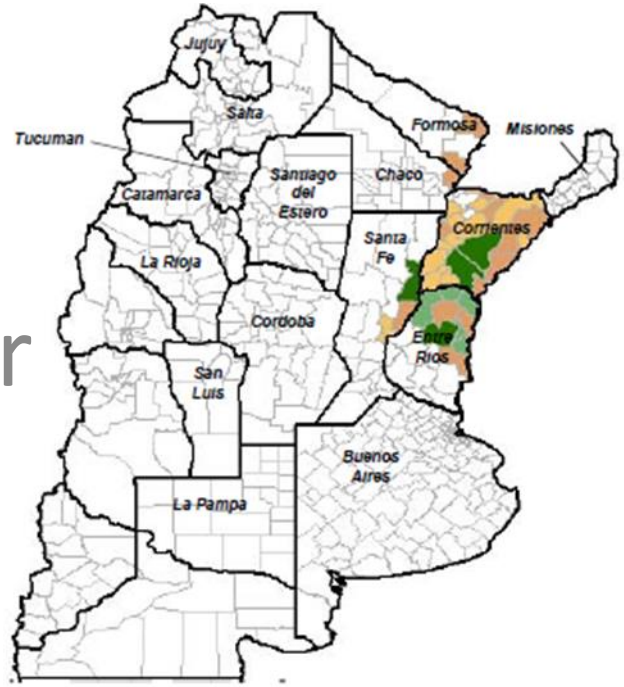
Rice
Bioenergy & Climate
Corrientes Conference

4/24/2013

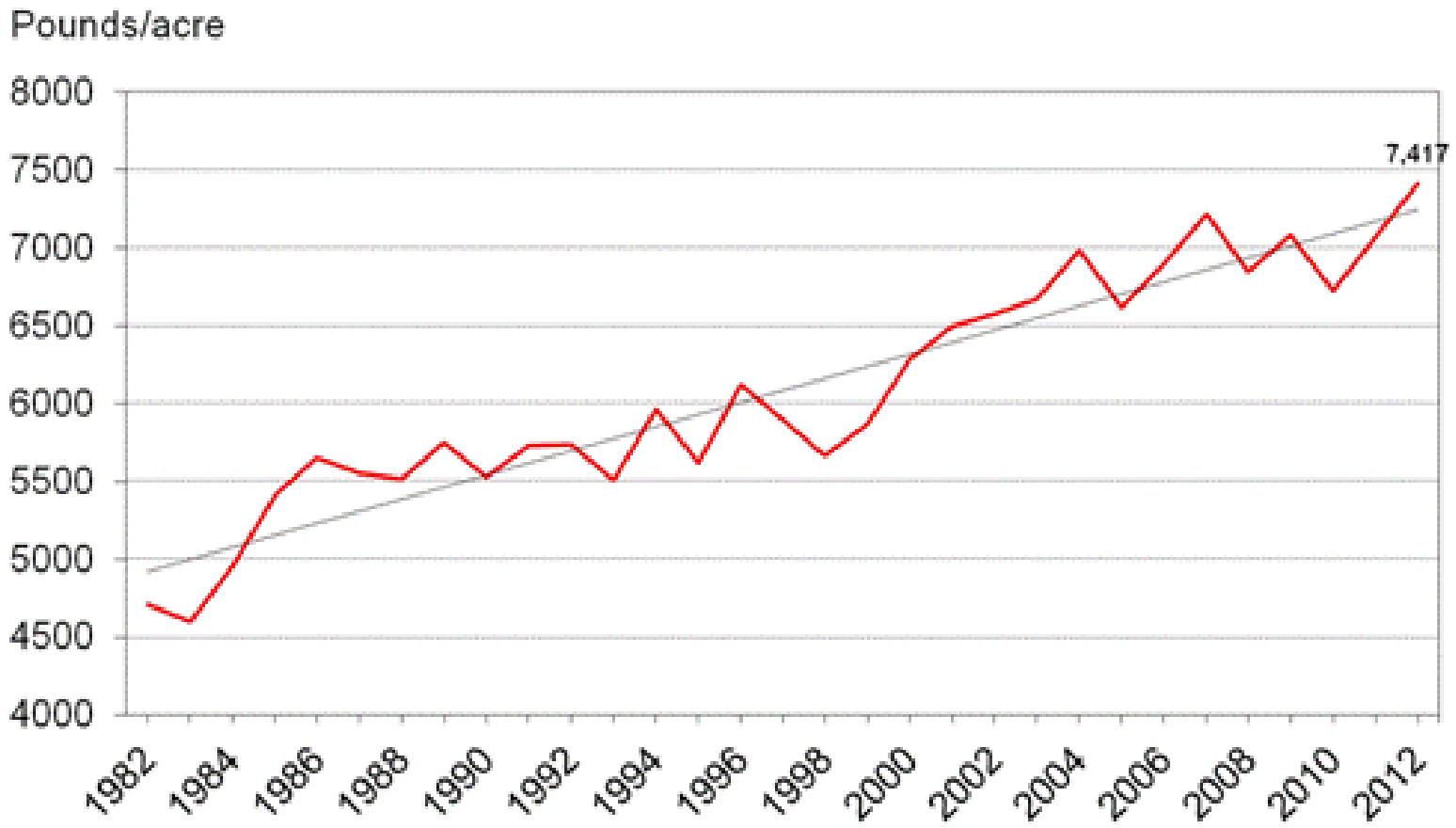
Elwynn Taylor



Age of Risk Management

- **Some years: Very Good Crop**
- **Some years: Very Poor Crop**

U.S. Rice Yield



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USDA-NASS
11-9-12

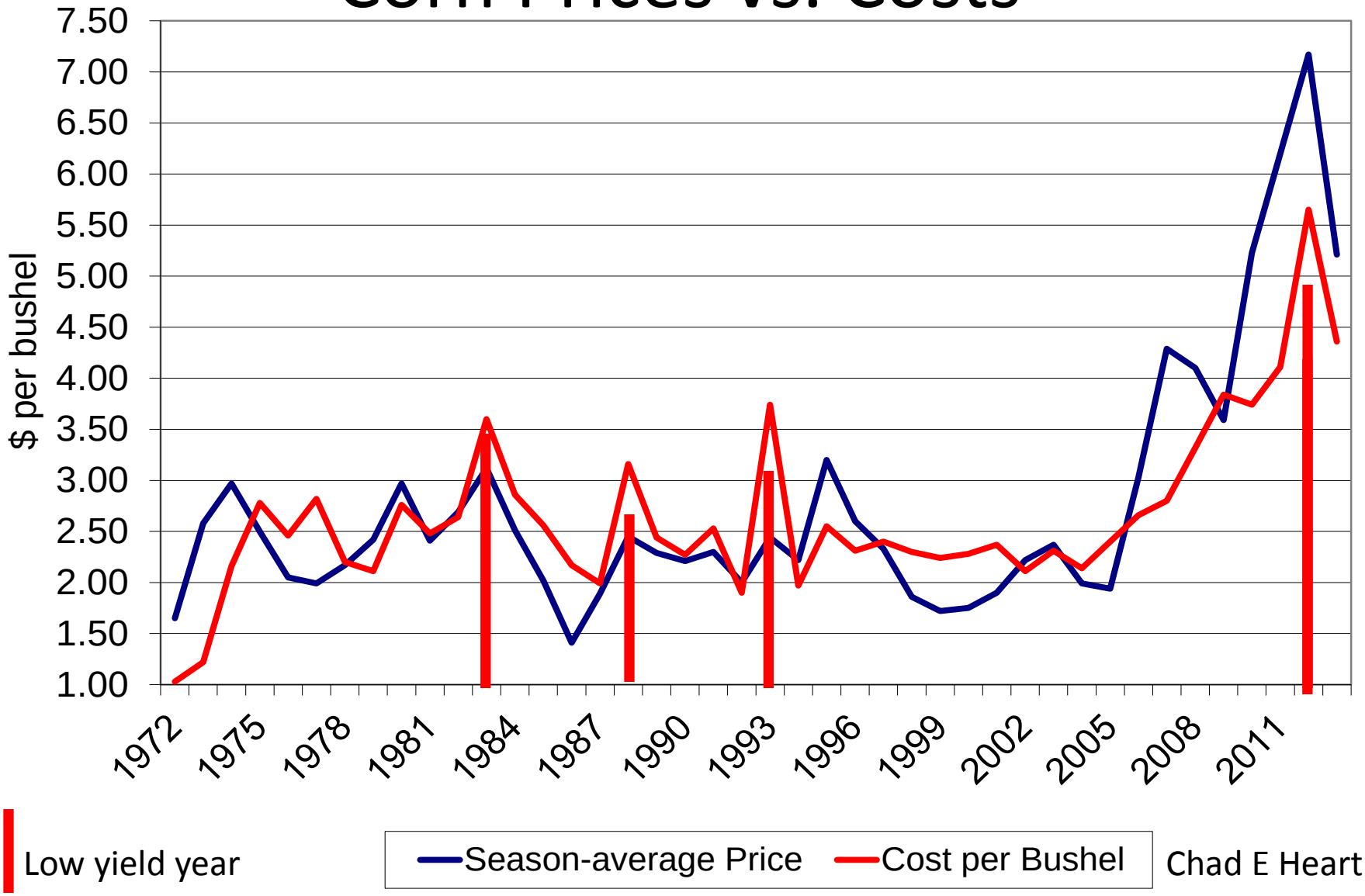
Relative Demand for Corn Increases (corn begins to take land from rice)

- **RICE > RICE**
- **CORN < CORN**

Why is US corn production up?

- **Corn has become profitable.**
- No other reasons..

Corn Prices vs. Costs

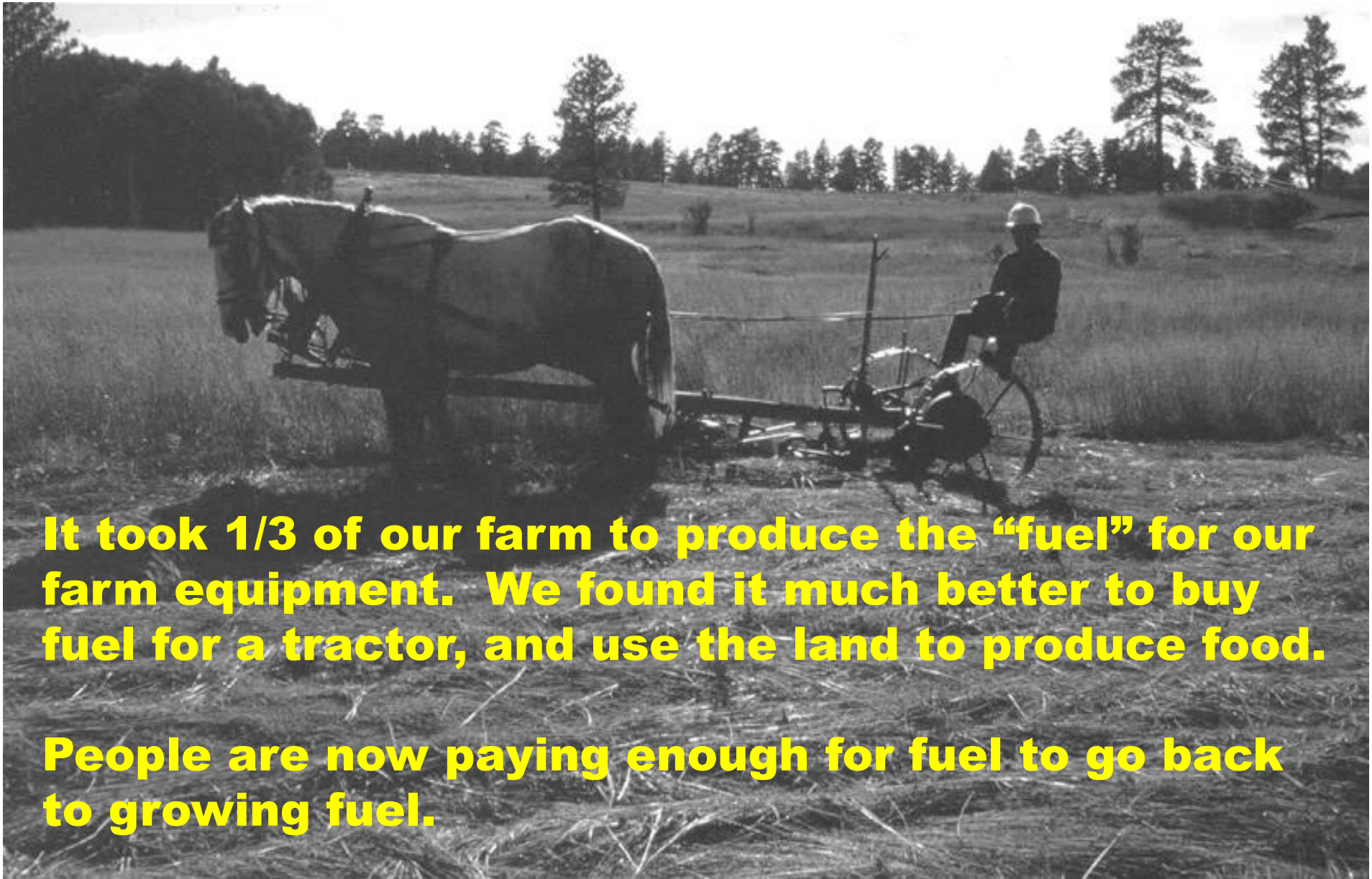


Chad E Heart

Change of Crop Demand

- **Food (Human or Livestock)**
  - **Food demand increases with population**
  - **Livestock demand increases with wealth**
- **Fiber ??**
- **ENERGY DEMAND (Bio-fuel)**
  - **Increases with wealth**
  - **Increases with population**
  - **Increases with Diminished supply of conventional fuel**
-

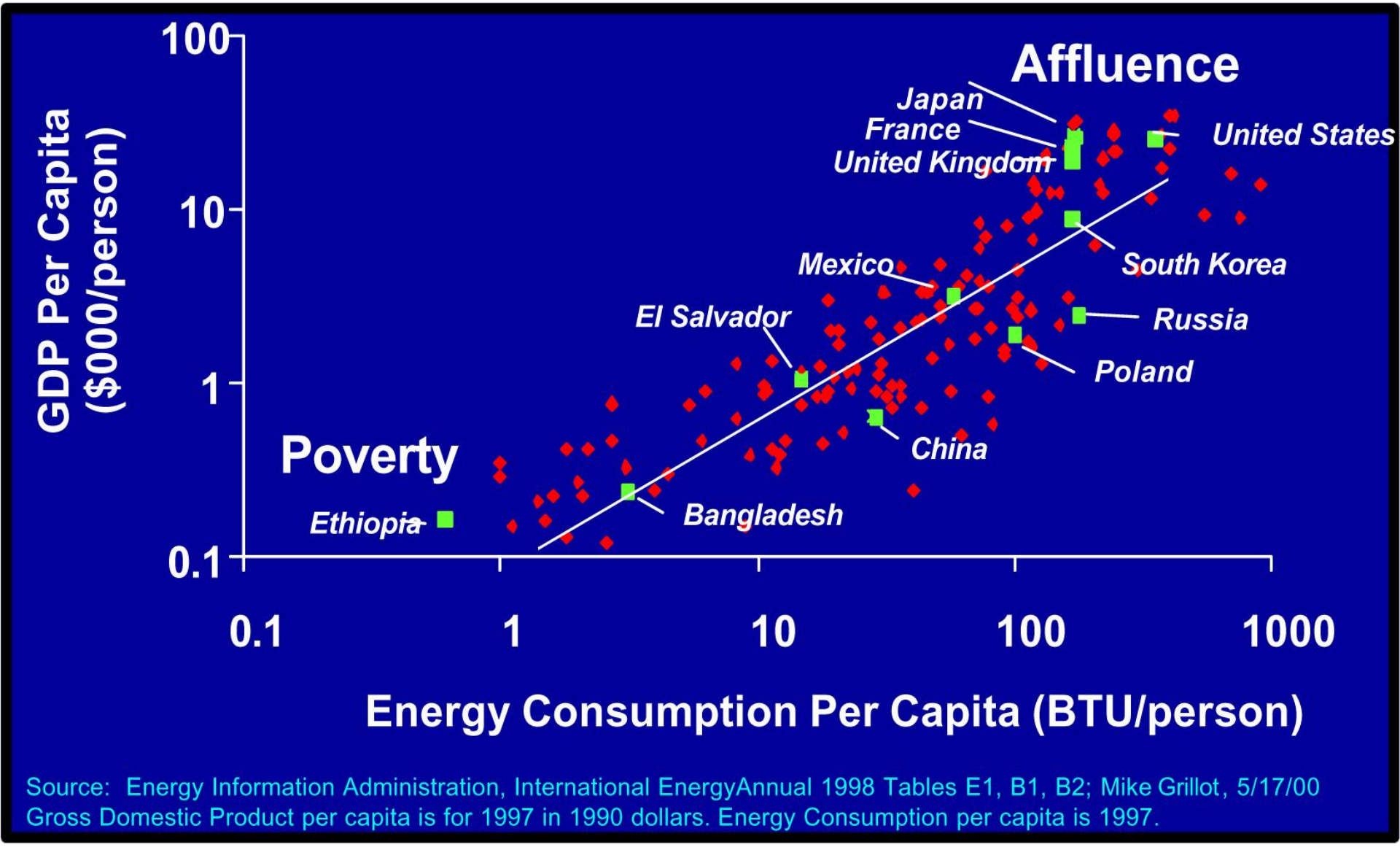
Bio-Fuel (Utah, 1944)



It took 1/3 of our farm to produce the "fuel" for our farm equipment. We found it much better to buy fuel for a tractor, and use the land to produce food.

People are now paying enough for fuel to go back to growing fuel.

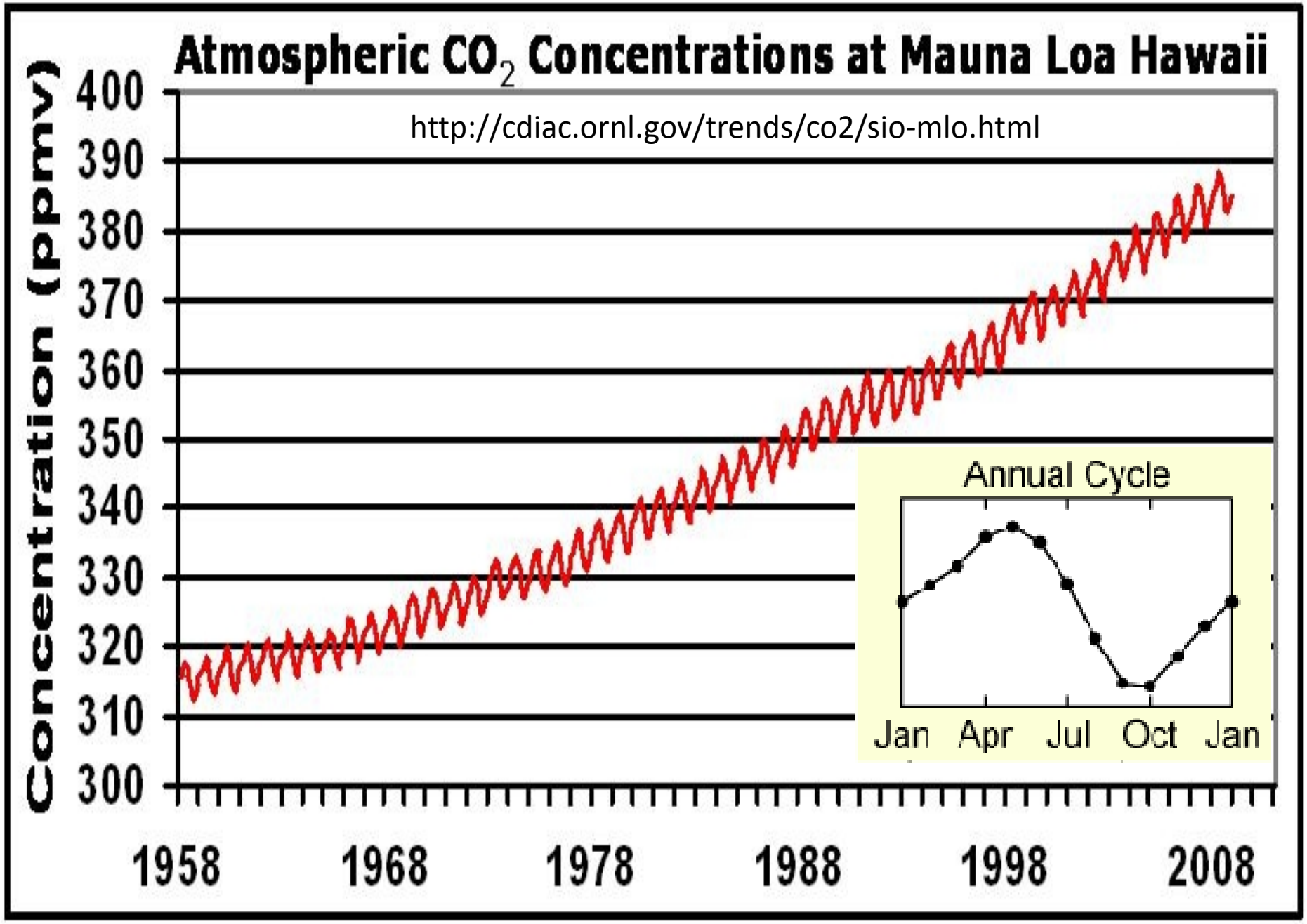
Global Energy Demand is Rising Rapidly Because Energy Consumption and Income are Linked



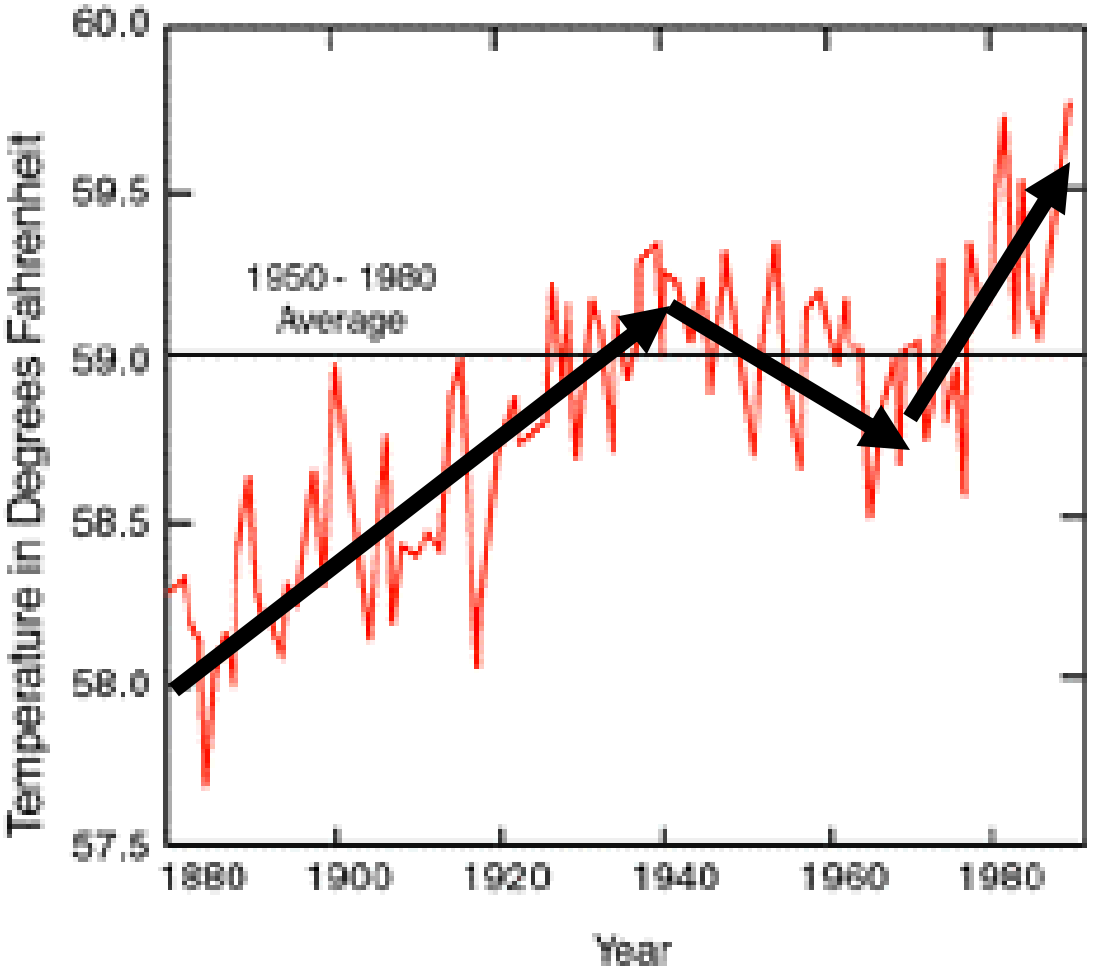
Source: Energy Information Administration, International EnergyAnnual 1998 Tables E1, B1, B2; Mike Grillot, 5/17/00
Gross Domestic Product per capita is for 1997 in 1990 dollars. Energy Consumption per capita is 1997.

Why Bio-Fuel ?

- **We Like our Energy**
- **Our hunger for Energy can influence the Climate of the Planet**
- **Bio-Energy approaches renewable in the short term**
- **Bio-Energy is a “food-fuel” trade-off**


Atmospheric CO_2 Concentrations at Mauna Loa Hawaii
http://cdiac.ornl.gov/trends/co2/sio-mlo.html
Concentration (ppmv)
400
390
380
370
360
350
340
330
320
310
300
1958
1968
1978
1988
1998
2008
Annual Cycle
Jan
Apr
Jul
Oct
Jan

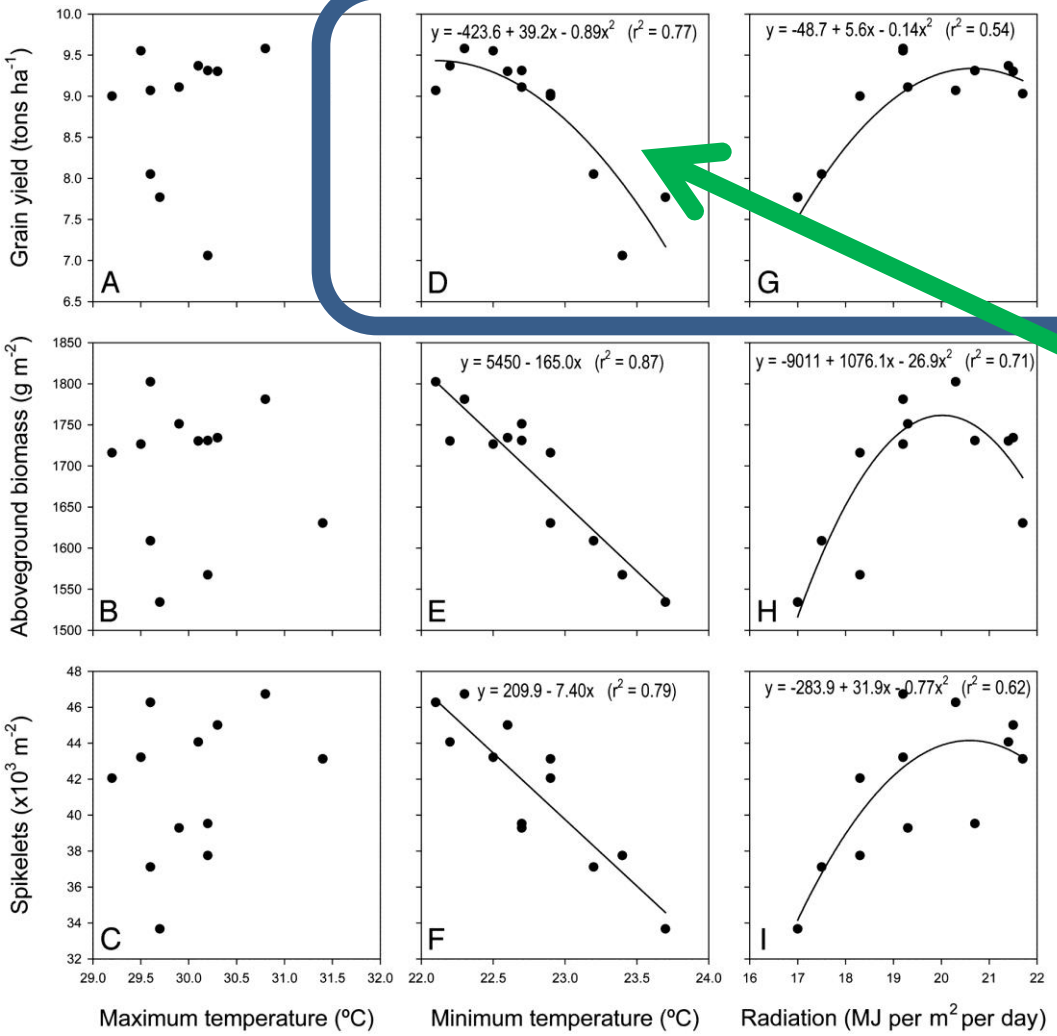
# of citrus', sandwiches, & climates change



In 1968 cooling was a major concern, so was population (Paul Ehrlich). "The greatest threat is our energy hunger, I ordered a lunch delivered, from 1400 miles away." Dr. Hyrum Johnson

Rice is VERY Sensitive to Climate

The relationship between rice-yield attributes (grain yield, above-ground total biomass, and spikelets per m2) and growing-season mean maximum temperature (A–C), minimum temperature (D–F), or radiation (G–I).



High sunlight, cool summer nights (increased grain fill)

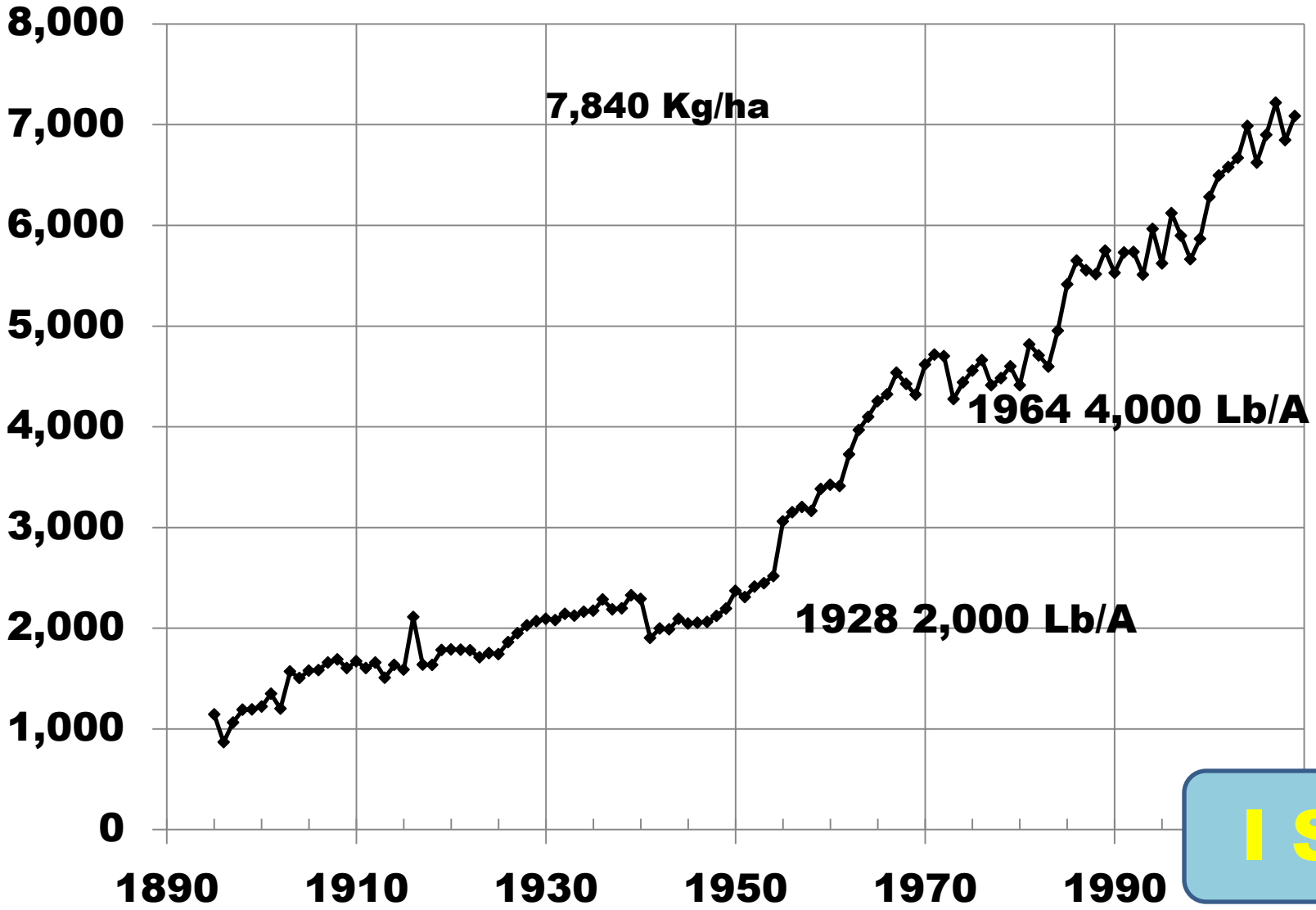
Night warmer by 2C cuts yield by 20%

Peng S et al. PNAS 2004;101:9971-9975

I S U

PNAS

US Rice Yield 1895-2009 (lb/A)



I S U

U.S. Rice Yield History

Rice

- **Opt temperature 35C**
- **Minimum germination temperature: 21C**
  - **25C to 36C has less disease on seedlings**
  - **20C = 6 to 14 days, 24C= 5 to 9 days, 28C = 4 to 7 days, 32 C = 1 to 4 days**
- **Water temperature: cold at bottom of lake (reduces yield)**
- **DD10 with 21C base. Time N application/flooding**

I S U

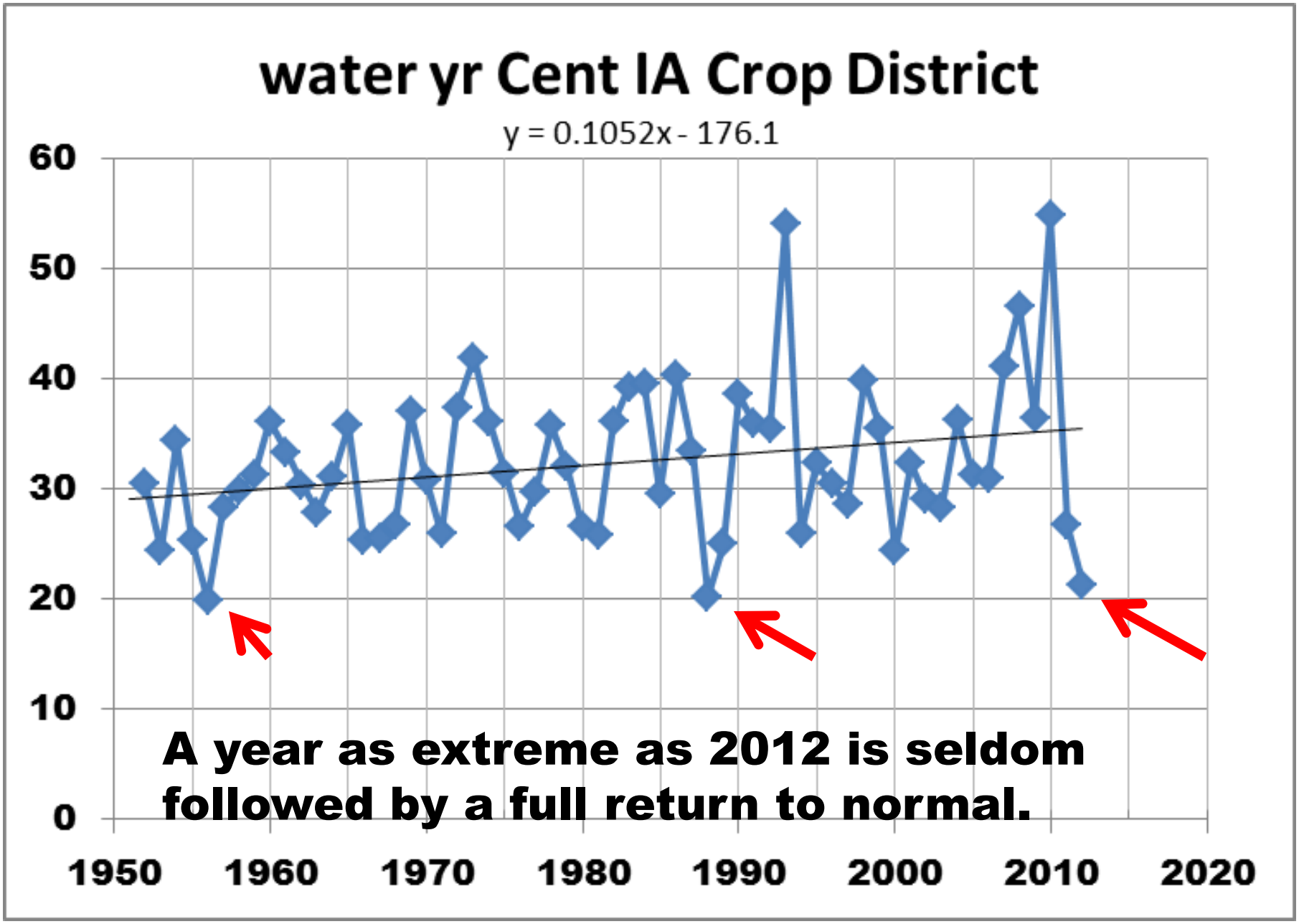
Use of GDD

- **GDD to estimate development (of both crop & pests) is more accurate than a calendar.**
- **GDD are less useful near the equator.**
- **Rice stage for applying N is less critical with "modern" cultivars.**
- **GDD accumulation rate, post pollination greatly impacts yield (But is seldom considered).**

Midwest Precipitation

Has a multi-cyclic nature

May be a “Climate Change” indicator in that a general increase is consistent with increased Atmospheric & Water Temperature


water yr Cent IA Crop District
y = 0.1052x - 176.1
60
50
40
30
20
10
0
1950
1960
1970
1980
1990
2000
2010
2020
A year as extreme as 2012 is seldom followed by a full return to normal.

There are 2 Kinds of Drought

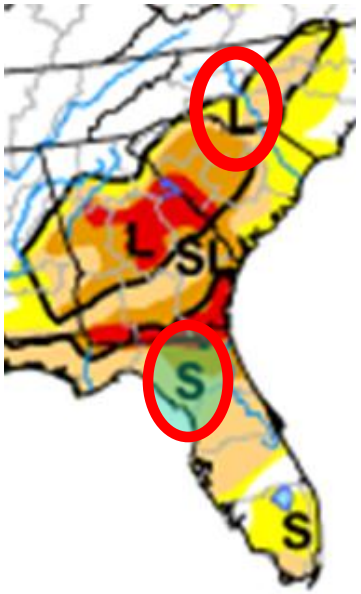
- Drought of "Hunger for Food"
- Drought of "Thirst for Water
  - Amos 8:11

Sometimes called:

Agricultural and Hydrological drought

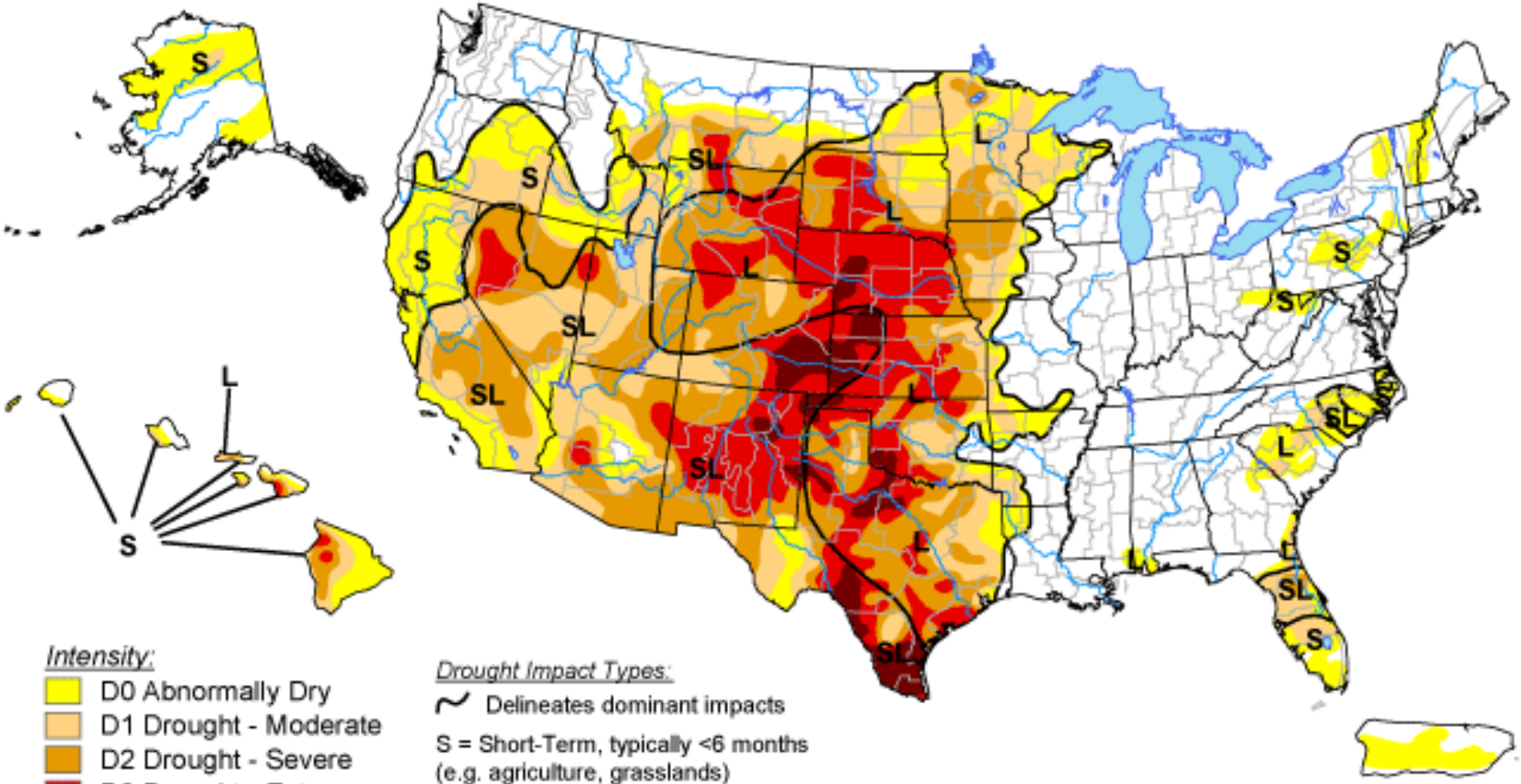
Or

Short Term and Long Term drought



U.S. Drought Monitor

April 16, 2013
Valid 7 a.m. EDT



Intensity:
- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically <6 months (e.g. agriculture, grasslands)

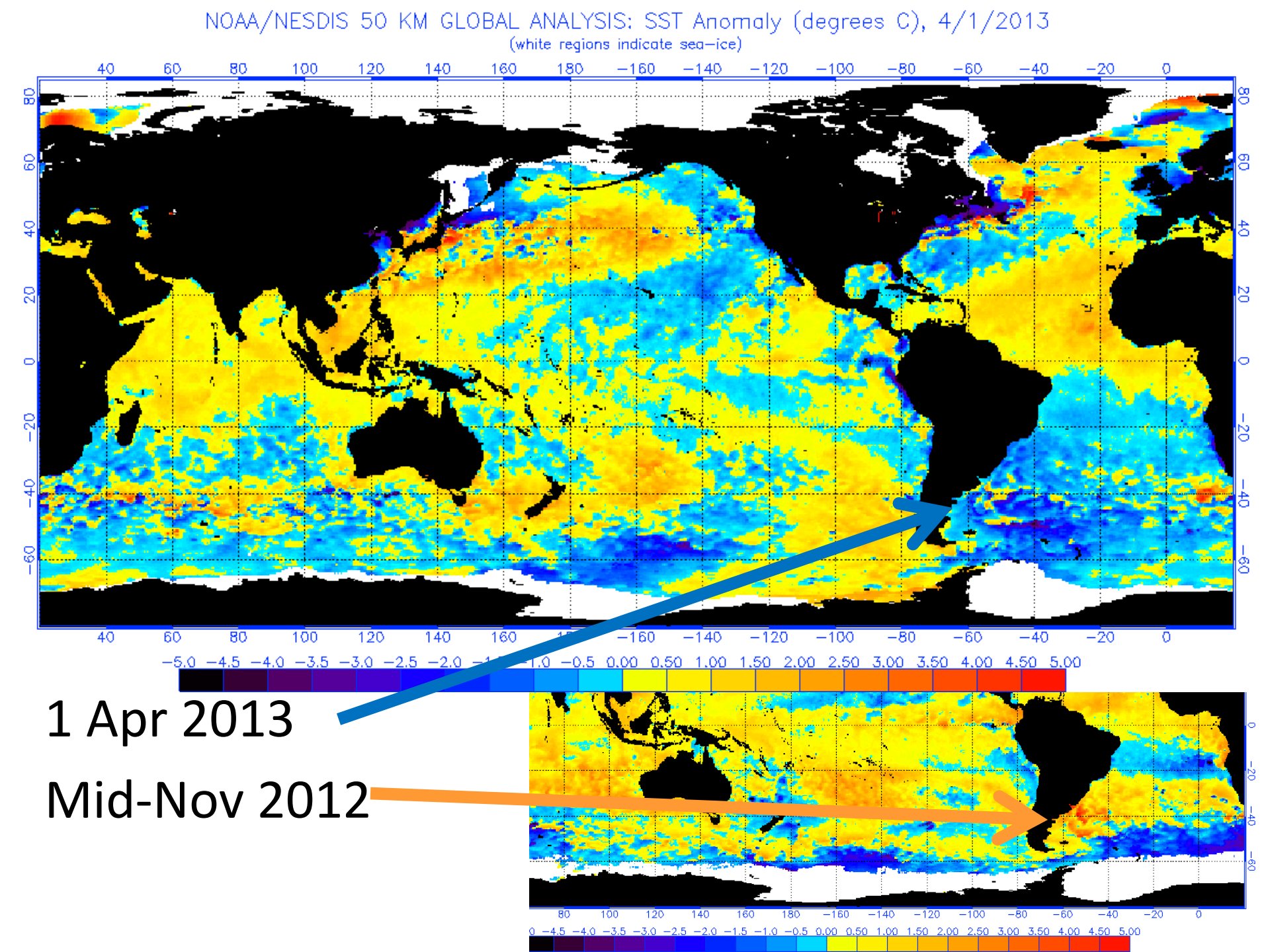
L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

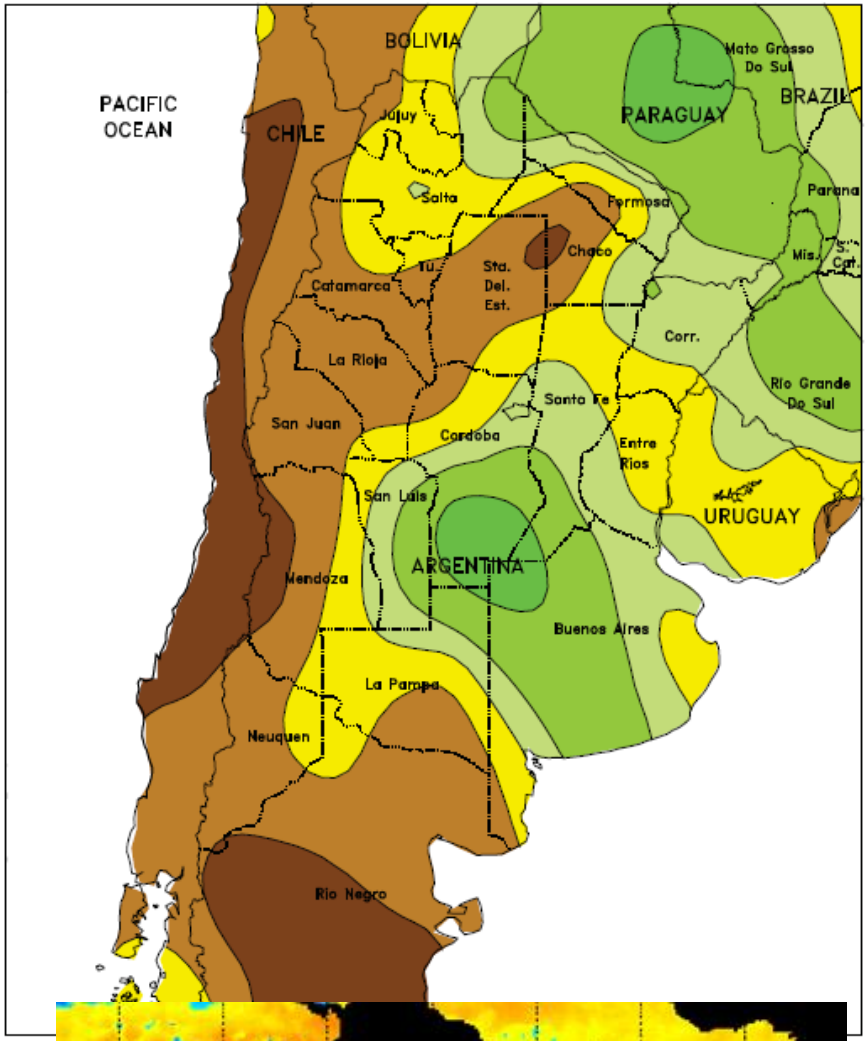
http://droughtmonitor.unl.edu/

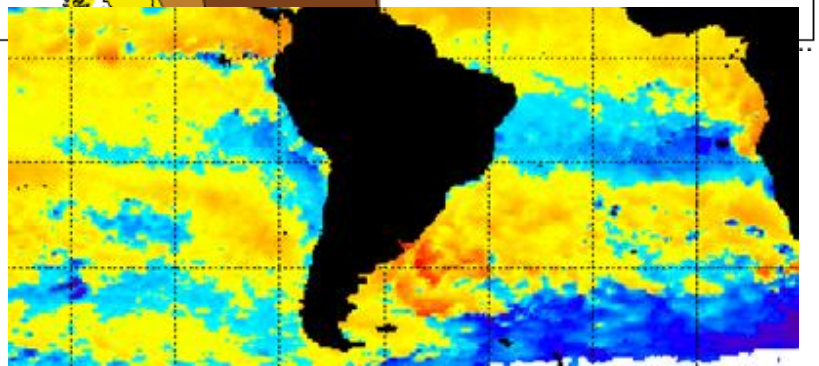
Released Thursday, April 18, 2013

Author: David Miskus, NOAA/NWS/NCEP/CPC

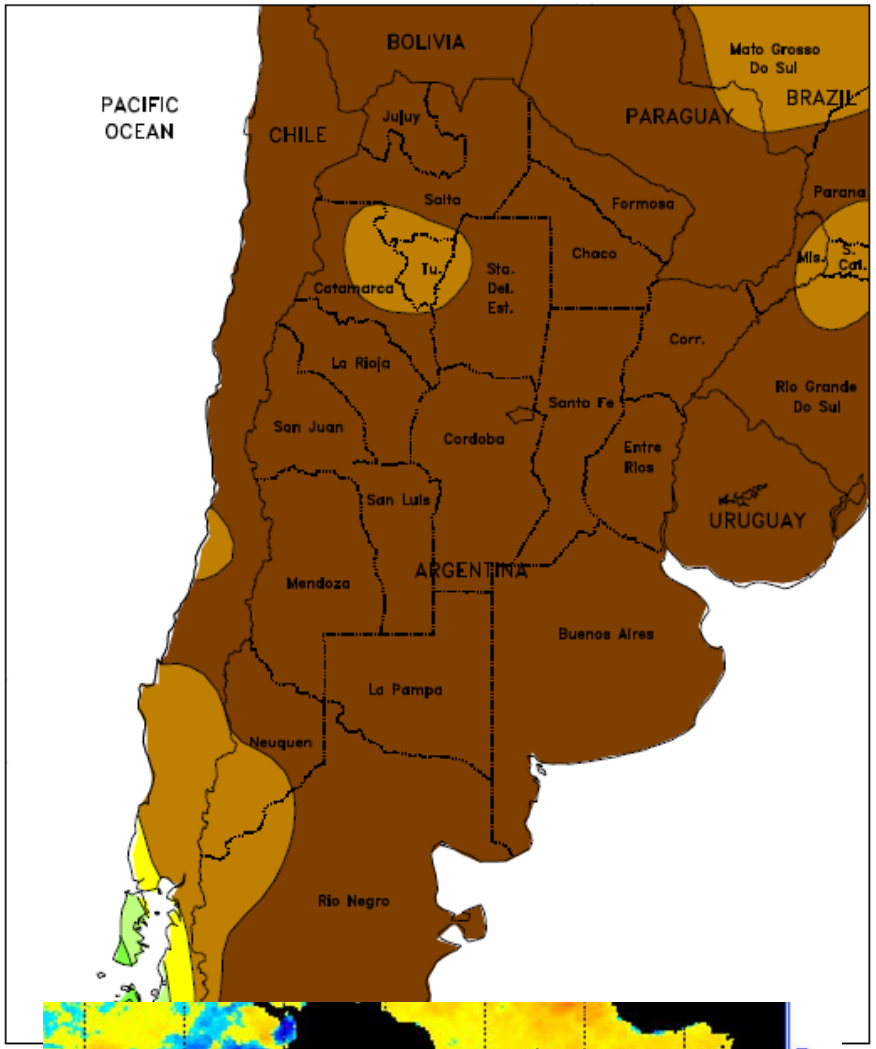

NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 4/1/2013
(white regions indicate sea-ice)
1 Apr 2013
Mid-Nov 2012

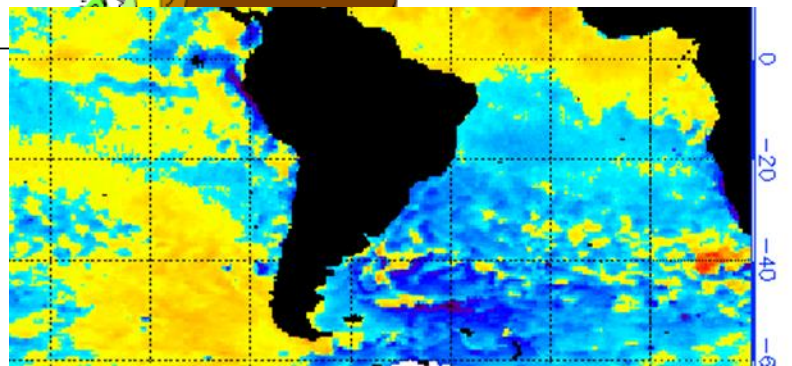
ARGENTINA
Total Precipitation (mm)
NOV 18 - 24, 2012



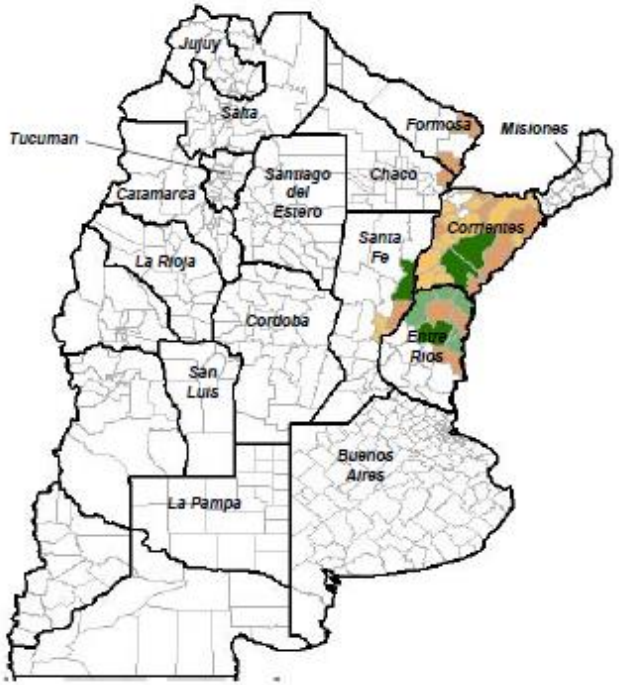


ARGENTINA
Total Precipitation (mm)
APR 14 - 20, 2013





Argentina Rice



*** State-Level Production (as % of total)**

Entre Rios	43
Corrientes	39
Santa Fe	12
Formosa	3
Chaco	3

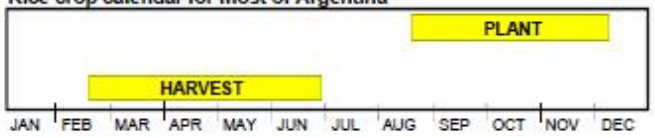
* 2006/07 to 2010/11 Average

Source: SAGPyA

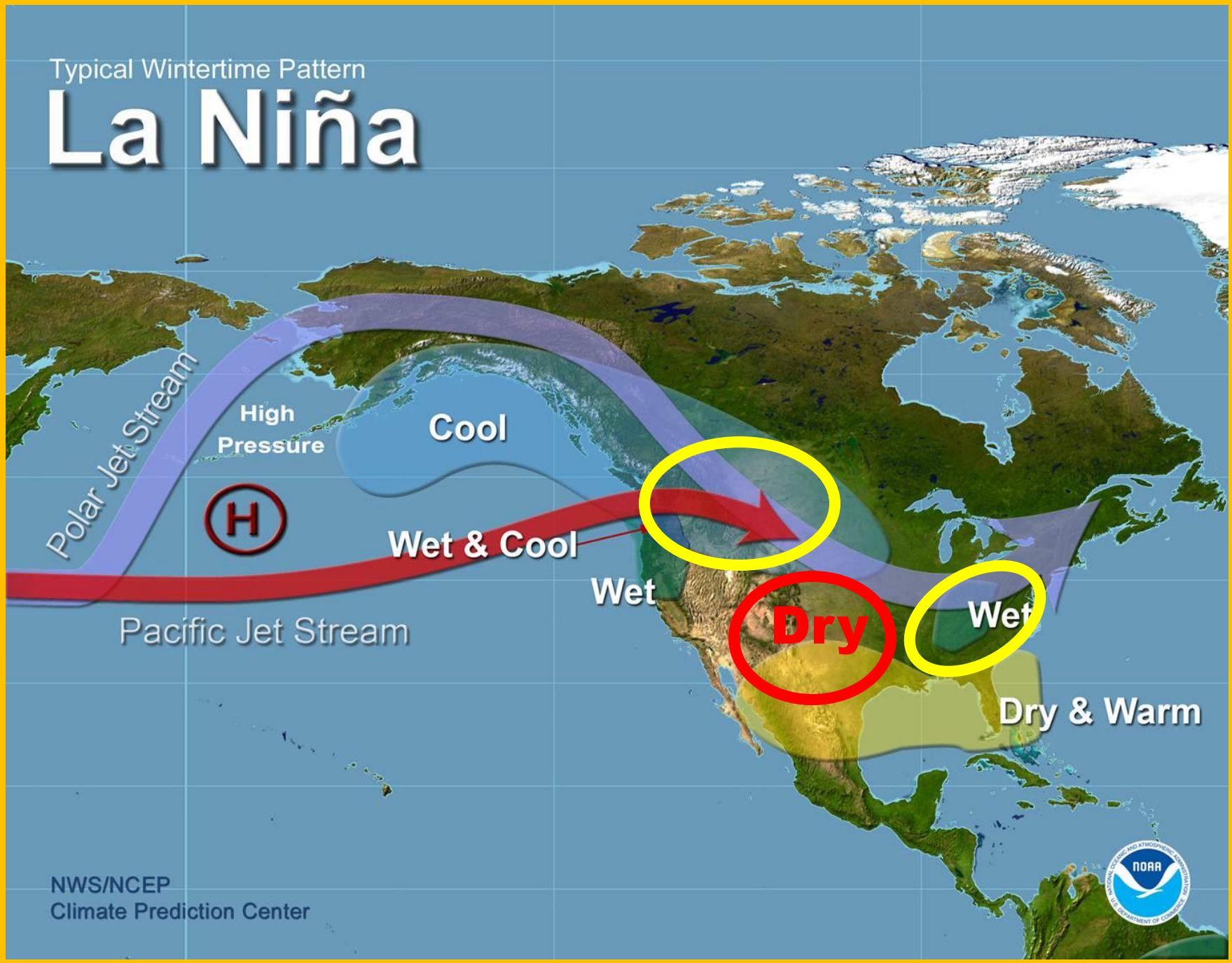
Rice Production
***Average (2006/07-10/11)**

*Source: SAGPyA

Rice crop calendar for most of Argentina



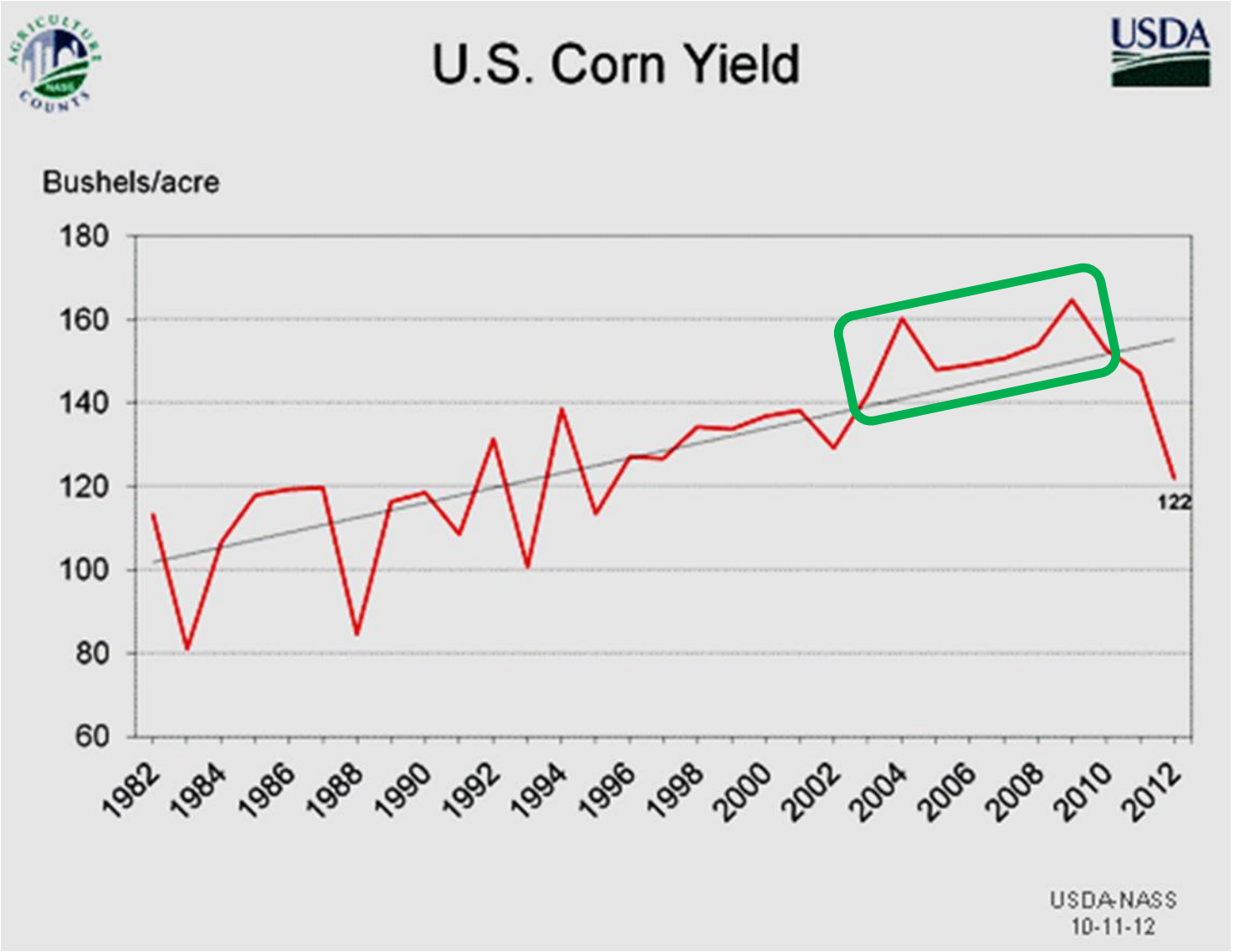
USDA Agricultural Weather Assessments
World Agricultural Outlook Board


Typical Wintertime Pattern
La Niña
Polar Jet Stream
High Pressure
H
Cool
Wet & Cool
Wet
Dry
Wet
Dry & Warm
Pacific Jet Stream
NWS/NCEP
Climate Prediction Center

ENSO has a Global Signal

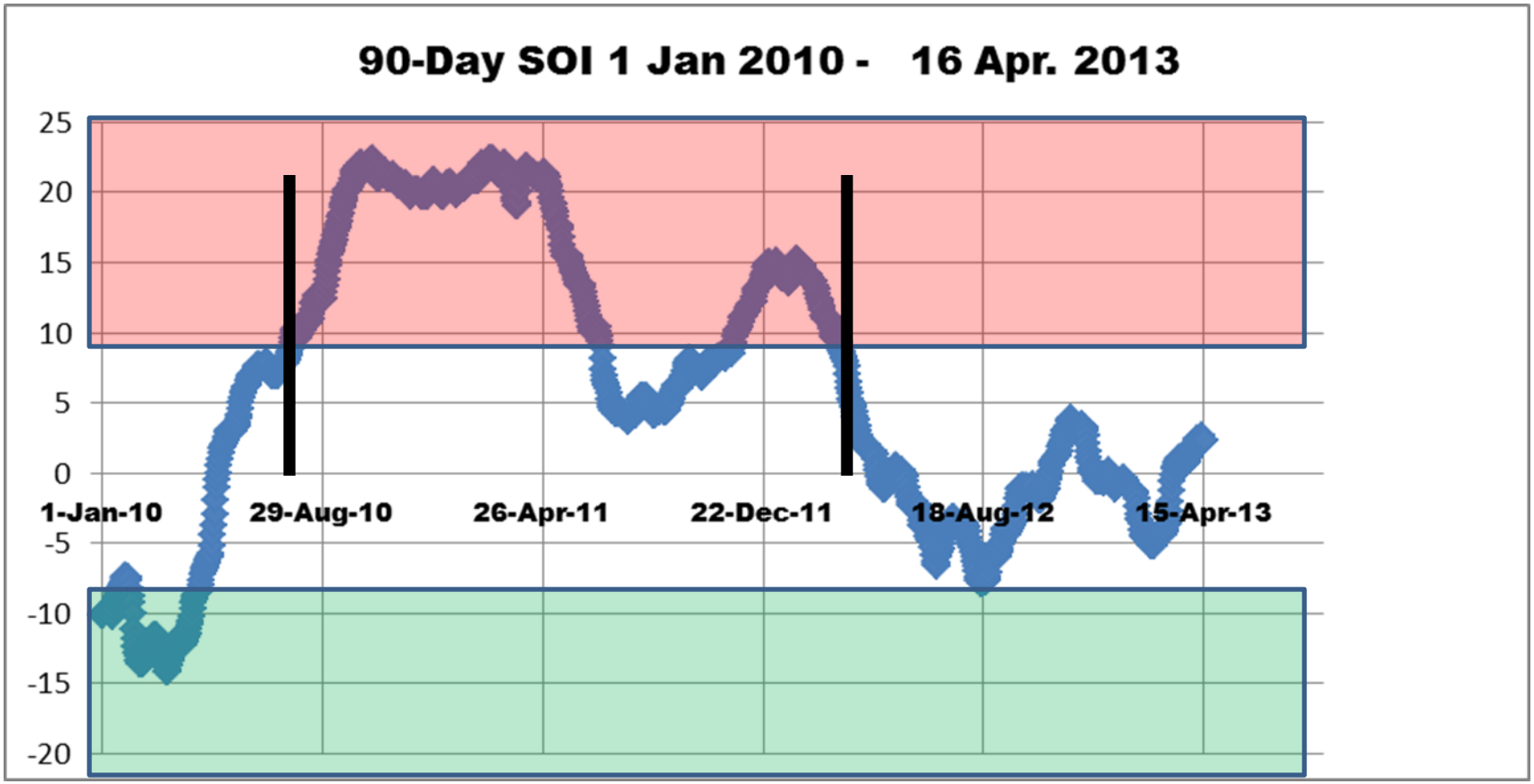
- During years of **El Nino**
  - US **Rice** & **Corn** do well
  - US & Canada **Wheat** suffers from Drought
- During years of **La Nina**
  - US **Corn** at risk
  - Canada **Wheat** usually good
  - Canada sometimes **floods**

Argentina responds to El Nino Much as does US corn & soy



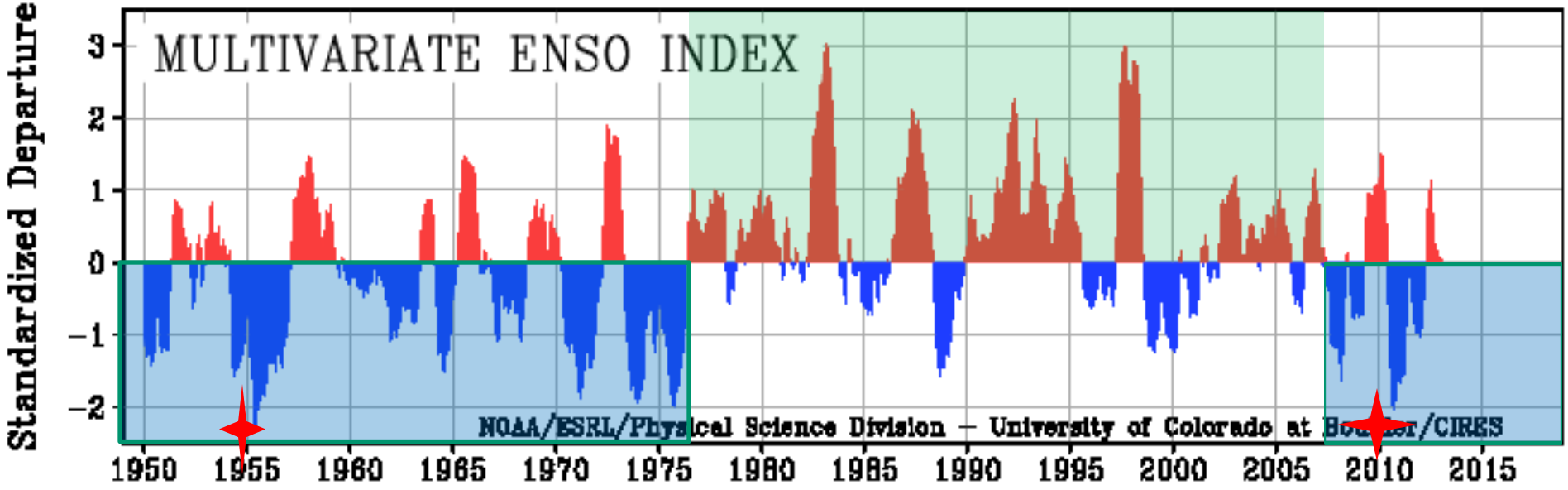
- **Above the US Corn Yield Trend Six Consecutive Years**

ENSO History 2010- Apr 2013



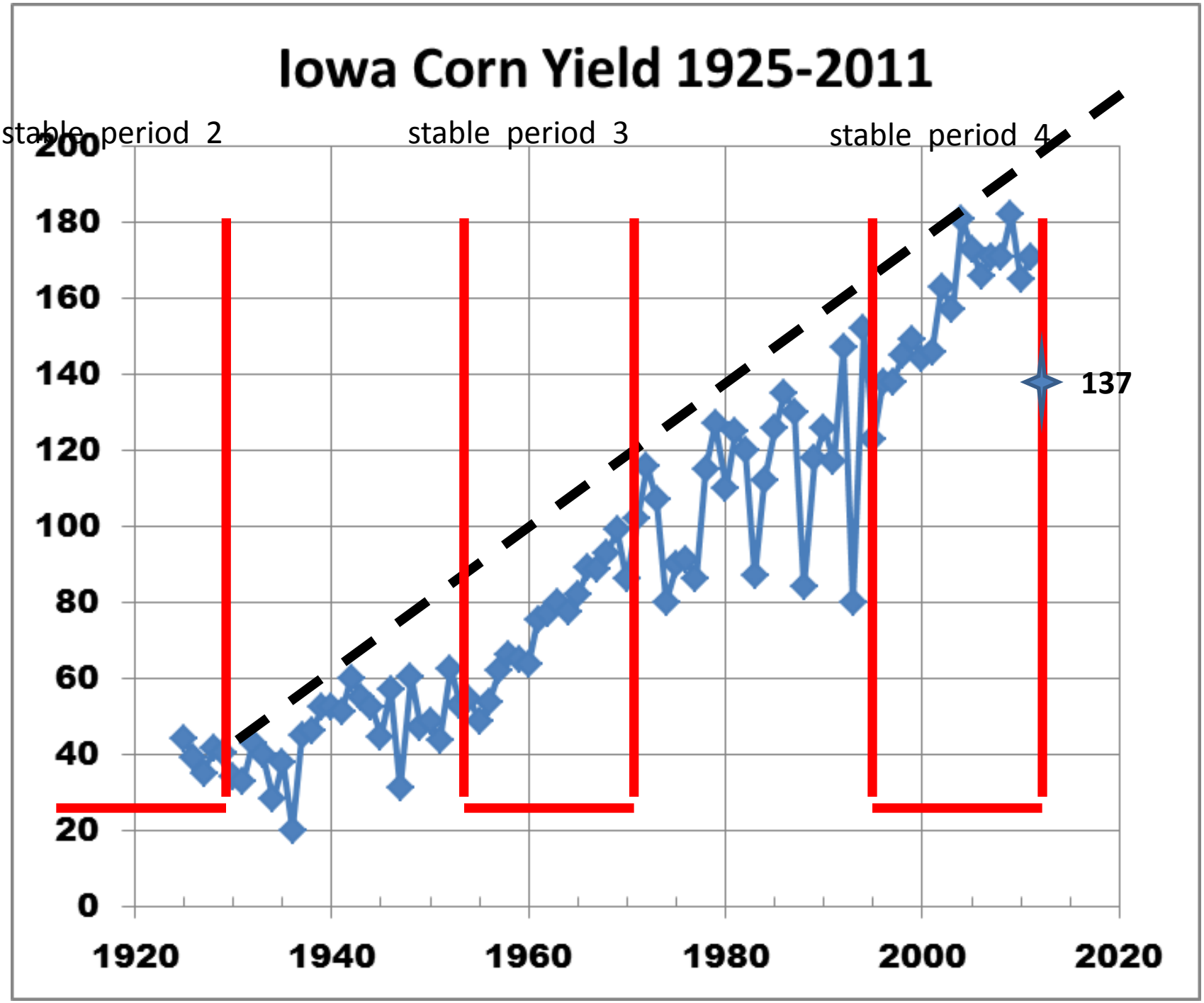
- The La Niña began 22 July 2010
- The La Niña ended 21 March 2012

- 21 June 2010 ET



- Age of El Nino: favorable Midwest Yield
- Age of La Nina: Erratic Yield

✦ Strongest La Nina events.


Iowa Corn Yield 1925-2011
stable period 2
stable period 3
stable period 4
200
180
160
140
120
100
80
60
40
20
0
1920
1940
1960
1980
2000
2020
137

Summary

- Hurricane season expected to be active
- Drought likely to persist/expand in West
- Climate will likely be increasingly erratic (25 year interval)

END

Twitter.com/elwynntaylor

Elwynn Taylor

Iowa State University

Climatologist

setaylor@iastate.edu

Management of Water Risk

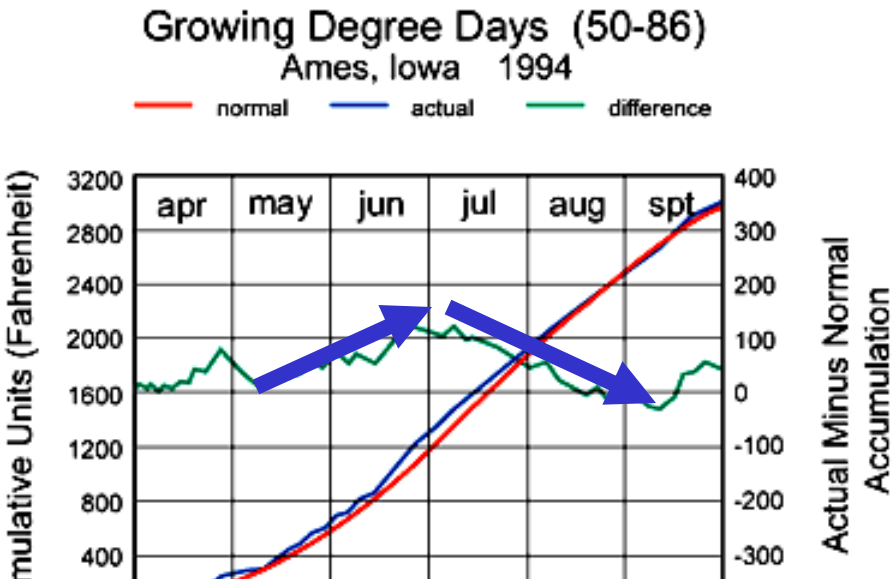
- Climate:
  - Determines the distribution of water
  - Determines the duration of moisture
- Management (a matter of budgeting)
  - How much do I have?
  - How much is coming in?
  - How much is going out?

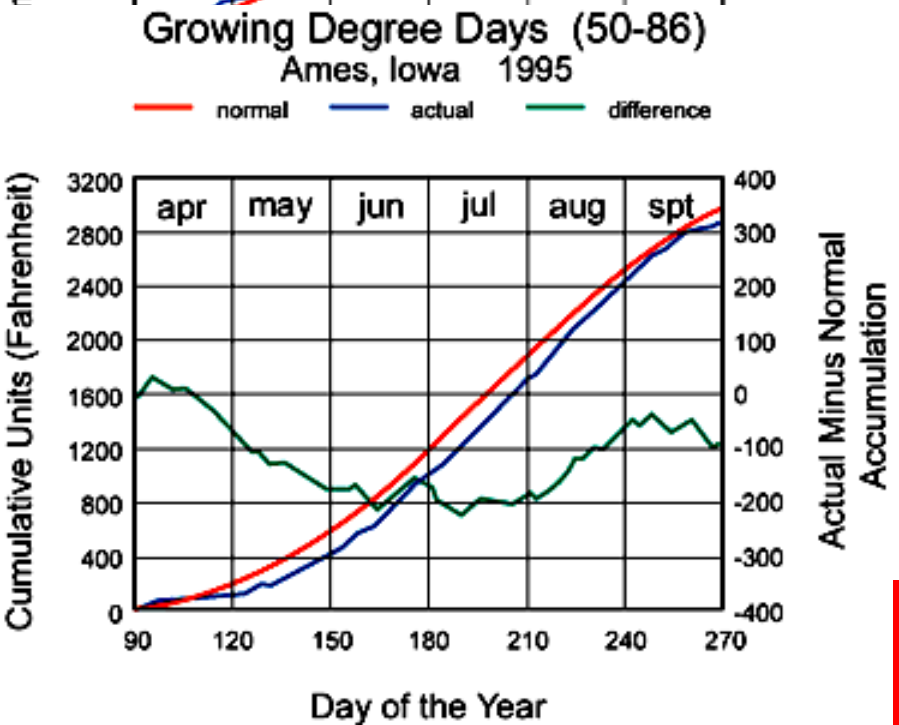
Extension: Teaching: Climate & Water Literacy
Delivering: Information essential to management of the risk

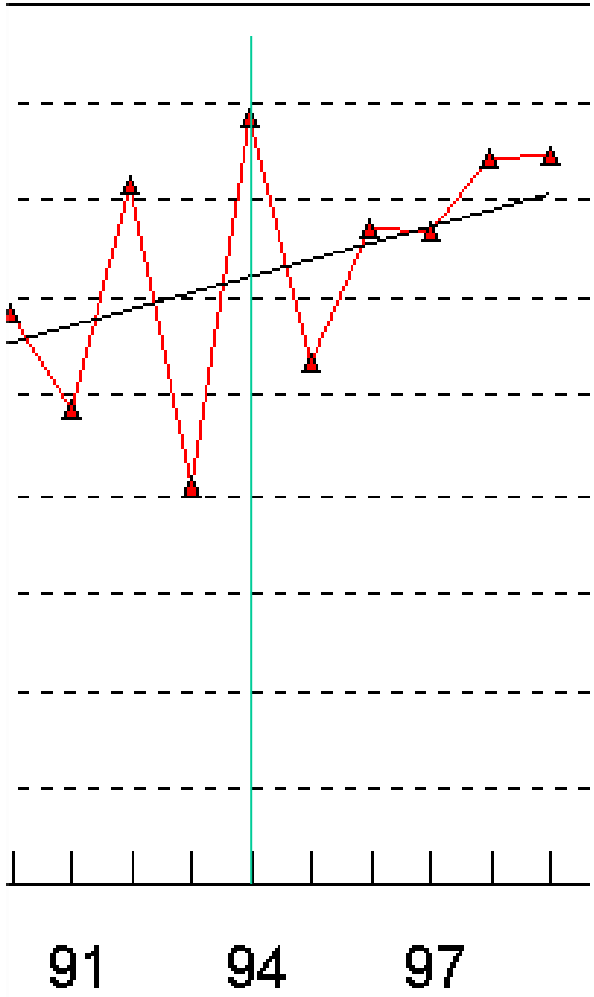
Check onset of Monsoon 2013

- Often by early May…

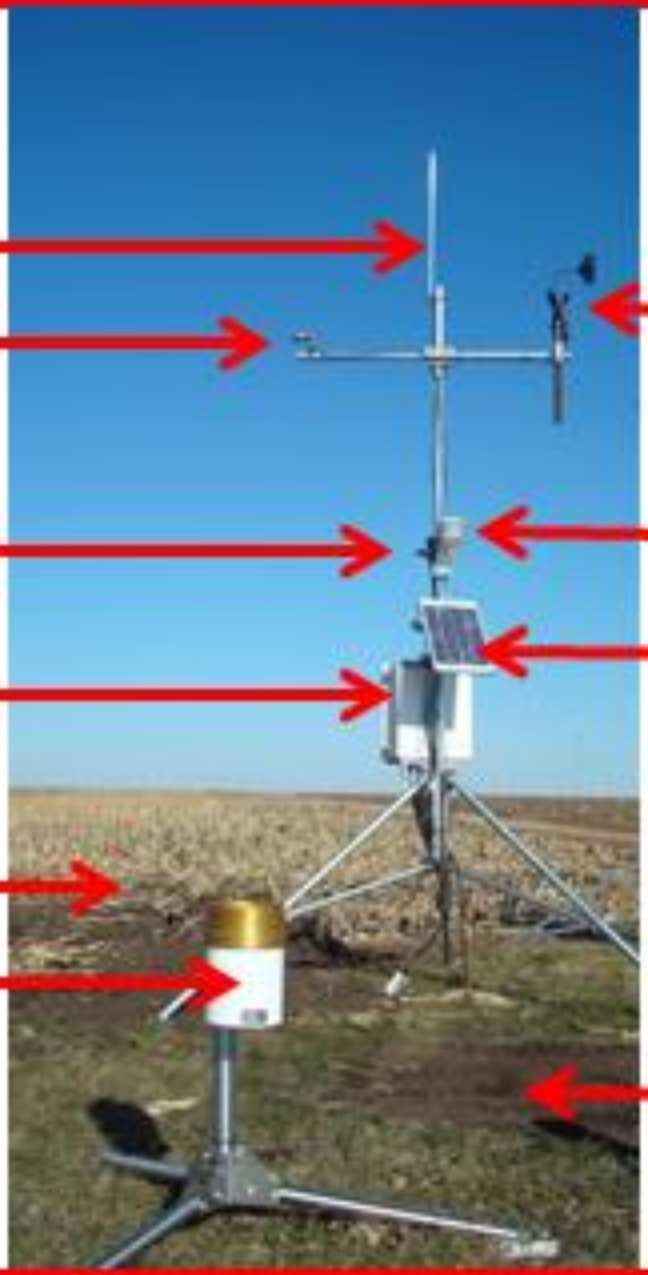
GDD & Yield


Growing Degree Days (50-86)
Ames, Iowa 1994
normal
actual
difference
apr
may
jun
jul
aug
spt
3200
2800
2400
2000
1600
1200
800
400
400
300
200
100
0
-100
-200
-300
Actual Minus Normal Accumulation

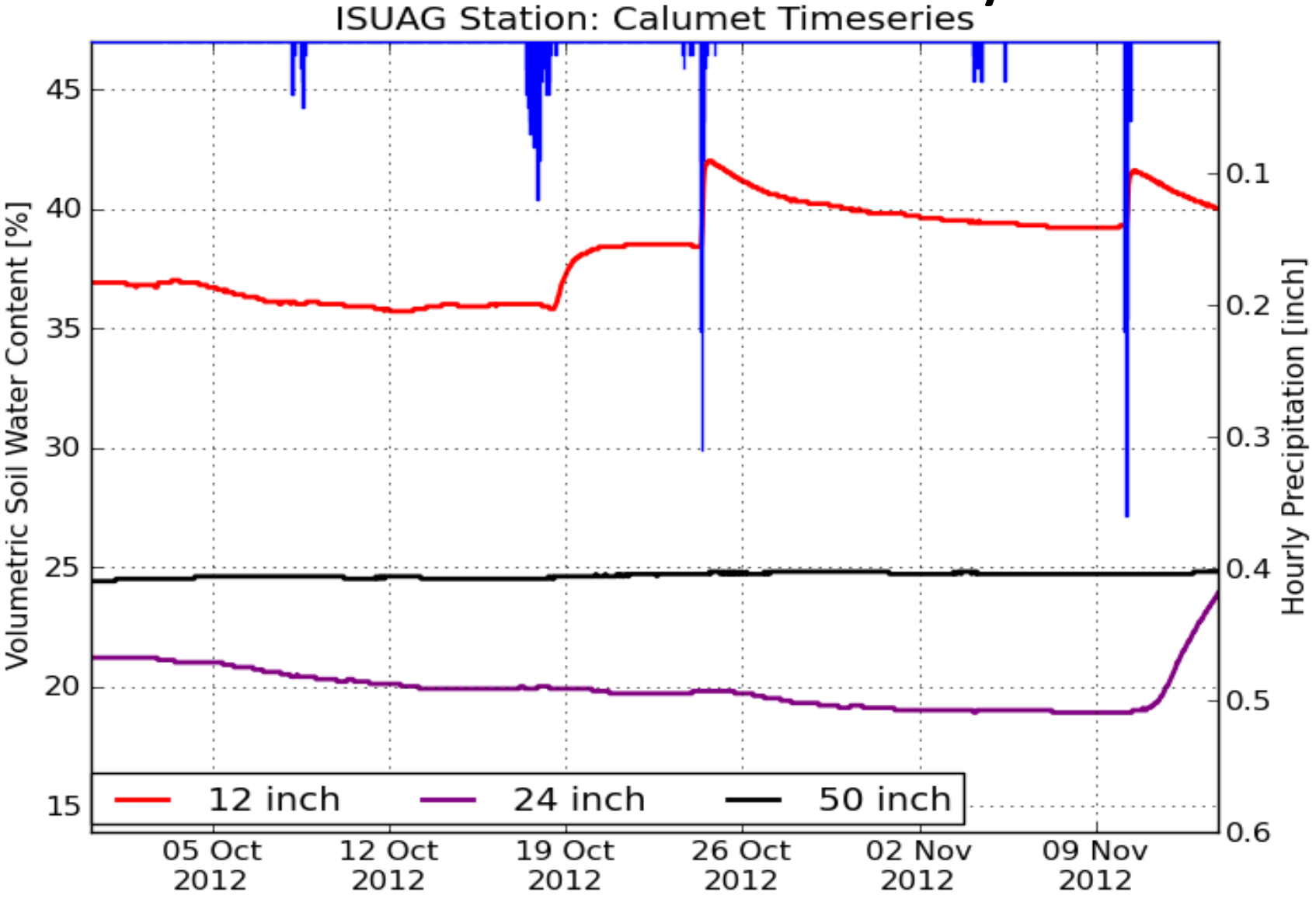

Growing Degree Days (50-86)
Ames, Iowa 1995
normal
actual
difference
apr
may
jun
jul
aug
spt
Cumulative Units (Fahrenheit)
3200
2800
2400
2000
1600
1200
800
400
0
400
300
200
100
0
-100
-200
-300
-400
Actual Minus Normal Accumulation
90
120
150
180
210
240
270
Day of the Year


91
94
97

2011
Missouri River


Lightning rod
Sun light sensor
Cell phone antenna
Control box
Soil Moisture
Rain gauge
Wind Direction & Speed
Air Temperature & Relative Humidity
Solar Charger
4" Soil Temperature

Soil Moisture History

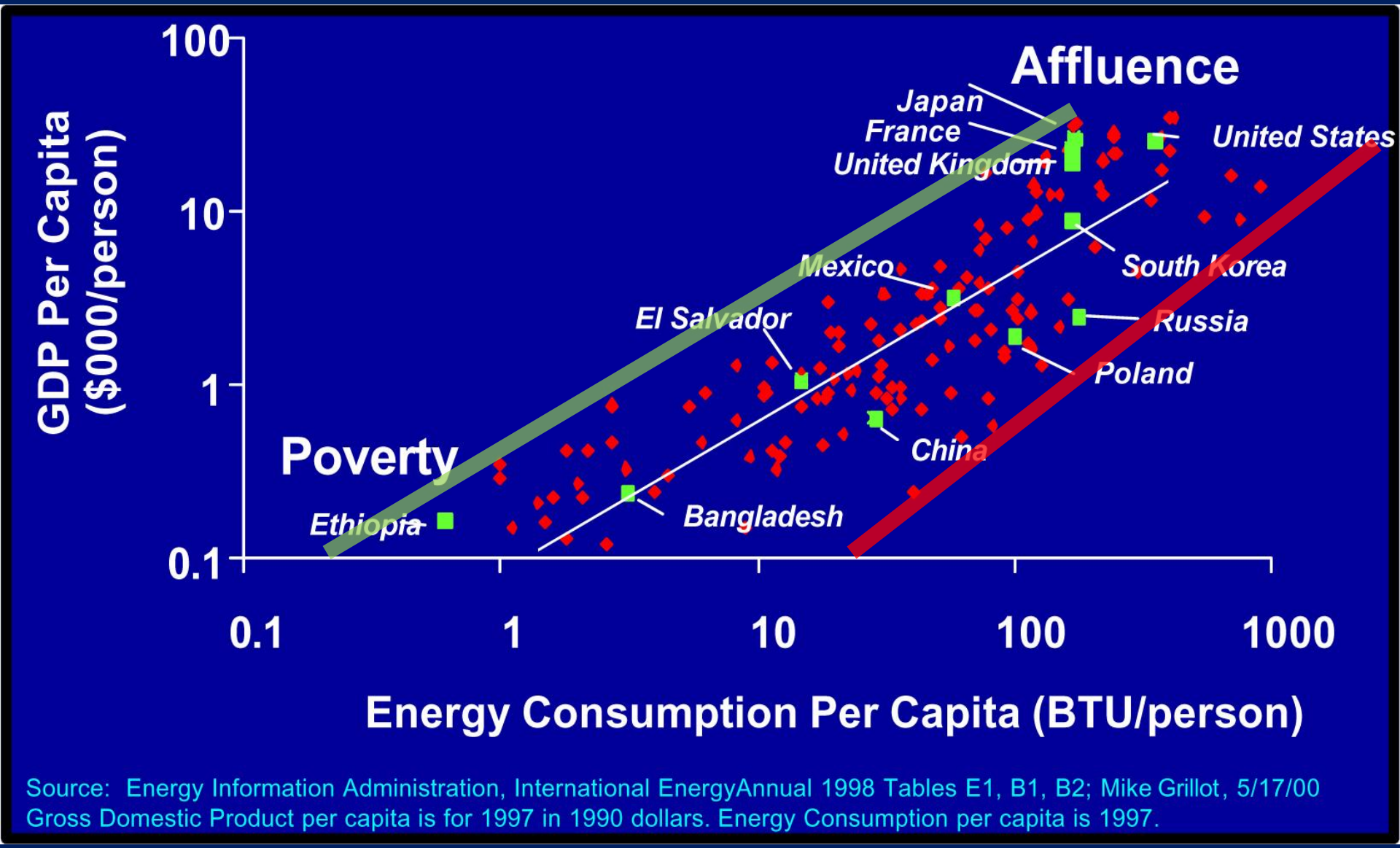


- 2012: Oct 1 - Nov 19

What is the average corn rooting depth in Iowa?

Photo C Gannon/Des Moines Register 2010

Global Energy Demand Rises When Income Rises



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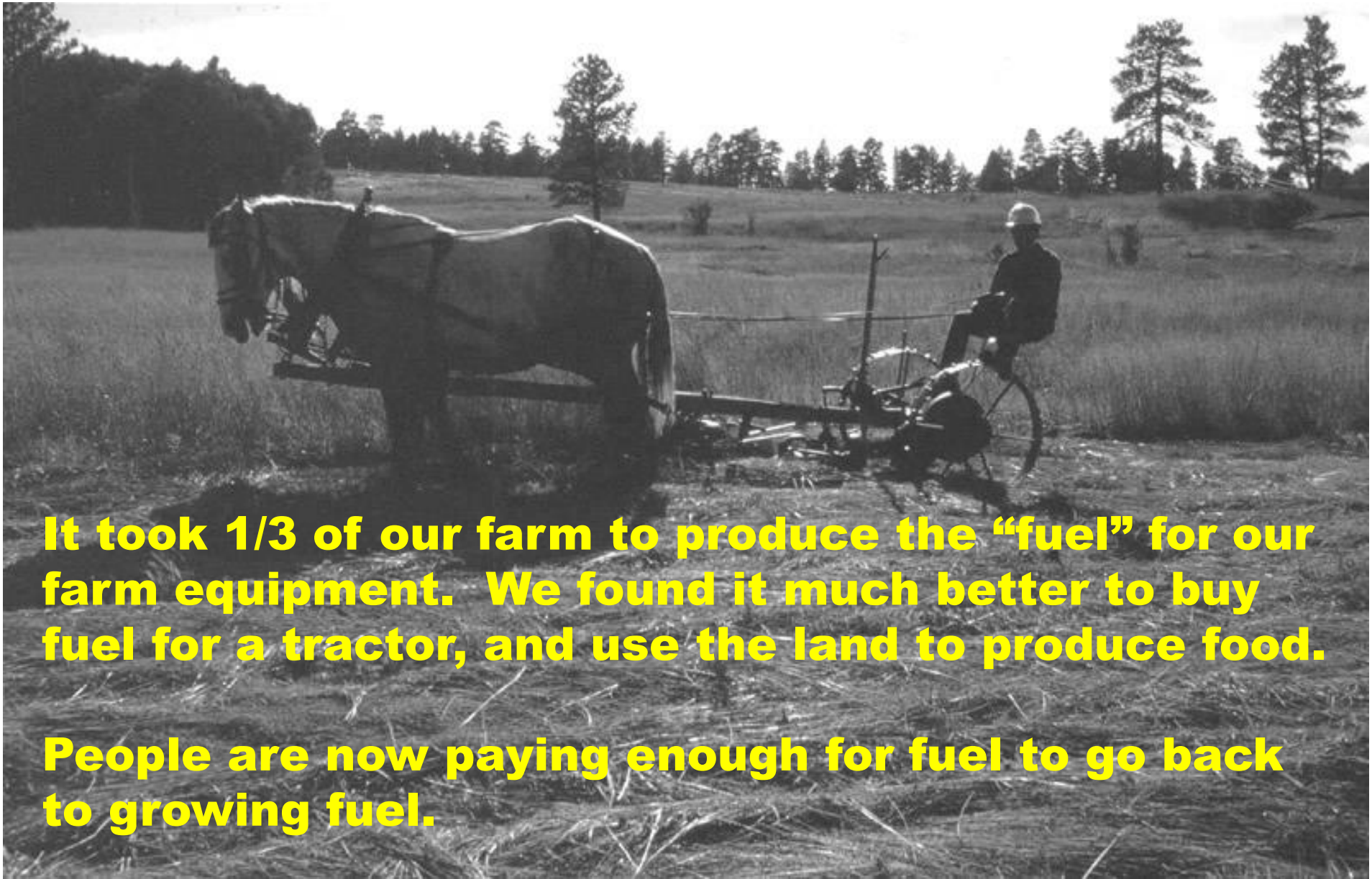

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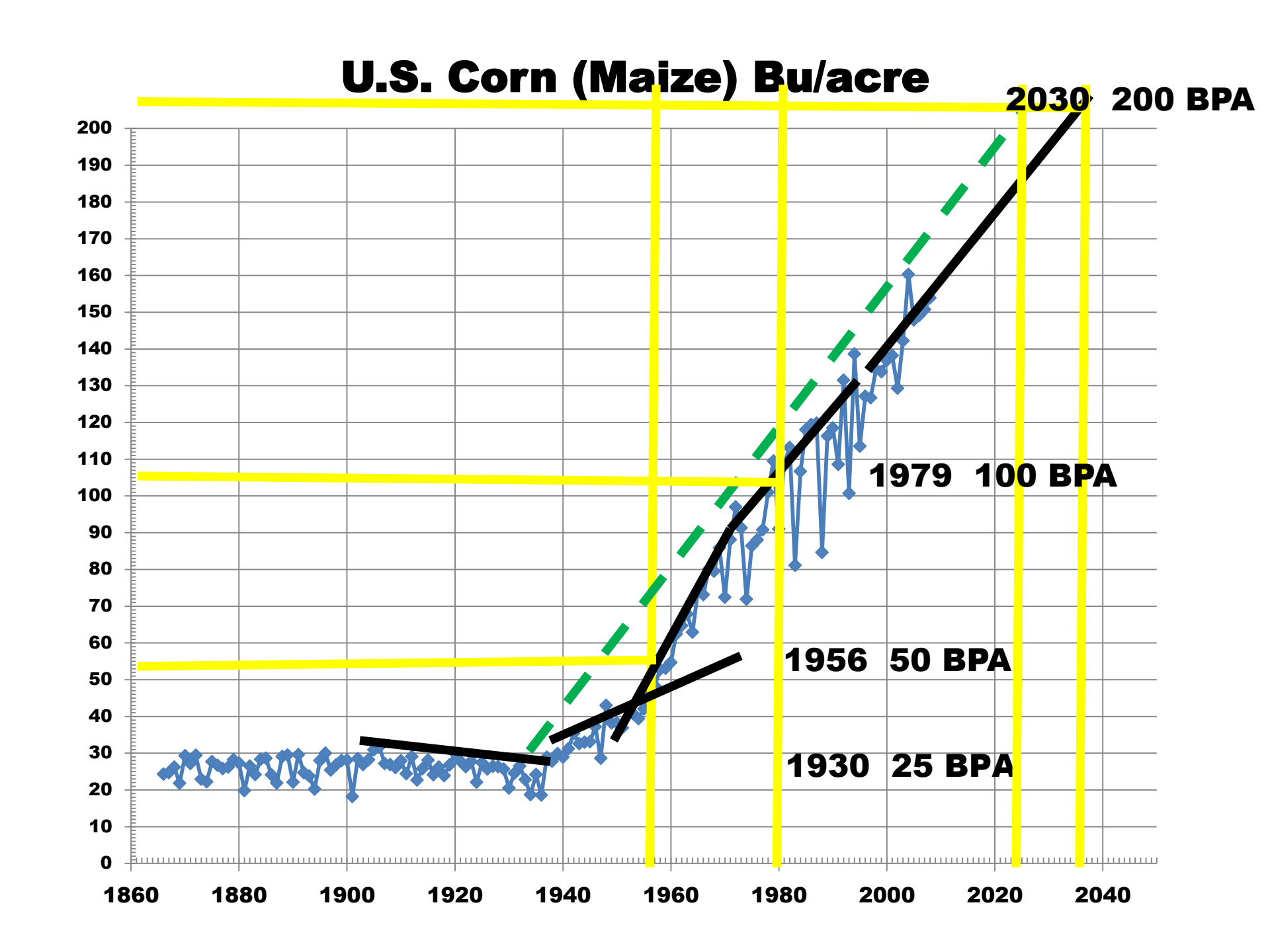
U.S. Corn (Maize) Bu/acre
2030 200 BPA
1979 100 BPA
1956 50 BPA
1930 25 BPA
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1860
1880
1900
1920
1940
1960
1980
2000
2020
2040