

## Winter warm-up costing New England region



Steve Crone has needed wheeled carts for dogsled rides in Central Maine this winter. At Maine's Sunday River Inn, Susan Isham said last winter was bad for Nordic skiing. A poppy blooming on Oct. 31 and early maple-sugaring in Vermont are signs of climate change. Paul Shaney waited for a nibble in Bowdoinham, Maine, where winter's warm start had ice fishing shacks floating on pontoons. (DINA RUDICK/GLOBE STAFF)

By Beth Daley  
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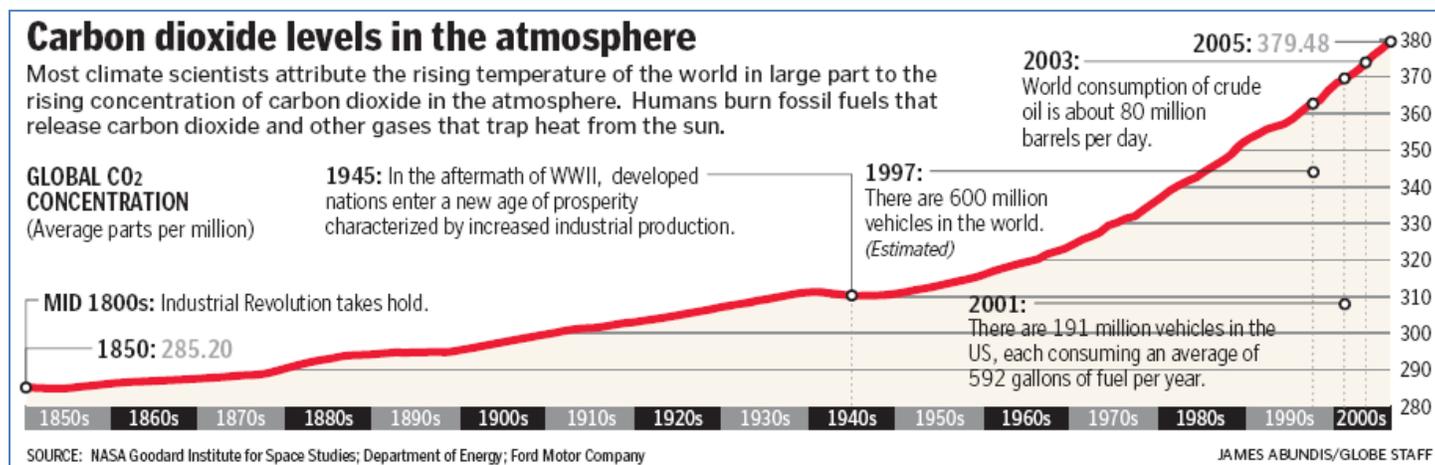
**MASON TOWNSHIP, Maine - The eight Alaskan huskies strained against their dogsled harnesses, eager to pull two vacationing boys through the hilly woods of western Maine.**

But there was no dogsled - because there was only an inch or so of snow. Instead, the yipping dogs were tethered to a gray golf cart. Steve Crone, the owner of New England Dogsledding, eased into the cart next to the youngsters, then gave a yell. The dogs took off. On steep hills, Crone pressed the gas pedal to help the huskies haul the heavy cart.

"We'd rather have snow," said Crone, with an embarrassed smile. He needs about 6 to 12 inches of snow to run the sleds properly. "But the weather has changed over the years, and we have to get more creative."

Records show New England's climate, the catalyst behind fiery orange foliage and deep-woods Nordic ski treks, is dramatically warming - and altering the region's character and economy as it does.

During the last century, the average annual temperature in New England increased 2 degrees Fahrenheit. And just since 1970, average winter temperatures have risen 4.4 degrees. The changes have meant less snow on the ground and thinner ice on lakes. Over the past 30-plus years, rising temperatures have pushed spring to begin a week or more earlier and the growing season to expand more than 10 days in some places.



For decades, scientists have studied the earth's polar regions to better understand global warming, the phenomenon that most climate scientists say is largely being caused by burning fossil fuels, which release heat-trapping gases into the atmosphere. Long vertical tubes of ice drilled from Antarctica's surface have revealed atmospheric conditions dating back 650,000 years. Analysis of these ice cores and the rapid melting of Arctic sea ice and glaciers have provided strong evidence of warming in the past century - and the serious long-term threat it presents.

Now, scientists are also documenting the effects of sustained warming in more temperate zones such as New England, where even subtle changes can have an enormous impact on the millions of people who live in the region.

Many of the observed changes in New England are consistent with computer models that project the response of the region's climate to global warming. Yet scientists are just beginning the complex study of how local regions are affected by the worldwide phenomenon. They have many unanswered questions, including why New England winters are warming so much faster than the other seasons.

Nowhere in New England are the wintertime changes more evident than around the 45th parallel - the latitude halfway between the equator and the North Pole. The line runs along the Vermont-Canada border and slices through the logging forests of Northern New Hampshire and Central Maine before heading into the Atlantic off Perry, Maine.

Weather pays mortgages in this region. The Jay Peak and Burke Mountain ski slopes sit close to the line, as do Island Pond, Vt., and Rangeley, Maine - towns that depend on snowmobilers for winter tourism dollars. Sugaring shacks, corn farms, hay fields, and blueberry barrens near the 45th parallel rely on weather many farmers say has become more erratic and extreme in the past decade.

## Heard along the 45th parallel

The Globe spent time this fall and winter visiting and talking about the changing climate with more than 80 people who live and work in Northern New England. Here are some of their observations:

Colebrook, New Hampshire

*"I worry about the snow — a lot of businesses in town rely on it and we don't get it like we used to."*

— Benoit Lamontagne, selectman

East Charleston, Vermont

*"In our Christmas bird count, we've definitely seen more American crow, which are usually more southern. Ravens, which are more northern, have decreased. The common denominator seems to be a warming climate."*

— Jayson Benoit, director of land management, NorthWoods Stewardship Center

East Burke, Vermont

*"The last three years have been off the charts bad. After last year, people were saying we can't have another bad year and here it is. It's a wake-up call that certain businesses can't be solely dependent on winter outdoor recreation."*

— Tim Tierney, executive director of Kingdom Trail Association

Shelburne, Vermont

*"The weather is less predictable. We are seeing more extremes, rain and droughts."*

— Sam Dixon, dairy farm manager, Shelburne Farms

Kingfield, Maine

*"We live here because we love winter. In December my husband printed up T-shirts that gave instructions for a snow dance on the back because we wanted to lift people's spirits. We hoped it would snow right away, but it took a while."*

— Amy Grant, who with her husband, Jim, owns a farm

45th parallel

Baring, Maine

*"We get a lot more freezing rain and ice, so the roads are icier."*

— Peggy Sawyer, office assistant, Moosehorn National Wildlife Refuge

Palmyra, Maine

*"We're always ice fishing by the first or second week in January. But it's mid-January and we haven't put the shack in yet."*

— Pat White, ice fisherman

Errol, New Hampshire

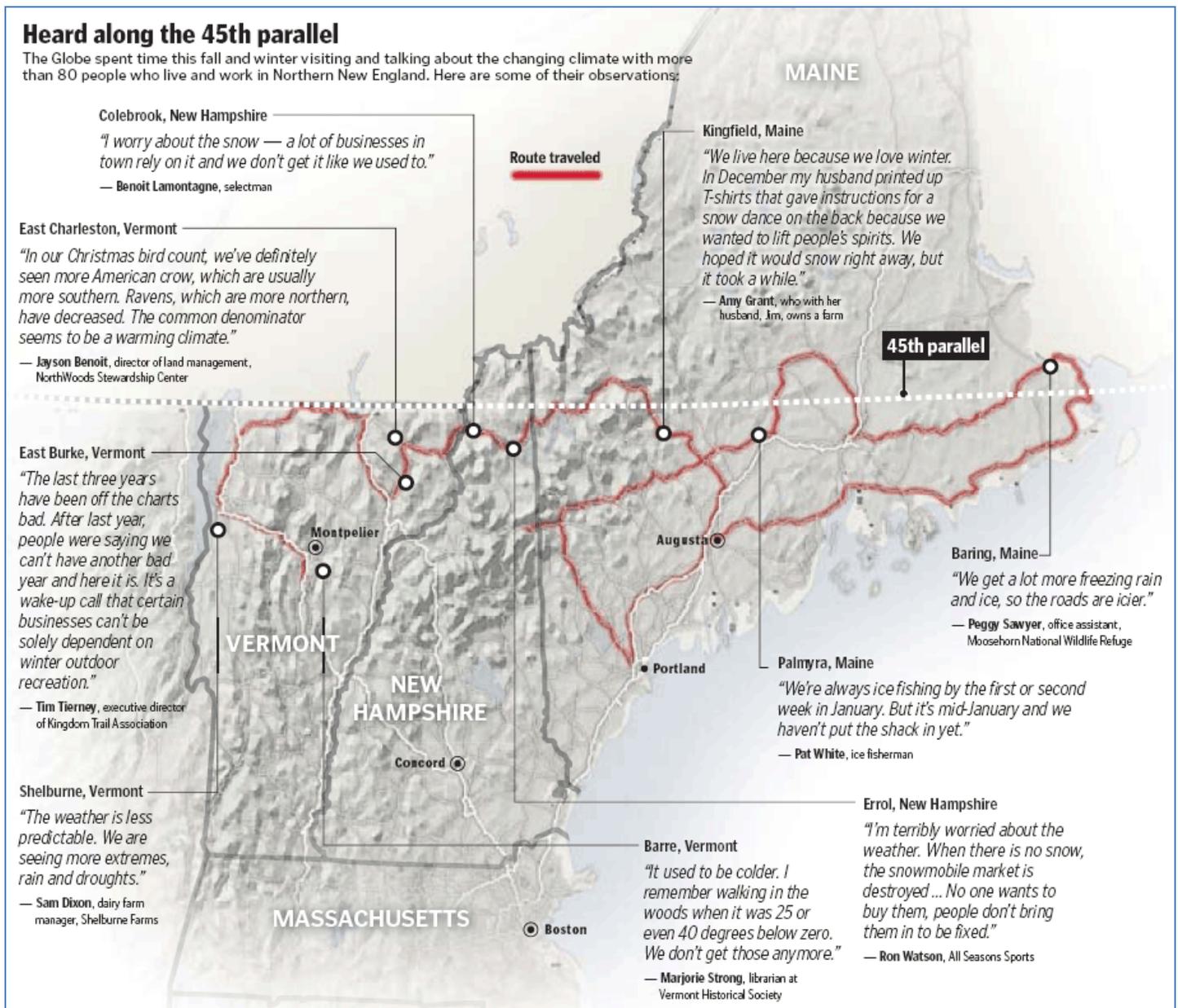
*"I'm terribly worried about the weather. When there is no snow, the snowmobile market is destroyed ... No one wants to buy them, people don't bring them in to be fixed."*

— Ron Watson, All Seasons Sports

Barre, Vermont

*"It used to be colder. I remember walking in the woods when it was 25 or even 40 degrees below zero. We don't get those anymore."*

— Marjorie Strong, librarian at Vermont Historical Society



The Globe followed the 45th parallel this fall and winter, logging nearly 1,000 miles and interviewing more than 80 residents and business owners about the warming's impact on their lives and the natural world around them. Much of the reporting took place during one of the warmest Decembers on record in New England in the warmest year on record in the United States.

Far from the debate about climate change in Washington, those who live on and around the 45th parallel say they are already experiencing a warmer existence, and for some a more economically uncertain world.

"Forget for a minute about what's causing this. The economic side is, our winter is getting shorter every year," said Rob Welch, a Rangeley selectman and owner of Pleasant Street Inn. His new five-bedroom inn was empty much of last winter and the start of this winter because of the lack of snow.

"Businesses here are not going to survive if we don't come up with something else to draw people here."

## Rewriting traditions

New England sits on the front line for some of the world's nastiest weather battles. Cold, dry air from the north and warm, moist air from the south wage an unending fight for control over the craggy terrain. Periodic attacks from ocean and mountain weather systems contribute to make the region's weather so wild and quick-changing that Mark Twain once described New England as being unable to hold all of its weather in.

Yet for all that variability, New England's overall climate was surprisingly predictable from Colonial times, when record keeping began, until about 10 to 20 years ago, residents around the 45th parallel say.

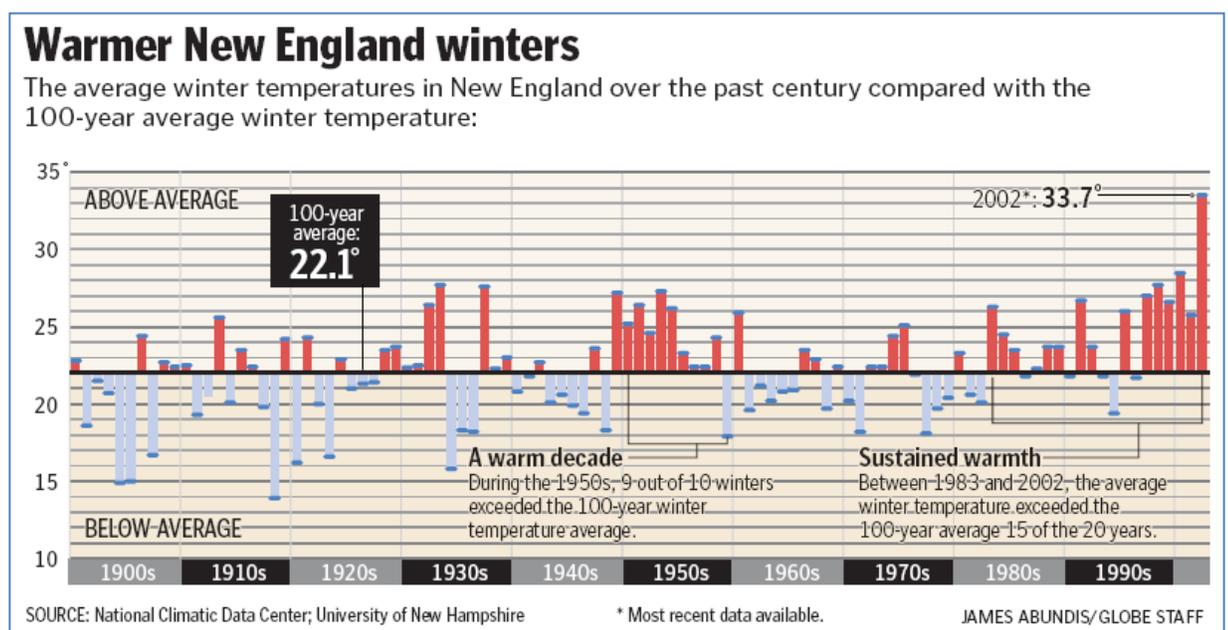
For generations, Vermont sugar-makers tapped trees after Town Meeting Day - the first Tuesday in March. A serious frost usually hit Northern New England by Oct. 15. Snow was on the ground by Thanksgiving, and ice fishing season began on New Year's Day.

Now those Farmers' Almanac traditions need to be rewritten. Many maple syrup producers are tapping their trees in February - and sometimes January. First frosts are arriving later in the fall and last frosts earlier in the spring. Serious snowfall can't be counted on by the first of December anymore.

On New England's western stretch of the 45th parallel, 85-year-old Fernand Dupere has witnessed the changes on 120-mile-long Lake Champlain, which forms part of the border between New York and Vermont.

A retired farmer in Alburg, Vt., Dupere has always kept track of when the lake freezes, but he began relying on it when he took up ice fishing 23 years ago. On most winter days he would carry a 6-gallon white bucket onto the lake, turn it over to make a stool, and fish for sunfish and perch through a hole in the ice. Other fishermen would haul plywood and metal fishing shacks onto the surface, creating colorful shantytowns.

But Lake Champlain doesn't freeze like it used to - if at all. Nowadays, it freezes an average of 14 days later than it did in 1816, when record keeping began. And of the 33 winters when the lake did not freeze, 17 have occurred since 1970.



"It's a lot different now than it was," Dupere said.

About 60 miles east, in tiny East Charleston, Vt., Arvin Anderson gestures outside to his land overlooking Echo Lake. Ever since moving here in 1969, he has planted bell peppers in his garden. The plants would produce only a few shiny vegetables in the early years, but they are now more productive, perhaps because of the longer growing season brought on by the warming temperatures.

"Now, I can reliably grow six to eight different varieties," Anderson said. He has noticed other changes. Temperatures used to hit 30 degrees below zero (Fahrenheit) or even colder for a week or more most winters when he first arrived. Now, he said, it rarely gets that cold for even a few days.

On top of a hill in Montpelier, about 60 miles south, seventh-generation syrup-maker Burr Morse is breaking tradition. For more than two centuries, his family drilled holes in sugar maples after Town Meeting Day in early March. The date almost always coincided with the delicate balance of freezing nights and warm days that gets the sugar maples' sap running. But now he regularly taps in February because that balance is happening earlier.

"I've got friends that cling to tradition who wait until after Town Meeting Day ... and they've gotten skunked many times in the last 20 years," said Morse, 58.

Far to the east, in the wild blueberry barrens of northeastern Maine, some farmers say uneven rainfall has prompted them to install irrigation systems. Jon Antil of Northfield put one in five years ago after a drought sliced his blueberry crop in half. "The springs are cold, the winter is warm, and the falls have lengthened out," he said.

#### Scientific uncertainties

At 9 p.m. on Jan. 8, 1829, school principal William Nutting pulled out a bulky brown diary in Randolph, Vt., and wrote in careful cursive: "Snow fell about 12 inches (day and night)." Three times a day for 35 years, Nutting fastidiously recorded the weather, until he died of pneumonia in 1863.

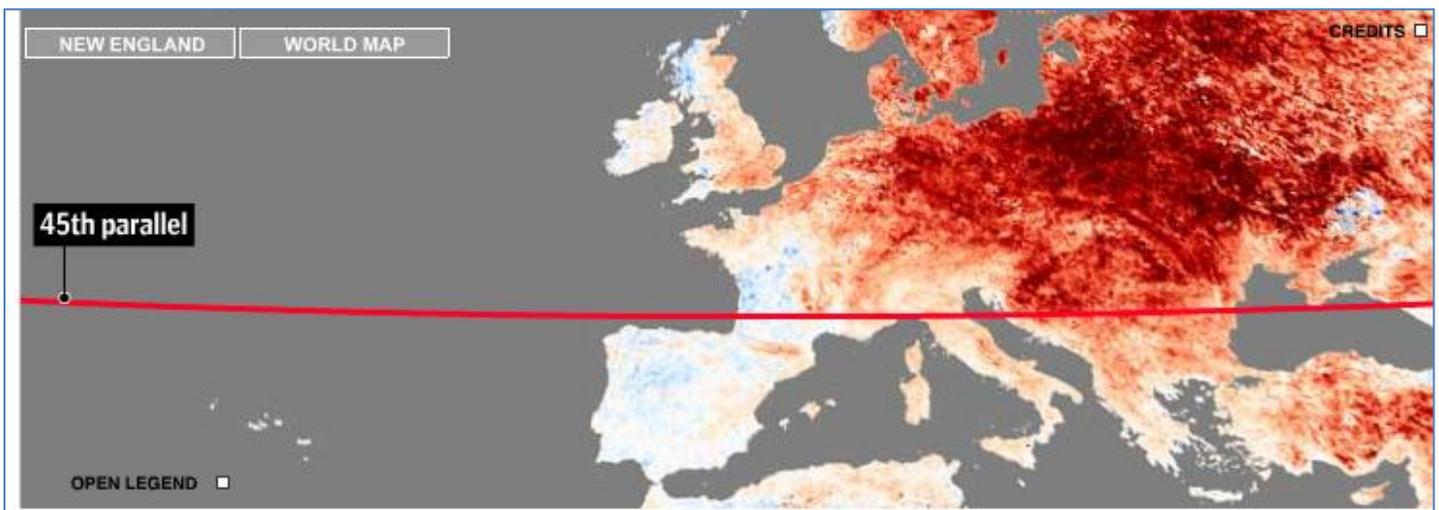
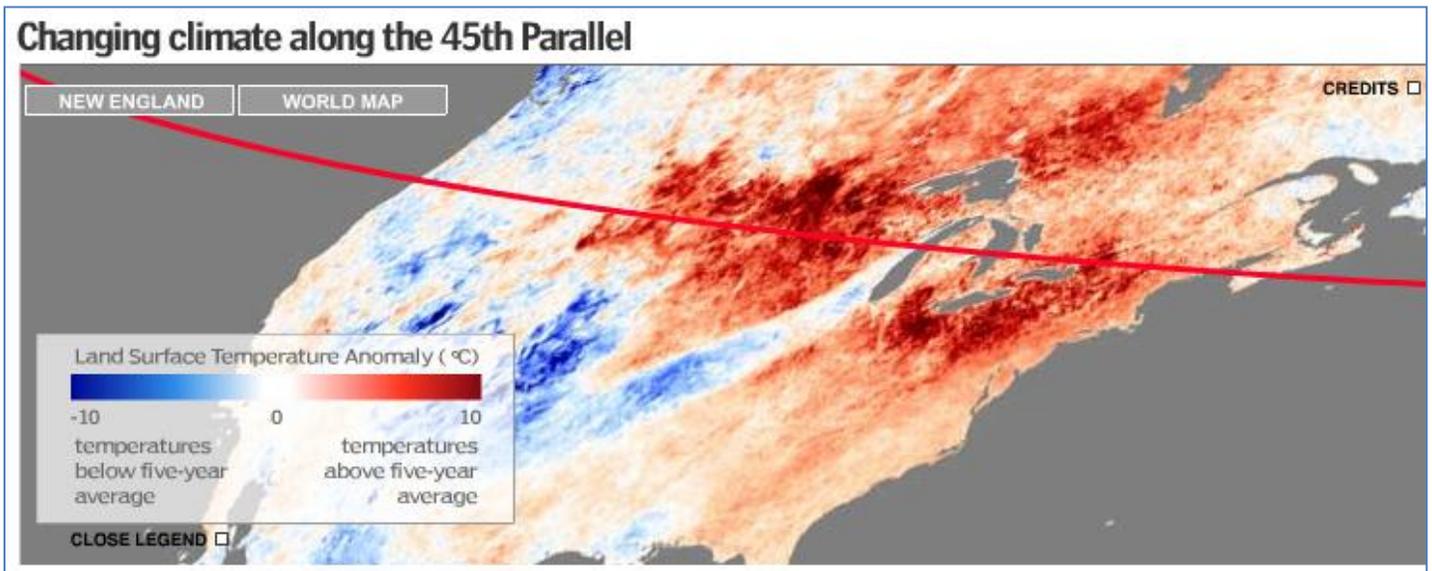
Today, Nutting's brittle diary, farmers' journals, archival photographs, and even the observations of naturalist Henry David Thoreau are being examined by scientists to address a critical question about New England's changing climate: Is it driven by man-made global warming?

Scientists face a number of uncertainties in answering the question. New England's official weather records go back about a century, limiting scientists' ability to compare the present with the distant past to assess how much of the changes they are tracking stem from global warming and how much can be explained by natural climate cycles. Unofficial records that go back farther or that measure key indicators, such as snow on the ground or the flowering dates of plants, are from isolated locations or sometimes measured in different ways, making it difficult for researchers to draw sweeping conclusions.

Now, researchers are beginning to use a mix of cutting-edge technology and dusty historical records to piece together a clearer picture of New England's warming. They are using sophisticated computer models and techniques that can simulate some regional weather dynamics. And they are becoming sleuths to find untraditional climate data to help answer whether the changes they are seeing are unprecedented.

"We need continuous records," said Richard Primack, a Boston University professor. Primack and BU graduate student Abraham Miller-Rushing are comparing Thoreau's detailed nature observations of bird migrations and plant flowering dates around Walden Pond in Concord, Mass., against the present. By scrutinizing historical photographs and museum specimens of flowering plants at Arnold Arboretum in Jamaica Plain, Primack has discovered that its plants are blooming about eight days earlier than they did at the beginning of the 20th century, a notable difference for biologists.

Some New England scientists say the weather systems in the region are so complex and so little understood that it is virtually impossible to distinguish warming caused by carbon dioxide emissions from natural temperature fluctuations. They point to this winter's balmy temperatures - largely attributed to the El Nino weather pattern in the Pacific Ocean - as an example of the vast, unpredictable forces that can shape the region's weather.



But many other scientists say that for a growing number of reasons, they are gaining confidence that New England's century-long heat rise is significantly related to global warming.

First, on Friday, an international group of hundreds of scientists is expected to conclude that there is more than 90 percent certainty that the rise of temperatures worldwide in the past 50 years is mostly

because of the increase in carbon dioxide and other gases in the atmosphere from the burning of fossil fuels. The surge of carbon dioxide coincided with the start of the Industrial Revolution in the mid-1800s and the subsequent invention of the automobile. Scientists can find no other explanation for the temperature rise without including humans' contribution.

Second, the increase in the region's winter temperatures began accelerating around 1970 - the same time overall global temperatures did.

Third, the temperature rise in New England is lasting longer than previous warm stretches in the past century that were attributed to natural variability. And the entire region has been affected.

Global warming is not expected to heat the world uniformly - some places may even cool. Scientists are becoming better at using computer models, which use decades of weather observations and complicated mathematical formulas that describe the physical processes that shape the climate, to predict global warming's impact on a regional scale.

A group of specialists brought together by a Cambridge-based advocacy group, the Union of Concerned Scientists, used eight computer models last year to determine global warming's impact on the entire Northeast. The models' simulation of the past 100 years closely matched the observational record - except that winters have warmed far more during the past 30 years than the models suggested.

"That's what really stood out," said Cameron Wake, a research associate professor at the University of New Hampshire who was a lead scientist in the modeling exercise. "There are dramatic changes taking place in the winter."

Wake and his colleagues are just beginning to study why winters are warming so much faster than the other seasons, but he suspects the answer may be related to why some people wear white on a hot, sunny day: The color reflects the sun's heat and keeps the wearer cooler. With less snow on the ground, the earth absorbs more of the sun's heat, warming the surface temperature. Scientists believe this amplifying effect is partly why the Arctic is warming so fast. The models analyzed by Wake and his colleagues were not able to measure this effect, called albedo, locally.

"We do know that global climate change is happening. We know that most of it is caused by human emissions ... and we know that it is likely already affecting New England," said Katharine Hayhoe, a research associate professor at Texas Tech University who helped lead the modeling study.

"But we just can't determine precisely how much yet."

#### Trouble for businesses

Snow helped save Colebrook, N.H. As family dairy farms failed and local factories cut back and closed in recent years, the picturesque community on the Connecticut and Mohawk rivers became more reliant on cars with out-of-state license plates towing snowmobiles. Their owners lured by an abundance of snow and a labyrinth of trails, snowmobiles were outnumbering cars in the parking lot of Howard's restaurant by the late 1990s.

But in the community of 2,500, where residents remember having to stick broomsticks into snowdrifts to find cars three decades ago, they need only a ruler now. Snowfall is unpredictable, residents say.

And many lakes and ponds don't reliably freeze over, making it dangerous for snowmobilers to use trails that traverse them.

The downturn had been gradual until the last several lackluster winters, forcing residents in Colebrook and elsewhere to confront the vulnerability of the billion-dollar winter tourism industry in Vermont, New Hampshire, and Maine.

While there are no firm figures for the economic loss, tourism officials say it has been enormous, as cross-country ski areas remained closed and Alpine slopes had to pay for expensive snow-making gear and advertising campaigns to draw skiers distracted by the green grass in their yards.

Rather, there are snapshots of the problem. Businesses in Northern New Hampshire, including those in Colebrook, unsuccessfully sought federal disaster aid recently because of the balmy December and early January, when lodging vacancy rates were as high as 80 percent.

In Highgate Springs, Vt., Martin's General Store owner Gilbert Gagner said his season for renting ice fishing shacks has shrunk compared with when he started the business 17 years ago.



Bob Vigue, northern regional manager for Seven Islands Land Co. in Northern Maine, said the warmer winters are making it harder to log, particularly in the past 10 years. Timber companies need frozen ground to reach trees in low-lying areas that are too soft during other seasons.

"We could always count on 10 to 12 weeks of frozen ground, but now we are losing almost a month," he said.

#### Search for alternatives

Some communities that rely heavily on winter tourism have begun to talk about expanding their attractions. In East Burke, Vt., residents are discussing how to bring more mountain bikers in the summer.

In Colebrook, Town Manager Donna Caron wants the community to allow all-terrain vehicles on snowmobile trails when there isn't enough snow for snowmobiling. But private trail owners have not liked the idea because the wheeled vehicles can destroy vegetation and cause erosion.

"If we don't do something, the winter businesses here could fold," Caron said.

Some businesses, such as Kingdom Cat, an Arctic Cat snowmobile dealership in Island Pond, Vt., have already closed.



When the downtown store opened eight years ago in the "snowmobile capital of Vermont," owners Peggy and Bob Halpin were optimistic. Island Pond teemed with snowmobiles from November to April.

"But the winters have gotten progressively worse," said Bob Halpin. He struggled through the dismal 2004 and 2005 seasons, but last summer, with 30 machines left unsold, he was forced to make a tough choice. He closed the store in September.

"We decided to cut our losses, and I'm glad I did; we would have been so much further in debt this year," said Halpin, who is now a salesman.

He does not know whether the past three years were just a bad weather spell or part of some bigger trend, he said, but warming temperatures have deeply affected his life - and he worries they could soon affect many others.

"People need to understand how important the weather is here, not just to me but to the gas station, the restaurant, the hotel," he said. "It trickles down to everyone."

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