

The year is 2037. This is what happens when the hurricane hits Miami

Jeff Goodell

The climate is warming and the water is rising. In his new book, [Jeff Goodell](#) argues that sea-level rise will reshape our world in ways we can only begin to imagine

The Guardian, https://www.theguardian.com/us-news/2017/dec/17/miami-hurricane-2037-climate-change?CMP=share_btn_tw

Sun 17 Dec '17 10.00 GMT Last modified on Tue 19 Dec '17 22.26 GMT



fter the hurricane hit Miami in 2037, a foot of sand covered the famous

bow-tie floor in the lobby of the Fontainebleau Hotel in [Miami](#) Beach. A dead manatee floated in the pool where Elvis had once swum. Most of the damage came not from the hurricane's 175-mile-an-hour winds, but from the twenty-foot storm surge that overwhelmed the low-lying city.

In South Beach, historic Art Deco buildings were swept off their foundations. Mansions on Star Island were flooded up to their cut-glass doorknobs. A seventeen-mile stretch of Highway A1A that ran along the famous beaches up to Fort Lauderdale disappeared into the Atlantic. The storm knocked out the wastewater-treatment plant on Virginia Key, forcing the city to dump hundreds of millions of gallons of raw sewage into Biscayne Bay.

Tampons and condoms littered the beaches, and the stench of human excrement stoked fears of cholera. More than three hundred people died, many of them swept away by the surging waters that submerged much of Miami Beach and Fort Lauderdale; thirteen people were killed in traffic accidents as they scrambled to escape the city after the news spread—falsely, it turned out—that one of the nuclear reactors at Turkey Point, an aging power plant twenty-four miles south of Miami, had been destroyed by the surge and had sent a radioactive cloud floating over the city.

The president, of course, said that Miami would be back, that Americans did not give up, that the city would be rebuilt better and stronger than it had been before. But it was clear to those not fooling themselves that this storm was the beginning of the end of Miami as a booming twenty-first-century city.

All big hurricanes are disastrous. But this one was unexpectedly bad. With sea levels more than a foot higher than they'd been at the dawn of the century, much of South Florida was wet and vulnerable even before the storm hit.

Because of the higher water, the storm surge pushed deeper into the region than anyone had imagined it could, flowing up drainage canals and flooding homes and strip malls several miles from the coast. Despite newly elevated runways, Miami International Airport was shut down for ten days. Salt water shorted out underground electrical wiring, leaving parts of Miami-Dade County dark for weeks.

Advertisement

Municipal drinking-water wells were contaminated with salt water. In soggy neighborhoods, mosquitoes carrying Zika and dengue fever viruses hatched (injecting male mosquitoes with the Wolbachia bacteria, which public health officials had once hoped would inhibit the mosquitoes' ability to transmit the viruses, had failed when the *Aedes aegypti* mosquitoes that carry the diseases developed immunity to the bacteria).

In Homestead, a low-lying working-class city in southern Miami-Dade County which had been flattened by Hurricane Andrew in 1992, thousands of abandoned homes were bulldozed because they were deemed a public health hazard. In Miami Shores, developers approached city officials with proposals to buy out entire blocks of waterlogged apartments, then dredge the streets and turn them into canals lined with houseboats. But financing for these projects always fell through.

Before the storm hit, damage from rising seas had already pushed city and county budgets to the brink. State and federal money was scarce too, in part because Miami was seen by many Americans as a rich, self-indulgent city that had ignored decades of warnings about building too close to the water. Attempts had been made to armor the shore with seawalls and elevate buildings, but only a small percentage of the richest property owners took protective action. The beaches were mostly gone too.

The Feds decided they couldn't afford to spend \$100 million every few years to pump in fresh sand, and without replenishment, the ever-higher tides carried the beaches away.

Flooding in North Miami, Florida. Photograph: Joe Raedle/Getty Images

By the late 2020s, the only beaches that remained were privately maintained oases of sand in front of expensive hotels. The hurricane took care of those, leaving the hotels and condo towers perched on limestone crags. Tourists disappeared.

After the hurricane, the city became a mecca for slumlords, spiritual healers, and lawyers. In the parts of the county that were still inhabitable, only the wealthiest could afford to insure their homes. Mortgages were nearly impossible to get, mostly because banks didn't believe the homes would be there in thirty years.

Still, the waters kept rising, nearly a foot each decade. Each big storm devoured more of the coastline, pushing the water deeper and deeper into the city. The skyscrapers that had gone up during the boom years were gradually abandoned and used as staging grounds for drug runners and exotic-animal traffickers. Crocodiles nested in the ruins of the Frost Museum of Science. Still, the waters kept rising.

By the end of the twenty-first century, Miami became something else entirely: a popular diving spot where people could swim among sharks and barnacled SUVs and explore the wreckage of a great American city.

T

hat is, of course, merely one possible vision of the future. There are

brighter ways to imagine it—and darker ways. But I am a journalist, not a Hollywood screenwriter. In this book, I want to tell a true story about the future we are creating for ourselves, our children, and our grandchildren. It begins with this: the climate is warming, the world's great ice sheets are melting, and the water is rising. This is not a speculative idea, or the hypothesis of a few wacky scientists, or a hoax perpetrated by the Chinese. Sea-level rise is one of the central facts of our time, as real as gravity. It will reshape our world in ways most of us can only dimly imagine.

My own interest in this story began with an actual hurricane. Shortly after Hurricane Sandy hit New York City in 2012, I visited the Lower East Side of Manhattan, one of the neighborhoods that had been hardest hit by flooding from the storm.

Even if we ban coal, gas, and oil tomorrow, we're not going to be able to turn down the earth's thermostat immediately

The water had receded by the time I arrived, but the neighborhood already smelled of mold and rot. The power was out, the shops were closed. I saw broken trees, abandoned cars, debris scattered everywhere, people hauling ruined furniture out of basement apartments. Dark waterlines were visible on many shop windows and doors. The surge in the East River had been more than nine feet high, overwhelming the seawall and inundating the low-lying parts of Lower Manhattan. As I walked around, watching people slowly put their lives back together, I wondered what would have happened if, instead of flooding the city and then receding in a few hours, the Atlantic Ocean had come in and stayed in.

Advertisement

I have been writing about climate change for more than a decade, but seeing the flooding on the Lower East Side made it visceral for me (I hadn't visited New Orleans until several years after Katrina hit—the TV images of the flooding there, catastrophic as they were, did not affect me as strongly as my walk through the Lower East Side). A year or so before Sandy hit, I had interviewed NASA scientist James Hansen, the godfather of climate change science, who told me that if nothing was done to slow the burning of fossil fuels, sea levels could be as much as ten feet higher by the end of the century. At the time, I didn't grasp the full implications of this. After Sandy, I did.

Soon after my visit to Lower Manhattan, I found myself in Miami, learning about the porous limestone foundation the city is built on and the flatness of the topography. During high tide, I waded knee-deep through dark ocean water in several Miami Beach neighborhoods; I saw high water backing up into working-class neighborhoods far to the west, near the border of the Everglades. It didn't take a lot of imagination to see that I was standing in a modern-day Atlantis-in-the-making. It became clear to me just how poorly our world is prepared to deal with the rising waters. Unlike, say, a global pandemic, sea-level rise is not a direct threat to human survival. Early humans had no problem adapting to rising seas—they just moved to higher ground. But in the modern world, that's not so easy. There's a terrible irony in the fact that it's the very infrastructure of the Fossil Fuel Age—the housing developments on the coasts, the roads, the railroads, the tunnels, the airports—that makes us most vulnerable.

Rising and falling seas represent one of the ancient rhythms of the earth, the background track that has played during the entire four-billion-year life of the planet. Scientists have understood this for a long time. Even in relatively recent history, sea levels have fluctuated wildly, driven by wobbles in the Earth's orbit that change the amount of sunlight hitting the planet. One hundred and twenty thousand years ago, during the last interglacial period, when the temperature of the Earth was very much like it is today, sea levels were twenty to thirty feet higher. Then, twenty thousand years ago, during the peak of the last ice age, sea levels were four hundred feet lower.

What's different today is that humans are interfering with this natural rhythm by heating up the planet and melting the vast ice sheets of Greenland and Antarctica. Until just a few decades ago, most scientists believed these ice sheets were so big and so indomitable that not even seven billion humans with all their fossil-fuel-burning toys could have much impact on them in the short term. Now they know better.

In the twentieth century, the oceans rose about six inches. But that was before the heat from burning fossil fuels had much impact on Greenland and Antarctica (about half of the recorded sea-level rise in the twentieth century came from the expansion of the warming oceans). Today, seas are rising at more than twice the rate they did in the last century. As warming of the Earth increases and the ice sheets begin to feel the heat, the rate of sea-level rise is likely to increase rapidly.

A 2017 report by the National Oceanic and Atmospheric Administration, the United States' top climate science agency, says global sea-level rise could range from about one foot on the low end to more than eight feet by 2100. Depending on how much we heat up the planet, it will continue rising for centuries after that.

Advertisement

But if you live on the coast, what matters more than the height the seas rise to is the rate at which they rise. If the water rises slowly, it's not such a big deal. People will have time to elevate roads and buildings and build seawalls. Or move away. It is likely to be disruptive but manageable. Unfortunately, Mother Nature is not always so docile. In the past, the seas have risen in dramatic pulses that coincide with the sudden collapse of ice sheets. After the end of the last ice age, there is evidence that the water rose about thirteen feet in a single century. If that were to occur again, it would be a catastrophe for coastal cities around the world, causing hundreds of millions of people to flee from the coastlines and submerging trillions of dollars' worth of real estate and infrastructure.

The best way to save coastal cities is to quit burning fossil fuels (if you're still questioning the link between human activity and climate change, you're reading the wrong book). But even if we ban coal, gas, and oil tomorrow, we're not going to be able to turn down the Earth's thermostat immediately. A good fraction of the CO₂ emitted today will stay in the atmosphere for thousands of years. That means that even if we did reduce CO₂ tomorrow, we can't shut off the warming from the CO₂ we've already dumped into the air. "The climatic impacts of releasing fossil fuel CO₂ to the atmosphere will last longer than Stonehenge," scientist David Archer writes. "Longer than time capsules, longer than nuclear waste, far longer than the age of human civilization so far."

For sea-level rise, the slow response of the Earth's climate system has enormous long-term implications. Even if we replaced every SUV on the planet with a skateboard and every coal plant with a solar panel and could magically reduce global carbon pollution to

zero by tomorrow, because of the heat that has already built up in the atmosphere and the oceans, the seas would not stop rising—at least until the Earth cooled off, which could take centuries.

An aerial shot of Miami Beach and Fisher Island. Photograph: Joe Raedle/Getty Images

However, if we don't end the fossil fuel party, we're headed for more than eight degrees Fahrenheit of warming—and with that, all bets are off. We could get four feet of sea-level rise by the end of the century—or we could get thirteen feet. The long-term consequences are even more alarming. If we burn all the known reserves of coal, oil, and gas on the planet, seas will likely rise by more than two hundred feet in the coming centuries, submerging virtually every major coastal city in the world.

Advertisement

The tricky thing about dealing with sea-level rise is that it's impossible to witness by just hanging out at the beach for a few weeks. Even in the worst-case scenarios, the changes will occur over years and decades and centuries, not seconds and minutes and hours. It's exactly the kind of threat that we humans are genetically ill equipped to deal with. We have evolved to defend ourselves from a guy with a knife or an animal with big teeth, but we are not wired to make decisions about barely perceptible threats that gradually accelerate over time.

One architect I met while researching this book joked that with enough money, you can engineer your way out of anything. I suppose it's true. If you had enough money, you could raise or rebuild every street and building in Miami by ten feet and the city would be in pretty good shape for the next century or so. But we do not live in a world where money is no object, and one of the hard truths about sea-level rise is that rich cities and nations can afford to build seawalls, upgrade sewage systems, and elevate critical infrastructure.

Poor cities and nations cannot. But even for rich countries, the economic losses will be high. One recent study estimated that with six feet of sea-level rise, nearly \$1 trillion worth of real estate in the United States will be underwater, including one in eight homes in Florida. If no significant action is taken, global damages from sea-level rise could reach \$100 trillion a year by 2100.

But it is not just money that will be lost. Also gone will be the beach where you first kissed your boyfriend; the mangrove forests in Bangladesh where Bengal tigers thrive; the crocodile nests in Florida Bay; Facebook headquarters in Silicon Valley; St. Mark's

Basilica in Venice; Fort Sumter in Charleston, South Carolina; America's biggest naval base in Norfolk, Virginia; NASA's Kennedy Space Center; graves on the Isle of the Dead in Tasmania; the slums of Jakarta, Indonesia; entire nations like the Maldives and the Marshall Islands; and, in the not-so-distant future, Mar-a-Lago, the summer White House of President Donald Trump. Globally, about 145 million people live three feet or less above the current sea level. As the waters rise, millions of these people will be displaced, many of them in poor countries, creating generations of climate refugees that will make today's Syrian war refugee crisis look like a high school drama production.

The real x factor here is not the vagaries of climate science, but the complexity of human psychology. At what point will we take dramatic action to cut CO2 pollution? Will we spend billions on adaptive infrastructure to prepare cities for rising waters—or will we do nothing until it is too late? Will we welcome people who flee submerged coastlines and sinking islands—or will we imprison them?

No one knows how our economic and political system will deal with these challenges. The simple truth is, human beings have become a geological force on the planet, with the power to reshape the boundaries of the world in ways we didn't intend and don't entirely understand. Every day, little by little, the water is rising, washing away beaches, eroding coastlines, pushing into homes and shops and places of worship.

As our world floods, it is likely to cause immense suffering and devastation. It is also likely to bring people together and inspire creativity and camaraderie in ways that no one can foresee. Either way, the water is coming. As Hal Wanless, a geologist at the University of Miami, told me in his deep Old Testament voice as we drove toward the beach one day, "If you're not building a boat, then you don't understand what's happening here."

Illustration by Joe Magee

- *The Water Will Come by Jeff Goodell is out now in the US and will be published by Black Inc in the UK in February (£17.99)*