8	112 F	29 deaths with 112 HI on the 3rd and 4th
1955	19-22	104 F	
1964	16-21	105 F	
1969	13-17	103 F	
1974	6-13	108 F	
1975	2-5	101 F	

1983	21-29	104 F	
1988	5-9	109 F	
1991	16-21	102 F	
1995	11-14	115 F	500,000 MN turkeys die, over 660 Chicago deaths
1999	23-30	115 F	650 bikers drop out of the MS TRAM across MN

July 30-31 of last year produced Heat Index values up to 110 F as well, but the heat wave was of shorter duration. It nevertheless was alleged to be a causal factor in Korey Stringer's death (Vikings star offensive lineman).

Of the 27 historical July Heat Waves, the ones in the 1930s, 1955, and 1988 were primarily attributable to very high air temperatures, while the others were due to combinations of temperatures in the 90s F and dew points in the 70s F.

MPR listener question: Steve Fossett the balloonist who just recently made a solo journey around the world, ending in Australia gave credit to his meteorological support team for the successful completion of his historical trip. What do meteorologists do for a balloonist?

Answer: There are a number of atmospheric features that are important to balloonists. Wind and temperatures aloft are critical in plotting both flight altitude and trajectory. In addition, traveling in the tropical and subtropical latitudes as Fossett did can be dangerous because of large scale convective thunderstorms. So areas where these are forecasted are to be avoided. Visibility is another important parameter for balloonists. Lastly, the forecasting of landing weather conditions is critical. Attention to detail and frequent updates mandate that the meteorological team maintain daily contact with the balloonist when such attempts as this are made.

Twin Cities Almanac for July 5th:

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

MSP weather records for this date include: highest daily maximum temperature of 100 degrees F in 1982; lowest daily maximum temperature of 66 degrees F in 1905; lowest daily minimum temperature of 45 degrees F in 1967; highest daily minimum temperature of 78 degrees F in 1982; record precipitation of 1.65 inches in 1994.

Average dew point for today's date is 59 degrees F, with a maximum of 77 degrees F in 1949 and a minimum of 40 degrees F in 1972.

All-time state records for July 5th:

Scanning the state climatic data base: the all-time high for this date is 108 degrees F at Pipestone in 1936; all-time low is 32 degrees F at Tower in 1972 and 1979.

Words of the Week: Heat Lightning

This is often misconstrued as lightning caused by excessive heat. But, it is really just a colloquial term used to refer to distant flashes of luminosity observed from lightning so far away that its thunder cannot be heard. It has been used by Native Americans, pioneers, and mariners for generations.

Outlook:

Chance of widely scattered thundershowers over the weekend with near seasonal temperatures. More chances for widely scattered showers Monday and Tuesday. Highs in the 80s and lows in the 60s F for the most part. Somewhat warmer and more humid by next weekend.

To: Perry Finelli, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, July 12, 2002

Topic: The 3rd Annual University of Minnesota St Paul Campus Open House hosted by the College of Agriculture, Food, and Environmental Sciences.

My College will host its 3rd Annual Open House on Saturday, July 27th from 9:00 am to 1:00 pm. There will be tours and presentations of interest to all ages and persuasions, including visits to the barn and greenhouses, the Horticulture Department's demonstration garden, and field tours showing antique and modern farm equipment. You can get gardening questions answered by the experts and get better informed about Minnesota's diverse agriculture. I will make a presentation on significant weather trends as well.....everyone is welcome....

Topic: wet week

Both Monday and Wednesday brought excessive rains to parts of Minnesota. Heavy, slow-moving thundestorms produced record rainfalls across northern Minnesota on Monday (July 8th), including.....3.61 inches at Marcell, 5.52 inches at Brainerd, 5.16 inches at Gull Lake, 3.98 inches at Isle, 2.60 inches at Hinckley, 2.32 inches at Babbitt, 2.14 inches at Floodwood, and 1.77 inches at Little Fork.

Again on Wednesday (July 10th) persistent thunderstorms dropped record setting amounts of rain across northern and central counties, including....3.44 inches at Alexandria, 5.60 inches at Fergus Falls, 4.53 inches at Glenwood, 1.96 inches at St Cloud, 1.93 inches at MSP airport, 2.32 inches at St Paul, 2.60 inches at Royalton, 2.50 inches at Thief River Falls, 8.33 inches at Climax, and 2.25 inches at Crookston.

Many rivers (Wild Rice, Marsh, Red Lake, Two Rivers, and even the Mississippi) and tributaries returned to flood levels for the third time this summer.

Topic: More on summer heat waves

As mentioned earlier this summer on MPR, recent summer heat waves in Minnesota have been more attributable to extreme dew points (water vapor) than extreme high air temperatures. This was the case earlier this week again when dew points rose into the mid 70s F.

On this date in 1995 Minnesota and the upper midwest in

general was in the midst of a terrible heat wave, driven primarily by extremely high dew points. MSP hit a dew point of 80 degrees F with an afternoon temperature of 91 F, producing a Heat Index of 109 F. This heat wave lasted from the 11th to the 14th of July and produced significant health problems. Over 600 heat-related deaths were reported from the Chicago area. Minnesota turkey farmers reported some heat-related deaths too, over 1/2 million birds!

Dew points of 80 degrees F and higher are very rare in Minnesota, but when they do occur it is most likely in the month of July.

Other significant heat waves driven by dew points of 80 degrees F or higher occurred from July 19-22, 1983 and again from July 28-30, 1999. The latter episode produced a dew point of 81 degrees F and a Heat Index of 117 F at MSP, a state record dew point of 84 degrees F at Jackson, and a state record heat index of 124 degrees F at Faribault.

MPR listener question: Are the urban heat islands of major metropolitan areas exempt from severe tornadoes?

Answer: Not really. Significant tornadoes have occurred in or near the heat islands of Oklahoma City, Omaha, and Miami. The tornado of May 6, 1975 in Omaha, NE and the tornado of May 3, 1999 in Oklahoma City produced estimated losses of \$1 billion.

Footnote: There is a nice article in the current edition of Weatherwise magazine about tornado oddities. Among these are stories about airborne objects. A tornado in Connecticut in 1917 swept up a jar of sweet pickles and dropped it unbroken in a ditch 25 miles away. A Kansas tornado in 1991 swept over the town of Stockton picking up a variety of debris. It deposited the check of a Stockton resident in Winneton, Nebraska, 223 miles away. In 1955, another tornado picked up both a girl and the horse she was riding in South Dakota and carried them 1000 ft before dropping them back to earth with minimal harm.

Twin Cities Almanac for July 12th:

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

MSP weather records for this date include: highest daily maximum temperature of 106 degrees F in 1936; lowest daily maximum temperature of 67 degrees F in 1926; lowest daily minimum temperature of 48 degrees F in 1941; highest daily minimum temperature of 83 degrees F in 1936; record precipitation of 2.93 inches in 1912.

Average dew point for today's date is 61 degrees F, with a maximum of 80 degrees F in 1995 and a minimum of 39 degrees F in 1926.

All-time state records for July 12th:

Scanning the state climatic data base: the all-time high for this date is 111 degrees F at Canby (Yellow Medicine County) in 1936; the all-time low is 27 degrees F at Tower in 1975.

Words of the Week: Tipple Cloud

This term is occasionally used to refer to a cloud which dumps excessive amounts of rain as it passes over an elevated spot in a landscape, such as a hill or mountain. It is taken from mining terminology. Coal mines and other mines often had tipples constructed near their entrances where the ore and mining waste from carts could be dumped and sorted.

Outlook:

Mostly sunny and pleasant for several days. A warming trend will commence by the middle of next week, producing some temperatures in the 90s F again and with more humidity. Increasing chances for showers by Thursday and Friday. It's the time of year to always use sunscreen when outdoors.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, July 19, 2002

Topic: The 3rd Annual University of Minnesota St Paul
Campus Open House hosted by the College of Agriculture,
Food, and Environmental Sciences.

My College will host its 3rd Annual Open House on Saturday,
July 27th from 9:00 am to 1:00 pm, with emphasis on providing
fun and education in a farm-like setting. There will be tours,
activities, and presentations of interest to all ages and
persuasions, including visits to the barn and greenhouses,
the Horticulture Department's demonstration garden, and
field tours showing antique and modern farm equipment.
You can get gardening questions answered by the
experts and get better informed about Minnesota's
diverse agriculture. I will make a presentation on
significant weather trends as well.....everyone is
welcome to this event...for more information MPR listeners
can call 612-625-4743 or 612-624-2346 or go to the college
web site at....

<http://www.coafes.umn.edu/openhouse2002>

Topic: Urban Heat Islands

On Thursday (July 18) of this week several interesting
articles appeared in local papers (Pioneer Press) about
urban heat islands, including descriptions of what causes
urban areas to have higher temperatures and ways to
mitigate against this. There was even reference to a
study that suggests the exhaust from air conditioning
systems contributes to the urban heat island effect.

Urban heat island effects have been studied for both
large and small cities. Some studies have shown a
warming effect associated with a population growth of
tens of thousands of new residents while other studies
have shown measurable effects from an increased
population of just a few thousand people. Detection of
this heat island effect has been documented both by
traditional ground-based temperature sensors as well
as NASA's satellite-based temperature (infrared) sensors.

There are primarily four features of urban areas that
have significant effects on the climate: (1) heat storage
by paved surfaces and buildings; (2) higher and faster
volumes of surface runoff (and therefore less moisture
storage) from precipitation events creating a drier overall
landscape surface (essentially associated with less
green space); (3) reduced wind speeds as a result
of the higher frictional loss in air movement over a

very rough landscape; and (4) discharge of a significant pollution plume over the urban landscape, including many more condensation nuclei for the formation of fog and precipitation. In essence these four features combine to impact several important aspects of the urban climate other than temperature, including precipitation, fog, cloud cover, wind speed, humidity, air quality, and radiation.

Studies of the 7 county metro area around the Twin Cities have shown an urbanization effect on mean annual temperature that amounts to about 4 degrees F. With light winds on Wednesday night and the dominance of a warm humid air mass, the urban heat island around the Twin Cities could be seen by looking at the overnight low temperatures reported for July 18th....

MSP (airport) 75 F	Downtown St Paul (airport) 74 F
Bloomington 74 F	Eden Prairie 75 F
Minnetonka 73 F	Roseville 73 F
Lakeville 72 F	Anoka 71 F
Maple Lake 70 F	Wild River State Park (WI) 68 F

Though urban heat islands clearly create some problems, such as increased water use, poor air quality, and sometimes serious air conditioning costs, one feature that few people complain about is the lengthening of the frost-free season for gardening.

Among the several mitigation measures proposed for dealing with urban heat islands are suggestions to expand green space and especially plant more shade trees, use more highly reflective pavements and building materials, and reduce traffic volume (emissions).

MPR listener question: Having recently moved here from South Carolina, I know Minnesota has a national reputation for cold temperatures and often reports the nation's lowest (excluding Alaska). But it seems this summer has been unusually warm. Has Minnesota recorded any national lows so far this summer?

Answer: Yes, indeed it has been warm and wet so far this summer in most areas of the state. We did report the lowest temperature in the 48 contiguous states back on June 18, when Silver Bay along the north shore recorded a low of just 30 degrees F. But that has been the only such report so far. In an average summer, Minnesota will report the lowest temperature in the contiguous 48 states at least a few times.

Twin Cities Almanac for July 19th:

The average MSP high temperature for today's 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 records for today's date include: highest daily maximum temperature of 100 degrees F in 1940, lowest daily maximum temperature of 63 degrees F in 1902; lowest daily minimum temperature of 51 degrees F in 1911 and 1947; highest daily minimum temperature of 79 degrees F in 1977; record rainfall of 1.75 inches in 1957.

Average dew point on this date is 61 degrees, with a maximum of 80 degrees F (1983) and a minimum of 41 degrees F (1958).

All-time state records for July 19th:

Scanning the state climatic data base: the all-time high for today's date is 108 degrees F at Canby (Yellow Medicine County) in 1932; all-time low is 31 degrees F at Stephens Mine (St Louis County) in 1911 and matched in 1912 at Roseau and Cloquet.

Word of the Week: Isoceraunic

This is another analysis term used in climatology to describe a line drawn on a map to depict equal frequency or intensity of thunderstorm activity (e.g. number of thunderstorm days per year). Isoceraunic (pronounced iso-se-ronik) is from the Greek words "iso" meaning equal and "ceraun" (or keraun) meaning thunderbolt.

In our region the average number of days per year with thunderstorms varies from about 30 to 45. The table below shows the values for some of the areas major cities.....

Location	Average number of days with thunderstorms per year
MSP (airport)	37
International Falls	32
Duluth	33
Fargo-Moorhead	31
St Cloud	34
La Crosse, WI	39
Rochester	40
Sioux Falls, SD	44

In our region 70-75 percent of all thunderstorms occur in the months of May-August. Historical statistics show the least occurrence of thunderstorms in January with a frequency generally less than once in 20 years.

Outlook:

Good chance of showers and thunderstorms by Saturday and Sunday, especially in the north, followed by cooler and less humid air next week. Highs will be generally in the 80s F with lows in the 60s F. Another chance for showers and

thunderstorms by Thursday. Those on the MS TRAM bike ride across Minnesota will be glad to know that winds will generally be light from the south most of the week.

GOOD LUCK TO THESE DEDICATED RIDERS!!

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, July 26, 2002

Topic: The 3rd Annual University of Minnesota St Paul Campus Open House hosted by the College of Agriculture, Food, and Environmental Sciences.

My College will host its 3rd Annual Open House Saturday (July 27) from 9:00 am to 1:00 pm, with emphasis on providing fun and education in a farm-like setting. There will be tours, activities, and presentations of interest to all ages and persuasions, including visits to the barn and greenhouses, the Horticulture Department's demonstration garden, and field tours showing antique and modern farm equipment. You can get gardening questions answered by the experts and get better informed about Minnesota's diverse agriculture. I will make a presentation on significant weather trends as well.....everyone is welcome to this event...for more information MPR listeners can call 612-625-4743 or 612-624-2346 or go to the college web site at....

<http://www.coafes.umn.edu/openhouse2002>

Topic: Cold air in Minnesota

After speaking last week about the lack of cold nights in Minnesota this summer, lo and behold on Tuesday (July 23) of this week Hibbing, Silver Bay, and Embarrass, MN all reported a morning low of 36 degrees F....the lowest in the nation (contiguous 48 states) for that date and a new record minimum temperature for the date at each location. On that same morning, International Falls reported a new record low of 41 degrees F.

The next day, on Wednesday morning (July 24) Embarrass, MN reported a low of 39 degrees F but this was not a record (record is 38 F in 1998).

Topic: Recent sultry conditions following a trend??

The latest round of sultry weather peaked in Minnesota last weekend. Dew points ranging from 75 to 80 F were common around the state on both Saturday and Sunday. The dew point hit 80 degrees at the Twin Cities International Airport on Saturday (July 20) evening. The highest heat index at MSP airport was 104 degrees F during Saturday evening and at 2:00 pm on Sunday (July 21). On Saturday, three locations tied the highest dew point ever observed in Minnesota as Morris, Madison, and Olivia all reported a dew point of 84 F during the evening. The highest heat index value reported on Saturday was

123 degrees F at Madison about 7 pm (temp 95 F and dew point 84 F). By the end of the day Monday, a change in air mass ushered in natural air conditioning as the dew point fell to 55 degrees F, bringing great welcome relief.

80 degree dew points are historically uncommon in Minnesota, though more frequent in recent years. In the Twin Cities historical records since 1945, there have been just 20 hours of 80 degree dew points. The majority of the 80 degree dew points have occurred just since 1995. Three of the past four summers have brought dew points this high. The most hours with 80 degree F dew point hours in the Twin Cities occurred in 1995 from 4:00 pm on July 12 to 1:00 am on July 13th. The highest dew point ever recorded in the Twin Cities was 81 degrees at 11:00 am on July 30, 1999.

On two other occasions, 84 degree F dew points have been observed in Minnesota....July 29, 1999 (at Jackson and Pipestone) and July 30, 1999 (at Jackson, Faribault, and Red Wing). The latter date is also memorable for the highest Heat Index ever measured in Minnesota, 125 degrees F at Red Wing (temp 97 F, dew point 84). Other high Heat Index values that day included 123 F at Winona and 122 F at Faribault.

MPR listener question: Isn't the last week of July on average the hottest of the summer?

Answer: Yes, for most Minnesota communities the historical average shows the highest daily temperatures somewhere between the dates of July 16 and July 30. Interestingly enough, next Monday (July 29th) marks the 85th anniversary of the all-time highest temperature ever measured in the state.....114.5 F at Beardsely (Big Stone County) on July 29, 1917. The National Climatic Data Center has rounded this to 114 F which ties another rounded extreme value of temperature measured at Moorhead, MN on July 6, 1936 when the observer recorded 113.6 F. So, 114 F is considered to be a record held by two Minnesota cities.

Twin Cities Almanac for July 26th:

The average MSP high temperature for today's 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).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 100 degrees F in 1894 and 1955; lowest daily maximum temperature of 68 degrees F in 1903; lowest daily minimum temperature of 45 degrees F in 1962; highest daily minimum temperature of 76 degrees F in 1931; record rainfall of 1.70 inches in 1953.

Average dew point on this date is 60 degrees, with a maximum of 77 degrees F in 1997 and a minimum of 37 degrees F in 1974.

Scanning the state climatic data base: the all-time high for today's date is 107 degrees F at Beardsley (Big Stone County) in 1931; all-time low is 27 degrees F at Tower (St Louis County) in 1980.

Word of the Week: BERMS

This is an acronym for a project initiated by the Climate Research Branch of Environment Canada. It stands for Boreal Ecosystem Research and Monitoring Sites. They have deployed instrumentation technology on three sites in northern Canada (north of Prince Albert, Saskatchewan) to study the carbon balance over three boreal forests, aspen, black spruce, and jack pine. These forests function as both a carbon source and a carbon sink and are of particular interest to those scientists studying global warming.

More on this project can be found at their web site.....

<http://berms.ccrp.ec.gc.ca>

Outlook:

A trend for warmer and more humid conditions begins this weekend, also bringing an increased chance for showers and thunderstorms through Monday. Relatively quiet weather after that, with an increasing chance for showers and thunderstorms towards the end of the week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, August 23, 2002

DON'T FORGET TO TAKE THE 6TH ANNUAL MINNESOTA STATE FAIR
WEATHER QUIZ FOUND ON THE MINNESOTA PUBLIC RADIO WEB SITE..

<http://www.mpr.org>

Topic: Wet summer continues

Most places in Minnesota have recorded a wetter than normal summer. This week brought the third 2 inch rain of the summer to the Twin Cities (normally there is just one per year). At 21.19 inches of rainfall since June 1st, the MSP airport reports the 4th wettest June, July, August in the climatological record. In addition, the MSP airport has already recorded the 3rd wettest August in history (7.84 inches) and the month is far from over. Only 1977 at 9.31 inches and 1914 at 8.14 inches were wetter. At 8.14 inches for the month so far, Sioux Falls, SD has recorded its 2nd wettest August, surpassed only by 9.09 inches in 1975.

Topic: An interesting proposal

Washington National Airport in D.C. records the official weather observations for the nation's capital. However, many climatologists have noted that it represents a true heat island effect and therefore registers both maximum and minimum temperatures that are several degrees higher than most other areas in and around Washington, D.C. With the modernization of the cooperative observer network to start next year, the National Weather Service Headquarters has proposed to move the official site for observations to the White House grounds. Apparently this is possible now with tightened security and 24 hour surveillance such that hourly weather observations could be made by the personnel there.

MPR listener question: What location in Minnesota has the lowest mean annual wind speed? How about in the nation?

Answer: This is a tough question. Based on mean monthly wind speeds, it appears that Crane Lake in northern St Louis County has the lowest value, averaging only about 6-7 mph. This is in a heavily forested area not frequented by too many large scale storm systems.

Nationally, the National Climatic Data Center keeps comparative data for over 300 United States cities. Among these, Oak Ridge, TN reports the lowest annual average wind speed at 4.1 mph. There are undoubtedly other locations in the United States with lower mean annual wind speed values, but these are not represented in the database. Incidentally, the mean annual wind speed in the Twin Cities is 10.1 mph.

Twin Cities Almanac for August 23rd:

The average MSP high temperature for today's date is 79 degrees F (plus or minus 8 degrees standard deviation), while the average low is 60 degrees F (plus or minus 7 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 97 degrees F in 1948; lowest daily maximum temperature of 60 degrees F in 1940; lowest daily minimum temperature of 42 degrees F in 1891; highest daily minimum temperature of 77 degrees F in 1948; record rainfall of 1.43 inches in 1899.

Average dew point on this date is 58 degrees, with a maximum of 77 degrees F in 1975 and a minimum of 32 degrees F in 1927.

Scanning the state climatic data base: the all-time high for today's date is 104 degrees F at Beardsley (Big Stone County) in 1922; all-time low is 25 degrees F at Tower (St Louis County) in 1977.

Word of the Week: Wind Shade

This is a term used to describe the effect of a blunt obstacle used as a shelterbelt or barrier to the wind. The maximum reduction in wind speed usually occurs below the top of the barrier and some distance away on the downwind side. Many shelterbelts such as trees and shrubs have the ability to reduce wind speeds in the wind shaded area by 60 percent or more.

Outlook:

Continued mostly cloudy to partly cloudy conditions with cooler than normal temperatures. Chance of showers in the north on Saturday, then more statewide on Monday through Wednesday, albeit on the lighter side.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: The Department of Soil, Water, and Climate
Re: Suggestions for MPR's Morning Edition, August 30, 2002

Topic: August Climate Summary

Temperatures for the month averaged close to normal. Extremes ranged from 96 degrees F at Canby on the 1st to 32 degrees F at Tower on the 19th.....

The real weather story for August was rainfall. Most places reported well above normal rainfall amounts for the month. In fact the statewide average exceeded 5.30 inches, ranking as the 6th wettest August overall. Many individual observers and communities reported record or near record rainfall totals, including....

Wabasha 12.93 inches (new August record)
Springfield 8.97 inches (new August record)
Northfield 8.85 inches (new August record)
Lakefield 10.12 inches (new August record)
Byron 8.40 inches (new August record)
Worthington 11.90 inches (new August record)
Montevideo 9.08 inches (2nd wettest August)
Hastings 8.57 inches (3rd wettest August)
Jordan 9.98 inches (2nd wettest August)
Litchfield 9.68 inches (2nd wettest August)
Sioux Falls, SD 8.26 inches (2nd wettest August)
Twin Cities 8.23 inches (3rd wettest August)

Most of the large rainfall amounts were due to intense individual thunderstorm events, most notably on the 3rd-4th, 6th-7th, 20th-21st, and 27th-28th. Several individual daily rainfall amounts were record-setting as well. Some of these included.....

6.30 inches at Montevideo on the 3rd
5.20 inches at Litchfield on the 21st
4.76 inches at Crookston on the 28th
4.70 inches at Madison on the 21st
4.30 inches at Dawson on the 21st

Many of these events caused flash flooding problems such as washed out roads and water in basements. The abundant rainfall in August followed a pattern established in June, marking this as one of the wettest ever summers for parts of the state.

Topic: 25th anniversary of the wettest evening at the State Fair

Wednesday evening brought the 3rd rainfall to the State Fair this year, and like the others it was relatively short-lived, lasting less than 1 hour, but delivering over 1/2 inch of rain. Still, other State Fairs historically have seen more intense storms.

August 30, 1977 was a rather normal day until early evening when dark clouds appeared on the horizon. An intense thunderstorm began about 8:30 pm and brought 4-5 inches of rainfall to the State Fairgrounds in St Paul by midnight. The maximum rainfall rate occurred between 9:00 and 10:00 pm when over 2.5 inches of rain fell. The storm total of 7.36 inches at the MSP airport remains the 2nd greatest in Twin Cities history, surpassed only by the 10 inches that fell on July 23-24 of 1987. Hundreds of homes in the Twin Cities reported water damage. Evening events at the State Fair were cancelled.

MPR listener question: Who writes the seasonal forecasts for the Farmer's Almanac and what methods are employed?

Answer: The seasonal forecasts published in the Farmer's Almanac have been written by a number of individuals dating back to its founder David Young in 1818. Following Young's death in 1852, Samuel Wright and his son Berlin took over responsibility for writing the seasonal forecasts. They handled this until the 1930s. The last acknowledged forecaster for the Farmer's Almanac was astronomer Dr. Kenneth Franklin of the American Museum of Natural History who wrote the forecasts in the 1980s.

Today the Farmer's Almanac seasonal forecasts are attributed to Caleb Weatherbee, a pseudonym for whoever is contracted to write them. The methods deployed to do the seasonal forecasts are unknown, although in the past they have acknowledged the use of climatic conditions (statistical correlations), sunspots, moon phases, and astronomical signs.

More information about the Farmer's Almanac can be found at their web site....

www.farmersalmanac.com

Twin Cities Almanac for August 30th:

The average MSP high temperature for today's date is 77 degrees F (plus or minus 8 degrees standard deviation), while the average low is 58 degrees F (plus or minus 6 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 96 degrees F in 1941; lowest daily maximum temperature of 60 degrees F in 1965; lowest daily minimum temperature of 45 degrees F in 1935; highest daily minimum temperature of 75 degrees F in 1932; record rainfall of 7.28 inches in 1977.

Average dew point on this date is 58 degrees, with a maximum of 75 degrees F in 1951 and a minimum of 34 degrees F in 1931.

Scanning the state climatic data base: the all-time high for

today's date is 101 degrees F at Beardsley (Big Stone County) in 1921; all-time low is 28 degrees F at Tower (St Louis County) in 1976.

Words of the Week: Heidke Skill Score, Gilbert Skill Score, and Kuiper Skill Score

All of these refer to statistical methods to evaluate the skill of seasonal climate forecasts. They consider the skill of getting the climate category right (above, below, or normal) as well as the area of the landscape right (upper midwest as opposed to eastern cornbelt region for example). Interestingly, some methods give a greater weight (skill) to getting the categories of above normal or below normal (warmer, cooler, wetter, drier) right compared to forecasting normal climate conditions. I find this analogous to sports betting in giving greater credit for picking the upsets (Twins over the Yankees) rather than picking most of the games correctly by going with the favorites.

Outlook:

Near normal to abovetemperatures over the weekend with a chance for showers and thunderstorms, especially in northern and central counties on Saturday, then statewide Sunday. Cooler and drier by Tuesday and Wednesday next week with an increasing chance for showers toward the end of the week.

To: Perry Finelli, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley, University of Minnesota
Re: Suggestions for MPR's Morning Edition, September 6, 2002

Topic: Ladysmith tornado and notes on severe weather

An F3 tornado (158-206 mph winds) devastated the town of Ladysmith, WI late afternoon on Labor Day earlier this week. Over 40 buildings were destroyed and 150 others damaged. Fortunately there were no fatalities. This tornado was perhaps the only F3 of the year so far in our region. Historically, September tornadoes are not especially common in Minnesota, with only 16 documented occurrences over the period from 1880-1995. In Wisconsin, September tornadoes are more frequent with 42 reports over the same period.

In fact tornado numbers are dramatically down this year, with Minnesota reporting only about 20 (recall that 74 were reported last year). Nationally only 555 tornadoes have been reported, dramatically less than in recent years. This correlates well with such a large fraction of the United States landscape suffering from drought this year.

Conversely, in our region, the number of severe thunderstorm reports is higher than any summer since 1998, with numerous reports of flashfloods and hail.

Topic: Wet Summer

Preliminary climate statistics for summer (June-August) show record breaking rainfall amounts all over the state. In fact, on a statewide basis the average rainfall for these three months in 2002 was over 17.5 inches, the most ever. Locally, MSP reported 21.79 inches, the 4th wettest summer in the historical record. Other locations reported their wettest summer ever, including.....

Crookston at 19.10 inches, Red Lake Falls at 20.82 inches, Royalton at 19.79 inches, Litchfield at 27.97 inches, Rockford at 27.23 inches, Springfield at 18.41 inches, Byron at 21.26 inches, Red Wing at 22.27 inches, Rosemount at 21.86 inches, Wabasha at 28.30 inches, and Delano at a whopping 32.22 inches.

These record breaking rainfalls went hand in hand with numerous severe thunderstorm warnings, flashfloods, wet basements, high water flows on many rivers, power outages, high mosquito populations, and several episodes of heat wave advisories driven by very high humidity.

MPR listener question: What are the statewide extremes of

temperature for the month of September?

Answer: The all-time high temperature for September is 111 degrees F at Beardsley (Big Stone County) on September 11, 1931. This occurred in the middle of a terrible heat wave of 5 consecutive days over 100 degrees F during the warmest September ever recorded in western Minnesota.

The all-time lowest September temperature is just 10 degrees F at Thorhult (Beltrami County) on September 22, 1974.

Twin Cities Almanac for September 6th:

The average MSP high temperature for today's date is 75 degrees F (plus or minus 10 degrees standard deviation), while the average low is 57 degrees F (plus or minus 8 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 98 degrees F in 1922; lowest daily maximum temperature of 55 degrees F in 1911; lowest daily minimum temperature of 41 degrees F in 1962; highest daily minimum temperature of 75 degrees F in 1913; record rainfall of 0.74 inches in 1938.

Average dew point on this date is 55 degrees, with a maximum of 75 degrees F in 1970 and a minimum of 33 degrees F in 1956.

Scanning the state climatic data base: the all-time high for today's date is 105 degrees F at New Ulm (Brown County) in 1922: all-time low is 23 degrees F at Park Rapids (Hubbard County) in 1885.

Words of the Week: TUTT

Another meteorological acronym.....this time it stands for Tropical Upper Tropospheric Trough (a mouthful). This is a pressure trough (low pressure) aloft near the top of the troposphere, as opposed to a surface low pressure system which we often observe as an unsettled period of weather, with associated warm and cold fronts. The position and strength of a TUTT can affect wind shear (speed and directional variation in winds aloft) and therefore over the warm tropical oceans it can either enhance the development of tropical storms and hurricanes (in areas of reduced wind shear) or help prevent their formation (under areas of increased wind shear). Thus TUTTs are closely monitored by the National Hurricane Center and other tropical weather forecasting offices.

Outlook:

Warmer than normal with a chance for showers and thunderstorms

in northern counties over the weekend and early next week. A significant cooling trend is in store for next Tuesday and Wednesday with a chance for showers by Thursday and Friday. Some overnight temperatures in the low 40s and high 30s F are probable for next week in northern counties.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley, University of Minnesota
Re: Suggestions for MPR's Morning Edition, September 13, 2002

Topic: Albertville, MN tornado of September 9th

An F1 tornado struck the town of Albertville, NW of the Twin Cities about midnight Monday night (Sept 9th). As we reported last week on Morning Edition, September tornadoes are rare in Minnesota, with only 16 documented occurrences over the period from 1880-1995. Even more unusual in this case was the hour this storm struck. In the Minnesota historical record back to 1880 I can only find two documented cases of a tornado striking near the midnight hour: 11:45 pm on July 1, 1928 in Lyon and Yellow Medicine Counties, and 11:44 pm on August 18, 1980 in Blue Earth County. These midnight cases combined with the Albertville tornado represent less than 0.5 percent of all tornadoes reported in Minnesota.

Topic: September frosts

Though it has been a hot summer around the state, the threat of frost yet this month should not be overlooked. Frost has occurred in parts of northern Minnesota every month of the year (Tower in St Louis County for example already reported frost in August), but in the Twin cities and other southern regions of the state a September frost is rather rare. The MSP climate record (1891-2002) shows that frost (defined as 32 degrees F or colder) has occurred in the Twin Cities a grand total of 39 times during September, with the earliest coming on September 3, 1974. September of 1942 produced five frosts in the Twin Cities, while that of 1974 produced four frosts. Overall, frosts have been reported in the Twin Cities 23 of the past 111 Septembers, with the most recent ones in 1995 and 2000.

September frosts are far more frequent in northwestern Minnesota counties. At Crookston for example over the 1891-2001 period, frost occurred in the month of September a grand total of 308 times, and in 90 of the 111 years, the earliest being September 2, 1946. In fact, Crookston has reported two frosts in August: August 28, 1893 and August 28, 1965.

Though September frosts may be of concern to farmers and gardeners, they are welcome by those Minnesotans who suffer from allergies or large populations of mosquitos. It appears the weekend will bring frosts to some parts of the state.

MPR listener question: Has the Twin Cities ever recorded snow in September?

Answer: Yes, but not very often. Three measurable September snowfalls occurred in the Twin Cities in the 20th Century: 1.7 inches on September 26, 1942, 0.1 inches on September 30, 1961, and 0.4 inches on September 24, 1985. Trace amounts of snow were reported in September of 1889, 1908, 1916, 1927, 1928, and 1945.

Elsewhere in Minnesota, September snowfalls are more common. In 1974, 33 Minnesota weather observers reported some snow in September. Two inches of snow fell at Tower, MN on September 27, 1899 and at Babbitt, MN on September 25, 1927. In fact, Babbitt, located in northeastern St Louis County, reported September snowfalls in 25 years out of a 67 year climate record.

Twin Cities Almanac for September 13th:

The average MSP high temperature for today's date is 70 degrees F (plus or minus 9 degrees standard deviation), while the average low is 53 degrees F (plus or minus 8 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 95 degrees F in 1939; lowest daily maximum temperature of 52 degrees F in 1903 and 1949; lowest daily minimum temperature of 34 degrees F in 1923; highest daily minimum temperature of 72 degrees F in 1939; record rainfall of 1.29 inches in 1994.

Average dew point on this date is 49 degrees, with a maximum of 71 degrees F in 1939 and a minimum of 22 degrees F in 1923.

Scanning the state climatic data base: the all-time high for today's date is 100 degrees F at Redwood Falls in 1939; the all-time low is 17 degrees F at Roseau in 1975.

Word of the Week: Isoryme

Breaking this word down to its roots, iso means equal value, while ryme refers to a granular ice structure. Isorymes are lines used on a map to show equal incidence of frost, or another words where the average frost dates or frequencies are the same. In Minnesota, average first fall frost dates range from early to mid September in the far north to early to mid October in the south and urban heat island areas.

Outlook:

Chance of lingering showers early Saturday, then predominately cool and dry for several days. Overnight lows in the 30s and 40s F will be more common, with daytime highs in the 60s and 70s F. A chance for showers again by Wednesday and Thursday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, September 20, 2002

Topic: New Monthly and Seasonal Climate Outlook....

The new climate outlooks for October, November and December released this week by the NOAA Climate Prediction Center (CPC) show a trend toward above normal temperatures is expected to persist in our region. This is predicated on the basis of a moderate El Nino episode in the equatorial Pacific Ocean, a feature of the Earth's climate system that has been historically associated with mild winters. The CPC has suggested precipitation over the same period may be near normal.

Topic: Nearly time for a little fall color.....

The time is rapidly approaching when Minnesotans love to admire the beautiful changes in color that autumn brings. For those MPR listeners new to the state, I think you will find that the fall season is perhaps the most favored one for most residents.

The color changes are progressing slowly this month, at least partially due to the warmth. Most places around the state have been reporting temperatures that are from 6 to 8 degrees F warmer than normal. There has also been a conspicuous absence of overnight lows in the 30s F, a climate signal that most vegetation responds to in addition to the rapidly changing day length. Hibbing did report a low of 30 degrees F last Sunday and some other northern and western counties reported a low in the 30s F as well, but several more mornings in the 30s F will trigger a more rapid change of color. Color changes occur variably around the state, starting in far northeastern counties typically around the 3rd week of September and lasting until the first few days of October, then progressing to more southerly counties where the peak color typically occurs during the first half of October.

Friends have often remarked that these color changes seem to be more vivid to the eye than those seen in spring green-up or during the flowering times of late spring and summer. There may be a number of reasons for this, perhaps some psychological, but two meteorological ones come to mind. The fall season usually brings an increase in atmospheric transmissivity, the ability of the atmosphere to let light pass through it. Some call this cleaner air, but whatever we choose to call it, we can see more clearly across some distance. The second feature of the climate that is evident is the declining sun angle. Light strikes the landscape from much lower angles and therefore there is more reflection of light off into lateral directions observed by the

human eye. Recall for example, your more frequent use of the sun visor in your car when commuting early in the morning or later in the afternoon during the fall season.

Well scientific explanations aside, get ready to enjoy what is arguably the most beautiful time of the year in Minnesota. The DNR web site is a good place to keep up with the progress in fall color change. Their URL is.....

http://www.dnr.state.mn.us/current_conditions/index.html

MPR listener question: We have gardened in the Twin Cities for the past 28 years and noticed that after the first autumn frost, especially if it is early in the season, the temperature seems to rebound dramatically the next day warming up significantly into a nice Indian Summer day. Is this true in your climate data, or are we just dreaming?

Answer: Actually, your perception is quite accurate, at least from my limited sample of data. I examined all first autumn frost dates in the month of September for the Twin Cities climate record (1891-2001) finding 23 years when frost occurred in September. The average warm up the day after was 31 degrees F, about 11 degrees F higher than the average daily range in temperature during September. In fact there were some startling warm-up examples of over 40 degrees F increase, including September 27, 1939 when following a frosty day with just 30 degrees F it warmed up to 75 degrees F under a bright sun and southerly breeze. This is probably due to a dry landscape, and to a dry atmosphere with clear skies, conditions that are conducive to overnight frost, but also to a rapid warming of the landscape, particularly if south winds are blowing the next day.

Twin Cities Almanac for September 20th:

The average MSP high temperature for today's date is 69 degrees F (plus or minus 10 degrees standard deviation), while the average low is 50 degrees F (plus or minus 9 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 91 degrees F in 1895; lowest daily maximum temperature of 50 degrees F in 1927; lowest daily minimum temperature of 28 degrees F in 1962; highest daily minimum temperature of 75 degrees F in 1895; record rainfall of 0.73 inches in 1964.

Average dew point on this date is 48 degrees, with a maximum of 72 degrees F in 1970 and a minimum of 22 degrees F in 1930.

Scanning the state climatic data base: the all-time high for today's date is 99 degrees F at Montevideo (Chippewa county) in 1984; the all-time low is 14 degrees F at Karlstad (Kittson county) in 1973.

Word of the Week: isophane

This is an old word derived from the Greek roots "iso" meaning equal and "phainein" meaning to show. It refers to a line on a map connecting points where the time of occurrence for some phenological event is the same. For example a line that shows where the peak color change in the landscape will be in Minnesota on September 29th. Usually for phenological events, local landscape position, and differences in soils can cause considerable variation, but nevertheless isophanes provide pretty good general descriptions.

Outlook:

Windy and cloudy around the state this weekend, with a chance for widely scattered showers in the north. Markedly cooler, as temperatures fall into the 30s and 40s F for overnight lows. A second wave of cool air will come in early next week and perhaps bring frost to most of the state by Tuesday or Wednesday mornings. There will be an increasing chance for precipitation by Wednesday and Thursday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, September 27, 2002

Topic: Cold elsewhere too

We are not the only ones with an early onset of very cold fall conditions. Berlin and Moscow have already seen freezing temperatures this month, while Regina in Saskatchewan reported a low of 23 degrees F earlier this week. Mt Wendelstein in the Bavarian Alps reported a sizable snowfall on Tuesday of this week, with low visibility, high winds and very cold temperatures. The polar jet stream has taken up a relatively low latitude position over both North America and Europe, allowing for the intrusion of polar air.

Topic: Preliminary Climate Summary for September

September was very much up and down with respect to temperature. The state high was 96 degrees F on the 7th at Moorhead and at Canby. The early part of the month was very warm in general. The state's lowest temperature was just 19 degrees F at Tower on September 24th when frost was widespread across the state. In fact well over half of the state's climate observers reported a killing frost during the month, somewhat unusual in the context of recent autumns which have seen later than normal frosts. Overall the mean temperature for September ranged from 3 to 5 degrees F warmer than normal around the state.

September rainfall was generally below normal around the state, especially so in the north and west. There were some exceptions: Floodwood, Royalton, Rockford, Milaca, Farmington, and Red Wing all reported over 4 inches, well above normal, while Rosemount and Hastings reported over 5 inches. St Cloud and ForestLake reported some of the more intense shower activity totaling over 6 inches. Heavy thunderstorms on the 6th of the month produced some local street flooding in St Cloud, Rosemount and Farmington.

Wind speeds were less than normal during the month, though St Cloud reported a peak wind speed of 51 mph on the 1st. Sunshine hours were well above normal, with many clear or partly cloudy days.

Topic: September 1807 in Minnesota

Alexander Henry was an explorer and trapper for the old Northwest Company of Canada back at the turn of the 19th Century. He explored and lived in the Red River Valley of Minnesota and North Dakota from 1800 to 1808. He camped and built temporary forts in many places along the river, including near Pembina and Drayton, ND as well as Warren,

Oslo, and Red Lake Falls, MN. Thanks to his daily weather journal, one of the oldest in our region, we have a written record of the weather in northwestern Minnesota for the period from September 1807 to June 1808.. September, 1807 according to Henry was highly variable. Very sunny and warm early in the month with several days in the 80s F. Then it turned cool and showery by mid-month with a number of frosts and a hard freeze on the 16th (28 F). Fall coloration and leaf drop came about mid-month, and he observed the migration of geese and swans heading south. September 18th brought every kind of weather according to Henry's journalstrong winds, heavy rain, hail, and even two inches of snow! This was followed by another hard freeze on the 20th (27 F). The month concluded with yet another freeze on the 28th, followed by light showers and foggy weather through the end of the month.

Henry's journal is a treasure to a historian or climatologist as it is one of the few written records of the daily weather from such an early time period, before settlement of the Red River Valley. He documents a number of spring snow melt floods in the region and remarks about how the floods used to drown hundreds of buffalo which would graze the numerous islands. The 1800-1808 period is still encompassed by the northern hemisphere's Little Ice Age that extended to roughly 1850. In this context it is not unexpected to find that Alexander Henry recorded snows in September and winter snow cover persisting well into the month of May in northern Minnesota.

MPR listener question: Following this wet summer, how much moisture is stored in the soil?

Answer: Of course this depends on the water holding capacity of your particular soil, a characteristic that can vary a great deal. Some of our data suggests that the stored soil water in a 5 foot root zone, ranges from 5 to 8 inches in most places around the state at this time. This is considerably more than the amount contained in soil storage at this time last year.

Twin Cities Almanac for September 27th:

The average MSP high temperature for today's date is 66 degrees F (plus or minus 11 degrees standard deviation), while the average low is 46 degrees F (plus or minus 8 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 88 degrees F in 1987; lowest daily maximum temperature of 40 degrees F in 1942; lowest daily minimum temperature of 29 degrees F in 1942 and 1991; highest daily minimum temperature of 64 degrees F in 1891; record rainfall

of 0.54 inches in 1947.

Average dew point on this date is 45 degrees, with a maximum of 67 degrees F in 1905 and a minimum of 24 degrees F in 1942.

Scanning the state climatic data base: the all-time high for today's date is 97 degrees F at Hallock (Kittson County) in 1952 and at Canby (Yellow Medicine County) in 1956; the all-time low is 16 degrees F at Wannaska (Roseau County) in 1967.

Words of the Week: Stuve diagram

This is one of several thermodynamic diagrams used by meteorologists to characterize the vertical distribution of temperature and moisture in the atmosphere. Temperature and dew point are plotted against elevation (usually expressed as both meters and pressure in millibars) from instrumented balloon soundings (RADIOSONDES) made every 12 hours. The wind speed and direction aloft is also shown. Meteorologists can examine such charts for areas of saturation (clouds) and dry air aloft, or to see the height of the freezing level. The Twin Cities Stuve diagram on Wednesday of this week (a cloudy, rainy day) showed a saturated level at about 8,000 ft, where the base of the clouds could be found. The freezing level (temp below 32 F) was above 10,000 ft, and wind speeds exceeded 100 knots from the west at 39,000 ft.

Upper air diagrams like the Stuve are available on the web at the Plymouth State College site....

<http://cyclone.plymouth.edu/uacalplt.html>

Outlook:

Generally cool Saturday with increasing cloudiness across the northern and central counties and a chance for light rain. Warming trend begins on Sunday, bringing 60s and 70s F to the state early next week, then another cool down with a chance for showers by Wednesday and Thursday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, October 4, 2002

Topic: Warm start to the week

Much like the first week of the month, the last day of September (Monday the 30th) brought record warmth to many parts of the state. The following record high temperatures were reported.....

Rochester 86 F (tied 1952) Benson 88 F (tied 1976)
Owatonna 88 F Red Wing 86 F Moose Lake 82 F (tied 1976)

Many other locations reported temperatures in the 80s F, though not record-setting.

Topic: One of the wettest growing seasons.....

May through September, the primary growing season for Minnesota gardeners and farmers, was one of the wettest in history for many locations. In fact, statewide many communities reported well over 25 inches for the period. The Twin Cities reported 28.52 inches of rainfall, the 2nd wettest ever growing season (1892 was 31.42 inches). Crookston in the Red River valley reported over 24 inches of growing season rainfall, their 2nd wettest in history, while Rosemount in Dakota County reported 30.10 inches, also their 2nd wettest growing season.

Topic: Paper airplanes galore!!

An article in the American Meteorological Society Bulletin describes an event that took place in Oklahoma this year to promote the study of aerodynamics and the upper atmosphere. Organized by Takeoff Technologies in Pomona, CA, this event promoted the design and use of paper airplanes made by school aged children in Oklahoma. Following school competitions for paper airplane designs, 600 paper airplanes were submitted for an experiment. These planes were loaded into a box and launched by balloon to an altitude of 95,000 ft (the top of the atmosphere). When the balloon burst, the box opened and distributed the paper airplanes throughout the sky. Each plane was numbered and marked with the name of the school. Volunteers scavenged the countryside to find the airplanes and for those found the latitude and longitude coordinates were logged. Knowing the altitude and position of the balloon when it burst, allowed teachers and students to compute the general trajectory of their respective "aircraft." Inference about design, fall velocity, and winds aloft provided students and teachers with plenty to talk

about. Further experiments are being conducted in Oklahoma with paper airplanes under the name SPACEPLANES.... The results can be found at the following web site....

<http://www.okspaceplanes.com/>

One paper airplane launched from a balloon on September 28th (last Saturday) was found 80 miles away.

MPR listener question: This was a question recently addressed by Eve Iverson, a meteorologist with Cargill in the Twin Cities area.....what is the longest stretch between days with temperatures of 90 degrees F or higher during a calendar year?

Answer: According to the TWIn Cities climate record (1891-2002), Eve found that the record stretch was set this year, with 91 degrees F recorded on April 15th and 91 degrees again recorded on September 8th, a period of 146 days.

Twin Cities Almanac for October 4th:

The average MSP high temperature for today's date is 65 degrees F (plus or minus 10 degrees standard deviation), while the average low is 45 degrees F (plus or minus 8 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 89 degrees F in 1922; lowest daily maximum temperature of 44 degrees F in 1932; lowest daily minimum temperature of 24 degrees F in 1935; highest daily minimum temperature of 68 degrees F in 1922; record rainfall of 1.83 inches in 1985.

Average dew point on this date is 42 degrees, with a maximum of 64 degrees F in 1955 and a minimum of 13 degrees F in 1952.

Scanning the state climatic data base: the all-time high for today's date is 91 degrees F at Bird Island (Renville County) and at Tracy (Lyon County) in 1922; the all-time low is 10 degrees F at Argyle (Marshall County) in 1989.

Words of the Week: Nephology

Taken from Greek root words this term refers to the study of clouds, but is rarely used in conversation anymore. The first cameras used for photographing clouds were dubbed nephographs. Though the height, depth and motion of clouds are depicted in radar and satellite images, most meteorologist still value the observations of the human eye, particularly for highly complex cloud formations that can be typical of this time of year. In the month of October almost any

cloud type (high, medium, or low....layered or cumuloform)
is possible in the state of Minnesota.

Outlook:

Quite a cool weekend coming up with a chance for rain showers
and perhaps snow showers Sunday into Monday. Generally a colder
and windy period will prevail until late next week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, October 11, 2002

Embarrass reported a low of just 17 degrees F on Monday, October 7th this week, the coldest in the nation....

Topic: Making of the wettest year????

Many communities, including the Twin Cities, have reported an unusually wet 2002. Currently MSP airport reports nearly 37 inches of precipitation for the year, a figure that would rank as the 6th wettest year in history even if it was bone dry for the rest of the year. Many other communities have reported similar values, including the following....

Rosemount 44.41 inches	Red Wing 38.53 inches
Delano 45 inches	Stillwater 39 inches
Litchfield 42 inches	Hastings 40.47 inches
Univ of MN 38.55 inches	Wabasha 46.45 inches

The value at Wabasha is already a new annual precipitation record for that community, only to be added to for the remainder of 2002.

Topic: Fall Temperature Control in Minnesota

This time of year the daily course of the sun has less and less to do with controlling the air temperature, as increased cloudiness and advection of large air masses begin to take control. We are losing 18 to 20 minutes of daylight each week and the midday sun angle is declining. In addition, the frequency and extent of cloudiness begins to increase. In fact, by the end of the month, the average number of clear days is half of what it is at the beginning of the month, with a corresponding increase in the number of partly cloudy to cloudy days. This begins to affect those who suffer from seasonal affected disorder.

The term advection refers to the transport of atmospheric properties (primarily heat and water vapor) horizontally through large scale wind fields. Winds from the northwest bring polar air masses that have been conditioned in high latitudes and are thus cooler and drier. Wind shifts to the southeast or southwest bring warmer and more moist air into the region, often with cloudiness that helps prevent overnight minimum temperatures from getting too low. The propagation of these air masses over our region typically takes two to three days, creating a so-called rollercoaster effect in autumn temperatures. Thus we alternate between periods of Indian Summer like conditions and cold, blustery November like conditions.

Advection takes even tighter control of air temperature conditions once snow cover is established at higher latitude positions in North America. This greatly modifies the source regions for polar air. An early establishment of autumn snow cover in Canada for example, predisposes the Minnesota landscape to outbreaks of sharply colder air masses.

MPR listener question: From Cargill in Minnetonka....how many times has the first snowfall accompanied the first frost of the season?

Answer: Great question....checking the Twin Cities climate record, there are at least 7 years that show the coincidence of snowfall with the first fall frost. They are listed below (note in some cases the first frost occurred on the morning after the first snowfall, while in other cases it occurred on the same date)....

September 18, 1863.....frost with trace of snow
September 28, 1908.....frost with trace of snow
October 3, 1935.....frost with trace of snow
October 5, 1952.....frost with trace of snow
October 8, 1959.....frost with 0.3 inches of snow
September 23, 1985.....frost with 0.4 inches of snow
October 15, 1992.....frost with 0.3 inches of snow

The 1863 pioneer record for the Twin Cities is an interesting one in that ground frost was reported in July, right in the middle of the growing season!

Twin Cities Almanac for October 11th:

The average MSP high temperature for today's date is 61 degrees F (plus or minus 11 degrees standard deviation), while the average low is 42 degrees F (plus or minus 8 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 84 degrees F in 1930; lowest daily maximum temperature of 39 degrees F in 1959; lowest daily minimum temperature of 23 degrees F in 1987; highest daily minimum temperature of 62 degrees F in 1930; record rainfall of 1.13 inches in 1912; and record snowfall of 0.5 inches in 1917 and 1977.

Average dew point on this date is 41 degrees, with a maximum of 67 degrees F in 1962 and a minimum of 16 degrees F in 1932.

Scanning the state climatic data base: the all-time high for today's date is 91 degrees F at Pipestone in 1910; the all-time low is 12 degrees F at Brimson (St Louis County) in 1987.

Word of the Week: Nephoscope

This term is derived from the Greek words "nepho" meaning cloud and "scope" meaning view. It is an instrument for viewing clouds and determining their motion. There are two types of nephoscopes, a direct view (binocular type) and a mirror view of the sky, each equipped to allow the observer to determine the compass direction that clouds are moving. Cloud motions may vary with elevation, that is low clouds may be moving in one direction and high clouds moving in another. We saw an example of that with the low pressure system on Monday of this week.

Outlook:

Looks like a wet Saturday coming up, followed by a cool period with frequent showers or snow showers in the north. Temperatures will average 10 to 15 degrees cooler than normal. Some moderation in temperature may occur by the end of next week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, October 18, 2002

Topic: Record reports this week.....

Cold and snow produced some daily records in Minnesota and across the region this week. On Tuesday, October 15th, International Falls reported a record-tying low of just 18 degrees F. On Wednesday, October 16th, Watertown, SD reported a new record snowfall of 3.0 inches, while Rochester reported a trace of snowfall, tying the record for the date. Also on Wednesday morning, Embarrass, MN reported the coldest temperature in the nation with a chilly 8 degrees F. On Thursday, October 17th, several locations reported new daily snowfall records as well, including the following....

Marshall 2.5 inches Windom 2.0 inches
Pipestone 2.0 inches Worthington 1 inch
Alexandria 2.0 inches Long Prairie 3.5 inches
Little Falls 2.0 inches Madison 2.2 inches

On Friday morning, October 18th Ada reported a record 4 inch snowfall, while Gull Lake reported a record 2.8 inches.

In addition, the Meteorological Office in Glasgow reported that the Scottish Highlands had their first snowfall of the season this week.

Topic: New Seasonal Climate Outlooks

The NOAA Climate Prediction Center issued the new seasonal climate outlooks this week covering the period from November through January (early winter). They are based on observed past El Nino effects as well as recent climate trends. For Minnesota, the outlook calls for above normal temperatures over the period, however this may be mitigated by periodic changes in the North Atlantic Oscillation (high latitude pressure pattern) which could bring high latitude, cold air down over the state from time to time.

There are equal chances for above or below normal precipitation during the period, but once again the trend favors above normal values.

MPR listener question: A family in St Paul is responsible for the seasonal snow plowing contract in their neighborhood. They received 2 bids: a flat \$300 fee to cover the entire snow season, or a charge of \$35 for each 2 inch snowfall removed. What is the most economical approach?

Answer: Interesting question.....it has been my experience that snow plowing contractors in the Twin Cities Metro area have the snowfall statistics worked out pretty well. Given the two bids for snow plowing in this case, any snow season with less than 9 daily two-inch snowfalls would give bidding advantage to the snow plow operator that charges for each daily service. Examining the Twin Cities climate record shows that historically there is an average of 8.6 daily snowfalls of 2 inches or more per snow season (here liberally defined as October through April). Since the winter of 1949-1950 (52 years) there have been 23 seasons with 9 or more 2-inch snowfalls, a frequency of 44 percent. Thus statistically, there is still an advantage to contracting with the plow operator who charges by the day. However, with an increasing trend for seasonal snowfall evident in the recent climate record, it might be wiser to contract at based on the fixed seasonal charge.

Twin Cities Almanac for October 18th:

The average MSP high temperature for today's date is 58 degrees F (plus or minus 11 degrees standard deviation), while the average low is 40 degrees F (plus or minus 9 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 87 degrees F in 1950; lowest daily maximum temperature of 30 degrees F in 1930; lowest daily minimum temperature of 18 degrees F in 1972; highest daily minimum temperature of 61 degrees F in 1950; record rainfall of 2.75 inches in 1924; and record snowfall of 1.3 inches in 1916 and 1976.

Average dew point on this date is 37 degrees, with a maximum of 65 degrees F in 1971 and a minimum of 9 degrees F in 1972.

Scanning the state climatic data base: the all-time high for today's date is 87 degrees F at St Paul's Holman Field Airport and at St Peter in 1950; all-time low is 5 degrees F at Crookston (Polk County) in 1992.

Words of the Week: Ice Plow

Before refrigeration, in the Pioneer settlement era and even the early 20th Century, ice plows were used to cut grooves in the ice over rivers, lakes, and ponds. These were sharp-bladed plows pulled by teams of horses that cut grided patterns across the ice. The ice blocks were sawed out, then floated to shore and taken by wagons or sleds to ice houses and caves.

Outlook:

Generally a dry, cold week coming up. There will be a chance for light showers or snow flurries in central and northern counties through Tuesday. Skies will be mostly cloudy and winds from the north. Temperatures will likely average about 15 degrees F colder than normal, before moderating toward the end of the week.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, October 25, 2002

Topic: Record reports this week.....

Many low temperature records and snowfall records were set in Minnesota and around the region this past week. Sunday, October 20th brought record cold to northern areas as Grand Forks, ND set a new low temperature record with 17 degrees F, while Warroad, MN tied the record low for the date with 16 degrees F. With the cold temperatures on Sunday and Monday came some record setting snowfall amounts ranging from 3.0 to 9.0 inches across portions of northern and central Minnesota. Morris reported a record 3.0 inches, Long Prairie and Fergus Falls reported a record 7 inches, and Little Falls reported a record 9 inches on Monday. Further to the east, Hinckley reported a record 5.0 inches and Moose Lake a record 3.0 inches. On Wednesday, October 23rd, Sioux Falls, SD reported a record 1.1 inches of snowfall, while Dickinson, ND reported a record low temperature of just 2 degrees F. Thursday morning, October 24th brought yet more record cold, as Brainerd reported a new record low of 14 degrees F, International Falls 12 degrees F, Eveleth reported a record low of 16 degrees F, and Aitkin tied their record low with 12 degrees F. Friday morning, October 25 brought a record-tying 10 degrees F to International Falls as well.

October snowfalls and record cold temperatures have now visited MT, WY, ND, SD, NE, MN, IA, and WI. Given the cold outlook for the week ahead, it may be prudent in these states to prepare for a cold, and perhaps snowy Halloween.

Topic: Cold Octobers in the Twin Cities

The persistent cloud cover and northerly winds have helped make this one of the coldest ever Octobers in the Twin Cities area and across much of the state. Should the forecasted temperatures hold true through Halloween, the average temperature for the month will be under 41 degrees F. The list below includes data from the old Pioneer Records in St Paul (1820-1890) as well as the modern Twin Cities record (1891-present) showing the coldest ever Octobers, the associated October snowfall, the following November temperature trend and snowfall, and the winter seasonal snowfall total.....

Year	mean October temperature	October snowfall	November Temp-Trend	November snowfall	Seasonal snowfall
------	--------------------------	------------------	---------------------	-------------------	-------------------

1843	36.4 F	2.0 in.	cold	7.0 in.	28.3 in.
1925	38.3 F	3.3 in.	normal	3.6 in.	37.0 in.
1917	38.6 F	2.3 in.	warm	0.9 in.	30.8 in.
1863	38.8 F	0.3 in.	cold	2.0 in.	19.6 in.
1869	40.0 F	Trace	cold	4.9 in.	55.0 in.
1840	40.8 F	1.0 in.	cold	14.0 in.	39.0 in.
1873	40.8 F	14.0 in.	cold	14.4 in.	67.2 in.
2002	40.8 F*	0.6 in.	?	?	?

Note that 1873 was probably the snowiest October on record, with 14 inches falling the last week of the month, followed by a snowy November and a heavy snow season. These cold Octobers reveal no definite indicators about the following November snowfall (they vary from dry, 0.9 inches to wet, 14.4 inches) or the winter total snowfall (it ranges from 19.6 inches to 67.2 inches). However, there is a tendency for the following November to be colder than normal as well.

MPR listener question: This was forwarded from Dr. Greg Filice of the Veterans Affairs Medical Center in Minneapolis. I have a high school friend who asked about the chances of having a extra day to complete a class paper thanks to a snow emergency declaration. It seems that most teachers will extend a deadline for papers if a snow emergency has been declared in the Twin Cities. What are the odds of this happening in the months of December, January and February?

Answer: I am tempted not to answer this question, as it might promote procrastination on student assignments! Using the St Paul criteria for snow emergencies, single day snowfalls of 3.0 inches or more, I examined the Twin Cities snowfall records since the winter of 1949-50. The following frequencies for snow emergencies emerged over this 53 year period.....

Months	No. of yrs with at least one snow emergencies	No. of yrs with multiple snow emergencies
DEC	24 (45 pct)	13 (25 pct)
JAN	30 (57 pct)	15 (28 pct)
FEB	31 (58 pct)	12 (23 pct)

These statistics suggest roughly a 1 out of 2 chance for having a least one snow emergency declared in each month, with a slightly higher frequency in January and February. Multiple snow emergencies are slightly more likely to occur in January, with changes of 1 in 4 years. In addition, certain school districts have their own snow emergency criteria that may differ from those of St Paul City.

Twin Cities Almanac for October 25th:

The average MSP high temperature for today's date is 55 degrees F (plus or minus 12 degrees standard deviation), while the average low is 37 degrees F (plus or minus 8 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 82 degrees F in 1989; lowest daily maximum temperature of 31 degrees F in 1919; lowest daily minimum temperature of 18 degrees F in 1962; highest daily minimum temperature of 56 degrees F in 1897; record rainfall of 0.53 inches in 1902; and record snowfall of 0.2 inches in 1942.

Average dew point on this date is 35 degrees, with a maximum of 59 degrees F in 1989 and a minimum of 8 degrees F in 1962.

Scanning the state climatic data base: the all-time high for today's date is 87 degrees F at New Ulm (Brown County) in 1927; all-time low is -10 degrees F at St Vincent (Kittson County) in 1887.

Word of the Week: Trowell

This term is used by Canadian meteorologists to refer to a tongue of warm air aloft, often over a frontal system. Warm air aloft usually brings more moisture and as it overtakes cold air near the surface, a cloud deck forms, sometimes with precipitation, even snow during this time of year. I suppose the term trowell may be used because an isothermal plot of the warm air aloft may have a trowel-like shape on a weather map.

Outlook.....

Generally cloudy and cold, with a chance for snow and light showers in the north over the weekend. An increasing chance for precipitation into Monday. A very unsettled period from Tuesday through Thursday, with stronger winds, plenty of clouds, and a chance for snow and plummeting temperatures.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, November 1, 2002

Topic: October Wrap-Up

Most Minnesotans are happy to see October end. It has been one of the coldest, cloudiest, and wettest Octobers in recent memory. Solar radiation (sunshine) as measured by the University of Minnesota was a new record low for October (lowest of 40 years since 1963). Most observers reported a wetter than normal month, with some exceptions in the northern counties. Snowfall amounts were variable, and higher than normal in some areas. Canby and Worthington reported 5.0 inches, Hinckley nearly 6 inches, Pipestone 8 inches, and Royalton 8.1 inches.

Temperatures for October averaged 5 to 8 degrees F colder than normal, marking the month as the 3rd coldest October on a statewide basis. Temperature extremes were 87 degrees F at Waseca and Albert Lea on the 1st, to just 8 degrees F at Blackduck on the 13th and at Embarrass on the 16th.

As a result of the cold October, the District Office of the Army Corps of Engineers put out a notice that the navigation season on the Upper Mississippi may end sooner than normal as a result of rapidly declining water temperatures. Mississippi River water temperatures are in just in the mid 40s F as we end October. Water temperatures in the mid 30s F can adversely affect navigation because of the risk of rapid ice formation when overnight temperatures plummet.

Topic: Weather during November election week in Minnesota

How many times have we heard the weather take the blame for an undesirable outcome....."housing starts were down this quarter due to bad weather in the east"....."food prices will be higher due to poor growing season weather"... "the space shuttle landing was postponed due to foul weather"...."construction costs were higher because of weather delays." But the one I can't stand is "voter turnout was low due to poor weather conditions." This is the case more often in other states rather than in Minnesota, where in relative voter turnout we nearly always look pretty good in national statistics. I see the estimate for nationwide voter turnout next week is just between 35-40 percent, while here in Minnesota it may be from 60 to 70 percent or higher!

With the possible exception of parenting our children, what's more important than using our right to vote? Albeit if weather conditions are dangerous, such as a blizzard, then voters may be justified in staying home, but I can't buy uncomfortable or inclement weather as an excuse for not voting.

Historically, election day has varied from the 2nd of November to the 8th of November. In Minnesota, high temperatures are typically in the 40s with lows in the 20s and 30s. There is frequently little or no precipitation, but there have been some notable exceptions of rather harsh weather in terms of both precipitation and temperature. 1901, 1910, 1911, 1933, 1936, 1951, 1959, and 1991 were all notable for being quite cold and/or snowy during election week. 1936 was the only case of a major national and local election in Minnesota taking place in the face of some pretty cold and icy weather. Heavy snows and glaze occurred in northern, western, and central counties during the first three days of November (up to 19 inches of snow) and near record setting cold temperatures accompanied the storms. Election morning (November 3rd) lows were in the single digits to teens. The streets and sidewalks were pretty icy from recent snows and the windchill index was well below zero all day and in the dangerous category (colder than -25) in some places (with winds of 15 to 25 mph). Yet, the voter turnout was over 1.1 million in Minnesota, probably over 70 percent of those eligible. Way to go Minnesota!

Interestingly enough, we have had measurable snowfalls just preceding or on election day in 10 of the past 14 years, with the most pronounced being 1991, which was not only the snowiest but one of the coldest (3.5 inches of snowfall, temperatures in the 20s F and 23 inches of snow on the ground). 1951 was comparable with temperatures in the 20s F, and 3 inches of snow on the ground).

The weather for next Tuesday's election looks to be colder than normal, with light winds, partly cloudy skies, and just a slight change for some light precipitation around our region.

MPR listener question: We moved here from New York state last year and have just finished our first gardening season in the Twin Cities. The past week, we planted bulbs in very cold soil. What time of year does the soil normally freeze up around here?

Answer: In the heat island of the Twin Cities metro area soils don't typically freeze up until early December. However in more rural locations soils start to freeze typically around the third to fourth week of November. With the type of October climate we experienced, soil temperatures have rapidly fallen into the 30s F. It would not take very many cold nights (temperatures in the teens) to freeze them at least a few inches deep.

Twin Cities Almanac for November 1st:

The average MSP high temperature for today's date is 50 degrees F (plus or minus 11 degrees standard deviation), while the average low is 33 degrees F (plus or minus 9 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 77 degrees F in 1933; lowest daily maximum temperature of 25 degrees F in 1951; lowest daily minimum temperature of 10 degrees F in 1951; highest daily minimum temperature of 56 degrees F in 1938; record rainfall of 1.85 inches in 1991; and record snowfall of 18.5 inches in 1991 (Still the single day snowfall record for the Twin Cities). Maximum snow depth on this date has been 14 inches in 1991. There have been five measurable snowfalls since 1948.

Average dew point on this date is 33 degrees, with a maximum of 58 degrees F in 1983 and a minimum of -4 degrees F in 1984.

Scanning the state climatic data base: the all-time high for today's date is 84 degrees F at Winona in 1950; all-time low is -10 degrees F at Campbell (Wilkin County) in 1919.

Word of the Week: SIMA

Another acronym.....not one used by meteorologists, but one very related to the weather. This term stands for Snow and Ice Management Association. It is the professional association for those working in snow and ice management. They also publish the magazine Snow Business and offer educational material on snow and ice control, especially for property managers and snow plow operators.

Their web site is <http://www.sima.org>

Outlook.....

Continued colder than normal, though not as extreme as it has been. Some sunshine over the weekend will help dry things out. There will be some moderation in temperature next week, with highs in the 30s and 40s F and more sun and wind. Generally, it will be a dry week. Overall it should be a good time to wrap-up farm and garden chores, and especially to rake those leaves. Towards next weekend, a strong storm system may develop.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, November 8, 2002

On this date in 1870, the first storm warning was issued by the U.S. Army Signal Corps, the precursor to the National Weather Service.

70s F in Benson, Morris, and Madison, MN on Thursday this week...what a surprise....not many meteorologists got that forecast right!!

Topic: Is is possible to paint outside in November?

In response to those MPR listeners who have said that listening to my weather reports is about as much fun as watching paint dry!!!! I offer the following ditty on painting weather.....

This is a question I get nearly every fall from people who have some last minute outdoor remodeling project. The general rule of thumb for painting outdoors is that you need temperatures of 50 degrees F or higher (and of course the absence of precipitation). Examining the Twin Cities climate record (1891-2002) shows that on average there are 7 days in November when the maximum temperature reaches or exceeds 50 degrees F, but typically one of these days has precipitation, so that rules out painting. Thus on average, we see about 6 opportunities to paint during the month of November. November of 2001 offered 16 days suitable for painting, perhaps the most of any previous November, while Novembers of 1911, 1943, 1991, 1992, and 1997 presented no opportunities for outdoor painting. By the time December 1st rolls around, there is less than a 2 percent chance of having a 50 F day for painting.

Topic: Remembering November 8, 1943

For many Minnesotans the most vivid memories of November blizzards are associated with the 1940 Armistice Day Blizzard (November 11) or the 1991 Halloween Blizzard (October 31-November 2). However, from a climatological perspective there is a third November episode of great significance associated with the ice storm and heavy snowfall of November 6-8, 1943. The storm produced heavier snowfalls in some areas than the Armistice Day and Halloween Blizzards and caused significant shoreline damage to the Lake Superior area. This storm, coming from the south, started out as rain, changing to freezing rain and sleet, then finally heavy snow. Occurring over a weekend (Saturday through Monday), the storm stranded many Minnesota duck

hunters in the countryside, though it did not result in many fatalities because the temperature drop was modest (about 8-10 degrees F) compared to those of the Armistice Day and Halloween Blizzards (over 40 degrees F drop). A total of five storm-related fatalities were reported across the state.

This storm produced a great deal of ice, up to 3 inches thick on some power lines in central Minnesota. Over 1700 power and telephone poles fell down as a result. The ice also caused numerous accidents and put a stop to train, plane, and streetcar traffic. When the temperature dropped sufficiently to produce snow on the 8th, great amounts piled up across southern and central counties. Some of the larger amounts, and still records for the date, include 22 inches at Faribault, 20 inches at Bird Island, 20 inches at Redwood Falls, 22 inches at Marshall, and 18 inches at Springfield. Strong winds of 30 to 40 mph produced enormous drifts in some areas. In Cottonwood County, 15 ft drifts closed state highways 71 and 30, and near Windom an Omaha bound train was completely buried in a snow drift.

Duluth and other cities along the northshore of Lake Superior reported enormous waves and erosion damage. Winds from the northeast gusted to near 45 mph. Sixty-five ore carriers took refuge in Duluth-Superior harbor. Fortunately, following the storm, relatively dry, mild weather took hold and soon dissipated the snow cover.

MPR listener question: What do the climatological statistics for freezing rain in Minnesota show? How often? Peak time of year? Peak hour of the day?

Answer: The average number of annual hourly reports showing freezing rain and/or freezing drizzle in Minnesota ranges from about 45 in northeastern counties (Lake, Cook, and St Louis) to less than 30 hours in southwestern counties. The most common months for the occurrence of freezing rain or freezing drizzle in Minnesota (listed by frequency of reports) are December, January, November, and March, respectively. The most common time of day for this type of precipitation is from 6:00 am to 9:00 am, while the fewest reports can be found from 2:00 pm to 4:00 pm.

The most recent significant freezing rain episode in Minnesota was probably February 24, 2001 when up to 1/4 inch of ice was reported in southeastern locations, including the cities of Preston, Dodge Center, and Caledonia. High winds caused many power lines to break. The most recent November freezing rain episode was November 18, 1996 when southwestern counties suffered from ice buildup and power outages.

Twin Cities Almanac for November 8th:

The average MSP high temperature for today's date is 44 degrees F (plus or minus 10 degrees standard deviation), while the average low is 29 degrees F (plus or minus 9 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 77 degrees F in 1999; lowest daily maximum temperature of 25 degrees F in 1991; lowest daily minimum temperature of 1 degree F in 1991; highest daily minimum temperature of 53 degrees F in 1977; record rainfall of 1.51 inches in 1932; and record snowfall of 8.5 inches in 1943. Maximum snow depth on this date has been 14 inches in 1991. There have been seven measurable snowfalls since 1948.

Average dew point on this date is 28 degrees, with a maximum of 54 degrees F in 1903 and a minimum of -3 degrees F in 1991.

Scanning the state climatic data base: the all-time high for today's date is 82 degrees F at Redwood Falls in 1999; the all-time low is -13 degrees F at Wannaska and Roseau in 1979 and again at Waseca and Isabella in 1991. This time of year nearly all of the state's low temperature records are associated with the presence of snow cover.

Words of the Week: Rogue waves

These are waves of unusual size that sometimes cause shipwrecks at sea. They occur very rarely and not always in exceptionally rough seas or during storms. In fact, typhoons and hurricanes often produce sea waves of 30 to 40 ft, however rogue waves of 60 to 80 ft in height have been reported by mariners. Waves of this size can be threatening even to the largest of ships. Scientific study suggests that they may be the result of interactions among major ocean currents and the wind. With improved satellite observations and instrumented buoys, the government weather services are getting better at observing and forecasting these rogue waves. The United Kingdom Meteorological Office hopes to start offering such as service in their shipping forecasts.

Outlook.....

Good chance for precipitation around the state this weekend, up north on Saturday, spreading statewide Sunday. Temperatures will continue above normal Saturday, then drop to near normal Sunday. Somewhat of a cool down Monday with some linger snow flurries. Then generally a dry, cool week to follow with increasing chances for precipitation toward next weekend.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, November 15, 2002

Coldest weather of the season settled over northern Minnesota on Wednesday and Thursday mornings this week. Snowfalls of 1 to 3 inches on Tuesday helped to set up a very cold night as skies cleared and winds died down. International Falls reported -1 degree F, Tower reported -5 degrees F, and Embarrass reported -2 degrees F on Wednesday morning. Our neighbors to the north in Manitoba were cold too, as Brandon reported -3 degrees F and Thompson -1 degree F. More snow on Wednesday ushered in additional cold air. Virginia, MN reported a snow depth of 5 inches by Wednesday night. Coldest temperatures by Thursday morning were in the northwestern counties. Several locations reported their coldest readings of the fall, including.... -2 F at Thief River Falls, -2 F at Roseau, and -2 F at Grand Forks. Hallock, MN with -6 degrees F reported the nation's low on Thursday morning, while Winnipeg, Manitoba reported a morning low of -5 F, their coldest reading of the season. Finally, on Friday morning, Embarrass, MN reported -14 degrees F, the coldest in the nation, including Alaska!

Actually Friday, November 15 is an anniversary for one of the all-time worst cold waves in Minnesota. On this date in 1911, northwestern Minnesota was hit by a snow storm that dropped between 1 and 2 feet of snow, followed by gusty northwest winds and a dramatic drop in temperatures, many going below zero F. Angus in Polk County fell to -36 degrees F, still the statewide record low for this date. The winds produced extreme windchills of -40 to -55 degrees F. Horse drawn sleds were used much of the rest of the month, including for family visits on Thanksgiving that year.

Topic: Weather phobias

There is a fascinating article in the current Weatherwise magazine by Dr. Ronald Kleinknecht of Western Washington University. He concentrates on storm phobia, its causes, symptoms, and cures. It ranks high in occurrence among the other phobias, surpassed only by fear of heights, fear of deep water, and fear of insects or snakes.

Symptoms of storm phobia include hyperalertness (restlessness), tremors, accelerated pulse and respiration, sweating, inability to sleep, and obsessive attention to NOAA weather radio or TV

weather broadcasts. Sometimes with the forecast of an approaching storm, people will take a day off work to prepare themselves for it.

Studies suggest that as many as 8 million Americans suffer from some form of storm phobia. The vast majority, estimated at 80 percent, acquired their phobia as a result of a traumatic or life-threatening experience with the weather, either as a child or adult. Perhaps they experience a terrible winter blizzard, a tornado, or hurricane. About 15 percent of storm phobics acquired this condition by a process called psychological contagion, whereby they lived with somebody (parents) or worked with people who exhibited great fear and hysteria caused by the weather. For about 5 percent of storm phobics, clinical diagnosis and treatment does not reveal how they acquired this condition.

Another interesting study showed that about one third of children who acquire storm phobia carry this condition into adulthood. Another interesting statistic is that among storm phobics, women outnumber men by a ratio of 3.6 to 1.

Treatments include "flooding" in which the patient is exposed to the characteristics of storms (lightning, thunder, wind) on a gradual basis perhaps through the use of virtual reality technology such as computer-simulation and visualization. The patient is not allowed to escape as the intensity of the storm characteristics increases. Another treatment method is simply education. Most storm phobics know little about weather and storms. As they acquire more knowledge sometimes their symptoms dissipate. In fact Dr. Kleinknecht states that weather education serves a great purpose in storm phobia prevention, a dimension of our Morning Edition weather chats that I never thought about!

Finally, the list of weather phobias is very long, and for the most part quite difficult to pronounce, but here goes.....

Aerophobia/Anemophobia	wind and drafts
Astraphobia	lightning and stars
Auroraphobia	Northern lights
Brontophobia	thunder
Chionophobia	snow
Homlichophobia	fog
Hygrophobia	dampness and moisture
Kyklonasophobia	tornadoes
Kryophobia	cold
Ombrophobia	rain
Pymmyraphobia	floods

Thermophobia heat
Trikyimia/Kataigidaphobia severe storms

Resources for help with weather phobia can be found on the web at...

www.adaa.org (Anxiety Disorders Association of America)
www.aabt.org (Assoc for Advancement of Behavior Therapy)

MPR listener question: How many hours of daylight do we lose in the Twin Cities area during the month of November? It seems like a lot!!

Answer: The sunrise/sunset tables for the Twin Cities show that we lose 1 hour and 6 minutes of daylength during the month. I think our perception of this loss in daylight is magnified by the fact that the sun angle is also declining and that November is our cloudiest month, so both the quantity and quality of light decline pretty significantly. This brings on Seasonal Affective Disorder for some people.

Twin Cities Almanac for November 15th:

The average MSP high temperature for today's date is 41 degrees F (plus or minus 11 degrees standard deviation), while the average low is 27 degrees F (plus or minus 11 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 69 degrees F in 1953; lowest daily maximum temperature of 13 degrees F in 1932; lowest daily minimum temperature of 1 degree F in 1911, 1932, and 1940; highest daily minimum temperature of 55 degrees F in 1930; record rainfall of 1.58 inches in 1996; and record snowfall of 5.1 inches in 1956. Maximum snow depth on this date has been 5 inches in 1991. There have been seven measurable snowfalls since 1948.

Average dew point on this date is 29 degrees, with a maximum of 54 degrees F in 1930 and a minimum of 0 degrees F in 1932.

Scanning the state climatic data base: the all-time high for today's date is 76 degrees F at Madison (Lac Qui Parle County) in 1953; the all-time low is -36 degrees F at Angus (Polk County) with 7 inches of snow on the ground back in 1911. This is the coldest temperature ever so early in the month in Minnesota.

Word of the Week: Brickfielder

No, this is not the guy that hands the bricks to the bricklayer..

Like Cock-eyed Bob and Willy-Willy, this is a colorful Australian

expression for a kind of wind. While we have clearly transitioned to more of a winter look in Minnesota, downunder they are approaching summertime. Occasionally the Australian summer hot, dry, dusty winds from the arid interior deserts blow hard toward the south coastal cities and ports, making the citizens uncomfortable and purportably quite irritable. This wind is called the brickfielder by the Australian Weather Bureau, presumably because it picks up the red, dusty brick-colored soil of the interior and deposits it over the coastal landscape.

Outlook.....

Cold temperatures will linger through much of the weekend, with chances for snow in the northern and central counties, especially on Sunday. Some moderation in temperature next week will bring readings a few degrees warmer than normal during the day.

To: Perry Finelli, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, November 22, 2002

With the drier than normal November so far (after 5 consecutive months of above normal rainfall), the Twin Cities yearly precipitation total stands at 38.24 inches, the 4th wettest year in history, trailing 1911 (40.15), 1965(39.94), and 1983 (39.07). But with over 5 weeks to go to finish out the year, additional precipitation will undoubtedly move this year up on the list.

Topic: The new seasonal climate outlook

Talk about "loading the dice" (see discussion below), the Climate Prediction Center is confidently predicting a warmer than normal December, January and February for Minnesota as the result of the current El Nino episode. This warmer than normal temperature pattern is forecasted for much of the U.S. but especially so over the Great Lakes region. The outlook for precipitation is mostly for near normal (equal chances of above or below) in Minnesota, but drier than normal to the east.

Topic: Luke Howard, the Father of Meteorology

This name is still not known well outside meteorological circles. Luke Howard was an English chemist (pharmacist) who proposed in 1803 a system of cloud classification based on his own observations and sketches. This classification system is for the most part still used today, 200 years later!

Using the botanical Linnean conventions (after Linnaeus the Swedish naturalist of the 18th century) to classify his observations of the "face of the sky" based on genera, species and varieties (or classes, orders, and suborders), Howard published his "Essay on the Modification of Clouds" in 1804. His scheme for classifying clouds was based on their appearance and the process of formation. There were three distinct types all derived from Latin words: cirrus (wispy hair or thread-like high clouds); cumulus (a heap or puffy cloud); and stratus (spreaded or blanket-like cloud). He also employed a Latin derived word for the rain cloud, nimbus. There were additional combination forms which he proposed as well including cirrocumulus, cirrostratus, and cumulostratus.

With some modifications, Howard's scheme of cloud classification was adopted as a standard in 1891 by the International Meteorological Organization, a non-governmental scientific group. Later, during the 1950s with some additional modification the government-based World Meteorological Organization adopted it as a standard for making cloud observations.

Howard was a chemist, a naturalist, an artist, and a devout

Christian. Despite being one of the most respected scientists of his time, he maintained a humble attitude which is depicted in his writings. He later authored "The Climate of London," and the first meteorological text book entitled "Seven Lectures in Meteorology." But, he is best remembered for his studies of clouds. It has been speculated by historians, that his contemporary, the poet Percy Shelley, wrote "The Ode to the West Wind" (1819) and "The Cloud" (1820) based on an understanding of the water cycle obtained through reading Howard's works. This Thanksgiving, November 28th, 230 years will have passed since the birth of Luke Howard, who some regard as the father of the clouds.

MPR listener question: I have heard about lake effect snows along the Lake Superior shoreline of Minnesota and Wisconsin. Is this caused by the ice-free lake surface releasing more water vapor into the cold overlying air? What is the current temperature of Lake Superior?

Answer: Yes, you are quite right. Cold, polar air carried by the winds, usually associated with the passage of a cold front, will move over the relatively warm waters and pick up a great deal of water vapor, enhancing the downwind deposition of snow. Currently surface water temperatures of Lake Superior are well above the freezing mark, ranging from 38 to 42 degrees F in most places.

Twin Cities Almanac for November 22nd:

The average MSP high temperature for today's date is 35 degrees F (plus or minus 10 degrees standard deviation), while the average low is 21 degrees F (plus or minus 9 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 59 degrees F in 1998; lowest daily maximum temperature of 12 degrees F in 1921; lowest daily minimum temperature of -3 degree F in 1896; highest daily minimum temperature of 42 degrees F in 1908; record rainfall of 0.58 inches in 1898; and record snowfall of 5.5 inches in 1898. Maximum snow depth on this date has been 8 inches in 1981. There have been 14 measurable snowfalls since 1948.

Average dew point on this date is 29 degrees, with a maximum of 53 degrees F in 1963 and a minimum of -7 degrees F in 1970.

Scanning the state climatic data base: the all-time high for today's date is 71 degrees F at Red Wing (Goodhue County) in 1990; the all-time low is -25 degrees F at Pokegama Dam in 1896 and at Itasca State Park in 1938.

Words of the Week: The loaded dice analogy

This terminology is used in climate forecasting, especially with regards to El Nino effects. Basically the presence of an El Nino episode in the equatorial Pacific Ocean will cause a change in the probability for positive (warmer) temperature deviations in the western Great Lakes region during the winter. For example, if there is a historical probability of 33 percent that temperatures will be warmer than normal in the month of January, the presence of an El Nino has been shown to double that probability to 66 percent. This is analogous to "loading the dice" to produce a higher frequency of certain numbers. The analogy is also used with other features of the earth climate system such as the North Atlantic Oscillation and the Madden-Julian Oscillation.

Outlook.....

A colder, unsettled period is in store for the weekend and the coming week. Cold and blustery conditions most days, with a chance for light snow.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, November 29, 2002

Many cold temperatures, below zero and single digit overnight readings, accelerated the freezing of soil and lakes around the region this week. Embarrass, MN reported a morning low of -17 degrees F on Tuesday, November 26, the coldest reading in the 48 contiguous states that day.

Topic: Preliminary Climate Summary for November

As November closes out this weekend, most of us will remember it as a dry month....the driest month of the year for many. Nearly all locations reported less than normal precipitation. Olivia in central MN reported the driest November on record with just a trace. Hutchinson with .05 inches, Willmar with 0.03 inches, and Red Wing with 0.06 inches reported their 2nd driest November.

Snowfall around the state was mostly lacking, but some northern locations reported significant amounts including Littlefork with 13 inches, Black Duck with 15.5 inches, International Falls with 9.2 inches, Cook with 8.0 inches, Roseau with 6.1 inches, and Babbitt with 7.0 inches.

Mean temperature for November was a degree or two either side of normal for most locations, with the cooler values in northern counties. Temperature extremes ranged from -17 degrees F at Embarrass on the 26th to 69 degrees at Canby, Morris, and Montevideo on the 8th.

Topic: Testing the 20/20 rule for December

Some older Minnesotan's have told about something they call the 20/20 rule....that is whenever you get 20 inches of snow during a winter month (Dec-Feb) you will likely also see a reading of at least -20 degrees F. I tested this idea with the Twin Cities climate record for the month of December, and sure enough it works pretty well. For the period from 1820 to 2001, I examined all Decembers when at least 20 inches of snowfall occurred. This has happend 13 times over the past 182 years (some of these are estimated in the Pioneer records)..

Year	December snowfall total (inches)	lowest temperature in degrees F
1830	20.0 (15 days with snow)	-26 F on the 21st
1849	30.0	-22 F on the 29th
1865	26.1	-26 F on the 21st

1879	20.0	-39 F on the 25th
1880	22.0	-27 F on the 28th
1902	24.0	-20 F on the 26th
1927	22.8	-15 F on the 31st

(Maple Plain reported -22 F in Dec 1927)

1950	25.0	-20 F on the 27th
1968	28.7	-19 F on the 31st

(St Paul reported -34 F in Dec 1968)

1969	33.2	0 F on the 27th
------	------	-----------------

(17 snowy days in December)

1983	21.0	-29 F on the 19th
1996	23.7	-27 F on the 26th
2001	30.2	-24 F on the 25th*

*data taken from NWS headquarters at Chanhassen

With two possible exceptions, 1927 and 1969, the 20/20 rule appears to hold up pretty well.

MPR listener question: What are the all-time records for extreme temperature in Minnesota during the month of December?

Answer: The warmest ever in December was 73 degrees F at Beardsley and Milan on December 6, 1939. The last time 70 degrees F was reported in the state during December was December 1, 1998 when Chaska reported a 70 F reading. The coldest temperature ever reported in December was -57 degrees F at Pokegama Dam on New year's Eve, 1898. The most recent bitterly cold December temperatures were in 1993 (-50 F at Tower) and 1983 (-52 F at Mora and Tower).

Twin Cities Almanac for November 29th:

The average MSP high temperature for today's date is 31 degrees F (plus or minus 11 degrees standard deviation), while the average low is 17 degrees F (plus or minus 12 degrees standard deviation).

Local Records:

MSP records for today's date include: highest daily maximum temperature of 62 degrees F in 1998; lowest daily maximum temperature of 3 degrees F in 1896; lowest daily minimum temperature of -13 degree F in 1891; highest daily minimum temperature of 50 degrees F in 1998; record rainfall of 1.38 inches in 1991; and record snowfall of 12.6 inches also in 1991. Maximum snow depth on this date has been 15 inches in 1983 (the coldest December of the 20th Century). There have been 12 measurable snowfalls since 1948.

Average dew point on this date is 18 degrees, with a maximum of 43 degrees F in 1962 and a minimum of -24 degrees F in 1958.

Scanning the state climatic data base: the all-time high for today's date is 68 degrees F at Albert Lea (Freeborn County) in 1998; the all-time low is -39 degrees F at Tower (St Louis County) in 1896.

Words of the Week: mandatory levels

To meteorologists this means the various vertical levels in the atmosphere where measurements are taken by radiosondes (instrumented balloons). Based on World Meteorological Organization standards, instrumented balloons are launched every 12 hours at over 900 locations around the world (launch times are 0Z and 12Z Greenwich Mean Time). They are tracked and transmit data back to ground stations. Data are stored for the 12 mandatory levels in the atmosphere, starting with the 1000 mb surface (typically about 100 meters above the surface), then incrementally to the top of the troposphere, usually ranging from 80,000 to 95,000 ft. Upper air charts, showing troughs and ridges of air pressure, as well as trajectory and speed of jetstreams are derived from these measurements of the mandatory levels.

Outlook.....

Temperatures will fall over the weekend to values that are several degrees below normal. It will be windy over the weekend as well. A chance of snow, especially in the Lake Superior area. Increasing chance for widespread snow later on Sunday, and lasting through Tuesday. Temperatures will be colder than normal for the coming week and continued chances for snow in the north and east.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 6, 2002

Question from an MPR listener: To what depth have soils already frozen around the state?

Answer: Most soils started to freeze up last month, especially freshly tilled soils without any vegetative cover or plant residue on the surface. The current depth of frozen soil ranges from 6 to 10 inches with a bare surface condition and from 1 to 3 inches under grass or some other type of vegetation. Continued deeper freezing will take place next week with below normal temperatures and not much snow cover. Ice fishing has improved with thicker reported on many lakes.

Topic: Errors in measuring snow and liquid equivalence

Very light snowfall occurred around the state on Tuesday night and Wednesday this week. Though some places reported over 1 inch, the water content of the snow was very limited with mostly trace amounts or a few hundredths of an inch reported after melting. This translates to roughly a 40:1 to 50:1 snow/water ratio.

With the passage of each winter storm, most true-blue Minnesotans are interested in how much snow fell. We rely on the National Weather Service and its network of cooperative observers to tell us. Unlike the somewhat reasonable precipitation estimates provided by National Weather Service radar, radar-based estimates of snowfall are very poor. But even the so-called ground-truth data provided by observers is sometimes quite uncertain because snow measurement is quite difficult and prone to errors.

Most of the measurements are made with snow gages, which are really rain gages that have the funnel and inner cylinder removed. Snow accumulates to some depth in the graduated larger diameter outside cylinder. The depth is noted by the observer every 24 hours and then the cylinder emptied or thawed to collect a liquid measurement of the snowfall.

There are several sources of error in measuring a snowfall. Wind can carry much of the snow over the gage opening, allowing less to collect in the gage itself. In addition, after a snowfall event ends, there is frequently blowing and drifting, especially significant with light, fluffy snow. Some of the wind blown snow may get deposited as spindrift in the gage before an observer makes an official measurement.

Another source of error occurs when a liquid measurement is attempted. If the cylinder is heated to melt the snowfall, then some evaporation occurs. This may represent a significant fraction of the precipitation if the snowfall amount is small. One of the better methods for determining the liquid water content is to melt the snow in the gage

with a known quantity of tap water, then measure the total liquid in the cylinder and subtract out the quantity that was used for thawing.

Snow boards (see below) or snow mats are sometimes used as alternatives to the snow gauge. These are essentially platforms for collecting snow which can be wiped clean after each new snowfall. They too, however are subject to wind effects.

Almanac: The average MSP high temperature for today's date is 29 degrees F (plus or minus 11 degrees standard deviation), while the average low is 14 degrees F (plus or minus 12 degrees standard deviation).

MSP Local Records:

MSP records for today's date include: highest daily maximum temperature of 63 degrees F in 1939; lowest daily maximum temperature of -2 degree F in 1972; lowest daily minimum temperature of -19 degree F in 1972; highest daily minimum temperature of 37 degrees F in 1951; record rainfall of 0.53 inches in 1935; and record snowfall of 4.4 inches in 1969. Maximum snow depth has been 21 inches in 1991 and there have been twelve measurable snows since 1948.

Average dew point on this date is 13 degrees, with a maximum of 42 degrees F in 1951 and a minimum of -28 degrees F in 1972.

Scanning the state climatic data base: the all-time high for today's date is 73 degrees F at Beardsley (Big Stone County) in 1939; the all-time low is -32 degrees F at Rothsay (Wilkin County) in 1972. December 9, 1939 is noteworthy as Wheaton recorded a temperature of 74 degrees F, the highest ever noted in the month of December in the history of the state.

Words of the Week: Boulay board

This is the name of the board used to measure fresh fallen snow. It is a pressed composite material with a flat, smooth white surface, about 1/4 inch thick and two feet on each side. This has become the National Weather Service standard for measuring fresh fallen snow within the Cooperative Observer Network. Snow measurement is made to the nearest 1/10 inch, then the board is swept free to wait for the next fall of snow. The name is derived from our own Pete Boulay, climatologist with the Minnesota State Climatology Office. He was the first to test this board as a standard for National Weather Service and now it is being deployed at thousands of locations in all 50 states.

Outlook:

Roller coaster pattern of temperatures is seen for the next week or so. A sharp cold trend over the weekend will give way to moderation and warm up by the middle of next week with

increasing chances for snow by the end of the week. The northern counties, and especially along the Lake Superior shoreline may see relatively more snow.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 13, 2002

Topic: Cold air intrusions

The pressure pattern at higher latitudes has had more to do with our weather this fall than El Nino. Indices of atmospheric pressure such as the Arctic Oscillation, North Atlantic Oscillation, and Pacific North American pattern all favored periodic intrusions of polar air over Minnesota. These have been very evident on numerous days. Minnesota has reported the lowest temperature in the contiguous 48 states this fall on the following dates.....

October 8, 8 degrees F at Embarrass
October 25, 10 degrees F at International Falls
November 13, -2 degrees F at Hallock
November 14, -6 degrees F at Hallock
November 15, -9 degrees F at Hallock
November 16, -9 degrees F at Cook
November 27, -8 degrees F at Silver Bay
November 30, 3 degrees F at Ely, Flag Island, and Warroad
December 1, 1 degree F at Grand Marais
December 3, -28 degrees F at Embarrass
December 6, -8 degrees F at Ely and Silver Bay
December 8, -11 degrees F at International Falls

Topic: Recent warmth.....

Southerly winds, sunshine and the absence of snow cover produced some record setting high temperatures on Tuesday (Dec 10) of this week...all of the following locations reported new record highs...

International Falls 41 F Eveleth 45 F Fargo-Moorhead 47 F
Benson 54 F Little Falls 50 F Montevideo 54 F

On Wednesday, Grand Forks, ND reported another record high with 49 degrees F, as did International Falls with 43 degrees F.

MPR listener question: I live in the bluff area of the Mississippi River Valley near Winona. Sometimes fog forms in the bluff areas and proceeds down to the river valley, while other times fog only forms along the river valley and never rises to the bluff areas. what causes this difference?

Answer: I would say that you are describing the two most common kinds of fog, an advection fog and a radiation fog. In an advection fog, warm, moist air flows aloft over a colder surface layer of air, often with the approach of a warm front and its associated southerly winds. Condensation readily occurs forming a lower cloud deck aloft, perhaps of the type you see along the bluffs of the Mississippi River

Valley. An inversion layer may keep the warm, moist air aloft from mixing with the colder, denser river valley air. The other type of fog, a radiation fog is more likely under cold, high pressure systems, with clear skies and nearly calm winds. In this case, the cold air pools in the river valley and when the air reaches saturation, fog forms. Higher air temperatures, and wind speeds along the bluffs keep the air from reaching saturation and forming fog there.

MPR listener question: what is the difference between freezing rain and freezing drizzle?

Answer: Good question. The distinction between freezing rain and freezing drizzle is technically the droplet size. Drizzle consists of droplets which are 0.2 to 0.5 millimeters (.01 to .02 inches) in diameter. Rain droplets are larger diameters. Another important characteristic difference is that being of such a small size drizzle tends to be more uniformly dispersed and often appears to float around among air currents before it finally lands on the surface. It is most often very light and of little significance, generally recorded as only a trace in a rain gage for example. On the other hand, the larger rain droplets tend to fall in shafts of varying density. In the freezing form, both kinds of precipitation fall as liquid, but freeze on contact with subfreezing surfaces.

Almanac: The average MSP high temperature for today's date is 26 degrees F (plus or minus 12 degrees standard deviation), while the average low is 11 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records:

MSP records for today's date include: highest daily maximum temperature of 53 degrees F in 1891; lowest daily maximum temperature of -5 degree F in 1917; lowest daily minimum temperature of -21 degree F in 1917; highest daily minimum temperature of 36 degrees F in 1928; record rainfall of 0.41 inches in 1983; and record snowfall of 6.3 inches also in 1983. Maximum snow depth has been 15 inches in 1950 and there have been fifteen measurable snows since 1948.

Average dew point on this date is 10 degrees, with a maximum of 37 degrees F in 1928 and a minimum of -26 degrees F in 1961.

Scanning the state climatic data base: the all-time high for today's date is 62 degrees F at Lynd (Lyon County) in 1921; the all-time low is -42 degrees F at Ada (Norman County) in 1901. The record at Ada is another example of a sharp cold wave, since the afternoon high on December 11th had been 29 F, the temperature dropped 71 degrees F by the morning of the 13th.

Word of the Week: GOOS

Another acronym that's kind of fun to pronounce. This one stands for Global Ocean Observing System, which is part of a global climate monitoring system initiated by the World Meteorological Organization, the International Oceanographic Commission, the United Nations Environment Programme and the International Council of Scientific Unions in the early 1990s. Besides monitoring winds, temperature and moisture for climate assessment and prediction, this program evaluates marine living resources, coastal zone environmental changes, carbon fluxes, sea ice and the general health of the oceans. Research in recent years has consistently pointed to the oceanic-atmospheric coupled processes that regulate the climate of Earth. Most historical climate data and research have been associated with land-based studies, but through this program much greater attention is given to ocean processes.

Outlook:

Continued partly cloudy with mild temperatures through the weekend and early next week. Increasing chances for snow later in the week, particularly toward next weekend.....

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 20, 2002

Happy Holiday Season to our friends who work for the National Weather Service which provides us with updated forecasts 24 hours a day, 7 days a week. Their guidance is especially appreciated during the heavy travel time over the holidays.

Topic: HAPPY WINTER SOLSTICE! The winter solstice will occur Saturday night, officially, at 0114Z on 22 December, or 7:14 PM CST. At that time, the earth's spin axis will be oriented so that the sun appears to be the farthest south in the local sky. While most of us consider this event to be the start of astronomical winter, the British call this day the "Midwinter Day", as the apparent sun will begin its northward climb again. For essentially all locations in the Northern Hemisphere, Saturday night will be the longest and the daylight on Sunday will be the shortest of the year. On a brighter note, starting Monday the length of darkness will begin to shrink as we head toward the summer solstice on 21 June 2003.

Topic: A few more records this week....

Eau Claire reported a record high temperature of 50 F on Wednesday, December 18th. A warm front brought some significant precipitation to our region as well. New daily precipitation records were set on Wednesday at Duluth with 0.53 inches, International Falls with 0.20 inches, and Grand Marais with 0.91 inches.

Topic: 2002 Climate Summary.....

The National Climatic Data Center issued its 2002 climate summary report for the United States and the world this week. On the home front, the year was characterized by warmth and drought. According to NCDC the year will go down as one of the 20 warmest since 1895 for the nation. In addition, the year will be remembered for dryness, as over 50 percent of the U.S. landscape was in drought, a rare proportion historically. This condition produced a severe wild fire season in the west, water rationing in some states, and agricultural losses in others. Among the 50 states, Alaska reports the warmest year ever.

>From a global perspective, it appears that 2002 will be the 2nd warmest year in the instrumental record, with a very active typhoon season in the western Pacific and Indian Oceans. There is also reported to be a significant loss of sea ice in the arctic, as well as loss in the Greenland ice sheet, though the satellite record period is somewhat short for this analysis, less than 30 years.

Locally in Minnesota, 2002 may be remembered as a very wet year,

with many late winter snowfalls, and some extremely heavy summer thunderstorms. Extreme temperatures across the state ranged from 100 degrees F at Tracy on July 21st, to -28 degrees F at Warroad on March 3rd, and again at Embarrass and Tower on December 3rd. Minnesota reported the lowest temperature in the 48 contiguous states on 32 different dates in 2002. Most of these readings were in northern communities like Silver Bay, Embarrass, Flad Island and Hallock.

There were many heavy thunderstorm rains which produced total amounts ranging from 6 to 12 inches during the months of June, July, and August. Annual precipitation totals exceeded 40 inches (rare for Minnesota) at a number of locations. The following locations set new annual precipitation records.....

Delano 50.55 inches Litchfield 44.29 inches
Rosemount 43.52 inches Hastings 42.03 inches
Red Wing 46.60 inches

Heavy late winter snowfalls in 2002 produced some records as well. Santiago in northern Sherburne County reported a new record amount for February and March combined with 56 inches. New Hope reported a record April snowfall with 17.2 inches, and Roseau reported a record May snowfall with 4.5 inches.

MPR listener question: I heard you mention recently that the historical chance of a white Christmas in the Twin Cities is 72 percent based on climatology (a 1 inch snow cover). Which parts of the state have the highest historical occurrence of a white Christmas?

Answer: Our friends in the Minnesota State Climatology Office have figured all of this out and posted it on our web site (<http://www.134.84.160.120>). There are several places that show a 100 percent chance, including Babbitt, Winton, Cass Lake, Cook, Cotton, Crane Lake, Gunflint Lake, Hoyt Lakes, Isabella, Park Rapids, Pigeon River, Remer, Roseau, Big Falls, Tower, Virginia, and Walker. Of course the length of the climate record varies among these locations. Perhaps the statistical winner is Walker (Cass County) which shows a white Christmas for 58 years. By the way, the place with the lowest historical probability for a white Christmas is Springfield in southwestern Minnesota, where they report a 60 percent chance.

Almanac: The average MSP high temperature for today's date is 26 degrees F (plus or minus 12 degrees standard deviation), while the average low is 10 degrees F (plus or minus 14 degrees standard deviation).

MSP Local Records:

MSP records for today's date include: highest daily maximum temperature of 51 degrees F in 1967; lowest daily maximum temperature of -11 degree F in 1916; lowest daily minimum temperature of -24 degree F in 1916; highest daily minimum

temperature of 39 degrees F in 1923; record rainfall of 0.74 inches in 1902; and record snowfall of 4.4 inches in 1978. Maximum snow depth has been 18 inches in 1983 and there have been eighteen measurable snows since 1948.

Average dew point on this date is 9 degrees, with a maximum of 44 degrees F in 1967 and a minimum of -30 degrees F in 1963.

Scanning the state climatic data base: the all-time high for today's date is 69 degrees F at Faribault in 1923; the all-time low is -49 degrees F at Tower (St Louis County) in 1983.

Word of the Week: Icesat

This is a new satellite recently launched by NASA to study the Earth's ice sheets. The acronym stands for Ice, Cloud, and Land Elevation Satellite. It is designed to use lasers to study the ice sheets over Antarctica, Greenland, the high elevations of Peru, and the polar regions of Canada. The fluctuating size of these ice sheets is important to understanding the Earth climate system. It is estimated that over 8 million cubic miles of fresh water are stored in these ice sheets. These data will undoubtedly be used by climate modelers in future research efforts to eliminate some of the uncertainty in climate predictions.

Outlook:

Generally declining temperatures over the weekend and into next week. Continued chances for light snow in the north through Sunday. Temperatures will likely fall to cooler than normal values on some days. Chances for light snowfalls on most days, perhaps a more vigorous storm system toward the end of next week.

To: Cathy Wurzer, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 27, 2002

Topic: A preliminary climate summary for December, 2002

Most communities in the state report a warmer than normal December with average monthly temperatures ranging from 5 to 8 degrees F above the 30 year mean. Though the month started out cold, most days after the 9th were warmer than normal. Statewide extreme temperatures ranged from 59 degrees F at Canby on the 15th to -28 degrees F at Embarrass on the 3rd.

Precipitation in December was well below normal for most Minnesota communities, with amounts generally less than 0.50 inches. Some heavier snows in the north produced above normal precipitation at Cook with 0.95 inches and at Moose Lake with 0.85 inches. Snowfall was scarce in the south and modest elsewhere around the state. Total December snowfall of 6 inches or greater occurred for the following communities....

Moorhead 8.9 inches Cook 6.2 inches Ada 6.5 inches
Littlefork 6.4 inches Browns Valley 6.3 inches

Topic 1: A Preliminary Review of the Climate of 2002

What was the "best day of the week" in 2002 in terms of not getting any precipitation in the Twin Cities? Well, Friday was of course. I rarely had to drive down to the MPR studios on wet pavement. There were only 9 Fridays during 2002 when measurable precipitation was recorded in the Twin Cities. On the other hand the wettest day of the week in 2002 was Wednesday, wet 24 times during the year.

Highest temperature in the Twin Cities during 2002 was 97 degrees F on June 30th, while the lowest was -3 degrees F on March 3rd. Greatest 24 hour precipitation total was 2.95 inches June 21st. Wettest months were June and August, each with 8.30 inches of precipitation. Snowiest month was April with 20.2 inches (very unusual), and snowiest day was March 14th with 9 inches.

Statewide in Minnesota, 2002 may be remembered as a very wet year, with many late winter snowfalls, and some extremely heavy summer thunderstorms. Extreme temperatures across the state ranged from 100 degrees F at Tracy on July 21st, to -28 degrees F at Warroad on March 3rd, and again at Embarrass and Tower on December 3rd. Minnesota reported the lowest temperature in the 48 contiguous states on 32 different dates in 2002. Most of these readings were in northern communities like Silver Bay, Embarrass, Flad Island and Hallock.

There were many heavy thunderstorm rains which produced total amounts ranging from 6 to 12 inches during the months of June, July, and August. Annual precipitation totals exceeded 40 inches (rare for Minnesota) at a number of locations. The following locations set new annual precipitation records.....

Delano 50.55 inches Litchfield 44.29 inches
Rosemount 43.52 inches Hastings 42.03 inches
Red Wing 46.60 inches

Heavy late winter snowfalls in 2002 produced some records as well. Santiago in northern Sherburne County reported a new record amount for February and March combined with 56 inches. New Hope reported a record April snowfall with 17.2 inches, and Roseau reported a record May snowfall with 4.5 inches.

Statewide, there were some climate features in 2002 which will be long remembered. A wild weather ride in April was the talk of the state for a while. Many snow storms caused problems with roads and cancelled events. Then, low and behold many communities recorded their earliest ever 90 F reading on April 15th.

July brought high dew points (over 80 F in some places) and associated high Heat Index values. The National Weather Service issued a number of heat advisory statements. The heat index, a "feels like" measure which factors together temperature and dew point, reached 123 F at Madison, MN at 7:00 pm on July 20. At that time, the air temperature was 95 degrees F and the dew point temperature was 84.

MPR listener question: How unusual were the recent December tornadoes in Missouri, Mississippi, and Georgia? Does this happen very often?

Answer: It is unusual, but not extremely so. In Missouri and Georgia weather histories, less than 5 percent of all tornadoes have occurred in the month of December. In Mississippi weather history, less than 8 percent of all tornadoes have struck in December. Tornadoes have been observed in all three of these states each month of the year, though peak occurrence clearly corresponds with the months of March, April, and May.

Twin Cities Almanac for December 27th:

The average MSP high temperature for December 27 is 24 degrees F (plus or minus 11 degrees standard deviation), while the average low is 8 degrees F (plus or minus 13 degrees standard deviation).

MSP Local Records for December 27th:

MSP weather records for December 27 include: highest daily maximum temperature of 46 degrees F in 1959; lowest daily maximum temperature of -9 degree F in 1924; lowest daily minimum temperature of -20

degree F in 1924; highest daily minimum temperature of 37 degrees F in 1959; record rainfall of 0.70 inches in 1959; and record snowfall of 6.0 inches in 1971. Maximum snow depth has been 16 inches in 1968 and 1983; there have been 16 measurable snowfalls since 1948.

Average dew point for December 27th is 11 degrees, with a maximum of 46 degrees F in 1959 and a minimum of -29 degrees F -34 degrees F in 1924.

All-time state records for December 27th:

Scanning the state climatic data base: the all-time high for December 27th is 54 degrees F at Canby (Yellow Medicine County) in 1994; the all-time low is -50 degrees F at Tower (St Louis County) in 1993. This is highly unusual to have state record temperatures occur in back to back years.

Word of the Week: Albedo

This term is derived from the Latin word, albus which means whiteness. Meteorologists and climatologists use this term to refer to the characteristic reflectivity of a surface or composite landscape. Technically, albedo refers to the ratio of the amount of radiation (visible or total solar) reflected by a surface to the amount of radiation incident upon it. Albedo can make a big difference during the winter season, as bare ground or forest canopies may have an albedo of 10 to 20 percent, while fresh snow cover over prairies or flat agricultural fields may have an albedo of 80 to 90 percent. Thus, the absorption of the sun's radiation at the surface, which provides the energy to heat the air, may be greatly reduced by snow cover. As measured from space borne instruments, the planetary albedo including the radiation reflected by the composite land surface of Earth and its atmosphere is about 30 percent.

Outlook:

Continued mild temperatures with increasing chances for snow over the weekend in the north, and perhaps rain or freezing drizzle in the central and south. Cooler and more unsettled starting on New Year's Eve with increasing chances for snow toward the end of the week.