



Weather Effects on Expected Corn and Soybean Yields

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Presentation outline

- Review of 2012 crop growing season
- 2012 crop market impacts
- Incorporating weather into corn yield models
- Corn yield model properties
- How weather affected 2012 corn yields
- Implications for 2013 corn yields
- Soybean yield model and 2013 implications
- Post-drought yield drag



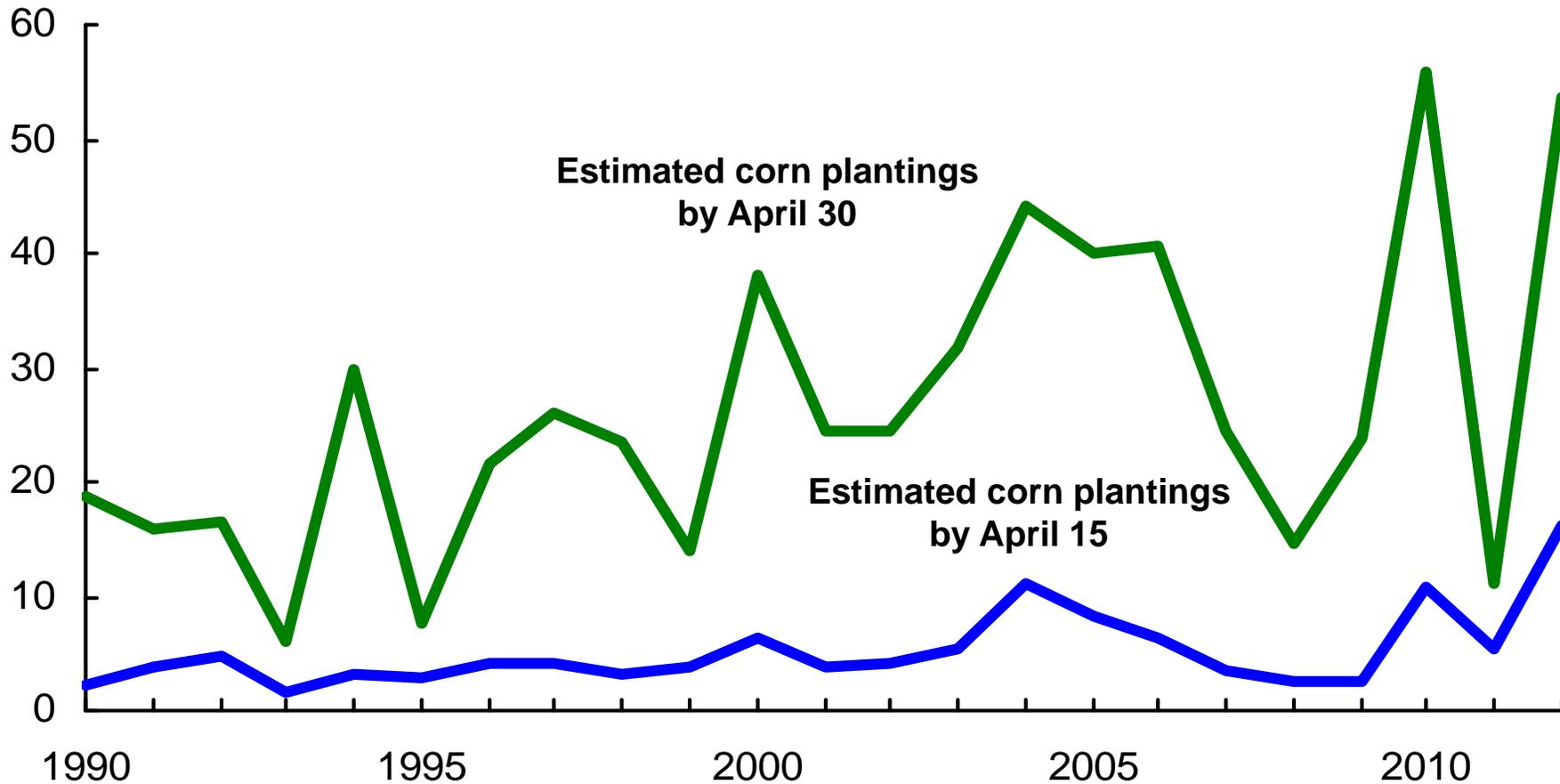
Review of 2012 crop growing season



2012 corn production prospects started out very promising:

Early corn plantings typically beneficial for yield prospects

Million acres

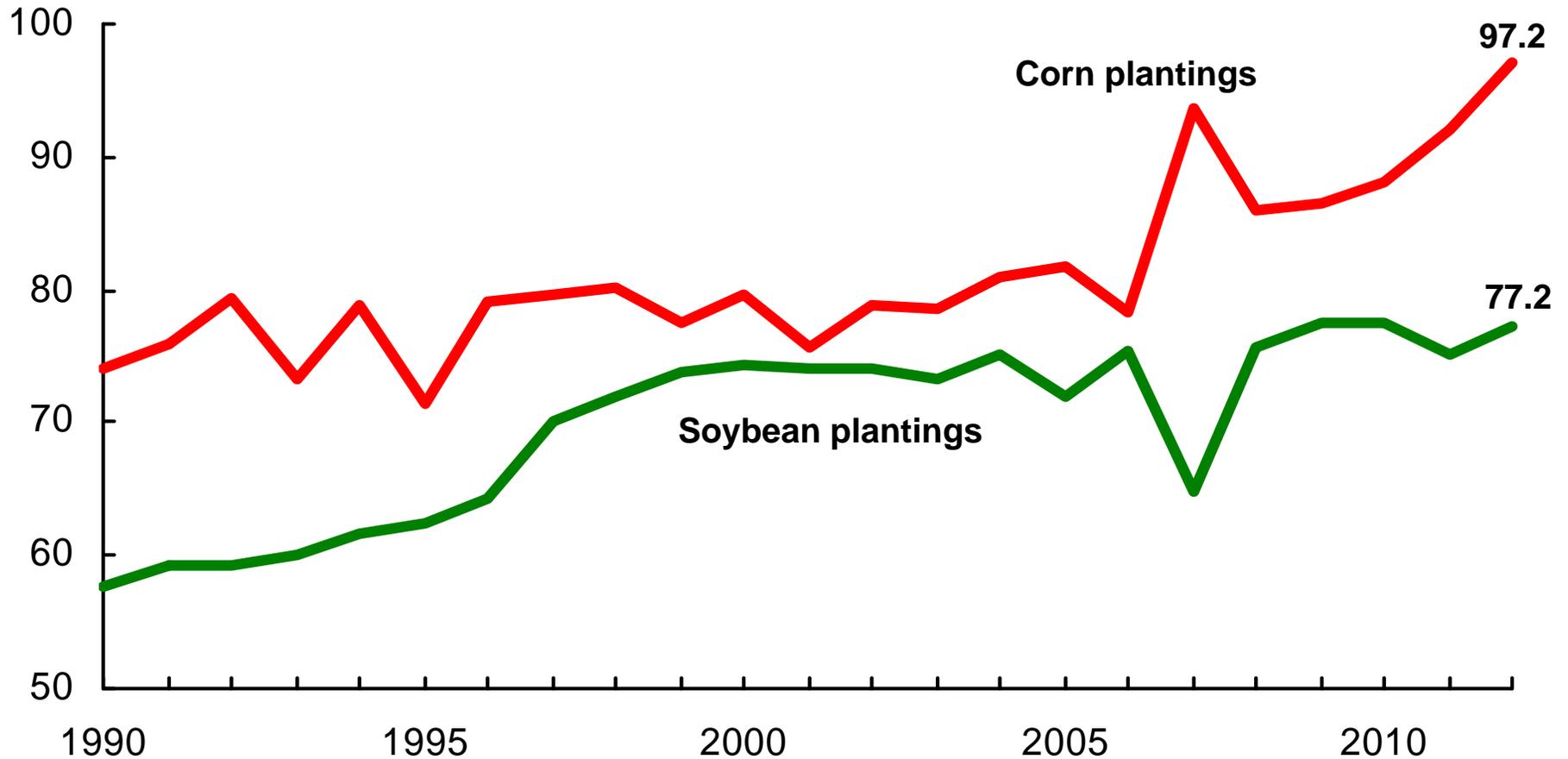


Source: ERS calculations, derived from the March *Prospective Plantings* report for U.S. total intended corn plantings times the 18-State (17-State in 1990s) aggregate corn planting progress as of April 15 and April 30 (USDA-NASS *Quick Stats*).



2012 production prospects started out very promising: Corn plantings largest since the 1930s; Soybean plantings third highest on record

Million acres

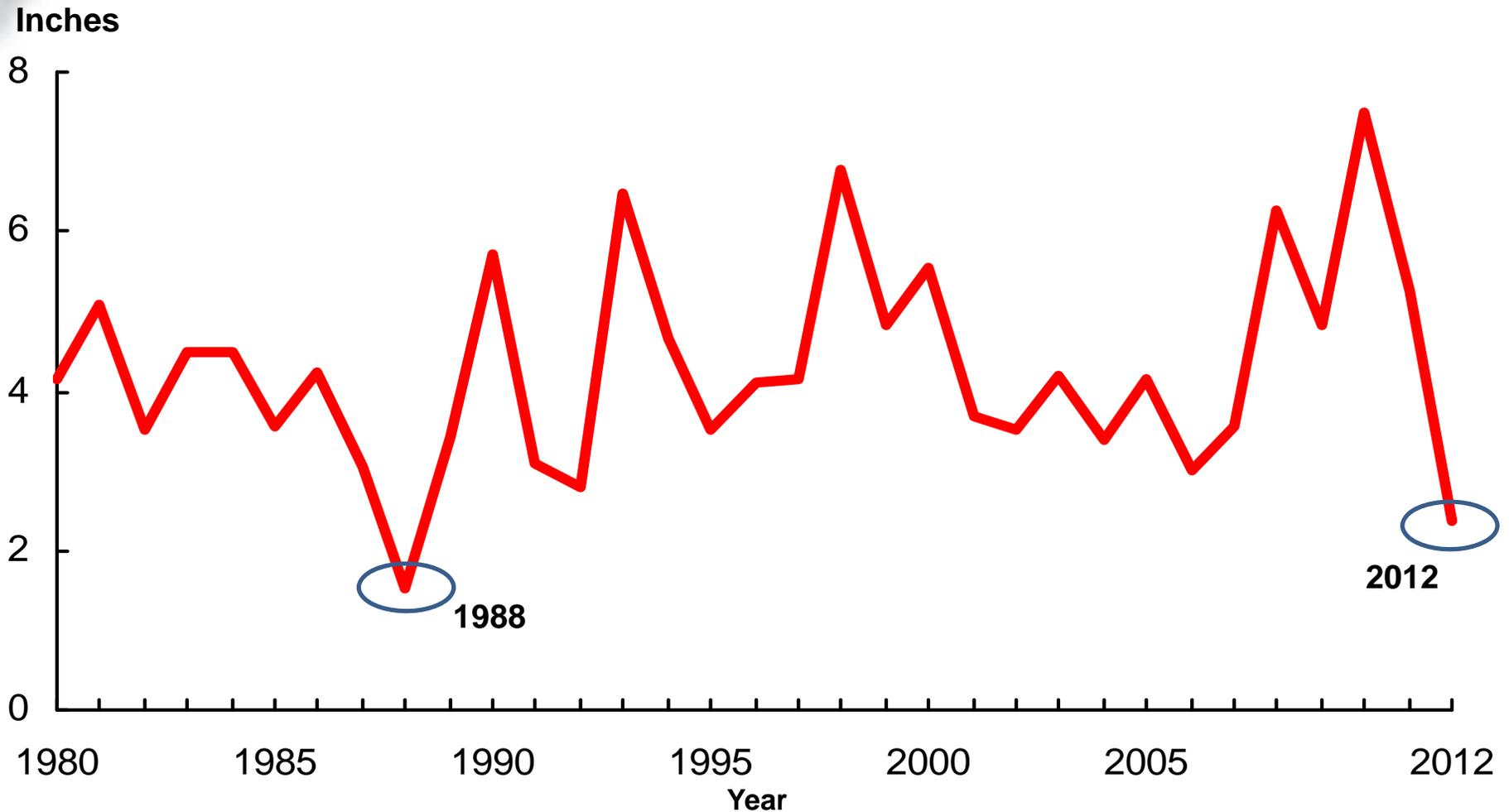


Source: USDA-NASS *Quick Stats*.



June precipitation, 8-State weighted average

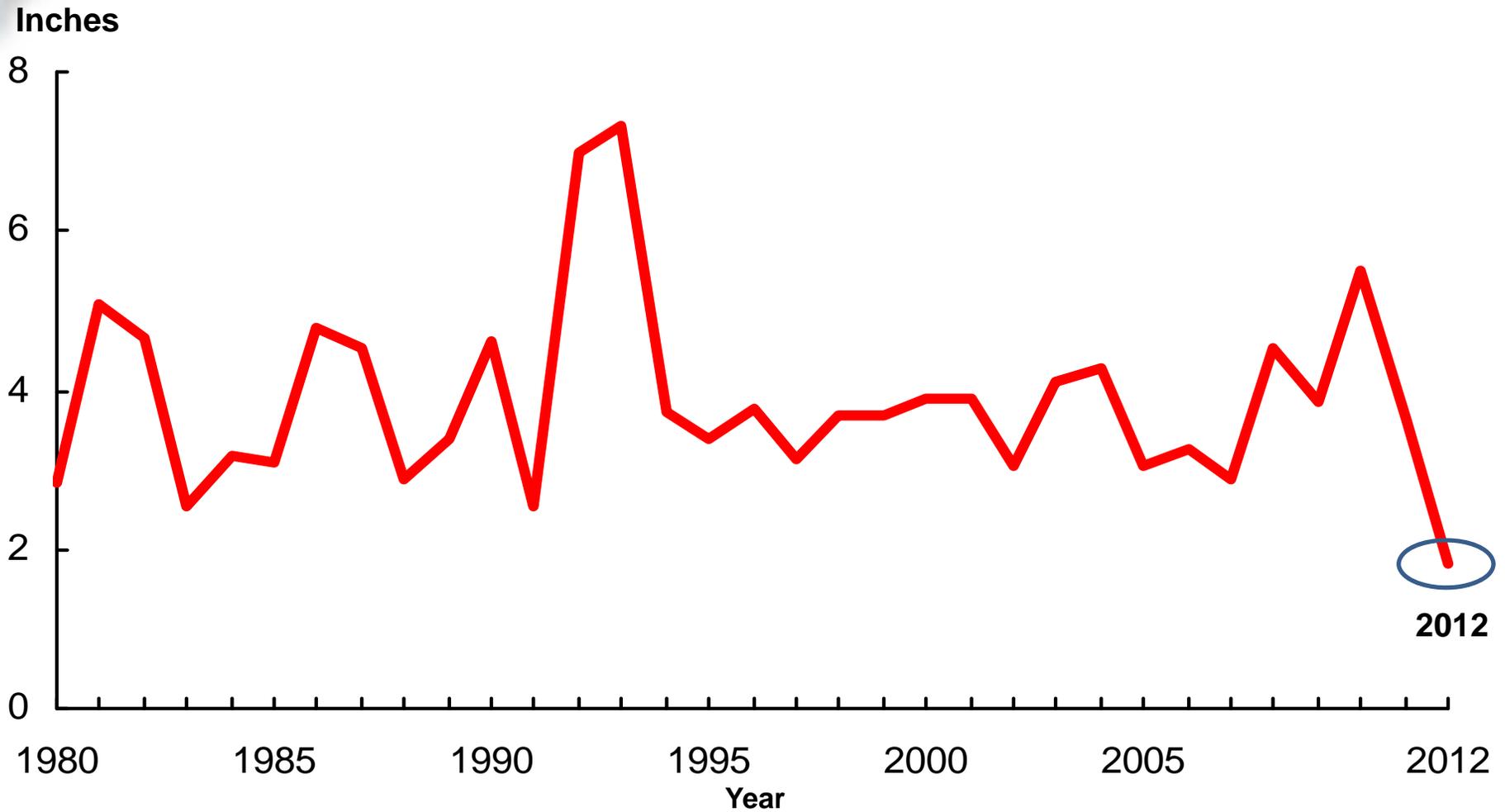
June 2012 was dry, much like June 1988



Eight States included are Iowa, Illinois, Nebraska, Minnesota, Indiana, South Dakota, Ohio, and Missouri. Weighted by corn harvested acreage.



July precipitation, 8-State weighted average July 2012 was dry



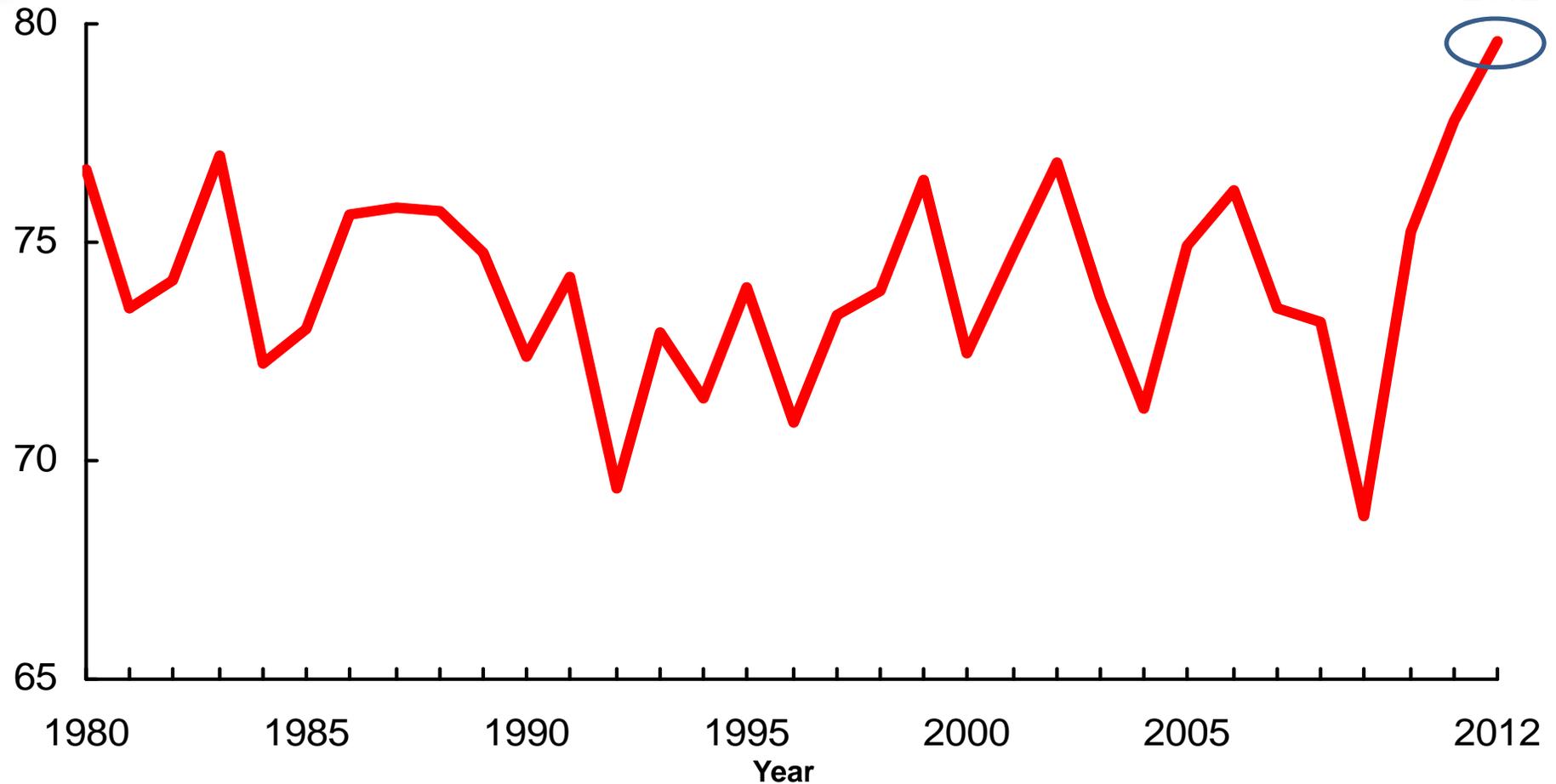
Eight States included are Iowa, Illinois, Nebraska, Minnesota, Indiana, South Dakota, Ohio, and Missouri. Weighted by corn harvested acreage.





July average daily temperature, 8-State weighted average July 2012 was very hot

Degrees, Fahrenheit



Eight States included are Iowa, Illinois, Nebraska, Minnesota, Indiana, South Dakota, Ohio, and Missouri. Weighted by corn harvested acreage.

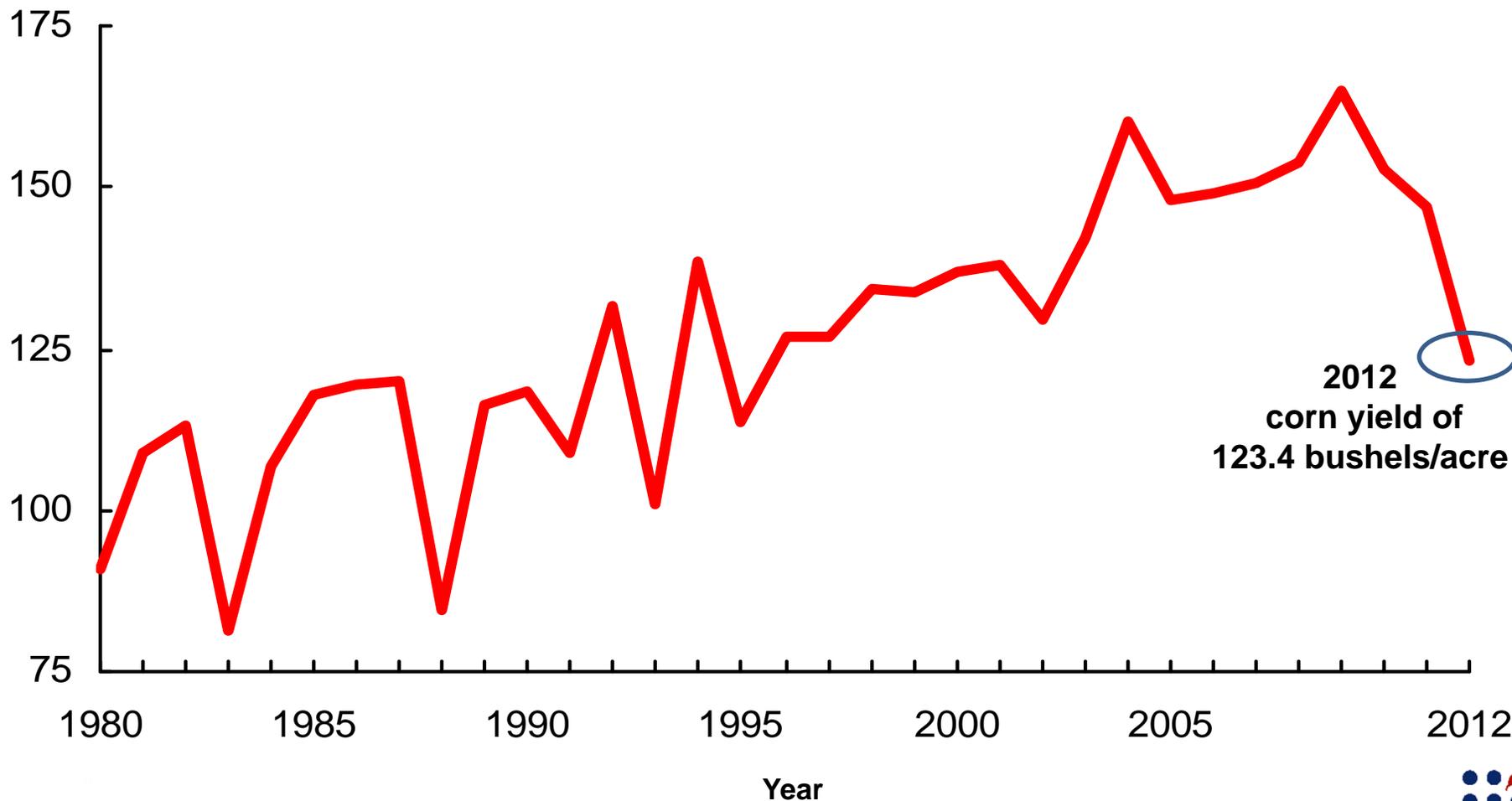




U.S. corn yields

2012 yields sharply reduced;
2010 and 2011 below expectations

Corn yield,
bushels per acre



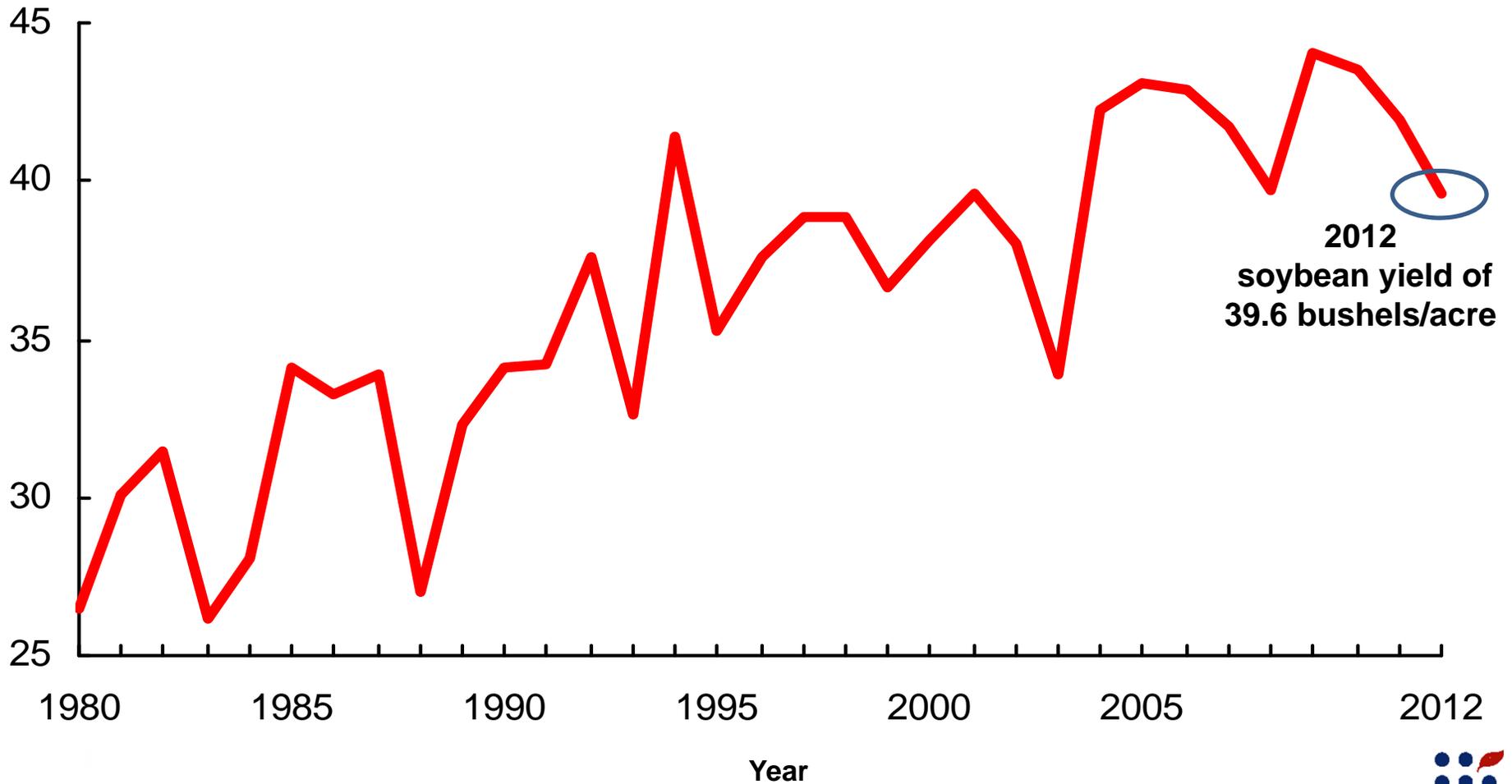
2012
corn yield of
123.4 bushels/acre



U.S. soybean yields

2012 yields also sharply reduced

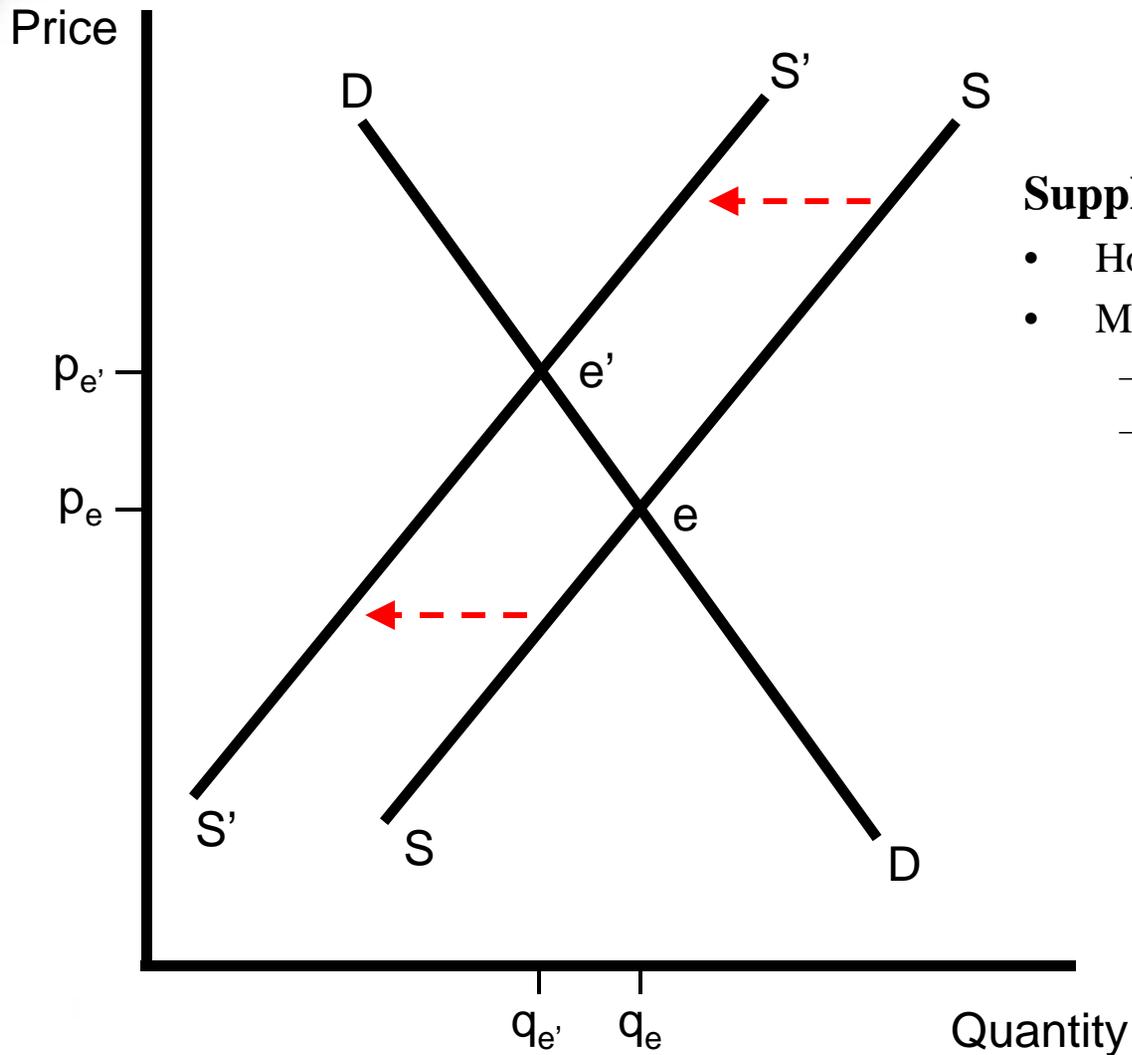
Soybean yield,
bushels per acre





2012 crop market impacts

Reduced production shifts supply curve to left



Supply Shift

- Horizontal shift of supply curve to S'S'
- Move to new equilibrium e'
 - Higher price
 - Lower equilibrium quantities



Corn sector impacts

Higher prices and lower use

U.S. corn projections, 2012/13 marketing year, May 2012 and January 2013 forecast comparison

Item	May 2012 forecast	Jan. 2013 forecast	Change	Percent of supply change
Planted acres (million acres)	95.9	97.2	1.3	
Harvested acres (million acres)	89.1	87.4	-1.7	
Yields: Bushels per harvested acre	166.0	123.4	-42.6	
Supply and use (million bushels):				
Beginning stocks	851	989	138	
Production	14,790	10,780	-4,010	
Imports	15	100	85	
Supply	15,656	11,869	-3,787	100
Feed & residual	5,450	4,450	-1,000	26
Ethanol and by-products	5,000	4,500	-500	13
Other food, seed, & industrial	1,425	1,367	-58	2
Domestic use	11,875	10,317	-1,558	
Exports	1,900	950	-950	25
Total use	13,775	11,267	-2,508	
Ending stocks	1,881	602	-1,279	34
Farm price (dollars per bushel)	4.60	7.40	2.80	

Note: Marketing year beginning September 1 for corn.



Soybean sector impacts

Exports adjust relatively more

U.S. soybean projections, 2012/13 marketing year, May 2012 and January 2013 forecast comparison

Item	May 2012 forecast	Jan. 2013 forecast	Change	Percent of supply change
Planted acres (million acres)	73.9	77.2	3.3	
Harvested acres (million acres)	73.0	76.1	3.1	
Yields: Bushels per harvested acre	43.9	39.6	-4.3	
Supply and use (million bushels):				
Beginning stocks, September 1	210	169	-41	
Production	3,205	3,015	-190	
Imports	15	20	5	
Total supply	3,430	3,204	-226	100
Crush	1,655	1,605	-50	22
Seed and residual	125	119	-6	3
Exports	1,505	1,345	-160	71
Total disposition	3,285	3,070	-215	
Ending stocks	145	135	-10	4
Prices:				
Soybean price, farm (\$ per bushel)	13.00	14.25	1.25	
Soybean oil (dollars per lb)	0.545	0.510	-0.035	
Soybean meal (dollars per ton)	350	445	95	

Note: Marketing year beginning September 1 for soybeans.



Incorporating weather into corn yield models



Weather and national corn yield model

- Dependent variable is national corn yield
- 1988-2012 estimation period
- Model variables for corn yields
 - Trend variable represents yield-enhancing technological developments and production practices
 - Planting progress and weather variables for 8 major corn producing States



Planting progress and weather variables

- Planting progress and weather variables for 8 major corn producing States
 - Mid-May planting progress
 - July precipitation
 - July temperature
 - June precipitation shortfall, in extreme years
 - June 1988 and 2012 were extremely dry (precipitation in the lower 10-percent tail of the statistical distribution)
 - Average June precipitation minus actual June precipitation in those years (drier implies larger shortfall)



Corn yield model

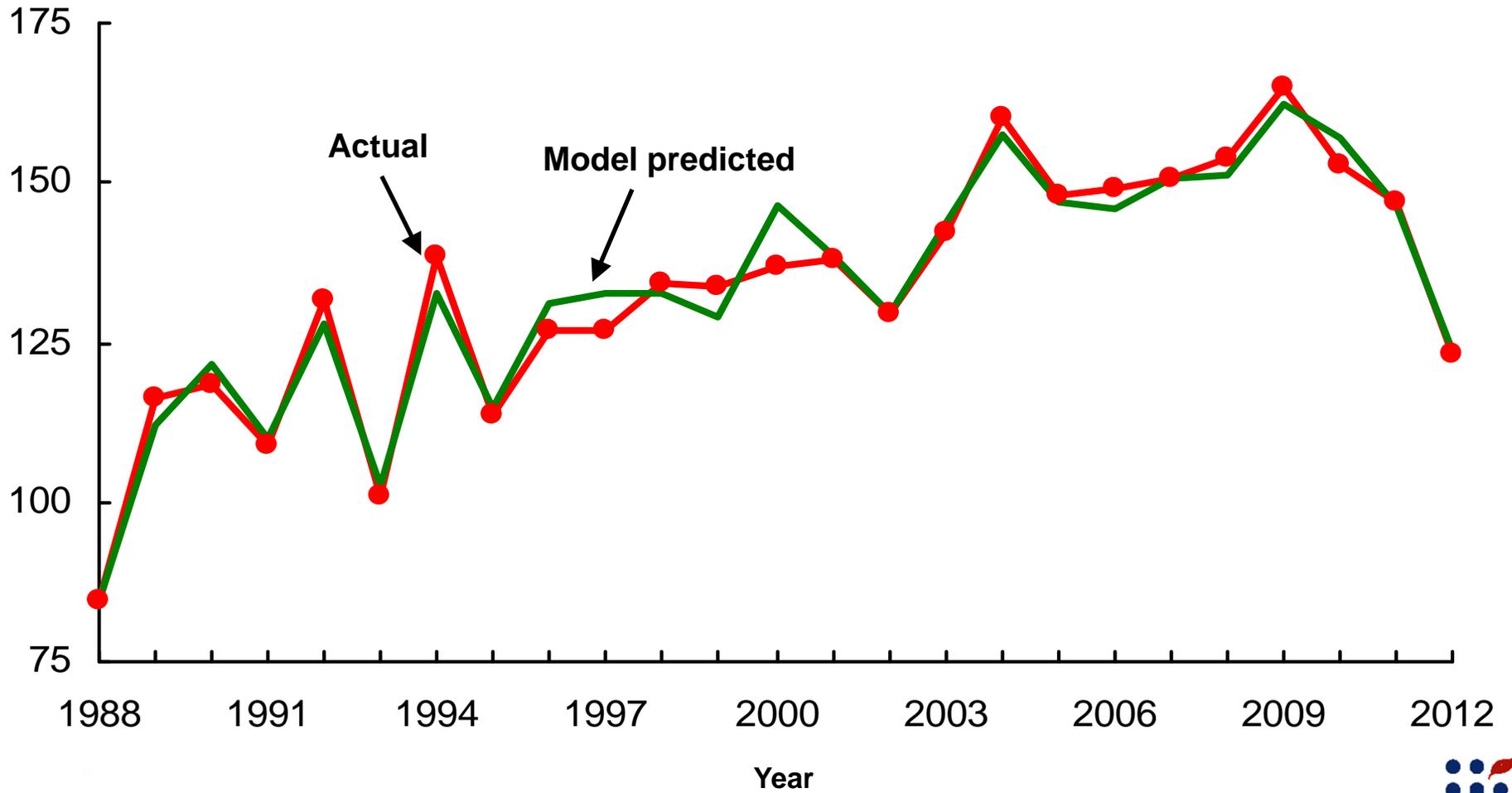
Variable	Coefficient	Coefficient standard error	t-statistic
Constant	228.5		
Trend	1.95	0.13	15.1
Mid-May planting progress	0.29	0.06	5.2
July temperature	-2.28	0.44	-5.2
July precipitation	13.79	4.73	2.9
July precipitation, squared	-1.52	0.47	-3.2
June precipitation shortfall	-9.54	1.67	-5.7
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R-squared			0.96
Estimation period			1988-2012



U.S. corn yield model results

Predicted and actual

Corn yield,
bushels per acre

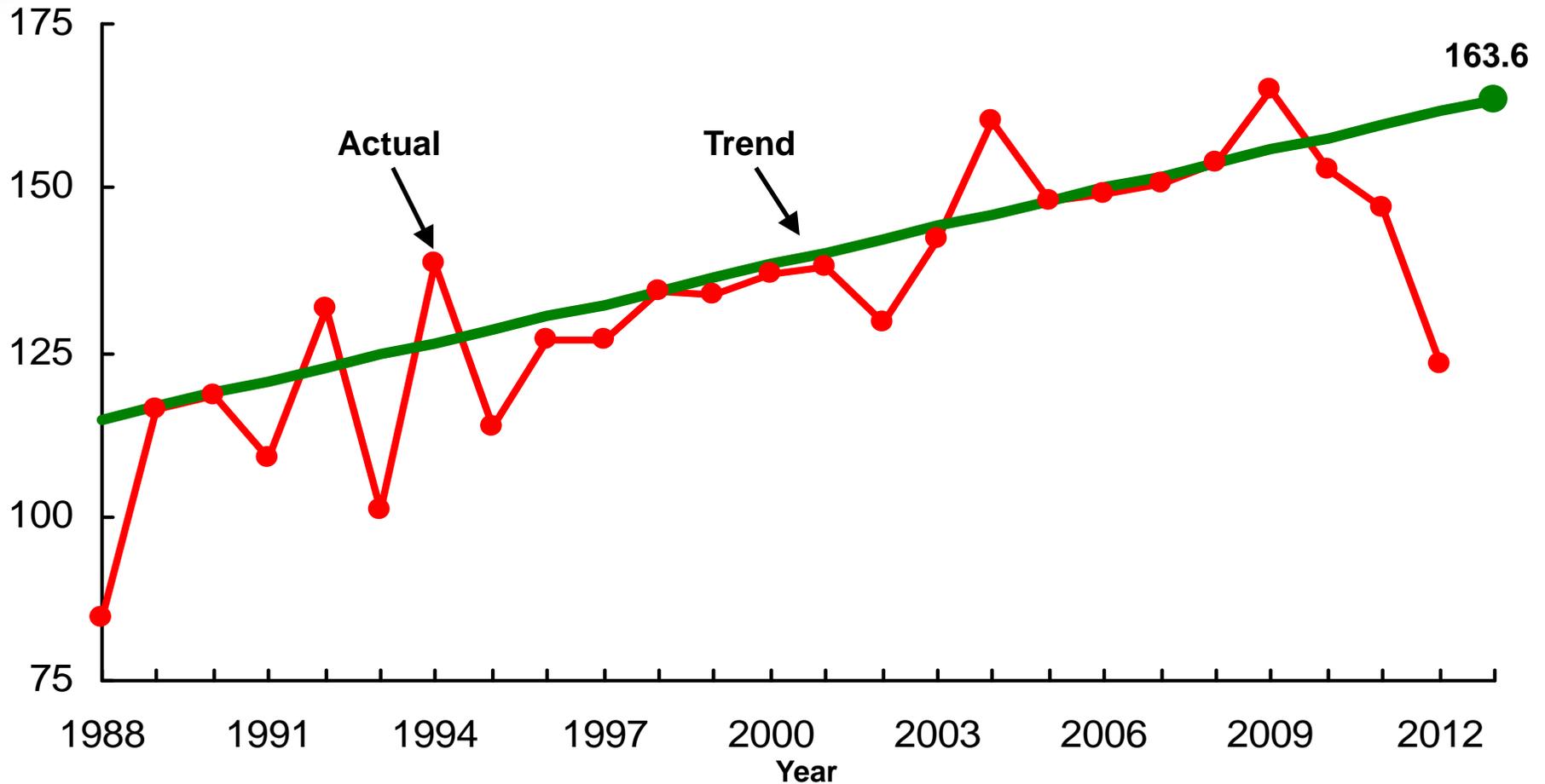




U.S. corn yield model results

Implied weather-adjusted trend

Corn yield,
bushels per acre



Trend evaluated at 10-year average for mid-May planting progress, sample means for July weather variables, adjusted for asymmetric yield response to July precipitation. Assumes June weather is not extremely dry.



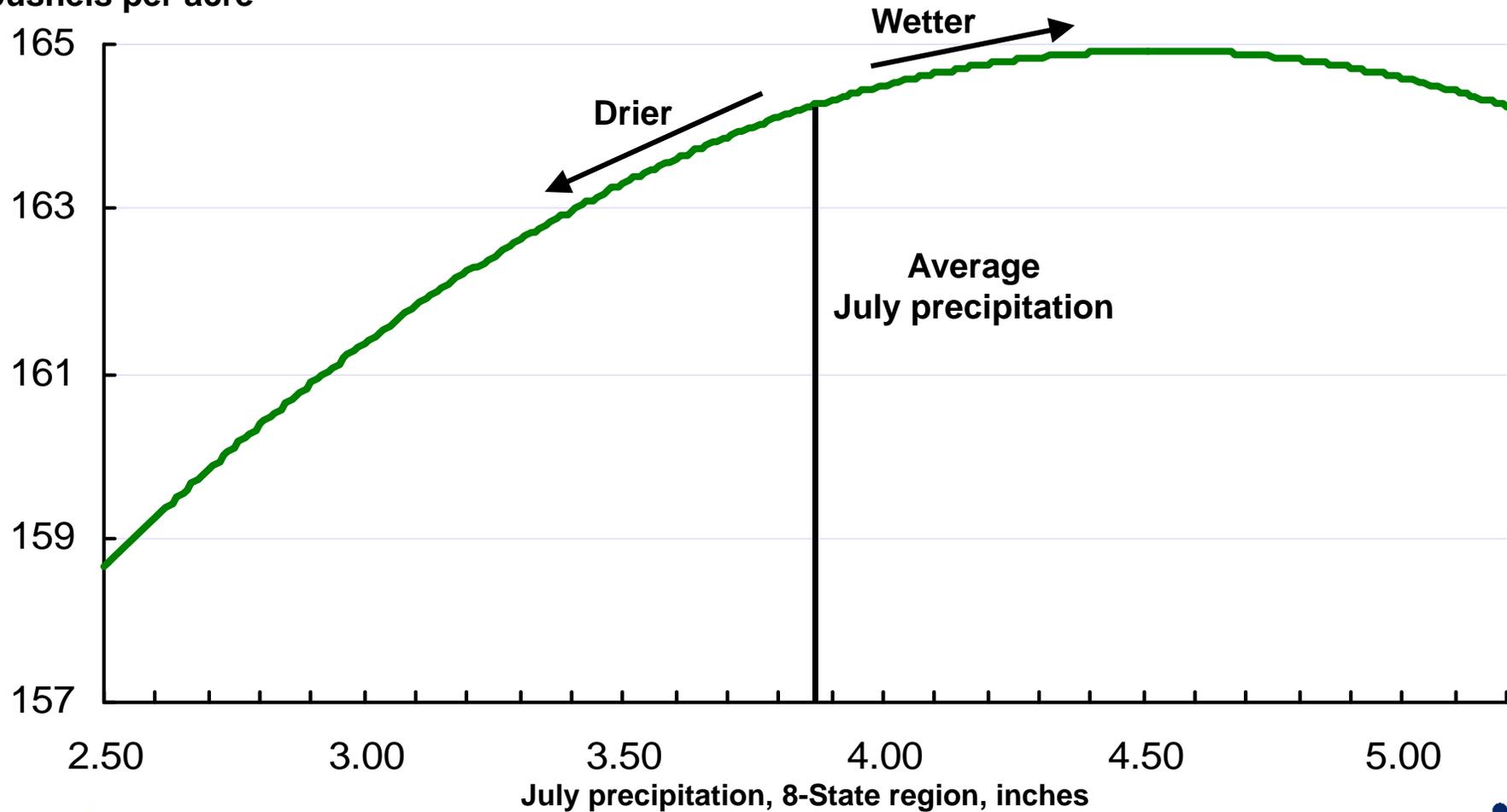
Corn yield model properties



Corn yield model properties

Asymmetric yield response to July precipitation

Corn yield,
bushels per acre

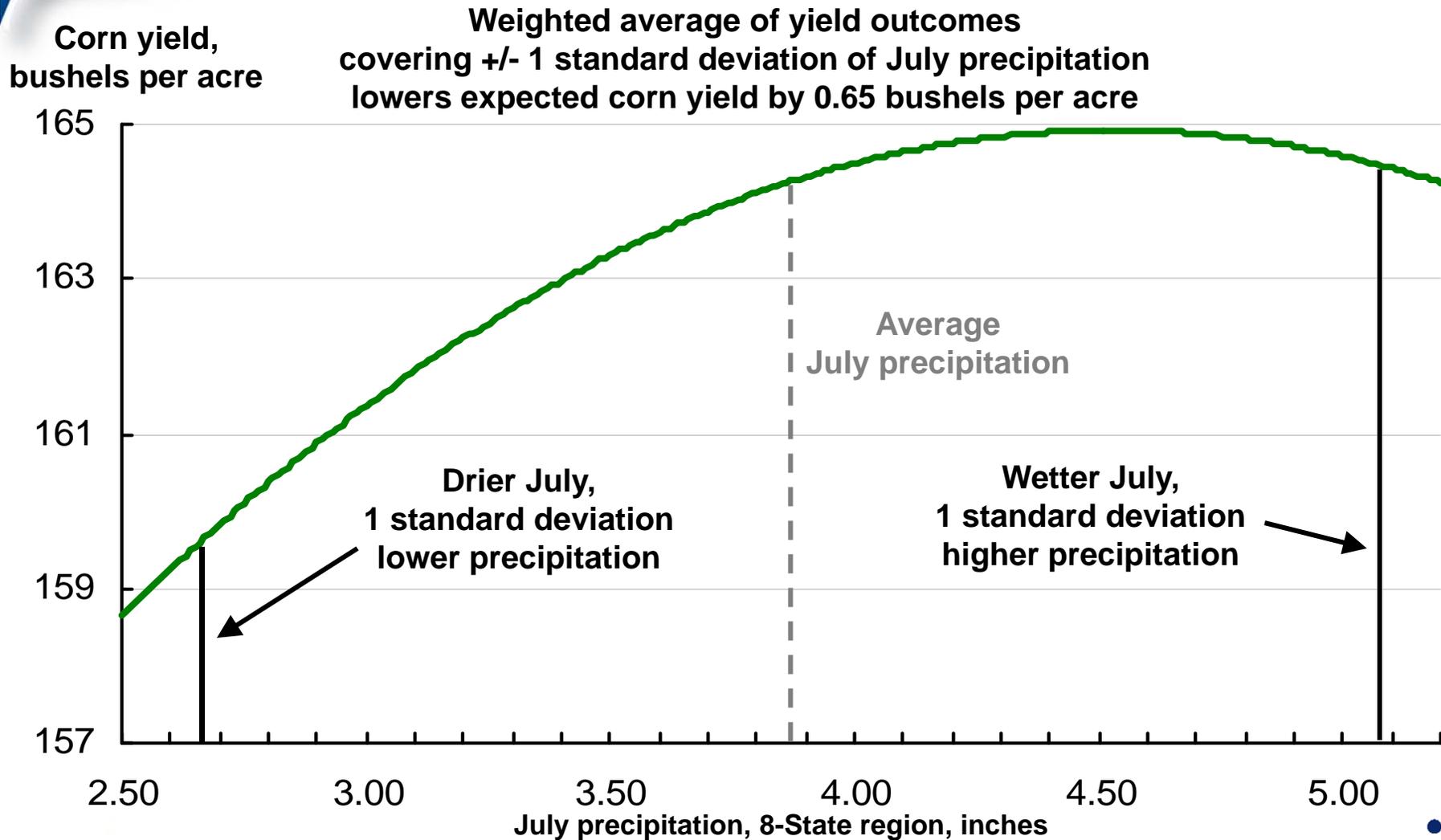


Note: Based on sample period average for July temperatures and 80 percent mid-May planting progress in the 8-State region.



Corn yield model properties

Asymmetric yield response to July precipitation



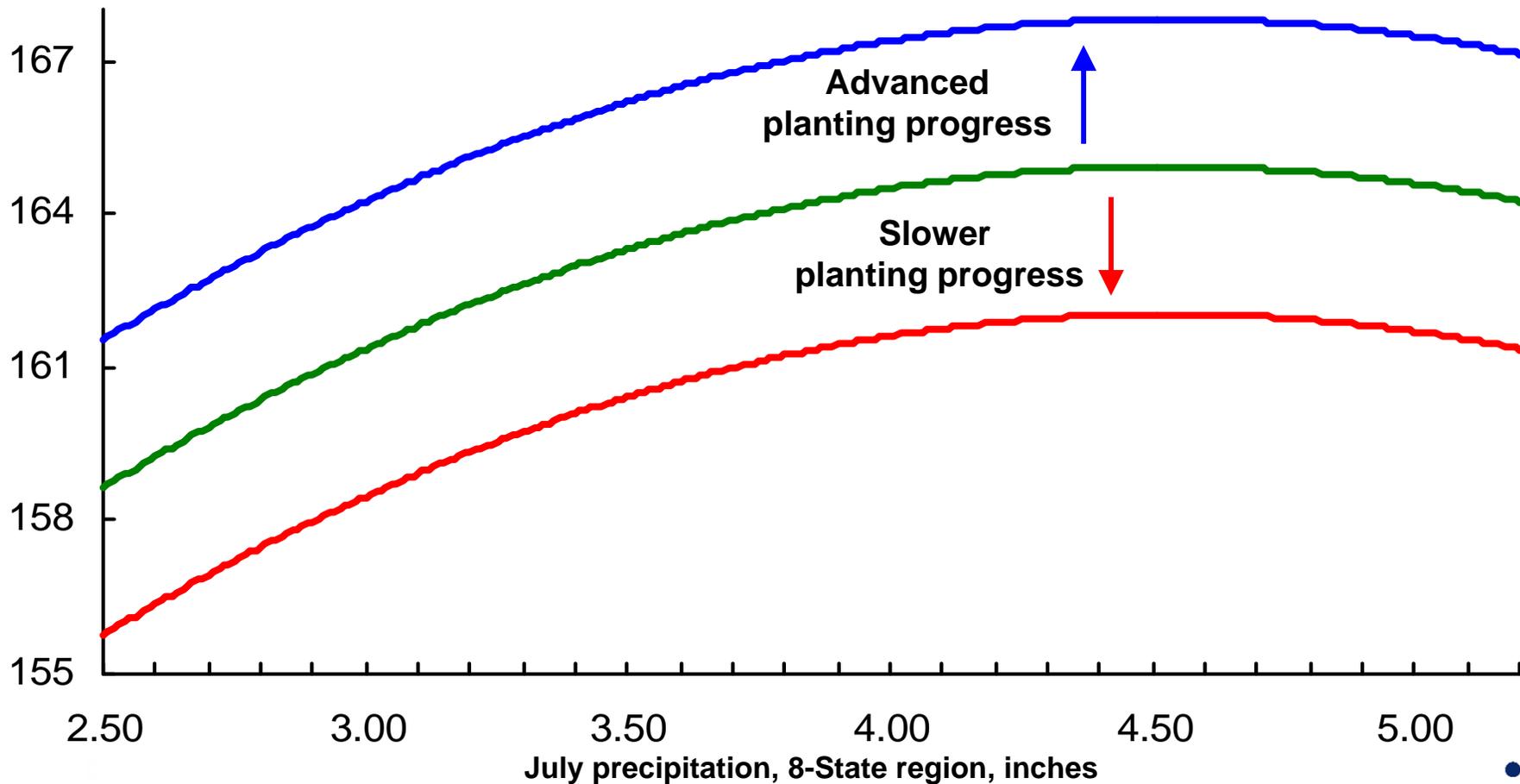
Note: Based on sample period average for July temperatures and 80 percent mid-May planting progress in the 8-State region.



Corn yield model properties

Yield response to mid-May planting progress

Corn yield,
bushels per acre



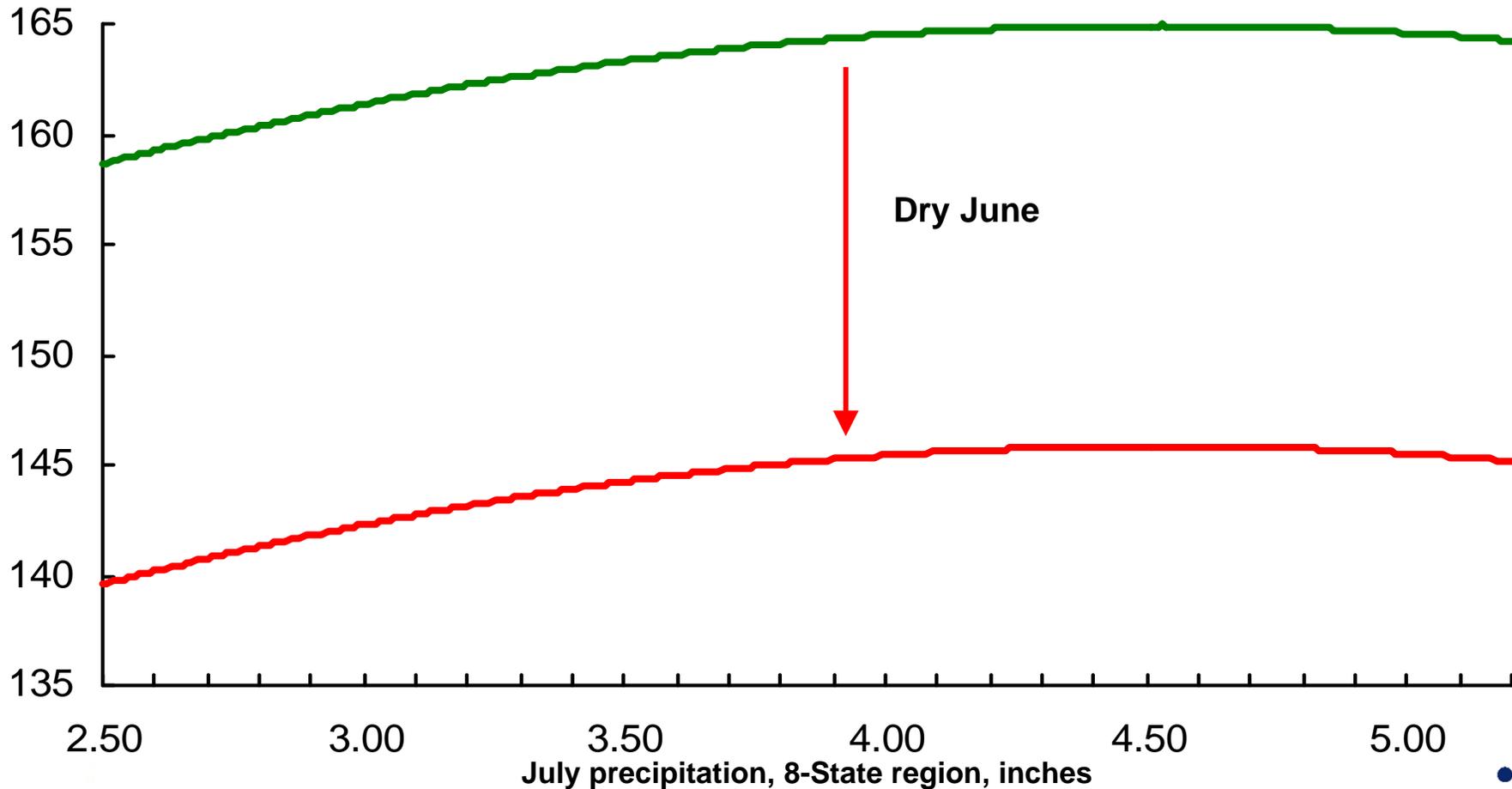
Note: Based on sample period average for July temperatures in the 8-State region. Middle curve assumes 80 percent mid-May planting progress in the 8-State region.



Corn yield model properties

Yield response to very dry June

Corn yield,
bushels per acre



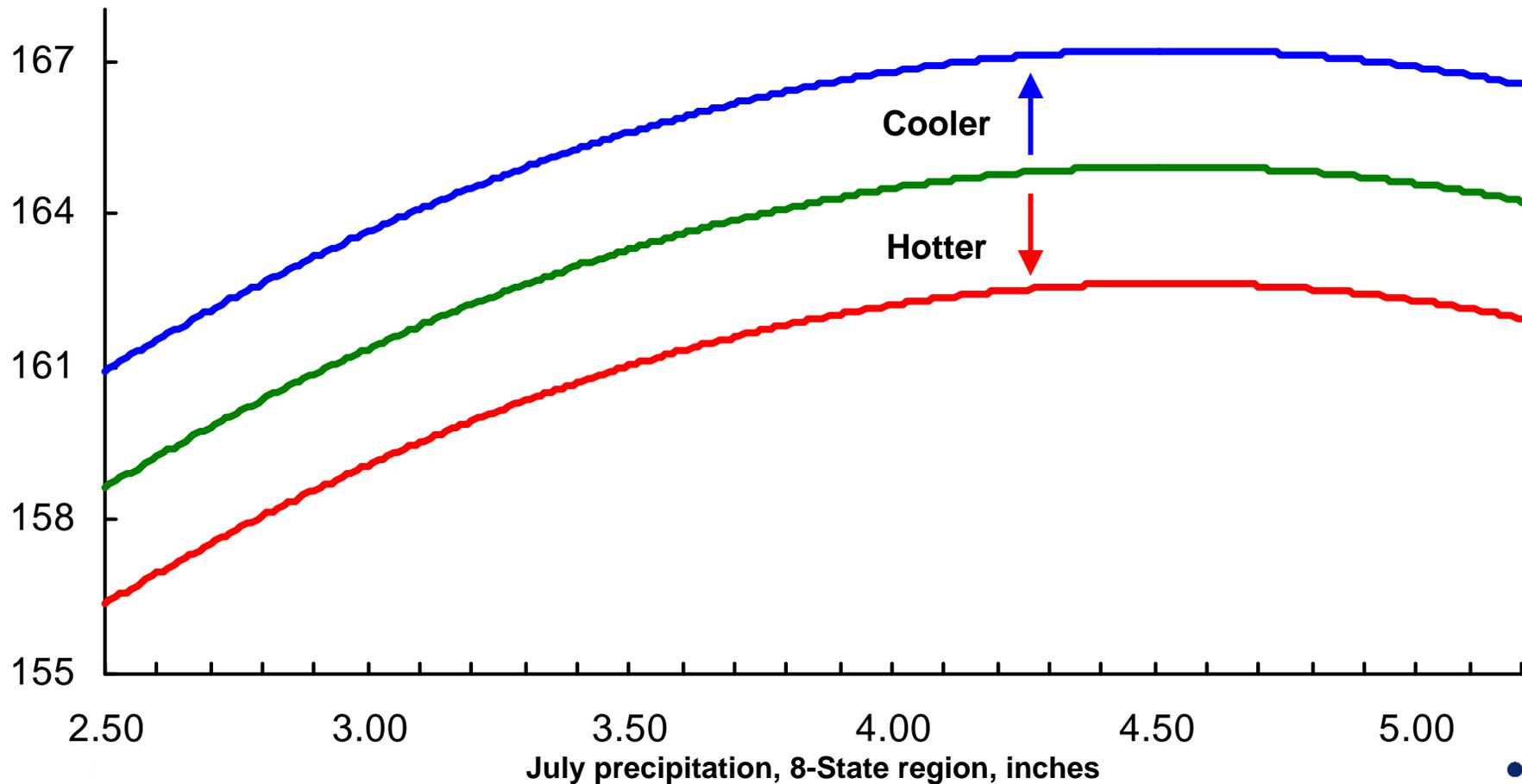
Note: Based on sample period average for July temperatures and 80 percent mid-May planting progress in the 8-State region.



Corn yield model properties

Yield response to July temperature

Corn yield,
bushels per acre



Note: Based on 80 percent mid-May planting progress in the 8-State region. Middle curve assumes sample period average for July temperatures in the 8-State region.



How weather affected 2012 corn yields

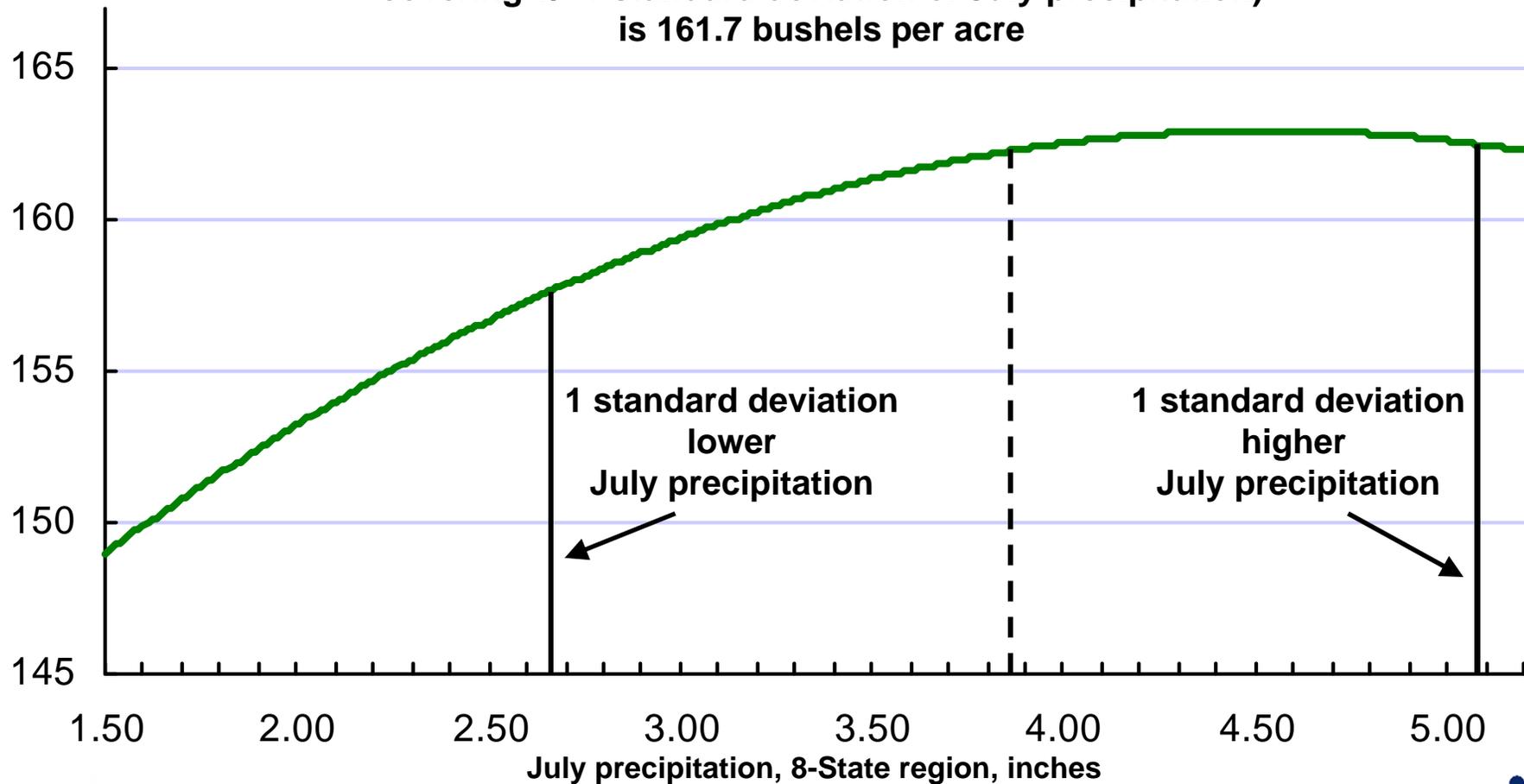


Corn yield model

2012 developments—initial expectation

Corn yield,
bushels per acre

Model's initial expected corn yield
(weighted average of yield outcomes
covering +/- 1 standard deviation of July precipitation)
is 161.7 bushels per acre



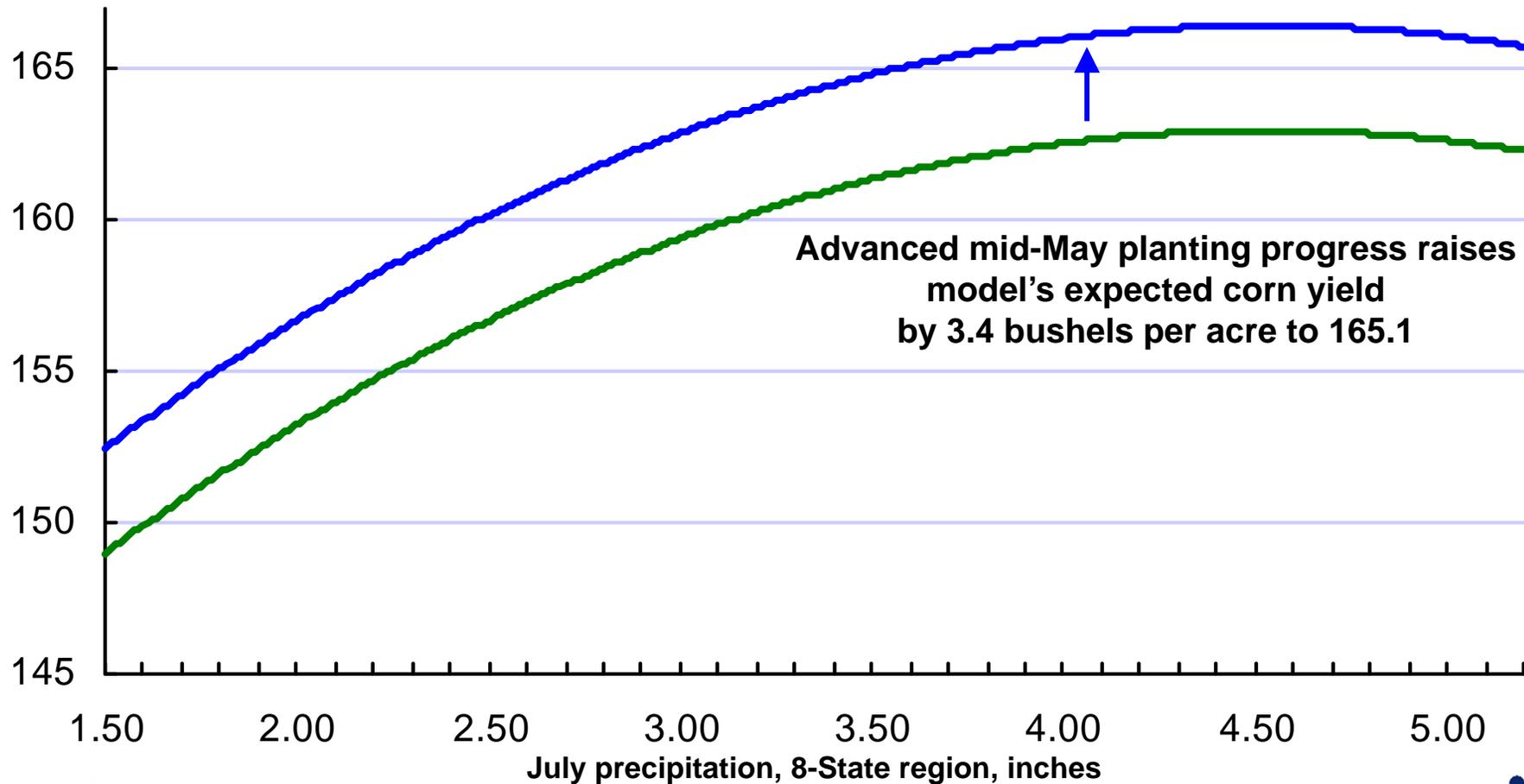
Note: Based on sample period average for July temperatures and 80 percent mid-May planting progress in the 8-State region.



Corn yield model

2012 developments—planting progress

Corn yield,
bushels per acre



Advanced mid-May planting progress raises model's expected corn yield by 3.4 bushels per acre to 165.1

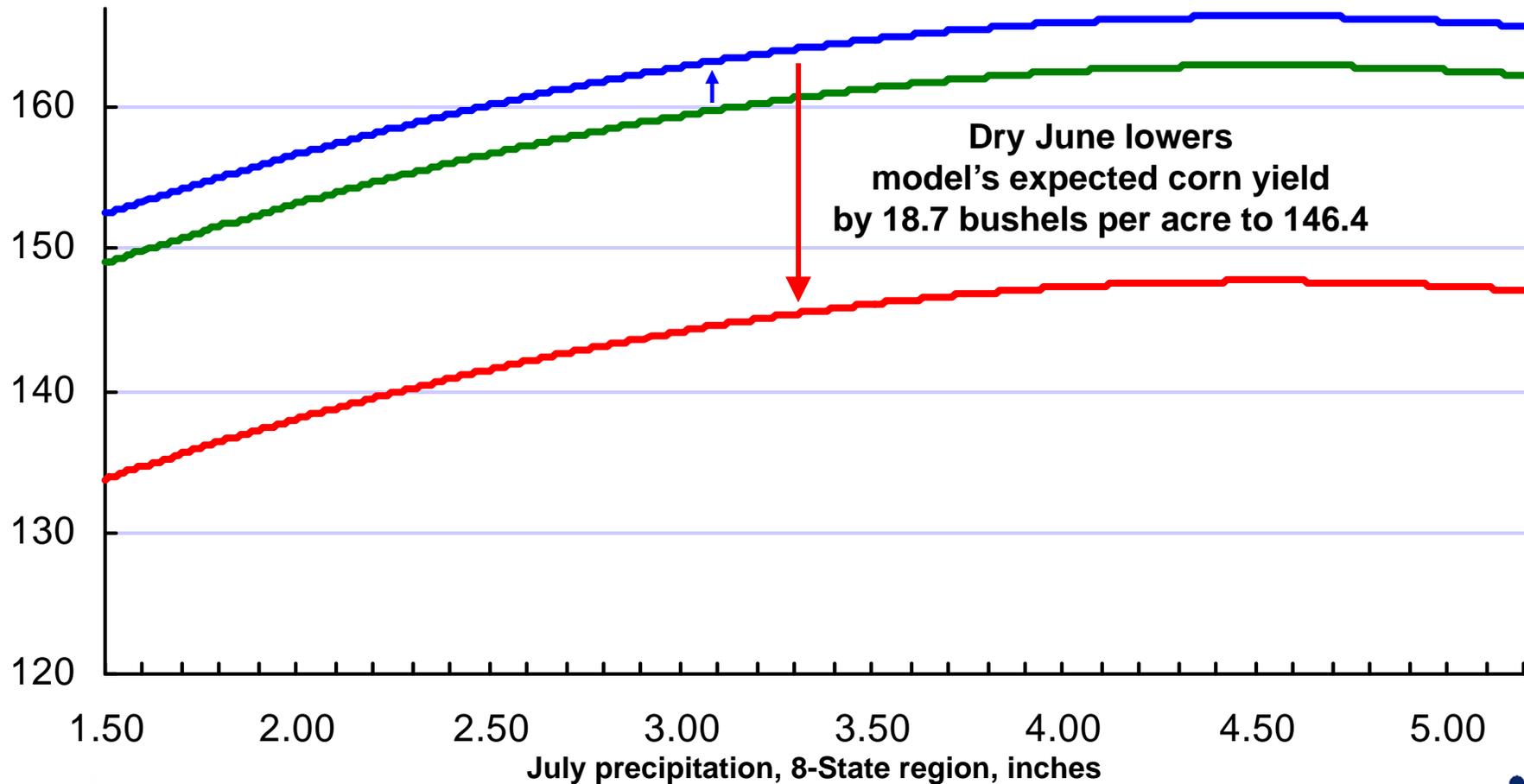
Note: Based on sample period average for July temperatures in the 8-State region. Mid-May planting progress of 92 percent in 2012 for the 8-State region, compared with a 10-year average of 80 percent.



Corn yield model

2012 developments—dry June

Corn yield,
bushels per acre



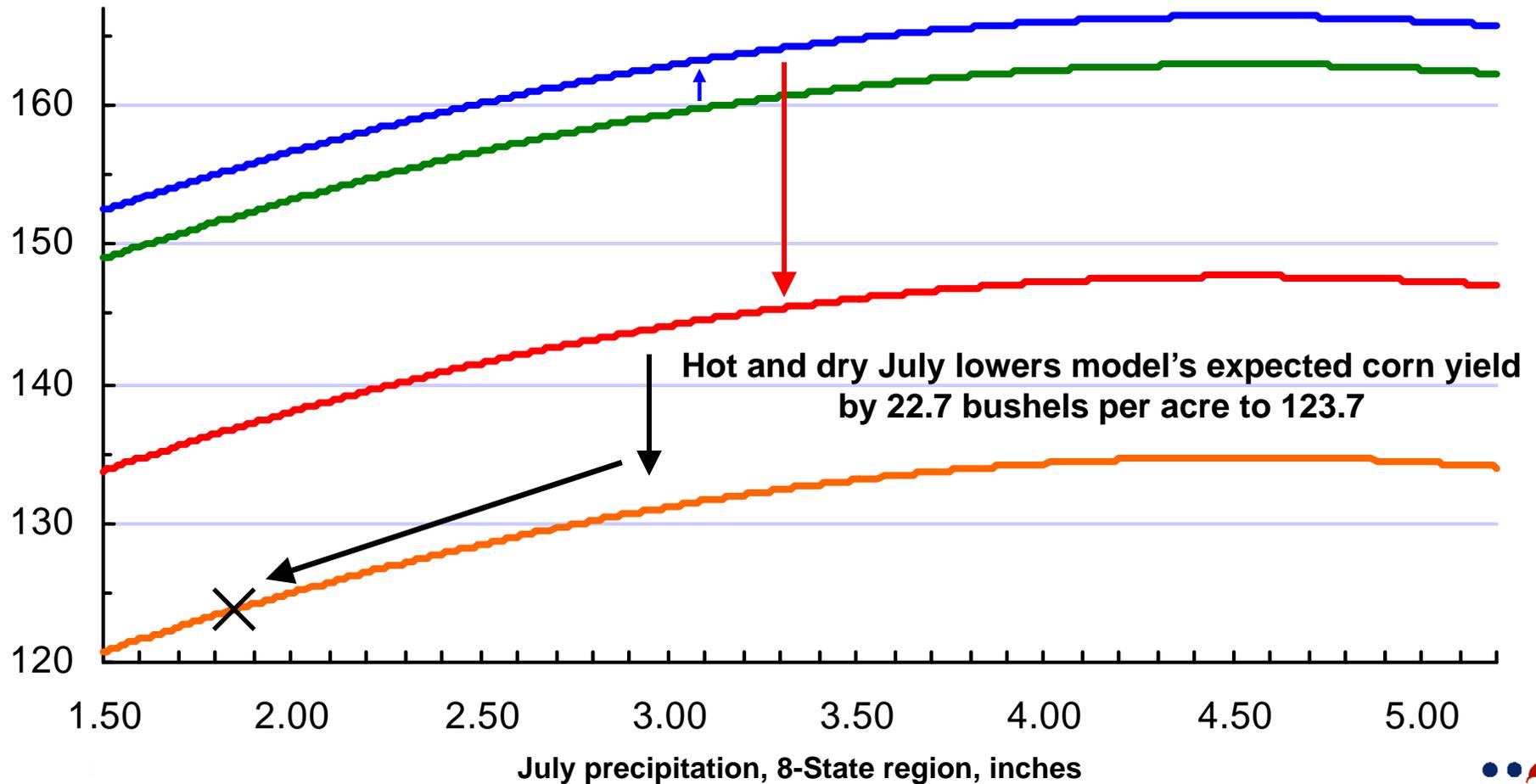
Note: Based on sample period average for July temperatures in the 8-State region.



Corn yield model

2012 developments—hot and dry July

Corn yield,
bushels per acre



Note: Hot July weather lowered the yield curve; dry July moved yields down along the lowered curve.

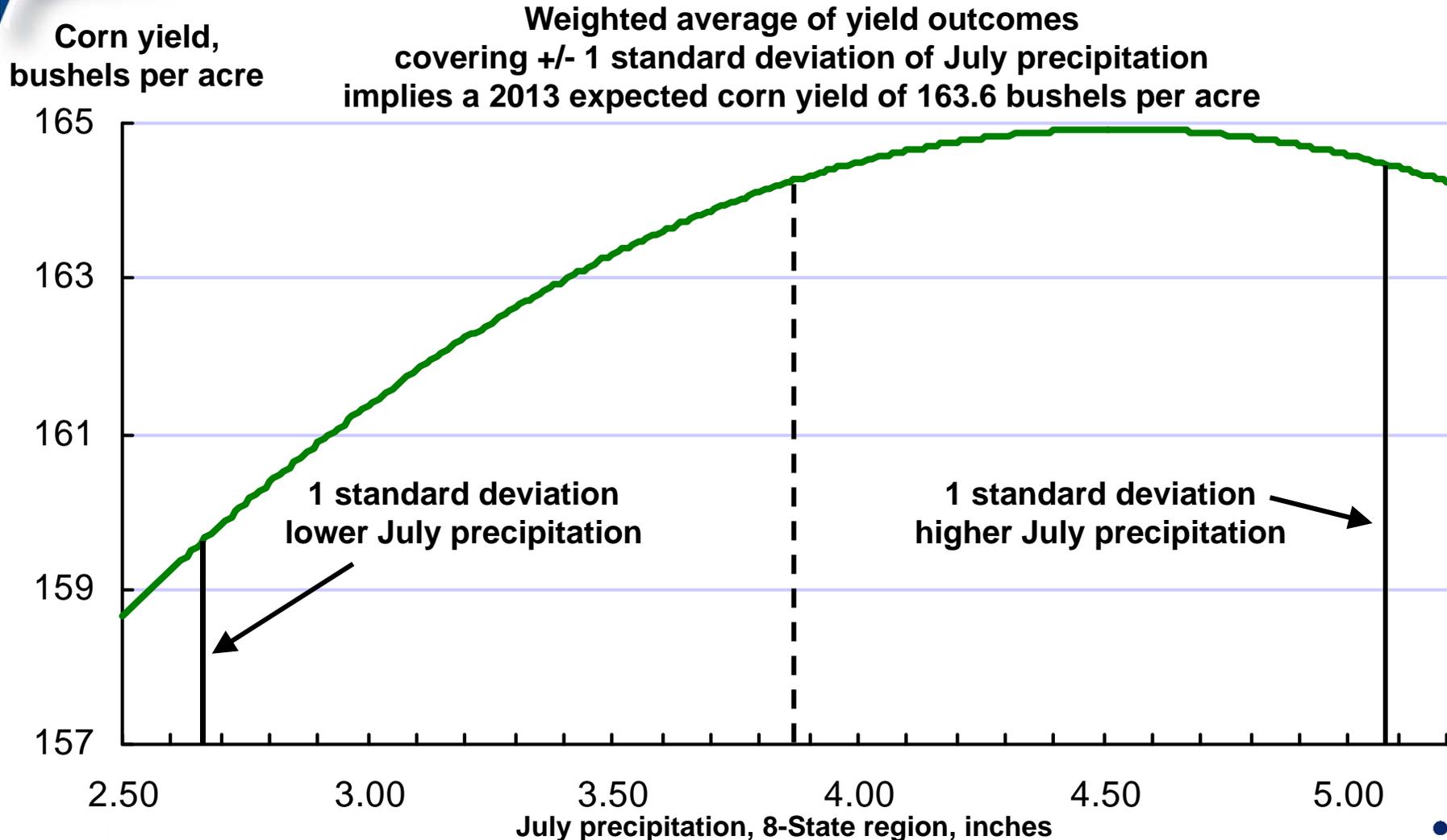


Implications for 2013 corn yields



Corn yield model

2013 initial yield expectation



Note: Based on sample period average for July temperatures and 80 percent mid-May planting progress in the 8-State region.



Soybean yield model and 2013 implications



Weather and national soybean yield model

- Dependent variable is national soybean yields
- 1988-2012 estimation period
- Model variables for soybean yields
 - Trend variable is a proxy for yield enhancing technological developments and production practices
 - Average of July and August precipitation
 - Average of July and August temperature
 - June precipitation shortfall in extreme years
 - Weather variables cover 7 major soybean producing States



Soybean yield model

Variable	Coefficient	Coefficient standard error	t-statistic
Constant	60.1		
Trend	0.45	0.06	7.3
July-August temperature	-0.51	0.24	-2.2
July-August precipitation	5.08	4.45	1.1
July-August precipitation, squared	-0.62	0.51	-1.2
June precipitation shortfall	-1.28	0.72	-1.8

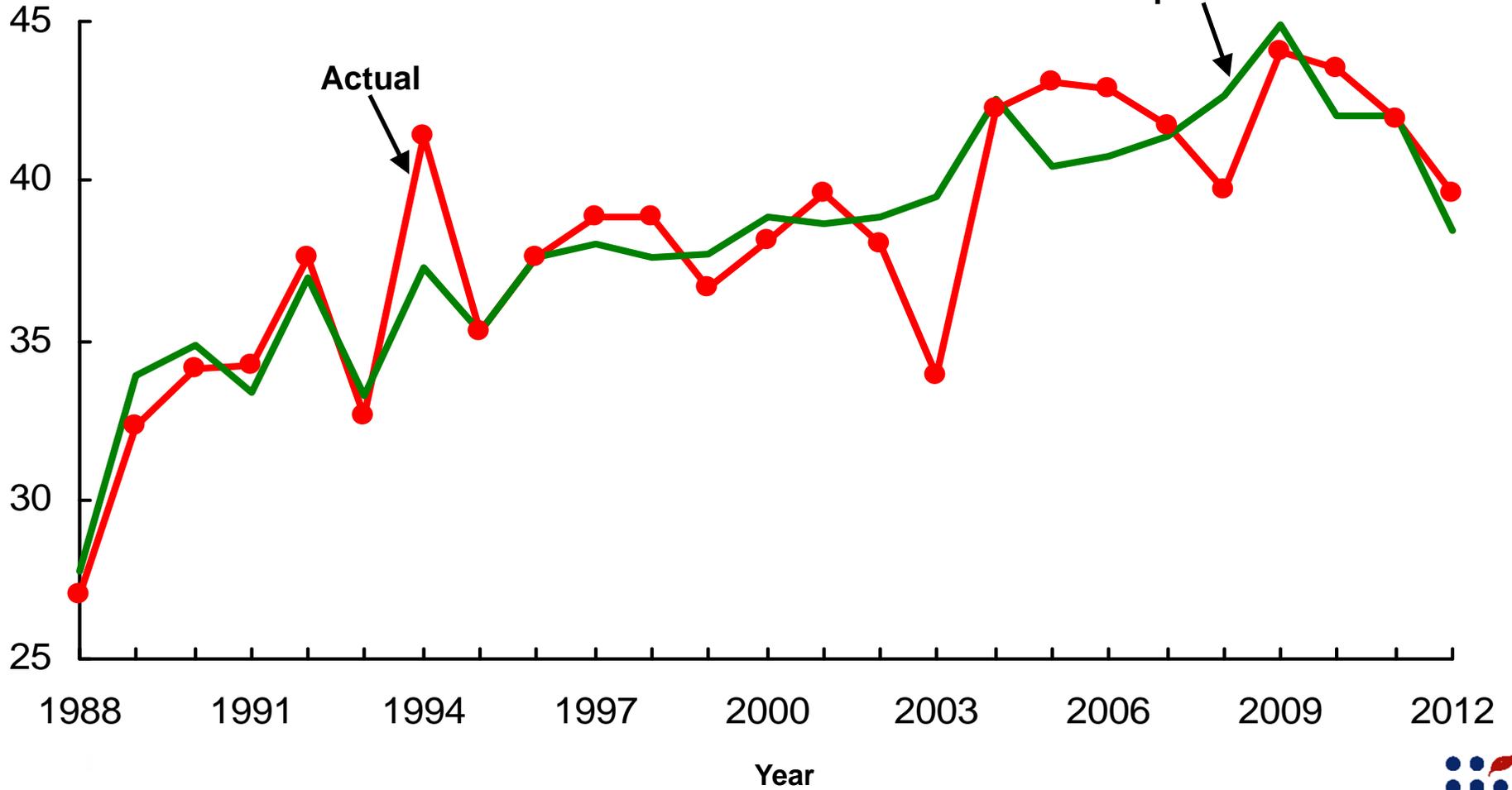
R-squared			0.80
Estimation period			1988-2012



U.S. soybean yield model results

Predicted and actual

Soybean yield,
bushels per acre

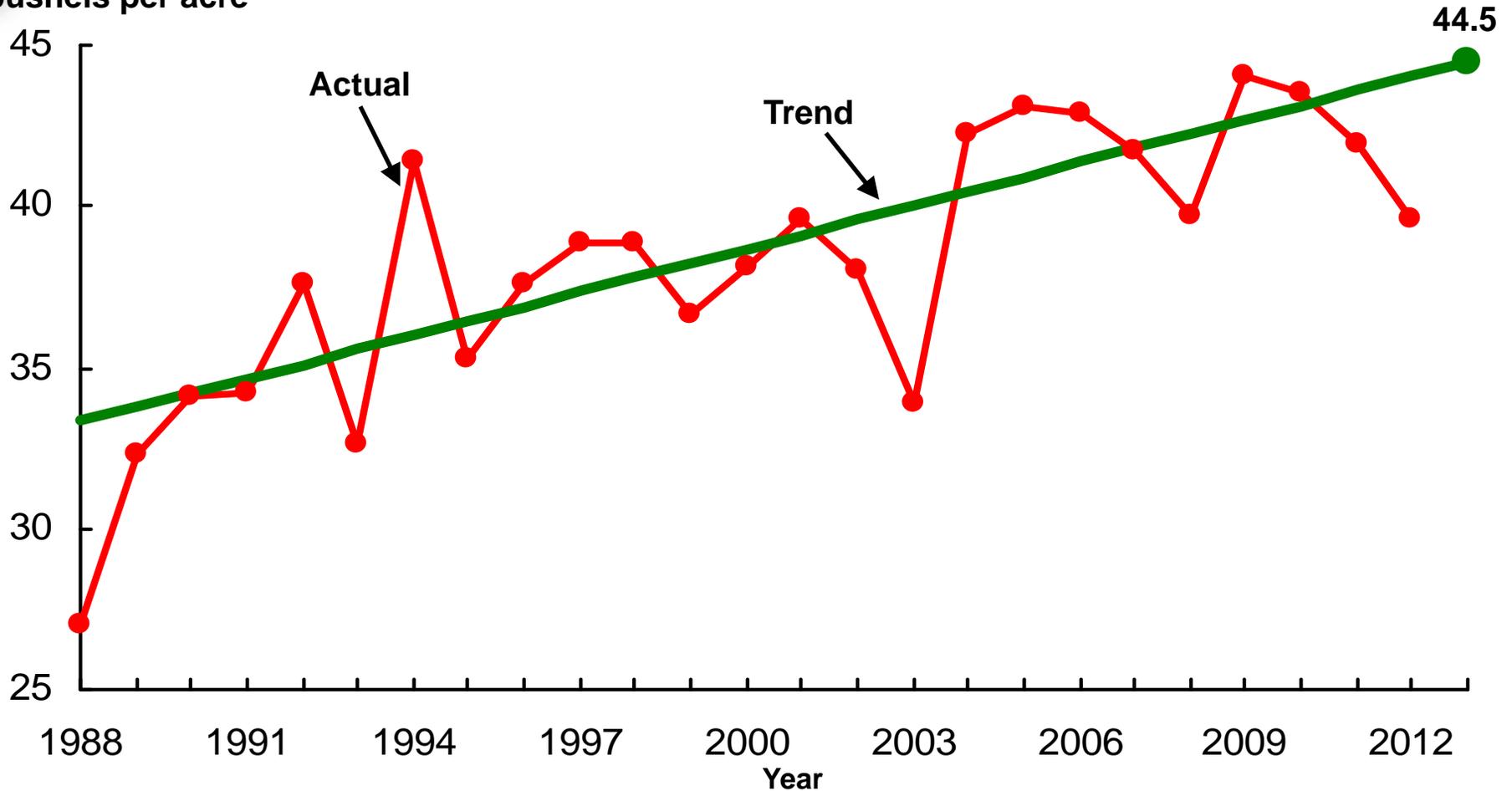




U.S. soybean yield model results

Implied weather-adjusted trend

Soybean yield,
bushels per acre



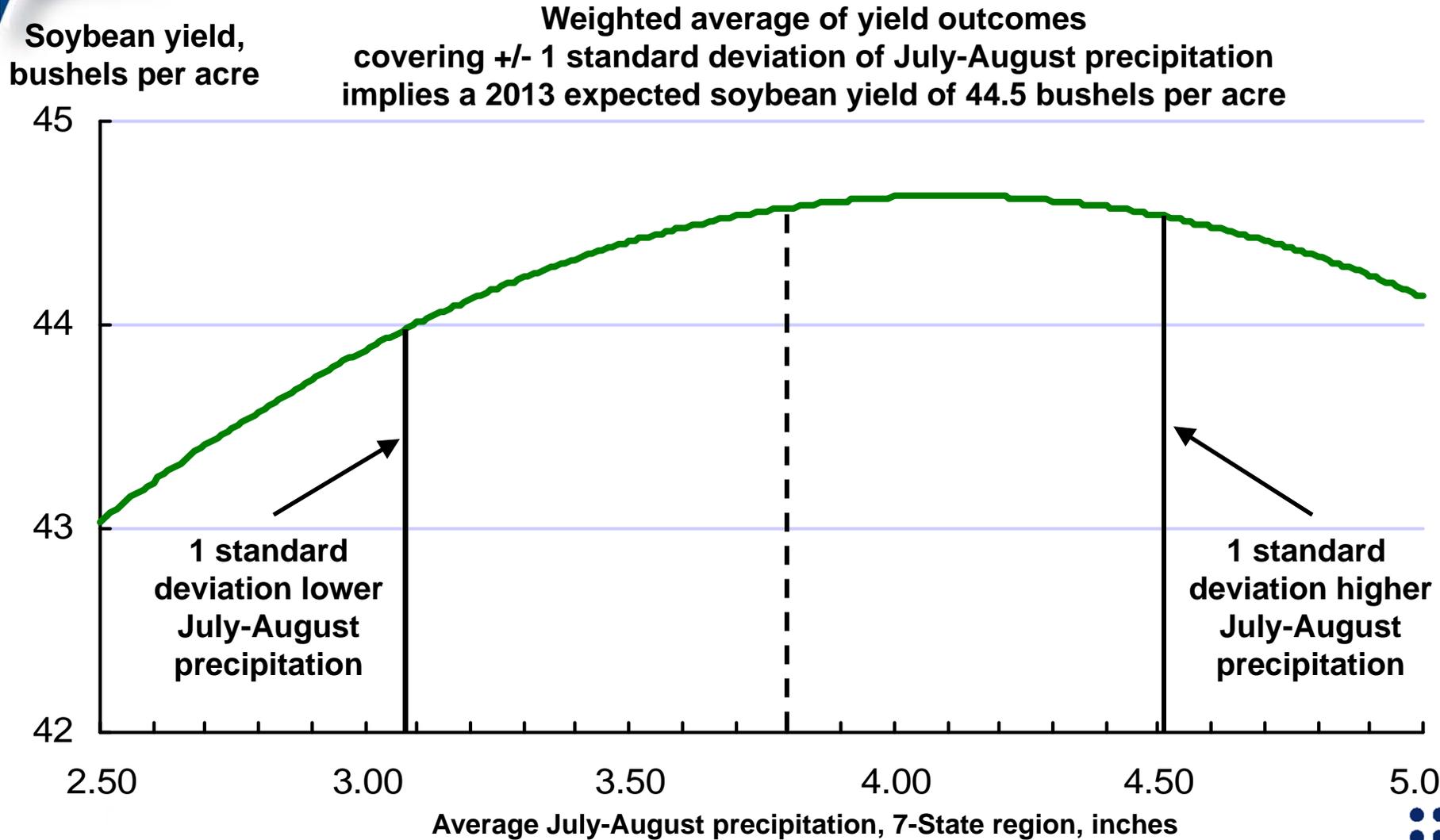
Trend evaluated at sample means for average July-July weather variables, adjusted for asymmetric yield response to average July-August precipitation. Assumes June weather is not extremely dry.





Soybean yield model

2013 initial yield expectation



Note: Based on sample period mean for average July-August temperatures in the 7-State region.



Post-drought yield drag



Palmer Modified Drought Index (PMDI) January 2013 ranking

State	2011 corn production rank	January 2013 PMDI low ranking since 1895
Iowa	1	10
Illinois	2	45
Nebraska	3	5
Minnesota	4	13
Indiana	5	64
South Dakota	6	6
Wisconsin	7	38
Ohio	8	91
Kansas	9	9
Missouri	10	14

Note: Extreme drought indicated for Nebraska; severe drought indicated for Iowa, Kansas, Minnesota, and South Dakota.



Post-drought yield drag

- Palmer Modified Drought Index (PMDI) low in several key States
- Alternative specifications to augment earlier yield models for PMDI did not result in a statistically significant effect
- Alternative specifications to augment earlier yield models for cumulative precipitation in pre-planting months did not result in a statistically significant effect
- Illustrates importance of growing season weather



Conclusions



Conclusions

- Adjusting for weather in analysis of historical U.S. corn and soybeans yields is important for determining underlying trends and future yield expectations
- Weather during the growing season is critical for corn and soybean yield development
- Yield responses in the models discussed here are asymmetric for variations in summer precipitation
- Mean expected 2013 U.S. yields
 - Corn: 163.6 bushels per acre
 - Soybeans: 44.5 bushels per acre