



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# CONSERVATION PRACTICES TO INCREASE RESILIENCY

Making sure we can handle the extremes!

---

Carolyn Olson, Ph.D.  
90<sup>th</sup> Annual Outlook Forum  
February 20-21, 2014

# SOIL MANAGEMENT AND SOIL HEALTH

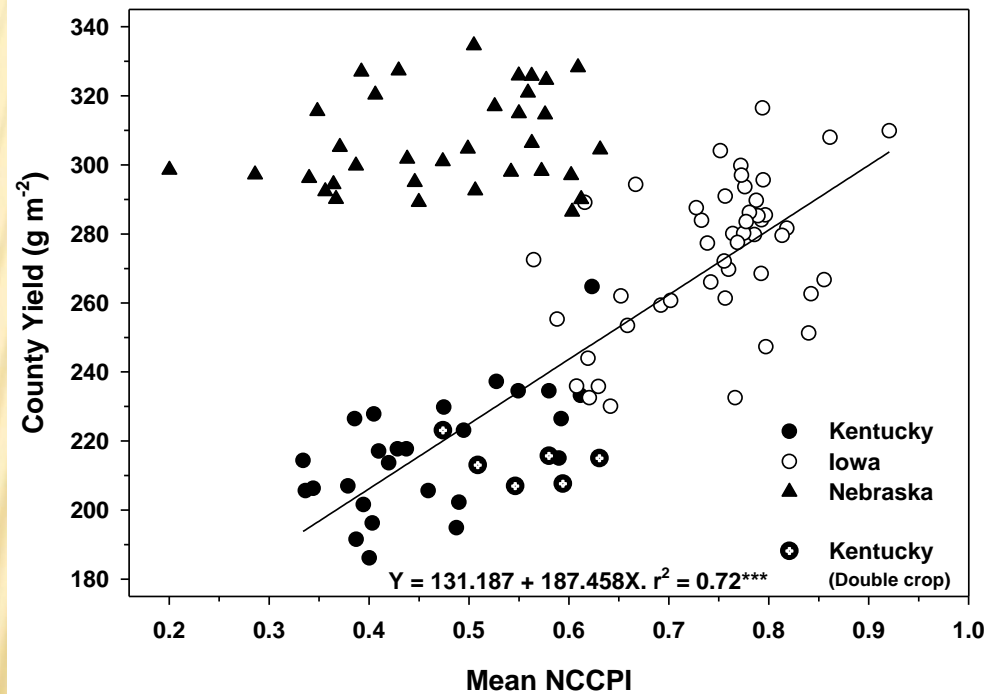
## FACTORS AFFECTING RESILIENCY

- **Inherent Soil Properties**
  - texture
  - mineral content
- **Dynamic Properties**
  - Water Holding Capacity
  - Organic Matter Content
  - Soil Moisture
  - Soil Temperature



# GOOD SOILS = GOOD YIELDS

Soybean yields  
across Iowa,  
Kentucky, and  
Nebraska



# SOIL WATER BALANCE

## Inputs

Soil Water

=

Precipitation  
irrigation

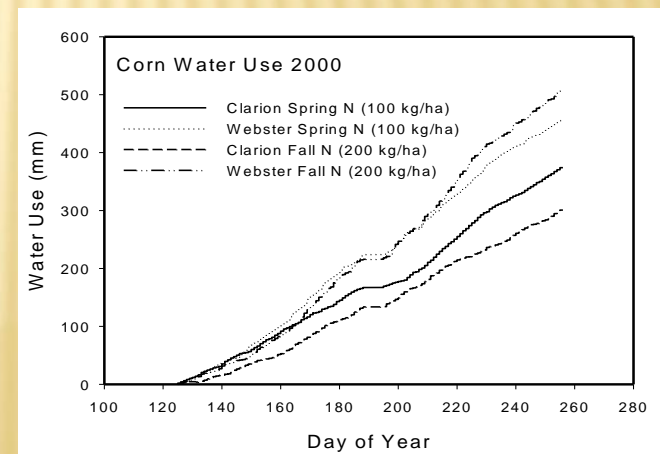
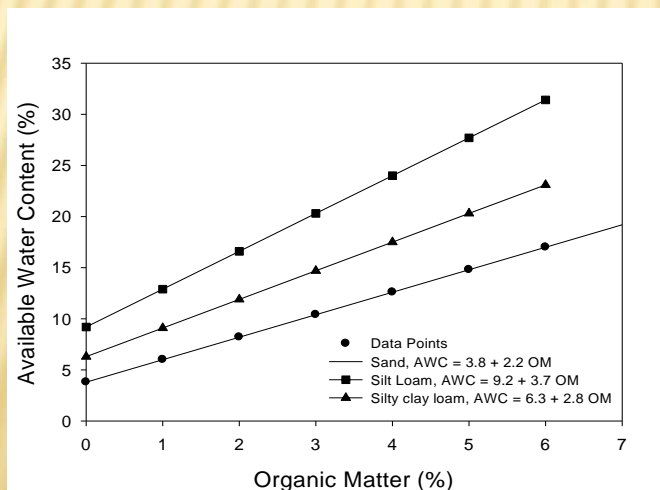
-

## Losses

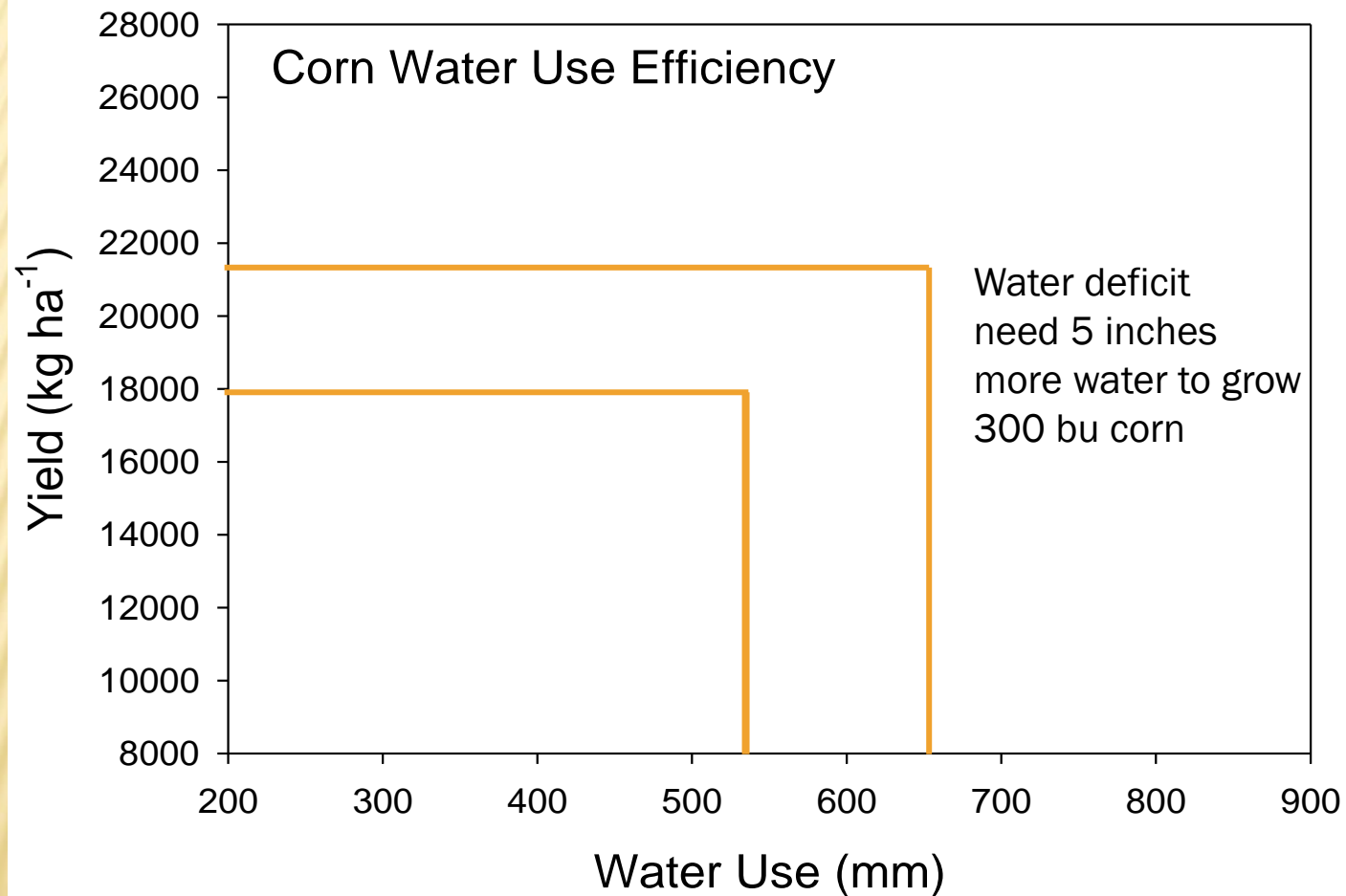
Evapotranspiration  
(ET)

Runoff

Drainage



# WATER IS REQUIRED FOR GRAIN PRODUCTION



# EVAPOTRANSPIRATION

---

ET = Soil water evaporation + Plant transpiration

## Components of ET

Energy  
Input  
  
(Net  
radiation)

Water Vapor  
Gradient  
f (temp,  
vapor  
pressure)

Windspeed  
Gradient

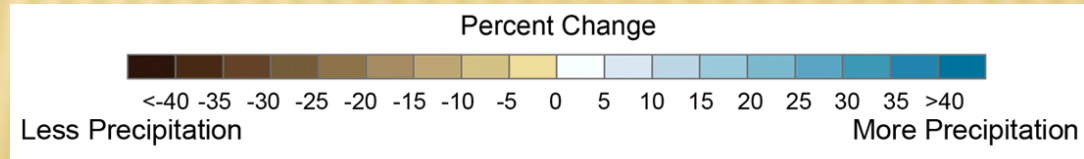
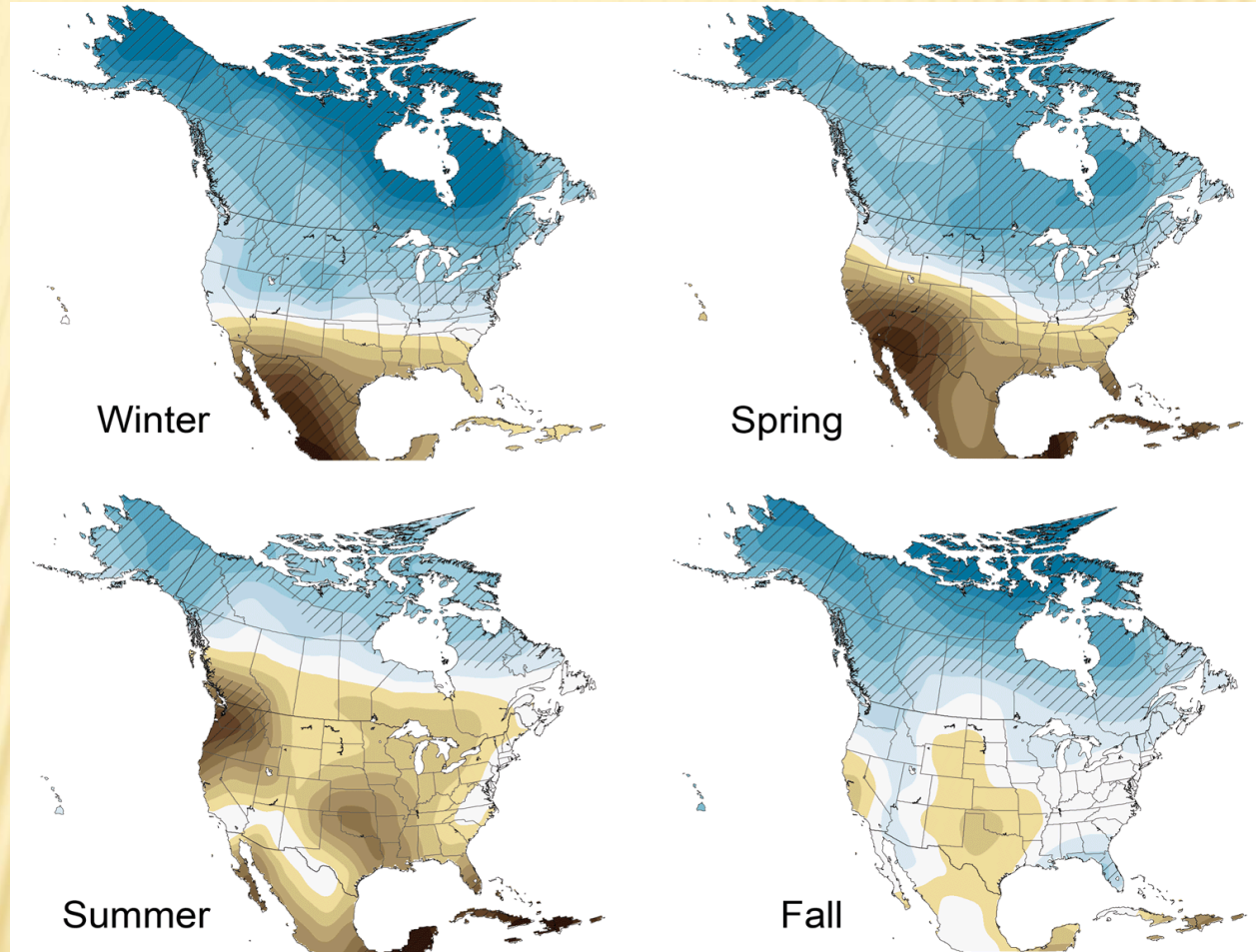
Soil Water  
Availability

↑ Rate-limitation

Potential ET (how much could evaporate) vs Actual ET (how much does)

# PROJECTED CHANGE IN NORTH AMERICAN PRECIPITATION

BY 2080-2090





# PRECIPITATION CHANGES

---

- Change in seasonality
- Change in intensity
- Change in frequency
- Change in regional distribution

# IMPLICATIONS

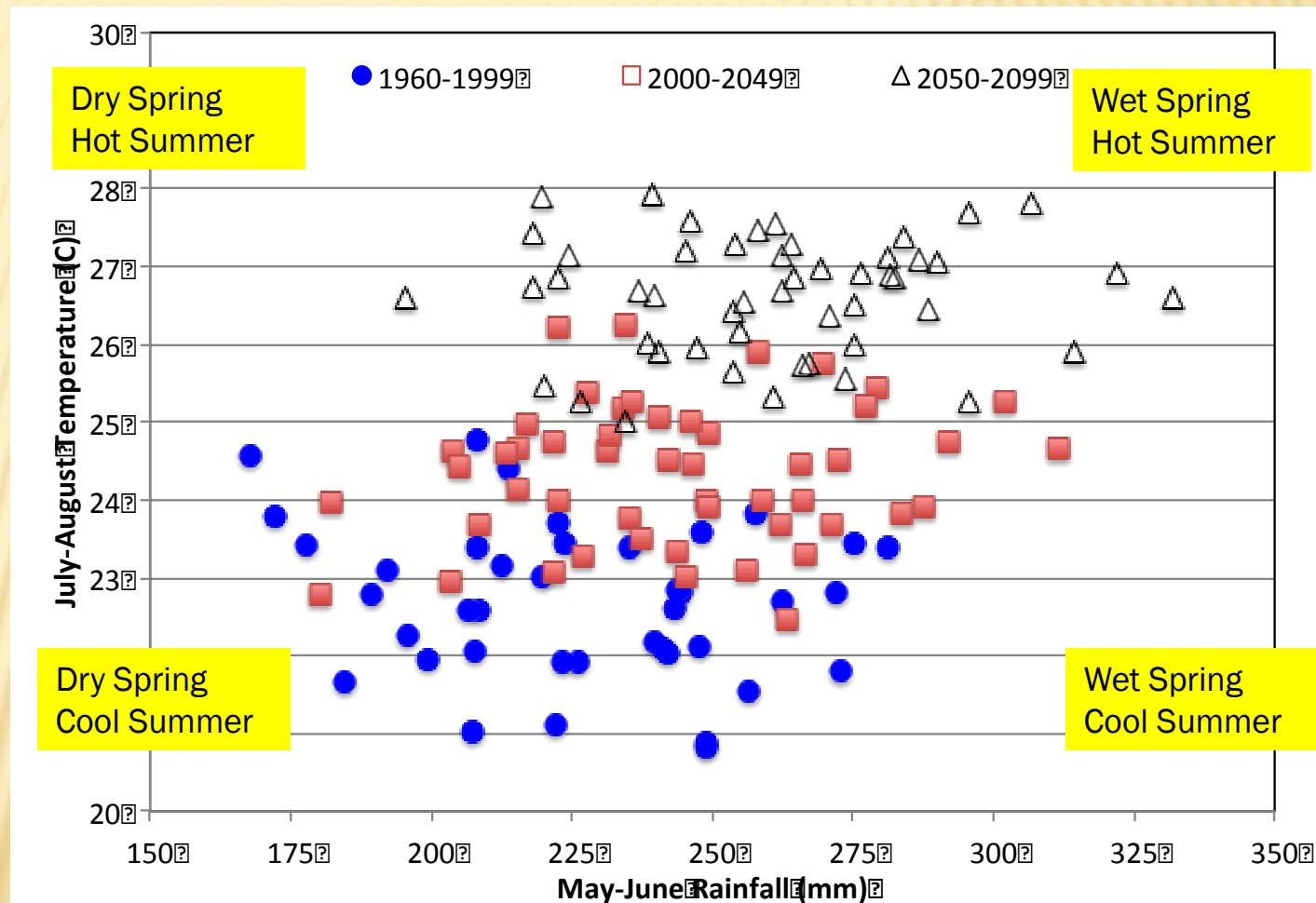
---

- Soil water availability will become more variable because the input will be more variable
- How do we manage soil water when the supply has an increased variation

# CLIMATE PROJECTION: WETTER SPRING, HOTTER SUMMER

lowa climate projection is average May-June rainfall and July-August temperature using 9 downscaled climate scenarios, spanning 3 GCMs and 3 emissions scenarios.

Training period for downscale method is 1960-1999.

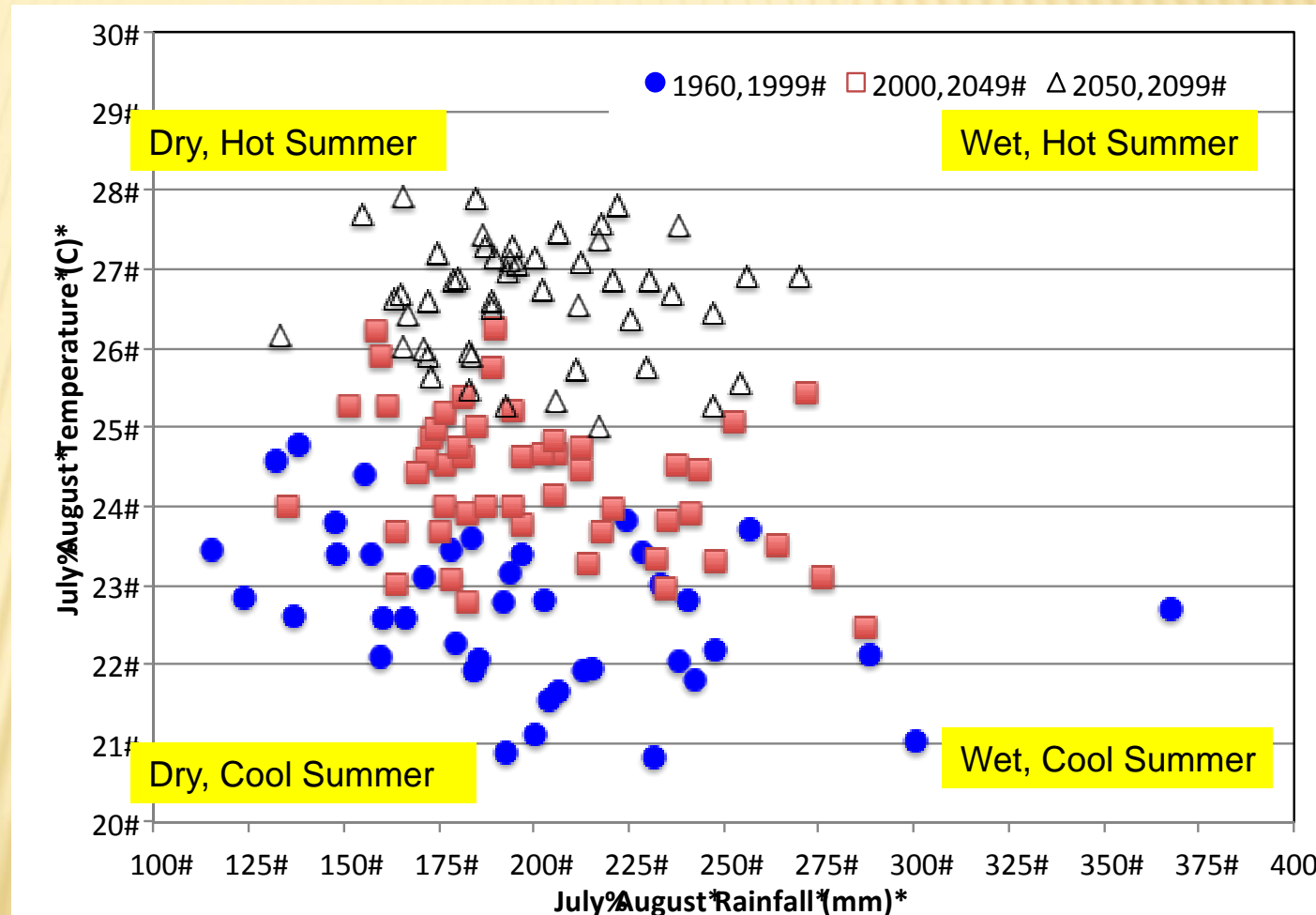


# CLIMATE PROJECTION: FEWER WET SUMMERS, MORE HOT SUMMERS

lowa climate projection is average May-June rainfall and July-August temperature using 9 downscaled climate scenarios, spanning 3 GCMs and 3 emissions scenarios.

Training period for downscale method is 1960-1999.

Data Source: Stoner et al. (2013)

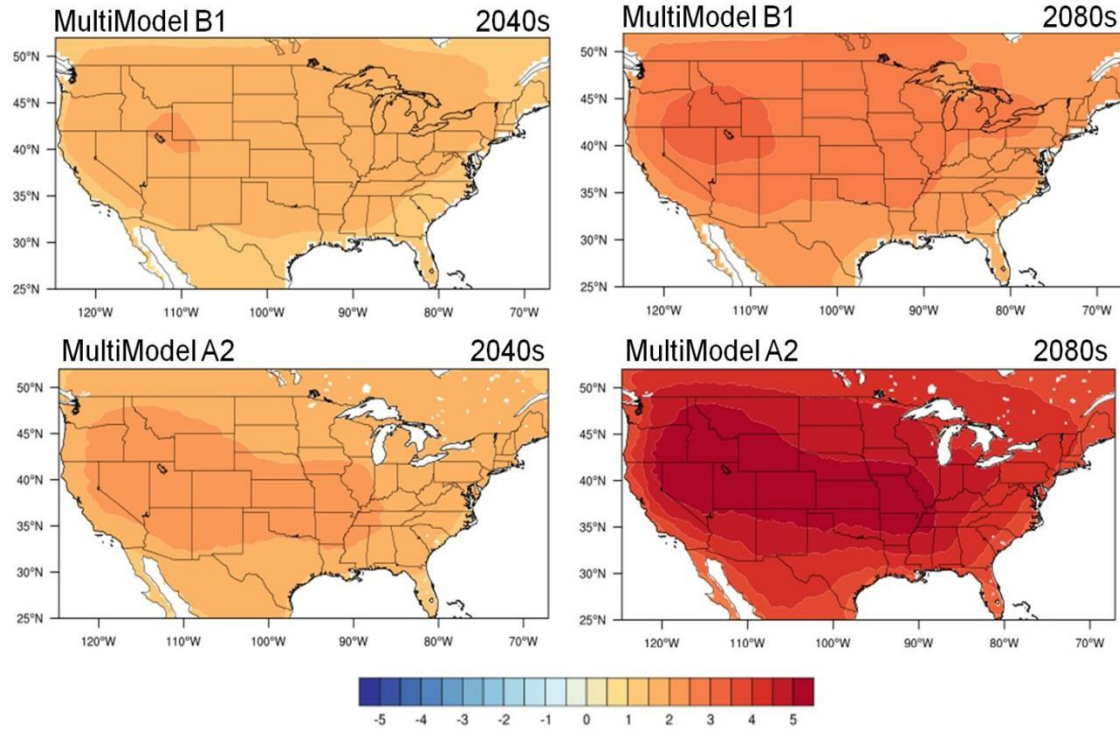


# TEMPERATURE CHANGES

---

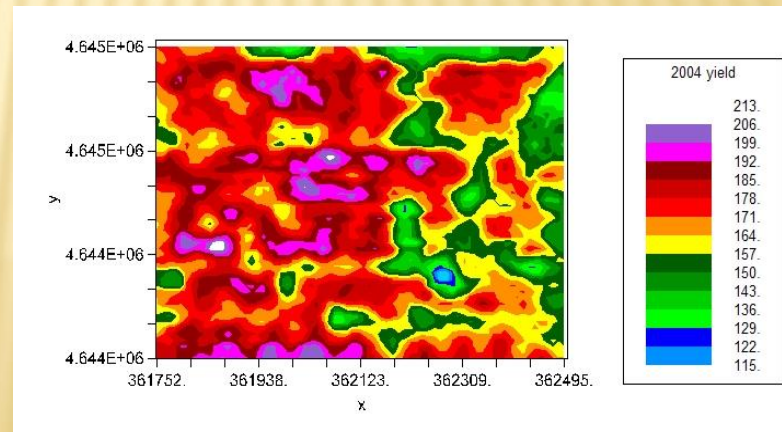
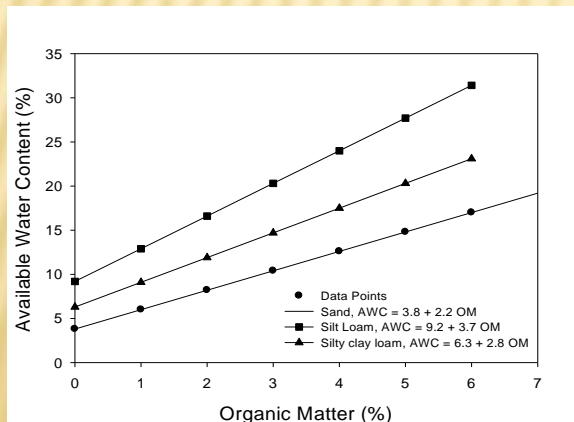
- Warmer temperatures increase ET demand through vapor pressure deficit
- Warmer temperatures will increase the rate of water use inducing agricultural drought more quickly

# Summer Temperature Change



# OBSERVATIONS

- Tillage increases the soil water evaporation rate
- Yield differences among soils within a field is related to organic matter content and soil water holding capacity
- Water use patterns within a field cause “drought” stress to occur in every year



# BENEFITS OF CONSERVATION AGRICULTURE

---

## ➤ Short-term

- Reduce soil water evaporation
- Increase infiltration of rainfall or irrigation events
- Reduce the overall of evapotranspiration rate if plants are grown in standing stubble

## ➤ Long-term

- Increase the soil water holding capacity through improved organic matter content
- Increase water availability to the crop
- Increase rooting depth



# RESILIENCY STRATEGIES

---

Conservation practices focused on dynamic soil properties such as improving soil organic matter and water holding capacity - broadly, soil health

- Conservation tillage
- Cover Crops
- Residue Management



# CONSERVATION PRACTICES

---

- Can't make it rain any more often and at the optimum time to have best yield
- Will increase the ability of the soil to capture more water, reduce the evaporation rate from the soil surface, and increase water availability to the crop
- Over the long-term will increase the capacity of the soil to store more water and make water available to the plant
- Will increase the overall resiliency of the cropping system to withstand climate stresses (variable precipitation and temperature extremes)