

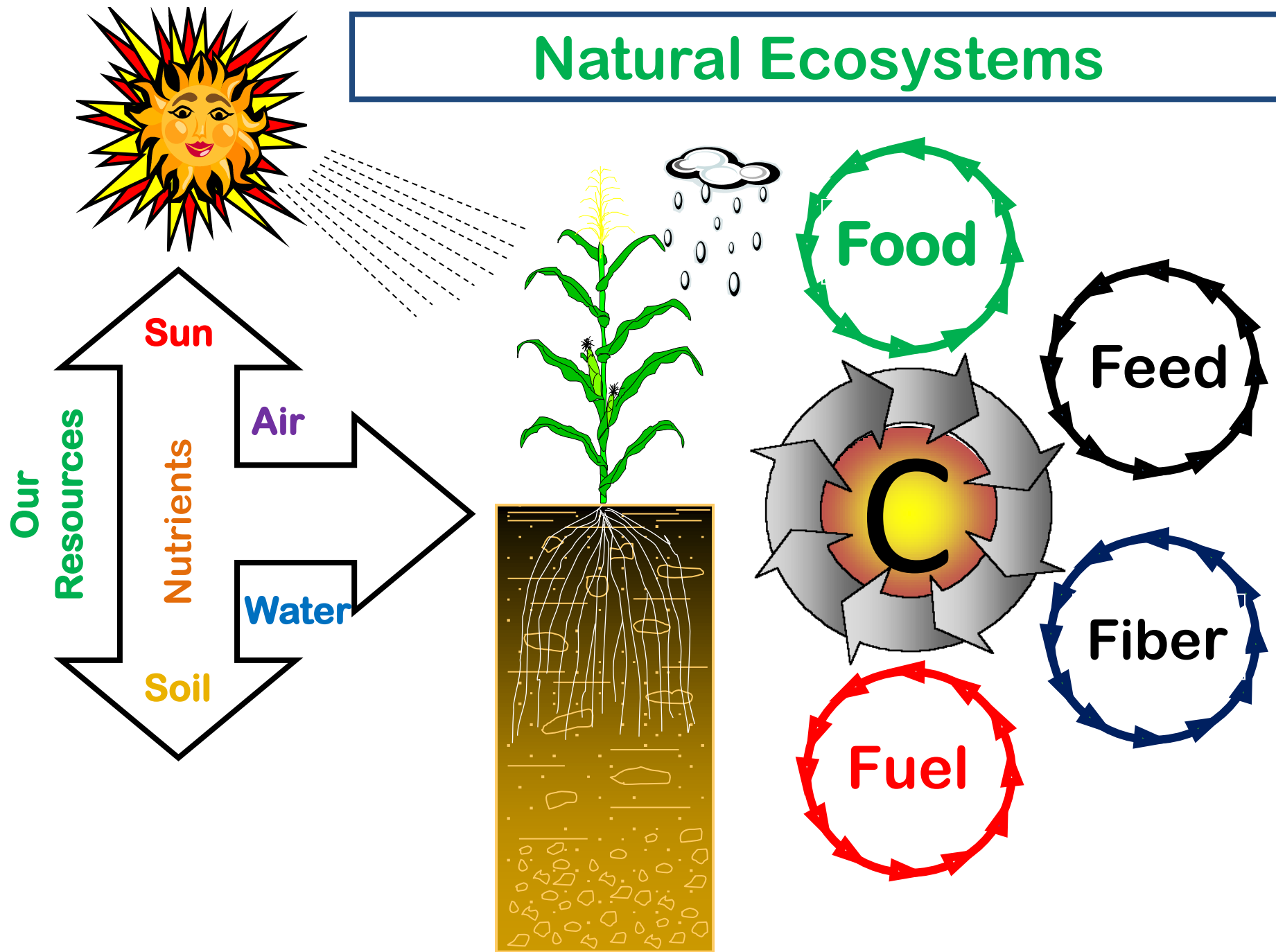
# Climate Change and 21<sup>st</sup> Century Agriculture

Rafiq Islam

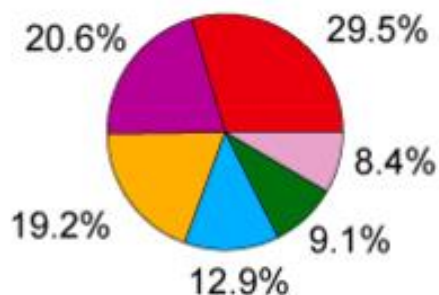
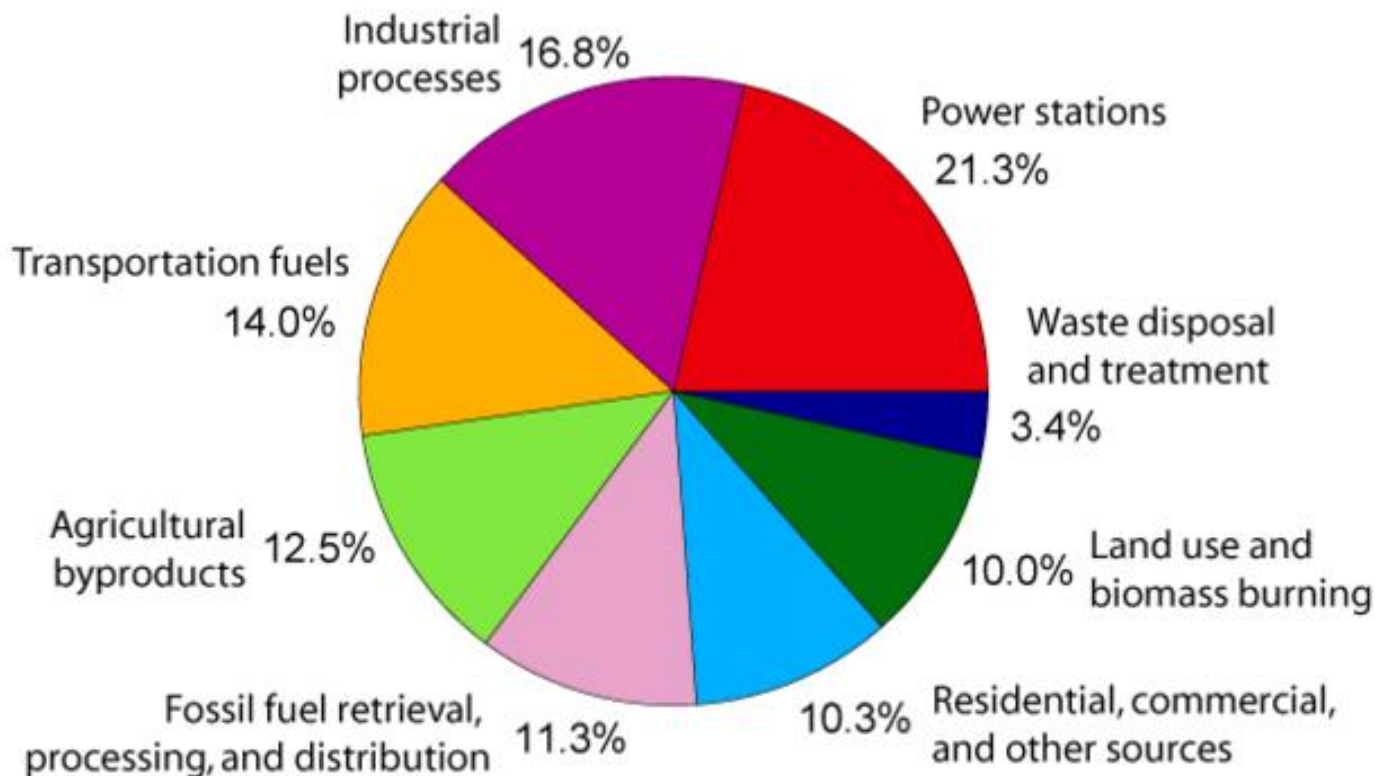
Ohio State University South Centers at Piketon

Presented at the Conservation Tillage and Technology Conference Annual Meetings,  
Ohio Northern University, Ada, OH, March 6, 2013

# Natural Ecosystems

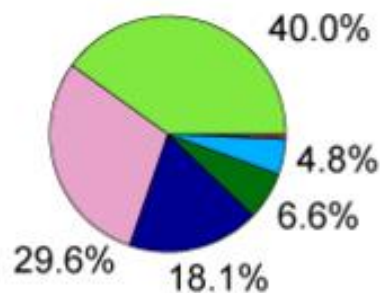


# Annual Greenhouse Gas Emissions by Sector



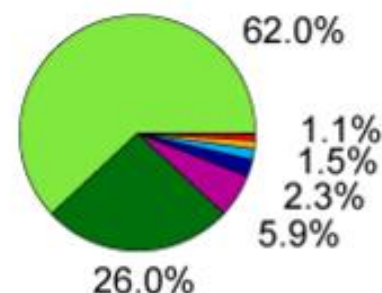
**Carbon Dioxide**

(72% of total)



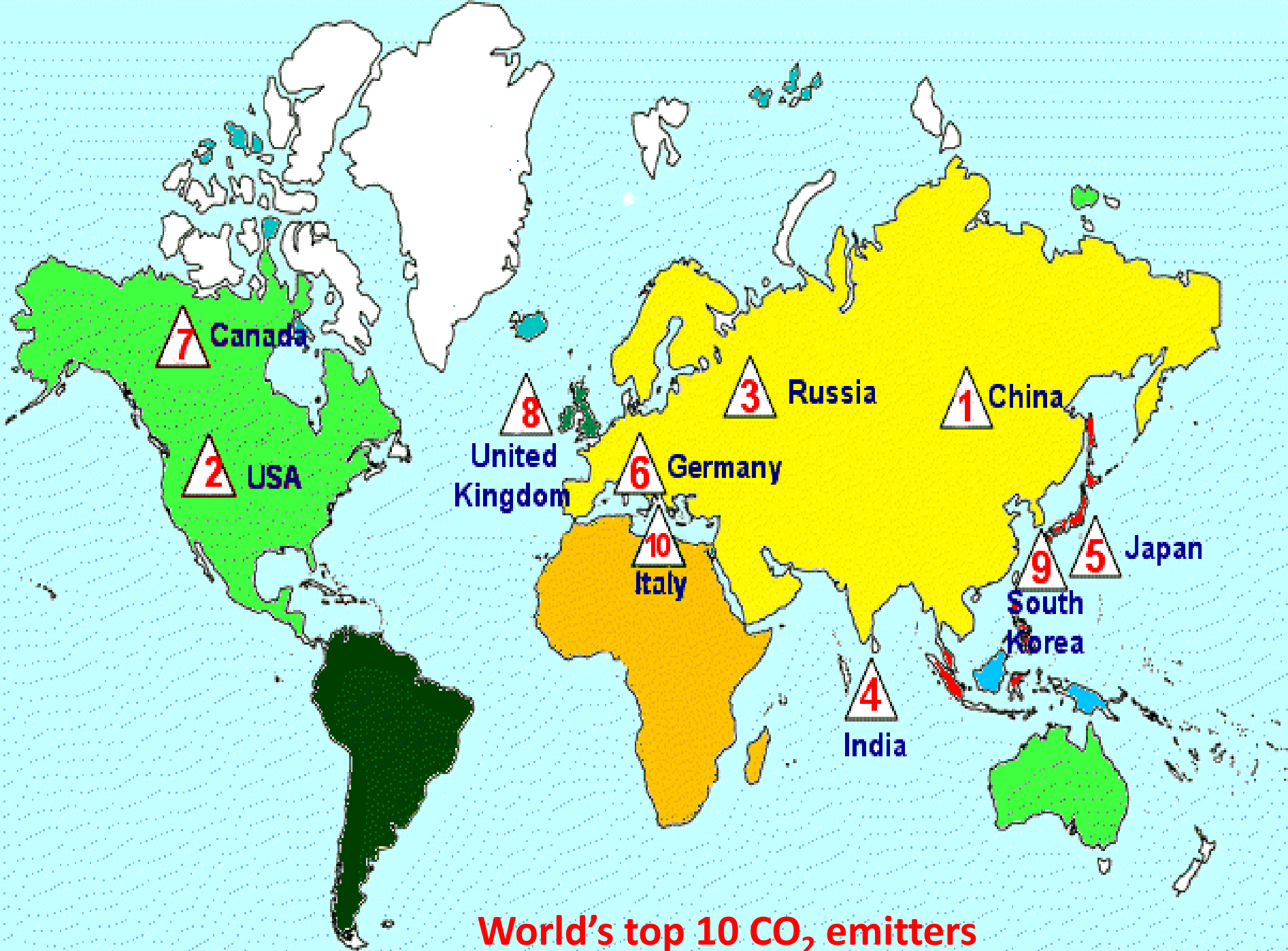
**Methane**

(18% of total)



**Nitrous Oxide**

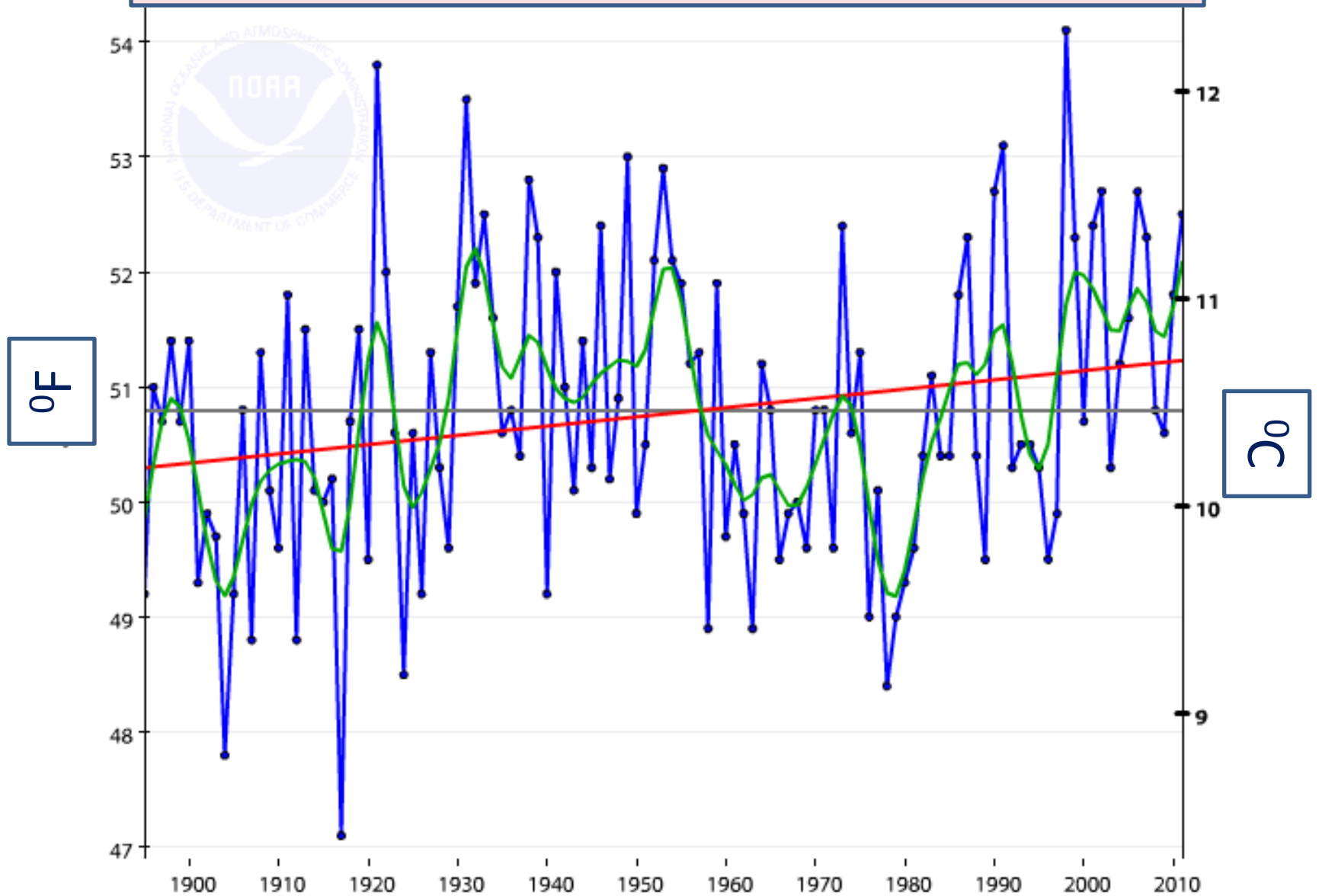
(9% of total)



**World's top 10 CO<sub>2</sub> emitters**

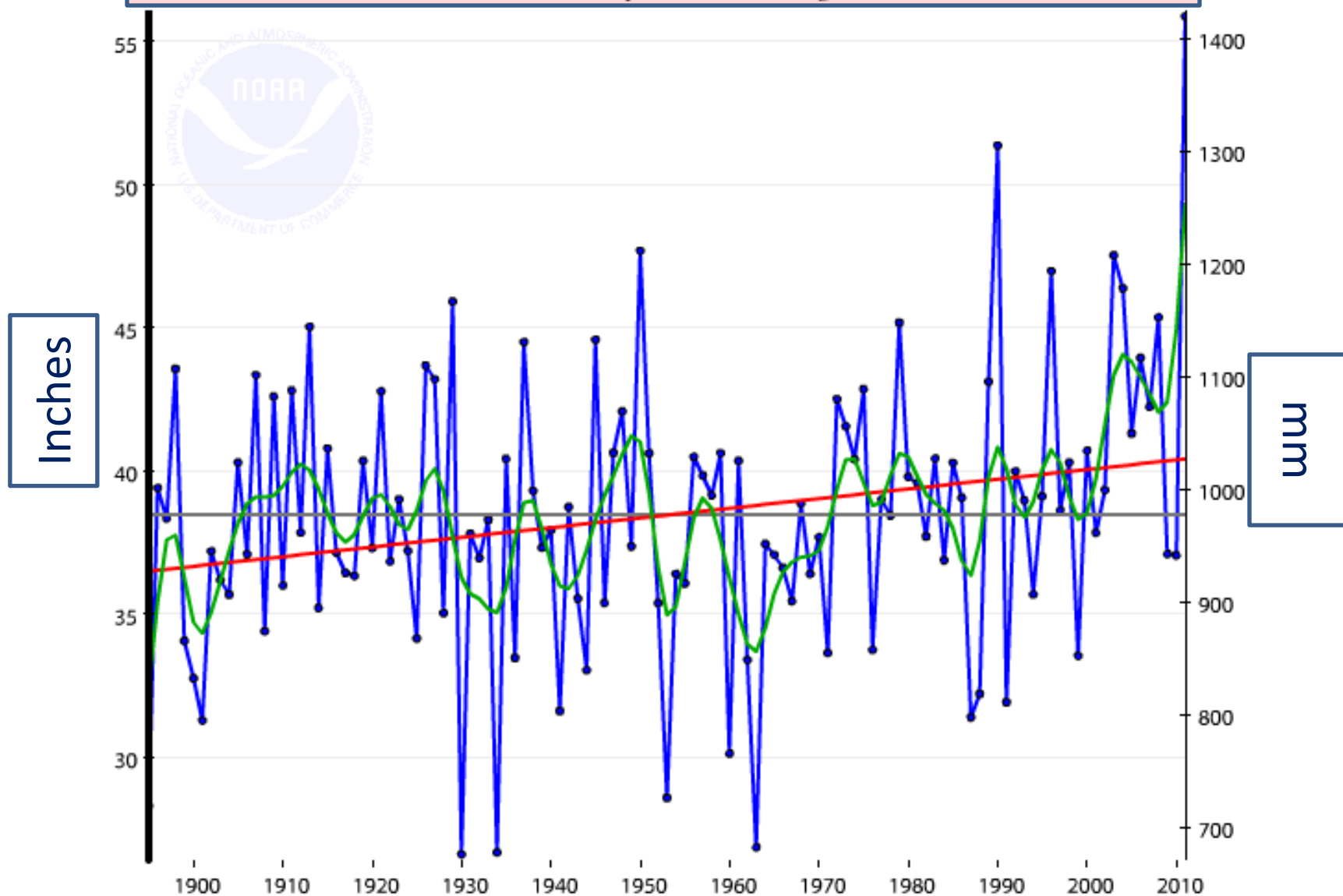
# Ohio, Temperature, January-December

9-Point Binomial Filter    Trend +0.8°F/Century    Long Term Average    Temperature



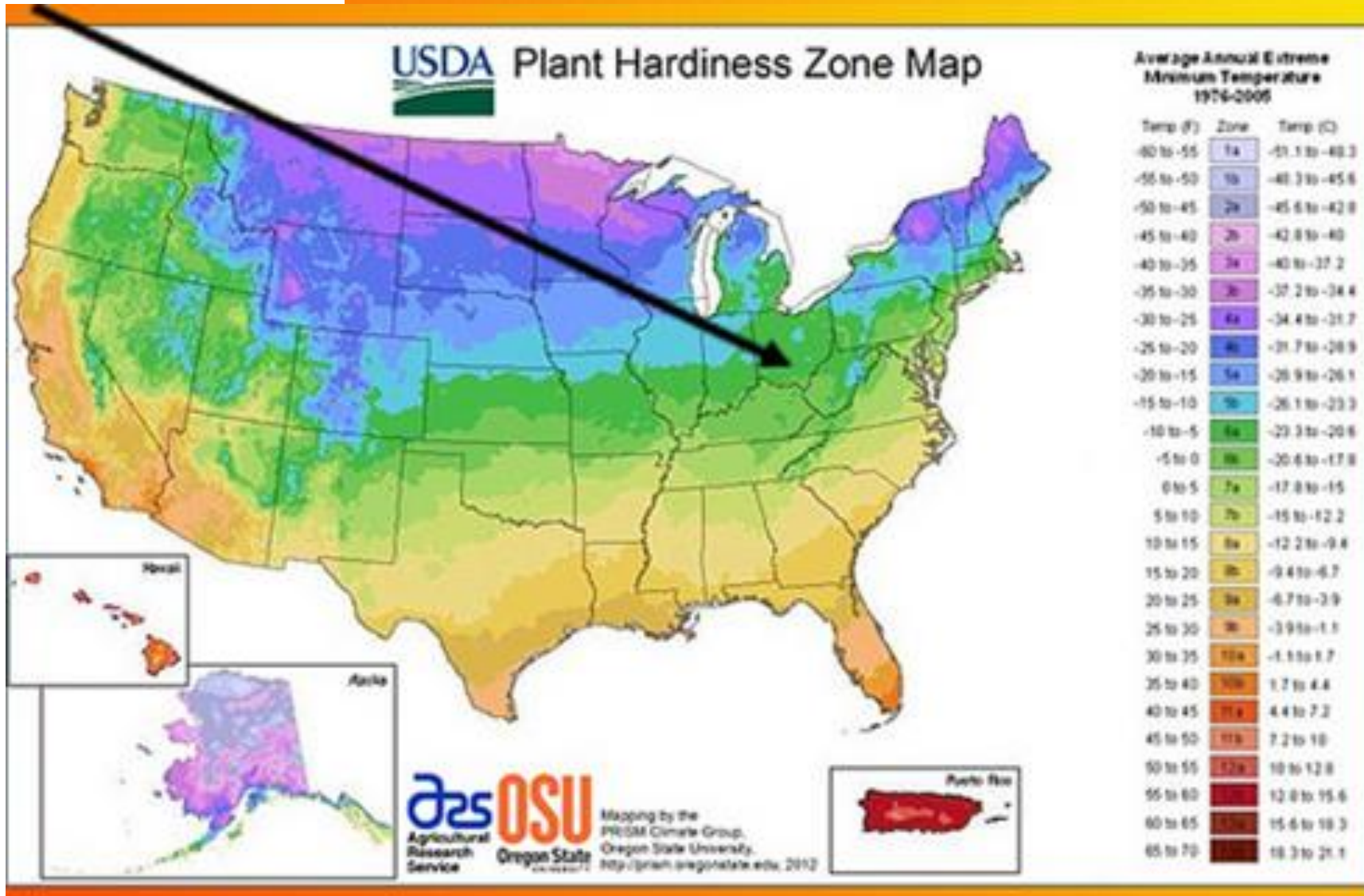
# Ohio, Precipitation, January-December

9-Point Binomial Filter      Trend +3.38"/Century      Long Term Average      Precipitation





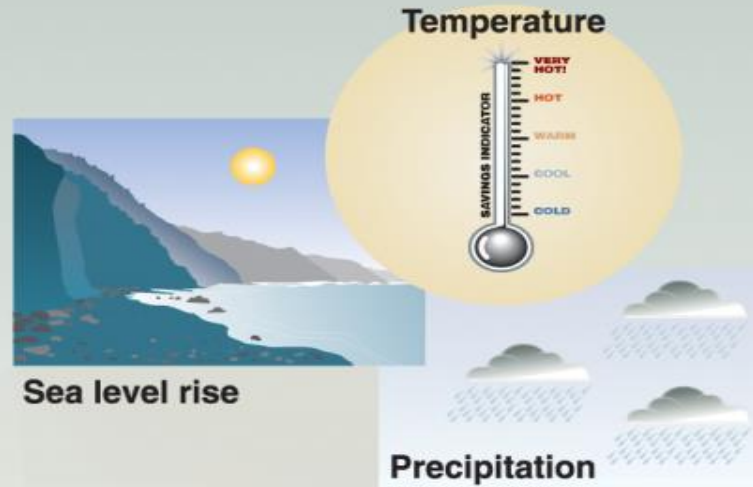
As of 2012 The USDA has determined that Ohio's climate has shifted from growing zone 5 to zone 6.







# Potential Climate Change Impact



## Impacts on...

### Health



Weather-related mortality  
Infectious diseases  
Air-quality respiratory illnesses

### Agriculture



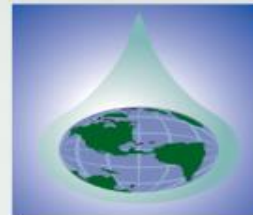
Crop yields  
Irrigation demands

### Forest



Forest composition  
Geographic range of forest  
Forest health and productivity

### Water resources



Water supply  
Water quality  
Competition for water

### coastal areas



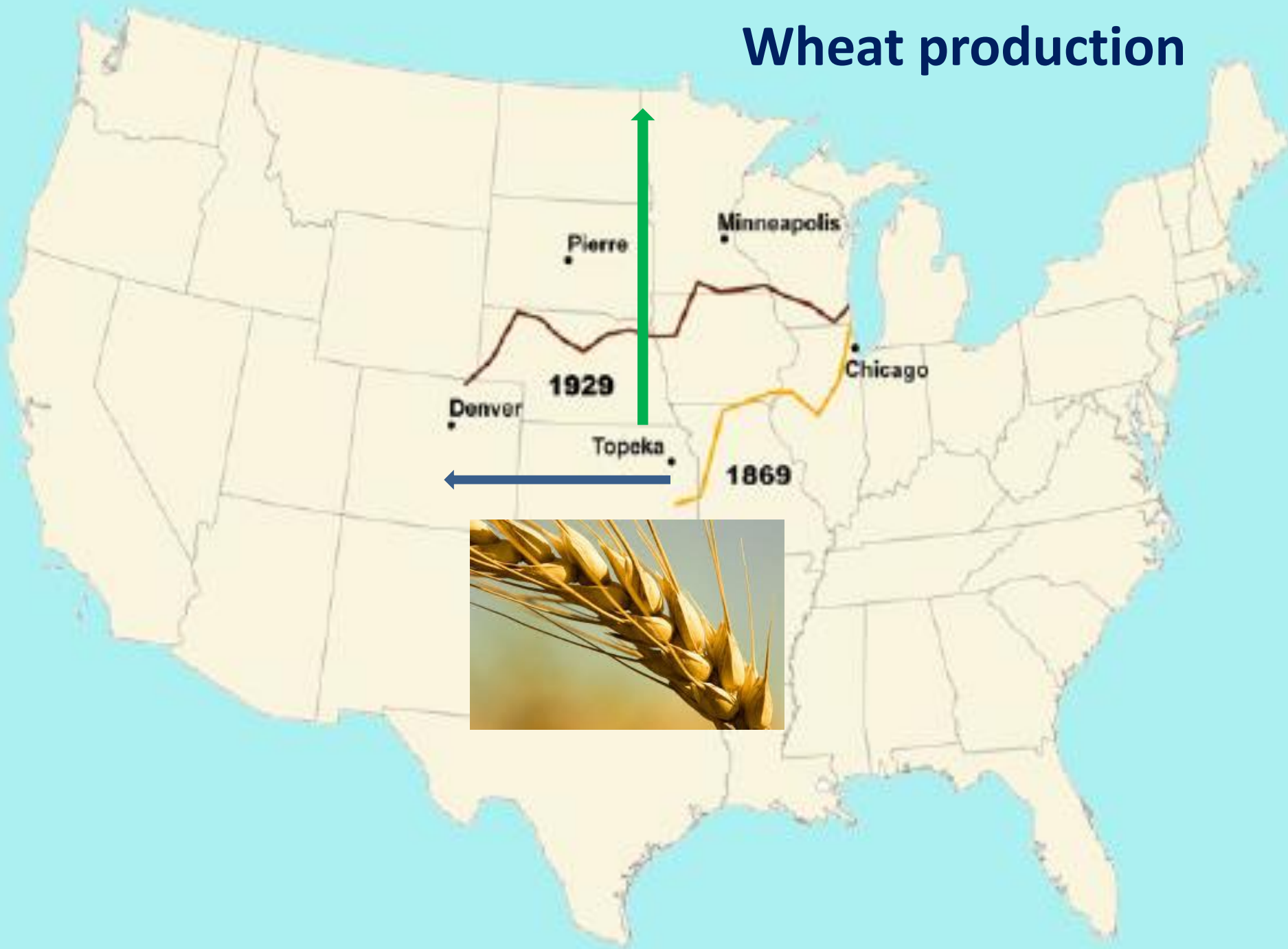
Erosion of beaches  
Inundation of coastal lands  
additional costs to protect coastal communities

### Species and natural areas



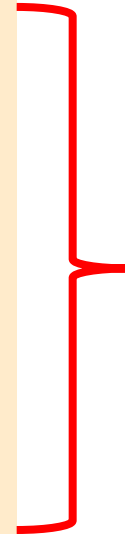
Loss of habitat and species  
Cryosphere:  
diminishing glaciers

# Wheat production

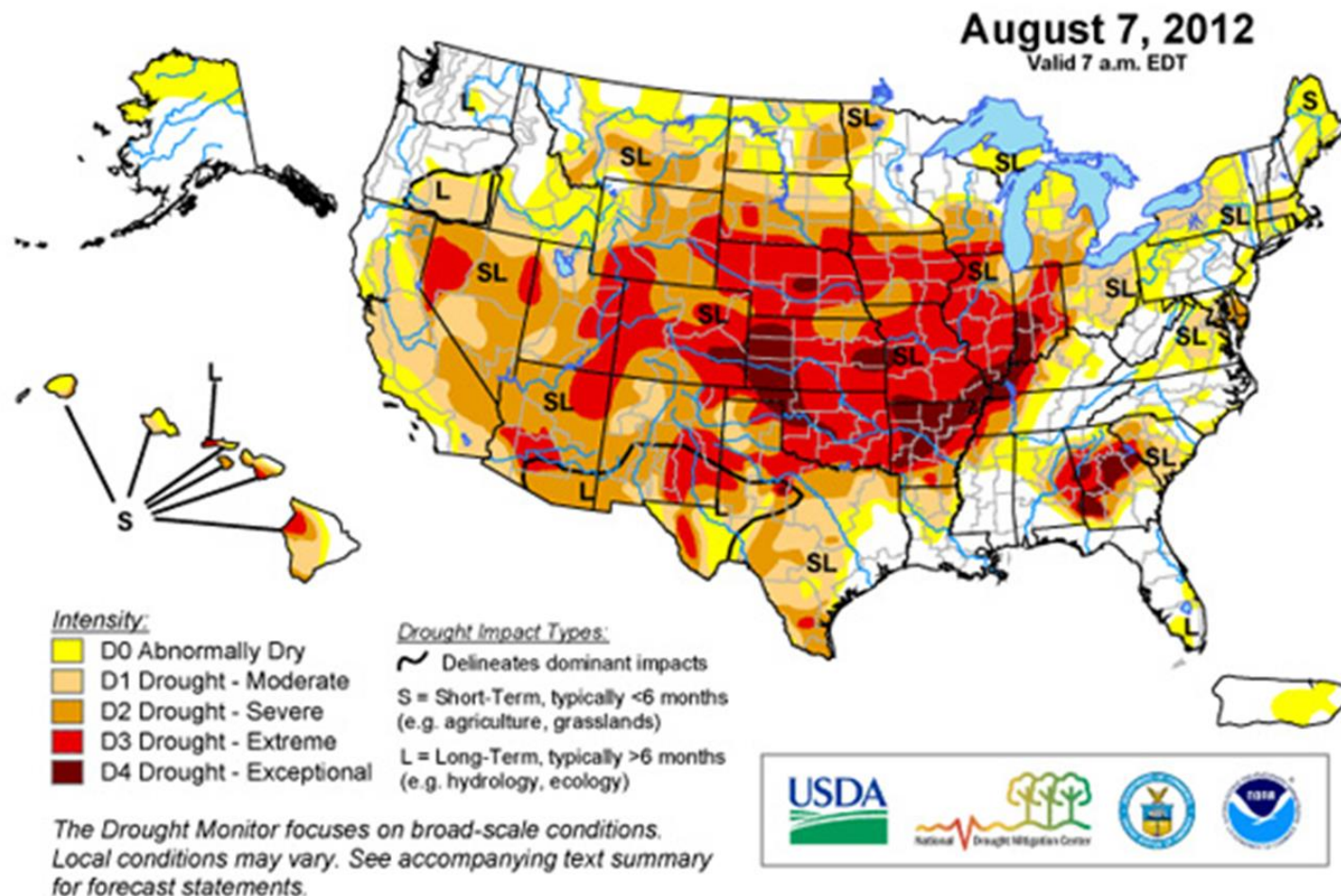


# Negative Effects of Climate Change on Agriculture

Phenomenon	Likelihood
Warmer days. Less cold days/nights	Virtually certain
More warm spells and heatwaves	Very likely
More heavy rain events	Very likely
More areas hit by drought	Likely
More intense tropical cyclones	Likely
More extreme sea levels (not tsunamis)	Likely



For 2012, the US Drought Monitor reports that 88% of corn and 77% of the soybeans were affected by the worst drought since 1988.





# CAUSES OF CROP LOSS

55%	DROUGHT
16%	EXCESS MOISTURE
12%	FROST/FREEZE
8%	HAIL
3%	WIND
2%	DISEASE
2%	FLOOD
1%	INSECTS
1%	OTHER





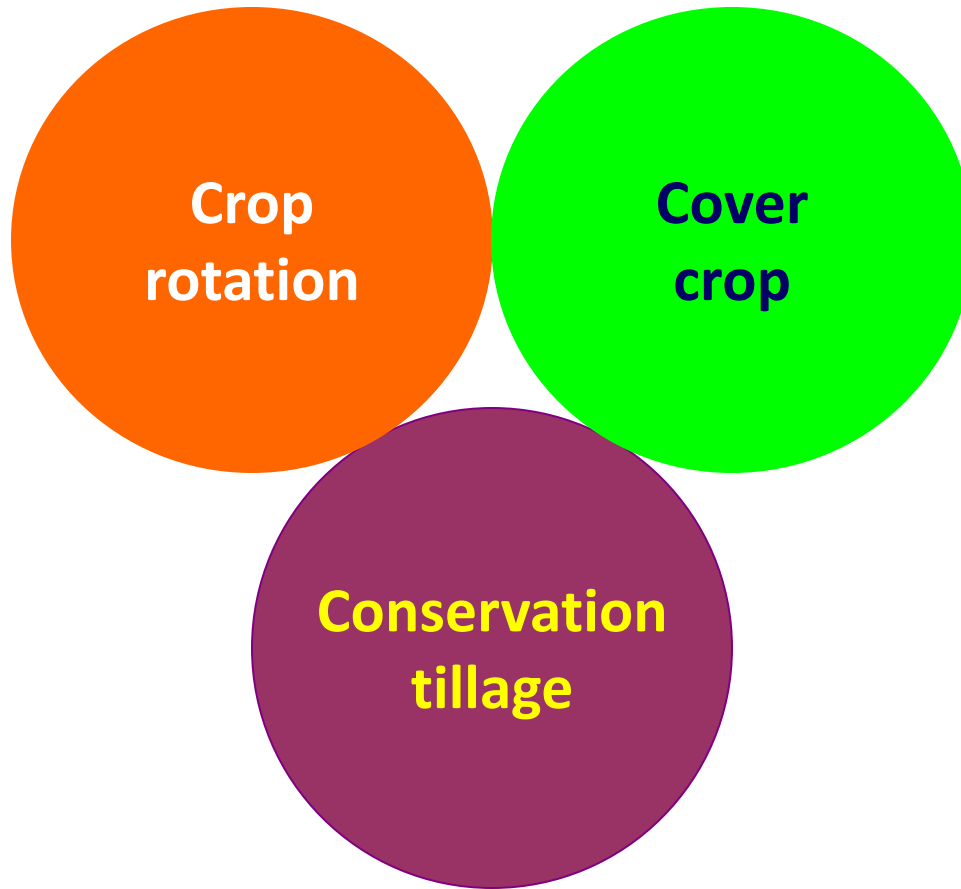


# 21<sup>st</sup>-Century Agriculture

## Adaptation and mitigation to climate change:

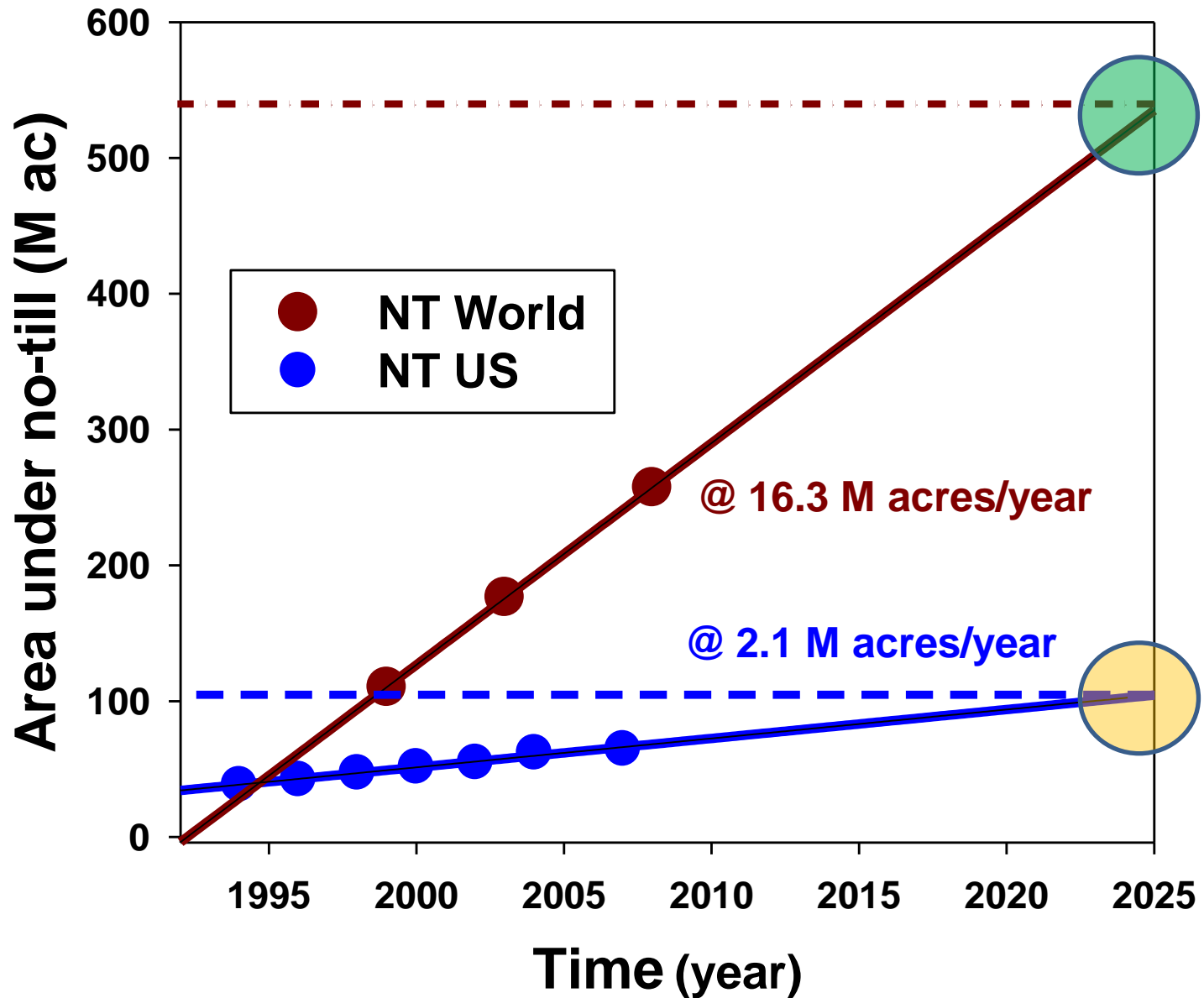
- Resurrect soil quality
- Make super crops
- Replace fertilizer
- Growth with precision
- Use advanced energy





**21<sup>st</sup> century agriculture: 3C**

# No-Till Agriculture





# Conservation tillage



10.17.2008





## No-till and cover crops blend (Dave Brandt Farm)







**No-till and cover crops blend**  
(Dave Brandt Farm), March 4<sup>th</sup> 2013





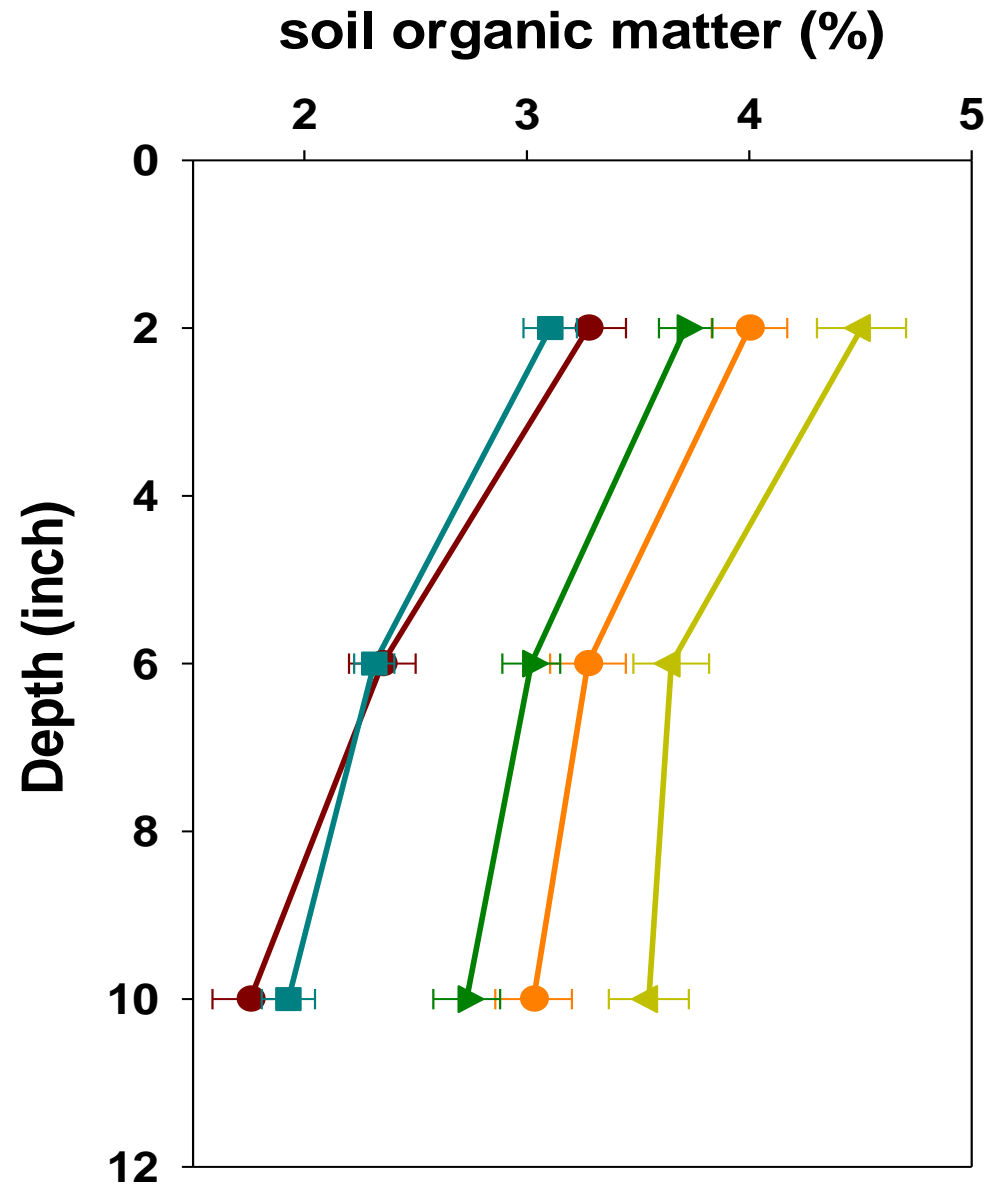


Growing soybeans as companion  
cover crop for proving N to corn

06.03.2012



# Effects of mixed cover crops in continuous no-till on **soil organic matter** content under corn-soybean-wheat rotation

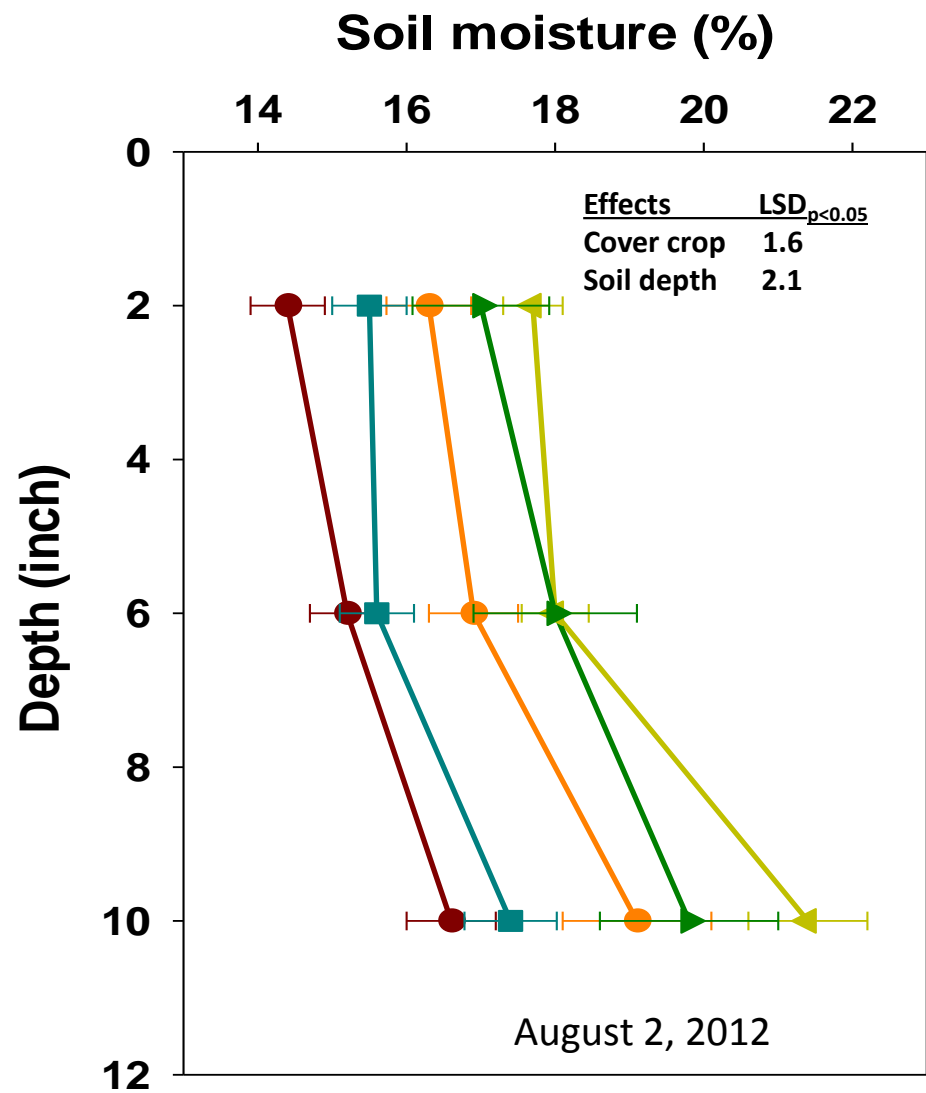


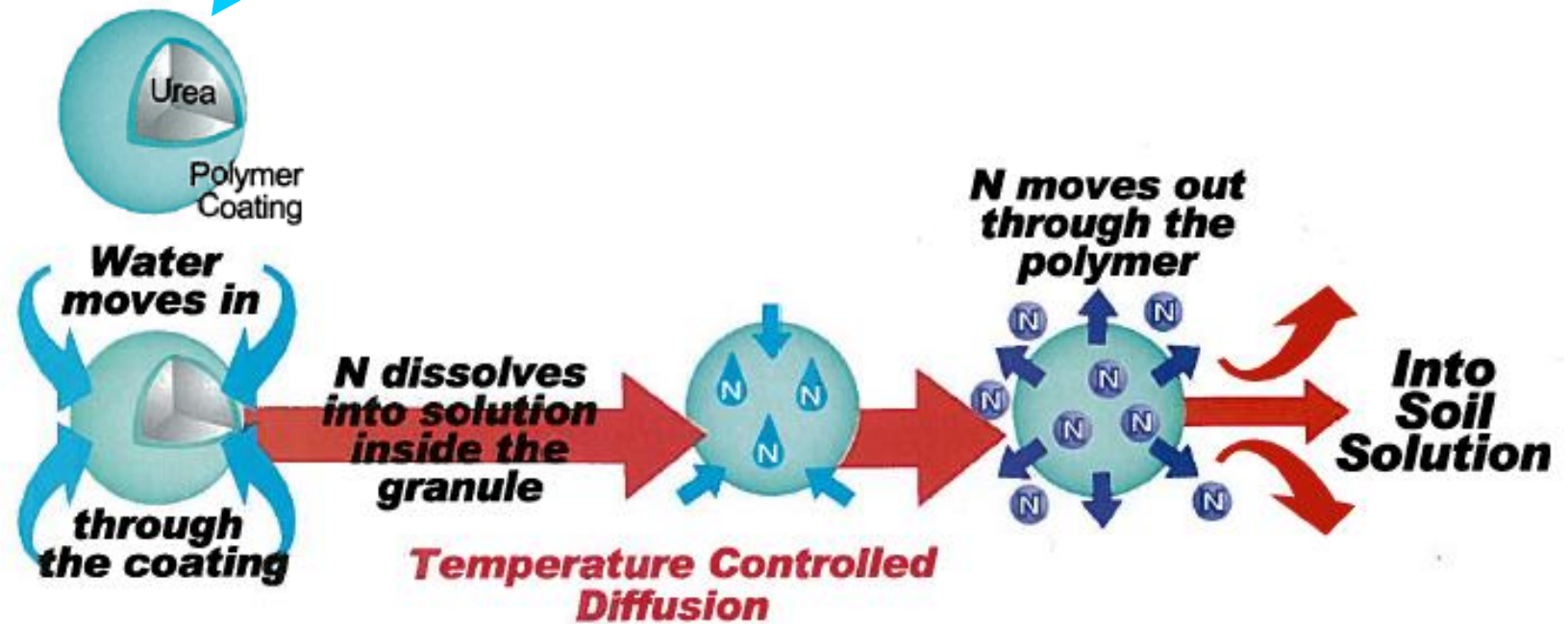
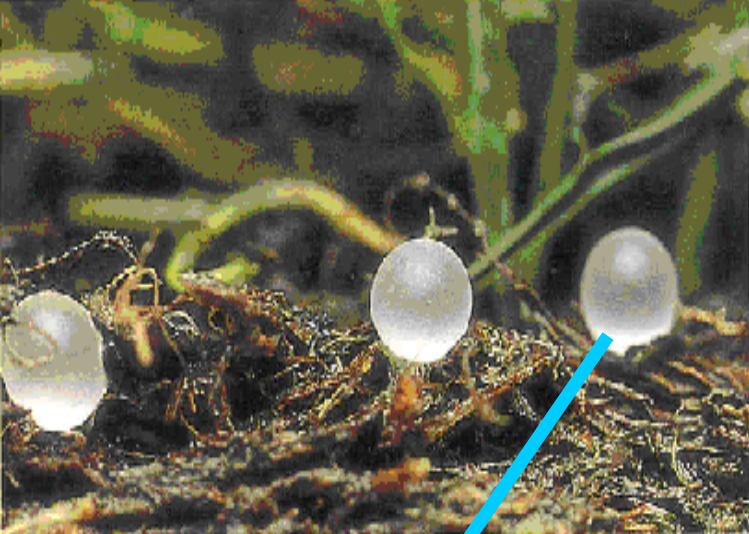


# Effects of mixed cover crops in continuous no-till on soil moisture storage under corn-soybean-wheat rotation



- NT = No-till (control)
- NTcc1 = No-till cover crop mix-1
- NTcc2 = No-till cover crop mix-2
- NTcc3 = No-till cover crop mix-3
- NTcc4 = No-till cover crop mix-4





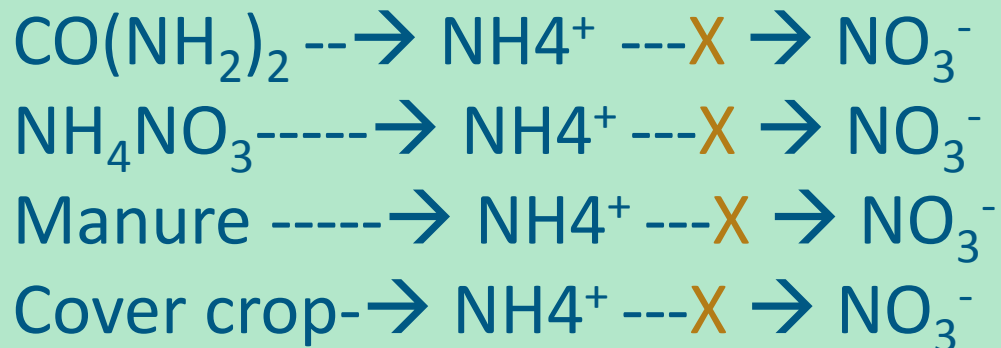


# Manure nutrient management



We found **Zeolite** (soil amendment):

- Increased ion exchange capacity
- Adsorbed  $\text{NH}_4^+$ ,  $\text{H}_2\text{PO}_4^-$ , and  $\text{HPO}_4^{2-}$
- Reduced reactive **N ( $\text{NO}_3^-$ ) formation**



- Acted as a controlled release fertilizer





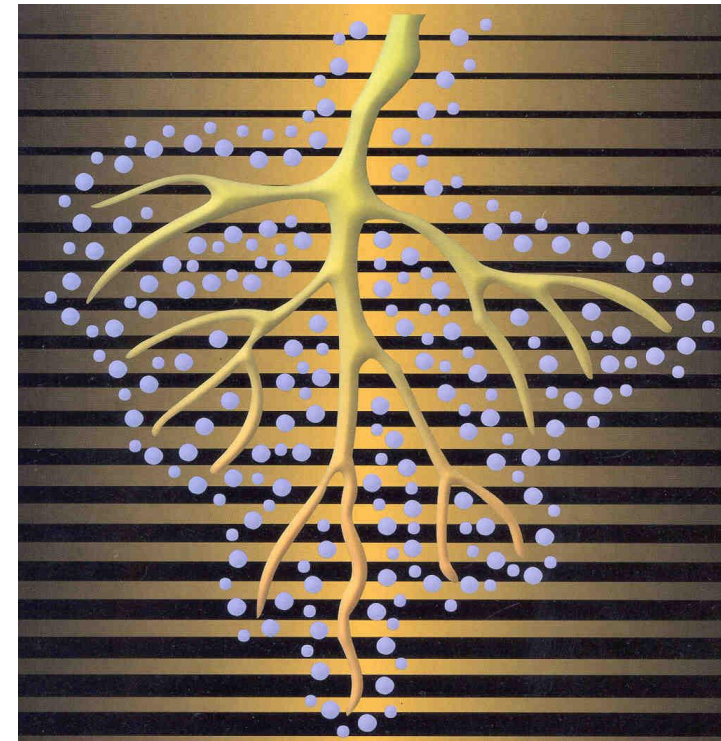
**Use super plants or improved crop varieties.**

Drought tolerant and partially salt resistant high yielding crops (e.g. soybeans)

## Bio-control Mechanisms:

- Antagonism
- Competition
- Mycoparasitism
- Systemic induced resistance

*Tricoderma spp.* (T-22) reduces root disease severity, suppresses soil-borne pathogens, and increases water- and nutrient-use efficiency







# Advanced Energy Crops

In Ohio alone, there are **353,000 acres** of CRP land, **600,000 acres** of degraded forest land (Smith et al., 2002), **40,000 acres** of reclaimed mine land (OSM 2003), and 54,000 acres of right of way (ROW) for growing advanced energy crops.

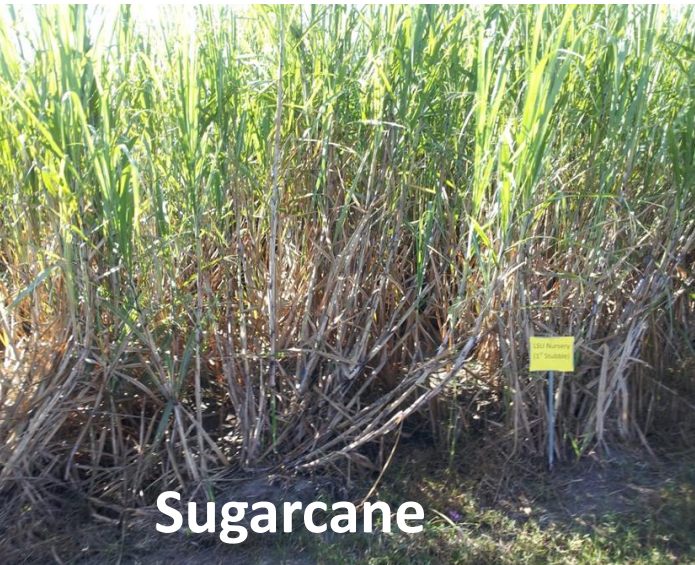


Highway Right of Way





# Advanced energy crops (Double alcohol)



Sugarcane



Energy  
beet



Sweet sorghum



Sweet corn



Sudan-sorghum





# One alcohol (cellulosic)

*Miscanthus giganteus*

*Arundo donax* (Spanish cane,  
Colorado River Reed, Wild cane,  
and Giant reed.







**Switchgrass**



**Indian grass**

**Warm season grasses**



**Big bluestem grass**



**Little bluestem grass**



# **Climate Change and 21<sup>st</sup> Century Agriculture**

**Rafiq Islam**

**Ohio State University South Centers at Piketon**

**Presented at the Conservation Tillage and Technology Conference Annual Meetings,  
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