

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 07, 2000

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

Topic: Blizzard anniversary

Today is the 127th anniversary of one Minnesota's worst blizzards. From January 7-10, 1873 a blizzard raged in southwestern counties and parts of northwestern Iowa. It struck in the middle of a rather mild winter afternoon when many people were outside doing chores or traveling. Over 70 deaths resulted, mostly from exposure. Trains were stuck in snow drifts for days and many cattle perished not to be found until the spring.

Topic: Warm Early Winter Continues

Some of the record-setting warmth of November carried over into December in Minnesota. Despite, a mid month outbreak of arctic air which plunged temperatures well below zero, the average temperature for December ranged from 7 to 11 degrees F warmer than normal for most Minnesota communities. December's temperature ranked in the warmest twenty percent historically for most southern counties, and the warmest ten percent for many northern counties. Precipitation in December was about half of normal for many locations and most reported little or trace amounts of snow cover by the end of the month.

Despite the absence of snow cover, frost depths in the soil remained rather shallow thanks in part to the mild temperatures and a number of sunny days. Frost depths range from 6 to 18 inches around the state. The recent snowfalls in January have provided a small amount of insulation which should help to stabilize these frost depths.

Topic: Dry Fall Pattern: Dare we say drought?

Preliminary data indicate that the recent October through December period was one of the driest ever in western and central Minnesota counties. Other severely dry fall seasons occurred in 1895, 1910, 1921, 1923, 1933, 1939, 1952, 1962, 1976, and 1980. It is justifiably a concern in the agricultural community to have such dry soil conditions going into the winter. However more than half (6 of 10) of those other historically dry falls were followed by a wetter than normal late winter and early spring, which helped alleviate the soil moisture deficits for the subsequent growing season. So, though many coffee shop chats are concerned with the risk of drought for the year 2000 crop season, it is far too early to count on it or factor it into any crop season plans.

MPR listener question: The week after Christmas brought many warm temperatures to the state, especially on December 29th when the Twin Cities set a new high temperature record of 53 degrees F. Did other locations set record highs as well?

Answer: Yes, indeed, many communities set new record high temperature readings on both December 29th and 30th. The high temperature of 60 degrees F at Redwood Falls on the 29th was not only a local record, but broke the all-time state high temperature record for that date (formerly 58 degrees F at Le Sueur in 1897).

Twin Cities Almanac for January 7th:

The average MSP high temperature for this date is 21 degrees F (plus or minus 13 degrees standard deviation), while the average low is 5 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records for January 7th:

MSP weather records for this date include: highest daily maximum temperature of 45 degrees F in 1943; lowest daily maximum temperature of -9 degrees F in 1912; lowest daily minimum temperature of -27 degrees F in 1912; highest daily minimum temperature of 34 degrees F in 1965; record precipitation of 0.30 inches in 1989; and record snowfall of 3.6 inches in 1989. There have been twenty-three measurable snowfalls on this date since 1891. The greatest snow depth on this date is 18 inches in both 1969. The coldest windchill conditions were -59 degrees F in 1912.

Average dew point for January 7th is 5 degrees F, with a maximum of 37 degrees F and a minimum of -33 degrees F.

All-time state records for January 7th:

Scanning the state climatic data base: the all-time high for this date is 59 degrees F at New Ulm in 1933; the all-time low is -54 degrees F at International Falls in 1909.

Words of the Week: Blustery and Tousie

Blustery is often used by the National Weather Service to refer to a day of strong and gusty winds, especially cool or cold northerly winds. Similarly the Scottish Weather Service will refer to such a day as tousie, which is a derivative of the term tousle meaning to tussle or rough about. While Minnesota often suffers a blustery day in winter due to strong, cold, dry winds from Canada, Scotland will get cold, damp winds from the North Sea.

Outlook:

Somewhat warmer than normal temperatures for the weekend with a chance

for snow in northern areas of the state. Chances for snow increasing statewide for Sunday through Tuesday, with temperatures cooling down by mid week, but remaining generally above normal for January.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 14, 2000

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

Topic: Record-setting snowfalls on January 12, 2000

MSP airport reported a record amount of snowfall totaling 8.7 inches from the storm on Wednesday of this week (Jan 12). In addition several other locations in Minnesota and western Wisconsin report record-setting amounts. Some were.....

Morris	3.8 in.	Stewart	7.0 in.	Mound	8.7 in.
Benson	9.5 in.	Red Wing	7.0 in.	Willmar	10.0 in.
New London	7.0 in.	Hutchinson	10.0 in.	Eau Claire (WI)	7.7 in.

And Zumbrota in southeastern MN tied their record for January 12th with 4.0 inches.

The snowfall/liquid water ratios were very high, ranging from 20:1 to over 30:1 indicating a very light snow. A map showing the snowfall amounts and the pattern of the storm can be viewed on the web site of the Chanhassen Office of the National Weather Service at.....

<http://www.crh.noaa.gov/mpx/index.html>

Topic: New monthly and seasonal climate outlooks

The Climate Prediction Center just released the new outlooks covering the month of February and the period from February to April. For Minnesota, the probabilities favor cooler than normal temperatures during this period, especially in northern counties. The precipitation outlook favors near normal conditions, with a pronounced area of dryness to the south in the central and southern plains states.

Topic: Significant Blizzard Anniversaries

Last week we mentioned the famous Minnesota blizzard of January 7-10 of 1873. This week is the 25th anniversary of Minnesota's Storm of the Century, a blizzard which occurred on January 10-12, 1975. This storm produced record low barometric pressure values, snowfalls ranging from 6 to 23 inches, winds in excess of 50 mph, windchill values of -50 to -80 degrees F and zero visibilities. Fortunately, it was a well-forecasted storm with National Weather Service forecasters giving up to 14 hour notice on expected blizzard conditions. Up to 35 deaths were blamed on the storm and it took up to 11 days to clear many blocked roads with snow drifts up to 20 feet. Up to 168 passengers were stranded on a train in Willmar

until the tracks could be cleared. The American Red Cross provided food and shelter to nearly 17,000 people who were either stranded or had lost power at home.

This week is also the 112th anniversary of one of the 19th century's most lethal blizzards in Minnesota history, that of January 12-13, 1888. Like the blizzard of 1873, this blizzard struck after a mild morning during which people had set off for school or to do outdoor chores. Many ended up being trapped out in fields, on the road or at schools. Dangerous windchill conditions persisted for many hours with very little visibility due to blowing snow. There were about 200 deaths associated with the storm, both in Minnesota and neighboring states. Many were school children trying to get home from school. The mercury dipped to -37 degrees F in St Paul following the storm, and the very next week it hit an all-time record low of -41 degrees F, unsurpassed in the modern weather records of the Twin Cities.

Topic: 19th Century Weather Signals for Great Lakes Shipping

During the 19th century the National Weather Service instituted a system of flag and pennant signals to provide tows and shipping vessels with with a warning of expected dangerous weather conditions. A square white flag alone indicated fair weather, a square blue flag rain or snow. A white flag with a black square in the center indicated the approach of a cold wave. A red flag with a black center indicated the approach of a severe storm. Pennants displayed with the flags indicated the expected wind direction. A red pennant was used for easterly winds, and a white pennant for westerly. If the pennant was above the flag, favors a northerly quadrant, while the pennant below the flag favors a southerly quadrant.

These weather signals were displayed continuously during daylight hours, but no nighttime signals were provided.

MPR listener question: Last January (1999) we received over 33 inches of snowfall in the Twin Cities area. With the recent snowfalls this week we have received over 12 inches of snow so far this January. Can we expect to reach 30 inches again? How often has the January total snowfall exceeded 30 inches?

Answer: The outlook certainly favors more snowfall this month, but I doubt that we will pick up another 18 inches in the second half of the month. Historically, the Twin Cities reported total snowfall for January of 30 inches or more just three times: 1967, 1982 (a record 46.4 inches), and 1999.

Twin Cities Almanac for January 14th:

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

MSP Local Records for January 14th:

MSP weather records for this date include: highest daily maximum temperature of 49 degrees F in 1944; lowest daily maximum temperature of -16 degrees F in 1972; lowest daily minimum temperature of -26 degrees F in 1963 and 1972; highest daily minimum temperature of 31 degrees F in 1906; record precipitation of 0.33 inches in 1999; and record snowfall of 4.4 inches in 1999. There have been twenty-six measurable snowfalls on this date since 1891. The greatest snow depth on this date is 17 inches in both 1970 and 1984. The coldest windchill conditions were -69 degrees F in 1972.

Average dew point for January 14th is 7 degrees F, with a maximum of 37 degrees F and a minimum of -38 degrees F.

All-time state records for January 14th:

Scanning the state climatic data base: the all-time high for this date is 57 degrees F at Browns Valley, Campbell, Lamberton, Windom, and Worthington in 1987; the all-time low is -50 degrees F at Cook and Cotton (both in St Louis County) in 1965.

Words of the Week: Snippin

This term is used by the English and Scottish to refer to a type of biting snow, usually composed of small, wind-driven snow crystals or sleet which stings when they strike exposed skin such as the face or hands. Often winter squalls from the North Sea can produce this type of precipitation.

Outlook:

Chance of snow for northern Minnesota this weekend, partly cloudy and mild in the south. Increasing chances for snow by Sunday night most locations. Snow likely to continue into Monday. Cooler by midweek, though temperatures will remain generally above normal. Another chance for snow towards the end of the week, as early as Thursday in the north.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 21, 2000

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

Topic: January 20th, Inaugural Day Weather

The wettest Inaugural Day was January 20, 1937 when FDR took office for the second time. He was sworn in under overcast skies with temperatures only in the 30s and rather consistent rainfall, amounting to 1.77 inches for the day. JFK was sworn into office in 1961 and while the weather in Washington, D.C. was cool with snow showers in nearby Maryland and Virginia, that day, citizens in the northeast, including his home state of Massachusetts were staying home from work and watching the Inauguration on television because a heavy snow storm was raging, dropping over 20 inches of snow in parts of New Jersey, New York and Massachusetts.

Topic: Wednesdays are bringing record snowfall amounts

For the second consecutive Wednesday, record-setting snowfall amounts occurred around the state. MSP airport reported a total of 5.5 inches on January 19th, not a record, but the second greatest snowfall historically on January 19th (the record is 7.5 inches set in 1988). This follows one week on the heels of a record-setting snow storm last Wednesday (January 12th) which produced amounts of 7 to 10 inches across central Minnesota, including a record 8.7 inches at the MSP airport. However, unlike last week's storm, the January 19th snowfalls this week cut a wider swath across central and southern Minnesota, creating blizzard conditions in the southeast and producing record-setting amounts at several other locations, including.....

Austin 10 inches
Albert Lea 8.5 inches
St Peter 8.5 inches
Redwood Falls 8 inches
Lamberton 8 inches
Fairmont 7 inches
Vesta 7 inches
Owatonna 6.5 inches
Mankato 6 inches
Springfield 6 inches
Blue Earth 6 inches
Hutchinson 6 inches (tied record)
Waseca 5.5 inches
Litchfield 5.5 inches

Red Wing 4.5 inches

Rochester reported 6.8 inches which was the second greatest snowfall ever for January 19th.

What will next Wednesday bring? Snow is in the forecast!

MPR listener question: After two consecutive Wednesdays with snowfalls of 8 inches or more around the state, I am prompted to ask how often does an 8 inch or greater snowfall amount occur in the Twin Cities during January?

Answer: According to the Twin Cities climate record, snowfalls of 8 inches or more during January are quite uncommon, only four times in the past 50 years and six times in the 20th Century. They are listed below...

9.0 inches on January 3, 1906
15.8 inches on January 21, 1917
17.1 inches on January 20, 1982
17.2 inches on January 22, 1982
8.4 inches on January 16, 1994
8.7 inches on January 13, 2000

In fact there have been only 27 daily snowfalls of 8 inches or greater in the past 50 years in the Twin Cities. They are most common in the month of March, during which 12 have occurred.

Twin Cities Almanac for January 21st:

The average MSP high temperature for this date is 23 degrees F (plus or minus 14 degrees standard deviation), while the average low is 6 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records for January 21st:

MSP weather records for this date include: highest daily maximum temperature of 48 degrees F in 1900; lowest daily maximum temperature of -7 degrees F in 1954; lowest daily minimum temperature of -29 degrees F in 1970; highest daily minimum temperature of 35 degrees F in 1934; record precipitation of 0.81 inches in 1917; and record snowfall of 15.8 inches in 1917. There have been twenty-five measurable snowfalls on this date since 1891. The greatest snow depth on this date is 24 inches in both 1982. The coldest windchill conditions were -67 degrees F in 1936.

Average dew point for January 21st is 6 degrees F, with a maximum of 38 degrees F and a minimum of -35 degrees F.

All-time state records for January 21st:

Scanning the state climatic data base: the all-time high for this date is 62 degrees F at Canby (Yellow Medicine County) in 1942;

the all-time low is -57 degrees F at Tower and Embarrass in 1996.

Words of the Week: Distinguishing an ice storm warning from
a freezing rain/freezing drizzle advisory

The National Weather Service Forecast Offices provide many notices of significant weather events to warn the public about conditions which may present threats to public safety and health. Two of these notices which are sometimes issued during the winter season in Minnesota are an ice storm warning and a freezing rain/freezing drizzle advisory. The significant difference between these two notices is that an ice storm warning means that ice accumulations are expected to equal or exceed 1/4 inch, while a freezing rain/freezing drizzle advisory pertains to ice accumulation of less than 1/4 inch. Both types of notices infer difficult driving conditions, while the ice storms also threaten power disruptions and damage to landscape plants and trees.

Outlook:

Chance of snow in the south on Saturday, then in the north on Sunday with perhaps some lingering snow into Monday. Temperatures will be cool but not far from seasonal normals over the weekend, then warming to above normal by the middle of next week. There will be another chance for snow by Tuesday and Wednesday.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Jan 28, 2000

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

Topic: Preliminary January Climate Summary

Despite some days which brought temperatures 15 to 20 degrees F colder than normal, the average temperature for January has been 3 to 6 degrees warmer than normal in most Minnesota communities. This continues a significant trend of above normal temperatures which started in November. The Heating Degree Days for this winter have not been terribly different from the past two mild winters, marking three heating seasons in a row when consumers have paid less for residential and commercial heating in Minnesota. The extremes of temperature during the month ranged from the high 40s F on the 8th in the southwest counties to the -30s F on the 20th and 21st in the far north.

Precipitation patterns in January were far from uniform. Most northern locations are reporting below normal amounts, while several southern and central counties report above normal. Snowfall was deficient in the north, except for parts of the Lake Superior shoreline. Conversely, snowfall in many central and southern counties ranged from 15 to 20 inches, well above normal for the second consecutive January. The added snow cover was enthusiastically greeted by agricultural producers (for the benefit of insulating pasture grasses and alfalfa fields) and who have been waiting to ski or snowmobile.

Topic: Attempts to Improve Pollution Forecasts

Some European countries are going to cooperate this year to see if they can improve the forecasting of pollution episodes. With the sponsorship of Zambon, an Italian pharmaceutical company, health specialists and meteorologists in Italy, France and Spain are participating in a project titled ASTHMA (Advance System of Teledetection for Healthcare Management of Asthma). A combination of data sources will be used, including standard meteorological surface observations, radiosonde reports, particulate and aerosol data from the European Aeroallergen Network and Pollen Information Service, and even satellite based spectroscopic observations. These data will be used in computer models to forecast pollution loads and dispersion for selected cities in Europe out to four days ahead. These forecasts are expected to help thousands of hay fever and asthma afflicted citizens adjust their daily schedules by perhaps spending more time indoors when high concentrations of pollens, spores or other pollutants are indicated.

Topic: Clear Air in February

One of the distinguishing features of February climate in Minnesota is known as atmospheric transmissivity, a way to express the attenuation of sunlight as it passes through the air and reaches the Earth's surface. The quantity of solar energy reaching the surface is affected by cloud cover predominately, but also by the amount of water vapor and aerosols in the atmosphere. In Minnesota these factors tend to be minimized during February (relative to other winter months), allowing a greater fraction of the sun's energy to reach the surface, over 80 percent on clear days. Combined with the high reflectivity of snow cover, it is almost mandatory to wear sunglasses on clear February days in Minnesota. Incidentally, atmospheric transmissivity is lowest in the summertime when the water vapor content and particulate content, especially soils and dust, tend to be at a maximum.

MPR listener question: I have been told that February is the driest month in Minnesota? Is that true and if so why?

Answer: It is not universally true in Minnesota that February is the driest month, but it is true for the vast majority of climate stations, including the Twin Cities. As to why, there are probably a number of reasons. A simple answer is that February is the shortest month of the year by two or three days, so it is logical it would exhibit less precipitation as a historical average. But it is more than that. February is characterized by the dominance of cold, dry arctic air masses which contain little precipitable water. High pressure cells which bring fair weather, with clear skies are also more frequent in Minnesota during February.

Twin Cities Almanac for January 28th:

The average MSP high temperature for this date is 22 degrees F (plus or minus 13 degrees standard deviation), while the average low is 4 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records for January 28th:

MSP weather records for this date include: highest daily maximum temperature of 47 degrees F in 1892; lowest daily maximum temperature of -15 degrees F in 1966; lowest daily minimum temperature of -26 degrees F in 1966; highest daily minimum temperature of 34 degrees F in 1892; record precipitation of 0.56 inches in 1909; and record snowfall of 4.1 inches in 1912. There have been twenty-nine measurable snowfalls on this date since 1891. The greatest snow depth on this date is 21 inches in both 1979 and 1982. The coldest windchill conditions were -70 degrees F in 1977.

Average dew point for January 28th is 4 degrees F, with a maximum of 36 degrees F and a minimum of -38 degrees F.

All-time state records for January 28th:

Scanning the state climatic data base: the all-time high for this date is 56 degrees F at Worthington (Nobles County) in 1931 and at Canby (Yellow Medicine County) in 1989; the all-time low is -50 degrees F at Pokegama Dam (Itasca County) in 1902 and also at Baudette (Lake of the Woods County) in 1966.

Word of the Week: NOGAPS

A meteorological acronym pertaining to weather prediction, this term stands for Navy Operational Global Atmospheric Prediction System. This global scale weather prediction model operates on a gridded resolution of about 12 miles and calculates conditions at 18 different vertical layers in the atmosphere. It is one of the few models which produce a wind field analysis on a global scale, showing streamlines aloft and at the surface, over oceans and over land masses. In addition to the normal radiosonde data, the NOGAPS assimilates ship observations, buoy observations and satellite observations from the Defense Meteorological Satellite Program system of polar orbiters. The web site to access NOGAPS model output is....

<http://www.fnmoc.navy.mil>

Outlook:

Chance of light snow in the south this weekend with a warming trend. The early portion of next week will be dry with high temperatures in the 20s and 30s. Increasing clouds and chances for significant snowfall by Wednesday and Thursday around the state.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 4, 2000

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

Topic: Winter Weather Odds and Ends

While the winter has been mild in Minnesota, it has arguably been even milder in South Dakota. There were reports earlier this week that in the absence of snow and without frozen soil conditions, some farmers were planting spring wheat in south-central South Dakota. This is at least two months ahead of normal!

Recent heavy snows along the Kenai Peninsula south of Anchorage, Alaska have produced dangerous conditions for travelers. The Seward Highway has been closed numerous times this week due to avalanches caused by high winds and fluctuating temperatures which make the snowpack unstable. Many motorists have been stranded by blocked roads. It is said that the avalanche conditions are the worst in 30 years.

Morning clouds prevented the groundhog from seeing his shadow in the Twin Cities area on Wednesday of this week (Groundhog Day), but it was an extremely mild day, with temperatures ranging from 10 to 20 degrees F above normal. A breezy warm front produced some record or near record-setting high temperatures across the region on February 2nd, including....
45 F at Crookston, MN.....48 F at Grand Forks, ND
47 F at Fargo, ND.....42 F at Thief River Falls, MN
60 F at Yankton, SD.....58 F at Huron, SD

Is winter over? I don't think so.

MPR listener question: Those of us in southwestern Minnesota are chiefly concerned with drought as we have seen very little precipitation since September. Looking for some hopeful sign of abundant precipitation, we were wondering how often does precipitation exceed 1 inch during February and is there much chance of getting as much as 5 inches before the spring planting season starts about May 1st.

Answer: Southwestern Minnesota is definitely the driest area of the state in terms of soil moisture. Using the climate records from Worthington, MN (Nobles County), I find that precipitation exceeds one inch for the month of February only about 20 percent of the time (one year out of five). This is also the frequency that snowfall for February exceeds 10 inches in Nobles County. Concerning the question of getting 5 inches or more of precipitation before May 1st, this has happened 28 times in the past 105 years

based on a summation of February through April precipitation. That's a frequency of about one year in four. With leap year, at least we get one extra day for precipitation to occur before May 1st.

Twin Cities Almanac for February 4th:

The average MSP high temperature for this date is 21 degrees F (plus or minus 15 degrees standard deviation), while the average low is 5 degrees F (plus or minus 16 degrees standard deviation).

MSP Local Records for February 4th:

MSP weather records for this date include: highest daily maximum temperature of 49 degrees F in 1925 and 1990; lowest daily maximum temperature of -10 degrees F in 1895 and 1907; lowest daily minimum temperature of -25 degrees F in 1893; highest daily minimum temperature of 32 degrees F in 1954 and 1991; record precipitation of 0.34 inches in 1955; and record snowfall of 4.4 inches in 1971. There have been twenty-six measurable snowfalls on this date since 1891. The greatest snow depth on this date is 21 inches in both 1969 and 1979. The coldest windchill conditions were -82 degrees F in 1917.

Average dew point for February 4th is 6 degrees F, with a maximum of 35 degrees F and a minimum of -42 degrees F.

All-time state records for February 4th:

Scanning the state climatic data base: the all-time high for this date is 61 degrees F at Browns Valley (Traverse County) in 1991; the all-time low is -52 degrees F at Willow River (Pine County) in 1907.

Words of the Week: UTC, GMT and Z time

By international agreement, all governmental weather services provide observational data and summaries at specified times during the day. Meteorological reports all follow the Universal Time Coordinated System (UTC), formally referred to as Greenwich Mean Time (GMT) or referenced often by the military as Z time, all meaning the clock time at the Prime Meridian of longitude located at zero degrees running through England. Instrumented balloon launches are done each day at 0000Z and 1200Z. This time is six hours ahead of Minnesota, so the National Weather Service balloon launches from Chanhassen are done at 6 am and 6 pm when it is not Daylight Saving Time. Surface weather observations are provided by all countries at 0000Z, 0600Z, 1200Z, and 1800Z.

Incidentally, if you are ever interested in setting your clock to the precise time observed by the Master Clock at the U.S. Naval Observatory, you can go to their web site and see it.....

<http://tycho.usno.navy.mil>

Outlook:

Warming trend for the weekend with partly cloudy skies. There will be a chance for snow in the south late Sunday and into Monday, then a chance for snow statewide by Wednesday and Thursday. Temperatures will continue to average above normal for most of the week.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 11, 2000

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

Topic: Hourly observations of weather on the Internet

Currently hourly weather observations are taken and reported by over 1500 automated weather stations across the country. Most are located at airports. Increasingly, these observations are available on the Internet and provide current conditions such as temperature, dewpoint, relative humidity, wind speed, wind gust, wind direction, atmospheric pressure, visibility, cloud cover, and an indication of significant weather (if it is raining, foggy, etc.). Some of these sites are.....

<http://twister.sbs.ohio-state.edu>
(Ohio State University Atmospheric Science Program)

http://www.dnr.state.mn.us/current_conditions
(Minnesota DNR current conditions)

<http://www.wunderground.com/US/MN/>
(University of Michigan-Weather Underground)

Topic: Overlooked dryness in January

In reporting the heavier snowfalls during January across central and southern Minnesota, I neglected to mention the near record absence of precipitation in some of the western counties. Crookston, in Polk County, reported only 0.05 inches of precipitation during January, the second lowest amount in their climate records. Alexandria in Douglas County reported only .08 inches for the month, the 4th lowest amount in their climate records.

Topic: Living Snow Fences

Blowing and drifting snow can present significant problems in Minnesota, not the least of which is closing roads. In the winter of 1996-1997 state and local units of government spent an estimated \$215 million on snowplowing alone. Granted that was a severe winter with many blizzards, but it illustrates the magnitude of cost (tax dollars) to keep our roads and highways open.

The first settlers and farmers in the state planted many trees around farmsteads and along railroads to control

blowing and drifting snow. During the first half of the 20th century many trees and shrubs were planted along field boundaries to help capture snow and to prevent soil erosion by wind. In recent decades, many of these have been lost to drought, disease, or old age and replantings have not occurred.

The Minnesota Department of Transportation in cooperation with Minnesota's Soil and Water Conservation Districts and other agencies has embarked on a program to restore and develop living snow fences around the state. It is estimated that there are 4,000 sites encompassing over 1,000 miles of roads which would benefit from barrier control of blowing and drifting snow. The cost benefit/cost ratios calculated using a cost of only \$1/ton for snow removal yield ratios as high as 36:1, and average about 17:1. This represents a potentially significant cost savings for the Minnesota taxpayer when living snow fences can be used for catching and controlling snow along troublesome stretches of highway. When factoring in the benefits in reducing road closures and accident potential, as well as providing wildlife habitat, the argument becomes even more convincing that the restoration and development of more of these living barriers across the Minnesota landscape would be of great benefit to us all.

Question from a WeatherTalk reader: How many sunny days per year occur in the Twin Cities area, and how does this compare to other midwestern cities such as Milwaukee, Chicago, Detroit and Indianapolis?

Answer: There are few historical records of sunny days, but there are records of daily cloud cover. So the best way to compare these cities in terms of sunshine might be to examine the frequency of days which are designated as clear sky conditions. The list below shows the average number of days per year with clear sky conditions dominant throughout the day.

Twin Cities 100 days Milwaukee 95 day Chicago 85 days
Indianapolis 90 days Detroit 77 days Des Moines 104 days

This is probably affected by sources of industrial pollution (emissions) as well as proximity to the Great Lakes.

Twin Cities Almanac for February 11th:

The average MSP high temperature for this date is 24 degrees F (plus or minus 14 degrees standard deviation), while the average low is 7 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records for February 11th:

MSP weather records for this date include: highest daily maximum

temperature of 51 degrees F in 1961; lowest daily maximum temperature of -15 degrees F in 1899; lowest daily minimum temperature of -31 degrees F in 1899; highest daily minimum temperature of 35 degrees F in 1908; record precipitation of 0.28 inches in 1940 and 1965; and record snowfall of 4.1 inches in 1979. There have been twenty-five measurable snowfalls on this date since 1891. The greatest snow depth on this date is 20 inches in both 1967 and 1969. The coldest windchill conditions were -59 degrees F in 1917.

Average dew point for February 11th is 9 degrees F, with a maximum of 34 degrees F and a minimum of -39 degrees F.

All-time state records for February 11th:

Scanning the state climatic data base: the all-time high for this date is 61 degrees F at Luverne (Rock County) in 1977; the all-time low is -55 degrees F at Leech Lake Dam (Itasca County) in 1899.

Words of the Week: COMET

This is an acronym for the Cooperative Program for Operational Meteorology, Education and Training administered by the University Corporation for Atmospheric Research. Sponsors include the National Weather Service, the Air Force Weather Agency, and the Naval Meteorology and Oceanography Command. The COMET mission statement is.. "to serve as a premier resource to support, enhance, convey, and stimulate scientific knowledge about the weather for the benefit of providers, educators, and users of weather information." COMET was established in 1989 and has sponsored the development of special forecasting methods and tools. Some previous COMET projects have produced better methods of forecasting windstorms, marine weather for the Great Lakes, lake effect snow storms, and flash floods. More information about COMET, including some examples of projects and case studies can be found at their web site.....

<http://www.comet.ucar.edu>

Outlook:

Chance of snow across the state by late Saturday and into Monday with some accumulation possible. Temperatures will trend towards above normal values during the coming week. There will be more frequent chances for snowfall, especially in northern counties by Thursday.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 18, 2000

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

Topic: New Climate Outlooks

The Climate Prediction Center released the new monthly and seasonal climate outlooks on Thursday (Feb 17) of this week. The March outlook favored no significant departures in temperature or precipitation across Minnesota, but a warmer and drier area to our south across the central and southern plains. The outlook for the entire period from March through May favored above normal temperatures in southern Minnesota and above normal precipitation across the north.

Topic: Valentine's Day tornadoes in Georgia

Several national news organizations ran a feature story on the destructive tornadoes (perhaps as many as eight) which ripped through parts of Georgia on Monday, killing over 20 people, destroying over 350 homes, and causing an estimated \$25 million in losses. Some of the descriptions used to characterize this event were either incorrect or misleading. For example, the number of tornadoes reported so far in the year 2000 (up to Feb 16) across the United States is 29, a number slightly less than the historical average of the last 50 years and a number that is less than all other years in the 1990s for a similar period. This fact is contrary to the impression that the number of tornadoes so far this year exceeds the normal. In addition, February tornadoes in Georgia are not all that rare. Historically, in the state of Georgia, February ranks third behind April and March in terms of tornado frequency. This too, runs contrary to the impression that a February tornado outbreak is quite unusual in Georgia. What was unusual about this outbreak was the time of day when they occurred. The 11 pm to 3 am time frame has historically been associated with the smallest frequency of tornadoes compared with other times of the day, and of course most people are sleeping during that time and not apt to respond rapidly to warnings.

The worst outbreak of tornadoes in Georgia actually occurred during the month of February, but back in 1884. February 19 of that year brought a large outbreak of tornadoes to the southeastern states. Starting at about 1 pm in the afternoon and lasting until 7 pm in the evening, a complex of thunderstorms produced 18 tornadoes across the Georgia. Approximately 180 people were killed even though there were no direct hits

on towns or cities. Losses totaled over \$4 million, a staggering sum for the 1880s. Most tornadoes in that outbreak were of the F2 and F3 intensity, though two were estimated to have been F4 (winds in excess of 207 mph). For comparison, the Valentine's Day killer tornadoes in Georgia this week were estimated to have been F3 (winds in excess of 158 mph).

Question from an MPR listener: Where is Flag Island, MN? It has appeared with some frequency as the nation's low temperature in the National Weather Service national summary this winter.

Answer: Flag Island is located in the Northwest Angle on Lake of the Woods. It is an automated weather station operated by the FAA for the purpose of helping routing and briefing of air traffic between the United States and Kenora in Canada. The reports appear in the hourly weather roundup and the daily climate summary sent out by the North Dakota (Internet URL: <http://iwin.nws.noaa.gov/iwin/nd/nd.html>) and Minnesota (Internet URL: <http://iwin.nws.noaa.gov/iwin/mn/mn.html>) National Weather Service Forecast Offices. It has only been part of the weather network for two years, but it has often been cited as having the nation's low temperature, as it was on Wednesday and Thursday of this week with readings of -13 and -17 degrees F, respectively. It appears that it will acquire a similar reputation around the country to that of International Falls, Embarrass and Tower, other Minnesota locations known as "ice boxes" and places which attract certain industries to do cold weather testing of their products.

Twin Cities Almanac for February 18th:

The average MSP high temperature for this date is 27 degrees F (plus or minus 13 degrees standard deviation), while the average low is 11 degrees F (plus or minus 15 degrees standard deviation).

MSP Local Records for February 18th:

MSP weather records for this date include: highest daily maximum temperature of 58 degrees F in 1981; lowest daily maximum temperature of -7 degrees F in 1941; lowest daily minimum temperature of -21 degrees F in 1903; highest daily minimum temperature of 36 degrees F in 1915 and 1998; record precipitation of 0.70 inches in 1961 and record snowfall of 7.0 inches in 1961. There have been twenty-seven measurable snowfalls on this date since 1891. The greatest snow depth on this date is 27 inches in both 1967. The coldest windchill conditions were -60 degrees F in 1941.

Average dew point for February 18th is 15 degrees F, with a maximum of 42 degrees F and a minimum of -28 degrees F.

All-time state records for February 18th:

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

date is 66 degrees F at Pipestone in 1981; the all-time low is -48 degrees F at Roseau in 1966.

Word of the Week: Xeriscaping

Who's escaping? Just kidding. This term is used to describe landscape planning and planting practices which strive to conserve water by mulching, using soil amendments like compost or manure, and by selecting species with low water requirements such that they can thrive on natural precipitation for the most part. This is not a common practice in Minnesota, but it has been tried in the drier climates of North Dakota, some of the western states, and especially the desert southwest. In some areas of the country over half of the residential water use goes to watering landscape plants and lawns. Xeriscaping has been shown to reduce water usage by up to 70 percent in some cases. The USDA and National Weather Service conducted a joint meeting in Washington D.C. to discuss drought strategies for the coming growing season in the United States. This was done with an awareness that more of the U. S. landscape is in drought or at least a dry weather pattern this winter than any other winter since that of 1987-88. Xeriscaping was one of the major topics on the agenda for this week's meeting, so we may see this practice being promoted more in parts of the country this year.

Outlook:

Mostly dry over the weekend with a warming trend. Slight chance for snow on Monday, but mostly dry until next Wednesday through Friday when snow and/ or rain appears in the forecast again. The warming trend will carry daytime temperatures into the 30s F during next week and likely stay in place until the end of the month.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Feb 25, 2000

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

Topic: February has turned record-setting

Record-setting maximum temperatures settled across the region beginning on Monday (Feb 21) of this week. In fact some places such as International Falls, MN reported three consecutive days with record maximum temperatures. This was the result of strong warm air advection on southerly winds, the relative absence of abundant snow cover, and a February sun which is growing stronger each day.

In addition to the numerous daily records broken this week, many places reported temperatures which tied or broke the all-time highs for the month of February. Some of those are listed below, most of which occurred on Feb. 22nd....

International Falls, MN 58 F Crookston, MN 50 F
Crane Lake, MN 56 F Warroad, MN 52 F
Grand Forks, ND 67 F Devils Lake, ND 60 F
Roseau, MN 50 F (tied record) Thief River Falls, MN 52 F
Hallock, MN 61 F (tied record) Lamberton, MN 65 F
St James, MN 63 F (tied record) Windom, MN 68 F

The temperature of 68 degrees F at Windom, MN (Cottonwood County) on February 22nd ranks as the third highest ever measured in the state during this month. The highest values of temperature measured during the month occurred on February 26, 1896 when Le Sueur reported 70 degrees F and Pleasant Mound (Blue Earth County) reported 73 degrees F. This warm advection event in 1896 brought high winds (30 to 50 mph) and a dust storm across the region. Omaha, NE reported a high of 78 degrees F and Vermillion, SD hit 79 degrees F. Thawed soils in southern MN continued to be blown around in March and some fields were planted very early. Active bees were observed during March of that year, an indication of how early spring arrived.

Returning to this week, the storm system which passed over the region on February 23rd brought some record-setting rainfall amounts to some areas. Faribault, MN reported 0.51 inches, Sioux Falls, SD reported 0.77 inches, Spencer, IA 0.66 inches, and Kearney, NE 0.86 inches, all of which were new record amounts for the date. Many areas of southern and central Minnesota reported amounts ranging from 0.25 to 0.50 inches. Yankton, SD reported one of the highest amounts

with 1.26 inches which was a record for the date as well. These significant rains in February are unusual (frequency about one year out of eight) and correspond with a warming trend observed in recent years. In fact this February may end up being ranked among the ten warmest statewide historically.

Topic: Power outages and power pole fires

Fifty power pole fires were reported around the seven county metro area on Wednesday of this week, along with many power outages. Road salt and dust buildup on mushroom-shaped porcelain line insulators apparently attracted a good deal of moisture from the air and allowed electricity to escape through the lines and into the poles, setting them on fire. Perhaps this should not be surprising given the remarkably high dewpoints this week. New dewpoint records were set on Tuesday (39 F), Wednesday (45 F) and Thursday (44 F) at the MSP International Airport. These dewpoints are more typical of mid-May and represent a large amount of water vapor. A cool surface like a porcelain insulator would undoubtedly attract a great deal of moisture especially when coated with a number of condensation nuclei like salt and dust particles.

Questions from an MPR listener: It has been such a foggy week around Minnesota. Isn't it uncommon to be so foggy in February? Also the forecast this week called for a chance of thunderstorms. Would this be quite unusual for February

Answer: No. Actually in terms of fog frequency, climatology shows that the period from November through March has the highest frequency of dense fog (visibility less than 1/4 mile). Each month in this period has an average of approximately one day with dense fog. Two of the factors which contribute to this are the longer nights of winter, which allow for greater loss of long wave radiation overnight with cooling down to the dewpoint temperature, and warm air advection over a snow covered or wet landscape, which evaporates moisture into the near surface layer where it can condense into fog droplets.

Concerning the chance for thunderstorms this week, yes it would be quite unusual. This has a historical frequency of less than one per cent over the past six decades, at least, according to the Twin Cities climate records. On the other hand, there have been record-setting dewpoint temperatures this week in the low to mid 40s F, which is roughly equivalent to the average water vapor content in mid-May, a time of year when thunderstorms are far more frequent.

Twin Cities Almanac for February 25th:

The average MSP high temperature for this date is 29 degrees F (plus or minus 12 degrees standard deviation), while the average low is 11 degrees F (plus or minus 13 degrees standard deviation).

MSP Local Records for February 25th:

MSP weather records for this date include: highest daily maximum temperature of 58 degrees F in 1976; lowest daily maximum temperature of 2 degrees F in 1934; lowest daily minimum temperature of -23 degrees F in 1967; highest daily minimum temperature of 38 degrees F in 1998; record precipitation of 0.63 inches in 1944 and record snowfall of 4.1 inches in 1994. There have been twenty-five measurable snowfalls on this date since 1891. The greatest snow depth on this date is 27 inches in both 1967. The coldest windchill conditions were -52 degrees F in 1919.

Average dew point for February 25th is 14 degrees F, with a maximum of 40 degrees F and a minimum of -30 degrees F.

All-time state records for February 25th:

Scanning the state climatic data base: the all-time high for this date is 66 degrees F at Beardsley (Big Stone County) in 1958; the all-time low is -50 degrees F at Leech Lake Dam in 1897.

Word of the Week: Terra

This is the name (taken from the Latin word for Earth) given to the new NASA spacecraft which was launched in December 1999 with a mission focus to study the interactions of land, ocean and atmosphere. The Terra spacecraft, about the size of a school bus, orbits the Earth from pole to pole using multispectral sensors to capture images of land and water surfaces, as well as cloud formations in great detail. It is on a six year mission to provide earth systems scientists with data to study ocean currents and cycles, as well as surface temperature patterns, radiation budgets, and other features the Earth (including polar ice caps) which may provide some insights on global climate change.

More information on Terra can be found on the NASA web site at...

<http://terra.nasa.gov>

Outlook:

Warm and wet are the key words for the end of February and beginning of March. A good chance for rain and snow Saturday, with perhaps continued thundershowers in the south. Winds will be stronger than of late. Somewhat dry later on Sunday, with some lingering precipitation in the north. Another chance for rain showers and snow returning later on Monday and continuing throughout much of next week. Temperatures will continue to average from 10 to 15 degrees warmer than normal. Soils will continue to thaw and it will be quite muddy in most places.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Mar 3, 2000

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

Topic: There's something about February

Of all the recent climate trends evident in monthly statistics for Minnesota, perhaps the most striking is for February. Eight of the past eleven Februarys have seen temperatures well above normal on a statewide basis. The past three consecutive Februarys rank in the ten warmest historically. Over a dozen February high temperature and dewpoint records were broken in the Twin Cities area alone in the past three years. The most recent February produced new dewpoint records in the 50s F statewide, something not seen in any of the historical records.

This trend has been economically beneficial from the standpoint of reduced residential and commercial heating costs, snowplowing costs, and overwinter construction delays. However, it has certainly produced some negative consequences as well including: a higher incidence of fog-related traffic accidents and transportation delays; problems for grain storage facilities in holding grain at constant temperature and moisture conditions; a shortening of the ice fishing season; shortening, cancellation, or postponement of a number of outdoor festivals (St Paul's Winter Carnival among others) skiing and dog sledding events; and an abbreviated season for snowmobiling.

It is not yet clear if this trend will continue, (it may be related to El Nino/La Nina Cycles, the Pacific Decadal Oscillation, the North Atlantic Oscillation, Global Climate Change, or all of the above), but it is certainly unprecedented in the historical climate records of Minnesota.

Listed below are the average temperatures recorded during February 2000 and their relative historical rank among the warmest....

Location	Temp (F)	Rank	Location	Temp (F)	Rank
Twin Cities	28.1	5th	Duluth	21.4	6th
Intern. Falls	18.9	8th	St Cloud	22.3	13th
Rochester	26.3	7th	Alexandria	22.3	8th
Hibbing	19.0	6th	Moorhead	22.8	8th
Waseca	27.2	6th	Morris	22.4	12th
Lamberton	28.0	3rd	Park Rapids	20.7	10th
Browns Valley	23.1	10th	Redwood Falls	27.9	7th
La Crosse, WI	30.6	6th	Fargo, ND	21.1	9th
Grand Forks	23.5	5th	Sioux Falls	33.5	1st

Topic: Current volcanic activity

There is always volcanic activity going on around the world, but sometimes it is so robust that it is detectable in satellite images. This is the case this winter with a number of active volcanoes. Two of the most active currently are the Mayon volcano in the Phillippines, about 190 miles southeast of Manila and the Pacaya volcano in Guetamala, about 25 miles south of Guetemala City. These are both releasing large quantities of smoke and ash. It remains to be seen whether there will be significant effects from this on local weather conditions.

The Space Science and Engineering Center at the University of Wisconsin, Madison, in cooperation with the Michigan Tech Geology Department maintains a web site which shows current satellite views of the ten most active volcanoes. It can be found at.....

<http://www.ssec.wisc.edu/data/volcano.html>

Questions from an MPR listener: The cancellation of the Birkebeiner cross country ski race last week was depressing and truly a weather disaster for ski enthusiasts. What's happening with the weather for this event? Should it be moved to earlier in February?

Answer: This is a difficult subject to approach because of the strong climate trend toward warm temperatures in February, which I discuss above. For the past ten winters in the Hayward, WI area, January and February snowfalls have been below normal about half of the time, but even when they have been normal or heavier than normal, the longevity of snow cover has been abbreviated by exceptionally warm temperatures, especially in the latter half of February. Climatology suggests that the probabilities for temperatures to rise above 40 degrees F increase significantly after the 15th of the month. In fact the frequency of temperatures above 40s F in the second half of February is over twice that of the first half of the month. Further the number of days with temperatures of 50 degrees F or greater during the second half of the month outnumber those of the first half by over a 5:1 ratio. There have been a number of years historically when the snow pack of early February was drastically reduced by a spring-like warm up in the second half of the month. Most notable are years like 1896, 1921, 1930, 1954, 1958, 1961, 1966, 1981, 1985, 1987, and 1998.

Since January tends to be the snowiest month of the year historically (despite some recent aberrations), the probabilities would favor the first half of February over the second half in terms of favorable conditions for the Birkebeiner. In addition, the recend strong warming trend so evident in February, is not nearly as strong in January.

Twin Cities Almanac for March 3rd:

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

MSP Local Records for March 3rd:

MSP weather records for this date include: highest daily maximum temperature of 65 degrees F in 1905; lowest daily maximum temperature of 11 degrees F in 1916; lowest daily minimum temperature of -7 degrees F in 1893; highest daily minimum temperature of 38 degrees F in 1894, 1934, and 1983; record precipitation of 1.19 inches in 1970 and record snowfall of 12.6 inches in 1985. There have been twenty-five measurable snowfalls on this date since 1891. The greatest snow depth on this date is 21 inches in 1962. The coldest windchill conditions were -44 degrees F in 1954.

Average dew point for March 3rd is 16 degrees F, with a maximum of 52 degrees F and a minimum of -13 degrees F.

All-time state records for March 3rd:

Scanning the state climatic data base: the all-time high for this date is 71 degrees F at St Peter, Milan, Montevideo, and Winnebago in 1905; the all-time low is -42 degrees F at Embarrass (St Louis County) in 1996.

Words of the Week: Cyclones, Typhoons and Hurricanes

The recent floods in Mozambique and Madagascar are the result of a very active tropical storm season in the Indian Ocean this year. In the western South Pacific and the Indian Ocean severe tropical cyclones (wind speeds of 74 mph or greater) are simply called cyclones. Australian, Indian, and east African weather services will use this term to describe such storms. In the western North Pacific these storms are called typhoons, while in the eastern Pacific Ocean, the Atlantic Ocean, and the Caribbean they are called hurricanes. The current conditions in the western south Pacific, Indian Ocean, and Mozambique channel off east Africa show very high ocean surface temperatures, ranging from 80 to 90 degrees F in many places. This serves as fuel for cyclones to develop. In addition, the jet stream winds are rather weak favoring strong vertical development and sustainability of thunderstorms. Australia and Madagascar have already been affected by a number of cyclones this season, but fortunately in areas that are not heavily populated. On the other hand, Mozambique in east Africa has seen severe flooding brought on by two cyclones which moved very slowly over land and dropped heavy rainfall. Nearly a million people have been displaced from their homes there. This week, yet another cyclone (Gloria) passed over Madagascar and the Mozambique channel dumping excessive rainfall, with strong winds and high seas (15 to 20 ft waves).

More information about cyclones in the southern hemisphere can be found on the Internet at the Naval Pacific Meteorological and Oceanography Center's Joint Typhoon Warning Center operating in Hawaii at URL....

<http://www.npmoc.navy.mil/jtwc.html>

Outlook:

Very warm with mostly sunny skies this weekend. Increasing clouds later on Sunday, with a chance for showers Monday through Wednesday next week. Temperatures will average well above normal, then decline later next week, with a chance for snow or rain approaching the weekend.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Mar 10, 2000

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

Topic: Minnesota's fall sunshine smiled on England this winter

The United Kingdom Meteorological Office reports that this winter (December through February) in parts of England, Wales and Scotland has been the sunniest since records began in 1907. The U.K. observing system routinely records hours of sunshine as their measure of how sunny it is. Conversely, here in Minnesota we recorded perhaps the sunniest ever fall, but since the end of November (our sunniest ever) the amount of sunshine (measured as solar radiation) has been declining and was actually slightly below average for the months of December through February. In fact, February brought the 4th lowest solar radiation values at the St Paul Campus since 1963, primarily thanks to the persistent incidence of fog. It would appear that our remarkably sunny fall weather migrated to the United Kingdom for the winter.

Question from an MPR listener: The dewpoint was awfully high earlier this week before the rains started. It felt more like summer than winter. What is the highest dewpoint recorded during the month of March?

Answer: The dewpoint on Tuesday of this week (March 7th) reached as high as 61 degrees F in southern Minnesota. This is about the historical limit for the state during the month of March. Tuesday's dewpoint of 58 degrees F in the Twin Cities was not only a new daily record for March 7th, but it was also the second highest ever recorded during the month. The highest was 60 degrees F recorded on March 24, 1945 just hours before an early evening thunderstorm. Even during the tornado outbreak in southern Minnesota on March 29, 1998 the dewpoints were in the low 50s, lower than what we experienced this week.

Topic: Measures of the recent record-setting warmth

Among dozens of recent records set in Minnesota by the very warm temperatures of late February and early March are these three lesser known but very significant and unprecedented ones:

(1) The 81 degrees F high temperature recorded at St James on Tuesday, March 7th was not only a state record for that date, but the record earliest date ever anywhere in the state

for a temperature of 80 degrees F or higher.

(2) The period from the last 70 degrees F day in the fall to the first 70 degrees F day in the spring averages 175 days in the Twin Cities (1891-2000) and has ranged from as long as 209 days (Sep 9, 1981 to Apr 23, 1982) to as short as 131 days (Nov 6, 1893 to Mar 17, 1893). That is, until this winter. The last 70 degrees F or higher temperature occurred last fall (1999) on Nov 13th. Last Sunday, March 5, 2000 the mercury hit 70 degrees F again, marking a new record shortest span between 70 degrees F readings of only 113 days. That's not much of a winter!

(3) For the two week period ending Tuesday March 8th, the daily mean temperature averaged nearly 25 degrees F above normal, with several individual daily readings which were 30 or more degrees F above normal. This marks the warmest ever final week of February and first week of March in the Twin Cities historical record and represents one of the longest significant positive temperature departures ever. (More on this in the topic below)

Topic: Expressing the uncertainty of predictions

There is a good article in the current Bulletin of the American Meteorological Society (Feb 2000) by Arthur Peterson concerning the philosophy of Climate Science. Periodically there has been discussion about the need for meteorologists and climatologists to better communicate what the uncertainties are in their computer model-based predictions of tomorrow, next week, next month, next year, or even 50 years from now. This subject is revisited by Peterson in his article.

The more traditional uncertainties include errors in measurements used as input data (temperature, pressure, humidity, to name a few simple ones) and the inexactness of some of the model parameterizations derived from various equations. After all the initial state of the atmosphere used in a prediction model is a freeze-frame of conditions and fluxes which must then be calculated hour by hour, day by day out to some future date, while compensating for different scaling effects and surface-atmosphere exchanges and interactions.

Other less often mentioned areas of uncertainty include unreliability and ignorance, yet these factors can most shake the confidence of scientists. The National Weather Service uses Model Output Statistics (MOS) to assess the reliability factor of given forecasts. That is the numerical forecasts are tuned to a specific area based on the characteristics of that particular landscape and the history of how similar weather systems have behaved as they pass over that landscape. Quite justifiably, history is used as a partner in making the forecast fit a specific area. Sometimes, however, weather and climate behave in a manner that is not predicted and in fact has no historical precedent. This brings a recognition of ignorance, acknowledging that "we do not know what

we do not know" and such a realization is the most menacing wrecking ball of all when it comes to our scientific tower of confidence.

Ignorance has certainly been a factor this year in making poor predictions for winter and spring weather conditions around the upper midwest. The strong warming trend of the past two winters has been even more obvious this winter, with over 75 percent of daily temperatures since November 1st registering above the historical average, and running counter to most climate predictions. Still further evidence for the ignorance factor lies in the fact that the temperature conditions for late February and early March have been so warm and virtually unprecedented historically in their persistence. There is no historical analogy to reference and even the forecast models, after adjustment by the MOS, have been consistently underestimating the magnitude of the temperatures recorded. This suggests that something is going on with the climate in the upper midwest which the community of weather scientists cannot account for (because we are ignorant).

Twin Cities Almanac for March 10th:

The average MSP high temperature for this date is 35 degrees F (plus or minus 10 degrees standard deviation), while the average low is 19 degrees F (plus or minus 11 degrees standard deviation).

MSP Local Records for March 10th:

MSP weather records for this date include: highest daily maximum temperature of 56 degrees F in 1977; lowest daily maximum temperature of -3 degrees F in 1948; lowest daily minimum temperature of -17 degrees F in 1948; highest daily minimum temperature of 38 degrees F in 1977; record precipitation of 0.55 inches in 1913 and record snowfall of 4.2 inches in 1956. There have been twenty-seven measurable snowfalls on this date since 1891. The greatest snow depth on this date is 22 inches in 1979. The coldest windchill conditions were -41 degrees F in 1948.

Average dew point for March 10th is 18 degrees F, with a maximum of 43 degrees F and a minimum of -29 degrees F.

All-time state records for March 10th:

Scanning the state climatic data base: the all-time high for this date is 63 degrees F at Canby (Yellow Medicine County) in 1957 and at Caledonia, Preston, Rochester, and Winona (SE MN) in 1977; the all-time low is -44 degrees F at Itasca State Park in 1948.

Word of the Week: CAT advisory

What would a meteorologist be doing issuing a CAT advisory? Do they have knowledge about weather which affects cats in an adverse way? Actually this term has nothing to do with pet cats. It is used by British meteorologists to designate a warning to pilots

about Clear Air Turbulence, which is usually a cloud-free wind shear zone aloft that can make for a bumpy plane ride.

Outlook:

The weekend will bring a warming trend, returning temperatures to above normal values, though not as drastically as early March. Daytime highs will rebound into the 30s and 40s F with increasing clouds by Sunday and a chance for rain and snow showers. It will be colder again on Monday and Tuesday, then moderating temperatures for the rest of the week averaging a few degrees warmer than normal. The week will be mostly cloudy and unsettled with frequent chances for precipitation especially approaching St Patrick's Day.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Mar 17, 2000

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

ST PATRICK'S DAY: THE WINDIEST CELEBRATION DAY ON THE CALENDAR

Of all the days designated each year for festivals, celebrations, and holidays, St Patrick's Day is clearly the windiest. The average wind speed in the Twin Cities on St Patrick's Day is nearly 12 mph, and has gusted as high as 60 mph. Last year (1999) was only the third time in history that winds have averaged over 20 mph all day and gusted to 45 mph or faster. It is common to have to "hold on to your hat" while watching or marching in the St Patrick's Day parade.

Topic: Minnesota's Reputation for Cold

At least a portion of Minnesota's reputation as a place for the traveler to "bring warm clothes" is derived from a National Weather Service product released each day called the National Weather Summary. The National Weather Summary highlights the nation's highest and lowest temperatures for the previous day (48 contiguous states). This has been done for many decades, and as we discussed earlier this summer, Flag Island, MN in the Northwest Angle has already reported the nation's low a number of times this winter.

A recent article in Weatherwise magazine by Professor David Hickcox of Ohio Wesleyan University recaps the nation's reported high and low temperatures during all of 1999. Minnesota reported the nation's low 44 times, ranking 5th among states. The four states which reported the nation's low more frequently in 1999 than Minnesota are all mountainous (CA, MT, WY, and CO) and derive many climate reports from higher elevations. Among the 44 dates when the nation's low temperature was reported from Minnesota, 22 of these came from Tower, MN. Tower also reported the lowest temperature reading of 1999 anywhere in the contiguous 48 states, with a -43 degrees F on January 1st. Minnesota's climate represented the nation's coldest most often in January, February, March, and December. Other locations in Minnesota which were highlighted as having the nation's low for a given date during 1999 included Roseau, Embarrass, International Falls, and Flag Island.

Given that the National Weather Summary is carried in many of the major newspapers around the country and referred to by radio and television meteorologists, it is not surprising that our state has a high degree of visibility when it comes to extreme cold.

Topic: Blizzard of March 15-16, 1941

Fifty-nine years ago this week, one of the worst blizzards in history struck North Dakota and northern Minnesota. It was a Saturday evening, when many farm families had been into town shopping and a number of others had been to local dances or movie houses for entertainment. The storm struck between 8:30 and 10:00 pm with sudden ferocity as the temperature dropped by as much as 20 degrees F and the wind velocity changed from 10-12 mph to 40 to 50 mph in less than an hour. Wind gusts as high as 85 mph were reported at Grand Forks, ND, as high as 74 mph at Fargo, and as high as 75 mph at Duluth.

Though the storm did not produce large amounts of snowfall, because snow cover was abundant over the landscape from previous storms, the exceptionally strong winds moved it about easily and reduced visibility to zero. Over 70 deaths were reported in ND and MN, and several others in Manitoba and Wisconsin. Most of these were the result of exposure, particularly stranded motorists who left their cars to seek help.

The National Weather Service Forecast Office in Chicago had responsibility for Minnesota in those days and had issued a cold wave and strong wind warning earlier in the day, but underestimated the magnitude and rapid development of the storm. For this they were sharply criticized by then Governor Stassen and Congressman R.T. Buckler from the northwest district in Minnesota. Since the National Weather Service had been transferred out of the USDA to the Department of Commerce in 1940, Stassen and Buckler lobbied Secretary of Commerce Jesse Jones to create a forecast office in Minneapolis. Buckler, citing the failures in accurate forecasting and the death tolls from the Armistice Day blizzard of November 11, 1940 and the subsequent blizzard of March 15-16, 1941, proposed a \$60,000 appropriation in Congress to establish a forecasting office in Minneapolis. As a result of this and lobbying efforts from other states the Congress approved an expansion of the National Weather Service Forecast Offices, which approximately doubled in number between 1941 and 1947. This essentially decentralized the forecast responsibilities from a small number of meteorologists in a few major cities to a more geographically distributed network, and opened up many opportunities for meteorologists trained by the military during WWII to move into government service as forecasters after the war.

Question from an MPR listener: What is meant by lake effect snow and does it have something to do with the difference in temperature between the lake and the air above it?

Answer: Lake effect snows are the result of a convectively driven process and usually occur on the downwind side of large lakes. The temperature difference between the relatively warm lake surface and the colder air aloft produces the convection (lift) necessary to trigger clouds and snow. Studies of lake effect snows in the

Great Lakes region have shown that temperature differences of 23 degrees F or greater between the lake surface and the 850 mb level (5000 ft) are needed to produce snow bearing clouds. For heavy snowfall events, temperature differences (between the lake surface and 5000 ft aloft) as great as 40 degrees F or more have been observed. Other features of lake effect snows are a somewhat shallow depth of cloud (usually 6000 to 12000 ft), absence of wind shear (change in wind direction with height), and a long fetch (travel distance) over water. Strong cold air advection from the northwest is the most typical trigger for lake effect snows in the Great Lakes states, but in Minnesota along the Lake Superior shoreline, northeasterly winds can trigger significant lake effect snows.

Twin Cities Almanac for March 17th:

The average MSP high temperature for this date is 37 degrees F (plus or minus 11 degrees standard deviation), while the average low is 21 degrees F (plus or minus 12 degrees standard deviation).

MSP Local Records for March 17th:

MSP weather records for this date include: highest daily maximum temperature of 76 degrees F in 1894; lowest daily maximum temperature of 8 degrees F in 1941; lowest daily minimum temperature of -8 degrees F in 1941; highest daily minimum temperature of 47 degrees F in 1894; record precipitation of 0.89 inches in 1965 and record snowfall of 11.2 inches in 1965. There have been twenty-two measurable snowfalls on this date since 1891. The greatest snow depth on this date is 21 inches in 1967. The coldest windchill conditions were -50 to -55 degrees F in both 1923 and 1941.

Average dew point for March 17th is 20 degrees F, with a maximum of 51 degrees F and a minimum of -18 degrees F.

All-time state records for March 17th:

Scanning the state climatic data base: the all-time high for this date is 81 degrees F at Grantie Falls (Chippewa County) in 1894; the all-time low is -30 degrees F at Baudette (Lake of the Woods County) in 1967.

Word of the Week: "C" Weather

"C" is the designator for contact weather, meaning that pilots of aircraft have sufficient visibility to fly without instruments and use only visual reference to the ground surface.

Outlook:

Chance of rain or snow on Saturday, possibly into Sunday. A warming trend will start Sunday and raise daytime temperatures back into the 40s and 50s F (maybe even 60s) around the state during next week. A series of small weather disturbances may

bring showers across the state Monday through Thursday, especially in northern counties.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Mar 24, 2000

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

Topic: Climate trend impacts on the logging industry,
bioremediation of contaminated soils, and composting

The recent string of wet years and mild winters in northern Minnesota has posed a problem to the logging industry. Though demand for wood remains high, winter harvesting has been hindered by a shortened season of frozen ground when large, heavy trucks and equipment can function without damaging the soils and roads too much. The rising water tables and mild temperatures of winter have kept the soils from freezing for long periods in many northern Minnesota counties. This increases the risk of damage from log harvesting (soil compaction and road damage) and further heightens the tension between environmental groups and those who make their living from the forest resources of the state.

From a more positive perspective, the climate trend toward warm winters has been good for composting activity by allowing more rapid microbial breakdown of organic wastes, a somewhat temperature dependent driven process. Finished compost for landscape use is produced faster when higher temperatures can be maintained in overwintering compost piles. It is not uncommon to have temperatures as high as 140 to 160 degrees F in the center of compost piles. Composting also progresses more rapidly if the pile is turned frequently to aerate and mix materials into the heated center of the pile. Information on composting can be found on the Internet at.....

<http://www.mastercomposter.com/advbuild.html>

Bioremediation makes use of the activity of microorganisms to breakdown and remove pollutants from the soil, water, and air. For those experimenting with bioremediation of contaminated soils, the bacterium which breakdown hydrocarbon contaminants can function for a longer period of time in a moist, unfrozen environment like that which has primarily been experienced around the state over the past three winters. Sometimes in northern climates, the soils are heated to stimulate more rapid biodegradation. Though still in the experimental stages of testing, bioremediation as an option for cleaning up contaminated soils may have a more realistic chance of success should this trend of mild winters and warmer soil temperatures continue into the new millenium.

Topic: Weather Education Resources for Young Children

Over the years, many parents have asked me to recommend books and other resources for teaching their young children about the weather. Recently I have had the chance to review materials from two web sites which advertise weather education for children. One is from the NOAA National Severe Storms Laboratory in Oklahoma. It is called the Billy and Maria Weather Coloring Book. It is printable in PDF format (with the Adobe Acrobat Reader software) and not only provides children with a coloring activity, but the text teaches them simple, but important lessons about severe weather, such as thunderstorms, tornadoes, and winter storms. This web site can be found at....

<http://www.nssl.noaa.gov/edu/>

A second web site which provides access to educational materials for children is located at the United Kingdom Meteorological Office in Bracknell, England. A number of short publications (leaflets) about specific topics such as monsoons, weather satellites, clouds, and simple weather instruments are available. In addition the BBC Weather Watch Book can be ordered there. This book includes explanations of simple weather concepts, ideas for science projects, and discussions about the impacts of weather on health, plants and birds, and even economic activities. The U.K. Meteorological Office web site is at....

<http://www.met-office.gov.uk/sec2/pg2/edproser.html>

Question from an MPR listener: In driving around the state this week, I observed many lakes that were ice-free. Isn't this quite unusual for March?

Answer: Quite right. Lake ice-out dates are record setting or close to it in many regions of the state. White Bear Lake was ice-free on March 21st, the earliest date in its 72 year old record for such data. Lake Minnetonka lost its ice on March 18, the second earliest date in 123 years. Many other lakes in the central and southern counties have recorded the earliest loss of ice since the spring of 1987.

This should not be surprising. Since the record setting warm weather ended on March 8th, temperatures have cooled but still averaged from 4 to 6 degrees warmer than normal over the past two weeks. Further, it appears that the month will end as it began with very warm temperatures which will accelerate the loss of ice on the lakes in northern counties. Further observations on lake ice-out, along with historical data for lakes around the state can be found at our Minnesota Climate Group web site...

<http://www.climate.umn.edu>

Twin Cities Almanac for March 24th:

The average MSP high temperature for this date is 44 degrees F (plus or minus 13 degrees standard deviation), while the average low is 27 degrees F (plus or minus 11 degrees standard deviation).

MSP Local Records for March 24th:

MSP weather records for this date include: highest daily maximum temperature of 76 degrees F in 1939; lowest daily maximum temperature of 14 degrees F in 1923; lowest daily minimum temperature of -8 degrees F in 1965; highest daily minimum temperature of 52 degrees F in 1945; record precipitation of 1.06 inches in 1949 and record snowfall of 6.8 inches in 1996. There have been sixteen measurable snowfalls on this date since 1891. The greatest snow depth on this date is 21 inches in 1951. The coldest windchill conditions were -37 degrees F in 1974.

Average dew point for March 24th is 22 degrees F, with a maximum of 60 degrees F and a minimum of -21 degrees F.

All-time state records for March 24th:

Scanning the state climatic data base: the all-time high for this date is 86 degrees F at Gull Lake (Cass County) in 1928; the all-time low is -41 degrees F at Thorhult (Beltrami County) in 1974.

Word of the Week: Indoex

This acronym stands for the Indian Ocean Experiment, a collaborate effort among scientists from Asia, Europe and the United States. One of the primary objectives during the 1999 field campaign was to utilize ships, balloon soundings, aircraft measurements and satellite imagery to assess how much pollution (dust, soot, fly ash, sulfates, nitrates, etc) was in the atmosphere over the Indian Ocean and how much was precipitating out in convective storms. During the northern hemisphere winter, a number of pollution plumes originating over India and the Asian continent can be tracked for hundreds of kilometers out over the Indian Ocean. Scientists think that these plumes may be having some impact on the temperature and water vapor patterns detected over that region. Given the severity of convective storm development in recent months (cyclones in the Indian Ocean which have struck Madagascar and Mozambique), this experiment may provide some valuable insight into why this region has seen an increased frequency and intensity of storms.

More information about this experiment is available on their web site:

<http://www-indoex.ucsd.edu>

Outlook:

Some chance of showers on Saturday, especially in eastern Minnesota. Generally drier on Sunday with warm temperatures. Another chance for precipitation Monday and Tuesday, then drier

toward the middle of next week. Yet another chance for rainfall by next Thursday and Friday. Warm temperatures will continue to the end of the month, averaging from 5 to 10 degrees above normal.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Mar 31, 2000

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

Topic: Preliminary March Climate Summary

This March came in like summer with temperatures that were 25 degrees F above normal, it moderated somewhat but still remained warmer than normal, then concluded like late spring with plenty of sunshine and mild temperatures. No "in like a lion, out like a lamb" pattern this year. Over half of the days produced a freeze-thaw cycle, somewhat stressful on vegetation which had broken dormancy. Climate observers around the state report average March temperatures which range from 6 to 9 degrees warmer than the historical average for the month.

Precipitation was mostly less than normal for March with a few exceptions. Parts of northern Minnesota received 2 to 3 inches of precipitation (mostly as snow), but the balance of the state saw less than 2 inches.

Topic: Deep ground temperature as a clue to past climate

Some recent research by geologists has revealed that past warm climates leave a signal that can be traced deep into the ground. Professor Henry Pollack of the University of Michigan has found that very warm surface temperatures of the past have left a pattern of heat conduction that is evident in deep ground temperatures. The heat from a thousand years ago may be evident in a temperature signal as deep as 500 meters into the ground. Because soil and rock are such poor heat conductors it takes a very long time for heat to be transferred to great depths. Dr. Pollack has developed a way to detect the heat signal from the background variability in ground temperature and is testing this by analyzing a number of samples from bore holes around the world. It may prove to be yet another technique to examine historical patterns in the Earth's temperature long before the instrumental records we now use to measure it.

Question from an MPR listener: What is the earliest planting date for corn in the state? It seems to get earlier and earlier.

Answer: I am sure that someone has planted corn as early as March historically, but that was just an experiment. Most corn hybrids planted in the state are well suited to late April or

early May plantings. According to the Minnesota Agricultural Statistics Service records, 1998 was perhaps the earliest planting season ever for corn. Fully 50 percent of the state's 7 million acres of field corn was planted by April 29th of that spring, the earliest since the very warm and dry spring of 1976. Corn planting is usually a function of soil moisture, soil temperature, and available field working days.

Twin Cities Almanac for March 31st:

The average MSP high temperature for this date is 46 degrees F (plus or minus 12 degrees standard deviation), while the average low is 29 degrees F (plus or minus 9 degrees standard deviation).

MSP Local Records for March 31st:

MSP weather records for this date include: highest daily maximum temperature of 82 degrees F in 1986; lowest daily maximum temperature of 23 degrees F in 1924 and 1936; lowest daily minimum temperature of -1 degrees F in 1969; highest daily minimum temperature of 52 degrees F in 1999; record precipitation of 1.25 inches in 1985 and record snowfall of 14.7 inches in 1985. There have been eighteen measurable snowfalls on this date since 1891. The greatest snow depth on this date is 12 inches in 1965. The coldest windchill conditions were -20 degrees F in 1926 and 1936.

Average dew point for March 31st is 28 degrees F, with a maximum of 56 degrees F and a minimum of -6 degrees F.

All-time state records for March 31st:

Scanning the state climatic data base: the all-time high for this date is 84 degrees F at Wheaton (Traverse County) in 1963, at St Peter and New Ulm in 1968, and at St James (Watonwan County) in 1986; the all-time low is -32 degrees F at Tower in 1975.

Word of the Week: Windburn

The strongest winds of March blew earlier this week on the 25th to the 27th, with many gusts between 40 and 50 mph. Exposure to such a wind, especially when the air is very dry, can lead to windburn. This is a superficial inflammation of the skin which appears somewhat like sunburn, but it is caused by exposure to dry winds which induce a dilation of the surface blood vessels in the skin. Windburn usually appears for shorter duration than sunburn. Sometimes dessication injury to landscape plants which is caused by strong, warm, and dry winds is also called windburn.

Outlook:

Following a warm and wet start, the first full week of April is shaping up to be cooler than normal, especially by the middle of next week. The moderate to strong winds that are characteristic of the month will also be in evidence.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Apr 7, 2000

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

Topic: Trends in northern hemisphere snow cover

Recent studies in Canada, Russia and China have examined time trends in the extent of winter snow cover over the northern hemisphere landscape in North America and Eurasia (primarily Russia and China) during the 20th century. Results suggest a somewhat uniform increasing trend in the wintertime extent of snow cover (area of the landscape covered by snow), especially during the months of December through February. However, decreasing snow cover trends were observed for the months of March and April. These months also show an increasing temperature trend. Mid winter snow cover water equivalence was found to be increasing as well, supporting the observed trend of increasing precipitation in the mid latitudes of the northern hemisphere.

Certainly the winter of 1999-2000 in North America has evolved quite the contrary to these findings. The extent of snow cover across the continent was quite small compared to most recent winters, and the snow water equivalence was less than normal. Spring snow melt flooding was of little concern this year in most places.

Question from an MPR listener: Soil moisture recharge is still a real concern for farmers in southern Minnesota this year. If we wait until the end of the month (April) to plant corn, what are the chances we will receive an additional 3 or 4 inches of precipitation?

Answer: The climatology of April precipitation in southern Minnesota counties suggests a probability of only 10 to 15 percent for 4 inches or more. The probability for 3 inches or more is 30 to 40 percent during the month. A big unknown is what kind of convective storms might develop and bring a whole lot of rainfall at once. With the early onset of spring this year, significant thunderstorm activity during the early part of this month is not out of the question at all. For example, frequent thunderstorm activity (mentioned in over 220 reports from weather observers) in 1896 brought rainfall amounts totally 5 to 6 inches to many counties in Minnesota. At New London in Kandiyohi County, five separate thunderstorms each produced over 1 inch of rainfall during the month.

Twin Cities Almanac for April 7th:

The average MSP high temperature for this date is 51 degrees F (plus or minus 12 degrees standard deviation), while the average low is 32 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for April 7th:

MSP weather records for this date include: highest daily maximum temperature of 83 degrees F in 1991; lowest daily maximum temperature of 25 degrees F in 1923 and 1936; lowest daily minimum temperature of 6 degrees F in 1936; highest daily minimum temperature of 54 degrees F in 1991; record precipitation of 1.72 inches in 1919 and record snowfall of 8.9 inches in 1923. There have been twelve measurable snowfalls on this date since 1891. The greatest snow depth on this date is 6 inches in 1975. The coldest windchill conditions were -31 degrees F in 1936.

Average dew point for April 7th is 27 degrees F, with a maximum of 49 degrees F and a minimum of 6 degrees F.

All-time state records for April 7th:

Scanning the state climatic data base: the all-time high for this date is 91 degrees F at Canby (Yellow Medicine County) in 1991; the all-time low is -16 degrees F at Tower in 1982.

Words of the Week: Beaufort weather notation

In addition to devising a scheme to visually estimate wind speed (the Beaufort wind scale) British Admiral Francis Beaufort (1774-1857) also invented a system of abbreviations and symbols used as codes to represent types of weather observed and logged in diaries and observation books. His system was widely adopted in the 19th century and later modified by British and American meteorologists. A full explanation of the Beaufort weather notation system and many examples of the letters and symbols used can be found at the following web site.....

<http://www.booty.demon.co.uk/metinfo/bletters.htm>

Outlook:

A warming trend is seen as we move toward the middle of April. A chance of showers by the middle of next week, otherwise partly cloudy skies will prevail.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Apr 14, 2000

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

Topic: Coldest in the Nation this Week

On Wednesday April 12 cold air dominated northern Minnesota, as it has on several occasions so far this month. Eveleth, Orr, and Crane Lake all reported lows of 12 degrees F. This was not a record low for any of those locations but it did represent the nation's lowest temperature (contiguous U.S.) on Wednesday, an honor which Minnesota has already recorded a number of times during the past few months.

Topic: New Monthly and Seasonal Climate Outlooks

The new climate outlooks from the National Climate Prediction Center favor below normal precipitation across much of Minnesota for the month of May and for the early part of summer (through July) as well. This pattern is expected over much of the central and southern plains states all the way down to Texas. The temperature outlooks favors near normal temperatures in Minnesota and above normal temperatures to the south.

Topic: Lower Water Levels in the Great Lakes and Consecutive Mild Winters: Probably Not a Coincidence

The preliminary climate summary for March showed that around Minnesota and the upper midwest it was one of the warmest ever. This continues a strong trend of warmer than normal weather which started back in November. The winter heating season has been the mildest of record, surpassing the record of 1931-32. Further, four of the last six winter heating seasons rank among the ten mildest of the 20th century, including the last three consecutive ones.

Does this relate at all to the declining water levels in the Great Lakes? Well, it probably does. Over winter storage of snow on the landscape generally feeds these lakes as runoff in the spring. But the considerably shortened winters of the last three years have produced less than normal snow storage, and therefore less spring runoff, especially in the Lake Superior watershed which feeds the other Great Lakes. Secondly, the lakes have remained relatively ice free, with a trend towards increasing water temperatures which has carried over from year to year. When combined with the warmer than normal air temperatures, this has allowed for more evaporative loss from

the surface.

The decline in the water levels of the Great Lakes will likely take a long time to reverse, but a return to long, cold, and snowy winters would likely help get the process started.

Question from an MPR listener: After a nearly record-setting warm March, this cold April has been hard to take, especially the snow and cold winds. What have been some of the heaviest snowfalls in April?

Answer: Indeed, earlier this week some parts of western and northern Minnesota received several inches of snow. This is not uncommon historically for the month of April. April of 1983 produced 22 inches at Faribault, 20 inches at Waseca and 18 inches at Red Wing. Another snowy April occurred in 1950, producing 23 inches at International Falls, 28 inches at Cloquet and 32 inches at Duluth. Even the Twin Cities shows some rather substantial April snowfalls in the historical record. The MSP record for today's date (April 14th) is also the highest amount for any day of the month, 13.6 inches on April 14, 1983. Other memorable April snowfalls in the Twin Cities record include:

- 8.9 inches on April 7, 1923
- 8.8 inches on April 14, 1949
- 8.5 inches on April 27, 1907
- 8.5 inches with 5ft drifts on April 20, 1893
- 8.5 inches on April 13, 1928
- 7.2 inches on April 4, 1957
- 7.1 inches on April 27, 1908
- 6.6 inches on April 29, 1984

The 8.5 inches on April 20, 1893, was from an all day snow storm and was accompanied by high winds which produced huge snowdrifts. Businesses were closed and even the street cars and railroads had to stop service. This was followed by two more days of on again off again snow as well. Conversely, the 13.6 inches of snow on April 14, 1983 melted rapidly, leaving a nuisance washboard effect on roads and highways, but otherwise causing little disruption or hardship.

Twin Cities Almanac for April 14th:

The average MSP high temperature for this date is 55 degrees F (plus or minus 11 degrees standard deviation), while the average low is 36 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for April 14th:

MSP weather records for this date include: highest daily maximum temperature of 85 degrees F in 1954; lowest daily maximum temperature of 32 degrees F in 1928; lowest daily minimum temperature of 18 degrees F in 1926 and 1928; highest daily minimum temperature of

57 degrees F in 1976; record precipitation of 1.56 inches in 1983 and record snowfall of 13.6 inches in 1983. There have been eleven measurable snowfalls on this date since 1891. The greatest snow depth on this date is 5 inches in 1949. The coldest windchill conditions were -19 degrees F in 1926.

Average dew point for April 14th is 31 degrees F, with a maximum of 61 degrees F and a minimum of 8 degrees F.

All-time state records for April 14th:

Scanning the state climatic data base: the all-time high for this date is 90 degrees F at Tracy (Lyon County) in 1954; the all-time low is -5 degrees F at Roseau in 1950.

Words of the Week: Four Basic Thunderstorm Types

Thunderstorms occur in a variety of forms, sometimes as an isolated cumulonimbus cloud (anvil shaped), sometimes as a cluster of clouds, sometimes as a squall line, and sometimes as a supercell (massive convective cloud system). The first type is known as a single cell storm usually composed of a convective cloud containing one updraft and one downdraft segment. These may produce some heavy rain, hail, or even a weak tornado, but they are usually short-lived (30 minutes or less). The second type is known as a multicell cluster composed of a group of convective clouds that move together as a single unit. There may be multiple updraft and downdraft segments, highly variable rates of rainfall, and some moderate hail. These systems may last for hours and produce flash flooding or weak tornadoes. The third type is the squall line composed of a line of convective clouds which share a common gust front along the leading edge (sometimes seen as a wall cloud). They can move at rapid speeds and produce heavy rainfall and moderate hail, sometimes resulting in flash flooding. Tornadoes may occur behind the squall line as well. The fourth type of thunderstorm is the most damaging, that is the supercell, which is composed of a system of clouds which rotate as one unit containing imbedded strong updrafts and downdrafts, large hail and frequent lightning. These can produce flooding and moderate to severe tornadoes. They may last for hours and travel across multiple states.

More information about types of thunderstorms can be found at the web site of the University of Illinois Atmospheric Sciences Dept..

[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/svr/type/home.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/svr/type/home.rxml)

Outlook:

Chance of showers and thunderstorms for the weekend across central and southern Minnesota, with a chance of snow in the north. Cooler temperatures for the weekend will be followed by a warmup early next week. Dewpoints and humidity will be on the rise and it will remain windy as it has been most of the month so far. It should be drier to start next week, then another round of precipitation

towards the middle and end of the week, with possibly some thunderstorms in the south.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Apr 21, 2000

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

HAPPY EARTH DAY

Topic: Listening to the rhythm of the falling rain

Meteorologists and climatologists have grappled with the scarcity of data in the tropical regions of the Earth for generations, especially over the vast expanses of tropical oceans. In recent years, satellite systems have improved the detection and estimation of wind fields, temperature and precipitation. In fact over the Indian Ocean and parts of the African continent, researchers and operational weather services rely heavily on satellite derived estimates of precipitation from the European satellite system (Meteosat), rather than a network of rain gages or ship reports. However, these estimates can have large errors and cannot provide good measures of rainfall intensity.

Recently, NASA's Tropical Rainfall Measuring Mission has come up with an acoustical way of measuring rainfall and rainfall intensity. Called the acoustic rain gage, this system makes use of submerged microphones attached to buoys. As it turns out raindrops striking the surface of the ocean are quite noisy and emit two types of sounds, the slapping sound of impact, followed by a ringing sound as air bubbles are trapped underwater by the splash. Small droplets are especially good at trapping air bubbles and therefore produce quite a ringing sound, while larger, high speed droplets make a distinct slapping sound as they strike the water surface. By tuning the instrument to discriminate among the various types of sound and integrate the signal over time, researchers hope to be able to accurately measure total rainfall and rainfall intensity over the oceans. These systems are being tested in the tropical Pacific, the South China Sea and the North Atlantic. It is estimated that more than two-thirds of the rainfall on Earth occurs between 35 degrees north and 35 degrees south latitude, an area of the planet which is inadequately equipped with measurement networks.

Topic: One year anniversary of the May 3rd tornadoes

The tornado outbreak in Oklahoma and Kansas last May was one of the worst of the 20th century. Certainly it was the most costly, with estimated damages and losses exceeding \$1 billion. It was also extensively studied by storm chasers and researchers at the National Severe Storms Laboratory in Norman, OK. Many

mobile units were dispatched to study the storms before they became severe. A mobile Doppler radar measured the highest wind velocity ever recorded as the tornado passed through Grady County, SW of Oklahoma City, with winds of 318 mph. Some of the tornado damage was rated F5 (>261 mph) and some was rated F4 (207-260 mph) around the Oklahoma City area.

Research findings, along with evaluations of community response and recovery will be explored at a special NOAA sponsored national symposium on the Great Plains Tornado Outbreak of May 3, 1999, to be held April 30 to May 3, 2000 at the Westin Hotel in Oklahoma City. One response to this episode has been a massive campaign to get up to 100,000 specially-priced NOAA Weather Radios with built-in alarm systems dispersed to residents, schools, and businesses in and around the Oklahoma City area. This is being coordinated by the National Weather Service and Oklahoma Department of Civil Emergency Management. The goal is to make NOAA weather radios as common as smoke detectors. Statistics show that 85 to 95 percent of Americans can receive NOAA Weather Radio broadcasts through the nationwide network of transmitters, but only 5 to 10 percent actually own one.

More information about NOAA Weather Radio can be found on their web site.....<http://www.nws.noaa.gov/nwr>

Question from an MPR listener: Is the widespread cloudiness and precipitation this week a sign that we are entering a wetter weather pattern for the spring?

Answer: I wish I knew the answer to this one. The official climate outlook for May favors drier than normal conditions, however the short-term outlook to the end of April favors more precipitation than normal. Even the rains this week, however welcome, did not amount to a great deal, as most observers reported 0.25 to 0.75 inches. The accumulated moisture deficits since last fall are much larger, especially in southwestern counties which could use 4 to 6 inches of rainfall to help the soil moisture get back to normal levels.

Twin Cities Almanac for April 21st:

The average MSP high temperature for this date is 59 degrees F (plus or minus 11 degrees standard deviation), while the average low is 38 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for April 21st:

MSP weather records for this date include: highest daily maximum temperature of 95 degrees F in 1980; lowest daily maximum temperature of 34 degrees F in 1893; lowest daily minimum temperature of 22 degrees F in 1966; highest daily minimum temperature of 59 degrees F in 1926; record precipitation of 0.74 inches in 1912 and record snowfall of 4.8 inches in 1972. There have been eight measurable snowfalls on this date since 1891. The greatest snow depth on this

date is 2 inches in 1924. The coldest windchill conditions were 0 degrees F in 1927.

Average dew point for April 21st is 34 degrees F, with a maximum of 60 degrees F and a minimum of 11 degrees F.

All-time state records for April 21st:

Scanning the state climatic data base: the all-time high for this date is 100 degrees F at Montevideo, Ada, and Campbell in 1980; the all-time low is 0 degrees F at Hallock (Kittson County) in 1945.

Words of the Week: Chase Hotel, Dryline Chaser, Meatwagon, White Elephant, StormTracker, U.S.S. Phoenix

As we have suggested in earlier commentaries, storm chasers are in a league of their own when it comes to jargon. These terms have all been used to refer to storm chase vehicles, usually purchased cheaply, then drastically modified to accommodate a variety of instruments and cameras. The Chase Hotel was a 1996 Ford F-150 4X4 pickup. It was not only equipped with special instruments, but it had a sleeping area in back (I guess for the sometimes long waiting periods while severe weather develops). The Dryline Chaser was a 1991 Dodge Caravan, especially equipped with a computer, scanner, ham radio, color TV, camcorder, automated mobile weather station, cellular Internet hookup, and global positioning system. The Meatwagon was a 1986 Pontiac Parisienne station wagon which survived an assault by Hurricane Andrew in Florida. The White Elephant was a 1967 Pontiac Tempest, while the StormTracker was a 1990 Chevy Astro Van with so many antennas hanging out it looked like a porcupine. One of the most economical storm chasing vehicles is the U.S.S. Phoenix, a Honda Civic SI hatchback used to chase storms in South Dakota and Minnesota.

More on the culture and jargon of storm chasers can be found at their web site....

<http://webchat.chatsystems.com/~tornado/vehicles/index.html>

Outlook:

A respite from the cloudiness and precipitation is in store for the Earth Day and Easter weekend. There is only a slight chance of scattered showers on Saturday. We will also begin a warming trend. Temperatures will climb into the 50s and 60s F and remain at or above normal for much of next week. There will be another chance for showers and thunderstorms Tuesday through Friday.

To: Bob Potter, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Apr 28, 2000

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

HAPPY ARBOR DAY

BASED ON THE NOTION THAT ANY CLIMATE AND ANY LANDSCAPE IS IMPROVED BY THE PRESENCE OF TREES

Final Exam for Bob Potter:

Since this is your last day as host of the Morning Edition Program and I have provided you with a weather lesson each Friday for the past 7 1/2 years, I thought it might be time for a final exam.....Just three simple questions.....

1. What is the best instant source of weather information in the state of Minnesota? (Hint: you have to put up with Igor's voice)
2. What is the coldest place in Minnesota? (Hint: a big media event occurred there on Feb 2, 1996, the observer is Kathleen Hoppa)
3. When greeting each other, what is it that Minnesotans are most likely to talk about? (Hint: your expertise on this topic will really come in handy in starting conversations with new clients who come to see you about financial matters)

Topic: Preliminary Climate Summary for April

Despite numerous cloudy and windy days with temperatures well below normal, average temperatures for the month ended up close to normal across the state. This was due primarily to a very sunny and warm finish to the month. Precipitation was generally less than normal around the state, but some significant rains finally came to southwestern counties where the threat of drought has been a major concern. Hopefully additional rainfall is in store for that area during early May.

Topic: Near record dry air on Tuesday, April 25

A dry high pressure system produced some remarkably dry, warm air over the state on Tuesday of this week. Dewpoints fell into the 20s F, with many afternoons high temperatures reaching the 70s F. This put the relative humidity at near record-setting low values, ranging from only 9 to 18 percent in many southern and western areas of the state. Unfortunately this created

high evaporation rates from freshly tilled soils, drying the seedbed too rapidly in some places.

Topic: A Tidal Theory for the Ice Ages

Recent research at the Scripps Institution of Oceanography in La Jolla, CA suggests that the coincidence of strong tidal forces may be a mechanism for triggering an ice age on Earth. Dr. Charles Keeling and Dr. Tim Whorf have put forth a theory that the proper sequencing in the orbits of the Earth, moon, and sun can greatly magnify tidal forces and stir up the colder waters in the ocean, bringing them to the surface and dramatically cooling the Earth. Their theory is based on an alignment of the Earth, sun, and moon, which produces a solar eclipse during the same time that the moon is closest to Earth and that Earth is closest to the sun in their respective orbits. The coincidence of this alignment with these close orbital positions occurs only about once every 1800 years. This last happened about 500 years ago during the Little Ice Age. They point out that no two alignment cycles are precisely alike and that other factors might regulate the ice ages as well.

Question from an MPR listener: I have heard that they have tornadoes in England. Can this be? How many do they have compared, say to the United States

Answer: Yes, indeed. The British Meteorological Office keeps track of the number of tornadoes reported in the United Kingdom each year. Most are rather weak, FO or F1 on the Fujita Scale (winds less than 115 mph) and short-lived, but there have been occasions of serious damage. In 1997 the U.K. reported 33 tornadoes and in 1998 they reported 45. The comparable numbers in the United States were 1148 tornadoes in 1997 and 1417 in 1998.

Twin Cities Almanac for April 28th:

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

MSP Local Records for April 28th:

MSP weather records for this date include: highest daily maximum temperature of 87 degrees F in 1934 and 1952; lowest daily maximum temperature of 34 degrees F in 1907; lowest daily minimum temperature of 26 degrees F in 1907, 1958, and 1965; highest daily minimum temperature of 61 degrees F in 1960; record precipitation of 0.80 inches in 1896 and record snowfall of 4.5 inches in 1907 and 1958. There have been six measurable snowfalls on this date since 1891. The greatest snow depth on this date is 7.5 inches in 1907. The coldest windchill conditions were -4 degrees F in 1907 and 1958.

Average dew point for April 28th is 36 degrees F, with a maximum of 65 degrees F and a minimum of 12 degrees F.

All-time state records for April 28th:

Scanning the state climatic data base: the all-time high for this date is 95 degrees F at Lynd (Lyon County) and Winnebago (Faribault County) in 1910; the all-time low is 8 degrees F at Baudette (Lake of the Words County) in 1909 and at Cass Lake (Cass County) in 1956.

Words of the Week: Chronoanemoisothermal diagram

That's a mouthful, pronounced chrono-anemo-iso-thermal diagram. This refers to a graphic which depicts the average temperature for a given place at all hours of the day for each cardinal wind direction (east, south, west, and north). It is especially helpful in regions where the wind direction has great influence on local temperature such as in a lake district or sea coast.

Outlook:

Generally dry on Saturday, with an increasing chance for rain by Sunday night, and continuing into Monday, especially in northern Minnesota. Temperatures will trend at or above normal into the first week of May, but with lighter winds than experienced in April. There will be another chance for showers by Thursday and Friday of next week.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, May 5, 2000

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

Topic: Farmers and Gardeners Not the Only Ones Wishing for Rain

With most of the crops being planted into relatively dry soil at a record-setting pace, home landscapes being manicured for the planting of annuals, and a high risk of fire danger in many northern counties, rain would be most welcome this weekend. In addition, thousands of Minnesotans who suffer from seasonal allergies are also hoping for rain. The run of warm, dry weather has enhanced the pollen count (especially tree pollen) to remarkably high levels around the state for the past several days, and in some places the mold count has climbed into the moderate category. The tree pollens in most abundance include ash, willow, oak, and birch. The mild winter, early onset of spring, recent strong winds, and the absence of frequent rain showers to cleanse the air of pollen have all contributed to the high counts and high exposure rates this week.

Some ideas for limiting exposure to pollen and molds include: staying indoors, especially during the 5 am to 10 am time period when pollen counts tend to be the highest of the day; shower and change clothes soon after being outdoors to avoid prolonged contact; dry your clothes in the clothes dryer rather than hanging them outside where they can accumulate pollens.

Additional information on air quality and the quantity of allergens in the air can be found in the Health Section of the Weather Channels web site (<http://www.weather.com/health/>) or at the web site of the National Allergy Bureau (<http://www.aaaai.org/nab/>).

Topic: Wine, Weather, and Climate

Based on a recent study of the climatology associated with viticulture, some general climatic optimums for the production of wine grapes have been determined. The ideal mean annual temperature ranges from 57 to 61 degrees F, with a summer monthly maximum of about 72 degrees F and a winter monthly minimum of about 27 degrees F. Required rainfall ranges from 18 to 30 inches, depending on soil type and the distribution of moisture throughout the growing season. Relative high sunshine amounts are required during the ripening process, especially for red grapes. Winter dormancy allows many vines to withstand short period exposures to temperatures as cold as 0 degrees F, but in the spring as the vines begin to produce flower clusters, they can only tolerate temperatures as low as

28 or 29 degrees F without serious damage.

Warmer climates tend to produce wines of a higher sugar content (dessert wines), while cooler climates tend to produce a more crisp, higher acidity product that is made into a dry table wine. Nearly ideal temperature conditions are found in Bordeaux, France, northern Spain, and central and northern Italy. Most wine producing landscapes in the world are located between 30 and 50 degrees latitude in both hemispheres. There are a few in tropical latitudes, such as in Bolivia, Kenya, and Tanzania but they are at higher altitudes where the climate is more favorable. The development of new cultivars, along with the fine tuning of management to fit soil types and microclimatic characteristics (limited exposure to wind, moderation effects of lakes and river valleys, orientation of sloping fields, etc) have allowed growers to expand grape growing to regions that were previously untested for wine production.

In Minnesota, wine production thrives in the Stillwater and Hastings areas of the St Croix and Mississippi River Valleys. Despite climate conditions which are far from optimal in terms of annual and wintertime temperatures, favorable summer temperatures, relatively abundant sunshine and adequate precipitation, along with some friendly microclimatic features allow the production of some very good wines.

Question from an MPR listener: (From faculty colleagues Dr. Jim Luby and Dr. Emily Hoover of the Horticulture Department) What date shows the largest difference between the all-time record high and record low temperature?

Answer: For the Twin Cities, March 1st shows the largest range in temperature with a record high of 59 degrees F in 1990 and a record low of -32 degrees F in 1962, a range of 91 degrees F. In some northern counties there is an even greater range, well over 100 degrees F. For example the March 7th records at Tower in St Louis County are 68 degrees F and -35 degrees F, while those for Hallock in Kittson County on March 23rd at 77 degrees F and -26 degrees F, a range of 103 degrees F. It is not surprising that the widest range in temperature should occur in March. The air is usually drier then and therefore surface heating during the day, and cooling during the night are relatively maximized. In addition, the variability in landscape snow cover is great in March and April and therefore surface heating by the sun can be substantial on a dry, snow-free landscape. Conversely, if the landscape is covered by fresh snow cover in those months and arctic high pressure settles over the state, some extreme low temperatures can be observed.

Twin Cities Almanac for May 5th:

The average MSP high temperature for this date is 67 degrees F (plus or minus 11 degrees standard deviation), while the average low is 45 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for May 5th:

MSP weather records for this date include: highest daily maximum temperature of 88 degrees F in 1909 and 1939; lowest daily maximum temperature of 39 degrees F in 1944; lowest daily minimum temperature of 27 degrees F in 1989; highest daily minimum temperature of 65 degrees F in 1926; record precipitation of 1.84 inches in 1991 and record snowfall of 0.3 inches in 1991. There have been only three measurable snowfalls on this date since 1891.

Average dew point for May 5th is 39 degrees F, with a maximum of 68 degrees F and a minimum of 16 degrees F.

All-time state records for May 5th:

Scanning the state climatic data base: the all-time high for this date is 97 degrees F at Angus (Polk County) and Argyle (Marshall County) in 1926; the all-time low is 12 degrees F at Tower (St Louis County) in 1900 and again at Cass Lake (Cass County) in 1967.

Words of the Week: Gustiness factor

Not much used anymore, this term was used to describe the variability in the wind conditions, based on short temporal measurements of wind gusts. It was more precisely defined as the ratio of the range in wind gusts (maximum minus minimum) divided by the mean wind speed. For example, the wind gusts during the 3 pm hour on Wednesday of this week in the Twin Cities ranged from a 30 mph maximum speed down to 6 mph minimum speed and the mean wind speed for the hour was 24 mph. The ratio was $24/24$ which equals a gustiness factor of 100 percent. This is not uncommon in the spring. This measurement used to be routinely reported from airports in order to alert pilots about significant wind variation that might affect their approach and take-off.

Outlook:

A cooling trend is on the way for the weekend, with increasing cloudiness and chances for showers and thunderstorms. Temperatures will be closer to normal next week with increased cloudiness and some chance for showers just about everyday, particularly toward the end of the week.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, May 12, 2000

The following will be posted as WeatherTalk on the University of Minnesota Climatology Working Group web site (<http://www.climate.umn.edu>), also accessible through the Morning Edition section of Minnesota Public Radio's web site: (<http://news.mpr.org/programs/morninged>).

Topic: An Anniversary for Balloon Measurements of the Atmosphere

This past Tuesday (May 9th) marked the 138th anniversary of the famous balloon ascents of British scientists James Glaisher and Henry Coxwell. They made 18 ascents in a gas filled balloon, the first of which was on May 9, 1862. They were the first to carry meteorological instruments aloft to make measurements of the character of the atmosphere. They established that nocturnal inversions were common and that lapse rate (change in temperature with altitude) can vary dramatically. They read their instruments on night ascents by wearing miner's lamps (the balloon was filled with highly combustible hydrogen!). In one famous ascent to an altitude of 30,000 ft, Glaisher lost consciousness and Coxwell, who was groggy and had numb, frozen hands, still found a way to pull the valve-cord hard enough with his teeth so that enough gas was released to allow them to descend back to Earth.

Topic: Flash Flooding in Missouri

This past Sunday torrential rainfalls in east central Missouri produced damaging flash floods in areas west and south of St Louis. Jefferson and Franklin Counties recorded 6 to 14 inches of rainfall in a period of 8 hours. This exceeds the maximum rainfall rate calculated for a 100 year return period, which in the Missouri area is about 7 inches. In fact the highest recorded rainfall for a single day in the state of Missouri is 18.18 inches which fell at Edgerton, MO on July 20, 1965. The Missouri storm had many attributes similar to those of the storm that dumped 10 inches over an 8 hour period on the Twin Cities back on July 23, 1987. Dewpoints were extremely high, indicating large quantities of water vapor, and the convective clouds kept regenerating over the same part of the landscape.

Topic: Urban Effects on Climate

By now most people might be familiar with the so-called urban heat island effect. This is brought about by the heat stored during the day by buildings and pavements. The effect of this heat storage is most pronounced during the night, when the central city area can be as much as 10 degrees F warmer than the surrounding suburbs. The effect was first reported in a study of London by Luke

Howard in 1820.

Another urban effect which is evident now that we are finally receiving measurable amounts of rainfall is the higher and faster peak in surface run-off. The sloped and paved surfaces of the city promote rapid discharge of rainfall through the drainage system. There are less vegetated land areas to absorb the moisture. Conversely, in the rural landscape, especially now where the soils have been recently tilled, rainfall is readily absorbed and little run-off is generated. It was often said by former State Climatologist Earl Kuehnast that the soil has the first mortgage on rainfall. After it has been recharged, then the ditches, streams and rivers will receive the surplus. Given how dry the soils have been this spring, it is not surprising that even relatively heavy amounts of rainfall generate little run-off in the rural landscape.

To keep updated on the dry conditions around the state and how people are coping with the associated problems listeners can go to the University of Minnesota Extension Service web site.....

<http://www.extension.umn.edu/>

Question from an MPR listener: I remember the last time the Twin Cities measured a May snowfall was in 1991. Is that a rare occurrence?

Answer: Relatively rare. The Twin Cities climate record back to 1891 shows that in 36 years May brought at least a trace of snowfall. That is about one third of the time. Some years brought more than one day in the month with snowfall, such as May 1924 and May 1935 when snow was measured on four separate days. In northern Minnesota, places like International Falls see at least a trace or more of snowfall in May with a frequency of about one year out of two.

Twin Cities Almanac for May 12th:

The average MSP high temperature for this date is 67 degrees F (plus or minus 10 degrees standard deviation), while the average low is 46 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for May 12th:

MSP weather records for this date include: highest daily maximum temperature of 90 degrees F in 1900 and 1961; lowest daily maximum temperature of 44 degrees F in 1953; lowest daily minimum temperature of 28 degrees F in 1946; highest daily minimum temperature of 62 degrees F in 1896 and 1944; record precipitation of 1.52 inches in 1906 and record snowfall of 0.2 inches in 1946. There have been only two measurable snowfalls on this date since 1891.

Average dew point for May 12th is 40 degrees F, with a maximum of 67 degrees F and a minimum of 10 degrees F.

All-time state records for May 12th:

Scanning the state climatic data base: the all-time high for this date is 98 degrees F at Hallock (Kittson County) in 1900; the all-time low is 11 degrees at Hallock in 1946.

Words of the Week: Lapse rate

This refers to the rate of change in an atmospheric property with altitude. The property of the atmosphere most often referred to is temperature. Most often during the day, temperature decreases with altitude, however the rate of change per thousand feet can be highly variable and is a measure of atmospheric stability. When there is a rapid decrease of temperature with height, the atmosphere is said to be unstable. This will enhance convection and may lead to clouds and thunderstorms. During the night, the temperature of the air may increase with height (called an inversion), indicating a high degree of atmospheric stability.

Outlook:

Chance of showers in the north and west Saturday, possibly lingering into early Sunday. The weekend will generally be quite cool, with some lows in the 30s F and highs in the 50s F. Partly cloudy skies early next week with a warming trend. Increasing chances for showers and thunderstorms by midweek.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, May 19, 2000

The following will be posted as WeatherTalk on the University of Minnesota Climatology Working Group web site (<http://www.climate.umn.edu>), also accessible through the Morning Edition section of Minnesota Public Radio's web site: (<http://news.mpr.org/programs/morninged>).

Topic: The consequences of this week's weather

The past six days have brought frost, wind, hail, and flash flooding to various parts of the state.....perhaps more like Minnesota spring seasons we remember from the past. The most significant consequence of this by far is the moisture recharge for our dry Minnesota soils. Rains on Monday and again on Wednesday and Thursday brought much needed moisture to many areas where crops are emerging and starting to send down roots. This was a special blessing to southwestern Minnesota counties which have been experiencing a prolonged dry spell since last summer. The University of Minnesota Southwest Experiment Station in Lamberton (Redwood County) had reported the lowest ever stored soil moisture on May 1st (2.72 inches in the 5 ft profile), but as recently as May 15th this had risen to 3.43 inches. Since this time an additional 2.25 inches of rainfall has occurred further raising soil moisture levels there.

The most abundant rain (and hail) occurred across southern Minnesota, with parts of Fillmore, Mower, Freeborn, Faribault, Olmsted, and Waseca counties reporting 4 to 6 inch amounts. The Austin and La Crosse areas experienced some flooding as a result of these heavy rains. In addition some areas reported 3/4 to 1 inch hail which may have temporarily damaged some emerging crops. Though some crops may have suffered leaf damage due to hail, they will likely recover with the return of warm temperatures. For southern Minnesota hay producers, the rains this week prevented the first cutting of alfalfa, and they will have to wait until the weekend to get started. The northern counties missed out on the significant rains this week, so the fire danger was not much alleviated there.

Frost in western and southern Minnesota counties affected some newly emerged crops last Sunday morning. Temperatures as low as 28 degrees were reported in some areas. But damage was not expected to be serious or permanent, as both corn and soybeans are capable of generating new vegetative growth to replace the frosted plant tissue.

Some relatively strong winds this week helped to enhance migration of insects from the south into Minnesota. Potato leafhoppers and cutworm moths are two species that may have been dispersed further across the landscape by these winds. Crop producers will

likely begin scouting fields for their presence.

And lastly for the homeowner.....it will be time to get out and cut the lawn this weekend after all that rain!

Topic: New Monthly and Seasonal Climate Outlooks

The NOAA Climate Prediction Center released the new monthly and seasonal climate outlooks on Thursday of this week. They call for above normal temperature and near normal rainfall during June in Minnesota. For the June through August period higher than normal temperatures and less than normal rainfall are expected, based at least in part on the widespread distribution of dry soils throughout the region. However the continuation of a wet pattern for the balance of May and into early June may sufficiently wet the Minnesota landscape and cause some deviation from this expected pattern.

At any rate, the agricultural commodity markets are likely to remain quite weather sensitive for some time due to the threat of drought throughout the primary growing regions.

Question from an MPR listener: How much does a cloud weigh?

Answer: Actually, this is a question I have been asked many times and I recently came across an answer in Weatherwise magazine. Meteorologist Thomas Schlatter from NOAA responded to this question with some simple calculations. He estimated the liquid water content of a cumulus cloud to be about 0.2 grams/cubic meter and then estimated the cloud volume to be about 1 cubic km (approximately one quarter of a cubic mile), which is a relatively small cumulus cloud. A computation of the mass of water contained in this cloud yields 200,000 kilograms or 440,000 pounds of water, enough to fill a large residential swimming pool. Most of these water droplets in the cloud are so small, that minor updrafts are sufficient to keep them suspended in the air for long periods of time.

Twin Cities Almanac for May 19th:

The average MSP high temperature for this date is 69 degrees F (plus or minus 11 degrees standard deviation), while the average low is 49 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for May 19th:

MSP weather records for this date include: highest daily maximum temperature of 89 degrees F in 1977 and 1978; lowest daily maximum temperature of 43 degrees F in 1971; lowest daily minimum temperature of 33 degrees F in 1961; highest daily minimum temperature of 64 degrees F in 1977; record precipitation of 0.99 inches in 1925 and record snowfall of 0.2 inches in 1971. There have been only three snowfalls on this date, occurring in 1892, 1924, and 1971.

Average dew point for May 19th is 45 degrees F, with a maximum of 65 degrees F and a minimum of 20 degrees F.

All-time state records for May 19th:

Scanning the state climatic data base: the all-time high for this date is 104 degrees F at Redwood Falls in 1934; the all-time low is 17 degrees F at Roseau in 1924.

Words of the Week: Windrow and Winnow

Since many Minnesota farmers are currently waiting for the first opportunity to cut hay, these verbs are both equally applicable. To windrow a crop is to rake or cut it such that you leave ridges or rows lying along the field in a parallel fashion and oriented perpendicular to the prevailing wind. This facilitates drying before baling, stacking and storing are done. To winnow a crop is to use the wind to help separate the chaff from the grain, or the stems from the leaves. During the harvest season, the person doing this task was called a winnower.

Outlook:

Generally fair weather will prevail early on Saturday. Increasing cloudiness late Saturday with a chance for showers and thunderstorms. Sunday will bring an increasing chance for showers to northern counties, perhaps lingering into Monday. Generally drier on Tuesday and Wednesday with a warming trend. A return to unsettled weather for Thursday and Friday with more showers and thunderstorms in the area.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, May 26, 2000

Topic: May frosts

An early agricultural season normally produces good results in the absence of late spring frosts. The early plantings and green-up this spring exposed many plants to frost damage and unfortunately frosts did occur around the state on May 14th (Mother's Day) and again on May 19. The May 19th date saw St Cloud tie its low temperature record of 28 degrees F for the date, and Princeton went down to 23 degrees F, setting a new record low in that area. Most row crops have bounced back from that damage, and it is expected that potato crops and strawberries may recover too, but their yields may not be as high as they might have been otherwise.

Topic: Urban trees: How much soil volume do they need?

This was the question asked by researchers from New York in a recent study presented at the American Meteorological Society's 12th Annual Conference on Applied Climatology earlier this month. Historically, urban foresters have blamed inadequate soil volume for the premature death of container trees or those planted in limited boulevard areas surrounded by pavement. New procedures to estimate required soil volume to sustain trees in the urban environment were developed by these scientists. These procedures consider tree species and dimensions (crown diameter); soil water holding capacity; and annual climatic data. The climatic data are used to estimate the soil moisture recharge by precipitation, as well as compute the daily and seasonal water use by the tree. Stressful soil water deficits due to inadequate precipitation are computed for recurrence intervals of 1/10 years, 1/20 years and 1/40 years using the frequency distributions in local climatological data. Thus, researchers could determine the maximum soil moisture deficit that occurs every 40 years and factor this into consideration of soil volume requirement to sustain the health of the tree through such a stressful period.

The results show that all factors studied have an effect on the required minimum soil volume, but the tree crown diameter and the recurrence interval for soil moisture deficit seem to have the most pronounced effects. For example, a tree with a crown diameter of 28 ft will require 20 times the soil volume (nearly 10 cubic meters) of a tree with a crown diameter of 7 ft (which needs only about 0.5 cubic meters of soil). This difference is magnified even more if the desire is to plant a tree in a soil volume which would allow it to withstand a precipitation deficit of a magnitude that occurs only once every 40 years. All of this assumes no supplementary watering, where tree longevity is solely based on rainfed conditions. In urban areas with poor quality soils, there is an even larger increase in the minimum soil volume required to sustain a healthy

tree over many decades of climate variability. In some cases, depending on tree size, up to 20 cubic meters of soil volume might be required. The researchers also point out that their method has value in determining the maximum size tree which a predetermined soil volume can support.

They hope that arborists, landscape designers and city planners will utilize their methods in making decisions about the future planting of trees in the urban landscape.

Topic: Up on the Roof

During the infancy of the National Weather Service in the late 19th century, observational networks were established and maintained by the U.S. Army Signal Service. Guidelines were quite stringent for locating instruments in suitable exposures, maintaining and calibrating instruments and filing reports. Failure to perform duties using these guidelines was not tolerated. Sergeants and corporals who failed to adhere to these guidelines were reduced in rank to first-class privates, while first-class privates were reduced to second-class for similar violations.

One of the exposure guidelines advocated for decades was to place the instruments (primarily thermometers and rain gages) on the rooftop of a tall building. This was indeed the case for the Twin Cities climate record as it shows rooftop placement of instruments on the U.S. Court House Building in Minneapolis (Marquette and 3rd St) from November of 1890 to April of 1938. This location essentially measured the climate 105 ft above street level. In addition, even when the Weather Service moved to the MSP airport location, rooftop readings were made from the 1930s until nearly 1960 at elevations that ranged from 30 to 40 ft above ground level.

So what are the consequences of these rooftop measurements? A number of studies have shown that temperature records kept for such locations are consistently higher than those kept near the ground. Some studies show average differences of 1 or 2 degrees F, while other studies show differences of several degrees, especially where overnight inversions are quite common, or where the radiative properties of the building produce a great deal of heat storage and reradiation which affects the air temperature. In all cases, rooftop readings are warmer than those taken in standard exposures 5 ft above the ground. This means that in climate change detection studies and forecast verification studies researchers must be careful to correct for observations that are based on rooftop measurements. It is interesting to note that in the private sector and various school systems around the country there is a marked increase in the number of rooftop measurements, likely producing a positive temperature bias in their reports.

Question from an MPR listener: Hurricane Aletta in the eastern Pacific off the west coast of Mexico was in the news this week. Isn't this early in the season for hurricanes?

Answer: Quite right, especially a category 2 hurricane like Aletta (with winds from 96-105 mph). Since 1949 there have been only three other hurricanes that formed off the west coast of Mexico during the month of May, and only Adolph in 1983 reached category 3 status briefly. The eastern Pacific hurricane season (starting on May 15th) is a bit longer than the one in the Atlantic Ocean. The waters of the eastern Pacific are warm right now and may contribute to maintaining Aletta's strength and perhaps the formation of another tropical storm. The next name on the list is Bud....

Twin Cities Almanac for May 26th:

The average MSP high temperature for this date is 71 degrees F (plus or minus 10 degrees standard deviation), while the average low is 52 degrees F (plus or minus 8 degrees standard deviation).

MSP Local Records for May 26th:

MSP weather records for this date include: highest daily maximum temperature of 94 degrees F in 1978; lowest daily maximum temperature of 45 degrees F in 1906; lowest daily minimum temperature of 34 degrees F in 1992; highest daily minimum temperature of 72 degrees F in 1911; record precipitation of 1.31 inches in 1906 and no snowfall ever on this date.

Average dew point for May 26th is 47 degrees F, with a maximum of 69 degrees F and a minimum of 28 degrees F.

All-time state records for May 26th:

Scanning the state climatic data base: the all-time high for this date is 103 degrees F at Tracy (Lyon County) in 1914; the all-time low is 20 degrees F at Cook (St Louis County) in 1961.

Words of the Week: Cyclostyle Map

In the late 19th century many Army Signal Corps Offices produced a daily weather map for posting in the local telegraph or railway office and for duplication by the local newspaper. The cyclostyle consisted of a box containing a bed-plate covered with zinc which showed an outline map of the United States, an inking board, roller, pen, ink vial, and paper. Station data were plotted on the map by hand showing temperature, pressure, and wind. Then a dotting pen was used to trace lines through equal values, much like the modern computer generated synoptic weather maps you see on the Internet today. These hand generated maps required an artistic touch to create.

Outlook:

Good chance of showers and thunderstorms on Saturday, perhaps lingering into Sunday in southern and eastern portions of the state. Temperatures will be a few degrees cooler than normal then warm on Monday through Thursday to about normal levels. There will be an

increasing chance for showers and thunderstorms to return by next
Wednesday and Thursday.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, June 2, 2000

Topic: May Climate Summary

The two most striking weather features of May in Minnesota were the frosts on the 14th and 19th (following an early spring and planting season) and the abundant rainfall in the southern part of the state. Most crops have apparently recovered from the frosts. The heaviest rainfall was in the southern counties where it was uniformly wetter than normal, with anywhere from 12 to 16 days of measurable rain. Rainfall was generally less than normal in northern counties, and mixed (above and below normal) in the central part of the state. Following the pattern of April, May temperatures averaged out to be quite close to the 30 year average in most places.

Southwestern Minnesota had previously been listed in the Severe Drought category by the Drought Mitigation Center as the month started. Stored soil moisture was estimated to be at an all-time low for May 1st. However, starting the 2nd week of May, rains began to occur fairly frequently. It was the wettest month since June of 1999 and broke a string of ten consecutive drier than normal months for the area.

The current drought assessment by the USDA shows no drought areas in the state, primarily thanks to the soil moisture recharge provided by the abundant rainfall. Some of the totals for May were impressive.....

Jackson 9.23 inches Tyler 8 inches Lakefield 6 inches
Lamberton 6.5 inches New Ulm 8 inches Rochester 7.37 inches

Topic: Wet Start to June

The early morning hours of Thursday June 1st saw some flash flooding occur in southeastern Minnesota, especially Olmsted, Fillmore, Freeborn, and Mower Counties. Four to six inch rains fell in less than six hours, producing large volumes of runoff. Interstate 90 was closed for a time near Austin, MN due to high water over the pavement. Harmony (Fillmore County) and La Crescent (Houston County) reported nearly 5.75 inches rain which is more than their average total for the entire month of June. Other reports included.....

Chatfield 5.23 in. Lanesboro 4.03 in. Preston 4.12 in.
Rochester 4.95 in. Wells 3.60 in. Owatonna 2.95 in.

As a result the Root River and Upper Iowa River rose dramatically, forcing some campers to evacuate.

Topic: Unusual Snow Storm in the Northwest

The last day of May brought an unusual snowfall to parts of Oregon and Montana this week. Both Umatilla, along the Columbia River Basin and Meachem near Pendleton in northern Oregon reported measurable snowfalls. At higher elevations up to 18 inches of new snow was measured in Oregon. In Montana, Great Falls with weather records dating back to 1893, reported only the second ever snowfall on May 31st, a new record amount of 3.4 inches. Butte also reported snowfall, though not a record amount.

Question from an MPR listener: How often are weather satellites replaced and are they critical to the mission of the National Weather Service?

Answer: Weather satellites are very critical to the mission of the National Weather Service as they provide continuous imaging of the North American continent in the visible, infrared and water vapor spectral bands. The Geosynchronous Satellites in orbiting positions over the 75 degree W (GOES-8) and 135 degrees W (GOES-10) bands of longitude have been designed for 5 to 10 year lifecycles. Sometimes the sensors give out and sometimes the power supply gives out. The oldest one in orbit is GOES-8 (eastern U.S. view) launched in 1994. GOES-9 (central U.S. view) was launched in 1995 and GOES-10 (western U.S. view) was placed in orbit in 1997. GOES-11 is scheduled to be launched in May of 2001 and set in an orbit midway between GOES-8 and GOES-10. These satellites are part of the GOES-NEXT project funded by Congress in the 1990s as part of the Modernization of the National Weather Service.

Twin Cities Almanac for June 2nd:

The average MSP high temperature for this date is 74 degrees F (plus or minus 9 degrees standard deviation), while the average low is 53 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for June 2nd:

MSP weather records for this date include: highest daily maximum temperature of 93 degrees F in 1940; lowest daily maximum temperature of 44 degrees F in 1945; lowest daily minimum temperature of 35 degrees F in 1946; highest daily minimum temperature of 70 degrees F in 1923; record precipitation of 2.00 inches in 1897.

Average dew point for June 2nd is 48 degrees F, with a maximum of 70 degrees F and a minimum of 29 degrees F.

All-time state records for June 2nd:

Scanning the state climatic data base: the all-time high for this date is 105 degrees F at Fairmont (Martin County) and New Ulm

(Brown County) in 1934; the all-time low is 24 degrees F at Wannaska (Roseau County) in 1982 and at Tower (St Louis County) in 1986 and 1993.

Words of the Week: Loaded Gun Sounding

This is an atmospheric sounding (profile measurement by instrumented balloon) which shows extreme instability (rapid loss of temperature with height) that is contained by a cap (inversion aloft) layer several thousand feet about the ground. Explosive thunderstorm development would occur if the cap is weakened or removed perhaps by surface heating later in the day. This occurs during the spring and summer in the plains states (including MN) and sometimes results in the rapid development of heavy thunderstorms late in the afternoon or early evening when the cap is removed and the warm humid air at the surface is free to rise vertically to form the conspicuous anvil shaped thunderheads.

Outlook:

Partly cloudy skies over the weekend with a chance for showers in western and central Minnesota Saturday night into Sunday. Generally dry elsewhere. A warming trend will begin early next week producing above normal temperatures by the middle of the week. A return to 80 degrees F will be common in central and southern Minnesota by the end of the week with a chance for showers and thunderstorms, especially in western counties.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, June 9, 2000

Topic: The Emerging Field of Paleotempestology

As the economic consequences of severe weather continue to escalate, the insurance industry has begun to fund more research into an examination of the frequency and severity of specific events such as the landfall of hurricanes. Recent estimates indicate that the landfall of class 4 or class 5 hurricanes along the Atlantic or Gulf Coast states could result easily in losses of tens of billions of dollars. Adequate historical documentation of hurricanes in the United States exists for only about the past 150 years. This gives a rather small statistical sample when it comes to the landfall of class 4 or class 5 hurricanes (sustained winds of 131 mph or greater). Fewer than a dozen have struck the United States in the past 100 years.

Recently scientists have perfected methods to study the sediments of coastal inland lakes and determine when significant hurricane storm surges caused a layer of sand to be deposited. Using this geological evidence they hope to reconstruct the historical frequency of hurricane landfalls back in time for several millenia. This has already been done for some of the Gulf coast states, showing a varying temporal distribution of hurricanes for the past 3,500 years. This research field is called paleotempestology, taken from the Greek term paleo meaning ancient and the Latin word tempest meaning storm. Some of the data indicate that over 1000 years ago, intense hurricanes struck the Gulf coast four to five times more often than they do now, probably under a different global climate regime. Sorting out what kind of climate would produce such a change in the frequency of hurricanes remains a very big and complicated challenge as current global climate computer models give different answers.

Incidentally, the current outlook for the Atlantic hurricane season favors a greater than normal number of storms this season. Dr William Gray's predictions call for 12 named storms and 8 that will reach hurricane status.

Topic: Detecting Forest Fires and Wildland Fires by Satellite

So far this month forest and wildland fires have been reported in several states including Utah, Arizona, New Mexico, Colorado and Florida. In Florida alone over 3000 fires have been reported since January.

The Global Fire Monitoring Center, which is part of the United Nation's International Strategy for Disaster Reduction collaborates with a number of government agencies to keep up to date with forest and wildland fires over the entire globe. Near real-time

fire data, analysis and satellite images on available over their web site.....

<http://www.ruf.uni-freiburg.de/fireglobe/welcome.html>

Some of the current fires they are assessing are found in Russia, Australia, western Canada, Brazil, and Southeast Asia, all of which can be seen in satellite images.

Topic: Abundant Moisture in England This Spring

We have focused recently on the abundant rainfall this spring in southern Minnesota. However other places in the northern hemisphere are having a wet spring as well. Parts of central China reported torrential rainfalls, which caused mudslides and flooding earlier this month. Similarly, heavy thunderstorms in late May produced flooding and mudslides in parts of Guatemala.

England and Wales have been drenched since the beginning of April when record amounts of rainfall occurred. Four to six inches of rain fell in most places during April, breaking some records for the month which dated back as far as 1782.

Question from an MPR listener: The Weatherguide calendar shows that in July there will be two new moons, one on the 1st and one on the 30th. Since the second full moon of a month is referred to as the Blue Moon, is there an equivalent expression for the second new moon of a month?

Answer: To my knowledge there is no common expression for the second new moon of a month. Perhaps we should propose one. I guess it should not be surprising that this is the case. After all, a full moon is rather conspicuous, in fact hard to miss in the absence of cloud cover. Conversely, the new moon phase is when the moon's unilluminated side faces Earth and it is not detectable unless there is a solar eclipse, so who would care as much about this condition?

You can find a wealth of information on moon phases at the U.S. Naval Observatory web site, including a discussion about the different definitions of a Blue Moon.....

<http://aa.usno.navy.mil/AA/>

Twin Cities Almanac for June 9th:

The average MSP high temperature for this date is 75 degrees F (plus or minus 8 degrees standard deviation), while the average low is 56 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for June 9th:

MSP weather records for this date include: highest daily maximum temperature of 95 degrees F in 1911, 1973, and 1976; lowest daily

maximum temperature of 56 degrees F in 1908 and 1998; lowest daily minimum temperature of 39 degrees F in 1915; highest daily minimum temperature of 73 degrees F in 1959; record precipitation of 2.33 inches in 1927.

Average dew point for June 9th is 52 degrees F, with a maximum of 74 degrees F and a minimum of 23 degrees F.

All-time state records for June 9th:

Scanning the state climatic data base: the all-time high for this date is 102 degrees F at Faribault, Albert Lea, Zumbrota, Waseca, Mankato, Owatonna, and St James in 1985; the all-time low is 24 degrees F at Roseau in 1915.

Word of the Week: LEDWI

This is a National Weather Service acronym which stands for Light Emitting Diode Weather Identifier. It is a sensor used by the Automated Weather Observation System to detect the present weather. Detection of changes in the optical properties of the air between two emitting diodes gives an indication of present weather type, rain or snow for example. Combined with other measures such as temperature, dewpoint, and visibility the system then interprets and reports a variety of other weather types including fog, freezing rain, mist, haze, and blowing snow.

Outlook:

Chance of showers and thunderstorms over the weekend, possible heavy showers in some areas, especially north and central. Showers may linger into Monday and Tuesday in central and southern areas. There will be a sharp drop in temperatures by Sunday which will carryover into much of next week, when daily temperatures will be slightly either side of the seasonal normals. Continued chance for scattered showers toward the end of the week.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, June 16, 2000

Topic: Records Temperatures Continue in June

Following record cold temperatures on June 5th (as low as 22 F at Tower) and record warm temperatures on June 8th and 9th (as high as 101 degrees F at Redwood Falls), June 10th and 11th produced record cold in the Arrowhead region of the state primarily as a result of cloudiness and easterly winds off of Lake Superior. The following locations reported all-time record cold daytime temperatures for June 11th....(June 10th report at Duluth)

Duluth 46 F Grand Marais 42 F Cloquet 43 F
Ely-Winton 47 F Crane Lake 52 F Grand Rapids 46 F

Additional record-setting low temperatures may occur in the north again this weekend before returning to more seasonal like conditions by the middle of next week.

Topic: Record-setting rains in the Red River Valley

Having suffered through a dry spring, with stunted crops and crusting soils, eastern North Dakota and Northwestern Minnesota received large amounts of rainfall on Monday, Tuesday, and Wednesday of this week. Several locations reported between 2 and 4 inches, and a few places west and north of Grand Forks reported over 10 inches. The weather observer at Larimore in western Grand Forks County reported 17 inches of rainfall over 12 hours on Monday and Tuesday. This is very likely an all-time North Dakota record for a single storm. The average annual precipitation at Larimore is only 19.5 inches, so essentially a year's worth of rainfall occurred in a 12 hour period. This is over double the maximum expected 100 year rainfall event for the area. Such heavy rainfalls produced significant rises in area rivers. The Turtle River rose as much as ten feet.

Topic: History of Weather Operations at MSP Airport

The National Weather Service originally evolved from the U.S. Army Signal Corps operations in the second half of the 19th century. In 1890 an act of Congress established the "Weather Bureau" as a part of the U.S. Department of Agriculture, with a mission to serve the information needs of the nation's farmers. This it did very well. As commercial aviation began to develop following World War I, more attention was given to servicing the weather information needs of pilots. The Air Commerce Act passed by Congress in

1926 modified the mission statement of the Weather Bureau, stating...."it shall be the duty of the.. Weather Bureau to furnish such weather reports, forecasts, warnings, and advices as may be required to promote the safety and efficiency of air navigation in the United States and above the high seas...and to establish (additional) meteorological offices and stations to do so.." There were no airport weather stations in the U.S. in 1926, but by 1930 there were 50, and today there are hundreds. By 1940, the old Weather Bureau was transferred out of the Department of Agriculture to the Department of Commerce, with a primary mission to serve aviation.

Weather Bureau operations were established at the old Wold-Chamberlain Field in January of 1934. For a time in the 1930s simultaneous observations were made on the rooftop at the airfield administration building and on the rooftop of the U.S. Courthouse in downtown Minneapolis. The airfield, later name the MSP International Airport, because the official Twin Cities Weather Office in 1937. Rooftop readings of observations continued until 1960 when instruments were moved closer to the ground and just off the airport runway. Though the National Weather Service Forecast Office left the MSP Airport in 1996 to relocate in Chanhassen, an Automated Surface Observation System continues to report the weather from the airport. It is located on the west end of the runways, just east of Cedar Avenue. Observations of snowfall, and snow water equivalence have been moved to Chanhassen, but other conditions like temperature, wind, cloud cover, visibility, and humidity are still officially reported from MSP airport, and primarily serve the interest of commercial aviation. But, I like to think that from a historical preservation viewpoint, it is perfectly fitting that observations should continue at MSP airport near the confluence of the Minnesota and Mississippi Rivers, where the very first weather observations in Minnesota were made back in 1819 with the establishment of old Fort Snelling.

Question from an MPR listener: What a wet June! Many places in southern Minnesota have already received six to eight inches of rainfall, and Rochester has already exceeded 10 inches for just the first half of the month. What is the record amount of rainfall for the month of June?

Answer: For Rochester, MN the record rainfall for June stands at 11.95 inches which occurred in 1914. The largest amount ever for southeastern Minnesota was probably the 14.5 inches which fell at Grand Meadow in 1914. So, Rochester may be on a pace to break such a record this month.

Twin Cities Almanac for June 16th:

The average MSP high temperature for this date is 78 degrees F (plus or minus 8 degrees standard deviation), while the average low is 58 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for June 16th:

MSP weather records for this date include: highest daily maximum temperature of 97 degrees F in 1933; lowest daily maximum temperature of 60 degrees F in 1972; lowest daily minimum temperature of 43 degrees F in 1961; highest daily minimum temperature of 72 degrees F in 1933; record precipitation of 2.16 inches in 1935.

Average dew point for June 16th is 54 degrees F, with a maximum of 73 degrees F and a minimum of 32 degrees F.

All-time state records for June 16th:

Scanning the state climatic data base: the all-time high for this date is 106 degrees F at Beardsley (Big Stone County) in 1933; the all-time low is 23 degrees F at Embarrass in 1999.

Words of the Week: Nacreous clouds

A rarely seen cloud form which exists in the stratosphere at altitudes up to 18 miles above the Earth's surface. They resemble cirrus clouds and are thought to be composed of ice crystals or supercooled water droplets. They may show iridescence when viewed before dawn or after sunset as they are illuminated by the sun against a relatively dark sky. They appear to stand still as does a wave cloud over a mountain. Sometimes they are referred to as "mother of pearl clouds" because of their soft, pearly luster. In fact 'nacre' is a french term for mother of pearl.

Outlook:

A cool weekend ahead with a chance for scattered light showers. Near record cold temperatures for Saturday morning are likely. Grandma's Marathon runners will find a cool, cloudy start, with perhaps a chance for light showers or mist and temperatures in the 40s to low 50s. Similarly, those attending the street rod and classic car show at the MN State Fair Grounds this weekend may need to bundle up. A warming trend will start Monday, with a chance for rainfall by Tuesday and Wednesday.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, June 30, 2000

Topic: Preliminary Climate Summary for June

Most observers in the state reported below normal average temperature for the month of June. This was the first time the state was uniformly colder than normal for any month since October of 1999. June temperatures generally ranged from 2 to 4 degrees F cooler than normal. Extremes were 101 degrees F at Lamberton and Redwood Falls on the 8th, and a chilly 22 degrees F at Tower on the 5th.

Rainfall during June was generally adequate and close to normal in many areas. The wettest areas were in northwestern and southeastern counties. Some communities recorded all-time record amounts of rainfall. The list below shows some of the wettest locations in June....(values in inches)

Rochester 12.84 new record, surpassing 11.95 in 1914
Fargo-Moorhead 11.72 new record
Preston 11.76 new record
Harmony 10.71 2nd most ever
Caledonia 10.13 3rd most ever
Winona 8.29 5th wettest June
Waseca 8.11 5th wettest June
Wabasha 8.58 7th wettest June

Waseca reported a total rainfall for May and June of 14.40 inches, a new record amount for the two month period.

Topic: Record Low Temperatures on June 29th

Clear skies and cool high pressure produced record low temperatures in northern Minnesota on June 29th. The locations below reported record lows between 4 am and 6 am.

Orr 33 F
Ely 42 F (tied record)
Eveleth 37 F
International Falls 38 F
Cambridge 43 F
Bigfork 39 F
Tower 28 F
Embarrass 30 F

Topic: Relatively Quiet Severe Weather Season So Far

Though rainfall was abundant in many places this June, there were not many severe thunderstorm warnings issued. However, there were numerous days with strong winds, peaking over 40 mph in many places, and over 50 mph in the Red River Valley.

The Storm Prediction Center reports that a total of 604 tornadoes have been reported in the United States this year, through the end of June. This is the smallest number for the January through June period since the drought year of 1988 when there were only 302.

Question from an MPR listener: What has been the hottest spell of weather in June?

Answer: The hottest week ever in this month was June 24-30 in 1931. At Canby in western Minnesota, the average high was 103 degrees F and the average low was 76 degrees F, giving a mean temperature of 90 F for the week. There was little relief from the heat even at night, as the overnight lows remained in the 80s over the last four nights of that month, peaking at 87 degrees F the night of June 28-29, the warmest night in the Minnesota climate record.

Twin Cities Almanac for June 30th:

The average MSP high temperature for this date is 82 degrees F (plus or minus 9 degrees standard deviation), while the average low is 62 degrees F (plus or minus 7 degrees standard deviation).

MSP Local Records for June 30th:

MSP weather records for this date include: highest daily maximum temperature of 100 degrees F in 1931; lowest daily maximum temperature of 56 degrees F in 1959; lowest daily minimum temperature of 47 degrees F in 1892; highest daily minimum temperature of 82 degrees F in 1931; record precipitation of 1.56 inches in 1978. The highest Heat Index values on this date were 108 to 114 degrees F in 1921, 1931, and 1949. All produced heat stress related deaths in the Twin Cities.

Average dew point for June 30th is 58 degrees F, with a maximum of 76 degrees F and a minimum of 36 degrees F.

All-time state records for June 30th:

Scanning the state climatic data base: the all-time high for this date is 109 degrees F at Canby (Yellow Medicine County) in 1931; the all-time low is 27 degrees F at Tower in 1982.

Word of the Week: DECTALK

This is the computer-based text-to-speech technology employed by the National Weather Service to broadcast messages over NOAA Weather Radio. It was developed by the Digital Equipment Corp. With this technology, computer generated text, such as storm warnings or updated forecasts are immediately broadcast over NOAA transmitters. The current voice used is nicknamed Igor, but there are female sounding voices available as well. This

technology saves considerable time since meteorologists used to have to record the audio message, then load it for transmission on the weather radio. There are now over 540 NOAA weather radio transmitters scattered across the United States which broadcast with DECTALK.

For years, this technology has been used for assisted living and to help those who are physically challenged. In fact, the renowned British physicist and cosmologist Professor Stephen Hawking, who is afflicted with ALS and motor neuron disease, uses DECTALK as his speaking voice. His only complaint is that the computer generated voice has an American accent.

Outlook:

Partly cloudy with warmer temperatures for the weekend. A chance for scattered showers and thunderstorms Saturday then a more widespread chance for showers on Sunday and Monday. Daily temperatures will be near normal or a little warmer for next week. Dewpoints will be much higher than of late. Chance of showers on the 4th of July and again Thursday and Friday.

To: Perry Finelli, Jim Bickal, Julie Siple, and Eugene Cha
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, July 21, 2000

Topic: A Cold Week in July

Tuesday of this week was one for the record books.....the coldest July 18th in Minnesota history..at least based on daytime temperatures. Dozens of communities across southern and central Minnesota recorded daytime highs that were only in the 50s to low 60s F. Persistent cloudiness, accompanied by occasional cold rain, and cool northeasterly winds kept temperatures down all day long. A friend of mine observed an Indiana family, visiting the Minnesota western lakes district for a mid summer vacation. They were in the local Pamida store buying up all the warm clothing they could find.

MSP airport reported a record tying low of 52 degrees F on Tuesday and recorded a high of only 60 degrees F, breaking the old record cold high of 64 F in 1911. Other locations setting records on that date (July 18th) were....

New record cold maximum temperatures on July 18th:

Brainerd	54 F	Cloquet	59 F
Blaine	57 F	Cambridge	52 F
Aitkin	55 F	Willmar	60 F
Winona	60 F	Grand Marais	54 F
Pine River Dam	55 F	Rush City	57 F
Moose Lake	59 F	Faribault	59 F
Owatonna	61 F	St. Cloud	57 F
Alexandria	54 F	Redwood Falls	58 F
Albert Lea	63 F	Appleton	57 F
Hutchinson	57 F	Glenwood	55 F
Litchfield	55 F	Mankato	57 F
Montevideo	57 F	Morris	54 F (coldest ever in July)
New Ulm	57 F	Red Wing	55 F
St. James	63 F	Mora	57 F
Madison	57 F	Little Falls	55 F

In addition, the morning of July 19th brought record low minimum temperatures to the north, where Tower reported 29 degrees F and Embarrass 31 degrees F. Temperatures for the week have been averaging between 10 and 20 degrees F colder than normal.

Topic: Atmospheric Trivia

The total weight of the Earth's atmosphere is by no means a constant value. In fact, it varies with the seasons plus or minus over 1000 kilograms. Why? Because the total atmospheric water vapor content varies. The global maximum in water vapor content occurs during the northern hemisphere summer (Now),

when larger quantities are released from the majority of the Earth's land surface.

Question from an MPR listener: What are the coldest maximum and minimum temperatures ever recorded in the state of Minnesota during July?

Answer: Based on a scan of the state climate data base the coldest daily maximum temperature ever was 47 F at Two Harbors on July 2, 1992. The coldest ever minimum temperature was 24 degrees F at Tower on July 7, 1997. The respective records for the Twin Cities are 58 degrees F maximum temperature on July 4, 1967 and a 43 F minimum on July 4, 1972.

Twin Cities Almanac for July 21st:

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

MSP Local Records for July 21st:

MSP weather records for this date include: highest daily maximum temperature of 105 degrees F in 1934; lowest daily maximum temperature of 69 degrees F in 1927 and 1947; lowest daily minimum temperature of 49 degrees F in 1947; highest daily minimum temperature of 79 degrees F in 1983; record precipitation of 1.36 inches in 1951. The highest Heat Index values on this date was 108 degrees F in 1983.

Average dew point for July 21st is 61 degrees F, with a maximum of 78 degrees F and a minimum of 40 degrees F.

All-time state records for July 21st:

Scanning the state climatic data base: the all-time high for this date is 113 degrees F at Milan (Chippewa County) in 1934; the all-time low is 36 degrees F at Tower in 1973.

Word of the Week: Ci-gulls

Since Luke Howard first developed his naming convention for cloud types (early 1800s) other keen observers of the sky have come up with a variety of cloud names: mare's tail, scarf cloud, mackerel sky, street clouds, etc. Stanley Gedzelman in a recent Weatherwise article has come up with a new name for a high level winged formation of cloud. He calls it ci-gull, derived from the words cirrus (the high, wispy clouds composed of ice crystals) and the winged formation, shaped like a soaring seagull. These clouds show evidence of high wind speeds aloft and may even be detectors of the jet stream.

Outlook:

Mostly dry and pleasant on Saturday and Sunday, increasing clouds in the northwest by Monday with a chance for showers. A chance for more widespread showers and thunderstorms Tuesday and Wednesday. Somewhat warmer next week with temperatures trending toward normal, and even above normal by the end of the week.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, July 28, 2000

Topic: Anniversary this weekend of two very uncomfortable days

The all-time high temperature for tomorrow's date (July 29) is 114.5 degrees F at Beardsley (Big Stone County) in 1917. This also represents the state maximum temperature record. It was perhaps the hottest day ever in parts of western and northern Minnesota. While Beardsley reported a high of 114.5 degrees F, other reports included 106 F at Bagley, 108 F at Fergus Falls, 110 F at Moorhead, 109 F at Red Lake, 108 F at Thief River Falls, even 102 degrees F at Lake Winnibigoshish on the headwaters of the Mississippi. It was also a very humid period with overnight lows staying in the low to mid 70s F, but the National Weather Service did not report Heat Index values (combined effects of temperature and humidity) back then.

July 29-30 of 1999 will be remembered as one of the most uncomfortable periods in Minnesota history. Dewpoints in the mid to upper 70's were prevalent across the state, with many locations in southern Minnesota reaching values exceeding 80 degrees.

At 1100 AM on July 30 the dewpoint temperature at the Twin Cities International Airport reached 81 degrees F, the highest dewpoint temperature ever recorded in the Twin Cities area. The previous records 80 degrees, recorded just eight days earlier. The high dewpoint temperatures, in conjunction with sweltering air temperatures in the mid to upper 90's, combined to produce heat index values exceeding 110 degrees in many southern Minnesota communities. Heat index values in excess of 105 degrees are considered to be dangerous. Faribault in southern Minnesota reached a heat index value of 124 F last July 30th, while the Twin Cities reached 115 degrees F HI value (the highest heat index value ever recorded in the Twin Cities is believed to be 119 degrees, occurring on July 11, 1966).

MPR listener question: What is the so-called urban heat island and how is it detectable in and around the Twin Cities?

Answer:

The noted climatologist Helmut Landsberg was one of the first to use this term and describe how the development of an urban area modifies the local environment. Urban areas host a higher concentration of atmospheric pollutants, present rougher surface terrain which affects wind fields, and are composed of different surface materials which affect heat storage and convection. The following table summarizes some of the observed effects of urban heat islands.

Elements Comparison with Rural Environment

Cloud cover	5 to 10 percent greater
Fog, winter	100 percent more
Fog, summer	30 percent more
Precipitation	5 to 10 percent more
Snowfall	5 percent less
Rain days with less than .02 in.	10 percent more
Relative humidity, winter	2 percent less
Relative humidity, summer	8 percent less
Solar radiation	15 to 20 percent less
Ultraviolet radiation, winter	30 percent less
Ultraviolet radiation, summer	5 percent less
Duration of sunshine	5 to 15 percent less
Pollutants	
Solid particles	10 times more
Gases	5 to 25 times more
Mean annual temperature	0.5 to 1.0 degrees C
Annual heating degree days	10 percent fewer
Annual mean wind speed	20 to 30 percent less
Frequency of calms	5 to 20 percent more

Some local effects related to the urban heat island of the Twin Cities are: Longer frost free growing season, 15 to 25 days longer than in the surrounding rural areas of Anoka, Scott, Carver and Dakota counties. Earlier green-up of lawns and gardens in the spring. Later freeze up in the fall of local area lakes than in surrounding rural counties. Average wind speeds that are 10 to 20 percent less than in surrounding rural areas. Generally higher average temperatures and less heating degree days are evident in the Twin Cities when compared with surrounding rural areas. Average precipitation is peculiar because MSP airport values appear to be less than those of the suburban communities surrounding the Twin Cities downtown areas. This was first noted in a 1973 study by Don Baker of the Department of Soil, Water, and Climate and then State Climatologist Earl Kuehnast who reported on the spatial distribution of rainfall in the Metro area. Of course using a single rain gage to report the precipitation climatology of an urban area is not wise, since it will likely underestimate the total precipitation in the area.

Almanac: Average maximum temperature locally for today's date is 83 (plus or minus 7 degrees standard deviation) and the average minimum is 63 (plus or minus 6 degrees standard deviation).

MSP records for today's date include: a maximum temperature of 100 degrees in 1955; a minimum temperature of 50 degrees in 1981; and record precipitation of 1.36 inches in 1951.

Scanning the state climatic data base: the all-time high for today's date is 113 degrees F at Beardsley (Big Stone County) in 1917 (after a morning low of 51 degrees F!); the all-time low is

33 degrees at Tower (St Louis County) in 1979. The interesting thing about Beardsley is that this town holds the all-time high temperature record for Minnesota, 114.5 degrees F on July 29, 1917, yet earlier that same month (July 2 and 3) they reported overnight lows in the upper 30s with ground frosts throughout the countryside.

Average dew point temperature for today is 61 degrees F. The highest dew point on this date is 76 degrees, while the lowest is 42 degrees. Mean dew point temperatures start to decline now as we move into August.

Words of the Week: Sunshine Recorder

This is an instrument used by weather services throughout the world to record the duration of sunshine (hours and minutes) without regard to intensity. European countries typically use a Campbell-Stokes sunshine recorder which is composed of a spherical lens mounted on an exposed mast. The lens burns an image of the sun onto a specially prepared card which has a time scale on it. The Marvin sunshine recorder has been used more commonly in the United States. It consists of two bulbs, one blackened and one clear, which are connected by a glass tube filled with mercury. When exposed to sunlight, the blackened bulb warms more readily than the clear one, as the air expands it forces the mercury to move through the glass connecting tube and to trip electrical contact points which start a pen trace on a chronograph (paper graph with time increments on it).

Some National Weather Service Forecast Offices continue to measure the hours and minutes of sunshine each day, along with percent possible sunshine when evaluated in the context of daylength.

Outlook: A somewhat unsettled period of weather coming up with temperatures near normal and scattered showers and thunderstorms, particularly across southern sections.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Aug 4, 2000

Topic: Preliminary Climate Summary for July 2000

For the third consecutive month most observers reported above normal rainfall, with the exception of some northern Minnesota counties. Several communities, including the Twin Cities, reported over 6 inches of rain for the month of July. Rosemount in Dakota County reported 9.07 inches of rainfall, the third wettest July in the historical record. Of course much of that fell during the wet weekend of July 7-10 when flash flooding caused serious property damage in Dakota County, especially in and around the Eagan community. Southeastern Eagan reported over 11 inches of rainfall.

Average temperatures for the month of July were slightly colder than normal, following the trend of June. The exception was in parts of northwestern Minnesota which saw temperatures from 1 to 2 degrees F warmer than normal. Record setting cool temperatures occurred on July 18th and 19th. Over three dozen communities registered record cold daytime highs on the 18th, many remaining in the 50s F all day long. The following morning, on the 19th, both Tower and Embarrass set new low temperature records falling to 29 and 31 degrees F, respectively.

July 25-26 brought severe weather to parts of western Minnesota, including hail, severe thunderstorm winds and tornadoes. Granite Falls was hit by an F-4 tornado (wind speeds in excess of 207 mph) on the evening of the 25th. It cut a path 500 ft wide and two miles long through a residential area, causing widespread serious damage. This was the first F-4 tornado in Minnesota since the March 29, 1998 outbreak which hit Comfrey and St Peter.

MPR listener question: Has there ever been an F-4 tornado in Hennepin or Ramsey County?

Answer: Yes, indeed. According to a compilation of tornado reports since 1880 by Thomas Grazulis, there have been four occurrences of F-4 tornadoes in Hennepin and Ramsey Counties, the most recent of which was May 6, 1965. In fact on this date two separate F-4 tornadoes occurred within a hour of each other resulting in the greatest damages ever seen from a weather event in the Twin Cities area. The towns of Fridley, Mounds View, and Golden Valley were especially hard hit.

Other F-4 tornadoes occurred on April 5, 1929 starting near Lake Minnetonka and ending by Forest Lake; June 18, 1939 plucking the feathers out of chickens near Maple Grove; and June 19, 1951 through Brooklyn Center and Fridley.

Twin Cities Almanac for August 4th:

The average MSP high temperature for this date is 83 degrees F (plus or minus 8 degrees standard deviation), while the average low is 62 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for August 4th:

MSP weather records for this date include: highest daily maximum temperature of 102 degrees F in 1947; lowest daily maximum temperature of 64 degrees F in 1915 and 1952; lowest daily minimum temperature of 48 degrees F in 1978; highest daily minimum temperature of 76 degrees F in 1947; record precipitation of 2.65 inches in 1941. Highest Heat Index value (combination of temperature and humidity) 109 degrees F in 1947.

Average dew point for August 4th is 59 degrees F, with a maximum of 74 degrees F and a minimum of 41 degrees F.

All-time state records for August 4th:

Scanning the state climatic data base: the all-time high for this date is 106 degrees F at Beardsley (Big Stone County) in 1947; the all-time low is 29 degrees F at Tower (St Louis County) in 1972.

Words of the Week: Moist Tongue

This term is used by meteorologists to describe an extension or protrusion of humid air into a region of relatively dry air, often at some elevation above the surface. A moist tongue of air may provide just enough additional water vapor to trigger cloudiness and precipitation from an otherwise dry air mass. This is sometimes the case for isolated thunderstorm development.

Outlook:

Chance of showers and thunderstorms late Friday and into early Monday around the state. Best chances will be on Saturday and Sunday, especially in northern counties. Temperatures should remain near seasonal normals for much of the week ahead, gradually warming toward the end of next week. Another chance for showers and thunderstorms by Wednesday through Friday of next week.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Aug 11, 2000

Topic: Meteorology and the Wildfires in the Western States

Ever since the May 4th controlled burn near Las Alamos, NM which rapidly developed into an uncontrolled wildfire, many of the western states have been plagued by a high frequency of fires. So far this year over 64,000 fires have occurred in western states burning over 4 million acres of land, primarily in New Mexico, Arizona, Colorado, Nevada, Idaho, Utah, and Montana. Meteorologically, the fire season has been provoked by drought conditions throughout the months of May, June, and July along with very low dewpoints, extremely high temperatures, and many dry lightning strikes. Dewpoints as low as the 20s and 30s F were even observed earlier this week in Montana, Idaho, and Nevada. Combined with the high temperatures in the 80s and 90s F, the resulting relative humidities were only in the single digits up to 20 percent in many places.

While the threat of drought has eased for the midwest this summer, it has intensified over the west where many states are in severe or extreme drought (by the Palmer Drought Index). It would appear that the weather pattern may be changing as the jet stream has shifted to a more southwesterly flow which will bring water vapor from the warmer Pacific Ocean near the Baja Peninsula more abundantly across the western states. This will help raise the dewpoints and humidity, as well as provide a chance for more frequent precipitation in the weeks ahead.

Topic: The weather-proof Nebraska Soddy

Early pioneer settlers in Nebraska dotted the landscape with many homes made out of sod. Lacking timber resources, pioneers would cut strips of sod from the native prairie grasses using a plough-like blade called a sodbreaker. The ribbons or bricks of sod would be stacked to form walls. Because the native buffalo grass and big blue stem grass had such intertwined root systems, then tended to reinforce the brick structure and last for many years. A few timbers were often used to reinforce the roof.

The thick walled structures with few windows were well adapted to the climate of the prairie. They would tend to stay cooler than the outside air in the summer, and warmer than the outside air in the winter. In addition, they were very strong and even provided protection from tornadoes. The roof and walls would readily absorb precipitation, preventing leakage to the interior. Sometimes flowers would even be planted in the roof! The National Sod House Society promotes the preservation of sod houses in many of the prairie states and there is a Sod House Museum in Gothenburg, NE.

Topic: A Bizarre Art Form

I read recently about a man in England who made huge snowballs (up to 10 ft in diameter) from the winter snow fields in the Scottish Highlands. In the spring, he then trucked them to some of the public parks in the London area and put them on display as melting art work. Children liked to draw on the surface of the giant snowballs or grab a handful and have a snowball fight. The moderate climate of the London area allowed the giant snowballs to survive for over two weeks.

MPR listener question: Is the UV Index and forecast still being used and who invented it?

Answer: Yes, the Climate Prediction Center of the National Weather Service still puts out a daily UV forecast each day at 2 pm Eastern Time, scaled to warn the public about exposures to ultraviolet radiation. Values of 7 or higher require some exposure precautions to avoid sunburn, etc.

Meteorologists for Environment Canada invented the UV index.

Twin Cities Almanac for August 11th:

The average MSP high temperature for this date is 80 degrees F (plus or minus 7 degrees standard deviation), while the average low is 60 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for August 11th:

MSP weather records for this date include: highest daily maximum temperature of 97 degrees F in 1947; lowest daily maximum temperature of 65 degrees F in 1964; lowest daily minimum temperature of 47 degrees F in 1968; highest daily minimum temperature of 77 degrees F in 1947; record precipitation of 1.19 inches in 1900. Highest Heat Index value (combination of temperature and humidity) 103 degrees F in 1947.

Average dew point for August 11th is 57 degrees F, with a maximum of 73 degrees F and a minimum of 33 degrees F.

All-time state records for August 11th:

Scanning the state climatic data base: the all-time high for this date is 104 degrees F at Montevideo (Chippewa County) in 1988; the all-time low is 28 degrees F at Tower (St Louis County) in 1997.

Words of the Week: birainy, belg, and meher

These terms are used to describe equatorial (tropical) climates which have two rainy seasons. Either side of the equator, generally between 12 degrees S and 12 degrees N, the rainy seasons are associated with the high sun, on or near the spring

and fall equinoxes. This is said to be a birainy climate, meaning double rainy season (not to be confused with birainy cuisine, which is a whole different meaning). The short rainy season in the Horn of Africa is associated with the spring equinox, on or about March 20th when the sun is directly over the equator. This season is called the belg. The longer rainy season associated with the fall equinox, on or about September 20th is called the meher. For many equatorial countries, agricultural production is dependent on both rainy seasons, as two different crops are raised. Parts of Ethiopia and Kenya have suffered from prolonged drought this year, partially as a result of the failure of the usual belg season rainfall.

Outlook:

Mostly dry, warm and sticky Saturday, with increasing cloudiness on Sunday and a chance for showers and thunderstorms continuing into Monday. Temperatures will remain at or above seasonal normals for much of next week, with another chance for showers by Thursday.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Aug 18, 2000

Topic: The "Sunday Effect"

This term was coined in the 1970s by atmospheric chemists who found that air quality in urban areas seemed to have a distinctive pattern based on day of the week. Best air quality tended to occur with higher frequency on Sundays (when traffic and industrial activity was relatively minimal), and the worst occurred on Wednesdays (during the peak of the work week). Further studies have found that there are also patterns of sunshine, temperature and precipitation that may be correlated to day of the week as well. A recent study in England (Wilby and Tomlinson in *Weather*, July, 2000) showed the highest frequency of sunny days in the winter falls on Sunday and the lowest frequency on Wednesday, though this pattern is less evident since the U.K Clean Air Act of 1968.

Studies of temperature and precipitation patterns associated with day of the week have produced mixed results. Some cities show lower precipitation on Sundays and higher precipitation during mid-week. However, a recent study by Cerveny and Balling (*Nature* 394, 1998) showed increased weekend rainfalls in the coastal northwest Atlantic as a result of advection of air pollutants from the inland areas during the work week.

To satisfy your curiosity, here are the frequencies of measurable precipitation by day of the week for selected cities in our region so far in the year 2000 (through August 17th)

Number of days with measurable precipitation Jan 1 to Aug 17, 2000

City	Day of the Week							Total Days with Precip
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	
MSP	11	11	16	15	4	10	14	81
Duluth	11	9	18	13	12	11	10	84
St Cloud	7	10	17	11	5	8	14	72
Rochester	13	15	15	11	10	11	13	88
International Falls	9	9	15	11	12	14	8	78
La Crosse (WI)	14	11	13	13	9	10	14	84
Sioux Falls (SD)	5	6	12	9	6	11	11	60
Fargo (ND)	13	15	17	13	9	9	6	82

The only ones showing a potential "Sunday Effect" are Fargo and International Falls. Actually most show a higher frequency in mid week precipitation. The Twin Cities shows a remarkable absence of precipitation on Fridays (perhaps the best day to golf!). But of course no conclusions can be drawn from such a limited set of data.

Topic: The Tornado and Severe Storm of August 20, 1904

This Sunday marks the anniversary of a remarkably destructive storm which passed through both Minneapolis and St Paul in 1904. It is thought that this storm started near Aberdeen, SD about 6pm as what is now known as a mesoscale convective system or cluster of thunderstorms. Later the storm intensified over Renville County and moved east through McLeod, Carver, Hennepin, Ramsey and Washington Counties. Severe damages occurred in Glencoe, Waconia, Excelsior, St Louis Park, Hopkins, Minneapolis, St Paul, and Stillwater. It was estimated that as much as \$1.5 million in damages occurred, with 15 storm related fatalities. Anemometers at the Weather Bureau in downtown St Paul registered wind gusts up to 110 mph, while an unofficial anemometer on the roof of the Pioneer Press building registered winds of 180 mph before it blew away.

The storm peaked after sunset, between 8:30 and 10:00 pm, and rainfall was so intense, over an inch per hour, that observations about the character of the storm are not conclusive. No funnel was observed in the Twin Cities, but some of the damages provide evidence of tornadic-like winds. In fact some evidence in the Waconia area and the destruction of portions of the High Bridge in St Paul, indicate perhaps an F-4 tornado (winds of 207 mph or higher). Greenish-yellow clouds and hailstones were reported. A total of 2.56 inches of rainfall occurred over 24 hours in St Paul, with 1.23 inches coming in only 35 minutes. The evening dewpoint in St Paul was a sultry 70 degrees F.

Being a Saturday night, patrons of the Tivoli and Empire Theaters in St Paul became alarmed and sought shelter in nearby stone buildings as glass windows broke and roofs were torn off. It took Northwestern Telephone Company over a week to restore phone service to 7000 customers.

MPR listener question: I have heard that hurricanes cannot form until the sea surface temperatures reach 79 degrees F. Is this true, and what is the current temperature in the Gulf of Mexico?

Answer: The threshold of ocean temperatures of at least 79 degrees F has long been considered a criteria for hurricane development, though it is not absolute, as other factors can significantly contribute to the development of such a storm. (Even the Madden-Julian convective oscillation in the western Pacific Ocean has a correlation to hurricane activity) Currently, Gulf of Mexico surface temperatures range from 82 to 88 degrees F, while western Atlantic temperatures range from 79 degrees F to 83 degrees F. So, from that standpoint conditions are ripe for hurricane development to occur. Tropical Storm Alberto, born August 5th in the Atlantic is now the longest lived tropical storm in the Atlantic during the month of August, primarily as a result of the warm sea surface temperatures. Other factors can equally control the formation of tropical storms and hurricanes, including development of low

pressure systems, strong convection, and the absence of vertical wind shear. The most active time for tropical storm formation in the Gulf of Mexico and North Atlantic is from now until October.

Twin Cities Almanac for August 18th:

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

MSP Local Records for August 18th:

MSP weather records for this date include: highest daily maximum temperature of 98 degrees F in 1976; lowest daily maximum temperature of 62 degrees F in 1924; lowest daily minimum temperature of 41 degrees F in 1977; highest daily minimum temperature of 77 degrees F in 1916; record precipitation of 2.26 inches in 1907. Highest Heat Index value (combination of temperature and humidity) 108 degrees F in 1995.

Average dew point for August 18th is 59 degrees F, with a maximum of 75 degrees F and a minimum of 37 degrees F.

All-time state records for August 18th:

Scanning the state climatic data base: the all-time high for this date is 107 degrees F at Browns Valley (Traverse County) in 1976; the all-time low is 24 degrees F at Tower (St Louis County) in 1975.

Words of the Week: Turkey Tower

This is the name given to a tall, narrow cumulus cloud that develops and falls apart rapidly. It often occurs when convective updrafts suddenly break through a cap layer (inversion) of warm air aloft. I assume that the name is derived from their sometimes turkey-like appearance.

Outlook:

The trend for below normal temperatures will continue throughout the weekend and into early next week. There will be a chance for showers and thunderstorms later on Sunday through Tuesday with a warming trend towards the end of next week.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Aug 25, 2000

Topic: Estimating cloud height in the summer

During hot and sunny summer afternoons it is common for cumulus clouds to form in Minnesota as a result of convective updrafts from heated air at the surface. When the lower atmosphere is well mixed by modest wind speeds, the height of the cumulus cloud base can simply be estimated by determining the difference between the surface air temperature and dewpoint depression (in degrees F), and then multiplying by 228. This gives an estimate of the cloud height in hundreds of feet. Because conditions must be well-mixed with adequate surface heating, this formula does not work at night or early in the morning hours.

I tested this formula [$228(T_a - T_d)$] on several days this past week, at a number of locations around Minnesota, and it seems to work pretty well after 11 am and before sunset.

Topic: 90th Anniversary of the Big BlowUp

In the middle of one of the driest years of the 20th Century, perhaps the worst ever wild fires in United States history took place on August 20-21 of 1910. Drought had plagued the high plains and western states for much of the year, with an early spring and exceptionally high temperatures, 80s and 90s F as early as March. July and early August had been unusually dry. Wildfires peaked the week of August 21st, scorching over 3 million acres in Montana, Idaho, and Washington. Smoke from the fires was detected all the way across the northern tier of states to New York. The same Bitterroot range of mountains that has been burning this month in Montana, was on fire back then. The end came in 1910 when the weather turned suddenly fall like on August 23, bringing rain and snow to the western region.

The 1910 fires provoked Congress to initiate fire fighting and suppression programs which allowed many forests to grow more dense in the absence of periodic uncontrolled fires. This proved to be a mistake, corrected at least partially in the 1970s by a program that allowed controlled burns. Fire suppression and control policies and strategies are still being debated today, especially in light of the worst wild fires in many decades, aggravated once again by widespread drought in the western states.

Topic: Freak Storm in England

Freak storms are those which suddenly appear without being forecasted, or those whose character is out of season (snow in May or September for example). Sometimes freak storms present weird combinations of conditions that are very unusual indeed. Such was the case earlier

this week in Yorkshire, Lincolnshire and Wales in the United Kingdom. Torrential rains, frequent lightning strikes, hail, snow, and even a tornado appeared from the same storm system. Up to eight inches of hail piled up on sidewalks and streets. A tornado passed over the Humber Estuary and became a spectacular water spout near Hull. Flash flooding occurred in parts of Wales. Many residents commented that they had never seen a summer storm like this one.

MPR listener question: Does the average relative humidity increase in August? It seems like during my trips to the State Fair I always feel the humidity more.

Answer: Actually, average water vapor content decreases during the month of August (as measured by a slow drop in average daily dewpoints), but afternoon relative humidity rises. How is this so? Average afternoon temperatures decline during the month of August at a faster rate than the average dewpoints decline. Therefore, the afternoon relative humidity (which is related to the difference between air temperature and dewpoint) actually increases.

Twin Cities Almanac for August 25th:

The average MSP high temperature for this date is 79 degrees F (plus or minus 8 degrees standard deviation), while the average low is 59 degrees F (plus or minus 6 degrees standard deviation).

MSP Local Records for August 25th:

MSP weather records for this date include: highest daily maximum temperature of 94 degrees F in 1948; lowest daily maximum temperature of 60 degrees F in 1958; lowest daily minimum temperature of 46 degrees F in 1958; highest daily minimum temperature of 74 degrees F in 1948; record precipitation of 1.51 inches in 1960. Highest Heat Index value (combination of temperature and humidity) 102 degrees F in 1948.

Average dew point for August 25th is 58 degrees F, with a maximum of 74 degrees F and a minimum of 41 degrees F.

All-time state records for August 25th:

Scanning the state climatic data base: the all-time high for this date is 100 degrees F at Beardsley in 1912, at Winona in 1949, and at Hallock in 1976; the all-time low is 26 degrees F at Tower (St Louis County) in 1897 and 1977.

Word of the Week: IMET

This is a National Weather Service acronym for Incident Meteorologist. What is an incident meteorologist? These are forecasters who are specially trained to provide detailed weather forecasts and advisories for incidents which may have particularly disastrous consequences, such as wild fires and forest fires, chemical spills or gas leaks. IMETs are trained to use portable weather stations and computers

to download satellite, radar, and forecast information on the site of the incident. They also do their own atmospheric soundings (radiosondes) and account for local terrain effects when making their local forecasts. There are currently 47 trained IMETs employed by the National Weather Service, some of whom are on duty in the western states helping to fight the wild fires this month.

Outlook:

Warmer than normal temperatures this weekend, with a chance for showers and thunderstorms in central and southern counties. Somewhat cooler by Tuesday with near normal temperatures and a chance for showers in the north. Only widely scattered showers for the remainder of the week with near normal temperatures heading into the Labor Day weekend.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Sep 1, 2000

Topic: Preliminary Climate Summary for August

The climate summary for August in Minnesota shows that temperatures averaged from 1 to 2 degrees F warmer than normal. Extremes around the state ranged from a high of 95 degrees F in the Moorhead area on the 14th, to lows in the mid 30s F in northern Minnesota on the 10th. A number of sultry days were recorded with dewpoint temperatures above 70 degrees F on the 1st, 12th, 13th, 28th, 30th, and 31st of the month.

Rainfall was generally below normal for the month with some exceptions. Some northern counties received above normal rainfall amounts which caused some disease problems with crops. Isolated heavy thunderstorms also brought some excessive amounts to some areas of southern Minnesota, notably Springfield, Winnebago, Preston, Wabasha and Rochester, all of which reported over 5 inches for the month. In fact, Rochester continues to set an all-time record for summer rainfall. The total for the months of May through August is 30.70 inches, breaking the record for the same period set in 1990 of 27.38 inches.

August was also a windy month, with occasional gusts over 40 mph.

Topic: Anniversaries for the Hinckley Fire and Largest Hailstone

On this date in 1894 one of the worst fire tragedies in Minnesota history occurred. Following an extremely dry, hot summer (temperatures as high as 110 F in July), prairie and forest fires become common in late August. On September 1st a fire started near Lake Mille Lacs and spread east, turning into a rapidly moving firestorm it destroyed the towns of Hinckley and Sandstone, as well as 500 square miles of forest. Over 400 lives were lost. Smoke plumes obstructed visibility on Lake Superior.

On September 3rd, 1970 the largest ever hailstone fell from a severe thunderstorm over Coffeyville, KS. The stone was 17.5 inches in circumference and weighed two pounds. Many other stones ranging from 5 to 8 inches in diameter were gathered from this storm. It must have taken extremely strong updrafts to keep these hailstones in the cloud system until they achieved such size.

MPR listener question: I heard you say that there has never been a measured snowfall in the month of August in Minnesota. What about September?

Answer: There have been measurable snowfalls in September, though they are very rare. There were only four in the Twin Cities during the 20th century (two in 1942, one each in 1961 and 1985). Traces of snowfall or snow flurries which melted when they hit

the ground occurred in 1908, 1916, 1927, 1928, 1945, 1951, and 1972. The earliest observation of snow flurries was on September 15, 1916.

Up north, September snows are a bit more common, though still rare. International Falls for example recorded a measurable snowfall in September at least a dozen times in the 20th century, the earliest in the month being September 14, 1964. In 1942, they recorded snow on five consecutive days in September.

Twin Cities Almanac for September 1st:

The average MSP high temperature for today's date is 78 degrees F (plus or minus 9 degrees standard deviation) and the average low is 58 degrees F (plus or minus 8 degrees standard deviation).

MSP records for today's date include: highest daily maximum temperature of 97 degrees in 1913; lowest daily maximum temperature of 59 degrees F in 1951; lowest daily minimum temperature of 36 degrees F in 1974; highest daily minimum temperature of 74 degrees F in 1937; and record precipitation of 1.05 inches in 1926. The highest Heat Index on this date was 103 degrees F in 1953.

All-time state records for September 1st:

Scanning the state climatic data base: the all-time high for today's date is 101 degrees F at Beardsley and Winona in 1913, and then at Tracy in 1922; the all-time low is 23 degrees F at Tower in 1974, and again in 1994.

Average dew point temperature for today is 56 degrees F. The highest dew point on this date is 75 degrees, while the lowest is 30 degrees.

Words of the Week: Orthodox conditions

Record-setting weather measurements and events are viewed with a critical eye by the meteorological community. New highs, new lows, record rainfall or snowfall, record wind speeds, and other elements are carefully scrutinized before they are accepted as official. One of the requirements is that the measurement or observation must meet the criteria of orthodox conditions. That is the observation or measurement must meet certain instrumental, exposure, or observational standards. A new temperature record must be measured by a standard instrument (thermometer or thermistor) that is shielded from the direct effects of the sun, while a new rainfall record must come from an official rain gage. Thus, orthodox conditions implies that the measurement or observation has complied with standard procedures.

Outlook:

A mixture of weather for the weekend, with cooler temperatures in

the north and warm, humid conditions in the south. Chance of showers and thunderstorms north and west and Saturday, and more widely scattered Sunday. Labor Day will bring a chance for showers in the north and southeast. Cooler by Tuesday and Wednesday, but still a few degrees above normal. Another chance for showers in southern counties by Wednesday through Friday.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Sep 8, 2000

Reminder: Saturday, September 9th from 9 am to noon the National Weather Service Forecast Office in Chanhassen, MN will host their annual open house. This is a great time to visit the Weather Service to see the new technologies deployed in weather forecasting. There will be some prizes given away and an instrumented balloon launch about noon.

Topic: 100 Yr and 50 Yr Anniversaries of Significant Hurricanes

One hundred years ago today (Sept 8, 1900) Galveston, TX was destroyed by a hurricane, perhaps one of the worst weather disasters in United States history. Over 6000 people lost their lives, mostly from drowning as a 20 ft storm surge inundated the city accompanied by 120 mph winds. Recovery included the construction of a 16 ft sea wall and the raising of city buildings by 10 to 17 ft above sea level. Galveston has been hit by other hurricanes since 1900, but none have inflicted the same damages as this one did. A more complete description of the 1900 hurricane can be found at a NOAA web site....

<http://www.noaanews.noaa.gov/stories/s496.htm>

Fifty years ago last Tuesday (Sept 5, 1950) Hurricane Easy went up along the west coast of Florida and stalled out over Yankeetown west of Ocala. There over a period of 24 hours, nearly 39 inches (38.7) of rainfall was recorded. That was a record 24 hour amount in the United States for nearly 30 years. On July 25-26, 1979 Tropical Storm Claudette stalled over Alvin Texas, south of Houston and deposited 43 inches of rainfall, setting the current 24 hour record amount for the United States.

Topic: Tropical Storm Fatalities Analyzed

Hurricanes and tropical storms have historically plagued the Gulf Coast states and the Atlantic seaboard, causing some of the greatest loss of life and property among all natural disasters. Public perception of these storm types has lead us to believe that most of the threat to life and property is associated with the high winds, coastal tidal surge, frequent lightning strikes and even associated tornadoes. However, this appears to be a false perception.

A recent article in the Bulletin of the American Meteorological Society by Dr. Edward Rappaport of the National Hurricane Center reveals that most of the fatalities associated with tropical storms striking the United States are due to inland flooding. From a total of 600 reported fatalities since 1970, fully 82 percent have been associated with inland flooding from heavy rainfall. Only 12 percent were wind related and 4 percent linked to the occurrence of tornadoes.

Dozens of cases involved abandoning flooded vehicles or residents remaining in their houses despite evacuation orders. The author concludes that coastal residents perhaps take advisories and warnings more seriously and remove themselves from danger, while inland residents fail to take necessary precautions to minimize risk from flash flooding and rain-swollen waterways.

Topic: Earliest Red River Valley Climate Records

Fur trading agent, William A. Henry kept a weather journal near Pembina, ND along the Red River Valley in 1807 and 1808. He recorded his observations three times per day, near sunrise, near midday, and near sunset. Wind and sky conditions as well as temperatures were recorded. This represents the earliest known climate journal for the region, though it was only for portions of two years. Mr. Henry recorded a light frost on this date (Sept 8th) in 1807, followed by an afternoon temperature of 73 degrees F. He noted hail on September 15th and again on the 18th, followed by 2 inches of snowfall. He harvested potatoes the first week of October in 1807. Many thunderstorm induced prairie fires were observed during October with a description of heavy smoke and dust in the air on the 18th and again on the 22nd. The Red River froze over for the winter on November 12th and remained ice covered until April 16, 1808.

Mr. Henry's journal is a valued description of the climate in the Red River Valley during the winter of 1807-1808. Obviously, an educated man, his writing is descriptive of other seasonal events such as the migration of water fowl (ducks and swans) and his success in netting a number of sturgeon (50-100 per day) from the river in the early spring.

MPR listener question: Will fall colors come early or late this year? Any thoughts?

Answer: This question comes up each year and is difficult to answer. An old rule of thumb applied by former State Climatologist Earl Kuehnast stated that 7 to 10 nights of temperatures in the 30s F brought on peak fall colors. Temperatures have not yet been this cool. Even the northshore areas along Lake Superior have only had one or two nights with readings in the 30s F so far. On the other hand, many parts of the state have been drier than normal since July. This dryness may accelerate the leaf color change in some places, particularly central and northern counties.

I would advise checking the MN-DNR web site for current conditions..

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

as we proceed through the month. Also keep track of the temperatures reported from your favorite areas around the state to see how often overnight minimums drop into the 30s F.

Twin Cities Almanac for September 8th:

The average MSP high temperature for today's date is 76 degrees F (plus or minus 10 degrees standard deviation) and the average low is 56 degrees F (plus or minus 7 degrees standard deviation).

MSP records for today's date include: highest daily maximum temperature of 99 degrees in 1931; lowest daily maximum temperature of 54 degrees F in 1929; lowest daily minimum temperature of 41 degrees F in 1965 and 1992; highest daily minimum temperature of 74 degrees F in 1931; and record precipitation of 0.99 inches in 1961. The highest Heat Index on this date was 103 degrees F in 1953.

Average dew point temperature for today is 55 degrees F. The highest dew point on this date is 73 degrees, while the lowest is 32 degrees.

All-time state records for September 8th:

Scanning the state climatic data base: the all-time high for today's date is 105 degrees F at New Ulm (Brown County) in 1931; the all-time low is 24 degrees F at Meadowlands (southern St Louis County) in 1956 and at Tower (northern St Louis County) in 1975.

Words of the Week: The Little Ice Age

This was an extended period of relatively cold conditions in many parts of the globe, extending roughly from 1400 to 1850 AD. Sea ice cover expanded, many glaciers grew and advanced, and growing seasons were shorter. There are some climate records available during this period, mostly in European countries, but few recorded observations are available for North America.

Outlook:

Chance of showers Saturday with warmer than normal temperatures. Showers lingering in the north Sunday and more scattered showers possible on Monday. Change in the weather on Tuesday with cooler temperatures, lower dewpoints and drier conditions. Temperatures for the rest of next week will finish out near normal.

To: Perry Finelli, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Sep 15, 2000

Topic: Weather for the Olympics in Sydney, Australia

It looks like the Olympics will have favorable weather.

Early spring brings generally pleasant weather to Sydney, the site of this year's Olympic Games. September is the driest month of the year there with an average of 2.2 inches of rainfall. Thunderstorms are observed infrequently, averaging only 2 days during the month of September. The maximum observed 24 hour rainfall rate in Sydney during the month is only 3.2 inches.

Compared to our Minnesota climate, the Sydney climate is quite moderate, modified by the waters of the South Pacific. The average daily maximum temperature during the second half of September ranges from the high 60s to low 70s F, with nearly 95 percent of all days showing a daily high above 60 F. The extreme high temperature during September has been 95 degrees F. Low temperatures during the last two weeks of September range from the upper 40s F to the mid 50s F, with the lowest extreme being 36 degrees F. Dewpoints are typically in the 40s F, though generally increasing towards the end of the month.

Daily changes in land-sea breezes keep the air well ventilated and relatively clean. Fog occurs less than 1 percent of the time, and visibility is quite good most days. Calm conditions occur about 14 percent of the time, while the most common wind direction is westerly, followed by easterly. Average wind speed is 8 to 12 mph. A recent windy period in Sydney, with gusts over 30 mph has fortunately come to an end just in time for the opening weekend of competition.

The Sydney Olympic Stadium which will host many of the track and field events, is oriented north to south, but it has no open ends to it and is quite high, with a great deal of shade. So the competing athletes will likely not be well exposed to weather elements such as direct sunshine, opposing winds, or cross winds. This may help insure that any new running records on the track are legal, since a helping wind of greater than 2.0 meters per second (about 4.5 mph) would disallow such records. Conversely, competitors in the throwing events (i.e. javelin and discus) like quartering winds (winds coming from a diagonal to their throwing trajectory) because they frequently help with lift and the distance of the throw. However, these types of winds may be absent from the competition because of shielding from the stadium. The land-sea breezes may be more of a factor in other venues which take place outside of the Olympic Stadium, such as beach volleyball, shooting, archery, and sailing.

Topic: New Monthly and Seasonal Climate Outlooks

The NOAA Climate Prediction Center just released the new monthly and seasonal climate outlooks on Thursday, September 14th. The outlook for October in Minnesota favors near normal temperatures in the state, except for the southern counties which are likely to see below normal temperatures. Precipitation in October is expected to be normal statewide.

The outlook for the October through December period favors near normal precipitation and temperature. This is significantly different than the past three years and suggests colder temperatures and more precipitation than we are recently accustomed to. With respect to the much higher energy costs for residential and commercial heating, we best prepare ourselves and our budgets for some shocking bills this winter.

MPR listener question: A recent article in the St Paul Pioneer Press newspaper showed that there were only six days this summer with temperatures of 90 degrees F or higher in the Twin Cities. Yet, it seemed that there were many humid nights when the temperature did not cool off much. How does the average temperature this summer rank in the historical context?

Answer: This summer's average temperature of 70.2 degrees F in the Twin Cities (June, July, and August) ranks 49th in the 110 year official record. So it is right in the middle of the historical distribution of summer temperatures. On a statewide basis (averaging all climate observation in the state), the average temperature for the summer of 2000 (June-August) ranks a bit cooler, only 37th out of 106 years. The coldest summer in the state was in 1915 and the warmest in 1988, at least based on average temperature.

Twin Cities Almanac for September 15th:

The average MSP high temperature for today's date is 70 degrees F (plus or minus 9 degrees standard deviation) and the average low is 51 degrees F (plus or minus 7 degrees standard deviation).

MSP records for today's date include: highest daily maximum temperature of 98 degrees F in 1939; lowest daily maximum temperature of 46 degrees F in 1916; lowest daily minimum temperature of 36 degrees F in 1964; highest daily minimum temperature of 72 degrees F in 1897; and record precipitation of 2.59 inches in 1992. The highest Heat Index on this date was 103 degrees F in 1939, the third consecutive day of a Twin Cities heat wave during which schools were let out early.

Average dew point temperature for today is 48 degrees F. The highest dew point on this date is 66 degrees, while the lowest is 30 degrees.

All-time state records for September 15th:

Scanning the state climatic data base: the all-time high for today's date is 100 degrees F at St Peter (Nicollet County) in 1939 and at Tracy (Lyon County) in 1955; the all-time low is 17 degrees F at Bigfork (Itasca County) in 1964.

Word of the Week: Bucketing

Misting or drizzling is an extremely light precipitation, while raining is descriptive of water droplets with enough velocity to splash on the ground. The torrential type rains such as those that fell in Eau Claire, WI on Monday of this week (nearly 8 inches in 9 hours) would classify as bucketing in Scottish terminology. Bucketing is an intense rainfall rate which greatly reduces visibility.

Outlook:

A pleasant fall weekend is in store with temperatures a few degrees warmer than normal. Unsettled weather arrives starting on Monday, with increasing cloudiness, stronger winds and a chance for rain, especially Tuesday and Wednesday. Cooler than normal temperatures will arrive later in the week, with some frosts, especially in the north.

To: Cathy Wurzer, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Sep 22, 2000

Topic: Record Warmth Before Season Ending Frosts

On Monday of this week, strong southerly winds brought record-setting high temperatures to many areas. The following locations set or tied record highs on September 18th....

St Cloud 88 F (tied 1984 and 1998)
Duluth 84 F (tied 1984)
Hibbing 85 F
Brainerd 87 F
Two Harbors 82 F (tied 1908)
Cook 84 F
Eveleth 84 F
Bigfork 88 F
Aitkin 84 F (tied 1998)
Moose Lake 88 F
Cloquet 84 F (tied 1948 and 1998)
Cambridge 86 F (tied 1955)
Red Wing 90 F

This is not unusual to have a strong warm front usher in record setting high temperatures just before the onset of the first real cold air mass of the season. Many areas of the state subsequently reported frost on Wednesday and Thursday of this week, with some upper 20s F across the northern and central parts of the state. Even southern Minnesota communities like Redwood Falls, Faribault, Owatonna, St James, Fairmont, Jackson, and Windom reported overnight lows from 30 to 32 degrees F on Thursday morning, bringing an official end to the agricultural season. This is somewhat unusual for southern Minnesota, as a season ending frost before the autumnal equinox occurs only about 10 to 20 percent of the time. In the urban heat island of the Twin Cities, fall frost on or before the equinox has occurred only 7 times in the past 110 years, the earliest being September 3, 1974.

The autumnal equinox today (12:30 pm Sept 22nd) marks a significant transition as the midday sun passes over the equator on its annual migration to the southern latitudes. Day length is declining at a rapid pace, at our latitude we lose about 3 to 4 minutes per day. Nights grow longer, pressure patterns in the northern hemisphere become stronger, producing sharply contrasting air masses...colder.. warmer..drier...wetter...and average wind speeds will gradually grow stronger in response to the stronger pressure gradients.

MPR listener question: Forecasted snow showers and flurries in northern Minnesota this weekend prompted a listener to call and ask "how often does this occur in the north woods?"

Answer: More often than you think. The last relatively widespread observation of September snows occurred in 1974, when 33 National Weather Service observers (from 14 different counties) reported snow. Hoyt Lakes and Crane Lake Ranger Station in St Louis County, as well as International Falls (Koochiching County) reported 1 inch of snow on the ground at least for a brief period of time. And Big Falls in Koochiching County actually reported a trace of snow on August 31st of that year, an extremely rare event indeed.

Even more recently, the Reserve Mining Company at Babbitt, MN reported 1.5 inches of snow on September 30, 1985. But this was a more isolated event geographically. The heaviest September snowfall I could find through a cursory scan of the state data base was 2.0 inches which occurred at Tower, MN on September 27, 1899 and again at Babbitt, MN on September 25, 1927.

In a 67 year climate record from Babbitt in St Louis County, September snows are reported in 25 of those years. That's better than one year in three. In addition, three separate September snowfall events were observed there in both 1942 and 1972. So, at least for parts of northern Minnesota, reports of snow in September should not cause too many mouths to fall open with shock or create panic about the premature onset of winter.

Twin Cities Almanac for September 22nd:

The average MSP high temperature for today's date is 68 degrees F (plus or minus 10 degrees standard deviation) and the average low is 48 degrees F (plus or minus 8 degrees standard deviation).

MSP records for today's date include: highest daily maximum temperature of 95 degrees F in 1936; lowest daily maximum temperature of 49 degrees F in 1913; lowest daily minimum temperature of 26 degrees F in 1974; highest daily minimum temperature of 71 degrees F in 1937; and record precipitation of 2.80 inches in 1895. The highest Heat Index on this date was 98 degrees F in 1936.

Average dew point temperature for today is 45 degrees F. The highest dew point on this date is 68 degrees, while the lowest is 20 degrees.

All-time state records for September 22nd:

Scanning the state climatic data base: the all-time high for today's date is 101 degrees F at Beardsley (Big Stone County) and at Moorhead (Clay County) in 1936; the all-time low is 10 degrees F at Thorhult (Beltrami County) in 1974.

Words of the Week: Freezing Level Chart

We have talked about the atmospheric freezing level in the past. This is defined as the height of the 32 degree F isotherm over

a particular point on the Earth's surface. It is determined twice daily over many points around the world from soundings that are made by radiosondes (balloon launched instruments). A freezing level chart is a synoptic depiction (map) of the height of this freezing level at a given point in time, but shown over a large geographic area (using isoheights or contour lines-lines of constant height). Thus a forecaster can compare the height of the freezing level over Minnesota against that over Illinois for example. He or she may use this as guidance in forecasting the type of precipitation expected from a frontal system or upper air disturbance. It is also used very commonly in pilot briefings.

The freezing level over Minnesota dropped several thousands of feet this week with a change in air mass (it was over 10,000 ft Monday and about 5000 ft by Wednesday). The lowering of the freezing level can be a factor in the observation of snow showers and snow flurries around the state this weekend, even though many of the official surface observations of temperature may be in the 30s and 40s F. This is because the snow flakes and snow crystals formed in the clouds aloft will not entirely melt as they pass through the shallower warm layer near the surface. Portions of Montana, North Dakota, Saskatchewan, and northern Manitoba where the freezing level has fallen, were expecting snow showers or flurries on Thursday.

Outlook:

Cool, fall-like weekend coming up with daytime highs in the 40s and 50s F and overnight lows in the 20s and 30s F. Chance of rain showers in the central and south, rain or snow showers in the north both days. Saturday will be windy. Cooler Sunday through Tuesday, with less wind and some frosty mornings. Some moderating temperatures by Wednesday of next week, less cloud cover and more sunshine. Temperatures will still average a few degrees colder than normal.

To: Cathy Wurzer, Eugene Cha, Julie Siple, and Jim Bickal
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Sep 29, 2000

Topic: New State Low Temperature Record for September 24th

Last Sunday brought record setting low temperatures to many parts of the state. All of the following locations reported new record lows for September 24th...

Hibbing 22 F St Cloud 24 F Aitkin 25 F
Morris 21 F Alexandria 28 F Cambridge 25 F
Princeton 21 F Madison 27 F Embarrass 17 F

But perhaps the most remarkable low temperature occurred that morning at Tower, MN. They reported a low of just 15 degrees F, the coldest ever reading in the state of Minnesota for September 24th. Calm winds, clear skies and extremely dry air allowed overnight temperatures to cool down so low.

Topic: Rainmakers

Documented histories of United States agriculture often include reference to the rainmakers of the late 19th and early 20 Century. There is an interesting article about them in the current issue of Weatherwise magazine (Sept/Oct 2000). A vast majority of the country's population was dispersed across the agricultural landscape in the late 19th Century, a time which predates the breeding of drought-tolerant crops and the deployment of irrigation technologies. Their livelihood was dependent on the weather, and particularly having enough rainfall to produce a crop. When droughts occurred, as they inevitably do, some groups of farmers and/or whole communities would contract with a rainmaker to "open up the clouds" and produce water from the sky. Many methods were employed. Some electrified the sky by discharging sparks across steel rods or chick wire. Some, known as percussionists, fired cannons into the sky, or launched fireworks to induce the formation of raindrops. Still others brewed chemicals in large vats or funnels and allowed the vapors to escape into the sky where they would presumably enhance the condensation of water vapor.

One of these rainmakers was Charles Hatfield, known as the "Robin Hood of the Clouds." He used plumes from an evaporating chemical mixture to bring rainfall. Many say that he simply used probability and timed his activity to coincide with the highest historical frequency of rainfall for a given area. For whatever reasons, he was highly successful and acquired quite a reputation.

Hatfield's endeavors for the city of San Diego, CA in January of 1916 put him forever in the weather history books. After

four consecutive years of drought, city council members, under pressure from local growers, negotiated a contract with Hatfield to produce rain. He began his operation on January 13th and by the 16th rains began to fall...and fall....and fall. Over a five day period many places in San Diego County reported rainfalls of 15 to 22 inches. By the end of the month 28 to 38 inches of rain had fallen, washing out roads and railroad tracks, flooding homes, and bursting dams. Insurance claims amounted to over \$3.5 million dollars. Hatfield demanded his payment of \$10,000, but the city council never paid him, they had failed to formally sign his contract. Though he wanted credit for making it rain, he claimed that he did not know how to make it stop!

Rainmaking as a profession has been dismissed by meteorologists for most of the 20th Century. However, cloud seeding operations are still conducted in many countries with varying claims of success. Cloud seeding was attempted in our region during the drought of 1976, but I don't know that it has been tried since.

MPR listener question: I read that the Dallas/Ft Worth area in Texas just suffered through their longest ever period without measurable rainfall, 84 consecutive days (ending this past Saturday, Sept 23rd). What is the equivalent record for the Twin Cities?

Answer: The longest period without measurable precipitation in the Twin Cities climate record (1891-2000) is 51 days, from November 15, 1943 to January 4, 1944. That was not the start of a drought, nor did that period have any serious implications for the local landscape since it was winter. That same season also brought the longest ever dry period measured in the state, 79 consecutive days without measurable precipitation, from November 9, 1943 to January 26, 1944 at Canby, Marshall, Beardsley and Dawson (all western MN locations).

Twin Cities Almanac for September 29th:

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

MSP records for today's date include: highest daily maximum temperature of 89 degrees F in 1897; lowest daily maximum temperature of 44 degrees F in 1985; lowest daily minimum temperature of 27 degrees F in 1945; highest daily minimum temperature of 63 degrees F in 1922, 1982, and 1995; and record precipitation of 0.92 inches in 1971. There was a trace of snowfall in 1908 and 1972 on this date, but never a measurable amount.

Average dew point temperature for today is 45 degrees F. The highest dew point on this date is 68 degrees, while the lowest is 24 degrees.

All-time state records for September 29th:

Scanning the state climatic data base: the all-time high for today's date is 96 degrees F at Moorhead (Clay County) in 1897; and the all-time low is a 13 degrees F at Hallock (Kittson County) in 1899 and at Mora (Kanabec County) in 1984.

Word of the Week: Kytoon

In the 19th century, meteorologists began using kite-shaped, tethered balloons to carry instruments aloft and measure temperatures and humidity. These were called kytoons and their data provided early indications of how temperature, moisture and wind varied considerably above the Earth's surface. In the 20th century, kytoons were replaced by radiosondes, instrumented balloons which transmit their data back to ground receivers via radio waves.

In recent years, there has been a renewed interest in the use of instrumented kites for a variety of studies involving measurements at fixed elevations above the ground. Instruments aboard kites have been used in the study of carbon dioxide and ozone atmospheric profiles, the study of insect migrations, and the study of bird and bat behaviors. Small digital cameras have even been attached to kite tethers in order to provide aerial photographs of landscape features for the study of soil erosion patterns or mapping vegetation. So, many meteorologists do not take offense when they are told to go fly a kite!

Outlook:

Windy, with mild temperatures this weekend and a chance for widely scattered showers, mostly in the north and especially on Sunday. Temperatures will moderate around normal early in the week the drop below normal from Wednesday through Friday. In fact the below normal temperature trend may hand around through the middle of October. Chance of showers Tuesday and Wednesday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Oct 6, 2000

Topic: October Blizzards on Hudson Bay

Earlier this week, on Monday and Tuesday (October 2-3) the Canadian Meteorological Centre issued a blizzard warning for communities in the northern Hudson Bay area. A strong low pressure center passed across the Bay picking up water vapor and producing winds from 20 to 40 mph. Combined with air temperatures in the mid to upper 20s F, windchill conditions dropped to -10 to -20 degrees F and visibility became less than 1/4 mile. October blizzards are not uncommon along the Hudson Bay, though they tend to occur with higher frequency toward the end of the month. Snowfalls will likely persist and begin to accumulate across the landscape there as temperatures are expected to remain below freezing most of the week. On Monday evening (Oct 2) snow began at Juneau, Alaska accumulating to 2 inches by morning, which marked the earliest snowfall of an inch or greater in the that capital city, and a tied for the earliest measurable snowfall (0.1 inch or more) of the season.

Closer to Minnesota, the towns of Gretna and Thompson in Manitoba reported snow earlier this week as well, and on Wednesday morning Embarrass and Tower both reported lows of only 13 degrees F.

Topic: Twin Cities Marathon

The 19th running of the Twin Cities Marathon will take place this Sunday (October 8th). It may very well be colder than any of the previous eighteen. The weather outlook favors morning low temperatures in the 20s F, warming only to the low 40s F throughout the day. In fact there may even be some snowfall on Saturday, but it will likely not stick around until Sunday. The record low for Sunday morning (October 8th) in the Twin Cities is 27 degrees F set in 1989, and we may break that record. The coldest previous marathons were in 1985, 1991, and last year when temperatures were in the high 30s F to start the race. Runners will probably adjust better to the temperature conditions than spectators.

Runners dissipate the heat they generate by conduction, convection (from the skin), evaporation (sweat), and respiration (breathing). Clothing style and color has a great impact on heat storage and dissipation, especially when the sun is out. Some studies have shown that dark colored clothing may keep the runner 3 to 7 degrees F warmer than light colored clothing of the same material. We might watch for a lot of dark colored, and layered clothing on the runners this Sunday.

MPR listener question: A senior citizen from Ellendale, ND claimed that it once represented the world's only box kite weather station? Could this be true?

Answer: The simple answer is no, but there is an interesting story behind this question.

Following the lead of 19th Century European meteorological studies, the National Weather Service began experimenting with kite measurements of the upper atmosphere in 1898. Sixteen upper air stations were established and many used kites to carry instruments aloft. By 1910, kites had given way to the use of hydrogen filled balloons which could still be used when winds were inadequate to fly kites. However, following World War I, Congress appropriated funds (through the Army Appropriations Act) to establish additional upper air stations since military aviation and airmail flights had become more important and needed the support of meteorology. In 1918, five new stations were established at locations where winds were more favorable for the use of kites. One of these new stations was Ellendale, ND. Everyday an instrumented box kite was flown at Ellendale and the data collected were transmitted to the Chicago forecasting office for analysis. The Ellendale data were highly valued as they represented an upwind site and a measure of the weather which was heading toward the Great Lakes region. The 1920s and 1930s saw tremendous growth in the aviation industry and soon pilot observations of weather aloft were replacing those taken from balloons and kites. The Ellendale kite station was the last to operate for the National Weather Service and closed in July of 1933. Thus when it closed, it was the only kite weather station left.

Interestingly, under the right kind of conditions kite altitudes were astonishingly high. Often times kites would be flown to altitudes of several thousand feet and for a time the National Weather Service, held the world's record for kite altitude, amazingly over 23,000 ft!

Almanac:

Almanac: Average maximum temperature locally for today's date is 63 (plus or minus 10 degrees standard deviation) and the average minimum is 43 (plus or minus 7 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 85 degrees in 1961; lowest maximum temperature of 40 degrees F in 1952; lowest minimum temperature of 26 degrees F in 1976; highest minimum temperature of 60 degrees F in 1949; record precipitation of 1.69 inches in 1941; and a trace of snow in 1952.

Scanning the state climatic data base: the all-time high for today's date is 94 degrees F at Madison (Lac Qui Parle County) in 1993 (after a morning low of 42 degrees); and the all-time low is 11 degrees F at Pokegama Falls (Itasca County) in 1904 and at Detroit Lakes (Becker County) in 1976.

Average dew point temperature for today is 41 degrees F. The highest dew point on this date is 62 degrees, while the lowest is 19 degrees.

Word of the Week: GANDOLF

The World Meteorological Organization conducted its own competition at the recent Sydney Olympics. Many government weather services were invited to participate in a forecasting contest to see who could perform the best in predicting the weather for the games. I don't know yet if a winner was declared, but I suspect that the Australian Bureau of Meteorology probably came out on top, as they deployed some of their best personnel and technology to forecast for their own Olympic games.

The British Meteorological Office attended and used a thunderstorm forecasting system called GANDOLF (an acronym for Generating Advanced Nowcasts for Deployment in Operation Land-Surface Flood Forecasting). This system utilizes radar, satellite, and upper air data along with various computer models to predict the development and decay of local thunderstorms. Unfortunately for the British, the Sydney weather was very cooperative for the 16 days of the games. Only one episode of thunderstorms occurred, so more testing of GANDOLF will have to be done elsewhere at other international competitions.

Outlook:

Quite cool over the weekend with a chance for snow flurries in the east on Saturday, dry elsewhere. Record or near record cold Saturday and Sunday with temperatures averaging 15 to 25 degrees F colder than normal. Rebound in temperature is seen for Monday through Thursday next week, as daytime highs climb back into the 50s and 60s F. Chance of precipitation again by Thursday. moderation in temperature by Wednesday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Oct 13, 2000

Not another Friday the 13th!!!!

Topic: Drought concerns are back

Despite what has turned out to be a good agricultural production season, many farmers are quite concerned about drought again, as they were last fall. This year's crops benefitted from the absence of heat stress, but used up most of the soil moisture reserves around the state. Examination of the current soil moisture conditions shows that western, central and southern counties are as dry or even drier than they were last fall at this time. Estimates of stored soil moisture in the top 5 ft of soil range from just 1.5 inches to 3.5 inches. Several more inches of moisture are needed to bring soil storage back to average levels before freeze-up occurs (usually around late November to early December). Should the mild weather continue late into the fall, soils were remain receptive to recharge from precipitation for a longer period of time, especially where they have been fall tilled. Storage efficiency in the fall is the highest of the year, with approximately 70 to 80 percent of the precipitation being retained by the soil.

The current soil conditions mandate that farmers be patient with their plans to do any fall nitrogen applications. Soils are too dry and too warm for the efficient application of anhydrous ammonia. The outlook for the remainder of the month favors mild temperatures.

Topic: New monthly and seasonal climate outlooks

The Climate Prediction Center released the new climate outlooks for November and early winter on Thursday, October 12th. They call for near normal temperature and precipitation in Minnesota and most of the midwest. The models considered in making these forecasts gave somewhat conflicting indications, but showed a highly variable circulation pattern in the northern hemisphere which could bring us oscillating periods of warmth and cold, as well as wetness (snow) or dryness. The number of cold air outbreaks in the Great Lakes region is expected to be greater than in recent years. Though there is much uncertainty in the details to expect for the winter months, an important conclusion to draw is that we should not expect the same degree of mildness experienced in the last three winters.

MPR listener question: How many places reported new record cold temperatures earlier this week?

Answer: Dozens of places in Minnesota reported record cold

temperatures on the 8th and 9th this month. Two features of this cold polar air mass are most noteworthy. Firstly, the large geographic scale of this cold air was unusual for so early in the fall season. As it spread out of Canada across the midwest, over 80 communities from several states saw low temperature records set, including:

Waterloo, IA 19 F Moline, IL 26 F Chicago, IL 30 F
Evansville, IN 29 F Goodland, KS 23 F Lexington, KY 31 F
Mobile, AL 42 F Jacksonville, FL 46 F St Louis, MO 30 F
Omaha, NE 25 F Erie, PA 34 F Brownsville, TX 44 F
Lynchburg, VA 30 F Jackson, TN 28 F Atlanta, GA 40 F

The second feature was the earliness of such cold air. In Minnesota alone, the following locations reported new record cold temperatures for so early in October.....

Lamberton 16 F on the 8th Olivia 15 F on the 8th
Pipestone 14 F on the 8th Redwood Falls 16 F on the 8th

Other locations which reported their earliest ever fall frost were Huntsville, Al with 29 F and Wichita Falls, TX with 31 F.

The air mass was slow moving but it has been modified and warmed as it passed over the U.S., this week and no further low temperature records were set after the 10th.

Almanac:

Average Twin Cities maximum temperature for today's date is 61 F (plus or minus 11 degrees standard deviation) and the average minimum is 41 F (plus or minus 8 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 84 degrees in 1956; lowest maximum temperature of 37 degrees F in 1937; lowest minimum temperature of degrees 22 degrees F in 1917; highest minimum temperature of 62 degrees F in 1968; record precipitation of 1.12 inches in 1956; and record snowfall of 0.4 inches in 1969. The coldest windchill conditions occurred in 1909 with a reading of 1 degree F.

Average dew point temperature for today is 41 degrees F. The highest dew point on this date is 67 degrees, while the lowest is 21 degrees.

Scanning the state climatic data base: the all-time high for today's date is 89 degrees F at Canby (Yellow Medicine County) in 1958 and at Fairmont (Martin County) and Luverne (Rock County) in 1975; the all-time low is 8 degrees F at Tower (St Louis County) in 1993.

Word of the Week: Pennant

This is the championship flag which will be awarded to the winner

of the NLCS and ALCS baseball series going on right now. It is also a nautical term used for various flag signals which are hoisted on ships.

In meteorology it is a term applied to the plotting of wind speed on a synoptic chart. Listeners who view the weather locally on Channel 17 or use the Internet to access weather information may have noticed the appearance of pennants on the upper air (Jet Stream) charts or the surface observations. It is a triangular flag pointing towards lower pressure and designates a wind speed of 50 knots (approx 58 mph). Lower wind speeds are denoted by the use of barbs (10 knots) and half-barbs (5 knots).

Outlook:

Some precipitation is expected around the state on Saturday and Sunday, perhaps lingering in the north on Monday. The recent mild temperatures will cool down somewhat before rewarming to near seasonal normals by the middle of next week. Most of next week also looks dry.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Oct 20, 2000

Topic: Record Warmth on October 19th

It could be argued that Thursday was the warmest October 19th in Minnesota history. Checking the state climate data base the warmest ever temperature on this date statewide was 89 degrees F at Morris (Stevens County) in 1947. At 3 pm on Thursday afternoon, Appleton in Swift County reported 90 degrees F.

Many other locations reported new record highs for Thursday, including....

MSP 84 F St Paul 84 F Bemidji 75 F Cambridge 81 F
Park Rapids 77 F (tied record) Big Fork 77 F Cook 79 F
Cloquet 79 F Montevideo 88 F Appleton 90 F
Marshall 84 F Redwood Falls 85 F Owatonna 84 F
Red Wing 84 F St Cloud 85 F Willmar 86 F
Litchfield 84 F Hutchinson 84 F Princeton 82 F
Hibbing 80 F Moose Lake 82 F La Crosse (WI) 82 F
and International Falls 75 F (tied record)

Of those shown above, the oldest record broken was 84 degrees F at Montevideo on this date in 1914....

Topic: Dry, Drier, Driest

In many respects, the central and southern Minnesota counties are drier now than they were last October. All of the landscape indicators are showing signs of severe moisture deficit.... low soil moisture values, low lake levels, diminished river and stream flows, wetlands that are drying out, and dropping shallow aquifers. In these parts of Minnesota the rainfall recorded since September 1st is only 35 to 45 percent of normal. Some of the driest locations in the state include Redwood Falls, Willmar, Olivia, Hutchinson, Canby, Red Wing, Lamberton, and Cambridge, all of which report less than 0.75 inches of precipitation in the last seven weeks. This followed a dry August as well.

Burning restrictions have been imposed in many places, including the Twin Cities metro counties. Moisture recharge potential appears slim until near the end of the month when a major storm system is expected across the region. But late fall moisture usually just serves to partially replenish soil moisture reserves. It does little for wetlands, lakes, rivers and streams, all of which will likely remain low throughout the winter.

Topic: Drought in Texas

Speaking of dryness, a recent economic assessment of the prolonged drought in Texas estimates crop damage of approximately \$1.1 billion. Nearly half of this figure is accounted for by reduced cotton yields. Farmers in one hundred eight-four Texas counties are eligible for low-interest disaster loans. The late fall and early winter climate outlook favors some moisture relief for Texas, as above normal precipitation is expected through December. This should help with their winter crops.

Topic: Soil Frost

One of the most distinguishing features of Minnesota's climate is soil freezing. Unlike our neighboring states to the south and to the east, our soils freeze for longer periods of time and to greater depths during the winter. But even within the state, there is a good deal of variability in soil freezing characteristics.

For example, the prairie clay soils of the Red River Valley usually begin to freeze about the last week of November, while the loess soils in southeastern Minnesota often do not freeze until near Christmas time. Average maximum frost depths range from less than 20 inches in some southern counties and in some heavily forested northern counties, to 4 feet or deeper in parts of western Minnesota where soils are often not well insulated by persistent winter snow cover.

The maximum penetration of soil frost usually occurs in late February or during March. This is followed by a gradual thawing, both from the surface and from below the frost layer where the soil temperature is nearly constant between 45 and 50 degrees F.

Topic:

MPR listener question: How many times has the Twin Cities reached a temperature of 60 degrees F or higher during the winter months?

Answer: During the months of December, January and February (the heart of winter), the Twin Cities has only seen a temperature of 60 degrees F or higher eight times, four times in December and four times in February, but never in January (at least back to 1891). The highest ever was 68 degrees F on December 1, 1998 (residents were actually playing golf at the time) and the most recent was 61 degrees F on February 29 of this year.

Almanac:

Average Twin Cities maximum temperature for today's date is 56 F (plus or minus 11 degrees standard deviation) and the average minimum is 39 F (plus or minus 9 degrees standard deviation).

MSP records for today's date include: highest maximum temperature

of 83 degrees in 1953; lowest maximum temperature of 32 degrees F in 1930; lowest minimum temperature of degrees 18 degrees F in 1960; highest minimum temperature of 61 degrees F in 1920; record precipitation of 2.64 inches in 1924; and record snowfall of 3.0 inches in 1916. The coldest windchill conditions occurred in 1913 with a reading of -8 degree F.

Average dew point temperature for today is 37 degrees F. The highest dew point on this date is 62 degrees F, while the lowest is 8 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 91 degrees F at Canby (Yellow Medicine County) in 1947; the all-time low is 0 degrees F at Roseau in 1916. This low temperature record also represents the earliest fall occurrence of 0 degrees F in the state and it came on the heels of a 9 inch snowfall in the area. Roseau is the site of the earliest below zero temperature reading in the fall, having recorded -2 degrees F on October 21, 1913 following a light snowfall.

Word of the Week: : Stevenson Screen

This was the first weather instrument shelter adopted for standard daily climate observations. The Stevenson Screen was designed in the 1860s by Scottish engineer Thomas Stevenson. It was adopted by the British as a standard instrument shelter in the United Kingdom and was used throughout the old British Empire as well, particularly in India. The Stevenson screen consists of a wooden box with double louvered sides. This box is mounted on four legs about four feet above the ground, most often over a grass surface. It is usually painted white with the thermometers mounted on brackets in the middle of the box.

Because of the trend away from the use of liquid in glass thermometers to thermistor-based measurements (electrical), the Stevenson Screen is disappearing from the world's climate observation networks. It is being replaced by the smaller Gill-type shield which is composed of stacked plates and concentric tubes (usually made of plastic) mounted on a single post.

Incidentally, the designer of the Stevenson Screen, Thomas Stevenson, was better known as the father of the great Scottish novelist and poet, Robert Louis Stevenson, who exhibited a sound knowledge of climate and climatic effects in his writings.

Outlook:

Generally above normal temperatures are expected to prevail across the state for much of the weekend and next week. There will be a chance for light showers late Sunday into Monday, but a better chance for showers later next week, with perhaps

mixed precipitation during Wednesday through Saturday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Oct 27, 2000

Topic: Fall Chores

The time for outdoor chores is rapidly coming to an end. I have had people ask me about the chances of having suitable weather yet to finish up outside painting, to rake and mulch leaves, fertilize lawns, prune trees, caulk windows and doors, finish autobody patching and painting, cover golf course greens, dry-dock boats and any number of other activities.

Some of these concerns are framed in questions such as: "Do you think it will reach 70 degrees again this month?" (only a 6-7 percent chance); or "Surely we'll have more daytime highs in the 50s so I can paint, won't we?" (about a 50 percent chance); or "I need two or three consecutive dry days to finish up the yard, do you think it will happen?" (60 to 70 percent chance); or "This putty only sets up if the air temperature is 60 degrees or warmer, any chance of that?" (about a 30 percent chance).

Topic: Preliminary Climate Summary for October

Despite record cold temperatures on the 7th, 8th, and 9th of the month, it looks like average temperatures for October will range from 2 to 5 degrees F warmer than the 30 year normal. It is hard to remember that some southern Minnesota counties reported temperatures as low as the mid-teens back on October 8th and 9th (the earliest ever for such temperatures), with snow flurries on that particular weekend. This cold period was more than offset by the recent run of very warm weather, with new record high minimum temperatures reported around the state from the 23rd to the 26th. Record high dewpoints were also reported, as southerly winds brought Gulf moisture into the state, making us feel summer-like humidity.

The first half of the month was exceptionally dry...some counties reporting no measurable precipitation. Conversely the last week of October delivered most of the precipitation to the landscape, ranging from 1 to 2 inches. Despite this, many observers will report below normal precipitation for the month, continuing a dry spell that began in August.

MPR listener question: I know it has been very dry since August, with little moisture in the soil. How much November rainfall would it take to bring the amount of stored soil moisture back close to normal?

Answer: Currently many of the drier areas of southwestern and central Minnesota report only 2.5 to 3.5 inches of stored soil moisture in

the top 5 feet of soil. This is well below normal for this time of year. The historical average soil moisture is roughly three inches more than that. In the late fall, however, the soil storage efficiency is highest, about 70 percent or better. That means that for each inch of precipitation, about 0.7 inches is retained and stored in the soil (assuming the soil remains unfrozen). Simple math shows that a net gain of 3 additional inches in stored soil moisture by the end of November, would require about 4.25 inches of precipitation during the month. The chance of this occurring based on historical climatology is about 1 in 13 (7.5 percent). However it looks like the last few days of October will bring some additional rain to the state. In this context, we may need only about 3 inches of precipitation in November to catch up on soil moisture. The chances of this occurring improve to 1 in 6 (16 percent) based on climatology. There is reason to be optimistic since the weather outlook for the first half of November favors wetter than normal conditions across the state.

Odds and Ends in the Weather:

The EPA reported on studies this week, that show the urban heat island effect can be reduced significantly by using lighter color roofing materials that reflect more solar radiation, and by planting more trees to shade parking areas and roadways. These conclusions were drawn from a pilot study of the urban heat island in Baton Rouge, LA, Sacramento, CA, and Salt Lake City, UT. It is being expanded to examine the urban climate in other major cities.

Heavy rains in Israel this week caused some flash flooding in major cities, temporarily replacing the violent clashes with the Palestinians as front page news.

New studies of damages due to flooding in the United States reveal that annual losses have increased to about \$5 billion per year during the decade of the 1990s, but most of this is accounted for by population growth and increased wealth (damage to costly structures).

Almanac:

Average Twin Cities maximum temperature for today's date is 54 F (plus or minus 11 degrees standard deviation) and the average minimum is 35 F (plus or minus 7 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 74 degrees in 1922 and 1948; lowest maximum temperature of 29 F in 1925; lowest minimum temperature of degrees 16 degrees F in 1976; highest minimum temperature of 50 degrees F in 1964; record precipitation of 2.22 inches in 1971; and record snowfall of 2.6 inches in 1919. The coldest windchill conditions occurred in 1925 with a reading of -14 degree F.

Average dew point temperature for today is 35 degrees F. The highest dew point on this date is 60 degrees F, while the lowest is 12 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 86 degrees F at Montevideo (Chippewa County) in 1955; the all-time low is -10 degrees F at Itasca State Park in 1919. This was one of the lowest ever October temperatures in Minnesota and followed a 13 inch snowfall which occurred on the 24th and 25th. The absolute coldest temperature in October occurred on the 26th in 1936 when Roseau reported -16 degrees F following a 6 inch snowfall.

Words of the Week: Dog Teeth

Norwegian meteorologists devised the concept of the weather front following World War I. For mapped synoptic depiction of clashing air masses and their associated frontal boundaries, symbols needed to be used to distinguish cold fronts from warm fronts. The Norwegians saw a moving boundary of an air mass across a land surface as analogous to the advance of the Allied army in WWI, thus they coined the use of the word front. In the battle for the Western Front in WWI, the British Army front line was symbolized by a solid blue line on maps, and some had dog teeth (right-facing triangles) along the forward edge. The blue line with dog teeth was adopted as the symbol for a cold front, characterized by the fast approach of harsh weather, with strong winds. Conversely, the red line (symbolic of the German Army front line in WWI), with half circles became symbolic of the warm front. Such colors and symbols are still used today. Any meteorologist will associate dog teeth with a cold front.

Outlook:

Temperatures will cool down to near seasonal normals over the weekend. Saturday will be mostly dry, but there will be increasing cloudiness on Sunday with a chance for showers carrying over into Monday. Temperatures will continue near seasonal normals next week, with highs in the 40s and 50s F and lows in the 20s and 30s F. There will be another chance for showers on Wednesday and Thursday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Nov 10, 2000

Topic: Remembering the Armistice Day Blizzard of 1940

In 1940, the Weather Bureau had just been transferred from the Department of Agriculture to the Department of Commerce, as more emphasis was being placed on forecasting for aviation. District forecast centers still had responsibility for large geographic areas. For example, the Chicago office issued four forecasts per day for Illinois, Indiana, Iowa, Michigan, Wisconsin, Minnesota and North and South Dakota. Early on the morning of November 11th they had issued a moderate cold wave warning for Minnesota. It had been drizzling on the 10th with some fog and moderate temperatures in the 40s F. The low pressure system moving toward Wisconsin from the southwest (Texas panhandle and Oklahoma) intensified and winds strengthened. New barometric low pressure records were later established at La Crosse (28.72 inches) at Duluth (28.66 inches), and at the downtown Minneapolis Weather Bureau Office a near-record low pressure of 28.93 inches was reported. Contrast this with a cold high pressure system to the northwest in Canada where the barometric reading was 30.7 inches and it is easy to see why the Armistice Day Blizzard is famous for having such strong winds, wind which averaged over 25 mph for a 24 hour period, and gusted to over 60 mph.

Rain turned to sleet and snow in the late morning on the 11th and worsened to blizzard conditions very rapidly, as snowfall rates approached 3 to 4 inches per hour. The air temperature fell by as much as 40 degrees F over 24 hours and ice as thick as an inch coated poles and phone lines, breaking many of them. Forty-nine Minnesotans perished, including many duck hunters. Thousands of game birds and a great deal of livestock and poultry were killed as well. Losses to the turkey industry alone exceeded 1/2 million dollars. Snow removal and clean up to clear state highways, as well as county and township roads was estimated to exceed 1/2 million dollars as well. Total snowfall at Collegetown was 26.6 inches and snow drifts over 20 feet were reported in the Willmar area.

This storm and the lethal March 15th blizzard the next spring, prompted Minnesota Governor Harold Stassen and Congressman R. T. Buckler of Crookston to criticize the Weather Bureau for inadequate storm warnings and lack of facilities in the state to provide 24 hour forecasting operations. They wrote letters to Secretary of Commerce Jesse Jones asking for support. Soon thereafter Minnesota had a 24 hour forecast office and a larger staff.

Topic: FROM THE "IT ALL DEPENDS" FILE

The use of the adverb "possibly" depends on the context. For example, when asking your boss about prospects for a raise the answer may be, "possibly", used as a three syllable "NO"; however, when asking a meteorologist about prospects for snow cover at Thanksgiving time, the answer may be, "possibly", used as a three syllable "YES". (since 1891 snowfalls have occurred over the Thanksgiving holiday weekend 57 percent of the time).

Yes, it has been a cold and wintry November so far, but it depends on your frame of reference. The all-time low temperature record for November is -45 degrees F at Pokegama Dam on November 30, 1896. Although some very cold readings have already been reported around the state and some are expected again this weekend, none have approached that record!

Topic: Alternative names for Winter

Winter is the coldest season of the year, especially in the mid and high latitudes. Astronomically, winter is the period when the sun is over the opposite hemisphere (between the winter solstice, Dec. 22, and the vernal equinox, Mar. 20 for the northern hemisphere). In ancient classical Mediterranean civilizations it was known as the hibernal season or the stormy season.

But countries and cultures around the world often describe or refer to winter based on observed effects.....

It is known as the wet season in places with dry summers.

It is the white season where snow covers the landscape.

It is the season of frozen soil, where the ground freezes hard and deep.

It is the season of fire and smoke for many nomadic tribes whose only source of warmth is a campfire.

To the Plains Indians of North America it was known as the season when the thunder sleeps (lack of thunderstorm activity).

It is the season when King Boreas (the north wind) reigns in some European countries.

And perhaps in the more modern context it is the season for home videos, or outdoor activities such as skiing or snowmobiling.

MPR listener question: How does the 16.8 inches of snow that resulted from the Armistice Day blizzard of 1940 rank among the historically heaviest snowfalls in the Twin Cities?

Answer: The Armistice Day Blizzard represented the heaviest total storm snowfall in the Twin Cities record for over 40 years. It was broken twice in January of 1982, when 17.4 inches fell on the 20th to 21st, and then again when 20 inches fell on the 22nd and 23rd. This was rather short-lived since in 1991 the Halloween Blizzard produced a new record storm total snowfall of 28.4 inches (still the record amount for the Twin Cities). The Armistice Day Blizzard still holds the record for the most dense heavy snowfall in the Twin Cities record as the ratio of snowfall to liquid precipitation was 6:1 (16.8 inches of snow produced 2.66 inches of water), far more dense than the 10:1 ratio of the Halloween Blizzard (28.4 inches of snow produced 2.83 inches of water).

Almanac:

Average Twin Cities maximum temperature for today's date is 44 F (plus or minus 10 degrees standard deviation) and the average minimum is 28 F (plus or minus 9 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 67 degrees in 1930; lowest maximum temperature of 19 F in 1986; lowest minimum temperature of degrees 3 degrees F in 1986; highest minimum temperature of 52 degrees F in 1909; record precipitation of 1.36 inches in 1915; and record snowfall of 5.0 inches in 1896. The coldest windchill conditions occurred in 1913 with a reading of -21 degree F. The last snowfall on this date was 1.3 inches in 1991.

Average dew point temperature for today is 26 degrees F. The highest dew point on this date is 51 degrees F, while the lowest is -3 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 78 degrees F at Fosston (Polk County) in 1909; the all-time low is -15 degrees F at Big Falls (Koochiching County) in 1933.

Words of the Week: Snow Garland

This is a very rare and particularly beautiful feature which sometimes occurs with snowfalls when the temperature hovers near 32 degrees F. Snow becomes festooned from trees, shrubs, and even fences. It takes the form of a rope or garland made of snow, and may be several feet long and an inch or more in diameter. This shape is retained by the surface tension provided by the thin films of water bonding individual snow crystals and aggregates together. Temperatures right around the freezing point are necessary to preserve the crystals and the thin films of water which bond them. Winds must be calm so that the garlands are undisturbed during accumulation.

Outlook:

Another snow storm is on the way for the weekend with colder than normal temperatures and plenty of wind. Best chances for snow will be late Saturday through Monday. Drier for the balance of next week, but colder temperatures are on the way, perhaps even some single digit lows.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Nov 17, 2000

Topic: New Monthly and Winter Season Climate Outlooks

The Climate Prediction Center released the outlook for December and for the December through February period on Thursday of this week. These outlooks favor near normal Minnesota conditions, with snowy spells and occasional outbreaks of cold arctic air. There is not a strong trend toward wetter, drier, warmer, or colder for the next three months.

Topic: Leonid meteor shower may be quite a show

A METEOR SHOWER OR STORM? (from Ed Hopkins, University of Wisconsin)

-- Astronomers predict that within the next two days the earth should experience the Leonid meteor showers. The Leonid meteor shower usually occurs at this time of year, with an average observed rate of between 10 to 15 meteors per hour. However, two years ago the comet Tempel-Tuttle, the parent comet of the Leonid meteor swarm, passed through the inner solar system after completing a 33 year orbit. As a result, as the earth passes through the tail of the comet, we could experience a meteor storm with as many as one hundred meteors per hour. While the storm would pose little threat to residents of the earth, spacecraft could be in jeopardy as the meteor swarm passes. Many of the meteor particles are as small as sand grains and traveling at more than 155,000 mph. These projectiles could damage or destroy sensitive portions of orbiting satellites, either by direct collision or by generation of electrostatic discharges. Some precautions have been taken to reduce the threat to NASA satellites. On Saturday morning, NASA plans to launch a camera-equipped balloon into the stratosphere to an altitude of 100,000 feet and then offer live pictures of the latter part of the meteor shower on the Internet. This will be the 3rd year that a NASA-sponsored balloon is launched. Additional information can be obtained from Science@NASA (See <http://www.leonidslive.com/>).

Peak viewing in eastern North America is about 0750 UTC (1:50 am Minnesota time) on Friday and Saturday. The moon is near last quarter, so viewing may be affected. If the skies are clear, look toward the east early on Friday and Saturday mornings. The Leonid meteors should disperse across your local sky as the radiant point near the constellation Leo rises in the southeast.

Topic: Snowfall in southern Minnesota

The following are total snowfall reports for Thursday morning, November 16th from some southern Minnesota locations.....

7 inches at Kenneth (Rock County)

6 inches at St Peter and Worthington
5 inches at New Ulm, Red Wing, Lamberton, Luverne, and St James
4.5 inches at Windom
4 inches at Faribault, Waseca, and Farmington

The reports from Waseca, and Lamberton represent new snowfall records for November 16th, while some of the other reports are the heaviest snowfalls on this date since 1909. Sioux Falls, SD now reports 11 inches of snow cover.

Topic: Climatology of the Thanksgiving Holiday

With Thanksgiving coming up next week, I have already had several people ask about what the weather will be like. I looked at the historical weather in the Twin Cities associated with the Thanksgiving Holiday period (Wed-Sun) each year since 1891.

Wednesday and Sunday either side of the holiday have evolved to become two of the heaviest travel days of the year. Historically both of these days show a frequency of measurable snowfall close to 25 percent (about one year in every four). The greatest snowfall on the Wednesday before Thanksgiving was 11.4 inches in 1983, while the greatest for the Sunday following the holiday was 8.4 inches in 1985. In 1939, it wasn't snowfall which created travel problems, but very dense fog which lasted much of the day on the Sunday after the holiday and created numerous traffic accidents.

Regarding the Thursdays when Thanksgiving is observed, some rather extreme conditions have occurred. For example the afternoon high was only 4 degrees F in 1930 with a windchill factor ranging between -30 and -33 degrees, while in 1914 the afternoon high reached 62 degrees F under sunny skies. But clearly the worst weather on Thanksgiving was in 1896 when southern Minnesota suffered from severe thunderstorms, and central and northern Minnesota counties were hit by a blizzard. Worthington (Nobles County) reported 4.80 inches of rainfall from a thunderstorm, while 14 inches of snow was falling in Ada (Norman County) creating 12 foot drifts across the Red River Valley. Following the blizzard temperatures plunged to record lows, dropping to -45 degrees F at Pokegama Dam, still the state record low for the month of November.

The Friday and Saturday after the holiday have become two of the busiest shopping days of the year. Based on history, there is about a 1 in 4 chance of having snowfall on either day. So in relative terms, Mother Nature has been kind to shoppers, with some exceptions. Friday, November 29, 1991 was not a pleasant shopping day, with 12.6 inches of snow falling, nor was Friday, November 29, 1929 which produced a high temperature of only 4 degrees F with windchills of

-35 to -40 degrees, blowing snow, reduced visibility, and cars trying to negotiate icy streets. But then 1929 was probably before shopping became such a popular Thanksgiving holiday activity and few people had any money to spend following the stock market crash.

Taken as a whole (Wed.-Sun.), the holiday period covering Thanksgiving shows nearly a 60 percent occurrence of snowfall on at least one day and a 50 percent occurrence of snow covering the ground. However, as recently as 1998, the holiday weekend produced temperatures in the mid 60s F (even low 70s F in southern counties), allowing Minnesotans to play golf.

MPR listener question: "You have often mentioned that November is the month with the most cloud cover in Minnesota. Does that also lead to a smaller difference between day and night temperatures?"

Answer: Good question! Historically speaking, there are more days with cloud cover during November than any other month. This condition tends to reduce heating of the air near the ground during the day and also prevents too much heat loss at night. The daily range of temperature, called diurnal fluctuation by climatologists, is from 20 to 30 F degrees much of the year in Minnesota. But in November it is typically only 14 to 16 degrees F. This is due to increased cloud cover, but it is also due to the combined effects of shorter daylength, declining sun angle, increased atmospheric humidity, and generally greater wind speeds (keeping the air mixed).

In fact, over the recent stretch of weather from November 6th through the 13th (8 consecutive days) the percent possible sunshine was zero! During this time the average difference between the overnight lows and daytime high temperatures was only 5 degrees F. These kinds of conditions tend to aggravate those who suffer from "seasonal affected disorder" (SAD) which is sometimes treated with light therapy.

Almanac:

Average Twin Cities maximum temperature for today's date is 42 F (plus or minus 12 degrees standard deviation) and the average minimum is 26 F (plus or minus 10 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 71 degrees in 1953; lowest maximum temperature of 15 F in 1927; lowest minimum temperature of degrees -2 degrees F in 1959; highest minimum temperature of 49 degrees F in 1952; record precipitation of 0.72 inches in 1971; and record snowfall of 8.3 inches in 1978. The coldest windchill conditions occurred in 1959 with a reading of -42 degree F. There have been seven measurable snowfalls on this date since 1948, the most recent of which was 1.0 inches in 1989.

Average dew point temperature for today is 26 degrees F. The highest dew point on this date is 58 degrees F, while the lowest is -14 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 74 degrees F at Morris (Stevens County) and Ada (Norman County) in 1953; the all-time low is -19 degrees F at Hallock (Kittson County) in 1914.

Word of the Week: Gale

This word is popularly used to describe an unusually strong wind (i.e. anything greater than 25 mph but less than hurricane strength of 75 mph). In nautical terminology it has more specific meaning: a moderate gale is a wind of 32 to 38 mph; a fresh gale is 39 to 46 mph; a strong gale is 47 to 54 mph; and a whole gale is greater than 55 mph. It first came into use in the nineteenth century with the British adoption of the Beaufort scale to estimate wind speeds at sea based upon observed effects (such as size of the swells).

Outlook:

Partly to mostly cloudy skies over the weekend with continued below normal temperatures. Chance of light snow both Saturday and Sunday, especially in the north. Some lingering snow into Monday over eastern sections. Colder yet on Monday and Tuesday, with lows falling into the single digits most places. A warming trend will start on Wednesday ahead of the Thanksgiving holiday. Temperatures will warm into the 30s F toward the end of the week. A winter storm potential looms for the end of the holiday weekend, so keep track of the weather forecasts in your area.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Nov 24, 2000

Topic: Record Cold Days Preceding Thanksgiving

Earlier this week, a cold Canadian high pressure system brought record cold to our region. Sioux Falls, SD reported a new record cold maximum temperature of only 13 degrees F on Monday, November 20th. Cambridge and St Cloud Minnesota reported new record lows for Tuesday, November 21st with -6 and -3 degrees F, respectively. Orr, MN reported a record low of -6 degrees F on Wednesday, November 22 (this was also the lowest temperature in the lower 48 states on Wednesday) and Red Wing reported a record low of 5 degrees F on the same morning. Most of these records were associated with new snow cover established last week. Thankfully, a strong warming trend will return temperatures to the 30s and 40s F for the Thanksgiving Holiday period.

Topic: Aviation Weather for the Busy Travel Season

The National Weather Service Aviation Weather Center provides valuable information to aviation and the airlines industry. Their web site is

<http://www.awc-kc.noaa.gov>

They provide current conditions, forecasts and advisories on nearly all features of the environment which affect aviation, such as convection, icing, turbulence, mountain waves, winds aloft, cloud ceilings and visibility. In addition they report on significant weather affecting air traffic routes and destination airports (through a network called Aerodrome reports). They even have a section on volcanic eruptions that may impact international routes. During this busy travel season, their web site gets plenty of action. It appears that the weather will be rather quiet across the United States for the Thanksgiving Holiday, except for some thunderstorms in the southeast states along the Gulf of Mexico.

Topic: The Climatology of Minnesota Snow Cover

A study by the late state climatologist Earl Kuehnast showed that the average date for the first 1 inch snow cover ranges from October 30 at Crane Lake, Minnesota (northern St Louis County) to as late as December 1st down at Albert Lea, Minnesota. The average duration of snow cover during the winter varies considerably as well, ranging from 85 days in southwestern Minnesota to over 160 days in the Arrowhead region. For the Twin Cities specifically, the average first snow cover date is November 22 and the average duration of snow cover is about

100 days.

Using the 100 plus years of record at Farmington, MN in Dakota County, we find that 7 times 1 inch snow cover has occurred by the end of October. On the other hand, there have been 3 occasions when 1 inch or greater snow cover did not occur until after Christmas. I would venture a guess that we probably had deeply frozen soils conditions during those winters. The depth of freezing in the soil as well as the severity or magnitude of cold temperatures which occur in the rooting area of soil are highly governed by the onset of permanent snow cover. Generally speaking, early snow covers help insulate the soil and prevent it from freezing as deeply or as severely.

MPR listener question: Many places in Minnesota have had significant snowfall this month. What is the record snowfall for the month of November?

Answer: The record snowfall for November is nearly 59 inches which occurred at Bruno (Pine County) in 1991 (much of it came from the Halloween Blizzard that year). In the same November, the Twin Cities recorded its largest November snowfall total with 46.9 inches.

Almanac:

Average Twin Cities maximum temperature for today's date is 35 F (plus or minus 10 degrees standard deviation) and the average minimum is 20 F (plus or minus 11 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 59 degrees in 1990; lowest maximum temperature of 10 F in 1893 and 1985; lowest minimum temperature of degrees -10 degrees F in 1893; highest minimum temperature of 39 degrees F in 1908; record precipitation of 0.42 inches in 1908; and record snowfall of 1.7 inches in 1977. The coldest windchill conditions occurred in 1950 with a reading of -43 degree F. There have been seven measurable snowfalls on this date since 1948, the most recent of which was 1.1 inches in 1996.

Average dew point temperature for today is 18 degrees F. The highest dew point on this date is 40 degrees F, while the lowest is -18 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 68 degrees F at Wheaton (Traverse County) in 1984; the all-time low is -31 degrees F at Pokegam Dam (Itasca County) in 1898.

Word of the Week: Snow Pillow

This is not a pillow made of snow, nor is it a pillow to sleep in the snow with. It is the name of an instrument used to measure the water content of snow by weight. It is laid on top of the

soil or just below the soil surface and weight changes due to accumulating snow cover on top of this instrument are recorded. Knowing the weight change and the area of the snow pillow surface, the water equivalence can be calculated. Snow pillows are usually made of inch-thick stainless steel and range in size from 3 to 20 square feet. The weight of snow resting on the pillow is converted to an electrical signal by transducers and the water content of the snow is calculated using the known surface area of the pillow.

There are over 1700 snow survey courses throughout the United States (mostly in the western states) operated by the USDA Natural Resource and Conservation Service and many of them are equipped with snow pillows and other electronic sensors which transmit their data to central computers using radio and satellite systems.

Outlook:

A warming trend will prevail throughout the region over the Thanksgiving Holiday weekend. Snow will melt during the day, releasing enough water vapor for overnight fog to form. Winds will be light to moderate with a good deal of sunshine during the afternoons. High temperatures should reach the 30s and 40s F. Chances for precipitation don't increase significantly until Tuesday, Wednesday and Thursday. A mix of rain and snow may occur in the south. Colder temperatures will return 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, Friday, Dec 1, 2000

Topic: November Climate Summary

The average temperature for November varied around the state. It was from 1 to 3 degrees F colder than normal in many parts of southern and central Minnesota, but in the far northern counties it was near normal or even a few degrees above normal. International Falls, MN reported nearly 4 degrees F warmer than normal. It was as warm as 75 degrees F on the 1st of the month around La Crosse and La Crescent in southeastern Minnesota, but before Thanksgiving most of the landscape was snow covered and lows had fallen below zero degrees F in many places, including as far south as Rochester.

Precipitation for November was well above normal everywhere across the state. Most places recorded two to three times the normal amount for November. Duluth recorded over 5 inches for only the second time since World War II and they reported 17.5 inches of snowfall as well. With the colder temperatures many places reported above normal November snowfall totals, including over 19 inches at Sioux Falls, SD, over 15 inches in the Fargo-Moorhead area, and nearly 10 inches in the Twin Cities.

A summary of November climate conditions from around the region..

Location	Nov Temp Departure (deg. F)	Total Precip (inches)	Precip Departure from normal (in.)	Precip Departure (in.)	Snow # of Foggy Days
Twin Cities	-2.0	3.26	+1.71	9.8	21
St Cloud	-1.1	3.24	+1.97	8.0e	22
Duluth	+0.2	5.08	+3.28	17.5	27
Rochester	-2.6	3.06	+1.45	5.4	24
Intl Falls	+3.9	2.75	+1.60	3.4	25
Fargo, ND	-2.7	4.13	+3.40	15.3	19
La Crosse, WI	-1.6	2.41	+0.68	2.8	19
Sioux Fls, SD	-7.8	2.52	+1.43	19.6	20

New record events reported during November from around our region included....

Record snowfall of 17 inches on the 21st near Marquette, MI
Record low of -3 degrees F at St Cloud on the 21st
Record monthly total precipitation of 3.29 inches at Williston, ND
Record cold maximum temperature of 13 degrees F at Sioux Falls, SD on the 20th
Record snowfall of 4.8 inches on the 28th at Aberdeen, SD
Record monthly snowfall of 30.5 inches at Aberdeen, SD

Topic: In a November Fog

One of the most significant features of the weather around the region during November was the frequency of fog. Nearly all major airport sites reported fog on 20 or more days during the month, and two locations, International Falls and Duluth reported fog on at least 25 days. This is an abnormally high frequency. Climatological statistics show that fog is typically reported once every 3 to 4 days during November. Then again this was a very wet November with plenty of water vapor around, so the odds were stacked in favor of fog formation. Driving with the headlights on has become pretty habitual this month.

Topic: England, Wales, and Rochester, MN are all wet

It was reported earlier this week that a persistent storm pattern in the North Atlantic has produced the wettest fall (Sep-Nov) ever over England and Wales. Precipitation since September 1st has averaged nearly 18.5 inches across the landscape there, causing numerous rivers to exceed flood stage.

Closer to home.....

With nearly 41 inches of precipitation so far this year, Rochester, MN is close to breaking their record for the wettest year. In 1990 they recorded 43.94 inches of precipitation, establishing a record annual total for that community. If December turns out to be wetter than normal, they could break that record this year.

MPR listener question: It seems we have been having fog on most mornings this week. When is the foggiest time of year in the Twin Cities?

Answer: Climatological records show that December has the highest frequency of fog in the Twin Cities, followed by January, February, November, and March. Historically, there is a better than a one in three chance that fog will be observed on a given day in December. The typical cause is daytime melting of snow or evaporation of water from the surface and then nighttime cooling with formation of an inversion layer. Thus, in the evening or early morning hours, water droplets are formed from condensation in the air layer nearest the ground.

Almanac:

Average Twin Cities maximum temperature for today's date is 31 F (plus or minus 10 degrees standard deviation) and the average minimum is 17 F (plus or minus 11 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 57 degrees in 1962; lowest maximum temperature of 1 F in 1919; lowest minimum temperature of degrees -15 degrees F in 1893; highest minimum temperature of 43 degrees F in 1962; record precipitation of 0.83 inches in 1985; and record snowfall of 8.4 inches also in 1977. The coldest windchill conditions

occurred in 1893, 1908, 1927, and 1930 when readings from -40 to -45 degrees F were recorded. There have been seventeen measurable snowfalls on this date since 1948, the most recent of which was 0.1 inches in 1996.

Average dew point temperature for today is 18 degrees F. The highest dew point on this date is 49 degrees F, while the lowest is -16 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 70 degrees F at Chaska (Carver County) in 1998; the all-time low is -51 degrees F at Pokegam Dam (Itasca County) in 1896.

Word of the Week: Smochy (pronounced smoc-kee)

No, this is not that Beanie Baby that looks like a frog. Smoch is an ancient Scottish word for heavy fog, and smochy is a derivation used to describe the air when it feels really chilly, and close, perhaps even intimidating as when visibility is quite limited. It is certainly not a pleasant sounding word.....

Outlook:

Temperatures will decline over the weekend and early next week. There will be a chance for snow, mostly in the north for late Sunday through Tuesday. Some moderation in temperature by the end of next week and a chance for snowfall statewide by Thursday and Friday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 8, 2000

Topic: Cold Enough

The abrupt change in the weather earlier this week ushered in some record setting values. On Tuesday, December 5th the lowest temperature reported in the lower 48 states was -17 degrees F at Orr, MN and at Fargo, ND. Then again on Wednesday, December 6th the lowest temperature reported from the lower 48 states was -11 degrees F at Cambridge, MN. Several places around the state set records for coldest high temperatures on December 5th. Some of these were:

3 degrees F at Cloquet 0 degrees F at Cambridge
5 degrees F at Albert Lea -2 degrees F at Orr

Alexandria, MN reported a high temperature of 2 degrees F on Tuesday, tying the record (from 1958) coldest for December 5th, while Rochester reported a high of 6 degrees F also tying the recorder coldest for the date (1937). The Twin Cities reported a high of just 9 degrees F on Tuesday, the 3rd coldest ever maximum temperature for December 5th.

Topic: Good Ice Making Weather

This is the time of year that the frost layer in the soil begins to deepen and lake ice begins to thicken. Ice on the Mississippi River begins to develop more extensively as well.

Soil frost depths currently range from 4 to 8 inches depending on surface cover. Lake ice thickness is highly variable and still dangerous in many places, as usual for this time of year. Earlier this week, resort operators on Lake Winnibigoshish and Lake Mille Lacs reported 6-9 inches of ice on many bays but variably lower ice thickness (2-5 inches) elsewhere on the lakes. Forecasted lower than normal temperatures for much of the week ahead will accelerate the penetration of ground frost and formation of lake ice.

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

Bear in mind that there is no reliable method to estimate the rate of ice formation on individual lakes. Several factors such as lake depth, vegetation, water currents, exposure to wind and snow cover all influence the rate of ice formation. Ice chisels or augers should be used to check thickness of lake ice. Remember a minimum thickness of 4 inches is recommended for ice fishing, and a thickness of 12 inches or greater is needed to support vehicles according to DNR guidelines.

Topic: Anniversary of a Blizzard (1927)

If you think that the windchill values have been severe this week, consider what our ancestors had to put up with back in 1927. This is the anniversary of one of the most dangerous December blizzards to ever strike the Twin Cities area. December 7-8, 1927 brought 8.5 inches of snowfall, accompanied by 35 to 45 mph winds and bitter cold. The windchill index remained in the -60 to -70 degree F category for much of the day on the 8th. (the coldest December windchill values before those of Christmas week 1983 which produced values of -80 F). Visibility was just a block or two within the Twin Cities. Fortunately, warnings were heeded and many businesses and schools closed. Milk deliveries were suspended because the trucks got stuck, or the milk froze in the cans. So there was a milk shortage for a brief time following the storm. New Years Eve at the end of the month was one of the coldest ever in 1927, with temperatures remaining below zero.

MPR listener question: The temperature in the Twin Cities fell to -4 degrees F on December 2nd. Is this unusually early for a below zero temperature reading?

Answer: Not much. The average first date for a temperature reading below zero in the Twin Cities is December 9th. So such cold arrived just a week early this winter. The earliest ever date for a below zero reading in the Twin Cities was November 4, 1991 (following the famous Halloween Blizzard). Conversely, the latest date for a below zero reading was January 16, 1955. Of course some northern Minnesota counties have reported below zero temperature readings much earlier in the fall. Grand Rapids (Itasca County) reported -10 degrees F on October 23, 1917.

Almanac:

Average Twin Cities maximum temperature for today's date is 27 F (plus or minus 13 degrees standard deviation) and the average minimum is 14 F (plus or minus 13 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 50 degrees in 1939; lowest maximum temperature of -6 F in 1927; lowest minimum temperature of degrees -15 degrees F in 1927; highest minimum temperature of 40 degrees F in 1907; record precipitation of 0.44 inches in 1963 and 1987; and record snowfall of 7.1 inches in 1995. The coldest windchill conditions occurred

in 1927 when readings from -65 to -70 degrees F were recorded. There have been twenty-five snowfalls on this date since 1891, the most recent of which was 0.9 inches in 1997.

Average dew point temperature for today is 13 degrees F. The highest dew point on this date is 46 degrees F, while the lowest is -20 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 63 degrees F at Madison (Lac Qui Parle County) in 1990; the all-time low is -38 degrees F at Big Falls (Koochiching County) in 1932.

Words of the Week: Mustard Winds

The English have several interesting expressions for weather conditions and this is one of them. When we have a cold front or cold wave move through the midwest, as we did earlier this week, our meteorologists talk about the windchill, but also sometimes refer to the wind as a "biting wind", a "penetrating wind", or a "bitter wind." The English will sometimes refer to a wind that brings on severe windchill conditions as a "mustard wind." This is most commonly a cold and damp northeasterly wind off the North Sea. The penetrating wind we had earlier in the week when windchills fell to -30 and -40 F, was actually a very dry wind as dewpoints fell into the minus teens, indicating little water vapor in the air.

In fact, mustard used as an adjective generally has a negative connotation: mustard gas was an irritating and blistering gas used in WWI; mustard oil has a very unpleasant odour; mustard beetle is a destructive insect pest; mustard plaster or mustard paper is a counter-irritant used in medicine; and anybody who has done laundry knows that a mustard stain is one of the most difficult to remove (just look at my tie collection!).

Outlook: This weekend, particularly starting on Sunday, and much of next week will be no picnic and nothing to mess with from a weather standpoint. It appears that one or possibly two major winter storms will be affecting our region. Strong low pressure will develop and bring snow to Minnesota starting on Saturday and continuing through Tuesday, then again on Thursday and Friday. Winds will be brisk and some dangerous windchill values are likely as arctic air settles in behind the cold fronts. Southern counties may be subject to more snowfall than northern areas. This pattern will persist for at least 10 days, keeping us colder and snowier than normal. (It may indeed have some impact on shopping patterns for the upcoming holiday season).

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 15, 2000

Topic: New Monthly and Seasonal Climate Outlooks

Near normal precipitation (snowfall) is suggested in the recent climate outlook for January and the entire three month winter period of January through March. The temperature outlooks for the same periods favor colder than normal conditions based primarily on the persistence of snow cover and intrusions of colder air from higher latitude regions. Though some Minnesotans will welcome the return to old-fashioned winter conditions, the expected below normal temperatures will definitely continue to hurt our pocketbooks through higher heating costs. Dry throats, dry skin, and static electricity will remain common symptoms from the cold weather expected this winter.

Topic: Record cold on December 12th

Tuesday morning (December 12th) brought record cold to many locations in Minnesota. Though the Twin Cities did not set a record low temperature (-11 F on Tuesday was the coldest December 12th since 1962, but not close to the record cold of -14 F in 1903), several other communities reported record lows, including....

Alexandria -21 F	Brainerd -23 F	Cambridge -24 F
Windom -17 F	Owatonna -15 F	Albert Lea -15 F
Red Wing -15 F	Hibbing -24 F	Park Rapids -27 F
Lamberton -14 F	New Ulm -15 F	(tied 1945 and 1932)
Embarrass -35 F	Littlefork -27 F	Babbitt -25 F
Eau Claire, WI -18 F		

Further, during the day on Tuesday, the maximum temperatures never recovered much. As a result many record cold maximum temperatures were recorded as well, including...

MSP -1 F	Rochester -5 F	Fergus Falls -5 F
Eau Claire, WI -1 F	St Cloud -4 F	(tied 1922)
Mankato -2 F	(tied 1995)	

Topic: Minnesota's ice box reputation

This week was a good one for preserving Minnesota's reputation as the nation's ice box. In fact, Minnesota reported the nation's lowest temperature (excluding Alaska) for five consecutive days this week (December 10-14) with -35 F at Flag Island on the 10th, -27 F at Flag Island on the 11th, -35 F at Embarrass on the 12th, -24 F at Flag Island again on the 13th, and -24F at Cambridge on the 14th. (note Flag Island is a relatively new weather station in MN, located on the Northwest Angle in Lake of the Woods).

Topic: Weather Related Odds and Ends

A new ordinance in Tokyo, Japan will require owners of new buildings to plant gardens on their rooftops. These gardens must cover at least one fifth of the roof space. It is hoped that such measures will help reduce the heat island effect so prominent in the urban environment.

In the United Kingdom, the Meteorological Office has entered an agreement with the National Health Service to provide a workload forecast for emergency services. This will be based on a combination of weather intelligence and health data such as air quality, allergens, and virus levels. The forecasts will be provided to hospitals and emergency health care facilities.

A wealthy businessman, Luis Guzman, is paying \$200,000 to have 300 tons of snow shipped from Quebec, Canada to San Juan, Puerto Rico this Christmas season. There, the snow will be transferred to a refrigerated event hall where customers can pay up to \$30 for 15 minutes of snowball fighting or snowman building. Mr. Guzman believes that Puerto Ricans will welcome the opportunity for a brief white Christmas adventure.

MPR listener question: It seems that many places around the state are receiving higher than normal snowfall so far this month. What is the record for the snowiest December?

Answer: In the Twin Cities climate record (1891-2000) the snowiest December was in 1969 when 33.2 inches fell. There have been some memorable snowy Decembers elsewhere around the state as well. Also in December of 1969, St Peter reported 37 inches of snowfall, and Duluth reported 39 inches. The northshore area of Lake Superior has had numerous snowy Decembers. In December of 1996, Two Harbors reported 49 inches of snow, while in December of 1995 Lutsen reported 36 inches. In December of 1950, New Ulm reported 37 inches of snowfall and Duluth reported 44 inches. Closer to the Twin Cities, Maple Plain reported 38 inches that same year. Probably the snowiest December occurred in 1927, when Campbell (Wilkin County) reported 50 inches and Maple Plain reported 43 inches. We'll see, but we may be in store for a rather snowy December this year.

Almanac:

Average Twin Cities maximum temperature for today's date is 26 F (plus or minus 13 degrees standard deviation) and the average minimum is 12 F (plus or minus 14 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 49 degrees in 1923; lowest maximum temperature of -5 F in 1932; lowest minimum temperature of degrees -21 degrees F in 1901; highest minimum temperature of 39 degrees F in 1928; record precipitation of 0.71 inches in 1902; and from the same storm

record snowfall of 7 inches in 1902 . The coldest windchill conditions occurred in 1916 when readings from -60 to -65 degrees F were recorded. There have been 33 measurable snowfalls on this date since 1891, the most recent of which was 0.1 inches in 1996.

Average dew point temperature for today is 10 degrees F. The highest dew point on this date is 36 degrees F, while the lowest is -22 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 60 degrees F at Tracy (Lyon County) in 1939; the all-time low is -47 degrees F at Pokegama Falls ((Itasca County) in 1901.

Words of the Week: Snow Stake

Sometimes called a snow scale, this is usually a wooden post, scaled much like a yardstick and set into the ground to visually show the snow depth, especially in regions which tend to accumulate large quantities of snow. Sometimes you will see them placed along roadsides or near government buildings. They are popular in the mountainous western states and in some communities around the Great Lakes.

Outlook:

Chance of snow in many areas of the state for Saturday through Monday. It may be mixed with some sleet or freezing rain in western sections, but heaviest snowfalls are likely in the northeastern counties. Temperatures will drop dramatically on Saturday and Sunday with the passage of a cold front. Windchill conditions will fall to the advisory category (-40 to -50 F) for Saturday and Sunday in many places. Temperatures will climb to near normal values for part of next week with another threat of snow Tuesday through Thursday.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 22, 2000

Topic: Snow over the Christmas Holiday Break in the Twin Cities

History shows that snowfall occurs about 45 percent of the time between Christmas Eve and Christmas Day in the Twin Cities area, and about 85 percent of the time during the week before New Years Day. Thus it is highly likely that Christmas gifts of boots, hats, gloves, skis, skates, sleds, and snowshoes will be used over the holiday break. In many years, the weather outside has been truly frightful, keeping people indoors for much of the holiday break. The National Weather Service criteria for issuing a wind chill advisory is a value of -40 degrees F or colder. This has occurred on Christmas Eve or Christmas Day in the following years....

Christmas Eve	Christmas Day
1892 (-47 F)	1892 (-56 F)
1902 (-54 F)	1902 (-66 F)
----	1903 (-63 F)
1910 (-40 F)	----
1914 (-40 F)	1914 (-44 F)
1917 (-49 F)	1917 (-53 F)
----	1920 (-40 F)
1921 (-55 F)	----
1924 (-44 F)	1924 (-55 F)
----	1925 (-42 F)
1926 (-40 F)	----
1933 (-50 F)	1933 (-45 F)
----	1934 (-60 F)
1935 (-43 F)	1935 (-49 F)
----	1944 (-40 F)
----	1962 (-46 F)
----	1977 (-55 F)
1980 (-42 F)	----
1983 (-79 F)	1983 (-52 F)
1984 (-40 F)	----
1985 (-53 F)	1985 (-48 F)
----	1990 (-48 F)
----	1992 (-40 F)
----	1993 (-42 F)

Thus since 1891, the wind chill advisory criteria has been reached in the Twin Cities area for Christmas Eve or Christmas Day in 23 years, a frequency of about once in five years. Certainly with the recent trend in arctic air over Minnesota, we may see it again this Christmas.

Christmas of 1879 was the coldest in history. Nearly 20 inches of snowfall had occurred during December and an arctic air mass on Christmas Eve and Christmas Day produced a low of -39 degrees F

in downtown St Paul. The old St Paul Dispatch newspaper termed this weather.... "as being of general inconvenience and discouraging to outdoor amusements." Interestingly enough, temperatures rebounded to 42 degrees F by New Years Day 1880.

Topic: The Significant Weather of the Year 2000

Time to review some of the most significant weather in Minnesota and the upper midwest during the past year. In chronological order, my list includes...

-Winter of 1999-2000 as defined by the period from November to March, was the warmest of the 20th Century in Minnesota, and second in the historical record to the winter of 1877-1878. Christmas Day of 1999 brought record warmth to Duluth (44 degrees F), International Falls (45 degrees F), Fargo-Moorhead (47 degrees F) and Grand Forks, ND (45 degrees F)

-Exceptionally warm February, warmest ever at Sioux Falls, SD and the 5th warmest in the Twin Cities record. It was 68 degrees F at Windom on the 22nd, with dewpoints in the 50s F, and no remaining snow cover. On the 25th, the National Weather Service issued their first ever severe thunderstorm watch (SW counties) in the month of February.

-Exceptionally warm March, with the earliest ever 80 degrees F reading reported at Sioux Falls, SD on the 7th, the earliest ever 70 degrees F mark reported at Duluth on the 7th, and the earliest ever 60 degrees F temperature reported at International Falls on the 3rd. The Twin Cities high of 72 degrees F on March 5th was a mere 39 degrees above normal! Many regional lakes reported no more ice cover by the third week of the month.

-April brought concerns for drought. Stream flows and lake levels were low, and many places reported the lowest soil moisture values since the drought of 1988.

-Very wet May with some southern counties reporting over 7 inches. Flash flooding occurred from heavy thunderstorms on the 17th and the 31st.

-Big temperature swings in June. Frosts in some areas on the 5th (28 F at Cambridge) hurt the strawberry crop. Record warmth on the 8th with highs of 101 degrees F at Redwood Falls (highest June reading since 1988) and 100 degrees F at Olivia (highest June temperature since 1995). Heavy thunderstorms and flash flooding in the Red River Valley on the 19th and 20th. Up to 7 inches of rainfall raised the Red River above flood stage, and flooded the Fargodome main floor with six feet of water.

-Flash flooding in Dakota County on July 7-8, with Eagan reporting over 8 inches. Record cold temperatures on the 18th and 19th. Many daytime maximum temperatures in the 50s F on the 18th, followed by frosts in some northern counties the morning of the 19th. Granite Falls tornado on July 25th, swept a nine mile long path through the city. It was classified as a rare F4 (wind speeds greater than 207 mph) tornado by the National Weather Service.

-August was sultry. Record dewpoints were set from the 12th to the 14th. Dewpoints as high as 80 degrees F (Faribault) and Heat Index values as much as 105 to 110 degrees F were reported across southern counties.

-Big temperature swings again in October. Record cold temperatures were reported on October 8th with 14 F at Pipestone and 15 F at Olivia, the coldest ever for so early in the fall. Then, the warmest October 19th in history occurred, with 90 degrees F at Appleton setting a new state record for the date. It was a record-setting 88 F at Montevideo and 86 F at Willmar, as well.

-A November 1st tornado in Kandiyohi County destroyed three farmsteads. A rare occurrence indeed, only the third tornado ever reported in the month of November in Minnesota. Then 5-6 inch snowfalls in SW counties on the 15th and 16th.

-Old-fashioned winter settled into the region. Abundant snowfall, below zero temperatures and dangerous wind chill values prevailed. Minnesota reported the nation's lowest temperature (excluding Alaska) on ten different days during the first half of the month.

MPR listener question: With 20 inches of snowfall so far this month in the Twin Cities, and 30 inches so far for the winter season, what do you expect might be the total snowfall for this winter when all is said and done?

Answer: It has indeed been a snowy winter so far. This is only the seventh December since 1884 that the Twin Cities has seen 20 or more inches of snowfall, and only the tenth time that 30 or more inches of seasonal snowfall has occurred by the end of December. In all of those historical years the average seasonal snowfall accumulation in the Twin Cities was 70 inches. Given the outlook of colder than normal temperatures to prevail through March, I would say that 70 inches for the season is a reasonable guess. This is the snowiest December in the Twin Cities since 1983 (21 inches) and it was the winter of 1983-84 which set the record seasonal snowfall total of 98.4 inches!

Almanac:

Average Twin Cities maximum temperature for today's date is 27 F (plus or minus 13 degrees standard deviation) and the average minimum is 13 F (plus or minus 13 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 48 degrees in 1931; lowest maximum temperature of -12 F in 1983; lowest minimum temperature of degrees -20 degrees F in 1983; highest minimum temperature of 34 degrees F in 1931; record precipitation of 0.52 inches in 1968; and from the same storm record snowfall of 7.6 inches in 1968. The coldest windchill conditions occurred in 1983 when readings of -60 F were recorded. There have been 24 measurable snowfalls on this date since 1891, the most recent of which was 0.7 inches in 1993.

Average dewpoint temperature for today is 13 degrees F. The highest dewpoint on this date is 35 degrees F, while the lowest is -32 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 55 degrees F at Mankato (Blue Earth County) in 1890; the all-time low is -44 degrees F at Baudette (Lake of the Woods County) in 1963.

Word of the Week: Snowcreep

This is not the guy who just put a snowball down the back of your neck, nor is it the snowplow driver who just cleared the alley by pushing all the snow onto your driveway. It is a term used to describe the slow, continuous downhill movement of a snowfield or mass of snow on a slope. Most often associated with mountainous areas, this feature can also be observed on less topographic terrain as well, such as the ridges of the Lake Superior shoreline, or the Mississippi River Valley in southeastern Minnesota.

Outlook:

No threat of heavy snow for a while. Light snow may occur in the SE on Saturday and again on Sunday in northern areas. There may be a chance for light snowfall again later next week for Wednesday through Friday.

Temperatures will continue to average 8 to 12 degrees colder than normal and wind chill conditions over the holiday weekend may fall into the advisory category (-40 F or colder) in many places. Some moderation in temperatures later next week as daytime highs struggle to reach the teens F. The current temperature forecast will produce one of the coldest Decembers in the past 100 years in the Twin Cities, with a monthly average value less than 9 degrees F (only five other Decembers have been this cold), and the coldest since 1985.

To: Cathy Wurzer, Jim Bickal, Eugene Cha, and Julie Siple
From: Mark Seeley
Re: Suggestions for MPR's Morning Edition, Friday, Dec 29, 2000

Topic: Preliminary Climate Summary for December 2000

The two most appropriate words for this month are cold and snowy. December's mean temperature is from 9 to 12 degrees F colder than normal around the state. The coldest December since 1985 for most locations and the coldest month since January of 1994. Temperatures above 30 degrees F have not been seen since December 4th in many places and there have been numerous reports of record setting lows, including several on Christmas Eve and Christmas Day. Preston (Filmore County) reported a record low of -32 degrees F on Christmas Eve, while the following locations all reported record lows on Christmas Day:
Cambridge -33 F Austin -28 F St Cloud -26 F
Winona -31 F Rochester -25 F La Crosse, WI -26 F

On the 22nd, Morris, MN (Stevens County) reported a -35 degrees F low, the coldest December temperature ever measured in that community. Winds were strong on several days, pushing the wind chill values as low as -50 to -60 degrees F.

Abundant snow was also a key feature of the month, with many locations reporting twice or three times the normal amount of snowfall. Rochester, Waseca, Preston, Roseau, La Crosse (WI) and the Twin Cities all reported over 2 feet of snowfall. In fact, Rochester reported a new record total snowfall for December of over 33 inches. The liquid equivalent of the snowfall ranged from 1 to 2 inches typically, with the heavier amounts in southern counties.

As a further indicator of how cold this December has been, Minnesota has reported the nation's lowest temperature on roughly half the days of the month. The following data from Minnesota locations represent the nation's lowest temperature (excluding Alaska) for the date shown:

12/5 -17 F at Orr
12/6 -11 F at Cambridge
12/10 -25 F at Flag Island
12/11 -27 F at Flag Island
12/12 -32 F at Embarrass
12/13 -24 F at Flag Island
12/14 -24 F at Cambridge
12/17 -18 F at Park Rapids
12/18 -13 F at Cambridge
12/19 -22 F at Warroad
12/22 -29 F at Roseau
12/24 -34 F at Embarrass (-26 F at Park Rapids)
12/25 -34 F at Embarrass (-33 F at Cambridge)
12/26 -17 F at Flag Island, International Falls, Hallock, Thief
River Falls, and Warroad)
12/27 -26 F at Ely and International Falls

Topic: Be wary of the snow load on your roof

In the absence of thawing temperatures, the snowfall this month has been accumulating on the roofs of buildings. Snow load refers to the weight of snow and is primarily a factor of the total water content (or snow density). If the snow on a roof contains 1 inch of water content, its weight is 5.2 lbs per square foot of surface area. In some places snow has accumulated to a depth of 20 or more inches and even deeper where the slope of a roof line is shallow or protected from the wind. In such cases, the water content of the drifted snow on the roof may be as much as 2 inches, or 10.4 pounds per square foot. For a 1000 square foot roof, this translates to over 10,000 pounds of weight. Depending on the age of the building and the weight bearing capacity of the roof, such heavy snow loads may present a damage risk.

MPR listener question: Such a cold December with no temperatures above the freezing mark since the 4th. Do you think we will still have a January thaw in the Twin Cities area?

Answer: Indeed, it has been a very cold December, but it is actually quite uncommon for a January thaw not to occur in the Twin Cities. Measured as two or more days with temperature at or above the freezing mark (32 F), January thaws have occurred over 90 percent of the time in the Twin Cities climate record (1891-2000). Only in 1912, 1918, 1929, 1937, 1940, 1977, 1978, 1979, and 1982 did a January thaw not occur.

Almanac:

Average Twin Cities maximum temperature for today's date is 24 F (plus or minus 11 degrees standard deviation) and the average minimum is 9 F (plus or minus 14 degrees standard deviation).

MSP records for today's date include: highest maximum temperature of 44 degrees in 1908; lowest maximum temperature of -4 F in 1909; lowest minimum temperature of degrees -24 degrees F in 1917; highest minimum temperature of 33 degrees F in 1965; record precipitation of 0.80 inches in 1972; and from the same storm record snowfall of of 3.7 inches in 1972 . The maximum snow depth on this date is 20 inches back in 1968. The coldest windchill conditions occurred in 1909 and 1917 when readings of -55 F to -60 F were recorded. There have been 23 measurable snowfalls on this date since 1891, the most recent of which was 1.7 inches in 1992.

Average dewpoint temperature for today is 7 degrees F. The highest dewpoint on this date is 38 degrees F, while the lowest is -24 degrees F.

Scanning the state climatic data base: the all-time high for today's date is 58 degrees F at Le Sueur in 1897; the all-time low is -47 degrees F at Itasca State Park in 1917.

Word of the Week: Barometer

The writer Ambrose Bierce joked that "the barometer is an ingenious instrument which indicates what kind of weather we are having." In reality it is an important instrument for measuring changes in atmospheric pressure and therefore determining the approach or passage of weather fronts.

Most often the instrument is called an aneroid barometer, which contains a small hollow vacuum tube restrained from collapsing by a spring. A measure of the deflection of the spring is proportional to atmospheric pressure. Usually a calibrated dial or column scale indicates the atmospheric pressure in inches, millibars, or millimeters (units common for use with older mercury barometers). The standard atmospheric pressure at sea level is 29.92 inches, 1013.2 mb, or 760 mm.

If you received a barometer for Christmas, set it according to the station pressure from the nearest National Weather Service Forecast Office. You can obtain this value from a NOAA weather radio, Cable TV Weather channel, or various Internet weather information sites.

It is not important to be precise with respect to your own elevation or temperature conditions, because the main use of the barometer as a home instrument is to observe pressure changes over periods of hours in order to infer if low pressure or high pressure and their associated weather features are approaching.

Outlook:

Remaining colder than normal through the New Years weekend, with a chance for light snow later on Saturday and Sunday. A warming trend will start on New Years Day and continue most of next week. Temperatures may climb into the 20s F during the first week of January and the chances of additional snowfall will be slight, with the best chance on Wednesday.