

NEW JERSEY

ASSESSING THE COSTS OF CLIMATE CHANGE

CLIMATE TRENDS IN NEW JERSEY

During the last century, New Jersey has experienced rising temperatures, increased precipitation, more frequent severe weather, and rising sea levels. Average annual temperatures have increased by 2° F since 1900, and average winter temperatures have increased by 4° F since 1970.^{1,2} Parts of New Jersey have seen an increase in precipitation of between 5 percent and 10 percent, and major weather events has become more frequent in the Mid-Atlantic region during the last century.^{3,4} The sea level along the New Jersey coastline has risen at a rate of about 1.5 inches every 10 years during the past 100 years, which is nearly twice the global average.⁵

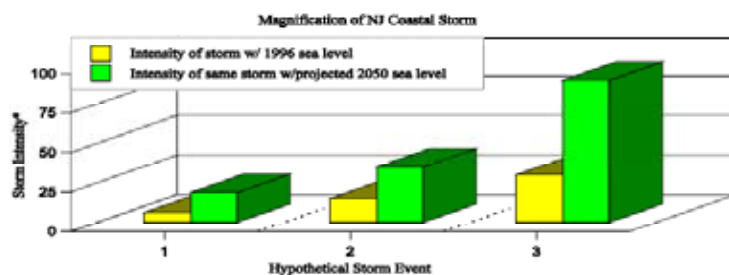
Researchers predict that climate change will cause global temperatures to increase in New Jersey by 2° F to 8° F by 2100, with most significant changes occurring in the summer and fall. Precipitation is predicted to increase by 10 percent to 20 percent, with more rainfall in the winter and less in the spring and summer.⁶

Researchers also forecast that, as ocean temperatures rise—causing thermal expansion of water—and ice melts at the poles, coastal sea levels will rise by 2 to 4 feet during the 21st century.⁷ The New Jersey Department of Environmental Protection predicts that large storms that currently occur every 20 years will occur every five years by 2050, increasing the potential for coastal damage (Figure 1).

OVERVIEW

In the coming decades, a changing climate is expected to increase the economic impacts on New Jersey and the nation. The most recent climate modeling predicts higher sea levels for the New Jersey coast. These changes will be more pronounced if global greenhouse gas emissions are not reduced. Tourism, transportation, real estate and human health are likely to be affected in various ways and could see losses in the billions of dollars. Since state economies are directly linked to those of neighboring states and regions, policymakers may wish to consider both state and regional policies to address climate change.

Figure 1. Increasing Intensity of Coastal Storms in New Jersey With Climate Change



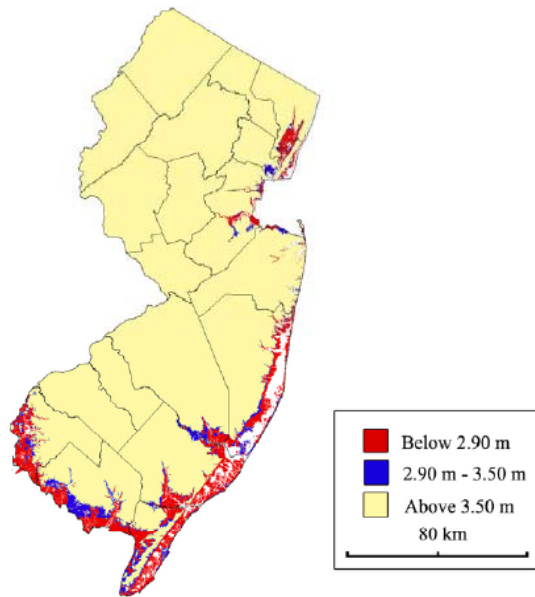
Source: New Jersey Department of Environmental Protection, 1999.

ECONOMIC IMPACTS

New Jersey's coastal infrastructure and development are thought to be the most susceptible to the impacts of climate change. By the end of the century, 1 percent to 3 percent of New Jersey's 210-mile shoreline is likely to be lost to rising sea levels, and 6.5 percent to 9 percent of the state's coastal area will be inundated by occasional flooding (Figure 2). These events are expected to place considerable strain on the coastal infrastructure and on the more than 6 million people who will live in the state's coastal



Figure 2. Inundation Scenarios Resulting from Sea Level Rise and Episodic Flooding



Source: Oppenheimer et al., 2005.

communities by 2020.⁸

Coastal Development

New Jersey's coastal counties, home to 60 percent of the state's population, host numerous tourist destinations, industrial sites and widespread commercial development. Land and property values in the shoreline counties of Monmouth, Ocean, Atlantic and Cape May total \$106 billion.⁹ Sea level rise, flooding and major storms caused by climate change and other variables are likely to impose high costs on these counties.

Rising waters are predicted to claim more land in New Jersey than the national average due to local conditions that make the state's shoreline particularly vulnerable to soil erosion and land subsidence. A 1 foot rise in sea level along the New Jersey coast will advance the shoreline inward 120 feet; the U.S. average is 78 feet.¹⁰ By 2100, under all greenhouse gas emissions scenarios, predictions indicate that Atlantic City will flood to the current 100-year flood level every one to two years on average.¹¹ Given the extensive development of the New Jersey shoreline, predictions indicate that residential and urban lands will be second only to wetlands to be inundated by a rise in sea level.¹²

Protecting coastal development from rising waters, beach erosion and salt-water intrusion will be costly. The U.S. Environmental Protection Agency's study at Long Beach Island, N.J., found that it would cost between \$160 million and \$790 million to protect the island residents from a 1 foot to 3 foot increase in sea level.



Adaptation options include moving entire houses (\$41,200 per house) or building levees (\$31,700 per house). Due to the extensive development on vulnerable barrier islands such as Long Beach Island and Atlantic City, damage costs associated with a 4-foot rise in sea level (the upper end of potential sea level rise predictions) are expected to exceed \$10 billion.¹³

More frequent and intense storms are also expected to impose economic costs on New Jersey. Hurricane damage along the northeast U.S. coast has cost approximately \$5 billion per year.¹⁴ The December 1992 northeaster, for example, hit the New Jersey coast during the high spring tide, creating high water levels that persisted for seven days and caused \$503 million in damages.¹⁵ The increased coastal storm damage puts pressure on private insurers to raise premiums or eliminate policies for high-risk coastal properties. The shift in coverage has already occurred in coastal regions of New Jersey, New York, Connecticut and Florida, putting increased strain on federal insurance programs.¹⁶

The increased risk of flooding is not a question of conjecture for the insurance industry, which gathers the best data available to calculate risks and protect its interests. Allstate, for example, includes climate change in risk models and is finding that insurance for coastal property is not profitable in many coastal regions. As a result, the company no longer is writing new policies for property owners in high weather-related risk areas of New Jersey and various other coastal states. It also is raising the rates and making changes to existing policies in these regions.

Tourism

New Jersey's tourism revenue exceeded \$30 billion in 2005. Seventy percent was generated in the state's coastal counties, renowned for their public beaches, beachfront real estate and tourist hotspots such as Atlantic City. The vibrant tourist industry is likely to suffer when faced with weakening coastal infrastructure, more major storms, beach erosion and the threat of flooding in top tourist areas.¹⁷

Beaches erode at a rate 50 to 100 times the rate of sea level elevation (for each inch rise in sea level, 50 to 100 inches of beach is lost), threatening this valuable tourist attraction.¹⁸ By 2100, under all greenhouse gas emissions scenarios, Atlantic City is predicted to flood to the current 100-year flood level every one to two years on average.¹⁹ Rising sea levels pose a risk for the ecotourism industry as well, since researchers estimate that 21 percent of the mid-Atlantic wetlands will disappear by 2100, reducing shorebird nesting areas and fish nurseries.²⁰ The loss of these critical wildlife habitats will decrease the value of these sites for ecotourism. If these changes lead to a 1 percent decrease in the number of tourists who visit New Jersey's coastal region each year, economic models predict an

indirect economic impact of more than \$3.7 billion by 2017 and a loss of 40,000 jobs.²¹

Transportation Infrastructure

The annual cost to operate, repair and develop New Jersey's transportation infrastructure is nearly \$4 billion²² State roads, bridges, and rails are an essential part of the state's economy. Potential flooding, rising seas and increased severe weather caused by climate change threaten the rails, bridges and tunnels that connect Northern New Jersey with New York City since they operate below, at or near sea level. Based on the Boston subway tunnel flooding of 1996, which cost an estimated \$121 million, annual transit maintenance costs could increase by several million dollars for the tri-state metropolitan area; recovery efforts following major flooding are likely to exceed \$1 billion.²³

Sea level rise also poses a serious threat to the operation of ports along the New Jersey shore. Low-lying access roads are at risk to flooding, while shipping ports would need to adjust infrastructure to maintain a working land-sea interface.

Because coastal infrastructure is so vital to the state's economy, a 1 percent increase in extreme storms every year from 2007 to 2017 would increase indirect economic impacts from \$3.9 million in 2007 to more than \$45 million in 2017. This would create 56 construction sector jobs in 2007 and 648 in 2017.²⁴ The construction sector benefits from flooding or the destruction of infrastructure because it will be involved in rebuilding. Depending on employment demand and other economic drivers, however, the capacity to construct new infrastructure to accommodate population growth may be limited.

OTHER EFFECTS

Agriculture

The net value of New Jersey agricultural products is just under \$864 million annually; crops account for two-thirds of the total value.²⁵ Although New Jersey agriculture products are diverse, hay, corn and soybeans historically are the most valuable. Total production of these crops is predicted to decrease by the end of the century under a range of climate change scenarios that alter precipitation patterns and temperatures.²⁶

The greatest economic losses in the agriculture sector likely will result from decreased dairy and fruit production. When temperatures exceed 75° F, dairy cows produce less milk as their bodies work to stay cool. Researchers predict that higher temperatures from climate change will cause a 10 percent loss in milk production by 2100, which could translate to a \$3.3 million loss.²⁷ New Jersey fruits, berries and tree nuts accounted for \$100 million in sales in 2002. Apples and many other fruits

and berries need cool temperatures (below 45° F) to properly develop. Higher temperatures due to climate change could lead to losses in the fruit industry.²⁸

Forests

Forestry, fishing and related activities generated \$161 million in 2005.²⁹ New Jersey forests will become as much as 20 percent less dense, and native species such as maple, beech and birch will likely be gone from northern New Jersey by 2100.³⁰ Forests also will experience a longer wildfire season, and the likelihood of fires will increase as temperatures rise and fire-prone tree species replace native species.³¹

Health

Temperature increases in cities and developed regions will be higher than surrounding areas, since buildings and pavements absorb and store heat. These urban heat islands can be 7° F to 10° F warmer than nearby suburbs, where there is more greenery to dissipate heat. As summer temperatures rise during the next century, inner city temperatures also will rise, increasing cooling costs and threatening vulnerable populations. Unseasonably warm summer temperatures in New York City in 1993, for example, caused the heat-related deaths of 300 people, many of whom were elderly or poor.³² Summer heat-related mortality could increase by 55 percent by 2020 and would continue to increase throughout the century.³³

Higher temperatures increase evaporation, leading to higher demand for water for drinking and irrigation. Warmer water and longer seasons facilitate the growth of algae and harmful bacteria that lead to fish kills and general water contamination. A higher probability of flooding poses an additional health threat, since flooding often contaminates fresh drinking water sources with bacteria, harmful chemicals and salt water.³⁴ Low freshwater flow or higher sea levels could contaminate aquifers, a major source of drinking water. Salt water contaminated the Potomac-Raritan-Magothy aquifer in 1992, for example, pushed chloride concentrations to less-than-ideal levels for drinking water.³⁵ This vulnerable aquifer may see further saltwater intrusion due to climate change. Flooding also increases the risk of mildew and mold contamination, which creates respiratory problems and requires costly remediation.





CONCLUSION

New Jersey is likely to face large challenges in adapting to climate change along its expansive coast, since this is where the most significant economic and ecological impacts will occur. Protecting coastal developments and natural habitats—which will face increased risk for erosion from higher water levels and more intense storms—will be a leading concern. Since some sea level rise and climate change is likely regardless of greenhouse gas reduction efforts (the excess greenhouse gases already in the atmosphere “lock in” a certain degree of warming), integrating adaptation strategies into coastline development and habitat protection plans may be prudent. Planners may also wish to improve flood response plans and adjust coastal development patterns to reduce community exposure to coastal flooding, erosion and storms.

Policies that provide research and funding on how to best mitigate the effects of rising sea levels, stronger storms and increased storm intensity on sea and land transportation infrastructure may also provide benefit. Efforts that maintain a dependable and robust transportation system and help coastal areas adapt to these changes may work to preserve New Jersey’s valuable tourism trade.

RESEARCH GAPS

This report is subject to the uncertainties inherent in measuring global climate change and climate change itself and attempts to reflect this reality. Data gaps exist between the effects of climate change in one particular sector and the ripple effects that are caused in connected sectors. Especially useful for policymakers would be more precise figures for land and property along the highly threatened portions of New Jersey’s coast.

NOTES

1. P.C. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions* (Cambridge, Mass.: Union of Concerned Scientists, 2007), www.climatechoices.org/ne/resources_ne/nereport.html.
2. U.S. Environmental Protection Agency, *Climate Change and New Jersey* (U.S. EPA 230-F-97-008dd) (Washington D.C.: U.S. EPA, 1997).

3. Ibid.
4. IPCC, *Climate Change 2001: Working Group II: Impacts, Adaptation and Vulnerability. Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2001).
5. M. Oppenheimer et al., *Future Sea Level Rise and The New Jersey Coast: Assessing Potential Impacts and Opportunities* (Princeton, N.J.: Princeton University, 2005).
6. U.S. EPA, *Climate Change and New Jersey*.
7. Oppenheimer et al., *Future Sea Level Rise and The New Jersey Coast: Assessing Potential Impacts and Opportunities*.
8. Ibid.
9. Ibid.
10. K. Zhang et al., “Global Warming and Coastal Erosion,” *Climate Change* 64 (2004): 41-58.
11. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
12. Oppenheimer et al., *Future Sea Level Rise and The New Jersey Coast: Assessing Potential Impacts and Opportunities*.
13. J.G. Titus, “Greenhouse Effect, Sea Level Rise and Barrier Islands, Case Study of Long Beach Island, New Jersey,” *Coastal Management* 18 (1990): 65-90.
14. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
15. N.P. Psuty et al., *Coastal Hazard Management Report* (Final Report to N.J. DEP, Institute of Marine and Coastal Sciences) (New Brunswick, N.J.: Rutgers University, 1996).
16. Evan Mills, *Responding to Climate Change – The insurance Industry Perspective (California: Lawrence Berkeley National Laboratory, U.S. Department of Energy, 2007)*.
17. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
18. Zhang et al., “Global Warming and Coastal Erosion.”
19. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
20. R.G.Najjar, et al., “The Potential Impacts of Climate Change on the Mid-Atlantic Coastal Region,” *Climate Research Journal* 14 (2000): 219-233.
21. Calculations using modified IMPLANTM economic model from the Regional Economic Studies Institute (RESI) of Towson University (2008).
22. Regional Planning Association, “Reform Revenue Results: How to Save New Jersey’s Transportation System” (PLACE: Publisher, 2005); www.rpa.org/pdf/RPARreformRevenueResults.pdf.
23. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
24. Calculations using modified IMPLANTM economic model from the Regional Economic Studies Institute (RESI) of Towson University (2008).
25. U.S. Department of Agriculture, National Agricultural Statistics Service, *Livestock, Crop, and Dairy Statistics by State* (Washington, D.C.: USDA, 2002); www.nass.gov.html.
26. U.S. EPA, *Climate Change and New Jersey*.
27. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
28. Ibid.
29. New Jersey Department of Labor and Workforce Development, *Current Domestic Product for New Jersey by Industry: 1997-2006* (New Jersey: N.J. Department of Labor and Workforce Development, 2007); www.wnjjpin.net/OneStopCareerCenter/LaborMarketInformation/lmi09/index.html.
30. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
31. T.J. Brown, B.L. Hall, and A.L. Westerling, “The Impact of Twenty-First Century Climate Change on Wildland Fire Danger in the Western United States: An Applications Perspective,” *Climate Change* 62 (2004): 365-388.
32. L.S. Kalkstien, “Health and Climate Change: Direct Impacts in Cities,” *Lancet* 342, no. 8884 (1993): 1397-1399.
33. W.D. Solecki et al., *Urban Heat Island and Climate Change: An Assessment of Interacting and Possible Adaptations in the Camden, New Jersey Region* (Trenton, N.J.: New Jersey Department of Environmental Protection, Division of Science Research and Technology, 2004).
34. Frumhoff et al., *Confronting Climate Change in the U.S. Northeast: Science, Impacts and Solutions*.
35. Oppenheimer et al., *Future Sea Level Rise and The New Jersey Coast: Assessing Potential Impacts and Opportunities*.

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