WEATHERING
CHANGE

ANTIOCH UNIVERSITY NEW ENGLAND
Center for Climate Preparedness and Community Resilience

Strengthen communities to prepare, respond and recover in the face of climate impacts and other disruptions through collaborative, innovative solutions.

communityresilience-center.org

Dr. Abigail Abrash Walton
Co-Director CCPCR

Climate Change Resilience

… a series of online courses focused on the fundamentals of climate change resilience.

- Engage in each course for 4 weeks
- Enroll for graduate credit or audit the course
- Increase your skill set in climate resilience for better outcomes
- Discover solutions to local issues you face on the job or in your community.
- Register for one course or the whole series.

http://www.communityresilience-center.org/climate-change-resilience-series/

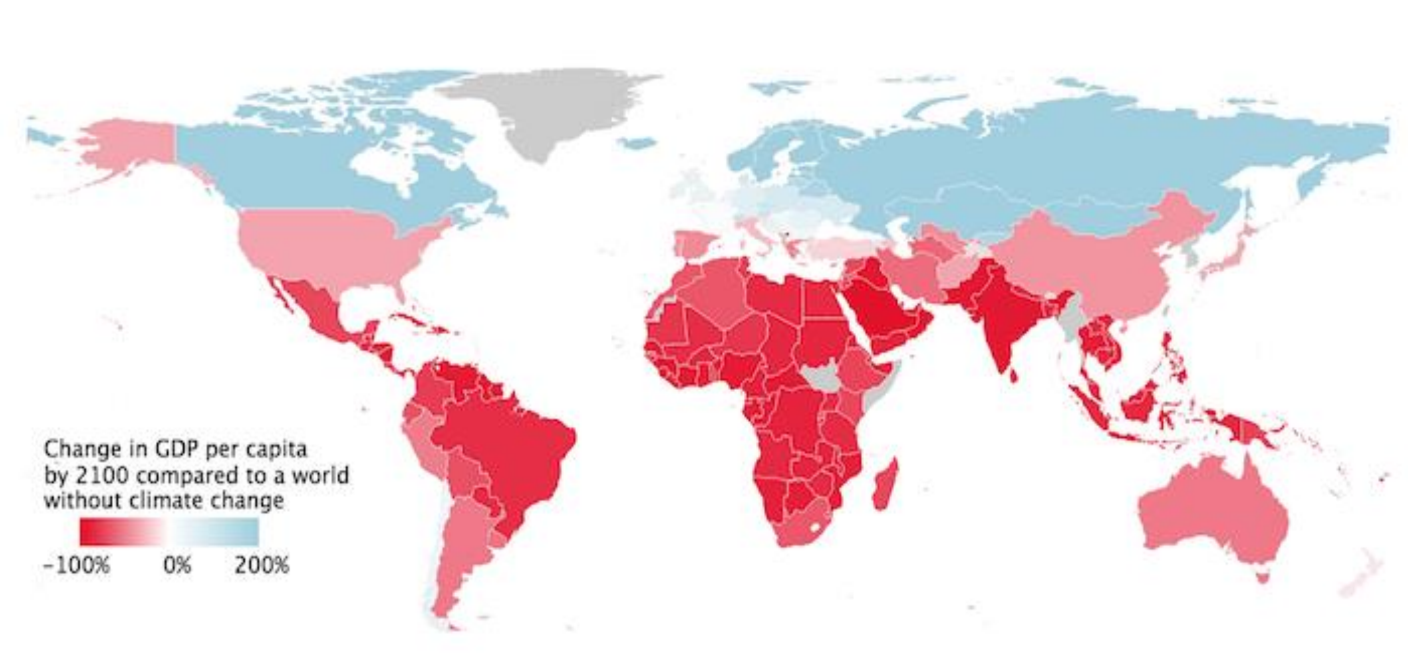
ANTIOCH UNIVERSITY NEW ENGLAND

Climate Change Resilience Certificate

Climate Response: Cost and Financing

Online (1-credit) Course May 3, 2020 through May 30, 2020

Already communities are being impacted by a changing climate. This module focuses on the associated costs analyses that should accompany any on-the-ground response to projected climate impacts. Funding sources and financing strategies will be introduced.



Source: Burke et al, Global Non-linear Effect of Temperature on Economic Production

For more information or to register for this course:

http://www.communityresilience-center.org/climate-response-costs-and-financing-adaptation-online-course/

U.S. Climate Resilience Toolkit

Meet the challenges of a changing climate by finding information and tools to help you understand and address your climate risks.

toolkit.climate.gov

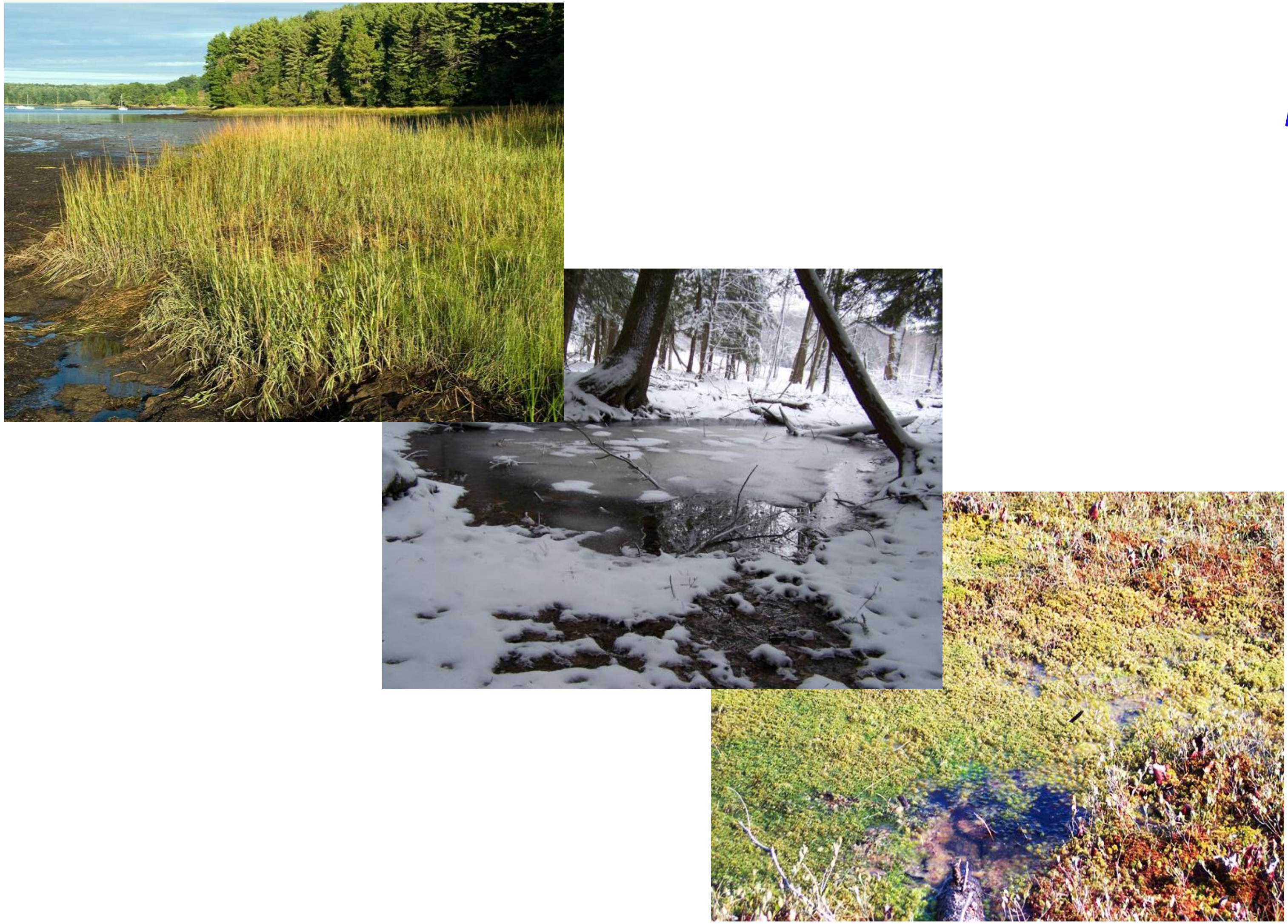
Dr. Ned Gardiner,
Engagement Manager

Logistics

If you have a question, please write it in the Q&A section (not Chat) and select to All Panelists, so we can see the questions.

If you are having technical difficulty, please use Chat and send to Host, so we can address the issue with you directly.

The presentation will be recorded and posted to the Antioch website within a week www.communityresilience-center.org



Vulnerability of Wetlands In the Glaciated Northeast

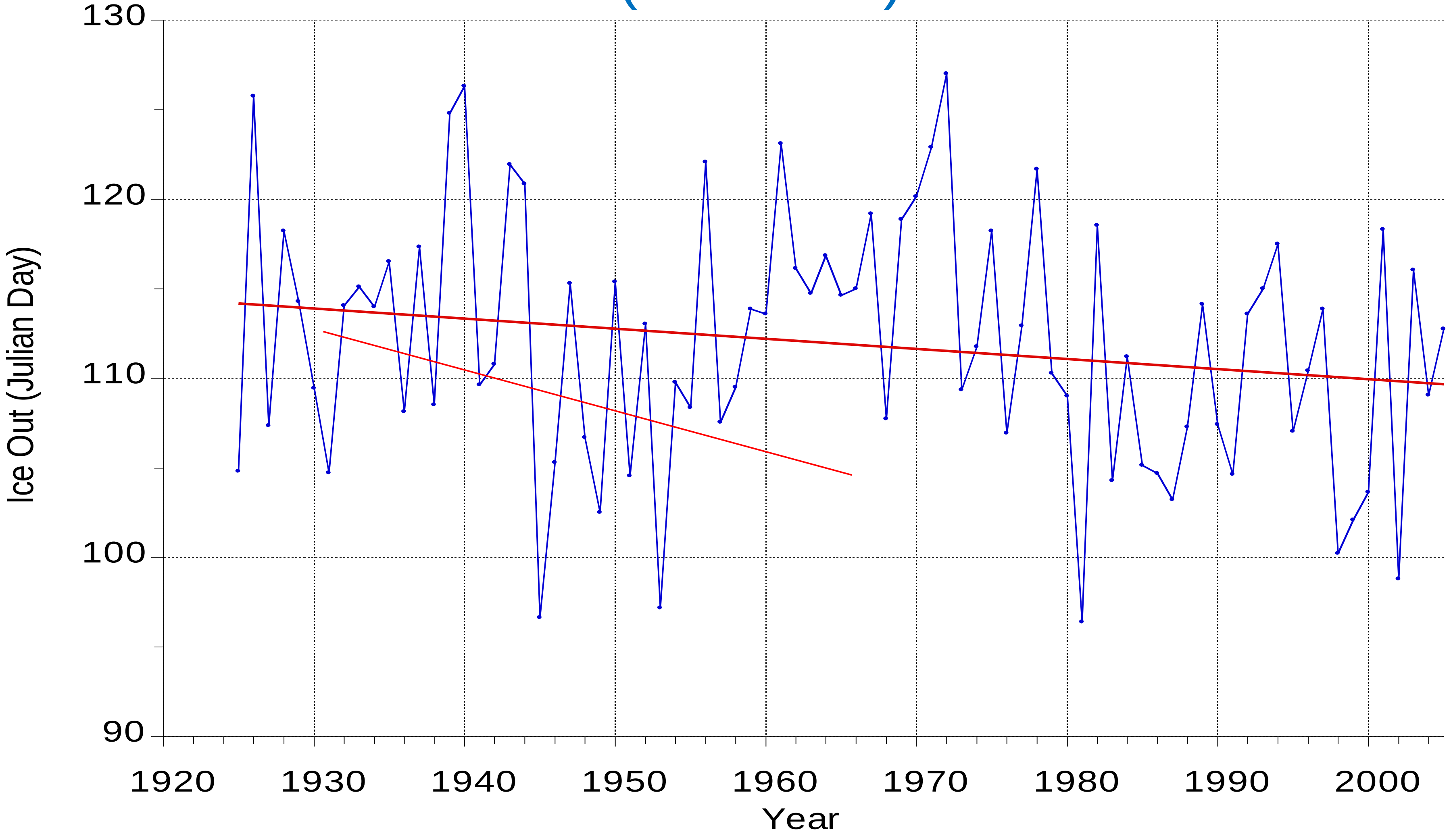
Michael Simpson,

Center for Climate Preparedness
and Community Resilience

ANTIOCH UNIVERSITY NEW ENGLAND
Center for Climate Preparedness
and Community Resilience

Average Ice Out Day Trend 1925-2005

(27 Lakes)

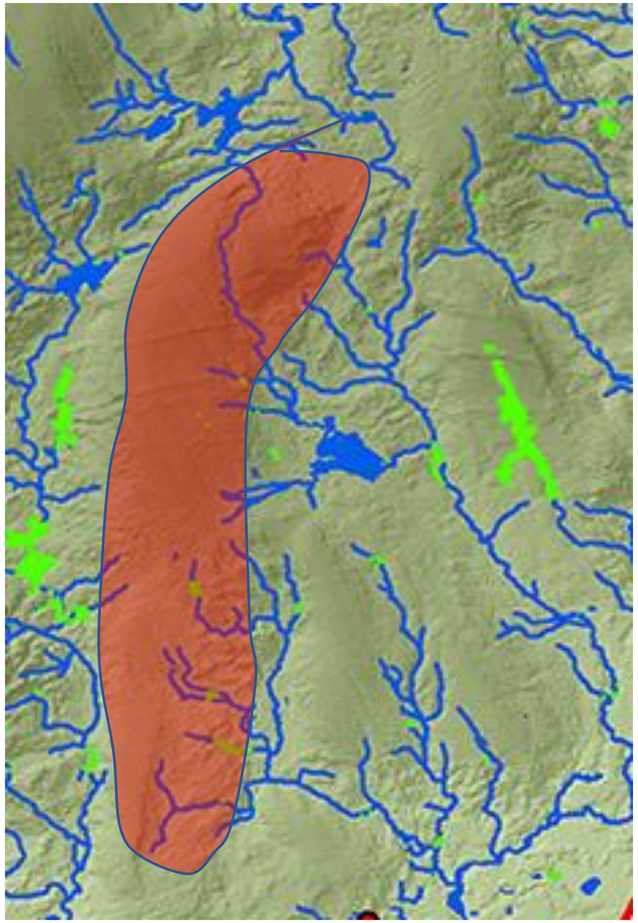


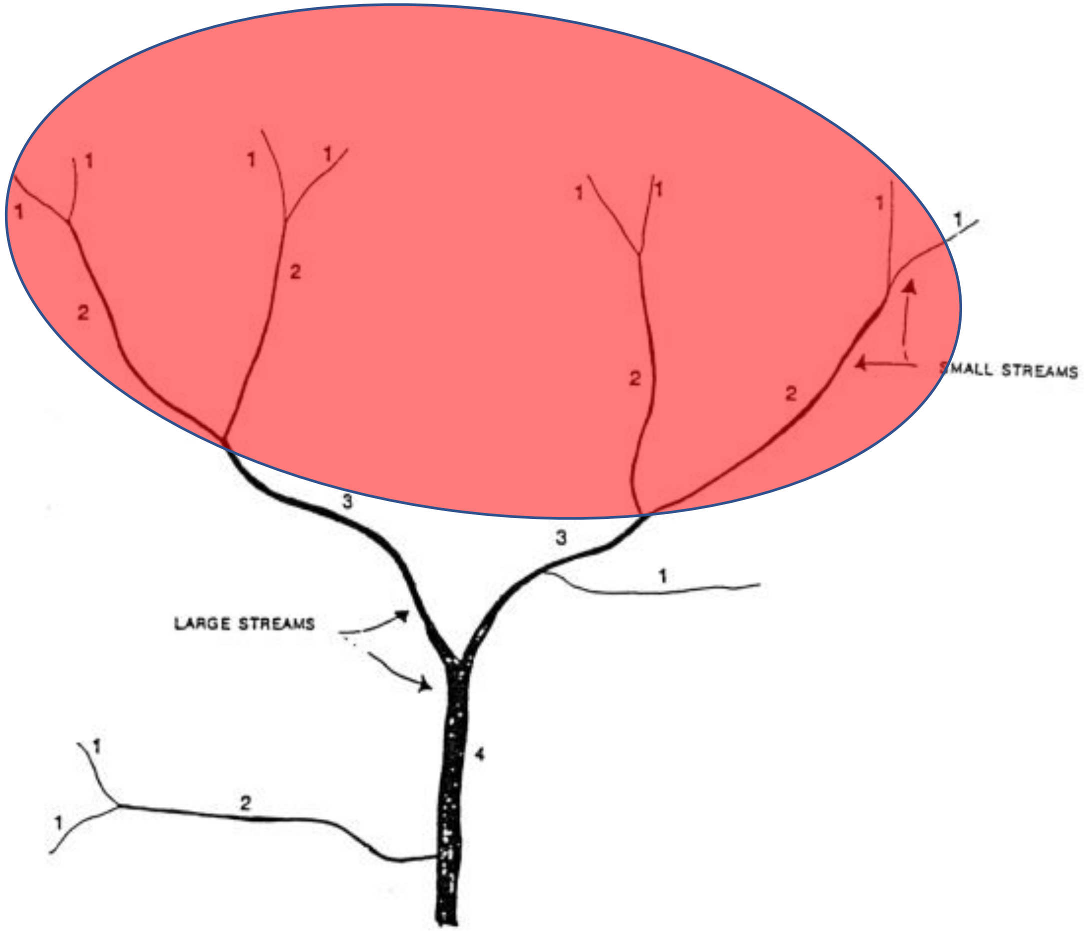
4.5 days earlier over 81 years
8.0 days earlier over 36 years

Wake 2008 (adapted from Hodgekins 2002

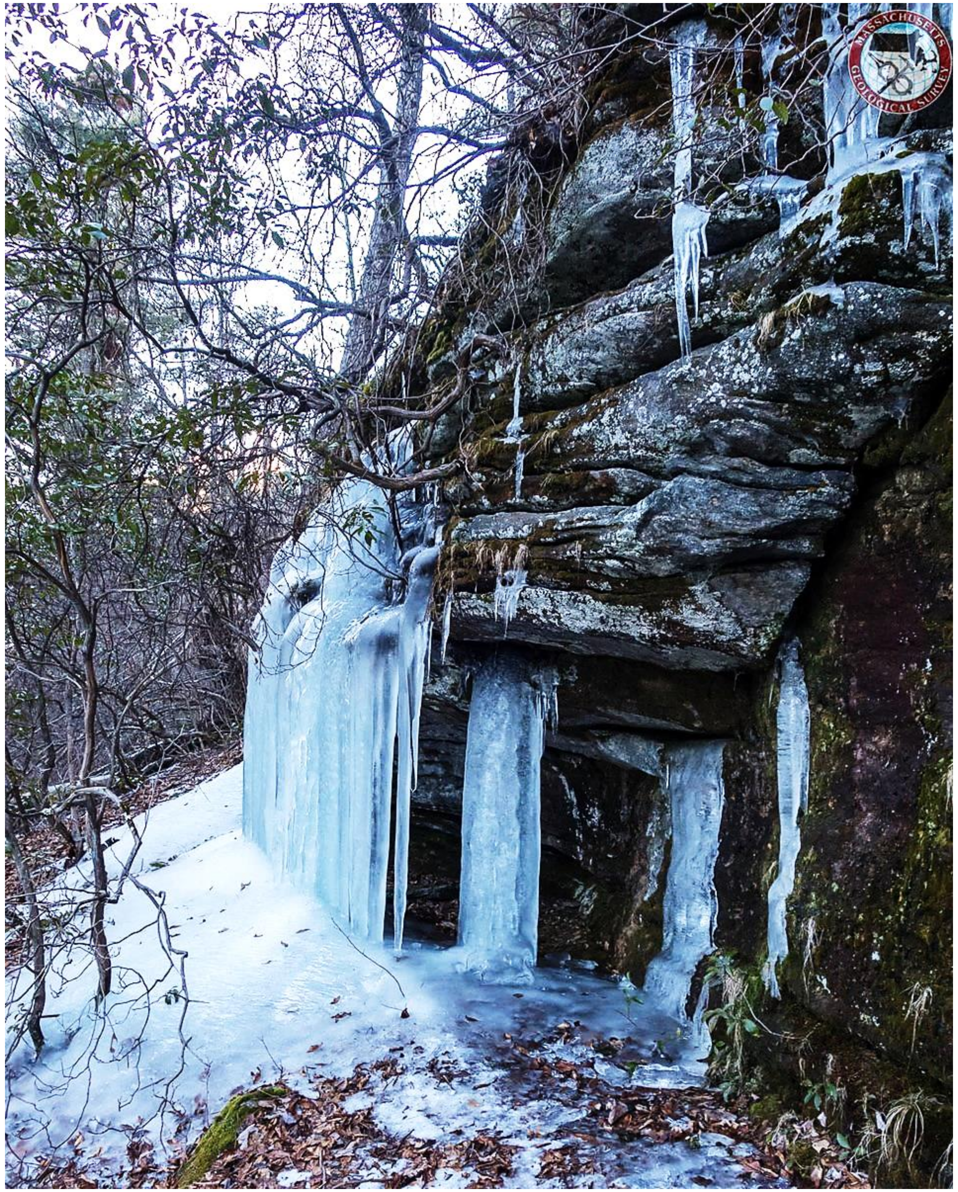
Headwater Zone - Vernal Pools

Headwater Zone






Lmachayes 2015

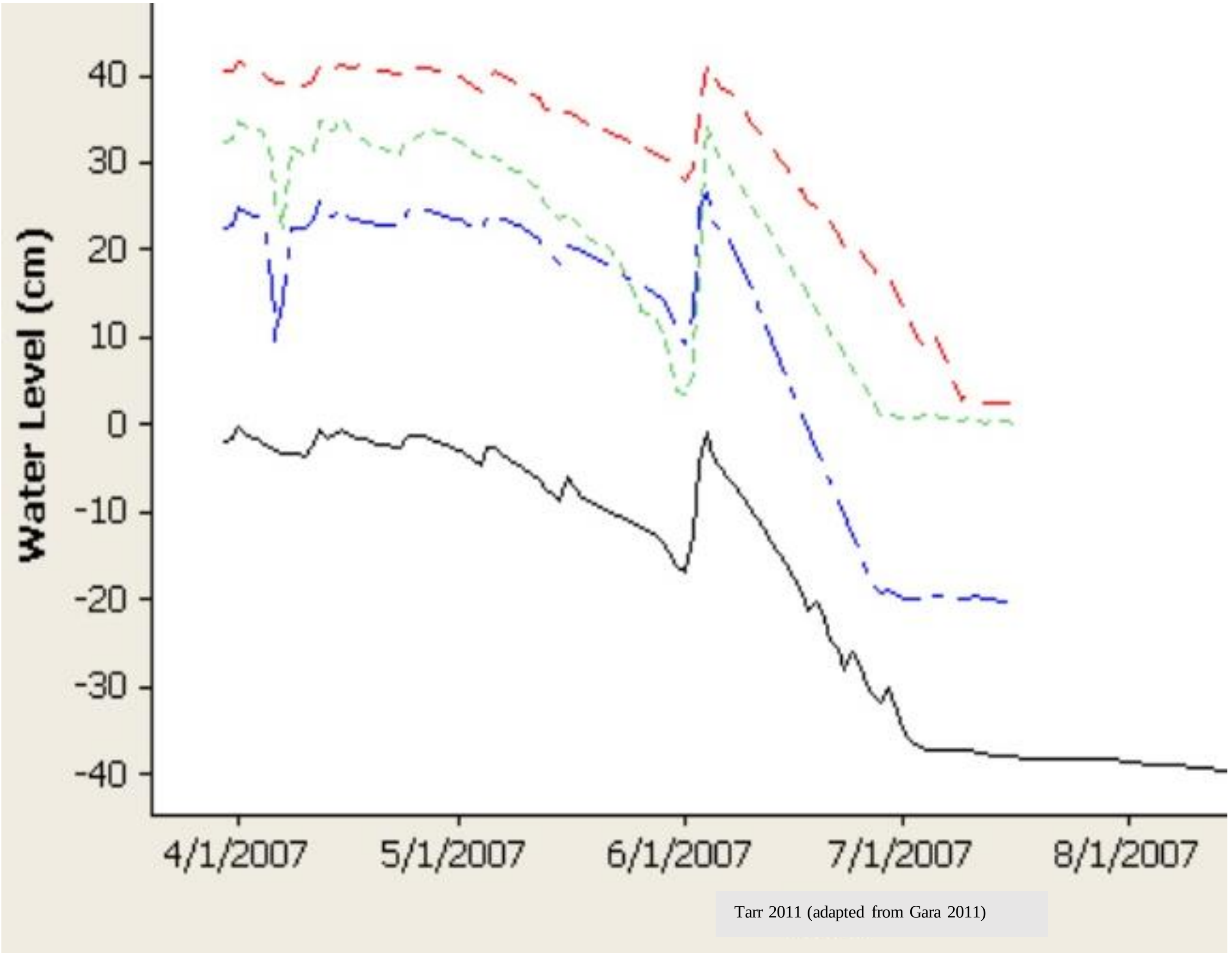

MASSACHUSETTS
GEOLOGICAL SURVEY

Ephemeral Hydrology

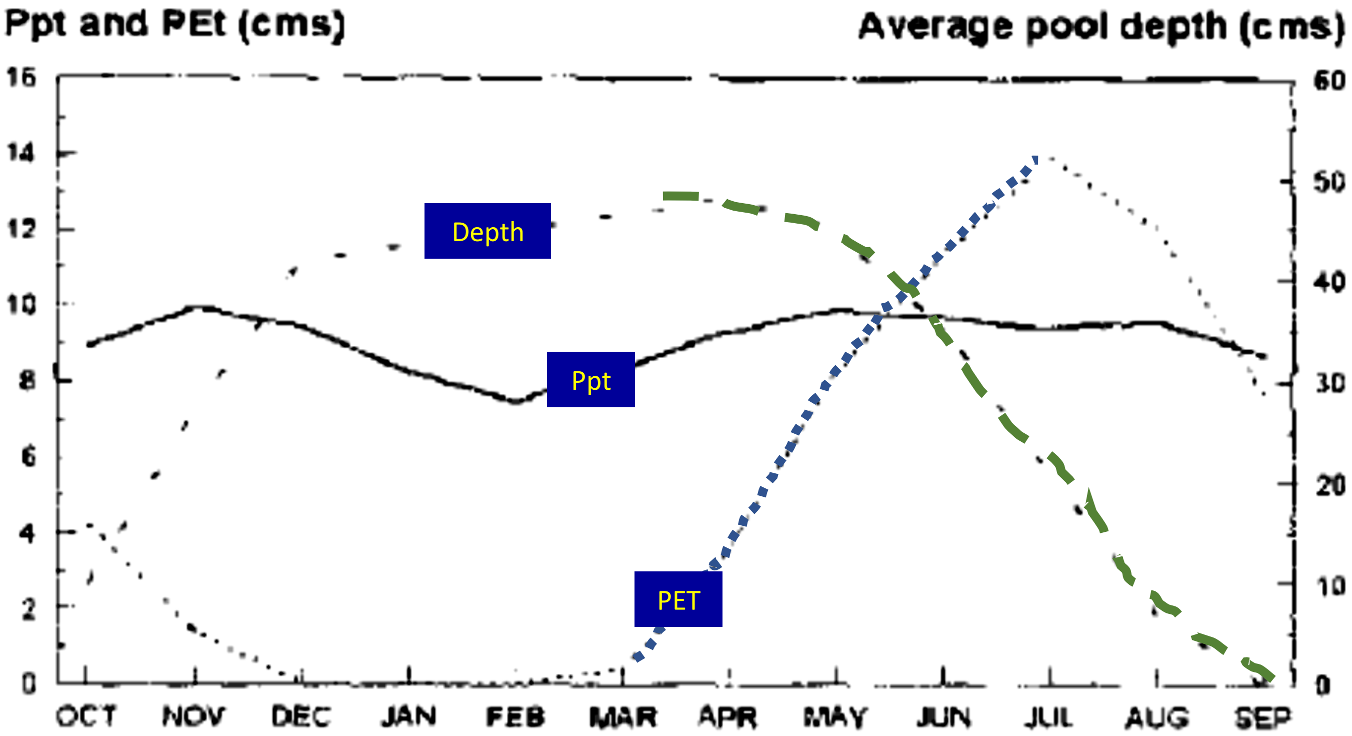
RI DEM

Vernal Pool Hydrograph

Hydroperiod affects:



Impact of Leaf-out
On Forested Vernal Pool Hydrology

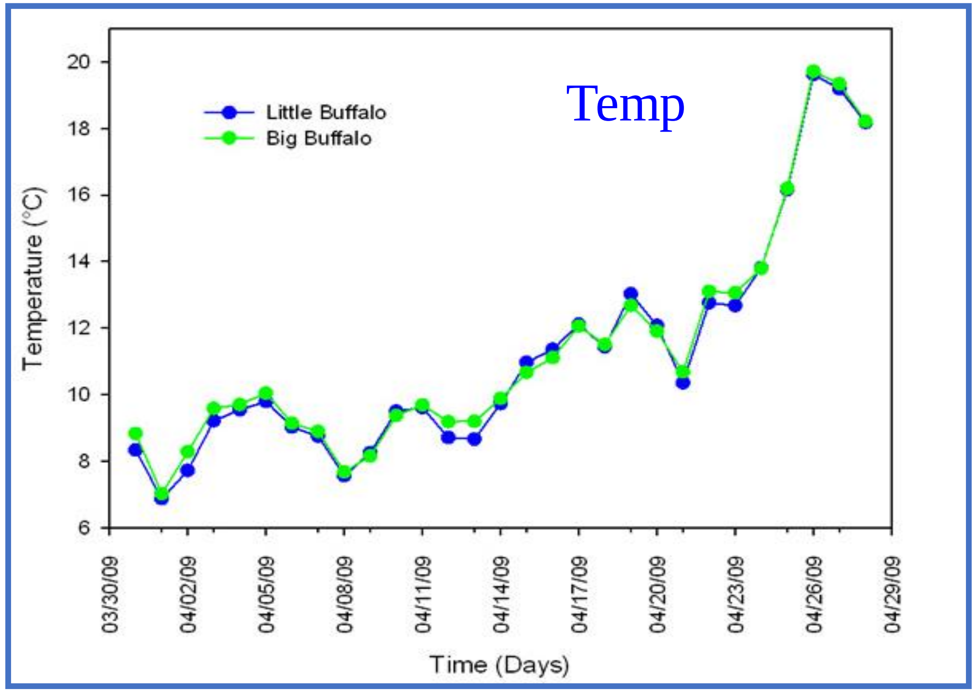


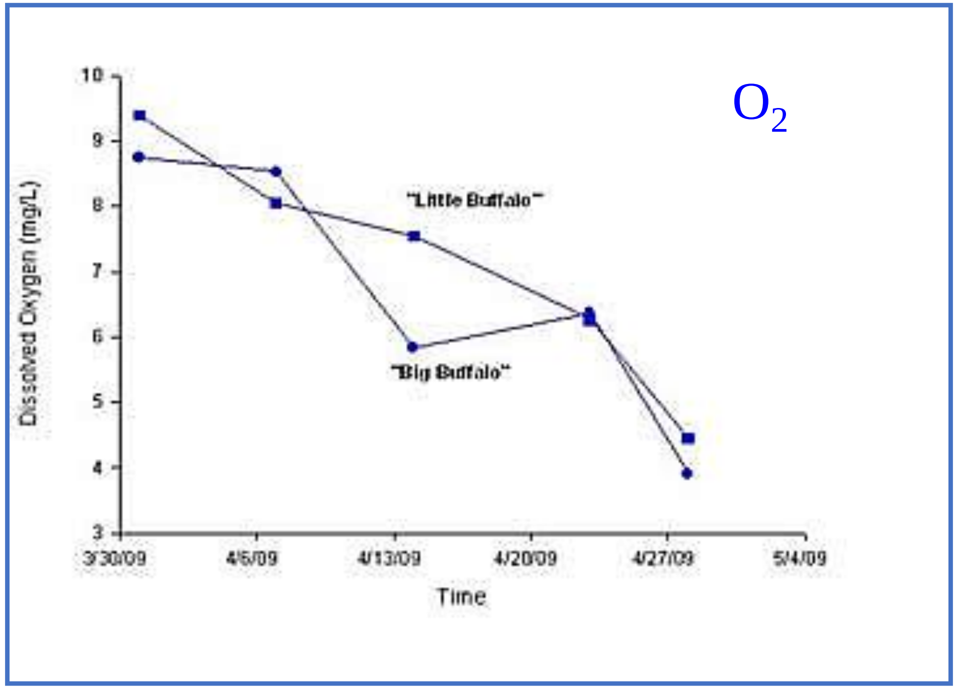
AU | ANTIOCH UNIVERSITY NEW ENGLAND Center for Climate Preparedness and Community Resilience

Brooks 2005

Vernal Pool

Dissolved Oxygen & Temperature





UNH, Center for Freshwater Biology 2009

NH List of Vernal Pool Wildlife

NH Fish & Game

Range of Pool Sizes

N=34

water present
>80% of site visits
(1998- 2000)

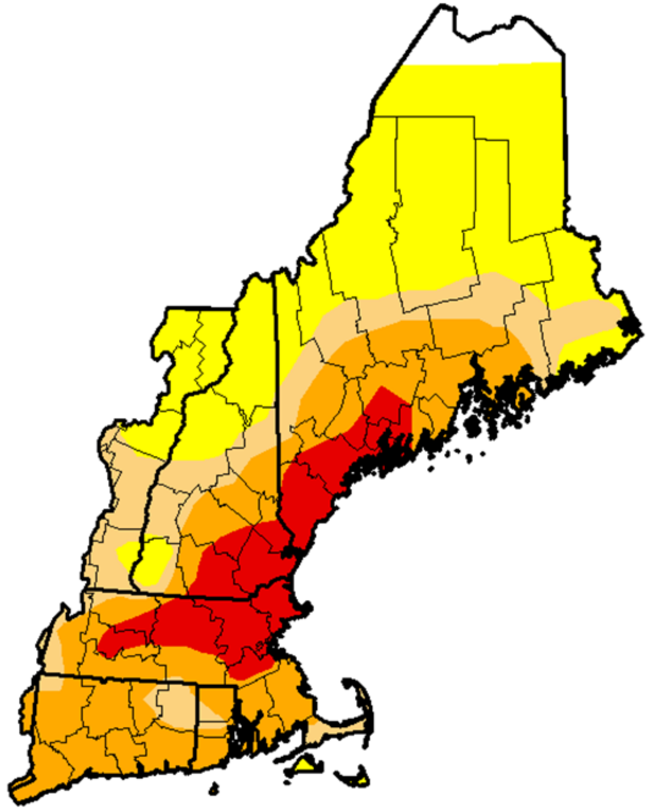
Max depth	.36 -3.1	ft		> 1.64 ft
Max area	734 - 31762	ft^2		> 10800 ft^2
Max vol	212 - 17862	ft^3		> 3530 ft^3
Max Per	98 - 1272	ft		

adapted from Brooks & Hayashi 2002

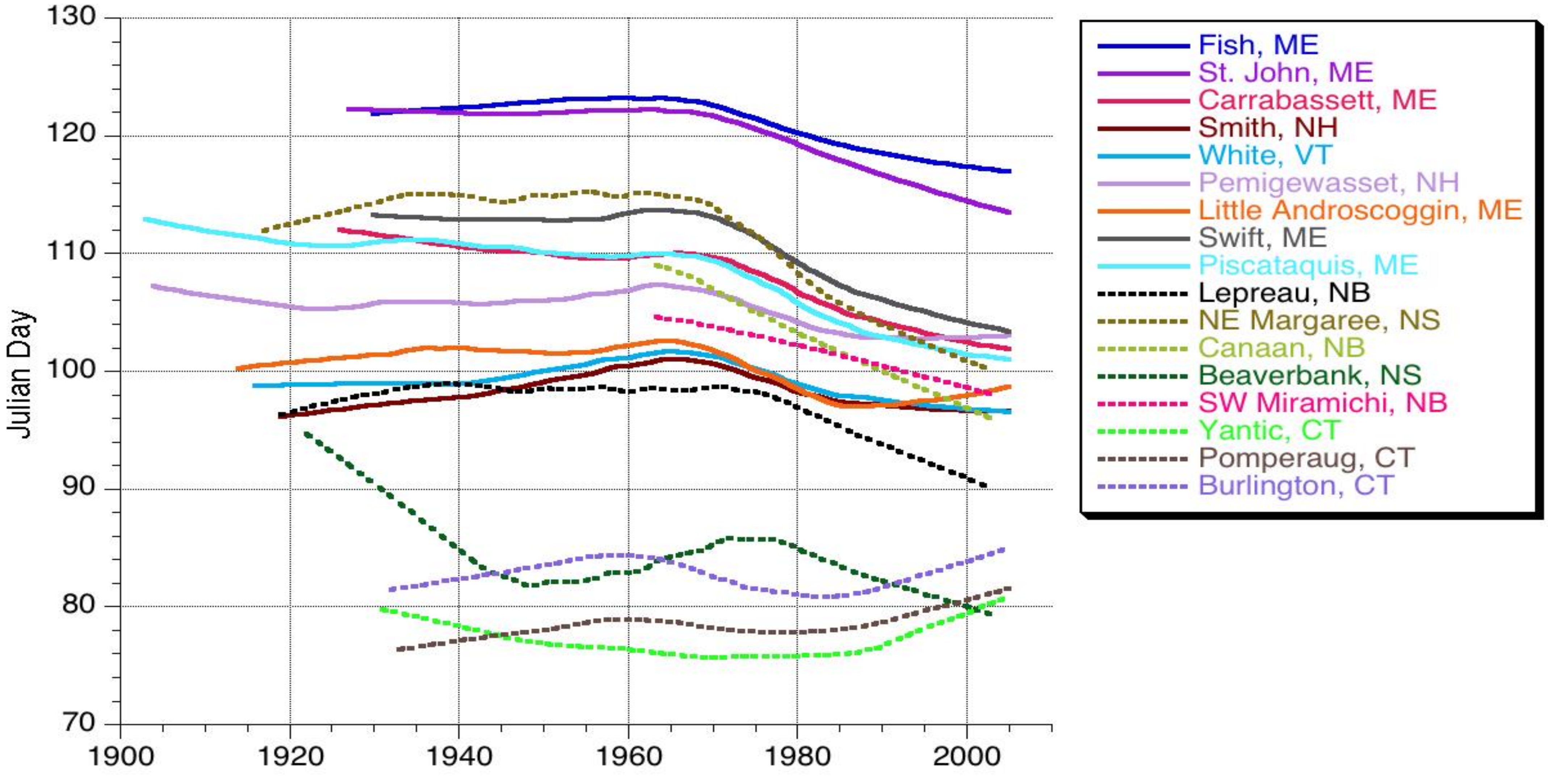
What has been happening?

Plymouth, NH
2011

U.S. Drought Monitor
New England Watershed
2016



Center of Runoff Volume Dates



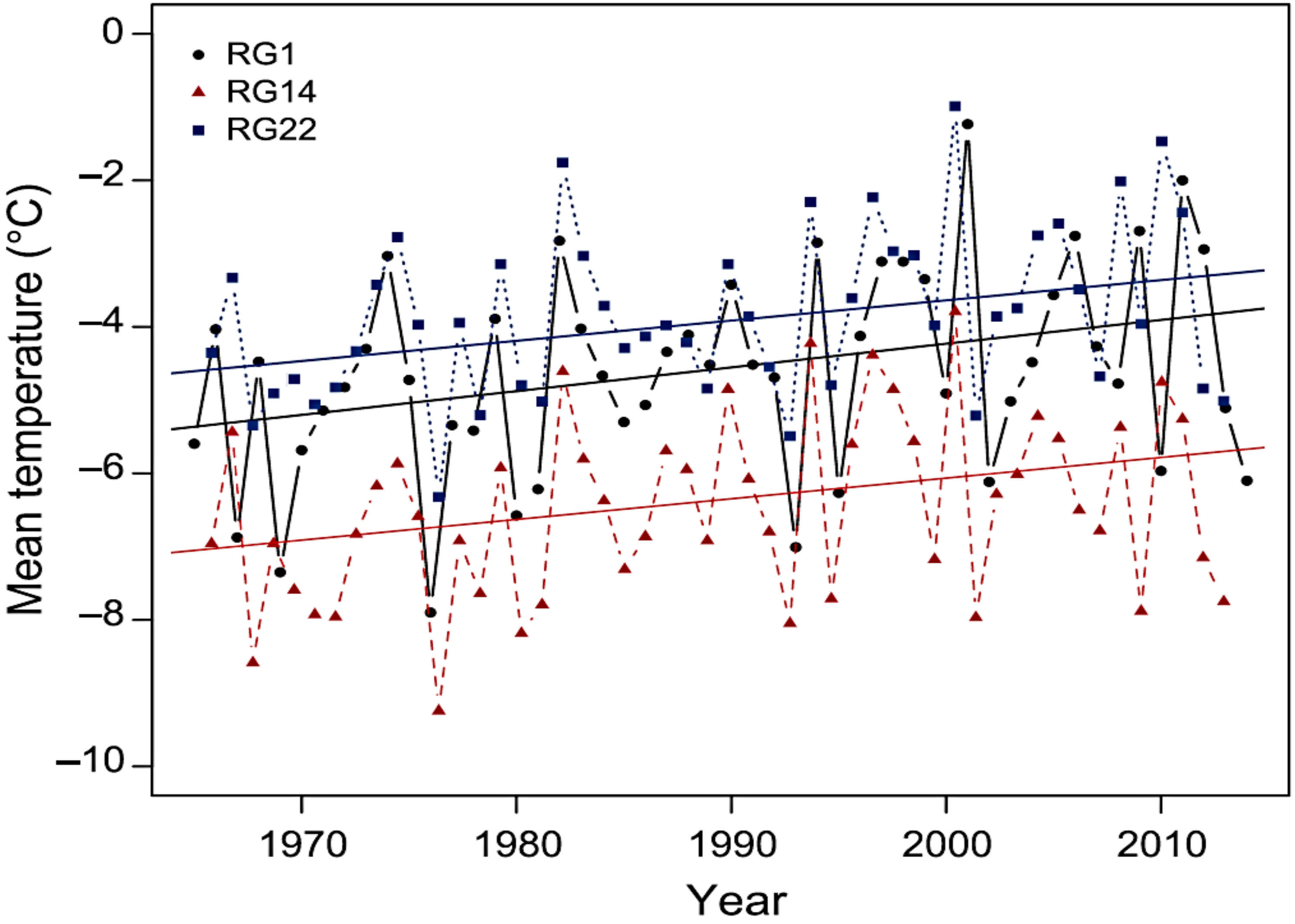
AU | Antioch University New England Center for Climate Preparedness and Community Resilience

Wake 2008 (adapted from Hodgkins et al 2003)

Mean Temperatures During Snow Making Season

Hubbard Brook NH

(1965 - 2015)

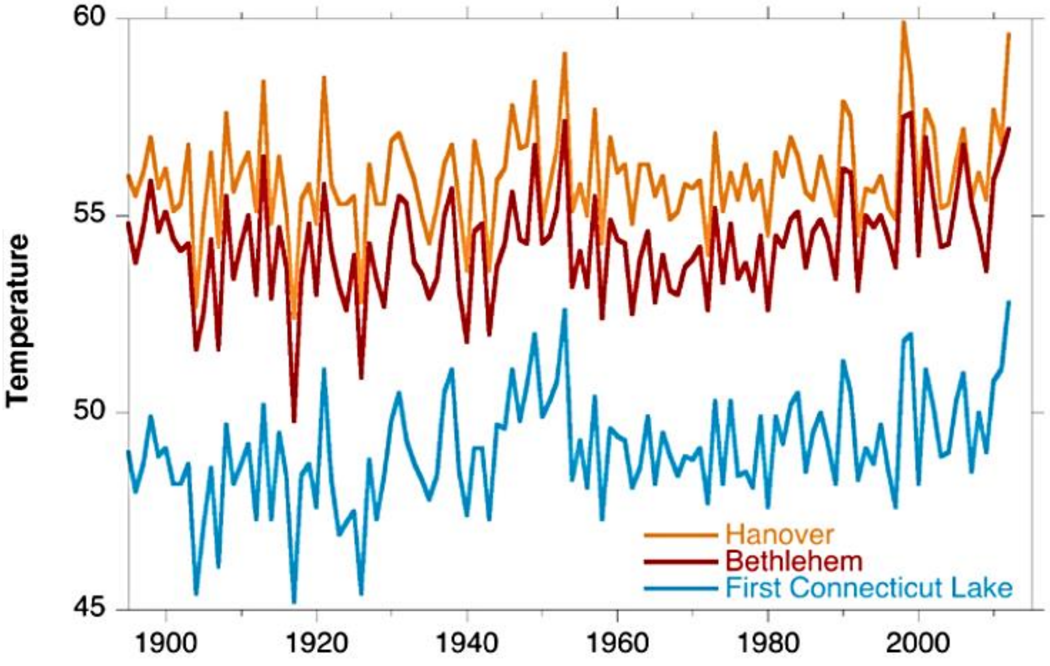


ANTIOCH UNIVERSITY NEW ENGLAND
Center for Climate Preparedness
and Community Resilience

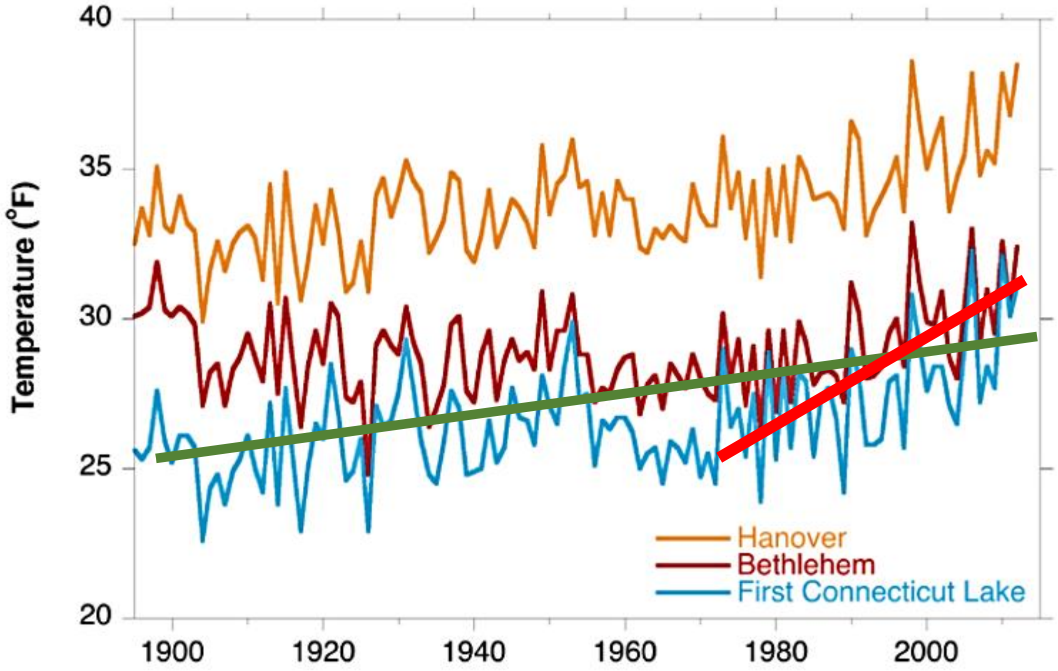
Wilson et al 2018

Northern NH
Average Maximum and Minimum Temperatures
(1895-2012)

Annual Maximum Temperature



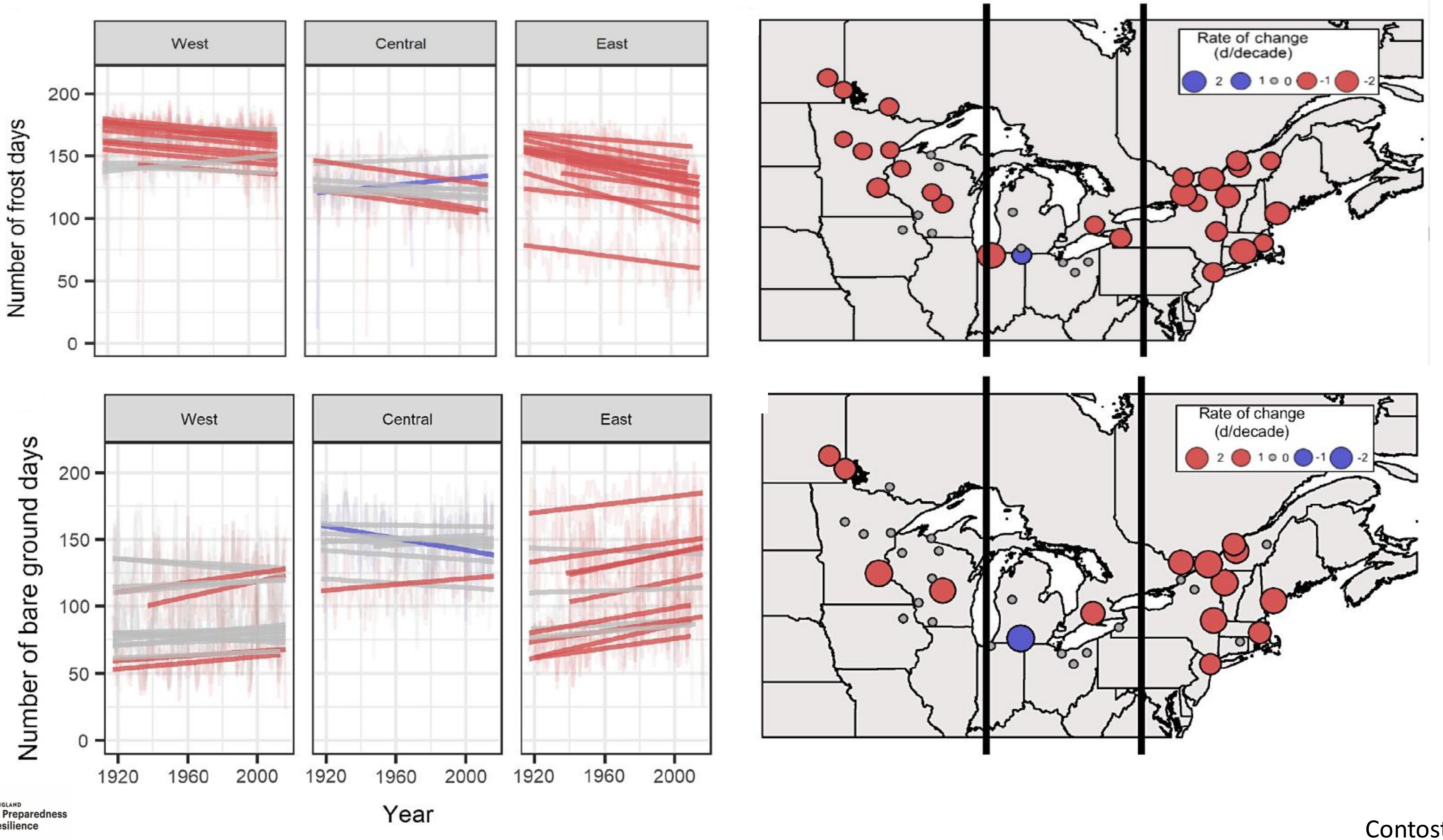
Annual Minimum Temperature



Wake et al 2014

Change in Frost & Bare Ground Days

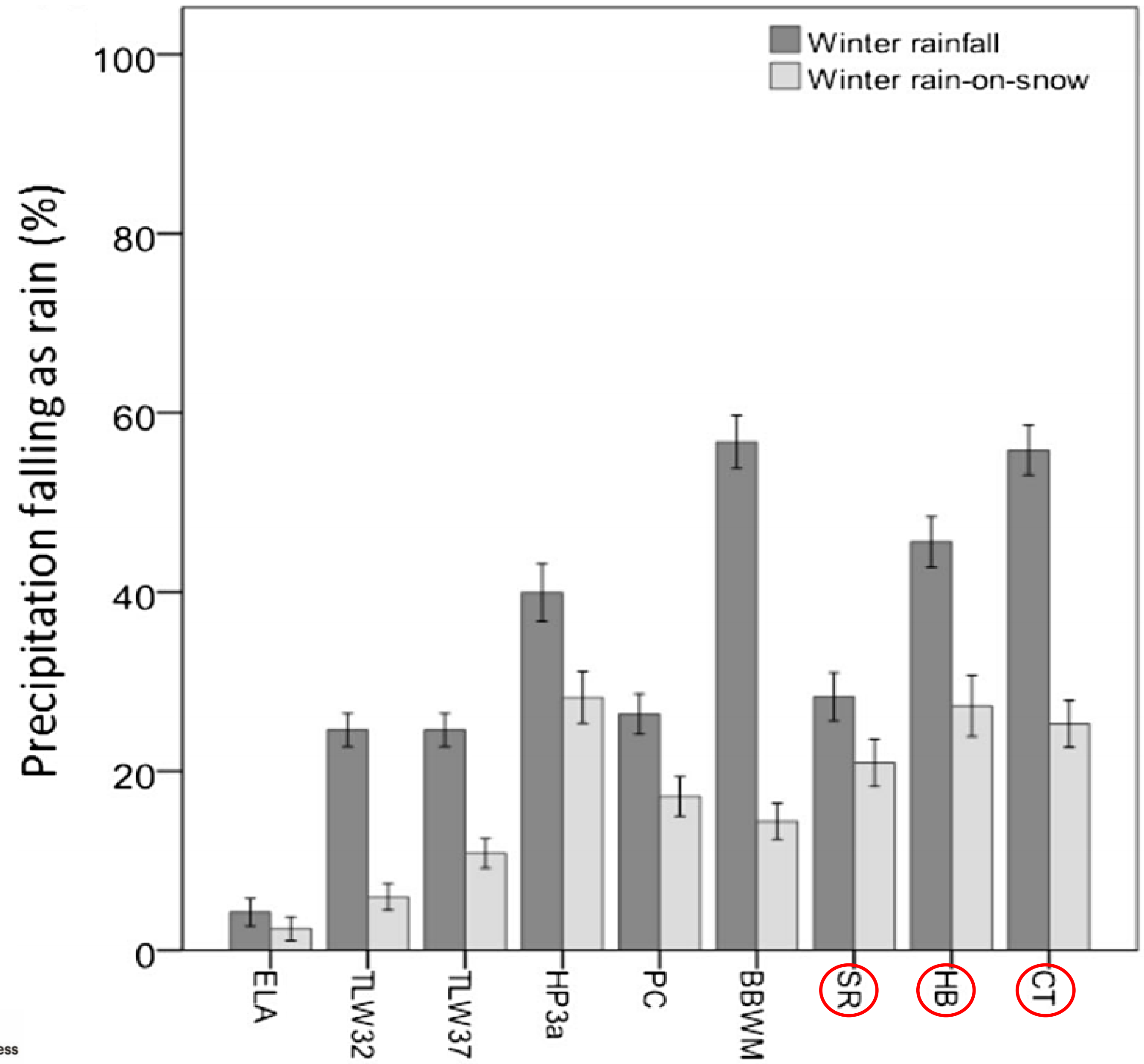
(1917-2016)



AU | ANTIOCH UNIVERSITY NEW ENGLAND
Center for Climate Preparedness
and Community Resilience

Contosta et al 2020

Rain on Snow
(1990 - 2010)



New England

BB – Northeast ME

HB – Northwest NH

SR – Northeast VT

CT – Southeast NY

Ontario

PC – Southeast

HP – Southeast

TLW – South Central

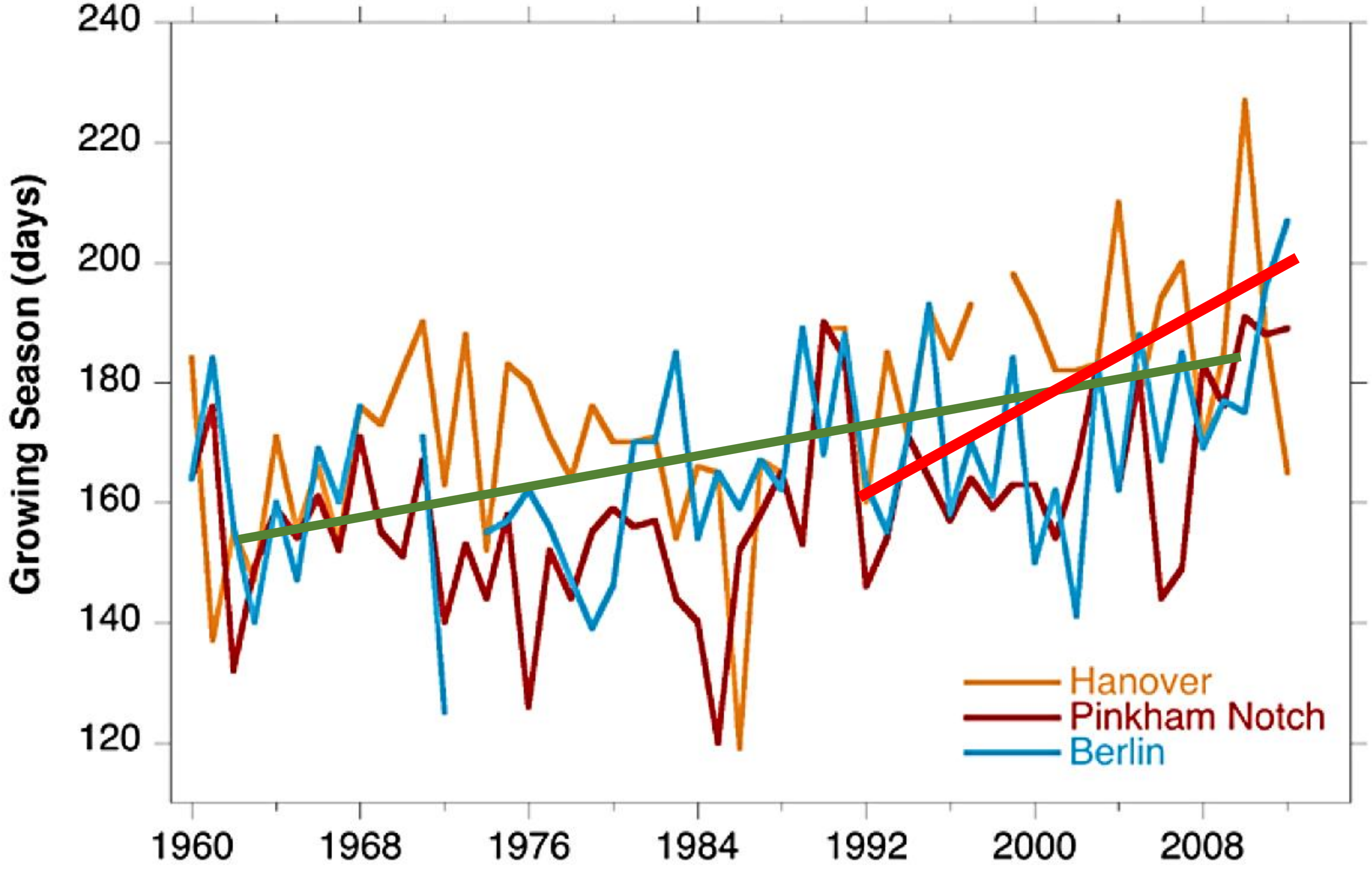
ELA – Southwest

Northern NH
Days Less Than 32° F
(1960-2012)

Location	Days < 32°F	
	1960-2012 average	Trend (days/ decade)
Berlin	168	**-3.2**
Pinkham Notch	180	**-3.5**
Hanover	151	**-3.8**

Wake et al 2014

Northern NH
Length of Growing Season
(1960-2012)



Wake et al 2014

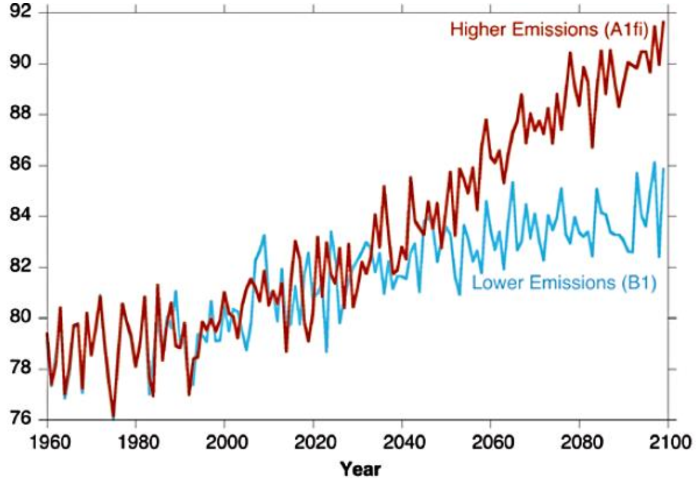
Projected Change in Temperatures

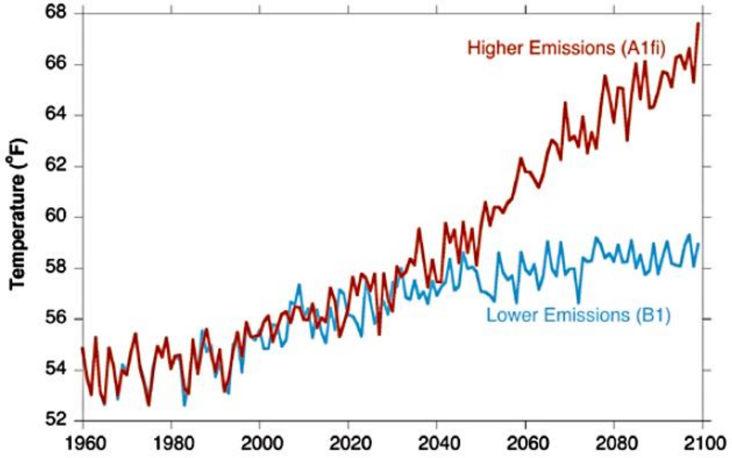
(Southern NH)

Maximum Temperature

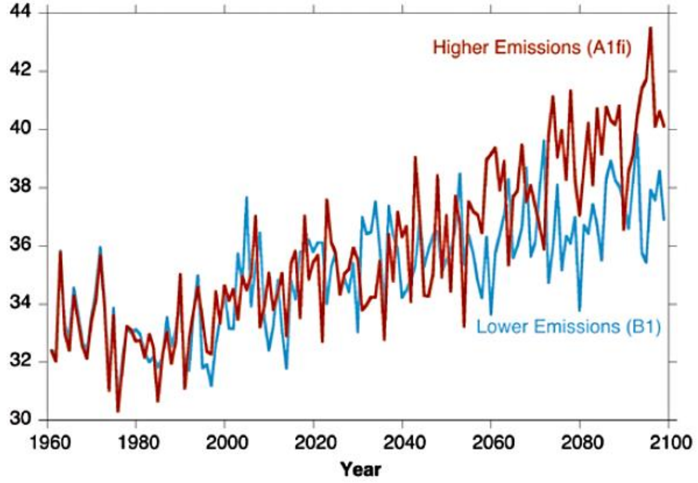
Minimum Temperature

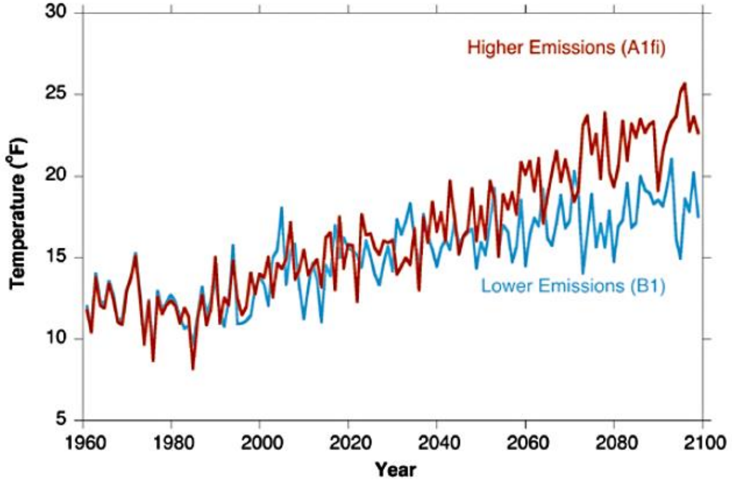
Summer





Winter

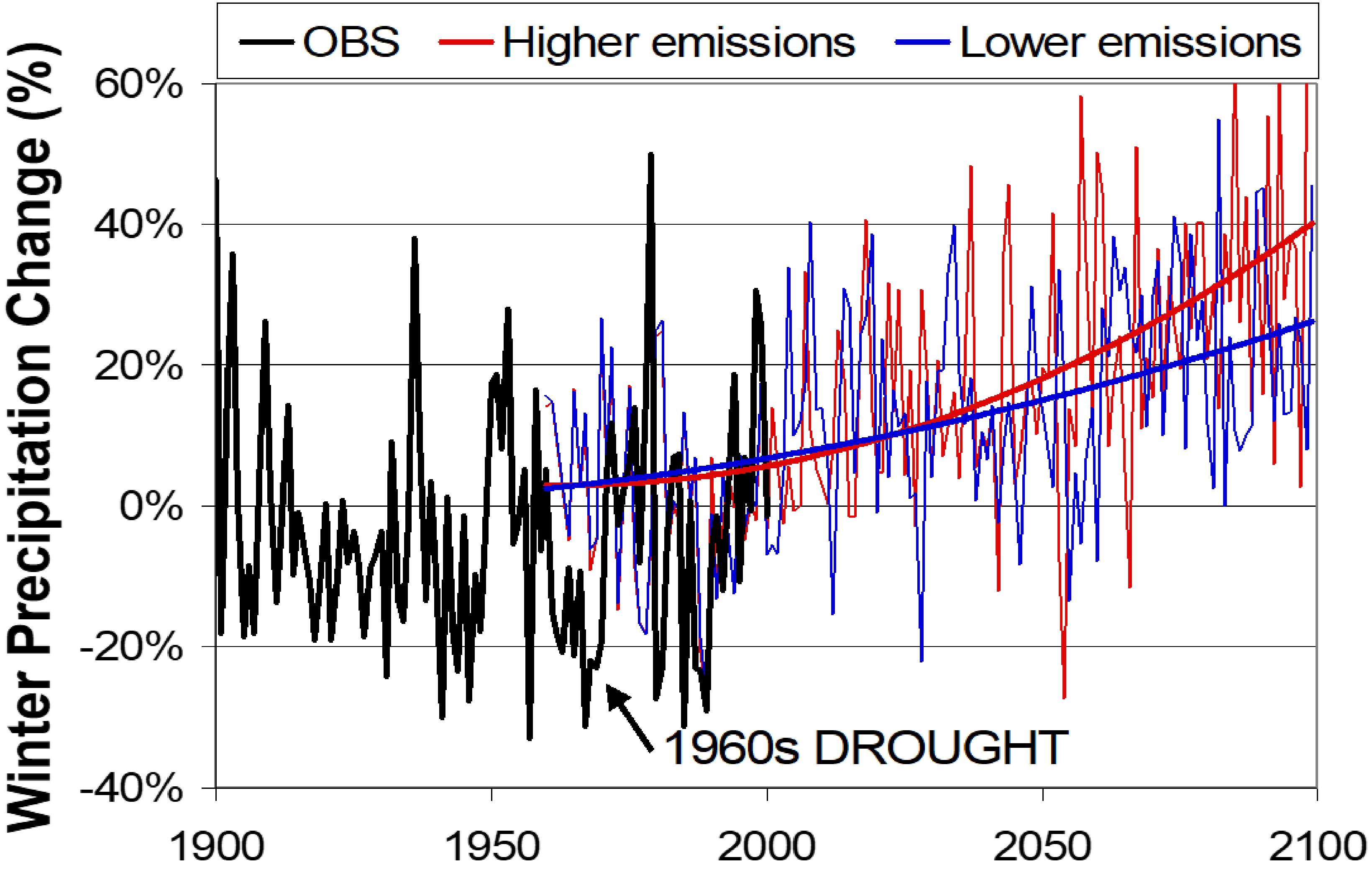




ANTIOCH UNIVERSITY NEW ENGLAND
Center for Climate Preparedness and Community Resilience

Wake et al. 2014

Projected Change in Winter Precipitation

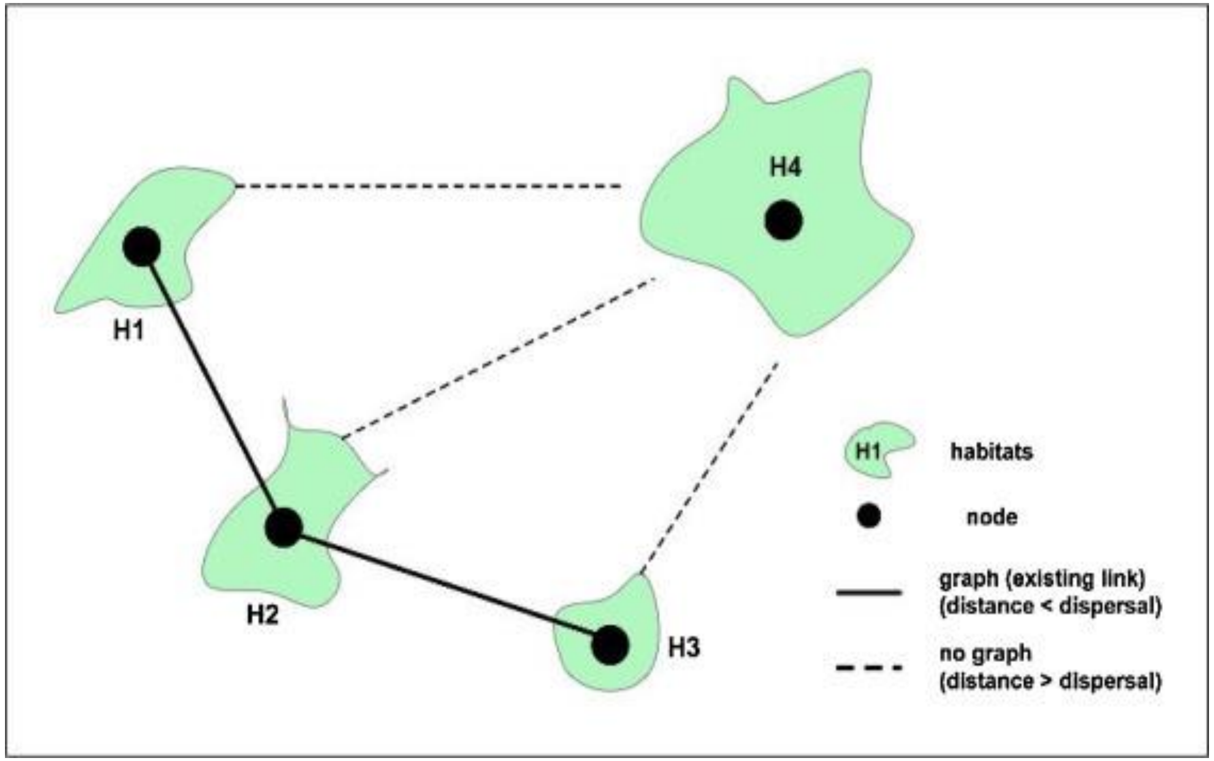


As temperatures rise, more falling as rain, less as snow

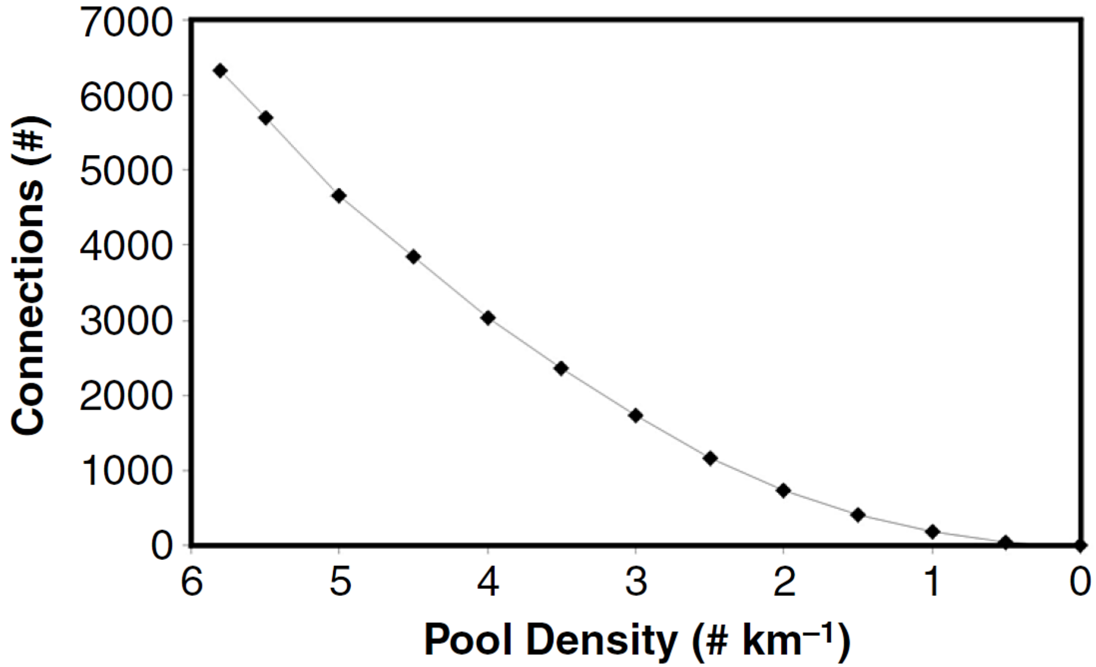
Hayhoe 2007, Wake 2008, NCA4 2018

High Elevation Vernal Pools:
The Meta-Population Challenge

Antioch University New England Center for Climate Preparedness and Community Resilience

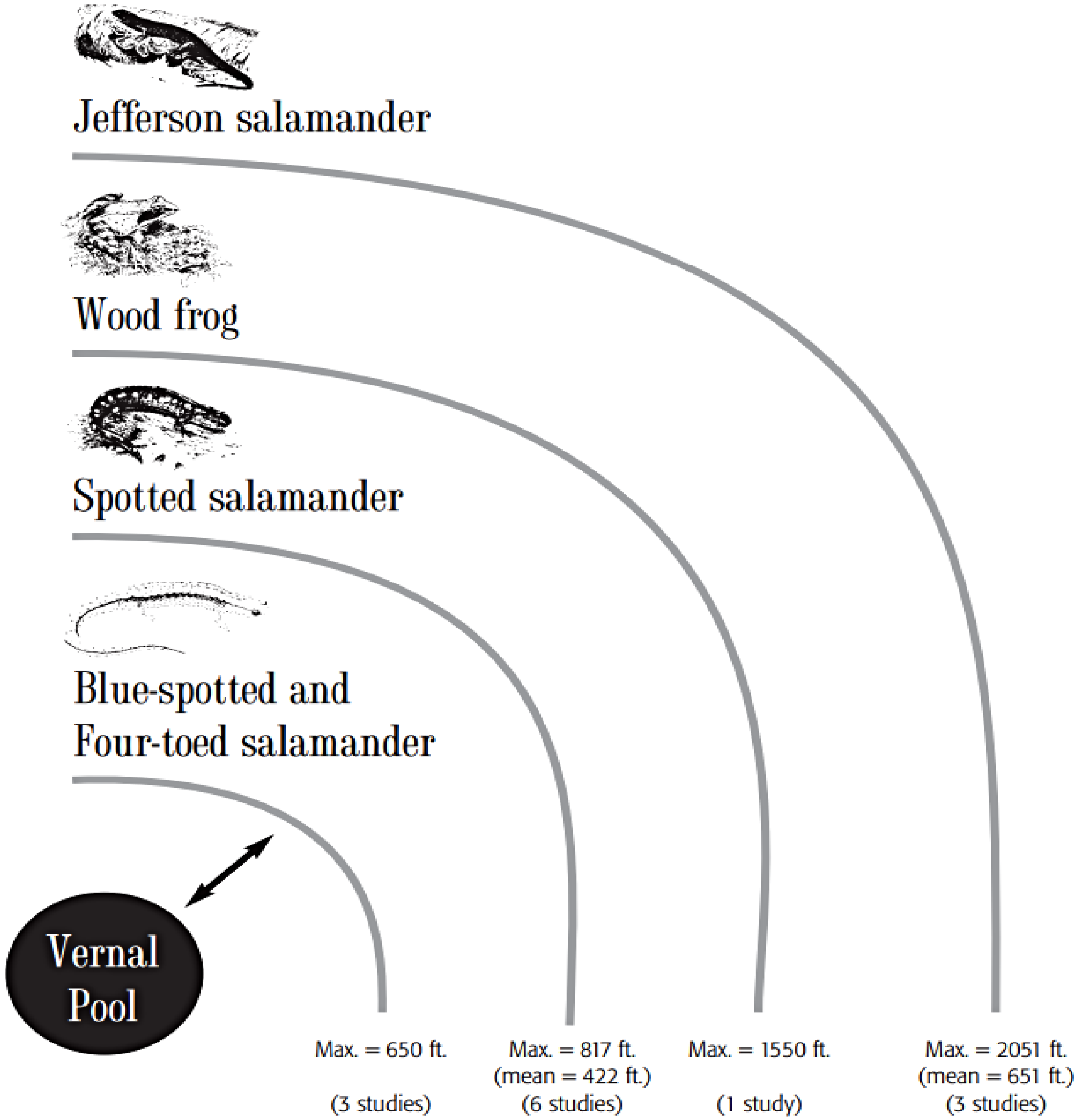


Pietsch 2018



Leobowitz & Brooks 2008

Migration Distances
Adult Vernal Pool Species



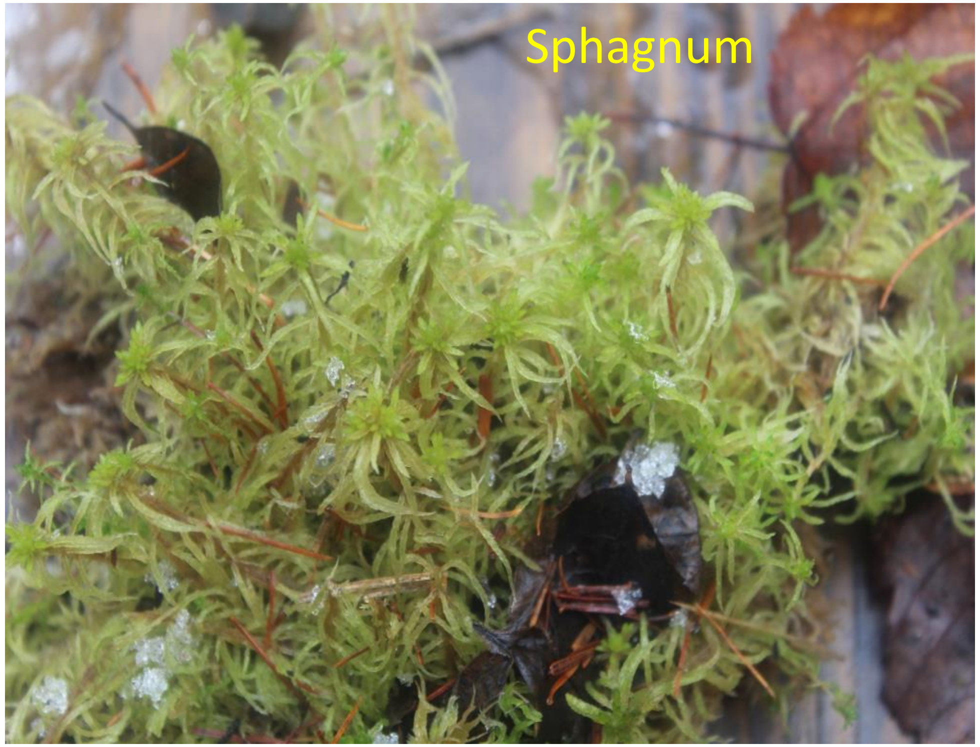
AU | ANTIOCH UNIVERSITY NEW ENGLAND
Center for Climate Preparedness
and Community Resilience

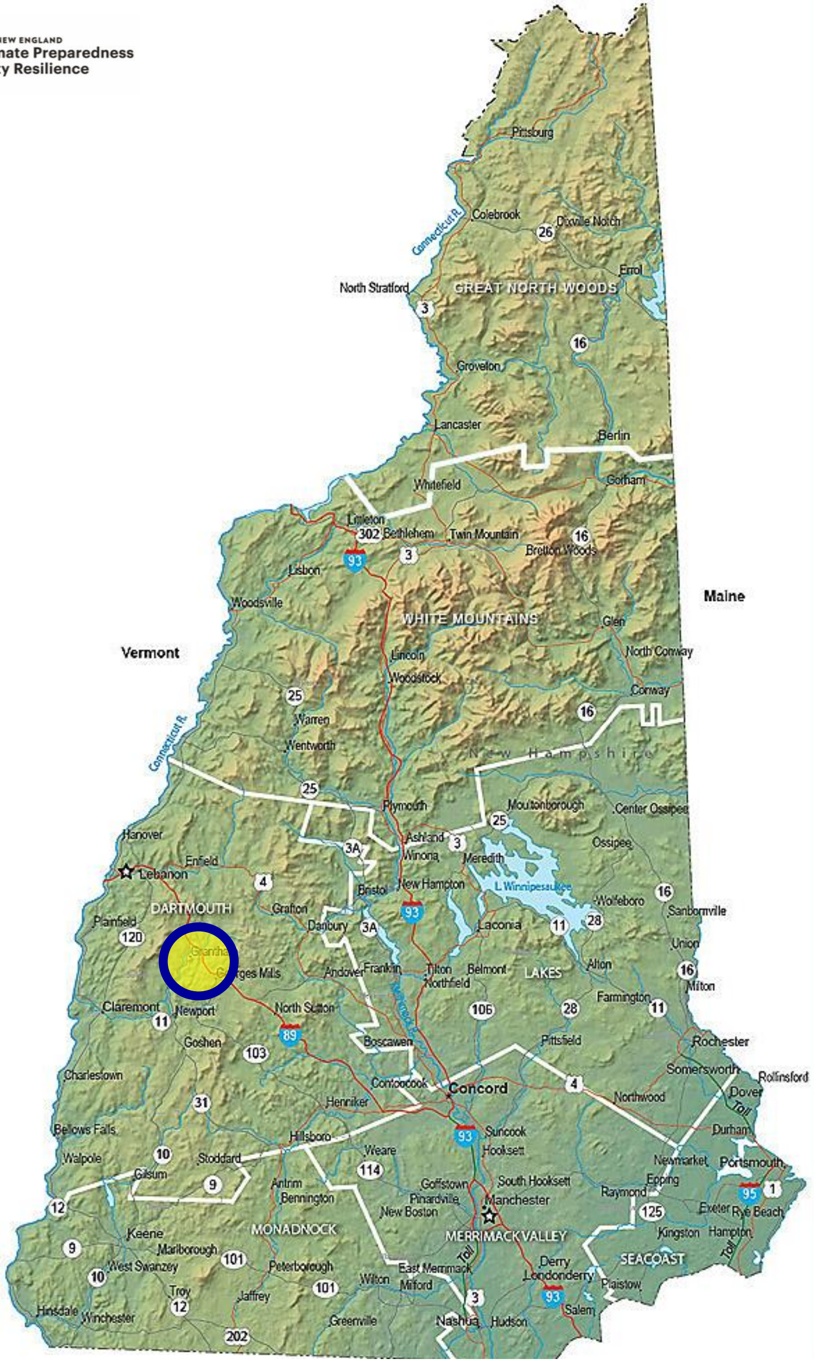
Calhoun & deMaynadier 2004

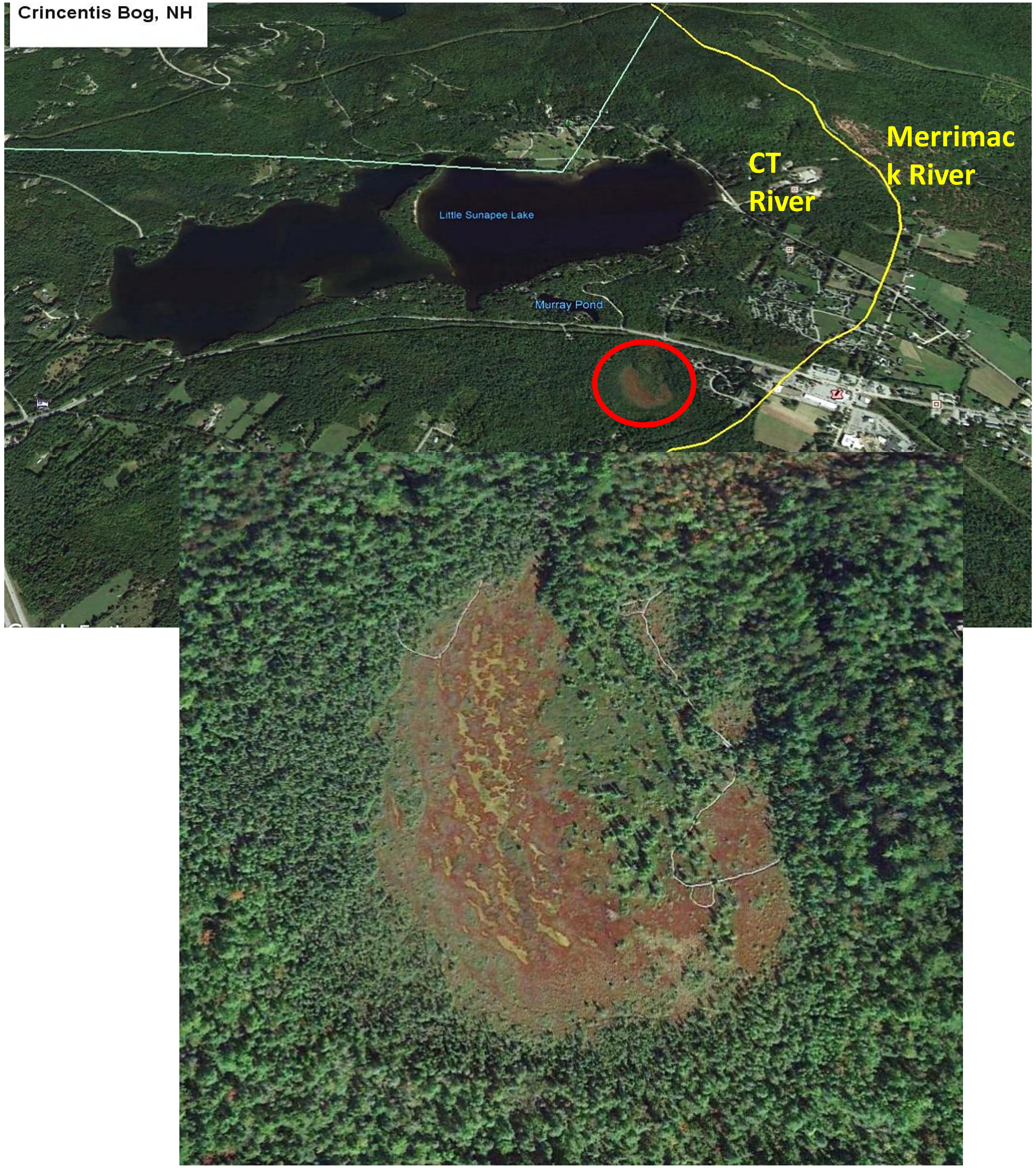

Kissner 2014

Ecosystem Engineers

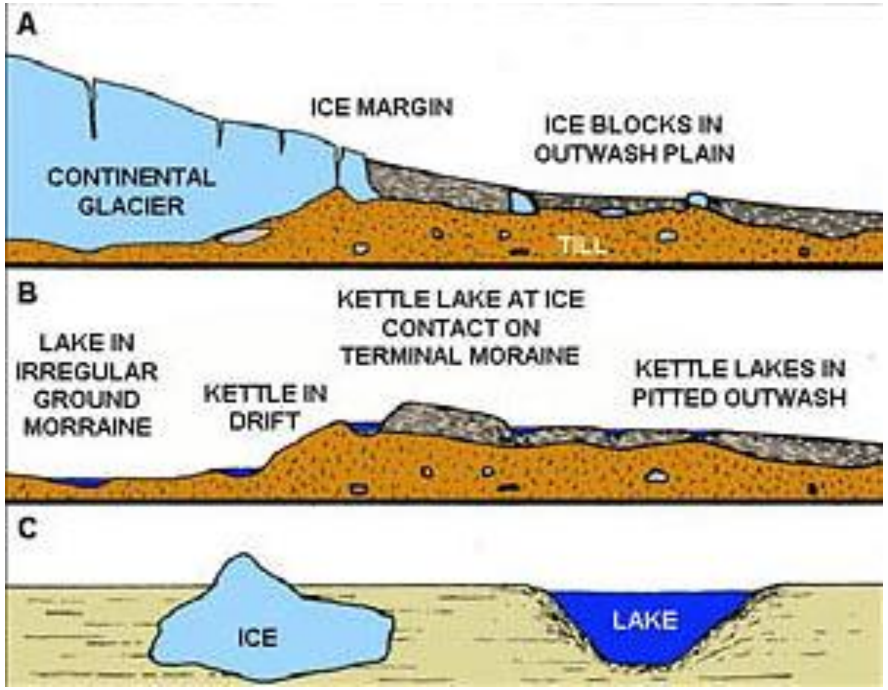
Ecosystem Engineers



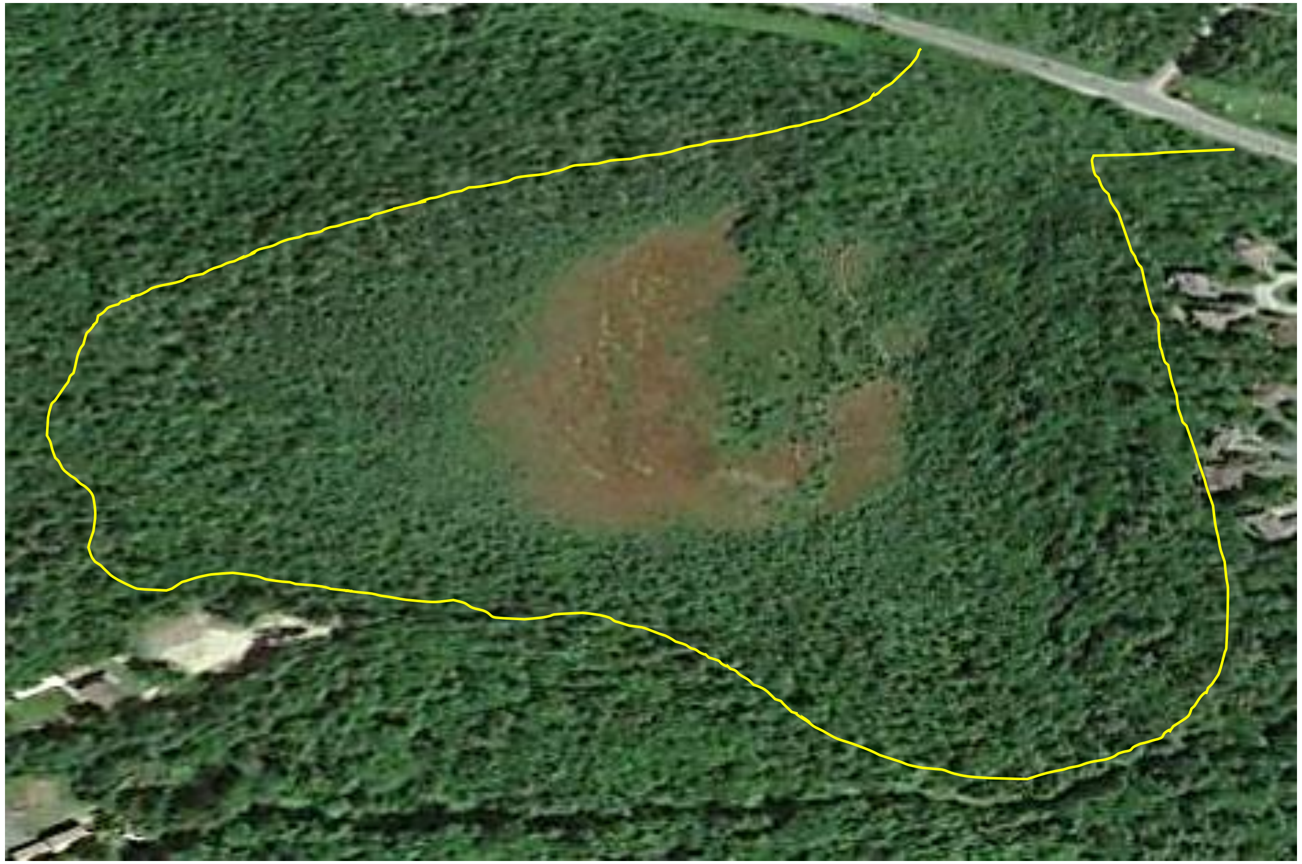

Quebec, Canada
Vermont
Maine
GREAT NORTH WOODS
WHITE MOUNTAINS
DARTMOUTH
LAKES
MONADNOCK
MERRIMACK VALLEY
SEACOAST
Pittsburg
Colebrook
Dixville Notch
Errol
North Stratford
Groveton
Lancaster
Berlin
Gorham
Whitefield
Littleton
Bethlehem
Twin Mountain
Bretton Woods
Lisbon
Woodsville
Glen
North Conway
Conway
Lincoln
Woodstock
Warren
Wentworth
Plymouth
Ashland
Meredith
Moultonborough
Center Ossipee
Ossipee
Hanover
Lebanon
Enfield
Grafton
Bristol
New Hampton
L. Winnipesaukee
Wolfeboro
Sanbornville
Plainfield
Danbury
Laconia
Union
Claremont
Newport
North Sutton
Andover
Franklin
Tilton
Belmont
Northfield
Alton
Farmington
Milton
Goshen
Boscawen
Pittsfield
Rochester
Rollinsford
Charlestown
Contoocook
Concord
Somersworth
Dover
Northwood
Henniker
Bellows Falls
Hillsboro
Suncook
Hooksett
Durham
Walpole
Stoddard
Weare
Newmarket
Portsmouth
Gilsum
Antrim
Goffstown
South Hooksett
Epping
Bennington
Pinardville
Manchester
Raymond
New Boston
Exeter
Rye Beach
Keene
Kingston
Hampton
Marlborough
West Swanzey
Peterborough
East Merrimack
Derry
Londonderry
Troy
Jaffrey
Wilton
Milford
Plaistow
Hinsdale
Winchester
Greenville
Nashua
Hudson
Salem
Connecticut R.
New Hampshire


Crincentis Bog, NH
Little Sunapee Lake
Murray Pond
CT River
Merrimack River

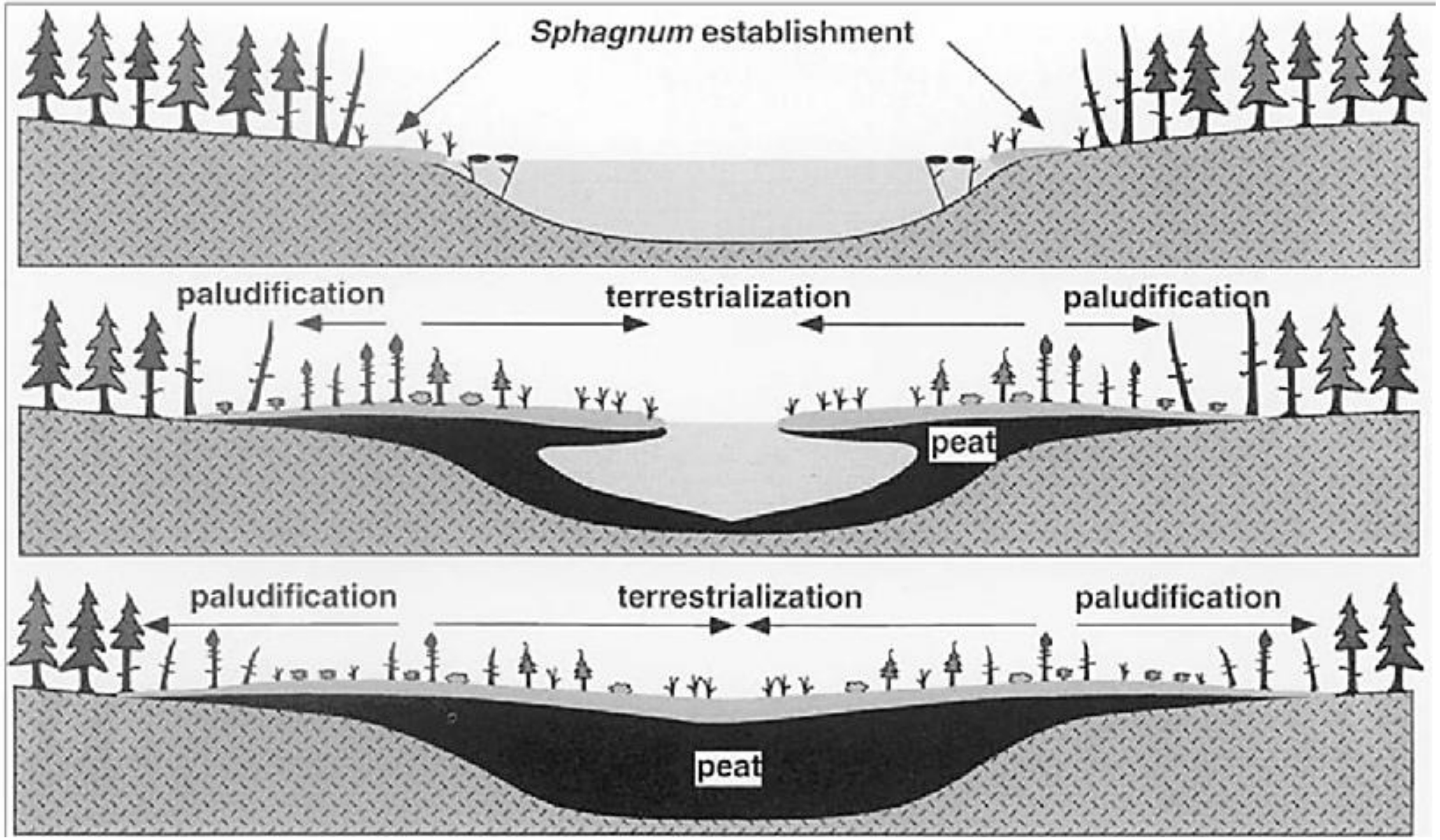

Power 2015


A
ICE MARGIN
ICE BLOCKS IN OUTWASH PLAIN
CONTINENTAL GLACIER
TILL
B
KETTLE LAKE AT ICE CONTACT ON TERMINAL MORAINE
LAKE IN IRREGULAR GROUND MORRAINE
KETTLE IN DRIFT
KETTLE LAKES IN PITTED OUTWASH
C
ICE
LAKE


US EPA

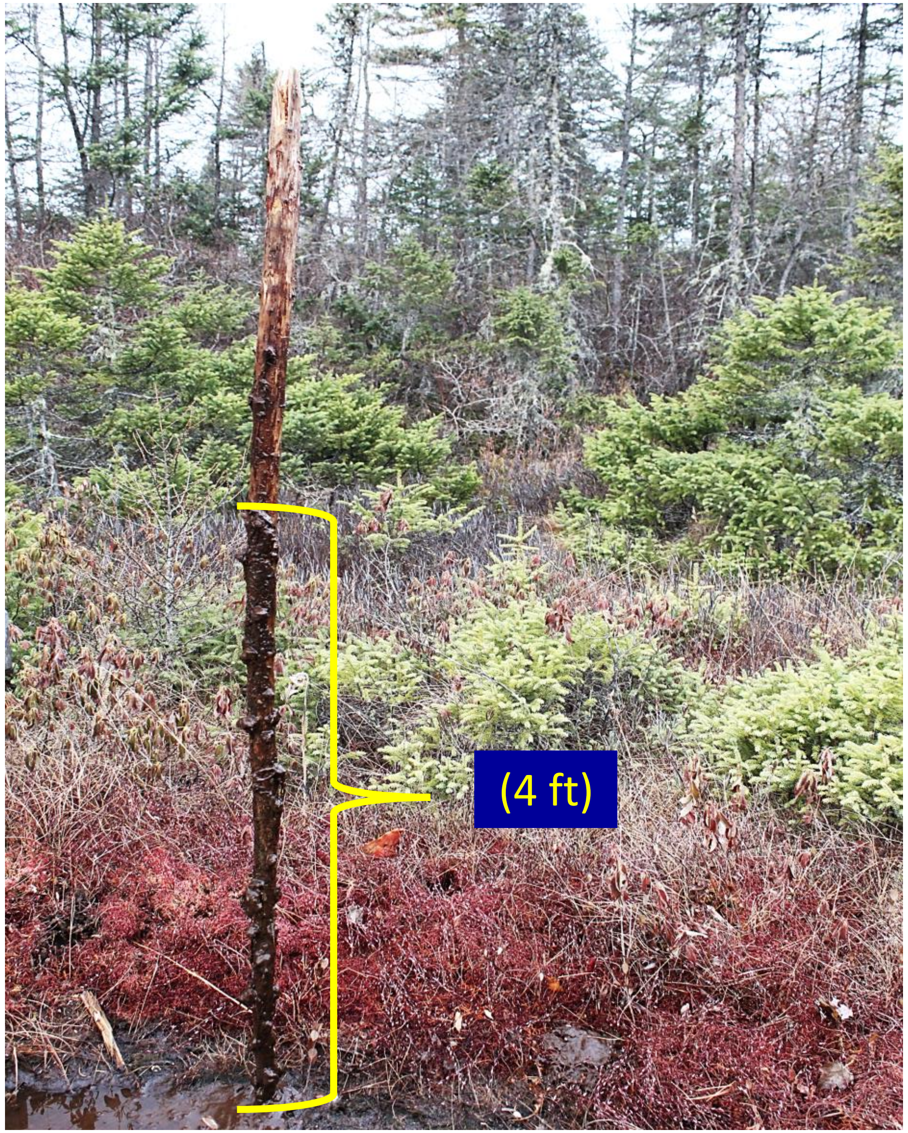


Peatland Development (Paludification)



McLaughlin 2013


Acrotelm
Catotelm

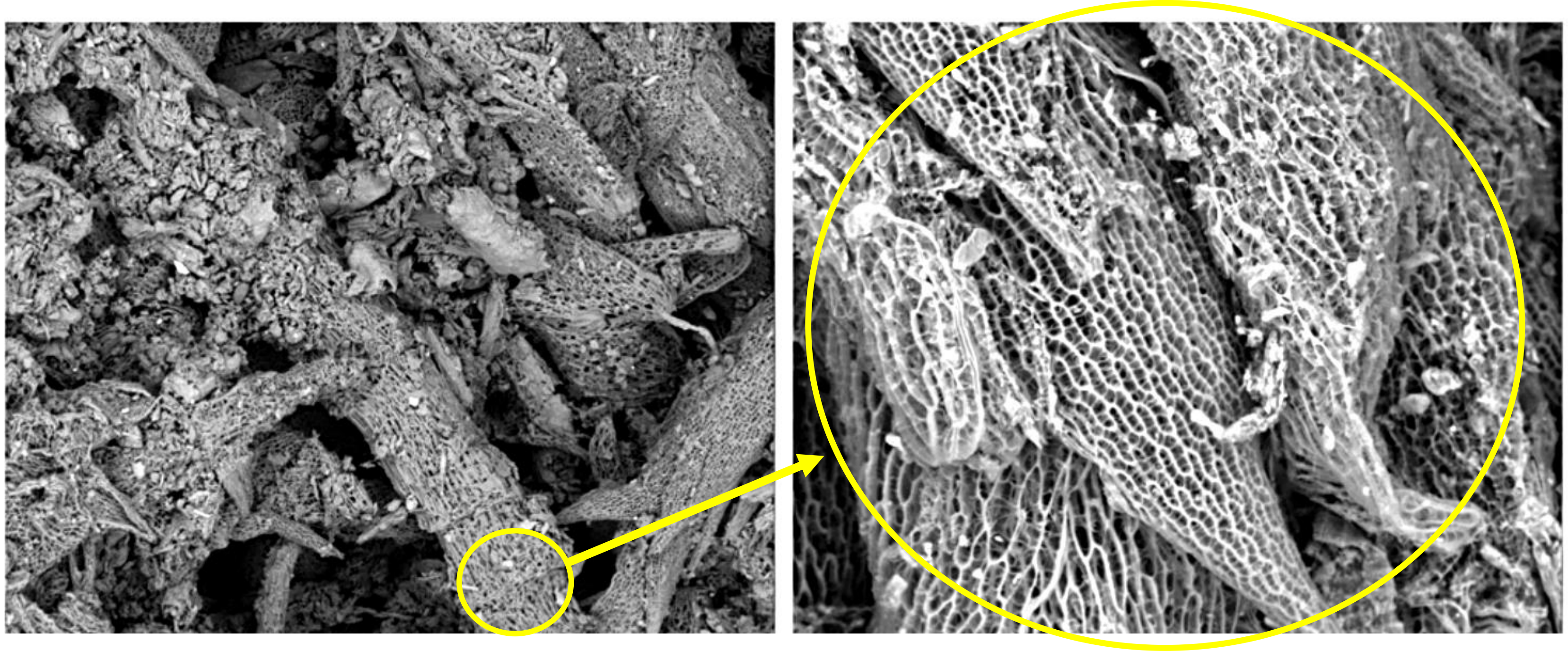

(4 ft)

Sphagnum moss is capable of absorbing 16x its air-dry weight.

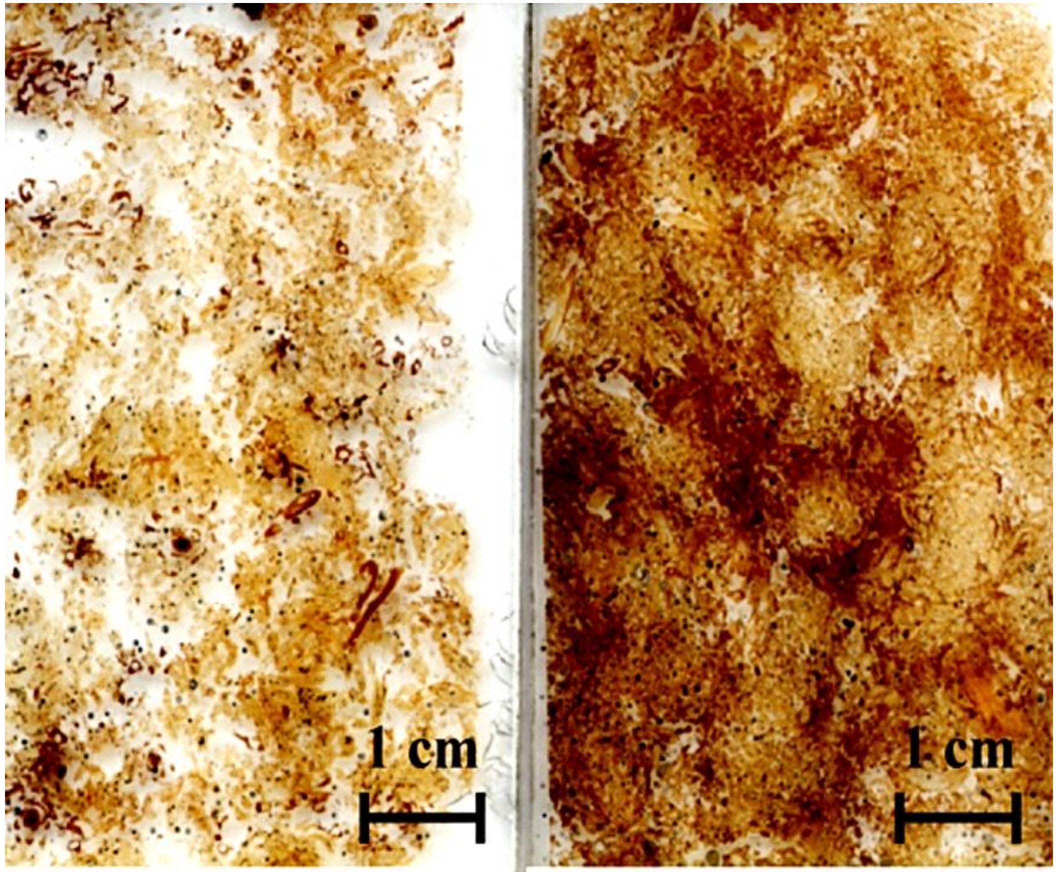
Kummel 1925

Undecomposed moss peats in the surface horizons contained the most water at saturation (95 to nearly 100% by volume).

Boelter 1964

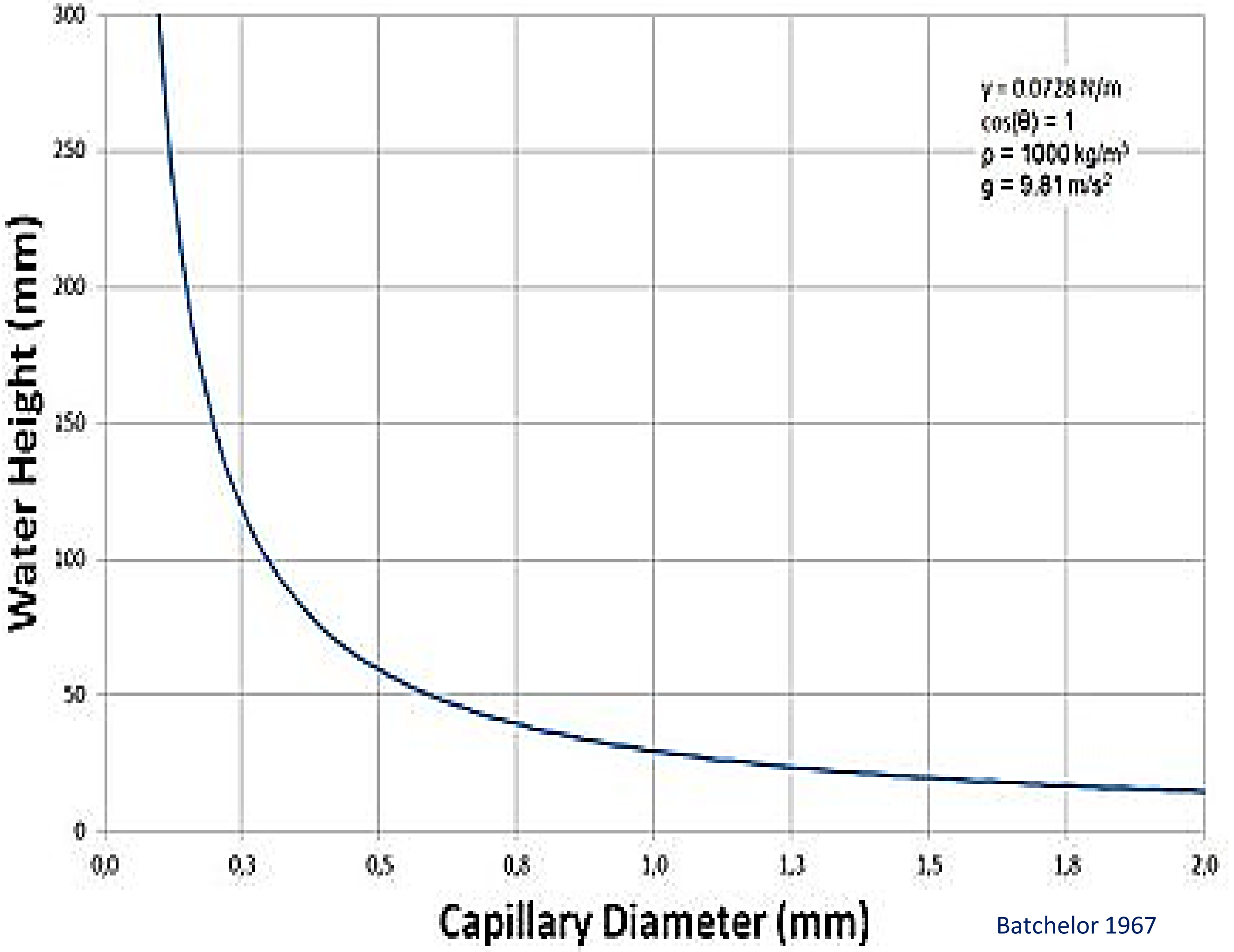


Rezanezhad et al. 2016



Depth: 5 cm   Depth: 55 cm

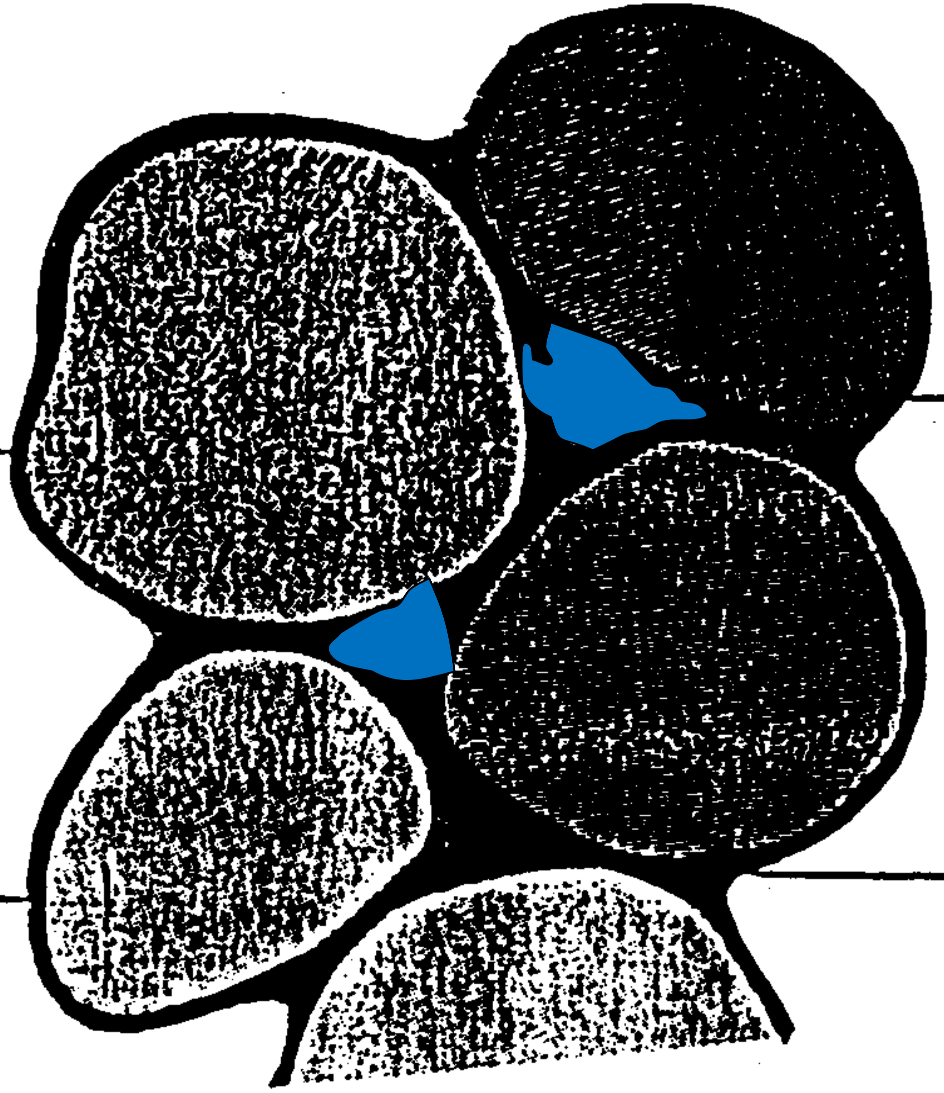
Rezanezhad et al. 2016



Batchelor 1967

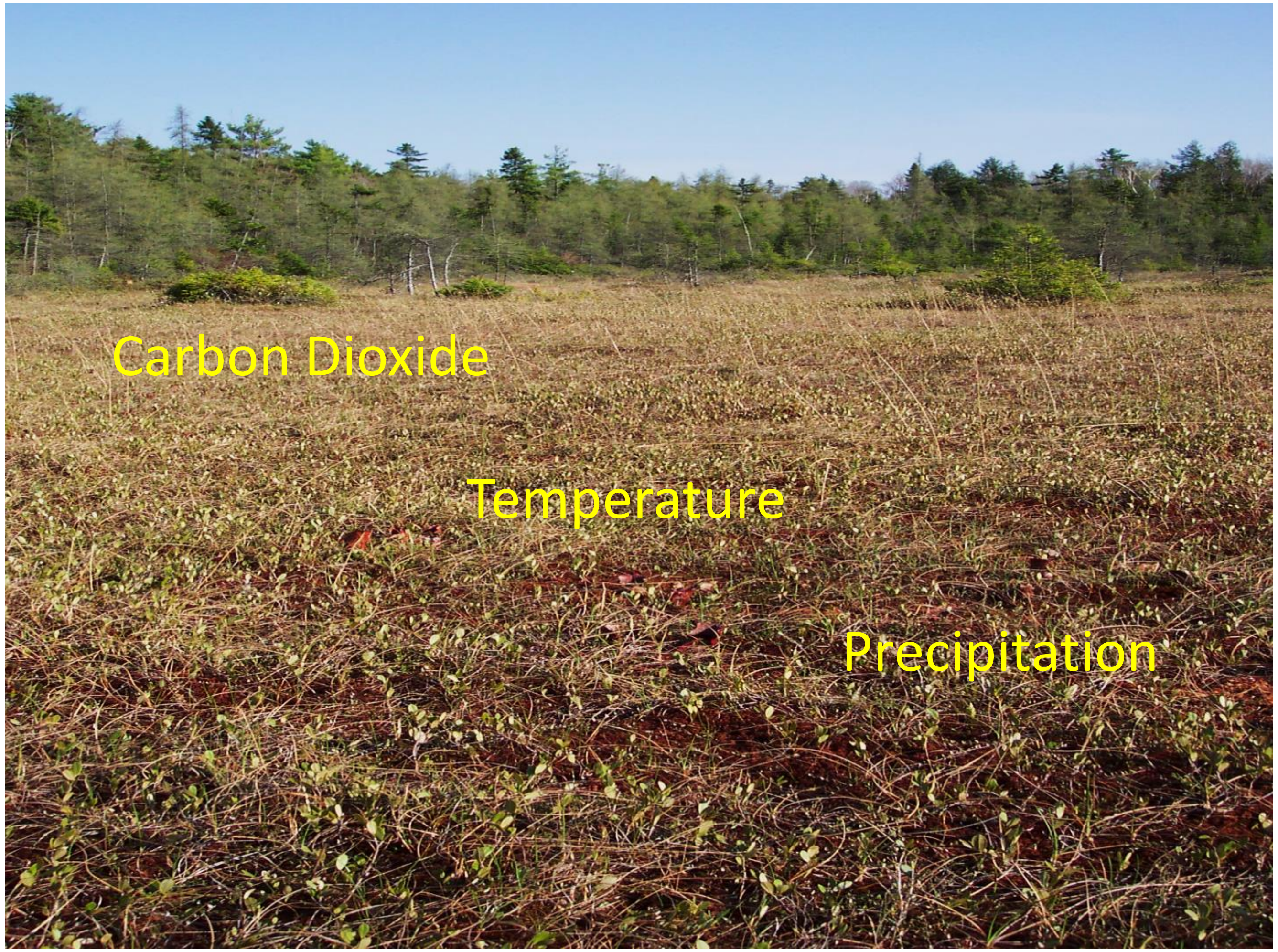
SOIL PORE SPACE WITH WATER FILM

AU | ANTIOCH UNIVERSITY NEW ENGLAND Center for Climate Preparedness and Community Resilience

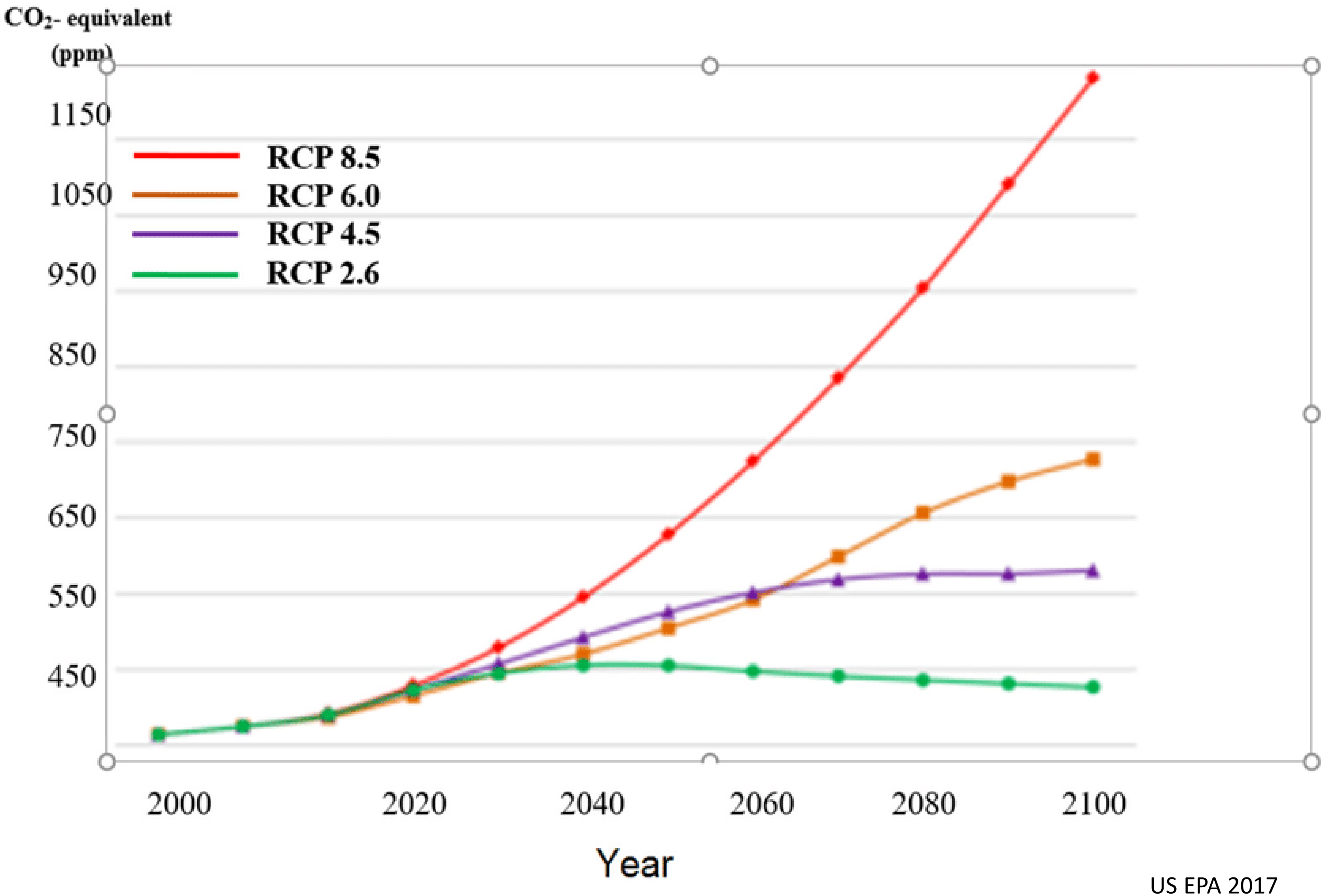


AU | ANTIOCH UNIVERSITY NEW ENGLAND Center for Climate Preparedness and Community Resilience

Simpson - NRRA 2016


Carbon Dioxide
Temperature
Precipitation

Projected Increase in $C0_2$ Equivalents



US EPA 2017

Observed Changes in Annual Average Temperature

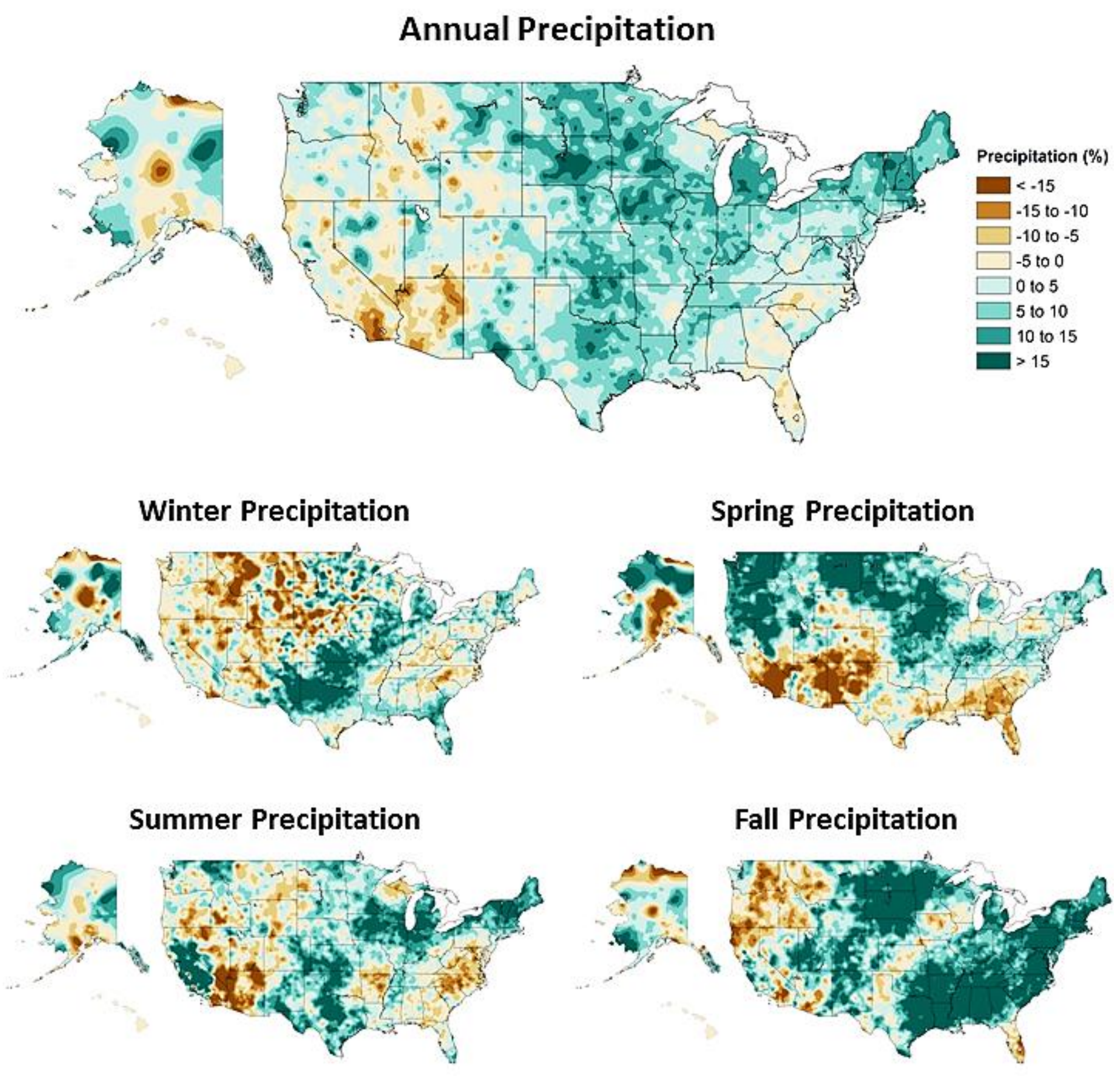
NCA Region	Change in Annual Average Temperature	Change in Annual Average Maximum Temperature	Change in Annual Average Minimum Temperature
Contiguous U.S.	1.23°F	1.06°F	1.41°F
Northeast	1.43°F	1.16°F	1.70°F

Projected Changes in Annual Average Temperature

NCA Region	Low Emissions Mid-Century (2036–2065)	High Emissions Mid-Century (2036–2065)	Low Emissions Late-Century (2071–2100)	High Emissions Late-Century (2071–2100)
Northeast	3.98°F	5.09°F	5.27°F	9.11°F

ANTIOCH UNIVERSITY NEW ENGLAND
AU | Center for Climate Preparedness and Community Resilience

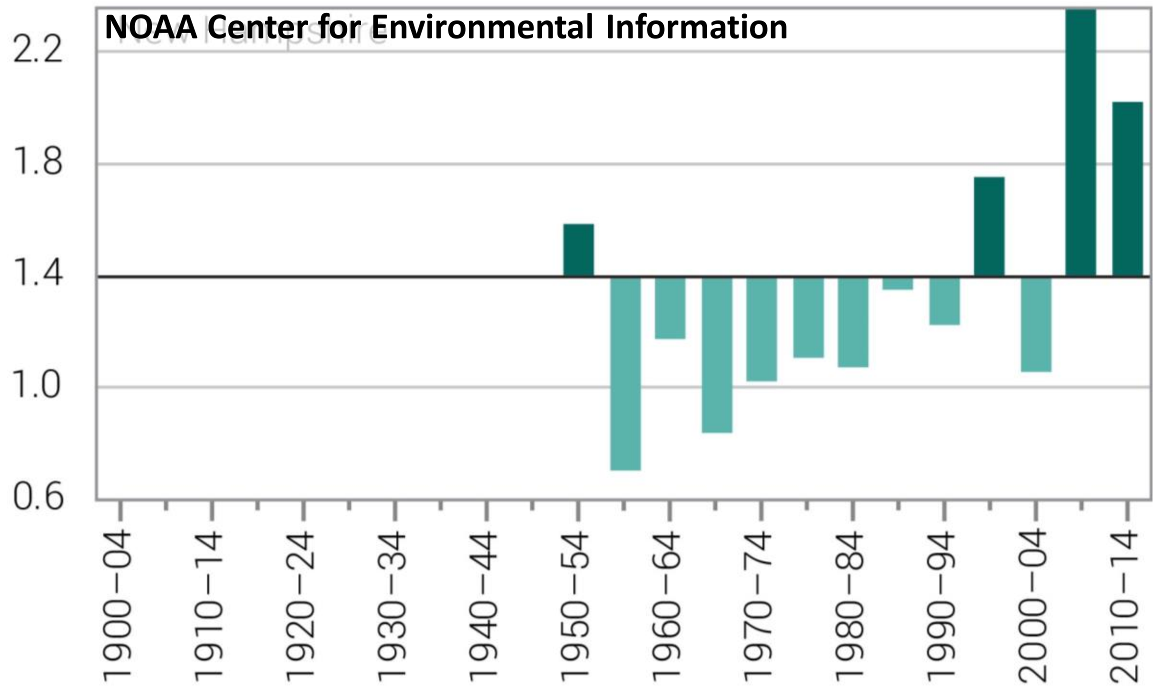
NCA4 2018



NCA4 2018

Extreme Precipitation

(Annual Events: > 2”)



AU | ANTIOCH UNIVERSITY NEW ENGLAND Center for Climate Preparedness and Community Resilience

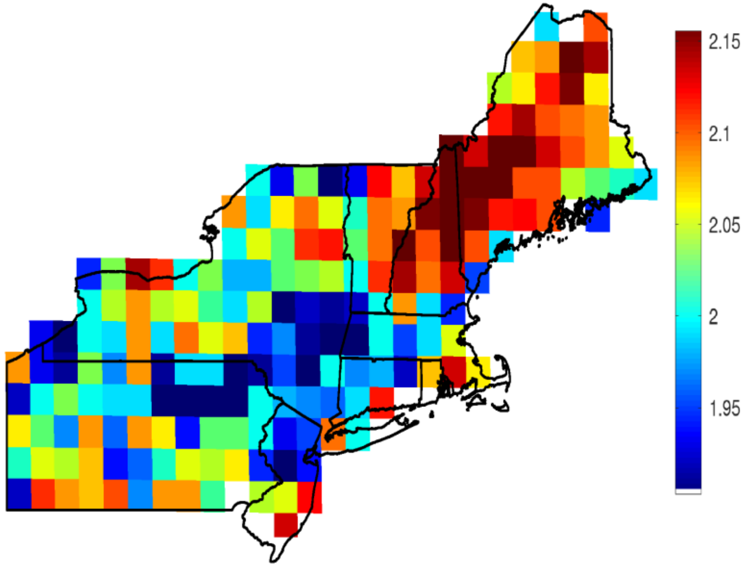
Northern New Hampshire

Indicators	Historical* 1980-2009	Change from historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Precipitation (inches)							
Annual mean	43.2	3.5	2.2	**10.1 %**	5.2	6.2	7.3
Winter mean	8.9	1.1	0.9	**14.1 %**	1.5	1.8	2.4
Spring mean	10.1	1.0	0.8	**16.8 %**	1.6	1.9	2.5
Summer mean	12.6	1.4	0.4	**4.8 %**	1.4	1.9	0.7
Fall mean	11.5	0.1	0.2	**7.8 %**	0.9	0.8	1.7

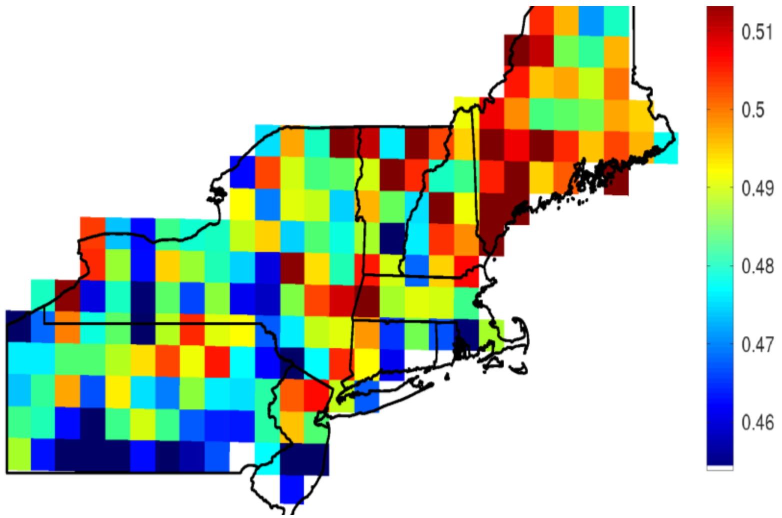
Wake et al. 2014

Trends in Drought over the Northeast United States
1901-2015

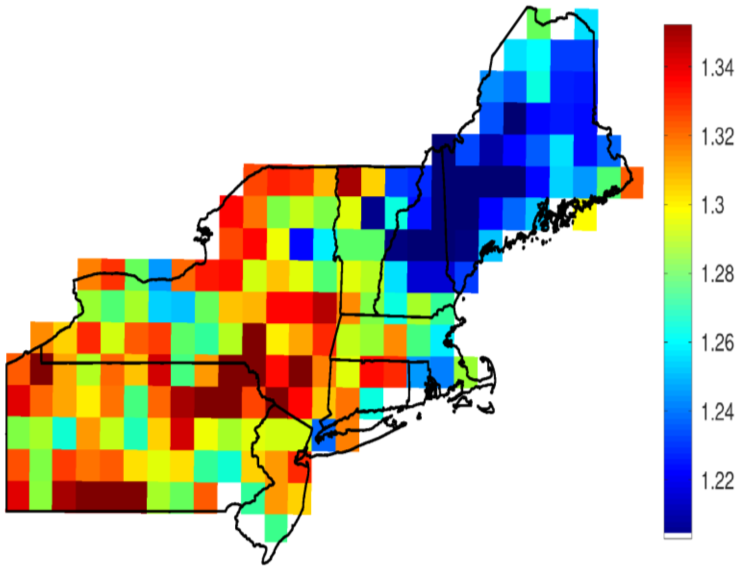
Frequency



Intensity



Duration

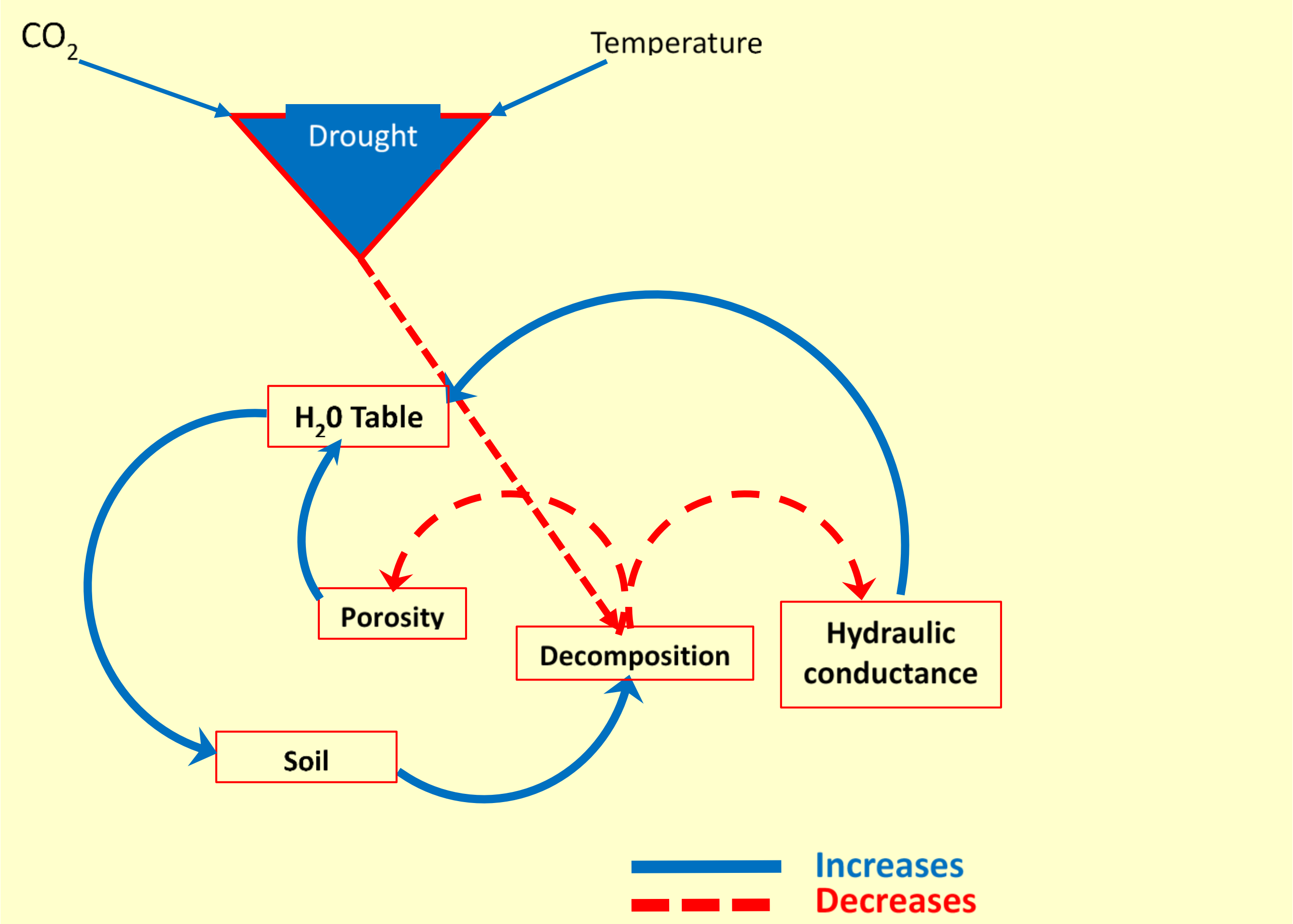


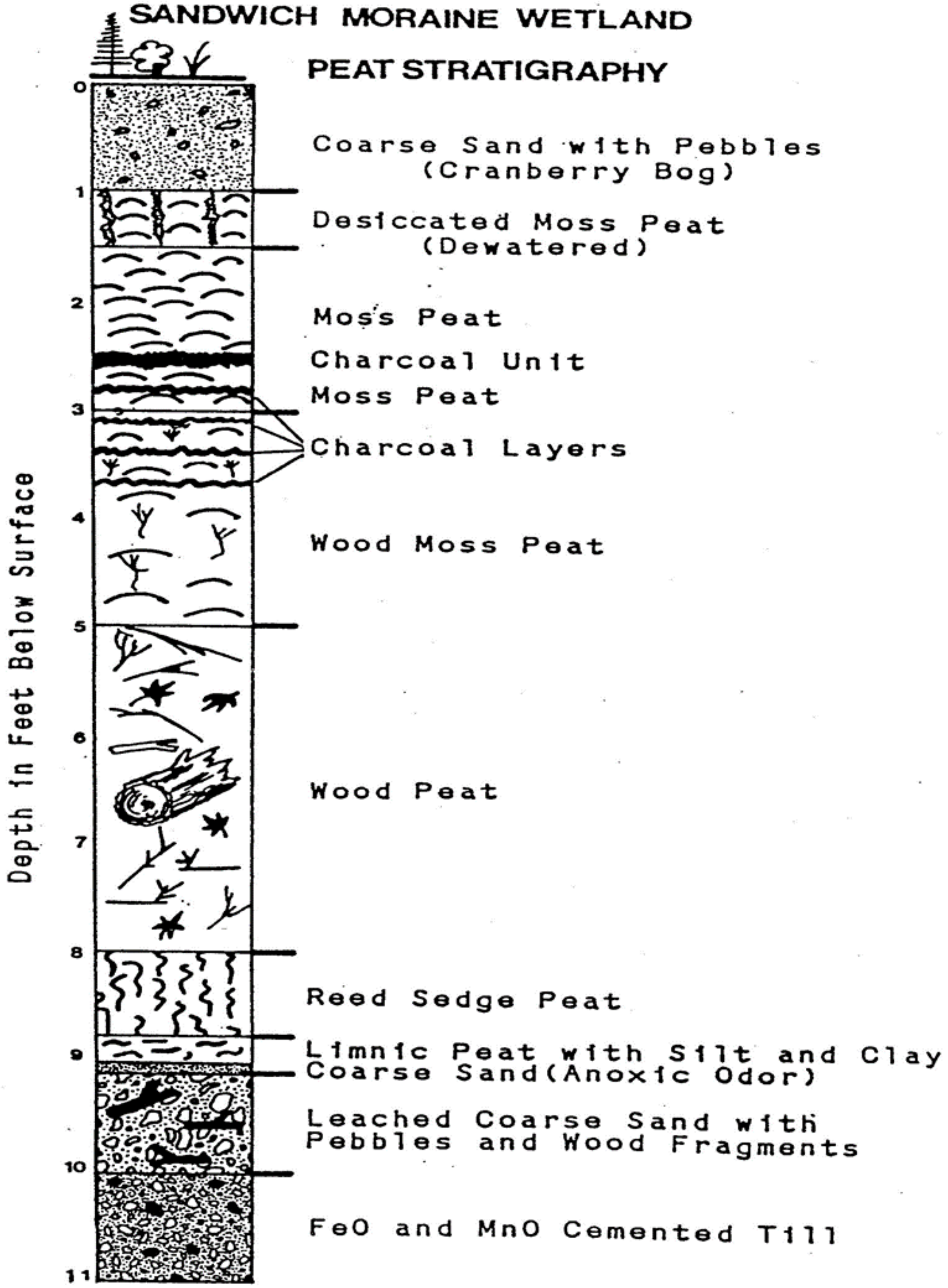
AU | ANTIOCH UNIVERSITY NEW ENGLAND Center for Climate Preparedness and Community Resilience

Krakauer et al 2019

Peatland Water Table: Pre/Post Leaf-out

Sphagnum Resilience



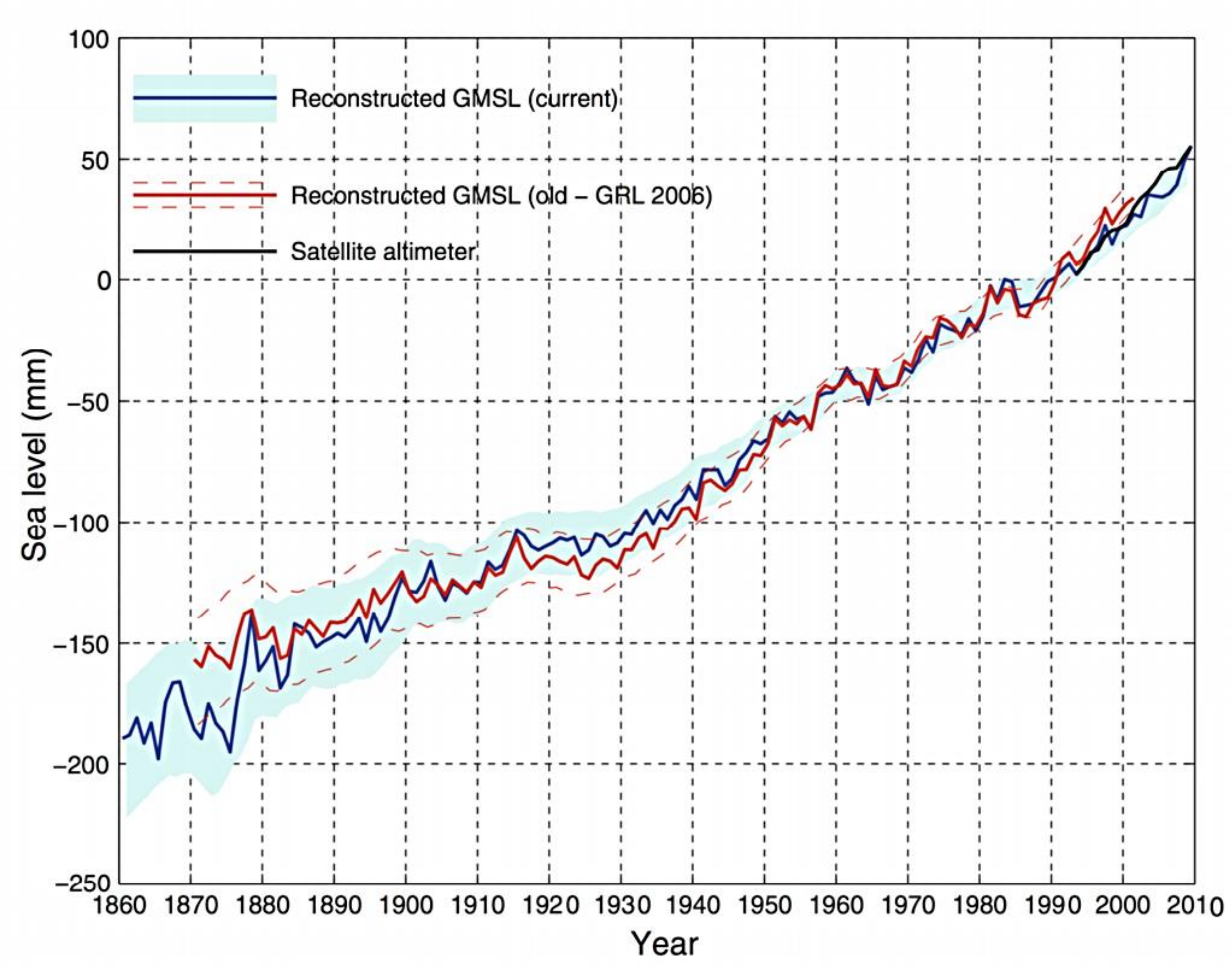


ANTIOCH UNIVERSITY NEW ENGLAND
AU | Center for Climate Preparedness and Community Resilience

Peters 1987


DANGER
THIS AREA
MAY FLOOD
DURING
HIGH TIDE

Historic Average Sea-level Rise



Church and White 2013

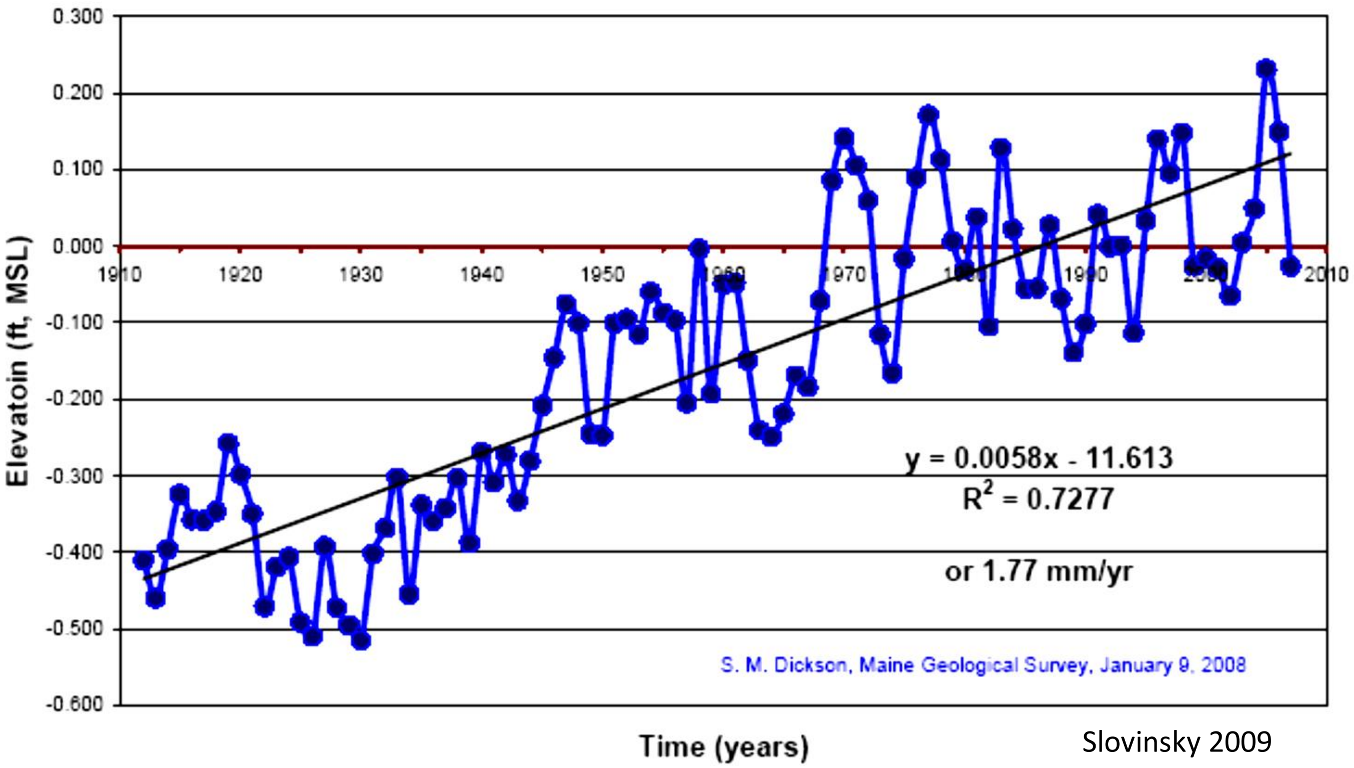
Large-scale Drivers for Sea-Level Rise

GMSL Rise Component	1971-2010		1993-2010	
	median	range (5-95%)	median	range (5-95%)
Thermal expansion	0.8	0.5 to 1.1	1.1	0.8 to 1.4
Glaciers (not including Greenland and Antarctic ice Sheets)	0.68	0.22 to 1.08	0.86	0.32 to 1.26
Greenland Ice Sheet	na	na	0.33	0.25 to 0.41
Antarctic Ice Sheet	na	na	0.27	0.16 to 0.38
Land water storage	0.12	0.03-0.22	0.38	0.26 to 0.49
Total contributions			2.8	2.3 to 3.4
Observed GMSL rise			3.2	2.8 to 3.6

Table 2.3. Estimated contributions to global mean sea-level (GMSL) rise (mm per year). Data from Church et al. (2013, Table 13.1).

Church et al. 2013

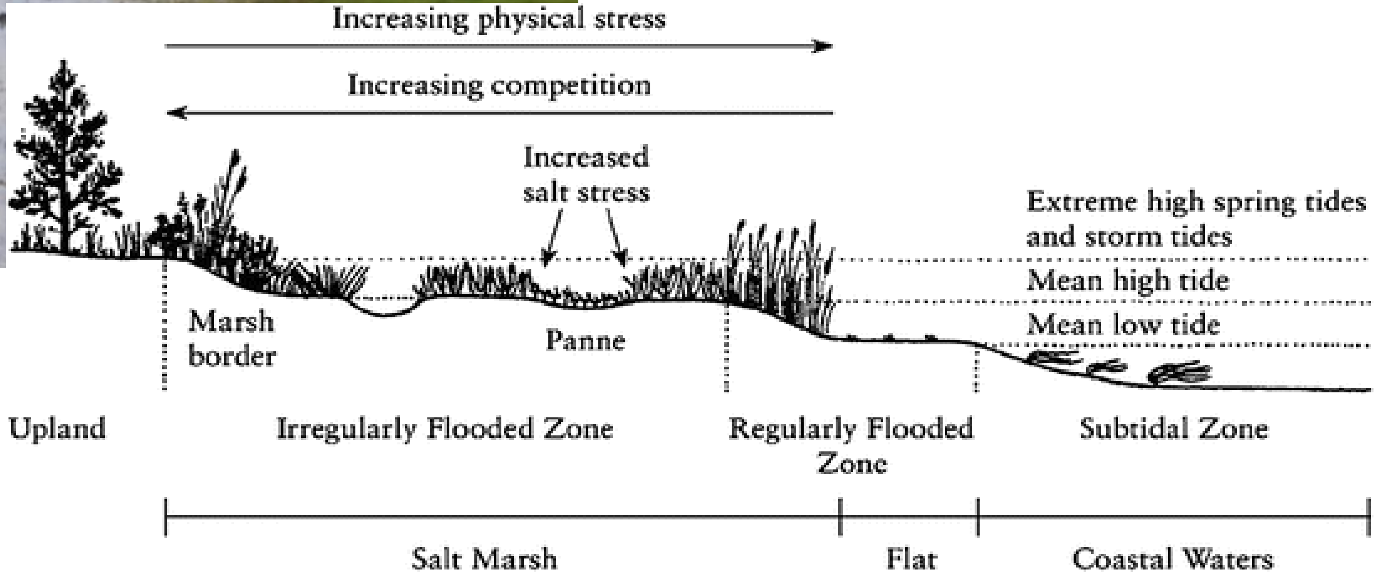
Portland Maine Sea-level



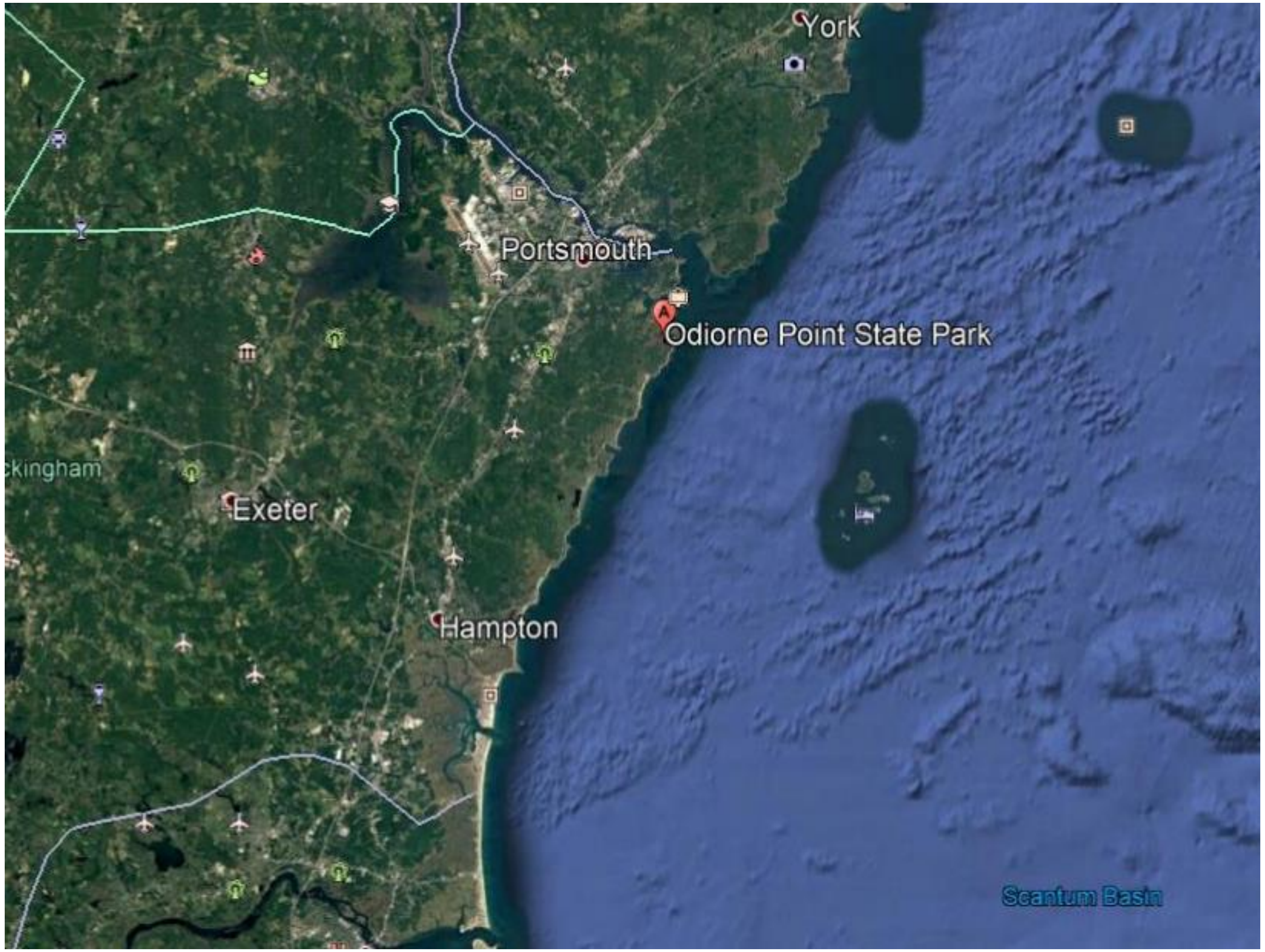
Slovinsky 2009

Walker et al.

Salt Marsh Vegetation Zonation



Tiner & Milton 2015

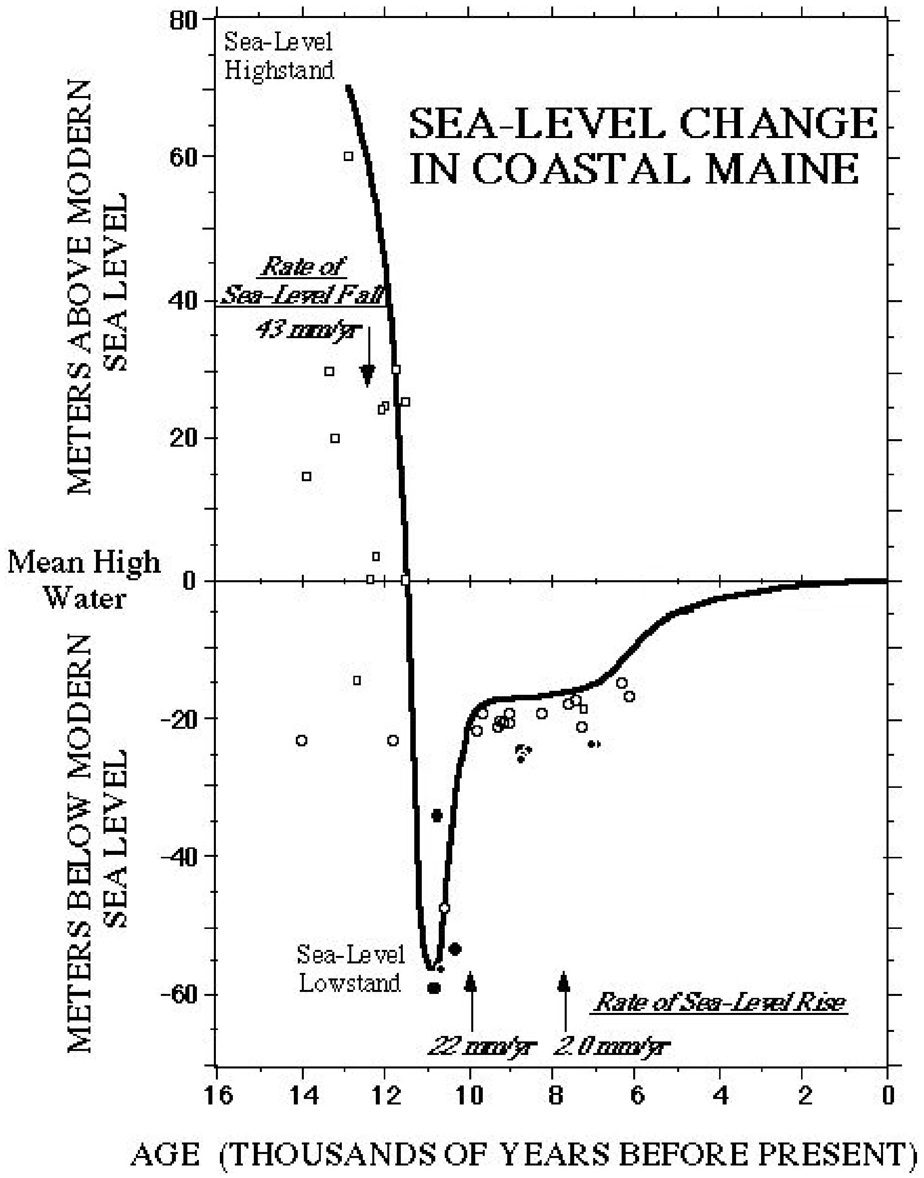

York
Portsmouth
Odiorne Point State Park
ckingham
Exeter
Hampton
Scantum Basin

AU | ANTIOCH UNIVERSITY NEW ENGLAND
Center for Climate Preparedness
and Community Resilience


Fairhill Swamp
Write a description for your map.

Gulf of Maine Sea Level History

13,000 Years Before Present (ybp) to Modern



@ ~13,000 ybp sea level ~70 m higher

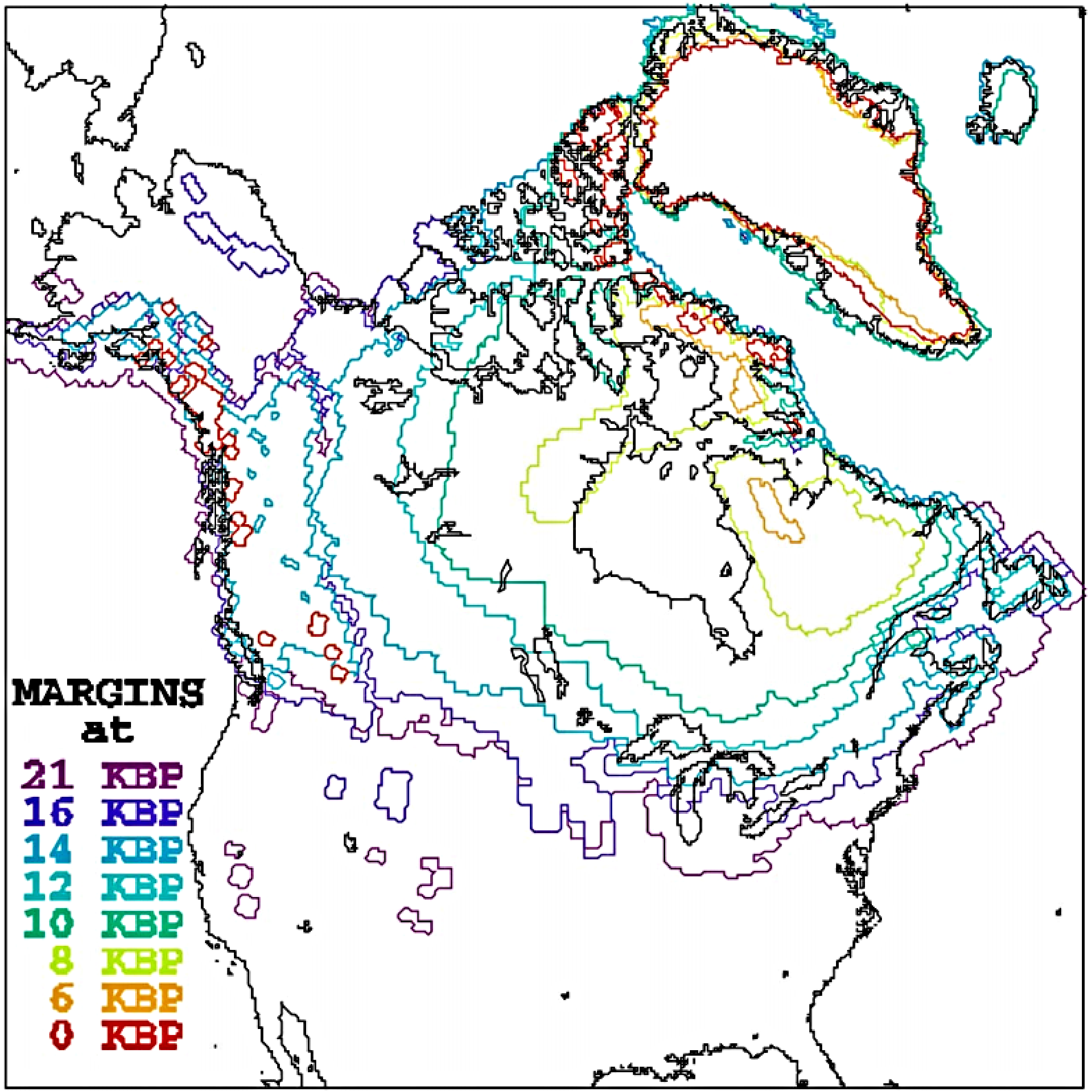
@ ~11,000 ybp sea level ~55 m lower

@ ~3,000 ybp sea level very close to present. Present shoreline development begins.

Based on Dickson (1999), Barnhardt (1994) and Belknap et al., (1987).

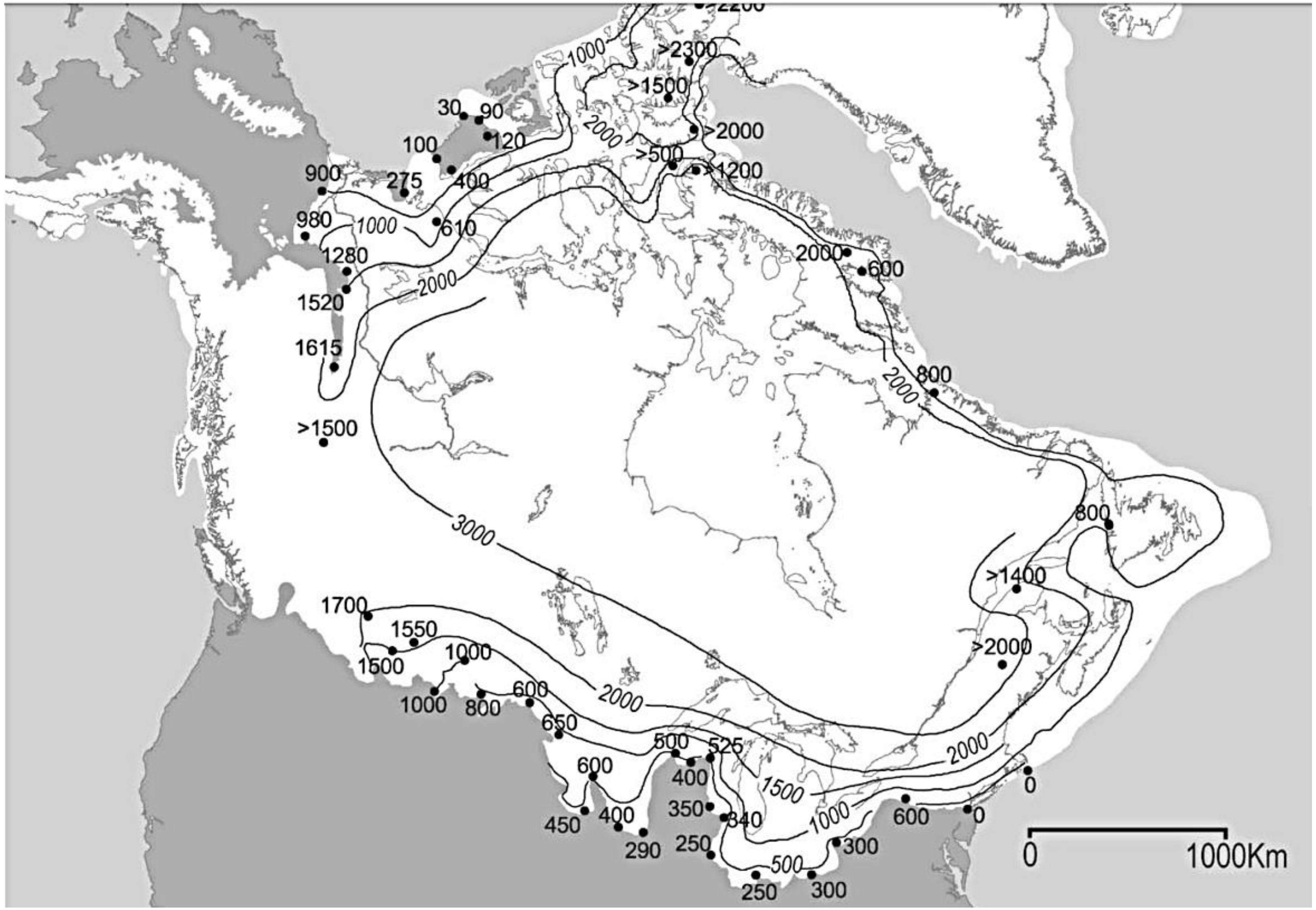
Ward 2008

Timing of Last Glacial Retreat



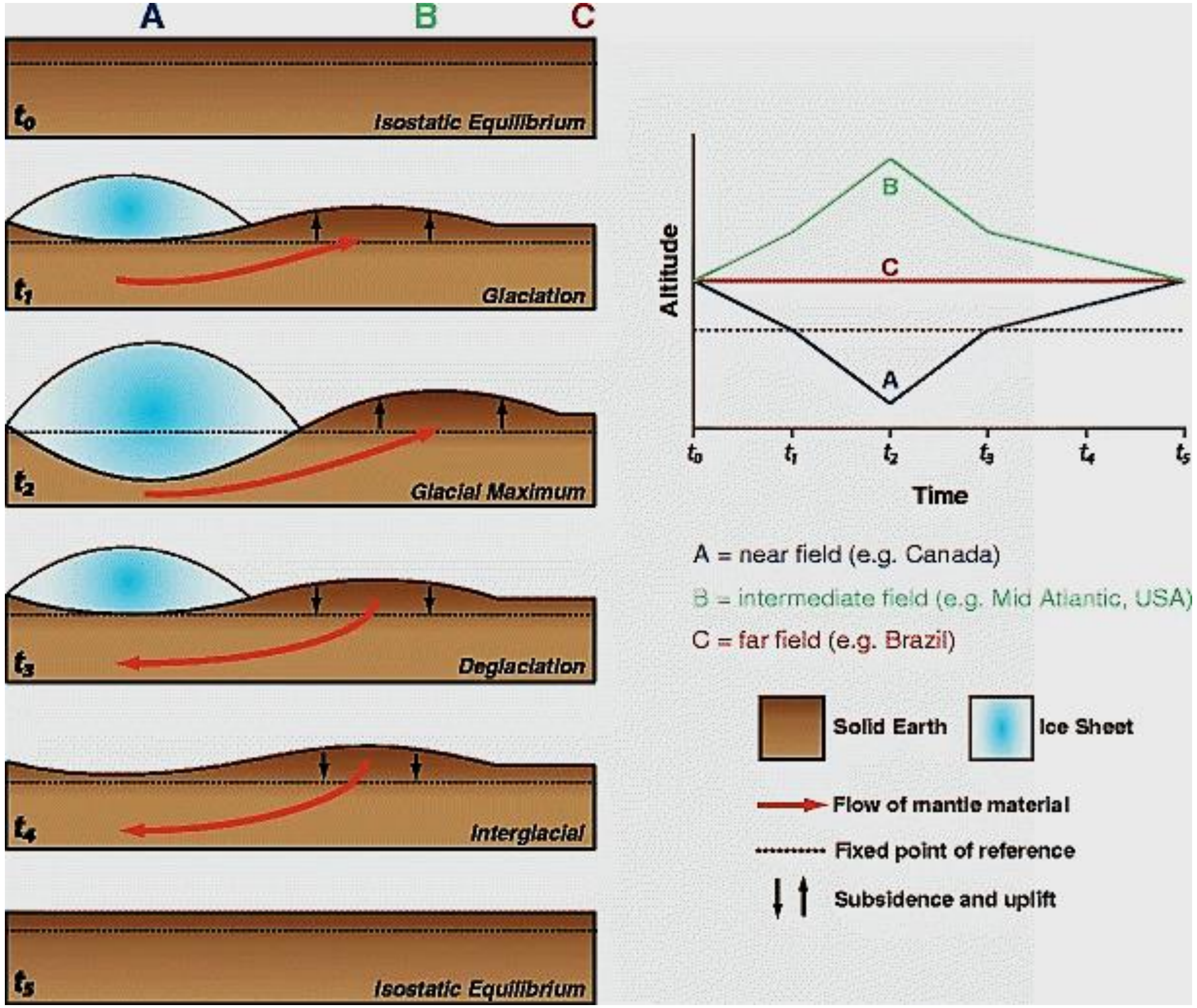
Peltier 2015

Last Glacial Maximum Ice Thickness (meters)

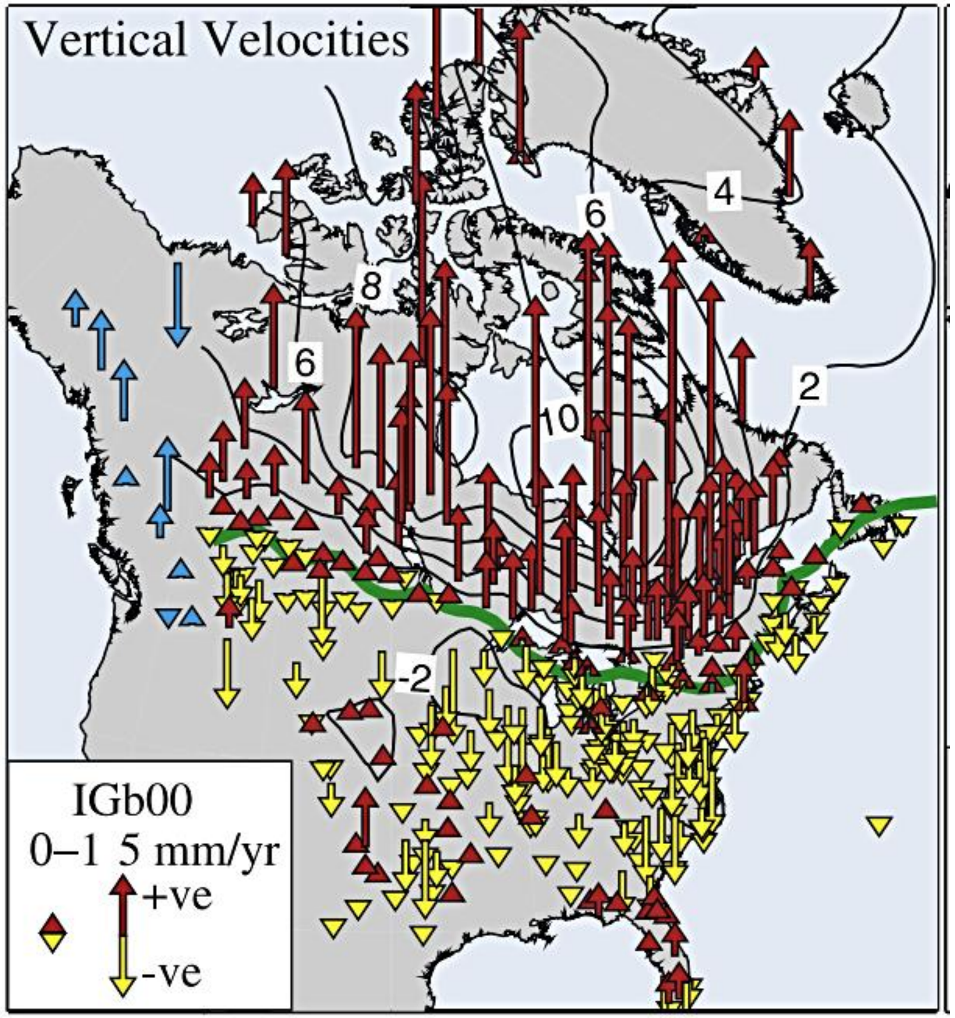


Dyke et al. 2003

Isostatic Response Post-glacial Advance



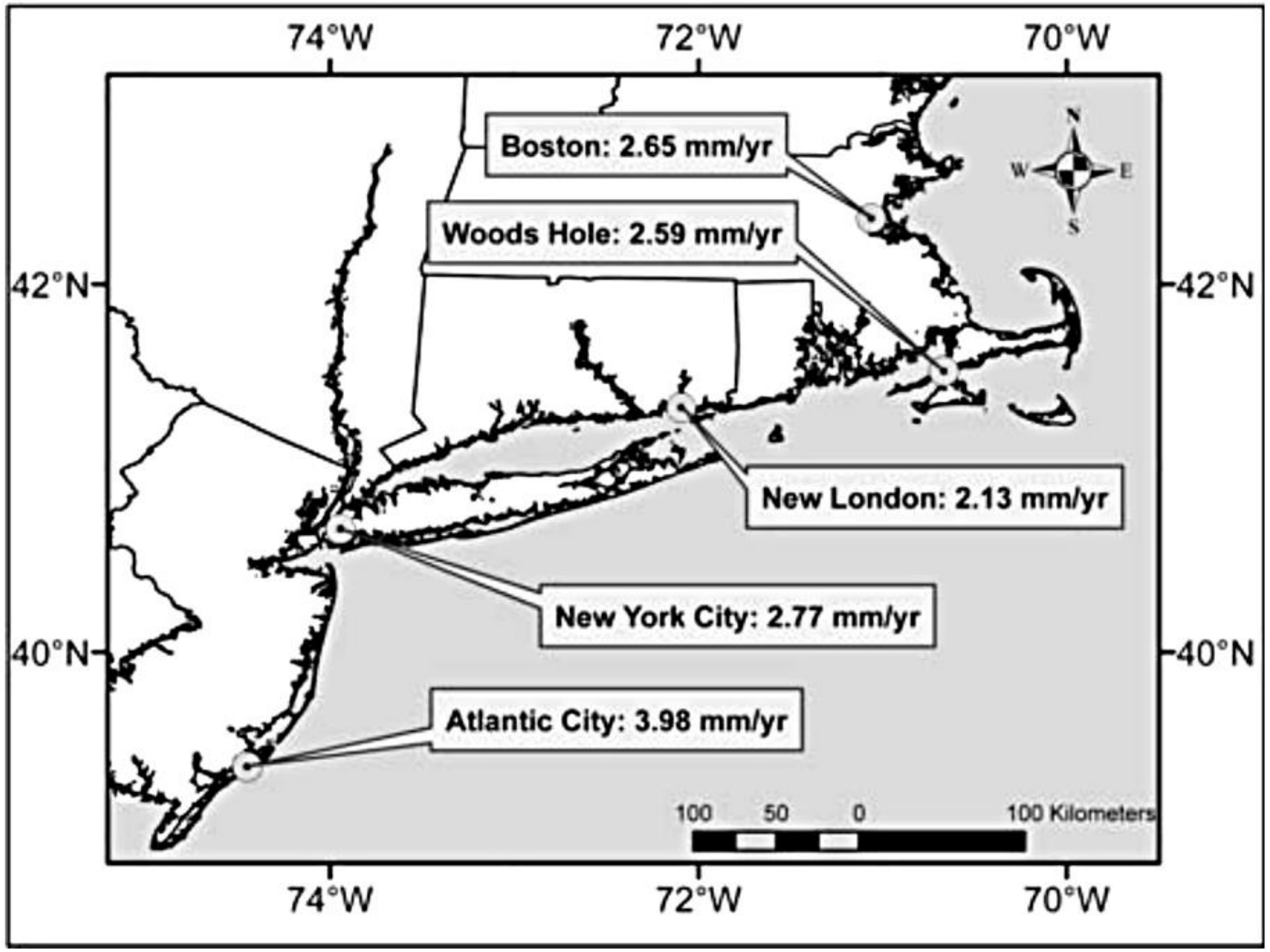
Kempet al. 2013



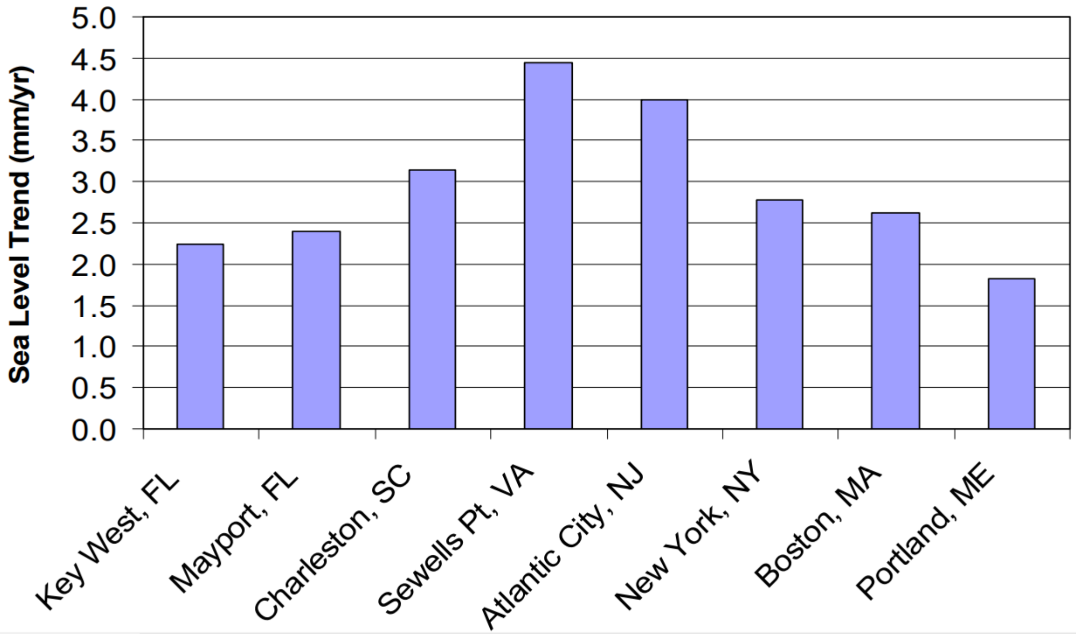
Sella et al. 2007

Hampton NH: Sunny-day Flooding:

Variance in Sea-level Rise Along Atlantic Coast



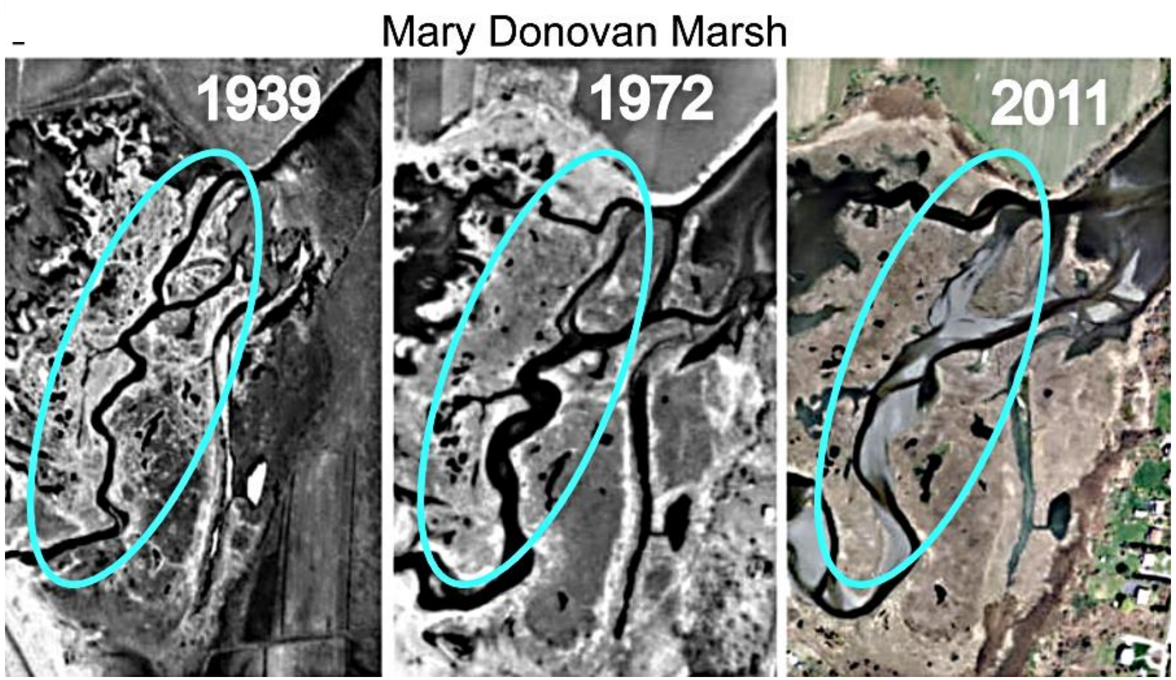
Kirshen et al. 2008

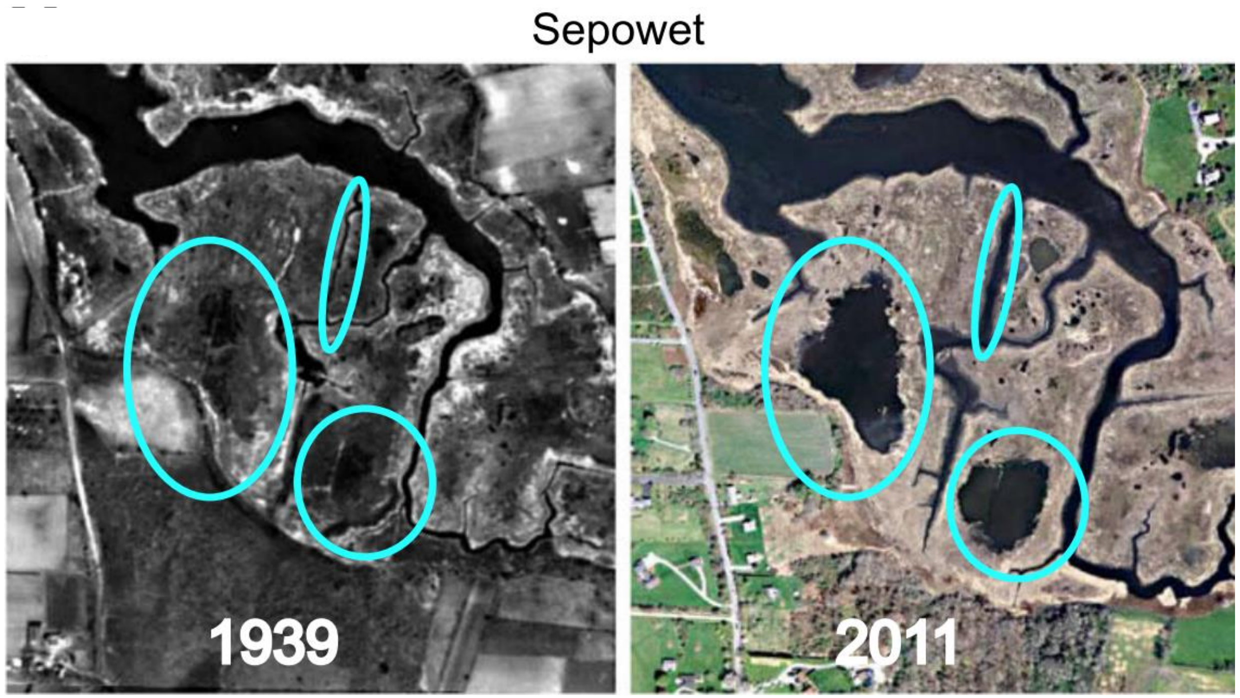


Boon et al. 2010


Robin Lubbock

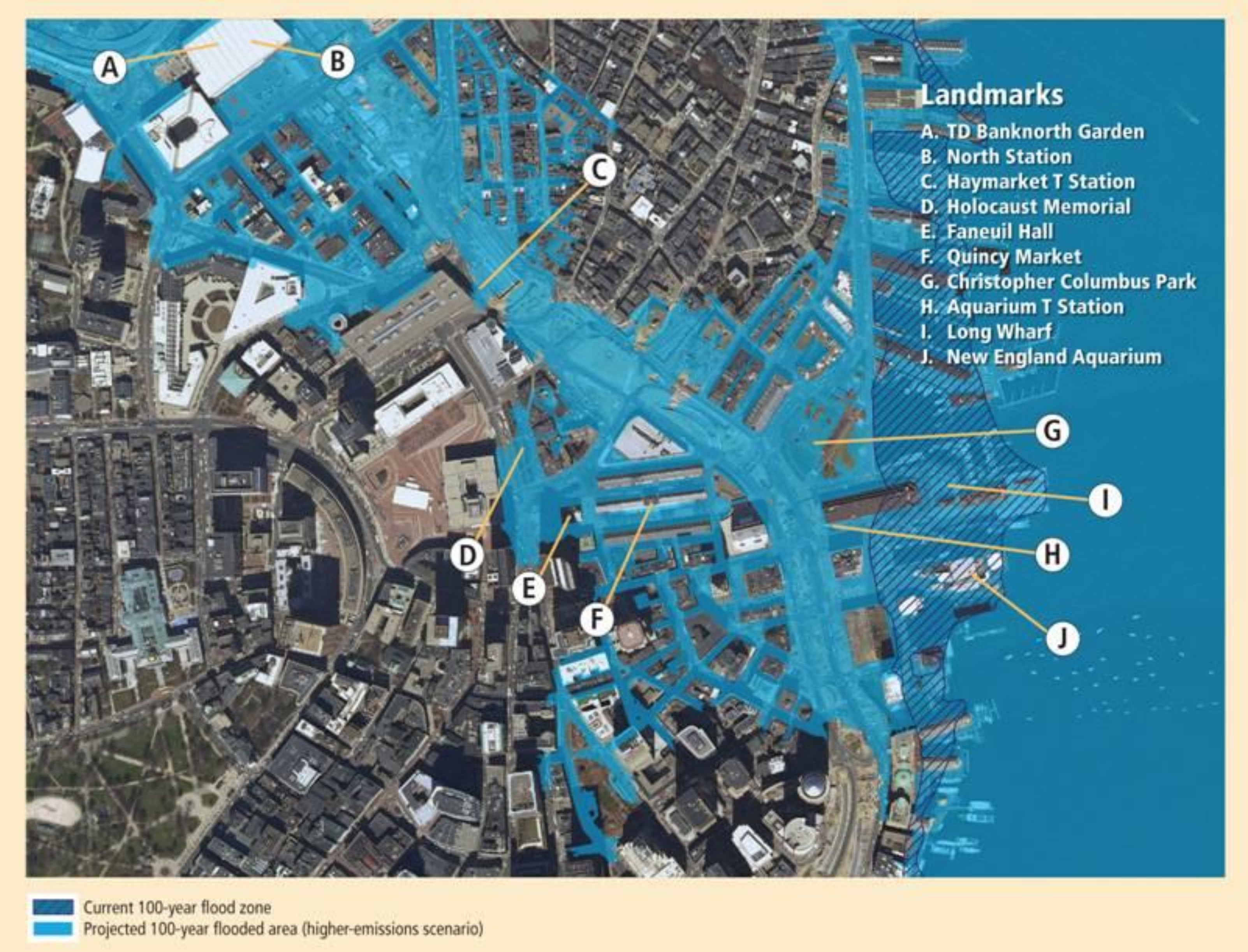
Historic Change to Salt marsh
Along Atlantic Coast





Watson et al. 2017

Boston: The Future 100-Year Flood under the Higher-Emissions Scenario



AU | ANTIOCH UNIVERSITY NEW ENGLAND Center for Climate Preparedness and Community Resilience


Chris Neill

Historic Rate of Sediment Accumulation

(cm/100 years)

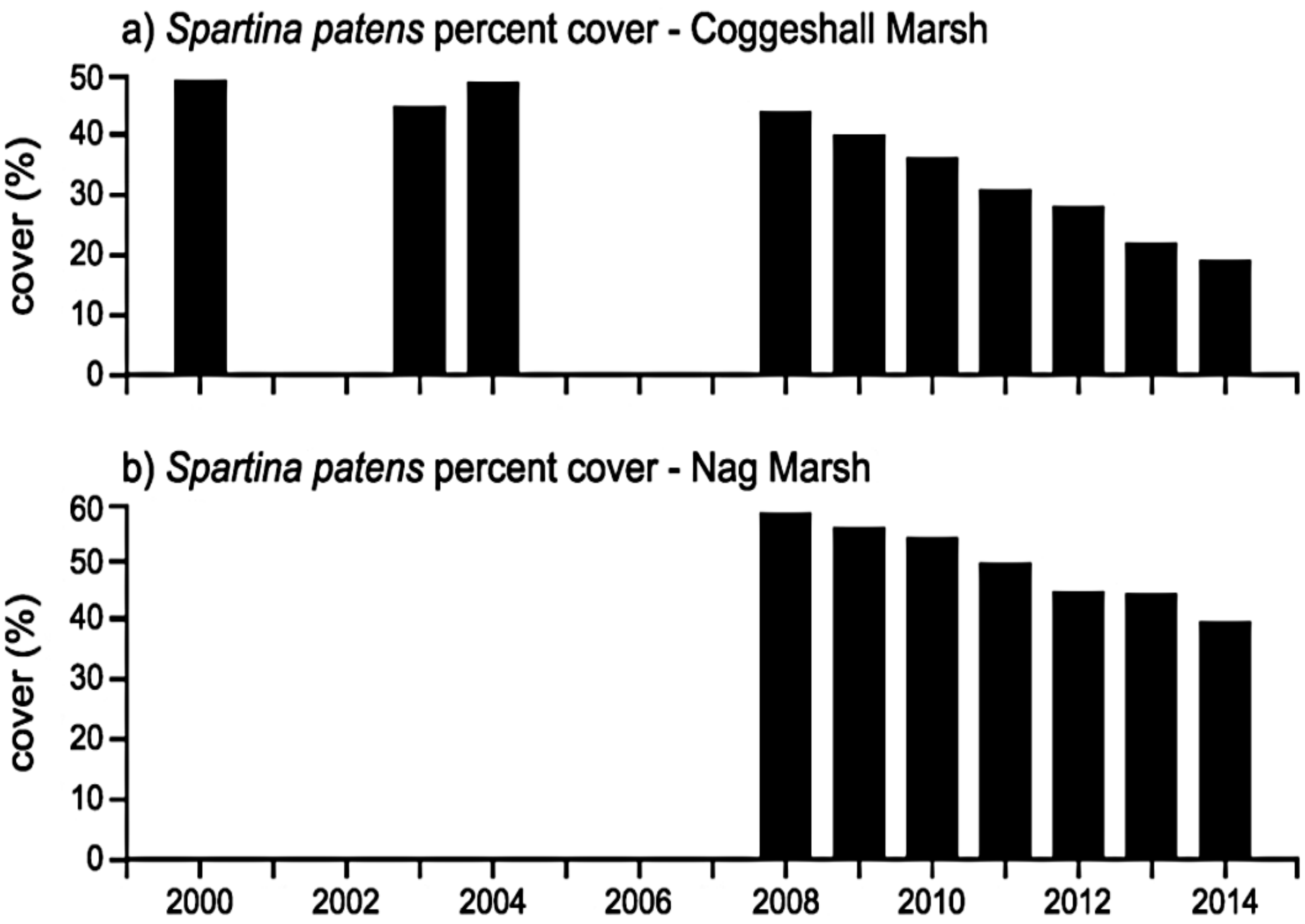
MA Coast	Accretion	Subsidence	Net Accumulation	Age (years)
Spartina alterniflora	61	30	31	490
Spartina patens	38	30	8	600

Chapman, 1990

Low Marsh Peat

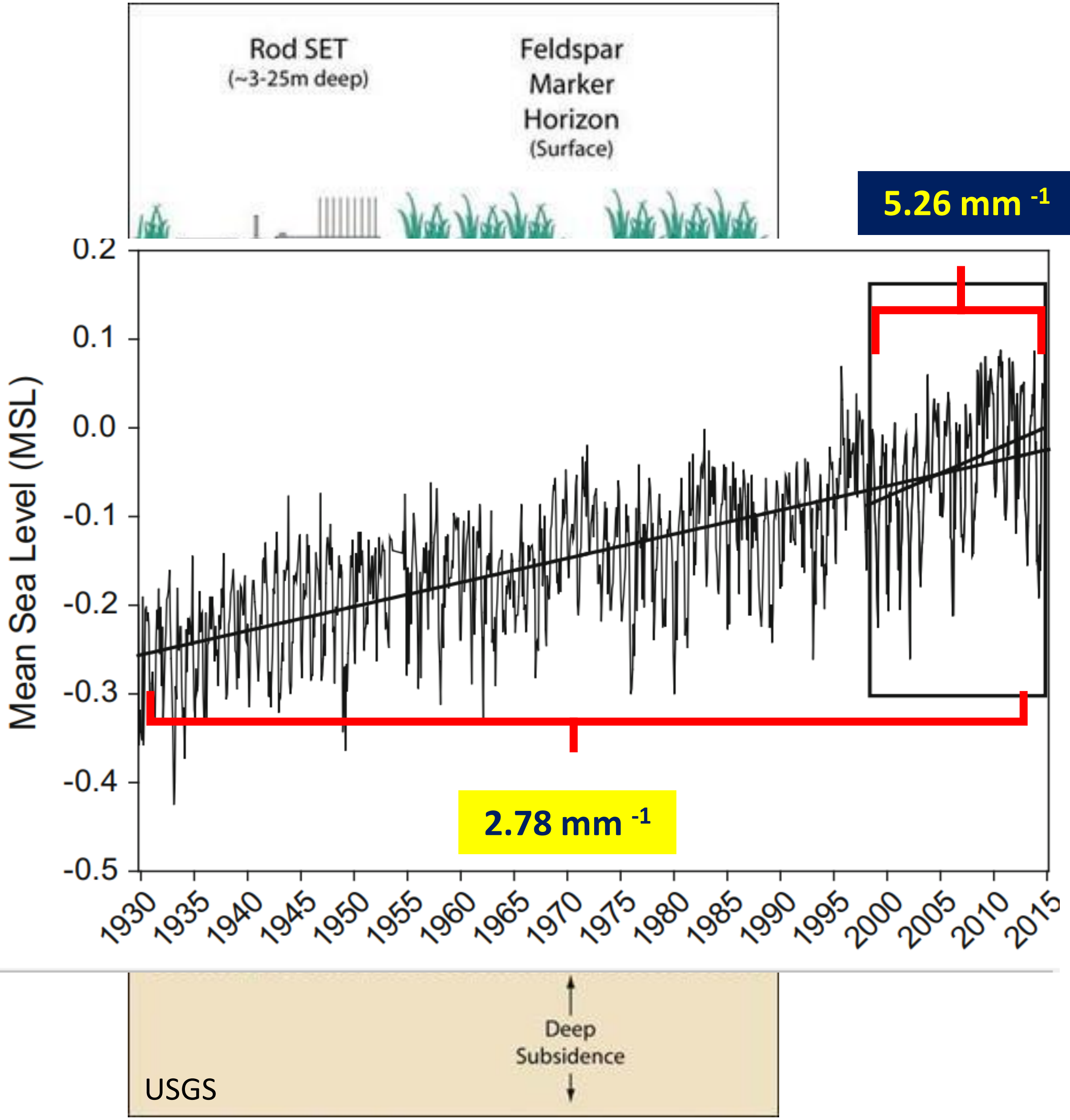
High Marsh Peat

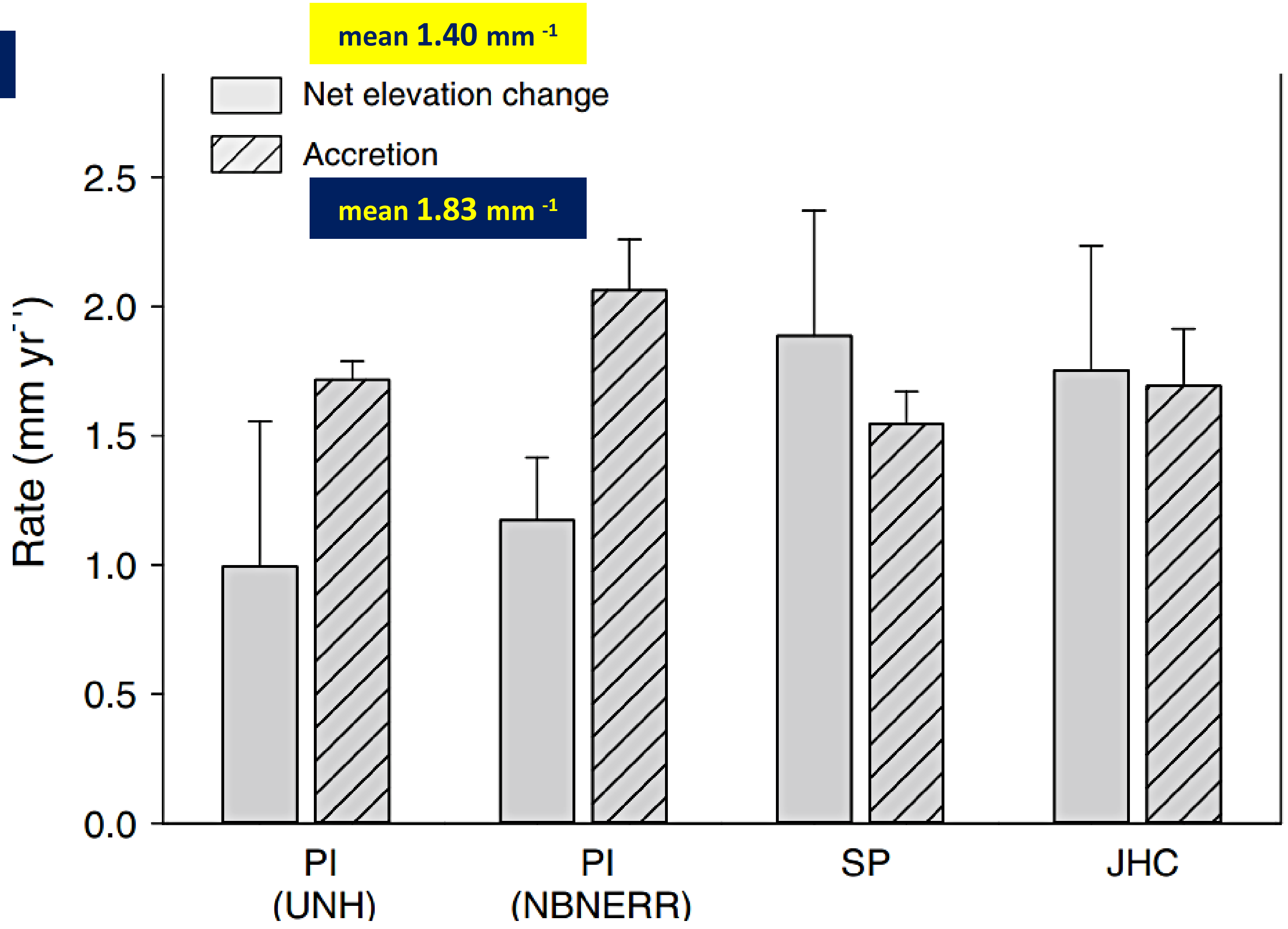
Loss of High Marsh Vegetation Cover



Watson et al. 2017

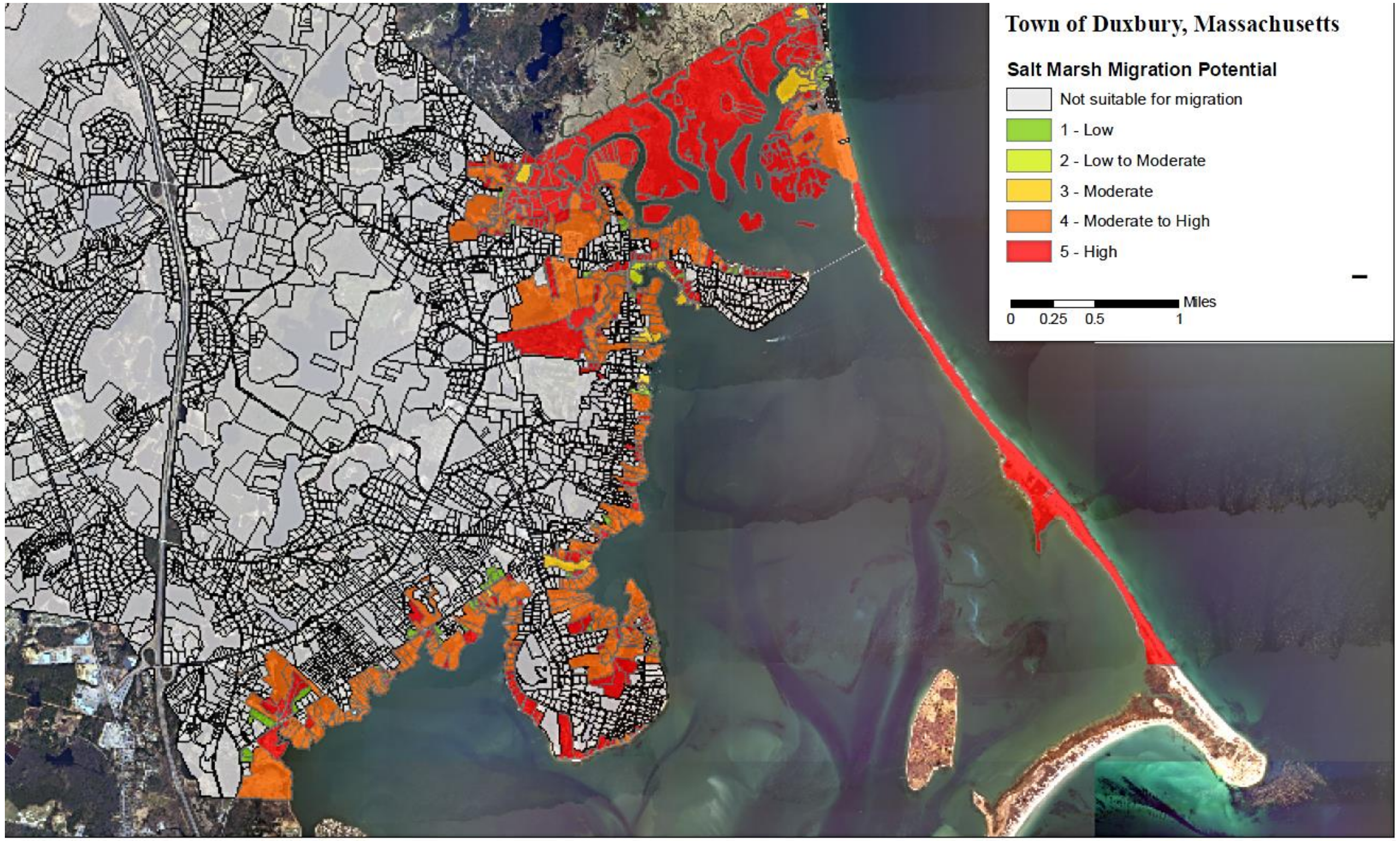
Salt Marsh Accretion/Subsidence





Raposa et al (2017)

Duxbury MA: Projected Tidal Marsh Migration



Kent 2010


Robin Lubbock

AESS
Association for Environmental Studies and Sciences

Antioch University New England

Diversity and the Environment Webinar Series

Diversity in Higher Education: Creating Equity in Evaluation of Faculty

Wednesday, May 6, 2020 – 12:00-1:00 PM EDT

Despite efforts to improve hiring practices to diversify the faculties of colleges and universities in the US, a lack of strong attention to retention practices may negate progress. In this webinar, the presenter will discuss an overview of areas of bias in faculty evaluations that impact retention and promotion. During the webinar, she will discuss strategies to cope with and overcome barriers, with a goal of envisioning how to change structures in higher education to become more equitable.

Learn more and register at: http://www.communityresilience-center.org/diversity-and-the-environment

ANTIOCH UNIVERSITY NEW ENGLAND

WEATHERING CHANGE

This concludes our
2019-20 Webinar Series.

Make sure to join our mailing list so that we can let you know once our 2020-21 series is announced.