SKYWARNEWS

National Weather Service State College, PA - Spring 2006

*"Working Together To Save Lives"*

## New Radar Displays on the Webpage!

**By Michael Dangelo, NWS CTP Webmaster**

Many of you have been to our website (http://weather.gov/statecollege), and lots of you have mentioned the new radar displays. Thank you for all of your comments and suggestions. I will pass them along to the headquarters folks who create those displays.

There are many new features available, and I thought I could highlight some of them.

"KCCX" is the identifier for the Central PA WSR-88D Radar. KCCX is located in northern Centre County near Black Moshannon State Park, and operated and maintained by the staff at WFO CTP. See our "All Local Radars" page (http://www.erh.noaa.gov/ctp/radar.php) for more info on the 88D and some pictures of the site (from a tour that was done many years ago for a PSU radar class). A link to the radar Status Message is also available from this page. We issue Status Messages when the radar is having maintenance performed on it, or is not available for some reason.

Links to images produced by KCCX, as well as the new regional and national mosaics are available from the dark blue left-hand menu common to all of our pages. The mosaics are a really nice feature, as the radar echoes from all the radars in a wide area are combined into one picture. The regional mosaics cover about a dozen states each, and the national one covers the lower 48 states. These mosaic images can also be looped! There are even two different sizes/resolutions of the national mosaic and loops.

There is both an "Enhanced" version of the individual radar displays, and a "Standard" version of the displays. The Enhanced displays are for those with high-bandwidth internet connections (cable/DSL), while the Standard displays are better for low-bandwidth (dial-up) users.

The Enhanced display allows you to toggle on and off some useful overlays of local warnings, a topographic background image, a legend, and various maps. The Standard display is on a white background, which was found to be easier to print out. Both versions of the display have looping capabilities. Look for links on the top left of the radar pages to switch between the Standard and Enhanced versions.

Using either the Enhanced or the Standard display, you can now view echo Velocity information - which is the biggest benefit of having a Doppler radar system. It shows the speed and direction of the echoes with respect to the radar – "Are the echoes moving toward or away from the radar?" Red colors indicate that the echo is moving away from the radar site, and green shades indicate that the echo is moving toward the radar site. The Storm Relative Velocity information may be rather difficult for the average person to interpret, but can show meteorologists the wind movement inside individual thunderstorms – which can lead to better warnings.

You can also now view the Rainfall Estimates produced by the radar for the past hour and for a storm-total. These estimates can be useful to see how much rain you can expect (from a storm moving toward your area), or how much rain you have received recently.

Enjoy the new radar displays!

## The "What" and "Why" of Droughts in Pennsylvania

**By Peter Jung, Service Hydrologist**

After a very wet Fall of 2005, complete with river and stream flooding, the Winter and Spring of 2006 were very dry over much of Pennsylvania. The general lack of wintertime snow, and light springtime rainfall, have caused river levels, ground water levels, and soil moisture to drop. This prompted the issuance of a Drought Watch for the entire Commonwealth of Pennsylvania on April 11, 2006.

For some background information, a Drought Watch is issued by the Secretary of Pennsylvania's Department of Environmental Protection (DEP). A Watch calls for a voluntary 5% reduction in water usage. A Drought Warning, the second level of drought severity, is also issued by the DEP Secretary, and calls for a voluntary 10-15% reduction in water usage. A Drought Emergency, the most severe state of drought status, is declared by the Governor of Pennsylvania. It includes bans on non-essential water use, and local water rationing plans. Some bans include (but with some exceptions via a variance process) watering grass, watering athletic fields, irrigating trees and landscaped areas, irrigating golf courses without an emergency operations plan, washing paved surfaces, using water for ornamental purposes, washing mobile equipment (e.g. cars) serving water in restaurants except when requested, filling or topping pools, using water from fire hydrants except to fight fires. Full regulations can be found on the DEP web page at: http://www.dep.state.pa.us/dep/subject/hotopics/drought/drought_regs.htm which link to applicable chapters in the Pennsylvania Code.

Drought declarations in Pennsylvania are based on 4 criteria: Precipitation, Stream-Flow, Ground Water and Soil Moisture.

- Precipitation - How far is recent and historical precipitation (both rain and snow) above or below normal? A sliding scale based on the time frame being reviewed is used to assess these criteria. NOAA's NWS is the primary agency that tracks this element.
- Stream-Flow - How do current river levels compare to long term averages? The USGS is the

primary agency that measures river levels.

- Ground Water - How are water levels in ground water monitoring wells compared to seasonal long-term normals? The USGS again is the primary agency that measures levels in these wells.
- Soil Moisture - What is the overall long-term soil moisture indicator? NOAA’s NWS computes and publishes a weekly Palmer Drought Severity Index which takes into account a number of meteorological and hydrological factors.

The DEP is the agency that examines and assesses these criteria, consults other participating agencies, and ultimately makes declarations (or recommendations in case of Drought Emergencies) for the Commonwealth.

For now, Precipitation, Stream Flow and Ground Water are all below average, while soil moisture is near normal over most of Pennsylvania. The amount of rainfall which eventually falls during the late Spring and Summer will certainly affect the Drought status in Pennsylvania. The latest Drought Statement for Central Pennsylvania issued on the second and fourth Wednesdays of the month, can be found on web at: weather.gov/statecollege.

## The Record Setting 2005 Hurricane Season

**By John La Corte, Senior Forecaster**

By all accounts the 2005 hurricane season will go down in the books as the most active in history. Twenty-eight (28) named tropical storms formed...breaking the old record of 21 set back in 1933. Fifteen (15) storms became hurricanes, breaking the old record of 12 set back in 1969. Seven of the hurricanes became major hurricanes, category three or higher on the Saffir-Simpson hurricane scale, including four, Emily, Katrina, Rita and Wilma which reached category 5 intensity. This is the first time since 1851 that four category 5 storms have been known to occur in one season.

This year the season got off to a furious and early start with the first storm, Arlene named on June 8th. The record setting season continued into July when 5 storms earned names. This was the most ever for the month since hurricanes started being tracked in the mid 1800’s. Combined with the 2 storms that formed in June, 2005 became the first year in history that so many storms had formed so early in the year.

When hurricane Dennis formed in July, it was the earliest storm to reach category 4 status in the Caribbean Sea (Saffir Simpson Hurricane scale, Table 1). It also was also the strongest hurricane to ever form so early in the season. Dennis moved over Cuba causing heavy damage and eventually made landfall on the Florida panhandle near Navarre Beach as a category 3 hurricane.

Before Dennis dissipated, it was followed by Emily, an even stronger storm. After forming east of Granada during the second week of the month, it moved steadily westward through the Caribbean briefly strengthening to

| Category | Damage |
|---|---|
| **1** | some damage to trees, shrubbery, and unanchored mobile homes |
| **2** | major damage to mobile homes; damage buildings' roofs, and blow trees down |
| **3** | destroy mobile homes; blow down large trees; damage small buildings |
| **4** | blow down all signs; damage roofs, windows, and doors; completely destroy mobile homes; lower floors of structures near shore are damaged by flooding |
| **5** | extensive damage to homes and industrial buildings; blow away small buildings; structures within 500 meters of shore on the lower floors which are less than 4.5 m (15 ft) above sea level are damaged |

**Table 1. Saffir Simpson Hurricane Scale**

category 5 status (the earliest category 5 storm ever) before slamming into the Yucatan Peninsula near Cozumel with 135 mph winds.

Several storms followed Emily that either stayed below hurricane strength or remained out over the open Atlantic, causing relatively few problems. Then in the third week of August Hurricane Katrina formed. It started as a tropical storm over the southern Bahamas and tracked southwestward across southern Florida as a category 1 hurricane late on August 25th. As Katrina entered the Gulf of Mexico, it strengthened steadily and by August 28th, it was a category 5 hurricane taking aim at the Louisiana-Mississippi coastline.

Katrina slammed ashore on the 29th and devastated the area in and around New Orleans. Katrina induced levee failures caused as much as 80% of New Orleans to flood. Up until that time, the peak intensity of 175 mph with a central pressure of 902 mb made Katrina the fourth most intense hurricane ever in the Atlantic basin.

It is estimated that Katrina caused around 1200 deaths in the United States, the deadliest hurricane since the Palm Beach-Lake Okeechobee hurricane in 1926. Causing 80 billion in damage and devastating the economy of New Orleans, this makes Katrina the most expensive storm in history.

The season remained active into the second week of September, but with storms of relatively little impact. Ophelia was the exception. It formed over the northern Bahamas and meandered slowly northward just off the Carolina coasts. It took until mid September to move away from the Mid Atlantic coast and head out into the north Atlantic. The slow movement just offshore, and the fact that it maintained category 1 strength for much of the time, helped cause nearly 2 billion dollars in damage and significant beach erosion from central Florida to the North Carolina coast.

Rita was the next storm of significance, forming just north of Hispaniola on September 18th. Rita moved westward through the southern Bahamas and Florida Keys, causing heavy damage along the way. After entering the southwestern Gulf of Mexico, Rita exploded from a category 2 hurricane to a category 5 in less than 24 hours with winds peaking out at near 175 mph early on September 22nd. With the central pressure dropping to 897 mb, Rita became the 3rd most intense tropical cyclone ever in the Atlantic basin.

Rita eventually made landfall as a category 3 hurricane near the border between Louisiana and Texas. Despite weakening from its former category 5 status, it was still a powerful hurricane when it hit the coast and caused renewed coastal flooding as far east as New Orleans, only a few weeks after the area was devastated by Katrina.

The record setting season would continue, with several storms preceding the strongest storm ever to form in the Atlantic, hurricane Wilma. Wilma formed over the central Caribbean Sea during the second week of October. It meandered southwest for a couple of days while strengthening slowly. Wilma became a hurricane on the 18th and began a remarkable intensification cycle that would prove to be record setting.

Wilma went from a 70 mph tropical storm to a category 5 hurricane in just 24 hours, unprecedented in the Atlantic basin! Wilma proved record setting in many regards. Besides deepening faster than any other storm on record, it also formed the smallest eye (2 nautical miles across) that has ever been observed by the National Hurricane Center. The 54 mb pressure drop between 00 and 06 UTC September 19 was the most ever in a 6 hour period. In addition, the 83 mb drop between 18 UTC on September 18 and 06 UTC September 19 set a 12 hour record for intensification. If that wasn't enough, the staggering 97 mb drop in the 24 hours between 12 UTC on the 18th and 12 UTC on September 19 also set a record.

In all, Wilma peaked with winds near 185 mph and a central pressure of 882 mb, the lowest ever recorded in the Atlantic basin.

The storm weakened slightly on the 20th and took aim at the Yucatan coastline. It eventually hit Cozumel on the 21st and early on the 22nd it made landfall over the northeastern coast of the Yucatan Peninsula before emerging over the Gulf of Mexico on the 23rd. From there Wilma accelerated toward southern Florida where it hit as a category 3 hurricane on October 24th. The storm would then race northeastward into the north Atlantic, bringing a close the worst of the 2005 Hurricane season.

While the worst was over, the season wasn't over yet. 4 more tropical storms and 2 more hurricanes would eventually form before the last storm dissipated during the first week of January. Storms Alpha, Beta, Gamma, Delta, Epsilon and Zeta marked the first time the Hurricane Center needed to use the Greek alphabet to name storms after running out of storms with names beginning with letters from the traditional alphabet.

For additional information on the hurricane season, visit the National Hurricane Center's web site at http://www.nhc.noaa.gov/2005atlan.shtml and http://www.nhc.noaa.gov/archive/2005/tws/index.shtml.

The table below summarizes all the storms that formed in 2005 and early 2006. A truly remarkable and record setting hurricane season!

| # | Name | Date | Wind | Pres | Cat |
|---|---|---|---|---|---|
| 1 | Tropical Storm ARLENE | 08-13 JUN | 60 | 30 | - |
| 2 | Tropical Storm BRET | 28-30 JUN | 35 | 1002 | - |
| 3 | Hurricane CINDY | 03-07 JUL | 65 | 992 | 1 |
| 4 | Hurricane DENNIS | 05-13 JUL | 130 | 930 | 4 |
| **5** | **Hurricane EMILY** | **11-21 JUL** | **160** | **929** | **5** |
| 6 | Tropical Storm FRANKLIN | 21-29 JUL | 60 | 997 | - |
| 7 | Tropical Storm GERT | 23-25 JUL | 40 | 1005 | - |
| 8 | Tropical Storm HARVEY | 02-08 AUG | 55 | 994 | - |
| 9 | Hurricane IRENE | 04-18 AUG | 85 | 975 | 2 |
| 10 | Tropical Depression TEN | 13-14 AUG | 30 | 1008 | - |
| 11 | Tropical Storm JOSE | 22-23 AUG | 45 | 1001 | - |
| **12** | **Hurricane KATRINA** | **23-31 AUG** | **150** | **902** | **5** |
| 13 | Tropical Storm LEE | 28 AUG-02 SEP | 35 | 1007 | - |
| 14 | Hurricane MARIA | 01-10 SEP | 100 | 960 | 3 |
| 15 | Hurricane NATE | 05-10 SEP | 80 | 979 | 1 |
| 16 | Hurricane OPHELIA | 06-18 SEP | 80 | 976 | 1 |
| 17 | Hurricane PHILIPPE | 17-24 SEP | 70 | 985 | 1 |
| **18** | **Hurricane RITA** | **18-26 SEP** | **150** | **897** | **5** |
| 19 | Hurricane STAN | 01-05 OCT | 70 | 979 | 1 |
| 20 | Tropical Storm TAMMY | 05-06 OCT | 45 | 30 | - |
| 21 | Hurricane VINCE | 09-11 OCT | 65 | 987 | 1 |
| **22** | **Hurricane WILMA** | **15-25 OCT** | **150** | **882** | **5** |
| 23 | Tropical Storm ALPHA | 22-24 OCT | 45 | 998 | - |
| 24 | Hurricane BETA | 27-31 OCT | 100 | 960 | 3 |
| 25 | Tropical Storm GAMMA | 18-21 NOV | 40 | 1004 | - |
| 26 | Tropical Storm DELTA | 23-28 NOV | 60 | 980 | - |
| 27 | Hurricane EPSILON | 29 NOV-08 DEC | 75 | 979 | 1 |
| 28 | Tropical Storm ZETA | 30 DEC-06 JAN | 55 | 994 | - |

**Table 2. Summary of 2005 Hurricane Season**

## Summer Swelter can be Downright Dangerous

**By Kevin Lipton, General Forecaster**

Although many people look forward to the hot, sultry days of summer, too much heat for an extended period of time can be downright dangerous – even deadly. This is particularly true for the elderly living in urbanized areas. The combination of heat and high humidity is especially hazardous, which makes the body difficult to cool, and places extra stress on the body's circulatory system – especially the heart.

Since 1995, heat has been the number one weather-related killer in the United States, with an average of 235 fatalities per year. In a 40-year period from 1936 to 1975, it is estimated that nearly 20,000 people in the United States succumbed to the effects of heat, with more than 1,250 people dying during just one year – 1980.  And these numbers may actually be underestimated – especially since many deaths may have been attributed to 'old age' or heart ailments – when in reality, the inability of the body to cool sufficiently may have been the true cause.

In Pennsylvania, 283 deaths have been attributed to heat between 1986 and 2000.  Only the state of Illinois surpassed this number of heat related deaths during this time.  The largest number of deaths occurred in major metropolitan areas – where the urban environment tends to retain the heat well into the night, leaving little opportunity for dwellings to cool.  In addition, these metropolitan areas also tend to have older populations, which are more susceptible to the ill effects of heat.  Also, the more densely populated urban areas tend to have a larger poor population, which may not have the added benefit of an air conditioning system.

Considering the staggering effects that heat can have on the human population, the National Weather Service has increased its awareness to more effectively alert the public and appropriate authorities to the dangers of heat waves.  One method involves the use of the Heat Index – which uses the combination of actual air temperature and relative humidity to produce an apparent temperature – or, in other words, an accurate measure of how hot it really feels when humidity values are considered in addition to the air temperature. By assessing the effects of heat and humidity on the human body, weather forecasters can then relay this information to the appropriate authorities to develop plans of mitigating the ill effects of heat on the public.

Below is a chart listing the heat indices.  Note how the heat index increases for a given temperature as the relative humidity increases.  For instance, for a given air temperature of 90 degrees, note how the heat index is 93 when the relative humidity is 45 percent, while for the same air temperature with a relative

Temperature (°F)

| Relative Humidity (%) | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 80 | 81 | 83 | 85 | 88 | 91 | 94 | 97 | 101 | 105 | 109 | 114 | 119 | 124 | 130 | 136 |
| 45 | 80 | 82 | 84 | 87 | 89 | 93 | 96 | 100 | 104 | 109 | 114 | 119 | 124 | 130 | 137 | |
| 50 | 81 | 83 | 85 | 88 | 91 | 95 | 99 | 103 | 108 | 113 | 118 | 124 | 131 | 137 | | |
| 55 | 81 | 84 | 86 | 89 | 93 | 97 | 101 | 106 | 112 | 117 | 124 | 130 | 137 | | | |
| 60 | 82 | 84 | 88 | 91 | 95 | 100 | 105 | 110 | 116 | 123 | 129 | 137 | | | | |
| 65 | 82 | 85 | 89 | 93 | 98 | 103 | 108 | 114 | 121 | 128 | 136 | | | | | |
| 70 | 83 | 86 | 90 | 95 | 100 | 105 | 112 | 119 | 126 | 134 | | | | | | |
| 75 | 84 | 88 | 92 | 97 | 103 | 109 | 116 | 124 | 132 | | | | | | | |
| 80 | 84 | 89 | 94 | 100 | 106 | 113 | 121 | 129 | | | | | | | | |
| 85 | 85 | 90 | 96 | 102 | 110 | 117 | 126 | 135 | | | | | | | | |
| 90 | 86 | 91 | 98 | 105 | 113 | 122 | 131 | | | | | | | | | |
| 95 | 86 | 93 | 100 | 108 | 117 | 127 | | | | | | | | | | |
| 100 | 87 | 95 | 103 | 112 | 121 | 132 | | | | | | | | | | |

**Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity**

Caution   Extreme Caution   Danger   Extreme Danger humidity of 55 percent, the heat index increases to 97 degrees. Thus – the higher the humidity for a given temperature, the higher the heat index. This makes sense for the human body, for when the humidity is higher, the cooling effect of sweat – the body's natural cooling mechanism – is diminished, since the evaporation of sweat is less when the humidity is higher. When the humidity is lower, then the sweat can evaporate much more efficiently and quickly – thus producing a cooling effect on the skin of the human body. This is indeed where the phrase "It's not the heat, but the humidity" comes from – in Arizona, when the air temperature is over 100 degrees, the relative humidity is often under 15 percent – creating a heat index nearly identical to, or even less than the actual air temperature. It should be noted that the heat indices listed below were devised for shady, light wind conditions. Exposure to full sunshine can actually increase these heat index values by up to 15 degrees F.

Here are some possible heat precautions, as listed by the National Weather Service, for people in higher risk groups:

**CAUTION**: Fatigue possible with prolonged exposure and/or physical activity.

**EXTREME CAUTION**: Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and/or physical activity.

**DANGER**: Sunstroke, heat cramps or heat exhaustion likely, and heatstroke possible with prolonged exposure and/or physical activity.

**EXTREME DANGER**: Heat stroke/sunstroke highly likely with continued exposure.

Here are some useful definitions, and actions to take regarding varying degrees of heat symptoms listed above:

**Heat Cramps**: Painful spasms usually in muscles of legs and abdomen possible; heavy sweating also occurs.

**First Aid Actions for Heat Cramps**:

1. Apply firm pressure on cramping muscles, or gentle massage to relive spasm.
2. Give sips of water. If nausea occurs, discontinue use.

**Heat Exhaustion:** Heavy sweating, weakness, skin cold, pale/clammy. Normal body temperature possible. Fainting and Vomiting.

**First Aid Actions for Heat Exhaustion:**

1. Get victim out of sun. Lay down and loosen clothing.
2. Apply wet, cool cloths.
3. Fan victim, or move victim to air-conditioned room.
4. Give victim sips of water. If nausea occurs, discontinue use. If vomiting continues, seek immediate medical attention.

**Heat Stroke (also known as Sunstroke):** High body temperature of 106 F or higher; hot, dry skin; Rapid and strong pulse; possible unconsciousness.

**First Aid Actions for Heat/Sunstroke:**

1. HEAT STROKE IS A MEDICAL EMERGENCY! SUMMON EMERGENCY MEDICAL ASSISTANCE OR GET THE VICTIM TO A HOSPTIAL IMMEDIATELY! DELAY CAN BE FATAL!
2. Move the victim to a cooler environment. Reduce the body temperature with a cold bath or sponging.
3. Remove clothing, and use fans and air conditioners.
4. If body temperature rises again, repeat steps 1-4. Do NOT give fluids. Persons on salt restrictive diets should consult a physician before increasing their salt intake.

Fortunately, there are ways to mitigate the worst effects of the heat, several of which are listed below.

**Heat Wave Safety Tips:**

1. **Slow Down**. Strenuous activities should be reduced, eliminated, or rescheduled to the cooler times of the day (such as the early morning, or evening hours). Individuals at risk, particularly the elderly, should stay in the coolest available place, not necessarily indoors.

2. **Dress for summer**. Wear lightweight, light-colored clothing. The light colors reflect heat and sunlight, helping your body maintain normal temperatures.

3. **Eat less**. Some foods, such as those rich in proteins, increase the body's heat production, and can also increase water loss.

4. **Drink plenty of water or other NON-ALCOHOLIC fluids**. Drink plenty of water, even if you don't feel thirsty. Your body needs water to keep cool. Persons who have epilepsy, heart or liver disease, are on fluid restrictive diets, or who have a problem with fluid retention should consult a physician before increasing their consumption of fluids.

5. **DO NOT DRINK ALCOHOLIC BEVERAGES**. Alcoholic beverages actually cause the body to increase water loss –something which should not happen when encountering a heat wave.

6. **Spend more time in air-conditioned places**. Air conditioning in homes and other buildings significantly reduces danger from heat. If you can not afford an air conditioner, spending more time each day during hot weather in an air conditioned environment can offer some protection against the heat.

7. **DO NOT get too much sun.** Sunburn makes the job of heat dissipation by the body that much more difficult.

By following these safety tips during the next heat wave, you can greatly diminish the potential dangers from the heat on your body.  Don't let hot summer weather make you another fatal statistic!!!

Please note that much of the aforementioned material related to heat waves is from NOAA's National Weather Service's brochure entitled Heat Wave: A Major Summer Killer, which was produced as a cooperative effort between NOAA's National Weather Service, the Federal Emergency Management Agency, and the American Red Cross.

## A tale of two winters

**By Richard Grumm, Science Officer**

The winter of 2005-2006 is a tale of two winters. It began cold and snowy in 2005 and flipped to warm and dry in 2006. A cold snap struck the commonwealth as Thanksgiving arrived and the first arctic air mass of the season brought snow and cold to many locations. The cold air lost its grip as a frontal system brought heavy rains and thunderstorms to the commonwealth on the 29th of November. Cold air then filtered in.

| Harrisburg Climate Summary January | | | |
|---|---|---|---|
| Temperatures | | Snow (in) | |
| **YEAR** | **Mean** | **Year** | **Mean** |
| 1932 | 42.5 | 2006 | Trace |
| 1950 | 39.8 | 1973 | Trace |
| 1933 | 38.9 | 1932 | Trace |
| 1913 | 38.6 | 1934 | 0.2 |
| 2006 | 38.3 | 1950 | 0.3 |

**Table 1.  Summary by year of the warmest monthly mean temperatures and of the lowest snowfall.**

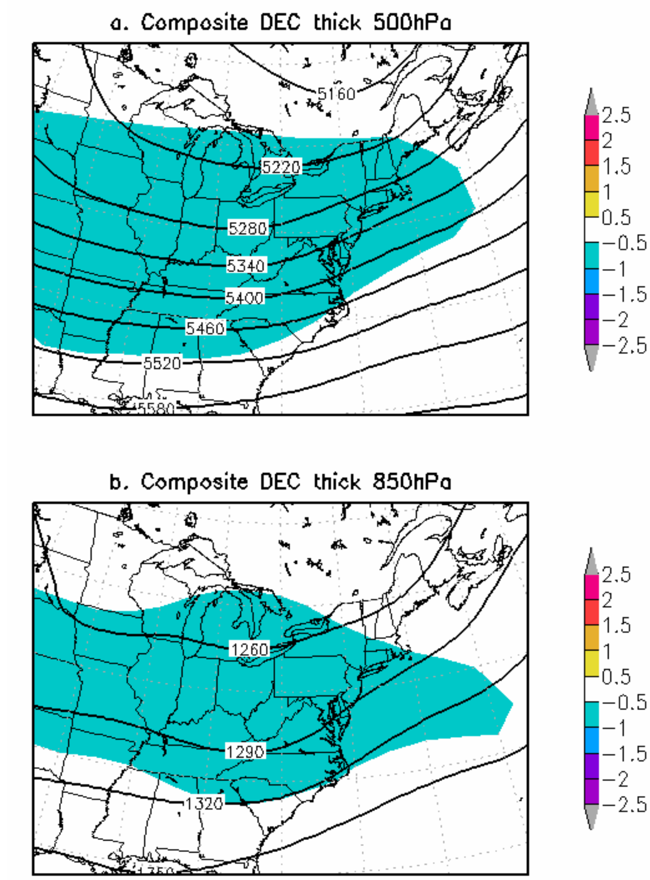



**Figure 1. Composite for 1-23 December 2005 showing a) 1000-500 mb and b) 1000-850 mb thickness contours (m) and departures from normal in standard deviations from normal.**

December got off to a cold and snowy start. An East Coast storm brought snow to the eastern areas on the 5th.  A more widespread storm brought snow to the commonwealth on the 8th. The cold set in and temperatures fell to record and near record lows on the 14th. A second major winter storm struck on the 16th with snow, sleet, and rain. Warm air produced rain in the southeastern areas with this storm. The additional accumulations of snow and sleet over central and northern sections locked in a White Christmas.

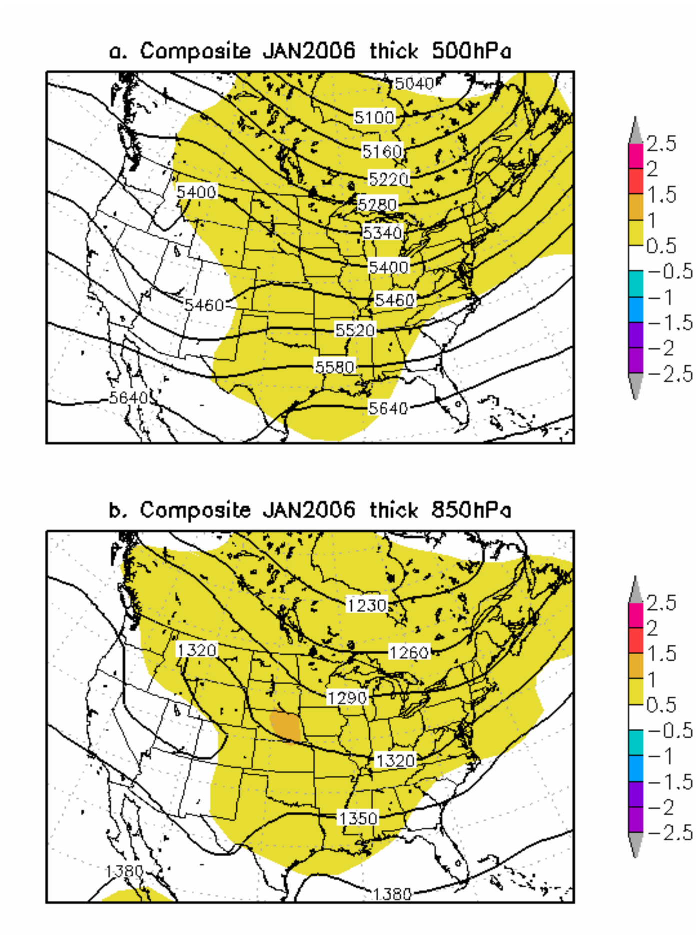



**Figure 2. As in Figure 1 except for 1-31 January 2006.**

Temperatures remained cold through the 23rd when the pattern began to change. Several mild days around Christmas were a prelude to change. Most locations saw temperatures in the 40s and 50s on Christmas Eve. The cold and snow had raised fears of a difficult winter. With high fuel prices the prospects looked bleak. Worse, several weather pontificators predicted record cold and snowy conditions for the winter over much of the eastern United States.

In January, a different pattern was in place. Warm temperatures dominated from the 8th through the 14th with several days of temperatures in the 50s and lower 60s. Warmth dominated. January 2006 would end up as one of the warmest January's at many Pennsylvania locations. It was the 5th warmest January on record at Harrisburg (Table 1). Snow was also hard to come by in most locations.

The flip from cold to warm is not unprecedented. A memorable flip was observed between December 1989 and January 1990. During that winter, a cold December gave way to a warm January and February. Unlike the winter of 2005-2006, the flip occurred on the 31st of December 1989. The flip in December 2005 occurred around 23rd.

Figure 1 shows the mean 1000-500 mb thickness and 1000-850 mb thickness and the departures of these fields from normal over the eastern United States. The thickness is directly related to temperature and the below normal values support that it was colder than normal over Pennsylvania from 1 to 23 December 2005. Computing similar values for the period from 1 to 31 December revealed that the month ended up close to normal (figure not shown). In other words; the warm-up at the end of the month nearly totally erased the very cold start to December.

Figure 2 shows the same data but for the period covering 1-31 January 2006. The data is displayed to show the entire United States. These data show not only that it was abnormally warm over Pennsylvania (the warm colors show above normal thickness values) but that it was abnormally warm over most of the United States. In fact, on average for the contiguous United States, it was the warmest January in history. Some areas of the upper mid west averaged some 10 to 15 degrees above normal.

Comparing the December 2005 data (Figure 1) to the January 2006 data clearly shows that conditions over the eastern United States flipped from cold to warm.

The warm weather persisted until February. However, a major East Coast storm struck eastern areas on the 12th and 13th of February making it look and feel a bit more like winter. But the snow did not last as warm air moved back into the state.

Early March saw a surge of warm air and some record to near record high temperatures on the 10th and 13th.

Altogether, the winter of 2005-2006 ended up warmer than normal with most areas seeing below normal snowfall. The cold and snowy start to the winter came to an abrupt end on the 23rd of December setting the stage for the warmest January on record. This pretty much drove a stake in the heart of the weather forecasters who were preaching record cold and snow back in the fall. Clearly, pattern changes can quickly alter conditions reminding us that placing a lot of faith in long-range forecasts is risky business. When it comes to placing any faith in long-range prognostications, the Latin phrase Caveat Emptor comes to mind. Let the buyer, or in this case, the users beware!

## Glad You Asked

**By Victor Cruz, Hydrometeoroligical Technician**

Everyday, the National Weather Service office receives telephone calls from the public, news media and emergency managers, inquiring about weather information. On normal days, most of the telephone calls revolve around what the meteorological or hydrological forecast is for a particular area. However, during severe weather, the telephone calls are more urgent, event driven and specific.

I recently did a poll among the forecasters, asking them that if they were calling up the weather office about a weather event, what questions would they ask? The following is the results of that poll.

**Tornado Events**

1. Where there any injuries, deaths, or significant property damage?
2. At what time was damage reported and from where were the reports?
3. How strong was the tornado (what was it on the Fujita scale)?
4. What weather system was responsible for the tornado and where is its current location?
5. Was a Tornado Watch or Warning in effect?
6. What is the Fujita Scale?
7. Why did you confirm it as Straight Line Wind Damage and not a Tornado?

**Severe Thunderstorm Events**

1. Were the thunderstorms from a line of thunderstorms or isolated cells?
2. What caused the severe weather outbreak?
3. Was hail reported, if so, where was it reported, how large was it, and what time was it reported?
4. Were trees and power lines down?
5. What were the highest winds speeds reported?

6. A lightning bolt struck a house and the house caught on fire, why don't you consider that a severe weather event?

**Flooding/Flash Flood Events**

1. How much rain fell in a given time?
2. What is the difference between a Caution and Flood Stage?
3. What damage is expected at Caution/Flood Stage from a particular forecast point?
4. Which creeks, streams, rivers, or streets flooded?
5. Can more flooding be expected in the short term or next few days?
6. When do you expect the river will crest or go above its flood stage?

**Winter Storm Events**

1. When and where was the heavy snow observed?
2. What is the definition of a Blizzard?
3. What was the significant impact of the storm on the people?
4. Was there more or less snow than you expected? Why? What happened to cause this?
5. Do you expect this snow to contain much water?
6. Is this unusual for this time of the year?
7. Will this much snowfall help to prevent a drought this coming Spring?

**New Climate Record Events**

1. What caused this record event?
2. What other years have we seen this type of event?
3. How long have records been kept for your station?
4. What weather records are kept by the National Climatic Data Center?
5. Is there a difference in roles between the State Climatologist and the National Climatic Data Center?
6. At what location do you verify your record temperatures?
7. How can I obtain certified weather records?

## Hail Formation and Occurrence

**By Barry Lambert, Senior Forecaster**

Hail causes $1 billion in damage to crops and property each year. The costliest hailstorm in the United States occurred in Denver in July 1990 with damage totaling $625 million. Even small hail can cause significant damage to young and tender plants.

Hailstones are balls of ice that grow as they're held up by winds, known as updrafts that blow vertically upwards in thunderstorms. The updrafts carry droplets of supercooled water (water existing in its liquid state below the freezing temperature), which collide with the suspended balls of ice and freeze instantly, making the hailstones grow (Fig 1). The faster the updraft, the bigger and faster the stones can grow.

These processes generally occur at the front of the thunderstorm, which is therefore also referred to as the embryo curtain. The strong updrafts entrain the initially small pellets, the water droplets and ice particles contained in the air being captured in the process. The hailstones begin to grow. Depending on the updrafts' changing intensity, the hailstones oscillate within the cloud. During these growth cycles the stones pass through different temperature

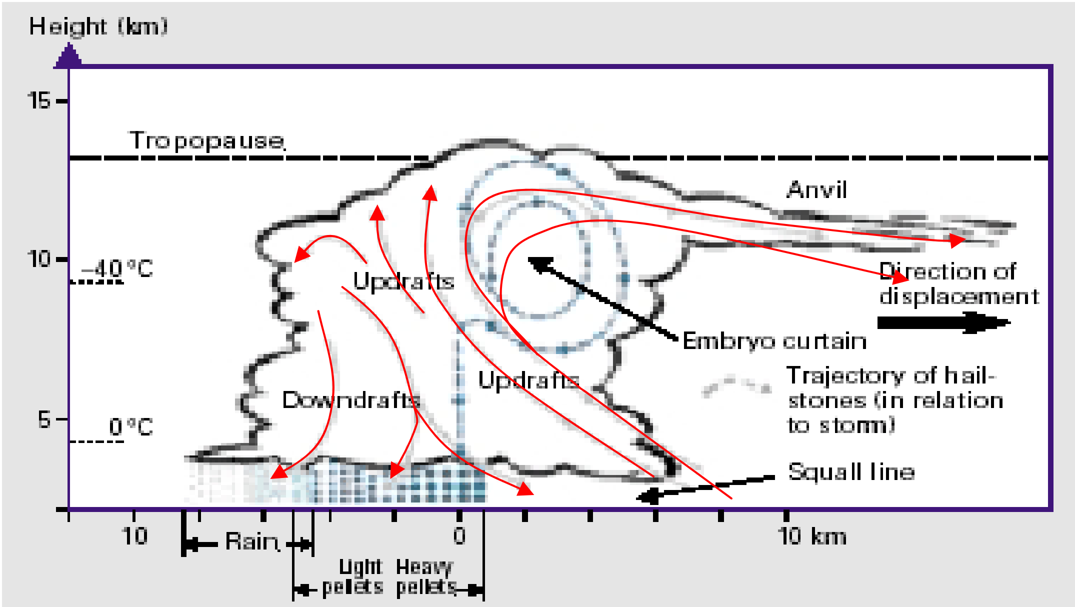



**Figure 1. Trajectory of Hailstones (red arrows) in a Thunderstorm**

regions. The warmer regions (0 °C to –10 °C) contain more water droplets which accumulate on the pellets, forming a layer of water around them. This film of water freezes into a clear layer. The higher and colder regions of the cloud (below –10 °C) contain a larger amount of ice particles. The few existing supercooled droplets freeze instantly upon contact with the pellet of hail.

The individual droplets and layers of ice crystals absorbed in the process create an opaque layer in which air is entrapped. This explains why hailstones have an onion-like structure and come in so many different sizes. As many as 25 layers have been counted in a single large hailstone. The strong updrafts needed for hail to form can only develop in thunderstorm cells. But not every thunderstorm produces hail. Often, atmospheric conditions do not encourage the formation of hail or only result in small pellets of hail that melt into drops when they pass through warmer layers of air and fall to the ground as rain. Observations suggest that hail falls in only 10% of all thunderstorms.

Most hailstones are smaller in diameter than a dime, but stones weighing more than a pound have been recorded. Details of how hailstones grow by being circulated in numerous cycles within the thunderstorms updrafts and downdrafts are complicated but, the results are irregular balls of ice that can be as large as baseballs, sometimes even bigger.  It also shows why giant hailstones, which are fairly rare. The latter require extremely strong updrafts to keep them suspended aloft. Updrafts of about 120 km an hour (74 mph), i.e. hurricane-force winds, are necessary for a hailstone “only” 7 cm (2.7 inches) in diameter.

Coffeeville, Kansas, had held the long-standing record for the largest hailstone in the U.S. since 1976. The hailstone that fell there weighed in at 758 g (1.67 lb) and measured 7.5 inches (19 inches) in diameter - about the size of a softball. Recently, a new record-setting hailstone fell in Aurora Nebraska on June 22, 2003. It measured over seven inches (18 centimeters) in diameter. Figure 2 shows a radar reflectivity image of the supercell thunderstorm that produced the record size hailstone, while Figure 3 is a "ground truth" photo of the hailstone.

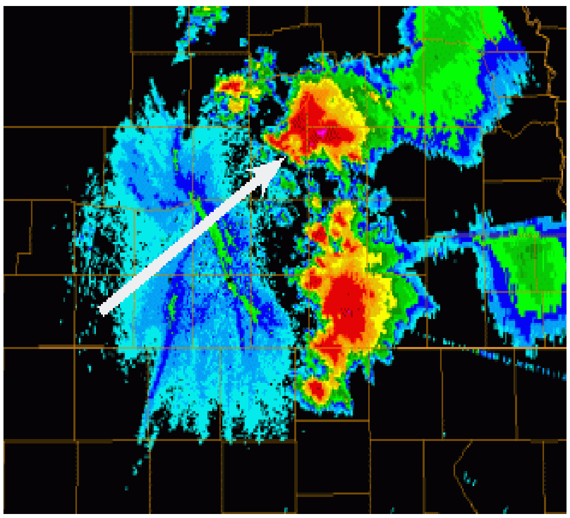


**Figure 2. Radar Reflectivity of the Supercell which produced the record Hail**

While crops are the major victims, hail is also a hazard to vehicles and windows (Fig 3). Deaths from large hail are rare in the United States. The last known U.S. hail fatality was an infant killed in Fort Collins, Colorado in August 1979.

The National Weather Service (NWS) issues two primary products to inform or warn the public on the occurrence of hail. Special Weather Statements are issued when NWS meteorologists expect strong thunderstorms containing "non-severe" hail between pea size and mothball size in diameter. Severe Thunderstorm Warnings are issued when Doppler Radar indicates, or severe storm spotters report hail of penny size (3/4 of an inch in diameter) or larger.


**Figure 3. Aurora, NE Hailstone**

The following is a list of standard objects used to assist in measuring the size of hail. For non-severe hail, there is pea size (1/4 inch), marble or mothball (1/2 inch), dime (5/8 inch). Hail sizes classified as "severe" are penny (3/4 inch), nickel (7/8 inch), quarter (one inch), half-dollar (1.25 inches), walnut (1.5 inches), golf ball (1.75 inches), tennis ball (2.5 inches), baseball (2.75 inches), softball (4.5 inches).

Significant, destructive hailstorms are not common in central Pennsylvania. However, similar to practically all other types of adverse weather, large hailstones occasionally fall over the commonwealth, especially from the spring through early fall months (Figs 4 and 5).

The higher frequency of hailstorms in extreme western Pennsylvania is similar to the occurrence of large hail in many areas from the Ohio valley to the Plains states. The highest frequency of hailstorms in the U.S. is found across the high plains and Central Rockies (Fig 6).

Similar to the peak occurrence of wind damage and tornadoes from severe thunderstorms, the most favorable time for large hail is between 4 pm and 6 pm local time (Fig 7).

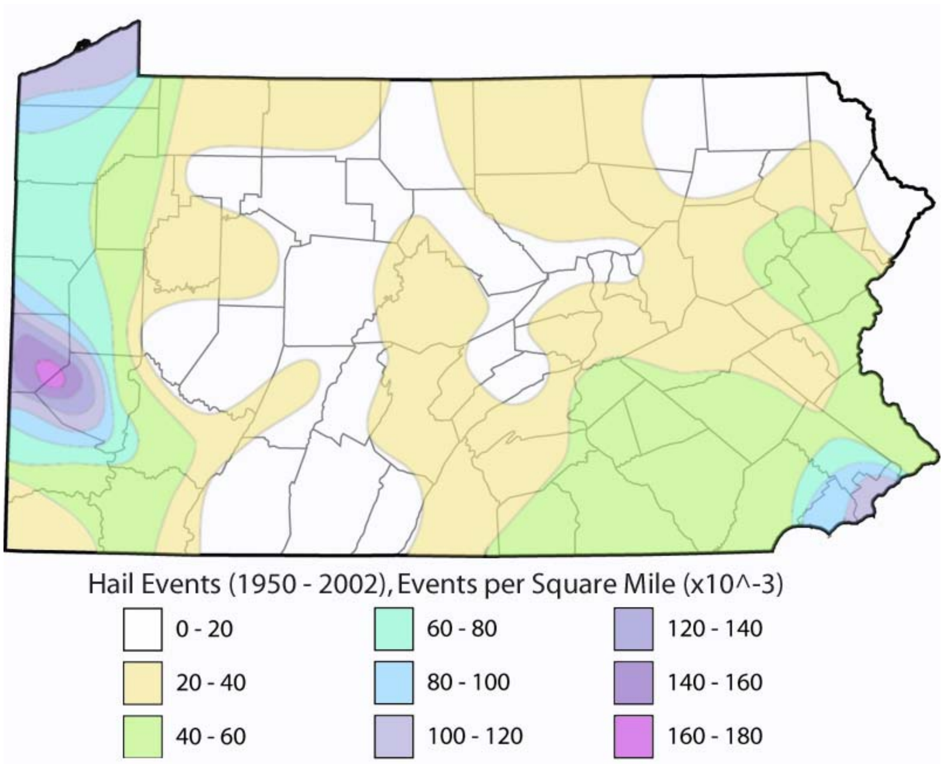



**Figure 4. The Number of Hail Events Per Square Mile from 1950 – 2002**

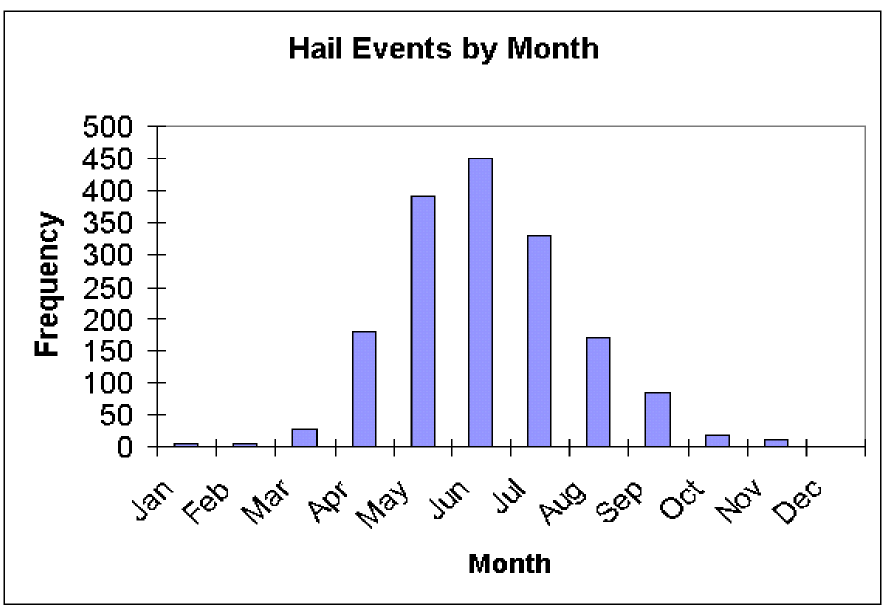



**Figure 5. Hail Occurrence by Month in Pennsylvania**

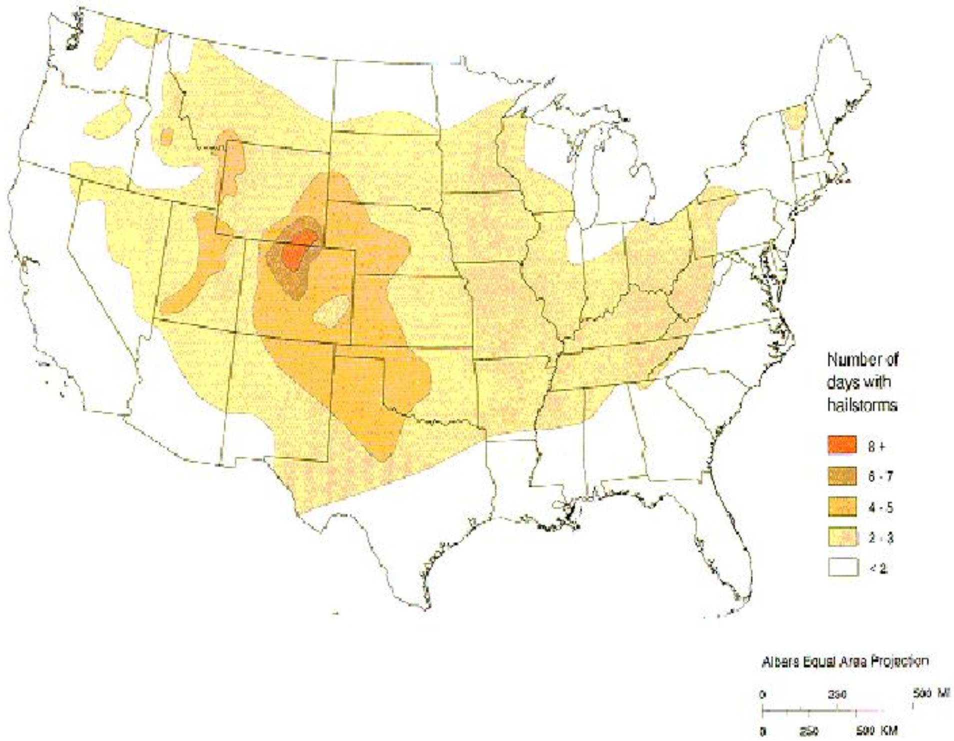



**Figure 6. Number of Days with Hailstorms**

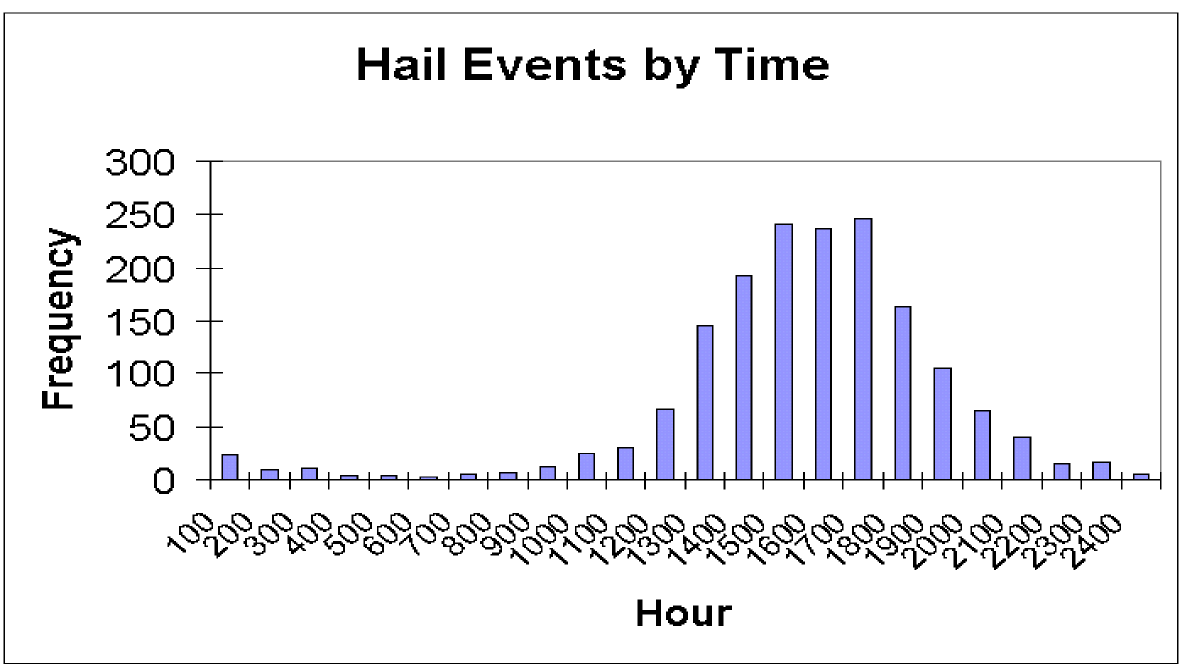
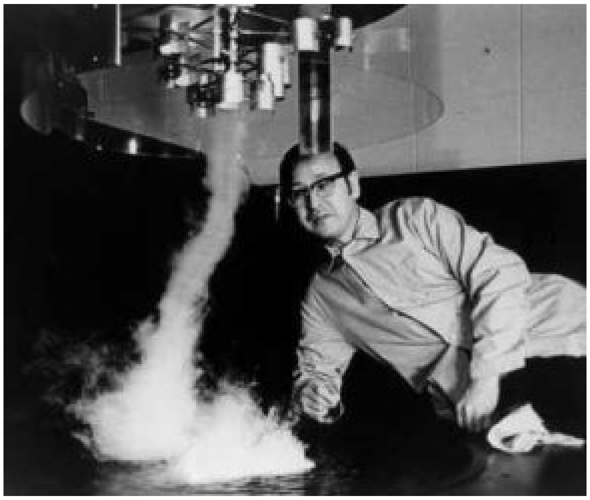



**Figure 7. Hail Occurrence by Time of Day in Pennsylvania**

# Fujita Scale changes on the horizon!

**By Dave Ondrejik, Warning Coordination Meteorologist**

In the early 1970's Dr. Theodore Fujita developed a way to interpret damage associated with a tornado. Dr. Fujita produced a scale that estimated wind speeds based upon the damage that a tornado inflicted on a manmade structure. This revolutionary breakthrough earned Dr. Fujita the nickname "Mr. Tornado".



Dr. Fujita's scale actually connected another wind scale called the Beaufort scale (Developed in 1805 by Sir Francis Beaufort of England) to the wind speed of Mach 1 (speed of sound)!
He took the difference in wind speeds and divided them into 12 equal parts and labeled them F1 thru F12. However in nature, we don't expect to see wind speeds greater than the F5 rating. One reason for F5 being the highest rating is most manmade structures are destroyed at or below wind speeds associated with an F5 tornado.

Recently, a group of scientists and structural engineers got together and developed a new scale that is more scientifically accurate than the current F-scale. The new scale is being called the Enhanced-Fujita (E-F) Scale.

The new scale will provide meteorologists and engineers with more precise tools to estimate wind speeds that are associated with damage to manmade structures. The new scale will be implemented in February of 2007.

If you are interested in finding out the specifics of the E-F Scale, just point your web browser to the following website:

www.spc.noaa.gov/faq/tornado/efscale.html

By the way, the National Weather Service will not be changing the ratings of past tornadoes when the new E-F Scale begins. The research forum wanted the tornado database to be preserved; therefore, they developed a correlation between the EF Scale and the original F Scale. The basic wind speed ranges in the EF Scale are derived from the original F Scale. The EF Scale still rates tornadoes on a scale from zero to five, with EF0 as having the lowest wind speed and EF5 as having the highest.

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