NORTHEASTERN

STORM BUSTER

A Publication for Emergency Managers & Storm Spotters

SKYWARN

U.S. DEPARTMENT OF COMMERCE

***Winter, 2005-06**-VOL. 11, NO. 1*

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SPECIAL 10TH ANNIVERSARY ISSUE

IN THIS SPECIAL ISSUE!

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STORMBUSTER PAST

THE BEST OF STORMBUSTER

This special edition of Northeastern StormBuster marks our 10th anniversary. Here we feature the 20 best articles from our first 10 years. It represents a slight departure from our usual publication. It was no easy task putting this together what with the large selection of articles to choose from. As the publication's editor, I attempted to select a wide variety of topics which I thought would be of greatest interest to our readers. No attempt has been made to rank these articles. My goal was to get the final number of entries down to 20, which was not simple, being as I started with a first cut of 42, and had to eliminate entries on a case-by-case basis, continually re-evaluating those which remained for consideration, until the field was finally narrowed to 20, plus the seasonal climate summary near the end.

StormBuster has had an interesting history. It began as a simple, non-routine newsletter with the winter of 1995-96 issue. Unfortunately, this initial issue has been lost forever. StormBuster began as a quarterly publication throughout 1996, but then took a hiatus in 1997, returned, and went into limbo again in 2000. From 2001 until early 2002, when it finally became a regular quarterly newsletter, it had fluctuated between being semi-annual and quarterly. It gradually transitioned from being a hardcopy-only publication, to an internet-only publication by the end of 2004. As a result of the change, the resource is now readily available to an unlimited number of potential readers as soon as the publication is ready. Throughout its 10-year run, it has gone through many changes. The way it was laid out, and the way the articles appeared, evolved over time. Even with this issue, we introduce a new look, in an attempt to more resemble an on-line magazine-style publication. I hope you enjoy reading these articles as much as I enjoyed putting them together for you.

-Evan L. Heller, Editor

THE MAY 31, 1998 NEW YORK AND NEW ENGLAND TORNADO OUTBREAK

Jonathan Blaes
Meteorologist, NWS Albany
Ken LaPenta
Senior Forecaster, NWS Albany
and
Warren Snyder
Scientific Operations Officer, NWS Albany
[Summer 1998]

For the third time in the past four years major tornadoes struck eastern New York and western New England. On May 29, 1995 (Memorial Day) an F2 tornado raked Columbia County in New York with an F3 tornado in Berkshire County in Massachusetts. On July 3, 1997 several tornadoes (F1 and F2) struck the same areas of New York and Massachusetts. Less than a year later, on May 31, 1998, tornadoes again devastated parts of the region. The worst, an F3, struck southeastern Saratoga County. In all 68 people were injured but there were no fatalities. There were tens of millions of dollars in damage to homes, businesses and forests. Power was out to over 130,000 customers at the storm's peak, while 12,000 were without power for over three days.

During the morning of May 31, 1998 a warm front moved northeast across the region. The air rapidly destabilized during the afternoon as a cold front pressed south toward the region. Lines of severe thunderstorms formed and moved rapidly east across New York and western New England at speeds of over 50 mph. Several storms became tornadic. The longest lived tornadic thunderstorm produced a series of tornadoes starting with an F3 in Stillwater and Mechanicville in Saratoga County. The F2 tornado then skipped east into Schaghticoke and Hoosic Falls in Rensselear County, and eventually into Bennington County, Vermont. Other tornadoes occurred in East Schodack and Nassau in southern Rensselaer County (F2), in Albany County near the International Airport, and south of New Preston in Litchfield County Connecticut (F1).

The tornadoes of May 31, 1998 were produced by supercells along a squall line in a highly sheared environment. Straight line wind damage occurred in most counties of Albany's County Warning Area. There were numerous reports of large hail. Cloud to ground lightning rates over the region reached an unprecedented 15,000 strokes per hour.

National Weather Service (NWS) warnings and advance notice of severe weather potential were recognized by the media and New York Governor George Pataki as playing a major role in preventing deaths. NWS forecasts began highlighting the severe weather potential as early as Saturday afternoon. The potential for tornadoes was highlighted early Sunday morning in Special Weather Statements and the first Tornado Watch was issued shortly after 800 am. During the event a total of 48 county warnings were issued by NWSFO Albany, (the most ever for a single event) with damage occurring in 45 warned areas. The warning for the Stillwater-Mechanicville tornado in Saratoga county had a lead time of 42 minutes. Average lead time for all warnings was 22 minutes. Local media effectively used program break ins and crawls for the numerous warnings further heightening public awareness. NWS warnings were relayed via Emergency Alert System (EAS) and NOAA Weather Radio. Warnings were also relayed to Emergency Operations Centers via HAM radio.

On June 1st and 2nd a total of 9 survey teams from NWSFO Albany traveled across the affected areas to assess damages. Aerial surveys were performed with WNYT Television and the New York State Police.

SEVERE WEATHER AND FLASH FLOODING OF MAY 22-24, 2004

Eugene P. Auciello
Meteorologist In Charge, NWS Albany
[Summer 2004]

From May 22 to 24, 2004, severe weather and flash flooding persisted across eastern New York and western New England. The series of events began May 22, when a front edged into southern New York, and remained nearly stationary for two days. A series of mesoscale convective systems (MCSs) developed over the Great Lakes, and moved east along the front. One MCS produced thunderstorms, several severe, on the night of May 22, and into the early part of May 23. During the afternoon of the 23rd, several severe storms developed over southeast New York and northwest Connecticut. As these storms abated during the evening, another round of severe storms moved into the Mohawk Valley. In addition to severe weather, there was flash flooding in parts of the western Mohawk Valley and the Adirondacks. On May 24, three waves of severe thunderstorms, each more intense and widespread than those of the previous days, moved across eastern New York and western New England. The first wave produced isolated severe weather around sunrise. During the late morning, the second wave, in the form of an organized line of thunderstorms, raced across the region. Then, after 3:00 p.m. EDT, the last wave of severe storms erupted. Some supercells formed, with radar indications of possible tornadoes. In fact, tornadoes were confirmed in Delaware and Broome Counties of central New York.

The storms were prolific hail producers, with numerous reports of widespread hail (nickel- to golf-ball size). Large hail caused significant defoliation of trees; flattened thousands of acres of crops; dented numerous automobiles; and, caused window, roof, and siding damage to homes. Worst hit were the Towns of Easton, Cambridge and White Creek, in southern Washington County, New York. Heavy rain also caused significant road washouts in these areas, resulting in infrastructure problems and costly repairs. National Weather Service Doppler Radar estimated rainfall amounts to be around 6 inches during the last wave of storms. A National Weather Service cooperative observer in the Town of Buskirk, Rensselaer County, just over the county line from Washington County, reported 4.17 inches of rain. Evidence of straight-line wind damage, caused by wind with speeds estimated between 70 and 90 mph, was found in the Town of Cambridge, where 75 to 100 pine trees were either uprooted or snapped, and all facing the same direction.

No injuries or deaths were reported during the three days of nearly continuous severe weather and flash flooding. During the event, the staff at the NWS Forecast Office at Albany, New York issued a record number of warnings for eastern New York and western New England. Between May 22 and 24, Albany issued 80 severe weather warnings, including 7 Tornado Warnings, 64 Severe Thunderstorm Warnings and 9 Flash Flood Warnings. Of the 9 Flash Flood Warnings issued, 8 verified, with an average lead-time of 2 hours, 36 minutes. Of the 64 Severe Thunderstorm Warnings issued, 41 verified, with an average lead-time of 17 minutes. Although funnel clouds and cloud rotation were reported by trained NWS SKYWARN Spotters, and NWS Doppler radar indicated hook echoes with several supercells, no tornadoes were reported with these storms.

The Albany staff demonstrated teamwork, dedication, hard work, and service above self during this three-day period that contributed to excellent lead-times and enhanced public safety.

OCTOBER 4TH 1987...A DAY TO REMEMBER

Hugh W. Johnson IV
Meteorologist, NWS Albany
[Fall 1996]

September 1987 had been a wet but otherwise fairly normal month weatherwise. The previous summer of 1987 was typical...albeit on the hot side. No hurricanes or tropical storms had directly affected the Hudson Valley or Western New England. There were very few clues that an extraordinary weather event was going to occur heading into the weekend of October 3rd and 4th 1987.

On the weather map...a rather innocuous looking cold front was approaching southern Canada and the Great Lakes Region early that Saturday morning. Behind the front however...was the coldest air mass from Canada so far that season. The front slipped across the region to just east of the Hudson Valley and then began to slow down. This was a clue any area of low pressure or a low pressure wave was forming along the front. During the afternoon and early evening hours...that is exactly what happened...a surface low began to develop across the Mid Atlantic region. There were numerous showers out ahead of the system...and by Saturday evening...a steady cold rain began to fall across eastern New York and western New England as the storm moved up along the coast and intensified.

Unfortunately...the usually reliable computer models gave little clue as to what would happen next. In many situations...forecasters can get an idea what will happen by examining conditions upstream of their region. That procedure would not work this time. Instead... meteorologists had to look literally overhead to figure out what was going to happen. That is sometimes a problem...considering that only two upper level observations are available during a 24 hour period. The air mass over the Northeast was actually cooling aloft due to heavy rain and melting snow...as an intensive study by senior meteorologist Ken LaPenta indicated a few months later.

At the surface the rain slowly changed to snow... beginning first across the higher elevations. Then as the cooler air began working its way to the surface... large wet flakes were seen at the Albany County Airport by daybreak. The snow became heavy for awhile...and by the time it was over late in the day...6.5 inches of snow was measured at the airport. This was more than three times the previous snowfall record for any October day!

Needless to say...this particular snowstorm was a complete surprise to all! Snowfall amounts were much higher over the Catskills...Helderbergs and Taconics where up to nearly two feet fell! The snow was very wet and heavy...and came before the leaves had a time to shed. The result was truly catastrophic. It was considered the most destructive storm to hit the region since a Hurricane in 1950. Many trees snapped in half...as if hit by a tornado. The destruction could be seen along the Taconic Parkway a year after the storm. Nearly half the region was in the dark without power. Ironically...the Mohawk Valley and Adirondacks escaped with very little snow. The brunt of the snowstorm was felt in an area bounded by a line from about Glens Falls and Amsterdam southwest to about Honesdale in northeast Pennsylvania...east to Fishkill and then to Great Barrington.

By the following Monday...temperatures soared back to the 60s under a sunny sky. The damage assessment had only begun. The Capital District was said to look "like a war zone." It took as long as two weeks for commercial power to be fully restored to some residents!

SUMMER '05: HOTTEST IN NATIONAL WEATHER SERVICE ALBANY HISTORY

Evan L. Heller
Climatologist, NWS Albany
[Fall 2005]

This past summer was Albany's 7th hottest since the beginning of reliable records (as far back as 1795), and the all-time hottest since the inception of the first

U.S. Weather Bureau station in Albany way back at the end of 1873. Interestingly, four summers within the previous 10 years remain in the Top 5…1872 (no. 1), 1873 (no. 2), 1870 (tied at no. 3), and 1868 (no. 5). With a 73.5º F mean temperature, the summer of 2005 came in at no. 7, ahead of yet another pre-weather service summer…1861. In fact, until this summer's placement on the list, only positions 9 and 10 on the Top 10 Hottest Summers list had been occupied by National Weather Service-era summers. A total of 14 out of the 92 days of summer reached or exceeded 90 degrees, with 94º being the warmest reading, on June 26th. July was the only very wet month of the season. Much lower amounts of rainfall during June and August resulted in Albany falling more than an inch and a half short of making the Top 10 Wettest Summers list. The greatest one-day rainfall was 2.18", on July 5th. Here now is a 'summery' of the season.

The Summer of 2005 began on a seasonably warm note…but then it quickly turned hot. The first 90 degree reading of the year was realized on June 8th. June's mean temperature of 72.8º in Albany wound up being a staggering 6.5º above normal, and placed it in a tie for 6th warmest June ever recorded, and the warmest June since the beginning of Weather Service records in 1874. Yet, there were no new daily high temperature records! However, there were four new daily high minimum temperature records, occurring from the 10th to the 13th. These were 74º, 71º, 75º (the high daily minimum temperature for the month) and 73º, consecutively. There were also four new daily high mean temperature records, occurring over the same days. These values were 81.0º, 81.0º, 82.5º (the warmest day of the month) and 81.5º, consecutively. Before all was said and done, the month of June produced eight days that reached 90 degrees or higher. Not all of June was hot. During about the 3rd week, there were a total of seven non-consecutive days of below normal temperatures, but nothing near cold enough to produce records. The balance of days were above normal. Twelve days were 10 or more degrees above normal. The coolest day was the 23rd, with a mean of 63.0º. The warmest reading of the month was 94º, on the 26th. The coolest was 47º, on the 23rd. The lowest maximum daily temperature was 69º, on the 16th. There were two mini heat-waves, one from the 11th to the 13th, and the other from the 25th to the 27th, where temperatures reached 90 degrees or higher each day. The daily mean maximum temperature for June was 83.5º, 6.0º above normal, and the daily mean minimum was 62.2º, 7.2º above normal. June 2005 tied for 64th hottest month of all-time in Albany (since the beginning of Weather Service records in 1874).

Precipitation was near normal in June. The 3.87" total exceeded the normal by just 0.13". Precipitation occurred during exactly half the days of the month, on 12 of which it was measurable. A tenth of an inch or more fell during 11 days, with 0.25" or more on 3 of these. Exactly an inch fell on the 16th, and another 1.77" fell on the 29th, the latter of which established a new daily record. This was the only new daily precipitation record for the month. There were 23 clear, 4 partly cloudy, and 3 cloudy days in June. Thunderstorms occurred on the 6th, 8th, 9th and 29th in Albany, with dense fog materializing on the 20th.

July 2005 was Albany's wettest July in Weather Service history, the 5th wettest since the beginning of record-keeping. 7.54" fell during the month, and this was more than double (4.04" above) the normal. It is Albany's 16th wettest month since 1874. Precipitation fell during 15 days of the month, on 13 of which it was measurable. 0.10" of an inch or more fell on 10 days, 0.25" or more on 8 of these, and 0.50" or more on 6 of those. An inch or more fell on both the 1st and 5th, with 1.59" recorded on the former, and 2.18" on the latter. Both were new daily precipitation records for their respective dates. There were no others. Clear days totaled 18 in July, with 10 partly cloudy, and 3 cloudy days. Thunderstorms occurred on the 1st, 5th, 12th, 14th, 19th, 27th and 31st.

July was comprised of mainly brief periods of alternating above and below normal temperatures, with the entire middle third of the month above normal, and the last few days below. Overall, the month was above normal, but by only 2.7 degrees. The mean temperature was 73.8º. This was warm enough to place July in a 3-way tie for 34th hottest month in Albany since 1874, with August 2005 repeating the result, to join the group and change it to a 4-way tie. However, July was far from making the list of Top 10 Hottest Julys. The mean daily maximum for the month was 83.3º, 1.1º above normal, and the mean daily minimum was 64.3º, 4.3º above normal. The warmest temperature recorded for the month was 91º, on both the 11th and 26th. The 20th was the other day the temperature reached 90º. The coolest temperature recorded was 54º, on the 3rd. The low maximum temperature for July was 68º, on the 8th, while the high minimum of 75º on the 18th was a record tie for that date. This was the only daily temperature record of any kind for the month. The warmest day, with a mean of 81.5º, was also the 18th. The coolest day, with a mean of 65.0º, was the 8th.

August's mean temperature was more above normal than July's, but less so than June's. The average temperature of 73.8º was still an impressive 4.8º above normal. This was just warm enough to place it in a tie for 9th Warmest August. The month also tied with three other months for 34th hottest month in Albany, including July 2005 right next door. The mean daily maximum temperature for August was 83.4º, 3.7º above normal, and the mean daily minimum was 64.2º, which was 5.9º above normal. The high temperature for the month was attained on the 4th, and again on the 10th, when the mercury topped out at 91 degrees. The other day to reach 90º was the 3rd. The low temperature for the month occurred on the 25th, when the mercury dipped to 52º. The low maximum temperature was 72º, on the 19th, and the high minimum was 74º, on the 30th. A high minimum temperature of 73º on the 13th tied a daily record for the date, and was the only new daily record of any kind for the month. With a mean temperature of 81.0º, the 13th was also the warmest day of the month. The coolest day, with a mean of 64.0º, was the 24th.

August precipitation in Albany totaled 3.01", and was 0.67" below normal. Precipitation occurred on 15 days of the month, during 10 of which it was measurable. 0.10" or more occurred during 7 days, with 0.25" or more on 4 of these, and 0.50" or more on 2 of those. More than half of the month's total rainfall occurred during the last two days of the month, thanks to the remnants of the devastating Hurricane Katrina. Thankfully, the impact on our area was little more than a healthy rainfall and some wind. The 30th was the wettest day, with a total of 0.89". There were 20 clear, 9 partly cloudy, and 2 cloudy days. Thunderstorms occurred on the 12th, 13th and 14th, with dense fog on the 26th.

The average temperature for the Summer of 2005 was 73.5º, 4.7º above normal. The mean maximum temperature was 83.4º, 3.6º above normal, and the mean minimum was 63.6º, 5.8º above normal. Rainfall totaled 14.42", 3.50" above normal.

HIGH WINDS: A REAL BUT SOMETIMES UNPERCEIVED THREAT TO NEW YORK AND NEW ENGLAND

John Quinlan
Meteorologist, NWS Albany
[Fall 1998]

High Wind events (excluding those directly associated with severe local storms) are relatively common across New York and New England. They tend to occur during the Fall, Winter and Spring seasons when storm systems are the strongest and only rarely occur during the Summer season when storm systems tend to be weak.

The National Weather Service defines a High Wind event as sustained wind speeds of 40 mph or greater lasting for an hour or longer, or wind speeds of 58 mph or greater for any duration. The National Weather Services issues High Wind Warnings, High Wind Watches, High Wind Outlooks, and Wind Advisories which are issued for lesser events. High Wind Warnings are usually issued for the first forecast period with activation of the tone alert on NOAA Weather Radio for short fuse, especially dangerous situations. High Wind Watches are issued when a High Wind condition is expected in the second forecast period while High Wind Outlooks are issued similar to other long range outlooks using a Special Weather Statement. Wind advisories are usually issued for the first forecast period for sustained winds of 31 to 39 mph lasting for an hour or longer, or wind gusts 46 to 57 mph for any duration.

There are four basic types of High Wind events: Gradient High Winds, Mesoscale High Winds, Channeled High Winds and Tropical Cyclone Associated High Winds. Gradient High Winds are the most common and occur over a large area due to synoptic scale, extra tropical low pressure systems (such as Nor'easters). Mesoscale High Winds usually occur in the wake of convection. These high winds are separated from the main area of convection so they are not covered by convective warnings. Channeled High Winds are the most common over localized areas as air is channeled through constricted passages such as deep, narrow mountain valleys (such as Pleasant Valley in Lamoille County in Vermont and Platte Clove in Greene County in New York) or tall buildings in cities. Tropical Cyclone Associated High Winds can occur several hundred miles inland from the coast of a tropical cyclone which makes landfall. Since Hurricane and Tropical Storm Warnings are not appropriate for inland areas, the National Weather Service has two products to cover such events: Inland High Wind Warning For Hurricane Force Winds and Inland High Wind Watch For Hurricane Force Winds.

Numerous High Wind events have occurred across New York and New England resulting in deaths and injuries as well as significant property damage. Two of the most devastating High Wind events on record occurred across New York and New England on November 24, 1950 which was called the "Great Appalachian Storm" (peak wind gust at Albany 83 mph and New York City 94 mph) and November 12-13, 1992 (several million dollars in damage and 5 injuries). Other memorable High Wind events in recent years occurred on December 25, 1992: November 28, 1993: February 24-25, 1996: and November 8, 1996.

TAKE HEART—THE WORST OF ‘THE DREARIES’ IS ALREADY BEHIND US!

Bob Kilpatrick
Meteorologist, NWS Albany
[Winter 2004-05]

The Christmas season here in eastern New York and adjacent portions of New England ought to remind us that at least one factor of our weather should soon start to improve. Of course, the snow season is still very much ahead of us. But take heart! While it may be cold and snowy in winter, it typically isn't as ‘dreary’ as in late fall.

Who doesn't get those late November and December ‘blahs’? You know…that depressed feeling, with only Thanksgiving dinner and Christmas lights to brighten up your life?? While the ‘blahs’ will typically be experienced throughout the northern two-thirds of the U.S, it's particularly noticeable in the Northeast – with that dull grey overcast over that dull grey landscape! It's particularly obvious to us for several reasons. First of all, before the onset of the ‘blahs’, we experience a warm, pleasant summer, and then we are immediately pampered with a show of bright and glorious fall colors. With the first hard frost, leaves turn brilliant shades of yellow, orange and red. Afterwards, they turn a dull brown, and then drop off, leaving a tangle of grayish twigs. What a downer! Only the evergreens refuse to participate. Thank you, O Tannenbaum!

At the same time, the days are getting shorter. Then at the end of October, the big shock hits: ‘fall back’ time – when we change the clocks, and suddenly it's getting dark a whole hour earlier!

But the worst thing of all is that dull grey overcast, that pall that seems to hang over the northeast. The climate statistics bear this out. Here in Albany, November is the dreariest month of all, with, on average, the lowest percentage of possible sunshine of any month of the year. Albany normally gets only 37% of November's possible sunshine. There's even less possible sunshine available in December, but we average 39% of it, and this is the earliest sign of an upswing.

Generally, things begin to improve right at the start of astronomical winter – about December 21st, the shortest day of the year where daylight is concerned. Besides the days getting longer with winter pushing on, the normal percentage of possible sunshine received rises to 46% in January, and then jumps to 52% in February. Just compare November's dreary 37% to more than 60% for each of June, July and August! Why this pattern? Our unique geographic location, along with the local terrain, is the reason. With the Atlantic Ocean just off to the southeast, all the Great Lakes to the northwest, icy Hudson's Bay due north, the even drearier Labrador Coast to the far northeast, the Canadian Plains on the other side of the Great Lakes, and the Appalachian backbone, weather patterns that normally make sunshine abundant elsewhere, usually bring dark, low clouds to our area.

In late fall and early winter, the bodies of water around us are still relatively warm…except for Hudson's Bay and the ocean off Labrador, which are almost always icy cold. The contrast between the ocean north and the ocean south of Newfoundland is striking – icy cold on one side, warm on the other. This contrast provides favorable conditions for cyclone intensification, which often occurs over the Canadian Maritimes. The circulation around these giant systems draws in air off the damp, chilly waters of Labrador. Then this air gets chilled and dampened even more upon crossing Hudson's Bay, and it arrives in our area with bone-chilling damp cold, and plenty of low clouds.

Normally, when a low pressure system passes by, it ushers in the “good” weather normally associated with a high pressure system. This is the cool, dry air accompanied by clear, sunny skies. But in this area, the cold air first must travel across the Great Lakes.

Depending on the wind direction, a given air parcel may pass over as many as three of the lakes. Particularly in November and early December, the lake waters are still relatively warm – as much as 30 degrees warmer than the air. The resultant effect is that the wind lifts the moisture off the water surface and carries it off – and, all other things remaining equal, the stronger the wind, the faster the rate at which this occurs. The air becomes moisture-filled and unstable, and then gets "bumped" into the higher terrain it moves over after crossing the lake. The result is low clouds, and snow or rain showers downwind from the lake. Sometimes the air is so unstable, we get "thunder-snow" – lightning and thunder, but with snow instead of rain.

In general, the closer a location is to the Lakes, the more clouds and snow it tends to receive. Places in and around Buffalo, Erie, Rochester, Syracuse, Utica and Cleveland all receive a lot of lake-effect snow, but the real champion is a no-man's land north and east of Syracuse, and northwest of Rome, known as the Tug Hill Plateau. It gets buried every winter, oftentimes with snow piling up over four feet deep. Because the air aloft is so cold, this "lake-effect" snow is often very light and fluffy.

As winter cold persists across the northern states, the waters of the Great Lakes continue to get colder, and finally begin to freeze, especially in shallow sections. Deeper areas generally take longer into the season to cool down, and often don't completely freeze up at the surface. This is particularly true of Lake Ontario, which almost never completely freezes over. The oceans off the east coast also continue to become cooler. When the temperature of the water starts to approach that of the air, the lack of contrast results in lower amounts of moisture and condensation, and, therefore, a reduction in lake-effect or ocean-effect cloudiness. So, lake-effect clouds and snow are more prevalent in November, December and early January, when the waters are still sufficiently warm, and are not as prevalent later on in winter, when air temperatures start to rise, but waters are coldest.

THE 2002 ENSO

Thomas A. Wasula
Meteorologist, NWS Albany
[Spring 2002]

El Niño/Southern Oscillation (ENSO) is an ocean-atmospheric phenomenon that can impact global weather. El Niño is the abnormal equatorial warming of Pacific ocean water near the coasts of Ecuador and Peru. Warm counter currents off the cold Peruvian coast typically occur in late December, which is why the local residents call this event, El Niño, which means "the child", after the Christ child. Every 3 to 7 years these counter currents of warm water are exceptionally strong for an extended period of time, setting up an anomalously strong pool of warm water over the central and eastern Pacific. In the past few decades, these events have been occurring more frequently. Strong El Niño episodes can cause extreme weather in different parts of the world.

When an El Niño occurs, the surface air pressure over the western Pacific near northern Indonesia and Australia significantly increases, while the pressure over the southeastern Pacific dramatically decreases. When an El Niño terminates, those pressure patterns reverse. The seesaw atmospheric pressure pattern between the eastern and western Pacific is called Southern Oscillation (SO). Thus the overall phenomenon is called El Niño/ Southern Oscillation in the scientific community, or ENSO for short. An index is calculated, and averaged on a monthly basis to measure ENSO. The Southern Oscillation Index (SOI), is a difference in pressure measured at Darwin, Australia and at the south Pacific Island of Tahiti. When the SOI is positive, there is a La Niña (or abnormal oceanic cooling in the eastern Pacific), but when the index is negative an El Niño (or abnormal oceanic warming in the eastern Pacific) is occurring. These periodic pressure reversals impact the trade winds. The northeast and southeast trade winds are much weaker than normal and may even reverse direction during ENSO. This allows the warm water that builds up in the western Pacific to slide on eastward along the equator to the eastern Pacific.

One of the strongest ENSOs on record occurred in 1982-83. That year, heavy rains and flooding occurred across normally dry portions of Ecuador and Peru. In some areas that normally receive only 4 to 5 inches of rainfall annually, over 140 inches of precipitation fell during that ENSO! Severe droughts were recorded in Australia, Indonesia and the Philippines. Warm water that built up over the eastern Pacific inhibited the upwelling of colder, nutrient-filled water, resulting in starvation of anchovies, severely impacting Peruvian fishing economies. Across parts of

North America, one of the warmest winters on record occurred, followed by one of the wettest springs over much of the United States. Powerful storms struck the California coast and brought on catastrophic flooding, landslides and beach erosion. Heavy snowfall in the Sierra Nevada and central Rocky mountains led to mudslides and flooding in Utah and Nevada, as well as along the Colorado River in the spring of 1983. The Gulf of Mexico region also saw unusually heavy rainfall with flooding in the Gulf states and Cuba.

The most recent ENSO occurred in 1997-98. It is unclear whether the southern U.S. droughts and heavy monsoons in Asia were ENSO-related. Severe droughts in Australia and flooding in eastern China were shown to be related to ENSO.

ENSOs have a variable impact on weather in the Northeast. Some ENSO winters have produced heavy snowfall and precipitation, while others have produced the opposite effect. The 1997-98 ENSO produced an anomalously warm winter across portions of eastern New York and western New England. For example, Albany, NY, averaged more than 8 degrees above normal in January and February 1998. Research studies have shown winters to generally be warmer than normal during ENSOs across the northern U.S. and Canada. Additionally, the Atlantic basin typically has fewer hurricanes during an ENSO.

The National Oceanic and Atmospheric Administration's Climate Prediction Center is currently predicting an El Niño to be likely in early Spring 2002, based on observed warming of the sea surface temperatures (SSTs) in the central and eastern Pacific during January and February. The SST anomalies are the most significant since the 1997-98 event. NOAA is not yet ready to predict the intensity of this event. Some scientists feel this ENSO will peak in late 2002, which will play a pivotal role in chaotic and abnormal weather patterns in the Northeast and around the world in the Winter of 2002-03.

NWS FLASH FLOOD CRITERIA FOR WARNINGS AND VERIFICATION

Steve DiRienzo
Senior Service Hydrologist, NWS Albany
[Spring 2005]

The definition of 'flash flood': a short-term flood event (typically within 6 hours of the cause) that requires immediate action to protect lives and property, such as dangerous small stream, urban and ice jam flooding, and dam or levee failures.

The National Weather Service (NWS) utilizes The Flash Flood Monitoring and Prediction (FFMP) system, which is an integrated suite of multi-sensor applications that detects, analyzes and monitors precipitation, and generates short-term warning guidance for flash flooding, automatically. NWS staff exercise professional judgment in issuing and verifying flash flood warnings, keeping in mind the ultimate goal: to warn the public of rising water that will inundate an area to the degree it threatens life or property.

Flash Flood Warning (FFW) and Verification Criteria is as follows: Usually within 6 hours of onset of a causative event, such as heavy rain, a dam break, or ice jam release, or when one or more of the following occurs:

• River or stream flows out of banks and is a threat to life or property.

• Person or vehicle is swept away by flowing water from runoff that inundates adjacent grounds.

• A maintained road is closed by high water.

• Approximately six inches or more of water flowing over a road or bridge. This includes low water crossings in a heavy rain event that is more than localized (i.e., radar and observer reports indicate flooding in nearby locations), and poses a threat to life or property.

• Dam break or ice jam release causes dangerous out-of-bank stream flows, or inundates normally dry areas, creating a hazard to life or property.

• Any amount of water in contact with, flowing into, or causing damage of an above-ground residence or public building, and that is runoff from adjacent grounds.

• Three feet or more of ponded water that poses a threat to life or property.

Nuisance Flooding vs. Threat to Life or Property
Nuisance flooding would not meet the flash flood criteria outlined above and would not pose a threat to life or property. An Urban or Small Stream Advisory (FLS)

would be issued in this case. Examples of nuisance flooding include:

• Urban/small stream flooding (conditions that do not pose a threat to life or property). For example: Roadside drainage ditches that fill during a summer thunderstorm. It should be stressed that children should never play in the water of storm water ditches or culverts, as the fast moving water could carry them away, and they could drown.

• Minor ponding of water during or after a heavy rain event or flood. Significant ponding may pose a threat to life and property. A 1988 United States Bureau of Reclamation (USBR) study indicates 3 feet or more as being a danger to people and vehicles.

• High stream levels that do not pose a threat to life or property. For example: Bank full rises on small creeks that fill during a summer thunderstorm. It should again be stressed that children should never play in creeks or streams during high water, as the fast-moving water poses a serious risk of drowning.

You should now have a better understanding of the flash flood warning process. If you have any questions, please contact me, Stephen.Dirienzo@noaa.gov. As always, please report flash flooding and any other severe weather to your nearest law enforcement agency.

LAST YEAR OF MILLENNIUM FEATURED JEKYLL AND HYDE WEATHER CONDITIONS

Evan L. Heller
Climatologist, NWS Albany
and
Hugh W. Johnson IV
Meteorologist, NWS Albany
[Winter 1999-2000]

The year began on a bitterly cold note. In fact, the coldest day of the year was January 2nd, with a low temperature of 10 degrees below zero at Albany. Then, a nasty ice storm on the 3rd turned sidewalks, driveways and some roadways into skating rinks. More ice and only a little snow came during the following week.

On January 14th, the first real snowstorm of the year blanketed the region with 6 to 12 inches of snow. That was followed by more sleet, freezing and liquid rain. The most noteworthy aspect of this storm was that temperatures remained well below zero during much of the storm. Initially, wind chills were as low as 50 degrees below zero!

An ugly January thaw followed the snowstorm, resulting in the usual problems of ice jams and swollen creeks. The most paralyzing winter storm (in terms of travel) was on Martin Luther King Day. It was another ice storm that coated over sixty miles of the Northway with glare ice, forcing its closure for the first time since the Blizzard of ‘93.

High temperatures during the last three days of January were only 20 degrees, with a low of minus 4 on the 31st. The January thaw before the ice storm was strong enough to offset the bitter cold of both the beginning and end of the month, so that January ended up milder than normal.

February was a kinder, gentler month. There was a little ice around on Ground Hog Day, but in no way comparable to the January ice storm. Snowfall during the month was slight, and precipitation as a whole was less than normal. Again, temperatures averaged above normal, by more than four degrees.

Then in March, the "purest" snowstorm took place, on the 6th. Eight to 14 inches of snow fell in the central and northern parts of our forecast area. This storm’s sleet and rain stayed south of Albany.

Another snowstorm came on the 14th, with locally up to a foot of wet snow across Litchfield County Connecticut. Much lighter amounts fell further north. The nastiest storm of the month was on the 22nd. A potpourri of precipitation included over a foot of heavy snow in the Adirondacks, drenching rains with flooding in the Catskills, and a wintry mix in the Capital Region, creating treacherous travel conditions. That was Albany's last measurable snowfall of the season.

March turned out snowier and wetter than normal. Despite being an otherwise colder than normal month, the last week of March was about 5 degrees above normal. The mercury topped out at 72 degrees on the 31st. So the average temperature for March wound up very slightly above normal.

April showers bring May flowers? Not this April. A drought slowly evolved, beginning this month, that would become severe by the early summer, and continue until the early fall. Along with the lack of rain, came lots of wind and plenty of sunshine, resulting in the most active month for brush fires in the region in many years.

Temperatures averaged about normal. But the sixth tenths of an inch of rainfall for the month recorded at Albany made it the second driest April on record, and the driest April of this century! It was also the first time on record that Albany received virtually no snow for two consecutive Aprils.

Some showers and, surprisingly, flowers came in May, despite April's dryness. Not enough, however, to reverse the trend toward worsening drought. May was a pleasant month with plenty of sunshine, warmer than normal temperatures without any stifling heat waves, and no severe weather.

Hot weather did arrive with a vengeance during June, however. On the 7th, the temperature climbed into the 90s for the first time in nearly two years, topping out at 95 degrees, and tying a pre-depression era record.

The sultry combination triggered the season's first severe thunderstorm outbreak later that evening. The storms dropped large hail in Litchfield County. And, a damaging downburst hit Winchester Center. Virtually all the rain that fell during June was associated with thunderstorms, and most of it was scant. As a result, by the end of the month, many communities had placed either voluntary or mandatory restrictions on water usage.

July of '99 sizzled, with temperatures averaging well above normal. The year's worst heat wave was at the end of the Independence Day Weekend. Temperatures again peaked at 95 degrees, on the 6th, with lots of humidity to boot. There were twelve days in July with a high of 90 degrees or more, the most during any July in the past eleven years. The most widespread severe thunderstorm outbreak of the year took place on the 6th, temporarily breaking the heat wave. A couple of squall lines brought wind damage or large hail to almost every county of our forecast area. One of the storms disrupted the National Weather Service's annual picnic at Lake George. While scattered thunderstorms brought locally heavy rains to some places during the month, most of the area remained drier than normal, further exacerbating the drought. The 90 degree heat soon returned, and the last half of July wound up being the hottest period of the year, with nine days topping out at 90 degrees or more.

August was a more docile month, with one exception. On Friday the 13th, a supercell thunderstorm developed over the Mohawk Valley, bringing damaging winds and large hail to portions of the Greater Capital region and southern Vermont. August opened with the last 90 degree day of the year, but temperatures, as well as rainfall, averaged near normal. The water shortages continued, however, and much of the region was placed under a drought emergency.

September opened with the summer theme; warm and dry. Then, during the second week, the remnants of Hurricane Dennis brought tropical rains, especially to Litchfield County Connecticut. For most of the region Dennis only dampened the dust.

On the 16th, a much more powerful hurricane, Floyd, brought exceptionally heavy rains and high winds to our region. Albany recorded its all-time greatest one-day rainfall, 5.60 inches, on the 16th. By the time the rain had ended the evening of the 17th, the storm total was 6.12 inches. Even higher amounts of rainfall inundated the Catskills, with Cairo receiving over a foot!

The drought was broken and was replaced by flooding. The Normanskill rose to its second highest flood on record. Many tributaries, which had lain dormant for months, became raging torrents. Wind gusts ranging from 45 to over 65 mph toppled trees throughout the region. Power outages were common and some roads were washed away. This storm was the most noteworthy and costliest of the year.

The weather settled down for the rest of September, but several more rainy days pushed the monthly rainfall total at Albany International Airport to 11.06 inches, easily smashing the previous September record of 8.90 inches, set over a century ago. In fact, it was the greatest monthly precipitation on record at Albany!

On October 4th an unseasonably early snowstorm surprised the folks in the Western Adirondacks, depositing 3 to 6 slushy inches. Otherwise, the weather during October was uneventful. October was the first month in 1999 to finish with below normal temperatures; about a degree cooler than normal. The total rainfall for the month was very close to normal.

After a gorgeous start to November, a rain and wind storm harassed poll-goers on Election Day. Though minor compared with Floyd, there were scattered power outages and downed trees across higher portions of the region.

Two moderate but prolonged Indian summers, interrupted only by a brief cold snap in the middle of the month, yielded the mildest November of the 90s in the Albany area. The average temperature was more than four degrees above normal. Rainfall was once again scarce, until the last week of the month. Some rain fell, but the total for the month was still more than an inch shy of normal. The season's first measurable snow in the Capital Region, one tenth of an inch, fell on the 29th, with another three tenths of an inch closing out the month.

December started out sunny but cold, but the cold did not last long. In fact, by the 6th, the mercury soared all the way to 61 degrees, for our second record-tying high temperature of the year. A little snow and sleet fell on the 14th, but melted away by evening. Clouds and damp weather persisted for much of the month. Once again, temperatures averaged above normal - a common theme for winter months in the 90s. Every winter month since December 1995 has been milder than normal at Albany. In fact, during the entire decade, all but six of the 30 winter months have been warmer than normal!

To sum it up, 1999 was warmer and a little wetter than normal, and snowfall was less than normal. We endured one of the most intense droughts followed by the heaviest monthly rainfall on record. What will the next Millennium bring? Only time will tell!

SEVERE WEATHER IN NOVEMBER

Hugh W. Johnson IV
Meteorologist, NWS Albany
[Winter 2004-05]

A strong cold front plowed into an unseasonably warm air mass on Thanksgiving Day. The result was a rash of severe weather, the first since late August across upstate New York. While most of the 10 or so severe weather reports received were just of a scattering of downed trees and wires in a few counties, one was a report of a microburst that blew down up to 80 trees in the village of Lomontville, Ulster County. One of the trees damaged a garage roof and travel trailer. Luckily, there were no injuries. A few large hailstones were also reported with the storms.

Unfortunately, a severe weather event on November 16, 1989 did cause a loss of lives in our CWA (County Warning Area). A fast-hitting tornado ripped through Orange County, NY (at the time, part of our CWA), and tore down a wall of a school in Coldenham, which resulted in 9 deaths and 18 injuries. This is possibly our region's all-time most fatal severe weather event. Widespread severe thunderstorm damage from this event was reported across many other counties, as well. In Orange County again, just four days later, straight-line winds were clocked as high as 90 mph at Stewart Field! This is sure to have resulted in some damage.

Other convective severe weather events have been noted in November, along with some of our most severe windstorms. The Great Appalachian Storm of late November 1950 holds the record for producing the highest official wind gust ever recorded at Albany…83 mph!

The main reason for severe weather and high winds in November is the presence of the subtropical jet stream. This jet stream is usually absent during the warmer months, and usually contains even stronger winds than the polar jet stream. On occasion, these winds can be translated to the surface via powerful surface lows and severe thunderstorms.

Severe thunderstorms have occurred at one time or another in Albany during each of the 12 months of the year. We had a significant severe thunderstorm outbreak back on December 17th, 2000.

No matter what time of year, it is to your advantage to have specially-equipped "All-Hazards Weather Radio" ready to alert you to any severe weather, whether it be a blizzard, high wind, severe thunderstorm, flash flood or tornado. Remember, even mere seconds can save lives.

THE ACTIVE 2005 HURRICANE SEASON: HIGHLIGHTED BY THE DEVASTATING HURRICANE KATRINA

Kenneth D. LaPenta
Senior Forecaster, NWS Albany
[Fall 2005]

The 2005 hurricane season was forecast to be very active, and by early September, 13 named storms had already developed, the most notable being Katrina, which devastated the Gulf coast states. The tropical depression that spawned Katrina formed over the Bahaman Islands, east of Florida, on August 23rd. The storm intensified into a hurricane as it approached the southeast Florida coast on the 25th, and moved inland between Hallandale Beach and North Miami Beach with wind gusts over 90 mph. It crossed extreme south

Florida and emerged over the warm waters of the Gulf of Mexico, where it steadily strengthened. By Friday evening, it had become a Category 2 storm on the Saffir-Simpson Scale, with winds of 100 mph, and a lowest barometric pressure of 28.50 inches. Twenty-four hours later, highest sustained winds reached 115 mph, with a central pressure of 27.73 inches. Atmospheric conditions were highly favorable for further intensification, and on the 28th, Katrina reached Category 5 status, with sustained winds of 175 mph, and a minimum pressure of 26.64 inches. This was the fourth lowest pressure ever measured in an Atlantic basin hurricane, behind only: Gilbert in 1988; the Labor Day storm of 1935, and; Allen in 1980. Katrina weakened slightly before moving inland early on the morning of the 29th near southern Plaquemines Parish, Louisiana. The combination of very high winds, a huge storm surge and torrential rains brought devastation to the Gulf coast. Then, after the storm passed, levee failures in New Orleans caused disastrous flooding. The recovery will be long and hard.

The hurricane season got off to an early start on June 9th with the formation of Tropical Storm Arlene in the northwest Caribbean Sea. Arlene crossed western Cuba, and then moved through the eastern Gulf of Mexico, making landfall near Pensacola, Florida with 60 mph winds. Tropical Storm Bret followed at the end of June, forming in the Bay of Campeche, and moving inland near Tuxpan, Mexico with highest winds of 60 mph. Five named tropical cyclones formed during July, a record for the month, with Dennis and Emily both becoming major hurricanes. Tropical Storm Cindy formed in the western Caribbean Sea on the 3rd, crossed the Yucatan Peninsula, and moved into the Gulf of Mexico. It moved northward, making landfall over southeast Louisiana at just below hurricane strength. The first hurricane of the season, Dennis, became a tropical storm in the eastern Caribbean on the 5th. It became a major hurricane two days later, with winds of 150 mph. Dennis caused considerable damage as it crossed Cuba, and it eventually made landfall again as a category 3 storm over the western Florida Panhandle. Emily formed east of the Lesser Antilles on July 11th, and became a hurricane near the island of Grenada. Peak intensity (155 mph – just below category 5) was reached south of Hispaniola. Emily crossed the Yucatan Peninsula, and made a second landfall, on the western Gulf Coast on the 20th, 75 miles south of the Texas border. Tropical Storm Franklin formed in the central Bahamas on the 21st, and moved northeast, passing about 200 miles west of Bermuda with its highest winds just below hurricane strength. Tropical storm Gert formed in the Bay of Campeche on the 24th, and moved inland near Cabo Rojo, Mexico the following day.

Above normal tropical activity continued throughout August, with five named storms. Harvey formed northeast of the Bahamas on the 2nd, and passed 50 miles southeast of Bermuda two days later with 65 mph winds. It continued toward Newfoundland over the next few days, never reaching hurricane intensity. Hurricane Irene was a long-lived Cape Verde storm that formed on the 4th, and reached peak intensity (105 mph winds) as it moved through the open waters of the central Atlantic, passing 300 miles southeast of Newfoundland. Jose was a short-lived, weak tropical storm in the Bay of Campeche. Katrina will go down as one of the worst natural disasters in United States history. The month ended with short-lived tropical storm Lee making a brief appearance east of the Lesser Antilles.

September began with the formation of tropical storm Maria on the 2nd, about a thousand miles east of the northern Leeward Islands. It became a large hurricane as it moved north through the central Atlantic during the following week. Hurricane Nate formed between the Bahamas and Bermuda on September 5th, and passed about 100 miles south of Bermuda before weakening in the north central Atlantic. Hurricane Ophelia formed to the southwest of Nate on the 7th, and meandered off the coast of the eastern U.S. for over a week. It produced hurricane force winds across coastal North Carolina before passing just south of Cape Cod on the 17th as a weakening tropical storm. As StormBuster was going to press (September 18th), Ophelia was dying out in the North Atlantic. But tropical storms Philippe (east of the Leeward Islands) and Rita (Bahamas) had just developed, and were forecast to strengthen into hurricanes. With 17 named storms already, the 2005 hurricane season is one of the most active in recorded history. The most active seasons on record are 1933, with 21 storms, and 1995, with 19 storms. How does this year compare with those two? In 1995, the 17th storm didn't take shape until October 7th, and in 1933, the 17th storm took until September 28th to form.

Thanks to the National Hurricane Center for most of the information contained in this article. Their web site is an outstanding resource for information about all aspects of hurricanes and tropical storms.

FALL MARKS A TRANSITION

Bob Kilpatrick
Hydrometeorologist, NWS Albany
[Fall 2001]

Many warmer parts of the world have a two-season climate. They have Wet Season and Dry Season. These trends occur over parts of Latin and Central America, Africa south of the Sahara, the Middle East, and, if a third (cool) season is included, the Indian subcontinent. Here in the Northeast, we usually enjoy adequate moisture every month of the year. But we do have a definite wet and dry season as far as the rivers and streams go due to the effects of our climate on the vegetation that covers most of our area.

The first half of Fall is part of the dry season. It is not bone and baking dry like the inferno of Latin America or Spain but reflects the depletion of moisture which results from summer. At the start of Solar Summer (June 20) the sun is over the Tropic of Cancer, which is as far north as it gets. At the start of Fall the sun is over the equator. Temperatures lag a month or so behind the sun due to the enormous amount of heat stored in the oceans and other large bodies of water. The Japan Current or Kiroshio circulates warm water around the North Pacific, which has a substantial effect on the air masses over North America since most of them have to cross the Pacific and cold air masses are substantially affected by warm water—as we all know from the Lake Effect snows we get in December and January. Even the icy Bering Sea does warm up some—observations the last day or two show water temperatures in the mid 40s. During winter much of the Bering sea freezes over.

As the nights get longer with the sun farther south, radiational cooling sets in and, usually, an Arctic air mass will make a visit during early or mid September with a hard frost. This frost triggers the trees and shrubs to end their summer season, so the green leaves are often replaced by yellow, red, or brown, and then the leaves fall off—hence the name "fall" for the season. With the lack of leaves and cooler temperatures, the amount of moisture lost from the ground by evaporation drops drastically during September and October.

By late October into November, the moisture that comes down as rain is recharging the soil—much like charging a battery. Often, much of the ground moisture is replenished by Thanksgiving time. So what does all this mean?

During September and early October, streams in the Northeast are usually at their lowest flows of the year. The US Geological Survey chooses to start the "Water Year" on October 1 for this reason. However, in late October and November, the streamflows usually increase substantially. The amount of flow differs from stream to stream, and on many larger rivers reservoirs affect this trend since they store water to use when needed or desired. The water tables sometimes take longer to react but often rise during late October and November as moisture from the rain makes its way down through the soil. Some of this water emerges as springs to provide what hydrologists call base flow as opposed to runoff which is a direct result of rainfall.

Lets look at a typical river; for example the Schoharie Creek, above the Schoharie Water Supply Reservoir. During the summer "dry" season the average streamflow at Prattsville is about 0.5 cubic feet per second per square mile. During the fall this increases to 0.75 for September, 1.25 for October, 2.0 for November and 2.25 for December.

Floods in Fall are relatively uncommon. There are two major types of weather events that cause them. One type is a Tropical Storm, or more commonly, the remains of one. A typical tropical storm will pump in huge amounts of moisture from the Gulf of Mexico or the Gulf Stream area of the Atlantic. Therefore, it can bring 5 to 10 inches of rain within a couple of days. When the ground is dry it can soak up three or four inches, but the remainder will run off. The other frequent cause of floods is a slow-moving or stalled cyclone, especially when late in the season. It can cause two to four inches of rain to fall after the combination of cool weather and rain has recharged some of the ground moisture. The ground no longer has room to soak up three or four inches, but can hold only an inch or two. History has shown that more than an inch of excess water will bring many streams and rivers to bankfull or slightly over. Some of our region's worst floods have been from the remains of hurricanes. They include the devastating flood of November 1927, the New England hurricane of September 1938, Hurricanes Connie and Dianne, which came a week apart in 1955, and more recently, Hurricane Floyd in September 1999.

THE JULY 21 TORNADO OUTBREAK

Evan L. Heller
Meteorologist, NWS Albany
[Fall 2003]

One of the most significant tornado outbreaks in the history of eastern New York and southern Vermont took place on Monday evening, July 21. An area of deep low pressure moved across the Great Lakes, and ahead of it, a warm front lifted through eastern New York and western New England. Within this warm, humid and very unstable air, a line of thunderstorms developed and produced spotty damage during the late afternoon hours as it traveled across portions of Albany, Greene, Rensselaer, Saratoga, Schenectady and Schoharie Counties.

But this was hardly the end of it. Following this episode, a Mesoscale Convective System (MCS) moved out of central New York and across eastern New York and southern Vermont during the evening hours. It was this complex of storms that produced far more serious weather and damage, including two separate tornadoes from a single supercell thunderstorm. The first tornado came about as a result of the merger of the MCS with thunderstorm cells which had developed ahead of it, as it moved across Ulster County. The merging of the cells into one supercell took place just north of Frost Valley in the Catskill Mountains at about 7:41 P.M. A funnel cloud began to develop shortly thereafter as it continued on its northeastward path toward the Mid-Hudson Valley and southeastern Greene County.

The supercell continued to strengthen and the first confirmed tornado touchdown occurred near the town of Palenville in Greene County at 8:14 P.M. The tornado traveled along a non-continuous path of 17 miles as it crossed eastern Greene County. It then crossed the river into Columbia County around 8:30 P.M., where it stayed on the ground throughout most of its 12.2 mile trip across the northwestern part of the county. About 15 minutes later, the tornado touched down again as it crossed into Rensselaer County in the town of Nassau. After a few more minutes of northeastward travel, the tornado once again lifted at 8:51 P.M. The supercell that produced the first tornado continued on, spawning a second tornado just across the state line in extreme southern Bennington County Vermont near North Pownal around 9:20 P.M.. The tornado traveled another 25 miles, ending its life just inside Windham County, Vermont near Stratton Pond around 10:00 P.M. At many points along the way, the tornado was classified as an F2 on the Fujita Scale of tornado intensity - not amongst the most powerful tornadoes, but a significant one, especially for the northeastern United States.

Overall, this supercell produced over a million dollars in damage. A state of emergency was declared in Columbia and Greene Counties. As many as 63,000 customers were without power in eastern New York, and another 2,000 in southern Vermont. It took the better part of a week for all power to be restored. Many communities applied for federal aid.

This supercell has the distinction of having produced tornadoes with the greatest distance between the points of initial touchdown and final point on the ground of any thunderstorm cell in the history of eastern New York or western New England since at least 1880. The total length of the supercell's track was approximately 125 miles, including 61 actual tornado miles in this broken tornado path. The path length of both the Great Barrington tornado of 1995 and the Mechanicville tornado of 1998 were far less; around 30 miles each.

An even more important distinction was that, despite its intensity and long path of destruction, the tornado of July 21, 2003 produced no fatalities. A series of anecdotes reported in the press, and to our damage survey teams, mentioned people taking shelter when they heard warnings. It seems likely that, without the timely warnings issued by the Albany office of the National Weather Service during this event, the human toll would have been far greater. The spotters who reported the storm's progress to the Albany office can take pride in this accomplishment. Without their help, the warning lead times would have been significantly shorter.

WARREN COUNTY, NY FLASH FLOOD EVENT OF JUNE 13, 2005

Ray O'Keefe
Warning Coordination Meteorologist, NWS Albany
and
Gene Auciello
Meteorologist In Charge, NWS Albany
[Summer 2005]

Thunderstorms trained across Warren County, NY during the late afternoon and early evening hours of Monday, June 13, 2005. These storms developed in an abnormally warm, moist environment that had been in place across Weather Forecast Office (WFO) Albany's forecast area for nearly a week. It was the third day in four that diurnal thunderstorm activity in an excessively moist environment resulted in Flash Flood Warnings being issued by the office.

The WFO Albany Multi-sensor Precipitation Estimator (MPE) indicated hourly rainfall totals from four to five inches in Warren County between 7 and 8 p.m. Albany's Doppler radar Storm Total Precipitation estimate yielded six to eight inches across the county. A review of the MPE data showed that the area receiving four or more inches of rainfall was roughly 6 by 10 miles, or 60 square miles. Flooding was reported on the Schroon River, as well as on numerous small creeks and streams. Reports from Lake George indicated an unprecedented rise of eight inches in the lake level Monday night. A spotter in the Town of Bolton, within the swath of heaviest MPE precipitation, reported 6.34" during the event. This real-time feedback by the spotter provided forecasters with valuable ground truth confirming the precipitation estimates were correct.

A mudslide on the Northway (I-87) just south of Exit 24 had closed the highway from exits 23 to 25, a ten mile stretch, in both directions. A 150-foot section of the Northway was washed out by run-off from the storms, with both the north- and south-bound lanes heavily damaged. Transportation officials indicated the road would be closed for at least several days, if not weeks. Additionally, a dozen other roads were closed in Warren County. Town of Queensbury Highway Superintendent Richard Missita described the damage to Route 11 as, "just devastating". A couple dozen Warren County residents were sheltered by the Red Cross Monday night. A State of Emergency was declared in the Towns of Bolton, Chestertown, Warrensburg and Horican. Preliminary Warren County damage estimates were \$3 to 5 million. About a dozen injuries were reported, mostly minor, including that of an unidentified woman who drove around a Northway barrier around 2 a.m. Tuesday, the 14th.

Based on Doppler radar estimated rainfall and Flash Flood Monitoring Program analysis, WFO Albany staff issued a Flash Flood Warning for Warren County at 5:20 p.m., valid until 8:15 p.m. At 7:34 p.m., WFO Albany issued a Flash Flood Statement, noting that additional training thunderstorms were impacting the Chestertown/Warrensburg area, where the mudslide occurred. A Flash Flood Warning was issued at 8:13 p.m. to replace the expiring 5:20 p.m. warning. At 8:36 p.m., a report from the New York State Police Information Network (NYSPIN) indicated that the Northway was closed due to a mudslide at Exit 24. Based on the initial 5:20 p.m. issuance of the first Flash Flood Warning (and its subsequent continuation with the 8:13 p.m. issuance of the follow-up warning), there was over three hours lead time before the mudslide occurred. In response to the 8:36 p.m. State Police report, WFO Albany staff posted a Local Storm Report with this information at 8:48 p.m. An updated Flash Flood Statement was issued at 8:57 p.m., stating that 'Flash Flooding was occurring in Warren County...[and a] mudslide had closed the Northway between Exits 23 and 25'. Follow-up Flash Flood Statements were issued at 9:19 p.m. (Headline: 'Serious Flash Flooding was Occurring in Warren County'), 10:45 p.m. (Headline: 'Serious Flash Flooding was Occurring in Warren County...More Heavy Rain Moving Into the County'), and 11:25 p.m. (Headline: 'A State of Emergency Has Been Declared in the Warren County Towns of...'). A third and final Flash Flood Warning was issued at 12:05 a.m. to replace the expiring 8:13 p.m. warning. All Flash Flood Warnings verified in Warren County with an average lead time of 68 minutes. There were no missed Flash Flood events.

In addition to the flooding events, a Severe Thunderstorm Warning was issued for Saratoga County at 9:11 pm. This warning verified with trees down in the Town of Galway, and with a 29 minute lead time. A Flash Flood Watch was issued at 10:16 p.m., effective until 5:00 a.m., for the northwestern third of the Albany forecast area. As the diurnal thunderstorm threat was subsiding, NWS radar showed the remnants of Tropical Storm Arlene approaching the area identified in the Watch. The Flash Flood Watch verified in Warren County; it did not verify elsewhere.

The average lead time of 68 minutes on the Flash Flood Warnings was 42% better than the 48 minute 2005 national goal. The warning accuracy on this event was 100%, exceeding the 2005 national goal of 89% to perfection. The 3 hour 10 minute lead time for the Northway washout provided critical time for Warren County officials to take protective action. John Farrell, Warren County Emergency Manager said, "With the issuance of the first warning, the county ramped up emergency operations. The warnings absolutely helped the County prepare for the flooding. The warnings were a big help."

Private campgrounds in the warned area also acted quickly. American Campground, at Exit 24 of the Northway, very near the site of the washout, evacuated 70 motor homes, travel trailers and campers from the beach area of the Schroon River to higher ground immediately upon receiving the 5:20 p.m. Flash Flood Warning. According to the camp manager, "When we heard the NOAA Weather Radio tone alert for the Flash Flood Warning, we had all the beachfront units move to higher ground". The beach and campsites were all washed out by the Schroon River flooding.

ATMOSPHERIC PRESSURE CHANGES INFLUENCE FISH FEEDING ACTIVITY?

Kurt Hemmerich
Senior Forecaster, NWS Albany
[Fall 1996]

I've been an avid fisherman longer than the 29 years I've been a professional meteorologist, and I've tried to relate what I know about the atmospheric science to my hobby. I've read extensively about sport fishing, and was particularly interested in what various writers have said about the effect of weather on fish feeding activity. Various relationships have been examined. Some ring true, but others appear to be implausible.

Perhaps the most improbable theory is that atmospheric pressure changes affect fish feeding activity. This idea has been declared axiomatically. It states that fish feed more actively as a storm center or storm front approach because fish are organisms designed to feed voraciously when the atmospheric pressure is falling. Innumerable fishing outings have suggested otherwise. Contrarily, when a fair-weather maker brings relatively high atmospheric pressure, the fish go into a state of suspended animation and feeding ceases. Once again, there are plenty of exceptions to relate.

There's no way of proving the case one way or the other, so it remains in the realm of opinion. However, when one considers some basic hydrostatic principles of fluids, it becomes very reasonable to believe that fish are not sensitive enough to be able to detect the relatively minuscule pressure changes of the atmosphere when compared to the relatively great pressure that exists in their aqueous environment.

This is apparent when one considers the relative density of the two fluids under consideration. Air is only about eight one thousandths s dense as water. To illustrate the effect this density difference has on the pressure exerted by the fluids, consider this. The weight of a column of air one square inch across by 20 miles in height (roughly the total depth of the atmosphere) averages to be 14.7 pounds. Another way of putting it, is the atmospheric pressure at the earth's surface under standard conditions of temperature and moisture is 14.7 pounds per square inch. Which is equivalent to your barometer reading slightly below 30 inches of mercury. What does the 30 inches represent?

You could look at it this way. Say you have an old fashioned balance scale with its 2 pans attached to the horizontal balance arm. If you were able to put all the atmosphere contained in a one square inch column of air that extended from the earth's surface to the top of atmosphere in one pan of the scale, you would have to put a one square inch column of mercury that was 30 inches high in the other pan in order to bring the two pans of the scale to the same height, i.e., become balanced. Now if we were to replace the mercury with water, how much would be needed to balance the air in the other pan? Ignoring the variations of density with depth and temperature, you'd need 36 feet or water in a column one square inch across, or about the depth I fish for large yellow perch and big bluegills most of the year. At 36 feet the pressure, or weight per square inch, is the weight of the matter above the fish. This would be the summation of the atmosphere's weight and that of the water -- two standard atmosphere's of pressure, or about 29 pounds per square inch.

Now let's examine the magnitude of a typical atmospheric pressure change. Excluding the effect of the usual diurnal changes in pressure, a vigorous storm system would drop the pressure at a given location about five one hundredths of an inch per hour. A real whopper of a storm might decrease it by a tenth of an inch per hour. This is roughly three hundredths or (0.3%) of the total weight of the atmosphere in an hour. Now consider this. Those panfish are down at 2 standard atmosphere's of pressure where the change of the atmospheric pressure relative to the total pressure on the fish is only fifteen hundredths or (0.15%) of a standard atmosphere in an hour.

Can fish detect such small differences in environmental pressure? Fish are highly sensitive organisms in some respects. They have the proper degree of sensitivity to survive in a very competitive environment. They can feel vibrations made by objects moving through the water which can be translated into a kind of "vision." From the vibrations they can determine the size and shape of the object making the vibrations, as well as its direction and speed of travel. Some fish have supersensitive olfactory organs. Others have very keen vision. But it seems unlikely that they can detect such small pressure differences as occur in the atmosphere, even those associated with powerful storms.

Even if fish could distinguish a falling barometer from a rising one, what would it mean to them, and why? What's the logic between a falling barometer and the need to eat? What's the logic of fish gorging themselves before a storm, and sleeping during halcyon conditions? It's more reasonable to assume that pressure is only an indirect factor associated with the more direct causative features inherent with the storm conditions. The most obvious direct factor associated with a storm would be visibility changes brought on by changing light intensity and a roiled water surface. Precipitation not only would dimple the water's surface decreasing light penetration, but would increase the runoff of water-carrying debris, clouding the lake or pond.

Fish usually feed most heavily under changing light conditions because a fish's eyes seem to need time to adapt to the change. This changeability leaves aquatic prey more vulnerable than when light conditions are stable, and giving the preying game fish a distinct advantage.

Rapidly changing air temperatures associated with a storm has a slight effect on the surface temperature of large bodies of water, but probably not enough to effect the feeding habits of fish. Most of the time fish feed below the surface, and usually several feet below it. Strongly acidic heavy rain could also decrease the pH of the water. However, this is likely to affect only the top few feet of water initially, and as it mixed through a deeper layer, its effect would greatly diminish. If acid rain was a factor at all, it would be most likely have a negative effect on fish feeding in shallow water.

So what can be concluded from all of this? Probably nothing with great certainty. There's plenty of room for opinion here, because unless a person can become a fish and then relate their experience to us, there's no way we could know for sure. Obviously we can neither see, smell, feel, hear, or get headaches from changing pressure like a fish. But, based on what seems reasonable given the hydrostatic properties of the fluids, water and air, it's my opinion that neither the barometer reading, nor it's changes has anything to do directly with a fish's feeding activity. However, although probably not a direct causative factor, pressure change might be used as a gauge of potential feeding activity since it is often associated with other factors that directly influence a fish's feeding behavior.

ADVANCED HYDROLOGIC PREDICTION SERVICES

Steve DiRienzo
Senior Service Hydrologist, NWS Albany
[Fall 2003]

Advanced Hydrologic Prediction Services (AHPS) are a new and essential component of the National Weather Service’s Climate, Water, and Weather Services. AHPS is a web-based suite of accurate and information-rich forecast products. They display the magnitude and uncertainty of occurrence of floods or droughts, from hours to days and months, in advance. These graphical products are useful information and planning tools for many economic and emergency managers. These new products will enable government agencies, private institutions, and individuals to make more informed, risk based, decisions about policies and actions to mitigate the dangers posed by floods and droughts.

Why AHPS? Weather influences our economic and social lives in many ways. Severe weather can impact revenues and profits of businesses, large and small. Weather can also disrupt and disorganize communities. As our nation's population grows and infrastructure costs increase, natural disasters can threaten social stability. Weather forecasting was initially developed in response to the need of societies to protect themselves from storms, severe heat and cold, floods, etc., and minimize consequent economic losses. It is estimated that inland flooding claims 133 lives, and property losses from flooding exceed $4 billion in an average year in the U.S. The National Weather Service (NWS) is our nation's agency entrusted with the mission to protect life and property, and to enhance the economy.

Who Can Use AHPS? AHPS forecast products are a basis for operation and management of flood-control structures. Emergency management officials at local and state levels use these forecasts to fight floods, evacuate residents, and to take other measures to mitigate the impact of flooding. As the population grows, people increasingly choose to live near water, creating an increased need for the NWS to educate the public about flood hazards, and improve flood forecasts. These products can be used by a wide range of people, such as barge operators, power companies, recreational users, farmers, households, businesses and environmental scientists.

Visit our AHPS Site. Advanced Hydrologic Prediction Service data may be obtained on-line. We would also appreciate your feedback on these new AHPS forecast products. Let us know if they were helpful to you. What can we do to make them better?

We are committed to working closely with our partners and customers to ensure their hydrologic information needs are met. Find out more about AHPS. Additional information on the Advanced Hydrologic Prediction Service may be obtained on-line at http://www.nws.noaa.gov/oh/ahps/ or, drop me an e-mail at: stephen.dirienzo@noaa.gov

TORNADO ALLEY OF THE NORTHEAST?

John Quinlan
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[Spring 1998]

Two major tornado outbreaks occurred across the Taconics of New York and the Berkshires of Massachusetts during the last three years (May 29, 1995 and July 3, 1997). The magnitude of these tornadoes (most F2-F4) makes one wonder if there is a scientific explanation to answer the question "Why did the tornadoes strike the Taconics and Berkshires?" To answer this question one must first look at the tornado climatology of the area to see if these tornadoes were unprecedented in the Taconics and Berkshires. In his book "Significant Tornadoes 1680-1991", Tom Grazulis lists the following tornadoes as having occurred in the Taconics or Berkshires (Note: the information for the tornadoes of May 29, 1995 and July 3, 1997 is from the Publication Storm Data):

Date m/dd/year	Time (est)	Fujita Scale	Location
5/23/1782	1200	?	Berkshire County
6/30/1819	?	?	Berkshire County
7/08/1821	?	?	Columbia County
			Berkshire County
8/14/1834	?	?	Berkshire County
6/16/1867	?	?	Columbia County
7/16/1877	?	F1	Columbia County
7/16/1879	1430	F2	Berkshire County
7/02/1883	1700	F2	Berkshire County
6/11/1922	?	F2	Berkshire County
8/28/1973	1300	F4	Columbia County
	1320		Berkshire County
5/29/1995	1740	F2	Columbia County
	1824	F4	Berkshire County
7/03/1997	1623	F1	Columbia County
7/03/1997	1636	F1	Berkshire County
7/03/1997	1705	F2	Berkshire County
7/03/1997	1711	F2	Berkshire County
7/03/1997	1817	F1	Columbia County
7/03/1997	1820	F2	Columbia County
	1824	F1	Berkshire County

*Note: While this list includes many tornadoes, it is far from a complete list of all tornadoes for the two counties.

The West Stockbridge Tornado (August 28, 1973) was the first F4 New England Tornado since the Worcester Tornado of June 9, 1953 which ranks as the most devastating New England Tornado. The Worcester Tornado had a path length of 46 miles and a path width of 1000 yards. It lasted for 84 minutes, killing 94 people and injuring 1288. The damage total was in excess of 52 million dollars. There have been a total of five F4 Tornadoes in New England and two of those have occurred in Berkshire County (August 28, 1973 and May 29, 1995).

An Analysis of the Great Barrington Tornado by Bosart et al. (1996) provides some answers which suggests that the Taconics and Berkshires may indeed be a favored area for tornadoes. First the north-south oriented river valleys in eastern New York (Hudson Valley) and western Massachusetts (Housatonic Valley) channel southerly flow which provides the necessary wind shear to sustain tornadic development. In addition, tornado genesis and mesocyclone intensification is enhanced by the cyclonic shear created as a result of northwesterly flow off the Catskill Mountains which encounters the terrain channeled southerly flow in the Hudson Valley. Several other factors may also play a significant role and those are the terrain channeling of low level moisture which results in dew point pooling in the Hudson Valley and Housatonic Valley and Upslope Flow which occurs as the thunderstorms cross the Taconic Ridge and again as they move into the Berkshires.

OVERDUE FOR A SIGNIFICANT ICE JAM SEASON?

Bob Kilpatrick
Hydrometeorologist, NWS Albany
[Winter 2002-03]

The last three winters have been abnormally warm and rather uneventful as far as river ice was concerned. While ice is a fact of life in this area, the problems caused by river ice vary from year to year, with our fall and winter weather the biggest factor.

Last winter, temperatures from December through February averaged almost 8 degrees above normal at Albany. The average temperature for January 2002 was 31.3 degrees while February averaged 31.6 degrees, just barely below freezing. Therefore, not much ice formed in the rivers last winter.

December 2000 was cold, averaging 22 degrees at Albany or about 4 degrees below normal. But, heavy rain in the middle of the month flushed out any ice that had formed, and much of the cold came later in the month followed quickly by temperatures several degrees warmer than normal in January and February.

What were some "bad" years? Looking into the history books, the following months were noteworthy: January and February 1976; March 1979; February 1981; February 1988; March 1993; and January 1997.

The weather in several of those winters followed a characteristic pattern for an active ice-jam season. First, there was a period of prolonged, bitter cold. For example in the winter of 1976, temperatures in early January, normally the coldest time of the year, averaged 10 degrees below normal. In the winter of 1979, temperatures early in February were much below normal, and remained below normal through late February. In the winter of 1980-81 temperatures in early January were 15 degrees below normal. For the second part of the pattern, the period of cold was followed by an abrupt change to warm weather, along with a good dose of rain and temperatures that briefly climbed well above freezing. This melted off at least part of the snow pack, and sent a surge of water into the rivers. As water levels in the rivers came up, the ice was floated off and moved down-river to the first obstruction, such as thick ice behind a dam, a shallow wide section, a bend, or an island or two. There the ice stopped, and piled up, creating a jam or blockade.

So how does that pattern fit with this winter? First of all, statistically, we're overdue. We haven't had a real bitter, sub-zero period of weather for several years. Also, the weather pattern for the last two months suggest that something might happen this winter. Consider that temperatures for the last half of November averaged 1.5 degrees below normal, and temperatures for the first 10 days of December have averaged nearly ten degrees below normal!

You can help us. First of all, if you find out from someone (such as an ice fisherman) how thick the ice on a river or lake is, please let us know about it. Even if you don't know how thick it is, it is also helpful to let us know how much of a river is ice covered, especially when ice covers parts of rivers that are normally free-flowing. Finally, if you see water backing up behind ice or overflowing the normal riverbank, that may imply an ice jam. It may be around a bend where you can't see it, but please notify us anyway. For direct reports via the internet go to http://cstar.cestm.albany.edu:7775/Hydrology/hyd_forms/ICE_REPORT.htm. Or call our 800 number.

SPRING AND SEVERE WEATHER: RIGHT AROUND THE CORNER

Hugh W. Johnson IV
Meteorologist, NWS Albany
[Spring 2004]

By the time you read this edition of StormBuster, chances are you will be putting your shovels and snow blowers away, and thinking about replacing them with rakes and mowers. Spring will be blossoming with its warmer, longer days...with blooming crocuses, and the increasing prevalence of thunderstorms. Now is a good time to review your warm season safety rules regarding severe weather? While thunderstorms have occurred during each of the 12 months, they become more frequent as we head later into spring, and especially, summer. Some of these storms become severe. Severe thunderstorms are those that produce wind gusts in excess of 57 mph and/or hail the diameter of a dime or greater. They can spawn tornadoes. On average, about 100 severe thunderstorm events occur throughout our 19-county warning area each year. Most years, several tornadoes touch down in our region. 1999 was the last year without any tornadoes reported. Last year, we had several significant tornado touchdowns in Greene County of eastern New York, which continued northeast across the Mid Hudson Valley, Taconics and southern Vermont, destroying many homes. Luckily, no lives were lost.

When atmospheric conditions appear conducive to the development of either severe thunderstorms or tornadoes, the National Weather Service will issue either a Severe Thunderstorm Watch or Tornado Watch. A watch means there is the potential for such weather, and it usually covers many counties. A Severe Thunderstorm Warning or Tornado Warning is issued when: there is a strong indication that a severe thunderstorm or tornado is or might be occurring, or is imminent, as indicated by radar signatures, or; if one is reported, possibly by you! Warnings are issued by county, and they can be issued with or without a watch being in effect.

If a watch is issued for your region, you can generally go about your business, but keep a watchful eye to the sky, and be prepared for the possibility of a rapid onset of threatening weather. Better yet, have a NOAA Weather Radio with a built-in alarm, as well as SAME coding that can differentiate warnings for particular counties, or have a cell phone. If a Severe Thunderstorm or Tornado Warning is issued for your locality, take shelter at once in a sturdy building, not a mobile home. You need to evacuate a mobile home during a tornado warning, and have a plan in place that takes you to a place of shelter. Once inside a sturdy building, head for the interior, away from windows. If you have a basement, go to it. Never try to outdrive a tornado. If caught out on the road near a tornado, abandon any vehicle and lie down flat in a ditch.

As a Weather Spotter, you are strongly encouraged to report anything which may indicate the presence of severe weather, including high winds, rotating wall clouds, funnel clouds, or hail of any size. Of course, never place yourself in jeopardy by making a phone call to the National Weather Service if your life may be on the line. Your own safety should be your primary concern.

Remember that lightning actually kills more people than tornadoes. Whenever you suspect a thunderstorm is near, severe or not, it is best to get inside. Lightning can strike as far as 10 miles away from its parent cloud. If you are outdoors and see any threatening weather near the horizon, please do not wait to hear the thunder or see the lightning. Assume the worst, and postpone that tennis or golf game until a later time. Once inside, it is best to not use the phone or any electrical devices. It is also not completely safe to shower during a thunderstorm, as electric currents can enter a home and travel through water.

Another product of some thunderstorms is flash flooding. The heaviest rainfall rates are usually associated with thunderstorms. Rain can fall heavily enough to swell a trickling stream in minutes, turning it into a wild and lethal torrent. If you live near a small stream or any flood prone area, have a plan to quickly get to higher ground. Last year, 35 flash flood events took place across our county warning area. NEVER attempt to drive through a flooded roadway. As little as six inches of running water can be enough to sweep a car off a road and down a stream or river. By that point, the odds of your surviving are slim.

HALOS, SUN DOGS AND SUN PILLARS

Thomas A. Wasula
Meteorologist, NWS Albany
and
Evan L. Heller
Meteorologist, NWS Albany
[Spring 2005]

Optical phenomena involving the sun can be seen on any given day under the right atmospheric conditions. The rainbow is probably the most spectacular and familiar of these phenomena. However, three other types of interesting optical phenomena are encountered from time-to-time. These are halos, sun dogs and sun pillars.

Halos are quite commonly, but rarely noticed by the casual observer. A halo appears as a narrow white ring having a circle centered around the sun. Halos frequently occur on days when the sky is covered with a thin layer of high-level clouds. This particular phenomenon is best viewed in the early morning just after sunrise, or the late afternoon near dusk, when the sun is near the horizon. Halos occur more often at higher latitudes, where low sun angles and cirrus clouds are more common. Sometimes halos can be seen around the moon.

The two most common types of halos are the 22º and the 46º. The 22º halos are the most common, with the ring having a radius of 22º from the midpoint of the sun, as viewed by the observer. The halo is generated as a result of the dispersion of sunlight, much like a rainbow.

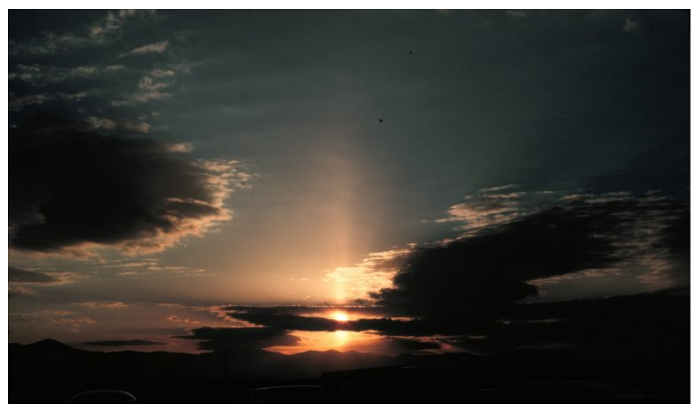
Dispersion is the separation of colors by refraction (the bending of visible light). Ice crystals in the atmosphere are what refracts the light to create the halo, not water droplets, like for a rainbow. The cloud types most frequently associated with halos are common cirrus and cirrostratus. These clouds typically occur in association with fronts and cyclonic storms. Therefore, halos around the sun or moon tend to be at least indirectly associated with foul, or unsettled, weather.

There are four basic types of ice crystals that help form halos: plates; columns; bullets, and; capped columns. These crystals are all hexagonal, or six-sided, and therefore similar to snowflakes. The randomness of these ice crystals within the clouds is what is needed to form the halos. With this arrangement, the sunlight strikes the surfaces of the different crystals at varying angles, and the dispersed light is therefore scattered at varying angles and intensities. But with the sun being at virtually the same angle from the perspective of all of the ice crystals, the randomness of the refracted light is more "focused", with a large portion of the scattered light favoring refraction in one direction over another. As an example, with a six-sided ice crystal, the angle of maximum scattering will be 22º for producing the 22º halo. What decides whether a halo is a 22º or a 46º halo is the ice crystal type, structure and orientation within the clouds, and the path that the visible light takes through these ice crystals. The radius of a 46º halo is 24 degrees greater than the radius of a 22º halo. Therefore, a 46º halo is 48 degrees wider (the radius difference on both sides of the sun) than a 22º halo. Halos are usually whitish in color. The white color is what's usually produced by ice crystals, due to their imperfect size and shape, and thus their imperfect light refracting. Rain droplets, being purer in size and shape, act as prisms, producing a rainbow, with its various colors.

Sun dogs are a beautiful sub-phenomenon accompanying some 22º halos. A sun dog consists of two brighter spots of light, sometimes called 'mock suns', that are situated on the halo ring on either side of the sun, exactly opposite one another, and at the same exact distance above the horizon. Another name for sun dogs is 'parhelia'. Like halos themselves, sun dogs also are produced by the dispersion of sunlight by the ice crystals of cirrus clouds. The formation of the sun dogs within halos relies on the ice crystals being numerous and vertically oriented. These ice crystals need to be descending slowly, thereby increasing, very slightly, the apparent angle of their refraction of the sun's light rays at any given moment during the event, to make the sun dogs appear to be slightly greater than 22º from the sun. The ideal set-up for sun dogs is to have the sun be low on the horizon, so that the impact angle of the sun's rays is perpendicular to the vertical crystal faces within the clouds.

The sun pillar is yet another optical phenomenon related to the halo. Sun pillars are vertical columns of light seen typically near sunrise or sunset, appearing to extend directly upward from the sun. These brilliant pillars of light are produced when sunlight is reflected from ice crystals in the form of falling plates and capped columns. These two ice crystal types are oriented vertically. The pillars are usually reddish in color, since direct sunlight is often of this color when the sun is low on the horizon. Sometimes, pillars can also be seen extending below the sun.

The pictures that follow are of a halo with sun dogs, and a sun pillar. So to witness something different, be on the lookout for these optical phenomena in the future. They can be seen in the Northeast from time to time.



Source: DOC, NOAA

STORMBUSTER PRESENT

FALL 2005: WET, WARM AND…UM, DID I MENTION WET?

Evan L. Heller
Climatologist, NWS Albany

Precipitation-wise, the season didn't quite begin with a bang here in Albany, New York. The month of September was actually more notable for being a warm, and somewhat dry month. The average temperature of 66.2º was a whopping 5.6º above normal, and the month came within only 0.7º of cracking the Top Ten list of Warmest Septembers, and is the warmest September since 1961. Rainfall for the month, however, totaled just 2.20", about one third less than the normal 3.31".

The average high temperature for the month was 77.4º, which was 6.1º above normal, and the average low was 54.9º, 5.0º above normal. The warm reading for the month was 90º, and this occurred on the 13th. The low reading for the month was 41º, on the 30th. The high mean temperature was 77º, on the 14th, while the low mean was 52.5º, on the 30th. The low maximum temperature for September occurred on the 30th, when the mercury reached only 64º, and the high minimum was 67º, on the 15th. Interestingly, even though September was way above normal in Albany, there were no new temperature records of any kind established. Perhaps this is because only about three days were more than 10 degrees above normal, with the balance of the month being between a few degrees below and 10 degrees above normal.

With a lackluster showing in the area of precipitation, the month of September produced no new records of any kind. There was a trace or more of precipitation on seven days during September, on six of which it was measurable. A tenth of an inch or more fell on five of those days, with 0.25" or more on three of these. Of the two days that produced a half an inch or more, the 26th provided the most…0.89 inches. The month gave Albany thunderstorms on the 14th and 15th, and dense fog on the 6th, 15th, 16th and 19th. There were 25 clear days, with only 2 partly cloudy, and 3 cloudy ones. The peak wind for the month was 44 mph, from the south-southeast on the windiest day overall, the 29th. The average wind speed for the day was 15.6 mph. The high winds across the area downed tree limbs and power lines. At the other end of the spectrum, the calmest day was the 7th, with an average wind speed of only 1.0 mph.

October 2005 became the wettest October in Albany National Weather Service history (back to 1874), the 2nd wettest since the beginning of record-keeping, and the 2nd wettest month of all-time, with its whopping 9.00" total. Only September 1999, highlighted by the remnants of Hurricane Floyd, was wetter. The month's 9.00" total was almost triple (5.77" greater than) the 3.23" normal. One would have to travel back almost to the Civil War to find a wetter October, and it was far wetter! The one in 1869 produced 13.48". Three non-consecutive days during this past October made up more than half of the month's total rainfall, each producing greater than an inch. But it was the day on which the month's one new daily record amount was established that produced the most, more than the other two days combined. The 2.63" total realized on the 8th from the remnants of Florida-originated Tropical Storm Tammy broke the previous record for the date of 1.67", which had stood since 1903. Precipitation actually occurred during only half the days of the month (16), on 15 of which it was measurable. A tenth of an inch or more fell on 12 days, 0.25" or more on 9 of these, and 0.50" or more on 6 of those. Just a tiny fraction of October's precipitation came in the form of snow. The 0.1" total was half of the normal 0.2" for October. Despite this miniscule amount, being that it was still only October, trace amounts having fallen on two days resulted in ties with existing daily records. A trace on the opening day of this year's snow season, the 22nd, tied the 2002 record, and a trace on the 25th tied one from 1962. The 0.1" fell on the 23rd, with yet another trace on the 26th.

The average temperature for October 2005 was still above normal, but only by about half what September was. There was also less of a balance between the average high and average low. The average high for October was 60.2º, only 0.5º above normal, while the average low of 44.2º was 5.4º above normal. This resulted in a monthly mean of 52.2º, which was 2.9º above normal. The warmest day in October was the 7th, with a mean of 73.5º, and Albany did mange to eke out two daily temperature records for the date, one for high mean, and one for high minimum, both on the 7th. The 73.5º mean broke the 72.5º record from 1963, while the high minimum of 69º broke the record from 1900 by 7 degrees. The high reading for the month was 80º, on the 6th, and the low, 31º, was on the 31st. The coldest day in October was the 27th, with a mean of 38.5º. It was also the date of the month's low maximum temperature reading of 43º

October provided Albany with a much needed break from thunderstorms, and dense fog, too. However, some wintry sleet fell on the 22nd. There were 10 clear, 5 partly cloudy and 16 cloudy days. The peak wind for the month was 46 mph, from the west-northwest on the 16th. It was also the windiest day, with an average wind speed of 21.0 mph. The calmest day was the 2nd, with an average wind speed of just 0.3 mph.

November was only slightly more above normal for temperature than October was, and while considerably drier than October, it was still wet enough to crack the Top Ten list again. The wetness continued in Albany, with 5.71" received for the month. This makes November 2005 the 4th wettest November since the beginning of the National Weather Service, the 5th wettest on record, yet only the 94th wettest month of all-time, in Albany. The wettest November is 1972, with 8.07". Precipitation fell during 18 days in November, on 14 of which it was measurable. A tenth of an inch or more fell on 8 days, with 0.25" or more on 6 of these, and 0.50" or more on 4 of those. Precipitation of an inch or greater fell on three days, the greatest daily amount of which established a new record. This occurred on the very last day of the climatological season. The 1.37" that fell on the 30th broke the daily record of 0.97", standing since 1923. Because November was another warm month, little of the month's water yield was condensed out in the form of snow…just 1.8". A trace or more of snow fell during 7 days of the month, on only 4 of which it was measurable, the greatest amount having fallen on the 24th, when there was 0.9" of the white stuff.

The average high temperature in Albany for November was 52.6º, 5.1º above normal, the average low, 32.1º, 1.3º above normal. This provided for a monthly mean of 42.4º, 3.2º above normal. The warm reading for November was 72º, on the 5th. But it was the high of 66º on the 29th that established a new daily record, breaking the 1941 record for the date by 5 degrees. The low reading for November was 17º, on both the 25th and 26th. The 5th and 29th tied for warmest day, each with a daily mean of 61.0º. The one for the 29th established a new record, breaking the 1934 record of 56.5º. Meanwhile, the 26th was the coldest day all by itself, with a mean of just 23.0º. Indeed, a brief deep-freeze occurred on the 26th, the date of the month's low maximum reading. The mercury failed to climb above the freezing mark that day, with a high of just 29º. The high minimum was 56º, on the 29th, and established the third and final daily temperature record for that day. This rounded out the season's new records. The previous high minimum of 53º was also from 1934.

November provided Albany with two days of thunderstorms, not especially common so late in the season. The days were the 6th and the 9th. Dense fog, and blowing snow, too, occurred on the 24th. There were 16 clear, 6 partly cloudy and 8 cloudy days in November. In an exact repeat of September, the peak wind for November was also 44 mph, from the south-southeast on the windiest day overall, the 29th…sound familiar? The average wind speed was close, too…15.2 mph. The calmest day this time was the 27th, with a 2.1 mph average speed.

Summing up the season, the average temperature of Autumn 2005 was 53.6º. It misses being one of Albany's ten warmest autumns by just one position. The average high was 63.4º, and the average low was 43.7º Now here's the topper…all three of these figures are 3.9º above their respective normal values. The seasonal precipitation total of 16.91" makes the Fall of 2005 the 2nd wettest since the beginning of records, and the wettest since 1874. Only 1869 was a wetter autumn, with a total of 18.39". And the total snow of 1.9" was 3.4" shy of what's normal.

KEN LAPENTA, STORMBUSTER WEBMASTER, AND GREG GERWITZ, RETIRE

Kenneth D. LaPenta, Senior Forecaster here at the Forecast Office in Albany, and long-time meteorologist with the National Weather Service, has decided to call it a career. In addition to his duties as forecaster, Ken has performed as a major atmospheric sciences researcher, and has kindly contributed to StormBuster based on his efforts over the years. Two of his articles, most recently, his article on the 2005 hurricane season, are highlighted in this issue. During the past few years, Ken has done an outstanding job of getting Northeastern StormBuster out on the world-wide web.

Gregory Gerwitz will be joining Ken on the retirement bandwagon. Greg has been a Senior Forecaster at Albany for the past three years, and is also a long-time meteorologist with the Weather Service, also having spent many years at the Albany office.

We hate to see them go, but we realize that they will begin living more comfortable, and more stress-free lives. We wish both Greg and Ken all the best in their new careers as retirees at the start of the new year. They will be missed.

WCM Words

Ray O'Keefe
NWS Albany Warning Coordination Meteorologist

Congratulations to our Editor, Evan Heller, for a great job in putting this Anniversary edition together. Nice job Evan! It's interesting to me that although I've only been here about 20 months, nine of the top 20 articles have been published while I've been here. I'm not sure if the weather's getting worse, or more interesting. In any case some great reading in this edition of StormBuster.

I too would like to add my congratulations to Ken and Greg on their retirement. They will be missed not only for their knowledge and leadership, but also for their humanity. Best wishes gentlemen.

Our winter weather has begun. Just a reminder to our spotters to get your snowfall (and ice...and rainfall) reports in to us. We (and our friends in the media) rely on these reports a great deal.

From the Editor's Desk

With this special issue, we introduce a new look that we hope will appeal to an ever-expanding base of readers as we head into our next 10 years. I have enjoyed working on Northeastern StormBuster and its improvements during my two years as its editor, and I look forward to bringing you future installments. We hope you enjoy the best StormBuster has to offer in this issue, and we look forward to offering more quality reading in the issues to come. We here at Northeastern StormBuster wish you a joyous holiday season. We'll see you again when the snow begins to melt.