THE CHALLENGE OF CLIMATE CHANGE

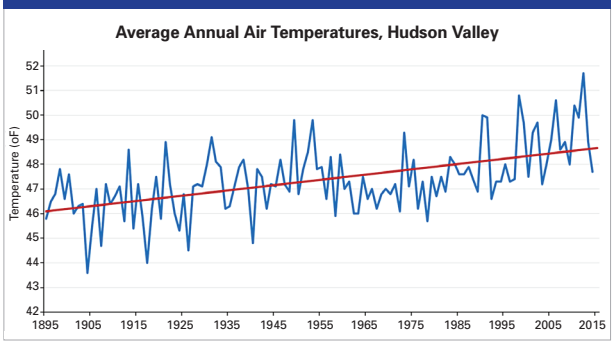
Tropical Storms Irene and Lee in 2011. Superstorm Sandy in 2012. The frigid, snowy winter of 2013-2014. While it is tempting to blame individual events on climate change — or lack of it — direct cause and effect cannot be established for specific events. What can be said is that the trend toward more extreme weather fits with the predictions of climate scientists, and that long-term data display abundant evidence of a warming Hudson Valley.

HOW HAS THE CLIMATE CHANGED IN OUR REGION?

As the sun warms Earth, our planet radiates heat. Certain gases, called greenhouse gases (GHGs), trap some of this heat in the lower atmosphere. Human activities that release GHGs, like burning fossil fuels, are elevating their concentrations and warming Earth. This global warming is affecting climate — long-term weather patterns — around the world and in the Hudson Valley.

New York State's average annual temperature has gone up nearly 2°F in 30 years. Winter average temperatures have warmed even faster — 5°F in 30 years. In the Hudson Valley, every year but one since 2000 has been hotter than the average established over the base period from 1901-2000. The year 2012 was the warmest on record here.

TREND: Average annual temperatures in the Hudson Valley are rising.

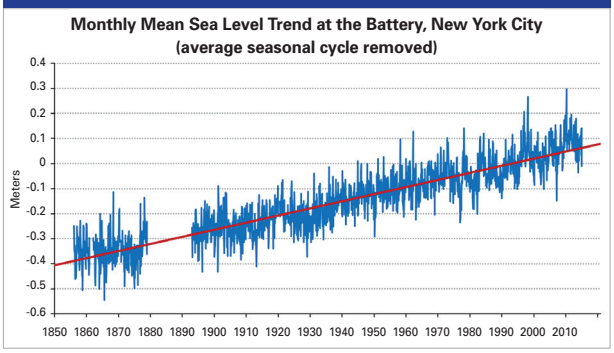


Data from National Climatic Data Center, National Oceanic and Atmospheric Administration

The warming trend can also be seen in the Hudson River itself. At Poughkeepsie, the river's annual average water temperature has increased by more than 2°F since the late 1940s. While two degrees may not seem like much, the impact on ecosystems and people can be substantial.

Statewide and here in the Hudson Valley, average rainfall is increasing, exceeding the 1901-2000 base period average in all but two years since 2000. 2011 was the wettest year on record. And of all regions in the U.S., the Northeast has experienced the greatest recent increase — 74% between 1958 and 2010 — in extreme precipitation events that deliver more than an inch in 24 hours.

TREND: At the Battery at the southern tip of Manhattan, mean sea level has been rising 2.83 millimeters — 0.11 inch — per year on average.



National Oceanic and Atmospheric Administration

SEA LEVEL IN AN ARM OF THE SEA

Sea level is rising due to global warming. This impacts the Hudson estuary — a long arm of the sea. Sea level in New York harbor, 15 inches higher now than it was in 1850, is expected to go up another 11-21 inches by 2050. At Troy, water levels will likely rise 9-19 inches by mid-century.

Sea level is rising due to expansion of ocean water as it warms, and melting of glacial ice on land. There is growing concern that the huge ice sheets covering Greenland and Antartica may be melting faster than previously thought. If true, then sea level could go higher than predicted, up to six feet by century's end.

TREND: According to the Northeast Regional Climate Center, the frequency of two-inch rainfall events in New York has increased since the 1950s, and storms once considered a 1 in 100 year event have become more frequent.

Steve Stanne/DEC

Engineers must take into account the prospects for intense precipitation events when planning structures to withstand high flows.

Flooding in Poughkeepsie during Tropical Storm Irene.

Steve Stanne/DEC

Steve Maslowski/U.S. Fish and Wildlife Service

Ruby-throated hummingbird.

RESETTING NATURAL CLOCKS

Our warming climate has altered the timing of events keyed to seasonal change. Statewide, bloom dates of many plants are 4-8 days ahead of where they were in the early 1970s.

At the Mohonk Preserve in Ulster County, where detailed records go back to the 1930s, some woodland flowers are now blooming earlier in spring — bloodroot 14 days earlier, and hepatica 20 days earlier. Amphibians are emerging from winter dormancy earlier — wood frog by 14 days, Jefferson's salamander by 23 days. The arrival of summer resident birds shows the same trend: the eastern towhee returns 10 days earlier, the ruby-throated hummingbird seven days earlier.

Dave Moore/U.S. Forest Service

Bloodroot

IMPACTS ON HUDSON VALLEY COMMUNITIES

The extreme storms of recent years bear out predictions of more intense disturbances. The downpours associated with Irene and Lee showed what might happen as this trend increases the risk of severe flooding. Sandy's impacts here had less to do with rainfall than with its size and high winds, which drove a massive storm surge into New York harbor and the Hudson estuary. Water levels went up dramatically, with catastrophic results. Steadily rising sea level will endow surge from lesser storms with the capacity to cause similar damage in the future.

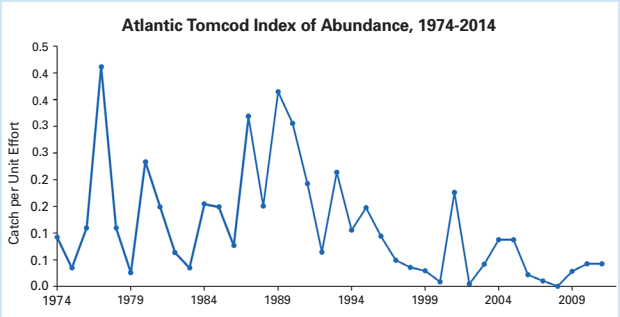
Shorter, warmer winters and longer, hotter summers will affect local farmers and winter recreation, and may increase the prevalence of some diseases as populations of their insect hosts shift northward. More numerous heat waves will boost the incidence of pollution-related asthma and heat exhaustion, especially in urban areas.

CLIMATE CHANGE AND THE ESTUARY ECOSYSTEM

As discussed in the aquatic habitats section, sea-level rise and flooding are likely to impact the estuary's tidal marshes and shallows. It remains to be seen whether they might survive in place or migrate into newly flooded shallows. The flooding associated with intense storms like Irene and Lee can carry huge volumes of sediment into the Hudson, where it hinders the growth of submerged aquatic vegetation.

Irene and Lee had acute but shorter term direct impacts on fish. Populations living in near-shore waters declined, while runoff swept young migratory fish further seaward than normal in late summer, a shift correlated with reduced growth rates.

In concert with rising water temperatures, the rainbow smelt has disappeared from the estuary, and Atlantic tomcod numbers are declining. While correlation is not causation, both are fish of more northerly waters, reaching the southern limit of their range in the Hudson. Their early life stages are known to require cool temperatures for survival.



Data from Long River Utilities Survey

Robert Adams/DEC

Atlantic tomcod.

RESPONDING TO CLIMATE CHANGE

The severity of climate change to come will depend on energy choices made over the next decade. Cutting GHG emissions is essential. Using more renewable energy sources — solar and wind power instead of fossil fuels — will help. Improving energy efficiency in buildings and transportation will reduce demand for energy. Conserving forests can also help lower atmospheric levels of carbon dioxide, the major GHG, because trees absorb this gas during photosynthesis.

Even under the most optimistic scenarios for cutting emissions, GHG concentrations will remain problematic for decades if not centuries. Accordingly, communities are adapting to climate change, taking charge of their future.

Within the estuary corridor, local and state governments are moving to build resilience – their ability to manage climate risks, respond productively as the climate changes, and recover quickly from extreme events. Examples in recent years are Waterfront Flooding Task Force initiatives in Piermont, Stony Point, Kingston, and Catskill. In each locality, concerned citizens have determined what is vulnerable, developed a vision for resilience, and submitted recommendations to residents and governing boards. At the state level, the New York Rising Community Reconstruction Program provides rebuilding and revitalization assistance to communities severely damaged by Sandy, Irene, and Lee.

In 2010, New York State initiated a Climate Smart Communities Program, through which communities pledge to minimize the risks of climate change and earn state certification of their accomplishments. Certification requires communities to reduce GHG emissions and adapt to predicted and actual climatic changes. By late 2014, 144 New York counties, cities, towns, and villages had earned certification as Climate Smart communities — 60 of them in counties bordering the Hudson estuary. The program emphasizes the key government roles of leading, educating, and setting an example in confronting the challenges of climate change.