CropAlert™ for Week Ending May 20, 2011

A Comparison of the Great Mississippi River Floods of 1993 and 2011: Implications for Crop Insurance and Reinsurance

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Origin of the 2011 Great Mississippi River Flood

The Great Mississippi River Flood of 2011 began when a critical weather pattern brought tornadoes, hail, damaging winds and large quantities of precipitation over the Mississippi and Tennessee Valleys. This large, slow-moving system, spanning a period of almost a month and encompassing several rainstorm events, has contributed to record accumulations of precipitation and major flooding in these regions.

Large quantities of precipitation have caused the Mississippi River to swell and overflow its banks; tributaries are also overflowing their banks all along the Upper and Lower Mississippi. Currently, the area affected includes the Mississippi River region and beyond. Thirteen states have been impacted by major flooding, with Missouri, Tennessee, Mississippi, Arkansas and Louisiana particularly hard hit. Aside from residential and commercial losses, thousands of acres of prime farmland have been inundated. This has destroyed crops and delayed the 2011 corn and soybean planting season, which shortens the growing season and increases the production risk and the chances of potential losses later in the season[1].

Figure 1, which AIR generated with data from the National Oceanic & Atmospheric Administration's Climate Prediction Center, provides perspective on the severity of the recent events. The left panel shows precipitation accumulations over the period from April 8 to May 8. The right panel shows a comparison with historical average annual precipitation accumulation.

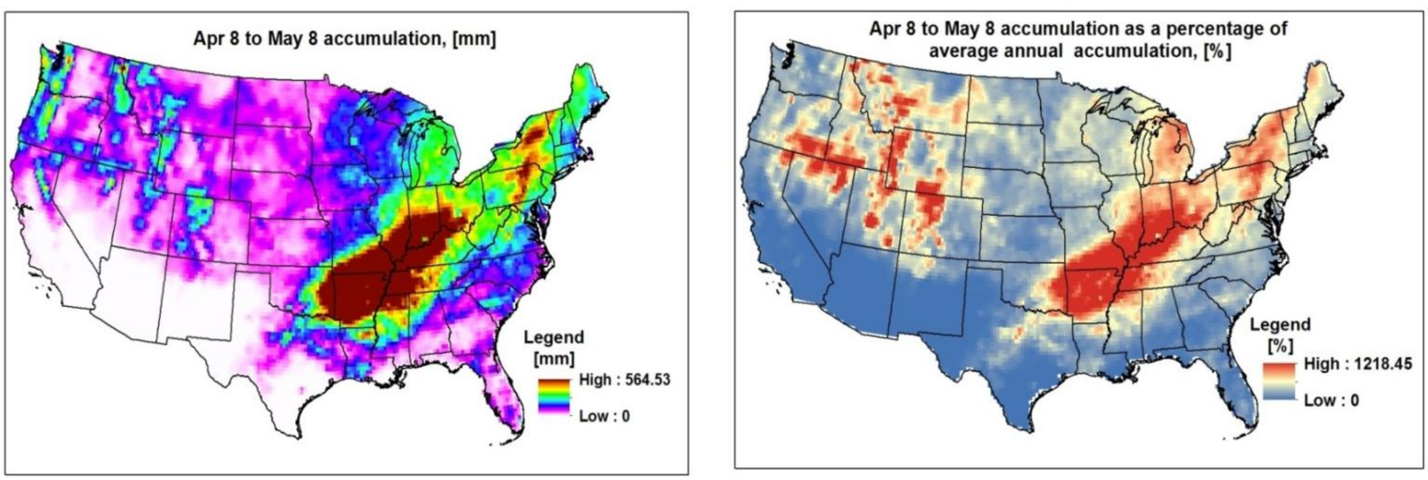


Figure 1. Precipitation accumulation for the period April 8–May 8, 2011 (left). Comparison of accumulation from this period as a percentage of with the historical average (right). (Source: http://www.cdc.noaa.gov/cdc/data.unified.html)

[1] http://solutions.dowjones.com/tnt/CMEGroup/cmegroup.html#hl4

The National Weather Service has provided a five day significant river flood outlook for the Upper and Lower Mississippi River Region. This outlook, in the form of a footprint showing significant river flooding occurring or imminent, is shown in Figure 2.

Comparing Two Major Flooding Events

From a meteorological standpoint, the present weather situation that triggered the Great Mississippi River Flood of 2011 has similarities to the persistent upper-level atmospheric pattern that developed over the central U.S. in June of 1993—the year of another enormous Great Mississippi River Flood. In both scenarios, a trough at high levels of the atmosphere became established over the western part of the country, allowing for the low-level winds to move unstable warm and moist air from the Gulf of Mexico north where it converged with the cold dry air moving south from Canada. This large-scale air mass interaction resulted in wave after wave of rainstorms that eventually soaked the Mississippi River basin.

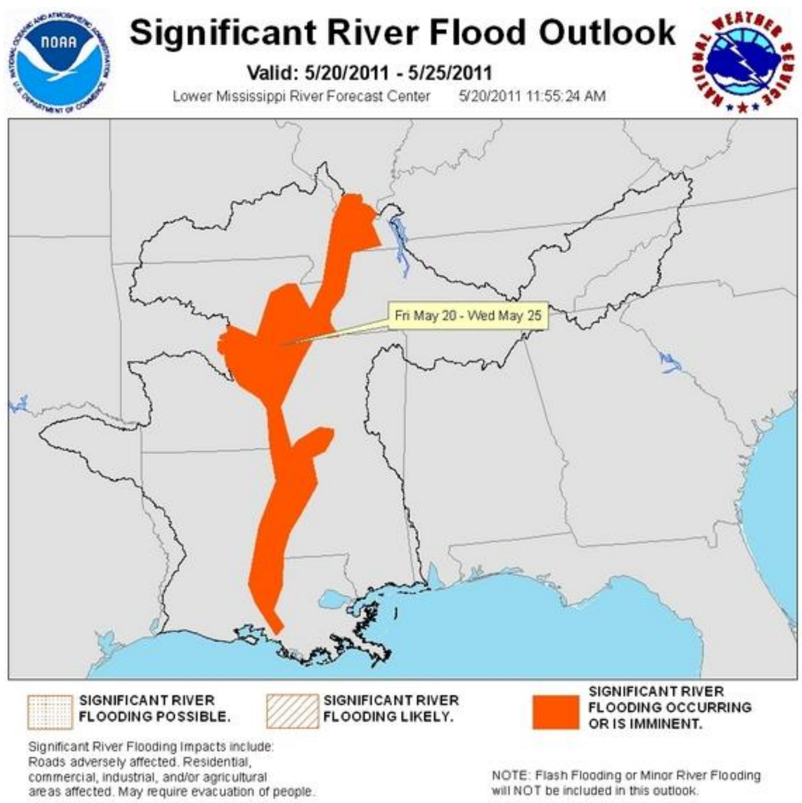
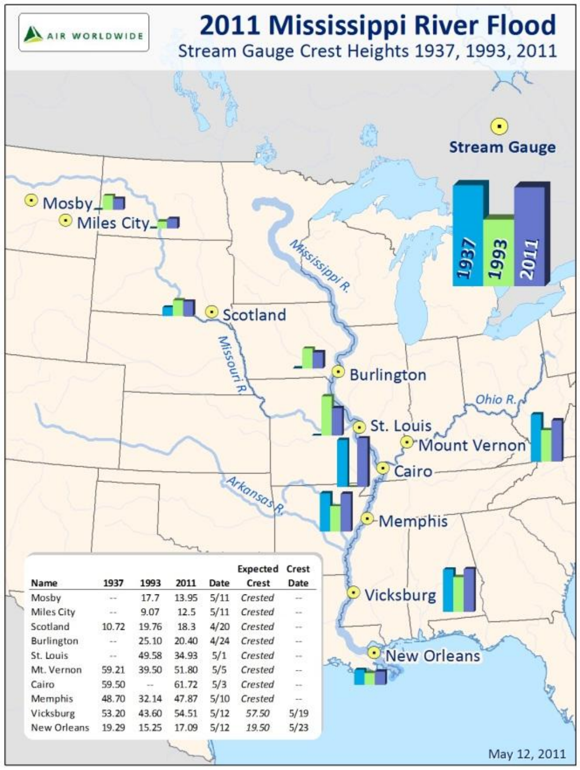


Figure 2. Significant River Flood Outlook from the National Weather Service shows areas either flooded or in imminent danger of flooding. (Source: http://www.srh.noaa.gov/lmrfc/?n=fop)

Another interesting comparison arises from the measurement of crest heights along the Mississippi River for both the 2011 and 1993 events. In the United States, real-time river level gauging stations established by the United States Geological Survey (USGS) record data on river heights at 15- to 60-

minute intervals. Data is relayed to the USGS for processing. All stations from which data is collected have at least 30 years of recorded usage. Figure 3 offers a perspective on the severity of the flooding along the Mississippi River by comparing water levels for the 2011 flood event with the 1993 flood event, as well as the flood of 1937 that affected 20 million acres of farmland in the region.



Name	1937	1993	2011	Date	Expected Crest	Crest Date
Mosby	--	17.7	13.95	5/11	*Crested*	--
Miles City	--	9.07	12.5	5/11	*Crested*	--
Scotland	10.72	19.76	18.3	4/20	*Crested*	--
Burlington	--	25.10	20.40	4/24	*Crested*	--
St. Louis	--	49.58	34.93	5/1	*Crested*	--
Mt. Vernon	59.21	39.50	51.80	5/5	*Crested*	--
Cairo	59.50	--	61.72	5/3	*Crested*	--
Memphis	48.70	32.14	47.87	5/10	*Crested*	--
Vicksburg	53.20	43.60	54.51	5/12	*57.50*	5/19
New Orleans	19.29	15.25	17.09	5/12	*19.50*	5/23

Figure 3. Comparison of water levels for the 1937, 1993 and 2011 great floods; in numerous locations along the Lower Mississippi, the 2011 crest heights exceed record heights. (Source: AIR using data from http://waterdata.usgs.gov/nwis and http://water.weather.gov/ahps/)

While the ongoing Great Mississippi River Flood of 2011 will have damaging consequences for the U.S. agricultural sector once the final insured losses are computed, the extent of loss is expected to be far less than that caused by the Great Mississippi River Flood of 1993. The key difference involves the timing of the event. Whereas farmers in the affected region this year have stopped planting crops or can plan to replant the lost crops once the waters recede, farmers in 1993 were caught by the flood event in the heart of the growing season. A short chronological review of the two flood events is presented in the next sections.

The Great Mississippi River Flood of 1993

Severe flooding began in May 1993 on the Redwood River in Minnesota, and then in June 1993 on the Black River in Wisconsin. Next, record flooding was observed on the Mississippi, Missouri, and

Kansas Rivers. The most severe flooding was concentrated along a 500-mile stretch of the Mississippi River between Cairo, Illinois and Minneapolis, Minnesota and along a 400-mile length of the Missouri River from Omaha, Nebraska to St. Louis, Missouri. Some sections of the Mississippi River were above flood stage from late March through most of August 1993. Figure 4 shows a satellite image comparison of the key area affected by the flood event.

Well over 17 million acres were flooded, covering parts of nine states. Over 4 million hectares of farmland were flooded, and crop losses exceeded $5 billion (in 1993 dollars). Total crop losses due to flooding or saturated fields exceeded 14 million hectares. The national soybean yield was 17 percent below the 1992 level, while the national corn yield was down by 33 percent. Overall economic damage estimates exceeded $15 billion, by far the greatest flood loss in U.S. history.

Federal disaster areas included all counties in Iowa, 62 percent of the counties in Missouri, 58 percent of the counties in Wisconsin and North Dakota, 52 percent of the counties in South Dakota, 46 percent of the counties in Nebraska, 40 percent of the counties in Minnesota, 25 percent of the counties in Illinois and 22 percent of the counties in Kansas[2].

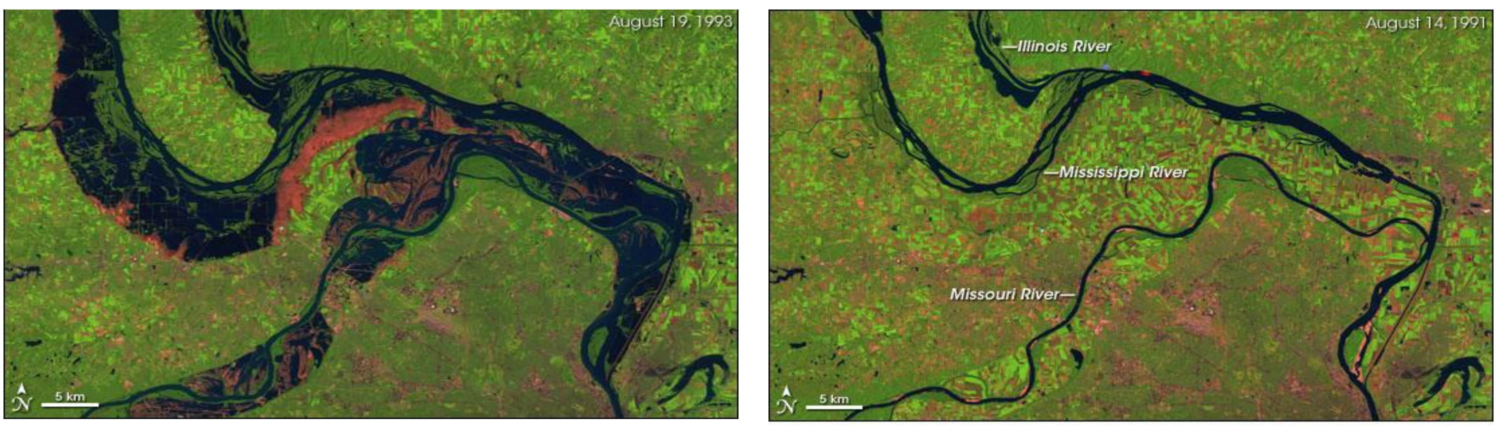


**Figure 4. (Left) The Great Mississippi River Flood as of August 19, 1993.
(Right) Comparison for the same region for August 14, 1991.
(Source: http://earthobservatory.nasa.gov/IOTD/view.php?id=5422)**

The Great Mississippi River Flood of 2011

Flooding from a large slow-moving storm system spawned in early April and encompassing several precipitation events has impacted Missouri, Ohio, and—worst of all—regions along the Upper and Lower Mississippi River. Floodwater from the swollen Mississippi has inundated low-lying farmland for miles. In Missouri, nearly 600,000 acres divided among 10 southeastern counties were flooded after the Army Corps of Engineers detonated sections of a nearby levee in an effort to save local towns[3].

[2] http://www1.ncdc.noaa.gov/pub/data/techrpts/tr9304/tr9304.pdf
[3] http://usda.mannlib.cornell.edu/MannUsda/viewTaxonomy.do?taxonomyID=8

Though the Mississippi River height has slightly receded in Memphis, Tennessee, towns in Mississippi and Louisiana are preparing for heavy flooding[4].

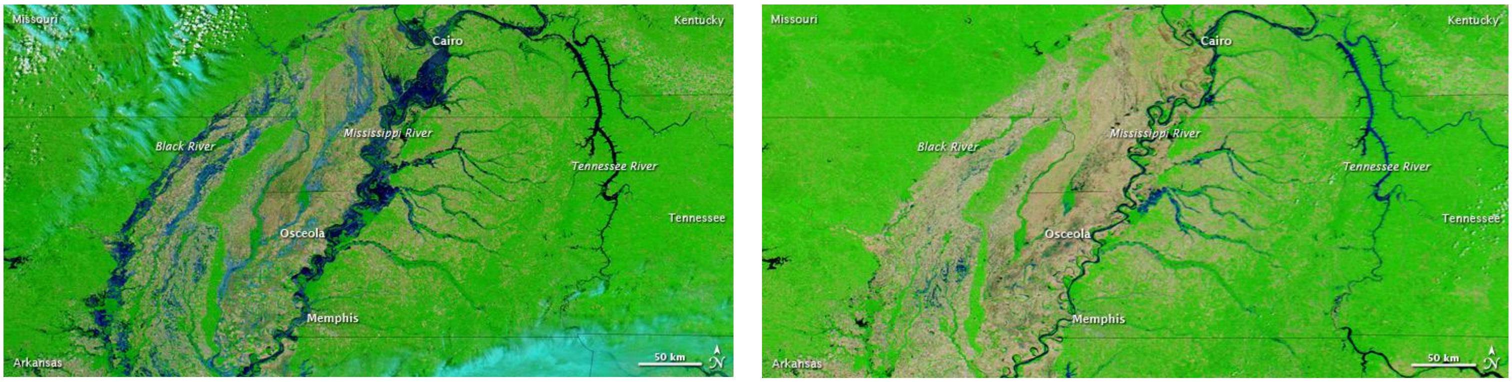


Figure 5. The Great Mississippi River Flood captured on May 6, 2011 (left).
The same region on May 6, 2010 showed more typical conditions (right).
(Source: http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=50504)

To the south, in Vicksburg, Mississippi, the slow-moving river crested on May 19 at more than 14 feet above flood stage, slightly lower than expected. Fears remain that the surge of floodwater can inundate Mississippi Delta, a flat area of farmland and small towns. Approximately 500,000 acres are expected to flood in Mississippi alone[5]. Agricultural losses in Mississippi, including grain and aquaculture, could approximate $800 million[6].

In Louisiana, the Army Corps of Engineers opened several flood gates on the Morganza Spillway for the first time in 37 years to relieve the downstream pressure. This could limit barge navigation along the rivers and disrupt grain supplies, potentially pushing commodities prices upward. While the opening of the spillway is expected to spare the more highly populated urban areas of New Orleans and Baton Rouge from widespread flooding, hundreds of thousands of acres of farmland and thousands of homes will be inundated in rural communities.

Given the extent of the current flood event affecting several key grain producing Midwest and Southern states, farmers are already coping with the prospect of replanting acreage lost to flooding and excess precipitation and assessing the adverse consequences that delayed planting can have on yields. According to the USDA[7], the overall progress of the U.S. corn crop planting is currently significantly behind schedule. According to Figure 6, 40 percent of the corn crop had been planted by

[4] For a description of the impact of the floods on commercial and residential property please see http://alert.air-worldwide.com/EventSummary.aspx?e=554&tp=54&c=1
[5] http://www.soybeansandcorn.com/news/May11_11-Extent-of-Flooded-Acres-Along-Mississippi-Still-Unknown
[6] http://www.usatoday.com/money/economy/2011-05-10-flood-impact_n.htm
[7] http://www.usda.gov/oce/weather/pubs/Weekly/Wwcb/wwcb.pdf

May 8. This is a tie with 2008 for slow planting progress. The worst year on recent record was in 1995, when only 22 percent of the corn crop was planted by May 8.

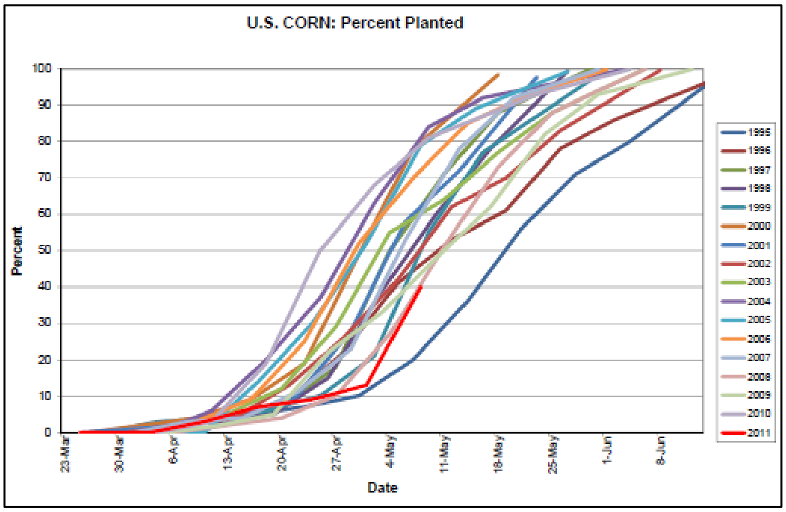


Figure 6. Planting progress of the U.S. corn crop for the week ending May 8

Corn Percent Planted

	Prev Year	Prev Week	May 8 2011	5-Yr Avg
CO	55	18	51	45
IL	93	10	34	62
IN	80	2	4	49
IA	92	8	69	69
KS	69	41	66	61
KY	88	17	19	71
MI	72	1	8	49
MN	93	1	28	65
MO	82	32	59	60
NE	74	15	57	62
NC	96	88	95	95
ND	52	0	3	35
OH	74	1	2	54
PA	52	1	10	44
SD	45	2	17	33
TN	88	38	42	86
TX	84	79	87	84
WI	66	1	16	45
18 Sts	80	13	40	59

These 18 States planted 92% of last year's corn acreage.

Winter Wheat Percent Headed

	Prev Year	Prev Week	May 8 2011	5-Yr Avg
AR	94	93	100	95
CA	97	95	97	97
CO	2	0	8	9
ID	0	0	0	0
IL	39	9	26	36
IN	12	1	10	15
KS	35	16	34	35
MI	0	0	0	0
MO	38	27	58	44
MT	0	0	0	0
NE	0	0	0	1
NC	87	87	97	91
OH	6	0	0	2
OK	83	85	93	88
OR	1	0	0	2
SD	0	0	0	0
TX	70	66	80	71
WA	2	0	0	4
18 Sts	39	33	42	40

These 18 States planted 89% of last year's winter wheat acreage.

Soybeans Percent Planted

	Prev Year	Prev Week	May 8 2011	5-Yr Avg
AR	40	NA	21	30
IL	30	NA	2	14
IN	33	NA	0	17
IA	40	NA	10	18
KS	13	NA	11	6
KY	10	NA	0	8
LA	50	NA	67	58
MI	33	NA	3	20
MN	37	NA	2	18
MS	74	NA	42	74
MO	13	NA	7	9
NE	23	NA	15	14
NC	15	NA	14	11
ND	5	NA	0	6
OH	33	NA	0	27
SD	4	NA	1	4
TN	10	NA	1	10
WI	18	NA	2	11
18 Sts	28	NA	7	17

These 18 States planted 95% of last year's soybean acreage.

Cotton Percent Planted

	Prev Year	Prev Week	May 8 2011	5-Yr Avg
AL	42	11	28	44
AZ	79	70	77	72
AR	52	6	11	47
CA	90	80	85	91
GA	26	15	20	25
KS	1	0	5	1
LA	63	64	78	66
MS	49	7	19	45
MO	46	0	2	44
NC	40	20	43	42
OK	13	5	12	9
SC	36	20	32	27
TN	13	2	2	17
TX	27	16	24	27
VA	41	17	46	43
15 Sts	34	18	26	33

These 15 States planted 99% of last year's cotton acreage.

Figure 7. Planting progress of the U.S. corn crop for the week ending May 8

Figure 7 indicates that planting delays are also affecting other key crops and regions that have not necessarily been directly affected by the floods, but have sustained abnormal precipitation at the start of the growing season. Most notably for corn, the current 40 percent planting progress is 40 percentage points behind last year and 19 points behind the 5-year average. The corn planting delays are strikingly noticeable in Indiana and Ohio.

In Indiana, Extension Service research indicates that there is not a strong relationship between planting date and the absolute end-of-the-season yield. This indicates that yield loss is due to several factors; delayed planting only plays a relatively minor role[8]. In Ohio, the Extension Service also found that historical observations do not suggest that lower grain yields are a certainty with late plantings[9]. In Arkansas, a state in which the corn crop has been directly affected by the flood event, the extension service has indicated that delayed planting may not necessarily reduce the expected yield and that corn could survive a moderate amount of flooding, depending on other environmental conditions such as temperature and runoff conditions[10].

Soybean planting is underway in all but four of the 18 major soybean-producing states. Planting progress, currently at 7 percent complete, is 21 percentage points behind last year and 10 points behind the 5-year average. Although planting was most advanced in the Mississippi Delta, one of the most significant delays will be evident in Arkansas, Mississippi, and Louisiana where flooding along the Mississippi River will leave thousands of acres underwater that will have to be replanted[11].

Nationally, 42 percent of the winter wheat crop was headed by May 8, 3 percentage points ahead of last year and 2 points ahead of the 5-year average. Heading was most active in Missouri where, despite cooler-than-normal weather, 31 percent of the winter wheat crop developed heads during the week. Overall, 33 percent of the winter wheat crop was reported in good to excellent condition, down slightly from last week and 33 percentage points below the same time last year. In Arkansas, flooding along the Mississippi River has left thousands of wheat acres underwater that will not be harvested[12].

Nationally, 26 percent of this year's cotton crop was planted by May 8. This was 8 percentage points behind last year and 7 points behind the 5-year average. Progress was most active in the Mississippi Delta and Southeast region, where producers planted at least 12 percent of their crop during the week.

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[8] http://www.agry.purdue.edu/ext/corn/news/timeless/PltDateCornYld.html
[9] http://corn.osu.edu/c.o.r.n.-newsletter#4
[10] http://deltafarmpress.com/corn/corn-planting-dates-and-replanting-tips
[11] http://deltafarmpress.com/soybeans/big-soy-planting-window-can-accommodate-flood-delays
[12] http://deltafarmpress.com/flooding-losses-high-wheat-fields

Implications for the Crop Insurance Industry of a Repeat of the 1993 Great Mississippi River Flood

As discussed before, there are several striking similarities from a meteorological point of view between the 1993 flood and the 2011 flood. Nevertheless, the 2011 flood will have less damaging consequences for the U.S. crop insurance sector than the 1993 flood given the timing of the event. While farmers in the affected region have stopped planting crops or can plan to replant the crops lost to the flood once the waters recede, farmers in 1993 were caught by the flood event in the middle of the growing season. Another key difference is that, contrary to what happened in 1993, Iowa and Minnesota have not been affected by the current flood event. As Figure 7 indicates, Iowa corn planting is progressing normally and regions affected by excess precipitation in Illinois, Indiana and Minnesota are expected to catch up soon in terms of corn planting progress. Let's explore in more detail the yield and price scenarios of 1993.

1993 Yield Losses

Figure 8 shows the extent of the yield shortfall for corn (left) and soybeans (right) in the Corn-Belt region. Most of the damage occurred to the west and north of Illinois. Iowa corn yields were only 60 percent of their expected value, while Illinois and Indiana corn yields were in line with or slightly above expectations. The yield loss pattern for soybeans was similar, but less severe, at 71 percent of their expected value in Iowa. Illinois and Indiana produced a small surplus.

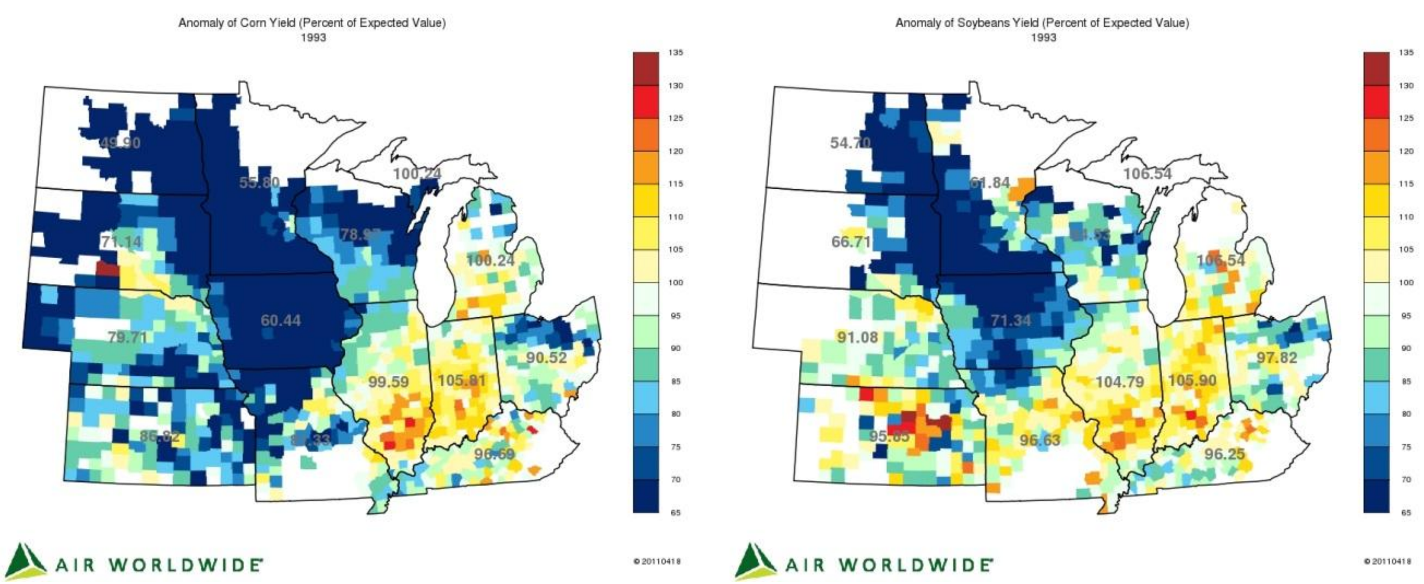

Figure 8. Corn and soybean yield anomalies due to 1993 flood event

1993 Crop Prices

The observed 1993 crop prices at planting and harvest, retrieved from the Kansas Extension Service, are shown in Table 1[13]:

Table 1. 1993 corn and soybean prices

Crop	Planting	Harvest
Corn	$2.40	$2.49*
Soybeans	$5.86	$6.15

*CRC Harvest Price (October)

In general, 1993 prices reflect a modest price increase between planting and harvest. The price for corn increased in November to $2.74, an additional 10% increase compared to the October value.

With both yield and price information, we use the AIR MPCI model[14] to recast the potential losses to the U.S. crop insurance industry if an event such as 1993 were to occur in the forthcoming growing season. Table 2 summarizes the recasted MPCI loss results for 1993 for key producing states and the U.S. as a whole. The recasted values are based on the current (2011) Standard Reinsurance Agreement (SRA) rules and regulations, current estimated MPCI premiums, current crop insurance program and available policies, and historical (1993) yields and prices. For comparison purposes, we also provide the official gross loss ratios retrieved from the RMA Summary of Business online application (the post-SRA loss ratios are not available).

Table 2. 1993 actual and recasted loss ratios for key producing states and US

State	Actual 1993 RMA Gross Loss Ratios[15]	AIR Modeled (Recasted) Gross Loss Ratios	AIR Modeled (Recasted) Post-SRA Loss Ratios
Iowa	465%	247%	168%
Illinois	63%	21%	66%
Indiana	55%	22%	67%
Ohio	91%	54%	61%
Minnesota	610%	214%	161%
Nebraska	188%	80%	83%
US Total	219%	106%	97%

Based on the AIR model, under current program conditions, a repeat today of a flood event similar to 1993 would have a relatively smaller impact in the U.S. crop insurance industry. Given that Illinois and Indiana yields were normal for corn and above normal for soybeans, the recasted loss ratios are low because current revenue policies (which do not trigger a payment under the 1993 scenario) carry a much higher premium volume today than the yield based policies available in 1993.

[13] http://www.agmanager.info/crops/insurance/workshops/filespdf/ABecorn.pdf
[14] For additional information on the AIR MPCI model, please see http://www.air-worldwide.com/PublicationsItem.aspx?id=14704
[15] http://www3.rma.usda.gov/apps/sob/current_week/state1993.pdf

The situation is different for Iowa and Minnesota, which experienced a huge yield shortfall in 1993 and therefore shows significant modeled losses on a gross and post-SRA basis if an event similar to 1993 were to recur.

Conclusion

The flooding situation in 2011 is similar in nature to the Great Mississippi Flood of 1993, but different in the particulars. First, the timing of the flood within the growing season is different. Second, the two floods occurred in different regions, with the 1993 flood affecting a portion of the Corn Belt and the 2011 flood affecting a region farther south. While floodwaters have inundated several million acres of cropland in 2011, yield losses from delayed planting are expected to be limited. Furthermore, the affected states from the current flood are primarily Group 2 states under the current SRA, which are provided with greater reinsurance protection by the government than the Group 1 states of Illinois, Indiana, Iowa, Minnesota, and Nebraska.

If a flood with similar characteristics to the 1993 event were to recur, crop insurance companies with significant portfolios in Illinois, Indiana and Ohio would not be affected by high loss ratios because yields in these states would be close to normal. On the other hand, crop insurance companies with significant portfolios in Iowa and Minnesota would experience significant losses both on a gross and post-SRA basis. Most of the losses would be concentrated in counties with riverfront exposure.

To manage these risks associated with exposure concentration, crop insurers can diversify their portfolios by expanding into regions in which the risk of a widespread flood (or drought) is uncorrelated to the Midwest region. Additionally, the new SRA includes provisions that encourage diversification by allowing crop insurance companies to retain more gains in a “good” year and share more losses with government reinsurance funds in a “bad” year.

Crop insurance companies have developed an unprecedented level of sophistication in assessing potential risk with the advent of probabilistic crop loss modeling tools. These models can provide portfolio risk optimization strategies to allow companies to proactively choose and retain policies that will fare better under the possibility of weather threats, and to cede policies with a potential likelihood of triggering an insured loss under price or yield shortfalls.

Given the rapid evolution of the crop insurance program, with new products being developed that increasingly emphasize whole farm revenue protection under a more stringent set of rules and regulations for the industry, it is only possible to recast past observed program losses into current terms by using sophisticated models that not only take into account changes in the crop policy mix, premium rates and the SRA terms, but can objectively capture the effect of observed adverse weather conditions on crop expected yields and convert them into accurate estimations of expected portfolio losses.

About AIR Worldwide

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