

# Subtle Climate Shift, Major Agricultural Impact ?



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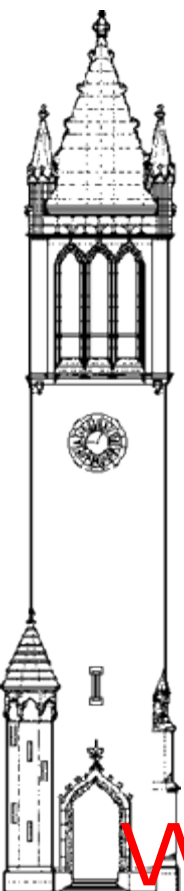
setaylor@iastate.edu

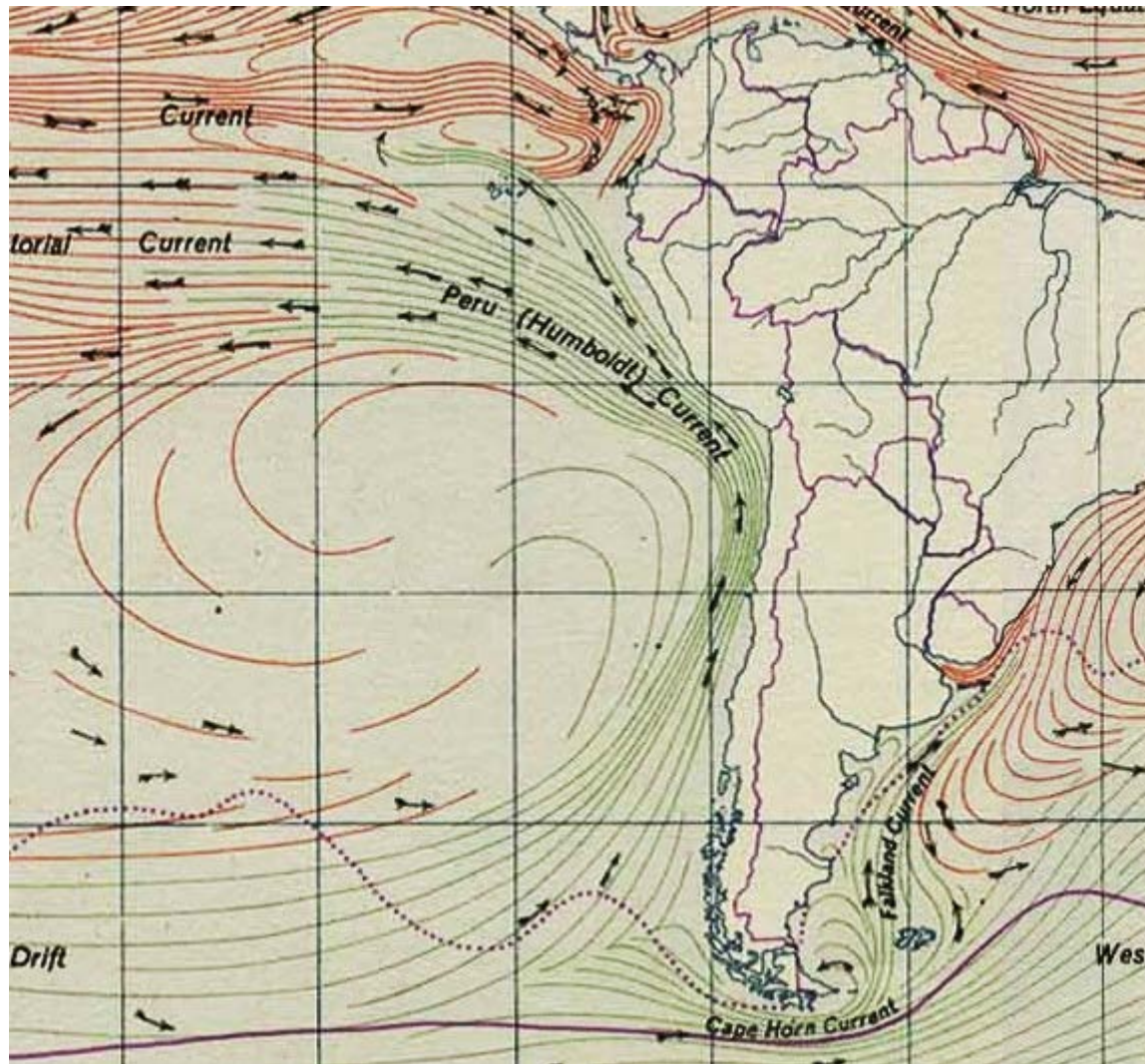
[www.twitter.com/elwynntaylor](http://www.twitter.com/elwynntaylor)



[www.extension.iastate.edu](http://www.extension.iastate.edu)

Iowa State University Extension





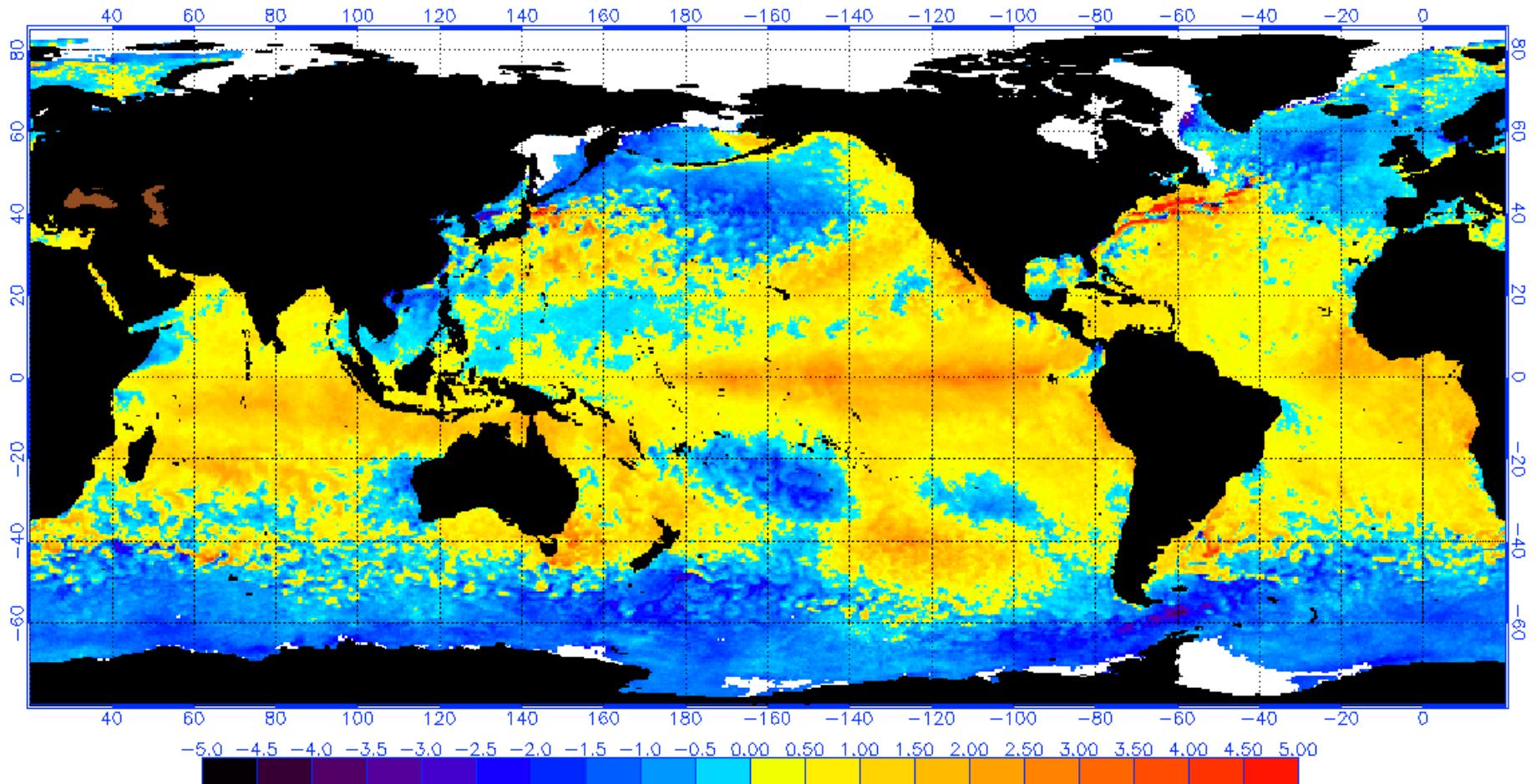
Is responsible for the aridity of [Atacama Desert](#) in [northern Chile](#) and coastal areas of Peru and also the aridity of southern Ecuador. Marine air is cooled by the current and thus is not conducive to generating precipitation (although clouds and fog are produced).



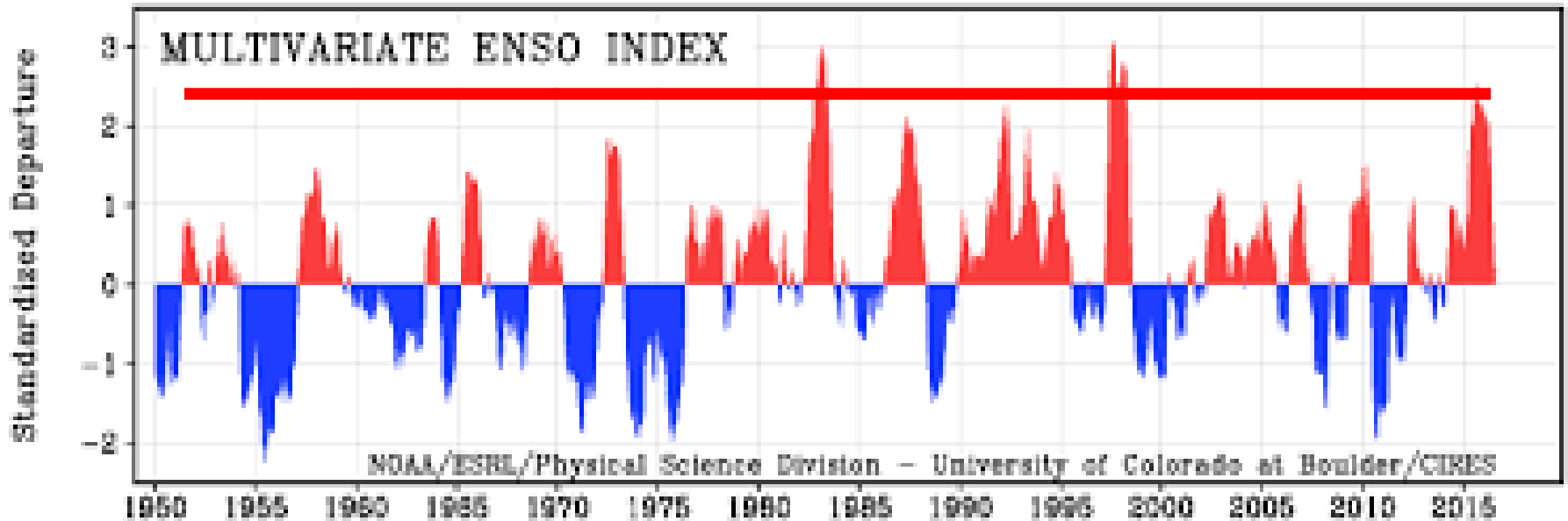
In parts of the coast known as lomas the fog is so dense that water condenses enough to support the local vegetation. (also in Mediterranean and in South California)

# Home of the El Nino

NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 3/3/2016  
(white regions indicate sea-ice)



# 2016: 3<sup>rd</sup> in strength since 1950



La Nina does not necessarily follow a strong El Nino, only a 35% chance of adversely impacting Midwest crops.

# El Nino

Most years strong enough about Christmas time to bring light rain.

About 1 year in 7, strong enough to bring disaster to Peru and to impact the weather of the United States

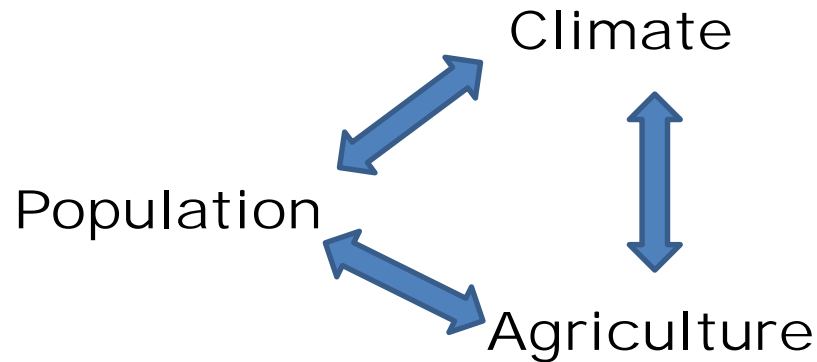


# Climate, Past & Future

"The climate is changing, climate has always changed & will always change. The question is; *'how much, how fast, how come?'* " D. M. Gates '66

The VICIOUS CYCLE:  
Population, Agriculture, Climate  
Who will BREAK the CYCLE ?

## The VICIOUS CYCLE:



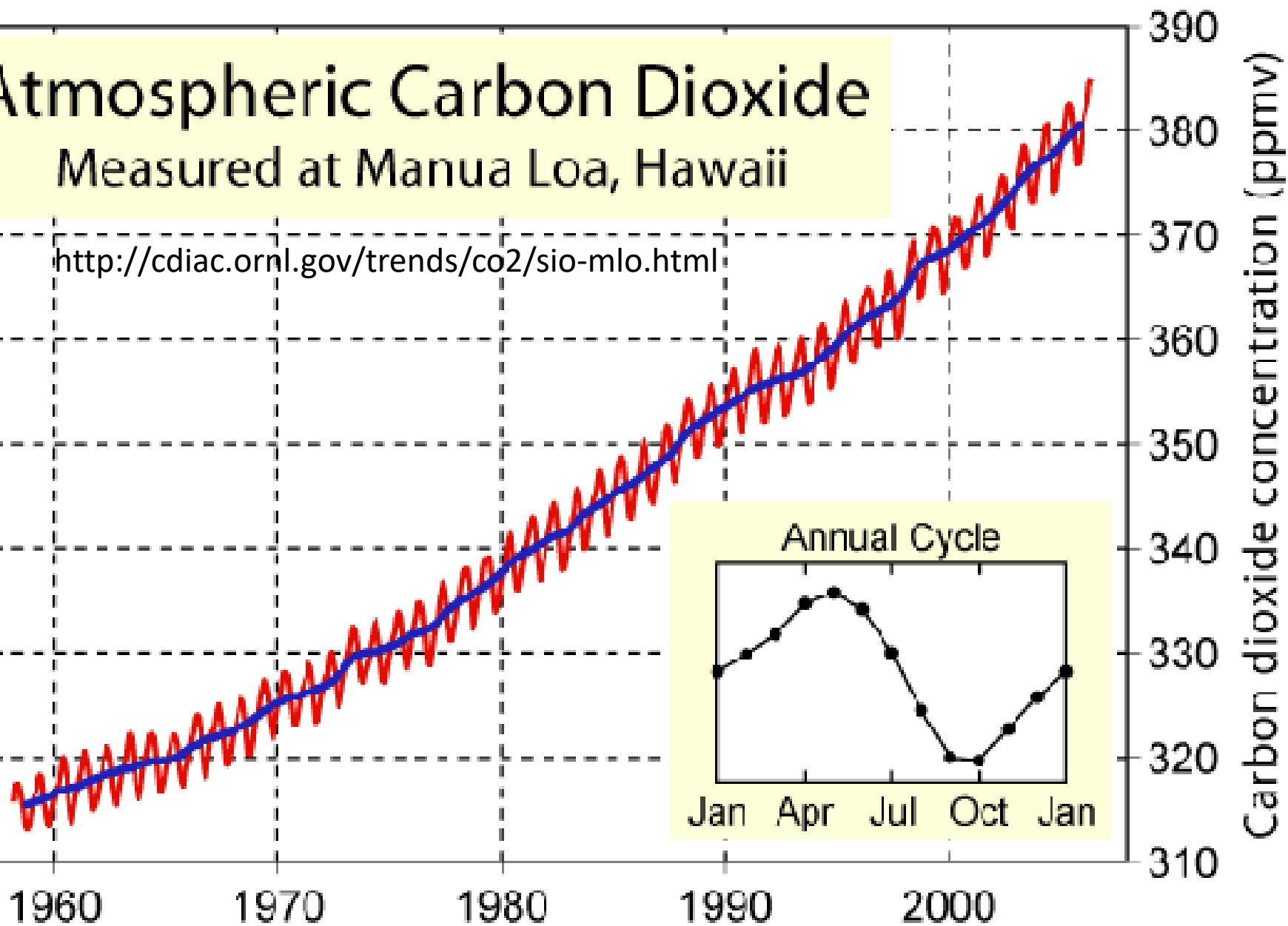
Who will BREAK the CYCLE ?

The VICIOUS CYCLE:  
Population, Agriculture, Climate  
Who will BREAK the CYCLE ?

# Atmospheric Carbon Dioxide

## Measured at Manua Loa, Hawaii

<http://cdiac.ornl.gov/trends/co2/sio-mlo.html>



# Agriculture: The Earth's Major Industry

Agriculture: Enables Climate Change

With "0" agriculture the population of Earth would not likely be of sufficient numbers to cause climate change.

Agriculture: Directly (and greatly) impacted by climate change.

Light, temperature, soil moisture, ...

Agriculture: Directly impacts climate change.

Albedo of the Earth (basis of "Gaia Hypothesis").

Fossil energy used in Agriculture, Carbon sequestered in the soil or released from soil.

# Agriculture Impact on Climate

## Soil Management:

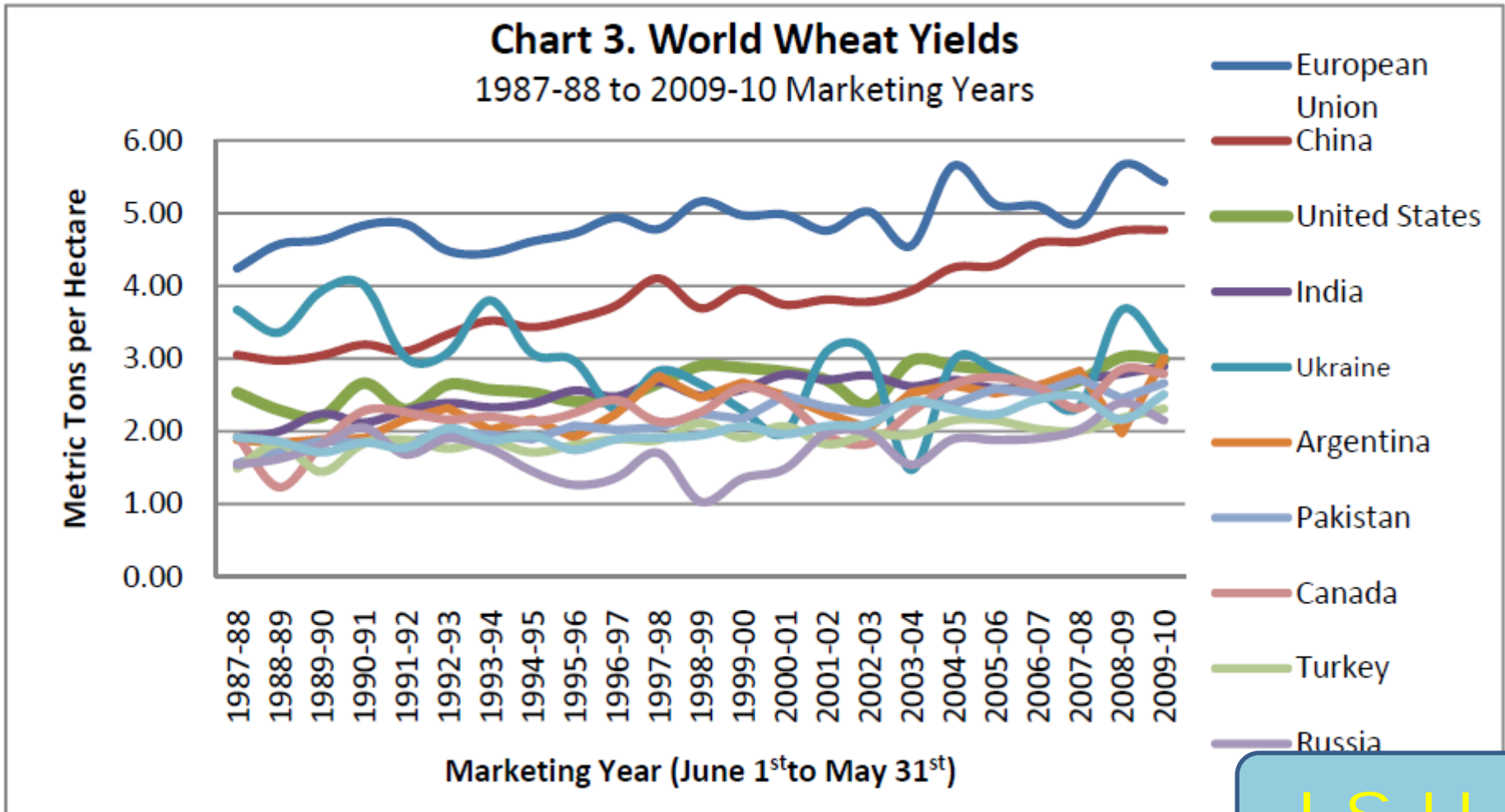
Soil carbon diminishes in disturbed soils.  
Soil carbon increases in forest soils.  
Prairie soils accumulate "best."

## Energy consumption:

Farming practice relies on fossil energy for fertility & equipment operation.  
1940: production without fossil energy, but not sufficient to sustain a large population. Soil conserved, not built.  
1990s: No-till agriculture can sequester soil carbon. High production without fossil input is possible.

# World Crop Trends/Volatility

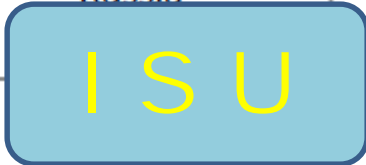
[http://www.agmanager.info/marketing/outlook/newletters/archives/GRAIN-OUTLOOK\\_04-28-10.pdf](http://www.agmanager.info/marketing/outlook/newletters/archives/GRAIN-OUTLOOK_04-28-10.pdf)



## World Wheat Market Supply-Demand Trends

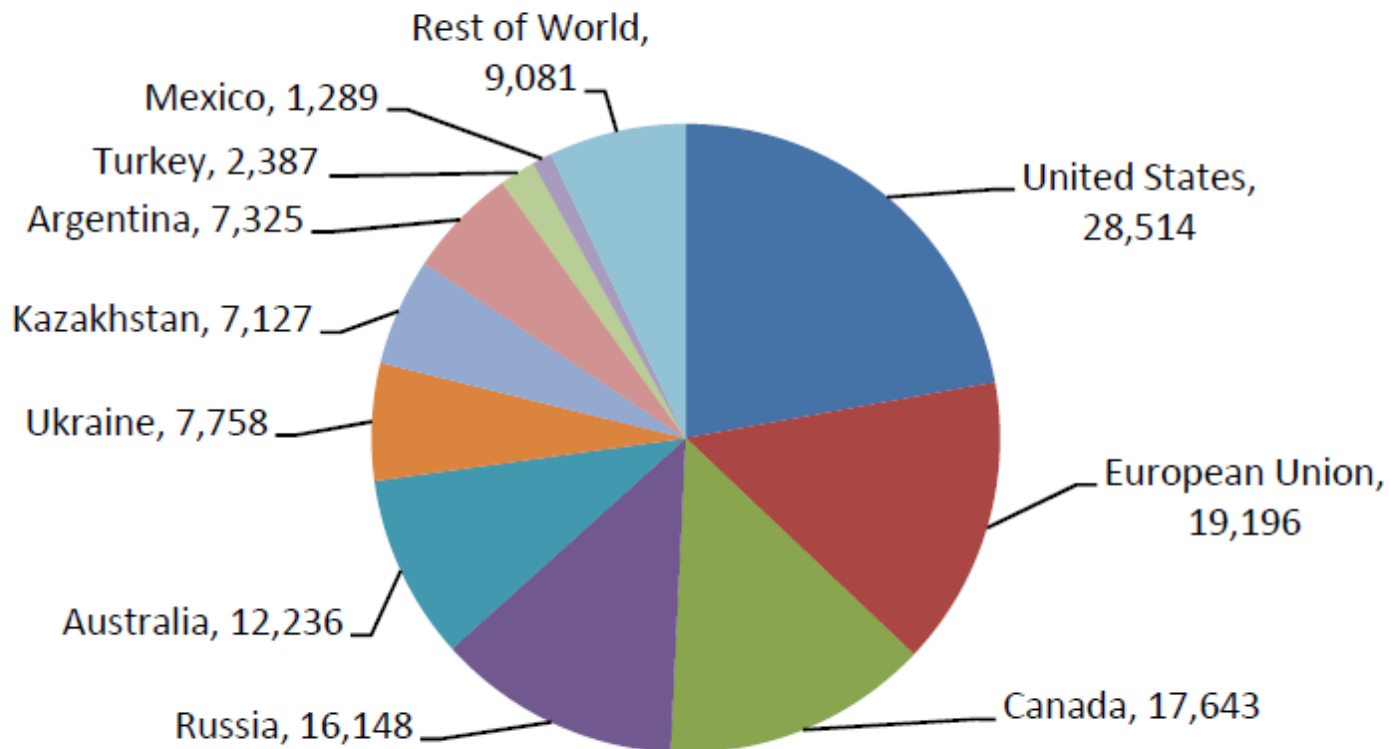
Daniel O'Brien – Extension Agricultural Economist

K-State Research and Extension April 28, 2010



## Chart 7. World Wheat Exports: 3 Year Average

Average of 2007-08 to 2009-10 Marketing Years (1,000 metric tons)



### World Wheat Market Supply-Demand Trends

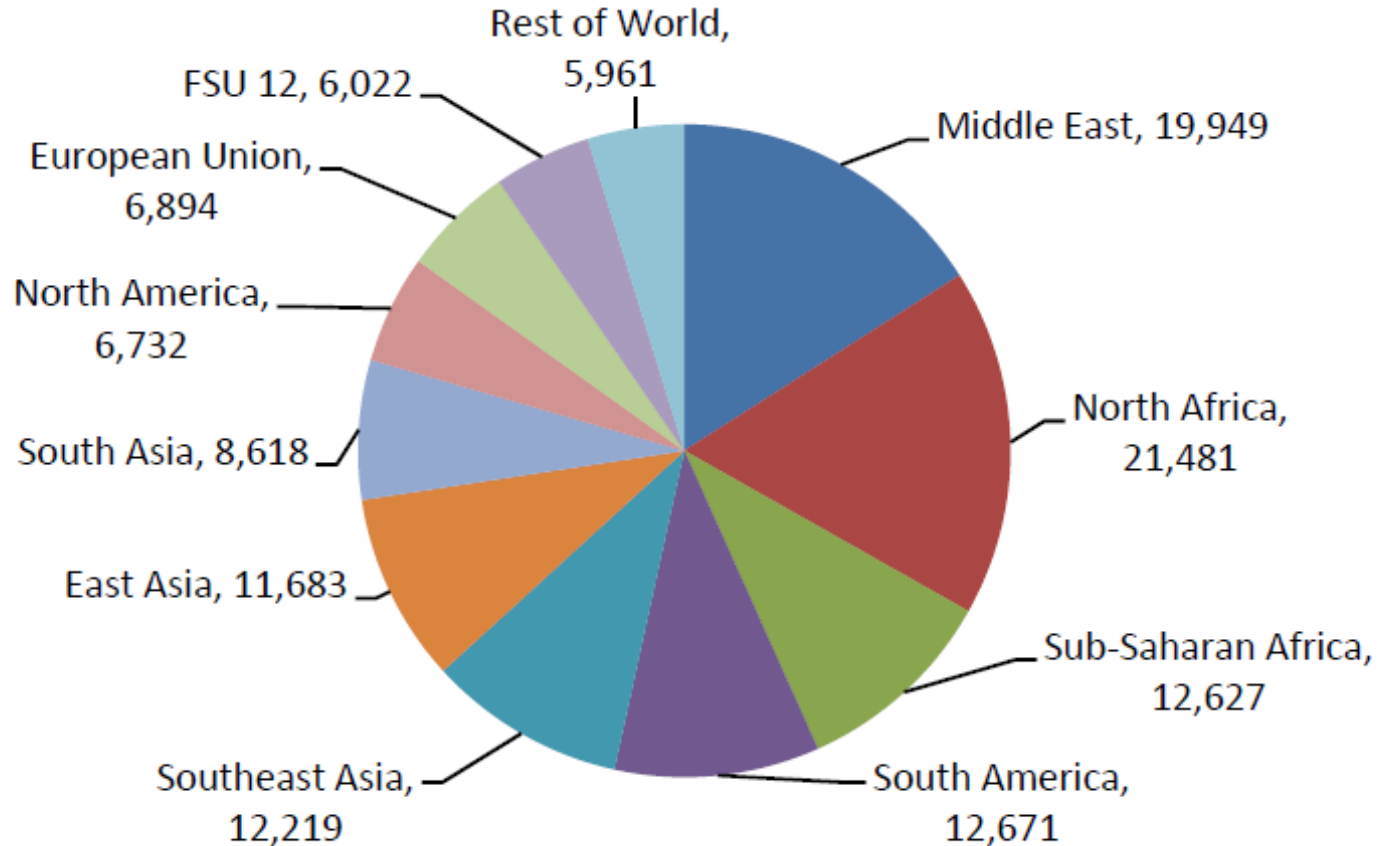
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K-State Research and Extension April 28, 2010

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## Chart 9. World Wheat Imports

Average of 2007-08 to 2009-10 Marketing Years (1,000 metric tons)



### World Wheat Market Supply-Demand Trends

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# Warmer Nights

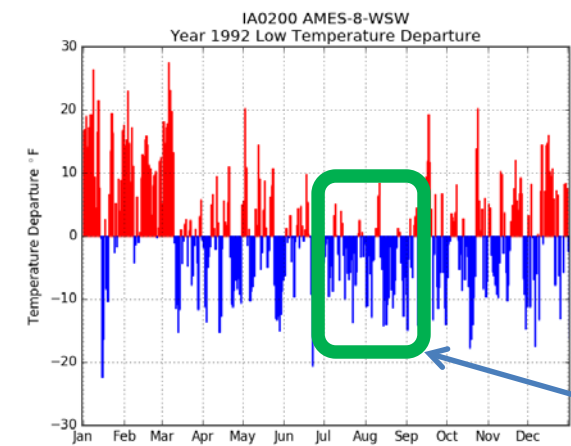
Diurnal Temperature Range (DTR)

Night-time temperature is often a major factor controlling crop yield.

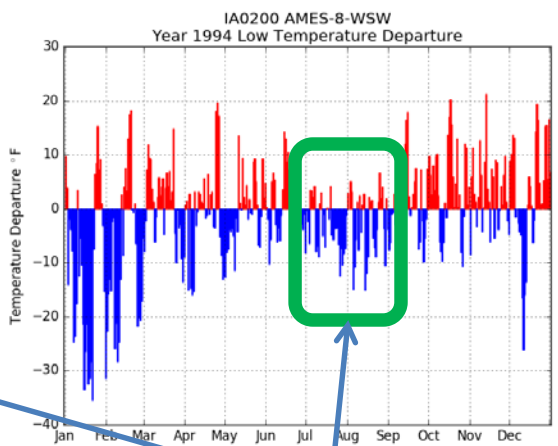
Plant development is temperature sensitive and **development** continues **day** and **night**.

Plant **dry-weight** increase is mainly limited to **day-time**.

Crop yield is a function of growth rate and of development.

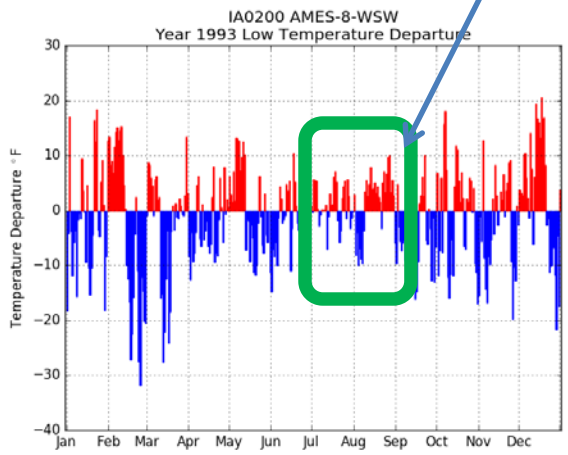
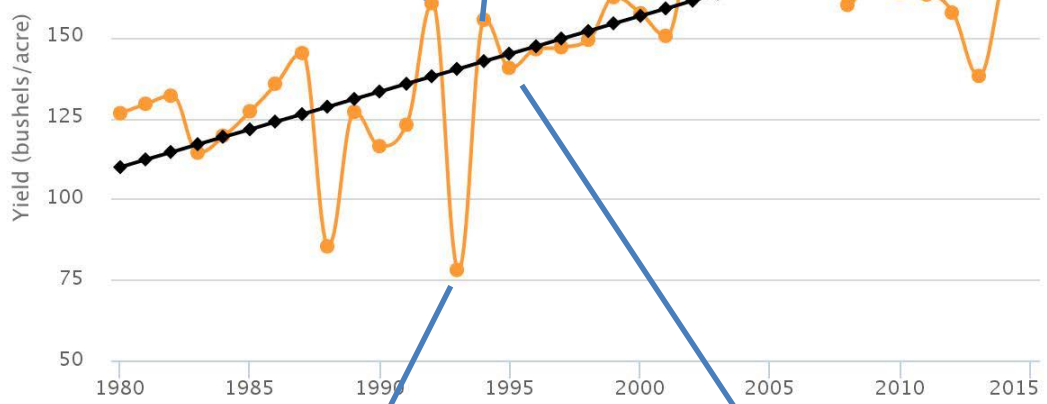


Plot Generated at 13 Sep 2016 5:50 PM CDT in 1.02s

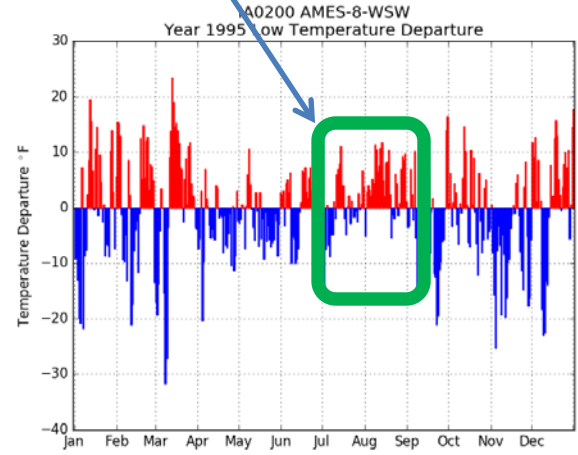


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Yield —◆— Corn Yield Trend



Plot Generated at 13 Sep 2016 5:52 PM CDT in 1.77s



Plot Generated at 13 Sep 2016 5:55 PM CDT in 0.99s

# Management for Climate Change

- Small changes may have large impacts
- Warm Nights (Philippines) example:
  - Cut rice yield.
  - Increased CO<sub>2</sub> may influence response significantly.

**“Rice yields decline with higher night temperature from global warming”**

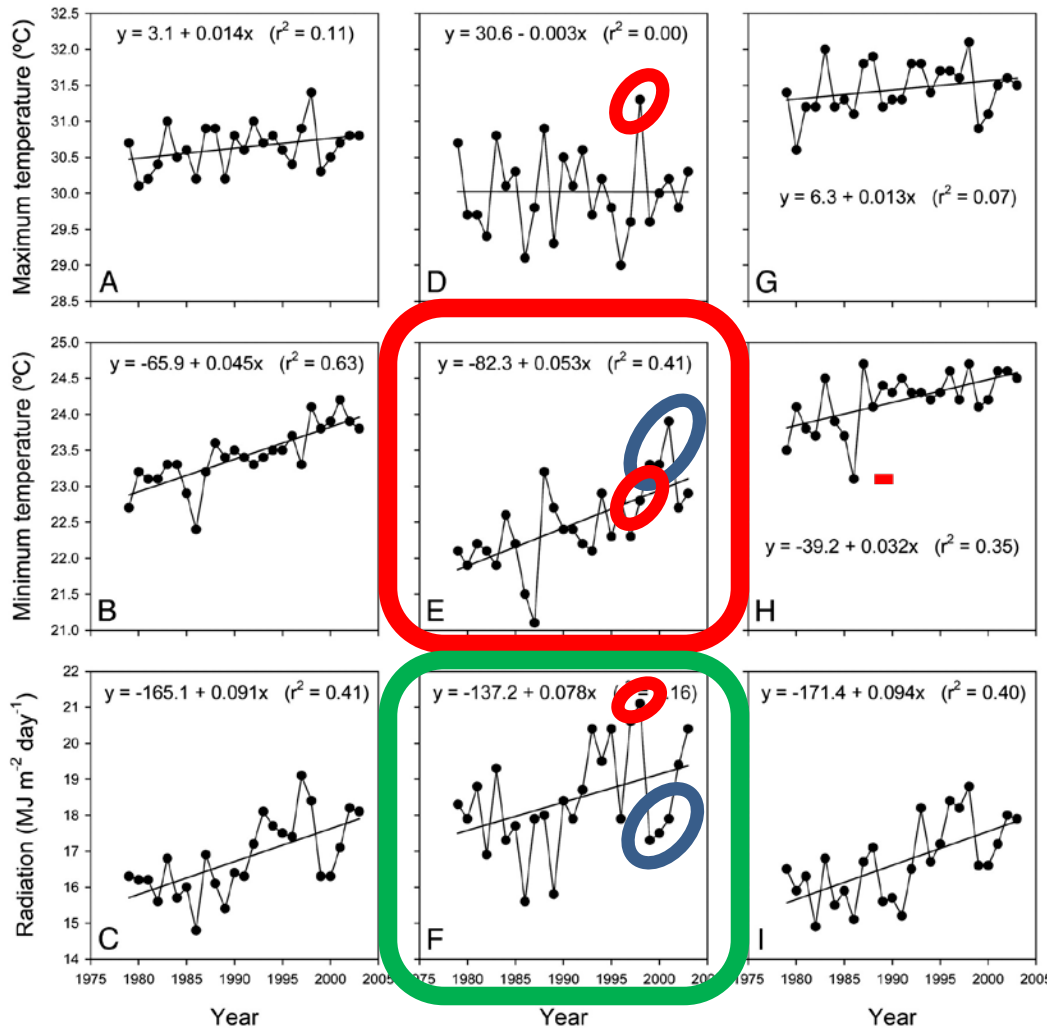
[Shaobing Peng\\*](#), [Jianliang Huang†](#), [John E. Sheehy\\*](#),

[Rebecca C. Laza\\*](#), [Romeo M. Visperas\\*](#),

[Xuhua Zhong‡](#), [Grace S. Centeno\\*](#),

[Gurdev S. Khush§,¶](#), and [Kenneth G. Cassman¶,||](#)

Trends in maximum and minimum temperatures and radiation from 1979 to 2003 for the whole year (A–C), dry season (January to April) (D–F), and wet season (June to September) (G–I) at the IRRI Farm.



Philippines rice

-Trend to increased night T

○ The season with **most sun** had highest **MaxT** but average MinT

○ The season with **least sun** had the highest **MinT**, but ave. MaxT

+Possible sunlight increase

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Warmer than normal nights, may be the primary result of increasing atmospheric composition modification.

Basic food crops may be the primary adverse result of warmer nights.

The only viable, to date, solution to the increase of atmospheric Carbon is agriculture (true biofuel).

Corn is the crop of choice, as of now, for biofuel.

Within 30 years it may be a crop with greater starch production (cassava)\*

**\*Cassava is the basis of a multitude of products, including food, flour, animal feed, alcohol, ...**



# Summary

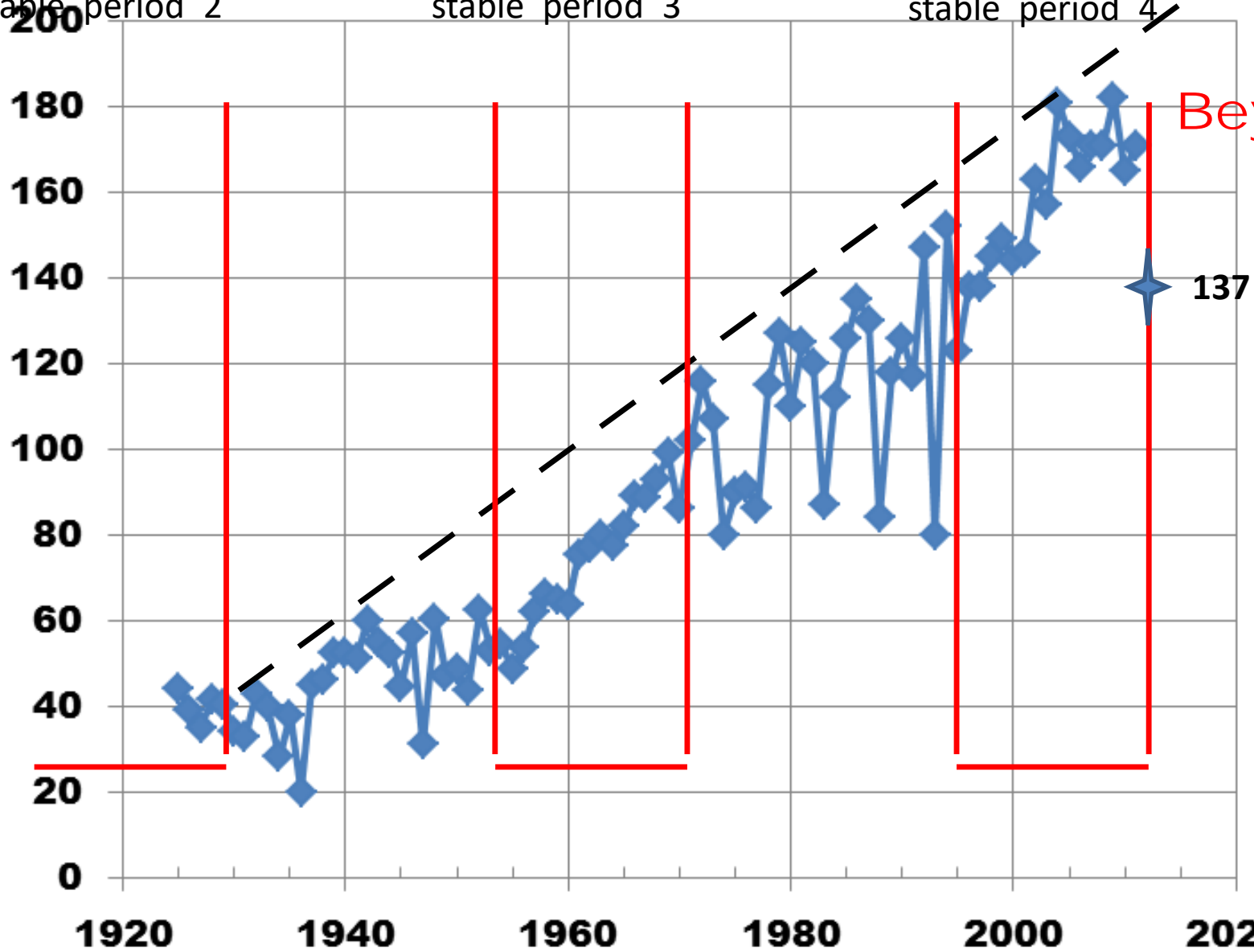
- Climate is changing
- Agriculture is impacted by climate
- Agriculture impacts climate
- Agriculture can reduce energy use impact on climate
- Agricultural interests can manage climate risk to crop yield

# Iowa Corn Yield 1925-2011

stable period 2

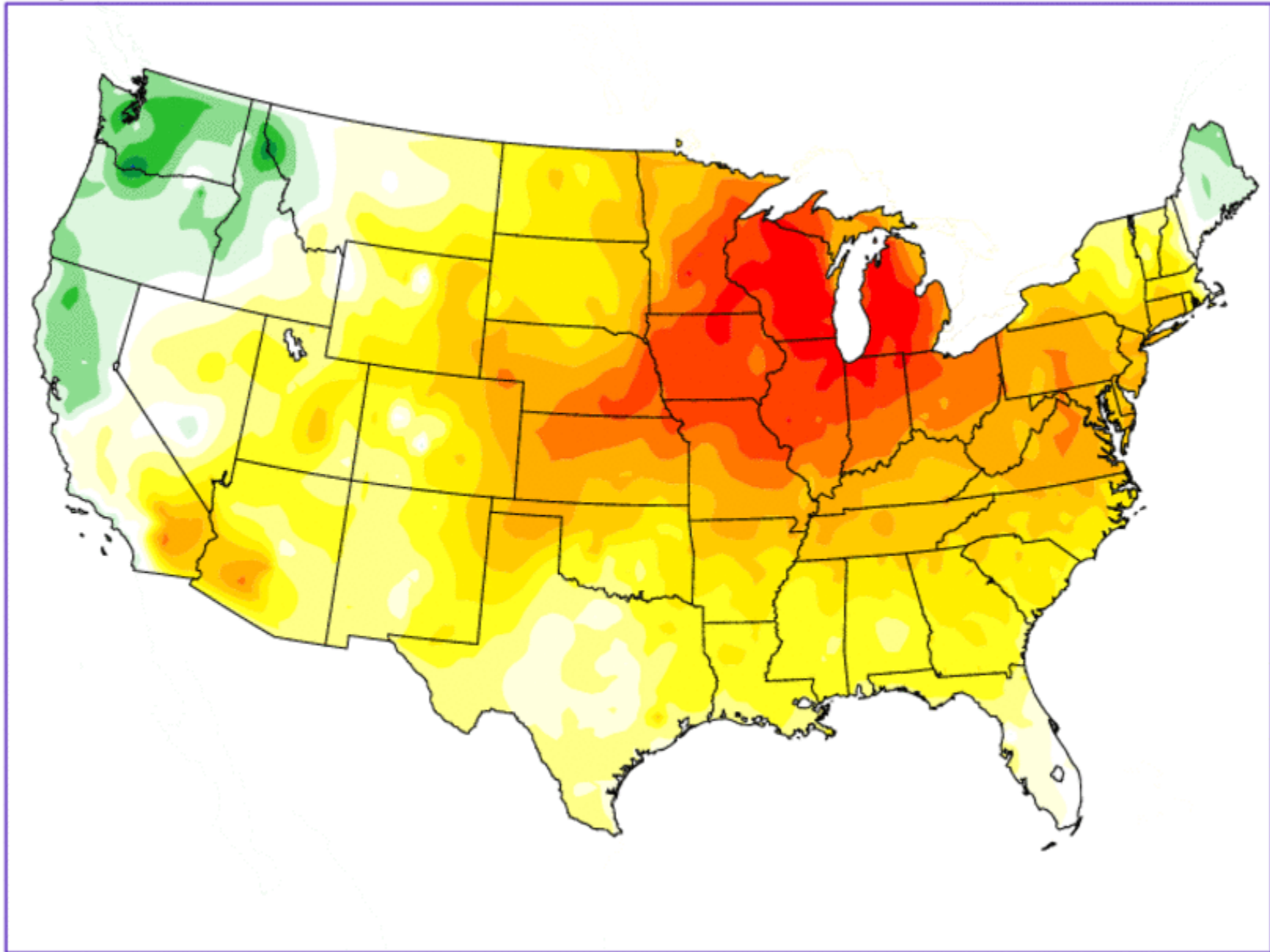
stable period 3

stable period 4



# High Temperature Departure from 1981-2010 Average

Map Valid: 17 Mar 2011

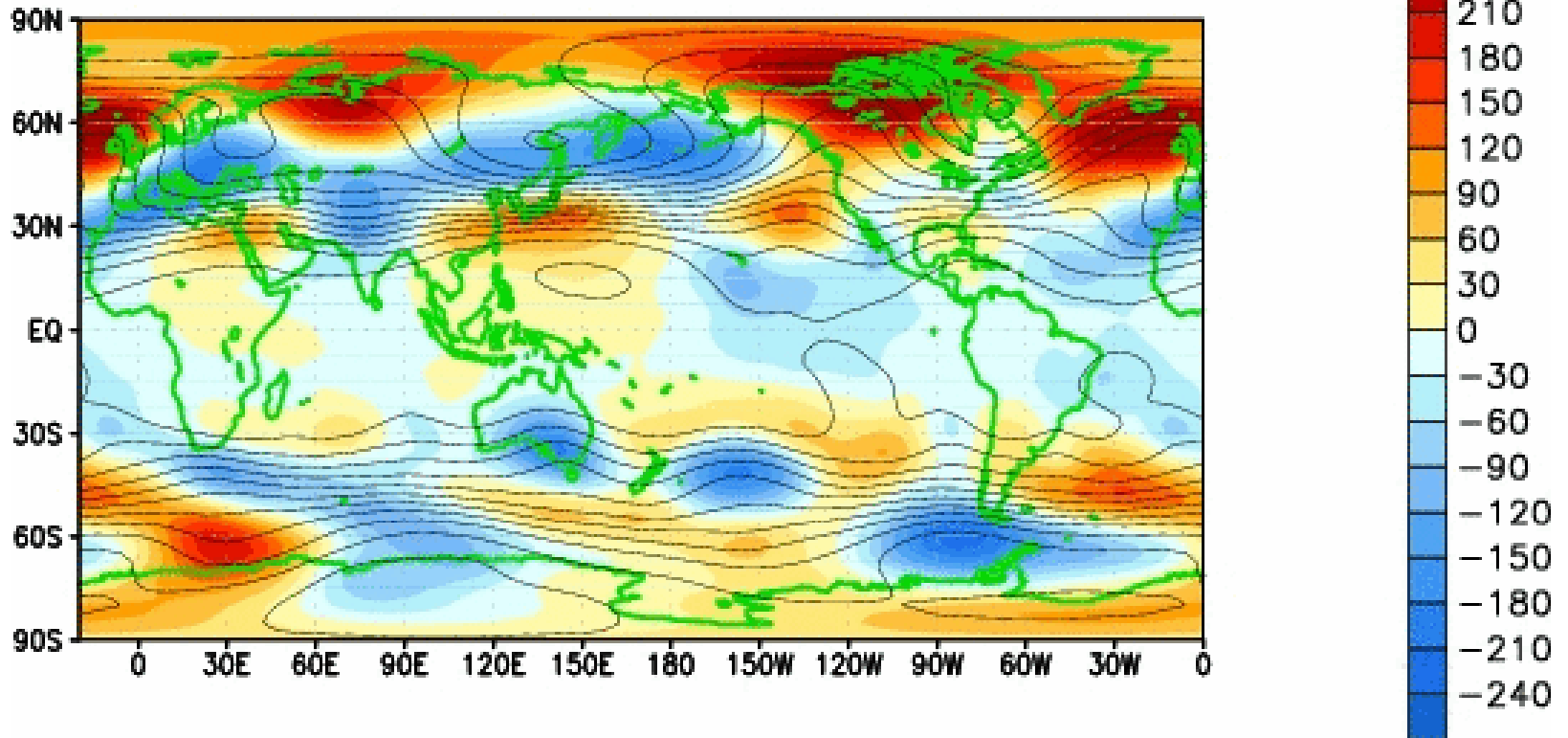


Iowa Environmental Mesonet

Map Generated 14 Mar 2012 11:21 PM

# Madden-Julian

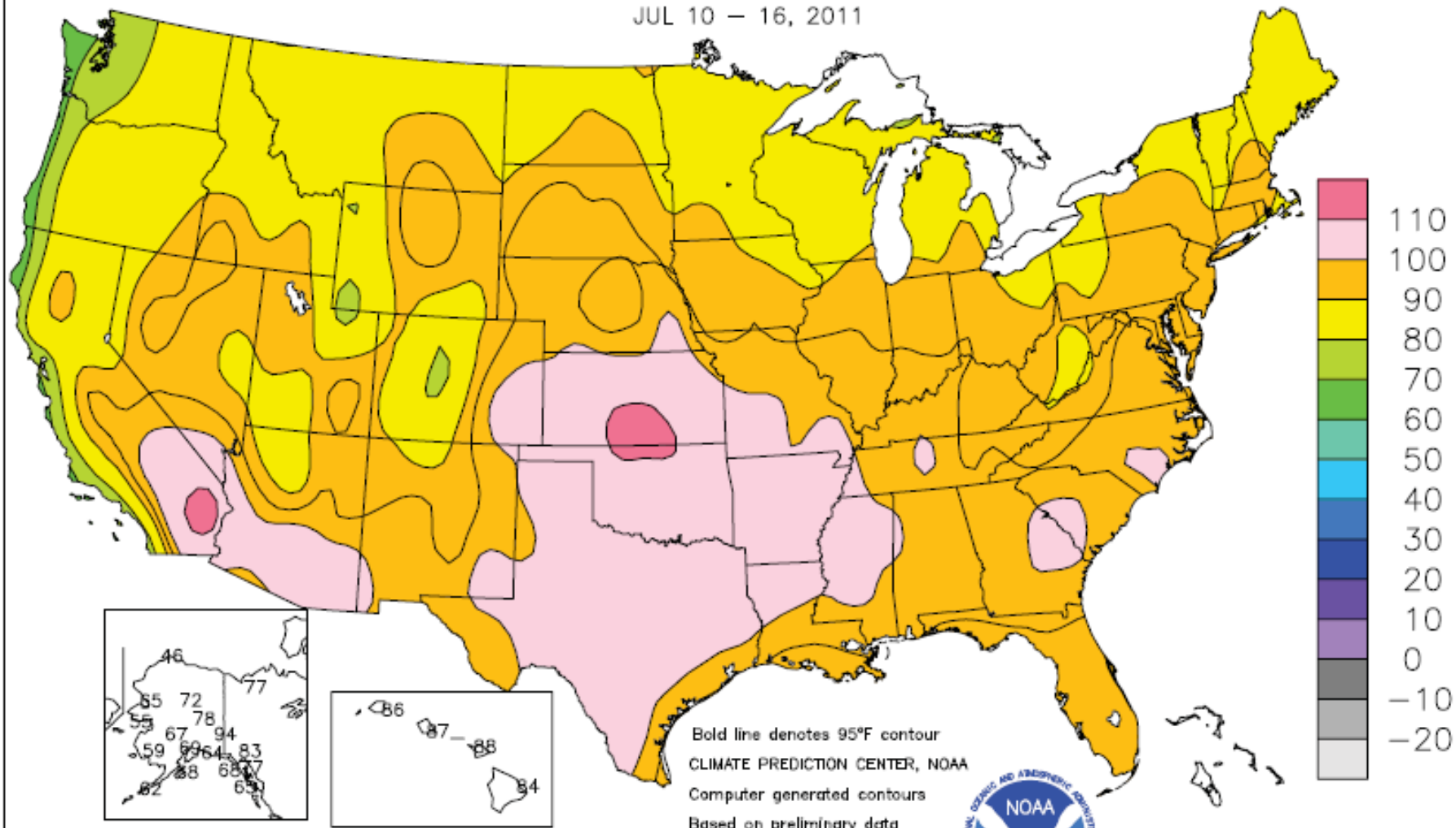
CDAS 200-hPa HT Anoms (11d rm)  
12FEB2012



- MJO updates :
- <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjoupdate.pdf>

# Extreme Maximum Temperature (°F)

JUL 10 – 16, 2011



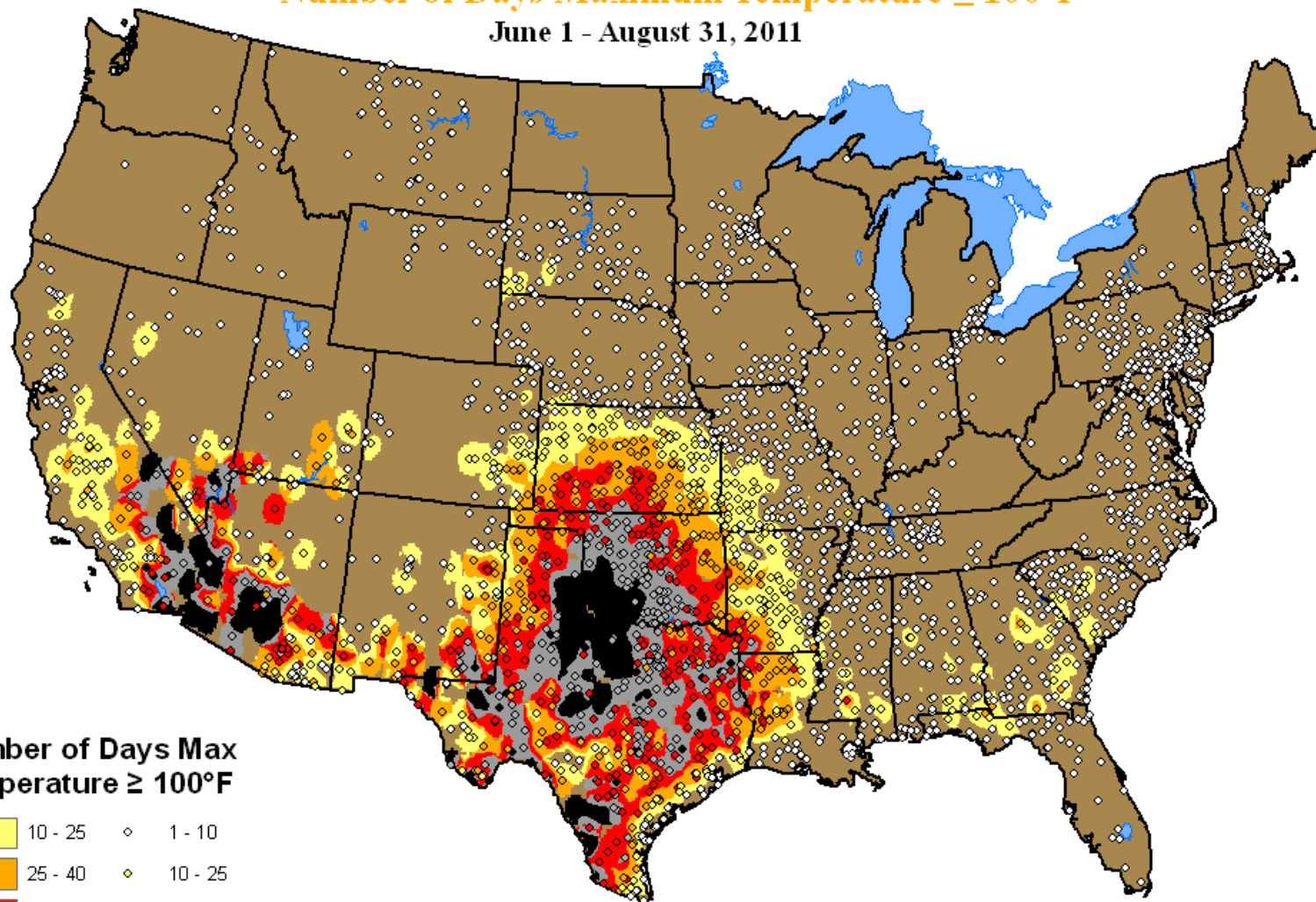
Bold line denotes 95°F contour  
CLIMATE PREDICTION CENTER, NOAA  
Computer generated contours  
Based on preliminary data



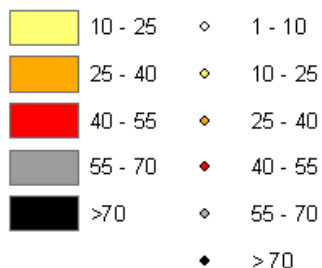
# Persistent Heat Engulfs Nation - Summer 2011

## Number of Days Maximum Temperature $\geq 100^{\circ}\text{F}$

June 1 - August 31, 2011



Number of Days Max  
Temperature  $\geq 100^{\circ}\text{F}$



Total number of stations: 2731 (only includes 60 or more non-missing days).

Leader: Laredo AP TX 90 out of 92 possible days.

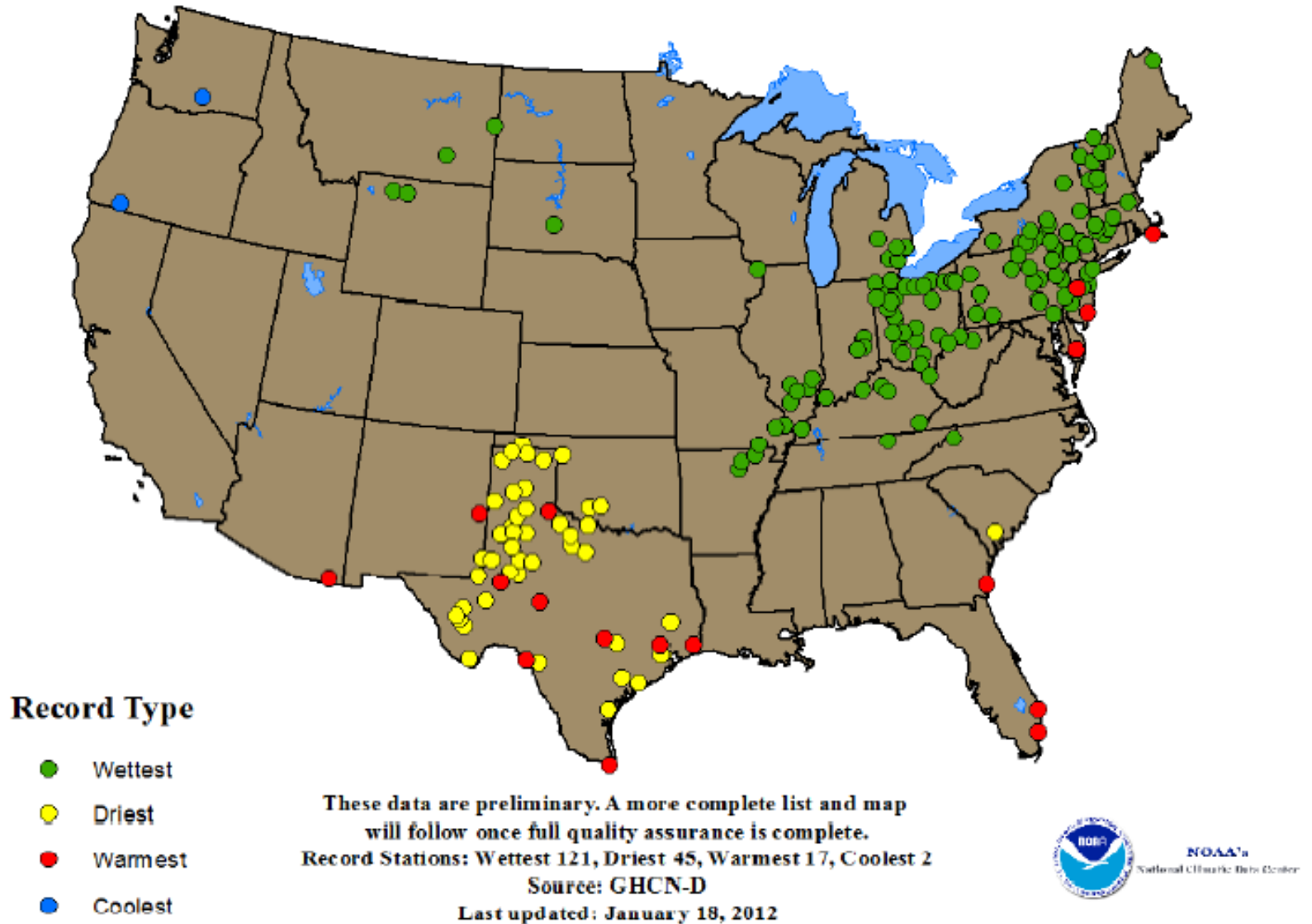
Preliminary data: full quality assurance not yet applied.

Updated: September 27, 2011



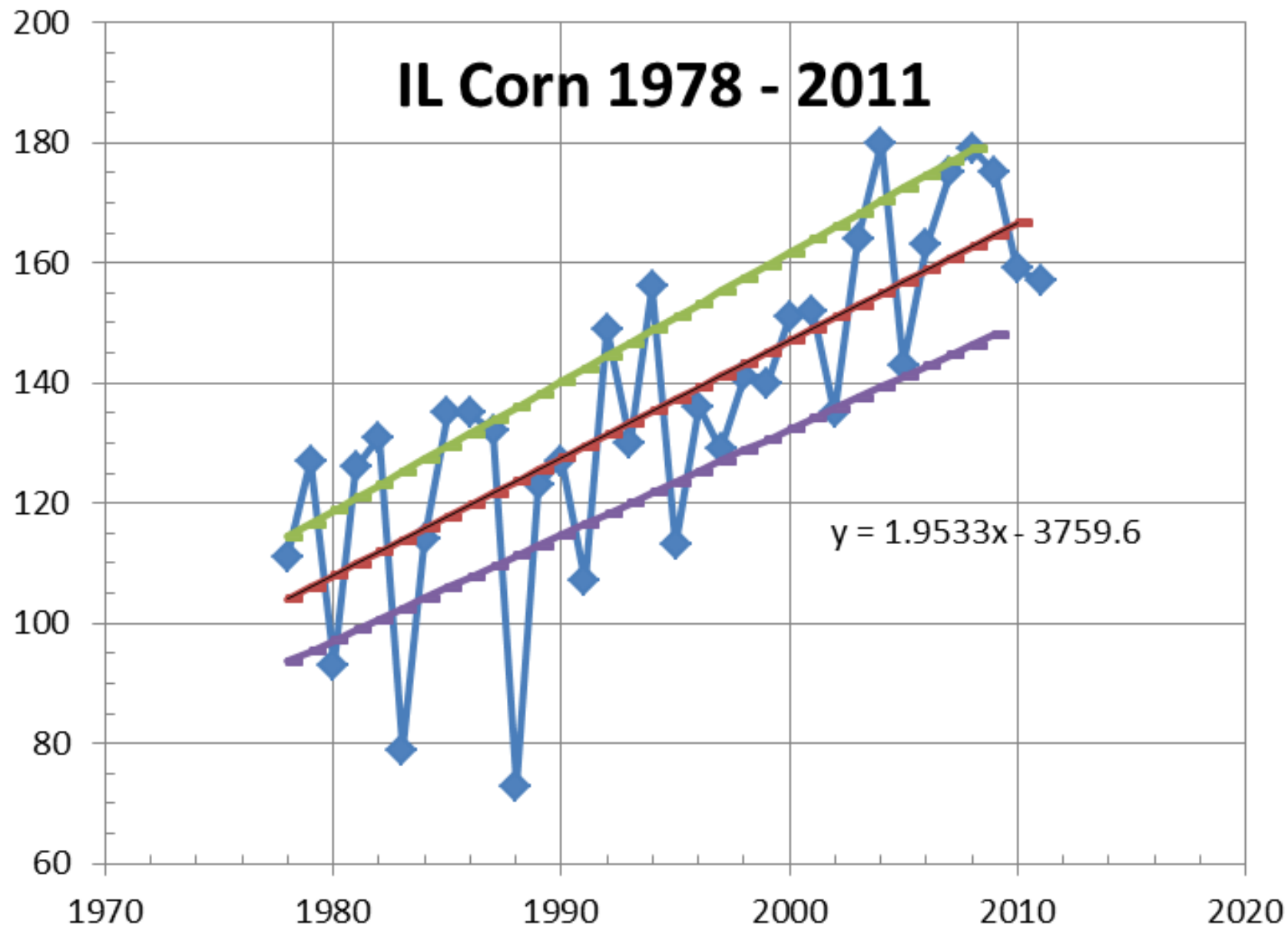
NOAA's  
National Climatic Data Center

## Selected Annual Climate Records for 2011



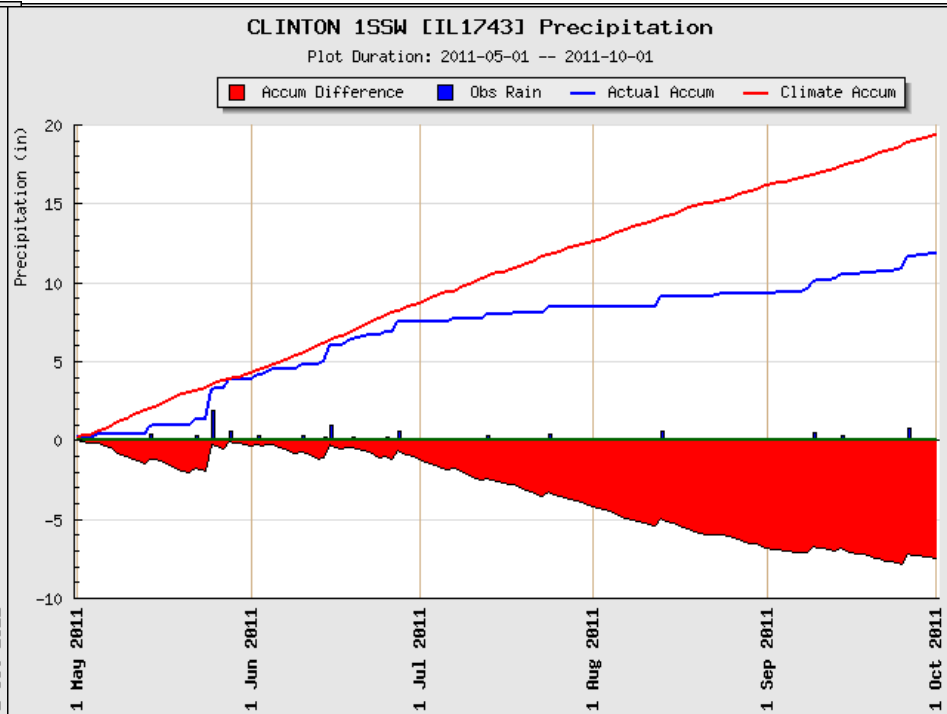
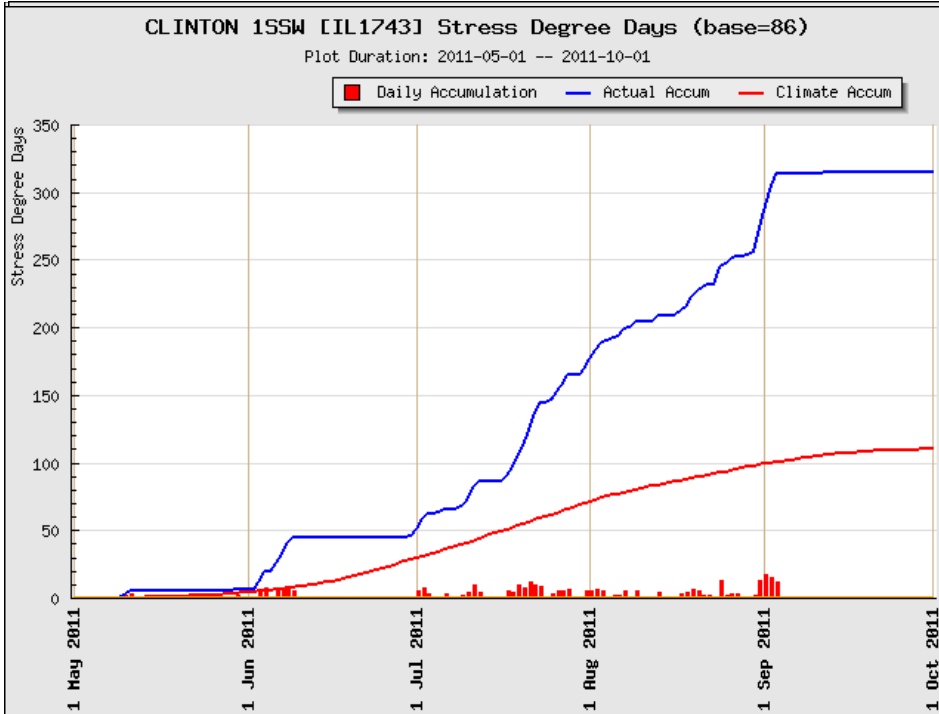
- Edging records of mid-teens & 50s for old stations

# IL Corn 1978 - 2011



# Weather Stations Near You

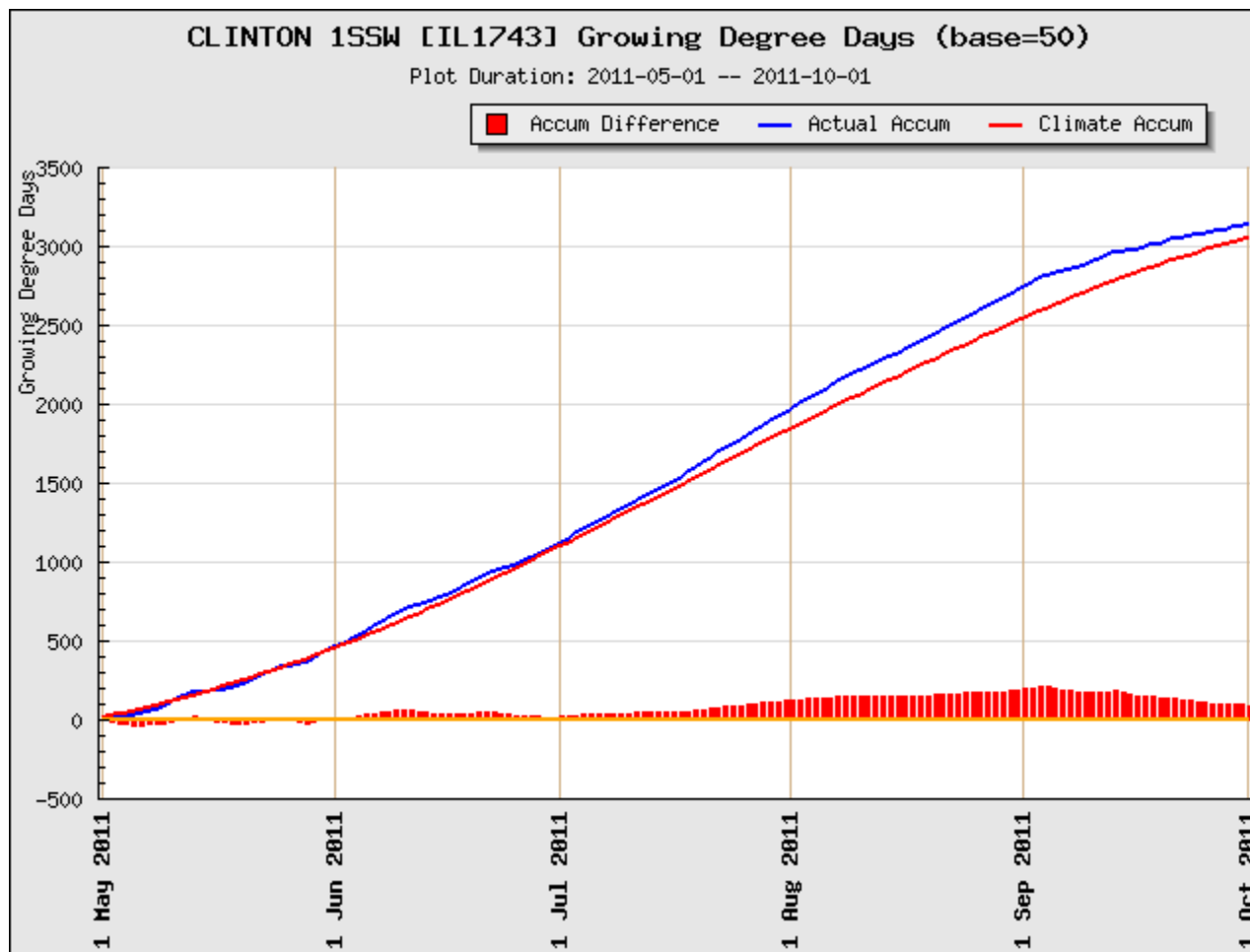




- Clinton: Hot & Dry July-Aug.
- <http://mesonet.agron.iastate.edu>



- Single Site Graphs



Clinton: Growing Degree Days advance after mid-July

- <http://mesonet.agron.iastate.edu>



END

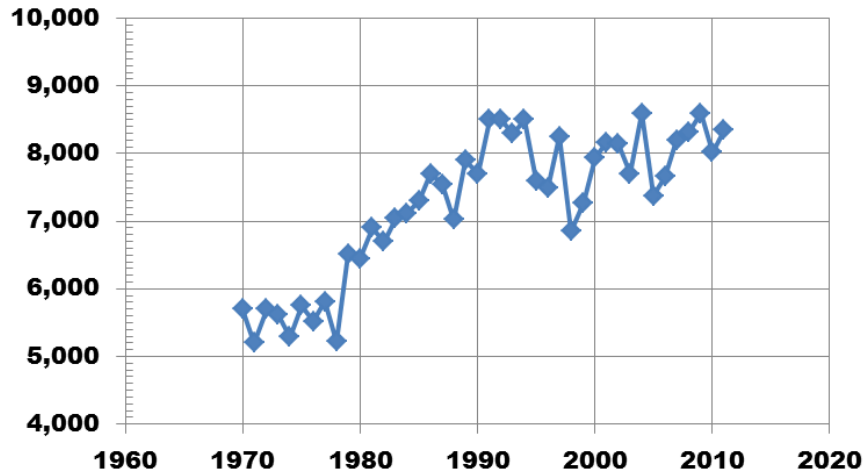


Elwynn Taylor

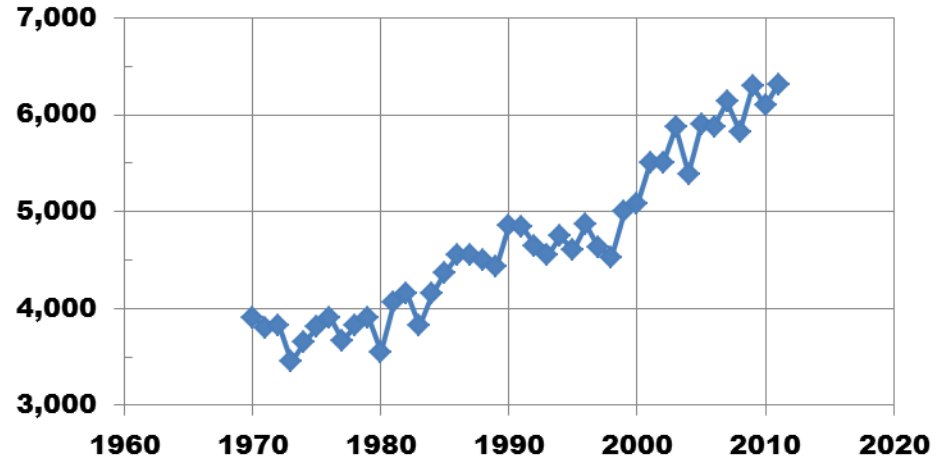
Iowa State University

Climatologist

### California Rice Yield



### Louisiana Rice Yield



### US Soybean Yield

