

HEALTH FACTS



Health and Climate Change: Accounting for Costs

Climate change endangers human health, and costs us money in both lost and interrupted lives and increased health care. In a study published in the journal *Health Affairs*, a team of scientists from the Natural Resources Defense Council (NRDC) partnered with university economists to investigate the health costs of six climate change-related events, and found the estimated costs totaled more than \$14 billion (in 2008 U.S. dollars).¹ The study team selected six types of events that will worsen with climate change in ways likely to harm human health—ozone smog pollution, heat waves, hurricanes, mosquito-borne infectious disease, river flooding, and wildfires. The health effects and related costs of these events offer an indication of the threats we will increasingly face under a warming climate.²

The projected health and economic burden of climate-related events will be enormous if global warming continues unchecked and communities are not prepared. Public health preparedness can reduce climate-related health costs. Measures to reduce carbon pollution are urgently needed. As this analysis illustrates, an investment in preparedness today could save billions of dollars in future health costs, and could also save lives. Actions to counteract extreme events cost four to five times less than paying for event-related health consequences.³

This is the first study that links health data from the scientific literature to U.S. events projected to worsen with climate change, and develops a uniform method of quantifying the associated health costs.

For each of six case studies, the team of scientists researched an event that occurred between 2002 and 2009 for which health outcomes had been quantified. The team used economic methods and state-collected or published data on the number of deaths, hospitalizations, and emergency room visits to calculate the health cost of each event and the total from all six events. (More details are provided in the online *Methods* section.) This is a conservative analysis, since it does not include all climate change-related events that affected health from 2002 to 2009 in the United States.

Health costs have seldom been included in valuations of climate change damages, resulting in substantial underestimates of climate change costs. For example, SwissRe's 2010 report *Weathering Climate Change* found that global insured economic losses from climate-related disasters, not including health costs, had soared from \$5 billion to \$27 billion U.S. dollars annually from 1970 to 2010.⁴ Our finding that health costs from just these six U.S. events topped \$14 billion demonstrates how much higher the true costs of climate change are and will be in the future.

Table 1. Health costs in climate change-related case study areas, with costs per health effect, 2002 through 2009.

Climate Change-Related Case Study	Premature Death	Illness	Total Health Cost by Case Study
Ozone smog pollution	\$6.3 Billion	\$254 Million	\$6.5 Billion
Heat wave	\$5.2 Billion	\$179 Million	\$5.3 Billion
Hurricane	\$1.1 Billion	\$255 Million	\$1.4 Billion
Wildfire	\$545 Million	\$34 Million	\$578 Million
Mosquito-borne infectious disease	\$190 Million	\$18 Million	\$207 Million
River flooding	\$16 Million	\$5 Million	\$20 Million
Total costs (in U.S. dollars, 2008)	\$13.3 Billion	\$744 Million	\$14.1 Billion



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Six U.S. Case Studies, 2002-2009, Resulted in More Than \$14 Billion in Climate-Related Health Costs.

Over a two-week heat wave, 655 deaths, 1,620 hospitalizations, and more than 16,000 excess emergency room visits, resulted in nearly \$5.4 billion dollars in costs. Major heat waves such as this are expected to occur more frequently in the future.

HEAT WAVE, CALIFORNIA, 2006



FLOODING, NO



WILDFIRES, SOUTHERN CALIFORNIA, 2003

These fires burned more than 736,000 acres and resulted in 69 deaths, 778 hospitalizations, and more than 47,600 outpatient visits. Together, this resulted in health-related costs exceeding \$578 million. Conditions conducive to wildfires, including drought and extreme heat, are expected to worsen in many parts of the country due to climate change.



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During the Red River and associated floods, two deaths, 263 emergency room visits, and an estimated 3,000 outpatient visits resulted in nearly \$20.4 million in health-related costs. Seasonal river flooding will increasingly affect many areas of the country, resulting in more injuries and deaths. Increased heavy downpours are projected from climate change as temperatures rise, raising levels of both evaporation and precipitation in many areas.

ORTH DAKOTA, 2009



FEMA News Photo



SMOG POLLUTION, NATIONWIDE, 2002

Across the U.S. in 2002, nearly 288 million Americans were exposed to ozone smog levels above the health-based standard, which was then 80 ppb. This exposure hastened death for 795 people, and caused 4,150 hospitalizations and more than 365,000 outpatient visits, at a cost of \$6.5 billion. Smog levels are anticipated to rise in the coming years, in the absence of strategies to reduce precursor emissions, because as climate change increases temperatures, ozone-forming chemical reactions also increase.



WEST NILE VIRUS, LOUISIANA, 2002

An outbreak of West Nile Virus in Louisiana in 2002 resulted in an estimated 24 premature deaths, 204 hospitalizations, and nearly 5,800 outpatient visits. Health-related costs totaled \$207 million. Mosquito-borne diseases are expected to emerge and spread into more northern climates as temperatures increase and create more habitable environments for mosquitoes.



FEMA News Photo

HURRICANES, FLORIDA, 2004

Four major hurricanes caused 144 premature deaths, nearly 2,200 hospitalizations, 2,600 emergency visits, and \$1.4 billion in health-related costs. Climate change is projected to increase the intensity of hurricanes, as sea surface temperature rise in the North Atlantic and provide more energy to drive storm systems. Some climate models project a doubling in the most intense hurricanes (Category 4 and 5) by late in this century.⁵



RECOMMENDATIONS

The increasing threat of extreme events with climate change cannot be ignored. As a June 2011 *Scientific American* article noted, “Now we can make the statement that particular events would not have happened in the same way without global warming.”⁶ A report from the international reinsurance company MunichRe, which has studied extreme events from 1980 through 2011, concluded that the frequency of extreme events in the United States is on the rise.⁷ To improve our understanding and ability to reduce and prepare for future health costs from climate change, we need:

- **Better Cost Analysis.** More comprehensive analyses of the health costs of climate change are needed at the national and local level to inform policy making.
- **Improved Tracking.** Increased funding can support tracking and monitoring of climate change-related outcomes and environmental indicators related to climate change. To this end, it is crucial to fund the Center for Disease Control and Prevention’s National Environmental Public Health Tracking program and other research initiatives.

- **Preparedness in Communities.** Only 13 U.S. states currently include public health measures in their climate change adaptation plans. Climate-adaptive strategic planning should become a priority at the local, state, regional, and national levels. Some examples include issuing heat-related health advisories, early warning systems, public cooling centers, providing better disease surveillance, redesigning communities to withstand floods and storms, and reducing wildfire risks.
- **Reduced Climate Change Pollution.** Carbon pollution needs to be reduced to limit the most serious health effects related to climate change. NRDC strongly supports the Environmental Protection Agency’s efforts to limit carbon pollution.

The degree to which climate change affects the likelihood or severity of health effects is an important question, but determining it was not the goal of this study. The team of scientist-authors did not try to establish a yearly figure for costs, since only six U.S. case study sites were represented, and thus an annualized figure would be an underestimate. The goal of this study was to quantify the health-related costs from some of the types of already documented extreme events that are projected to increase further under a changing climate. Health costs are seldom included in government valuations of climate change damages. While we have used a conservative estimate of more than \$14 billion, the total health-related cost of the six events could actually be as high as \$40 billion if all the possible sources of variability in the estimated health effects, and the methods used to place cost values on health effects, are included. This study is a first step toward comprehensive inclusion of human health costs among the important economic damages of climate change.

For more information about methods used to estimate the health costs of climate-related events and citations for the six case studies, please see www.nrdc.org/health/accountingforcosts.

¹ Knowlton K, Rotkin-Ellman M, Geballe L, Max W, Solomon G. 2011 (in press). Health costs of six climate change-related events in the United States, 2002-2009. *Health Affairs*, 2011; 30(11) p.2167-2176.

² Karl TR, Melillo JM, Peterson TC, editors. *Global climate change impacts in the United States*. New York: Cambridge University Press; 2009.

³ Rose A, Porter K, Dash N, Bouabid J, Huyck C, Whitehead JC, et al. Benefit-Cost Analysis of FEMA Hazard Mitigation Grants. *Natural Hazards Review*. 2007; 8(4):97-111. doi:10.1061/(ASCE)1527-6988(2007)8:4(97)

⁴ Reichenmiller P, Spiegel A, Bresch D, and Schnarwiler R. Weathering climate change: Insurance solutions for more resilient communities. Zurich: Swiss Re; 2010. http://www.swissre.com/rethinking/climate/Weathering_climate_change.html. Accessed October 20, 2011

⁵ Bender M, Knutson T, Tuleya R, Sirutis J, Vecchi G, Garner S, et al. Modeled Impact of Anthropogenic Warming on the Frequency of Intense Atlantic Hurricanes. *Science*. 22 January 2010; 327 (5964),454-458; Knutson T, McBride J, Chan J, Emanuel K, Holland G, Landsea C, et al. Tropical cyclones and climate change. *Nature Geosci*. 2010; 3:157 - 163.

⁶ Carey J. Storm warnings: extreme weather is a product of climate change. *Scientific American* [online, June 28-30, 2011 (3-part series)]. <http://www.scientificamerican.com/article.cfm?id=extremeweather-caused-by-climate-change>. Accessed August 1, 2011.

⁷ Munich Re. 2011. Half-Year Natural Catastrophe Review, July 12, 2011. MR NatCatSERVICE. http://www.munichreamerica.com/webinars/2011_07_natcatreview/MR_III_2011_HalfYear_NatCat_Review.pdf. Accessed October 20, 2011.