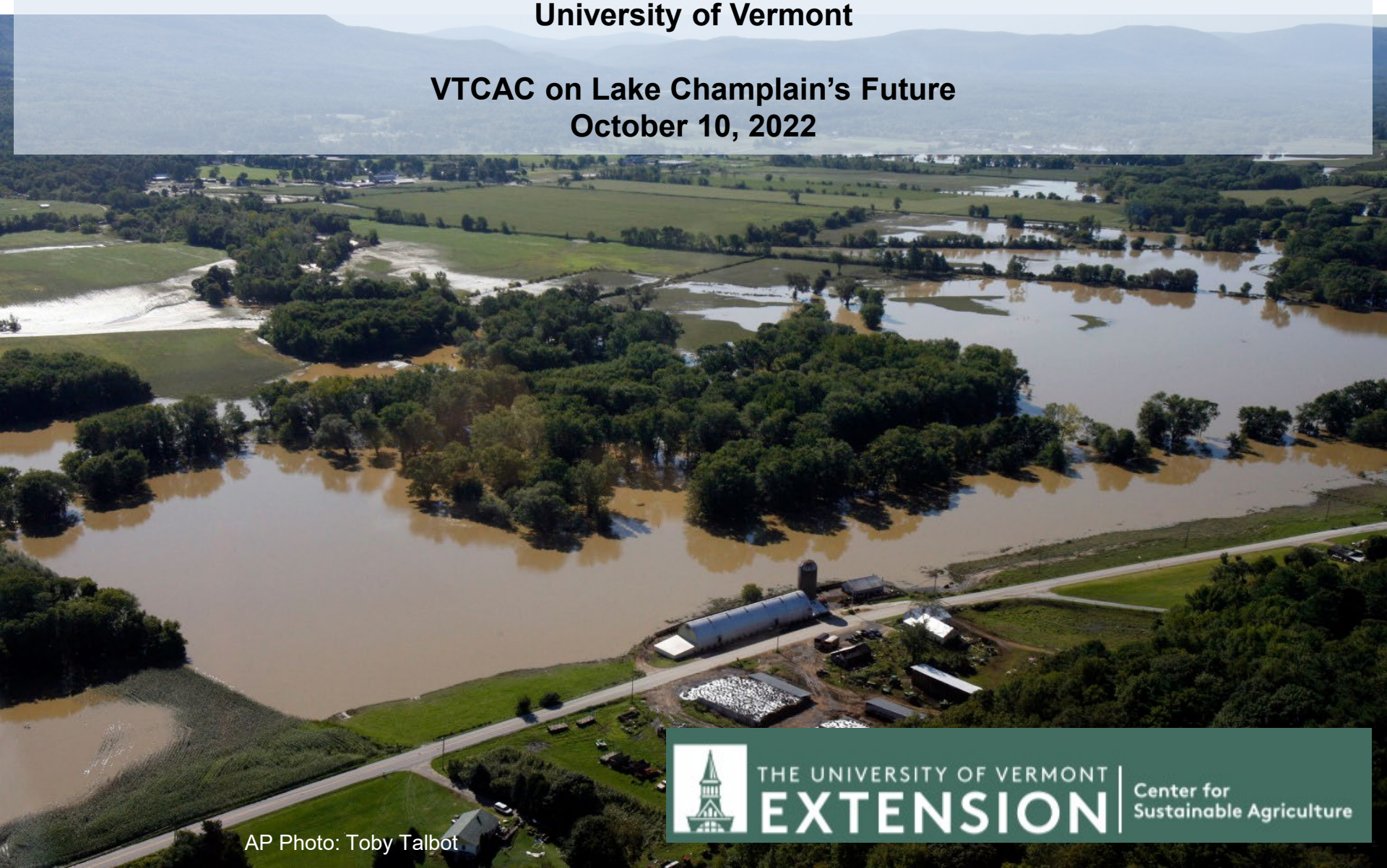
Climate Change and Agriculture in Vermont

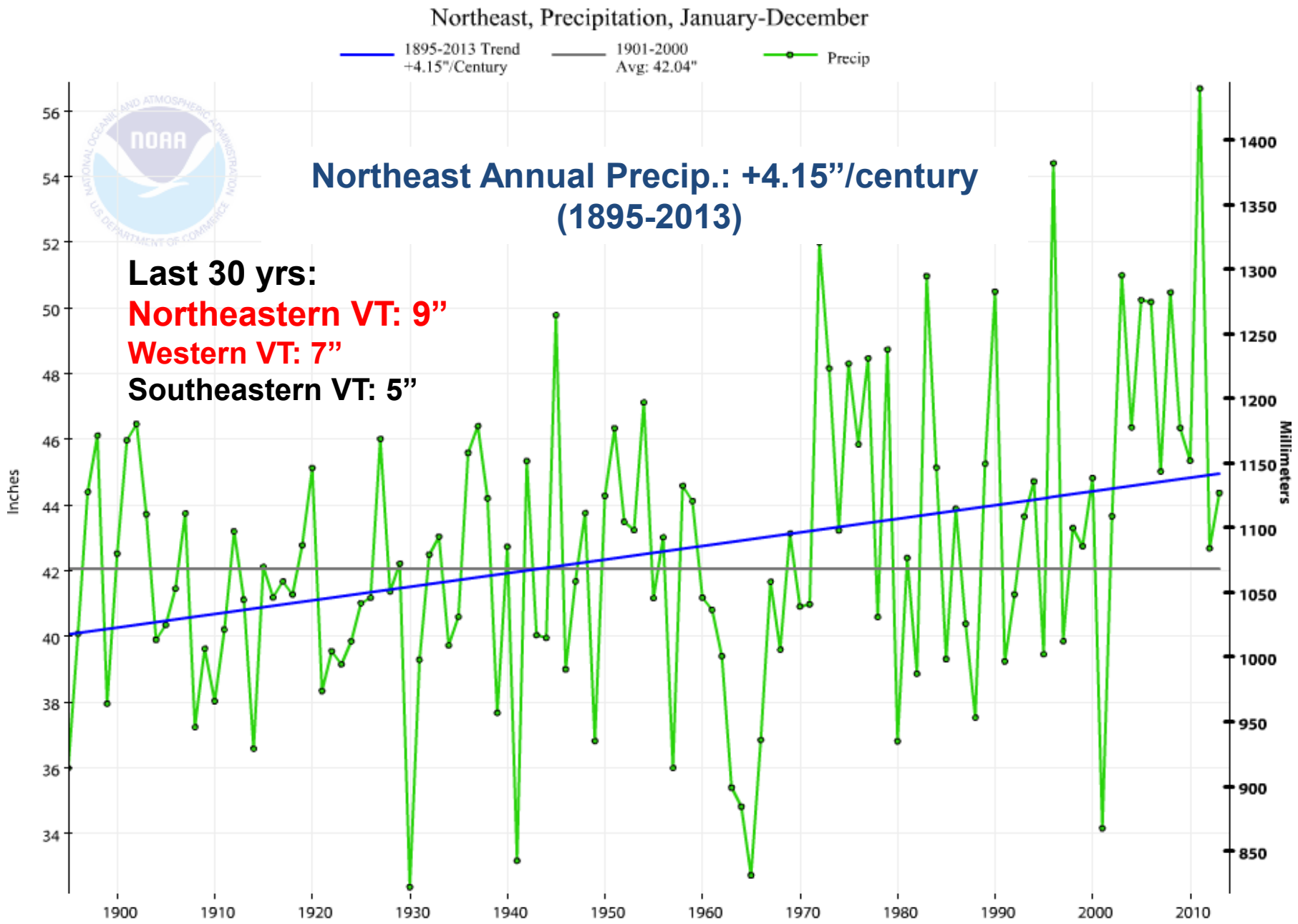
Joshua Faulkner, PhD
University of Vermont

VTCAC on Lake Champlain's Future
October 10, 2022

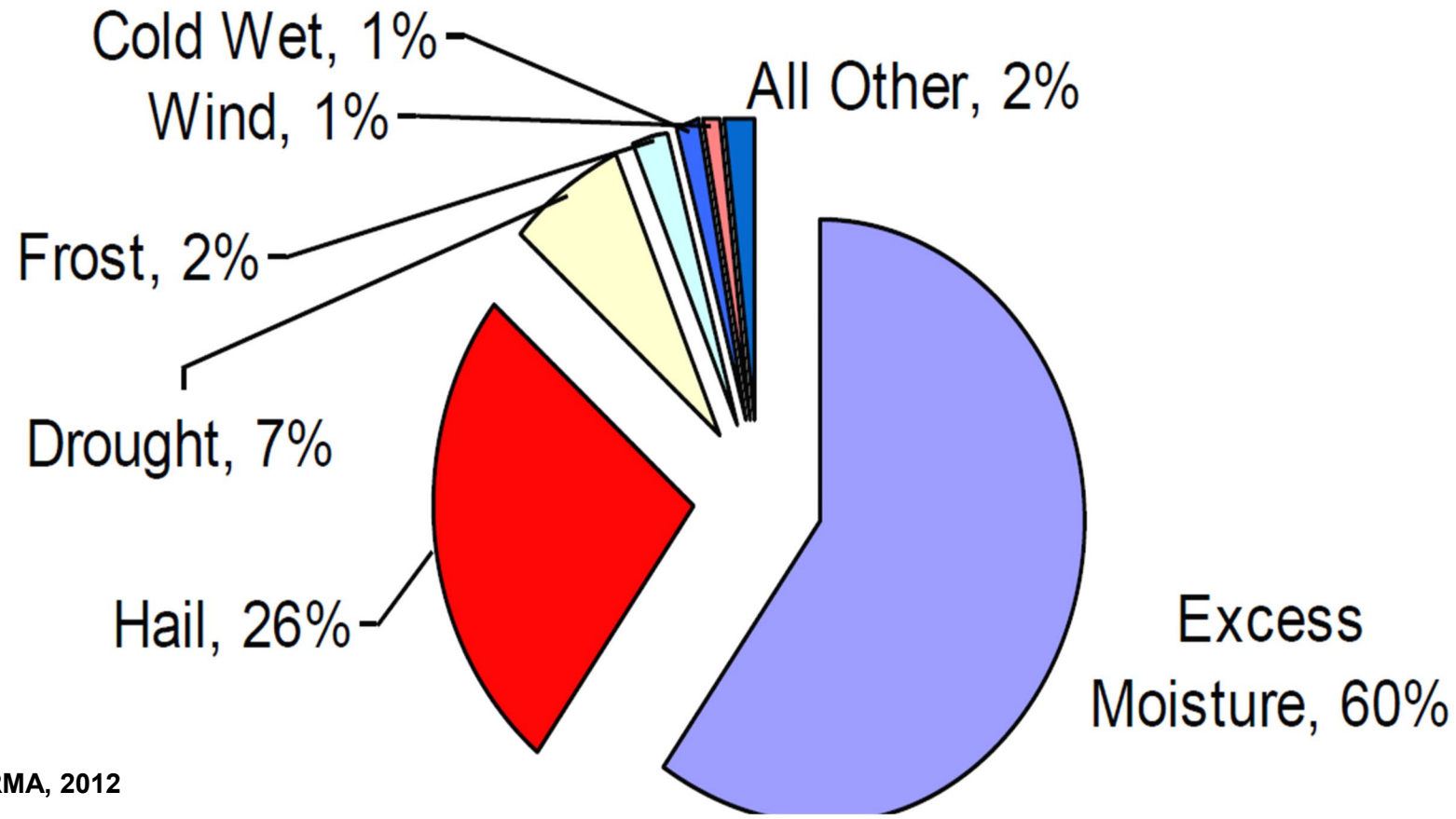


AP Photo: Toby Talbot

THE UNIVERSITY OF VERMONT EXTENSION | Center for Sustainable Agriculture

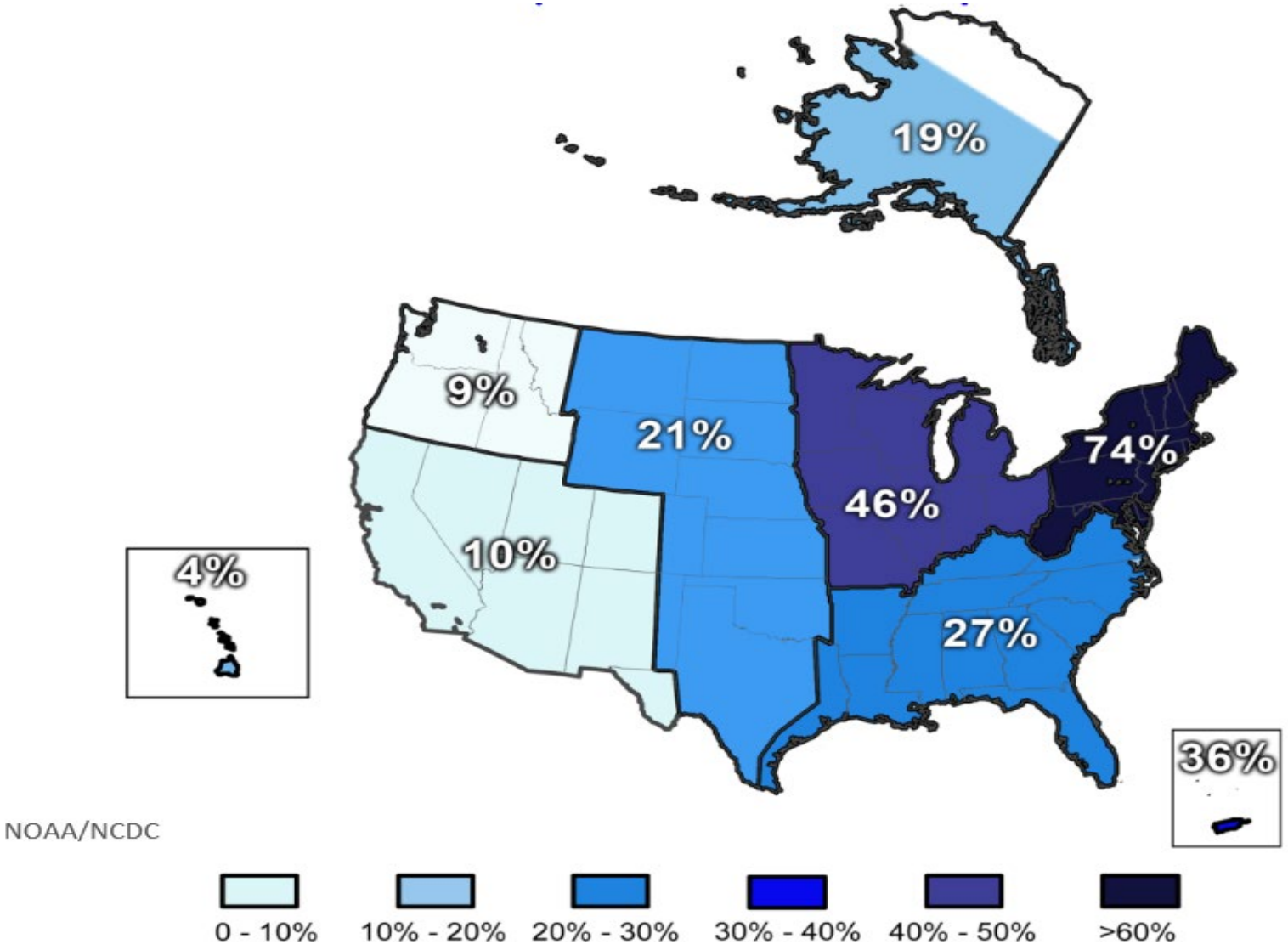

Northeast, Precipitation, January-December
1895-2013 Trend
+4.15"/Century
1901-2000
Avg: 42.04"
Precip
Northeast Annual Precip.: +4.15”/century
(1895-2013)
Last 30 yrs:
Northeastern VT: 9”
Western VT: 7”
Southeastern VT: 5”
Inches
Millimeters
56
54
52
50
48
46
44
42
40
38
36
34
1400
1350
1300
1250
1200
1150
1100
1050
1000
950
900
850
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

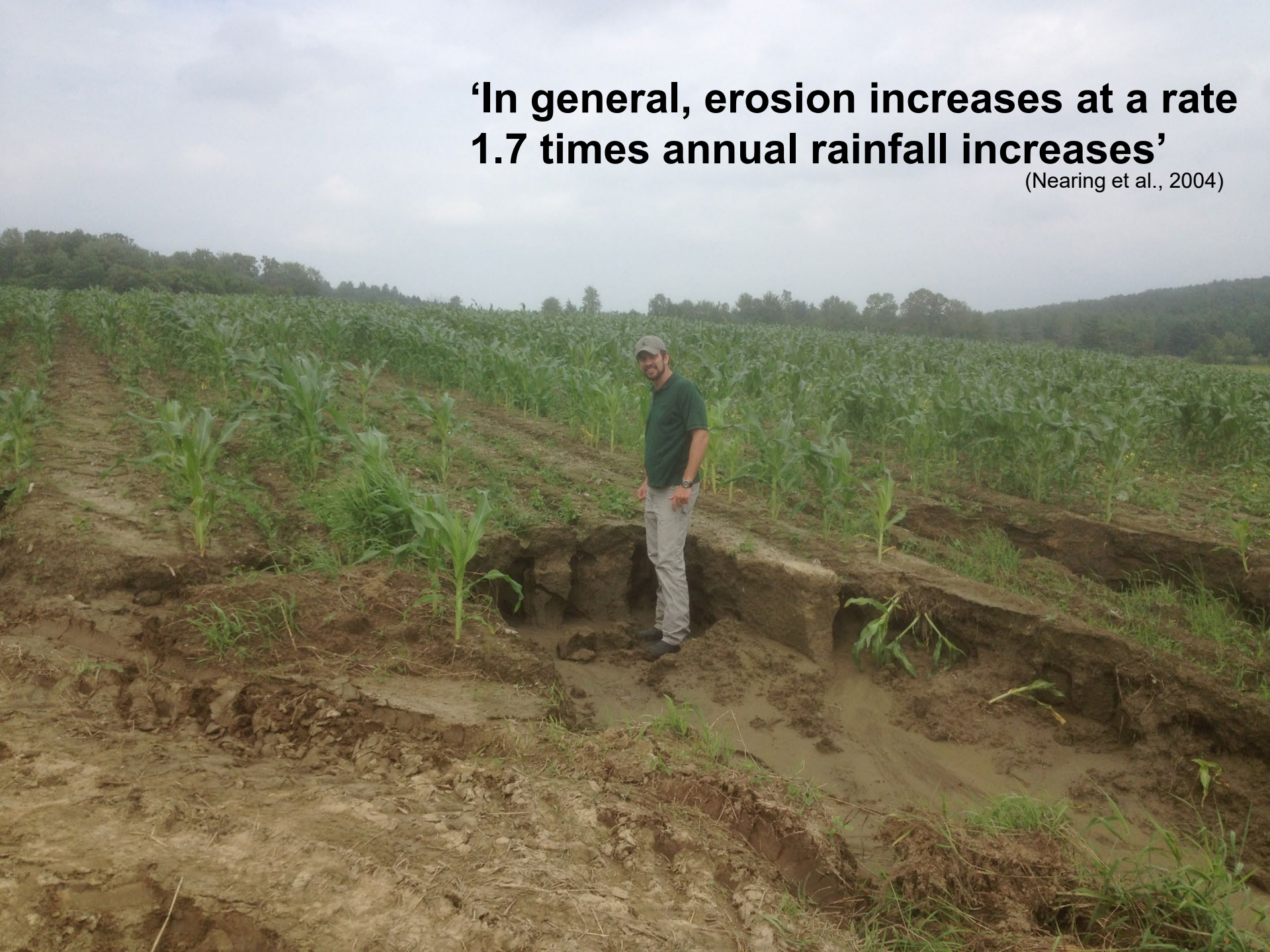
Why Vermont Crops Fail (2001-10)



RMA, 2012

Trend in 1-day Very Heavy Precipitation
(1958-2010)

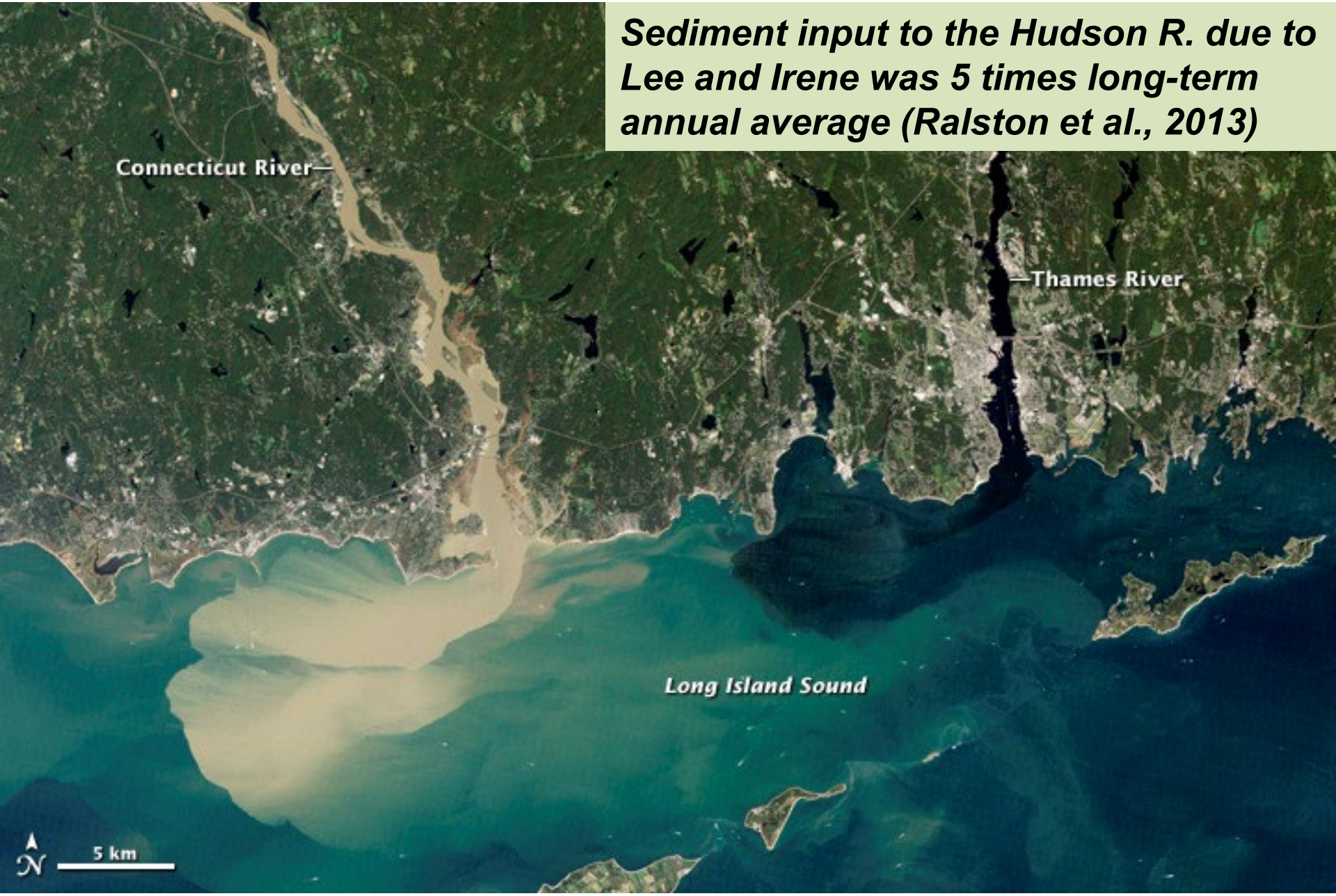



‘In general, erosion increases at a rate 1.7 times annual rainfall increases’
(Nearing et al., 2004)

Flooding and Downstream Impacts

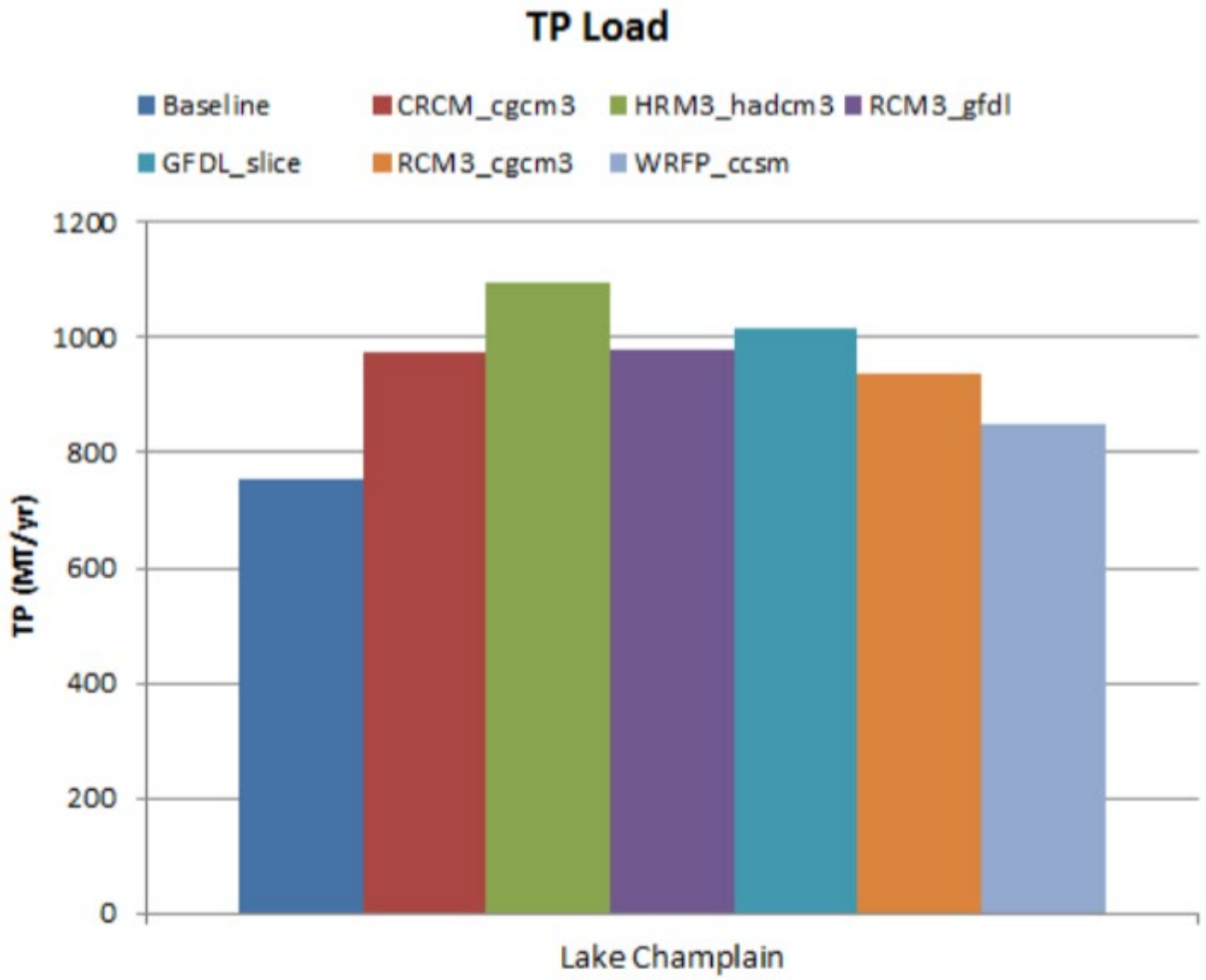
Photo: Vern Grubinger, UVM

Sediment input to the Hudson R. due to Lee and Irene was 5 times long-term annual average (Ralston et al., 2013)

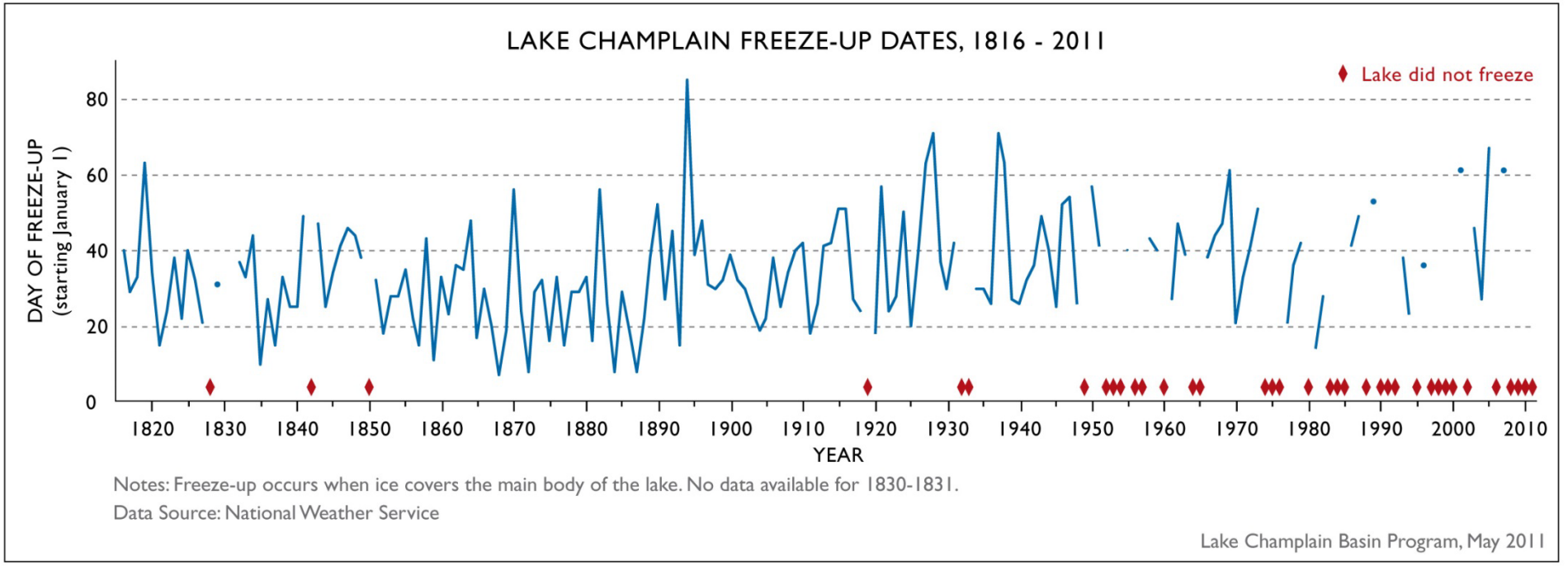


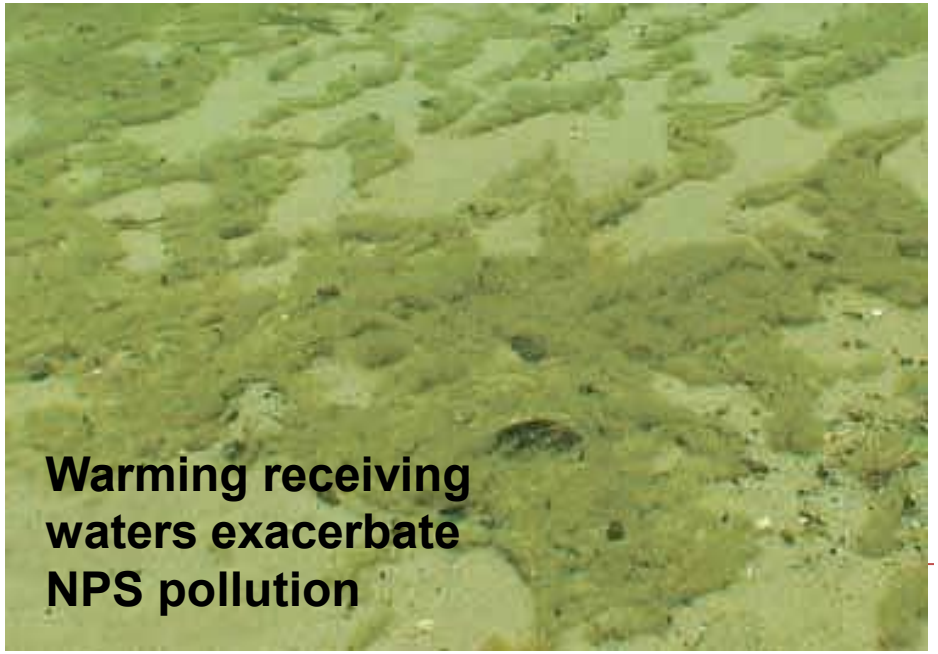
(Source: earthobservatory.nasa.gov))

Modeled Total P: Six Climate Scenarios

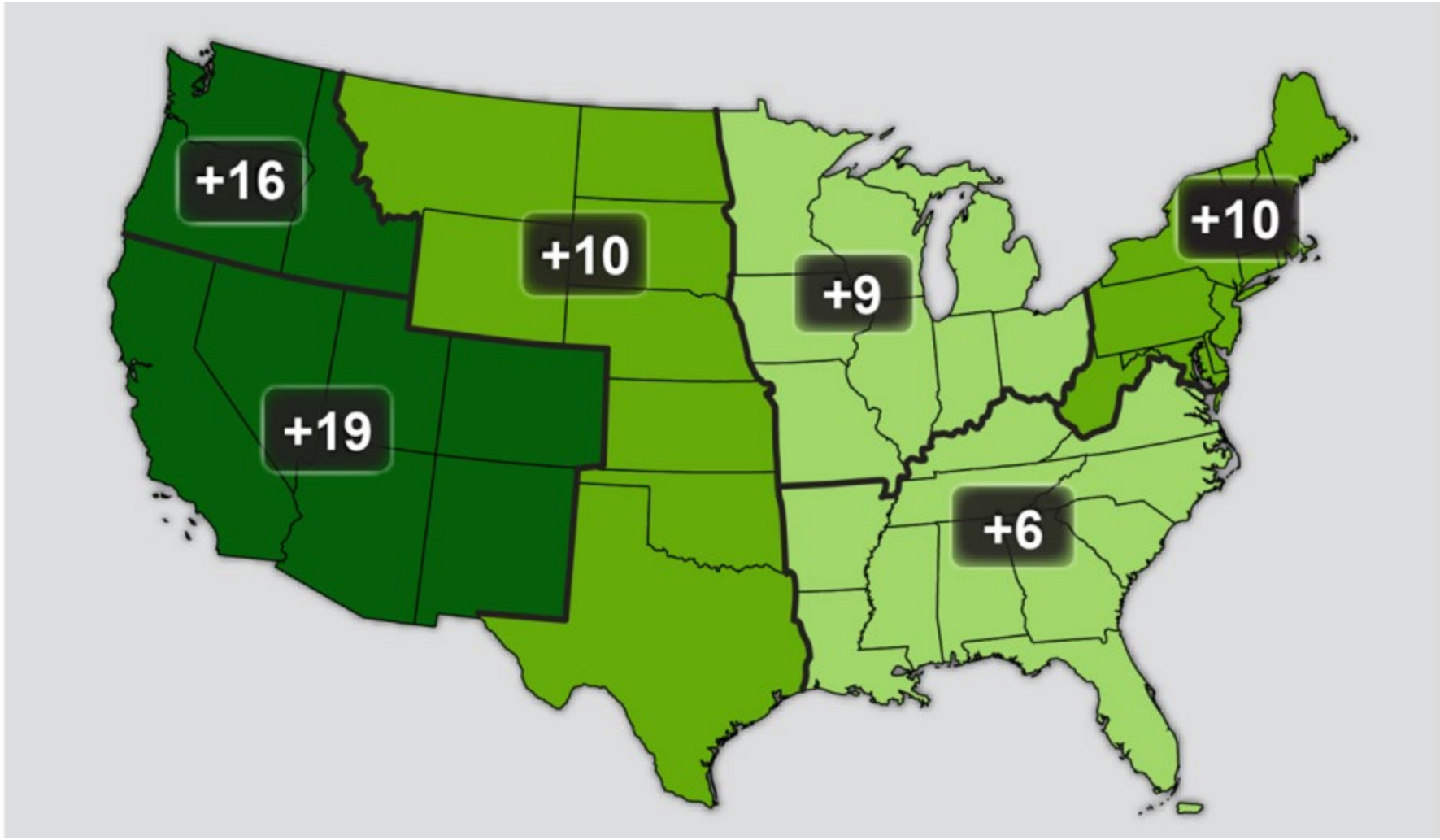


(Tetra Tech, 2013)

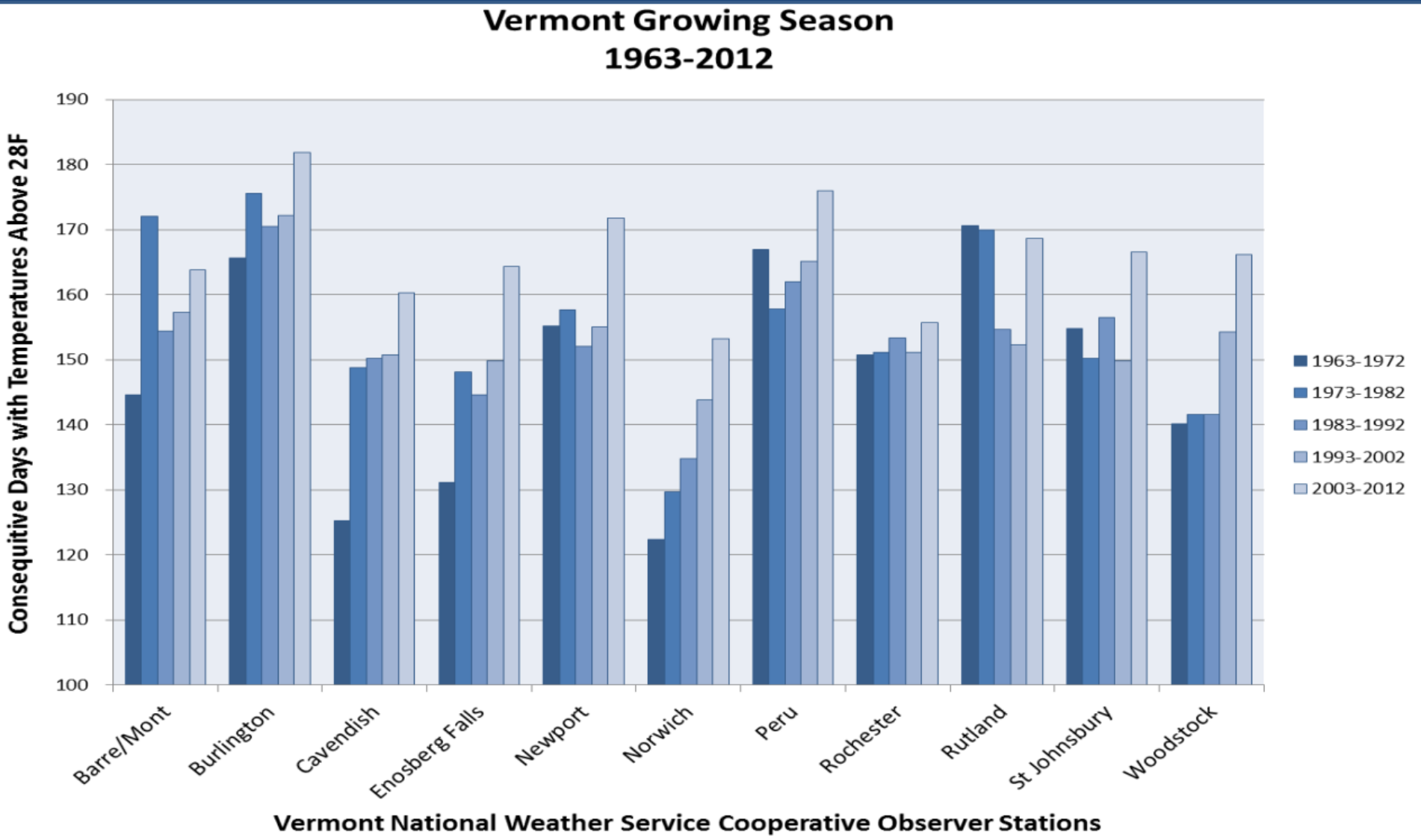

LAKE CHAMPLAIN FREEZE-UP DATES, 1816 - 2011
Lake did not freeze
DAY OF FREEZE-UP
(starting January 1)
0
20
40
60
80
1820
1830
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
YEAR
Notes: Freeze-up occurs when ice covers the main body of the lake. No data available for 1830-1831.
Data Source: National Weather Service
Lake Champlain Basin Program, May 2011


Warming receiving waters exacerbate NPS pollution

Observed Increase in Frost-Free Season Length 1991-2012 relative to 1901-1960



Source: Kenneth E. Kunkel, Cooperative Institute for Climate and Satellites – NC
Image Source: NOAA NCDC / CICS-NC



(Galford et al., 2014. Vermont Climate Assessment)

Growing season increasing by 3.7 days/decade

How does climate change impact crops?

- Cool-season crops will be of lower yield or quality
  - Sweet corn
- Reduced grain yield (rapid maturation and moisture)
  - Field corn, nutrient content…
- Reduced vernalization lower some fruit yields; increased frost risk?
  - Apples
- New pests are able to over-winter, emerge early; increased pesticides
  - Flea beetle, SWD?
- Some warmer season crops will do better
  - Red wine grape, peaches, watermelon
- Water stress in crops…

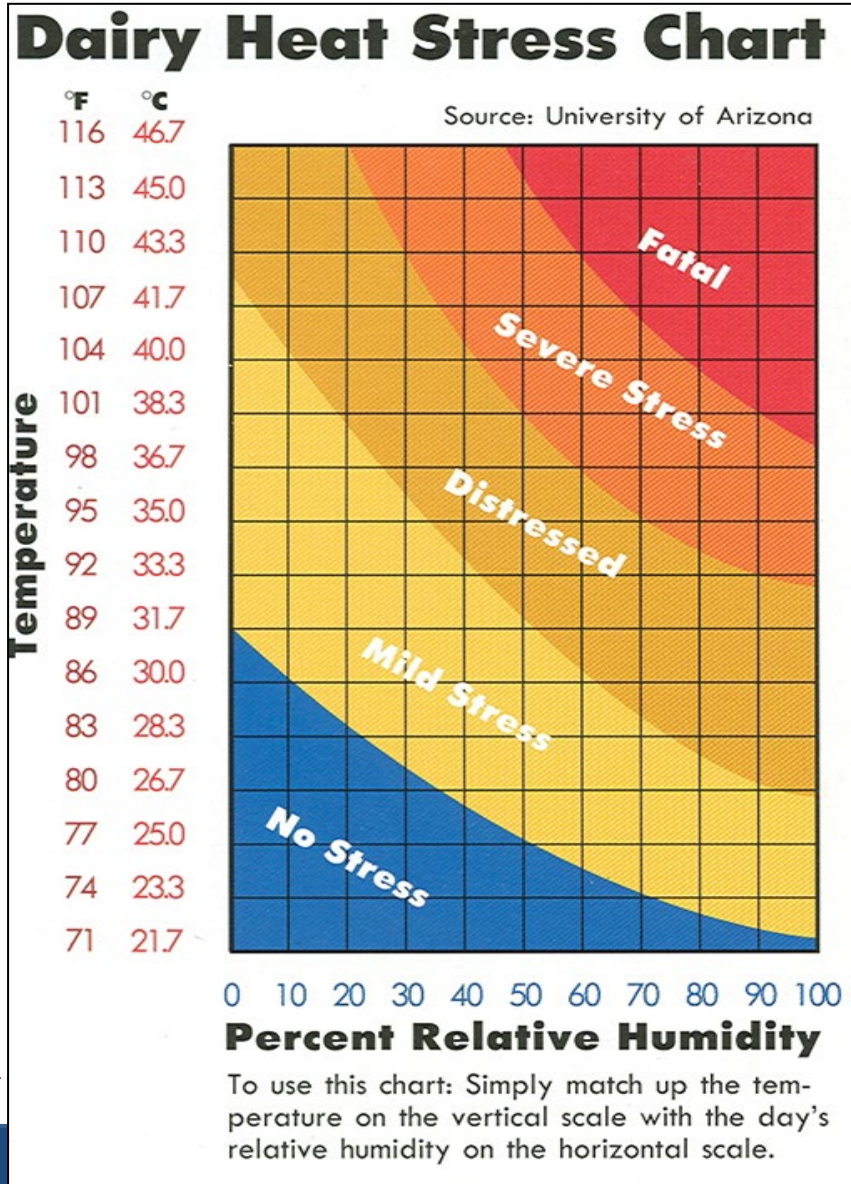
Water Management for Production

Losses of over 30% were experienced by fruit and vegetable farmers in areas of NY due to 2016 drought
(Sweet et al., 2017)

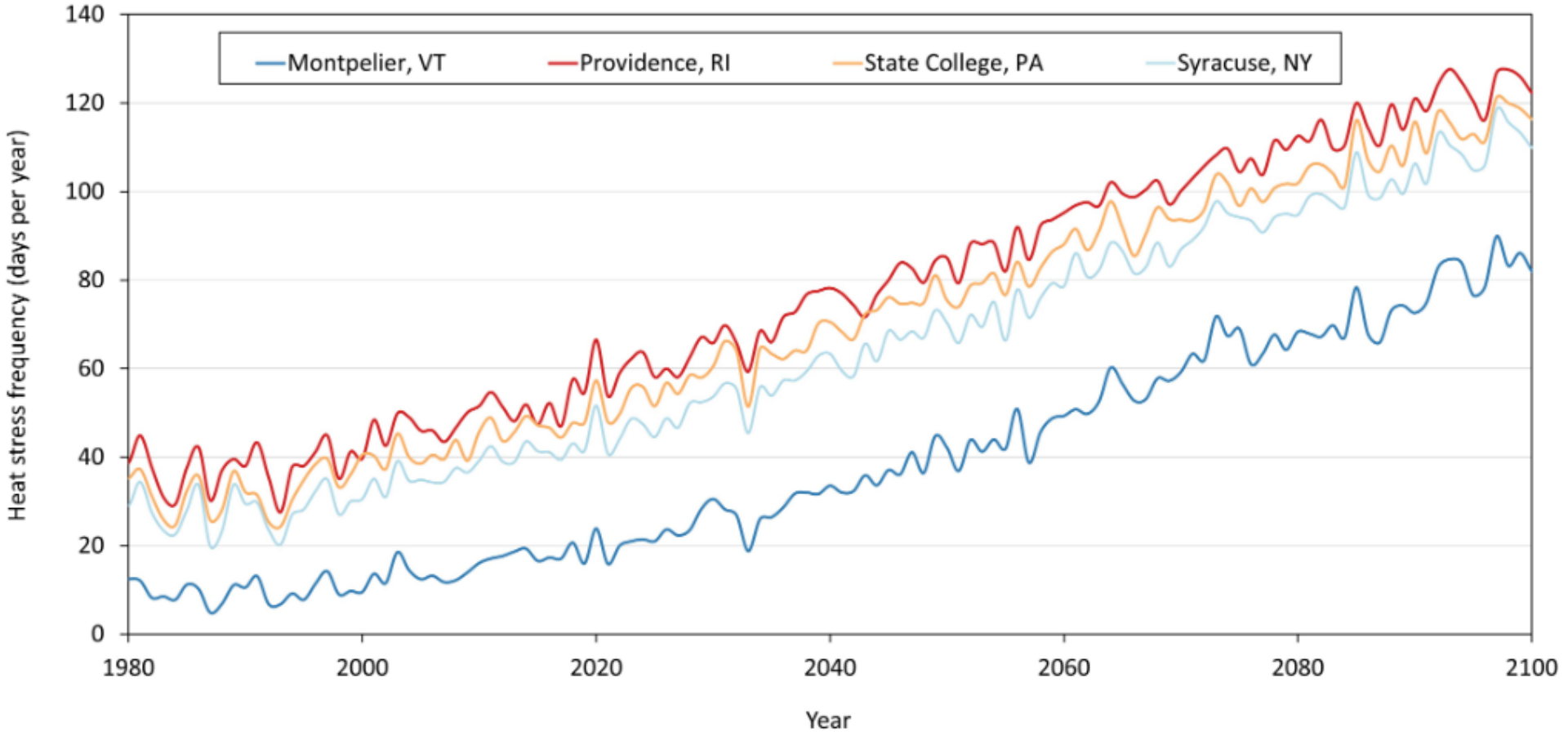
(McDonald and Girvetz, 2013)

How does climate change impact livestock?

- Warming Temperatures
  - Livestock
    - Heat stress in dairy cattle
  - Higher body temperatures
  - Increased respiration rates
  - Less activity
  - Increased water intake
- Performance
  - Dry matter intake down by 10-20%
  - Milk production down by 10-25%
  - Reproductive processes decrease



Heat Stress in Dairy Cattle (days/yr)



- Moving northward
- Shade/ventilation/cooling becoming more important

Gunn et al. 2019. Projected heat stress challenges and abatement opportunities for U.S. milk production. PLOSONE. https://doi.org/10.1371/journal.pone.0214665 .

Soil Management Approaches to Landscape Storage

Three principles of healthy, resilient soils:

1. ***Constant soil cover (preferably living!)***
2. ***Building organic matter***
3. ***Reduced disturbance/soil structure***

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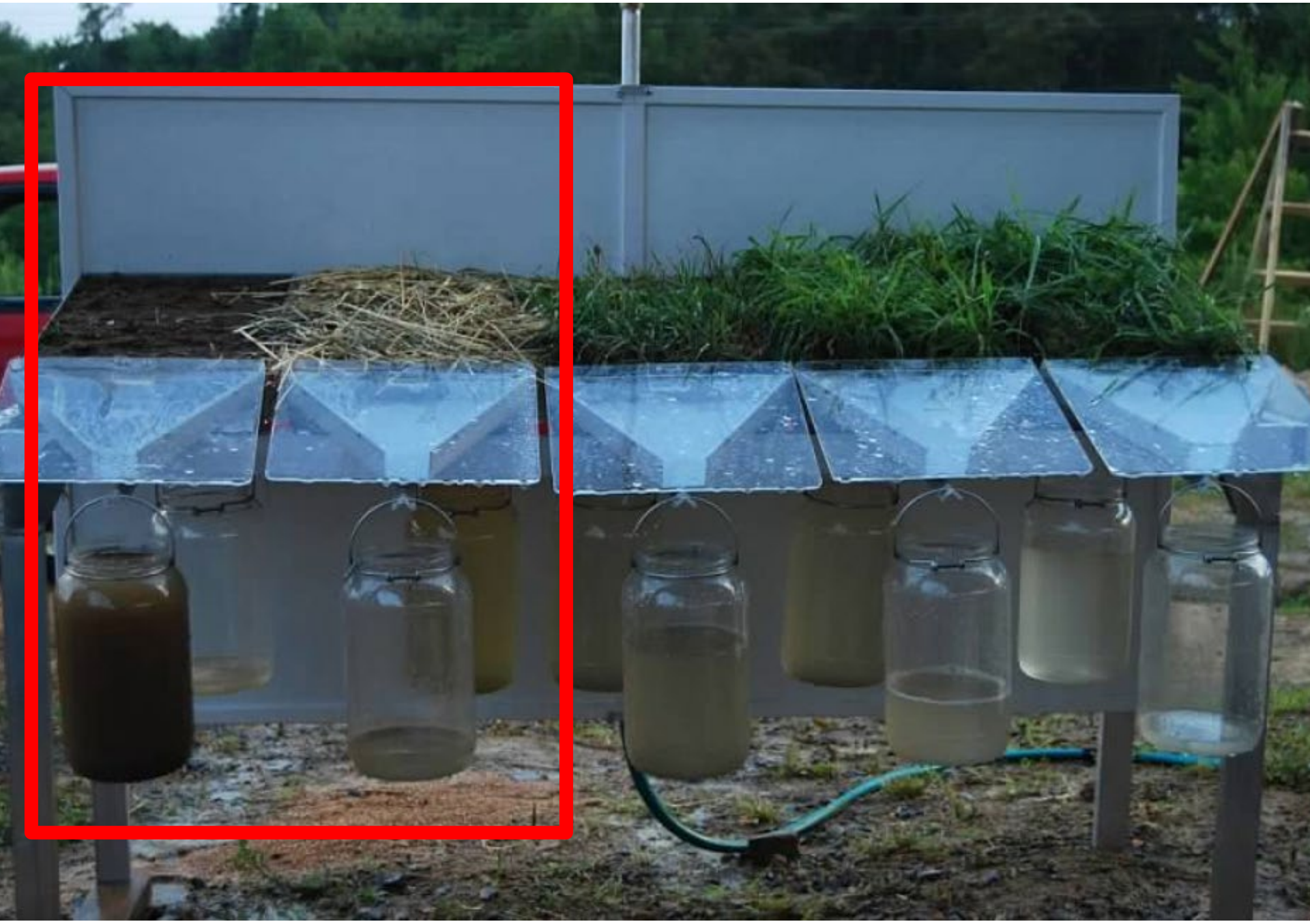
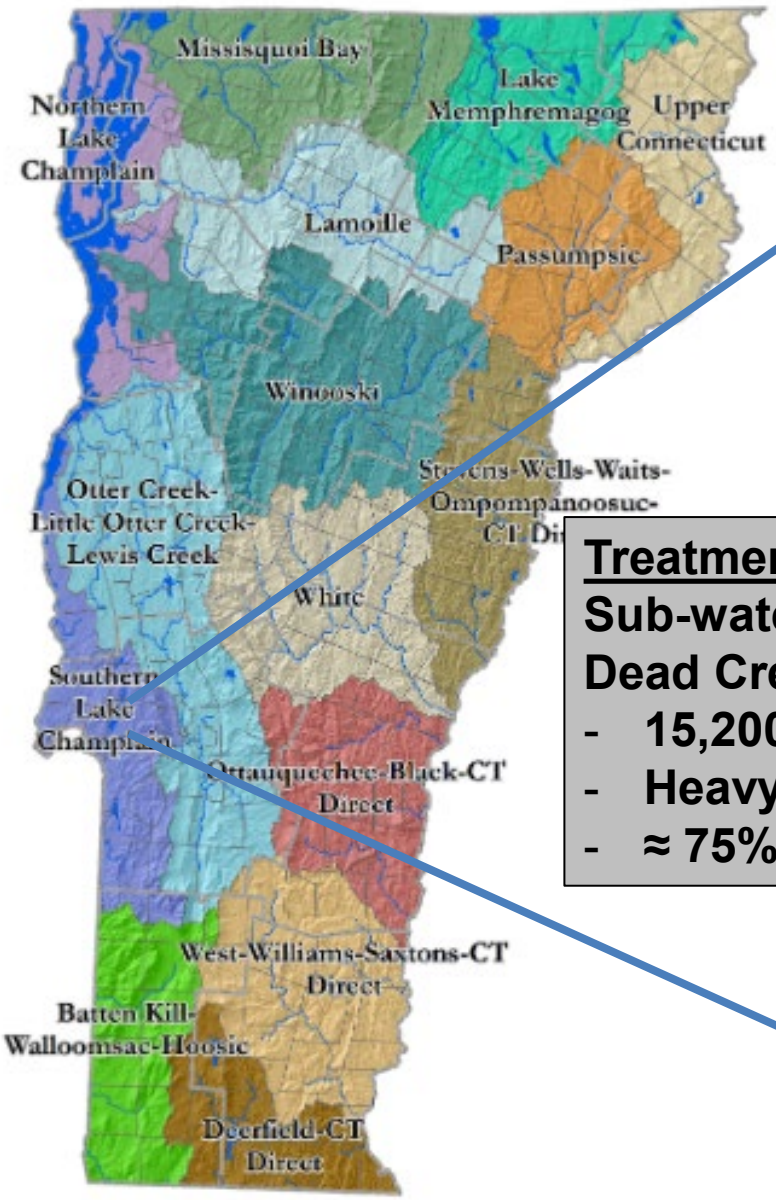
www.nrcs.usda.gov



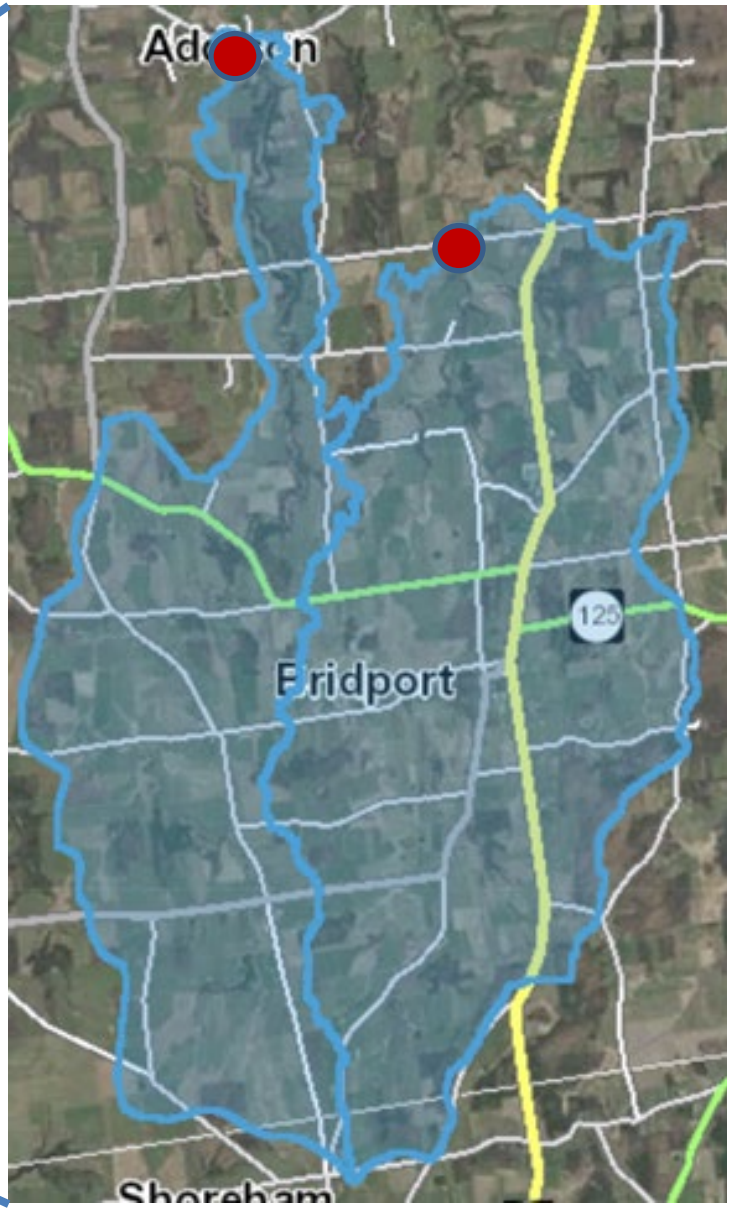
Watershed Scale Research

- Long-term evaluation of conservation practices at the watershed-scale (via NRCS CEAP)
- Flow gages installed w/ each station
- Baseflow and storm samples analyzed for:
  - Phosphorus, Nitrogen, Sediment
- Documentation of land use and conservation practices on <u>every</u> field on <u>every</u> farm!

CEAP: Paired Watershed Approach



Treatment Watershed
Sub-watersheds of Dead Creek
- **15,200 ac**
- **Heavy clay soils**
- **≈ 75% ag**



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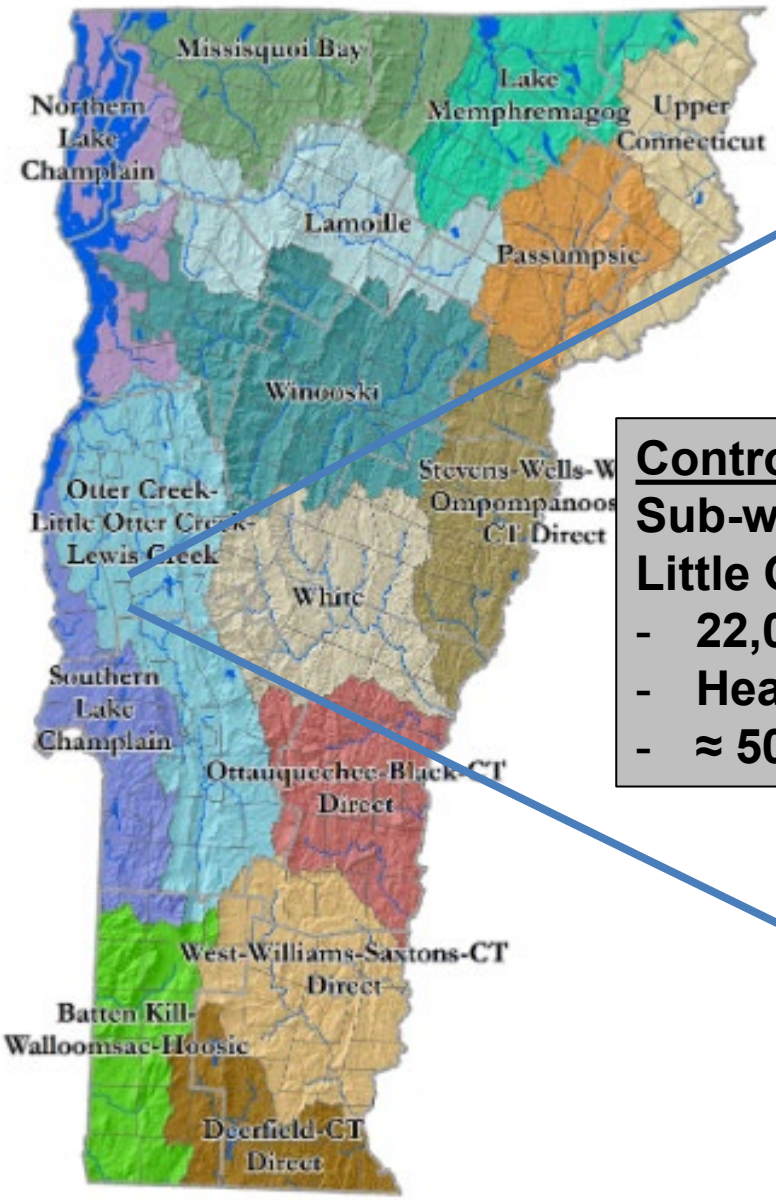


Control Watershed
Sub-watershed of Little Otter Creek
- **22,000 ac**
- **Heavy clay soils**
- **≈ 50% ag**

Soil Health in CEAP Watersheds

- Correlation of water quality and soil health at watershed scale
- Fall 2020: 41 fields
- Spring 2021: 29 fields

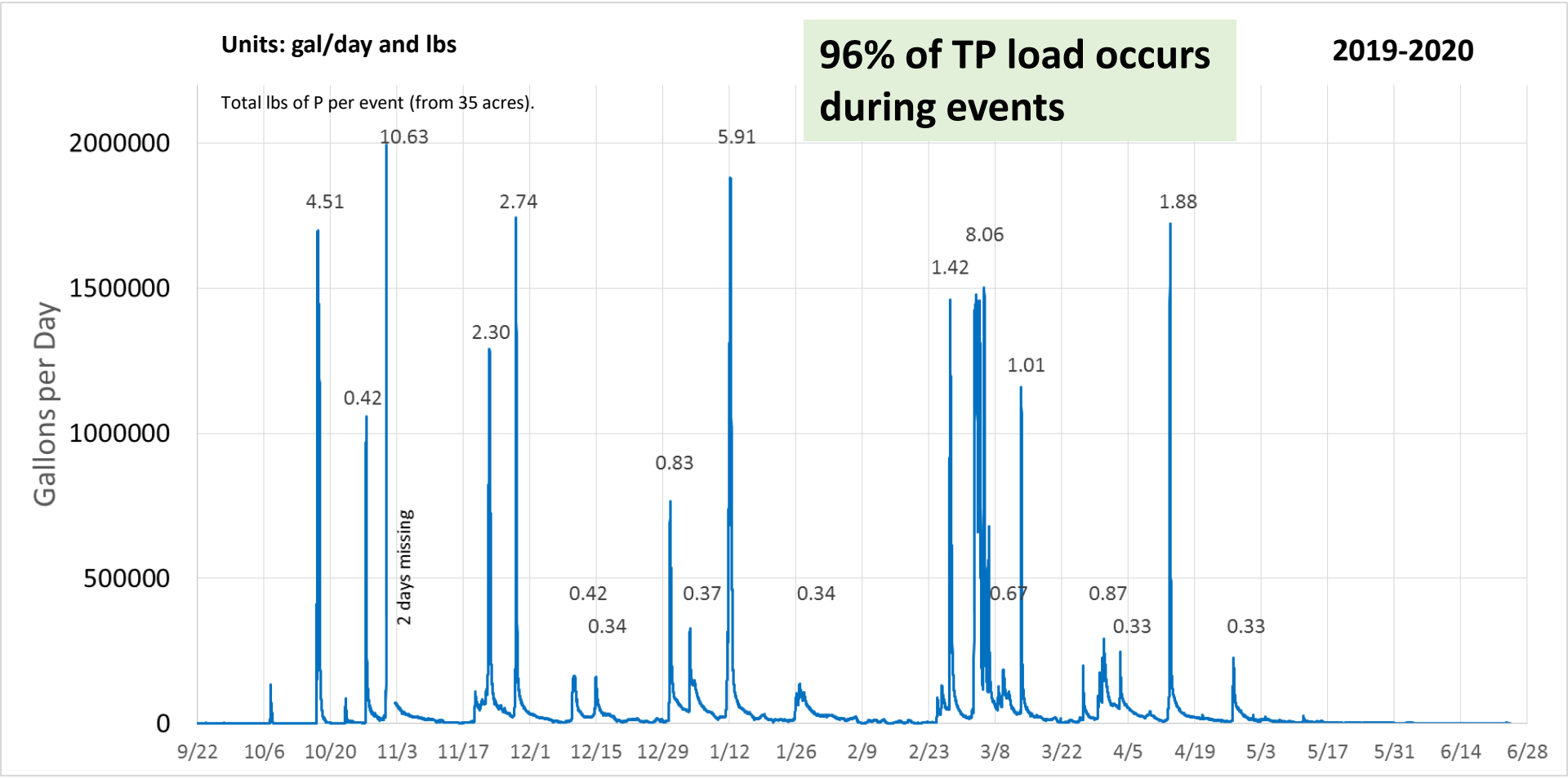
Su
"If

**"All
now**

Photo: Dwight Burdette.

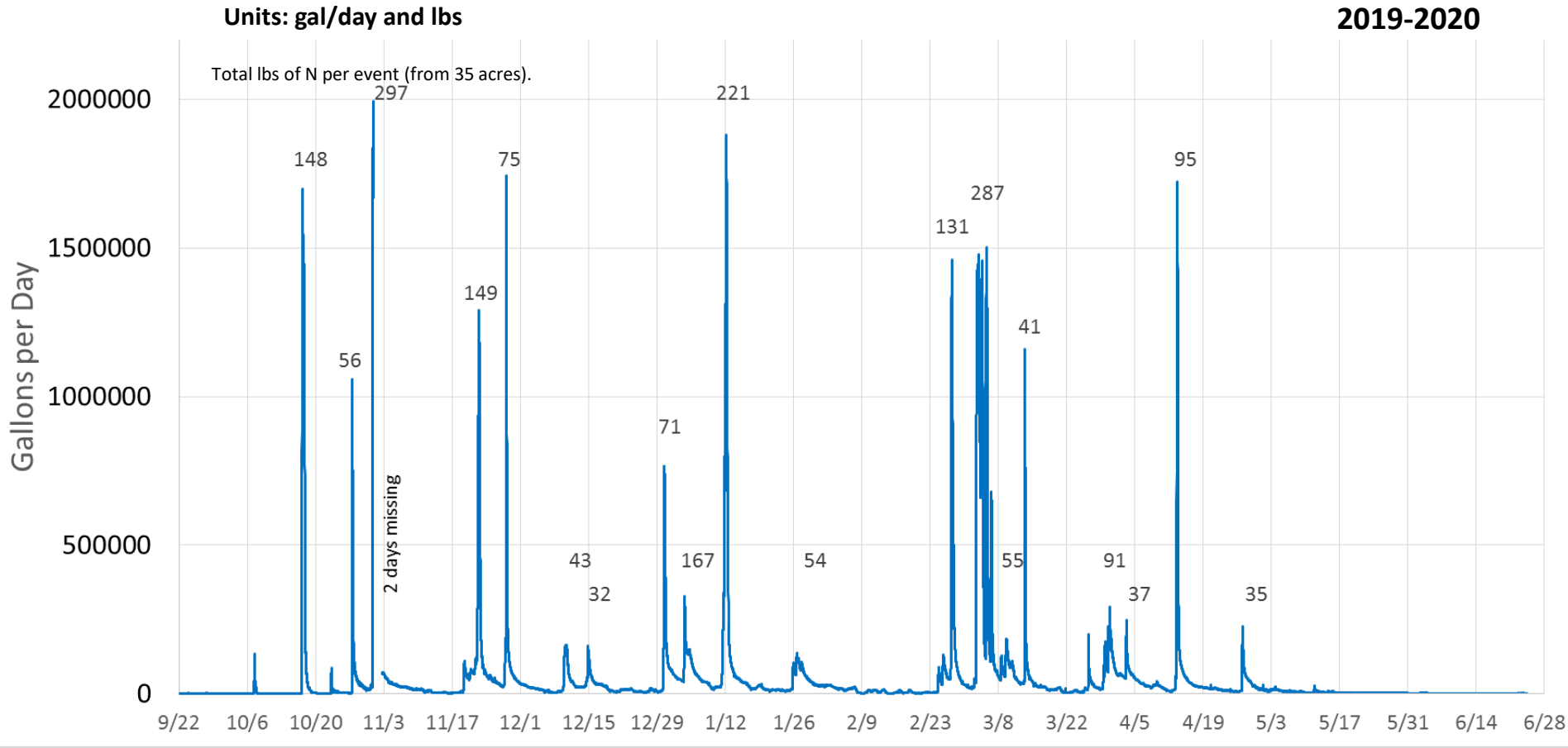
Field-Scale Research

AHS Tile Study: From Oct 7, 2019 thru June 3, 2020, 45.0 lb of TP was exported or 1.4 lbs/acre



Management: Corn silage, fall injection, cover crops, very light spring tillage before planting

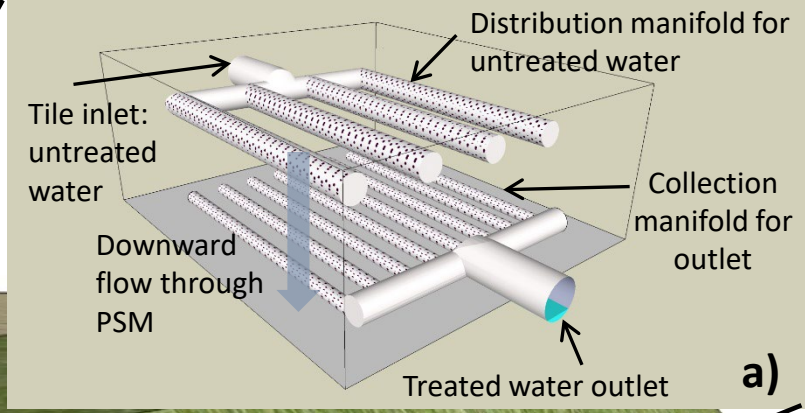
Nitrogen Concern$? Oct 7, 2019 thru June 3, 2020, 2493 lb of TN was exported or 71 lbs/acre



Management: Corn silage, fall injection, cover crops, very light spring tillage before no-till planting

Large Plot Scale: Discovery Acres

Tile and Ditch Phosphorus Filters

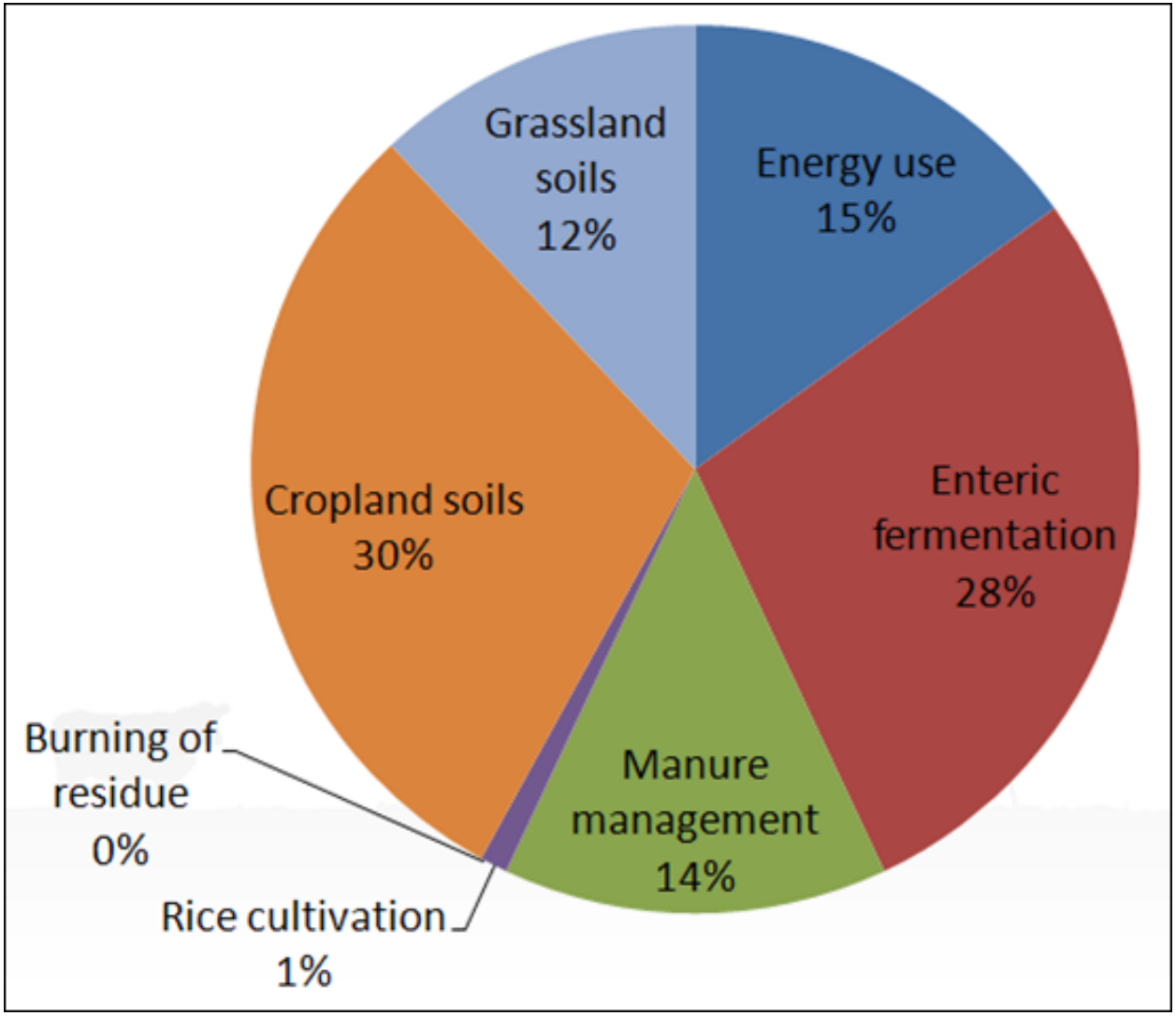


Drainage Ditch

Slide Courtesy of Chad Penn, USDA-ARS

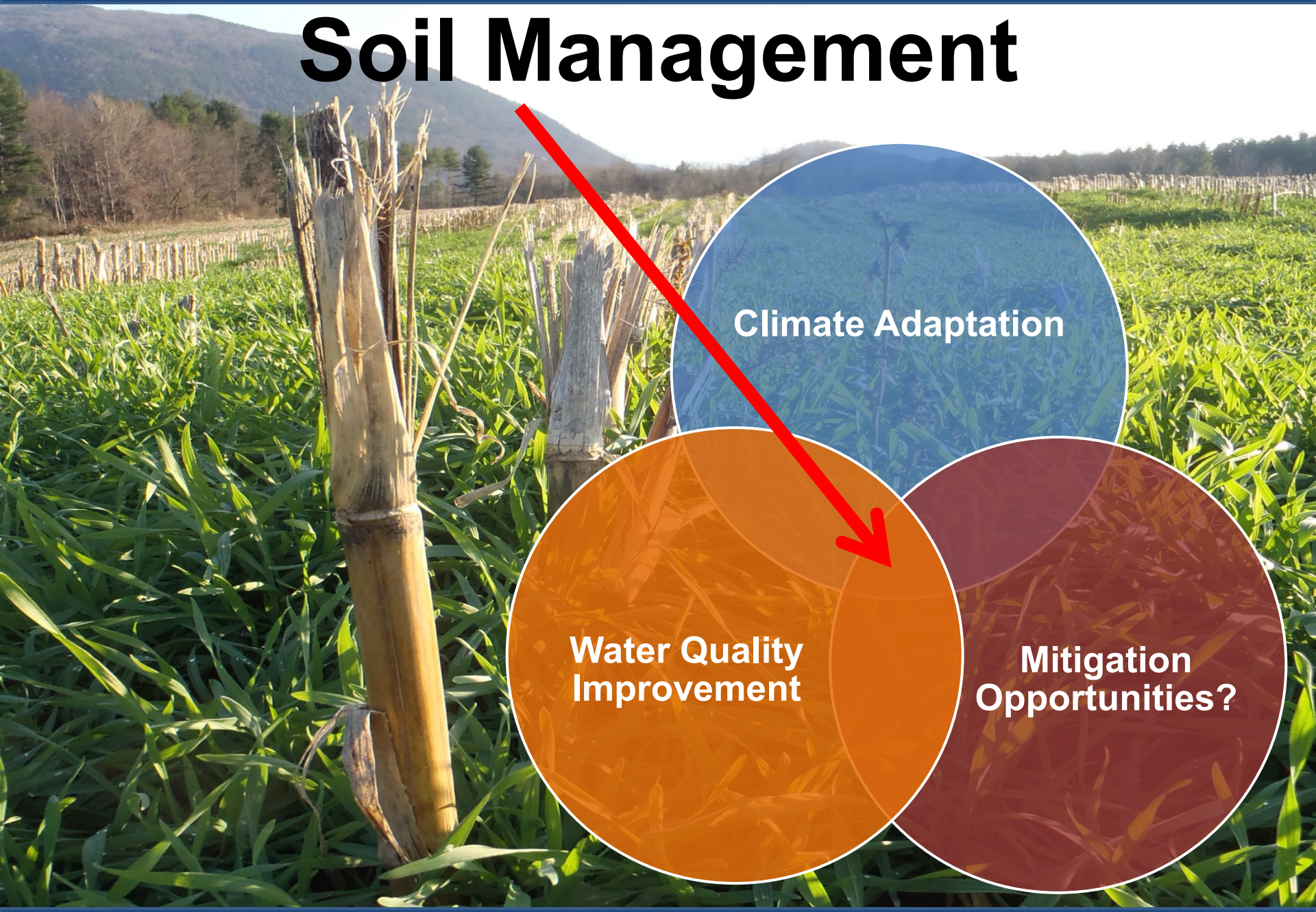
How does agriculture impact climate change? (US)

8% of Total GHG Emissions



U.S. agricultural greenhouse gas sources (Adapted from Archibeque et al., 2012)

Soil Management

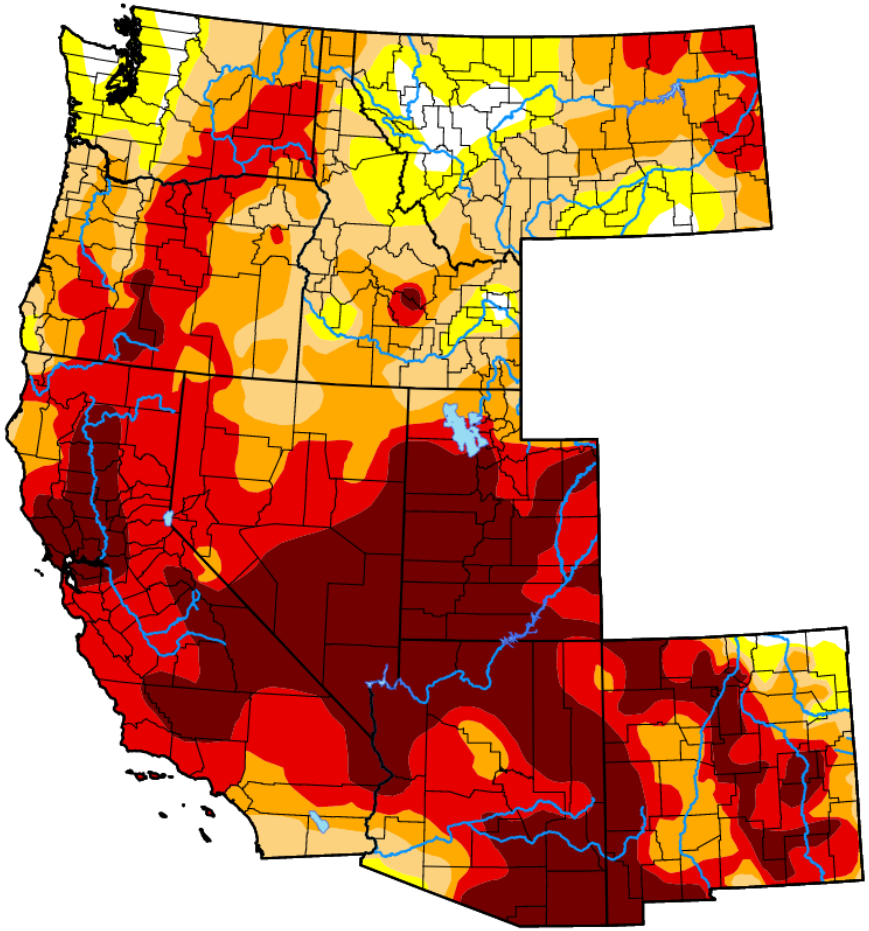


(Photo: Kirsten Workman)

The University of Vermont

U.S. Dairy Net Zero Initiative: University of Vermont Research

Elsewhere…



Map released: Thurs. June 17, 2021

Data valid: June 15, 2021 at 8 a.m. EDT

Intensity

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
- No Data

Authors

United States and Puerto Rico Author(s):
Curtis Riganti, National Drought Mitigation Center

Pacific Islands and Virgin Islands Author(s):
Richard Tinker, NOAA/NWS/NCEP/CPC

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying ***text***