

# CLIMATE CHANGE IMPACT

## Communities at Risk

Don Nardo



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#### About the Author

Classical historian, amateur astronomer, and award-winning author Don Nardo has written numerous volumes about scientific topics, including *Destined for Space* (winner of the Eugene M. Emme Award for best astronomical literature), *Tycho Brahe* (winner of the National Science Teaching Association's best book of the year), *Deadliest Dinosaurs*, and *The History of Science*. Nardo, who also composes and arranges orchestral music, lives with his wife, Christine, in Massachusetts.

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## CHAPTER ONE

# Destruction Caused by Extreme Weather

Under the slow but relentless onslaught of climate change, communities large and small on the US Eastern Seaboard are getting not only warmer and warmer but also wetter and wetter. The same is true of towns and cities in western Europe, Australia, eastern and southern Asia, and central Africa, along with some other global regions. This was the key finding of an important study of earth's changing climate released in mid-2023. Published in the respected scientific journal *Earth's Future*, the study was conducted at China's Northwest A&F University, with world-renowned climate researcher Haijiang Wu as the lead author.

Wu and his colleagues concluded that, although some parts of the world are getting hotter and dryer, or "dry-hot," thanks to climate change, others will become increasingly "wet-hot" in the decades ahead. The principal reason for this form of extreme weather, the researchers explain, is related to the way the planet's atmosphere absorbs water. Scientists have known for more than two centuries that the warmer the air, the more moisture it can absorb. Eventually, enough water builds up in each expanse of air until it is released as precipitation in the form of rain or snow.

The 2023 study points out that climate change is steadily increasing the incidence and intensity of this fundamental physical process. As the atmosphere progressively warms, the air above some areas of the planet is retaining much more moisture than normal. For every rise in temperature of 1.8°F (1°C), the ability of

a given volume of air to hold on to water vapor increases by 6 to 7 percent. In turn, that means that over the course of months and years, more water will be available to fall as precipitation on that area.

In the wake of increasing climate change, the excess moisture is causing and will continue to cause various outcomes that are detrimental to human civilization. First, say scientists at the American Geophysical Union in Washington, DC, “When wet-hot conditions strike, heat waves first dry out the soil and reduce its ability to absorb water. Subsequent rainfall then has a harder time penetrating the soil and instead runs along the surface, contributing to flooding, landslides and crop failures.”<sup>8</sup>

This scenario is complicated by the fact that the land areas most likely to be affected by wet-hot extremes contain numerous heavily populated communities. The string of dozens of large cities and towns clustered along the American Eastern Seaboard, from Maine to Florida, is a prominent example. That region is already prone to flooding generated by another serious outcome of climate change—sea level rise. Miami and New York City are only two of many seaboard communities that are already struggling with floods caused by rising sea levels.

Moreover, flash floods, landslides, and crop losses are increasing in the eastern United States, western Europe, and elsewhere as by-products of excess water in the air. The large flash floods and massive landslides that struck western Europe in the summer of 2021, claiming more than two hundred lives, constitute only one example. The growing threat to life in such heavily populated areas prompted Wu to remark, “If we overlook the risk of . . . wet-hot extremes and fail to take sufficient early warning, the [negative] impacts . . . would be unimaginable.”<sup>9</sup>

## CONSIDER THIS

From 2010 to 2022 governments and large companies worldwide spent roughly \$600 billion annually to slow climate change. Climate scientists estimate that at least four times that much per year will be needed to do the job.

—*New York Times*

## Larger-than-Normal Precipitation Events

It turned out that 2021 witnessed many more destructive flash floods than the ones that wreaked havoc in western Europe. That brand of extreme-weather-driven disaster, a result of climate change, occurred in towns and cities all over the world that year. On August 21 in New York City, for instance, nearly 2 inches (5 cm) of rain fell in Central Park in a single hour, the most the city had ever before experienced in so short a time. Yet incredibly, that record was obliterated a mere eleven days later, when 3.15 inches (8 cm) of rain poured down on the city in the space of an hour.

As a result of these downpours, most of the city's subway tunnels flooded, bringing travel via that vast underground railway system to a halt. Meanwhile, aboveground, the torrential rains triggered still more chaos as numerous streets and underpasses flooded. Thousands of motorists abandoned their cars. At the same time, thousands of other residents, mainly those with basement apartments, lost many of their belongings as water poured from the streets into their homes.



*Miami is already struggling with floods caused by rising sea levels. This photo shows flooding in the neighborhood of Little Havana that occurred in June 2022 after heavy rain.*

## Death in a Chinese Tunnel

The flash floods that struck western Europe and New York City in the summer of 2021 were far from unique. Similar massive precipitation events spawned by climate change happened in other parts of the world in that same period. On July 21, 2021, for example, in Zhengzhou, China, a sudden flash flood trapped hundreds of people in the city's large subway system. Before the floodwaters subsided, twelve people had died.

Some of the survivors took cell phone videos that showed many of the trapped residents urgently struggling to breathe in random pockets of air as the water rapidly rose. After the tragedy, Slobodan Djordjevic, an engineer at England's University of Exeter and a leading expert on the mechanics of subway floods, reviewed the videos and told an NPR reporter, "None of us had seen people with water up to their necks, standing in underground trains." Besides the deaths that occurred, he said, more than five hundred other people would surely have drowned if rescuers had not rushed down into the flooded tunnels to save them. He said that the images on the videos were so graphic and disturbing, "I actually considered whether this was even real."

Quoted in Rebecca Hersher, "NYC's Subway Flooding Isn't a Fluke. It's the Reality for Cities in a Warming World," *All Things Considered*, NPR, September 2, 2021. [www.npr.org](http://www.npr.org).

Following this outbreak of extreme weather, scientists pointed out that climate change–induced sea level rise was not the culprit. True, they explained, such rising sea levels do cause flooding in coastal cities and will continue to do so often in the coming decades. But the flash floods of 2021 were the result of abrupt and much-larger-than-normal precipitation events—that is, massive rainstorms. In the case of the New York floods, the storms were unleashed by a combination of warm, moisture-laden air hanging over both the land portions of the Eastern Seaboard and the nearby ocean.

## An Onslaught of Monster Hurricanes

Experts say that the huge amounts of excess water hanging above the ocean consisted primarily of the remnants of Hurricane Ida. That enormous storm had struck New Orleans earlier that week (in mid-August 2021), dropping more than 6 inches (15.2 cm) of rain

on towns and cities in southern Louisiana. At the time, it was the second-most-destructive hurricane ever to make landfall in that state. When it moved on after a couple of days, it traveled overland toward the northeast and, though weakened, still packed a considerable punch when it reached New York.

That Ida was potent enough to dump torrential rain on communities in a swath from the Gulf Coast all the way up to New York, do \$75.3 billion worth of damage, and kill 107 people was not a fluke. Meteorologists and climate scientists point out that it was part of an ongoing pattern of climate change–driven extreme weather that takes the form of very powerful hurricanes. Put simply, the wet-hot pattern of moisture-laden air seen on land in the eastern United States also occurs in the nearby ocean. There the warmer-than-average air combines with warmer-than-average ocean water.

That water gets warmer because much of the extra atmospheric warmth generated by the changing climate is absorbed by the upper layers of the oceans. Science writer Oliver Milman reports that in 2021, the upper 6,560 feet (2,000 m) of the Atlantic Ocean absorbed an “amount of extra energy 145 times greater than the world’s entire electricity generation.” As a result, that year “saw the hottest ocean temperatures in recorded history, the sixth consecutive year that this record [had] been broken.”<sup>10</sup>

That degree of added warmth in the oceans is problematic, scientists point out, because hurricanes are essentially giant heat engines. As water temperatures rise, what starts out as a small tropical storm grows increasingly large. It also becomes potentially more destructive when it comes ashore and passes over the hundreds of towns and cities huddled along the Gulf Coast and Eastern Seaboard.

Moreover, this pattern of progressively more powerful hurricanes is not something that might occur at some hard-to-predict future date; rather, an onslaught of monster hurricanes has already begun to spread ruin through American coastal communities. To name only a few of Ida’s recent sibling storms: in 2018 Florence did \$24.2 billion worth of damage and killed 54 people;

*In 2022 Hurricane Ian caused mass destruction in Florida. Ian caused \$112 billion in damages and took 150 lives.*



in 2020 Sally did damages of \$7.3 billion and killed 4 persons; and in 2022 Ian caused a whopping \$112 billion in damages and took 150 lives. The many deaths and enormous costs of rebuilding after hurricanes is troubling, says the Union of Concerned Scientists. Therefore, the group says, “it is essential to do whatever we can to avoid dangerous [atmospheric and ocean] warming and protect coastal communities for ourselves and our children.”<sup>11</sup>

## **Record Heat Waves and Droughts**

In addition to the various negative effects generated by the so-called wet-hot climate change pattern, several examples of extreme weather derive from the pattern that scientists often call dry-hot. Areas where dry-hot conditions are common have far fewer lakes, streams, rivers, and other water sources from which to draw moisture than regions where wet-hot conditions prevail. So the dry-hot areas are considerably drier to begin with, and as the air steadily warms, it and the landforms beneath it tend to

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## **Chapter Two: Threats to Fresh Water and Food Production**

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# ORGANIZATIONS AND WEBSITES

## **Center for Climate and Energy Solutions (C2ES)**

[www.c2es.org](http://www.c2es.org)

C2ES, formerly called the Pew Center on Global Climate Change, promotes reducing carbon dioxide emissions and adopting cleaner energy solutions. The website features links to information on how both individuals and groups can support C2ES and thereby help fight climate change.

## **Intergovernmental Panel on Climate Change (IPCC)**

[www.ipcc.ch](http://www.ipcc.ch)

The IPCC is the leading international organization presently studying and fighting climate change. Its website provides up-to-date reports on the activities of several IPCC working groups, plus tells how students and other everyday people can get involved in efforts to stop climate change.

## **National Oceanic and Atmospheric Administration (NOAA)**

[www.noaa.gov](http://www.noaa.gov)

NOAA's main website provides a simple definition for climate change, along with links to helpful articles on the subject. There are also links to climate predictions by scientists and information from the National Weather Service.

## **US Global Change Research Program**

[www.globalchange.gov](http://www.globalchange.gov)

This federal agency examines the impact of climate change on the planet and society. Its website offers many reports, webinars, podcasts, videos, and other resources that review in detail the concerns related to specific environmental threats.

## **World Meteorological Organization (WMO)**

<https://wmo.int>

The WMO's website has many links to articles relating to global weather patterns and how they affect human civilization. Visitors to the site will find links to helpful publications about climate change, and a "WMO for Youth" section provides entertaining activities related to fighting climate change.

# FOR FURTHER RESEARCH

## Books

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Bill Gates, *How to Avoid a Climate Disaster*. Vancouver, WA: Vintage, 2022.

Joanne Mattern, *Wildfires*. Minnetonka, MN: Kaleidoscope, 2023.

Olsin McGann, *A Short, Hopeful Guide to Climate Change*. Dublin, Ireland: Little Island, 2022.

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World Health Organization, “Climate Change Is an Urgent Threat to Pregnant Women and Children,” November 21, 2023. [www.who.int](http://www.who.int).

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