

Global agricultural production estimates from advanced image analysis

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Topics

- About Lanworth
- Timeliness and value
- The view from space
- 2008 in retrospect
- Outlook: US Winter Wheat 2008-09
- Outlook: South America
- Outlook: Indonesia Palm Oil

About Lanworth

Our Goal

Provide timely, accurate, and independent estimates of global agro-forest production.

Our clients

Large producers, supply chain managers, land stewards, and commodities traders.

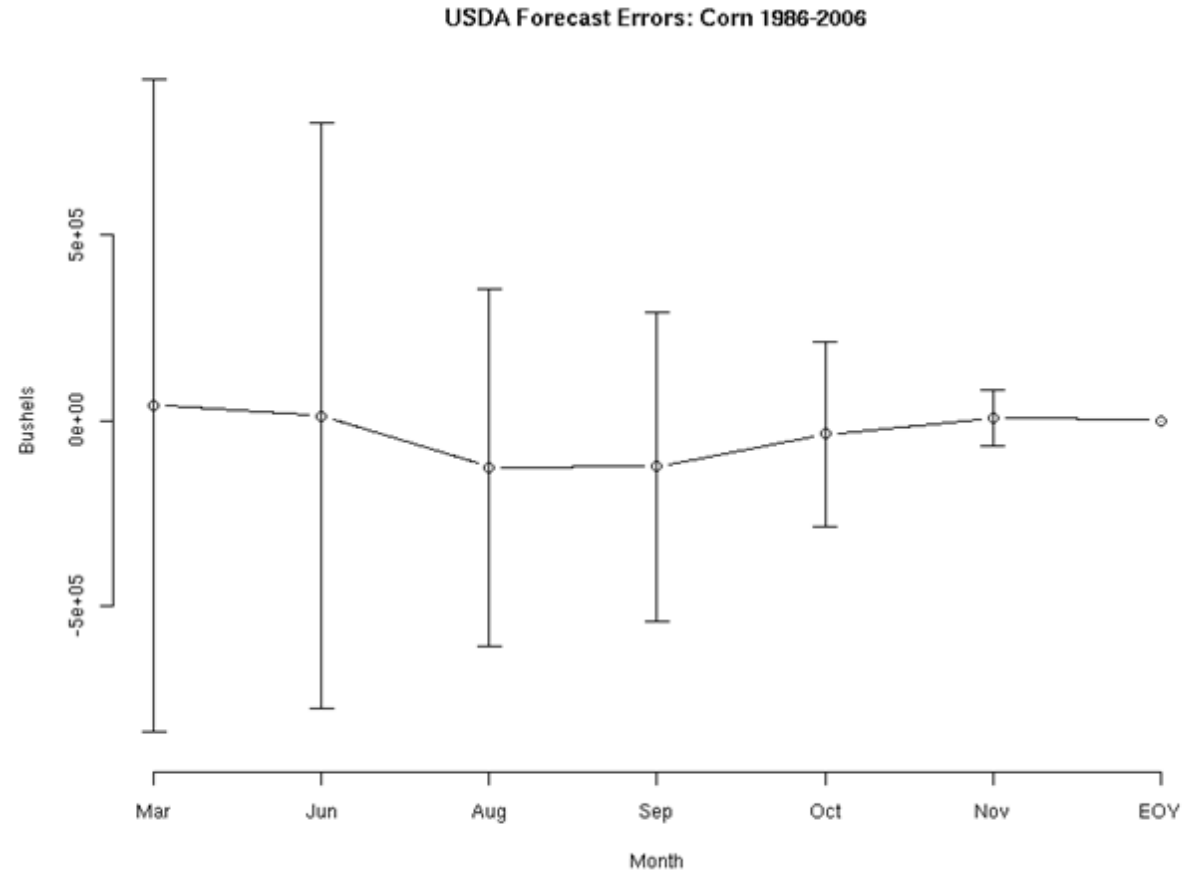
Our history

Founded in 2000, Lanworth was acquired in 2007 by The Westervelt Company, a natural resources and land management organization.



Typical USDA/NASS Forecast Profile

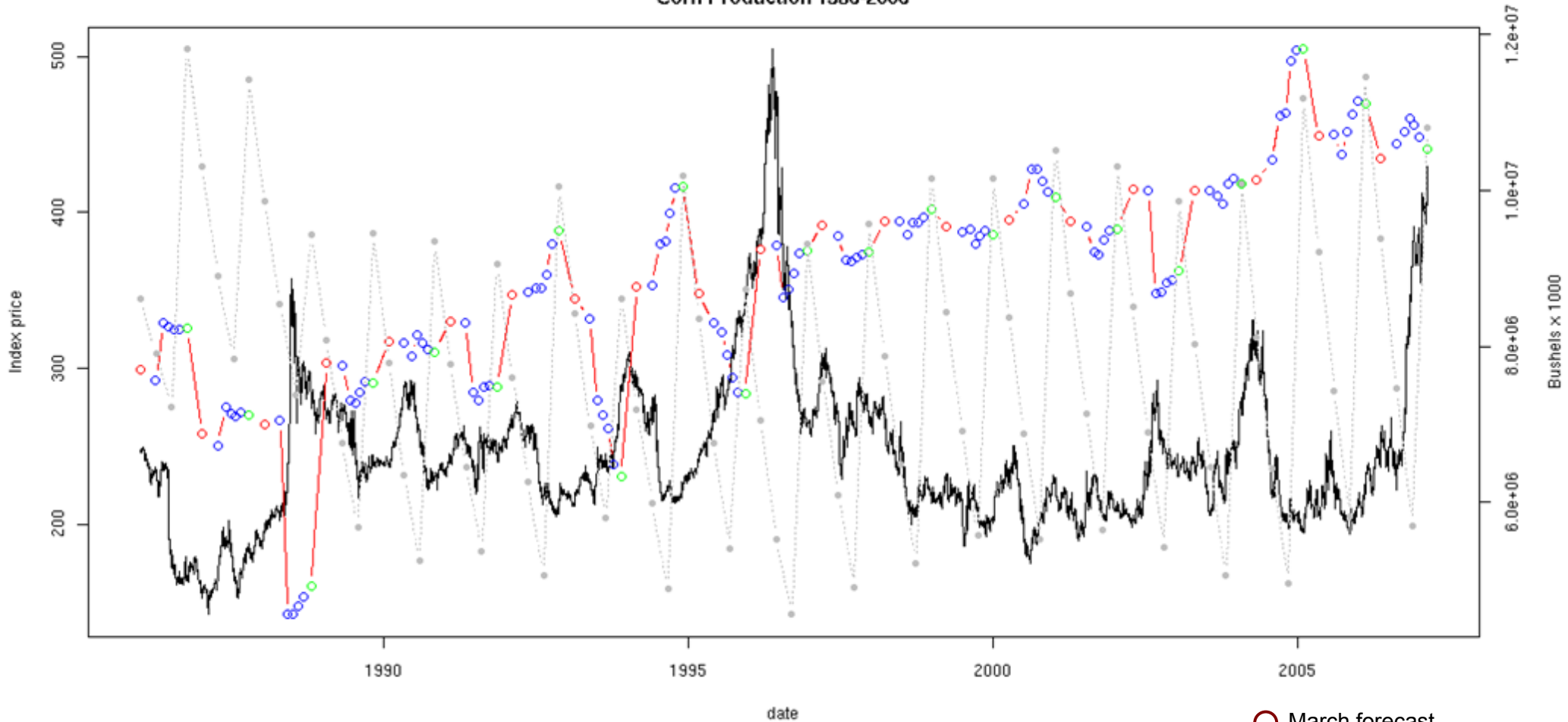
- USDA's annual forecast cycle is characterized by seasonal biases and significant errors that can persist through harvest.
- Lag is due to sampling methodology and to latency in information flow.
- Advances in the collection and processing of satellite imagery reduce sampling requirements, accelerate information flow, and lower early season error.



Accuracy of NASS early season US corn production forecasts relative to end of season estimates. Error bars indicate standard error (1 sigma) of successive estimates.

USDA/NASS Forecast History

Market Reaction to USDA Forecast Revisions:
Corn Production 1986-2006



Recently, market prices have become more sensitive to USDA's production forecast revisions—particularly for corn.

- March forecast
- Interim (Jul-Nov) forecast
- Final estimate
- Stocks estimate

A satellite image:

Can

Map planted areas

Recognize stressed crops

Optimize value of field work

Anticipate government reports

Evaluate other data sources

Can't

Perfectly discriminate all crops

Directly predict yield

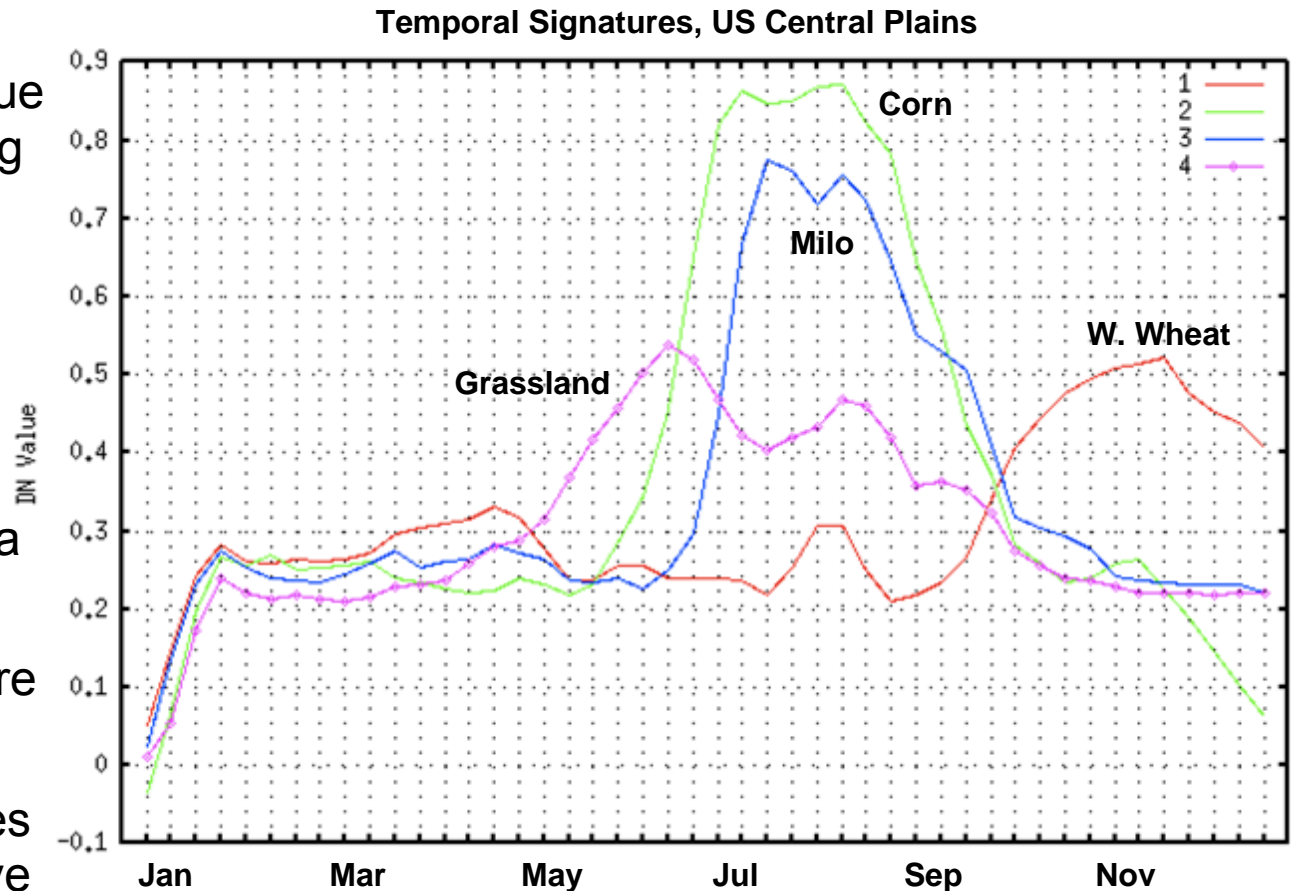
Replace a good crop scout

Tell you their content

Replace them entirely

Lanworth's approach

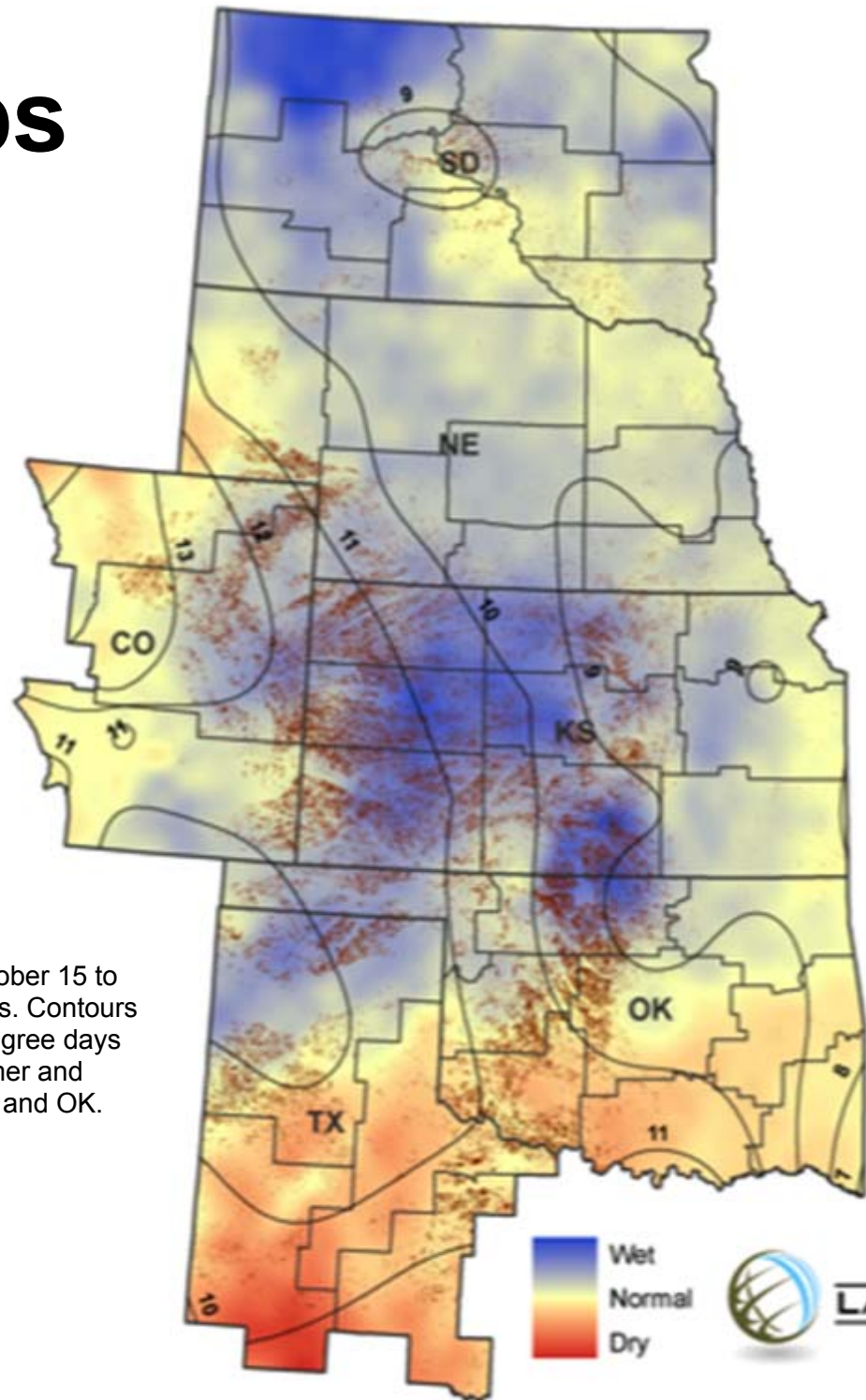
- Commodity crops exhibit distinctive greenup patterns due to growth patterns and planting practices.
- Daily satellite imagery can capture greenup patterns and map cropped areas.
- Crop maps are combined with soil, weather, and rotation data within yield models.
- Satellite measures of stress are used to “test” model outputs.
- Maps and production estimates are validated through extensive field checks.



The value of maps

- Maps integrate multiple variable to present synoptic views of current conditions.
- Tables quantify the effects of observed phenomena by county/district/state
- Geospatial data on crop and weather conditions can be viewed and analyzed in detail via common web and desktop applications.

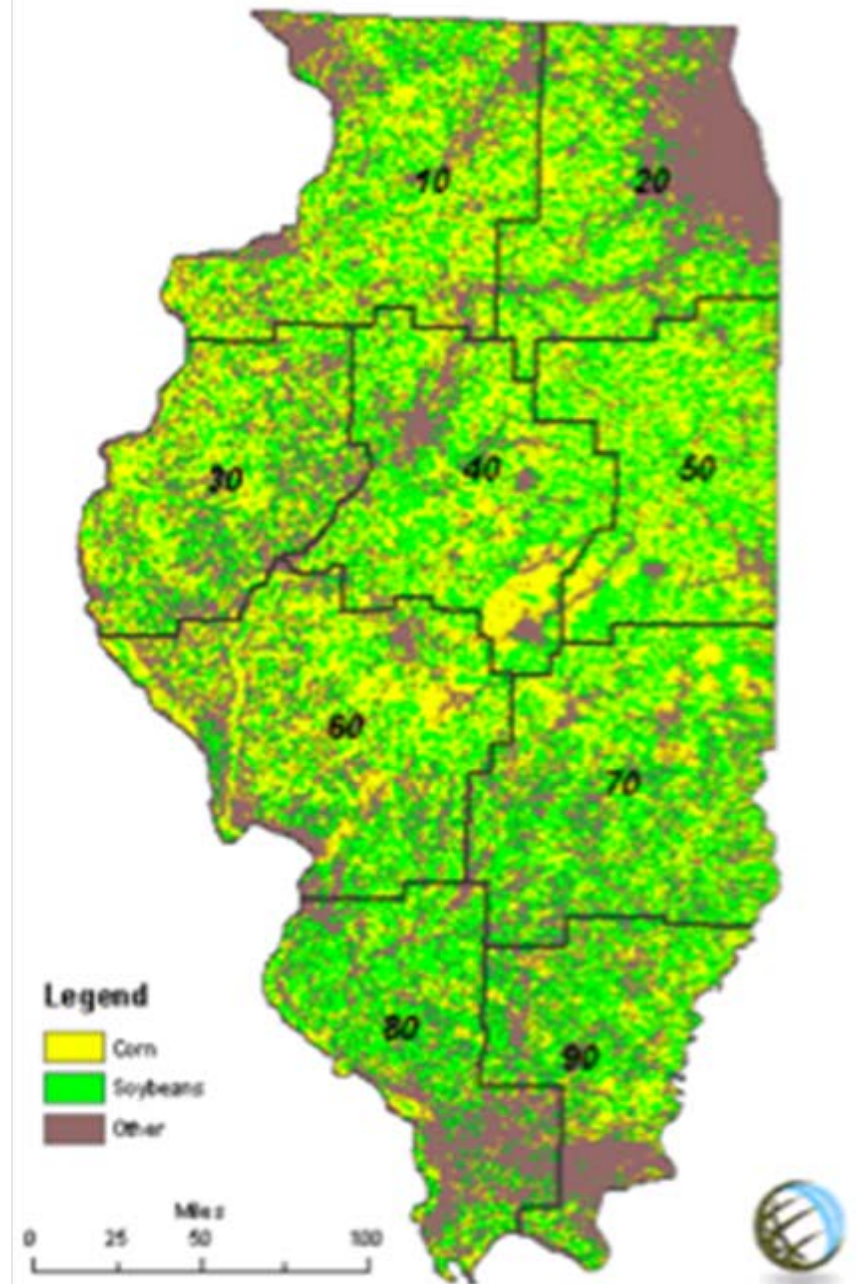
Emerged wheat (brown) overlain on soil moisture conditions from October 15 to December 15 in the principal Hard Red Winter Wheat producing states. Contours represent 30 year anomalies of accumulated winter wheat growing-degree days since planting. Conditions for growth and emergence have been warmer and wetter than usual, excepting moisture-stressed (pink-red) areas of TX and OK.



Acreage

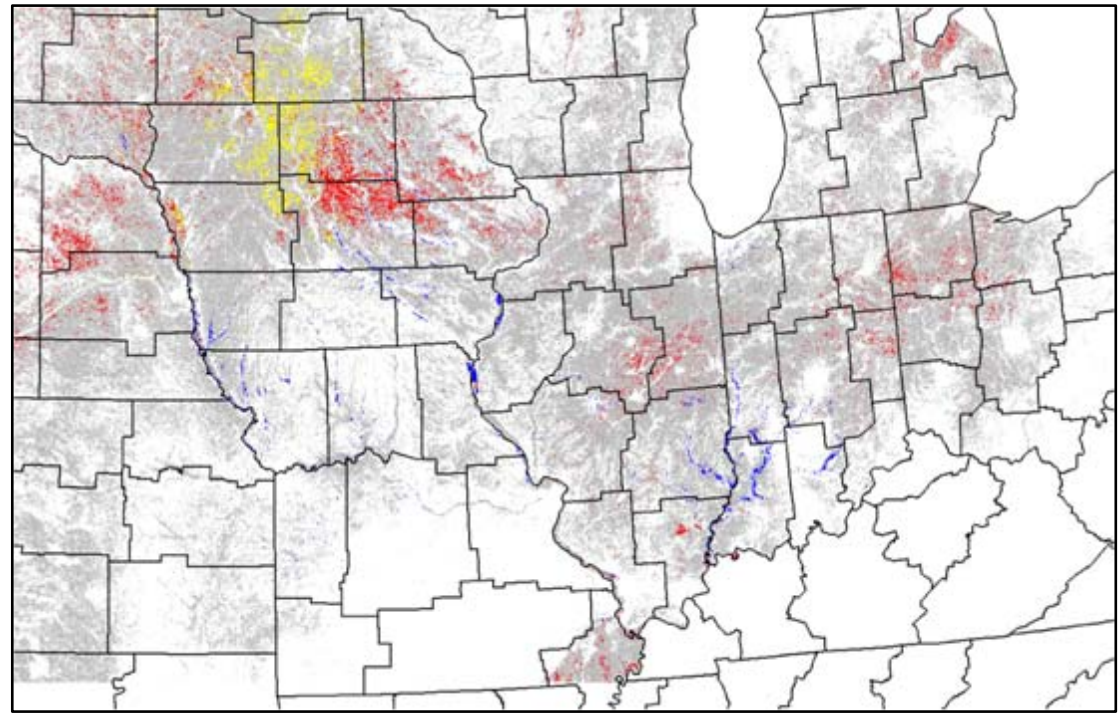
- Lanworth produces maps of corn, soybean, and spring wheat plantation in mid-June to anticipate USDA's *Acreage* report.
- While comparable at national and state levels, Lanworth and USDA acreage estimates vary at district and county levels due to Lanworth's "ground-up" approach.

District	Corn			Soy		
	USDA	Lanworth	Diff.	USDA	Lanworth	Diff.
1710	2.09	1.98	-5.2%	0.82	0.94	14.5%
1720	1.25	1.28	2.8%	0.67	0.79	17.2%
1730	1.23	1.32	7.0%	0.77	0.71	-8.3%
1740	1.90	1.87	-1.8%	0.94	1.01	7.1%
1750	1.86	1.88	1.3%	1.12	1.08	-3.5%
1760	1.84	1.86	1.2%	1.08	1.04	-3.4%
1770	1.72	1.62	-5.9%	1.42	1.43	0.6%
1780	0.63	0.68	8.5%	0.80	0.86	7.8%
1790	0.69	0.74	7.7%	0.72	0.73	1.0%
Total	13.20	13.23	0.2%	8.35	8.59	2.9%



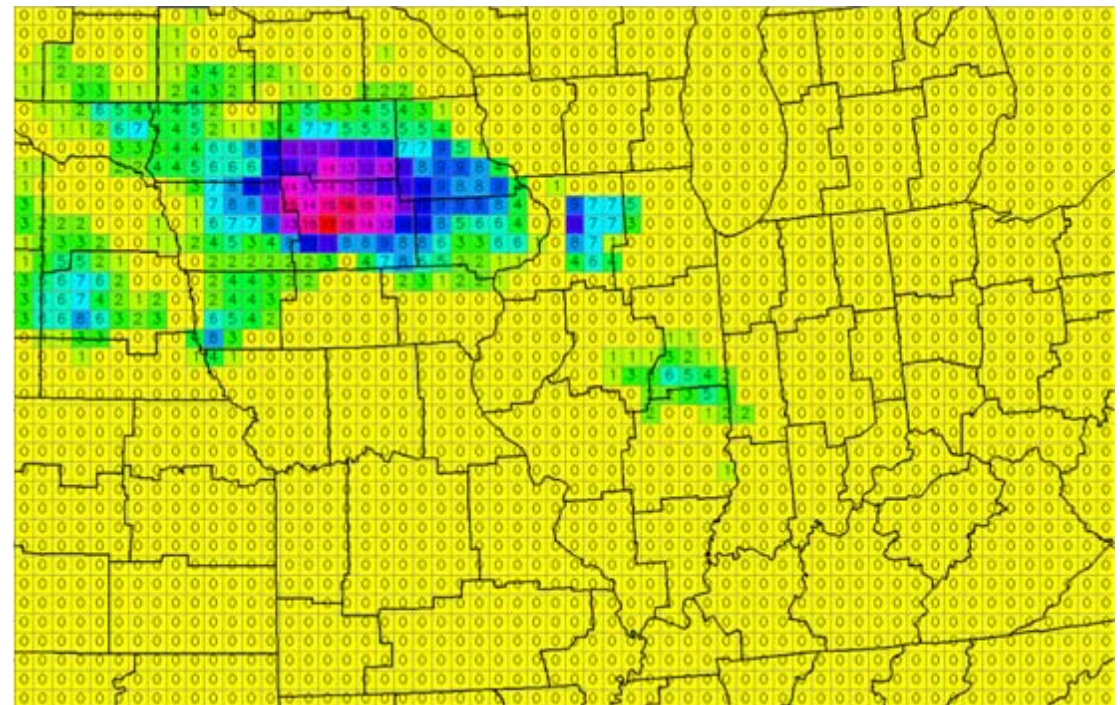
Extreme events

- Daily satellite data allow observation of extreme events as they unfold.
- Near real-time monitoring of events such as the Midwest floods of 2008 supports quantitative evaluation of key production parameters such as lost or delayed plantings and crop damage.

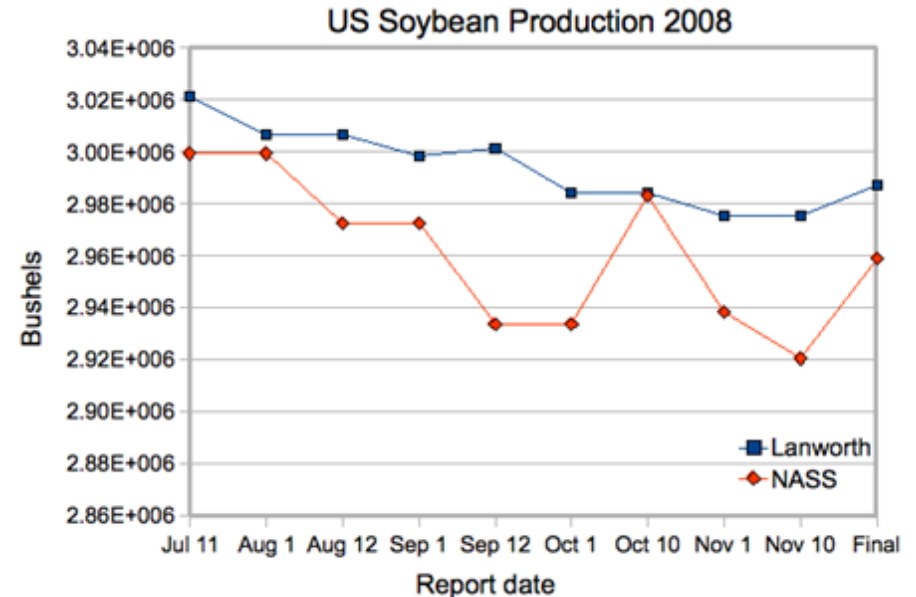
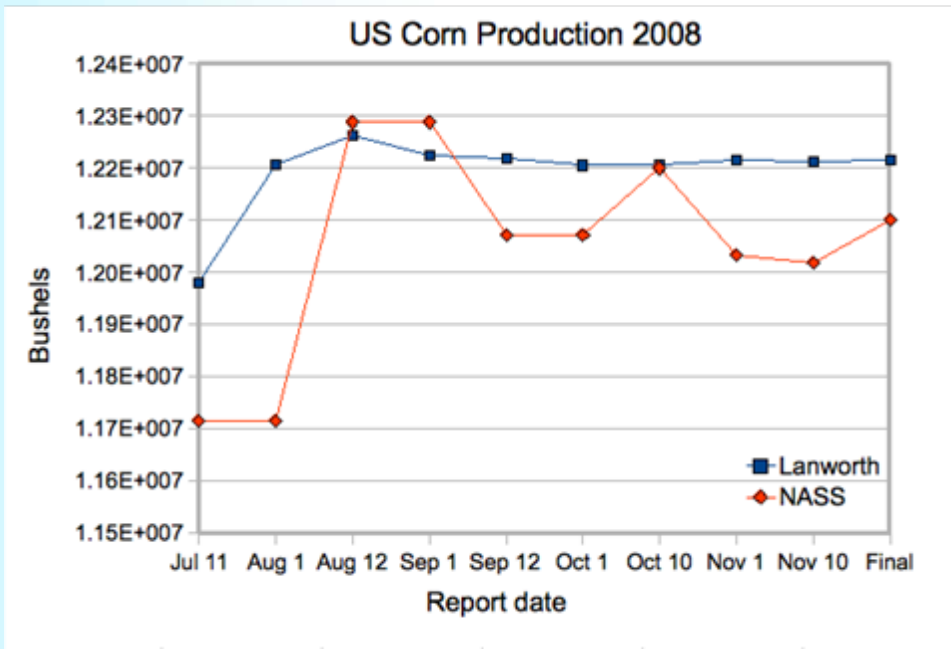


Top Right: Satellite map of cropland flooded in May-June 2008. Blue indicates planted areas lost to flooding along major waterways. Yellow indicates planted areas with evidence of pooled water and probable yield loss. Red indicates areas minimally affected by flooding.

Bottom right: Satellite map showing the magnitude and duration of flooding on planted cropland in Iowa, Illinois, and Nebraska.



2008 in retrospect



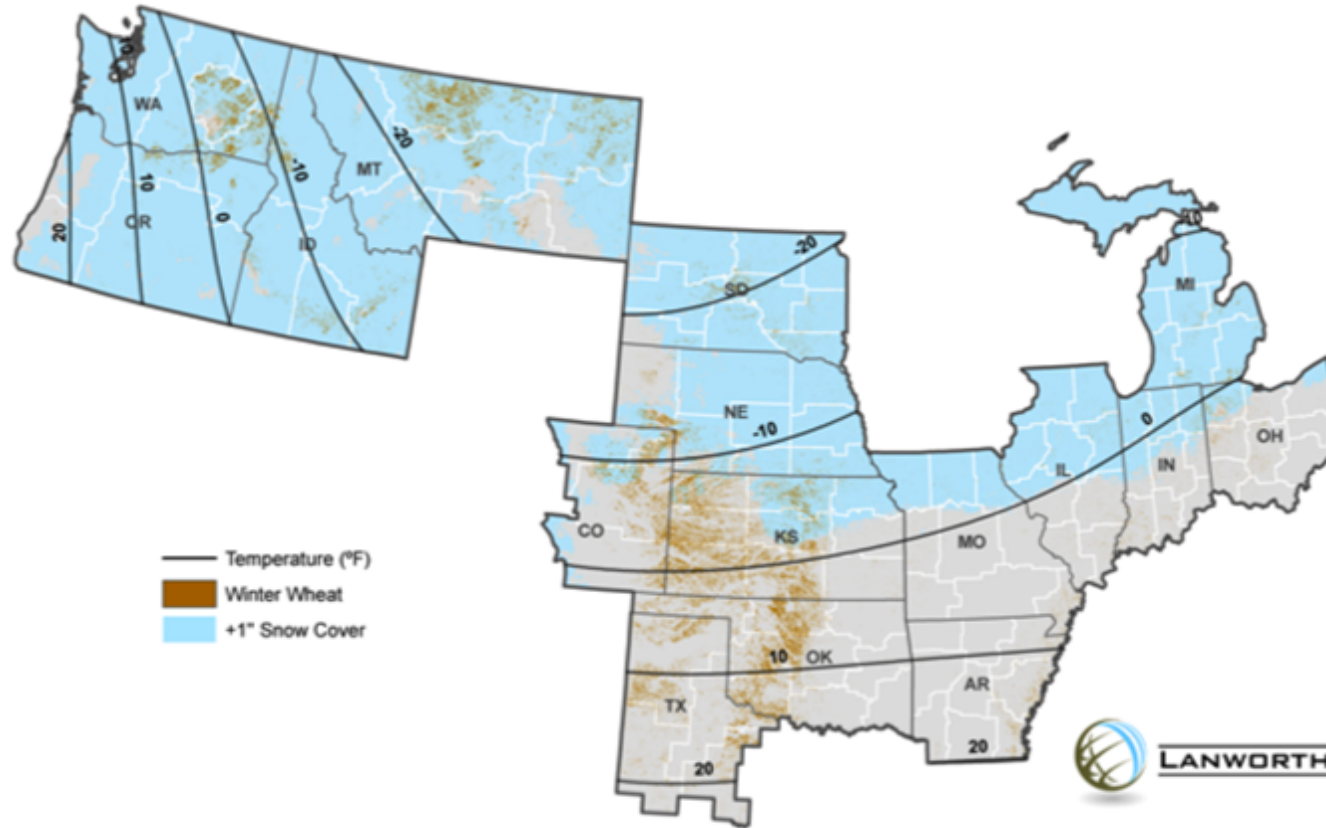
- In mid-June 2008, Lanworth's acreage maps correctly predicted USDA's March-June acreage revisions as well as the magnitude of flood loss.
- In subsequent months, Lanworth's production forecasts remained generally stable against more variable NASS estimates, which by the end of the season were revised within 1% of Lanworth's.

US Winter Wheat Outlook 2008-09

All Winter Wheat	44.04 M acres, -4% from last year
Hard Red Winter Wheat	31.48 M acres, +2% from last year
Soft Red Winter Wheat	8.86 M acres, -21% from last year
White Winter Wheat	3.70 M acres, -3% from last year
All Winter Wheat Production*	1,620 ± 130 (1σ) million bushels, -13% from last year

* currently based on 10-year average harvested-to-planted ratios and trend-line yield models; quantitative assessment of abandonment and yield begins in March.

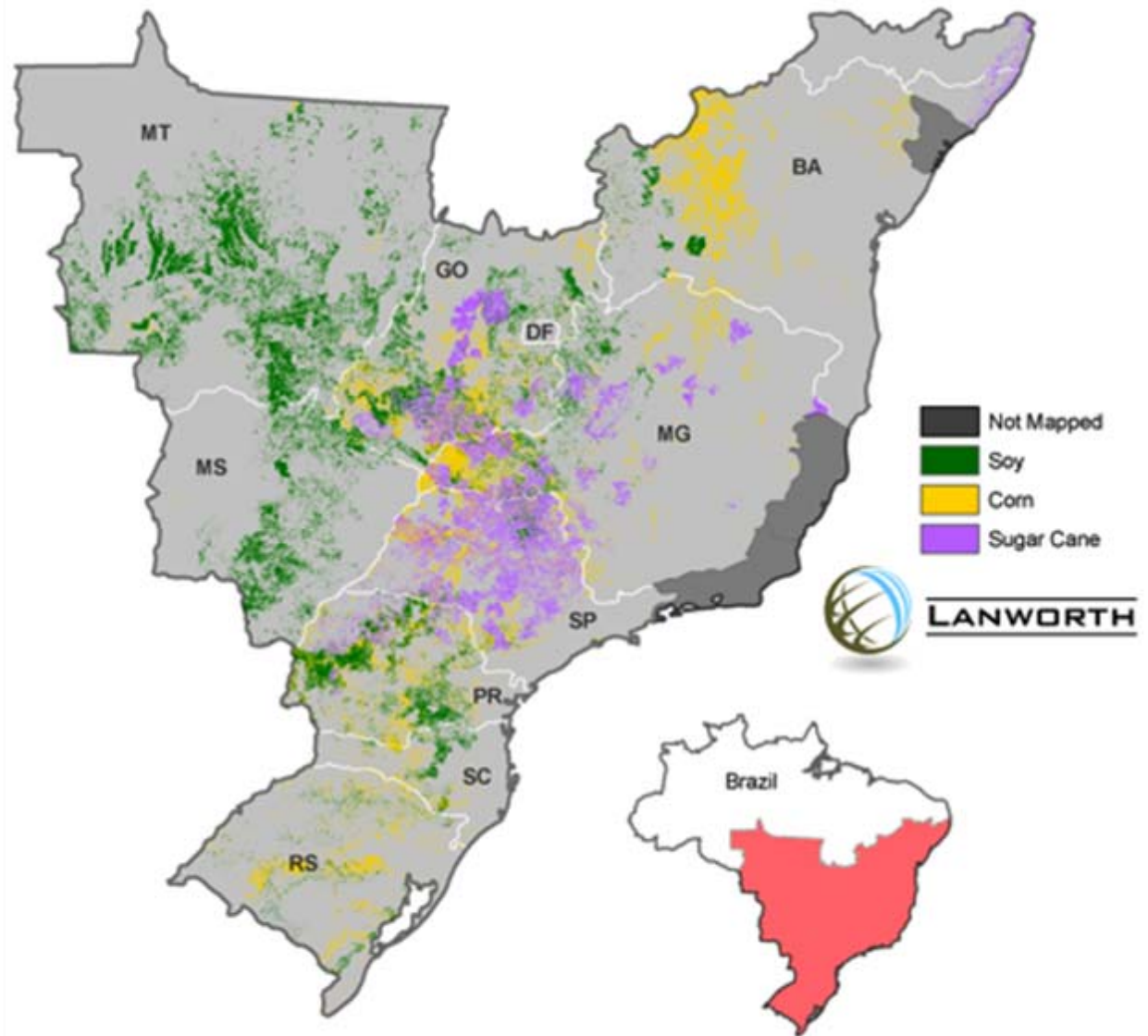
Winter kill risk 2008-09



- Two episodes of extremely cold temperatures affected key winter wheat growing areas in December 2008 and January 2009.
- By mapping wheat, snow cover, and surface temperature, Lanworth has identified more than 400k acres exposed to temperatures $< -10^{\circ}\text{F}$ and 5.0+ million acres exposed to sub-zero temperatures.
- These areas will be targeted for evaluation of acreage and yield loss in late winter and early spring.

South America Outlook 2008-09

- Lanworth has mapped 2008-09 planted acres of soybeans, corn, and sugar cane in Brazil and Argentina
- Early estimates captured trends reported by government sources and established position on variances among them.
- Present focus is on production implications of drought conditions in Argentina and parts of Brazil.



Brazil soybean plantings 2008-09

IBGE 21.36 Mha, +0.4% from last year, +0.1% from last report

Rising costs of production have slowed the expansion of planting and limited the application of technology

CONAB 21.25 Mha, -0.3% from last year, no change from last report

Credit limits, high input costs, and global economic uncertainty have limited planted area and investments in production technology

FAS 22.10 Mha, +1.7% from last year

“...credit limitations, combined with the recent drop in commodity prices, should lead to a slightly smaller increase in area than expected...”

Lanworth 21.86 Mha, +1.1% from last year

Current estimate is more optimistic than Brazilian government sources and most closely aligned with FAS. Present concern focuses on reduced yield and production due to restricted fertilizer use, delayed plantings, and persistent drought.

Argentina soybean plantings 2008-09

SAGPyA 16.54 Mha, no change from last year, -7.0% from last report

Early season expectations of record plantings faded in face of drought.

FAS 18.20 Mha, +9.6% from last year

Fall 2008: "The area increase is...due to an initial drop in planted area for corn and sunflowers due to high input costs and low prices, in addition to some lost wheat, corn, and sunflower area (due to drought) replanted with soybeans."

Lanworth 16.32 Mha, -1.1% from last year

Current estimate is in broad agreement with SAGPyA. Persistent dryness and high input costs will limit yield and production relative to past years.

Brazil first crop maize plantings 2008-09

IBGE 9.34 Mha, -3.2% from last year, -0.5% from last report

Retraction of planted area due to low prices, high production costs, and adequate export stocks

CONAB 9.30 Mha, -3.5% from last year, -0.4% from last report

Planted area reduced in response to reduced demand, high stocks, and falling prices.

FAS All maize plantings down 2.7% from last year

“...farmers are opting to plant soybeans or beans (feijao) or use the land for pasture. Acreage shifts from corn to soy are based on soy’s lower input costs in a tight credit environment and greater liquidity.”

Lanworth 9.24 Mha, -3.0% from last year

Current estimates indicate slightly smaller reductions in planted area than reported by government Brazilian sources.

Argentina maize plantings 2008-09

SAGPyA 3.41 Mha, -17.6% from last year, -2.6% from last report

Reduced plantings of grains and oilseeds under drought conditions.

FAS 2.5 Mha (harvested), -23.3% from last year

“...drop in planted area for corn and sunflowers due to high input costs and low prices, in addition to some lost wheat, corn, and sunflower area (due to drought) replanted with soybeans.”

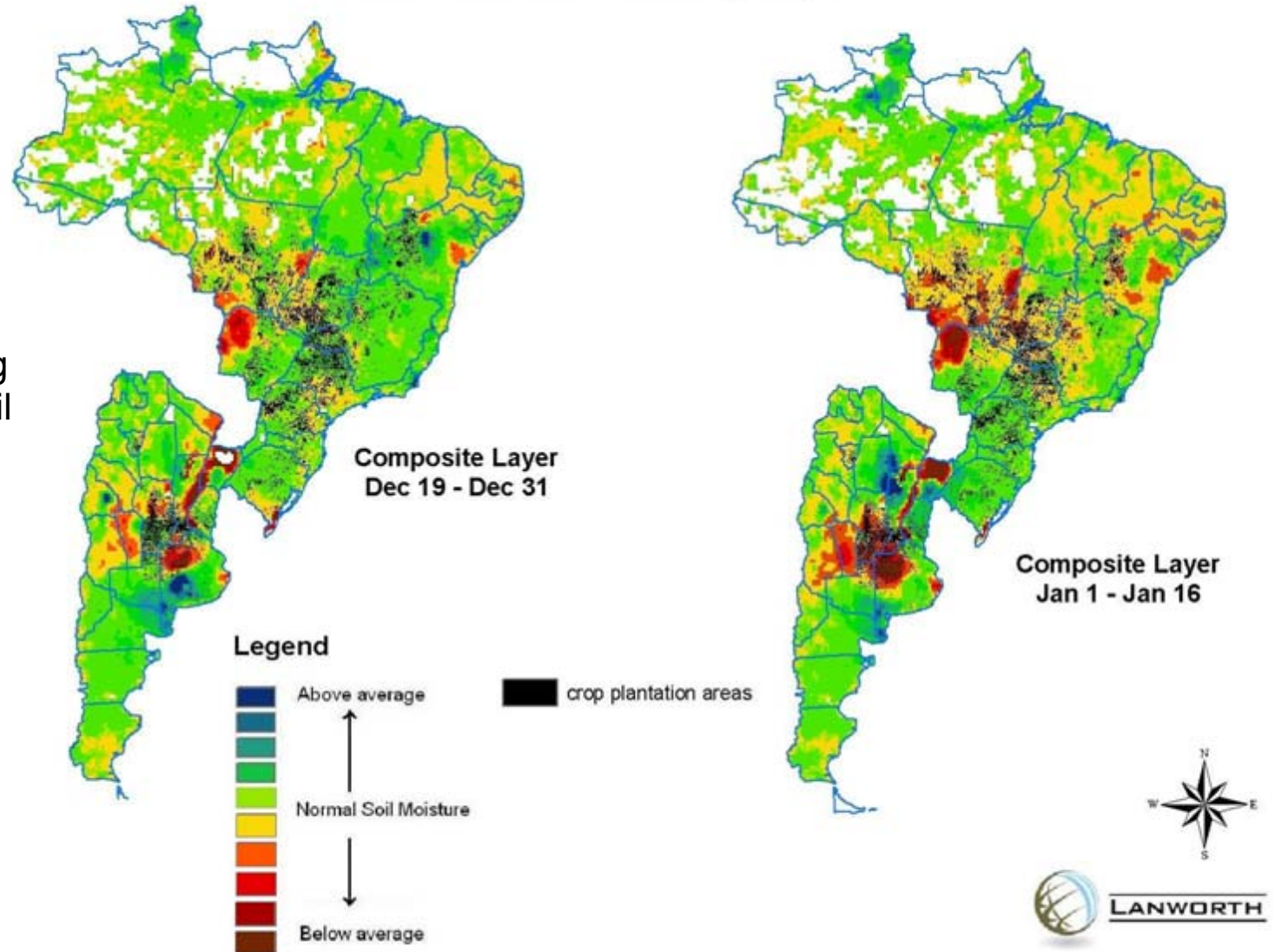
Lanworth 3.20 Mha, -20.4% from last year

Current estimate is more conservative than SAGPyA. Persistent dryness and high input costs will limit yield relative to past years.

South America Drought Conditions

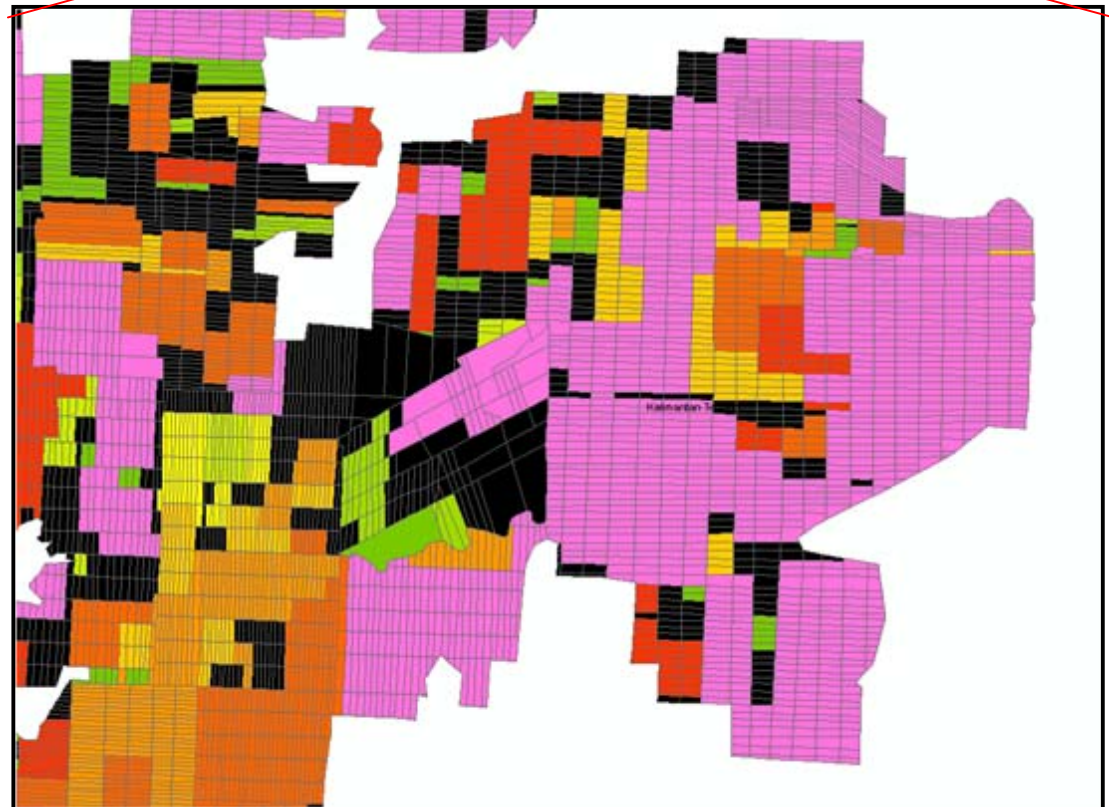
- Satellite-based measurements of surface soil moisture conditions present a view of changing drought conditions in Brazil and Argentina
- Lanworth integrates satellite, meteorological, and soils data into quantitative models of soybean and maize production.

Soil Moisture Anomaly Maps



Palm Oil Production Estimates

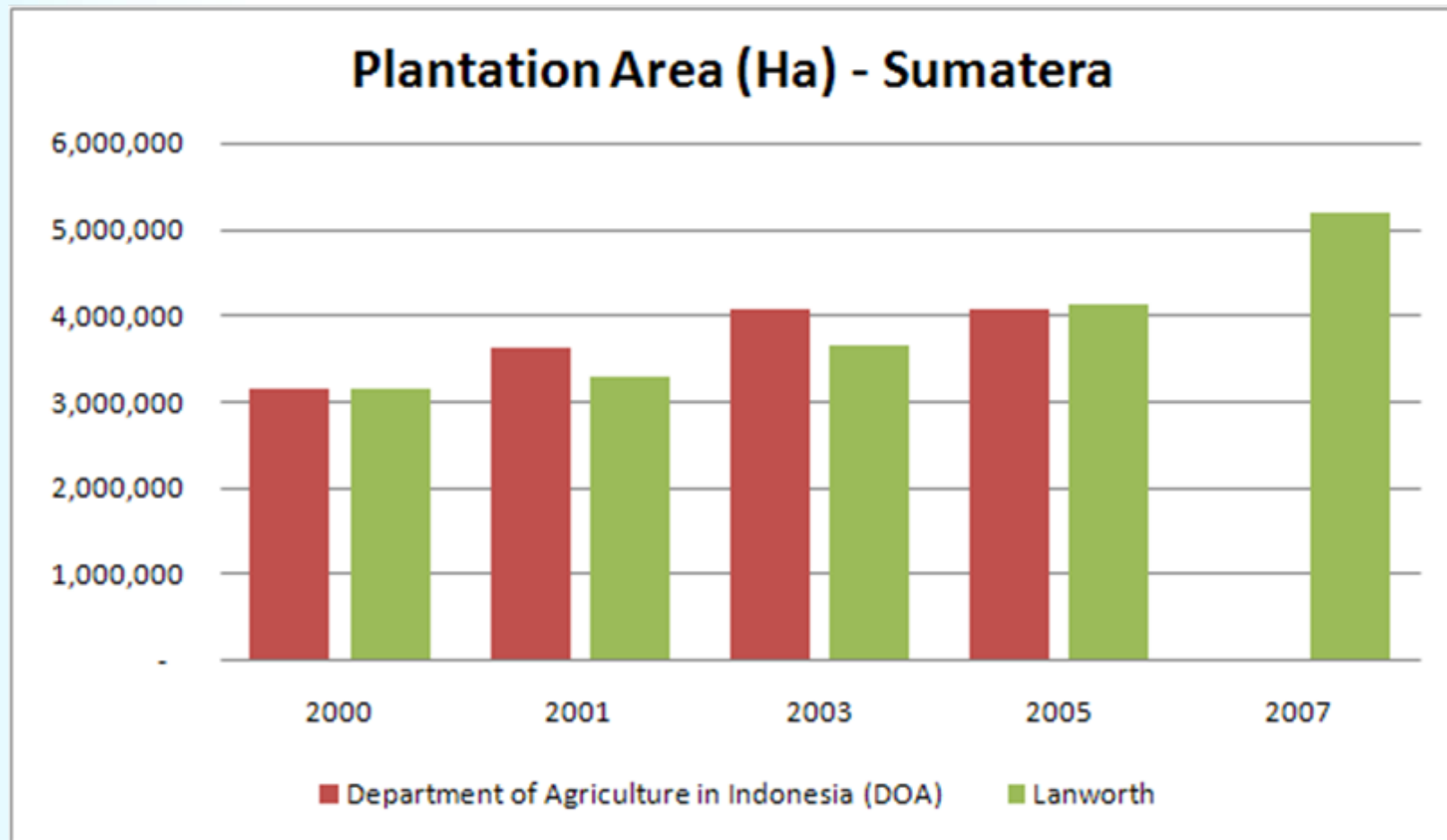
- Satellite images reveal the area and age structure of oil palm plantations across Indonesia
- Age structure and site conditions can be integrated into models of CPO yield to forecast production in future years.



Year of Plantation

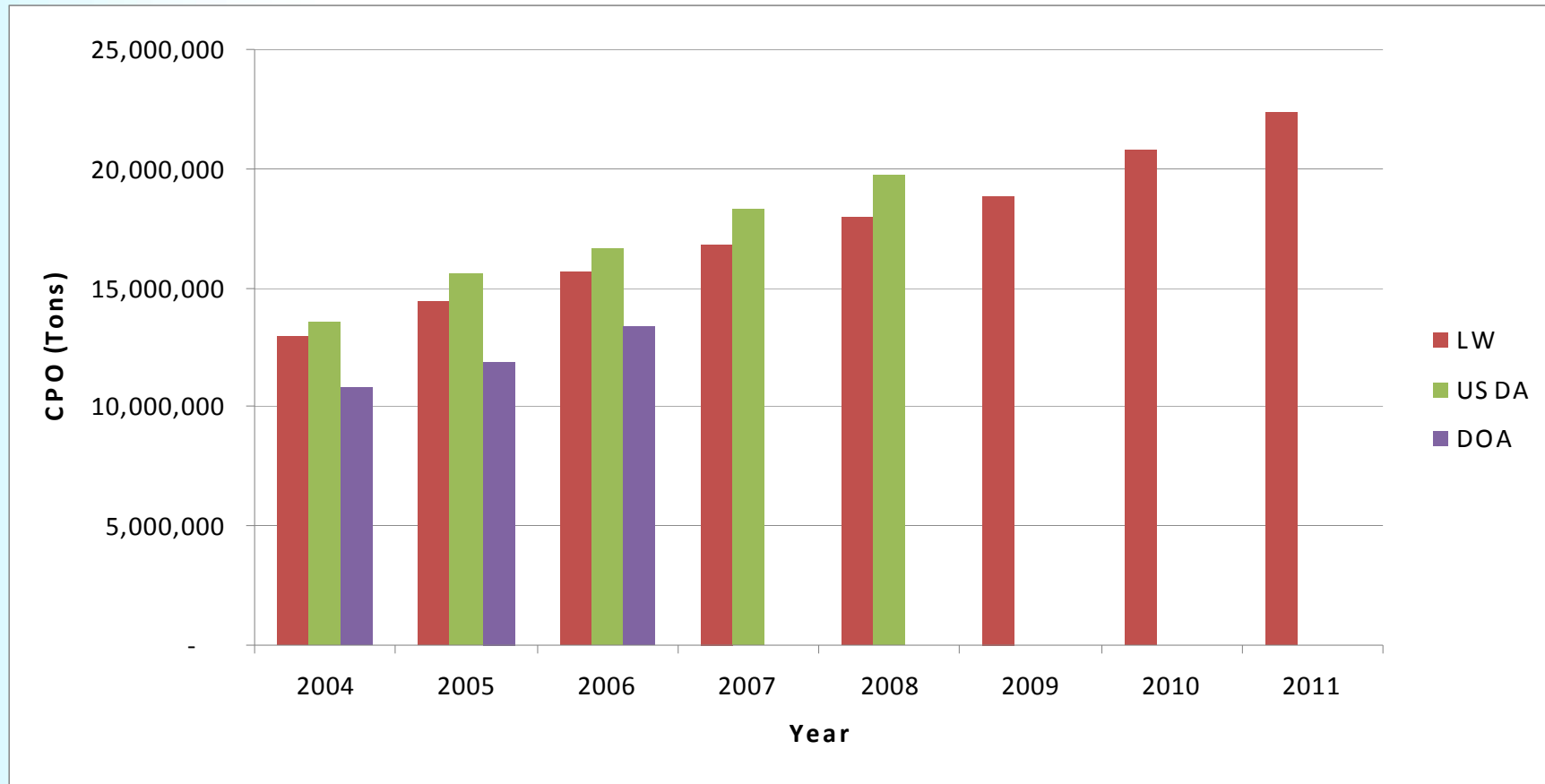
- Before 1990
- 1990
- 1994
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2007
- 2008

Expansion of Palm Oil plantation in Sumatera



The rate of palm area expansion has more than doubled in the past two years. While 900,000 ha were added in 2001-2005; more than 1 million hectares were added in 2005-2007.

Indonesia CPO Production Outlook 2009-2011



Lanworth and USDA data indicate 1.4-1.5 MT annual increase in CPO production from 2004-2008. Lanworth data indicates an increase in production by 8-10% from 2010 onwards.

Lanworth US Reporting Schedule

- Parenthesis indicate reporting periods when Lanworth publishes its first estimates. First estimates are supported by field and phone validations but are subject to further, minor revision.
- Bold letters indicate reporting periods when high-confidence Lanworth estimates will anticipate major USDA reports; these periods present potentially significant trading opportunities.

Phase key:

planting (yellow)
 maturing (green)
 harvest (orange)
 dormant (blue)
 bare (brown)

Crop key:

Corn (C)
 Soybeans (S)
 Cotton (G)
 Winter wheat (Ww)
 Spring wheat (Ws)

Lanworth report key:

A (acres)
 P (production as Lanworth acres * Lanworth yield)

	Corn	Soybeans	Spring Wheat	Winter Wheat	Cotton	USDA
Jan						A: Ww P: -
Feb						A: - P: -
Mar				A		A: C,S,G,Wws P: -
Apr				A(P)		A: - P: -
May	(A)	(A)	(A)	P	(A)	A: P: Ww
Jun	A	A	A	P	A	A: C,S,G,Wws P: Ww
Jul	A(P)	A(P)	A(P)	P	A(P)	A: P: Wws
Aug	P	P	P		P	A: P: C,S,G,Wws
Sep	P	P	P		P	A: P: C,S,G,Wws
Oct	P	P		(A)	P	A: P: C,S,G
Nov	P	P		A	P	A: P: C,S,G
Dec					P	A: P: G



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