Center for American Progress

Extreme Weather, Extreme Costs

How Our Changing Climate Wallops Americans' Wallets

By Kristina Costa, Miranda Peterson, and Howard Marano October 27, 2017

Five years ago, Superstorm Sandy cut a destructive path up the East Coast of the United States, taking 117 lives, leaving thousands of people homeless, and causing more than $71 billion in damage. Experts described it as a 1-in-260-year event, meaning that a storm of that caliber had a 0.3 percent chance of happening in any given year .[1] However, extreme weather is more frequent and widespread than this statistic suggests. In 2016 alone there were more than 15 extreme weather and climate events with losses exceeding $1 billion per event in the United States. Thus far, there have already been 15 events with losses totaling at least $1 billion each in 2017.[2]

In total, from 2011 to the present, there have been 84 extreme weather events in the United States causing at least $1 billion each in damage. Seventy-two of these disasters were extreme storms and floods; tropical cyclones such as hurricanes; or severe winter weather. U.S. counties have issued more than 13,000 major disaster declarations as a result of $1 billion events during this period—there are only 3,144 counties and county equivalents in the country. Total damage from these events tops half a trillion dollars—an estimated $675 billion, when taking into account preliminary estimates from the 2017 hurricane season. And some 2,000 Americans have died from extreme weather events over this time period—a number that will surely increase before the year is out.[3]

Climate change is already costing taxpayers dearly. A report from the nonpartisan Government Accountability Office—which is consistently conservative in its calculations—recently found that the federal government has spent $350 billion over the last 10 years in responding to climate-related disasters, and that those costs could reach $35 billion annually by 2050. Those figures do not include state and local government expenditures, costs to businesses, or costs borne by families and individuals.[4]

While varying topography, populations, and government decision-making influence how well a city or region can withstand and recover from extreme weather, one fact remains constant: Extreme weather events tend to most severely harm families who live paycheck to paycheck, because they are least able to prepare for and recover from these disasters.

Forty-six percent of Americans say that they do not have enough money to cover an unexpected $400 expense, according to a study conducted by the Federal Reserve.[5] The costs of preparing for or evacuating in advance of a disaster can quickly top that amount: plywood to board up windows; food and emergency supplies for possible days of sheltering in place; last-minute plane tickets or multiple tanks of gasoline to drive hundreds of miles; a room in a hotel that can accommodate family pets, since many emergency shelters do not.[6] Then, following a major disaster, even those who are eligible for federal aid may face weeks or months of delays for home inspections, flood insurance payments, and even small grants to help meet day-to-day expenses—all while grappling with the loss of thousands of dollars of property.[7] Some of the most vulnerable populations never see federal aid at all. In Immokalee, Florida, which was devastated by Hurricane Irma, thousands of migrant farmworkers who grow and pick many of the tomatoes consumed in the United States live in "trailers so insecure that they say they can't even apply for homeowner's insurance," according to the *Miami Herald*.[8] Furthermore, undocumented immigrants do not qualify for cash aid or disaster-related unemployment assistance from the Federal Emergency Management Agency (FEMA).[9]

The Center for American Progress has analyzed $1 billion disasters between 2011 and 2017 to date alongside data on the median income of households in affected counties. The results of this analysis find that extreme weather's impacts are typically felt more severely by low- and middle-income communities that have fewer resources to recover and rebuild their lives.

TABLE 1

When dangerous storms hit home, they hit hard

Middle- and low-income U.S. households are most affected by extreme storm disasters

Type of extreme weather	Events with $1 billion or more in damages	Fatalities	Estimated economic loss, in billions of dollars	Estimated damages per household in affected counties	Estimated median income of affected counties	Estimated percent difference between U.S. and disaster area median household incomes
Severe storm and flooding	60	966	142.6	1,129	53,255	-1.17%
Winter storm and freeze	4	82	8.4	567	51,961	-3.58%
Hurricanes and tropical storms	8	513	441.3	3,116	58,200	8.00%

Note: Loss and income statistics are consumer price index-adjusted for 2017. Please see Methodology section of report for information on CAP's analysis and a complete list of citations.

Extreme storm events on average affected counties where the median income is below the U.S. national median income:

- On average, extreme storms and floods led to disaster declarations in counties with median incomes 1.17 percent lower than the national median.
- On average, severe winter weather led to disaster declarations in counties with median incomes 3.58 percent below the national median.
- Tropical cyclones such as hurricanes and tropical storms appear at first to be the exception: Between 2011 and 2017, these events led to disaster declarations in counties where median incomes are on average 8 percent higher than the national median.[10]

However, when a few unusual extreme weather events are treated as outliers, the picture for hurricanes and tropical storms changes. Tropical cyclones do not typically affect the Northeast—at least not at full strength. Most recorded landfalls of tropical cyclones occur in the Southeast, along the Gulf Coast, Florida, or the Carolinas.[11] But in 2011, Hurricane Irene marched up the Eastern Seaboard, resulting in emergency or major disaster declarations from counties whose average median household income was 8 percent higher than the national median. Similarly, 2012's Superstorm Sandy slammed directly into the New York-New Jersey metropolitan area, one of the country's wealthiest regions.[12]

Without the two outliers of Superstorm Sandy and Hurricane Irene, hurricanes and tropical storms from 2011 to present affected counties where median incomes average 8.72 percent lower than the national median.[13]

To be sure, there are limitations to the methodology used to produce this report. A map displaying census income data reveals that households with incomes above the national median are disproportionately clustered in and around major metropolitan areas—meaning that there are more counties with incomes below the national median, and those counties are spread across a bigger geographic area.[14] This could bias the results to show that disasters disproportionately affect such households. Meanwhile, while household income data can be refined to the individual census tract level, information on disaster impacts cannot, because disaster declarations occur only on the county level. That means that the data may mask income inequality between a family earning $30,000 in Bedford-Stuyvesant, Brooklyn, compared with one earning 10 times as much in the wealthy Brooklyn Heights area—both neighborhoods in Kings County, New York, which declared disaster after Superstorm Sandy.

Finally, extreme weather events are not random—certain events typically occur in certain geographies. States in the South and Midwest saw the most billion-dollar storm events of all types between 2011 and 2017, while wealthier states in New England and the West saw the fewest.[15] A complete accounting of the 84 extreme weather and climate events costing at least $1 billion from 2011–present, including costs, number of fatalities, and states affected by each event, can be found in the Appendix.

One thing is certain: Extreme weather is a problem that is only going to worsen. Extreme weather regularly affects four times as many U.S. counties today compared with 40 years ago.[16] From 1980 through 2007, the United States averaged four $1 billion disasters per year; since 2007, the country has seen an average of 11 such disasters per year.[17] The latest version of the National Climate Assessment notes that the "global, long-term, and unambiguous warming trend" is expected to continue, and that this warming will create more "record-setting extremes."[18] Simply put, climate change will continue to cause more intense heat waves, droughts, and wildfires; increasingly severe storms, flooding, and hurricanes; and more severe winter storms that threaten every region of the country.

Even as this issue brief was being prepared, Hurricane Nate made landfall on the Gulf Coast of the United States, the fourth storm to hit the United States this hurricane season. The head of the Mississippi Emergency Management Agency credited the measures that communities have undertaken to build resilience to extreme weather for mitigating the damage from Hurricane Nate, telling *The New York Times,* "If Nate would have hit us 15 years ago, the damage would have been much more extensive, we would have had loss of life. But we have rebuilt the coast in the aftermath of Katrina higher and stronger."[19]

Devastating storms such as Superstorm Sandy and Hurricane Maria, which cause damage from storm surge, deluges, and destructive winds, tend to dominate news coverage of extreme weather. But the last seven years have also seen the most expensive and destructive wildfire season on record; in 2015, 10.2 million acres burned, costing $1.71 billion to fight.[20] By some measures, the 2017 season has been even worse.[21] Even as this issue brief was being prepared, wildfires broke out in Northern California, torching more than 245,000 acres, destroying more than 8,400 structures, and killing at least 42 people.[22] The system of fires was the deadliest in the state's history.[23] Before that, California had endured five years of drought, which cost farmers billions of dollars, raised electricity prices, and put thousands of farmworkers out of work.[24] And earlier this year, a heat wave in the Southwest shattered records; temperatures rose so high that Phoenix Sky Harbor Airport had to ground planes.[25]

This brief first explores recent trends in extreme weather—specifically, severe thunderstorms, downpours, and floods; tropical cyclones; and winter storms and freezes—and considers how climate change is making each kind of event more severe. The brief then examines how extreme storms disproportionately affect low- and moderate-income Americans. Finally, the brief considers nonstorm events such as droughts, wildfires, and heat waves, which are also being made worse by climate change.

Extreme weather is the new normal

The conclusion that extreme weather events are occurring more frequently and are becoming more severe reflects decades of scientific research and reporting, including the 2017 Climate Science Special Report of the National Climate Assessment, a consortium of scientists from federal agencies and universities throughout the United States. The report reaffirms that high levels of pollution from human activities have warmed the atmosphere and triggered changes to air temperature, sea level, precipitation rates, and drought.[26] These changes intensify the impact of extreme weather by as much as 30 percent.[27]

While it is difficult to claim that any specific event was the result of climate change, it is beyond dispute that climate change has an amplifying effect on extreme storms. "[E]verything in the atmosphere now is impacted by the fact that it's warmer than it's ever been," said Brendan Miller, CNN's senior meteorologist, in the wake of hurricanes Harvey and Irma. "There's more water vapor in the atmosphere. The ocean is warmer. And all of that really only pushes the impact in one direction, and that is worse: higher surge in storms, higher rainfall in storms."[28]

This issue brief considers each category of extreme storms and the connection to climate change in more detail below.

Floods and severe storms

Floods are the most common natural disaster in the United States, according to FEMA.[29] They are also the deadliest extreme weather event, killing more people in the United States in a typical year than tornadoes, hurricanes, or lightning.[30]

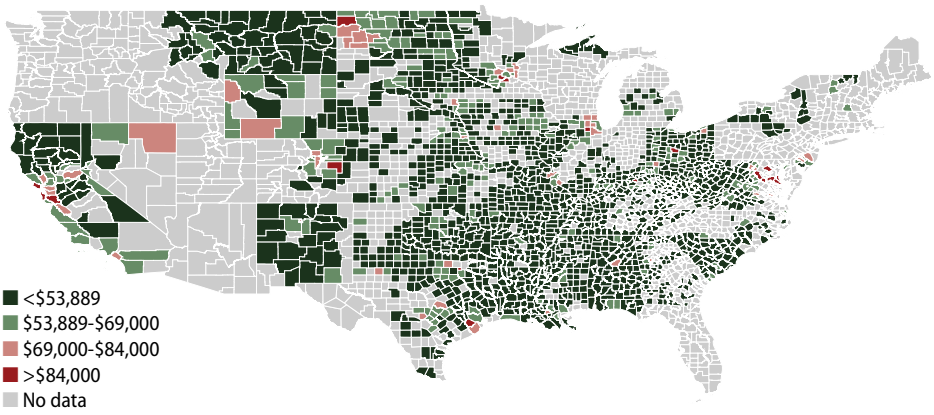
In recent decades, heavy downpours have increased in frequency and severity across the United States, particularly in the Midwest and the Northeast. More frequent and intense rains have triggered an increase in local flooding events, according to the 2014 National Climate Assessment.[31]

The recent flooding caused by Hurricane Harvey in Houston is an extreme example of what the uptick in severe precipitation events could mean for America's cities. Harvey smashed records, producing more than 3 feet of rainfall across the greater Houston area and as much as 60 inches near Port Arthur, Texas.[32] It was the single largest precipitation event since record-keeping began in the United States.[33] Preliminary results from FEMA models indicated that as many as 90,000 residential structures suffered flood damage across three counties as a result of Harvey, with local officials in Harris County, where Houston is located, estimating that 136,000 homes in that county alone had been damaged.[34]

FIGURE 1

Severe storms and flooding

Median household income for counties affected by billion-dollar extreme weather events, 2011 through 2017



Notes: Income in the past 12 months is in 2015 inflation-adjusted dollars. Household income estimates from the U.S. Census Bureau's American Community Survey are not available for Bedford City, Virginia, or the U.S. Virgin Islands. Map reflects counties where FEMA disasters were declared for billion-dollar disasters events. Not all states and counties declare disaster for billion-dollar disaster events. For more information, see Methodology section.

Sources: Authors' calculations are based on data from the Federal Emergency Management Administration, "FEMA.gov Data Visualization Datasets, Summary of Disaster Declarations and Grants," available at https://www.fema.gov/media-library/assets/documents/106308 (last accessed October 2017); Federal Emergency Management Administration, "FEMA Disaster Declarations Summary – Open Government Dataset," available at https://www.fema.gov/media-library/assets/documents/28318 (last accessed October 2017); National Oceanic and Atmospheric Administration National Centers for Environmental Information, "Billion-Dollar Weather and Climate Disasters: Table of Events," available at https://www.ncdc.noaa.gov/billions/events/US/2011-2017 (last accessed October 2017).

Hurricane Harvey was a tropical cyclone, a bigger and more powerful storm system than an everyday thunderstorm. But Harvey deserves mentioning here because 2017 was actually the third consecutive year in which Houston suffered a flood so severe that it had a 1 in 500 chance—or lower—of happening in any one year. The 2015 Memorial Day floods in the Houston metropolitan area killed seven people and triggered federal recovery aid from FEMA for 13,000 Houstonians, according to the *Houston Chronicle*.[35] In 2016, Houston's Tax Day floods killed eight people and were followed by an additional flooding event, once again around Memorial Day.[36] Houston's East Side, home to many of the city's low-income communities and communities of color, is typically hit hardest by flood events.[37]

There has also been an increase in coastal flooding events as a result of sea level rise induced by climate change—where high tides can inundate streets and send water rushing into homes and businesses. These so-called nuisance or sunny day floods do not typically cross the billion-dollar threshold for damages and thus are not reflected in the analysis of this issue brief. However, these events can be disruptive and costly for local communities. Miami Beach saw a 400 percent increase in such tidal flooding between 2006 and 2016.[38] In response, the city launched a $100 million project earlier this year to build new flood control infrastructure, including higher roads and stronger pumping systems, to deal with the risks posed by rising sea levels.[39] Instances of sunny day flooding have increased between 300 and 925 percent on all U.S. coasts since the 1960s, according to the National Oceanic and Atmospheric Administration (NOAA), with the biggest upticks on the East Coast.[40]

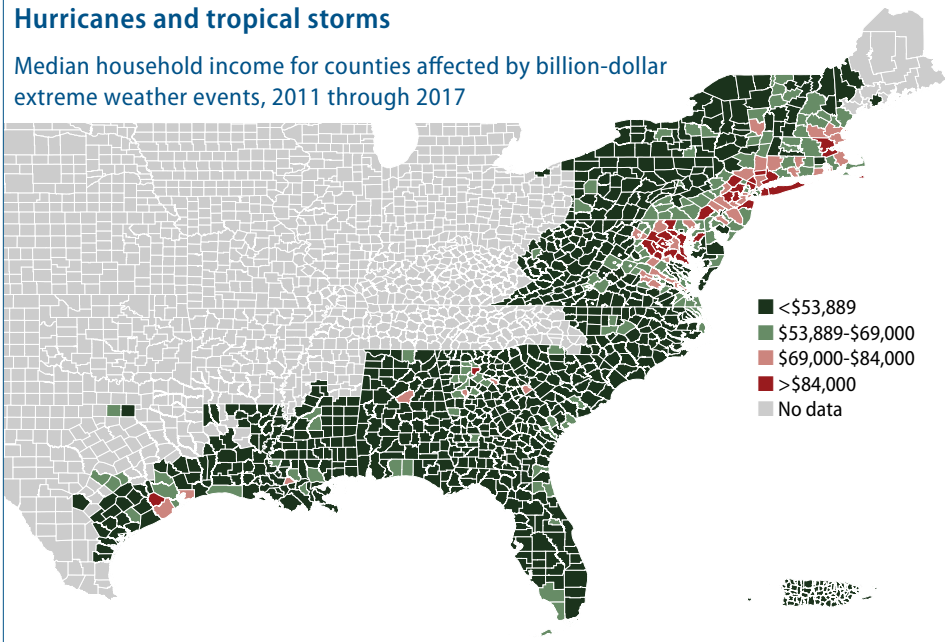
Hurricanes and tropical storms

Hurricanes have grown more frequent, intense, and longer-lasting since the 1980s, according to the National Climate Assessment.[41] This 30-year period has seen the most major hurricanes, days with hurricane activity, and energy generated by tropical cyclones' winds in 167 years of federal record-keeping.[42] Compared with the entire record, 2003, 2004, 2005, 2008, 2010, 2012, and 2016 saw hurricane seasons that were more intense than usual. According to the Associated Press, "The 2005 season, which included Katrina, Rita, and Wilma, was so active forecasters ran out of names for storms."[43]

FIGURE 2

Hurricanes and tropical storms

Median household income for counties affected by billion-dollar extreme weather events, 2011 through 2017



Notes: Income in the past 12 months is in 2015 inflation-adjusted dollars. Household income estimates from the U.S. Census Bureau's American Community Survey are not available for Bedford City, Virginia, or the U.S. Virgin Islands. Map reflects counties where FEMA disasters were declared for billion-dollar disasters events. Not all states and counties declare disaster for billion-dollar disaster events. For more information, see Methodology section.

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While multiple factors contribute to the formation of tropical cyclones, sea surface temperatures are a major variable that helps determine the strength of a storm—the hotter the ocean, the more energy available to fuel a tropical cyclone. Globally, ocean temperatures have risen between 1 degree and 3 degrees Fahrenheit during the last 100 years.[44] As Hurricane Harvey grew to full strength in the Gulf of Mexico, sea surface temperatures were between 2.7 degrees and 7.2 degrees Fahrenheit higher than average, and Hurricane Irma intensified over waters that were 0.9 degrees to 2.25 degrees Fahrenheit higher than average.[45]

The Atlantic Ocean also undergoes natural variation in sea surface temperatures, which has led to disputes among scientists about how much of the increase in recent hurricane activity can be attributed to human-caused climate change. However, climate models developed by the National Center for Atmospheric Research show that the changes in Atlantic sea surface temperature exceed what is expected from the natural oscillation cycle.[46]

2017 has also already seen four major hurricanes that intensified rapidly—Harvey, Irma, Jose, and Maria. Hurricane Maria underwent a particularly startling transformation, with wind speeds increasing from a tropical storm with 65 mph winds at 2 p.m. ET on Sunday, September 17, to a Category 5 hurricane with 160 mph winds by 7:45 p.m. ET the following day.[47] Kerry Emanuel, a hurricane expert at the Massachusetts Institute of Technology (MIT), has found that climate change may make these rapidly intensifying storms more frequent.[48]

Winter storms

In February 2015, Sen. Jim Inhofe (R-OK) brought a snowball onto the Senate floor. "In case we have forgotten because we keep hearing that 2014 has been the warmest year on record," said Sen. Inhofe, who is a notorious denier of the mainstream science of climate change. Inhofe continued, "I asked the chair, do you know what this is? It's a snowball just from outside here. So it's very, very cold out. Very unseasonable."[49] While 2014 was indeed the hottest year on record at that time, it has since been replaced by 2015 and then by 2016, and the 10 hottest years ever recorded have all occurred since 1998.[50]

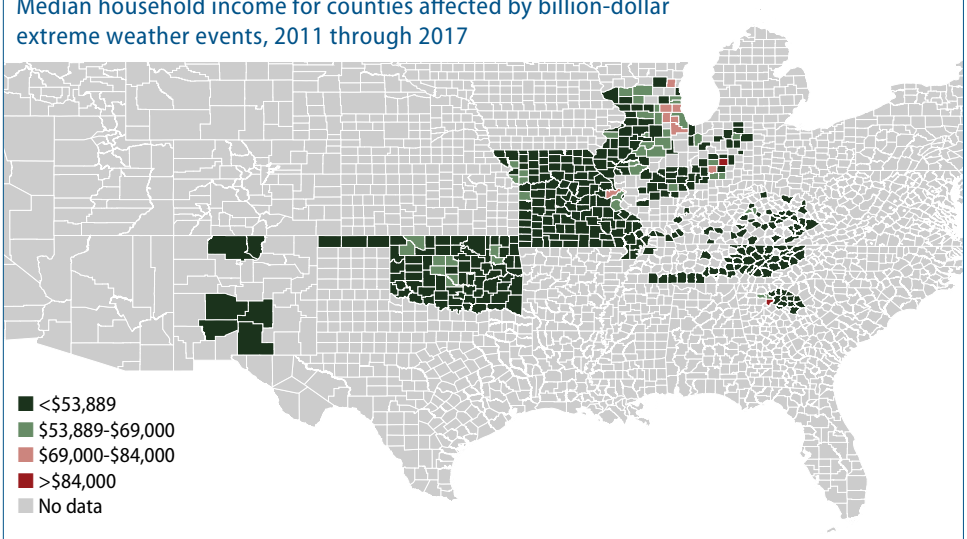
Not only does the continued existence of winter not disprove the science of climate change, but there is evidence that climate change actually makes some kinds of winter storms more severe. Winter storms have become more frequent and more intense since the 1950s, according to the National Climate Assessment.[51] Specifically, the second half of the 20th century saw about twice as many extreme snowstorms as the first half, according to NOAA.[52]

In fact, years with above-average temperatures tend to see winters with more snowstorms, not fewer.[53] And while average snowfall is expected to decrease in a warmer world, some studies predict an increase in extreme snowfall events for the same reasons as other extreme precipitation events are expected to increase.

FIGURE 3

Winter storms and freezes

Median household income for counties affected by billion-dollar extreme weather events, 2011 through 2017



Notes: Income in the past 12 months is in 2015 inflation-adjusted dollars. Household income estimates from the U.S. Census Bureau's American Community Survey are not available for Bedford City, Virginia, or the U.S. Virgin Islands. Map reflects counties where FEMA disasters were declared for billion-dollar disasters events. Not all states and counties declare disaster for billion-dollar disaster events. For more information, see Methodology section.

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"People may know the expression, 'It's too cold to snow'—if it's very cold, there is too little water vapor in the air to support a very heavy snowfall," said Peter O'Gorman, a professor at MIT and the author of one such study, in 2014.[54] Warmer air holds more water vapor, meaning that the snowstorms that do occur will have more fuel. And in extreme cases, large bodies of freshwater could either not freeze or only partially freeze in a warmer winter, leading to an increase in lake-effect snow—snowstorms occurring as a result of cold air moving over relatively warmer, open, unfrozen water.[55] Just such an increase happened in 2006, when Lake Erie did not freeze over for the first time in recorded history.[56]

Additionally, some studies have concluded that climate change may even be altering the patterns of the jet stream that helps direct weather patterns throughout the United States. "Enhanced warming of the Arctic affects the jet stream by slowing its west-to-east winds and by promoting larger north-south meanders in the flow," a NOAA-led study concluded in 2012.[57] The reduction in Arctic sea ice cover also appears to be contributing to a weakening of the polar vortex, which in recent years has contributed to extreme cold temperatures in late winter.[58]

Middle- and lower-income Americans are more vulnerable to extreme weather events

Extreme weather events affect entire communities, but they are by no means social equalizers, as some assume. Extreme weather disproportionately harms families who struggle to make ends meet, including low- and middle-income households who have the fewest resources to prepare for and respond to disasters. Additionally, extreme weather events can also exacerbate existing racial and socioeconomic inequities around housing, access to services, and economic opportunity.

This disparity is borne out both in the immediate aftermath of a disaster and in the long-term recovery of a community. For instance, when Superstorm Sandy hit New York City, some 375,000 New Yorkers lived in mandatory evacuation zones—but only about 6,800 showed up at emergency shelters.[59] As Cathleen Kelly and Tracey Ross from the Center for American Progress recounted in their 2014 report, "One Storm Shy of Despair," federal emergency workers soon discovered why:

> *Many low-income elderly and disabled residents of New York City's public housing complexes were stranded in their dark and cold apartments without heat, backup generators, emergency boilers, or working elevators, the latter preventing many of these residents from descending multiple flights of stairs. Others endured these conditions because they had no other affordable place to stay or no reasonable means of leaving their neighborhoods because mass transit was shut down, among other reasons.*[60]

In the five years that have passed since Superstorm Sandy devastated the East Coast, families are still struggling to get back on their feet and return home.[61]

After some disasters, many low-income families never fully recover and make it back home. Approximately 400,000 people were displaced from New Orleans following Hurricane Katrina in 2005, and the storm so completely devastated the city's stock of affordable housing that 16,000 families were still on a waiting list for subsidized housing a decade later.[62] Many displaced residents never returned: In 2014, 100,000 fewer African Americans and 9,000 fewer whites lived in New Orleans than in 2000; low-income African Americans were among the least likely to return to the city in the years following the storm.[63]

Repeated disasters appear to make counties poorer over time, according to a recent working paper in the National Bureau of Economic Research (NBER). Looking at 90 years of data, researchers found that an increase of 2.4 disasters more than the average led to a 1 percent increase in people moving out of an affected county, and very large disasters caused poverty rates to increase more than 1 percent in affected counties.[64] "The findings indicate that the non-poor are moving out, the poor are migrating in, and/or that the existing population transitions into poverty following a severe weather event," Eleanor Krause and Richard V. Reeves of the Brookings Institution concluded in summarizing the NBER paper.[65]

According to a 2012 analysis from Columbia University, a single flood event can push a low-income family below the poverty line.[66] Even if a family's home escapes serious damage, storms can create other barriers for low-income households. Hurricane Harvey destroyed hundreds of thousands of cars in Houston, a city with few other transportation options, and as many as 90,000 of those cars were uninsured.[67] One 18-year-old Houstonian depended on his car to get to and from work; the car was totaled in the storm. "A friend who is a mechanic told [him] it will take $2,500 to fix his sedan. That's more than three months' worth of rent," The Texas Tribune wrote.[68] For a person living paycheck to paycheck, an extreme storm can create perverse cycles: The car they use to get to work is totaled, meaning they are unable get to work, meaning they cannot earn money to fix the car—and that is assuming they still have a job to go to.

For most workers in Florida's hospitality industry—including hotel workers, barkeepers, servers, and tour guides—the aftermath of Hurricane Irma meant a week or more without a paycheck. "Businesses typically aren't required to pay non-exempt employees if they're not working because a business is closed," *Florida Today* reported.[69] Workers living paycheck to paycheck may wind up endangering their livelihoods if they choose to evacuate in advance of a storm, particularly in states such as Florida where there are no protections preventing employers from firing workers who miss work regardless of the circumstance.[70]

And as the polar vortex pushes extreme winter storms into new regions of the country, low- and moderate-income communities in regions unaccustomed to such weather also stand to suffer. As with hurricanes, road and business closures as a result of heavy snowfall and freezes can reduce paychecks for nonsalaried workers.[71] And when schools close due to extreme weather, children who depend on free or reduced-price meals may go hungry. In Kentucky and Tennessee, where counties issued disaster declarations as a result of extreme winter weather in 2015, more than 900,000 children are eligible for free or reduced-price school lunches.[72]

Low-income communities and communities of color are also disproportionately affected by environmental hazards. This year's hurricanes have made that risk painfully clear. More than a dozen federal Superfund sites, including some of the most dangerous sites in the country, dot the Houston metropolitan area.[73] Hurricane Harvey flooded 14 toxic waste sites and prompted at least 100 spills of dangerous substances.[74] At least 500 federal Superfund sites are located in flood plains nationwide, 50 of which are on coasts also at risk for impacts from sea level rise.[75] Nationwide, of people living within three miles of Superfund sites, 46 percent are nonwhite, 15 percent live below the poverty line, and 26 percent have household incomes below twice the federal poverty level of $24,600 for a family of four.[76]

Other climate disasters

While this issue brief is focused on extreme storms, other events that can be made worse by climate change—including drought, wildfire, and heat waves—bear mentioning, as they have already and will continue to have a negative impact on the U.S. economy and on American families.

The Western United States suffered a historic drought from 2011 through 2016 that caused billions of dollars in damage, largely due to losses in the California agricultural sector. Scientists estimated that human-induced climate change had likely intensified the California drought by 15 to 20 percent.[77] The California drought was particularly harmful to low-income farmworkers, tens of thousands of whom lost their jobs as fields sat fallow. In parched regions such as Tulare County, low-income families—in 2011 the average California farmworker earned $14,000—were forced to use bottled water rations from the county government, as they could not afford to drill a private well at a cost of between $7,000 and $15,000.[78]

Climate change also exacerbates wildfire risks in the Western United States. LeRoy Westerling, a climate scientist at the University of California, Merced, told SFGATE, "Higher temperatures mean more evaporation, which means drier fuels, and that means more fire."[79] Higher average temperatures due to climate change also increase the number of days with conditions conducive to wildfires. Already, wildfire seasons are lasting 75 days longer than they did in the 1970s.[80] A 2016 study estimated that climate change is to blame for 55 percent of the increased dryness observed in Western forests since 1979.[81]

TABLE 2

Wildfires destroy land and burn through taxpayer dollars

Year	Acres burned	U.S. Forest Service firefighting suppression costs, in billions of dollars	Department of Interior firefighting suppression costs, in millions of dollars
2011	8,711,367	1.14	345.5
2012	9,326,238	1.53	496.4
2013	4,319,546	1.41	419.1
2014	3,595,613	1.23	336.7
2015	10,125,149	1.76	430.2
2016	5,509,995	1.63	378.9
2017	8,825,062	2.41	N/A
Total	**50,412,970**	**11.12**	**2,406.8**

Notes: Data are not yet available for Department of Interior suppression costs in 2017. Acres burned data are available through October 24, 2017. Suppression cost data were consumer price index-adjusted to August of each year.

Sources: National Interagency Fire Center, "Federal Firefighting Costs (Suppression Only)," available at https://www.nifc.gov/fireInfo/fireInfo_documents/SuppCosts.pdf (last accessed October 2017); National Interagency Fire Center, "National Preparedness Level 2," available at https://www.nifc.gov/fireInfo/nfn.htm (last accessed October 2017); U.S. Department of Agriculture, "USDA Weekly Fire Update – October 23, 2017," available at https://www.fs.fed.us/sites/default/files/usda-weekly-fire-update-oct-24-2017.pdf (last accessed October 2017).

In early October of this year, at least one dozen wildfires began in a 24-hour period in Northern California, quickly torching thousands of acres and requiring tens of thousands of people to evacuate.[82] Even before the California fires, the 2017 wildfire season was already one for the record books, with the cost of fire suppression totaling more than $2 billion across several Western states.[83] The 2017 wildfire season has so far burned more than 8 million acres—if the areas were contiguous, they would be bigger than the state of Maryland.[84]

These explosive fire seasons have had a serious effect on the federal budget. In 1995, firefighting costs accounted for 16 percent of the U.S. Forest Service budget. Twenty years later, that number was more than 50 percent.[85] With firefighting costs taking an increasingly bigger bite from both state and federal budgets, less money is available for forestry management programs that could mitigate wildfire risks.[86] While most wildfires occur in rural areas with small populations, the smoke plumes generated by wildfire travel far and wide, affecting air quality in urban and suburban areas. "Smoke exposure increases respiratory and cardiovascular hospitalizations, emergency room visits and medication for asthma, bronchitis, chest pain, and other ailments," according to the National Climate Assessment.[87]

Higher average summer temperatures and more frequent and severe heat waves also pose a dangerous trend. While floods are the deadliest extreme weather event, extreme heat is the most common weather-related killer, resulting in between 600 and 1,500 deaths in the United States each year.[88] Average annual temperatures in the United States have increased between 1.3 degrees and 1.9 degrees Fahrenheit since 1895, with the greatest increases occurring since 1950, according to the National Climate Assessment.[89] That overall figure masks the dangerous extremes in certain regions of the United States. The 25 cities that have seen the biggest increases in the number of days above 95 degrees Fahrenheit since 1970 are experiencing between 11 and 31 more such days each year.[90]

Heat waves and overall hotter temperatures are a major driver of climate change-related health impacts. Heat contributes to the formation of ground-level ozone, or smog, which can in turn cause asthma attacks, diminished lung function, and even premature death, according to the National Climate Assessment.[91] Longer, warmer summers and fewer days with frost in the winter are also causing longer pollen seasons, which are an irritant for people with allergies and a danger for those living with asthma.[92] And heat waves have caused increases in death rates in cities such as Philadelphia, St. Louis, Chicago, and Cincinnati, as low-income, elderly, and medically vulnerable populations in particular suffer heat stroke, cardiovascular disease, respiratory disease, and cerebrovascular disease.[93]

Low-income Americans and those suffering from chronic conditions can reasonably be expected to suffer the most severe impacts as a result of both wildfire smoke and heat waves. "Poor adults are almost five times as likely to report being in fair or poor health as adults with family incomes at or above 400 percent of the federal poverty level … and they are more than three times as likely to have activity limitations due to chronic illness," according to a comprehensive 2015 Urban Institute report on income and health.[94] Low-

income adults have higher rates of coronary heart disease, stroke, emphysema, and chronic bronchitis than higher-income adults, and low-income children have a higher prevalence of asthma.[95] The U.S. Global Change Research Program additionally identified low-income Americans, as well as other vulnerable groups, as a "population of concern" for suffering negative health consequence as a result of climate change in a 2016 assessment.[96]

Conclusion

Climate change is already affecting every region of the United States and every part of the American economy. The extreme weather events amplified by climate change have caused billions of dollars in damage, claimed hundreds of American lives, and traumatized communities in ways that will reverberate for years to come. Denying these facts or attempting to sow doubt about the accepted conclusions of climate science does nothing to change the reality that American communities are living.

"The most dangerous myth that we have bought into as a society is not the myth that climate isn't changing or that humans aren't responsible," Katharine Hayhoe, a climate scientist and professor at Texas Tech University told CNN in the wake of Hurricanes Harvey and Irma. "It's the myth that 'it doesn't matter to me.'"[97]

Climate change matters to every American—and to low- and middle-income families most of all. Extreme weather events such as those outlined in this issue brief threaten the health, safety, and prosperity of communities across the country. It is past time for policymakers at every level to take these threats seriously, take immediate action to curb the greenhouse gas pollution that causes climate change, and build just and resilient communities that are prepared to withstand the effects that cannot be avoided.

For additional reading on solutions to the climate crisis, please see:

- "Safe, Strong, and Just Rebuilding after Hurricanes Harvey, Irma, and Maria: A Policy Road Map for Congress," October 2017[98]
- "A Framework for Local Action on Climate Change: 9 Ways Mayors Can Build Resilient and Just Cities," September 2017[99]
- "A Clean Energy Action Plan for the United States," September 2016[100]
- "Electric Utilities and the Future of Clean Transportation," April 2016[101]

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Methodology

This Center for American Progress analysis matches billion-dollar weather disasters from 2011 through October 6, 2017 to county-level disaster and median income data during that period.

Data on the billion-dollar weather disasters used for this analysis were primarily compiled from NOAA's National Centers for Environmental Information (NCEI).[102] As of October 6, 2017, several 2017 events that are likely to reach $1 billion in cost were still unpublished, so preliminary estimates of the costs and deaths associated with these disasters were gathered from other sources, including news reports. Citation 10 has more details.

To compare the median income of counties affected by each of these disasters, the authors matched billion-dollar weather disasters with county-level disaster and emergency declarations from the FEMA's Disaster Declaration Database.[103] To be considered part of a billion-dollar disaster, each FEMA disaster or emergency declaration had to be consistent with the state where the disaster occurred, the disaster date, and the disaster type. If an event occurred within two days of a disaster and was consistent with these other criteria, it was included for the purposes of this analysis.

In some cases, NCEI data did not provide a comprehensive list of states affected by each billion-dollar disaster. In these cases, the authors used regions or watersheds—in the case of flooding events—to determine if a county disaster declaration should be included as part of a billion-dollar disaster. In some years, certain types of disasters—such as severe winter weather—did not reach a billion dollars in cost, so there are no affected counties in those years for this analysis.

In order to compare the median income of affected counties with that of the United States as a whole, the authors use five-year estimates—2011 through 2015—from the U.S. Census Bureau's 2015 American Community Survey.[104] The weighted average median household income for affected counties is compared with the 2011–2015 five-year estimates for U.S. average median income, which is $53,889.[105] The five-year estimates, which are characterized as the "most reliable" by the U.S. Census Bureau, are used because they take into account data for all areas of the United States, including rural areas, whereas more recent one-year estimates only account for areas with populations of 65,000 and more.[106]

TABLE 3

7 years of heavy weather takes nearly 2,000 lives and $700 billion from U.S. economy

U.S. extreme weather events with $1 billion or more in damage, January 2011 through October 2017

Extreme weather event	Type of extreme weather	Estimated economic loss, in billions of dollars	Fatalities	States	Time frame
2017					
North Dakota/ South Dakota/ Montana drought		2.5	0	ND, SD, MT	Spring–fall
Hurricane Maria		95	51–450*	PR, USVI	September
Hurricane Harvey		180	84	LA, TX	August–September
Hurricane Irma		65	95	FL, GA, SC, PR	August–September
Western wildfires		2	42	CA, CO, ID, MT, OR, WA	Summer–fall
Midwest severe weather		1.2	0	IA, IL, NE	June
Minnesota hail storm and Upper Midwest severe weather		2.5	0	MN, WI, WY, TX, IA, IL, KS, MO, NE, NY, PA, VA	June
Colorado hail storm and Central severe weather		2.2	0	CO, OK, TX, NM, MO	May
Missouri/Arkansas flooding and Central severe weather		1.7	20	MO, AR, IL	May
South/Southeast severe weather		2.1	0	TX, OK, TN, KY, MS, AL	March
Southeast freeze		1	0	SC, GA, NC, TN, AL, MS, FL, KY, VA	March
Midwest tornado outbreak		2.1	2	AR, IA, IL, KS, MI, MN, MO, NE, NY, OH, WI	March
Central/Southeast tornado outbreak		1.8	6	AL, AR, FL, IL, IN, KY, LA, MO, MS, NC, SC, TN, VA, WV	March
California flooding		1.5	5	CA	February
Southern tornado outbreak and Western storms		1.1	24	CA, AL, FL, GA, LA, MS, SC, TX	January

continues

Extreme weather event	Type of extreme weather	Estimated economic loss, in billions of dollars	Fatalities	States	Time frame
2016					
Western/Southeast wildfires		2.5	21	AK, AL, CA, CO, GA, KY, MS, NC, SC, SD, TN, VA, WV, WY	Summer–fall
West/Northeast/ Southeast drought		3.6	0	AL, AR, AZ, CA, CO, CT, FL, GA, KY, LA, MA, ME, MS, MT, NC, NH, NJ, OK, OR, PA, RI, SC, SD, TN, TX, UT, VT, WY	Yearlong
Hurricane Matthew		10.3	49	FL, GA, SC, NC	October
Louisiana flooding		10.3	13	LA	August
Rockies/Northeast severe weather		1.5	0	CO, WY, VA, MD, PA, NJ, NY	July
West Virginia flooding and Ohio Valley tornadoes		1	23	WV	June
Rockies/Central tornadoes and severe weather		1.2	0	MT, CO, KS, MO, TX	May
Plains tornadoes and Central severe weather		1.8	2	NE, MO, TX, OK, KS, CO, IL, KY, TN	May
South/Southeast tornadoes		2.5	6	AR, KS, KY, IL, IN, LA, MO, MS, NE, OH, OK, TX	April
Houston flooding		2.8	8	TX	April
North/Central Texas hail storm		3.6	0	TX	April
North Texas hail storm		2.1	0	TX	March
Southern severe weather		1.2	1	TX, LA, MS	March
Texas/Louisiana flooding		2.4	5	TX, LA	March
Southeast/Eastern tornadoes		1.1	10	AL, CT, FL, GA, LA, MA, MD, MS, NC, NJ, NY, PA, SC, TX, VA	February

continues

Extreme weather event	Type of extreme weather	Estimated economic loss, in billions of dollars	Fatalities	States	Time frame
2015					
Western drought		4.7	0	CA, NV, OR, WA, ID, MT, UT, AZ	Yearlong
Texas tornadoes and Midwest flooding		2.1	50	MO, IL, AR, TN, MS, LA	December
Western/Alaskan wildfires		3.2	12	CA, AK, OR, WA, ID, MT, ND, CO, WY, TX	Summer–fall
South Carolina/ East Coast flooding		2.1	25	SC	October
Central/Northeast severe weather		1.2	1	CO, CT, IA, IL, MD, MI, NJ, NY, PA, SD, VA, VI	June
Texas/Oklahoma flooding and severe weather		2.6	31	TX, OK, KS, CO, AR, OH, LA, GA, SC	May
Southern Plains tornadoes		1.3	4	IA, KS, NE, OK, CO, SD, TX	May
South/Southeast severe weather		1.3	0	AL, AR, FL, GA, KS, LA, MS, NC, OK, SC, TN, TX	April
Midwest/Ohio Valley severe weather		1.6	2	AR, IA, IL, IN, KS, KY, MI, MO, NC, OH, OK, PA, TN, TX, WI, WV	April
Central/Eastern winter storm and cold wave		3.1	30	CT, DE, GA, IL, KY, MA, MD, ME, MI, NC, NH, NJ, NY, OH, PA, RI, SC, TN, VA	February
2014					
Western drought		4.2	0	CA, TX, OK, KS	Yearlong
Rockies/Plains severe weather		1.5	0	CO, KS, TX	September
Michigan/ Northeast flooding		1.1	2	MI, MD, NY	August
Rockies/central Plains severe weather		2	2	NE, KS, WY, IA, AR	June
Rockies/Midwest/ Eastern severe weather		3.9	0	CO, MT, IA, IL, IN, OH, SC, VA, PA, DE, NY	May
Midwest/Southeast/ Northeast tornadoes and flooding		1.8	33	AL, AR, DE, FL, GA, KS, MD, MO, MS, NC, NJ, NY, PA, TN, VA	April
Plains severe weather		1.5	0	IL, KS, MO, TX	April
Midwest/Southeast/ Northeast winter storm		2.3	16	AL, GA, IL, IN, KY, MD, MI, MO, MS, NC, NJ, NY, OH, PA, SC, TN, VA	January

continues

Extreme weather event	Type of extreme weather	Estimated economic loss, in billions of dollars	Fatalities	States	Time frame
2013					
Western/Plains drought and heat wave		11.2	53	AZ, CA, CO, IA, ID, IL, KS, MI, MN, MO, ND, NE, NM, NV, OK, OR, SD, TX, UT, WA, WI, WY	Spring–fall
Ohio Valley tornadoes		1.2	8	IL, IN, KY, MI, MO, OH	November
Colorado flooding		1.6	9	CO	September
Midwest severe weather		1.1	0	MN, WI	August
Midwest/Plains/ Northeast tornadoes		1.9	10	IL, IN, KS, MO, NY, OK, TX	May
Midwest/Plains/ Eastern tornadoes		2.5	27	GA, IA, IL, KS, MO, NY, OK, TX	May
Illinois flooding and severe weather		1.1	4	IL, IN, MO	April
Midwest/Plains severe weather		1.5	1	IN, KS, MO, NE	April
Southeast severe weather		2.1	1	MS, AL, GA, TN	March
2012					
U.S. drought and heat wave		32.4	123	CA, NV, ID, MT, WY, UT, CO, AZ, NM, TX, ND, SD, NE, KS, OK, AR, MO, IA, MN, IL, IN, GA	Yearlong
Western wildfires		1.9	8	CO, ID, WY, MT, CA, NV, OR, WA	Summer–fall
Hurricane Sandy		70.2	159	MD, DE, NJ, NY, CT, MA, RI, NC, VA, WV, OH, PA, NH	October
Hurricane Isaac		3	9	LA, MS, AL, FL	August
Plains/East/Northeast severe weather		3.1	28	IL, IN, KY, OH, WV, SC, NC, VA, MD, DC, NJ	June–July
Rockies/Southwest severe weather		2.8	0	CO, NM, TX	June
Southern Plains/ Midwest/Northeast severe weather		2.5	1	TX, OK, KS, MN, PA, NY	May
Midwest/Ohio Valley severe weather		3.5	1	TX, OK, KS, MO, IL, IN, KY	April–May
Midwest tornadoes		1.2	6	OK, KS, NE, IA	April
Texas tornadoes		1.1	0	TX	April
Southeast/Ohio Valley tornadoes		3.4	42	AL, GA, IN, OH, KY, TN	March

continues

Extreme weather event	Type of extreme weather	Estimated economic loss, in billions of dollars	Fatalities	States	Time frame
2011					
Texas/New Mexico/ Arizona wildfires		2	5	TX, NM, AZ	Summer–fall
Tropical Storm Lee		2.8	21	LA, MS, AL, GA, TN, PA, NY, NJ, CT, VA, MD	September
Southern Plains/ Southwest drought and heat wave		13.3	95	TX, OK, NM, AZ, KS, LA	Spring–summer
Hurricane Irene		15	45	NC, VA, MD, NJ, NY, CT, RI, MA, VT	August
Midwest/Southeast severe weather		1.3	0	IA, KS, MO, NE, SD	August
Rockies/Midwest severe weather		1.4	2	CO, WY, IA, IL, MI, MN, OH	July
Missouri River flooding		2.2	5	MT, ND, SD, NE, IA, KS, MO	May–June
Midwest/Southeast tornadoes and severe weather		1.7	3	OK, TX, KS, NE, MO, IA, IL, TN, GA, NC, SC	June
Mississippi River flooding		3.3	7	AK, TN, MS, MO, LA	April–May
Midwest/Southeast tornadoes		10.1	177	MO, TX, OK, KS, AR, GA, TN, VA, KY, IN, IL, OH, WI, MN, PA	May
Southeast/Ohio Valley/ Midwest tornadoes		11.3	321	AL, AR, LA, MS, GA, TN, VA, KY, IL, MO, OH, TX, OK	April
Ohio Valley/South tornadoes		1.2	0	AR, IL, IN, KY, MO, OH, TN, TX	April
Midwest/Southeast tornadoes		2.3	38	OK, TX, AR, MS, AL, GA, NC, SC, VA, PA	April
Southeast/Midwest tornadoes		2.4	0	NC, SC, TN, AL, TX, OK, KS, IA, WI	April
Midwest/Southeast tornadoes		3.1	0	KS, MO, IA, IL, WI, KY, GA, TN, NC, SC	April
Groundhog Day blizzard		2	36	IL	February
84 total events		**673.7**	**1,920**		

Note: Estimated economic loss numbers are consumer price index-adjusted for 2017. *Official death toll numbers as of the writing of this analysis were 51 in Puerto Rico after Hurricane Maria. Reporting by Vox asserts that the death toll may be as high as 450. See the list of sources below for more information.

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