



# Evaluating weather and climate impacts on global crop production

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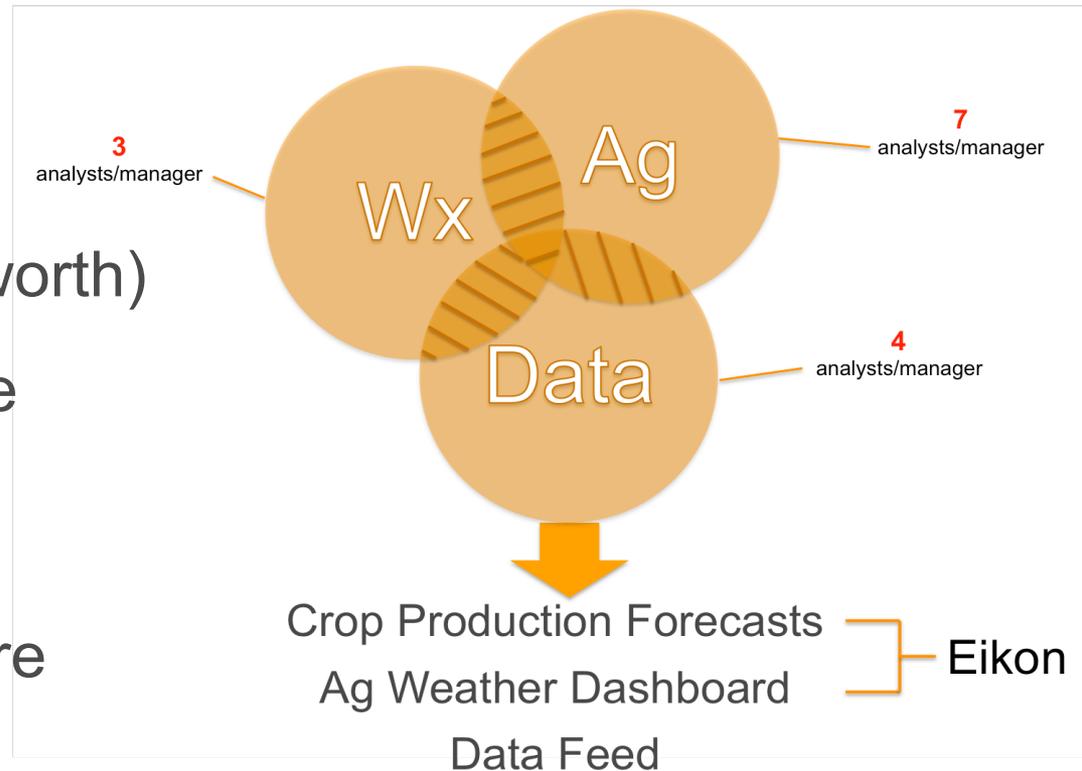
**40<sup>th</sup> Annual Climate Diagnostics and Prediction Workshop**  
**29 October 2015**

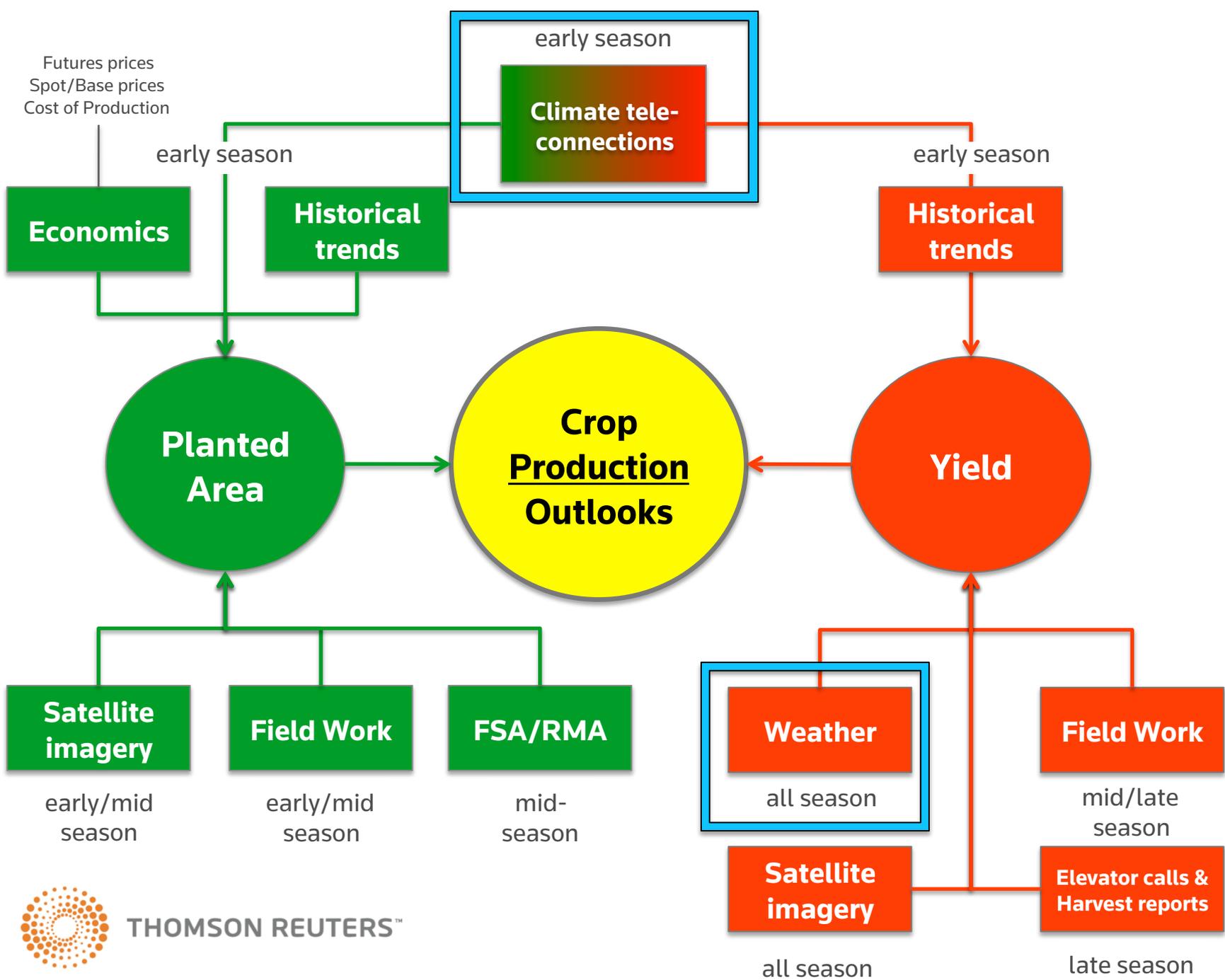


**THOMSON REUTERS**

# How does Thomson Reuters Research & Forecasts use weather and climate data?

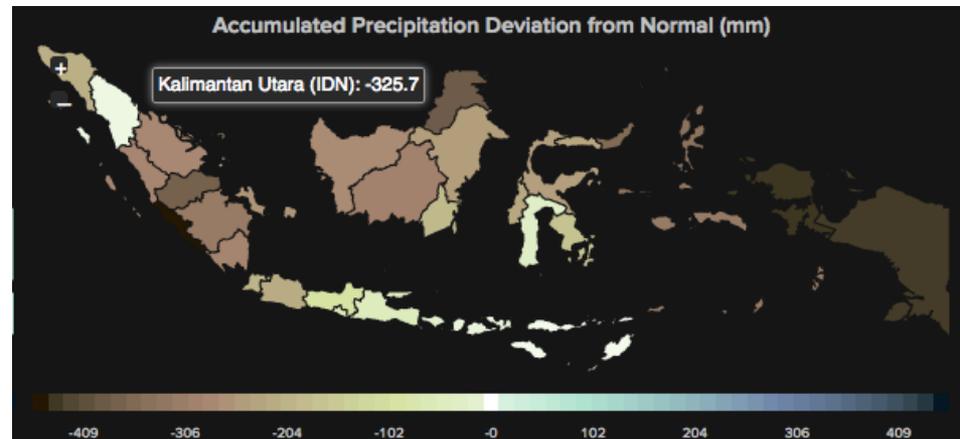
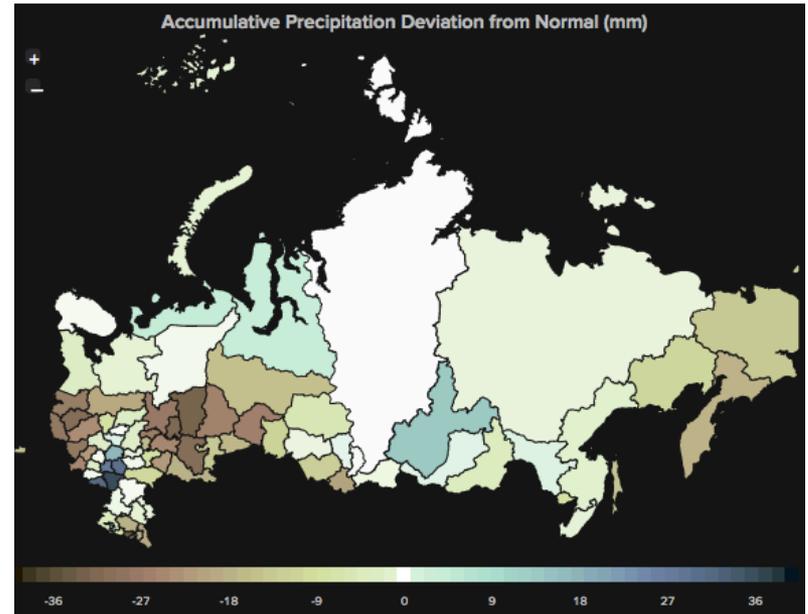
- Analytically/statistically compared to crop data to determine global crop production outlooks (Lanworth)
- Visually via the Agriculture Weather Dashboard
- Analytically via insight/forecasts on the Agriculture Weather Dashboard
- Available on Data Feed



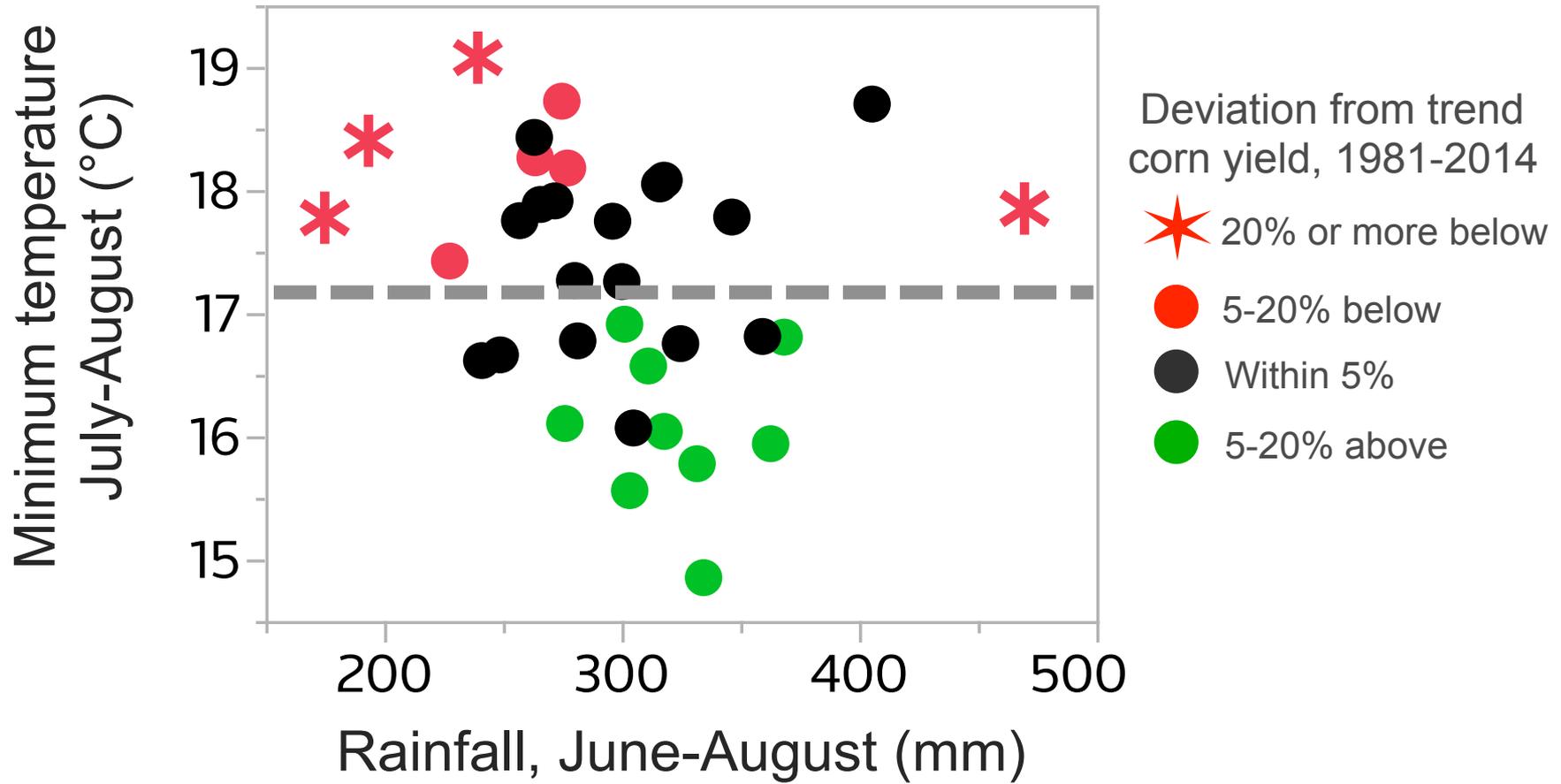


# Weather and Climate impacts on crops

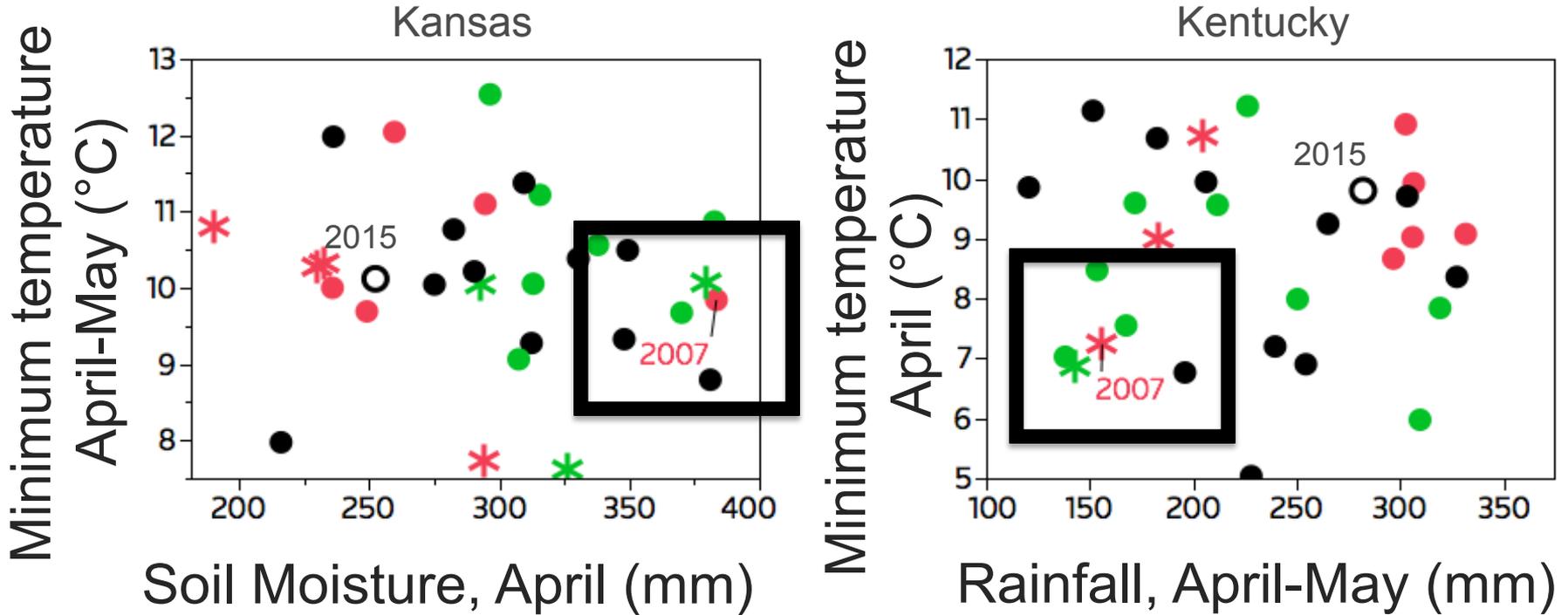
- Temperatures
  - Warm Anomalies
  - Cool Anomalies
  - Frost/Freeze
- Precipitation/Soil Moisture
  - Drought
  - Wet Anomalies
- Climate Impacts
  - Most notably... ENSO



# Temperature Example: US Corn Yield



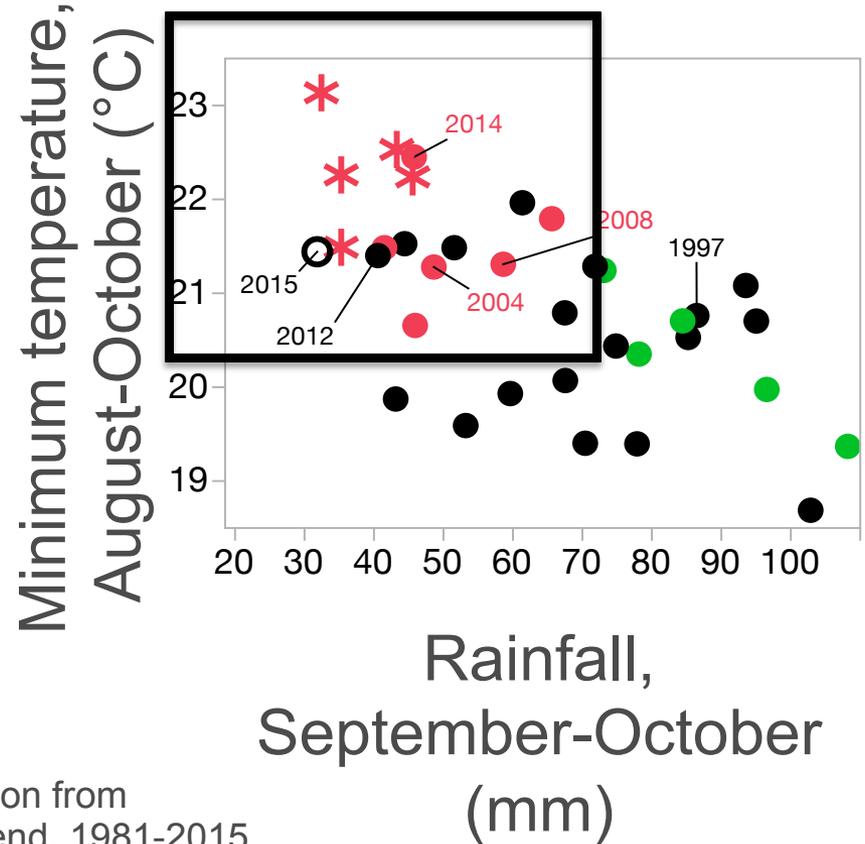
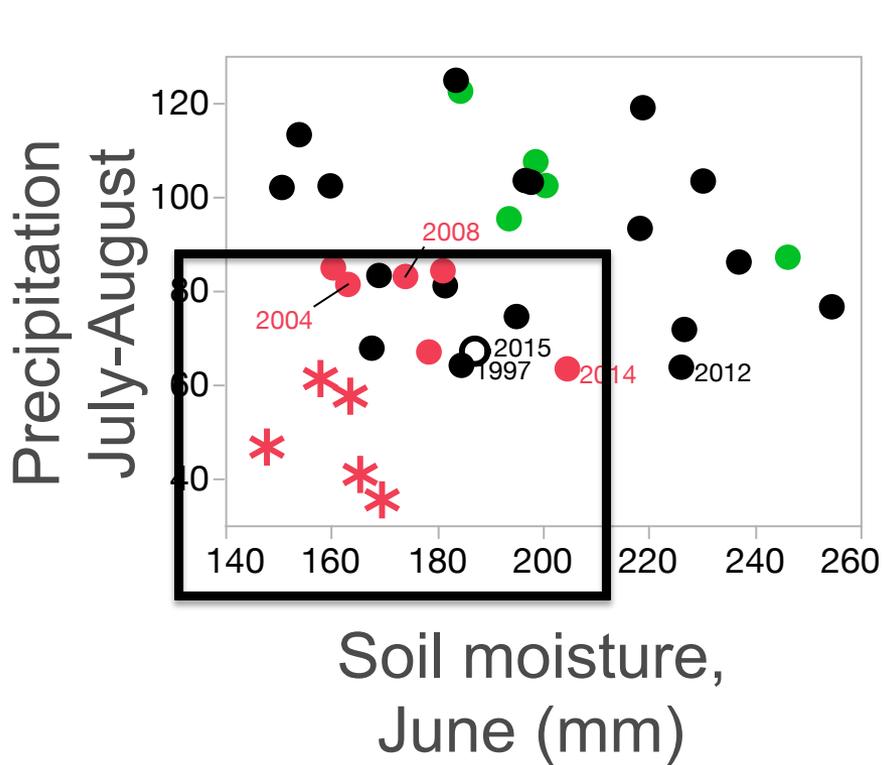
# Frost & Freeze Example: 2007 US winter wheat



Deviation from trend  
Winter wheat productivity, 1985-2015

- ★ 25% or more below
- 10-25% below
- Within 10%
- 10-25% above
- ★ 25% or more above

# Precipitation Example: Australia Wheat

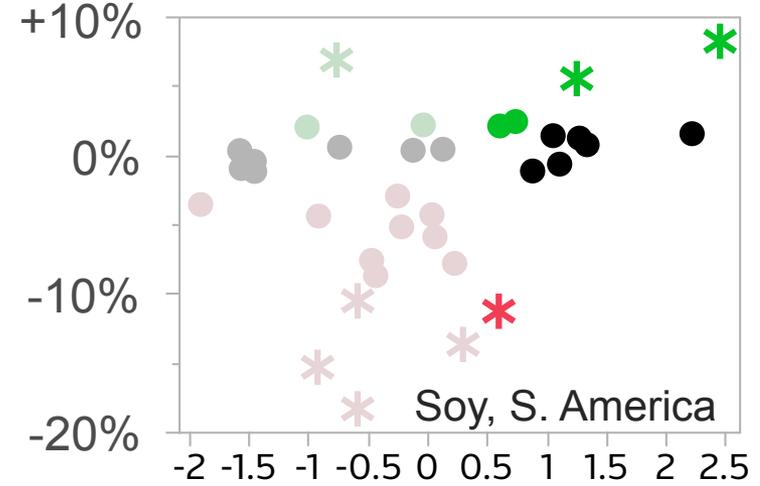
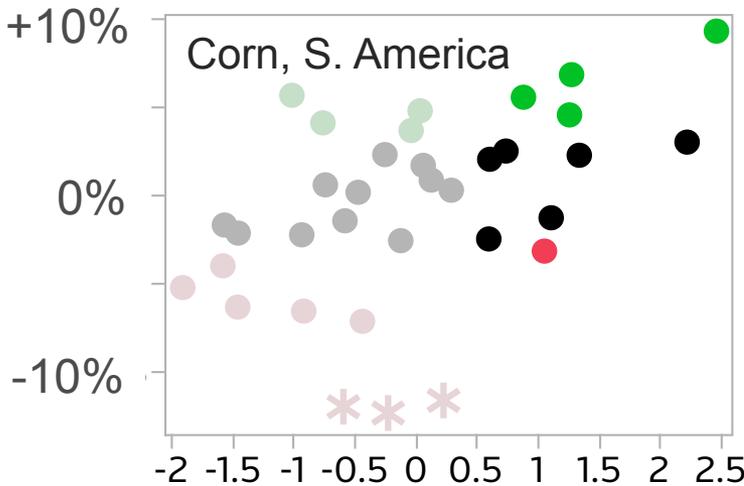
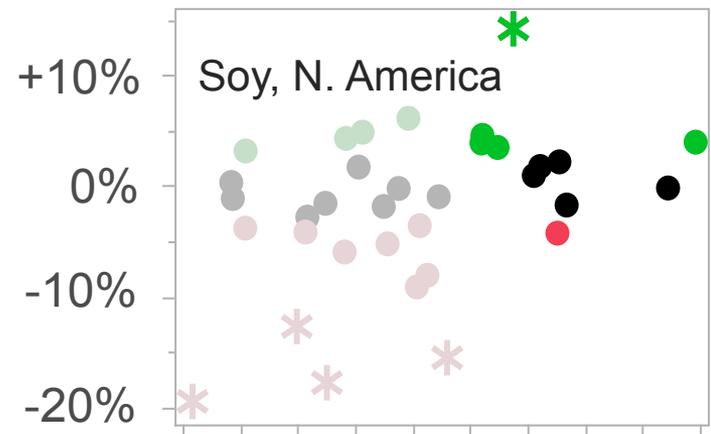
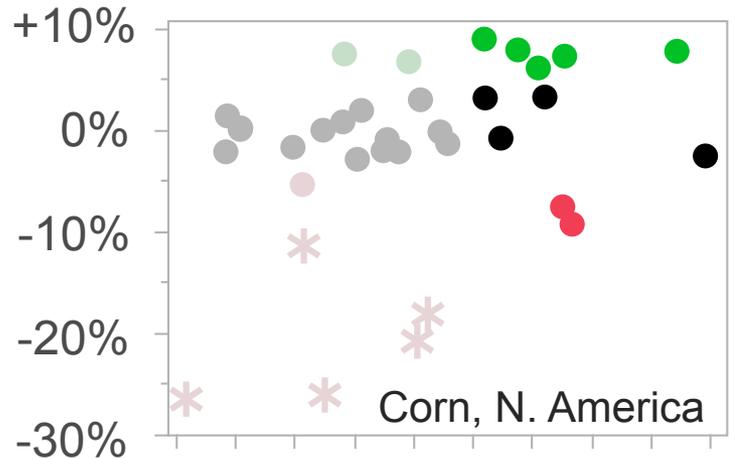


Deviation from wheat yield trend, 1981-2015

- ★ 25% or more below
- 10-25% below
- Within 10%
- 10-25% above
- ★ 25% or more above

Deviation from trend yield (bu/acre)

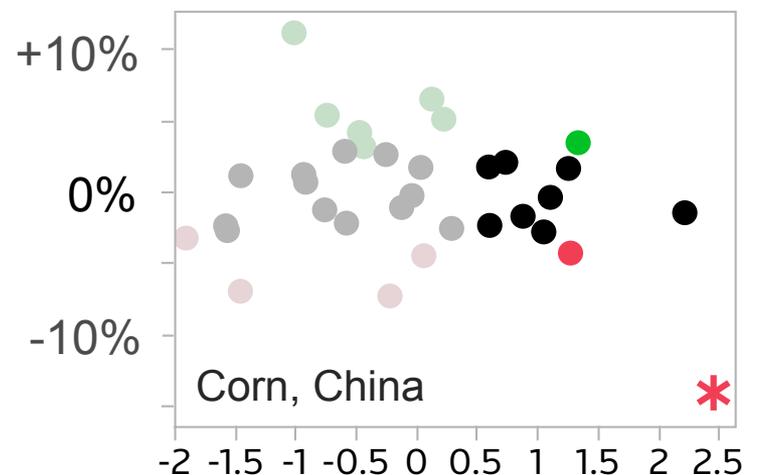
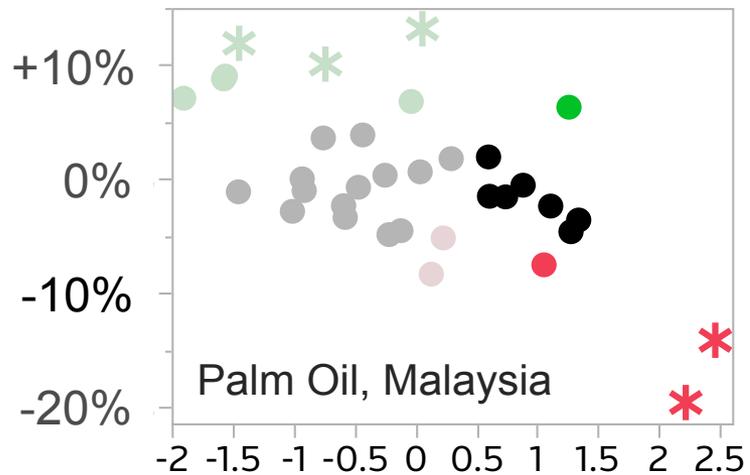
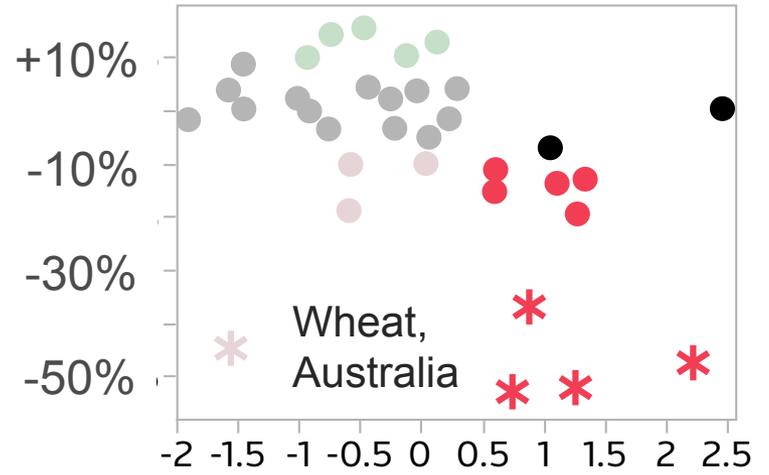
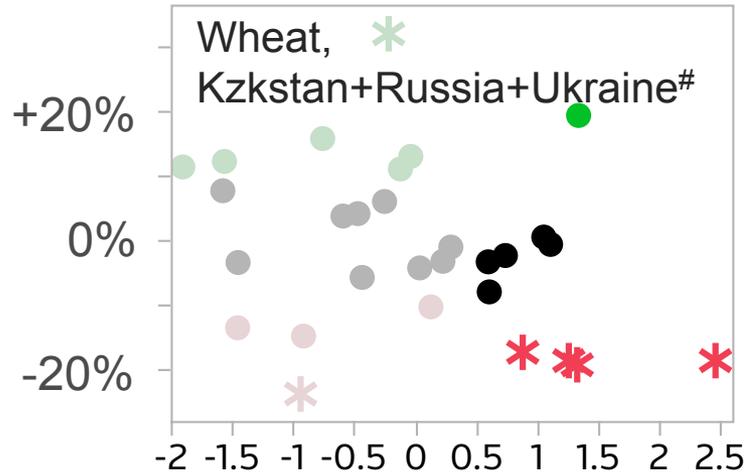
# ENSO: El Niño vs. Western Hemisphere



Niño 3.4 sea surface temperature anomaly, Sep-Feb (°C)

Deviation from trend yield (bu/acre)

# ENSO: El Niño vs. Eastern Hemisphere



Niño 3.4 sea surface temperature anomaly, Sep-Feb (°C)



# AGRICULTURE WEATHER DASHBOARD: INSIGHT

- Weekly or bi-weekly updates for relevant geographies during important times of year
- Monthly outlooks for US
- Long-range outlooks for all other geographies ahead of critical crop seasons
- US frost/freeze climatology
- Monthly ENSO outlooks
- Daily Morning Headlines

## CURRENT SHORT-TERM FORECAST

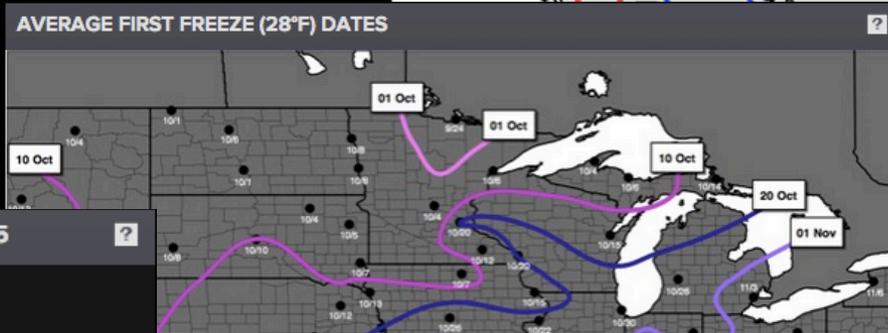
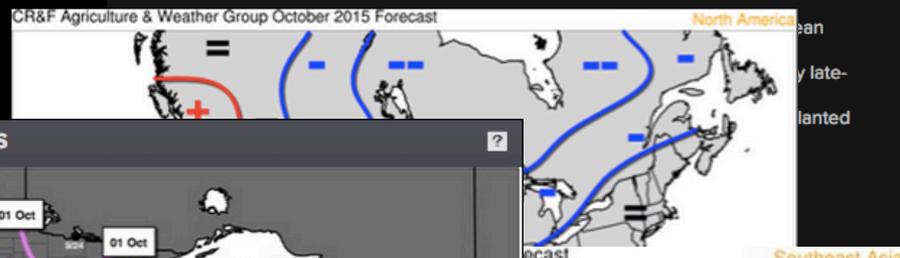
### A MORE ACTIVE US WEATHER PATTERN TO EMERGE

Tuesday, October 13th 2015, 10:00:00 am, Thomas Walsh

Author: Tom Walsh, Weather Research Manager

Release Date: 13 October 2015

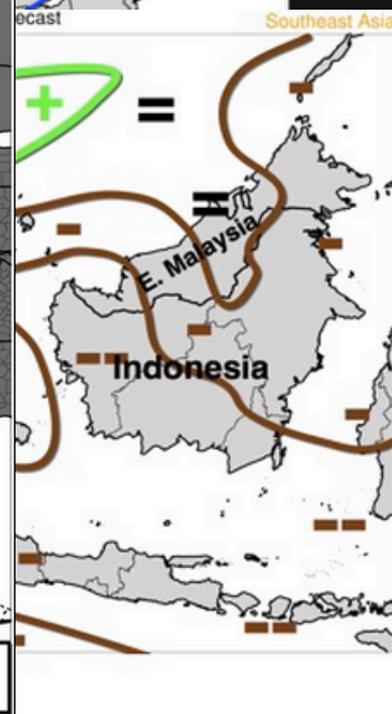
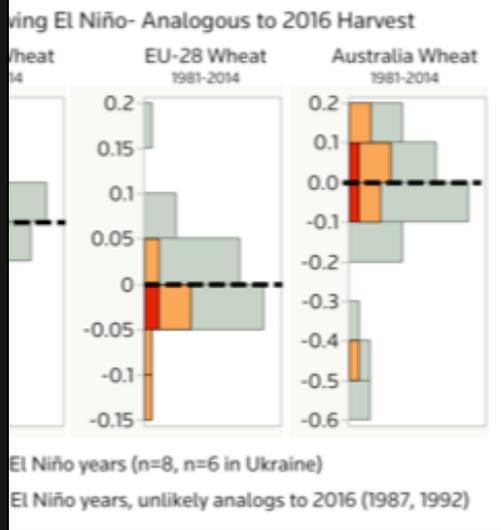
WHAT TO WATCH:



## MORNING HEADLINES FOR 13 OCTOBER 2015

by Adam Turchioe, Research Analyst, Weather

- Unusually hot weather kicks off the dry season in **India**, a pattern that will continue to draw down soil moisture after a disappointing monsoon (14% below normal rainfall); want to learn more about how a weak monsoon impacts the India gold market? Click [here!](#)
- Lack of extreme heavy rainfall across **northeastern China** leaves little concern for ongoing corn harvest
- Very heavy rainfall remains just north of **Argentina** wheat/soy belts, with more normal amounts up to 2 inches over the next ten days
- Storm system could bring beneficial rain to **Ukraine** in the 10-15 day period, but uncertainty remains high; southern **Russia** (Krasnodar & Stavropol) to receive needed rainfall, up to 2 inches over the next ten days
- Dry weather returns to the northern **US Plains** as harvest wraps up; normal rainfall expected for the central/eastern **US corn/soy** belts; first widespread frost this weekend from Iowa to Ohio

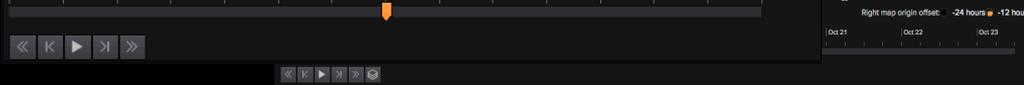
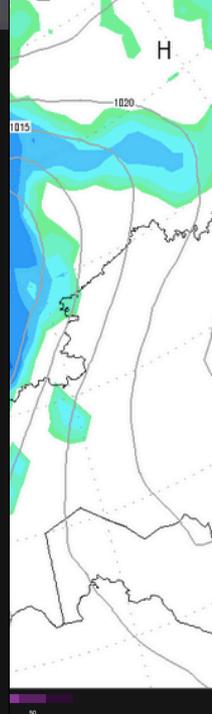
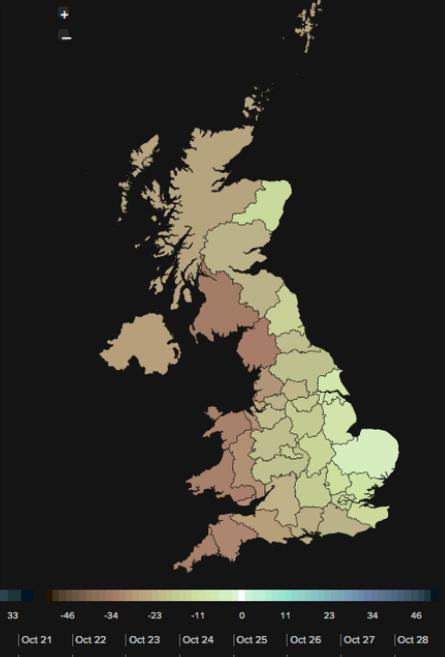
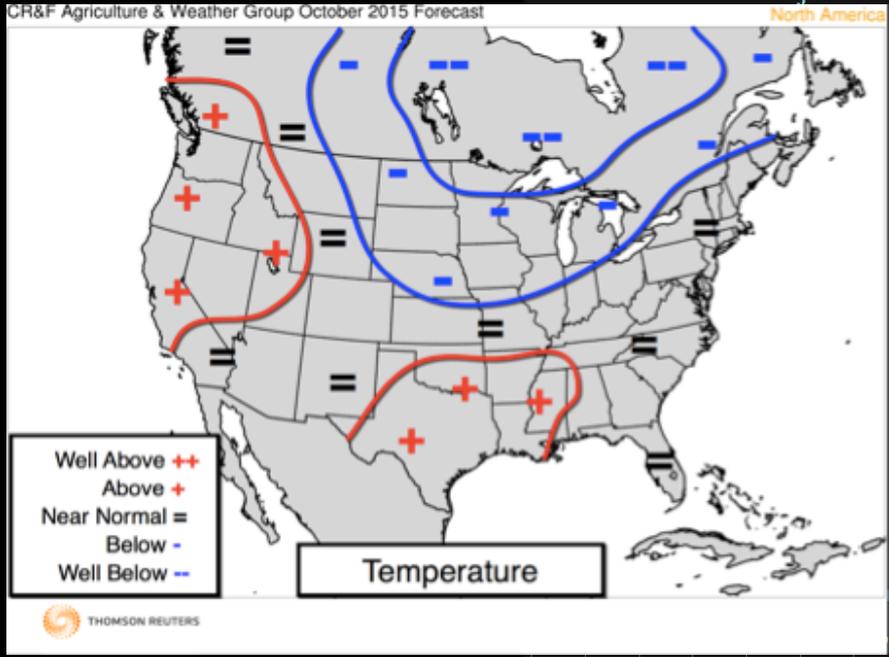
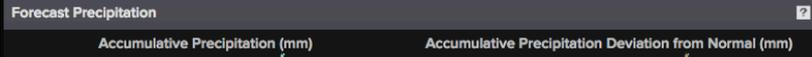
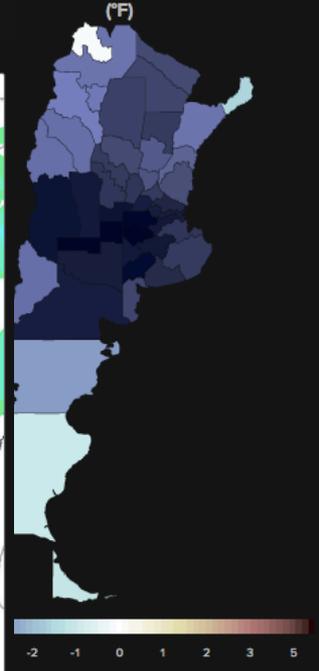
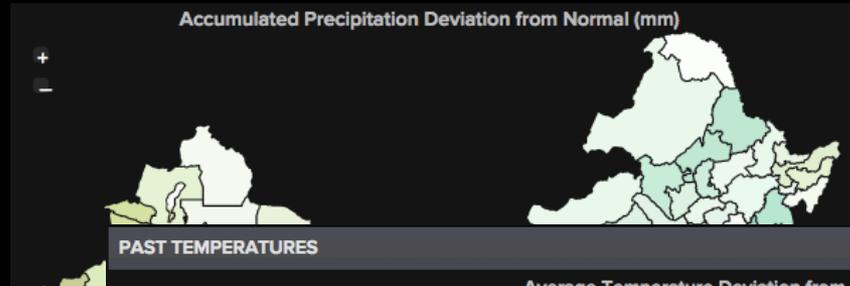


(28°F)

ation pattern for October to December 2015

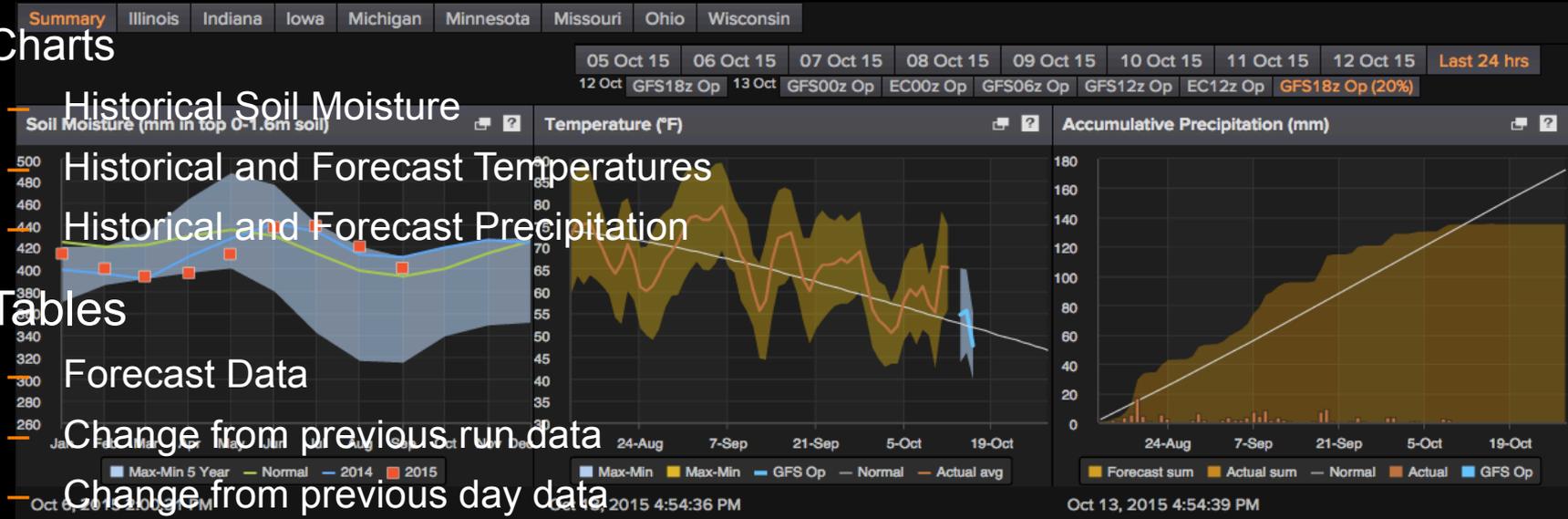
# AGRICULTURE WEATHER DASHBOARD: MAPS

- Past Weather (7 to 180 days)
- Forecasted Weather
  - Model Guidance
  - Summarized over crop regions
- Monthly/long-term forecasts
  - Hand-designed



# AGRICULTURE WEATHER DASHBOARD: DATA

- Charts



- Tables

Forecast Data

Change from previous run data

Change from previous day data

Forecast Weather Summary					
UTC	Wed 14	Thu 15	Fri 16	Total	
Avg Temp (°F)	54.5	55.4	47.5	52.5	
Min Temp (°F)	43.7	45.9	39.9	43.2	
Max Temp (°F)	65.1	64.8	55.2	61.7	
Precip (mm)	0	0.2	0.3	0.5	
Oct 13, 2015 4:54:39 PM					

Change from Previous Model Run				
UTC	Wed 14	Thu 15	Fri 16	
Avg Temp (°F)	-0.2	-0.2	-0.7	
Min Temp (°F)	-0.2	0	-0.5	
Max Temp (°F)	-0.2	-0.5	-0.7	
Precip (mm)	0	0	0.2	
Oct 13, 2015 4:54:39 PM				

Change from 24 Hours Ago			
UTC	Wed 14	Thu 15	Fri 16
Avg Temp (°F)	0.7	-1.1	-1.6
Min Temp (°F)	0.2	0	-1.4
Max Temp (°F)	1.3	-2.2	-1.4
Precip (mm)	0	-0.2	-0.6
Oct 13, 2015 4:54:39 PM			

# ENSO Forecasting

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- Main Intent: to establish a workflow to incorporate climate variables into crop yield models.
- Why? Climatological indicators may provide earlier insight into risks to crop production compared to typical 1-2 week weather forecast lead times.

## ENSO Forecasting (continued)

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- Statistical modeling of the following variable types (to predict ENSO):
  - Recent Niño Region sea surface temperatures
  - Equatorial Pacific Ocean heat content
  - 850mb trade winds
  - SOI
  - AAM
  - ‘Significant’ MJO Days (amplitude > 1)
  - Other lesser correlating variables include OLR, PDO, PNA, NAO, AAO, AO, MJO Amplitude, etc.

# ENSO Forecasting (Current)

- Our latest release focuses on what happens after El Niño runs its course during Northern Hemispheric Winter of 2015/16:
  - La Niña or Neutral ENSO? *About equal chances*
  - Repetitive El Niño? *Highly unlikely*

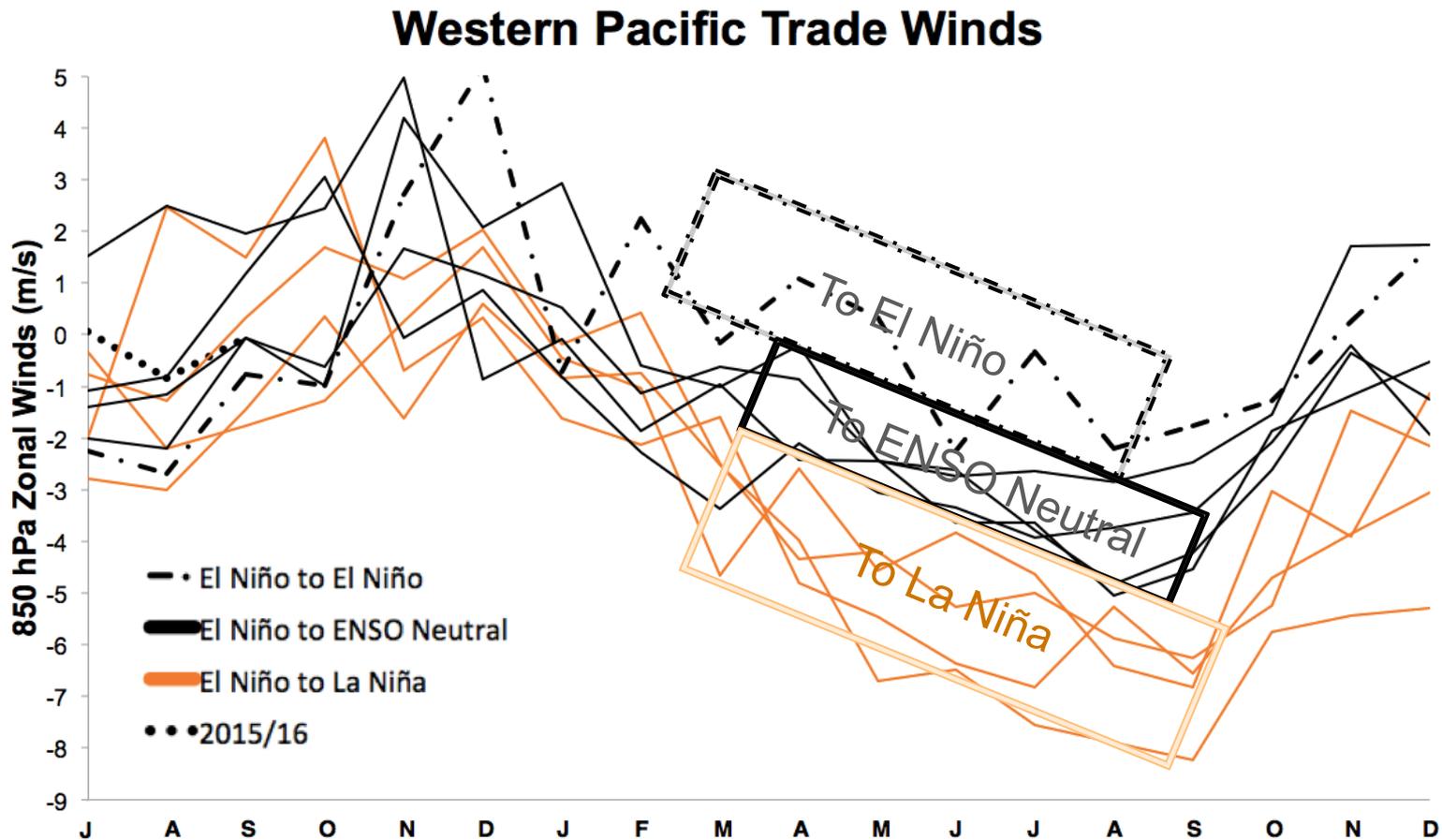
Year	ENSO	Year	ENSO
2009/10	EN	2010/11	LN
2002/03	EN	2003/04	=
1997/98	EN+	1998/99	LN+
1991/92	EN	1992/93	=
1987/88	EN	1988/89	LN+
1986/87	EN	1987/88	EN
1982/83	EN+	1983/84	=
1972/73	EN+	1973/74	LN+
1965/66	EN+	1966/67	=
1963/64	EN	1964/65	LN-



Figure 1: The historical likelihood of the last ten moderate or stronger El Niño years (columns 1 and 2), and the subsequent winter (columns 3 and 4). EN (LN) represents El Niño (La Niña), plus (minus) indicates a strong (weak) event, and the equal sign represents an ENSO neutral year. SOURCE: NOAA

# ENSO Forecasting (Current)

- Focus on Western Pacific trade winds



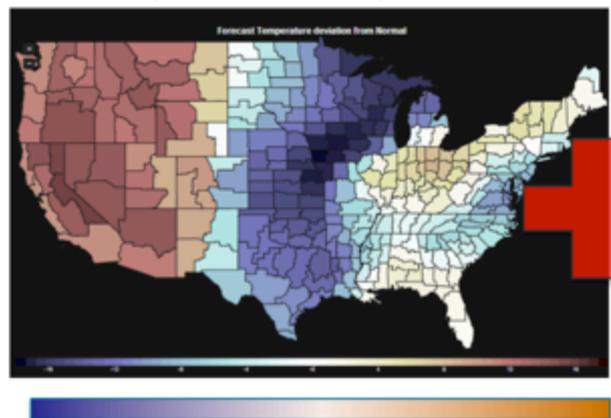
# LANWORTH FUNDAMENTAL DATA FEED ON POINTCONNECT

**Core data:** Daily & forecast weather, weekly cloud & crop masked imagery, production histories

Collected, cleaned & aggregated at state & sub-state level for Lanworth analysis and forecasting

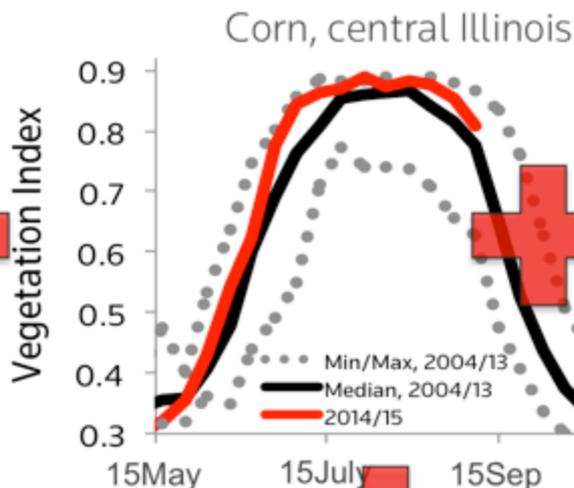
**Minimum coverage:** Argentina, Australia, Brazil, Canada, China, EU28, India, Indonesia, Kazakhstan, Malaysia, Paraguay, Russia, Ukraine, US

Temperature anomaly: next week

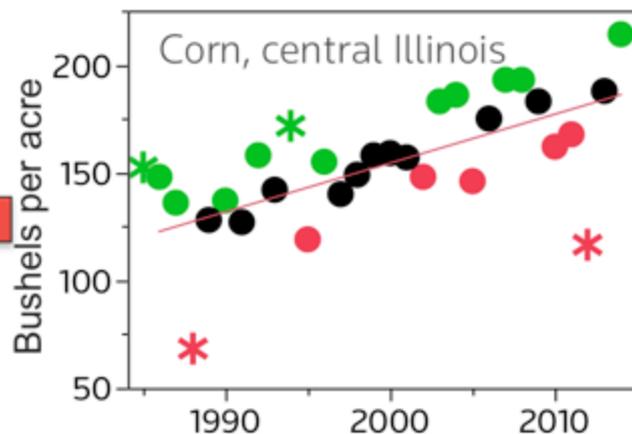


-18F                      0F                      +18F  
 Source: Thomson Reuters, Ag Weather Dashboard (NOAA, ECWMF)  
 5039227\_AgsWea\_TR\_Temp\_ECOP\_AVG\_L1\_USA\_F\_2014-07-15.CSV

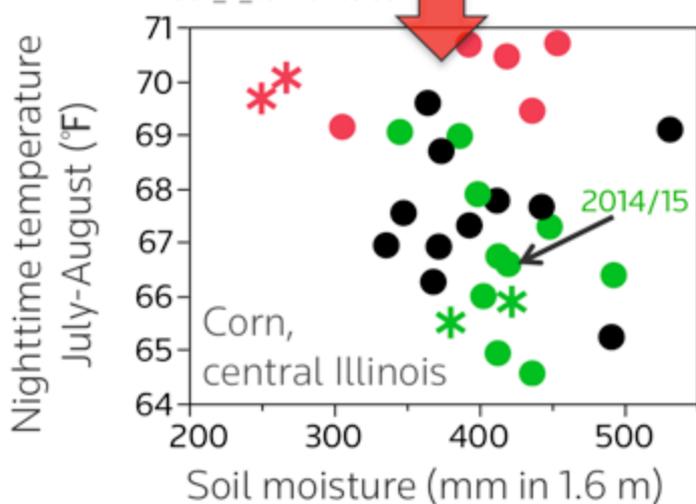
*Historical and forecast weather, imagery and production histories can be combined at a sub-state level, allowing for accurate prediction of crop yield well ahead of official estimates.*



15May                      15July                      15Sep  
 Source: Thomson Reuters, Lanworth vegetation data (MODIS)  
 5044559\_AgVeg\_TR\_ndvix\_Crop\_MODIS\_median\_MaskCat100\_USA\_A\_2014-07-08.CSV



Source: Thomson Reuters, Lanworth production data (USDA)



*Example: Cool temperatures predict corn yield well above trend in central Illinois during 2014/15. Satellite imagery indicates very high vegetation density, confirming the record yield.*

# THANK YOU!

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- Any questions?