Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

backgrounder

All information in this summary is entirely based on "Global Climate Change Impacts in the United States" (USGCRP, 2009). To enhance clarity, slight modifications were made that maintain the intended meaning of the report.

Northeast

Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont West Virginia

CLIMATE

Since 1970, the annual average temperature in the Northeast has increased by 2°F, with winter temperatures rising twice this much. This warming has resulted in many other climate-related changes, including :

- More frequent days with temperatures above 90°F;
- A longer growing season;
- Increased heavy precipitation;
- Less winter precipitation falling as snow and more as rain;
- Reduced snowpack and earlier breakup of winter ice on lakes and rivers;
- Earlier spring snowmelt resulting in earlier peak river flows, and
- Rising sea surface temperatures and sea level.

Over the next several decades, temperatures are projected to rise an additional 2.5 to 4°F in winter and 1.5 to 3.5°F in summer. By mid-century and beyond, however, today's emissions choices would generate starkly different climate futures; the lower the emissions, the smaller the climatic changes and resulting impacts.

By late this century, under a higher-emissions scenario:

- Winters in the Northeast are projected to be much shorter with fewer cold days and more precipitation.
- The length of the winter snow season would be cut in half across northern New York, Vermont, New
- Hampshire, and Maine, and reduced to a week or two in southern parts of the region.
- Cities that today experience few days above 100°F each summer would average 20 such days per summer, while certain cities, such as Hartford and Philadelphia, would average nearly 30 days over 100°F.
- Short-term (one- to three-month) droughts are projected to occur as frequently as once each summer in the Catskill and Adirondack mountains, and across the New England states.
- Hot summer conditions would arrive three weeks earlier and last three weeks longer into the fall.
- Sea level in this region is projected to rise about 2 feet, with the potential for a much larger rise

AGRICULTURE

Agricultural production, including dairy, fruit, and maple syrup, are likely to be adversely affected as favorable climates shift. Large portions of the Northeast are likely to become unsuitable for growing popular varieties of apples, blueberries, and cranberries under a higher emissions scenario. Climate conditions suitable for maple/beech/birch forests are projected to shift dramatically northward, eventually leaving only a small portion of the Northeast with a maple sugar business.

Fruits that require long winter chilling periods will likely experience declines. Many varieties of fruits (such as popular varieties of apples and berries) require between 400 and 1,800 cumulative hours below 45ºF each winter to produce abundant yields the following summer and fall.

By late this century, under a higher emissions scenarios, winter temperatures in many important fruit-producing regions such as the Northeast will likely be too consistently warm to meet these requirements. Cranberries have a particularly high chilling requirement, and there are no known low-chill varieties. Massachusetts and New Jersey supply nearly half the nation's cranberry crop. By the middle of this century, under higher emissions scenarios, it is unlikely that these areas will support cranberry production due to a lack of the winter chilling they need.

Heat stress in dairy cows depresses both milk production and birth rates for periods of weeks to months. The dairy industry is the most important agricultural sector in this region, with annual production worth $3.6 billion. By late this

century, all but the northern parts of Maine, New Hampshire, New York, and Vermont are projected to suffer declines in July milk production under the higher emissions scenario.† In parts of Connecticut, Massachusetts, New Jersey, New York, and Pennsylvania, a large decline in milk production, up to 20 percent or greater, is projected. Under the lower emissions scenario, however, reductions in milk production of up to 10 percent remain confined primarily to the southern parts of the region. This analysis used average monthly temperature and humidity data that do not capture daily variations in heat stress and projected increases in extreme heat. Nor did the analysis directly consider farmer responses, such as installation of potentially costly cooling systems. On balance, these projections are likely to underestimate impacts on the dairy industry.

INCREASED FLOODING – INLAND AND COASTAL
Since most large U.S. cities are on coasts, rivers, or both, climate change will likely lead to increased flood damage. The largest impacts are expected when sea-level rise, heavy runoff, high tides, and storms coincide.

Flooding from Precipitation Changes

Precipitation intensity is projected to increase everywhere, with the largest increases occurring in areas in which average precipitation increases the most.

- The Midwest and Northeast, where total precipitation is expected to increase the most, will likely experience the largest increases in heavy precipitation events.
- The number of dry days between precipitation events is also projected to increase, especially in the more arid areas.
- Observations indicate a transition to more rain and less snow in both the West and Northeast in the last 50 years.
- Runoff in snowmelt-dominated areas is occurring up to 20 days earlier in the West, and up to 14 days earlier in the Northeast. For the Northeast, projections indicate spring runoff will advance by up to 14 days.

Earlier runoff produces lower late-summer streamflows which stress human and environmental systems through less water availability and higher water temperatures. Scientific analyses to determine the causes of recent changes in snowpack, runoff timing, and increased winter temperatures have attributed these changes to human-caused climate change.

Heavy downpours can overload drainage systems and water treatment facilities, increasing the risk of water-borne diseases. Downpours can trigger sewage overflows, contaminating drinking water and endangering beachgoers.

Heavy rains can lead to flooding, which can cause health impacts including direct injuries as well as increased incidence of water-borne diseases due to bacteria, such as *Cryptosporidium* and *Giardia*
(also noted under the section on infectious disease).

- The consequences will likely be particularly severe in the 950 U.S. cities and towns, including New York, Chicago, Washington DC, Milwaukee, and Philadelphia, that have "combined sewer systems;" an older design that carries storm water and sewage in the same pipes.
- During heavy rains, these systems often cannot handle the volume, and raw sewage spills into lakes or waterways, including drinking water supplies and places where people swim.
- In 1994, the EPA established a policy that mandates that communities substantially reduce or eliminate their combined sewer overflow, but this mandate remains unfulfilled. In 2004, the EPA estimated it would cost $203 billion to address these and other needs of publicly-owned wastewater treatment systems.

Flooding from Sea-Level Rise and Storm Surge

Significant sea-level rise and storm surge will adversely affect coastal cities and ecosystems around the nation; low-lying and subsiding areas are most vulnerable.

- Recent estimates of global sea-level rise substantially exceed the IPCC estimates, suggesting sea-level rise between 3 and 4 feet in this century.
- Even a 2-foot rise in relative sea level over a century would result in the loss of a large portion of the nation's remaining coastal wetlands, as they are not able to build new soil at a fast enough rate.
- Accelerated sea-level rise would affect seagrasses, coral reefs, and other important habitats. It would also fragment barrier islands, and place into jeopardy existing homes, businesses, and infrastructure, including roads, ports, and water and sewage systems.
- Portions of major cities, including Boston and New York, would be subject to inundation by ocean water during storm surges or even during regular high tides.
- Remnants of hurricanes moving inland also threaten cities of the Appalachian Mountains, which are vulnerable if hurricane frequency or intensity increases.

Severe flooding due to sea-level rise and heavy downpours is likely to occur more frequently.

- Because of their proximity to the ocean, coastal cities are vulnerable to sea-level rise, storm surge, and increased hurricane intensity, while inland cities might not be directly affected by those particular concerns.
- Cities such as New Orleans, Miami, and New York are particularly at risk, and would have difficulty coping with the sea-level rise projected by the end of the century under a higher emissions scenario.
- A two foot rise in global seal level by the end of this century would result in a relative sea-level rise of 2.3 feet at New York City.
- Under a higher emissions scenario, what is now considered a once-in-a-century coastal flood in New York City is projected to occur at least twice as often by mid-century, and 10 times as often (or once per decade on average) by late this century.
- With a lower emissions scenario, today's 100-year flood in New York is projected to occur once every 22 years on average by late this century.

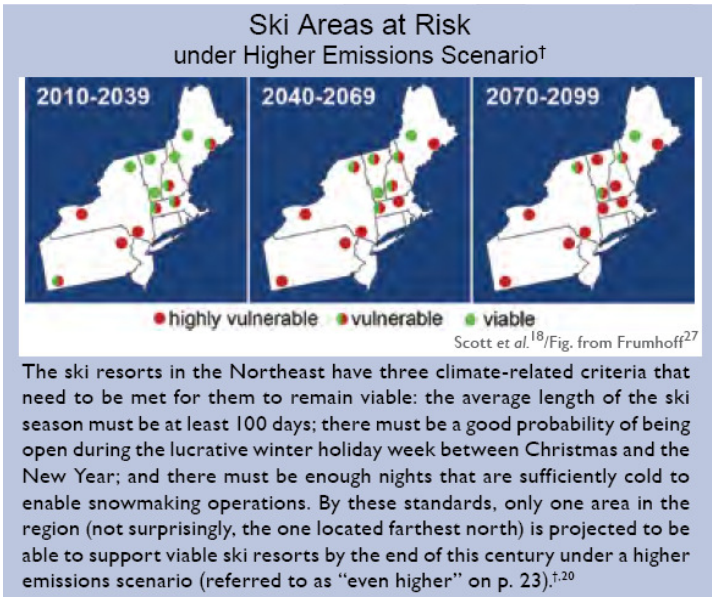
The combined effects of sea-level rise and storm surge are projected to dramatically increase the frequency of flooding.

- What is currently called a 100-year storm is projected to occur as often as every 5 years.
- Portions of lower Manhattan and coastal areas of Brooklyn, Queens, Staten Island, and Nassau County, would experience a marked increase in flooding frequency.
- Much of the critical transportation infrastructure, including tunnels, subways, and airports, lies well within the range of projected storm surge and would be flooded during such events.

The densely populated coasts of the Northeast face substantial increases in the extent and frequency of storm surges, coastal flooding, coastal erosion, property damage, and loss of wetlands.

- New York State alone has more than $1.9 trillion in insured coastal property.
- Much of this coastline is exceptionally vulnerable to sea-level rise and related impacts.
- Some major insurers have withdrawn coverage from thousands of homeowners in coastal areas of the Northeast, including New York City.

WINTER RECREATION



The ski resorts in the Northeast have three climate-related criteria that need to be met for them to remain viable: the average length of the ski season must be at least 100 days; there must be a good probability of being open during the lucrative winter holiday week between Christmas and the New Year; and there must be enough nights that are sufficiently cold to enable snowmaking operations. By these standards, only one area in the region (not surprisingly, the one located farthest north) is projected to be able to support viable ski resorts by the end of this century under a higher emissions scenario (referred to as "even higher" on p. 23).†[20]

The projected reduction in snow cover will adversely affect winter recreation and the industries that rely upon it. Winter snow and ice sports, which contribute some $7.6 billion annually to the regional economy, will be particularly affected by warming. Of this total, alpine skiing and other snow sports (not including snowmobiling) account for $4.6 billion annually. Snowmobiling, which now rivals skiing as the largest winter recreation industry in the nation, accounts for the remaining $3 billion. Other winter traditions, ranging from skating and ice fishing on frozen ponds and lakes, to cross-country (Nordic) skiing, snowshoeing, and dog sledding, are integral to the character of the Northeast, and for many residents and visitors, its desirable quality of life.

Warmer winters will shorten the average ski and snowboard seasons, increase artificial snowmaking requirements, and drive up operating costs. While snowmaking can enhance the prospects for ski resort success, it requires a great deal of water and energy, as well as very cold nights, which are becoming less frequent. Without the opportunity to benefit from snowmaking, the prospects for the snowmobiling industry are even worse. Most of the region is likely to have a marginal or non-existent snowmobile season by mid-century.

FISHERIES

The center of lobster fisheries is projected to continue its northward shift and the cod fishery on Georges Bank is likely to be diminished. Lobster catch has increased dramatically in the Northeast as a whole over the past three decades, though not uniformly. Catches in the southern part of the region peaked in the mid-1990s, and have since declined sharply, beginning with a 1997 die-off in Rhode Island and Buzzards Bay (Massachusetts) associated with the onset of a temperature-sensitive bacterial shell disease, and accelerated by a 1999 lobster die-off in Long Island Sound. Currently, the southern extent of the commercial lobster harvest appears to be limited by this temperature-sensitive shell disease, and these effects should only increase with projected rising water temperatures. Analyses also suggest that lobster survival and settlement in northern regions of the Gulf of Maine could be increased by warming water, a longer growing season, more rapid growth, an earlier hatching season, an increase in nursery grounds suitable for larvae, and faster development of plankton.

Cod populations throughout the North Atlantic are adapted to a wide range of seasonal ocean temperatures, including average annual temperatures near the seafloor ranging from 36 to 54°F. A maximum ocean temperature of 54°F represents the threshold of thermally suitable habitat for cod and the practical limit of cod distribution. Temperature also influences both the location and timing of spawning, which in turn affects the subsequent growth and survival of young cod. Studies indicate that increases in average annual bottom temperatures above 47°F will lead to a decline in growth and survival. Climate change will thus introduce an additional stress to an already-stressed fishery.

TRANSPORTATION

In many northern states, warmer winters will bring about reductions in snow and ice removal costs, lessen adverse environmental impacts from the use of salt and chemicals on roads and bridges, extend the construction season, and improve the mobility and safety of passenger and freight travel through reduced winter hazards. On the other hand, more freeze-thaw conditions are projected to occur in northern states, creating frost heaves and potholes on road and bridge surfaces and resulting in load restrictions on certain roads to minimize the damage. With the expected earlier onset of seasonal warming, the period of springtime load restrictions might be reduced in some areas, but it is likely to expand in others with shorter winters but longer thaw seasons. Longer construction seasons will be a benefit in colder locations.

ECOSYSTEM CHANGES

In the United States, spring now arrives an average of 10 days to two weeks earlier than it did 20 years ago. Climate change already is having impacts on animal and plant species throughout the United States. Some of the most obvious changes are related to the timing of the seasons: when plants bud in spring, when birds and other animals migrate, and so on. The growing season is lengthening over much of the continental United States. Many migratory bird species are arriving earlier. For example, a study of northeastern birds that migrate long distances found that birds wintering in the southern United States now arrive back in the Northeast an average of 13 days earlier than they did during the first half of the last century. Birds wintering in South America arrive back in the Northeast an average of four days earlier.1

Shifts in tree species on mountains in New England, where temperatures have risen 2 to 4ºF in the last 40 years, offer another example. Some mountain tree species have shifted uphill by 350 feet in the last 40 years. Tree communities were relatively unchanged at low and high elevations, but in the transition zone in between (at about 2,600 feet elevation) the changes have been dramatic. Cold-loving tree species declined from 43 to 18 percent, while warmer-loving trees increase from 57 to 82 percent. Overall, the transition zone has shifted about 350 feet uphill in just a few decades, a surprisingly rapid rate since these are trees that live for hundreds of years. One possibility is that as trees were damaged or killed by air pollution, it left an opportunity for the warming-induced transition to occur more quickly. These results indicate that the composition of high-elevation forests is changing rapidly.2

Large declines in trout populations also are projected to occur around the United States. Over half of the wild trout populations are likely to disappear from the southern Appalachian Mountains because of the effects of warming stream temperatures. Losses of western trout populations might exceed 60 percent in certain regions. About 90 percent of bull trout, which live in western rivers in some of the country's most wild places, are projected to be lost due to warming. Pennsylvania is predicted to lose 50 percent of its trout habitat in the coming decades. Projected losses of trout habitat for some warmer states, such as North Carolina and Virginia, are up to 90 percent.