NE CASC

Northeast **Climate Adaptation Science Center**

Improving the way climate adaptation science informs resource management

2018 in Numbers

- *38* peer-reviewed publications
- *41* presentations of our science to academic and natural resource partners
- *35* Graduate and Post-doc Fellows contributing to NE CASC projects
- *19* projects came to completion this year
- *10* new projects, and *5* projects expanded their scope this year
- *17* new science delivery and applicaiton tools assembled
- *11* webinars viewed by *857* stakeholders in total

Update from the Directors...

2018 was a year in which we saw great accomplishments in our science and stakeholder involvement, but it was also a year in which the growing impacts of climate change became more apparent; the needs to develop adaptation strategies in our region are ever more pressing. NOAA estimated that in 2018, weather and climate-related disasters (associated with hurricanes, wildfires, and floods) exceeded $306 billion in the US. The NE CASC's opportunity to support resource managers in 22 states with over 40% of the US population continues to demand not only the resources provided to us by USGS but also our continued efforts to leverage and seek support from a wide variety of other sources.

As we wind down the first cycle of our program, we see the benefits from the completion of 57 high-impact research projects. Fish managers are preparing for changes in stream and lake temperatures. Wildlife managers have information on climate effects and management options at population, community, and ecosystem levels. Forest managers are better equipped to respond to invasive pests and drought conditions. Parks have implemented adaptation strategies based on scenario planning using the best available climate science. And there is more to come. We are excited for the 3rd annual Indigenous Planning Institute and the USET Tribal Climate Resilience Summit in summer 2019. We look forward to building and deepening partnerships to provide climate adaptation science and support the stewardship of natural and cultural resources.

Richard Palmer
University Director
UMass Amherst
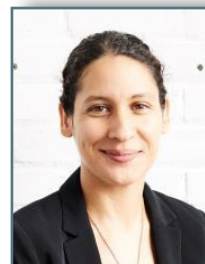
Olivia LeDee
Interim Federal Director
USGS

NE CASC Staff

Jeanne Brown
Communications and Outreach Director

Addie Rose Holland
University Deputy Director

Sara Smith
Midwest Tribal Resilience Liaison

Michelle Staudinger
Science Coordinator, USGS

Alexander Bryan
Climate Postdoctoral Fellow

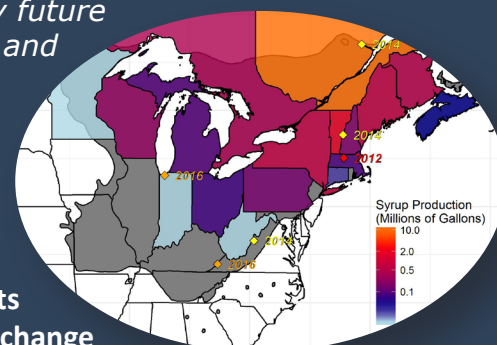**Toni Lyn Morelli**
Research Ecologist, USGS

Casey Thornbrough
NE / SE Tribal Climate
Science Liaison

The Northeast Climate Adaptation Science Center works with natural and cultural resource managers in the Northeast and Midwest regions to apply future climate scenarios to decision making and co-produce information and tools for climate change adaptation.

Priority Science Themes
- **Climate change projections and assessments**
- **Impacts on land-use and land-cover**
- **Impacts on freshwater resources and ecosystems**
- **Impacts on Atlantic and Great Lakes coastal and nearshore environments**
- **Ecosystem vulnerability and species response to climate variability and change**
- **Impacts of climate variability and change on cultural resources**
- **Decision frameworks for evaluating risk and managing natural resources under climate change**

Syrup Production
(Millions of Gallons)
10.0
2.0
0.5
0.1

Front Cover: UMass Affiliated Investigator Brian Yellen, NE CASC Graduate Fellow Caroline Ladlow, and UMass undergraduate Waverly Lau conducting research in tidal marshes. Photo credit: Jon Woodruff

Alex Bryan led the Climate Adaptation and Scenario Planning (CLASP) project from 2014-2018. As an 'outreach scientist' he met directly with natural and cultural resource managers to help interpret downscaled climate change data that met their needs. Alex possessed the service-oriented mindset essential to the task. "I was eager to meld my love of science and service," he reflects, and for him, it was a perfect fit. He wanted his work to be applied to creating real-world solutions; as he comments, his role was in essence "taking science on the road."

His work with conservation managers was diverse and broad in scope, from threat comparisons of winter tick parasitism and heat stress on moose populations in the northeast, to drought projections for managers at Saguaro National Park as part of a temporary position with the Southwest CASC. Alex led scenario planning and provided climate tends for Tribal communities and the National Park Service. His work was designed to focus on actionable science and emphasize iterative development of research and information dissemination to provide climate science guidance for natural resource managers in decision-making. His work will impact cultural resources managers, wildlife conservation professionals, and Tribal communities across the country for years to come, and we at the NE CASC are so grateful to have worked alongside him.

Tribal Engagement

There are 60 federally-recognized Tribal Nations in the NE CASC region, as well as numerous state-recognized and unrecognized Tribal Nations and Indigenous communities. In 2018, the NE CASC led efforts in partnership with the College of the Menominee Nation and United South and Eastern Tribes Inc. (USET), in connecting partners and resources, identifying Tribal research needs and priorities, and providing technical support in the design and implementation of research projects and climate adaptation planning efforts.

Chris Caldwell, NE CASC PI at the College of Menominee Nation, continues to assemble Tribes and researchers to find solutions to pressing climate adaptation science challenges. Chris coordinated the development of community-based

scenarios with the Little Traverse Bay Band of Odawa to provide input for the development of a climate change adaptation plan. Chris and Sara Smith have been working with an advisory council to continue to build the Northeast Indigenous Climate Resilience Network, which provides the latest tools and resources for Tribes and scientists in our region.

Casey Thornbrugh, NE and SE CASC Tribal Climate Science Liaison with USET, conducted many site visits with Tribal Nations in 2018. He spoke with members of the Shinnecock Indian Nation about the issues and

solutions related to sea level rise, and with Michelle Staudinger, contributed to the Native Youth in Science-Preserving our Homelands summer camp with the Mashpee Wampanoag Tribe. As part of a national workgroup of Tribal organizations, Tribal colleges, and other partners, he has helped to address policy and resource issues associated with Tribal climate resilience. Casey assisted Tribal Nations to complete drafts of climate adaptation plans by hosting a writing retreat for Tribal managers and staff from the Aroostook Band of Micmacs, Houlton Band of Maliseet Indians, Passamaquoddy Tribe at Pleasant Point, and the Wampanoag Tribe of Gay Head at the Wabanaki Culture Center in Calais, Maine.

Sara Smith, Midwest Tribal Resilience Liaison, met with numerous Tribal Nations in the Midwest, including the Sault Ste. Marie Tribe of Chippewa Indians, Fond du Lac Band of Lake Superior Chippewa, and Keweenaw Bay Indian Community. Sara has been working on priority issues such as emerald ash borer impacts on

black ash trees, which are culturally significant to many Midwestern Tribal communities, coastal erosion along the Great Lakes, changes in phenology for snowshoe hare, and manoomin (wild rice) which also have great cultural significance for Midwest Tribal Nations. Sara is assisting on vulnerability assessments in Tribal communities and the creation and publication of the Tribal Adaptation Menu, an extensive collection of adaptation measures for Tribal natural resource management.

In 2018, the NE CASC entered into the 7th year of our USGS-university consortium partnership. As we reflect on our accomplishments, we want to express our appreciation to our USGS colleague who contributed greatly to our Center's successes: **Mary Ratnaswamy**, USGS Federal Director who retired in April 2018. Mary leaves a legacy of strong partnerships and a robust research program and that addressed the needs of managers in applying climate science in sound management decisions.
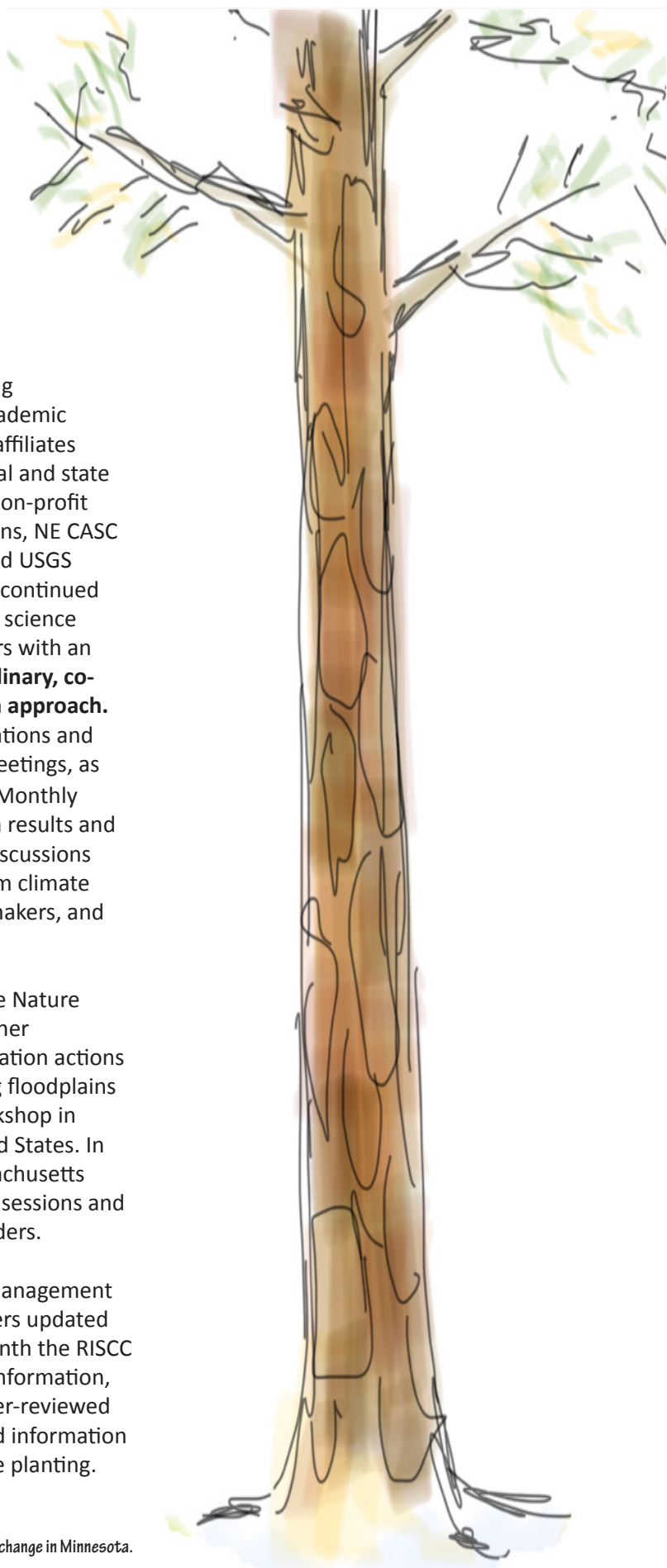

Photo: Toni Lyn Morelli

Mary in her element with the red squirrel research outings in the White Mountains of New Hampshire.

Our growing team of academic scientists, affiliates from federal and state agencies, non-profit organizations, NE CASC Fellows, and USGS colleagues continued to produce science that matters with an **interdisciplinary, co-production approach.**

Our researchers produced a number of break-through publications and delivered results in our NE CASC webinars and stakeholder meetings, as well as at conferences and meetings throughout the region. Monthly **brown-bag talks** provided an opportunity to present research results and updates on our program. These included highly interactive discussions with attendees and viewers on-line. The audience ranged from climate adaptation scientists, to natural resources managers, policy makers, and other researchers.

NE CASC collaborated with UMass Amherst Extension and The Nature Conservancy to hold **Slow the Flow** workshops to bring together practitioners and decision-makers interested in climate adaptation actions that mitigate anticipated extreme flows, such as reconnecting floodplains or reducing impervious cover. The kick-off Slow the Flow workshop in May attracted practitioners from throughout the New England States. In October, we simultaneously held workshops in Boston, Massachusetts and Lansing, Michigan. Sixty attendees joined in on simulcast sessions and represented state, federal, nonprofit, and university stakeholders.

The **Regional Invasive Species and Climate Change (RISCC)** management network continues to grow and keep researchers and managers updated on the latest research and activities in the region. Twice a month the RISCC community receives a research summary that distills critical information, take home points and management implications from the peer-reviewed science. RISCC "Management "Challenges" series summarized information on sleeper species, warming waters, and native vs. non-native planting.

Illustration by Jamie Mosel, NE CASC Graduate Fellow studying tree response to climate change in Minnesota.

Tribal colleges and universities	Chris Caldwell	Focused on the specific actions of Tribal Colleges and universities to engage in climate change initiatives, as a model for other communities.
Metapopulation model of marbled salamanders	Curtice Griffin, Kevin McGarigal	Developed an analysis to assess what surfaces best support genetic pattern and movement of salamanders across the landscape.
Agent-based models to identify conservation solutions	Frank Thompson	Addressed migration, habitat use, human influences and other limiting factors on waterfowl populations during the non-breeding period.
Predicting fire frequency with chemistry and climate	Frank Thompson, Joanna Whittier, Richard Guyette	Developed a predictive model for estimating fire frequency based on theories and data in physical chemistry, ecosystem ecology, and climatology.
Climate and land cover to predict avian abundance	Frank Thompson, Joshua Millspaugh	Created a modeling framework to evaluate land cover and climate relationships with abundance of avian species with varying habitat requirements across the Midwestern U.S.
Downscaling of climate models for impacts assessments	Radley Horton	Evaluated local projected changes in climate, as well as divers of high-resolution hydrologic and ecological models for across the Lake Champlain Basin.
Changes in spruce-fir forests and forest-dependent wildlife	Dave King, Keith Nislow	Long-term surveys at multiple locations across the region to relate wildlife dynamics to variation and long-term change in climate.
Atmospheric nitrogen deposition and climate impacts to estuarine habitats	Ivan Valiela	Analysis of a long-time series of atmospheric N deposition and climate determined trends and the associated impacts to estuarine systems.
Climate assessments and scenario planning (CLASP)	Alexander Bryan	Interpreted and delivered science to land managers to assist in adaptive planning efforts.
Reconnecting floodplains and restoring green space	Richard Palmer, Keith Nislow	Identified opportunities to manage flows, connections, and landscapes to increase the resilience of human communities and ecosystems.
Fitting the climate lens to grassland bird conservation	Ben Zuckerberg	Identified vulnerable grassland bird species, developed impact assessments, and identified climate adaptation strategies.
Climate effects on the culture and ecology of maple sugar	Kristina Stinson	Addressed the impact of climate change on the production of maple syrup.
Adaptive capacity of a forest indicator species	Evan Grant	Identified habitat and forest characteristics that improve the resiliency of forest dwelling amphibians and other wildlife to climate change.
Making decisions in headwater stream ecosystems	Evan Grant	Addressed the conservation of headwater stream ecosystems through cooperative landscape decision-making.
Supporting collaborative relationships between tribes and climate scientists	Chris Caldwell	Focused on developing climate scenario planning activities led by the Tribes and was supported by NE CASC resources to provide climate science information.
Managing floodplains in the Midwest	Robert Jacobson	Worked with floodplain managers to identify high priority information needs, and develop tools to apply to conservation in the Midwest.
Lake and stream thermal habitat under climate change.	Jordan Read	This project employed state-of-the-science methods to model historical and future thermal habitat for nearly ten thousand lakes.
How fish populations are affected by climate change	Brian Irwin	Analyzed data of fish populations from across the Great Lakes basin to evaluate spatial and temporal variation in fish catches.
Projections of snow, ice and winter severity impacts on deer and waterfowl.	Michael Notaro	Projected impacts of climate change on winter severity, snowpack, and lake ice across the Great Lakes Basin and on white-tailed deer and dabbling ducks.

NE CASC Fellows

Thirteen NE CASC Graduate and Postdoctoral Research Fellows gathered at the foot of the White Mountains in New Hampshire to explore ways to co-produce actionable climate adaptation science. This year's retreat, held May 14-17, was hosted by NE CASC PI Tony D'Amato, University of Vermont.

Since the first retreat on Plum Island, MA in 2013, the NE CASC has assembled its Fellows annually throughout our region. This year's retreat, in northern New Hampshire, featured typical spring conditions of the north woods: a day of rain, a day of sun, and black flies dropping by for dinner. While visiting Bartlett and Hubbard Brook Experimental Forests, the NE CASC Fellows heard from stakeholders and scientists who have long-term adaptation research and management initiatives that address climate impacts in a high-elevation forested ecosystem. Although the focus was on forested montane ecosystems, Fellows examined watershed-wide issues applicable to our entire region while drawing from their climate adaptation science expertise. Presenters included Forest Service researchers, state wildlife biologists, federal lands managers, and NGO science-to-translation outreach specialists. Fellows also discussed how to work across disciplines to develop research projects that directly answer natural resource management questions.

Annual NE CASC Fellows retreats are designed to inspire Fellows to pursue stakeholder and interdisciplinary partnerships in their own research through interaction with experts and engagement with managers on the ground.

Photo: Jeanne Brown, NE CASC

Where are they now?

Non-Profit

Emily Powell Coastal Resilience Specialist, National Wildlife Federation
Tim Duclos Conservation Manager at Merck Forest and Farmland

Academic

Valerie Pasquarella Assistant Director of the Center for Remote Sensing at Boston University
Kuk-Hyun Keith Ahn Assistant Professor, KongJu National University, Korea
Javier Lloret Research Scientist, Marine Biological Laboratory
Mary Heskel Assistant Professor, Macalester College
Marcelo Somos Valenzuela Assistant Professor, Universidad de La Frontera, Chile
Daniel Hocking Assistant Professor, Frostburg State University

Federal

Jaymi LeBrun Wildlife Biologist with US Fish and Wildlife Service Region 3
Eleonora Demaria Southwest Watershed Research Center, Tucson, Arizona
Daniel Miller Hydrologist with US Fish and WIldlife Service Region 5

Private

Abigail Ericson Civil Engineer at GZA GeoEnvrionmental
Alexander Bryan Energy Meteorologist for Integrated Environmental Data, LLC.
Alexandra McIntyre Assistant Engineer at Hazen and Sawyer

State

Madeline Magee Wisconsin Department of Natural Resources

Non-native invasive species are a prominent threat to native species and ecosystems, including rare and endangered species. Climate change will increase invasive species competitiveness, alter invasive species ranges, and threatens to decrease the efficacy of management and control. The NE CASC conducts research to assess how invasive species management should adapt to climate change in terms of changing priorities for target species and associated adaptive management approaches.

- **Bethany Bradley** (UMass Amherst) and her students, in collaboration with state and federal partners, synthesized watch lists of high-priority species for intensive range management.

- **Toni Lyn Morelli** (NE CASC/USGS Research Ecologist), with Bethany Bradley and partners from the New York Invasive Species Research Institute is building externally-funded research programs to fulfill needs explicitly identified through stakeholder relationships.

- **Tony D'Amato** (University of Vermont) examined the ecological and hydrological impacts of emerald ash borer on black ash-dominated wetlands throughout the Lake States. Tony and his team used large-scale experimental studies documenting impacts of black ash mortality on ecosystem processes and wildlife communities and evaluated adaptation strategies under future climate and invasion scenarios.

- **Radley Horton** (Columbia University) developed projection maps of the northward expansion of the southern pine beetle. They found a projected year of emergence of the southern pine beetle using a model that combined temperature projections with suitable habitat.

- **Frank Thompson** (USFS Northern Research Station and University of Missouri) used LANDIS PRO to model forest response to climate change and other threats. With this tool, the spread of invasive species can be predicted with the effects of other disturbances, management actions, and climate change.


Ash girdling. Photo: Tony D'Amato

Fourth National Climate Assessment

The Fourth National Climate Assessment (NCA4) was released on November 23rd. It finds climate-related risks to increase or worsen without additional action. Decisions made today determine risk exposure for current and future generations and will either broaden or limit options to reduce the negative consequences of climate change. Here's how NE CASC researchers contributed to the final report:

- Chapter 6, Forests: Anthony D'Amato (NE CASC PI from University of Vermont)

- Chapter 7, Ecosystems, Ecosystem Services and Biodiversity: Toni Lyn Morelli (USGS research ecologist) and Michelle Staudinger (USGS science coordinator)

- Chapter 15, Tribes and Indigenous Peoples: Chris Caldwell (NE CASC PI from the College of Menominee Nation)

- In addition to numerous NE CASC peer-reviewed publications cited in the report, we contributed to the Northeast and Midwest chapters, and the Climate Science Special Report (Radley Horton, NE CASC PI from Columbia University).
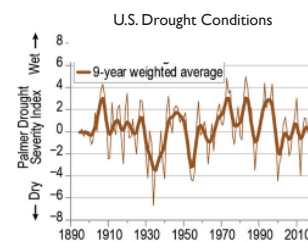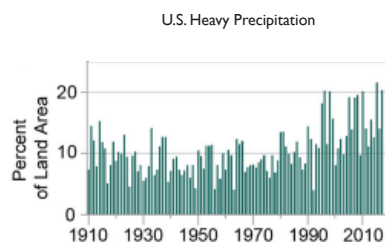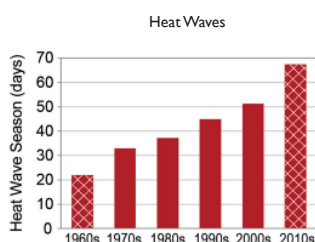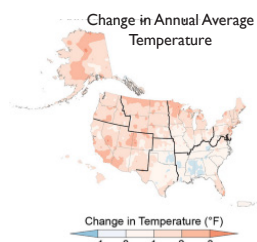
Images: NAC4 (2018)

Research Expertise from the NE CASC

The NE CASC, with its core of seven consortium institutions, assembles climatologists, biologists, ecologists, and hydrologists, working together to inform natural and cultural resource management.

Coastal processes • estuaries • eutrophication • freshwater input • food web interactions.
 Led by Linda Deegan, Woods Hole Research Center

Lake modeling • land use • atmospheric and climate changes n biogeochemical flux • aquatic processes.
 Led by Hilary Dugan, Univerity of WI Madison

Temperate and boreal forests • adaptive management • silviculture • forest disturbance.
 Led by Tony D'Amato, University of Minnesota

Ecological integrity • species responses • ecosystem risk management • ecological thresholds.
 Led by Curt Griffin, University of Massachusetts

Hydrology • stream temperature • aquatic habitat • stream fish • extreme flow • ecological drought.
 Led by Keith Nislow, University of Massachusetts

Landscape conservation design • forest management and succession • avian demographics and population dynamics.
 Led by Frank Thompson, University of Missouri

Mammalian ecology • vulnerable species and habitats • landscape conservation design • conservation biology.
 Led by Mary Ratnaswamy, USGS

Great Lakes • aquatic connectivity • temperature and flow regimes • fish migrations • coastal fisheries.
 Led by Peter McIntyre, University of Wisconsin

Landscape and species conservation • climate adaptation • translational ecology • mammal vulnerability • decision analysis.
 Led by Toni Lyn Morelli, USGS

Tribal resilience • connecting tribes and climate scientists • cross-cultural and cross-disciplinary education, applied research and outreach.
 Led by Chris Caldwell, College of Menominee Nation

Aquatic and marine species vulnerability and adaptive capacity • phenology • adaptation and conservation strategies.
 Led by Michelle Staudinger, USGS

Climate model assessment and future climate scenarios • paleoclimate • climate extremes.
 Led by Raymond Bradley, University of Massachusetts

Climate extremes • risk assessment • combined impacts of multiple extremes • natural and built systems • science of adaptation.
 Led by Radley Horton, Columbia University

Water resources • streamflow • stream temperature • stream health • water supply systems • decision analysis.
 Led by Richard Palmer, University of Massachusetts

Climate model assessment for ecological applications • climate science communication • air quality.
 Led by Alex Bryan, USGS

Wildlife impacts • adaptation planning • decision analysis • natural resource policy • conservation funding.
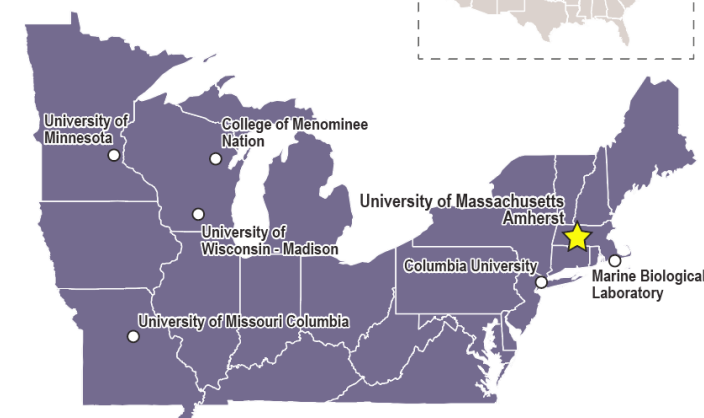 Led by Olivia LeDee, USGS

THE UNIVERSITY of WISCONSIN MADISON

COLLEGE OF MENOMINEE NATION · KESHENA, WISCONSIN

UNIVERSITY OF MINNESOTA

Mizzou University of Missouri - Columbia

U.S. DEPARTMENT OF THE INTERIOR · MARCH 3, 1849

USGS science for a changing world

NORTHEAST CLIMATE ADAPTATION* SCIENCE CENTER & CONSORTIUM MEMBERS

University of Minnesota

College of Menominee Nation

University of Wisconsin - Madison

University of Missouri Columbia

University of Massachusetts Amherst

Columbia University

Marine Biological Laboratory

MBL Biological Discovery in Woods Hole

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