# EYE ON THE SKY

National Weather Service
Louisville, Kentucky

*Winter 2003-2004*
*Volume 4, Issue 3*

**A Newsletter for Emergency Managers, Core Storm Spotters, Media, and Public Officials in Central Kentucky and South-Central Indiana**

Comments and suggestions are always welcome. Your feedback is very important to us!

Please contact us by phone, e-mail, or mail at

**National Weather Service**
**6201 Theiler Lane**
**Louisville, Kentucky 40229**

**(502) 969-8842**
**www.crh.noaa.gov/lmk**
**w-lmk.webmaster@noaa.gov**

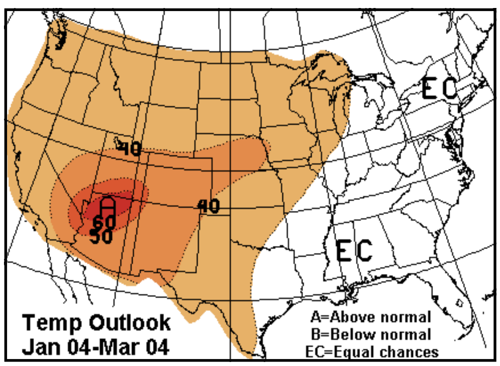
This publication also is available on-line at
**www.crh.noaa.gov/lmk/newsletter**

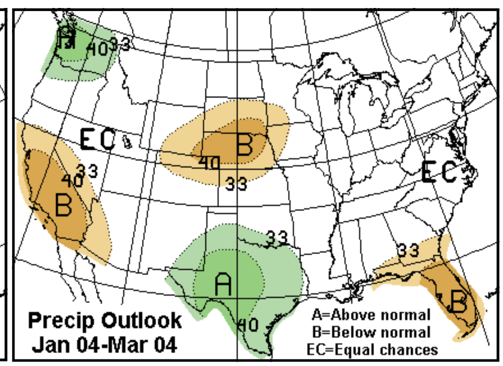
Chief Editors and Layout Design
***Ted Funk / James Brotherton***

## Winter 2003-2004: What Will it Be Like?

*by Norm Reitmeyer, Warning Coordination Meteorologist and Ted Funk, Science and Operations Officer*

The bottom line is that no one really knows for sure what any season will be like, including this coming winter. It is virtually impossible to say when and what type of individual storm or frigid cold wave will strike weeks and months in advance. Instead, National Weather Service forecasters and climatologists analyze large-scale patterns and trends to decide seasonal precipitation and temperature tendencies with respect to normal. While this information is useful to long-term planners, it cannot predict the day-to-day weather within a season. In fact, a "normal" season can have many swings in temperature and precipitation. For example, a major snowstorm and cold wave could paralyze an area, while the rest of the winter is relatively mild and snow-free. Thus, as a whole, the winter ends up "normal," although most people only remember the big storm thinking the winter was particularly harsh. Nevertheless, when the topic of "what's this winter going to be like?" is brought up for discussion, most people's attention is drawn as if someone has the inside scoop.




The official NWS outlook for this winter shows little in the way of distinctive trends across the Ohio Valley (see accompanying images). The experts' call for our area is "equal chances" or "too close to call," almost like an election prediction. In other words, there is no clear tendency for seasonal temperature and precipitation to end up above or below average; instead, an "equal chances" or "normal" winter is shown. However, from the Plains westward to the West Coast, especially the southwestern United States, warmer than average temperatures are predicted from January through March. Meanwhile, above normal precipitation is forecast over most of the southern Plains and Pacific Northwest, with drier conditions favored across areas centered on Florida, Nebraska, and California.

***...Continued on Page 2...***

### INSIDE THIS ISSUE:

## The Data Bank

*by Don Kirkpatrick, Lead Forecaster*

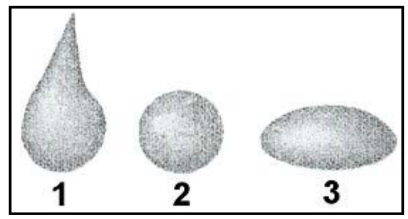
Continuing with this issue, interesting and little known weather facts relevant to the ongoing or upcoming season are presented to you via "The Data Bank." In this issue, we explore a few tidbits about autumn leaf color, raindrops, and snow cover.

Let's reminisce for a moment about this past autumn season and its degree of color. To this observer, this fall failed to produce a brilliant display of yellow, orange, and red leaves. Those that did exhibit such colors departed trees early due to wind, and what was left turned brown quickly.

Temperatures on the morning of October 3 reached the lower to mid 30s accompanied by a widespread frost, followed by a windy day on the 14th (gusts around 35 mph). Contrary to what many people may believe, it is not the first frost that causes the leaves of deciduous trees to change color. Several weeks before the first frost, a chemical change begins in the leaf, due to shorter days and cooler nights. Chlorophyll (green pigments) in the leaf decrease and other pigments (yellow and orange carotenoid) begin to show through.

An impressive display of fall colors is dependent upon warm, calm, sunny days followed by clear, cool nights with temperatures dropping below 45 degrees, but remaining above freezing. In contrast, early season temperatures around freezing and the subsequent gusty winds likely diminished the brilliant colors this past autumn.

Have you ever heard anyone say, "It's raining hamburger buns?" More likely, you've heard the phrase, "It's raining cats and dogs."




As rain falls, the drops take on a characteristic shape, dependant on the size. Most people would guess that rain drops are tear-shaped (#1 in the image at right). However, small raindrops less than 2 millimeters (mm) in diameter are nearly spherical (#2). The attraction among the molecules of the liquid (surface tension) tends to squeeze the drop into a shape that has the smallest surface area for its total volume, i.e., nearly round.

Larger raindrops that exceed 2 mm take on a different shape as they fall. As the drop descends, the air pressure against the drop is greatest on the bottom and least on the sides. This produces a flattened-bottom, rounded-top, slightly elongated drop (#3). The pressure of the air on the bottom flattens the drop, while the lower pressure on its sides allows it to expand. This shape could be described as a loaf of bread or a hamburger bun.

***...Continued on Page 3...***

## Winter 2003-2004 Outlook *(continued from page 1)*

A variety of other opinions, some based on folklore, are available on the coming winter, but none of those have inside information. It's as if there is something to gain in making a prediction and nothing to lose. If someone is wrong, the prediction will be forgotten. If a source is accurate, then credit can be taken.

So what should we do about winter? First, be ready for whatever happens. Fortunately, we rarely have storms or brutally cold outbreaks that isolate us for long periods. One such case was the week of January 17, 1994, when 10-20 inches of snow was followed by subzero cold. Interesting enough, most of the remainder of that winter was normal, but only this storm is remembered.

As we enter winter, check your house and vehicle(s) to make sure they are ready to go. Have basic supplies available, such as a flashlight with extra batteries, a battery-powered NOAA Weather Radio and portable radio to receive emergency information, and extra water and food, some of which requires no cooking or refrigeration. An emergency heating source also would be helpful. In vehicles, carry additional winter survival items, such as blankets or sleeping bags, extra clothing to keep dry, non-perishable food, a shovel, windshield scraper and brush, booster cables, compass, and road maps. Have these on hand especially if you plan travel through rural areas.

So while we may not know what this winter will bring, we must always be prepared. Then we'll be glad if it turns out to be a typical Ohio Valley winter with only a couple significant snows and a few weeks of really cold temperatures.

## What a Difference a Year Makes

*by Pat Waidley, Hydrometeorological Technician, and Ted Funk, Science and Operations Officer*

As many may remember, Summer 2002 was quite hot and dry across much of central Kentucky and south-central Indiana. A year later, however, Summer 2003 was nearly opposite with relatively cool temperatures and above normal rainfall.

In Louisville, monthly average temperatures were below normal for six consecutive months from May through October 2003. For the summer period (June to August), monthly temperatures averaged nearly 2.5 degrees below normal, making Summer 2003 the second coolest in 20 years. In fact, only 11 days warmed to 90 degrees or above (the majority in August), with the warmest being 93 on August 27. This compared to 31 days of 90+ weather in Summer 2002. Rainfall for June through August in Louisville totaled 12.63 inches, which was just over an inch above normal for the period. For the same period in Summer 2002, only 5.06 inches of rain fell, making it the fourth driest summer on record. The string of below normal monthly temperatures was broken last month when November averaged 3.1 degrees above normal with 5.69 inches of rain.

In Lexington, monthly average temperatures were below normal for 5 of the 6 months from May to October, with August, which averaged nearly a degree above normal, being the exception. June 2003, which was 3.2 degrees below average, tied for the tenth coolest June on record. Only 7 days reached 90 degrees or higher from June to August, with the warmest being 93 on July 8. This compared to 36 days of 90+ weather in Summer 2002. Rainfall was plentiful in Lexington this past summer, with 16.04 inches from June to August, or 2.85 inches higher than average for the 3 month period. Conversely, Summer 2002 only brought 7.36 inches of rain, making it the tenth driest on record. Last month, November averaged 3.5 degrees above normal along with 5.93 inches of rain.

Bowling Green experienced temperatures below normal during May, June, July, and September 2003, while readings in August, October, and November were above normal. During Summer 2003 (June through August), 20 days reached 90 degrees or higher, with the warmest being 94 on August 22, compared to 43 days the previous summer. Rainfall this past summer reached 16.76, or 4.57 inches above normal for the period. Half of the rainfall total occurred in June 2003, when 8.92 inches fell, including 6 separate days of rainfall close to or exceeding one inch. The previous summer, only 9.87 inches of rain fell. Finally, November 2003 was quite mild, averaging a healthy 4.0 degrees above normal along with 5.17 inches of rainfall.

The weather pattern over the Ohio Valley for much of this past summer featured numerous upper-level troughs and surface cold fronts moving through the region keeping the Bermuda high pressure system over the Atlantic Ocean at bay. This pattern precluded extended hot spells, and brought cooler than normal temperatures and sufficient rainfall and thunderstorms to our area. Despite the active weather pattern, no tornadoes were reported with the thunderstorms that occurred in central Kentucky or south-central Indiana.

Frost occurred in many areas during the first few days of October, although temperatures moderated thereafter. No unusual weather occurred during Fall 2003 with normal periods of warm and cool temperatures and rainfall. What might the winter months ahead hold for us? This is discussed in the feature article on the cover of this newsletter.

***Check the climatological tables on the last page for more climate details!***

## The Data Bank *(continued from page 2)*

Anyone who has walked through the woods on a snowy day knows the quiet created by a thick blanket of snow. Once snow settles on the ground, it can affect the way sound waves are transmitted. Freshly fallen snow can absorb sound. As the snow gets deeper, this absorption increases. As snow becomes older and more densely packed, its ability to assimilate sound is reduced.

Snow's temperature also plays a role on the sound produced. New snow covering a pavement generates no sound when the air and snow are only slightly below freezing. The pressure from the heel of a boot partially melts the snow, allowing it to flow under the weight of the boot resulting in negligible sound. New snow will squeak when you walk on it if the snow temperature drops below 14 degrees. The heel of the boot will not melt the snow, and the ice crystals are crushed. The crunching of the crystals produces the creaking sound.

## Preparing to be StormReady

*by Norm Reitmeyer, Warning Coordination Meteorologist*

"StormReady" is a National Weather Service program that helps community leaders and emergency managers strengthen their local hazardous weather operations.  Since 85-90 percent of all Presidentially-declared disasters are weather related, it is vital that communities have the skills and education needed to survive severe weather.

StormReady communities are better prepared to save lives from the onslaught of severe weather through better planning, education, and awareness.  Communities have fewer fatalities if they plan before dangerous weather arrives.  No community is storm proof, but StormReady can help communities save lives.

In becoming StormReady, emergency managers and other community leaders work together with local National Weather Service offices to complete an application and review process.  To be recognized as StormReady, a community must:

1) Establish a 24-hour warning point and emergency operations center.
2) Have more than one way to receive severe weather forecasts and warnings and to alert the public.
3) Create a system that monitors local weather conditions.
4) Promote the importance of public readiness through community seminars.
5) Develop a formal hazardous weather plan including training weather spotters and holding emergency exercises.

So far, Casey, Scott, Adair, and Russell Counties in central Kentucky have been recognized as StormReady.  Several other counties are in the process of filling out applications and will be StormReady within the next few months.

This past August, the University of Kentucky became the fourth university in the United States to become StormReady.  This was accomplished by a concerted effort from several university people.  Over 100 NOAA Weather Radios were secured for placement in the most used buildings on campus, such as dormitories, classroom buildings, and administrative centers.  The effort was coordinated by Tom Priddy of the UK Agricultural Weather Center.

Emergency managers and other community leaders considering StormReady for their counties are encouraged to contact their local National Weather Service office.  In central Kentucky and south central Indiana, call Warning Coordination Meteorologist Norm Reitmeyer at 502-968-5820.  Everything possible will be done to simplify and expedite the process of becoming StormReady.

## Astronomical Calendar

### Sunrise and Sunset

| | Louisville | | Lexington | | Bowling Green | | |
|---|---|---|---|---|---|---|---|
| **Date** | **Sunrise** | **Sunset** | **Sunrise** | **Sunset** | **Sunrise** | **Sunset** | Times are given in EST (Eastern Standard Time) and CST (Central Standard Time), as appropriate. |
| Jan 1 | 8:00 am est | 5:33 pm est | 7:54 am est | 5:29 pm est | 6:59 am cst | 4:40 pm cst | |
| Feb 1 | 7:48 am est | 6:05 pm est | 7:43 am est | 6:00 pm est | 6:49 am cst | 5:10 pm cst | |
| Mar 1 | 7:14 am est | 6:37 pm est | 7:09 am est | 6:32 pm est | 6:16 am cst | 5:40 pm cst | |
| Apr 1 | 6:27 am est | 7:07 am est | 6:22 am est | 7:01 pm est | 5:31 am cst | 6:09 pm cst | |

### Moon Phases

| New Moon | First Quarter | Full Moon | Last Quarter |
|---|---|---|---|
| Dec 23 | Dec 30 | Jan 7 | Jan 15 |
| Jan 21 | Jan 29 | Feb 6 | Feb 13 |
| Feb 20 | Feb 28 | Mar 6 | Mar 13 |
| Mar 20 | Mar 28 | Apr 5 | Apr 12 |

**Start of Winter:**
Dec 22 at 2:04 am est (1:04 am cst)

*Louisville skyline—courtesy Greater Louisville CVB*

The Science Corner

By Ted Funk
Science and Operations Officer

## Cloud Classifications and Characteristics

Clouds are classified according to their height above and appearance (texture) from the ground. The following cloud roots and translations summarize the components of this classification system: 1) **Cirro-**: curl of hair, high; 2) **Alto-**: mid; 3) **Strato**-: layer; 4) **Nimbo-**: steady precipitation; and 5) **Cumulo-**: heap.

### *High-level clouds:*

High-level clouds occur above about 20,000 feet and are given the prefix "cirro." Due to cold tropospheric temperatures at these levels, the clouds primarily are composed of ice crystals, and often appear thin, streaky, and white (although a low sun angle, e.g., near sunset, can create an array of color on the clouds). The three main types of high clouds are **cirrus**, **cirrostratus**, and **cirrocumulus**.

Cirrus clouds are wispy, feathery, and composed entirely of ice crystals. They often are the first sign of an approaching warm front or upper-level jet streak. Unlike cirrus, cirrostratus clouds form more of a widespread, veil-like layer (similar to what stratus clouds do in low levels). When sunlight or moonlight passes through the hexagonal-shaped ice crystals of cirrostratus clouds, the light is dispersed or refracted (similar to light passing through a prism) in such a way that a familiar ring or halo may form. As a warm front approaches, cirrus clouds tend to thicken into cirrostratus, which may, in turn, thicken and lower into altostratus, stratus, and even nimbostratus.

Finally, cirrocumulus clouds are layered clouds permeated with small cumuliform lumpiness. They also may line up in "streets" or rows of clouds across the sky denoting localized areas of ascent (cloud axes) and descent (cloud-free channels).

### *Mid-level clouds:*

The bases of clouds in the middle level of the troposphere, given the prefix "alto," appear between 6,500 and 20,000 feet. Depending on the altitude, time of year, and vertical temperature structure of the troposphere, these clouds may be composed of liquid water droplets, ice crystals, or a combination of the two, including supercooled droplets (i.e., liquid droplets whose temperatures are below freezing). The two main type of mid-level clouds are **altostratus** and **altocumulus**.

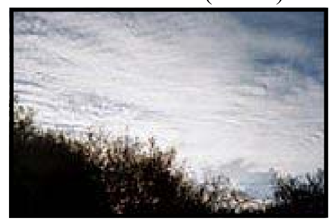
Altostratus clouds are "strato" type clouds (see below) that possess a flat and uniform type texture in the mid levels. They frequently indicate the approach of a warm front and may thicken and lower into stratus, then nimbostratus resulting in rain or snow. However, altostratus clouds themselves do not produce significant precipitation at the surface, although sprinkles or occasionally light showers may occur from a thick alto-stratus deck.

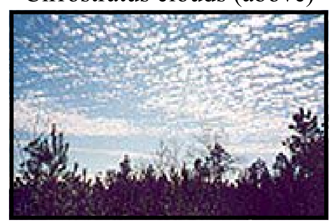
Altocumulus clouds exhibit "cumulo" type characteristics (see below) in mid levels, i.e., heap-like clouds with convective elements. Like cirrocumulus, altocumulus may align in rows or streets of clouds, with cloud axes indicating localized areas of ascending, moist air, and clear zones between rows suggesting locally descending, drier air. Altocumulus clouds with some vertical extent may denote the presence of elevated instability, especially in the morning, which could become boundary-layer based and be released into deep convection during the afternoon or evening.

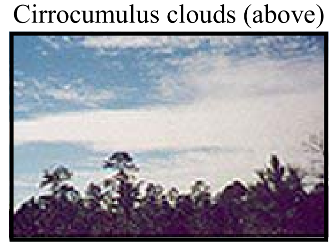
### *Low-level clouds:*

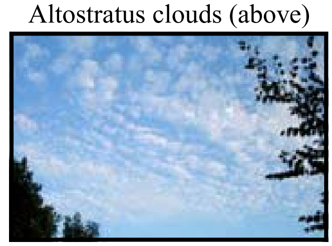
Low-level clouds are not given a prefix, although their names are derived from "strato" or "cumulo," depending on their characteristics. Low clouds occur below 6500 feet, and normally consist of liquid water droplets or even supercooled droplets, except during cold winter storms when ice crystals (and snow) comprise much of the clouds.


Cirrus clouds (above)


Cirrostratus clouds (above)


Cirrocumulus clouds (above)


Altostratus clouds (above)


Altocumulus clouds (above)


Stratus clouds (above)


Stratocumulus clouds (above)

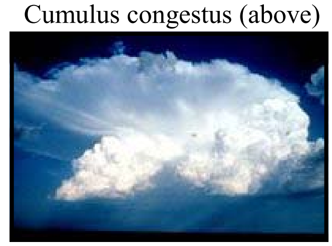
The two main types of low clouds include **stratus**, which develop horizontally, and **cumulus**, which develop vertically. Stratus clouds are uniform and flat, producing a gray layer of cloud cover which may be precipitation-free or may cause periods of light precipitation or drizzle. Low stratus decks are common in winter in the Ohio Valley, especially behind a storm system when cold, dismal, gray weather can linger for several hours or even a day or two. **Stratocumulus** clouds are hybrids of layered stratus and cellular cumulus, i.e., individual cloud elements, characteristic of cumulo type clouds, clumped together in a continuous distribution, characteristic of strato type clouds. Stratocumulus also can be thought of as a layer of cloud clumps with thick and thin areas. These clouds appear frequently in the atmosphere, either ahead of or behind a frontal system. Thick, dense stratus or stratocumulus clouds producing steady rain or snow often are referred to as **nimbostratus** clouds.

Nimbostratus clouds (above)

Cumulus clouds (above)

In contrast to layered, horizontal stratus, cumulus clouds are more cellular (individual) in nature, have flat bottoms and rounded tops, and grow vertically. In fact, their name depends on the degree of vertical development. For instance, scattered cumulus clouds showing little vertical growth on an otherwise sunny day used to be termed “cumulus humilis” or "fair weather cumulus," although normally they simply are referred to just as cumulus or flat cumulus. A cumulus cloud that exhibits significant vertical development (but is not yet a thunderstorm) is called **cumulus congestus** or **towering cumulus**. If enough atmospheric instability, moisture, and lift are present, then strong updrafts can develop in the cumulus cloud leading to a mature, deep **cumulonimbus** cloud, i.e., a thunderstorm producing heavy rain. In addition, cloud electrification occurs within cumulonimbus clouds due to many collisions between charged water droplet, graupel (ice-water mix), and ice crystal particles, resulting in lightning and thunder.

Cumulus congestus (above)



Cumulonimbus (above)

### *Other interesting clouds:*

**Wall Cloud**: A localized lowering from the-free base of a strong thunderstorm. The lowering denotes a storm's updraft where rapidly rising air causes lower pressure just below the main updraft, which enhances condensation and cloud formation just under the primary cloud base. Wall clouds take on many shapes and sizes. Some exhibit strong upward motion and cyclonic rotation leading to tornado formation, while others do not rotate and essentially are harmless.

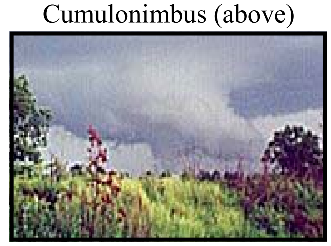
**Shelf Cloud**: A low, horizontal, sometimes wedge-shaped cloud associated with the leading edge of a thunderstorm’s outflow or gust front and potentially strong winds. Although often appearing ominous, shelf clouds normally do not produce tornadoes.

**Fractus**: Low, ragged stratiform or cumuliform cloud elements that normally are unattached to larger thunderstorm or cold frontal cloud bases. Also known as scud, fractus clouds can look ominous, but by themselves are not dangerous.

**Mammatus**: Drooping underside (pouch-like appearance) of a cumulonimbus cloud in its latter stage of development. Mammatus most often are seen hanging from the anvil of a severe thunderstorm, but do not produce severe weather themselves. They can accompany non-severe storms as well.

**Contrail**: Narrow, elongated cloud formed as jet aircraft exhaust condenses in cold air at high altitudes, indicative of upper level humidity and wind drift.

**Fog**: Layer of stratus clouds on or near the ground. The two main fog types include radiation fog (forms overnight and burns off in the morning) and advection fog.



Wall cloud (above)

Shelf cloud (above)

Fog (above)

Contrails (above)

Mammatus cloud (above)

Fractus cloud (above)

## The Role of the Service Hydrologist at the NWS

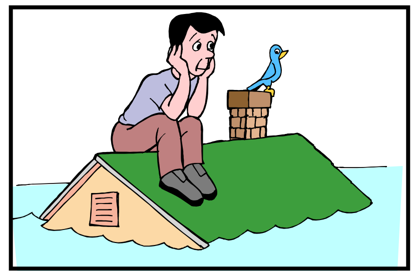
*by Mike Callahan, Service Hydrologist*

Did you know that besides meteorology, the National Weather Service (NWS) has a program in hydrology, which is the study of water and rivers? In fact, the NWS is responsible for issuing all flood watches and warnings in the country. While we work closely with other federal agencies, such as the U.S. Army Corps of Engineers and the U.S. Geological Survey, flood products come directly from the NWS. The responsibility for running the hydrologic program at local weather offices falls to the Service Hydrologist, who is kind of a "Jack of all Trades" in the NWS. He or she must be familiar with both the sciences of meteorology and hydrology, and must pass on knowledge of the latest developments and improvements in hydrologic science and software to meteorologists.

The Service Hydrologist also must be comfortable working with computers. It is his or her responsibility to make sure that a large hydrologic database is up-to-date in order for the hydrologic software to function properly. This database contains everything from the river crests of past floods to the phone numbers of cooperative observers.

Additionally, the Service Hydrologist works closely with state and local emergency managers to make them aware of NWS hydrologic products and services, and to help improve community flood response plans. Responsibility also includes travel to river gage locations to inspect equipment and to determine whether the flood plain has changed. He or she also helps in the location and recruitment of cooperative observers.

Whenever a flood or drought strikes the area, the expertise of the Service Hydrologist is invaluable in providing critical information to both government officials and news media outlets. In these situations, he or she frequently is called upon for a live interview with little or no preparation.



The next time you hear of a flood or drought in a part of the country, you can be sure that a Service Hydrologist is working hard, in conjunction with meteorologists, to make sure the National Weather Service is doing everything it can to help the public prepare and respond properly and quickly.

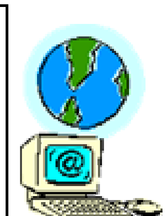
## New NWS Forecast Products

*by James Brotherton, Meteorologist*

As many of you already know, the National Weather Service has been producing grid-based graphical (image-based) forecasts of various weather elements for several months on a national scale. Numerous grids are produced for the forecast area of each NWS office, including maximum, minimum, and hourly temperatures, dewpoint temperatures, relative humidity, wind direction and speed, wind chill, heat index, sky condition, weather condition, probability of precipitation, precipitation amount, and snowfall.

The most basic principle to come out of the new weather grids is a specific, grid-based online weather forecast for any latitude and longitude via the click of a mouse button. These grid-based forecasts can be tailored to each customer, whether it is the general public that needs to know a basic weather forecast, or, for example, a fire weather customer such as the National Park Service or Forest Service, that needs a highly-specific localized forecast. Eventually, even terminal aviation forecasts (TAFs) will be created from the gridded database for our aviation customers.

***Did you know?***
A grid-based weather forecast, tailored for your specific latitude/ longitude, is only a click away at *weather.noaa.gov/ louisville*



To that end, several new products have been created to further utilize the new method of creating weather forecasts. The latest additions to these new products are the Area Forecast Matrices (AFM) and the Point Forecast Matrices (PFM). Both of these products are tabular and display various weather elements at three-hour intervals.

***Area Forecast Matrices:***
The AFM is created every time a new forecast is produced or updated. The AFM is similar to the bread-and-butter NWS product, the Zone Forecast, in that it is based on a zone, i.e., a group of counties such as the several Kentucky and Indiana counties that comprise the Louisville metropolitan area. The product is created with computer formatters that average the data from each weather element grid within each predefined matrix or zone. An example of the AFM is shown below.

***...Continued on Page 8...***

## Verifying a NWS Weather Forecast

*by James Brotherton, Meteorologist*

A coworker, Mike Callahan (Service Hydrologist at NWS Louisville), once stated observantly, “The main difference between a weather forecast and a river forecast is the hydrologist must make each new forecast based on the old, and inherit all the potential errors, while the meteorologist gets to start from scratch every time.” While the logic here is inherently true, most weather forecasters do not simply ignore their previous forecast (whether it was good or not; perhaps contrary to popular opinion!).

In reality, an important step in creating a new weather forecast is to interrogate the old. This involves comparing forecast values to actual observed values and determining if the forecast is accurate or needs modification. This process also involves incorporating new computer model-generated forecasts into our official NWS forecast database.

Several statistical methods are used to verify a weather forecast, including temperature and probability of precipitation (POP). Mean absolute error (MAE) often is used for temperature forecasts. MAE is simply a measure of the error of the temperature forecast over a period of time. Similarly, the bias of the error is investigated, i.e., whether forecasts are warmer or cooler than observed values. POP forecasts are verified in several ways. One of the most common statistical methods is called the Brier score. The Brier score is calculated by the square of the difference between whether or not the event occurred (in this case precipitation) and our forecast (e.g., 70% POP or 0.7). The event is scored either as a 1 (yes, precipitation occurred) or 0 (no, precipitation did not occur). The Brier score acts as a ratio between 0 and 1, where 0 is a perfect forecast and 1 is the worst possible forecast. So, in the above example, if rain occurred, then the Brier score would be 0.09 [$(0.7 - 1.0)^2 = 0.09$]. Had we forecast 100% POP in this case, the score would be 0 [$(1.0 - 1.0)^2 = 0$]. Another useful POP verification tool is “Wet POP” and “Dry POP”. Wet and Dry POP simply answers the question, “When precipitation occurs, what is the mean forecast POP?” and inversely, “When precipitation does not occur, what is the mean POP?”. Thus, the higher the Wet POP the better the forecast, and the lower the Dry POP the better the forecast.

Using some of the above methodology, verification of the NWS National Digital Forecast Database (NDFD) is becoming more important. In the future, verification of the NDFD will become the predominant method of forecast verification. Verification of the grids in the NDFD requires a comparative-scale grid of actual or observed data. This is the main sticking point in verification of the NDFD, since observed data is only available as an analysis of the nation’s relatively limited network of surface observations.

***...Continued on Page 9...***

## New NWS Forecast Products *(continued from page 7)*

***Point Forecast Matrixes:***
The PFM also is created every time a new forecast is produced or updated. The PFM format is similar to the AFM as described previously. The main difference is the PFM uses pre-defined points within the forecast area of each NWS office. For the Louisville office, these points are: Louisville, Frankfort, Lexington, Bowling Green, Huntingburg, Scottsburg, Campbellsville, and Burkesville. The PFM also is created with computer formatters; however, a small radius around each pre-defined point is used to extract data from each weather grid in the database. An example of the PFM is shown at right.

```
AREA FORECAST MATRICES...UPDATED
NATIONAL WEATHER SERVICE LOUISVILLE KENTUCKY
935 PM EST MON DEC 22 2003

INZ076>079-083-084-089>092-KYZ023>025-028>034-038-045-053-230936-
BRECKINRIDGE-BULLITT-CLARK IN-CRAWFORD IN-DUBOIS IN-FLOYD IN-HANCOCK-
HARDIN-HARRISON IN-HENRY-JEFFERSON-JEFFERSON IN-LARUE-MEADE-NELSON-
OLDHAM-ORANGE IN-PERRY IN-SCOTT IN-SHELBY-SPENCER-TRIMBLE-
WASHINGTON IN-
INCLUDING THE CITIES OF...BARDSTOWN...CORYDON...ELIZABETHTOWN...
HARDINSBURG...JASPER...LOUISVILLE...NEW ALBANY...SHELBYVILLE
935 PM EST (835 PM CST) MON DEC 22 2003

DATE                    TUE 12/23/03            WED 12/24/03         THU
UTC 3HRLY     20 23 02 05 08 11 14 17 20 23 02 05 08 11 14 17 20 23 02 05 08 11
EST 3HRLY     15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 03 06

MIN/MAX                     47          51          28          36          23
TEMP                  49 47 47 50 50 48 42 37 34 31 28 30 35 36 31 28 26 25 23
DEWPT                 47 47 46 47 46 43 38 34 31 28 26 25 23 22 22 21 19 18 18
RH                    93100 96 89 86 83 86 89 89 88 92 81 61 56 69 75 74 74 81
WIND DIR               S  S  S  S SW  W NW NW NW NW  W  W  W  W  W  W  W  W  W
WIND SPD              13 14 17 19 18 14 11 13 12 11 10 10 11 11 11 11 10  9 10
WIND GUST                      25
CLOUDS                OV OV OV OV OV OV OV OV OV OV OV BK BK BK SC SC SC SC SC
POP 12HR                    40          90          50          10          10
QPF 12HR             0.05-0.54   0.35-0.63   0.00-0.07           0           0
SNOW 12HR                00-00       00-00       00-00
FLURRIES                                      C  C  C  C  C  C
SNOW                                    C  C  S
RAIN                     C  C  C  D  D  L  C
WIND CHILL                              36 29 25 22 19 21 27 28 22 18 17 15 13
MIN CHILL                   37    30    31    21    15    17    20    14    10


DATE           12/25/03  FRI 12/26/03  SAT 12/27/03  SUN 12/28/03  MON 12/29/03
UTC 6HRLY     17 23 05   11 17 23 05   11 17 23 05   11 17 23 05   11 17 23
EST 6HRLY     12 18 00   06 12 18 00   06 12 18 00   06 12 18 00   06 12 18

MAX/MIN          40      29    48      34    51      38    52      39    48
TEMP          35 37 32   29 42 44 37   34 45 47 41   38 47 48 42   39 46 47
DEWPT         19 23 25   27 30 33 33   31 34 37 37   36 38 40 39   36 36 36
PWIND DIR         W      SW    SW      SW    SW       S     S      SW    SW
WIND CHAR        GN      GN    GN      LT    GN      GN    GN      GN    GN
AVG CLOUDS    SC SC SC   SC SC SC SC   SC SC SC SC   BK BK BK BK   BK BK SC
POP 12HR          5       5     5      10    10      10    30      30    30
```

*Example of AFM alphanumeric product*

```
POINT FORECAST MATRICES...UPDATED
NATIONAL WEATHER SERVICE LOUISVILLE KY
938 PM EST MON DEC 22 2003

KYZ030-230938-
LOUISVILLE-JEFFERSON KY
38.18N  85.73W
938 PM EST MON DEC 22 2003

DATE                    TUE 12/23/03            WED 12/24/03         THU
UTC 3HRLY     20 23 02 05 08 11 14 17 20 23 02 05 08 11 14 17 20 23 02 05 08 11
EST 3HRLY     15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 21 00 03 06

MIN/MAX                     47          52          28          36          23
TEMP                  49 47 47 50 51 48 43 38 34 31 28 30 35 36 31 28 26 24 23
DEWPT                 47 47 46 47 47 44 39 35 32 29 26 25 24 22 22 20 19 18 17
RH                    93100 96 89 86 86 86 89 92 92 92 81 64 56 69 71 74 77 77
WIND DIR               S  S  S  S  S  W NW NW NW  W  W  W  W  W  W  W  W  W  W
WIND SPD              13 14 17 19 20 16 10 13 12 11 10 10 11 11 12 11 10 10 10
CLOUDS                OV OV OV OV OV OV OV OV OV OV OV OV BK BK SC SC SC SC SC
POP 12HR                    40          90          50          10          10
QPF 12HR                  0.13        0.52        0.03           0           0
SNOW 12HR                00-00       00-00       00-00
FLURRIES                                         C  C  C  C  C
SNOW                                       C  S
RAIN                   C  C  C  D  D  L  C
WIND CHILL                              37 30 25 22 19 21 27 28 21 18 16 14 12
MIN CHILL                               37    25    19    20    21    16    12


DATE           12/25/03  FRI 12/26/03  SAT 12/27/03  SUN 12/28/03  MON 12/29/03
UTC 6HRLY     17 23 05   11 17 23 05   11 17 23 05   11 17 23 05   11 17 23
EST 6HRLY     12 18 00   06 12 18 00   06 12 18 00   06 12 18 00   06 12 18

MAX/MIN          42      30    49      33    52      37    53      39    49
TEMP          36 37 33   30 43 45 37   33 46 48 41   37 48 49 42   39 46 48
DEWPT         19 23 25   27 30 33 32   31 33 36 37   36 38 39 38   36 36 36
PWIND DIR         W      SW    SW      SW    SW       S     S      SW    SW
WIND CHAR        GN      GN    GN      LT    GN      GN    GN      GN    GN
AVG CLOUDS    SC SC SC   SC SC SC SC   SC SC SC SC   BK BK BK BK   BK SC SC
POP 12HR          5       5     5      10    10      10    30      30    30
RAIN SHWRS                                            C  C  C  C    C  C  C

$$
```

*Example of PFM alphanumeric product*

The AFM has replaced the Revised Digital Forecast (RDF), while the PFM will soon replace the Coded Cities Forecast (CCF). Both of the new products use formatters that are much more accurate than the previous method.

## Amateur Radio, SKYWARN, and the NWS

*by Stu Kratz, Amateur Radio Operator (WX4ME)*

As stated on the NWS webpage, "Skywarn is the National Weather Service (NWS) program of trained volunteer severe weather spotters". Skywarn volunteers support their local community and government by providing the NWS with timely and accurate severe weather reports. These reports, when integrated with modern NWS technology, are used to inform communities of the proper actions to take as severe weather threatens. Skywarn, formed in the early 1970's, historically has provided critical severe weather information to the NWS to help in the issuance and verification of warnings. Thus, the key focus of the Skywarn program is to save lives and property through the use of the observations and reports of trained volunteers. The elaborate radar and forecasting equipment at the NWS allows for determination of the potential or likelihood for severe weather. The NWS relies on reports from the public and law enforcement personnel for actual severe weather reports. Accurate and reliable information from the general public can be difficult to obtain, as severe weather is complicated and confusing. Therefore, NWS-led regular training of weather spotters improves the quality of information received. The NWS collaborates with Amateur (Ham) Radio organizations and others to put together these training programs. The NWS brings its weather knowledge and Amateur Radio personnel their expertise in emergency communications, and together they work with local government and the Red Cross.

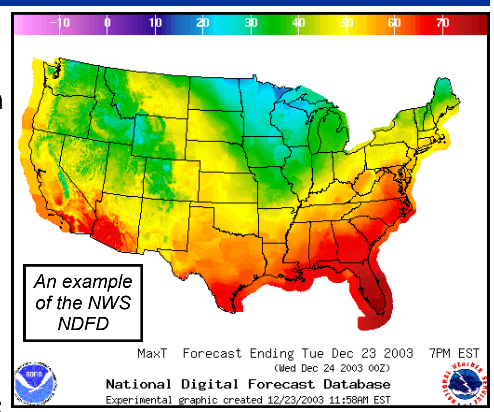
Amateur Radio operators' participation in the Skywarn program is formally acknowledged and encouraged in a Memorandum of Understanding (MOU) between the Amateur Radio Relay League (ARRL) and the NWS. This agreement indicates that ARRL will encourage its local volunteer groups operating as the Amateur Radio Emergency Services (ARES) to provide the NWS with spotters and communicators as requested by the NWS during times of severe weather. When the threat of severe weather is imminent, the NWS calls in Ham radio operators to run a weather net and gather information around Kentucky and southern Indiana from other licensed and trained operators. When radio operators enter the NWS building, the first thing they ask is, " Where is the severe weather occurring?" A meteorologist shows them the radar and points out critical areas of oncoming severe weather. The radio operator then begins asking other Hams for reports over the air of hail size, wall cloud sightings, wind speed, and observed storm damage.

***...Continued on Page 10...***

## NWS Forecast Verification *(continued from page 8)*

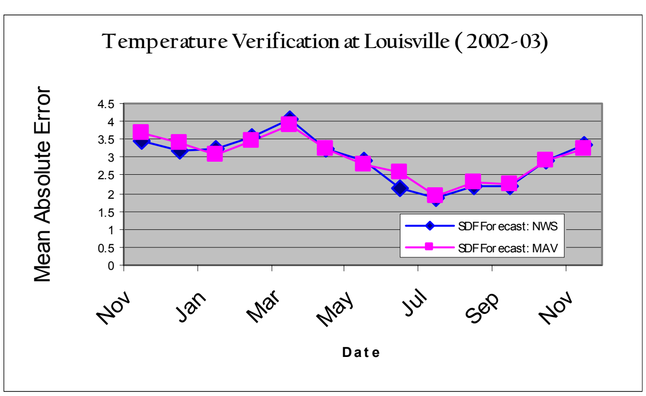
Verification of the NDFD (example graphic shown at right) is performed on a national scale. However, local verification at NWS Louisville still revolves around verification at four stations: Louisville International Airport, Lexington Bluegrass Airport, Bowling Green, and Huntingburg, Indiana.

Below is an example of verification data at Louisville, graphing the MAE from the first five periods of our forecast versus the Global Forecast System (GFS) model's "MAV". As one product in a group of Model Output Statistics (MOS) generated from various computer models, the MAV provides guidance alphanumeric information (temperatures, winds, POPs, etc) that generally are consistent and used as a benchmark for NWS forecast verification. The chart reveals the seasonal variability in the skill of the NWS and computer model generated forecast. During the cold season, daily temperature variability can be strongly affected by mid-latitude storm systems, cold and warm fronts, clouds, and precipitation. However, during the summer, daily temperature fluctuations are driven mainly by solar heating, or "insolation." Thus, temperature forecasting is most challenging during the winter season.




*An example of the NWS NDFD*

**The NDFD:**
The NWS National Digital Forecast Database contains several weather element grids on a national and regional scale. ***Check it out*** at www.nws.noaa.gov/forecasts/graphical/




*Mean Absolute Error (MAE) at Louisville Standiford Field (SDF): comparing the NWS forecast versus the "MAV" forecast.*

## Climatological Calendar

| Observed Temperatures and Precipitation: Summer and Fall 2003 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Location** | **Month** | **Average Temperature** | **Departure From Normal** | **Total Precipi-tation** | **Departure From Normal** | **Highest Temp (Date)** | **Lowest Temp (Date)** |
| **Louisville** | Jul | 76.0 | -2.4 | 4.33 | 0.03 | 92 (4th) | 60 (24th) |
| | Aug | 76.4 | -0.6 | 4.70 | 1.29 | 93 (27th) | 62 (19th, 24th) |
| | Sep | 66.3 | -3.8 | 6.63 | 3.58 | 87 (1st) | 41 (30th) |
| | Oct | 57.8 | -0.7 | 2.24 | -0.55 | 80 (20th) | 35 (3rd) |
| | Nov | 50.7 | 3.1 | 5.69 | 1.88 | 82 (3rd) | 23 (25th) |
| **Lexington** | Jul | 75.1 | -1.0 | 5.10 | 0.29 | 93 (8th) | 57 (24th) |
| | Aug | 75.7 | 0.9 | 4.51 | 0.74 | 91 (27th) | 61 (12th, 24th) |
| | Sep | 65.1 | -2.9 | 5.07 | 1.96 | 86 (1st) | 40 (30th) |
| | Oct | 56.2 | -0.3 | 1.75 | -0.95 | 78 (11th) | 33 (18th) |
| | Nov | 49.5 | 3.5 | 5.93 | 2.49 | 77 (3rd, 4th) | 22 (2nd, 5th) |
| **Bowling Green** | Jul | 76.7 | -1.8 | 4.43 | -0.11 | 91 (16th, 20th) | 57 (24th) |
| | Aug | 77.3 | 0.5 | 3.41 | 0.05 | 94 (22nd) | 61 (12th) |
| | Sep | 66.9 | -2.7 | 6.88 | 2.75 | 90 (1st) | 39 (30th) |
| | Oct | 58.3 | 0.4 | 1.31 | -1.86 | 80 (20th) | 34 (3rd) |
| | Nov | 51.5 | 4.0 | 5.17 | 0.71 | 80 (3rd) | 22 (25th) |

| | Normal High/Low Temperatures | | | | Record Monthly High/Low Temperatures | | | |
|---|---|---|---|---|---|---|---|---|
| **Location** | **Dec 1** | **Jan 1** | **Feb 1** | **Mar 1** | **Dec** | **Jan** | **Feb** | **Mar** |
| **Louisville** | 50/34 | 42/26 | 43/26 | 51/32 | 76 (1982)<br>-15 (1989) | 79 (1943)<br>-22 (1994) | 78 (1992)<br>-19 (1951) | 88 (1929)<br>-1 (1960) |
| **Lexington** | 49/33 | 41/25 | 41/25 | 50/32 | 75 (1982)<br>-19 (1989) | 80 (1943)<br>-21 (1963) | 80 (1996)<br>-20 (1899) | 86 (1929)<br>-4 (1873) |
| **Bowling Green** | 52/33 | 44/26 | 45/26 | 53/32 | 78 (1982)<br>-14 (1989) | 78 (1943)<br>-26 (1886) | 83 (1918)<br>-20 (1951) | 92 (1929)<br>-6 (1960) |

## Amateur Radio, SKYWARN, and the NWS *(continued from page 9)*

These reports either help prompt the NWS to issue warnings, or provide verification for already issued warnings. As I have always said, "Hams are the eyes and ears of the NWS." With this close relationship, we strive to help our communities throughout the United States.

Ham radio operators take the Skywarn program very seriously. As a result, the NWS and the American Radio Relay League decided to let the Hams have a little fun every year by creating "Skywarn Recognition Day". SRD was developed in 1999 in celebration of the contributions that volunteer Skywarn radio operators make to the NWS. During this event, Skywarn operators visit their local NWS office with high frequency radios and string up antennas to make contacts throughout the United States and the world for a 24-hour period. NWS meteorologists can join in the fun and operate the radios along side of the Hams. After this event concludes, Hams around the world send in their contacts to the NWS and, in return, receive a certificate as a "Thank You" for providing information to the NWS during severe weather throughout the year.