

Climate Change and Agriculture No Longer Business as Usual

Mike Hoffmann

Associate Dean

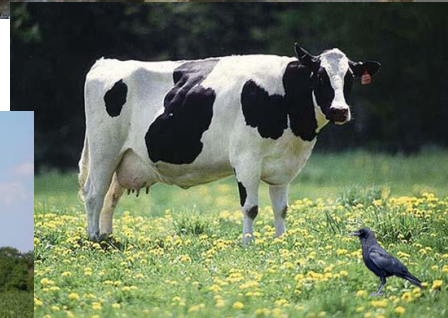
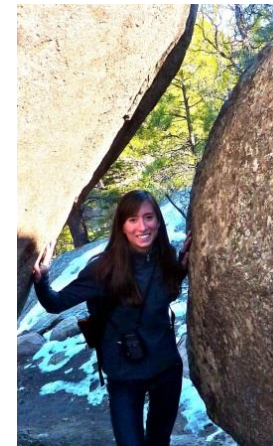
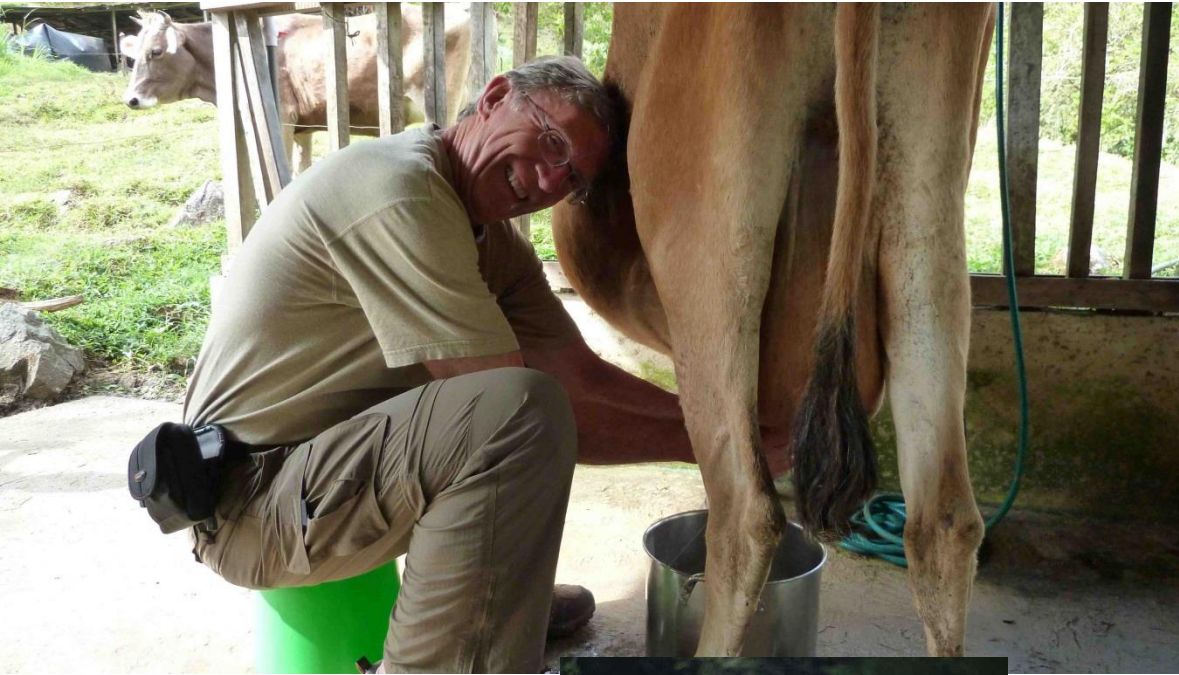
College of Agriculture and Life Sciences

Director

Cornell University Agricultural Experiment Station (Ithaca)



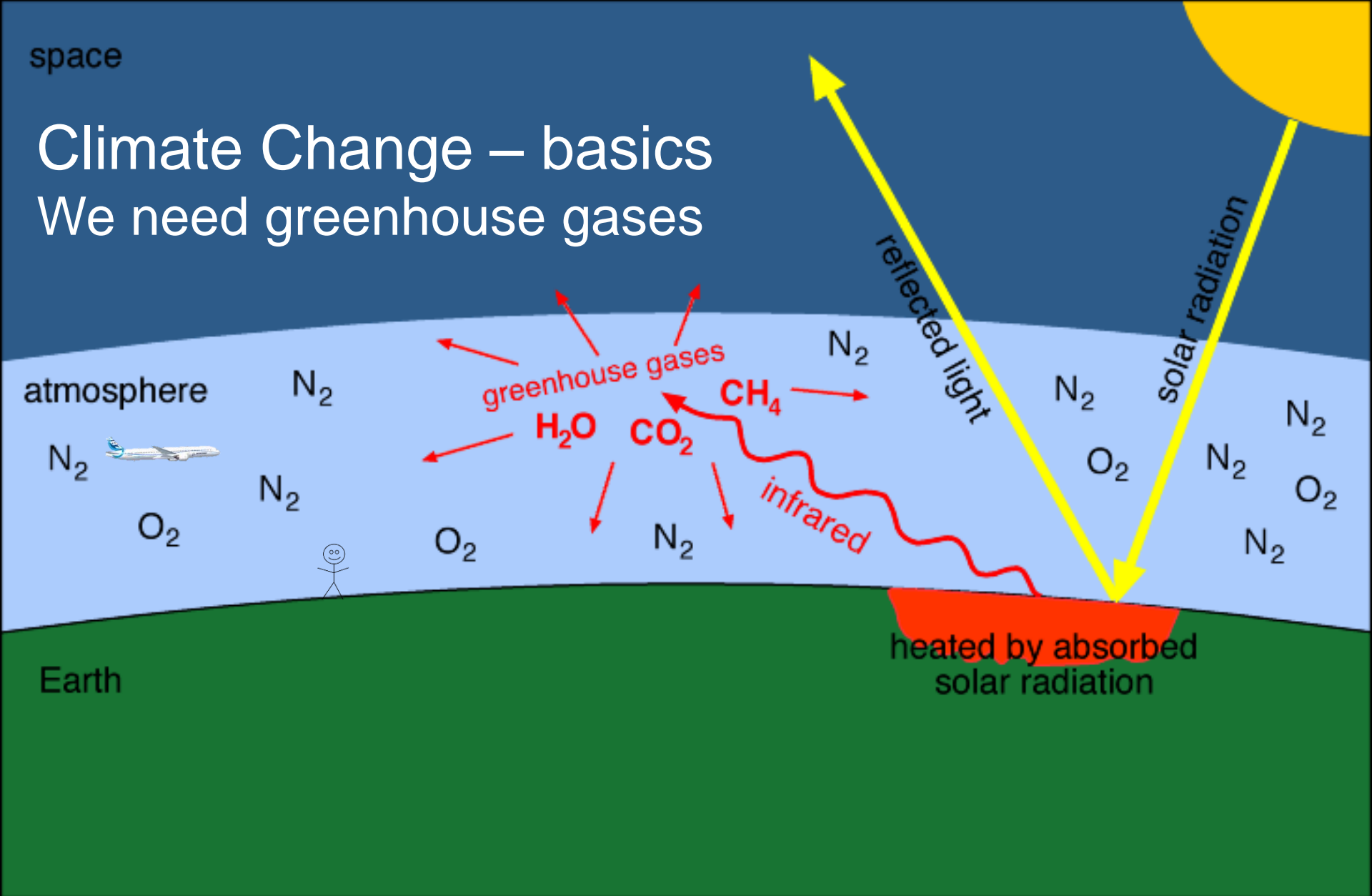
Why me?



space

Climate Change – basics

We need greenhouse gases



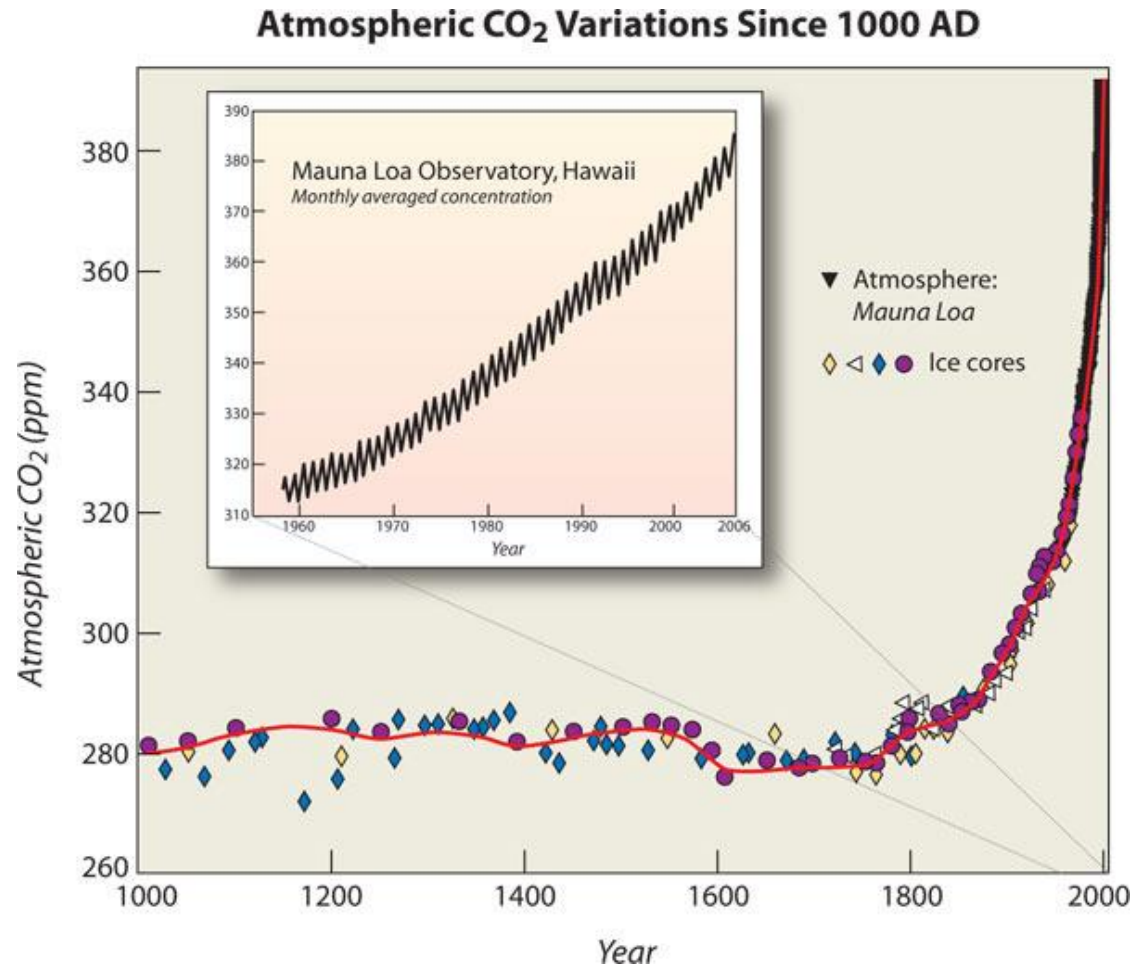
The “blanket” is getting thicker



It is caused by humans

Carbon Dioxide

- Tyndall 1857
- 1800: 270 ppm
→ a good thing
- 2014: **400 ppm**
→ highest in millions of yrs.
- 2100: **900+ ppm**
- ^{12}C from fossil fuels



The Atmosphere (Bathtub) is Filling Up!

GHG Faucet: From burning fossil fuels, deforestation



GHG Drain: To plants and oceans
100's -1000's of years to rebalance

Sources of Greenhouse Gases (US)



Transportation 28%



How many flights/day?

Electricity 33%



Industry 20%



Agriculture 8%

Climate Change Facts

- 1.5°F increase globally
 - Warmer at the poles
- Hottest decade: 2001-2010: 2012
- Hotter summers, warmer winters
- Rate of warming is fast
 - 8°F in 100 yrs. (usual business)
 - 50X faster – from last ice age

A Grand Challenge



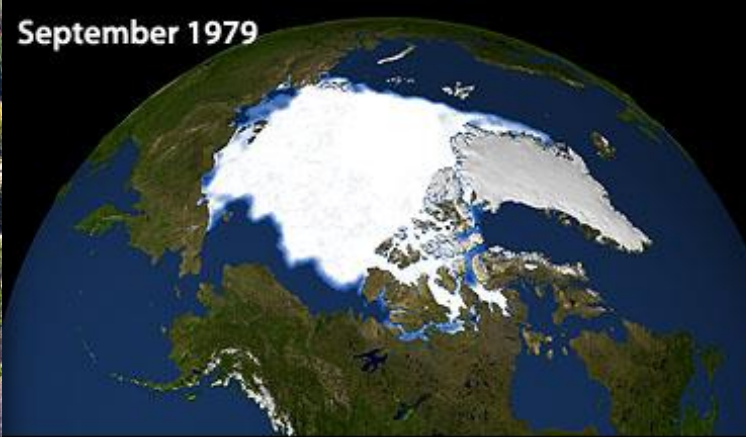
Climate vs. Weather

Climate vs. Weather

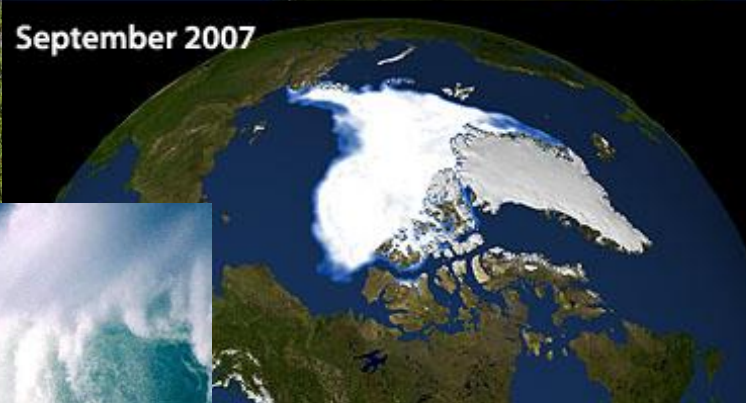
Evidence all around us



September 1979



September 2007



S. Beck '01



Atlatreux Glacier, Jasper National Park Canada in 1917 and 2005. Wheeler Survey photo (color) © 2005



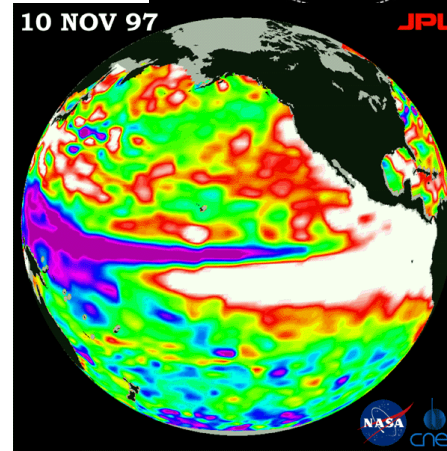
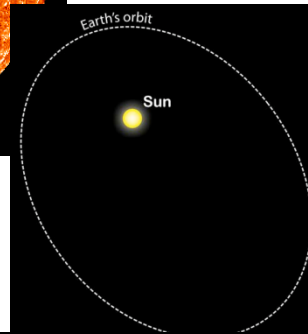
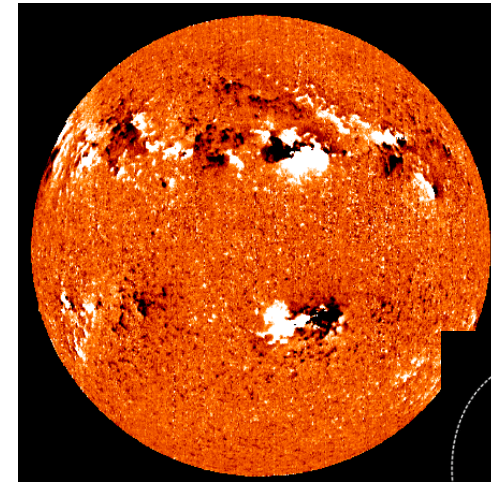
Even more evidence!



But Wait a Minute

Some of this could be natural!

- Solar output varies
 - Since 1960 slight cooling
- Earth's orbit
 - Wobbles every 41,000 yrs.
 - Near/far every 22,000 yrs.
- El Niño, La Niña
 - Natural cycles
 - 2015 El Niño could be a record breaker
 - Record high temps, California drenched



Depressed? Overwhelmed?

Options:

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



Agriculture

No Longer Business as Usual

- Hotter summers, warmer winters
- Changes in precipitation patterns
- Increasing extreme weather events
- New pests
- More variability, more risk
- Impacts local to global

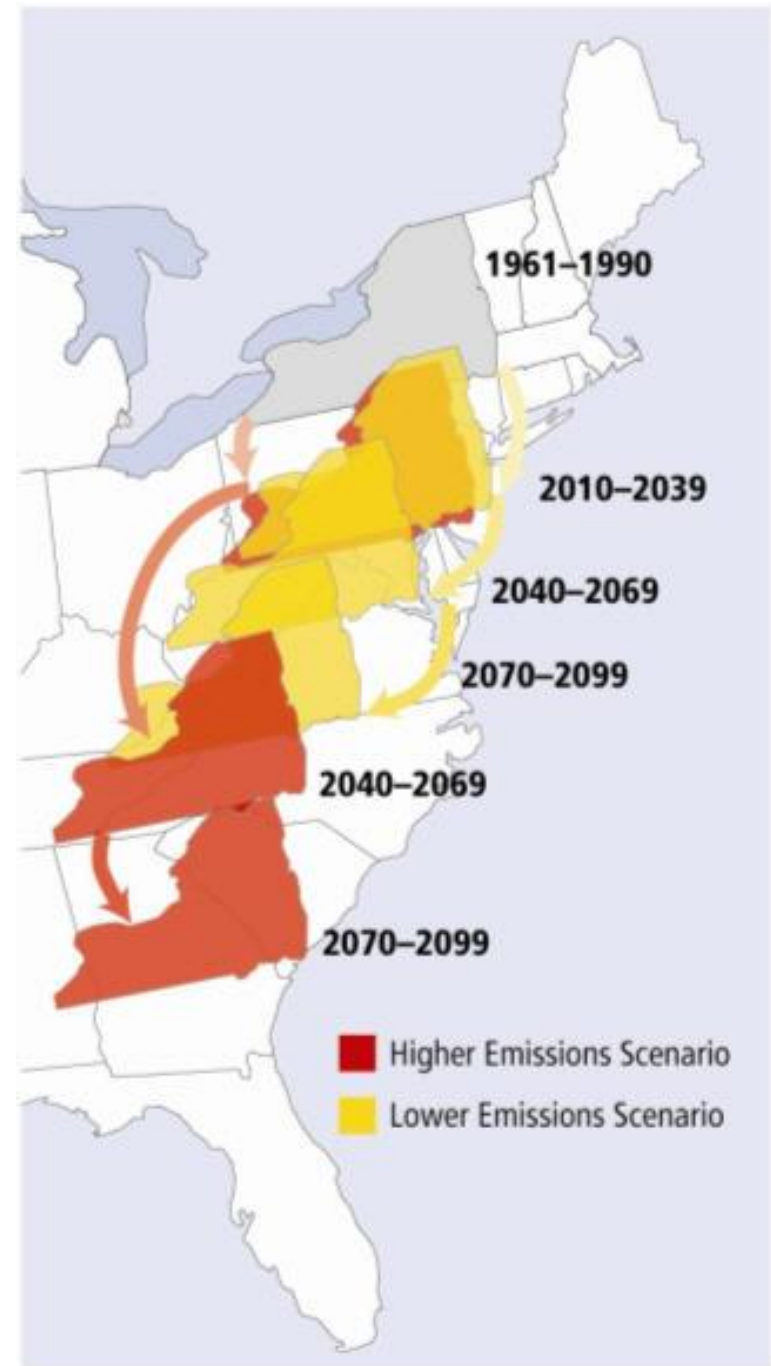


Summer heat index:

How hot summers will “feel” in

Upstate New York

By 2100 >50 days above 95°



Rapid Shift in “Plant Hardiness” Zones

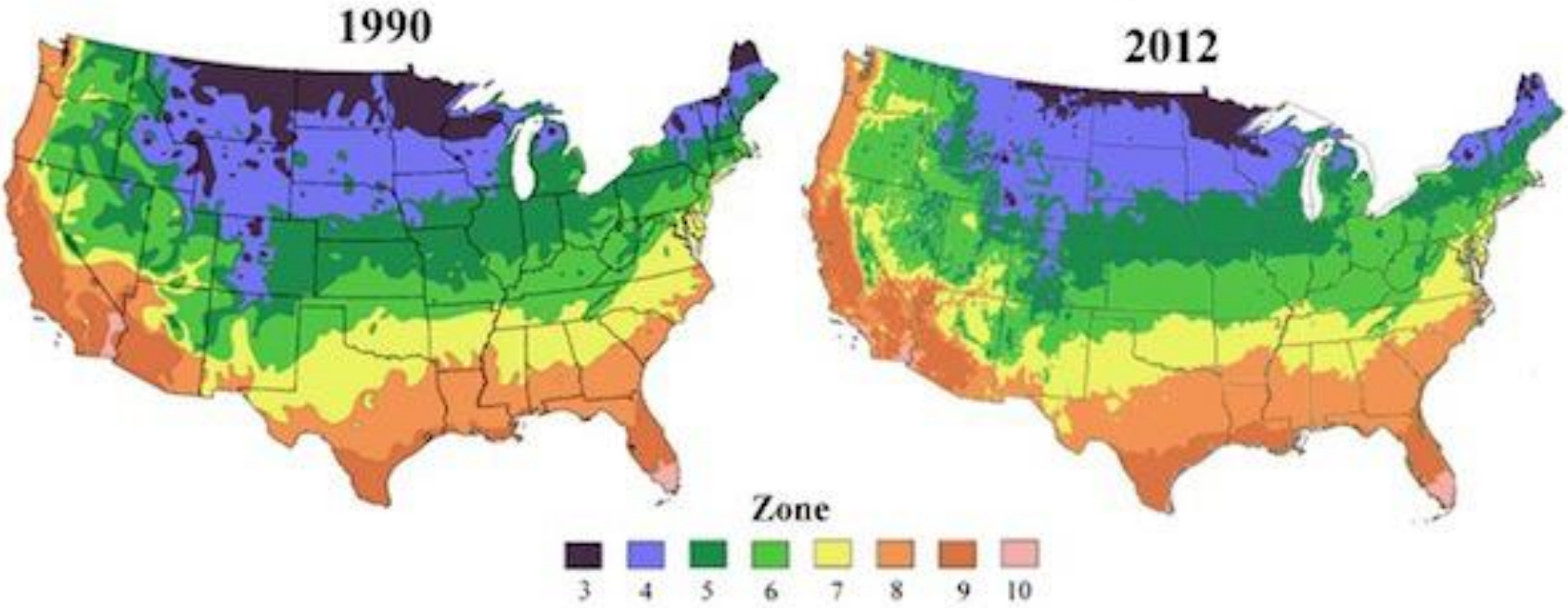
(maps based on minimum winter temperatures)

Zones moving North 30yds/day!

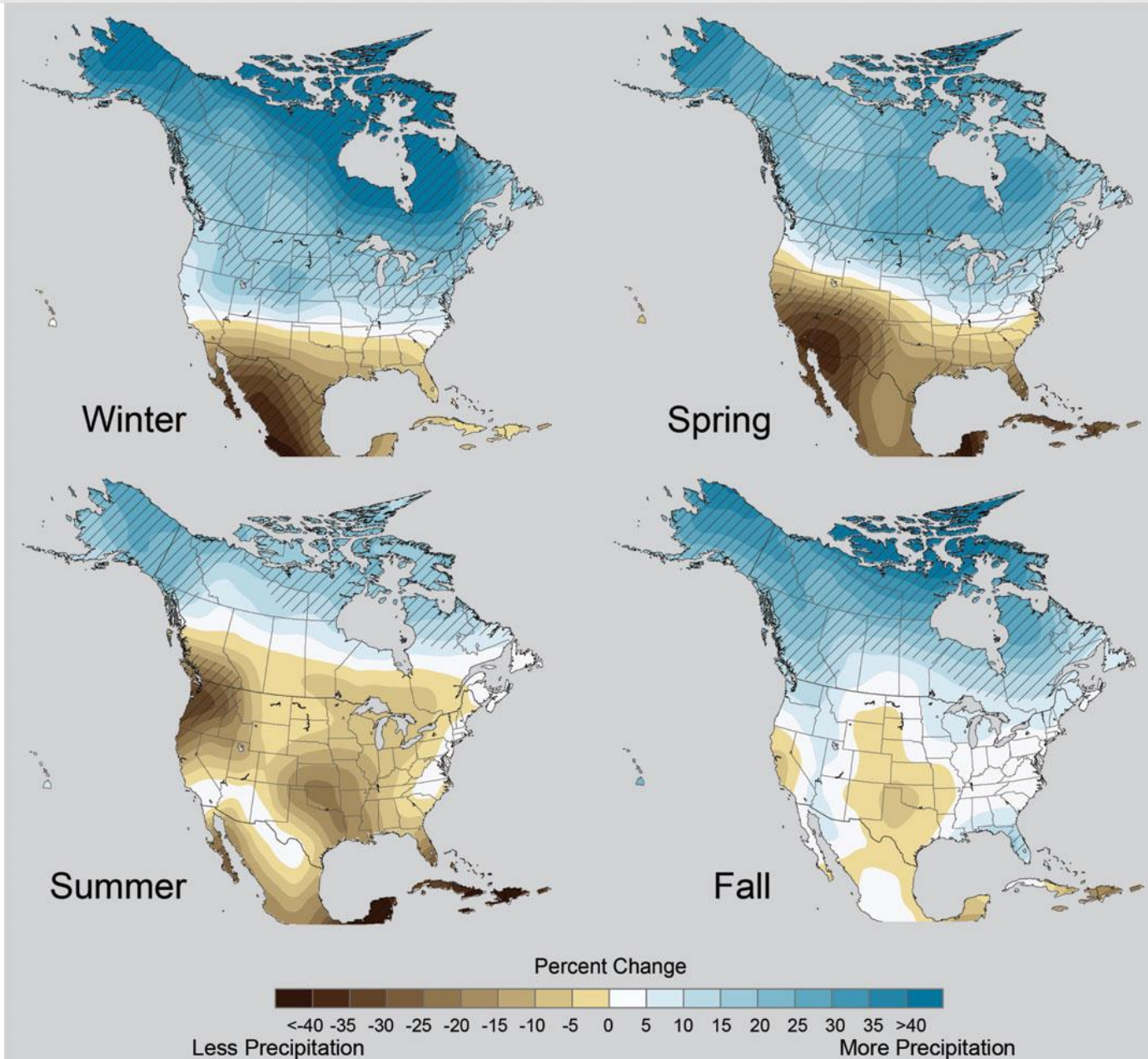
Red River Valley, Manitoba
2005-8; 20K acres grain
Today 1.1 million & expanding

Zone	Avg. Annual Low
1	Below -50°F
2	-40°F through -50°F
3	-30°F through -40°F
4	-20°F through -30°F
5	-10°F through -20°F
6	0°F through -10°F
7	10°F through 0°F
8	20°F through 10°F
9	30°F through 20°F
10	40°F through 30°F

USDA Plant Hardiness Zone Maps



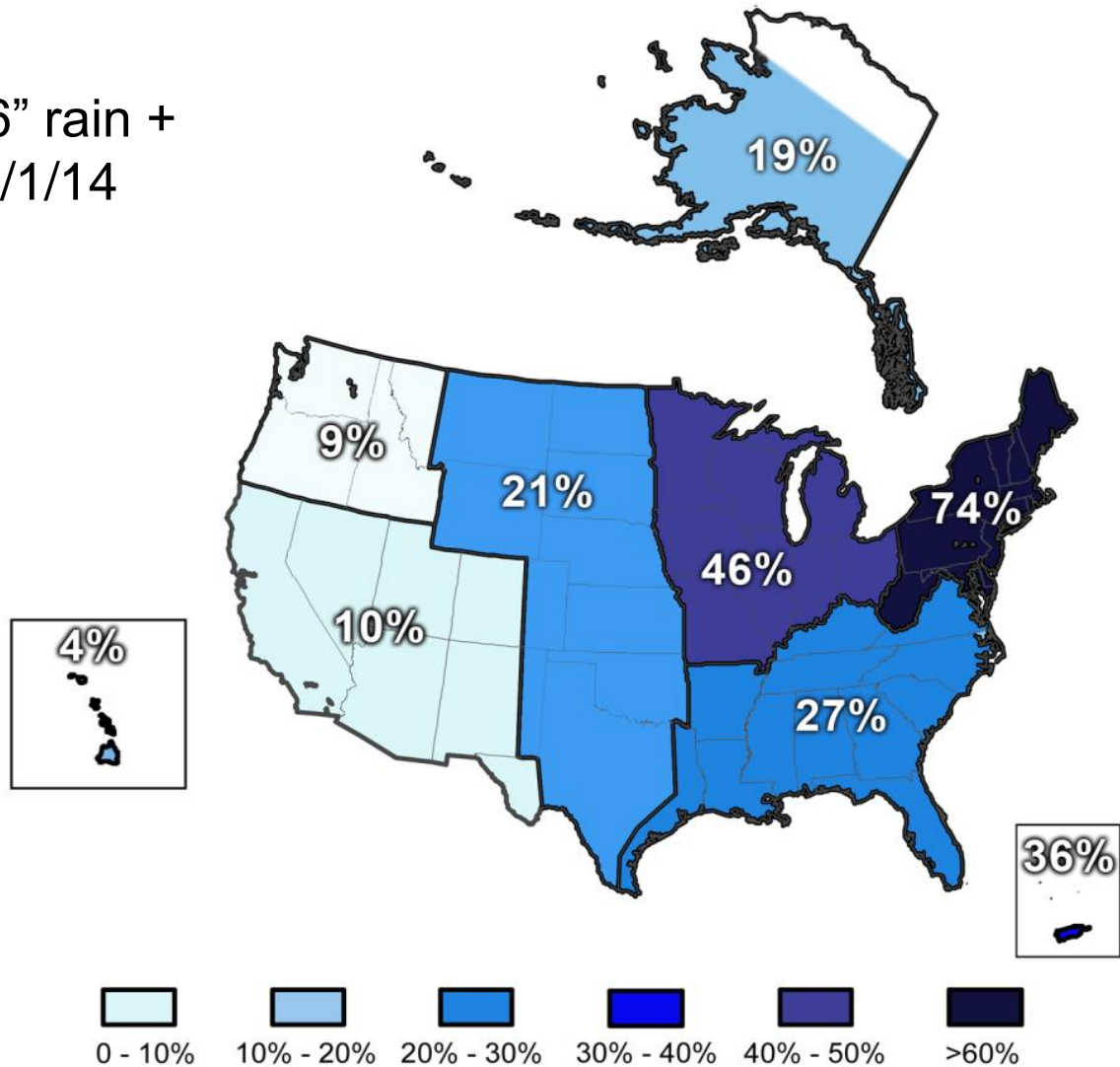
Projected Change in Precipitation: 2081-2099



Relative to
1960-1990

Trend (1958-2010) for increased frequency of heavy precipitation events

NYSAES: 6" rain + hail, 7/28-8/1/14



Climate Change and Agriculture Northeast US

Challenges

- Extreme weather: floods, droughts, high temp stress
- New pests
- More unpredictable



Opportunities

- Adequate water
- Longer and warmer growing seasons
- Shifts in productivity elsewhere
 - California drought
 - Glacial melt waters



The Opportunities – NE US

- Potential to expand and diversify agriculture
 - New crops, new varieties
 - Double cropping, increased yields
- Expanded markets
 - 22% of US population in NE – great cities to feed
 - Local grown, lower carbon footprint food supply
 - Job creation, economic development



What is needed to adapt?

- Decision tools based on economics
 - Cooling for dairies, new crops...
- Improved water management
 - Too much (drainage) or too little (irrigation)
- IPM strategies – new pests
- Communication
 - Among farmers, educators, researchers
- Risk management



What is needed to mitigate?

- Reduce GHG emissions -

- Nutrient management
- Reduced tillage, cover crops
- Energy conservation
- Waste to heat and power
- Renewable energy
 - Willows, grasses – cellulosic ethanol, combustion
- Solar and wind power



What farmers are saying

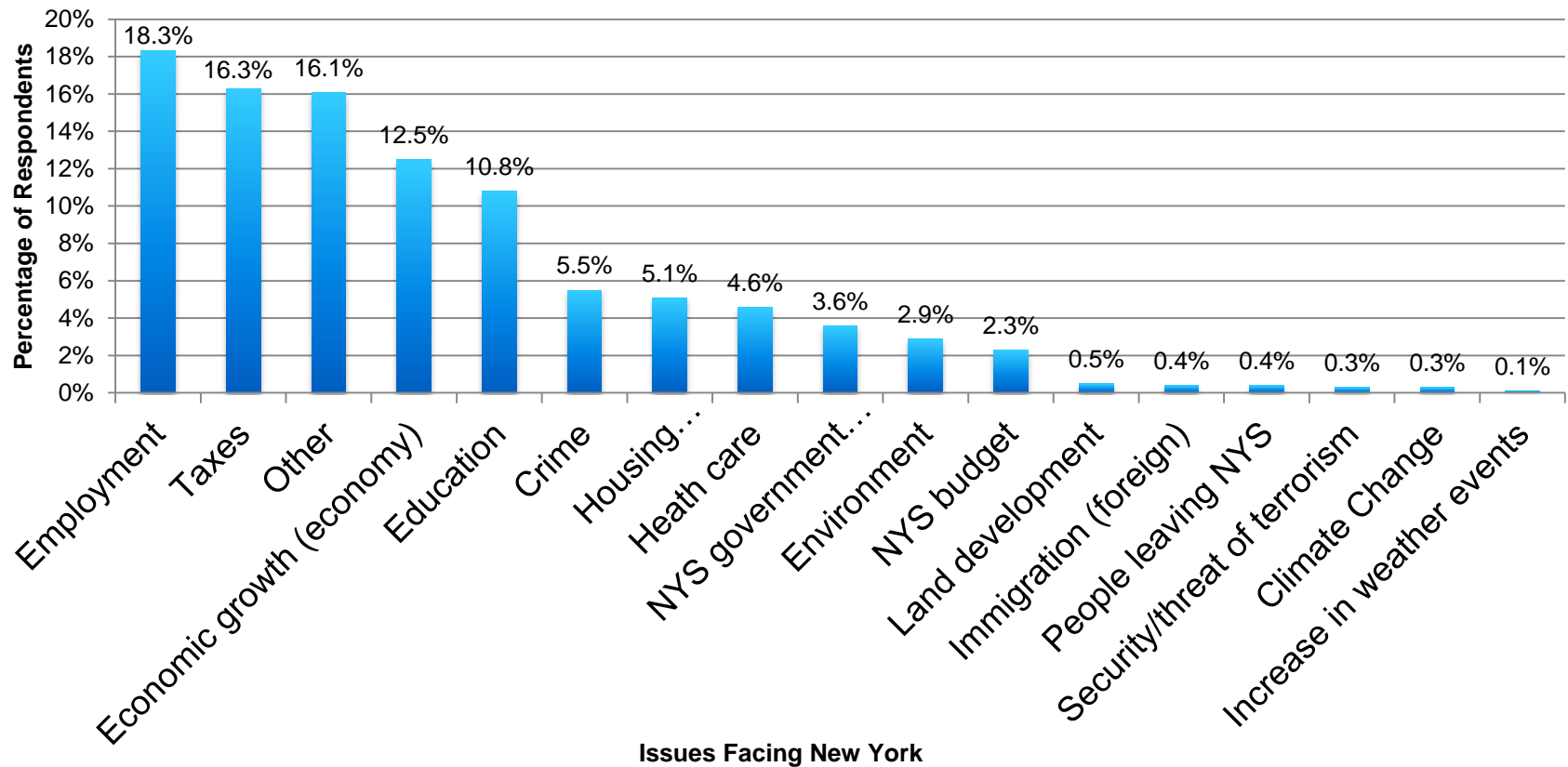


- “I have seen the local effects of extreme weather and climate change. It seems like winters are less severe, we have more severe weather. In one season, we lost a minimum of \$40,000 in crops. As a farmer, you can weather the storm, but you can’t weather continuous storms.”
- “We delayed planting of crops because of the cold, wet spring. Then the week we finally planted seeds, we had an extreme rainfall event with over 2 inches of rain in one day, and more rain expected in two days – I would estimate we lost \$50,000 of seed and will have to replant.”
- “I have serious questions about the long-term viability of farming on my farm. Temperatures are increasing, there is a longer growing season, extreme rain events are increasing. In June 2012, we had 8 inches of rain in 24-hour period. We have seen more pests, emerging earlier, multiple successions, later re-emergence in fall crops. To adapt, we have increased the use of cover crops.”

What New Yorkers are saying

Empire State Poll 2014:

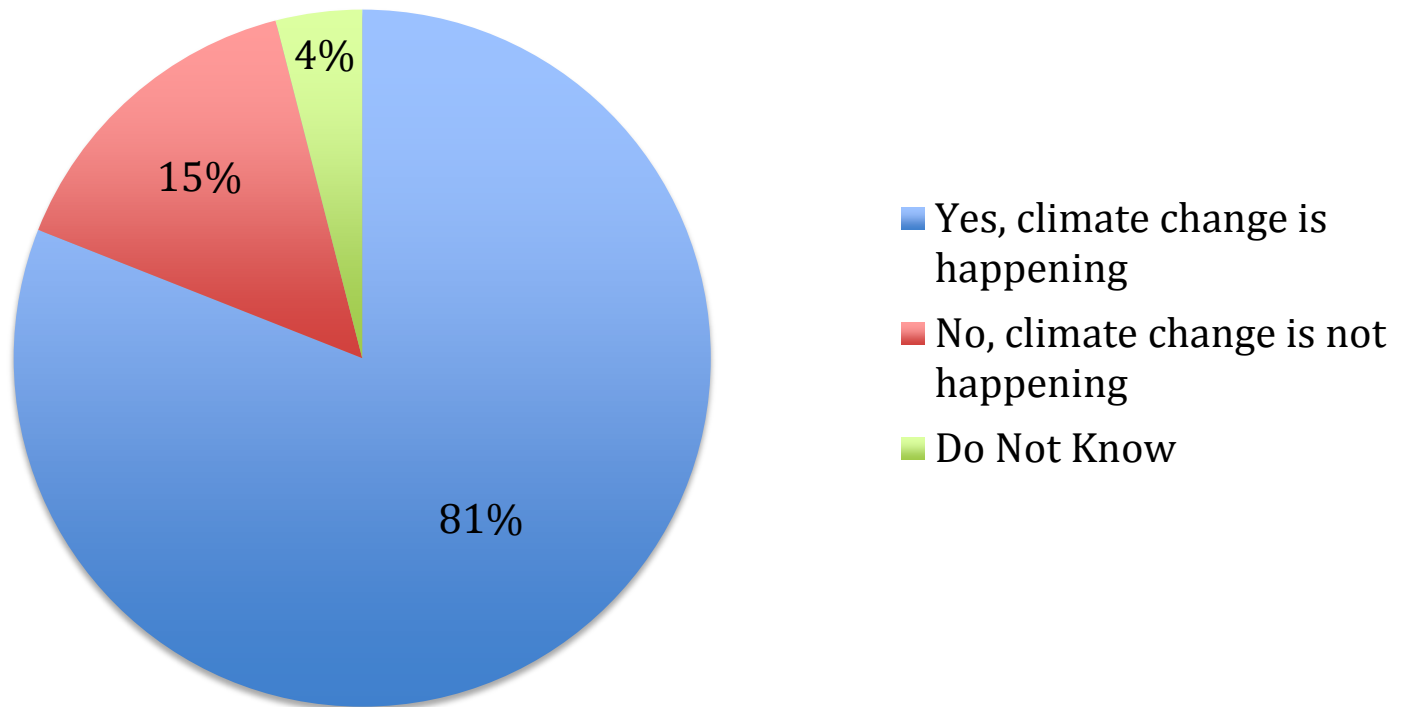
In your opinion, what do you think is the single most important issue facing New York State as a whole?



What New Yorkers are saying

Empire State Poll 2014:

Do you believe that climate change is happening?



But what can I do?

Awareness –

Acceptance – “Oh sh...”

Action –

Start talking about it.

Spread the word!

[Think of that younger person]

“To live is to roll up your sleeves
and embrace trouble”

Nikos Kazantzakis, Zorba the Greek

Cornell '06



We are all on trial!

Cornell '10



In 2050, what will my daughters say about their dad?

Did he try?

Thank You

Mike Hoffmann

Cornell University Agricultural Experiment Station

mph3@cornell.edu

Comments - 3X5 cards



Resources

- Cornell Climate Change Resources:
climateinstitute.cals.cornell.edu
Cornell Institute for Climate Change and Agriculture:
<http://cuaes.cornell.edu/cals/cuaes/sustainability/cicca.cfm>
- USDA Climate Change:
http://www.usda.gov/oce/climate_change/
- US Global Change Research Program (National, Northeast and Agriculture Assessment):
<http://globalchange.gov/>
- Intergovernmental Panel on Climate Change:
<http://www.ipcc.ch/>

The screenshot shows the Cornell Climate Change website homepage. At the top, there is a search bar and navigation links for 'About', 'Research', 'Tools & Resources', 'Students & Courses', 'News & Events', and 'Contact'. The main content area features a large image of a farm with a red barn and silos, titled 'Farming and Agriculture' with the subtitle 'Helping farmers adapt to climate change, save energy and reduce greenhouse gases'. Below this are several sections: 'What's With The Weather?' with a video player, 'Climate Change Forum' with a 'Gardeners part of climate-change solution' article, 'News & Events' with a 'Cows' carbon footprint is smaller than thought' article, 'Featured Resource' with a 'New York's Changing Climate 14-page factsheet', and 'Climate Change Q&A' with a question about the pace of temperature increase.

CORNELL UNIVERSITY COLLEGE OF AGRICULTURE AND LIFE SCIENCES
CLIMATE CHANGE FACTS
CORNELL COOPERATIVE EXTENSION

FARMING SUCCESS IN AN UNCERTAIN CLIMATE

Climate preparedness makes good business sense. The Earth's climate is always in flux, but today's pace of change is far beyond what previous generations of farmers have had to face. Climate change is already posing new challenges, such as increased risk of flooding, summer heat stress, and more intense pest and weed pressures.

Some farmers are beginning to plan to minimize the risks and capitalize on opportunities. In New York, there will be plenty of both. Making business decisions on future scenarios is always a hair-raising endeavor, even more so with the complication of trying to discern between normal weather variability and long-term climate shifts. Many of the commodities that currently dominate the New York agricultural sector, like dairy products, apples, cabbage, and potatoes, are not well suited for the warming trends predicted for this century. However, there will be profitable opportunities to experiment with new crops or new crop varieties as temperatures rise and the growing season lengthens.



FLOODING

More precipitation is occurring in heavy rainfall events (more than 2 in / 48 hrs), and this trend is expected to continue.