

# - Our Changing Menu -

*What climate change means to the foods we love and need*

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**Wells College**

**September 30, 2019**



# Why me?



***Better a Cruel Truth than a  
Comfortable Delusion***

**COMFORTABLE DELUSION  
BETTER A CRUEL TRUTH THAN A**

Edward Abbey (1990)

*Our planet is a lonely speck in the  
great enveloping cosmic dark. In  
our obscurity, in all this vastness,  
there is no hint that help will come  
from elsewhere to save us from  
ourselves.*

*Carl Sagan, Pale Blue Dot*



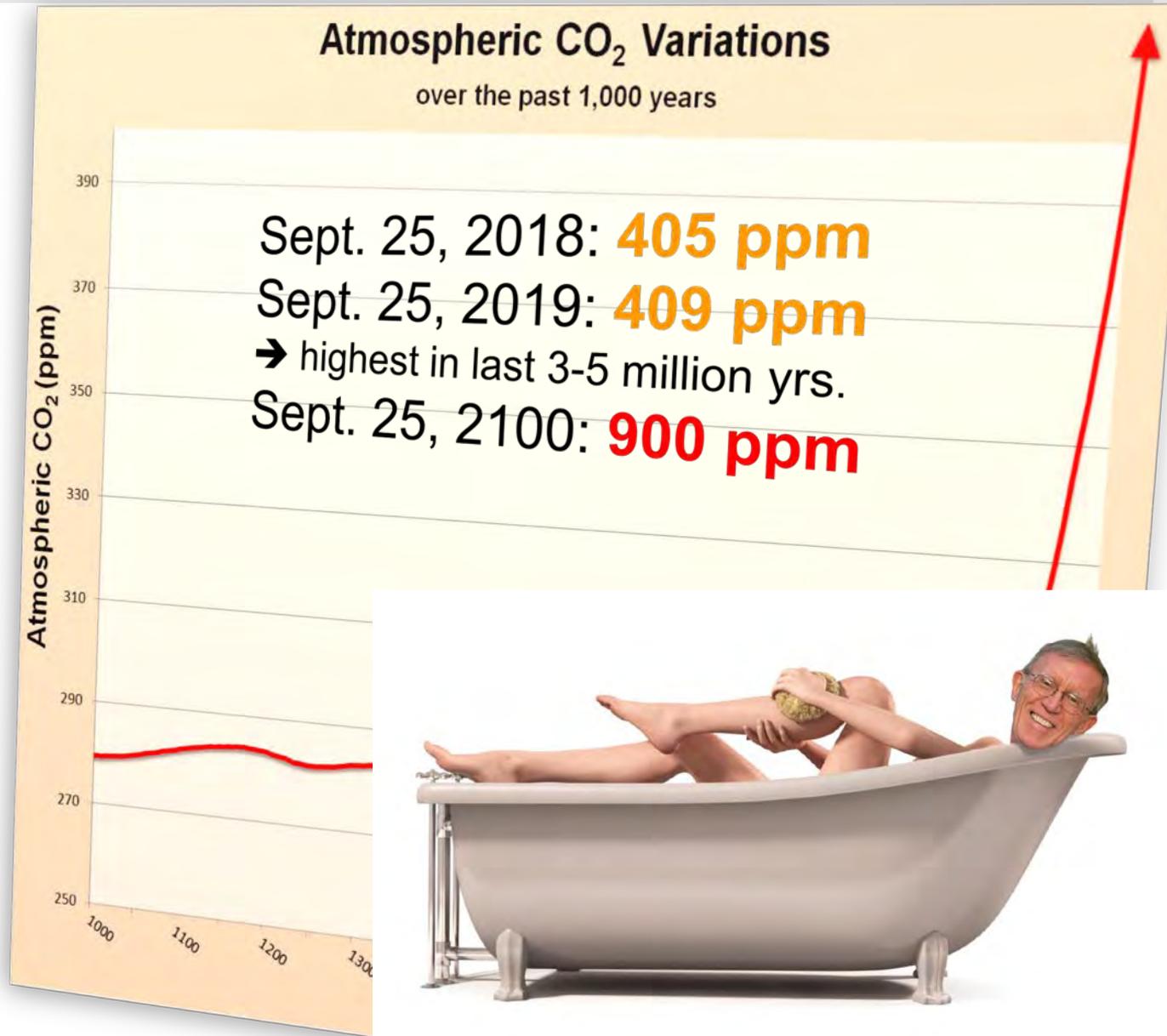


← The blanket is getting denser

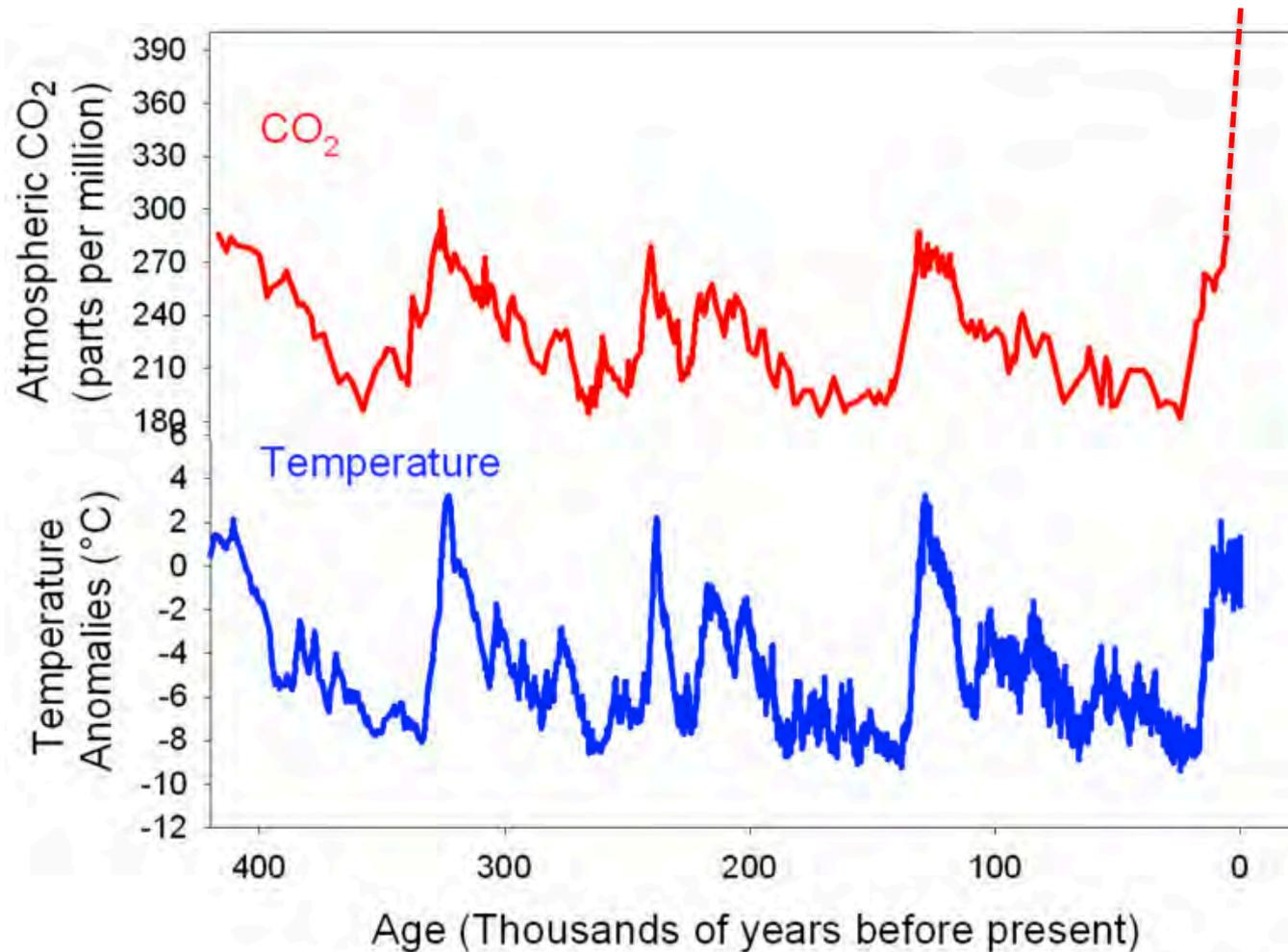
# Climate Change is Caused by Humans

## Carbon Dioxide

- Nitrous oxide
- Methane
- Experts agree
- It's not natural



# CO<sub>2</sub> Concentration & Temperature Linked



Petit et al. 1999 Nature



**1.1 billion motor vehicles worldwide**



# Sources of GHG's (US)

US EPA

**Transportation 26%**



**>102,000 flights/day worldwide**



**Electricity  
30%**

**Industry 21%**



**Commercial &  
residential 12%**



**Agriculture 9%**

# Climate Change Facts

- 1.8°F increase globally
  - Warming faster at the poles
- 2014-18 hottest yrs. ever recorded
- 100's – 1,000 of yrs. to reverse
- Global warming
  - Climate change
  - Weather

**A grand challenge -**

**That you can help solve**



**The Evidence**  
**- Is All Around Us -**

**- Is All Around Us -**  
**THE EVIDENCE**

**Nature's best thermometer,  
perhaps its most sensitive and  
unambiguous indicator of  
climate change, is ice.**



**“Ice asks no questions,  
presents no arguments,  
reads no newspapers  
listens to no debates.**

**It is not burdened by ideology and carries  
no political baggage as it changes  
from solid to liquid.**

**It just melts.**

*From A World Without Ice by Henry Pollack, 2009*



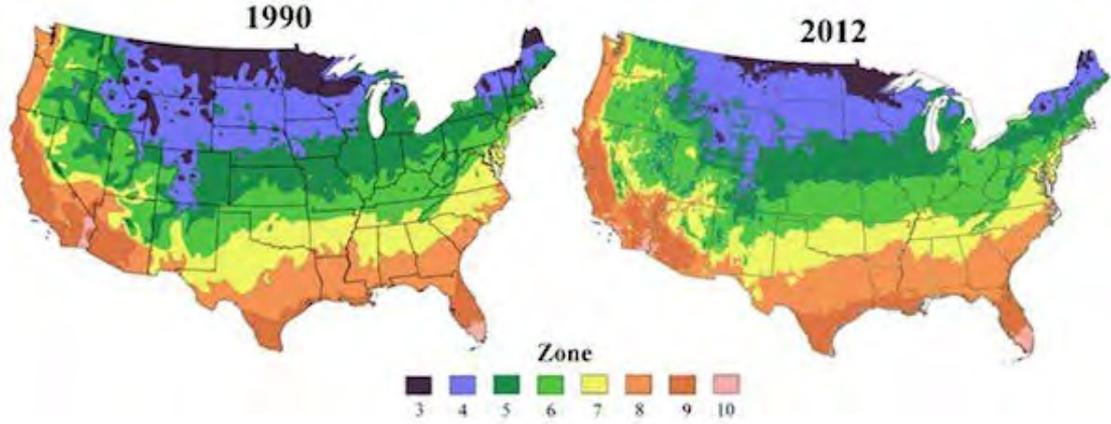
# - Impacts on Agriculture - - Food Security -

No Longer Business as Usual  
Change, More Variability, More Risk  
Local to Global Impacts

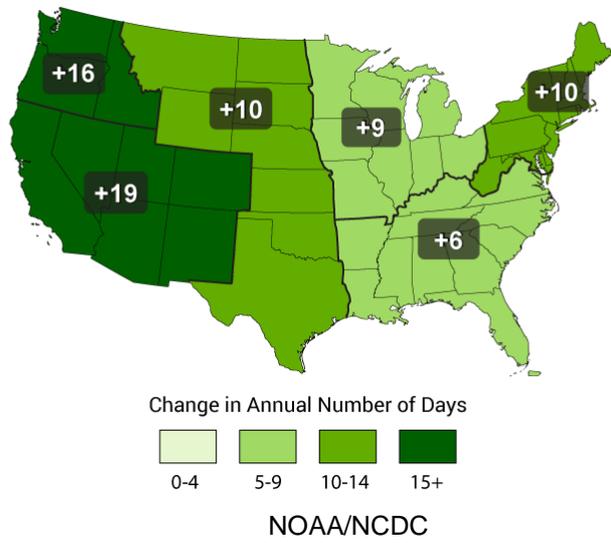


# Food Production is Shifting North

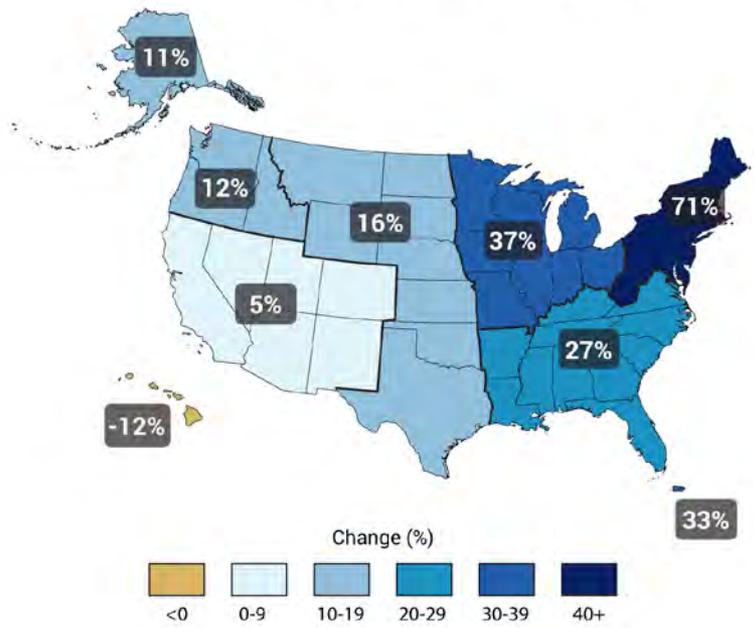
## USDA Plant Hardiness Zone Maps



## Observed Increase in Frost-Free Season Length



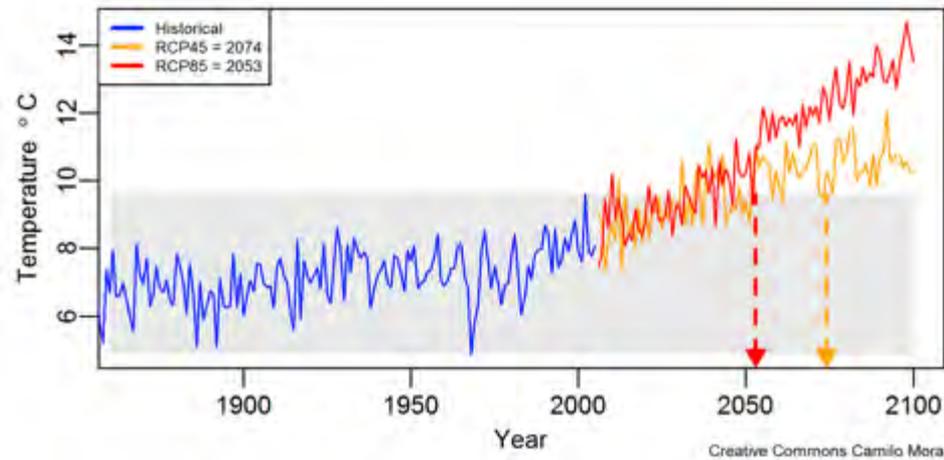
## Observed Change in Very Heavy Precipitation



Updated from Karl et al. 2009

A photograph of a flooded cornfield. In the foreground and middle ground, several large, round hay bales are partially submerged in muddy, brown water. The corn plants are also in the water, their green leaves and brown stalks visible. The background shows a line of trees under a grey, overcast sky. The text is overlaid on the right side of the image.

“As a farmer,  
you can  
weather the  
storm, but  
you can’t  
weather  
continuous  
storms.



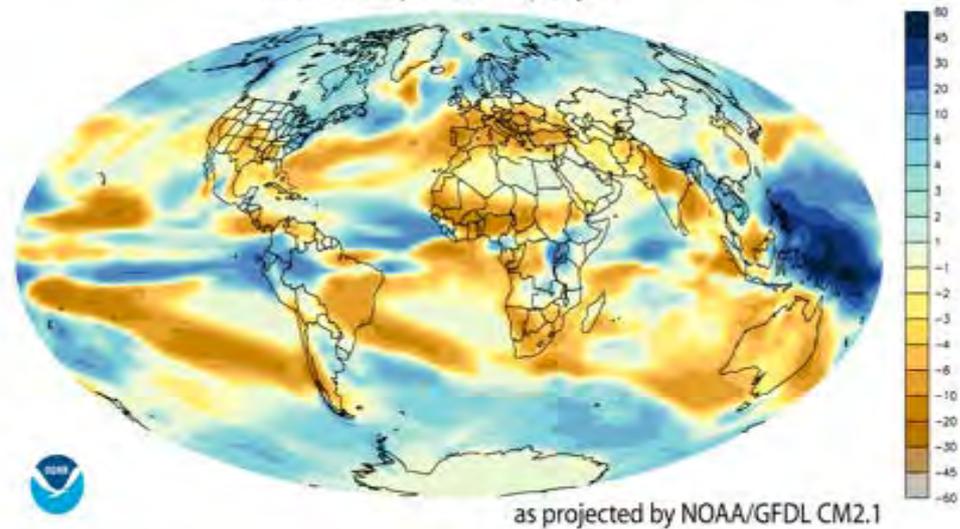
## A much warmer future for Central NY:

> 2050, coldest year, hotter than previous 200 hottest yrs.

## End of century – Globally

- > Wet – wetter; Dry – drier
- > Western & central US – drier
- NE - wetter

CHANGE IN PRECIPITATION BY END OF 21st CENTURY  
inches of liquid water per year



# Ice Cream Might Melt Faster!

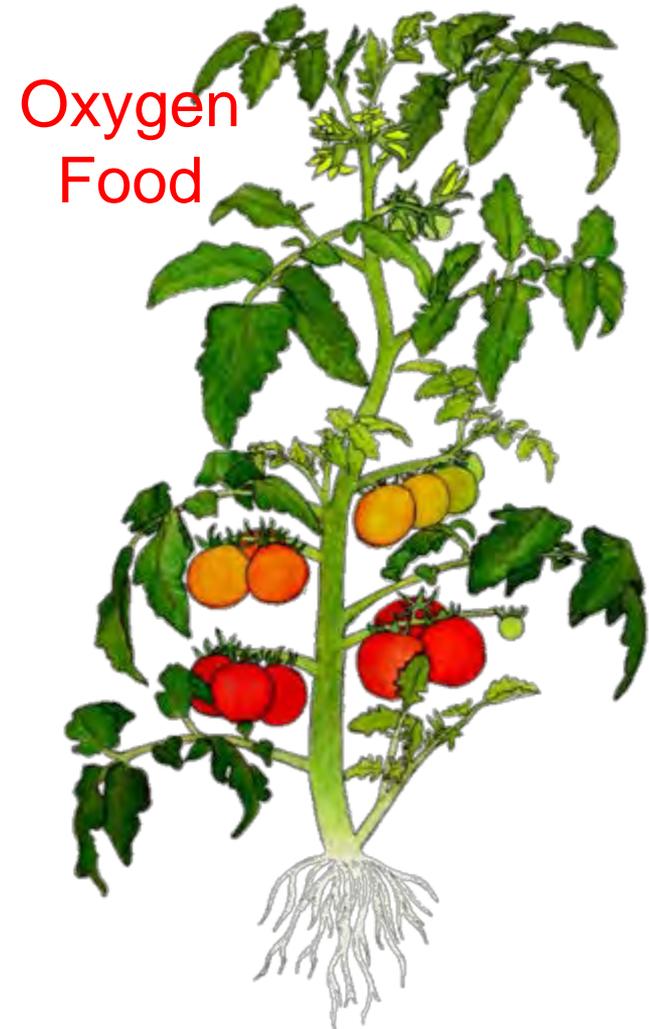


# What does climate change mean to the crop plants we depend on for life?

To grow and reproduce plants need:

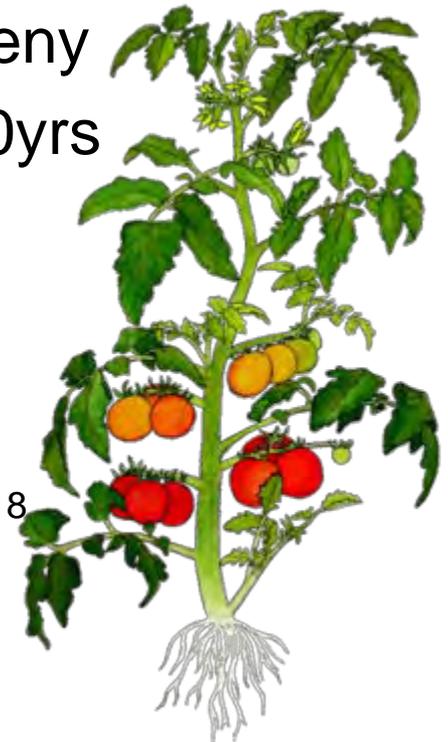
- ✓ Air – CO<sub>2</sub>
- ✓ Water
- ✓ Warmth
- ✓ Soil
- ✓ Sunlight

It's all changing except sunlight!



# Increases in CO<sub>2</sub>

- Increases beneficial to 95% plants – grow faster, larger
  - But offset by high T° and water stress
  - Weeds harder to control
  - Insects eat more, live longer, more progeny
  - 30% less protein in pollen for bees – 100yrs
  - **Human/insect nutrition – 2050 (550ppm)**
    - 3-17% less protein, iron, zinc – many crops
    - **Worldwide implications**



Ziska, USDA, ARS; Evich, 2017, Dong 2018, Smith and Myers, 2018



# Increases in CO<sub>2</sub>

- **Eat your vegies!**
- 8 to 59% higher concentrations of fructose, glucose, total soluble sugar, total antioxidant capacity, total phenols, total flavonoids, ascorbic acid, and calcium.
- Better tasting kale?

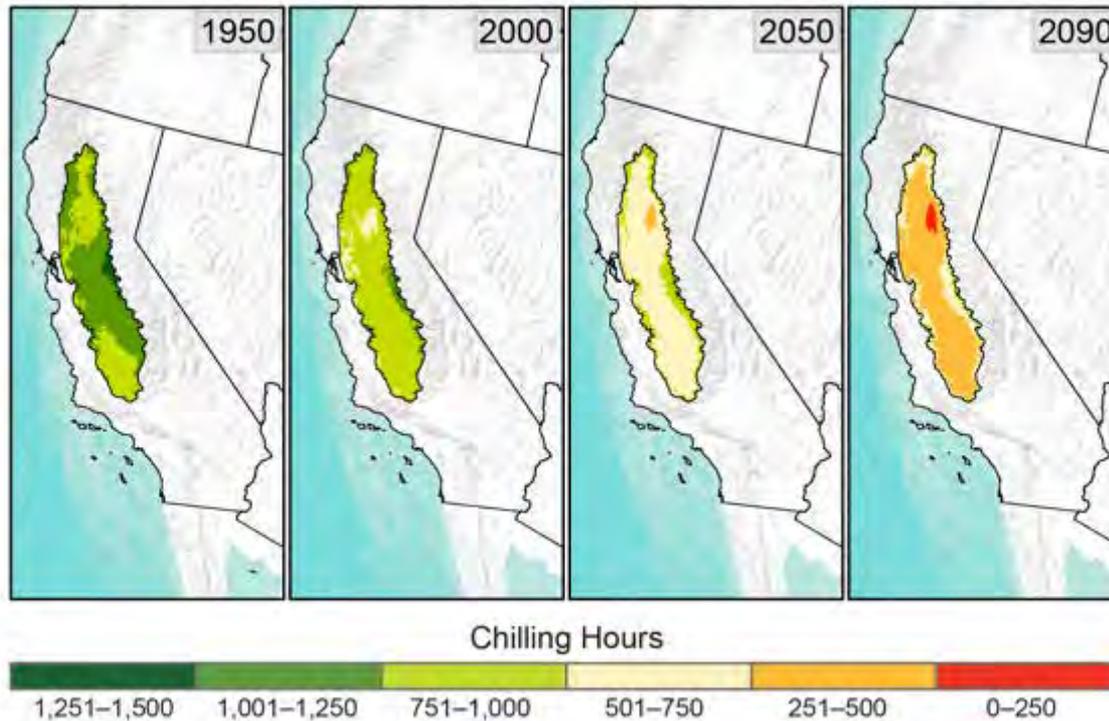
# Changes in Temperature

- It's warming, but it's not simple
  - Cool regions warm faster than warm regions
  - Cold seasons warm faster than warm seasons
    - Winters warming 2X faster than summers
  - Cool nights warming 20% faster than days
    - Warm nights reduce rice yields
  - More heat waves
    - 1-3 day heat extreme = reduced yield in wheat



# Loss of Winter Chill

Reduced Winter Chilling Projected for California



National Climate Assessment

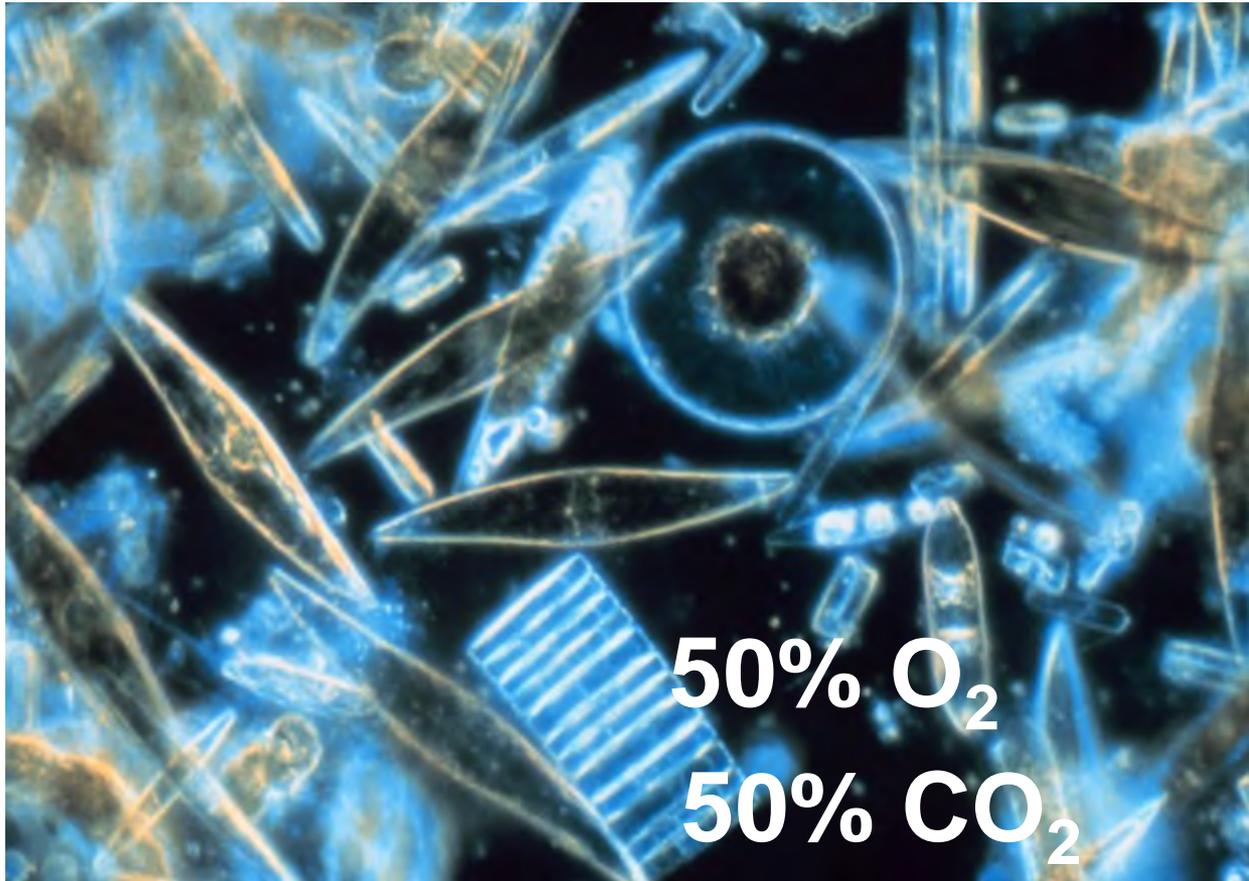


Joey Williamson, ©2015 HGIC,  
Clemson Extension



# And plants in the ocean?

Phytoplankton –  
The basis of the  
ocean food chain  
is also changing.  
20% decline –  
Indian Ocean



Roxy et al., 2016

# Fourth National Climate Assessment - Agriculture

*Rising temperatures, extreme heat, drought, wildfire on rangelands, and heavy downpours are expected to increasingly disrupt agricultural productivity in the U.S...*

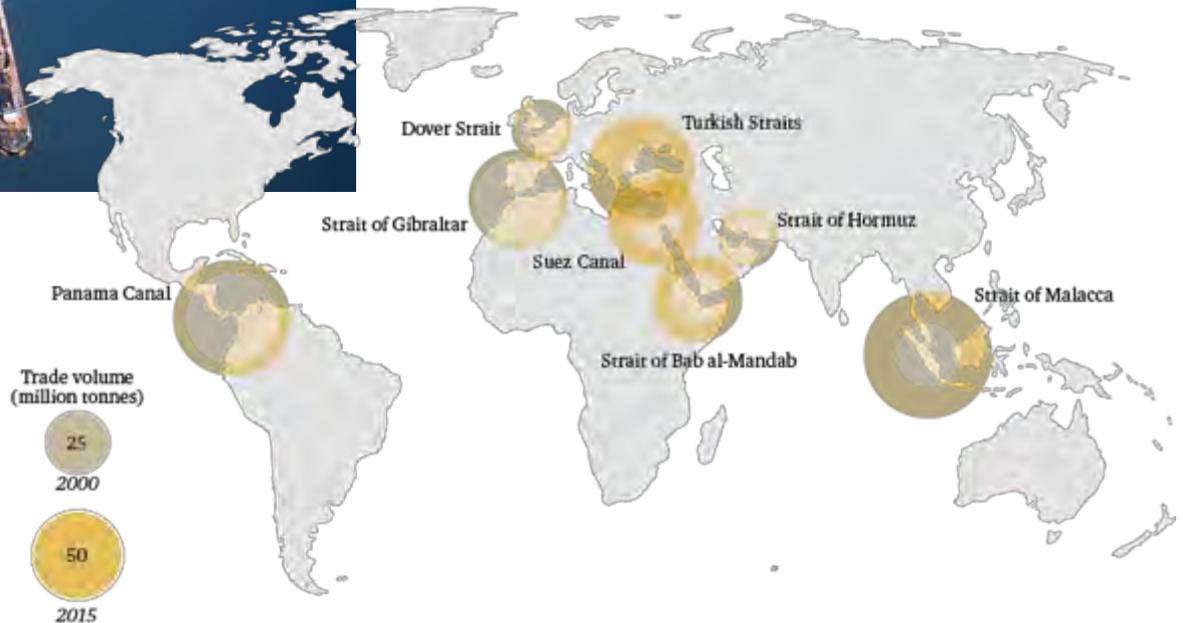
**+ IPCC 1.5 Report**

# Supply Chain Chokepoints



- Mississippi River 2012, 13, & today Drought/flood
- SLR – 60,000 miles

Annual maritime chokepoint throughput of maize, wheat, rice and soybean, 2000 and 2015



(FHWA 2008, USDA 2019)

# Proof!



# Our Interconnected Food System is Changing – What's up with dinner?

- Growing food is no longer business as usual
- Supply chains changing
- Supply and price volatility
- More risk

**The Menu is Changing!**

*Bon appétit!*

## *Dinner Menu*

D'Anjou Pear Salad with Farmstead Goat Cheese  
Fennel, Black Walnut and White Balsamic

Poached Maine Lobster  
Candied Carrots and Black Trumpet Mushrooms  
Dumol Chardonnay "Pavian River" 2008

Dry Aged Rib Eye with Buttermilk Crisp Onions  
Double Stuffed Potatoes and Creamed Spinach  
Quilceda Creek Cabernet "Columbia Valley" 2005

Old Fashioned Apple Pie with  
Vanilla Ice Cream  
Poet's Leap Riesling "Botrytis" 2008

# Climate change and dinner



# The foods and beverages I need and love [and don't] are changing.

- **Need and love**

1. Gin
2. Gin
3. Gin
4. Wine
5. Coffee
6. Mashed potatoes
7. Pecan pie

- **Sort of**

1. Kale\*



Make your own favorite list – what is changing?

\*My daughter "encourages" me to eat it

# The next time you eat - Ask what's up with the food?

Rice	Spices
Wheat	Maple syrup
Garlic	Kiwi
Beer	Pistachios
Apples	Perfume
Olives	Cotton
Soybean	Tea

Search *climate change + any food/ingredient*. See if you can get someone's attention about climate change via food?

# Most of us are fortunate... But what If?

Low income/poor

You live where agriculture is rain-fed

You have few resources to adapt

Food security challenge

Moral challenge





# And it's not just human food - Plant-based industries -

- Pet food (\$30B in US, 2016)
- Apparel (cotton, silk, wool)
- Resins, dyes
- Perfumes (\$70B by 2026)
- Flavors
- Cosmetics
- Pharmaceuticals
- Medicinal herbs (\$111B by 2023)
- Food additives



# Depressed? Overwhelmed?

## Options:

- Move?
- Ignore?
- Deny?
- Too busy
- Not in our DNA
  - Far away in time, location
- Life is good



# Solutions & Hope

Solutions & Hope

# What Can We All Do?

## - Tackling climate change - saving the menu -

- *Farmer, [rancher, fisher]*
  - *Climate smart farming*
- *Food & beverage industry – food chain*
- *Research & Innovation*
  - *Resilient crops*
- *You*
  - *Be informed*
  - *Accept*
  - *Act*
  - *Raise your voice*



# *Farmer, Rancher*

*Appreciate and support*

*Farmers are stewards of the land*

*“A normal season does not seem like it happens any more. It’s either really dry, or really wet. It seems like when we get rain, it’s apocalyptic... We got 5 inches of rain in about 1.5 hours, and I had a lot of soil loss... I see the impact for generations.”*



# US Farms/Farmers

- <2% of population
- 97% family farms
- 50% had negative income
- It's a risky business
- Add climate change
- Reflect - *Who grows my food and where?*



# A continuum of farm types

## Potential for common ground

### Conventional - organic



# Climate Smart Farming

## - Key Strategies -

- Focus on soil health
- Effective water management
- Ecologically-based pest management
- Diversify for financial resiliency
- Reduce livestock stress
- Farm/company planning & adaptive management

Climate Smart Farming in the Northeast: Six Key Strategies for Farmers  
Brewer et al., 2018. Cornell Institute for Climate Smart Solutions

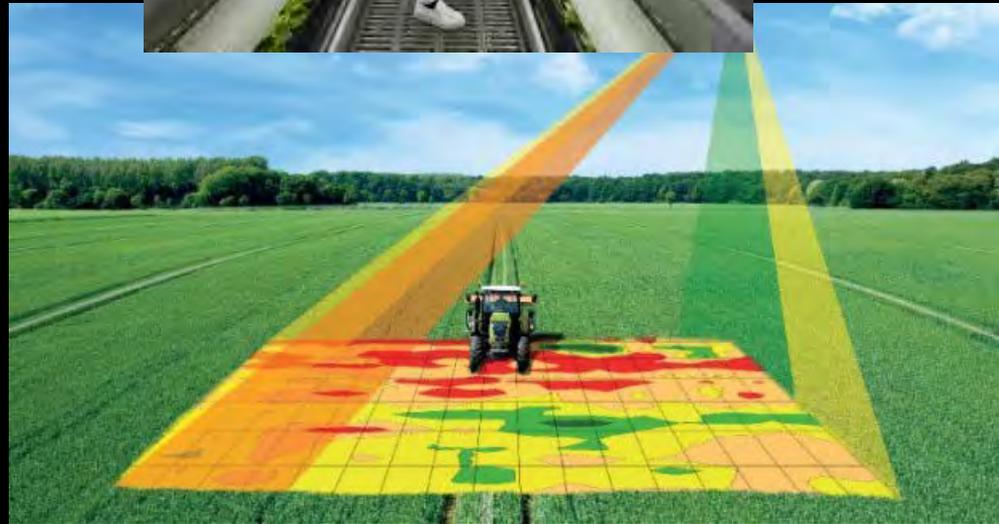
# Soil – The Skin of the Earth

- Most biologically active part of the planet
  - Current carbon deficit – 30-75%
  - Carbon farming - Potential to off-set global GHG emissions
  - Cover crops, 15 M acres, up 50% 5 yrs.
  - Conservation tillage, 65% soybean, corn, wheat
  - Rangeland management
  - Agroforestry/Silvoculture
  - Make a farmer your friend



# Research & Innovation

- Precision agriculture
  - Less fertilizers, water, pesticides
- Artificial intelligence
  - Pest, weed identification
- Controlled Environment Agriculture
- Climate smart decision tools
- Climate resilient crops
  - Traditional breeding and genetic-engineering





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Powerful and user-friendly climate tools for farmers in the Northeast

How is the changing climate affecting your farm?

## Climate Smart Farming Decision Tools

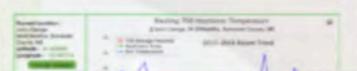
Cutting-edge tools to help farmers manage climate risk.

See more Tools

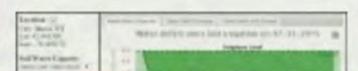
CSF Growing Degree Day Calculator



Grape Hardiness & Freeze Risk



CSF Irrigation Scheduler

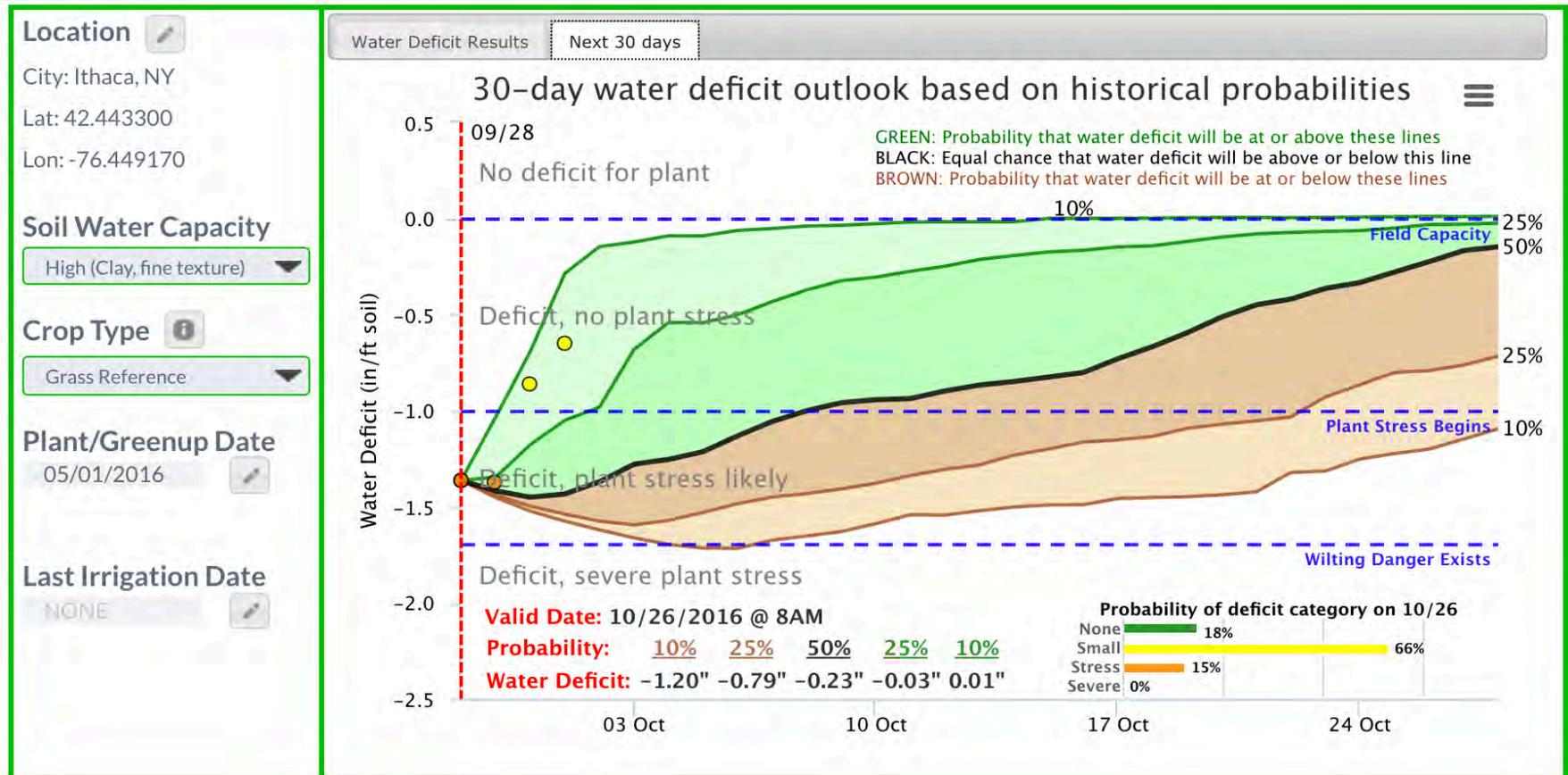


Climate Normals - Northeast Regional Climate Center



# CSF Water Deficit Calculator

- Can be used to plan water applications to minimize plant stress and maximize water conservation
- Assesses the probability of naturally reaching certain levels of soil water content over the next month



# NE Climate Center

## Current Location

County: Tompkins  
State: NY

[View County Map](#)

## Temperature

- Season length
- Max Temp (Annual)
- Min Temp (Annual)
- Extreme Temp Events
- GDD (Annual)

Base: 50°F

## Precipitation

- Precipitation (Annual)
- Extreme Prcp Events

View Projections

[Info](#)



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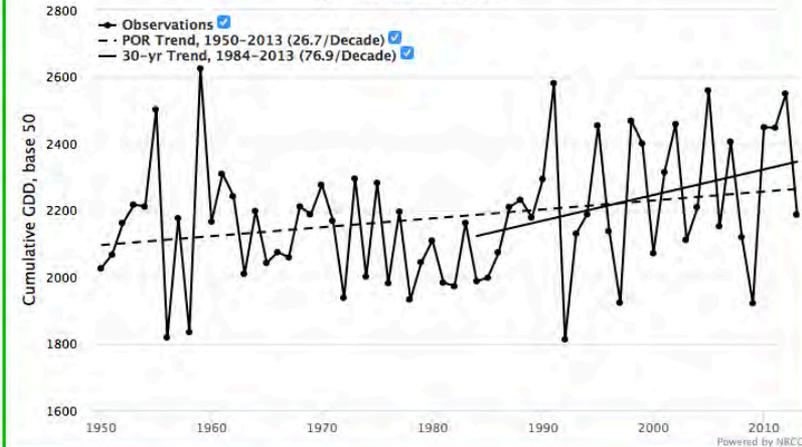
- Precipitation (Annual)
- Extreme Prcp Events

View Projections

[Info](#)

## Cumulative Growing Degree Days, base 50 (Annual)

@ Tompkins County, NY



# Climate change in your county

## Current Location

County: Tompkins  
State: NY

[View County Map](#)

## Temperature

- Season length
- Max Temp (Annual)
- Min Temp (Annual)
- Extreme Temp Events
- GDD (Annual)

Base: 50°F

## Precipitation

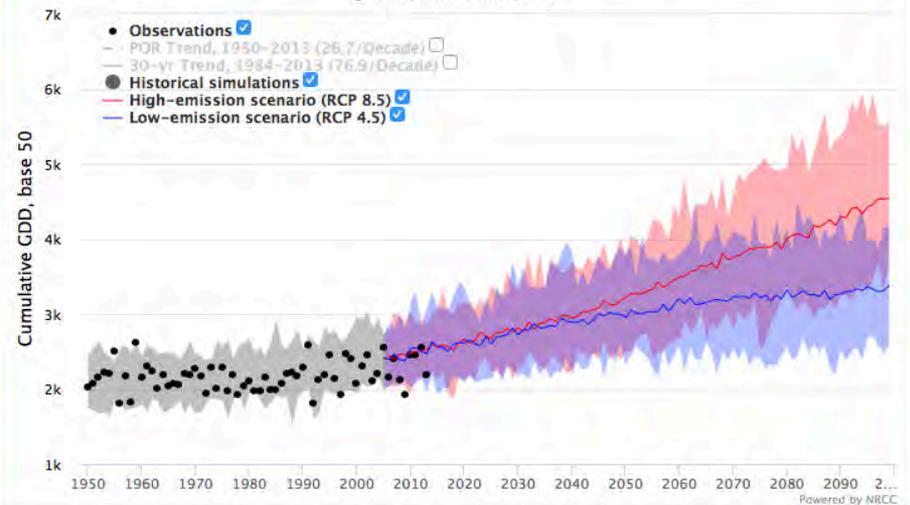
- Precipitation (Annual)
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View Projections

[Info](#)

## Cumulative Growing Degree Days, base 50 (Annual)

@ Tompkins County, NY



# Climate Resilient Crops

## - Plant breeding -

- Desired characteristics:
  - Today - taste, aroma, appearance, height, color, yield, harvestability, storage, processing qualities, resistance to insects, fungi, bacteria...
  - Climate resilient - drought, salinity, heat, flood, nutrition (protein, zinc, iron)...
- Traditional breeding - genetic modification
  - We have been eating >100 years



# Climate Resilient Crops

## - Plant breeding -

- Genetically engineered (modified) crops
  - Introducing trait (gene) that does not already occur there – from same species or another
  - *Bt* crops
    - *Bt* occurs naturally in soil
    - *Bt* - a sprayable insecticide – conventional & organic farms
    - 2018 - 80% cotton and corn *Bt*



# Climate Resilient Crops

## - Plant breeding -

- Genetically engineered crops
  - National Academy of Sciences – 2016
    - Economic benefits
    - Environmental benefits
    - Region wide pest suppression
    - Human food – no more health risk than conventional foods
    - Not a silver bullet
    - Believe the science – climate change & GMO's

# Climate Resilient Crops

## - Plant breeding -

Clustered regularly interspaced short palindromic repeats - CRISPR



Piano with 32,000 keys

Corn plant with 32,000 genes

# Food & Beverage Businesses

- Encourage climate smart farming
- Supply chain risk assessment
- Develop & use technology for conservation
- Invest in suppliers to ensure productivity & resiliency
- Research & develop alternative ingredients
- *Jobs, the economy, and political attention/action?*
  - *A message for the food industry to convey*

From: *Adapting to Climate Change: A Guide for the Food, Beverage, and Agriculture Industry*. BSR Report

# Now its Your Turn

## What can I do?

- Be informed – be climate change literate:
  - Understand:
    - the essential principles of Earth's climate system,
    - the likely impacts of climate change,
    - the costs & impacts of climate change mitigation & adaptation,
  - know how to assess credible information about climate,
  - communicate effectively about climate change,
  - is able to make informed & responsible decisions with regard to actions that may affect climate.
  - At Cornell – EA, SA, UA resolutions

# Now its Your Turn

## What can I do?

*Drive, fly, light, heat, cool, buy - less*

*Shift to a plant-based diet\**

*Reduce food waste\**

*Speak up, raise your voice*

*Begin talking about climate change\*\**

\**Drawdown* – Paul Hawkin, ed.

\*\*Katherine Hayhoe

# Talking About Climate Change

- Meet people where they are. Listen to what they say and then respond.
- Avoid too many facts, feelings are more important
- Make it relevant – personal - kids, grandkids, coffee
- Don't use fear, make it a conversation
- Talk about solutions in your personal life and workplace

*Captive audience on a plane*

# Can we draw attention to climate change through food?

Everybody eats!

*Melting glaciers are bad enough but the loss of coffee is downright terrifying!*



# Taking Action

Get informed

Accept the truth

Act - Get involved

Push for changes big  
enough to matter. McKibben

# - Taking Action -

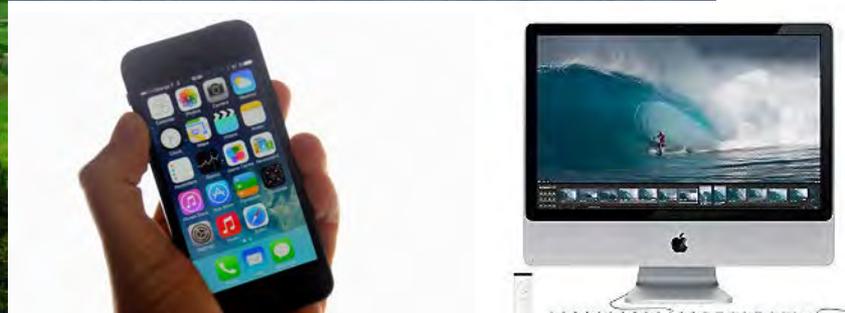
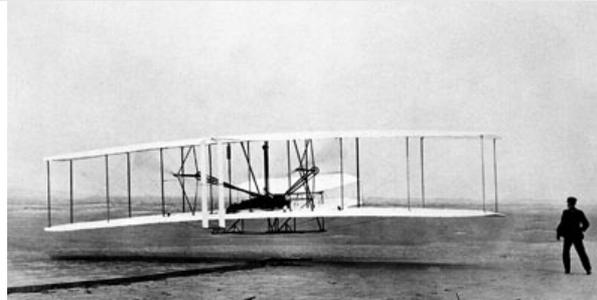
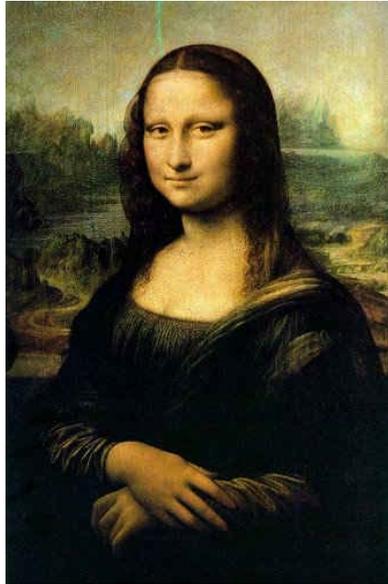
- Remember that you are not alone.
- There are a million ways to solve this problem but one person can only do just so much.
- Find one thing you can do best and most effectively.
- Don't give up.
- Raise your voice – we all eat!

Climate anxiety doesn't have to ruin your life. Here's how to manage it.

<http://grist.org/article/how-i-learned-to-stop-worrying-and-deal-with-climate-change/>



- Climate Change -  
A grand challenge we can tackle  
If we have the will



# Thank you!

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*TEDx: Climate Change: It's time to raise our voices*

*Forthcoming book – Our changing menu: What climate change means to the foods we love and need*

