

Notes for MPR "Morning Edition", Program of January 7, 1994

For: Greg Magnuson and Bob Potter

From: Mark Seeley, University of Minnesota

Re: For your review and comment.

1. Almanac (typical max of low 20s and min of low single digits)

MSP record high for January 7 is 45 set in 1949. The record low is -34 degrees set in 1887. Coldest this century has been -27 degrees in 1912. Record precipitation for January 7 is 0.60 inches in 1886 and the record snowfall is 3.6 inches in 1989.

Scanning the State Climate Data Base other records of note are: The all-time state high temperature is a balmy 55 degrees at Beardsley (Big Stone County), Windom (Cottonwood County) and Winnebago (Faribault County) in 1914. The all-time low temperature for this date is -53 degrees at Pokegama Dam (Itasca County) in 1912. The high that day was -12 degrees.

2. Word of the Week: **Ombrometer or ombrograph**

Ombros is the Greek term for rain. Therefore, this is an instrument for measuring rainfall, e.g. a rain gage. But more commonly it refers to a specific type of rain gage, a trace recorder or micropluviometer (pluvio is the Latin for rain), which is used to measure trace quantities of rainfall that would be too small to register in a normal rain gage.

For acid rain and other pollution type monitoring systems, an ombrometer composed of an electrical circuit sensitive to moisture is sometimes used as a sampling trigger. When it gets wet, it trips a switch which removes the cover from a sampling bucket allowing for the collection of a sample of the precipitation to determine its chemical composition.

3. Topic: Current Cold Weather

The January Weather Outlook released by the National Weather Service last week is so far right on the money - calling for below normal temperatures and above normal precipitation. We have not experienced this type of January to any degree since 1982 when the monthly temperature averaged just 2.3 degrees and we received a total of 46.5 inches of snow. We need the snow cover to keep the soil from freezing too deeply. Currently frost depths range from around 7 inches to just over 1 foot. Interestingly at the St Paul Campus Climate Observatory we measure frost depth under snow cover and without snow cover (the snow is removed to keep the bare soil exposed). The frost depth under snow is about 9 inches, while the frost depth under the bare soil is nearly 30 inches. An illustration of the insulating value of snow cover.

I mentioned that 1982 saw low January temperatures and above normal snowfall. We also experienced some of the most severe wind chill conditions: Notably -60 to -60 degrees on the 15th and 16th and -70 to -75 degrees on the 9th and 10th. Elsewhere around the state wind chills of -100 degrees were reported. Fortunately these two severe cold spells occurred on back to back weekends and most people remained indoors. Twenty two of the 31 days in the month saw minimum temperatures below zero and 4 days reported maximum temperatures that were below zero.

The coldest January this century was 1912 when the monthly mean was just -2.7 degrees. This was only beaten by one year (1875 at -3.4 degrees) in the old Pioneer Records. The most notable feature of January 1912 was that for many Minnesota communities the mercury never rose above 0 degrees for the first 12 days of the month - the longest number of consecutive days below zero in the southern Minnesota record books. Further on January 4th of that year winds of up to 42 mph produced wind chills of -80 degrees. All of Minnesota's rivers and streams were frozen with 32 inches of ice reported on the Red River at Moorhead and 24 inches of ice on the Mississippi at La Crosse. Weather Bureau reports from that time commented how many railways and trolley lines became frozen to their tracks and had to be thawed. The slow down and delays on the railway system produced some supply shortages, especially coal. Reports went on to say how the ice harvest off area lakes was of wonderful quality and benefit to local refrigeration storage. Further the persistence of the cold spell helped prevent the outbreak of sickness and disease. Of course there probably wasn't a lot of social activity going on to spread any disease in the first place!

Only years when January temperature has average below zero are 1857, 1875, 1888, and 1912. Perhaps with the development of the Metropolitan area and the urban heat island such cold conditions cannot occur again.

Notes for MPR "Morning Edition", Program of February 4, 1994

For: Greg Magnuson, Nancy Cole and Bob Potter

From: Mark Seeley, University of Minnesota

1. Almanac (typical max of low 20s and min of low single digits)

MSP record high for February 4 is 50 set in 1834. The warmest this century has been 49 degrees on this date in 1925 and 1990. The record low is -28 degrees set in 1886. The lowest minimum temperature this century has been -23 degrees in 1965. Record precipitation for February 4th is 0.80 inches set in 1884. Record snowfall is 4.4 inches in 1971. Greatest snow depth locally on this date is 21 inches in 1969 and 1979.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 61 degrees at Browns Valley (western Minnesota) in 1991. The all-time low temperature is -52 degrees at Detroit Lakes in 1907.

2. Word of the Week: **Black Ice**

This term has been used for a number of years to refer to new ice that has formed on a body of fresh or salt water, which is dark in appearance due to its transparency. It is a term which has also been used by mariners to refer to a dreaded form of transparent icing which can sometimes be sufficiently heavy to capsize a small ship.

More often than not in Minnesota, this term refers to a type of transparent ice which can form on roads and highways very quickly at low temperatures. It often occurs in and near intersections where cars have to stop for a time and vapors from their exhaust freeze onto the pavement. The two most dangerous characteristics of black ice on roadways are its rapid formation and transparent appearance such that it is hard to visually discriminate it from the normal road surface, particularly when the sun is not out and there is little or no reflection.

3. Listener question about sound from Douglas Coffler: "Do airplanes sound louder during very cold, clear weather?" Indeed they do as I am sure that most people would attest. The transmission of sound through the atmosphere is affected by the composition of the air, the temperature, humidity and wind distributions. Cold, dense air of low humidity and little wind, so common on crisp clear winter mornings in Minnesota transmits sound much better than warm, humid air with a good deal of wind motion. Another reason that we hear airplane noise so much more clearly on these winter mornings is lack of competitive sound waves. Snow cover absorbs sound, in fact fresh snow can have the same effect of acoustic tiles. As the snow gets

deeper it can absorb more sound. Thus many surface noises such as street traffic for example are muffled or diminished by the snow cover as they propagate laterally across the landscape. Thus, unless you are listening to a walkman or something, the sound waves coming from a jet passing overhead directly downward upon you could very well be the only sound waves or certainly the dominant sound waves picked up by your ears.

Another interesting feature of the Minnesota climate related to sound is the crunching of snow when you walk through it. New snow on a sidewalk will often produce a squeaking sound when you walk through it as the fresh snow is compressed. The sound produced by your boots is related to the snow's temperature. When the air and snow temperature are near or slightly below freezing, the pressure of the boot partially melts the snow allowing it to flow slightly under the boot and producing little or no sound. But when the snow temperature drops below 14 degrees F the pressure from the boot will not melt the snow and the ice crystals are crushed, producing a crunching or creaking sound.

And finally an additional comment about the impact of cold dense air masses in the winter. The length of runway required for an airplane to take off depends to a large degree on the properties of the air near the ground. The more dense the air, the shorter the runway required to take off. With the very cold dense air we have experienced recently, the length of runway required to take off from MSP airport has been reduced. I wonder if this is noticeable to the frequent flyers?

4. Notes on Blizzard Conditions:

The most severe type of winter storm is the blizzard, characterized by winds of 35 mph or greater, considerable falling or blowing snow, and temperatures of 20 degrees or lower. These conditions also produce very limited visibility and usually severe wind chill index values. "Severe blizzards" occur when wind speeds reach 45 mph or greater, with falling or blowing snow and temperatures of 10 degrees F or less. A blizzards duration maybe from a few hours to a few days.

Western Minnesota is more subject to "ground blizzard" conditions as loose light snowcover or fresh snow may be blown around by the generally stronger winds there even though measurable snowfall may not occur. Less dense snow which falls at lower temperatures is much more subject to movement by the wind than the heavier wet snow which occurs when the temperature is up around the freezing mark.

Notes for MPR "Morning Edition", Program of February 11, 1994

For: Greg Magnuson, Nancy Cole and Bob Potter

From: Mark Seeley, University of Minnesota

Your listener who remembers that I said it would be a warm February has me perplexed because I don't specifically remember that. Earlier this winter when we talked about El Nino, I mentioned that warmer than normal temperatures during the months of November through March were associated with this phenomena. But recent assessments of El Nino show that the index has returned to near neutral or zero values which have negligible effects.

Average climate records show that the coldest week of the year in our state is the third week of January. But look what we have had for lows the 2nd week of February.

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|------------|-----|-------------|-----|--------------|-----|-----------|-----|
| Intl Falls | -31 | Morris | -33 | Crookston | -34 | Staples | -30 |
| Lamberton | -25 | Waseca | -25 | Cedar Creek | -28 | Roseau | -37 |
| Fargo | -32 | Cloquet | -29 | Grand Rapids | -31 | Rice | -33 |
| Westport | -31 | Park Rapids | -32 | Perham | -37 | Princeton | -25 |

Recent satellite imagery shows that Lake Superior is nearly ice covered. This hasn't occurred since early March of 1978 (it also occurred in early March of 1977 and 1974). This is substantiated by the climatic summary since December 20th which shows that for much of the state the mean temperature over the past 54 days has fallen in the coldest 5 percent for the same corresponding period historically.

The Wall Street Journal on Wednesday of this week ran a story "What's the Matter With the Weather Anyway?" In this article two items drew my attention: one was that it was such a cold January and that MSP reported a deviation of 6 degrees below the January mean temperature. The standard deviation of January mean temperature is nearly 5.5 degrees. We have experienced a negative deviation in January temperature of this order or greater 20 times this century, so it is a bit unusual but not exceptionally so. The other item I noted was the depiction of a zonal or west to east jetstream as a normal winter time jet axis. Actually, during many winters the jet axis is highly variable, sometimes northwesterly, sometimes southwesterly, even sometimes straight from the north pole as it was for a brief time last month. The Earth's atmospheric, although subject to the known laws of physics is very much a chaotic system. In recent years a good deal of literature has suggested that measured perturbations or aberrations in climate are attributable to other measurable phenomena such as El Nino, volcanic ejections of aerosols, solar activity and anthropogenic (human generated) activity such as industrial or agricultural emissions. True to a degree, but every climatic aberration is not explainable in these terms. There is tremendous built-in natural variability. Given the ability to examine the climate of the Earth's surface comprehensively, a meteorologist or climatologist can find wacky weather in almost any space-time coordinates (days to weeks to months, or cities, to states to countries).

1. Almanac (typical max of mid 20s and min of 3 to 5 degrees)

MSP record high for February 11 is 57 set in 1882. The warmest this century has been 51 degrees on this date in 1961. The record low is -31 degrees set in 1899. The lowest minimum temperature this century has been -25 degrees in 1939. Record precipitation for February 11 is 0.28 inches set in 1940 and 1965 and record snowfall is 4.1 inches in 1979. Greatest snow depth locally on this date is inches in 20 inches in both 1967 and 1969.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 61 degrees at Luverne (SW) in 1977. The all-time low temperature is -55 degrees at Leech Lake Dam in 1899. More about 1899 later.

2. Word of the Week: **Isothermal**

This term is used to describe a condition of equal or constant temperature either over space or over time. For example, when we have a very foggy day, sometimes the temperature will remain isothermal or constant for a period of several hours or perhaps all day. With the abundant snow cover in some places, we are finding isothermal conditions in some soil profiles. That is to say the soil is frozen, but it is at a constant 27 or 28 degrees all the way down to a depth of 12 inches.

3. Remembering Feb. 9, 1899. Perhaps the coldest day in the history of Minnesota. Of the 59 official climate reports made for this date in the state of Minnesota, the average low was -37 degrees and the average high was -17 degrees. Leech Lake reported a minimum temperature of -59 degrees F which is still the state record low temperature.

This came in the middle of one of the worst ever Cold Wave outbreaks which lasted from the 1st to the 13th of the month. The area covered by this cold wave was immense. The high pressure system had been building all winter long in the Arctic latitudes, with central pressure in the NW Territories of Canada measured at 31.42 inches (near Swift Current). There were no disturbances to this air mass until a series of relatively strong low pressure centers passed across the southeastern U.S. and pulled this air mass down from the Canadian Rockies.

Ft Logan, MT reported a low of -61 degrees. But most striking was the penetration of the air mass into the southern and eastern states, where many all-time low temperature records were set.

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|-----------------|-----|--------------|----|------------|----|-----------|----|
| Atlanta | -6 | New Orleans | 7 | Montgomery | -4 | Galveston | 6 |
| Nashville | -12 | Jacksonville | 10 | Shreveport | -4 | Baltimore | -7 |
| Washington D.C. | -15 | Tallahassee | -2 | | | | |

Parts of Florida reported 3.5 inches of snow. Ice formed on the Mississippi all the way down to New Orleans where 1 inch thick

ice flows were seen dumping into the Gulf. Ice over frozen rivers in the central and southern U.S. caused fish kills and many birds were killed as well due to cold exposure. The Red River of the North was frozen 42 inches thick at Moorhead and the Mississippi at St Paul was frozen to 30 inches thick. Even at St Louis the Mississippi was frozen 12 to 16 inches and people skated on it. The Missouri at Omaha was frozen to 20 inches. The Niagara River was frozen from the base of the Falls to Lake Ontario. Dynamite was used to break up the ice dams in order to keep water flowing through some of the power plants along the river.

In the Chicago area where protective snow cover was absent, the soil froze to depths beyond 5.5 feet, breaking water and gas mains. Many children in the upper midwest did not attend school at all during the first two weeks of February. Transportation systems were so encumbered that food and fuel shortages became a problem in some major cities. MSP daily mean temperature from Feb. 1 to Feb. 13 was -11 degrees.

Notes for MPR "Morning Edition", Program of February 18, 1994

For: Greg Magnuson, Nancy Cole and Perry Finelli

From: Mark Seeley, University of Minnesota

1. Almanac (typical max of mid 20s and min of 5 to 6 degrees)

MSP record high for February 18 is 58 set in 1981. The record low is -21 degrees set in 1903. Record precipitation for February 18 is 0.52 inches set in 1984 and record snowfall is 7 inches in 1961. Greatest snow depth locally on this date is 27 inches in 1967.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 66 degrees at Pipestone (SW) in 1981. The all-time low temperature is -48 degrees at Roseau in 1966.

2. Word of the Week: Relationship of **glad, glade and glare**

I found it interesting that these words are all related and derived from similar origins - the Anglo Saxon term glaed, the Dutch glad, the German glatt and the Norwegian glada. All refer to brightness or shining (beauty) to some degree, as in "it was a glad evening" or "glad morning" (bright beautiful). "A beautiful glade of roses" refers to a well lit opening or clear space (perhaps in a wooded area) where beds of roses are planted. A moonglade refers to the reflection of the moon on a still body of water. A lake or river glade this time of year is an opening in the frozen water. And of course an everglade is a flooded or inundated landscape dotted with islands or high patches of grass. The term glare is used meteorologically to refer to a type of ice that produces very bright, almost blinding reflection of light sometimes on roads, lakes or glaciers. This time of year a severe glare can be produced on automobile windshields by dusts and particles from the road surface. These types of particles scatter light predominately in a forward direction such that the glare produced by them is most noticeable when you are driving looking into the sun.

3. Subject: What controls the air temperature this time of year?

The Power of Advection

A question put to me during a recent lecture. Despite the fact that we are now experiencing about 10.5 hours of daylight, this time of year advection is a dominant control of our day to day air temperature. Advection in a traditional usage refers to the transport of atmospheric properties horizontally through large scale wind fields. If wind fields are from the northwest, a source of high pressure polar air masses moving over a snow covered landscape, then cooler

temperatures generally prevail. When winds shift to the southwest or southeast they transport generally warmer and more moist air over the state. At this time of year advection effects prevail over surface heating due to bright sunny days because much of the sun's energy is being reflected back by snow cover. Thus even back to back days which are quite sunny (like we have had this week) can have significantly different afternoon temperatures when the winds are from different directions or different air masses move across the region. Yesterday's 3 pm temperatures around the area were well above freezing ranging from 40 to 44 degrees, despite the presence of snow cover. This was mainly due to the warm southeasterly breezes of 10 to 15 mph which brought towards us the mild properties of the air over the southeastern U.S.

As we move later and later into the spring, the sun's effect on surface heating becomes greater relative to the effects of advection of air mass properties.

As long as snow cover is dominating the landscape to our north and west we will be subject to substantial cooling effects of northerly winds and thus may still experience some below normal temperatures during the balance of the month and into March.

Another feature very dominant is the differential loss of snow cover. The sun angle changes more rapidly now as we approach the vernal equinox next month. Slopes with southern aspects and unshaded clear areas in the woods will start to lose snow cover much more rapidly now due to increasing interception of solar radiation.

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3. Subject: What controls the air temperature this time of year?

A question put to me during a recent lecture. This time of year advection is a dominant control of our day to day air temperature. Advection in a traditional usage refers to the transport of atmospheric properties horizontally through large scale wind fields. If wind fields are from the northwest, a source of high pressure

polar air masses moving over a snow covered landscape, then cooler temperatures generally prevail. When winds shift to the southwest or southeast they transport generally warmer and more moist air over the state. At this time of year advection effects prevail over surface heating due to bright sunny days because much of the suns energy is being reflected back by snow cover. Thus even back to back days which are quite sunny can have significantly different afternoon temperatures when the winds are from different directions. As we move later and later into the spring, the suns effect on surface heating becomes greater relative to the effects of advection of air mass properties.

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Notes for MPR "Morning Edition", Program of February 25, 1994

For: Greg Magnuson, Bob Potter, and Nancy Cole

From: Mark Seeley, University of Minnesota

The loss of snow cover across the state in the past 1.5 weeks has both positive and negative effects. On a positive note, the loss of a good deal of frozen water on the land has helped diminish the threat of spring flooding somewhat, albeit we still have to face what March brings. On a negative note, many plants in the home landscape and crops in the field have lost their protective snow cover. Exposure to oscillating freezing and thawing temperatures over the next several weeks can cause a good deal of damage to these plants.

1. Almanac (typical max near 30 and min of 9 or 10 degrees)

MSP record high for February 18 is 58 set in 1976. The record low is -23 degrees set in 1967. Record precipitation for February 25 is 0.63 inches set in 1944 and record snowfall is 2.5 inches in 1917. Greatest snow depth locally on this date is 27 inches in 1967.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 66 degrees at Beardsley (Big Stone County) in 1958. The all-time low temperature is -46 degrees at Big Falls (Koochiching County) in 1934.

2. Word of the Week: **Firn Snow**

The word "firn" from the German means old or of last year, much like the Anglo Saxon term fyrr meaning former or past. Accordingly, this term has been used for years in the meteorological community to refer to "old snow" that has become granular and dense with age as a result of melting, refreezing and sublimation. The granules of snow are usually somewhat uniform and spherical in shape. This is also recognized by glaciologists as the first phase in the process of snow turning into glacier ice. After all the recent melting and refreezing over the past 1.5 weeks, there is a good deal of firn snow around Minnesota.

3. Topic: Ice-sheeting

This occurs somewhat often in Minnesota during the winter and early spring. Snow cover melts, partially runs off or infiltrates the soil before refreezing takes place. Then a solid blanket of ice covers the soil surface (especially low spots in fields or yards) for days or weeks as temperatures remain below freezing. This can cause terrible loss of perennial plants, pasture and alfalfa stands due to smothering. The ice covering over the soil inhibits the exchange of gases, carbon dioxide, oxygen and other products of respiration. Toxic products of aerobic and anaerobic respiration can build up in the soil and kill the crowns and roots of plants. Fields or gardens that have stubble,

crop residue or mulches over them tend to survive better as they help prevent smothering effects by protruding through the ice cover.

Other symptoms of stress to plants in the landscape may become apparent as we move into spring.

The mechanism by which plants survive the winter conditions in Minnesota is referred to as winter hardening or cold hardening, whereby physiological changes occur in plants as the days shorten and temperatures cool in the fall. A maximum degree of hardiness is achieved when temperatures gradually cool to the freezing point and then below it, accompanied by bright sunny days. It has been observed, for example that dogwood can survive temperatures of -100 degrees F, and birch and poplar have survived temperatures of -70 degrees F if the hardening process has been induced gradually. Some plants tend to lose their hardiness when exposed to prolonged periods of relatively warm temperatures. This is the worrisome feature of this winter in Minnesota, since we have experienced two such periods, one in mid December and one in mid February. Some species may have dehardened somewhat under these mild conditions and lost their capability of withstanding the subsequent cold periods which followed. Generally speaking, roots are less hardy than topgrowth or exposed plant tissue. Roots of many plants were protected for a long period by substantial snow cover in January and early February. But the recent loss of snow cover, at least in some southern Minnesota counties may be a detriment to the survivability of some plants. Insufficient soil nutrients such as potassium, phosphorus and calcium have been related to inadequate winter hardening of some plants as well.

Notes for MPR "Morning Edition", Program of March 11 1994

For: Greg Magnuson and Bob Potter

From: Mark Seeley, University of Minnesota

1. Almanac (typical max mid 30s and min of high teens)

MSP record high for March 11 is 61 set in 1822 and 1902. The record low is -27 degrees set in 1948. Record precipitation for March 11 is 1.30 inches set in 1990. Record snowfall is 8.2 inches in 1962. Greatest snow depth on this date is 22 inches in 1979.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 66 degrees at Marshall in 1990 (Pokegama Falls reported 67 degrees in 1902, but I don't believe it). The all-time low temperature is -40 degrees at Pokegama Falls in 1948.

2. Word of the Week: **Precipitable Water**

This term is used to describe the total water vapor in a vertical column (of unit cross-section) of the atmosphere between two specified pressure levels. Can be thought of as the height of liquid water which might be condensed from a vertical column of air extending from the surface to the top of the troposphere (e.g. 40 to 45,000 ft) for example. Measurements from rainshowers and thunder storms sometimes exceed the precipitable water in the overlying layer of the atmosphere. This is because of convergence, that is to say that the water vapor from the air surrounding a frontal system or an individual thunderstorm is drawn into the cyclonic circulation of the system and feeds more water vapor into it. Still, in general there is a correlation between the precipitable water of an air mass and the amount of precipitation measured from a given storm. Precipitable water does provide some guidance to meteorologists when they are forecasting rain or snow showers as to the potential amount of precipitation which might occur. Values of 2 to 4 inches of precipitable water are considered high in such guidance.

3. Usually we talk about meteorology or climatology at this point, but this week I would like to talk about agriculture. One of the growing trends in agriculture is more precise management sometimes referred to as "soil-specific management", "site-specific management" or "precision farming." Proverbial nemeses to the crop producer are spatial and temporal variability. Why does one field produce better than another? Why does one area of a field produce relatively well in a wet year? Why do split applications of fertilizer work well in one place and not another? Why does herbicide X cause crop damage when used in late May instead of early June?

Modern measurement technology, coupled with a variety of better information processing technology and field equipment has produced new capabilities to actually optimize certain operations. For example, Global Positioning Systems (GPS) can be used in conjunction with digitized soils maps to apply fertilizer rates for specific soils across a field. Rather than uniformly apply a fertilizer or herbicide over 100 acres, changes in soils can be compensated for on-the-go and rates of application adjusted as tractors, spreaders and applicators cross the field. There are variable rate applicators manufactured for just such purposes. This cannot only be economic but highly environmental as well since only the needed amount of fertilizer or compound is applied for each specific soil situation.

Best Management Practices (BMPs) are being adapted to protect the environment and to demonstrate the value of sustainable agricultural management systems. The deployment of precision technologies and information in agriculture is growing rapidly to meet this need as many large agricultural industries now have precision management divisions and equipment manufacturers are producing implements which adjust for changes in soils and field conditions. Managing high levels of crop residue with relatively little tillage and calculating crop yields as a harvester goes across a field to show productivity variability within a field are two areas where progress is being made.

Later this month (March 27-30) there will be an international conference on Site-Specific Management for Agricultural Systems at the Thunderbird Hotel in Bloomington. Those interested in this topic might want to contact the Minnesota Extension Service about this conference.

Lastly, my own personal preference here is to get producers to listen to and utilize weather forecasts better in planning their day to day and week to week field operations. Forecasts are getting better and should be utilized to optimize the success of certain operations like planting, fertilizing, spraying, cultivating, irrigating and harvesting a crop. Even in spreading manure for crying out loud!

Notes for MPR "Morning Edition", Program of March 18, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

Finally made it back to 12 hours of daylength. The Vernal Equinox occurs this Sunday, March 20th. It appears that we won't be seeing as much sun as of late, with a series of storm systems projected to bring us some rain and snow showers around the state starting this weekend.

A listener called to ask when was the last time we had no measurable precipitation over the first 17 days of March. Well in fact the last and only other time this occurred in the Twin Cities was 1967. But, I might add that it was much colder in 1967, averaging about 10 degrees cooler than we have experienced this month. The closest climate analogies to what we have been experiencing this month occurred in 1910 and 1981 when temperatures were on the mild side and precipitation was all but absent (0.05 in 1910 and 0.01 in 1981). Actually our last significant precipitation was back on Feb. 25 when we received 0.36 inches.

Can we encourage listeners to clean-up these terrible looking boulevard areas around the Cities? The accumulation of ice, snow, sand, salt and grit from the roads has not been good for the grass, trees and other vegetation which grows in the boulevard areas. A little raking to clean off the debris and open up the soil would do wonders before we start to get some rain to help the vegetation recover.

1. Almanac (typical max high 30s and min near 20)

MSP record high for March 18 is 73 set in 1842. The warmest on this date during this century has been 71 degrees in 1921. The record low is -8 degrees which occurred in 1923. Record precipitation for March 18 is 1.07 inches in 1968 and record snowfall is 9.6 inches in 1951. Greatest snow depth on this date is was also in 1951 with 27 inches of snow on the ground. In fact March of 1951 was one of the snowiest in Minnesota records. The Rosemount Agricultural Experiment Station just SE of the Twin Cities reported nearly 50 inches of snow for the month. The average amount statewide was over 29 inches. St Cloud reported at least a trace of snow or more on 23 of the 31 days in March and the Twin Cities reported snow on 20 days. Many rural roads were closed for weeks due to drifting and a number of roofs collapsed or began leaking due to the excessive snow.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 83 degrees at Montevideo in 1921 and the all-time low temperature is -36 degrees at Pokegama Falls in 1939.

2. Word of the Week: **Rafted Ice**

This term is sometimes used to describe the situation when one ice floe has been pushed up onto the top of another one due to perhaps an ice jam along a river or due to pressure differences as might occur in lakes or oceans. Sometimes this is referred to as pressure or telescoped ice as well. Some pressure ice or rafted ice was visible around the state these past two weeks where ice dams had occurred such as along the Redwood River near Marshall and the Root River near Hokah.

3. March Winds:

This month has been a rather windy one. Typically our greatest average wind speeds occur in the month of April. It would appear that they are arriving early this year. We usually have about twice as many hours of wind above 25 mph in April than we do in March. But we have already had a number of occasions of 25 mph winds or greater. In fact 35 to 45 mph winds have occurred around the state this month without the presence of any major frontal systems or convective storms. Part of this was due to a sinking (downward) polar jet stream which resided over the top of Minnesota for a while. There was greater than normal vertical mixing in the atmosphere and some of the high speed winds aloft were transferred down to the surface.

Thankfully our tilled landscape has had snow cover (in the north) or remained somewhat wet so that the soil has not been moved around much by the wind. But if we continue this dry pattern into next month and experience our usual higher winds during April we could see some wind erosion occur.

Notes for MPR "Morning Edition", Program of March 25, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

Though some shallow soil temperatures climbed into the 50s earlier this week in southern Minnesota, there is still a frost layer in most soils somewhere between 8 and 16 inches below the surface. Nevertheless, the prolonged March thaw has allowed some internal drainage and redistribution of moisture in many soils, and tile lines are flowing in much of southern Minnesota. At this point, this is a good sign and has raised optimism for a good planting season this year.

Despite the nice March weather, it is still too early to uncover roses and mulched perennials (such as strawberry plants). The roots of these plants could still be damaged by severely cold temperatures until about mid-April.

1. Almanac (typical max low 40s and min low 20s)

MSP record high for March 25 is 78 set in 1939. The record low is -8 degrees which occurred in 1867. Lowest temperature this century has been -5 degrees in 1940. Record precipitation for March 25 is 1.43 inches in 1890 and record snowfall is 3 inches in 1900. Greatest snow depth on this date is was in 1951 with 20 inches of snow on the ground.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 83 degrees at Canby and Tracy in 1939 and the all-time low temperature is -31 degrees at Big Fork (Itasca County) in 1965.

2. Word of the Week: **Sounding**

This term derives from both Latin and Anglo Saxon terms meaning to submerge something in order to detect depth. In meteorology the term sounding refers to an upper air observation or a complete radiosonde report. Balloons equipped with instrumentation are launched twice each day (12 hours apart) from upper air stations. They transmit back data about temperature, pressure and humidity as they pass through various vertical layers of the atmosphere. These are referred to as radiosondes. Another type is a rawinsonde, which is a radiosonde that is tracked by either radar or a radio direction finder such that wind direction and speed aloft can be plotted for various vertical layers.

These balloons rise to heights of 80,000 to 100,000 feet before they burst. Sometimes farmers and others find the instrument package in their fields. There are instructions on the container to mail the package back to the government so the instruments can be reconditioned and reused.

3. The average number of days with measurable snowfalls in March is 7. This month we have had only 3 measurable snowfalls, all of the very light variety. The average snowfall in March is nearly 11 inches and to date we haven't even totaled 1 inch. At this point it looks like below normal temperatures will dominate the balance of the month.

Easter Sunday (April 3 this year). Someone called to ask me if I knew or had an indication of what the weather might be like this year on Easter. It is still a bit too early, but the Weather Service 6-10 day

outlook later today might have some indication about Easter. In the 94 years since 1900, rain or snow has fallen on April 3rd 29 times or 31 percent of the years. The most recent snow was in 1982. The average high temperature on this date is 48 degrees and the average low is 27 degrees. The warmest was 80 degrees in 1921 and the coldest 9 degrees in 1954. Since most Easter worship services occur in the morning, sometimes even at sunrise, I examined the distribution of morning low temperatures

on this date. The data show that nearly 50 percent of the time the morning low is in the 30s. Nearly 90 percent of the time the morning low temperature is less than 40 degrees - not particularly comfortable for an outdoor sunrise service or easter egg hunts!

Incidentally this year, Easter Sunday also corresponds to the date that we switch to Daylight Savings time. Might be tough to get up on that morning with the loss of an hours sleep.

Notes for MPR "Morning Edition", Program of April 1, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

1. Almanac (typical max mid 40s and min mid 20s)

MSP record high for April 1 is 82 dating back to 1882. The highest temperature this century has been 75 degrees in 1975. The record low is 1 degree which occurred way back in 1843. Lowest temperature this century has been 9 degrees in 1975. Record precipitation for April 1st is 0.54 inches in 1967 and record snowfall is 2.7 inches in 1896. Our most recent significant snowfall on this date was 1.3 inches in 1971. Greatest snow depth on this date is 10 inches which occurred in both 1975 and 1985.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 85 degrees at Winona in 1986 and the all-time low temperature is -21 degrees at Thorhult (just north of the Red Lakes in Beltrami County) in 1975.

2. Word of the Week: **Vertebratus Clouds**

This is a cloud variety which applies mainly to the cloud genus of cirrus, which are the high fibrous looking clouds, composed of ice crystals. This time of year these clouds can appear out ahead of an approaching warm front. The variety *vertebratus* is noted for appearing to take the form of connected vertebrae (Latin for a joint or joining of bone) or ribs and may sometimes even take on the arrangement of a fish skeleton (look for a Walleye in the sky this spring).

3. Subject: Long Range Outlooks

The new National Weather Service 30 and 90 day outlooks were released Wednesday afternoon of this week indicating expected temperature and precipitation conditions for the month of April, and in general for the period from April through June. We can discuss this.

A listener called and asked a question about how long range outlooks are put together - is it anymore than somebody's wild guess? Well, it is considerably more. One of the central features used for long range guidance is the pattern of the average 700 mb pressure surface aloft, variation in the height of this pressure and the general circulation. Any departures or anomalies detected in the current average pattern at 700 mb are compared to those for the 1948-1970 climatology. Of course even when this pattern is described (usually in mapped form)

a key question is "Will it persist?" Meteorologists examine the stability of the given pattern in past records and run dynamical models of the upper atmosphere (global circulation models like those used by the climate modelers) to see if the situation is expected to change. These models produce estimates of temperature and moisture on a grid basis (typically 50 mile to 65 mile grid spacings) not for specific cities or states. The model output has to be analyzed using isopleths (lines of equal value). For the 90 day outlooks, statistical contingencies are used to account for anomalous patterns in sea surface temperatures in the Pacific, which tend to affect global circulation (e.g. El Nino or La Nina events). Inferences of temperature and precipitation patterns which follow certain circulation patterns are derived from statistical climatology (past history). Despite these statistical analyses and numerical models, in the end the forecasters own judgements may supersede this guidance for any particular case or region, providing a final modulation.

Typically, probability estimates are provided in mapped form, highlighting areas of significant anomalies (e.g. where temperatures are expected with some probability to be above or below normals for the period, or similarly, precipitation is expected to be above or below normal). These data are also expressed in tabular form by state and by major city (including 100 U.S. cities). These outlooks are available to users of the Internet and from some dialup weather services. 30 day outlooks are produced twice monthly, near the 15th and end of each month; 90 day or seasonal outlooks are produced once per month usually on the last or next to the last day.
each month

I am sure that this is way more than the listener wants to know!

Notes for MPR "Morning Edition", Program of March 4, 1994

For: Greg Magnuson and Bob Potter

From: Mark Seeley, University of Minnesota

I came across perhaps yet another little known effect of last years crummy growing season. According to Minnesota Agricultural Statistics Service, state honey production was down 16 percent to 14.4 million pounds. Most of this was blamed on the cool wet weather, affecting both the quality and quantity of plants and the foraging habits of the bees. Guess the bee keepers are hoping for a "sweet" 1994 growing season.

Although we have experienced a good deal of protective snow cover this winter, there is some concern about winter injury to pastures, alfalfa and other perrenial plants. Oscillating freezing and thawing temperatures over the next several weeks may cause a good deal of damage to these plants as well. We'll have to hope for a relatively mild and stable March. The outlook for March favors near normal temperatures and near normal to below normal precipitation.

1. Almanac (typical max near 32 and min of 14 or 15 degrees)

MSP record high for March 4 is 61 set in 1983. The record low is -26 degrees set in 1865. Coldest this century has been -15 degrees in 1917. Record precipitation for March 4 is 0.80 inches set in 1984, which also set the record for snowfall of 9.6 inches. That storm brought much greater amounts to other places in southern Minnesota and eastern South Dakota and was accompanied by 30 to 40 mph winds which closed many roads in southwestern Minnesota. Montevideo reported a total of 20 inches of snow from the storm. Greatest snow depth locally on this date was 24 inches in 1962.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 68 degrees at both Hutchinson and Springfield in 1983. The all-time low temperature is -43 degrees at Bagley (Clearwater County) in 1917.

2. Word of the Week: **Firn Snow**

The word "firn" from the German means old or of last year, much like the Anglo Saxon term fyrrn meaning former or past. Accordingly, this term has been used for years in the meteorological community to refer to "old snow" that has become granular and dense with age as a result of melting, refreezing and sublimation. The granules of snow are usually somewhat uniform and spherical in shape. This is also recognized by glaciologists as the first phase in the process of snow turning into glacier ice. After all the recent melting and refreezing, there is a good deal of firn snow around Minnesota, especially in the northern portions.

3. Topic: Ice-sheeting

This occurs somewhat often in Minnesota during the winter and early spring. Snow cover melts, partially runs off or infiltrates the soil before refreezing takes place. Then a solid blanket of ice covers the soil surface (especially low spots in fields or yards) for days or weeks as temperatures remain below freezing. This can cause terrible loss of perennial plants, pasture and alfalfa stands due to smothering. The ice covering over the soil inhibits the exchange of gases, carbon dioxide, oxygen and other products of respiration. Toxic products of aerobic and anaerobic respiration can build up in the soil and kill the crowns and roots of plants. Fields or gardens that have stubble, crop residue or mulches over them tend to survive better as they help prevent smothering effects by protruding through the ice cover.

Other symptoms of stress to plants in the landscape may become apparent as we move into spring.

The mechanism by which plants survive the winter conditions in Minnesota is referred to as winter hardening or cold hardening, whereby physiological changes occur in plants as the days shorten and temperatures cool in the fall. A maximum degree of hardiness is achieved when temperatures gradually cool to the freezing point and then below it, accompanied by bright sunny days. It has been observed, for example that dogwood can survive temperatures of -100 degrees F, and birch and poplar have survived temperatures of -70 degrees F if the hardening process has been induced gradually. Some plants tend to lose their hardiness when exposed to prolonged periods of relatively warm temperatures. This is the worrisome feature of this winter in Minnesota, since we have experienced two such periods, one in mid December and one in mid February. Some species may have dehardened somewhat under these mild conditions and lost their capability of withstanding the subsequent cold periods which followed. Generally speaking, roots are less hardy than topgrowth or exposed plant tissue. Roots of many plants were protected for a long period by substantial snow cover in January and early February. But the recent loss of snow cover, at least in some southern Minnesota counties may be a detriment to the survivability of some plants. Insufficient soil nutrients such as potassium, phosphorus and calcium have been related to inadequate winter hardening of some plants as well.

Notes for MPR "Morning Edition", Program of April 8, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

We mentioned that March was the driest since 1958 in the Twin Cities reporting only 0.32 inches of precipitation. Elsewhere around the southern half of the state, March precipitation was among the lowest historically. For Worthington and Winnebago it was the second driest this century, while for Rochester it was the third driest. Some associate dry March weather with dry summers in general. This was certainly true in Minnesota for 1910 and 1958 which were very dry growing seasons. However, the record book shows that both 1883 and 1887 were very dry in March, but were not followed by a dry growing season. Sometimes a dry March or a dry April is the result of an persistent blocking high to the west of Minnesota (described later on).

1. Almanac (typical max around 50 and min around 30)

MSP record high for April 8 is 83 back in 1931. The record low is 8 degrees which occurred way back in 1865. Lowest temperature this century has been 16 degrees in 1923. Record precipitation for April 8th is 0.73 inches in 1906 and record snowfall is 5.0 inches in 1980. Greatest snow depth on this date is 4 inches which occurred in 1975.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 89 degrees at Fairmont, Montevideo and Tracy in 1931. The all-time low temperature is -8 degrees at Cotton (St Louis County) in 1982.

2. Word of the Week: **Matrimony**

This is not a weather word, but a word used to describe the union of a man and woman in marriage or wedlock.

Sometimes the weather in spring is indeed inspirational. You get up in the morning, see the bright sun bathing the yard in warmth, or breathe in the cold crisp fresh air after an overnight rain and suddenly you are inspired to do something ambitious, or romantic or exciting. Such is the case for Don Perkins and Elise Eslinger, a couple of our MPR listeners who are also weather buffs. Don would like to know if Elise would consent to become his wife and steal off to Chicago for the weekend. **THAT'S HOW INSPIRED THIS GUY IS TODAY!**

3. Blocking Highs

This is not referring to something that the Vikings or Cowboys do, but refers to a meteorological phenomena which sometimes affects our weather. Blocking highs are large high pressure cells which sometimes develop at mid latitudes and remain stationary or move extremely slowly. This dome of air blocks the normal west to east

migration of low pressure systems and associated fronts resulting in prolonged dry spells for regions underneath or just to the east of the blocking high. In the continental U.S. blocking highs occur most frequently in the spring, and may persist for a week or more.

4. The Home Landscape and Field Work:

As soon as the soil is dry enough radish, onion, pea, spinach and lettuce can be planted. New plantings of trees and shrubs can begin as well. It is probably time to uncover roses and mulched plants since the soil will be warming up more rapidly now under longer days and higher sun.

The outlook favors above normal temperatures and less than normal precipitation for next week, so I expect the checkered flag to drop on the field working season across southern Minnesota (if we don't get too much precipitation in the meantime). Most crop producers are ready to go having done some tillage and soil testing in the fall.

Notes for MPR "Morning Edition", Program of April 15, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

Despite the cooling effects of the rainfall this week, soil temperatures have been climbing gradually and are now in the mid 40 to mid 50 degree range. This is more than adequate to plant onions, radishes, carrots, lettuce, spinach and peas to say nothing of the oats, wheat and barley that most farmers are waiting to plant. Some farmers have already planted potatoes on the sandy well-drained soils in central Minnesota. A highly desirable very warm and dry period is expected next week which should accelerate the field working a activity around the state.

1. Almanac (typical max of 54 and min of 34)

MSP record high for April 15 is 82 in both 1915 and 1976. The record low is 13 degrees which occurred way back in 1857. Lowest temperature this century has been 18 degrees in 1935. Record precipitation for April 15th is 0.87 inches in 1873, the most this century is 0.63 inches in 1973. Record snowfall is 2.0 inches in 1961 and it snowed 0.4 inches on this date last year. Greatest snow depth on this date is 10 inches which occurred in 1983.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 89 degrees at Winona in 1954. The all-time low temperature is 2 degrees at Zumbrota (Goodhue County) in 1928 and at Orr (St Louis County) in 1962.

2. Word of the Week: **Friable Tilth**

Friable is an adjective derived from a Latin root word (friabilis) and used to describe a material or aggregate of materials which easily crumbles or breaks into small pieces when put under pressure. Tilth is from the Anglo Saxon root word (tilian) and is a term used by soil scientists and agronomists to describe the nature of a soil seedbed after cultivation or tillage is done. It is very much a qualitative term referring to the aggregate size (clods), friability, uniformity, looseness, porosity and roughness of the soil surface. This time of year it is very important to plant in a soil with good tilth. Some of the fall tillage has weathered and left a partially sealed surface or aggregates which are too large for a suitable seedbed. Thus many producers will due some form of secondary tillage just before planting, or they will use attachments which run in tandem with the planter and disturb or open up the seedbed just ahead of the planter so that they can till and plant in one pass across a field.

Shall we try to check out the soil tilth at Kevin Paap's farm on

Sunday or Monday? Maybe he won't want us to do that because he hasn't done his spring tillage yet.

3. Wet Thursdays

In the 1960s English climatologists found that for a number of cities in the United Kingdom, Thursday was the wettest day of the week in terms of total rainfall. This prompted speculation that forecasters always included a chance for showers in their forecasts issued for Thursdays (often stated as "tomorrow's weather will be a mixture of sunshine and showers"). Recent data summaries for the period of 1954-1992 still seemed to confirm that Thursday was indeed the wettest day of the week. That is until a statistician got hold of the data. In a letter published in Weather, a monthly publication of the Royal Meteorological Society, Professor MacDonald Jackson found that in a statistical test of the rainfall records for each day of the week, there was no statistically significant difference among days. Well, that put a damper on that hypothesis.

Actually this prompted me to look at our local MSP records for last year (1993) to check for which day of the week it rained most often. I found the following frequencies, bearing in mind that each day of the week appears on the calendar about 52 times each year.

| | | | | | | | |
|---------|----|-----------|----|------------|----|-----------|----|
| Mondays | 21 | Tuesdays | 18 | Wednesdays | 19 | Thursdays | 20 |
| Fridays | 14 | Saturdays | 18 | Sundays | 17 | | |

This of course is just one year. However, I would encourage you to schedule your golf and boating on Fridays or Sundays Bob. Look at those rainy Mondays (didn't the Momas and Papas used to sing about rainy days and Mondays).

4. Foreign Weather:

As if the former Yugoslavia were not having enough troubles, Niksic, Titograd, and Ulcinj all along the southern end of the Adriatic Sea south of Sarajevo have received 8 to 12 inches of rain this week.

Notes for MPR "Morning Edition", Program of April 22, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

Monday (4/18) of this week brought record high temperatures to some parts of southern Minnesota. 89 degrees at Albert Lea and 88 degrees at Waseca were both record highs for that date. We reached 84 degrees at MSP, about 26 to 27 degrees warmer than normal. Soil temperatures actually climbed into the 70s briefly on Monday, but have now dropped back into the 50s and low 60s. Still high enough for planting many crops though.

1. Almanac (typical max of 59 and min of 37)

MSP record high for April 22 is 90 in 1980. The record low is 23 degrees which occurred way back in 1874. Lowest temperature this century has been 25 degrees in both 1927 and 1967. Record precipitation for April 22 is 1.33 inches in 1883, the most this century is 0.99 inches in 1975. Record snowfall is 5.4 inches in 1963.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 101 degrees at Hawley (Clay County) in 1980. That is a mere 46 degrees above normal for that town (pop. 1200) on that date. In addition the communities of Browns Valley, Ada, Georgetown, Campbell and Montevideo (all in western Minnesota) reported a high temperature of 100 or more on the 21-22 of April that year. Those dates represent the earliest spring occurrence of 100 degree temperatures in the state. And further, the 101 degrees at Hawley is the all-time highest April temperature ever recorded in Minnesota.

There were many grass fires reported that month in Minnesota with high winds, high temperatures, low humidity and lack of precipitation. The Fargo-Moorhead area experienced winds of 20 to 30 mph and afternoon humidity of 10 to 12 percent. A number of the grass fires were started by sparks from trains traveling across central Minnesota. One was started by a gentlemen who was trying to brand his horse. Ten observers in western Minnesota reported rainfall totals of a trace for the entire month of April, 1980. This was obviously record low monthly rainfall for these sites.

The all-time low temperature for April 22 is 6 degrees at New London in Kandiyohi County which occurred in 1936.

2. Word of the Week: **Sun Kinks**

Actually this is a railroad term, but it does relate to the weather. Large temperature changes (such as those experienced earlier this week) cause rails to expand and/or contract excessively, especially on bright sunny hot days. This can lead to sun kinks or bending of

the rails. These are sometimes visible if you look down the line of track closely. Occasionally these kinks are large enough that they can prevent drawbridges from opening or closing properly.

3. Wet Thursdays

In the 1960s English climatologists found that for a number of cities in the United Kingdom, Thursday was the wettest day of the week in terms of total rainfall. This prompted speculation that forecasters always included a chance for showers in their forecasts issued for Thursdays (often stated as "tomorrow's weather will be a mixture of sunshine and showers"). Recent data summaries for the period of 1954-1992 still seemed to confirm that Thursday was indeed the wettest day of the week. That is until a statistician got hold of the data. In a letter published in Weather, a monthly publication of the Royal Meteorological Society, Professor MacDonald Jackson found that in a statistical test of the rainfall records for each day of the week, there was no statistically significant difference among days. That is the difference between rainfall totals for particular days of the week was not statistically different from the mean rainfall total for a day computed from the total of all 7 days. Well, that put a damper on that hypothesis.

Actually this prompted me to look at our local MSP records for last year (1993) to check for which day of the week it rained most often. I found the following frequencies, bearing in mind that each day of the week appears on the calendar about 52 times each year.

| | | | | | | | |
|---------|----|-----------|----|------------|----|-----------|----|
| Mondays | 21 | Tuesdays | 18 | Wednesdays | 19 | Thursdays | 20 |
| Fridays | 14 | Saturdays | 18 | Sundays | 17 | | |

This of course is just one year. However, I would encourage you to schedule your golf and boating on Fridays or Sundays Bob. Look at those rainy Mondays.

Notes for MPR "Morning Edition", Program of April 29, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

Well, looks like the big gains and rapid progress made on the planting season will be slowed to a dead stop this week. What a week! 4 to 8 inches of snow fell on freshly planted small grains and sugarbeets in the northern Red River Valley. At least the rainfall in southern sections was helpful to those who had already planted seed.

Happy Arbor Day. Anybody going to plant a tree?

1. Almanac (typical max of low 60s and min of 40)

MSP record high for April 29 is 92 in 1952. The record low is 22 degrees which occurred back in 1958. Record precipitation for April 29 is 1.30 inches in 1991 and record snowfall is 6.6 inches in 1984.

Scanning the State Climate Data Base other records of note are: The all-time high temperature in Minnesota for this date is 93 degrees at Pine River (Cass County) in 1952 and the all-time low temperature for this date is 3 degrees at Babbitt (St Louis County) in 1958. Not far from good old Embarrass, MN.

This date in 1984 saw quite a snow storm strike the southern and eastern portions of the state, accompanied by 30 to 50 mph winds. Snowfalls of 6 inches or more occurred south of a line from Marshall to Hinckley from the 29th to the 30th of April. Power was lost for prolonged periods in many rural communities. The 9.7 inches of snow which fell in the Twin Cities area was the most ever recorded from one storm so late in the season. Waseca received 12 inches of snow which melted into 2 inches of liquid water. This too was a record amount for so late into the season.

2. Word of the Week: **Frog Storm**

This is not to be confused with the term "frog strangler" which is used in the southern United States to describe a heavy rainfall from a thunderstorm. A frog storm is a term used to describe the first bad weather of the spring following a prolonged warm or dry spell. It is sometimes referred to as a whip-poor-will storm. These terms are possibly used because of the effect that such storms have on frogs or whippoorwills during the spring. I think the weather we have experienced this week might justly be referred to as a frog storm.

3. Question from a listener: Are there any places in Minnesota which

have experienced freezing temperatures in all months of the year?

Yes, Big Falls in Koochiching County for one. I will try to check out other places as well by Friday.

Notes for MPR "Morning Edition", Program of May 6, 1994

For: Greg Magnuson, Bob Potter and Sasha Aslanian

From: Mark Seeley, University of Minnesota

Bob, your question about weekend weather made me think to follow up on our discussion of "wet thursdays" a couple of weeks ago. As you may recall, the distribution of measurable rainfall events by days of the week during 1993 for MSP was the following:

| | | | |
|------------|--------------|---------------|--------------|
| Mondays 21 | Tuesdays 18 | Wednesdays 19 | Thursdays 20 |
| Fridays 14 | Saturdays 18 | Sundays 17 | |

For 1994 so far we have had measurable rainfall events by days of the week as follows:

| | | | |
|-----------|-------------|--------------|-------------|
| Mondays 8 | Tuesdays 4 | Wednesdays 5 | Thursdays 6 |
| Fridays 9 | Saturdays 3 | Sundays 5 | |

For the 18 weekends this year, we have had no measurable rainfall on 12, one day with measurable rainfall 4 times and both days with measurable rainfall only twice.

Looks like a somewhat wet Saturday coming up, more so for southern Minnesota than the northern part. However, we may get quite a nice day on Sunday to enjoy some outdoor activity on Mother's Day. Any word from Kevin Paap on how the planting season is going?

1. Almanac (typical max of 66 and min of 43)

MSP record high for May 6 is 89 in 1896 and 1934. The record low is 25 in 1989. Record precipitation for May 6 is 1.51 inches in 1939. And in 1947 on this date 0.2 inches of snow fell.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 98 degrees at Grand Meadow (Mower County) in 1934, also the warmest May on record. The all-time low temperature is 14 degrees which occurred at Hallock (Kittson County) in 1906 and at Tower (St Louis County) in 1974.

2. Observer and Community Notes:

Starting this week in 1894, James Brault began taking the first daily climate observations on Gunflint Lake along the Ontario Border in Cook County, perhaps one of the most remote climate stations in the state of Minnesota, 30 miles NW of Grand Marais. This is also the centennial year for climate observations in the town of Campbell (pop. 280) in Wilkin County of western Minnesota. Starting with Arthur Metcalf in 1894, this town has now accumulated over 100 years of daily climatic observations kept by various volunteers. The all-time temperature records for the past century at Campbell, MN are 111 degrees on 7/10/36 and -41 degrees on 1/16/77.

3. Word of the Week: **Tortuosity**

This refers to the quality or state of being tortuous, that is winding, twisted or crooked (from the Latin root *tortuositas*), such as the tortuous stream or path. It has been used in both meteorology and soil science as a way of characterizing pathways for energy dissipation. For example, when a tornado funnel extending from a cloud base to the ground is full of twists and curves, it is said to be tortuous, that is the length of the funnel itself is much longer than the simple linear distance (vertical) from cloud to ground. A funnel of this shape tends to dissipate its energy more readily, while a funnel which is less tortuous and takes more of a vertical shape from cloud to ground tends to maintain energy and therefore delivers greater force. This shape is associated with some of the more damaging (severe) tornadoes.

In soil science this term is used to characterize macropore pathways from the surface to greater depths. These macropore pathways may be caused by deep cracks due to alternating shrinking and swelling or freezing and thawing of the surface, or by biological activity such as the decay of old plant roots or burrowing by insects and earthworms. When heavy rainfall events occur, the water can be delivered rapidly to deeper soil layers, occasionally all the way to the water table, by the less tortuous (more vertical) macropore pathways. Research at the University of Minnesota is being conducted to determine the role that macropores have in carrying soluble contaminants from the soil surface to the underlying water table.

4. In Praise of Earthworms:

As mentioned above, several species of earthworms form macropores in soils. Some form meandering (tortuous) pores (perhaps 1/8 inch in diameter) throughout the shallow surface layer (say the top foot of soil), while others like the nightcrawler form larger (perhaps a 1/4 inch diameter) less tortuous macropores which may extend down to 3 feet or deeper in the soil profile. In the summer earthworm densities may be quite high, ranging from 100 to over 1000 worms per square meter of soil. This can translate to rapid infiltration of rainfall into the soil profile, distributing moisture throughout the rootzone for most plants. High densities of earthworms also promote maintenance of soil structure.

Earthworms either ingest decomposed residues in the soil or feed on fresh plant materials. Earthworms and microorganisms in the soil work in conjunction to create humus and other stable organic matter. Some species of earthworms are capable of processing, stabilizing and detoxifying organic wastes (such as sewage sludge, and municipal solid wastes).

Like most other living things, earthworms have their own environmental preferences. They prefer soils which are high in organic matter content (pasture, forests, or agricultural land with a lot of crop residue or where manure has been applied). They also prefer soil

temperatures between 50 and 70 degrees F and moderate soil moisture conditions. When soils become too wet or too warm, they will migrate to deeper depths. Sometimes when heavy rains occur on saturated soils earthworms may be found on streets and sidewalks volunteering for Johnny's bait can.

Notes for MPR "Morning Edition", Program of May 13, 1994

For: Greg Magnuson, Perry Finelli and Mary Ann Combs

From: Mark Seeley, University of Minnesota

On Tuesday during the solar eclipse our instruments recorded solar radiation values about .3 of what they should have been for the noontime period and temperatures which were about 4 to 5 degrees cooler than what they might have been for that time of day (without an eclipse).

1. Almanac (typical max of 67 and min of 44)

MSP record high for May 13 is 89 in 1900 and 1977. The record low is 29 in 1888 and 1953. Record precipitation for May 13 is 1.12 inches in 1867.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 95 degrees at Campbell (Wilkin County) in 1932 and at Rothsay (Wilkin County) in 1977. The all-time low temperature is 18 degrees which occurred in 1953 at both Cloquet and Grand Rapids.

2. Observer and Community Notes:

This week I would like to salute the Opjorden family of Milan, MN who are in their 102nd consecutive year of making daily weather observations for their community in Chippewa County. There are perhaps 5 or 6 family generations who have participated diligently 365 days each year in recording daily high and low temperatures, along with precipitation. They have produced a sizable climatic record of considerably high quality for Chippewa County. Record temperatures for their 102 year old record are a high of 113 degrees on July 21, 1934 and a low of -42 degrees on February 16, 1936.

3. Words of the Week: **acclimatation, acclimation and acclimatization**

These terms are often used synonymously to refer to the process by which a living organism adapts to a change of environment. Sometimes acclimatize refers to the use of human ingenuity in adaptation, such as the utilization of air conditioning in the desert southwest or employing special diets to survive on polar expeditions. And on the other hand acclimate is sometimes used to refer to natural adaptation, such as the adjustment in the eyes which takes place in moving from inside a somewhat darkened building out into the bright sun, or an increase in appetite, particularly for carbohydrates, when living or exercising in cold conditions.

4. Topic: Comments on Climatic Data Integrity

One of the current debates in the climatology community concerns the deployment of automated measurement systems to supplement and in some cases replace the older instruments which are manually read by observers. The debate centers on preserving the integrity of many long-term climate records which have been established. Local

climatic trends and patterns, even regional and global trends and patterns are difficult to sort out due to differences in observation time, relocation of observers within a community, changes in local land use and urbanization effects. Changing instruments, even though the instruments today are more precise and robust in many cases, just adds another confounding layer which might disrupt the continuity of historical records. It is not yet clear what the effective difference is between taking daily temperatures from electronic thermometers that integrate values over 10 seconds to 1 minute versus mercury or alcohol in glass thermometers. These instruments are shielded from the direct sunlight in different ways as well. Still other questions are raised about the correlation of solar radiation measurements from automated systems and sunshine hours from manually observed recorders, or the relationship of tipping bucket raingages which record the number of tips of a fixed amount (such as 0.01 inches) versus weighing raingages or stick gages which are manually recorded every 24 hours.

Aside from the desire to preserve continuity in the climatic records, there are few objections to the deployment of automated measuring systems. Some of their advantages include: placement in unpopulated or remote locations where environment has not been monitored before; telemetering the measurements to a central computer or forecast office on a continuing basis by phone, radio or satellite transmissions to provide information on current weather conditions; more precise measurements with respect to timing maximum rainfall intensity, peak wind gusts, or other weather features which vary tremendously over short periods of time; specialized instrumentation for measuring air pollution, radiation of specific wavelengths, or soil temperature and moisture.

With the increasing concern for better monitoring of the environment, I suspect will see continued increases in the kind and number of automated weather stations deployed around the country.

Notes for MPR "Morning Edition", Program of May 20, 1994

For: Greg Magnuson, Perry Finelli and Mary Ann Combs

From: Mark Seeley, University of Minnesota

Not a bad week weatherwise. I am sure that the countryside a number of smiling faces as the rest of the 1994 crop is being planted this week.

1. Almanac (typical max of 70 and min of 47)

MSP record high for May 20 is 91 in 1934. The record low is 30 in 1892. Record precipitation for May 20 is 3.34 inches in 1877.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 100 degrees at Redwood Falls, Pipestone, St Peter and Fairmont in 1934. The all-time low temperature is 18 degrees which occurred in 1907 at Hallock (Kittson County). 1907 is notable for having the lowest average May temperatures for Minnesota.

2. Observer and Community Notes: Worthington, MN (Nobles County)

This community is in the midst of their 102nd year of recording daily climatic observations for Nobles County. Observations begun in 1893 by Mr. E. L. Porter, are now taken by City employees. Worthington temperature records are 110 degrees on July 17, 1936 and -37 degrees on February 9, 1899. Greatest rainfall recorded there was 8 inches on August 20, 1913.

3. Words of the Week: **acclimatate, acclimate and acclimatize**

These terms are often used synonymously to refer to the process by which a living organism adapts to a change of environment. Sometimes acclimatize refers to the use of human ingenuity in adaptation, such as the utilization of air conditioning in the desert southwest or employing special diets to survive on polar expeditions. And on the other hand acclimate is sometimes used to refer to natural adaptation, such as the adjustment in the eyes which takes place in moving from inside a somewhat darkened building out into the bright sun, or an increase in appetite, particularly for carbohydrates, when living or exercising in cold conditions.

4. Topic: Field Working Days

Field working days have been somewhat oddly distributed this year. For the week ending April 24th, 20 percent of the state's corn

acreage had been planted, a good start. However a cool wet weather pattern slowed progress over the next two weeks such that by May 8th corn acreage planted had only advanced to 46 percent. Then last week was very suitable for field work and as of Sunday 79 percent of the acreage had been planted, a jump of 33 percent in one week. Even with 5 or 6 days suitable for field work that represents a great deal of progress. How was it accomplished? Long working days. Now that we are experiencing nearly 15 hours of daylight, many farmers have been putting in 14 to 16 hour workdays. This emphasizes how important timely planting is to the farmer. I suspect that the state is now just about completely planted as far as corn is concerned.

With a significant warmup expected next week, rapid germination and emergence will occur, such that many planted fields should start to show tinges of green by Memorial Weekend. Unfortunately, the big warm up, with southerly winds will also lead to an accelerated appearance of some of our insect friends.

Notes for MPR "Morning Edition", Program of May 20, 1994

For: Greg Magnuson, Perry Finelli and Mary Ann Combs

From: Mark Seeley, University of Minnesota

Not a bad week weatherwise. I am sure that the countryside a number of smiling faces as the rest of the 1994 crop is being planted this week.

1. Almanac (typical max of 70 and min of 47)

MSP record high for May 20 is 91 in 1934. The record low is 30 in 1892. Record precipitation for May 20 is 3.34 inches in 1877.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 100 degrees at Redwood Falls, Pipestone, St Peter and Fairmont in 1934. The all-time low temperature is 18 degrees which occurred in 1907 at Hallock (Kittson County). 1907 is notable for having the lowest average May temperatures for Minnesota.

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Notes for MPR "Morning Edition", Program of May 27, 1994

For: Greg Magnuson, Bob Potter and Marianne Ann Combs

From: Mark Seeley, University of Minnesota

With field planting mostly complete, I suspect that the rains this week are most welcome. Next on the list is to accomplish some weed control.

Memorial weekend frosts have been quite a frequent occurrence in parts of the west and the north, but very infrequent locally and in southern counties. Ground frosts have occurred on or near Memorial weekends in 1901, 1907, 1924, 1925, 1947, 1965 and 1992.

1. Almanac (typical max of 72 and min of 49)

MSP record high for May 27 is 95 in 1969. The record low is 34 in 1907. Record precipitation for May 27 is 2.17 inches in 1978 and we had a trace of snow on this date in 1965.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 104 degrees at Hallock (Kittson County) in 1934. The all-time low temperature is 19 degrees which occurred in 1907 at Blackduck (Beltrami County) and at Roseau (Roseau County) in 1917.

2. Observer and Community Notes: St Johns University (Collegeville)

College personnel begin making daily weather observations on the campus in October of 1892, so they are now in their 103rd year of daily observations there. This provides a terrific climatic record for Stearns County in central Minnesota. Many college personnel have contributed to this lengthy record.

Some of the all-time extremes at Collegeville are:
5.84 inches of rain on May 22, 1962
24 inches of snow on March 17, 1965
-39 degrees on January 22, 1936
106 degrees on July 10, 1936

3. Words of the Week: **isobront (homobront)**

On several occasions we have talked about types of isopleths, lines of equal value used by meteorologists in plotting maps and diagrams. This is yet another example. This particular one is somewhat timely given the weather of late. Iso-bront derives from the Greek, iso meaning equal and bront meaning thunder (as in the naming of the Brontosaurus or thunder

lizard). It refers to a line drawn through geographical points that have the same average number of days with thunder over a specific period of time (a month or a season typically). Most places in Minnesota experience between 20 and 60 days with thunder each year, 90 percent concentrated between the months of April and October.

4. Topic: Weather and the Construction Industry

We are in the midst of the peak construction season for Minnesota. Weather and climate information are used a great deal by the construction industry. Last week we talked about field working days for farmers to plant. Similarly climatic data are used to estimate probable working days for construction projects, including likelihood of rainfall disruptions. Downtime or lost working days due to weather are often the basis for amending contracts, particularly time schedules for the completion of various construction phases. Many specific activities are weather sensitive: pouring and curing of concrete, roofing (shingles or tiles), brickwork, paving, excavating, painting, and of course re-landscaping denuded work sites. In addition to rainfall climatology and precipitation forecasting, wind forecasting can be very important, particularly to sites where tall structures are being erected and they are storing or moving around materials like floor or roof sheeting, duct work, insulation, tiles, sheet rock and other things which can be caught up by the wind.

In Minnesota, like most other states, private meteorologists often provide construction companies with custom forecasts for specific sites and projects. These generally prove to be a valuable investment, especially for long projects which require several months.

Notes for MPR "Morning Edition", Program of June 3, 1994

For: Greg Magnuson, Perry Finelli and Marianne Ann Combs

From: Mark Seeley, University of Minnesota

The preliminary climatic summary for May is in. Some characteristics of this past month:

Temperatures averaged 2 to 5 degrees warmer than normal for the month. Precipitation was less than normal most places, except for Hallock, Rochester and Aitkin, which reported 2.82 and 3.20 and 3.41 inches, respectively, above normal values for those locations. Number of days with measurable rainfall ranged from 8 to 12. Fortunately intervals between rains were long enough to allow timely planting of crops this year.

How are these temperatures for the first 5 days of June:

| | | | | | |
|-----|-----|-----|-----|-----|-----|
| | 6/1 | 6/2 | 6/3 | 6/4 | 6/5 |
| MAX | 101 | 105 | 95 | 97 | 99 |
| MIN | 65 | 65 | 64 | 65 | 62 |

That's what it was like in Fairmont, MN to start June of 1934.

1. Almanac (typical max of 75 and min of 52)

MSP record high for June 3rd is 92 in 1923. The record low is 34 in 1945. Record precipitation for June 3 is 1.71 inches in 1914.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 98 degrees which occurred in 1968 at Madison, Montevideo, Lamberton, and Springfield. The all-time low temperature is 21 degrees up in Bigfork in northern Itasca County.

2. Observer and Community Notes: Fergus Falls, MN

This community located in western Otter Tail County off of Interstate 94 began daily climate observations in January of 1892. Charles Kissinger was a well known observer there from 1898 to 1936, keeping the weather station records at his residence. The current observer is Charlie Kampa with radio station KBRF. All-time temperature extremes in this 103 year old climate record are 110 degrees on July 6, 1936 and a low of -38 degrees (four times) on February 9th and 11th, 1899; January 24, 1904, and January 22, 1936.

3. Words of the Week: **adret and ubac**

These are terms used in microclimatology and topoclimatology. Adret refers to the sunny side of a hill or mountain slope, that is south-facing in the northern hemisphere. The shady side or north-facing aspect is referred to as the ubac. In mountainous regions, the ubac generally has the lower timber line and snow line (more severe climate). The climatic differences between the two slopes can be very significant, especially with respect to solar radiation reaching the surface. Vegetation differences can also be noted on the two types of slopes.

4. Topic: Summertime inversions

Thursday (yesterday) morning's lows were quite cool in the east-central and northeastern sections of the state. MSP reported a low of 35 degrees tying the record low set in 1946. Other lows were 32 degrees at Cedar Creek Natural History Center in northern Anoka County and 29 degrees at Wild River State Park in northern Chisago County. Tower in St Louis County (north of Virginia) reported 25 degrees just missing the all-time state low for June 2nd of 24 degrees set there both in 1986 and 1993.

These low temperatures are the result of radiation loss from the Earth's surface to clear overnight sky conditions in conjunction with little mixing of the air layers near the ground due to lack of wind. The gardener should be aware that in such conditions strong inversions are set up (that is temperature increases with increasing height above the ground), such that ground surface temperatures can be from 2 to 8 degrees (or even more) cooler than the temperatures reported from instrument shelters (official reports). Fortunately, this time of year the soil serves as a heat source (since its temperature rises into the 70s and 80s during the day) and helps keep the air layer near plants warm. Nevertheless, ground frosts commonly occur in Minnesota when official temperature reports from instrument shelters indicate minimums in the mid 30s, rather than below 32 degrees.

Notes for MPR "Morning Edition", Program of June 4, 1993

For: Bruce MacDonald, Nancy Cole, and Perry Finelli

From: Mark Seeley, University of Minnesota

Re: For your review and comment.

June is the month for baking rhubarb pie in Minnesota, as much of it will be harvestable soon. Of course late in the month strawberries may be ripening and we can partake of that wonderful combination of strawberry-rhubarb pie.

Many people are griping about what a cool wet spring we are having, especially in the southern half of the state. March, April and May have all had temperatures average below normal (with a mean for the three months of 43.6 degrees), but we have had far cooler springs than this. Though we have only measured one maximum temperature above 80 degrees so far this year, there have been several like it, including 1905, 1907, 1927, 1945, and 1947. As recently as 1983, we did not measure an 80 degree temperature for the first time until June 8th. And in 1924 and 1935, we did not reach 80 degrees until June 12th.

1. Word of the Week: **Isohyet**

This term is derived from the Greek **iso** meaning equal and **hyetos** meaning rain or rainfall. It is a term used by meteorologists and climatologists in the plotting of analyzed precipitation maps to describe a line representing an equal amount of rainfall. For example, in the month just concluded isohyets showing the areas of Minnesota which received 5 inches or more of precipitation for the month are rather common and describe a rather sizable area of the state.

Speaking of May precipitation, for some places it was indeed remarkable. Staples in northern Todd County recorded 9.84 inches, the most this century. Pipestone in southwestern Minnesota recorded 8.67 inches, the third most since 1892. And Montevideo in Chippewa County recorded 7.70 inches, the second wettest May since 1889.

2. Almanac (means of mid 70s for max, low 50s for min)

Record maximum temperature for today's date is 96 degrees set in 1823 and again in 1968. Record low temperature is 38 degrees just three years ago in 1990.

Record rainfall for this date is 1.80 inches in 1984 and we have never recorded snow on this date.

3. Topic of the Week: Climatic Statistics for June

With 3 consecutive months of below normal temperatures people are wondering if June will carry on that trend and set back crop progress.

Often in climatology we use means, standard deviations, and extreme values of various measured parameters (primarily temperature and precipitation) to describe the climate of a particular place. But it is also said, especially here in Minnesota, that the average value hardly ever occurs. Because of the interest in expected June temperature, I examined June mean temperatures from the long term eastern Minnesota record (1820-1992). The grand mean temperature for June (all 173 years) is 67.8 degrees. How many times have we had this temperature occur? Exactly 5 times - less than 3 percent of the time. OK, so that's pretty strict criteria to examine. So let's try how many times has the average temperature for June been plus or minus 1 degree of the grand mean? 56 times or less than 33 percent. 79 Junes have had temperatures average above the grand mean and 89 have averaged below that value.

Interestingly, in 8 of the past 10 years June has averaged above the grand mean of 67.8 degrees. So, in some sense, we have grown accustomed to warm June temperatures and are perhaps due for more cool ones, which by the way, is the favored trend in the 30 day outlook for southern Minnesota.

Additional Statistics: Coldest June average temperature was 56 degrees in 1842. (coldest this century was 61.4 in 1945). The warmest was 77.9 degrees in 1933. In fact over the second half of June (1933) the average high temperature was 93.7 degrees and the average low 70.1 degrees. There were 4 all-time record highs set during that period, with 17 days over 90.

34 times in 173 years of the eastern Minnesota record (19.6%) show the March-May period temperatures were below normal. In 17 of those years, June recorded below normal temperatures as well. 12 times June temperatures were normal, and 5 times they were above normal. Of the same 34 cool springs, 24 were followed by cooler than normal temperatures in July and August, 8 by warmer than normal temperatures in July and August, and 2 by near normal temperatures in July and August.

Notes for MPR "Morning Edition", Program of June 10, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

Did you know that the Rosemount Agricultural Experiment Station reported nearly 5.5 inches of precipitation last Sunday? The experiment station has received over 5 inches of rainfall from a single storm only twice in its recorded history. The other was the 5.8 inches they received on July 23, 1987 while we were getting our famous 10 inches of rainfall here.

1. Almanac (typical max of 75 and min of 53)

MSP record high for June 10 is 99 in 1956. The record low is 41 in 1977. Record precipitation for June 10 is 1.55 inches in 1946.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for this date is 106 degrees at Fairmont, MN (Martin County) in 1933. The all-time low temperature is 23 degrees at Tower, MN (St Louis County) in 1980.

2. Observer and Community Notes: Fergus Falls, MN

This community located in western Otter Tail County off of Interstate 94 began daily climate observations in January of 1892. Charles Kissinger was a well known observer there from 1898 to 1936, keeping the weather station records at his residence. The current observer is Charlie Kampa with radio station KBRF. All-time temperature extremes in this 103 year old climate record are 110 degrees on July 6, 1936 and a low of -38 degrees (four times) on February 9th and 11th, 1899; January 24, 1904, and January 22, 1936.

3. Words of the Week: **Aridity**

This term is derived from the Latin word aridus, meaning dryness. In climatologg it is used to refer to the degree to which a local or regional climate exhibits moisture deficiency, specifically agricultural areas with insufficient moisture for crop production without irrigation, or natural areas with only enough precipitation to support sparse vegetation, usually xeric or drought tolerant species. Deserts are examples of extreme aridity. Several indices and aridity coefficients have been developed to compare the relative aridity place to place or from season to season.

4. Topic: Soil Moisture, the Palmer Drought Severity Index and Crop Moisture Index

Since April 1st some areas of the state have been experiencing a precipitation deficit. Parts of Roseau, Lake of the Woods, Beltrami, and Marshall Counties have received less than 50 percent of normal precipitation since that time. In general, the northwestern third of the state, from Traverse County northeast to St Louis County in the arrowhead has received less than normal precipitation. Both native vegetation and crops growing in those areas have reduced the amount of stored soil moisture in the topmost layer. Good subsoil moisture (deeper in the rootzone) exists in most places, but this area could definitely use some more rain.

One method that the National Weather Service uses to assess areas of moisture deficiency and surplus is the Palmer Drought Severity Index (PDSI). This index is used to evaluate the area, duration and severity of prolonged periods of abnormally dry or wet conditions in the United States and Canada. Index values are derived for each crop reporting district on a weekly basis using precipitation and temperature reports, water holding characteristics of the dominant soil types, and previous history of the index (trend in direction up or down).

These weekly index values are tracked by government agencies and used to anticipate impacts on irrigation water supplies, reservoir and lake levels, streamflow, range conditions, livestock water supplies, and forest fire conditions. Index values range between +4 for extreme wetness to -4 for extreme drought.

Short term deviations in soil moisture supply are computed using another index, called the Crop Moisture Index (CMI). This index is derived from weekly values of precipitation and estimates of crop water need (evapotranspiration), with recognition that crop water needs vary over time as a crop goes through vegetative, reproductive and maturation phases. The scale used for the CMI is similar to the PDSI, ranging from +4 for very wet or flooded field conditions to -4 for severe drought conditions.

Currently, Minnesota climatic divisions 1 (NW) and 2 (NC), along with divisions 4 (WC), 5 (C) and 6 (EC) show negative values, albeit very slight ones, indicating a drying trend going on in those areas. Southern Minnesota, along with much of Iowa, Missouri, eastern Nebraska and eastern South Dakota are still in the midst of a wet climatic anomaly.

Talk about wet, I see evidence for the monsoon season in reports from India of over 22 inches of rainfall at Mangalore this past week and over 16 inches at Calcutta.

Notes for MPR "Morning Edition", Program of June 24, 1994

For: Bob Potter, John Bischoff, and Marianne Combs

From: Mark Seeley, University of Minnesota

This next week is a good time to harvest rhubarb from the garden. After June it is best to leave the plants alone to allow them to store energy for next year. The stalks get woodier and less palatable anyway. It is also a good time to apply mulch to the garden to help conserve soil moisture and to control weeds.

Having come from field day meetings with farmers this week in southern Minnesota, I am compelled to say that crop conditions look wonderful despite some fairly recent incidents of heavy rain and hail. Crops are developing very rapidly and some corn may tassel by the end of the first week of July. Yield potential of major crops looks to be excellent this year.

1. Almanac (typical max of 80 and min of 59)

MSP record high for June 24 is 101 degrees in 1988. The record

low is 44 in 1972. Record precipitation for June 24 is 2.36 inches in 1911.

Scanning the State Climate Data Base other records of note are:

The all-time maximum temperature for this date is 106 degrees F at both Artichoke Lake (Big Stone County) and Marshall (Lyon

County) in 1988. The all-time low temperature is a crisp 27 degrees at Tower (St Louis County) in 1985.

2. Observer and Community Notes: Southern Experiment Station
Waseca, MN

Daily climatic observations started there in August of 1914. Robert E. Hodgson, superintendent of the experiment station was the observer there for over 40 years (1919-1960). Mr. Vernon Ferch has more recently served as the observer since the mid 1960s. This 80 year climatic record is truly a valuable asset to Waseca County and contains some of the best soil temperature (2, 4, 8, 20, and 40 inch depths), solar

radiation and evaporation measurements in southern Minnesota. All-time climatic records at the Southern Experiment Station include: 106 degrees F on May 31, 1934 and again on July 14, 1936; -37 degrees F on January 5, 1924; and a single storm rainfall of 5.40 inches on August 31, 1962 (wonder what happened to the crops?)

3. Word of the Week: **Parallax error**

From the Greek term parallaxis meaning to alter or change a little. Specifically refers to the apparent change or displacement of an object when viewed from two different angles. There are a number of potential observational errors when reading an instrument. This is one of them which sometimes occurs when reading a thermometer or a mercury barometer. It is caused when the line of sight is not carefully kept perpendicular to the reading scale of the meteorological instrument. In the case of reading a liquid in-glass thermometer, this error might range from a few tenths of a degree to nearly two degrees.

4. Topic: Vacation Weather and Falsified Forecasts

This is the time of year that many people begin to take vacations - camping, sightseeing, fishing, etc. In many European countries, travel agencies or holidaymakers book package vacations to various resorts and beaches. Often they provide clients with climatological information about their destinations and sometimes provide updated weather forecasts for various resort communities.

During the 1980s when Ceausescu was leader of the communist government in Romania, he instructed the Ministry of Tourism and the National Meteorological Institute in Bucharest to falsify weather reports and forecasts for the Black Sea resorts

to stimulate Romanian citizens to vacation there. Even though lousy summer weather might prevail (cold, damp and windy), reports and forecasts always indicated conditions were warm and sunny, nearly ideal for swimming and sunbathing.

In addition, during some of the hard winters of the 1980s when there were shortages of energy and heating fuel (therefore a good deal of discontent among the population), Ceausescu ordered the Meteorological Institute not to report

or forecast any temperatures colder than 14 degrees F for certain regions. Only after the communist regime was overthrown in late 1989, did the administrator of the National Meteorological Institute reveal the falsification of these reports and forecasts. The European meteorological community began to notice a marked improvement in the reports and forecasts issued by the Romanian Meteorological Institute and their credibility as forecasters has been restored.

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Notes for MPR "Morning Edition", Program of July 1, 1994

For: Greg Magnuson, Perry Finelli, and Marianne Combs

From: Mark Seeley, University of Minnesota

PRELIMINARY JUNE WEATHER SUMMARY AND SUMMER OUTLOOK

A preliminary climate summary for June (through the 29th) shows that temperatures averaged from 1.5 to 3.0 degrees above normal for the month. The maximum value of 97 degrees occurred at Olivia, Willmar and Redwood Falls on the 14th. The minimum value of 33 degrees occurred at Hibbing on the 2nd. This was the second consecutive month with above normal temperatures, helping to speed crop development around the state.

June rainfall was very erratic. Approximately 50 percent of the climate observers in the state reported below normal rainfall and 50 percent reported above normal rainfall. Grand Rapids with 9.66 inches, Pokegama Dam with 11 inches and Luverne with 11 inches set all-time high marks for the month of June. Worthington with 10.23 inches reported the 4th wettest June this century (remember last year they set the record with 12.29 inches). Yet Browns Valley in western Minnesota received barely 1 inch of rainfall, as small grains in that area of the state actually suffered from drought stress during the month.

Though we experienced relatively little severe weather or heavy rainfall locally during June, south-central, southwestern and northern counties had more than their fair share. Thunderstorm frequencies are about equal between June and July, before they begin to taper off in August, so we could still see a number of severe thunderstorms this next month.

The recent 30 day outlook released by the National Weather Service this week calls for above normal temperatures to continue across the state during July with near normal precipitation. The 90 day outlook for July through September favors near normal temperatures and precipitation, except for northern Minnesota counties which are expected to see above normal rainfall amounts.

Looks like the first half of our upcoming holiday weekend will be dry and pleasant, then more unsettled late on Sunday with a chance for shower activity on July 4th. I'll take a closer look tomorrow.

Incidentally, did you know that we had frost in northern Minnesota communities on July 4th of 1972?

31 at Wannaska (Roseau County) 32 at Big Falls (Koochiching)
30 at Cook (St Louis County) 31 at Cotton (St Louis)
30 at Hoyt Lakes (St Louis) 27 at Tower (St Louis)

1. Almanac (typical max of low 80s and min of 60)

MSP record high for July 1st is 100 degrees in 1883. The warmest this century has been 99 degrees in 1911. The record low is 46 degrees in 1969. Record precipitation for July 1st is 2.46 inches in 1898. Last year on this date we received 1.44 inches of rainfall.

Scanning the State Climate Data Base other records of note are:

The all-time high temperature in the state on this date is 103 degrees at Fergus Falls in 1921 and at Winona in 1931. The all-time low temperature is 31 degrees at Cotton (St Louis County) in 1969.

2. Observer and Community Notes: Crookston, MN

The Northwest School, now known as the University of Minnesota Northwest Experiment Station, began making daily climate observations at Crookston in November of 1885. This nearly 110 year old daily record has been used to describe the climate

of the northern portion of the Red River Valley. The current observer there is Jim Cameron.

Climate records at the Northwest Experiment Station include: 106 degrees on July 18, 1917; -51 degrees on February 15, 1936; and 5.85 inches of rainfall on August 31, 1908.

3. Word of the Week: **Parallax error**

From the Greek term parallaxis meaning to alter or change a little. Specifically refers to the apparent change or displacement of an object when viewed from two different angles. There are a number of potential observational errors when reading an instrument. This is one of them which sometimes occurs when reading a thermometer or a mercury barometer. It is caused when the line of sight is not carefully kept perpendicular to the reading scale of the meteorological instrument. In the case of reading a liquid in-glass thermometer, this error might range from a few tenths of a degree to nearly two degrees.

4. Topic: The new National Weather Service UVI forecast

Over the years the Weather Service has given us the Wind Chill Index, the Livestock Weather Safety Index, the Crop Moisture Index and the Palmer Drought Index among others.

Starting June 28th (earlier this week) the National Weather Service began issuing a daily ultraviolet radiation index (UVI) forecast. This is an experimental forecast being tested in 58 U.S. cities. It is a joint effort with the Environmental Protection Agency and the Center for Disease Control.

Each day at 1 pm, the MSP forecast office will issue a UVI forecast for the following day. The UVI is based on a scale of 1 to 15, with larger numbers indicating a relatively greater exposure to ultraviolet radiation. The forecast is relevant to the hour of the day centered on solar noon (currently around 1:30 pm). Index categories are the following:

0-2 = minimal
3-4 = low
5-6 = moderate
7-9 = high
10 and greater = very high

The UVI forecast will be issued on the weather wire and broadcast on NOAA weather radio as well. It is based on satellite derived estimates of column ozone overhead, as well as model projections of temperature and cloud conditions for the following day. It is valid for the MSP area and does not apply statewide.

EPA suggests that for UVI values of 5 or greater, precautions should be taken by those planning to be outside for some period of time. Sun glasses and sun screen or sun block are proven methods to protect the eyes and exposed skin from too much sun.

Notes for MPR "Morning Edition", Program of July 1, 1994

For: Greg Magnuson, Perry Finelli, and Marianne Combs

From: Mark Seeley, University of Minnesota

PRELIMINARY JUNE WEATHER SUMMARY AND SUMMER OUTLOOK

A preliminary climate summary for June (through the 29th) shows that temperatures averaged from 1.5 to 3.0 degrees above normal for the month. The maximum value of 97 degrees occurred at Olivia, Willmar and Redwood Falls on the 14th. The minimum value of 33 degrees occurred at Hibbing on the 2nd. This was the second consecutive month with above normal temperatures, helping to speed crop development around the state.

June rainfall was very erratic. Approximately 50 percent of the climate observers in the state reported below normal rainfall and 50 percent reported above normal rainfall. Grand Rapids with 9.66 inches, Pokegama Dam with 11 inches and Luverne with 11 inches set all-time high marks for the month of June. Worthington with 10.23 inches reported the 4th wettest June this century (remember last year they set the record with 12.29 inches). Yet Browns Valley in western Minnesota received barely 1 inch of rainfall, as small grains in that area of the state actually suffered from drought stress during the month.

Though we experienced relatively little severe weather or heavy rainfall locally during June, south-central, southwestern and northern counties had more than their fair share. Thunderstorm frequencies are about equal between June and July, before they begin to taper off in August, so we could still see a number of severe thunderstorms this next month.

The recent 30 day outlook released by the National Weather Service this week calls for above normal temperatures to continue across the state during July with near normal precipitation. The 90 day outlook for July through September favors near normal temperatures and precipitation, except for northern Minnesota counties which are expected to see above normal rainfall amounts.

Looks like the first half of our upcoming holiday weekend will be dry and pleasant, then more unsettled late on Sunday with a chance for shower activity on July 4th. I'll take a closer look tomorrow.

Incidentally, did you know that we had frost in northern Minnesota communities on July 4th of 1972?

31 at Wannaska (Roseau County) 32 at Big Falls (Koochiching)
30 at Cook (St Louis County) 31 at Cotton (St Louis)
30 at Hoyt Lakes (St Louis) 27 at Tower (St Louis)

1. Almanac (typical max of low 80s and min of 60)

MSP record high for July 1st is 100 degrees in 1883. The warmest this century has been 99 degrees in 1911. The record low is 46 degrees in 1969. Record precipitation for July 1st is 2.46 inches in 1898. Last year on this date we received 1.44 inches of rainfall.

Scanning the State Climate Data Base other records of note are: The all-time high temperature in the state on this date is 103 degrees at Fergus Falls in 1921 and at Winona in 1931. The all-time low temperature is 31 degrees at Cotton (St Louis County) in 1969.

2. Observer and Community Notes: Crookston, MN

The Northwest School, now known as the University of Minnesota Northwest Experiment Station, began making daily climate observations at Crookston in November of 1885. This nearly 110 year old daily record has been used to describe the climate of the northern portion of the Red River Valley. The current observer there is Jim Cameron.

Climate records at the Northwest Experiment Station include: 106 degrees on July 18, 1917; -51 degrees on February 15, 1936; and 5.85 inches of rainfall on August 31, 1908.

3. Word of the Week: **Parallax error**

From the Greek term parallaxis meaning to alter or change a little. Specifically refers to the apparent change or displacement of an object when viewed from two different angles. There are a number of potential observational errors when reading an instrument. This is one of them which sometimes occurs when reading a thermometer or a mercury barometer. It is caused when the line of sight is not carefully kept perpendicular to the reading scale of the meteorological instrument. In the case of reading a liquid in-glass thermometer, this error might range from a few tenths of a degree to nearly two degrees.

4. Topic: The new National Weather Service UVI forecast

Over the years the Weather Service has given us the Wind Chill Index, the Livestock Weather Safety Index, the Crop Moisture Index and the Palmer Drought Index among others.

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Notes for MPR "Morning Edition", Program of July 8, 1994

For: Greg Magnuson, Perry Finelli, and Marianne Combs

From: Mark Seeley, University of Minnesota

Early Tuesday morning of this week, heavy thunderstorms dropped from 1.5 to 2.0 inches of rainfall over parts of the Twin Cities area, most occurring in a period of 30 minutes or less. This prompted an observer to ask, "How often do storms of this intensity occur?" Frequency statistics are used to estimate recurrence intervals for various storms, ranging typically from 5 minutes to 24 hours in duration. The data for east-central Minnesota show that a half hourly rainfall amount of 1.61 inches has an estimated recurrence interval of 25 years. So that indeed is a rare event!

1. Almanac (typical max of low 80s and min of 60)

MSP record high for July 8th is 101 degrees in 1936 and again in 1974. The record low is 46 degrees in 1842, but the coldest this century has been 51 degrees in 1958. Record precipitation for July 8th is 3.07 inches in 1925. This was accompanied by high winds and hail with crop damage in the surrounding countryside.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 105 degrees at Beardsley (Big Stone County) in 1936. The all-time low temperature is 32 degrees up at Cook (St Louis County) in 1961.

2. Observer and Community Notes: Crookston, MN

The Northwest School, now known as the University of Minnesota Northwest Experiment Station, began making daily climate observations at Crookston in November of 1885. This nearly 110 year old daily record has been used to describe the climate of the northern portion of the Red River Valley. The current observer there is Jim Cameron.

Climate records at the Northwest Experiment Station include: 106 degrees on July 18, 1917; -51 degrees on February 15, 1936; and 5.85 inches of rainfall on August 31, 1908.

3. Word of the Week: **Parallax error**

From the Greek term parallaxis meaning to alter or change a little. Specifically refers to the apparent change or displacement of an object when viewed from two different angles. There are a number of potential observational errors when reading an instrument. This is one of them which sometimes occurs when reading a thermometer or a mercury

barometer. It is caused when the line of sight is not carefully kept perpendicular to the reading scale of the meteorological instrument. In the case of reading a liquid in-glass thermometer, this error might range from a few tenths of a degree to nearly two degrees.

4. Topic: The new National Weather Service UVI forecast

Over the years the Weather Service has given us the Wind Chill Index, the Livestock Weather Safety Index, the Crop Moisture Index and the Palmer Drought Index among others.

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Notes for MPR "Morning Edition", Program of July 15, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

Last week while in the studio with Perry, MPR ran a story about the Minnesota PCA requiring the State Fair people to file a livestock waste management plan since the amount of waste generated on the Fair Grounds each year was considerable and some neighbors were concerned about odours and such. Following up on that, I have prepared a little something under item 4 about smells. Please be assured that I will wipe my feet before coming into the building on Friday.

1. Almanac (typical max of low 80s and min of 60)

MSP record high for July 15th is 102 degrees in 1988. The record low is 48 degrees in 1863, but the coldest this century has been 49 degrees in 1912. Record precipitation for July 15th is 1.87 inches in 1907.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 112 degrees at Beardsley (Big Stone County) in 1931 (pretty darn close to the state record of 114.5 degrees at Beardsley on July 29, 1917). The all-time low temperature is 32 degrees up at Tower (St Louis County) in 1973.

2. Observer and Community Notes: Crookston, MN

The Northwest School, now known as the University of Minnesota Northwest Experiment Station, began making daily climate observations at Crookston in November of 1885. This nearly 110 year old daily record has been used to describe the climate of the northern portion of the Red River Valley. The current observer there is Jim Cameron.

Climate records at the Northwest Experiment Station include: 106 degrees on July 18, 1917; -51 degrees on February 15, 1936; and 5.85 inches of rainfall on August 31, 1908.

3. Word of the Week: **Dragon**

We have previously discussed funnel clouds, tornadoes and waterspouts, all of which are visible wind voices which descend from the bases of thunderstorm clouds, usually cumulonimbus. In nautical literature a waterspout is sometimes referred to as a dragon. This, in part, stems from the occasional serpent-like appearance of a waterspout and also from Chinese mythology which associates dragons with severe weather (e.g. floods and thunderstorms).

4. Topic: Outdoor Odours ("Collars and Scents About Smells")

Sometime ago my colleague Dr. Don Baker at the university pointed out that the English have developed a "scenting chart" to indicate the relative ease or difficulty a hunting dog may have in tracking an animal's scent. This chart is based on air temperature and relative humidity. Generally speaking, over a temperature range of 35 to 75 degrees, most hunting dogs will find it easy to follow a scent across grass or plowed fields if the humidity is above 85 percent and winds are less than 12 mph (gentle breeze or force 3 on the Beaufort Scale). For lower humidities, higher temperatures and higher wind speeds, scents become increasingly more difficult to follow as the volatile oils given off by the body of an animal being hunted are more readily and widely dispersed throughout the environment.

Further on this topic, in England where population density is much higher than most places in the United States, the Ministry of the Environment has had to clamp down on livestock producers and slaughtering operations which pollute the air with odours. Owner/operators now must pay the British Meteorological Office to conduct an odour plume analysis on their site in order to determine if any local residence or businesses within 1 km might be affected by odours. This is now a requirement for anyone to obtain a permit to build or in anyway modify a livestock facility in the United Kingdom.

Two meteorological variables are important to this analysis: atmospheric stability (stable, neutral or unstable) which is a measure of how rapidly and widely odours might be dispersed in both the vertical and horizontal directions; and prevailing wind direction (wind roses). Stable or neutral atmospheric conditions are usually accompanied by cloudy skies, light winds and moderate temperatures. Under such conditions odours may remain concentrated near the ground and disperse along the path of low lying areas. Unstable conditions, usually associated with higher temperatures, higher winds and abundant sunshine will disperse odours rapidly. Prevailing wind direction, particularly in the summer months, usually points to the surrounding areas which might be most subject to risk of odour pollution.

There are some measures which can be taken in and around livestock sites to help reduce the potential odour plume problems. Dispersing the animals over a larger area rather than a compact site seems to help. In addition, the planting of shelterbelts, usually combinations of deciduous and evergreen trees, downwind from the site can help induce more turbulence (mixing) in the air flow and thereby more readily disperse odours. Shelterbelts also serve to intercept some of the dusts and airborne particulates and visually improve livestock sites.

Though this type of analysis is very rare in the United States, clearly the trend is to more seriously consider potential air pollution sources and risk to workers and nearby residents. Young people thinking of a career in environmental engineering might want to consider the possibility of becoming an "odour plume specialist."

5. Alternative Topic: The new National Weather Service UVI forecast

Over the years the Weather Service has given us the Wind Chill Index, the Livestock Weather Safety Index, the Crop Moisture Index and the Palmer Drought Index among others.

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EPA suggests that for UVI values of 5 or greater, precautions should be taken by those planning to be outside for some period of time. Sun glasses and sun screen or sun block are proven methods to protect the eyes and exposed skin from too much sun.

Notes for MPR "Morning Edition", Program of July 22, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

Believe it or not, last year on this date, the morning low at Tower, MN was 38 degrees. Nice sleeping weather.

Despite generally favorable crop conditions around the state, some areas have had their share of problems lately. Several northwestern counties have filed for federal disaster relief in order to cut CRP acreage for hay. They have also seen a deterioration in the wheat crop due to scab brought on by excessive rainfall and cool temperatures this month. Some parts of western Minnesota have recently experienced crop loss due to severe hail damage (see below).

Looks like a few showers and thunderstorms leading into the weekend, then a pretty nice Saturday and Sunday coming up with near normal temperatures - the salad days of summer (see below).

1. Almanac (typical max of mid 80s and min of low 60s)

MSP record high for July 22nd is 105 degrees in 1934. The record low is 49 degrees in 1947. Record precipitation for July 22nd is 1.15 inches in 1846.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 111 degrees at Beardsley (Big Stone County) in 1934. The all-time low temperature is 31 degrees up at Meadowlands in St Louis County in 1985.

2. Observer and Community Notes: Itasca State Park

Daily climatic observations were first made at Lake Itasca in May of 1911 by Mr. J. Stillwell. Personnel of The Lake Itasca Forestry and Biological Station of the University of Minnesota have been responsible for the daily weather observations there in recent decades. The current observer is Dan Traun, resident manager of the station. This is probably one of the most beautiful places in the state to be a weather observer. This site provides the only long-term daily records of temperature and precipitation for Clearwater County. Being a heavily forested site, it shows some rather interesting climatic characteristics: only 11 days this century with temperatures of 100 degrees or greater; yet, 86 days with lows of -40 degrees or colder (evidence of the still air in the forest); and a maximum snow depth of 47 inches on the ground (no wonder they use snowshoes in that area to get around!).

Some records of note there include: 105 degrees on July 28, 1917 and again on July 12, 1936; -51 degrees three times on January 22, 1922, February 8, 1933 and February 15, 1936; and 5.42 inches of rain on June 22, 1957.

3. Word of the Week: **Salad Days of Summer**

Shakespeare used the term "salad days" to describe a time of youthful inexperience. However in more modern times, this term is used to describe the time of summer when sunny days and warm nights chase away our hunger for hot foods and we turn to cool drinks, ice cream and salads. Of course it also happens to be the time of year when fresh ingredients for salads are in great abundance. Marketing research has indeed shown that our diets and drinking habits are related closely to weather conditions and many food retailers gear up for the peak of "salad days" in the summertime. In fact marketing research also shows that the public get their daily dose of weather information more from radio and less from television during the summertime since many more activities keep people away from their television sets.

4. Topic: Hail

Earlier this week our State Climatology Office received reports of severe hail damage in western Minnesota (Big Stone, Yellow Medicine, Traverse, and Lac Qui Parle Counties). Sunflower, corn, wheat and soybean crops were damaged. One report said that corn fields looked like cane fields because only the stalks were left standing. Golf ball size hail damaged some vehicles and buildings as well. County Rd 10 in Big Stone County was impassible due to 6 to 12 inches of hail over the road.

Some characteristics of hail: It is most frequent in May, June and July in Minnesota. In general our region sees 2-4 days with hail each year, but only about 5 percent of the hailstorms contain hailstones of 1 inch diameter or greater. Nearly 40% of the severe hailstorms in the U.S. occur between the hours of 3 pm and 6 pm.

Hailstone structure is onion like, being composed of concentric shells of ice. They often start out as small ice pellets and grow as they pass through saturated layers of super-cooled water within thunder clouds. Strong updrafts within thunderstorms can keep hailstones aloft and circulating up and down within a saturation zone such that they grow by accumulating ice layers. Sometimes these strong updrafts actually blow smaller hail out through the leading edge of the cloud and they appear to be falling from clear skies out ahead of the thunderstorm cell.

Hail is dependent on strong convective activity with vertical updrafts and a relatively low freezing level in the atmosphere. It is most common between 30 and 60 degrees latitude in

mountainous regions or mid continents.

Hail is measured using hailpads, which are styrofoam platforms covered with aluminum foil and range in size from 1 square foot on up. Hail size and distribution are recorded by the impressions left on the platform. This measurement method is somewhat rare, but still used for special studies.

Notes for MPR "Morning Edition", Program of July 29, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

1. Almanac (typical max of mid 80s and min of low 60s)

MSP record high for July 29th is 98 degrees in 1933. The record low is 47 degrees in 1971. Record precipitation for July 29th is 1.67 inches in 1872. Most rainfall this century is 1.11 inches in 1989.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 114.5 degrees at Beardsley (Big Stone County) in 1917 (this is also the state maximum temperature record). The all-time low temperature is 34 degrees at Grand Rapids (Itasca County) in 1925 and at Cotton (St Louis County) in 1968.

Today marks the 77th anniversary of perhaps the hottest day ever in parts of western and northern Minnesota. Beardsley measured 114.5 degrees on July 29, 1917. Other reported temperatures were 106 at Bagley, 108 at Fergus Falls, 110 at Moorhead, 109 at Red Lake, 108 at Thief River Falls, even 102 degrees at Lake Winnibigoshish on the headwaters of the Mississippi. Even the overnight lows were in the low to mid 70s.

2. Observer and Community Notes: None this week

3. Word of the Week: **Calm**

This of course is the condition of Bob Potter each morning on the radio. But meteorologically this refers to the absence of wind. On the Beaufort Scale, calm is associated with smoke rising vertically or when the surface of the sea or inland lake is smooth and mirror-like. For the National Weather Service reporting, calm is indicated when speeds are less than one mph. Many anemometers have a start up threshold of approximately 1 mph to move the cups, so typically anemometers show no movement whatsoever when there is a calm.

Incidentally, for many locations in Minnesota, July and August are the months with the highest frequency of calms. They generally occur between 10 pm and 5 am.

4. Topic: **AASC**

This is not a word of course, but the abbreviation for the American Association of State Climatologists, a non-profit scientific organization of climatologists from each state, from the federally funded regional climate centers, and from

the National Weather Service. I am at their annual meeting in Madison, WI this week. This organization promotes cooperation between federal, state and private agencies whose functions include the collection, analysis and dissemination of climatic information. They are basically keepers of the climatic records, and in addition provide and/or coordinate climatic information services for each state. Many of them also hold research and teaching appointments at Land Grant Universities or within other federal or state agencies.

Some of the more important topics presented at their annual meeting included:

Contention that the heated tipping bucket rain gauges which are part of the ASOS (Automated Surface Observation System), are still showing errors when compared to the universal gauge. These errors are thought to be associated with light snowfall and with the heating mechanism which causes either evaporation or a heat plume to form around the opening of the gauge. National Weather Service is being advised on this matter and may include universal gauges at all the proposed ASOS sites.

Higher resolution precipitation mapping will soon be available through the PRISM program which couples a gridding technique and a DEM (Digital Elevation Model). It is being tested in the western United States, where it has demonstrated very high skill.

1.8 billion dollars has been allocated in the federal budget (beginning in October) to go toward Global Change research. Over 20 agencies are involved in various aspects, including climate modeling, monitoring, bioindicators, impacts, etc.

The National Oceanic and Atmospheric Administration's GLOBE program has begun. This stands for Global Observations to Benefit the Environment and was an initiative started by VP Al Gore. 200 million dollars has been appropriated for the coming fiscal year. These funds will provide for training and equipment to allow K-12 schools to participate in global monitoring activities under the guidance of science teachers.

The Climate Analysis Center (CAC) will start new long range guidance products over the next year. A new 8-14 day outlook based on numerical prediction models will begin sometime in 1995. In addition 30 day and 90 day outlooks will be released with greater lead times. The 30 day guidance will have a two week lead time, while the 90 day guidance will now be offered for periods up to 1 year ahead. Skill levels of the various products will be indicated. Where no skill is found, CAC will designate the use of climatic probability instead.

Notes for MPR "Morning Edition", Program of August 5, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

A listener called to ask about percent possible sunshine. What is it? Based on sunrise-sunset tables, the National Weather Service can estimate the total possible minutes of sunshine for each day.

A sunshine recorder is used to record the actual number of minutes of sunshine which are then compared each month to the total possible. This ratio (actual/possible) is what is recorded as percent possible sunshine for each month at National Weather Service Forecast Offices.

Naturally sunshine recorders have to be periodically adjusted so that they record light intensity above a certain threshold. This prevents them from recording diffuse light or sunlight that is obscured by clouds.

We all know that during May, Mother Nature provided a climate very favorable for the start of the growing season in Minnesota. One of the climate features which escaped our attention was that the percent possible sunshine for May was 86 percent. On average it is only about 59 percent, so this was a remarkable departure. The Weather Service recorded 5 days in May with 100 percent of possible sunshine. Since May, percent possible sunshine values have been much closer to normal.

1. Almanac (typical max of mid 80s and min of low 60s)

MSP record high for August 5th is 100 degrees in 1947. The record low is 48 degrees in 1870. But, the lowest this century is 49 degrees in 1948. Record precipitation for August 5th is 2.60 inches in 1865. Most rainfall this century is 1.17 inches in 1935.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 104 degrees at Moorhead (Clay County) in 1947. The all-time low temperature is 35 degrees at Cass Lake (Cass County) in 1957.

2. Observer and Community Notes: Winona, MN

This community located along the scenic Mississippi River Valley in SE Minnesota has a long climatic record. Weather observations were first taken in August of 1885 by Mr. J.M. Halsinger. Winona is one of only a few long term climate records along the Upper Mississippi Valley. The staff of the local newspaper, now the Winona Daily News, have taken the observations in town for many years, while the staff of the Army Corps of Engineers at the Lock and Dam have taken their observations right along the river's edge.

All-time records at Winona include: 108 degrees on July 12, 1936; -35 degrees on January 12, 1912; rainfall of 4.30 inches on July 1, 1978; and snowfall of 16 inches as recently as December 1, 1985.

The climate along the Mississippi River Valley in SE Minnesota is one of the most hospitable in the state for growing plants. From Hastings to La Crosse the growing season is extended

beyond what the uplands experience. For example the average growing season (frost free days) in Winona is 164 days long, while away from the river valley over at Rochester it is only 147 days, or 2.5 weeks less. In fact some growing seasons in the Mississippi River Valley have been over 200 days long. In addition, winter temperatures are not so extreme here as in other areas of the state and perennial plants and trees tend to survive for longer periods of time. This in part is why you might notice vineyards, apple orchards, as well as other fruit and nut trees while you drive along the river valley.

3. Word of the Week: **Calm**

This of course is the condition of Bob Potter each morning on the radio. But meteorologically this refers to the absence of wind. On the Beaufort Scale, calm is associated with smoke rising vertically or when the surface of the sea or inland lake is smooth and mirror-like. For the National Weather Service reporting, calm is indicated when speeds are less than one mph. Many anemometers have a start up threshold of approximately 1 mph to move the cups, so typically anemometers show no movement whatsoever when there is a calm.

Incidentally, for many locations in Minnesota, July and August are the months with the highest frequency of calms. They generally occur between 10 pm and 5 am.

4. Topic: **AASC**

Some of the more important topics presented at their annual meeting of the American Association of State Climatologists included:

Contention that the heated tipping bucket rain gauges which are part of the ASOS (Automated Surface Observation System), are still showing errors when compared to the universal gauge. These errors are thought to be associated with light snowfall and with the heating mechanism which causes either evaporation or a heat plume to form around the opening of the gauge. National Weather Service is being advised on this matter and may include universal gauges at all the proposed ASOS sites.

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guidance products over the next year. A new 8-14 day outlook based on numerical prediction models will begin sometime in 1995. In addition 30 day and 90 day outlooks will be released with greater lead times. The 30 day guidance will have a two week lead time, while the 90 day guidance will now be offered for periods up to 1 year ahead. Skill levels of the various products will be indicated. Where no skill is found, CAC will designate the use of climatic probability instead.

Notes for MPR "Morning Edition", Program of August 12, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

With the cool days we experienced on Monday, Tuesday and Wednesday of this week, a listener called to ask how often our daily high temperature never gets out of the 60s during this time of August (8th-12th). Going back to 1900 the answer is less than 6 percent of the time. Some other years in which August has started off quite cool are 1902, 1903, 1904, 1907, 1912, 1915 and 1964. As recently as 1991 we experienced consecutive early August days with maximum temperatures only reaching the mid 60s. The coldest maximum temperature in the Twin Cities area for today's date is 61 degrees back in 1916.

In fact, Monday, Tuesday and Wednesday of this week produced record setting low maximum temperatures all around the state. Some of the lowest observed maximums included:

| | | | |
|-------------|--------------|----------------|--------------|
| Becker 60 | Lamberton 62 | Morris 57 | Staples 62 |
| Waseca 62 | Rosemount 62 | Cedar Creek 61 | Rice 61 |
| Westport 59 | MSP 60 | St Cloud 61 | Rochester 58 |

These maximum temperatures are much more typical of mid October, so Mother Nature was getting two months ahead of herself. (In northern Minnesota which was relatively free of clouds, daily highs were 8 to 10 degrees greater than in southern locations. This suggests that the cool temperatures were very much related to the extent and duration of cloud cover.)

1. Almanac (typical max of 80 and min of upper 50s)

MSP record high for August 12th is 94 degrees in 1886 and 1965. The record low is 45 degrees in 1961. Record precipitation for August 12th is 2.42 inches in 1985.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 101 degrees at Canby and Montevideo in 1988. The all-time low temperature is 32 degrees at Thorhult and Warroad in 1961.

2. Observer and Community Notes: Decorah, IA

MPR member station in Decorah may not realize that their community possesses one of the longest climatic records in the state of Iowa. Daily observations in the Upper Iowa River Valley there go back to 1878. In fact just down the road at Ft Atkinson they go all the way back to 1844. Because of the topography along the river valley and the diverse mixture of native vegetation, Decorah remains one of the most scenic landscapes in Iowa. Climatic records there include: 111 degrees on July 14, 1936; -43 degrees on January 30, 1951; 15 inches of snow on December 1, 1985;

and 7.70 inches of rain on May 28th, 1941 which caused the Upper Iowa River to flood the town. I am sure the river was quite frozen this past winter, as Decorah reported 3 days in January of minimum temperatures colder than -30 degrees.

Decorah is also known as the home to Luther College and to the Sievert Springs Norwegian Museum.

3. Words of the Week: Radar and Anomalous Propagation

Radar is a term derived from radio detection and ranging. It is an electronic instrument used for the detection and ranging of distant objects that scatter or reflect radio waves. Radar has evolved to become one of the most valuable tools used in weather forecasting, particularly for severe weather. Radio energy is emitted in a narrow focused beam from a transmitter out through the atmosphere. Objects in its path may absorb, scatter or reflect this radio energy. Some of the scattered and reflected energy returns back along the same path and is intercepted by a receiver (detector). The radio frequency can be adjusted to locate different types of targets (airplanes, ships, storm cells). The return signal or echo provides information on the target direction, distance, speed of movement, and nature of the object. Weather radars are used to locate and track different types of storms, especially dangerous thunderstorms. A new more powerful Doppler weather radar has recently been installed in Chanhassen for use by our National Weather Service. It will be commissioned and become operational over the next several months, as the staff simultaneously phase out the use of the 1957 radar system.

Anomalous propagation sounds like a reference to a 10 month old child learning to walk, but in radar meteorology it refers to either a false echo from a radar signal or an echo produced from an unintended target or object such as hills, a river valley, power lines, or some other surface feature. Thus a weather radar detector shows scattering or reflection from a target that is either not real or is outside the intended instrument line of sight. Though a rare occurrence, it is very obvious in the summertime when the radar scope shows a pattern of echoes even though skies are perfectly clear. The explanation often lies with an unusual vertical distribution of temperature and moisture (water vapor) associated with density discontinuities in the atmosphere which refract (bend) the radio energy at one or more vertical levels. In some cases large amounts of water vapor left in the air by a passing thunderstorm are still detected as echoes by the radar scope even though the cloud mass has moved off to the distant horizon. In other cases, the target echoes detected by the radar scope are not coming from the line of sight of the radar (return path of the transmitted energy), but from somewhere else because they have been refracted. This is often referred to as "ground clutter."

Notes for MPR "Morning Edition", Program of August 12, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

With the cool days we experienced on Monday, Tuesday and Wednesday of this week, a listener called to ask how often our daily high temperature never gets out of the 60s during this time of August (8th-12th). Going back to 1900 the answer is less than 6 percent of the time. Some other years in which August has started off quite cool are 1902, 1903, 1904, 1907, 1912, 1915 and 1964. As recently as 1991 we experienced consecutive early August days with maximum temperatures only reaching the mid 60s. The coldest maximum temperature in the Twin Cities area for today's date is 61 degrees back in 1916.

In fact, Monday, Tuesday and Wednesday of this week produced record setting low maximum temperatures all around the state. Some of the lowest observed maximums included:

| | | | |
|-------------|--------------|----------------|--------------|
| Becker 60 | Lamberton 62 | Morris 57 | Staples 62 |
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These maximum temperatures are much more typical of mid October, so Mother Nature was getting two months ahead of herself. (In northern Minnesota which was relatively free of clouds, daily highs were 8 to 10 degrees greater than in southern locations. This suggests that the cool temperatures were very much related to the extent and duration of cloud cover.)

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Notes for MPR "Morning Edition", Program of August 19, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

I was immediately reminded by a listener last week, that we failed to mention the all-time extremes at Decorah, IA where climate records date back to 1878. Some of the climatic records there include: 111 degrees on July 14, 1936; -43 degrees on January 30, 1951; 15 inches of snow on December 1, 1985; and 7.70 inches of rain on May 28th, 1941 which caused the Upper Iowa River to flood the town.

The return to near normal temperatures this week is pleasing to the farmers around the state. All of the positive growing degree days which we gained with above normal temperatures in May and June have been surrendered due to the cooler than normal temperatures for the past seven weeks (See the comment on the temperatures during the first half of August below). Still, with timely planting this year and near normal temperatures expected for the mid-August to mid-September period, I would project corn maturation in the southern part of the state by the 10th to the 17th of September, and perhaps the 17th to the 24th of September across central Minnesota. This would make those projections of bumper row crops more likely to come through since the crop would mature before any likely frost.

1. Almanac (typical max of 80 and min of upper 50s)

MSP record high for August 19th is 97 degrees in 1976.
The record low is 39 degrees in 1967. Record
precipitation for August 19th is 2.00 inches in 1839.
The most rainfall this century for the date is 0.96
inches in 1904.

Scanning the State Climate Data Base other records of note are:
The all-time high temperature for today's date is 107 degrees
at Browns Valley in 1976. The all-time low temperature is
27 degrees at Tower in 1977.

2. Observer and Community Notes: None this week

3. Word of the Week: **Aeolian or Eolian**

This term derives from Aeolus, in ancient Greek mythology the god of the winds. The term is used in geology, climatology, soil science and even music. It refers to an action or effect produced by the wind, e.g. something that was borne, deposited, produced or eroded by the forces of wind. An aeolian harp is a box instrument composed of stretched silk or gut strings which produce different tones as the wind passes across them. An aeolian anemometer is based on the principle that the pitch of these aeolian tones is governed by the wind speed, thus a change in pitch would indicate a relatively faster or slower

wind.

Wind borne soil materials found in the landscape are referred to as aeolian deposits. These might be silt-like loess material such as that found in southeastern Minnesota, volcanic ash spewed from an erupting volcano and deposited in the surrounding landscape according to the prevailing wind direction, or dune sand found sometimes in steep ridges or low swells, such as the Sand Dunes State Forest in Sherburne County of central Minnesota. Much of the loess and sand materials were deposited by winds during a period of relative aridity after the retreat of the glaciers in North America.

4. Topic: Average temperatures first half of August

Dave Ruschy of the climatology staff at the university brought the following to my attention. The mean temperature at MSP for August 1-15 this year was 65.4 degrees. That is the second coldest first half of August this century, beaten only by the 64.1 degree average of 1903. Further, he found that for the 12 days from August 4th to the 15th, the mean temperature was 62.9 degrees which is indeed the coldest such period this century, nearly 9 degrees colder than average.

Great sleeping weather, but on the other hand we will probably all wilt if we hit 90 degrees again this summer.

Notes for MPR "Morning Edition", Program of August 26, 1994

For: Bob Potter, John Bischoff, and Marianne Combs

From: Mark Seeley, University of Minnesota

A thunderstorm developed over the northern portion of the Twin Cities on Tuesday evening, depositing from 0.90 inches to 1.25 inches of rain in about 40 minutes. Good thing the Fair hadn't started yet. For some that was nearly as much rain as had fallen for the entire month so far.

1. Almanac (typical max of 78 and min of mid 50s)

MSP record high for August 26th is 94 degrees in 1948. The record low is 44 degrees in 1964 and 1968. Record precipitation for August 26th is 1.11 inches in 1967.

Scanning the State Climate Data Base other records of note are:

The all-time highest temperature in the state for today's date is 101 degrees at Browns Valley (Traverse County) in 1976.

The lowest temperature is 23 degrees at Roseau in 1915, putting an end to the growing season that year.

2. Observer and Community Notes: Roseau, MN

Located west of the southern tip of Lake of the Woods in northwest Minnesota, this little town has the oldest climate record in Roseau County. Daily observations were begun by Mr. O.B. Ekman in February of 1894. They are still taken each day, now by Mr. Brad Zoeller.

Record extremes at Roseau include: 107 degrees on July 12, 1936; -52 degrees on February 11, 1914; 5.07 inches of rainfall on September 2, 1957.

3. Words of the Week: **Squall and Cockeyed Bob**

Squall is a sudden strong wind with a duration of minutes, followed by a rapid decrease in wind speed. In observational

practice a squall is a wind speed of greater than 18 mph (fresh breeze or 5 on the Beaufort Scale, waves form on inland waters) which is sustained for at least 2 minutes. This distinguishes it from a wind gust which may last a few seconds up to a minute or longer.

Cockeyed bob is a colloquial term used in western Australia to describe a summer squall, usually associated with thunder or a very small scale storm or dust devil. (I wonder if sometimes this term is used to refer to the Captain of "This Just In.")

4. Topic: FFA at the State Fair

The Future Farmers of America have been official weather observers at the State Fair for over 25 years. They measure and report temperature conditions from the State Fair Barnyard every hour. They also have a contest every year to see who can most accurately predict the total amount of rain that will fall during the 12 days of the fair. History shows that more often than not one of these young experts does a better job of predicting total rainfall than many of the so-called professional meteorologists in the Twin Cities. Just for the fun of it, Bob, why don't you and I each make a guess and we'll see how we stack up.

The FFA members formed their own state network for rainfall observations back in the mid 70s under the guidance of former State Climatologist Earl Kuehnast and Professor Donald Baker of the University of Minnesota. During 1977 1521 FFA members reported rainfall to the State Climatology Office. Since that time the number of observers has declined, but many former FFA members are adult observers in various state climatic networks today.

One other note about the State Fair - since most people spend the better part of their day out of doors at the fair, comfort is very important. What clothes to wear, whether or not to take the sun block, an umbrella, sunglasses, etc. Dew point is an important index for comfort and typically during the fair average dew points are in the mid to upper 50s, but can range all the way into the mid 70s which is terribly uncomfortable. The record high dew point at fair time is 77 degrees and the record low dew point is 29 degrees believe it or not.

Notes for MPR "Morning Edition", Program of September 9, 1994
For: Bob Potter, Greg Magnuson, and Marianne Combs
From: Mark Seeley, University of Minnesota

The warm temperatures are certainly a welcome site for agriculture as they will assure that most row crops reach maturation before frost becomes too widespread in the state. Normal average fall frost dates in the primary corn and soybean producing areas of the state range from Sept 25 to Oct. 10th.

The higher temperatures expected for the weekend, pushing 90 degrees are not inappropriate for this time of year. Back in 1990 we reached 90 degree temperatures about this time in September.

1. Almanac (typical max of low 70s and min of low 50s)

MSP record high for September 9th is 95 degrees in 1947. The record low is 38 degrees in 1883, but the lowest temperature this century has been 39 degrees in 1924. Record precipitation for September 9 is 1.79 inches in 1900.

Scanning the State Climate Data Base other records of note are:

The all-time highest temperature in the state for today's date is 105 degrees at Beardsley in 1931. The lowest temperature is 22 degrees at Tower in 1975.

2. Observer and Community Notes: None this week

3. Word of the Week: Biofog

This refers to a type of steamfog that results when a very cold air mass comes into contact with the warm moist air which usually surrounds humans or animals. It is usually very local in nature and sometimes can be seen around livestock feedlots in the fall in Minnesota. Another very small scale example is when people exit from a health club or gymnasium in the evening and the warm moist air from inside the building meets the cold night air near the doorways. Sports fans may have memories or visions of what this looks like as a result of seeing Viking or Packer football players emerge from the locker room at halftime. There are also some historical references to this in literature which describes massive steam clouds surrounding buffalo herds on the great plains during the harsh winters of the 19th century.

4. Topic: Al Gore's GLOBE Program

This stands for Global Observations to Benefit the Environment. This program is endorsed by the AMS (American Meteorological Society) and funded beginning in fiscal 1995 through the National Oceanic and Atmospheric Administration with an initial budget of 200 million dollars. The purpose is to support K-12 teachers (primarily science teachers) who want to purchase equipment or instruments which will allow students to make climatic or ecological observations on a continuing basis. Besides the usual climatic observations (temperature, rainfall, soil frost, etc.) these might include observations of plant growth and development, animal populations or behavior, stream, well or lake levels and quality or a number of others.

Listeners who are teachers and would like more information on the GLOBE program can contact me at the university and I will send them some additional information. My phone numbers are 625-4724 or 625-5797. Lastly, I would like to offer best wishes to Richard Naistat and his family who will be moving to Maine. Richard has been one of the best meteorologists in the state of Minnesota, serving the people as a lead forecaster with the National Weather Service for the past 20 years or so. He has accepted a promotion and transfer to Maine.

To: Greg Magnuson, Bob Potter and Marianne Combs
From: Mark Seeley
RE: Suggestions for Morning Edition, Friday, September 16, 1994

Quite a warm week for us, with temperatures 10 to 15 degrees above normal. But how about those dew point temperatures, 66 on Monday, 72 on Tuesday and 73 on Wednesday, the latter two being record high dew points for the dates.

I wanted to mention that the University of Minnesota will be hosting the Annual Kuehnast Memorial Lecture on October 4th. The speaker this year is Dr. Paul Wagonner who will discuss the question, "How Much Land Can 10 Billion People Spare for Nature in an Uncertain Climate?"

1. Almanac: Normal highs and lows are around 70 and 50.

Record high for MSP is 94 degrees in 1955. Record low is 38 degrees in 1900. The greatest amount of rainfall for today's date is 1.34 inches in 1933.

Scanning the state climatic records: the all-time high temperature for today's date is 98 degrees at Pipestone in 1955. The all-time low temperature is 21 degrees at Roseau in 1916. Last year on this date it was 25 degrees up at Tower, MN in the arrowhead. Looks like we may see cool temperatures up in that part of the state by next week sometime.

2. Community Notes: Thief River Falls, MN (home of MPR's KQMN and KNTN)

Located in Pennington County of northwestern Minnesota, this community has kept daily climatic records since May of 1899. Radio station KTRF has been responsible for the daily observations there since 1947. Some of the all-time climatic extremes observed in Thief River Falls include: 108 degrees on July 28, 1917; -45 degrees on February 11, 1914 and again on January 13, 1916. Perhaps their shortest growing season ever was 1917, when the last killing frost occurred on June 15 and the first killing frost occurred on August 29th- only a 75 day growing season!

3. Word of the week: Pluvial

This term is certainly appropriate for this week, as it refers to rainfall, particularly abundant rainfall. Pluvio is the Latin word for rain. In geologic time scales a period dominated by heavy rainfall is sometimes referred to as a pluvial period, often this is descriptive of the near equator climates during the glaciation of the mid latitudes. During pluvial periods lakes were at their highest levels and often many small lakes combined into one large one, such as the ancient Glacial Lake Agassiz in northwestern Minnesota during Pleistocene times. Pluvio is also used to form other words pertaining to rainfall, such as pluviometer (rain gauge), pluviograph (a recording rain gauge), or pluvial index (the total daily precipitation which is equalled or exceeded only once per century, or that has a return period of 100 years). These terms are somewhat rare in the United States, but the Bureau of Meteorology in Australia for example refers to their network of precipitation observers as the Pluvio Network.

4. Topic: NOAA Weather Radio

Last week we mentioned VP Al Gore's GLOBE Program for K-12 schools. This week I want to mention the VP's active role in expanding the NOAA Weather Radio Program. This program has been in existence since the early 1970s and provides continuous broadcasts of weather information over a network of private and government operated transmitters. Information is broadcast over a frequency of 162 Mhz covering an area with a radius of 40 square miles. The problem is that this service is not available to everybody.

Last March, when severe weather and tornadoes struck the southeast many people were injured and killed due to the absence of any functional warning systems for severe weather. VP Gore visited northeastern Alabama where the Goshen United Methodist Church was destroyed and people were killed. He learned that this area did not have NOAA Weather Radio available and that the public for the most part was unaware of severe weather watches and warnings. He likened this to the absence of smoke detectors in a crowded building. Gore organized a task force to look into expanding NOAA Weather Radio coverage, estimated to be about 70 percent across the U.S. However there are many states and regions which have less than 50 percent coverage by this network of transmitters.

The National Oceanic and Atmospheric Administration is now partnering with the private sector to initiate the deployment of more transmitters and more receivers around the country. Their goal is to reach 95 percent coverage potential by installing up to 250 additional transmitters over the next 2-3 years. In Minnesota, we have spotty areas in the west and large numbers of counties in the north-central and northeastern sections which do not have NOAA Weather Radio available to them. NOAA is soliciting for private industry donations and corporate sponsorship to allow placement of more receivers in schools, churches, hospitals, summer camps, nursing homes and the like.

The end result of all this may be that NOAA Weather Radio will become the primary all-hazards broadcast network for many states with the ability to trigger strategically placed alarmed receivers in businesses, schools, malls and other places where people gather.

To: Greg Magnuson, Bob Potter, John Bischoff, and Marianne Combs
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, September 23, 1994

Autumn officially began this morning at 1:19 am as the sun passed over the equator on its migration to southern latitudes. We will begin to see a more steady decline in temperatures now, which will accelerate in October. In fact, even on this date we experience low temperatures in the 30s locally about 15 percent of the time.

Some farmers in western Minnesota are already combining soybeans which have matured. A few are harvesting early planted corn or corn which has been damaged by hail or insects and is at risk of lodging.

I wanted to mention that the University of Minnesota will be hosting the Annual Kuehnast Memorial Lecture on October 4th. The speaker this year is Dr. Paul Wagonner who will discuss the question, "How Much Land Can 10 Billion People Spare for Nature in an Uncertain Climate?"

1. Almanac: Average max upper 60s and average min in the mid 40s

MSP records for today's date include a maximum of 90 degrees in 1891 and 1937. Record low is 30 degrees in 1983 and record rainfall is 3.10 inches in 1869. On this day in 1985, we recorded the earliest measurable snowfall in the Twin Cities area, measuring 0.4 inches.

Scanning the state climate data base some records of note are: the all-time high temperature for today's date is 97 degrees at St Peter in 1937. The all-time low temperature is 18 degrees at Roseau in 1913 and at Wannaska (Roseau County) in 1976.

2. Community Notes: Detroit Lakes, MN (Becker County)

Becker County in northwestern Minnesota is a mixture of forests, lakes and prairie set in a somewhat rolling topography. The landscape is a particularly nice one for viewing fall colors (see reference below). The best historical records for characterizing the climate there are from Detroit Lakes, a community in the southwestern part of the county, where they began official daily climatic observations in December of 1895. George and Mina Peoples were the first observers, keeping the daily records from 1895 to 1930. Record temperatures there include -53 degrees on February 9, 1899 and 107 degrees on July 11, 1936. The average first frost date in Detroit Lakes is September 19, compared to the average of October 13th for the Twin Cities.

3. Word of the week: **Isophane or Isophene**

Derived from the Greek words, iso meaning equal and phainein meaning to show. These terms refer to a line drawn through geographical points where a given seasonal phenological event occurs at the same time. For example, the flowering of crab apple trees, or the leaf color change on birch trees or maple trees in the fall. In fact the maps contained in our local newspapers each week showing where the fall colors are beginning, peaking, or ending are usually using isophanes to delineate the regions.

4. Topic: Fall Color and Climatology

We are in the midst of fall color changes in Minnesota. These are primarily triggered by changes in daylength. With shorter days, chlorophyll breaks down faster than it is produced and allows the yellow, red and purple pigments in plant leaves to become more visible. We are now losing 2-3 minutes of daylight each day, which certainly adds up and is noticeable on a weekly basis.

The pace at which this color change occurs can be modified by the temperature pattern of late summer and early fall. For example, the cool temperatures experienced in August helped to trigger some early color change in places. However, that has been somewhat slowed by the warm temperature pattern of September so far. The current cool period, though expected to be of relatively short duration, will likely accelerate the rate of color change we have already seen.

Former State Climatologist Earl Kuehnast found a relationship between overnight minimum temperatures in the 30s and the rate of leaf color change. Three nights with temperatures in the 30s were associated with the onset of leaf color change, and peak fall color was associated with 7 to 10 nights in the 30s. So far climate observations from extreme northern Minnesota (Hibbing, International Falls, Tower and Big Falls) show 5 to 7 nights with minimums in the 30s. Most central and southern Minnesota areas have yet to see such temperatures.

There's a very good article by Tom Eiber of the DNR in the current issue of the Minnesota Volunteer magazine which describes 5 favorite routes to follow in order to observe the diversity of Minnesota color. Hwy 34 between Walker and Detroit Lakes, Pillsbury State Forest near Brainerd, Hwy 61 in SE Minnesota, Hwy 95 from Stillwater to Taylors Falls, and County Roads 23 and 116 near Orr and Ely.

5. Alternative Topic: NOAA Weather Radio

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From: Mark Seeley
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Record low is 30 degrees in 1983 and record rainfall is 3.10 inches in 1869. On this day in 1985, we recorded the earliest measurable snowfall in the Twin Cities area, measuring 0.4 inches.

Scanning the state climate data base some records of note are: the all-time high temperature for today's date is 97 degrees at St Peter in 1937. The all-time low temperature is 18 degrees at Roseau in 1913 and at Wannaska (Roseau County) in 1976.

2. Community Notes: Detroit Lakes, MN (Becker County)

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However, that has been somewhat slowed by the warm temperature pattern of September so far. The current cool period, though expected to be of relatively short duration, will likely accelerate the rate of color change we have already seen.

Former State Climatologist Earl Kuehnast found a relationship between overnight minimum temperatures in the 30s and the rate of leaf color change. Three nights with temperatures in the 30s were associated with the onset of leaf color change, and peak fall color was associated with 7 to 10 nights in the 30s. So far climate observations from extreme northern Minnesota (Hibbing, International Falls, Tower and Big Falls) show 5 to 7 nights with minimums in the 30s. Most central and southern Minnesota areas have yet to see such temperatures.

There's a very good article by Tom Eiber of the DNR in the current issue of the Minnesota Volunteer magazine which describes 5 favorite routes to follow in order to observe the diversity of Minnesota color. Hwy 34 between Walker and Detroit Lakes, Pillsbury State Forest near Brainerd, Hwy 61 in SE Minnesota, Hwy 95 from Stillwater to Taylors Falls, and County Roads 23 and 116 near Orr and Ely.

The warm temperatures are certainly a welcome site for agriculture as they will assure that most row crops reach maturation before frost becomes too widespread in the state. Normal average fall frost dates in the primary corn and soybean producing areas of the state range from Sept 25 to Oct. 10th.

The higher temperatures expected for the weekend, pushing 90 degrees are not inappropriate for this time of year. Back in 1990 we reached 90 degree temperatures about this time in September.

1. Almanac (typical max of low 70s and min of low 50s)

MSP record high for September 9th is 95 degrees in 1947. The record low is 38 degrees in 1883, but the lowest temperature this century has been 39 degrees in 1924. Record precipitation for September 9 is 1.79 inches in 1900.

Scanning the State Climate Data Base other records of note are: The all-time highest temperature in the state for today's date is 105 degrees at Beardsley in 1931. The lowest temperature is 22 degrees at Tower in 1975.

2. Observer and Community Notes: None this week

3. Word of the Week: Biofog

This refers to a type of steamfog that results when a very cold air mass comes into contact with the warm moist air which usually surrounds humans or animals. It is usually very local in nature and sometimes can be seen around livestock feedlots in the fall in Minnesota. Another very small scale example is when people exit from a health club or gymnasium in the evening and the warm moist air from inside the building meets the cold night air near the doorways. Sports fans may have memories or visions of what this looks like as a result of seeing Viking or Packer football players emerge from the locker room at halftime. There are also some historical references to this in literature which describes massive steam clouds surrounding buffalo herds on the great plains during the harsh winters of the 19th century

4. Topic: Al Gore's GLOBE Program

This stands for Global Observations to Benefit the Environment. This program is endorsed by the AMS (American Meteorological Society) and funded beginning in fiscal 1995 through the National Oceanic and Atmospheric Administration with an initial budget of 200 million dollars. The purpose is to support K-12 teachers (primarily science teachers) who want to purchase equipment or instruments which will allow students to make climatic or ecological observations on a continuing basis. Besides the usual climatic observations (temperature, rainfall, soil frost, etc.) these might include observations of plant growth and development, animal populations or behavior, stream, well or lake levels and quality or a number of others.

Listeners who are teachers and would like more information on the GLOBE program can contact me at the university and I will send them some additional information. My phone numbers are 625-4724 or 625-5797.

Lastly, I would like to offer best wishes to Richard Naistat and his family who will be moving to Maine. Richard has been one of the best meteorologists in the state of Minnesota, serving the people as a lead forecaster with the National Weather Service for the past 20 years or so. He has accepted a promotion and transfer to Maine.

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To: Greg Magnuson, Bob Potter, John Bischoff, and Marianne Combs

From: Mark Seeley

Re: Suggestions for Morning Edition, Sept. 30, 1994

The new 30 and 90 day outlooks are supposed to be released on Thursday afternoon of this week. I will discuss them Friday morning if you like, unless they are totally nondescript.

Extremes for last week were 110 degrees at Imperial, CA and 4 degrees at Big Piney, WY.

1. Almanac: Average max mid 60s, average min low 40s, daylength 11h 46m

MSP record max for today is 87 degrees in 1897. Record low is 26 degrees in 1939. One tenth of an inch of snow on this date in 1961 here at MSP, but 4 inches at Faribault, MN.

Scanning the State Climate Records: the all-time high temperature in Minnesota for today's date is a sweltering 93 degrees at Tracy (Lyon County) in 1952. The all-time low is 17 degrees at Campbell (Wilkin County) in 1939.

Last year on this date we had frost across much of southern Minnesota, with some temperatures as low as the mid 20s.

2. Words of the Week: Ephemeral Stream, Perennial Stream, and Intermittent Stream

From the Greek word *ephemeros* meaning daily or lasting one day. Ephemeral stream refers to a stream channel (a creek or a brook for example) which carries surface waters only during and immediately after a rain or snow event. Streams like this can be found in areas with some topography or rocky surface features which transport precipitation runoff rapidly. They are also found in some farm fields as grassy waterways which carry off water from substantial rainfall events or during spring snowmelt.

From the Latin word *perennis* meaning lasting the whole year through. A perennial stream is one which carries surface waters at all times, except during periods of extreme drought, like that of 1988.

From the Latin *intermittere* meaning to send between. An intermittent stream carries surface waters much of the time, but ceases to flow occasionally or seasonally because of a frozen condition, streambed seepage, or evapotranspiration exceeding the available water supply.

Being a state with a good deal of water, some topography, variable geology and soils, and very distinct climatic seasonality, including a prolonged frozen period in winter, we have an abundance of all three kinds of streams in Minnesota. The size and number of ephemeral and intermittent streams which feed the Minnesota River in the southern part of the state contribute to the significant variability observed in the sediment load of that river.

3. Community Notes: None this week.

4. Topic: Listener question about fog

A listener called and left a question: In which month do we have the highest frequency of fog in Minnesota? Well having just come through the summer months, all of which have a low probability of fog, we will see an increasing probability as we go through October into November and December, which is the month with the highest probability for fog (over 35 percent of the daily obs show a report of fog).

A counter trend occurs with respect to the probability for thunderstorms. The chance for thunderstorms declines rapidly during the months of October and November and is practically zero during December,

January and February. This corresponds to the decline in water vapor in the atmosphere as measured by the average dew point temperature. After all condensation of abundant water vapor provides much of the energy for thunderstorms. The average dew point temperature for this time of year is 43 degrees here at MSP, but by Christmas the average dew point temperature will have dropped to about 10 degrees.

To: Greg Magnuson, Bob Potter, John Bischoff, and Marianne Combs

From: Mark Seeley

Re: Suggestions for Morning Edition, Friday, October 7, 1994

I hope you all have had a fine week. It was good to finally see the sun on Wednesday. Nice article about the bumper crops in the Star Tribune by Jim Walsh this week. The cool weather early this week certainly accelerated the leaf color changes.

1. September climate summary: Average temperature for the month was from 2 to 5 degrees warmer than normal. It was a nice month for finishing off crop development, as nearly all crops (even those planted late) reached maturity without frost damage. Some extreme temperatures for the month included 93 degrees at La Crescent (SE) and 26 degrees up at Grand Rapids.

Precipitation was on the surplus side. Over two thirds of our climate observers reported above normal rainfall. Some places in western Minnesota recorded barely over an inch (Browns Valley), while others in the southeast recorded nearly 9 inches (Red Wing).

2. Almanac: Normal high low to mid 60s, lows in the low 40s

MSP records for October 7th include a high of 84 degrees in 1980, a low of 25 degrees in 1976, 0.98 inches of rain in 1904 and a trace of snow in 1915 and 1921.

Scanning the State Climate Records: the all-time high for today's date is 94 degrees at Canby just last year (1993). In fact several western MN communities hit 90 at this time last year. The all-time low temperature is 15 degrees which has occurred a number of times in different places (Roseau in 1990, Detroit Lakes and Baudette in 1989, and Hibbing in 1979).

3. Word of the week: bloxam

This term honors J.C. Bloxam who wrote "On the Meteorology of Newport in the Isle of Wight" in 1860. In deriving daily values of temperature and other climatic parameters from historical time series (many years) he used a method of calculating a sort of running mean for 10 or 11 consecutive days, using this as a value for the middle day in the order. He iterated this process on the historical data until he derived daily values (temperature for example) which ascended or descended in a regular manner corresponding to the seasons. Thus it provided a smoothing function.

This would be something analogous to calculating the mean daily temperature for October 7th (today), by computing the mean value for October 2-12 each year, then averaging across years using a similar process. This method is called the bloxam process. With longer and longer historical climatic records available today, it is rarely used as a means of smoothing data.

4. Topic: Symmetry of Minnesota Spring and Fall

A listener called to remark that the rate at which the sun retreats into the southern latitudes during October is very close to the rate at which it advances into the northern latitudes during the month of March. Does this explain why the daily mean temperature increases 15 degrees in March (from 21 degrees on Mar. 1 to 36 degrees on Mar. 31) and decreases 15 degrees in October (from 55 degrees on Oct. 1 to 40 degrees on Oct. 31).

Indeed, this listener's perception is correct for the most part. The heat gain in terms of daily mean temperature during March is in correspondence with the heat loss during October. We also see a gain of a little more than 90 minutes in daylength during March and a loss of more than 90 minutes in October.

But there is an interesting discrepancy in the extremes of temperature observed for those months. The extremes for October are a high of 96 degrees at both Madison and Wheaton (western MN) in 1963 and a low of -14 degrees at Itasca State Park in 1919. This is a spread of 110 degrees for the month. On the other hand the extremes for March are a high of 84 degrees at Canby (1939), Wheaton (1963) and St James (1986) and a low of -44 degrees at Itasca State Park (again) in 1948. This is a spread of 128 degrees and considerably greater than that of October. What's the explanation?

The answer is probably snow cover (something we shouldn't talk about until at least Halloween). Snow cover is a greater modifier of March climate in Minnesota as it often exists as a remnant of winter, while the establishment of any extensive snow cover over the state in October is indeed a very rare event.

Perhaps the mention of snow will stimulate Bob to start thinking about dry-docking the boat.

To: Greg Magnuson, Cathy Wurzer, John Bischoff, and Marianne Combs

From: Mark Seeley

Re: Suggestions for Morning Edition, Friday, October 14, 1994

Frost on Sunday and Monday just about brought an end to the growing season for most of Minnesota, and accelerated the leaf color changes around the state as well. For most Minnesotans this weeks weather would certainly qualify as Indian Summer, pleasant but a little cool, and for the fashion conscious a particularly good time of year to wear colorful sweaters or sweatshirts. I wonder if more are sold in stores this time of year?

If there is time this week I would like to mention a topic of interest to listeners who use Internet. Our University of Minnesota Department of Soil Science has its own Gopher system accessible via Gopher.Soils.UMN.EDU (if using a Gopher client) or by WWW.Soils.UMN.EDU (if using a World Wide Web client). Our Gopher contains a variety of information, including climatic normals and summaries for the state, as well as the complete text from our Friday morning MPR discussions (especially for those who missed our word of the week or almanac segments).

1. Almanac: Normal high around 60 and low around 40

MSP records for October 14th include a high of 86 degrees in 1947, a low of 24 degrees in 1937, 1.89 inches of rain in 1966 and a trace of snow in 1909, 1943 and 1959.

Scanning the State Climate Records: the all-time high for today's date is 91 degrees at Redwood Falls in 1947. The all-time low is 8 degrees at Beardsley in 1937.

2. Word of the week: Actinometer

From the Greek actino meaning ray of light and meter meaning to measure. This is the general name for an instrument which measures the intensity of radiant energy, particularly that coming from the sun. We have three types at the St Paul Climatological Observatory (one of which we have talked about on Morning Edition): a pyroheliometer measures direct solar radiation; a pyranometer measures global radiation (the combined energy of direct and diffuse radiation); and a pyrgeometer measures terrestrial radiation (radiant energy emitted by the Earth to space).

3. Topic (A): Symmetry of Minnesota Spring and Fall

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Topic (B): Indian Summer and Such

Much of the weather this past week certainly qualifies as the proverbial "Indian Summer", a period defined as mid to late autumn when skies are generally clear, winds are calm, days are sunny and hazy with comfortably warm temperatures and cool nights. In New England, the same definition applies except that this period always occurs after the first killing frost of the season. In our region, it may occur before or after the first frost. The term Indian Summer dates back to at least 1778 and probably originated from the way native American Indians used the last spells of good weather in the autumn to increase their winter stores of supplies and food.

In general usage, Indian Summer is often a brief period in the fall during which past favorable climatic conditions occur (with the exception of daylength, which is declining rapidly). According to the Glossary of Meteorology, the corresponding period in Europe is sometimes referred to as "Old Wives Summer" or "halcyon days." The former refers to the stockpiling nature of experienced wives who planned for the onset of winter by stocking up on food and supplies; the latter refers to a period of tranquility and peace associated in ancient times with the nesting of the halcyon (kingfisher) at sea on or about the winter solstice.

In England, Indian Summer is referred to by other names depending on when it occurs: St Austin's Summer if in September, St Luke's Summer if in October; Allhallow Summer if in early November; and St Martin's Summer if in mid November. Presumably these names derive from the observed holidays or festivities at those times of the year.

To: Greg Magnuson, Cathy Wurzer, John Bischoff, and Marianne Combs

From: Mark Seeley

Re: Suggestions for Morning Edition, Friday, October 21, 1994

1. Almanac: Normal high mid to upper 50s and lows mid to upper 30s.

MSP records for October 21st include a high of 88 degrees in 1947, a low of 16 degrees in 1913, 1.78 inches of rain in 1894 and 0.10 inches of snow in 1936.

Scanning the State Climate Records: the all-time high for today's date is 91 at Redwood Falls in 1947. In fact how about 90, 88, 85, 84, 81, 80, 83, 89, 86 degrees for consecutive days (Oct. 14-Oct. 22) at St Peter in that year. That's more typical of July! Then again October of 1947 was the warmest in Minnesota records back to 1819.

The all-time low for today's date is -2 degrees at Roseau in 1913.

2. Word of the week: Cat Connotations

Most people have heard of the term "raining cats and dogs", which has been in use for centuries. The connotation being that it is raining (thundering, etc) so loudly as to create the same distracting din as a bunch of cats and dogs fighting. But, the word cat is also used by meteorologists to describe other features of the weather.

Cat ice (shell ice) is the thin layer of unbroken ice which remains over a pond, lake or stream after the water level drops, leaving a cavity between the water surface below and the ice above. Presumably the connotation is that this ice could only support the weight of a cat.

Cat's Paw is a term used to describe a very local scale light breeze that is just enough to cause irregular patches of ripples on an otherwise glassy water surface. This creates a pattern not unlike a series of cats paw prints.

Cat's Nose is a term used in England to describe a cool northwest wind which may have the same affect as being touched on the face or hands by a cool cat's nose (or saxophone).

3. Topic: Composting those leaves

Many homeowners around the state compost leaves in the fall. My university home, the Department of Soil Science has developed recommendations for composting and mulching of organic yard wastes, including leaves. Carl Rosen and Tom Halbach among others have published a guide to composting and mulching which is available from county extension offices. Some of the important points about composting:

Large plastic bags, barrels, wire cages or wooden frames will all work well for composting.

Shredded leaves will decompose faster than whole leaves.
(Basically, smaller breaks down faster than larger)

Key ingredients include: organic waste (leaves, grass clippings, plant residues from gardens), proper aeration (stirring or mixing occasionally), moisture (periodically water the compost pile), and nitrogen (either from manure, blood meal, or fertilizer).

Depending on the amount of material, composting may take from 6 months to a year or more before you have a usable mulch.

Weather is certainly a factor in governing the speed of the composting process. Leaves placed in a compost pile early this fall will be subject to more decomposition before winter freeze up. During the winter months in Minnesota, compost piles are usually frozen and little if any biological activity occurs. Thus if you would like to use the mulched material by next summer or fall, start composting now and don't wait for the last leaf to fall.

To: Greg Magnuson, Bob Potter, John Bischoff, and Marianne Combs

From: Mark Seeley

Re: Suggestions for Morning Edition, Friday, October 28 1994

Locally around the Twin Cities area our first frost occurred this week on Wednesday Oct. 26 with a low of 28 degrees, about 2 weeks or more later than the long-term average. Most places reported lows from 23 to 29 degrees that morning. In fact, the latest frost recorded in the MSP area this century was in 1900, when a freezing temperature did not occur until November 7th. That year, residents of the Twin Cities were still picking red raspberries into the first week of November, if you can believe it!

Halloween coming up on Monday. Some climatology from the MSP records for Halloween: Average high temperature is 52 degrees, average low temperature is 35 degrees, average 'Trick or Treating' temperatures in the 40s, with sunset shortly after 5 pm. Record extremes for Halloween include: a high of 83 degrees in 1950 and a low of 18 degrees in 1951. Since 1891 there have been only 5 snowfalls on Halloween (1896 trace, 1926 trace, 1932 1.5 inches, 1954 0.4 inches, and 1991 a whole bunch). Chances of getting any kind of precipitation on Halloween (historically) are 28 percent.

1. Almanac: Normal max low 50s and min in the low 30s.

MSP records for October 28th include a high of 75 degrees in 1948, a low of 17 degrees in 1905 and 1925, 1.09 inches of rain in 1961 and 0.4 inches of snow in 1895.

Scanning the State Climate Records: the all-time high for today's date is 83 degrees at Canby (Yellow Medicine County) in 1937. The all-time low is a very chilly -8 degrees at Campbell (Wilkin County) in 1919. This occurred with 6 inches of snow on the ground that year.

2. Word of the week: Personal Equation

This describes a systematic observational error due to the characteristics of an individual observer. (I suppose this must apply with individual economists or money managers as well). A statistical analysis of the observer's recorded data may reveal a bias or a level of uncertainty particular to that observer. There are many examples: observations of cloud cover in tenths, one observer may see 0.6 cloud cover differently than another; observations of pan evaporation, one observer may measure the reduced volume of water in an evaporation pan each day, another observer may refill the evaporation pan to a fixed level each day; or parallax error

in reading a glass thermometer where subtle changes in line of sight can make a difference (e.g. left vs right eye, looking upward at the thermometer versus looking downward).

3. Community Notes: St Peter, MN

Home to MPR member stations KGAC 90.5 and KNGA 91.5 FM, this community has kept a record of daily climate observations since May of 1893. Located less than 1/2 mile from the Minnesota River in Nicollet County, the Minnesota Security Hospital personnel have been responsible for making the daily observations for over 101 years, one of the best records in the state.

All-time extremes for the St Peter station include: 109 degrees on July 14, 1936; -40 degrees on January 12, 1912; and 8.62 inches of rainfall on August 7, 1968.

4. Topic: Weather Sleuths - Forensic Meteorologists

There is an interesting article in this month's Weatherwise magazine about forensic meteorology, referring to those weather people who provide expert analysis and interpretation of data in a court of law, especially liability cases where weather conditions are presumed to have had an impact in regards to a personal injury, property loss, or fatality. The degree of spatial and temporal variability in weather is often called into question. Some weather characteristics which are often contentious between plaintiff and defendant:

Degree of visibility at the site of an automobile accident:

This can be influenced by a large number of factors including low winter-time sun angles, high reflectivity of snow covered surfaces, dense low lying fog, or heavy frost on windows.

Pavement conditions in a slip and fall accident: This may involve whether or not pavement was wet or icy, or whether or not snow had been properly shovelled in a timely manner to meet local ordinances. Sometimes meltwater from snows can accumulate in shaded spots on paved areas and refreeze even though the sun is out and the official reported temperatures are above freezing.

Heavy rainfall events which cause property damage or the cancellation of outdoor events: There may be insurance claims filed, but they must be substantiated with official records of rainfall. As we all know, sometimes one side of town might receive 0.10 inches of rainfall from a thunderstorm, while a few miles away as much as 2 inches might occur. The spatial variability can be tremendous depending on the size, development and speed of movement in the cloud system.

Notes for MPR "Morning Edition", Program of August 5, 1994

For: Bob Potter, Greg Magnuson, and Marianne Combs

From: Mark Seeley, University of Minnesota

A listener called to ask about percent possible sunshine. What is it? Based on sunrise-sunset tables, the National Weather Service can estimate the total possible minutes of sunshine for each day. A sunshine recorder is used to record the actual number of minutes of sunshine which are then compared each month to the total possible.

This ratio (actual/possible) is what is recorded as percent possible sunshine for each month at National Weather Service Forecast Offices.

Naturally sunshine recorders have to be periodically adjusted so that they record light intensity above a certain threshold. This prevents them from recording diffuse light or sunlight that is obscured by clouds.

We all know that during May, Mother Nature provided a climate very favorable for the start of the growing season in Minnesota. One of the climate features which escaped our attention was that the percent possible sunshine for May was 86 percent. On average it is only about 59 percent, so this was a remarkable departure. The Weather Service recorded 5 days in May with 100 percent of possible sunshine. Since May, percent possible sunshine values have been much closer to normal.

1. Almanac (typical max of mid 80s and min of low 60s)

MSP record high for August 5th is 100 degrees in 1947. The record low is 48 degrees in 1870. But, the lowest this century is 49 degrees in 1948. Record precipitation for August 5th is 2.60 inches in 1865. Most rainfall this century is 1.17 inches in 1935.

Scanning the State Climate Data Base other records of note are: The all-time high temperature for today's date is 104 degrees at Moorhead (Clay County) in 1947. The all-time low temperature is 35 degrees at Cass Lake (Cass County) in 1957.

2. Observer and Community Notes: Winona, MN

This community located along the scenic Mississippi River Valley in SE Minnesota has a long climatic record. Weather observations were first taken in August of 1885 by Mr. J.M. Halsinger. Winona is one of only a few long term climate records along the Upper Mississippi Valley. The staff of the local newspaper, now the Winona Daily News, have taken the observations in town for many years, while the staff of the Army Corps of Engineers at the Lock and Dam have taken their observations right along the river's edge.

All-time records at Winona include: 108 degrees on July 12, 1936; -35 degrees on January 12, 1912; rainfall of 4.30 inches on July 1, 1978; and snowfall of 16 inches as recently as December 1, 1985.

The climate along the Mississippi River Valley in SE Minnesota is one of the most hospitable in the state for growing plants. From Hastings to La Crosse the growing season is extended beyond what the uplands experience. For example the average growing season (frost free days) in Winona is 164 days long, while away from the river valley over at Rochester it is only 147 days, or 2.5 weeks less. In fact some growing seasons in the Mississippi River Valley have been over 200 days long. In addition, winter temperatures are not so extreme here as in other areas of the state and perennial plants and trees tend to survive for longer periods of time. This in part is why you might notice vineyards, apple orchards, as well as other fruit and nut trees while you drive along the river valley.

3. Word of the Week: **Dog Days**

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

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

The ancient Greeks and Romans observed that one of the brightest of the stars, Sirius the Dog Star (located in the constellation Canis Major, Latin for Greater Dog) rose in conjunction with the sun during the six weeks of mid-summer. Hot and sultry weather, which depleted the energy of humans and caused vegetation to wilt, was often experienced during this period and was attributed to the evil effects of Sirius. In the mid northern latitudes this period encompasses mid July to mid August. Indeed on the average in Minnesota our hottest temperatures occur between July 20 and July 30, right in the middle of this period. Thankfully, we have almost finished the dog days for this year.

Sometimes this term has been misconstrued to refer to the time of summer when dogs are most apt to go mad. Like other mammals dogs exposed to high temperatures will exhibit stress symptoms like increased panting, change in diet, increased thirst, and lethargic behavior, but I don't know that they go mad anymore frequently.

4. Topic: **AASC**

Some of the more important topics presented at their annual meeting of the American Association of State Climatologists

included:

Contention that the heated tipping bucket rain gauges which are part of the ASOS (Automated Surface Observation System), are still showing errors when compared to the universal gauge. These errors are thought to be associated with light snowfall and with the heating mechanism which causes either evaporation or a heat plume to form around the opening of the gauge. National Weather Service is being advised on this matter and may include universal gauges at all the proposed ASOS sites.

Higher resolution precipitation mapping will soon be available through the PRISM program which couples a gridding technique and a DEM (Digital Elevation Model). It is being tested in the western United States, where it has demonstrated very high skill.

1.8 billion dollars has been allocated in the federal budget (beginning in October) to go toward Global Change research. Over 20 agencies are involved in various aspects, including climate modeling, monitoring, bioindicators, impacts, etc.

The National Oceanic and Atmospheric Administration's GLOBE program has begun. This stands for Global Observations to Benefit the Environment and was an initiative started by VP Al Gore. 200 million dollars has been appropriated for the coming fiscal year. These funds will provide for training and equipment to allow K-12 schools to participate in global monitoring activities under the guidance of science teachers.

The Climate Analysis Center (CAC) will start new long range guidance products over the next year. A new 8-14 day outlook based on numerical prediction models will begin sometime in 1995. In addition 30 day and 90 day outlooks will be released with greater lead times. The 30 day guidance will have a two week lead time, while the 90 day guidance will now be offered for periods up to 1 year ahead. Skill levels of the various products will be indicated. Where no skill is found, CAC will designate the use of climatic probability instead.

To: Greg Magnuson, Bob Potter, John Bischoff, and Marianne Combs
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, November 11, 1994

What an extraordinary fall we are having. Four consecutive weeks, and seven of the last nine weeks we have measured above normal average temperatures around the state. Many people are wondering when will we get our first snow cover. We are approaching the time period which corresponds to the historical average date for 1 inch snow cover at many places: Canby Nov. 12
Crookston Nov. 12 Moorhead Nov. 12 Hibbing Nov. 11
Morris Nov. 12 Wadena Nov. 11 Warroad Nov. 12

First 1 inch snow cover typically ranges from near November 1st in the NE (Arrowhead) to around the last week of November in SE Minnesota. Another feature of the Minnesota climate which we begin to see this time of year is the formation of ice cover on lakes, which like snow cover begins early in the month in northern counties and late in the month in the south. It is apparent that ice formation on lakes will be much later than normal this year. More on this in the Almanac discussion.

1. Almanac: Normal highs in the low 40s and lows in the mid 20s

MSP records for today's date are a maximum of 62 degrees in 1961 and 1964 and a minimum of -1 degrees in 1986. Snowfall was 8.2 inches (2.52 inches of water) in 1940, culminating in a total of 16.2 inches of snow by the next day. This of course was the famous Armistice Day Blizzard in Minnesota. Collegeville in central Minnesota reported nearly 27 inches of snowfall from the same storm.

Scanning the State Climate Records: the all-time high temperature for today's date is 73 degrees at Grand Meadow (Mower County) in 1949. The all-time low is -22 degrees at Itasca State Park) in 1919. In fact the fall of 1919 produced the earliest ice cover ever recorded on many Minnesota lakes. Lake ice records for Detroit Lake in Becker County have been kept since 1893. The average date for complete ice cover on this lake is November 8th, but in 1919 the lake was frozen by October 25th (the latest date ever for first ice cover on this lake is December 13th).

2. Word of the Week: Freezing Level

This is a term used in meteorology to refer to the lowest altitude in the atmosphere over a given location at which the air temperature is 32 degrees F (0 degrees C). In other words the height of the 32 degree temperature surface. It is highly variable and changes markedly with the seasons in Minnesota. In summer it might be as high as 10,000 ft, while in winter it comes right down to the ground at times. Average height of the freezing level at MSP during the first week of November is about 3200 ft, but by the end of the month it is about 1200 ft. This change in average freezing level during the month of November is associated with a number of other significant changes in climate during the month including: over a 1 hour reduction in daylength (over 10 hrs to just over 9 hrs); an 18 degree decline in daily mean temperature (from 40 degrees to 22 degrees); an increase in cloudiness; and an increase in the occurrence of freezing precipitation (freezing rain, sleet, snow).

3. Topic: Climate and the Fall Migration of Birds

Our neighborhood dentist, Dr. Raymond Gerst is an avid outdoorsman and hunter. As such, he is also a keen observer of nature and a very good conversationalist and storyteller. (I suppose many dentists are since they have to carry on one-way conversations while their patients stare up at the ceiling with a mouthful of cotton pads and instruments). Anyway, the other day he was telling my wife (patient) about his observations of ducks during the hunting season in Minnesota. Following up on some of his observations conveyed to me by my wife, I decided to look into weather and climate effects on migrating birds, particularly waterfowl. I visited with some of our university wildlife biologists and surveyed some of the literature.

It is an interesting topic. There are both direct and indirect effects of weather and climate on bird migration behavior. For many birds one of the triggers to prompt fall migration is the declining daylength (a direct effect). For others migration is triggered by local changes in the food chain. Many insects decline in numbers, especially following autumn frosts (an indirect effect), thereby prompting insect-eating birds to move south (or equatorward) where their food supply is more abundant. In turn, birds of prey (some hawks and vultures) may find their quarry (other birds and small mammals) to be scarce as the weather turns more inhospitable (another indirect effect), and therefore begin their migration south as well.

Waterfowl (primarily ducks, geese and swans) which depend on aquatic plants or field crops may hang around longer into the fall as long as their food supply is abundant and accessible. On occasion the formation of lake ice early in the season will prompt waterfowl to begin their migration. Often following the first large scale snowstorm and outbreak of arctic air, the majority of these birds will embark on their journey south. Because this fall has been so mild in the upper midwest, many birds are hanging around in Canada, the Dakotas and Minnesota waiting for Mother Nature to give them a stronger sign that it is time to leave. It looks like this sign may come next week.

Other interesting characteristics of bird migration include:

Most birds gorge themselves in the fall to build up fat reserves (energy) necessary to fly long distances.

Migrating birds can be seen at lower altitudes when flying into headwinds. Thus low pressure systems and their associated strong southerly winds along frontal boundaries will sometimes stall migrating flocks. On the other hand, birds will often fly at high altitudes which provide strong tailwinds such as the northerly winds which accompany strong cold high pressure following a frontal passage in the fall. Though most frequently spotted at altitudes of 1000-5000 ft, some migrating birds have been observed at 20,000-30,000 ft by aircraft. At these altitudes they can take advantage of tailwinds of 80 mph or more to help push them along to their destination and shorten the trip.

Often in the fall, the peak migrations will be noted during cold high pressure outbreaks with northerly winds. Cooler temperatures help the birds to dissipate heat from the energy they expend in

flying for long distances. During unusually warm conditions in the fall, many waterfowl do not like to fly because they overheat or respire too much water vapor and become dehydrated. Birds also prefer the good visibility (absence of clouds) which often accompanies high pressure systems.

On rare occasions, migrating birds forced to fly through stormy conditions have been grounded due to icing. This is due to traveling through super-cooled clouds which deposit ice onto the bird's body and wings, making it both heavier and less aerodynamic.

Many of the largest migrations are nocturnal (occur at night) and therefore not visible to most birdwatchers. However, wildlife biologists can detect and study these migrations using radar. There are some advantages to overnight migrations:

- (1) Nights are longer in the fall, so more distance can be covered at night than during the daytime.
- (2) There is reduced exposure to predators (raptors), except for owls.
- (3) Birds have to expend less energy flying at night, since winds are usually less, there is less turbulence, cooler temperatures (better heat dissipation), and reduced loss of body fluids (less risk of dehydration).
- (4) For some species migration routes can be maintained in night flights by using the stars for navigation.

Lastly, concerning navigation techniques, wildlife biologists have offered a number of explanations, many of which have yet to be fully accepted. Some of these include: celestial markers such as the sun, moon and stars; internal detection of the Earth's magnetic field or subtle changes in the gravitational field; following infra-sound beacons such as the sound frequencies of magnetic storms, sea waves, jetstreams, earth tremors, or wind currents through mountains; following scent beacons or regional odours characteristic of different landscapes over which the birds pass; and simple memory, having flown a route once with its parents or flock, a bird will forever remember it in nearly every detail.

References: (1) Bird Migration by Thomas Alerstam, 1990. Cambridge University Press. Travels and Traditions of Waterfowl by H. Albert Hochbaum, 1956. University of Minnesota Press. Bird Migration: Physiology and Ecophysiology edited by E. Gwinner, 1990. Springer-Verlag. Bird Migration: A General Survey by Peter Berthold, 1993. Oxford University Press.

To: Greg Magnuson, Bob Potter, and John Bischoff
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, November 18, 1994

Well the prolonged nice fall weather region-wide has certainly had a pronounced economic impact: lower drying costs to store harvested grain and the associated increased barge traffic on the Mississippi, housing construction projects completed ahead of schedule, early retail sales for the Christmas season unimpinged by foul weather, extension of the road repair season for the Department of Transportation, and probably a number of others I am not aware of. The only exception appears to be Tropical Storm Gordon which produced damaging winds and rains in central and southern Florida (a real exception for so late in the season).

Thanksgiving week outlook: It would appear that we might be on a bit of a rollercoaster ride next week, with temperatures fluctuating either side of normal. A cold air outbreak for mid to late week (by the weekend) may be in store, but the forecast models don't agree well. It does appear that it will be on the dry side after Sunday and Monday, with moderating temperatures for Tuesday through Thursday (Thanksgiving Day) then another low pressure system will approach and might bring us an outbreak of very cold air.

1. Almanac: Normal highs near 40 and lows in the low 20s

MSP records for November 18th are a high of 68 degrees in 1904 and 1941; low of -4 degrees in 1891; precipitation of .90 inches in 1843 (old Pioneer records) and 0.82 inches this century; and snowfall of 7.6 inches in 1957 (.76 inches of precipitation).

Scanning the state climate data base: the all-time high temperature for today's date is 73 degrees in 1953 at Winona (SE) and Red Lake (Beltrami County); the all-time low temperature is -18 degrees at Wannaska (Roseau County) in 1986.

2. Words of the Week: Linke-scale or cyanometer

Last week a listener called (on Saturday's Midday) to ask why the sky is blue. This occurs because of Rayleigh scattering. Lord Rayleigh (1842-1919) was the first to show the relationship between the radius of scattering particles (molecules) and the wavelength of the energy that is scattered. This affects the amount and direction of scattering of specific wavelengths. Most light waves are larger than air molecules and bypass them as they enter the Earth's atmosphere. However, shorter wavelengths, corresponding to the blue portion of the sun's spectrum, strike the air molecules and are scattered in all directions very effectively, resulting in the blue skies.

So what does this have to do with a Linke-scale or cyanometer? A cyanometer is an instrument used to measure the blueness of the sky. From the Greek kyano meaning dark-blue and metre meaning to measure. The Linke-scale (named for German scientist F. Linke) is a type of cyanometer comprised of a set of 8 colored cards, each a standard shade of blue. They are

numbered evenly 2 through 16, allowing the observer to interpolate odd numbers if the sky color falls between two successive shades of blue. To a degree this is governed by atmospheric turbidity - that is how much water vapor, dust, or aerosols are in the air.

Actually, this time of year we see very little blue sky, since November tends to be our cloudiest month. February in Minnesota is usually the time when the atmosphere is the least turbid, the air is cleanest and therefore the sky may appear a deep blue shade on cloudless days.

3. Topic: Use of Color in the Agricultural Sciences

Continuing on the topic of color, like the Linke-scale notation used to describe blueness of the sky, agricultural scientists use Munsell color notation to describe the color of soils and the color of plant tissues. A.H. Munsell developed a system of color notation based on three attributes: hue, value and chroma. These attributes are used by such organizations as the National Bureau of Standards to define color.

There are 10 major hue notations in the natural color spectrum, each referring to the dominant wavelength of the color: Red, Yellow-Red, Yellow, Green-Yellow, Green, Blue-Green, Blue, Purple-Blue, Purple, and Red-Purple. The value notation indicates brightness or the degree of lightness or darkness of a color in relation to a neutral gray scale, with 0 representing black and 10 representing absolute white. The chroma notation indicates the departure of a given hue from a neutral gray of the same value (brightness). It is a measure of the strength of color saturation or purity of the hue.

Soil colors are described by Munsell color notation using standard color charts developed in conjunction with the Soil Conservation Service for the purpose of conducting soil surveys. Soil hues typically range from 10 Red to 10 Yellow-Red to 5 Yellow. Value notation (brightness) for soils can range from 2 (black) to 8 (almost white), while chroma notation (color purity) can range from 0 (gray) to 8 (saturated hue). Soil color is related to the particle size distribution (sand, silt or clay), mineral content including amount of iron oxide, organic matter and moisture among other factors.

Soil colors in Minnesota tend to be Yellow-Red to Yellow in hue, dark with values of 2 to 4 and tending toward gray with chroma of 1 to 4. For example, the Seeleyville Soil Series (no relation) found along streambeds and depressions in Dakota County has a Munsell color of 10YR 2/1 (hue/value/chroma).

Munsell color charts for plant tissues can be used to quantify differences in color among plant cultivars and to detect plant stress, such as nutrient deficiencies, herbicide injury, insect damage, or drought stress. Colors of plant tissues range across nearly all hues, but leaves typically fall in the Yellow, Green-Yellow, Green, or Blue-Green hues.

Soybeans inoculated with nitrogen fixing Rhizobia show dark green leaves of 7.5GY 5/4, while those without sufficient nitrogen fixing bacteria may be as pale as 5.0Y 7/4 (yellow). Foliage of Colorado blue spruce are dark with a color notation

of 2.5B 6/6, while other varieties of spruce are in the 5.0 to 7.5GY 5/2. Healthy field corn shows a color of 7.5GY 4/2, while nitrogen deficient corn or drought stressed corn may be pale and/or bright in the range of 2.5GY 8/8. Potassium deficiency in alfalfa will cause the plant color to change from 7.5GY 5/6 to 5Y 8/8.

(Munsell Color Charts are also used by anthropologists to characterize skin, hair and eye color as well).

To: Greg Magnuson, Bob Potter, and John Bischoff
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, November 25, 1994

Comments: No measurable snowfall yet locally! Certainly some in northern counties. Actually there have been two years when we have gone as late as December until the first measurable snowfall in the MSP area: December 2, 1963 and December 3, 1928. Maybe we'll make it to December this year.

Less rare is no measurable snowfall events before the traditional Thanksgiving holiday period. This occurs close to 20 percent of the time historically.

While climatology shows that much of the northern half of Minnesota would typically be snowcovered by the end of November, locally we observe a lack of snowcover in November about 35-40 percent of the years.

Almanac: Normal highs in the mid 30s and lows in the teens

MSP records for today's date are: a maximum of 62 degrees in 1914, a minimum of -12 degrees in 1977 (though it was -18 degrees in 1880 before the Weather Service was established), 5.3 inches of snow here in 1952.

Scanning the State Climate Records: the all-time high for today's date is 71 degrees at Madison (Lac Qui Parle County) in 1960. The all-time low is -36 degrees at Pokegama Falls in 1903.

Word of the Week: fido

This is another acronym used by weather people. It is derived from a project called Fog Investigation Dispersal Operations. It is a system for dissipating fog around airport runways, whereby gasoline or other fuel is burned at equally spaced intervals along a landing strip in order to clear fog and improve visibility. Fido systems were used frequently at bomber bases in England during WWII and may still occasionally be used at some airports.

Topic: Wind-chill Index

With low temperatures around the state ranging from 10 to 20 degrees this week, I thought it might be time to discuss this topic once again.

The cooling effect of any combination of temperature and wind, expressed as the loss of body heat in kilogram calories per hour per square meter of skin surface. The wind-chill index is based on the cooling rate of a naked body of medium size positioned in the shade. It is only an approximation because of variations in shape, size and metabolism of individuals. A critical value is 1400 kg cal per hour per square meter, which is a level at which skin begins to freeze due to exposure.

A windchill index value of -22 to -23 degrees F is generally considered to be a threshold for skin to freeze. Values colder than this cause more rapid heat loss from the body and lead to

freezing of exposed flesh in shorter periods of time. For example, at an ambient temperature of -20 degrees with a 20 mph wind, the windchill will be approximately -67 degrees, sufficient to freeze exposed flesh in 1 minute or less. Of course, body size and shape, metabolism and clothing vary considerably and will affect this.

Many public school systems in Minnesota do not have a set policy for protecting children from the risk of frostbite caused by excessive windchill conditions. Most rely on the judgement of the principal or playground supervisor in determining whether or not to let children outside for recess or play activities. Those with such responsibility should be aware that local conditions (microclimate) can modify the reported windchill readings. Buildings, trees, hills, ponds and other features of the local landscape can greatly change the local wind strength and pattern. Winds can be diminished, blocked, or channeled by local features. A temperature of -1 degree F with a 5 mph wind would produce a WC of -5 degrees, but a 10 or 12 mph gust would produce WC values of -22 to -27 degrees, which is enough to freeze exposed skin.

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To: Greg Magnuson, Bob Potter, John Bischoff, and Marianne Combs

From: Mark Seeley

Re: Suggestions for Morning Edition, Friday, November 4, 1994

I am in the Chicago area this week attending a workshop on Long Lead Climate Forecasts, put on by the National Weather Service and the Midwest Climate Center in Illinois. The purpose of the workshop is to introduce us (users) to some new climate forecast products. Starting in 1995, the National Weather Service will release a dozen climate forecasts each month, covering successive overlapping periods (30 and 90 days) out to 1 year. Of course, these climate forecasts will give probabilities (chances of warmer or colder than normal conditions, or wetter or drier than normal conditions) which might be used in long range planning by state and local governments as well as industry. We will be learning about various ways to use this information.

1. Almanac: Normal highs in the upper 40s and lows in the upper 20s

MSP records for today's date are a maximum of 74 degrees in 1975 and a minimum of -3 degrees in 1991. There was 0.61 inches of rainfall in 1988 and 1.0 inches of snow in 1910. In fact, it has snowed here locally on this date each of the last two years, with 0.4 inches in 1992 and 0.6 inches in 1993.

Scanning the State Climate Records: the all-time high temperature for today's date is 79 degrees at Redwood Falls in 1975. The all-time low is -12 degrees at both Thorhult (Beltrami County) and Wild River State Park (Chisago County) in 1991. Of course, the state was pretty well blanketed with snow in 1991.

2. Word of the Week: Pibal

This is merely an acronym for a pilot-balloon observation. This is a small balloon which is used to compute the speed and direction of winds aloft. Upon release, the balloons elevation and azimuth angles are tracked from the ground, usually in 1 minute intervals as it ascends.

Speaking of winds, we usually see a pronounced shift to northerly wind directions during the month of November with a general increase in wind speed and cloudiness. The first few days have certainly followed that format.

3. Community Notes: St Peter, MN

Home to MPR member stations KGAC 90.5 and KNGA 91.5 FM, this community has kept a record of daily climate observations since May of 1893. Located less than 1/2 mile from the Minnesota River in Nicollet County, the Minnesota Security Hospital personnel have been responsible for making the daily observations

for over 101 years, one of the best records in the state.

All-time extremes for the St Peter station include: 109 degrees on July 14, 1936; -40 degrees on January 12, 1912; and 8.62 inches of rainfall on August 7, 1968.

4. Topic: Weather during November election week in Minnesota

Historically election day has varied from the 2nd of November to the 8th of November. High temperatures are typically in the 40s and 50s with lows in the 20s and 30s. There is frequently little or no precipitation, but there have been some notable exceptions in terms of both precipitation and temperature. 1901, 1910, 1911, 1933, 1936, 1951, 1959, and 1991 were all notable for being quite cold and snowy during election week. 1936 was the only case of a major national and local election in Minnesota taking place in the face of some pretty cold and snowy weather. Interestingly enough, we have had measurable snowfalls during election week each year since 1988, with the most pronounced being 1991, which was not only the snowiest but the coldest, surpassing 1951 in terms of weather misery.

Incidentally, the outlook for next week, including election day on Tuesday, favors near to above normal temperatures and a chance for rain or snow showers around the state. I would like to think that even inclement weather would have little effect the turnout of stout-hearted Minnesotans who cherish their voting priveleges.

To: Greg Magnuson, Bob Potter, John Bischoff, and Stephanie Curtis
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, December 2, 1994

The preliminary summary for November shows that temperatures around the state averaged 4 to 6 degrees warmer than normal, continuing a trend started in September. Both September and October temperatures averaged 3 to 4 degrees warmer than normal. It was indeed a remarkable fall in Minnesota.

A listener who recently moved here from North Carolina called to ask what has been the coldest ever windchill reading in the Twin Cities area. Unfortunately, long historical records do not exist for this feature of the weather. Nevertheless, there have been some extreme cases of windchill conditions in the modern records. Two which stand out are December 23-24, 1983 and January 13-14, 1972.

Listed below for selected locations are the minimum windchill conditions computed from hourly data during these two episodes. Average air temperature and wind speed are noted in parentheses.

| Dec. 23-24, 1983 | | Jan. 13-14, 1972 | |
|------------------|--------------------|------------------|--------------------|
| Location | Windchill | Location | Windchill |
| MSP | -77 (-25 F, 22mph) | MSP | -76 (-20 F, 27mph) |
| Rochester | -88 (-26 F, 30mph) | Rochester | -67 (-18 F, 22mph) |
| St Cloud | -59 (-19 F, 16mph) | St Cloud | -64 (-26 F, 14mph) |
| Inl. Falls | -73 (-28 F, 17mph) | Inl. Falls | -79 (-32 F, 17mph) |
| Duluth | -71 (-25 F, 18mph) | Duluth | -81 (-32 F, 18mph) |
| Fargo, ND | -71 (-20 F, 23mph) | Fargo, ND | -76 (-24 F, 22mph) |

With respect to lowest ever windchill readings, these data are conservative estimates since they are based on hourly averages. Temperature generally varies little over the course of an hour, however wind speed can vary considerably. An hourly average wind speed of 20mph may encompass wind gusts ranging as high as 35mph. Thus windchill calculations for shorter intervals of time (say 5 minutes) could easily reach -100 F or lower.

Almanac: Typical high temperatures for today's date are in the low 30s, typical lows in the mid teens.

MSP records for this date are a high of 63 degrees in 1982 and a low of -13 degrees in 1940, 1976 and 1985 (though it was -25 degrees at Ft Snelling in 1821 on this date). The most precipitation on this date is 0.30 inches in 1933 and 1945, while the most snowfall on this date is 2.7 inches in 1978.

Scanning the state climatic records: the all-time high temperature for this date is 63 degrees in 1982 at MSP, N. Mankato, St Peter and Chaska. The all-time low temperature is -47 degrees at Pokegama Dam (Itasca County) in 1896, where local residents experienced one of the coldest weeks in Minnesota history. Below are the morning low temperatures recorded at Pokegama Dam from November 27 to December 3, 1896.

| | | | | | | |
|-------|-------|-------|-------|------|------|------|
| 11/27 | 11/28 | 11/29 | 11/30 | 12/1 | 12/2 | 12/3 |
| -12 | -20 | -37 | -45 | -51 | -47 | -30 |

This gives a mean minimum temperature for the entire week of

-35 degrees F, a measly 45 degrees below normal for that time of year.

Word of the Week: Almanac

This was originally derived from ancient Arabic, al-ma-nakha, meaning literally the place to kneel down, a place where camels would kneel down and rest, a camp or a settlement. In modern times it is the Arabic word for weather. In Arab countries the weather and progression of the seasons have always been associated with changes in the sky. Thus tables and books, called almanacs, were produced to show these changes in celestial features along with the weather to be expected over days, weeks and months. This calendar type of format has expanded to show average or normal weather conditions for each day, astronomical data (sunrise, sunset, phases of the moon, etc.), tides, festivals, religious holidays, and other regular annual phenomena or occasions.

Topic: Wind-chill Index

With low temperatures around the state ranging from 0 to 12 degrees earlier this week, it seems a good time to discuss this topic once again.

The cooling effect of any combination of temperature and wind, expressed as the loss of body heat in kilogram calories per hour per square meter of skin surface is called the wind-chill index. The WC index is based on the cooling rate of a naked body of medium size positioned in the shade. It is only an approximation because of variations in shape, size and metabolism of individuals. A critical value is 1400 kg cal per hour per square meter, which is a level at which exposed skin begins to freeze.

A wind-chill index value of -22 to -23 degrees F is generally considered to be a threshold for skin to freeze. Values colder than this cause more rapid heat loss from the body and lead to freezing of exposed flesh in shorter periods of time. For example, at an ambient temperature of -20 degrees with a 20 mph wind, the wind-chill will be approximately -67 degrees, sufficient to freeze exposed flesh in 1 minute or less. Of course, body size and shape, metabolism and clothing vary considerably and will affect this. What is unbearably cold to one person may be tolerable to another. Some have argued that using such an index number to define how cold it feels outside is no more meaningful than trying to determine the temperature of a hot cup of coffee or the weight of a heavy suitcase.

The real value of the wind-chill index, in my opinion, is to somewhat quantify extreme weather conditions which clearly present dangers to humans and animals when they are exposed to the outside environment for any period of time. Many public school systems in Minnesota do not have a set policy for protecting children from the risk of frostbite caused by excessive wind-chill conditions. Most rely on the judgement of the principal or playground supervisor in determining whether or not to let children outside for recess or play activities. Those with such responsibility (including daycare providers, scout leaders and others) should be aware that local conditions (microclimate) can modify the reported windchill readings heard

over the radio or released by the National Weather Service. Buildings, trees, hills, ponds and other features of the local landscape can greatly change the local wind strength and pattern. Winds can be diminished, blocked, or channeled by local features. A temperature of 10 degrees F with a 5 mph wind would produce a WC of 6 degrees (cold but tolerable for some outdoor activity when properly dressed), however an 18 or 22 mph gust would produce WC values of -22 to -27 degrees, which is enough to freeze exposed hands or face.

Those people with the responsibility for the safety of children during the winter months are perhaps already aware that people feel and respond differently to the same WC values. But they should also be cautious about local scale climate modification which may considerably alter the wind fields in an area and produce more extreme WC values on occasion which could be harmful even over periods of short duration.

To: Greg Magnuson, Bob Potter, John Bischoff, and Stephanie Curtis
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, December 9, 1994

I neglected to highlight a particular point about the wind-chill index last week. A critical value is -22 degrees which is cold enough for exposed flesh to freeze. Values colder than this cause more rapid heat loss from the body and lead to freezing of exposed flesh in shorter periods of time. For example, some of the extreme wind-chill values which we talked about last week, such as -70 degrees or colder will freeze exposed flesh in less than 1 minute.

The real value of the wind-chill index is to somewhat quantify these extreme weather conditions which clearly present dangers to humans and animals when they are exposed to the outside environment for any period of time. Many public school systems in Minnesota do not have a set policy for protecting children from the risk of frostbite caused by excessive wind-chill conditions. In many cases determining whether or not to let children outside for recess or play activities is a judgement call by the principal or teacher. Those with such responsibility should be aware that local conditions (microclimate) can modify the reported wind-chill readings heard over the radio. A temperature of 10 degrees F with a 5 mph wind would produce a WC of 6 degrees (cold but tolerable for some outdoor activity when properly dressed), however an 18 or 22 mph gust would produce WC values of -22 to -27 degrees, which is enough to freeze exposed hands or face.

Those people with the responsibility for the safety of children during the winter months are perhaps already aware that people feel and respond differently to the same WC values. Because local scale features may considerably alter the wind fields in an area and produce more extreme WC values than those reported on the radio, a conservative approach, say using a WC value of -5 or -10 as a threshold for keeping children indoors is advised.

Speaking of the cold, Bettles, McGrath and Ft Yukon in Alaska, not far from Mount McKinley National Park, reported a temperature earlier this week of -52 degrees.

Almanac: Normal highs are mid to upper 20s and normal lows are 7-10 degrees

MSP records for today's date include: a maximum temperature of 58 degrees in 1939; a minimum temperature of -14 degrees in 1927, 1977 and 1978; record precipitation of 1.19 inches in 1899; record snowfall of 7.4 inches in 1961; and record snow depth of 15 inches in 1950 and 1991.

Scanning the state climatic data base: the all-time maximum temperature for today is 67 degrees at Tracy (Lyon County) in 1939; the all-time low temperature is -39 degrees at Warroad

Roseau County) in 1909.

Word of the Week: Tyndall Flowers (not botanical)

John Tyndall was an English physicist who studied the scattering of light as it passed through smokey air, mist, fog and ice. He noted the effects of the differential radiative absorption and scattering by ice.

A legacy of his work is the name given to small water-filled, hexagonally shaped cavities which appear in the interior of ice masses bathed in sunlight. These are called Tyndall flowers. They are formed when ice melts by radiative absorption at points of defect in the ice lattice. They may be occasionally seen through clear lake ice on bright sunny winter days in Minnesota.

Community and Observer Notes: Willmar, MN

This week I would like to salute the staff of the Willmar Regional Treatment Center, formerly known as the Willmar State Hospital. Axel F. Elfstrum began taking daily climate observations there in February of 1893. Personnel of the treatment center there continue to make daily observations. Willmar boasts one of the best and longest climatic records in central Minnesota.

Some of the extremes observed there include: a record high temperature of 107 degrees on July 21-22, 1936; a record low of -41 degrees on January 9, 1977; a record rainfall of 7.20 inches on June 9, 1895; and a record snowfall of 18 inches on November 30, 1985.

Topic: Health Effects of Winter Weather

Though many Minnesotans truly enjoy the winter season, it also tests our health. Shorter daylengths and increased cloudiness are contributors to the depression felt by those who suffer from Seasonal Affective Disorder (SAD). Snow shoveling and slippery sidewalks and roadways test our stamina, sure-footedness and driving abilities. Contagious flu bugs usually make an appearance and circulate among us. And perhaps the most widely felt effect of winter is the Minnesota Desert, the extraordinary low indoor humidities we are exposed to on most winter days, sometimes falling into the single digits. This is what produces our dry noses, lips, hands, throat and feet, as well as that annoying static shock we get from touching metal objects in the winter.

There are a number of methods to combat the Minnesota Desert, including the use of humidifiers, house plants, keeping exhaust from clothes dryers indoors, hanging laundry on drying racks in the basement, not running kitchen or bathroom exhaust fans in order to keep water vapor indoors. I would be interested in hearing if listeners have other methods to keep indoor humidity levels tolerable in the winter.

Speaking of a tolerable winter, looks like temperatures will average out above normal later next week, after chilly Saturday, Sunday and Monday nights.

To: Greg Magnuson, Bob Potter, John Bischoff, and Stephanie Curtis
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, December 9, 1994

I neglected to highlight a particular point about the wind-chill index last week. A critical value is -22 degrees which is cold enough for exposed flesh to freeze. Values colder than this cause more rapid heat loss from the body and lead to freezing of exposed flesh in shorter periods of time. For example, some of the extreme wind-chill values which we talked about last week, such as -70 degrees or colder will freeze exposed flesh in less than 1 minute.

The real value of the wind-chill index is to somewhat quantify these extreme weather conditions which clearly present dangers to humans and animals when they are exposed to the outside environment for any period of time. Many public school systems in Minnesota do not have a set policy for protecting children from the risk of frostbite caused by excessive wind-chill conditions. In many cases determining whether or not to let children outside for recess or play activities is a judgement call by the principal or teacher. Those with such responsibility should be aware that local conditions (microclimate) can modify the reported wind-chill readings heard over the radio. A temperature of 10 degrees F with a 5 mph wind would produce a WC of 6 degrees (cold but tolerable for some outdoor activity when properly dressed), however an 18 or 22 mph gust would produce WC values of -22 to -27 degrees, which is enough to freeze exposed hands or face.

Those people with the responsibility for the safety of children during the winter months are perhaps already aware that people feel and respond differently to the same WC values. Because local scale features may considerably alter the wind fields in an area and produce more extreme WC values than those reported on the radio, a conservative approach, say using a WC value of -5 or -10 as a threshold for keeping children indoors is advised.

Speaking of the cold, Bettles, Alaska not far from Mount McKinley National Park reported a temperature on Monday of this week of -51 degrees.

Almanac: Normal highs are mid to upper 20s and normal lows are 7-10 degrees

MSP records for today's date include: a maximum temperature of 58 degrees in 1939; a minimum temperature of -14 degrees in 1927, 1977 and 1978; record precipitation of 1.19 inches in 1899; record snowfall of 7.4 inches in 1961; and record snow depth of 15 inches in 1950 and 1991.

Scanning the state climatic data base: the all-time maximum temperature for today is 67 degrees at Tracy (Lyon County) in

1939; the all-time low temperature is -39 degrees at Warroad (Roseau County) in 1909.

Word of the Week: Tyndall Flowers (not botanical)

John Tyndall was an English physicist who studied the scattering of light as it passed through smokey air, mist, fog and ice. He noted the effects of the differential radiative absorption and scattering by ice.

A legacy of his work is the name given to small water-filled, hexagonally shaped cavities which appear in the interior of ice masses bathed in sunlight. These are called Tyndall flowers. They are formed when ice melts by radiative absorption at points of defect in the ice lattice. They may be occasionally seen through clear lake ice on bright sunny winter days in Minnesota.

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Some of the extremes observed there include: a record high temperature of 107 degrees on July 21-22, 1936; a record low of -41 degrees on January 9, 1977; a record rainfall of 7.20 inches on June 9, 1895; and a record snowfall of 18 inches on November 30, 1985.

Topic: Health Effects of Winter Weather

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tolerable in the winter.

Speaking of a tolerable winter, looks like temperatures will average out above normal next week, after chilly Saturday and Sunday nights this weekend.

To: Greg Magnuson, Bob Potter, John Bischoff, and Stephanie Curtis
From: Mark Seeley
Re: Suggestions for Morning Edition, Friday, December 16, 1994

A listener asked, "How often do we have a white Christmas in the Twin Cities area (snow on the ground) and how often does it snow on either Christmas Eve or Christmas Day? Since I won't be here for Morning Edition on Friday, December 23, I thought I would try to answer these questions now.

I do not have complete records for snowfall back to the beginning of this century. But the records back to 1948 indicate that approximately 80 percent of the time we can expect a white Christmas in the Twin Cities area. (only '49, '57, '58, '65, '67, '76, '77, '79, '82, and '88 show no snow on the ground on Christmas Day.) The second question I can also address in the context of the 1948-1994 period. Over that period (46 years) it has snowed on either Christmas Eve or Christmas Day 52 percent of the time (24 years).

These answers make me realize that the new sleds, skis, snowshoes, snowmobiles, snowboots, caps, gloves, etc. being given for Christmas have a high probability for use on Christmas Day.

Incidentally, the climatology for Christmas Day shows an average high of 24 degrees, an average low of 8 degrees, and an average snowdepth of 4 inches. Temperature records are 51 degrees in 1922 and -20 degrees in 1960. Record snowfall is 9.6 inches in 1945.

Almanac: Normal high around 25 and normal low is 6 degrees

MSP records for today's date include: a maximum temperature of 58 degrees in 1939; a minimum temperature of -20 degrees in 1963; record precipitation of 0.93 inches in 1894; record snowfall of 4.9 inches in 1940; and record snow depth of 19 inches in 1983.

Scanning the state climatic data base: the all-time maximum temperature for today is 65 degrees at St Peter (along the Minnesota River Valley in southern Minnesota) in 1939; the all-time low temperature is -38 degrees at Bigfork (Itasca County) in 1963.

Word of the Week: CAVU

This is an old term still used in aviation meteorology to report cloud ceiling and visibility. It indicates that the ceiling is more than 10,000 feet and that visibility is greater than 10 miles. It is really an acronym for the words "ceiling and visibility unlimited or unrestricted.

Community and Observer Notes: Morris, MN

The staff of the West-Central Experiment Station of the University of Minnesota have been taking daily climate observations since April of 1885. The first observer was Mr. D. L. Wheaton who kept the daily records for over 34 years. Since 1967, Dr. Sam Evans, soil scientist at the station has been the observer. This record of

approximately 110 years is the best and most complete in western Minnesota.

All-time records observed there include: a maximum of 109 degrees on July 18, 1940; a minimum temperature of -41 degrees on February 16, 1936; and a record rainfall of 6.90 inches on April 26, 1954.

Topic: Annual Snowfall in Minnesota

Most places in Minnesota receive between 35 and 65 inches of snow each winter. Locally, the Twin Cities averages 49 inches. There are some interesting variations around the state. For example Angus, in northwestern Minnesota (Polk County) averages less than 30 inches of snow per winter. Along the northshore ridge above Lake Superior (in some places 1200 ft above the lake) it is not uncommon to get over 100 inches of snow, rivaling the snowfall totals typically seen on the eastern side of the Great Lakes. In fact the Immigration Inspection Station at the Pigeon River Bridge in Cook County (extreme NE Minnesota) averaged over 107 inches of snow during a period from 1931-1950, and reported a record 147.5 inches in the winter of 1936-37.