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and
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Indiana State Climate Office

Monthly Weather Report

Oct 9, 2013



<http://www.iclimat.org>

September 2013 Climate Summary

Month Summary

The hottest day of the year in many Indiana cities and towns was recorded on September 11th, so late on the calendar. Moderate drought advanced from Illinois into northwest Indiana in early September. By mid-month only 17% of Indiana soils were rated in normal soil moisture status. Dry weather the first half of the month hurt crops in the grain fill stage.

The rains returned on September 19th when severe thunderstorms with heavy lightning and intense rainfall raked northern and central Indiana. Two Gary men were killed, one struck outdoors by lightning while a second died in a house fire started by lightning. Lightning started other fires in homes and restaurants in northern and central Indiana that day.

The September state average temperature of 67.1°F is 1.5°F above normal and ties 1972 as the 44th warmest September in Indiana since 1895. Some recent warmer Septembers include 2002 and 2005 tied for 17th warmest at 69.3°F; 2007 with 68.9°F in the 23rd spot; and 2010 tied with 1912, 1945, and 1948 in 36th place with a 67.5°F average. The warmest September on record was a 72.2°F average in 1925. The day split in September 2013 was 11 days of below normal temperature, 18 days above normal, and 1 day at normal. The daily state average temperature was 10°F or more below normal on 1 day. There were 2 days when the daily state temperature was 10°F or more above normal. Two cities reached 100°F, the hottest temperature of the month: Logansport on September 11th, and Terre Haute the next day. The cool spot in Indiana was 32°F recorded at Marion on September 14th.

September state precipitation averaged 2.98 inches, a tad 0.11 inch below normal. This places September 2013 in the middle of the ratings pack, very close to the September normal. The distribution of rainfall was very unbalanced when the bulk of the precipitation came at the very start of the month and during the third week. Regionally September 2013 precipitation was about 80% of normal in northern Indiana, close to normal in central, and about 110% of normal in the south. Normal September precipitation is about 3.1 inches. The highest single day precipitation came on September 19th at Rensselaer when a CoCoRaHS observer there reported 4.81 inches. The largest one-day measurement at a cooperative station was 3.50 inches in Francesville. Widespread rain fell on about 11 days this month.

Severe weather was localized to just a few central Indiana counties on September 10th and on the next day in extreme northeast Indiana. Damage on both days was related to high winds and power outages. With the lightning event already reported for September 19th, in total there were 3 severe weather days this month. Details on these events follow in the weekly narratives below.

September 1st – 7th

Temperatures were moderate this first week of the month. Despite some rainfall over the Labor Day weekend the significant weather story continues to be deteriorating soil moisture in Indiana. This week saw the introduction of moderate drought in our northwest counties while abnormally dry conditions persist across much of central Indiana. Storm systems are moving rapidly across the Midwest which leaves little time to transport Gulf moisture northward into our state.

It was warmer than normal early and late this week with cool weather in midweek. The month opened with state average temperatures about 4°F above normal. Indiana was located in a sector of warm air that covered the east half of the country. The next day a cold but mostly dry front passed through the state. The state temperature fell only slightly to 2°F above normal. The cold front moved quickly to the Atlantic Coast on September 3rd and a ridge of fair weather began building in from the Great Plains. The state temperature fell to 3°F below normal, the coolest of the week.

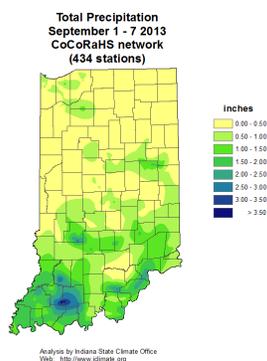
The next day the ridge was overhead Indiana wedged between two cold fronts, the original front in the Gulf states, and a new one approaching from Michigan. A high pressure center in Manitoba pushed the Michigan front through Indiana on September 5th. The state average temperature was now just 1°F below normal. This front also traveled quickly through the Midwest and reached the Gulf states the next day. The Manitoba pressure center raced eastward across Michigan and then to New York. From this location this center pumped light southerly winds into Indiana, raising the temperature slowly to normal by September 6th. To end the week this system drifted south to Virginia as Indiana warmed slightly to nearly 3°F above normal. Usually at the start of September daily maximum temperatures should range from about 78°F to 86°F north to south across Indiana. Daily minimums normally vary from near 58°F in far northern counties to about 62°F in the far southwest area.

The only substantial rainfall this week came on September 1st. The promise of more rain to help parched soils ended there as only tiny amounts of rain were recorded the next few days. The rainfall now turned off with dry weather the remaining 3 days this week. Regionally about a quarter inch fell across northern Indiana this week, a half inch in central, and just over an inch in the south. These totals equate to about 35% of normal in northern Indiana, 90% in the central section, and double the normal in the south. The holiday weekend rainfall was helpful to southern Indiana with locally heavy downpours in that area. Some September 1st amounts tallied by CoCoraHS observers included 4.12 inches at Huntingburg. Two other Huntingburg volunteers each recorded 3.06 inches that day. The rain gage at Stendal collected 3.20 inches while 3.08 inches was noted in Washington. Not much more rain came later in the week so the maximum weekly totals were nearly the same as those of September 1st.

Rainfall has been scarce the past few weeks in the Midwest. Drought conditions in Illinois were worsening and on the move eastward and have now reached Indiana. The September 3rd edition of the US Drought Monitor has introduced moderate drought (D1 category) into Newton and Benton counties of northwest Indiana. Abnormally dry conditions (D0 category) have expanded to cover nearly all of St Joseph, Marshall, Elkhart, Kosciusko, Lagrange, and Noble counties and parts of Steuben and Dekalb counties in northern Indiana since a week earlier. There was a bit of good news as the southern tier of central Indiana counties in the abnormally dry area of last week have improved to normal soil moisture status. But the forecast for a continued shortage of rainfall in coming weeks means the deterioration of soil moisture may persist and should be watched carefully.

The Drought Monitor puts moderate drought coverage at 2% of total Indiana land area, abnormally dry at 36% coverage, and the remaining 64% in normal soil moisture status.

The warm temperatures and rainfall deficit are hurting corn and soybean crops according to the September 9th edition of the USDA Indiana Weather and Crops report. Some fields are dying prematurely while others are accelerating to maturity, cutting short kernel and bean pod filling. Indiana corn was rated at 9% mature and 61% in good or excellent condition, a slide from a week ago. Soybeans were turning color and shedding leaves with small bean pods or pods being aborted. Soybeans were rated at 55% in good or excellent condition. Pastures have declined to 32% in good or excellent condition but livestock were holding up fairly well with only minor heat stress evident. Hay yields were smaller than expected. The weekly soil moisture survey rated both topsoils and subsoils at 70% short or very short of moisture.



September 8th – 14th

Unlike a week ago Indiana daily average temperatures ran up and down the thermometer in a 23°F spread. September 10th became the hottest day of the year, so late on the calendar, in many cities and towns. Rainfall still was hard to come by with mostly light amounts on 3 days. The subpar rainfall meant most Indiana soils continued to dry out. But corn and soybean condition ratings changed little in the past week.

On September 8th state average temperatures sat at 5°F above normal. A cold front in central Indiana was struggling to push south to the Ohio River. The front marked the battle line between two high pressure centers, one in Canada and another in Georgia, to see which would win out. The cold front stalled over Indiana the next day, then reversed direction as a warm front on September 10th. The southern high pressure center gained control of the eastern half of the country and the summer heat really turned on. Maximum temperatures recorded at the morning observation on September 11th had soared to 97°F and 98°F the previous afternoon, setting new record high temperatures for the date in several towns of northern and central Indiana. State average temperatures peaked at 13°F above normal, the warmest of the week. The heat continued through September 11th with a second day of near record maximum temperatures, a few degrees cooler than the day before.

In the upper atmosphere a huge high pressure dome of hot air has dominated southwest states for months now. This dome has slid to the Great Lakes region from time to time this year, spilling its heat eastward, then withdrawing west. This cycle has repeated again triggering this late summer Indiana heat wave. But now the high pressure dome retreats west again and a big temperature change is underway.

A series of four cold fronts, each wave a step colder than the one before, enforced a major cool down across Indiana over two days. The first two fronts moved through the state on September 12th. This bulge of cold air headed directly south from Hudson Bay dropped the state average temperature to 7°F above normal. Two more cold fronts passed through Indiana on September 13th which then merged over the southern Gulf states. Cold air poured into the Great Lakes region and eventually spread to cover nearly the eastern two-thirds of the country. Indiana state average temperatures now plunged to 7°F below normal. The massive cold high pressure center moved overhead Indiana at the close of the week. Colder air continued to stream into the state, dragging state temperatures to 10°F below normal, the coldest of the week. Considering its very warm start and cold ending, the overall temperature for the week averaged to 4°F above normal. Typically for this part of September daily maximum temperatures should vary between 76°F in far northern Indiana to 83°F in the southwest corner of the state. Daily minimums normally range from 56°F to 59°F north to south across Indiana.

The week began dry until the series of cold fronts squeezed at least some moisture from the skies. Regionally for the week about 0.5 inch fell in northern Indiana, 0.4 inch in central, and 0.3 inch in the south. These totals are far below normal with just half the normal amount in northern and central counties and 40% of normal in southern Indiana. Yet showers were scattered and rain did not fall evenly on all areas. The heavier CoCoRaHS reports on the morning of September 11th included 2.33 inches in English, 1.56 inch at Milltown, and 1.53 inch in Cannelton, all in south central Indiana. Kokomo had 1.47 inch that day and Spencer measured 1.43 inch. Only slightly more rain fell the remaining days of the week adding to the weekly totals. Some of the heaviest weekly totals noted were 2.46 inches at English and reports of 1.63 inch and 1.46 inch at two locations in Milltown. Two Kokomo volunteers had 1.60 inch and 1.48 inch for the week.

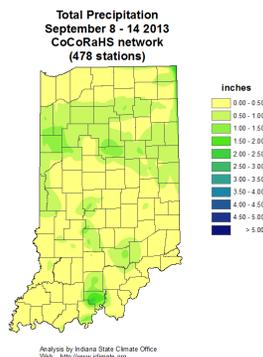
The four cold fronts marked the transition to much colder temperatures and with this sudden change some severe weather could be expected. On September 10th localized severe weather occurred in two Indiana counties. In Rush county a tree fell on a house and other trees were uprooted in high winds. Gusty winds caused damage to two homes and an apartment building in Marion county. Many power outages were also reported.

The next day the action shifted to far northeast Indiana. In Lagrange county wind gusts tore the roof off a building and damaged a local hotel. In adjacent Steuben county trees and power lines were taken down by high winds.

The spotty rains did little to slow down the advancing Indiana drought. The September 10th edition of the US Drought Monitor shows that abnormally dry conditions (D0 category) have expanded in northeast Indiana to include all of Steuben and DeKalb counties. Newly added as abnormally dry are Allen, Whitley, and Kosciusko counties and in west central Indiana, Carroll, and part of White counties. Moderate drought (D1 category) has spread this week to include Tippecanoe, Clinton, Montgomery, and Boone counties and a part of Warren county. The net impact this week is that moderate drought has expanded from 2% to 8% of total Indiana area while abnormally dry

conditions now cover 37% of total state area. About 9% of Indiana has moved this week from normal soil moisture status to abnormally dry. Indiana land designated still in normal soil moisture status has been reduced to 55%, or about half, of total state area according to the Drought Monitor.

The record high temperatures and ongoing shortage of rainfall this week continues to impact Indiana agriculture. According to the September 16th edition of the Indiana Weather and Crops report, the heat has pushed crops faster to maturity. While mature crops cannot be helped, corn and soybeans not yet at maturity will benefit from what rain did fall. Harvest is just beginning in some counties. The report notes the corn crop is now rated at 22% mature with 64% of the crop in good or excellent condition. Soybeans are rated at 56% in these same condition categories. Despite the heat livestock are remarkably in mostly good condition with only minor heat stress reported. Pasture condition has declined to 29% in good to excellent condition. The weekly soil moisture survey results put 70% of topsoils in short or very short moisture status. Subsoils are rated at 64% in these same categories.



September 15th – 21st

The big cool down late last week was already fading away as the new week began. Indiana warmed very slowly early this week aided by a West Virginia high pressure center. The warm up was interrupted briefly on September 16th as a cold front rushed through Indiana on its journey south. The state temperature held at near 4°F below normal. A new Canadian high pressure ridge behind the front now sprawled across the eastern half of the country. As this ridge trekked eastward the Indiana warm up accelerated, reaching 2°F above normal by September 18th.

A warm front attached to a storm system in Minnesota moved through Indiana the next day. Indiana was now positioned inside the warm air sector between the storm's warm and cold fronts. The unstable warm air mass was favorable to the development of severe weather on September 19th with thunderstorm downpours and deadly lightning. The state temperature now peaked for the week on September 20th at 7°F above normal.

The next day two cold fronts surged through Indiana before merging in Ohio, quickly dropping temperatures to 1°F above normal to close out the week. Temperatures had been warming nearly all

week long but had started well below normal. The net effect was a week that averaged right at normal temperature. Typically for this third week of September daily state maximum temperatures should range between 73°F and 80°F north to south across the state. Daily minimums normally vary between 53°F in far northern counties to 56°F in the southwest corner of Indiana.

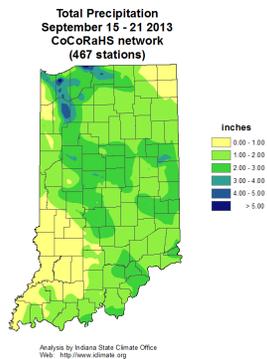
Rainfall amounts were light last week and this trend continued to the middle of this week. Then heavy rainfall returned as did severe weather on September 19th. Torrential rain fell in northwest Indiana, then became less intense as it migrated southeast over the next two days. Extreme northeast Indiana and most of southwest Indiana missed out on the heavy rainfall and received less than an inch for the week. Regionally northern and central Indiana averaged near 1.7 inch with about 1.5 inch in the south. These amounts equate to about 240% of normal in northern counties, 280% in central, and 220% of normal in southern Indiana. Some of the heaviest rain totals among CoCoRaHS observers on September 19th included Rensselaer with 4.81 inches, Wheatfield with 4.25 inches, and Hebron with 3.90 inches. The next day two New Carlisle volunteers measured 4.55 and 3.91 inches in that town. The largest CoCoRaHS weekly totals were 4.77 inches in Wheatfield, 4.23 inches at Hebron, and 4.15 inches in Westville. Two Valparaiso observers tallied 4.10 and 3.93 inches.

The thunderstorms on September 19th were violent in northern and central Indiana. Two deaths in Gary were attributed to lightning strikes. A man working on a Gary billboard was hit by lightning and later died. Another man was killed in a Gary house fire started by lightning while a child was injured. Lightning also started a fire in Plymouth. In central Indiana in New Castle and Carmel, lightning strikes heavily damaged restaurants. Another lightning strike destroyed a home in Elwood and yet another damaged a house in Carmel. Another round of storms that evening spawned a funnel cloud near Earl Park but no tornado touched down. Yet wind gusts in Benton county were estimated at 60 mph and flattened crops in the northern part of the county. Hail up to 1.5 inch in diameter was also observed there. To the north in Newton county hail size reached 1.75 inch in diameter.

The September 17th edition of the US Drought Monitor shows the drought was worsening in Indiana. Improvements due to the heavy rains late this week will be reflected in next week's map. Before the heavy rains hit the US Drought Monitor had expanded coverage of at least abnormally dry conditions (D0 category) to all of the state except for 17 counties in far southern Indiana. There are also small parts of 7 counties along the Ohio border which remain in normal soil moisture status. The net result is a 33% increase in abnormally dry soils from a week ago, pushing total state D0 area to 70% coverage. Moderate drought status (D1 category) was expanded this week into four additional counties: Tipton, Hamilton, Madison, and Lake. This is a 5% increase to 13% total land area in moderate drought since last week. Only 17% of Indiana area was rated in normal soil moisture status this week.

According to the September 23rd edition of the USDA Indiana Weather and Crop report, the latest rain event will benefit only late and double crop soybeans, wheat, pasture, and cover crops. Other crops are already too advanced. Some corn and soybean harvesting is already underway in parts of Indiana. Corn harvest is 6% complete with 47% of the crop mature. Corn condition this week is rated at 64% good or excellent. Soybean condition is 58% good or excellent with 4% of the crop harvested. Livestock are in mostly good condition due to the mild temperatures this week. Pastures are rated at 28% in good or excellent condition. The weekly soil moisture survey includes the

impact of the late rains and isn't as harsh as the US Drought Monitor ratings. The survey concludes topsoil is 47% short or very short of moisture while half of subsoils are in these same categories.



September 22nd – 30th

High pressure in the Ontario region of Canada spread southeast and kept storms away from Indiana for much of the final 9 days of September. This ridge also aided a long term warm up with state average temperatures climbing a little more nearly every day. Only one cold front during the interval moved into Indiana on September 29th allowing temperatures to drop for just one day.

The state average temperature started the week at nearly 4°F below normal. Temperatures rose to 1°F above normal by September 24th, then stabilized at nearly 3°F above normal over the next 3 days. A cold front across the Great Plains on September 25th did not survive and was broken into northern and southern systems, neither of which reached Indiana. The Ontario ridge reset itself the next day to reclaim the eastern half of the country. This ridge slipped eastward to the Atlantic states over the next two days. Indiana temperatures resumed their ascent to peak at nearly 4°F above normal by September 28th.

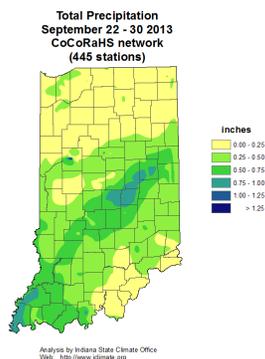
The western edge of the ridge was now eroding and a new cold front moved into Indiana on September 29th. The showers and cloudy skies cooled state temperatures to 1°F below normal. The Atlantic ridge held its position and the Indiana cold front stalled into a stationary front to close the month. The state average temperature recovered to 3°F above normal by September 30th. Over the full 9 days the state temperature averaged 1°F above normal. Typically for this final stretch of September daily maximum temperatures range from 70°F in far northern counties to 77°F in the southwest corner of the state. Normal daily minimums vary between 49°F and 52°F north to south across the state.

Tiny amounts of rain fell across Indiana at the start of the 9 day interval as the Ontario ridge was taking hold of the Midwest. Five days of dry weather followed. The only significant rain was measured throughout Indiana on the mornings of September 29th and 30th. These two rain days summed into the total rainfall for the entire 9 days: about 0.2 inch in northern Indiana with 0.4 inch in central and southern areas. These totals equate to about 20% of normal in the north, 50% in central, and 40% of normal across southern Indiana. As usual there were a few spots with heavier

daily rain amounts. On the morning of September 29th a CoCoRaHS observer in Lafayette measured 1.50 inch while in Castleton, 0.98 inch was recorded. The next morning two Greenfield volunteers had 1.16 and 0.98 inch while 1.02 inch was collected by the Muncie rain gage. The 9 day extreme totals were very close to these same numbers as rain essentially fell on just these two days.

At the end the month the October 1st edition of the US Drought Monitor shows improvement in the drought status of Indiana since mid-September. Only parts of 4 counties, Lake, Newton, Benton, and Warren remain in moderate drought status (D1 category) compared to parts of 17 counties rated at this level on September 17th. This is an improvement from 12% of state area in moderate drought to just 3% coverage on October 1st. Several northwest Indiana counties were removed from abnormally dry (D0 category) and put back into normal soil moisture status. Also some counties south and southeast of Indianapolis saw changes from abnormally dry status at the end of the month. The net result was a reduction of abnormally dry areas from 70% coverage to 53% of total Indiana area. The state area in normal soil moisture status changed from 17% to 44% by the end of September.

The September 30th edition of the USDA Indiana Weather and Crop report noted that mild temperatures with little rain allowed the harvest process to speed up at the end of this month. Corn is now 66% mature with 13% of the crop harvested. Corn in the field is rated as 65% in good or excellent condition. The harvest of soybeans has jumped ahead of corn at 16% harvested with crop still in the field rated at 60% in good or excellent condition. Harvest progress has allowed winter wheat planting to get underway. Hay is in good condition with its fourth cutting in progress. The report says pastures are at 26% in good or excellent condition with livestock doing well in the recent mild temperatures.



September 2013

Region	Temperature	Temperature	
		Normal	Deviation
Northwest	65.8	64.6	1.2
North Central	64.9	63.9	0.9
Northeast	64.3	63.5	0.8
West Central	67.7	65.9	1.8
Central	67.2	65.3	1.9
East Central	66.4	64.5	1.9
Southwest	69.7	68.2	1.4
South Central	69.1	67.5	1.6
Southeast	68.4	66.9	1.5
State	67.1	65.7	1.5

Region	Precipitation	Precipitation		
		Normal	Deviation	Percent of Normal
Northwest	3.11	3.21	-0.11	97
North Central	2.80	3.30	-0.50	85
Northeast	2.07	3.19	-1.13	65
West Central	2.47	3.03	-0.56	81
Central	3.24	2.99	0.26	109
East Central	3.41	2.79	0.63	122
Southwest	3.01	3.13	-0.12	96
South Central	3.35	3.11	0.24	108
Southeast	3.47	2.97	0.50	117
State	2.98	3.09	-0.11	97

Autumn so far (same as September)

Region	Temperature	Temperature	
		Normal	Deviation
Northwest	65.8	64.6	1.2
North Central	64.9	63.9	0.9
Northeast	64.3	63.5	0.8
West Central	67.7	65.9	1.8
Central	67.2	65.3	1.9
East Central	66.4	64.5	1.9
Southwest	69.7	68.2	1.4
South Central	69.1	67.5	1.6
Southeast	68.4	66.9	1.5
State	67.1	65.7	1.5

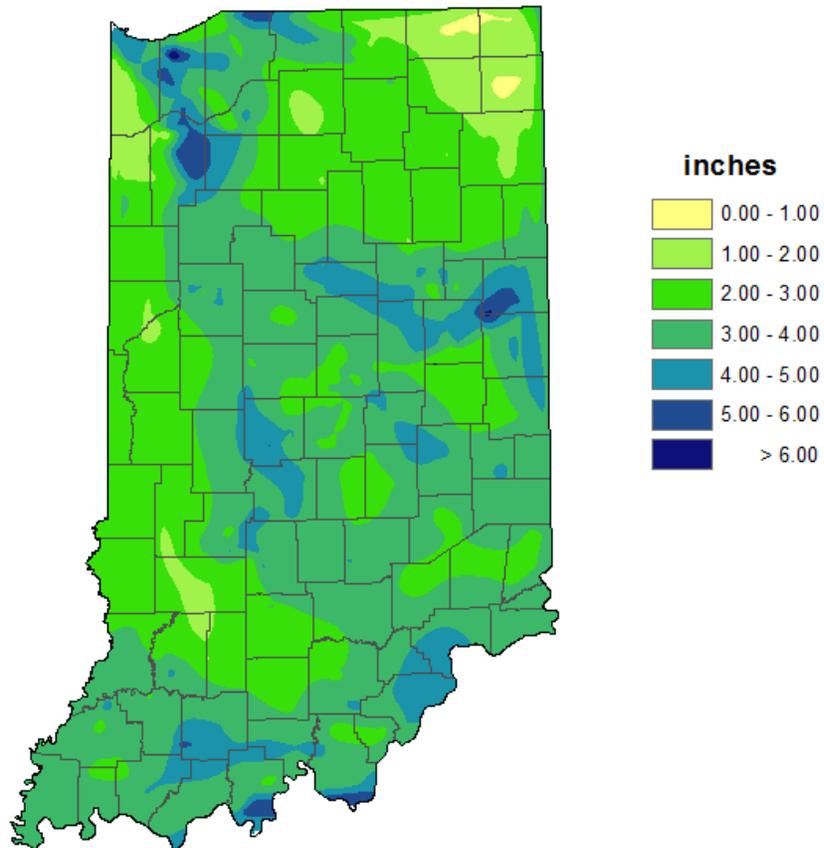
Region	Precipitation	Precipitation		
		Normal	Deviation	Percent of Normal
Northwest	3.11	3.21	-0.11	97
North Central	2.80	3.30	-0.50	85
Northeast	2.07	3.19	-1.13	65
West Central	2.47	3.03	-0.56	81
Central	3.24	2.99	0.26	109
East Central	3.41	2.79	0.63	122
Southwest	3.01	3.13	-0.12	96
South Central	3.35	3.11	0.24	108
Southeast	3.47	2.97	0.50	117
State	2.98	3.09	-0.11	97

2013 Annual (through September)

Region	Temperature	Temperature	
		Normal	Deviation
Northwest	52.9	53.5	-0.6
North Central	52.6	53.0	-0.3
Northeast	52.5	52.6	-0.1
West Central	54.7	55.1	-0.4
Central	54.7	54.6	0.1
East Central	54.3	53.8	0.5
Southwest	57.7	58.3	-0.6
South Central	57.3	57.7	-0.3
Southeast	56.6	56.8	-0.2
State	54.9	55.1	-0.2

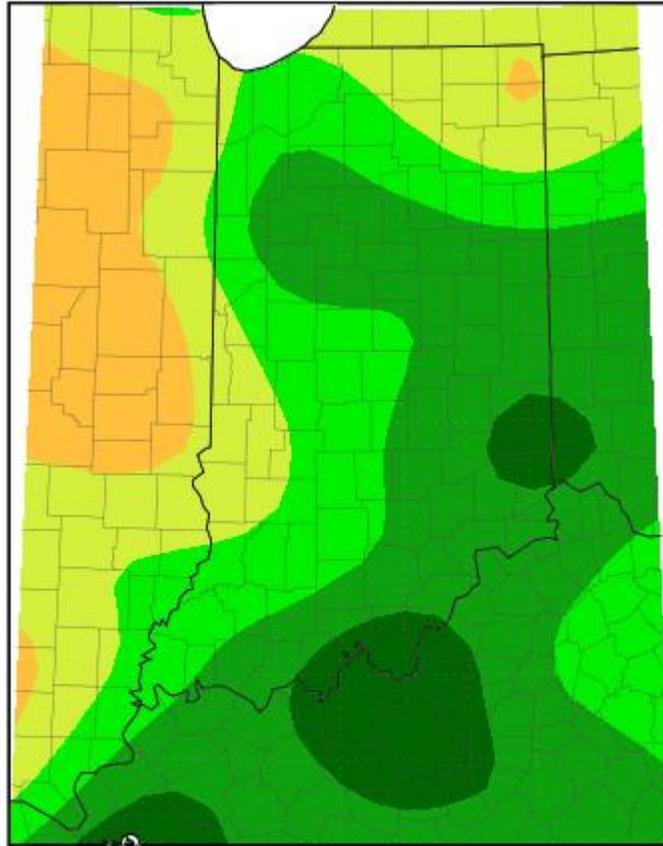
Region	Precipitation	Precipitation		
		Normal	Deviation	Percent of Normal
Northwest	32.11	29.28	2.84	110
North Central	33.57	29.30	4.28	115
Northeast	30.30	28.34	1.96	107
West Central	34.64	31.77	2.87	109
Central	32.56	31.30	1.26	104
East Central	30.14	30.27	-0.13	100
Southwest	39.10	34.71	4.39	113
South Central	36.96	35.04	1.92	105
Southeast	34.01	34.02	-0.01	100
State	33.96	31.63	2.33	107

**Total Precipitation
September 2013
CoCoRaHS network
(474 stations)**



Analysis by Indiana State Climate Office
Web: <http://www.iclimate.org>

Accumulated Precipitation: Percent of Mean
September 1, 2013 to September 30, 2013

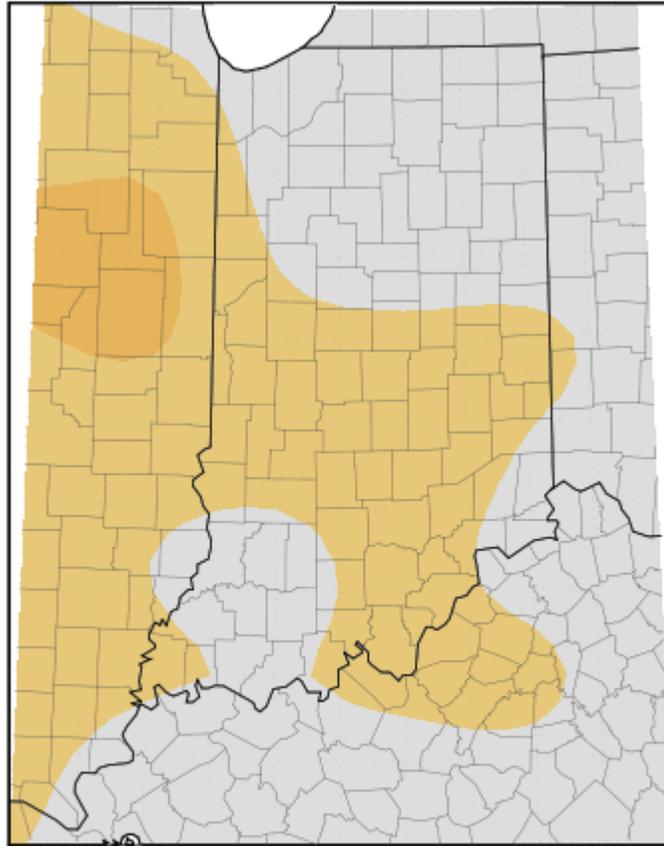


Mean period is 1981-2010.



Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
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Average Temperature (°F): Departure from Mean
September 1, 2013 to September 30, 2013



Mean period is 1981–2010.



Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
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Drought Summary from the U.S. Drought Monitor

Below is a drought summary for the state of Indiana from the U.S. drought monitor. Areas in white are not experiencing any drought. Yellow areas are abnormally dry, but not considered a drought. Drought begins when the moisture levels become more severe, with beige, orange, red, and brown indicating increasing levels of drought (moderate, severe, extreme, and exceptional, respectively). The table below indicates how much of the state is not under drought conditions, and also how much of the state is under drought conditions from its respective column upwards.

Indiana

Drought Severity

D0 - Abnormally Dry
 D1 Drought - Moderate

D2 Drought - Severe
 D3 Drought - Extreme

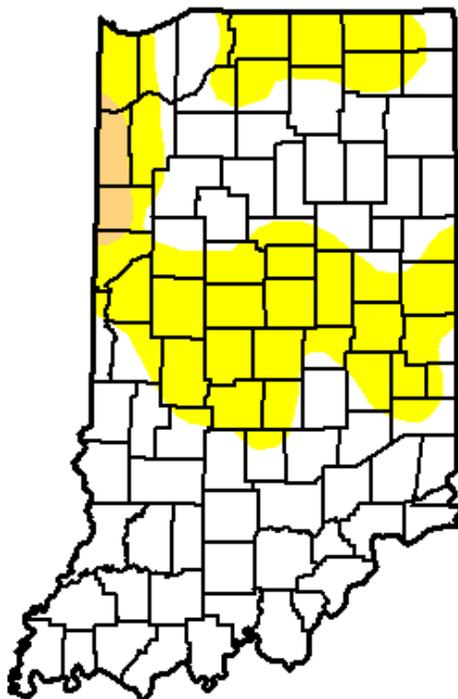
D4 Drought - Exceptional

Statistics type: Traditional (D0-D4, D1-D4, etc.) Categorical (D0, D1, etc.)

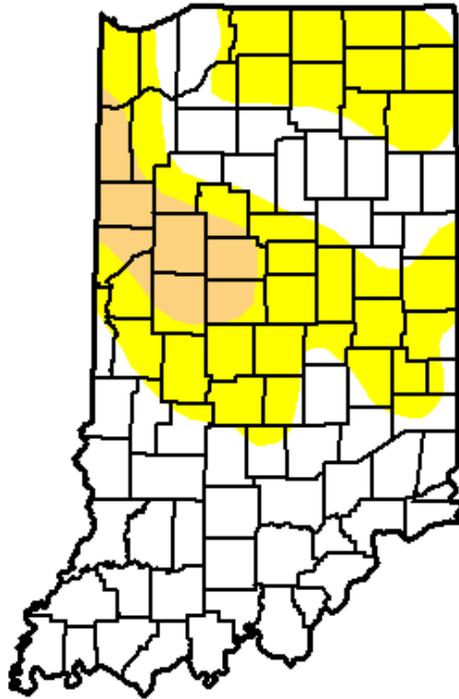
Percent Area in U.S. Drought Monitor Categories

Week	Nothing	D0	D1	D2	D3	D4
10/1/2013	43.89	52.99	3.12	0.00	0.00	0.00
9/24/2013	44.23	53.07	2.70	0.00	0.00	0.00
9/17/2013	17.41	70.11	12.48	0.00	0.00	0.00
9/10/2013	55.05	36.73	8.22	0.00	0.00	0.00
9/3/2013	63.53	34.53	1.95	0.00	0.00	0.00

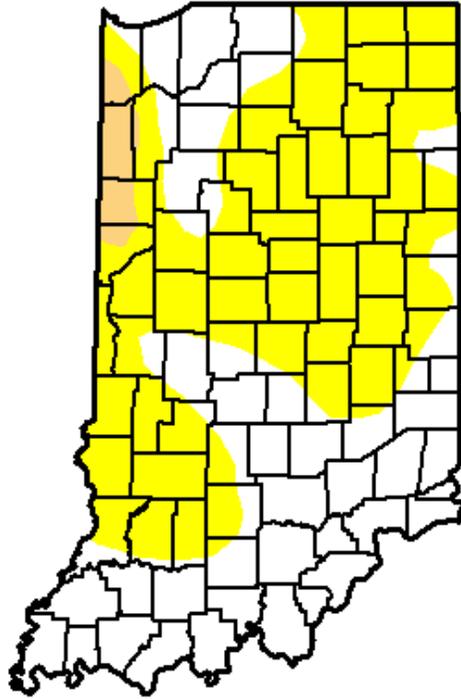
September 3rd Drought Summary



September 10th Drought Summary



September 24th Drought Summary



October 1st Drought Summary

