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Your 24 hour a day source for weather information across Central Indiana

Sky Watch

Volume 11 Issue 2

A Wet and Stormy Spring

Above: A wall cloud on May 26th taken by weather spotter Bob Poortinga

The waning La Nina pattern brought an active weather pattern to central Indiana through spring. Numerous storm systems pushed through the state, resulting in above normal rainfall during the season. Along with the rainfall, came the typical spring thunderstorms and severe weather.

Severe weather impacted many areas in Central Indiana during the month of April. Four tornadoes touched down during the month, with 3 of the 4 happening on April 19th. The first outbreak was on April 4th, when strong Thunderstorm winds resulted in damage in Lebanon,

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A Wet and Stormy Spring — Continued

Month	Average Temperature	Temperature Departure from Normal	Precipitation	Precipitation Departure from Normal
April	55.8	+3.8	7.98	+4.37
May	63.8	+1.2	4.97	+0.61
June	73.7	+2.0	5.76	+1.63

Above: A table displays the average temperature, precipitation, and the departure from normal for each month this past spring at Indianapolis

(Continued from page 1)

removing roofs and in Williamsport, knocked over a bank sign.

One of the stormiest days of the month came on April 19th, when 3.06 inches of rain fell at Indianapolis. On that day, a strong storm system moved through the area, bringing multiple lines of strong to severe thunderstorms. Widespread wind damage also occurred, in addition to the 3 tornadoes. One longer track tornado pushed through Vermillion and Parke Counties. The other two tornadoes were brief touch downs in Tippecanoe and Boone counties.

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Right: Water flows onto a road from a spillway.

Below: River flood waters surround a home.

Left: An April 21st Tornado knocked the brick wall of this storage barn.

A Wet and Stormy Spring — Continued

Above: Near Golfball size hail fell on May 10th

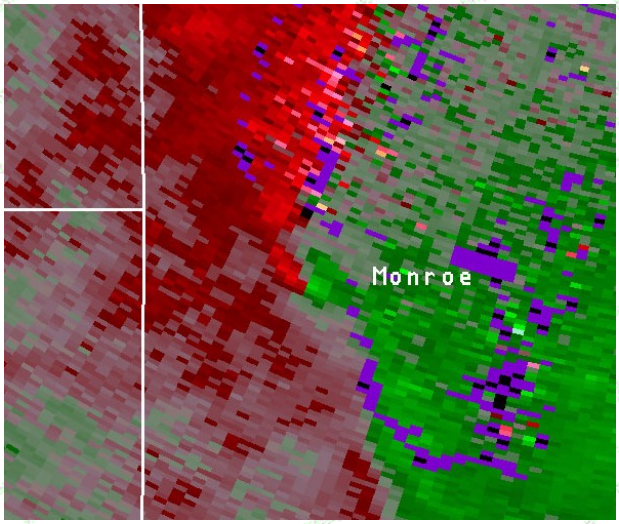
(Continued from page 2)

The fourth tornado of April touched down on the 23rd when additional strong to severe storms were moving across the area. Strong storms moved across the area at times during the last week of April as well, with wind damage occurring across southern sections of the area on the 28th.

The wet April which brought 7.98 inches of rain to Indianapolis, which was over 4 inches above the normal. This resulted in flash and areal flooding initially, followed by river flooding. The photos o page 2 show some of the effects of the wet and stormy April.

May 2011 would end up being a less wet month, but storms would continue throughout the month. Severe events occurred on May 22nd, 23rd, 25th, and 28th. On May 22nd, storms dropped hail up to 3 inches in diameter. A squall line pushed eastward across the area during the evening of the 23rd and gusts up to 80 mph resulted in numerous reports of wind damage and power outages. On May 25th, southwestern portions of central Indiana were placed in a high risk for severe weather for the first time since late October of 2010, while the rest of central Indiana was in a moderate risk. The approach of a potent low pressure system from the west provided a rich environment for severe storm development throughout the day. Seven tornadoes touched down during the evening causing damage ranging from EF-0 to EF-2 intensity across central Indiana.

The frequency of severe weather in June diminished to some degree from the number of events experienced



Top: A rotating Thunderstorm as seen by the IND RADAR. The red and next to each other indicate the rotating thunderstorm couplet.
Bottom: Tornadic Thunderstorm damage to a home in Lawrence County.

A Wet and Stormy Spring — Continued

Above: The Vincennes Boat Club is Flooded

(Continued from page 3)

across central Indiana across April and May. However, there were several notable events throughout the month. A squall line developed over northern Indiana on the evening of June 4th and quickly spread south into the northern portions of central Indiana. These thunderstorms produced hail and damaging winds. A tree fell on a vehicle at Mounds State Park near Anderson as the storms arrived that evening, causing one fatality and three injuries.

Several rounds of storms during the early afternoon of June 10th and the overnight hours produced damaging winds up to 60-70 mph, resulting in downed trees, power lines, and tree limbs. The damage associated with the storm development occurred along the northern portion of central Indiana near a stationary front.

Above: Damage to starage facility in Medora.

The last notable severe weather event of the month occurred in the early morning of June 20th as thunderstorms developed along a weak boundary across the region.

Above: This Trampoline was damaged by Thunderstorm winds. The NWS continues to NOT recommend taking shelter on trampolines during severe weather.

So far this year, there has been 13 tornados in Central Indiana, and a total of 60 in the entire state of Indiana. Your work as spotters has helped the National Weather Service protect lives and property. Thank you!

River Forecasting

By John Kwiatkowski, Science and Operations Officer

This spring brought record rainfall to many parts of Indiana. This resulted in record river flooding in some areas. Not everyone realizes the National Weather Service forecasts river levels, but it is one of the most important things we do. While the complete story of this process is very complicated, the basics are relatively simple.

Step one is to determine how much rain fell on a river basin. This can be done in a number of ways, but the most common is to use combination of radar data and observer ground truth. Both the amount of rain and the time it took to fall are important. An inch of water that comes over a day will have a greatly different impact from the same amount of rain that falls in an hour.

Next, runoff has to be estimated. When precipitation occurs, some of it is absorbed by the ground. What isn't absorbed is runoff, the water that actually makes it into rivers. Estimating runoff is one of the most complicated aspects of river forecasting. It requires knowledge of soil type, topography, and previous weather history. There are different ways to determine runoff, ranging from rules of thumb to sophisticasted computer models.

Given runoff in a river basin is known, the amount of water entering a river is also known. This can be matched to historical records indicating how the river responded to similar input in the past. For example, if we know that one inch of runoff over one day produced a certain stage at Point X in the past, it is likely the same runoff will produce a similar result in the future.

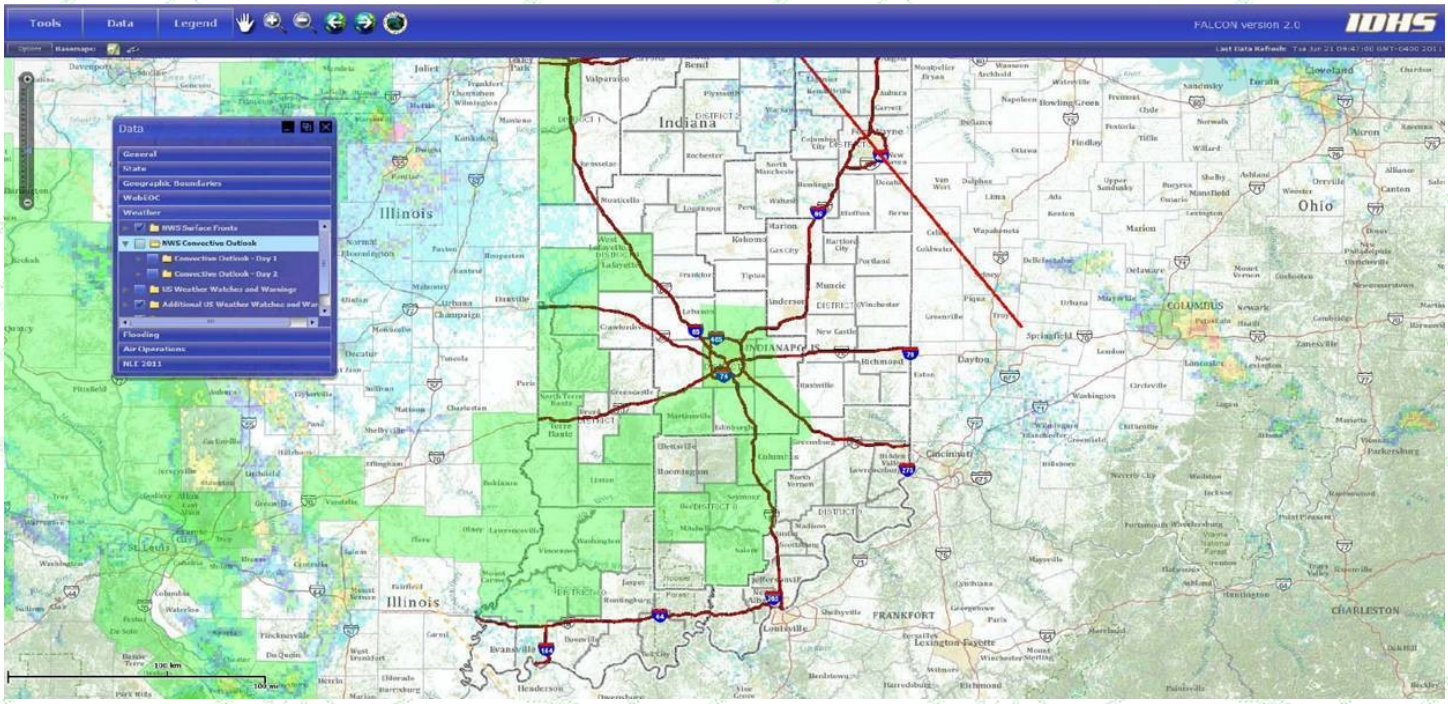
Above: The Wabash *River Basin and its Tributaries.*

But that's not the whole story. For a larger river, like the Wabash, rain may fall over some of its tributaries but not others. In that case, the water going into each tributary has to be computed. These values are added to determine what the main river is receiving. A complicating factor with this process is timing—*when* the water arrives at the main river and how fast it moves downstream once it gets there are just as important as *how much* water there is.

As mentioned before, the details for river forecasting are extremely complicated. That's why the National Weather Service has hydrologists whose sole duty is to be river experts. The forecasts generated by our hydrologists are disseminated in many forms, but some of the most useful are from the Advanced Hydrologic Prediction Service, abbreviated as AHPS. You can see AHPS data for Indiana on the web by going to http://crh.noaa.gov/ind, finding "Hydrology" in the left hand column, and then selecting "Rivers & Lakes".

NWS Plays an Important Role in IDHS Activities

By Ashlee Moore, IDHS GIS Analyst/CI Planner



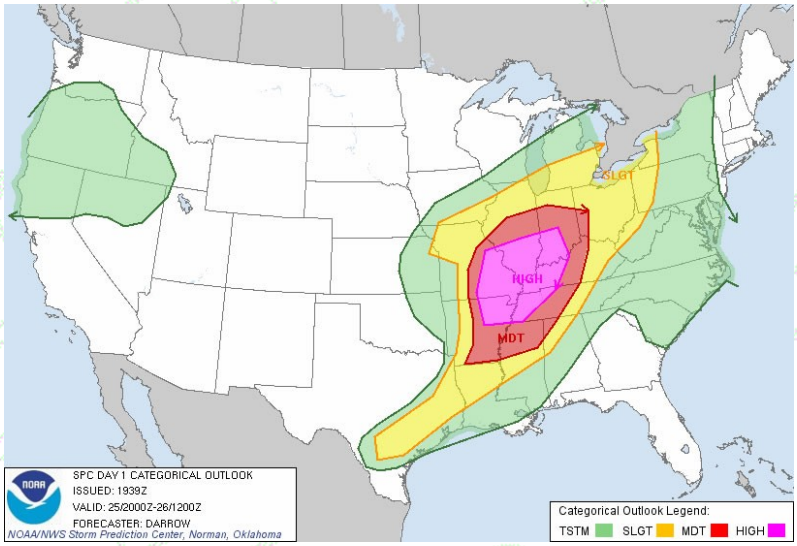
Weather forecasts and weather-related geographic information system (GIS) data are invaluable tools in the world of emergency management. From anticipating a significant weather event days in advance, to building a case for a Presidential Disaster Declaration and writing statewide plans, the Indiana Department of Homeland Security (IDHS) utilizes weather information on a daily basis.

The IDHS Watch Desk Officers monitor information on a daily basis from the Storm Prediction Center (SPC), Advanced Hydrological Prediction Service (AHPS), as well as numerous other NOAA/NWS resources as a first line of information about weather systems that could significantly impact the state of Indiana. The state Emergency Operations Center (EOC) becomes the coordination hub of state and federal agencies during times of disasters; email alerts are sent out to pre-identified personnel when a situation looks to have a significant impact. During events the state EOC stays in touch with the various NWS offices that have jurisdiction in Indiana by participating in conference calls, interacting through WebEOC (IDHS' crisis information management system), monitoring NWSChat and on some occasions requesting the presence of an NWS representative in the EOC.

The face-to-face interaction with NWS staff in the EOC was particularly beneficial during the February 2011 ice/snow event that impacted a large portion of the state. NWS meteorologists were able to update the state EOC on changing conditions and ice accumulation amounts in a very timely manner. As a result, the state EOC was better able to assess what the impact

NWS Plays an Important Role in IDHS Activities

By Ashlee Moore, IDHS GIS Analyst/CI Planner



could be and where resources would be needed; updates to ice accumulation totals were particularly helpful since high winds, coupled with ice accumulation, threatened to knock out power throughout a large portion of the state.

Easy access to detailed and reliable forecasts allows GIS analysts in the state EOC to assess the population and infrastructure with the highest likelihoods of being impacted. As our technology advances, so does the use of GIS data as it pertains to weather. The NWS provides some of its current weather data in a format that is consumable by GIS users. IDHS takes advantage of this data and has incorporated information like Storm Prediction Center Convective Outlooks, warning products (polygons), surface fronts and river gauge observations/forecasts into its map viewer (named FALCON) and GIS database as a dynamic data set. By consuming GIS data directly from NWS, IDHS GIS analysts are able to overlay weather information with in-house data that is pertinent to planning, response and recovery efforts.

By combining the use of GIS weather data with infrastructure data, IDHS can better pinpoint areas of potential damage in which to conduct Preliminary Damage Assessments (PDAs). Conducting joint PDAs with the Federal Emergency Management Agency (FEMA) is an important step in the Presidential Disaster Declaration process. In addition to meeting the threshold for damage necessary for a declaration, a detailed assessment is essential for communicating the magnitude of the event – this includes storm reports, record events, and a detailed analysis of how the event unfolded.

Forecasts and weather information provided by the NWS are an important component in numerous activities that take place at IDHS. Weather is something that impacts everyone, everyday. IDHS understands the importance of taking significant weather events seriously and as a result has purchased and distributed approximately 13,500 all hazards alert radios to at-risk Hoosiers throughout the state over the last two years. The radios were divided among all 92 counties and delivered to each county emergency management agency for distribution. Economically disadvantaged Hoosiers, including residents of mobile homes, were targeted to receive these radios. Protecting the lives and property of Hoosiers would not be possible without strong partnerships like those between IDHS and the NWS.

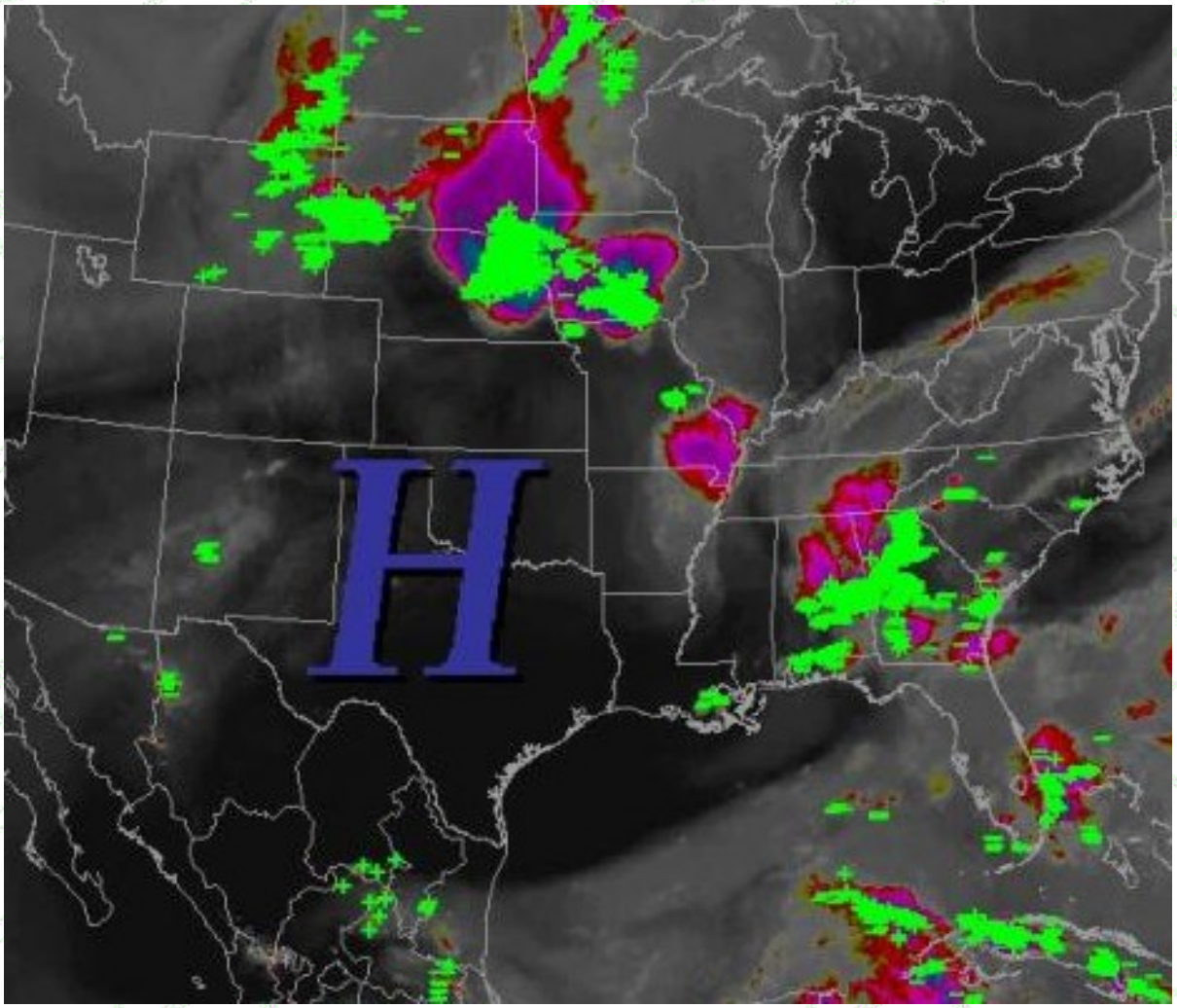
Word Search: Locations with EF-5 Tornado Damage (Since 2007)

By Adam Baker, Meteorologist Intern

U R H I G J P E L M G B S I
Q L A H R N N R A R H P Q B
R Z C S U Y R F U U C Q L R
A O K Y B U N B Z C B Q A B
W K L A S T S O N Y M I J C
O L E J R N P A P I N R T M
N G B I E B X U U S L U W T
O F U E K P O T V O W P V U
N E R B R M I I I N N C O J
E G G R A V L M S I U Y N J
R N O W P L N O T S E R P G
L E I N E Q K X I W U M L E
E D V L J H N I X F P Y Z N
H H C S M I T H V I L L E B

Greensburg (KS, 5/4/07)
Parkersburg (IA, 5/25/08)
Smithville (MS, 4/27/11)
Hackleburg (AL, 4/27/11)
Preston (MS, 4/27/11)
Rainsville (AL, 4/27/11)
Joplin (MO, 5/22/11)
El Reno (OK, 5/24/11)

By Joe Nield, Meteorologist



Many people are aware of the "ring of fire" as it pertains to geology - a zone surrounding the Pacific Ocean basin characterized by high levels of seismic and volcanic activity. The "ring of fire" also exists in meteorology, and is often observed in the summer, when upper level ridges of high pressure settle across the southern or southeastern portions of the nation. Underneath the high pressure, downward motion occurs and conditions are stable. However, around the periphery of the ridge, upper level disturbances and moisture riding around the ridge can allow thunderstorms to form. The image below is an example taken from Sunday evening, June 26th, near 8 PM EDT. If you were to look at a loop of this image, you would see the thunderstorm complexes rotating in a clockwise fashion around the periphery of the ridge over the southern plains.

Note that in just one hour, 21,002 lightning strikes were observed across the country! We just finished the annual Lightning Safety Awareness Week, but it is always good to remind ourselves of the danger lightning poses, not only from strong or severe storms, but even from a weak and otherwise non-severe summertime thunderstorm.

Lightning Safety Awareness Week

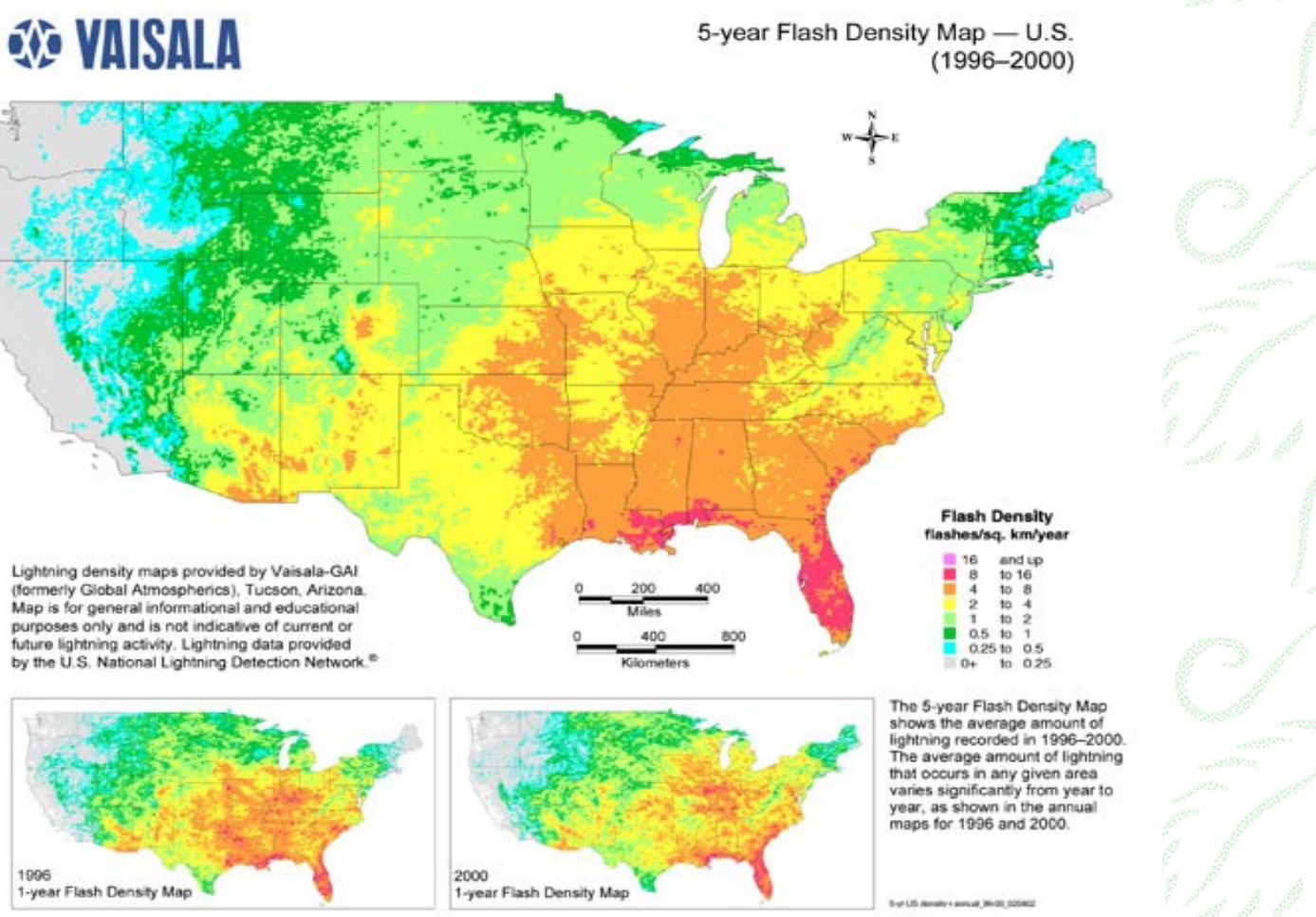
By Tara Dudzik, Meteorologist

The week of June 19-25 was National Lightning Safety Awareness Week. This is a time to draw attention to the dangers of lightning. Each year, lightning is responsible for an average of 55 deaths and 500+ injuries across the nation. Yet, people generally do not respect just how powerful this one element of severe weather really is and do not always take the necessary precautions.

So, how does lightning form? First, cumulus clouds develop, usually late in the day when the earth's surface warms. The warm air starts to rise, and cumulus clouds slowly form. Some of these cumulus clouds will grow into thunderstorms that contain precipitation. Basically, the different types of precipitation in the cloud (ice, hail, rain, etc.) start colliding with one another, becoming charged. Eventually, these positive and negative charges start reacting with one another within the cloud and with charges on the ground. When the charges become strong enough, lightning forms. Lightning can occur within the cloud itself, or between the cloud and ground. It is this cloud-to-ground lightning that is so dangerous. One way to determine how close lightning is, is to count the seconds between the lightning flash and thunder, since thunder is the sound made by lightning. The sound of thunder travels about a mile every 5 seconds, so if you count the seconds between the lightning flash and the thunder and divide by 5, you get the number of miles away the lightning is from you. http://www.lightningsafety.noaa.gov/overview.htm

To give you some idea of how hot lightning really is, multiply the temperature of the surface of the sun about 5 times. You will find out that lightning is approximately 50,000 degrees Fahrenheit. Now

Lightning Safety Awareness Week– Continued



imagine being struck by something that intense! There are ways to prevent this from happening. Here are some safety tips to protect you from the deadly consequences of lightning:

First and foremost, Go Indoors! So many people try to get those final innings of a baseball game in, or those last few putts on the golf course. But, is risking your life over it really worth it? You will want to go into a safe building, which is one with a fully enclosed roof, walls and floor, and has plumbing and wiring. Some examples of unsafe buildings include car ports, covered patios, open garages, tents, baseball dugouts, or sheds. In addition, do not stand under tall, isolated trees.

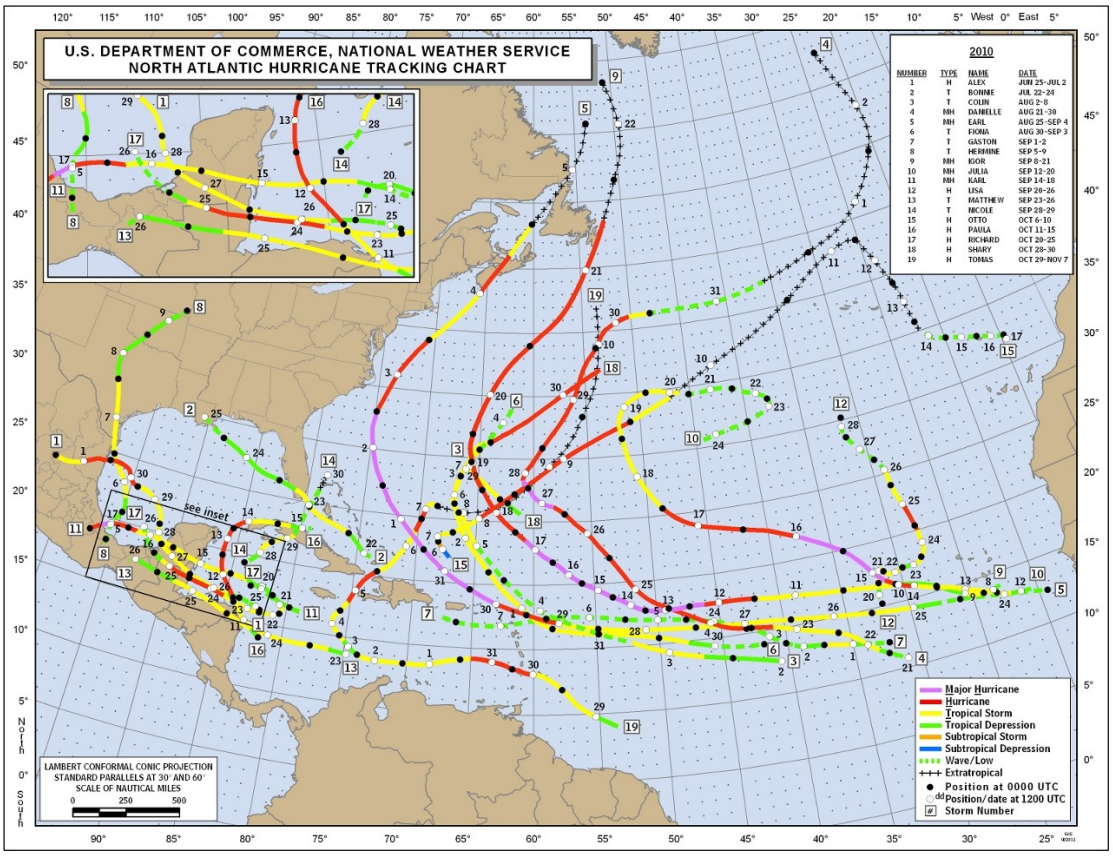
Once inside a safe building, do not use any corded appliances or electronic equipment. Also stay away from showers, sinks, and bath tubs. If you are not near a safe building, a safe vehicle is another option. Safe vehicles include any hard-topped car, minivan, bus, truck, etc. And, never leave the vehicle during the thunderstorm.

Here is an additional link that includes many interactive activities for kids such as coloring books, fun facts, and games: http://www.lightningsafety.noaa.gov/kids.htm

Hurricane Outlook 2010

By Adam Baker, Meteorologist Intern

The 2011 Atlantic Hurricane Season lasts from June 1st until November 30th, and climatologically peaks on September 10th, so we have plenty of time to see how this year's season shapes up! As of mid May, NOAA's Climate Prediction Center forecast the season to be above normal, with 12-18 named storms (at least tropical storm intensity with winds of 39 mph), 6-10 hurricanes (winds at least 74 mph), and 3-6 major hurricanes (Category 3 or higher with winds at least 111 mph). Last season was unique in that it was quite active and above normal, however there were no hurricane landfalls in the U.S. and only 2 tropical storms tracked over any



Above: The 2010 Northern Atlantic Hurricane tracks.

portion of the country (Bonnie and Hermine). All in all, there were 19 named storms, 12 hurricanes, and 5 major hurricanes (see map above, http://www.nhc.noaa.gov/tracks/2010atl.jpg).

Last season was impacted by "La Niña", which is characterized by the cooling of the equatorial Pacific and increased sea surface temperatures in the Atlantic. Although this season will likely see the La Niña come to an end, some of the typical impacts of La Niña are expected to continue into this season, including reduced wind shear. The combination of increased sea surface temperatures and reduced wind shear are several main ingredients that provide a favorable environment for tropical cyclone development. Tropical cyclones are fueled by air-sea interactions across areas of relatively warm sea surface temperatures and are allowed to organize into well-defined circulations in areas of low wind shear. Areas of high wind shear tend to tear the storm apart. Large-scale global circulations and disturbances can also influence the favorability for storm development.

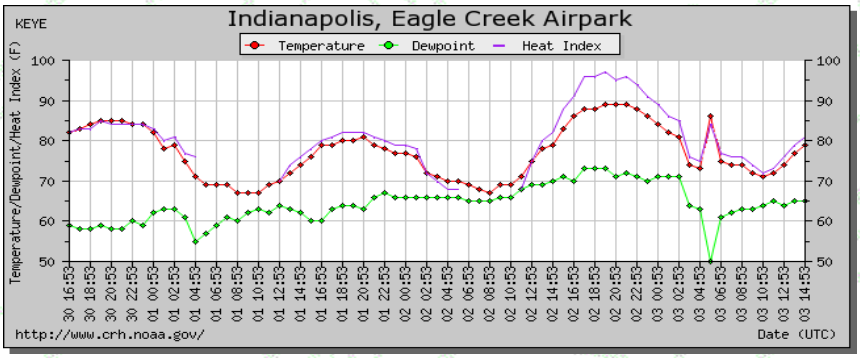
Although hurricanes and tropical storms can pose great threats to coastal areas, the remnants of these storms can track well into the mainland of the U.S. and threaten inland regions with high winds, heavy rains, flooding, and isolated tornadoes. A recent example of this was when the remnants of Hurricane Ike tracked over Indiana back in September of 2008 and damaging winds left thousands of residents without power.

Heat Burst

By Joe Nield, Meteorologist

In addition to the impressive natural fireworks show, gusty winds, small hail, and very heavy rainfall from a strong thunderstorm complex across central Indiana on July 2nd, an interesting and fairly rare atmospheric phenomenon occurred in the Indianapolis area - a **heat burst**.

Heat bursts are not completely understood, partially owing to the fact that their small spatial scales and short duration make observing them difficult. However, several researchers over the past few decades have offered hypotheses based on observational studies of heat bursts occurring in areas with an established mesonetwork *(small scale network of observation sites)*.



Temperature and dewpoint meteogram for KEYE. Notice the rapid changes between 0500 UTC (1:00 AM EDT) and 0600 UTC (2:00 AM EDT). The temperature rose from 72 to 86 degrees

In general, these studies indicate that heat bursts are the result of dry downbursts *(strong, small scale downdrafts from thunderstorms)* occurring from decaying nocturnal thunderstorms, perhaps with a contribution from a descending rear inflow jet into the decaying storms. Typically, these downbursts originate from fairly high in an atmosphere with significant dry air aloft. These downbursts descend quickly, with the air drying and warming as moisture in the air evaporates and increasing pressure compresses and warms the air. As with the downbursts that typically cause damaging winds in a severe thunderstorm, this downburst strikes the ground and spreads out horizontally, resulting in a rapid increase in wind speed and gusts. In addition to increasing temperature, decreasing dewpoint, and increasing winds, rapid pressure drops are often observed as well.

Some heat bursts can be particularly severe, with damaging winds of 80-100 mph, and temperature increases to above 100 degrees occurring in the middle of the night. A recent case in Wichita, KS resulted in temperatures rising to 102 degrees with damaging wind gusts. A handful of historical cases have occurred where temperatures associated with heat bursts have briefly approached 130+ degrees.

Fortunately, the heat burst that occurred in the Indianapolis area last night was not nearly this severe. Observations around 1:30 AM EDT in the area indicate the temperature rose and the dewpoint dropped nearly 15 degrees in a less than an hour, causing the relative humidity to drop nearly 40-50%. Winds increased rapidly, with gusts to near 50 mph. One NWS Indianapolis employee reported that his neighbor's patio furniture ended up in his backyard. It is likely that at least a few small limbs were downed by these winds as well.

The observation site at Eagle Creek Airpark (KEYE) best observed the temperature, dewpoint, and pressure changes. The site at Indianapolis International Airport (KIND) observed the strongest wind gusts associated with the heat burst.

Spotters! Remember, this newsletter is for you! You could be a guest columnist in our next issue of "SKYWATCH". If you have an interesting weather story or storm chasing experience to share with the other spotters, submit it to our webmaster at w-ind.webmaster@noaa.gov.

Please keep any submissions to one page of typewritten text. We are also always looking for pictures of hail, tornados and storm damage that occurred in Central Indiana. Feel free to send those items also. Any photos submitted may be included in the next edition of Skywatch. Or our online IND Photo Gallery. We try to give credit for photo submissions where possible. The next issue of "SKYWATCH" is planned for fall.

NWS Indianapolis is now on Facebook!

Like us on Facebook at:

http://www.facebook.com/pages/US-National-Weather-Service-Indianapolis-Indiana/207144502648963

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